User's Manual

LG Programmable Logic Controller

GLOFA GM3/4 Series

LG Industrial Systems

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Chapter 1. GENERAL

1.1 Guide to User's Manual

This User's Manual gives the specifications, performance and handling instructions for each of the necessary units of the GLOFA-GM3/4 series PLC system.

The configuration of the User's Manual is given below.

No	Title	Content
Chapter 1	General	Describes configuration of this manual, units' features and terminology.
Chapter 2	System Configuration	Describes available units and system configurations in the GLOFA-GM3/4 series.
Chapter 3	General Specifications	Describes general specifications of various units used in the GLOFA3/3 series.
Chapter 4	CPU Module	Describes the performance, specifications and functions of the CPU module.
Chapter 5	Battery	Describes the specifications and handling instructions for other modules except for the CPU module.
Chapter 6	Memory Module	
Chapter 7	Digital I/O Module	
Chapter 8	Power Supply Module	
Chapter 9	Base Unit and Extension Cable	
Chapter 10	Installation and Wiring	Describes installation, wiring and handling instructions for reliability of the PLC system.
Chapter 11	Maintenance	Describes the check items and method for long term normal operation of the PLC system.
Chapter 12	Troubleshooting	Describes various operation errors and corrective actions.
Appendix 1	System Definitions	Describes parameter setting for basic I/O module and communications module.
Appendix 2	Function/ Function Block List	Describes the types and processing time of function/function block.
Appendix 3	Flag List	Describes the types and content of various flags,
Appendix 4	Outer Dimensions	Shows outer dimensions of the CPU, I/O module and base unit.

REMARK

1) This manual does not describes the special/communications module and programming for them. For their own functions, refer to the related User's Manual.

1.2 Features

1) GLOFA-GM series features:

(1) Design on the basis of international standard specifications(IEC 1131-3)

- Easy programming device support.
- Languages in compliance with IEC1131-3 are given. (IL/ LD / SFC)

(2) Open network by use of communications protocol in compliance with international standard specifications.

(3) High speed processing with an operation-dedicated processor included.

(4) Various special modules that enlarge the range of application of the PLC.

2) GM3/4-CPUA features :

(1) High speed operation processing

High speed processing of 0.2 μS/step with an operation-dedicated processor included.

(2) Heightened Self-diagnosis

Cause of errors is easily found as error codes has been more divided in accordance with their contents.

(3) Restart mode setting

The User can set Cold/Warm/Hot restart mode in accordance with the environment. Especially, the User can set a allowed time in the Hot restart mode for exact control of the process.

(4) Debug operation

On-line debugging is available if the PLC operation mode is set to debug operation mode.

Debugging functions :

- Executed by one instruction.
- Executed by the break-point settings
- Executed by the device status
- Executed by the specified scan times

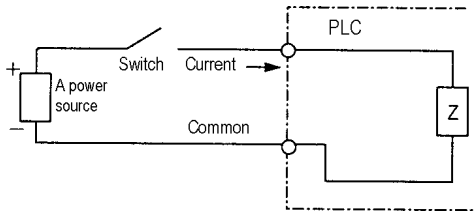
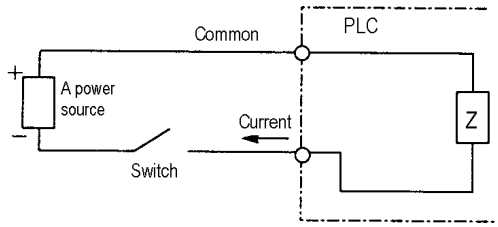
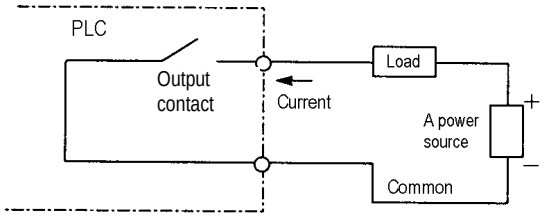
(5) Various Program Executions

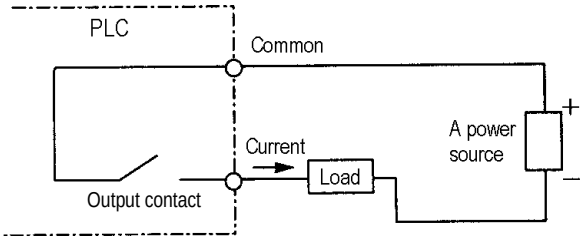
Time driven task, external and internal contact task programs as well as scan program can be executed by setting the execution condition. The user can set variously the program execution mode.

1.3 Terminology

The following table gives definition of terms used in this manual.

Terms	Definition	Remarks
Module	A standard element that has a specified function which configures the system. Devices such as I/O board, which inserted onto the mother board or base unit.	Example) CPU module Power Supply module I/O module
PLC system	A system which consists of the PLC and peripheral devices. A user program can control the system.	
Cold Restart	To restart the PLC system and user programs after all of the data(Variables and programs of I/O image area, of internal register, of timer of counter) were set to the specified conditions automatically or manually.	
Warm Restart	In the warm restart mode, The power supply Off occurrence will be informed to the user program and the PLC system restarts with the previous user-defined data and user program after the power supply Off.	
Hot Restart	After a power supply Off, the PLC system return all of the data to the previous status within maximum allowed time and restarts.	
I/O Image Area	Internal memory area of the CPU module which used to hold I/O statuses.	
Watch Dog Timer	Supervisors the pre-set execution times of programs and warns if a program is not completed within the pre-set time.	
Function	Operation Unit which outputs immediately its operation result of an input, while four arithmetic operations comparison operation store their results in the inside of instructions.	
Function Block	Operation Units which store operation result in the inside of instruction such as timer and counter and use the operation results which have been stored through many scans.	
Direct Variable	Variables used without separate declaration of names and type. I.Q.M area correspond to this variable	Example) • %IX0.0.2 • %QW1.2.1 • %MD1234

Terms	Definition	Remarks
Symbolic Variable	Variables used after the user's definition of their names and types. Declarations as 'INPUT_0' = %IX0.0.2, 'RESULT = %MD1234' makes INPUT_0 and RESULT be able to used instead of %IX0.0.2 and %MD123 in programming.	
GMWIN	A peripheral device for the GLOFA-GM series. It executes program creation, edit, compile and debugging.	
FAM	Abbreviation of the word 'Factory Automation Monitoring S/W'. It is used to call S/W packages for process supervision.	
Task	It means startup conditions for a program. There are three types of plus cycle task, internal junction task and external junction task. External junction task starts by the input signals of external input modules.	
RTC	Abbreviation of the word 'Real Time Clock'. Used to call a general IC which includes clock function.	
Sink Input	Current flows in from the switch to the PLC input terminal if a input signal turns on. 	
Source Input	Current flows in from the PLC input terminal to the switch if a input signal turns on. 	
Sink Output	Current flows in from the load to the output terminal if the PLC output junction turn on. 	

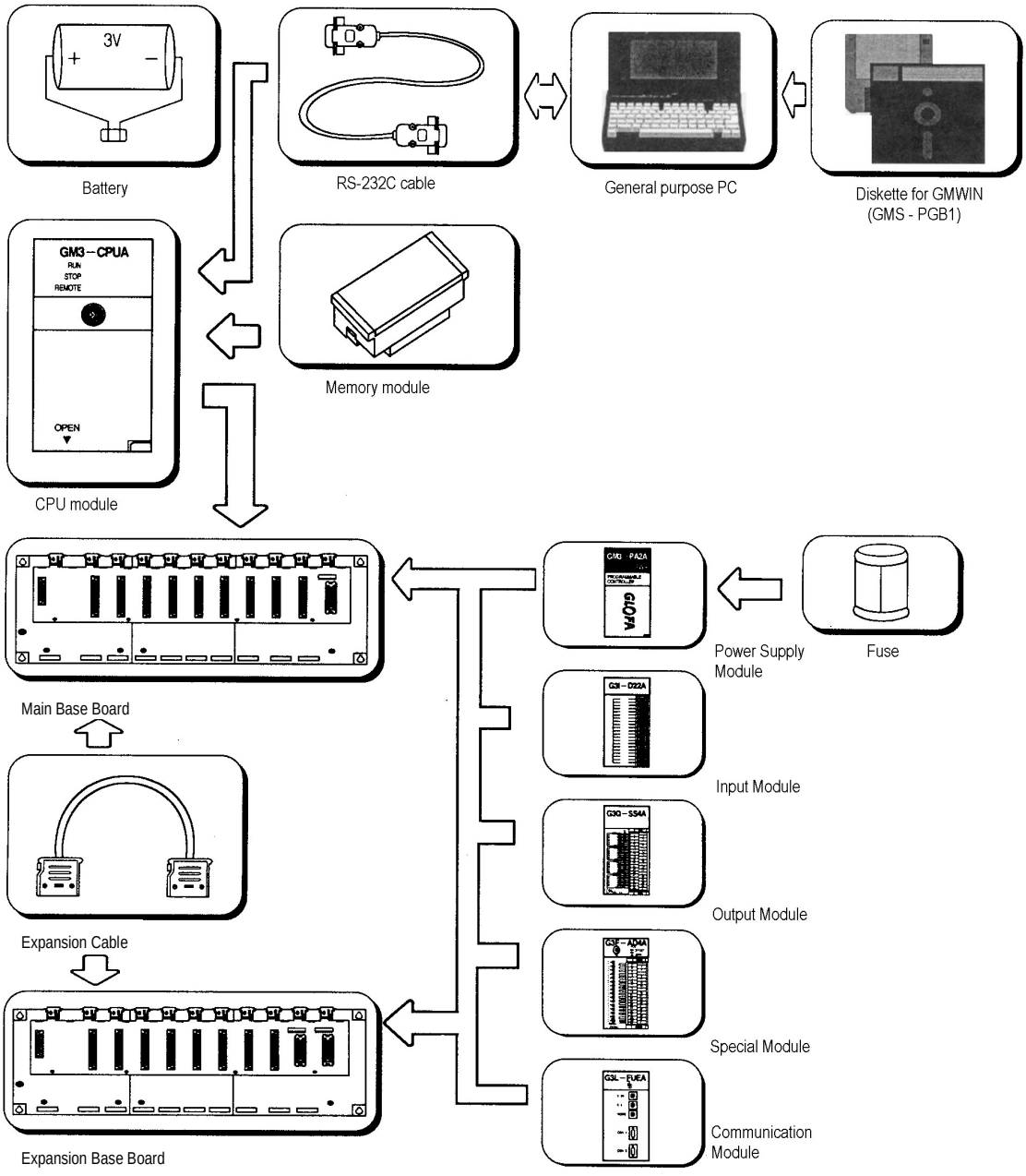
Terms	Definition	Remarks
Source Output	Current flows in from the output terminal to the load if the PLC output junction turn on. 	
Fnet	Fieldbus Network	
Cnet	Computer Network	
Mnet	Mini-MAP Network	

Chapter 2. SYSTEM CONFIGURATION

The GLOFA-GM3/4 series has various units suitable to configuration of the basic, computer link and network systems. This chapter describes the configuration and features of each system.

2.1 Overall Configuration

The following shows the overall configuration of the GLOFA-GM3/4 series.



2.2 System Configuration Component Units List

The following table shows components units configuration of GLOFA-GM3/4 series.

2.2.1 GM4 series Configuration

Items	Models	Description		Remarks
CPU module	GM4-CPUA	• Maximum I/O points: 1,024		
Digital input module	G4I-D22A	• 16-point 12/24 VDC input module(current source/sink input)		
	G4I-D22B	• 16-point 12/24 VDC input module(current source input)		
	G4I-D24A	• 32-point 12/24 VDC input module(current source/sink input)		
	G4I-D24B	• 32-point 12/24 VDC input module(current source input)		
	G4I-A12A	• 16-point 110 VAC input module		
	G4I-A22A	• 16-point 220 VAC input module		
Digital output module	G4Q-RY2A	• 16-point relay contact output module(2 A)		
	G4Q-TR2A	• 16-point transistor output module(0.5 A, sink output)		
	G4Q-TR4A	• 32-point transistor output module(0.1 A, sink output)		
	G4Q-SS2A	• 16-point triac output module(1 A)		
	G4Q-SS4A	• 16-point triac output module(0.6 A)		
Main base unit	GM4-B04M	• Up to four modules can be mounted.		
	GM4-B06M	• Up to six modules can be mounted.		
	GM4-B08M	• Up to eight modules can be mounted.		
	GM4-B12M	• Up to twelve modules can be mounted.		expansion impossible
Expansion base unit	GM4-B04E	• Up to four modules can be mounted.		
	GM4-B06E	• Up to six modules can be mounted.		
	GM4-B08E	• Up to eight modules can be mounted.		
Memory module	G4M-M032	• Flash memory (32Kstep)		
Power supply module	GM4-PA1A	Input 110 VAC	• 5 VDC(1) : 4 A, 5 VDC(2) : 1 A • 24 VDC : 0.7 A	5 VDC(1) for I/O modules 5 VDC(2) for peripheral devices
	GM4-PA2A	Input 220 VAC		
	GM4-PA1B	Input 110 VAC	• 5 VDC : 3 A, 24 VDC : 0.5 A	
	GM4-PA2B	Input 220 VAC		
Expansion cable	G4C-E041	• 0.4 m long		
	G4C-E041	• 1.2 m long		
	G4C-E041	• 3 m long		

Items		Models	Description	Remarks
Special modules	A/D conversion module	G4F-AD2A	• Voltage/current input : 4 channels • DC -10 to 10V / DC -20 to 20 mA	
	D/A conversion module	G4F-DA1A	• Voltage/current input : 2 channels • DC -10 to 10V / DC -4 to 20 mA	
	High speed counter module	G4F-HSCA	• Counting range: 0 to 16,777,215(24 bit binary) • 50 KHz, 1 channel	
	Positioning module	G4F-POPA	• Pulse output, 1 axis control	
	Thermocouple input module	G4F-TC2A	• Temperature sensor: seven types(K, J, E, T, B, R or S) • Input point: 4 channels	
	Temperature-measuring resistor input module	G4F-RD2A	• Temperature sensor: Pt 100, Jpt 100 • Input point: 4 channels	
	PID control module	G4F-PIDA	• Controls maximum 8 loops	
	Analog timer module	G4F-AT3A	• Timer point: 8 points • Setting value range: 0.1 to 1.0 sec, 1 to 10 sec, 10 to 60 sec, 60 to 600 sec	
	Interrupt input module	G4F-INTA	• Input point : 8 points	
Communications modules	Fnet I/F module	G4L-FUEA	• For Fnet I/F • 1 Mbps base band • For twisted cable	
		GOL-FUEA		
	Fnet remote I/F module	G4L-RBEA	• For Fnet remote I/F • For twisted cable	
	Standalone remote I/F module	GOL-SMIA	• 16-point 12/24 VDC input	
		GOL-SMQA	• 16-point relay output (1 A)	
	Repeater	GOL-EREA	• For Fnet	
	Optic converter	GOL-FOEA	• Optic/Electric converter	
	Active coupler	GOL-FAPA	• Power supply board for active coupler	
		GOL-FABA	• Base unit for active coupler	
		GOL-FACA	• Card for active coupler	
		GOL-FADA	• Dummy card for active coupler	
	Computer link module	G4L-CUEA	• RD-232C / RS-422 : 1 channel for each	
Others	Pseudo input switch	G4S-SW16	• 16-point pseduo switch for GM4 input	
	Dust protection module	GM4-DMMA	• Keeps unused slots from dust	

2.2.2 GM3 series Configuration

Items		Models	Description		Remarks
CPU module		GM3-CPUA	• Maximum I/O points: 2,048		
Digital input module		G3I-D22A	• 16-point 12/24 VDC input module(current source/sink input)		
		G3I-D28A	• 64-point 12/24 VDC input module(current source input)		
		G3I-A12A	• 16-point 110 VAC input module		
		G3I-A22A	• 16-point 220 VAC input module		
		G3I-A14A	• 32-point 110 VAC input module		
		G3I-A24A	• 32-point 220 VAC input module		
Digital output module		G3Q-RY2A	• 16-point relay contact output module(2 A)		
		G3Q-RY4A	• 32-point relay contact output module(1 A)		
		G3Q-TR2A	• 16-point transistor output module(2 A, sink output)		
		G3Q-TR4A	• 32-point transistor output module(0.5 A, sink output)		
		G3Q-TR8A	• 64-point transistor output module(0.1 A, sink output)		
		G3Q-SS2A	• 16-point triac output module(2 A)		
		G3Q-SS4A	• 32-point triac output module(1 A)		
Main base board		GM3-B04M	• Up to four modules can be mounted.		
		GM3-B06M	• Up to six modules can be mounted.		
		GM3-B08M	• Up to eight modules can be mounted.		
Expansion base board		GM3-B04E	• Up to four modules can be mounted.		
		GM3-B06E	• Up to six modules can be mounted.		
		GM3-B08E	• Up to eight modules can be mounted.		
Memory module		G3M-M032	• Flash memory (64Kstep)		
Power supply module		GM3-PA1A	Input 110 VAC	• 5 VDC (1) : 6 A, 5 VDC (2) : 1 A • 24 VDC : 1.5 A	5 VDC (1) for I/O modules 5 VDC (2) for peripheraldevices
		GM3-PA2A	Input 220 VAC		
		GM1-PA1A	Input 110 VAC	• 5 VDC (1) : 12 A, 5 VDC (2) : 1 A	
		GM1-PA2A	Input 220 VAC		
Expansion cable		G3C-E061	• 0.6 m long		
		G3C-E121	• 1.2 m long		
		G3C-E301	• 3 m long		
Special modules	A/D conversion module	G3F-AD4A	• Voltage/current input : 16 channels • -10 to 10 VDC / DC -20 to 20 mA		
	D/A conversion module	G3FDA4V	• Voltage output : 16 channels • -5 to 5 VDC / -10 to 10 VDC		
		G3F-DA4I	• Current output: 16 channels • DC 4 to 20 mA		
	Power supply module	G3F-PA1A	110 VAC input	• +15 VDC : 0.5 A • -15 VDC : 0.1 A	
		G3F-PA2A	220 VAC input		

Items		Models	Description	Remarks
Special modules	High speed counter module	G3F-HSCA	• Counting range: 0 to 16,777,215(24 bit binary) • 50 KHz, 1 channel	
	Positioning module	G3F-POPA	• Pulse output, 1 axis control	
		G3F-POAA	• Analog output, 2 axes control	
	Thermocouple input module	G3F-TC4A	• Temperature sensor: seven types(K, J, E, T, B, R and S) • Input point: 16 channels	
	Temperature-measuringresistor	G3F-RD3A	• Temperature sensor: Pt 100, Jpt 100 • Input point: 8 channels	
	PID control module	G3F-PIDA	• Controls maximum 32 loops	
	Analog timer module	G3F-AT4A	• Timer point: 16 points • Setting value range: 0.1 to 1.0 sec, 1 to 10 sec, 10 to 60 sec, 60 to 600 sec	Can be set by 1 point
	Interrupt input module	G4F-INTA	• Input point : 16 points	
Communi cations modules	Fnet I/F module	G3L-FUEA	• For Fnet I/F • 1 Mbps base band • For twisted cable	
		GOL-FUEA		
		G3L-FUOA	• For Fnet I/F • 1 Mbps base band • For optic cable	For mounting inside the computer
	Fnet remote I/F module	G3L-RBEA	• For remote Fnet I/F • For twisted cable	
		G3L-RBOA	• For remote Fnet I/F • For twisted cable	
	Mini-MAP I/F module	G3L-MUEA	• Mini-MAP specifications(FAIS 2.0 adapted) • 5 Mbps carrier band • For coaxial cable	
		GOL-MUEA		For mounting inside the computer
	Computer link	G3L-CUEA	• RD-232C / RS-422 : 1 channel for each	
Others	Pseudo input switch	G3S-SW32	• 32-point pseudo switch for GM3 input	
	Dust protection module	GM3-DMMA	• Keeps unused slots from dust	

Hint :

1) The GM3 series includes the following units besides above units. For details, refer to GM4 series units configuration.

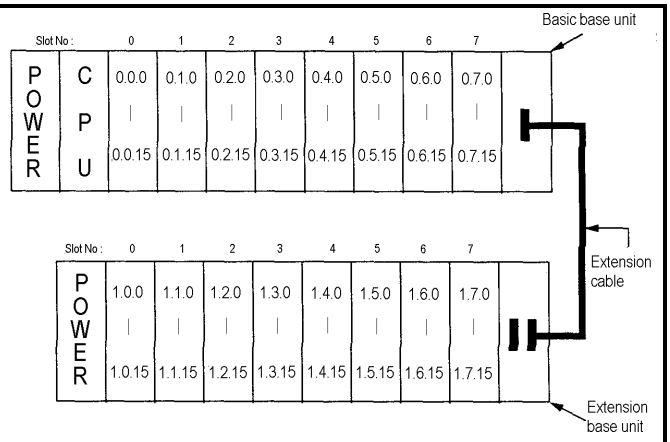
(1) Standalone remote I/F module
(2) Repeater
(3) Optic converter
(4) Active coupler

2.3 System Configuration Types

System configuration is classified into 3 types. First, Basic system that is configured with only basic and expansion base units. Second, Computer link system that executes data communications between the CPU module and a computer by use of a computer link module(G3/4L-CUEA). Third, Network system, which is used to control the PLC and remote I/O modules.

2.3.1 Basic System

The following describes basic system which is configured with a cable connection of only basic base units and expansion base units.

<table>
<tr><td colspan="2">Example of System configuration</td><td colspan="3"> 

(The above figure shows the configuration where 16-input/output modules are loaded.)</td></tr>
<tr><td colspan="2"></td><td>GM4</td><td colspan="2">GM3</td></tr>
<tr><td colspan="2">Maximum Number of Expansion Stages</td><td colspan="3">Three</td></tr>
<tr><td colspan="2">Maximum Expansion Distance</td><td colspan="3">3 m</td></tr>
<tr><td colspan="2">Maximum number of Input/Output modules</td><td colspan="3">32 modules</td></tr>
<tr><td colspan="2">Maximum number of Input/Output points</td><td>• 16-point module loaded: 512 points
• 32-point module loaded: 1,024 points</td><td colspan="2">• 32-point module loaded: 1,024 points
• 64-point module loaded: 2,048 points</td></tr>
<tr><td rowspan="6">Configuration units</td><td>CPU module</td><td>GM4-CPUA</td><td colspan="2">GM3-CPUA</td></tr>
<tr><td>Power Supply module</td><td>GM4-PA1/2A, GM4-PA1/2B</td><td colspan="2">GM3-PA1/2A, GM3-PA1/2aA</td></tr>
<tr><td>Basic Base Unit</td><td>GM4-B04/06/08/12M</td><td colspan="2">GM3-B04/06/08M</td></tr>
<tr><td>Expansion Base Unit</td><td>GM4-B04/06/08E</td><td colspan="2">GM3-B04/06/08E</td></tr>
<tr><td>Expansion Cable</td><td>G4C-E041/121/301</td><td colspan="2">G3C-E061/121/301</td></tr>
<tr><td>I/O module</td><td>G4I-
G4Q-
G4F-</td><td colspan="2">G3I-
G3Q-
G3F-</td></tr>
<tr><td colspan="2">I/O number allocation</td><td colspan="3">64 I/O points have been fixedly allocated for every slot in the base unit.
64 points are allocated to each slot in a base unit whatever it is empty or not.
There's no limitation in the loading location and loading number of special modules, Special modules do not have fixed I/O numbers while a fixed I/O number is allocated to a digital I/O module.
A dedicated function block controls a special module and memory is allocated automatically.</td></tr>
</table>

2.3.2 Computer Link System

Computer Link System communicates data between the CPU module and peripheral devices like a computer or a printer by use of RS-232C and RS-422(or RS-485)interface of the computer link module. The G3L-CUEA is the computer link module for GM3 series, and the G4L-CUEA for GM4 series. For details of computer link module, refer to related User's Manual.

REMARK :

1) Only up to 8 computer link modules can be mounted onto the basic base unit for GM3 series, and 4 modules for GM4 series

2.3.3 Network System

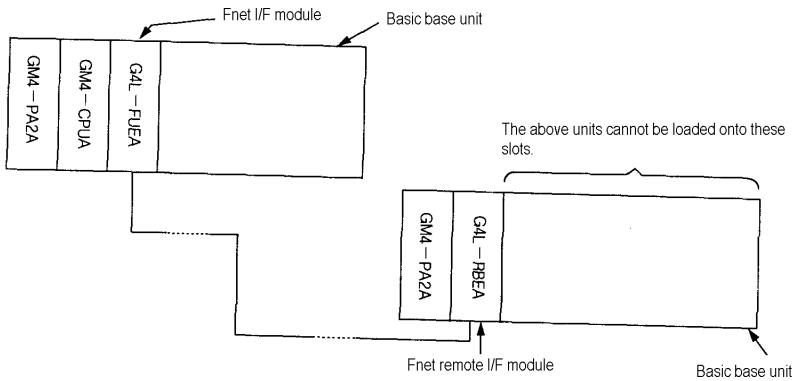
The Network system adapted in the GLOFA series a Fnet system that satisfies the IEC/ISA field bus specifications. Fnet system as a network system is used for data communications between CPU modules and control of remote I/O modules so that distribution of control and concentration of supervision could be easy. For details, refer to Fnet system user's manual.

REMARK :

1) Only up to 4 Fnet I/F modules can be mounted onto the basic base unit for GM3 series, and 2 modules for GM4 series.
2) System configuration method when a remote system is configured by the Fnet remote I/F module is same as the basic system, but the following modules cannot be used.

Item	Module	GM4	GM3
Special modules	PID control module	G4F-PIDA	G3F-PIDA
	Positioning module	G4F-POPA	G3F-POPA G3F-POAA
	Analog timer module	G4F-AT3A	G3F-AT4A
Communications modules	Fnet I/F module	G4L-FUEA	G3L-FUEA
	Computer link module	G4L-CUEA	G3L-CUEA

Configuration Example)



Chapter 3. General Specifications

3.1 General specifications

The following shows the general specifications of the GLOFA-GM series.

<table>
<tr><th>No</th><th>Item</th><th colspan="6">Specifications</th><th>References</th></tr>
<tr><td>1</td><td>Operating ambient temperature</td><td colspan="6">0 ~ 55 °C</td><td></td></tr>
<tr><td>2</td><td>Storage ambient temperature</td><td colspan="6">-25 ~ +75 °C</td><td></td></tr>
<tr><td>3</td><td>Operating ambient humidity</td><td colspan="6">5 ~ 95%RH, non-condensing.</td><td></td></tr>
<tr><td>4</td><td>Storage ambient humidity</td><td colspan="6">5 ~ 95%RH, non-condensing.</td><td></td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibration</td><td colspan="4">Occasional vibration</td><td rowspan="8">10 times per axis,
on X,Y, Z axis</td><td rowspan="8">IEC 1131-2</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td></tr>
<tr><td>10≤ f<57 Hz</td><td colspan="2">-</td><td>0.075 mm</td></tr>
<tr><td>57≤f≤150 Hz</td><td colspan="2">9.8 m/s ^{2}{1 G}</td><td>-</td></tr>
<tr><td colspan="4">Continuous vibration</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td></tr>
<tr><td>10≤f <57 Hz</td><td colspan="2">-</td><td>0.035 mm</td></tr>
<tr><td>57≤f≤150 Hz</td><td colspan="2">4.9 m/s^2 {0.5G}</td><td>-</td></tr>
<tr><td>6</td><td>Shocks</td><td colspan="6">Maximum shock acceleration: 147 m/s^2{15G}
Duration time: 11 ms
Pulse wave: half sine pulse (3 shocks per axis, on X,Y,Z axis)</td><td>IEC 1131-2</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Noise Immunity</td><td>Square wave Impulse Noise</td><td colspan="5">± 1,500 V</td><td></td></tr>
<tr><td>Electronic discharge</td><td colspan="5">Voltage : 4 kV (contact discharge)</td><td>IEC 1131-2,
IEC 801-3</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="5">27 ~ 500 MHz, 10 V/m</td><td>IEC 1131-2,
IEC 801-3</td></tr>
<tr><td rowspan="2">Fast transient/burst noise</td><td>Item</td><td>Power supply</td><td>Digital I/O (>24V)</td><td>Digital I/O (<24V)
Analog I/O interface</td><td>IEC 1131-2,
IEC 801-4</td></tr>
<tr><td>Voltage</td><td>2 kV</td><td>1 kV</td><td>0.25 kV</td><td></td></tr>
<tr><td>8</td><td>Operating ambience</td><td colspan="6">Free of corrosive gases and excessive dust.</td><td>IEC 1131-2</td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="6">2,000 m or less</td><td></td></tr>
<tr><td>10</td><td>Pollution</td><td colspan="6">2</td><td></td></tr>
<tr><td>11</td><td>Cooling method</td><td colspan="6">Air-cooling</td><td></td></tr>
</table>

Hint :

1) IEC(International Electromechanical Commission) : An international civilian institute who establishes international standards in area of electric's and electronics.

2)Pollution : An indicator which indicates pollution degree which determine insulation performance of equipment. Pollution 2 means that nonconductive pollution usually occurs but temporal conduction occurs with condensing

Chapter 4. CPU module

4.1 Performance specifications

The following shows the general specifications of the GLOFA-GM series.

Items			Specifications		Remarks
			GM3	GM4	
Operation method			Cyclic operation of stored program, Interrupt task operation		
I/O control method			Scan synchronous batch processing method(Refresh method)		
Programming language			Ladder Diagram Instruction List Sequential Function Chart		
Number of instructions	Operator		21		
	Basic function		194		
	Basic function block		11		
	Special function block		82	62	
Processing speed	Operator		Refer to Appendix 3.		
	Basic function				
	Basic function block				
Programming memory capacity			256 kbyte(64 kstep)	128 kbyte (32 kstep)	
I/O points			2048 points	1024 points	
Data memory	Direct variable area		4 to 32 kbyte	2 to 16 kbyte	
	Symbolic variable area		116 kbyte - Direct variable area	54 kbyte – Direct variable area	
Timer			No limitations in points. Time range : 0.01 to 4294967.29 sec(1193 hours)		1 point occupies 20 bytes of symbolic variable area.
Counter			No limitations in points Counting range: -32768 to +32767		1 point occupies 8 bytes of symbolic variable area.
Program types	Numbers of program blocks		180		
	Initialization programs		2 (_INT, _H_INIT)		
	Task Programs	Time driven tasks	32		
		External interrupt tasks	16	8	
		Internal task	16		
Operation modes			RUN, STOP, PAUSE and DEBUG		
Restart modes			Cold, Warm, Hot		
Self-diagnostic functions			Watch dog timer, Memory error detection, I/O error detection, Battery error detection, Power supply error detection, etc.		
Data protection method at power failure			Set to 'Retain' variables at data declaration.		
Maximum extension stages			3		
Internal current consumption			130		
Weight			0.42 Kg	0.25 Kg	

4.2 Operation Processing

4.2.1 Operation Processing Method

1) Cyclic operation

A PLC program is sequentially executed from the first step to the last step, which is called scan.

This sequential processing is called cyclic operation. Cyclic operation of the PLC continues as long as conditions do not change for interrupt processing during program execution.

This processing is classified into the following stages.

Stages	Processing
Operation Start	-
Initialization	• Stage for the start of a scan processing. it is executed only one time when the power is applied or reset is executed. It executes the following processing. ▸ I/O modules reset ▸ Execution of self-diagnosis ▸ Data clear ▸ I/O module address allocation or type registration
Input image area refresh	• Input module conditions are read and stored into the input image area before operation processing of a program.
Program operation processing Program start ~ Program end	• Program is sequentially executed from the first step to the last step
Output image area refresh	• The contents stored in the output image area is output to output modules when operation processing of a program is finished.
END processing	• Stage for return processing after the CPU module has finished 1 scan. The following processing are executed. ▸ Self-diagnosis ▸ Change of the present values of timer and counter, etc. ▸ Processing data communications between computer link module and communications module. ▸ Checking the switch for mode setting.

2) Time driven interrupt operation method

In time driven interrupt operation method, operations are processed not repeatedly but at every pre-set interval. Interval, in the GM3/4 CPU module, can be set to between 0.01 to 4294967.29 sec. This operation is used to process operation with a constant cycle.

3) Event driven interrupt operation method

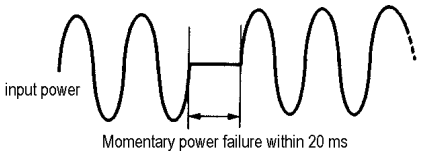
If a situation occurs which is requested to be urgently processed during execution of a PLC program, this operation method processes immediately the operation which corresponds to interrupt program. The signal which informs the CPU module of those urgent conditions is called interrupt signal. The GM3/4 CPU module has two kind of interrupt operation methods, which are internal and external interrupt signal methods.

4.2.2 Operation processing at momentary power failure occurrence

The CPU module detects any momentary power failure when the input line voltage to the power supply module falls down below the defined value.

when the CPU module detects any momentary power failure, the following operations will be executed.

1) Momentary power failure within 20 ms



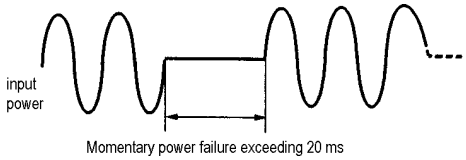
(1) The operation processing is stopped with the output retained.

(2) The operation processing is resumed when normal status is restored.

(3) The output voltage of the power supply module retains the defined value.

(4) The watch dog timer(WDT) keeps timing and interrupt timing normally while the operations is at a stop.

2) Momentary power failure exceeding 20 ms



- The re-start processing is executed as the power is applied.

HINT

1) Momentary power failure

The PLC defining power failure is a state that the voltage of power has been lowered outside the allowable variation range of it. The momentary power failure is a power failure of short interval(several to tens ms).

4.2.3 Scan Time

The processing time from a 0 step to the next 0 step is called scan time.

1) Expression for scan time

Scan time is the addition value of the processing time of scan program that the user has written, of the task program processing time and the PLC internal processing time.

(1) Scan time = Scan program processing time + Task program processing time + PLC internal processing time

- Scan program processing time = The processing time used to process a user program that is not specified to a task program.
- Task program processing time = Total of the processing times of task programs executed during one scan.
- PLC internal processing time = Self-diagnosis time + I/O refresh time + Internal data processing time + Communications service processing time

(2) Scan time differs in accordance with the execution or non-execution of task programs and communications processing, etc.

2) Flag

(1) Scan time is stored in the following system flag area.

- _SCAN_MAX : Maximum scan time (unit : 1 ms)
- _SCAN_MIN : Minimum scan time (unit : 1 ms)
- _SCAN_CUR : Current scan time (unit : 1 ms)

(2) To measure the processing time of the task program for calculation of the scan time, write the number of the task that will be measured to the system run status information flag '_STSK_NUM' in the GMWIN variables monitor mode and then monitor '_STSK_MAX, _STSK_MIN and _STSK_CUR. (For details of system run status information flags, refer to the APP 2.

3) Example of calculation of scan time

The following shows an example of calculation of maximum scan time when the user program has the same structure as shown below and the system executes data communications through communications modules.

- Task : T_SLOW (interval : =T#10 msec,) (priority : = 0,) (task No. := 0)

  PROC_1 (single : = %MX0,) (priority := 3,) (task No. := 48)

  E_INT1 (Interrupt : = 0,) (priority : = 2,) (task No. : = 32)

- Program : program → P0

  program → P1 with task T_SLOW

  program → P2 with task PROC_!

  Program → P3 with task E_INT1

(1) Maximum scan time (_SCAN_MAX) will be measured while communications service through the communications module and monitoring through the GMWIN are being executed under the condition that only the scan program except for task programs has been executed.

(2) In order to measure the execution time of a time driven interrupt program, start the program including time driven interrupt task programs, and then register the flags '_STSK_NUM, _STSK_MAX, STSK_MIN and _STSK_CUR ' and enter '0' to '_STSK_NUM' as the task No. '0", and then measure the value of '_STSK_MAX'.

(3) After stop other task program and start the program including single task program, designate task number 48 to '_STSK_NUM' and start task with GMWIN. Measure the value of '_STSK_MAX'.

(4) After stop other task program and start the program including interrupt task program, designate task number 32 to '_STSK_NUM' and make input of interrupt input module turn on. Measure the value of '_STSK_MAX'.

(5) It is available to measure this by set the priority of measuring task as most significant to prevent from any delay by another task after executing the main program.

(6) If the measured max. operation times are Tp0=17ms, Tp1=2ms, Tp2=7ms, Tp3=2ms, the basic scan time will be 24ms(Tp0 + Tp2) when single task is started during program operation.

Time driven interrupt occurs 2 times in the above case, so scan time is 28ms (Tp0 + Tp2 + Tp1 × 2).

If external interrupt occurs in here, scan time will be 30ms (Tp0 + Tp2 + Tp1 × 2 + Tp3) and max. scan time will be 32ms (Tp0 + Tp2 + Tp1 × 3 + Tp3) because time driven interrupt can be occur 1 time.

If the external interrupt can be occur in 32ms, consider the number of occurrence of time driven interrupt after adding the operation time. (See the timing chart in chap. 4.3.3)

4.2.4 Scan Watchdog Timer

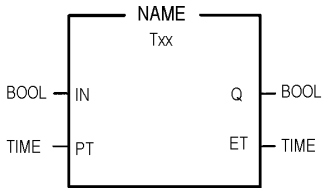
1) Watchdog timer is used to detect a delay of abnormal operation of sequence program. (Watchdog time is set in menu of basic parameter of GMWIN.)
2) When watchdog timer detects an exceeding of preset watchdog time, the operation of PLC is stopped Immediately and all output is off.
3) If an exceeding of preset watchdog time is expected in sequence program, use 'WDT_RST' function. 'WDT_RST' function make elapsed watchdog time as zero.
4) In order to clear watchdog error, using manual reset switch, restarting the PLC and mode change to STOP mode are available.

HINT

Setting range of watchdog : 1 ~ 65,335ms(1ms base)

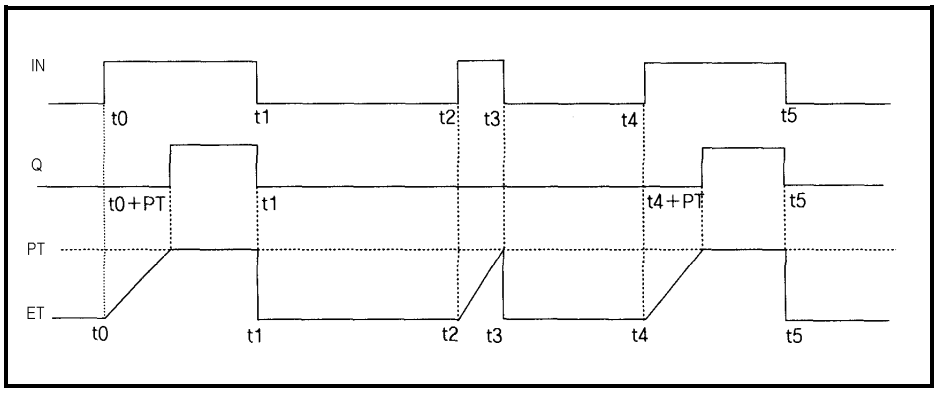
4.2.5 Timer Processing

The CPU module timer is on incremental timer which increase its present value according to the measuring time. Three types of On Delay Timer(TON), Off Delay Timer(TOF) and Pulse Timer(TP) are available.
Its measuring range is 0.001 to 4,294,967,295 sec (1,193 hours) by 1 ms. For details, refer to 'GLOFA-GM Programming'.



