T-solution Leader in Electrics & Automation

User Manual

GLOFA GM7U

Programmable Logic Controller

Safety Instructions

- Read this manual carefully before installing, wiring, operating, servicing or inspecting this equipment.
- Keep this manual within easy reach for quick reference.

LS Industrial Systems

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SAFETY INSTRUCTIONS

To prevent injury and property damage, follow these instructions. Incorrect operation caused by ignoring instructions may cause harm or damage. The consequences are indicated by the following symbols.

⚠ DANGER	This symbol indicates instant death or serious injury.
⚠ WARNING	This symbol indicates the possibility of death or serious injury.
⚠ CAUTION	This symbol indicates the possibility of injury or damage to property.

■ The meaning of each symbol on the equipment is shown below.

⚠ This is the safety alert symbol.
Read and follow instructions carefully to avoid dangerous situation.

⚠ This symbol alerts the user to the presence of “dangerous voltages”.
Harm or electric shock may occur inside of these areas.

SAFETY INSTRUCTIONS

Design Precautions

⚠ Warning

- Install a safety circuit external to the PLC that keeps the entire system safe even when there are problems with the external power supply or the PLC module. Otherwise, serious problems such as erroneous outputs or operations may occur.
  - Outside the PLC, construct mechanical damage preventing interlock circuits. These include emergency stop, protective circuits, positioning upper and lower limits switches and interlocking forward/reverse operation.

    When the PLC detects watchdog timer error, module interface error, or other hardware errors, it will stop calculation and turn off all output.

    However, one or more outputs could be turned on when there are problems that the PLC CPU cannot detect, such as malfunction of output device (relay, transistor, etc.) themselves or I/O controller. Build a fail safe circuit exterior to the PLC to insure the equipment operates safely at such times. Also, build an external monitoring circuit to monitor any single outputs that could cause serious problems.

- Make sure all external loads connected to output does NOT exceed the rating of the output module.

  Over current exceeding the rating of the output module could cause fire, damage or malfunction.

- Build a circuit that turns on the external power supply when the PLC main module power is turned on.

  If the external power supply is turned on first, it could cause an erroneous output or operation.

SAFETY INSTRUCTIONS

Design Precautions

⚠ Caution

- Do not bunch the control wires or communication cables with the main circuit, power wires, or close together. They should be installed 100mm (3.94 inches) or more from each other.
  Not doing so could result in noise that may cause erroneous operation.

Installation Precautions

⚠ Caution

- Use the PLC in an environment that meets the general specification contained in this manual or datasheet.
  Using the PLC in an environment outside the range of the general specifications could result in electric shock, fire, erroneous operation, and damage to the product.

- Completely turn off the power supply before loading or unloading the module.
  Not doing so could result in electric shock or damage to the product.

- Make sure all modules are loaded correctly and securely.
  Not doing so could cause a malfunction, failure, and/or drop.

- Make sure I/O and extension connectors are installed correctly.
  Poor connection could cause an input or output failure.

- When install the PLC in a vibrating environment, be sure to insulate the PLC from direct vibration.
  Not doing so could cause electric shock, fire, and/or erroneous operation.

- Be sure that there are no foreign substances such as conductive debris inside the module.
  Conductive debris could cause fires, damage, and/or erroneous operation.

SAFETY INSTRUCTIONS

Wiring Precautions

⚠ Warning

- Completely turn off the external power supply when installing or wiring.
  Not turning off the external power supply may cause an electric shock or damage to the product.

- Make sure that all terminal covers are correctly attached.
  Not attaching the terminal cover could result in an electric shock.

⚠ Caution

- Be sure that wiring is done correctly by checking the product's rated voltage and the terminal layout.
  Incorrect wiring could result in fire, damage, or erroneous operation.

- Tighten the terminal screws with the specified torque.
  Loose terminal screws, it could result in short circuits, fire, or erroneous operation.

- Be sure to ground the FG or LG terminal to the protective ground conductor.
  Not doing so could result in erroneous operation.

- Be sure there are no foreign substances such as sawdust or wiring debris inside the module.
  Such debris could cause fire, damage, or erroneous operation.

SAFETY INSTRUCTIONS

Startup and Maintenance Precautions

⚠ Warning

- Do not touch the terminals while power is on.
  This may cause an electric shock or erroneous operation.

- Switch all phases of the external power supply off when cleaning the module or retightening the terminal or module mounting screws.
  Not doing so could result in electric shock or erroneous operation.

- Do not charge, disassemble, heat, place in fire, short circuit, or solder the battery.
  Mishandling of the battery could cause overheating or cracks resulting in injury and/or fires.

⚠ Caution

- Do not disassemble or modify the modules.
  Doing so could cause erroneous operation, injury, or fire.

- Switch all phases of the external power supply off before mounting or removing the module.
  Not doing so could cause failure or malfunction of the module.

- Use cellular phones or walky-talkies more than 30cm (11.81 inch) away from the PLC.
  Not doing so could cause a malfunction.

Disposal Precaution

⚠ Caution

- When disposing of this product, treat it as industrial waste.
  Not doing so could cause environmental damage or explosion.

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Chapter 1. General

1.1 Guide to Use This Manual

This manual includes specifications, functions and handling instructions for the GLOFA-GM 7U series PLC.
This manual is separated into the following chapters:

No.	Title	Contents
Chapter 1	General	Describes the contents of this manual, the features of the PLC and terminologies
Chapter 2	System Configuration	Describes available units and system configurations for the GLOFA-GM7U series
Chapter 3	General Specifications	Describes general specifications of the units used in the GLOFA-GM7U series
Chapter 4	Names of Parts	Describes each component, names, and main functions
Chapter 5	Power Supply / CPU	Describes each component's usage
Chapter 6	Input and Output Specifications	
Chapter 7	Usage of Various Functions	
Chapter 8	Communication Functions	Describes built-in communication functions
Chapter 9	Installation and Wiring	Describes installation, wiring and handling instructions for insuring the reliability of the PLC system
Chapter 10	Maintenance	Describes the checklist and method for long-term normal operation of the PLC system
Chapter 11	Troubleshooting	Describes various operation errors and the corresponding corrective actions
Appendix 1	System Definitions	Describes parameter settings for the basic I/O and communication modules
Appendix 2	Flag Lists	Describes the types and descriptions of various flags
Appendix 3	Function / Function Block Lists	Describes the types and descriptions of various Functions / Function Blocks
Appendix 4	Dimensions	Shows dimensions of the main units and expansion modules

REMARK

This manual does not describe the programming method. For these functions, refer to the related user's manuals.

1.2 Feature

1) GLOFA-GM7U series have the following features.

1) GLOFA-GM series features

(1) Designed on the basis of international standard specifications (IEC61131-3)
- Supports easy programming
- Provides IEC61131-3 Language (IL / LD / SFC)

(2) Supports an open network by the international standard communication protocol
(3) High speed processing with an embedded operation-dedicated processor.
(4) Various special modules that enlarge the PLC application range

2) GM7U series are extremely compact to fit a wide range of applications.

(1) High speed processing
High speed processing with 0.1~0.9 μs/step
(2) Various built-in functions
Only with the base unit, the user can configure various systems because it has many built-in functions.

- Fast Processing Applications
  -Pulse catch: allows the base unit to read a pulse stably as short as 10μs
  -High-speed counter: supports high-speed counting up to 1 phase 100kHz, and 2 phase 50kHz
  -External contact interrupts: enables the applications which require immediate responses by using a built-in 8-point interrupt input
- The input filter function helps to reduce the possibility of false input conditions from external noise, such as signal chattering. The filter time can be programmed from 0 to 1000 ms.
- The built-in positioning control function enables to control a stepping motor or a servo motor without a separate positioning module. (DRT, DT type)
- Using RS-232C and RS-485 built-in ports, GM7U can connect to external devices, such as computers or monitoring devices. These devices can communicate 1:1 with the GM7U or GM6 system.
- Using the built-in PID control function, the PID control system can be configured easily without using separate PID module.

(3) The user can easily turn On/Off the system with RUN/STOP switch.
(4) The user can configure various systems using a separate Cnet I/F module.
(5) The user program can be easily saved in EEPROM by simple manipulation in GMWIN without using external memory.
(6) Advanced self-diagnostic functions
- GLOFA-GM7U series can detect the errors precisely with more detailed error codes.

(7) Unintentional reading and writing can be prevented by using a password.
(8) Restart mode setting
- The user can select Cold/Warm restart mode.

(9) Battery-less

- With the EEPROM, the user program and parameter can be saved permanently without the battery.

(10) Debugging function

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

- Executed by one command
- Executed by break-point settings
- Executed by the condition of the device
- Executed by the specified scan time

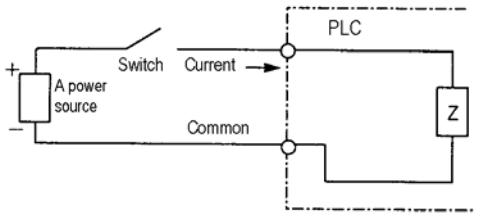
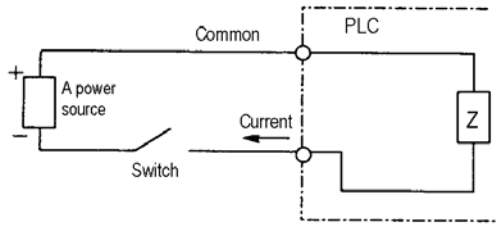
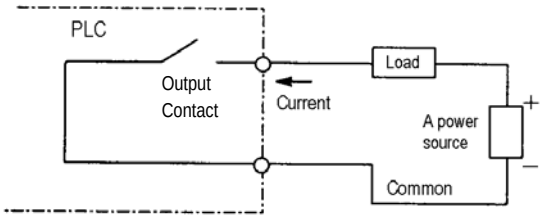
(11) Various program execution function

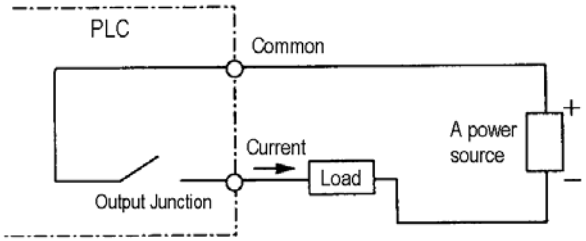
- Time driven interrupt, external and internal interrupt programs as well as scan programs can be executed by setting the execution condition. This allows the user to set various program execution modes.

1.3 Terminology

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

Terms	Definition	Remarks
Module	A standard element that has a specified function which configures the system. The devices such as I/O board, which inserted onto the mother board or base unit.	Example) CPU module, Power supply module, I/O module
Unit	A single module or group of modules that perform an independent Operation as a part of PLC system.	Example) Main unit
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 the power went off, the PLC system restores the data to the previous conditions and restarts in the maximum allowed time.	
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 the definition of their names and types. There are I, Q, M areas.	Example) •%IX0.0.2 •%QW1.2.1 •%MD1234 etc.

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 periodic task, internal contact task and external contact task which starts by the input signals of external input modules.	
RTC	Abbreviation of 'Real Time Clock'. It is used to call general IC that contains clock function.	
Sink Input	Current flows from the switch to the PLC input terminal if a input signal turns on. 	
Source Input	Current flows from the PLC input terminal to the switch after an input signal turns on. 	
Sink Output	Current flows from the load to the output terminal and the PLC output turn on. 	

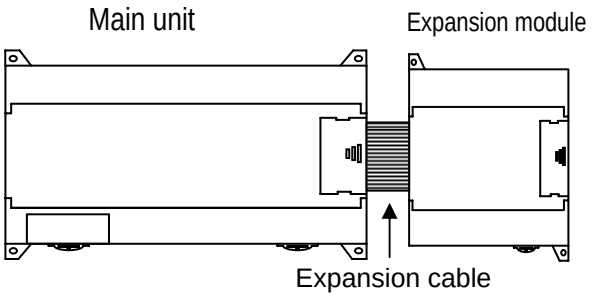
Terms	Definition	Remarks
Source Output	Current flows from the output terminal to the load and the PLC output turn on. 	
Fnet	Fieldbus Network	
Cnet	Computer Network	
Dnet	DeviceNet Network	

Chapter 2. System Configuration

The GLOFA-GM7U series has 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

2.1.1 Basic system



Total I/O points			20 ~ 120 points	
Maximum number of expansion modules	Digital I/O module		3	Total 3 modules (External Memory and RTC modules can be connected as a 4th expansion module)
	A/D-D/A module		3	
	Analog timer		3	
	Cnet I/F module		1	
Item	Main unit		• G7M-DR20,30,40,60U • G7M-DR20,30,40,60U/DC	
			• G7M-DRT20,30,40,60U(N) • G7M-DRT20,30,40,60U(N)/DC	
			• G7M-DT20,30,40,60U(N) • G7M-DRT20,30,40,60U(N)/DC	
			• G7M-DT20,30,40,60U(P) • G7M-DRT20,30,40,60U(P)/DC	
	Expansion module	Digital I/O	G7E-DR10A/G7E-DR20A/G7E-TR10A/G7E-DC08A/G7E-RY08A/G7E-DR08A G7E-RY16A	
		A/D,D/A	G7F-ADHA/G7F-AD2A/G7F-DA2I/G7F-ADHB/G7F-DA2V/G7F-AD2B /G7F-ADHC	
		RTD Input	G7F-RD2A	
		Analog Timer	G7F-AT2A	
	Communication I/F module	Cnet I/F	G7L-CUEB,G7L-CUEC	
		DeviceNet I/F	G7L-DBEA	
		Fnet I/F	G7L-FUEA	
		Pnet I/F	G7L-PBEA	
		Rnet I/F	G7L-RUEA	
	Option module	RTC	G7E-RTCA	
		Memory	G7M-M256B (*1)	

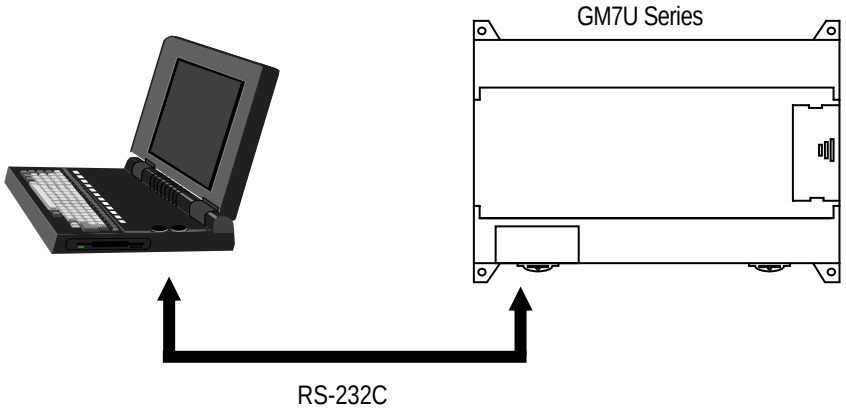
* G7M-M256 is not available for GM7U series. Please use G7M-M256B.

2.1.2 Cnet I/F system

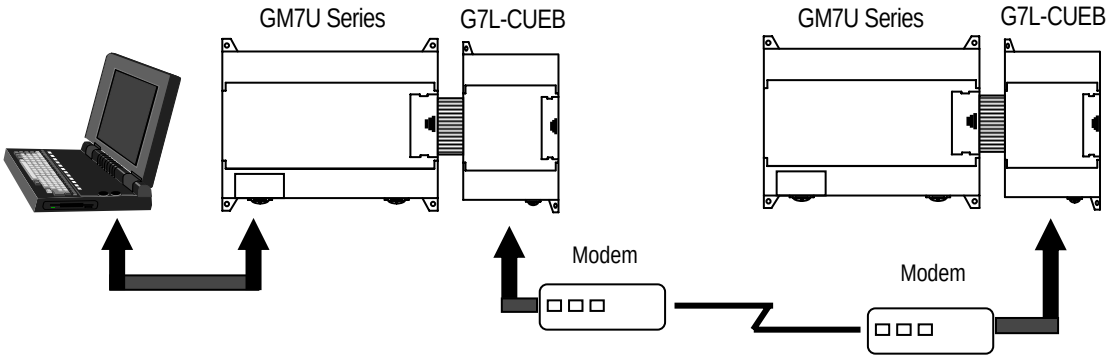
The Cnet I/F System are used for communication between the main unit and external devices using RS-232C/RS-422 Interface. The GM7U has a built-in RS-232C port, RS-485 port and has also G7L-CUEB for RS-232C, G7L-CUEC for RS-422. It is possible to construct communication systems on demand.

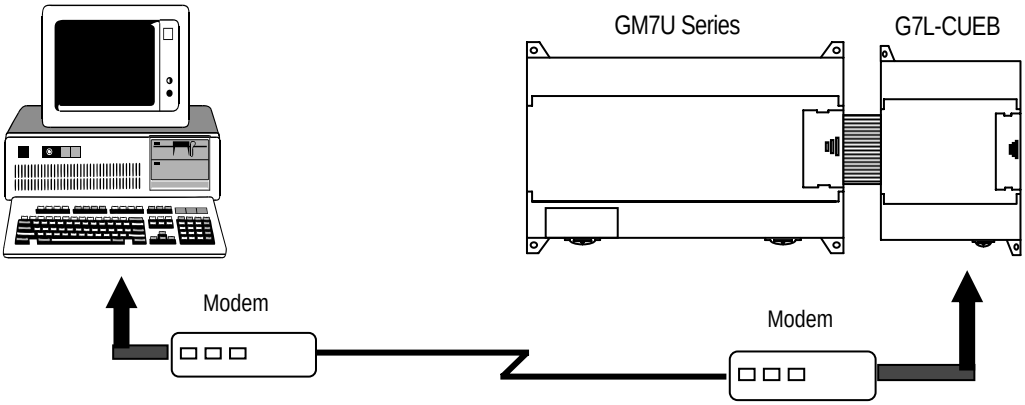
1) 1:1 Communications system

(1) 1:1 communication between PC and GM7U via RS-232C built-in port

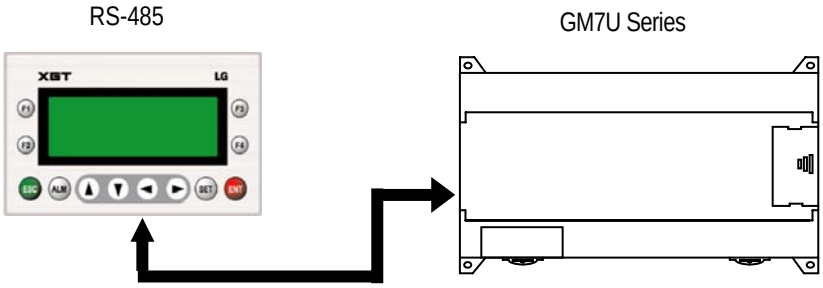


(2) 1:1 communication via modem connection function of Cnet I/F module to interface with long distance devices





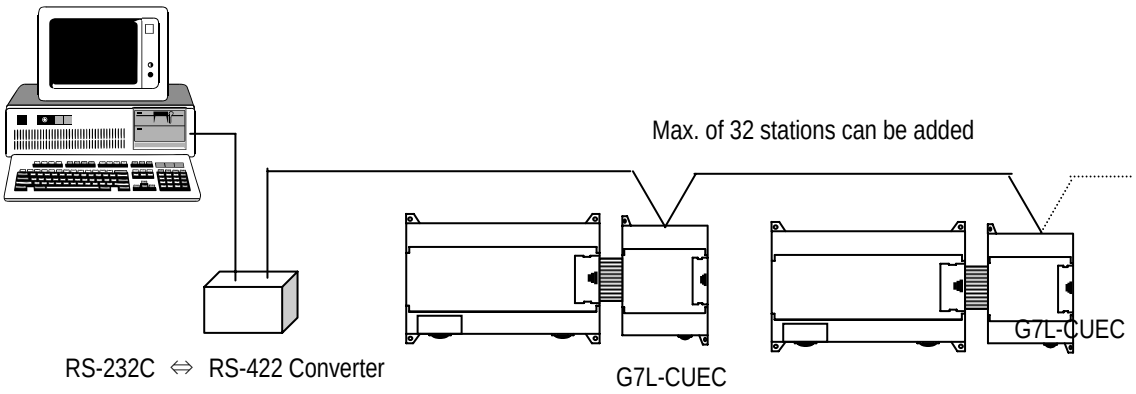
(3) 1:1 communication between HMI andGM7U via RS-485 built-in port



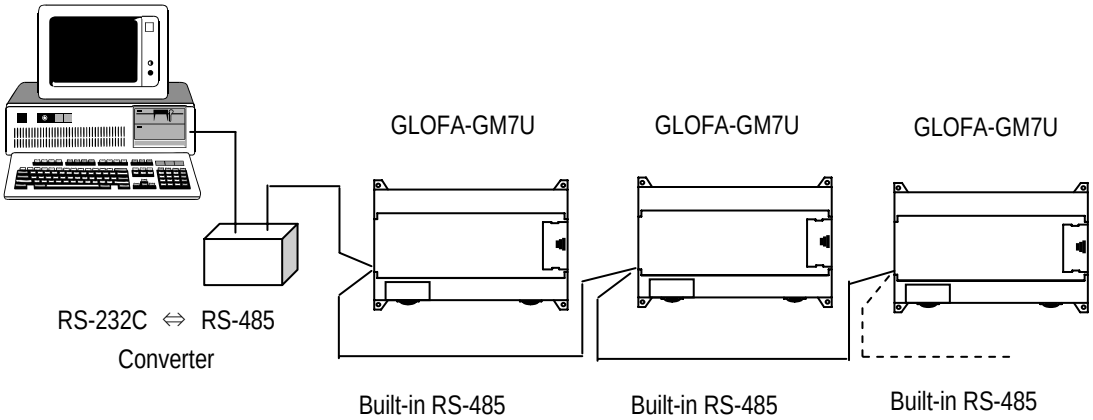
2) 1:N communication system

This method can connect a computer to multiple main units up to a maximum of 32 stations.

(1) Via RS-422 Cnet I/F module



(2) Via RS-485 Cnet I/F module



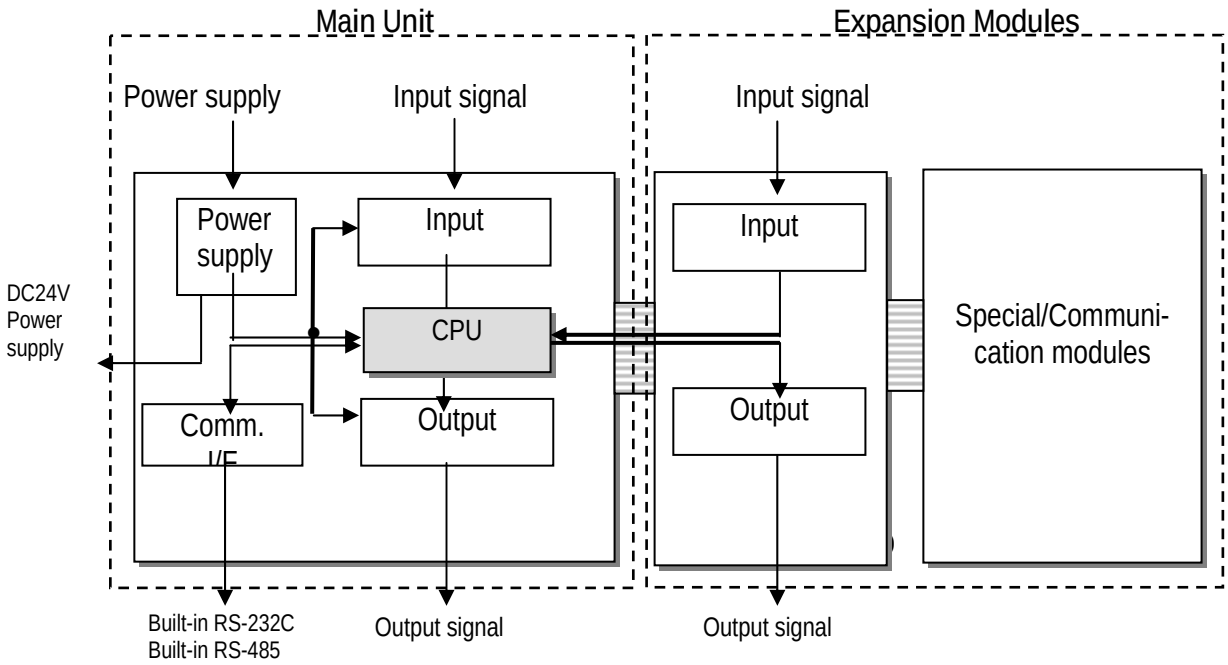
* For details, refer to the section chapter 8. ‘Communication Function’.

2.2 Product List

The following describes functional model of the GLOFA-GM7Useries.

2.2.1 Product functional block

Product configuration block for the GM7U series is as follows.



Sub-system	Description
CPU	• Signal processing function - Operating system function - Application program storage / memory function - Data storage / memory function - Application program execution function
Input	The input signals obtained from the machine/process to appropriate signal levels for processing
Output	The output signals obtained from the signal processing function to appropriate signal levels to drive actuators and/or displays
Power Supply	Provides for conversion and isolation of the PLC system power from the main supply
Communication Interface	Supports 1:1 or 1:N communication system using built-in communication I/F function or GMWIN

2.2.2 GM7U series system equipment product

1) Main Unit

Items	Models	I/O Point & Power Supply	Built-in Function	Remark
Main unit	G7M-DR20U G7M-DR20U/DC	1) DC24V input 12 points 2) Relay output 8 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V	- High speed counter 1 phase: 100kHz 2Ch, 20 kHz 2Ch 2 phase: 50kHz 1Ch, 10 kHz 1Ch - Pulse catch: 10 μs 2 points / 50 μs 6 points (IX0.0.0~IX0.0.7) - External interrupt: 1 μs 2 points/50 μs 6 points (IX0.0.0~IX0.0.7) - Input filter: 0 ~ 1s (can be designated with groups) - PID control - RS-232C / RS-485	
	G7M-DR30U G7M-DR30U/DC	1) DC24V input 18 points 2) Relay output 12 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DR40U G7M-DR40U/DC	1) DC24V input 24 points 2) Relay output 16 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DR60U G7M-DR60U/DC	1) DC24V input 36 points 2) Relay output 24 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DRT20U(N) G7M-DRT20U(N)/DC	1) DC24V input 12 points 2) Relay output 4 points 3) NPN TR output 4 points 4) AC 85 ~ 264[V] /DC : DC10.8~26.4V	- High speed counter 1 phase: 100kHz 2Ch, 20 kHz 2Ch 2 phase: 50kHz 1Ch, 10 kHz 1Ch - Pulse catch: 10 μs 2 points / 50 μs 6 points (IX0.0.0~IX0.0.7) - External interrupt: 10 μs 2 points / 50 μs 6 points (IX0.00~IX0.0.7) - Input filter: 0 ~ 1s (can be designated with groups) - PID control - RS-232C / RS-485 - Positioning function - 2axes 100 kpps - Absolute / Incremental positioning - Single / Repeat operation - End / Keep / Continuous mode - Return to origin, JOG, PWM, velocity control (N) : NPN TR. output (P) : PNP TR. output	
	G7M-DRT30U(N) G7M-DRT30U(N)/DC	1) DC24V input 18 points 2) Relay output 8 points 3) NPN TR output 4 points 4) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DRT40U(N) G7M-DRT40U(N)/DC	1) DC24V input 24 points 2) Relay output 12 points 3) NPN TR output 4 points 4) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DRT60U(N) G7M-DRT60U(N)/DC	1) DC24V input 36 points 2) Relay output 20 points 3) NPN TR output 4 points 4) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DT20U(N) G7M-DT20U(N)/DC G7M-DT20U(P) G7M-DT20U(P)/DC	1) DC24V input 12 points 2) TR. output 8 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DT30U(N) G7M-DT30U(N)/DC G7M-DT30U(P) G7M-DT30U(P)/DC	1) DC24V input 18 points 2) TR. output 12 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DT40U(N) G7M-DT40U(N)/DC G7M-DT40U(P) G7M-DT40U(P)/DC	1) DC24V input 24 points 2) TR. output 16 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		
	G7M-DT60U(N) G7M-DT60U(N)/DC G7M-DT60U(P) G7M-DT60U(P)/DC	1) DC24V input 36 points 2) TR. output 24 points 3) AC 85 ~ 264[V] /DC : DC10.8~26.4V		

2) Expansion/Special modules

Items	Models		Specifications	Remark
Expansion module	Digital I/O	G7E-DR10A	• DC 24V input 6 points / Relay output 4 points	
		G7E-DR20A	• DC 24V input 12 points / Relay output 8 points	
		G7E-RY16A	• Relay output 16 points	
		G7E-TR10A	• TR output 10 points	
		G7E-RY08A	• Relay output 8 points	Slim type
		G7E-DR08A	• DC input 4 points, Relay output 4 points	
		G7E-DC08A	• DC 24V input 8 points	
Special module	A/D , D/A combination	G7F-ADHA	• A/D : 2 channel , D/A : 1 channels	
		G7F-ADHB	• A/D : 2 channels , D/A : 2 channels	Slim type
		G7F-ADHC	• A/D : 1 channel (0~1V), D/A : 1 channel (current output)	
	A/D	G7F-AD2A	• A/D : 4 channels	
		G7F-AD2B	• A/D : 4 channels	Slim type
	D/A	G7F-DA2I	• D/A : 4 channels (current output)	
		G7F-DA2V	• D/A : 4 channels (voltage output)	Slim type
	Analog timer	G7F-AT2A	• Timer points: 4 points • Digital output range: 0 ~ 200	
	RTD input	G7F-RD2A	• 4 channels	Slim type
Communication module	Cnet I/F	G7L-CUEB	• RS-232C : 1 channel	
		G7L-CUEC	• RS-422 : 1 channel	
	DeviceNet I/F	G7L-DBEA	• DeviceNet (Slave) I/F module	
	Fnet I/F	G7L-FUEA	• FieldBus (Fnet) I/F module	
	Pnet I/F	G7L-PBEA	• ProfiBus (Slave) I/F module	
	Rnet I/F	G7L-RUEA	• Remote I/O I/F module	
Option module	RTC pack	G7E-RTCA	• RTC module	
	Memory pack	G7M-M256B	• Memory module	

* External memory G7M-M256 is not supported in GM7U series. Only G7M-M256B is available for GM7U series.

Chapter 3. General Specifications

3.1 General Specifications

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

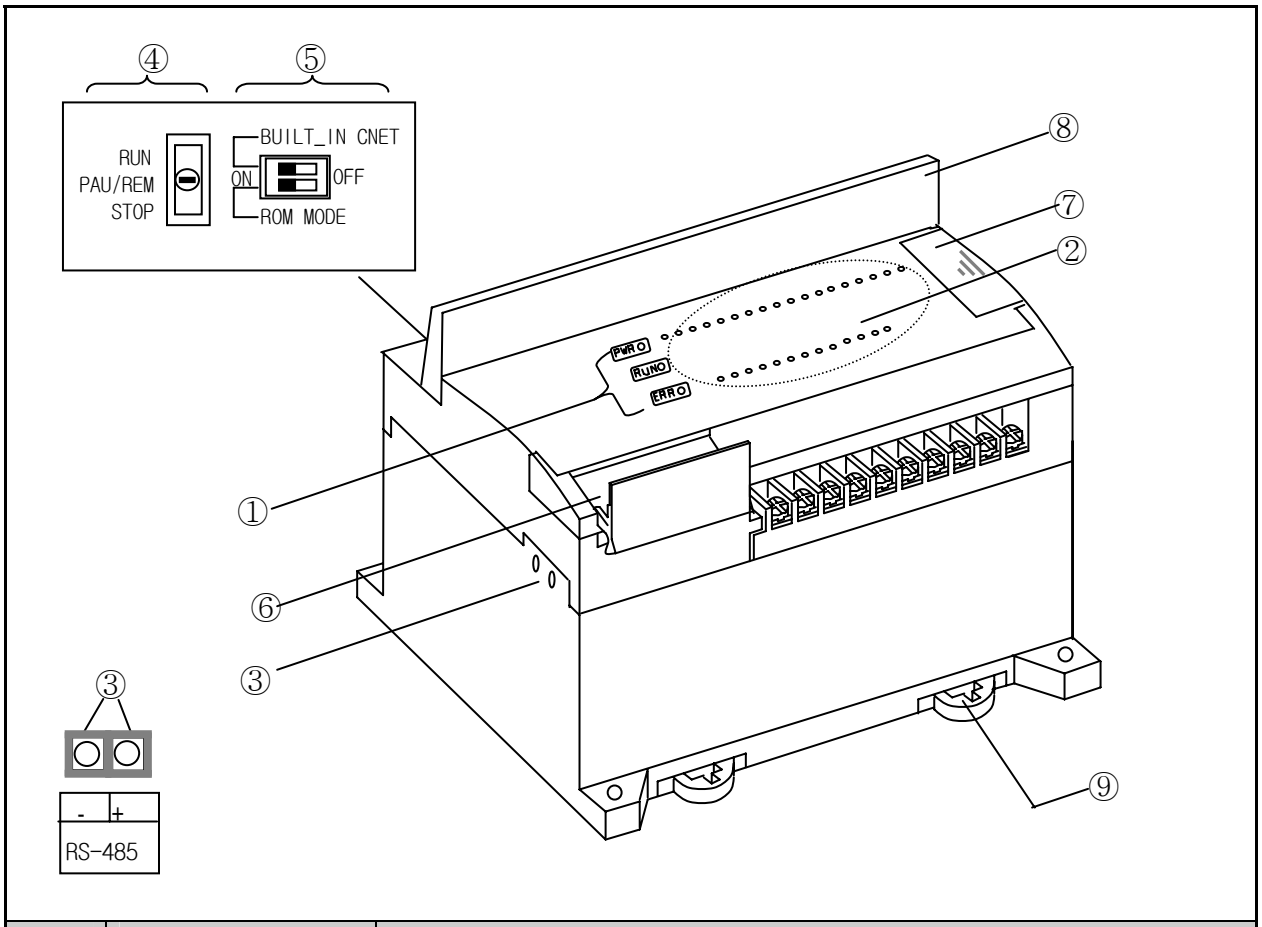
No.	Item	Specifications					References
1	Operating ambient temperature	0 ~ 55 °C					
2	Storage ambient temperature	–25 ~ +70 °C					
3	Operating ambient humidity	5 ~ 95%RH, non-condensing					
4	Storage ambient humidity	5 ~ 95%RH, non-condensing					
5	Vibrations	Occasional vibration				-	IEC 61131-2
		Frequency	Acceleration	Amplitude		Sweep count	
		10 ≤ f < 57Hz	–	0.075mm		10 times for each X, Y, Z axis	
		57 ≤ f ≤ 150Hz	9.8m/s² {1G}	–			
		Continuous vibration					
		Frequency	Acceleration	Amplitude			
		10 ≤ f < 57Hz	–	0.0375mm			
		57 ≤ f ≤ 150Hz	4.9m/s² {0.5G}	–			
6	Shocks	• Maximum shock acceleration: 147 m/s² {15G} • Duration time: 11ms • Pulse wave: half sine pulse (3 shocks per axis, on X, Y, Z axis)					IEC 61131-2
7	Noise immunity	Square wave Impulse noise	± 1,500 V				LSIS' Standard
		Electronic discharge	Voltage: 4 kV (Discharge by contact)				IEC 61131-2, IEC 1000-1-2
		Radiated electromagnetic field noise	27 ~ 500 MHz, 10 V/m				IEC 61131-2, IEC 1000-1-3
		Fast transient /burst noise	Item	Power supply	Digital I/O (>24V)	Digital I/O (<24V) Analog I/O Interface	IEC 61131-2 IEC 1000-1-4
			Voltage	2kV	1kV	0.25kV	
8	Atmosphere	Free of corrosive gases and excessive dust					
9	Altitude	Up to 2,000m					
10	Pollution degree	Below 2					
11	Cooling method	Air-cooling					

REMARK

1) IEC (International Electro-technical Commission): An international non-governmental organization enacting international standards of electric and electronic fields.
2) Pollution degree: Index indicating the pollution of operating environment to determine the insulation capacity of equipment.
Pollution degree 2: Normally only nonconductive pollution occurs. Temporary conductivity caused by condensation is to be expected.

Chapter 4. Names of Parts

4.1 Main Units

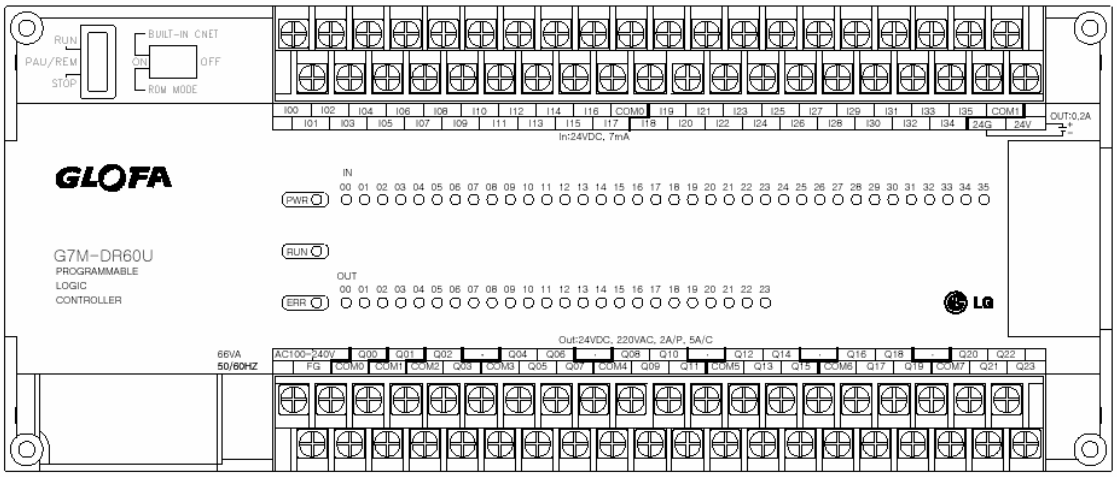


No.	Name		Descriptions
①	CPU condition LED	PWR LED	Indicates the status of the power supply to the system • On: when the supplied power is normal • Off: when the supplied power is abnormal
		RUN LED	Indicates operating status of the main unit • On: indicates local key switch or remote running mode • Off: the following turns the LED off - the supplied power to the main unit is abnormal - the key switch is on stop mode - an error is detected which makes operation stop
		ERR LED	Indicates operating status of the CPU • Flickering: self-inspected error • Off: CPU is working normally

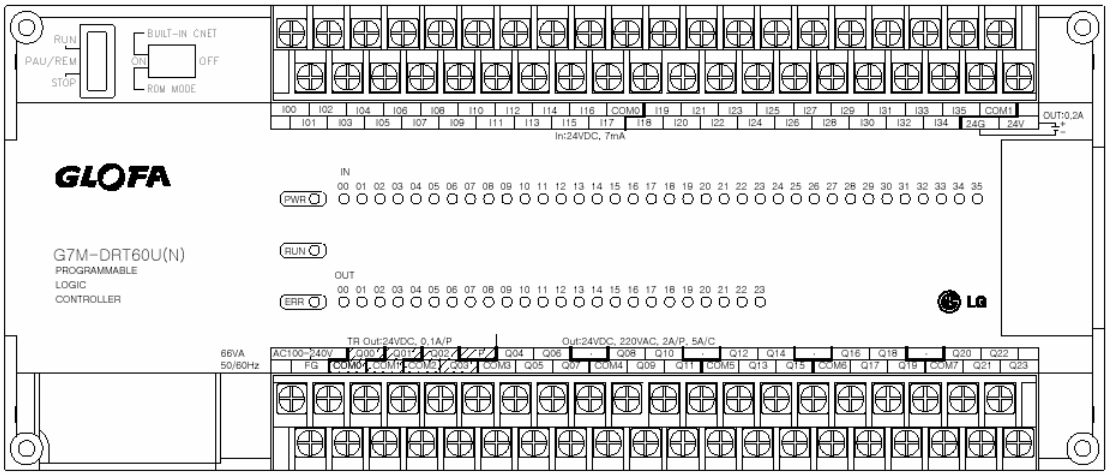
No.	Name	Descriptions
②	I/O LED	Indicates the operating status of I/O
③	Built-in RS-485 connector	A connector for built-in RS-485 communications
④	Mode selection key switch	Designates the main unit's operation mode • RUN: runs the operation • STOP: stops the operation • PAU / REM: the usage of each modules is as follow - PAUSE: temporarily stops the operation - REMOTE: remote driving
⑤	Dip-switch for Cnet I/F	See Chapter 5. Power Supply / CPU
⑥	RS-232C connector	A connector to connect with PADT (GMWIN)
⑦	Expansion connector cover	A cover of connector which is used to connect with expansion unit
⑧	Terminal block cover	A protective cover for the terminal block's wiring
⑨	DIN rail hook	A hook for DIN rail mounting

4.1.1 60-point main unit

1) G7M-DR60U



2) G7M-DRT60U(N)



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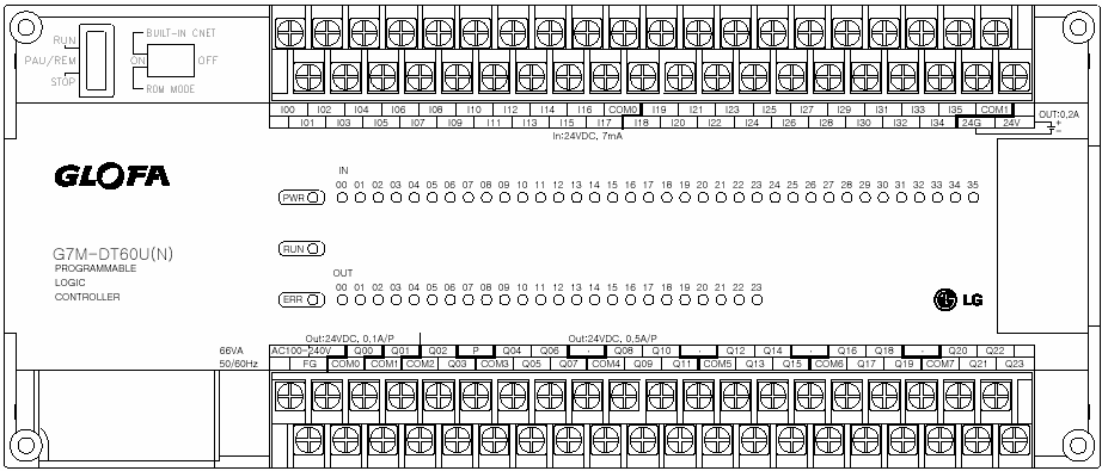
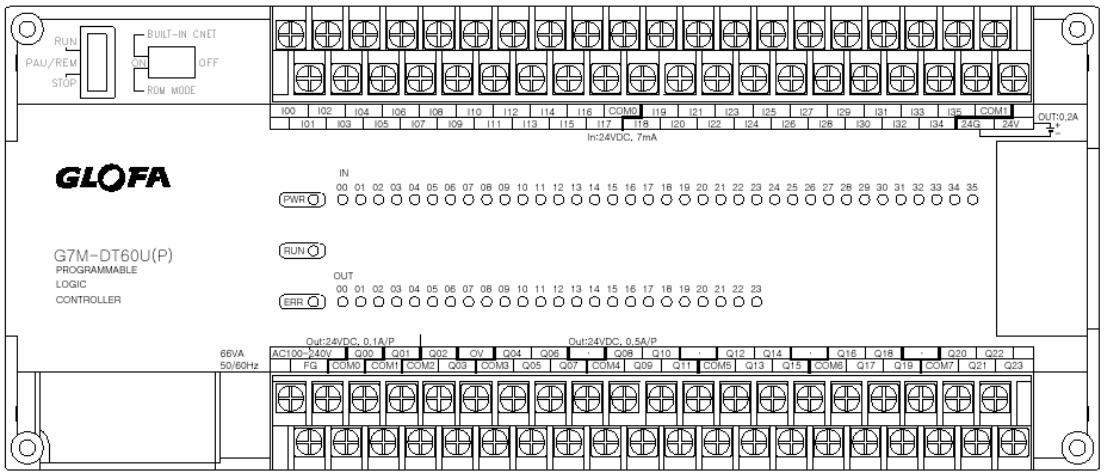
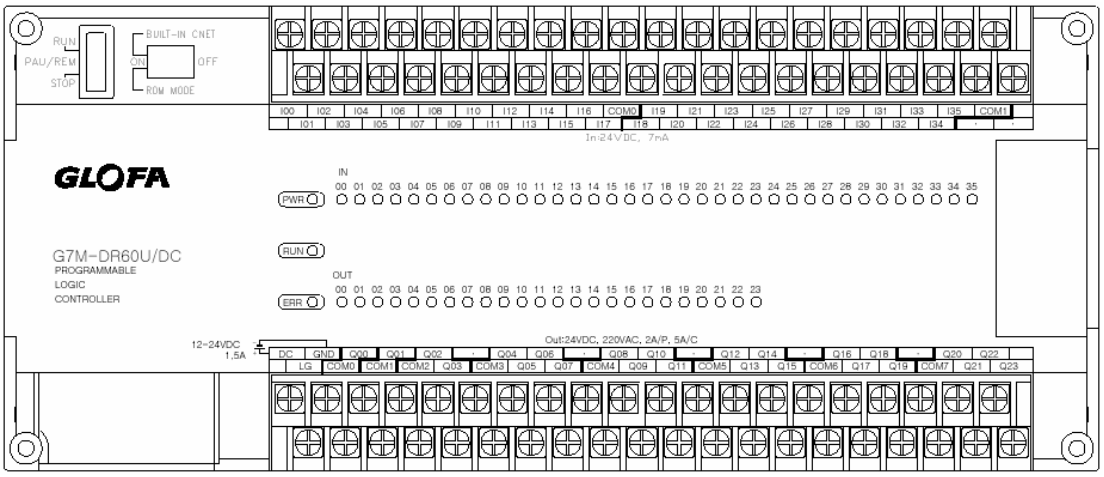


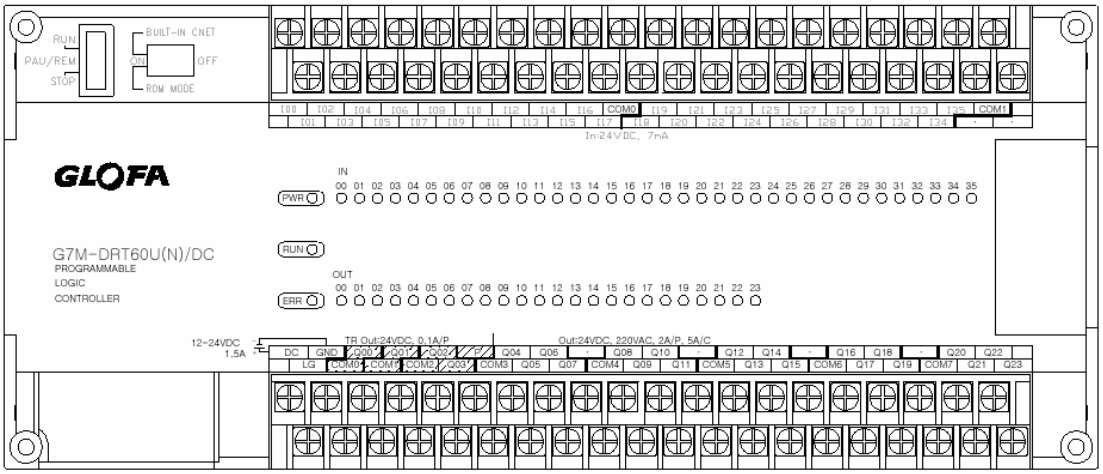
4) G7M-DT60U(P)



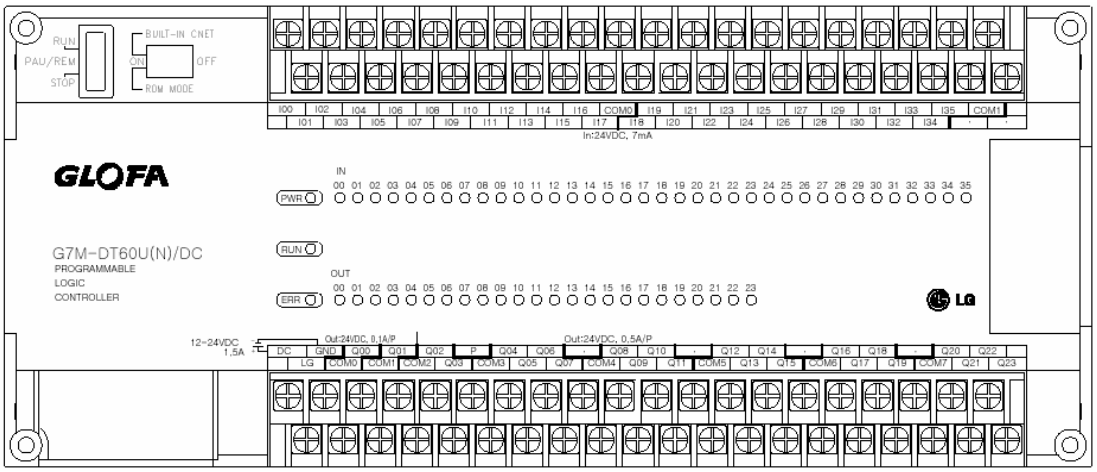
5) G7M-DR60U/DC



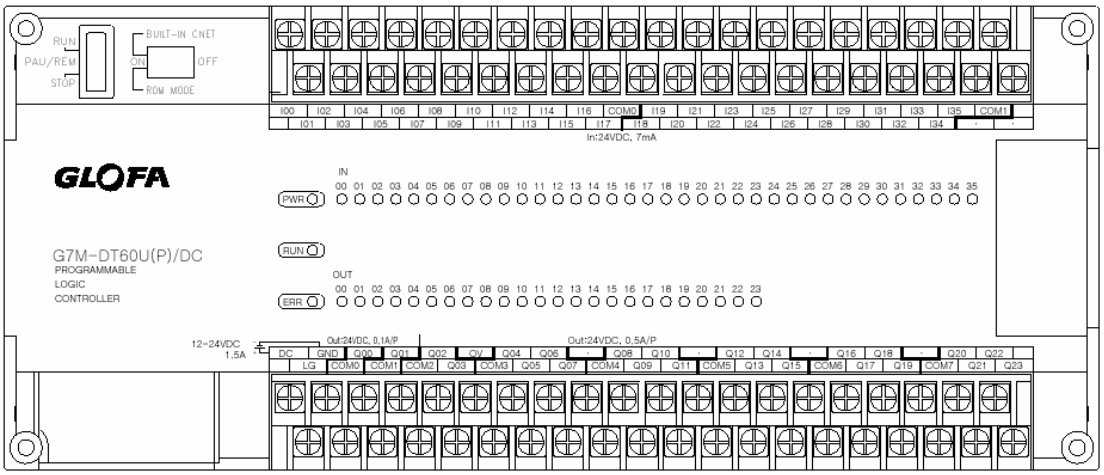
6) G7M-DRT60U(N)/DC



7) G7M-DT60U(N)/DC

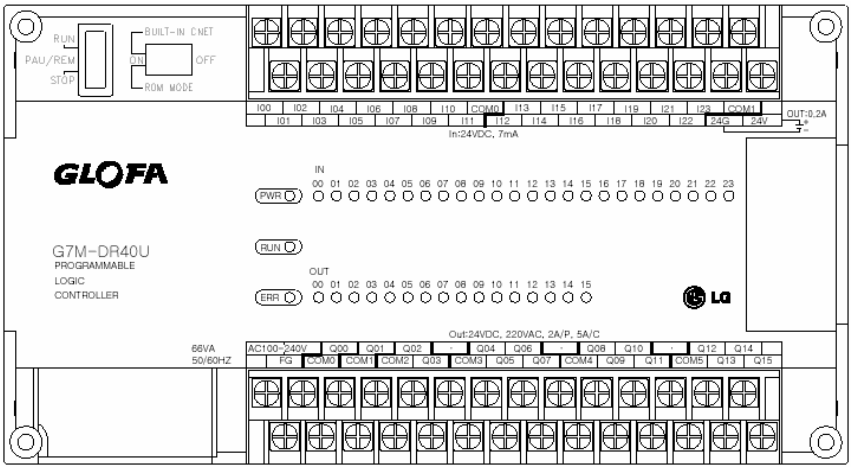


8) G7M-DT60U(P)/DC

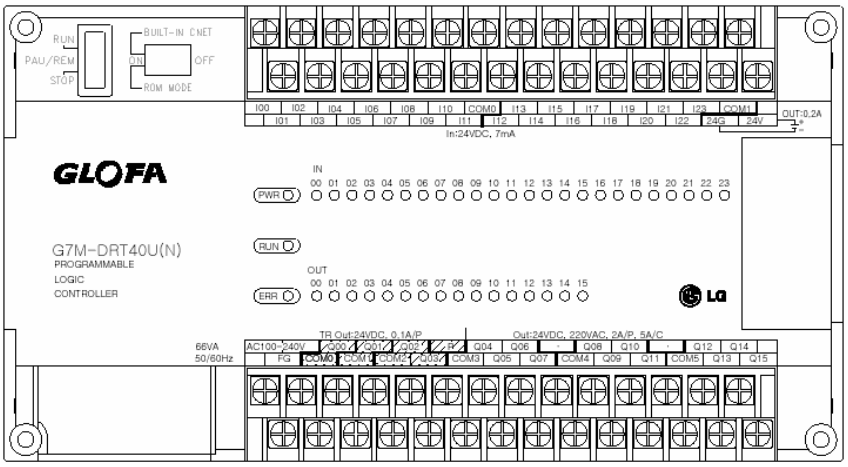


4.1.2 40-point main unit

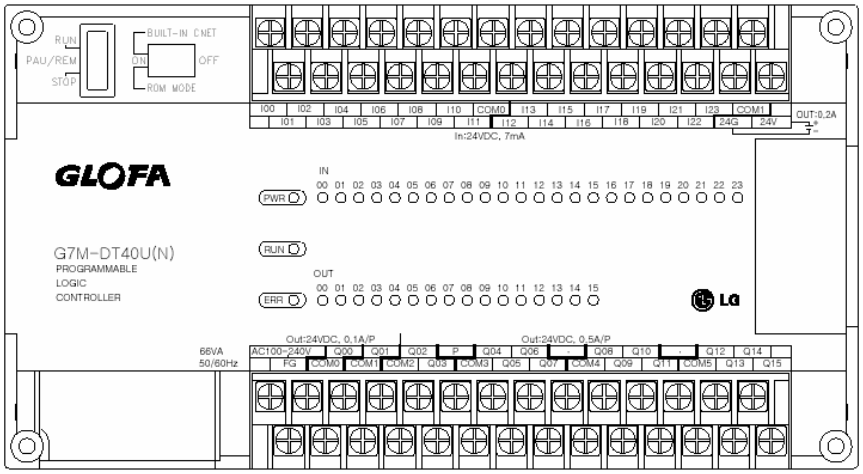
1) G7M-DR40U



2) G7M-DRT40U(N)



3) G7M-DT40U(N)



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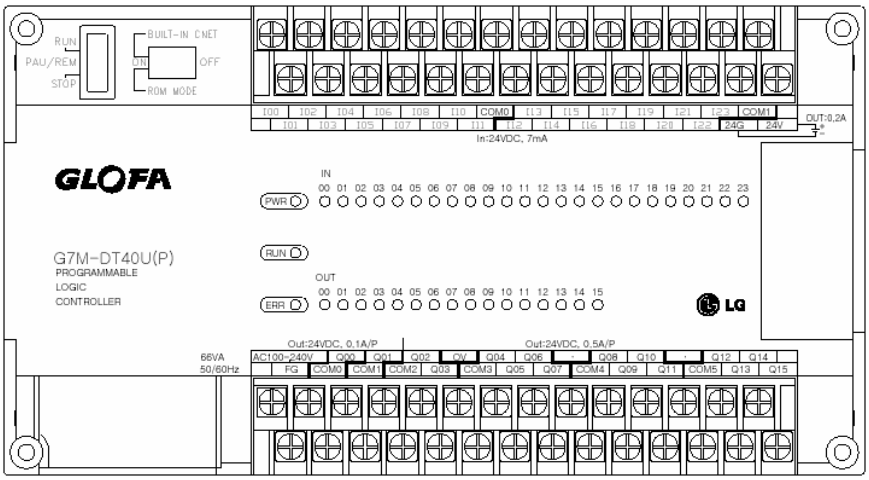
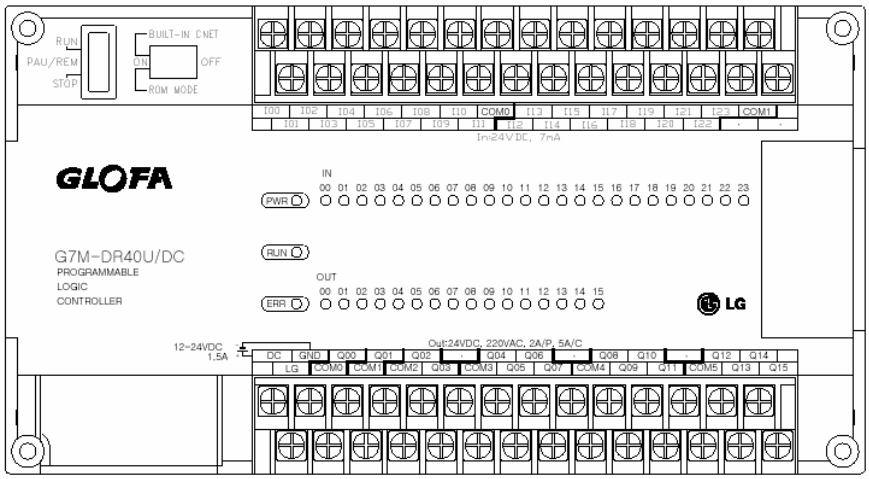
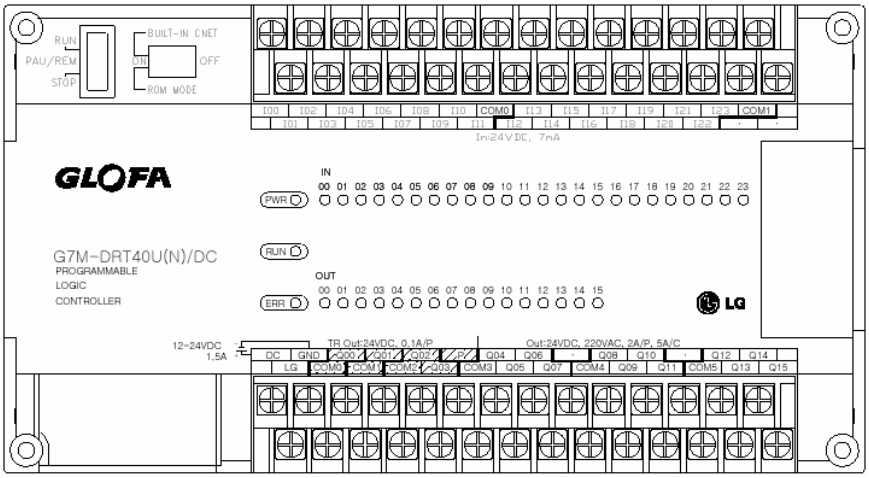


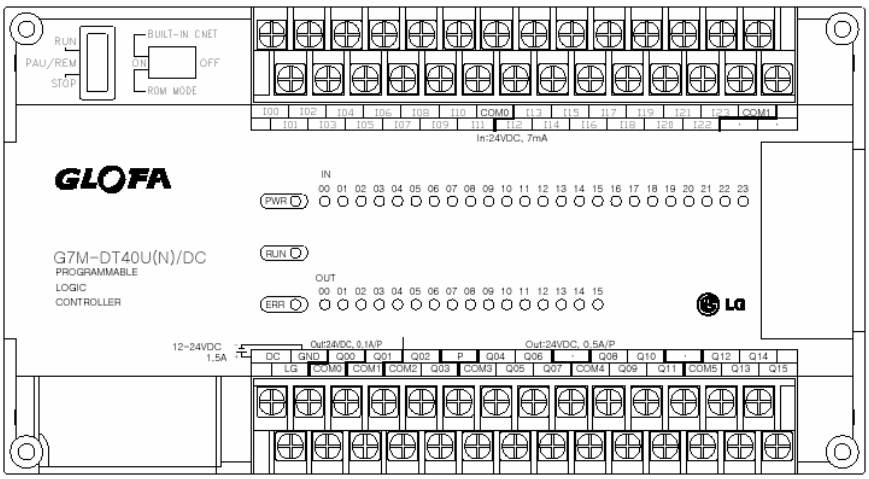
5) G7M-DR40U/DC



6) G7M-DRT40U(N)/DC



7) G7M-DT40U(N)/DC



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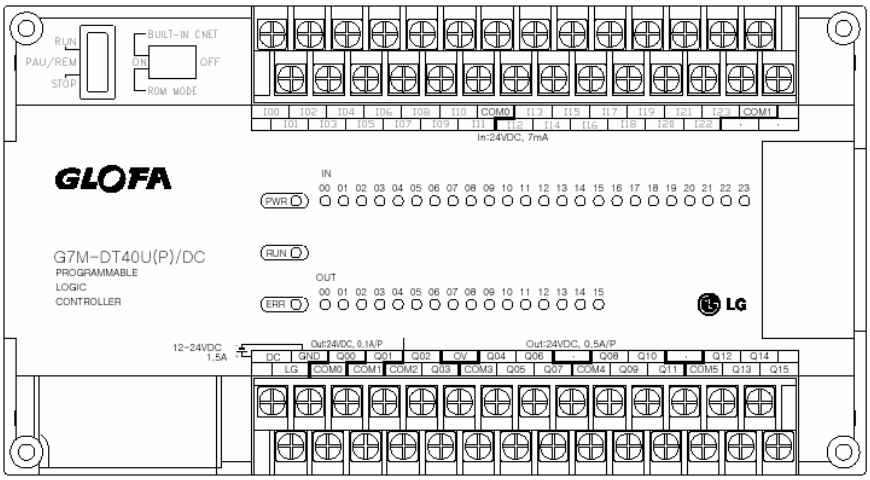
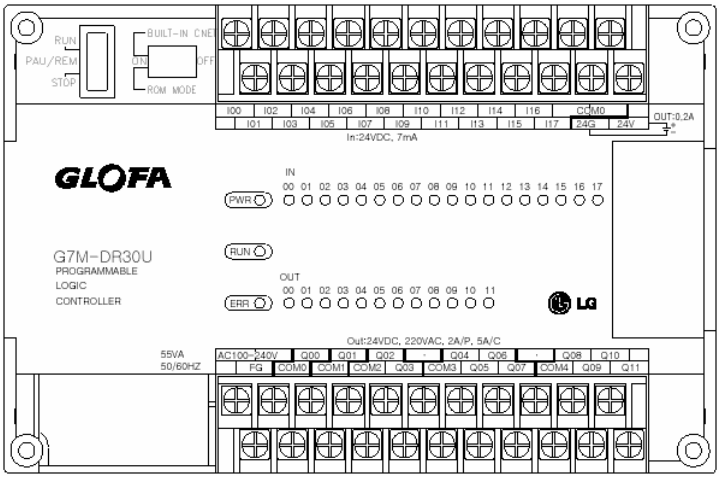
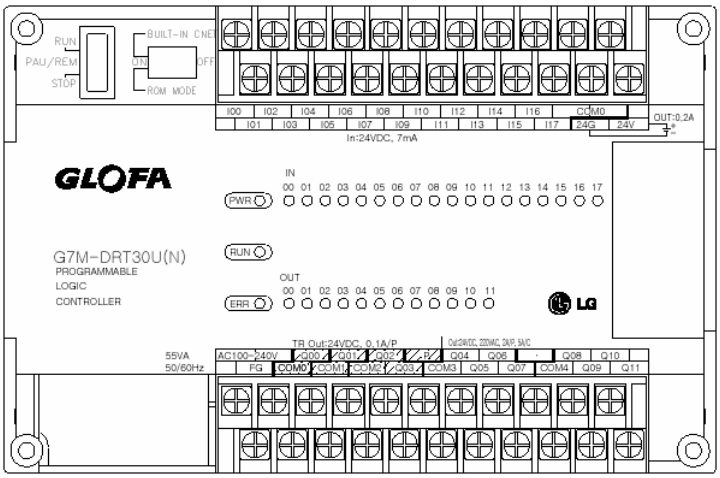


4.1.3 30-point main unit

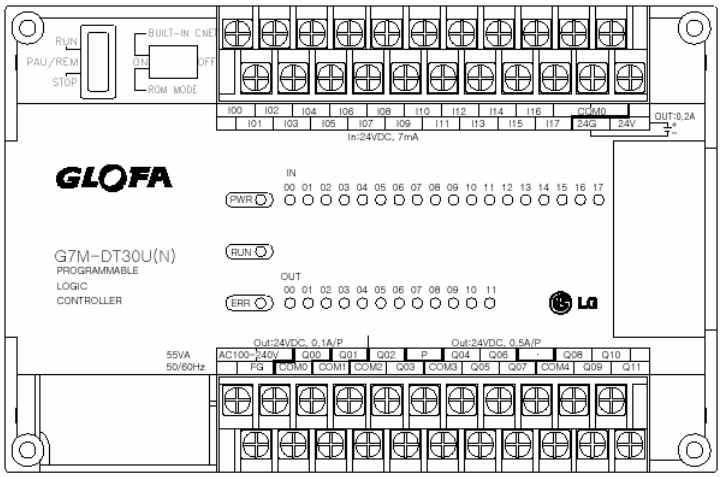
1) G7M-DR30U



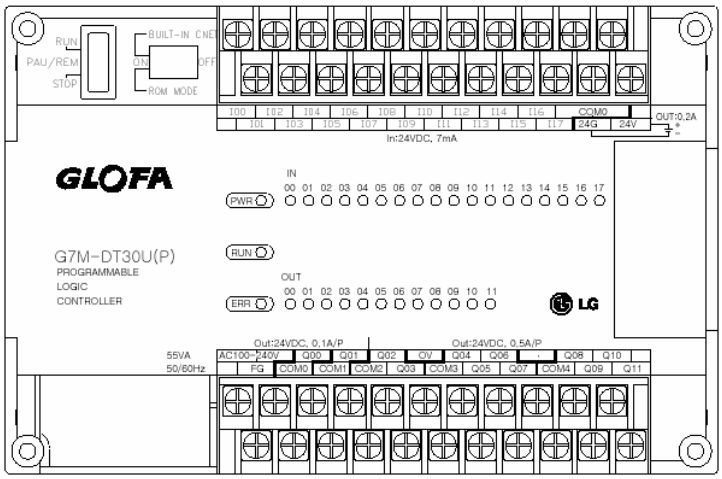
2) G7M-DRT30U(N)



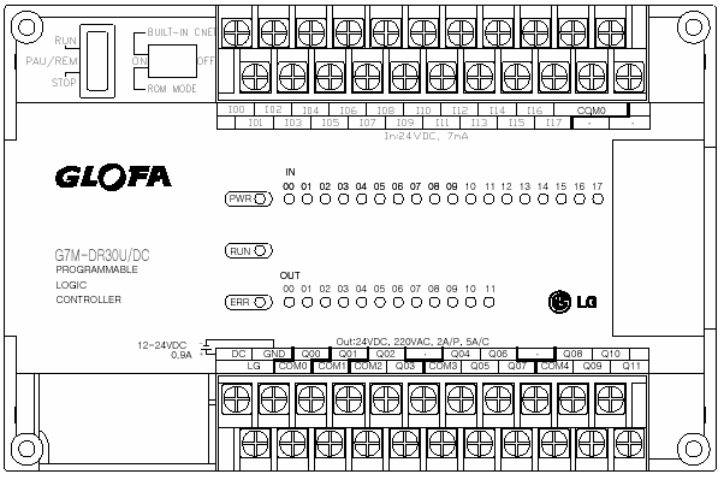
3) G7M-DT30U(N)



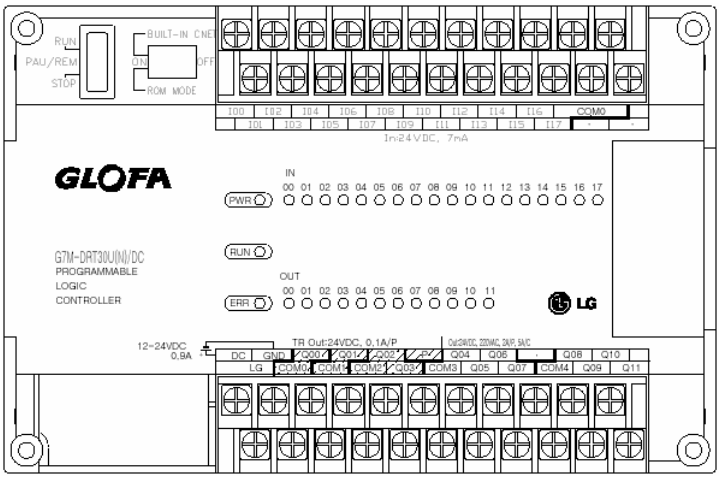
4) G7M-DT30U(P)



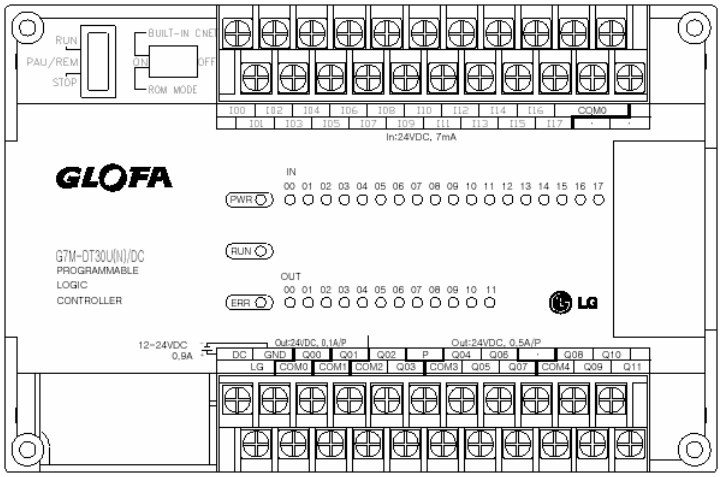
5) G7M-DR30U/DC



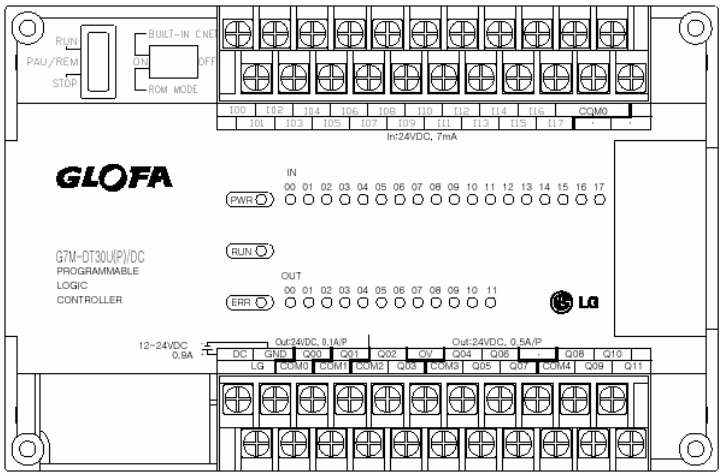
6) G7M-DRT30U(N)/DC



7) G7M-DT30U(N)/DC

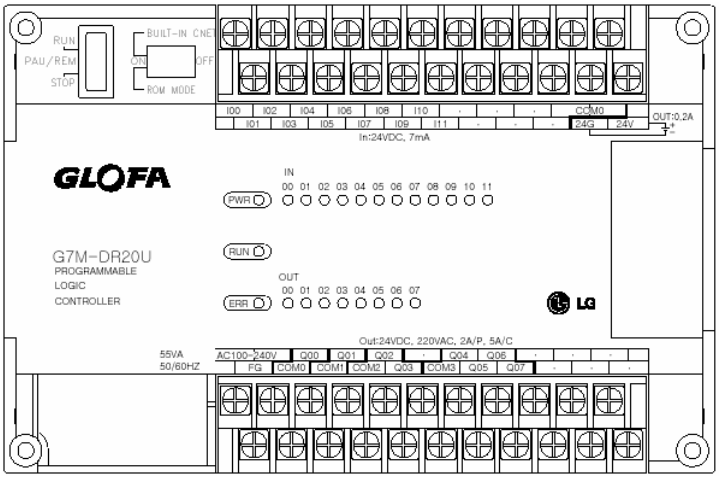


8) G7M-DT30U(P)/DC

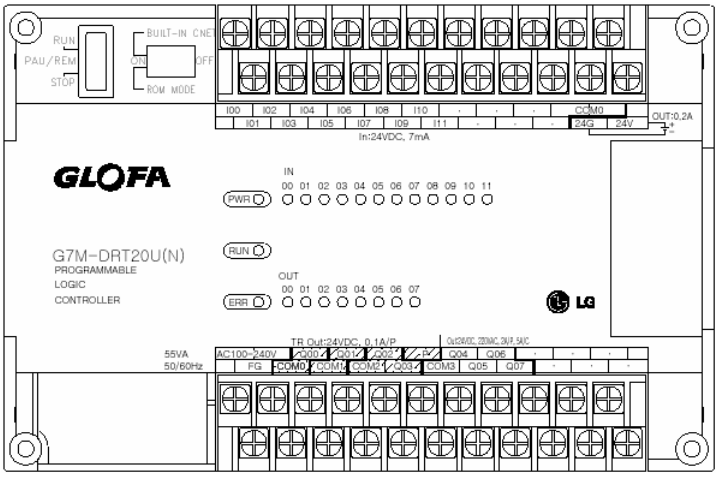


4.1.4 20-point main unit

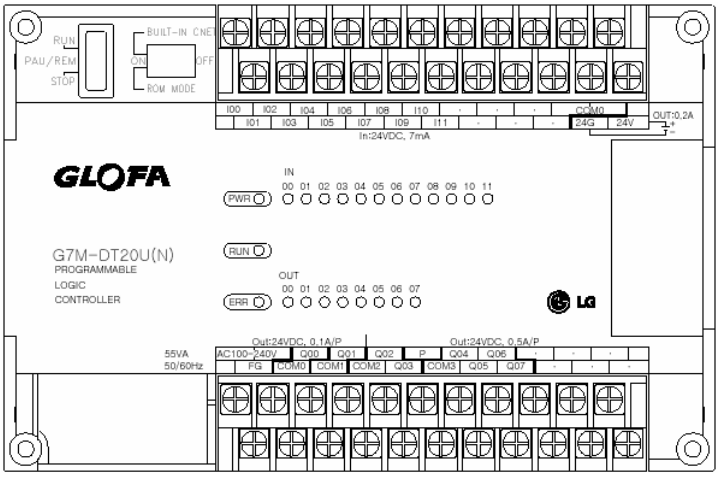
1) G7M-DR20U



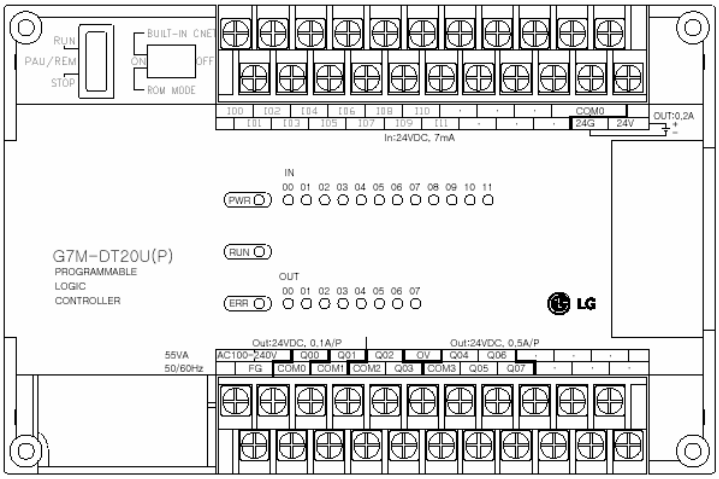
2) G7M-DRT20U(N)



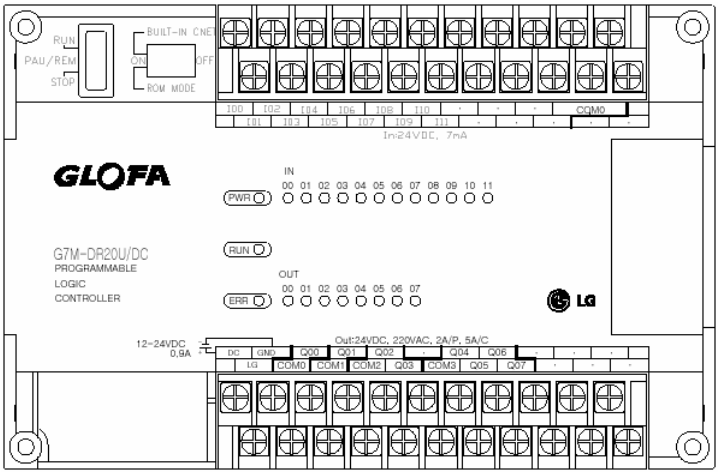
3) G7M-DT20U(N)



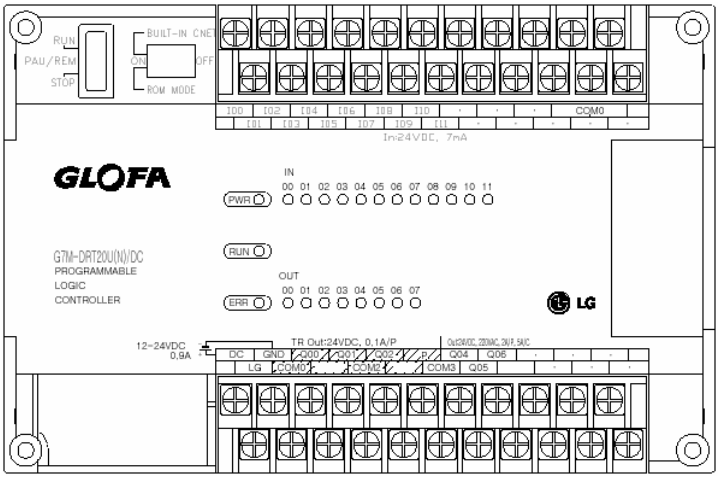
4) G7M-DT20U(P)



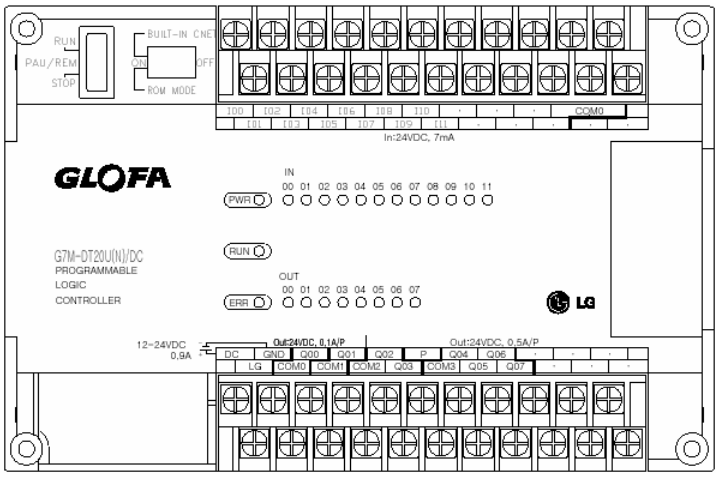
5) G7M-DR20U/DC



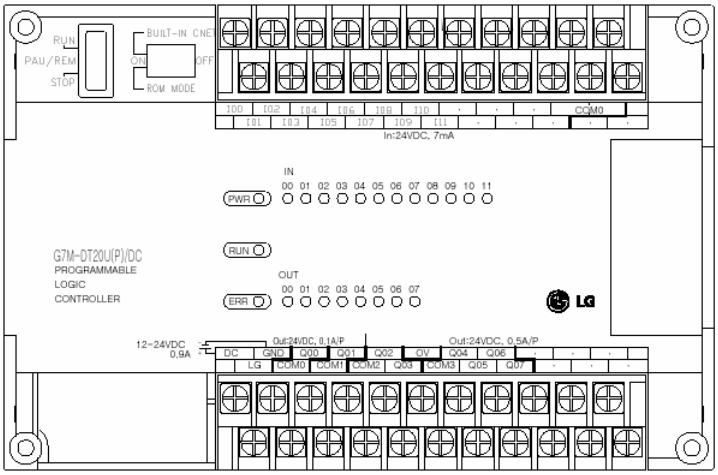
6) G7M-DRT20U(N)/DC



7) G7M-DT20U(N)/DC



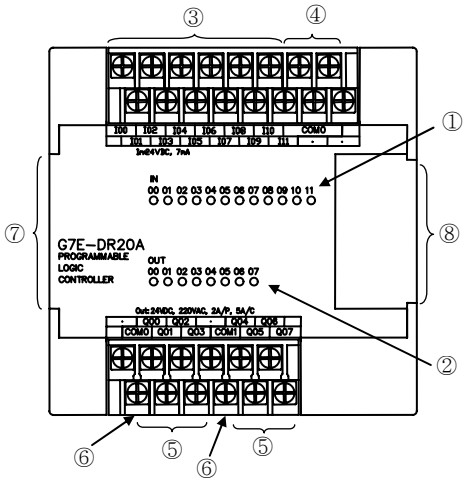
8) G7M-DT20U(P)/DC



4.2 Expansion Modules

4.2.1 20-point I/O expansion module

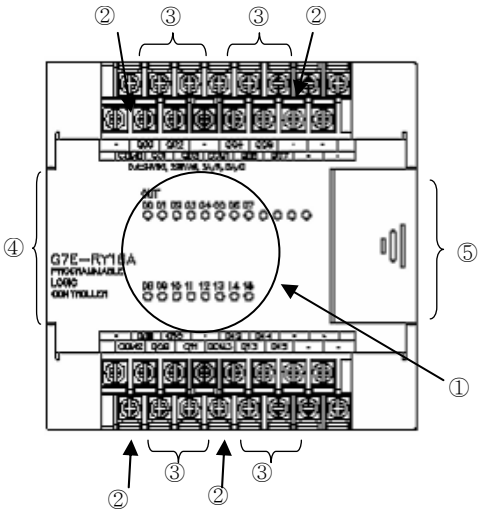
1) G7E-DR20A



No.	Names
①	Input LED
②	Output LED
③	Input Contact
④	Input Common Terminal
⑤	Output Contact
⑥	Output Common
⑦	Expansion Cable
⑧	Expansion Cable Connecting Terminal

4.2.2 16-point I/O expansion module

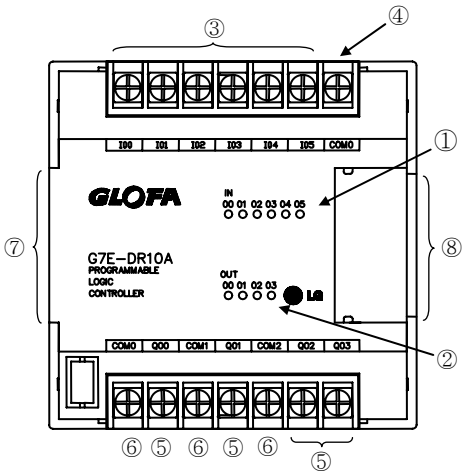
2) G7E-RY16A



No.	Names
①	Input LED
②	Output Common
③	Output Contact
④	Expansion Cable
⑤	Expansion Cable Connecting Terminal

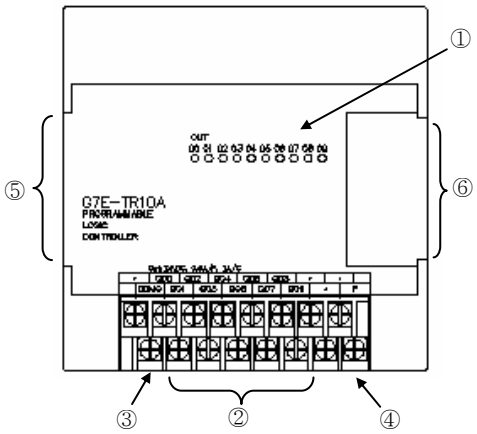
4.2.3 10-point I/O expansion module

1) G7E-DR10A



No.	Names
①	Input LED
②	Output LED
③	Input Contact
④	Input Common Terminal
⑤	Output Contact
⑥	Output Common
⑦	Expansion Cable
⑧	Expansion Cable Connecting Terminal

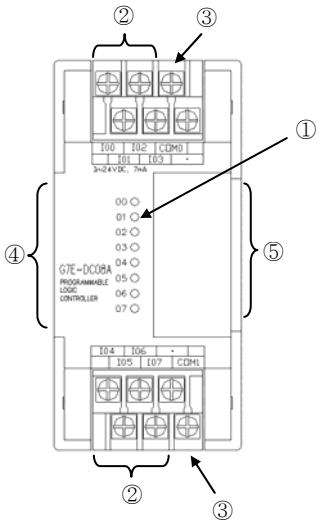
2) G7E-TR10A



No.	Names
①	Output LED
②	Output Contact
③	Output Common Terminal
④	External Power Supply Terminal (DC 24V)
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal

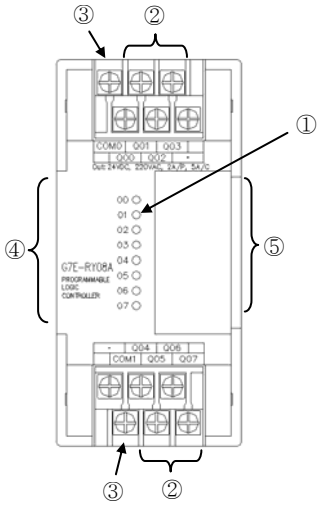
4.2.4 8-point I/O expansion module

1) G7E-DC08A



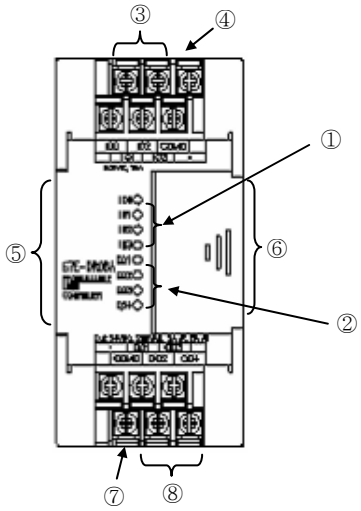
No.	Names
①	Input LED
②	Input Contact
③	Input Common Terminal
④	Expansion Cable
⑤	Expansion Cable Connecting Terminal

2) G7E-RY08A



No.	Names
①	Output LED
②	Output Contact
③	Output Common Terminal
④	Expansion Cable
⑤	Expansion Cable Connecting Terminal

3) G7E-DR08A

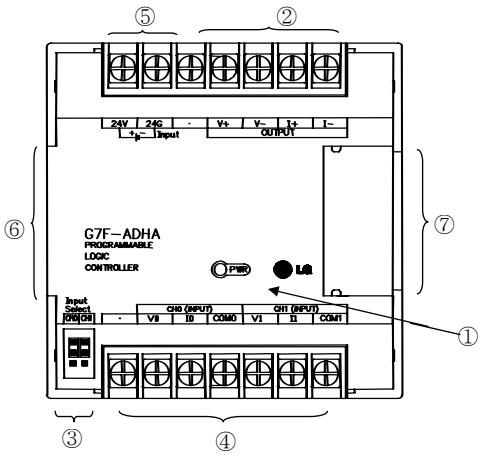


No.	Names
①	Input LED
②	Output LED
③	Input Contact
④	Input Common Terminal
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal
⑦	Output Common Terminal
⑧	Output Contact

4.3 Special Modules

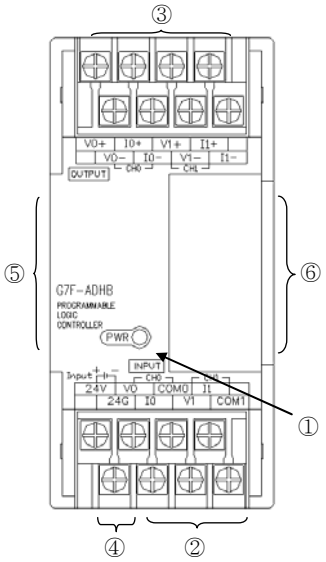
4.3.1 A/D · D/A combination module

1) G7F-ADHA



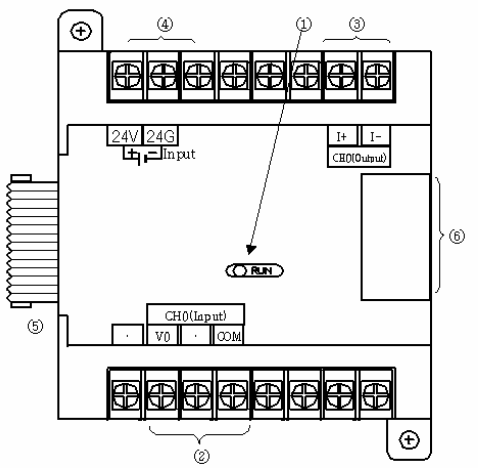
No.	Names
①	RUN LED
②	Analog Output Terminal
③	Analog Input (Voltage/current) selecting jumper pin
④	Analog Input Terminal
⑤	External Power Supply Terminal (DC24V)
⑥	Expansion Cable
⑦	Expansion Cable Connecting Terminal

2) G7F-ADHB (Slim Type)



No.	Names
①	RUN LED
②	Analog Input Terminal
③	Analog Output Terminal
④	External Power Supply Terminal (DC24V)
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal

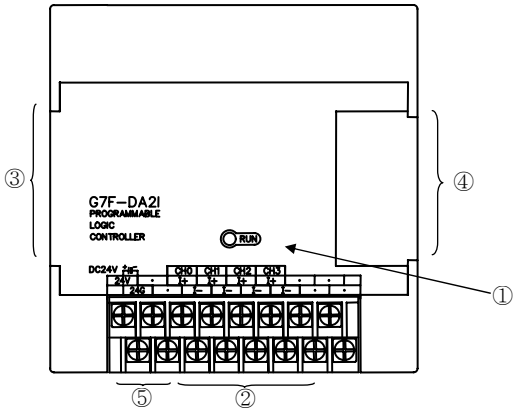
3) G7F-ADHC



No.	Names
①	RUN LED
②	Analog Input Terminal
③	Analog Output Terminal
④	External Power Supply Terminal (DC24V)
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal

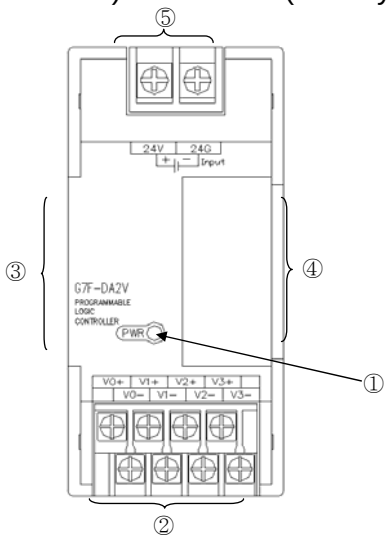
4.3.2 D/A conversion module

1) G7F-DA2I



No.	Names
①	RUN LED
②	D/A Output Channel
③	Expansion Cable
④	Expansion Cable Connecting Terminal
⑤	External Power Supply Terminal (DC24V)

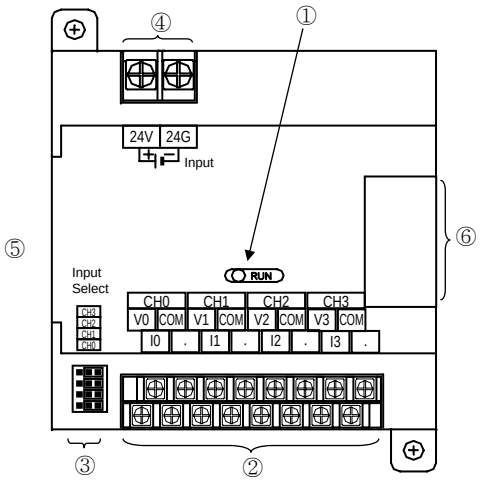
2) G7F-DA2V (Slim Type)



No.	Names
①	RUN LED
②	D/A Output Channel
③	Expansion Cable
④	Expansion Cable Connecting Terminal
⑤	External Power Supply Terminal (DC24V)

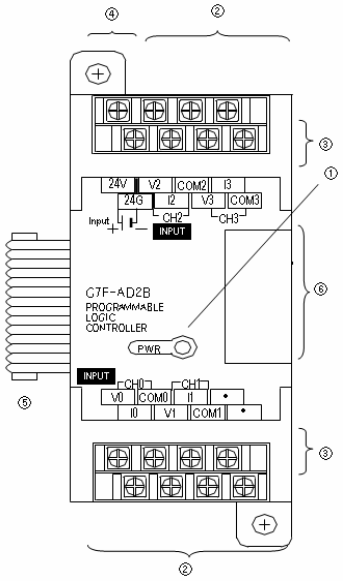
4.3.3 A/D conversion module

1) G7F-AD2A



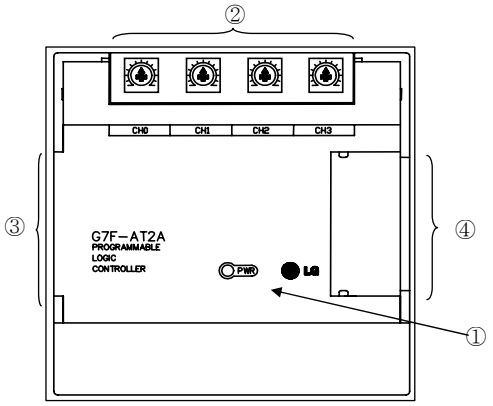
No.	Names
①	RUN LED
②	Analog Input Terminal
③	Analog Input (Voltage/current) Selecting Jumper Pin
④	External Power Supply Terminal (DC24V)
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal

2) G7F-AD2B



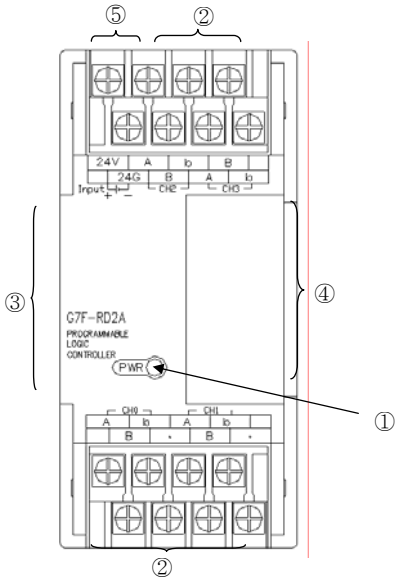
No.	Names
①	RUN LED
②	Analog Input Terminal
③	Analog Input (Voltage/current) Selecting Jumper Pin
④	External Power Supply Terminal (DC24V)
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal

4.3.4 Analog timer module



No.	Names
①	RUN LED
②	Analog Timer Volume Control Resistor
③	Expansion Cable
④	Expansion Cable Connecting Terminal

4.3.5 RTD input module

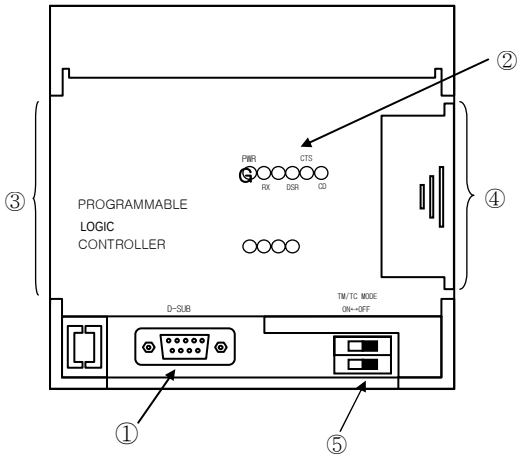


No.	Names
①	RUN LED
②	RTD Input Channel
③	Expansion Cable
④	Expansion Cable Connecting Terminal
⑤	External Power Supply Terminal (DC24V)

4.4 Communication I/F Module

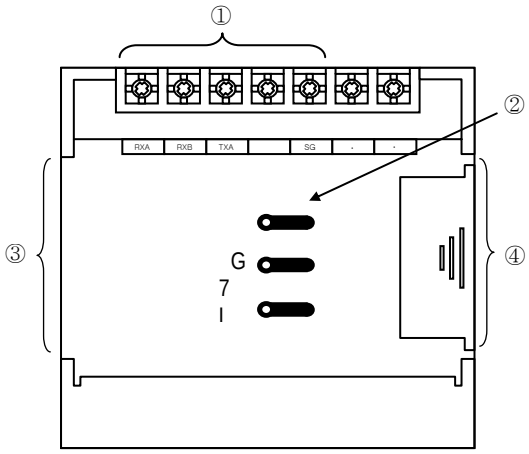
4.4.1 Cnet I/F module

1) G7L-CUEB



No.	Names
①	RS-232C connector
②	Communication status LED
③	Expansion cable
④	Expansion cable connecting terminal
⑤	TM/TC selecting dip switch

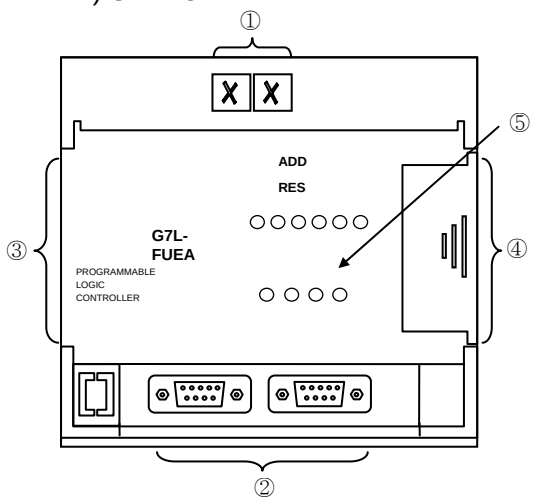
2) G7L-CUEC



No.	Names
①	RS-422/485 connector
②	Power supply/Communication status LED
③	Expansion cable
④	Expansion cable connecting terminal

4.4.2 Fnet I/F module

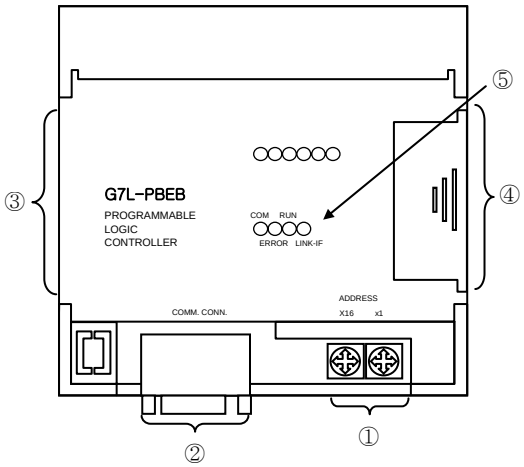
1) G7L-FUEA



No.	Names
①	Station No. selecting switch
②	Fnet cable connector 1 and 2
③	Expansion cable
④	Expansion cable connecting terminal
⑤	Communication status LED

4.4.3 Pnet I/F module

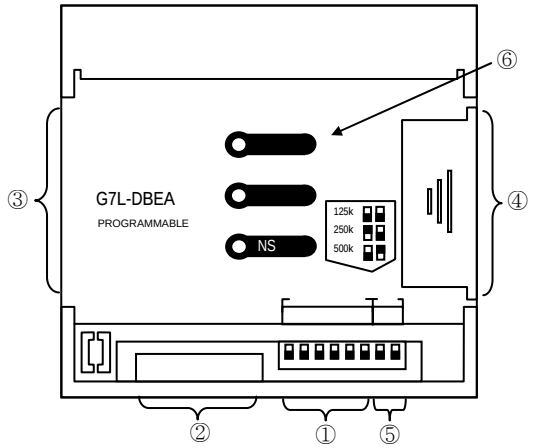
1) G7L-PBEA



No.	Names
①	Station No. selecting switch
②	Pnet Connecting Cable
③	Expansion cable
④	Expansion cable connecting terminal
⑤	Communication status LED

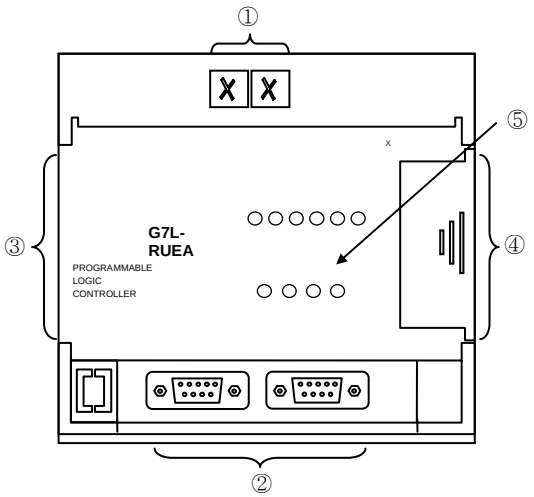
4.4.4 DeviceNet I/F module

1) G7L-DBEA



No.	Names
①	Station No. selecting switch(NA)
②	DeviceNet cable connector
③	Expansion cable
④	Expansion cable connecting terminal
⑤	Baud rate selecting switch
⑥	Power supply/Communication status LED

4.4.5 Rnet I/F module



No.	Names
①	Station No. selecting switch(NA)
②	Rnet cable connector 1, 2
③	Expansion cable
④	Expansion cable connecting terminal
⑤	Communication status LED

Chapter 5. Power Supply / CPU

5.1 Power Supply Specifications

5.1.1 AC power supply

Items \ Models		G7M-DR20U G7M-DRT20U(N) G7M-DT20U(N/P)	G7M-DR30U G7M-DRT30U(N) G7M-DT30U(N/P)	G7M-DR40U G7M-DRT40U(N) G7M-DT40U(N/P)	G7M-DR60U G7M-DRT60U(N) G7M-DT60U(N/P)
Input	Voltage	AC 85 ~ 264V			
	Frequency	50 / 60 Hz (47 ~ 63 Hz)			
	Current	0.5A (AC110V) / 0.25A (AC220V)		0.6A (AC110V) / 0.3A (AC220V)	
	Inrush current	30 A or less			
	Efficiency	65% or higher (rated input/load)			
	Fuse	2A/AC250V (Time Lag Type)			
	Momentary Power Failure	10 ms or less			
Output (1)	Voltage	DC 5V			
	Current	1.2 A		2.0 A	
Output (2)	Voltage	DC24V			
	Current	0.2 A			
Power indicator		PWR LED On when the power supply is normal			

5.1.2 DC power supply

Items \ Models		G7M-DR20U/DC G7M-DRT20U/DC G7M-DT20U(N/P)/DC	G7M-DR30U/DC G7M-DRT30U/DC G7M-DT30U(N/P)/DC	G7M-DR40U/DC G7M-DRT40U/DC G7M-DT40U(N/P)/DC	G7M-DR60U/DC G7M-DRT60U/DC G7M-DT60U(N/P)/DC
Input	Voltage	DC 10.2 ~ 28.8V			
	Current	1.6A (DC12V) / 0.9A (DC24V)		2.5A (DC12V) / 1.5A (DC24V)	
	Inrush current	70 A or less		80 A or less	
	Efficiency	50% or higher (rated input/load)		55% or higher (rated input/load)	
	Momentary Power Failure	10ms or less (DC 24V/80% load)			
Output	Voltage	DC 5V		DC 5V	
	Current	1.2 A		2.0 A	
Power indicator		PWR LED On when the power supply is normal			

5.2 CPU Specifications

The following table shows the general specifications of the GLOFA–GM7U series.

