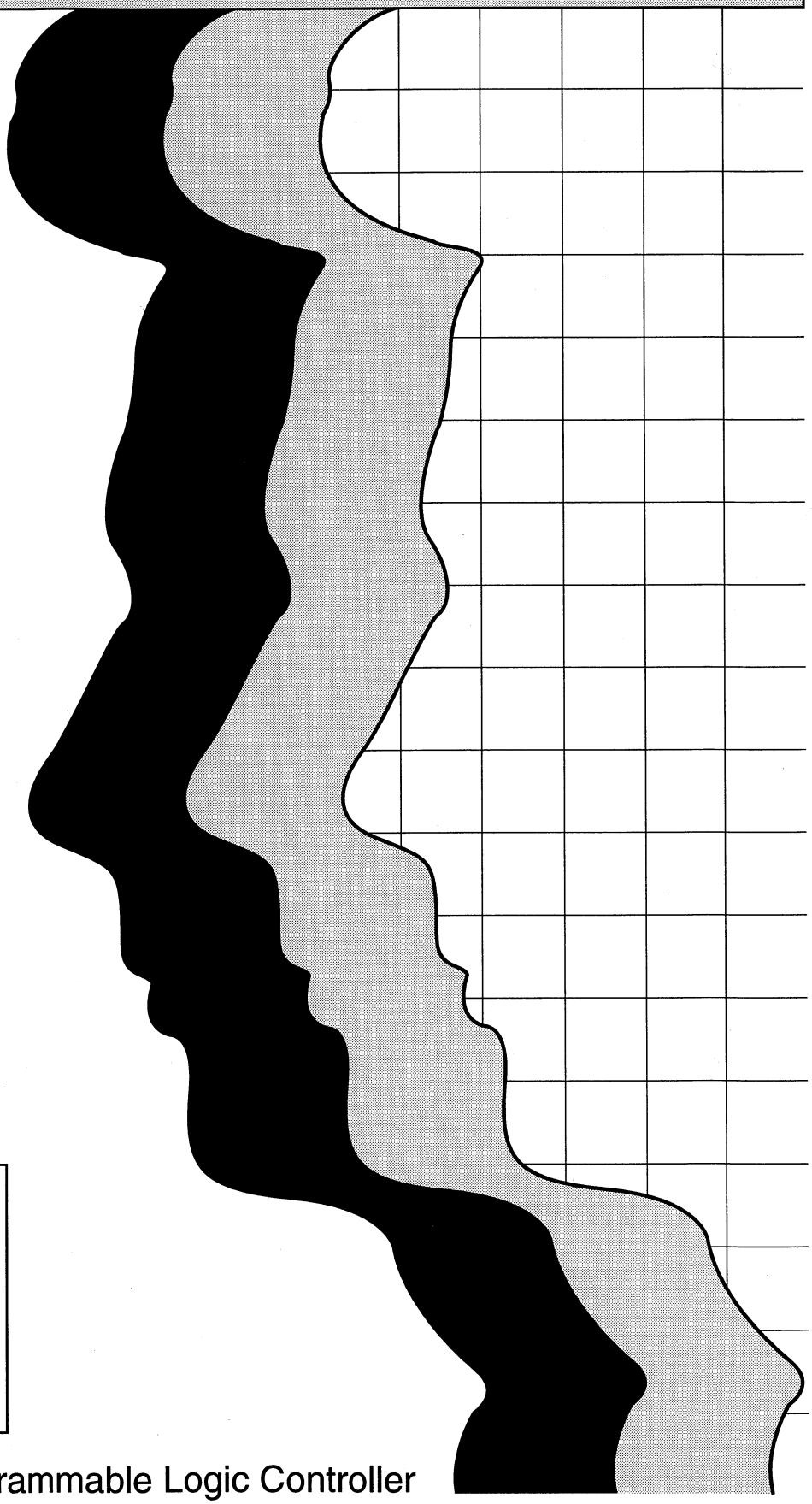
MITSUBISHI

# A-series maintenance course (for GX Developer)

# A-SERIES TRAINING MANUAL



A
MELSEC

Mitsubishi Programmable Logic Controller

# • SAFETY PRECAUTIONS •

(Always read these instructions before using this equipment.)

When designing a system, always read the related manuals and give full consideration to safety.
During training, fully note the following points to handle the equipment correctly.

## [Precautions for Training]

### ⚠ WARNING

- To prevent an electric shock, do not touch the terminals when power is on.
- Before opening the safety cover, switch power off or ensure safety.
- Keep your hands away from the moving parts.

### ⚠ CAUTION

- Follow the instructor's instructions during training.
- Do not remove the module of the training machine or change its wiring without permission.
  A fault, malfunction, injury or fire may occur.
- Before removing or installing the module, switch power off.
  If the module is removed or installed with power on, it may become faulty or you may get an electric shock.
- When unusual odor or noise is generated in the training machine (such as an X/Y table), press the [power switch] or [emergency switch] to stop the machine.
- If any alarm has occurred, immediately call the instructor.

REVISIONS

* The text number is given on the bottom left of the back cover.

| Print Date | * Text Number | Revision |
|---|---|---|
| Jun., 2001 | SH (NA) 080176-A | First edition |





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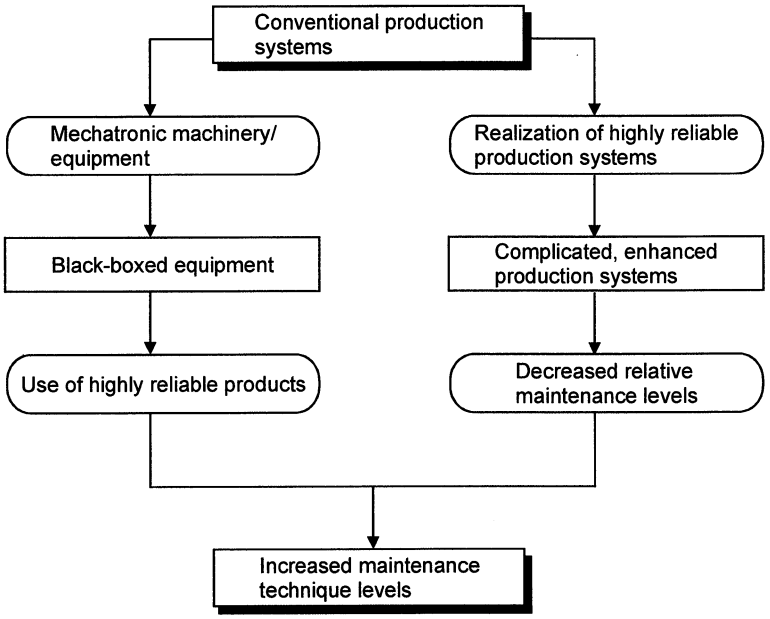
# CHAPTER 1 SIGNIFICANCE OF PRODUCTION MAINTENANCE



A production system stop due to a failure or power cut will produce loss corresponding to a stop time.
Therefore, it is requested to design a facility system which will not [stop due to a failure] or [stop due to a power cut].
Should a production system stop, the important goal is how fast the system can be restored. To achieve this goal, maintenance personnel are posted in each plant to increase the availability rate of the production system.

## 1.1 Importance of Maintenance

With the remarkable progress of mechatronic machinery/equipment and complex, enhanced systems, equipment in recent production systems are getting black-boxed and relative maintenance levels are going down, making it difficult to improve the availability rate.
This makes "highly reliable products" and "increased maintenance technique levels" strongly demanded.





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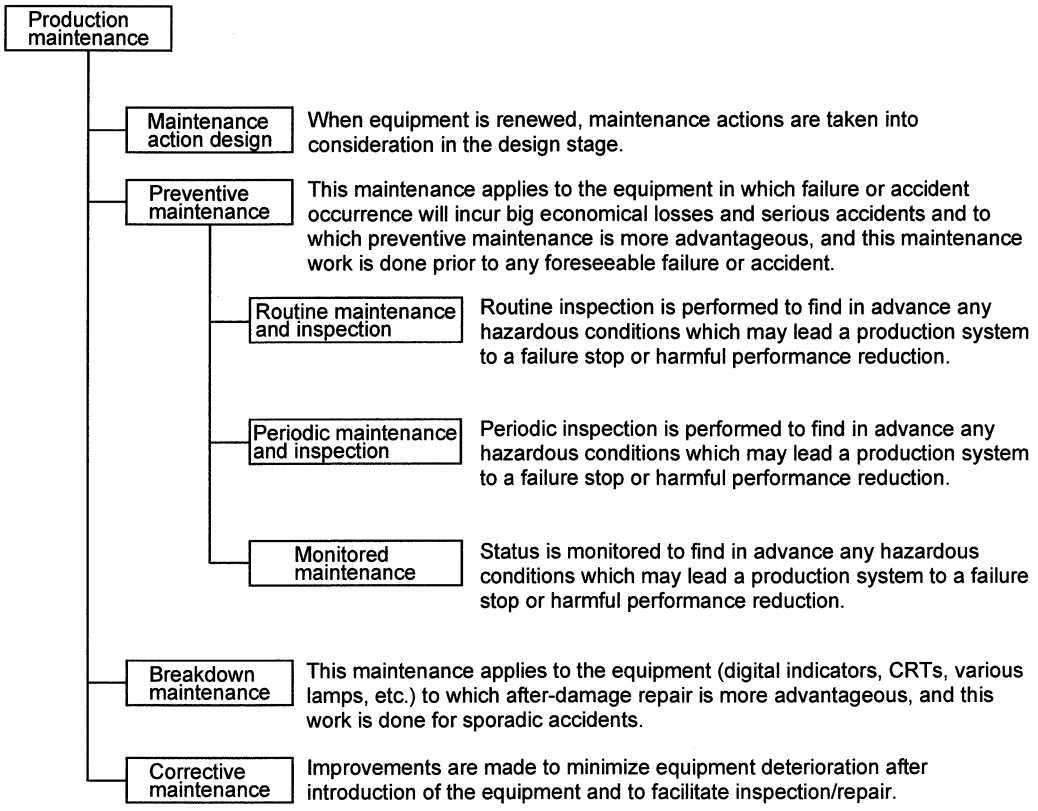
## 1.2 Maintenance System



To realize a highly reliable production system, it is significant to arrange a proper maintenance system. The following chart outlines a maintenance system.



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## 1.3 Maintenance Schedule

In a production system, examination of repair after failure occurrence can lead to a long repair time, making the availability rate hard to increase.
Hence, maintenance must be scheduled at the point of production system introduction to make it efficient. If a failure occurs, maintenance must be performed as scheduled, to repair the system within a short time, as listed below.

Table 1-1 PLC System Maintenance Schedule

| Schedule Item | Description | |
|---|---|---|
| Maintenance training | PLC knowledge | • Fundamental knowledge of PLC, e.g. principle, functions, performance<br>• Features of PLC (differences between PLC and computer, relay, etc.)<br>• Position of PLC (sequence control, data collection, distributed control function)<br>• Introduction condition of PLC (e.g. operating condition in your own department)<br>• Description of introduced (adopted) model (e.g. model, functions, performance, features of PLC used) |
| | Maintenance scope and maintenance techniques | • Maintenance knowledge about PLC (features of PLC on maintenance aspect, maintenance items of PLC)<br>• Instructions for PLC maintenance (handling methods, maintenance points, etc.) |
| | Training | • Functions relating to PLC maintenance (self-diagnostic functions, RAS functions, etc.)<br>• Functions relating to peripheral device maintenance (troubleshooting functions, etc.)<br>• Training for troubleshooting (peripheral device operation, hardware replacement, etc.) |
| Maintenance timing | Clearly differentiate the targets of preventive maintenance and breakdown maintenance to determine the maintenance timing. | |
| Maintenance tools | Arrangement of maintenance spares, members, instruments, measuring apparatuses, etc. | |
| Maintenance procedure | Arrange manuals, for example, to clarify how to perform maintenance and what to do. | |
| Maintenance personnel | Secure personnel and determine their posts, coverage, etc. | |
| Maintenance method improvement | Examine improving maintenance methods, for example | |
| Grasping of PLC maker's service and support system | After-sales service | • Service locations (such as places, contacts, persons in charge)<br>• Service scope (such as corresponding models, handling range)<br>• Service time (such as start and end times, time required for arrival, emergency service)<br>• Service period (warranty period, service on commercial basis)<br>• Service parts supply period (such as repair after production stop, supply period)<br>• Actions for production stop (such as stop declaration, repair period)<br>• Period for repair (such as standard, shortest and longest delivery times) |
| | Technical support | • Support locations (such as places, contacts, persons in charge)<br>• Support ranges (corresponding models, hardware/software, system)<br>• Support methods (phone, fax, visit, school, machine operation)<br>• Manuals (manuals effective for maintenance) |


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## 1.4 Management of Maintenance Data

To repair any failure within a short time, the data listed below must be arranged and managed properly.

Table 1-2 Maintenance Data to Be Managed

| Data Category | Data Name | Description |
|---|---|---|
| System-specific data | System/control specification | Describes the functions and operations of the corresponding system/control. (Operation sequence/timing, operational conditions, operation procedure, interlock conditions) |
| | Electrical wiring diagrams | Developed connection diagrams (Power supply circuit, power circuit, control circuit, operation circuit, display circuit, etc.) Inter-equipment/panel connection diagrams (cabling diagram, ground cabling diagram) |
| | Equipment layout diagrams | In-panel electrical equipment layout diagram, terminal block wire number layout diagram, connector pin connection assignment table (Diagrams which identify various instrument models, wire numbers, etc.) |
| | List of used hardware | List of electrical equipment used in a system (Types and specifications of all electrical equipment such as units which comprise PLC system, peripheral devices, electrical parts in control box, I/O devices and software packages) |
| | PLC programs | PLC control programs (ladder diagrams/lists) |
| | I/O and other assignment lists | External I/O number and internal device assignment lists (Signal names corresponding to device numbers, signal explanations, set values) |
| | Program instructions (Specification) | Instruction manuals for program structure, processing and functions (Explanation of arithmetic operations which are difficult to understand, etc.) |
| | Instruction manual and maintenance and inspection procedure of controlled object | For handling (operation) and maintenance/inspection of controlled object |
| General data | Used hardware catalogs | Provide model makeup, makers, etc. |
| | Used hardware instruction manuals/technical information | For troubleshooting hardware and software |

## 1.5 Maintenance Records

The following maintenance records must also be managed for use as maintenance reference after repair of a failure.

Tale 1-3 Maintenance Records to Be Managed

| Record Item | Description |
|---|---|
| Error, failure occurrence conditions | Apparatus/equipment name, phenomenon, circumstances |
| System stop time | Occurrence time, stop period |
| Influence of occurrence | Loss, lost time, influence on others |
| Cause | Cause finding method, cause including estimation |
| Repair method | Replacement, repair or other repair method |
| Recurrence prevention | Similar failure recurrence prevention, lessons |
| Trouble records | Occurrence cause, remedy and other records |
| Person in charge | |


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## 1.6 Failure Cause Trends

The following graphs show the failure location and failure cause ratios at PLC trouble occurrence.
[Sources: Japan Electrical Manufacturers' Association (JEMA)]

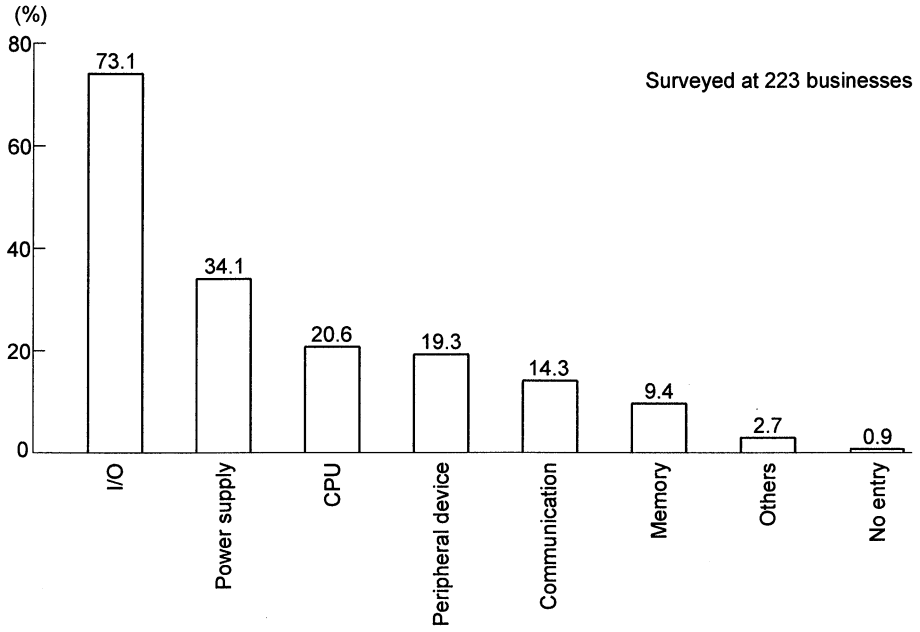


Diagram 1-1 PLC Failure Locations (Plural choices allowed)

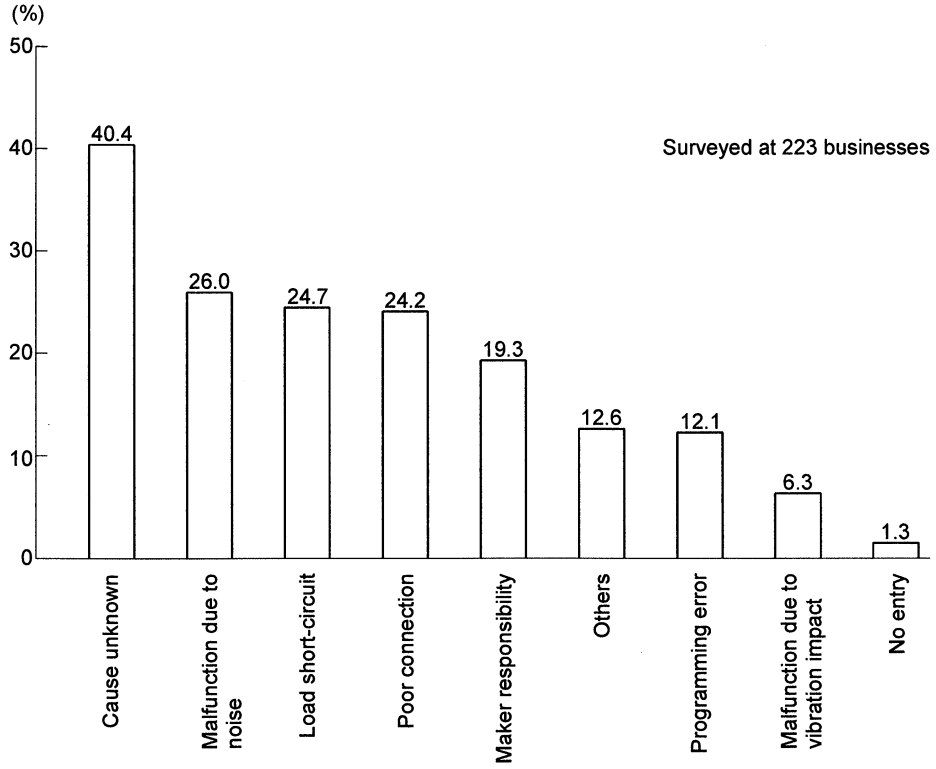


Diagram 1-2 PLC Failure Causes (Plural choices allowed)


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## 1.7 Failure Stages

Generally, how a complicated system fails is separated into three stages, initial failure, random failure, and wear-out failure, as shown in Diagram 1-3. Initial failures are considered to be removed in the manufacturing and inspection processes of a manufacturer.

Random failures are unforeseeable, sporadic failures which occur at any time prior to the progress of wear within the useful life of equipment, and are difficult to take technical measures. Therefore, at present, actions taken are only based on statistics.

Wear-out failures occur at nearly the end of useful life in the course of deterioration or as a result of wear, and increase abruptly with the elapse of time. Point tb in Diagram 1-3 indicates the years when parts will be changed. Preventive maintenance will be made appropriate by changing specific parts for new ones at this point.

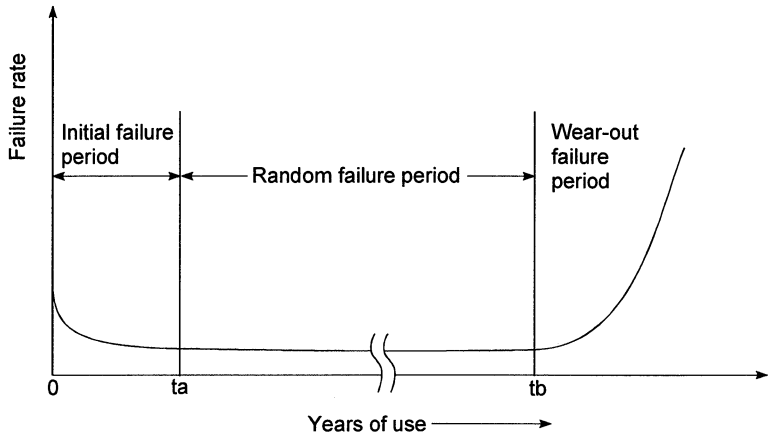


Diagram 1-3 Bath-tub Curve


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# CHAPTER 2 UNDERSTANDING THE PLC SYSTEM

A PLC system is usually constructed using a base unit, CPU module, power supply, I/O modules and special function modules.

## 2.1 System Construction of the Training Kit



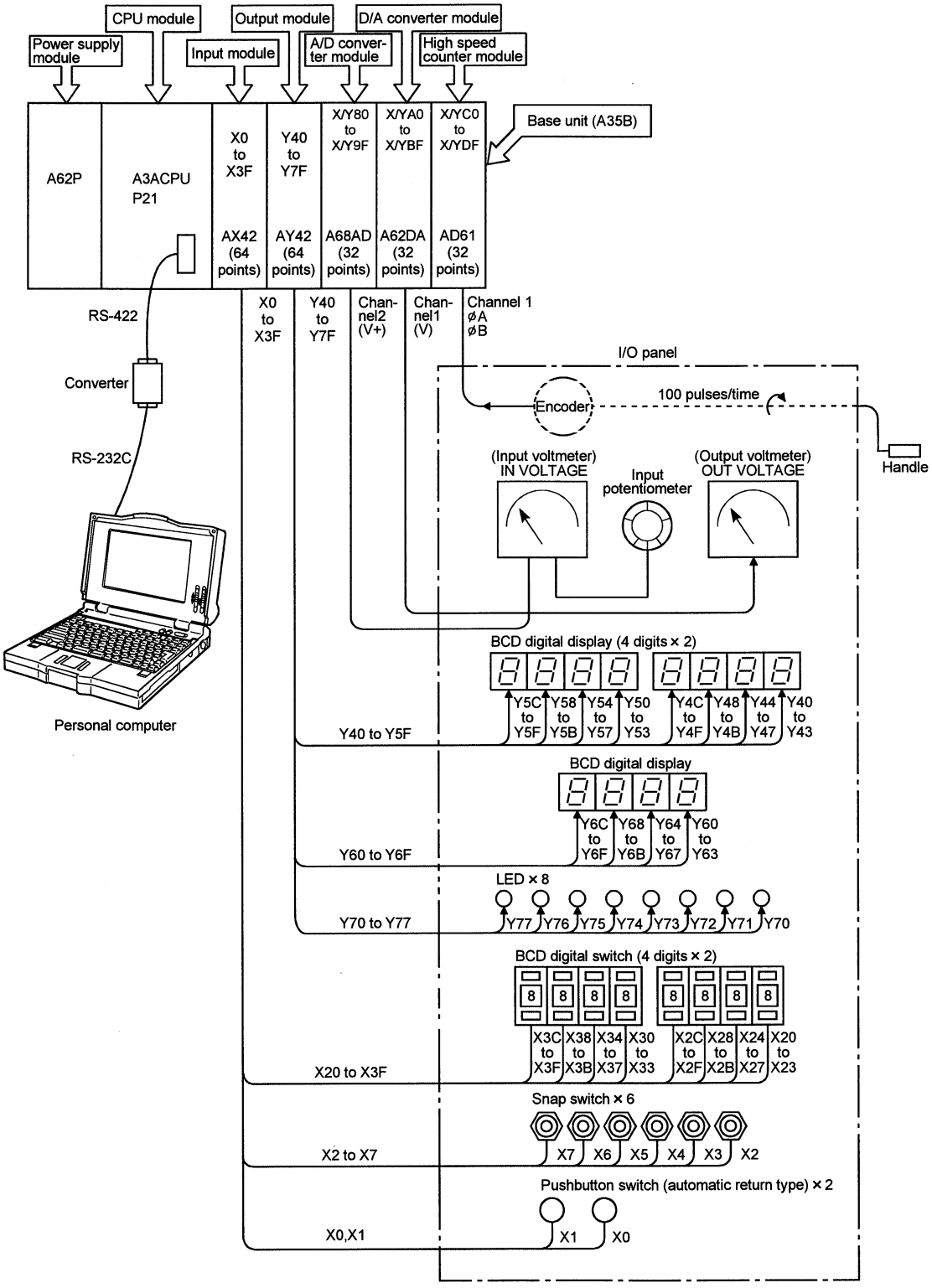


Diagram 2-1 System construction of the training kit



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## 2.2 I/O Address Allocation

This section explains I/O address allocation, which is necessary for ACPU to exchange data with I/O and special function modules.



The sequence program uses the I/O addresses to read data from input modules and send data to output modules.
The I/O addresses are shown as 3 digit, hexadecimal numbers.
Diagram 2-2 below shows a system where only 16 point modules are used.

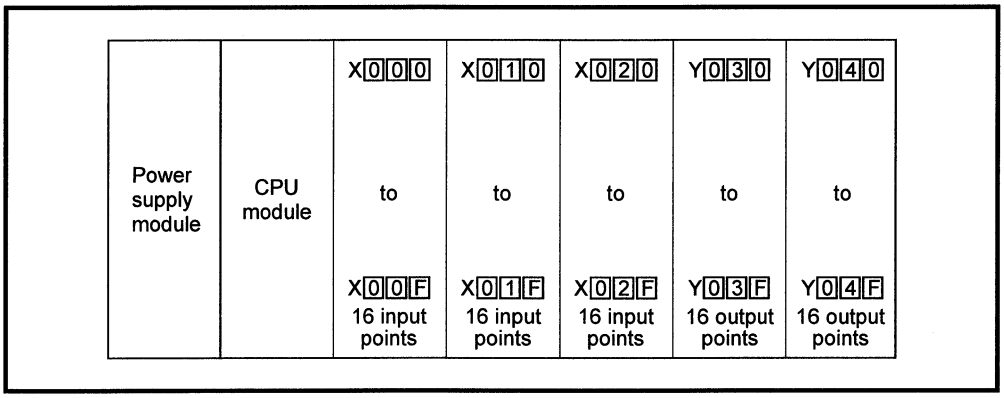


Diagram 2-2 I/O allocation


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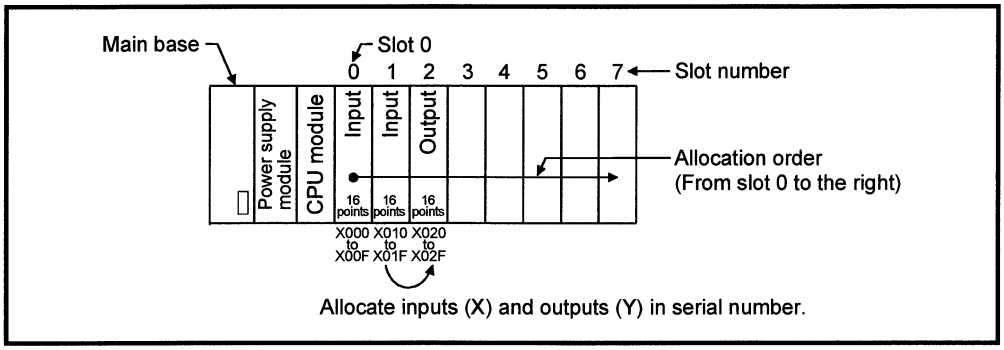
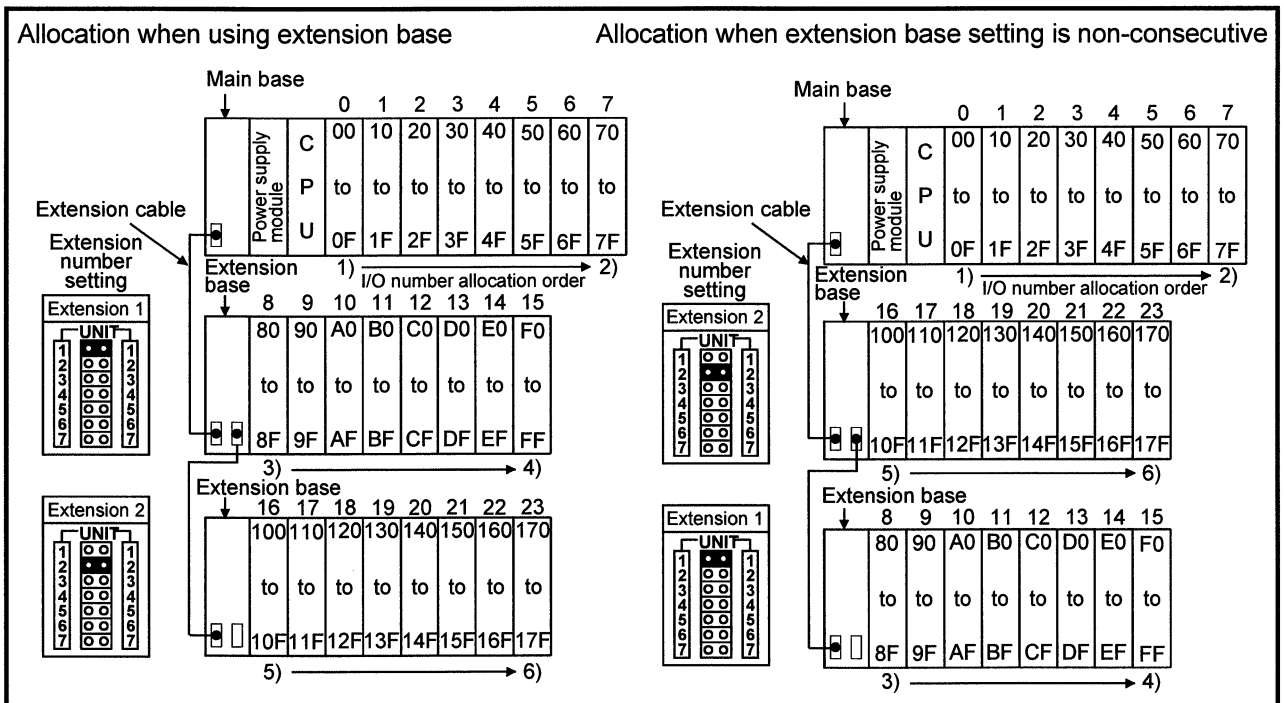
## (1) I/O address allocation

When the power is turned on or the system is reset, the I/O address allocation will be like that shown below.
The I/O addresses used in the sequence program must comply with the items shown below.

(a) I/O addresses start from slot 0 of the main base (right of the CPU) and continue in ascending order to the right.
Allocation for input module X□□□ and output module Y □□□ is consecutive.




(b) The following explains the I/O allocation when using an extension base.
Extension base I/O allocation is not determined by the order of the extension cables but by the stage setting on the extension base.





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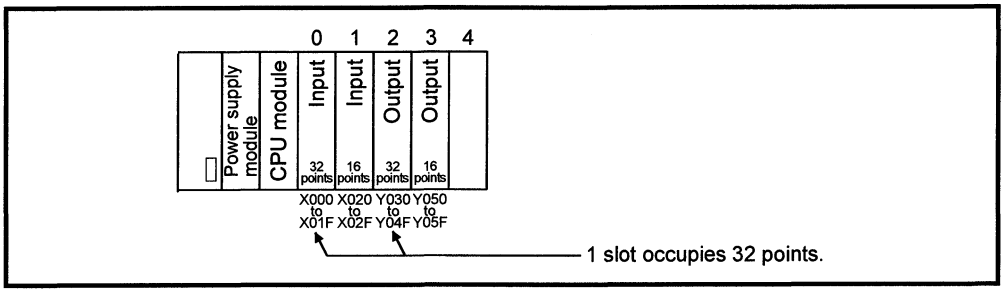
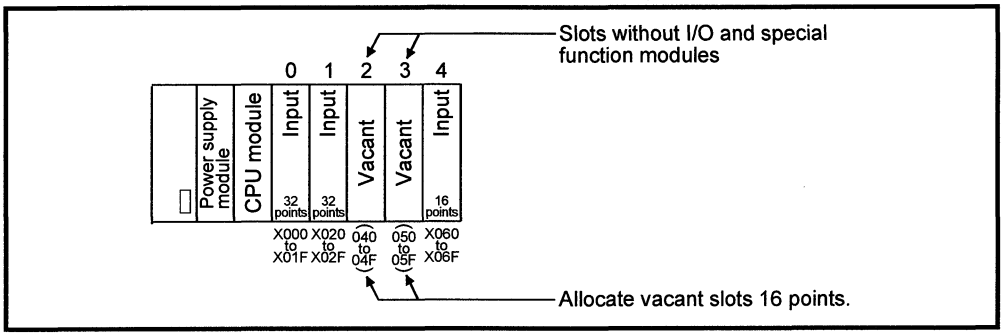
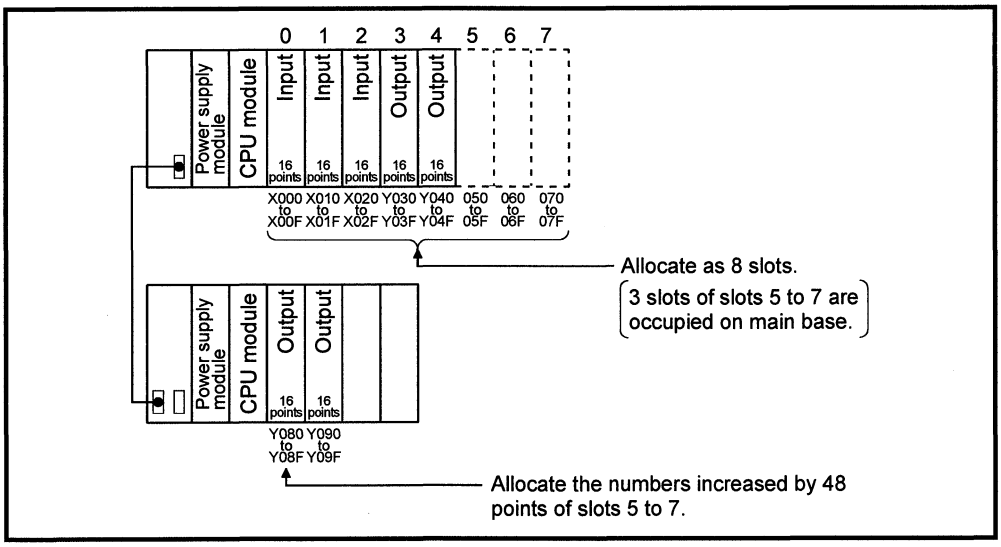
(c) One module occupies a given amount of I/O address.
For instance, when a 32 point input module is installed in slot 0 it occupies 32 points from X00 to X1F.




(d) Vacant slots are allocated 16 points.




(e) 8 slots are allocated to all main and extension bases, regardless of their actual size.
For instance, if a 5 slot base is used 3 extra slots (48 vacant points) will also be allocated.





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## (2) I/O allocation using a peripheral device

Even if I/O allocation is not made with a peripheral device, all I/O and special function modules can still be used.
Setting the I/O allocation with a peripheral device is effective in the following cases.

(a) Reason for setting I/O allocation with a peripheral device.

1) When using a 5 slot base you can set the I/O allocation for the 3 slots that do not exist to 0 points, allowing effective use of I/O addresses.
2) Vacant slots can be reserved for adding planned modules to extend the system in future.
3) When an I/O or special function module with more than 16 points is removed for repair the I/O addressing will not change.

(b) Principles of I/O allocation using a peripheral device.

1) Modules of slots for main and extension bases can be allocated as shown in the table below.

| I/O allocation points | | | |
|---|---|---|---|
| Vacant slot | Input module | Output module | Special function module |
| 0 | — | — | — |
| 16 | 16 | 16 | 16 |
| 32 | 32 | 32 | 32 |
| 48 | 48 | 48 | 48 |
| 64 | 64 | 64 | 64 |

2) I/O allocation of slots using a peripheral device takes priority, even if the I/O usage of the actual module is different.
   - If the number of points set in I/O allocation is less than the number of points used by the actual module, the number of addressable points will be reduced.
     For instance, if a 32 point input module is used and I/O allocation is made for only 16 points, the latter half of 16 points cannot be used (10H to 1FH).
   - If the number of points set in I/O allocation is more than number points used by the actual module, the extra points will effectively be "dummy" points.
   - If the I/O allocation for the slot occupied by an actual module is set to "vacant", then the module will not be addressable (cannot be used).

3) If I/O allocation for a slot is not set with a peripheral device, then the allocation will be determined by the actual I/O usage of the module.


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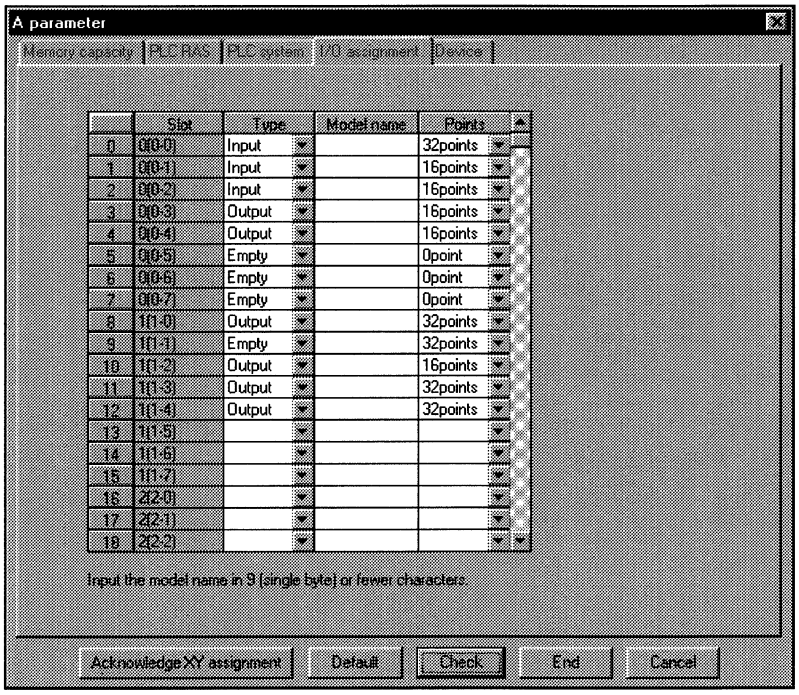
## (3) Example of I/O allocation with peripheral device.

See the example below for reasons why I/O allocation might be carried out.

(a) A 16 point input module is not available, so a 32 point input module is substituted.

(b) A 5 slot base is used and you don't want to lose I/O addresses to the 3 unoccupied slots.

(c) You are waiting for delivery of a 32 point module. In the meantime, you want to reserve a 32 point empty slot.





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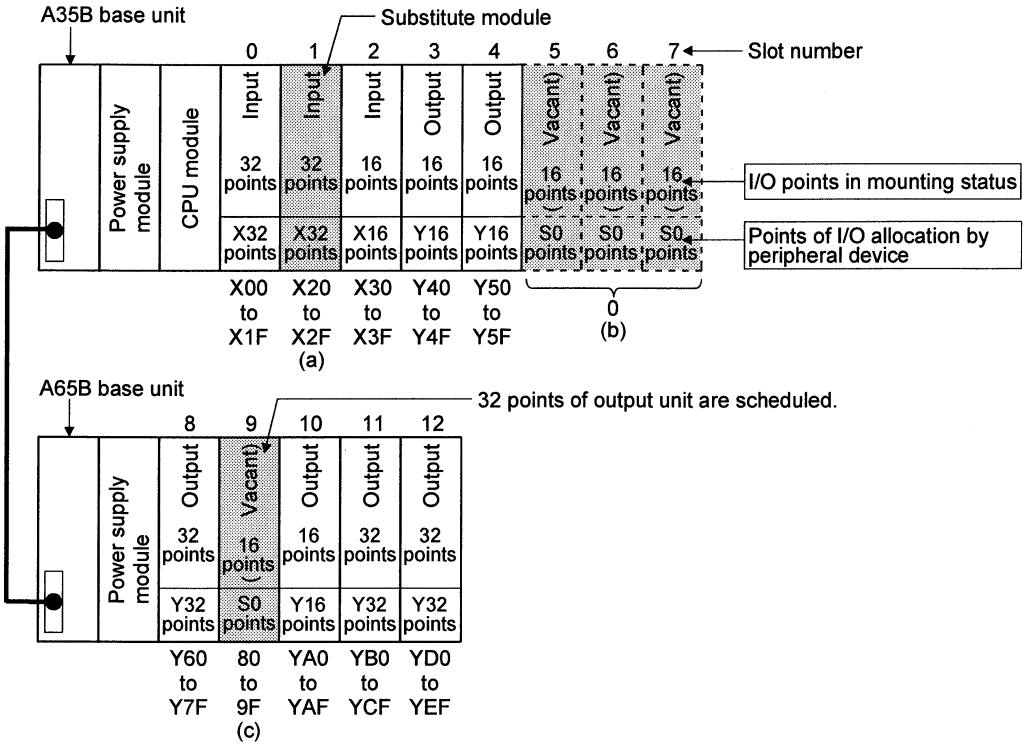
A35B base unit
Substitute module
Slot number
0
1
2
3
4
5
6
7
Power supply module
CPU module
Input
32 points
X32 points
X00 to X1F
Input
32 points
X32 points
X20 to X2F
(a)
Input
16 points
X16 points
X30 to X3F
Output
16 points
Y16 points
Y40 to Y4F
Output
16 points
Y16 points
Y50 to Y5F
Vacant)
16 points (
S0 points
Vacant)
16 points (
S0 points
Vacant)
16 points (
S0 points
0
(b)
I/O points in mounting status
Points of I/O allocation by peripheral device
A65B base unit
32 points of output unit are scheduled.
8
9
10
11
12
Power supply module
Output
32 points
Y32 points
Y60 to Y7F
Vacant)
16 points (
S0 points
80 to 9F
(c)
Output
16 points
Y16 points
YA0 to YAF
Output
32 points
Y32 points
YB0 to YCF
Output
32 points
Y32 points
YD0 to YEF


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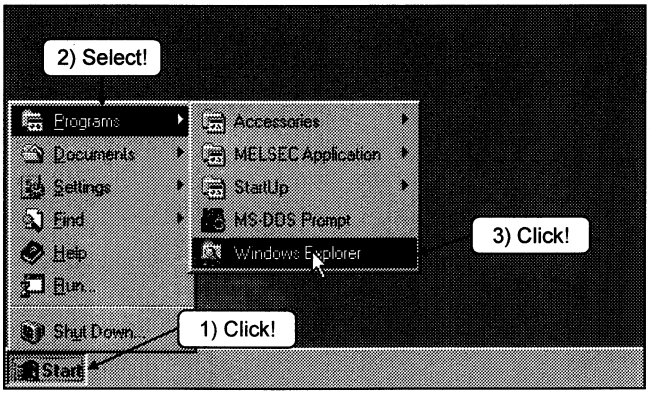
MEMO


2 - 8

# CHAPTER 3 LEARNING GX Developer OPERATIONS

## 3.1 Formatting a Floppy Disc

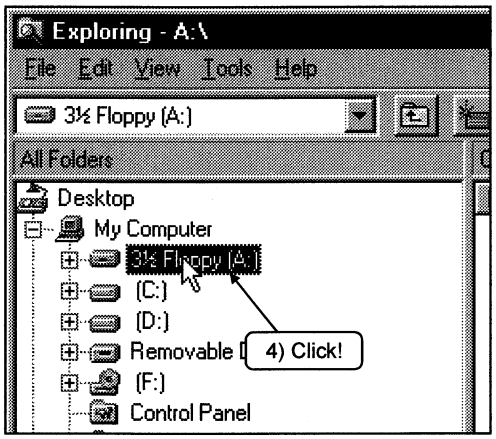
When using an unformatted floppy disc, carry out formatting as follows.
(This procedure is not necessary if the disc is already formatted.)
After turning on the power to the PC, display the Windows screen below.



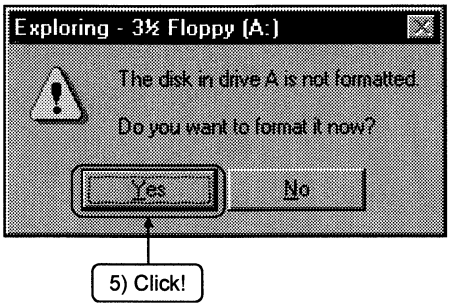

1) Click on the [Start] button.

2) Select [Programs] menu.

3) Click on the [Windows Explorer] menu item and Explorer will start.



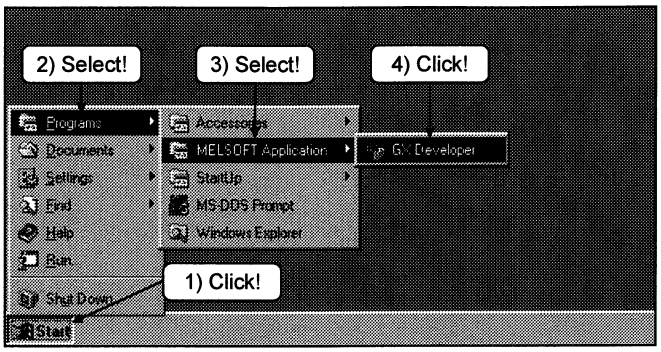

4) Click on "3 $^{1}/_{2}$ Floppy (A:)".




5) Click the "Yes" button and formatting will commence.


3 - 1

## 3.2 Creating a New Project with GX Developer

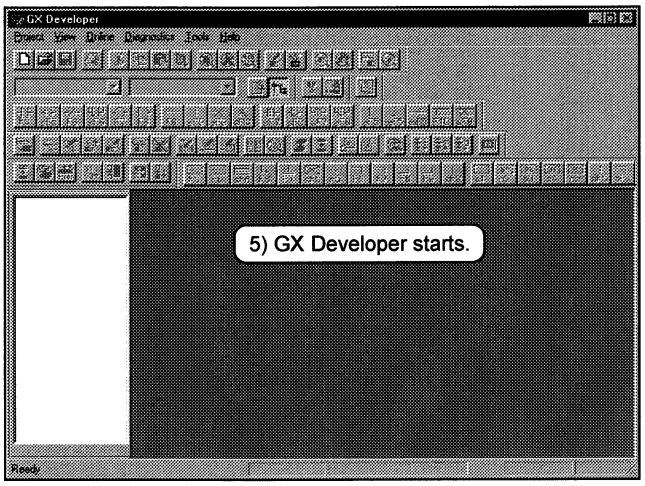



1) Click on the [Start] button.

2) Select [Programs] menu.

3) Select [MELSOFT Application].

4) Click on the [GX Developer for Windows].




5) GX Developer will start.

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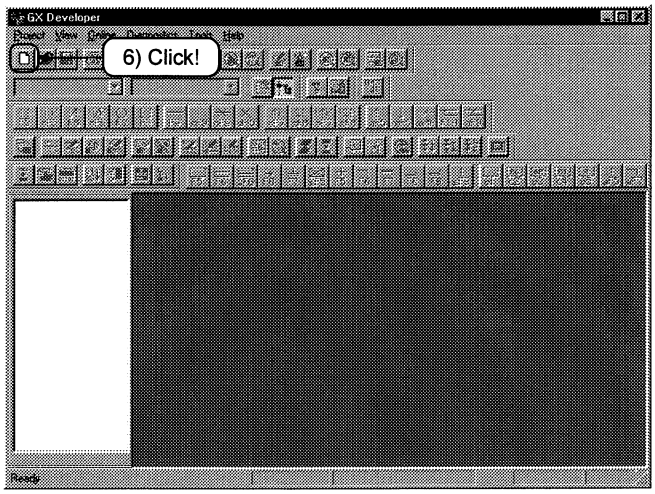
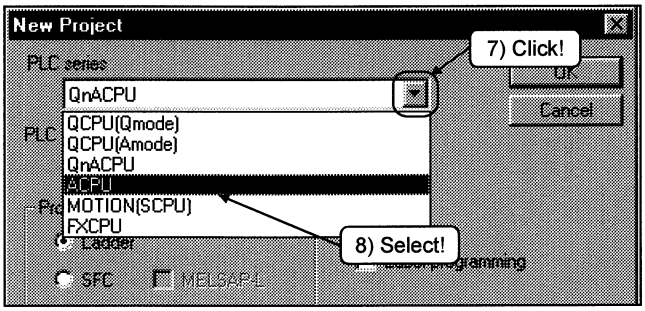
(From preceding page)

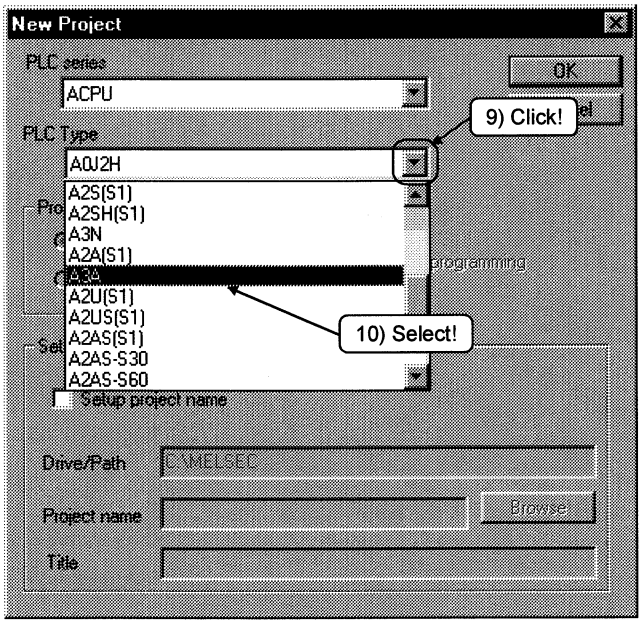



6) Click the following button on the toolbar: (Create new project).




7) Click on the [PLC series] list box.

8) While the list of PLC types is displayed, select "ACPU".




9) Click on the [PLC type] list box.

10)While the list of CPU types is displayed, select "A3A".