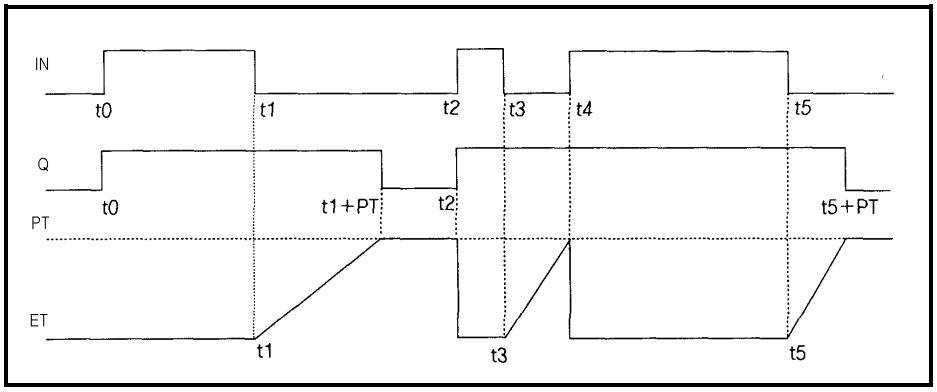
1) On Delay Timer Process Time Change and Contact On/Off)

Timer Process time is newly changed when the timer function block is executed. When the process time reaches the setting time (process time = setting time), the Timer output contact turns on.
On Delay Timer Timing Diagram is shown as below.



2) Off Delay Timer Process Time Change and Contact On/Off

- If input condition turns on, timer output contact(Q) turns on. If input condition turns off, timer process time change starts.
- The process time is newly changed when the timer function block is executed. When the process time reaches the setting time (process time = setting time), the contact (Q) turns off. The following diagram shows Off Delay Timer Timing.



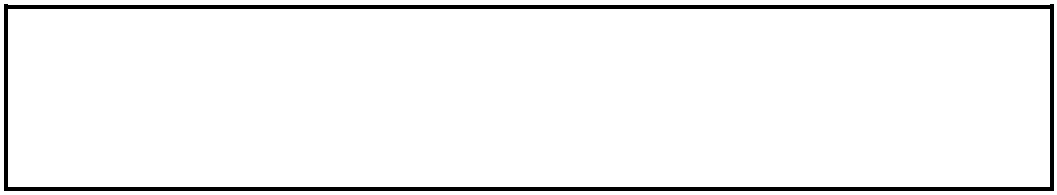
3) Pulse Timer Process Time Change and Contact On/Off

If input condition turns on, output contact (Q) turns on.

The process time is newly changed when the timer function block is executed. When the process time reaches the setting time (process time = setting time), the contact (Q) turns off.

The contact turns off after the setting time regardless of input condition off status.

The following diagram shows pulse timer timing.



4) Timer error

The maximum timer error is

'1 scan time + time from the start of scan to execution of the timer function block".

4.2.6 Counter Processing

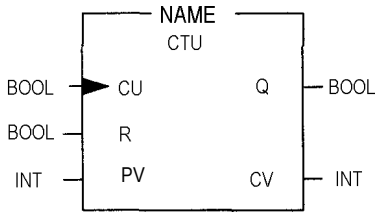
The CPU module counter increment/decrement the present counting value by the detection of rising edge(off→on) of input signal. Three types of counter are increment counter, Decrement counter and Increment-Decrement Counter. For details, refer to 'GLOFA – GM Programming'.

- The Increment counter is a counter which increment the present counting value
- The Decrement counter is a counter which decrement the present counting value
- The Increment-Decrement counter is a counter which compares the counting values of two input conditions.

1) Counter Present Value Change and Contact On/Off

(1) Increment Counter

- It should have Input condition (CU), reset condition (R) and setting value (PV).

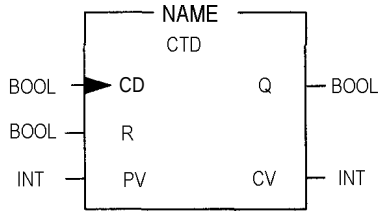


- If the counting value (CV) increments and reaches the setting value(PV) the output contact (Q) turns on.

  When the reset signal is turned on, the counting value is set to '0' and the output contact (Q) turns off.

(2) Decrement Counter

- It should have input condition (CU), load (LD) and setting value (PV).

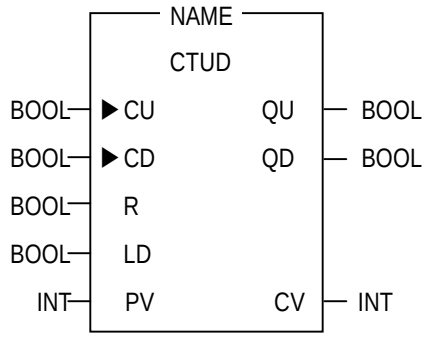


- If the counting value (CV) decrements and reaches '0', the output contact (Q) turns on.

  If the reset signal is turned on, the counting value is set to the setting value and the output contact (Q) turns off.

(3) Increment/Decrement Counter

- It should have Increment input condition (CU), Decrement input condition (CD), load (LD) and setting value (PV).



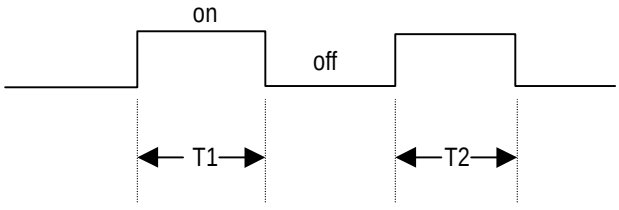
- If reset signal(R) turns on, counting value (CV) is set to '0'.
- If load signal(LD) turns on, counting value is set to setting value(PV).
- It is increased by 1at the rising edge of increment input(CU) and decreased by 1 at the edge of decrement input(CD). If counting value(CV) is equal or larger than setting value(PV),QU will be on, and if counting value(CV) is equal or less than setting value(PV),QD will be on.

2) Counting speed

- The counting speed is decided by scan time and it will be counted when on time or off time of input condition is larger than each scan time.

Max. Counting speed (Cmax.) = n / 100 × 1 / ts [pps] [n : Duty(%), ts : scan time(s)]

- Duty is percent of on time / off time.



T1 ≤ T2 : n = T1 / (T1+T2) × 100 [%]

T1 > T2 : n = T2 / (T1+T2) × 100 [%]

4.3 Program

4.3.1 Program Configuration

A program consists of all of the function elements that is needed to execute a particular control. It is to be stored in the internal RAM of the CPU module or the flash memory of the memory module.

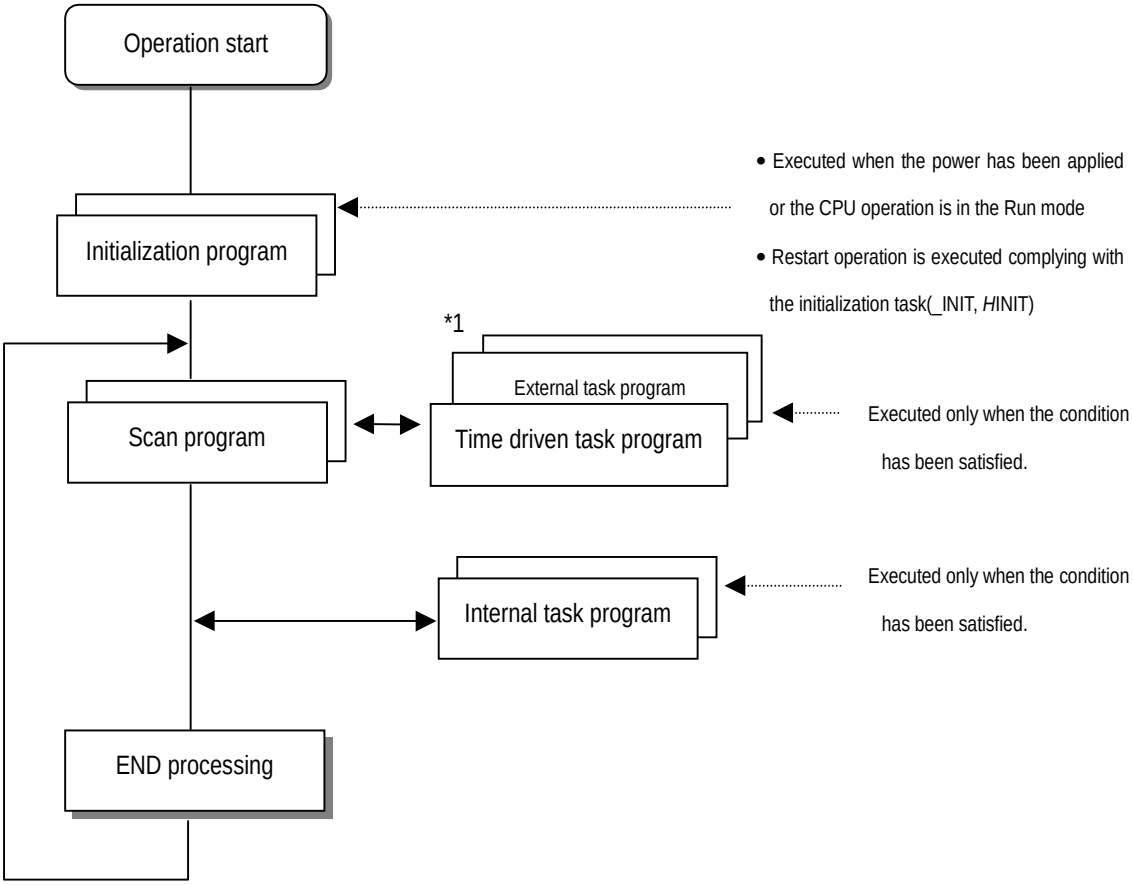
The function elements are classified as below.

Function Elements	Processing Operation
Initialization program	• Executed when the power is applied or the CPU operation is transited to the RUN mode. • Executes the initial/fixes data setting for execution of scan program and the initialization of peripheral devices on special modules. • The execution method of initialization differs according to the setting of Restart Mode, etc.
Scan program	• Processes the constantly repeated signals which are executed every scan.
Time driven task program	• When the following time conditional processings are required the program is executed complying with the time interval setting. ▸ In case that the processing need a shorter interval than that of average one scan processing time. ▸ In case that the processing need a longer interval than that of average one scan processing time. ▸ In case that the processing should be executed by the specified time interval.
Event driven task program	• A shorter processing is executed for internal or external interrupt.

4.3.2 Program Execution Procedure

The followings explain the program execution procedure when the power is applied or the CPU module key switch is in the RUN status.

Program operation processing is executed as the procedure given below



HINT

1) *1 : In the GLOFA PLC, the time driven task programs and event driven task programs are called task program.
Event driven programs are classified into single task(internal interrupt) or interrupt task (external interrupt) according to the S/W and H/W interrupt signaling method.

1) Initialization program

(1) Function

- The Initialization program initializes the program to execute scan and task programs.
- The initialization can be executed with the restart mode which has been specified for program.

(2) Restart mode execution conditions

- The initialization tasks can be specified as below complying with the purpose of the initialization task.
  - Program for Cold/ Worm restart started by the _INIT task
  - Program for Hot Restart : started by the _H_INIT task

(3) Cold/ Warm Restart program

- The initialization program specified to _INIT task is executed with cold or warm restart mode when the operation starts.
- This initialization program executes the operations repeatedly until the setting conditions are satisfied(that is, until the Flag_INIT_DONE in the initialization program turns on). However, the I/O refresh is still executed.

(4) Hot restart mode program

- Task programs specified to the _H_INIT task executes initialization with the hot restart mode when momentary power failure has been occurred.
- This initialization program executes the operations repeatedly until the setting conditions are satisfied(that is, until the flag _INIT_DONE in the initialization program turns on). In this case, I/O refresh will not be executed. Therefore, the operation is executed with the data that has been stored into the input image area before a momentary power failure had occurred.

2) Scan program

(1) Function

- In order to process signals which repeats constantly, the program executes its sequential operation repeatedly from the first step to the end step.
- If the interrupt task execution condition has been satisfied by a time driven task or event driven task module during scan program execution, the program that is under execution will be temporary stopped and the corresponding task program will be executed.
- If the scan program has been completely executed, the single task(internal interrupt) execution condition will be checked and the corresponding task program will be executed.

(2) configuration

- Up to 180 scan programs can be used.

(If task programs are used, the usable number is reduced as many as that of the used task programs)

- Program has been not specified to initialization or task program when writing that program, it will be automatically specified to scan program.
- Scan program has lowest execution priority and the priorities of scan program are determined their registration sequence in the GMWIN screen when writing those programs.

3) Task program

(1) Function

- In order to process internal/ external signal which occurs periodically or non-periodically, the task program temporarily stop the operation of scan program and processes first the corresponding function

(2) Types

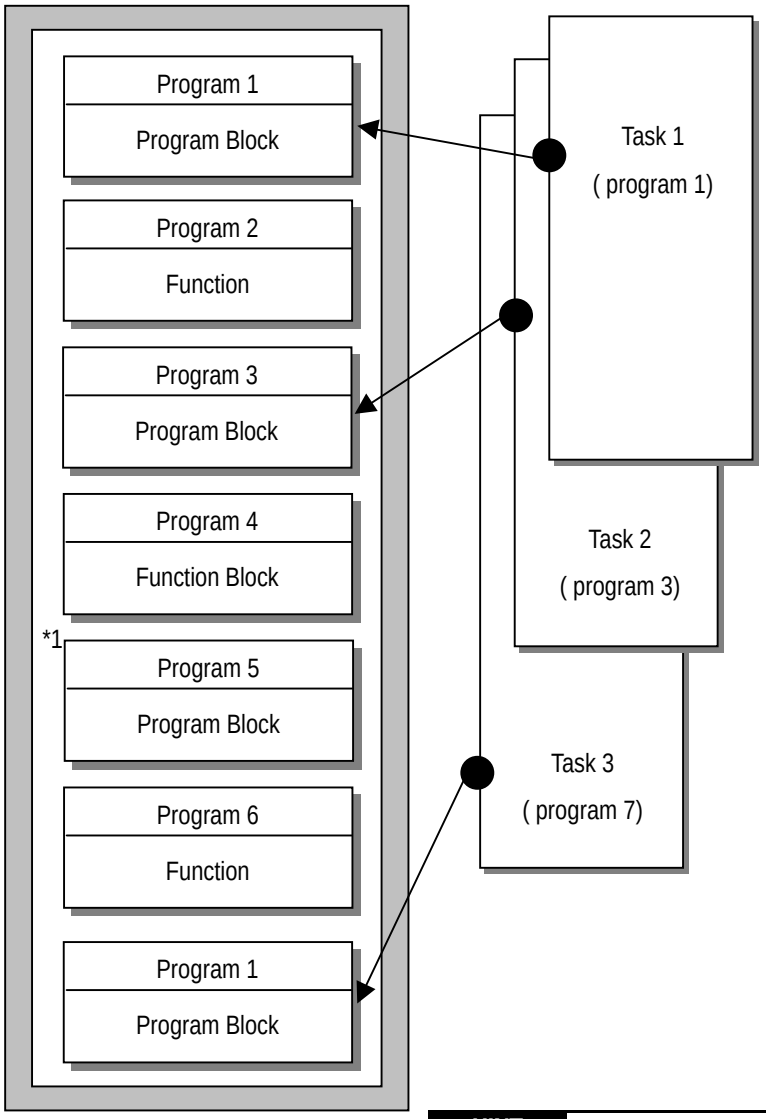
- Task programs are classified into the three types as below
  - Time driven task program : Up to 32 programs are applicable
  - Single (internal) task program : Up to 16 programs are applicable
  - Interrupt (external) task program : Up to 8 programs for GM4 series and 16 programs for GM3 series are applicable
- Time driven task program
  - The program is executed by the time internal set before
- Single (inernal) task program
  - The corresponding program will be executed if the rising edge of the internal contact occurs in the program
  - The detection of the rising edge will be executed after the scan program has been processed.
- Interrupt (external) task program
  - The program is executed according to the external signal a input to the interrupt module

HINT

1) Refer to section 4.3.3 task for details of task program

4.3.3 Task

The followings explain the program structure and tasks of the GMWIN, that is, the GLOFA-GM programming S/W, in order to give an understanding of the task function



HINT

1) A task executes the some function as the control panel which are used to execute programs. Each task consists of one or more program blocks in the three types of program. Those programs are called task programs A program to which a task has not been specified as marked with '*1' will be automatically specified to scan program

1) Task types and functions

The following table show the types and functions of tasks

Type / Specifications	Time driven task	External interrupt task	Internal interrupt task
Number	32	GM4 : 8 / GM3 : 16	16
Start up condition	Time driven interrupt (up to 4,294,967.29sec by the 10msec)	Rising or falling edge of interrupt module input contact	The rising edge of the BOOL variable data which has been specified of buffer data
Detection and execution	Executed periodically as setting time	Immediately executed when an edge occurs in the interrupt module	Executed with edge detection after scan program has been finished
Detection delay time	Up to 5msec delay	Maximum 5msec delay + Interrupt module delay(Within 0.5msec	Delayed for the same time as maximum scan time
Execution priority	Level 0 to 7 (Level 0 has highest priority)	Level 0 to 7	Level 0 to 7

2) Task program processing Method

The following explains the common processing method and instructions for task programs

(1) Task program characteristics

- The task program will be executed when a execution condition is satisfied while the scan program is repeatedly processed at every scan. Be sure to consider that point when writing a task program
- For example, if a timer and a counter have been used in a 10 sec cycle time driven task program, the timer can occur up to 10 sec error and an input which has been changed within 10 sec will not be counted because the counter checks its input status every 10 sec

(2) Execution priority

- The higher priority task program will be first executed if several tasks are ready for their execution If same priority tasks are ready, the FIFO will be applied.
- If a newly invoked task has higher priority than that of existing tasks which are under execution, they are temporary stopped and task has higher priority will be executed.
- When determining the priority of a task program, consider the characteristics, importance and urgency of the program

(3) Processing delay time

The following factors influence on the processing delay of task program, consider the characteristics, importance and urgency of the program

- Task detection delay (Refer to the detailed description of each task)
- Execution delay due to the execution of prior task programs
- Delay due to the execution of higher priority task programs while executing task programs

(4) Relationship of task program to initialization or scan program

- User defined tasks will not start while the initialization task program is being executed. In case of hot restart, the ready tasks before the power failure will be executed after the power has been restored.
- As scan program has the lowest priority, if a task is invoked the scan program will be stopped and the task programs will be processed prior to them. Therefore, if tasks are invoked many times or concentrated sometimes the scan time may be extended abnormally. Be cautious when setting task conditions.

(5) Protection of the programs under execution from task programs

- If problems can be occur in case that program lose its execution continuousness by the task programs which have higher proprieties, the execution of task programs can be partly perverted For program protection, use the DI function(Task program start-up disable) or EI function(task program start-up enable)

3) Time driven task program processing method

The followings explain the processing method of a task program when its task condition(start-up condition) has been set to be driven by time.

(1) Settings that have to be set for the task

- Set the task execution cycle and its priority which are used as start-up conditions for the task programs to be executed. Check the task NO. for task control

(2) Time driven task processing

- The corresponding time driven interrupt task program will be executed every setting time internal (execution cycle).

(3) Precautions for using the time driven task program

- While a time driven task program is being executed or ready for its execution, if a same priority task program has been invoked to be executed the newly invoked task will be ignored, the representative task collision warning flag (_TASK_ERR) will be set to ON, the detailed system error flag(_TC_BMAP[n] will be set to ON at its corresponding location and occurrence time of the time driven tasks whose execution requests have been ignored will be written at its corresponding location of the flag _TC_CNT[n].
- The timer that invokes the execution request for time driven task programs will be incremented only when the operation mode is in the RUN mode

  If the RUN mode has been changed into the PAUSE mode while operating with the RUN mode, and then the operation mode has been changed again into the RUN mode, the operation time spent with the PAUSE mode and the power failure time of Hot restart will all be ignored.
- When setting the execution cycle for a time driven task program, be cautious that execution requests for many time driven task programs can occur. If four time driven task programs of cycle 2, 4, 10 and 20sec are used, four execution requests will occur every 20 sec and scan time can be momentarily extended.

4) External contact program processing method

The following explains in the case that the task(start-up condition) of a task program has been set to an external interrupt contact signal.

(1) Settings that have to be set for the interrupt module

- Set the dip switch to rising edge or falling edge at each contact of the interrupt module complying with the requested conditions.

(2) Settings that have to be set in the task

- Set the contact No. of interrupt module and priority module in the task that will be used as start-up conditions of the task programs to be executed. Check the task No. for task control.

(3) External contact task processing

- If an interrupt occurs in the interrupt module by a signal which is applied from the external, the CPU module recognize this signal and executes the task program which are invoked by the contact at which the signal has been occurred.

(4) Precautions for using an external contact task.

- While a task program which are invoked by an interrupt module contact is being executed or ready for its execution, if an execution request of a task program has been occurred to the same input contact then the newly invoked task will be ignored, the representative task collision warning flag(_TASK_ERR) will be set to ON, the detailed system error flag(_TC_BAMP[n]) will be set to ON at its corresponding location and the occurrence time of the external task whose execution request has been congested.
- Execution request for a task program can be accepted only when the operation mode is in the RUN mode. That is, if the RUN mode has been changed into the PAUSE mode while operating with the RUN mode and the operation mode has been changed into the RUN mode again, all execution requests occurred during the operation with the PAUSE mode will be ignored.

5) Internal task program processing method

The following explains the processing method when the task (start-up condition) of a task program has been set to the contact of direct variable area(I, Q or M) or automatic variable area.

(1) Settings that have to be set for the task.

- Set the contact and priority that will be the startup conditions of the task program that will be executed. Check the task No. for task control .

(2) Internal contact task processing

- After the execution of scan program has been completed in the CPU module, the contacts that are the start-up conditions of the task program will be checked and the internal task programs where rising edge has been occurred will be executed with its priority. Task program will be executed only once when rising edge is detected.

(3) Precautions when using an internal task program.

- The internal task program is executed when scan program has finished its execution. Therefore, though the execution condition for the internal task program has been invoked in the scan program or task program(time driven, external) the task (start-up condition) will not be immediately executed but will be executed when scan program has finished its execution.

- If execution of an internal task program is requested, the execution conditions will be checked when scan program has finished its execution. Therefore, if an internal task execution conditions, during 'one' scan, has been occurred and disappeared (if the specified contact has been turned from OFF to ON, and then from ON to OFF) by scan program or (time driven or external) task program the task will not be executed as the execution condition can not be detected at the time that execution conditions are being checked.

6) Task processing at momentary power failure

- If the momentary power failure time has been longer than the allowable hot restart setting time and the system restarts with cold restart or warm restart mode, the ready tasks and the tasks invoked during the power failure will all be ignored and only the tasks from the start time will be processed.
- In case of the power failure of 20 msec or less, the ready tasks before the power failure will be executed, a time driven task will be invoked with calculation of the power failure time, and time driven tasks invoked repeatedly before the power failure will be ignored.

7) Examination on task program

After writing down a task program, be sure to examine the following items.

(1) Task setting has been correctly done?

If tasks are invoked more frequently than necessary or several tasks are invoked simultaneously within one scan, the scan time become longer and irregular. In case that the task setting cannot be changed, check the maximum scan time.

(2) Task priorities are properly arranged?

The lower priority tasks still may not be processed after its time due to delay by higher priority tasks. In some cases, if the prior tasks have been delayed and next task occurs task collision can occur. Set the priority with due consideration of items such as urgency and execution time of a task.

(3) Task programs are written as shortly as possible?

If execution time of a task program is long, the scan time may become longer and irregular and also collision of task programs may occur. Therefore, write task programs as shortly as possible.

(4) Protection of lower priority programs against higher priority program isn't needed during execution of those programs.

If the priority of a task program (or a scan program) has been set to lower priority and other tasks must not interrupt during its execution, use the function 'DI' and 'EI' to protect the program partly. When processing global variables used commonly in other programs, special modules or communications modules, problems can occur.

HINT

1) For examination on processing speed of scan program and task program, refer to the 'Scan time Calculation Example in the Section 4.2.3 'Scan Time'.

8) Example of program configuration and processing

When the task and program have been registered as below,

- Task registration : T_SLOW (interval : T#10ms, priority : = 0)

  PROC_1 (single : %MX0, priority : = 3)

  E_INT1 (interrupt : 0, priority : = 0)

- program registration : program → P0

  program → P1 with the task T_SLOW

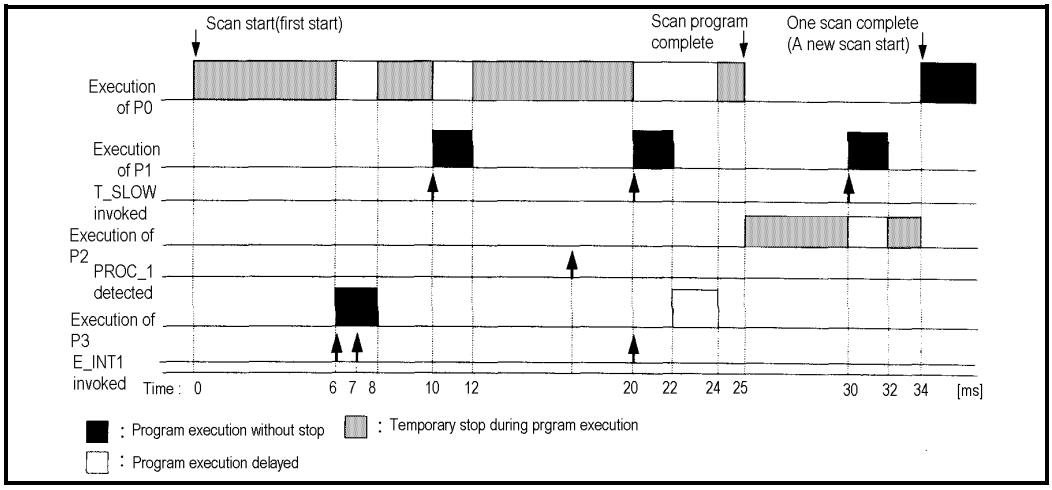
  program → P2 with the task PROC_1

  program → P3 with the task E_INT1

If program execution time is equal to external interrupt occurrence time :

- Execution time for each program : P0 = 17 msec, P1 = 2 msec, P2 = 7 msec, P3 = 2 msec
- Interrupt E_INT occurrence time : Occurred at the 6, 7, 20 msec after the operation started.
- PROC_1 : Invoked during execution of scan program

Program execution is shown as below.



- Processing with time

  0 [msec] : Scan starts and the scan program P0 starts its execution.
  0 to 6 [mses] : The program P0 is being executed.
  6 to 8 [msec] : Execution request for P3 is input, and P0 is stopped and P3 is executed. Execution request for P1 by E_INT1 at the 7 [msec] is ignored as the P2 is being executed.
  8 to 10 [msec] : P3 finishes its execution and the P0 stopped continues its execution.
  10 to 12 [msec] : P0 is stopped and P1 is executed due to execution request for P1.
  12 to 20 [msec] : P2 finishes its execution and the P0 stopped continues its execution.
  20 [msec] : Execution requests for P1 and P3 are simultaneously exist, but the higher priority P1 is executed and P3 is ready for its execution.
  20 to 22 [msec] : P0 is stopped and P1 is executed.
  22 to 24 [msec] : P1 finishes its execution and the higher priority P3 is executed before P0.
  24 to 25 [msec] : P3 finishes its execution and the P0 stopped completes its execution.
  25 [msec] : Execution request for P2 is checked at the finish time of the scan program (P0) and P2 is executed.
  25 to 30 [msec] : The program P2 is executed.
  30 to 32 [msec] : Execution request for P1 is input and P2 is stopped and P1 finishes its execution.
  32 to 34 [msec] : P1 finishes its execution and the P2 stopped finishes its execution.
  34 [msec] : A new scan starts. (P0 starts its execution.)

4.3.4 Error Handling

1) Error Classification

Errors occur due to various causes such as PLC system defect, system configuration fault or abnormal operation result. Errors are classified into fatal error mode, which stops system operation for system stability, and ordinary error mode, which continues system operation with informing the user of its error warning.

The main factors that occurs the PLC system error are given as followings.

- PLC hardware defect
- System configuration error
- Operation error during execution of the user programs
- External device malfunction

2) Operation mode at error occurrence

In case of error occurrence, the PLC system write the error contents the corresponding flags and stops or continues its operation complying with its operation mode.

(1) PLC hardware defect

The system enters into the STOP state if a fatal error such as the CPU module defect has occurred, and continues its operation if an ordinary error such as battery error has occurred.

(2) System configuration error

This error occurs when the PLC hardware configuration differs from the configuration defined in the software. The system enter into the STOP state.

(3) Operation error during execution of the user programs

If the numeric operation error of these errors occurs during execution of the user programs, its contents are marked on the error flags and the system continues its operation. If operation time overruns the watch dog time or I/O modules loaded are not normally controlled, the system enters into the STOP state.

(4) External device malfunction

The PLC user program detects malfunctions of external devices. If a fatal error is detected the system enters into the STOP state, and if an ordinary error is detected the system continues its operation.

HINT

1) In occurrence of a fatal error the state is to be stored in the representative system error flags, and an ordinary error in the representative system warning flags.
2) For details of flags, refer to Appendix 2. Flag List.

4.3.5 Precautions when using special modules

This system offers convenience and high performance in using special modules compared with the existing methods. Therefore, take some precautions when composing the system. Check the system after the following items have been thoroughly understood.

1) Special module programming

(1) Special function block is offered for each special module to make programs concise and to prevent errors in writing down the user program.

(2) Function blocks are largely of two types. 'Initialization' function block for initializing special modules and 'control' function block for control of the operations of special modules. Function block functions as an interface between the user program data and the special modules. As it includes the function that watches the operation status of special modules and indicates the error status, other separate error detection program does not have to be written.

(For detailed description of function block, refer to the User's Manuals of special modules and GLOFA-GM instructions.)

2) Special Module Initialization

This means to define the operations of a special module. It is done with 'initialization' function block. Generally, it specifies the data range to used channel, resolution or filtering method, etc. It defines the hardware characteristics and only one time execution at system start is sufficient.

HINT

1) As the initialization should be finished before the scan program starts its execution, its program should be written in the restart program (initialization task program). If the hot restart is used, the same initialization program should also be written in the hot restart initialization program.

3) Control of special modules

In control the operations of special modules, write the program using function blocks which correspond to the operations that have to be controlled. These function blocks can locate at any place within the program.

HINT

1) If a power failure occurs in the base unit where special units are loaded, special modules data are removed. Therefore, data should be newly written down in the program.
2) If hot restart is used the data in the other parts of the system continues. However, output modules such as the 'D/A conversion module' output standard output of the STOP mode before new data are to be written in the program. If data are written to the special modules every scan normal output is immediately output, but standard output maintains if the output data are changed or written periodically. In this case, in order to maintain continuity of output, it is recommended that an output data restore program be written in the hot restart program.

4) Control of special module on the remote base unit

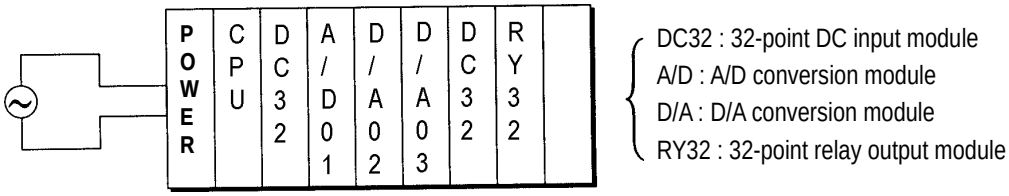
- In order to the operations of special modules on the remote base unit, use remote function blocks offered for control of each module in programming. Initialization and control of the module are similar with those of special modules on the extension base unit.
- As, in remote base unit, mounting or dismounting is possible during its operation, initialization and data restore programs are requested, which should have the condition flags of the remote base unit as its start-up conditions.

5) Restart Program Example

(1) System Configuration

The followings give an example for writing the initialization program of the system where a special module has been loaded onto its basic base unit shown as below figure.

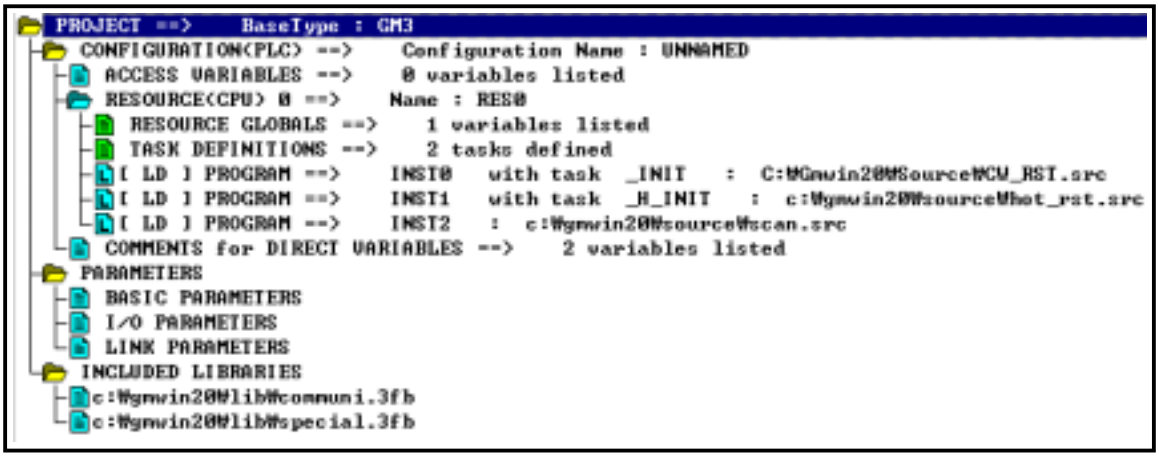
The followings describe an example for writing the 'cold/warm restart program', 'hot restart program' and 'scan program' for the scan program where the 'D/A 02' outputs data every scan and the 'D/A 03' outputs data only when the data has been changed.



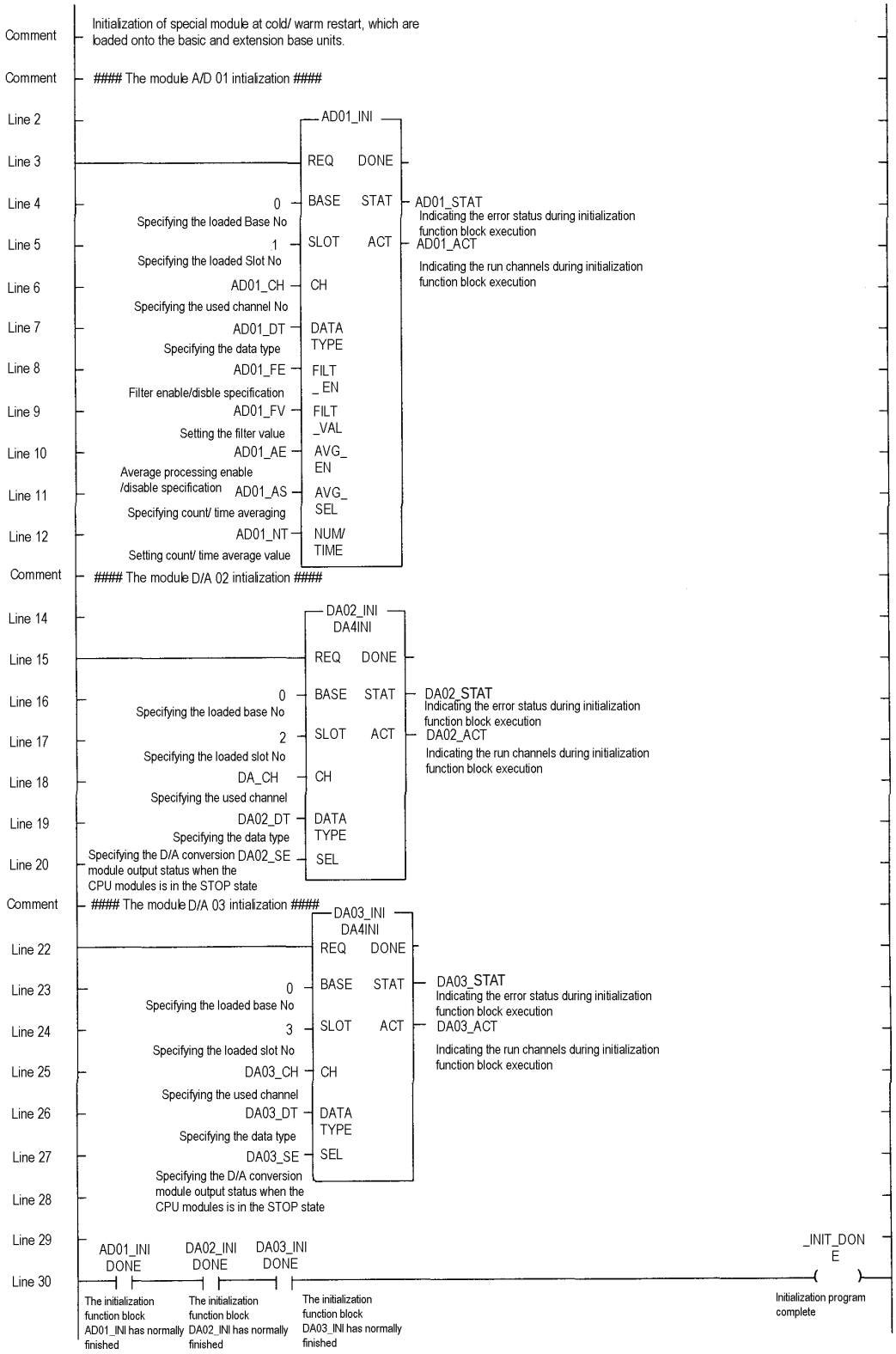
- As cold/warm restart makes the whole system restart, the 'cold/warm restart program' consists of only initialization program of special module.
- Initialization of special modules by the hot restart program' is needed before the scan program which has been stopped at the hot restart will continue its execution. It is possible that the output conditions of the module 'D/A 03', which outputs data only when the data has been changed, are restored to the state before the stop of the program.