Items		Specifications				Remarks
		20-point Main Unit	30-point Main Unit	40-point Main Unit	60-point Main Unit	
Operation method		Cycle execution of stored program, Time-driven interrupt, Process-driven interrupt				
I/O control method		Scan synchronized batch processing method (Refresh method), Direct input/output method by input/output function				
Program language		Instruction List, Ladder Diagram, Sequential Function Chart				
Numbers of instructions	Operator	LD: 13, IL: 21				
	Standard function	138				
	Standard function block	11				
	Special function block	Function blocks for built-in functions, special, communication modules				
Processing speed	Operator	0.1 ~ 0.9μs				
	Standard function/function block	Refer to the section Appendix 3				
Program memory capacity		132K byte				Including parameter (Approx. 8K bytes)
I/O points		• 20-point main unit: 12-point input/8-point output • 30-point main unit: 18-point input/ 12-point output • 40-point main unit: 24-point input/ 16-point output • 60-point main unit: 36-point input/ 24-point output				Max. of 3 expansion modules can be attached I/O point: 20~120
Data Memory	Direct variable area	14K Byte				
	Symbolic variable area	30K Byte				
Timer		No limitation, Time range: 0.001~4,294,967.295 sec(1,193 hours)				
Counter		No limitation, Count range: -32,768 ~ +32,767				
Operation mode		RUN, STOP, PAUSE, DEBUG				
Data retention at power failure		Set to 'Retain' at data declaration				
Number of program blocks		100				

(Continued)

Items			Specifications				Remarks
			20-point Main Unit	30-point Main Unit	40-point Main Unit	60-point Main Unit	
Program Type	Scan		100				
	Task	Time-driven	8	8 in total			
		External	8				
		HSC	4				
		Internal	8				
		Initialization	1(_INIT)				
Built-in communication	PID control		Control by function block, Auto tuning, Forward/Reverse operation, PWM output function, Manual output, Operation scan time setting, Anti-windup, Selecting PID algorithm (velocity, positioning) available, Delta MV, SV ramp function, etc				
	Cnet interface		Dedicated MODBUS User-defined No protocol LS inverter 1 RS-232C port 1 RS-485 port				
	HSC	Counting speed	1-phase: 100 kHz (2 channels) / 20 kHz (2 channels) 2-phase: 50 kHz (1 channel) / 10 kHz (1 channel)				
		Counting method	• 1-phase up counter • 1-phase up/down counter (up/down: selection by B-phase) • 2-phase up/down counter (up/down: pulse input) • 2-phase up/down counter (up/down: automatic selection by phase difference)				
		Additional	• Internal/external preset • Latch counter • Comparison output • RPM				
	Positioning	Basic	No. of control axis: 2, Control method: PTP/speed/synchronous, Control unit: pulse Positioning data: 20/axis (operation step no. 1~20) Operation mode: end/continuous/keep Operation method: single/repeat				DRT/DT Type Only
		Positioning	Positioning method: absolute/incremental Address range: -2,147,483,648 ~ 2,147,483,647 Speed: Max.100Kpps (setting range: 5 ~ 100,000pps) Acceleration/Deceleration method: Trapezoidal method				
		Return to origin	DOG/HOME (ON), DOG/HOME (OFF), approximate origin				
		JOG	Setting range: 5 ~ 100,000pps (high/low speed)				
		Synchronous control	Control high speed counter and synchronous output Scale rate: 0 ~ 100 %				

(Continued)

Items		Specifications				Remarks
		20-point Main Unit	30-point Main Unit	40-point Main Unit	60-point Main Unit	
Built-in communication	Pulse catch	Pulse width: 10 ㎲ (2 points, IX0.0.0 ~ IX0.0.1) / 50 ㎲ (6points, IX0.0.2 ~ IX0.0.7)				
	External interrupt	8 points: 10 ㎲ (2 points, IX0.0.0 ~ IX0.0.1) / 50 ㎲ (6 points, IX0.0.2 ~ IX0.0.7)				
	Input filter	0,1,2,5,10,20,50,100,200,500,1000ms				
Weight(g)		520	540	660	850	

5.3 Operation Processing

5.3.1 Operation method

1) Cyclic execution

A PLC program is sequentially executed from the first step to the last step. This process is called a scan, and the sequential processing is called cyclic execution. Cyclic execution of the PLC continues as long as the conditions are not changed for the 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 process: ▶ I/O reset ▶ Execution of self-diagnosis ▶ Data clear ▶ Allocating I/O address and type
Input image area refresh	Input conditions are read and stored into the input image area before starting process.
Program operation processing Program starts ⋮ Program ends	Program is sequentially executed from the first step to the last step.
Input/Output image area refresh	The contents stored in the output image area is output to output part when operation processing of a program is finished.
END processing	Stage for return processing after the CPU part has finished 1 scan. The END processing following process is executed. ▶ Self-diagnosis ▶ Change the present values of the timer and counter, etc. ▶ Processing data communications between the computer link and communications module. ▶ Checking the switch for mode settings.

2) Time-driven operation

In time driven interrupt operation method, operations are processed not repeatedly but at every preset interval. In the GM7U series, interval time can be set between 0.001 to 4,294,967.29 sec. This operation is used to process operation with a constant cycle.

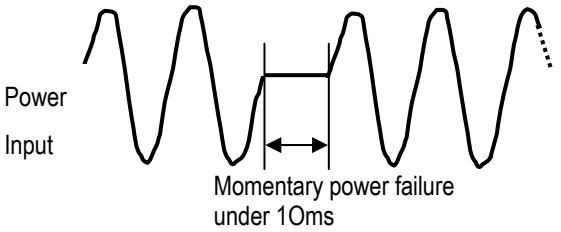
3) Interrupt task operation

The existing PLC program can be interrupted if an operation is required to be urgently processed.
The signal which informs the CPU of the urgent conditions is called the interrupt signal. The GM7U CPU has three kinds of interrupt operation methods. These are internal, external, and high speed counter interrupt signal me thods.

5.3.2 Operation processing at momentary power failure

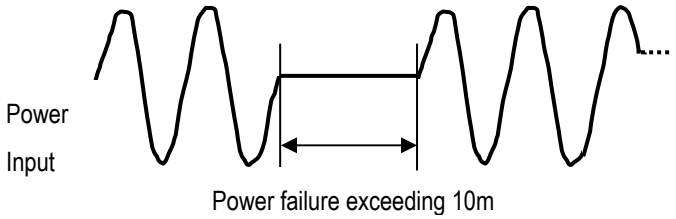
Momentary power failure occurs when the input voltage to the power supply falls below the rated voltage. If there is momentary power failure under 10ms, the CPU maintains operation processing. If it exceeds 10ms, the CPU will stop processing and all outputs will be turned off. When the power is restored, the operation will be executed again automatically.

1) Momentary power failure under 10 ms



- The operation is maintained.

2) Momentary power failure exceeding 10 ms



- The operation is stopped.
- The operation is executed again when the power is restored

REMARK

1) Momentary power failure?
The PLC defines power failure as a state when the voltage has been lowered over the allowable range. The power failure with a short interval (several to tens ms) is called momentary power failure.

5.3.3 Scan time

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

1) Scan time measurement

Scan time is the sum of the processing time that the user has written, and this includes the task program processing time and the PLC internal processing time. The scan time can be measured as below.

(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 = The total processing time of interrupt 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 interrupt programs and commun ication 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)

5.3.4 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 makes elapsed watchdog time as zero.

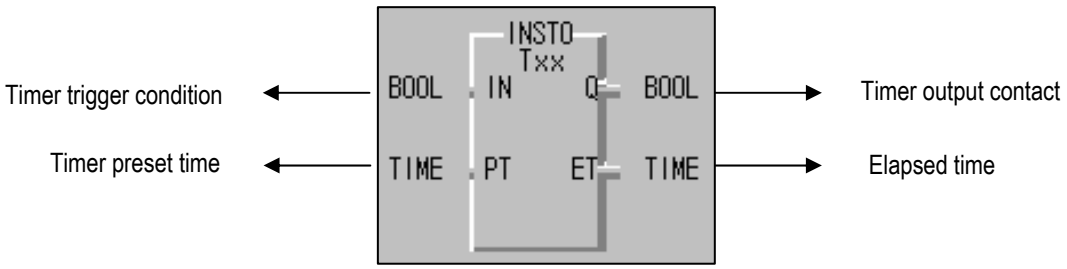
4) In order to clear watchdog error, using manual reset switch, restarting the PLC or mode change to STOP mode are available.

REMARK

1) Setting range of watchdog: 1 ~ 65535ms (unit: 1ms).

5.3.5 Timer processing

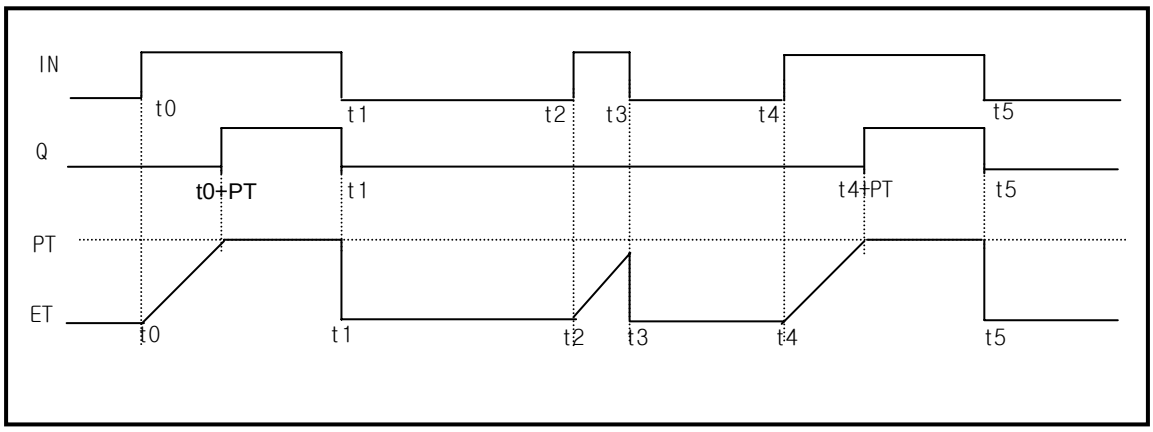
The CPU timer is an incremental timer, which increases its present value according to the measuring time. Three types of On Delay Timer (TON), Off Delay Timer (TOF) and Pulse Timer (TP) are available. Its measuring range is 0.001 to 4,294,967,295 sec (1,193 hours) by 1 ms. For details, refer to “GLOFA-GM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



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

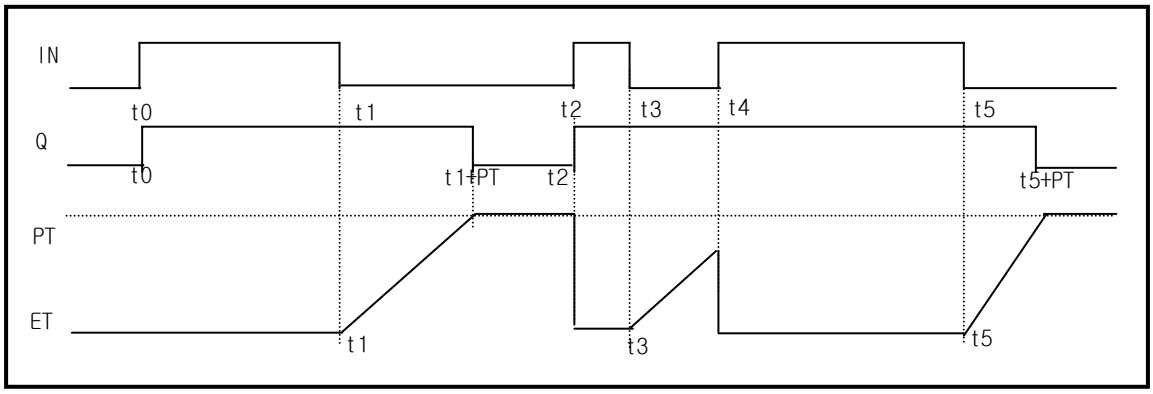
Timer Process time is newly changed when the timer function block is executed. When the process time reaches the setting time (process time = setting time), the Timer output contact turns on.

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 starts increasing.
- 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.



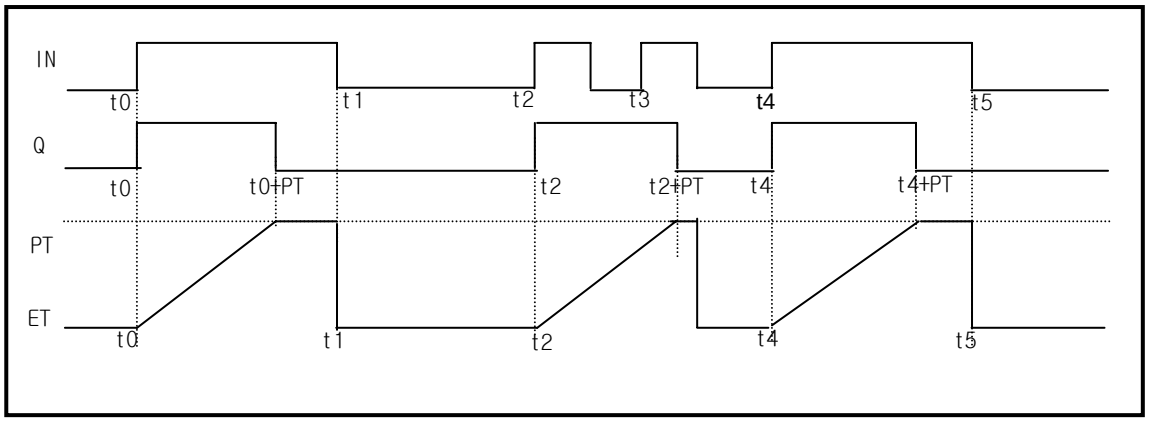
3) Pulse Timer Process Time Change and Contact On/Off

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'

5.3.6 Counter processing

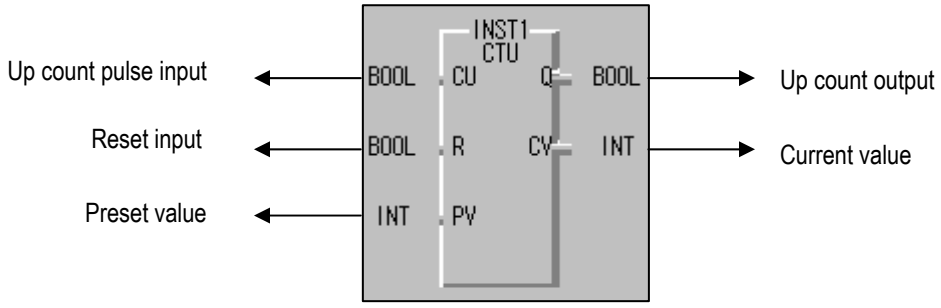
The CPU part counter increase/decrease the present counting value by the detection of rising edge (Off → On) of input signal. Three types of counter are increment counter, Decrement counter and Increment/Decrement Counter. For details, refer to GLOFA — GM Programming'.

- 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

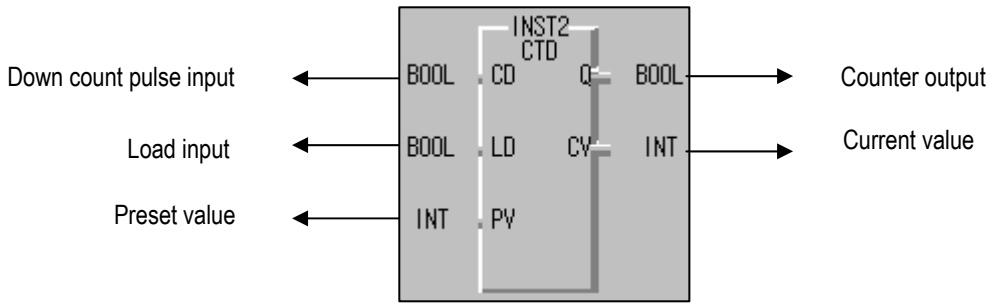
- It should have Input condition (CU), reset condition (R) and setting value (PV).



- If the counting value (CV) increments and reaches the setting value (PV), the output contact (Q) turns on. When the reset signal is turn on, the counting value is set to 0' and the output contact (Q) turns off.

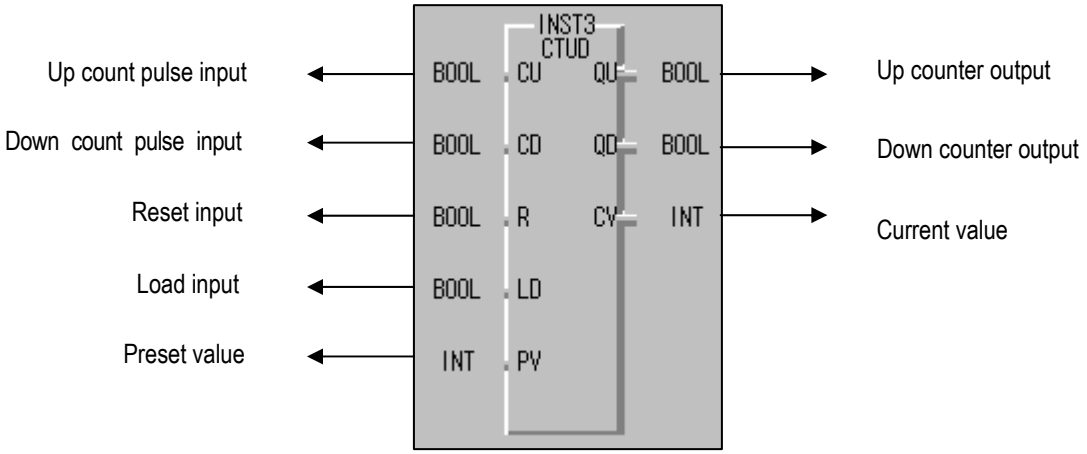
(2) Decrement Counter

- It should have input condition (CD), load (LD) and setting value (PV).
- If the counting value (CV) decrements and reaches 0', the output contact (Q) turns on. If the load (LD) 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 1 at 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

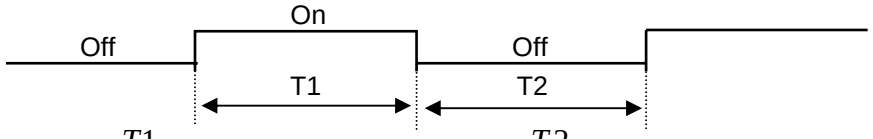
- The counting speed is decided by scan time and it will be counted when on time or off time of input condition is larger than each scan time.

Max. Counting speed $C_{max} = \frac{n}{100} \times (\frac{1}{t_S})$ [pps/s]

n : duty (%)

ts : scan time [s]

- Duty (n) is the percentage (%) of On/Off of the input signal.



T1 ≤ T2: $n = \frac{T1}{T1+T2} \times 100[\%]$, T1 > T2: $n = \frac{T2}{T1+T2} \times 100[\%]$

5.4 Program

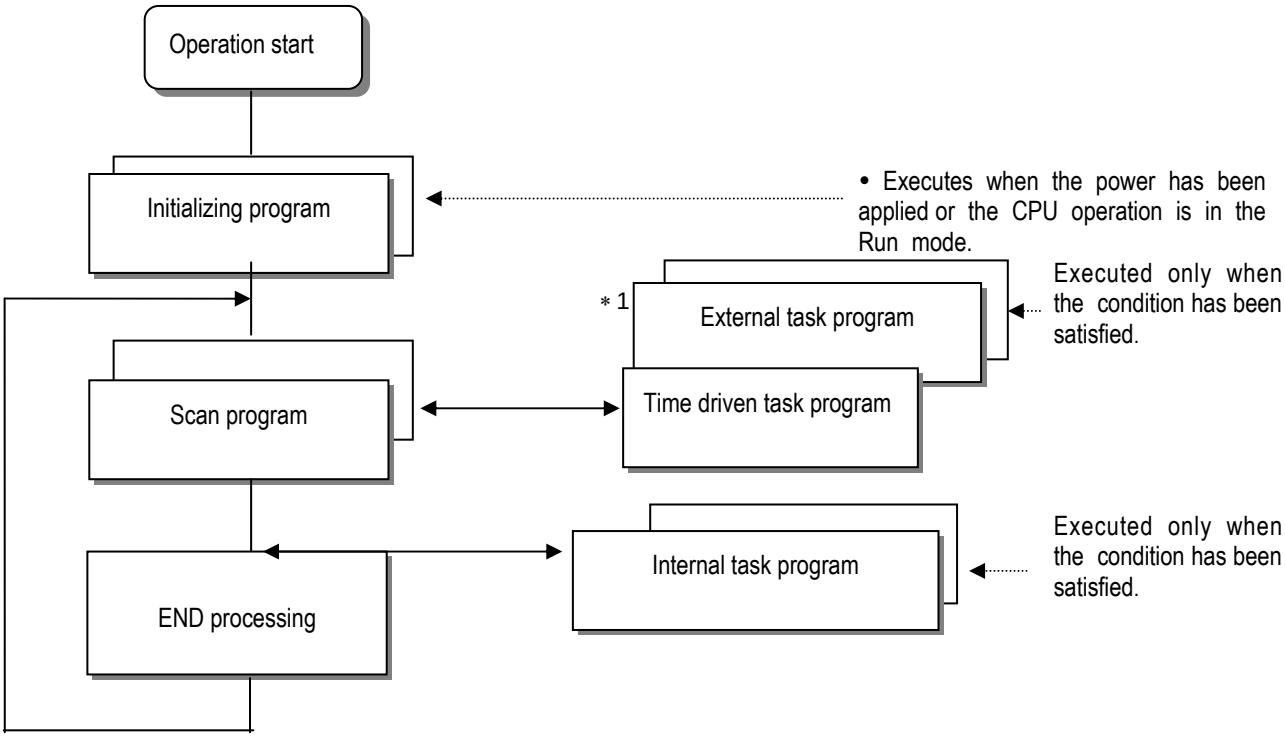
5.4.1 Program configuration

A program consists of all of the function elements that are needed to execute a particular control. It is to be stored in the internal RAM of the CPU part or the EEPROM memory. The function elements are classified as below.

Function elements	Processing Operation
Initialization program	• Executes 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.
Scan program	• Processes the constantly repeated signals that are executed every scan.
Time driven task Program	• When the following time conditional processing is required the program is executed complying with the time interval setting. - In case of the processing need a shorter interval than that of average scan processing time. - In case of the processing needs a longer interval than that of average scan processing time. - In case that the processing should be executed by the specified time interval.
Interrupt program	• A fast processing is executed for internal or external interrupt.
HSC interrupt program	• Executes when HSC Comparison Output occurs.

5.4.2 Program execution procedure

The followings explain the program execution procedure when the power is applied or the mode-setting switch of CPU part is in the RUN status. Program operation processing is executed as the procedure given below:



REMARK

∗ 1: In the GLOFA PLC, the time driven interrupt task programs and event driven interrupt 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.

(2) 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.

(3) Flag

- _INIT_RUN flag is on during executing the initialization program.

2) Scan program

(1) Function

- In order to process signal, 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 during scan program execution, the program that is under execution will be temporary stopped and the corresponding task program will be executed.

(2) Configuration

- Up to 100 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-periodicity the task program temporarily stop the operation of scan program and processes first the corresponding function.

(2) Types

- Task programs are classified into four types as below.
  - ▶ Time driven task program : Up to 8 programs are applicable
  - ▶ Single (internal) task program: Up to 8 programs are applicable
  - ▶ Interrupt (external) task program: Up to 8 programs are applicable
  - ▶ High speed counter task program: Up to 4 programs are applicable.

- Time driven task program
  - ▶ The program is executed by the time internal set before.

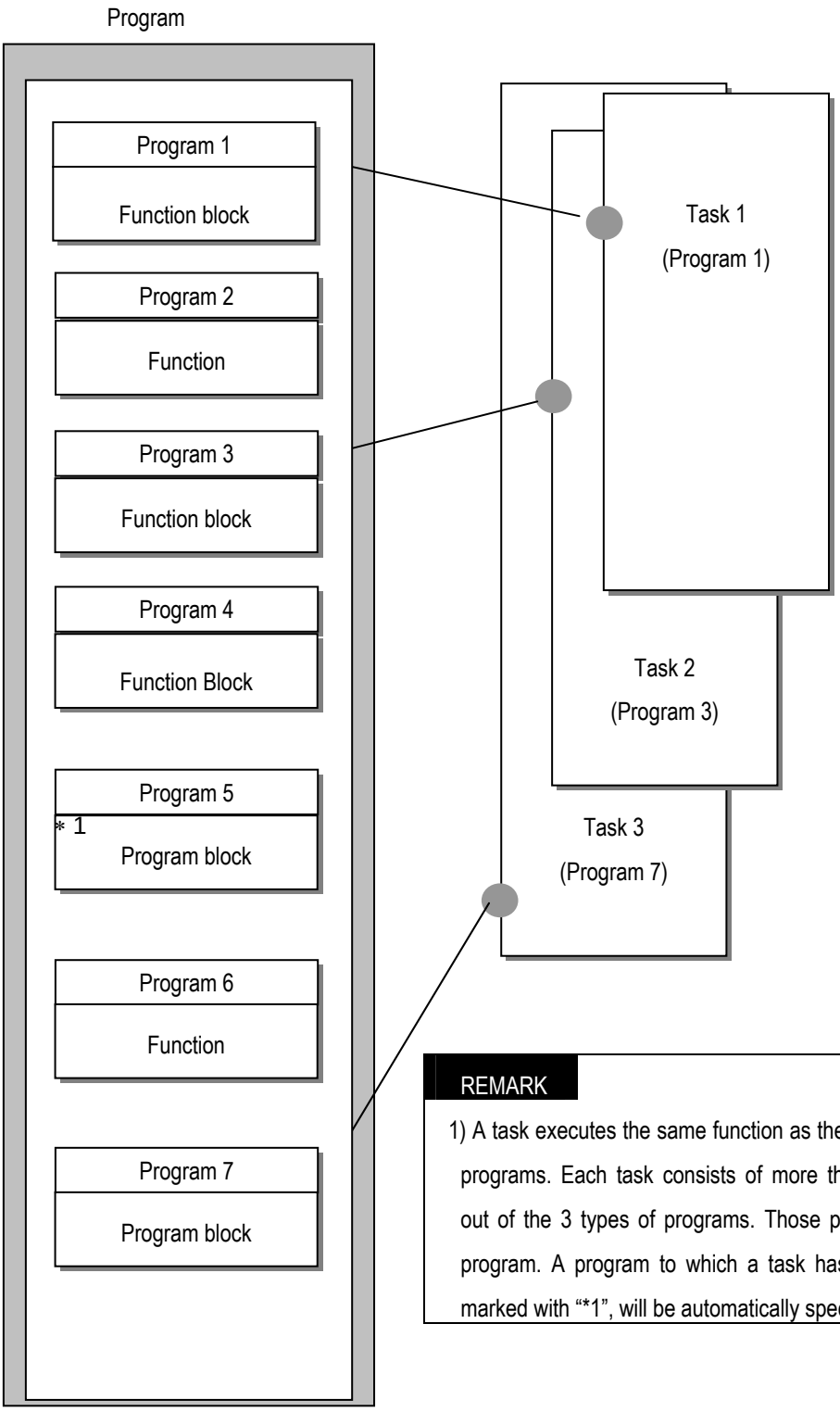
- Single (internal) task program
  - ▶ The corresponding program will be executed at the rising edge and on state of internal contact in the program.
  - ▶ The detection of the start up condition will be executed after the scan program has been processed.
- Interrupt (external) task program
  - ▶ The program is executed according to the external signal a input to the interrupt module
- High-speed counter task program
  - ▶ The program is executed according to speed level.

REMARK

1) Refer to section 5.4.3 “Task” for details of task program.
2) GM7U series use separate digital input contact to execute interrupt signal. Refer to section 5.4.3 “Task” for details of task program.

5.4.3 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. (Refer to GIMWIN section for details of GMWIN program)



REMARK

1) A task executes the same function as the control panel executing programs. Each task consists of more than one program blocks out of the 3 types of programs. Those programs are called task program. 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 shows the types and functions of tasks.

Type / Size	Time driven task	External interrupt task	Internal interrupt task	High speed task
Number	8	8	8	4
Start up condition	Time driven interrupt (up to 4,294,967.29 sec by the 10 ms)	At the rising / falling / rising ·falling edge of the input contact (IX0.0.0~IX0.0.7)	The rising edge or on state of the BOOL variable data which has been specified of buffer data.	Using HSC parameter
Detection and execution	Executed periodically as setting time	Immediately executed at the rising / falling / rising ·falling edge of the input contact (IX0.0.0~IX0.0.7)	Executed with edge detection after scan program has been finished.	When reaches the SV, it executes.
Detection delay time	Up to 1 ms delay	10 ㎲ 2 points (IX0.0.0 ~ IX0.0.1) 50 ㎲ 6 points (IX0.0.2 ~ IX0.0.7)	Delayed for the same time as max. scan time.	10 ㎲ 2 points (IX0.0.0 ~ IX0.0.1) 50 ㎲ 6 points (IX0.0.2 ~ IX0.0.7)
Execution priority	Level 0 to 7 (Level 0 has highest priority)	Level 0 to 7 (Level 0 has highest priority)	Level 0 to 7 (Level 0 has highest priority)	Level 0 to 7 (Level 0 has highest priority)

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 an 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 executed firstly.
- 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.

REMARK

1) The priority for GM7U can't be set as the same. If it is set as the same, an error will occur.

(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 white 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.
- 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)
- Use 'DI' function where program needs protection and 'EI' function where program needs cancellation. After the scan program ends of the running program, automatically it becomes permissible. Initialization program doesn't get influences from 'DI and EI.'

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 drive 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. Priority number will be task number.

(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 (TASKERR) will be set to ON, the detailed system error flag (JC 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 will 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

In GM7series, it is different from GM1/2/3/4 to use normal digital input task program, not a separate interrupt input module. The following explains in the case that the task (start-up condition) of a task program has been set to an external input signal.

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

- Set the contact No. of input module and priority for the task that will be used as start-up conditions of the task programs to be executed. Priority will be the task number.

(2) External contact task processing

- The CPU module checks the occurrence of interrupt input every time and executes the task program, which are designated by the contact at which the signal has been occurred.

(3) Precautions for using an external contact task.

- Input interrupt that is possible to set is up to %IX0.0.0~%IX0.0.7.
- While a task program which are designated by an input module having interrupt input, 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], TC_CNT [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 No. of input module and priority for the task that will be used as start-up conditions of the task programs to be executed. Priority will be the task number.

(2) Internal contact task processing

- After the execution of scan program has been completed in the CPU module, the internal contacts that are the start-up conditions of the task program will be checked and the internal task programs where rising edge or on state has been occurred will be executed in accordance with its parameter.

(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 scans 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.

REMARK

1) When an action must continuously be executed according to the related contact point set as a start-up condition, select a level.

6) Execution of high-speed task program

GM7U series uses general digital input contact point to count high-speed pulse, not a separate high-speed pulse input module. Setting a task (startup condition) as the same with the one of the high-speed pulse input will be explained.

(1) Conditions to be set for a task

- Set the priority on the tasks that are startup conditions for the task program to be executed. Then a task number will automatically be added in the priority order.

(2) Processing the high speed counter task

- When CHSC_SET F/B of the program assigns a set value, the task program whose set value matches with the counted value of the pulse that is input in a high speed is executed.

(3) Precautions for using high speed counter task program

- Even though the operation is in the PAUSE mode, counted value rises. However, the task program is not executed although the counter value reaches to the set value.

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. If the task setting cannot be changed, check the maximum scans 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.

8) Example of program configuration and processing

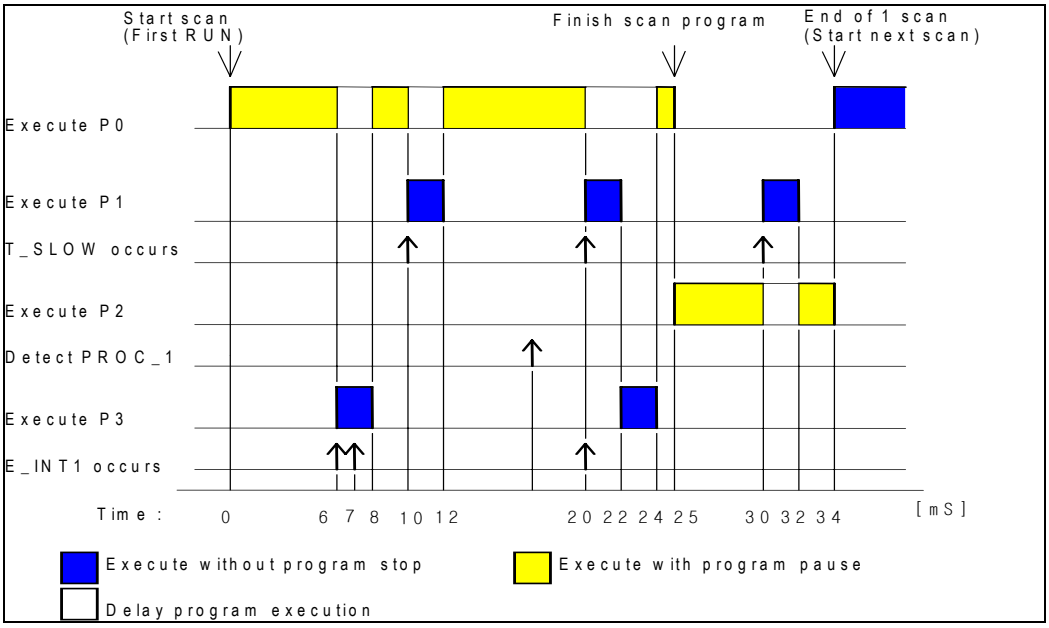
When the task and program have been registered as below,

- Task registration : T_SLOW (interval T#10ms, priority = 0)
  PROC_1 (internal contact point: %MX0, priority = 3)
  E_INT1 (external contact point: %IX0.0.1, priority = 2)
- 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= 17ms, P1= 2ms, P2= 7ms, P3= 2ms
- Interrupt E_INT1 occurrence time: Occurred at the 6, 7 and 20ms after the operation started.
- PROC_1 occurrence: Invoked during the execution of scan program

Program execution is shown as below.



- Processing with time

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

5.4.4 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 GM7U series. The system enters into the STOP state.

(3) Operation error during execution of the user programs

It 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 watchdog 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.

REMARK

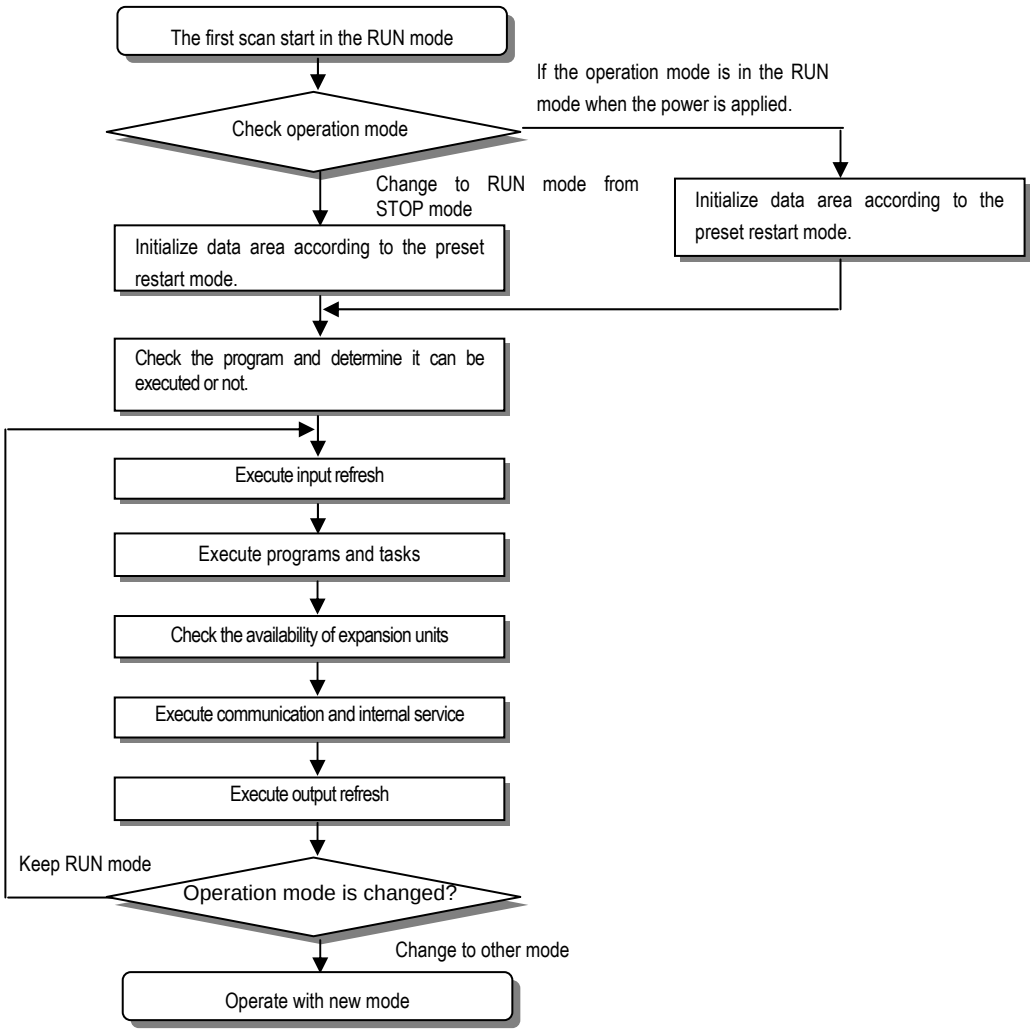
1) In occurrence of a fatal error the state is to be stored in the representative system error flags, and an ordinary error in the representative system warning flags.
2) For details of flags, refer to Appendix 2. Flag List.

5.5 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.

5.5.1 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 refreshes 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.

5.5.2 STOP mode

In this mode, programs are not operated.

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.

5.5.3 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 and input image are not cleared and the operating conditions just before the mode change is maintain.

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.

5.5.4 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 by one time every scan.

(2) Communications service or other internal operations are processed.

3) 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 'Debugging'.

4) Debug operation conditions

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

Operation conditions	Description
Executed by the one (step over)	If an operation command is ordered, the system operates one operation unit operation unit, and stops.
Executed to the specified breakpoint	• If break step is specified in the program, the operation stops at those step, before execution. • Up to 8 break points 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. (after execution)
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.

5.5.5 Operation mode change

1) Operation mode change methods

The following method is used to change the operation mode.

(1) Change by the mode-setting switch of CPU module.

(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', 'ESTOP function' during program execution.

2) Operation mode change by the mode-setting switch of CPU module

The following shows the operation mode change by the mode-setting switch of CPU module.

Mode setting switch position	Operation mode
RUN	Local RUN
STOP	Local STOP
STOP → PAU / REM	Remote STOP
PAU / REM → RUN ∗1	Local RUN
RUN → PAU / REM * 2	Local PAUSE
PAU / REM → STOP	Local STOP

REMARK

1) ∗1: If the operation mode changes from RUN mode to local RUN mode by the mode setting switch, the PLC operates continuously without stopping.

2) * 2: If Local PAUSE disable (or Local PAUSE enable) is set by parameter in GMWIN, it operated as Remote RUN (or Local PAUSE).

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 setting switch position is in the STOP→ PAU/REM').

Mode setting switch 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	X	X
	Remote STOP → DEBUG	○	○
	Remote RUN → Remote PAUSE	○	○
	Remote RUN → Remote STOP	○	○
	Remote RUN → DEBUG	X	X
	Remote PAUSE → Remote RUN	○	○
	Remote PAUSE → Remote STOP	○	○
	Remote PAUSE → Remote DEBUG	X	X
	DEBUG → Remote STOP	○	○
	DEBUG → Remote RUN	X	X
	DEBUG → Remote PAUSE	X	X

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 setting switch 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)

5.6 Functions

5.6.1 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. Two restart modes, cold and warm 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 as '0' and only variables of which initial value has been defined will be set as 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) In case of selection 'Reset' command in the GMWIN, it restarts in accordance with setting in parameter and in case of selection 'Overall Reset' command; it restarts as cold restart mode.

2) Warm Restart

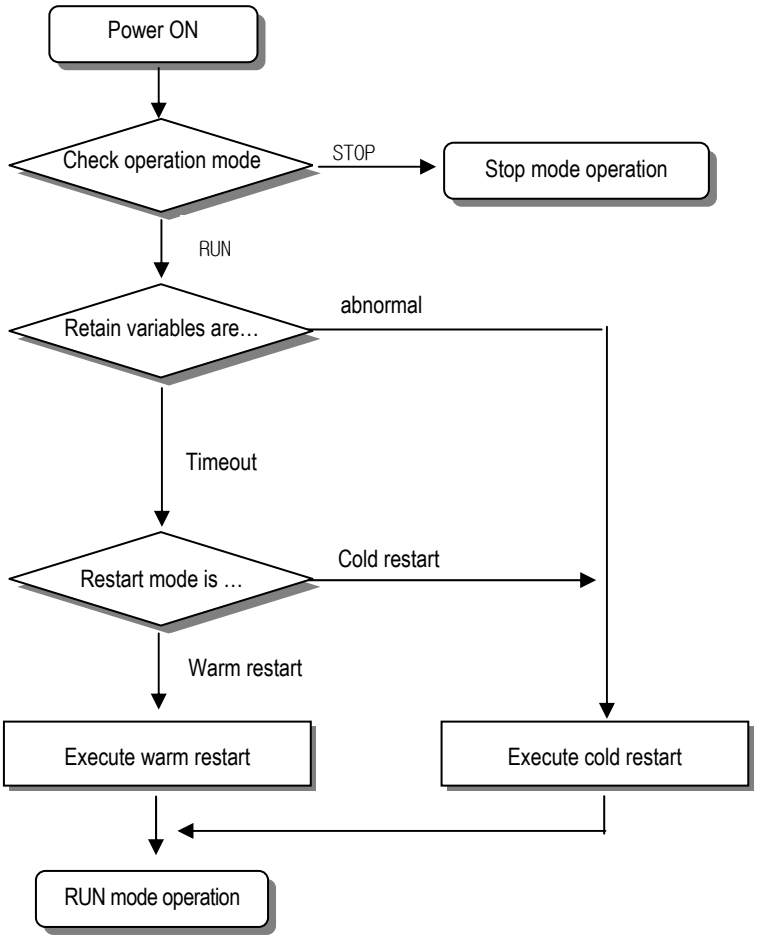
(1) It is executed when the restart mode parameter has been set to the warm restart mode.

(2) A data which set as retain & initial will be retain and a data which set as initial value will be set with default value 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)

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



3) 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
Default	Initialized with 0’	Initialized with 0’
Retain	Initialized with ‘0’	Previous value is retained.
Initialization	Initialized with the user defined value	Initialized with the user defined value
Retain & Initialization	Initialized with the user defined value	Previous value is retained.

REMARK

Definitions of variable

(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.

5.6.2 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

REMARK

1) Refer to 11.5 'Error Code List of Chapter 11'. Troubleshooting for details of contents of self-diagnosis and corrective actions.

5.6.3 Remote function

The CPU module can be controlled by external operations (from GMWIN and computer link module, etc.). For remote operation, set the mode setting switch of CPU module 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 mode- selling switch of CPU module 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 mode-setting switch of CPU module 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 mode setting switch of CPU module 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.

REMARK

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

5.6.4 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 changes of the operation mode or operation by reset switch (GM3) 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.

REMARK

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

5.6.5 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_IN7' 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_07' 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.

5.6.6 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_WB [n']] is used to indicate warning.

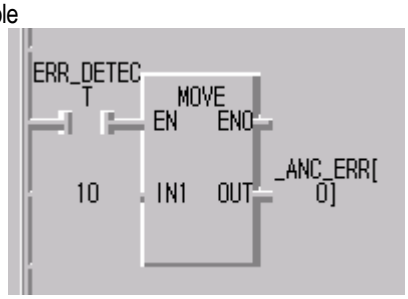
2) External device fatal-fault (error) processing

(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 8 elements (n: 0 to 7), the user can classify error states largely. User defined error No. can be written to the elements. A number of 1 to 65,535 is available.

■ 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_WB [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

Flag Status	Description
_ANNUN_WR = 1 _ANC_WAR[0] = 10 _ANC_WAR[1] = 0 _ANC_WAR[2] = 0 _ANC_WAR[3] = 0 _ANC_WAR[4] = 0 _ANC_WAR[5] = 0 _ANC_WAR[6] = 0 _ANC_WAR[7] = 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 _ANC_WAR[0] = 10 _ANC_WAR[1] = 1 _ANC_WAR[2] = 2 _ANC_WAR[3] = 3 _ANC_WAR[4] = 15 _ANC_WAR[5] = 40 _ANC_WAR[6] = 50 _ANC_WAR[7] = 60	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 h as lower priority than the numbers 1, 2 and 3, it will be the lower element of _ANCWAR [n]. T he _ANC_WB [75] is not indicated as it is turned on and the warning that occurred before has written to the _ANC_WARIn1.
_ANNUN_WR = 1 _ANC_WAR[0] = 1 _ANC_WAR[1] = 2 _ANC_WAR[2] = 3 _ANC_WAR[3] = 15 _ANC_WAR[4] = 40 _ANC_WAR[5] = 50 _ANC_WAR[6] = 60 _ANC_WAR[7] = 75	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 c ontents of _ANC_WAR [1..7] will shift into the lower elements. The content of _AN7_WAR [7] will has been cleared by the shifting and the content of _AN7_WB [75] will be written to _ANC_WA R[7].
_ANNUN_WR = 0 _ANC_WAR[0] = 0 _ANC_WAR[1] = 0 _ANC_WAR[2] = 0 _ANC_WAR[3] = 0 _ANC_WAR[4] = 0 _ANC_WAR[5] = 0 _ANC_WAR[6] = 0 _ANC_WAR[7] = 0	If all warnings indicated on the _ANC_WB [n] are released during operation, the ANNUN_WR an d _ANC_WAR [n] will be shown as left.

5.7 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	Memory Capacity
Overall program memory area	132 kbyte
Parameter area • Basic parameter area • High speed link parameter area • interrupt setting information area	7.8 kbyte
Program area • Scan program area • Task program area • User defined function/function block area • Standard library area • Variable initialization information area • Protective variable specification information area	124.2 kbyte

■ Data memory configuration

Item	Memory Capacity
Overall data memory area	44 kbyte
System area • I/O information table • Force I/O table	1 kbyte
System flag area	2 kbyte
Input image area (%IX)	128 byte
Output image area (%QX)	128 byte
Direct variable area (%M)	10 kbyte
Symbolic variable area	30 kbyte

3) Purpose

(1) System area

It used to save the self-producing data of the CPU module for the system management and GMWIN system control data.

(2) System flag area

It used to save the user flags and system flags. The user operates it by flag names.

(3) Input image area

It used to save input data read from input modules. Overall size is %IX0.0.0~%IX0.7.63. Only %QX0.0.0~%QX0.3.63 can be used as a real input domain but the other unused domain can be used as convenience, especially remote output data for communication can be saved here as convenience.

(4) Output image area

It used to save operation results that are automatically output through the output device. Overall data size is %QX0.0.0~%QX1.7.63. In GM7U, only %QX0.0.0~%QX0.3.63 can be used as a real input domain but the other unused domain can be used as convenience, especially remote output data for communication can be saved here as convenience.

(5) Direct variable area

The user can use this area to access direct memory data, using the variable names such as %MX0, %MB0, and %MW0, %MD0, which was defined in advance by the system. Memory size is defined when the user makes program. Refers to “system definitions” for the variable area available to use according to the setting.

(6) Symbolic variable area

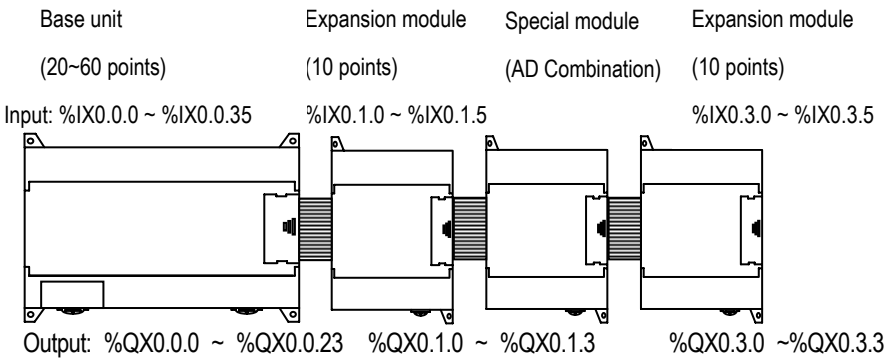
It used to save the variables that when the user creates a program or when the user defines a global variables, is automatically allocated its memory. The variables used in program blocks are located in the ‘PB instance memory’ of the related program, and the memory used in the function block is located in the ‘FB instance memory.’

5.8 I/O No. Allocation Method

I/O no. allocation gives an address to each module in order to read data from input modules and output data to output modules.

(1) Fixed 64 points are allocated to each module for I/O area, and the special and communication modules don't allocate I/O area. (The rests are available to use as internal relay.)

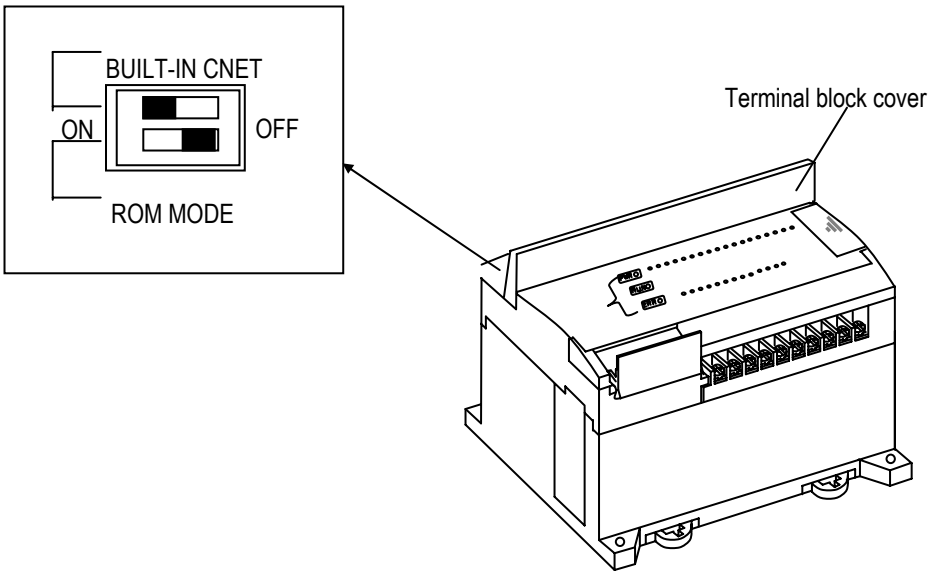
(2) The I/O allocation method is as shown below.



5.9 Built-in/external Communication Setting Switch

5.9.1 Structure

You can see dipswitches as shown below when you open I/O terminal block cover.



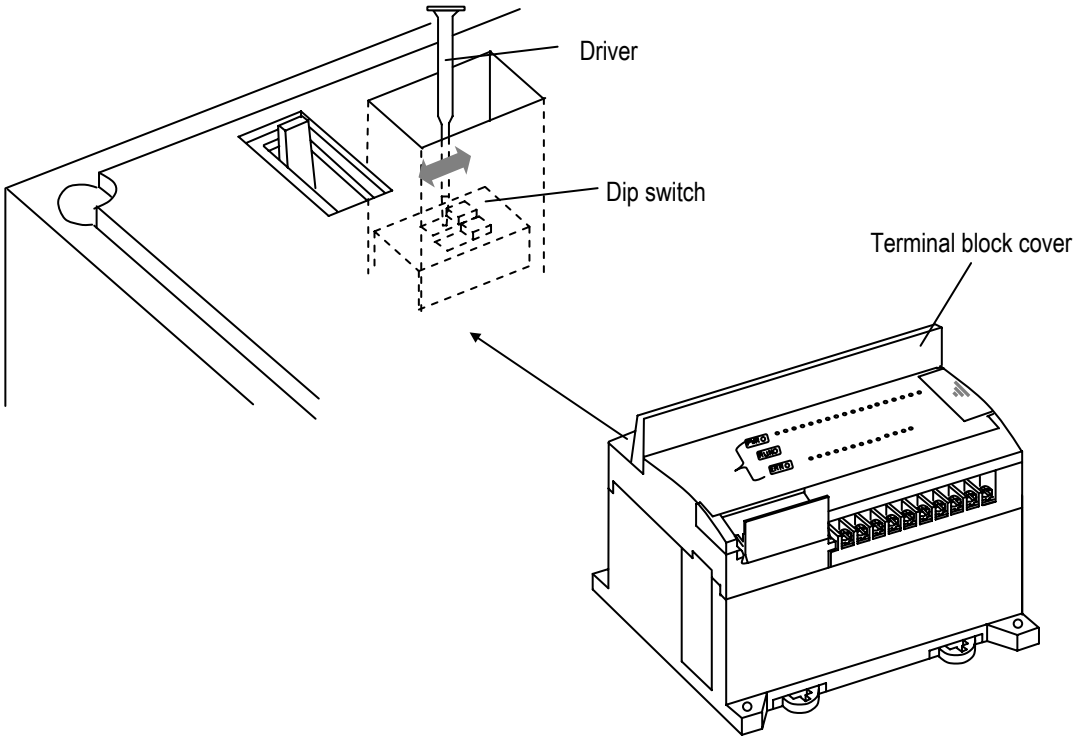
5.9.2 Usage

Dip switch position	Description
Switch for communication setting ON OFF ROM MODE	A switch for Built-in RS-232C communication setting (Use no. 4,7,5 pin of 9-pin communication connector.)
Switch for O/S downloading ON OFF ROM MODE	A switch for GM7U operating system downloading

REMARK

1) The lower ROM mode switch is for the GM7U operating system downloading.
2) Its ON status causes malfunction of the system, so make sure to turn it off for the normal operation.

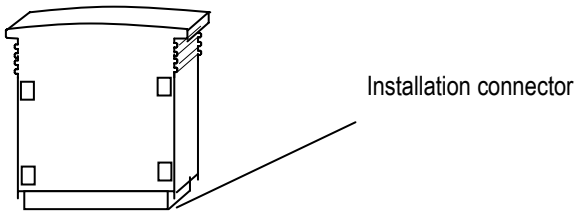
The dip switch for the built-in/external communication setting is placed deep within to prevent an accidental operation. Use a small driver to operate it. (Be careful to not touch the ROM Mode switch.)



5.10 External Memory Module

The GM7U series supply an external memory module for the user to save programs safely or download programs on the system. It can be used in the event that a program is damaged.

5.10.1 Structure



5.10.2 Usage

1) Saving the user's program on the external memory module.

(1) Turn the power of the base unit off.

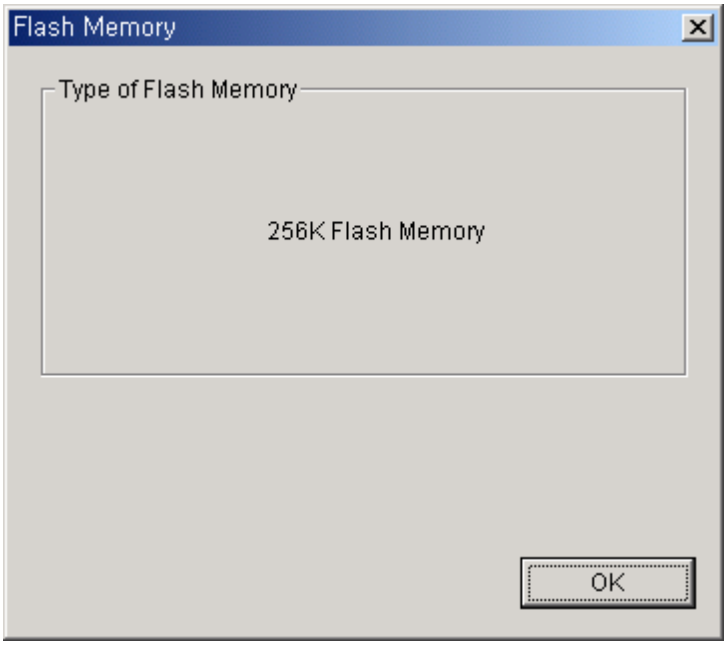
(2) Install the memory module.

- When only basic unit is used: Connect to the expansion connector of the basic unit.
- When expansion unit is used: Connect to the expansion connector of the last connected expansion unit.

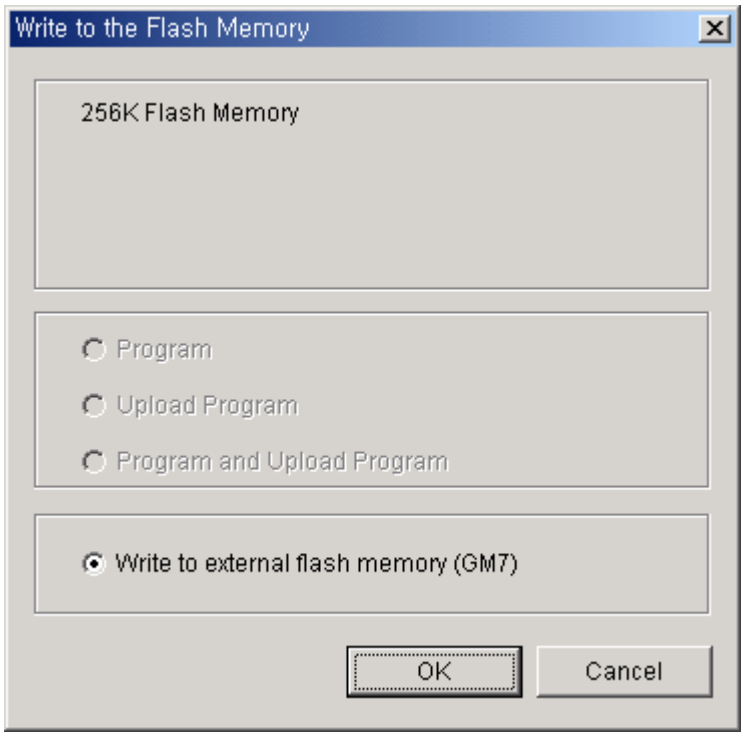
(3) Turn the power of the main unit On, and stop the PLC operation mode.

(4) Connect GMWIN and PLC.

(5) Select *Online – Flash memory – Read Type* to confirm the flash memory size and installation of the memory module.



(6) Choose *Online – Flash memory – Write program* in the menu, and the following message box will be displayed.



(7) Select OK.

(8) Turn the power of the base unit off after writing program.

(9) Remove the external memory module.

Through the above steps a user can save a program into the external memory module.

2) Run the PLC with a program of external memory module

(1) Turn the power of the base unit off.

(2) Install the memory module.

- When only base unit is used, connect to the expansion connector of the base unit.
- When expansion unit is used, connect to the expansion connector of the last connected expansion unit.

(3) Turn the power of the main unit On, and set the PLC operation mode Run.

- GM7U automatically reads the program from the memory module.
- If there is an upload program, it reads it as well.
- PWR LED, RUN LED, ERR LED are On during the program reading.

Using the above steps, the user can operate the PLC with a program stored in the external memory module. (If a system memory module is installed, the PLC operates by the program/parameter of the module when the power is On.

REMARK

1) Do not operate the PLC with the external memory module is always installed.

2) Be careful with the PLC operation mode when the power of the main unit is On.

5.11 RTC Option Module

GM7U series provides RTC (Real Time Clock) function for GM7U series (G7E-RTCA).
The RTC module will send the RTC data to main unit per every scan. By the super capacitor back up, the RTC module keeps operating while the power is off or 20m seconds momentary power off. It can be used for time-scheduling control or recording an error occurrence time. The RTC data is updated into system operation status flag per every scan.

5.11.1 Specifications

(1) RTC data

Item	Data
Year	Upper 2 digit of year data
	Lower 2 digit of year data
Month	1 ~ 12
Date	1 ~ 31
Hour	0 ~ 23 (24 hour)
Minute	0 ~ 59
Second	0 ~ 59
Day	0 ~ 6 (Monday:0 ~ Sunday:6)
Century	Indicate upper 2 digit of year data

(2) Accuracy
Max. ±2.2 sec / 1 day (At 25 °C)

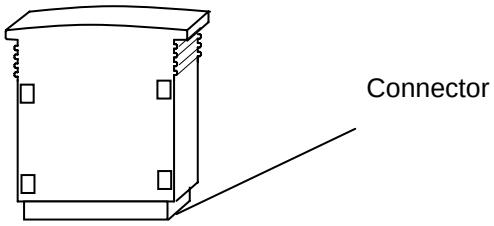
(3) RTC data back-up time
200 hours (at 25 °C)

(4) Read/Write of RTC data
Select the menu 'Online – PLC Information' win GNWIN software.

REMARK

1) The RTC module is sold with no initial RTC data setting. Be sure to input the RTC data when use a RTC module first time.
2) The RTC module may show abnormal operation when an improper RTC data is written.
Example) 14(Month) 32(Date) 25(Hour)
In this case, an error will be cleared with new RTC data.
3) The system flag _RTC_ERR of _CNF_WAR will turn On when a RTC data error occurred. _RTC_ERR flag will turn Off automatically when the error is cleared.

5.11.2 Structure

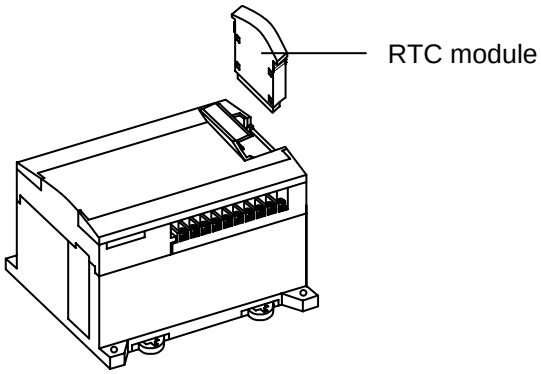


5.11.3 Usage

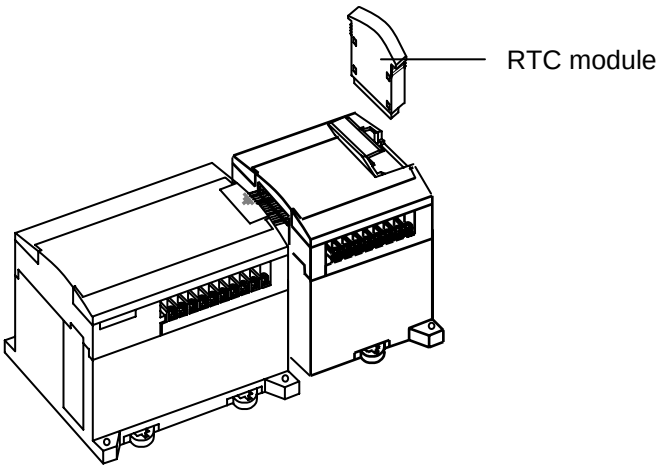
(1) Turn the power of the base unit Off.

(2) Install the G7E-RTCA module.

- When use the base unit only: insert the RTC module into the expansion connector of the base.



- When use the base unit and expansion unit: insert the RTC module into the expansion connector of the expansion module.



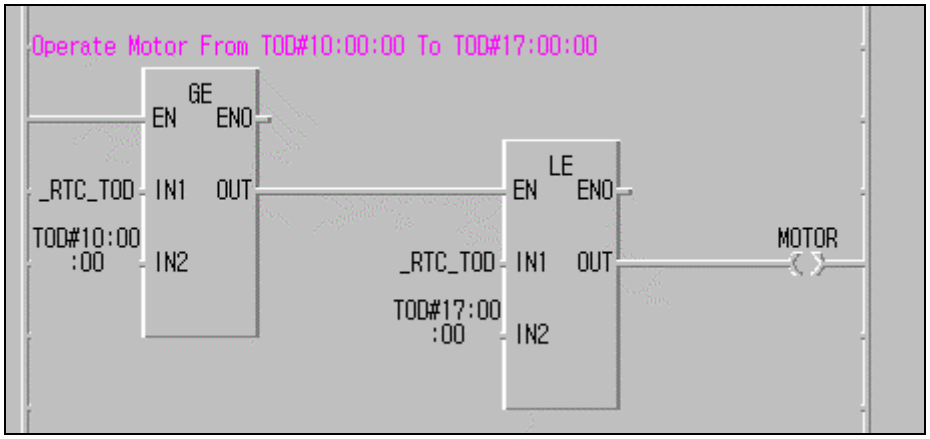
5.11.4 Read RTC data

Example) 1998. 12. 22. 19:37:46, Tuesday

Keyword	Type	Name	Description	Data
_RTC_TOD	TOD	Present time	Present time data	TOD#19:37:46
_RTC_WEEK	UINT	Present day	Day data *(0: Monday, 1:Thuesday, 2: Wednesday, 3: Thursday, 4: Friday, 5: Saturday, 6:Sunday)	1
_INT_DATE	DATE	Present date	Present date data (January 1, 1984 ~ December 31, 2083)	D#1998-12-22
_RTC_ERR	BOOL	RTC Error	Indicates '1' when and an RTC data error detected	0
_RTC_TIME[n] * n : 0 to 7	BCD	Present time	BCD data of present time of RTC _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] : century Day of the week : 0 : Mon., 1: Tue., 2: Wed., 3:Thur., 4:Fri., 5: Sat., 6:Sun.	_RTC _TIME[0]: 16#98 _RTC _TIME[1]: 16#12 _RTC _TIME[2]: 16#22 _RTC _TIME[3]: 16#19 _RTC _TIME[4]: 16#37 _RTC _TIME[5]: 16#46 _RTC _TIME[6]: 16#1 _RTC _TIME[7]: 16#19

Example Program)

A program example to run a motor from 10 A.M to 5 P.M.

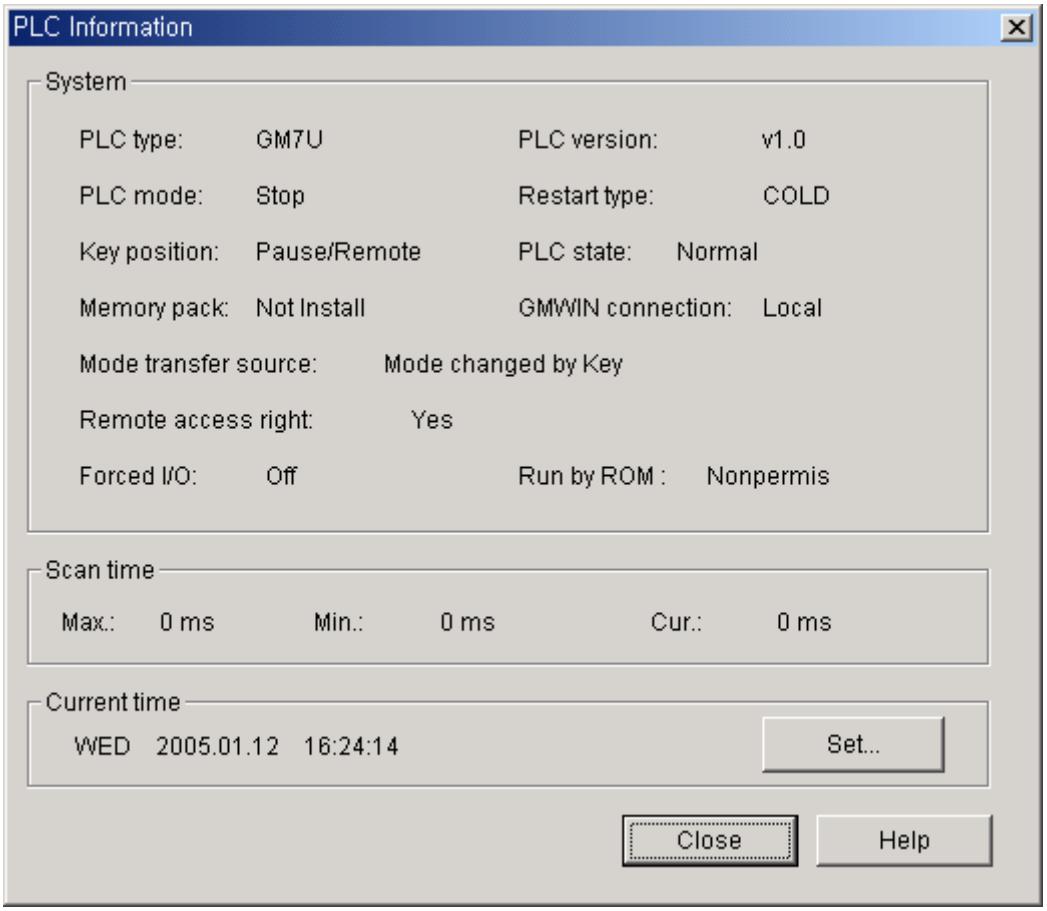


5.11.5 Write RTC data

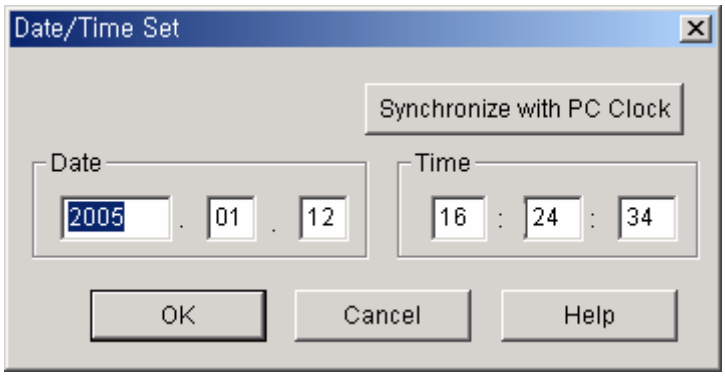
1) Using GMWIN

There are two ways to write new RTC data to the CPU.

- Select Menu-Online-PLC Information-System Info.



- If you want to setup or edit present time, select Set... - Date/Time Set.



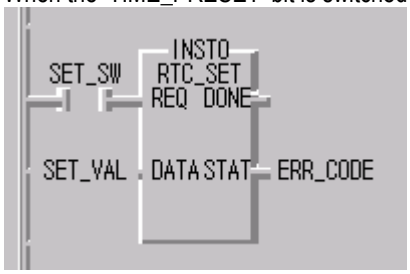
- Setup Date and Time in Date-Time Set dialog box.
- For detailed information, refer the GMWIN user's manual.

2) Using F/B (RTC_SET)

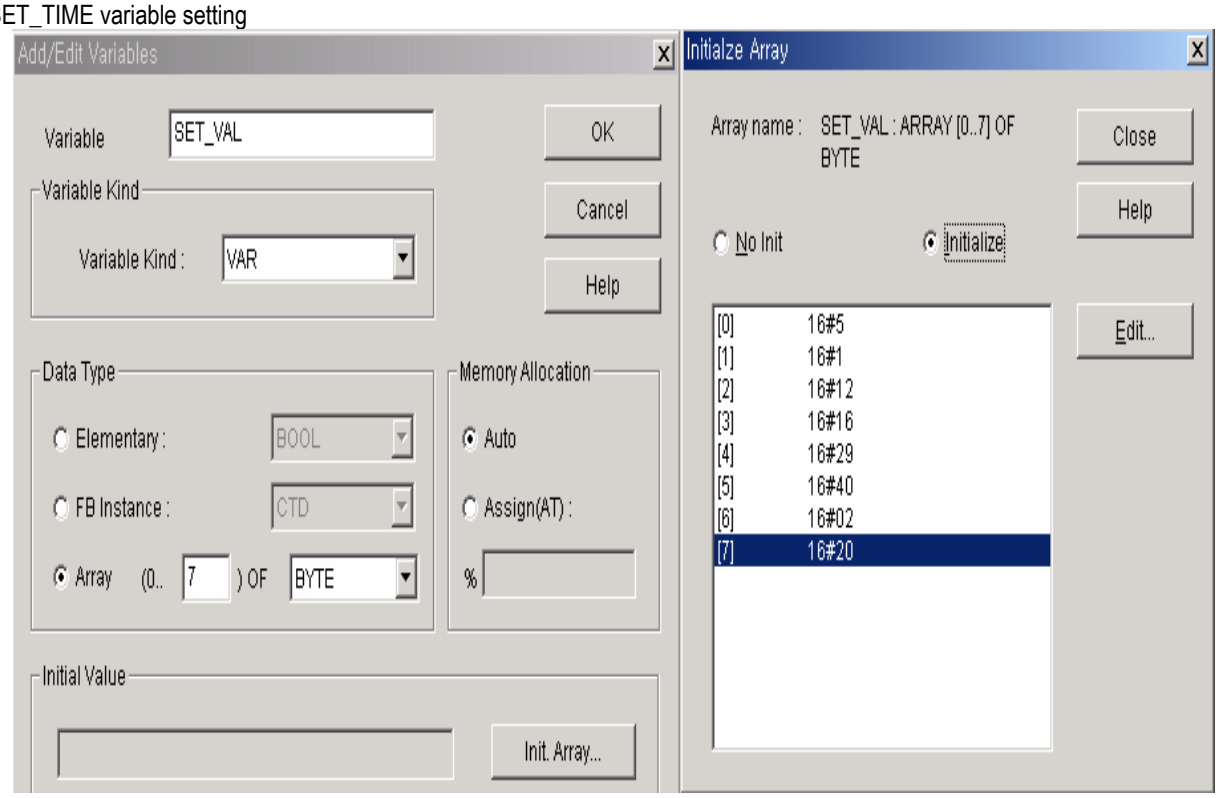
By executing a F/B(RTC_SET), user can replace the current RTC data with the preset data stored in a specified variable. The following is an example program.

Example) The preset RTC data: 1999. 1. 17. 11:53:24, Sunday

When the 'TIME_PRESET' bit is switched on, the new data in 'SET_TIME' will be moved to '_RTC_TIME'.



* SET_TIME variable setting



- F/B Error code

The following table shows error codes appear at the STAT output.

Error code	Description
00	No error
01	RTC Module is not found * Insert the RTC module into the expansion connector
02	A improper RTC data is written. Ex) 14(Month) 32(Date) 25(Hour) * Please write a correct RTC data

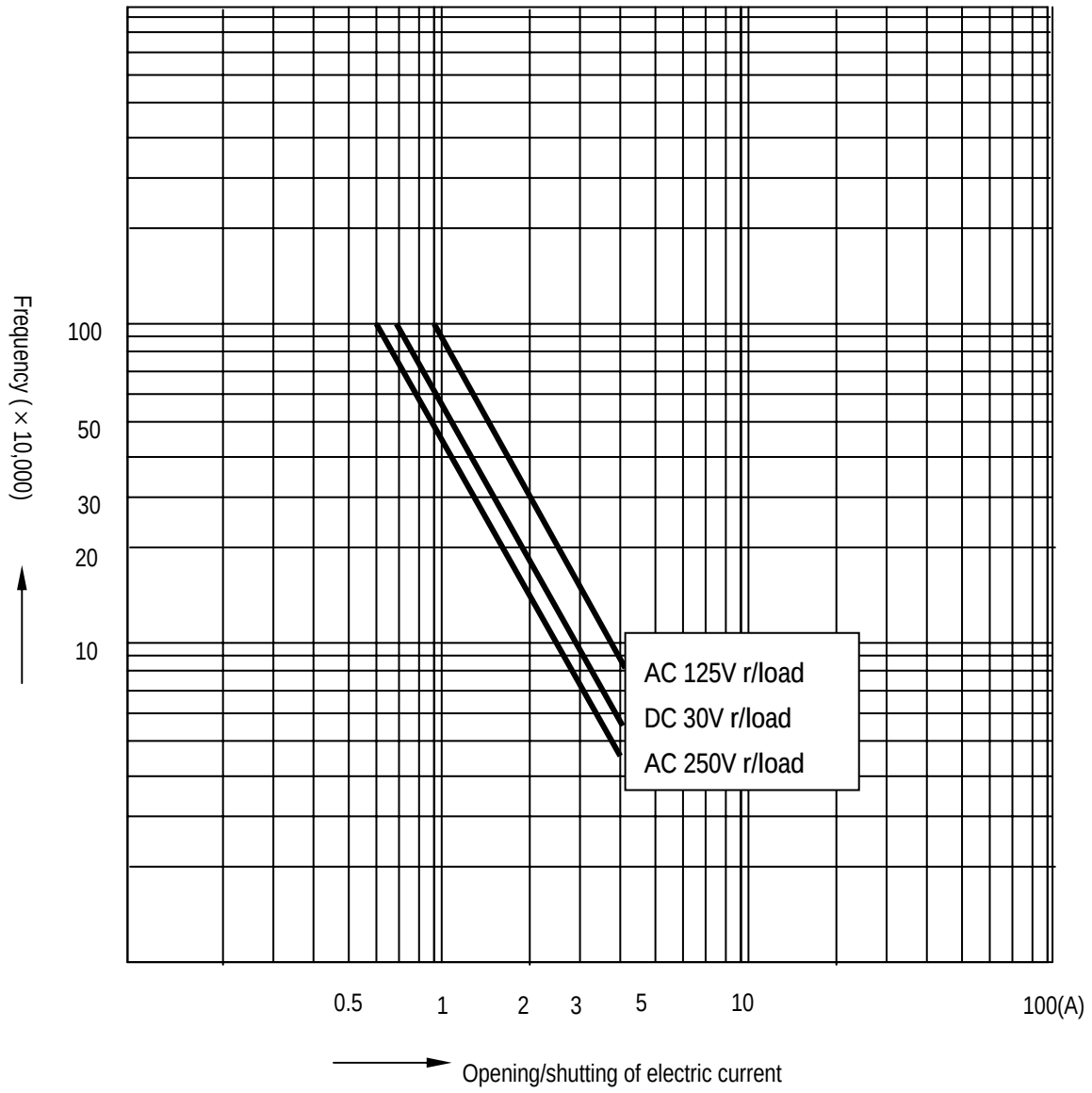
Chapter 6. Input and Output Specifications

6.1 Input / Output Specifications

Digital input that offers to GM7U series are made to use both of electric current sink and electric current source.

To keep use coil load as an output module, maximum opening and shutting frequency is 1 second on and 1 second off.

The following diagram shows maximum life relay for relay output.



6.2 Digital Input Specifications

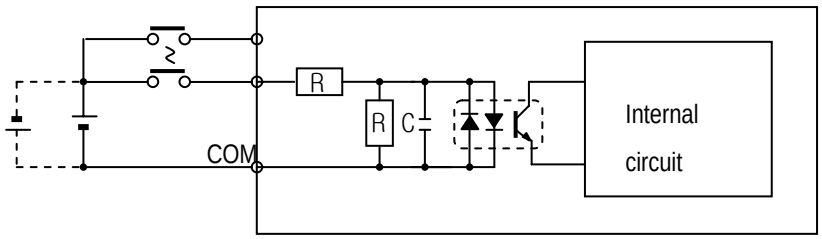
6.2.1 Main unit

1) Specifications

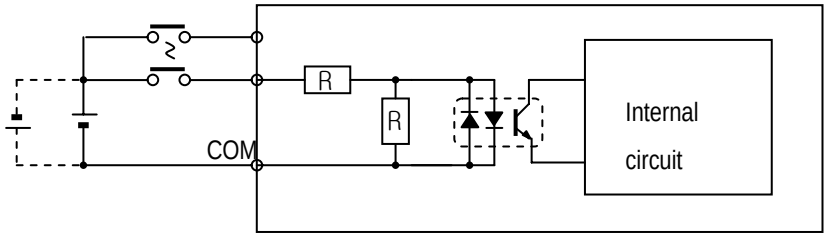
Model / Specification		Main unit			
		20-point	30-point	40-point	60-point
Number of input points		12 points	18 points	24 points	36 points
Insulation method		Photo coupler			
Rated input voltage		DC 24V			
Rated input current		7 mA			
Operating voltage range		DC20.4 ~ 28.8V (ripple: less than 5%)			
Max. simultaneous input points		100% simultaneously On			
On voltage / On current		DC19V or higher / 5.7 mA or higher			
Off voltage / Off current		DC6V or lower / 1.8 mA or lower			
Input impedance		Approx.3.3 kΩ			
Response time	Off → On	0,1,2,5,10,20,50,100,200,500,1000ms (Default : 10ms)			
	On → Off	0,1,2,5,10,20,50,100,200,500,1000ms (Default : 10ms)			
Common terminal		12 points / COM	18 points / COM	12 points / COM	18 points / COM
Operating indicator		LED turns on at ON state of input			

2) Circuit diagram

Input: IX0.0.0 ~ IX0.0.1



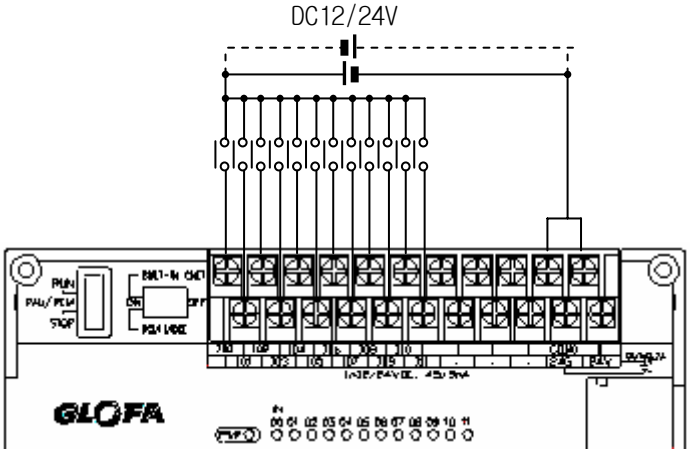
Input: IX0.0.2 ~



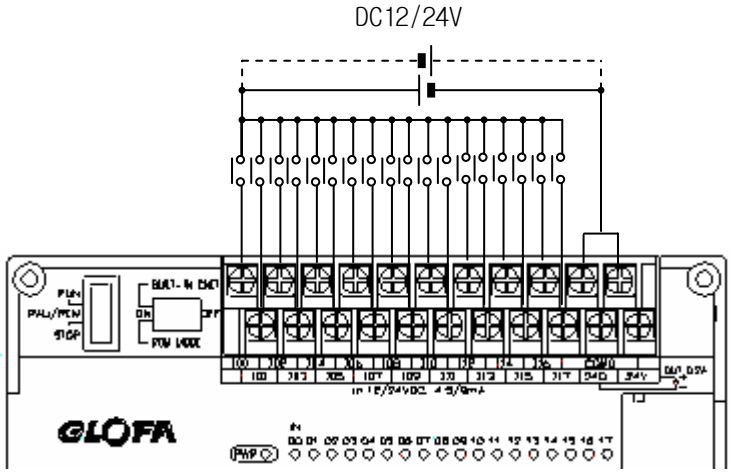
3) Input wiring

Main unit's wiring method is as follows. DC input specifications offered by GM7U is to be used for both electric current sink and electric current source.

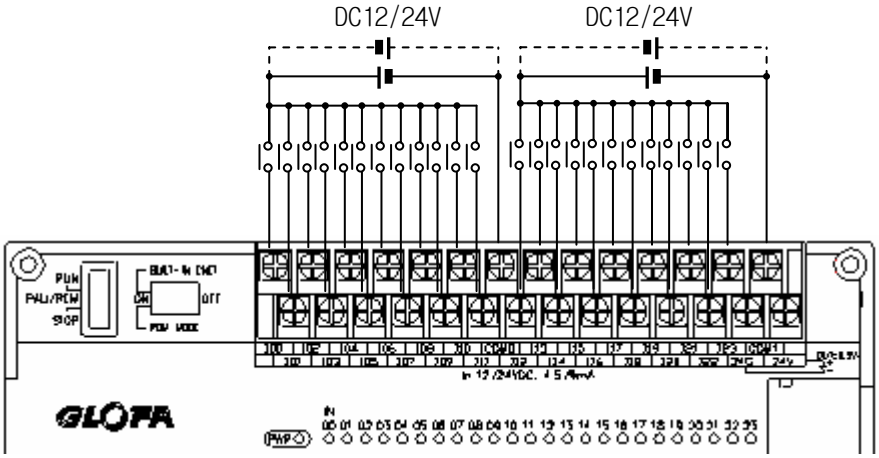
(1) 20 points main unit



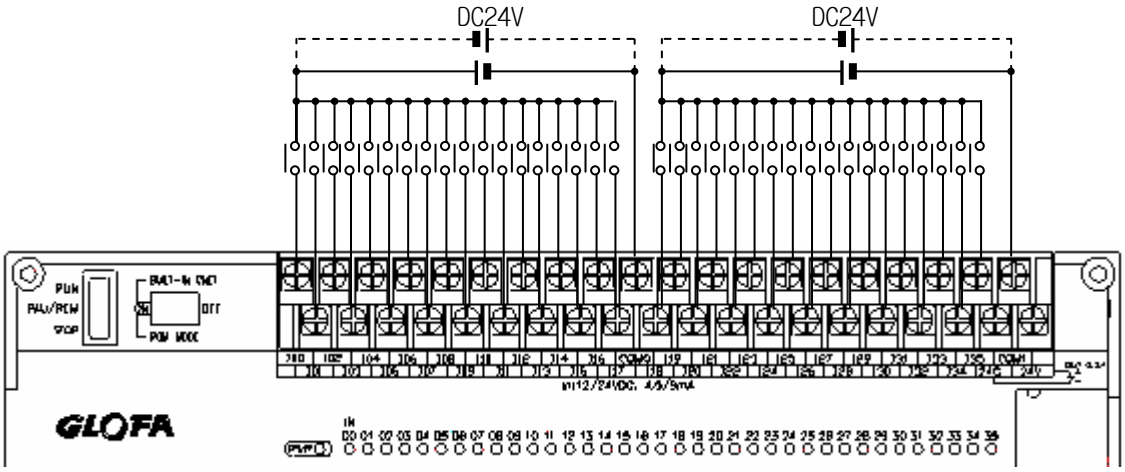
(2) 30 points main unit



(3) 40 points main unit

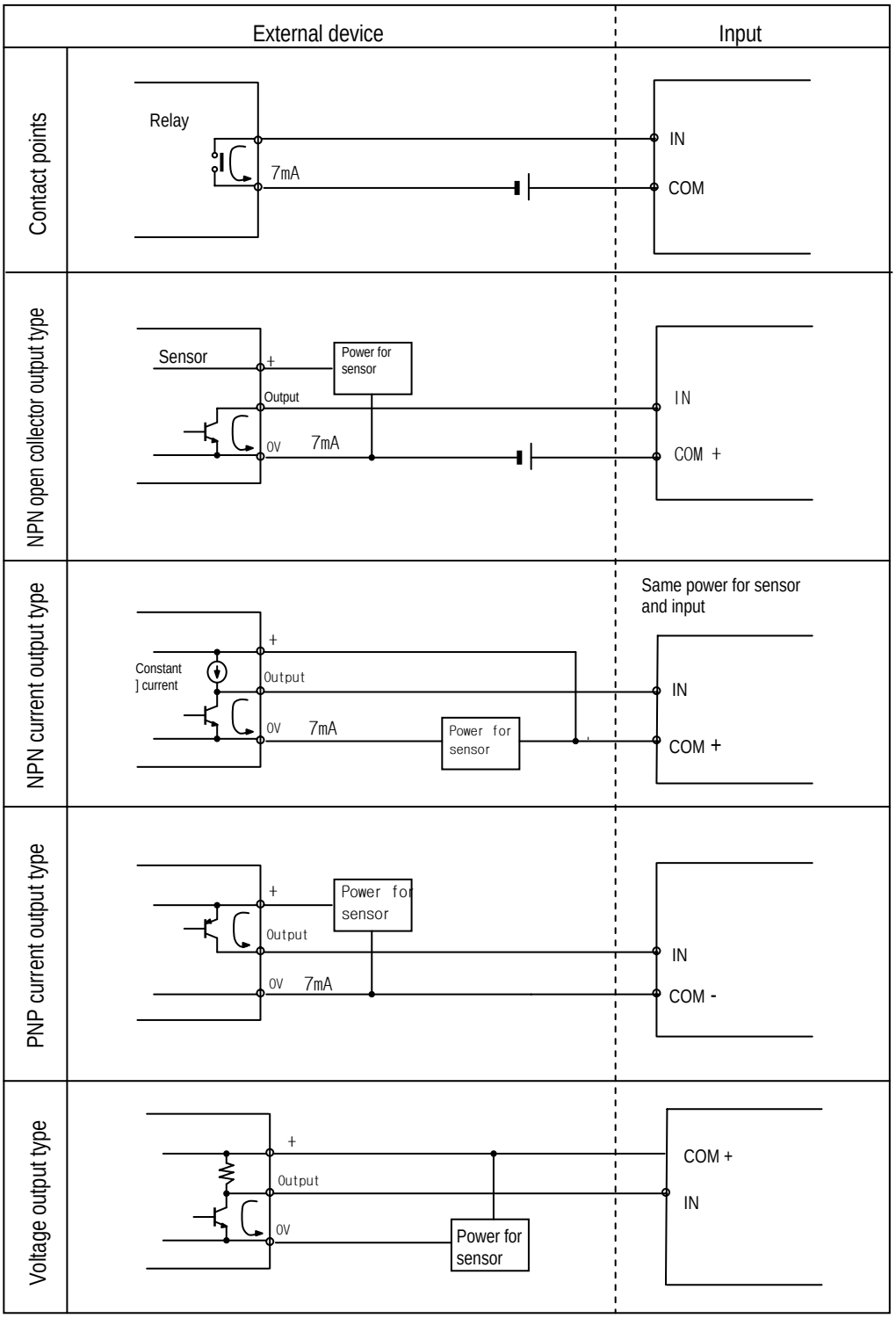


(4) 60 points main unit



4) Example of external devices

To connect with external device of DC output type into DC input module, wire depending on the type of the external device as shown.