(Next page)



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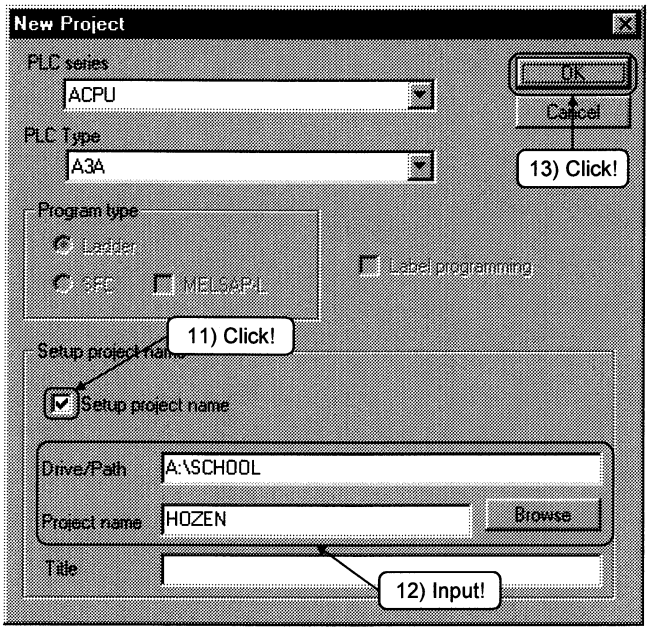
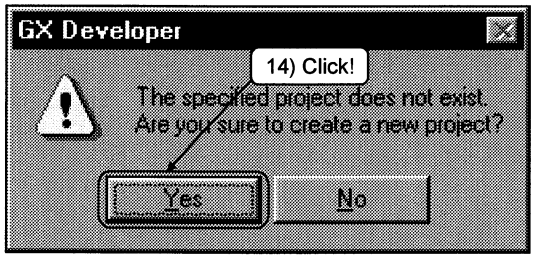
(From preceding page)



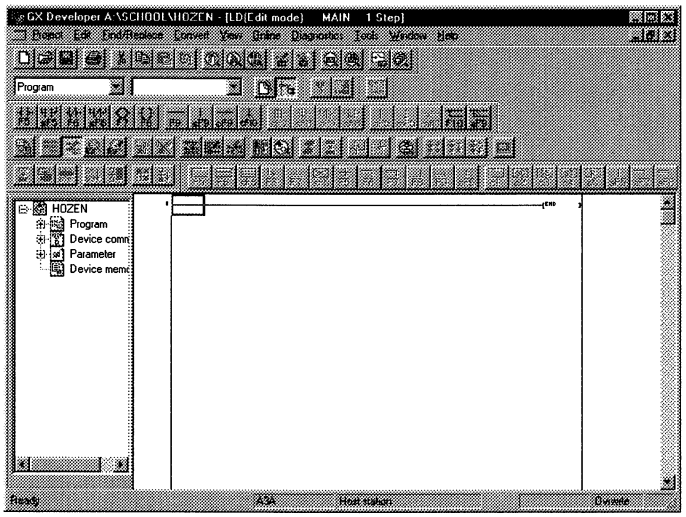

11)Click on the [Setup project name] check box.

12)Enter the following for drive/path and project name:
Drive/Path : A:\SCHOOL
Project name : HOZEN

13)Click on the [OK] button.




14)Click on the [Yes] button.




15)A new project is created.

(Next page)



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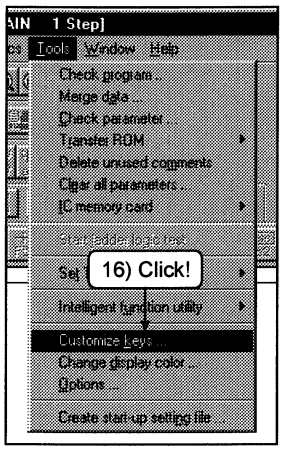
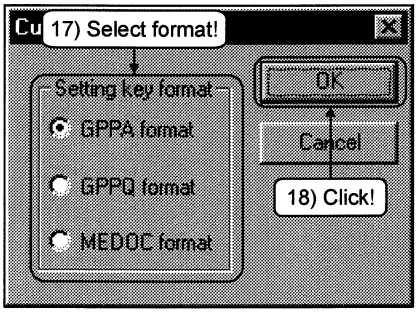



16)Click on [Tools] → [Customize keys] menu.
(Function key allocation setting)

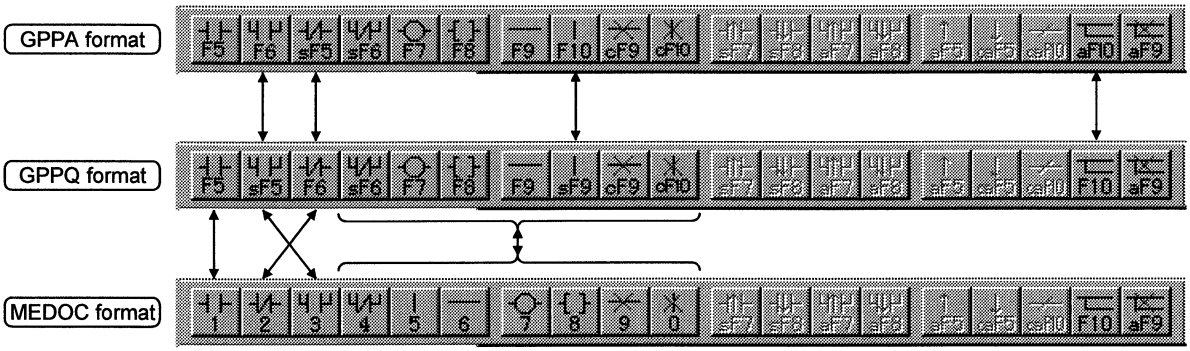



17)Clicking on one of the selections will set that particular key format. Select GPPA format.

18)Click on the [OK] button.

## REFERENCE

The toolbar display for each format is different. Also, shortcut keys are different.





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## 3.3 Making a Program in Ladder Mode

The following items deals with creating a new program up to the point of executing it.

### (1) Function key operations in ladder mode

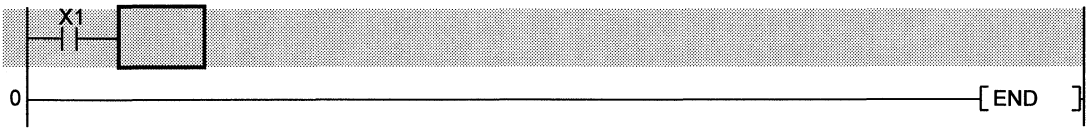
| Key combination | None | Alt | Ctrl | Shift |
|---|---|---|---|---|
| F1 | ——— | Ladder/list change | ——— | ——— |
| F2 | Write mode | ——— | ——— | Read mode |
| F3 | Start monitor | Stop monitor | Monitor (All windows) | Monitor (Write mode) |
| | | Stop monitor (All windows) | | |
| F4 | Convert | Convert (all programs being edited) | | Convert (write during RUN) |
| F5 | "a" contact (⊣ ⊢) | ——— | ——— | "b" contact (⊣/⊢) |
| F6 | "a" contact OR (└┤ ├┘) | ——— | ——— | "b" contact OR (└┤/├┘) |
| F7 | Coil (-( )-) | ——— | ——— | ——— |
| F8 | Application instruction (-[ ]-) | ——— | ——— | ——— |
| F9 | Horizontal line (—) | Delete free-drawn line (⊠) | Delete horizontal line (✳) | ——— |
| F10 | Vertical line ( \| ) | Free-drawn line (⌐) | Delete vertical line (✳) | ——— |
| Ins | ——— | ——— | Insert column | Insert line |
| Del | ——— | ——— | Delete column | Delete line |

1) The operating mode is changed using the F2, Shift + F2 and F3 keys.

2) After you have finished writing, there are 3 ways to convert the program:
   - F4 ( ) .....Convert program being edited.
   - Ctrl + Alt + F4 ( ) .....Convert all programs being edited.
   - Shift + F4 .....Convert and write to the CPU during RUN.

3) The procedure for writing instructions using the function keys is explained below.

   a. Input operation for contacts.
   Via the keyboard input F5 → "X1".
   The contact instruction is written on the editing screen using the ↵ or OK button.





3 - 6

b. Input operation for application instructions.
Via the keyboard input [F8] → "MOV K1 D0".


**REFERENCE**

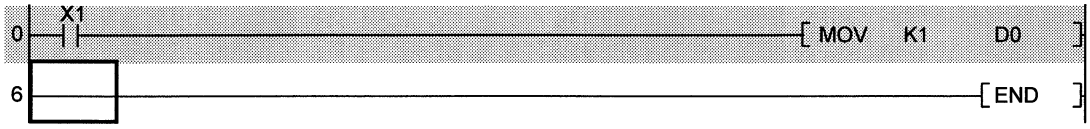
The methods below can be used to input instructions.

- When using list instruction format
  Type "MOV K1 D0".


- When using tool buttons
  Click on [F8] and type "MOV K1 D0".


- When using menus
  Select [Edit] → [Ladder symbol] → [Application instruction] and type "MOV K1 D0".


The instruction is written on the editing screen using the [↵] or [OK] button.




4) The following method is used for switching between ladder and list modes.

a. Modes can be switched by pressing [Alt] + [F1].

b. Alternatively, switching is carried out by clicking on the icon (Ladder/instruction list view switches) on the toolbar.

c. Finally, you can select [View] → [Instruction list] menus to switch the view.

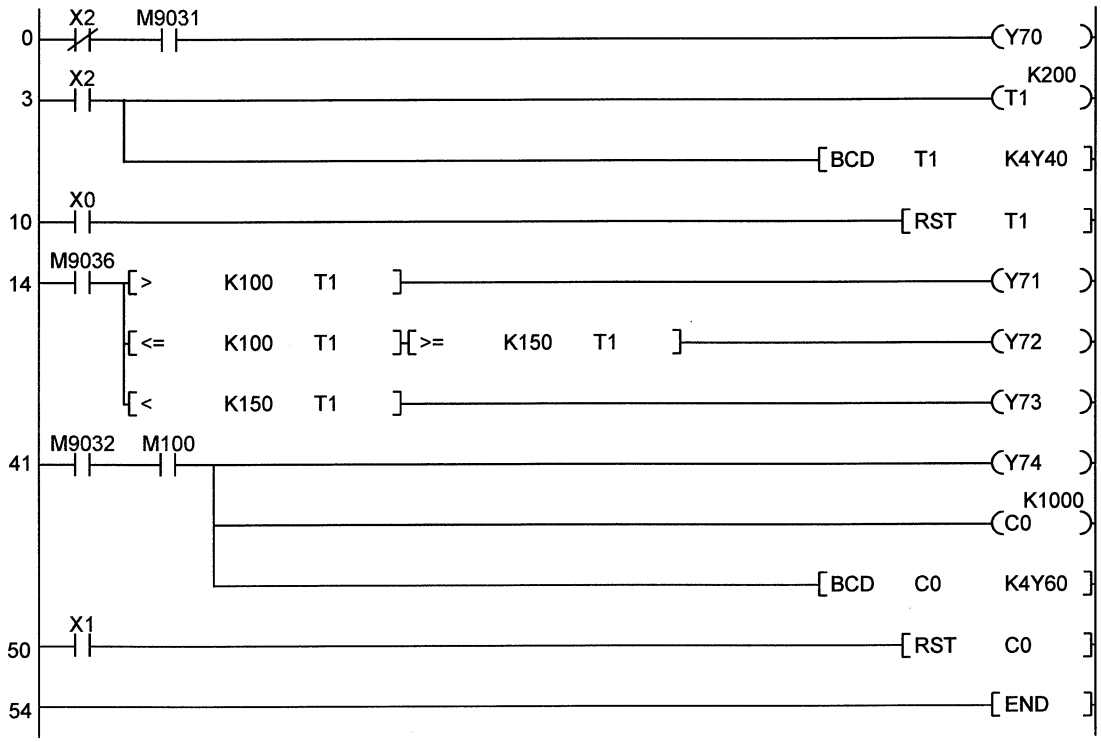
**REFERENCE**

Other operations can also be accessed using similar methods (key board input, toolbar icons and selecting from menus).
Use the method that you find the easiest.


3 - 7

| Drive/path name | A:\SCHOOL |
|---|---|
| Project name | HOZEN |

## (2) Program writing operation in ladder mode




Use the function keys [F5] to [F10] for inputting the program.

1) [Shift] + [F5] X 2 [↵] [F5] M 9 0 3 1 [↵]
(-|/|-) (-| |-)
[F7] Y 7 0 [↵]
(-( )-)

2) [F5] X 2 [↵] [F7] T 1 [ ] K 2 0 0 [↵]
(-| |-) (-( )-) (space)
[→] [↑] [F10] [↵] [↓] [F8] B C D [ ] T 1
( | ) (-[ ]-) (space)
[ ] K 4 Y 4 0 [↵]
(space)

3) Use the same input operations and input the program up to the [END] instruction.

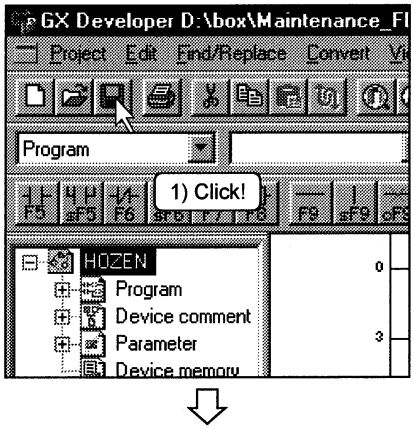
4) Click on the toolbar icon  (Program convert)

| Key | F5 | F6 | Shift + F5 | Shift + F6 | F7 | F8 | F9 | F10 |
|---|---|---|---|---|---|---|---|---|
| Ladder | -\| \|- | -\| \|- | -\|/\|- | -\|/\|- | -( )- | -[ ]- | — | \| |


3 - 8

## 3.4 Program Save

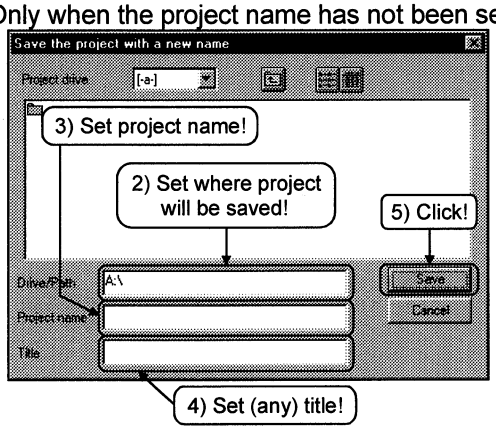
Give the parameters and program a project name and save it to a file.




1) Click on the toolbar icon (Save).

If the project name has already been set then the save operation is completed.

(Only when the project name has not been set)

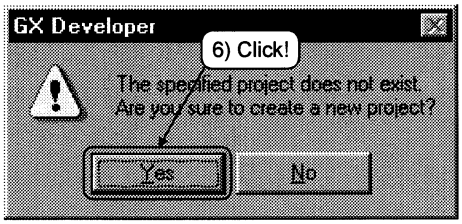



2) Designation where the program will be saved to.

3) Input the project name.

4) If needed, input a title.

5) After setting all the above items, click on [Save] button.




6) Click on the [Yes] button. The save operation is now finished.

**REFERENCE**

- The following characters cannot be used: / \ > < * ? " " | : ; (: \ can only be used for drive designation)
  Also, do not enter a period/full stop after the project name.
- Up to 150 characters can be used for project path + project name.
- Up to 32 characters can be used for the title.
- When the project name set using SW6D5-GPPW has eight or more characters, the characters after the eighth one are not displayed if SW2D5-GPPW or earlier version is used to read.
- When a space is included in a project path or project name, double-clicking the GPPW.gpj,***.gps file on Explorer will not start GX Developer properly.
  When a space is included in a project path or project name, start GX Developer and choose the [Project] → [Open project] menu to open the project.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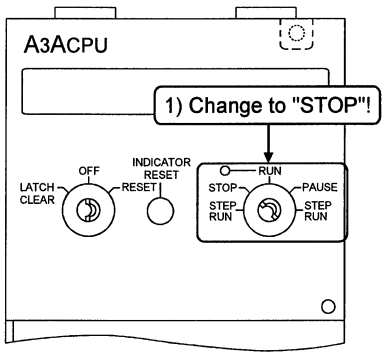
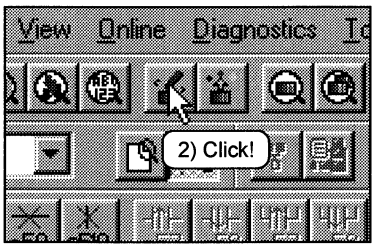
## 3.5 Writing data to the PLC CPU

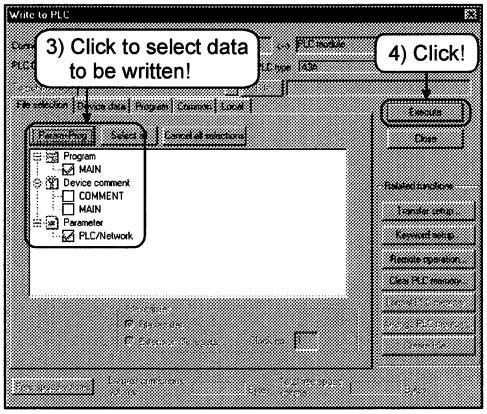
We will now write the program that was created in section 3.3 to the CPU.
Connect the PLC CPU to the PC with a RS-232C/RS-422 conversion cable.




1) Turn the CPU "RUN/STOP" key switch to "STOP".

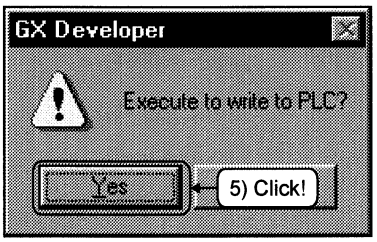



2) Click on (Write to PLC).




3) Select which program and parameter files to be written to the CPU or click on the Param + prog button.

4) After completing selection, click on Execute.




5) Confirm that you want to write the project to the PLC by clicking on the Yes button.

(Next page)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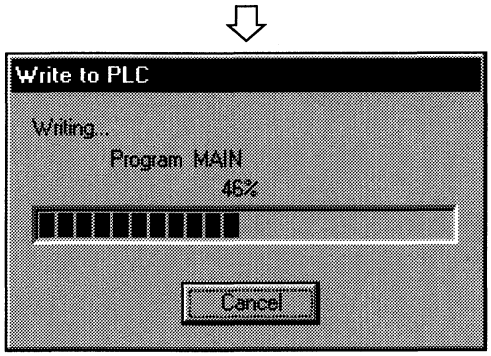
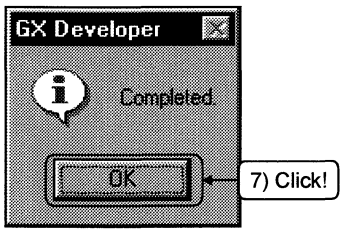
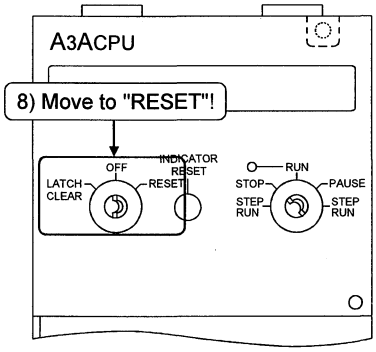
(From preceding page)




6) While the project is written to the PLC, the dialog box on the left is displayed.




7) When writing to the PLC is completed a message appears. Click on the OK button.




8) Turn the CPU "RESET" key switch to "RESET". When the key if released it will automatically return to the "OFF" position.

**REFERENCE**

Reset the CPU after downloading (writing to PLC CPU) new programs or parameters.
This is necessary to initialize devices and clear errors that occurred before download.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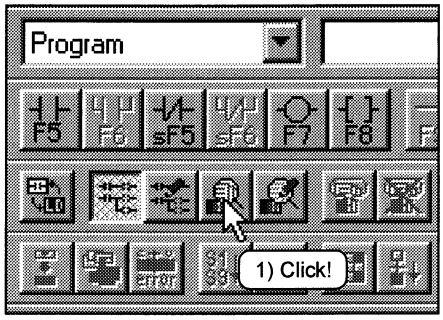
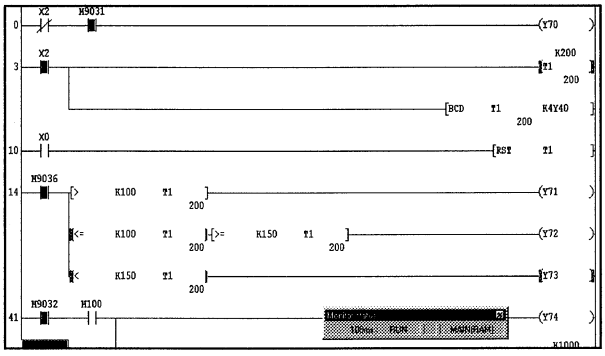
## 3.6 Ladder Monitor Operation

We will now monitor the program that was downloaded to the CPU in section 3.5 and observe the CPU operations using ladder monitor.

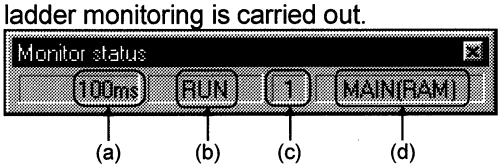
Turn the CPU "RUN/STOP" key switch to "RUN".




1) Click on (Monitor mode).



2) The monitor status dialog box appears and ladder monitoring is carried out.



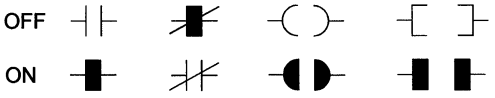

(a) Scan time
The maximum scan time for the CPU is shown. It is shown in modules of 10ms.

(b) PLC CPU status
PLC CPU operation status is displayed.

(c) Monitor execution status
Flashes during monitoring.

(d) Name of program being executed.

ON and OFF display status of ladder elements is shown below.




Training kit operation

1) Switch on X2 and monitor timer T1.
2) Confirm that timer T1 is reset when switch X0 is turned ON.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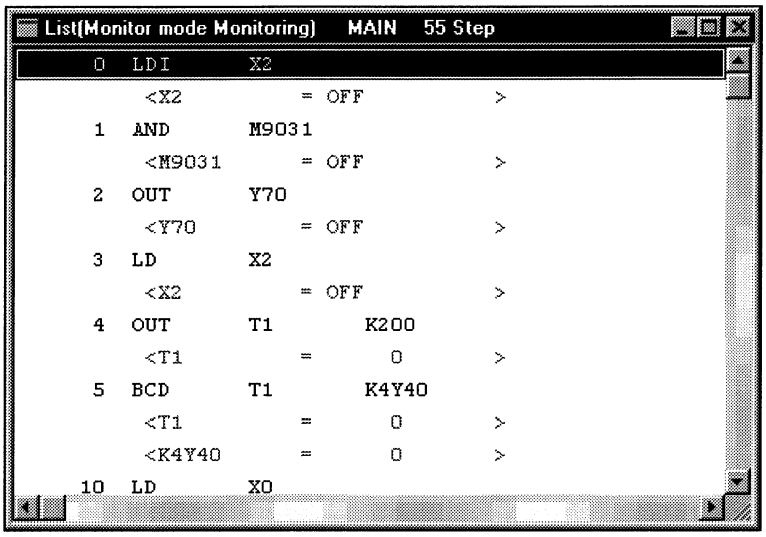
## REFERENCE

• Data may also be monitored in the list mode.




In the list mode, the ON and OFF statuses are as follows.

1) Bit device

The device name and monitoring status appear under the line where the list instruction is displayed.

When OFF [X0=OFF], when ON [X0=ON]

2) Word device

The present value appears.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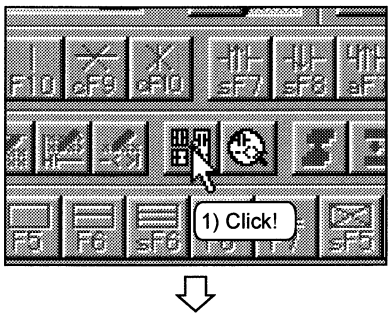
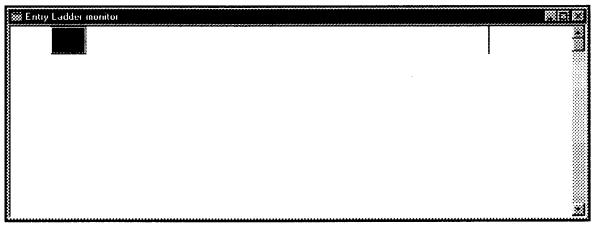
## 3.7 Entry Ladder Operation Monitor

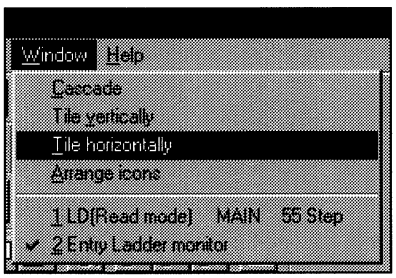
By entering any ladder block, batch monitoring can be carried out for multiple related ladder blocks.
Also, by using the arranging the monitor screen display as a horizontally tiled view you can monitor the entry ladder and another part of the ladder at the same time.
This section describes the execution of entry ladder monitoring for the ladder block that was downloaded to the CPU in section 3.5.




1) Click on (Entry ladder monitor).

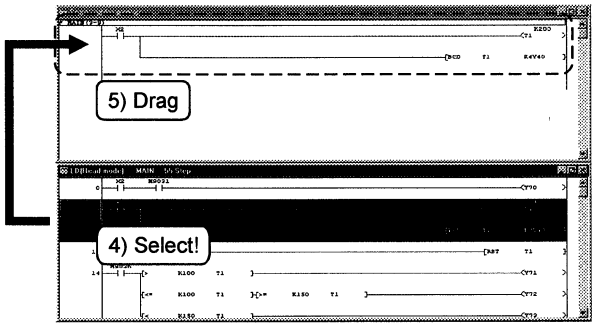



2) The entry ladder monitor screen is displayed.




3) Click on [Window] → [Tile horizontally].

(Entry ladder monitor screen)




4) From the ladder monitor screen, click on the registered ladder block to select it.
The selected ladder block will be displayed in blue.

5) Drag the selected ladder block to the entry ladder monitor window.

(ladder monitor screen)

(Next page)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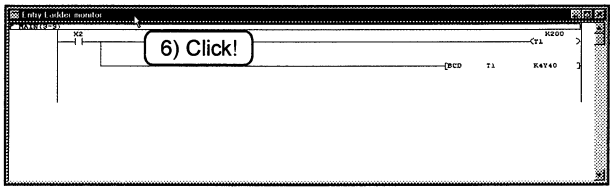
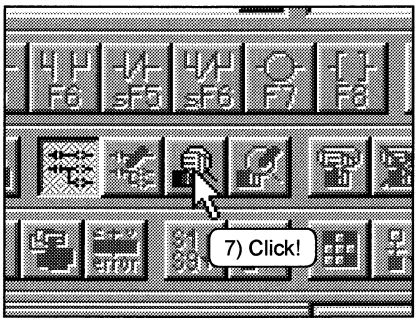
(From preceding page)

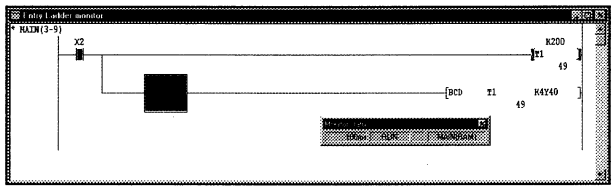
Turn the CPU "RUN/STOP" key switch to "RUN".




6) Click on the entry ladder monitor window title bar.

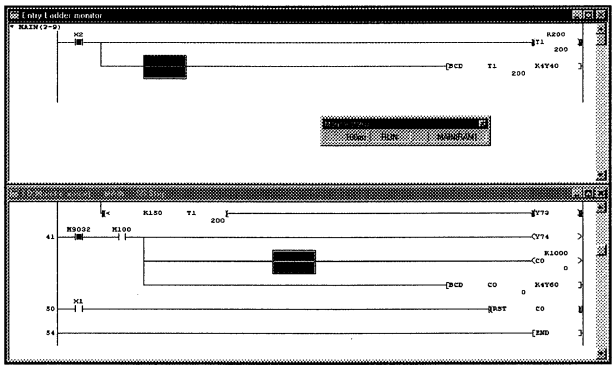



7) Click on (Monitor mode).



8) The entry ladder monitor window will now start monitoring.

9) Turn X0 ON/OFF.
You can monitor the current value of the timer device as it changes.



10) After clicking on the ladder monitor screen title bar, when the ladder monitor is scrolled no matter what other program steps are displayed and monitored the entry ladder monitor simultaneously continues monitoring.

**REFERENCE**

The following functions are available in the entry ladder monitor window:

1. Ladder blocks can be deleted.
2. Search for device, instruction or characters.
3. Display comments, statements or notes.
4. Device test.
5. Maximize / minimize the display.
6. Drag and drop to device entry monitor.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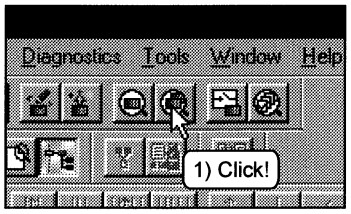
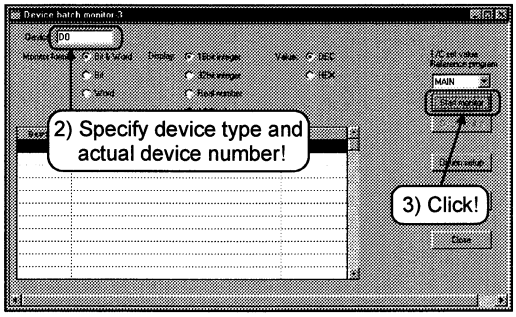
## 3.8 Device Batch Monitor Operation

This section deals with monitoring devices statuses for the program downloaded to the CPU in section 3.5.
For device monitoring [Batch monitor] or [Entry monitor] but in this section monitoring will be executed using one type of device only with [Batch monitor].

Turn the CPU "RUN/STOP" key switch to "RUN".

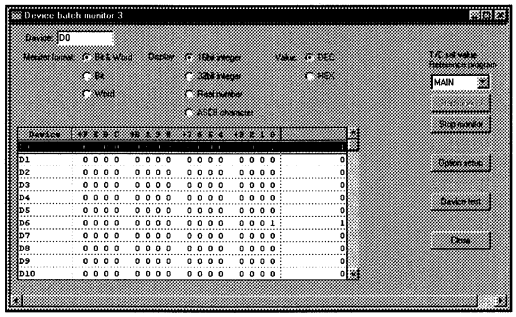



1) Click on (Batch monitor).



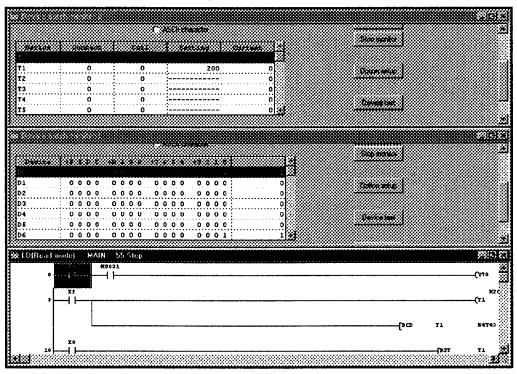

2) Designate the actual device number for the device to be monitored.
D 0

3) Click the Start monitor button.



4) Monitoring starts for the designated device. (D0 onwards is displayed)

5) Using the same operations as described above, execute batch monitoring for T0. (T0 onwards is displayed)



6) Batch device monitor windows and the ladder monitor window can be displayed at the same time by selecting from the [Window] menu the option [Tile horizontally] menus.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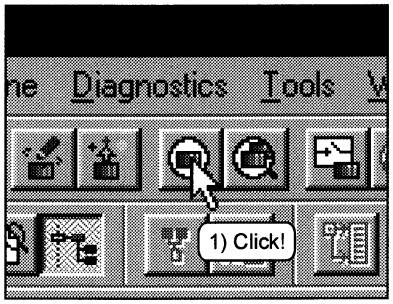
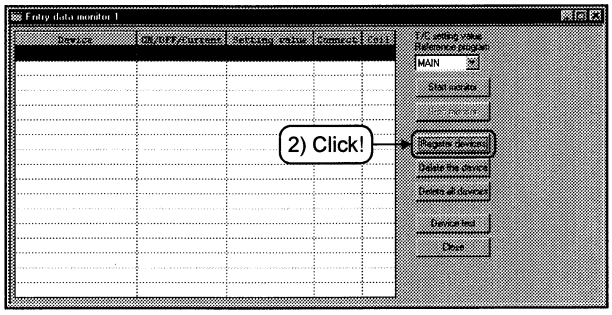
## 3.9 Entry Data Monitor Operation

Because devices that are not shown on the ladder monitor screen cannot be monitored directly, using the entry data monitor function allows devices to be entered and monitored.

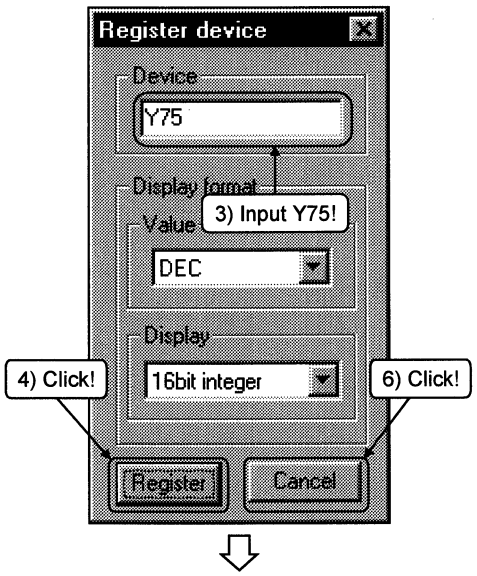
Turn the CPU "RUN/STOP" key switch to "RUN".




1) Click on (Entry data monitor).




2) Click the Register devices button.




3) Input a device to be monitored (Y75).

4) Click on the Register button.

5) Enter other devices ("X0", "T1", "M100", "C0") using the same operation.

6) Click on the Cancel button.

(Next page)



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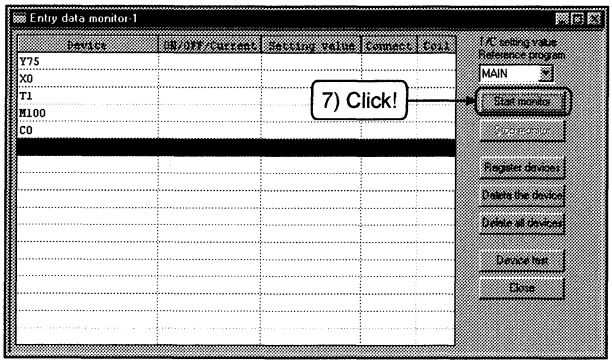
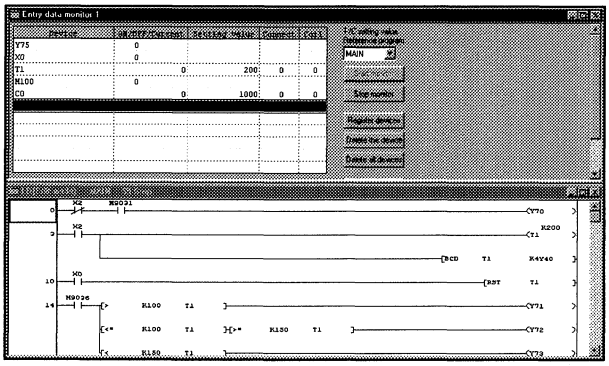
(From preceding page)




7) When you want to confirm the status of the device, click on the Start monitor button.




8) Both the ladder monitor and entry data monitor screens can be tiled horizontally for easy viewing.
Select the [Window] menu and clink on [Tile horizontally].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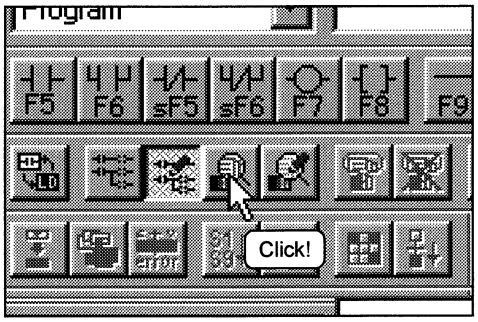
## 3.10 Device Test Operation

PLC test operations allow the user to force ON/OFF bit devices (X,Y,M,L,B,F) and change the current values of word devices (D,W,T,C, etc.).
There are 2 methods to carry out device test, one involves double clicking on the device in Ladder monitor and the other is to use the device test dialog box.
In this section, device test operations are carried out on the program that was downloaded to the CPU in section 3.5.

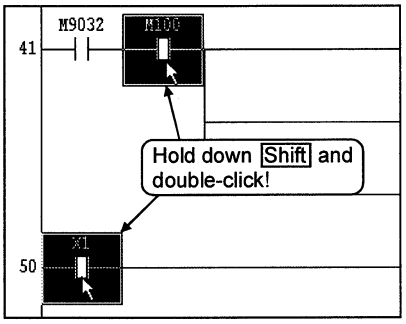
Turn the CPU "RUN/STOP" key switch to "RUN".




Click on (Monitor mode).

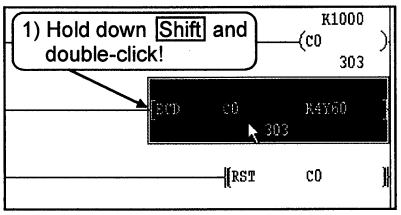
### (1) Operation by double clicking on a device during ladder monitor.

• Ex. 1 : Turning internal relay M100 and input X1 ON/OFF.

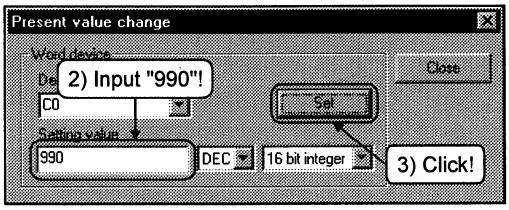



In ladder monitor select M100 or X1, hold down Shift and double click.

• Ex. 2 : Making the current value of counter C0 equal 990.




1) In ladder monitor select C0, hold down Shift and double click.
(Either the BCD instruction or coil instruction may be selected.)




2) Input the set value of "990".

3) Click on Set button.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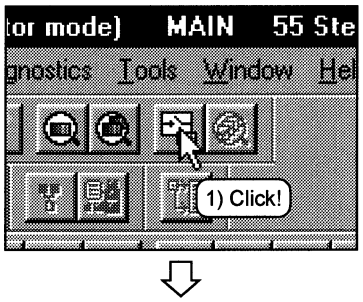
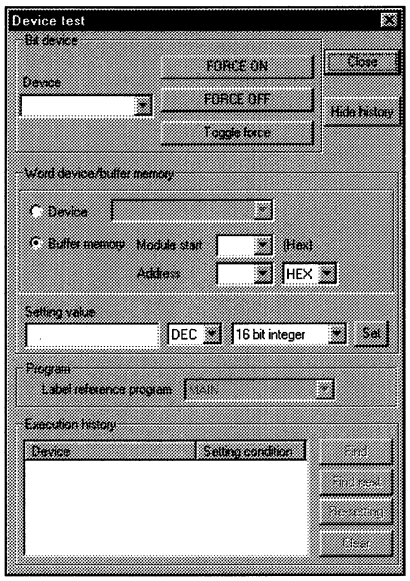
## (2) Operation using the device test dialog box

The dialog box is displayed by following the procedure below.

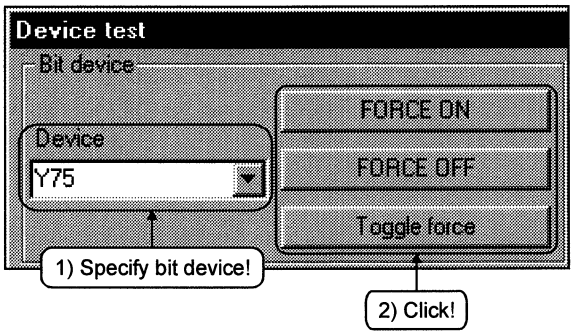



1) Click on (Device test).




2) The device test dialog box will be displayed.

• Turning output Y75, internal relay M100 and input X1 ON/OFF.




1) In the "Device" entry field, designate a device to turn ON/OFF (Y75, M100 or X1)

   [Y] [7] [5],
   [M] [1] [0] [0],
   [X] [1]

2) Click the buttons shown below to turn the designated device ON/OFF.

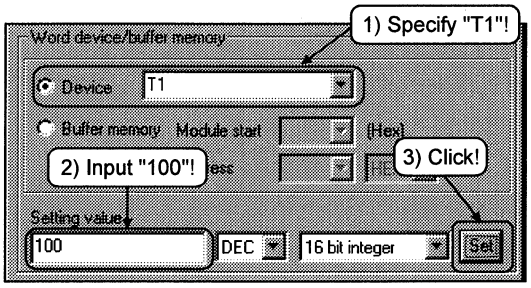
   [FORCE ON] : Force the designated device ON.

   [FORCE OFF] : Force the designated device OFF.

   [Toggle force] : Reverse the current status of the designated device.


3 - 20

• Making the current value of timer T1 equal 100.




1) In the "Device" entry field, designate the device that you want to change the current value for (T1).

   [T] [1]

2) Input the set value of "100".

   [1] [0] [0]

3) Click on the [Set] button.


3 - 21

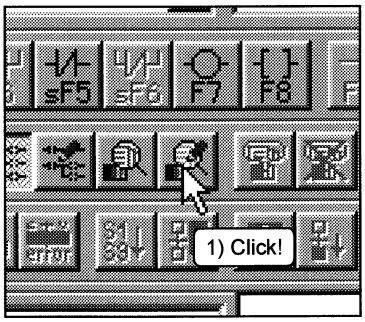
## 3.11 Write During RUN

Changing the PLC CPU during RUN.

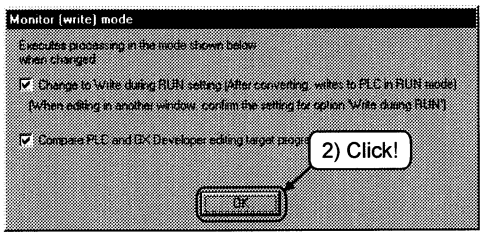
> Write during RUN warning
>
> The instructions given in this section are based on the assumption that the program and parameters in CPU memory and the program and parameters being edited in GX Developer are the same.

Follow the instructions below to change the set value of timer T1 to 100 seconds.

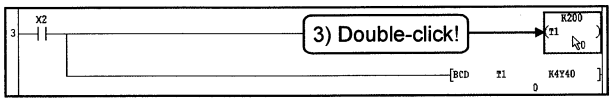
Turn the CPU "RUN/STOP" key switch to "RUN".



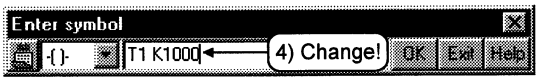

1) Click on (Monitor write mode).



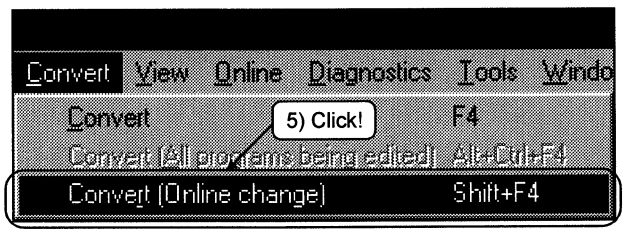

2) Click on the OK button.




3) In ladder monitor, select T1 and double click.




4) Change the value from "K200" to "K1000".




5) Select the [Convert] menu and click on [Convert (Online change)].

(Next page)



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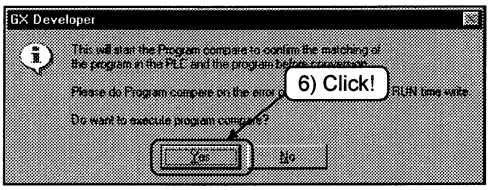
(From preceding page)

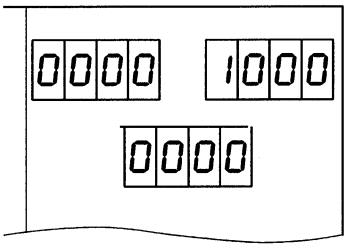



6) Click on the Yes button.
Write during RUN is executed.

Training kit operation

When X2 is turned ON, T1 times up to 1000.

Digital display

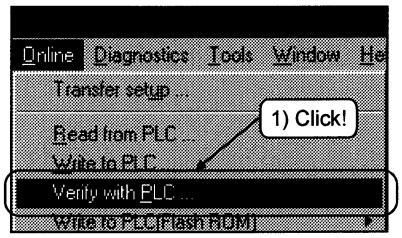




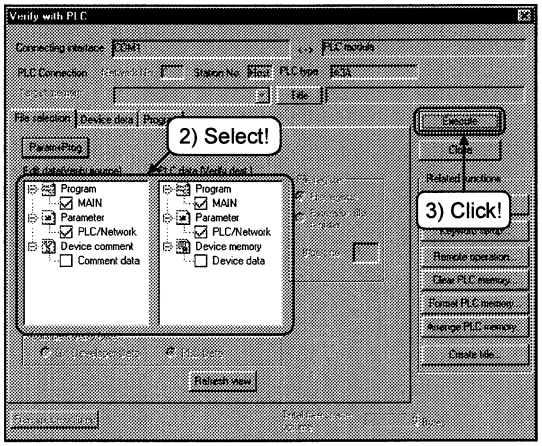
3 - 23

## 3.12 PLC Program Verify Operation

Compares the project that is being edited in GX Developer, with the project that is stored in the PLC.
This operation compares the program, parameters, and the device comment data.

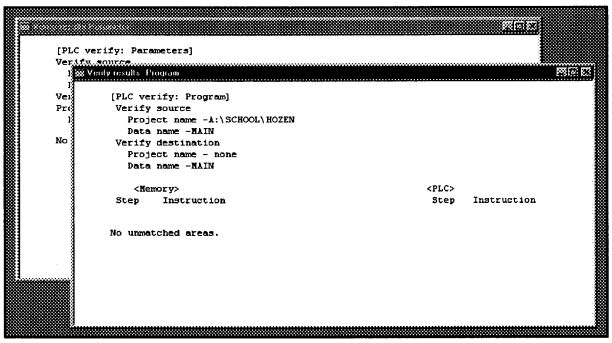



1) Select the [Online] menu and click on [Verify with PLC].




2) Click on the items you want to verify.

3) Click on the Execute button.

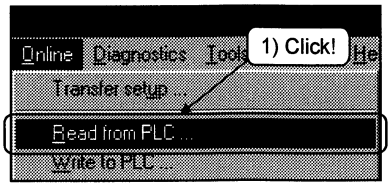



4) The verification results are displayed.

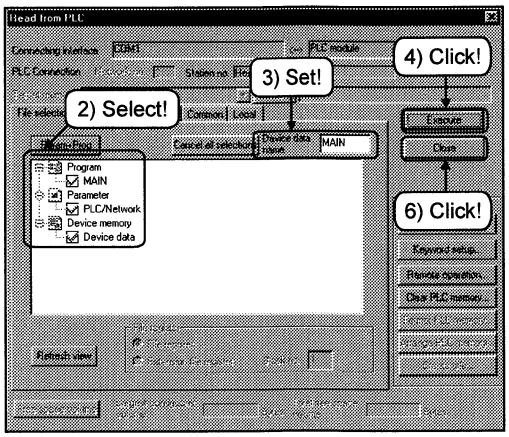

3 - 24

## 3.13 PLC Read Operation

Reads (uploads) the program, parameters and comments stored in the PLC CPU.




1) Select the [Online] menu and click on [Read from PLC].



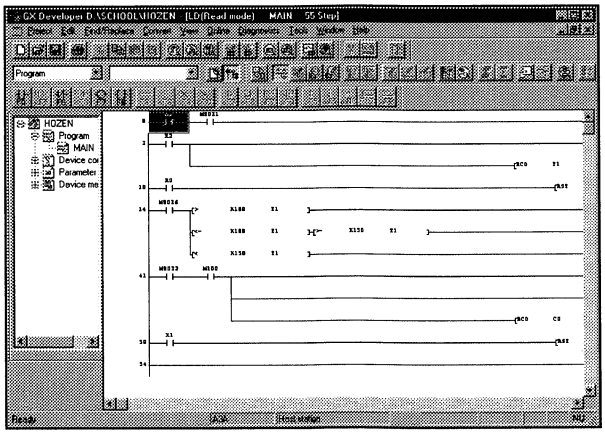

2) The PLC read dialog appears, click on the items you want to read from the CPU.

3) When device memory is selected, set the device data names.
(Only when reading more than one device memory)

4) Click on the Execute button. "When "Execute to read to PLC?" appears, click the Yes button.

5) When "Completed" is displayed, click on the OK button.

6) Click on the Close button of the PLC read dialog box.



7) The program read from the PLC is now displayed.



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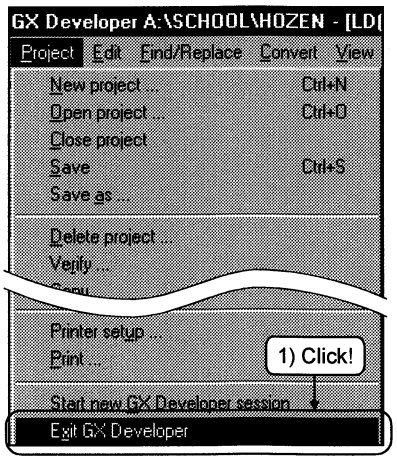
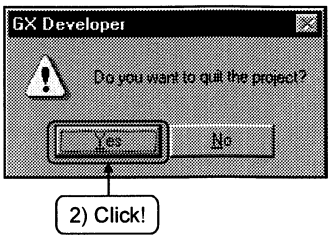
## 3.14 Exiting GX Developer

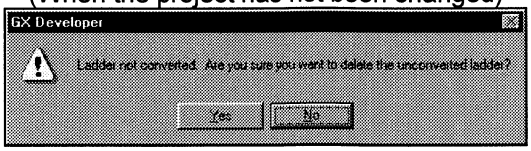



1) Select the [Project] menu and click on [Exit GX Developer].




2) When the confirmation dialog box is displayed, click on [Yes].
GX Developer will then close.

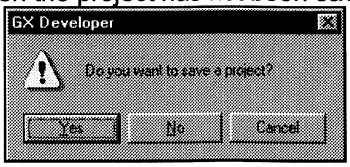
(When the project has not been changed)




Depending on the project status, the dialog boxes on the left will be displayed.

[Yes] ..... Close GX Developer without any changes.
[No] ..... Do not close GX Developer.

(When the project has not been saved).




[Yes] ..... Close GX Developer after saving the project.
[No] ..... Close GX Developer without saving the project
[Cancel] ..... Do not close GX Developer.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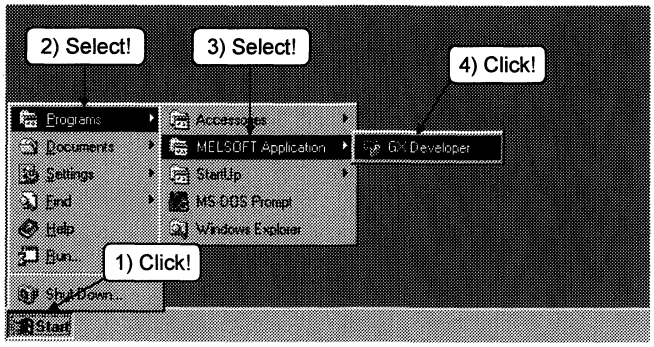
## 3.15 Read a New Project from the PLC

Reads the program, parameters and comments from the PLC CPU directly after starting GPPW.