(2) program

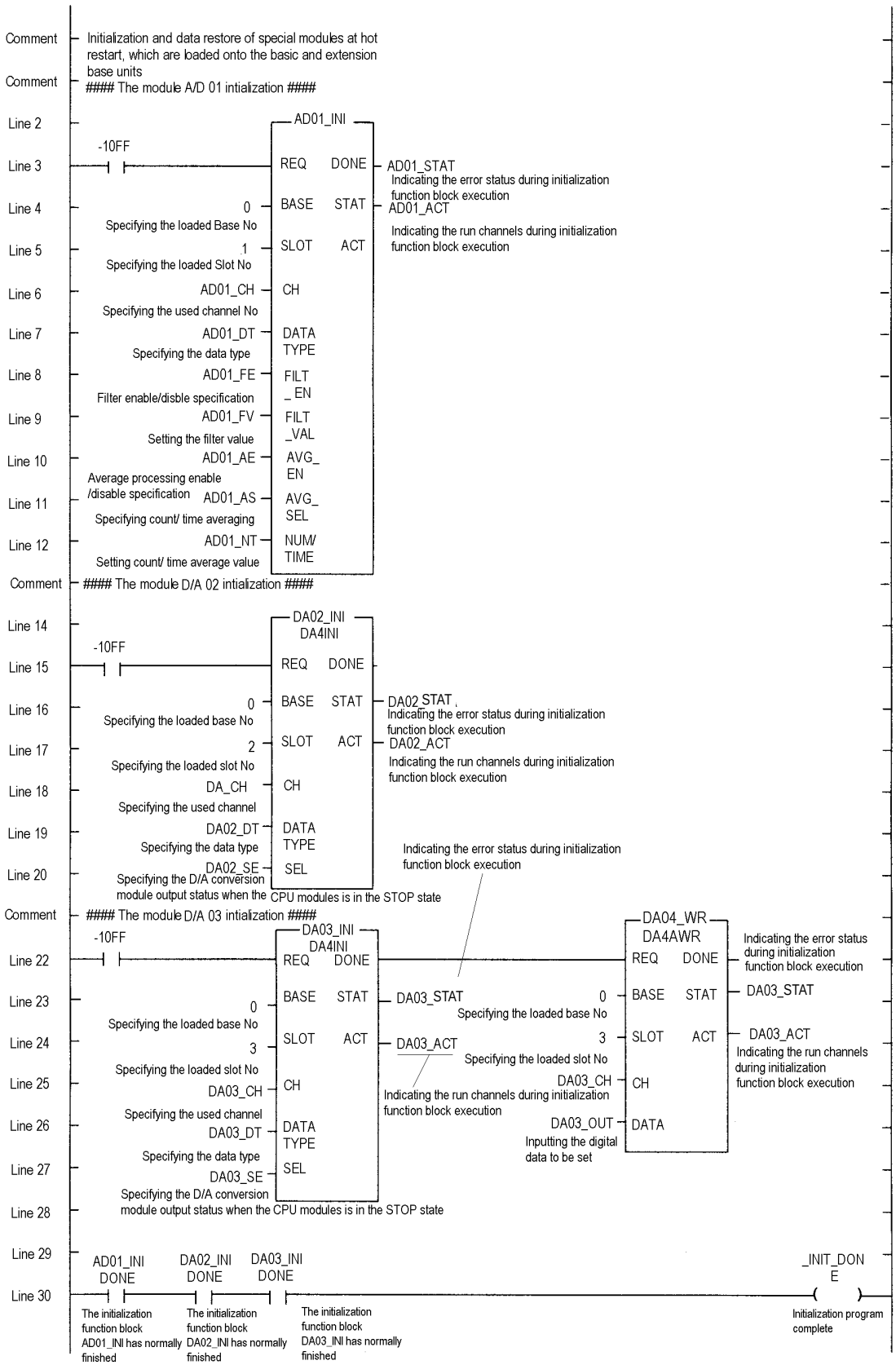
- Project Configuration : Restart.prj



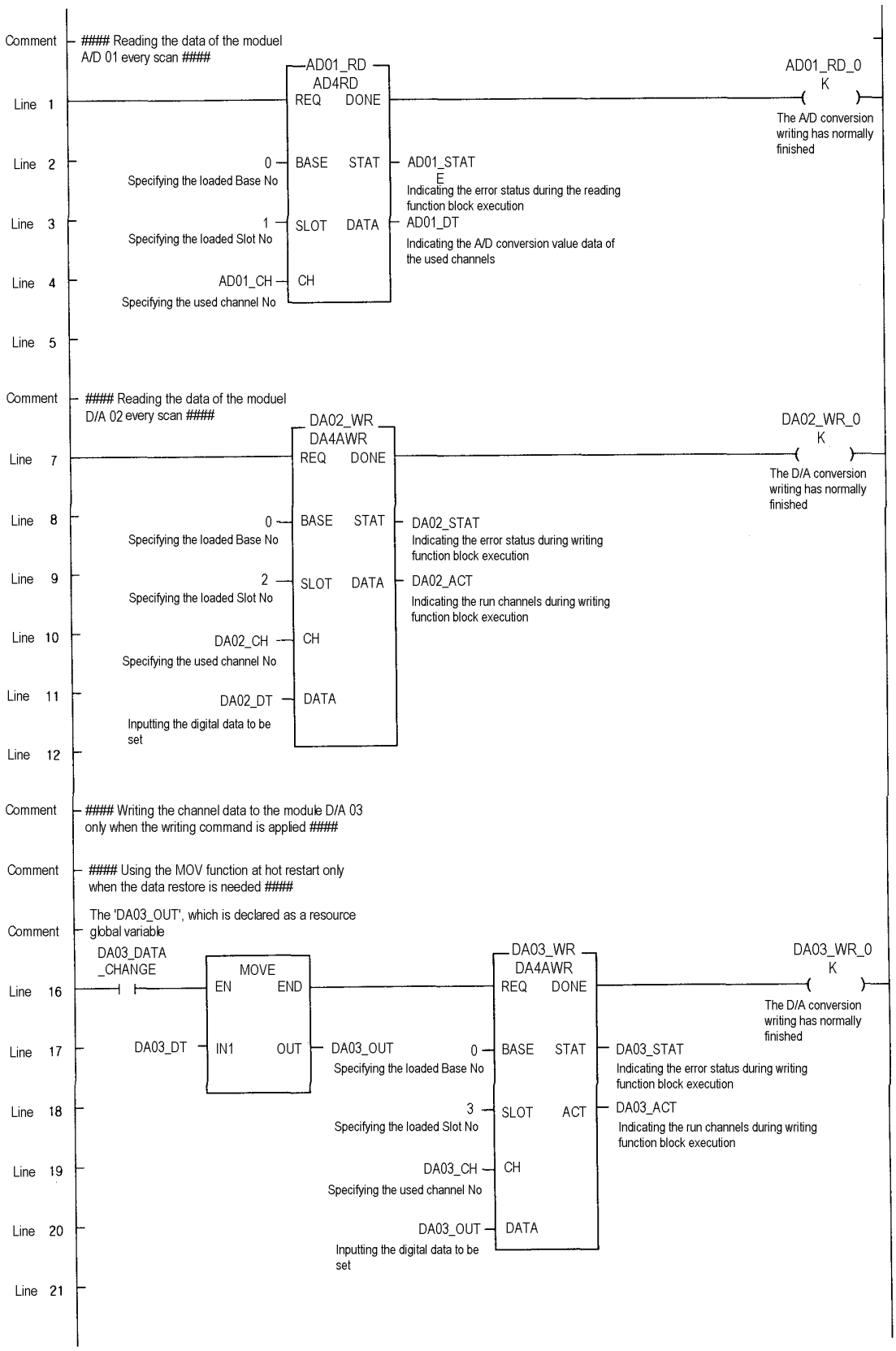
- Program : cw_rst.src (cold/warm restart initialization program)



• Program : hot_rst.src (hot restart initialization program)



• Program : scan.src (scan program)

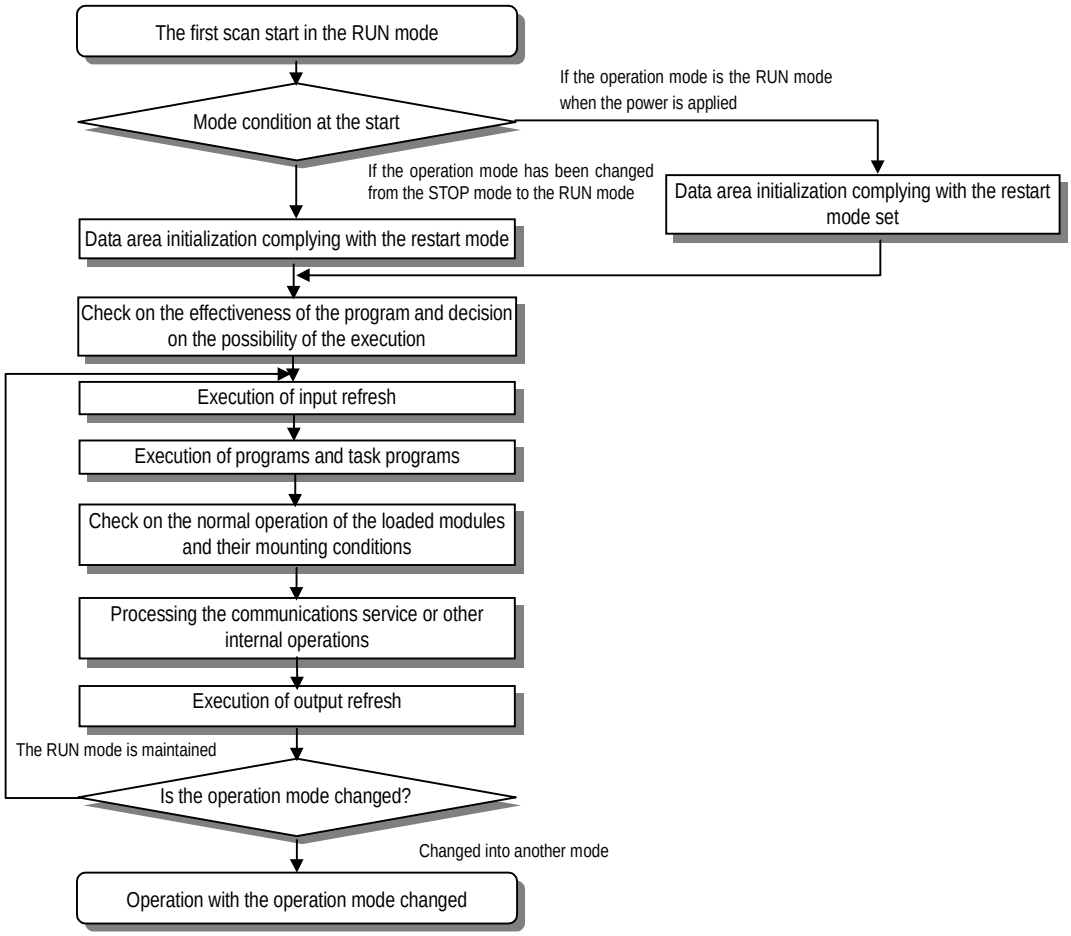


4.4 Operation Modes

The CPU module operates in one of the four modes - the RUN, STOP, PAUSE and DEBUG mode.
The following describes the PLC operation processing in each operation mode.

4.4.1 RUN mode

In this mode, programs are normally operated.



1) Processing when the operation mode changes.

Initialization of data area is executed when the first scan starts.
(1) If the PLC is in the RUN mode when applying the power :
(2) If the operation mode has been changed into from the STOP mode into the RUN mode : the initialization is executed complying with the restart mode set. (cold / warm / hot)
(3) The possibility of execution of the program is decided with check on its effectiveness.

2) Operation processing contents

I/O refresh and program operation are executed.
(1) Task programs are executed with the detection of their start-up conditions.
(2) Normal or abnormal operation and mounting conditions of the loaded module are checked.
(3) Communications service or other internal operations are processed.

4.4.2 STOP mode

In this mode, programs are not operated. Program sending through the GMWIN is available only in the remote STOP mode.

1) Processing when the operation mode changes

The output image area is cleared and output refresh is executed.

2) Operation processing contents

(1) I/O refresh is executed.
(2) Normal or abnormal operation and mounting conditions of the loaded module are checked.
(3) Communications service or other internal operations are processed.

4.4.3 PAUSE mode

In this mode, the program operation is temporarily stopped. If it returns to the RUN mode, the operation continues from the state before the stop.

1) Processing when the operation mode changes

Data area clear and input image clear are not executed and the operating conditions just before the mode change is maintains.

2) Operation processing contents

(1) I/O refresh is executed.
(2) Normal or abnormal operation and mounting conditions of the loaded module are checked.
(3) Communications service or other internal operations are processed.

4.4.4 DEBUG mode

In this mode, errors of a program are searched and the operation sequence is traced. Changing into this mode is only possible in the STOP mode. In this mode, a program can be checked with examination on its execution state and contents of each data.

1) Processing when the operation mode changes

(1) Data area is initialized at the starting time of the mode change complying with the restart mode, which has been set on the parameters.
(2) The output image area is cleared and output refresh is executed.

2) Operation processing contents

(1) I/O refresh is executed.
(2) Debug operation is executed complying with the setting status.
(3) Output refresh is executed after the debug operation has been executed to the end of a program.
(4) Normal or abnormal operation and mounting conditions of the loaded module are checked.
(5) Communications service or other internal operations are processed.

3) Debug operation conditions

- Two or more of the following four operation conditions can be simultaneously specified.

Operation conditions	Description
Executed by the one operation unit, (step over)	If an operation command is ordered, the system operates one operation unit and stops.
Executed to the specified breakpoint.	• If breakpoints are specified in the program the operation stops at those breakpoints. • Up to 32 breakpoints can be specified.
Executed according to the contact state	If the contact area to be watched and the condition (Read, Write, Value) where the operation has to stop are specified, the operation stops when the specified operation occurs at the specified contact.
Executed by the specified scan number.	If the number of scan that will be operated is specified, the operation stops after it has operated by the specified scan number.

4) Operation method

(1) Execute the operation after the debug operation conditions have been set in the GMWIN.

(2) In task programs, each task can be specified to operation enable/disable.(For detailed operation method, refer to the GMWIN User's Manual Chapter 9.

4.4.5 Operation mode change

1) Operation mode change methods

The following method are used to change the operation mode.

(1) Change by the CPU module mode keys.

(2) Change by the GMWIN connected with the CPU module communications port.

(3) Change by the GMWIN connected to the remote CPU module through Fnet.

(4) Change by the user's command using FAM or computer link module, etc.

(5) Change by the 'STOP function' during program execution.

2) Operation mode change by the CPU module mode keys

The following shows the operation mode change by the CPU module mode keys.

Mode key position	Operation mode
RUN	Local RUN
STOP	Local STOP
STOP → PAU/REM	Remote STOP
PAU/REM → RUN *1	Local RUN
RUN → PAU/REM	Local PAUSE
PAU/REM → STOP	Local STOP

HINT

1) *1 : If the operation mode changes from RUN mode to local RUN mode by the mode key, the PLC operates continuously without stop.

3) Remote operation mode change

Remote operation mode change is available only when the operation mode is set to the remote STOP mode (i.e., the mode key position is in the 'STOP →PAU/REM').

Mode key position	Mode Change	Mode change by the GMWIN	Mode change using FAM or computer link, etc.
PAU/REM	Remote STOP → Remote RUN	❍	❍
	Remote STOP → Remote PAUSE	×	×
	Remote STOP → DEBUG	❍	❍
	Remote RUN → Remote PAUSE	❍	❍
	Remote RUN → Remote STOP	❍	❍
	Remote RUN → DEBUG	×	×
	Remote PAUSE → Remote RUN	❍	❍
	Remote PAUSE → Remote STOP	❍	❍
	Remote PAUSE → Remote DEBUG	×	×
	DEBUG → Remote STOP	❍	❍
	DEBUG → Remote RUN	×	×
	DEBUG → Remote PAUSE	×	×

4) Remote operation mode change enable/disable

It is possible to disable the mode change for system protection so that some parts of the operation mode sources cannot change the mode. If remote operation mode change has been disabled, the operation mode change is possible only by the mode key and GMWIN. To enable the remote operation change, set the parameter 'Enabling the PLC control by communications' to enable. (For details, refer to the Appendix 1. System Definitions)

4.5 Functions

4.5.1 Restart mode

The restart mode defines how to initialize variables and the system and how to operate in the RUN mode when the system starts its operation with the RUN mode by re-application of the power or mode change. Three restart modes, cold, warm and hot restart are available and the execution condition for each restart mode is given below.
(For details, refer to the '4.5.1 Basic Parameters Edit' of the GMWIN User's Manual Section 4.5 Parameters Edit.

1) Cold Restart

(1) It is executed when the restart mode parameter has been set to the cold restart mode.
(2) All data are cleared with '0' and only the variables to which their initial value has been defined will be set to their initial value.
(3) Though the parameter has been set to the warm restart mode, cold restart will be executed at the first execution of a program after it has been changed.
(4) Pressing the manual reset switch(the reset command in the GMWIN performs same function) makes the system operate with the cold restart mode regardless of the restart mode set by the parameter.

2) Warm Restart

(1) It is executed when the restart mode parameter has been set to the warm restart mode.
(2) If a data is specified so that it can retain its previous value, the value remains during the warm restart. If a data has been set to an initial value, the value will be set during the warm restart. All other data will be cleared with '0'.
(3) Though the parameter has been set to the warm restart mode, cold restart will be executed at the first execution of a program after it has been stopped due to its down load and error.
(4) Though the parameter has been set to the warm restart mode, cold restart will be executed if data contents are abnormal (i.e., the data does not remain at a power failure)

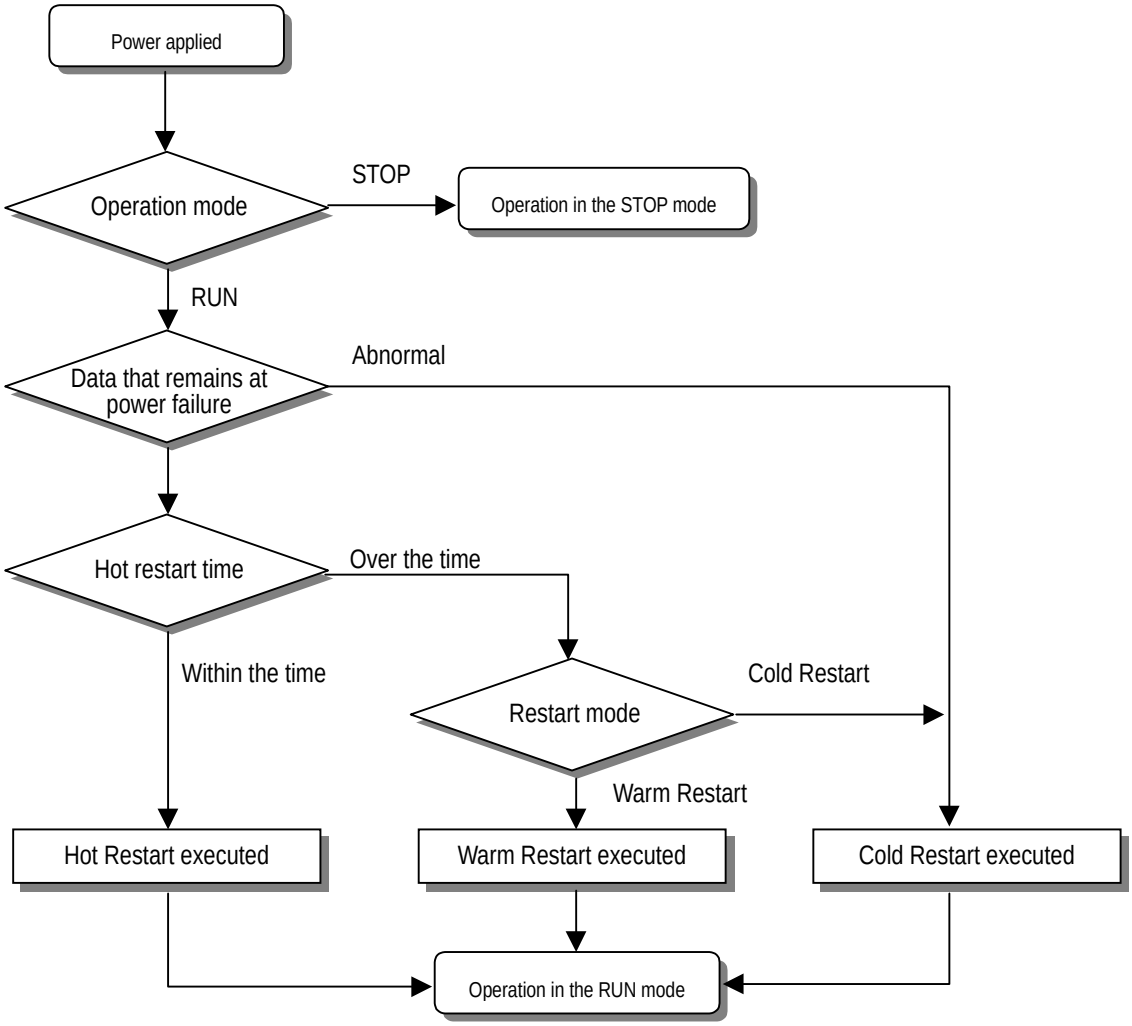
3) Hot Restart

(1) If the operation mode is in the RUN mode when the power is re-applied after a power failure and the time from power failure to re-application of the power falls into within the allowable hot restart time, the operation starts with the hot restart mode. .
(2) All data and program execution elements will be restored to their state before the power failure. As the program is executed from the state just before the power failure, continuity of the program is maintained even at the momentary power failure
(3) If the allowable hot restart time has been overrun, the restart mode which has been set by the parameter will be executed.
(4) Cold restart will be executed if data contents are abnormal (i.e., the data does not remain at a power failure)

HINT

1) Consider the followings when setting the allowable hat restart time.
(1) The system executes the hot restart initialization program if the time from a power failure to completion of system check after the restore is less than the setting time.
(2) If a power failure occurs again before the hot restart initialization program completes its execution, the hot restart program executes again. If a power failure of 20 ms or more has occurred, about 0.5 sec delay can occur until the system operates normally after it has been restored form the power failure. The allowable hot restart time is set by the second.

• Restart mode is executed as the figure given below when the power has been re-applied during execution of the CPU module



4) Data initialization according to the restart mode

The variables relating to the restart mode are classified into three types, i.e, default variable, initialization variable and retain variable. The following table shows the initialization method for each type variable.

Mode / Variable type	Cold	Warm	Hot
Default	Initialized with '0'	Initialized with '0'	Previous value is retained
Retain	Initialized with '0'	Previous value is retained	Previous value is retained
Initialization	Initialized with the user defined value	Initialized with the user defined value	Previous value is retained
Retain & Initialization	Initialized with the user defined value	Previous value is retained	Previous value is retained

HINT

1) Definitions
(1)Default variable : A variable whose initial value is not defined or previous value will not be retained.
(2)Initialization variable : A variable whose initial value is defined.
(3)Retain variable : A variable whose previous value will be retained.

4.5.2 Self-diagnosis

1) Functions

(1) The self-diagnosis function permits the CPU module to detect its own errors.
(2) Self-diagnosis is carried out when the PLC power supply is turned on and when an error occurs the PLC is in the RUN state. If an error is detected, the system stops operation to prevent faulty PLC operation.

2) Error flag

If an error occurs, it will be stored to the following flags and the STOP LED flickers.
- Representative system error flag : _CNT_ER
- Representative system warning flag : _CNF_WAR

HINT

1) Refer to 12.5 Error Code List of Chapter 12. Troubleshooting for details of contents of self-diagnosis and corrective actions.

4.5.3 Clock function

A clock device(RTC) is basically included in the CPU module. The RTC continues its operation by the backup battery when the power turns off or at the 20msec or more momentary power failure.
The clock data of the RTC can be used for time control of system or of error history. The system operation status information flag is updated with the RTC present time every scan.

1) Clock Data

Item	Data
Year	2 digit (solar calendar)
Month	1 to 12
Day	1 to 31
Hour	0 to 23 (the twenty-four-hour system)
Minute	0 to 59
Second	0 to 59
1/100 sec	0 to 99
Day of the week	0 to 6 (Monday to Sunday)

2) Timer error

±5 sec per month

3) Clock data Read/Write

Clock data can be read from/written to the PLC information in the GMWIN on-line mode.
(For details, refer to the GMWIN User's Guide Section 7.10 PLC information)

HINT

1) The RTC, at first, has no written clock data.
When using the CPU module, be sure to set exactly the RTC with a clock data.
2) If a data outside the clock data range is written, it does not operate normally.
Example) Month:14, Day:32, Hour: 25
3) Battery error can cause the RTC to stop or error in it.
In this case, writing a new clock data to the RTC removes the error.
4) If a RTC error occurs, the flag _RTC_ERR of the system warning flag _CNF_WAR turns on.
If the RTC is restored to normal state, the flag _RTC_ERR turns off.

4.5.4 Remote function

The CPU module can be controlled by external operations (from GMWIN and computer link module, etc. For remote operation, set the SPU module mode setting key to remote position.

1) Remote RUN/STOP

(1) The remote RUN/STOP permits external operations to RUN/STOP the CPU module under the condition that the CPU module key switch is in the remote position.
(2) This function is convenient when the CPU module is located on the place where it is difficult to control the CPU module or the user want to control the CPU module in the control panel from outside.

2) Remote PAUSE

(1) The remote PAUSE permits external operations to execute PAUSE operations under the condition that the CPU module key switch is in the remote position. The PAUSE operations stop the CPU module operation processing while maintaining the On/Off state of the output module.
(2) This function is convenient when the user wants to maintain the ON state of the output module under the condition the CPU module has been stopped.

3) Remote DEBUG

(1) This function permits external operations to execute DEBUG operations under the condition that the CPU module key switch is in the remote position. The DEBUG operations execute programs complying with the specified operation conditions.
(2) This function is convenient when program execution or contents of any data are checked for debugging of the program.

4) Remote reset

(1) This function permits remote operations to reset the CPU module, which locates in the place where direct operations cannot be applied, when an error has occurred.

HINT

1) For remote function operations, refer to the GMWIN User's Manual Chapter 7. On-line.

4.5.5 I/O Force On/Off function

1) Force On/Off setting method

Force on/off setting is applied to input area and output area.
Force on/off should be set for each input and output, the setting operates from the time that 'Force I/O setting enable' is set.
This setting can be done when I/O modules are not really loaded.

2) Force on/off Processing timing and method

(1) Force Input

- After data have been read from input modules, at the time of input refresh the data of the junctions which have been set to force on/off will be replaced with force setting data to change the input image area. And then, the user program will be executed with real input data and force setting data.

(2) Force output

- When a user program has finished its execution the output image area has the operation results. At the time of output refresh the data of the junctions which have been set to force on/off will be replaced with force setting data and the replaced data will be output. However, the force on/off setting does not change the output image area data while it changes the input image area data.

(3) Force on/off processing area

- Input/output areas for force on/off setting are larger than the real I/O areas. If remote I/O is specified using this area, the force on/off function is as just available in it as in the basic I/O areas.

(4) Precautions

- Turning the power off and on, changed of the operation mode or operations by reset key does not change the previous force on/off setting data. They remain within the CPU module and operation is executed with the same data.
- Force I/O data will not be cleared even in the STOP mode.
- If a program is downloaded or its backup breaks, the force on/off setting data will be cleared. The operating program in memory differs from the program in the flash memory so that if operation restarts with the program in the flash memory the on/off setting data will be also cleared.
- When setting new data, disable every I/O settings using the setting data 'clear' function and set the new data.

HINT

1) For detailed operation, refer to the GMWIN User's Manual Chapter 7 'Force I/O setting'

4.5.6 Direct I/O Operation function

This function is usefully available when an input junction state is directly read during execution of a program and used in the operation, or the operation result is directly output to an output junction.

1) Direct input

- Direct input is executed by use of the 'DIRECT_IN' function. If this function is used, the input image area will be directly updated and applied to the continuing operations.

2) Direct output

- Direct output is executed by use of the 'DIRECT_O' function. If this function is used, the data of the output image area, which has the operation results by the time, will be directly output to the direct output module.

3) Force on/off

- Force on/off settings are still effective when processing direct I/O.

HINT

1) For detailed direct I/O functions, refer to the GLOFA-GM commands.

4.5.7 History Log-In

History Log-In is classified into three types, i.e., error history, mode change history and power off history. Up to latest 16 histories are stored.

1) Error recording time and content

(1) Error history

- Recording time : When an error has occurred during operation.
- Stored content : Occurrence time and error code

(2) Mode change history

- Recording time : When an operation mode change has occurred
- Stored content :Occurrence time, operation mode and restart mode

(3) Power off history

- Recording time : When a power off has been occurred during operation in the RUN mode.
- Stored content : Occurrence time(16), Occurrence count(1)

2) Stored History Data Reset

The stored history data will not be cleared until it is cleared by menu selection in the GMWIN.

HINT

1) For detailed instructions, refer to the 'PLC information' in the GMWIN User's Manual Chapter 7 On-line.

4.5.8 External Device Error Diagnosis function

Flags are given for the user to implement easily the program in which the error detection of external devices and system stop and warning are coded. By use of these flags, error indication of external devices is possible without complex programming and monitoring of the error location can be done without special tools (GMWIN, etc.) or source programs.

1) External device fault detection and classification

(1) The user program detects external device faults. The faults are classified into fatal fault(error), where the PLC stops its operation, and ordinary fault(warning), where operation continues.

(2) The flag ANC_ERR[n] is used to indicate error. The flag ANC_WN[n] is used to indicate warning.

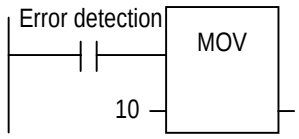
2) External Device Fatal-fault (Error) Processing.

(1) If an error of external device is detected and the error type, where other value than 0 is used, is written to the system flag ANC_ERR[n], the flag will checked at the time that scan program finishes its execution. If an error is indicated on the flag, it will be also indicated on the _ANNUN_ER of the representative system error flag _CNF_ER, the PLC turns all output modules off and the error state will be same as the PLC self-diagnosis.

(2) The user can know the cause of error by use of the GMWIN, and also by direct monitoring of the flag _ANC_ERR[n].

(3) As the flag _ANC_ERR[n] has sixteen elements(n : 0 to 15), the user can classify error states largely. User defined error No. can be written to the elements. A number of 1 to 65535 is usable.

Example)



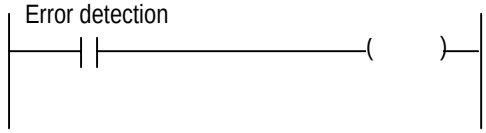
3) External device Ordinary-fault (Warning) Processing.

(1) If a warning of external device is detected and the corresponding flag of the system flag _ANC_WB[n] is set to on, the flag will checked from the _ANC_WB[0] at the time that scan program finishes its execution. If an error is indicated on the flag, it will be also indicated on the _ANNUN_WR of the representative system warning flag _CNF_WAR. External device waning numbers will be written to from _ANC_WAR[0] to _ANC_WAR[7] according to occurrence sequence.

(2) The user can know the cause of error by use of the GMWIN, and also by direct monitoring of the flags _ANC_WAR[n] and _ANC_WB[n].

(3) If an external device waning is removed, that is, the elements of _ANC_WAR[n] are released from warning, the corresponding _ANC_WAR[n] will be automatically cleared. If all element flags are cleared, the flag _ANNUN_WR of the system flag _CNF_WAR will be reset.

Example




```
_ANNUN_WR   =   1
            =   10
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
```

If the user program had detected a system fault and set _ANC_WB[10] to ON, the states of _ANNUN_WR and _ANN_WAR [0..7] will be shown as left after the scan has been finished

```
_ANNUN_WR   =   1
            =   10
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
```

After the next scan has been finished, if the numbers 1, 2, 3, 10, 15 , 40 , 50, 60 and 75 of _ANC_WB[n] are tuned on _ANC_WAR[n] will be shown as left

As the number 10 has turned on (has occurred) in the previous scan, though the number 10 has lower priority than the numbers 1, 2 and 3, it will be the lower element of _ANC_WAR[n]. The _ANC_WB[75] is not indicated as it is turned on and the warning that occurred before has written to the ANC WAR[n].

```
_ANNUN_WR   =   1
            =   10
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
```

After the next scan has been finished, if the numbers 1, 2, 3, 10, 15 , 40 , 50, 60 and 75 of _ANC_WB[n] are tuned on _ANC_WAR[n] will be shown as left.

The No. 10 warning has been released the content of _ANC_WAR[0] will be cleared and the contents of _ANC_WAR[1..7] will shift into the lower elements. The content of _ANC_WAR[7] will has been cleared by the shifting and the content of _ANC_WB[75] will be written to _ANC_WAR[7].

```
_ANNUN_WR   =   1
            =   10
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
            =   0
```

If all warnings indicated on the _ANC_WB[n] are released during operation, the _ANNUN_WR and _ANC_WAR[n] will be shown as left.

4.6 Memory Configuration

The CPU module includes two types of memory that are available by the user. One is program memory which is used to store the user programs written to implement a system by the user. The other is data memory which stores data during operation.

1) Program memory configuration

The table given below shows the contents to be stored and the storage capacity of program memory.

Item	GM4	GM3
Overall program memory area	129 Kbyte	256 Kbyte
System area : • System program area • Backup area	1.5 Kbyte	1.5 Kbyte
Parameter area • Basic parameter area • I/O parameter area • High speed link parameter area • Interrupt setting information area	3.5 Kbyte	3.5 Kbyte
Program area • Scan program area • Task program area • User defined function/function block area • Standard library area • Access variable are • Variable initialization information area • Protective variable specification information area	123 Kbyte	251 Kbyte

2) Data memory Configuration

The table given below shows the contents to be stored and the storage capacity of program memory.

Item	GM4	GM3
Overall data memory area	64 Kbyte	128 Kbyte
System area • I/O information table • Force I/O table	7.5 Kbyte	7.5 Kbyte
System flag area	1.5 Kbyte	1.5 Kbyte
Input image area (%IX)	512 Kbyte	512 Kbyte
Output image area (%QX)	512 Kbyte	512 Kbyte
Direct variable area (%M)	2 to 6 Kbyte	4 to 32 Kbyte
Symbolic variable area (maximum)	52 Kbyte – the size of direct variable area	116 Kbyte – the size of direct variable area
Stack area	4 Kbyte	4 Kbyte

3) Purpose

(1) System area

Used to store the self-created data of the CPU module for system management and GMWIN system control data.

(2) System flag area

Used to user flags and system flags. The user operates it with flag name.

(3) Input image area

Used to store input data read from input modules. Overall size is %IX0.0.0 to %IX63.7.63, however, the area %IX.0.0.0 to %IX3.7.63 is really used for input module area.

The area that is not used by the real input module loaded is a free area that the program can use. Especially, it will be convenient to use that free area for storing remote input data through high speed link.

(4) Output image area

Used to store operation results. The stored data are automatically output to output modules. Overall size is %QX0.0.0 to %QX63.7.63, however, the area %QX.0.0.0 to %QX3.7.63 is really used for output module area in the GM3/4 series.

The area that is not used by the real output module loaded is a free area that the program can use. Especially, it will be convenient to use that free area for storing remote output data through high speed link.

(5) Direct variable area

The user can use this area to access direct memory data through the variable names such as %MX0, %MB0, %MW0, %MD0 and %ML0, which was pre-defined by the system.

(6) Symbolic variable area

Used to store the variables that the user created, that is, whose names the user defined when writing a program. Global variables and instance memory are located in this area. The variables used in program blocks locates in the ‘PB instance memory’ of the program, and the memory used in function block locates in the ‘FB instance memory’.

The maximum size of the PB instance memory is 32 Kbyte. If the used size overruns the maximum size, divide the program blocks or use global variables.

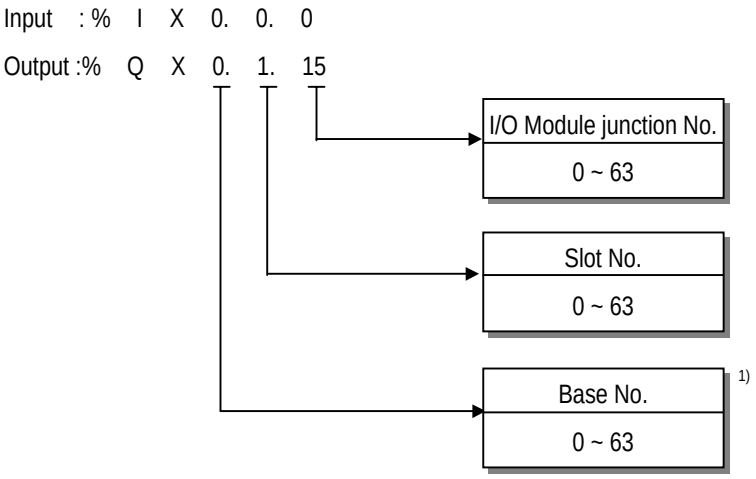
4.7 I/O No. Allocation Method

1) I/O No. allocation means to give an address to each module in order to read data from input modules and output data to output modules.

2) Fixed 64 points are allocated to each module for I/O points.

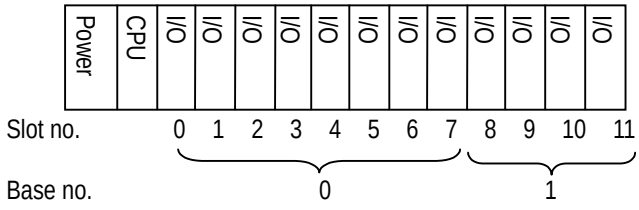
3) Fixed 64 points are allocated regardless of mounting/dismounting or type of modules.

4) The following shows I/O No. allocation method.



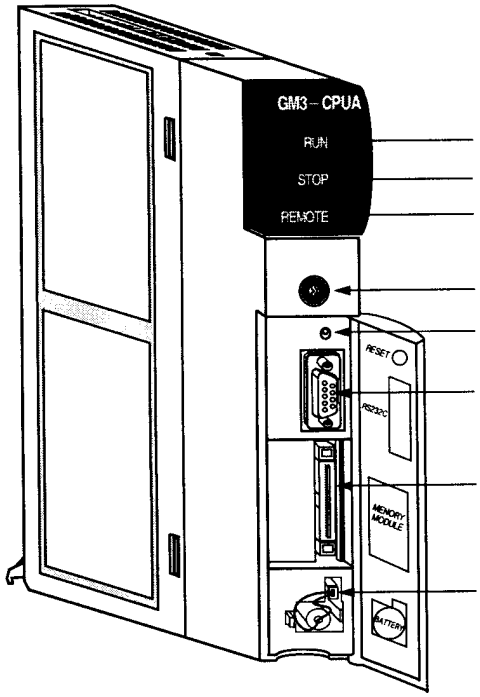
HINT

1) The main base having 12 I/O slots is recognized as base no. 1.

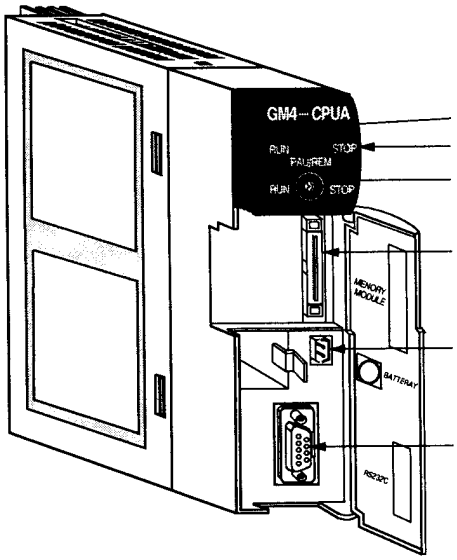


4.8 Names of Parts

The following describes the names and functions of parts of the CPU module.



<GM3 – CPUA>



<GM4 – CPUA>

No.	Name	Function
1	RUN LED	Indicates the operation status of the CPU module. • On : when the CPU module operates with the key switch in the local or remote RUN state. • Off : when the followings occur The voltage is not normally supplied to the SPU module. The key switch is in the STOP or PAU/REM state. An error which makes operation stop is detected.
2	STOP LED	• On : when the key switch is in the local or remote STOP state. • Off : when the followings occur The key switch is in the local RUN or local PAUSE state. The operation state is in the RUM/PAUSE/DEBUG state. • Flickering : when an error is detected by self-diagnosis during operation.
3	Remote LED	• On : when the followings occur The key switch is in the remote STOP state. The operation state is in the remote RUM/PAUSE/DEBUG state. • Off : when the key switch is in the local RUN/STOP/PAUSE state. (Only the GM3-CPUA has the remote LED.)