6.2.2 Expansion module

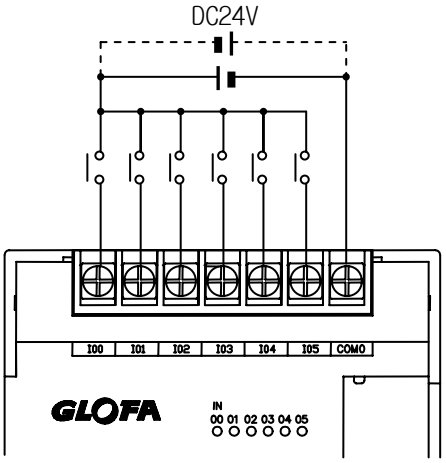
1) Specifications

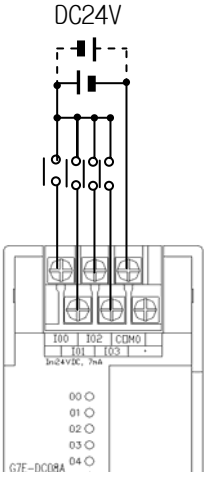
Specification \ Model		Expansion Module			
		G7E-DR10A	G7E-DC08A	G7E-DR20A	G7E-DR08A
Number of input points		6 points	8 points	12 points	4 point
Insulation method		Photo coupler			
Rated input voltage		DC 24V			
Rated input current		7 mA			
Operating voltage range		DC 20.4 ~ 28.8V (ripple: less than 5%)			
Max. Simultaneous input points		100% simultaneously On			
On voltage / On current		DC19V or higher/ 5.7 mA or higher			
Off voltage / Off current		DC6V or lower / 1.8 mA or lower			
Input impedance		Approx. 3.3 kΩ			
Response time	Off → On	0,1,2,5,10,20,50,100,200,500,1000ms (Default : 10ms)			
	On → Off	0,1,2,5,10,20,50,100,200,500,1000ms (Default : 10ms)			
Common terminal		6 points / com	4 points / com	12 points / com	4 points / com
Operating indicator		LED turns on at ON state of input			

2) Circuit diagram

It's the same with the one for the main unit.

3) Input wiring





6.3 Digital Output Specifications

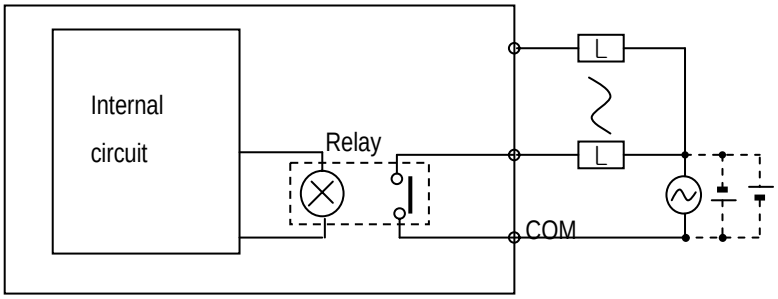
6.3.1 Main unit (Relay output)

1) Specifications

(1) Standard type

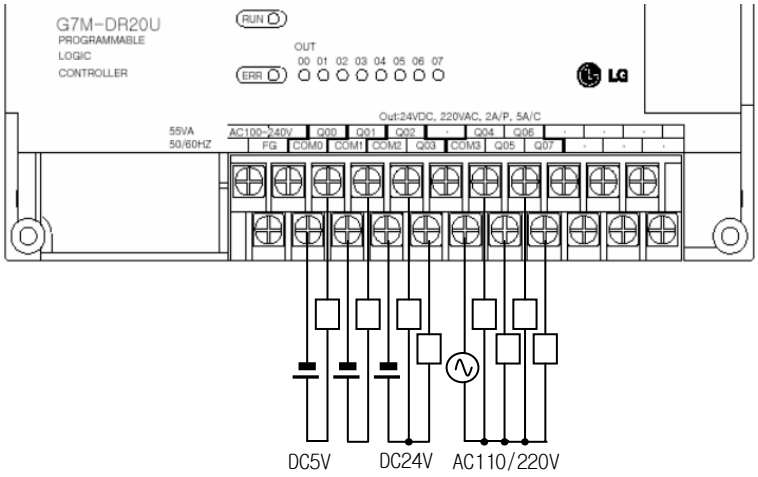
Specifications \ Model		Main Unit			
		G7M-DR20U(/DC), G7M-DRT20U(N)(/DC)	G7M-DR30U(/DC), G7M-DRT30U(N)(/DC)	G7M-DR40U(/DC), G7M-DRT40U(N)(/DC)	G7M-DR60U(/DC), G7M-DRT60U(N)(/DC)
Output point		8 points, 4 points	12 points, 8 points	16 points, 12 points	24 points, 20 points
Insulation method		Relay insulation			
Rated load voltage/current		DC24V / 2A (r/load), AC220V / 2A (COS Ψ = 1)/1 point , 5A / 1COM			
Min. load Voltage/current		DC5V / 1mA			
Max. load voltage/current		AC250V, DC110V			
Off leakage current		0.1mA (AC220V, 60Hz)			
Max. On/off frequency		1,200 times/hr			
Surge absorber		None			
Life	Mechanical	More than 20,000,000			
	Electrical	Rated on/off voltage/current load 100,000 or more			
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 or more			
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 or more			
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100,000 or more			
Response time	Off → On	10 ms or lower			
	On → Off	12 ms or lower			
Operation indicator		LED is on at on status of output			

2) Circuit diagram

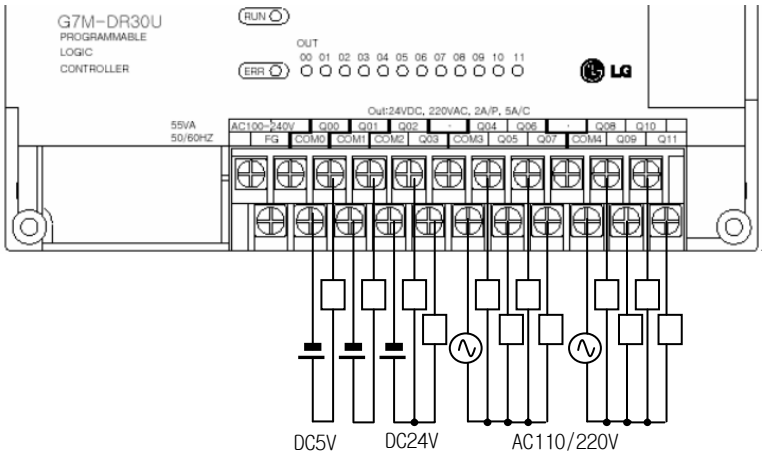


3) Output wiring

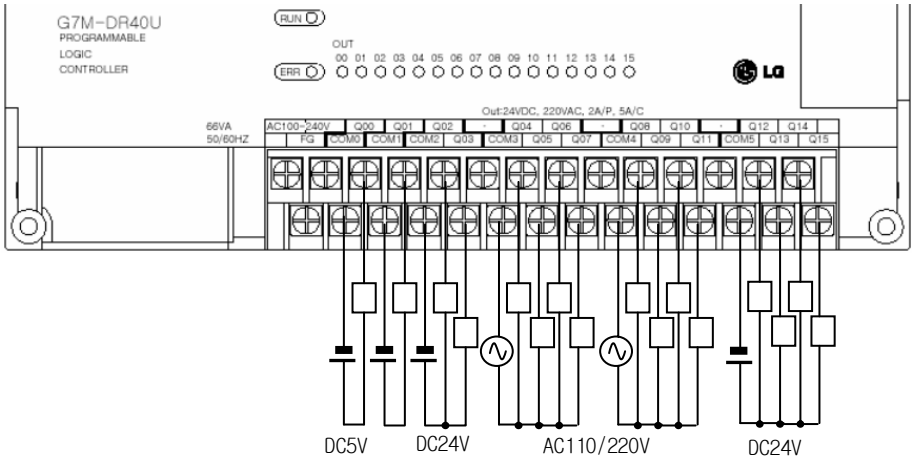
(1) 20 points main unit



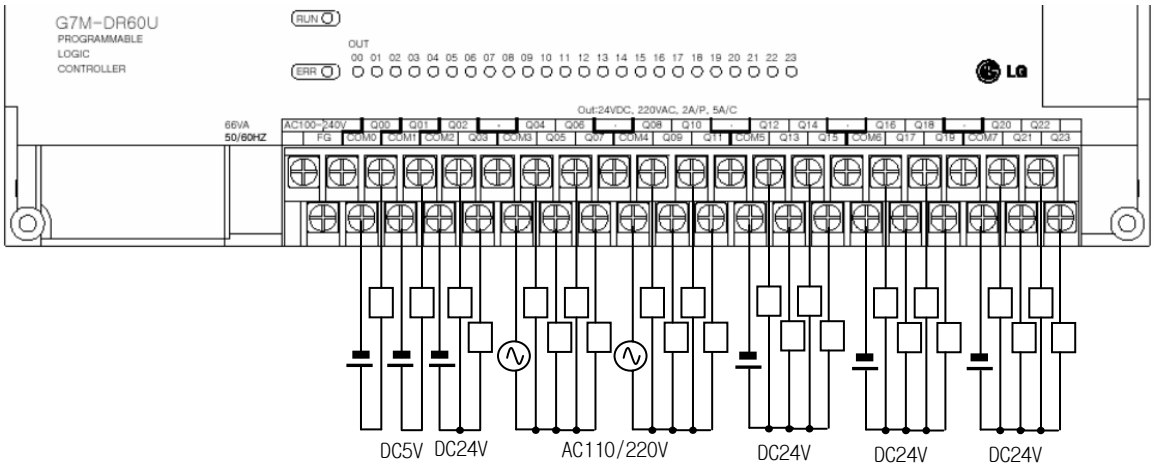
(2) 30 points main unit



(3) 40 points main unit



(4) 60 points main unit

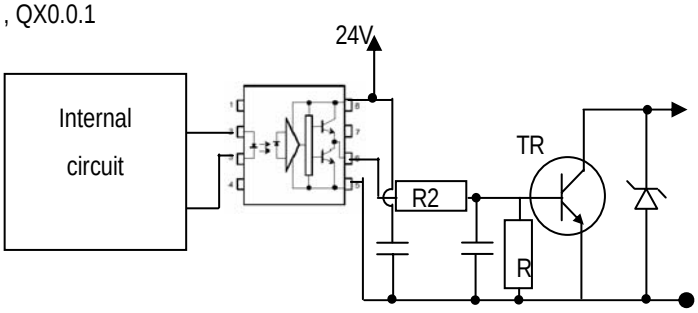


6.3.2 Main unit (NPN TR output)

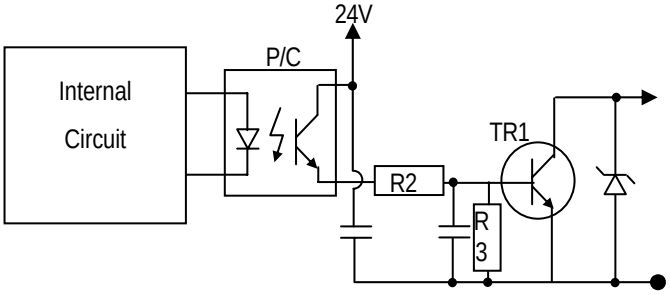
1) Specifications

Specifications \ Model		Main Unit			
		G7M-DRT20U(N)(/DC) G7M-DT20U(N)(/DC)	G7M-DRT30U(N)(/DC) G7M-DT30U(N)(/DC)	G7M-DRT40U(N)(/DC) G7M-DT40U(N)(/DC)	G7M-DRT60U(N)(/DC) G7M-DT60U(N)(/DC)
Output point		4 points (8 points)	4 points (12 points)	4 points (16 points)	4 points (24 points)
Insulation method		Photo coupler insulation			
Rated load voltage		DC12/24V			
Operation load voltage		DC10.2 ~ 26.4V			
Max. load current		0.5A/point (but, QX0.0.0, QX0.0.1 : 0.1A)			
Surge absorber		Zener diode			
Off leakage current		Less than 0.1mA			
Voltage drop when on		Less than DC 0.3 V (0.1A)			
Inrush current		Less than 4A, 10ms			
Response time	Off → On	0.2 ms or lower			
	On → Off	0.2 ms or lower			
Operation indicator		LED is on at on status of output			

QX0.0.0 , QX0.0.1



QX0.0.2 , QX0.0.3



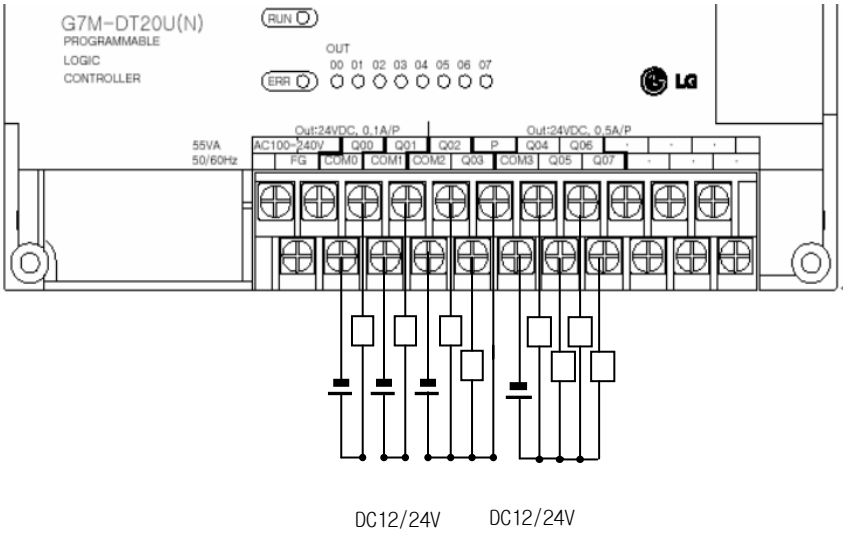
REMARK

1) 4 points of QX0.0.0~QX0.0.3 are for positioning function in G7M-DRT(DT)20/30/40/60U(N)(/DC). They also can be used for general TR output.

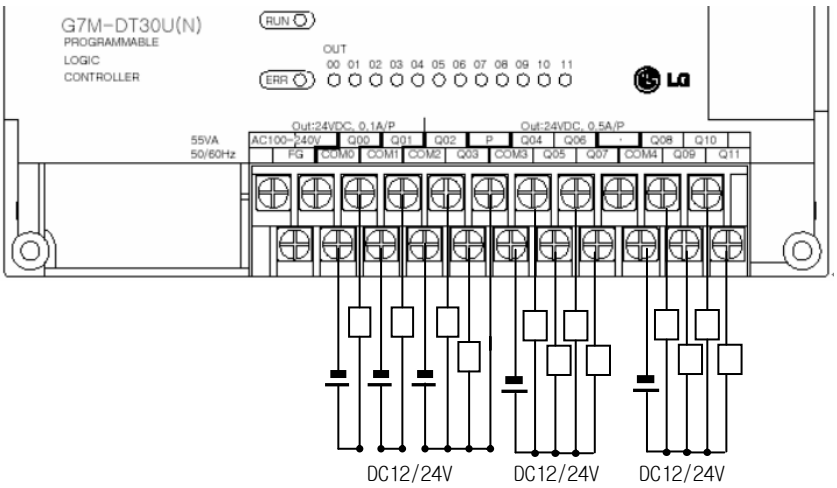
2) Do not use for AC load, or they can be destroyed.

2) Output wiring

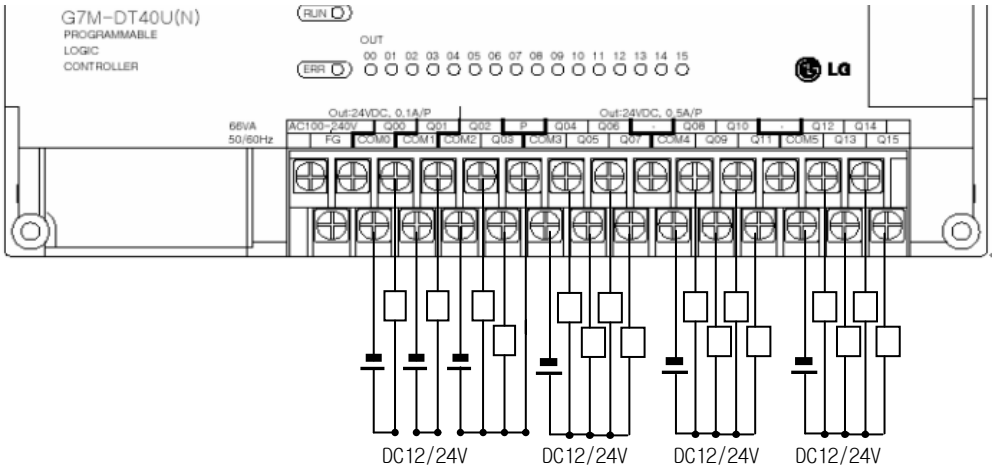
(1) 20 points main unit



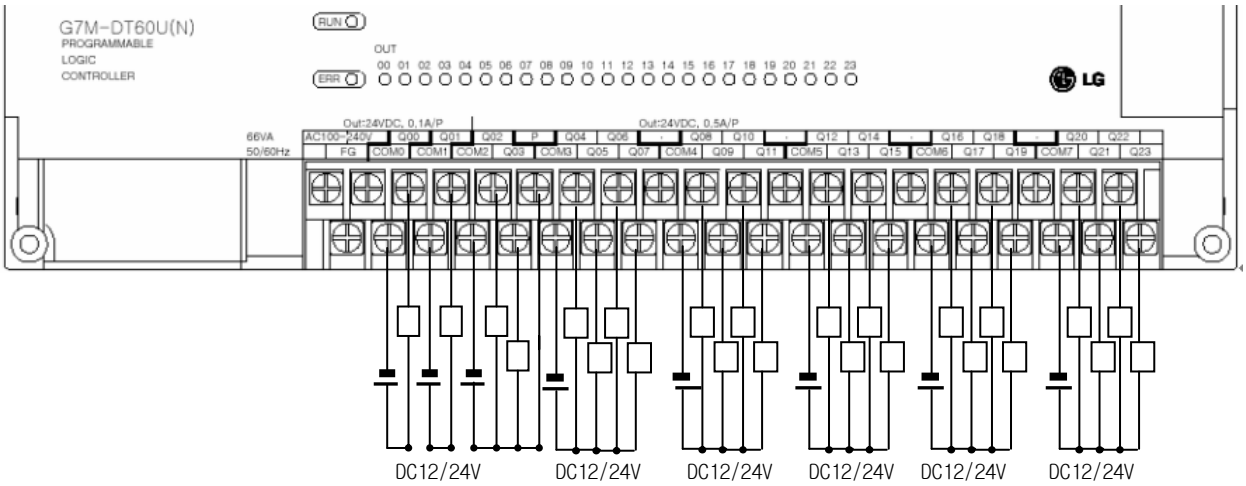
(2) 30 points main unit



(3) 40 points main unit



(4) 60 points main unit

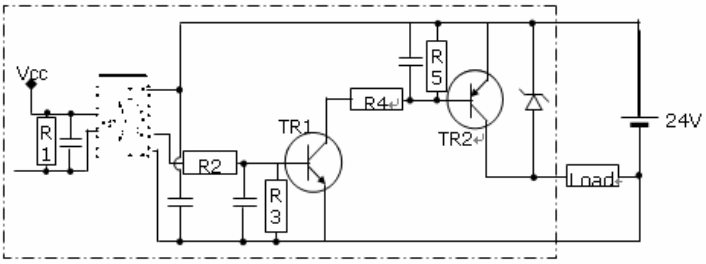


6.3.3 Main unit (PNP TR output)

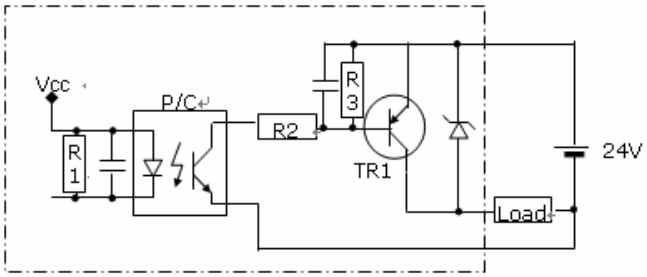
1) Specifications

Specifications \ Model		Main Unit			
		G7M-DT20U(P)(/DC)	G7M-DT30U(P)(/DC)	G7M-DT40U(P)(/DC)	G7M-DT60U(P)(/DC)
Output point		8 points	12 points	16 points	24 points
Insulation method		Photo coupler insulation			
Rated load voltage		DC12/24V			
Operation load voltage		DC10.2 ~ 26.4V			
Max. load current		0.5A/point (but, QX0.0.0, QX0.0.1 : 0.1A)			
Surge absorber		Zener diode			
Off leakage current		Less than 0.1mA			
Voltage drop when on		Less than DC 0.3 V (0.1A)			
Inrush current		Less than 4A, 10ms			
Response time	Off → On	0.2 ms or lower			
	On → Off	0.2 ms or lower			
Operation indicator		LED is on at on status of output			

QX0.0.0 , QX0.0.1



QX0.0.2 , QX0.0.3



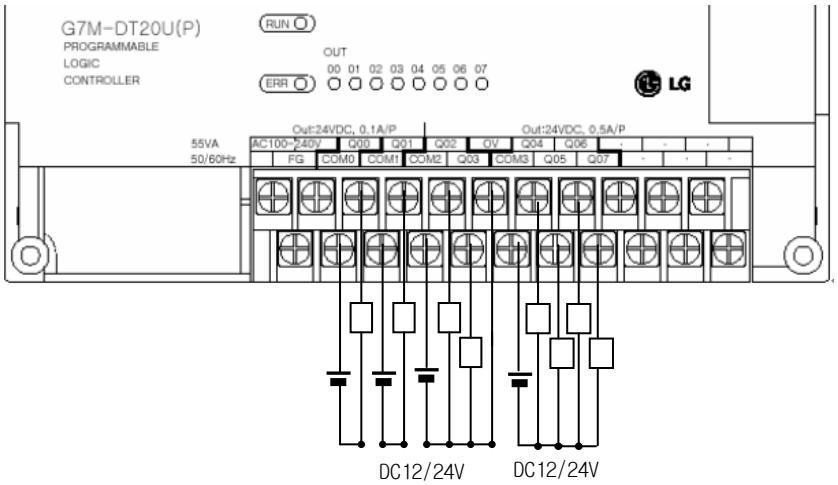
REMARK

1) 4 points of QX0.0.0~QX0.0.3 are for positioning function in G7M-DT20/30/40/60U(P)(/DC). They also can be used for general TR output.

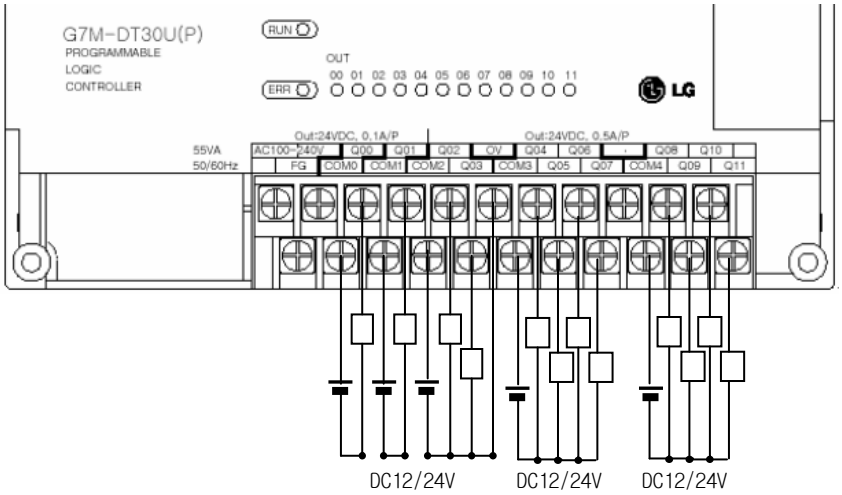
2) Do not use for AC load, or they can be destroyed.

2) Output wiring

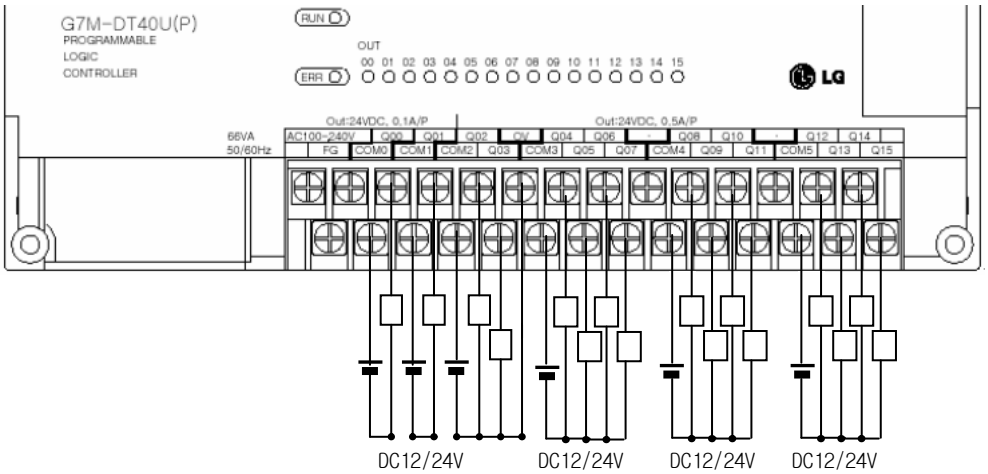
(1) 20 points main unit



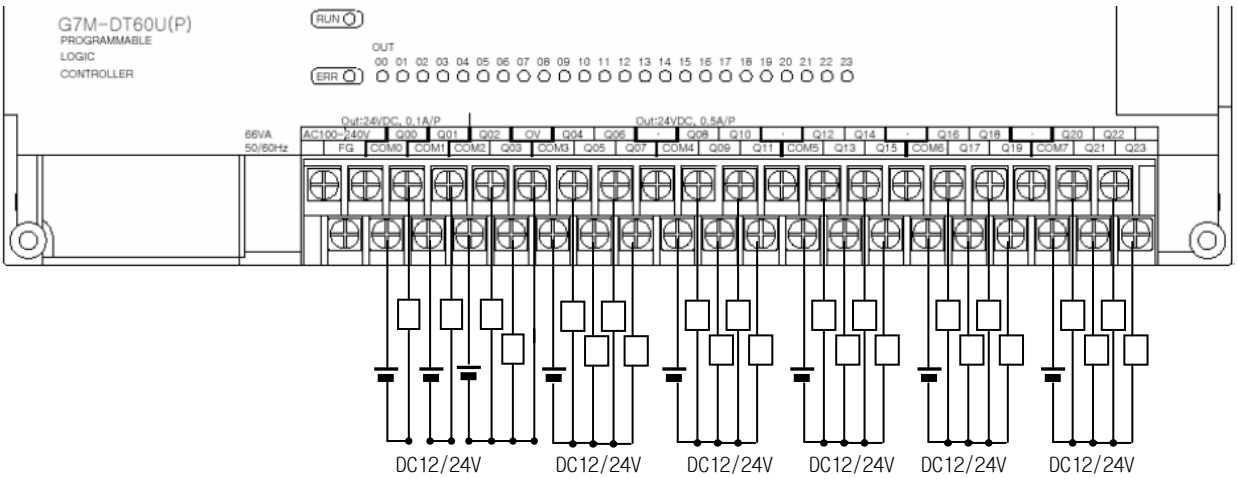
(2) 30 points main unit



(3) 40 points main unit



(4) 60 points main unit



6.3.4 Expansion module (Relay output)

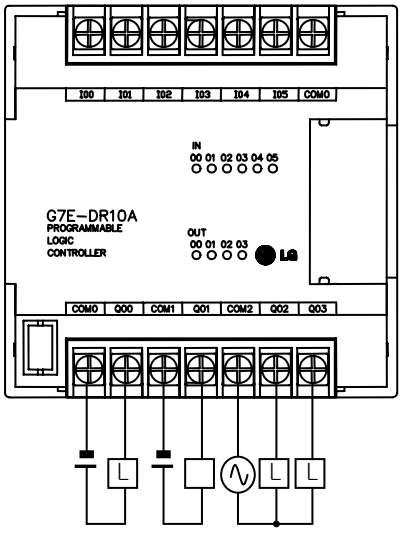
1) Specifications

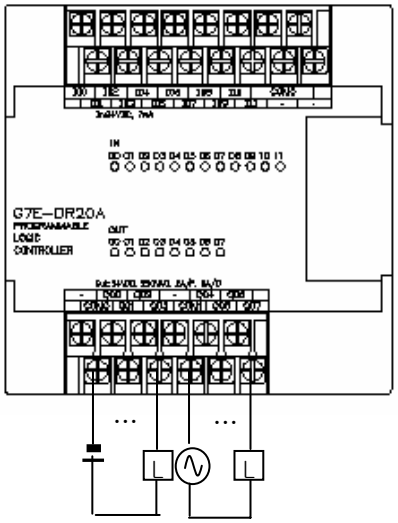
Specifications \ Model		Expansion Module				
		G7E-DR08A	G7E-DR10A	G7E-DR20A	G7E-RY08A	G7E-RY16A
Output point		4 points		8 points		16 points
Insulation method		Relay insulation				
Rated load voltage/current		DC24V / 2A (Resistive load), AC220V / 2A (COS Ψ = 1) / 1 point 5A / 1COM				
Min. load voltage/current		DC5V / 1mA				
Max. load voltage/current		AC250V, DC110V				
Off leakage current		0.1mA (AC220V, 60Hz)				
Max. on/off frequency		1,200 times/hr				
Surge absorber		None				
Service life	Mechanical	More than 20,000,000				
	Electrical	Rated on/off voltage/current load 100,000 or more				
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 or more				
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 or more				
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100,000 or more				
Response time	Off → On	10 ms or lower				
	On → Off	12 ms or lower				
Common		1 point/COM, 2 points/COM				
Operation indicator		LED is on at on status of output				

2) Circuit diagram

It's the same with the output circuit of the main unit.

3) Output wiring

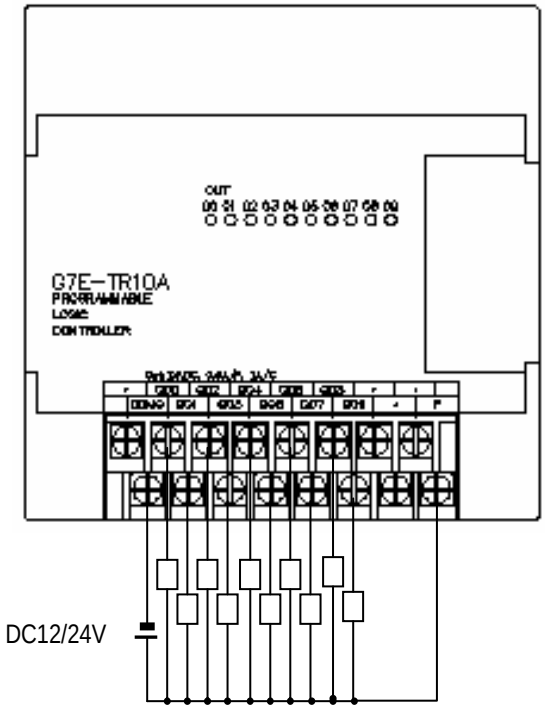




6.3.5 Expansion module (TR output)

1) Specifications

Specifications \ Model		Digital I/O module
		G7E-TR10A
Output point		10 points
Insulation method		Photo coupler insulation
Rated load voltage/current		DC12V//24V
Operating load voltage range		DC10.2 ~ 26.4V
Max. load current		0.5A/1 point, 4A/1COM
Off leakage current		0.1mA or lower
Max. inrush current		4A/10ms or lower
Max. voltage drop when on		DC 1.5V or lower
Surge absorber		Clamp diode
Response time	Off → On	2 ms or lower
	On → Off	2 ms or lower
Common		10 points/COM
Operation indicator		LED is on at on status of output



REMARK

1) Refer to 7.2 'Special Functions' for the special modules

Chapter 7. Usage of Various Functions

7.1 Built-in Functions

7.1.1 High speed counter function

This chapter describes the specification, handling, and programming of built-in high speed counter of GM7U. The built-in high speed counter of GM7U (hereafter called HSC) has the following features;

Function		Description
Counter format		• Linear counter: Up/Down counter. Counting range is from -2,147,483,648 to 2,147,483,647 • Ring counter: Counter value rotates from 0 to (set value-1)
Counter mode		4 counter functions as followings • 1-phase operation mode • 1-phase pulse + direction mode: Up / down is selected by direction pulse • 2-phase CW/CCW mode: Up / down is selected by CW or CCW pulse input • 2-phase multiplication mode: Up / down is automatically selected by the phase difference between A-phase and B.(multiplied by 4)
Additional function	Preset function	Change current value to preset value.
	Latch counter	Latches current value.
	Comparison output	When current value is equal to comparison value, turns on the output contact points or executes interrupt program
	RPM function	Calculate the RPM(Rotates Per Minute) of input pulse

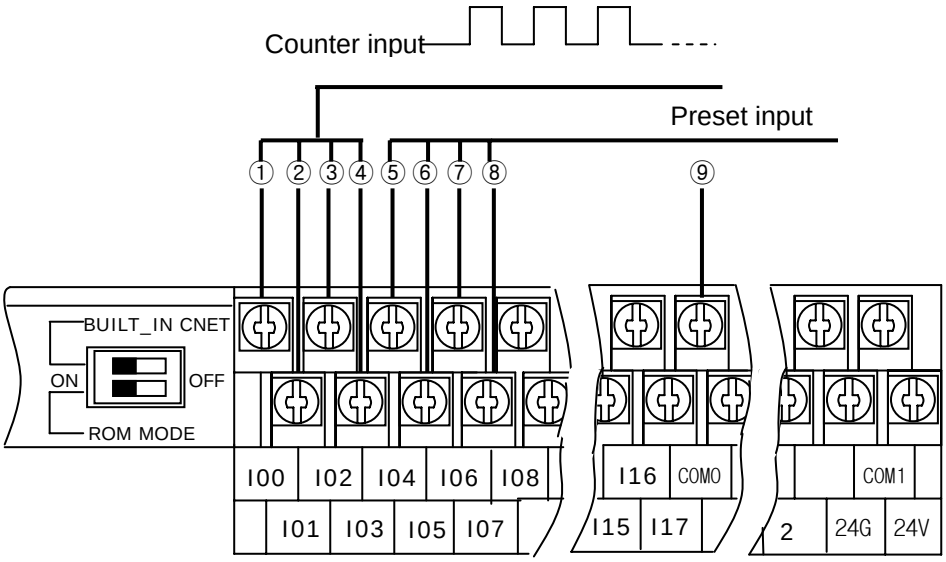
1) Performance Specifications

Items		Specifications
Points		1 phase: 4 points, 2 Phase: 2 points
Input types		A-Phase, B-Phase, Preset input
Counting ranges		from -2,147,483,648 to 2,147,483,647(Binary 32 bits)
Max. counting speed		1-phase 100kHz/ 2-phase 50kHz (Ch0, Ch1) 1-phase 20kHz/ 2-phase 10kHz (Ch2, Ch3)
Up / Down selection	1-phase	Up counter
	1-phase Pulse + direction input	A-Phase: Input pulse, B-Phase: Direction pulse
	2-phase CW/CCW mode	A-Phase: Up counting pulse, B-Phase: Down counting pulse
	2-phase multiplication mode	Auto-select by phase difference of A-phase and B
Additional function		Ring counter, Latch counter, Preset, Comparison output, RPM function

2) Input specification

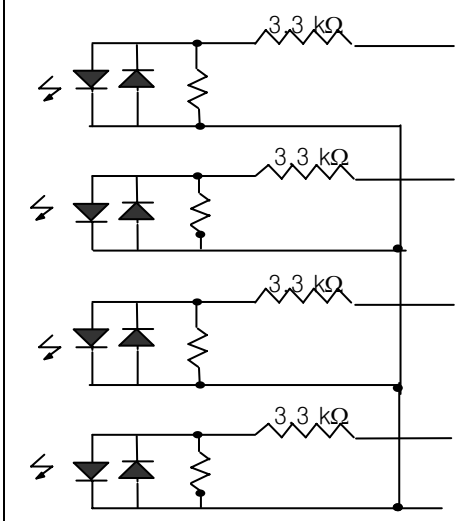
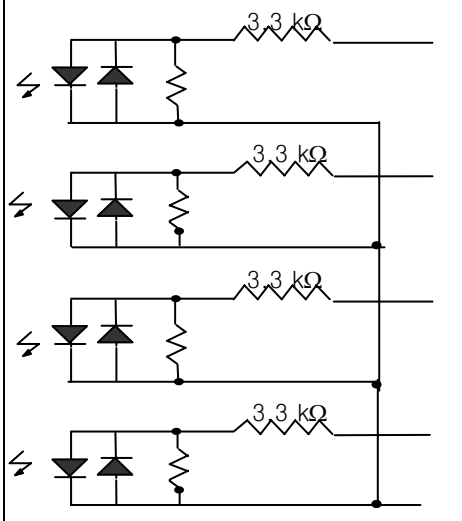
Items		Specifications	Items		Specifications
A / B phase	Rated input	24VDC (7mA)	Preset input	Rated input	24VDC (7mA)
	On voltage	20.4 ~ 28.8VDC		On voltage	20.4 ~ 28.8VDC
	Off voltage	6VDC or lower		Off voltage	6VDC or lower
				On delay time	200 ㎲ or lower
				Off delay time	200 ㎲ or lower

3) Names of wiring terminals



No.	Terminal No.	Names		Usage	
		1Phase	2Phase	1Phase	2Phase
①	IX0.0.0	Ch0 Input	Ch0 A Phase Input	Counter input terminal	A Phase Input terminal
②	IX0.0.1	Ch1 Input	Ch0 B Phase Input	Counter input terminal	B Phase Input terminal
③	IX0.0.2	Ch2 Input	Ch2 A Phase Input	Counter input terminal	A Phase Input terminal
④	IX0.0.3	Ch3 Input	Ch2 B Phase Input	Counter input terminal	B Phase Input terminal
⑤	IX0.0.4	Ch0 Preset 24V	Ch0 Preset 24V	Preset input terminal	Preset input terminal
⑥	IX0.0.5	Ch1 Preset 24V	-	Preset input terminal	-
⑦	IX0.0.6	Ch2 Preset 24V	Ch2 Preset 24V	Preset input terminal	Preset input terminal
⑧	IX0.0.7	Ch3 Preset 24V	-	Preset input terminal	-
⑨	COM0	Input Common		Input common terminal	

4) External interface circuit

I/O	Internal circuit	Terminal No.	Signal name		Operation	Input warranted voltage
			1Phase	2Phase		
Input		I00	Ch0 Input pulse	Ch0 A Phase Input	On	20.4~28.8V
					Off	6V or lower
		I01	Ch1 Input pulse	Ch0 B Phase Input	On	20.4~28.8V
					Off	6V or lower
		I02	Ch2 Input pulse	Ch2 A Phase Input	On	20.4~28.8V
					Off	6V or lower
		I03	Ch3 Input pulse	Ch2 B Phase Input	On	20.4~28.8V
					Off	6V or lower
		COM0	Common			
Input		I04	Ch0 Preset input	Ch0 Preset input	On	20.4~28.8V
					Off	6V or lower
		I05	Ch1 Preset input	-	On	20.4~28.8V
					Off	6V or lower
		I06	Ch2 Preset input	Ch2 Preset input	On	20.4~28.8V
					Off	6V or lower
		I007	Ch3 Preset input	-	On	20.4~28.8V
					Off	6V or lower
		COM0	Common			

5) Wiring instructions

A high speed pulse input is sensitive to the external noise and should be handled with special care. When wiring the built-in high speed counter of GM7U, take the following precautions against wiring noise.

(1) Be sure to use shielded twisted pair cables. Also provide Class 3 grounding.

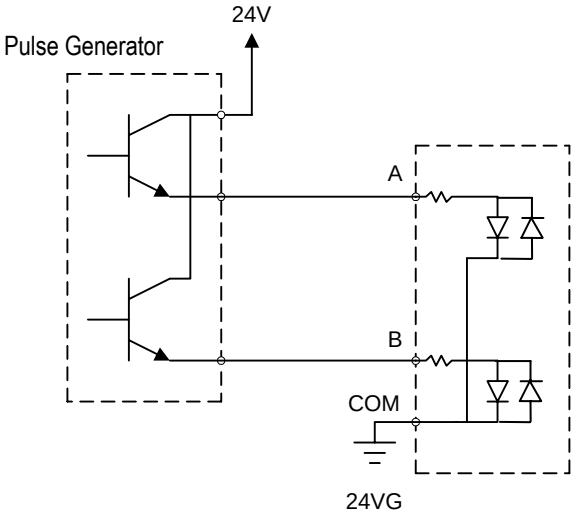
(2) Do not run a twisted pair cable in parallel with power cables or other I/O lines which may generate noise.

(3) Before applying a power source for pulse generator, be sure to use a noise-protected power supply.

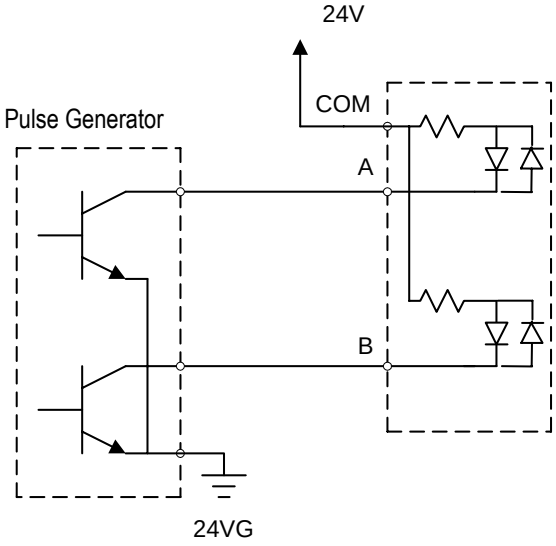
(4) For 1-phase input, connect the count input signal only to the phase A input; for 2-phase input, connect to phases A and B.

6) Wiring example

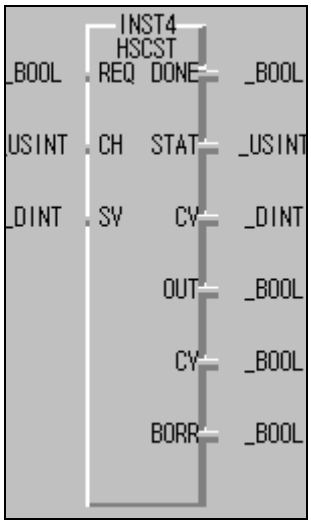
(1) Voltage output pulse generator



(2) Open collector output pulse generator



7) Function block (HSCST)

Function block	Description	
	Input	REQ: Execute the HSC function block Ch: Set the HSC channel (0~3) SV: Set Value (32 bit) Setting range (-2,147,483,648 ~ 2,147,483,647)
	Output	DONE: Turns on after the F/B is executed with no error Stat: Indicates the operation status of F/B CV: Saving area of the current value OUT: On when the current value is over than preset value Off when the current value is less than preset vlaue CY: On when 'Carry' occurs BORR: On when 'Borrow' occurs

■ HSCST S SV CV

(1) Functions

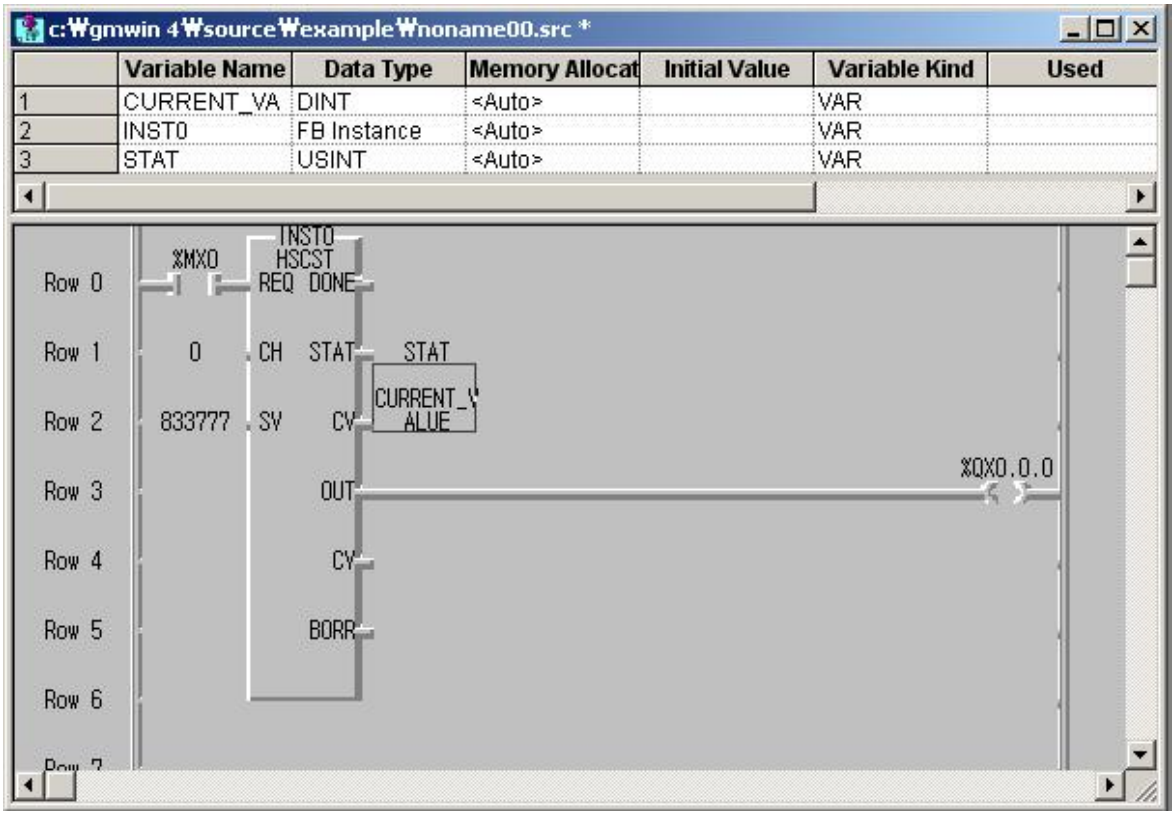
- When input condition turns on, corresponding high speed counter is enabled.
- When input condition turns off, high speed counter stop counting and turns output point off . The current value is retained.
- The high speed counter can counts from -2,147,483,648 to 2,147,483,647(binary 32 bits)
- When current value is greater than set value, output point F17*(* is channel number) turns on and it turns off when current value is less than set value.
- If current value is greater than 2,147,483,647, carry flag F18* turns on and and it turns off when input condition turns off. If HSC designated as ring counter, carry flag is set when current value reaches set value.
- If current value is smaller than -2,147,483,648, borrow flag F19* turns on and and turns off when input condition turns off If designated as ring counter, if current value is 0, borrow flag is set at next pulse's rising edge and current value goes 'set value –1'(in down counter mode)

(2) Error code

Code	Error	Corrective actions
H 10	Mode setting error	When Ch0 is set as 2-Phase, Ch 1 can't be used and Ch3 can't be used if Ch2 is set to 2-Phase.
H 11	Ring counter setting error	Adjust the range of ring counter within 2 ~ 2,147,483,647.
H 12	SV2 setting error	Set SV2 greater than SV1 if zone comparison set is selected.
H 13	Ring counter and SV2 setting error	Adjust the range of ring counter within 2 ~ 2,147,483,647 Set SV2 greater than SV1if zone comparison set is selected

Ex.) When the counter setting value of CH2 is -123, the error code H11 is saved in STAT.

(3) Program example



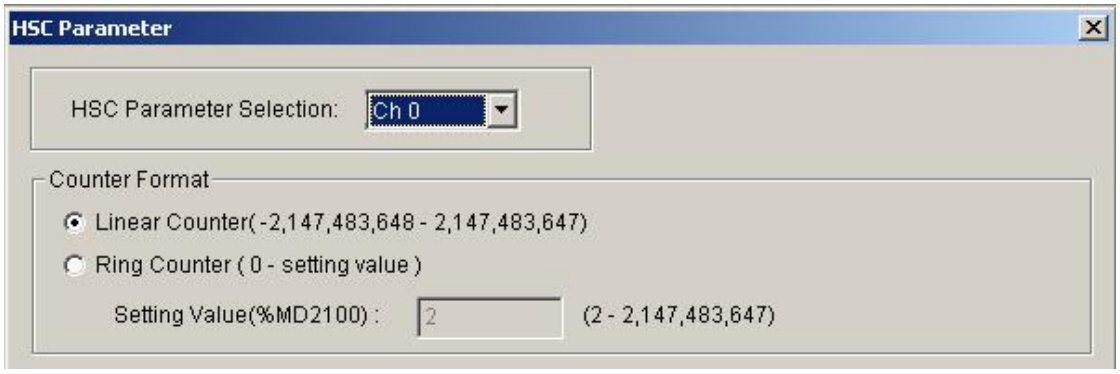
When the input condition %MX000 turns On, the CH 0 is enabled following the set mode.
When the present value becomes 8,333,777, %Q0.0.0 turns On.
The present values are saved in Current_Value.

REMARK

- For the additional settings, refer to the section Chapter 8. High Speed Counter 'Parameter settings'.

8) High speed counter parameter settings

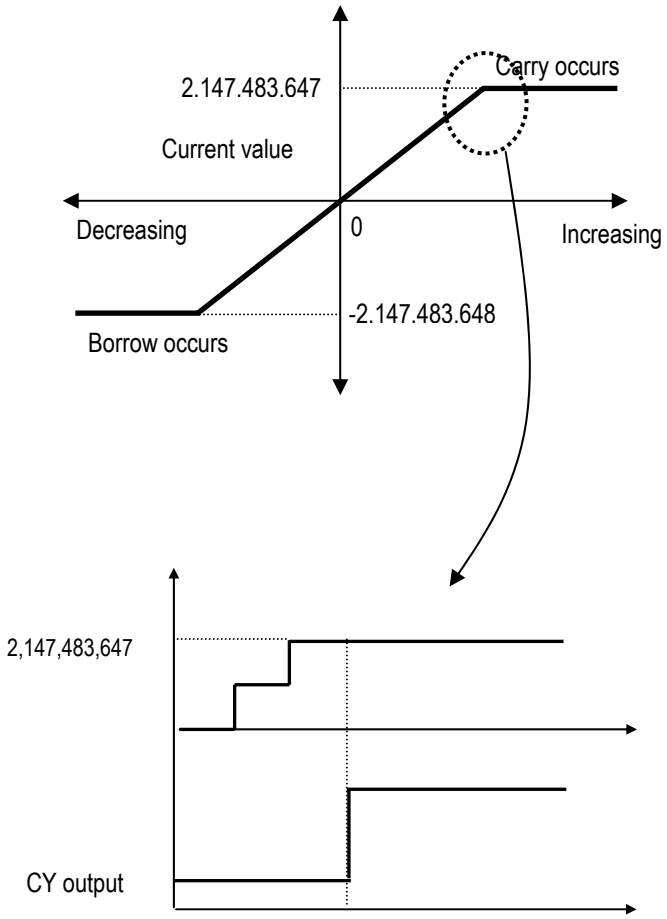
(1) Format setting



(a) Linear counter

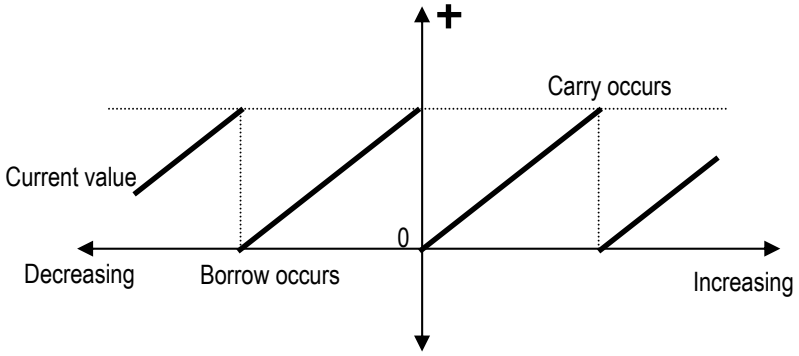
- If HSC is designate as Linear counter, it can counts from -2,147,483,648 to 2,147,483,647.
- When the counter value reaches 2,147,483,647, CY output is set for the next pulse input, and the counter stops.
- When the counter value reaches -2,147,483,648, BORR output is set for the next pulse input, and the counter stops.

- CY (Carry) and BORR (borrow) function blocks can be reset by preset operation and HSC can re-starts its operation.

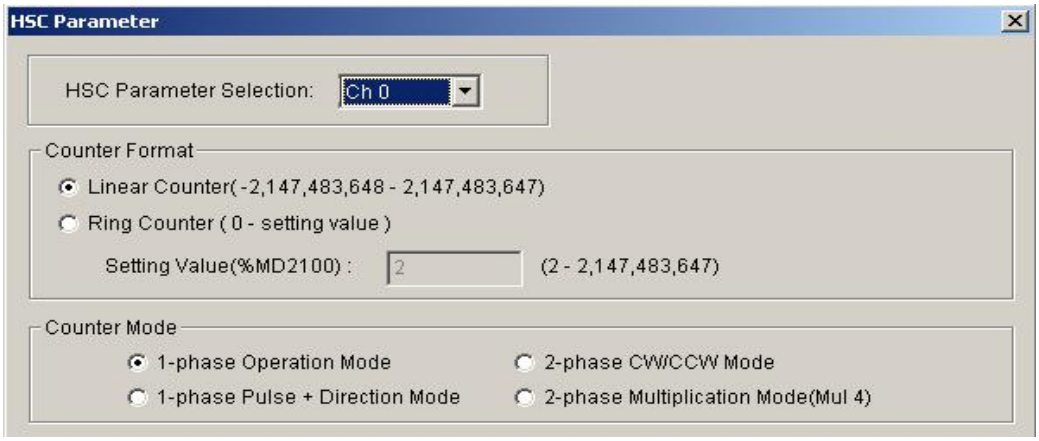


(b) Ring counter

- If HSC is designate as Ring counter, it can counts from 0 to set value.
- The carry flag turns On when the current value of high speed counter reaches set value during up counting and current value is changed to 0.
- The borrow flag turns on when the current value of high speed counter is reaches 0 during down counting and current value is changed to 'set value –1'.
- When set value is out of range(2 ~ 2,147,483,647), Ring counter setting error(h'11) occurs and HSC operates as linear counter.
- When current value is changed to out of range(2 ~ 2,147,483,647) by preset operation, Ring counter setting error(h'11) occurs and HSC operates as linear counter.
- The ring counter setting error can be corrected by re-start of instruction(HSCST) only.

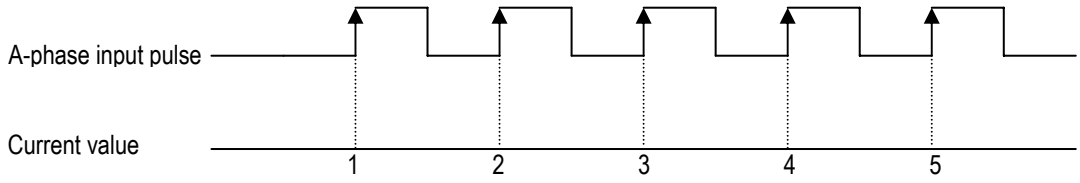


(2) Mode setting



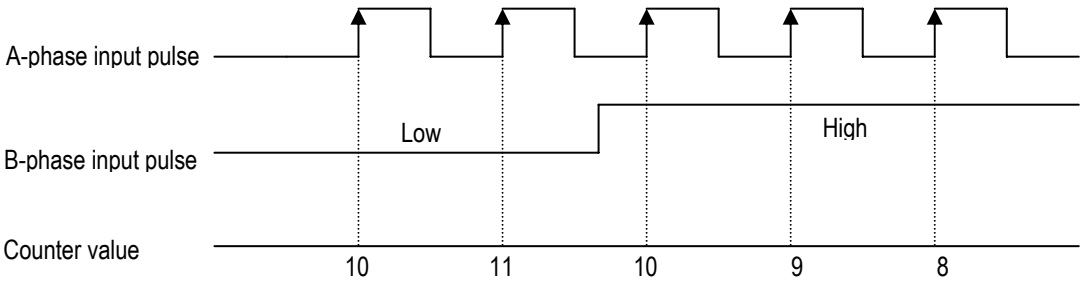
(a) 1-phase operation mode

- Current value increases by 1 at the rising edge of input pulse.



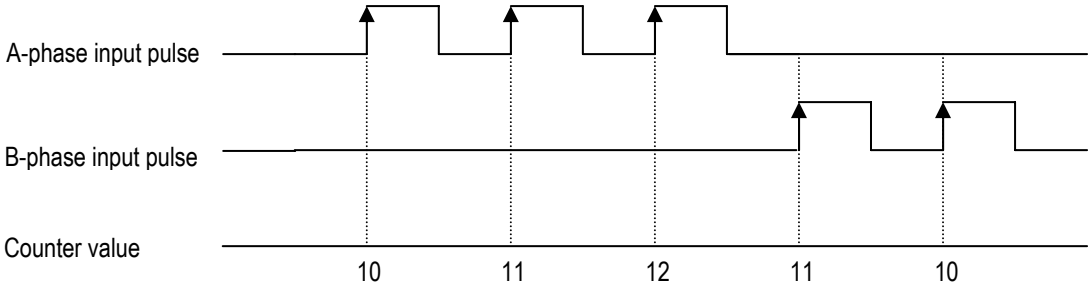
(b) 1-phase pulse + direction mode

- Current value increases by 1 at the rising edge of A-Phase pulse when B-phase is 'low' state.
- Current value decreases by 1 at the rising edge of A-Phase pulse when B-phase is 'High' state.



(c) 2-phase CW/CCW mode

- Current value increases by 1 at the rising edge of A-Phase pulse when B-phase is 'low' state.
- Current value increases by 1 at the rising edge of B-Phase pulse when A-phase is 'low' state.

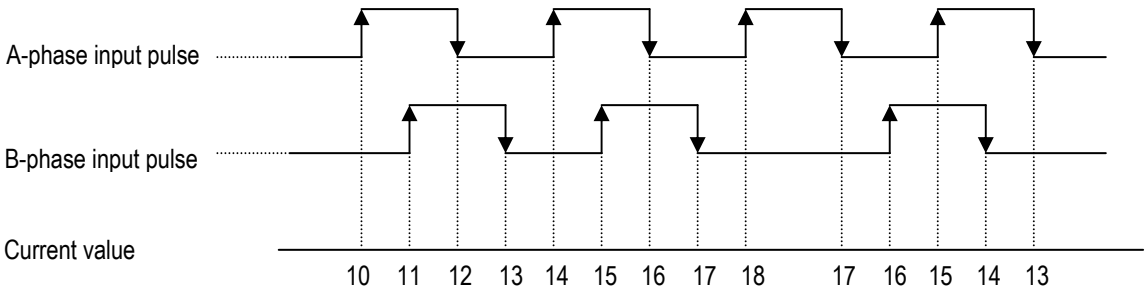


(d) 2-phase multiplication mode (MUL4)

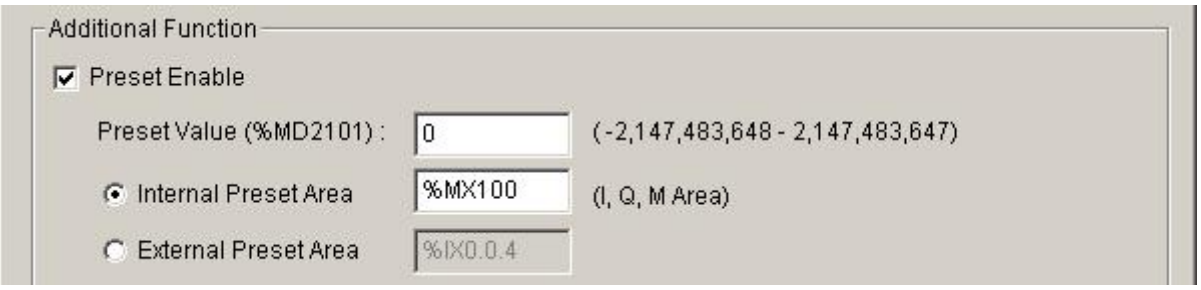
- Up or Down is set automatically by the phase difference between A and B phase.

- Up counter
  - At the rising edge of A-Phase pulse when B-phase is 'low'.
  - At the falling edge of A-Phase pulse when B-phase is 'high'.
  - At the rising edge of B-Phase pulse when A-phase is 'high'.
  - At the falling edge of B-Phase pulse when A-phase is 'low'.

- Down counter
  - At the rising edge of A-Phase pulse when B-phase is 'high'.
  - At the falling edge of A-Phase pulse when B-phase is 'low'.
  - At the rising edge of B-Phase pulse when A-phase is 'low'.
  - At the falling edge of B-Phase pulse when A-phase is 'high'.



(3) Preset setting



(a) Internal Preset

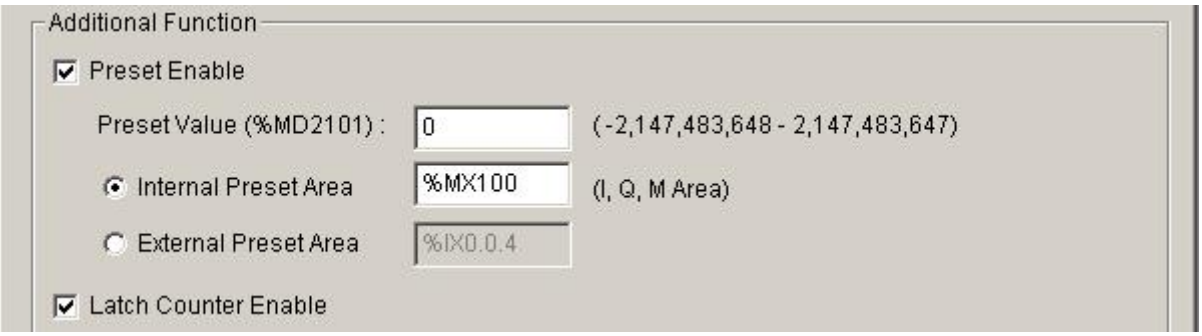
- Set internal preset area and preset value.
- Current value of high speed counter is replaced with preset value at the rising edge of internal preset device.

(b) External Preset

- Set external preset area and preset value.
- External devices are fixed as following

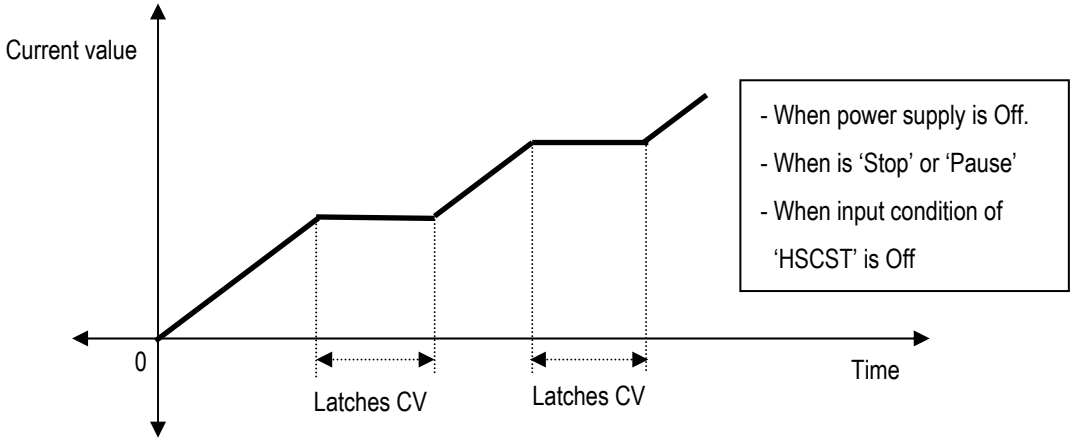
  Ch0: IX0.0.4, Ch1: IX0.0.5, Ch2: IX0.0.6, Ch3: IX0.0.7
- Current value of high speed counter is replaced with preset value at the rising edge of external preset device.

(4) Latch Counter setting



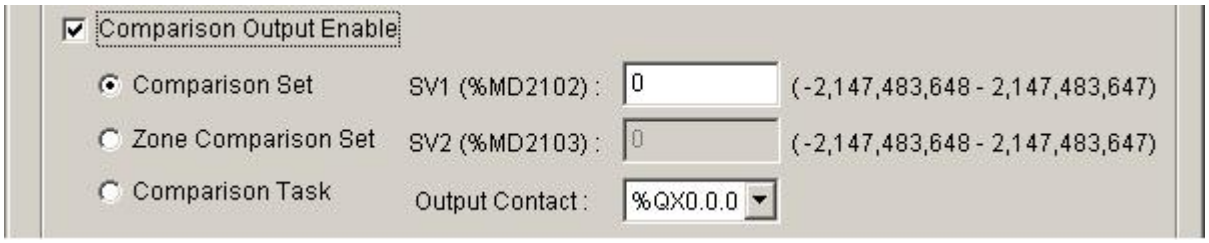
With Latch Counter, the count values can be always latched.

- Convenient to save the count value when the power went Off.
- Only by Preset, the current value can be cleared or changed.

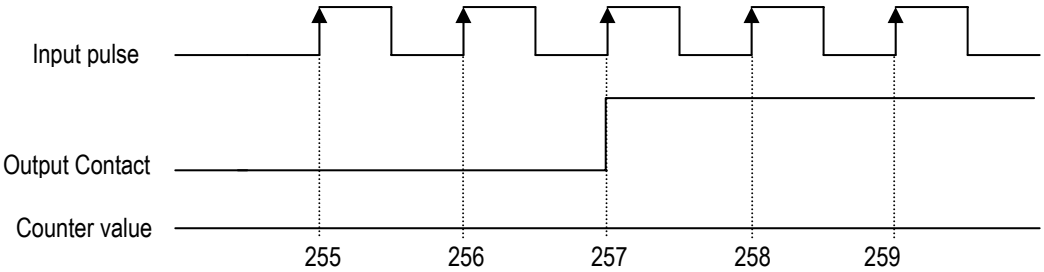


(5) Comparison Output setting

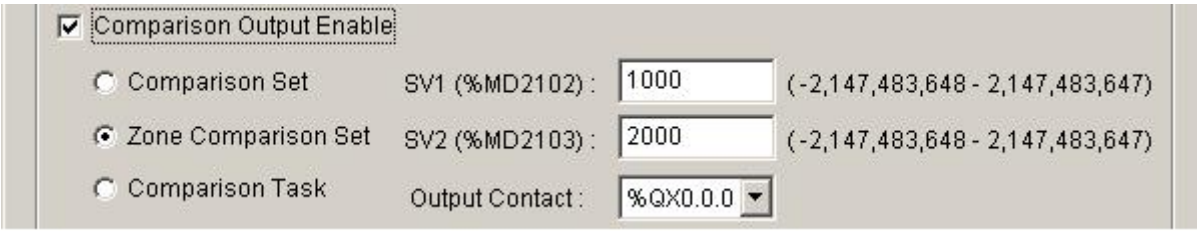
(a) Comparison set



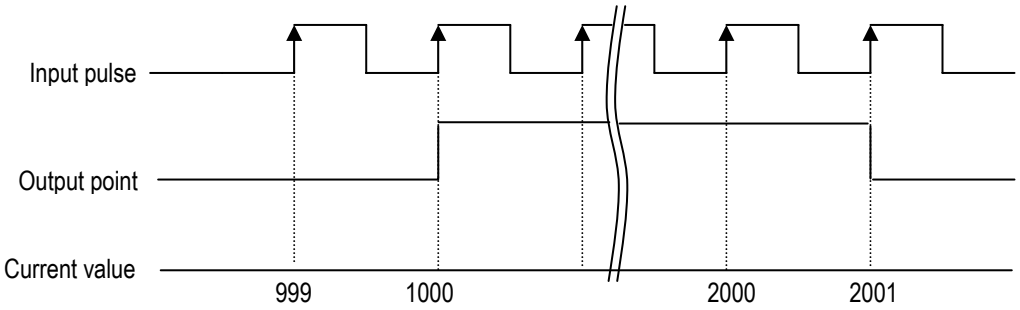
- When current value of HSC is equal to SV1, corresponding output point turns on.
- Only QX0.0.0 ~ QX0.0.7are available for comparison output point.



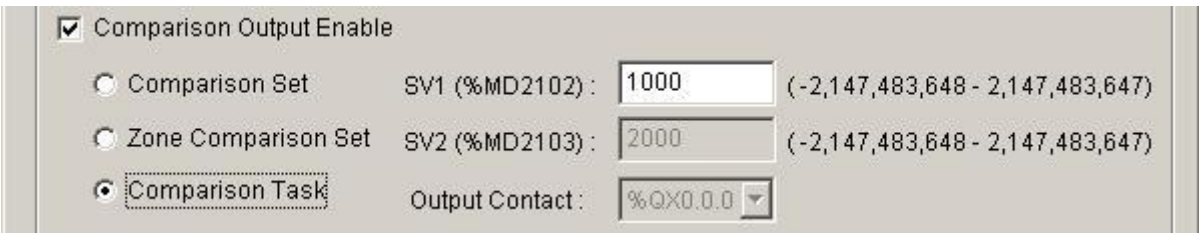
(b) Zone Comparison Set



- When current value of HSC is equal or more than SV1 and equal or less than SV2. corresponding output point turns on.
  - Only QX0.0.0 ~ QX0.0.7 are available.
  - If the set value of SV2 is less than SV1, SV2 setting error(h' 12) occurs and zone comparison set becomes disabled.



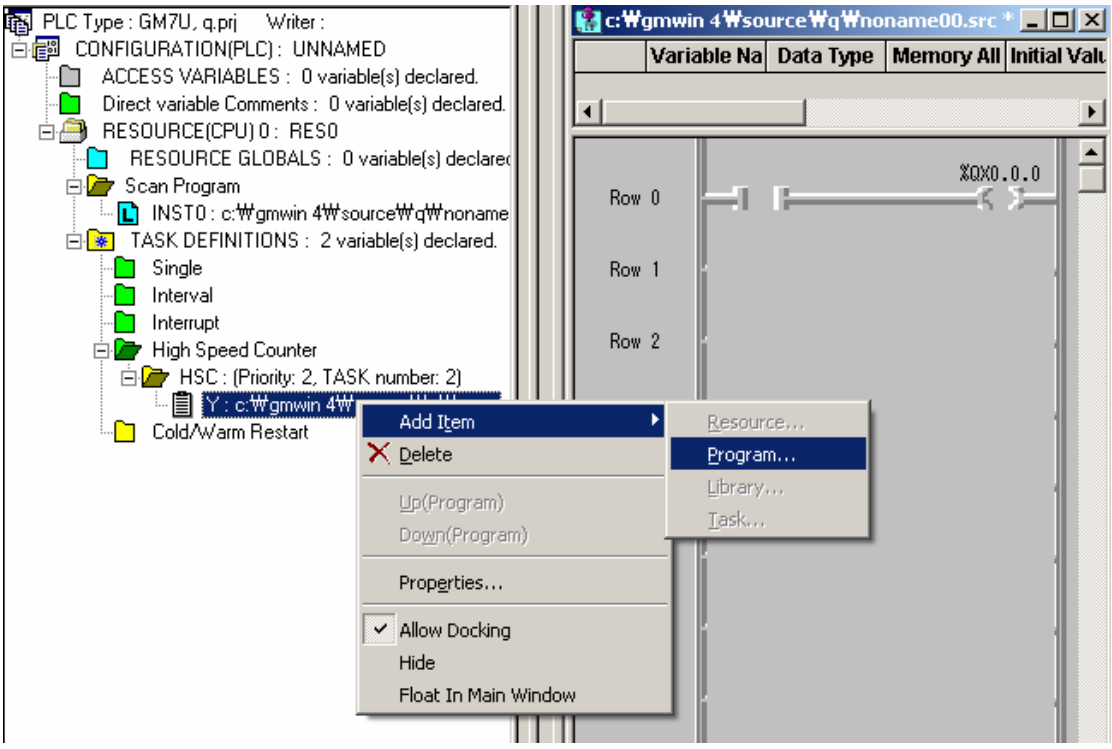
(c) Comparison Task



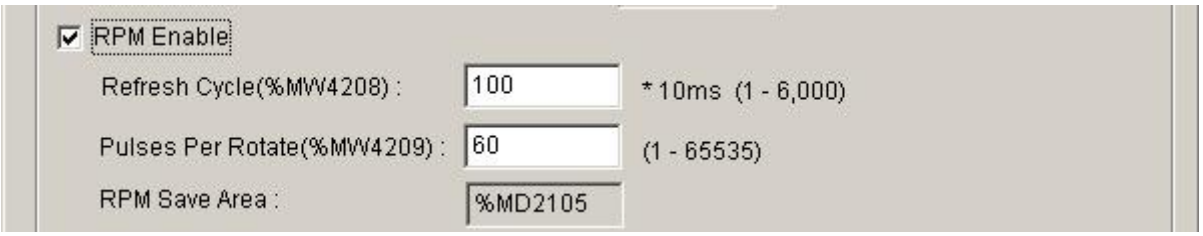
- When current value of HSC is identical with SV1, the HSC task program is executed.
- Define Task at the Execution control and write a program.

a) Program example

– %QX0.0.0 turns On when the High Speed Link task occurs.



(6) RPM setting



– Select 'RPM Enable', and input the set value.

– The RPM output displays the RPM value using the counter value's difference at every refresh cycle.

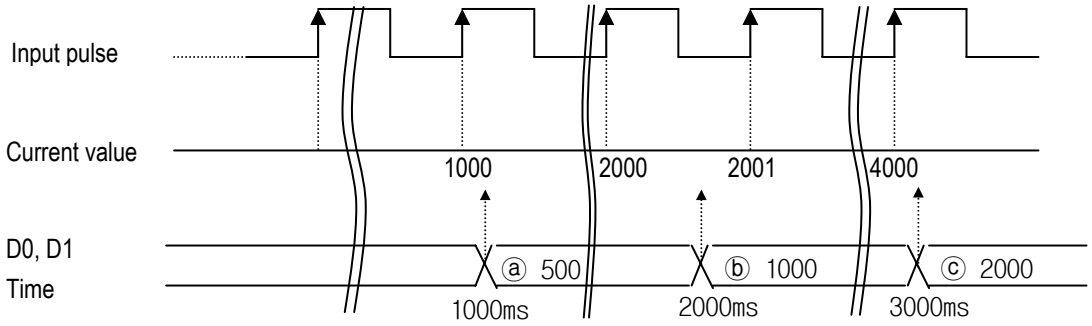
– The RPM is expressed as:

$$\text{RPM} = \frac{(\text{Current Value} - \text{Last Value}) \times 60{,}000}{\text{Pulses per rotate} \times \text{refresh cycle[ms]}}$$

- The refresh cycle is inputted as 10ms unit.
- The RPM saving areas are fixed for each channel. (Ch0: MD2105, Ch1: MD2115, Ch2: MD2125, Ch3: MD2135)

(a) Program example

- Channel 0, Refresh cycle: 1000ms (Set value 100), Pulses per rotate: 60



ⓐ Previous value = 500 (Assumption), Current value = 1000

RPM = {(1000 –500) × 60,000} / {60 × 1000} = 500

ⓑ Previous value = 1000, Current value = 2000

RPM = {(2000 –1000) × 60,000} / {60 × 1000} = 1000

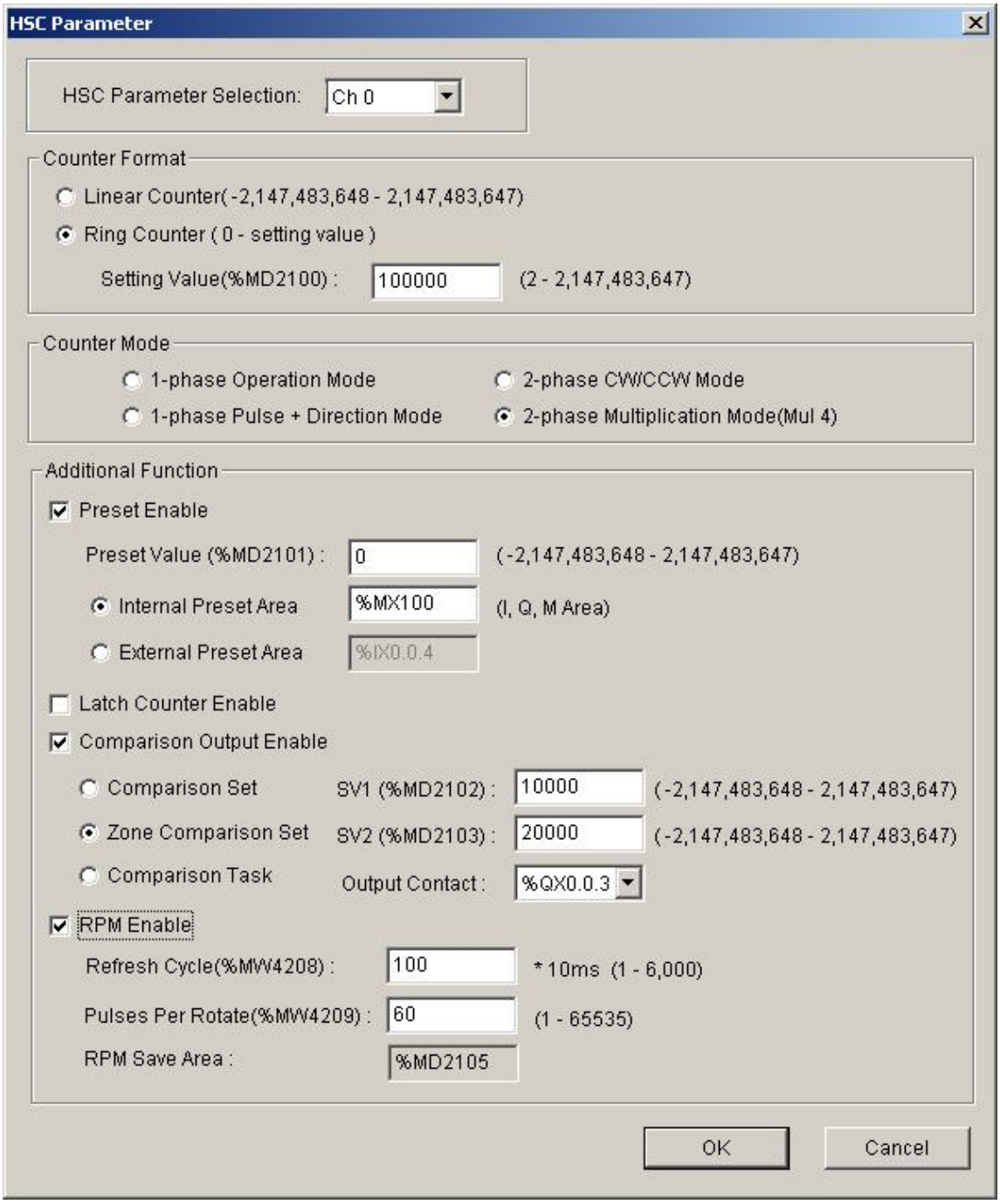
ⓒ Previous value = 2000, Current value = 4000

RPM = {(4000 –2000) × 60,000} / {60 × 1000} = 2000

9) Programming example

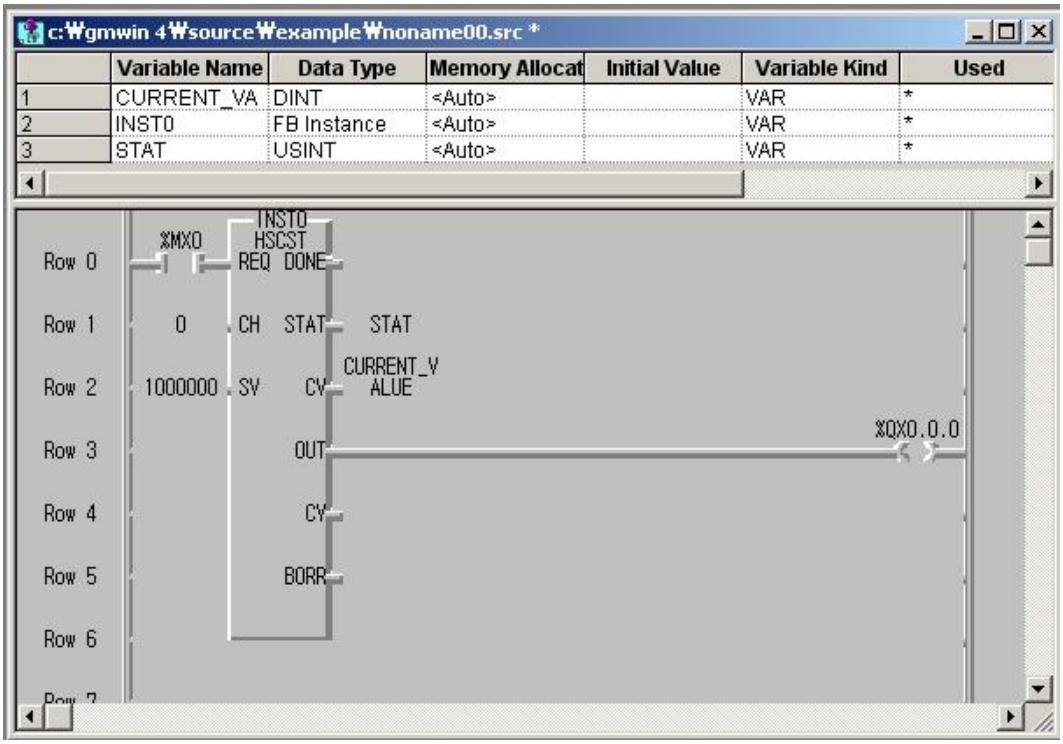
(1) Parameter setting

- Channel: Ch0
- Counter format: Ring counter (0 ~ 100,000)
- Counter mode: 2-phase multiplication mode
  - IX0.0.0: A-phase pulse input, IX0.0.1: B-phase pulse input
- Preset: change the current value to ‘0’ when the value of %MX100is ‘1’
  - Preset type: internal preset (%MX100)
  - Preset value: 0
- Last counter setting
  - None
- Comparison output: Turn %QX0.0.3 On when the value is in the range of SV1(10,000) ≤ Counter value ≤ SV2(20,000)
  - Output mode: Zone comparison set
  - SV1: 10,000, SV2: 20,000,
  - Output contact: %QX0.0.3
- RPM setting: Saves RPM value at %MD2105 at every second
  - Refresh cycle: 100 (*10ms)
  - Pulses per rotate: 60



(2) Programming

- When %MX0.0.0 turns on, HSC starts its operation
- If the current value is equal or more than 1,000,000, the output %QX0.0.0 is On.
- The current value is saved in CURRENT_VALUE (Double Word).
- %QX0.0.3 turns On if the current value is equal or more than 10,000 and less or equal than 20,000
- RPM renews at MD2105 at every second.



REMARK

The contact point which is designated as HSC input can't be used for pulse catch or external interrupt.

Duplicated designation may cause faults.

7.1.2. Pulse Catch

The input contacts (IX0.0.0 ~ IX0.0.7) are embedded in GM7U series' main unit. Using this contact point, short pulse signals like 10 ㎲ can be taken which can not be executed by general digital input.

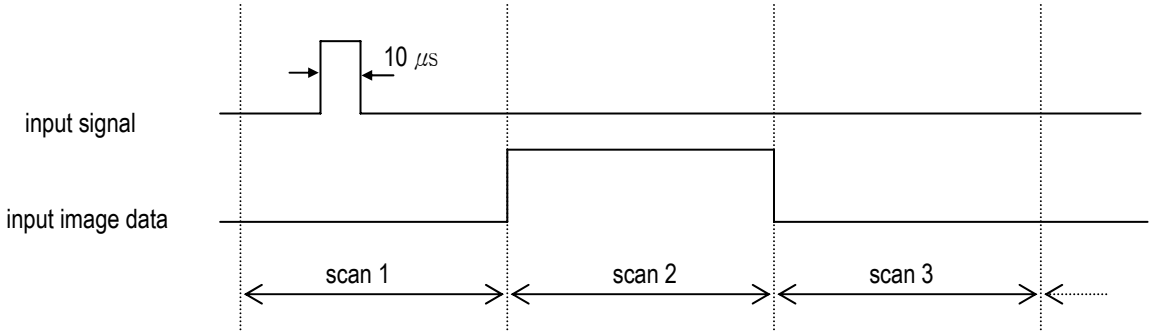
1) Usage

When narrow width of pulse signal is input, a trouble occurs which can not be detected by general digital input, so the operation does not perform as user's intention. But in this case through pulse catch function even narrow interval of pulse signal as 10 ㎲ can be detected.

2) Minimum input pulse width

- IX0.0.0 ~ IX0.0.1: 10 ㎲
- IX0.0.2 ~ IX0.0.7: 50 ㎲

3) Operation



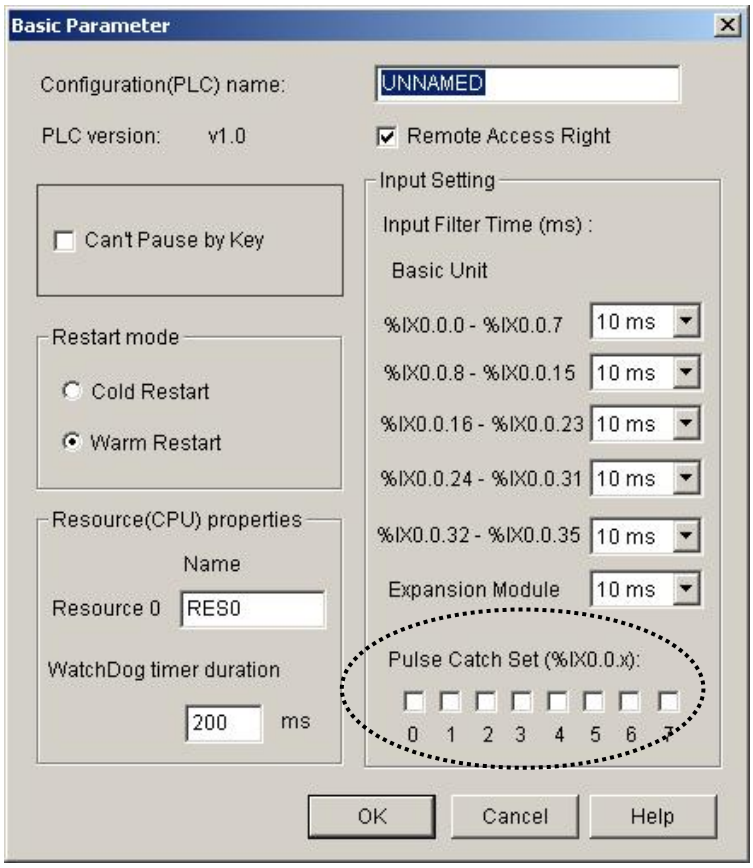
Step	Description
Scan1	CPU senses input when pulse signal, min. 10 ㎲, is input, then saves the status.
Scan2	Turn On the input image data area.
Scan3	Turn Off the input imaged data area.

4) Using method

(1) Click the basic parameter on the project window of GMWIN

(2) Select no. to use for pulse catch input in the basic parameter window.

For details about GMWIN, refers to the corresponding manuals.



REMARK

1) Only 8 points (%IX0.0.0 ~ %IX0.0.7) can be used for pulse catch input.

2) Pulse catch input contacts operate as general digital input if they are not designated as Pulse Catch Input.

2) Do not designate HSC input points as pulse catch input.

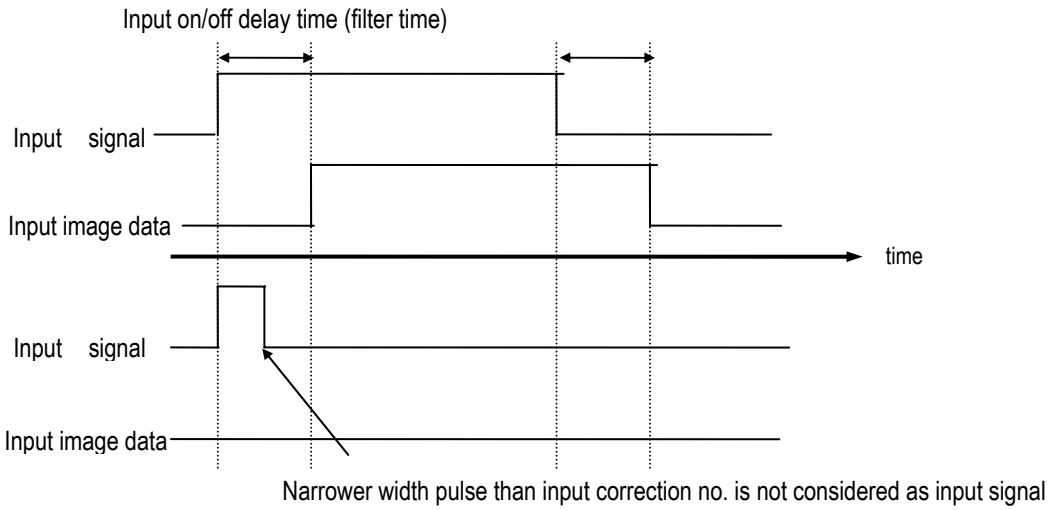
7.1.3 Input Filter

External input of GM7U selects input On/Off delay time from the range of 0-1000ms of GMWIN. Reliable system will be established by controlling the input filter time following the environment.

1) Usage

Input signal status affects to the reliability of the system where noise occurs frequently or pulse width of input signal affects as a crucial factor. In this case the user sets up the proper input on/off delay time, then the trouble by miss operation of input signal may be prevented because the signal which is shorter than set up value is not adopted.

2) Operation



3) Using method

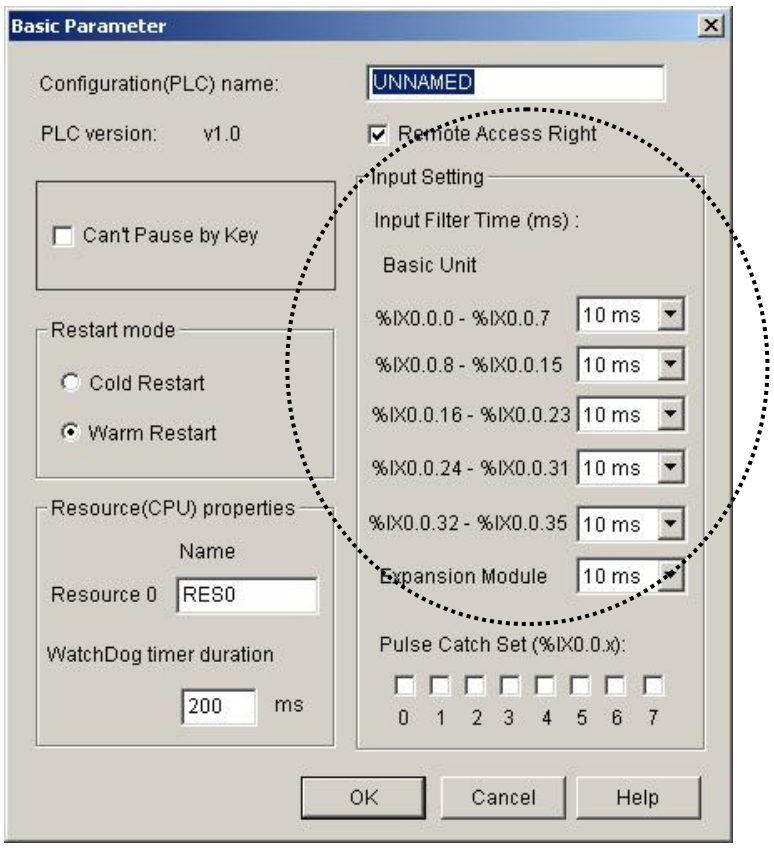
(1) Select 'Parameter' window in GMWIN.

(2) Set the filter value in Input Filter Time.

(3) For main unit, the input filter time can be set as a unit of 7 points, but for expansion unit it can be set at a time.

(4) Input filter time is set as default value of 10ms as one of 0,1,2,5,10,20,50,100,200,500,1000ms.

(5) The set on/off delay time for input is applied for all inputs in use.

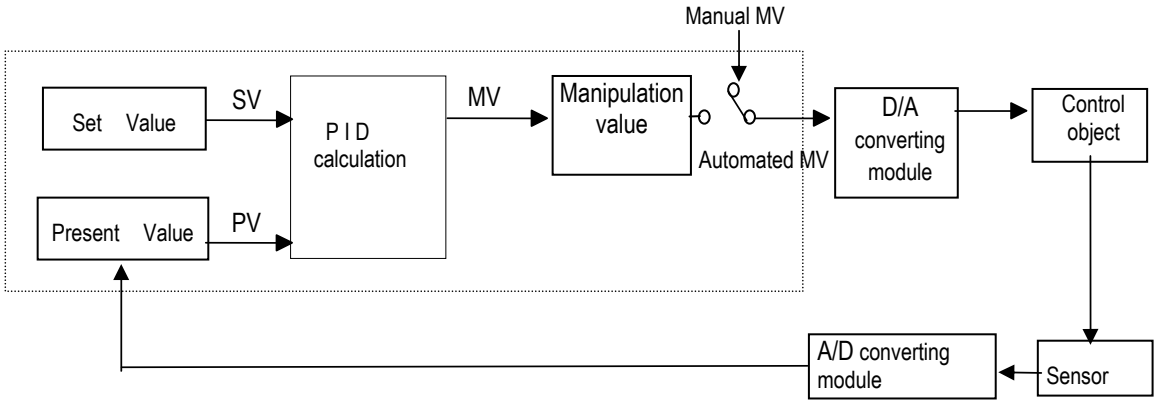


7.1.4 PID control

1) Introduction

This chapter will provide information about the built-in PID (Proportional Integral Derivative) function of GM7U main unit. The GM7U series does not have separated PID module like GM 3and GM4 series, and the PID function is integrated into the main unit.