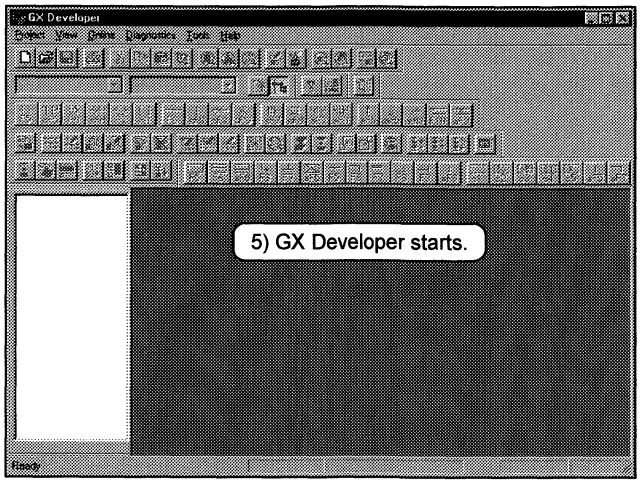



1) Click on the [Start] button.

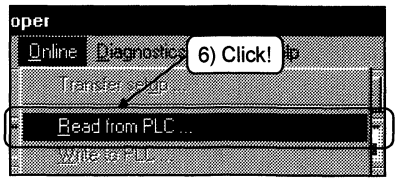
2) Select [Programs] menu.

3) Select [MELSOFT Application] menu.

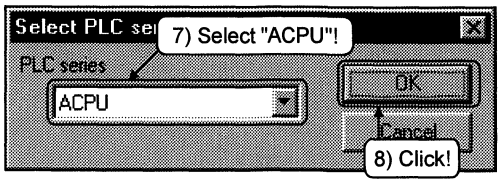
4) Click on [GX Developer for Windows].




5) GX Developer starts.




6) Select the [Online] menu and click on [Read from PLC].




7) In the PLC series box, select “ACPU”.

8) Click on the [OK] button.

(Next page)



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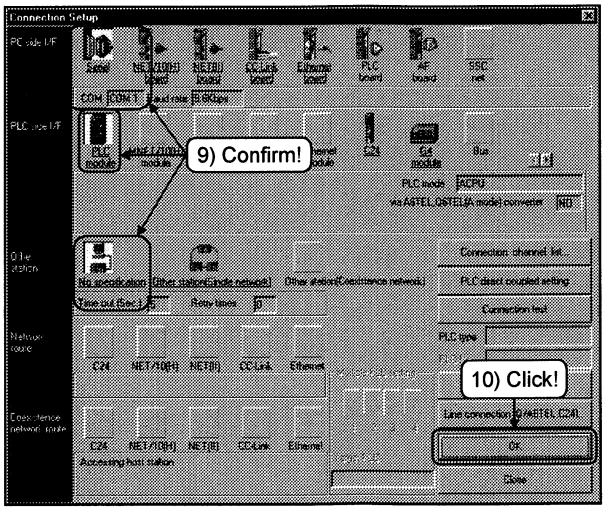
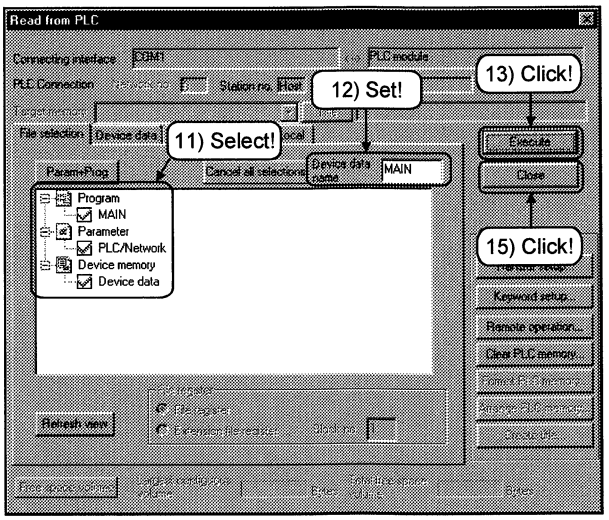
(From preceding page)




9) Click on the “Online” menu, and then click on (Transfer set up).

PC side I/F :Serial (COM1)
PLC side I/F :CPU module (ACPU)
Other station :No specification

10)Click on the [OK] button.



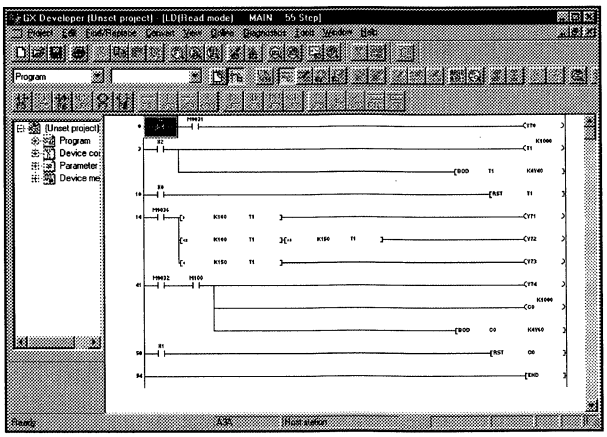

11)When the PLC read dialog is displayed, select the items to be read.

12)When device memory is selected, set the device data names.
(Only when reading more than one device memory)

13)Click on the [Execute] button. "Execute to read to PLC?" appears, click the [Yes] button.

14)When “Completed” is displayed, click on the [OK] button.

15)Click on the [Close] button of the PLC read dialog box.



16)The program read from the PLC is displayed.



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# CHAPTER 4 MAINTENANCE MEASURES AND PLANNING

It is necessary to consider maintenance as a planning stage for automation projects in order to reduce breakdowns or accidents and give maintenance staff an easy to follow maintenance work plan.

## 4.1 Advance Preparation to Carry Out Maintenance Measures

### (1) Use products that are less prone to failure

In simple terms, this means using highly reliable products but the following points should also be considered.

1) Are the maker's products reliable?
2) Does it conform to recognized local and international standards?
3) Is the design simple?
4) Are low failure rates for the product based on real results?
5) Does the product have a good reputation in it's related industry?



### (2) Good system planning for maintainability

When planning for a system that can be easily maintained, consider the following points.

1) Use a PLC that has easily obtainable spares or replacement modules.
2) Use a PLC that has high maintainability with functions like self-diagnostics.
3) Use a PLC that allows easy program reading, modification and storage.
4) Make the design display error contents automatically.
5) Plan for space to make maintenance inspection and repair operations easy.
6) Plan for making changes in parts, products, wiring, etc as easy as possible.

### (3) ROM based sequence programs

Storing the sequence program on RAM is useful for allowing easy program changes but the program may be lost or corrupted in the event of RAM battery failure, noise from lightning strikes, power supply failure, etc.
In order to avoid problems it is safer to store programs on EP-ROM or EEP-ROM.

### (4) Sequence program backups

Be certain to keep a floppy disc backup of sequence programs in order to easily write the program to PLC in the event of failure or repair.
Document the date of creation of the backup program and any revisions that have been made.


4 - 1

## 4.2 Safe Design Using Failsafe Circuits

When the PLC power supply is switched ON-OFF, delays between the PLC power supply and the external process power supply (especially DC) and differences in initialization times can cause process outputs to behave abnormally for a short period. For instance, it may be necessary to construct a circuit to supply power to the PLC before the external process in order to avoid periodic errors that occur with DC output modules when the PLC power supply is turned on while power is supplied to the external process.

Also, consider what may happen in the event of external power supply abnormalities or problems that may arise if the PLC fails.

Construct external circuits (Emergency stop circuits, protective circuits, interlocks, etc.) in order to ensure that single problems do not cause the whole system to fail and from a safety viewpoint to guard against parts that fail due to abnormal operation causing the machine to fail or be damaged.

The following page shows circuit design examples regarding the points raised above.





4 - 2

## (1) System circuit example

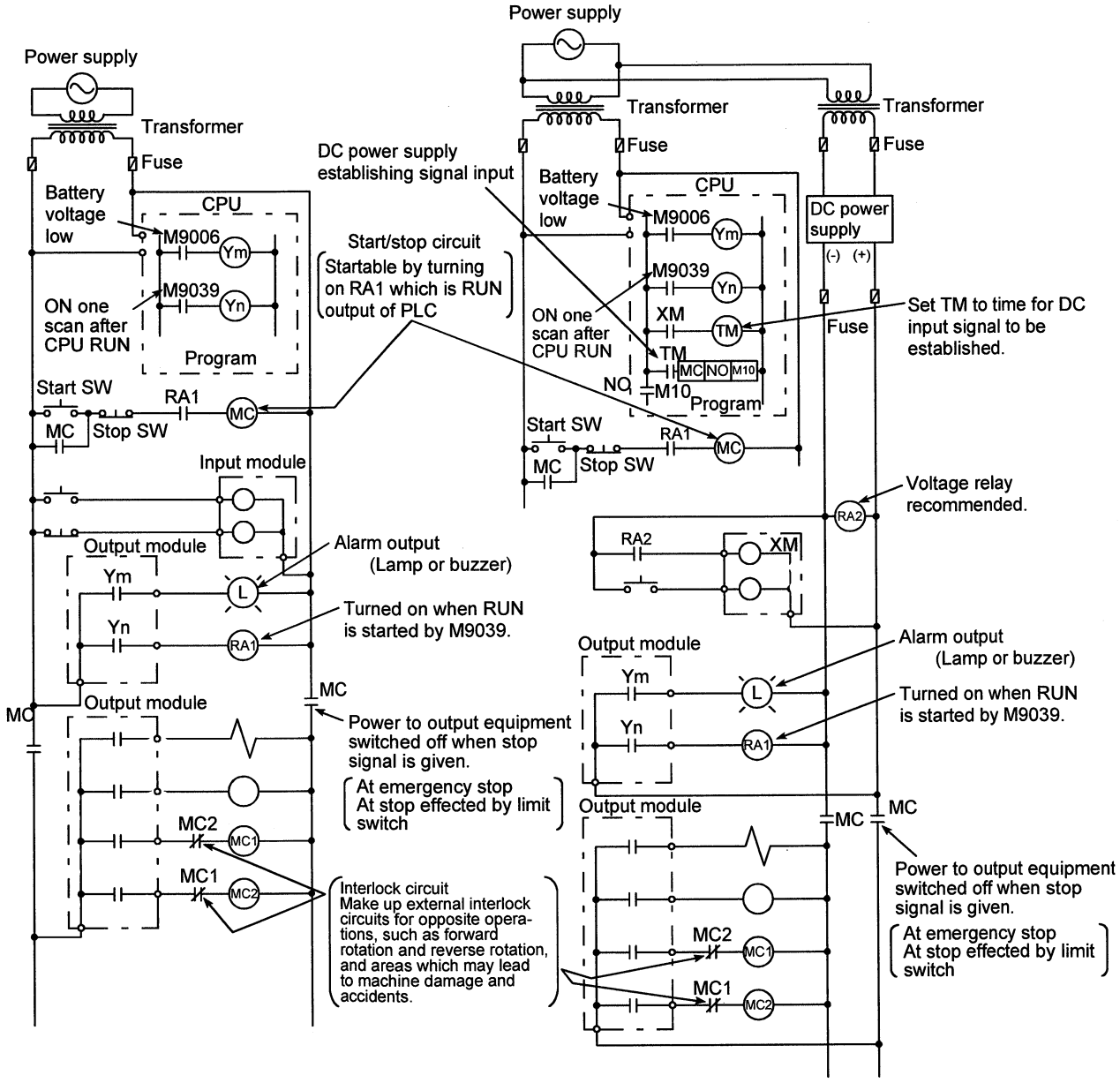



Diagram 4-1 When using AC

Diagram 4-2 When using AC/DC

Power up sequence is as follows

When using AC

1) Turn on the power supply.
2) Set CPU to "RUN".
3) Turn start switch on.
4) Turn the electromagnetic contactor (MC) on with the program, drive the output equipment.

When using AC/DC

1) Turn on the power supply.
2) Set CPU to "RUN"
3) DC power supply is established, RA2 turns on.
4) Timer for when DC power supply reaches 100% (TM) turns on. (TM set value is the time taken from RA2 turning on to DC power supply reaching 100%. Set the value to 0.5s)
5) Turn start switch on.
6) Turn the electromagnetic contactor (MC) on with the program, drive the output equipment. (When using a voltage relay for RA2, program control timer (TM) is not needed)



4 - 3

## (2) Failsafe measures when PLC fails

Failure of PLC CPU and memory is detected by self diagnostic functions but abnormalities in the I/O control area may not be detected.
In this case, according to the conditions of the failure all I/O points may be turned ON or OFF. Therefore, the correct operation and safety of the control object cannot be guaranteed.
As a manufacturer, we always strive to achieve the highest quality.
However, in order to prevent damage to machinery or accidents caused by PLC failure, please construct external fail-safe circuits.
An example of a fail-safe circuit is shown below:

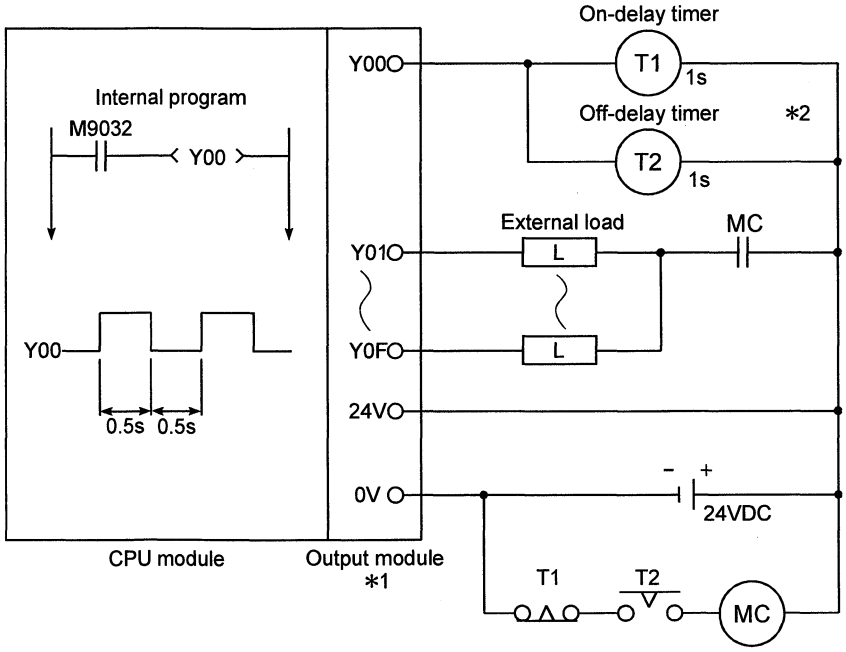



Diagram 4-3 Failsafe circuit example 1

*1: Because Y00 turns ON/OFF at 0.5 second intervals, use a non-contact type output module (in the example above a transistor output module is used).

*2: If it is difficult to obtain off-delay timers (particularly miniature timers), refer to the example on the following page which shows a failsafe circuit constructed with on-delay timers.


4 - 4

Construction of a fail-safe circuit using only on-delay timers.

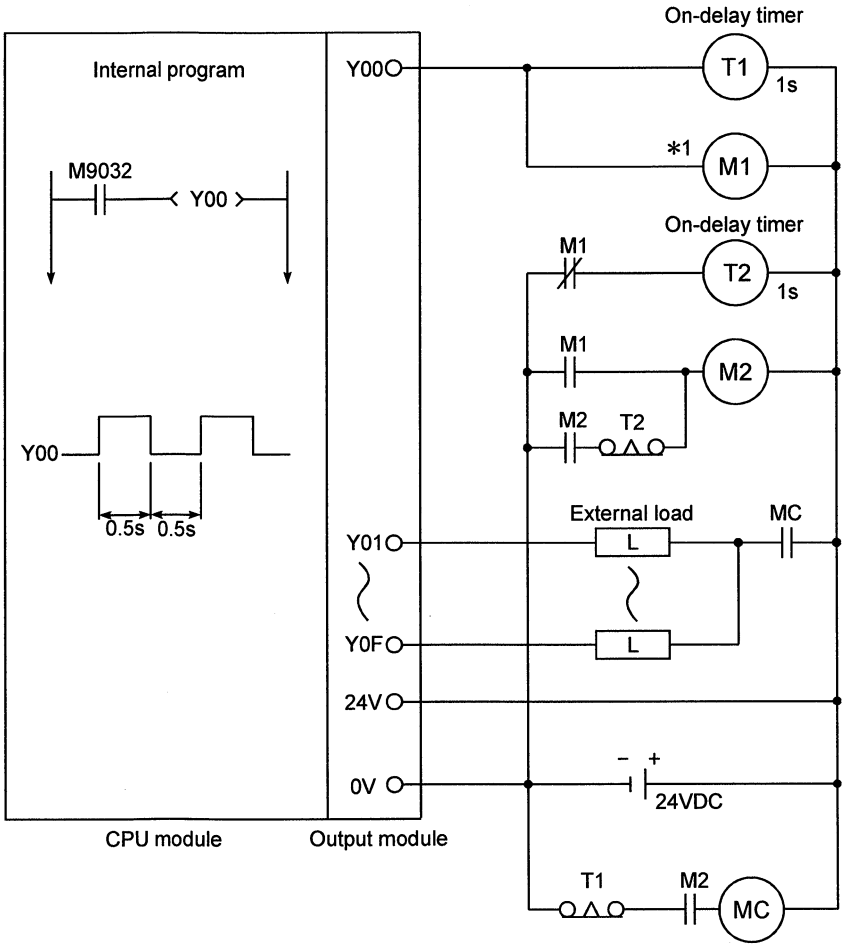



Diagram 4-4 Fail-safe circuit example 2

*1: Use a solid-state relay for M1.



4 - 5

MEMO


4-6

# CHAPTER 5 PREVENTATIVE MAINTENANCE

Preventative maintenance involves daily and periodic maintenance checks.

## 5.1 Necessity of Preventative Maintenance

After a production system breaks down and is under repair, the target productivity of expensive equipment cannot be achieved.
While the highest priority is to have equipment that will not fail or stop, if preventative maintenance is carried out critical breakdowns will be less frequent and in event of a breakdown repair time is shorter.

## 5.2 Using a Highly Maintainable PLC

MELSEC-A series has excellent RAS functions and a self-diagnostic function.

### 5.2.1 RAS functions

These are functions that are aimed at promoting "Reliability", "Availability" and "Serviceability", all of which have been requested by designers, manufacturers and maintenance staff.



Table 5-1 RAS functions

| Name | | Meaning | PLC RAS function (Excluding self diagnostics) |
|---|---|---|---|
| R | Reliability | Reliability of hardware/ systems related to breakdowns | The required level of quality is built-in with design, manufacture and quality assurance, to make a reliable product that has a low failure rate. |
| A | Availability | Effectiveness of equipment and availability (up-time) | • Easy module replacement<br>• I/O module replacement while running<br>• Sampling trace function<br>• Status latch function<br>• External failure diagnostic module |
| S | Serviceability | Ease of maintenance Functions that raise equipment availability | • Offline switch<br>• Pause RUN<br>• Monitoring with peripheral equipment |

The thinking behind RAS

R (reliability) is regarded as high if a breakdown occurs once in 5 years.
However, if there are no spare parts available and if repair takes a long time due to lack of experience of failures with the product, S (serviceability) is low and A (availability) is inferior.
Also, when breakdowns occur occasionally, if they are repaired in a short time R (reliability) is low but S (serviceability) is high and A (availability) is improved. A balance of RAS functions is required to achieve the best qualities.


5 - 1

## 5.2.2 Self diagnostic functions

### (1) Automatic detection of PLC errors

With this function, internal PLC error occurrences are automatically detected, a pre-designated bit device (bit signal) is turned ON and an error code is stored in a word device (word signal).

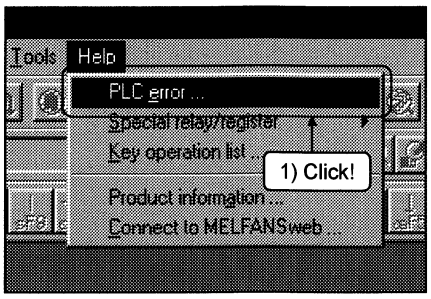
Table 5-2 Automatic self diagnostic function

| Processing function | Error occurrence examples |
|---|---|
| Shows a bit device is ON/OFF from error diagnosis result<br><br>Special relay (M9000 to M9255) | • Self diagnostic error (Shows a major error was found by self diagnosis)<br>• Calculation error (Shows a calculation error occurred)<br>• Low battery voltage drop (Warns that RAM backup battery voltage is low)<br>• AC down detection (Power supply drop within the stated instantaneous power failure time)<br>• I/O module verify error<br>(I/O module installation status has changed since it was registered at power up)<br>• Watchdog timer (W.D.T.) error<br>(Program scan does not finish in the specified time, calculation delay occurs)<br>• Fuse blown detection (Detects fuse blown in I/O module) |
| Shows an error code in a word device from error diagnosis result<br><br>Special register (D9000 to D9255) | • Fuse blown (I/O address of the module with a blown fuse)<br>• I/O module verify error<br>(I/O address of the I/O module whose installation status has changed since it was registered at power up)<br>• AC down count (Counts number of times AC power supply has dropped for a brief period)<br>• Self diagnostic error (Error number given when self diagnostic error occurs)<br>• Error step (Program step number where an error occurred) |

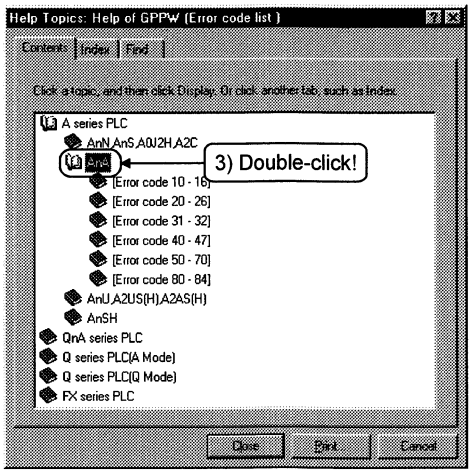
1) When a problem occurs with the PLC if the results of self-diagnostics are read with a peripheral device (PC, etc.) the reason for the error is shown. If measures are taken in accordance with the error explanation, the problem can be quickly resolved.
2) When operation stops suddenly, if the AC down detection flag is ON then it indicates that either the supply voltage was cut-off or dropped below the rated level.
3) When contacting the manufacturer, they will be able to investigate any problem that has occurred quickly if the self-diagnostic error code is given.


5 - 2

## (2) Viewing the error code list with GX Developer

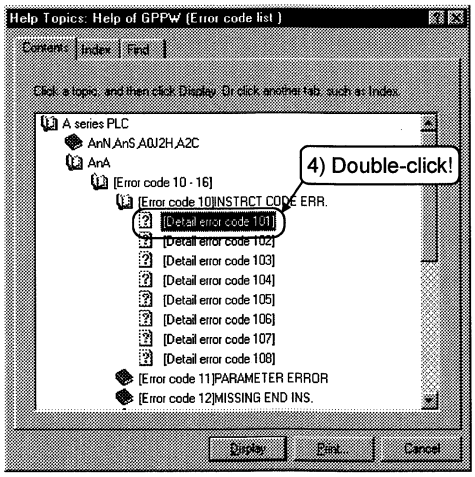



1) Click on the [Help] menu and select [CPU error].

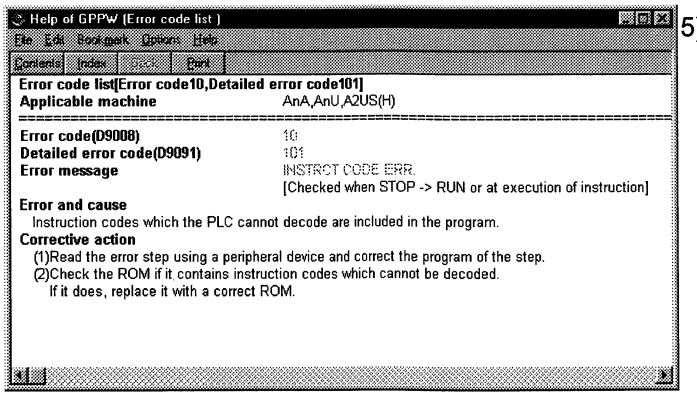



2) GX Developer help (error code list) is displayed.

3) Select the help menu for the PLC CPU being used.
For example, in the "A series CPU" menu double click on "AnA".




4) The error code list for the selected CPU is displayed.
Select the error code that you want to view and double click to check the contents.
For example, to select error coded 101 double click on [Error code 10 – 16], then [Error code 10] and finally [Detail error code 101].




5) Details of the causes for the selected error and countermeasures are displayed.

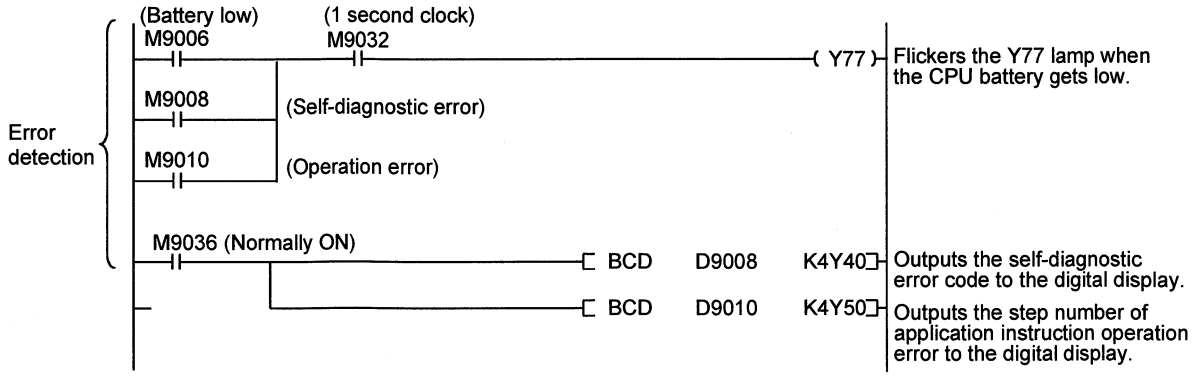

5 - 3

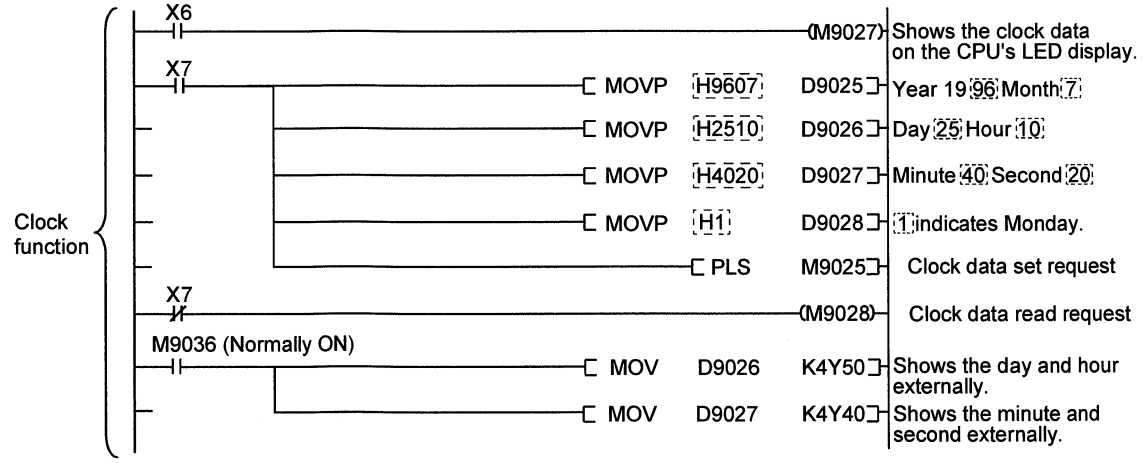
(3) Special relays and registers are designated for internal use by the CPU

They are used for error detection, CPU operating status and other special functions.

(Usage differs according to the CPU type)

[ PLC program usage example ]

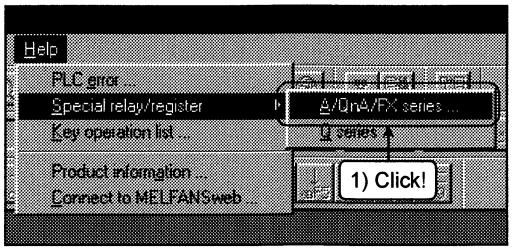


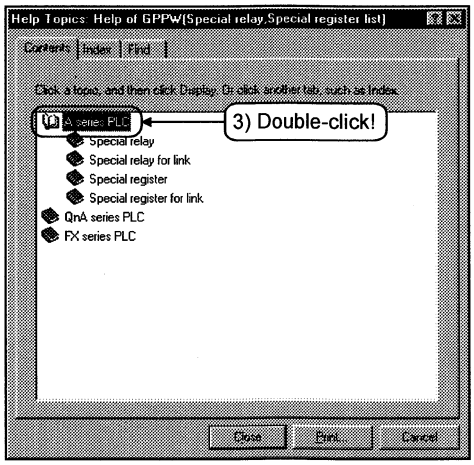



5 - 4

## (4) Viewing special relays and registers with GX Developer

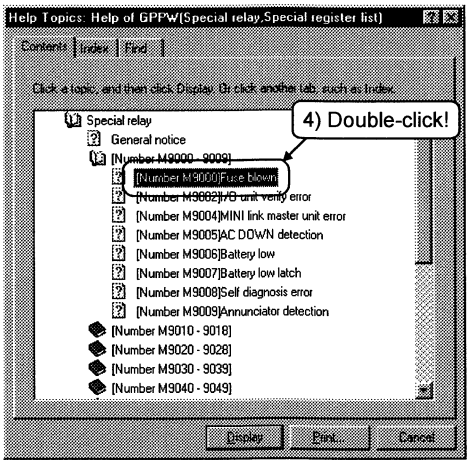



1) Click on the [Help] menu and select [Special relay/register] → [A/QnA/FX series].

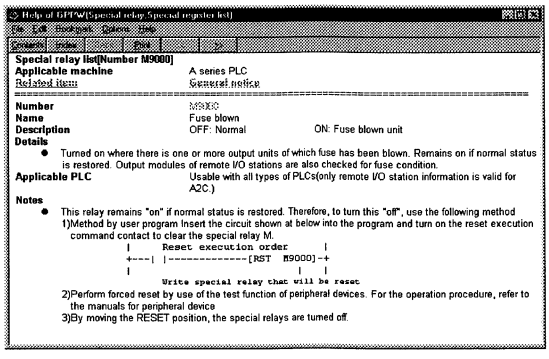



2) GX Developer help is displayed (Special relay, special register list).

3) Select the help menu for the PLC CPU being used.
For example, select "A series CPU" and double click on it.




4) The special relay and register list for the selected CPU is shown.
Select the device that you would like to check and double click on it.
For instance, select [Special relay], then select [Number M9000 to 9009] and finally [Number M9000]




5) A detailed explanation of the selected special relay is displayed.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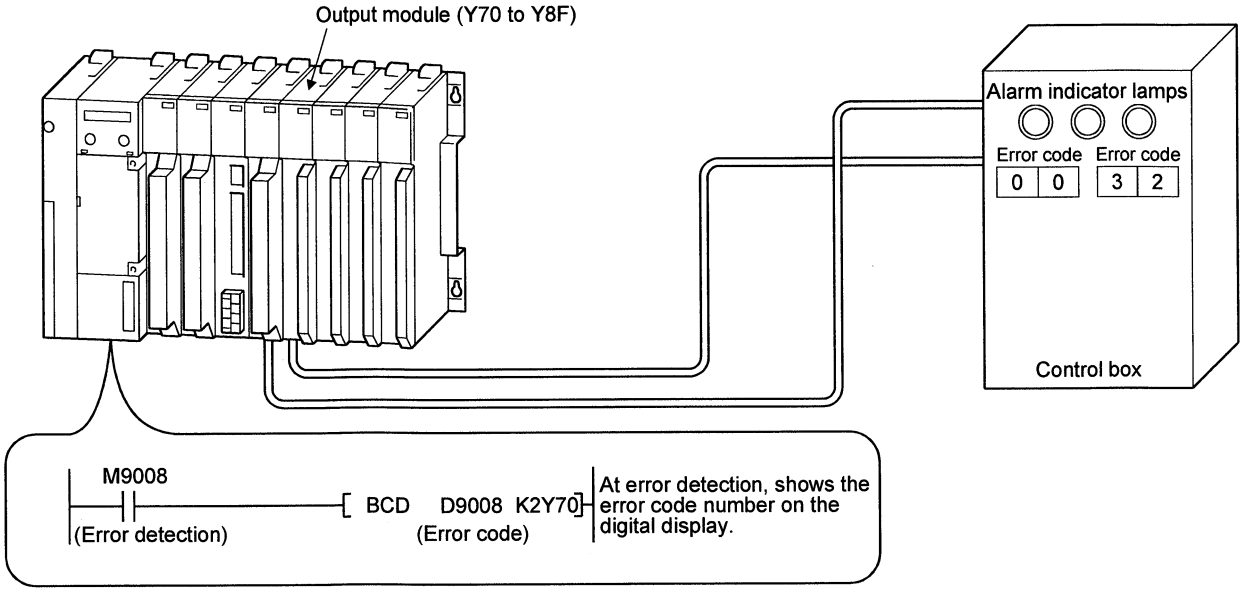
## 5.3 Inspection of Condition for Maintenance

The condition of manufacturing systems should always be able to be inspected externally so that error occurrence or breakdown conditions are known as quickly as possible and maintenance measures can be planned.
The following is an example of inspecting the condition of a PLC.

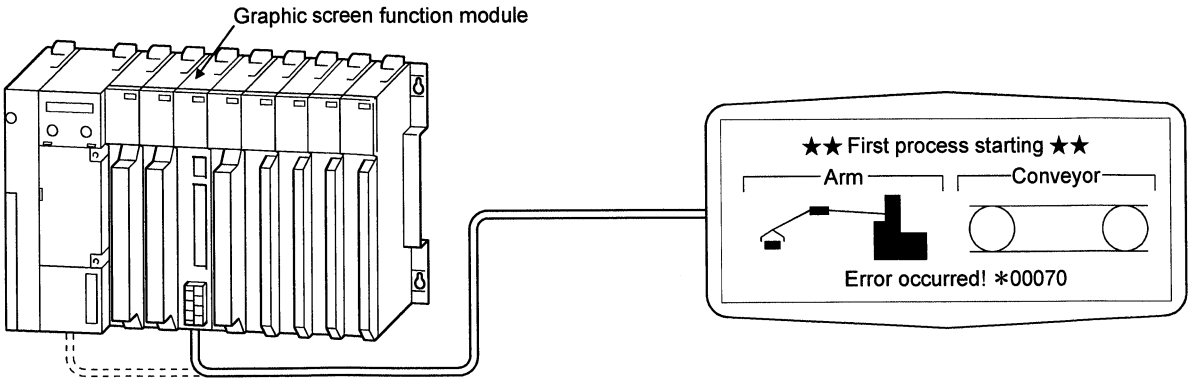
### (1) Example of external error code display

One of the PLC output modules is connected to a digital display so that when an error code is detected it will be displayed.




### (2) Example of error code display on a GOT screen

By means of a PLC graphic screen function module the error contents can be displayed on and external LCD device.





5 - 6

## 5.4 Daily Maintenance Points

In order to find conditions which are hazardous for the manufacturing system, the following points should be inspected daily.

Table 5-3 Daily maintenance points

| Item | Check point | | Check contents | Evaluation criteria | Treatment |
|---|---|---|---|---|---|
| 1 | Base unit mounting condition | | Check screws are tight and covers are in place | Unit is securely mounted | Tighten screws |
| 2 | Mounting of I/O modules, etc. | | Check modules are securely mounted and mounting hooks are being used | Module is securely mounted | Attach hook to base securely. Tighten screws. |
| 3 | Connection status | | Loose terminal screws | No looseness found | Tighten screws |
| | | | Crimp terminal spacing | Correct spacing | Rectify |
| | | | Extension cable connectors | Cables are secure | Tighten captive screws on connector |
| 4 | LED panels | "POWER"LED | Check illumination | LED is lit (Error when unlit) | • Check supply voltage<br>• Check fuse<br>• Check power supply attachment |
| | | "RUN" LED | Confirm it is lit for "RUN" status | LED is lit (Error when unlit or flashing) | Depends on CPU. Check manual |
| | | Input LED | Check LEDs turn ON/OFF | Lit when input ON<br>Unlit when input OFF<br>(Any other condition is an error) | |
| | | Output LED | Check LEDs turn ON/OFF | Lit when input ON<br>Unlit when input OFF<br>(Any other condition is an error) | |
| 5 | Condensation | | Presence of water, humidity | No moisture found | Remove source of condensation |



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## 5.5 Periodic Maintenance Points

In order to find conditions that are hazardous for the manufacturing system, the following points should be inspected every 6 to 12 months.

Table 5-4 Periodic maintenance points

| Item | Check point | | Check contents | Evaluation criteria | Treatment |
|---|---|---|---|---|---|
| 1 | Environment | Temperature | Measure humidity, temperature and levels of corrosive gases | 0 to 55°C | When mounted in a control panel, adjust the interior humidity and temperature |
| | | Humidity | | 10 to 90%RH | |
| | | Atmosphere | | No corrosive gases | |
| 2 | Supply voltage check | | 100/200VAC Measure at supply terminals | 85 to 132VAC<br>170 to 264VAC | Adjust supply voltage<br>Change transformer |
| 3 | Mounting | Looseness, play | Check for movement | Module is firmly secured | Tighten screws |
| | | Dirt, foreign material | Visual inspection | Module is clean | Remove and clean |
| 4 | Connections | Loose terminal screws | Check screws | No looseness | Tighten screws |
| | | Crimp terminal spacing | Visual inspection | Correct spacing | Rectify |
| | | Loose connectors | Visual inspection | No looseness | Tighten captive screws |
| 5 | Battery | | Monitor status of M9006 (battery error) with a peripheral device | (Preventative maintenance) | Even if there is no low voltage warning, change the battery when its rated life span has expired |
| 6 | Fuse | | Check fuse LED for fuse breakage | (Preventative maintenance) | Even if fuse is not blown, inrush current will stress the fuse so replace fuses periodically |
| 7 | Spares | | Check operation of installed modules | Operates according to specification | Ensure correct replacements for installed modules |
| 8 | Check backup program | | Verify with program being used | Programs are the same | Correct backup program if it is different |
| 9 | Fan<br>Filters | | Operation status<br>Operating noise<br>Dirt/dust | Operation sound is normal<br>No dirt/dust found in filter | Change if faulty<br>Clean |
| 10 | Analog I/O | | Check offset/gain values | Same as specification (design value) | If settings are wrong, adjust them |


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## 5.6 Usage Environment Checks

The usage environment may change if the equipment has been changed, re-organized, extended or replaced.
Therefore it is necessary to check the following points:

Table 5-5 Usage environment

| Check point | Check period |
|---|---|
| Supply voltage, voltage drops, momentary supply voltage interruption, frequency shifts | Generally when there is a change made to the equipment configuration (especially if equipment that consumes a lot of power is installed)<br>(Normally new equipment may affect voltage level or cause voltage fluctuations, waveform distortion, harmonics, noise and surge impulses) |
| Noise, surge levels | When equipment is installed/connected that may produce harmonics and noise, or require large supply currents |
| Temperature | When ambient environment has changed |
| Humidity | When ambient environment has changed |
| Vibration, impacts | When these phenomena occur |


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MEMO


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# CHAPTER 6 CORRECTIVE MAINTENANCE

Corrective maintenance is required when breakdowns occur for unexpected reasons that cannot be anticipated by preventative maintenance measures, despite the fact that PLC hardware is reliable and not prone to breakdown or accidental failure.
Problems can be divided into the following 4 categories, so it is necessary to be familiar with them in order to quickly find the causes of problems that occur.

Table 6-1 Types of problems

| Type of problem | Contents |
|---|---|
| Hardware failure | Continuous error condition arising from PLC component damage, damage to PCB tracks, etc. Repair module or replace. |
| PLC system operation error | CPU error caused by noise, surges, voltage dips, momentary power supply interruption, short power outages, external electromagnetic emissions, static electricity, etc. Discover the cause and take measures to prevent re-occurrence. |
| Problems caused by accidents | Accidents caused by shorting the power supply or load, cutting signal cables, misoperation of PLC or peripheral equipment. Once the fault has been corrected, the PLC should function. |
| PLC program errors | Problems like incorrect interlock programming, wrong device addresses, etc. can cause the program to fail or not execute properly. Once the program is corrected, normal operation will resume. |



## 6.1 Important Points for Corrective Maintenance

Corrective maintenance is applied to discover problems, understand the causes and carry out corrective action. The following points illustrate important matters and preparations that should be observed.

### (1) Important matters

1) Error codes that are detected by the PLC and read.
   These can be used in conjunction with the error code list (for instance in GPPW help function) to help determine the cause of the error.
2) Knowing the true cause of the problem.
   When a module that you suspect to be faulty is replaced with a new module and the system returns to normal operation, confirm that the original module was the cause by reinstalling it to see it the problem can be reproduced. However, if the problem cannot be reproduced then the module that was replaced may well be error free and another cause for the problem exists.
3) Minimizing production system stoppages.
   If stoppage times are long, production losses will be large and so maintainability will be poor.
4) After restoring the system to normal take care when re-starting operation.
   Take necessary measures to check that sufficient safety precautions are in place when starting operation.


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## (2) Preparation

1) Good understanding of the equipment or machine.
   It is important to have a deep understanding of the equipment or machine from reading related manuals and receiving sufficient explanation during trial and test operation periods.
2) Good understanding of the PLC and related peripheral equipment.
   Receiving training from the PLC manufacturer, etc. provides invaluable product knowledge.
3) Being accustomed to peripheral equipment operation.
   Receiving training from the PLC manufacturer, etc. gives the user a good opportunity to become accustomed to the operation and usage of peripheral equipment.
4) Understanding the incidents preceding a breakdown.
   Another important point is to carry out periodic checks on the equipment or machine so as to understand the normal operation status.
5) Understanding causes and countermeasures.
   The final key item is to study in order to gather knowledge before problems occur through methods such as reading technical documentation on this subject or receiving training from the PLC manufacturer, etc.





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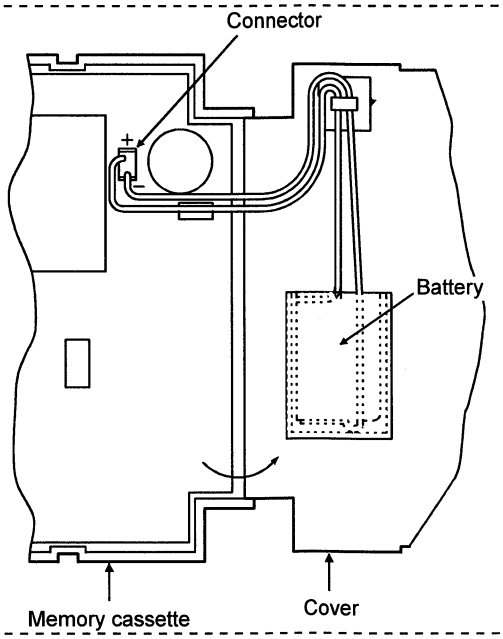
## 6.2 Operation for Reading Error Codes with GX Developer

By using the PLC diagnostic function, GX Developer can be used to display the current error status or error history.
In this section an error is deliberately caused and operations are carried out to the error code using the PLC diagnostic function.

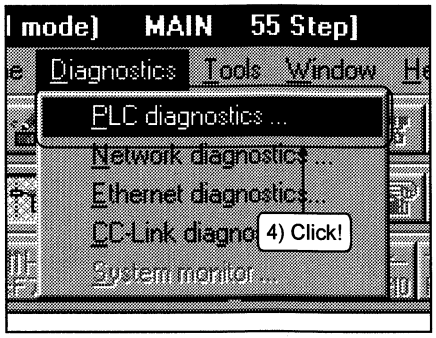
(Actual operation)



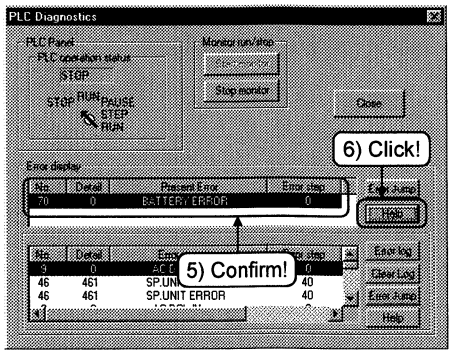

1) Turn the PLC CPU power off and open the memory cassette cover.

2) Disconnect the battery connector.

3) Close the memory cassette cover and turn the PLC CPU power on.




4) In the [Diagnostics] menu, click on [PLC diagnostics].




5) The PLC diagnostics dialog box is displayed. Confirm the current error is "70 BATTERY ERROR".

6) Click on the [Help] button.

GX Developer help (error code list) is displayed. The operation for searching the help file is explained in section 5.2.2. Check the contents of error code 70.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## 6.3 Troubleshooting Basics

The following section describes the basic and essential elements of troubleshooting.

### (1) Visual checks

1) The cause of a problem may be visibly detected within the PLC or in the external machinery.
   (However, there are many cases when the cause will not be visible).
2) Take note of the condition of the machine when watching it operate.

| |
|---|
| • What kind of output did the process control object produce?<br>• Is the process object in run status or stop status?<br>• Has the type of stoppage caused one of the following; runaway condition, wrong processing order, fire or human error? |

3) Take note of the status of I/O and special function modules.

| |
|---|
| • What is the wiring condition of each module?<br>• What is the status of the setting switches for each module? |

4) Observe the status of the LED display for each module.

| |
|---|
| • Is the power supply module "POWER" LED lit or unlit? |
| • Is the CPU module "RUN" LED lit or unlit?<br>• Is the CPU module "ERROR" LED lit or unlit? |
| • Are the I/O module monitoring LEDs lit or unlit? |
| • Are the special function module monitoring LEDs lit or unlit? |

### (2) Check the error code in one of the following ways

1) Read the error code using GX Developer.
2) Read the error code using programming module.

### (3) Observe errors by resetting the CPU

When the CPU is reset and returns to normal operation, the problem may have been caused by noise affecting the CPU, I/O modules, supply wiring, external equipment, etc.

1) Set the "RUN" switch to [STOP].
2) Use the "RESET" switch to reset the CPU.
3) Turn the power OFF then ON.

### (4) Troubleshooting for each module

Carry out troubleshooting for the following modules:

1) Power supply module.
2) CPU module.
3) Input modules.
4) Output modules.
5) Special function modules.


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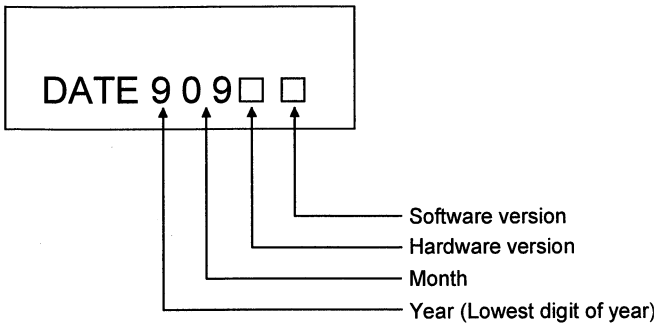
(5) Reduce the number of causes for breakdown

1) Check that PLC modules (I/O, etc.) are changed for spare modules.
2) Try removing the earth wiring and the control wiring separately, in order to locate cause for breakdown.

(6) Researching failed modules

1) Take note of the version number that is written in the date field of the label.




2) Make an inspection sheet for failed modules and send to the manufacturer (An example sheet is included in Appendix 3. Feel free to copy and use it).
3) Carry out measures suggested by the manufacturer when they reply to the inspection sheet.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## 6.4 Power Supply Module Troubleshooting

Problems related to power supply modules include selection of the wrong module and the POWER LED not being lit.

Power supply module output current

↓

| |
|---|
| A61P<br>5VDC 8A |
| A62P<br>5VDC 5A<br>24VDC 0.8A |
| A63P<br>(24VDC input)<br>5VDC 8A |
| A65P<br>5VDC 2A<br>24VDC 1.5A |
| A66P<br>24VDC 1.2A |
| A1CPU<br>A1NCPU<br>5VDC 5A<br>24VDC 0.8A |

| CPU type | No options | Fiber optic (P21) | Co-axial (R21) |
|---|---|---|---|
| A1CPU | 1.5 | 3.4 | 3.7 |
| A2CPU | 1.6 | 3.5 | 3.8 |
| A2CPU-S1 | 1.6 | 3.5 | 3.8 |
| A3CPU | 1.7 | 3.6 | 3.9 |
| A3HCPU | 3.1 | 3.7 | 4.1 |
| A1NCPU | 0.53 | 1.23 | 1.63 |
| A2NCPU | 0.73 | 1.38 | 1.78 |
| A2NCPU-S1 | 0.73 | 1.38 | 1.78 |
| A3NCPU | 0.90 | 1.55 | 1.95 |
| A2ACPU | 0.4 | 1.0 | 1.4 |
| A2ACPU-S1 | 0.4 | 1.0 | 1.4 |
| A3ACPU | 0.6 | 1.1 | 1.6 |
| A2UCPU | 0.4 | — | — |
| A2UCPU-S1 | 0.4 | — | — |
| A3UCPU | 0.5 | — | — |
| A4UCPU | 0.5 | — | — |

| Input module | |
|---|---|
| AX10<br>AX20<br>AX40<br>AX50<br>AX50-S1<br>AX60<br>AX60-S1<br>AX70<br>AX80<br>AX80E | 0.06 |
| AX11<br>AX21<br>AX41<br>AX71<br>AX81 | 0.11 |
| AX42<br>AX82 | 0.11 |

| Dynamic mixed I/O module | |
|---|---|
| A42XY | 0.11 |

| Output module | |
|---|---|
| AY10<br>AY10A<br>AY11<br>AY11A<br>AY11E | 0.12 |
| AY13<br>AY13E | 0.23 |
| AY22 | 0.31 |
| AY23 | 0.59 |
| AY40 | 0.12 |
| AY40A | 0.19 |
| AY41 | 0.23 |
| AY42 | 0.29 |
| AY50<br>AY60<br>AY60E<br>AY80 | 0.12 |
| AY60S1 | 0.08 |
| AY60EP<br>AY80EP | 0.12 |
| AY51<br>AY81 | 0.23 |
| AY70 | 0.1 |
| AY71 | 0.2 |
| AY81EP | 0.23 |
| AY82EP | 0.29 |



6 - 6

## 6.4.1 Power supply module selection

Incorrect selection of power supply module may lead to insufficient 5VDC and 24VDC supply which can cause operation errors for I/O, special function and data link modules.
Therefore, a power supply module that can provide a greater amount of output current than the combined power consumption of all the installed modules is required.