No.	Name	Function
4	Mode setting key switch	Sets the operation mode of the CPU module. . • RUN : Program operation is executed. • STOP : Program operation is temporarily stopped. • PAU/REM : PAUSE : Program operation is temporarily stopped. REMOTE: Used for the remote operation
5	Manual reset switch	Executes the PLC system reset and initialization when an error has occurred during operation.
6	RS-232C connector	Used to connect to peripheral devices(GMWIN, etc.)
7	Memory module installing connector	Used to load the memory module onto the CPU module.
8	Battery installing connector	Used to connect to the backup battery.

HINT

The followings shows the LED status complying with the operation mode, and the operation mode complying with the position of the mode setting key switch.

1) LED status complying with the operation mode

Operation Mode	LED Status		
	RUN	STOP	REMOTE
Local Run	On	Off	Off
Local Stop	Off	On	Off
Local Pause	Off	Off	Off
Remote Run	On	Off	On
Remote Stop	Off	On	On
Remote Pause, Remote Debug	Off	Off	On

2) Operation mode complying with the position of the mode setting key switch.

Position of Mode key	Operation Mode
STOP ⟶ PAU/REM	
PAU/REM ⟶ RUN	Local Run
RUN ⟶ PAU/REM	Local Pause
PAU/REM ⟶ STOP	Local Stop

* Change of remote mode is available only after the operation mode has entered into the remote STOP mode.

Chapter 5. BATTERY

5.1 Specifications

Item	Specifications
Normal voltage	3.0 VDC
Warranty life time	5 years
Application	Programs and data backup, and RTC runs in power failure
Specifications	Lithium Battery, 3 V
External dimension (mm)	$\Phi 14.5 \times 26$

5.2 Handling Instructions

1) Do not heat or solder its terminals.

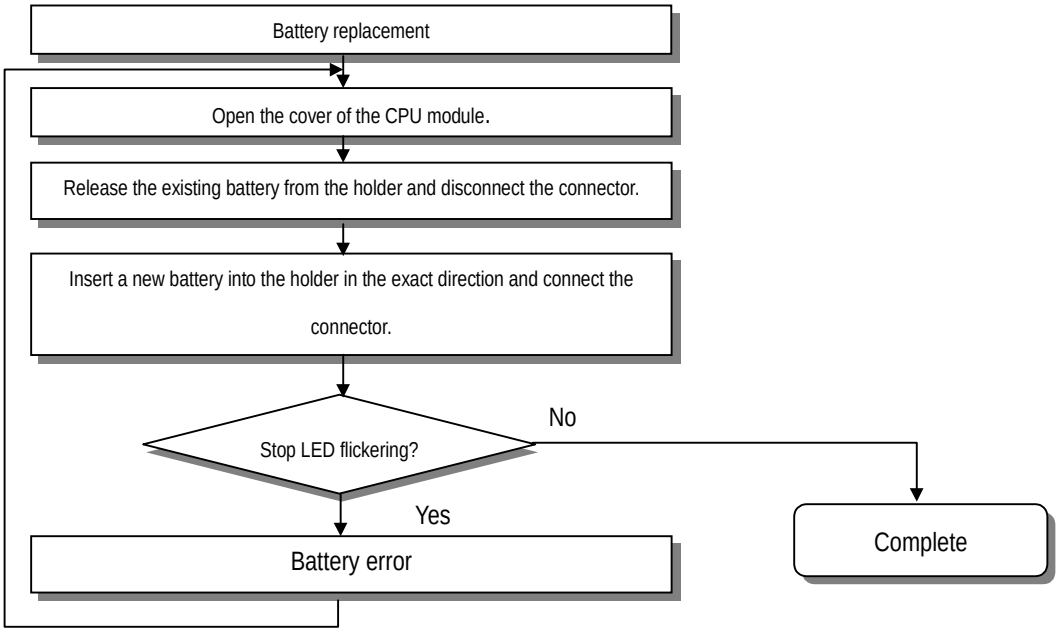
2) Do not measure its voltage with a tester or short circuit.

3) Do not disassemble.

5.3 Battery Replacement

Backup battery needs periodic replacement. Programs and power failure retain data remains for about 30 minutes by the super capacitor though the battery is removed at a power failure, but the battery has to be replaced as soon as possible.

The following shows the battery replacement procedure.

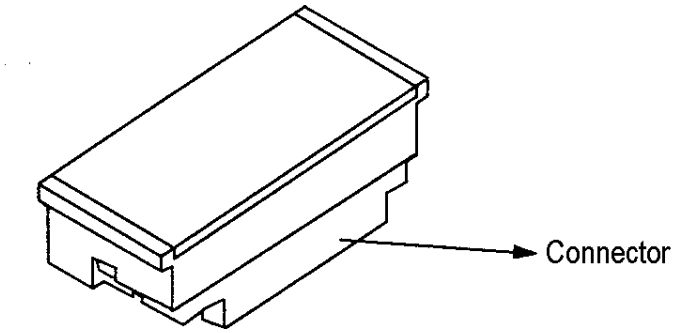


Chapter. 6 MEMORY MODULE

This chapter describes user programs storage method and operation method of the PLC mounted with the memory module.

Flash memory is being used for the memory module in this PLC. Read from/Write to this memory module is available only by mounting it onto the CPU module. No special writing device is needed.

6.1 Structure



6.2 Specifications

Items \ Models	GM4	GM3
	G4M-M032	G3M-M064
Memory type	Flash memory	Flash memory
Memory capacity	128 K bytes(32 K steps)	256K bytes(64 K steps)
Weight(kg)	0.01	0.014

6.3 Handling

1) Method of writing a user program to the memory module

Be sure to turn the power off when mounting the memory module onto the CPU module. It means to store the user program in the program memory of the CPU module to the memory module. That is only available when the operation mode is the STOP mode.

- The following shows the method of writing a user program to the memory module,

Start

Power On

Change the operation mode to the STOP mode and turn the power off.

↓

Mounting the memory module

Mount correctly the memory module onto the connector for memory module in the CPU module.

↓

Turn the power on.

↓

Check the memory module information

Use the GMWIN to check the memory module just mounted.

↓

Execution

Select the Flash Memory Write in the GMWIN
(This instruction makes the contents of the program memory of the PLC written to the memory module. A program to be stored into the memory module has to exist in the program memory.)

Complete

HINT

1) For detailed handling instructions, refer to the chapter 7 “Flash Memory” of the GMWIN User’s Manual.

2) Operation method

- Be sure to turn the power off when mounting the memory module onto the CPU module.
- If the operation mode is the RUN mode when the power is turned on or the operation mode changes from other mode into the RUN mode after the power has turned on, a user program in the memory module starts its operation after it has been written to the program memory of the CPU module.

Start

Power-Off

Change the operation mode into the STOP mode and then turn the power off

Mounting the memory module

Load correctly a memory module where a user program has been written onto the connector for memory module in the CPU module as described above.

Power-On

(If a memory module where no program has been written is mounted onto the CPU module, 'Write to memory module' will be executed.)

Changing the operation mode

Change the operation mode into the RUN mode.

Execution Check

Check if the changed program is executed or not.

Complete

HINT

1) If the operation mode was the RUN mode when the power has been turned on then mounting a memory module makes the contents in the memory module will be written to the program area of the CPU module. Be cautious when mounting a memory module to write a user program to the memory module.
It will be convenient to operate the PLC without memory module when debugging and mount a memory module after the debugging.

Chapter. 7 INPUT AND OUTPUT MODULES

7.1 Notes on Selecting Input and Output Modules

The followings describe instructions for selection of digital I/O modules that will be used in the GLOFA-GM3/4 series.

1) The types of digital input are current sink input and current source input.
When selecting DC input modules consider the specifications of those input devices as the wiring method of the external input power supply varies complying with the type of digital input.
In the GM4 series, the types are dedicated source input and source/sink common DC input.

2) Maximum simultaneous input points differs with the type of a module. Check the specifications of the input module to be applied before use.

3) Use the interrupt module if high speed input response is requested.
But, only one interrupt module can be mounted in each CPU module.

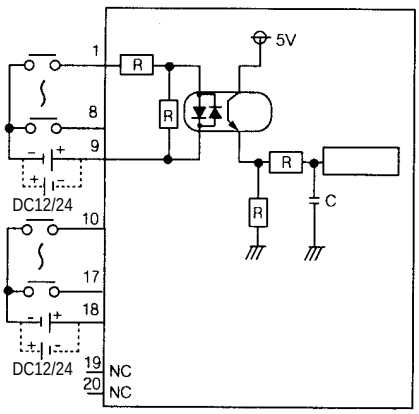
4) Use triac output modules with a load that is frequently opened and closed or with an inductive load as, in those cases, the life span of a relay output module will become shorter than specified.

7.2 Digital Input Module Specifications

7.2.1 16-points 12/24 VDC input module (source/sink type)

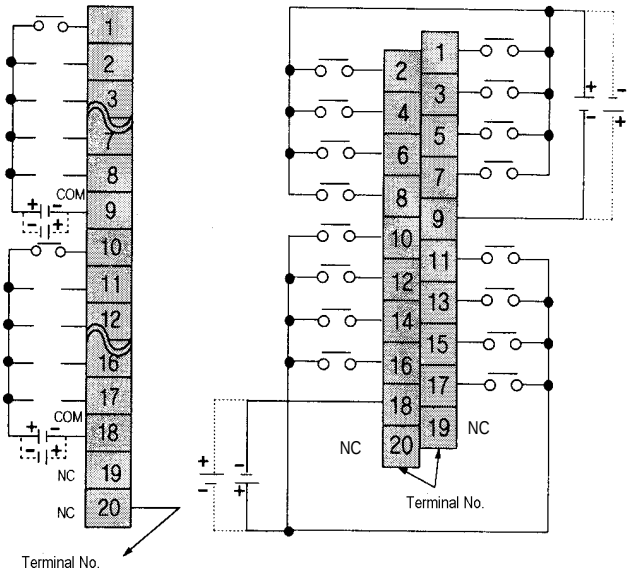
Specifications \ Model		GM3	GM4
		G3I-D22A	G4I-D22A
Number of input points		16 points	
Insulation method		Photo coupler	
Rated input voltage		12/24 VDC	
Rated input current		5/11 mA	
Operating voltage range		10.2 to 26.4 VDC (ripple: less than 5%)	
Maximum simultaneous input points		100% simultaneously ON	
ON voltage/ON current		9.5 VDC or higher/4.0 mA or higher	
OFF voltage/OFF current		6 VDC or lower/1.0 mA or lower	
Input impedance		Approx. 2.2 kΩ	
Response time	OFF → ON	10 msec or less	
	ON → OFF	10 msec or less	
Common terminal		8 points/common(COM)	
Internal current consumption		70 mA	
Operating indicator		LED turns on at ON state of input	
External connections		20-points terminal block connector(M3 × 6 screws)	
Weight		0.37 kg	0.25 kg

Circuit configuration



External connections

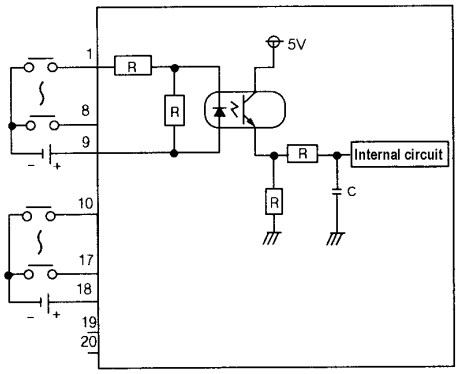
[G3I-D22A]



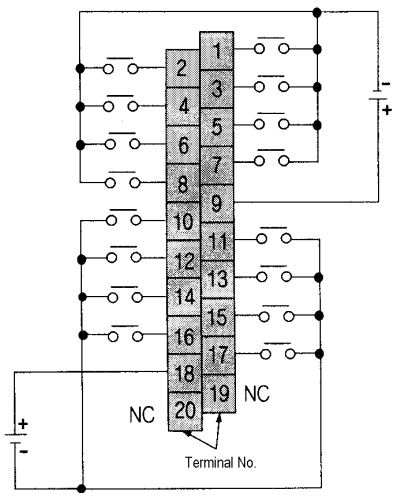
7.2.2 16-points 12/24 VDC input module (source type)

Specifications \ Models		GM4	
		G4I-D22B	
Number of input points		16 points	
Insulation method		Photo coupler	
Rated input voltage		12 VDC	24 VDC
Rated input current		5 mA	11 mA
Operating voltage range		10.2 to 26.4 VDC (ripple: less than 5%)	
Maximum simultaneous input points		100% (8 points/COM) simultaneously ON	
ON voltage/ON current		9.5 VDC or higher/4.0 mA or higher	
OFF voltage/OFF current		6 VDC or lower/1.0 mA or lower	
Input impedance		Approx. 2.2 kΩ	
Response time	OFF → ON	10 msec or less	
	ON → OFF	10 msec or less	
Common terminal		8 points/COM	
Internal current consumption		70 mA	
Operating indicator		LED turns on at ON state of input	
External connections		20-point terminal block connector(M3 × 6 screws)	
Weight		0.37 kg	o.25 kg

Circuit configuration



External connections

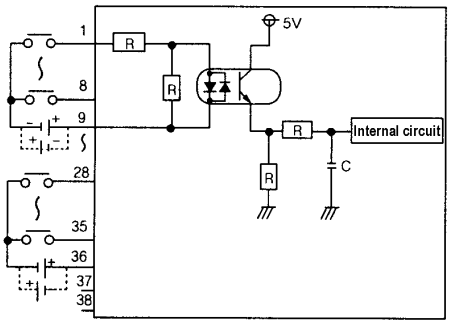


7.2.3 32-points 12/24 VDC input module (source/sink type)

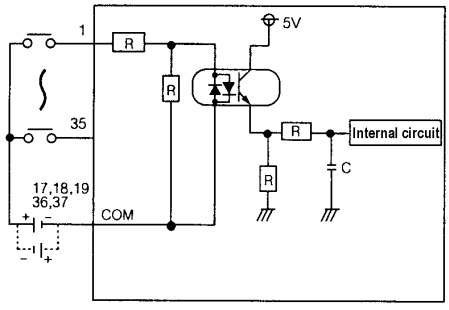
Specifications \ Model		GM3	GM4
		G3I-D24A	G4I-D24A
Number of input points		32 points	
Insulation method		Photo coupler	
Rated input voltage		12/24 VDC	
Rated input current		5/11 mA	3/7 mA
Operating voltage range		10.2 to 26.4 VDC (ripple: less than 5%)	
Maximum simultaneous input points		60% simultaneously ON (5 points/COM)	60% simultaneously ON (19 points/COM)
ON voltage/ON current		9.5 VDC or higher/4.0 mA or higher	9.5 VDC or higher/3.0 mA or higher
OFF voltage/OFF current		6 VDC or lower/1.0 mA or lower	6 VDC or lower/1.5 mA or lower
Input impedance		Approx. 2.2 kΩ	Approx. 3.3 kΩ
Response time	OFF → ON	10 msec or less	
	ON → OFF	10 msec or less	
Common terminal		8 points/common	32 points/common
Internal current consumption		125 mA	75 mA
Operating indicator		LED turns on at ON state of input	6-points indication by selection switch.
External connections		38-point terminal block connector(M3 × 6 screws)	37-pin D-Sub connector
Weight		0.46 kg	0.19 kg

Circuit configuration

[G3I-D24A]

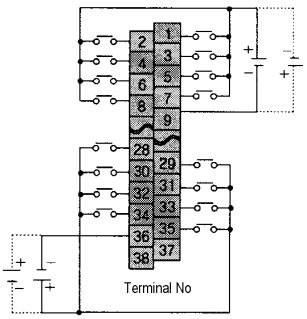


[G4I-D24A]

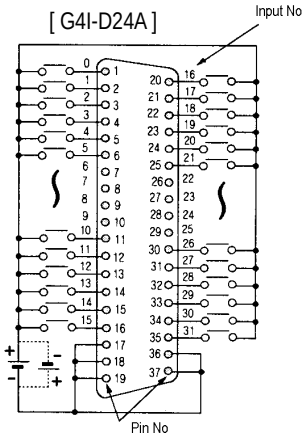


External connections

[G3I-D24A]



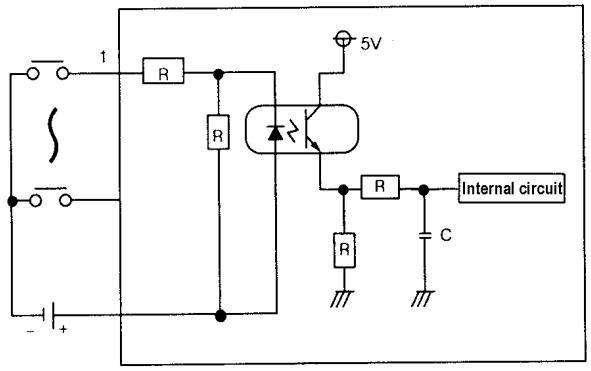
[G4I-D24A]



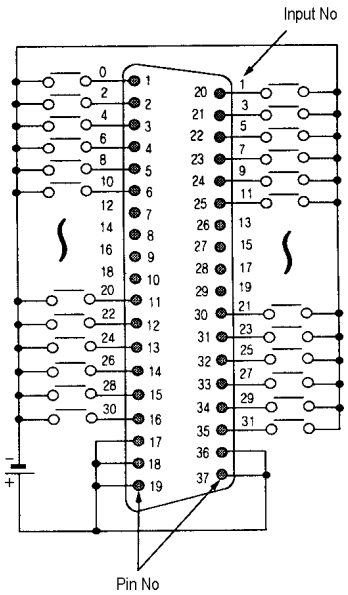
7.2.4 32-points 12/24 VDC input module (source type)

Specifications \ Model		GM4	
		G4I-D24B	
Number of input points		32 points	
Insulation method		Photo coupler	
Rated input voltage		12 VDC	24 VDC
Rated input current		3 mA	7 mA
Operating voltage range		10.2 to 26.4 VDC (ripple: less than 5%)	
Maximum simultaneous input points		60% (19 points/ 1 COM) simultaneously ON	
ON voltage/ON current		9.5 VDC or higher/3.0 mA or higher	
OFF voltage/OFF current		6 VDC or lower/1.5 mA or lower	
Input impedance		Approx. 3.3 kΩ	
Response time	OFF → ON	10 msec or less	
	ON → OFF	10 msec or less	
Common terminal		32 points/1 COM(common)	
Internal current consumption		70 mA	
Operating indicator		LED turns on at ON state of input	
External connections		37-pin D-sub connector	
Weight		0.19 kg	

Circuit configuration



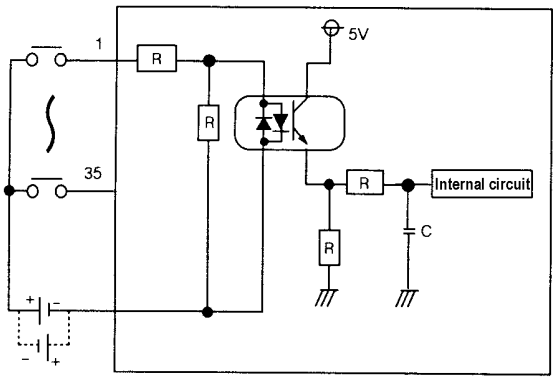
External connections



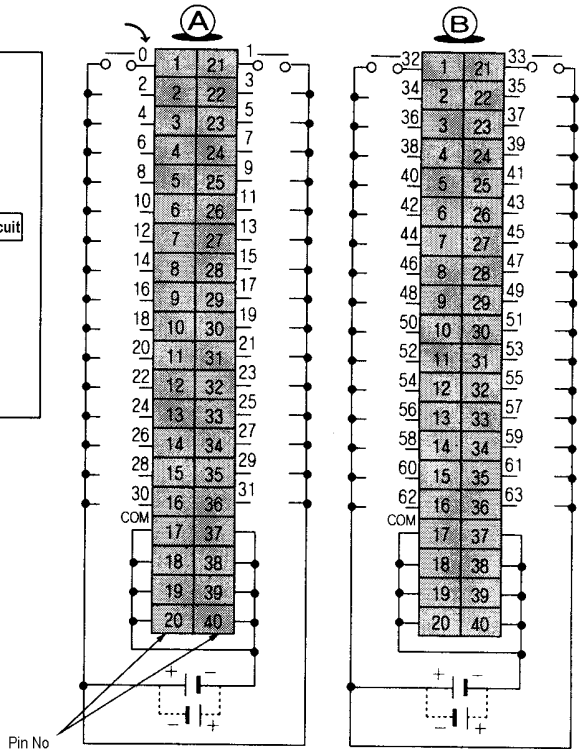
7.2.5 64-points 12/24 VDC input module (source/sink type)

Specifications \ Model		GM3	
		G3I-D28A	
Number of input points		64 points	
Insulation method		Photo coupler	
Rated input voltage		12 VDC	24 VDC
Rated input current		3 mA	7 mA
Operating voltage range		10.2 to 26.4 VDC (ripple: less than 5%)	
Maximum simultaneous input points		60% (19 points/ 1 COM) simultaneously ON	
ON voltage/ON current		9.5 VDC or higher/4.0 mA or higher	
OFF voltage/OFF current		6 VDC or lower/1 mA or lower	
Input impedance		Approx. 3.3 kΩ	
Response time	OFF → ON	10 msec or less	
	ON → OFF	10 msec or less	
Common terminal		32 points/1 COM(common pins: 17,18,19,20,37,38,39,40)	
Internal current consumption		120 mA	
Operating indicator		LED turns on at ON state of input	
External connections		Two 40-pin D-sub connectors	
Weight		0.46 kg	

Circuit configuration



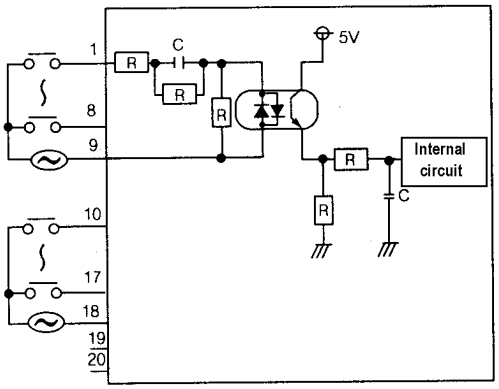
External connections



7.2.6 16-points 110 VAC input module

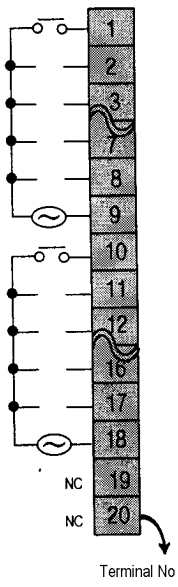
Specifications \ Models		GM3	GM4
		G3I-A12A	G4I-A12A
Number of input points		16 points	
Insulation method		Photo coupler	
Rated input voltage		100 to 120 VAC (50/60 Hz)	
Rated input current		11 mA (110 VAC / 60 Hz)	
Operating voltage range		85 to 132 VAC (50/60 Hz ± 3 Hz)	
Maximum simultaneous input points		100% simultaneously ON	
Inrush current		600 mA, 0.12 msec or lower (264 VAC)	
ON voltage/ON current		80 VAC or higher/6 mA or higher	
OFF voltage/OFF current		30 VAC or lower/3 mA or lower	
Input impedance		Approx. 10 kΩ	
Response time	OFF → ON	15 msec or less	
	ON → OFF	25 msec or less	
Common terminal		8 points/1 COM	
Internal current consumption		70 mA	
Operating indicator		LED turns on at ON state of input	
External connections		20-point terminal block connector(M3 × 6 screws)	
Weight		0.42 kg	0.29 kg

Circuit configuration

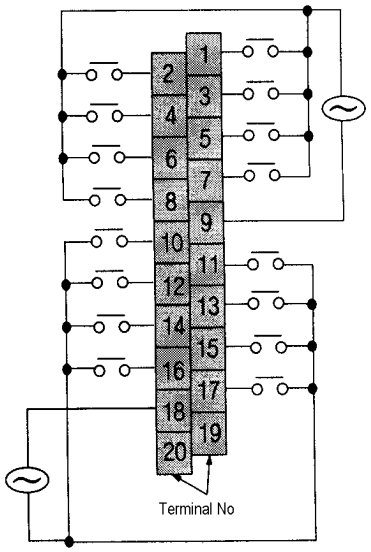


External connections

[G3I-A12A]



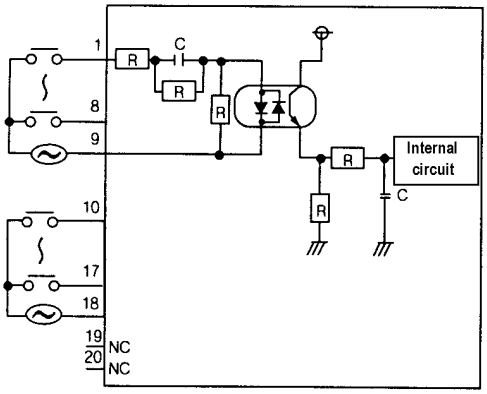
[G4I-A12A]



7.2.7 16-points 220 VAC input module

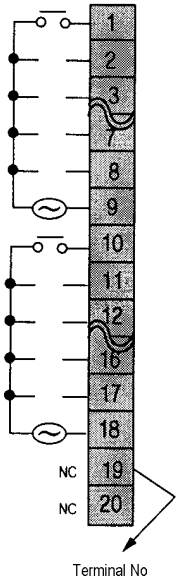
Specifications \ Model		GM3	GM4
		G3I-A22A	G4I-A22A
Number of input points		16 points	
Insulation method		Photo coupler	
Rated input voltage		200 to 240 VAC (50/60 Hz)	
Rated input current		11 mA (220 VAC / 60 Hz)	
Operating voltage range		170 to 264 VAC (50/60 Hz ± 3 Hz)	
Maximum simultaneous input points		100% simultaneously ON (8 points / 1 COM)	
Inrush current		600 mA, 0.12 msec or lower (264 VAC)	
ON voltage/ON current		80 VAC or higher/6 mA or higher	
OFF voltage/OFF current		30 VAC or lower/3 mA or lower	
Input impedance		Approx. 10 kΩ	
Response time	OFF → ON	15 msec or less	
	ON → OFF	25 msec or less	
Common terminal		8 points/1 COM	
Internal current consumption		70 mA	
Operating indicator		LED turns on at ON state of input	
External connections		20-point terminal block connector(M3 × 6 screws)	
Weight		0.42 kg	0.29 kg

Circuit configuration

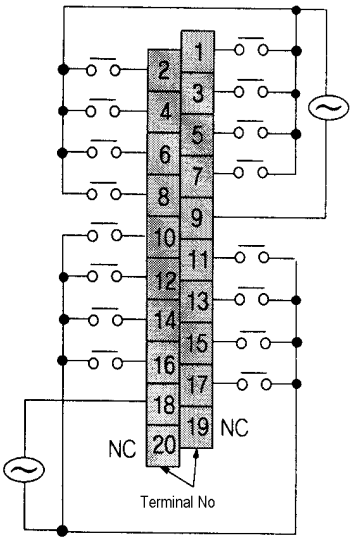


External connections

[G3I-A22A]



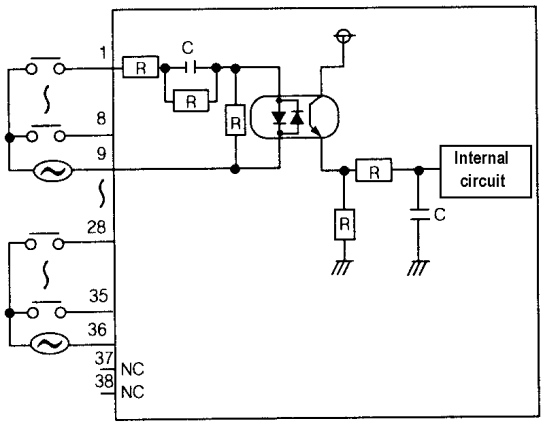
[G4I-A22A]



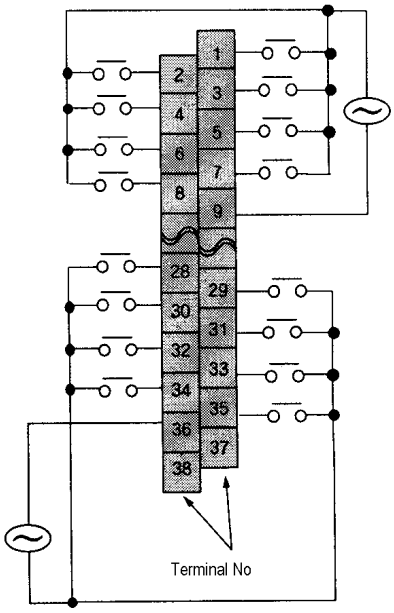
7.2.8 32-points 110 VAC input module

Specifications \ Model		GM3
		G3I-A14A
Number of input points		32 points
Insulation method		Photo coupler
Rated input voltage		100 to 120 VAC (50/60 Hz)
Rated input current		11 mA (110 VAC / 60 Hz)
Operating voltage range		85 to 132 VAC (50/60 Hz ± 3 Hz)
Maximum simultaneous input points		60% (5 points/1 COM) simultaneously ON
Inrush current		Maximum 300 mA, 0.3 msec or lower (132 VAC)
ON voltage/ON current		80 VAC or higher/6 mA or higher
OFF voltage/OFF current		30 VAC or lower/3 mA or lower
Input impedance		Approx. 10 kΩ
Response time	OFF → ON	15 msec or less
	ON → OFF	25 msec or less
Common terminal		8 points/1 COM
Internal current consumption		120 mA
Operating indicator		LED turns on at ON state of input
External connections		38-point terminal block connector(M3 × 6 screws)
Weight		0.56 kg

Circuit configuration



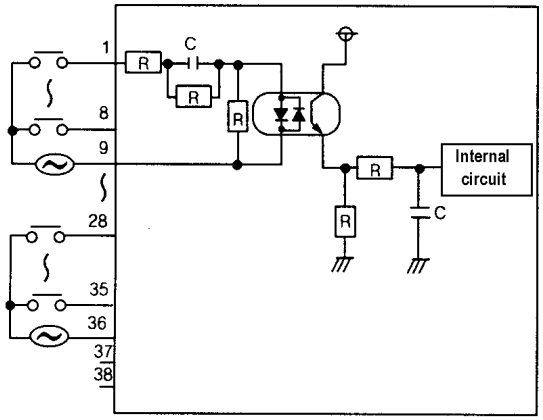
External connections



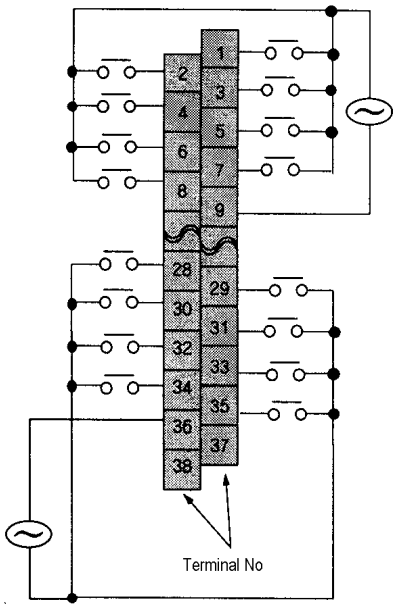
7.2.9 32-points 220 VAC input module

Specifications \ Model		GM3
		G3I-A24A
Number of input points		32 points
Insulation method		Photo coupler
Rated input voltage		200 to 240 VAC (50/60 Hz)
Rated input current		10 mA (220 VAC / 60 Hz)
Operating voltage range		170 to 264 VAC (50/60 Hz ± 3 Hz)
Maximum simultaneous input points		60% (5 points / 1 COM) simultaneously ON
Inrush current		600 mA, 0.12 msec or lower (264 VAC)
ON voltage/ON current		150 VAC or higher/4.5 mA or higher
OFF voltage/OFF current		50 VAC or lower/3 mA or lower
Input impedance		Approx. 10 kΩ
Response time	OFF → ON	15 msec or less
	ON → OFF	25 msec or less
Common terminal		8 points/1 COM
Internal current consumption		120 mA
Operating indicator		LED turns on at ON state of input
External connections		38-point terminal block connector(M3 × 6 screws)
Weight		0.56 kg

Circuit configuration



External connections

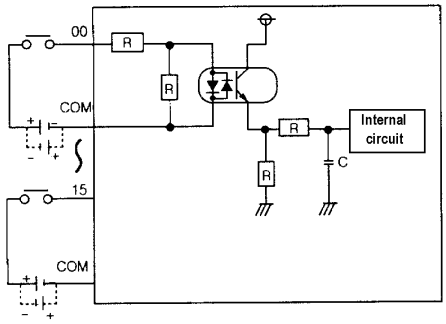


7.2.10 Interrupt input module

Specifications \ Model		GM3	GM4
		G3F-INTA	G4F-INTA
Number of input points		16 points	8 points
Insulation method		Photo coupler	
Rated input voltage		24 VDC	
Rated input current		10 mA	
Input impedance		Approx. 2.4 kΩ	
Operating voltage range		21.6 to 26.4 VDC	
Maximum simultaneous input points		100% simultaneously ON	
ON voltage/ON current		15 VDC or higher/6.5 mA or higher	
OFF voltage/OFF current		5 VDC or lower/2.0 mA or lower	
Response time	OFF → ON	0.5 msec or less	
	ON → OFF	0.5 msec or less	
Common terminal		1 point/ 1COM	
Internal current consumption		Ascending or descending edge (Setting Dip switch by the channel)	
Internal current consumption		200 mA	65 mA
Operating indicator		LED turns on at ON state of input	
External connections		38-point terminal block connector(M3 × 6 screws)	20-point terminal block connector(M3 × 6 screws)
Weight		0.4 kg	0.16 kg

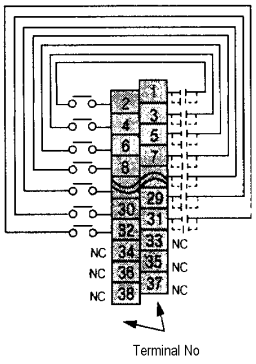
Circuit configuration

[G3F-INTA]



External connections

[G3F-INTA]



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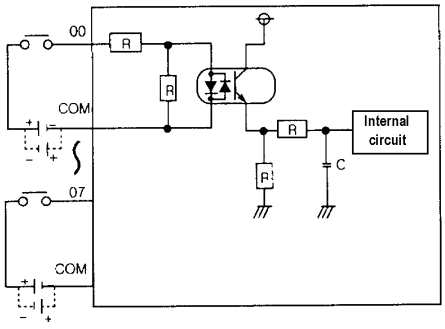

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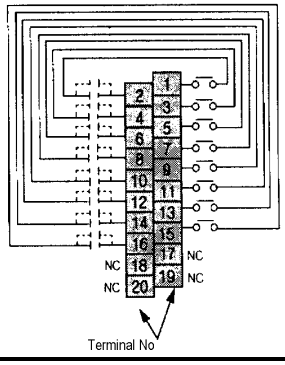
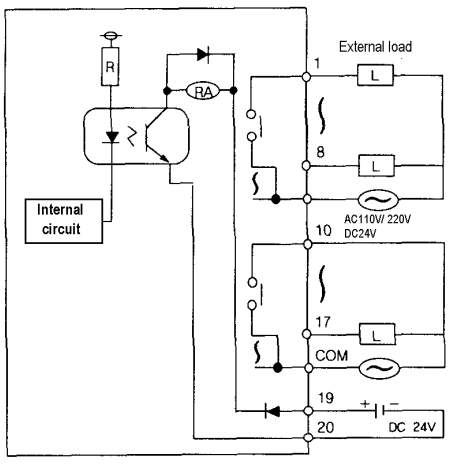


7.3 Digital Output Module Specifications

7.3.1 16-point relay output module

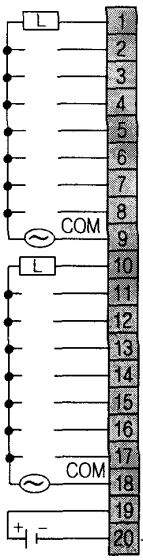
Specifications \ Models		GM3	GM4
		G3Q-RY2A	G4Q-RY2A
Number of output points		16 points	
Insulation method		Photo coupler	
Rated load voltage/current		24 VDC 2A(load resistance)/1 point, 8 A/ 1 COM 220 VAC 2A(COSΨ = `1)	24 VDC 2A(load resistance)/1 point, 4 A/ 1 COM 220 VAC 2A(COSΨ = `1)
Minimum load voltage/current		5 VDC / 1 mA	
Maximum load voltage/current		250 VAC, 125 VDC	
Off leakage current		0.1 mA (220 VAC, 60 Hz)	
Maximum switching frequency		3600 times per hour	
Surge absorber		None	
Service life	Mechanical	20 million times or more	
	Electrical	Rated load voltage/current 100000 times or more	
		200 VAC 1,5 A, 240 VAC 1 A (COSΨ = 0.7) 100000 times or more	
		200 VAC 1 A, 240 VAC 0.5 A (COSΨ = 0.35) 100000 times or more	
		24 VAC 1,5 A, 100 VDC 0.1 A (L/R= 7 msec) 100000 times or more	
Response time	Off → On	10 msec or less	
	On → Off	12 msec or less	
Common terminal arrangement		8 points/common	
Internal current consumption		100 mA (24 VDC all points ON)	100 mA (24 VDC all points ON)
External power supply	Voltage	24 VDC ± 10 % (ripple voltage : 4VP-P or less)	
	Current	150 mA (24 VDC all points ON)	
Operation indicator		LED turns on at ON state of output	
External connections		20-point terminal block connector (M3 × 6 screws)	
Weight		0.46kg	0.31 kg

Circuit configuration

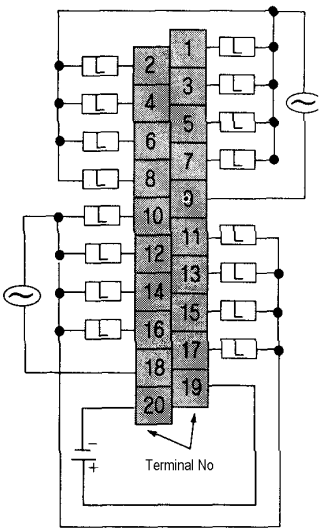


External connections

[G3Q-RY2A]



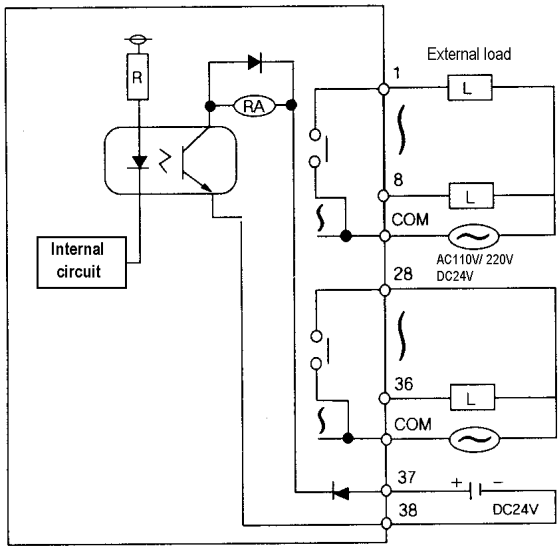
[G4Q-RY2A]



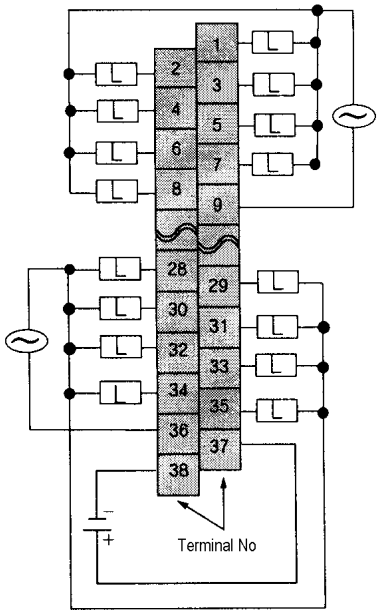
7.3.2 32-point relay output module

Specifications \ Model		GM3
		G3Q-RY4A
Number of output points		32 points
Insulation method		Photo coupler
Rated load voltage/current		24 VDC 2A(load resistance), 220VAC /2A(COSΨ = `1)/1 point 5 A/1 COM
Minimum load voltage/current		5 VDC / 1 mA
Maximum load voltage/current		250 VAC, 125 VDC
Off leakage current		0.1 mA (220 VAC, 60 Hz)
Maximum switching frequency		3600 times per hour
Surge absorber		None
Service life	Mechanical	20 million times or more
	Electrical	Rated switching voltage/current 100000 times or more
		200 VAC 1,5 A, 240 VAC 1 A (COSΨ = 0.7) 100000 times or more
		200 VAC 1 A, 240 VAC 0.5 A (COSΨ = 0.35) 100000 times or more
		24 VAC 1,5 A, 100 VDC 0.1 A (L/R= 7 msec) 100000 times or more
Response time	Off → On	10 msec or less
	On → Off	12 msec or less
Common terminal arrangement		8 points/1 COM
Internal current consumption		240 mA (all points ON)
External power supply	Voltage	24 VDC ± 10 % (ripple voltage : 4VP-P or less)
	Current	170 mA or less(24 VDC all points ON)
Operation indicator		LED turns on at ON state of output
External connections		38-point terminal block connector (M3 × 6 screws)
Weight		0.55 kg

Circuit configuration



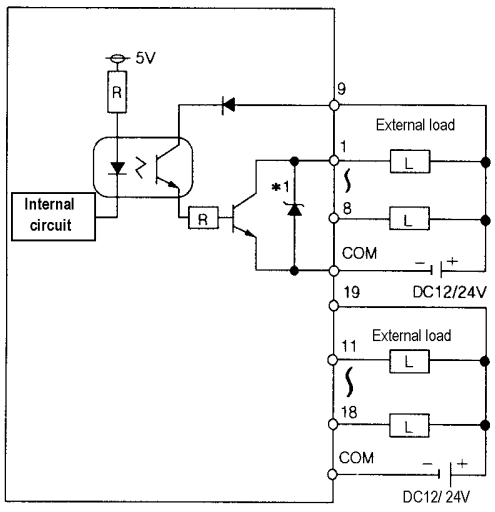
External connections



7.3.3 16-point transistor output module (sink type)

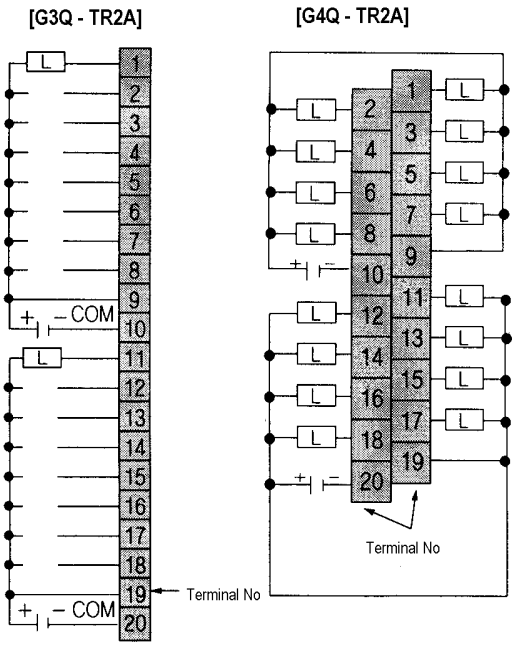
Specifications \ Models		GM3	GM4
		G3Q-TR2A	G4Q-TR2A
Number of output points		16 points	
Insulation method		Photo coupler	
Rated load voltage/current		12/24 VDC	
Operating load voltage range		10.2 to 26.4 VDC	
Maximum load current		2 A / 1 point, 5 A / 1 COM	0.5 A / 1 point, 3 A / 1 COM
Off leakage current		0.1 mA	
Maximum inrush current		8 A / 10 msec or less	4 A / 10 msec or less
Maximum voltage drop at ON circuit		1.5 VDC	
Surge absorber		Clamp diode	Barrister
Response time	Off → On	2 msec or less	
	On → Off	2 msec or less	
Common terminal arrangement		8 points/1 COM	
Internal current consumption		120 mA (24 VDC all points ON)	110 mA (24 VDC all points ON)
External power supply	Voltage	24 VDC ± 10 % (ripple voltage : 4VP-P or less)	
	Current	100 mA or less (24 VDC per COM)	
Operation indicator		LED turns on at ON state of output	
External connections		20-point terminal block connector (M3 × 6 screws)	
Weight		0.54 kg	0.27 kg

Circuit configuration



*1 : G4A-TR2A includes a barrister as s surge absorber.