The PID control means a control action in order to keep the object at a set value (SV). It compares the SV with a sensor measured value (PV: Present Value) and when a difference between them (E: the deviation) is detected, the controller output the manipulate value (MV) to the actuator to eliminate the difference. The PID control consists of three control actions that are proportional (P), integral (I), and derivative (D).



The characteristics of the PID function of GM7U is as following;

- the PID function is integrated into the CPU module. Therefore, all PID control action can be performed with instruction (PID7,PID7CAL) without any separated PID control module.
- P operation, PI operation, PID operation and On/Off operation can be selected easily.
- PWM(Pulse Width Modulation) output is available.
- The manual output (the user-defined forced output) is available.
- By proper parameter setting, it can keep stable operation regardless of external disturbance.
- The operation scan time (the interval that PID controller gets a sampling data from actuator) is changeable for optimizing to the system characteristics.
- SV Ramp and Delta MV function are available.

2) Specification

(1) Control operation

(a) Proportional operation (P operation)

(a) P action means a control action that obtain a manipulate value which is proportional to the deviation (E : the difference between SV and PV)

(b) The deviation (E) is obtained by multiplying a reference value to the actual difference between SV and PV. It prevents the deviation from a sudden change or alteration caused by external disturbance. The formula of deviation is as following;

$$MV = K_P \times E$$

(c) E happens, MV by P operation is like Fig.7.1

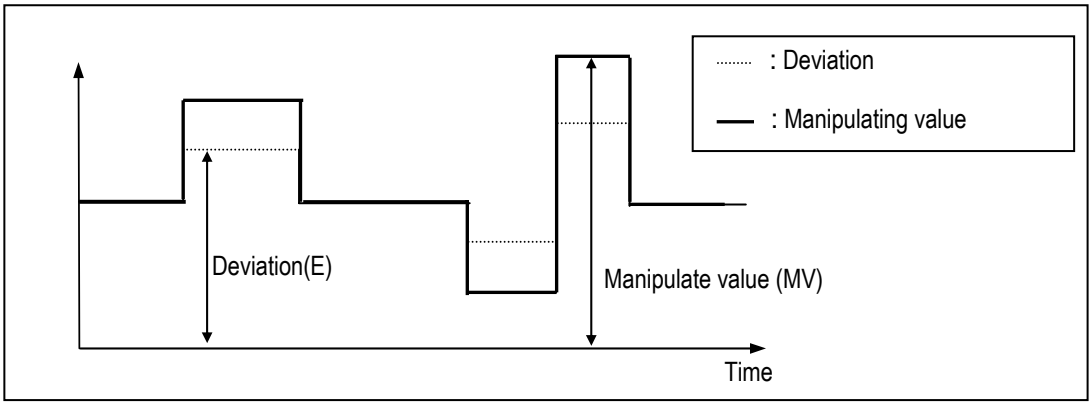


Fig 7.1 MV by P operation

(d) If the Kp is too large, the PV reaches to the SV swiftly, but it may causes a bad effect like oscillations.

(e) If the Kp is too small, oscillation will not occur. However, the PV reaches to the SV slowly and an offset may appear between PV and SV shown in the Fig. 7.2.

(f) The manipulation value (MV) varies from 0 to 4,000. User can define the maximum value of MV (MV_MAX) and minimum value (MV_MIN) within the range 0 ~ 4,000.

(g) When an offset remains after the system is stabilized, the PV can be reached to the SV by adding a certain value. This value is called as bias value, and user can define the bias value

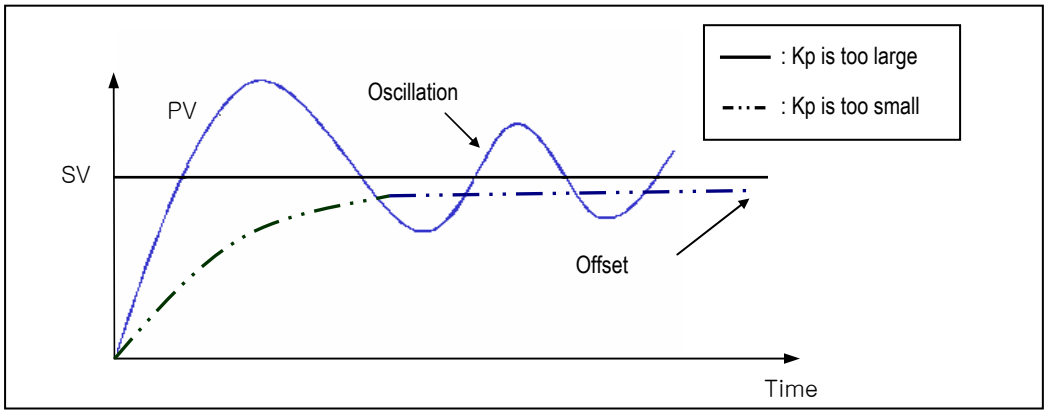


Fig. 7.2 The relation between Proportional constant (Kp) and present value (PV)

(b) Integral operation (I operation)

① With integral operation, the manipulate value (MV) is increased or decreased continuously in accordance time in order to eliminate the deviation between the SV and PV. When the deviation is very small, the proportional operation can not produce a proper manipulate value and an offset remains between PV and SV. The integral operation can eliminate the offset value even the deviation is very small.

The period of the time from when the deviation has occurred in I action to when the MV of I action become that of P action is called Integration time and represented as Ti.

② Integral action when a constant deviation has occurred is shown as the following Fig. 7.3.

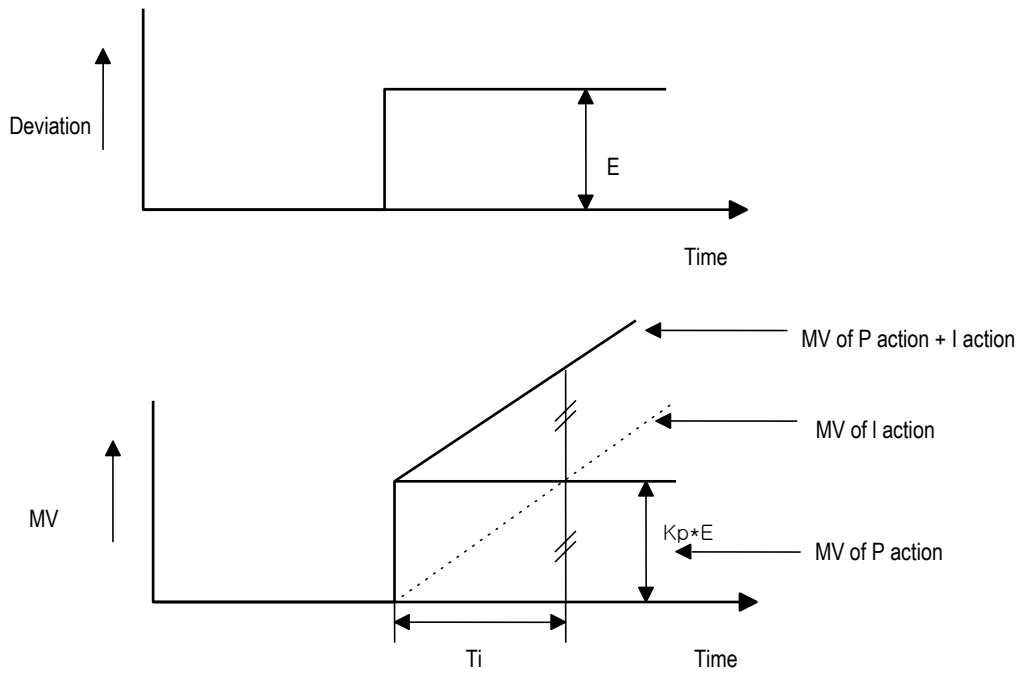


Fig. 7.3 The integral action with constant deviation

③ The expression of I action is as following;

$$MV = \frac{Kp}{Ti}\int Edt$$

As shown in the expression, Integral action can be made stronger or weaker by adjusting integration time (Ti) in I action. That is, the more the integration time (the longer the integration time) as shown in Fig. 7.4, the lesser the quantity added to or subtracted from the MV and the longer the time needed for the PV to reach the SV.

As shown in Fig. 7.5, when the integration time given is short the PV will approach the SV in short time since the quantity added or subtracted become increased. But, If the integration time is too short then oscillations occur, therefore, the proper P and I value is requested.

④ Integral action is used in either PI action in which P action combines with I action or PID action in which P and D actions combine with I action.

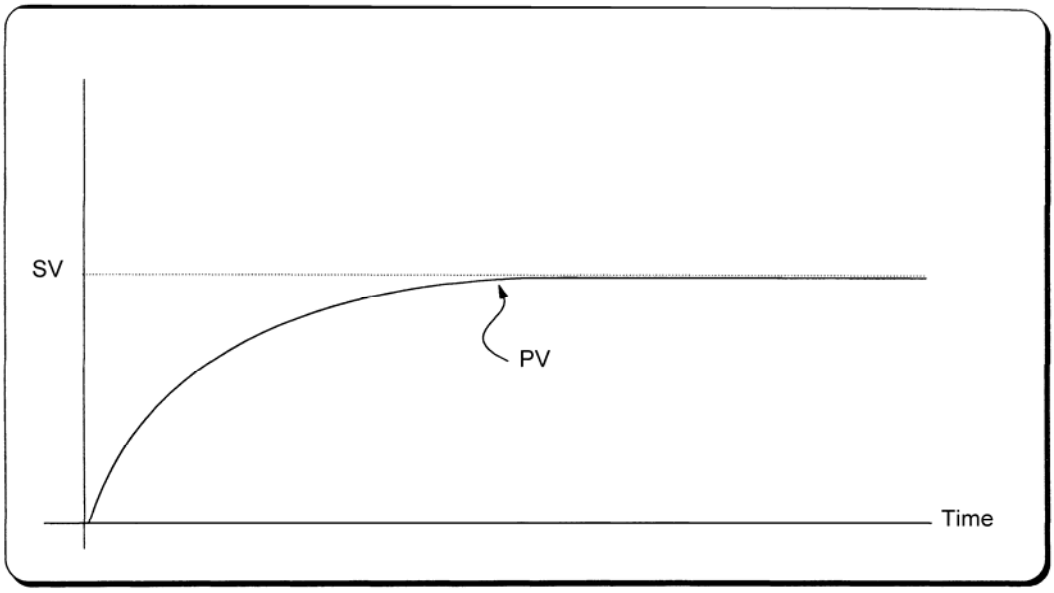


Fig. 7.4 The system response when a long integration time given

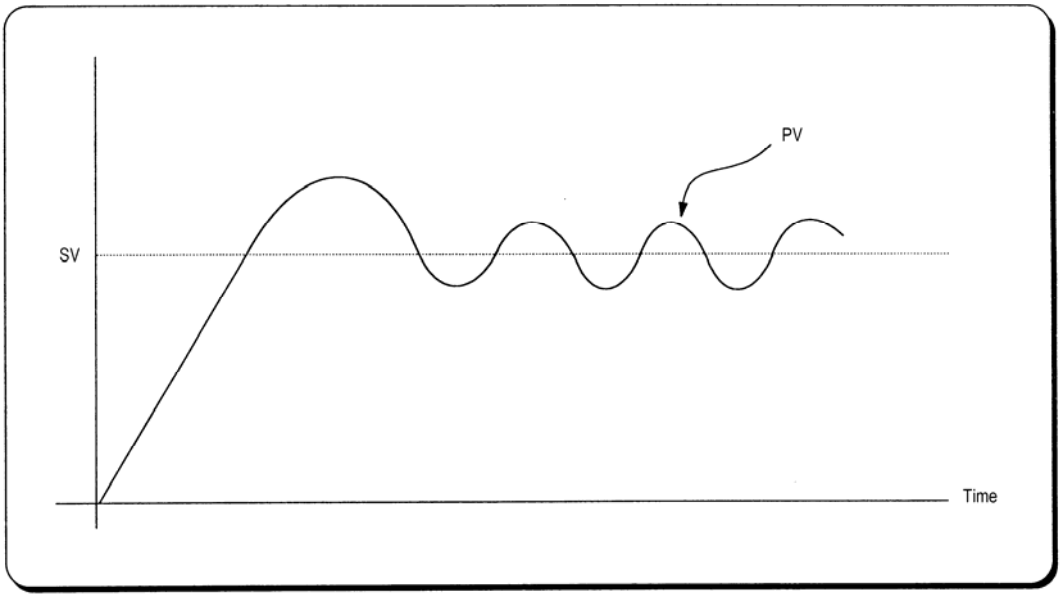


Fig. 7.5 The system response when a short integration time given

(c) Derivative operation (D action)

① When a deviation occurs due to alteration of SV or external disturbances, D action restrains the changes of the deviation by producing MV which is proportioned with the change velocity (a velocity whose deviation changes at every constant interval) in order to eliminate the deviation.

② D action gives quick response to control action and has an effect to reduce swiftly the deviation by applying a large control action (in the direction that the deviation will be eliminated) at the earlier time that the deviation occurs.

③ D action can prevent the large changes of control object due to external conditions.

④ The period of time from when the deviation has occurred to when the MV of D action become the MV of P action is called derivative time and represented as Td.

⑤ The D action when a constant deviation occurred is shown as Fig. 7.6

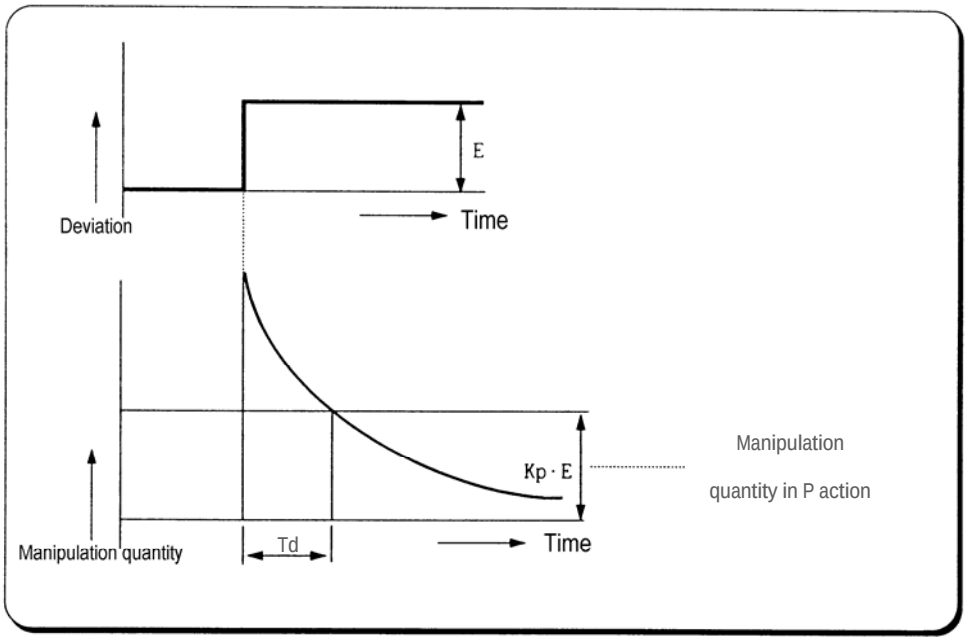


Fig. 7.6 Derivative action with a constant deviation

⑥ The expression of D action is as following;

$$MV = Kp \times Td \frac{dE}{dt}$$

⑦ Derivative action is used only in PID action in which P and I actions combine with D action.

(d) PID action

① PID action controls the control object with the manipulation quantity produced by (P+I+D) action

② PID action when a given deviation has occurred is shown as the following Fig. 7.7.

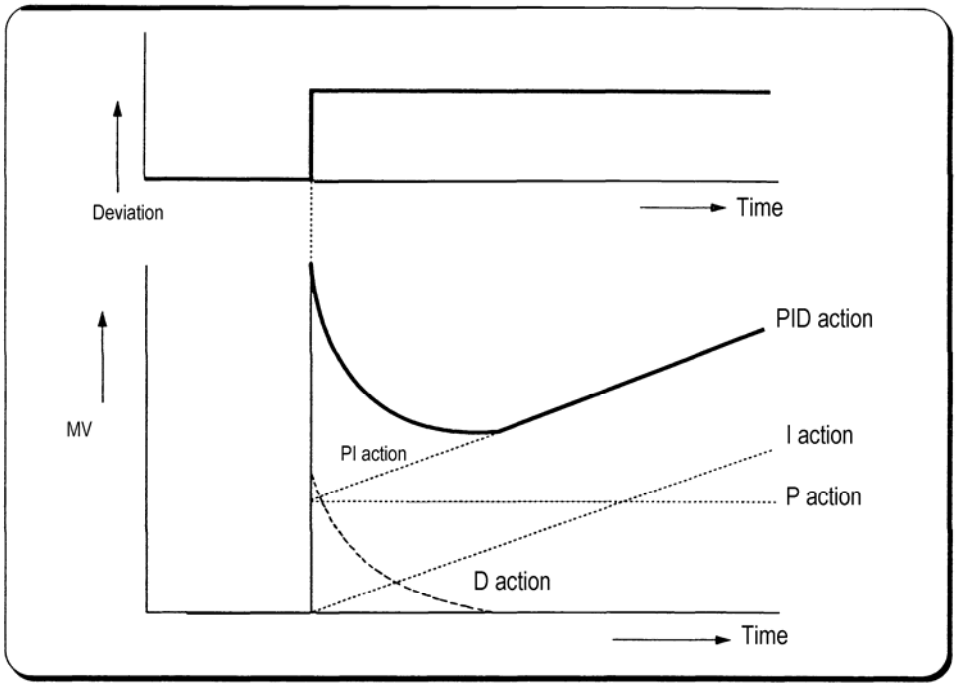


Fig. 7.7 PID action with a constant deviation

(e) Integral windup

All devices to be controlled, actuator, has limitation of operation. The motor has speed limit, the valve can not flow over the maximum value. When the control system has wide PV range, the PV can be over the maximum output value of actuator. At this time, the actuator keeps the maximum output regardless the change of PV while the PV is over the maximum output value of actuator. It can shorten the lifetime of actuator.

When the I control action is used, the deviation term is integrated continuously. It makes the output of I control action very large, especially when the response characteristic of system is slow.

This situation that the output of actuator is saturated, is called as 'windup'. It takes a long time that the actuator returns to normal operating state after the windup was occurred.

The Fig. 7.8 shows the PV and MV of PI control system when the windup occurs. As shown as the Fig. 7.8, the actuator is saturated because of the large initial deviation. The integral term increase until the PV reaches to the SV (deviation = 0), and then start to decrease while the PV is larger than SV (deviation < 0). However, the MV keeps the saturated status until the integral term is small enough to cancel the windup of actuator. As the result of the windup, the actuator will output positive value for a while after the PV reached to the SV, and the system show a large overshoot. A large initial deviation, load disturbance, or miss-operation of devices can cause windup of actuator.

There are several methods to avoid the windup of actuator. The most popular methods are adding another feedback system to actuator, using the model of actuator and stop integrating when actuator is saturated.

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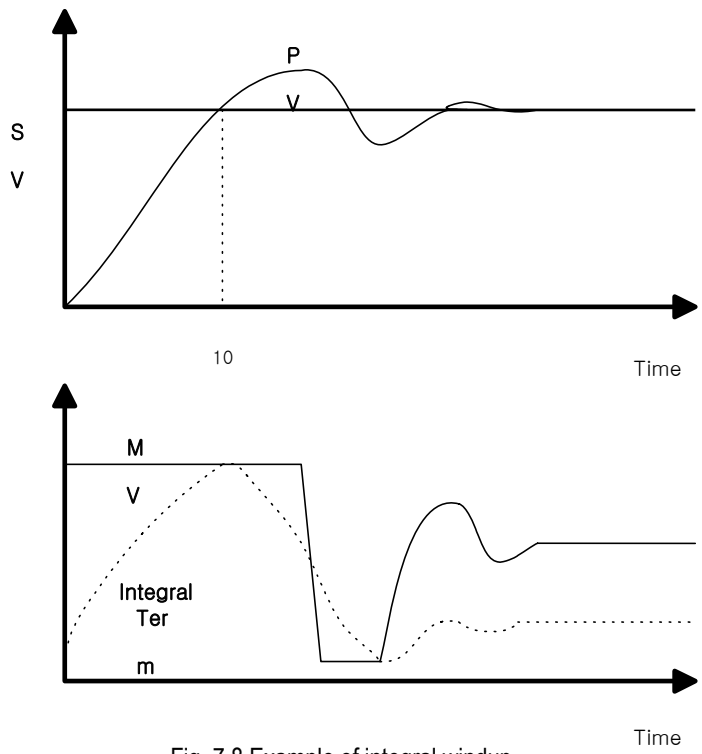


Fig. 7.8 Example of integral windup

(2) Realization of PID control on the PLC

In this chapter, it will described that how to get the digitized formula of the P, I, and D terms.

(a) P control

The digitized formula of P control is as following;

$$P(n) = K_P(SV - PV)$$

Kp: proportional gain constant, SV: set value, PV: present value

(b) I control

The continuous formula of I control is as following;

$$I(t) = \frac{K_P}{T_i}\int_0^t E(s)ds$$

Kp: proportional gain constant *Ti*: integral time

E(s): deviation value

By derivation about t, we can obtain;

$$\frac{dI}{dt} = \frac{K_P}{T_i}E$$

where, e = (SV – PV): deviation value

The digitized formula is as following;

$$\frac{I(n+1) - I(n)}{h} = \frac{K_P}{T_i}E(n)$$

where, h: sampling period

$$I(n+1) = I(n) + \frac{K_P h}{T_i}E(n)$$

(c) D control

The continuous formula of derivative term is as following;

$$\frac{T_D}{N}\frac{dD(n)}{dt} + D(n) = -K_P T_d \frac{dy}{dt}$$

N: high frequency noise depression ratio

y: the object to be controlled (PV)

3) Function block

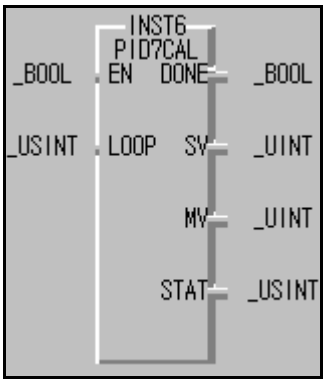
For the PID operation of GM7U, following 2 instructions are included in the GMWIN software.

No.	Name	Description
1	PID7CAL	Perform the PID operation
2	PID7AT	Perform the auto tuning operation

REMARK

1) Array is not supported for GM7U PID function block.
2) For details, refer to the GMWIN user's manual.

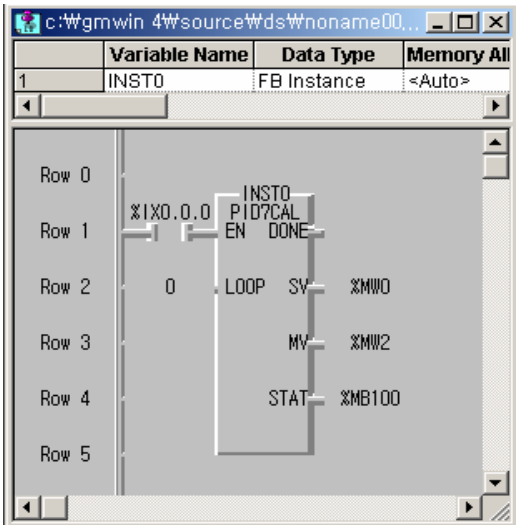
(1) The function block for PID operation (PID7CAL)

Function block	Description	
	Input	EN: enables PID7CAL function block (Level operation) LOOP: sets execution loop (0~7)
	Output	DONE: On when the execution is finished without an error. Off when an error occurred or there is not execution request SV: outputs current SV (set value) (range: 0~4000) MV: outputs MV (manipulation value) (range: 0 ~ 4000) STAT: outputs error code

a) Usage

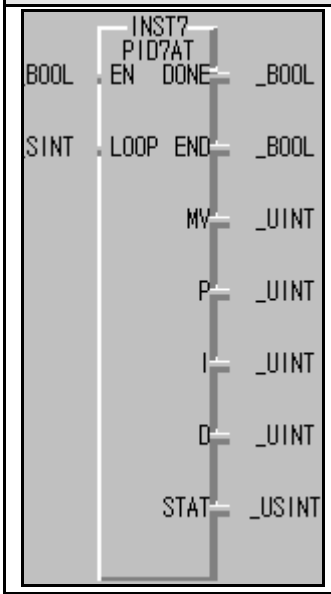
- When the condition of the execution is On, PID operation is executed following the set values of the parameter. (The PID operation does not operate at the edge, it operates while the execution condition is On.)
- LOOP No. (LOOP) designates the PID operation LOOP no. (0~7)
- Stat disignates the area where the PID Operation loop's status is saved.

b) Program example



- When the input codition %IX0.0.0 turns On, the PID operation starts following the parameters.
- The satus during the PID operation is saved in %MB100, and the PID control output value (MV) is saved in %MW2.
- For SV Ramp function, the changing SV is save in %MW0.

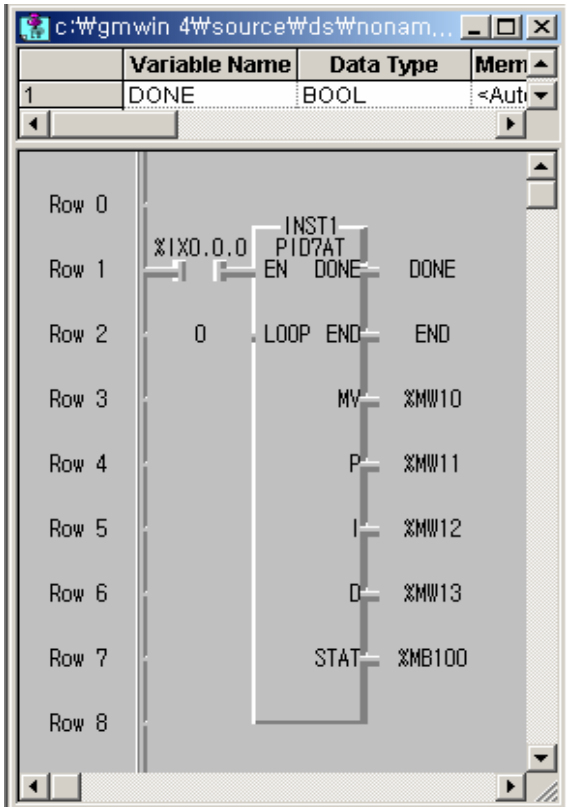
(2) Auto tuning function block (PID7AT)

Function block	Description	
	Input	EN: enables PID7CAL function block (Level operation) LOOP: sets execution loop (0~7)
	Output	DONE : Turn on whenever the auto tuning operation is completed. END : Turns on when the F/B operation is completed with no error, and keep the status until next F/B execution. STAT Displays the error code MV: The manipulated value of current loop on which the auto tuning operation is performed. P: The proportional gain constant obtained by auto tuning operation. I: The integral time constant obtained by auto tuning operation. D: the derivative time constant obtained by auto tuning operation.

a) Usage

- When the condition of the execution is On, PID auto tuning operation executes and calculates P,I,D constant.
- LOOP No. (LOOP) designates the LOOP no. that is registered at the PID auto tuning parameter. (0~7)
- Stat disignates the area where the PID auto tuning loop's status is saved.

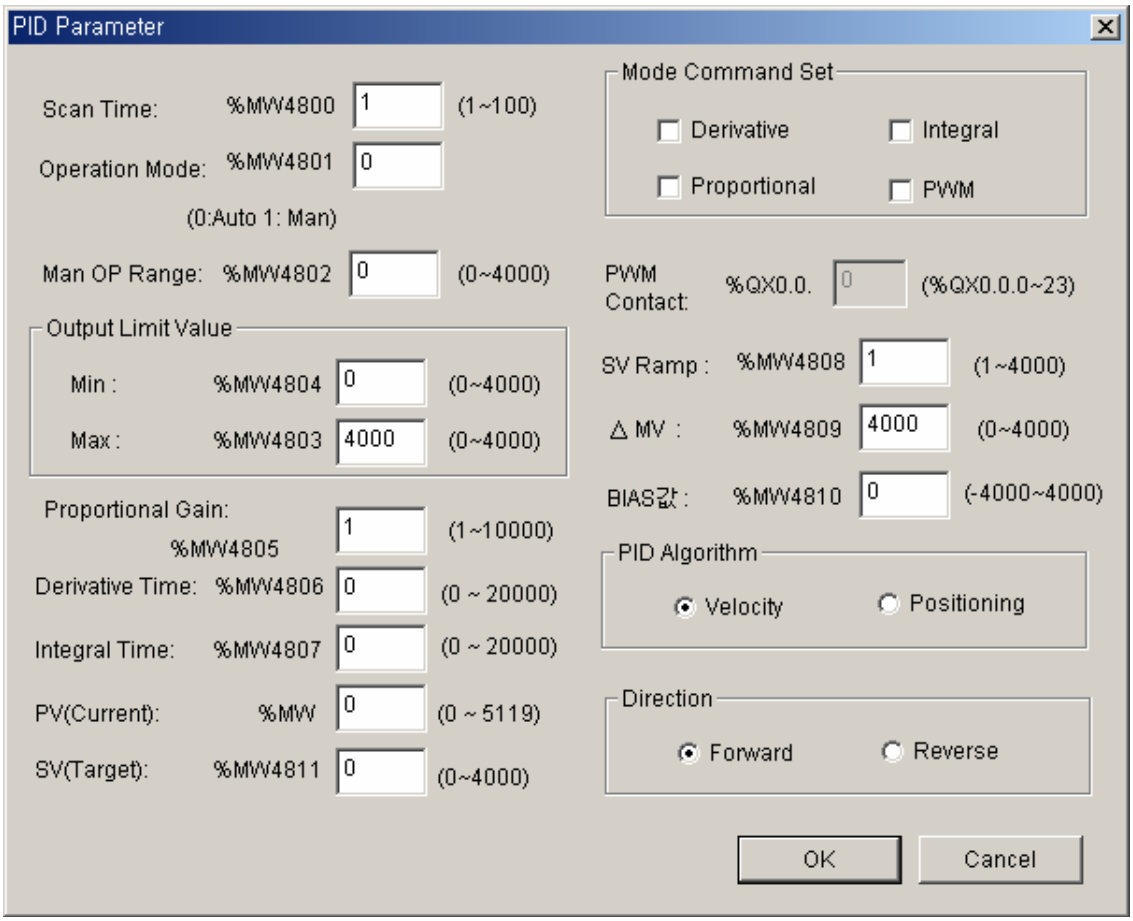
b) Program example



- When the input condition %IX0.0.0 turns On, the auto tuning starts its operation following the parameter 0.
- During the auto tuning, DONE state keeps On, and when it finished END state turns On.
- When an error occurs the STAT is ouputted at %MB100.
- MV is saved in %MW10.
- The P,I,D values are saved in %MW11,%MW12,%MW13 respectively.

4) parameter setting and explanation

a) PID parameter settings



(1) Scan time (%MW4800)

Scan time is the period of reading data (sampling), and also 10 times scaled up. The range of sampling time is 0.1 ~ 10 seconds, and actual input range is 0 ~ 100. Generally, Scan time of Digital PID control should be less than 1/10 of time constant of system response for better performance. Time constant is the time taken the system's step response reaches to the 63% of steady state.

(2) Operation mode (%MW4801)

Select automatic or manual operating mode

(3) Manual operate range (%MW4802)

When manual operation is designates , manual operation value designates. (input range: 0 ~ 4000)

(4) Output limit value (%MW4803, %MW4804)

Designate minimum and maximum values of available manipulate value. (range: 0 ~ 4000)

(5) Proportional gain (%MW4805)

Indicates the proportional gain. It uses10 times scaled up value. (range: 1 ~ 10000)

(6) Derivative time and integral time (%MW4806,%MW4807)

I_TIME and D_TIME are 10 times scaled up. The range of actual input is 0 ~ 20000.

(7) Mode command set

In GM7U, only the following 7 operation modes are available. Other operation modes, such as PD or I, are not permitted.

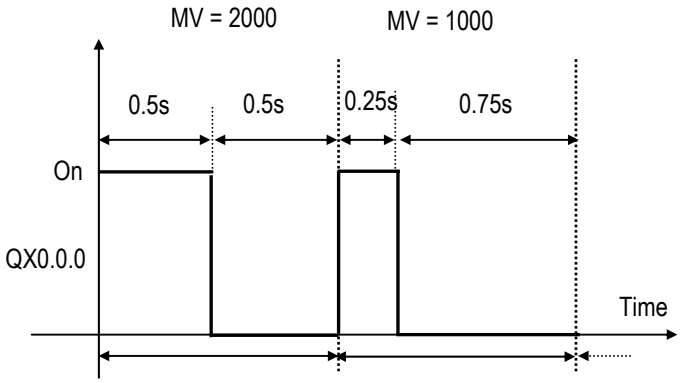
No.	EN_P	EN_I	EN_D	PWM output	Operation
1	1 (enable)	0 (disable)	0 (disable)	0 (disable)	P operation
2	1 (enable)	1 (enable)	0 (disable)		PI operation
3	1 (enable)	1 (enable)	1 (enable)		PID operation
4	1 (enable)	0 (disable)	0 (disable)	1 (enable)	P operation/PWM output
5	1 (enable)	1 (enable)	0 (disable)		PI operation/PWM output
6	1 (enable)	1 (enable)	1 (enable)		PID operation/PWM output
7	0 (disable)	0 (disable)	0 (disable)	0 (disable)	On/Off operation

- If PWM output is selected, the calculated value is outputted with PWM.

(8) Set PWM

PWM (Pulse Width Modulation) is a output method which changes on-off duty of output pulses by calculated manipulation value. The figure below shows an example of PWM output. Using PWM output, PID control system can be constructed easily without D/A conversion module and power regulator. The output can be designated when PWM is selected, but only main unit's contacts can be used for PWM output. (The expansion module's output cannot be used.)

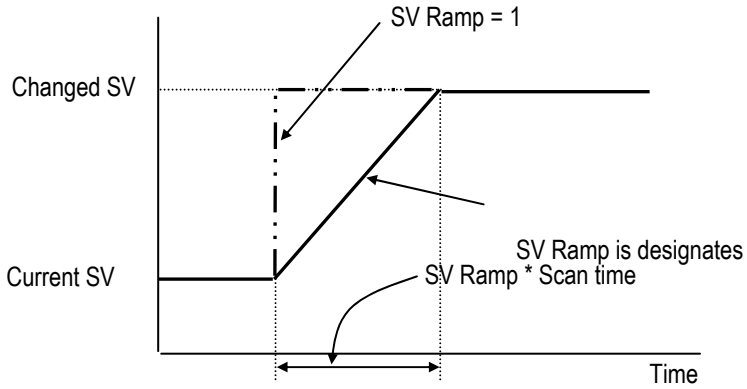
Ex.) Output range limit: 0~4000, operation scan time: 1s, PWM output contact: QX0.0.0



(9) SV Ramp

If a large amount of SV changes during PID operation, The deviation(E) changes rapidly. Then manipulation value(MV) is changed rapidly also. This can cause damage on load or actuator. To prevent this situation, SV can be changed step by step by parameter setting. Setting range is 1~4000(Default value is 1). Setting value represents the number of time which taken from starting set value to last set value.

For example, if the operation scan time is set to 5 (0.5 sec), SV Ramp is 500, and SV changed from 1000 to 2000 during operation, it increases by 2 at every scan and reach 2000 after 500 scan time.



(10) Delta MV

This is useful to limit maximum change of manipulation value. For example, if Δ MV is set to 500, the MV value in the operation scan does not change more than 500. The value should be set with proper value because the speed could be reduced. Setting range is 0 ~ 4000 and default value is 4000.

(11) Bias (%MW4810)

The Bias data is used for the compensation of offset in the proportional control. The range of input is 0 ~ 4000. Be cautious that The actual range of Bias is –2000 ~ 2000. namely, 0~2000 represents 0 ~ +2000 and 2001 ~ 4000 represents -1 ~ -2000.

Example) If offset (SV-PV) is 100 → Bias should be 100.
If offset (SV-PV) is -100 → Bias should be 2100.

(12) SV(Target) and PV(Current)

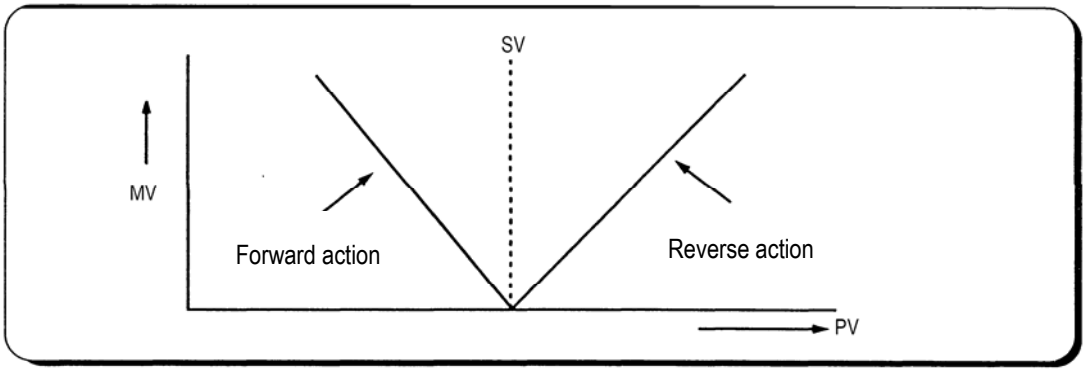
SV (setting value: the designated value) and PV (process value: present value) of GM7U PID operation have the range 0 ~ 4000. The range is set with the consideration of the resolution of A/D and D/A module of GM7U series (12bits) and offset value.

(13) Forward and reverse action

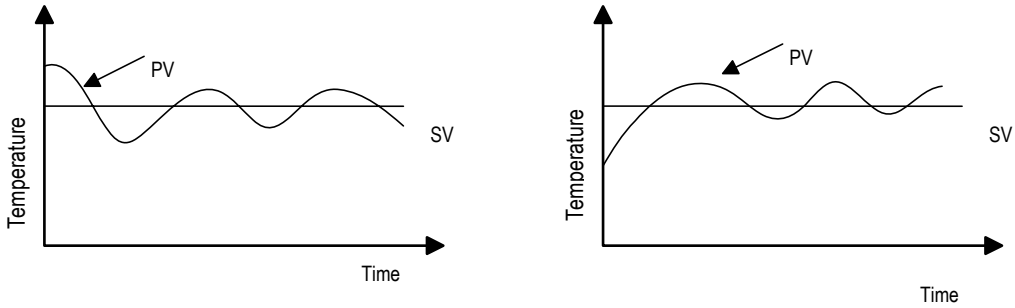
PID control has two kinds of action, forward action and reverse action.

- Forward action makes PV reach SV by outputting MV when PV is less than SV, the heating system is an example of the forward action.
- Reverse action makes PV reach SV by outputting MV when PV is more than SV, the air cooling systems is an example of the reverse action.

A diagram in which forward and reverse actions are drawn using MV, PV and SV is shown as below.



Forward and reverse action with MV, PV and SV



Reverse action (for cooling)　　Forward action (for heating)

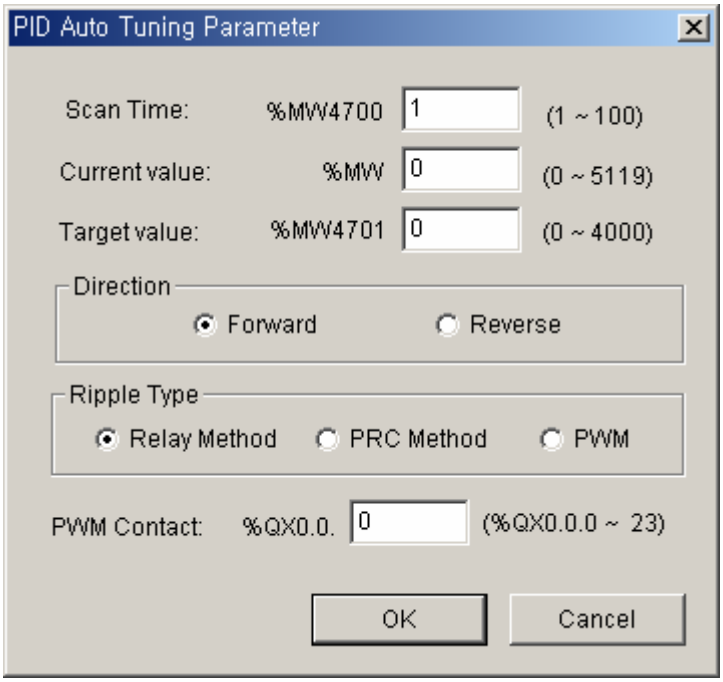
Examples of process control by forward and reverse actions

(14) PID Algorithm

In GM7U, two type of PID algorithm is available, The velocity form(Speed) and positioning form.

Velocity form(Speed) operates incremental manners. Namely, It calculates the change(Δ n) required from previous manipulate value(MVn-1), But positioning form calculates an absolute manipulate value(MVn) every sampling steps. Generally, The velocity form is suit for the system which's load change is slow like temperature control system, and positioning form is useful for system which's load change is fast.

b) PID Auto Tuning Parameter settings



① Scan time (%MW4700)

Scan Time is the period of reading data (sampling), and 10 times scaled up for more precious operation.

The range of sampling time is 0.1 ~ 10 seconds, and actual input range is 0 ~ 100.

② SV(set value) / PV (present value)

SV (set value: the designated value) and PV (process value: present value) of GM7U PID operation have the range 0 ~ 4000. The range is set with the consideration of the resolution of A/D and D/A module of GM7U series (12 bits) and offset value. When setting the SV or PV, please be careful convert the analog value of control object (temperature, velocity, etc.) to digital value that are the output of A/D convert module.

ⓐ When using sensor and A/D conversion module

Assume that PID control is used for temperature control with Pt100 (operation range: -200 °C ~ 600 °C), and the goal value is 100 °C. The equivalent digital output of A/D module (current input range: 4 ~ 20mA) is 1500 if the A/D module outputs 0 (4mA) with -200 °C, and 4000(20mA) with 600 °C. Therefore, the input of SV should be 1500, not 100.

ⓑ When using sensor and RTD module(G7F-RD2A)

Assume that PID control is used for temperature control with Pt100 (operation range: -200 °C ~ 600 °C), and the goal value is 100 °C. The digital output of RTD module is calculated as below.

$$DigitalOutput = \frac{Temp. \times 10 + 2000}{2}$$

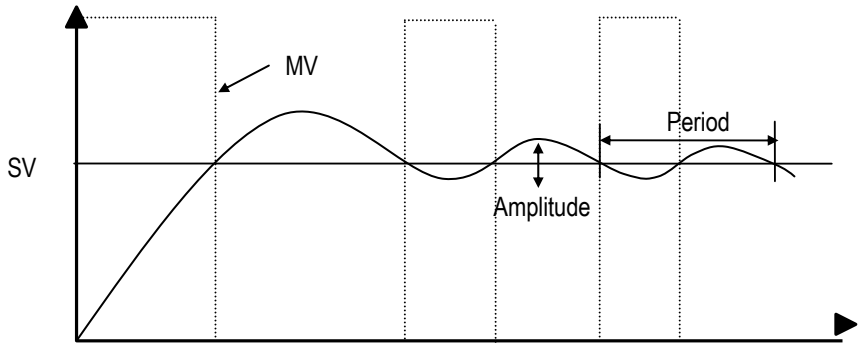
Therefore, SV should be 1500,

③ Tuning method

The GM7U perform auto-tuning operation in two methods. One is relay response method and the other is process reaction curve method.

ⓐ Relay response method.

- PID parameters are obtained by On/Off operation during 1 cycle of PV variation.
- PID parameters are obtained by amplitude and period of oscillation
- The On/Off operation will be occur at the SV value.

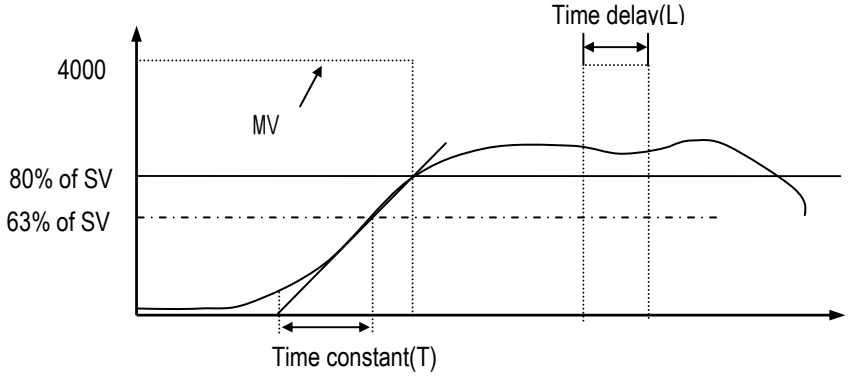


ⓑ Process reaction curve method(PRC method).

- PID parameters are obtained by step response of process.
- It is useful fo r time 1st order time delay system expressed as following

$$K\frac{e^{-Ls}}{Ts+1}$$

- Obtained parameters may not accurate if the process can't approximated to 1st order system, In this case, use relay response method.

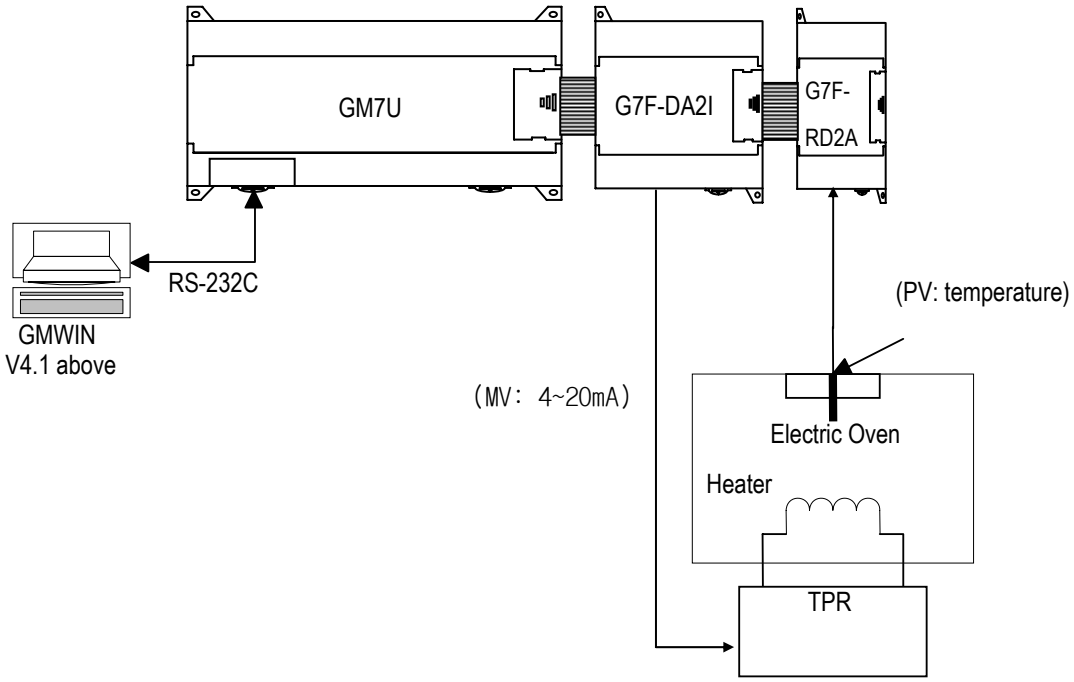


ⓒ PWM Tuning

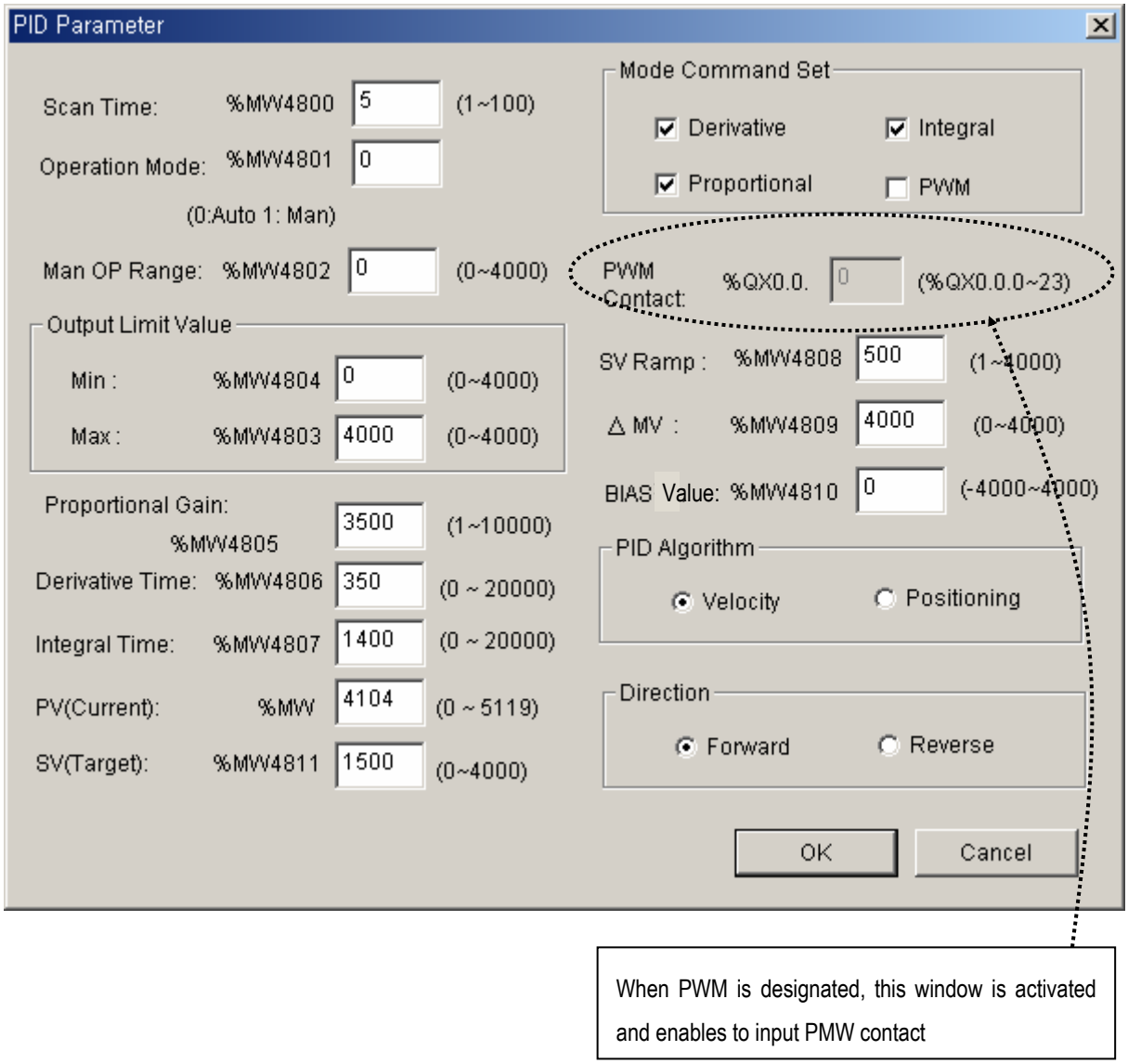
PWM (Pulse Width Modulation) is a output method which changes on-off duty of output pulses by calculated manipulation value. The figure below shows an example of PWM output. Using PWM output, PID control system can be constructed easily without D/A conversion module and power regulator. The output can be designated when PWM is selected, but only main unit's contacts can be used for PWM output. (The expansion module's cannot be used.)

5) Program example

(1) System configuration



(2) In case of using PID function only



When PWM is designated, this window is activated and enables to input PMW contact

a) PID operation explanation (without A/T function)

- Measure current temperature (-200~600°C) by RTD module then digital conversion value(0 ~ 4000).
- PID8 instruction will calculate manipulate value (MV: 0 ~ 4000) based on PID parameter settings (P_GAIN, I_TIME, D_TIME, etc.) and PV from RTD module. Then, the calculated MV is output to the channel 0 of D/A module.
- D/A module will convert the MV to analog signal and output to the actuator (power converter).

b) Parameter settings

- Scan Time: 0.5 s (input '5')
- Operation Mode: 0 (operation mode is set to 'Auto')
- Output Limit Value: Max: 4000, Min: 0

- SV setting (G7E-RD2A): 1300(60°C),1350(70°C),1400(80°C),1500(100°C)
- Current value setting: %MW4104 (Digital value of RTD module Ch 0, expansion module #2)
- BIAS setting: 0 (If only P control is used, input proper value other 0)
- Mode Command Set: select the related items Derivative, Integral, Proportional (select PWM when it is needed)

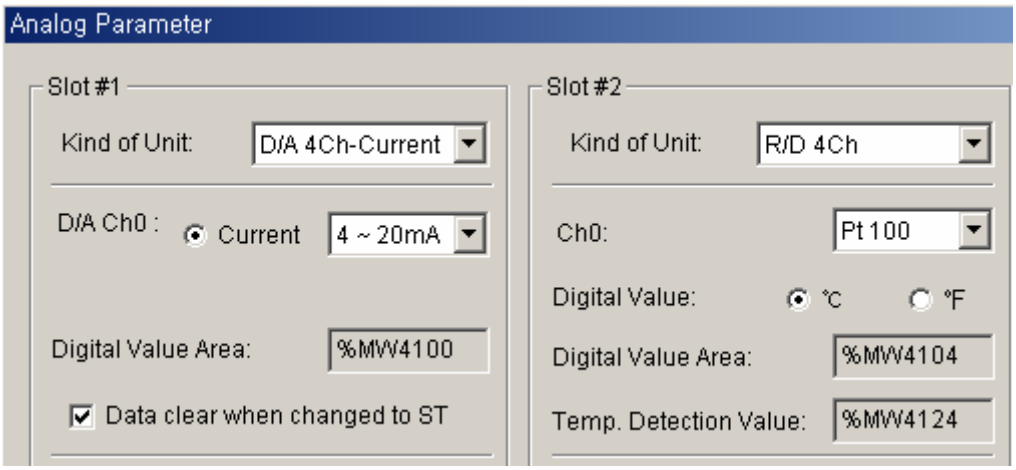
- PWM contact: When it is activated, input proper values.
- SV Ramp: 500 (when SV converted'500*0.5 sec = 25 sec')
- ΔMV : 4000 (delta MV function is not used)
- PID Algorithm: Velocity

c) RTD module setting

- Channel setting: channel 0
- RTD type setting : Pt100
- Digital conversion data registration area: %MW4104

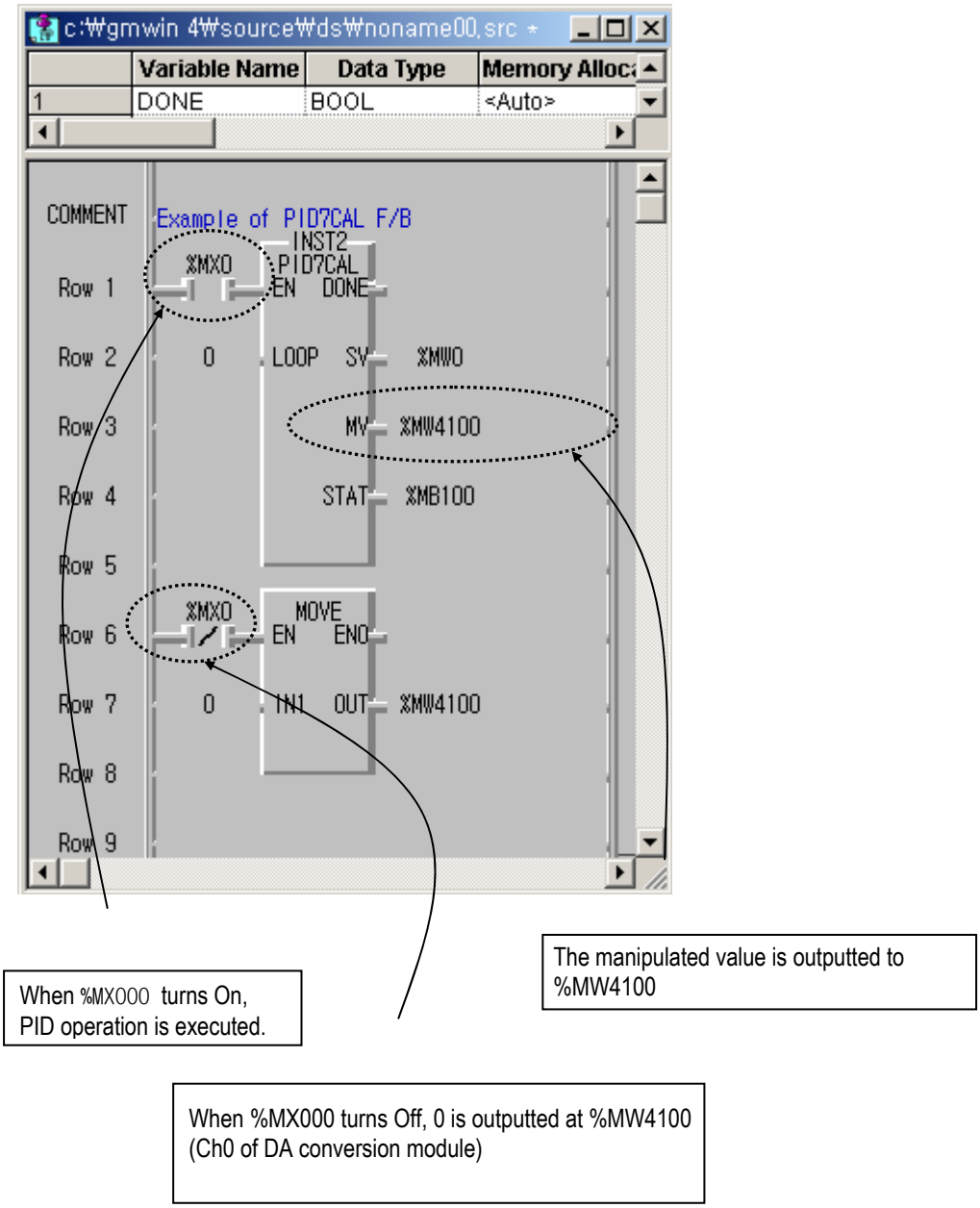
d) D/A module setting

- Channel setting: channel 0
- Output range setting: DC 4 ~ 20 mA
- D/A conversion data registration area: %MW4100



e) Program

- When the input condition %MX0 turns on, PID operation executes at no.0 loop.
- PID execution status registrate %MB100 and the output value of control result registrate %MW4100 (output to channel 0 of D/A conversion module).
- When the input condition turns off, it outputs 0 to the %MW4100 (channel 0 of D/A conversion module).



(3) In case of using combined function of PID operation and auto tuning

(a) PID operation explanation (with A/T function)

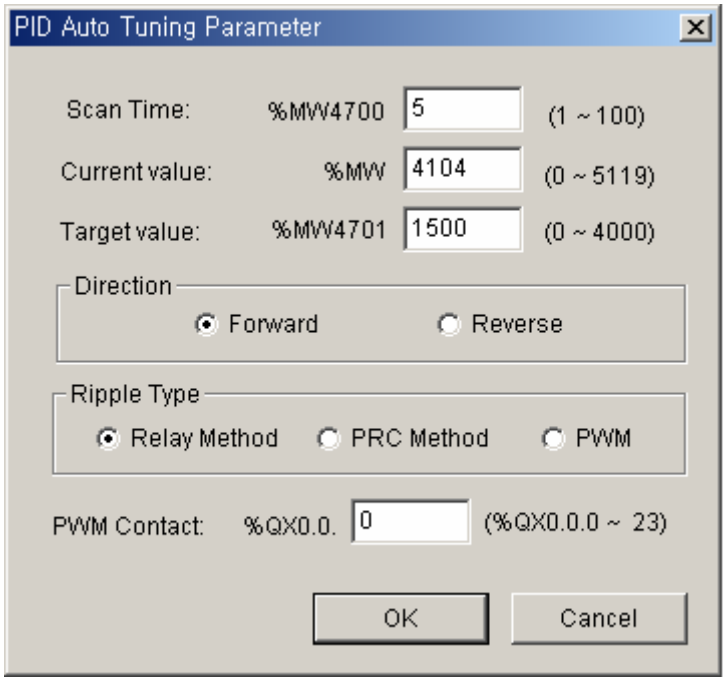
- Measure current temperature by RTD module then digital conversion value(0 ~ 4000) is stored.
- PID7AT instruction will calculate manipulate value (MV : 0 ~ 4000) based on the SV and PV from RTD module and output the value in range of 0~4000 to the D/A conversion module.
- The END bit of auto tuning status device will be 1 when the auto tuning is completed, and the calculate P, I, D constants are saved respectively in the designated value. These values become the P, I, D control constant. Program to execute the PID operation when the END bit becomes 1.
- D/A conversion modules convert the manipulate value to analog signal (4~20mA) and input it to the actuator.

(b) PID Auto Tuning Parameter

- Target value (for G7F-RD2A)

  - 1300(60℃),1350(70℃),1400(80℃),1500(100℃)

- Scan Time: 0.5 sec(input '5')
- Current value: %MW4104 (conversion value of the RTD module's channel 0)
- Ripple Type: Relay Method



(c) Auto tuning parameters

- Scan Time: 0.5 sec (input '5')
- Operation Mode: 0 (Auto)
- Output Limit Value: Max: 4000, Min: 0
- Man OP range: 0 (Operation mode is set to 'Auto')

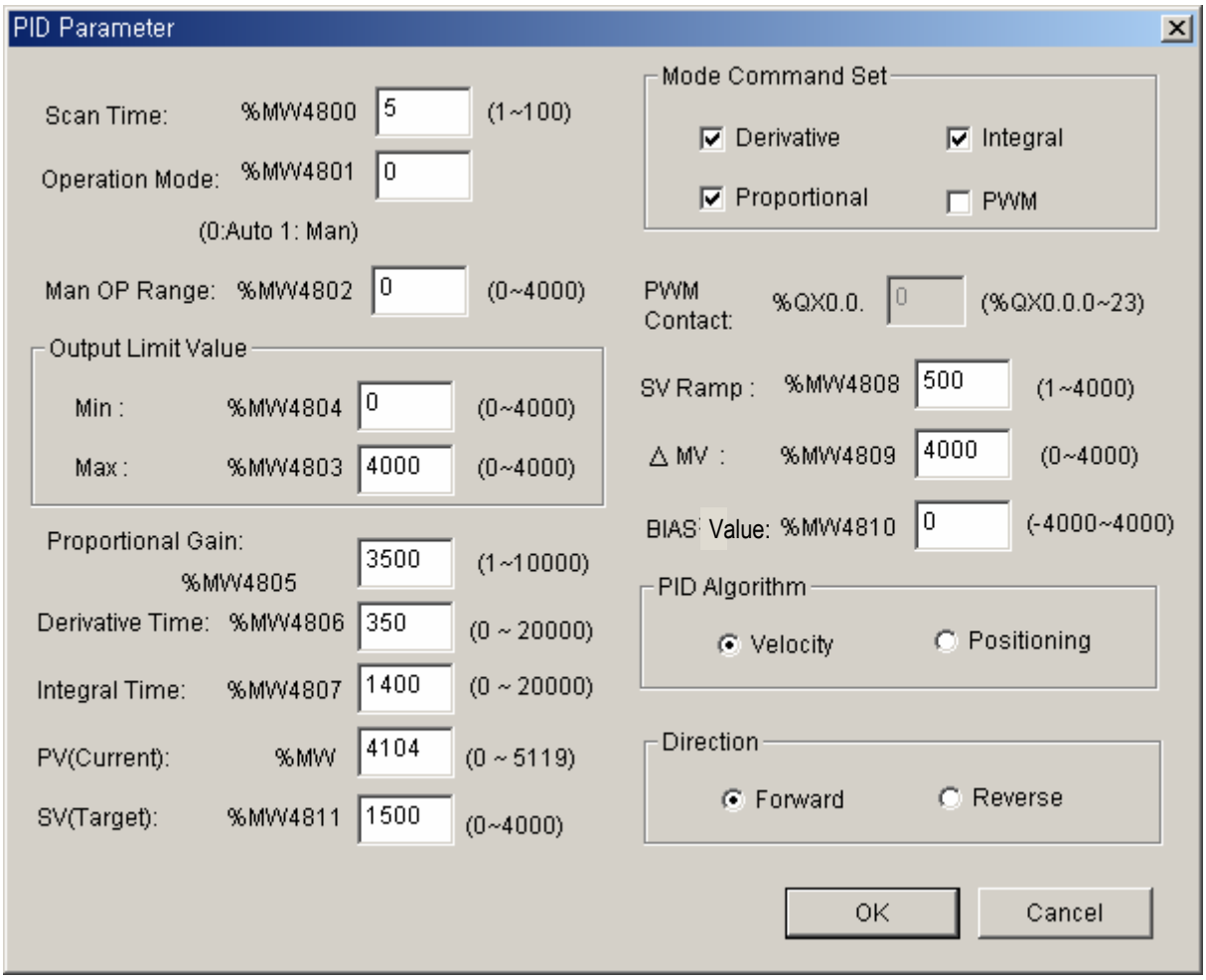
- SV(Target) (for G7F-RD2A)

- 1300(60℃),1350(70℃),1400(80℃),1500(100℃)

- PV(Current) conversion value of the RTD module's channel 0 (Expansion module #2's channel 0: %MW4104)
- Set Proportional Gain, Derivational Time, Integral Time
- BIAS: 0 (input proper value to use P control only)
- Mode Command Set: select the related items Derivative, Integral, Proportional

(select PWM when it is needed)

- PWM Contact: set the contact when the PWM output is selected
- SV Ramp: 500 (when SV converted'500*0.5 sec = 25 sec')
- ΔMV : 4000 (delta MV function is not used)
- PID Algorithm: Velocity



(e) RTD module setting

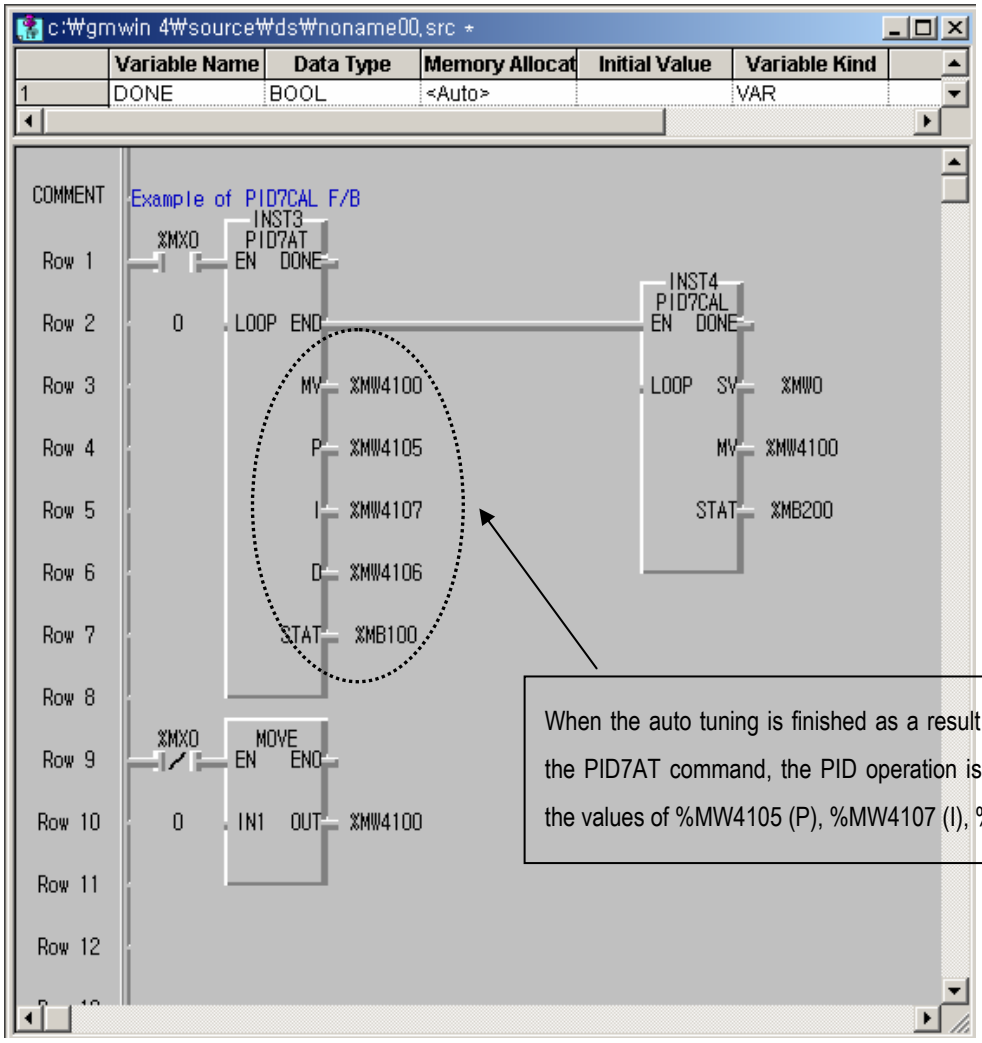
- Follow the same way when the PID function is only used.

(f) D/A module setting

- Follow the same way when the PID function is only used.

(g) Program

- When the input condition %MX0 turns on, PID auto tuning operation is executed following the registered auto tuning parameter at 0 loop.
- Auto tuning status is registered in %MB100, and the output value of control result is registered in %MW4100 (channel 0 of D/A conversion module)
- When auto tuning is completed, END output becomes 1 and the calculated P,I,D values are saved in %MW4805, %MW4807, %MW4806 respectively.
- When END output is On, PID operation is executed following the registered PID parameter at 0 loop.
- PID operation status is registered in %MB200, and the output value is registered in %MW4100 (channel 0 of D/A conversion module)
- When %MX0 contact turns Off, 0 is outputted at %MW4100 (channel 0 of D/A conversion module)



When the auto tuning is finished as a result of the execution of the PID7AT command, the PID operation is executed following the values of %MW4105 (P), %MW4107 (I), %MW4106(D).

6) Error code list

(1) PID7AT

Error Code	Description	Countermeasure
H01	Auto tuning parameter setting error	Set the auto tuning parameters within the range.
H02	Auto tuning direction setting error	Set the direction forward or reverse.
H03	Scan time setting range error	Set scan time in available setting range (1~100).
H04	SV setting range error	Set SV in available setting range (0~4000).
H05	PV setting range error	Set PV setting address in available range (%MW0~%MW5119) or check whether PV is out of range (0~4000).
H06	PRC auto tuning execution error	PV is bigger than 80% of SV(or less than 120% of SV in reverse operation) at the starting point of auto tuning.
H07	LOOP duplication error	Do not execute the auto tuning using the parameters used in other FB.
H08	LOOP number error	Set the loop number correctly (0~7).

(2) PID7CAL

Error Code	Description	Countermeasure
H01	Mode command setting error	Set the mode command P(+PWM), PI(+PWM) or PID(+PWM) only. Do not set I, D, ID or PD.
H03	Scan time setting range error	Set scan time to available setting range (1~100).
H04	Manual operation range error	Set manual operation value to available setting range.
H05	Output limit value error(Min.)	Set minimum output limit value to available setting.
H06	Output limit value error(Max.)	Set maximum output limit value to available setting.
H07	Max./Min. output setting error	Set the Min. value less than the Max. value.
H08	P gain setting error	Set P gain period to available setting range.
H09	I time setting error	Set I time period to available setting range.
H0A	D time setting error	Set D time period to available setting range.
H0B	Bias setting error	Set Bias to available setting range.
H0C	PV setting range error	Set P gain period to available setting range (%MW0~%MW5119), or check whether PV is in the range of 0~4000.
H0D	SV setting range error	Set SV to available setting range.
H0E	SV Ramp setting error	Set SV Ramp to available setting range.
H0F	Delta MV setting error	Set Delta MV to available setting range.
H10	PID algorithm setting error	Check PID algorithm setting.
H11	Operation mode setting error	Available operation mode is 0 or 1.

Error Code	Description	Countermeasure
H12	Auto tuning direction parameter setting error	Select forward or reverse operation.
H13	LOOP duplication error	Do not execute the auto tuning using the parameters used in other FB.
H14	LOOP number error	Set the loop number correctly (0~7).

7.2 Special Modules

The special module and allocated data registers are as follow.

Data Register	Expansion	Item						
		Combination module			A/D Conversion module	D/A Conversion module	Analog timer	RTD input module
		G7F-ADHA	G7F-ADHB	G7F-ADHC	G7F-AD2A G7F-AD2B	G7F-DA2I G7F-DA2V	G7F-AT2A	G7F-RD2A
%MW4100	Analog module #1	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 D/A value	CH0 A/T value (%MW4160)	CH0 Temperature value
%MW4101		CH1 A/D value	CH1 A/D value	-	CH1 A/D value	CH1 D/A value	CH1 A/T value (%MW4161)	CH1 Temperature value
%MW4102		CH0 D/A value	CH0 D/A value	CH0 D/A value	CH2 A/D value	CH2 D/A value	CH2 A/T value (%MW4162)	CH2 Temperature value
%MW4103		-	CH1 D/A value	-	CH3 A/D value	CH3 D/A value	CH3 A/T value (%MW4163)	CH3 Temperature value
%MW4104	Analog module #2	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 D/A value	CH0 A/T value (%MW4164)	CH0 Temperature value
%MW4105		CH1 A/D value	CH1 A/D value	-	CH1 A/D value	CH1 D/A value	CH1 A/T value (%MW4165)	CH1 Temperature value
%MW4106		CH0 D/A value	CH0 D/A value	CH0 D/A value	CH2 A/D value	CH2 D/A value	CH2 A/T value (%MW4166)	CH2 Temperature value
%MW4107		-	CH1 D/A value	-	CH3 A/D value	CH3 D/A value	CH3 A/T value (%MW4167)	CH3 Temperature value
%MW4108	Analog module #3	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 D/A value	CH0 A/T value (%MW4168)	CH0 Temperature value
%MW4109		CH1 A/D value	CH1 A/D value	-	CH1 A/D value	CH1 D/A value	CH1 A/T value (%MW4169)	CH1 Temperature value
%MW4110		CH0 D/A value	CH0 D/A value	CH0 D/A value	CH2 A/D value	CH2 D/A value	CH2 A/T value (%MW4170)	CH2 Temperature value
%MW4111		-	CH1 D/A value	-	CH3 A/D value	CH3 D/A value	CH3 A/T value (%MW4171)	CH3 Temperature value

RTD input module stores the temperature value and the digital conversion value of temperature in a range of 0 to 4000.

Expansion	Digital conversion value				Temperature value			
	Ch 0	Ch 1	Ch 2	Ch 3	Ch 0	Ch 1	Ch 2	Ch 3
#1	%MW4100	%MW4101	%MW4102	%MW4103	%MW4120	%MW4121	%MW4122	%MW4123
#2	%MW4104	%MW4105	%MW4106	%MW4007	%MW4124	%MW4125	%MW4126	%MW4127
#3	%MW4108	%MW4109	%MW4110	%MW4011	%MW4128	%MW4129	%MW4130	%MW4131

REMARK

1) Offset/gain value can't be changed, it is fixed.
2) Analog inputting is set the current since this is manufactured.
3) Max. of 3 expansion modules can be used.

7.2.1 A/D·D/A Combination module

1) Performance specification

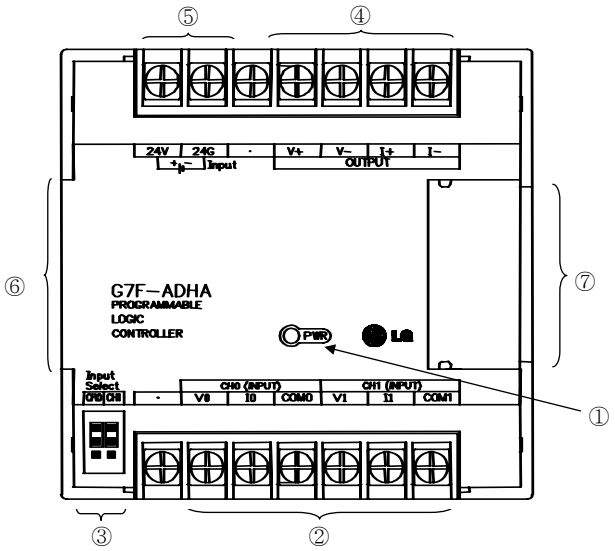
The performance specifications of the analog mixture module are following.

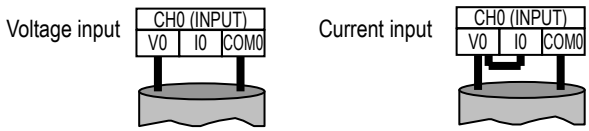
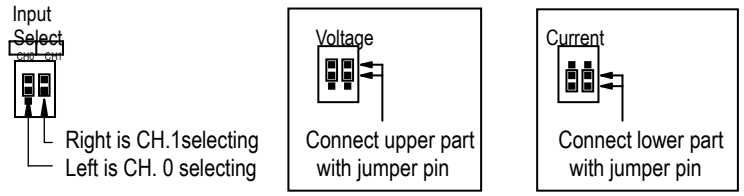
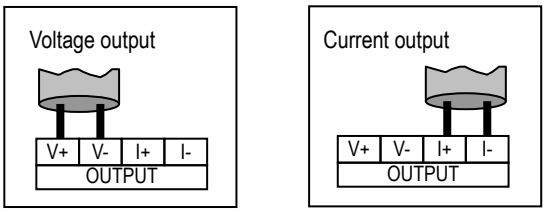
Item			Specifications		
			G7F-ADHA	G7F-ADHB	G7F-ADHC
Analog Input	Input range	Voltage	DC 0～10V C(input resistance more than 1 MΩ)		DC 0~1V (input resistance more than 1 MΩ)
		Current	DC 0～20 mA (input resistance 250Ω) DC 4～20 mA (input resistance 250Ω) Classified by GMWIN parameter settings		-
	Digital output		12 bits (0 ~ 4000)		
	Voltage/Current selection		1.Set by the jumper pin for V/I selection on the upper part of product (Up: voltage, Down: Current)	1. Set by the dipswitch for V/I selection on left side of product (Up: voltage, Down: Current	Fixed as DC 0~1V
			2. Voltage/current selected by program 3. When current input is used, short the V and I terminal.		
	No. of channel		2 channels / 1 module		1 channel / 1 module
	Absolute max. input	Voltage	DC +12V		
		Current	DC +24 mA		-
Analog output	Output range	Voltage	DC 0～10V (External resistance 2 kΩ～1 MΩ)		Fixed as voltage output
		Current	DC 0～20 mA (External resistance 510Ω) DC 4～20 mA (External resistance 510Ω) Classified by GMWIN parameter settings		
	Digital Input		12 bits (0 ~ 4000)		
	Voltage/current selection		Separated from terminal		
	No. of channel		1 channel / 1 module	2 channel / 1 module	1 channel / 1 module
	Absolute max. output	Voltage	DC +12V		-
		Current	DC +24 mA		
Common	Max. resolution	Voltage	DC 0～10V: 2.5 mV (1/4000)		0.25 mV (1/4000)
		Current	DC 0～20 mA: 5 μA (1/4000)		
			DC 4～20 mA: 6.25 μA (1/3200)		
	Accuracy		±0.5% (Full Scale)		
	Max. conversion speed		1 ms/CH ＋Scan time		A/D:1 ms/CH+Scan time D/A:10ms/CH+Scan time
	No. of installation module		Max.3		
	Isolation		Photo coupler insulation between I/O terminals and PLC power supply (No isolation between channels)		
	Connect terminal		2 of 9-point terminal	2 of 8-point terminal	2 of 7-point terminal
	Internal current consumption		20 mA	20 mA	20 mA
	External power supply	Voltage	DC 21.6 ～ 26.4V		
		Current	80 mA	95 mA	100 mA
	Weight		240g	180g	180g

2) Names of parts and functions

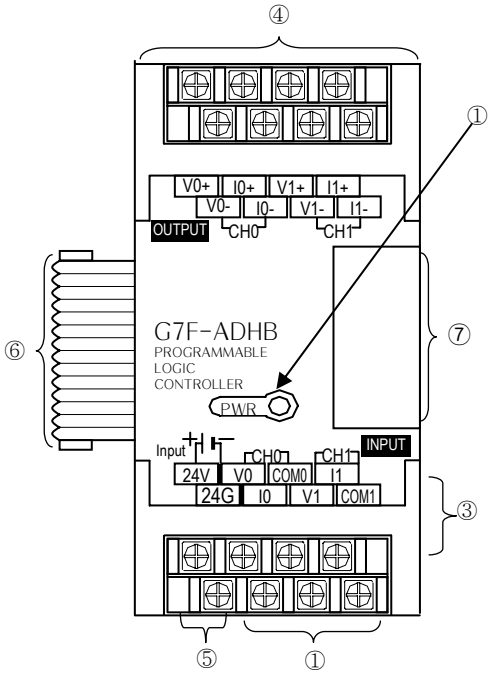
Explain about names of parts and functions

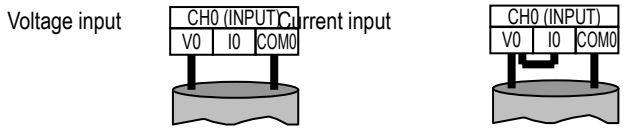
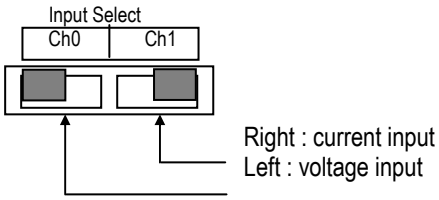
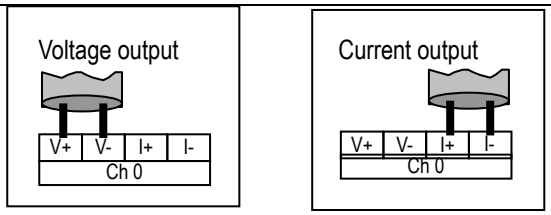
(1) G7F-ADHA



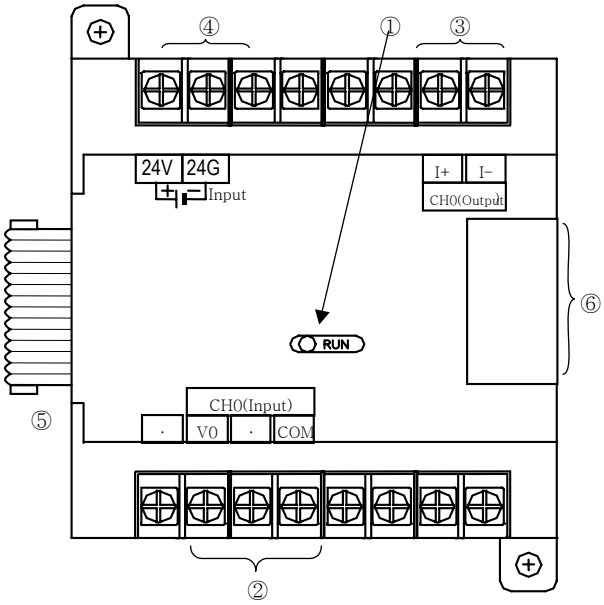
No.	Name	Functions
①	RUN LED	Indicates the operating status the G7F-ADHA
②	Analog input terminal	 • When current input is used, short the V and I terminal.
③	Jumper pin for analog input	
④	Analog output terminal	 • Only one type of output (current or voltage) is available on a module
⑤	External power supply terminal	Supplies DC 24V
⑥	Extension cable	A cable to connect analog combination module
⑦	Expansion cable connector	A connector to connect expansion cable

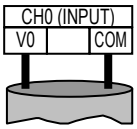
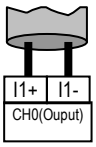
(2) G7F-ADHB



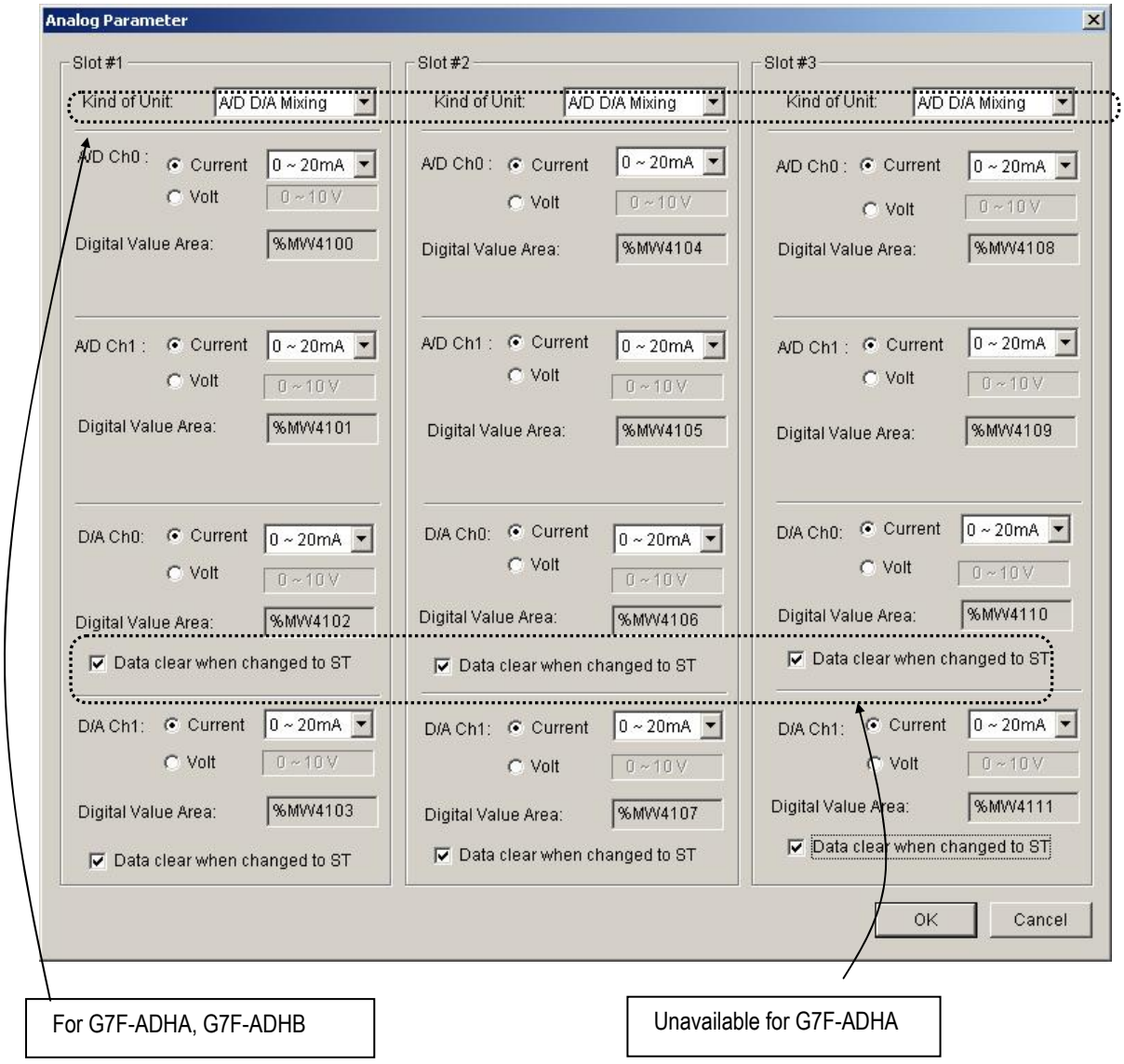
No.	Name	Functions
①	RUN LED	Indicates the operating status the G7F-ADHB
②	Analog input terminal	 • When current input is used, short the V and I terminal.
③	Dip switch for inalog input	
④	Analog output terminal	
⑤	External power supply terminal	Supplies DC 24V
⑥	Extension cable	A cable to connect analog combination module
⑦	Expansion cable connector	A connector to connect expansion cable

(3) G7F-ADHC



No.	Name	Functions
①	RUN LED	Indicates the operating status the G7F-ADHC
②	Analog input terminal	Voltage input 
③	Analog output terminal	Voltage output 
④	External power supply terminal	Supplies DC 24V DC24V
⑤	Extension cable	A cable to connect analog combination module
⑥	Expansion cable connector	A connector to connect expansion cable

3) Parameter setting

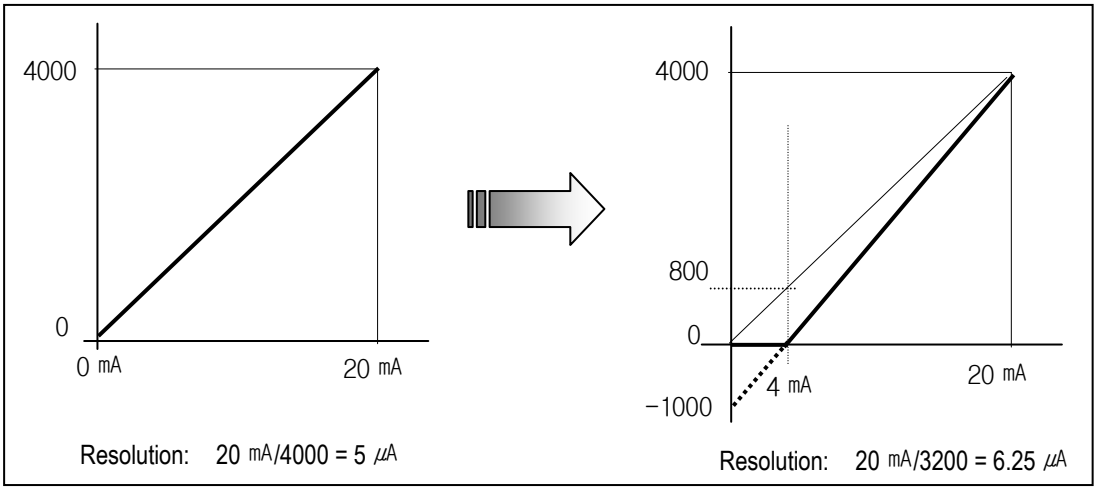


- Scaling function

  This function convert automatically range when the inout/output range is not matched.

  In case that input/output is current , this function is useful that external equapment' range is not matched each other.

  (GM7U series converts range automatically as following : 0 ~ 20mA ⇔ 4 ~ 20mA)



Conversion method is as below.

Scaling conversion value (A/D conversion = $\frac{[(\text{data of } 0 \sim 20\text{mA}) - 800] \times 4000]}{3200}$

Example) 8mA input in the range of 0 ~ 20 ㎃

- Before the scaling conversion : 8 ㎃ / 5 ㎂ = 1600
- After the scaling conversion: (1600 –800) x 1.25 = 1000

Scaling conversion value (D/A conversion) = $\frac{[(\text{data of } 0 \sim 20\text{mA}) \times 3200]}{4000} + 800$

Example) Output 1000 in the range of 0 ~ 20 ㎃

- Current output value before the scaling conversion : 1000 x 5 ㎂ = 5 ㎃
- Current output value after the scaling conversion: (1000 x 0.8) + 800 = 1600
  1600 x 5 ㎂ = 8 ㎃

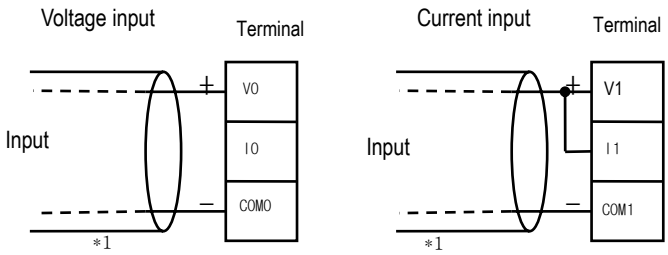
4) Wiring

(1) Caution for wiring

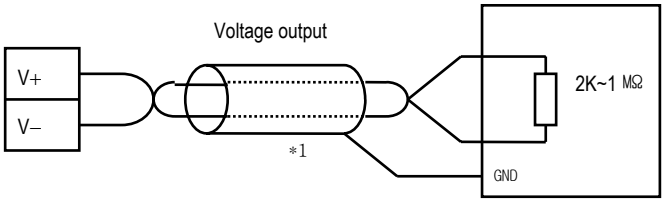
- Make sure that external input signal of the mixture module of AC and analog I/O is not affected by induction noise or occurs from the AC through using another cable.
- Wire is adopted with consideration about peripheral temperature and electric current allowance. For wire, thicker than AWG22 (0.3 ㎟) one is recommended.
- If wire is put near to high temperature radiated device or contacted with oil for a long time, it may cause of electric leakage so that it gets broken or miss-operation during wiring.
- Be sure to connect with care of polarity while connecting to external 24V DC power supply.
- In case of wiring with high voltage line or generation line, it makes induction failure so then it may cause of miss-operation and out of order.

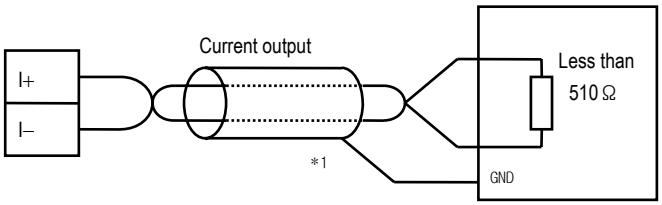
(2) Wiring example

a) Analog input



b) Analog output



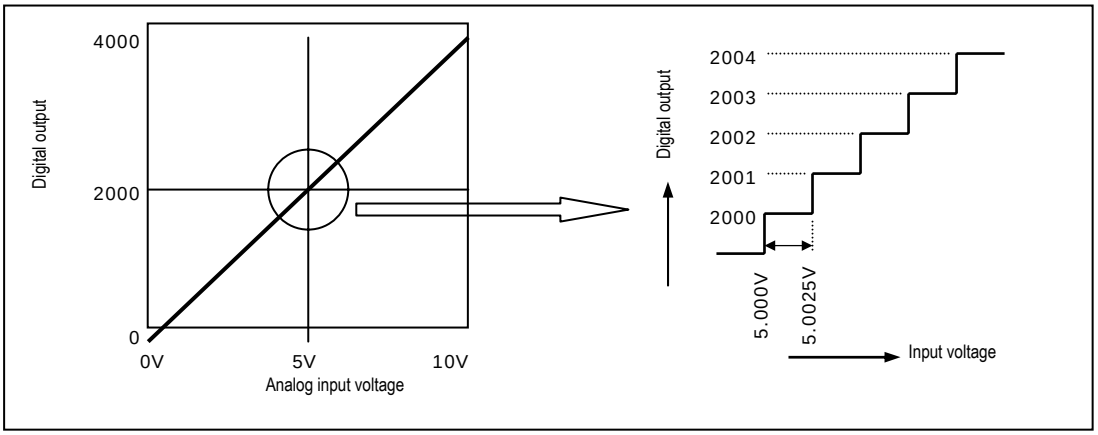


* 1: Make sure to use two-core twisted shield wire.
* G7F-ADHA has only 1 analog output channel.
* Analog ouput cannot be used for voltage and current simultaneously.