### (1) 5VDC current consumption for all modules (in amperes).

| Special function modules | | |
|---|---|---|
| AI61 | Interrupt module | 0.14 |
| A11VC | Sound output | 0.6 |
| AD61(S1) | High speed counter | 0.3 |
| A68AD/A68ADS2 | A/D converter | 0.9 |
| A84AD | A/D and D/A converter | 0.24 |
| A62DA/A62DAS1 | D/A converter | 0.6 |
| AD70 | Positioning module | 0.3 |
| AD71(S□) | | 1.5 |
| AD75P□ | | 0.7 |
| A61LS/A62LS | Position detection module | 0.8/1.5 |
| AD72 | Positioning module | 0.9 |
| AD76 | | — |
| A616AD/A60MX(R) | A/D converter | 1/0.5 |
| A616TD/A60MXT | Temperature/digital converter | 1/0.8 |
| A616DAI/A616DAV | D/A converter | 0.3/0.38 |
| AJ71P22/R22 | Data link module | 1.9/2.2 |
| AJ72P25/R25 | | 2.3/2.6 |
| AJ71P32/T32 | Data link module (MINI) | 0.23/0.26 |
| AJ71C22 | Multi-drop link module | 1.4 |
| AJ71C24(S□) | Computer link module | 1.4 |
| AD51<br>AD51S3/AD51H | Communication module | 1.3/1.0 |
| AD57/AD57S1/AD57G | Control module | 1.21/1.55/1.1 |
| AD58 | | 1.3 |
| AJ71PT32-S3 | MELSECNET/MINI-S3 | 0.35 |
| AJ71B62 | B/NET interface | 0.17 |
| AJ71P41 | SUMINET interface | 0.4/0.7<br>(No supply device) |
| AJ71C21/<br>AJ71C21S1 | Terminal interface | 0.8 |
| AD59/AD59-S1 | Memory card / Centronics interface | 0.3 |

| Peripheral equipment | |
|---|---|
| A7PU/A7PUS | 0.4 |
| A6WU | 0.8 |
| AD71TU | 0.3 |
| AD75TU | 0.2 |


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## (2) Preparation for using an extension base that does not require a power supply module

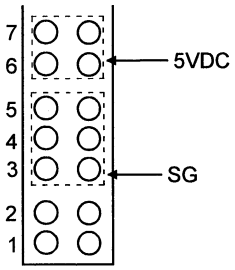
Both A55B and A58B extension bases draw power (5VDC supply) from the main base via the extension cable. Accordingly, voltage drops in the extension cables may result in the voltage at the receiving end being low, resulting in input/output errors. The calculations shown below are carried out to ensure that this will not occur.

1) Selection conditions

(a) Power supply module 5VDC output voltage is above 4.9V.

(b) Base unit receiving voltage is above 4.75V.

Measurements are taken at the extension base I/O connector SG pins (SG3, 4 and 5 pins) and 5VDC pins (pins 6 and 7).




(c) Combined extension cable length is less than 6.6m.

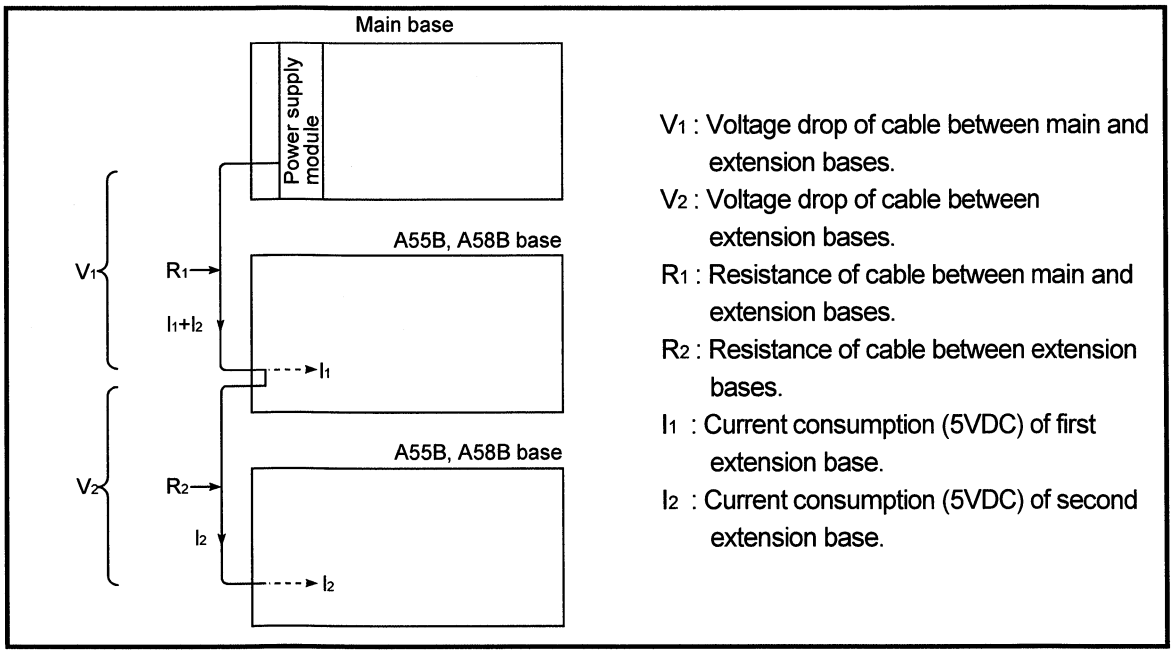
2) Receiving terminals voltage calculation method.

Extension cable resistance:

AC06B..... 0.019Ω

AC12B..... 0.028Ω

AC30B..... 0.052Ω




Voltage drop $V_1$ and $V_2$

$V_1 = R_1 (I_1 + I_2)$

$V_2 = R_2 I_2$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Voltage at the receiving terminal of the second extension base:

Receiving terminal voltage = $4.9 - (V_1 + V_2) > 4.75$

To satisfy the condition of the receiving terminal voltage being over 4.75V:

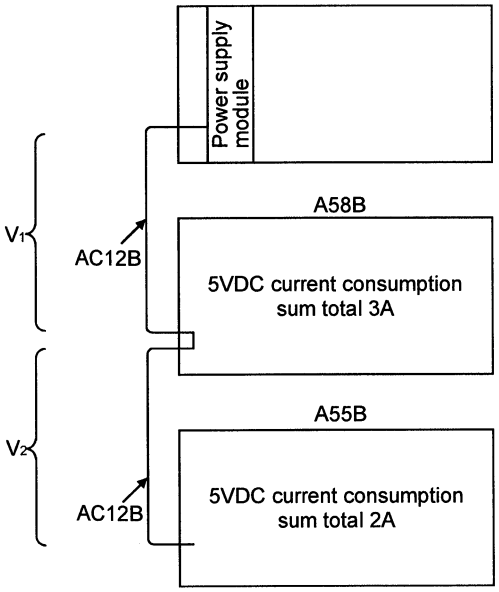
$4.9 - 4.75 \geq V_1 + V_2$

$0.15 \geq R_1 (I_1 + I_2) + R_2 I_2$

Such a condition is acceptable for the second extension base.

In short, to calculate the total number of possible extension bases that can be used, the voltage drop at the receiving terminal must be less than 0.15V from the main supply in order for the conditions above to be satisfied.

Example




AC12B resistance = 0.028Ω

$V_1 = 0.028 \times (3 + 2)$

$= 0.14$ [V]

$V_2 = 0.028 \times 2$

$= 0.056$ [V]

$V_1 + V_2 = \underline{0.196\ [V]}$

(Voltage at receiving terminal of second extension base is 4.9 - 0.196 = 4.704V)

Therefore, A55B cannot be used as the second extension base because the voltage drop is greater than 0.15V. If the extension cable is changed to AC06B, it is then possible to use A55B.

$V_1 = 0.019 \times (3 \times 2)$

$= 0.095$ [V]

$V_2 = 0.019 \times 2$

$= 0.038$ [V]

$V_1 + V_2 = \underline{0.133\ [V]}$

(Voltage drop at the receiving terminal of the second extension base is 4.9 - 0.133 = 4.767V)

Hence, a voltage drop is less than 0.15V. Under this condition, you can use two extension base units.

**POINT**

When using I/O and special function modules that consume a lot of current, use a power supply on both the main base and extension bases (A65B and A68B).



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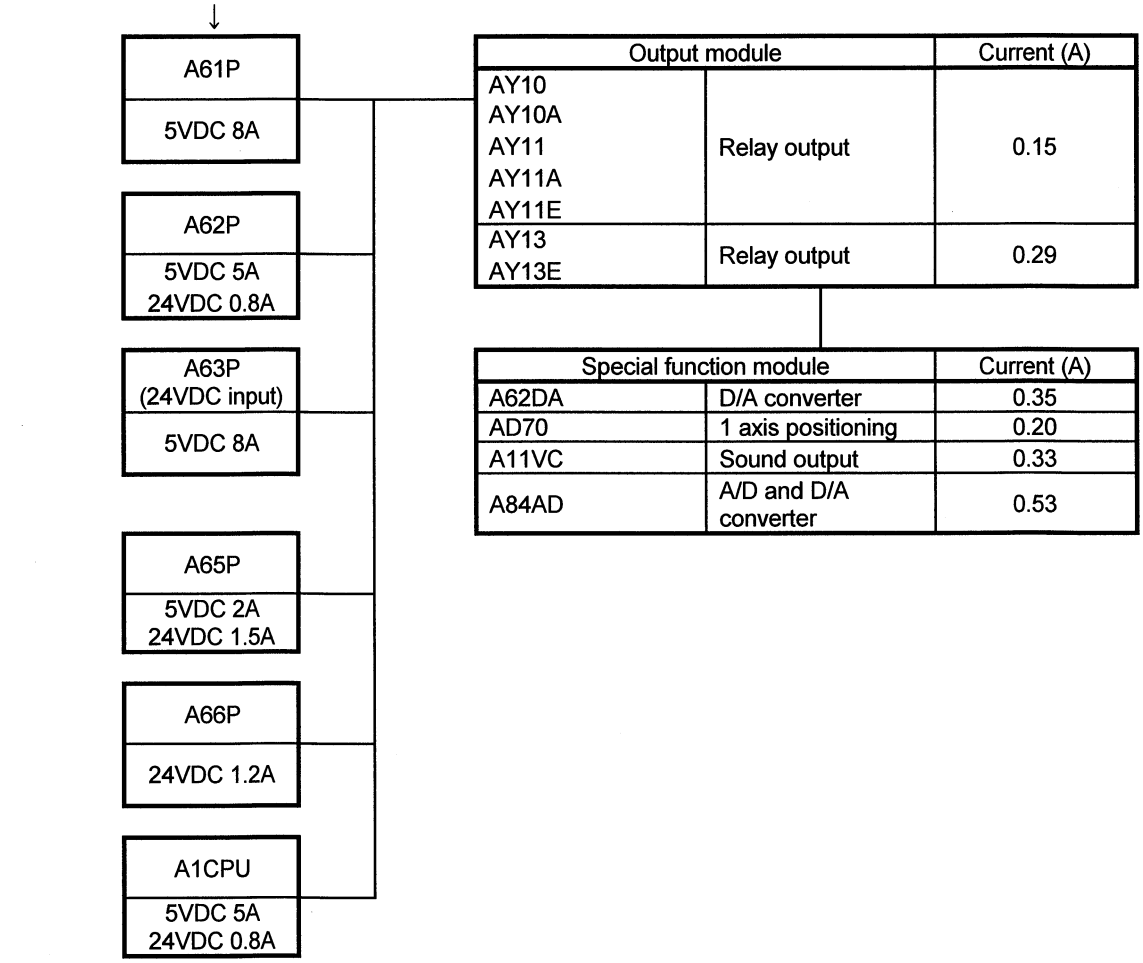
### (3) 24VDC current consumption for all modules (in amperes)

The output current for the 24VDC power supply module and the 24VDC current consumption for all modules is shown below. If the supply current of the power supply module is insufficient, use an external 24VDC supply.

Power supply module output current




| Output module | | Current (A) |
|---|---|---|
| AY10<br>AY10A<br>AY11<br>AY11A<br>AY11E | Relay output | 0.15 |
| AY13<br>AY13E | Relay output | 0.29 |

| Special function module | | Current (A) |
|---|---|---|
| A62DA | D/A converter | 0.35 |
| AD70 | 1 axis positioning | 0.20 |
| A11VC | Sound output | 0.33 |
| A84AD | A/D and D/A converter | 0.53 |


6 - 10

## (4) Power supply module selection example

If an A7PU (5VDC, 0.4A) is added to the example below the total consumption is 5VDC, 4.0A and 24VDC, 0.65A. As a result A62P (5VDC 5A, 24VDC 0.8A output) is ideal.

If an external 24VDC power supply is used, A61P (5VDC, 8A output) can also be used.

| | A62P | A3ACPUIP21 | AX42 | AY42 | A68AD | A62DA | AD61 | AX10 | AY10 | AY10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 5VDC current consumption | | 1.1A | 0.11A | 0.29A | 0.9A | 0.6A | 0.3A | 0.06A | 0.12A | 0.12A |
| 24VDC current consumption | | - | - | - | - | 0.35A | - | - | 0.15A | 0.15A |

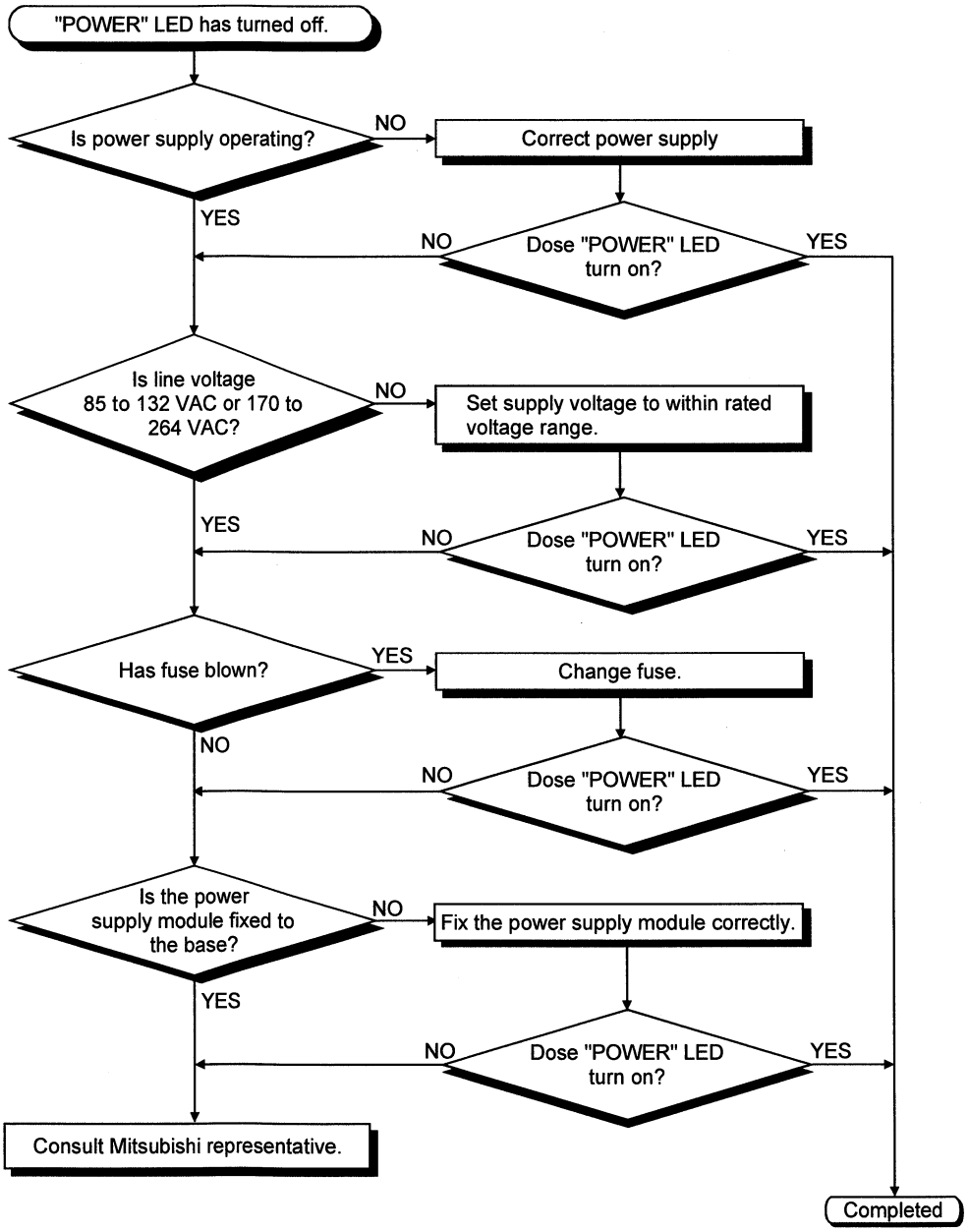


6 - 11

## 6.4.2 When the [POWER] LED is not lit

If during operation or when the supply power is turned on and the [POWER] LED is not lit, the cause may be one of the items listed below.

1) Supply voltage is low.
2) Fuse is blown.
3) Hardware failure of the power supply module.





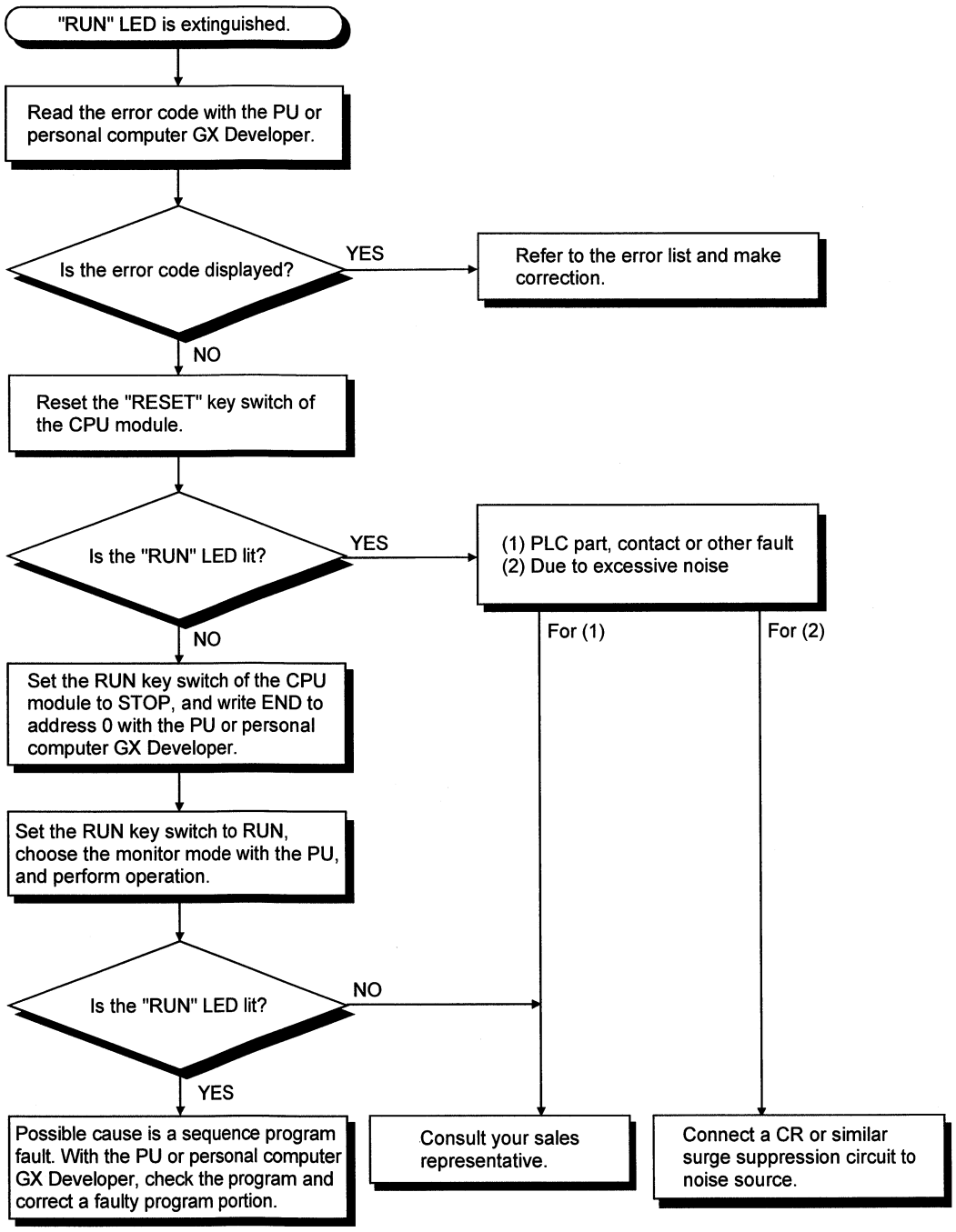
6 - 12

## 6.5 CPU Troubleshooting

Some of the problems experienced with CPUs include hardware failure and incorrect program downloading.

### 6.5.1 Hardware failure

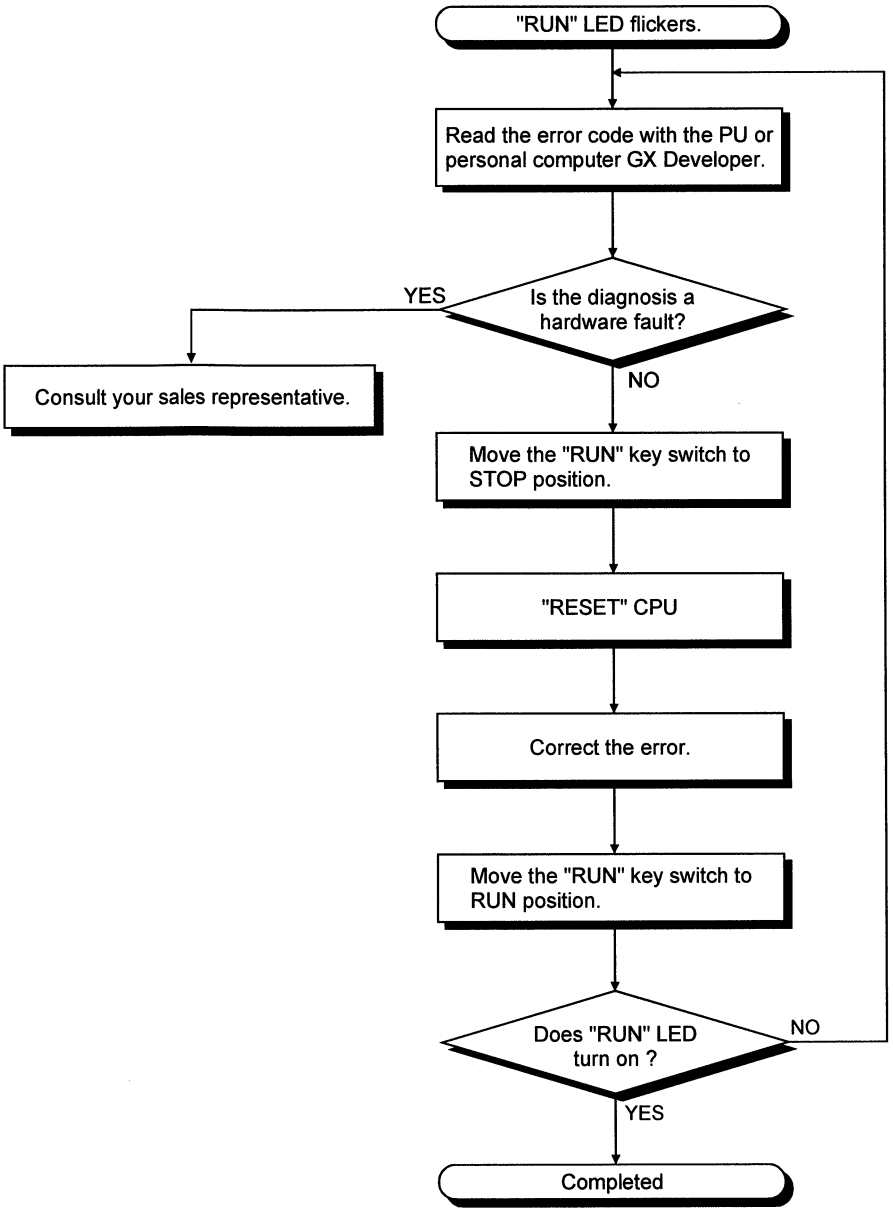
(1) If during operation the [RUN] LED is not lit, hardware failure may be assumed





6 - 13

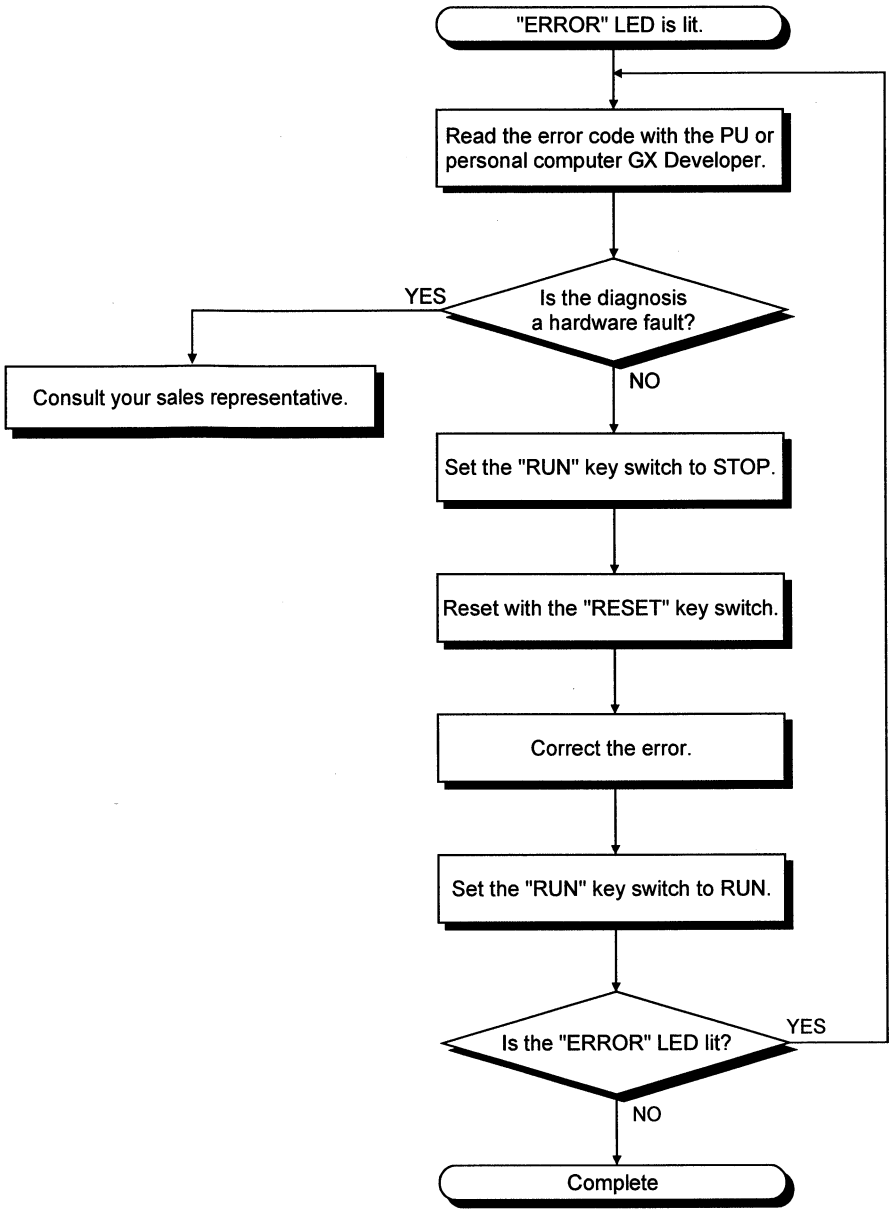
(2) If the "RUN" LED flickers during operation, it is assumed to be a program creation mistake or a hardware failure.





6 - 14

(3) If during operation the [ERROR] LED is lit, a variety of error conditions may be assumed





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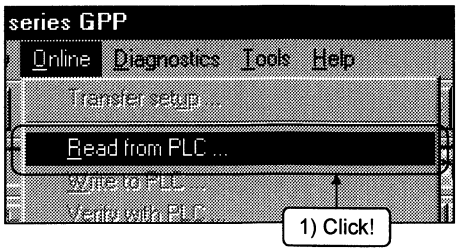
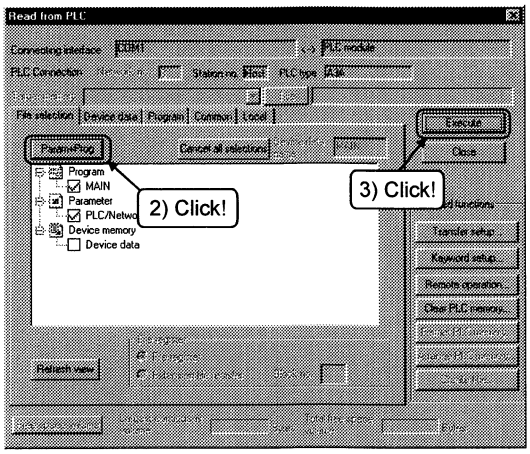
## 6.5.2 Judging quality of the CPU

In order to judge the quality of the CPU (i.e. is it faulty or not) the CPU must be powered and running a program.
The PLC CPU should run the program from step number 0 to the END instruction with the [RUN] being lit, when this occurs the CPU is judged OK.

### (1) Read the program and parameters from the CPU.

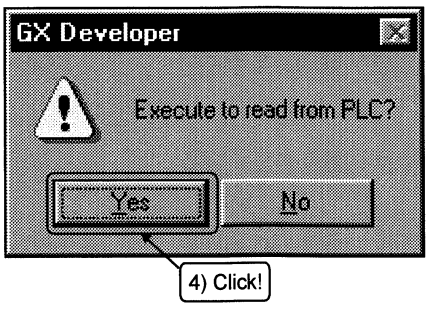



1) Click on the [Online] menu and select [Read from PLC].




2) Click on the [Param+ Prog] button.

3) Click on the [Execute] button.




4) Click on the [Yes] button.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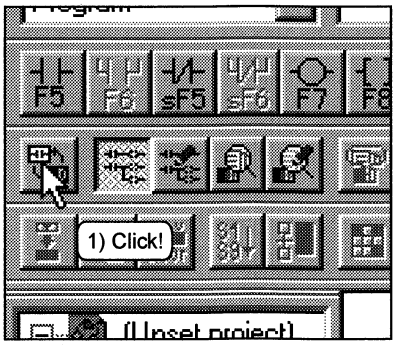
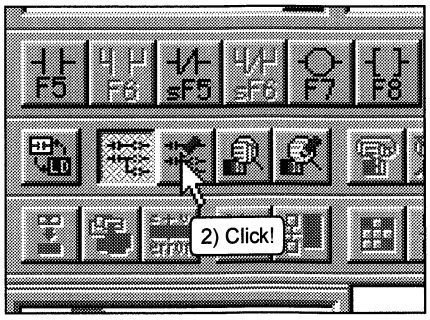
## (2) Writing an END instruction at step 0 of an uploaded program.

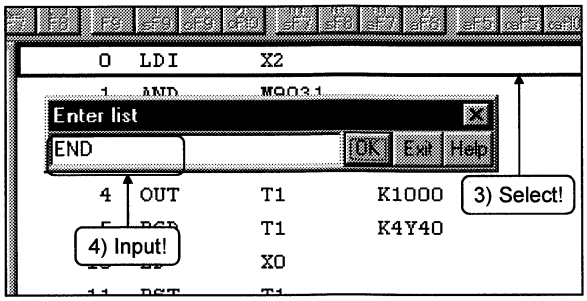
When using a CPU that has no errors and you do not want to change program, use list mode to write a memo at step 0 (also, insert an END instruction).




1) Click on the icon (List display). The program is displayed in list mode.




2) Click on the icon (Write mode). GPPW switches to write mode.




3) Select step 0.

4) Input E N D ↵.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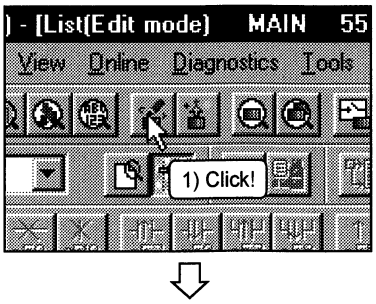
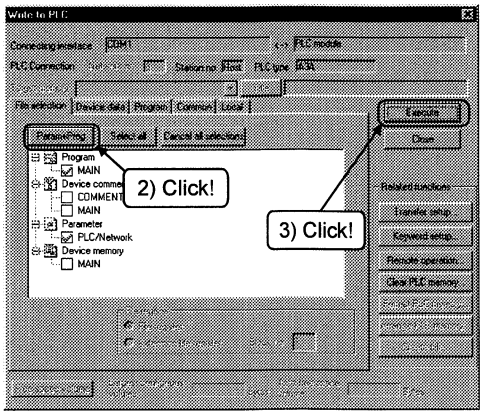
(3) Write the modified program to the CPU.

Set the CPU "RUN/STOP" key switch to "STOP".

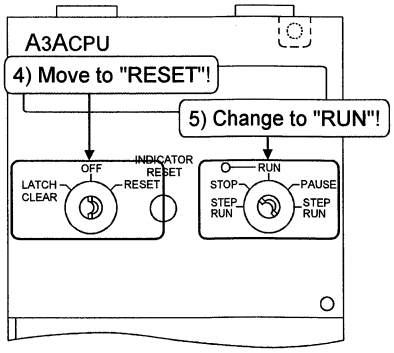



1) Click on the icon (Write to PLC).




2) Click on the Param+ Prog button.

3) Click on the Execute button.




4) Reset the CPU.

5) Turn the CPU "RUN/STOP" key switch to "RUN".

6) If the RUN LED on the CPU is lit then the CPU is OK. If it is not lit or flashing then there is a problem.
When the CPU is judged to be OK, return the program to its original state (remove the memo from step 0) and download to the CPU.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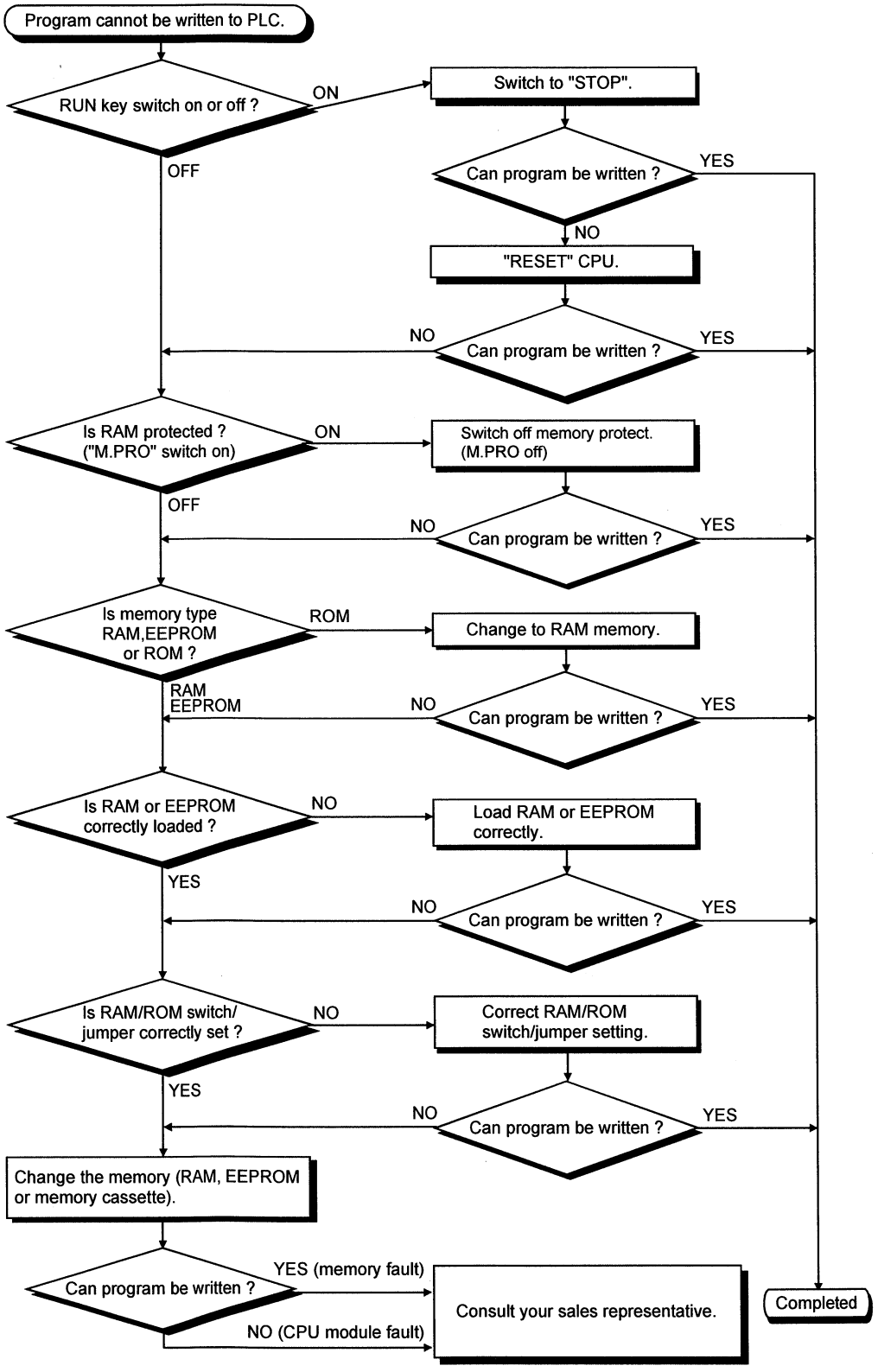
## 6.5.3 When a program will not download

Incorrect memory switch settings or memory failure can be the cause problems that prevent the program being downloaded to the CPU. The flow chart in this section shows measures for when a program cannot be written to the CPU (the memory EEPROM in the following flow charts is used only with an A0J2 or A1 type CPU)





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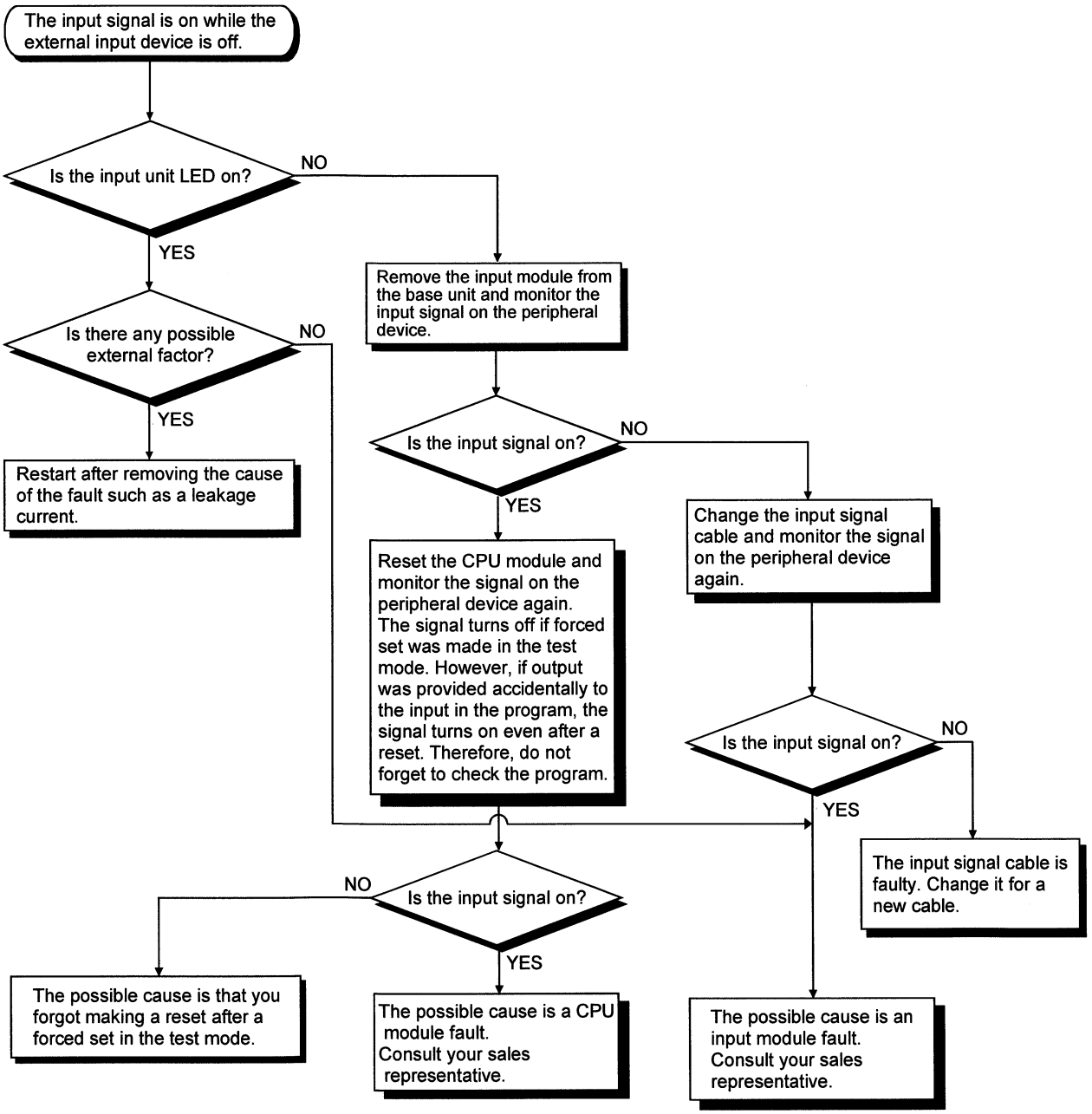
## 6.6 I/O Module Troubleshooting

### 6.6.1 Hardware failure

(1) The flow chart below shows procedures for when the PLC input turns on even though the external input device is off.




| POINT |
| --- |
| The external cause for the fault may be a faulty external device, faulty external power supply, bad wiring or noise. |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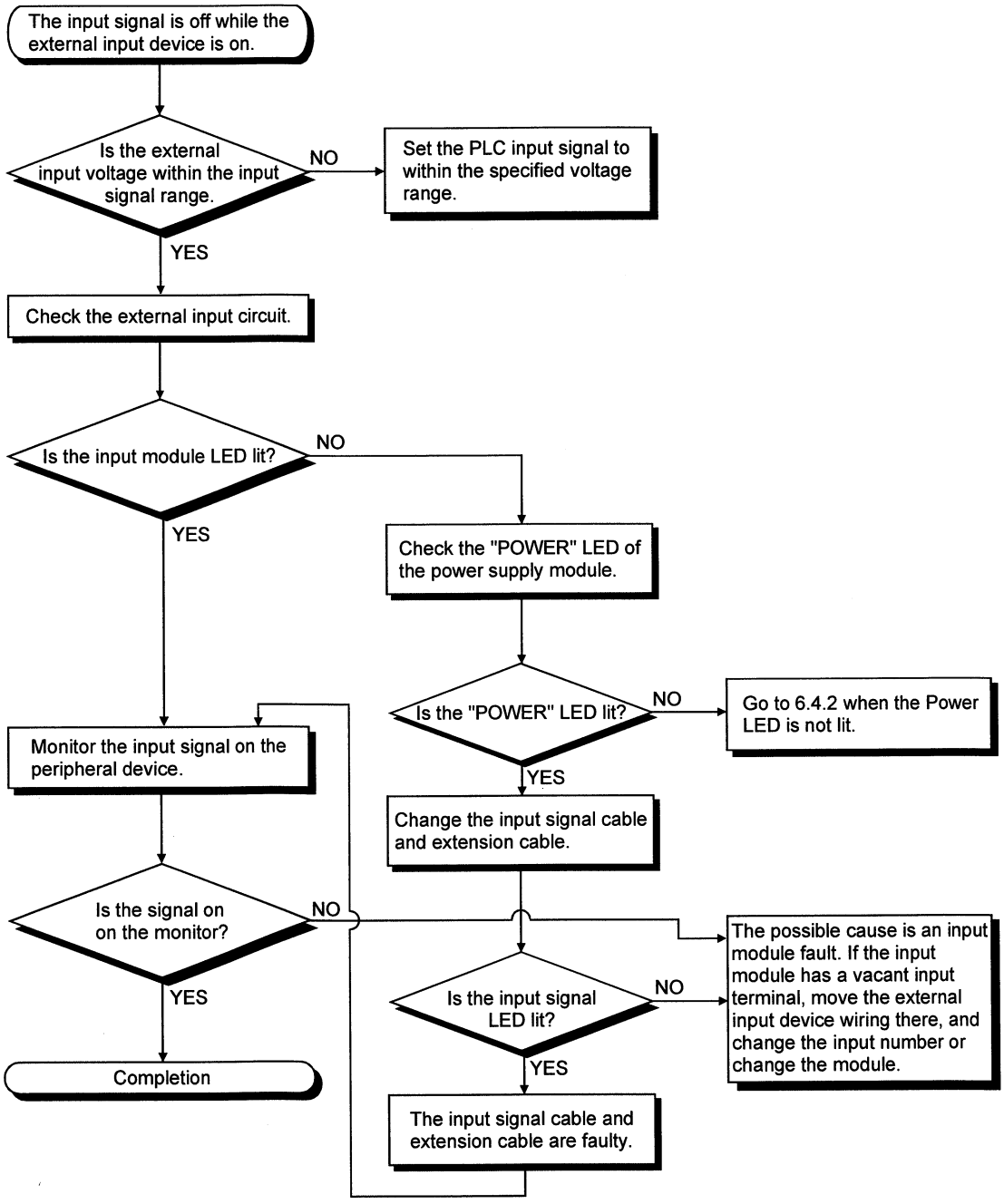
(2) The following flow chart explains what happens if the CPU input turns ON when the external device turns ON.





6 - 21

## 6.6.2 Input circuit troubleshooting

This section describes possible problems with input circuits, and corrective actions.

Table 6-2 Input circuit troubleshooting

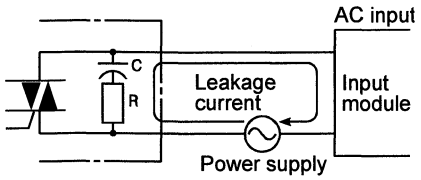
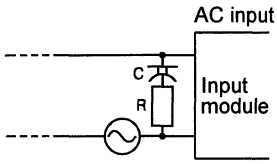
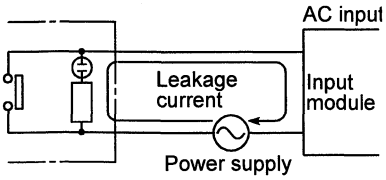
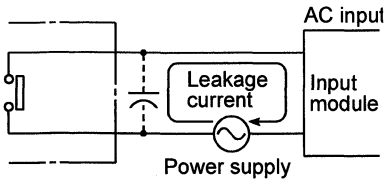
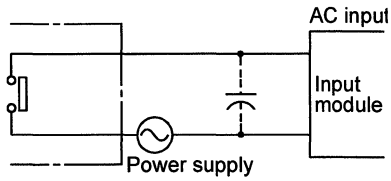
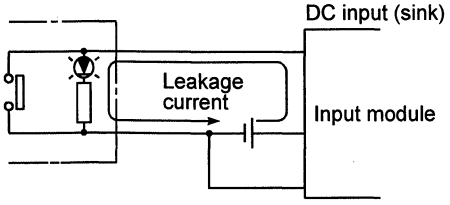
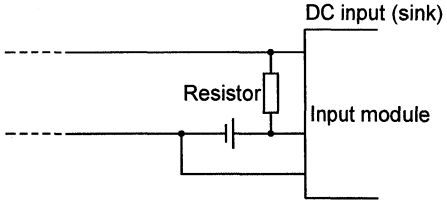
| | Condition | Cause | Countermeasures |
|---|---|---|---|
| Ex.1 | AC input signal does not turn OFF. (Input LED may remain on or flicker) | • Input device leakage current (driven by a non-contact switch, etc.)<br>  | • Connect a CR network across the terminals of the input to drop the voltage below the input modules OFF threshold.<br>  <br>For CR constant,<br>C=0.1 to 0.47μF, R=47 to 120Ω (1/2W) is recommended. |
| Ex.2 | AC input signal does not turn OFF. (Input LED may remain on or flicker) | • Leakage current due to contact switch with neon indicator.<br>  | • Same as Ex.1<br>• Construct independent display circuit. |
| Ex.3 | AC input signal does not turn OFF. (Input LED may remain on or flicker) | • Leakage current due to line capacity of wiring cable. Line capacity C of twisted pair wire is approx. 100pF/m.<br>  | • Same as Ex.1<br>• Leakage current is not generated when power supply is located on the input equipment side, as shown below.<br>  |
| Ex.4 | DC input signal does not turn OFF. (Input LED may remain on or flicker) | • Leakage current due to contact switch with LED indicator.<br>  | • Connect a resistor across the input terminals and com to drop the voltage below the input modules OFF threshold.<br>  <br>*A calculation example for the connected resistor value is shown on the following page. |



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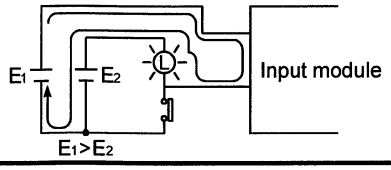
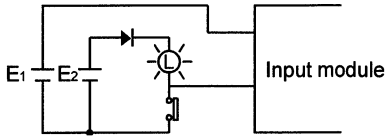
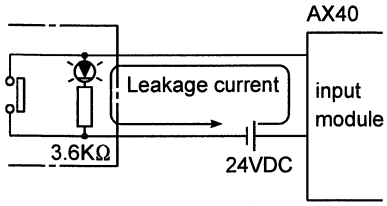
Table 6-2 Input circuit troubleshooting (continued)

| | Condition | Cause | Countermeasures |
|---|---|---|---|
| Ex.5 | DC input signal does not turn OFF. (Input LED may remain on or flicker) | • Current flow due to the use of two power supplies.<br>  | • Use single power supply.<br>• Use diode as shown below:<br>  |

Example:

Calculation for example 4

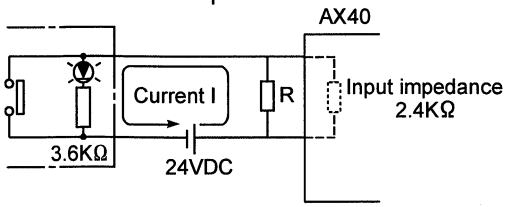



Consider a contact switch with LED indicator is connected to an AX40 module, giving a 4mA leakage current.

• The voltage $V_{TB}$ across the terminal and com is obtained by the following expression:

$V_{TB}$ = 4[mA] x 2.4[kΩ] = 9.6[V] (The voltage drop across the LED may be ignored).

The OFF threshold voltage is 6V so that the input will remain energized when the contact switch is open. Use resistor R as shown below :




• Calculate the resistor value, R, as shown below:

For an input voltage < 6V, current I must be:

(24 - 6 [V]) ÷ 3.6[kΩ] = 5mA

Resistor R must be selected to give a current I > 5mA.