External connections

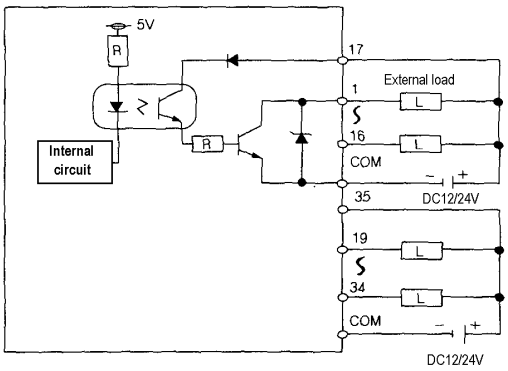


7.3.4 32-point transistor output module (sink type)

Specifications \ Models		GM3	GM4
		G3Q-TR4A	G4Q-TR4A
Number of output points		32 points	
Insulation method		Photo coupler	
Rated load voltage/current		12/24 VDC	
Operating load voltage range		10.2 to 26.4 VDC	
Maximum load current		0.5 A / 1 point, 3 A / 1 COM	0.1 A / 1 point, 2 A / 1 COM
Off leakage current		0.1 mA or less	
Maximum inrush current		4 A / 10 msec or less	4 A / 10 msec or less
Maximum voltage drop at ON circuit		1.5 VDC	1.0 VDC
Surge absorber		Clamp diode	None
Response time	Off → On	2 msec or less	
	On → Off	2 msec or less	
Common terminal arrangement		16 points/1 COM	32 points/1 COM
Internal current consumption		200 mA (all points ON)	160 mA (all points ON)
External power supply	Voltage	24 VDC ± 10 % (ripple voltage : 4VP-P or less)	
	Current	150 mA or less (24 VDC per COM)	100 mA or less (24 VDC per COM)
Operation indicator		LED turns on at ON state of output	
External connections		38-point terminal block connector (M3 × 6 screws)	37-pin D Sub-connector
Weight		0.5kg	0.18 kg

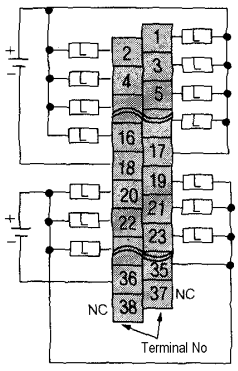
Circuit configuration

[G3Q - TR4A]

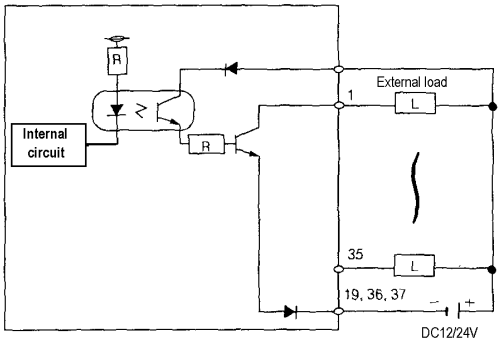


External connections

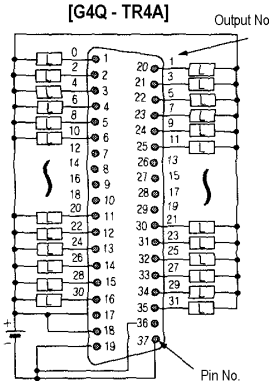
[G3Q - TR4A]



[G4Q - TR4A]



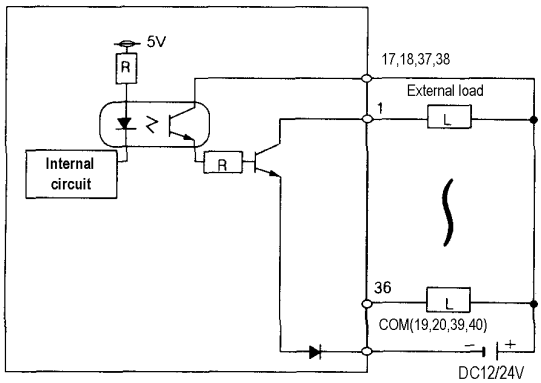
[G4Q - TR4A]



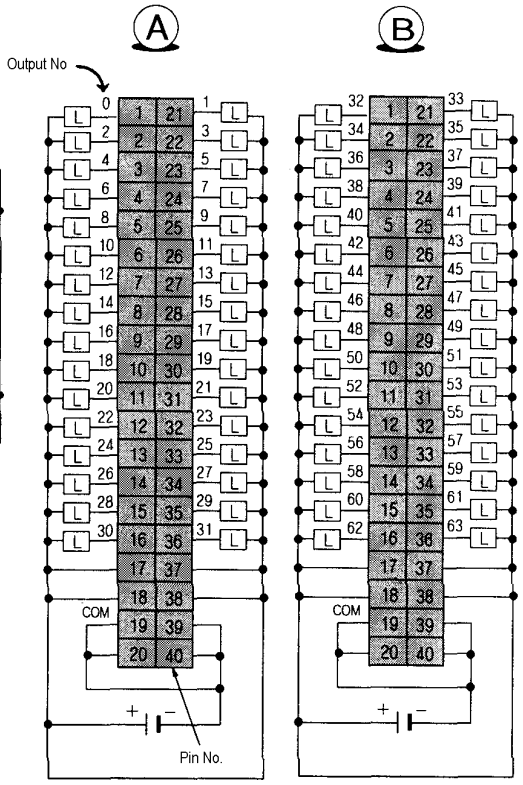
7.3.5 64-point transistor output module (sink type)

Specifications \ Model		GM3
		G3Q-TR8A
Number of output points		64 points
Insulation method		Photo coupler
Rated load voltage/current		12/24 VDC
Operating load voltage range		10.2 to 26.4 VDC
Maximum load current		0.1 A / 1 point, 2 A / 1 COM
Off leakage current		0.1 mA or less
Maximum inrush current		0.4 A / 10 msec or less
Maximum voltage drop at ON circuit		1.0 VDC
Response time	Off → On	2 msec or less
	On → Off	2 msec or less
Common terminal arrangement		32 points/1 COM
Internal current consumption		300 mA (all points ON)
External power supply	Voltage	10.2 to 26.4 VDC
	Current	100 mA (24 VDC per COM)
Operation indicator		LED turns on at ON state of output
External connections		Two 40-point connectors
Weight		0.42kg

Circuit configuration



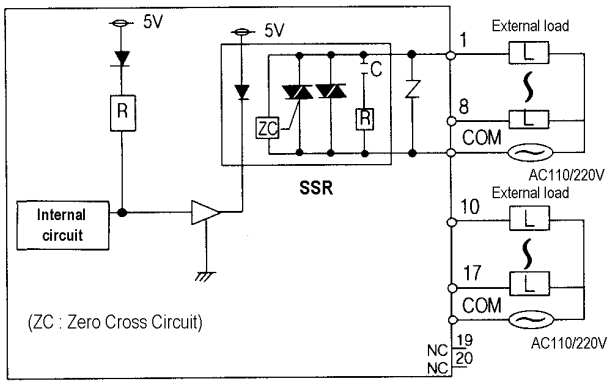
External connections



7.3.6 16-point triac output module

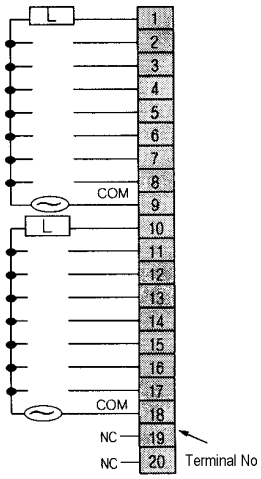
Specifications \ Models		GM3	GM4	
		G3Q-RY4A	G4Q-SS2A	G4Q-SS2B
Number of output points		16 points		
Insulation method		Photo coupler		
Rated load voltage		100 to 240 VAC (50 to 60 Hz)		
Minimum load voltage		264 VAC		
Maximum load current		2 A / 1 point, 5 A / 1 COM	1 A / 1 point, 5 A / 1 COM	0.6 A / 1 point, 2.4 A / 1 COM
Minimum load current		20 mA		10 mA
Off leakage current		25 mA (220 VAC, 60 Hz)		
Maximum inrush current		40 A 10 msec or less	25 A 10 msec or less	20 A 10 msec or less
Maximum voltage drop at ON circuit		1.5 VAC or less (2 A)	1.5 VAC or less (1 A)	1.5 VAC or less (0.6 A)
Surge absorber		Barrister (387 to 473 V), C.R absorber		
Response time	Off → On	0.5 cycle + 1 msec or less		
	On → Off	0.5 cycle + 1 msec or less		
Common terminal arrangement		8 points/1 COM		
Internal current consumption		330 mA (all points ON)		
Operation indicator		LED turns on at ON state of output		
External connections		20-point terminal block connector (M3 × 6 screws)		
Weight		0.55 kg	0.35 kg	

Circuit configuration

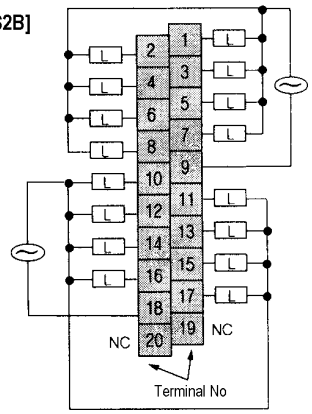


External connections

[G3Q - SS2A]



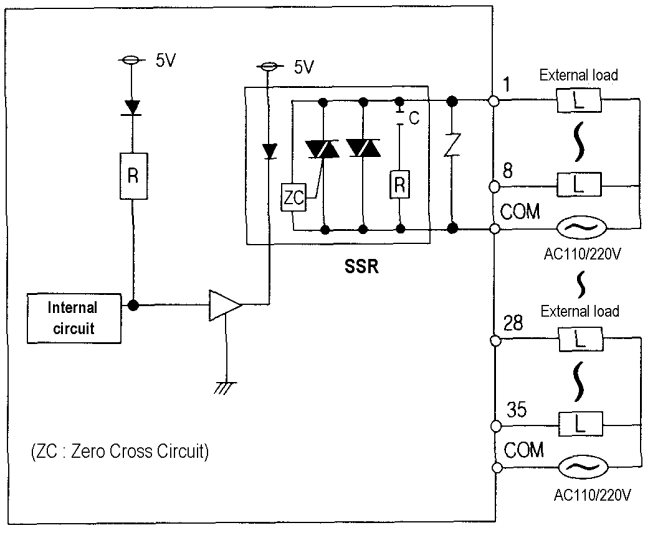
[G4Q - SS2A / G4Q - SS2B]



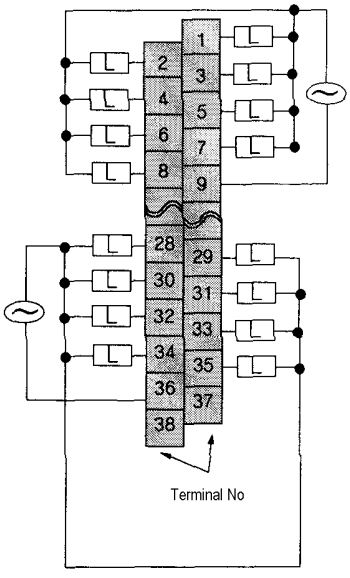
7.3.7 32-point triac output module

Specifications \ Model		GM3
		G3Q-SS4A
Number of output points		32 points
Insulation method		Photo coupler
Rated load voltage		100 to 240 VAC (50 to 60 Hz)
Minimum load voltage		264 VAC
Maximum load current		1 A / 1 point, 5 A / 1 COM
Minimum load current		20 mA
Off leakage current		2 mA (220 VAC, 60 Hz)
Maximum inrush current		25 A, 10 msec or less
Maximum voltage drop at ON circuit		1.5 VAC or less (1 A)
Surge absorber		Barrister (387 to 473 V), C.R absorber
Response time	Off → On	0.5 cycle + 1 msec or less
	On → Off	0.5 cycle + 1 msec or less
Common terminal arrangement		8 points/1 COM
Internal current consumption		600 mA (all points ON)
Operation indicator		LED turns on at ON state of output
External connections		38-point terminal block connector (M3 × 6 screws)
Weight		0.6 kg

Circuit configuration



External connections



Chapter 8. POWER SUPPLY MODULE

This chapter describes the selection method, type and specifications of the power supply module.

8.1 Selection of power supply module

Selection of the power supply module is determined by the total current consumption of digital input modules, special modules and communications modules, etc. whose powers are supplied by the power supply module.
If total load overrun the rated output capacity, the system will not normally operate. When configuring a system, select a power supply module with due consideration of current consumption of each module.

1) GM4 series modules current consumption

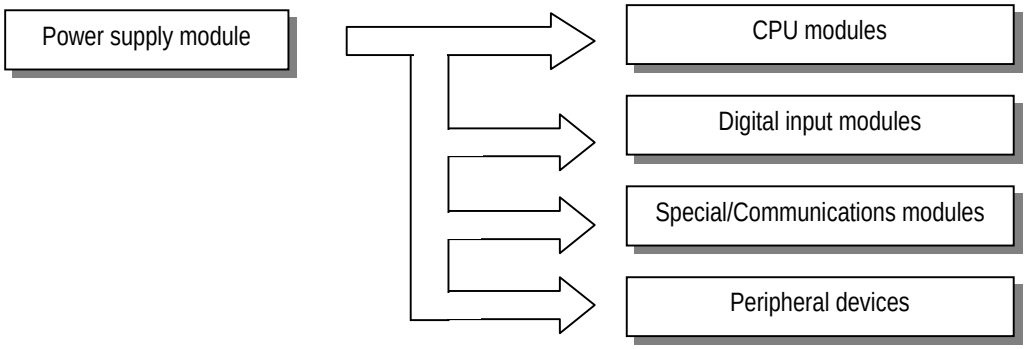
(unit: mA)

Modules	Models	Current Consumption	Modules	Models	Current Consumption
CPU module	GM4-CPUA	130	A/D conversion module	G4F-AD2A	350
12/24 VDC input module	G4I-D22A	70	D/A conversion module	G4F-DA1A	450
	G4I-D22B	70	High speed counting module	G4F-HSCA	300
	G4I-D24A	125	Positioning module	G4F-POPA	400
	G4I-D24B	125	Thermocouple input module	G4F-TC2A	350
110 VAC input module	G4I-A12A	70	Temperature-measuring resistor input module	G4F-RD2A	350
220 VAC input module	G4I-A22A	70	PID control module	G4F-PIDA	150
Relay output module	G4Q-RY2A	100	Analog timer module	G4F-AT3A	150
Transistor output module	G4Q-TR2A	120	Computer link module	G4L-CUEA	100
	G4Q-TR4A	160	Fnet I/F module	G4L-FUEA	160
Triac output module	G4Q-SS2A	330	Fnet remote I/F module	G4L-RBEA	150
	G4Q-SS2B	330	Interrupt module	G4L-INTA	65

2) GM3 series modules current consumption

(unit: mA)

Module	Model	Current Consumption	Module	Model	Current Consumption
CPU module	GM3-CPUA	130	A/D conversion module	G3F-AD4A	600
12/24 VDC input module	G3I-D22A	70	D/A conversion module	G3F-DA4V	300
	G3I-D24A	125		G3F-DA4I	300
	G3I-D28A	120	High speed counting module	G3F-HSCA	300
110 VAC input module	G3I-A12A	70	Positioning module	G3F-POPA	400
	G3I-A14A	120		G3F-POAA	700
220 VAC input module	G3I-A22A	70	Thermocouple input module	G3F-TC4A	700
	G3I-A24A	120	Temperature-measuring resistor input module	G3F-RD3A	800
Relay output module	G3Q-RY2A	100	PID control module	G3F-PIDA	300
	G3Q-RY4A	200	Analog timer module	G3F-AT4A	300
Transistor output module	G3Q-TR2A	120	Fnet I / F module	G3L-FUEA	170
	G3Q-TR4A	200		G3L-FUOA	130
	G3Q-TR8A	300	Fnet remote I / F module	G3L-RBEA	160
Triac output module	G3Q-SS2A	330		G3L-RBOA	130
	G3Q-SS4A	600	Mnet I / F module	G3L-MUEA	550
Interrupt input module	G3F-INTA	200	Computer Link module	G3L-CUEA	100



8.2 Specifications

1) GM4

Item		GM4-PA1A	GM4-PA2A	GM4-PA1B	GM4-PA2B
Input	Input voltage	110 VAC (85 to 132 V)	220 VAC (170 to 264 V)	110 VAC (85 to 132 V)	220 VAC (170 to 264 V0
	Input frequency	50 / 60 Hz (47 to 63 Hz)			
	Input current	1.3 A (110 VAC)	0.8 A (220 VAC)	0.65 A (110 VAC)	0.35 A (220 VAC)
	Inrush current	40 A or less			
	Efficiency	65% or more (rated load, 110/220 VAC)			
	Input fuse	3 A/ Slow / 250 VAC			
	Allowable momentary power failure	20 msec or less			
Output (1)	Output voltage	5 VDC			
	Output current	5 VDC(1) : 4 A 5 VDC(2) : 1 A		3 A	
	Over-current protection	5 VDC(1) : 4.4 A or more 5 VDC(2) : 1.2 A or more		3.2 A or more	
Output (2)	Output voltage	24 VDC			
	Output current	0.7 A		0.5 a	
	Over-current protection	0.8 A or more		0.6 A or more	
Voltage status indicator		LED tuns On at normal output voltage.			
Used wire specifications		0.75 to 2 mm^2			
Weight		0.4 kg			

HINT

1) 5 VDC output (2) is used to drive peripheral devices. Therefore, do not include it when calculating current capacity.

1) GM3

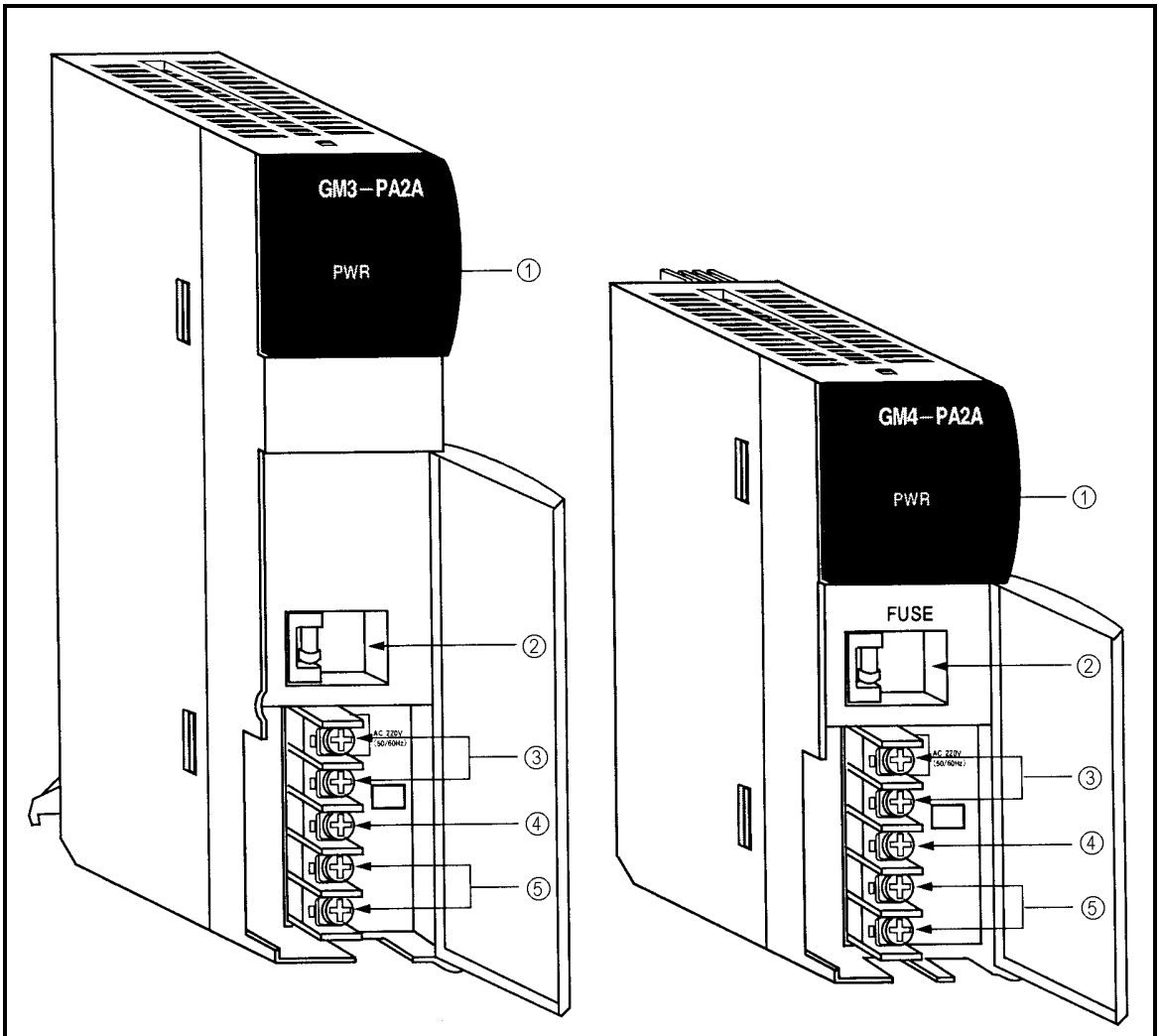
Item		GM3-PA1A	GM3-PA2A	GM1-PA1A	GM1-PA2A
Input	Input voltage	110 VAC (85 to 132 V)	220 VAC (170 to 264 V)	110 VAC (85 to 132 V)	220 VAC (170 to 264 V)
	Input frequency	50 / 60 Hz (47 to 63 Hz)			
	Input current	2.5 A (110 VAC)	1.5 A (220 VAC)	1.8 A (110 VAC)	0.9 A (220 VAC)
	inrush current	40 A or less			
	Efficiency	65% or more (rated load, 110/220 VAC)			
	Input fuse	3 A/ Slow / 250 VAC		3 A/ Slow / 250 VAC	
	Allowable momentary power failure	20 msec or less			
Output (1)	Output voltage	5 VDC			
	Output current	5 VDC(1) : 5 A 5 VDC(2) : 1 A		5 VDC(1) : 12 A 5 VDC(2) : 1 A	
	Over-current protection	5 VDC(1) : 0.75 A or more 5 VDC(2) : 1.2 A or more		5 VDC(1) : 13 A or more 5 VDC(2) : 1.2 A or more	
Output (2)	Output voltage	24 VDC		–	
	Output current	1.5 A		–	
	Over-current protection	1.6 A or more		–	
Voltage status indicator		LED tuns On at normal output voltage.			
Used wire specifications		0.75 to 2 mm^2			
Weight		0.7 kg		0.7 kg	

HINT

1) Allowable momentary power failure time
   : Duration from the time an input voltage has been turned off to the time that the 110/220 VAC voltage fall below the rated voltage (85/170 VAC)
2) Over-current protection
   (1) If a current flows in the 5/24 VDC circuit, a n over-current protection device close the circuit and stop the system.
   (2). If a over-current has been occurred, correct its cause such as insufficient current capacity or short circuit and then restart the system.

8.3 Names of Parts

The followings describe names of parts and their purposes of the power supply module.



No.	Name	Purpose
1	Power LED	Use to indicate the 5 VDC power supply.
2	Power fuse or fuse holder	Used to fix the AC power input 3 A fuse onto the holder.
3	Power input terminal	Used to connect 110 or 220 VAC power.
4	LG terminal	Use to ground the power supply filter.
5	24 VDC and DC24G terminal	Use to the 24 VDC power to the output module as the internal power supply.

Chapter 9. BASE BOARD AND EXPANSION CABLE

9.1 Specifications

9.1.1 Main base board

1) GM3

Items \ Models	GM3-B04M	GM3-B06M	GM3-B08M
Loaded I/O modules	4 modules	6 modules	8 modules
Outer dimensions (mm)	289 × 250 × 17	367 × 250 × 17	437 × 250 × 17
Panel installation hole size	ϕ4.5 (for M4 screw)		
FG terminal connection screws specifications	BHM 3 × 6 washer		
Weight (kg)	1.7	2.1	2.5

2) GM4

Items \ Models	GM4-B04M	GM4-B06M	GM4-B08M	GM4-B12M
Loaded I/O modules	4 modules	6 modules	8 modules	12 modules
Outer dimensions (mm)	289 × 135 × 17	367 × 135 × 17	437 × 135 × 17	540 × 135 × 17
Panel installation hole size	ϕ4.5 (for M4 screw)			
FG terminal connection screws specifications	BHM × 6 washer			
Weight (kg)	0.95	1.1	0.73	0.85
Accessory	Connector cover			

HINT

1) Expansion cable cannot be connected in the GM4-B12M.

9.1.2 Expansion Base board

1) GM3

Items \ Models	GM3-B04E	GM3-B06e	GM3-B08E
Loaded I/O modules	4 modules	6 modules	8 modules
Outer dimensions (mm)	297 × 250 × 17	367 × 250 × 17	437 × 250 × 17
Panel installation hole size	ϕ4.5 (for M4 screw)		
FG terminal connection screws specifications	BHM 3 × 6 washer		
Weight (kg)	2.6	2.1	1.7

2) GM4

Item \ Model	GM4-B04E	GM4-B06E	GM4-B08E
Loaded I/O modules	4 modules	6 modules	8 modules
Outer dimensions (mm)	297 × 135 × 17	367 × 135 × 17	437 × 135 × 17
Panel installation hole size	ϕ4.5 (for M4 screw)		
FG terminal connection screws specifications	BHM 3 × 6 washer		
Weight (kg)	0.9	1.15	1.4
Accessory	Dust Cover, Connector cover		

9.1.3 Expansion Cable

1) GM3

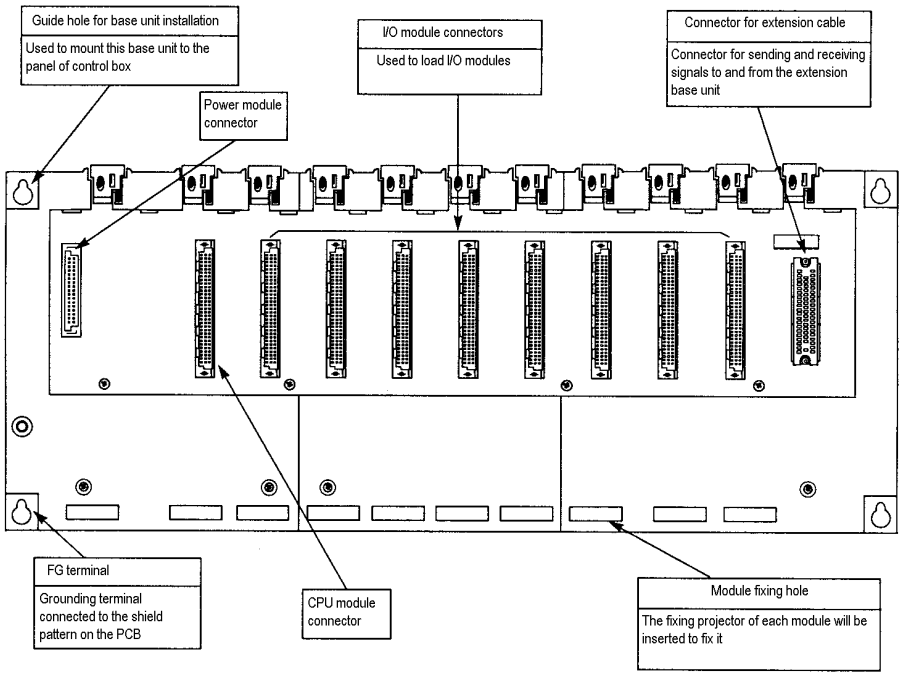
Items \ Models	G3C-E061	G3C-E121	G3C-E301
Length (m)	0.6	1.2	3.0
Weight (kg)	0.37	0.52	1.27

Items \ Models	G4C-E041	G4C-E121	G4C-E301
Length (m)	0.6	1.2	3.0
Weight (kg)	0.21	0.52	1.09

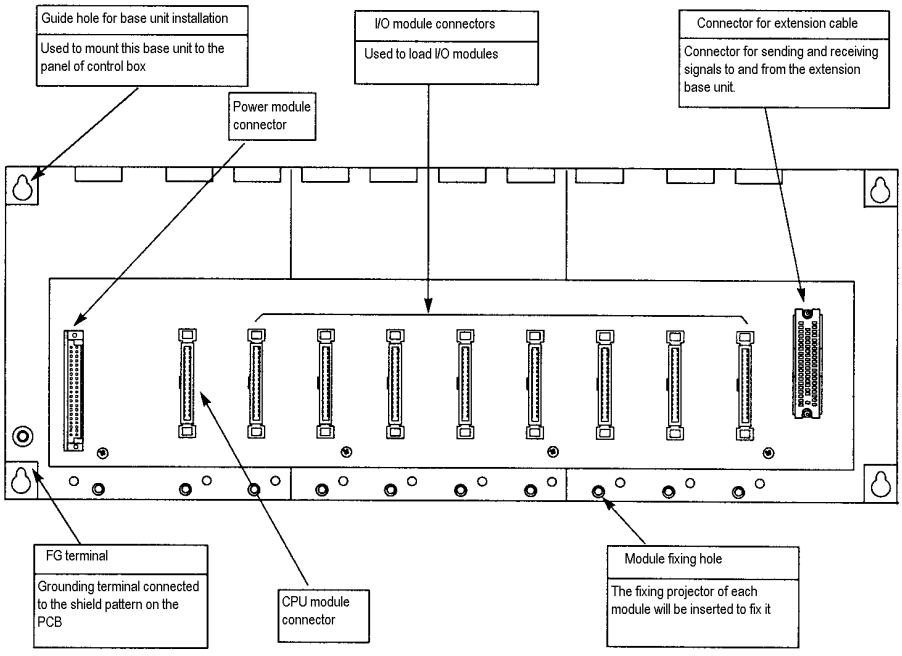
9.2 Names of Parts

9.2.1 Main base board

1) GM3

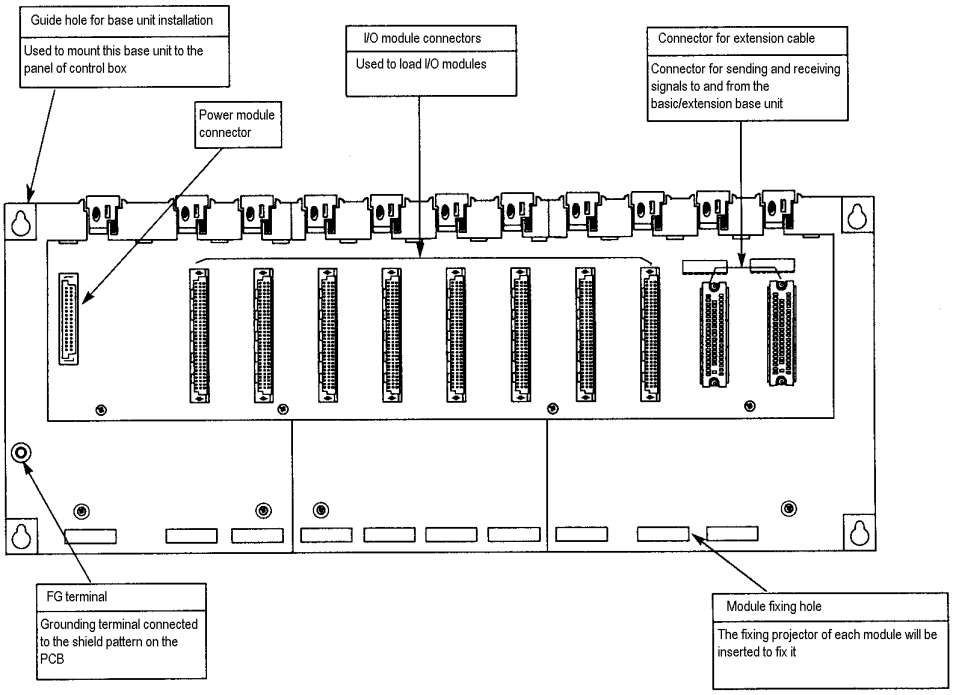


2) GM4

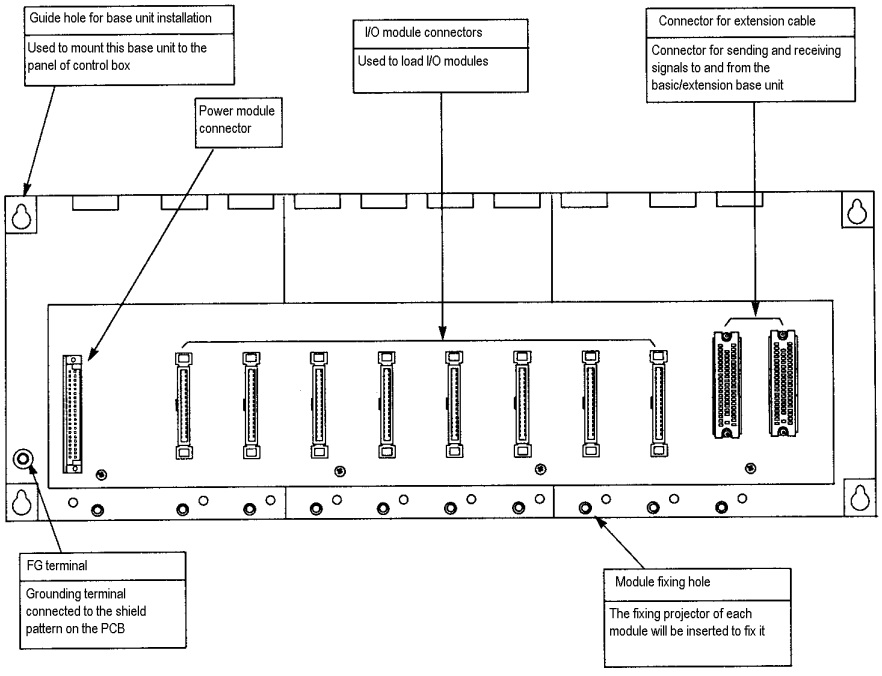


9.2.2 Expansion Base board

1) GM3



2) GM4



Chapter 10. INSTALLATION AND WIRING

10.1 Installation

10.1.1 Installation Environment

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

1) Environment requirements

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

(1) Water leakage and dust.

(2) Continuous shocks or vibrations.