5) I/O converstion characteristics

(1) Analog input characteristics (For G7F-ADHA,ADHB)

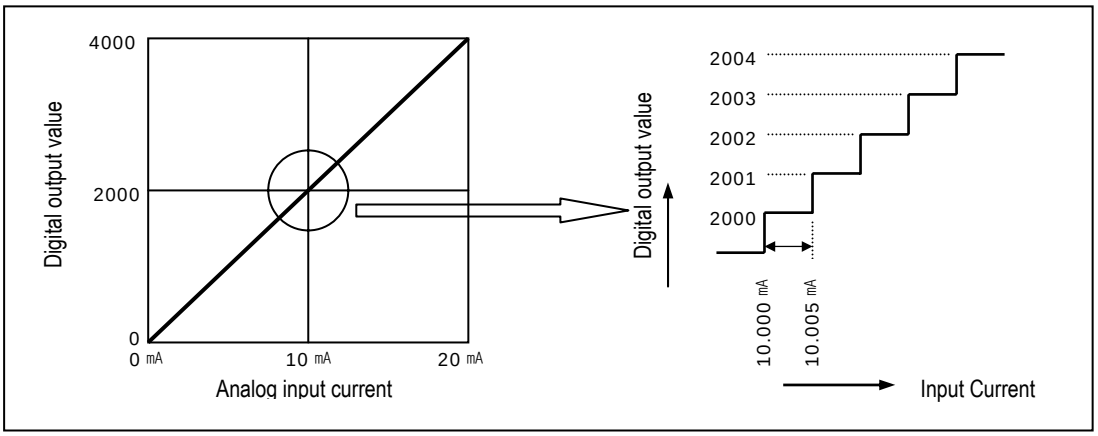
a) Voltage input



A/D conversion characteristics (voltage input)

In voltage input, digital amount 0 is output by 0V input and 4,000 is output by 10V input. Therefore input 2.5mV equals to digital amount 1, but value less than 2.5mV can't be converted.

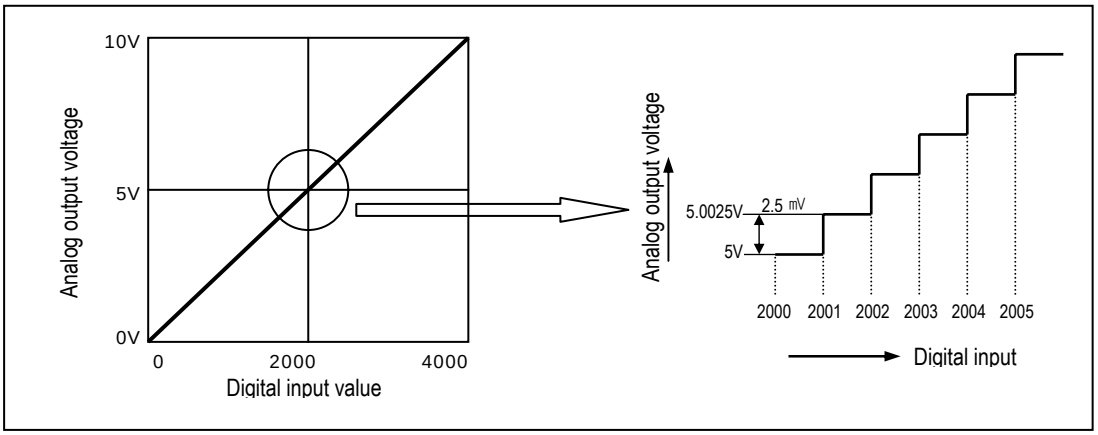
b) Current input



Current input 0mA becomes output 0, 10mA does 2000 and 20mA does 4000. therefore input 5 ㎂ equals to digital amount 1, but value less tan 5 ㎂ can't be converted. So abandon it.

(2) Analog output characteristics (For G7F-ADHA,ADHB)

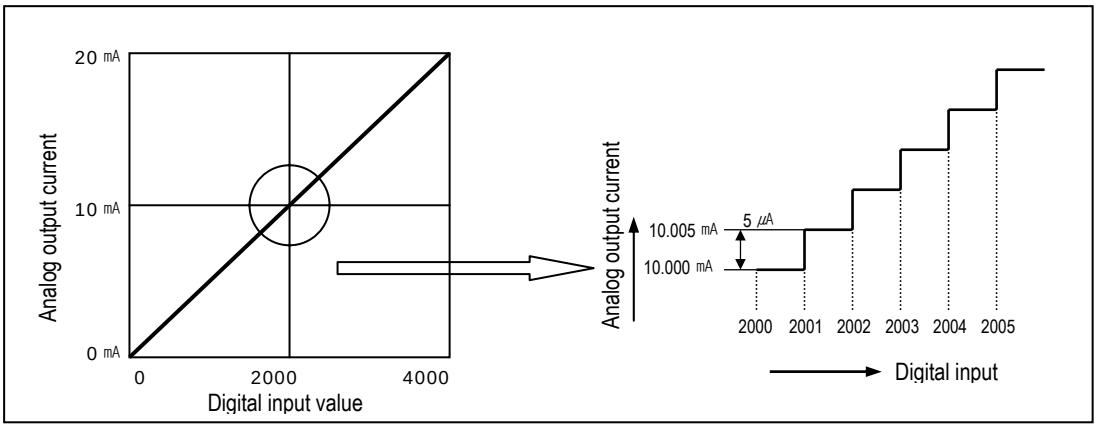
a) Voltage output



D/A conversion characteristic (Current output)

Input of digital amount 0 outputs analog amount 0V, 4000 does 10V.Digital input 1 equals to 2.5mV of analog amount.

b) Current output



D/A conversion characteristic (Current output)

In current output, digital amount 0 exchanges to 0mA, and 4,000 does 20mA.

Analog amount of digital input 1 equals to 5 μA.

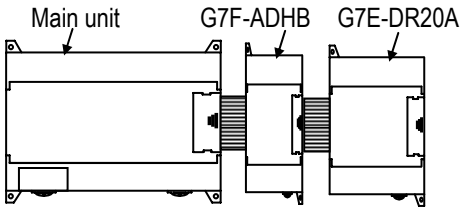
6) Program example

(1) Distinction program of A/D conversion value

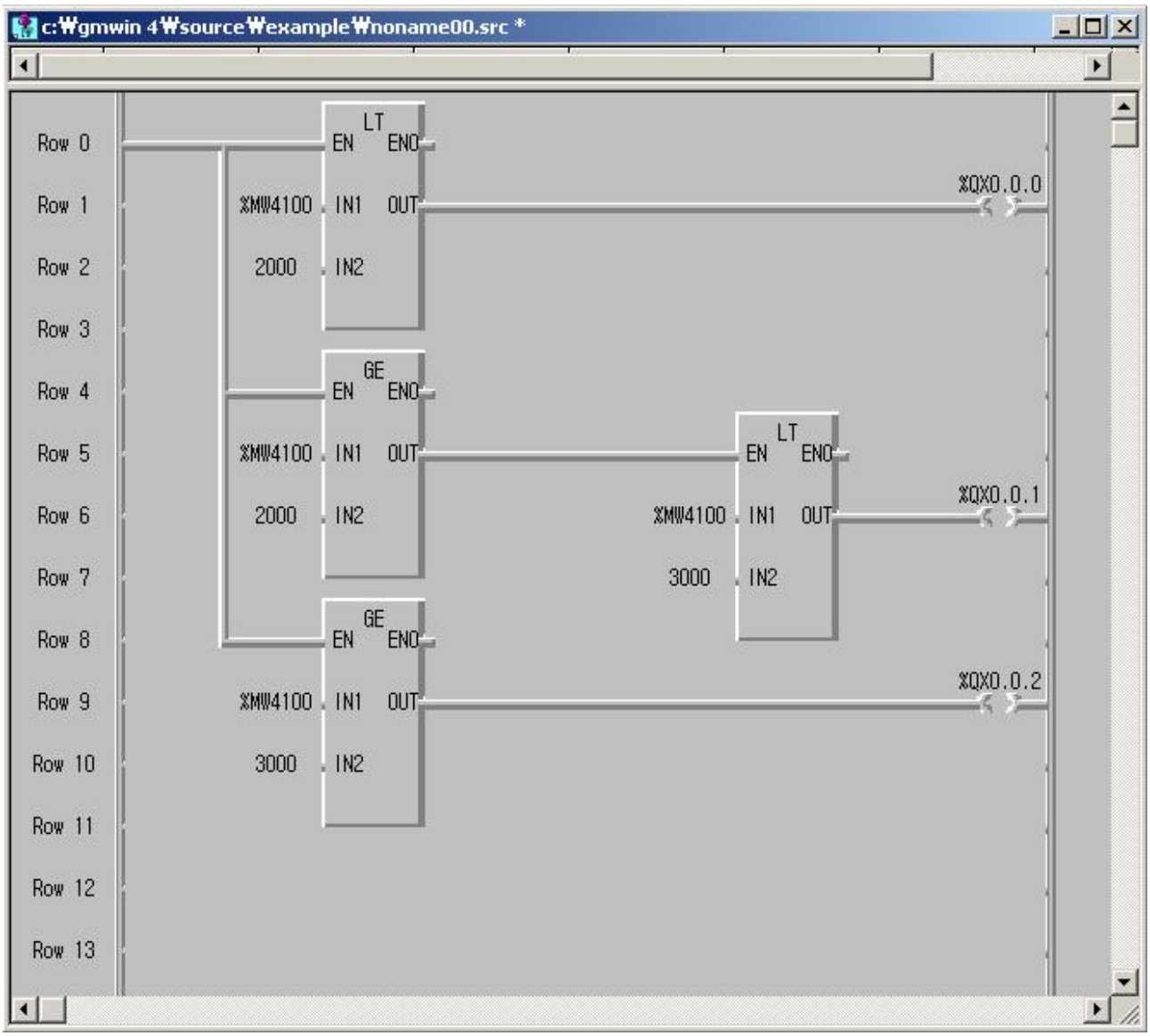
a) Program explanation

- When digital value of channel 0 is less than 2000, %QX0.0.0 is On
- when digital value of channel 0 is more than 3000, P091 is on, %QX0.0.1 is On
- When digital value of channel 0 is more or same than 2000 or lesser than 3000, %QX0.0.2 is On

b) System configuration



c) Program

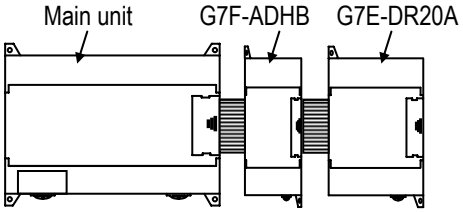

c:₩gmwin 4₩source₩example₩noname00.src *
Row 0
Row 1
Row 2
Row 3
Row 4
Row 5
Row 6
Row 7
Row 8
Row 9
Row 10
Row 11
Row 12
Row 13
LT
EN
ENO
%MW4100
IN1
OUT
2000
IN2
%QX0.0.0
GE
EN
ENO
%MW4100
IN1
OUT
2000
IN2
LT
EN
ENO
%MW4100
IN1
OUT
3000
IN2
%QX0.0.1
GE
EN
ENO
%MW4100
IN1
OUT
3000
IN2
%QX0.0.2

(2) Program which controls speed of inverter by analog output voltage of 5 steps

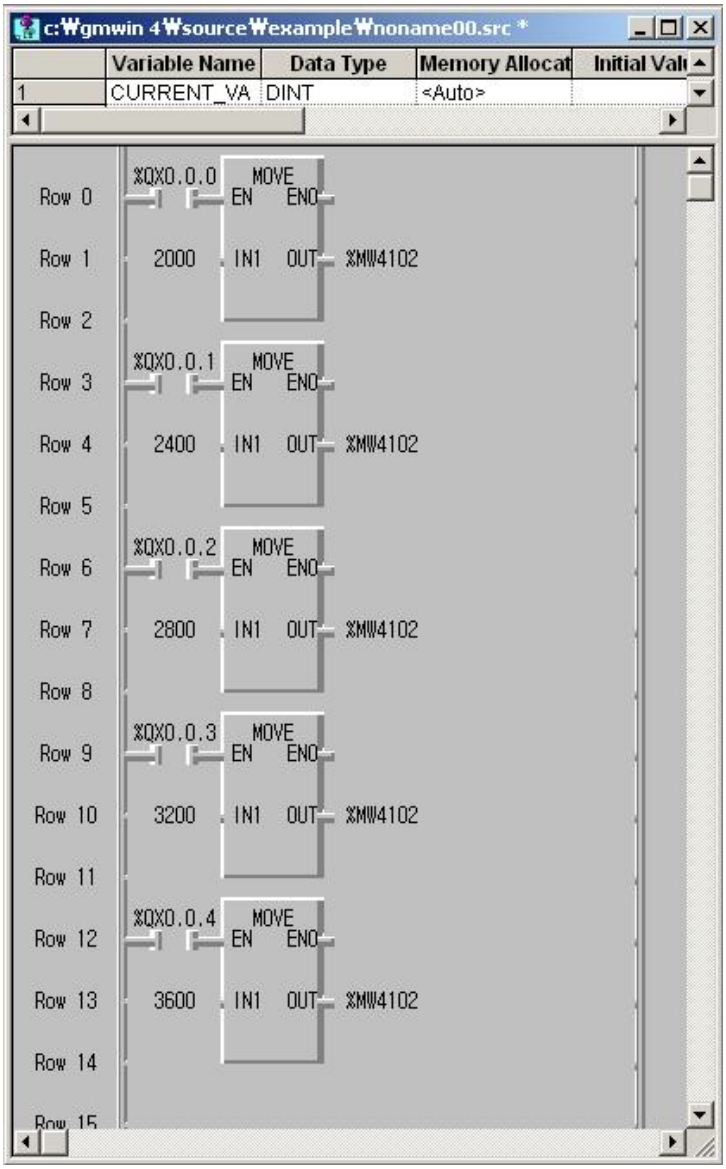
a) Program explanation

-.When %QX0.0.0 turns On, 2000 (5V) is output.
-. When %QX0.0.1 turns On, 2400 (6V) is output.
-.When %QX0.0.2 turns On, 2800 (7V) is output.
-.When %QX0.0.3 turns On, 3200 (8V) is output.
-.When %QX0.0.4 turns On, 3600 (9V) is output.

b) System configuration



c) Program



7.2.2 A/D Conversion module

1) Performance specifications

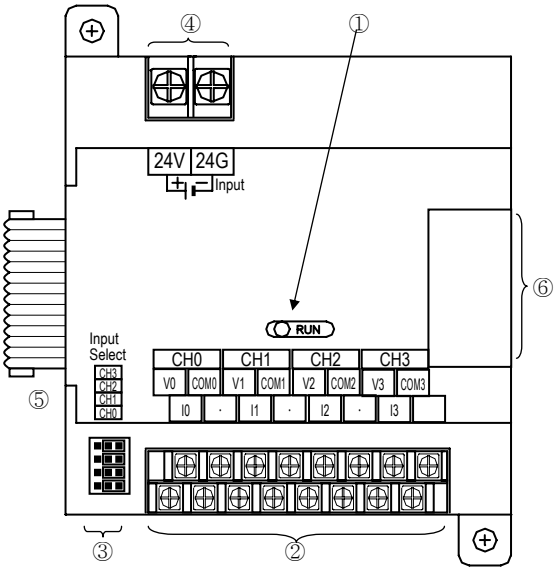
The performance specifications of the analog input module are following.

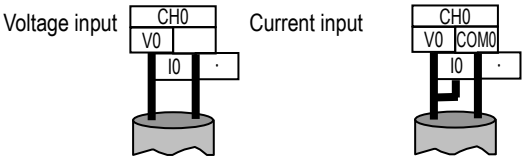
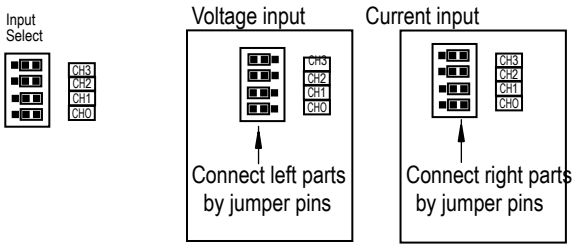
Item		Specifications
Analog input	Voltage	DC 0～10V (input resistance 1 MΩ)
	Current	DC 4～20 mA (input resistance 250Ω) DC 0～20 mA (input resistance 250Ω) Classified by GMWIN parameter settings
	Voltage/Current Selection	- Setting by input terminal (When current input is used, short the V and I terminal.) - Input range is classified by GMWIN parameter settings
Digital output		12 bits (0～4000)
Maximum resolution	DC 0～10V	2.5 mV (1/4000)
	DC 0～20 mA	5 μA (1/4000)
	DC 4～20 mA	6.25 μA (1/3200)
Overall accuracy		±0.5% (Full Scale)
Max. conversion speed		1 ms/CH + scan time
Max. absolute input		Voltage: ±15V, Current: ±25 mA
Number of analog input point		4 channels/ 1 module
No. of installation module		Max. 3
Isolation		Photo coupler insulation between I/O terminals and PLC power supply (No isolation between channels)
Connect terminal		2 points/16 points terminal
Internal current consumption	+5V	100mA
External power supply	Voltage	DC 21.6 ~ 26.4V
	Current consumption	100 mA
Weight		300g

2) Names of parts and functions

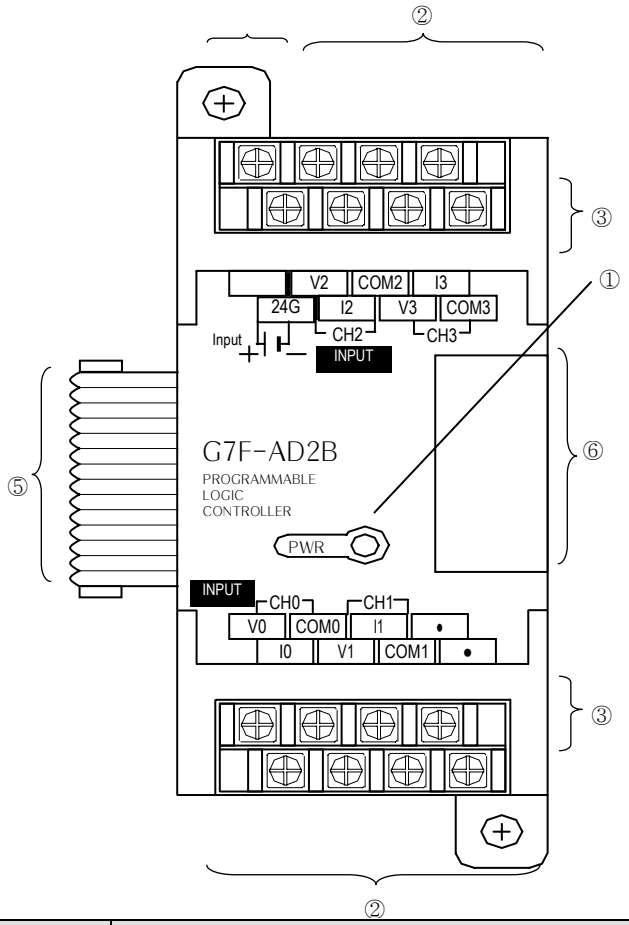
The Names of parts and functions of the analog input module are following.

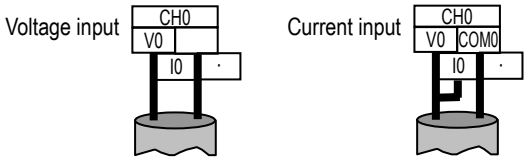
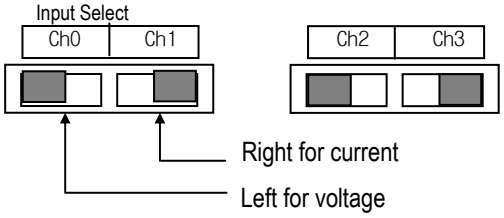
(1) G7F-AD2A



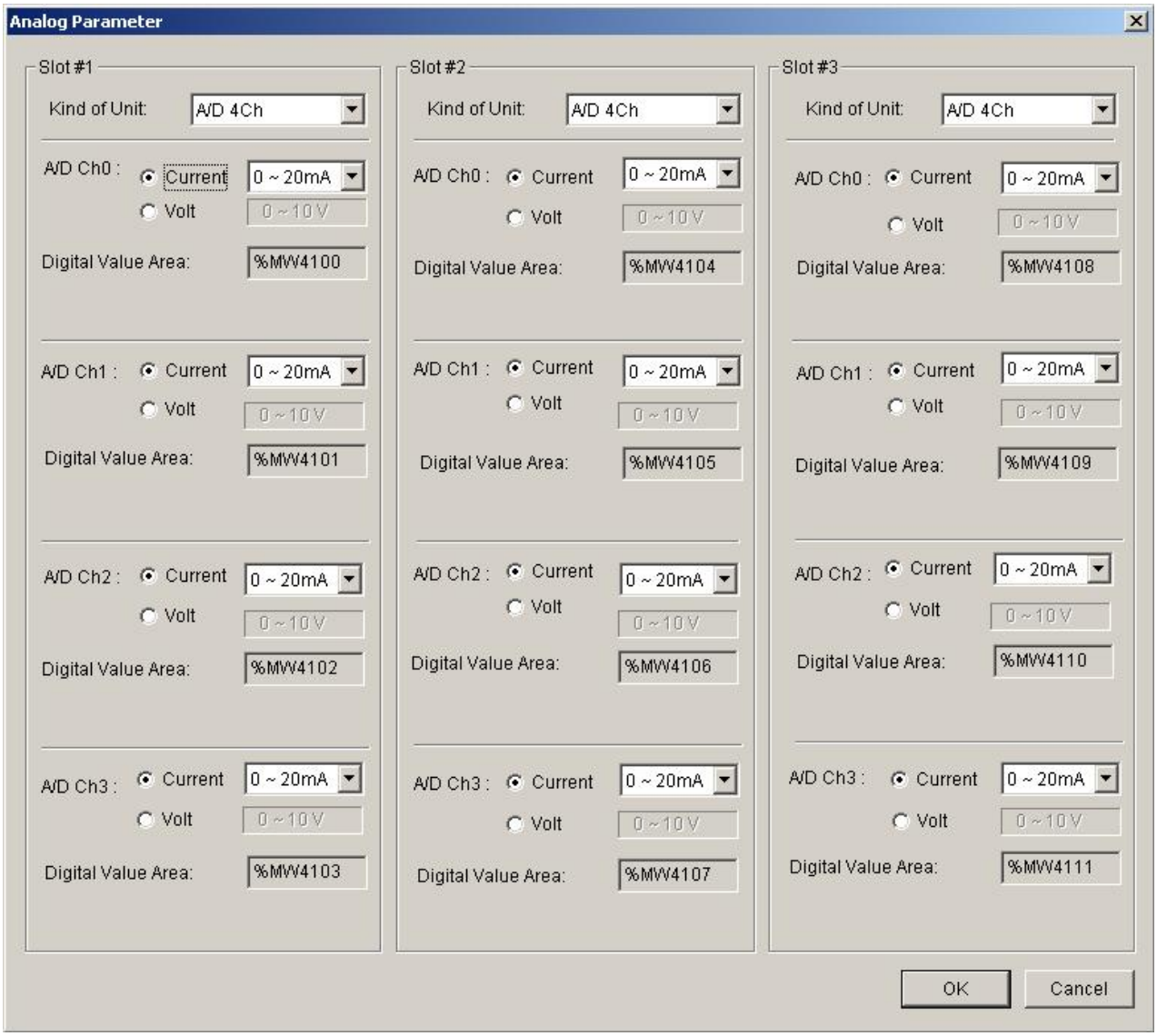
No.	Name	Functions
①	RUN LED	Indicates the operating status of G7F-AD2A
②	Analog input terminal	 • When current input is used, short the V and I terminal.
③	Jumper pin for analog input	
④	External power supply terminal	Supplies DC 24V
⑤	Extension cable	A cable to connect analog input module
⑥	Extension cable connector	A connector to connect expansion cable

(2) G7F-AD2B



No.	Name	Functions
①	RUN LED	Indicates the operating status of G7F-AD2B
②	Analog input terminal	 • When current input is used, short the V and I terminal.
③	Jumper pin for analog input	
④	External power supply terminal	Supplies DC 24V
⑤	Extension cable	A cable to connect analog input module
⑥	Extension cable connector	A connector to connect expansion cable

3) Parameter setting



(1) Scaling function

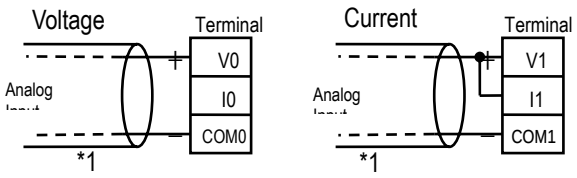
The scaling function is the same that of A/D, D/A combination module.

4) Wiring

(1) Caution for wiring

- Make sure that external input signal of the mixture module of AC and analog I/O is not affected by induction noise or occurs from the AC through using another cable.
- Wire is adopted with consideration about peripheral temperature and electric current allowance. For wire, thicker than AWG22 (0.3 ㎟) one is recommended.
- If wire is put near to high temp. radiated device or contacted with oil for a long time, it may cause of electric leakage so that it gets broken or miss-operation during wiring.
- Be sure to connect with care of polarity while connecting to external 24V DC power supply.
- In case of wiring with high voltage line or generation line, it makes induction failure so then it may cause of miss-operation and out of order.

(2) Wiring

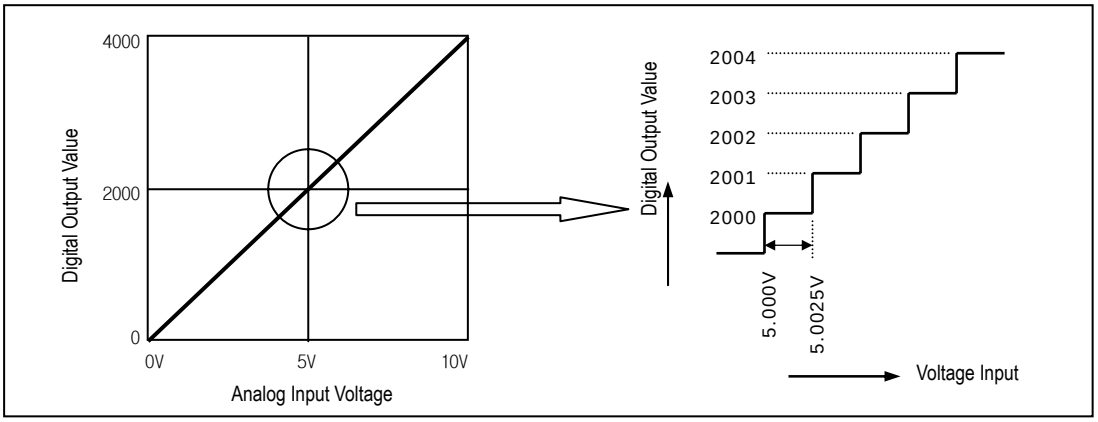


*1: Be sure to use two-core twisted shield wire.

5) Analog/Digital conversion characteristics

(1) Analog input characteristics

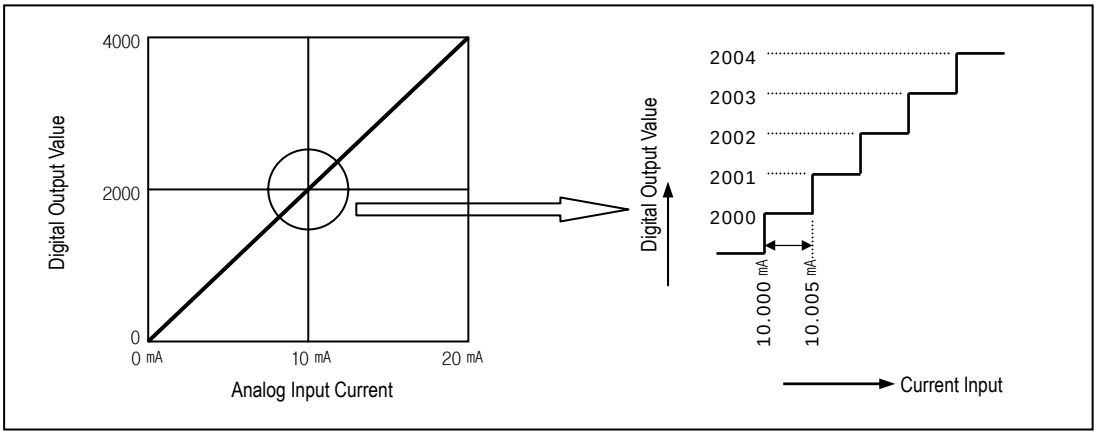
a) Voltage input



A/D Conversion Characteristics (Voltage Input)

In voltage input, digital amount 0 is output by 0V input and 4,000 is output by 10V input. Therefore input 2.5mV equals to digital amount 1, but value less than 2.5mV can't be converted.

b) Current input



A/D Conversion Characteristics (Current Input 0～20 ㎃)

Current input 0mA becomes output 0, 10mA does 2000 and 20mA does 4000. therefore input 5 ㎂ equals to digital amount 1, but value less tan 5 ㎂ can't be converted. So abandon it.

6) Program example

Distinction program of A/D conversion value (Analog input range: 4～20 ㎃)

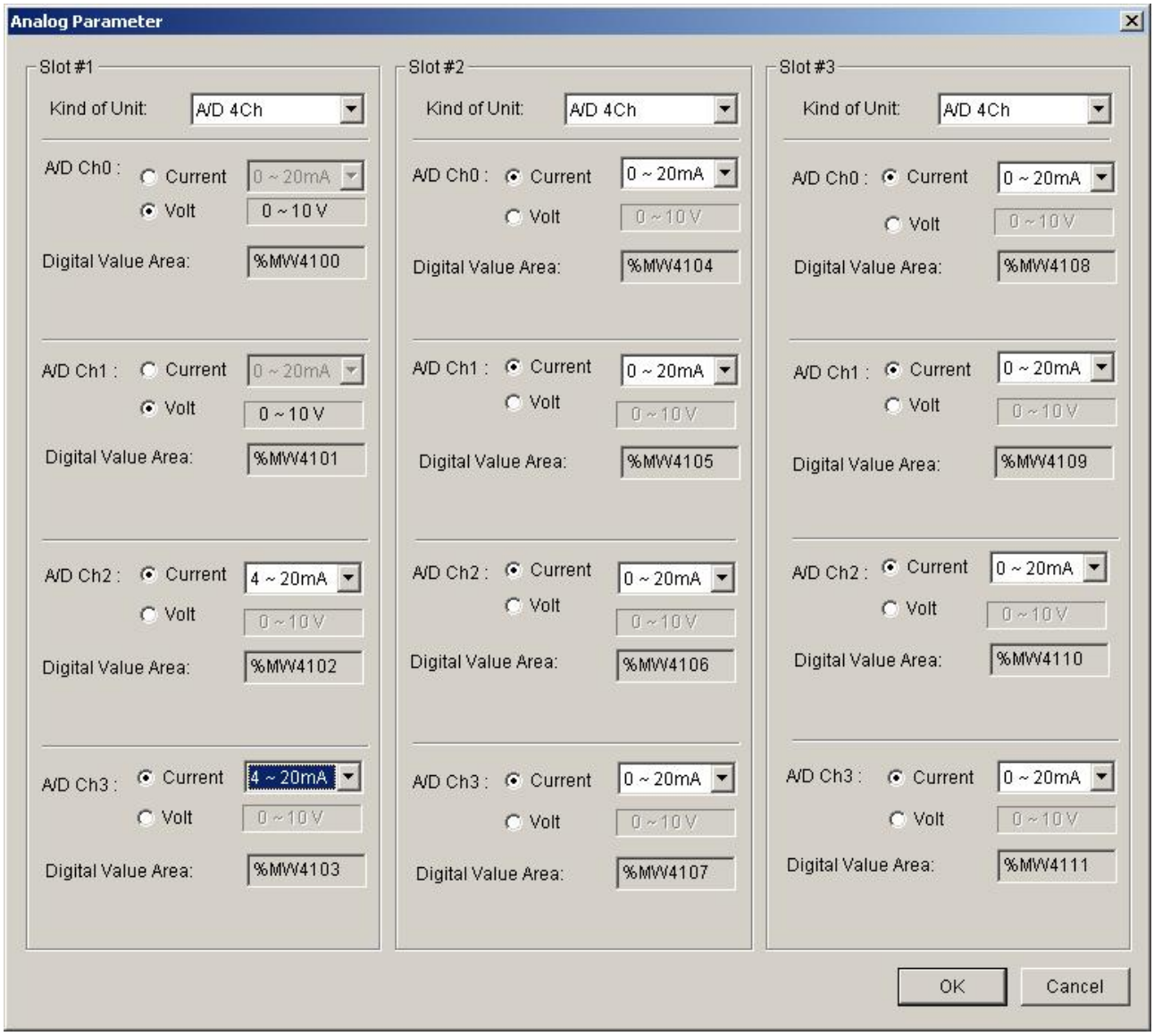
a) Program explanation

- When digital value of channel 0 is the same or more than 2000 and the same or less than 3000, %QX0.0.0 is On
- When digital value of channel 1 is the same or more than 2000 and the same or less than 3000, %QX0.0.1 is On
- When digital value of channel 2 is the same or more than 2000 and the same or less than 3000, %QX0.0.2 is On
- When digital value of channel 3 is the same or more than 2000 and the same or less than 3000, %QX0.0.3 is On

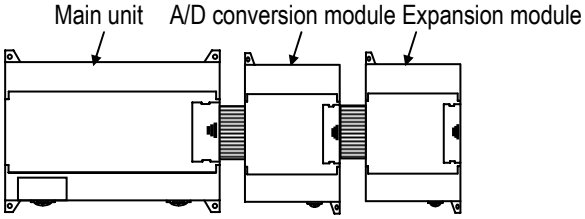
b) System configuration

(a) Analog parameter settings

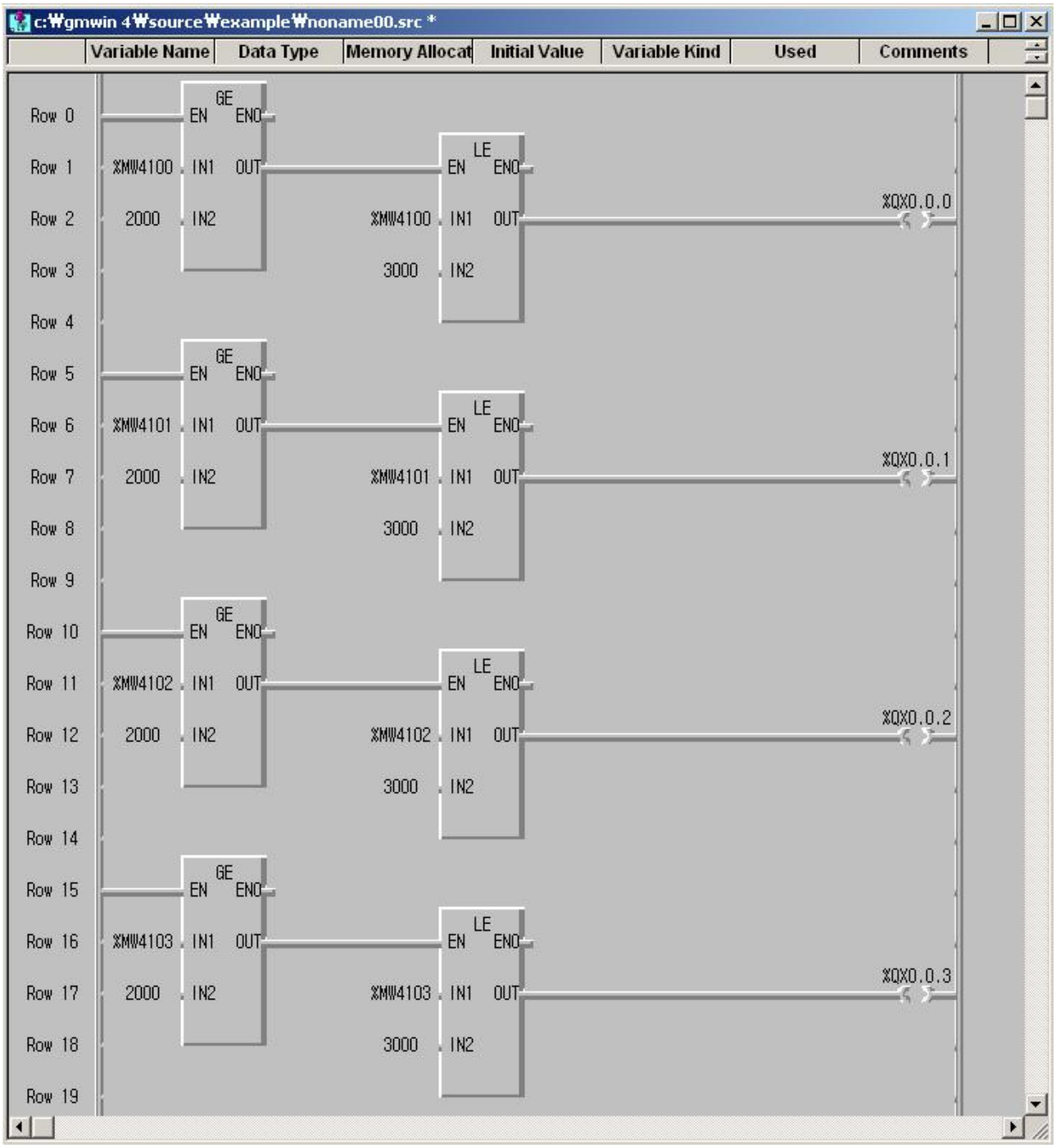
- Channel "0", "1": voltage input (0～10VDC)
- Channel "2", "3": current input (DC 4～20 ㎃)



(b) System configuration



(c) Program



7.2.3 D/A Conversion module

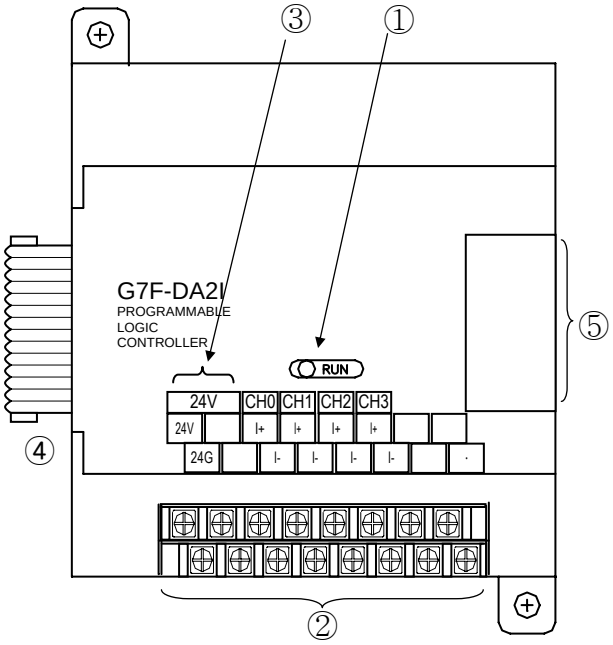
1) Performance specifications

The performance specifications of the analog output module are following.

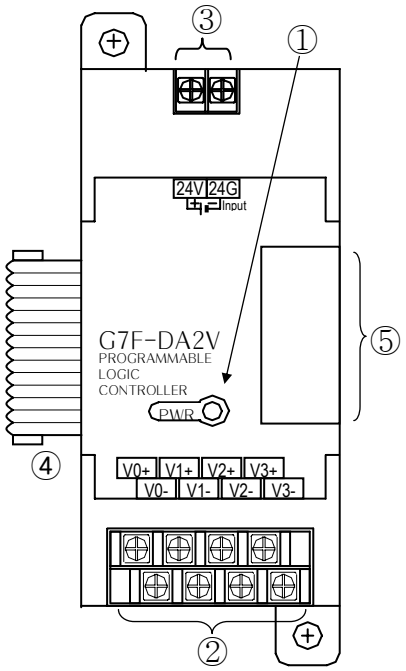
Item		Specifications	
		G7F-DA2I	G7F-DA2V
Output Range		DC 0～20 ㎃ (Load resistance 510Ω) DC 4～20 ㎃ (Load resistance 510Ω) Classified by GMWIN parameter settings	DC 0～10V (Load resistance 2 ㎏Ω～1 ㎆Ω)
Digital input		12 bits (0 ~ 4000)	
No. of channel		4 channels/1 module	
Max. absolute output		DC +24 ㎃	DC 12V
Maximum resolution		DC 0～20 ㎃ : 5 ㎂ (1/4000)	2.5 ㎷ (1/4000)
		DC 4～20 ㎃ : 6.25 ㎂ (1/3200)	
Accuracy		±0.5% (Full Scale)	
Max. conversion speed		500us/all Ch ＋ Scan time	1 ㎳/all Ch ＋ Scan time
No. of installation module		Max. 3	
Isolation		Photo coupler insulation between I/O terminals and PLC power supply (No isolation between channels)	
Connect terminal		16 points terminal	2 of 8 points terminal
Internal current consumption		20 ㎃	15 ㎃
External power supply	Voltage	DC 21.6 ～ 26.4V	
	Current consumption	80 ㎃	90 ㎃
Weight		280g	160g

2) Names of parts and functions

The Names of parts and functions of the analog input module are following.



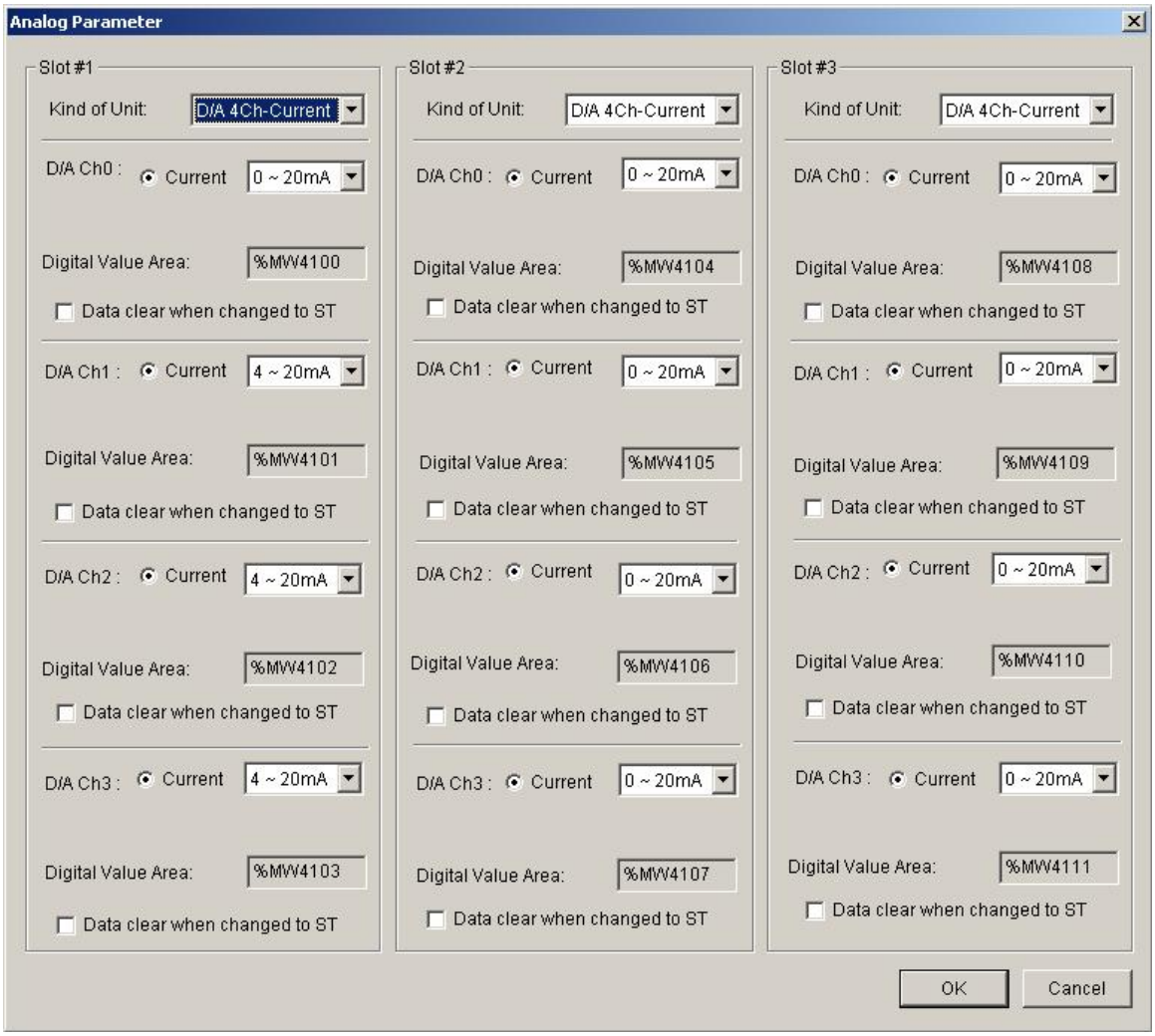
G7F – DA2I

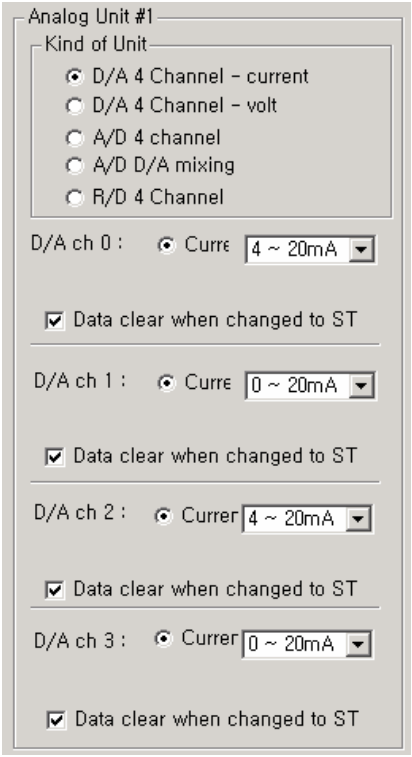


G7F – DA2V

No.	Name	Functions
①	RUN LED	Indicates the operating status of G7F-DA2I, G7F-DA2V
②	Analog output terminal	Analog current/voltage output terminal
③	External power supply terminal	Supplies DC 24V
⑥	Extension cable	Cable to connect analog output module
⑦	Extension cable connector	A connector to connect expansion cable

3) Parameter setting

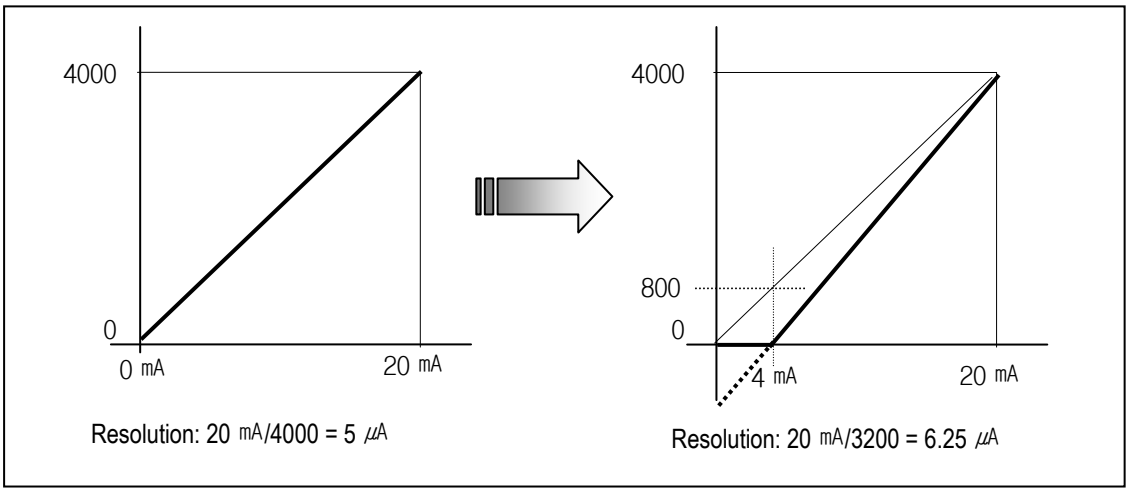




- Data clear when changed to ST
  1) Set PLC ST mode for each channel
  2) Data clear when changed to PLC STOP mode (output value 0)

4) Scaling function (for G7F-DA2I)

Scaling is the function that changes the offset and gain value for an easy operation.



- Changing method is as below.

$$\text{Scaling conversion value} = \frac{(\text{Digital input value} \times 3200)}{4000} + 800$$

Example) Digital value 1000 input in a range of 0 ~ 20 mA

- Before the scaling conversion (current range 0 ~ 20mA):

$$\frac{(\text{Digital input value} \times 20)}{4000} = \frac{1000 \times 20}{4000} = 5\text{mA}$$

- After the scaling conversion (current range 4 ~ 20mA):

$$\frac{(\text{Digital input value} \times 3200)}{4000} + 800 = \frac{1000 \times 3200}{4000} + 800 = 1600 \times 5\ \mu\text{A} = 8\text{mA}$$

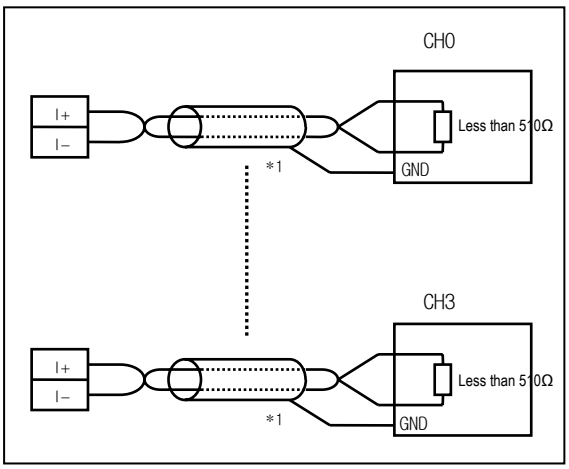
5) Wiring

(1) Caution for wiring

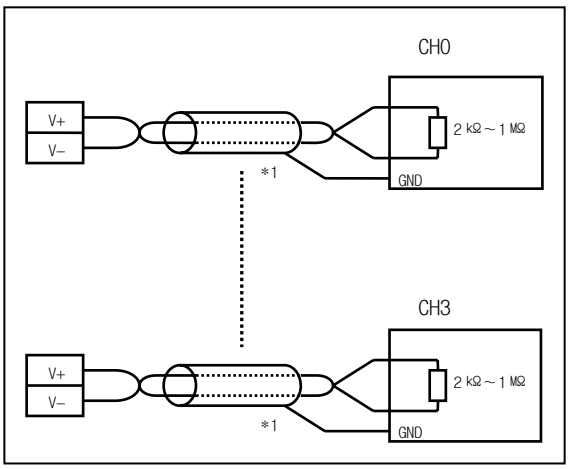
- Make sure that external input signal of the mixture module of AC and analog I/O is not affected by induction noise or occurs from the AC through using another cable.
- Wire is adopted with consideration about peripheral temperature and electric current allowance. For wire, thicker than AWG22 (0.3 ㎟) one is recommended.
- If wire is put near to high temperature radiated device or contacted with oil for a long time, it may cause of electric leakage so that it gets broken or miss-operation during wiring.
- Be sure to connect with care of polarity while connecting to external 24V DC power supply.
- In case of wiring with high voltage line or generation line, it makes induction failure so then it may cause of miss-operation and out of order.

(2) Wiring

a) G7F-DA2I



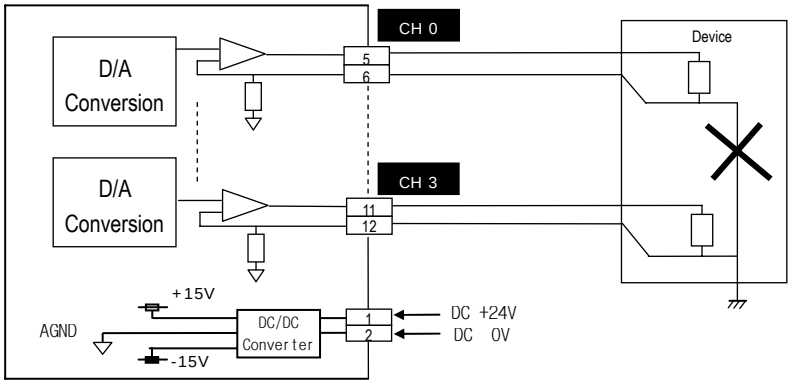
b) G7F-DA2V



*1: Be sure to use two-core twisted shield wire.

REMARK

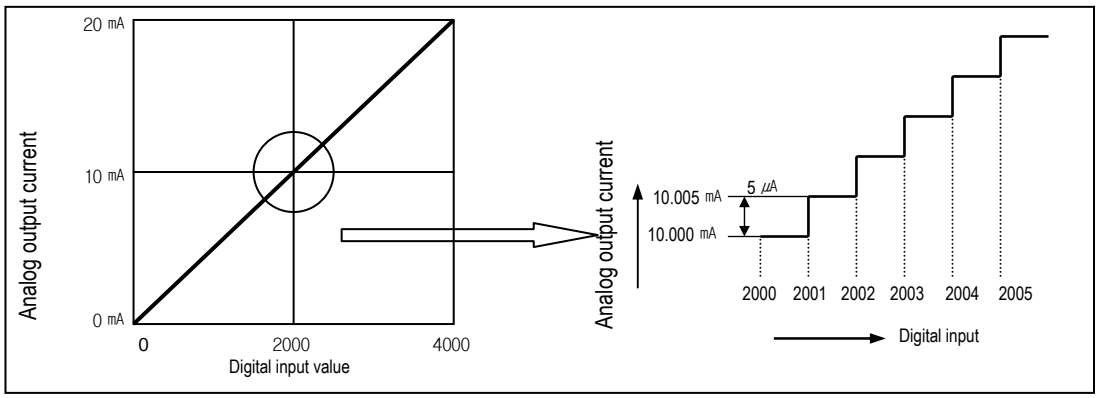
- The common grounding with other devices is not permitted when D/A conversion module is used as current output type.



6) Digital/Analog conversion characteristics

(1) G7F-DA2I

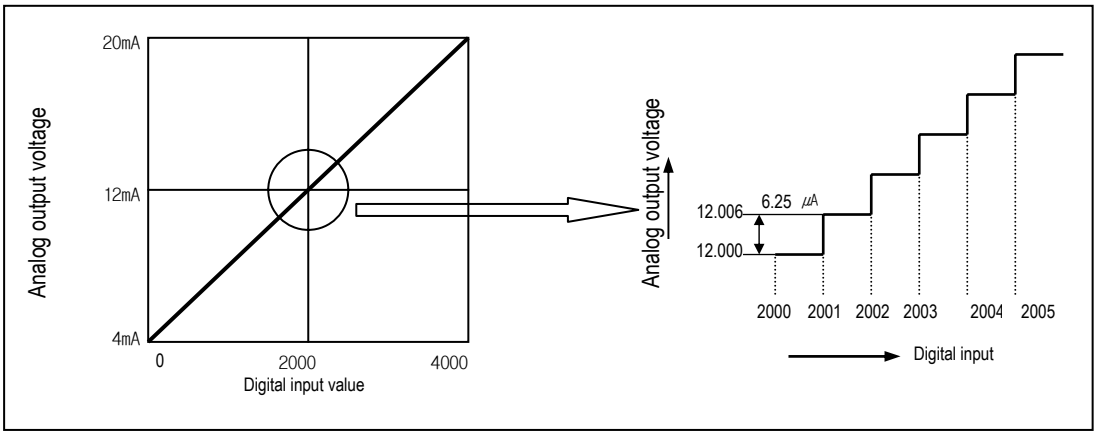
a) 0~20mA output



D/A conversion characteristics (Current output)

Digital amount 0 outputs analog amount 0mA, 4000 does 20mA.Digital input 1 equals to 5 μA of analog amount.

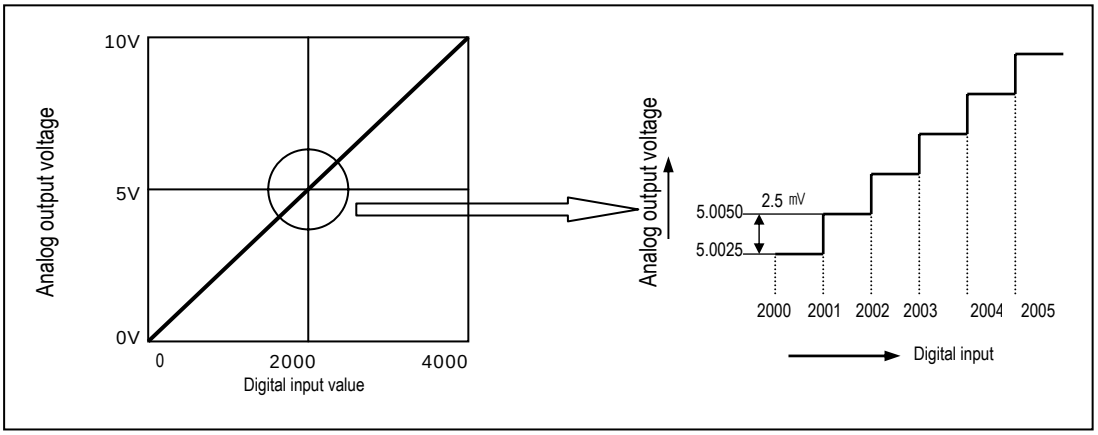
b) 4~20mA output



D/A conversion characteristics (Current output)

Digital amount 0 outputs analog amount 4mA, 4000 does 20mA.Digital input 1 equals to 6.25 μA of analog amount.

(2) G7F-DA2V



D/A conversion characteristics (Current output)

Digital amount 0 outputs analog amount 0V, 4000 does 10V. Digital input 1 equals to 2.5mV of analog amount.

.

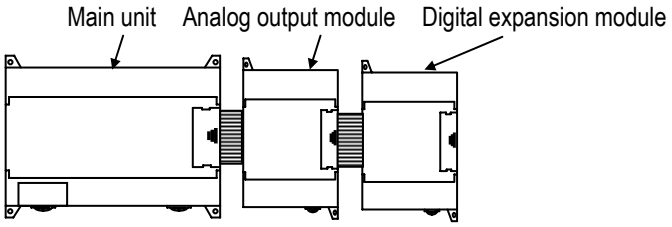
7) Program example

(1) Program which controls speed of inverter by analog output current (or voltage) of 5 steps (0 ~ 20mA /0~10V)

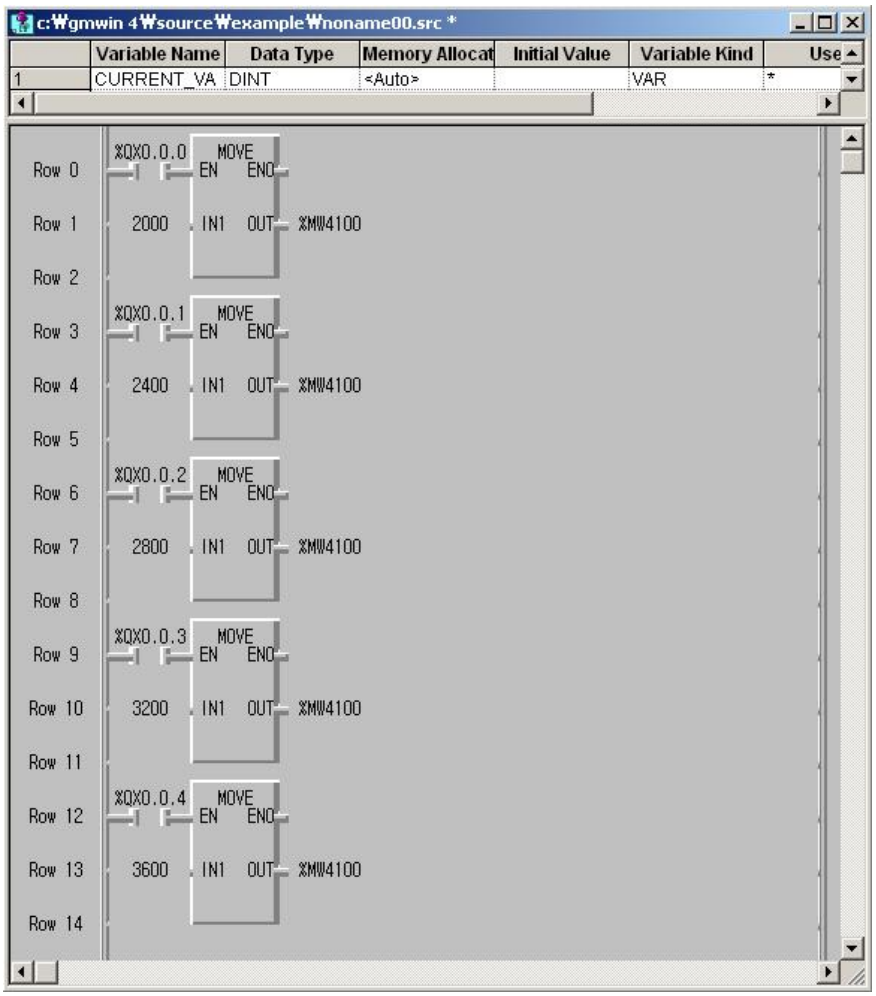
a) Program explanation (0 channel of the expansion module no.1)

- When %QX0.0.0 is On, 2000(10 ㎃/5V) is output.
- When %QX0.0.1 is On, 2400(12 ㎃/6V) is output.
- When %QX0.0.2 is On, 2800(14 ㎃/7V) is output.
- When %QX0.0.3 is On, 3200(16 ㎃/8V) is output.
- When %QX0.0.4 is On, 3600(18 ㎃/9V) is output.

b) System configuration



c) Program



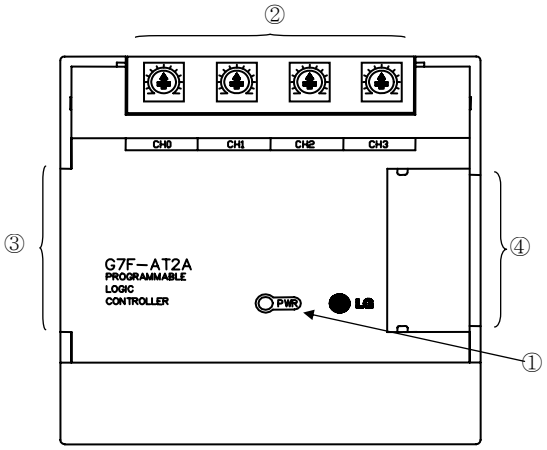
7.2.4 Analog timer

1) Performance specification

The performance specifications of the analog timer module are following.

Item	Specifications		
Number of channels	4		
Output value range	8 bits (Digital output range: 0 ～ 200)		
Setting type	Setting by variable resistance		
Accuracy of timer	±2.0% (Accuracy about max. value)		
Internal current consumption	50 ㎃		
Weight	200g		
A/T conversion value data register	Analog module #1	Analog module #2	Analog module #3
	%MW4160~%MW4163	%MW4164~%MW4167	%MW4168~%MW4171

2) Names of parts and functions



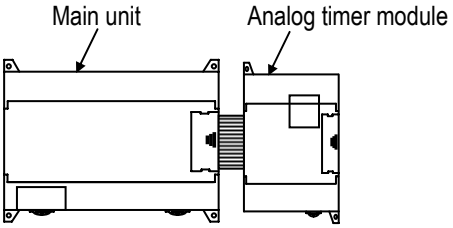
No.	Name	Function
①	RUN LED	Indicate the operating status of G7F-AT2A. On: normal operation Off: DC 5V power off
②	Channel	Setting up the length of timer through variable resistance to every channel
③	Extension cable	A cable to connect analog timer module
④	Extension cable connector	A connector to connect expansion cable

3) Program example

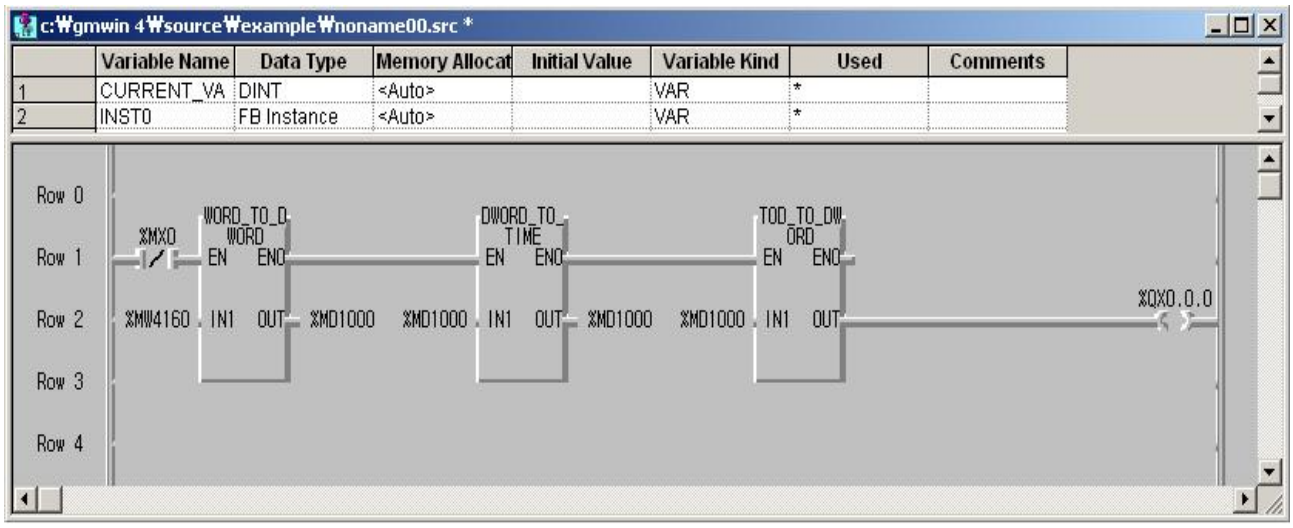
(1) Program

Program which controls on-delay time of output contact point within 0 to 200 ms by analog timer module. Timer T000 starts to count and turns on %QX0.0.0 when it reaches the value of %MD100.

(2) System configuration



(3) Program



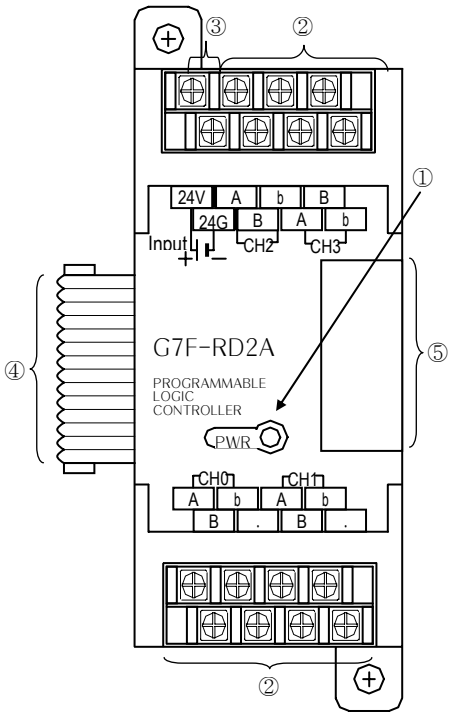
7.2.5 RTD input module

1) Performance specification

The performance specifications of the RTD input module are following.

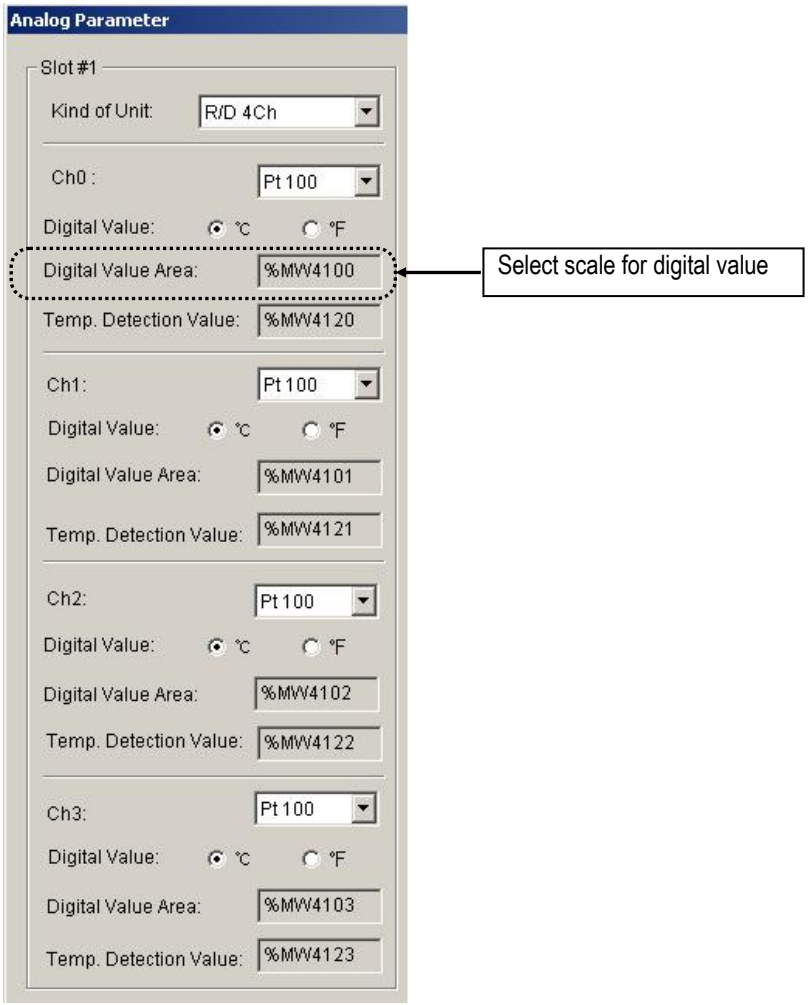
Item		Specifications
Connectable RTD		Pt 100 (JIS C1640-1989, DIN 43760-1980) JPt100 (KS C1603-1991, JIS C1604-1981)
Temperature input range		Pt 100: -200 ~ 600℃ (18.48 to 313.59Ω) JPt100: -200 ~ 600℃ (17.14 to 317.28Ω)
Digital output		Digital conversion value: 0 ~ 4,000 Detected temperature value: -2000~6000(one digit after point X 10)
Burn out detection		Three wires at every channel has detection function respectively
Accuracy		±0.5% [Full Scale]
Maximum conversion speed		40 scan / all channel
Temperature input point		4 channel / 1 module
No. of module installation		Max. 3 modules
Insulation		Photo-coupler insulation between the input terminal and the PLC power supply (non-insulation between channels)
Connection terminal block		2 of 8 points terminal
Current consumption		25 ㎃
External power supply	Voltage	DC 21.6 ～ 26.4V
	Current	70 ㎃
Weight		240g

2) Names of parts and functions



No.	Name	Function
①	RUN LED	Indicates the operating status of G7F-RD2A.
②	RTD input terminal	Terminal which connects Pt100 or JPt100
③	External power input terminal	Supply external voltage DC 24V
④	Extension cable	This cable is used to connect while RTD input module is used.
④	Extension cable connector	The connector connects extension cable when extended module is used.

3) Parameter settings



4) Special data register

Ch.	Detected Temperature value	Digital conversion value	Remark
0	%MW4120	%MW4100	Analog module #1
1	%MW4121	%MW4101	
2	%MW4122	%MW4102	
3	%MW4123	%MW4103	
0	%MW4124	%MW4104	Analog module #2
1	%MW4125	%MW4105	
2	%MW4126	%MW4106	
3	%MW4127	%MW4107	
0	%MW4128	%MW4108	Analog module #3
1	%MW4129	%MW4109	
2	%MW4130	%MW4110	
3	%MW4131	%MW4111	

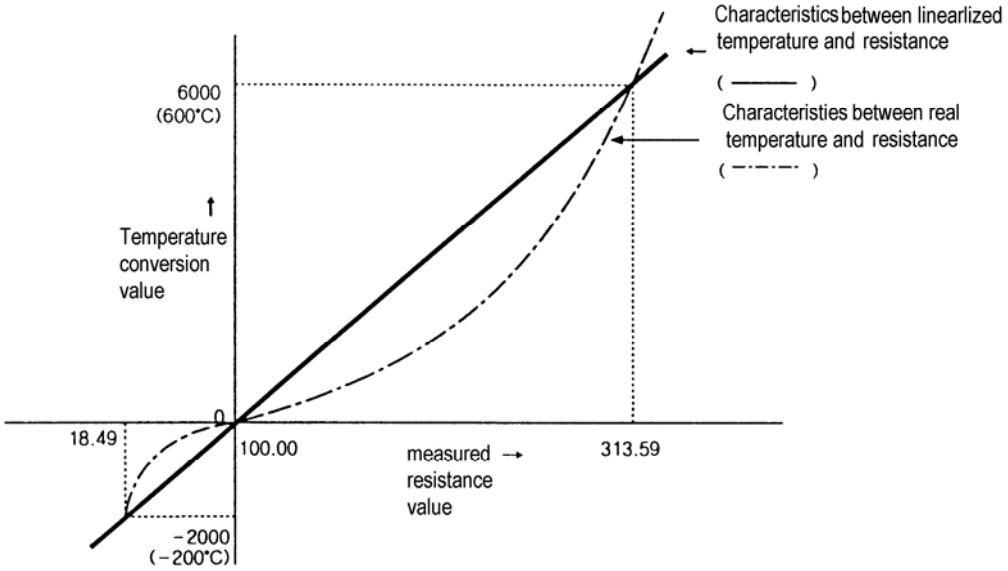
5) Error codes (%MW4140 ~ %MW4151)

Error codes are saved in order from %MW4140.

Error code	Description	Corrective action
0	Normal run status	—
16(10h)	A disconnection detected	Fix the A disconnection between RTD input module and RTD.
17(11h)	B disconnection detected	Fix the A disconnection between RTD input module and RTD
18(12h)	b disconnection detected, A and B disconnection detected simultaneously.	Fix the b disconnection between RTD input module and RTD. Or, Fix the A and B disconnection.
19(13h)	Temperature outside the range	Correctly specify the type of the RTD, or use the temperature within the range (-200.0°C ~ 600.0°C)

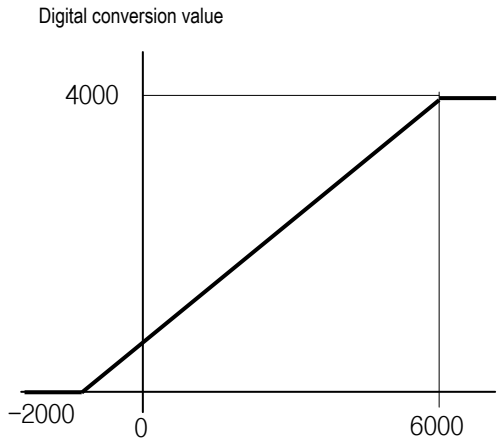
6) Temperature conversion characteristics

The RTD input module, as shown below, linearlizes the non-linear characteristic resistance input of the RTD.



7) Digital conversion value

The RTD input module, as shown below, outputs digital converted value of detected temperature value.
(Range 0 ~ 4000)



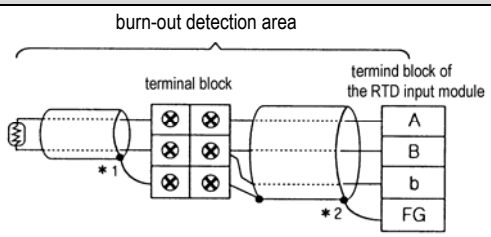
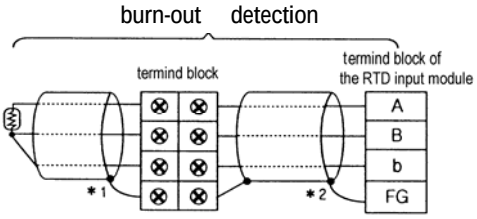
Digital Conversion value = (Detected Temp. value+2000)/2

Example) Assume that Detected temperature value(D4980) is 2345, then real temperature = 234.5℃, and Digital conversion value(D4770) is (2345+2000)/2 = 2172.

8) Burn-out detection function

The RTD input module has the function of burn-out detection on the Pt100, JPt100 or cable.

- As shown below, if disconnection occurs in the RTD or cable then a voltage outside the measurable range voltage is inputted by the internal burn-out detection circuit and burn-out detection error code is generated.
- The RTD input module can detect disconnection for each channel. But, burn-out detection is possible only in the channels enabled.
- If disconnection is detected in two or more wires, first, disconnection error code is generated by 'b' and then disconnection error code is generated by 'A' or 'b' sequentially. If disconnection is detected simultaneously in 'A' and 'B', only disconnection error code is generated by 'b'.

Connection Method	Connection Example	Remark
2-wire type		- In 4-wire type, only all wires marked '2' connected to the terminal block A are all detected as disconnection then the A disconnection error can be detected.
3-wire type		

4-wire type	burn-out detection termind block termind block of the RTD input module A B b FG *1 *2	*1 : Pt *2: Shield wire
No wiring	termind block of the RTD input module A B b FG	

9) Wiring

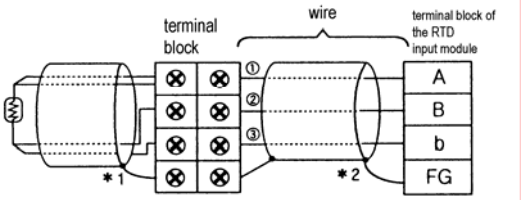
(1) Caution for wiring

- Make sure that external input signal of the mixture module of AC and analog I/O is not affected by induction noise or occurs from the AC through using another cable.
- Wire is adopted with consideration about peripheral temperature and electric current allowance. Thicker than Max. size of wire AWG22 (0.3 ㎟) is better.
- If wire is put near to high temp. radiated device or contacted with oil for a long time, it may cause of electric leakage so that it gets broken or miss-operation during wiring.
- Be sure to connect with care of polarity while connecting to external 24V DC power supply.
- In case of wiring with high voltage line or generation line, it makes induction failure so then it may cause of miss-operation and out of order.

(2) Wiring example

- Number of method of connection between Pt and RTD input module are three, that is, 2-wired type, 3-wired type and 4-w wired type.
- The resistance of the wires used to connect Pt to RTD input module should be 10 Ω or less per wire.
  The same wire (in thickness, length, and kind, etc.) should be used for each channel.

Connection Method	Connection Example	Wire Conditions
2-wired type	terminal block wire terminal block of the RTD input module ① ② ③ A B b FG *1 *2	ℵ wire resistance≤ 10Ω ℑ wire resistance≤ 10Ω ℜ wire resistance≤ 10Ω The difference between the resistance values of the wires ① and ② : 1Ω or less The difference between the resistance values of the wires ② and ③ : 1Ω or less The difference between the resistance values of the wires ③ and ① : 1Ω or less
3-wired type	terminal block wire terminal block of the RTD input module ① ② ③ A B b FG *1 *2	

4-wired type		

Method of Connection between Pt and RTD Input Module

*1: RTD (Pt100 or JPt1000)

*:2: Shielded wire - The shields of the RTD and shields of wire should be connected to the FG of the RTD input module.

REMARK

The difference between the resistance values of the wires used should be 1 Ω or less, or the accuracy shown in 1) Performance specification could not be satisfied.

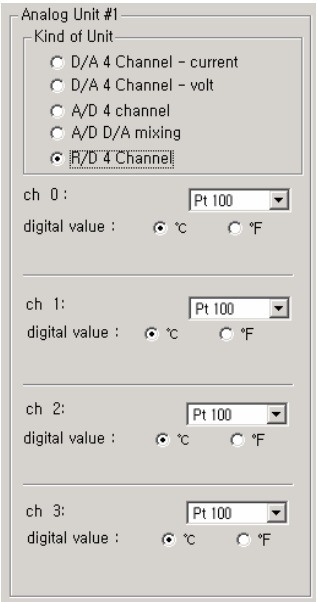
10) Program example

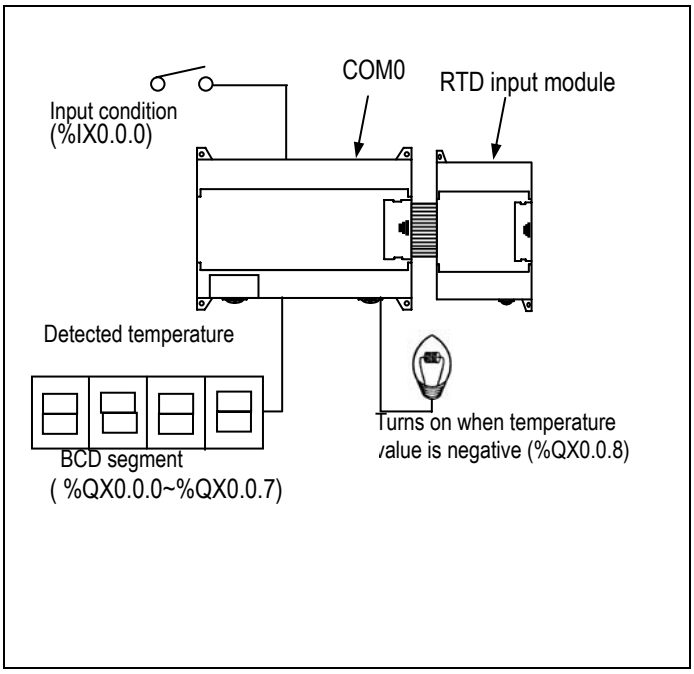
(1) A program for output of detected temperature value as a BCD value

a) Program explanation

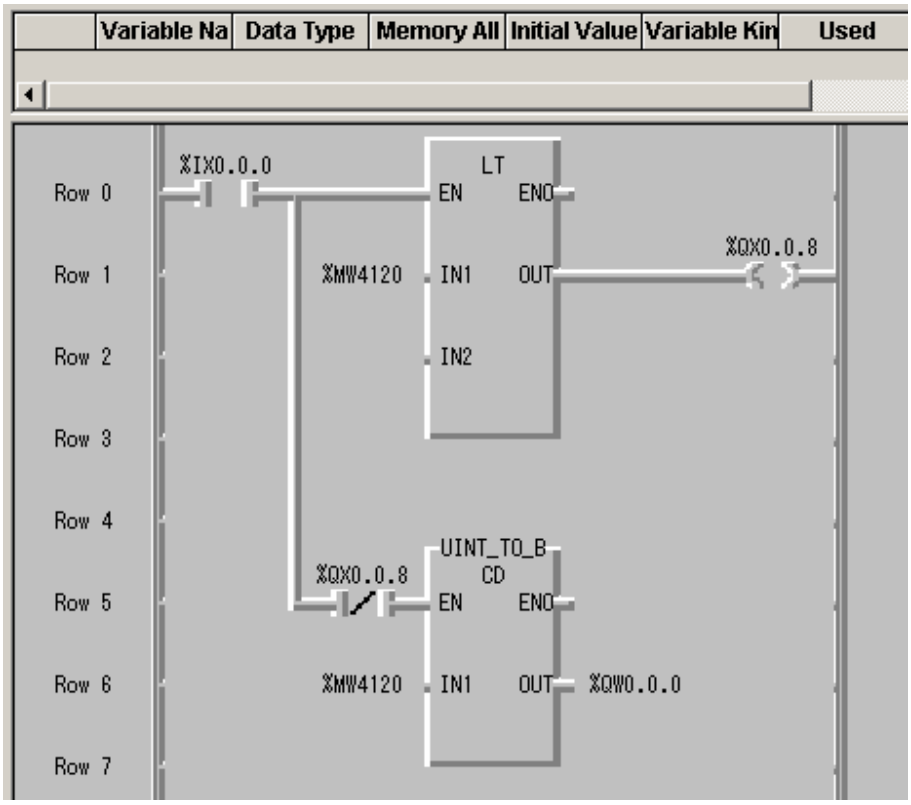
The present A/D conversion value of the detected temperature value which is detected from the temperature-measuring resistor Pt 100 is displayed on the BCD digital display by use of channel 0 of the temperature-measuring resistor input module. The lamp turns on when the detected temperature value is a negative number and turns off when it is a positive number

b) System configuration and parameter setting



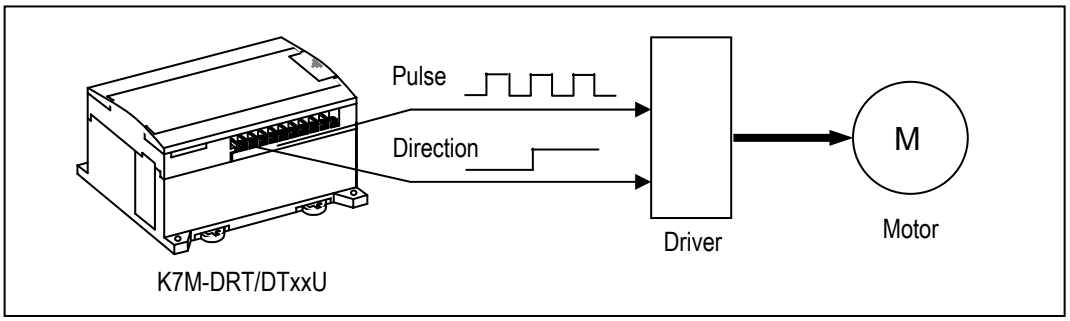


c) Program


Variable Na
Data Type
Memory All
Initial Value
Variable Kin
Used
Row 0
Row 1
Row 2
Row 3
Row 4
Row 5
Row 6
Row 7
%IX0.0.0
LT
EN
ENO
%MW4120
IN1
OUT
IN2
%QX0.0.8
UINT_TO_B
CD
%QX0.0.8
EN
ENO
%MW4120
IN1
OUT
%QW0.0.0

7.3 Positioning Function

The DRT/DT type of GM7U series support 2 axes of positioning function. The purpose of positioning function is to transfer the moving objects by setting speed from the current position and stop them on the setting position correctly. And it also control the position of high precision by positioning pulse string signal as it is connected to various servo running devices or stepping motor control running devices.

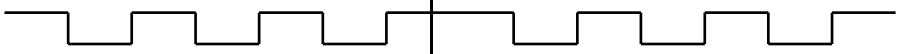


7.3.1 Specification

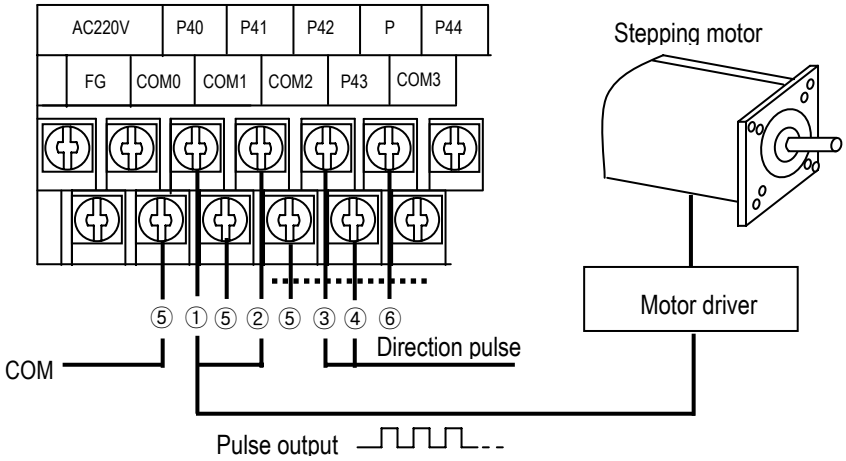
1) Performance specifications

Items			Specification
No. of control axis			2 axes
Control method			PTP(Point-To-Point), Speed control
Control unit			Pulse
Positioning data			20 data per each axis (Operation step No. : 1 ～ 20)
Positioning	Positioning method		Absolute / Incremental method
	Address range		-2,147,483,648 ～ 2,147,483,647
	Speed		Max. 100kpps , Speed setting range : 5 ～ 100,000pps(unit of pulse)
	Acceleration/ Deceleration method		Operation pattern : Trapezoidal method Acceleration time : 0 ～10,000 ㎳(unit of 1ms) Deceleration time : 0 ～10,000 ㎳(unit of 1ms)
	Backlash compensation		0 ~ 1,000 Pulse
	Bias speed		5 ～ 100,000pps
	Speed limit		5 ～ 100,000pps
Operation mode			End, Keep, Continuous operation
Operation method			Single, Repeated operation
Return to origin	Speed	High speed	Speed setting range: 5 ～ 100,000pps
		Low speed	Speed setting range: 5 ～ 100,000pps
	Dwell time		Setting range : 0～10,000 ㎳
	Method	1	Origin detection when approximate origin turns off
		2	Origin detection after deceleration when approximate origin turns on.
		3	Origin detection by approximate origin
JOG	Speed	High speed	Speed setting range: 5 ～ 100,000pps
		Low speed	Speed setting range: 5 ～ 100,000pps
PWM Output			Period setting range: 1 ～ 20,000 ㎳
			Duty setting range: 0 ～ 100%

2) Output specification (QX0.0.0, QX0.0.1, QX0.0.2, QX0.0.3)

Signal Name	Rated load voltage	Load voltage range	Max. load current	Max. voltage drop during On
Positioning (CW / CCW)	DC 12/24V	DC 10.2～26.4V	100 ㎃	DC 0.3 V or less
	Forward direction		Reverse direction	
QX0.0.0 ~.1				
QX0.0.2 ~.3				

3) Names of wiring terminal



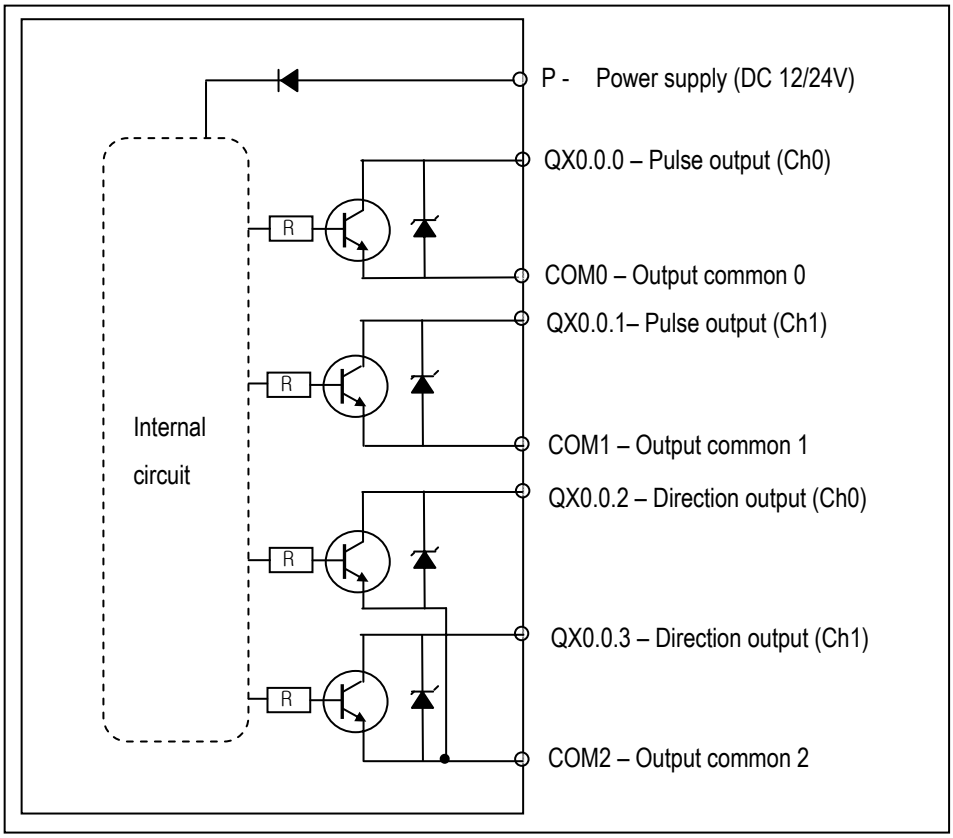
No.	Terminal No.	Name	Usage
①	QX0.0.0	Pulse output (Ch0)	Pulse output terminal
②	QX0.0.1	Pulse output (Ch1)	Pulse output terminal
③	QX0.0.2	Direction output (Ch0)	Direction output terminal
④	QX0.0.3	Direction output (Ch1)	Direction output terminal
⑤	COM0,COM1,COM2	Common	Pulse output common terminal
⑥	P	24V	External 24V supply terminal

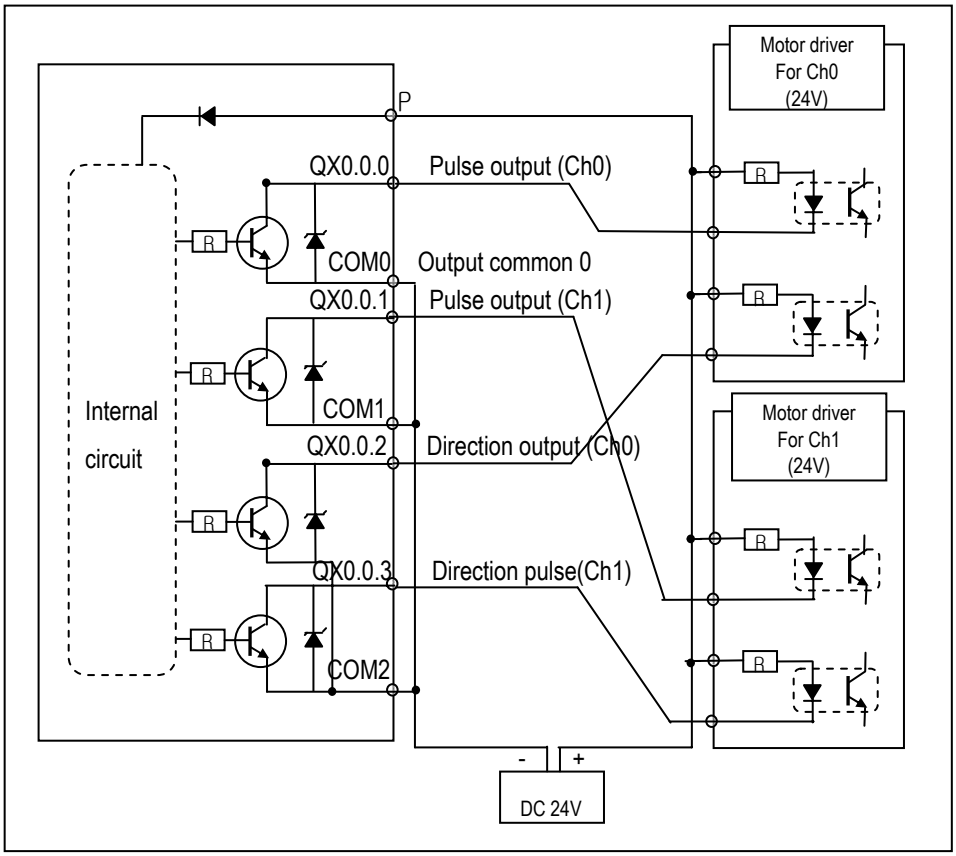
REMARK

Positioning function is sensitive to the external noise and should be handled with special care.

1) Be sure to use shielded twisted pair cables. Also provide Class 3 grounding
2) Do not run a twisted pair cable in parallel with power cables or other I/O lines which may generate noise
3) Before applying a power source for pulse generator, be sure to use a noise-protected power supply

4) Internal circuit and wiring example





7.3.2 Positioning function

1) Positioning function

Positioning Control includes position control, speed control.

(1) Position control

Positioning control from start address (present stopped position) to goal address (transfer amount) for the assigned axis

A) Control by Absolute method (Absolute coordinate)

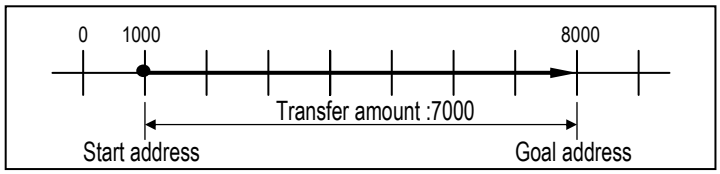
ⓐ Positioning control from start address to goal address (the address assigned by positioning data).

ⓑ Positioning control is carried out based on the address assigned (origin address) by return to origin.