• Hence, for resistor, R

6[V] ÷ R > 5 – 2.5[mA]

6[V] ÷ 2.5[mA] > R

2.4 [kΩ] > R

For R = 2kΩ, the power capacity must be:

W = (applied voltage)$^2$ / R (or W =(Maximum current)$^2$ x R)

Resistor R terminal voltage is:

$$\frac{2.4 \times 2}{2.4 + 2}(k\Omega) : \frac{2.4 \times 2}{2.4 + 2} + 3.6(k\Omega) = X : 24[V]$$

X = 5.58[V]

Therefore, the power capacity W of resistor R is:

W = (5.58[V])$^2$ / 2[kΩ] = 0.015[W]

• Use a safety factor of 3 to 5. Resistor should therefore be rated at 0.5 to 1W.

A 3kΩ, 0.5 to 1W resistor should therefore be connected across the relevant input terminal and its COM.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## 6.6.3 Input module terminal voltage check method

There are many different control voltages used for input modules, such as 12VAC, 24VAC, 100VAC, 200VAC, 12VDC, 24VDC, 48VDC, 60VDC and 100VDC, also sink or source types are available. As a result a wide variety of combinations are available. The check method for each input module is explained below:

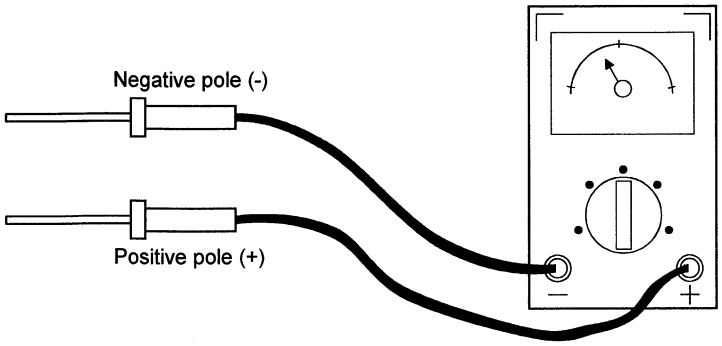
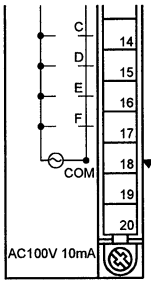
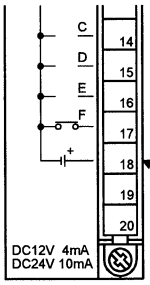
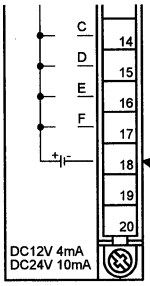



Table 6-3 Terminal voltage check method

| Voltage | Location where measurement is taken |
|---|---|
| 100VAC<br>200VAC |  For measuring 100VAC and 200VAC voltage range modules.<br>Any input terminal is used for negative test terminal<br>COM is used for positive test terminal |
| 12VDC<br>24VDC<br>48VDC<br>60VDC<br>100VDC<br>Sink input |  For measuring up to 100VDC input range modules.<br>Any input terminal is used for negative test terminal<br>COM is used for positive test terminal |
| 12VDC<br>24VDC<br>48VDC<br>60VDC<br>100VDC<br>Source input |  For measuring up to 100VDC input range modules.<br>Any input terminal is used for positive test terminal<br>COM is used for negative test terminal |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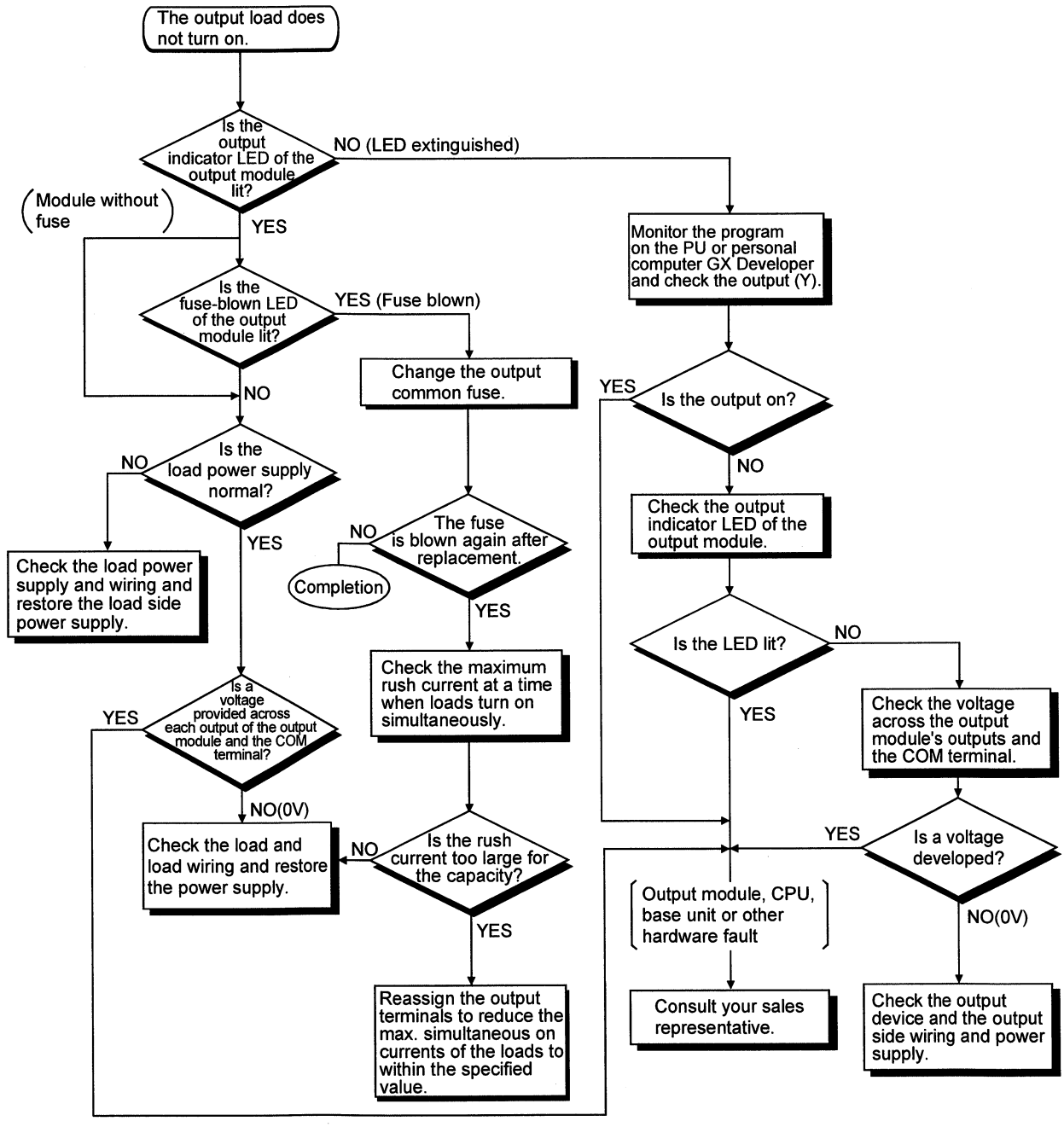
## 6.7 Output Module Troubleshooting

### 6.7.1 Hardware failure

The following flow chart explains what happens when the load of an output module does not turn on during operation. The following causes should be considered:

1) Wiring malfunction on the load side, or faulty power supply or load
2) Faulty output module or blowing a fuse in the output module
3) Hardware fault; i.e., the CPU, basic module, or cable





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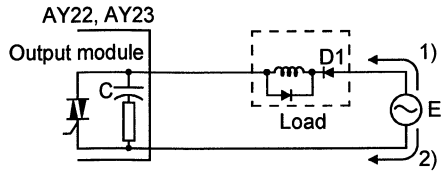
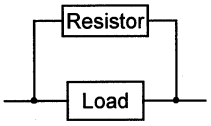
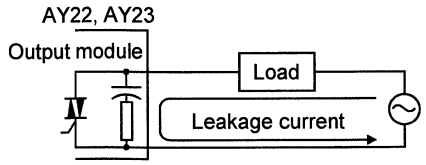
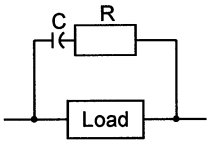
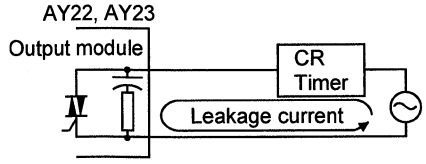
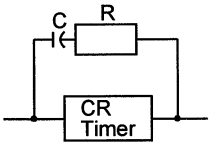
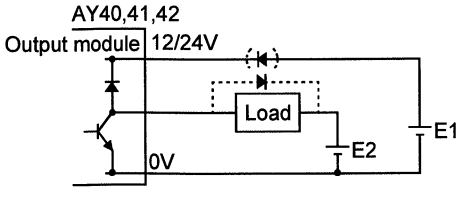
## 6.7.2 Output circuit troubleshooting

This section explains output circuit problems and countermeasures.

Table 6-4 Output circuit troubleshooting

| | Condition | Cause | Countermeasures |
|---|---|---|---|
| Ex.1 | When the output is off, excessive voltage is applied to the load. | • Half wave rectification by load(Typical in some solenoids).<br>  <br>• When the polarity of the power supply is as shown in 1), C is charged. When the polarity is as shown in 2), the voltage changed in C plus the line voltage are applied across D1. Max. Voltage is approx. 2.2E | • Connect a resistor of several 10 kΩ to several 100 kΩ across the load. If a resistor is used in this way, it does not pose a problem for the output element, However, it may cause the diodes built into the load to deteriorate, Which could result in fire, etc.<br>  |
| Ex.2 | The load does not turn OFF (triac output) | • Leakage current due to built-in noise suppression.<br>  | • Connect C and R across the load. When the wiring distance from the output card to the load is long, there may be a leakage current due to the line capacitance.<br>  <br>Suggested CR constant: 0.1 to 0.47μF + 47 to 120Ω (1/2W) |
| Ex.3 | When the load is a CR type timer, time constant fluctuates (triac output) |  | • After driving the relay, drive the CR type timer by the same contact. Some timers have half-wave rectified internal circuits. Therefore, take the precautions indicated in the example.<br>  <br>CR constant is calculated according to the load. |
| Ex.4 | The load does not turn OFF (For DC) | • Current flow due to the use of two power supplies.<br>  <br>• When $E_1 < E_2$, current flows. | • Use single power supply.<br>• Connect a current flow prevention diode. When the load is a relay or similar device, it is necessary to connect a reverse-voltage absorbing diode to the load. (Shown by the dotted line on the left) |

**POINT**

For the CR network used in Example 2,3, see the following recommendations

1) CR assembly

| C | 01.μF | 047. μF | 05. μF |
|---|---|---|---|
| R | 120Ω | 47Ω | 50Ω |

2) C is a paper or metallized paper capacitor.

3) Rated voltage for C is 630VDC or 200VAC.

4) Power rating of R is 1/2W or more.

5) When load power consumption is over 30VA, use a CR of 0.47μF + 47Ω



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## 6.7.3 Output module terminal voltage check method

There are many different AC and DC control voltages used for output modules. As a result a wide variety of combinations are available.
The check method for each output module is explained below:

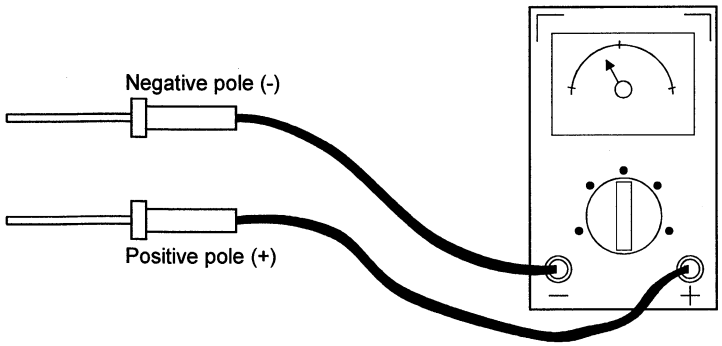



Table 6-5 Terminal voltage check method

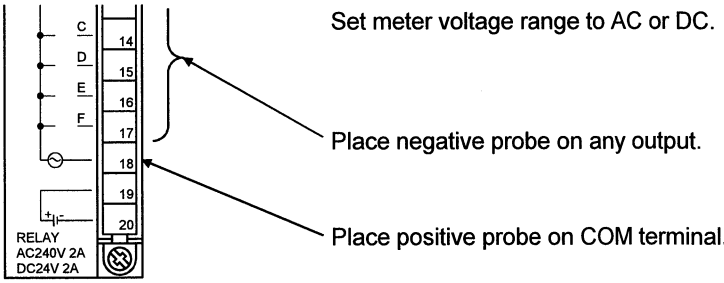
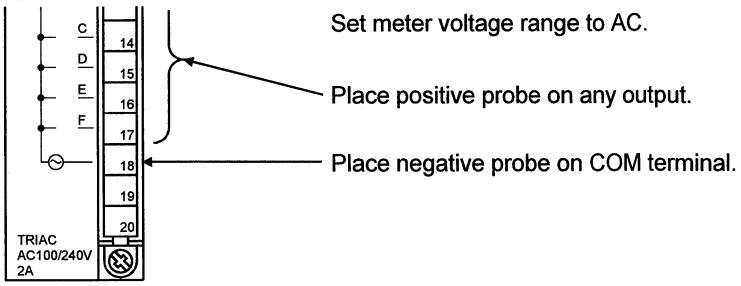
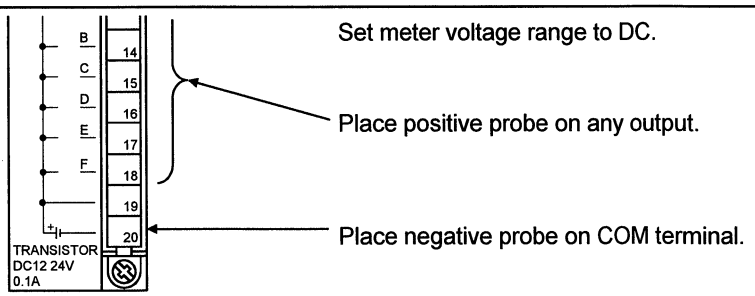
| Voltage | Measurement location on module terminal block |
|---|---|
| Contact output<br>Both AC, DC |  |
| Triac output<br>AC only |  |
| Transistor DC<br>sink output only |  |


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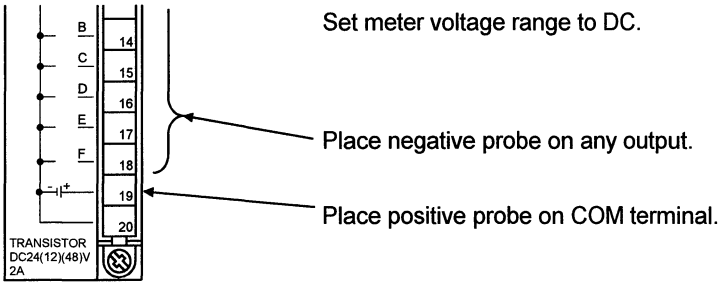
Table 6-5 Terminal voltage check method (continued)

| Voltage | Measurement location on module terminal block |
|---|---|
| Transistor DC source output only |  |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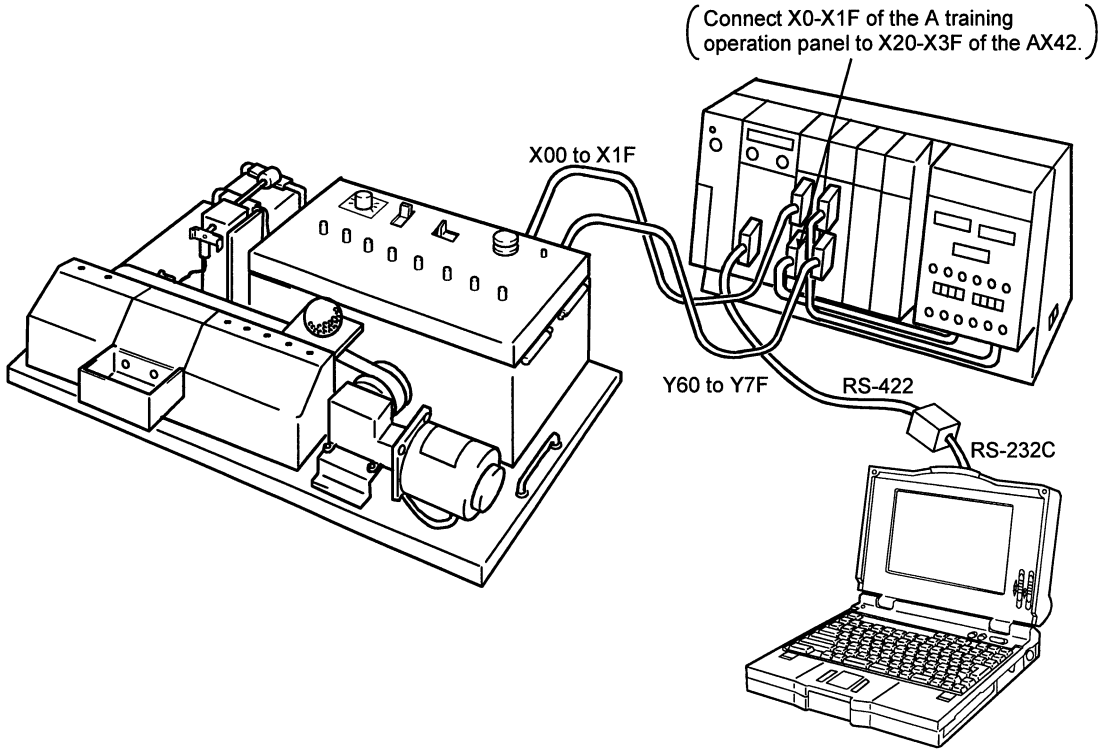
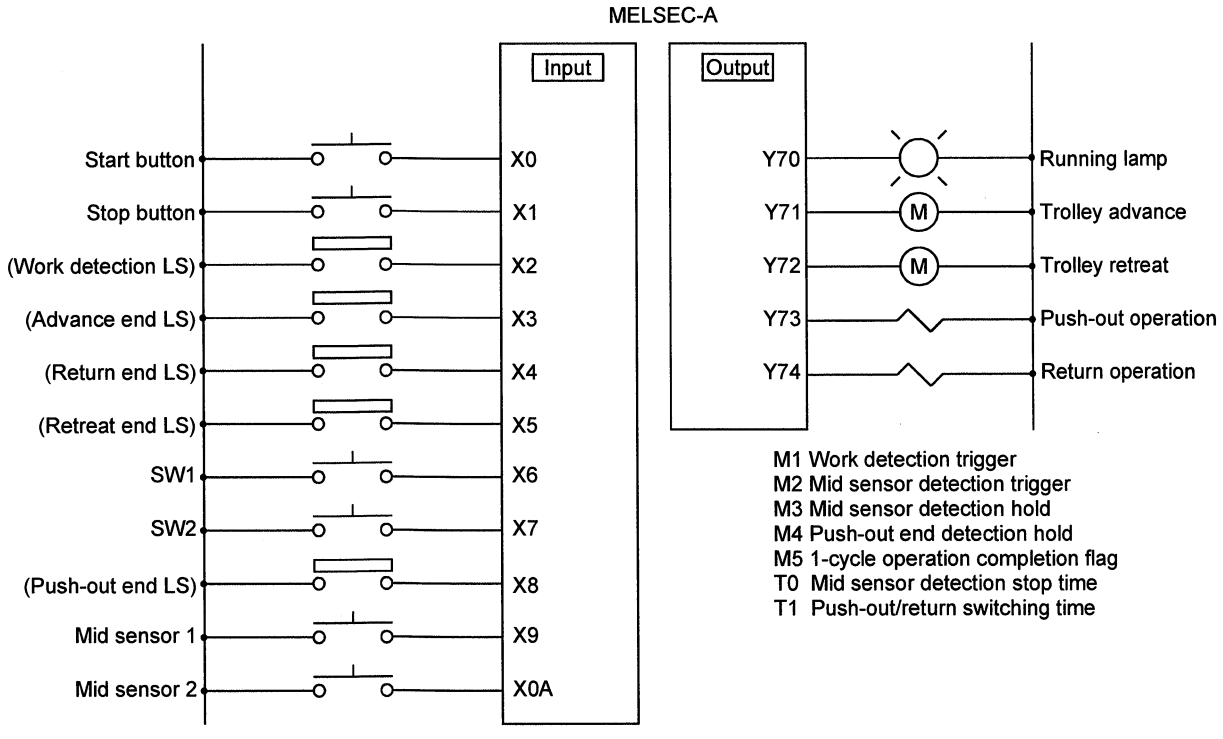
## 6.8 Troubleshooting Using Trolley Conveyor System Training Kit

### (1) Explanation of training kit

This example is carried out using a training system which transports a work-piece (golf ball).
The work-piece is placed on the conveyor and moves toward sensors 1 and 2 in the middle. After a 2 second pause, it proceeds to the end and stops.
After the work-piece is pushed out of the exit hole by the pushing arm, the arm returns to its original position when the push limit (edge) is reached.




### (2) I/O signal allocation

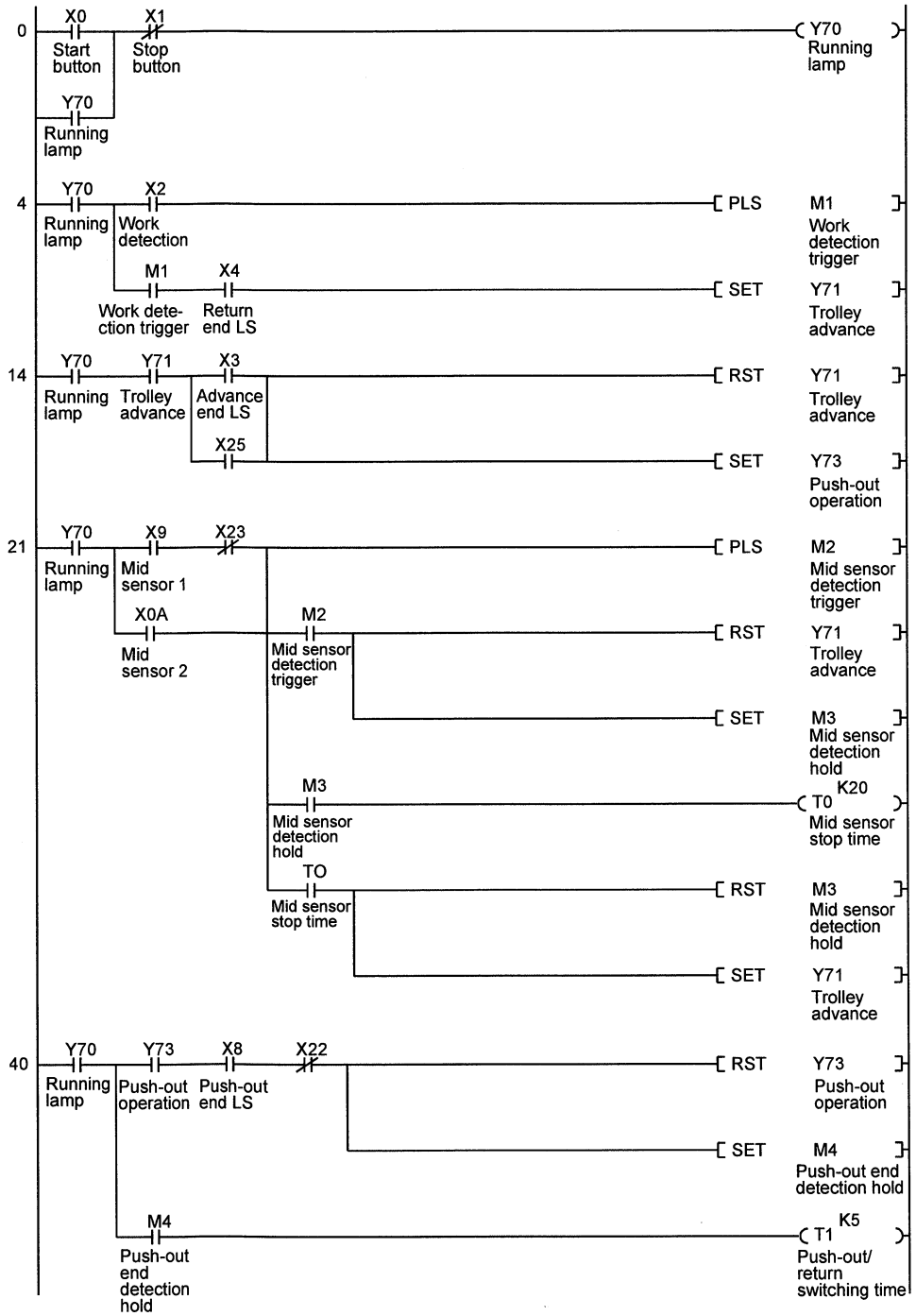



M1 Work detection trigger
M2 Mid sensor detection trigger
M3 Mid sensor detection hold
M4 Push-out end detection hold
M5 1-cycle operation completion flag
T0 Mid sensor detection stop time
T1 Push-out/return switching time


6 - 29

| Drive/path | A:\SCHOOL |
|---|---|
| Project | TROLLEY |

## (3) Sequence program



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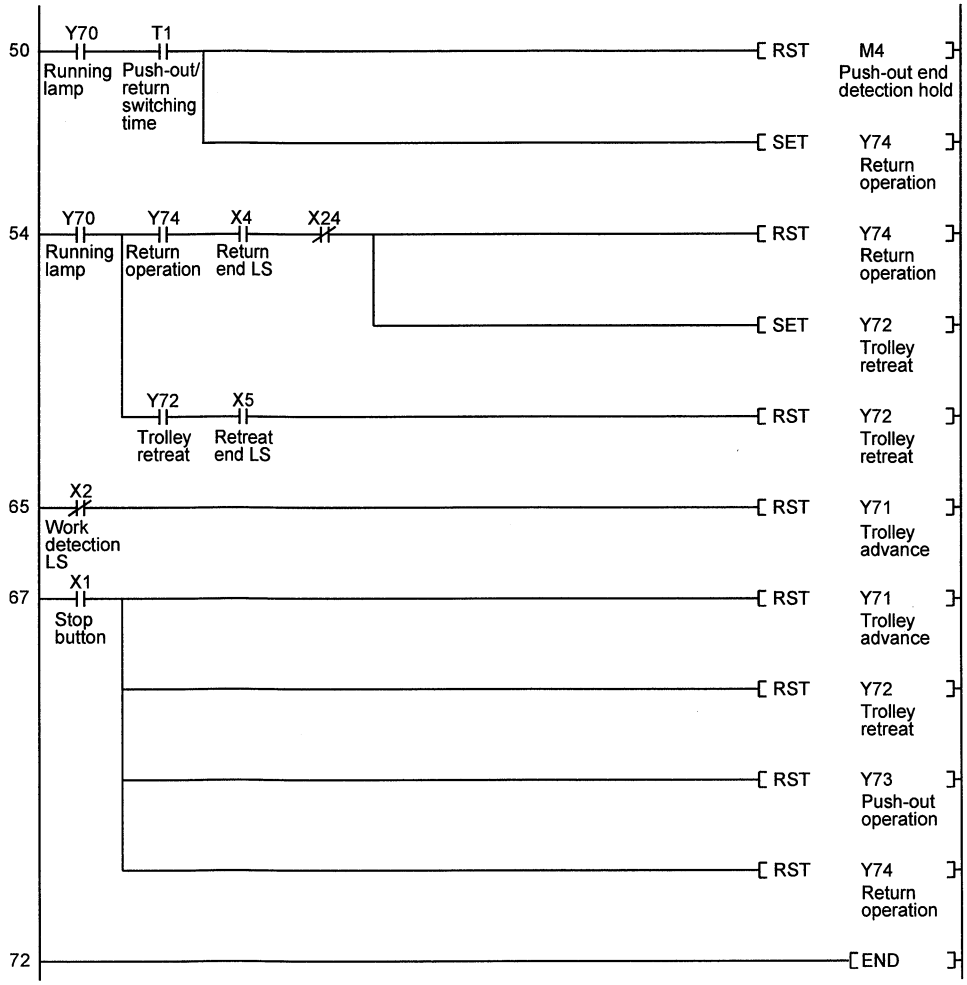
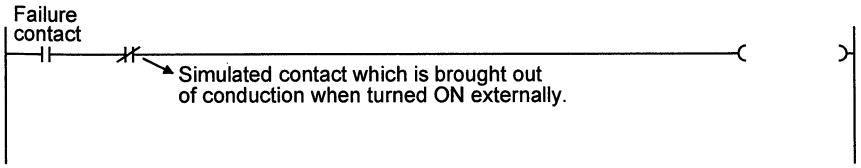


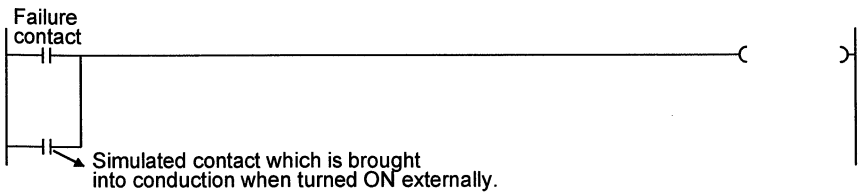

## (4) Problem example for equipment operation

As an example of a problem, use the simulated contact as shown below.

1) Contact does not turn ON.




2) Contact does not turn OFF.





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<Example problem 1> Push arm does not return.

1) Confirm correct operation → Golf ball is loaded on trolley.
2) Assume failure has occurred → X22 is turned ON.
3) Execute wrong operation → Golf ball is loaded on trolley.(Not operating normally)
4) Study cause of wrong operation → With ladder monitor, find the cause of wrong operation.
5) Return to normal → X22 is turned OFF.

<Example problem 2> Does not stop at mid-point sensor 1.

1) Confirm correct operation → Golf ball is loaded on trolley
2) Assume failure has occurred → X23 is turned ON.
3) Execute wrong operation → Golf ball is loaded on trolley.(Not operating normally)
4) Study cause of wrong operation → With ladder monitor, find the cause of wrong operation.
5) Return to normal → X23 is turned OFF.

<Example problem 3> Trolley does not return.

1) Confirm correct operation → Golf ball is loaded on trolley.
2) Assume failure has occurred → X24 is turned ON.
3) Execute wrong operation → Golf ball is loaded on trolley.(Not operating normally)
4) Study cause of wrong operation → With ladder monitor, find the cause of wrong operation.
5) Return to normal → X24 is turned OFF.

<Example problem 4> Trolley does not move.

1) Confirm correct operation → Golf ball is loaded on trolley.
2) Turn PLC A training kit power supply OFF.
3) Assume failure has occurred → Remove connectors for outputs Y60 to Y7F.
4) Turn PLC A training kit power supply ON.
5) Execute wrong operation → Golf ball is loaded on trolley.(Not operating normally)
6) Study cause of wrong operation → With ladder monitor, find the cause of wrong operation.
7) Turn PLC A training kit power supply OFF.
8) Return to normal → Replace connectors for outputs Y60 to Y7F.
9) Turn PLC A training kit power supply ON.

<Example problem 5> Trolley does not move.

1) Confirm correct operation → Golf ball is loaded on trolley.
2) Assume failure has occurred → Using the push switch, push the arm until return limit switch X4 turns OFF.
3) Execute wrong operation → Golf ball is loaded on trolley.(Not operating normally)
4) Study cause of wrong operation → With ladder monitor, find the cause of wrong operation.
5) Return to normal → Using the push switch, push the arm until return limit switch X4 turns ON.
6) Push stop switch (X1), push start switch (X0).

<Example problem 6> Trolley does not move.

1) Confirm correct operation → Golf ball is loaded on trolley.
2) Assume failure has occurred → X25 is turned ON.
3) Execute wrong operation → Golf ball is loaded on trolley.(Not operating normally)
4) Study cause of wrong operation → With ladder monitor, find the cause of wrong operation.
5) Return to normal → X25 is turned OFF.
6) Push stop switch (X1), push start switch (X0).


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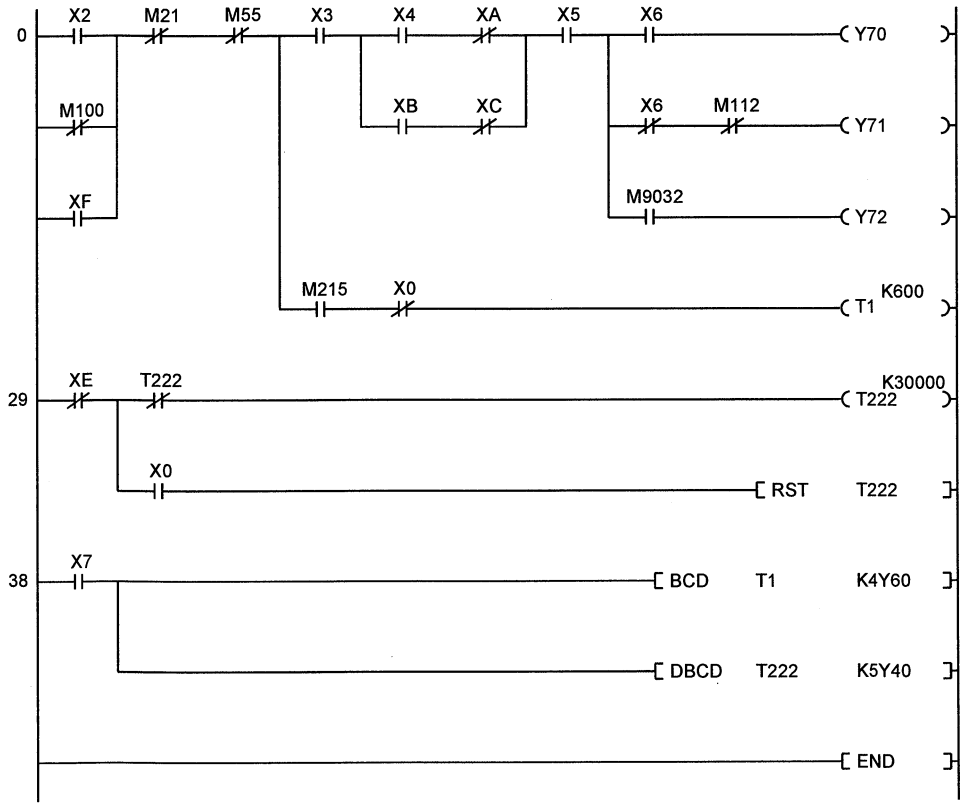
## 6.9 Troubleshooting Error Example with Training Kit A

| Drive/path | A:\SCHOOL |
|---|---|
| Project | HOZEN |



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## (1) Problem 1

1) Training system

| A62P | A3ACPU P21 | AX42 | AY42 | A68AD | A62DA | AD61 |
|---|---|---|---|---|---|---|
| | | 64 points | 64 points | 32 points occupied | 32 points occupied | 32 points occupied |

2) Error condition
CPU does not RUN normally.

3) Answer method
Check in the training school text in troubleshooting (Section 6.5) and follow the flow chart to determine the cause of the error that is making the CPU run incorrectly.


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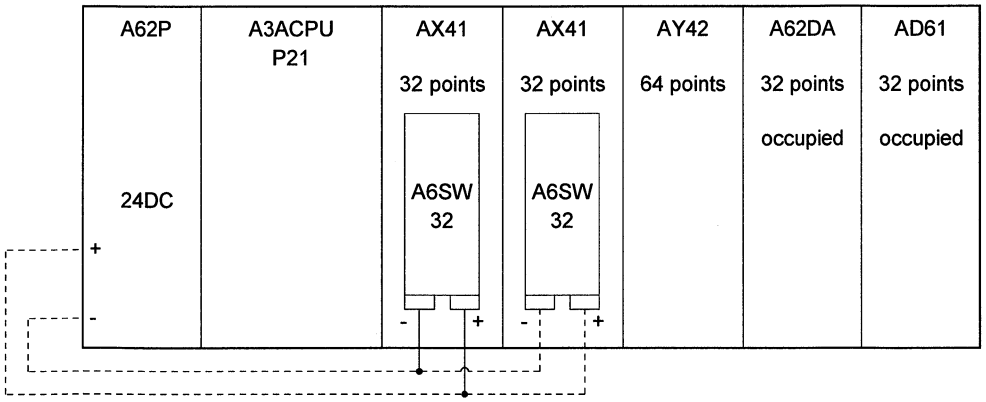
## (2) Problem 2

1) Training system




2) Error condition

When input signals X02, X03, X04, X05 and X06 turn ON the monitor LEDs light up but no action occurs in the program.

| Object / Input | External device | AX41 monitor LED | Program |
|---|---|---|---|
| X02 to X06 | Switch ON/OFF | Lit/unlit | Stays OFF |

3) Answer method

Check in the training school text in troubleshooting (Section 6.6) and follow the flow chart to determine the cause of the error when external input signals are being received but the CPU does not read them.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## (3) Problem 3

1) Training system

| A62P | A3ACPU P21 | AX42 | AY42 | A68AD | A62DA | AD61 |
|---|---|---|---|---|---|---|
| | | 64 points | 64 points | 32 points | 32 points | 32 points |
| | | | | occupied | occupied | occupied |

2) Error condition

The CPU is set to RUN, outputs Y60, Y61, Y62 and Y63 are switched ON/OFF by the program but the output LEDs on the AY42 module stay lit and the external equipment shows no output.
Also, Y70, Y71 and Y72 are switched ON/OFF by the program and although AY42 monitor LEDs are operating the external equipment is not.
However, the external wiring is correct.

| Object / Output | Program | AY42 LEDs | External device |
|---|---|---|---|
| Y60 to Y63 | Switching ON/OFF | Stays lit | No output (stays OFF) |
| Y70 to Y72 | Switching ON/OFF | Lit/unlit | No output (stays OFF) |

3) Answer method

Check in the training school text in troubleshooting (Section 6.7) and follow the flow chart to determine the cause of the error when external equipment does not turn ON/OFF.


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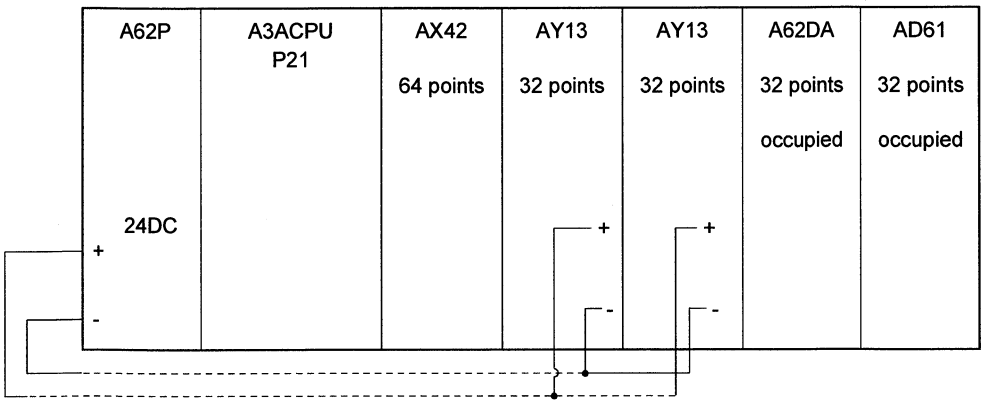
## (4) Problem 4

1) Training system




2) Error condition

Even if outputs Y70, Y71 and Y72 are turned ON by the program, the external equipment does not operate when AY12 monitor LEDs light up. (Y70 LED is not lit)
(Output relays also do not turn ON)
(Because AY13 is a relay type output module, operation can be checked by listening to hear if the relays are opening and closing)

| Object / Output | Program | AY13 LEDs | AY13 relays |
|---|---|---|---|
| Y70 to Y72 | ON / OFF | ON / OFF | Stays OFF |

3) Answer method

Check in the training school text in troubleshooting (Section 6.7) and follow the flow chart to determine the cause of the error when AY13 output relays do not turn ON/OFF.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## 6.10 Special Function Module Troubleshooting

This section provides a common explanation of the details which are needed for troubleshooting. However, there are various types of PLC special function module.

### 6.10.1 Common items of special function modules

#### (1) Special function module types

Special function modules are designed to carry out functions which cannot be done by the PLC CPU or the CPU support for the function is limited. Typical kinds of modules are explained below.

1) Analog to digital converter module
   Analog input (±10V, 4 to 20mA).

2) Digital to analog converter module
   Analog output (±10V, 4 to20mA).

3) High speed counter module
   Accepts high speed pulse or encoder input.

4) Positioning module
   Outputs high speed pulse train to a positioning servo amp.

5) MELSECNET data link module
   Carries out data communication between PLCs.

6) RS-232C, RS-422, Printer interface module
   Data link connection to computers, printers, bar code readers, ID systems, etc.

7) Sound output module
   Playback pre-recorded announcements.

8) External fault detection module
   Detects errors in external I/O signal operation.


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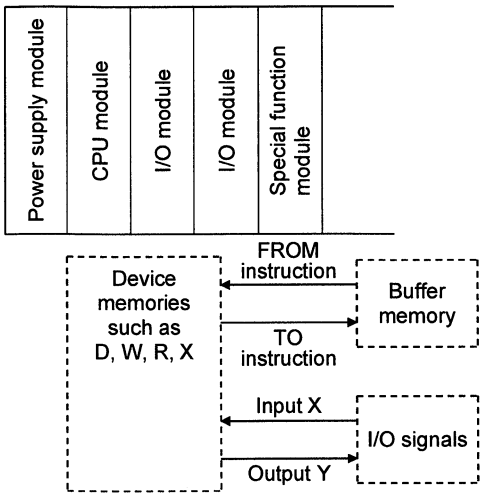
## (2) Relationship to PLC CPU

Special function modules have an internal buffer memory which is used to store data.
When required the CPU can read data from the buffer memory using the FROM instruction and write to it using the TO instruction.

Also, when the PLC CPU issues instructions to a special function module, output signals (Y) can also be turned ON/OFF and the module can reply to the CPU using input signals (X) to allow data exchange of module status.




**REFERENCE**

When an error occurs from using TO/FROM instructions, the CPU stops and the following error codes are stored in D9008.
40: Cannot execute.
41: No reply received.
46: Not special function module.

Buffer memory locations and I/O signal allocation for each special function module can be found in the respective user's manual.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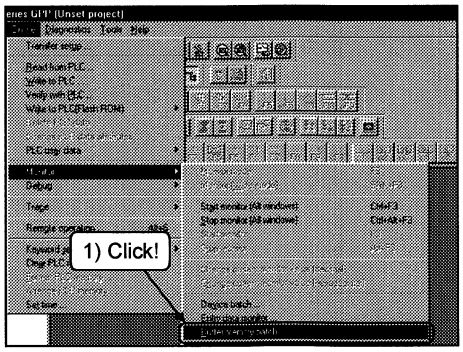
## 6.10.2 Buffer memory operation of special function module

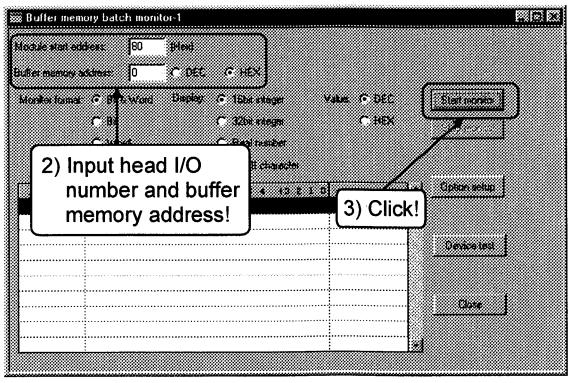
Special function module buffer memory can be directly monitored and the present value can be changed using GX Developer.

### (1) Buffer memory monitor

Set the CPU "RUN/STOP" switch to "RUN".

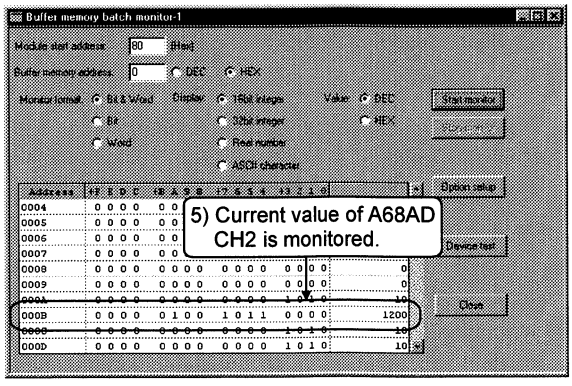



1) In the [Online] menu, select [Monitor] and click on [Buffer memory batch].




2) Specify the I/O head address (all digits) and buffer memory address (Decimal or Hexadecimal) of the special function module. In this case, input "80" for the I/O head address and "0" for the buffer memory.

3) Click on [Start monitor] button.




4) Monitoring starts for the specified buffer memory.

5) On the A series training kit, turn the analog voltage input knob module the voltmeter shows 5 to 8VDC.
The current value of A68AD CH2 can be monitored.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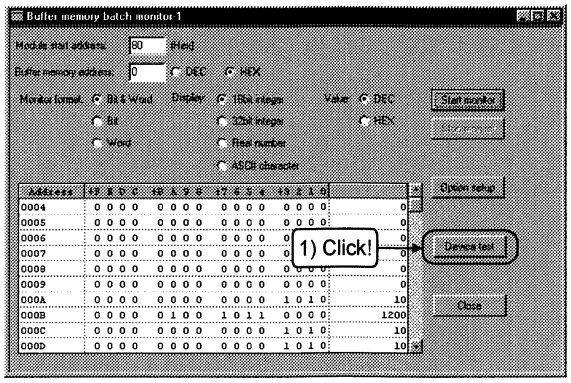
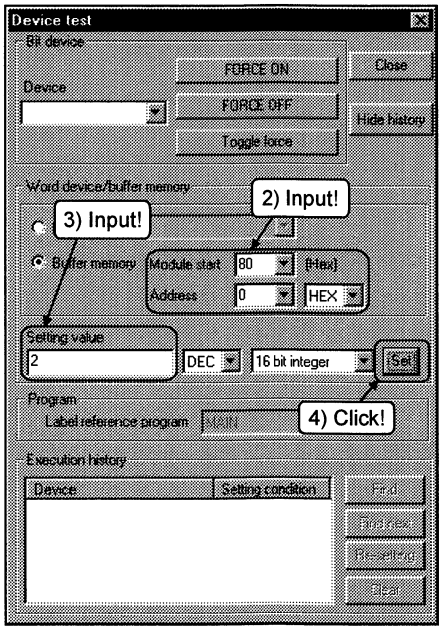
## (2) Changing the current value of a buffer memory address

Change the present value of the buffer memory monitored in (1).



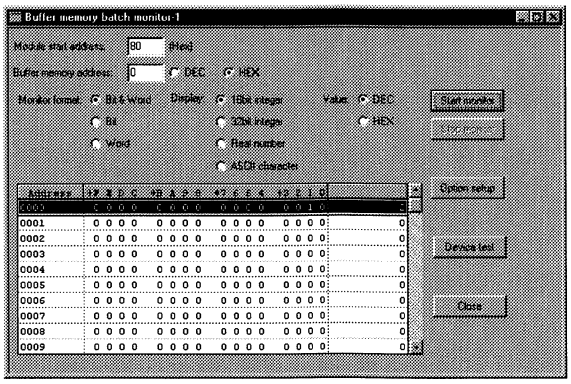

1) Click on the Device test button.




2) Input "80" for the "Module head address" and "0" for "Buffer memory".

3) Input "2" in the "Setting value" box.

4) Click on the Set button.




5) The current value will change to the newly set value.



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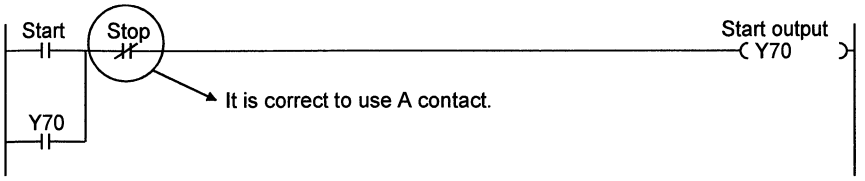
## 6.11 PLC Program Problems

Below are descriptions of some programming mistakes. They can be viewed with ladder monitor to check the ON/OFF status of devices used in the program.

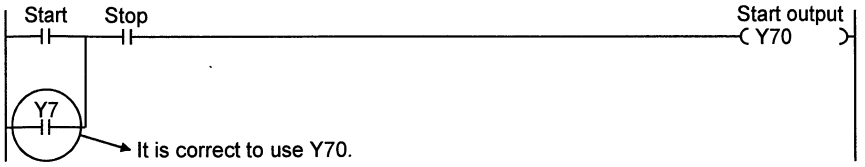
### (1) Example of A/B contact programming mistake

When an external stop switch is used with a B contact, because a B contact is used in the program, the stop B contact does not conduct and thus cannot be operated.



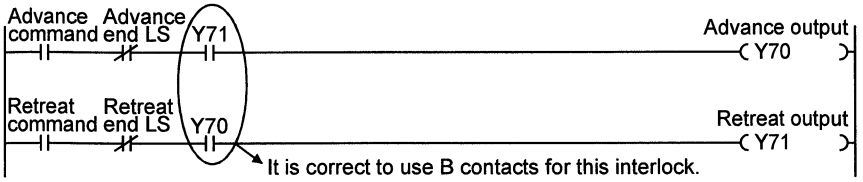

### (2) Example of device number programming mistake

Y70 is supposed to be self latching but is mistakenly input as Y7 and thus does not latch.



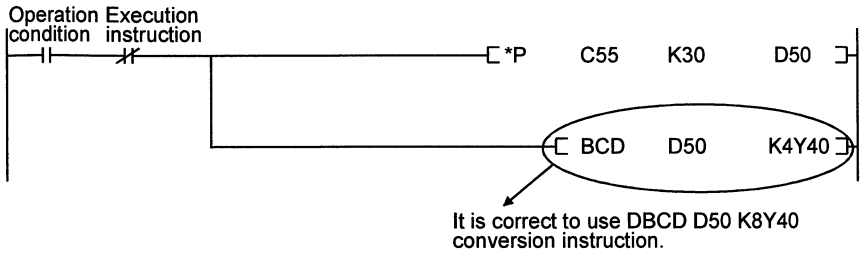

### (3) Example of interlock programming mistake

Even when advance and retreat instructions conditions are true, there is no operation.




### (4) Example of a calculation mistake in programming

The contents of C55 are multiplied by 30 and output to a display module. When the contents of D50 exceed 9999, 4 digit BCD conversion will not be sufficient and an error occurs.