(3) Direct sunlight.

(4) Dew condensation due to rapid temperature change.

(5) Higher or lower temperatures outside the range of 0 to 55 °C

(6) Relative humidity outside the range of 5 to 95 %

(7) Corrosive or flammable gases

2) Precautions during installing.

(1) During drilling or wiring, do not allow any wire scraps to enter into the PLC.

(2) Install it on locations that are convenient for operation.

(3) Make sure that it is not located on the same panel that high voltage equipment located..

(4) Make sure that the distance from the walls of duct and external equipment be 50 mm or more.

(5)Be sure to be grounded to locations that have good ambient noise immunity.

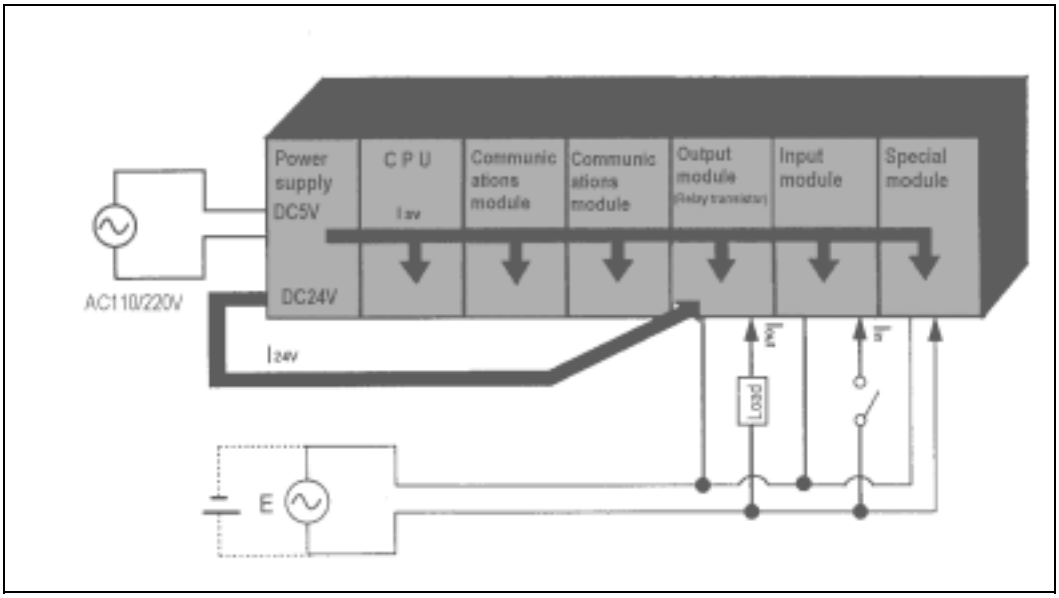
3) Heat protection design of control box

(1) When installing the PLC in a closed control box, be sure to design heat protection of control box with consideration of the heat generated by the PLC itself and other devices.

(2)It is recommended that filters or closed heat exchangers be used.

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

1) PLC system power consumption block diagram



2) Power consumption of each part

(1) Power consumption of a power supply module

Approximately 70% of the power supply module current is converted into power and 30% of that 70% dissipated as heat, i.e., 3/7 of the output power is actually used.

- $Wpw = 3/7 \{(I_{5V} \times 5) + (I_{24V} \times 24)\}$ (W)

where, I_{5V} = 5 VDC circuit current consumption of each module

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

(2) Total 5 VDC power consumption

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

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

(3) Average 24 VDC power consumption (with points simultaneously switched ON)

The total power consumption of all modules is the average power of the 24 VDC output circuit of the power supply module.

- $W_{24V} = I24_V \times 24$ (W)

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

- Wout = Iout × Vdrop × output points × the rate of points switched on simultaneously (W)

{ Iout : output current (actual operating current) (A)
{ Vdrop : voltage dropped across each output load (V)

(5) Average power consumption of input circuits if input modules (with points simultaneously switched ON)

- Win = Iin × E × input points × the rate of points switched on simultaneously (W)

Iin : input current (effective value for AC) (A)

E: input voltage (actual operating voltage) (V)

(6) Power consumption of the special module power supply

- $Ws = I_{5V} \times 5 + I_{24V} \times 24 + I_{100V} \times 100$ (W)

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

- $W = W_{PW} + W_{5V} + W_{24V} + W_{OUT} + W_{IN} + W_S$ (W)

Check the temperature rise within the control panel with calculation of that total power consumption(W).

The temperature rise in the control panel is expressed as:

T = W/UA [°C]

W : Power consumption of the entire PLC system (obtained as shown above)

A : Control panel inside surface area (m2)

U : 6 (if the control panel temperature is controlled by a fan, etc.)

4 (if control panel air is not circulated)

10.1.2 Handling Instructions

to installing the temperature-measuring resistor input module, be sure to check the following:

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

1) I/O module handling instructions

The followings explains instructions for handling or installing the input module.

(1) I/O module specifications re-check

Re-check the input voltage for the input module. If a voltage over the maximum switching capacity is applied, it can cause faults, destruction or fire.

(2) Used wire

Select the wire with due consideration of ambient temperature and rated current. Its minimum specifications should be AWG22(0.3 mm^2) or more.

(3) Environment

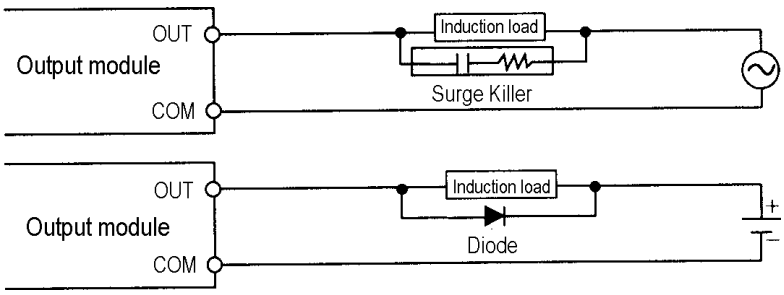
When wiring the I/O module, if it locates near a device generating an cause short circuit, destruction or malfunction.

(4) Polarity

Before applying the power to a module that has polarities, be sure to check its polarities.

(5) Wiring

- Wiring I/O wires with high voltage cable or power supply line can cause malfunction or disorder.
- Be sure that any wire does not pass across during input LED (I/O status will not be clearly identified.
- If an inductive load has been connected to output module, connect parallel surge killer or diode to a load. Connect the cathode part of diode to the + part of the power supply.



(6) Terminal block

Check its fixing. During drilling or wiring, do not allow any wire scraps to enter into the PLC. It can cause malfunction and fault.

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

2) Base board mounting instructions

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

(1) Allow sufficient distance from the upper part of the module for easy module replacement.

(2) Do not mount the PLC in a vertical or horizontal position because it affects on ventilation.

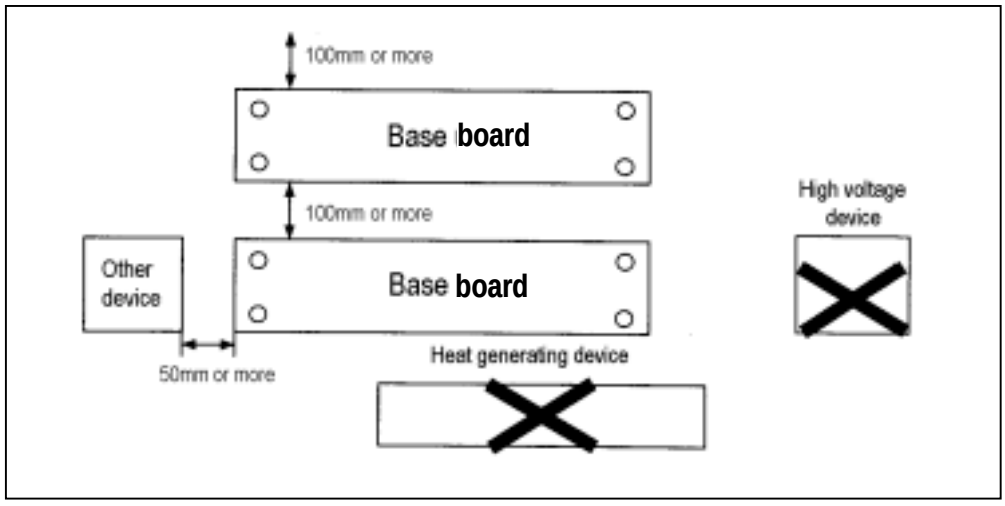
(3) Do not mount the base board together with a large-sized electromagnetic contactor or no-fuse breaker, which produces vibration, on the same panel. Mount them on different panels, or keep the base board away from such a vibration source.

(4) Mount the wire duct as it is needed.

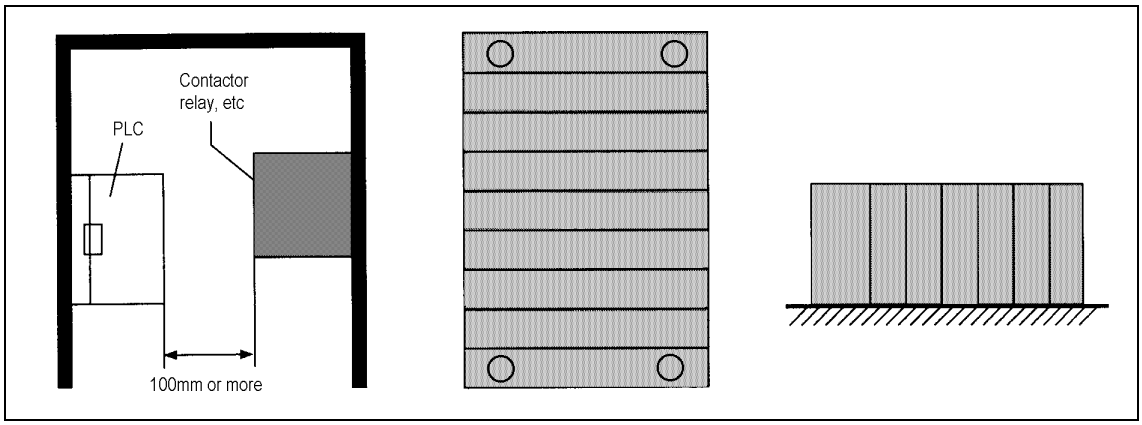
If the clearances are less than those in Fig 10.1, follow the instructions shown below.

- If the wire duct is mounted on the upper part of the PLC, make the wiring duct clearance 50mm or less for good ventilation. Also, allow the distance enough to press the hook in the upper part from the upper part of the PLC.
- If the wire duct is mounted on the lower part of the PLC, make optic or coaxial cables contact it and consider the minimum diameter of the cable.

(5) To protect the PLC from radiating noise or heat, allow 100 mm or more clearances between it and parts. Left or right clearance and clearance from other device in the left or right side should be 50 mm or more.



[Fig. 10.1] PLC mounting



[Fig.10.2] Clearance from the front device [Fig. 10.3] Vertical mounting [Fig 10.4] Horizontal mounting

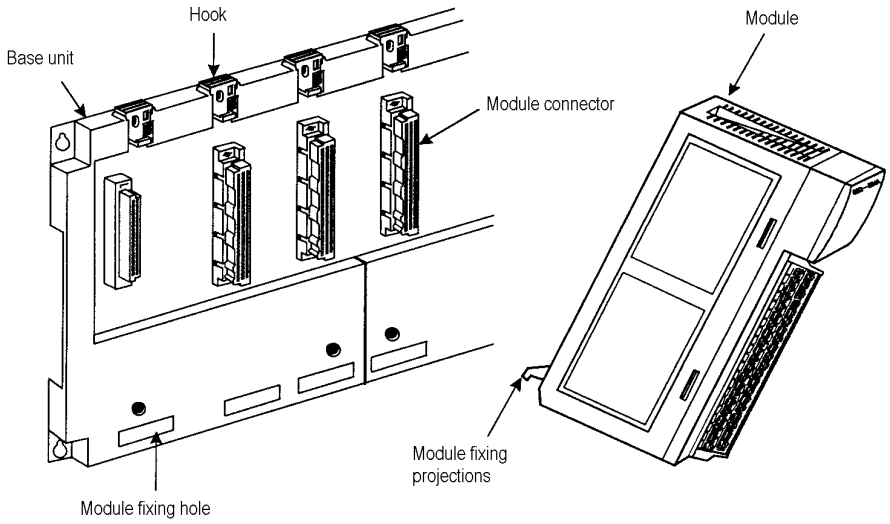
10.1.3 Mounting and Dismounting of module

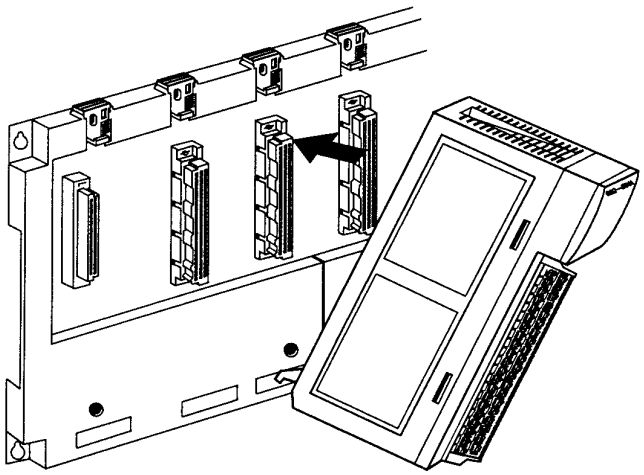
The following explains the mounting and dismounting of various modules.

1) Module mounting

(1) GM3 series module mounting

- Insert the module fixing projections in the lower part into the module fixing hole in the base board.
- Install the module onto the base board by pushing the top forward.
- Check that the module is firmly mounted onto the base board by pulling the upper part of the module.



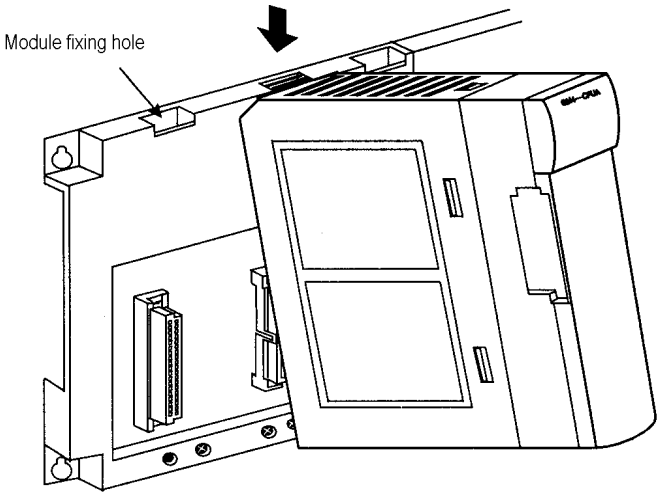


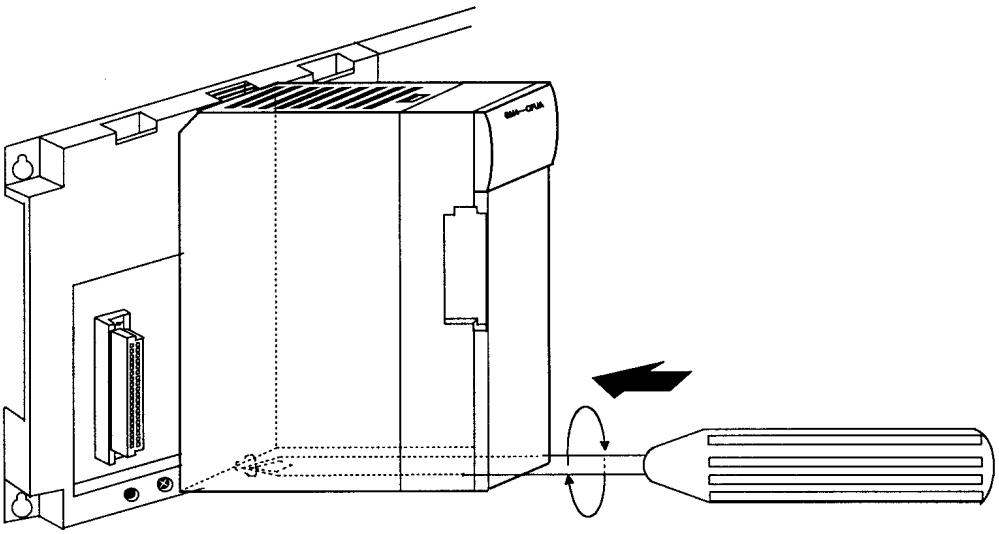
HINT

1) When installing the module, make sure that the module fixing projections is inserted into the module fixing hole and fixed. If the module is forcibly mounted the pins in the module connector may be bent or damaged. If the module is mounted in the location that has large vibration or shock, fix it onto the base board with screws.

(2) GM4 series module mounting

- Insert the module fixing projections in the upper part into the module fixing hole in the base board.
- Install the module onto the base board by pushing the bottom forward and fix it onto the base board with module fixing screws.
- Check that the module is firmly mounted onto the base board by pulling the upper part of the module.





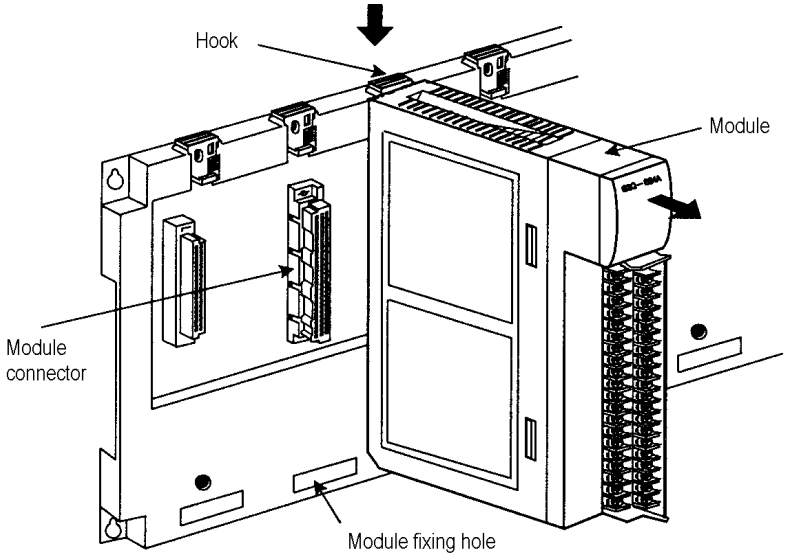
HINT

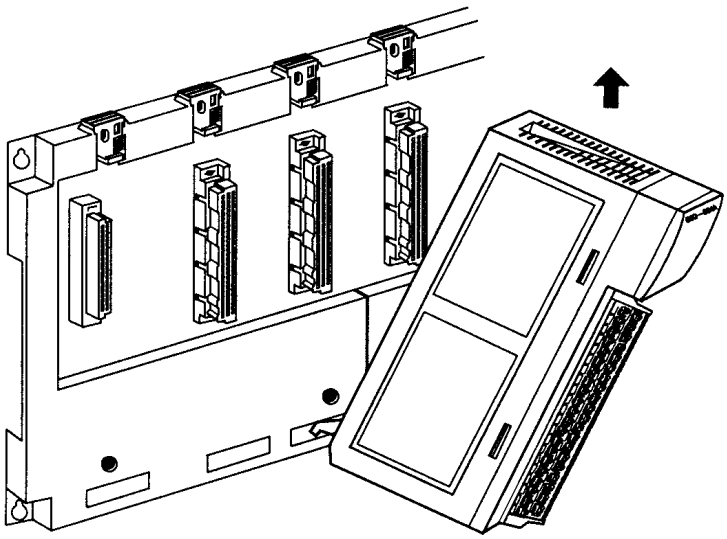
1) When installing the module, make sure that the module fixing projections is inserted into the module fixing hole and fixed. If the module is forcibly mounted the pins in the module connector may be bent or damaged

2) Module dismounting

(1) GM3 series module dismounting

- First, push the hook latch fully.
- While pushing the hook latch, pull the upper part of the module toward you.
- Lift upwards and remove the module hook from the module fixing hole.



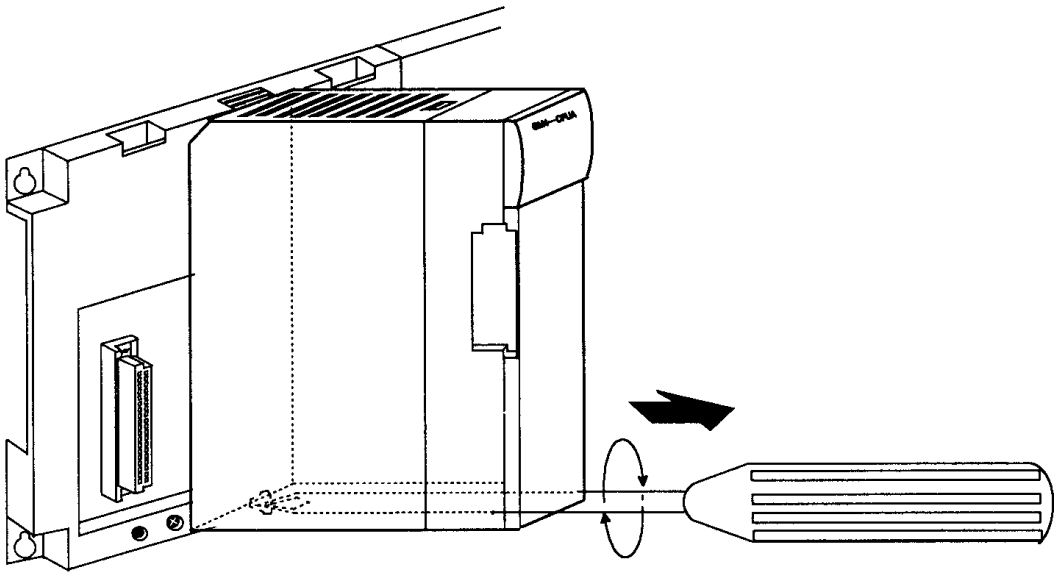


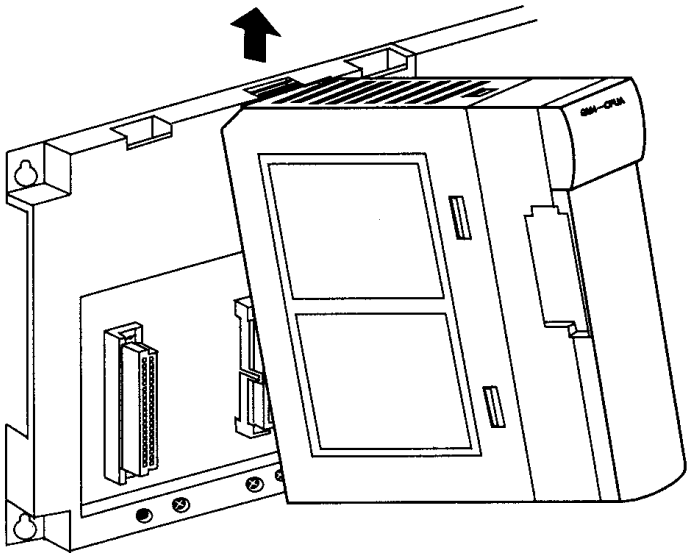
HINT

To dismount the module, be sure to disengage the hook from the module fixing hole and then remove the module fixing projection from the module fixing hole. If the module is forcibly removed, the hook or module fixing projection will be damaged.

(2) GM4 series module dismounting

- First, release the module fixing screws in the bottom from the base board.
- While pushing the hook latch, pull the upper part of the module toward you.
- While lifting the module upwards and remove the module hook from the module fixing hole.



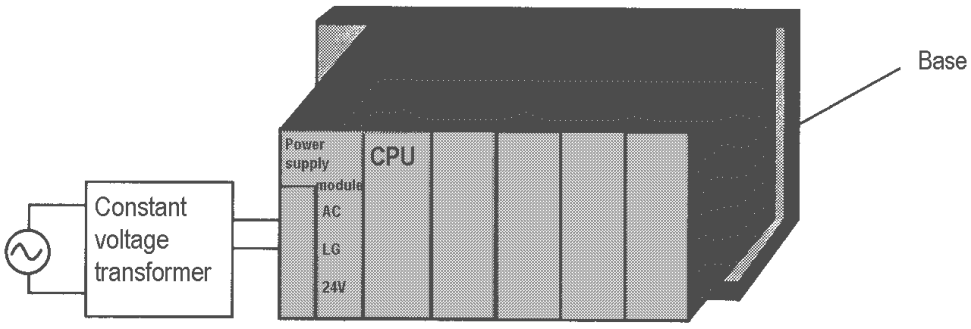


10.2 Wiring

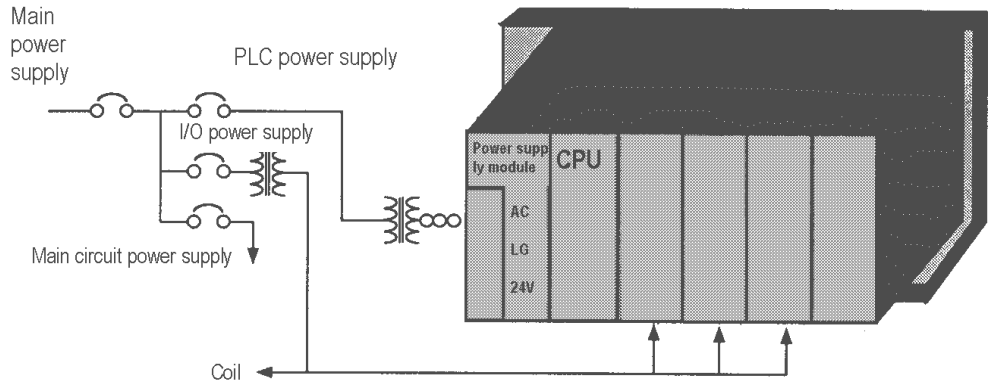
The followings explains the wiring instructions for use of the system.

10.2.1 Power Supply Wiring

1) When voltage fluctuations are larger than the specified value, connect a constant-voltage transformer.

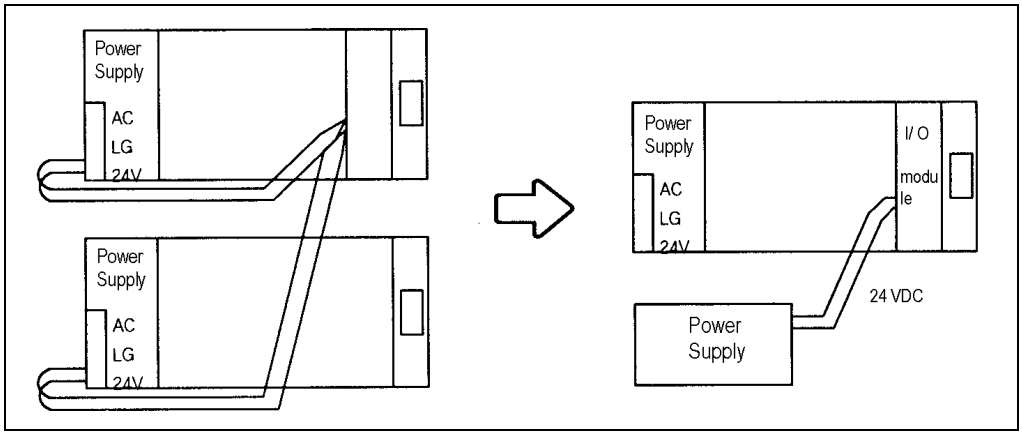


2) Use a power supply which generates minimal noise across wire and across PLC and ground. (When excessive noise is generated, connect an insulating transformer)
3) When wiring, separate the PLC power supply from the I/O and power device as shown below.



4) Notes on using 24 VDC output of the power supply module

- To protect the power supply modules, do not supply one I/O module with 24 VDDC from several power supply modules connected in parallel.
- If 24 VDC output capacity is sufficient for one power supply module, supply 24 VDC from the external 24 VDC power supply as shown below.

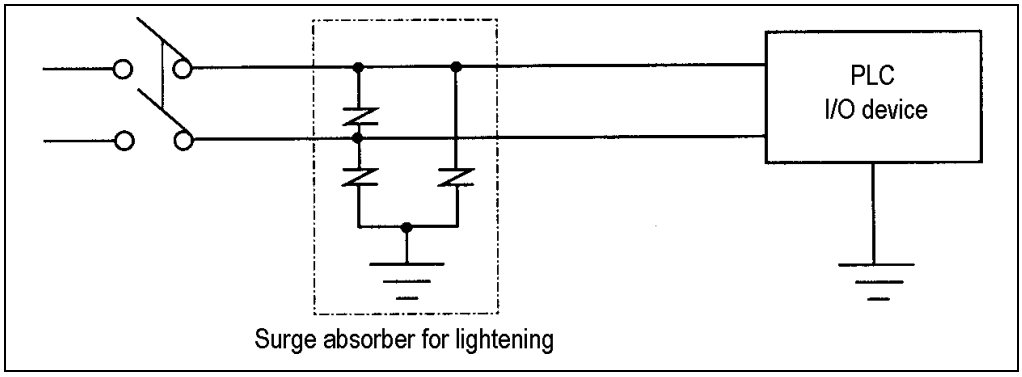


5) Twist the 110 VAC, 220 VAC, and 24 VDC cables as closely as possible. Connect modules with the shortest possible wire lengths.

7) To minimize voltage drop, use the thickest (max. 2 mm^2) wires possible for the 100 VAC, 200VAC and 24 VDC cables.

8) Do not bundles the 100 VAC and 24 VDC cables with main-circuit(high voltage, large current) wires or the I/O signal wires. If possible, provide more than 100 mm distance between the cables and wires.

8) As a lightning-protection measure, connect a surge absorber as shown below.



Surge absorber for lightening

HINT

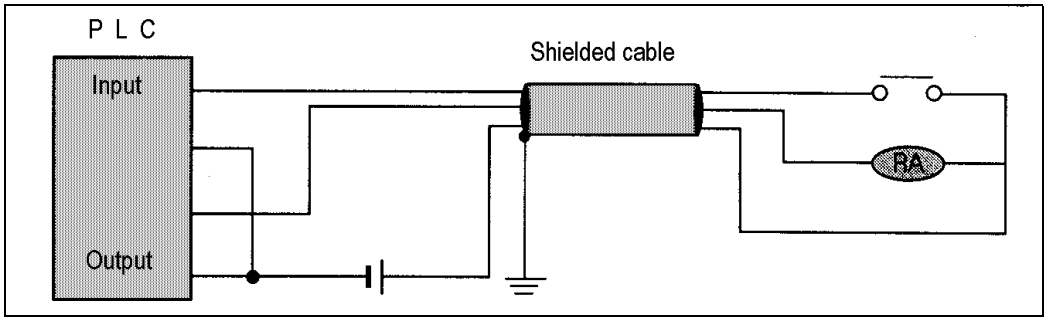
1) Ground the surge absorber (E1) and the PLC(E2) separately from each other.
2) Select a surge absorber making allowances for power voltage rises.

9) Use a insulating transformer or noise filter for protection against noise .

10) Twist every input power supply wires as closely as possible. Do not allow the transformer or noise filter across the duct.

10.2.2 Input and Output Devices Wiring

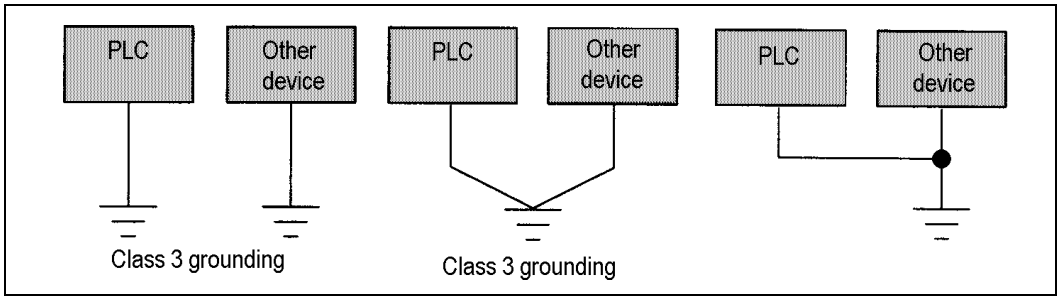
1) Applicable size of wire for I/O wiring is 0.3 to 2 mm^2. However, it is recommended to use wire of 0.3mm^2 for convenience.
2) Separate the input and output lines.
3) I/O signal wires must be at least 100 mm away from high voltage and large current main circuit wires.
4) When the I/O signal wires cannot be separated from the main circuit wires and power wires, ground on the PLC side with batch-shielded cables.



5) If wiring has been done with a piping, ground the piping.
6) Separate the 24 VDC I/O cables from the 110 VAC and 220 VAC cables.
7) If wiring over 200 m or longer distance, problems can be caused by leakage currents due to line capacity. Refer to the Section 12.4 Examples.

10.2.3 Grounding

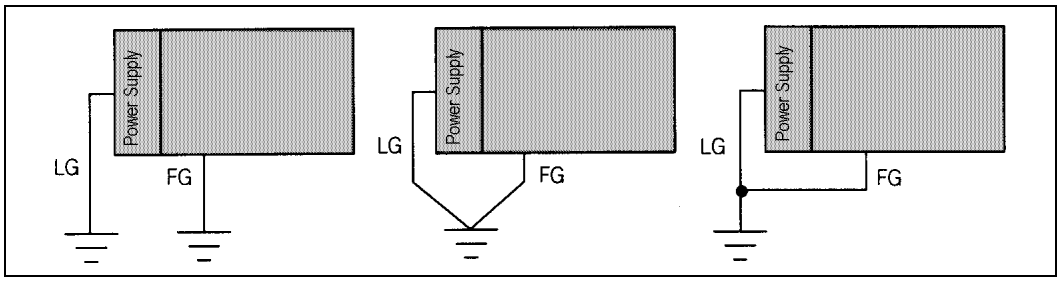
1) This PLC has sufficient protection against noise, so it can be used without grounding except for special much noise. However, when grounding it should be done conforming to below items.
2) Ground the PLC as independently as possible. Class 3 grounding should be used (grounding resistance 100 Ω or less).
3) When independent grounding is impossible, use the joint grounding method as shown in the figure below (B).



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

4) Use 2 mm^2 or more wire for grounding line. Make the distance as short as possible with the grounding point located to nearest to the PLC.

5) Ground LG (Power Supply Module) separately with FG (Base board).



(A) Independent grounding : BEST (B) Joint grounding : GOOD (C) Joint Grounding : Not Allowed

6) If a malfunction occurs depend on grounding point, separate FG (Base Board) with ground.

10.2.4 Cable Specifications for wiring

Kinds of external connection	Cable Specifications (㎟)	
	Minimum	Maximum
Digital Input	0.18 (AWG 24)	1.5 (AWG16)
Digital Output	0.18 (AWG24)	2.0 (AWG14)
Analog Input/Output	0.18 (AWG24)	1.5 (AWG16)
Communication	0.18 (AWG24)	1.5 (AWG16)
Main Power	1.5 (AWG16)	2.5 (AWG12)
Grounding	1.5 (AWG16)	2.5 (AWG12)

Chapter 11. MAINTENANCE

Be sure to perform daily and periodic maintenance and inspection in order to maintain the PLC in the best conditions.

11.1 Maintenance and Inspection

The I/O module mainly consist of semiconductor devices and its service life is semipermanent. However, periodic inspection is requested for ambient environment may cause damage to the devices. When inspecting one or two times per six months, check the following items.

Check Items		Judgment	Corrective Actions
Ambient environment	Temperature	0 to +55°C	Adjust the operating temperature and humidity with the defined range
	Humidity	5 to 95%RH	
	Vibration	No vibration	Use vibration resisting rubber or the vibration prevention method
Play of modules		No play allowed	Securely enrage the hook
Connecting conditions of terminal screws		No loose allowed	Retighten terminal screws
Change rate of input voltage		-15% to 15%	Hold it with the allowable range
Spare parts		Check the number of spare parts and their storage conditions	Cover the shortage and improve the storage condition

11.2 Daily Inspection

The following table shows the inspection and items which are to be checked daily

Check Items		Check points	Judgment	Corrective Actions
Base unit mounting conditions		Check for loose mounting screws	The base unit should be securely mounted	Retighten Screws
Mounting conditions of I/O modules		• Check if the hook is securely engaged • Check if the upper cover is securely mounted	The hook should be securely engaged	Securely engage the hook
Connecting conditions of terminal block or extension cable		Check for loose terminal screws	Screws should not be loose	Retighten terminal screws
		Check the distance between solderless terminals	Proper clearance should be provided	Correct
		Check connectors of extension cable	Connectors should not be loose	Correct
Indicating LED	Power LED	Check that the LED is ON	ON(OFF indicates an error)	See chapter 12
	Run LED	Check that the LED is ON during Run	ON(ON or flickering indicates an error)	"
	Stop LED	Check that the LED is OFF during Run	OFF(ON indicates an error)	"
	Input LED	Check that the LED turns ON and OFF	ON when input is ON, OFF when input is off	"
	Output LED	Check that the LED turns ON and OFF	ON when output is ON. OFF when output is OFF	"

11.3 Periodic Inspection

Check the following items once or twice every six months, and perform the needed corrective actions.

Check Items		Checking Methods	Judgment	Corrective Actions
Ambient environment	temperature	Measure with thermometer and hygrometer Measure corrosive gas	0 to 55°C	
	Ambient humidity		5 to 95% RH	
	Ambience		There should be no corrosive gases	
PLC conditions	Looseness, play	Move the unit	The module should be mounted securely	Retighten screws
	Ingress of dust or foreign material	Visual check	No dust or foreign material	
Connecting conditions	Loose terminal screws	Retighten	Screws should not be loose	Retighten
	Distance between solderless terminals	Visual check	Proper clearance	Correct
	Loose connector	Visual check	Connectors should not be loose	Retighten connector mounting screws
Line voltage check		Measure voltage across 110/ 220 VAC terminal	85 to 132VAC 170 to 264VAC	Change supply power
Battery		Check battery replacement time and battery capacity reduction	• Check total power failure time and the specified source life • Battery capacity reduction should not be indicated	If battery capacity reduction is not indicated, Change the battery when specified service life is exceeded
Fuse		Visual check	No melting disconnection	If fuse melting disconnection, change the fuse periodically because a surge current can cause heat

Chapter 12. TROUBLE SHOOTING

The following explains contents, diagnosis and corrective actions for various errors that can occur during system operation

12.1 Basic Procedures of Troubleshooting

System reliability not only depends on reliable equipment but also on short down-times in the event of faults.

The short discovery and corrective action is needed for speedy operation of system.

The following shows the basic instructions for troubleshooting.

1) Visual checks

Check the following points

- Machine motion(In stop and operating status)
- Power ON or OFF
- Status of I/O devices
- Condition of wiring (I/O wires, extension and communications cables)
- Display states of various indicators(such as POWER LED, RUN LED, STOP LED and I/O LED). After checking them, connect the peripheral devices and check the operation status of the PLC and the program contents.

2) Trouble Check

Observe any change in the error conditions during the following.