ⓒ Transfer direction shall be determined by start address and goal address.

- Start address < Goal address : forward direction positioning
- Start address > Goal address : reverse direction positioning

Example] When Start address is 1000 and goal address is 8000, this will be forward direction and transfer amount shall be 7000 (7000=8000-1000).



- Parameter setting

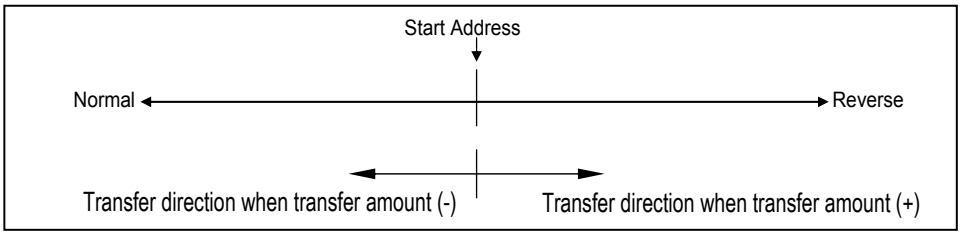
Items of positioning data	Step No.	Coordinate	Operation method	Goal address	Speed (pps)	Dwell time (㎳)
Setting	1	Absolute	Single	8,000	5,000	100

B) Control by Incremental method (Relative coordinate)

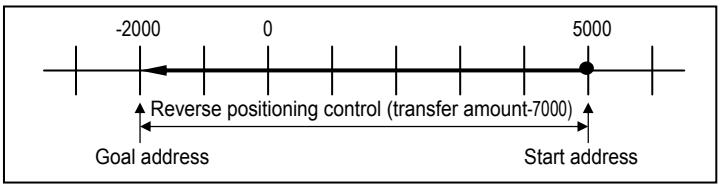
ⓐ Positioning control as much as the goal transfer amount from start address.

ⓑ Transfer direction shall be determined by the sign of transfer amount.

- When transfer direction is (+) or no sign : forward direction (address increase) positioning
- When transfer direction is (-) : reverse direction (address decrease) positioning



Example) When start address is 5000 and goal address is -7000, this will be reverse direction and positioning will be at the point of 2000



- Parameter setting

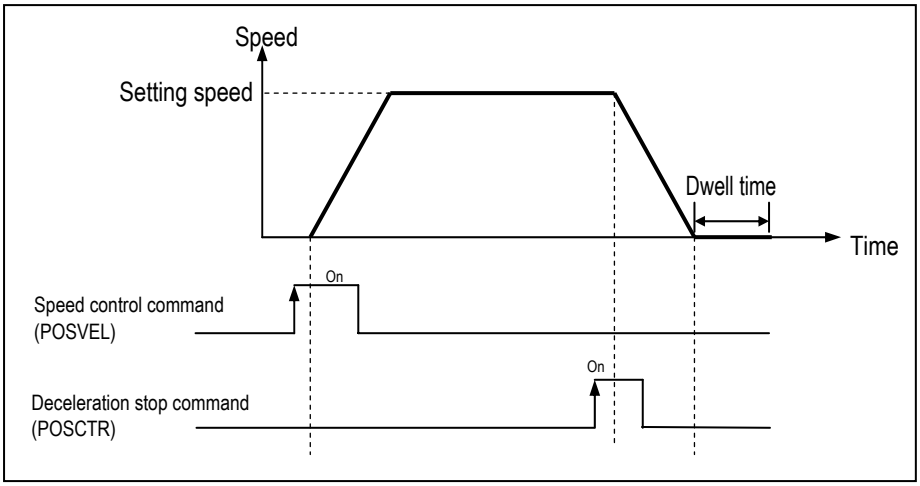
Items of positioning data	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed(pps)	Dwell time(㎳)
Setting	1	Incremental	End	Single	-7,000	5,000	100

(2) Speed Control (Uniform Speed Operation)

- This controls the speed by the setting speed until deceleration stop command(POSCTR) is entered after execution by POSVEL command..
- The speed can be changed by the speed override instruction(POSSOR)
- Speed control contains 2 types of start method : Forward direction start and Reverse direction start.
  - Forward direction : when position address is positive number (+) ("0" included)
  - Reverse direction : when position address is negative number (-)

Forward direction	Reverse direction
Set second operand of POSVEL instruction to 0	Set second operand of POSVEL instruction to 1

- Timing diagram



REMARK

Please refer to the section 'POSVEL' for details.

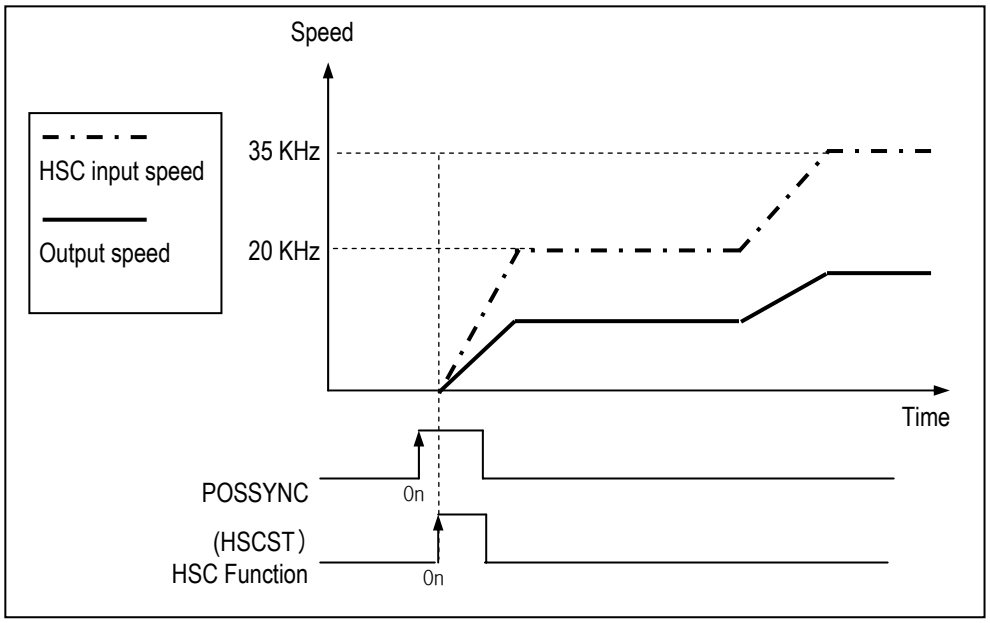
(3) Synchronization control

- After the execution of POSSYNC, the HSC input pulse speed is synchronized by the designated synchronization scale.
- Scale can be changed during the execution.
- Setting range: 0 ~ 100%

$$\text{Scale} = \frac{\text{Positioning speed}}{\text{HSC input speed}}$$

- Execution timing

Example) Execute POSSYNC function block by 50% of speed



2) Operation pattern

- Operation pattern describes various configuration for how to operate the positioning data using several operation step no and how to determine the speed of position data.
- Operation mode types are as follows

Operation mode	Remark
End	One operation step is executed with one start command
Keep	When one operation step has over, executes next operation step without additional start command
Continuous	When one operation step has over, executes next operation step without Deceleration.

- Operation methods are as follows.

Operation method	Remark
Single	When one operation step is over, executes next operation step No. automatically
Repeat	When one operation step is over, executes assigned step No. repeatedly

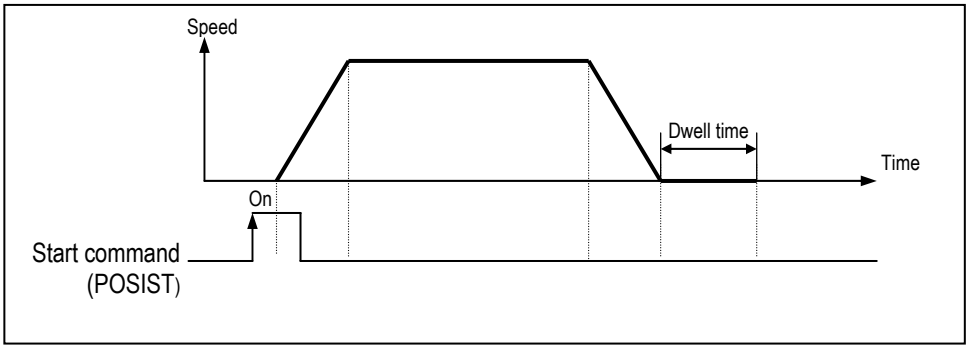
- Step No. can be assigned within 1 ~ 20

Items of parameter	Step No.	Coordinate	Operation mode	Operation method	Address	Speed(pps)	Dwell time (㎳)
Setting	1 ~ 20	Absolute Incremental	End Keep Continuous	Single Repeat	-2.147,483,648 ~ 2,147,483,647	5 ~ 100,000	0 ~ 10,000

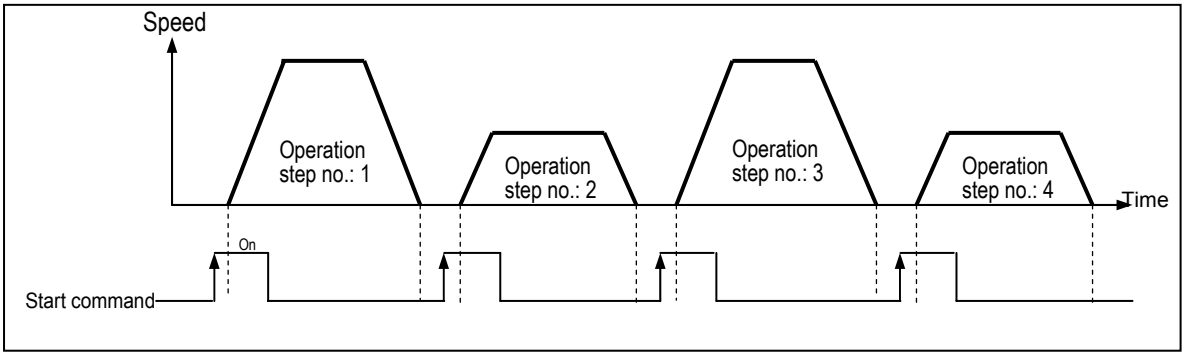
3) Operation mode

(1) End operation

A) With one time start command (rising edge of POSIST command), the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.
B) This operation mode can be used as last positioning data of pattern operation.
C) Operation direction shall be determined by position address.
D) Operation action is trapezoid type operation that has acceleration, constant, deceleration section according to the setting speed and position data.



[Example] End operation



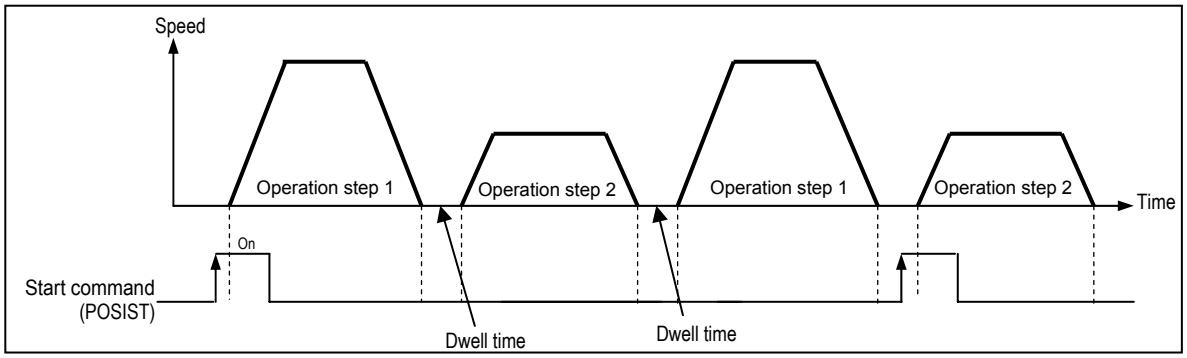
- Parameter setting

No. of program start command	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed (pps)	Dwell time (㎳)
1	1	Absolute	End	Single	10,000	50,000	0
2	2	Absolute	End	Single	20,000	20,000	0
3	3	Absolute	End	Single	30,000	50,000	0
4	4	Absolute	End	Single	40,000	20,000	0

(2) Keep operation

A) With one time Start command (POSIST), the positioning to the goal position of operation step is executed and the positioning shall be completed at the same time as dwell time proceeds and without additional start command, the positioning of operation step for (current operation step no. +1) shall be done.
B) Keep operation mode is available to execute several operation step in order.
C) Operation direction shall be determined by position address.

[Example] Keep operation



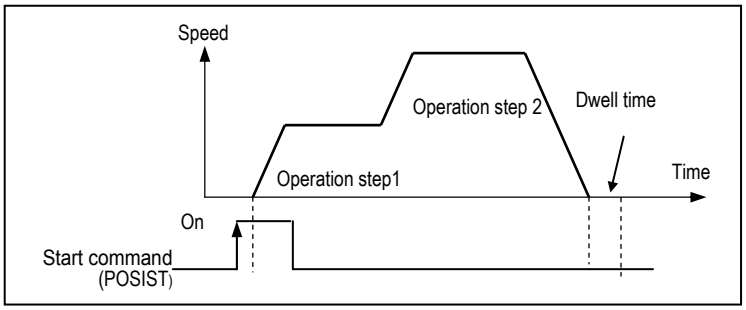
• Parameter setting

No. of program start command	Step No.	Coordinate	Operation method	Goal address	Speed (pps)	Dwell time (㎳)
1	1	Absolute	Single	10,000	50,000	10
	2	Absolute	Single	20,000	20,000	10
	3	Absolute	Single	30,000	50,000	0
2	4	Absolute	Single	40,000	20,000	0

(3) Continuous Operation

A) With one time Start command (rising edge of POSIST command), the positioning for operation step set by continuous operation mode is executed to the goal position without stop and the positioning shall be completed at the same time as dwell time proceeds.
B) If you want to operate with the position and speed of next step before the operation step that is active currently reaches the goal position, the operation by Next Move continuous operation command is available.
C) With Next Move continuous operation command, the operation in the acceleration, constant speed, deceleration section of Continuous operation is available.
D) Operation direction shall be determined by position address and should be same direction. If operation direction is not same, error occurs(Refer to 7.3.5 error flags)

[Example] Continuous operation



● Parameter setting

No. of program start command	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed (pps)	Dwell time (㎳)
1	1	Absolute	Continuous	Single	10,000	50,000	10
	2	Absolute	End	Single	20,000	20,000	10

4) Operation method

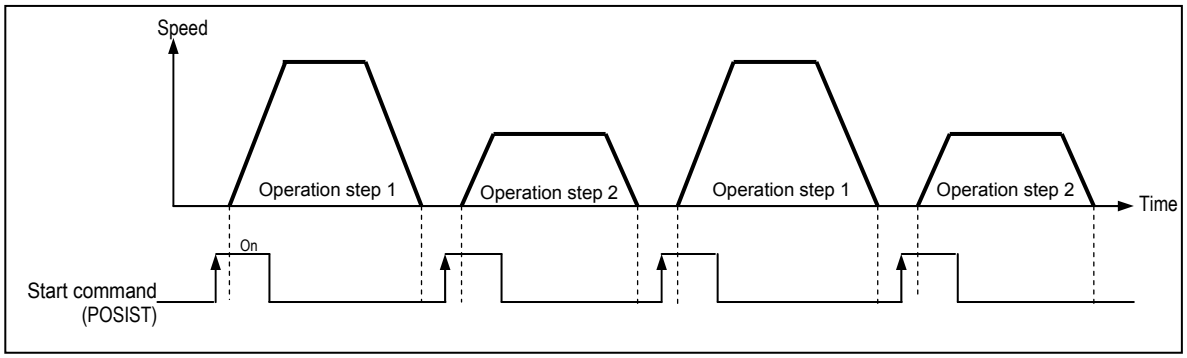
(1) Repeat operation

A) With one time start command, the positioning to the goal position is executed and the positioning shall be completed at the same time as the dwell time proceeds.

B) The operation type of Repeat operation mode is same as that of Single operation but the different thing is to determine next operation by operation step no. assigned by repeat step no. change command after positioning completion of Repeat operation mode.

C) Operation direction shall be determined by position address.

[Example] Repeat pattern



• Parameter setting

No. of program start command	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed (pps)	Dwell time (㎳)
1,3	1	Incremental	End	Single	10,000	50,000	0
2,4	2	Incremental	End	Repeat 1	20,000	20,000	0
	3	Absolute	End	Single	30,000	50,000	0
	4	Absolute	End	Single	40,000	20,000	0

→ In this case, Operation step 3, 4 does not start.

5) Positioning start

(1) Direct start (POSDST)

- This is used to operate directly by setting the axis, goal position address, operation speed without parameter setting.
- Refer to the section 'POSDSST' for details.

(2) Indirect start (POSIST)

- This is used to operate by setting the operation step no. by parameter.
- Refer to the section POSIST for details.

(3) Speed control start (POSVEL)

- This is used to operate directly by setting the axis, direction, operation speed without parameter setting.
- The speed can be changed by the speed override instruction(POSSOR)
- Refer to the section POSVEL for details.

6) Positioning stop

(1) Deceleration stop (POSCTR)

- If encounters deceleration stop command during operation, it stop operation after deceleration.
- In case of deceleration stop by deceleration stop command in acceleration or constant speed section, starts to operate current operation step again by Start command and operation step
- In case of deceleration stop by deceleration stop command in deceleration speed section, starts to operate 'current operation step+1' again by Start command and operation step
- Refer to the section POSCTR for details.

(2) Emergency stop (POSCTR)

- If encounters emergency stop command during operation, it stops operation without deceleration.
- When emergency stop has occurs, emergency stop error and output disable flag are set.
- Error and output disable flag should be reset by error reset command of POSCTR for re-start operation
- Refer to the section POSCTR for details.

7) Return to origin (POSORG : Rising edge ↑)

- Return to Origin (homing) is carried out to confirm the origin of the machine when applying the power.
- In case of Return to Origin, it is required to set Return to Origin parameter for each axis.
- If the origin position is determined by origin return, the origin detection signal is not recognized during positioning operation.

(1) Origin return method

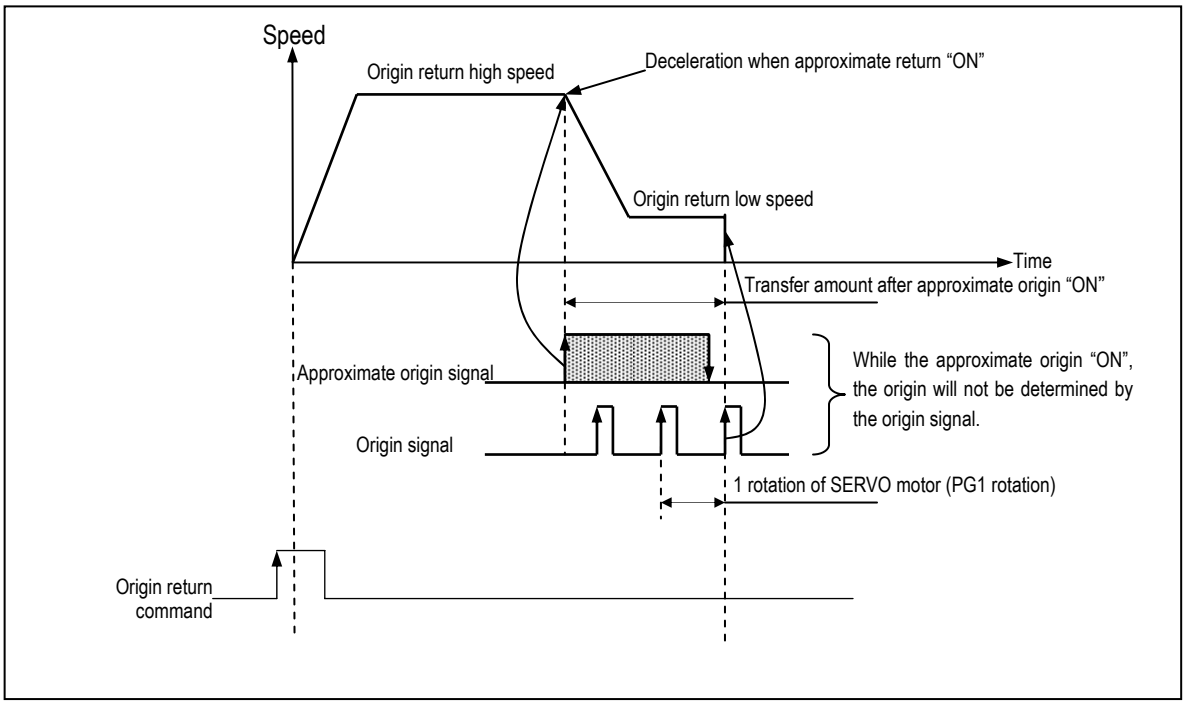
- Method by approximate origin (approach DOG)
  - Origin return processing method by approximate origin (approach DOG) has 3 kinds of method as follows.
    (A) Origin detection when approximate origin turns off
    (B) Origin detection after deceleration when approximate origin turns on
    (C) Origin detection by approximate origin

- The items that effects to the origin return from parameter are as follows.
  (A) Origin return speed (high speed, low speed)
  (B) Origin return dwell time

(2) Origin Detection when Approximate origin turns off

This is the method using the approximate origin and origin signal and the action by origin return command(POSORG) is as follows.

(A) It accelerates to the setting origin return direction and acts by origin return high speed.
(B) In this case, if approximate origin as external input is entered, it decelerates and acts by origin return low speed.
(C) If origin signal as external input is entered after the approximate origin signal has changed from ”On” to “Off”, it stops.



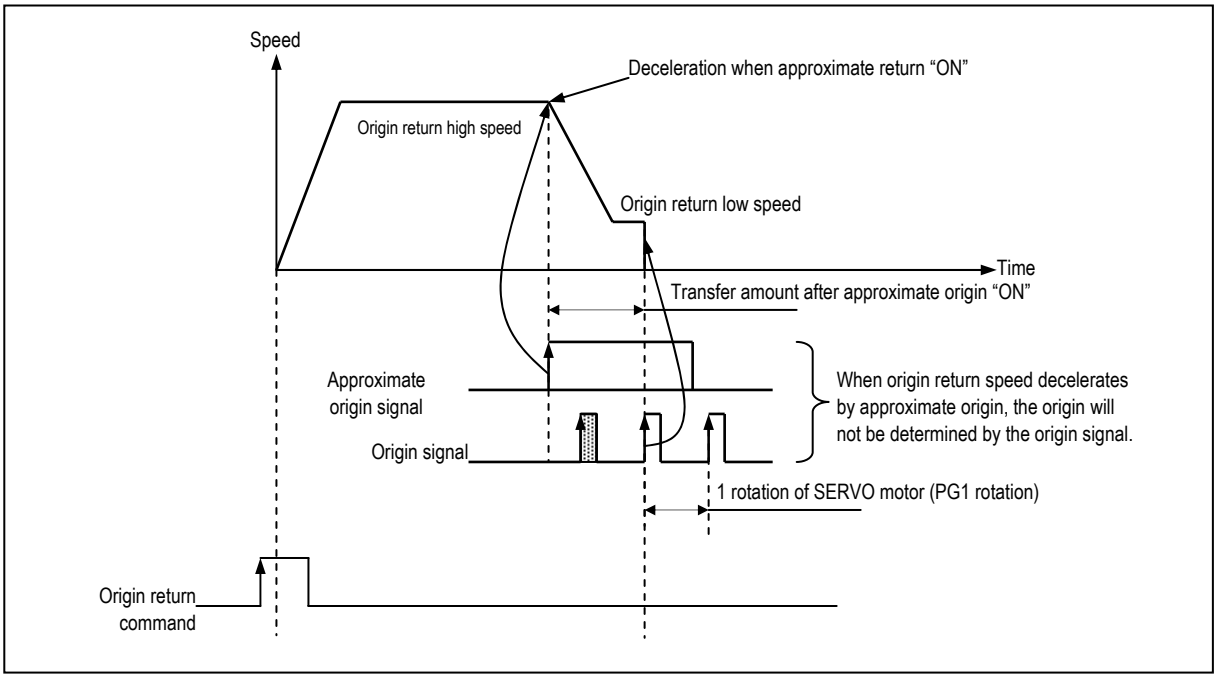
(3) Origin Detection after Deceleration when Approximate origin turns on

This is the method using the approximate origin and origin signal and the action by origin return command is as follows.

(A) It accelerates to the setting origin return direction and acts by origin return high speed.

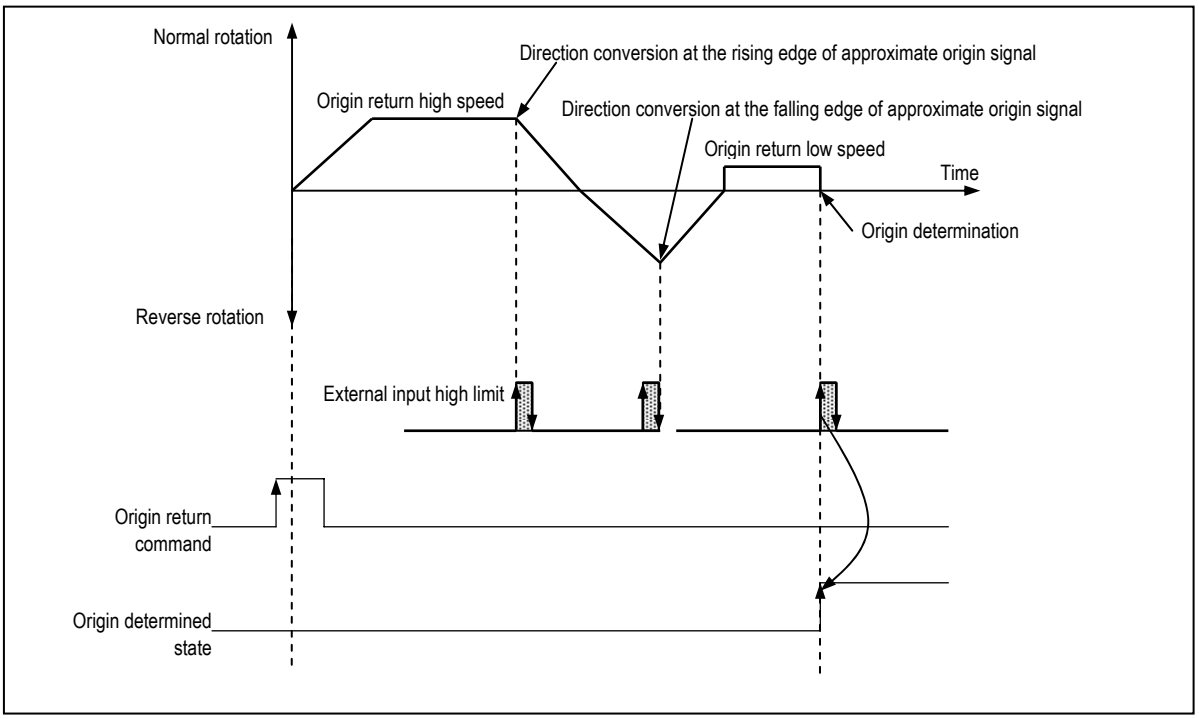
(B) In this case, if approximate origin as external input is entered, it decelerates and acts by origin return low speed.

(C) If encounters the origin signal as external input signal while the origin return low speed is active, the origin shall be determined and it stops.



(4) Origin Detection by approximate origin

This is the method using the approximate origin signal only.



8) JOG Operation (POSJOG : Level input)

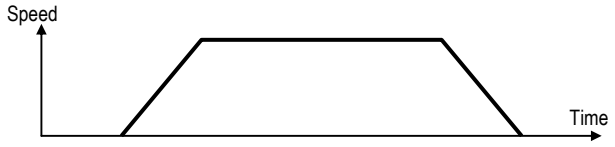
(1) JOG operation

- Carries out the positioning control by Jog command(POSJOG).
- Carries out the monitoring when the positioning acts by JOG command and the position address is changed.
- This is used when acting without origin determination.

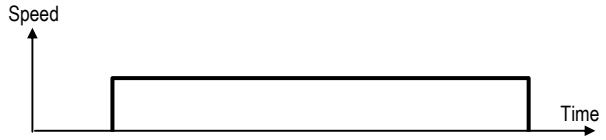
(2) Acceleration/Deceleration Processing and Jog speed

(A) The acceleration/deceleration processing is controlled based on the setting time of JOG acceleration/ deceleration time from parameter setting.

- Jog high speed operation : operation pattern with acceleration/deceleration



- Jog low speed operation : operation pattern without acceleration/deceleration



(B) If speed operand of POSJOG command as device not constant, JOG speed can be changed from low speed to high speed or high speed to low speed during operation

(C) If Jog speed is set out of the setting range, error will occur and the operation does not work.

Setting range	Jog high speed operation	5～100,000 pps	(Setting unit :1pps)
	Jog low speed operation	5～100,000 pps	

9) Speed Override Command(POSSOR : Rising edge ↑))

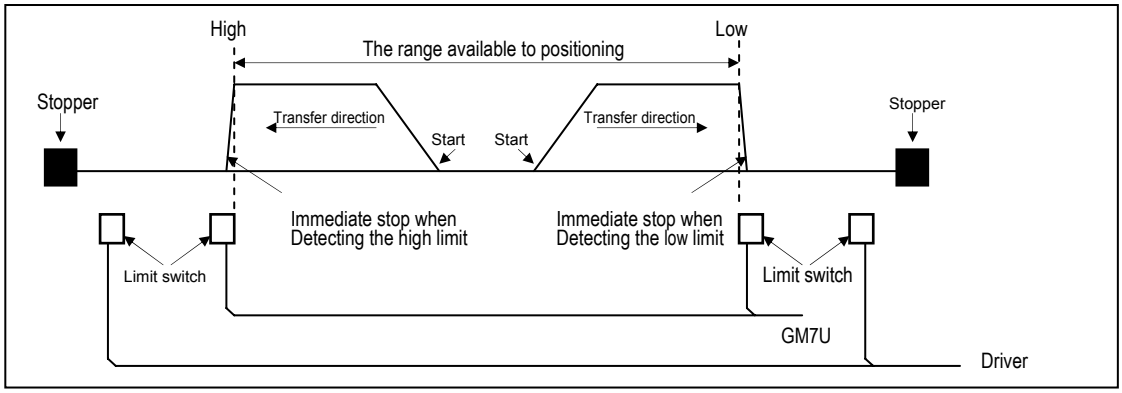
- This is used to change the operation speed from operation data of step no. in operation of each axis
- This command is used only in Acceleration and Constant speed section from operation pattern.
- Setting range is 5 ~ 100,000
- This command can be used in position control and speed control.

Remark

If POSSOR is executed in deceleration section, error code H44 will occur and continues operation

10) External Input Stroke High / Low Limit

- External input stroke limit includes External input high limit signal and External input low limit signal.
- This is used to stop the positioning function promptly before reaching Stroke limit/Stroke End of the Driver by installing the stroke limit inside Stroke limit/Stroke end of the Driver.
- If it deviates the high limit, Error H53 will occur and if it deviates the low limit, Error H54 will occur.
- External input stroke limit can be set in GMWIN parameter
- High/Low limit input contact point is fixed to P0,P1 for ch0 and P2,P3 for ch1.



- If positioning module stops out of the range available to control, the positioning operation does not work.
  If it stops by external input stroke limit detection, move within the range of positioning module available to control by manual operation (Jog operation).
- As external input stroke high/low limit error is detected by the edge of positioning module, it is available to release the output prohibit out of stroke range and carry out manual operation.
- The flags related with external input stroke limit are as followings.
  - %IX0.0.0 (Ch0) Off : External input stroke Low limit has not detected, On : External input stroke Low limit has detected
  - %IX0.0.1 (Ch0) Off : External input stroke High limit has not detected, On : External input stroke High limit has detected
  - %IX0.0.2 (Ch1) Off : External input stroke Low limit has not detected, On : External input stroke Low limit has detected
  - %IX0.0.3 (Ch1) Off : External input stroke High limit has not detected, On : External input stroke High limit has detected

REMARK

If external input stroke High/Low limit signal is occur during origin return, it stops operation immediately, Then, changes direction and continues origin return operation.

11) M Code (After mode)

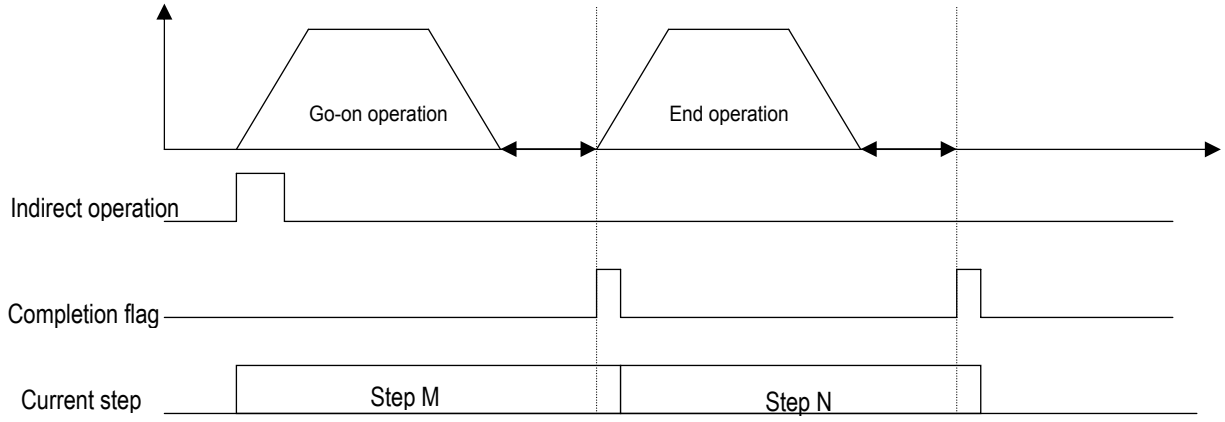
This is the mode that sets M Code Set bit when the M Code Enable bit is On after completing the positioning.
To operate the next step, the M Code Set bit must be reset.

- Special relays are as follow.

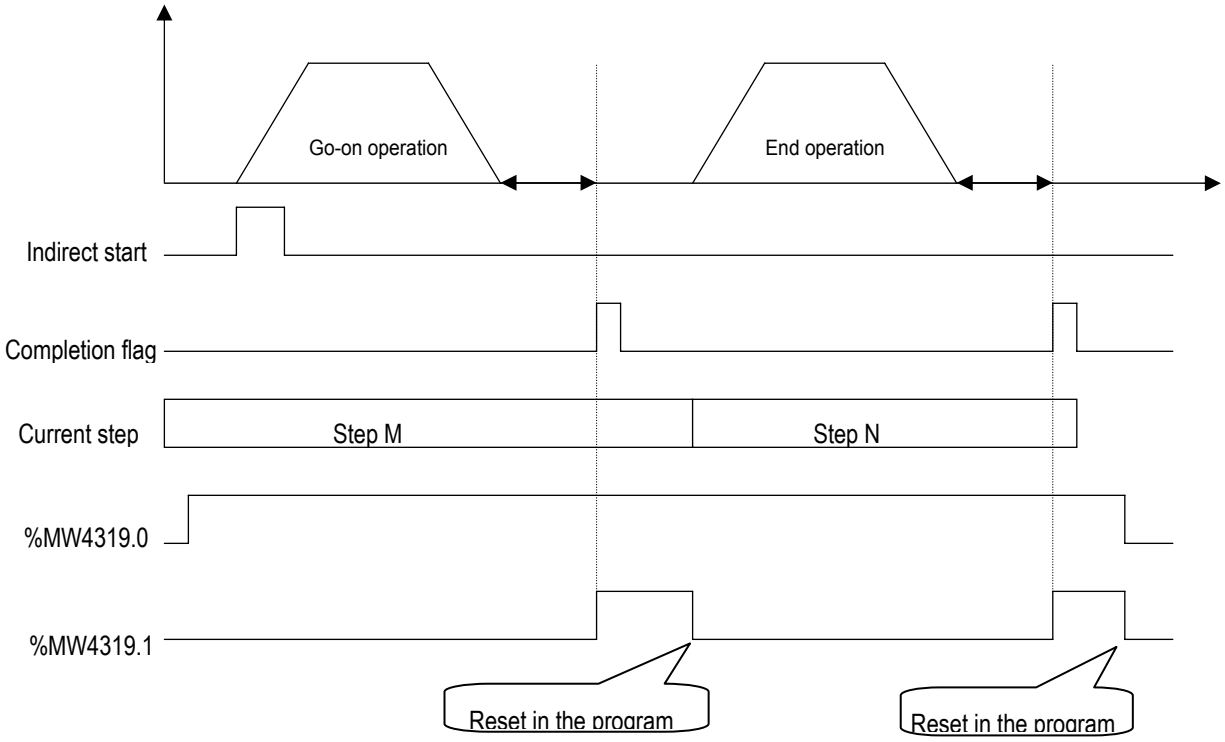
Area	Description	Remark
0 bit of %MW4319	M Code Enable Bit (Ch0)	Set M Code when it is On
1 bit of %MW4319	M Code Set Bit (Ch0)	Set when the positioning is completed
0 bit of %MW4519	M Code Enable Bit (Ch1)	Set M Code when it is On
1 bit of %MW4519	M Code Set Bit (Ch1)	Set when the positioning is completed

- Timing chart

1) Without M Code output



2) With M Code output



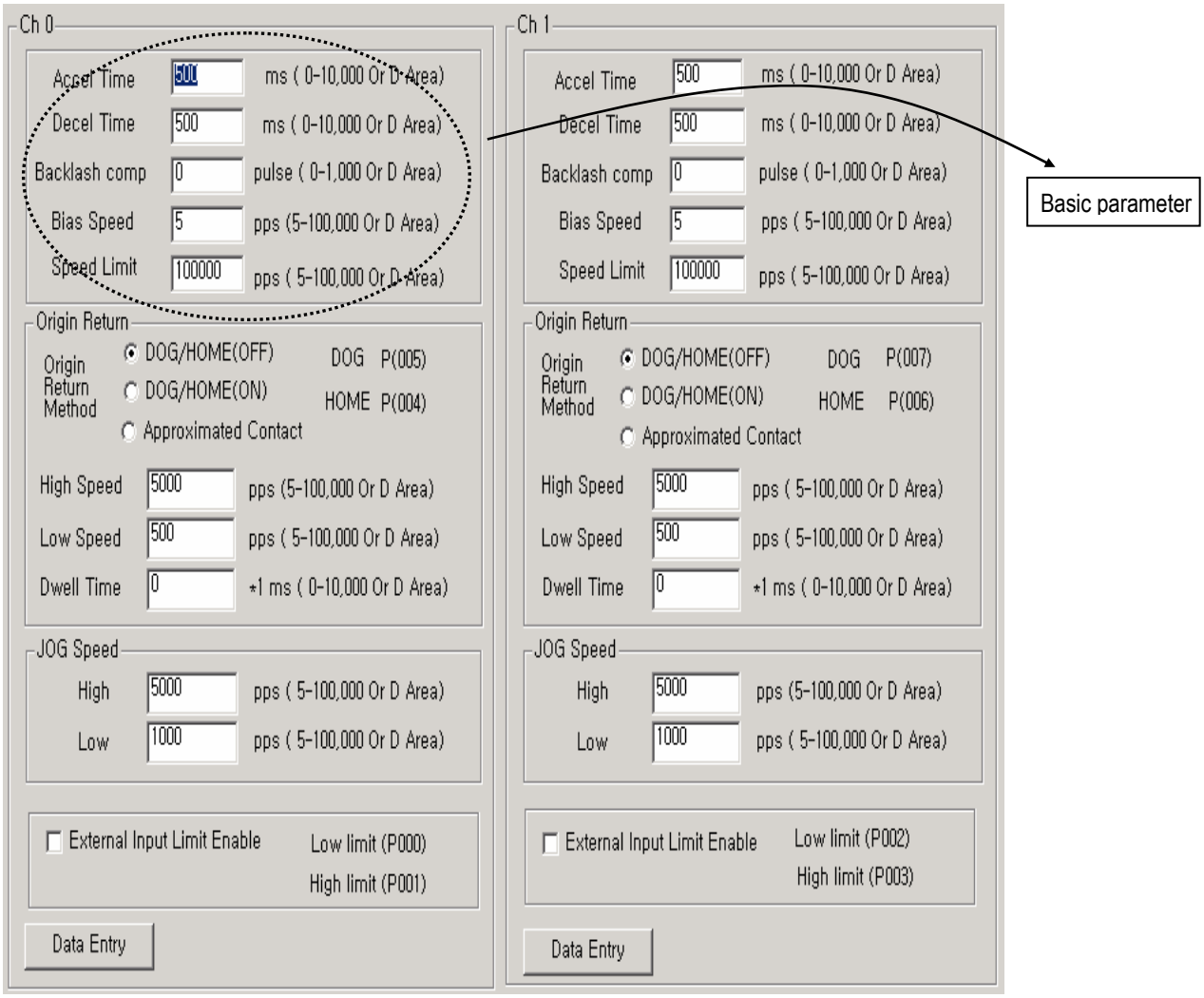
12) Error and Output Prohibition

- Error includes Light failure error and Heavy failure error.
- If light failure error occurs, the positioning operation will continue and only error will occur.
- In case of heavy failure error, if the error is not cleared, it is not available to carry out the positioning operation. And if the heavy failure error occurs during operation, the operation will stop.
- If external high/low limit, external emergency stop during the positioning operation are detected during the positioning operation, it stops promptly and becomes the pulse output prohibition status. Thus it is required to release the pulse output prohibition by Error reset command (POSCTR)
- For further information, please refer to Error code list .

7.3.3 Positioning parameter and operation data

1) Positioning parameter

- Positioning parameter setting
- Parameter should be assigned for each axis



(1) Basic parameter

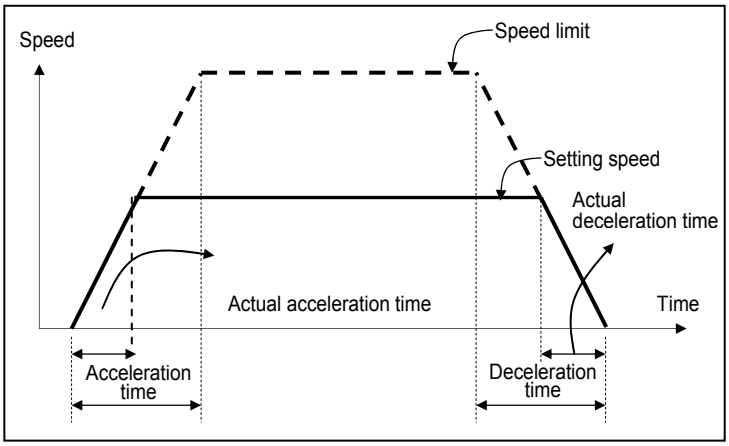
Accel Time (%MW4300):	500	ms (0 -10,000)
Decel Time (%MW4301):	500	ms (0 -10,000)
Backlash comp (%MW4302):	0	pulse (0-1,000)
Bias Speed (%MD2152):	5	pps (5-100,000)
Speed Limit (%MD2153):	100000	pps (5-100,000)

(A) Acceleration/Deceleration time

- This is applied at the starting/ending point of positioning operation, return to origin high speed, and JOG high speed operation
- The setting range is 0 ～ 10,000 (unit: 1ms) for each axis.
- When set to zero, operates constant speed.

① Acceleration time : the time required to reach from speed "0"(stop state) to the speed limit which is set by parameter. In case of using BIAS, it is the time required to reach from the bias speed to the speed limit which is set by parameter.

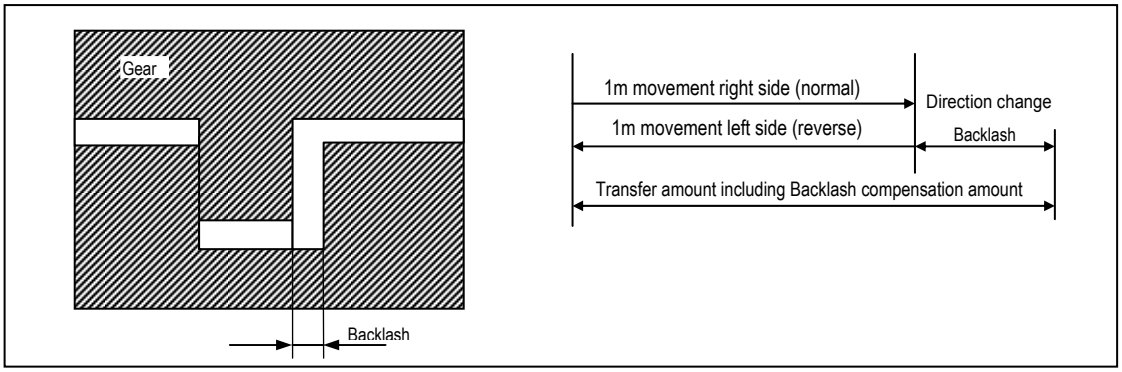
② Deceleration time : the time required to reach from the speed limit set by parameter to the speed "0"(stop state). In case of using BIAS, it is the time required to reach from the speed limit set by parameter to the setting bias speed.



- Speed limit : max. speed available to set for positioning operation at the parameter of GMWIN.
- Setting speed : speed value of operation data that position data operates actually.
- Actual acceleration time : the time required to reach from speed "0"(stop state) to the speed value which is set by operation data.
- Actual deceleration time : the time required to reach from the speed value set by operation data to speed

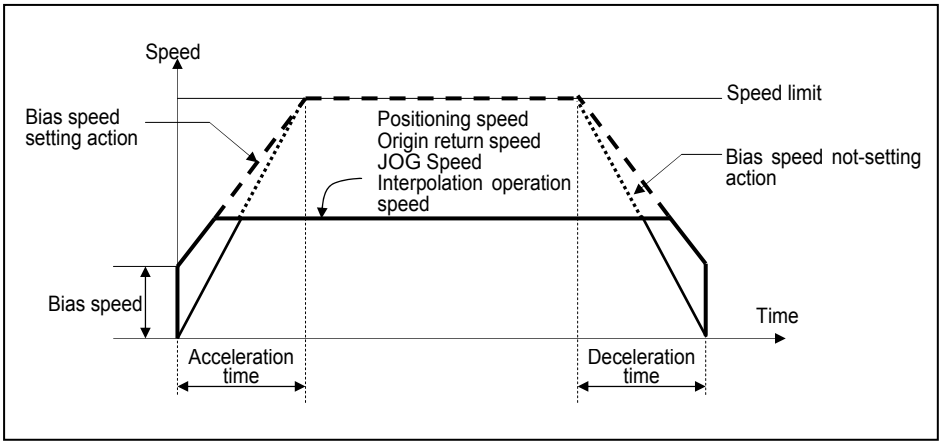
(B) Backlash Compensation Amount

- The tolerance that the machine does not work by the wear when the rotation direction changes in case that a gear, screw etc is combined to run at the motor axle, is called as 'Backlash".
  Therefore, when you change the rotation direction, it is required to add the backlash compensation amount to the positioning amount for output.
- The setting range is 0 ～ 1,000(unit: Pulse) at each axis.
- If the position moved 1m to the right and again 1m to the left, it is not possible to reach the original position by backlash. At this time, it is required to add backlash compensation amount.



(C) Bias Speed

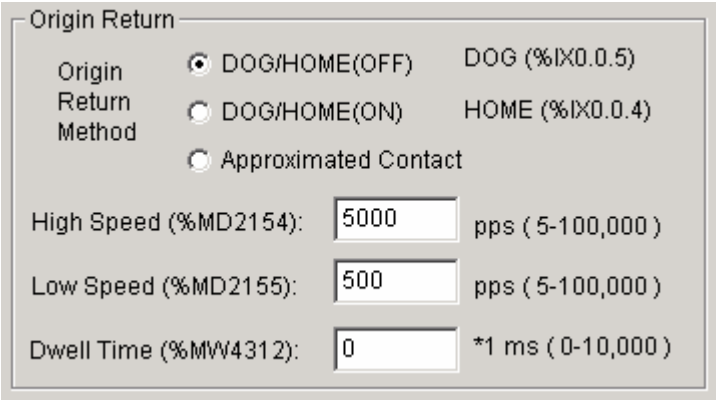
- As the stepping motor has unstable torque near zero speed, the start speed shall be set in the beginning of operation in command to smooth the rotation of motor and reduce the positioning time. The speed to be set at this time is called "Bias Speed".
- The setting range is 5～10,000(unit: 1pps) at each axis.
- Bias speed shall be used for the main axis of
  ① positioning operation by setting command,
  ② origin return operation,
  ③ JOG operation.



(D) Speed Limit

- max. Speed available to set for positioning operation.
- The setting range is 5~100,000 (unit : 1pps).
- The operation speed of positioning operation, origin return speed and Jog operation speed is influenced by speed limit and if they are set as higher value than speed limit, error will occur.

(2) Origin return parameter



(A) Origin return method

- For the details, please refer to '7) Return to Origin' in chapter 7.3.2

(B) DOG, origin signal

	Ch 0	Ch 1
DOG	IX0.0.5	IX0.0.7
Origin	IX0.0.4	IX0.0.6

(C) Origin return speed

- The speed when returning to the origin by origin return command : high speed and low speed
- When setting the origin return speed, it should be "speed limit ≥ origin return high speed ≥ origin return low speed ≥ bias speed".

① Origin return high speed

- The speed that acts to the constant speed section via acceleration section by origin return command.
- Origin return-high speed setting range : 5 ～ 100,000(unit: 1pps)

② Origin return-Low speed

- The speed that acts to the constant speed section via deceleration section by origin return command.
- Origin return-low speed setting range : 5 ～ 100,000(unit: 1pps)

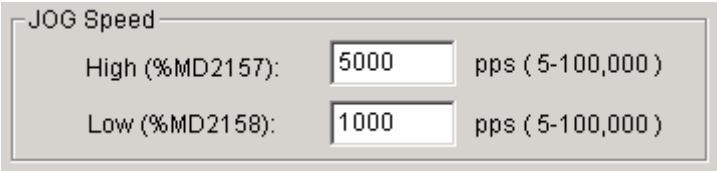
REMARK

When setting the origin return speed, it is recommended to set the origin return-low speed as low speed as possible. If setting the low speed as "too fast", it may cause the incorrect origin signal detection.

(D) Dwell Time

- This is the time needed to maintain the precise stop accuracy of SERVO motor when using the SERVO motor for positioning.
- Practically, Dwell time is the time needed to remove the residual pulse of deviation counter after completion of positioning and especially Dwell time when returning to the origin is called as "origin return dwell time".
- Setting range of Origin return dwell time : 0 ～ 10,000(unit: 1 ㎳)

(3) JOG speed



(A) JOG High Speed

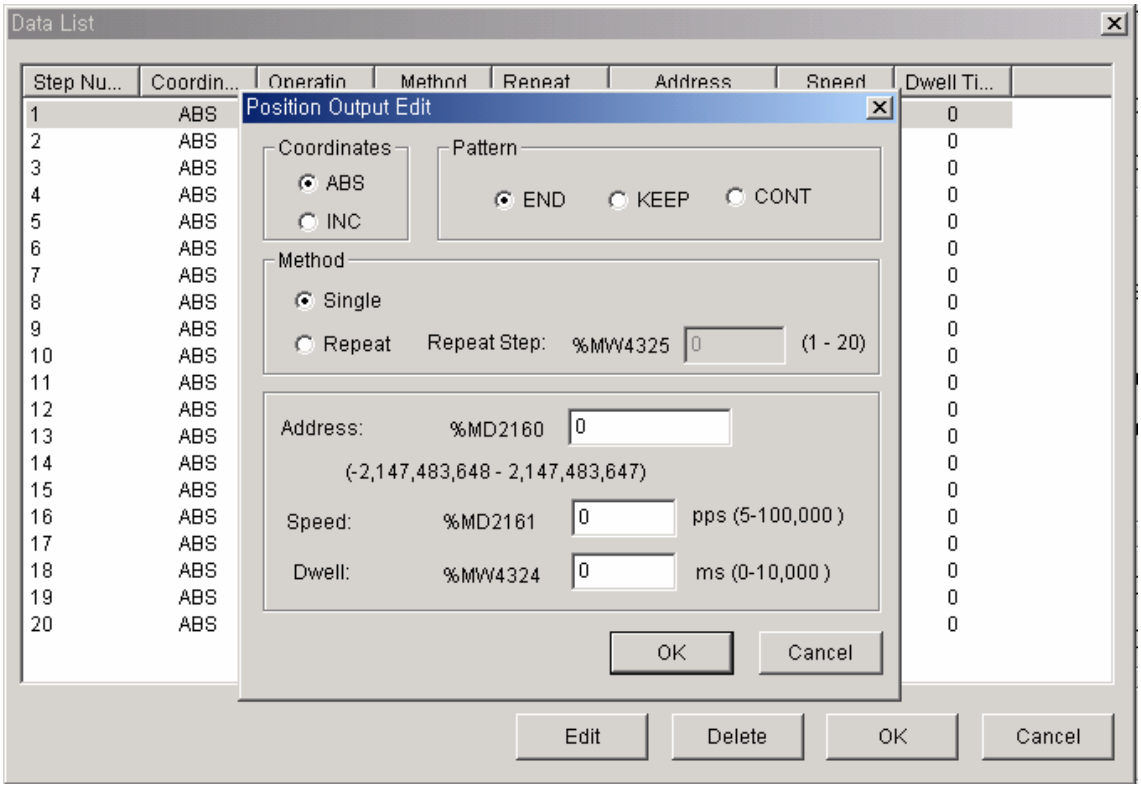
- JOG high speed operation has operation pattern as acceleration, constant speed, deceleration section. Therefore, acceleration section and deceleration section is controlled by JOG acceleration/deceleration time.
- JOG high speed setting range : 5 ～ 100,000(unit: 1pps)
  (notices when setting the high speed : Bias speed ≤ Jog high speed ≤ Speed limit)

(B) JOG Low Speed

- JOG low speed operation has only constant speed operation pattern.
- JOG low speed setting range : 5～ 100,000 (unit: 1pps)

2) Positioning parameter

Here describes Positioning parameter



(1) Step No.

- The setting range of positioning data as serial no. is 1 ～ 20.

> **REMARK**
>
> If step No. set to 0, operating step increase to next step automatically when current operation step finished

(2) Coordinate

- The coordinate of position data includes Absolute and Incremental

(A) Absolute Coordinate (Control by Absolute method)

① This carries out the positioning control from the current position to the goal position (the goal position assigned by positioning data).

② Positioning control is carried out based on the assigned position of origin return or POSPRS command (origin address).

③ Transfer direction shall be determined by the current position and goal position.

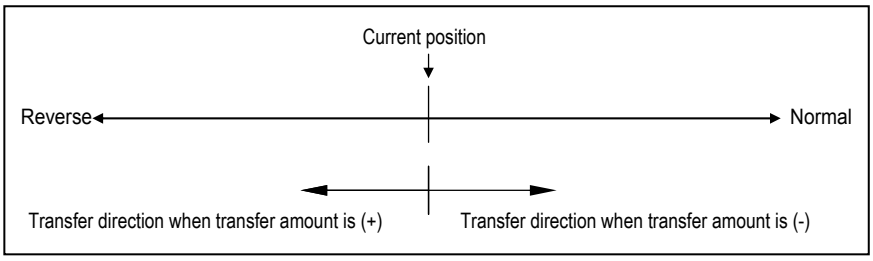
- Start position < Goal position : forward direction positioning
- Start position > Goal position : reverse direction positioning

(B) Relative Coordinate (Control by Incremental method)

① This carries out the positioning control as much as goal transfer amount from the current position.

② Transfer direction shall be determined by the sign of transfer amount.

- When transfer direction is (+) or no sign : normal direction positioning (position increase direction)
- When transfer direction is (-) : reverse direction positioning (position decrease direction)



(3) Operation Mode (End / Keep / Continuous)

- Operation Mode is divided into following three kinds.
- For the details, please refer to '3) Operation mode' in chapter 7.3.2

Control method	Operation mode
Position control	End
	Keep
	Continuous

(4) Operation Method (Single/Repeat)

- Select operation method : Single operation or Repeat operation.
- For the details, please refer to '4) Operation method' in chapter 7.3.2.

Control method	Operation method
Position control	Single
	Repeat

(5) Positioning Address

- This is the area to set the transfer amount of position data as “positioning address”.
- The setting range is –2,147,483,648 ～ 2,147,483,647(setting unit: Pulse).
- The change of position address value is available when assigned by D area

(6) Speed

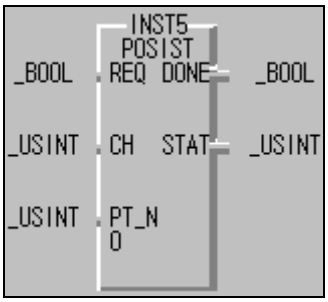
- Operation speed can be assigned for each operation step No.
- Setting range of operation speed : 5 ~ 100,000(Setting unit: 1pps)
- The change of speed value is available when assigned by D area

(7) Dwell Time

- This is the waiting time before carrying out the next positioning operation after completing one positioning operation.
- Setting range is 0 ～ 10,000 (setting unit : 1 ㎳).
- Especially, in case of using SERVO motor, this is the data to set the waiting time by the stable stop state as positioning module is in the stop state but actual SERVO motor does not reach to the goal position or in transition state.

7.3.4 Instructions

1) Positioning Indirect start (POSIST)

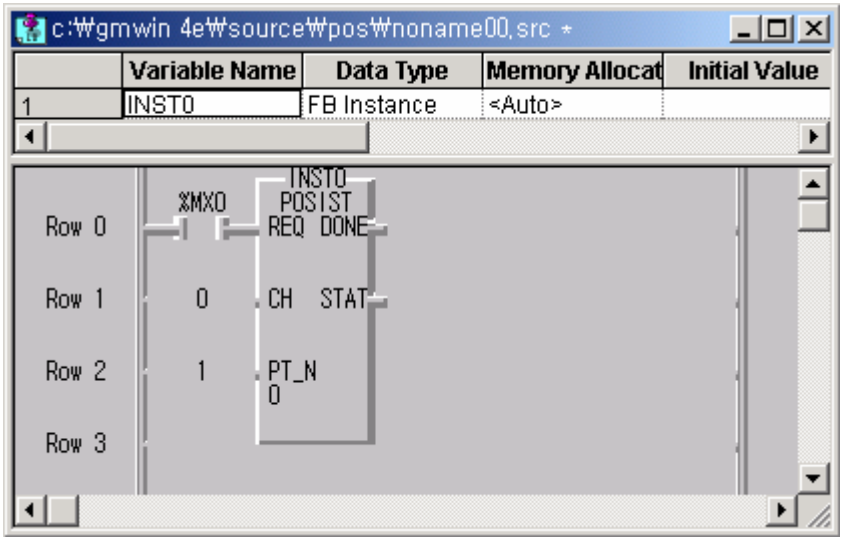
Function block	Description	
	Input	REQ: Executes POSIST function block CH: Sets the channel (0 ~ 1) PT_NO: Sets the start pattern no. (0 ~ 20)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

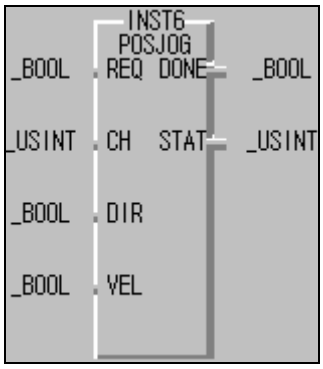
- When input condition turns on, corresponding positioning control starts from assigned step No.
- Positioning operation is edge triggered.

(2) Example program

- When input condition(%MX000) turns on, Ch.0 starts positioning from Step no.1



2) JOG Operation (POSJOG)

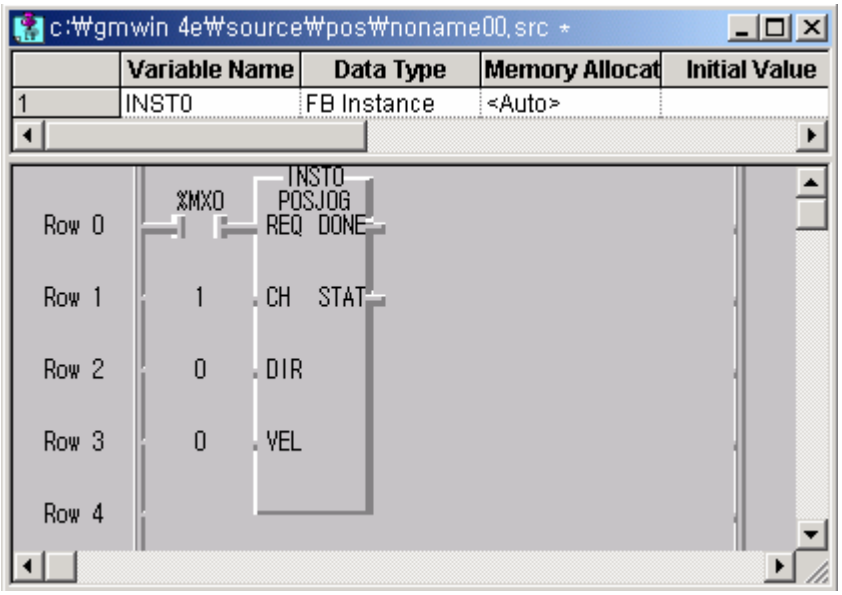
Function block	Description	
	Input	REQ: Executes POJOG function block CH: Sets the channel (0 ~ 1) DIR: Direction (0 : Forward, 1: Backward) VEL: Velocity (0 : Low speed,1: High speed)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

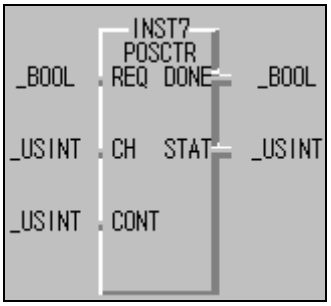
- When input condition turns on, corresponding Ch. Starts JOG operation.
- If input condition turns off, corresponding Ch stops JOG operation.
- The speed can be changed during operation but the direction can't be changed.

(2) Example program

- When input condition (%MX000) turns on, Ch.1 starts JOG operation by designated direction (M0001) and speed (M0002)
- When input condition(%MX000) turns off, Ch.1 stops JOG operation.



3) Positioning Control Instruction (POSCTR)

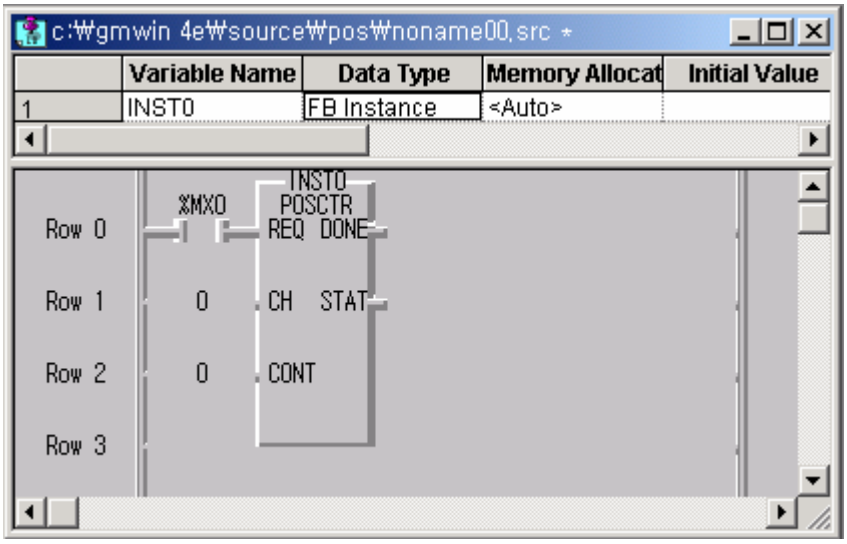
Function block	Description	
	Input	REQ: Executes POSCTR function block CH: Sets the channel (0 ~ 1) CONT: Sets Control command (0: Deceleration stop 1:Emergency stop 2: Error reset)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

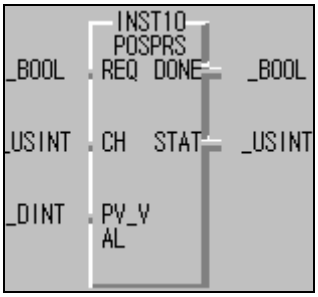
- Operates designated control operation at the rising edge of input condition.
  - Deceleration stop : Stops positioning after deceleration
  - Emergency stop : Stops positioning immediately without deceleration
  - Error Reset : Resets occurred error and output prohibition signal.

(2) Example program

- When input condition (%MX000) turns on, Ch.1 stops positioning after deceleration.



4) Current position preset (POSPRS)

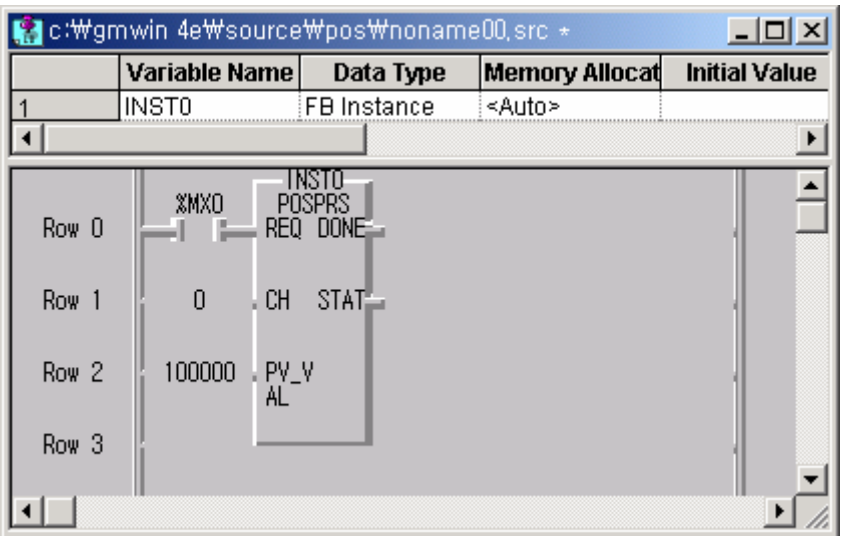
Function block	Description	
	Input	REQ: Executes POSPRS function block CH: Sets the channel (0 ~ 1) PV_VAL: Sets reset value (-2,147,483,648 ~ 2,147,483,647)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

- Current address is changed to preset value at the rising edge of input condition.

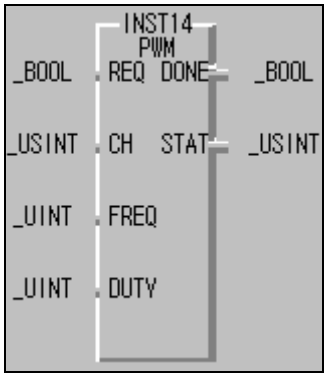
(2) Example program

- When input condition (%MX000) turns on, Address of Ch.0 is changed to 100,000.



5) PWM output (PWM)

- Pulse Width Modulation output

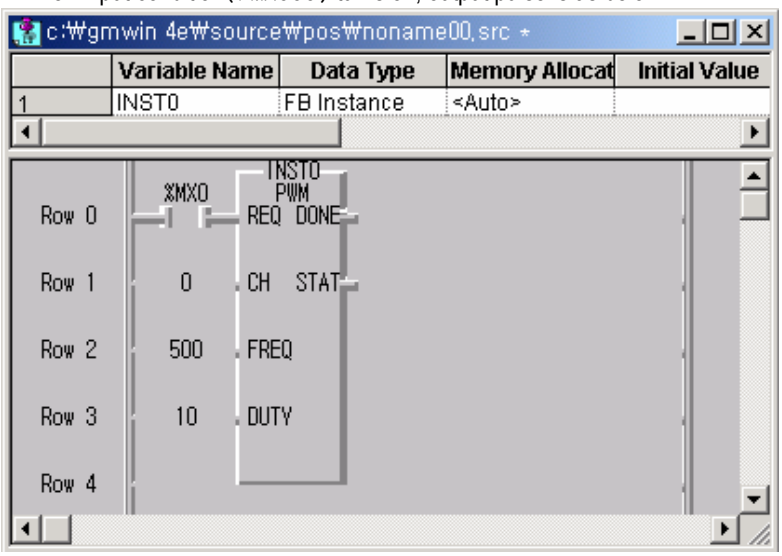
Function block	Description	
	Input	REQ: Executes PWM function block CH: Sets the channel (0 ~ 1) FREQ : Sets PWM output period (1 ~ 20,000ms) DUTY : Sets Off Duty (0 ~ 100%)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

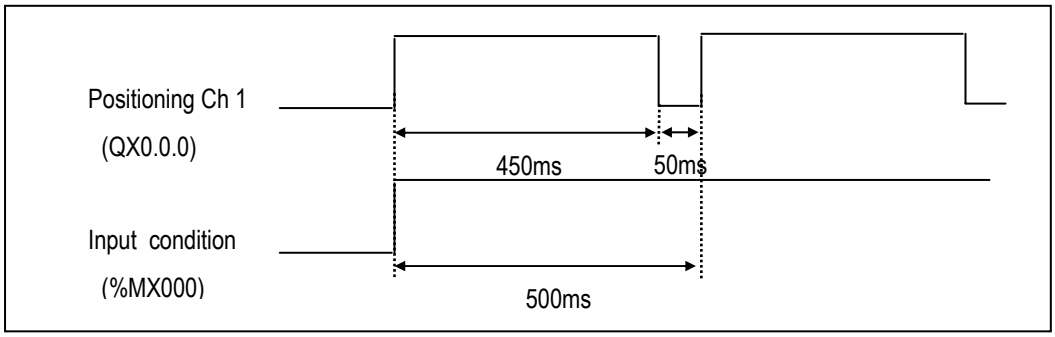
(1) Functions

- When input condition turns on, the period pulse is outputted which is set at FREG.
- Duty ratio of pulses is assigned by the set value at DUTY
- When input condition turns off, PWM operation stops

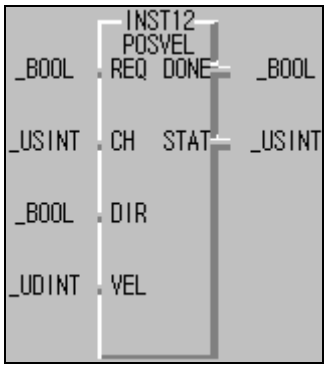
(2) Example program

- When input condition(%MX000) turns on, output pulse is as below.





6) Speed control operation (POSVEL)

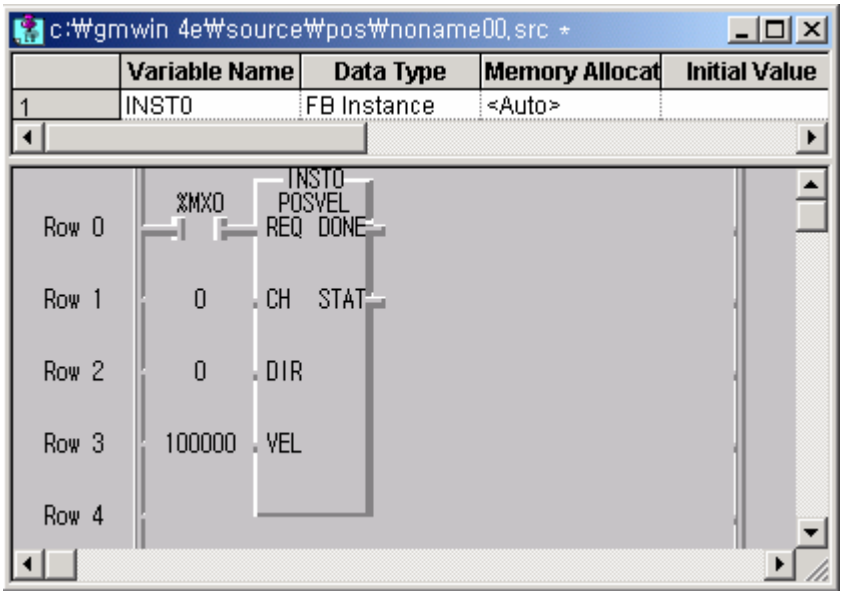
Function block	Description	
	Input	REQ: Executes POSVEL function block CH: Sets the channel (0 ~ 1) DIR : Sets operation direction (0:Forward, 1:Reverse) VEL : Velocity (5 ~ 100,000 pps)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

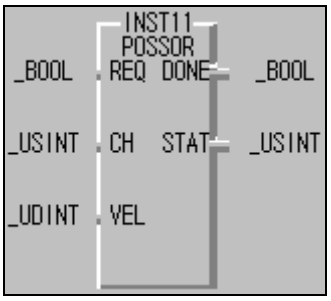
- When input condition turns on (rising edge), corresponding Ch. starts speed control by designated direction and speed.

(2) Example program

- When input condition (%MX000) turns on, Ch. 0 starts speed control from the rising edge to the designated direction with 100kpps.
- Speed can be changed by POSSOR instruction.
- Operation stops after deceleration by POSCTR instruction.



7) Speed override (POSSOR)

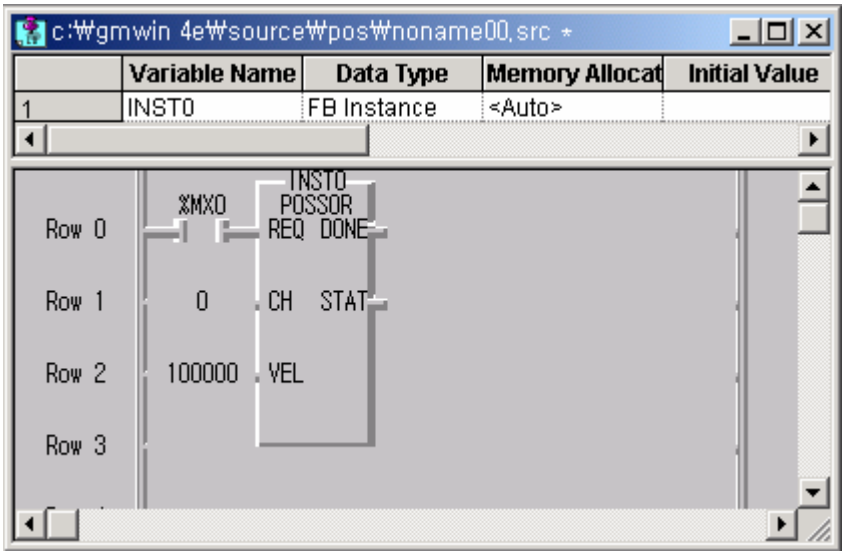
Function block	Description	
	Input	REQ: Executes POSSOR function block CH: Sets the channel (0 ~ 1) VEL: Velocity (5 ~ 100,000 pps)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

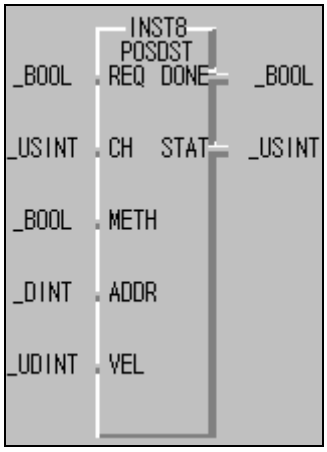
- When input condition turns on (rising edge), Operation speed of corresponding Ch. changed to designated speed.
- This instruction is valid to current operating channel only
- Speed changing within deceleration section is not available.

(2) Example program

- When input condition (%MX000) turns on, operation speed of Ch. 0 is changed to 100kpps.



8) Positioning direct start (POSDST)

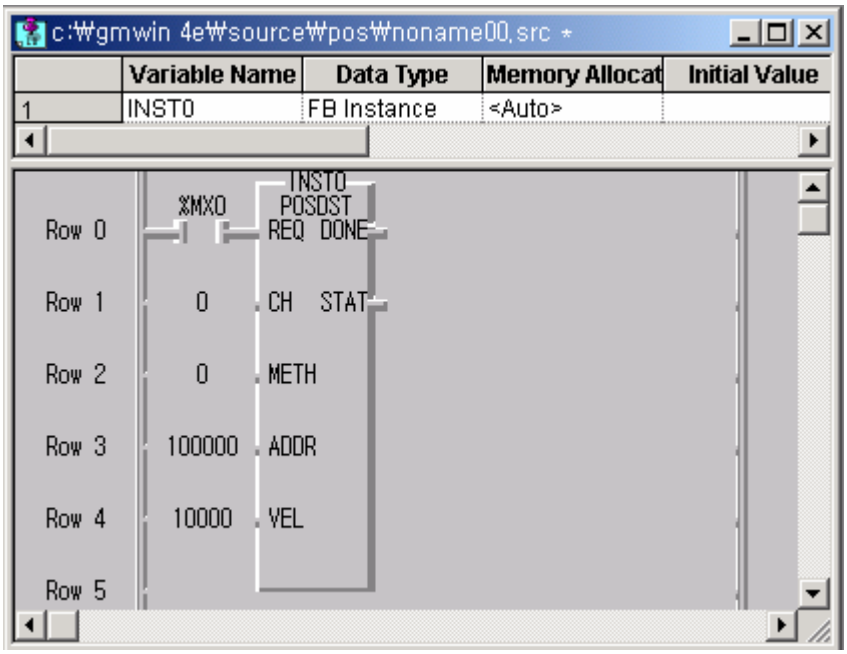
Function block	Description	
	Input	REQ : Execute POSDST function block CH: Sets the channel (0 ~ 1) METH : Absolute/Incremental coordinate designation (0:Absolute, 1:Incremental) ADDR : Positioning address (-2,147,483,648 ~ 2,147,483,647) VEL : Velocity (0 ~ 100,000)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

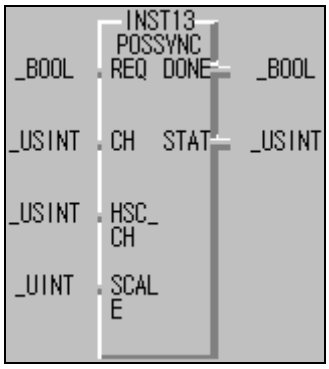
- When input condition turns on (rising edge), corresponding Ch. starts positioning by designated coordinate, address and speed

(2) Example program

- When input condition (%MX000) turns on, Ch. 0 outputs 100,000 pulses by designated coordinate, forward direction and speed of 100 kpps.
- Acceleration/deceleration time is applied by corresponding parameter.



9) Return to origin (POSORG)

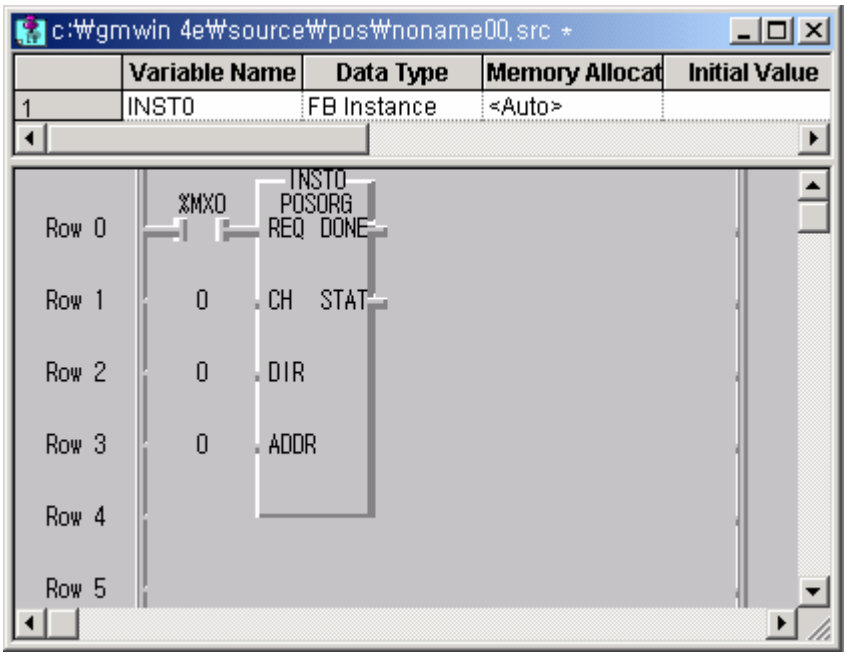
Function block	Description	
	Input	REQ : Execute POSORG function block CH: Sets the channel (0 ~ 1) HSC_CH: Sets POSORG input channel (0~3) SCALE: Sets the scale (0 ~ 100%)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

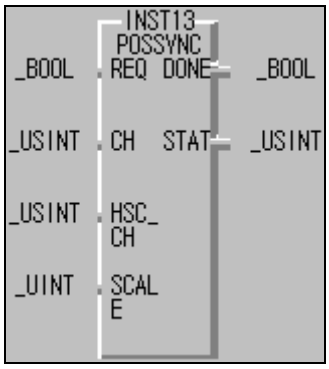
- When input condition turns on, corresponding origin return operation starts (Rising edge trigger)
- After operation, current address is preset to designated origin address.

(2) Example program

- When input condition(%MX000) turns on, Ch. 0 operates return to origin function to the DIR (designated direction).
- After return to origin operation, the position address becomes 0 (ADDR designated value).



10) Synchronization control (POSSYNC)

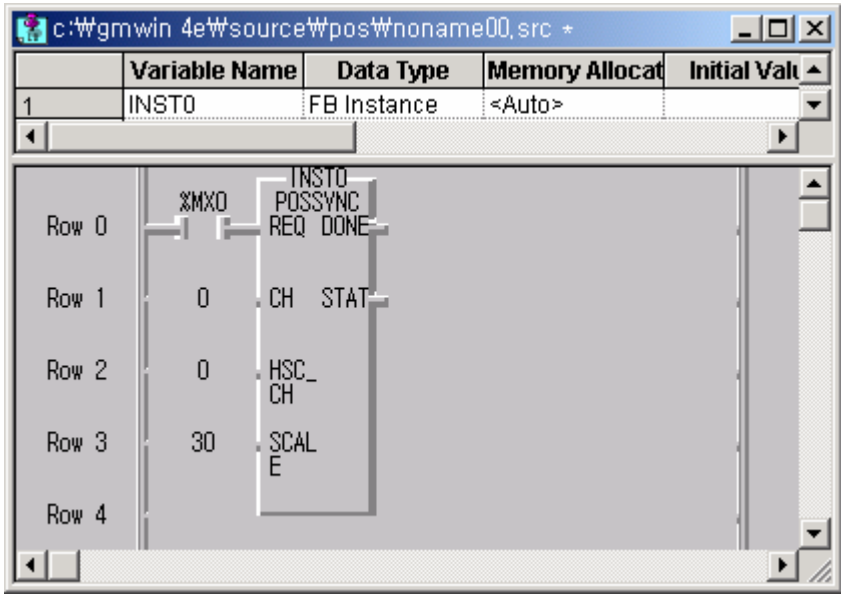
Function block	Description	
	Input	REQ : Execute POSSYNC function block CH: Sets the channel (0 ~ 1) HSC_CH: Sets POSSYNC input channel (0~3) SCALE: Sets the scale (0 ~ 100%)
	Output	DONE: Turns On after the function block is executed without error, and turns Off if an error occurs or there is no execution command. STAT: Displays error status

(1) Functions

- When input condition turns on, the designated channel at the rising edge executes the synchronization control by specified scale.

(2) Example program

- When the input condition (%MX000) turns on, Ch. 0 operates synchronization control by 30% of HSC Ch. 0's speed.



7.3.5 Flag list and error codes

1) Flag list

Key word		Type	Function	Description	S flag map
_P0_STEP_NUM		UINT	Current step number	Ch0 current step number	%SW817
_P0_ERR_CODE		UINT	Error code	Ch0 error code	%SW816
_P0_CUR_ADDR		UDINT	Current address	Ch0 current address	%SD409
_P0_CUR_VEL		UDINT	Current velocity	Ch0 current velocity	%SD410
_P0_BIT_STAT		UDINT	Bit status key word	Ch0 bit status key word	%SD411
	_P0_RUNNING	BOOL	Operating flag	Operation status of Ch0 (0: stop, 1:Busy)	Bit 0
	_P0_ERR	BOOL	Error status	Error status of Ch0 (0: normal, 1: error)	Bit 1
	_P0_DONE	BOOL	End of positioning	Indicates end of operation for Ch0 (0: operating, 1: End) *1Scan On	Bit 2
	_P0_ORG_FIX	BOOL	End of Origin return	Indicates end of origin return operation of Ch0(0:operating, 1: End)	Bit 3
	_P0_L_LIMIT	BOOL	Low limit detection	Indicates stroke low limit detection of Ch0	Bit 4
	_P0_H_LIMIT	BOOL	High limit detection	Indicates stroke high limit detection of Ch0	Bit 5
	_P0_E_STOP	BOOL	Emergency stop status	Indicates emergency stop status Ch0 (0: enable, 1: Disable)	Bit 6
	_PO_BAN	BOOL	Output prohibition	Output prohibition of Ch0 (0: enable, 1: disable)	Bit 7
	_P0_DIR	BOOL	Direction	Operation direction of Ch0 (0: Forward, 1: Backward)	Bit 8
	_P0_ACCEL	BOOL	Acceleration	Accelerating Ch0	Bit 9
	_P0_UNIFORM	BOOL	Constant speed	Constant speed operation of Ch0	Bit 10
	_P0_DECEL	BOOL	Deceleration	Decelerating Ch0	Bit 11
	_P0_DWELL	BOOL	Dwelling	Dwelling Ch0	Bit 12
	_P0_POS_RUN	BOOL	Position control	Position control operation of Ch0	Bit 16
	_P0_SPD_RUN	BOOL	Speed control	Speed control operation of Ch0	Bit 17
	_P0_ORG_RUN	BOOL	Return to origin	Return to origin operation of Ch0	Bit 18
	_P0_JOGL_RUN	BOOL	JOG low speed	JOG low speed operation of Ch0	Bit 19
	_P0_JOGH_RUN	BOOL	JOG high speed	JOG high speed operation of Ch0	Bit 20
	_P0_PWM_RUN	BOOL	PWM operation	PWM output operation of Ch0	Bit 21

Key word		Type	Function	Description	S flag map
_P1_STEP_NUM		UINT	Current step number	Ch1 current step number	%SW825
_P1_ERR_CODE		UINT	Error code	Ch1 error code	%SW824
_P1_CUR_ADDR		UDINT	Current address	Ch1 current address	%SD413
_P1_CUR_VEL		UDINT	Current velocity	Ch1 current velocity	%SD414
_P1_BIT_STAT		UDINT	Bit status key word	Ch1 bit status key word	%SD415
	_P1_RUNNING	BOOL	Operating flag	Operation status of Ch1 (0: stop, 1:Busy)	Bit 0
	_P1_ERR	BOOL	Error status	Error status of Ch1 (0: normal, 1: error)	Bit 1
	_P1_DONE	BOOL	End of positioning	Indicates end of operation for Ch1 (0: operating, 1: End) *1Scan On	Bit 2
	_P1_ORG_FIX	BOOL	End of Origin return	Indicates end of origin return operation of Ch1(0:operating, 1: End)	Bit 3
	_P1_L_LIMIT	BOOL	Low limit detection	Indicates stroke low limit detection of Ch1	Bit 4
	_P1_H_LIMIT	BOOL	High limit detection	Indicates stroke high limit detection of Ch1	Bit 5
	_P1_E_STOP	BOOL	Emergency stop status	Indicates emergency stop status Ch1(0: enable, 1: Disable)	Bit 6
	_P1_BAN	BOOL	Output prohibition	Output prohibition of Ch1(0: enable, 1: disable)	Bit 7
	_P1_DIR	BOOL	Direction	Operation direction of Ch1(0: Forward, 1: Backward)	Bit 8
	_P1_ACCEL	BOOL	Acceleration	Accelerating Ch1	Bit 9
	_P1_UNIFORM	BOOL	Constant speed	Constant speed operation of Ch1	Bit 10
	_P1_DECEL	BOOL	Deceleration	Decelerating Ch1	Bit 11
	_P1_DWELL	BOOL	Dwelling	Dwelling Ch1	Bit 12
	_P1_POS_RUN	BOOL	Position control	Position control operation of Ch1	Bit 16
	_P1_SPD_RUN	BOOL	Speed control	Speed control operation of Ch1	Bit 17
	_P1_ORG_RUN	BOOL	Return to origin	Return to origin operation of Ch1	Bit 18
	_P1_JOGL_RUN	BOOL	JOG low speed	JOG low speed operation of Ch1	Bit 19
	_P1_JOGH_RUN	BOOL	JOG high speed	JOG high speed operation of Ch1	Bit 20
	_P1_PWM_RUN	BOOL	PWM operation	PWM output operation of Ch1	Bit 21

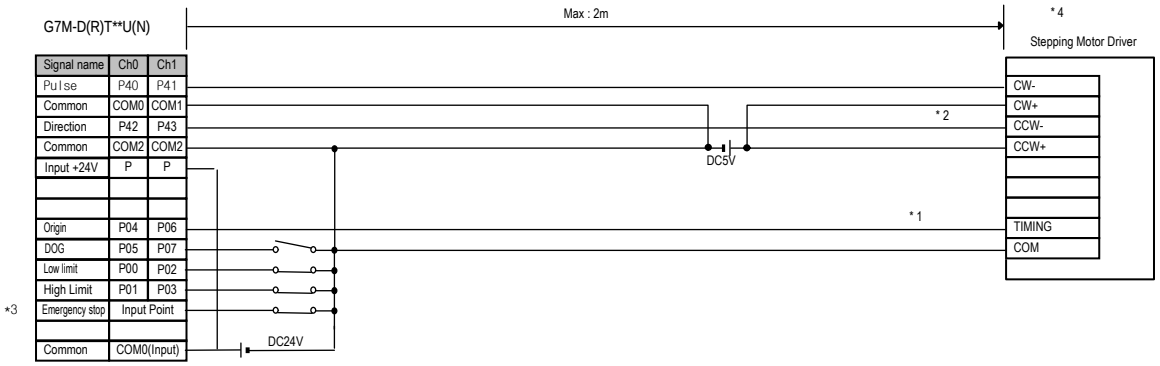
2) Error code

Error code	Condition	Operation	Corrective action
H10	Acceleration time of basic parameter is out of range	Stop	Set Acceleration time within 0~10,000 range
H11	Deceleration time of basic parameter is out of range	Stop	Set Deceleration time within 0~10,000 range
H12	Speed limit of basic parameter is out of range	Stop	Set speed limit within 5~ 100,000 range.
H13	Bias speed of basic parameter is out of range	Stop	Set bias speed within 5 ~ 100,000 range.
H14	Backlash compensation of basic parameter is out of range	Stop	Set backlash compensation within 0~ 1,000 range
H15	JOG high speed of parameter is out of range	Stop	Set JOG high speed within bias speed ~ speed limit
H16	JOG low speed of parameter is out of range	Stop	Set JOG high speed within 5 ~ JOG high speed
H17	Origin return high speed of parameter is out of range	Stop	Set Origin return high speed within bias speed ~ speed limit
H18	Origin return low speed of parameter is out of range	Stop	Set Origin return low speed within bias speed ~ Origin return high speed
H19	Dwell time of parameter is out of range	Stop	Set Dwell time within 0 ~ 10000.
H20	Operation speed of positioning parameter is out of range	Stop	Set Operation speed within bias speed ~ speed limit
H21	Dwell time of pulse out parameter is out of range	Stop	Set Dwell time of pulse out parameter within 0 ~ 10000
H30	POSIST command can't be executed during operation	Operating	Check if positioning operation is executing when POSIST signal occur.
H31	POSIST command can't be executed when output is prohibited	Stop	Check if output is prohibited when POSIST signal occur. Output can be enabled by POSCTR command.
H32	POSIST command can't be executed when origin is not determined	Stop	Check if origin is not designated when POSIST signal occur. Origin can be designated by POSORG or POSPRS command.
H33	Step No. of POSIST command can't be over 20	Stop	Set step No. within 0~20
H34	POSDST command can't be executed during operation	Operating	Check if positioning operation is executing when POSDST signal occur.
H35	POSDST command can't be executed when output is prohibited	Stop	Check if output is prohibited when POSDST signal occur. Output can be enabled by POSCTR command.
H36	POSDST command can't be executed when origin is not determined	Stop	Check if origin is not designated when POSDST signal occur. Origin can be designated by POSORG or POSPRS command.
H37	Operation speed of POSDST command is out of range	Stop	Set Operation speed within 5 ~ speed limit
H38	POSVEL command can't be executed during operation	Operating	Check if positioning operation is executing when POSVEL signal occur.
H39	POSVEL command can't be executed when output is prohibited	Stop	Check if output is prohibited when POSVEL signal occur. Output can be enabled by POSCTR command.