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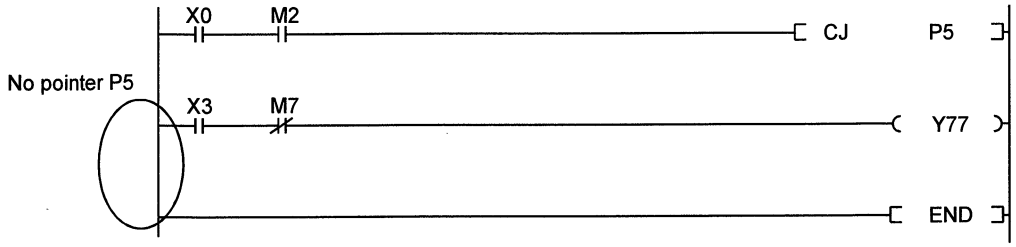
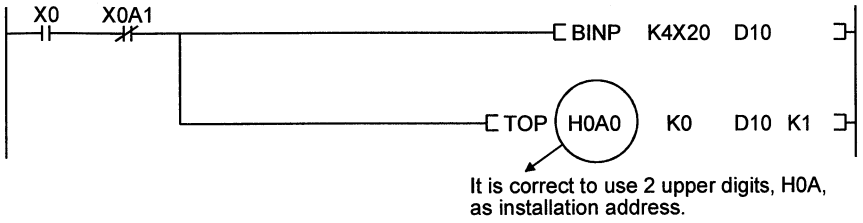
(5) Example of CJ/CALL jump instruction programming mistake

Jump pointer P5 was not entered on the left of the rung.




(6) Example of TO instruction programming mistake

A62DA module is installed at I/O address X/Y0A0, However, due to the TO instruction being incorrect, there is no analog output.





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| Drive/path | A:\SCHOOL |
|---|---|
| Project | HOZEN |

## 6.12 Training for Error Occurrence

This section enables you to use GX Developer so ftware to read error definitions and take corrective actions. The sequence program used has [Project name: HOZEN]. Work through this section in the following order, Training 1 to Training 10.

### 6.12.1 Training 1 ROM/RAM select switch setting mistake

This example is to check what will happen if the ROM/RAM select switch is set in the ROM position for operation to be performed using RAM memory.

1) Set the ROM/RAM select switch to the ROM position, reset the CPU, and set it to RUN.
   "This results in an error and the CPU does not run."

2) Perform the following operation to read the error step/code.

   <Operation>
   (a) Choose the [Diagnostics] → [PLC diagnostics] menu.
   (b) Confirm "Error display" in the PLC diagnostics dialog box.

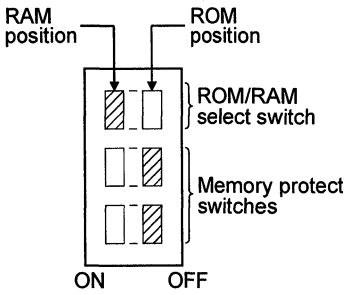
| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 11 | 111 | PARAMETER-ERROR | 0 |
| or | | | |
| 12 | 121 | MISSING END INS | 0 |

   For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.

3) Corrective action
   Move the ROM/RAM select switch to the RAM position and reset the CPU.
   The CPU will run only if the correct program is stored in RAM memory.

**REMARKS**

- The ROM/RAM select switch is at the top, as shown on the right.
- The memory protect switches are at the second and lower positions from the top.
- When using ROM memory to perform operation, write a program to ROM memory, fit odd-address ROM and even-address ROM into the ROM sockets of the memory cassette taking case not to make a mistake. Finally, set the ROM/RAM select switch to the ROM position.





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## 6.12.2 Training 2 I/O module verify error

This is example is to observe what will happen if an I/O module is removed while the PLC power is on.

1) While the POWER LED of the power supply module is on, remove the AY42 output module.
"An error occurs. If during RUN, the CPU stops."

2) Perform the following operation to read the error step/code.

<Operation>
(a) Choose the [Diagnostics] → [PLC diagnostics] menu.
(b) Confirm "Error display" in the PLC diagnostics dialog box.

| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 31 | 31 | UNIT VERIFY ERR. | 0 |

For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.

3) The special relay and special register detect the I/O module number in error.
Monitor the error definition.
M9002 turns on at occurrence of an I/O module verify error.
D9002 stores the module number in I/O module verify error.

<Operation>
(a) Choose the [Online] → [Monitor] → [Entry data monitor] menu.
(b) Click the Register devices button in the "Entry data monitor" dialog box.
(c) The register device dialog box appears.
After clicking the Register button, click the Start monitor button.
- Registration of M9002 (device: M9002, display format: no change)
- Registration of D9002 (device: D9002, display format: hexadecimal display, 16-bit integer)

| Device | ON/OFF/Current | Setting value | Connect | Coil |
|---|---|---|---|---|
| M9002 | 1 | | | |
| D9002 | 0040 | | | |
| | | | | |

I/O number (X/Y040) in verify error


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In D9116 to D9123, the bits corresponding to the module numbers (in increments of 16 points) are on.
Monitor them by performing the following operation.

<Operation>

(a) Choose the [Online] → [Monitor] → [Device batch] menu.

(b) Type "D9116" into "Device" in the "Device batch monitor" dialog box, and specify "Bit & Word" in "Monitor format".

(c) Click the Start monitor button.

| Device | +F E D C | +B A 9 8 | +7 6 5 4 | +3 2 1 0 | |
|---|---|---|---|---|---|
| D9116 | 0 0 0 0 | 0 0 0 0 | 1 1 1 1 | 0 0 0 0 | 240 |

Means that the I/O numbers in error are 40 to 7F.

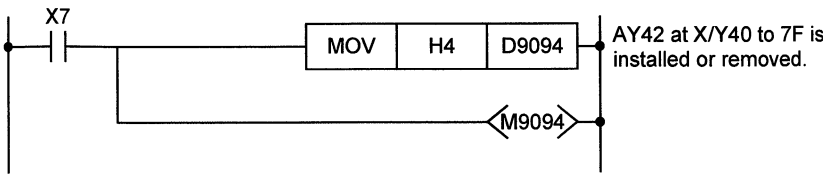
4) Corrective action

Install the I/O module correctly and reset the CPU.

## REMARKS

The A1, A2, A2-S1, A3 and A3HCPUs should be powered off to install, remove or change I/O modules.
The A1N, A2N, A2N-S1, A3N, A2A, A2A-S1, A3A, A2U, A2U-S1, A3U and A4UCPUs allow I/O modules to be installed, removed or changed by turning on the special relay M9094.
Set in the special register D9094 the upper two digits of the I/O number corresponding to the standard I/O module you want to install or remove online, this disables I/O module verify and holds the corresponding X/Y data.

Program example (install or remove while X7 is on)





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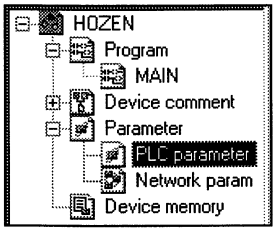
## 6.12.3 [Training 3] Mistakes in I/O number assignment when using GX Developer software.

This example will check what fault will occur when the parameter I/O number setting made from personal computer GX Developer is different from that of the installed module.

1) Perform the following operation to assign slot 0 to 16 input points.

<Operation>

(a) Choose "Parameter" in the project data list and double-click "PLC parameter".




(b) Click the "I/O assignment" tab in the "A parameter" dialog box.

(c) Set slot 0 assignment, as shown below.

• "Type":Input, "Model name": AX42, "Points": 16 points

| | Slot | Type | Model name | Points |
|---|---|---|---|---|
| 0 | 0(0-0) | Input | AX42 | 16points |
| 1 | 0(0-1) | | | |

(d) Click the [End] button.

(e) Set the CPU to STOP.

(f) Click (Write to PLC) on the toolbar.

(g) Choose "Parameter" → "PLC/Network " in the "Write to PLC" dialog box, and click the [Execute] button.

(h) As the confirmation dialog box appears, click the [Yes] button.

2) By setting the CPU to RUN and turning on X2, the timer current values do not appear on the digital display Y40 to Y4F.

3) Monitor the ON/OFF states of outputs Y40 to Y4F by performing the following operation.

<Operation>

(a) Choose the [Online] → [Monitor] → [Device batch] menu.

(b) Type "Y40" into "Device" in the "Device batch monitor" dialog box.

(c) Click the [Start monitor] button.

| Device | +F E D C | +B A 9 8 | +7 6 5 4 | +3 2 1 0 | |
|---|---|---|---|---|---|
| Y40 | 0 0 0 0 | 0 0 1 0 | 0 0 0 0 | 0 0 0 0 | 512 |
| Y50 | 0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 0 |
| Y60 | 0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 0 |
| Y70 | 0 0 0 0 | 0 0 0 0 | 0 0 0 0 | 1 0 0 0 | 8 |

Turn X2 on and X0 on/off.

In the program, it is understood that normal outputs are provided to Y40 to Y4F.

It is assumed that the timer current values are not sent to the output module due to a fault other than a program error.



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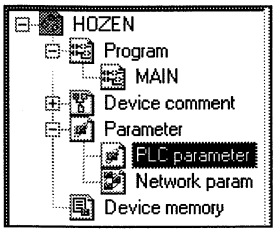
4) Corrective action
Correct the parameter I/O assignment to match the installed module.

REMARKS

The I/O numbers may not match the installation in either of the following cases.
• Incorrect I/O number assignment was made from the DOS/V personal computer.
• The connector pins provided at the back of the I/O module are bent or faulty.

5) Before starting [Training 4], set the CPU to STOP and perform the following operation to return the parameters to the original status.

<Operation>
(a) Choose "Parameter" in the project data list and double-click "PLC parameter".




(b) Click the "I/O assignment" tab in the "A parameter" dialog box.
(c) Click the [Default] button.
(d) As the confirmation dialog box appears, click the [Yes] button.
(e) Click the [End] button.
(f) Click (Write to PLC) on the toolbar.
(g) Choose "Parameter" → "PLC/Network" in the "Write to PLC" dialog box, and click the [Execute] button.
(h) As the confirmation dialog box appears, click the [Yes] button.

Set the CPU to RESET.
↓
Set the CPU to RUN.

The timer current values now appear on the digital displays Y40 to Y4F. (Turn X2 on and X0 on/off.)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## 6.12.4 Training 4 END instruction inexecutable malfunction

This example will show what will happen when END processing cannot be performed and the CPU goes into an error status.

1) Perform the following operation to delete the END instuction of the existing program. Set the CPU to STOP, and write the program.

<Operation>

(a) Click (Instruction list) on the toolbar to choose the list mode.

(b) In the read mode ( ), press the following keys to search for the END instruction.

E N D ↵ ↵ ↵

(Search) (Search end)

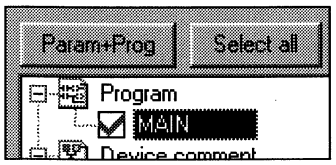
(c) Click (Write mode) on the toolbar to choose the write mode.

(d) Hold down Shift and press the Delete key.

(e) Set the CPU to STOP.

(f) Click the (Write to PLC) menu on the toolbar.

(g) Click and choose "MAIN" at program, and click the Execute button.




(h) As the confirmation dialog box appears, click the Yes button to perform write to PLC.

2) Set the CPU to RUN.
"An error occurs and the CPU stops."

3) Perform the following operation to read the error step/code.

<Operation>

(a) Choose the [Diagnostics] → [PLC diagnostics] menu.

(b) Confirm "Error display" in the PLC diagnostics dialog box.

| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 12 | 121 | MISSING END INS. | 0 |

For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.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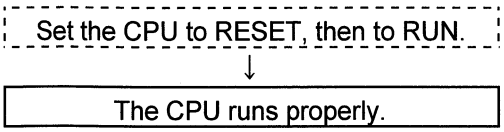
4) Corrective action
Add the END instruction to the end of the program in the list mode.
(END cannot be written in the ladder mode.)

REMARKS

Factors for no END instruction
- Program was created in list mode, with no END instruction being added.
- The CJ, SCJ or JMP instruction caused a jump over the END instruction.
- During RAM memory operation, backup battery capacity shortage corrupted the program.
- Noise trouble may have corrupted the program.

5) Before starting the next training example, set the CPU to STOP and add END to the program by performing the following operation.
<Operation>
(a) In the list display mode, choose the last line of the program and press the [E] [N] [D] [↵] keys.
(b) Click  (Write to PLC) on the toolbar.
(c) Click and choose "MAIN" at program, and click the [Execute] button.
(d) As the confirmation dialog box appears, click the [Yes] button to perform write to PLC.





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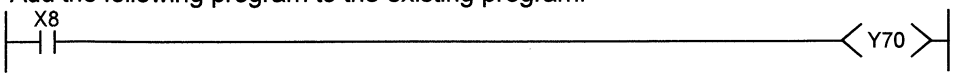
## 6.12.5 Training 5 Operation fault due to double coils

This example shows when there are two or more coils of the same device in a program, resulting in the operation being faulty.

1) Add the following program to the existing program.



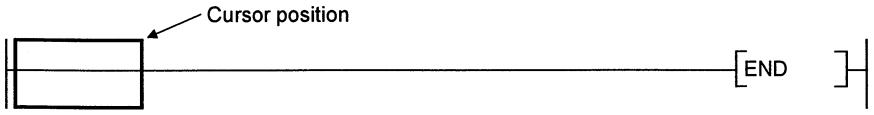

<Operation>

(a) Press the following keys in the ladder read mode ( ).

E N D ↵ ↵ ↵

(Search) (Search end)

(b) Move the cursor to the left end of the END instruction.




(c) Click (Write mode) on the toolbar to choose the write mode.

(d) Press the following keys to add a ladder.

F5 X 8 ↵ F7 Y 7 0 ↵

(⊣⊢) (-( )-)

(e) Choose the [Convert] → [Convert(Online change)] menu.

Click the Yes button.

As "RUN write processing has completed." appears, click the OK button. This modifies both the DOS/V personal computer and CPU programs at the same time.

(Online change can be made only when the pre-change programs are the same.)

2) Turn off X2 and X8.

Y70 is dimly lit when the I/O control system is direct processing. Y70 is extinguished when the system is (image memory) refresh processing (e.g. AnA, AnU).

3) The following operation methods to check for double coils.

- Display coils in the ladder or program list

(a) Click (Read mode) on the toolbar to choose the read mode.



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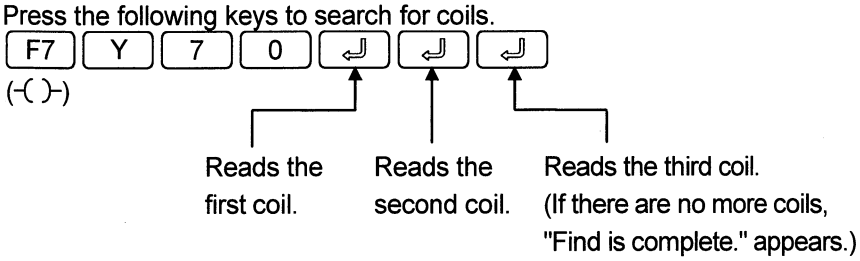
(b) Press the following keys to search for coils.




• Display coils in the "List of used devices"

(a) Choose the [Find/Replace] → [List of used devices] menu.

(b) Type "Y70" into "Find device" in the "List of used devices" dialog box.

(c) Click the Execute button.

[List of used devices]

| Device | -\| \|- | -( )- | Count | Error | Comment |
|---|---|---|---|---|---|
| Y70 | | * | 2 | ERR | |
| Y71 | | * | 1 | ERR | |
| Y72 | | * | 1 | ERR | |

Means that -(Y70)- exists in two places.

• Display coils in the "Cross reference list"

(a) Choose the [Find/Replace] → [Cross reference list] menu.

(b) Type "Y70" into "Find device" in the "Cross reference list" dialog box.

(c) Click the Execute button.

[Cross reference list]

| Block | Step | Sequence step | Instructi.. | Pos.. | Program name |
|---|---|---|---|---|---|
| | | 2 | -( )- | * | MAIN |
| | | 55 | -( )- | * | MAIN |

Means that the Y70 coil exists in two places, step 2 and step 55.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4) Corrective action

Change the added Y70 coil for unused output Y76.

<Operation>

(a) In the write mode (  ), press the [Ins] key to choose the overwrite mode.

(b) Double-click Y70 in the added ladder and press the following keys.

[Y] [7] [6] [↵]

(c) Choose the [Convert] → [Convert(Online change)] menu.

Click the [Yes] button.

As "RUN write processing has completed." appears, click the [OK] button.

The Y70 LED flickers.

REMARKS

Be careful when the message "The specified coil is already used." appears.
Note that multiple identical coils may be used with the SET and RST instructions.


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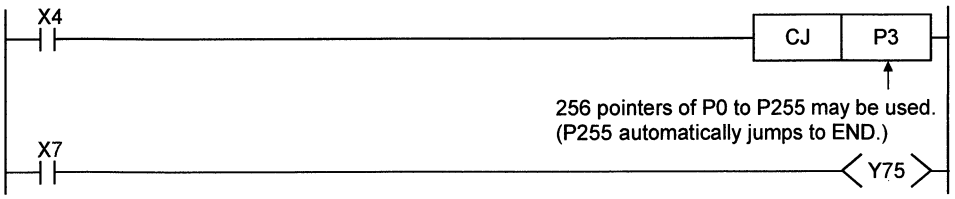
## 6.12.6 Training 6 Jump destination error when CJ instruction is used

This example shows how the CPU stops when there is no jump destination specified for a branch instruction used.

1) Add the following program to the existing program.




<Operation>

(a) Press the following keys in the ladder read mode ( ).

X 8 ↵ ↵ ↵

(Search) (Search end)

(b) Click (Write mode) on the toolbar to choose the write mode.

(c) Press the following keys.

Shift Ins F5 X 4 ↵

(Line insertion) (-| |-)

F8 C J SP P 3 ↵ F5 X 7 ↵

(-[ ]-) (-| |-)

F7 Y 7 5 ↵

(-( )-)

(d) Choose the [Convert] → [Convert(Online change)] menu.

Click the Yes button.

As "RUN write processing has completed." appears, click the OK button.

2) Turn on X4.

"An error occurs and the CPU stops."

3) Perform the following operation to read the error step/code.

<Operation>

(a) Choose the [Diagnostics] → [PLC diagnostics] menu.

(b) Confirm "Error display" in the PLC diagnostics dialog box.

| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 13 | 132 | CAN'T EXECUTE(P) | 55 |

For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.

4) Reset the PLC CPU.

(a) Turn off X4.

(b) Move the "RESET" key switch of the CPU to the RESET position.



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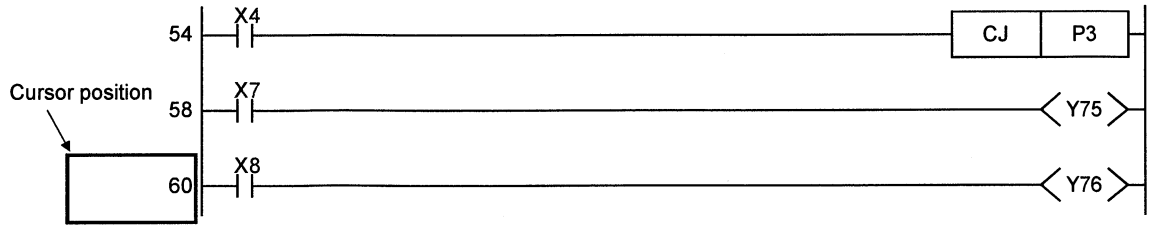
5) Corrective action

When programming the CJ, SCJ, JMP, CALL or CALLP instruction, always insert the jump destination pointer "P3" before the jump destination ladder as a label.

(a) In the write mode ( ), choose the outside of the left rail in the ladder immediately under the added CJ instruction ladder.



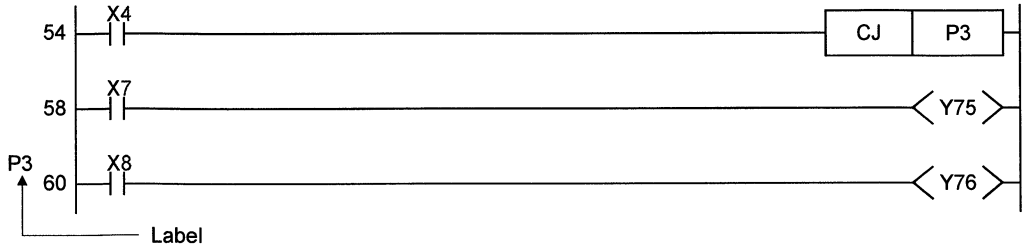

(b) Press the following keys.

P 3 ↵

(c) Choose the [Convert] → [Convert(Online change)] menu.

Click the Yes button.

As "RUN write processing has completed." appears, click the OK button.




(d) Turn on X4.

No error occurs.

## REMARKS

- The CAN'T EXECUTE(P) error occurs when there are no or multiple jump destinations specified for the CJ, SCJ, JMP, CALL or CALLP instruction. "No destination" occurs when you forgot inserting a label P0 to P254. "Multiple destinations" occurs when destinations that were inputed from the PU programming module. GX Developer makes a check to prevent entry of multiple destinations.
- After the timer coil has turned on, the current value is updated if the jump instruction causes a jump over the timer coil.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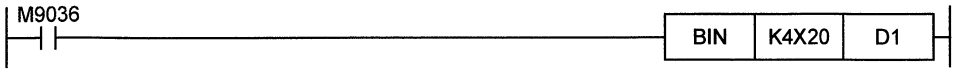
## 6.12.7 Training 7 BCD code error

In this example an error occurs when the input data is not a BCD code during execution of the instruction for conversion into a binary code (e.g. BIN), or when there is an unconvertible value for execution of the instruction for conversion into a BCD code (e.g. BCD).

1) Add the following program to the existing program.




<Operation>

(a) In the ladder read mode ( ), press the following keys.

E N D ↵ ↵ ↵ ←

(Search) (Search end) (Moves the cursor to the right side of the left ladder rail)

(b) Click (Write mode) on the toolbar to choose the write mode.

(c) Press the following keys.

F5 M 9 0 3 6 ↵

(⊣⊢)

F8 B I N SP K 4 X 2 0 SP

(⊣[ ]⊢)

D 1 ↵

(d) Choose the [Convert] → [Convert(Online change)] menu.
Click the Yes button.

As "RUN write processing has completed." appears, click the OK button.

2) Change the value of the X20 to X2F digital switch until an error occurs.
(Some digital switches may be designed not to result in a BCD error.)

3) Perform the following operation to read the error step/code.

<Operation>

(a) Choose the [Diagnostics] → [PLC diagnostics] menu.

(b) Confirm "Error display" in the PLC diagnostics dialog box.

| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 50 | 503 | OPERATION ERROR | 62 |

Means that the instruction at step 62 is in operation error.

For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.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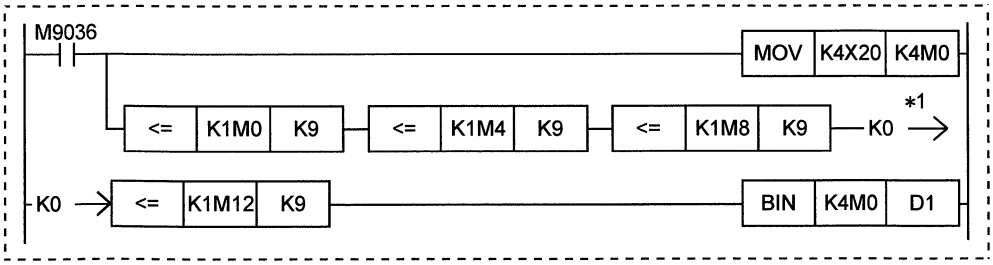
4) Read the program at the error step.
You may use either of the following two ways to read.
• Click the [Error Jump] button in the "PLC diagnostics" dialog box which was used to read the error step in 3).
• Press the [6] [2] [↵] keys in the ladder/list.

You can read the error step 62 (BIN K4X20 D1).

In this case, the instruction is used to convert a BCD code into a binary code, but an error occurs if the code is not in BCD.
The cause of the error is that the program is designed to always import the BCD code of the digital switch and a hexadecimal A-F code occurred when the digital switch value was changed.

5) Corrective action
Make modification and addition to the program as shown below so that signals other than 0 to 9 are not imported.
If a series ladder of 12 or more contacts is created on one line as shown below, an automatic return (*1) is made to the lower line. (A free returnable line must have been inserted beforehand.)




## REMARKS

The following examples will result in a BCD code error.
• When [BIN | K4M0 | D1] was executed, the M0 to M15 data were not BCD codes (binary-coded decimal).
• When [BCD | D8 | K4Y40] was executed, the D8 data was negative or greater than 9999.
• When [DBCD | D8 | K8Y40] was executed, the 32-bit D8, D9 data was negative or greater than 99999999.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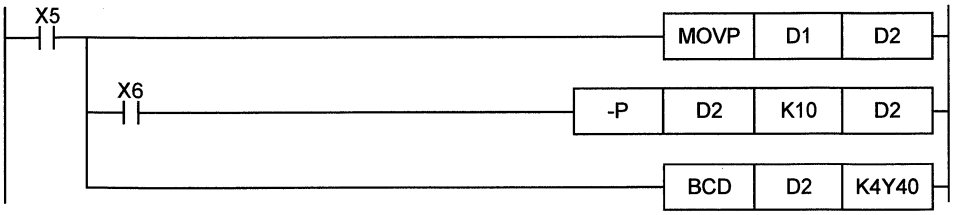
## 6.12.8 Training 8 Error resulting from execution of BCD instruction for negative data

This example will show how to check what error will occur when the BCD instruction is executed for negative data.

1) Add the following program to the existing program.




<Operation>

(a) In the ladder read mode ( ), press the following keys.

[E] [N] [D] [↵] [↵] [↵] [←]

(Search) (Search end) (Moves the cursor to the right side of the left ladder rail)

(b) Click (Write mode) on the toolbar to choose the write mode.

(c) Press the following keys.

[F5] [X] [5] [↵] [F8] [M] [O] [V] [P] [SP]

(⊣⊢) (⊣[ ]⊢)

[D] [1] [SP] [D] [2] [↵] [↑] [→]

(Moves the cursor to beside X5)

[F10] [↵] [↓] [F5] [X] [6] [↵] [F8] [-] [P]

( | ) (⊣⊢) (⊣[ ]⊢)

[SP] [D] [2] [SP] [K] [1] [0] [SP] [D] [2] [↵]

[→] [↑] [F10] [↵] [↓] [F8] [B] [C] [D] [SP]

(Moves the cursor to X6) ( | ) (⊣[ ]⊢)

[D] [2] [SP] [K] [4] [Y] [4] [0] [↵]

(d) Choose the [Convert] → [Convert(Online change)] menu.
Click the Yes button.

As "RUN write processing has completed." appears, click the OK button.

2) In the ladder monitor status, set the PLC to RUN, set 0050 to the X20-X2F digital switch, and turn X5 on and X6 on/off. This decrements D1 by 10, and when its data becomes negative, a BCD code error occurs.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3) Perform the following operation to read the error step/code.

<Operation>

(a) Choose the [Diagnostics] → [PLC diagnostics] menu.

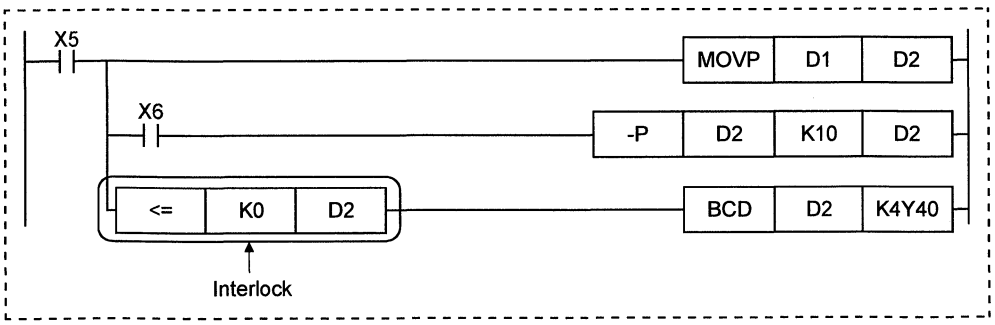
(b) Confirm "Error display" in the PLC diagnostics dialog box.

| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 50 | 503 | OPERATION ERROR | 109 |

For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.

4) Corrective action

Provide the following interlock so that BCD conversion will not be made when the D1 data has become negative.





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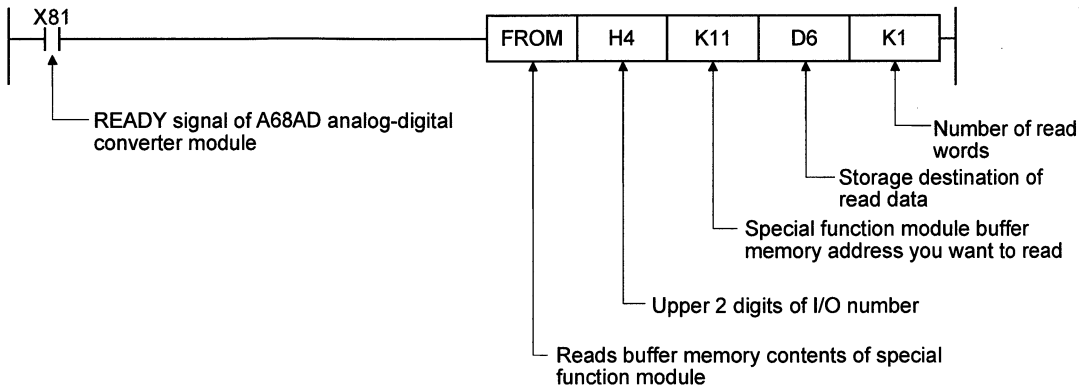
## 6.12.9 Training 9 Program error for special function module

An error will occur if the FROM/TO instruction used to access the buffer memory of the special function module is incorrect.

1) Add the following program to the existing program.




<Operation>

(a) In the ladder read mode ( ), press the following keys.

E N D ↵ ↵ ↵ ←

(Search) (Search end) (Moves the cursor to the right side of the left ladder rail)

(b) Click (Write mode) on the toolbar to choose the write mode.

(c) Press the following keys.

F5 X 8 1 ↵ F8 F R O M

(⊣⊢) (-[ ]-)

SP H 4 SP K 1 1 SP D 6

SP K 1 ↵

(d) Choose the [Convert] → [Convert(Online change)] menu.
Click the Yes button.

As "RUN write processing has completed." appears, click the OK button.

2) If the PLC is in the RUN mode, an error occurs and the PLC stops.

3) Perform the following operation to read the error step/code.

<Operation>

(a) Choose the [Diagnostics] → [PLC diagnostics] menu.

(b) Confirm "Error display" in the PLC diagnostics dialog box.

| No. | Detail | Present Error | Error step |
|---|---|---|---|
| 46 | 461 | SP. UNIT ERROR | 122 |

Means that the instruction at step 122 is in operation error.

For error details, refer to "GX Developer help (error code list)" (A series CPU → AnA → error code) displayed by clicking the Help button in the PLC diagnostics dialog box.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4) Corrective action

Read the program at the error step.

You may use either of the following two ways to read.

1) Click the [Error Jump] button in the "PLC diagnostics" dialog box which was used to read the error step in 3).

2) Press the [1] [2] [2] [↵] keys in the ladder/list.

You can read the error step 122 (FROM H4 K11 D6 K1).

Upper 2 digits of I/O number assigned to the special function module

In | FROM | H4 | K11 | D6 | K1 |, K4 must be replaced by H8.

Perform the following operation to correct the program.

<Operation>

(a) In the write mode (  ), press the [Ins] key to choose the overwrite mode.

(b) Double-click the "FROM" instruction in the added ladder.

(c) As "FROM H4 K11 D6 K1" appears in the "Enter symbol" dialog box, press the [H] [8] keys to correct it to "FROM H8 K11 D6 K1", then press the [↵] key.

(d) Choose the [Convert] → [Convert(Online change)] menu.
Click the [Yes] button.

As "RUN write processing has completed." appears, click the [OK] button.

Reset the CPU on completion of program modification.

Correction is complete if the analog-to-digital converted value ON CH2 of the A68AD converter module installed in slot 3, can be monitored in D6, when you click and choose  (Monitor mode) on the toolbar.



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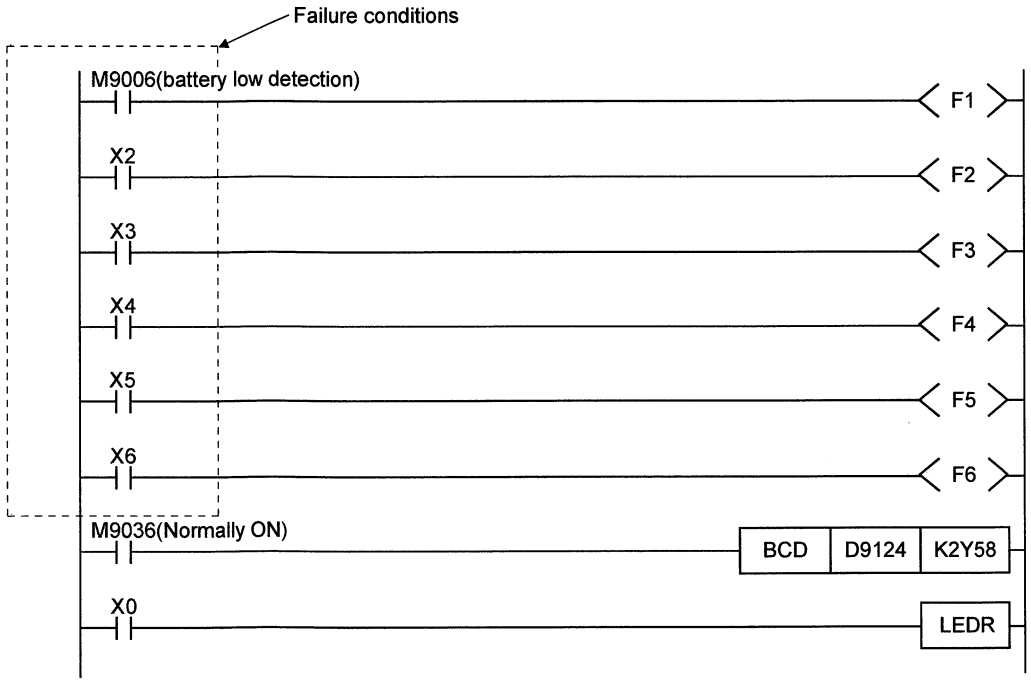
## 6.12.10 Training 10 How to use failure detecting annunciators (F)

If the failure conditions of external signals are received by the annunciators (F), the F numbers which turn on according to the nature of the failures are automatically stored into the special registers (D9125 to D9132), and the number of failures detected is stored into D9124. This data can be presented on the external display or read by the host computer.

1) Add the following program to the existing program.




Turning X0 on executes the LEDR instruction, resetting the stored data.
X2 to X6 are assumed to be the failure conditions of external failure signals, such as the "stroke limit signal", "knife breakage detection signal" and "arm breakage detection signal", and turn on the corresponding annunciators F.

2) Write the program to the CPU.

Set the CPU to STOP.

(a) Click (Write to PLC) on the toolbar.

(b) Click the Param+Prog button in the "Write to PLC" dialog box and click the Execute button.

(c) As the confirmation dialog box appears, click the Yes button.

Set the CPU to RUN.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3) Perform the following operation to monitor the special relays and special registers. They indicate whether the annunciators (F) are ON or OFF, which annunciators turned ON first, and how many annunciators are ON.

<Operation>

(a) Choose the [Online] → [Monitor] → [Entry data monitor] menu.

(b) Click the Register devices button in the "Entry data monitor" dialog box.

(c) The "Register device" dialog box appears.

(d) After registering the following devices by clicking the Register button, click the Start monitor button.

M9006..... Turns on when the battery voltage drops to less than the specified, and turns off when it returns to normal.
M9007..... Turns on when the battery voltage drops to less than the specified, and remains on if it returns to normal.
M9008..... Turns on when an error is found as a result of self-diagnosis, and remains on if it returns to normal.
M9009..... Turns on if any of the annunciators F turns on.
D9124..... Stores the number of annunciators F which turned on.
D9125..... Stores the F number which turned on first.
D9126..... Stores the F number which turned on second.
D9127..... Stores the F number which turned on third.
D9128..... Stores the F number which turned on fourth.
D9129..... Stores the F number which turned on fifth.
D9130..... Stores the F number which turned on sixth.
D9131..... Stores the F number which turned on seventh.
D9132..... Stores the F number which turned on eighth.

The following screen appears. Check the data.

| Device | ON/OFF/Current | Setting value | Connect | Coil |
|---|---|---|---|---|
| M9006 | 0 | | | |
| M9007 | 0 | | | |
| M9008 | 0 | | | |
| M9009 | 0 | | | |
| D9124 | 0 | | | |
| D9125 | 0 | | | |
| D9126 | 0 | | | |
| D9127 | 0 | | | |
| D9128 | 0 | | | |
| D9129 | 0 | | | |
| D9130 | 0 | | | |
| D9131 | 0 | | | |
| D9132 | 0 | | | |

## REMARKS

For the A3 or A3HCPU, changing the annunciator display mode of the PLC parameter item to "Display comments" shows the comments of the annunciators F in the LED display of the CPU. (Comments must be created on the DOS/V personal computer and written to the CPU memory.)
The D9124 to 9132 contents are not cleared if the annunciators F turn off.
They can be cleared by executing the LEDR instruction.


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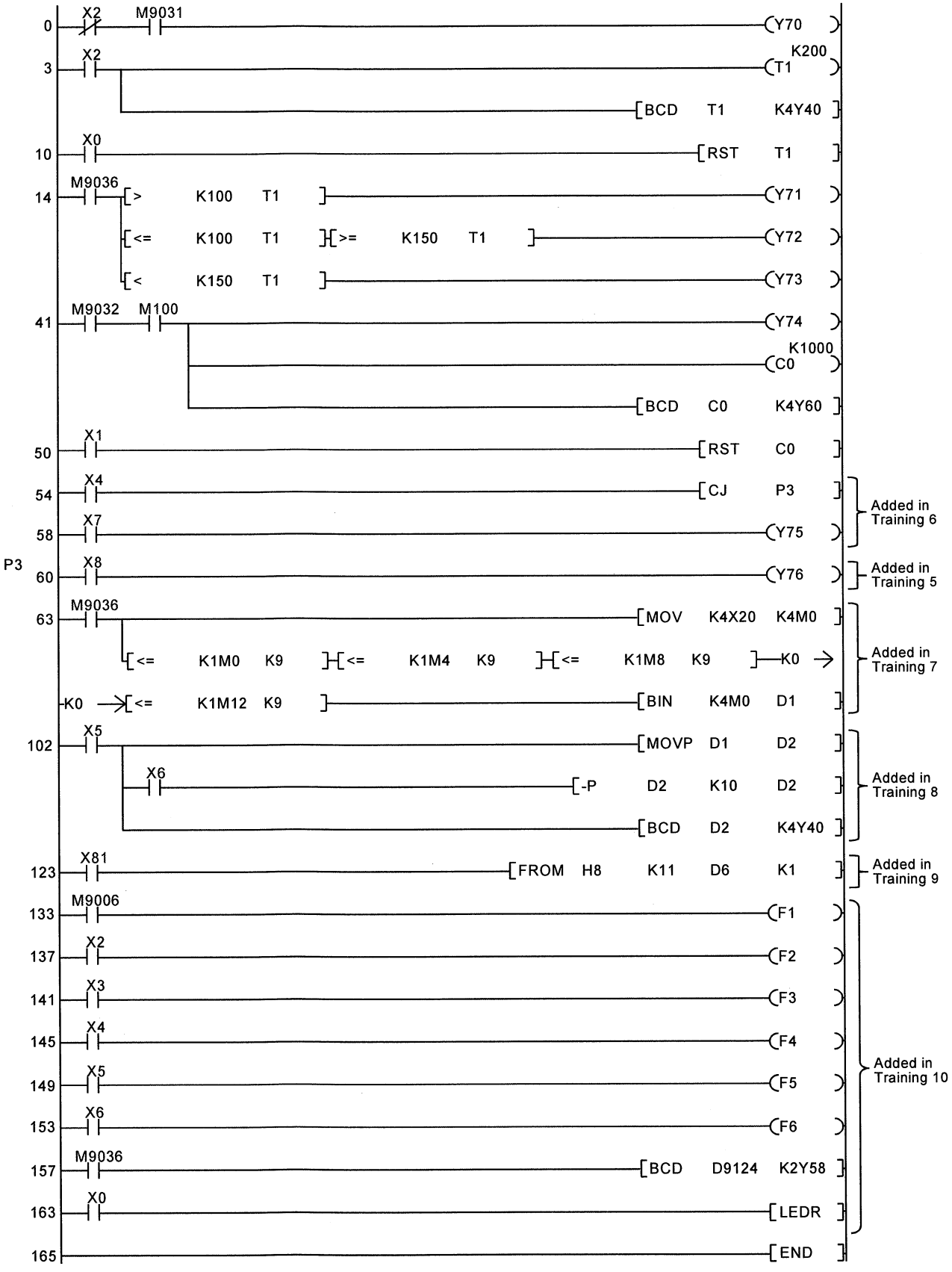
| Drive/path | A:\SCHOOL |
|---|---|
| Project | F |

4) Sequence program



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## 6.13 GX Developer Troubleshooting

This section describes troubleshooting for use of GX Developer.

| No. | Trouble | Remedy |
|---|---|---|
| 1 | In some video card (card designed to store as data the characters and pictures shown on the display) types installed in personal computers, each ladder is framed by white lines during editing of ladder diagrams. What should I do to erase them? | Make setting in "Control Panel" of Windows 95/Windows 98/Windows NT Workstation 4.0.<br><Operation procedure><br>1) Open "Control Panel".<br>↓<br>2) Open "System".<br>↓<br>3) Open the "Performance" tab.<br>↓<br>4) Press the "Graphics" button.<br>↓<br>5) Choose next (second) to "None" to set "Hardware Acceleration". |
| 2 | What should I do if the error message "Can not allocate Share memory" or "Initialization failed" appears at the start of the GX Developer? | Restart the GPP function software package, or restart Windows 95/Windows 98/Windows NT Workstation 4.0 and start the GX Developer. |
| 3 | Why does it take so long until the dialog box appears after Setup.exe is started? | It may take some time if a virus checker or similar resident software is operating. |
| 4 | Which would be better to reinstall the updated software; overwriting the existing software package or performing uninstallation once and then performing installation? | We recommend you to perform installation after uninstallation.<br>Note that if the program to be installed is the update-only software, the old software should not be uninstalled.<br>In this case, you cannot perform installation unless the old version of application exists. |
| 5 | Why can't a program be read from the floppy disk which is protected (write-inhibited)? | Since multiple GX Developer projects can be started, one floppy disk may be accessed by multiple GPPWs. To prevent this, the "accessing" flag is written to the floppy disk accessed, avoiding access from other GX Developer projects.<br>Therefore, the protected floppy disk cannot be read. |


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<License FD-related precautions>

For SW7D5C-GPPW (GX Developer Ver. 7) and later, the management system has been changed from the license key FD to the product ID. (This also applies to GX Simulator.)

Since the SW3* to SW6*-GPPW/LLT products use the license key FD system, they must be handled with the following precautions. The following precautions apply to the SW3* to SW6*-GPPW/LLT products.

| No. | Trouble | Remedy |
|---|---|---|
| 6 | What should I do if the personal computer or hard disk is broken?* | 1) Insert the license key FD of GX Developer and perform uninstallation (make the product invalid). The installation right is given back. After that, return the personal computer, hard disk, Windows, etc. to normal, and perform reinstallation as when you purchased the product.<br>2) If the hardware is heavily damaged and cannot be returned to normal in the above procedure 1), use the spare license. Return the personal computer, hard disk, Windows, etc. to normal, and perform reinstallation as when you purchased the product.<br>3) About the number of spare licenses<br>For 1-license product<br>The license key FD is designed to enable installation up to five times.<br>For n-license product<br>The backup license key FD (number of licenses you purchased) is designed to enable installation. |
| 7 | What should I do if Windows is broken? | Take the remedy in No. 6. |
| 8 | What should I do if the personal computer does not operate well and is desired to be formatted? | Take the remedy in No. 6. |
| 9 | What should I do if the personal computer is formatted? | Take the remedy in 2), No. 6. |
| 10 | What should I do if software, such as GX Developer, is accidentally erased? | Take the remedy in No. 6. |
| 11 | What should I do if GX Developer does not operate well (e.g. part of a file was erased)? | Take the remedy in No. 6. |
| 12 | What should I do if the license key FD is broken? | Contact the supplier. |
| 13 | What should I do if the CD-ROM product or license key FD is lost? | Unfortnately you will have to purchase a new product. |


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| No. | Trouble | Remedy |
|---|---|---|
| 14 | What should I do if the personal computer used with GX Developer must be changed due to rental or lease expiration? | 1) Insert the license key FD of GX Developer into the personal computer whose rental/lease will be expired, and perform uninstallation (make the product invalid).<br>Your installation right is given back. After that, perform reinstallation on a new personal computer as when you purchased the product.<br>2) If you have already returned the personal computer whose rental/lease will be expired, use the spare license. The installation procedure is the same as when you purchased the product.<br>3) For the number of spare licenses, refer to 3) in No. 6. |
| 15 | I changed the personal computer. What should I do to use GX Developer on the new computer? | 1) Insert the license key FD of GX Developer into the old personal computer, and perform uninstallation (make the product invalid).<br>Your installation right is given back.<br>After that, perform reinstallation on the new personal computer as when you purchased the product.<br>2) If you do not have the old personal computer, use the spare license. The installation procedure is the same as when you purchased the product.<br>3) For the number of spare licenses, refer to 3) in No. 6. |
| 16 | As I purchased new Windows, what should I do to exchange them? | 1) When overwriting old Windows to install new Window, exchange them as they are.<br>2) To newly install new Windows or to install it after formatting the hard disk, insert the license key FD of GX Developer into the personal computer, and perform uninstallation (make the product invalid).<br>Your installation right is given back.<br>After that, format the personal computer, install new Windows, and reinstall GX Developer as when you purchased the product.<br>3) Use the spare license if you have already performed formatting to exchange old Windows for new Windows.<br>For the number of spare licenses, refer to 3) in No. 6. |


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MEMO


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# CHAPTER 7 IMPROVEMENT MAINTENANCE

In order to have good system maintainability and to reduce deterioration of the system, it is necessary to make improvements so that maintenance operations are simplified.

## 7.1 Improving Equipment Maintainability

### (1) Improvements that reduce equipment deterioration

1) Re-examine the ambient environment and check if air conditioning or fans will help reduce equipment deterioration.
2) Improve measures to prevent ingression of dust and moisture, and take measures to reduce vibration.
3) Substitute any devices that show a tendency to degrade quickly with more durable devices.

### (2) Improvements to simplify repairs

1) Improve system construction.
2) Ensure that there is sufficient space to carry out repairs.
3) Change over to products which are easy to repair.

### (3) Change over to less fallible products

1) Switch to products that have high reliability and low failure rates.

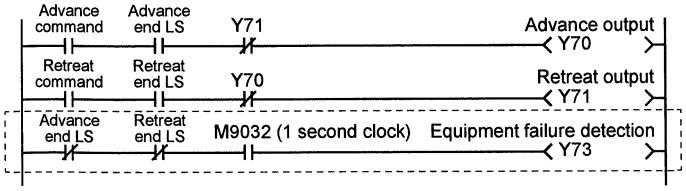
## 7.2 Improving Automatic Detection of Equipment Breakdown

### (1) Detection using sequence program

Change over to using a sequence program which can automatically detect machine breakdowns.

<Program example>

By using the "b" contacts of limit switches a circuit can be constructed which will automatically detect if an error exists. In the case below, both limit switches should not be active at the same time so the circuit is used to check if a switch is broken or stuck.





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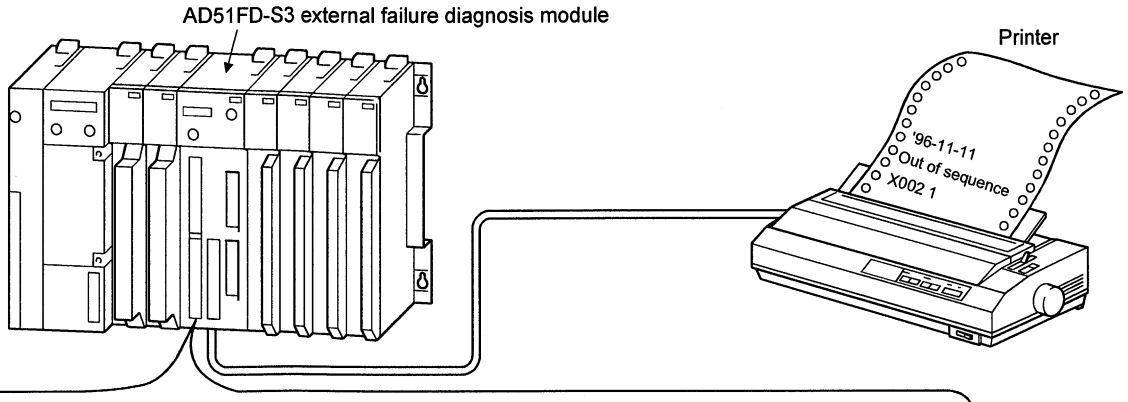
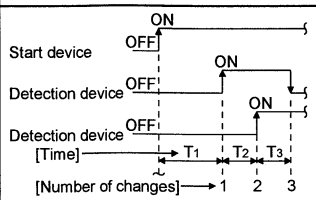
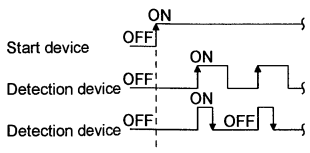
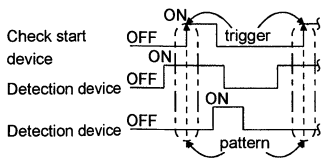
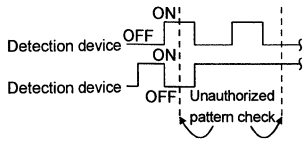
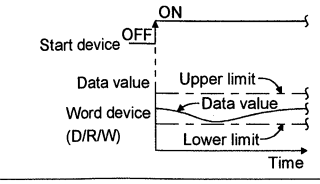
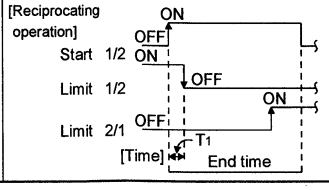
## (2) Detection by failure diagnosis module

Using a failure detection module or software allows the sequence of breakdowns to be registered and enables automatic detection of equipment failure.