- Set the key switch to the STOP position, and then turn the power ON and OFF

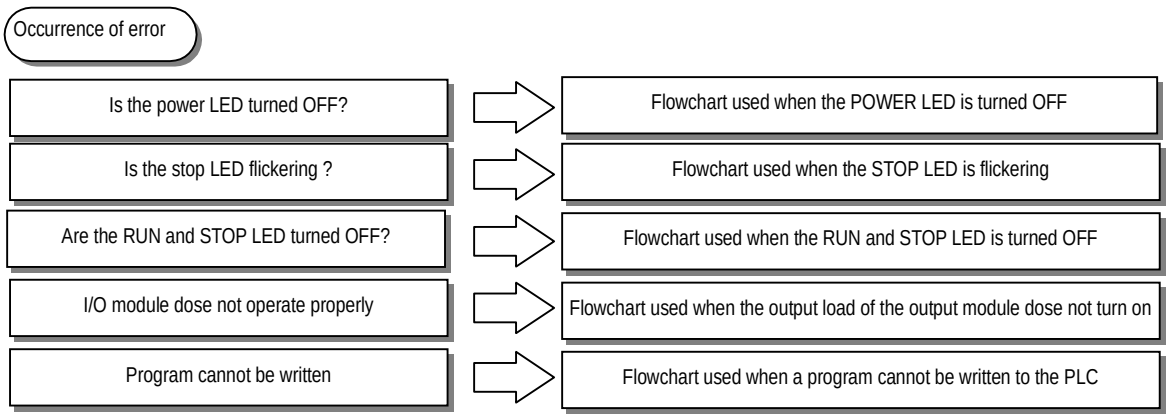
3) Narrow down the possible causes of the trouble

Deduce where the fault lies, i. e:

- Inside or outside of the PLC
- I/O module or another module
- PLC program ?

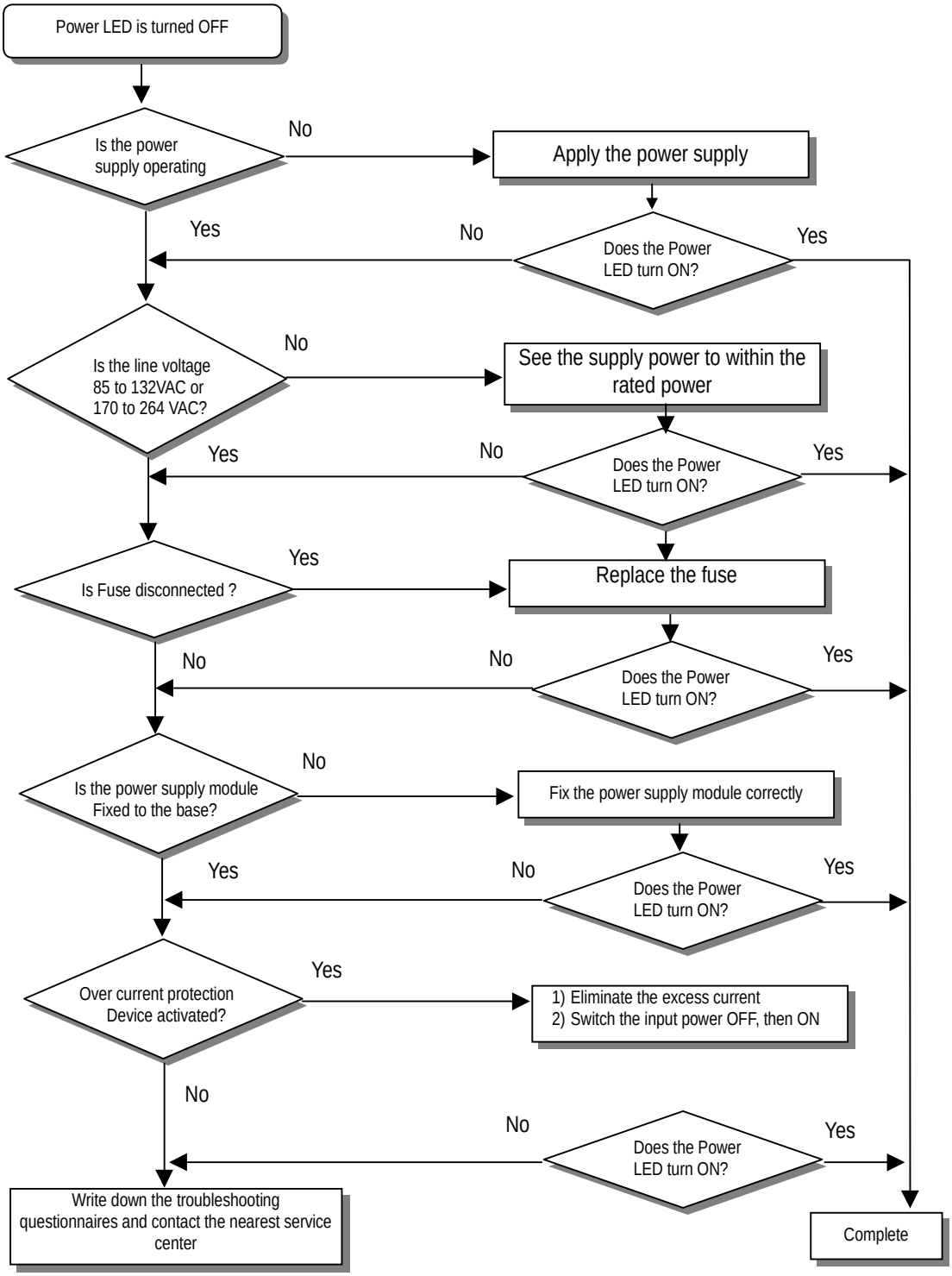
12.2 Troubleshooting

This section explains the procedure for determining the cause of troubles as well as the errors and corrective actions for the error codes.



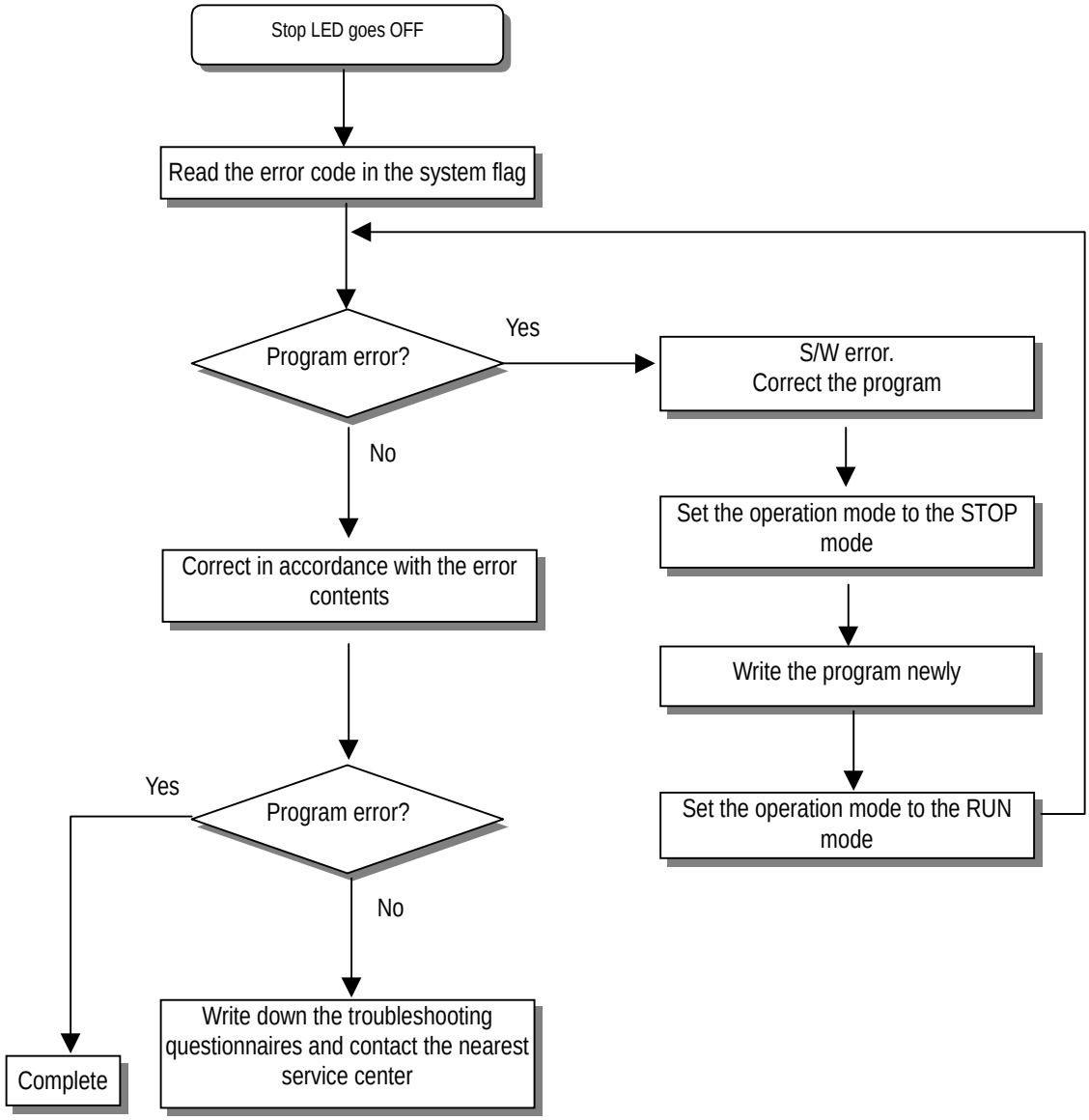
12.2.1 Troubleshooting flowchart used when the POWER LED turns OFF.

The following flowchart explains corrective action procedure used when the power is all lied or the POWER LED turns OFF during operation



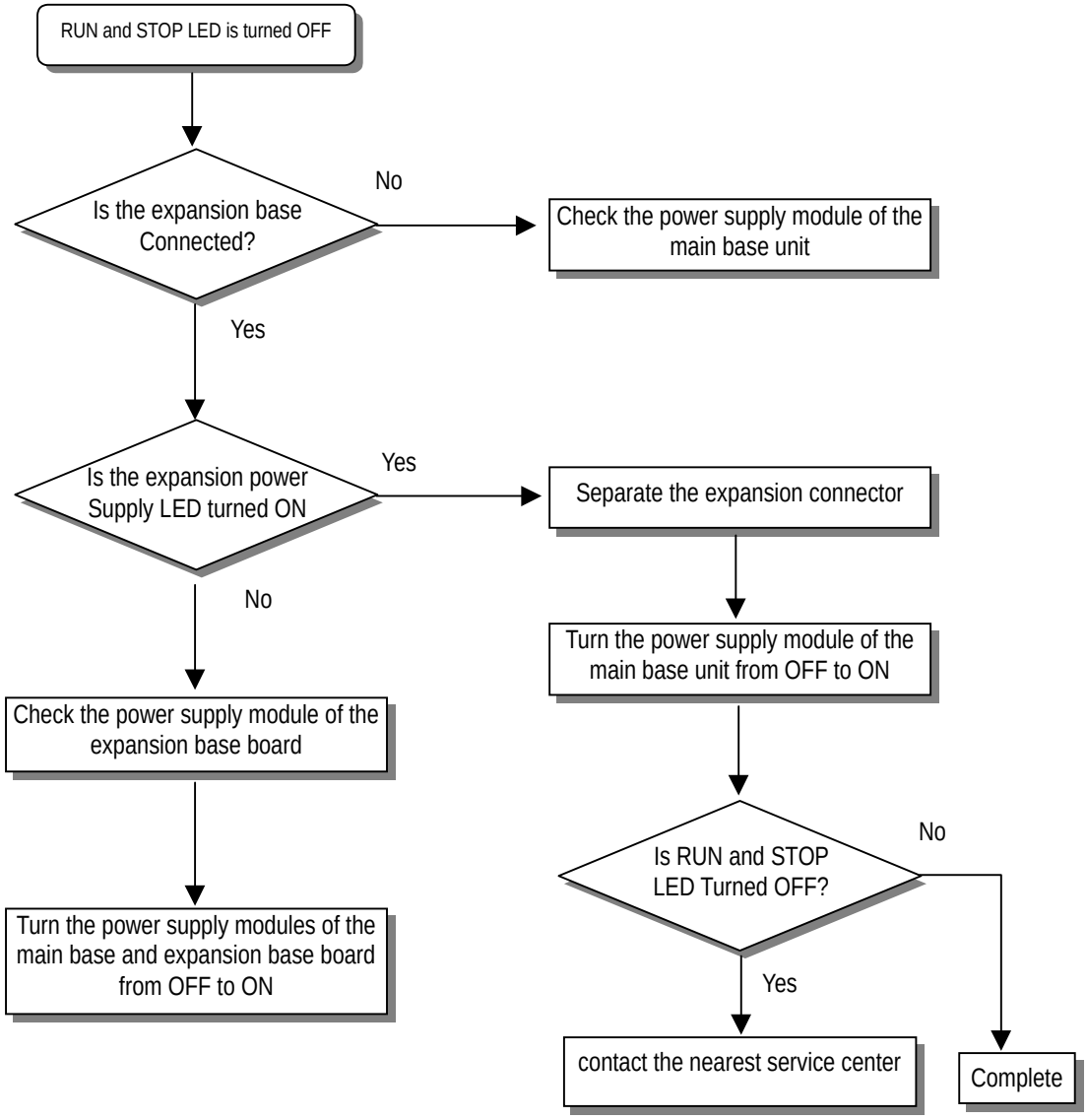
12.2.2 Troubleshooting flowchart used when the STOP LED is flickering

The following flowchart explains corrective action procedure use when the power is applied starts or the STOP LED is flickering during operation



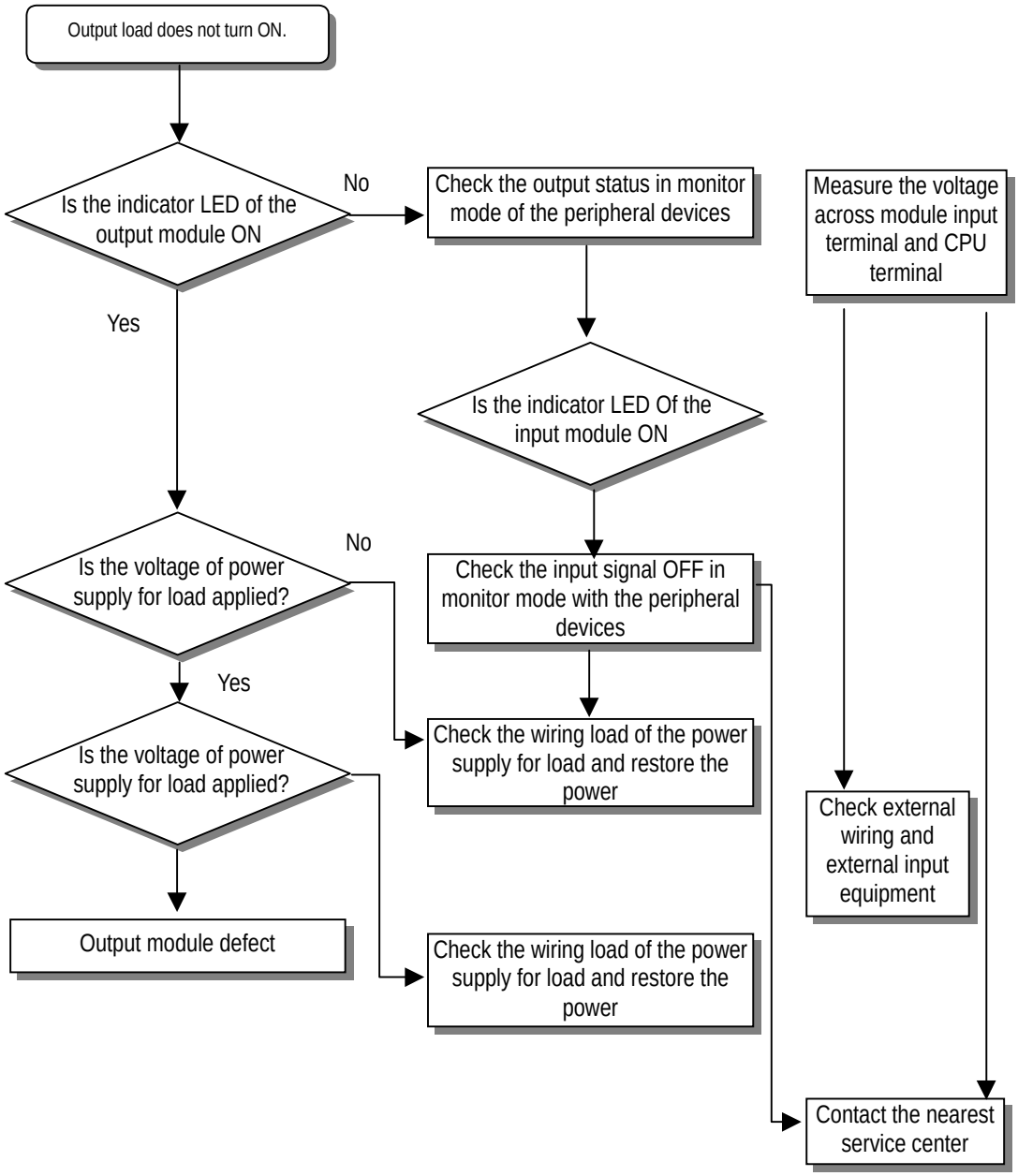
12.2.3 Troubleshooting flowchart used when the RUN and STOP LEDs turns off.

The following flowchart explains corrective action procedure use when the power is applied starts or the RUN and STOP LED is turned OFF is flickering during operation



12.2.4 Troubleshooting flowchart used when the output load of the output module does not turns on.

The following flowchart explains corrective action procedure used when the output load of the output module does not turn ON during operation

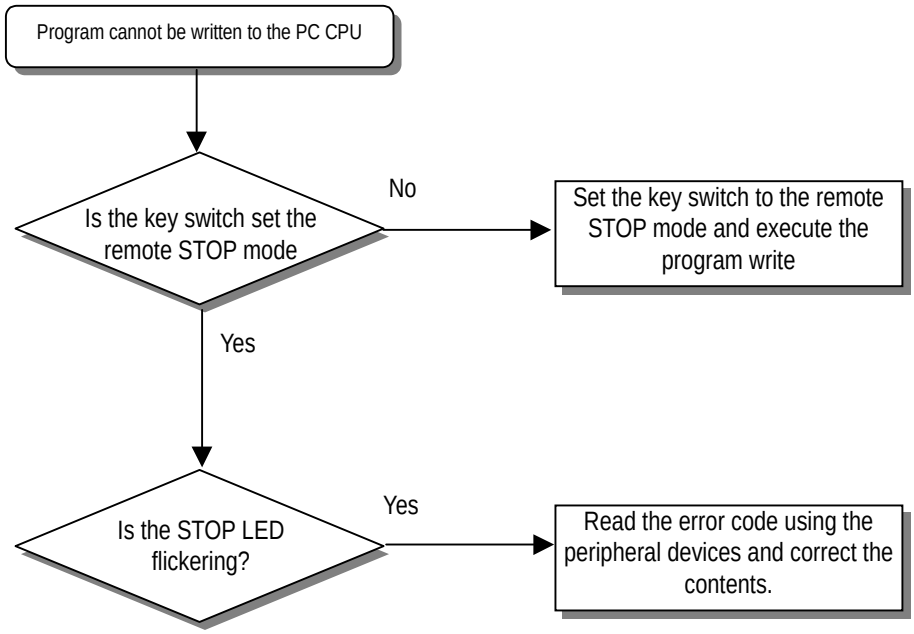


HINT

1) If the input or load signals are not switched OFF, see Section 12.4.1

12.2.5 Troubleshooting flowchart used when a program cannot be written to the CPU module.

The following flowchart shows the corrective action procedure used when a program cannot be written to the PLC module



12.3 Troubleshooting Questionnaire

When problems have been met during operation of the GM3/4 series PLC, please write down this questionnaires and contact the service center via telephone or facsimile

- For errors relating to special or communications modules, use the questionnaire included in the user's Manual of the unit

1. Telephone & FAX No. Tel) _____
   FAX) _____
2. Used Equipment ( )
3. Details of used Equipment
   - CPU module : - OS version No.( ), - Serial No.( )
   - GMWIN version No. used to compile programs
4. General description of the device or system used as the control object

5. Operations used by the CPU module
   - Operation by the key switch( ), - Operation by the GMWIN or communications.( )
   - Memory module operation( )
6. Is the STOP LED of the CPU module turned ON? Yes( ), No( )
7. GMWIN error message :
8. Used initialization program : initialization program( )
9. History of corrective actions for the error message in the article 7.
10. Other tried corrective actions
11. Error character sties
    - Repetitive( ) : Periodic( ), Related to a particular sequence( ), Related to environment( )
    - Sometimes( ) : General error assurance interval
12. Detailed Description of error contents :

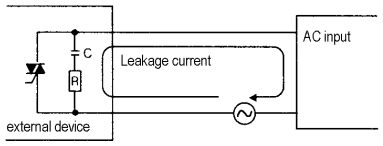
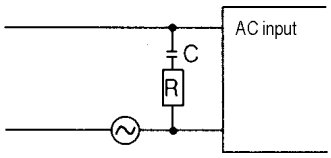
13. Configuration Diagram for the applied system :

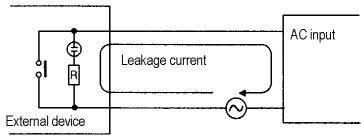
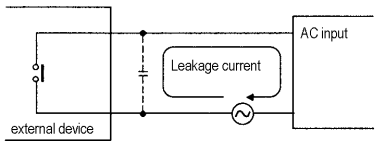
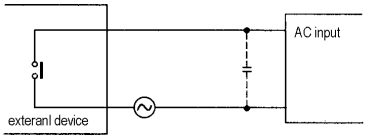
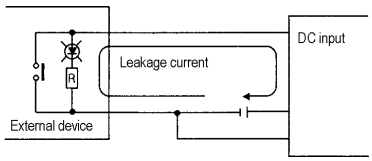
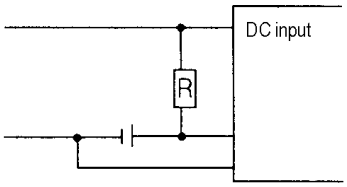
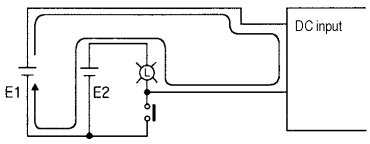
12.4 Troubleshooting Examples

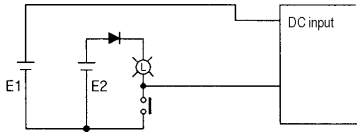
Possible troubles with various circuits and their corrective actions are explained.

12.4.1 Input circuit troubles and corrective actions

The followings describe possible troubles with input circuits, as well as corrective actions.

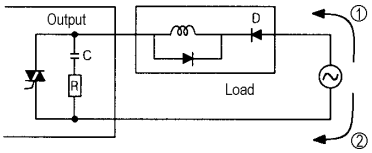
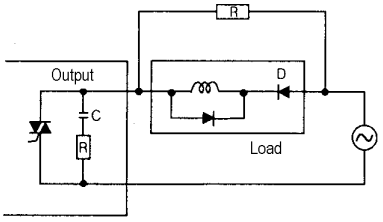
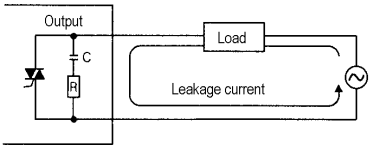
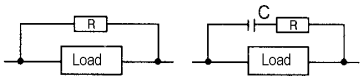
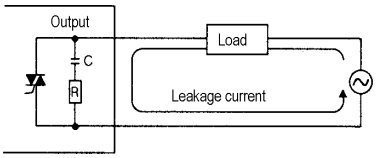
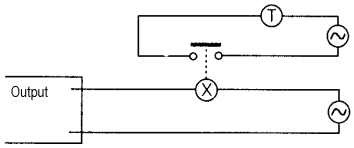
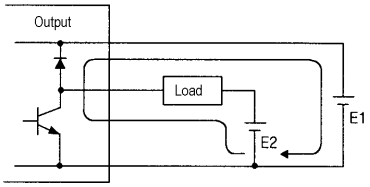
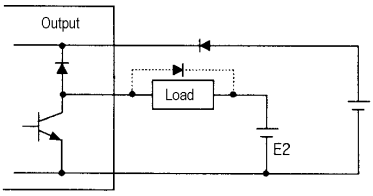
<table>
<tr><th>Condition</th><th>Cause</th><th>Corrective Action</th></tr>
<tr><td>Input signal close not turn OFF</td><td>Leakage current of external device (such as a drive by non-contact switch)
 
</td><td rowspan="2">• Connect an appropriate register and capacity which will make the voltage across the terminals of the input module lower than
 

• C and R values are determined by the leakage current value
- Reminded value C : 0.1 ~ 0.47 μF
R : 47 ~ 120Ω (1/2W)
Or make up another independent display circuit</td></tr>
<tr><td>Input signal does not turn OFF</td><td>Leakage current of external device (Drive by a limit switch with neon lamp)
 
</td></tr>
<tr><td>Input signal does not turn OFF</td><td>Leakage current due to line capacity of wiring cable
 
</td><td>• Power supply is located on the external device side as shown below
 
</td></tr>
<tr><td>Input signal does not turn OFF</td><td>Leakage current of external device (Drive by switch with LED indicator)
 
</td><td>• Connect an appropriate register which will make the voltage across input module terminal and common higher than the OFF voltage, as shown below
 
</td></tr>
<tr><td>Input signal does not turn OFF</td><td>• Sneak current due to the use of two different power supplies
 

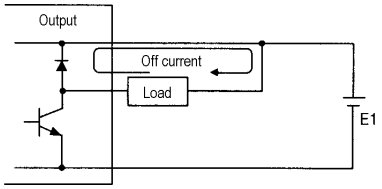
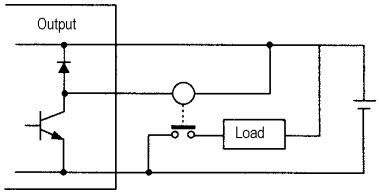
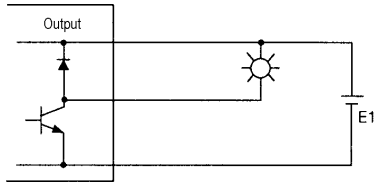
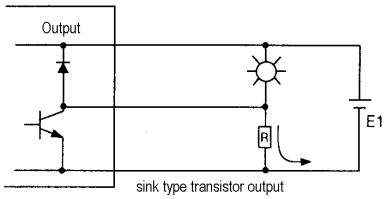
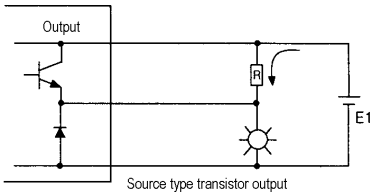
• E1 > E2, Sneaked</td><td>• Use only one power supply
• Connect a sneak current prevention diode, as shown below
 
</td></tr>
</table>

12.4.2 Output circuit troubles and corrective actions

The following desires possible troubles with output circuits, as well as corrective actions

Condition	Cause	Corrective Action
When the output is Off, excessive voltage is applied to the load	• Load is half-wave rectified inside (in some cases, it is true of a lolenoid) • When the polarity of the power supply is as shown in ①, C is charged. When the polarity is as shown in②, the voltage charged in C plus the line voltage are applied across D. Max voltage is approx.  If a resistor is used in this way, it does not pose a problem to the output element. But it may make the performance of the diode(D), which is built in the load, drop to cause problems	• Connect registers of tens to hundreds kΩ across the load in parallel 
The load does not turn OFF	• Leakage current by surge absorbing circuit which is connected to output element in parallel 	• Connect C and R across the load, which are of registers of tens kΩ When the wiring distance from the output module to the load is long, there may be a leakage current due to the line capacity 
When the load is C-R type timer, time constant fluctuates	• Leakage current by surge absorbing circuit which is connected to output element in parallel 	• Drive the relay using a contact and drive the C-R type timer using the since contact • Use other timer than the C-R contact Some timers have half-ware rectified internal circuits therefore, be cautious. 
The load does not turn OFF	• Sneak current due to the use of two different power supplies  • E1 < E2 : sneak current • E1 is switched Off and E2 is switched ON : sneak current	• Use only one power sypply • Connect a sneak current prevention diode(Figure below)  If the load is the relay, etc, connect a counter-electromotive voltage absorbing code as show by the dot line

Output circuit troubles and corrective actions(continued)

Condition	Cause	Corrective Action
The load off response time is long	• Over current at Off state [The large solenoid current fluidic load (L/R is large) such as is directly driven with the transistor output  • The off response time can be delayed by one or more second as some loads make the current flow across the diode at the off time of the transistor output	• Insert a small L/R magnetic contact and drive the load using the same contact 
Output transistor is destroyed	Surge current of the white lamp  A surge current of 10 times or more when turned ON.	• To suppress the surge current make the dark current of 1/3 to 1/5 rated current flow  sink type transistor output  Source type transistor output

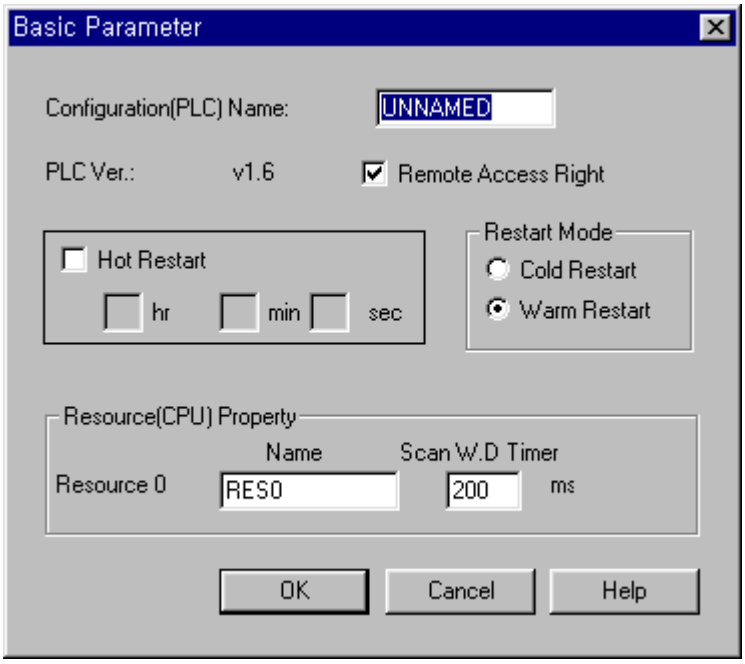
12.5 Error code list

Error code	Cause	Corrective Action	Operation status	STOP LED Flickering cycle	Diagnosis time	Re-start mode
2	OS ROM error	Contact the service center if it reactively occurs when the power is re-applied.	Defect	0.4 sec	When power is applied	-
3	OS ROM error	"	Defect	0.4 sec	When power is applied	-
4	RTC fault	"	Defect	0.4 sec	When power is applied	-
5	Dedicated processor fault	"	Defect	0.4 sec	When power is applied	-
6	Program memory fault	"	Defect	0.4 sec	When power is applied	-
7	Data memory fault	"	Defect	0.4 sec	When power is applied	-
10	Watch dog error due to OS program congestion	RE-apply the power	Reset	0.4 sec	During run	Cold
20	Program memory backup error	Replace the battery if it has error check the program after cc-loading it, and if an error is detected replace the CPU module	STOP	0.4 sec	When power is applied	Cold
21	Memory module defect	Check and correct the memory module mounting condition Re-apply the power and if an error occurs, replace the memory module	STOP	0.4 sec	When power is applied	Cold
22	Memory module program fault	Correct the memory module program and re-operate the system	STOP	0.4 sec	Change into the RUN mode	Cold
23	An normal program	Re-load the program and start it	STOP	0.4 sec	Change into the RUN mode	Cold
30	Inconsistency between the specified modules by parameters and the loaded modules	Module type inconsistency error Refer to the flags(_IO_TYER,_IO_ DEER_N, _IO_TYER [n]) and correct the incorrective slot, and re-start the system	STOP	0.4 sec	Change into the RUN mode	Cold
31	Module dismounting or additional mounting during run	Module mounting/ dismounting error Refer to the flags(_IO_DEER,_IO_ DEER_N, *IO*_DEER [n]) and correct the in corrective slot, and re-start the system	STOP	0.4 sec	When scan completes	Cold
32	Fuse disconnection during run	Fuse disconnection error Refer to the flags(_FUSE_ER,_FUSE _ER_N, FUSE_ER[n]) and correct the in corrective slot, and re-start the system	STOP	0.4 sec	When scan completes	Cold
33	Abnormal I/D module data access during run	I/O module read/ write error Refer to the flags(IO_RWER, _IP_RWER_N, _IO_RWER [n]) and restart the system	STOP	0.4 sec	When scan completes During execution of program	cold
34	Abnormal special/ link module data access during run	Special/ link module interface error Refer to the flags(_SP_IFER,_IP_ IFER_N,_IP_IFER [n]) and restart the system	STOP	0.4 sec	When power is applied When scan completes During execution of program	cold
40	During run, Scan time over than the scan delay time specified by parameters	Check the scan delay time specified by parameters and correct the parameters or the program, and then re-start the program	STOP	0.4 sec	During execution of program	cold
41	Unreadable instructions in the user program	Re-load the program and re-start it	STOP	0.4 sec	During execution of program	cold
50	External device fatal error	Refer to the external device fatal error flags(_ANNUN_ER,_ANC_ERR[n]) and correct the fault devices and then re-start the system	STOP	0.4 sec	When scan completes	cold
60	The 'E-STOP' function has been executed	Correct the program so that the error elements that invoked the 'E_STOP' function can be eliminated in the program and re-start the system(Cold re-start)	STOP	-	During execution of program	cold
100	Communications module configuration error	If the number of computer 4communications module is included, then adjust the maximum number with in 8	STOP	0.4 sec	When power is applied	cold
101	Special/ Communications module initialization failure	Adjust the number of high speed communications modules loaded	STOP	0.4 sec	When power is applied	cold
500	Data memory backup error	If the battery has no error	RUN	-	When power is applied	cold
501	RTC data error	If the battery has no error, re-set the time using the GMWIN	RUN	2 sec	When power is applied When scan completes	-
502	Lower battery voltage	Replace the battery which the power is being applied.	RUN	4 sec	When power is applied When scan completes	-

Appendix 1. System Definitions

1) Basic Parameters

The basic parameters are necessary for operation of the PLC and used to allocate memory, set the restart mode and set the scan watch dog time, etc.



(1) Configuration (PLC) Name

- It is a representative name for the PLC system. It is used to designate this PLC system when a network system is configured using communication modules.

(2) Enabling/Disabling the control of the PLC via communications

- This parameter is used to enable or disable the remote control of this PLC system through the FAM or computer link module, etc. except for the GMWIN. If this parameter has been set to enable, change of the operation mode and download of programs are available via communications.

(3) %M area

This parameter is used to set the size of the direct variable area of the CPU module's data buffer. This buffer area is an area where direct addressing is available by the direct addressing parameter %M when writing a program. The buffer size set by the parameter limits the buffer area that can be addressed directly by %M.

(4) Restart Mode

- This parameter is used to set the restart mode in the PLC system. When the system re-starts, one of the 'cold restart' or 'warm restart' is selected in compliance with the parameter setting.

(5) Hot Restart

- This parameter is used to set the 'hot restart mode' and 'hot restart allowable time'. The allowable time can be set to up to the '23 hour 59 minutes 59 second' by the 1 second.

(6) Resource (CPU) Name

- Resource Name is the name that each CPU module configuring the PLC has. When configuring a network system the name is used to designate each CPU module that is used the system.
- Only one CPU module can be mounted in the GM3/4 series, therefore, only the resource 0 is valid.

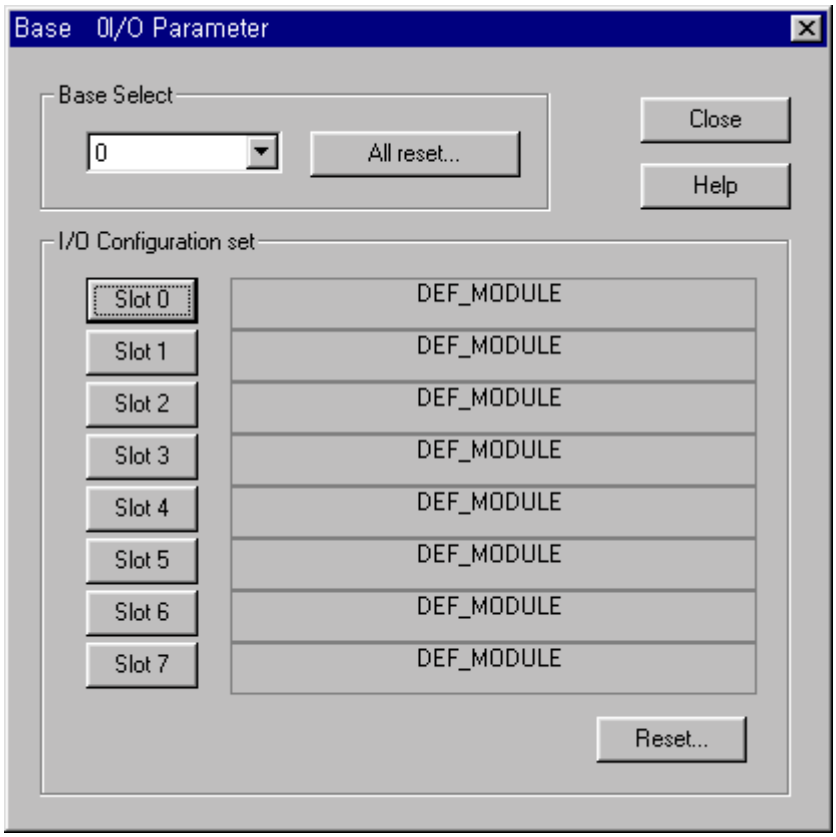
(7) Scan Watch Dog Time

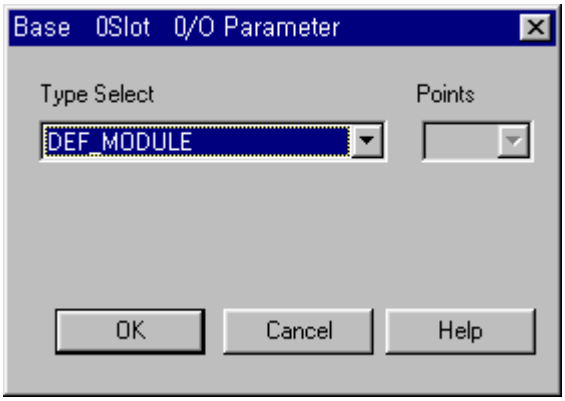
- This parameter is used to set the maximum allowable execution time of an user program in order to supervisor its normal or abnormal operation.
- Only one CPU module can be mounted in the GM3/4 series, therefore, scan watch dog is valid to only the resource 0.

2) I/O Configuration Parameters

These parameters are used to set the configuration of a system that will be operated. They set the modules that will be mounted and operated onto their own slot in the base unit. If a parameter that has been set and the real mounted module are different, the operation will not be executed. When writing a new project I/O configuration parameters will be all set to default (DEF_MODULE).

If I/O configuration parameters are set to default, the operation starts on the basis of the configuration of the real mounted module when the power is applied. Therefore, though a power failure had occurred during normal operation or the system configuration had been changed due to slip-out of a mounted module, operation starts and continues when the power has been re-applied because the system considers that it is a normal operation state. To prevent this error, be sure to set correctly the I/O configuration parameters complying with the real modules that shall be mounted and operated.