Error code	Condition	Operation	Corrective action
H3A	Operation speed of POSVEL command is out of range	Stop	Set Operation speed within 5 ~ speed limit
H3B	POSJOG command can't be executed during operation	Operating	Check if positioning operation is executing when POSJOG signal occur.
H3C	POSJOG command can't be executed when output is prohibited	Stop	Check if output is prohibited when POSJOG signal occur. Output can be enabled by POSCTR command.
H3D	Direction can't be changed in JOG operation	Operating	Change direction after JOG operation end.
H3E	PWM command can't be executed during operation	Operating	Check if positioning operation is executing when PWM signal occur.
H3F	PWM command can't be executed when output is prohibited	Stop	Check if output is prohibited when PWM signal occur. Output can be enabled by POSCTR command.
H40	PWM period of PWM command is out of range	Stop	Set period within 1 ~ 20,000
H41	Off duty of PWM command is out of range	Stop	Set duty within 0 ~ 100
H42	POSSOR command is available during operating only	Stop	Check if positioning operation is not executing when POSSOR signal occur.
H43	Speed override value of POSSOR command is out of range	Operating	Set override value within 5 ~ speed limit
H45	POSORG command can't be executed during operation	Operating	Check if positioning operation is executing when POSORG signal occur.
H46	POSORG command can't be executed when output is prohibited	Stop	Check if output is prohibited when POSORG signal occur. Output can be enabled by POSCTR command.
H47	POSCTR setting error	-	Check control command is within 0~3
H48	Deceleration stop command is available during operating only	Stop	Check if positioning operation is not executing when deceleration stop command occur
H49	POSORG command can't be executed when JOG operating	Operating	Check if JOG operation is executing when deceleration stop command occur
H50	POSPRS command can't be executed during operation	Operating	Check if positioning operation is executing when POSPRS signal occur
H51	Direction can't be changed in continuous operation	Stop	Set operation mode as end or keep mode
H52	Emergency stop error	Stop	Remove the causes of emergency stop and clear error by POSCTR command
H53	Stroke high limit error	Stop	Get rid of the external upper limit signal range by POSJOG command and then carry out POSCTR command and clear the error. Output prohibit shall be released by POSCTR command as output prohibit release option
H54	Stroke low limit error	Stop	Get rid of the external lower limit signal range by POSJOG command and then carry out RST command and clear the error. Output prohibit shall be released by POSCTR command as output prohibit release option.
H55	The position of High/Low limit detection Sensor has been changed.	Stop	Install the upper limit detection sensor in the direction that the current position increases and the lower limit detection sensor in the direction that the current position decreases

7.3.6 Wiring with servo and stepping motor drive (Open Collector)

1) Wiring with stepping motor drive (DC 5V)



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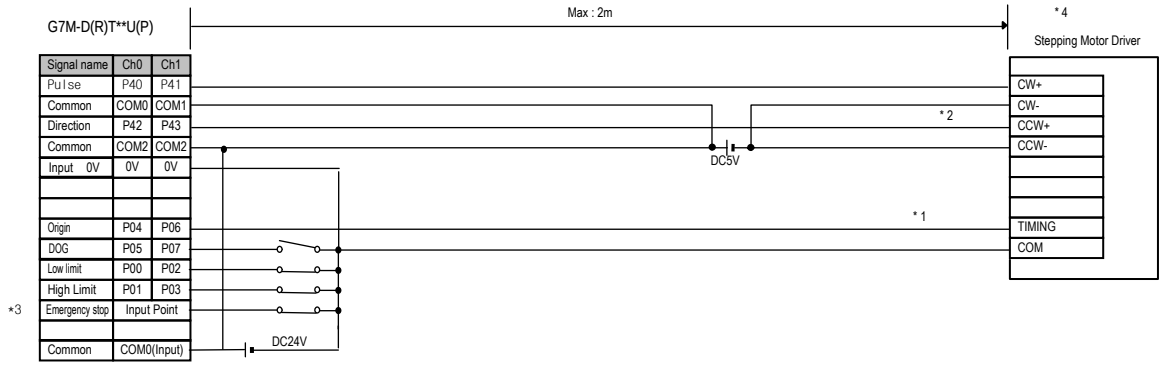
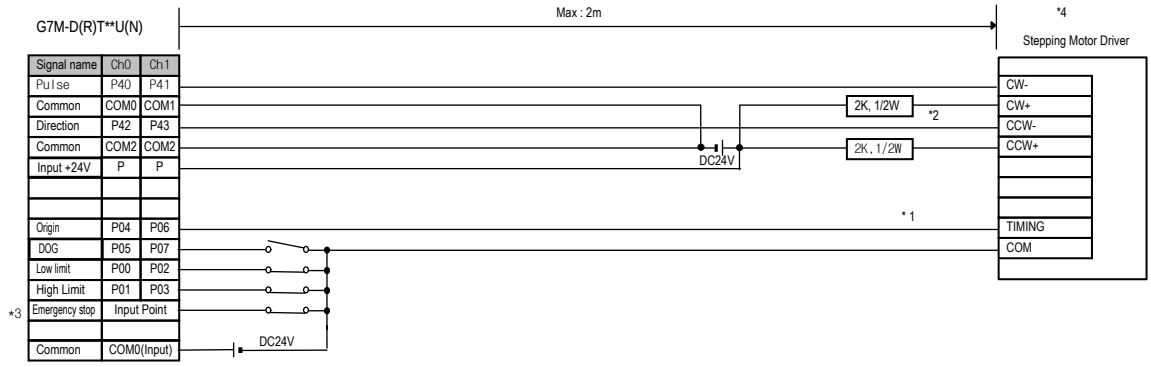


< PNP Type >

2) Wiring with stepping motor drive (DC 24V)



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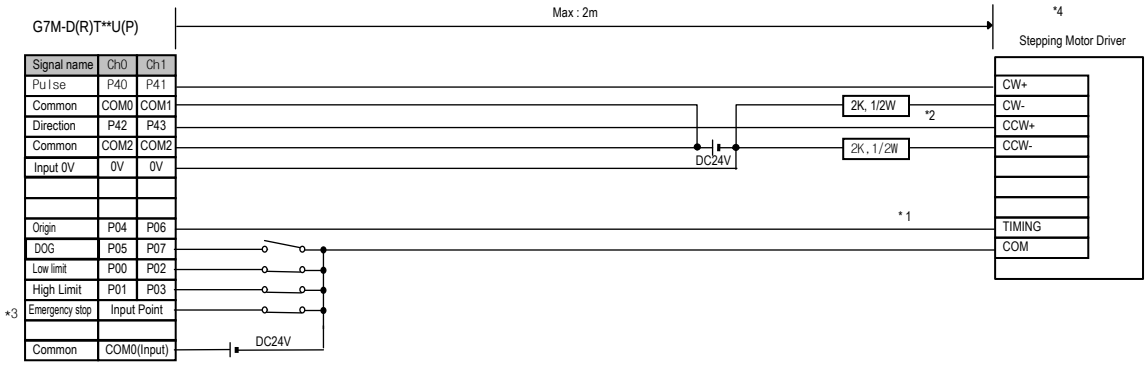


< PNP Type >

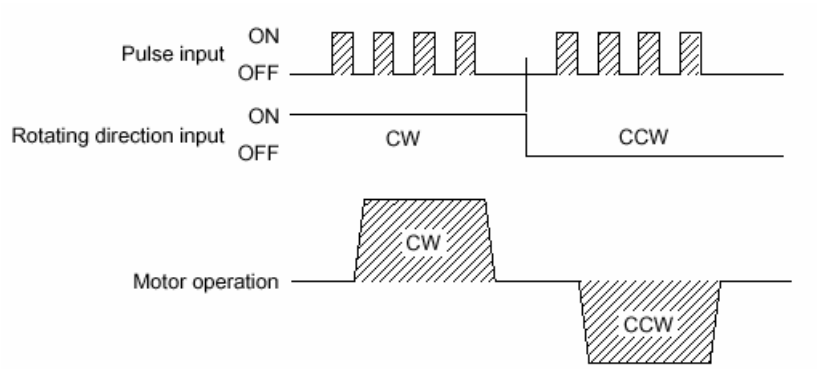
REMARK

1) In case of VEXTA RK series, TIMMING output turns on when a motor rotates at every 7.2 degree. For exact 'return to origin', we suggest you to configure 'AND' operation using TIMMING output and DOG sensor. It may be different to each system features to return to origin by the DOG sensor without TIMMING output signal (The rated input for the origin of GM7U is DC 24V.)

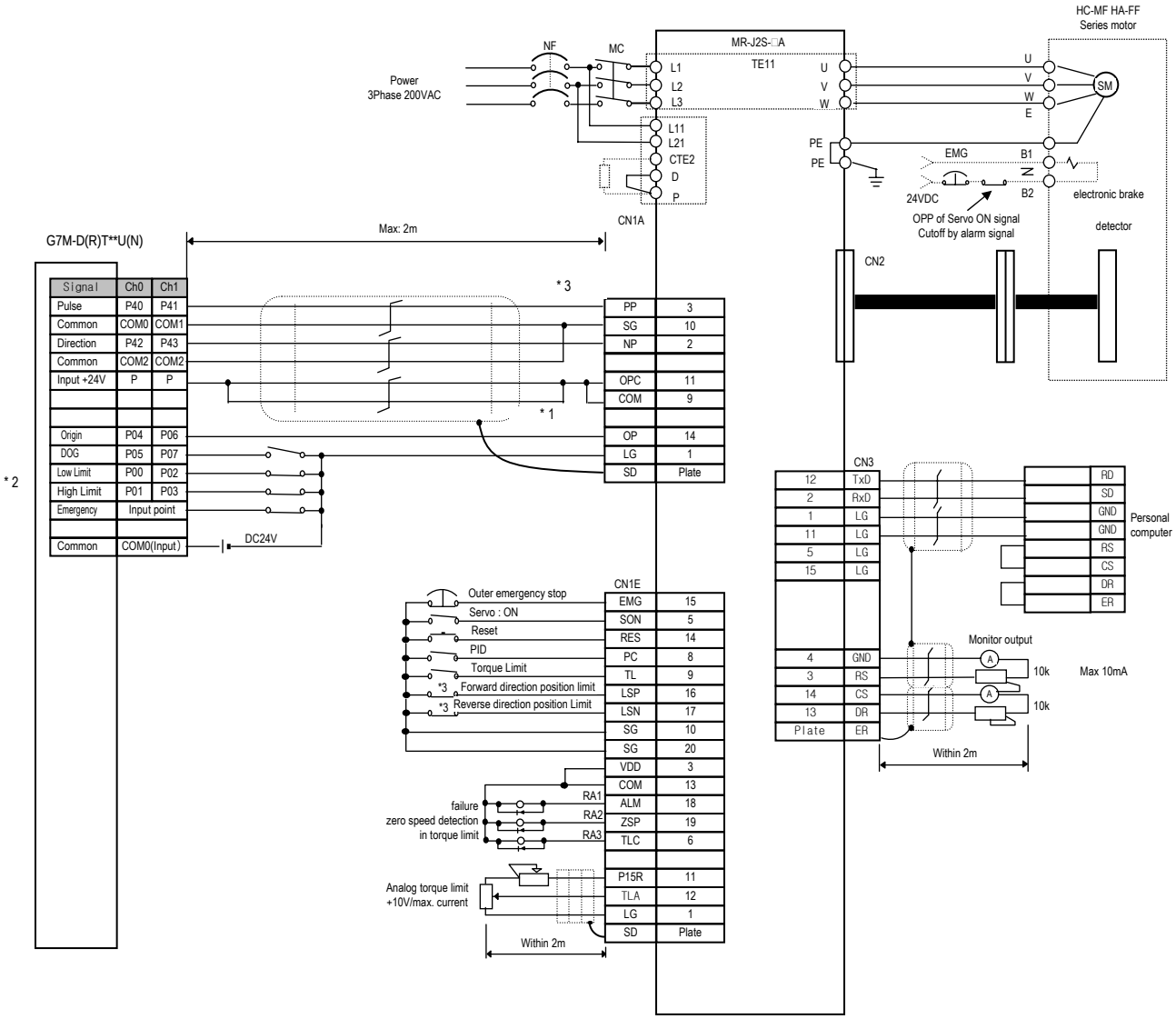
2) Using DC 24V, wire a proper resistor to driver in series.

3) Input points for origin, approximate origin point, and upper/lower limit signal are fixed but, if they're not used you able to use them general input point. You can use emergency stop with the command(POSCTR)

4) Positioning phase of GM7U is as follow: Set the input mode of a step mode driver to 1 phase input mode because motor operation mode is determined by rotating direction input.



3) Wiring with servo motor drive (MR-J2/J2S-□A)



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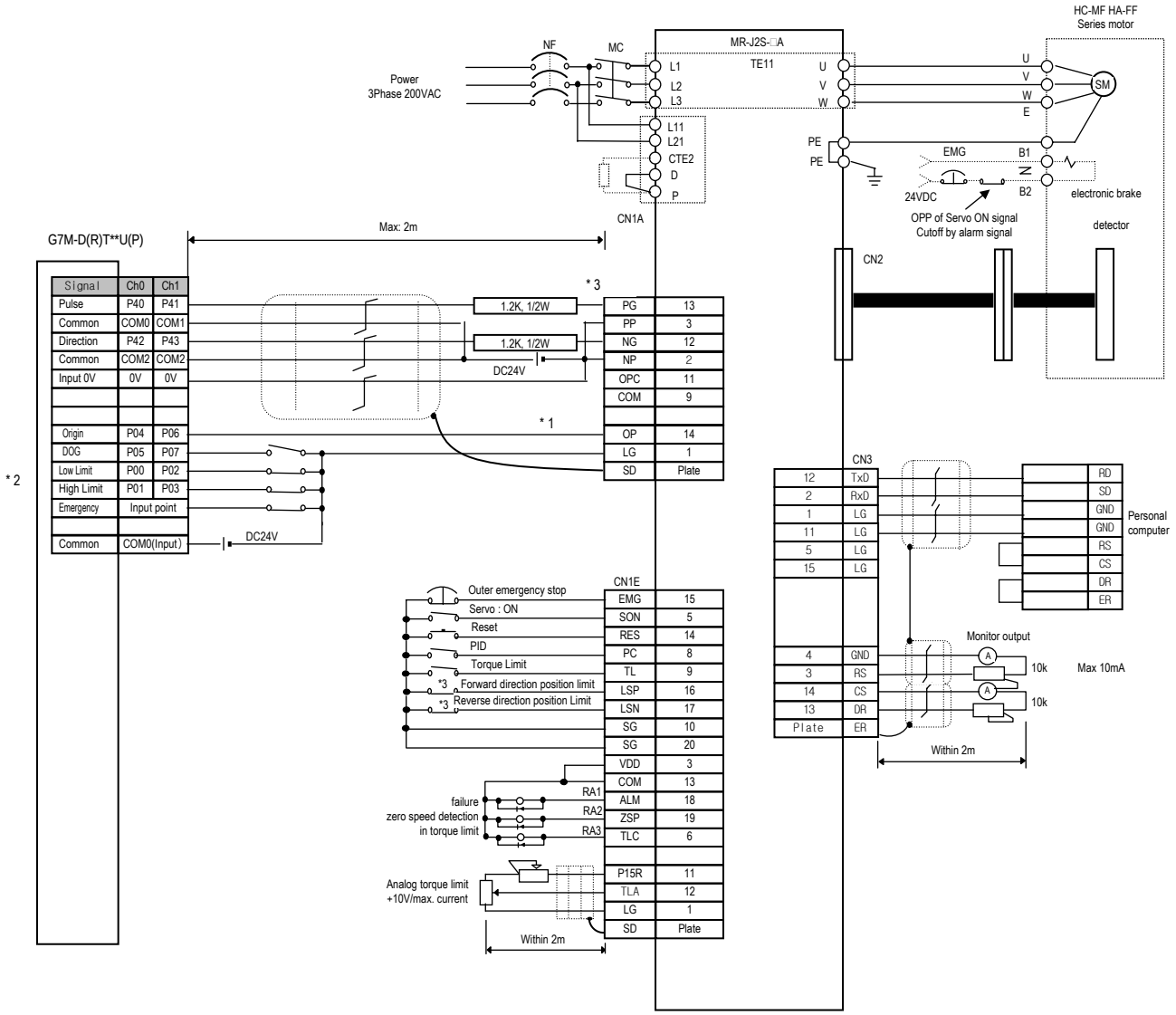


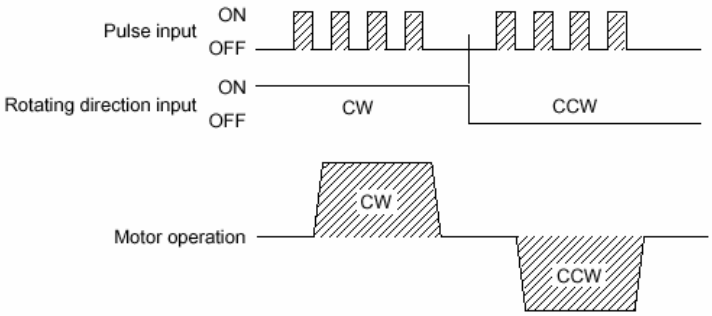
< PNP Type >

REMARK

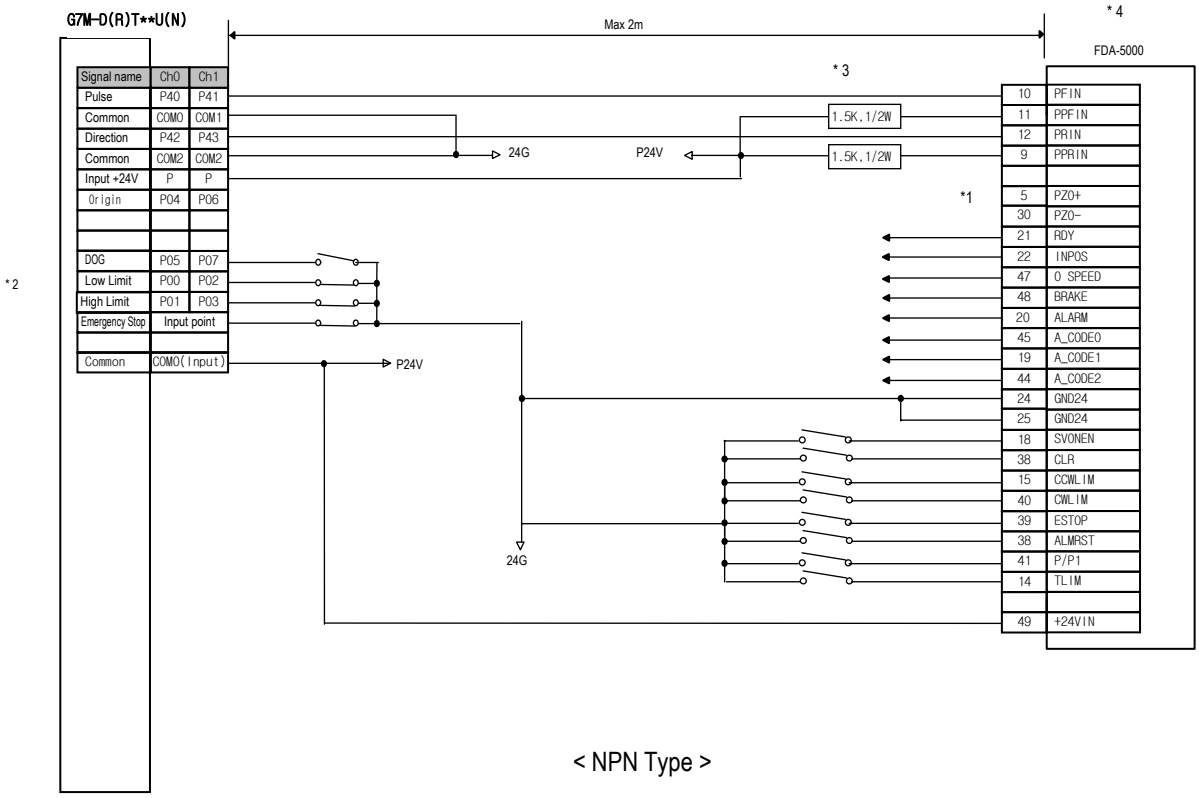
1) The rated input for the origin of GM7U is DC 24V.

2) Input points for origin, approximate origin point, and upper/lower limit signal are fixed but, if they're not used you able to use them general input point. You can use emergency stop with the command(POSCTR)

3) Positioning phase of GM7U is as follow: Set the input mode of a step mode driver to 1 phase input mode is determined by rotating direction input.



4) Wiring with servo motor drive (FDA-5000 AC Servo Driver)



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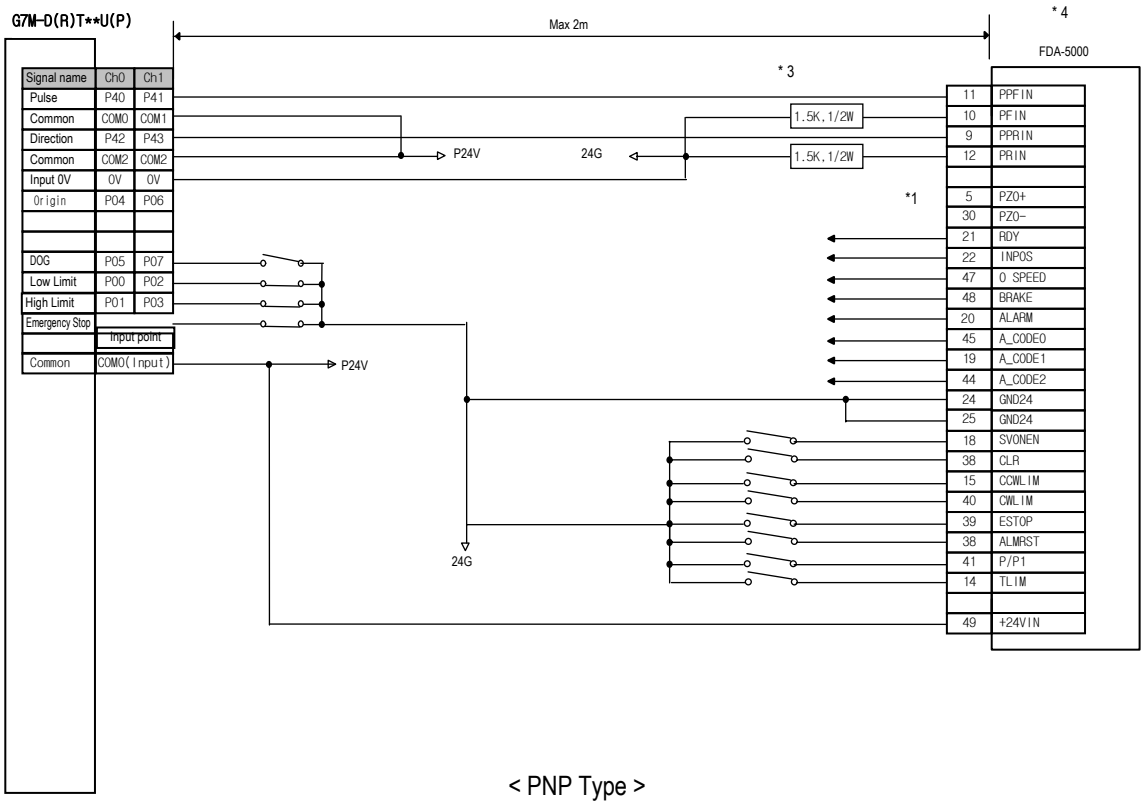
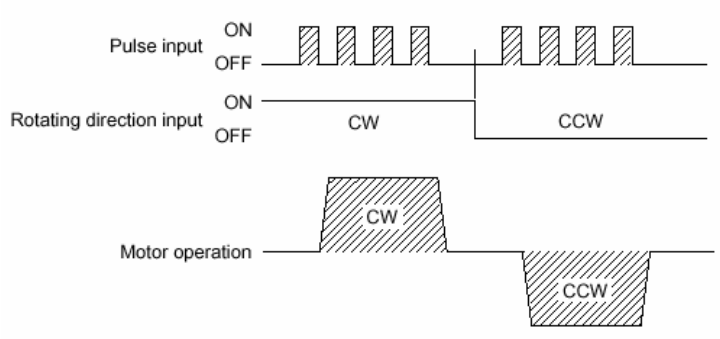


< PNP Type >

Remark

1) The rated input for the origin of GM7U is DC 24V. Line driver output, wire a DC SSR and return to origin by DOG signal or using a origin sensor of original signal.
2) Input points for origin, approximate origin point, and upper/lower limit signal are fixed but, if they're not used you able to use them general input point. You can use emergency stop with the command (POSCTR)
3) Using DC 24V, wire a proper resistor(1.5K, 1/2W) to driver in series.
4) Positioning phase of GM7U is as follow: Set the input mode of a step mode driver to 1 phase input mode because motor operation mode is determined by rotating direction input.



Chapter 8. Communication Functions

8.1 Dedicated Protocol Communication

8.1.1 Introduction

GM7U's built-in Cnet communication is a function to execute a dedicated communication only with a GM7U main unit. That is, it doesn't need a separate Cnet I/F module to facilitate the user-intended communication system by utilizing reading or writing of any area in CPU, and monitoring function. Without additional expanses, the user can use the basic functions like read/write internal device area and register/execute monitoring with GM7U main unit.

GM7U main unit serves as follows:

- Individual/continuous reading of device
- Individual/continuous writing of device
- Reading CPU status
- Monitor devices registration
- Executing monitoring
- 1:1 connection (link between GM7Us) system configuration (GM7U main unit: RS-232C)

REMARK

GM7U built-in communication function supports Cnet communication without any separate Cnet I/F module. It must be used under the following instructions.

1) Channel 0 of GM7U main unit supports 1:1 communication only. For 1:N system having master-slave Format, use RS- 485 communication in channel 1 or GM7U main unit with G7L-CUEC module connected. G7L-CUEC module supports RS-422/485 protocol.
2) RS-232C communication cable for GM7U main unit is different from RS-232C cable for GMWIN in pin arrangement and from the cable for Cnet I/F module, too. The cable can't be used without any treatment. For the detailed wiring method, refer to 8.1.2.
3) Basic items like baud rate type and station no. can be set in GMWIN.

8.1.2 System configuration method

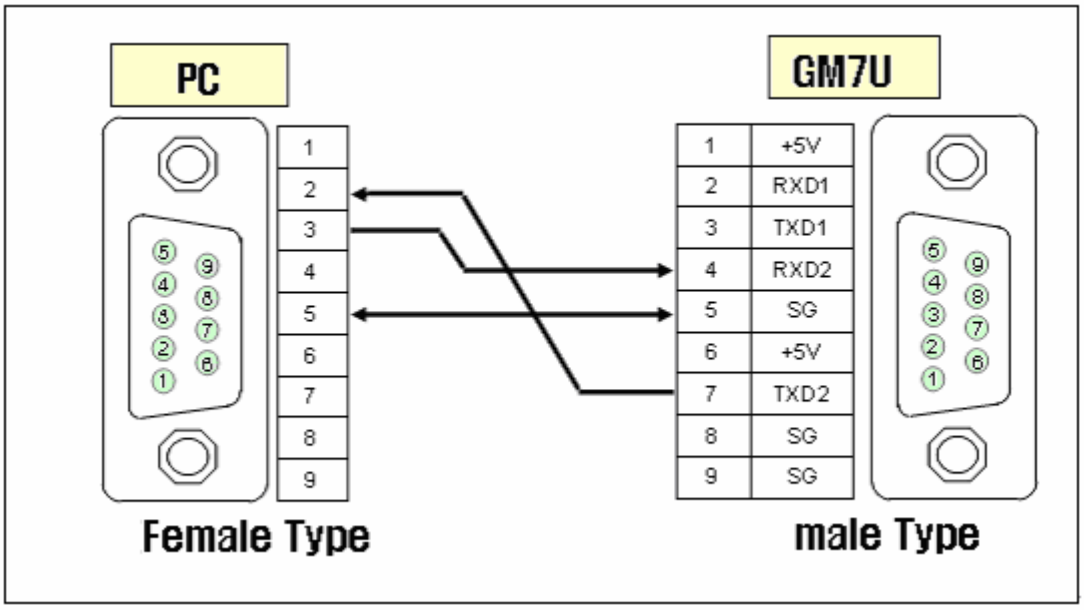
According to the method of connection, the system using GM7U built-in communication can be composed.

1) Connecting system configuration (link between GM7Us)

(1) 1:1 connection with general PC

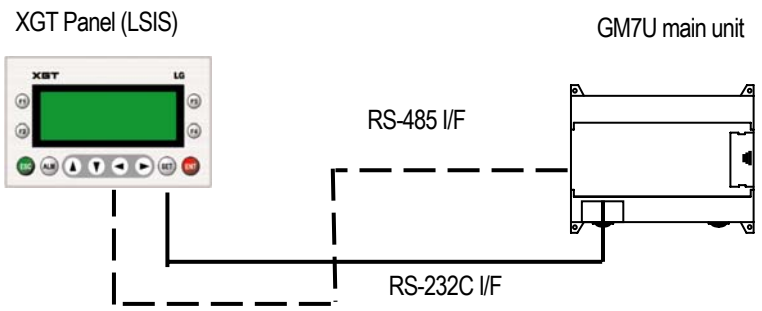
a) Communication program made by C or BASIC computer language on the user's computer, or utility program like FAM or CIMON can be used.

b) Wiring method



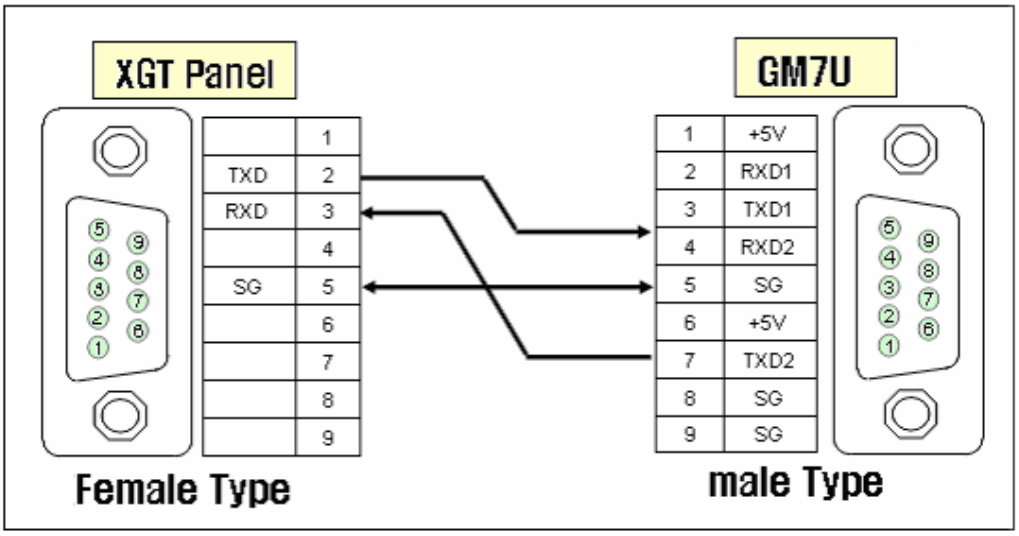
TXD1, RXD1 are for loader communication and TXD2, RXD2 are for Cnet I/F.
To use channel 1, connect 485+ and 485- of RS-485 terminal.

(2) 1:1 connection with a monitoring device like XGT Panel

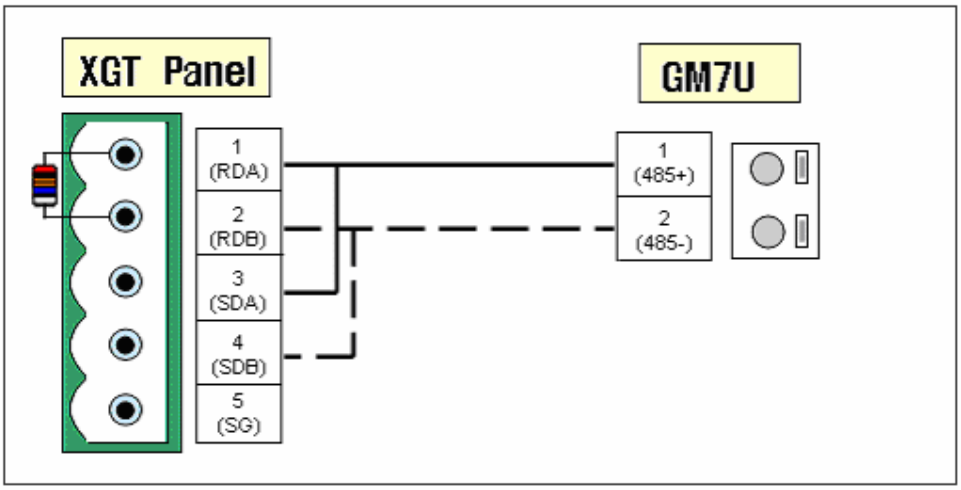


(a) Wiring

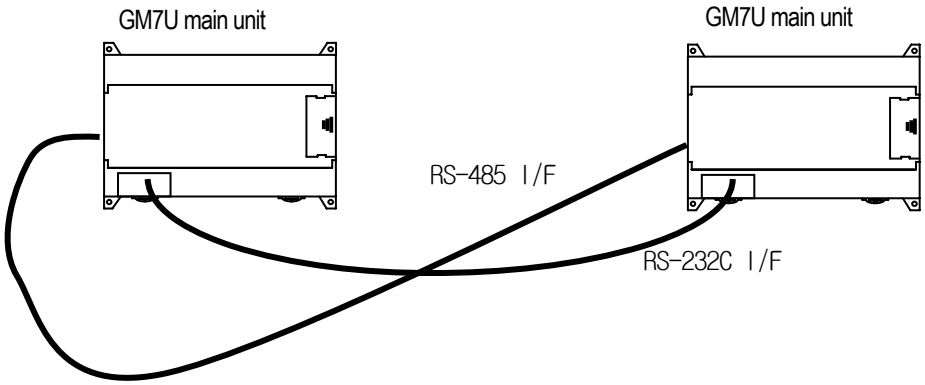
The wiring diagram using RS-232C I/F is as follow.



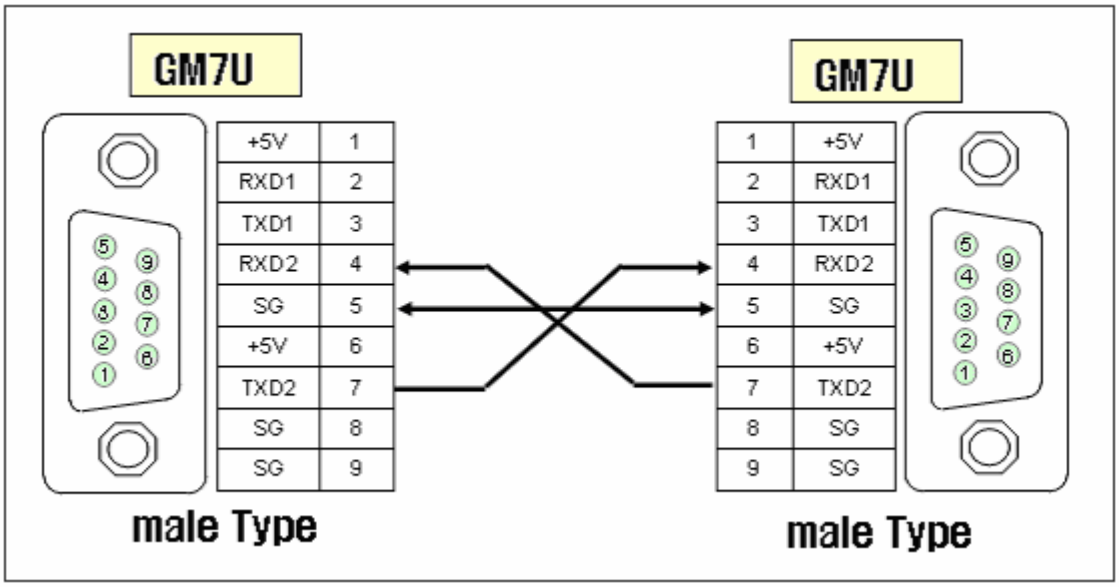
The wiring diagram using RS-485 I/F is as follow.



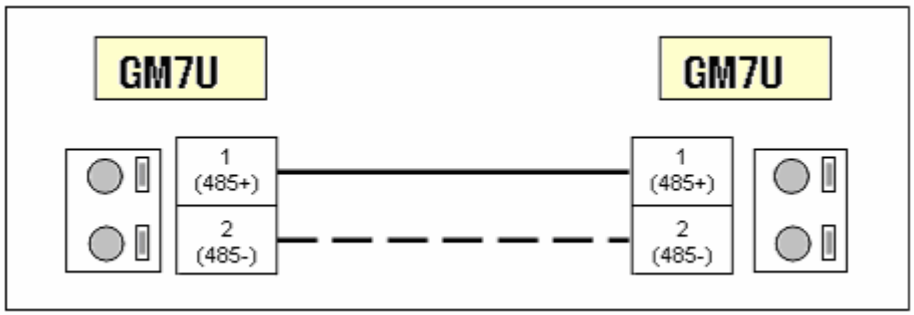
(3) 1:1 connection with LSIS'



The wiring diagram using RS-232C I/F is as follow.



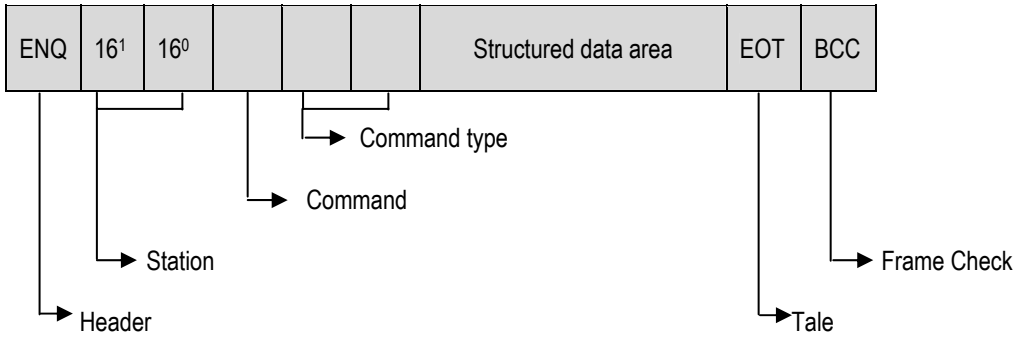
The wiring diagram using RS-485 I/F is as follow.



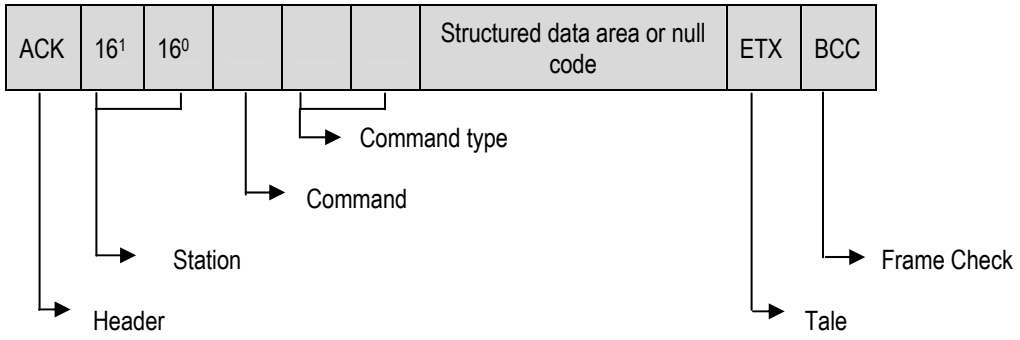
8.1.3 Frame structure

1) Base format

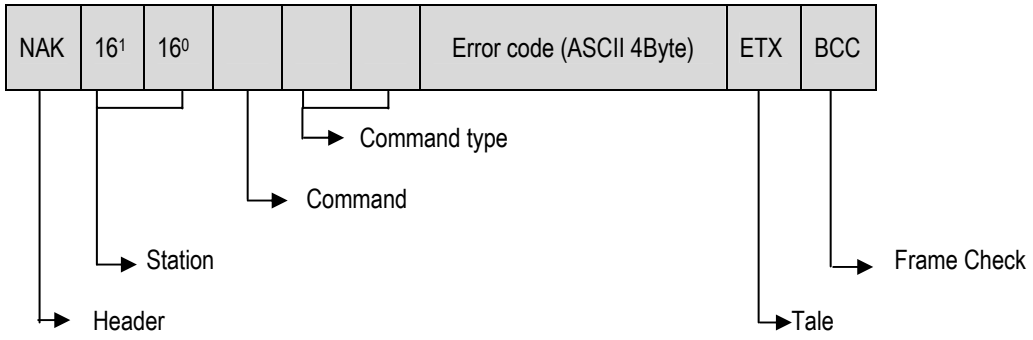
(1) Request frame
- External communication device → GM7U main unit
- Max. 256 Bytes



(2) ACK Response frame
- GM7U main unit → external communication device, when receiving data normally
- Max. 256 Byte



(3) NAK Response frame
- GM7U main unit → external communication device when receiving data abnormally
- Max. 256 Byte



- Control code

  - The control codes used are as follow. Be familiar with the following control codes, because they are important for communication.

Codes	Hex value	Name	Contents
ENQ	H05	Enquire	Request frame initial code
ACK	H06	Acknowledge	ACK response frame initial code
NAK	H15	Not Acknowledge	NAK response frame initial code
EOT	H04	End of Text	Request frame ending ASCII code
ETX	H03	End Text	Response frame ending ASCII code

- The numerical data of all frames are ASCII codes equal to hexadecimal value, if there's no clear statement.

  The terms in hexadecimal are as follows.

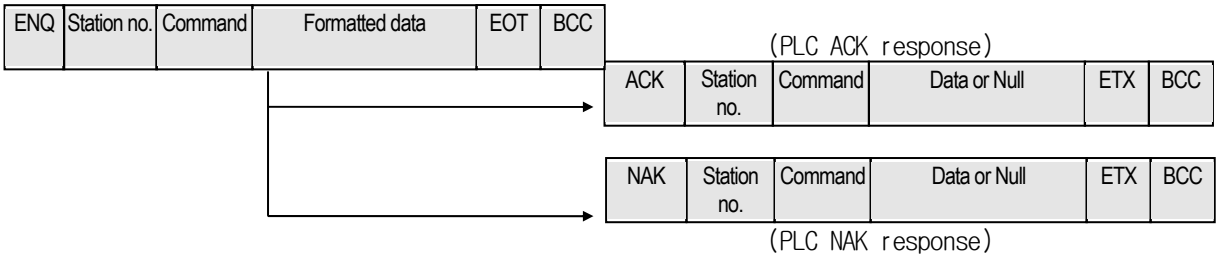
  - Station No.
  - When the main command is R(r) or W (w) and the command type is numerical (means a data type)
  - All of the terms indicating size of all data in the formatted data area.
  - Monitoring registration and command registration number of execution commands.
  - All contents of data

REMARK

If it is hexadecimal, H is attached in front of the number of frames like H01, H12345, H34, H12, and H89AB

1) Sequence of command frame

(1) Sequence of command request frame



8.1.4 Command list

Classification / Item		Command				Description
		Main command		Command type		
		Code	ASCII code	Code	ASCII code	
Reading device	Individual	r(R)	H72 (H52)	SS	5353	Reads data from device of Bit, Byte, Word type.
	Continuous	r(R)	H72 (H52)	SB	5342	Reads device Word in block unit. (Continuous reading Bit is unavailable)
Writing device	Individual	w(W)	H77 (H57)	SS	5353	Writes data to device of Bit, Byte and Word type.
	Continuous	w(W)	H77 (H57)	SB	5342	Writes data to Byte and Word type in block unit. (Continuous reading Bit is unavailable)
CPU Status reading		r(R)	H73 (H53)	ST	5354	Reads flag list like PLC operation status and error information.

Item	Command				Description
	Main command		Register No.		
	Code	ASCII code	Register no.	ASCII code	
Monitoring variable register	x(X)	H78 (H58)	H00~H09	3030 ~ 3039	Register device to monitor.
Execution of monitoring	y(Y)	H79 (H59)	H00~H09	3030 ~ 3039	Execute registered device to monitor.

REMARK

- GM7U main unit identifies capitals or small letters for main commands, but not for the others.

8.1.5 Data type

It's possible to read and write device in built-in communication. When device is used, be aware of data type.

1) Data type of device

The dedicated built-in communication can only read/write direct variables.

(1) Data type of direct variables

- Available types of device: M (internal memory), Q(output), I(input)
- When direct variable is used, attach '%'(25H) in front of the characters.

Data type	Characters	Examples
Bit	X(58H)	%MX0, %QX0.0.0, %IX0.0.0
Byte	B(42H)	%MB10, %QB0.0.0, %IB0.0.0
Word	W(57H)	%MW10, %QW0.0.0, %IW0.0.0
Double Word	D(44H)	%MD10, %QD0.0.0, %ID0.0.0

REMARK

- Reading/writing of symbolic variable is not available in dedicated communication.
- Memory address 100 in '%MB100' is a decimal value.
- Long word is not available.

8.1.6 Command Execution

1) Individual reading of direct variable (R(r)SS)

(1) Introduction

- This is a function that reads PLC device specified in accord with memory data type. Separate device memory can be read up to 16 at a time.

(2) PC request format

Format name	Header	Station No.	Command	Command type	Number of blocks	Device length	Device name	...	Tail	Frame check
Frame	ENQ	H10	R(r)	SS	H01	H06	%MW100		EOT	BCC
ASCII value	H05	H3130	H52(72)	H5353	H3031	H3036	H254D57313030		H04	

1 block (setting can be repeated up to max. 16 blocks)

Item	Description
Station No.	HEX value is displayed as ASCII 2 bytes in station. The example above shows H10 that is the case when the station no. 16 of GM7U is requested data.
Number of blocks	This specifies how much of the blocks composed of "[device length][device name]" are in this request format. This can be set up to 16. Therefore, the value of [Number of blocks] must be set between H01 (ASCII value: 3031)-H10 (ASCII value: 3030).
Device length	This indicates the number of device name's characters, which is allowable up to 16 characters. This value is one of ASCII converted from HEX type, - If the device name is %MW0, it has 4 characters to be H04. - If the device name is %QW0.0.0, it has 8 characters to be H08.
Device name	Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, '%' only is allowable to be entered.
Frame check (BCC)	When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ENQ to EOT is converted into ASCII and added to BCC. Example) BCC of the above frame is obtained as below: H05+H32+H30+H72+H53+H53+H30+H31+H30+H36+H25+H4D+H57+H31+H30+H30+H04 =H03A4 Therefore, BCC value A4 becomes H4134 (ASCII).

REMARK

1) 'H' of example frame represents HEX value, and is unnecessary during preparing real frame.
2) The device type for each block should be identical; otherwise an error will be occurred.

(3) GM7U basic unit response format (ACK response)

Format name	Header	Station No.	Command	Command type	Number of blocks	Device length	Device name	...	Tail	Frame check
Frame	ACK	H20	R(r)	SS	H01	H02	HA9F3		ETX	BCC
ASCII value	H06	H3230	H52(72)	H5353	H3031	H3032	H41394633		H04	

1 block (max. 16 blocks possible)

Item	Description
Station No.	HEX value is displayed as ASCII 2 bytes in station. The example above shows H10 that is the case when the station no. 16 of GM7U is requested data.
Number of data	Number of data means byte number of HEX type, and is converted into ASCII. This number is determined according to data type (X,B,W,D) included in device name of computer request Format. ● Number of data in accordance with its data type is as follows:
Data	In data area, there are the values of HEX data converted to ASCII code saved.
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ACK to ETX is converted into ASCII and added to BCC, and then sent.

Data type	Available variable	Number of data
BOOL(X)	%MX,%QX,%IX	1
Byte(B)	%MB,%QB,%IB	1
Word(W)	%MW,%QW,%IW	2
Double Word(D)	%MD,%QD,%ID	4

● The number of data and an example of using data

- The number of data is H04 (ASCII code value: H3034) means that there is HEX data of 4 bytes in data. Hex data of 4 bytes is converted into ASCII code in data.

If number of data is H04 and the data is H12345678, ASCII code converted value of this is "31 32 33 34 35 36 37 38," and this contents is entered in data area. Name directly, highest value is entered first, lowest value last.

REMARK

- If data type is BOOL, data read is indicated by bytes. Namely, if bit value is 0, it indicated by H00 (ASCII: 30 30), and if 1, by H01 (ASCII: 30 31).

(4) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Command type	Error code (Hex 2 Byte)	Tail	Frame check
Frame (Ex.)	NAK	H20	R(r)	SS	H1132	ETX	BCC
ACSII value	H15	H3230	H52(72)	H5353	H31313332	H03	

Item	Description
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.
Frame check (BCC)	When command is lowercase(r), only one lower byte of the value resulted by adding 1 byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC.

(5) Example

- This example assumes when 1 WORD from %MW20, and 1 WORD from %QW0.0.1 address of station No.1 are read. H1234 is entered in %MW20, and data of H5678 is entered in %QW0.0.1.

① Computer request format (PC → GM7U main unit)

Format name	Header	Station No.	Command	Command type	Number of blocks	Variable length	Format name	Device length	Format name	Tail	Frame check
Frame	ENQ	H01	r	SS	H02	H05	%MW20	H08	%QW0.0.1	EOT	BCC
ACSII value	H05	H3031	H72	H5353	H3032	H3035	H254D573230	H3038	H25515730 2E302E31	H04	

② For ACK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Number of blocks	Variable length	Format name	Device length	Format name	Tail	Frame check
Frame	ACK	H01	r	SS	H02	H02	H1234	H02	H5678	ETX	BCC
ACSII value	H06	H3031	H72	H5353	H3032	H3032	H31323334	H3032	H35363738	H03	

③ For NAK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Error code	Tail	Frame check
Frame	NAK	H01	r	SS	Error code (2)	ETX	BCC
ACSII value	H15	H3031	H72	H5353	Error code (4)	H03	

※ Frame check BCC is automatically operated.

2) Continuous reading (R(r)SB) of device

(1) Introduction

This is a function that reads the PLC device memory directly specified in accord with memory data type. With this, data is read from specified address as much as specified continuously.

(2) PC request format

Format name	Header	Station No.	Command	Command type	Device length	Device	Number of data (Max. 128 bytes)	Tail	Frame check
Frame	ENQ	H10	R(r)	SB	H06	%MW100	H05	EOT	BCC
ASCII value	H05	H3130	H52(72)	H5342	H3036	H254D57313030	H3035	H04	

Item	Description
Station No.	HEX value is displayed as ASCII 2 bytes in station. The example above shows H10 that is the case when the station no. 16 of GM7U is requested data.
Device length	This indicates the number of device name's characters, which is allowable up to 16 characters. This value is one of ASCII converted from HEX type, - If the device name is %MW0, it has 4 characters to be H04. - If the device name is %QW0.0.0, it has 8 characters to be H08.
Device name	Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, '%' only is allowable to be entered.
No. of data	Specifies the no. of data to read continuously from the specified address. The example above reads 5 words serially from %MW100. Up to 120 data is available for continuous reading.
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ENQ to EOT is converted into ASCII and added to BCC, and then sent.

(3) GM7U main unit response format (ACK response)

Format name	Header	Station No.	Command	Command type	Number of blocks	Number of data	Data	Tail	Frame check
Frame (Ex.)	ACK	H10	R(r)	SB	H01	H02	H1122	EOT	BCC
ASCII value	H06	H3130	H52(72)	H5342	H3031	H3134	H31313232	H03	

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Station No.</td><td>HEX value is displayed as ASCII 2 bytes in station.
The example above shows H10 that is the case when the station no. 16 of GM7U is requested data.</td></tr>
<tr><td>Number of data</td><td>The number of data means the byte to respond. It is converted into ASCII. This number is determined by multiplying the data number of the computer request format by the data size (in the table below) according to the memory type (B, W, D) included in the variable name of computer request format.
<table>
<tr><th>Data type</th><th>Available device</th><th>Data size (byte)</th></tr>
<tr><td>Byte(B)</td><td>%MB,%QB,%IB</td><td>1</td></tr>
<tr><td>Word(W)</td><td>%MW,%QW,%IW</td><td>2</td></tr>
<tr><td>Double Word(D)</td><td>%MD,%QD,%ID</td><td>4</td></tr>
</table></td></tr>
<tr><td>Data</td><td>The HEX data in respond data area converted to ASCII code are saved.</td></tr>
<tr><td>Frame check (BCC)</td><td>When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ACK to ETX is converted into ASCII and added to BCC, and then sent.</td></tr>
</table>

Example 1)

When memory type included in variable name of computer request Format is W(Word), and data number of computer request Format is 03, data number of PLC ACK response after execution of command is indicated by H06(2*03 = 06 bytes)Byte and ASCII code value 3036 is entered in data area.

Example 2)
In just above example, when data contents of 3 words are 1234, 5678, and 9ABC in order, actual ASCII code converted values are 31323334 35363738 39414243, and the contents are entered in data area.

(3) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Command type	Error code (Hex 2 Byte)	Tail	Frame check
Frame (Ex.)	NAK	H10	r	SB	H1132	ETX	BCC
ASCII value	H15	H3130	H72	H5342	H31313332	H03	

Item	Description
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.

(3) Example

- This example assumes that 2 Double words from %MD0 of station no.10 is read.

(In this case, H12345678 is in %MD0 and H9ABCDEF0 is in %MD1)

① PC request format (PC → GM7U main unit)

Format name	Header	Station No.	Command	Command type	Data length	Variable name	Number of data	Tail	Frame check
Frame (Ex.)	ENQ	H0A	r	SB	H04	%MD0	H02	EOT	BCC
ASCII value	H05	H3041	H72	H5342	H3034	H254D4430	H3032	H04	

② For ACK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Number of data	Data	Tail	Frame check
Frame (Ex.)	ACK	H0A	r	SB	H08	12345678 9ABCDEF0	ETX	BCC
ASCII value	H06	H3041	H72	H5342	H3038	H31323334353637383 941424344454630	H03	

③ For NAK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Error code	Tail	BCC
Frame (Ex.)	NAK	H0A	r	SB	Error code (2)	ETX	BCC
ASCII value	H15	H3041	H72	H5342	Error code (4)	H03	

3) Individual writing of the direct variable (W(w)SS)

(1) Introduction

This is a function that writes the PLC device memory directly in accordance with the memory data type.

(2) PC request format

Format name	Header	Station No.	Command	Command type	Number of blocks	Device Length	Device Name	Data	…	Tail	Frame check
Frame	ENQ	H10	R(r)	SS	H01	H06	%MW100	H00E2		EOT	BCC
ASCII value	H05	H3130	H52(72)	H5353	H3031	H3036	H254D57313030	H30304532		H04	

1 block (setting can be repeated up to max. 16 blocks)

Item	Description
Number of blocks	This specifies how much of the blocks composed of "[device length][device name]" are in this request format. This can be set up to 16. Therefore, the value of [Number of blocks] must be set between H01 (ASCII value: 3031)-H10 (ASCII value: 3030).
Device length	This indicates the number of device name's characters, which is allowable up to 16 characters. This value is one of ASCII converted from HEX type, - If the device name is %MW0, it has 4 characters to be H04. - If the device name is %QW0.0.0, it has 8 characters to be H08.
Device name	Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, '%' only is allowable to be entered.
Data	If the value to be written in the %MW100 area is HEX A, the data format must be H000A. If the value to be written in %MW100 area is HEX A, the data format must be H000A. In the data area, the ASCII value converted from HEX data is entered.
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ENQ to EOT is converted into ASCII and added to BCC, and then sent.

- Example

  - If the type of data to be written is double word, the data is H12345678, the ASCII code converted value of this is “3132333435363738, and this content must be entered in the data area. The most significant value must be sent first and the least significant value last.

REMARK

1) Device data types of each block must be identical.
2) If data type is BOOL, the data to be written is indicated by HEX 1 bye. Namely, if the bit value is 0, it must be indicate by H00 (3030), and if 1, by H01 (3031)
3) GM7U main unit response format (ACK response)

(3) GM7U main unit response format (ACK response)

Format name	Header	Station No.	Command	Command type	Tail	Frame check
Frame (Ex.)	ACK	H20	W(w)	SS	ETX	BCC
ASCII value	H06	H3230	H57(77)	H5353	H03	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ACK to ETX is converted into ASCII and added to BCC, and then sent.

(4) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Command type	Error code (Hex 2 bytes)	Tail	Frame check
Frame (Ex.)	NAK	H20	W(w)	SS	H4252	ETX	BCC
ASCII value	H15	H3230	H57(77)	H5353	H34323532	H03	

Item	Description
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.

(5) Example

This example assumes that “HFF” is written in %MW230 of station no.1 and the BCC value is checked.

① PC request format (PC → GM7U main unit)

Format name	Header	Station No.	Command	Comm and type	No. of blocks	Device length	Device name	Data	Tail	Frame check
Frame (Ex.)	ENQ	H01	w	SS	H01	H06	%MW230	H00FF	EOT	BCC
ASCII value	H05	H3031	H77	H5353	H3031	H3036	H254D57323330	H30304646	H04	

② For ACK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Tail	Frame check
Frame (Ex.)	ACK	H01	w	SS	ETX	BCC
ASCII value	H06	H3031	H77	H5353	H03	

③ For NAK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Error code	Tail	Frame check
Frame (Ex.)	NAK	H01	w	SS	Error (2)	ETX	BCC
ASCII value	H15	H3031	H77	H5353	Error (4)	H03	

4) Continuous writing of the direct variable (W(w)SB)

(1) Introduction

This is a function that directly specifies the PLC device memory and continuously writes data from the specified address for as long as specified.

(2) Request format

Format name	Header	Station No.	Command	Command type	Device length	Device name	No. of data	Data	Tail	Frame check
Frame (Ex.)	ENQ	H10	W(w)	SB	H06	%MD1 00	H01	H111 12222	EO T	BCC
ASCII value	H05	H3130	H57(77)	H5342	H3036	H254D 44 313030	H3031	H313 13131 32323 232	H04	

Item	Description
Number of blocks	This specifies how much of the blocks composed of "[device length][device name]" are in this request format. This can be set up to 16. Therefore, the value of [Number of blocks] must be set between H01 (ASCII value: 3031)-H10 (ASCII value: 3030).
Device length	This indicates the number of device name's characters, which is allowable up to 16 characters. This value is one of ASCII converted from HEX type, - If the device name is %MW0, it has 4 characters to be H04. - If the device name is %QW0.0.0, it has 8 characters to be H08.
Device name	Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, '%' only is allowable to be entered.
No. of data	Specifies the no. of data to read continuously from the specified address. The example above writes 1 double word serially from %MW100. Up to 120 data is available for continuous writing.
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 byte each to the ASCII values from ENQ to EOT is converted into ASCII and added to BCC, and then sent.

(3) GM7U main unit response format (ACK response)

Format name	Header	Station No.	Command	Command type	Tail	Frame check
Frame (Ex.)	ACK	H10	W(w)	SB	ETX	BCC
ASCII value	H06	H3130	H57(77)	H5342	H03	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ACK to ETX is converted into ASCII and added to BCC, and then sent.

(4) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Command type	Error code (HEX 2 byte)	Tail	Frame check
Frame (Ex.)	ENQ	H10	W(w)	SB	H1132	EOT	BCC
ASCII value	H05	H3130	H57(77)	H5342	H31313332	H03	

Item	Description
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.

(5) Example

This example assumes that HAA15056 is written in %QD0.0.0 at station no.1

① PC request format (PC → GM7U main unit)

Format name	Header	Station No.	Command	Command type	Variable length	Variable name	No. of data	Data	Tail	Frame check
Frame (Ex.)	ENQ	H01	w	SB	H08	%QD0.0.0	H01	HAA15056F	EOT	BCC
ASCII value	H05	H3031	H77	H5342	H3038	H254442302 E302E30	H3031	H41413135 30353646	H04	

② For ACK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Tail	Frame check
Frame (Ex.)	ACK	H01	W	SB	ETX	BCC
ASCII value	H06	H3031	H77	H5342	H03	

③ For NAK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station No.	Command	Command type	Error code	Tail	Frame check
Frame (Ex.)	NAK	01	W	SB	Error code (2)	ETX	BCC
ASCII value	H15	H3031	H77	H5342	Error code (4)	H03	

5) Registering variable for monitoring (X##)

(1) Introduction

Variables separately registered up to 10 (from 0 to 10) in combination with actual variable reading command, and carries out the registered one through monitor command after registering.

(2) PC request fromat

Format name	Header	Station No.	Command	Register no.	Registration format	Tail	Frame check
Frame (Ex.)	ENQ	H10	X(x)	H09	See register format	EOT	BCC
ASCII value	H05	H3130	H58(78)	H3039	[※]	H04	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from ENQ to EOT is converted into ASCII and added to BCC, and then sent.
Register no.	Up to 10 can be registered (0 to 9, H00-H09). If a registered no. is registered again, only the one currently being executed is registered.
Register format	This is used to before EOT in command; individual reading of direct variable and continuous reading format.

[※]: Only one of following can be selected for register format.

① Individual reading of the direct device

RSS	Number of blocks (2 Byte)	Device length (2 Byte)	Device name (16 Byte)	…

1 block (max. 16 blocks)

② Continuous reading of the direct device

RSB	Device length (2 Byte)	Device name (16 Byte)	Number of data

(3) GM7U main unit response format (ACK response)

Format name	Header	Station No.	Command	Registration No.	Tail	Frame check
Frame (Ex.)	ACK	H10	X(x)	H09	ETX	BCC
ASCII value	H06	H3130	H58(78)	H3039	H03	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.

(4) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Registration No.	Error code (Hex 2Byte)	Tail	Frame check
Frame (Ex.)	ACK	H10	X(x)	H09	H1132	ETX	BCC
ASCII value	H06	H3130	H58(78)	H3039	H31313332	H03	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.

(5) Example

This example assumes that the direct variable %MW0 of station no.1 is registered for monitoring.

① PC request format (PC → GM7U main unit)

Format name	Header	Station No.	Command	Registration No.	Registration format				Tail	Frame check
					Command	No. of blocks	Device length	Device name		
Frame (Ex.)	ENQ	H01	x	H01	RSS	H01	H04	%MW0	EOT	BCC
ASCII value	H05	H3031	H78	H3031	H525353	H3031	H3034	H41534446	H04	

② For ACK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station no.	Command	Registration no.	Tail	Frame check
Frame (Ex.)	ACK	H01	x	H01	ETX	BCC
ASCII value	H06	H3031	H78	H3031	H03	

③ For NAK response after execution of command (PC ← GM7U main unit)

Format name	Header	Station	Command	Registration no.	Error code	Tail	Frame check
Frame (Ex.)	NAK	H01	x	H01	Error code (2)	ETX	BCC
ASCII value	H15	H3031	H78	H3031	Error code (4)	H03	

6) Monitoring execution (Y##)

(1) Introduction

This is a function that carries out the reading of the variable registered by monitor register. This also specifies a registered number and carries out reading of the variable registered by the number.

(2) PC request format

Format name	Header	Station No.	Command	Registration No.	Tail	Frame check
Frame (Ex.)	ENQ	H10	Y(y)	H09	EOT	BCC
ASCII value	H05	H3130	H59(79)	H3039	H03	

Item	Description
Register No.	Register No. uses the same number registered during monitor register for monitor execution. It is possible to set from 00-09(H00-H09).
BCC	When the command is lower case(y), only one lower byte of the value resulted by adding 1 byte each to the ASCII values from ENQ to EOT is converted into ASCII, and then added to BCC.

(3) GM7U main unit response format (ACK response)

① In case that the register format of register no. is the Individual reading of device

Format name	Header	Station No.	Command	Registration No.	Number of Blocks	Number of data	Data	Tail	Frame check
Frame	ACK	H10	Y(y)	H09	H01	H04	H9183AABB	ETX	BCC
ASCII value	H06	H3130	H59(79)	H3039	H3031	H3034	H3931383341414242	H03	

② In case that the register format of register no. is the continuous reading of device

Format name	Header	Station No.	Command	Registration No.	Number of data	Data	Tail	Frame check
Frame	ACK	H10	Y(y)	H09	H04	H9183AABB	ETX	BCC
ASCII value	H06	H3130	H59(79)	H3039	H3034	H3931383341414242	H03	

(4) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Registration No.	Error code (Hex 2Byte)	Tail	Frame check
Frame	NAK	H10	Y(y)	H09	H1132	ETX	BCC
ASCII value	H15	H3130	H59(79)	H3039	H31313332	H03	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.

(5) Example

This example assumes that registered device no. 1 at station no. 1 is read, and the BCC value is checked. It is also assumed that the device %MW0 is registered and the number of blocks is 1.

① PC request format (PC → GM7U main unit)

Format name	Header	Station No.	Command	Registration No.	Tail	Frame check
Frame (Ex.)	ENQ	H01	Y	H01	EOT	BCC
ASCII value	H05	H3031	H79	H3031	H04	

② For ACK response after execution of command (PC → GM7U main unit)

Format name	Header	Station No.	Command	Registration No.	Number of Blocks	Number of data	Data	Tail	Frame check
Frame	ACK	H01	y	H01	H01	H04	H23422339	ETX	BCC
ASCII value	H06	H3031	H79	H3031	H3031	H3034	H3233343232333339	H03	

③ For NAK response after execution of command (PC → GM7U main unit)

Format name	Header	Station No.	Command	Registration No.	Error code	Tail	Frame check
Frame (Ex.)	NAK	H01	y	H01	Error code (2)	ETX	BCC
ASCII value	H15	H3031	H79	H3031	Error code(4)	H03	

7) Reading PLC Status (RST)

(1) Introduction

This is a function that reads flag list including operating status of PLC and error information.

(2) PC request format

Format name	Header	Station No.	Command	Command type	Tail	Frame check
Frame (Ex.)	ENQ	H0A	R(r)	ST	EOT	BCC
ASCII value	H05	H3041	H52(72)	H5354	H04	

Item	Description
BCC	When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ENQ to EOT is converted into ASCII and added to BCC.

(3) GM7U main unit response format (ACK response)

Format name	Header	Station No.	Command	Command type	PLC status data (Hex 20 Byte)	Tail	Frame check
Frame (Ex.)	ACK	H0A	R(r)	ST	Status data format	ETX	BCC
ASCII value	H06	H3041	H52(72)	H5354	[※]	H03	

Item	Description
BCC	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from ACK to ETX is converted into ASCII, and then added to BCC, and sent.
PLC status data	PLC status data: data format is 20 bytes in HEX format and converted into ASCII code. Its contents are constituted as the table below after converting the ASCII code into HEX code. ※ Status data format

Data type	Flag name	Status data order
UINT	PC_DEVICE_IDENTIFIER;	H00(L) ~ H01(H)
Byte	Logical;	H02(Offset)
Byte	Physical;	H03
Byte	_CPU_TYPE;	H04
Byte	_VER_NUM;	H05
Word	_SYS_STATE;	H06(L) ~ H07(H)
Byte	_PADT_CNF;	H08
Byte	_Domain_ST;	H09
Word	_CNF_ER;	H0A(L) ~ H0B(H)
Word	_CNF_WR;	H0C(L) ~ H0D(H)
Word	Reserved	H0E(L) ~ H0F(H)
Word	Reserved	H10(L) ~ H11(H)
Word	Reserved	H12(L) ~ H13(H)

REMARK

1) For the details of each flag, refer to GM7U User's Manual "Appendix 2, list of flag".
2) PC_DEVICE_IDENTIFIER, Logical, and Physical are dedicated to be used only for system, so it should not be processed.

(4) GM7U main unit response format (NAK response)

Format name	Header	Station No.	Command	Command type	Error code (Hex 2 Byte)	Tail	Frame check
Frame (Ex.)	NAK	H0A	R(r)	ST	H1132	ETX	BCC
ASCII value	15	3041	5272	5354	31313332	03	

Item	Description
Frame check (BCC)	When the command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to the ASCII values from NAK to ETX is converted into ASCII and added to BCC, and then sent.
Error code	Hex and 2 bytes (ASCII code, 4 bytes) indicate error type. For the details, see 8.1.8 Error codes.

(5) Example

This example supposes that the status of GM7U Main unit of station no. 1 is read.

① Computer request Format (PC → GM7U Main Unit)

Format name	Header	Station No.	Command	Command type	Tail	Frame check
Frame (Example)	ENQ	H01	R(r)	ST	EOT	BCC
ASCII value	H05	H3031	H52(72)	H5354	H04	

② For ACK response after execution of command (PC ← GM7U Main Unit)

Format name	Header	Station No.	Command	Command type	Status data	Tail	Frame check
Frame (Example)	ACK	H01	R(r)	ST	See status data format	ETX	BCC
ASCII value	H06	H3031	H52(72)	H5354		H03	

③ For NAK response after execution of command (PC ← GM7U Main Unit)

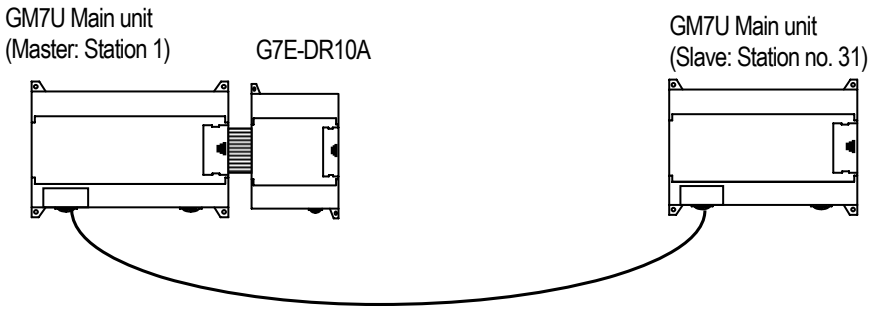
Format name	Header	Station No.	Command	Command type	Error code	Tail	Frame check
Frame (Example)	NAK	H01	R(r)	ST	Error code (2)	ETX	BCC
ASCII value	H15	H3031	H52(72)	H5354	Error code (4)	H03	

8.1.7 1:1, 1:N Built-in communications between LSIS products

1) Introduction

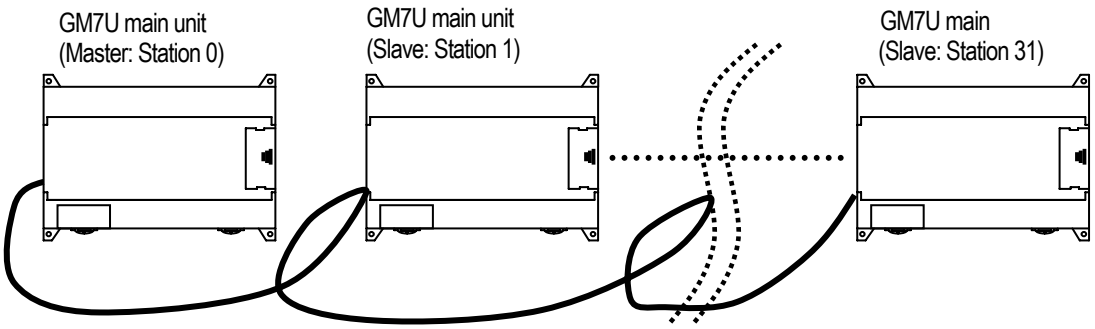
1:1 built-in communication between GM7U's is that which constitutes a built-in communication system with the method of 1(master): 1(slave). Setting Base parameter and communication parameter in GMWIN can easily constitute this system. Communication protocol currently applied is the same with Cnet I/F used for GLOFA. Main functions are following.

- It can organize input (I), output (Q), and internal memory (M) area into 64 data access blocks by WORD unit, and set a communication time-out limit for each block.
- Up to 32 stations can be connected. (When using built-in RS-485 (Ch. 1), G7L-CUEC)
- It can reestablish flag in relation with error codes and slave PLC operating mode according to parameter setting.
- It can reset flag related with error codes and sending/receiving error frequency of each parameter.
- It monitors communication status, using monitoring function of GMWIN.



1:1 dedicated protocol communication between GM7U's (using RS-232C)

- This communication cabling map is the same for (3) 1:1 connecting with other GM7U in 8.1.2 "System configuration method using built-in communication."



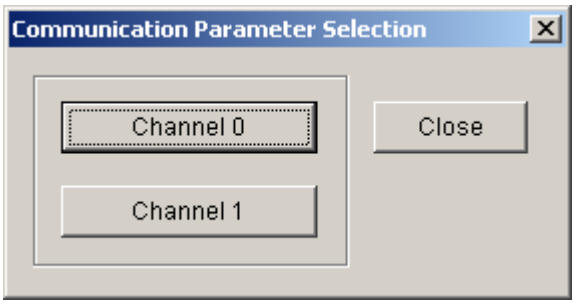
1:N dedicated protocol communication between GM7U's (using RS-485C)

2) Parameter setting

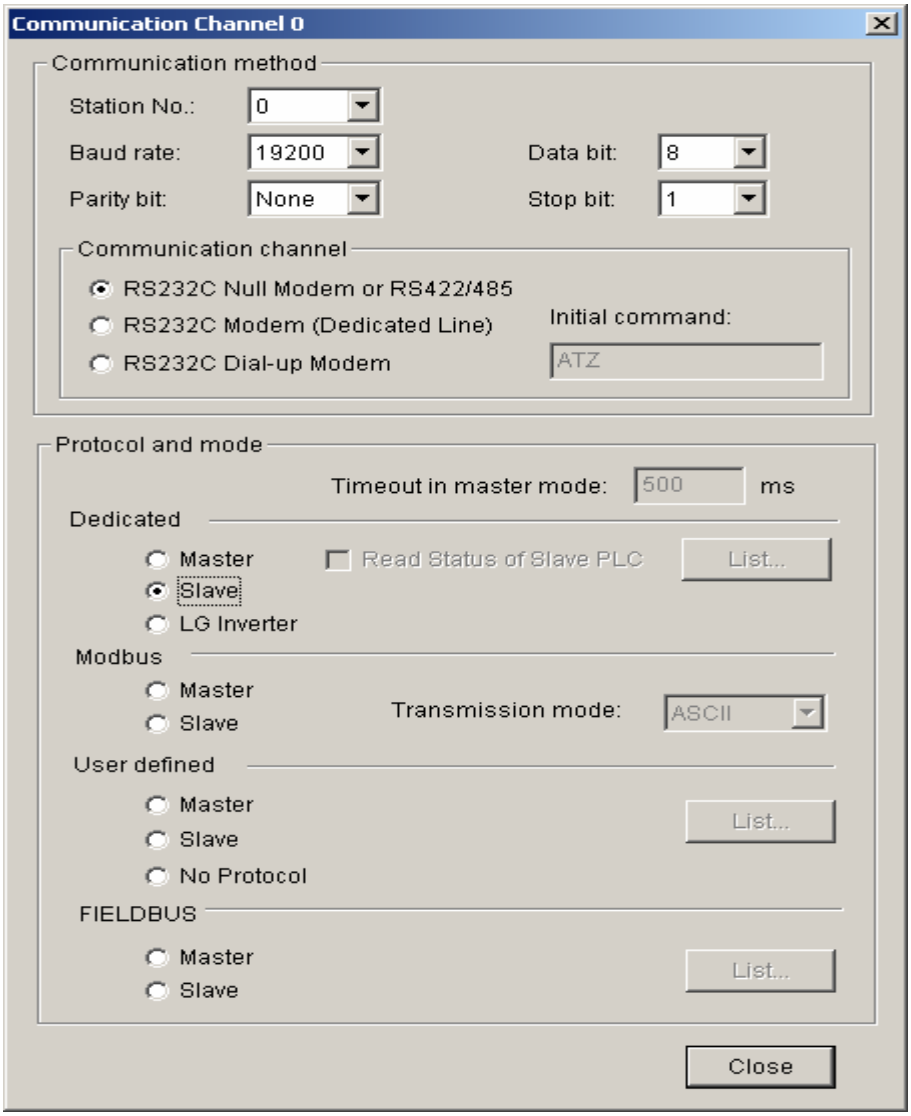
(1) Communication Parameter Setting

- Open a new project file from GMWIN
  - GM7U must be selected for PLC type.

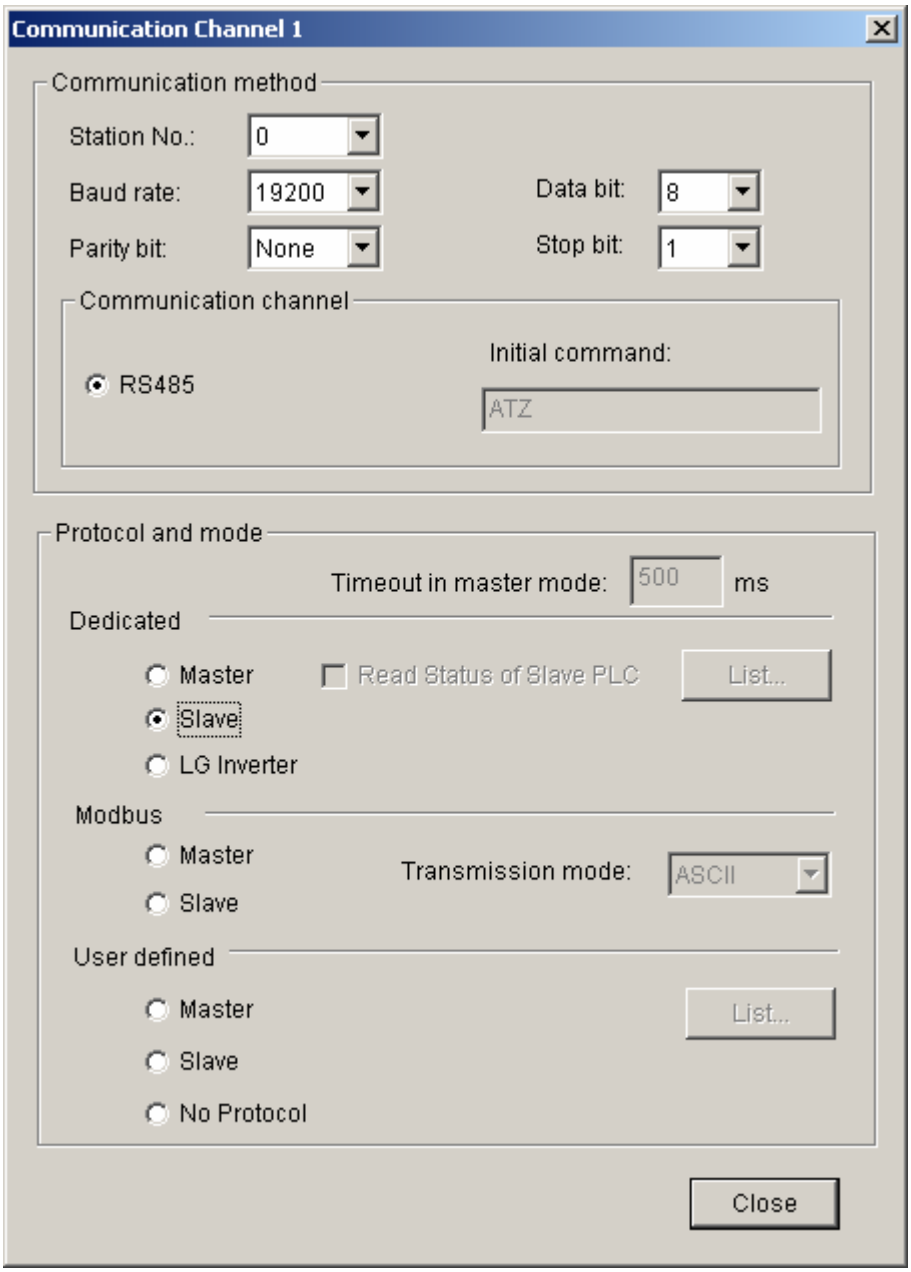
- After selecting communication parameter from GMWIN the following window pops up.



a) When uses Ch.0: Built-in RS-232C or External Cnet I/F module



b) When uses Ch.1: Built-in RS-485

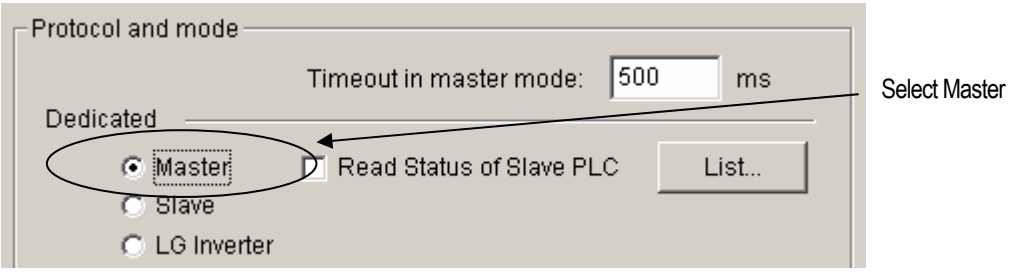


- Set according to the following table

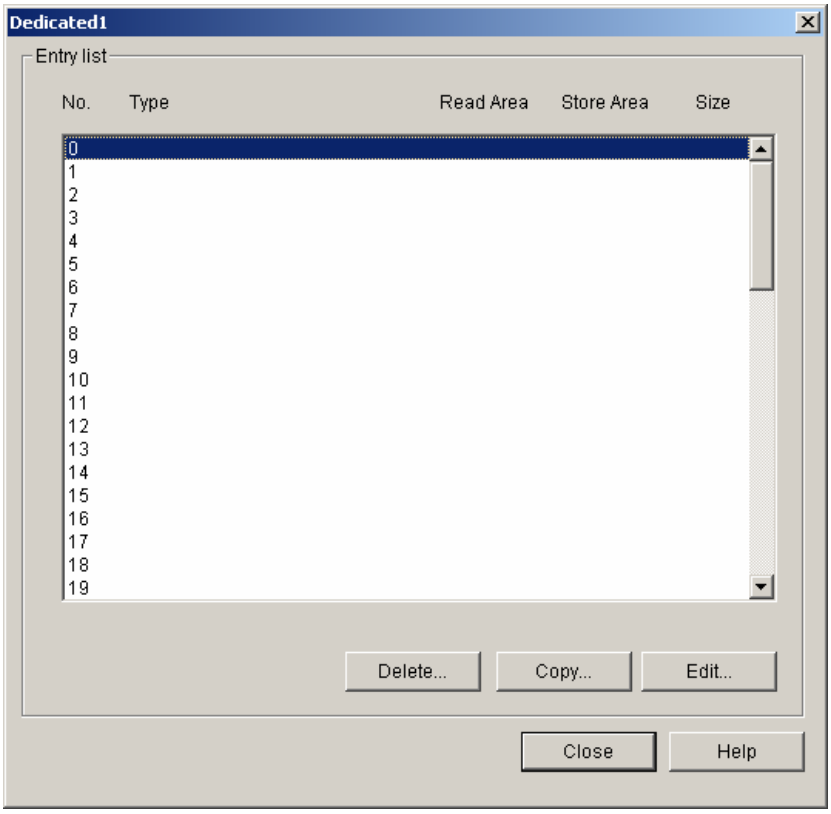
Item	Descriptions
Station No.	Sets one of station from 0 to 31.
Baud rate	Sets one of 1200, 2400, 4800, 9600, 19200, 38400, 57600 bps
Data bit	Sets one of 7 or 8 Bits
Parity bit	Sets one of none, Even, Odd
Stop bit	Sets one of 1 or 2 Bit(s)
Communication channel	• RS232C null modem or RS422/485: can be selected as a communication channel when communication is processed by built-in functions of GM7U Main unit or Cnet I/F module (G7L-CUEC). • RS232C dedicated modem: can be selected when communication is processed by Cnet I/F module (G7L-CUEC). • RS232C dial-up modem: can be selected when common modem communication calling the opponent station is processed by Cnet I/F module (G7L-CUEC). * Notes: RS232C dedicated modem and RS232C dial-up modem communication can be processed only by Cnet I/F module (G7L-CUEC) support RS-232C, not Cnet I/F module (G7L-CUEC) supporting RS-422/485.
Timeout in Master Mode	• It's an interval waiting after sending request frame from GM7U before receiving a response. • Default value is 500ms. • Setting must be done in consideration of maximum interval of sending and receiving cycle of a master PLC. • If the time out is less than the maximum interval of the s/r cycle, error can occur.
Dedicated Master/Slave	GM7U can read from and write on Slave GM7U.
Read status of slave PLC	Can be select especially when you read Slave GM7U for monitoring, but not for the other purposes, lest it may cause decreasing communication speed.

(2) Setting registration list

- Click 'master' from 'exclusive use' in 'protocol and sending mode' then 'List' button will be activated.



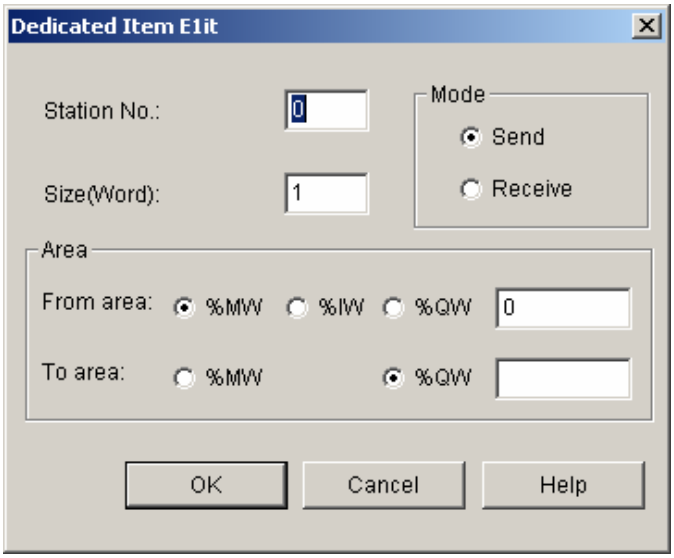
- Click the 'List…' button to open the registration list window.



a) Total 64 data blocks can be assigned. But it's not possible to set a register number.
b) Sending and receiving data size can be set up to 60 Words. There is no period for sending and receiving.
c) Set device area

- Sending: reading device area I/Q/M, saving device area: Q/M
- Receiving: reading device area I/Q/M, saving device area: Q/M

- Designate station no., size, mode, area in following windows.



a) Station no.: set the number of the slave or opponent station.

b) Mode: click 'send' for writing data on the slave station, or 'receive' for reading from it.

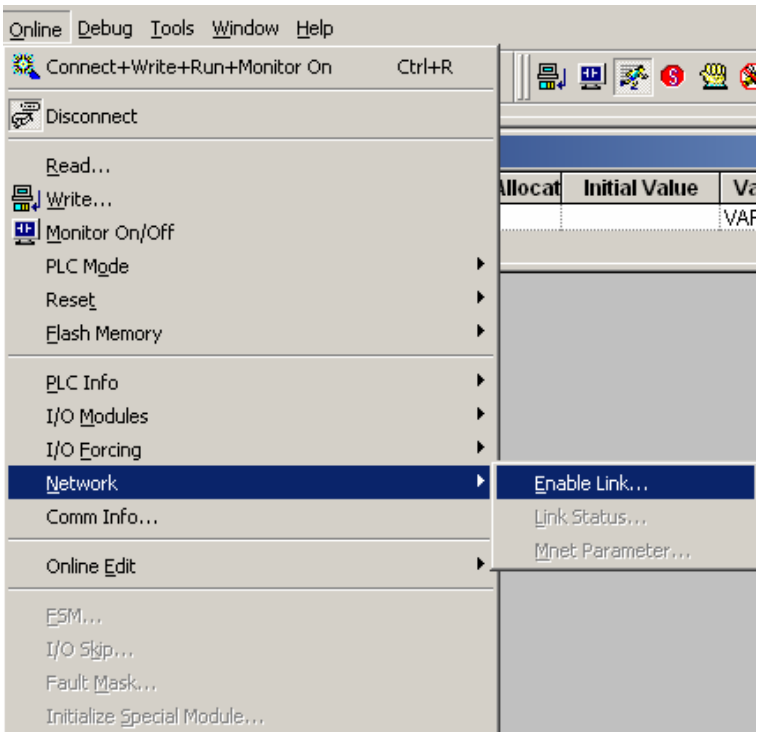
c) Size: data size for reading and writing of the master station can be specified up to 60 words.

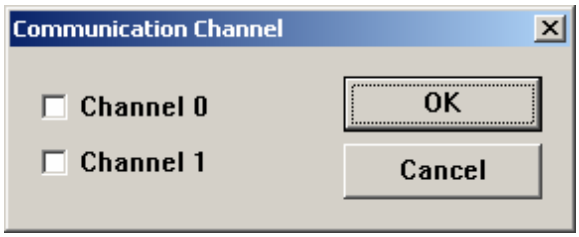
d) Area:

	Send mode	Receiving mode	Indication
From Area	It is in the master station to temporarily save the data to be written.	It is in the slave station for the data to be read.	- When selecting %MW0, click '%MW' and enter '0' in the blank next to it. - When selecting %QW0.1.0, click '%QW' and enter '0.1.0' in the blank next to it.
To Area	It is in the slave station to write the data.	It is in the master station to temporarily save the data to be read.	

3) Setting communication enable

To process 1:1 built-in communication between GM7U's, after setting communication parameter and constituting program, the user must access the master GM7U through GMWIN, click 'connect(C)' of 'online (O)' in menu bar, and set 'Communication Enable(L)' of 'Online (O)' in the same menu bar.





4) Flag related with operating status

(1) Sending/receiving error count for each station (total 32 stations)

- Flag name: _MRS_ERR_CNT[n] (n = 0 ~ 31)
- Data type: array byte
- Description: each station can renew number of errors.
  Namely, the number of s/r errors of the station no. 1 is renewed at _MRS_ERR_CNT [0], and the number of the station no. 31, at _MRS_ERR_CNT [31].

(2) Sending/receiving error description of each station (total 32 stations)

- Flag name: _MRS_ERR[n] (n = 0 ~ 31)
- Data type: array byte
- Description:
  Error code 1: time overrun error for the responding time of sending/receiving
  Error code 2: NAK time error

(3) Slave PLC mode and error description of each station (total 32 stations)

- Flag name: _SRS_STATE[n] (n = 0 ~ 31)
- Data type: array byte
- Description: 0 Bit: error status of the slave PLC (1: error, 0: normal)
  1-3 Bit: Reserved
  4-7 Bit: operating mode of the slave PLC
  - 4 Bit: STOP
  - 5 Bit: RUN
  - 6 Bit: PAUSE
  - 7 Bit: DEBUG

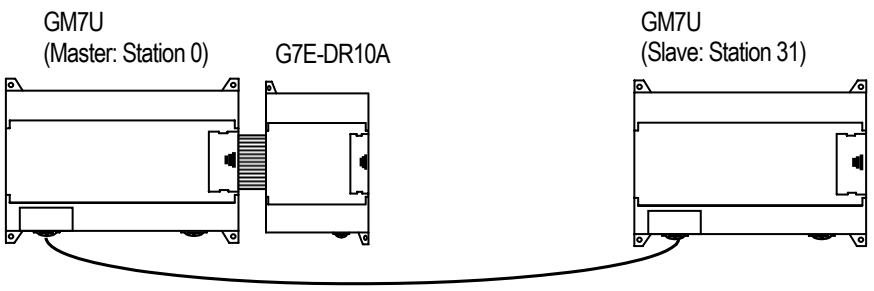
(4) Status flag of the master PLC

- Flag name: _MRS_STATE [n] (n=0-31)
- Data type: array byte
- Contents:
  -2 Bit: overextending M area when setting communication parameter

(5) Max/min/current sending/receiving cycle of set parameter

- Flag name:
  - (Time Type) _MRS_SCAN_MAX
  - (Time Type) _MRS_SCAN_MIN
  - (Time Type) _MRS_SCAN_CUR
- Contents: the interval between after sending and before receiving

5) Example



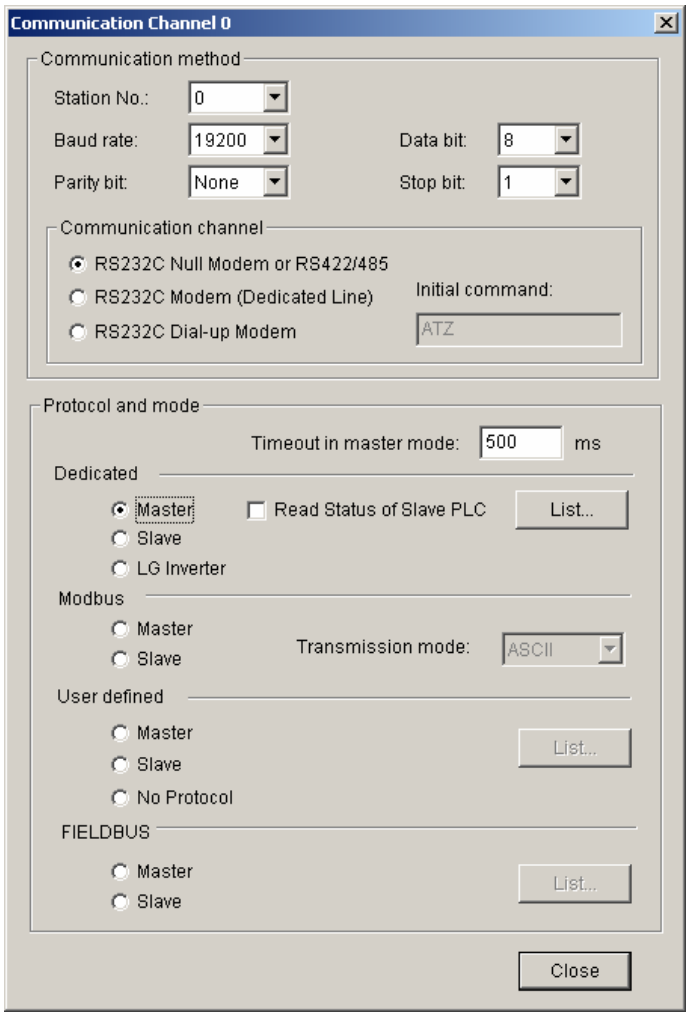
1:1 dedicated protocol communication cable between GM7Us

The following example uses the above diagram to explain the operation of GM7U main unit.

-The data of the master GM7U main unit uses ADD function to increase %MW0 area, and write the data to the slave station of theGM7U main unit. The written data in the output contact is read by the master station of GM7U, and is written to the output contact of the expansion digital I/O module, G7E-DR10A.

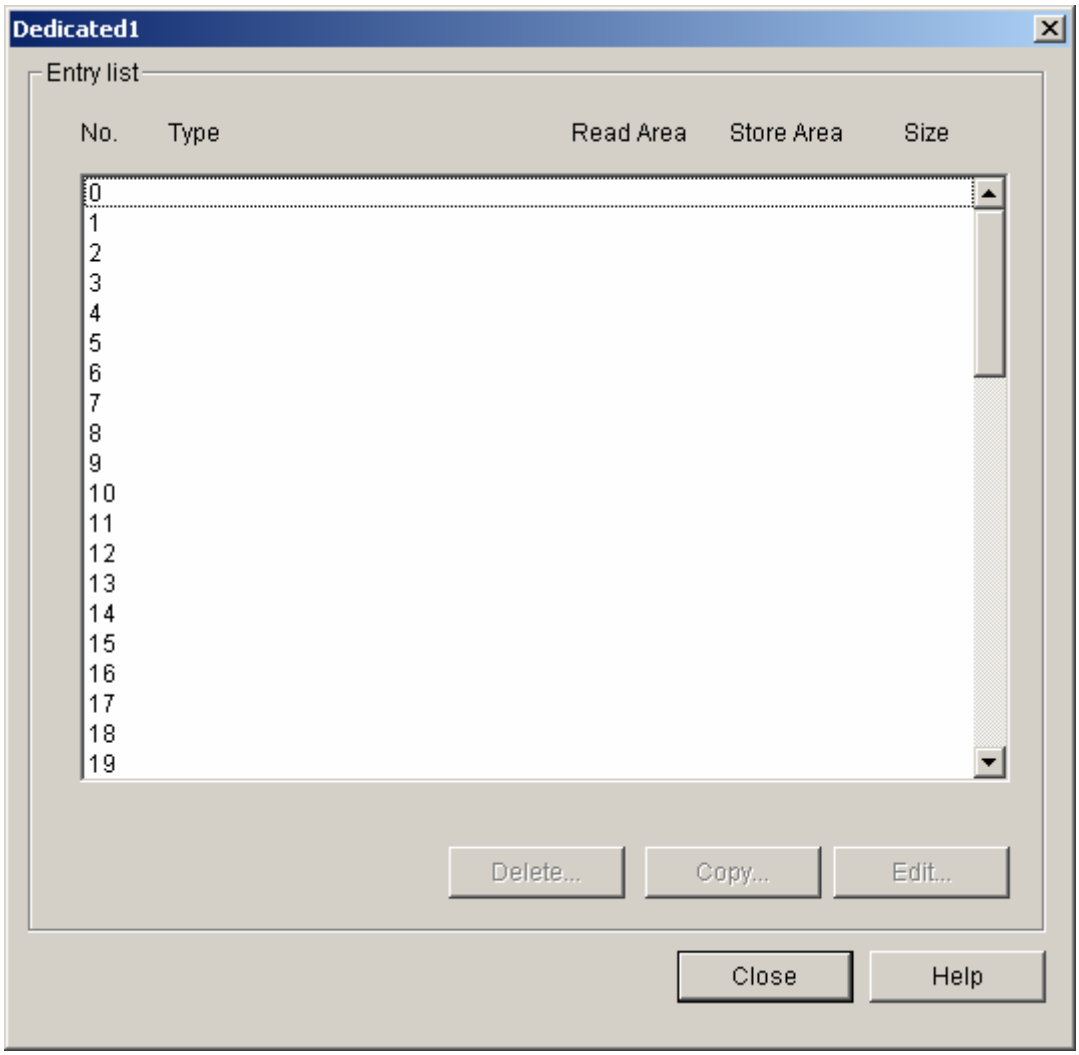
.