Make and insert external equipment failure conditions in advance.

| Detection Method | Operation | Description |
|---|---|---|
| Sequence /time check |   | ▪ Whether the detection devices turn ON/ OFF as in the preset sequence and time (number of changes) is checked to detect the device which does not turn ON/OFF.<br>▪ For time check, a warning is output in accordance with the setting of the warning range. |
| Count check |   | ▪ Whether the detection devices turn ON or OFF as in the preset count is checked to detect a device in count error.<br>▪ A warning is output in accordance with the setting of the warning range. |
| Normal pattern check |   | ▪ Whether the ON/OFF operations of the detection devices triggered by the check start device match any of the preset normal ON/OFF patterns is checked to detect a mismatch pattern.<br>(Failure occurs on a mismatch.) |
| Unauthorized pattern check |   | ▪ Whether the ON/OFF operations of the detection devices mismatch the preset unauthorized ON/OFF patterns is checked, and an alarm is output on a match.<br>(Failure occurs on a match.) |
| Upper/lower limit check |   | ▪ Whether the word device value is within the preset upper and lower limit range is checked, and an alarm is output if it is outside the range.<br>▪ A warning is output in accordance with the setting of the warning range. |
| Reciprocating operation check |   | ▪ Whether two limit switches turn ON/OFF as in the preset sequence and time for the end time is checked to detect the device which does not turn ON/OFF.<br>▪ For time check, a warning can be output. |

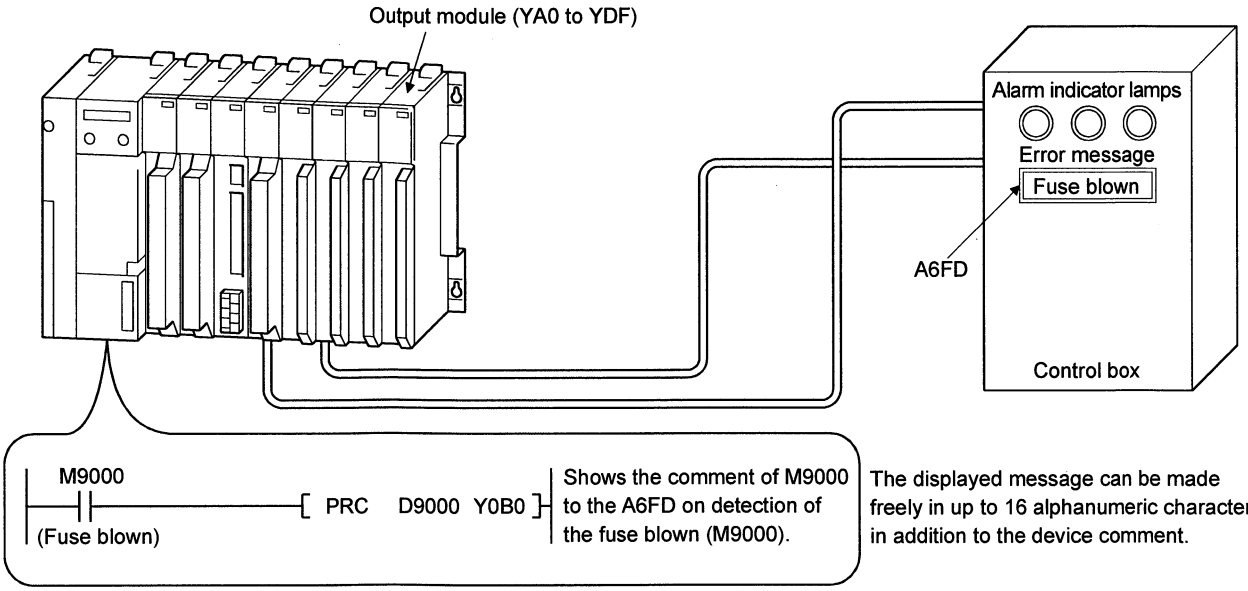
## 7.3 Complete Condition Monitoring Maintenance

In order to plan for complete functionality that allows regular monitoring of the PLC status, the following section gives 4 examples of automatic error display and reporting.

Ex. 1 Error contents displayed as a text message

Test display

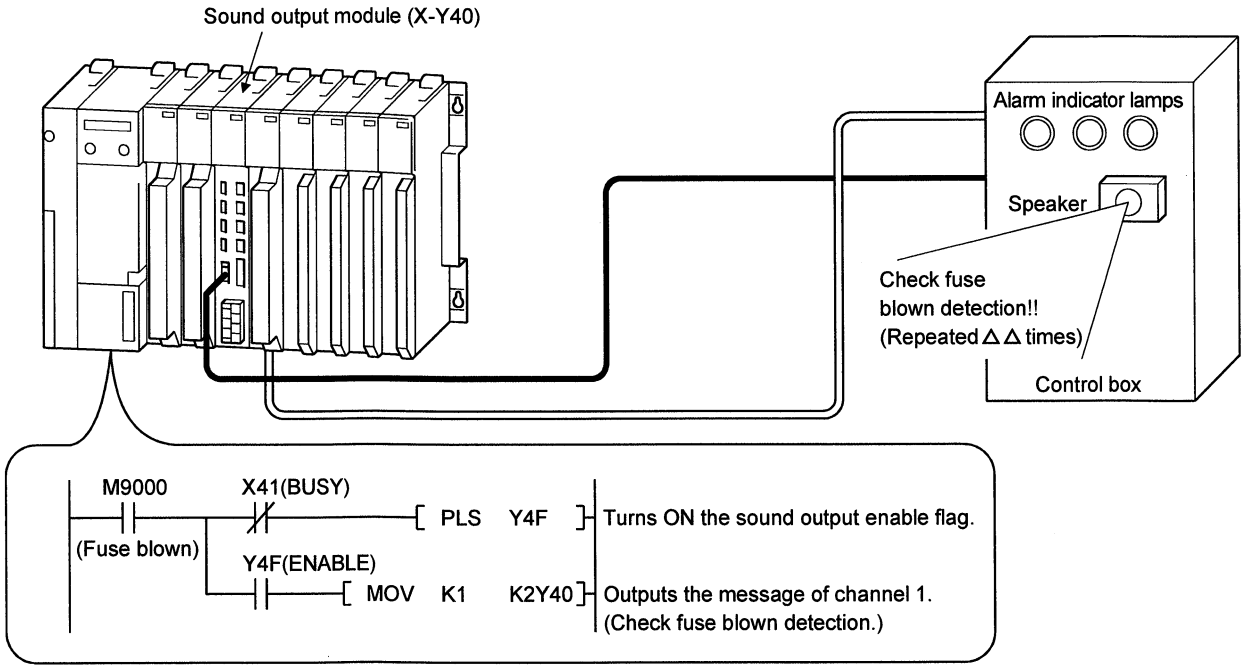
A6FD (External display module) is wired to a PLC output module. When an error is detected, an error message up to 16 characters long can be displayed.




Ex. 2 Announcement of error detection with sound output module

Vocal notification

A11VC (sound output module) is used to playback error messages recorded by the user directly using a microphone. (Requires speakers and amplifier).



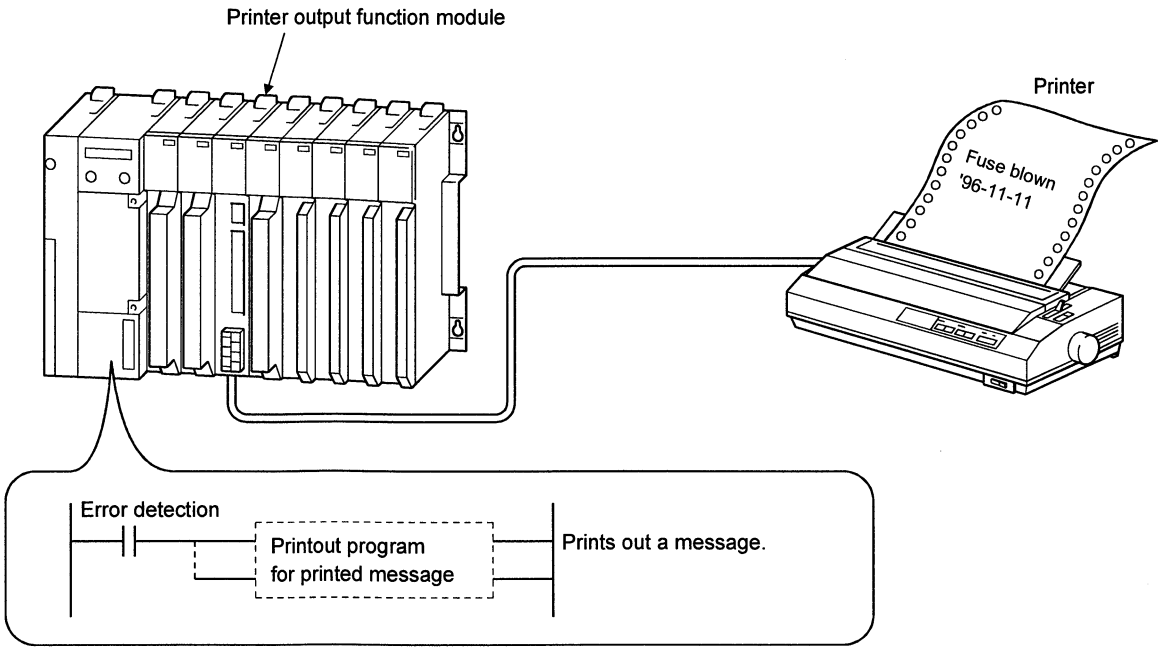

A11VC sound output module can store 60 channels (60 different messages) up to 64 seconds in length for replay.


7 - 3

Ex. 3 Printout of error detection

Printout

Error messages and time of occurrence can be printed when a printer output module is connected to a printer.



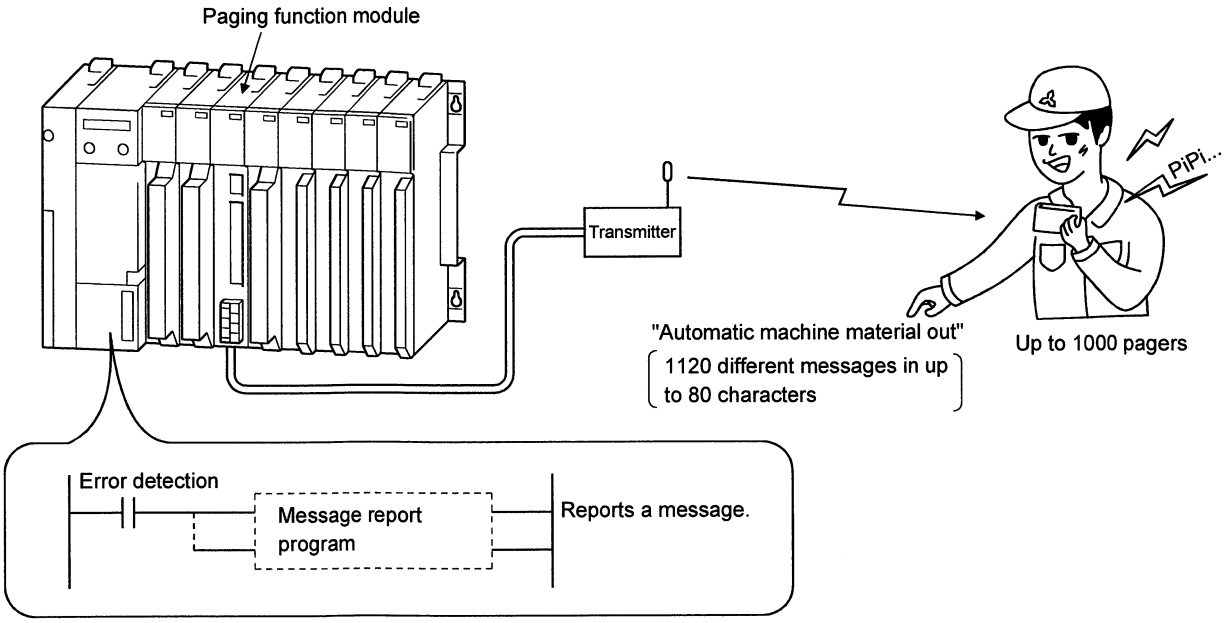

There are several methods for connecting MELSEC-A to printers.

| Printer output module | Printer type |
|---|---|
| AD51H<br>AD59 | Centronics |
| AJ71UC24<br>AD51H<br>AD51FD | RS-232C |
| A870GOT(A8GT-70PRF)<br>A850GOT(A8GT-50PRF) | Parallel ESC/P |
| A985GOT, A975GOT, A960GOT<br>A950□GOT(A9GT-50PRF) | Parallel ESC/P (20-pin, half pitch) |

Ex. 4 Pager notification of error detection

**Pager**

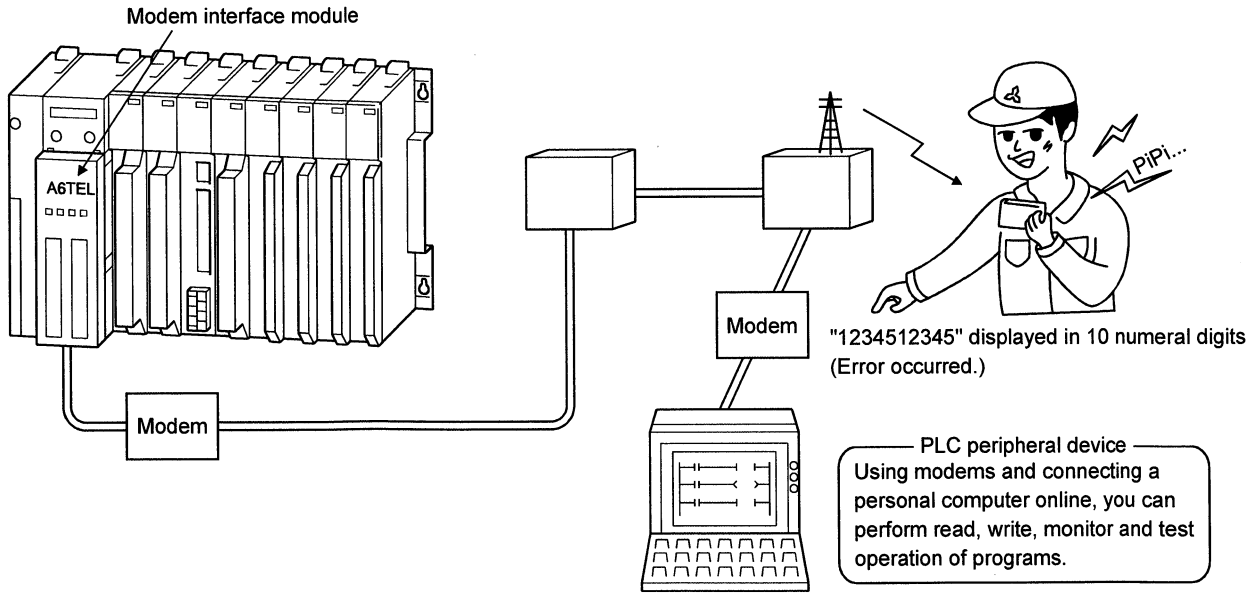
Connecting AD22-S1 paging module and a transmitter to a PLC system allows error detection notification via pager.




| Paging module | Pager |
|---|---|
| AD22-S1 | Pager transmitter<br>Pager receiver<br>Manufactured by SPC Electronics Corp. |

**Telephone**

Connecting A6TEL modem interface module to a phone line (NTT) allows error detection messages to be sent to a pager.



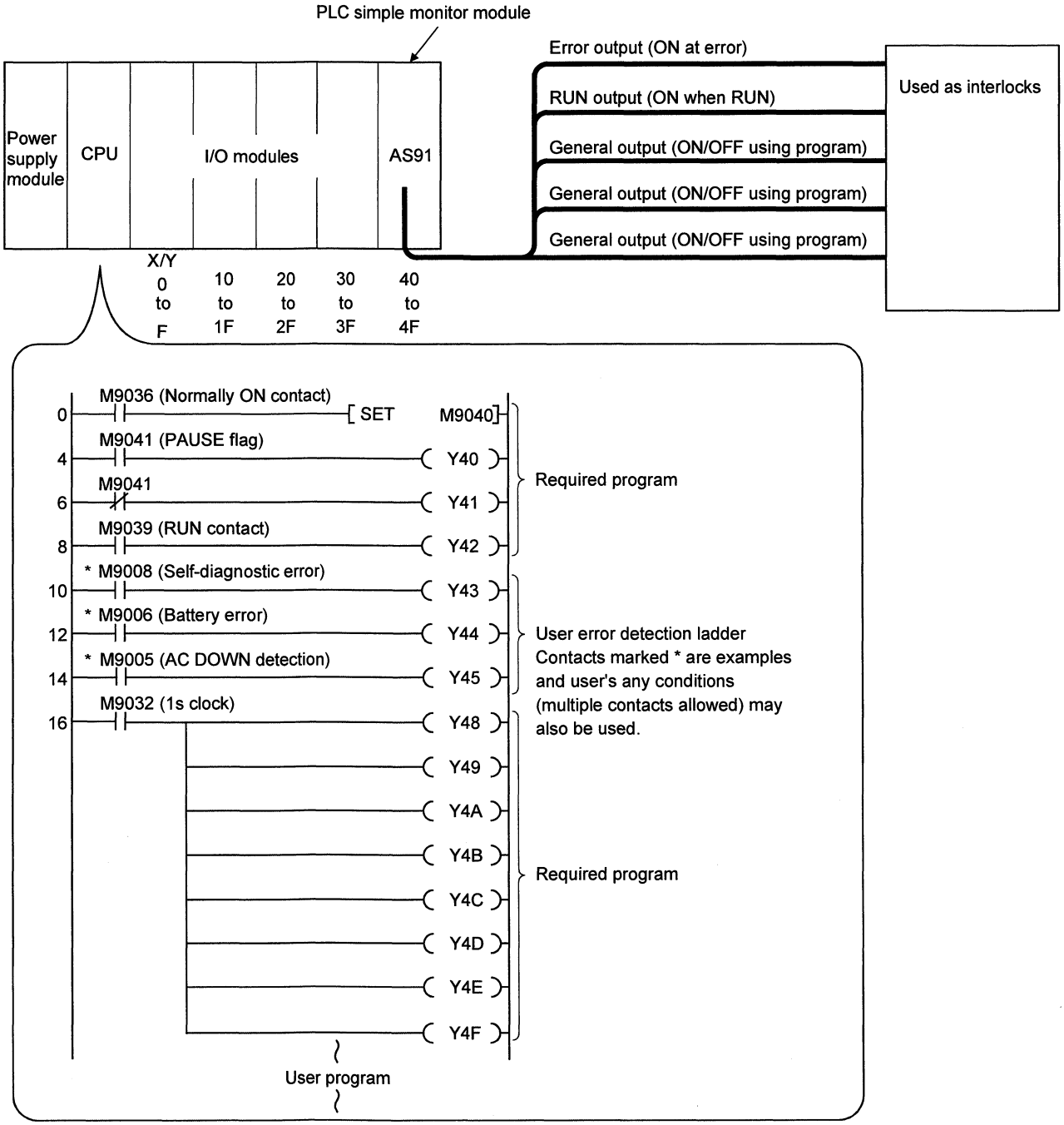


7 - 5

Ex. 5 Using a fail-safe circuit to prevent machine damage and accidents

Failsafe circuit

A fail-safe circuit can be made up in the PLC to prevent machine damage and accidents if the PLC CPU becomes faulty.




By creating an error detection program, the PLC'simple monitor module'monitors eight output points from Y48 to Y4F derived from M9032 (0.5s ON/0.5s OFF).
If any one point remains on or off, the external outputs "RUN output" and "general outputs" are turned off to turn on the "error output".
These external outputs are used as interlocks for corresponding external loads to prevent malfunctions.

# CHAPTER 8 RE-EVALUATION OF EQUIPMENT ENVIRONMENT

## 8.1 Ambient Environment

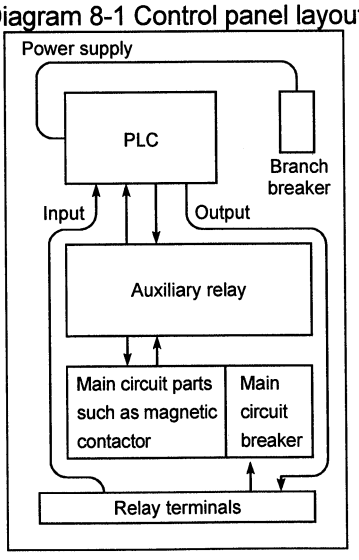
Avoid installing PLC equipment in the following environment:

(1) Places where the ambient temperature range exceeds 0 to 55°C (If used in a control panel then the internal panel temperature).
(2) Places where the ambient humidity range exceeds 10 to 90%RH.
(3) Places where sudden temperature changes cause condensation.
(4) Places with flammable or corrosive gases.
(5) Places with airborne conductive, corrosive or saline particles. Also where oil mist, conductive swarf and organic solvents are present.
(6) Places subject to direct sunlight.
(7) Places subject to strong electromagnetic fields.
(8) Places where the PLC system is subject to vibration and impacts.

## 8.2 Electrical Environment

(1) 100VAC or 200VAC power supply fluctuations are within +10% and -15%.
Particularly in ambient temperatures of 50°C and over, supply voltage should be near 100%.
(2) Instantaneous power loss.
Operation continues if less than 20ms.
(3) Power supply waveform distortion.
Sinusoidal input distortion of 5% or less. Pay attention to smoothing capacitors and rectifiers.
(4) Segregate control wiring and high voltage/current wiring where possible.
Where cabling is laid in parallel, separate by 100mm(3.94inch) or more.
(5) Do not install in the same control as electrically noisy devices.
Where possible, install the PLC in a separate control panel from high frequency equipment, inverters, electrostatic discharge equipment, etc. Also, keep all wiring separate.
(6) Separate from contactors, circuit breakers, etc. which are prone to arcing.

Diagram 8-1 Control panel layout







8 - 1

## 8.3 Mounting Conditions

This section explains mounting precautions and installation.

### 8.3.1 Mounting precautions

The items below are advisory points for installing a PLC in a control cabinet.

(1) In order to provide sufficient ventilation and allow easy changeover of modules, maintain a 80mm(3.15inch) or greater clearance around the module (30mm(1.18inch) or greater for A1SCPU).

(2) Install in the correct orientation to ensure proper ventilation, do not lay down flat or stand the module on its end.

(3) Ensure that the mounting surface for the base unit is flat to avoid bending the PCB. Flexing the PCB can lead to problems.

(4) Avoid mounting near sources of vibration such as large contactors or circuit breakers.

(5) Install wiring ducts as required.

(a) When ducting is installed above the PLC, the depth of the duct should be 50mm(1.97inch) or less to allow sufficient ventilation.

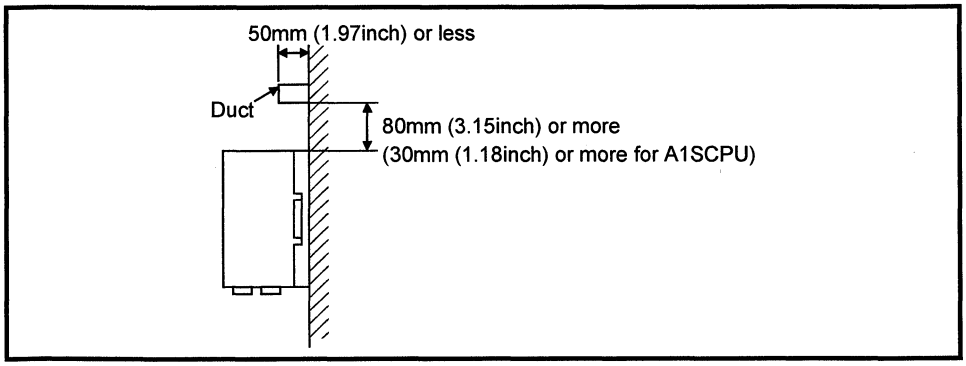



Diagram 8-2 Duct measurements

Also, ensure that there is sufficient room above the PLC to be able to press the release latch.
If the release latch is not accessible, you will not be able to change the module.

(b) When equipment is installed below the PLC, consider the amount of space that is needed for fiber optic or co-axial network cables and the minimum bending radius.

(6) If equipment is mounted in front of the PLC (for instance, attached to the door inside of the control panel, ensure that there is at least 100mm(3.94inch) clearance between the PLC and the equipment to reduce the effects of radiated noise and heat.

(7) Other equipment should be installed more than 50mm(1.97inch) to the left or right of PLC modules.




8 - 2

## 8.3.2 Installation for A1 to A3 type CPU

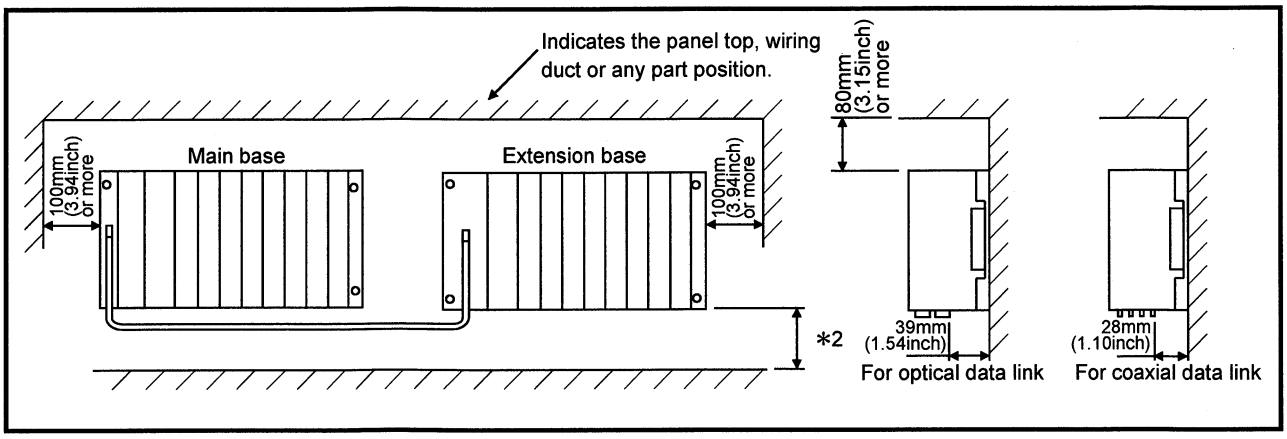



Diagram 8-3 Parallel installation

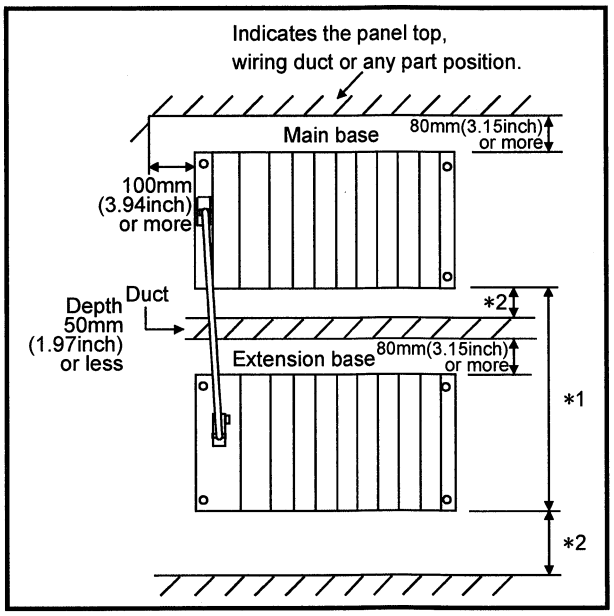



Diagram 8-4 Serial installation

*1 .....Distance depends on the extension cable length

When using 600mm(23.64inch) cable
.....Less than 400mm(15.76inch)
When using 1200mm(47.28inch) cable
.....Less than 1000mm(39.4inch)
When using 3000mm(118.2inch) cable
.....Less than 2800mm(110.32inch)

*2 .....When not using link module

..... More than 50mm(1.97inch)

When using $\phi$4.5mm(0.18inch) dia. fiber optic cable
..... More than 100mm(3.94inch)
When using co-axial cable
..... More than 100mm(3.94inch)
When using $\phi$8.5mm dia. fiber optic cable
.....More than 130mm(5.12inch)

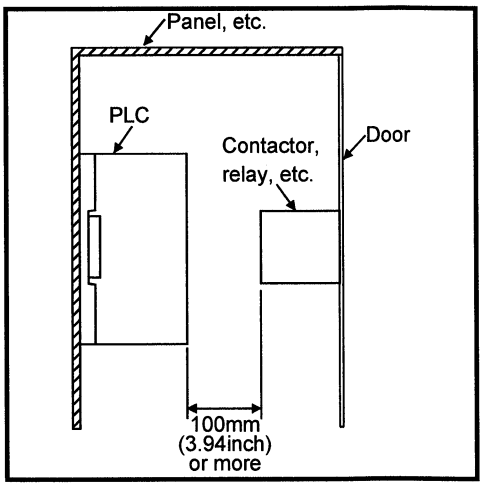



Diagram 8-5 Clearance in front of PLC

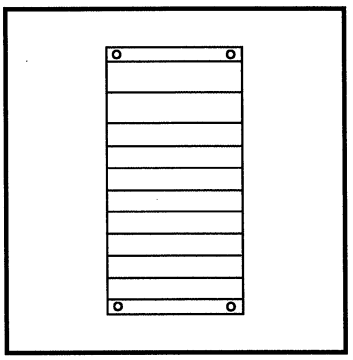


Diagram 8-6 Standing installation (not allowed)

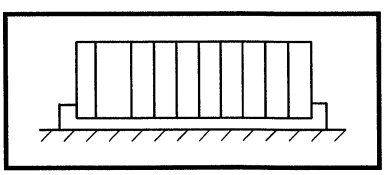


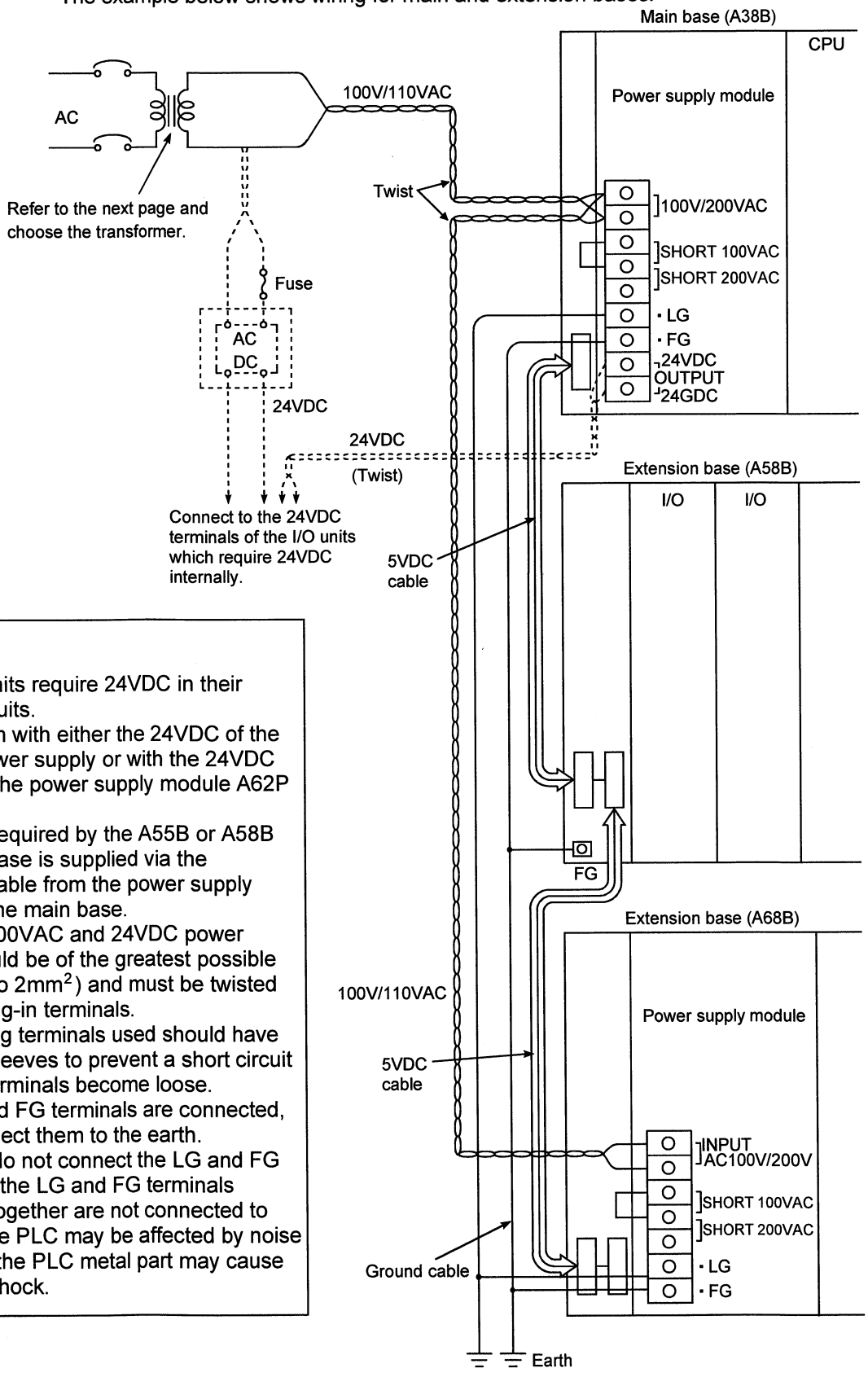
Diagram 8-7 Flat installation (not allowed)


8 - 3

## 8.4 Wiring and Earthing

### 8.4.1 Wiring example

The example below shows wiring for main and extension bases.




**POINTS**

(1) Some I/O units require 24VDC in their internal circuits.
Supply them with either the 24VDC of the external power supply or with the 24VDC terminal of the power supply module A62P or A65P.

(2) The 5VDC required by the A55B or A58B extension base is supplied via the extension cable from the power supply module of the main base.

(3) The 100V/200VAC and 24VDC power cables should be of the greatest possible gauge (up to 2mm$^2$) and must be twisted from the plug-in terminals.
The crimping terminals used should have insulation sleeves to prevent a short circuit when the terminals become loose.

(4) If the LG and FG terminals are connected, always connect them to the earth.
Otherwise, do not connect the LG and FG terminals. If the LG and FG terminals connected together are not connected to the earth, the PLC may be affected by noise or touching the PLC metal part may cause an electric shock.

Diagram 8-8 Wiring and earthing


8 - 4

## 8.4.2 Precautions for power supply wiring

1) Use a fixed voltage transformer when the supply voltage differs greatly from the rated voltage.
   However, ensure that the voltage waveform is not distorted by more than 5%
   Use a fixed voltage transformer for electronic equipment, select one with a capacity of 200 to 300%.

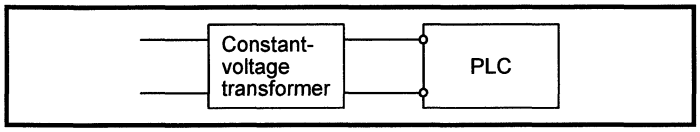



Diagram 8-9 Fixed voltage transformer

2) Use a power supply that produces minimal noise in wiring and earthing.
   If there is excessive noise, use an isolating transformer.

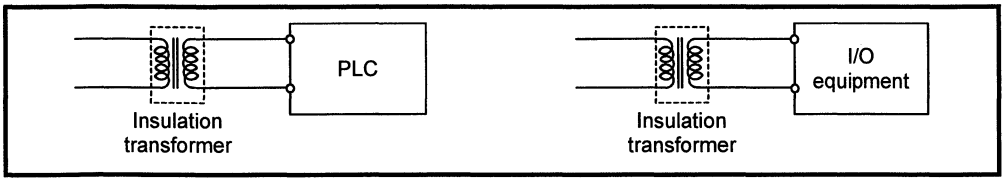



Diagram 8-10 Isolating transformer

3) When using an isolating transformer or a transformer to convert 200VAC to 100VAC, follow the guidelines given in the table below for transformer capacity.

| Power supply module | Transformer capacity |
|---|---|
| A0J2CPU internal<br>A0J2HCPU internal | 56VA |
| A0J2PW | 120VA |
| A2CCPU internal<br>A66PC | 110VA |
| A1S61P<br>A1S62P | 110VA |
| A1CPU internal<br>A1NCPU internal | 110VA |
| A61P<br>A62P<br>A65P<br>A66P | 110VA |

When using a fixed voltage transformer, consider the power supply inrush current and select a transformer with 200 to 300% capacity.


8 - 5

4) Separate wiring for PLC power supply, I/O and moving equipment according to the diagram below:

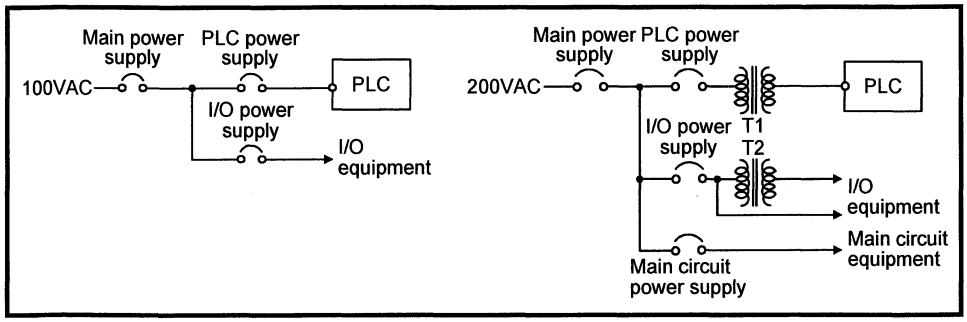



Diagram 8-11 Wiring system

5) Use twisted cables for 100VAC, 200VAC and 24VDC wiring. Keep all wiring as short as possible.
6) Use wiring with a large cross-sectional area (MAX2mm$^2$) to reduce voltage drops for 100VAC, 200VAC and 24VDC wiring.
7) Do not bundle 100VAC, 24VDC, incoming supply (high voltage/current) and I/O wiring together.
8) Follow the precautions shown below (installing a varistor) to prevent surges caused by lightning.

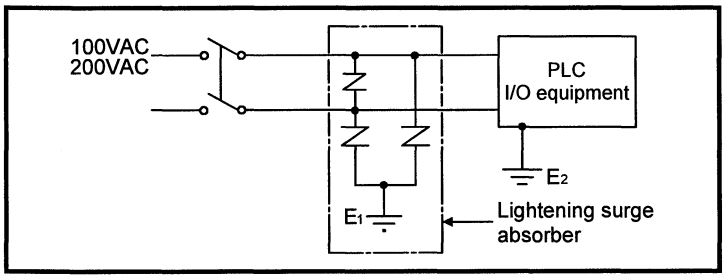



Diagram 8-12 Varistor

**POINT**

(1) Separate lightning absorber earth ($E_1$) and PLC earth ($E_2$).
(2) Select a surge absorber with a maximum allowable voltage specification greater than the peak power supply voltage.


8 - 6

## 8.4.3 Precaution for wiring I/O equipment

1) Wiring sizes from 0.75 to 2mm$^2$ can be used with the terminal connectors, however 0.75mm$^2$ is recommended.
2) Separate input and output wiring.
3) Separation distance between I/O wiring and high voltage/current cables should be 100mm(3.94inch) or more.

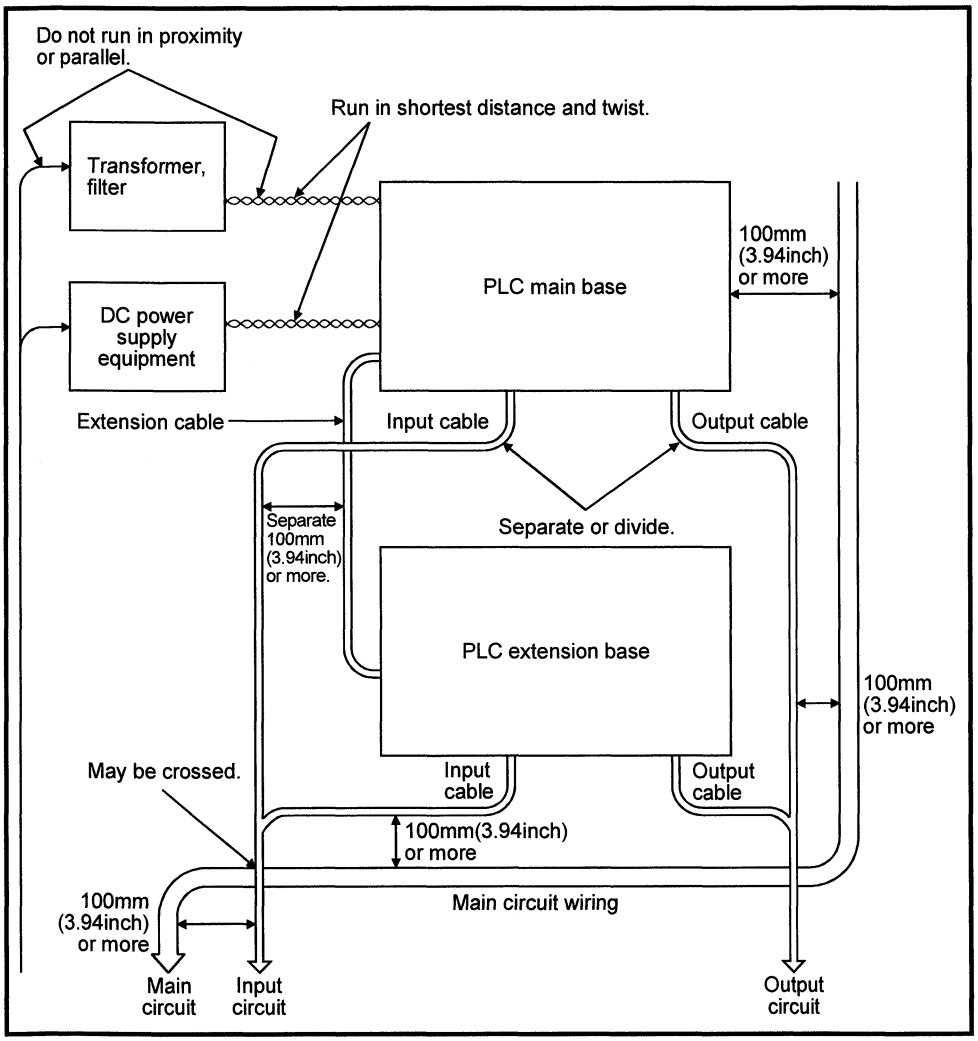



Diagram 8-13 Wiring inside panel

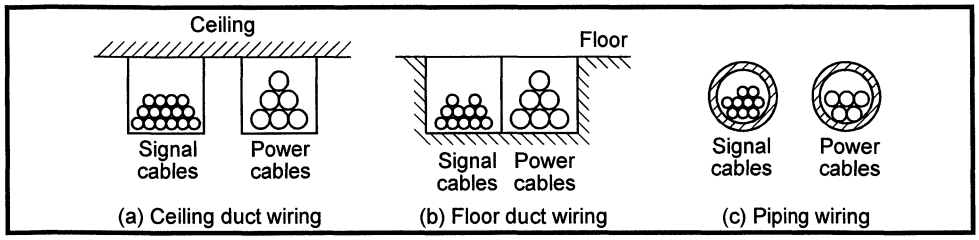



Diagram 8-14 External wiring


8 - 7

4) When power supply cables and operating cables cannot be separated, use shielded cabling and earth at the PLC. However, there may be cases where earthing is connected at the opposite end. Be sure to earth the cable in only one place.

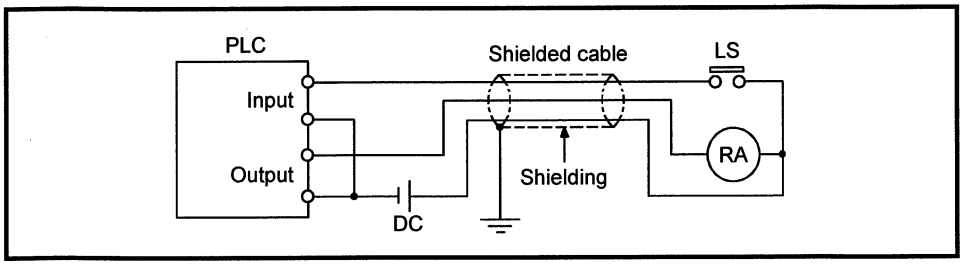



Diagram 8-15 Shielded cable earthing

5) If using water pipes for earthing cables, ensure that the earthing is effective.
6) Separate 24VDC I/O cables from 100VAC and 200VAC lines.
7) Problems caused by leakage current may occur in cabling that extends over 200m(655.74feet) due to the capacitance between cables.


8 - 8

## 8.4.4 Earthing

Earthing is effective for preventing common mode noise.

1) This PLC has some countermeasures against noise built in. As a result earthing is only required in very noisy applications.
   However, when earthing is used follow points 2 to 7 below.
2) Where possible, use dedicated earthing. (Earthing resistance is less than 100Ω)
3) When dedicated earthing cannot be used, use common earthing as shown below.

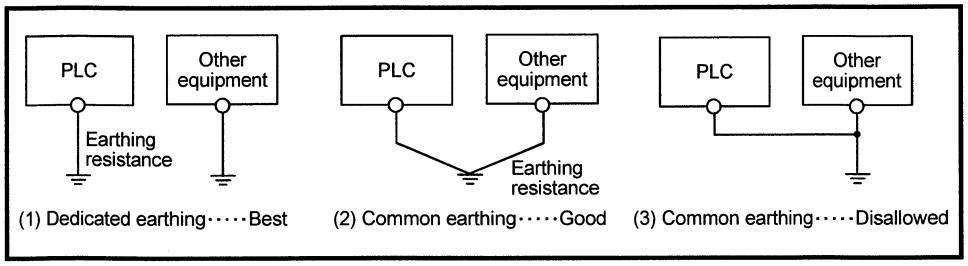



Diagram 8-16 Earthing

4) The cross-sectional area of earth cables should be more than 2mm$^2$.
   Earth wiring should be as close as possible to the PLC, and at worst within 50m(163.93feet).
5) If an error should occur from earthing, remove either or both of the FG and LG wires on the base unit and any other earth wires.
   However, if earth wiring is removed, make sure that there is no wiring connecting FG and LG.

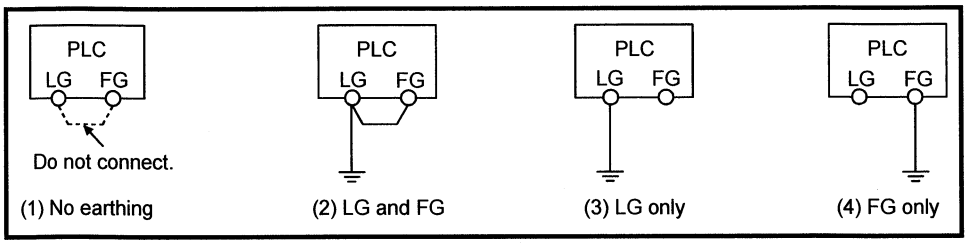



Diagram 8-17 Earthing terminals

6) When the PLC power supply module or I/O modules are connected to 200V (surface voltage is over 150V), it is necessary to earth the metallic parts of the base for safety (heavy duty earthing).
7) Even if the PLC is not earthed, make certain that the control panel is earthed to prevent injury from stray currents (heavy duty earthing).

**COMMENTS**

LG..... Connection terminal for internal AC supply filter.
FG..... Connection terminal for noise filter ground for 5VDC supply to CPU, I/O modules, etc.
Connected internally to base unit shield pattern.
SG..... Ground for 5VDC supply to CPU, I/O modules, etc.


8 - 9

MEMO


8 - 10

# CHAPTER 9 NOISE COUNTERMEASURES

## 9.1 Common Mode Noise and Normal Mode Noise

Noise can cause problems in the PLC, which may result in the PLC to STOP. Countermeasures against noise are indispensable for maintenance.
Generally, common mode noise has a larger influence on the PLC than normal mode noise. This is because normal mode noise occurs between wiring and can be eliminated with a filter but common mode noise is caused by floating capacitance, which is not so easy to counteract. The user can act against normal mode noise but the level of durability against common mode noise originates from the way the module is built by the manufacturer and as a result the user cannot do much to improve it.

## 9.2 Common Mode Noise

The diagram below shows a basic outline of common mode noise.

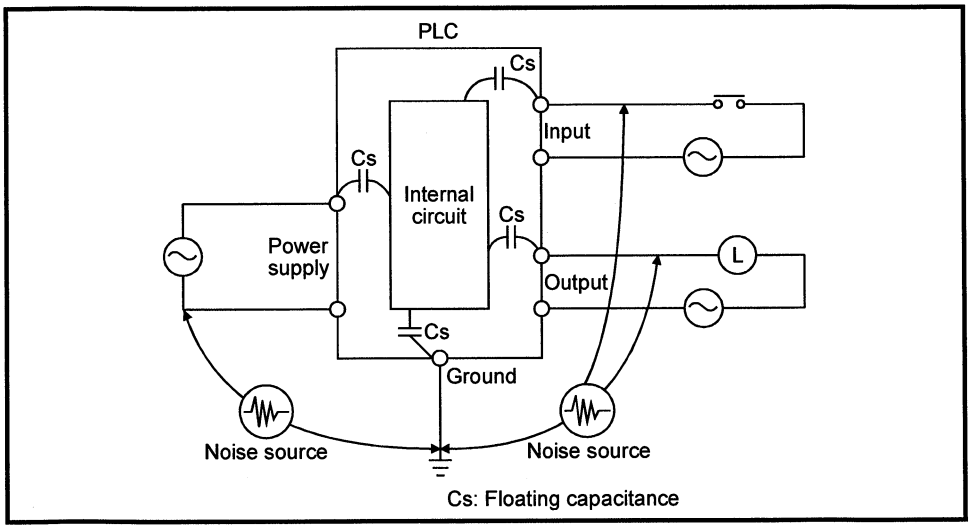



Diagram 9-1 Common mode noise

An electric potential difference is generated by noise between the ground, power supply and I/O signal lines. This causes a disturbance in the internal circuitry which causes malfunctions. This is called common mode noise.
Charging and discharging of electrical charges arises from the floating capacity between each external signal and the internal circuit, which causes the internal circuit voltage to fluctuate suddenly.
The strength of common mode noise is determined by the floating capacitance, Cs. If the PLC has a metal case, common mode noise is generally weak.
Also, good earthing is an important countermeasure against common mode noise.





9 - 1

## 9.3 Normal Mode Noise

The diagram below shows a basic outline of normal mode noise.

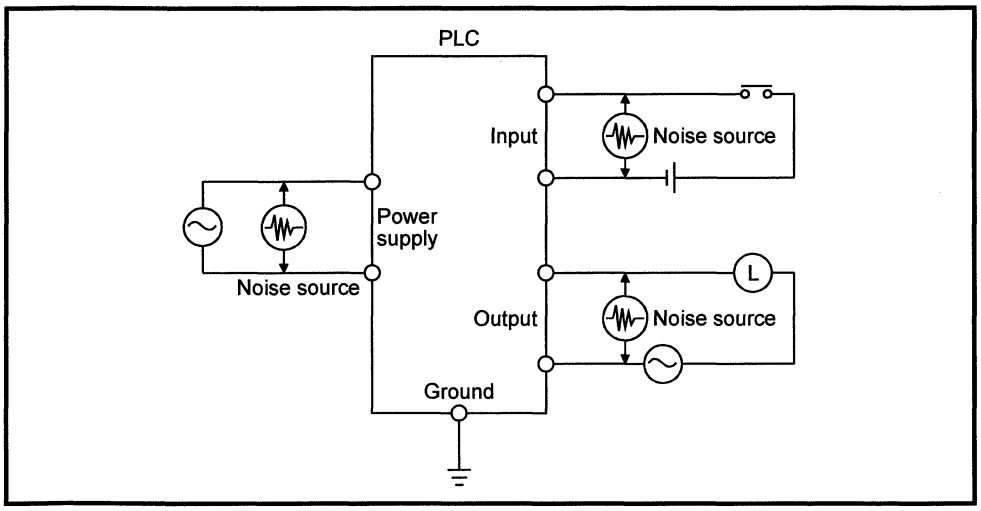



Diagram 9-2 Normal mode noise

As shown in the figure above, normal mode noise applies to input, output and power supply lines. Thus, it is sometimes called line noise.
Most normal mode noise is caused by the reverse electromotive force (back e.m.f.) of an inductive load connected to the line. Noise that occurs in a device connected to a power supply system appears in the power supply circuit. Noise that occurs in a device controlled by the PLC appears in the output lines.
Normal mode noise can be prevented by applying noise suppression in the device where the noise is generated and by installing a filter, transformer or surge suppressor with the PLC.