<I/O Parameters Setting List>

Keywords	Description	Applicable Modules
DC input	DC input module	G3I-D22A(16 points), G3I-D24A(32 points), G3I-D28A(64 points) G4I-D22A(16 points), G4I-D24A(32 points), G4I-D22B(16 points) G4I-D24B(32 points)
110 VAC input	110 VAC input module	G3I-A12A(16 points), G3I-A14A(32 points), G4I-A12A(16 points)
220 VAC input	220 VAC input module	G3I-A22A(16 points), G3I-A24A(32 points), G4I-A22A(16 points)
Relay output	Relay output module	G3Q-RY2A(16 points), G3Q-RY4A(32 points), G4Q-RY2A(16 points)
SSR output	Triac output module	G3Q-SS2A(16 points), G3Q-SS4A(32 points), G4Q-SS2A(16 points) G3Q-SS2B(16 points)
TR output	Transistor output	G3Q-TR2A(16 points), G3Q-TR4A(32 points), G4Q-TR8A(16 points) G4Q-TR2A(16 points), G4Q-TR4A(32 points)
Interrupt input	Interrupt input module	G3F-INTA(16 points), G4F-INTA(8 points)
Analog timer	Analog timer module	G3F-AT4A(16 points), G4F-AT3A(8 points)
A/D	A/D conversion module	G3F-AD4A(16 points), G4F-AD2A(4 points)
DAV, DAI	D/A conversion module	G3F-DA4V(16 channels, voltage type), G4F-DA4I(16 channels, current type), G4F-DA1A(2 channels, voltage/current type)
T/C	Thermocouple input module	G3F-TC4A(16 channels), G4F-TC2A(4 channels)
RTD	Temperature-measuring resistor input module	G3F-RD3A(8 channels), G4F-RD2A(4 channels)
PID	PID input module	G3F-PIDA(32 loops), G4F-PIDA(8 loops)
HSC	High speed counting module	G3F-HSCA(2 channels), G4F-HSCA(1 channel)
POSITION CONTROL(ANALOG)	Positioning module (analog output)	G3F-POAA(2 axis)
POSITION CONTROL(PULSE)	Positioning module (pulse output)	G3F-POPA(2 axis), G4F-POPA(1 axes)
GLOFA Fnet	Fnet I/F module	G3L-FUEA, G4L-FUEA
GLOFA Mnet	Mnet I/F module	G3L-MUEA

<I/O Parameters Setting List> (continued)

Keyword	Description	Applicable Module
DEF_I	All input modules	G3I-D22A(16 points), G3I-D24A(32 points), G3I-D28A(64 points) G4I-D22A(16 points), G4I-D24A(32 points), G4I-D28B(16 points) G4I-D24B(32 points), G3I-A12A(16 points), G3I-A14A(32 points) G3I-D12A(16 points), G3I-D22A(16 points), G3I-D24A(32 points) G4I-A22A(16 points)
DEF_O	All output modules	G3Q-RY2A(16 points), G3Q-RY4A(16 points), G3Q-RY2A(16 points) G3Q-SS2A(16 points), G3Q-SS4A(32 points), G3Q-SS2A(16 points) G4Q-SS2B(16 points), G3Q-TC2A(16 points), G3Q-TR4A(32points) G3Q-TR8A(64 points), G4Q-TR2A(16 points), G4Q-TR4A(32 points)
DEF_IO	All mixed I/O modules	G4H-DR2A, G4H-DT2A (16 points)
DEF_SP	All communications / special modules	• All special modules • All communications modules
DEF_MODULE	All modules	• All input modules • All output modules • All mixed I/O modules • All special modules • All communications modules
DEF_EMPTY	Empty slot	–

3) Communications Parameters

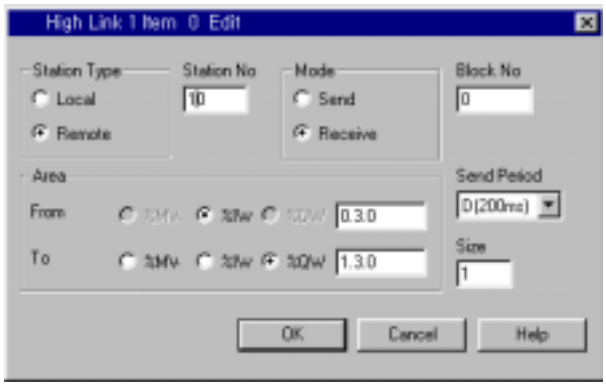
These high speed link parameters are used to set the opposite station for data communications, data and communications cycle when communicating a defined data repeatedly through communication modules.

(For detailed descriptions, refer to the User's Manual relating to data communications)

(1) Network type : Used to set the type of the communications module

(2) Slot No. : Location number of slot where the communications module has been mounted.

(3) Local No. : Local number of the module which executes high speed link communications.



(1) Station type : Type of the communications module in the opposite station. Local or remote will be set.

(2) Station No. : Used to indicate the station that has invoked data during communications.

(3) Mode : Used to set the communications mode to Send or Receive.

(4) Block No. : Designating number for identification of a data block in the same communications module.

(5) Data communications cycle : Used to set the cycle of sending and receiving of data.

(6) Area: I, Q and M areas should be set by the decimal number or word.

(7) Size : Number of words that will be sent and received.

Appendix 2. Flag List

1) User Flag List

Keyword	Type	Write	Name	Description
_LER	BOOL	Enable	Operation error latch flag	Operation error latch flag by the program block(BP). Error indication occurred while executing a program block
_ERR	BOOL	Enable	Operation error latch flag	Operation error flag by the operation function (FN) or function block(FB). It is newly changed whenever an operation is executed.
_T20MS *	BOOL	–	20 msec Clock	These clock signals are used in the user programs, toggles on/off every half cycle. The clock signal can be delayed or distorted in accordance with program execution time as the signal toggles after scan has been finished, therefore, it is recommended that clock of enough longer than scan time be used. Clock signals starts from Off when the initialization program or scan program starts • Example : _T100MS clock
_T100MS *	BOOL	–	100 msec Clock	
_T200MS *	BOOL	–	200 msec Clock	
_T1S *	BOOL	–	1 sec Clock	
_T2S *	BOOL	–	2 sec Clock	
_T10S *	BOOL	–	10 sec Clock	
_T20S *	BOOL	–	20 sec clock	
_T60S *	BOOL	–	60 sec Clock	
_ON *	BOOL	–	Always On	Usable in user programs.
_OFF *	BOOL	–	Always Off	Usable in user programs
_1ON *	BOOL	–	First scan On	Turn On only during the first scan after the operation has started.
_1OFF *	BOOL	–	First scan Off	Turn Off only during the first scan after the operation has started.
_STOG *	BOOL	–	Scan Toggle	Toggles On/Off at every scan while a user program is being executed. (On at the first scan)
_INT_DONE	BOOL	Enable	Initialization Program Complete	If this flag is set to on in the initialization program in an user program, the initialization program stop its operation and the scan program will starts.
_INT_DATE	DATE	–	RTC present date	Date Data of standard format (Reference date – Jan. 1, 1984)
_RTC_TOD	TOD	–	RTC present time	Time Data(Reference time – 00:00:00)
_RTC_WEEK	UNIT	–	RTC present day	Day data (0: Monday, 1:Thuesday, 2: Wednesday, 3: Thursday, 4: Friday, 5: Saturday, 6:Sunday)

HINT

1) Flags with the mark '*' are initialized when the initialization program starts, and after its execution has been competed the flags will change in accordance with the restart mode set.

- If cold or warm restart has been set, the flags will be initialized when the scan program starts its execution.
  If hot restart has been set , the flags will be restored to the state before the last stop when the scan program starts its execution.

2) Representative System Error Flag List

Keyword	Type	Bit No.	Name	Description
_CNF_ER	WORD	Representative keyword	System error (fatal error)	This flag handles the following operation stop error flags in batch.
_IO_TYER	BOOL	Bit 1	Module type inconsistency error	This representative flag indicates that I/O configuration parameters differ from the real loaded module or that a certain module is loaded onto a slot where it should not be loaded. (Refer to _IO_TYER_N and _IO_DEER[n])
_IO _DEER	BOOL	Bit 2	Module loading/unloading error	This representative flag indicates that module configuration of each slot has been changed during operation. (Refer to _IO_DEER_N and _IO_DEER[n])
_FUSE _ER	BOOL	Bit 3	Fuse disconnection error	This representative flag indicates that one of fuses of slots including them has disconnection. (Refer to _FUSE_ER_N and _FUSE_ER[n])
_IO _RWER	BOOL	Bit 4	I/O module read/write error	This representative flag indicates that a I/O module does normally executes read/write. (Refer to _IP_RWER_N and _IP_IFER[n])
_SP _IFER	BOOL	Bit 5	Special/communications module interface error	This representative flag indicates that special or communications module has failed in initialization or normal interface is impossible due to module malfunction. (Refer to _IP_IFER_N and _IP_IFER[n])
_ANNUN_ER	BOOL	Bit 6	External device fatal fault detection error	This representative flag indicates that an external device has fatal error. The error code has been written to _ANC_ERR[n].
–	–	Bit 7	–	–
_WD_ER	BOOL	Bit 8	Scan watch dog error	This flag indicates that the scan time of a program has overrun the scan watchdog time specified by the parameter.
_CODE_ER	BOOL	Bit 9	Program code error	This flag indicates that an unreadable instruction has been met while executing an user program.
_P_BCK_ER	BOOL	Bit 11	Program error	This flag indicates that program execution is impossible due to destroyed memory or program error.

3) Representative System Warning Flag List

Keyword	Type	Bit No.	Name	Description
_CNF _WAR	WORD	Representative keyword	System warning	This flag treats the below warning flags relating to continuous operation in batch.
_RTC_ERR	BOOL	Bit 0	RTC data error	This flag Indicates that RTC data has error.
_D_BCK_ER	BOOL	Bit 1	Data backup error	This flag indicates
_H_BCK_ER	BOOL	Bit 2	Impossible hot restart error	This flag indicates that hot restart time had been overrun or backup of the operation data needed in hot restart had not normally performed at restoration from power failure and hot restart was impossible so that a restart operation by the parameters (warm or cold restart) has been started. .
_AB_SD_ER	BOOL	Bit 3	Abnormal shutdown	This flag indicates that the program had been stopped during restore from power failure due to causes such as power off, and then cold restart has been executed and the continuous operation which retains the data is impossible. Usable in the initialization program. Automatically reset when the initialization program has finished. (The same things given above will be applied when the program has been stopped by the 'ESTOP' function)
_TASK_ERR	BOOL	Bit 4	Task collision (plus cycle and external tasks)	This flag indicates that task collision has occurred as execution request for a same task had been repeatedly invoked. (Refer to the flag _TC_BMAP[n] and _TC_CNT[n])
_BAT_ERR	BOOL	Bit 5	Battery fault	This flag detects and indicates that the voltage of the battery, which is used to backup user programs and data memory, is lower than the defined value.
_ANNUN_WR	BOOL	Bit 6	External device warning detection	This representative flag indicates that the user program has detected an ordinary fault of external devices and has written it to the flag _ANC_WB [n].
–	–	Bit 7	–	–
_HSPMT1_ER	BOOL	Bit 8	High speed link parameter 1 error	This representative flag detects error of each high speed link parameter when the high link has been enabled and indicates that high speed link cannot be executed. It will be reset when the high speed link is disabled.
_HSPMT2_ER	BOOL	Bit 9	High speed link parameter 2 error	
_HSPMT3_ER	BOOL	Bit 10	High speed link parameter 3 error	
_HSPMT4_ER	BOOL	Bit 11	High speed link parameter 4 error	

4) Detailed System Error and Warning Flag List

Keyword	Type	Data setting range	Name	Description
_IO_TYER_N	UINT	0 to 31	The number of slot whose module type is inconsistent.	This flag detects that I/O configuration parameters of each slot differ from the real loaded module configuration or a particular module is loaded onto the slot where modules cannot be loaded, and indicates the lowest slot No. of the detected slot numbers.
_IO_TYERR[n]	BYTE	n: 0 to 3	The location of slot where module type is inconsistent.	This flag detects that I/O configuration parameters of each slot differ from the real loaded module configuration or a particular module is loaded onto the slot where modules cannot be loaded, and indicates the slot locations in the bit map of base units.
_IO_DEER_N	UINT	0 to 31	The number of slot where module mounting/dismounting error occurred.	This flag detects that module configuration of each slot has been changed, that is, module mounting/dismounting error has been occurred, and indicates the lowest slot No. of the detected slot numbers.
_IO_DEERR[n]	BYTE	n: 0 to 3	The location of slot where module mounting/dismounting error occurred.	This flag detects that module configuration of each slot has been changed, that is, module mounting/dismounting error has been occurred, and indicates the slot locations in the bit map of base units.
_FUSE_ER_N	UINT	0 to 31	The number of slot where fuse breaks.	This flag detects that fuses of fuse-mounted modules has broken, and indicates the lowest slot No. of the detected slot numbers.
_FUSE_ERR[n]	BYTE	n: 0 to 3	The location of slot where fuse breaks.	This flag detects that fuses of fuse-mounted modules has broken, and indicates the slot locations in the bit map of base units.
_IO_RWER_N	UINT	0 to 31	The number of slot where I/O module read/write occurred.	This flag detects that input modules of a slot cannot be normally read from or written to, and indicates the lowest slot No. of the detected slot numbers.
_IO_RWERR[n]	BYTE	n: 0 to 3	The location of slot where I/O module read/write occurred.	This flag detects that input modules of a slot cannot be normally read from or written to, and indicates the slot locations in the bit map of base units.
_IP_IFER_N	UINT	0 to 31	Special/link module interface error slot No.	This flag detects that initialization cannot be executed for special or link module of a slot, or normal interface is impossible due to module malfunction, and indicates the lowest slot No. of the detected slot numbers.
_IP_IFERR[n]	BYTE	n: o to 3	Special/link module interface error location	This flag detects that initialization cannot be executed for special or link module of a slot, or normal interface is impossible due to module malfunction, , and indicates the slot locations in the bit map of base units.
_ANC_ERR[n]	UINT	n : 0 to 15	External device fatal error	This flag detects fatal error of external devices and its content is written to this flag. A number that identifies error type will be written to each of the sixteen locations. (The number 0 is not allowed)
_ANC_WAR[n]	UINT	n : 0 to 7	External device ordinary error	If the user program indicates a warning on the flag _ANC_WB[n], the bit locations are sequentially written to _ANC_WAR[n] from _ANC_WAR[0] complying with their occurrence sequence.
_ANC_WB[n]	BIT	n: 0 to 255	External device ordinary error bitmap	The user program detects ordinary error of external device and the errors are indicated on a bitmap. (The number 0 is not allowed)
_TC_BMAP[n]	BIT	n : 0 to 47	Task collision bitmap Plus cycle (n : 0 to 31) External (n : 32 to 47)	The flag detects that task collision has occurred because, while a task was being executed or ready for execution, an execution request has occurred for the same task, indicates the errors on a bitmap.
_TC_CNT[n]	UINT	n : 0 to 47	Task collision counter	This flag detects task collision occurrence time for each task when executing a user program, indicates the task collision occurrence time.
_BAT_ER_TM	DATE & TIME	—	Batter voltage drop time	The first detection date and time of battery voltage drop are written to this flag. It will be reset if the battery voltage has been restored.
_AC_F_CNT	UINT	0 to 65535	Momentary power failure occurrence count	The accumulated momentary power failure occurrence times during operation in the RUN mode is written to this flag.
_AC_F_TM[n]	DATE & TIME	n : 0 to 15	Momentary power failure history	The times of the latest sixteen momentary power failures are written.
_ERR_HIS[n]		n : 0 to 15	Error history	The times and error codes of the latest sixteen errors are written to this flag. • Stop time : DATE & TIME (8 bytes) • Error code : UINT (2 bytes)
_MODE_HIS[n]		n : 0 to 15	Operation mode change history	The times, operation modes and restart modes of the latest sixteen operation mode changes are written to this flag • Change time : DATE & TIME (8 bytes) • Operation mode : UINT (2 bytes) • Restart : UINT (2 bytes)

* Write is available in user programs.

5) System Operation status Information Flag List

Keyword	Type	Data setting range	Name	Description
_CPU_TYPE		0 to 16	System type	GM1 : 0, GM2 : 1, (GM3 : 2, GM4 : 3, GM% : 4) (FSM : 5,6), Twofold : 16
_VER_NUM		—	O/S version No.	System O/S version No.
_MEM_TYPE		1 to 5	Memory module type	Type of program memory module (0: Unloading state, type : 0 to 5)
_SYS_STATE		Representative keyword	PLC mode and operation status	System operation mode and operation state information
		Bit 0	Local control	Operation mode change is possible only by mode key or GMWIIN
		Bit 1	STOP	CPU module operation state
		Bit 2	RUN	
		Bit 3	PAUSE	
		Bit 4	DEBUG	
		Bit 5	Operation mode change factor	Operation mode change by key
		Bit 6	Operation mode change factor	Operation mode change by GMWIN
		Bit 7	Operation mode change factor	Operation mode change by remote GMWIN
		Bit 8	Operation mode change factor	Operation mode change by communications
		Bit 9	STOP by STOP function	Operation in the RUN mode is stopped by STOP function after the scan has finished
		Bit 10	Force input	Input junction force On/Off is being executed.
		Bit 11	Force output	Output junction force On/Off is being executed
		Bit 12	STOP by ESTOP function	Operation in the RUN mode is directly stopped by ESTOP function.
		Bit 13	—	—
		Bit 14	During monitoring	External monitoring is being executed for programs or variables
		Bit 15	Remote mode ON	Operation in the remote mode
_GMWIN_CNF		Representative keyword	GMWIN connection state	Connection state between CPU module and GMWIN
		Bit 0	Local GMWIN connection	Local GMWIN connection state
		Bit 1	Remote GMWIN connection	Remote GMWIN connection state
		Bit 2	Remote communications connection	Remote communications connection state
_RST_TY		Representative keyword	Restart mode information	Restart type of program which is being executed in present. (History)
		Bit 0	Cold restart	See the Section 4.5.1
		Bit 1	Warm restart	
		Bit 2	Hot restart	
_INIT_RUN		Bit 3	During initialization	An initialization program written by the user is being executed
_SCAN_MAX		—	Maximum scan time (msec)	Maximum scan time is written during operation.
_SCAN_MIN		—	Minimum scan time (msec)	Minimum scan time is written during operation.
_SCAN_CUR		—	Present scan time (msec)	Present scan time is continuously updated during operation.
_RTC_TIME[n]		N : 0 to 7	Present time	BCD data of present time of RTC (Example : 96-01-12-00-00-00-XX) _RTC _TIME[0] : year, _RTC _TIME[1] : month, _RTC _TIME[2] : day, _RTC _TIME[3] : hour, _RTC _TIME[4] : minute, _RTC _TIME[5] : second, _RTC _TIME[6] : day of the week, _RTC _TIME[7] : unused Day of the week : 0 : Mon., 1: Tue., 2: Wed., 3:Thur., 4:Fri., 5: Sat., 6:Sun.
_SYS_ERR		Error code	Error type	See the Section 12.5 Error Code List

6) System Configuration status Information Flag

(1) User Program Status Information

Keyword	Type	Data setting range	Name	Description
_DOMAN_ST	BYTE	Representative keyword	System S/W configuration information	GM1 : 0, GM2 : 1, (GM3 : 2, GM4 : 3, GM% : 4) (FSM : 5,6), Twofold : 16
		Bit 0	Basic parameter error	Checks and indicates Basic parameter error
		Bit 1	I/O configuration parameter error	Checks and indicates I/O configuration parameter error
		Bit 2	Program error	Checks and indicates Program error
		Bit 3	Access variable error	Checks and indicates Access variable error
		Bit 4	High speed link parameter error	Checks and indicates High speed link parameter error

(2) Operation Mode Key Status Information

Keyword	Type	Data Setting range	Name	Description
_KEY_STATE	BYTE	Representative keyword	Key setting position	Indicates CPU module key switch state
		Bit 0	KEY_STOP	Indicates that the key switch is in the STOP state.
		Bit 1	KEY_RUN	Indicates that the key switch is in the RUN state.
		Bit 2	KEY_PAUSE/REMOTE	Indicates that the key switch is in the PAUSE/REMOTE state.

(3) I/O Module Installation Status Information

Keyword	Type	Data Setting range	Name	Description
_IO_INSTALL[n]	BYTE	n : 0 to 3	I/O module installation location	Locations of slots where I/O modules are loaded are indicated in the bitmap of base units.

7) Communications Flag

- GLOFA Mnet / Fnet / Cnet Flag List

(1) Communication Module Information Flag List

- n is the number of slot where a communications module is loaded. (n = 0 to 7)

Keyword	Type	Applicable Net	Name	Description
_CnVERNO	UINT	Mnet/Fnet/Cnet	Communications module version No.	• Communications module O/S version No.
_CnSTNOH _CnSTNOL	UINT UDINT	Mnet/Fnet/Cnet	Communications module station No.	• Indicates the number which is set on communications module station switch. Mnet : MAC station No. marked on the front of communication module. Fnet : Station switch No. marked on the front of communications module. Cnet : Station No. set by the frame editor _CnSTNOH : Station No. set on the side of RS-232C _CnSTNOL : Station No. set on the side of RS-422
_CnTXECNT	UINT	Mnet/Fnet/Cnet	Communications frame sending error	• Increments by one whenever sending error of communications frame occurs. • Connection condition of network is evaluated by this value. • In Cnet, this value is the sum of errors occurred during receiving through RS-232 and RS-422.
_CnRXECNT	UINT	Mnet/Fnet/Cnet	Communications frame receiving error	• Increments by one whenever communications service fails. • Connection condition of network is evaluated by this value. Overall network communications quantity and program stability are also evaluated by this value.
_CnSVCFCNT	UINT	Mnet/Fnet/Cnet	Communications service processing error	• Indicates the maximum time that is spent until every station connected to network has the token at least one time and sends a sending frame.
_CnSCANAV	UINT	Mnet/Fnet/Cnet	Maximum communications scan time (unit : 1 msec)	• Indicates the average time that is spent until every station connected to network has the token at least one time and sends a sending frame.
_CnSCANMN	UINT	Mnet/Fnet/Cnet	Average communications scan time (unit : 1 msec)	• Indicates the minimum time that is spent until every station connected to network has the token at least one time and sends a sending frame.
_CnLINF	UINT	Mnet/Fnet/Cnet	Minimum communications scan time (unit : 1 msec)	• Indicates operation state of communications module with a word.
_CnLNKMOD	BIT 15		Operation mode (RUN=1, TEST=0)	• Indicates that operation mode of communications module is in the normal operation mode or test mode.
_CnINRING	BIT 14		In-ring (IN_RING = 1)	• Indicates that the communications module can communicates(IN_RING = 1) with other station or not.
_CnIFERR	BIT 13		Interface error (error = 1)	• Indicates that interface with communications modules has been stopped.
_CnSVBSY	BIT 12		Insufficient common RAM (Insufficient = 1)	• Indicates that service cannot be offered due to insufficient common RAM. • Indicates communications module hardware defect or system O/S error.
_CnCRDER	BIT 11		Communications module system error (error = 1)	
_NETn_LIV[k] (k = 0 to 63, k:Station No.)	BIT ARRAY	Fnet	Stations connected to the network (1=connected, 0=disconnected)	• Indicates whether k remote station or local PLC is connected to the network or not. The state value is written to each bit. These values shows present state of the network. (Write is disabled)
_NETn_RST[k] (k = 0 to 63, k:Station No.)	BIT ARRAY	Fnet	Re-connection of a station (1=re-connected, 0=no changed condition)	• Indicates re-connected stations, which had been disconnected before, on a bitmap. Because this value has been replaced with '1' when re-connected, the user program has to clear this value with '0' so that next re-connection can be detected. (Write is enabled)
_NETn_232[k] (k = 0 to 63, k:Station No.)	BIT ARRAY	Cnet	The indication that the user defined frame has been received. Indicated at each setting No. (Received = 1).	• When a receiving frame is received through RS-232C while the part of RS-232C in Cnet is operating in the user-defined mode, the bit corresponding to setting No. is turned ON. If RCV_MSG F/B has read that, that bit will be cleared with 0.
_NETn_422[k] (k = 0 to 63, k:Station No.)	BIT ARRAY	Cnet	The indication that the user defined frame has been received. Indicated at each setting No. (Received = 1).	• When a receiving frame is received through RS-422 while the part of RS-232C in Cnet is operating in the user-defined mode, the bit corresponding to setting No. is turned ON. If RCV_MSG F/B has read that, that bit will be cleared with 0.

(1) Communications Module Information Flag List (continued)

Keyword	Type	Applicable Net	Name	Description
_FSMn_reset	BIT	Fnet	Remote I/O station S/W reset	• Requests reset for remote I/O station (Write is enabled) Request can be done individually or wholly complying with the settings in the FSMn_st_no.
_FSMn_io_reset	BIT	Fnet	Remote I/O station digital output reset	• Requests output reset for remote I/O station (Write is enabled) • Request can be done individually or wholly complying with the settings in the FSMn_st_no.
_FSMn_hs_reset	BIT	Fnet	Remote I/O station high speed link information initialization	• If a momentary power failure occurs in the remote I/O station, the operation mode bit of high speed link information turns off and link trouble has the value 1. If the bit is turned on to clear that bit, the operation mode bit turns on and link trouble is cleared with 0. • Request can be done individually or wholly complying with the settings in the FSMn_st_no.
_FSMn_st_no	USINT		Numbers of I/O stations where _FSMn_reset, _FSMn_io_reset and _FSMn_hs_reset will be executed. (Write is enabled)	• Sets the numbers of I/O stations where _FSMn_reset, _FSMn_io_reset and _FSMn_hs_reset will be executed. (Write is enabled) • 00 to 63 ➨ individual station No. setting • 255 ➨ Whole station No. setting

(2) Detailed High Speed Link Information Flag List

Keyword	Type	Applicable Net	Name	Description
_HSmRLINK	Bit	Fnet/Mnet	High speed link RUN link information	• Indicates that all stations are normally operating complying with the parameter set in the high speed link. This flag turns on under the following conditions. 1) All stations set in the parameter are in the RUN mode and have no error, and 2) All blocks set in the parameter normally communicate, and 3) The parameter set in all stations, which are set in the parameter, normally communicate. • Once this flag is turned on, it maintains that state as long as link enable does not make that state stopped.
_HSmLTRBL	Bit	Fnet/Mnet	High speed link trouble information	• This flag turns on when, under the condition that _HSmRLINK is turned on, communications of the stations and data blocks set in the parameter is under the following conditions. 1) A station set in the parameter is not in the RUN mode, or 2) A station set in the parameter has an error, or 3) The communications of data blocks set in the parameter does not normally operate. • This flag turns on if the above conditions 1), 2) and 3) occur. If those conditions are restored, it will turn off again.
_HSmSTATE[k] (k = 0 to 63, k:Station No.)	Bit Array	Fnet/Mnet	K Data Block overall communications state information	• Indicates overall communications state of every blocks of the parameters set. _HSmSTATE[k] = _HSmMOD[k] & _HSmTRX[k] & _HSmERR[k]
_HSmMOD[k] (k = 0 to 63, k:Station No.)	Bit Array	Fnet/Mnet	K Data Block setting stations mode information. (RUN = 1, others =-0)	• Indicates the operation modes of stations set the K data block of parameters.
_HSmTRX[k] (k = 0 to 63, k:Station No.)	Bit Array	Fnet/Mnet	K Data Block communications state information (Normal = 1, abnormal = 0)	• Indicates that communications of the K data block of parameters are normally operating as set or not. .
_HSmERR[k] (k = 0 to 63, k:Station No.)	Bit Array	Fnet/Mnet	K Data Block setting stations state information. (Normal = 1, abnormal = 0)	• Indicates that the stations set in the K data block of parameters have an error or not.

Appendix 3. Function/Function Block List

1) Function List

Name	Function	Size of PB (byte) *1	Size of library (byte) *2	Processing speed (μsec) *3	
				GM3	GM4
ABS (int)	Absolute value operation	24	—	1	1.2
ADD(int)	Addition	24	—	1.3	1.7
AND (word)	Logical multiplication	16	—	0.8	4.3
DIV(int)	Division	32	—	3.5	32.9
DIV(dint)	Division	32	—	5.8	62.9
EQ (int)	'Equality' comparison	20	—	1.2	1.6
LIMIT(int)	To output upper and lower limits	48	794	8.7	11.8
MAX(int)	To output the maximum input value	48	738	10	12.9
MOVE	To copy data	8		0.4	1.0
MUL(dint)	Multiplication	24		6.5	65.9
MUL (int)	Multiplication	24		5.2	35.9
MUX (int)	To output a selected input value	56	682	12.6	15.8
MUX(dint)	To output a selected input value	84	682	35.3	53.2
ROL	To rotate left	40	160	6.8	9.7
BCD_TO_DINT	Conversion of BCD type into DINT type	12	300	39.1	273.9
BCD_TO_INT	Conversion of BCD type into INT type	12	200	19.1	111.9
BCD_TO_SINT	Conversion of BCD type into SINT type	12	140	8.7	40.9
BYTE_TO_SINT	Conversion of BCD type into SINT type	8		0.4	0.4
DATE_TO_STRING	Conversion of DATE type into string	48	458	60.3	205.9
DINT_TO_INT	Conversion of DINT type into INT type	8		0.5	1.3
DINT_TO_BCD	Conversion of DINT type into BCD type	12	278	66.8	446.9
DT_TO_DATE	Conversion of DT type into DATE type	16		1.9	3.3
DT_TO_TOD	Conversion of DT type into TOD type	16	12	2.4	4.1
DT_TO_STRING	Conversion of DT type into string	48	780	113.8	524.9
DWORD_TO_WORD	Conversion of DWORD type into WORD type	8		0.4	1.3
INT_TO_DINT	Conversion of INT type into DINT type	12		0.9	0.9
INT_TO_BCD	Conversion of INT type into BCD type	12	180	22.8	129.9
NUM_TO_STRING (int)	Conversion of number into string	52	808	45.8	159.9
SINT_TO_BCD	Conversion of SINT type into BCD type	12	140	13.1	67.9
STRING_TO_INT	Conversion of string into INT type	16	1308	61.8	281.9
CONCAT	To concatenate strings	72	248	40.8	54.9
DELETE	To delete string	68	298	50	63.9
EQ	'Equality' comparison	20	788	33.2	38.3
FIND	To find a string	40	222	64.8	73.9
INSERT	To insert a string	68	524	84.8	418.9
LEFT	To obtain the left part of a string	56	158	23.1	33.4
LEN	To obtain the length of a string	16	48	16.8	17.5
LIMIT (str)	To output upper or lower limits	80	794	43.7	80.9
MAX (str)	To output the maximum input value	76	738	56.7	68.4
MID	To obtain the middle part of a string	64	236	36.5	47.1
REPLACE	To replace a string with another	73	584	86.8	97.9
RIGHT	To obtain the right part of a string	56	226	41.8	53.9
ADD_TIME (time)	Time addition	40	280	7.8	11.6
DIV_TIME(i1 = time)	Time division	40	266	11.5	67.9

HINT

1)The items marked with '*' has following meaning.
*1 : The size of the program memory which a program occupies when it uses the function once.
*2 : The size of the program memory which a program occupies only one time though it uses the function many times.
*3: of IL programs (2 input variables, 10 strings)

2)The above shows the function list when programs are written with IL(Instruction List) language. If programs are written with LD(Ladder diagram), the following differences occur.
(1) 16 byte will be added to the size of the PB.
(2) In non-execution, 0.4 will be added to the processing speed. In execution, 0.8 μsec will be added.

2) Function Block List

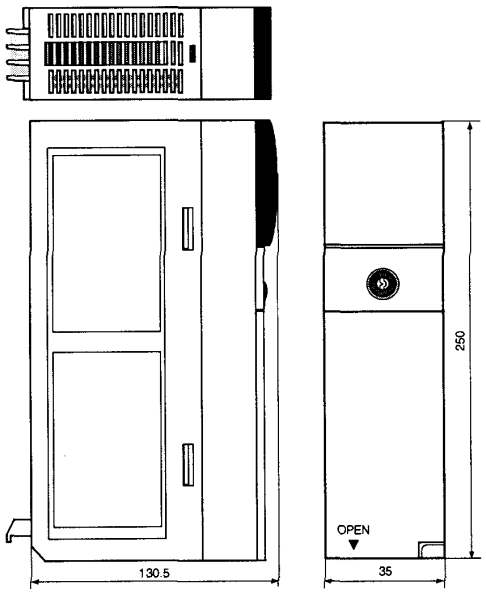
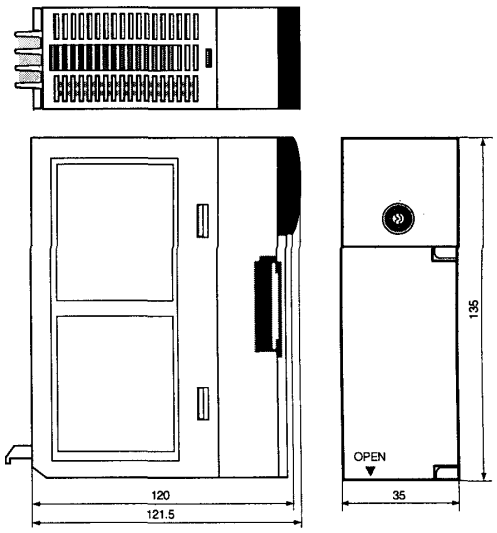
Name	Function	Size of PB (byte) *1	Size of library		Processing speed (μsec)	
			Size (byte) *2	Size of instance memory *3	GM3	GM4
CTU	Addition counter	72	110	6	10.2	12.8
CTUD	Addition/subtraction counter	112	186	6	15.6	18.4
F_TRIG	Descending edge detection	40	38	1	5.7	6.6
RS	Preference reset table	48	72	2	7.5	8.7
TON	ON delay timer	56	200	2000	8.5	11.1

HINT

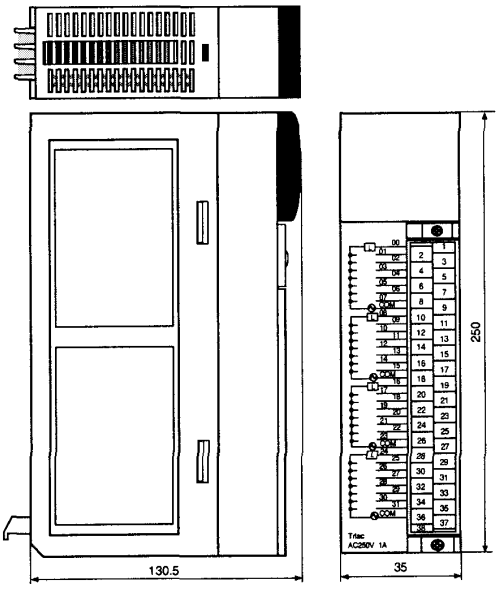
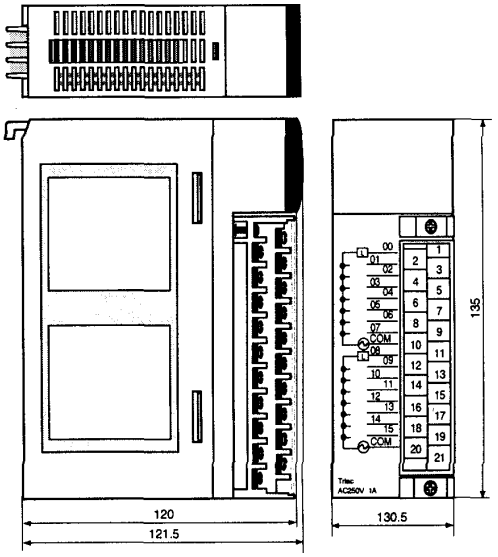
1) The items marked with '*' has following meaning.
*1 : The size of the program memory which a program occupies when it uses the function once.
*2 : The size of the program memory which a program occupies only one time though it uses the function many times.
*3: The size of the program memory which a program occupies whenever it uses the function block once.
2) The occupied memory size and processing speed of IL programs are same as LD programs.

Appendix 4. Dimensions (Unit : mm)

1) CPU module

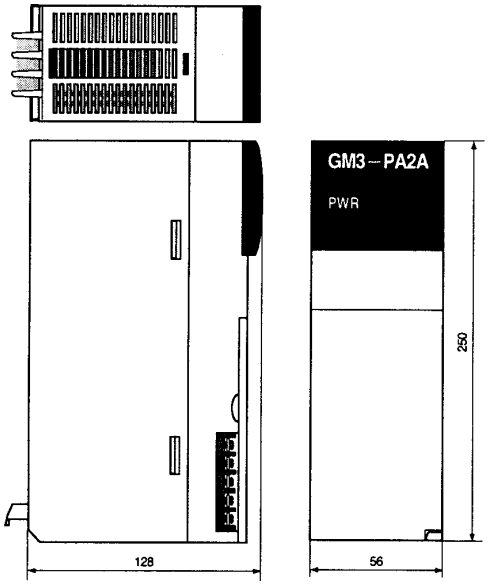
GM3 - CPUA	GM4 - CPUA
	

2) I/O Module

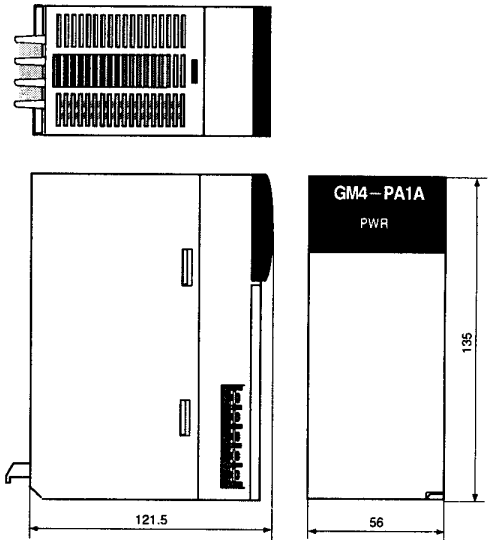
GM3	GM4
	

3) Power Supply Module

GM3

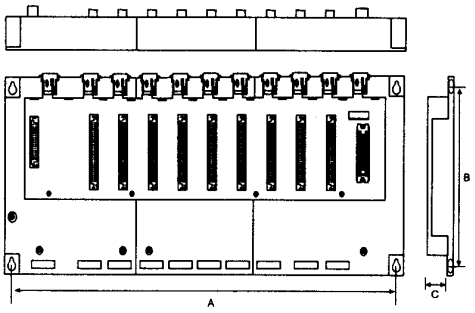


GM4



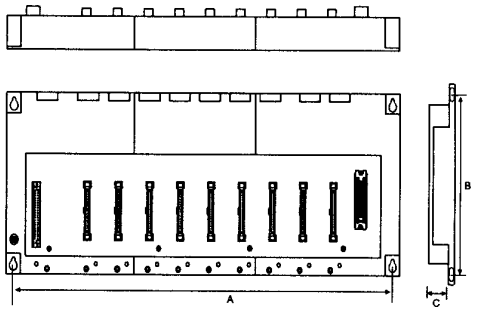
4) Basic/Extension Base Unit

GM3



Model		A	B	C
	GM3-B04M	284	230	17
	GM3-B06M	354	230	17
	GM3-B08M	424	230	17
	GM3-B04E	284	230	17
	GM3-B06E	354	230	17
	GM3-B08E	424	230	17

GM4



Model		A	B	C
	GM3-B04M	284	115	17
	GM3-B06M	354	115	17
	GM3-B08M	424	115	17
	GM3-B12M	524	115	17
Extension Base Unit	GM3-B04E	284	115	17
	GM3-B06E	354	115	17
	GM3-B08E	424	115	17