9 - 2

## 9.4 Precautions Against Noise in the External Input Lines

1) When an inductive load is connected in parallel with the input unit of the PLC, connect a CR surge suppressor (for the AC input), or a flywheel diode (for the DC input), in parallel with the load as shown below. Connect the surge suppressor as close as possible to the inductive load.

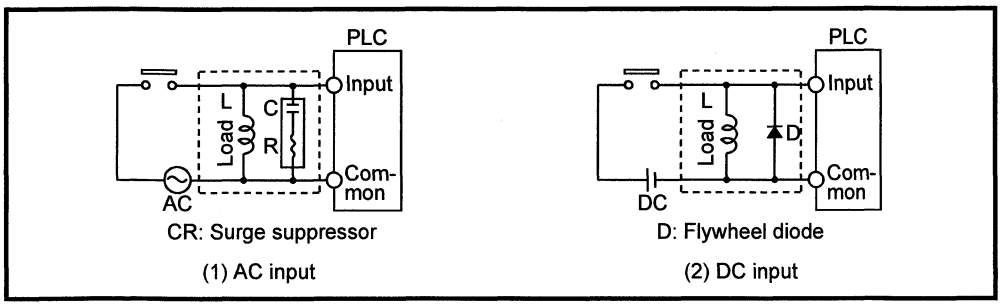



Diagram 9-3 Inductive load is in parallel with input

2) In any of the following cases, take countermeasures against an induced voltage as shown below.
   - External wiring is 200m(655.74feet) or longer.
   - If the operation indicator neon lamp is built in or the limit switch contact is open, a voltage is developed by the current of the neon lamp.
   - An induced voltage is large in an AC input signal.

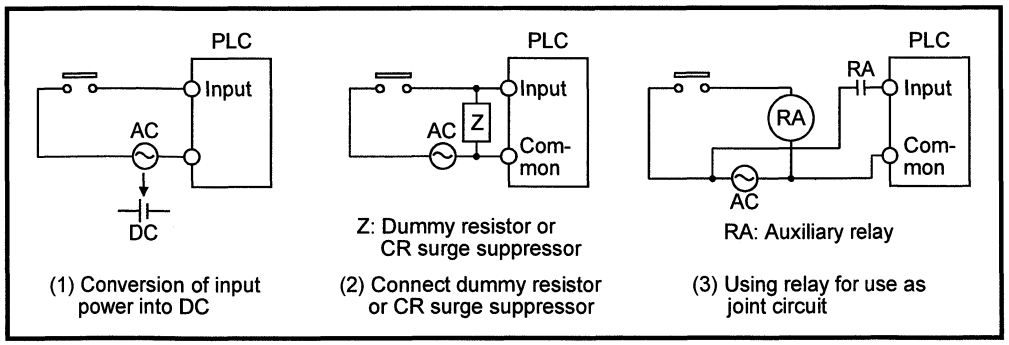



Diagram 9-4 Countermeasures for input against induced voltage


9 - 3

## 9.5 Precautions Against Noise in the External Output Lines

1) In the case of inductive loads, noise is created by in-rush current when an output signal turns ON. In addition, when an output signal is turned OFF, noise is created by reverse electromotive force. Arc noise is also created from contacts such as magnetic contactors, etc.
   In the case of AC inductive load, connect CP surge suppressors to both ends of the load. Use a CR surge suppressor of 0.5μF + 47Ω for 100VAC, 200VAC and 400VAC. If this CR surge suppressor is not connected to the position closest to the load, it will have no effect.

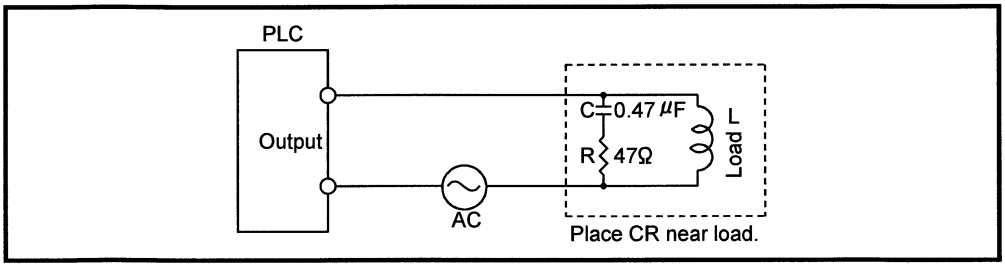



Diagram 9-5 Countermeasures against AC inductive load noise

2) In the case of DC inductive loads, connect fly wheel diodes to both ends of the load. Connect these diodes as close as possible to the load. The reverse voltage rating of the diode must be at least four times the load voltage.
   When a fly wheel diode is connected to a DC inductive load, the load operation is delayed by the current flowing in the diode during breaking. If this delay causes a problem, connect a CR surge suppressor, to give you an alternative to the above mentioned countermeasures against AC inductive load noise.

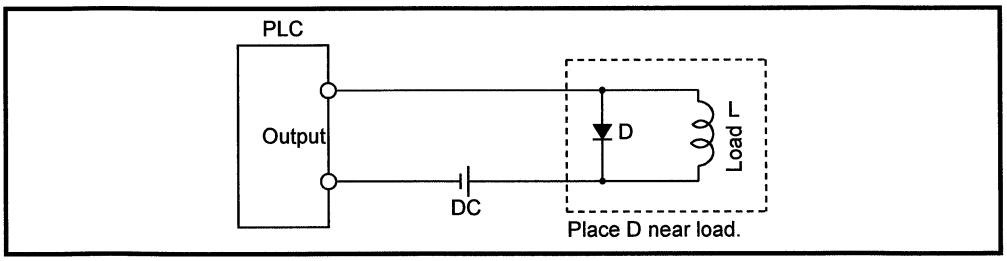



Diagram 9-6 Countermeasures against DC inductive load noise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3) When the load to be connected to a PLC output is opened and closed by an external contact, be sure to take the same countermeasures as shown in Diagrams 9-5 and 9-6, regardless of the presence or absence of noise countermeasures on the PLC side.

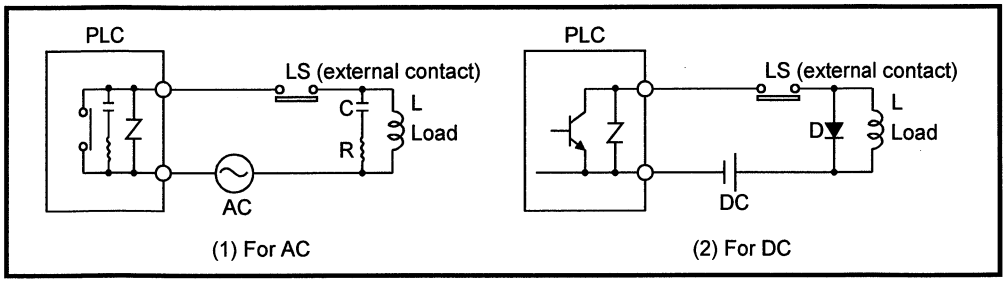


Diagram 9-7 When opening and closing a load by an external contact

4) Switching by using a triac that breaks when the load current is zero is effective for an AC inductive load with significant noise during breaking.
5) Connecting CR surge suppressors to both ends of the contact is effective as a countermeasure against arc noise during contact switching of magnetic contactors. Be alert for leakage current by the CR surge suppressor circuit even when the contact is open (See diagram 9-8(A)).
6) If the breaking noise of motors and transformers cause problems, connect a CR surge suppressor between the phases (See diagram 9-8(B)).

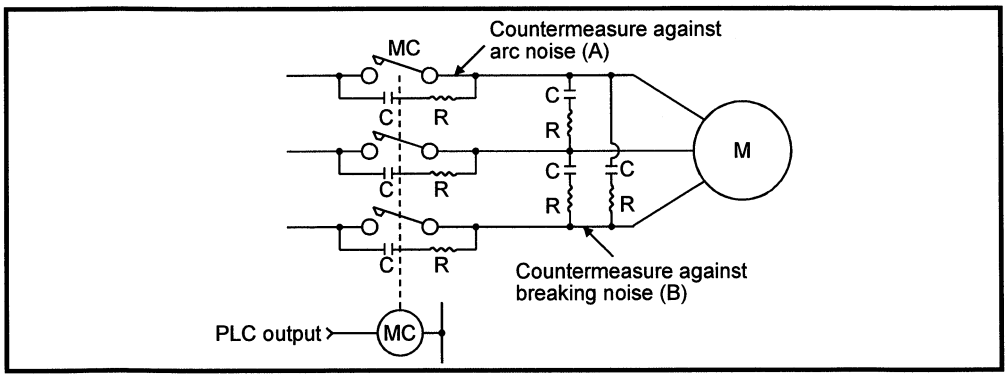


Diagram 9-8 Countermeasures against large capacity noise

7) The relay in the panel also has an effect.
Using relays is also effective against PLC outputs that are particularly noisy.

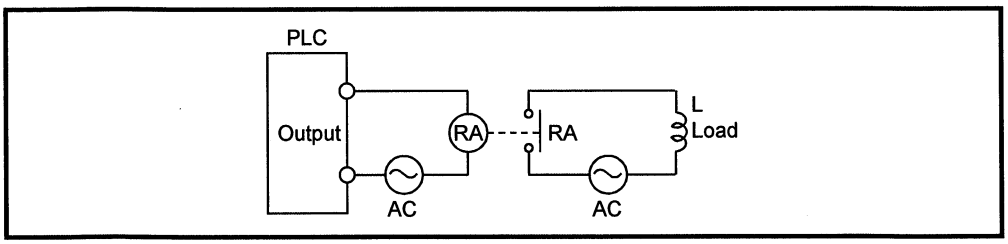


Diagram 9-9 Driving a load with a relay


9 - 5

## 9.6 Troubleshooting and Noise Countermeasures

Below shows how external noise may be the cause when the following control errors occur.

Table 9-1 Troubleshooting and noise countermeasures

| | |
|---|---|
| (1) Error occurs which synchronizes with the operation of a specific PLC controlled output device. | 1) When a device is turned ON/ OFF, an error may occur, stopping the PLC. Take anti-noise countermeasures explained under "Output device" earlier in this section. The countermeasures given in Diagrams 9-5 and 9-6 are normally effective. If a surge suppressor and a diode are not installed in the position closest to the load, there will be no effect. In the case of a large capacity load, take the countermeasures given in Diagram 9-8.<br>2) Faulty connections, such as a loosely connected input line, disconnections, faulty ground contacts, mixed contacts and input devices, etc. may cause problems that occur which synchronize with the operation of other devices. Therefore, check them very carefully. |
| (2) Error occurs which synchronizes with the device operations unrelated to the PLC. | 1) In such cases, the cause is noise or surge from another device. Take the same countermeasures as those for (1) above for the corresponding device.<br>2) Ground any devices which are not grounded. If they are grounded, try disconnecting the ground connection. Separate I/O signal lines from the wiring of the corresponding device or change the wiring route. |
| (3)Error occurs when a large capacity load is turned ON. | 1) Power supply voltage drop and the rise of the ground electric potential of a shared ground connection may be the cause. When the power supply voltage drops below the specified value when turned on, change the power supply system by installing a low voltage transformer in the power supply.<br>2) Try disconnecting the ground connection for grounded devices. |
| (4) The operation of the PLC is randomly unsteady. | 1) Frequent momentary power supply failures or particularly bad voltage waveforms. When there is a great deal of noise, install a constant voltage transformer, or change the power supply system. Also, using an isolating transformer can help.<br>2) Influence of high frequency equipment. Ground high frequency equipment and the PLC panel. The I/O signal lines of the PLC should be shielded. |
| (5) There is a large input inductive voltage. | 1) In this case, the PLC does not stop and an output error occurs caused by an incorrect input, Even if the inductive voltage is low, an incorrect input occurs due to noise. In this case, take the countermeasures given in Diagram 9-3. |
| (6) Others (Error occurs when...) | 1) An automobile passes (e.g. noise from fork-lift ignition system).<br>2) The panel door is opened (E.M.I noise).<br>3) A mobile phone or walkie-talkie is used (E.M.I noise). |

Take the above countermeasures against PLC noise problems. When making a panel, or when laying external wiring, costs can be reduced by taking these countermeasures. When setting up a system using a PLC, it is important to consider which countermeasures should be taken. It is also necessary to check whether the countermeasures taken when the problem occurred were really effective by removing the countermeasures in order to reproduce the problem.


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## 9.7 Outline of Noise Measurements

This section explains the outline for measurements of items related to PLC power supply 100VAC, 200VAC, 24VDC and 5VDC, and an outline of noise measurement.

Table 9-2 100/200VAC system noise measurements

| System | Type | Item | Measurement location | Checkpoint | Measuring device | Assessment level | Actual value | Check |
|---|---|---|---|---|---|---|---|---|
| 100/200 VAC | Between lines | Voltage | PLC power supply module input terminals (A61P, etc.) | Input voltage is within specified range | D.V.M. | 100V system 85 to 132V 200V system 170 to 264V | | |
| | | Waveform | | Waveform is sinusoidal | Synchroscope Digital scope Memory hi-corder (Repeated observation) When noise is observed in 200V system use positive voltage probe | Peak voltage 85 to 132V no fluctuations, 5% distortion | | |
| | | Frequency | | Waveform stability is observed with the same trigger | | 47.5 to 63Hz, no noticeable fluctuations | | |
| | | Noise | | No transient or repetitive noise observed | | ±1500V, less than 1μs | | |
| | | Stoppages | | | | Less than 200ms | | |
| | Line and FG | Waveform | One side of input terminal(high voltage side) and FG | Waveform is sinusoidal | | Peak voltage 85 to 132V no fluctuations, 5% distortion | | |
| | | Noise | | No transient or repetitive noise observed | | ±1500V, less than 1μs | | |


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Table 9-3 24VDC system noise measurements

| System | Type | Item | Measurement location | Checkpoint | Measuring device | Assessment level | Actual value | Check |
|---|---|---|---|---|---|---|---|---|
| 24VDC system | Between lines | Voltage | Module input terminals, breaker terminals or power supply output terminals | Input voltage is within specified range | D.V.M. | For A63P, 15.6 to 31.2V<br>For A I/O (e.g.AX41) 10.2 to 26.4V<br>For A2CI/O (e.g.AX40Y50C) 10.2 to 31.2V | | |
| | | Waveform | | Input voltage is within specified range | Synchroscope<br>Digital scope<br>Harmonics chart recoder, i.e. memory hicorder<br>Positive voltage probe | Same as voltage assessment level<br>Slight fluctuation | | |
| | | Noise | | No transient or repetitive noise observed | | ±750V, less than 1μs | | |
| | | Rise, fall | | Over or undershoot is within voltage range for module when turned ON/OFF | | Same as voltage assessment level | | |
| | | Stoppages | | No stoppages or drops | | 0ms except for particular modules | | |
| | Line and FG | Waveform | +24V and FG | Input voltage is within specified range | | Same as voltage assessment level<br>Slight fluctuation | | |
| | | Noise | | No transient or repetitive noise observed | | ±750V, less than 1μs | | |


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Table 9-4 5VDC system noise measurements

| System | Type | Item | Measurement location | Checkpoint | Measuring device | Assessment level | Actual value | Check |
|---|---|---|---|---|---|---|---|---|
| 5VDC system | Between lines | Voltage | Connector of empty I/O slot on base, between 2-4AB pin (5V) and 56AB pin (SG)<br><br>CPU connector for peripheral device RS422, between pins 12, 13, 24, 25(5V) and pins 7,8, 20 (SG)<br><br>Extension base cable connector between pins 13, 14, 28, 42, 43 (5V) and 15, 16, 29, 44, 45 (SG) | Voltage drop is not too large | D.V.M.<br>Synchroscope | 4.75V to 5.25V | | |
| | | Ripple | | Ripple is not too large | Synchroscope<br><br>Digital scope | Less than 300mVpp See Diagram 9-10 | | |
| | | Spikes | | Spikes are not too large | Where needed, contact probe set to AC range | Less than 800mVpp See Diagram 9-10 | | |

Table 9-5 Noise measurement between earth terminals

| System | Type | Item | Measurement location | Checkpoint | Measuring device | Assessment level | Actual value | Check |
|---|---|---|---|---|---|---|---|---|
| Betwe en SG-FG | — | Noise | FG and SG(DC5V system measurement location and GND) | Noise ingression from FG does not affect PLC | Synchro/digital scope<br><br>Harmonics chart recoder, i.e. memory hicorder | Less than 10Vpp, even if noise is below this level care should be taken | | |

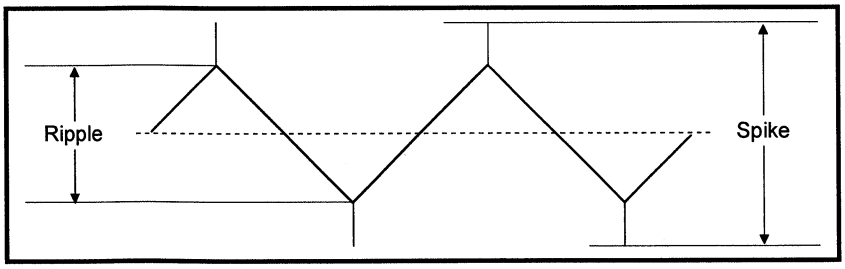



Diagram 9-10 Ripple/spike waveforms


9 - 9

## 9.8 Examples of Solving Noise Problems

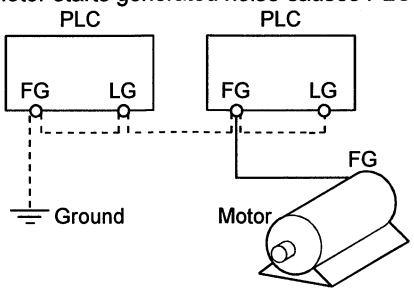
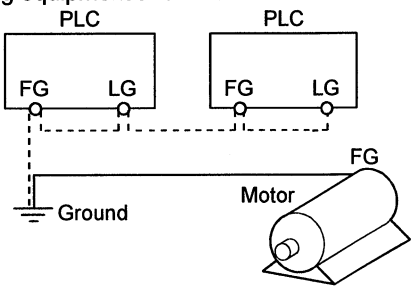
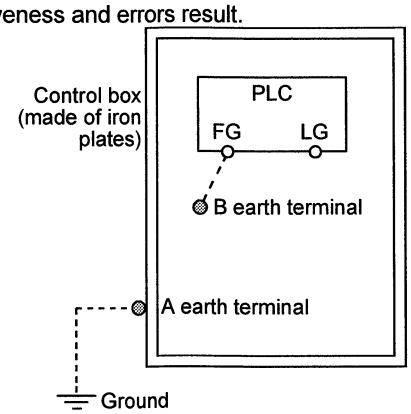
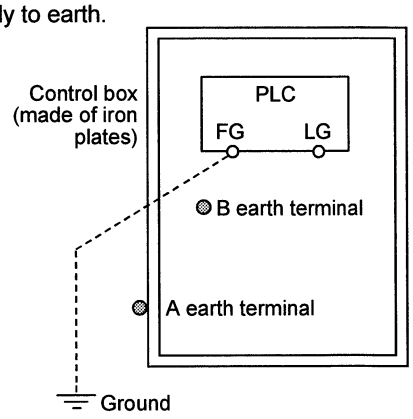
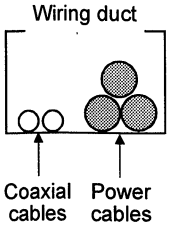
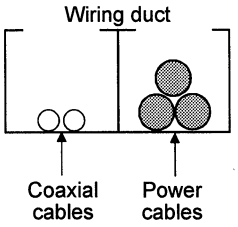
<table>
<tr><th></th><th>Before</th><th>After</th></tr>
<tr><td>(1) Separating earth wires</td><td>Earthing for moving equipment and PLC is shared, when motor starts generated noise causes PLC error.<br> 
</td><td>Performance improved by separating earthing for moving equipment and PLC.<br> 
</td></tr>
<tr><td>(2) Dedicated PLC earth</td><td>Earthing between points A and B is connected via steel panel, earthing impedance reduces grounding effectiveness and errors result.<br> 
</td><td>Performance is improved by connecting PLC directly to earth.<br> 
</td></tr>
<tr><td>(3) Separating cables in ducts</td><td>MELSECNET co-axial cables and motor cables are mixed within witing duct. MELSECNET transmission errors occur.<br> 
</td><td>Performance is improved by separating co-axial cables and motor cables in the wiring duct.<br> 
</td></tr>
</table>

Diagram 9-11 Examples of solutions 1, 2 & 3


9 - 10

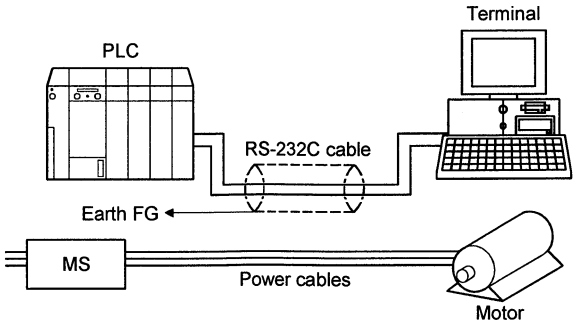
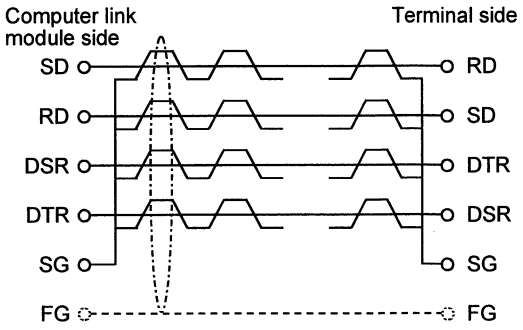
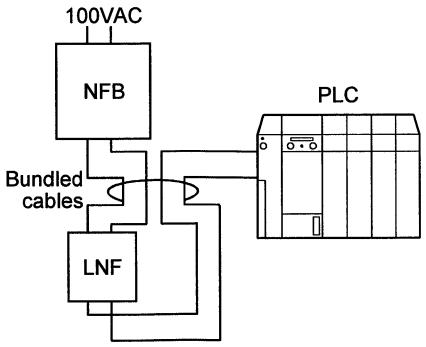
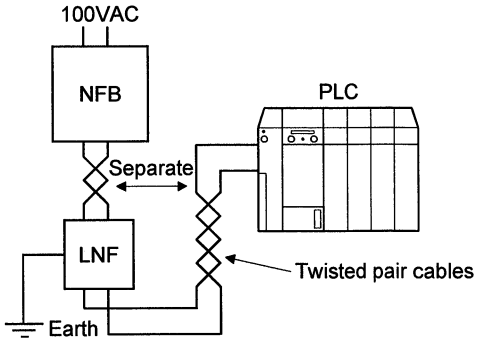
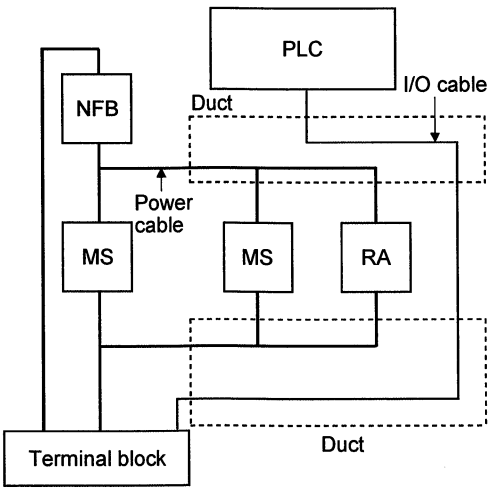
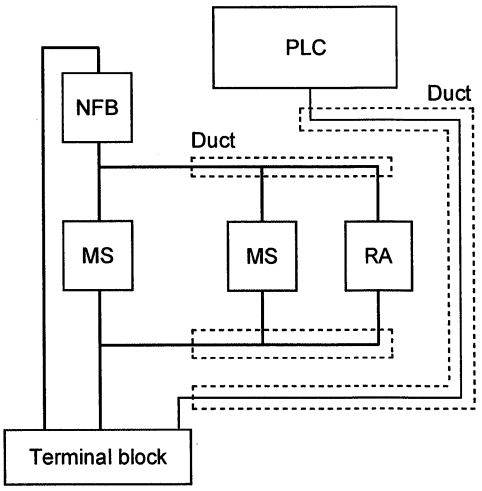
| | Before | After |
|---|---|---|
| (4) Twisted pair signal lines | RS-232C cable and motor cables are close together, terminal CRT display is distorted.<br>  | Performance is improved by all signal lines of RS-232C cable being twisted together with SG.<br>  |
| (5) Separating cable bundles | Noise filter (LNF) primary and secondary cables are bundled together, power supply noise enters PLC and errors result.<br>  | Performance is improved by separating noise filter primary and secondary wiring by 10cm(3.94inch) or more, and twisting the wiring.<br>  |
| (6) Separating control wiring and motor wiring | PLC errors occur due to PLC I/O lines and motor cables being installed in the same duct.<br>  | Performance is improved by installing I/O lines and motor cables in separate ducts.<br>  |

Diagram 9-12 Solution examples 4, 5 & 6



9 - 11

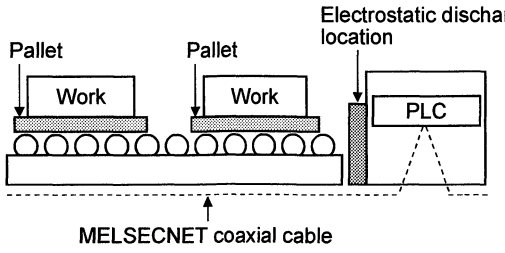
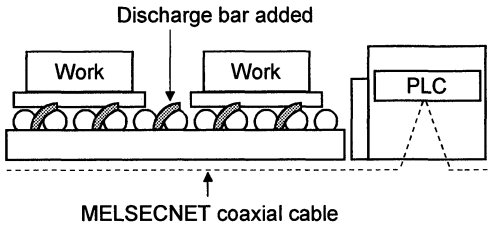
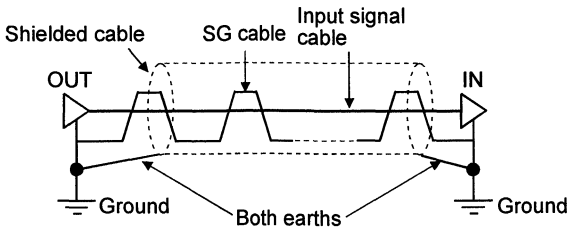
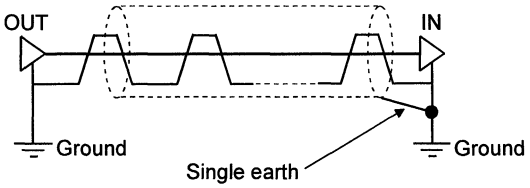
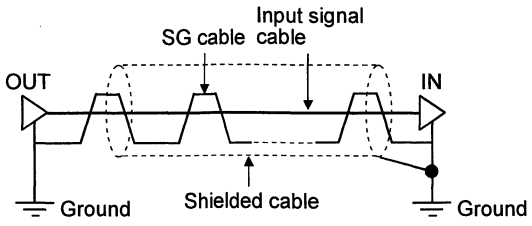
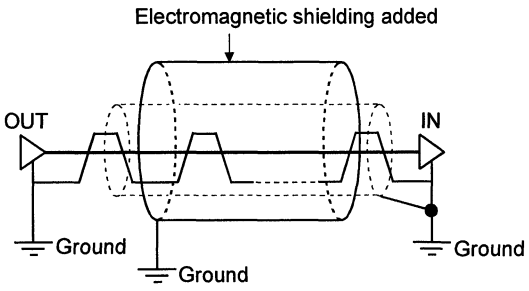
| | Before | After |
|---|---|---|
| (7) Removing electrostatic noise | Communication failure from electrostatic discharge to MELSECNET co-axial cable caused by moving pallets.<br>  | Performance is improved by installing discharge bars to remove static electricity.<br>  |
| (8) Removing relay noise | Errors caused by relay noise from control lines being passed to nearby I/O lines.<br>  | Performance is improved by earthing shielded cable at the end.<br>  |
| (9) Removing motor noise | Errors caused by motor noise being passed from main circuit cables to nearby I/O lines.<br>  | Performance is improved by using shielded cable to provided electromagnetic shielding.<br>  |

Diagram 9-13 Solution examples 7, 8 & 9


9 - 12

# CHAPTER 10 LIFETIME OF PLC PARTS

## 10.1 Battery Lifetime

### (1) Replacement of battery

M9006 or M9007 turns ON when the voltage of the battery for program backup and power failure drops below a certain level. Even if this special relay turns ON, the contents of the program, and power failure compensation are not lost immediately. However, if the ON state is overlooked, the PLC memory contents may be lost. As a preventative maintenance measure, Mitsubishi recommends early replacement of batteries.
This section explains battery lifetimes and gives replacement details.

| Battery model name | A6BAT |
|---|---|

### (2) Service life of battery

The service life of the battery depends on the capacity of the memory.

Table 10-1 Battery lifetimes

| CPU name/ Memory cassette \ Battery lifetime | | Battery lifetime (Total power failure time) [Hr] | |
|---|---|---|---|
| | | Guaranteed | Actual use |
| A2 type CPUs A3 type CPUs | A3MCA-0 A3NMCA-0 | 10800 | 27000 |
| | A3MCA-2 A3NMCA-2 | 7200 | 18000 |
| | A3MCA-4 A3NMCA-4 | 5400 | 13000 |
| | A3MCA-8 A3NMCA-8 | 3600 | 9000 |
| | A3MCA-12 A3NMCA-16 | 2150 | 5400 |
| | A3MCA-18 A3NMCA-24 | 1950 | 4900 |
| | A3NMCA-40 | 1400 | 3500 |
| | A3NMCA-56 | 450 | 1125 |
| | A3NMCA-96 | 1860 | 9495 |
| A4 type CPUs | A4UMCA-128 | 1500 | 2880 |
| | A4UMCA-8E | | |
| | A4UMCA-32E | | |
| | A4UMCA-128E | | |
| A0J2, A1 type CPU | | 7200 | 18000 |
| A0J2H, A2C, A1SCPU | | 5400 | 13000 |

*The actual use value indicates a typical value and the guaranteed value indicates the minimum value.

Preventive maintenance is described as follows. See examples on the following page.
Even if the total power failure time is less than the guaranteed value in the above table, change the battery after four or five years.
When the total power failure time has exceeded the guaranteed value in the table above and M9006 has turned on, change the battery. When a power failure occurs, the battery lifetime lasts about 1 week (168 hours) after M9006 is turned on.

### (3) Replacement

Although the times for battery changeover vary according to memory cassette type, all replacements must be done within 3 minutes.





10 - 1

## 10.2 Fuse Lifetimes

MELSEC-A uses the fuses shown below.
Although fuses are designed to fail if subjected to over-current or short-circuits, change fuses every few years to counter stress failures that may occur due to power supply inrush current.

Table 10-2 List of fuses

| Model | Purpose | Modules | Model name | Rating | Form | Measurements (mm) | Maker |
|---|---|---|---|---|---|---|---|
| Building block | Power supply | A1 type CPU A61P, 62P 65P, 66P | GTH4 | 4A | Glass tube | φ6×32 | Nagasawa |
| | | A63P | SM6.3A | 6.3A | Glass tube | φ6×32 | See above |
| | Output module | AY22 | HP-70K | 7A | Plug | 30.3×8×20 | Daito |
| | | AY23 | HP-32 | 3.2A | Plug | See above | See above |
| | | AY50, 80 | MP-20 | 2A | Plug | 17.2×5.5×19 | See above |
| | | AY60 | MP-32 | 3.2A | Plug | See above | See above |
| | | AY60E | MP-50 | 5A | Plug | 17.2×5.5×19 | Daito |
| | | AY11E, 13E | MF51NM8 | 8A | Glass tube | φ5.2×20 | Nagasawa |
| A0J2 | Triac output module | A0J2-E□S | HP-32 | 3.2A | Plug | 30.3×8×20 | Daito |

(Note)
Fuses for the power supply of the following modules cannot be changed:
A0J2, A0J2H, A2C and A1SCPU. Also, A1S output module fuses can not be changed.




10 - 2

## 10.3 Lifetime of Electrolytic Capacitors

Modules that use electrolytic capacitors (e.g. power supply module, AD75, A62DA, etc.) have a 10 year lifetime at 35ºC but at higher temperatures, this value will be reduced by 4 to 6 years.
In terms of preventive maintenance, it is recommended that consideration should be given to the following explanation for lifetime and system overhauls with new module replacements should be carried out.
Generally, the interior aluminium capacitors are chemically reactive and because of this characteristic, depending on the ambient temperature the lifetime will vary drastically (A 10ºC temperature change doubles the affect on lifetime).
This characteristic is called the "Arrhenius rule", the diagram below shows a curve representing the characteristic.

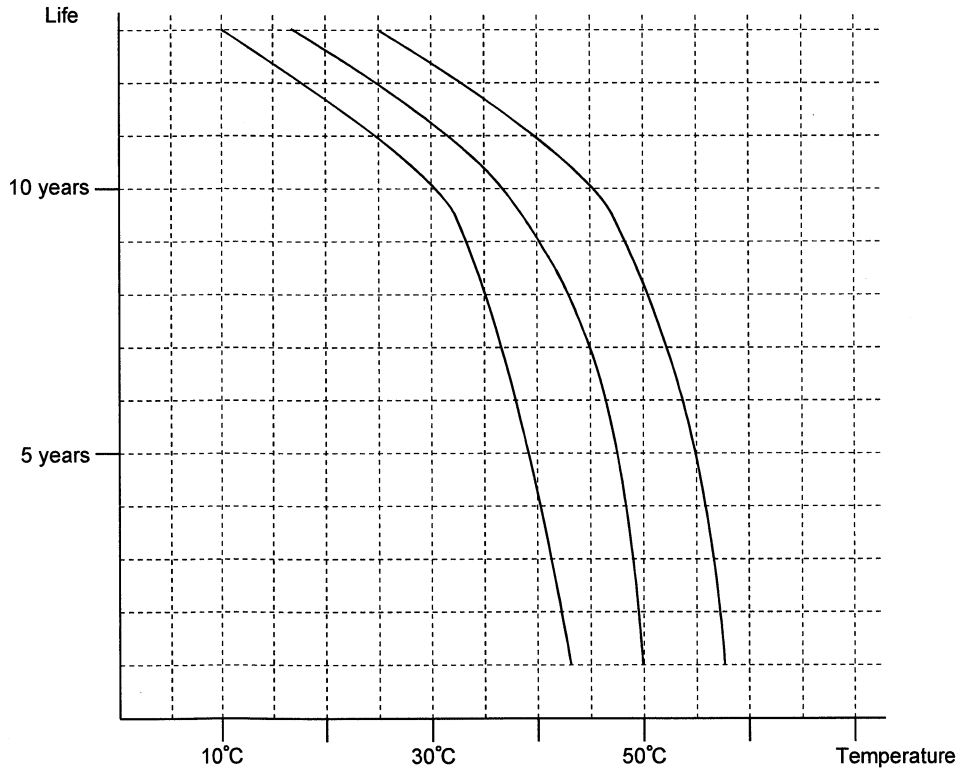



Diagram 10-1 Arrhenius rule


10 - 3

## 10.4 Relay Lifetimes

A contact output module's relay lifetime is expended by opening and closing switch operation.
When a relay directly attached to the printed circuit board of a output module fails the output module must be replaced.
As a countermeasure against this expendability, substitute non-contact output modules such as triac output modules in AC voltage applications and transistor output modules in DC output applications.

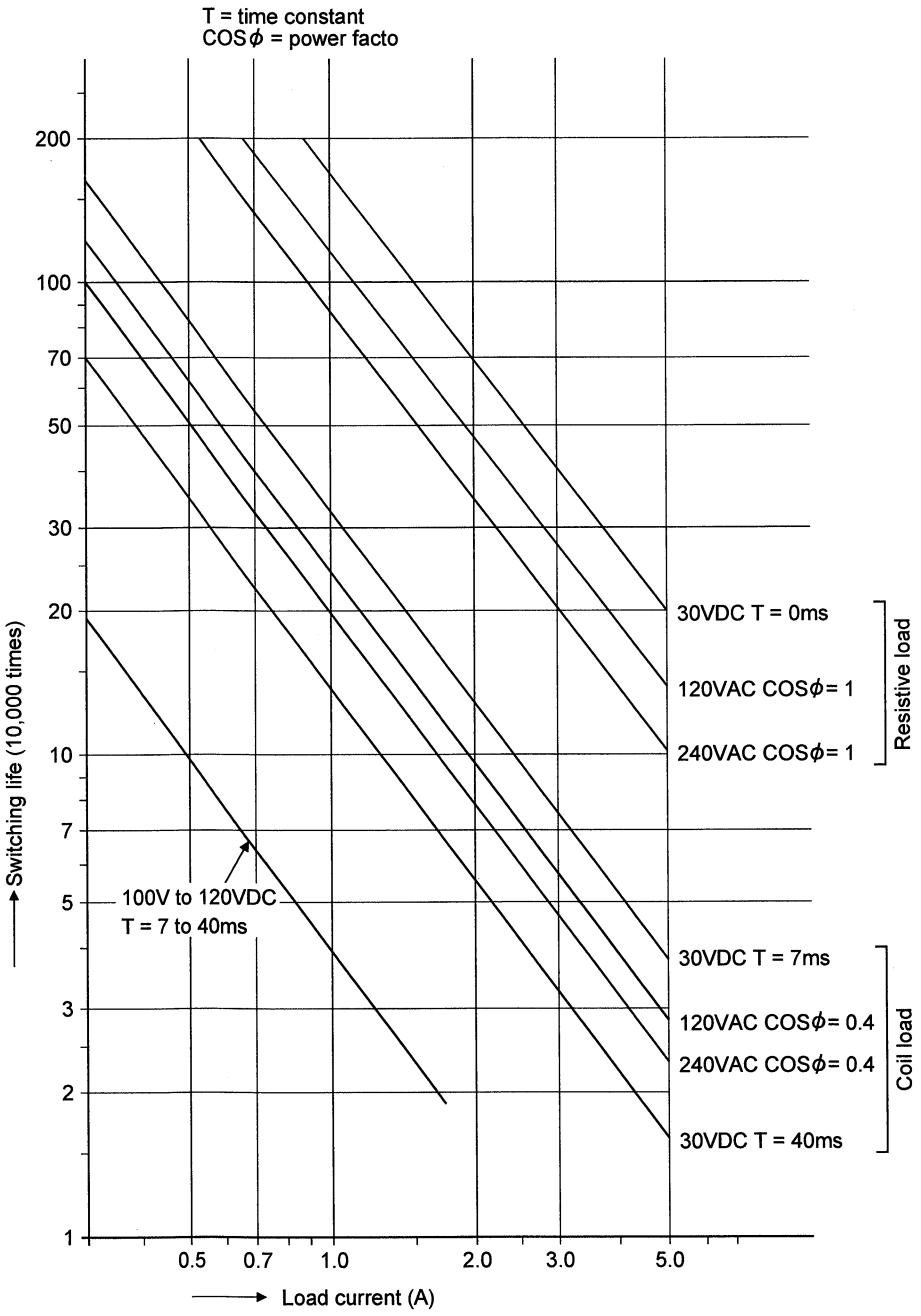



Diagram 10-2 Output relay contact lifetime characteristic


10 - 4

## 10.5 Spare Parts

In Japan, since replacement parts can be easily obtained from service centers, branch offices, agents, etc. they can be purchased as needed. However, when a PLC is used overseas, replacement parts must be ordered beforehand.
Pay attention to the following design points. Doing so makes maintenance easier.

### (1) Quickly replaceable types

With building block type modules, module replacement is easy. Only malfunctioning modules need to be replaced.

### (2) Types of memory

IC-RAM memory and latch memory need battery replacement.
Because EP-ROM (EEP-ROM) prevents program changes and thus eliminates programming mistakes and also does not require batteries, they are suitable for export.

### (3) Reduction of module categories

Standardizing the types of modules used reduces the variety and volume of spares.

### (4) Ensuring replacement contacts

If there are no module replacement parts, the spare number of points can be secured by changing the connection and program (I/O signal change) by not utilizing 10 to 20% of the available I/O for 16, 32 and 64 point modules.


10 - 5

## (5) Spares

Table 10-3 Spares

| No. | Name | Quantity | Remarks |
|---|---|---|---|
| 1 | Battery | 1 to 2 | The storage lifetime of a lithium battery is about 5 years. However, prepare 1 or 2 batteries for unforeseen contingencies. |
| 2 | Fuses | Number needed | The AC power supply module and output modules have one fuse each attached. |
| 3 | Power supply module | One per type | Since the parts can attain very high temperatures, if the ambient temperature becomes too high, it could shorten the lifetime of the module. |
| 4 | I/O module | One per type | Remember that malfunctions easily occur during test operation. After extended use the contacts of relay modules will wear out. |
| 5 | CPU module | One per type | Since this is the main part of the PLC, if a malfunction occurs the system will stop. |
| 6 | Memory and memory cassette | 1 set | |


10 - 6

# CHAPTER 11 TEST OPERATION AND ADJUSTMENT



When a PLC is newly installed or has been modified, before operation is started if sufficient safety checks are not carried out, problems could occur.
This section explains check points and test operation adjustment procedures that will eliminate problems before they occur.

## 11.1 Check Point Before Start of Test Operation

The table below shows check points for the PLC.

Table 11-1 Check points

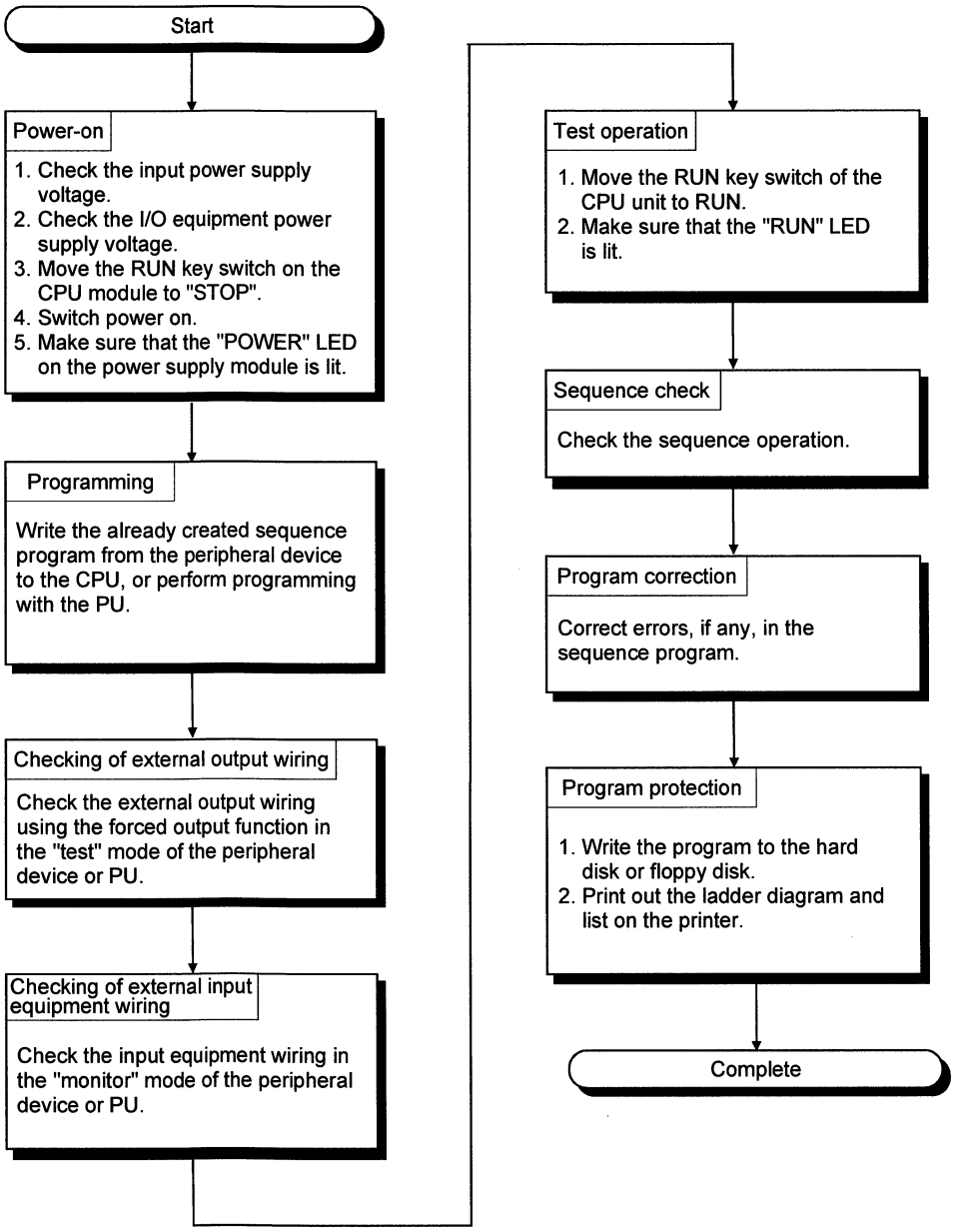
| No. | Check points | Description |
|---|---|---|
| 1 | Loading and setting of memory cassette | • Check that the memory cassette is securely inserted.<br>• Check that the used memory capacity is sufficient.<br>• Check that the RAM/ROM setting is correct.<br>• Check that memory protect is ON. |
| 2 | Loading of battery | • Check whether the connector for battery lead wires, which has been disconnected before shipment, is securely inserted in the pin connector on the PCB. (The red lead is positive, the blue lead is negative)<br>• Check that the battery voltage has not decreased (Nominal value: 3.6V) |
| 3 | Connection of extension base cable | • Check that the connectors of the main and extension bases are properly connected with the connectors of the extension cable.<br>• Check that the extension connector position of the extension base is correct. |
| 4 | Extension stage number setting of extension base | • Check that the settings have been made.<br>• Check that the same number has been set.<br>• Check that settings have not been duplicated on other bases, |
| 5 | Loading of modules | • Check that the types of modules installed on the main and extension bases is correct.<br>• Check that the point setting switch settings for dummy module (AG62) is correct.<br>• Check whether the module configuration uses more I/O points than the CPU I/O specifications. |
| 6 | Fuse | • Check if fuses are blown or damaged. |
| 7 | Connection of power and I/O cables | • Check the cables connected to each terminal of the terminal block.<br>• Check the terminal screws of the terminal block for the power supply module and terminal blocks for I/O modules.<br>• Check the cable size. |



11 - 1

## 11.2 Test Operation and Adjustment Procedure

This section shows the flow chart from after the completion of installation to the test operation of the PLC.



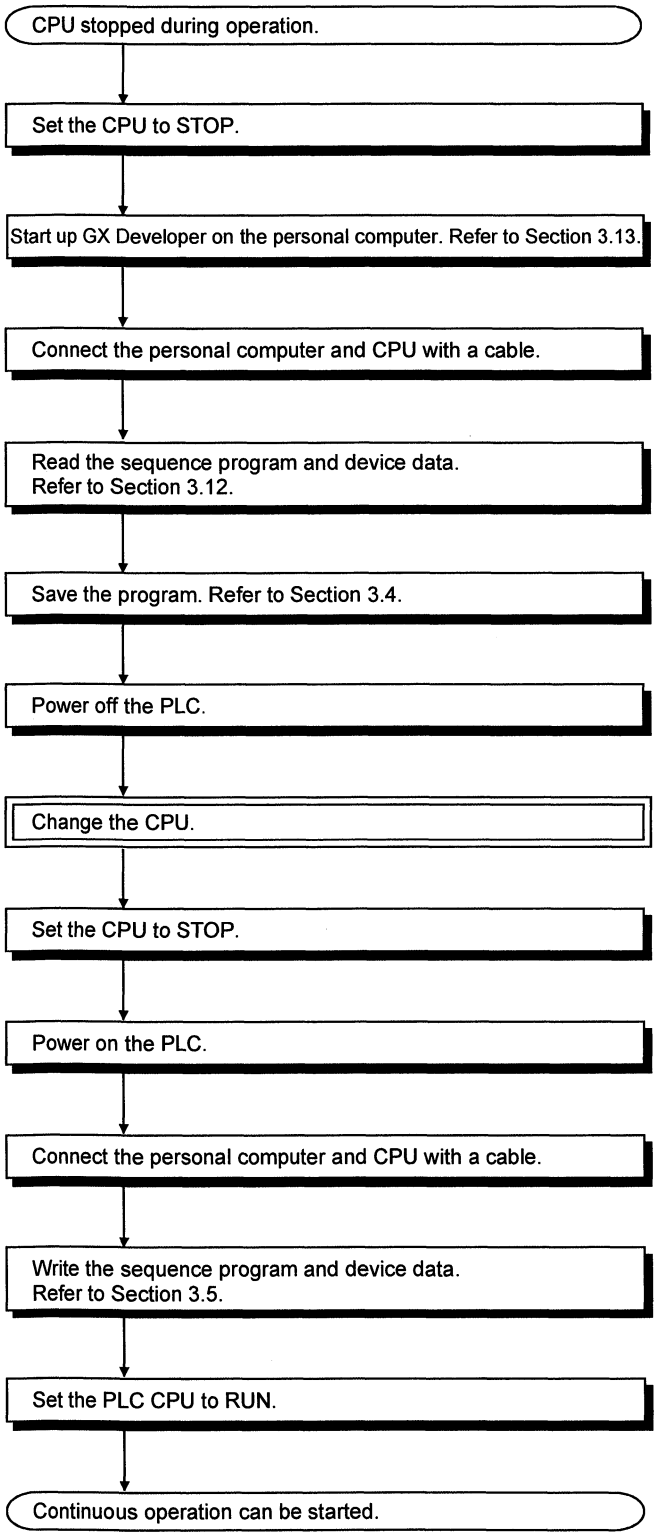



11 - 2

# CHAPTER 12 PROCEDURE FOR CHANGING A CPU DURING OPERATION

To have continuous operation when changing the CPU during system or machine operation, it is necessary to read the PLC program and device data (latch data, etc.) with a peripheral device and restore after CPU replacement. The procedure is explained below.








12 - 1

# MEMO





12 - 2

# A-series maintenance course (for GX Developer)

# A-SERIES TRAINING MANUAL

| | |
|---|---|
| MODEL | A-MAINTE-WIN-E |
| MODEL CODE | 13JS19 |
| SH(NA)-080176-A(0106)MEE | |

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