(1) MASTER station's parameter settings and program



- Station No: Select 1 (0 ~ 31 available)
- Baud rate: Select 19200
  (1200, 2400, 4800, 9600, 19200, 38400, 57600)
- Parity bit: None (None, Even, Odd available)
- Data bit: Select 8 (7, 8 available)
- Stop bit: Select 1 (1,2 available)
- Communication channel:
  Select RS-232C Null Modem or RS-422/485
- Timeout in master mode: Select 500ms
  (10 ~ 2000ms available)
- Protocol and mode: Select Dedicated Master
  (Master/Slave)

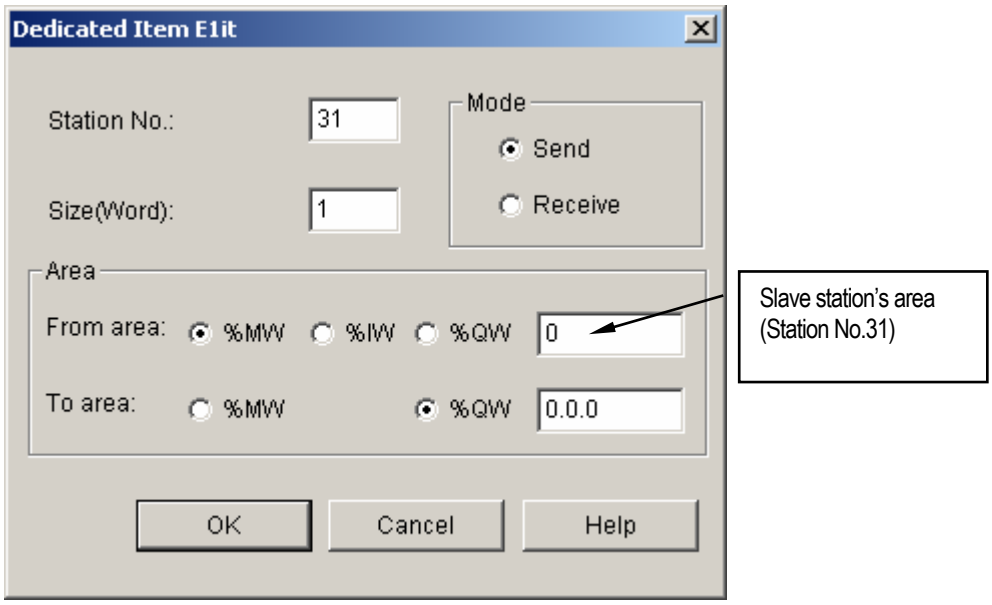
● After setting, the following window will be displayed.



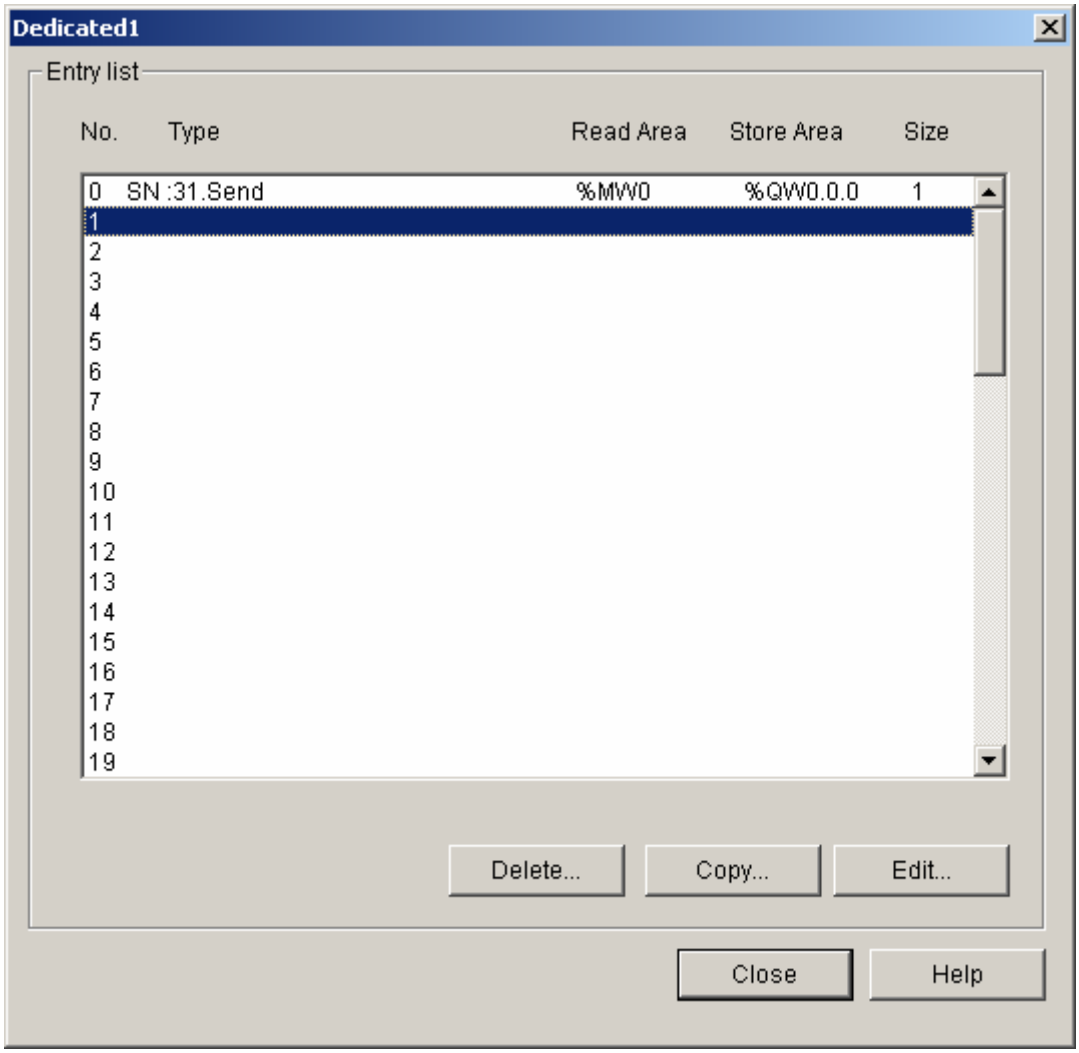
● Select '0' to set the master station's sending parameter.

- After parameter settings, click 'OK'.

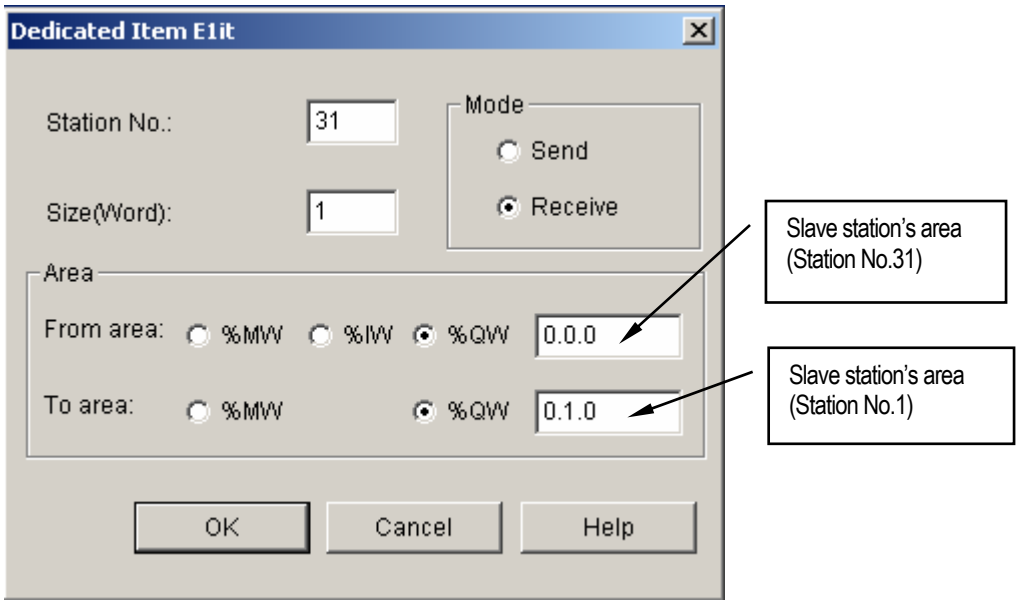
Station No.	Size	Mode	From area	To area
31	1	Send	%MW0	%Q0.0.0



- When the item 0 is registered, the following window is show up.



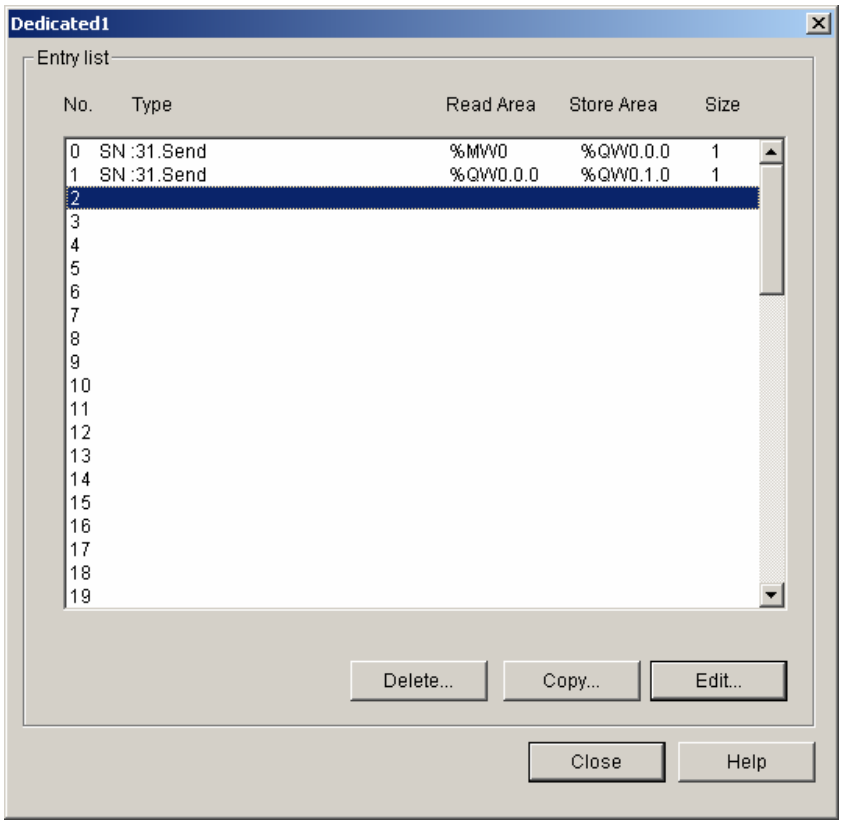
- Select '1', and register as below.



- After parameter settings, click 'OK'.

Station No.	Size	Mode	From area	To area
31	1	Receive	%QW0.O.O	%Q0.1.0

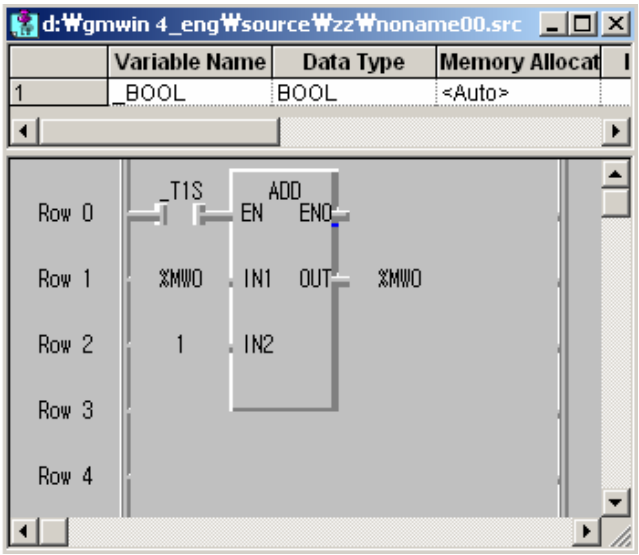
- Check the item 0 and 1 are registered in the Entry list, and Close the window.



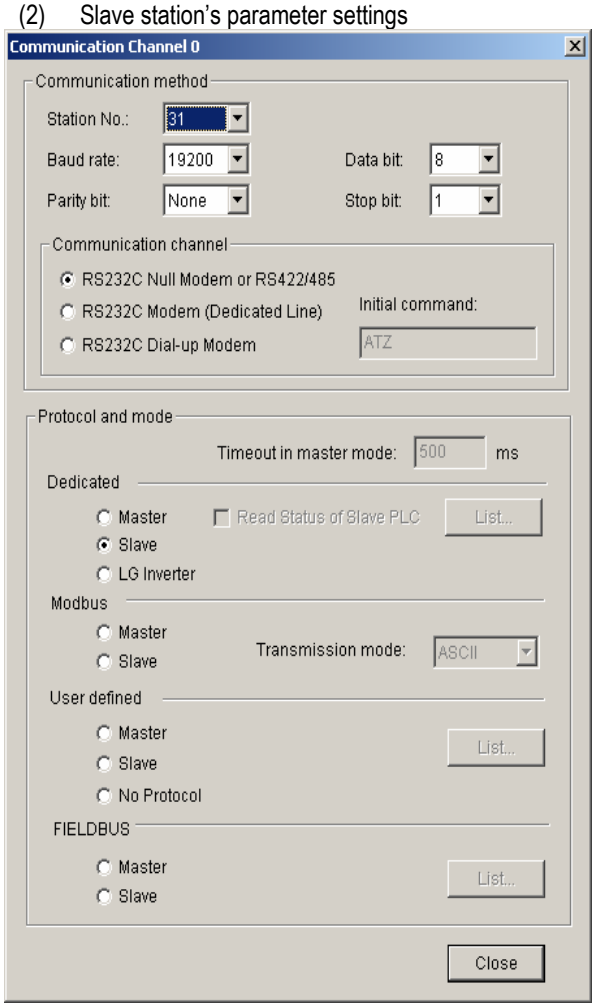
- Select 'OK' in the communication parameter window to complete the parameter settings.

- Program description

  - Increase the value of %MW000 at the rising edge at every second.
  - Communication is executed following the parameter settings.



(2) Slave station's parameter settings



- Station No: Select 31 (0 ~ 31 available)
- Baud rate: Select 19200
  (1200, 2400, 4800, 9600, 19200, 38400, 57600)
- Parity bit: None (None, Even, Odd available)
- Data bit: Select 8 (7, 8 available)
- Stop bit: Select 1 (1,2 available)
- Communication channel:
  Select RS-232C Null Modem or RS-422/485
- Timeout in master mode: Select 500ms
  (10 ~ 2000ms available)
- Protocol and mode: Select Dedicated Slave
  (Master/Slave)

8.1.8 Error codes

Error code	Error type	Error condition and causes	Treatment
H0001	PLC system error	Interface with PLC is impossible.	Turn Off/On the power
H0011	Data error	Errors occurred when exchanging ASCII data to numbers.	Check if other letters than capitals/small letters, numbers, and ('%','_','.') in device and data, correct and execute again
H0021	Command error	Set a wrong device memory that is to use commands other than w(W), r(R), x(X), y(Y), s(S)	Check the commands
H0031	Command type error	Wrong command type that is to use characters like wSS, wSB using other letters from "SS" or "SB"	Check the command type
H1132	Device memory error	A memory device other than m(M),q(Q),I(I) is set.	Check the device type
H1232	Data size error	The number of data is 0 or longer than 128 bytes.	Correct data length (If the data type is byte, the number of data must be from 1~128)
H2432	Data type error	When characters other than x(X), b(B),w(W),d(D) are used. When b(B), d(D) are used. Ex) Use commands like %db or %dd.	Check the data type and execute again.
H7132	Device request Format error	When omit % When omit '.' at QX command	Check the data type and execute again
H2232	Exceeded area error	When the assigned area is exceed Ex 1) %QX0.0.64 → exceed assigned area %MB0.0.8 → exceed assigned area Ex 2) The address is not in decimal value such as %MX00A, %MB00A Ex 3) When the M area size is set as 2 K bytes in GMWIN, but exceeds over 2 K bytes like %MB400.	Correct the size within the assigned area and execute again.
H0190	Monitor execution error	Exceeding limit of register No.	Correct the monitor register no. not to go over than 9 and reset
H0290	Monitor register error	Exceeding limit of register No.	Correct the monitor register no. not to go over than 9 and reset
H6001	Syntax error	When use commands that aren't supported. Ex1) When use device like %MX100, %QX0.0.0 in RSB command	- Be familiar with the manual - Check if the system stopped - Reset
H6010	Syntax error	OVER-RUN, FRAME error	Be familiar with the manual
H6020	Syntax error	TIME_OUT error	Confirm the setting of the RS-232C communication ports. Turn the power off and on to restart.
H6030	Syntax error	Syntax error in commands	Check if each sends frame has ENQ, EOT.
H6040	Syntax error	When a FRAME text exceeds over 256 bytes	Correct the send frame not to go over 256 bytes.
H6050	Syntax error	BCC error	Check if BCC is right.

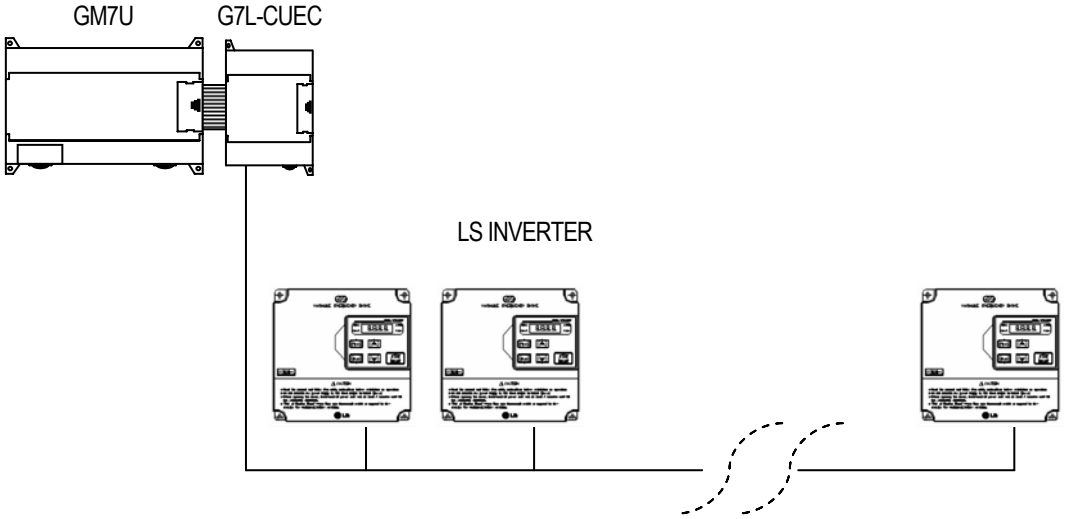
8.1.9 LS inverter-dedicated protocol

1) Introduction

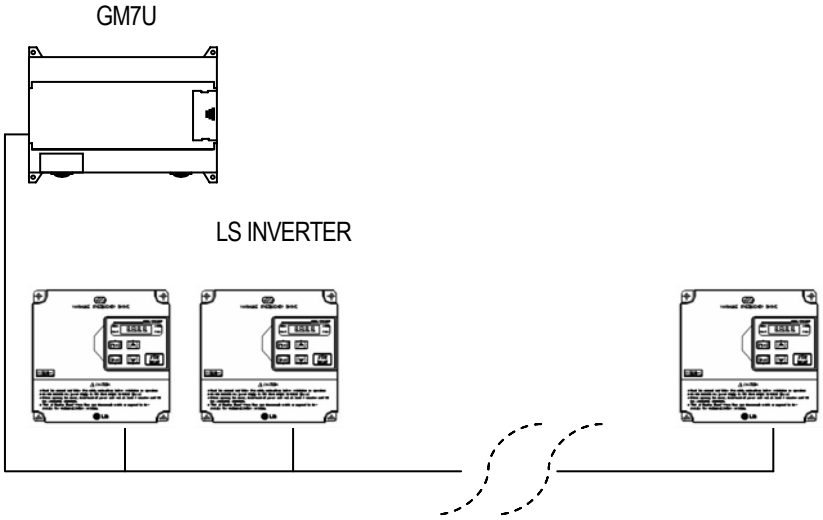
LS inverter dedicated protocol enables to build a 1:N (inverter as slave) system using LS-BUS (ASCII) protocol. This system can be built easily with communication parameter settings in GMWIN. Up to 31 inverters can be used for each channel (channel 0, channel 1).

2) System configurations

(1) Configuration using channel 0



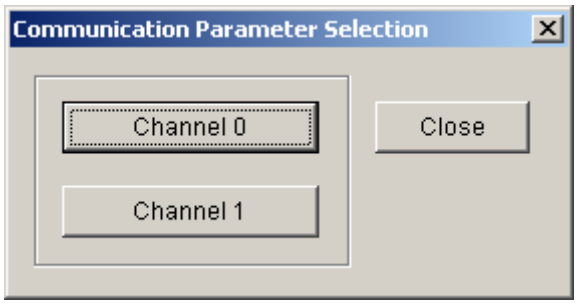
(2) Configuration using channel 1



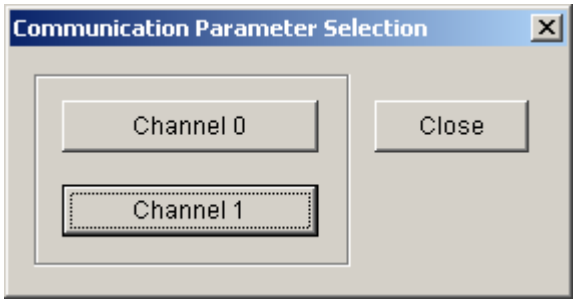
3) Parameter settings

(1) Communication parameter settings

- Select 'Parameter' -> 'Communication Parameter' in GMWIN, and select channel 0 or channel 1.

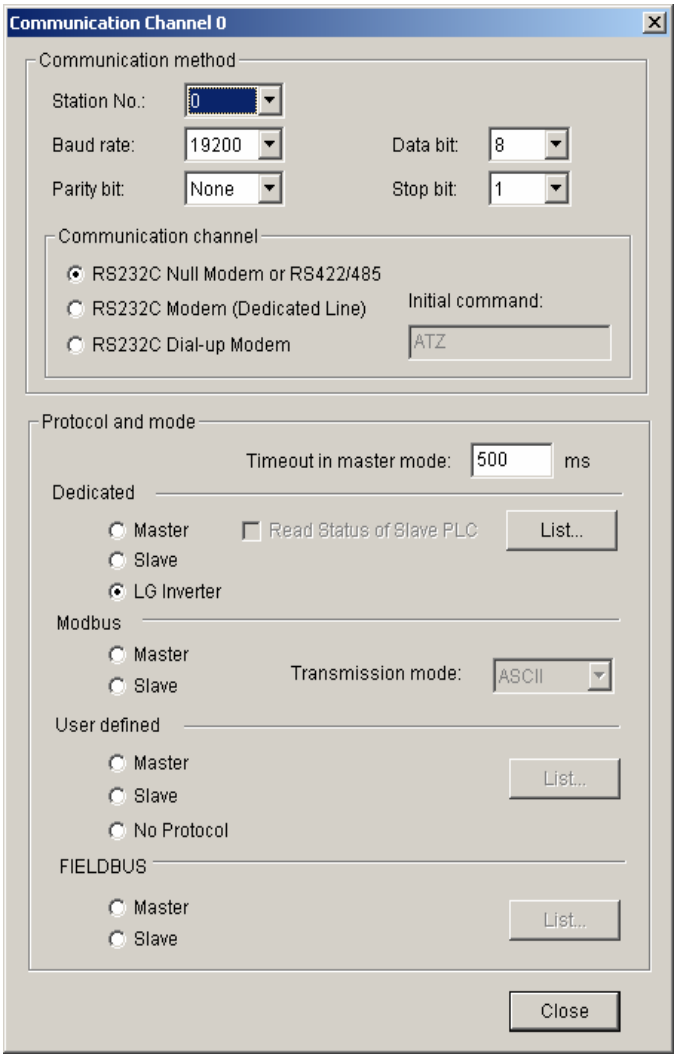


Selecting Channel 0

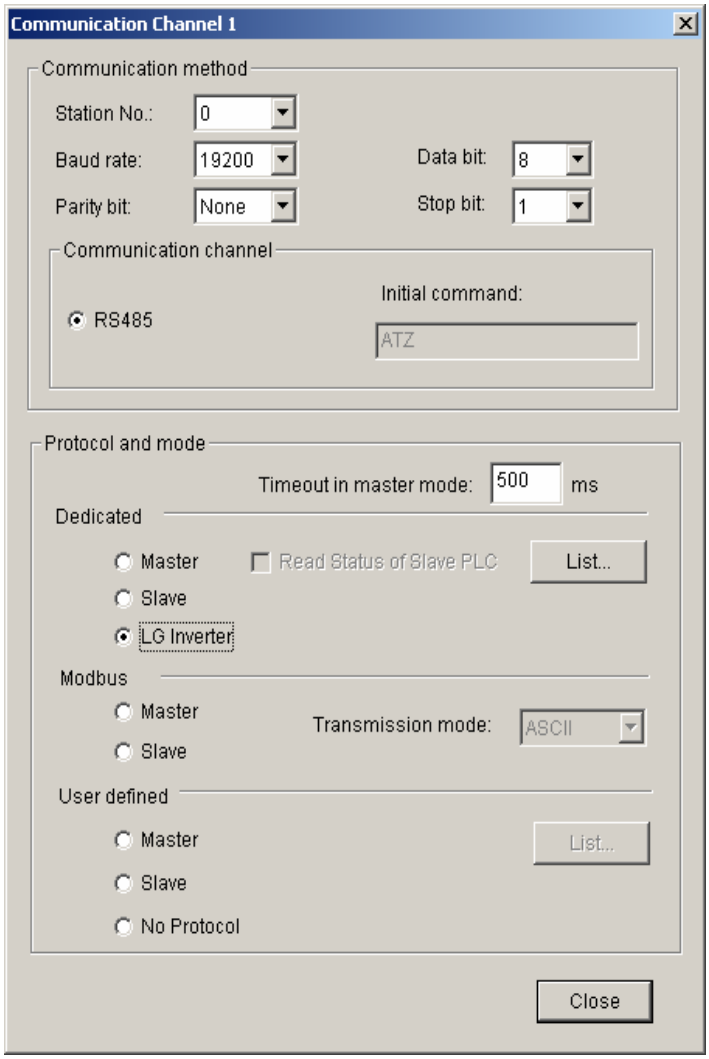


Selecting Channel 1

- After selecting, the figure below will be displayed. (Left for Channel 0, right for Channel 1)



Selecting Channel 0

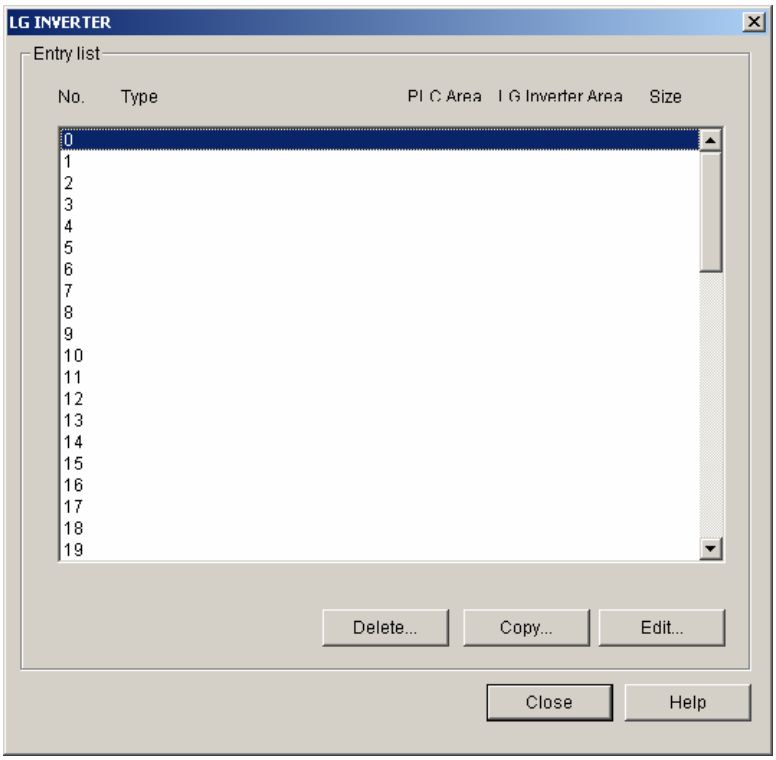


Selecting Channel 1

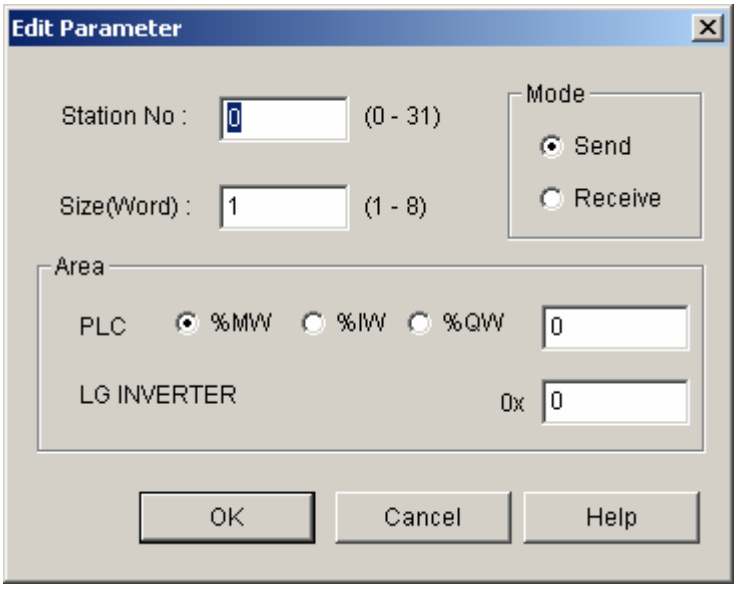
- Set Station No. (PLC station), Baud rate, Parity bit, Data bit, and Stop bit.

(2) Entry List settings

- Select 'Dedicated' -> 'LG Inverter' -> 'List…', and then the following window will be displayed.



- Select the items, and then the following window will be displayed..



- Station No. is for slave inverter station's number. Stations No. 0 to 31 is available.
- Select 'Send' to write data to an inverter.
- Select 'Receive' to read data from inverter.
- Size is the data size to send and receive, and 1 to 8 words are available.
- PLC area and LG INVERTER area can be set in Area.
- M, I, Q areas (unit: word) can be used for PLC area.
- Input the inverter's address in the LG INVERTER Area. H0000 to Hffff is available.
- Download the communication parameter after settings.

8.2 User Defined Protocol Communication

8.2.1 Introduction

User Defined Protocol Communication allows users who do communication between GM7U main unit and other kind of device to define the other company's protocol at GM7U PLC. There're a number of kinds of protocols made by many companies, that it's difficult to have all protocols in it. So if a user defines a protocol that can be applied to his/her purpose, GM7U main unit executes the communication with the other kind of device through the defined protocol.

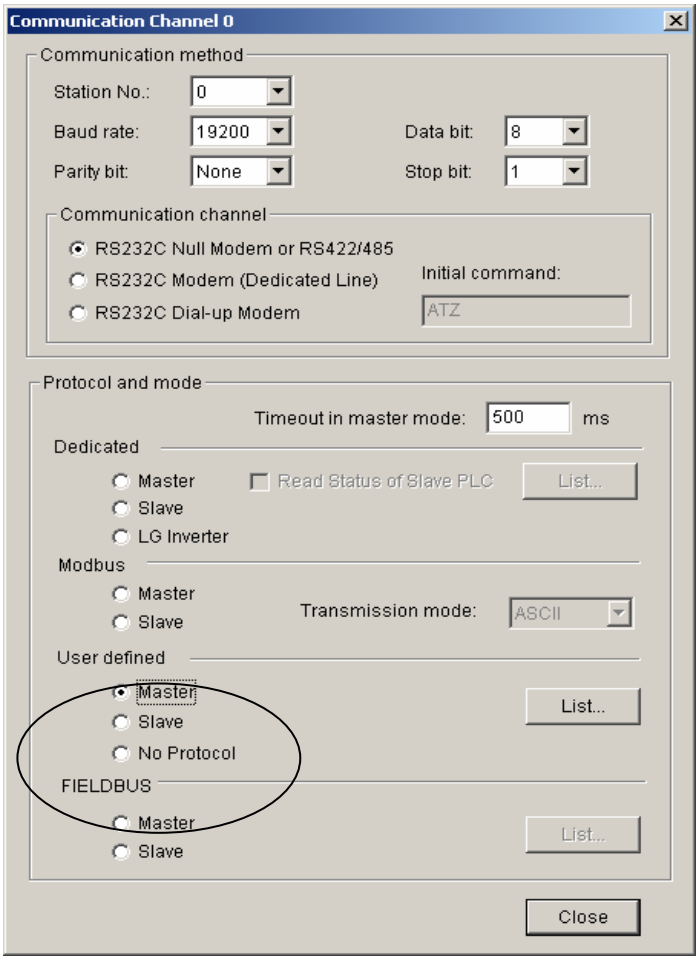
For this, protocol frame must be defined in GMWIN. And exact knowledge about the contents of the protocol defined by the user is vital in making the communication possible. GMWIN can download a user defined protocol frame into GM7U main unit and it is saved. it is not erased by power's off/on. For using user-defined mode, he/she should program with instruction controlling sending of PLC as well as edit frames. This section explains User Defined Protocol Communication setting & usage.

8.2.2 Parameter setting

1) Setting Communications Parameter

(1) Open a new project file from GMWIN and select GM7U as PLC type

(2) After setting communication parameter at GMWIN. Double click it to activate this window.

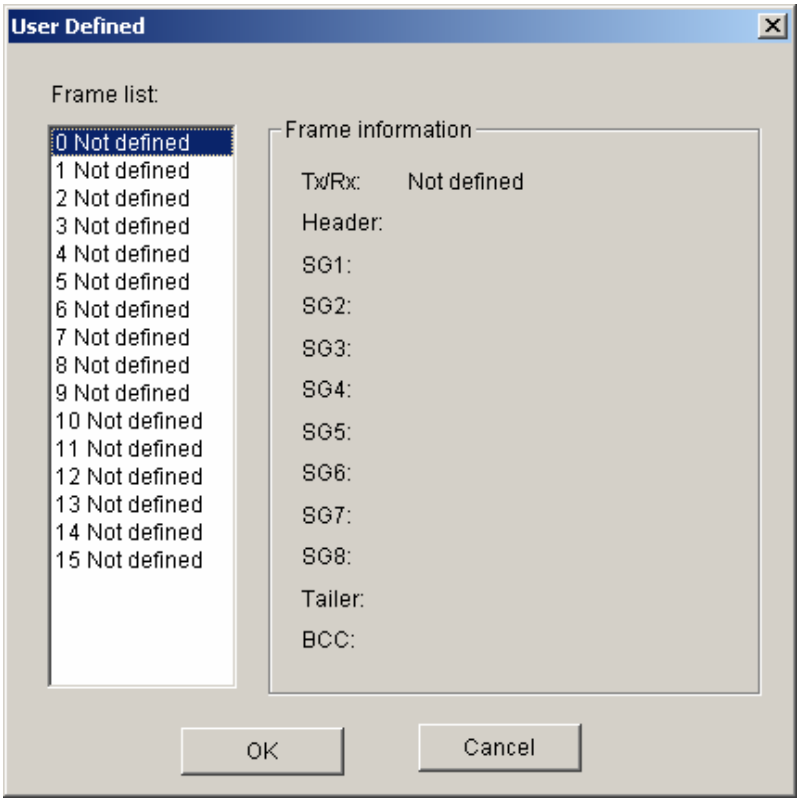


(3) Set according to the following table.

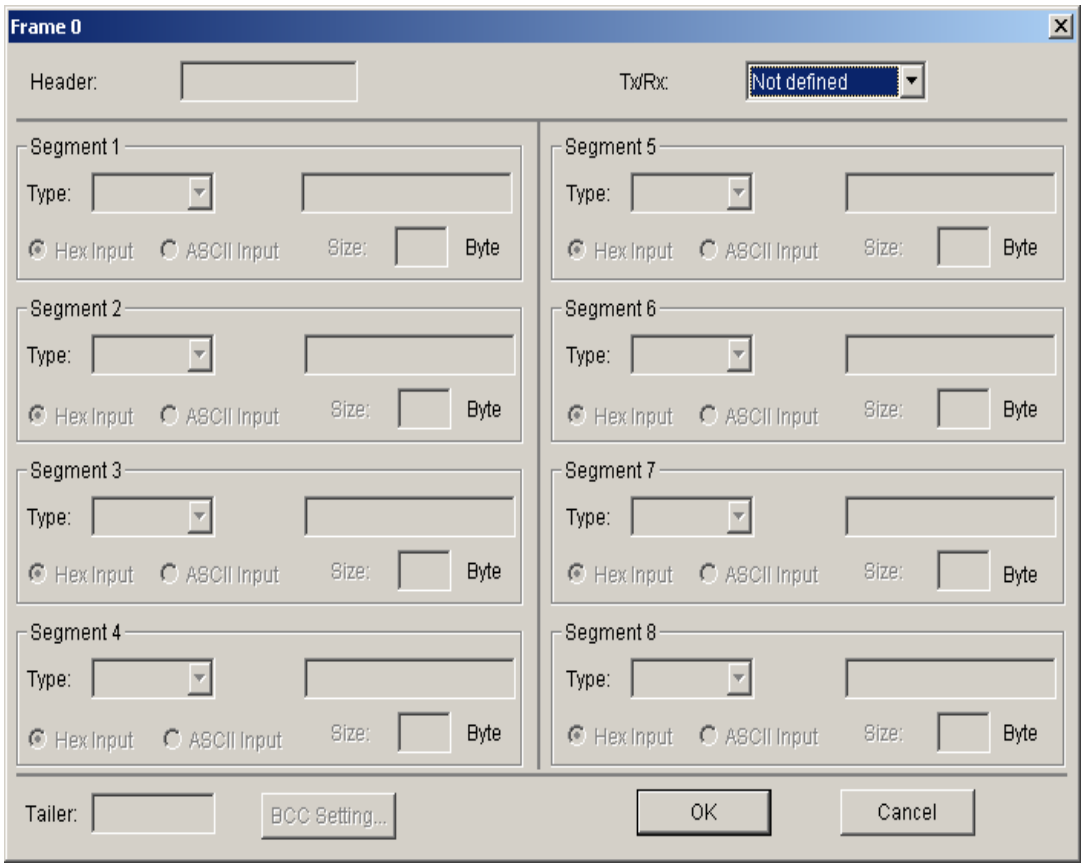
Item	Setting range
Station No.	Station no. from 0 to 31.
Baud Rate	1200, 2400, 4800, 9600, 19200, 38400, 57600 bps
Data Bit	7 or 8 bits
Parity Bit	0, Even or Odd
Stop Bit	1 or 2 bit(s)
Communication Channel	● RS-232C Null Modem or RS-422/485: It's a communication channel for the communication, using GM7U base unit's built-in communication and Cnet I/F module (G7L-CUEC). ● RS232C Modem (Dedicated Line): It's to be selected for the communication, using a dedicated modem with Cnet I/F module (G7L-CUEB). ● RS232C Dial Up Modem: It's to be selected for the general communication connecting through the telephone line by dial up modem and Cnet I/F module (G7L-CUEB). Remark) Using Cnet I/F module (G7L-CUEB) supporting RS232C, RS232C dedicated or dial-up modem communication can be done, but not through Cnet I/F module (G7L-CUEC) supporting RS422/485.
Timeout in Master Mode	● It's the time waiting a responding frame since the master GM7U base unit sends a request frame. ● The default value is 500ms. ● It must be set in consideration of the max. periodical time for sending/receiving of the master PLC. ● If it's set smaller than the max. send / receive periodical time, it may cause communication error.
User Define Master / Slave	If it is set as the master, it's the subject in the communication system. If it's set as the slave, it only responds to the request frame of the master.

2) Frame setting

(1) Click "List" button to activate the following window.



(2) Select one of 0～15 in frame list to open the following window.



① Frame specification

- Header

  - Used in [Header] type.

  - Possible characters, as headers are 1 alphabet letter, 1 numeric number, or control characters as below.

Available Control Code							
NUL(H00)	SOH(H01)	STX(H02)	ETX(H03)	EOT(H04)	ENQ(H05)	ACK(H06)	BEL(H07)
BS(H08)	HT(H09)	LF(H0A)	VT(H0B)	FF(H0C)	CR(H0D)	SO(H0E)	S1(H0F)
DLE(H10)	DC1(H11)	DC2(H12)	DC3(H13)	DC4(H14)	NAK(H15)	SYN(H16)	ETB(H17)
CAN(H18)	EM(H19)	SUB(H1A)	ESC(H1B)	FS(H1C)	GS(H1D)	RS(H1E)	US(H1F)
DEL(H7F)							

Example 1)

[NUL], [ENQ], [1], [A]: Possible

Example 2) NUL, ENQ, [12], [ABC]: impossible

- It is allowed to be only 3 consecutive characters.

Example 3)

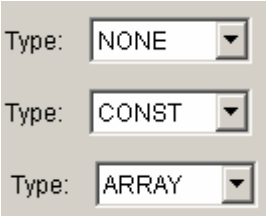
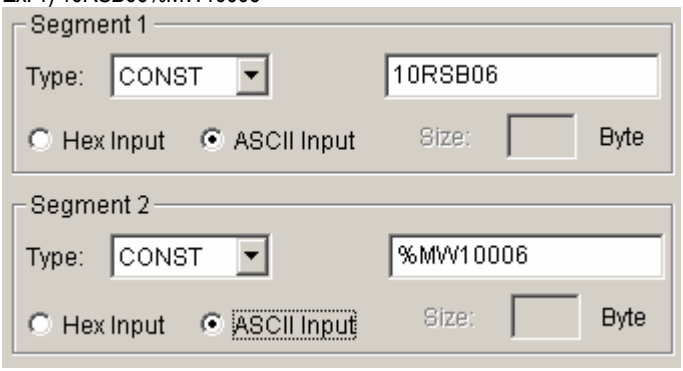
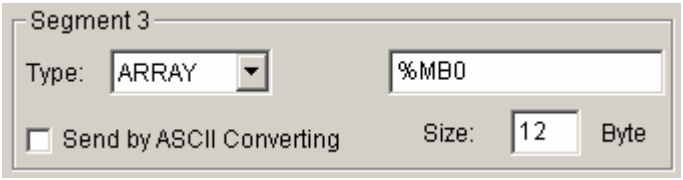
[ENQ][STX][NUL]: Possible

Example 4)

[A][NUL][ENQ][STX]: impossible

- Send / Receive
  - Not defined: It is the initial value that doesn't declare a frame format.
  - Send: It is that declares send frame.
  - Receive: It is that declares receive frame.
  - When Frame 0 window is activated, Tx/Rx term is set as "Not defined," and all the segments are not in activation.

- Segment (1-8): Enter segment by segment to separate fixed sending data area (CONSTANT) and device area (Array).

Item	Contents
	To set a segment type, there're NONE (not defined), CONST (fixed data area), ARRAY (Device area). CONST declares commands and fixed data that are used for communication frame and ARRAY is used to input and save the data needed for interactive communication. ARRAY type must be always set by byte. Ex.1) %MB0, %QB0.0.0 (← ○) Ex.2) %MX0, %MW0, %MD0, %QX0.0.0, %QW0.0.0(← ×)
	This field is to declare commands and fixed data that will be used in communication frame and constant data to be declared by inputting. ASCII input must be done within 10 characters and hex within 20 characters. If the number exceeds the limit, set the next segment as the same type and continue to input there. Ex. 1) 10RSB06%MW10006  If the segment is declared as ARRAY type, although word type data is declared in CONST type, the related area is to be set by byte. Ex2) As a dedicated protocol communication, 10RSB06%MW10006 is a frame to execute reading 6 word data from %MW100 at the slave station no. 16. At the moment, ARRAY must be set in 6 words that is 12 bytes, as the area to save the data that is read. 

Item	Contents
Hex Input ASCII Input	It is a radio button to select the input type of commands. There're 2 kinds as hex or ASCII value. Ex1) ASCII : 1 0 R S B 0 6 % M W 1 0 0 Ex2) Hex : 31 30 52 53 42 30 36 25 57 44 31 30 30
Receive by Hex Converting Send by ASCII Converting	If ARRAY (variable data area) is set, it asks whether it would convert data to ASCII to send (at send frame), or convert to hexadecimal to receive (at receive frame).
Size: Byte	If ARRAY is set, the size of area is to be set by byte. The unit is a byte.

- Tail

  - Used in [Tail] type.

  - Possible characters as headers are 1 alphabet letter, 1 numeric number, or control characters as below

Available Control Code							
NUL(H00)	SOH(H01)	STX(H02)	ETX(H03)	EOT(H04)	ENQ(H05)	ACK(H06)	BEL(H07)
BS(H08)	HT(H09)	LF(H0A)	VT(H0B)	FF(H0C)	CR(H0D)	SO(H0E)	S1(H0F)
DLE(H10)	DC1(H11)	DC2(H12)	DC3(H13)	DC4(H14)	NAK(H15)	SYN(H16)	ETB(H17)
CAN(H18)	EM(H19)	SUB(H1A)	ESC(H1B)	FS(H1C)	GS(H1D)	RS(H1E)	US(H1F)
DEL(H7F)							

Example 1) [1], [2], [A], [a], [NUL], [EOT]: possible

Example 2) 1, [12], A, [AB], [ABC], NUL, EOT: impossible

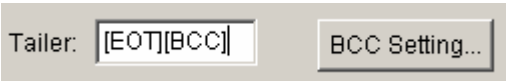
- It is allowed to be only 3 consecutive characters.

Example 3) [ENQ][STX][NUL] : possible

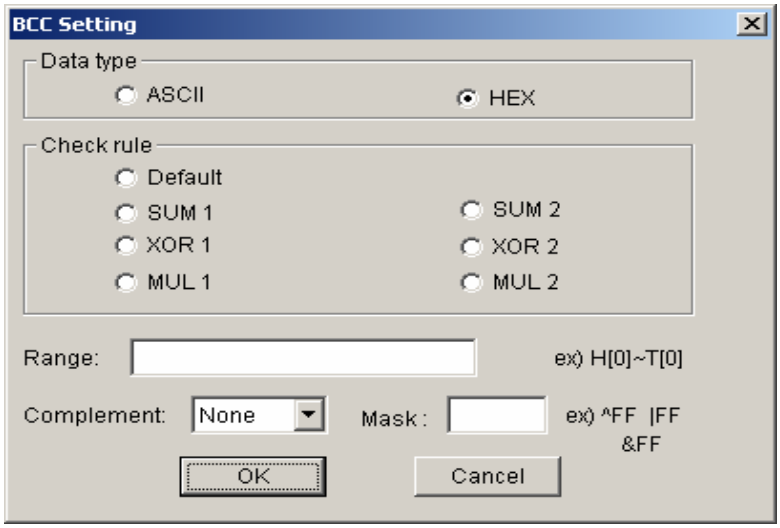
Example 4) [A][NUL][ENQ][STX] : impossible

- It's possible to use BCC that can detect errors. BCC must be set as [BCC] to be used. To set BCC contents, click "BCC Setting" button on the right side.

Example 5)



- BCC setting: set BCC when it is needed.



Item		Contents
Data Type		ASCII adds 2 bytes BCC value in ASCII type to frame. Hex adds 1 byte BCC value in Hex type to frame. For the detailed setting BCC, refer to 8.1.6 "Execution of Commands".
Check Rule	Default	It is that sum all the data from 2nd data to the data before the data marked as [BCC] and input the result to the [BCC] area
	LRC/CRC	Set as LRC/CRC check which is provided in modbus protocol. For ASC communication set LRC, for HEX communication set CRC.
	SUM 1	BCC method uses sum like defaults, but the user can set the BCC area.
	SUM 2	BCC method is the same with SUM 1, but it's used when the user masks any value to the last BCC value.
	XOR 1	BCC method is OR (Exclusive OR).
	XOR 2	BCC method is the same with XOR 1, but it's used when the user masks any value to the last BCC value.
	MUL 1	BCC method is MULTIPLY that is, multiplication.
	MUL 2	BCC method is the same with MUL 1, but it's used when the user masks any value to the last BCC value.
Range		H signifies header, S is for segment, and T is for tail. Ex1) When header is set as [ENQ][STX], tail is set as [EOT][ETX], and the range of setting BCC is to be from [STX] to [ETX], then set as H [1]~T [1].
Complement		It is to set whether not to take complement number or to take the complement number of 1 or 2 at [BCC] value. If mask setting is done after taking a complement number, the user can set any value to do masking.
Mask		Sets any value and method of masking. Ex1) When masking by XOR method, using a value, HFF : ^FF Ex2) When masking by OR method, using a value, HFF : |FF Ex3) When masking by AND method, using a value, HFF : &FF

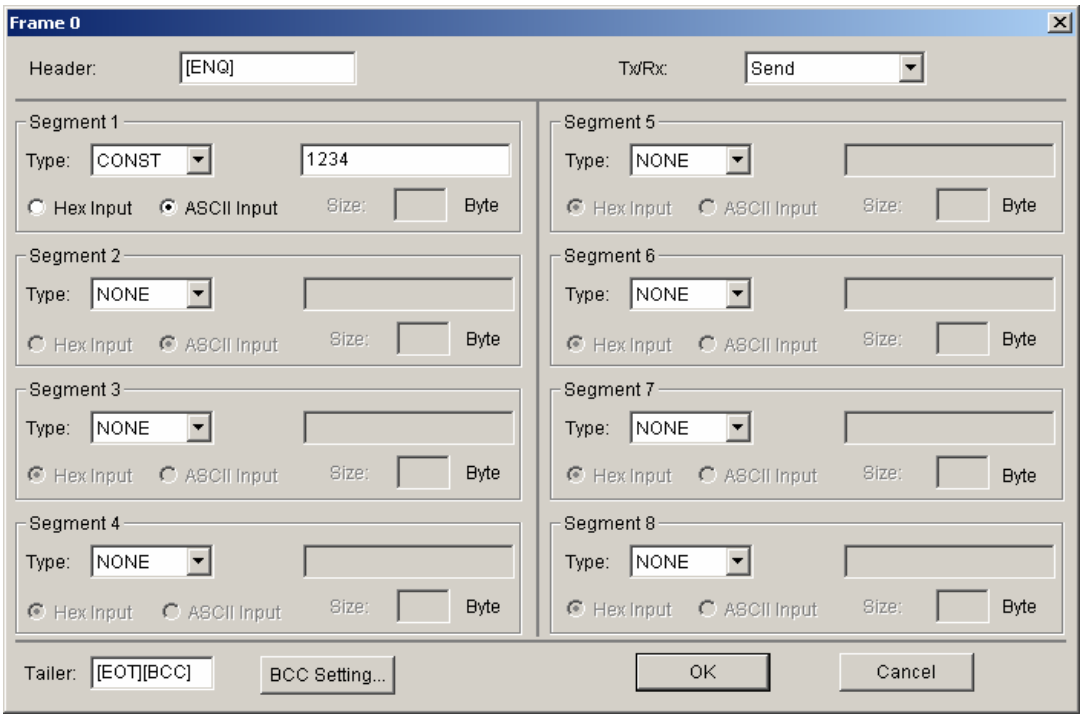
- Frame size

  - ASCII communication: max. 128 bytes

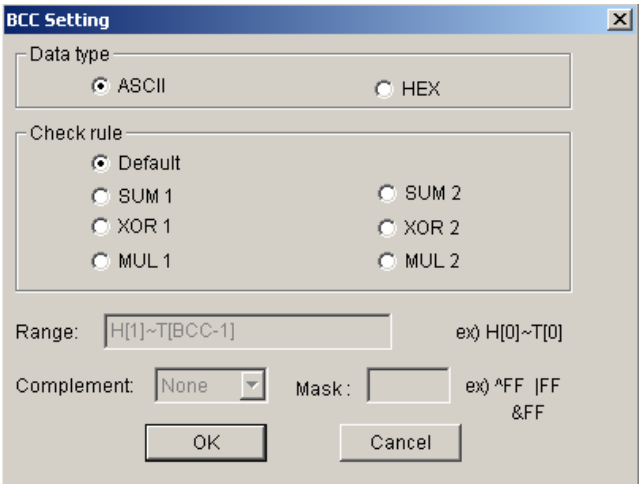
  - Hex communication: max. 256 bytes

- Flag (_RCV [n]: n is a frame list no.)
  - It is a flag to indicate whether a user-defined frame is received in the order set by the user.
  - It is a BOOL type and ARRAY type in the size of 16.
  - If the received frame is matched with the declared frame in frame list number 3, _RCV [3] starts blinking. (0 → 1 → 0)
  - Channel 0 : _RCV[n] (n: frame list number)
  - Channel 1 : _RCV1_422[n] (n: frame list number)

- When frame receiving is done, GM7U main unit check if there's any match between the received frame and the declared frame in frame list. If there is, let the Link relay L(n) flag blink and save the received data in the assigned area.



Example) When frame is set as below, the result of calculation is as follow.



(1) Default setting

The kinds of Input segment	The value of sum check	The last transmitting frame	
		BCC Type setting	
		ASCII Type	Hex Type
ASCII Input	31 + 32 + 33 + 34 + 04 = CE	05 31 32 33 34 04 43 45	05 31 32 33 34 04 CE
Hex Input	12 + 34 + 04 = 4A	05 12 34 04 34 41	05 12 34 04 4A

(2) SUM 1, XOR 1 or MUL 1 setting.

① SUM 1

The kinds of segment input	The value of sum check	The last transmitting frame	
		BCC Type setting	
		ASCII Type	Hex Type
ASCII Input	05 + 31 + 32 + 33 + 34 + 04 = D3	05 31 32 33 34 04 44 33	05 31 32 33 34 04 D3
Hex Input	05 + 12 + 34 + 04 = 4F	05 12 34 04 34 46	05 12 34 04 4F

② XOR 1

The kinds of segment input	The value of sum check	The last transmitting frame	
		BCC Type setting	
		ASCII Type	Hex Type
ASCII Input	05 ^ 31 ^ 32 ^ 33 ^ 34 ^ 04 = 05	05 31 32 33 34 04 30 35	05 31 32 33 34 04 05
Hex Input	05 ^ 12 ^ 34 ^ 04 = 27	05 12 34 04 32 37	05 12 34 04 27

③ MUL 1

The kinds of segment input	The value of sum check	The last transmitting frame	
		BCC Type setting	
		ASCII Type	Hex Type
ASCII Input	05 * 31 * 32 * 33 * 34 * 04 = 60	05 31 32 33 34 04 36 30	05 31 32 33 34 04 60
Hex Input	05 * 12 * 34 * 04 = 20	05 12 34 04 32 30	05 12 34 04 20

④ LRC and CRC check BCC in the same error check method which is provided in the modbus protocol. CRC is used in the HEX communication, and LRC is used in the ASC communication. However, LRC is only used when the number of data is an even number in the check range.

⑤ Complement setting : Complement calculation as below

Example> 1's and 2's complements of D3

1	1	0	1	0	0	1	1	= D3
0	0	1	0	1	1	0	0	= 2C (Complements of 1)
0	0	1	0	1	1	0	1	= 2D (Complements of 2)

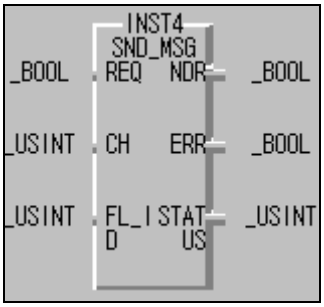
⑥ For SUM2,XOR2,MUL2, mask the above SUM check value (1 byte) and get the SUM Check value.

Example> Masking D3 as FF

1	1	0	1	0	0	1	1	=	D3
1	1	1	1	1	1	1	1	=	FF
1	1	0	1	0	0	1	1	=	D3 (AND Masking)
1	1	1	1	1	1	1	1	=	FF (OR Masking)
0	0	1	0	1	1	0	0	=	2C (Exclusive OR Masking)

8.2.3 Function block

1) User defined function block (SND_MSG)

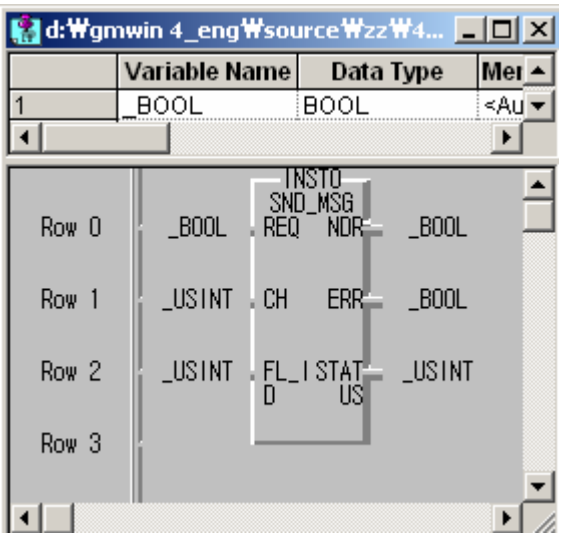
Function block	Description	
	Input	REQ: Execute function block at rising edge (0 → 1) CH: Set communication channel (0 ~ 1) FL_ID: Frame list field number to send. (0 ~ 15)
	Output	NDR: When ends without error, this is set to 1 and keeps till the next request for function block. ERR: When an error occurs, this is set to 1 and keeps till the next request for function block. STATUS: When an error occurs, output error code.

(1) Function

- When the execution condition is on, the communication starts with protocol at parameter which is designated early.
- 'CH' is a communication channel, and 'FL_ID' designates a frame list number which is registered in the user defined communication parameter.

(2) Program example

- When input condition (%MX000) is on, channel 1 starts communication with protocol at user defined parameter number 3.



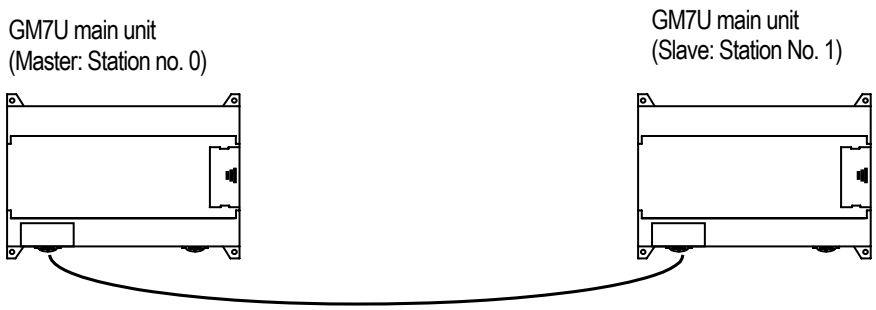
- The communication status is saved in the COM_STAT value, and its type is USINT.
- NDR: When transfer is completed normally, this bit turns on during 1 scan.
- ERR: When communication error occurs, ,this bit turns on.

(3) Error code

Code	Error type	Description
06	Slave Device Busy	It's sending or waiting to receive
09	Parameter Error	Communication parameter setting error, Link enable setting error
10	Frame Type Error	Frame does not setting or frame does not 'sending'

8.2.4 Example

1) System configuration



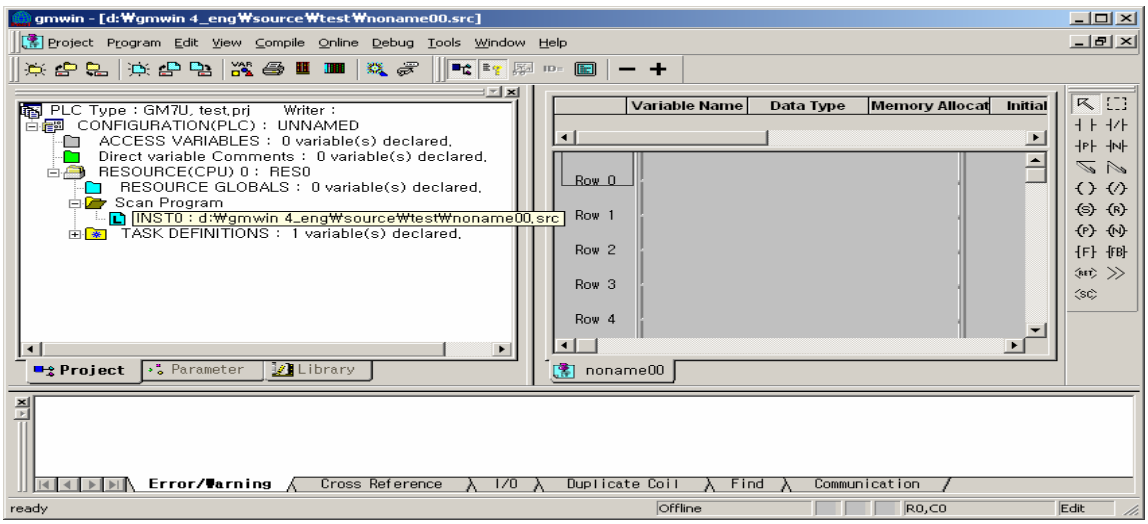
1:1 dedicated protocol communication cable between LSIS'

- This example assumes that there's a communication between LSIS' products by the user-defined protocol. The system configuration is as follows and the cable is the same with the one of 1:1 dedicated protocol communication.
- The data in M area of the master station is sent to the slave station and the slave station saves received data in M area, output as direct variable, and sends the data back to the master. This process repeats between the master and the slave.

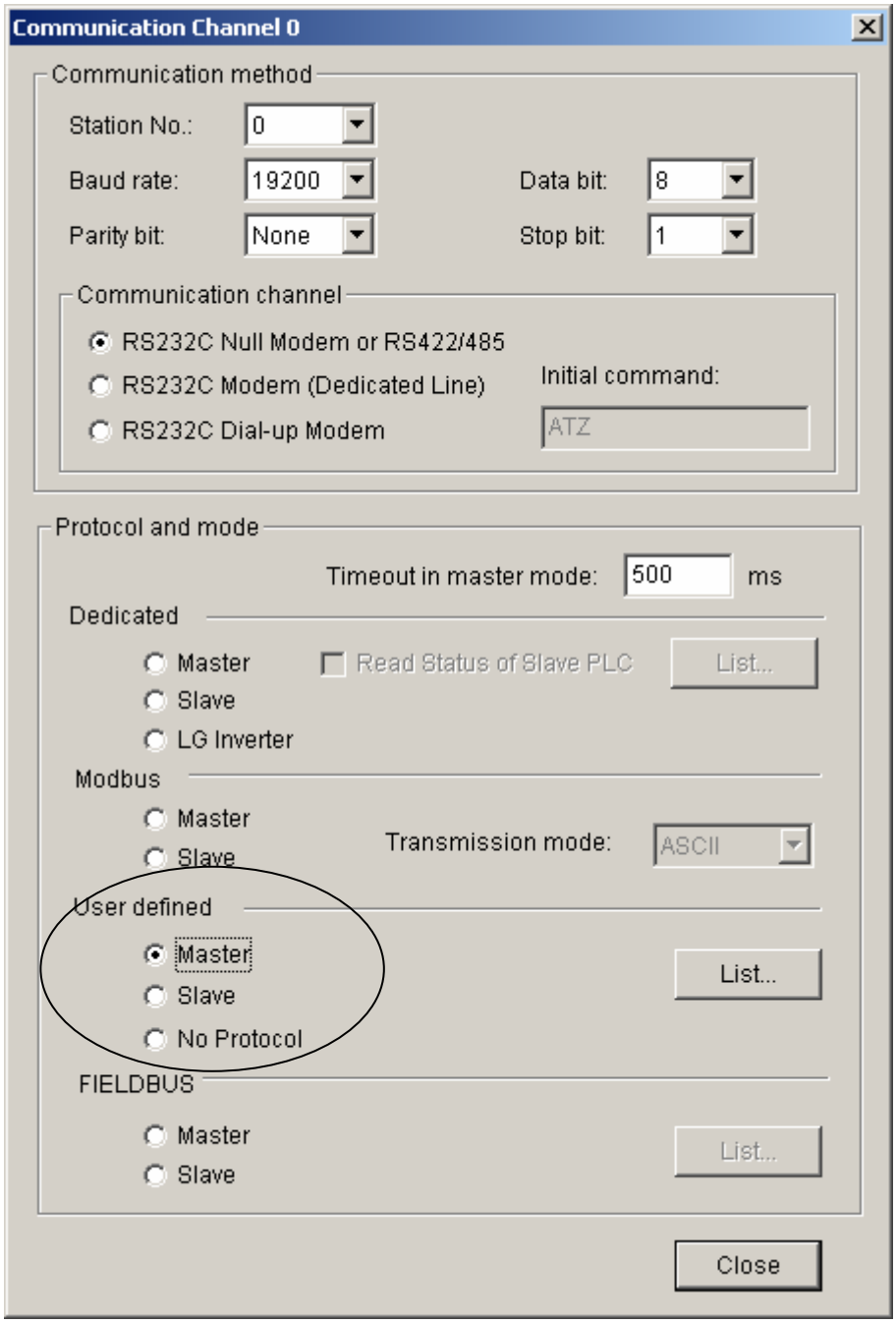
2) Setting master station and program

① Set for master station no.0

② Create a new project file and make a new program for the master station.



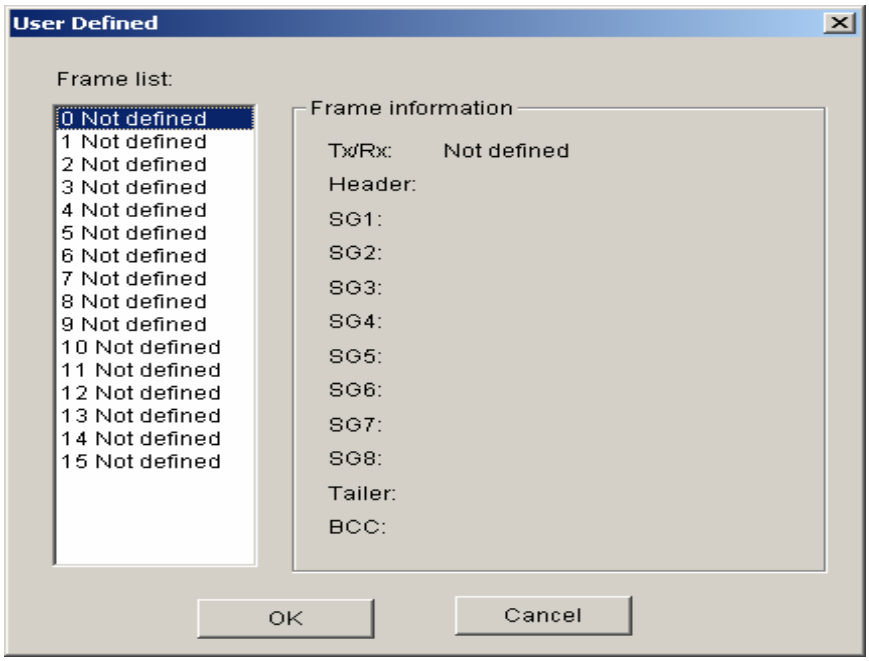
③ Select 'Communication Parameters' in GMWIN parameters.

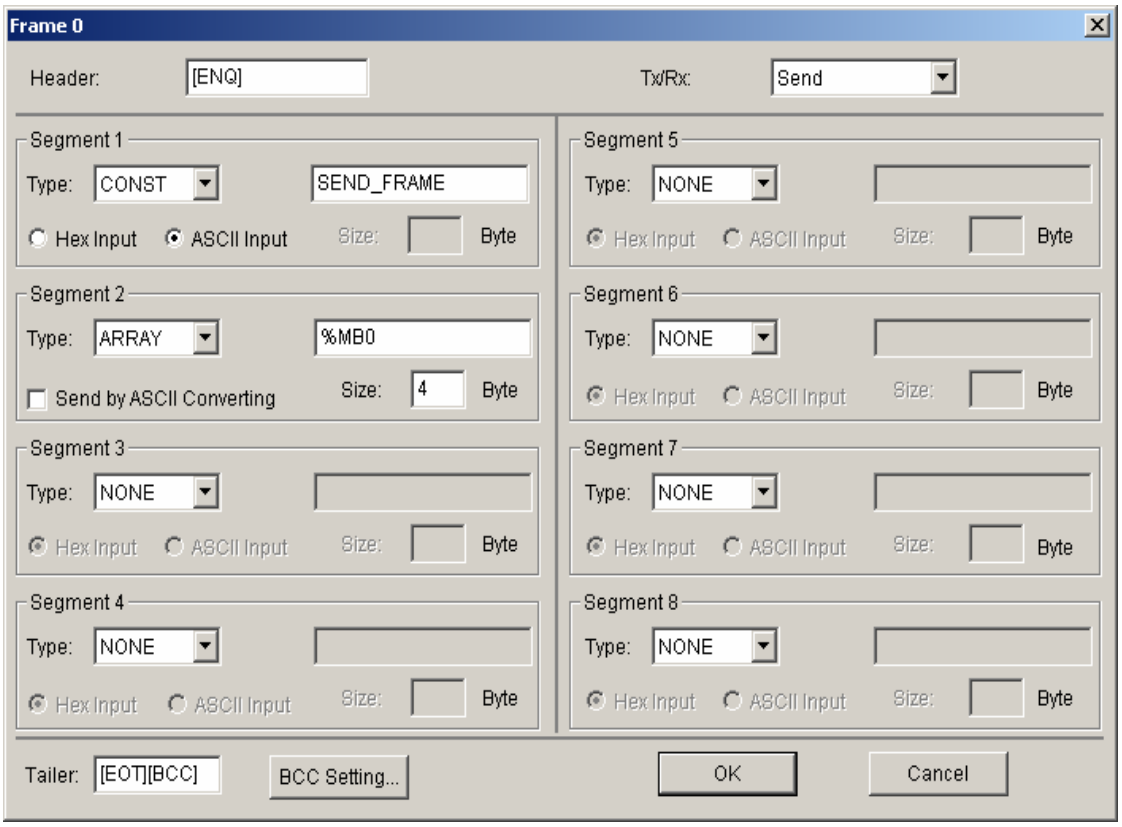


- After communication method and channel setting, select 'Master' at User defined in Protocol and mode.
- Set the parameters according to the following table.

Communication Method						Protocol and Mode
Station no.	Baud rate	Data bit	Parity bit	Stop bit	Communication channel	User defined
0	9600	8	None	1	RS-232C null modem or RS-422/485	Master

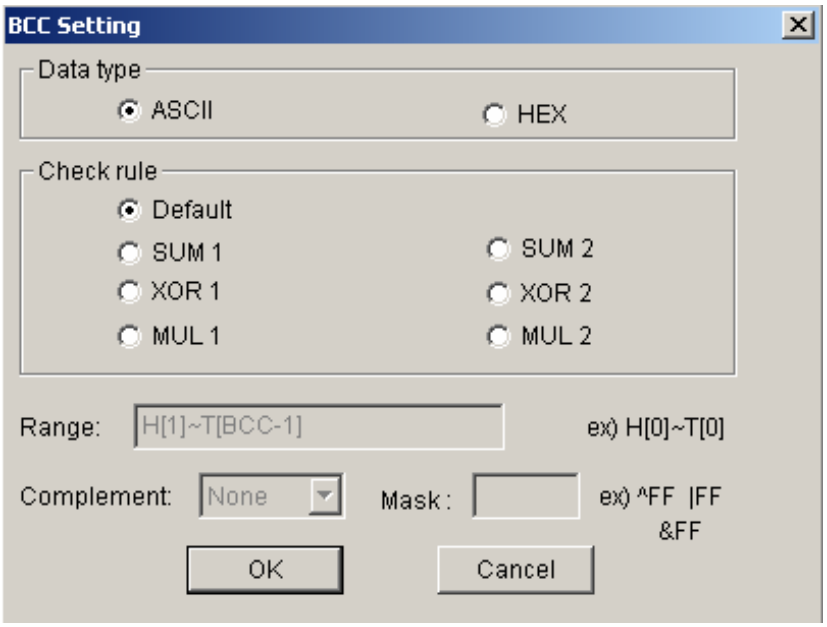
- Select 'Frame 0' to define the Tx frame





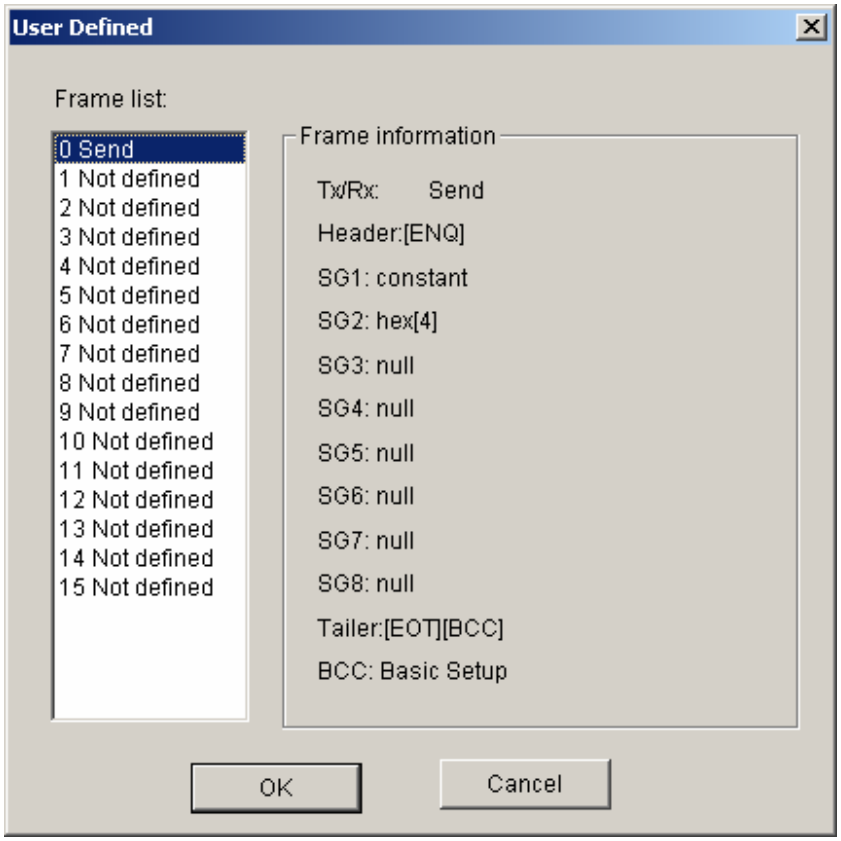
Item	Setting value
Header	[ENQ]
Tx/Rx	Receive
Segment 1	Type: CONST, Field: SND_FRAME
Segment 2	Type: ARRAY, Field: %MB000
Tailer	[EOT][BCC]

- "[BCC]" is set in tail after setting. Click 'BCC Setting' to activate the BCC setting window. Set as follows and click "OK" to close.

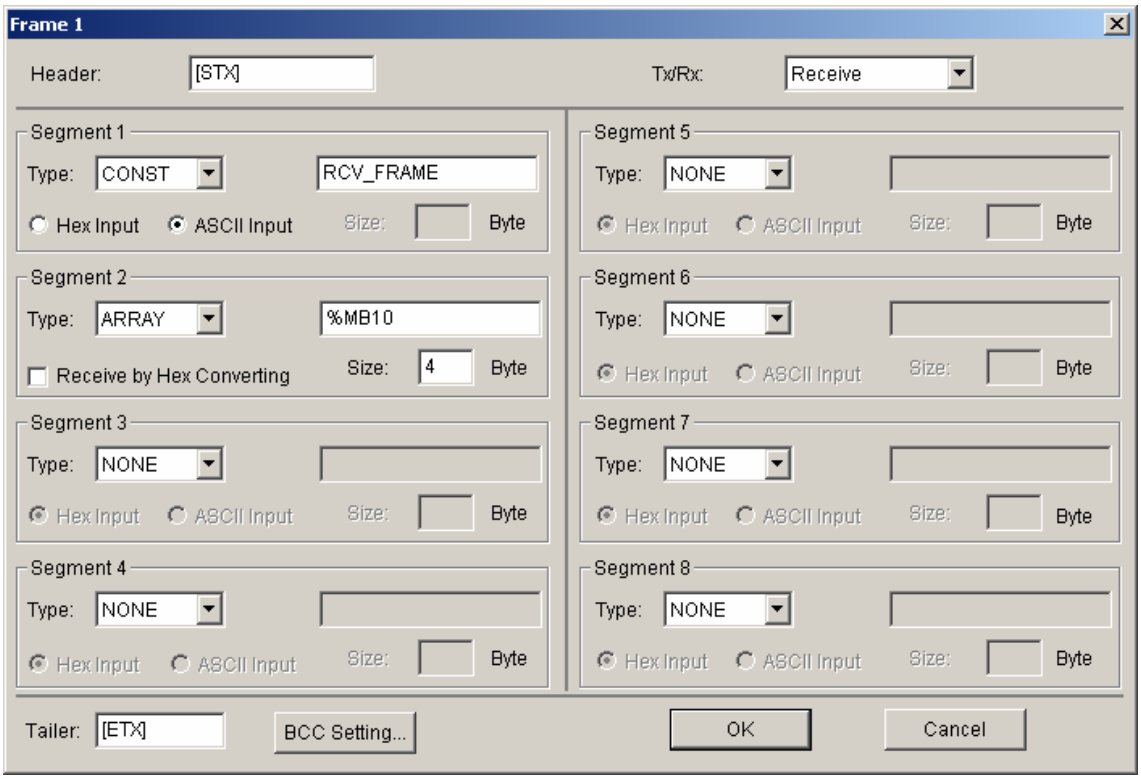


Item	Setting value
Type	ASCII
Check rule	Default

- Click 'OK', and then the following Frame List window is displayed.

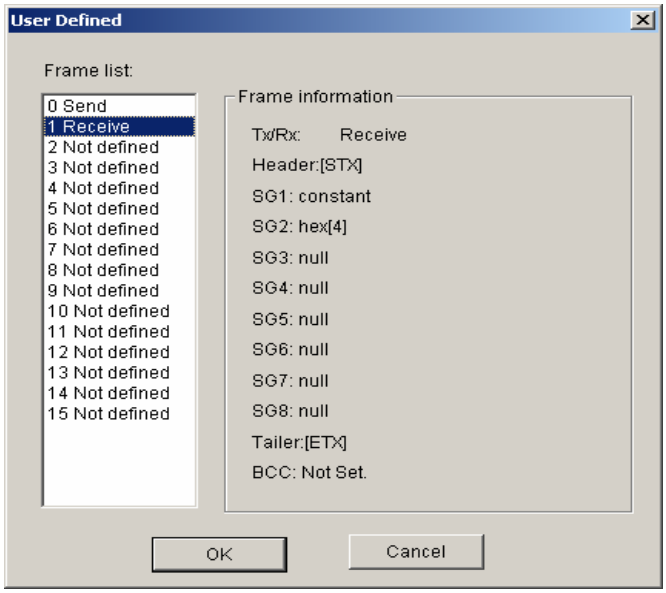


- Click Frame List 1 and set as below.



Item	Setting value
Header	[STX]
Tx/Rx	Receive
Segment 1	Type: CONST, Field: RCV_FRAME, ASCII Input
Segment 2	Type: ARRAY, Field: %MB10, Size: 4 Byte
Tailer	[ETX]

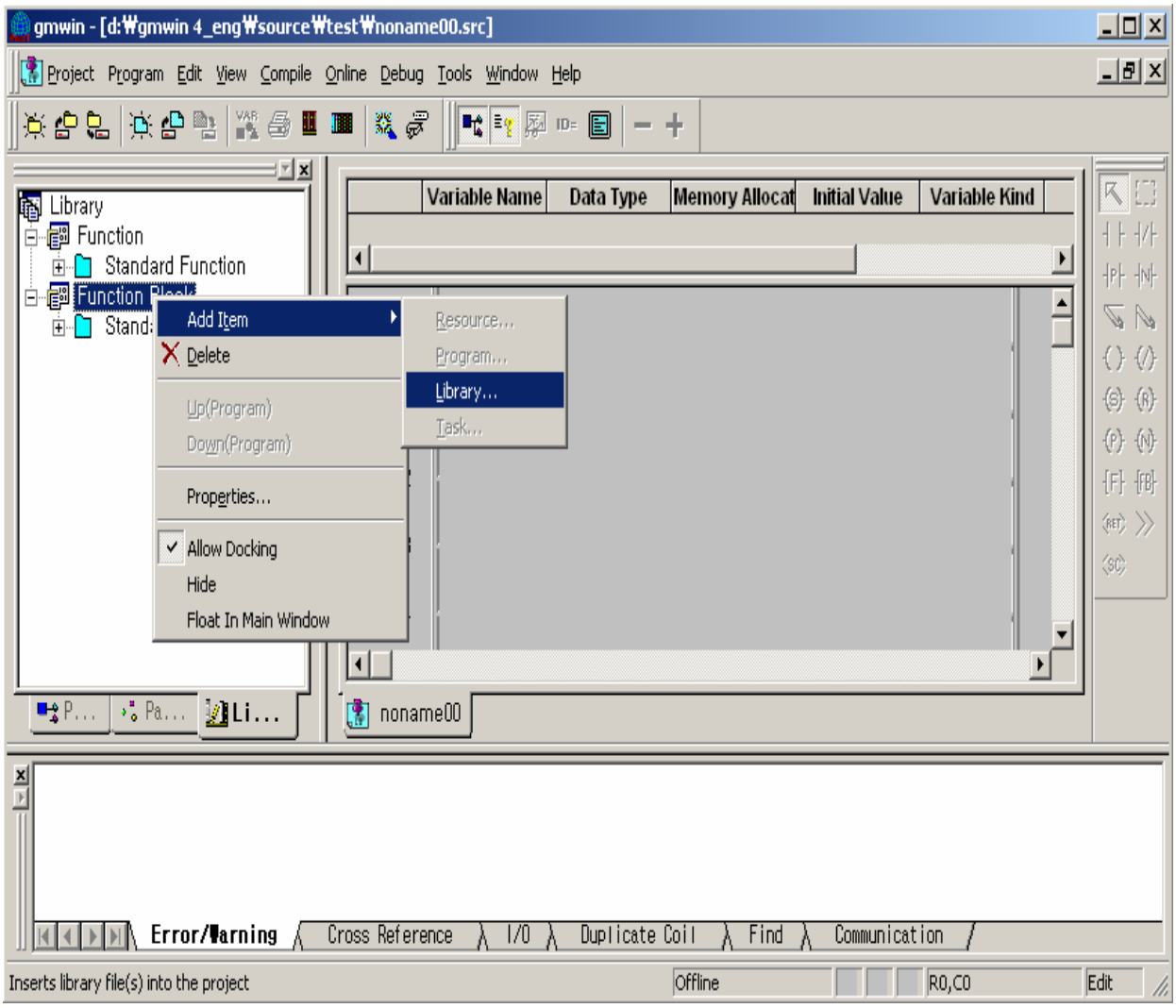
- After the frame setting, click 'OK', and then the frame will be registered as below.

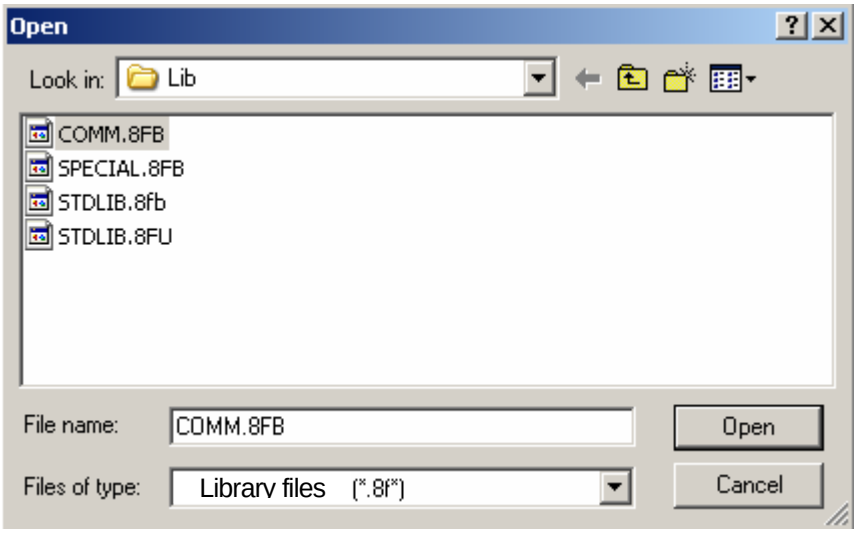


(4) Click 'OK' to exit communication parameter setting and click "OK" to complete setting.

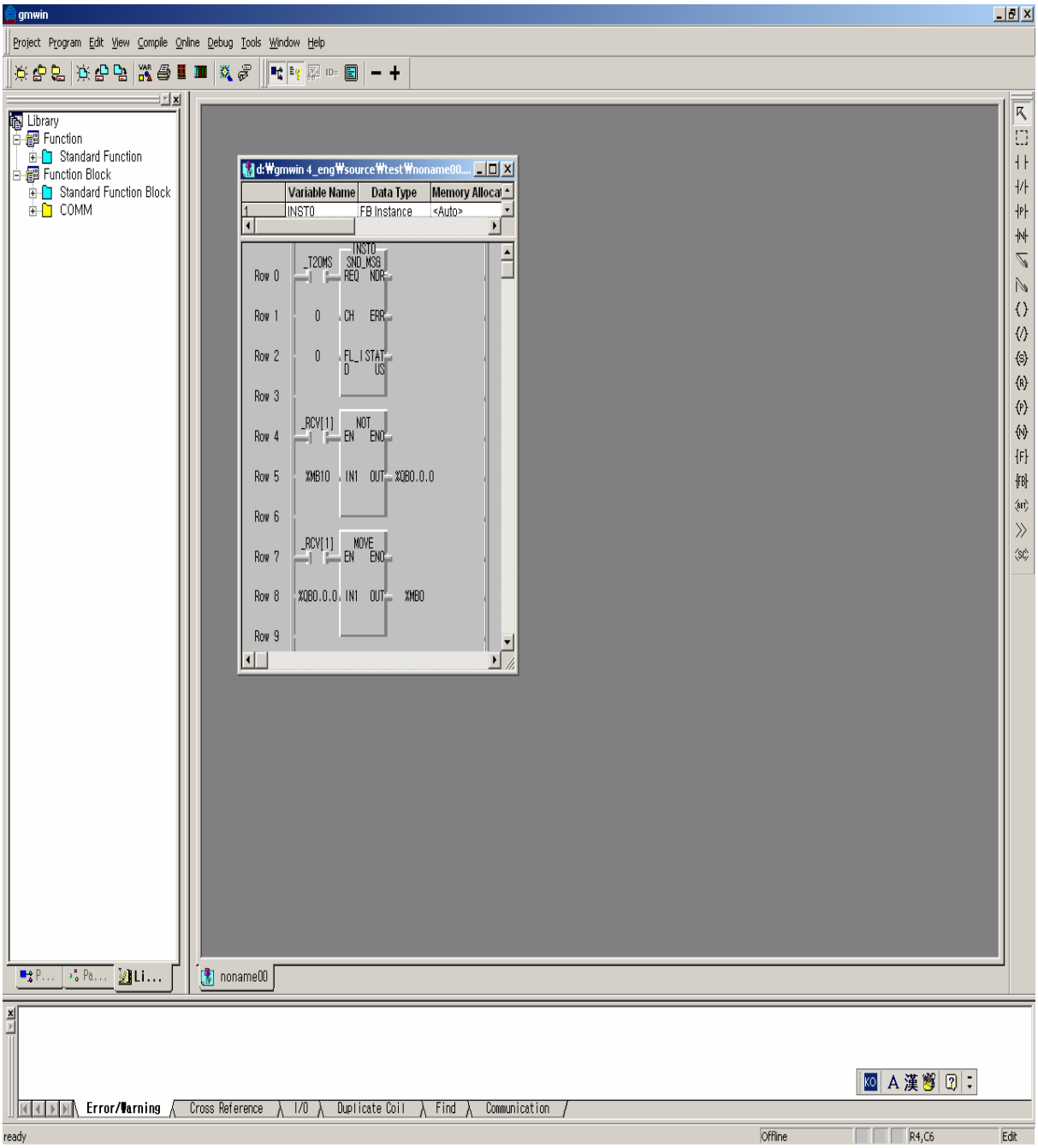
(5) Setup a program like the following figure and download it to the slave station of GM7U. For detailed program setting and downloading information, refer to the GMWIN manual.

- Insert 'Communication Library' (COMM.8FB) at Library window before using the function blocks.





- It sends Frame 0 by operating the function block every 200m.
- Frame 0 sends 4-byte value from %MBO of the master station.
- Frame 1 is saved in %MB10 (refer to frame setting of Frame 1), and the saved %MB10 value is reversed and outputted at %QB0.0.0. The output value of %QB0.0.0 is saved again in %MB0.
- When 8 LED of the master are on, then 8 LED of the slave are off, and vice versa.



- 'Enable Link' must be set for master and slave.

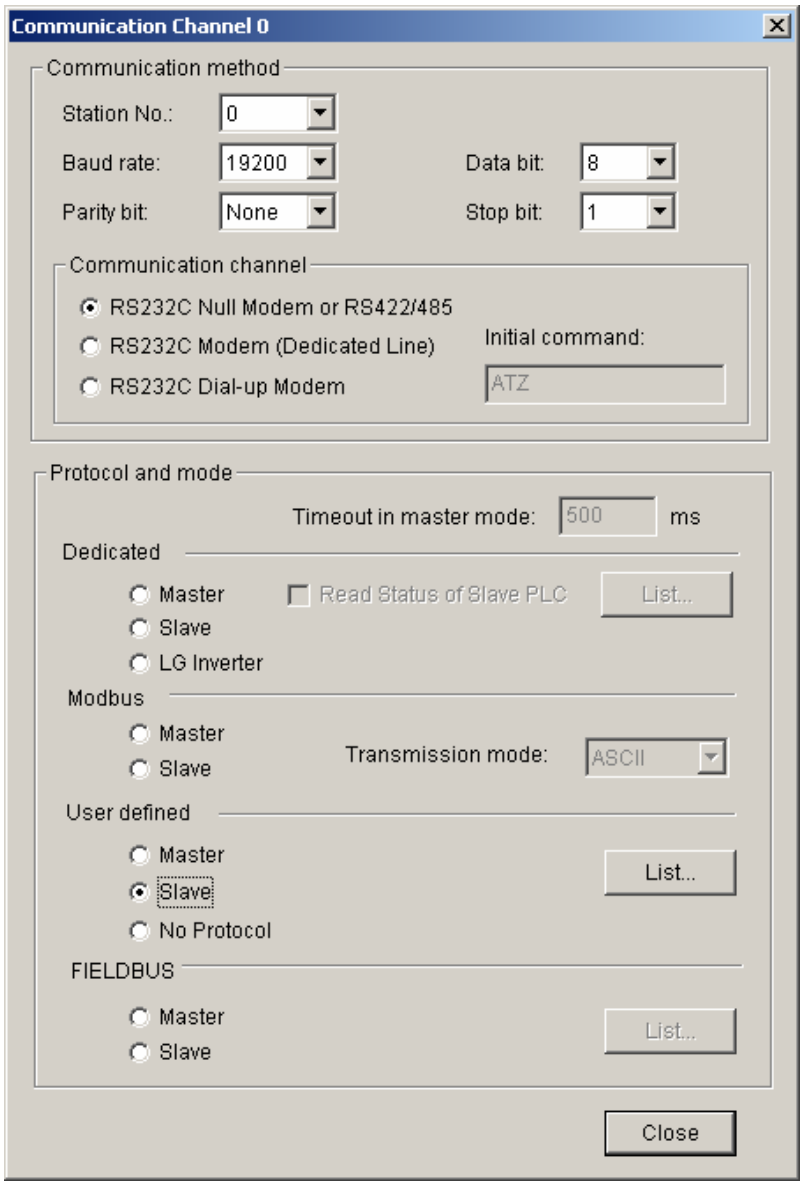
3) Setting slave station and program

(1) Create a new project file and new program.

(2) Set for slave station no.1

(3) Create a new project file and make a new program for the slave station.

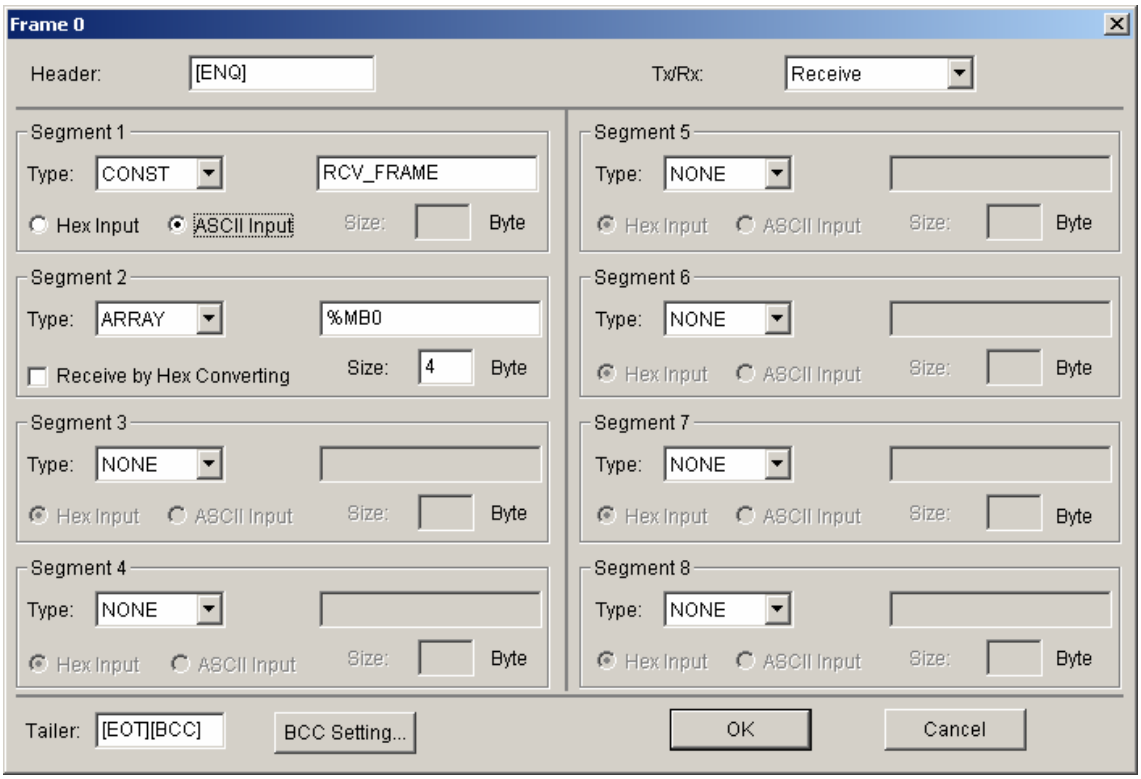
- Click the list after set the communication method and communication channel.



- Set the parameters according to the following table, and click 'OK'.

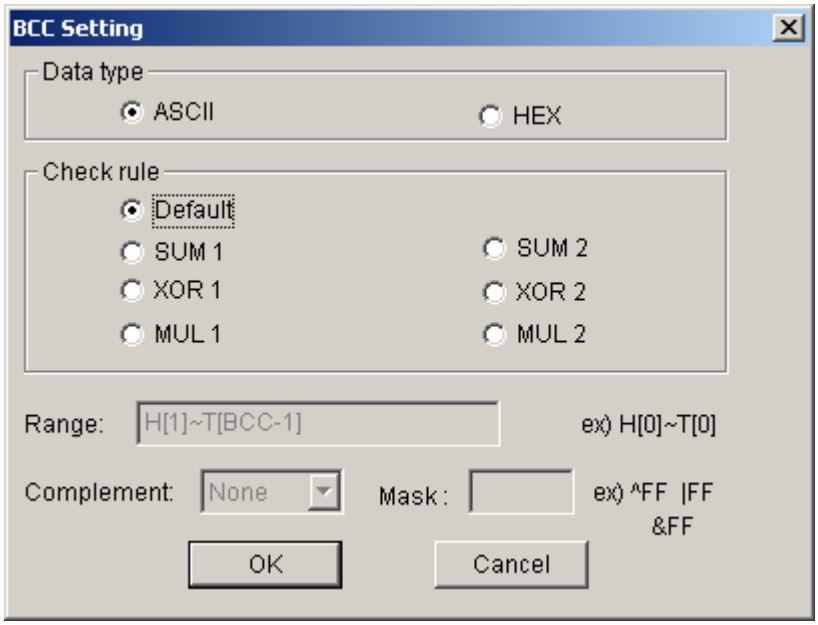
Communication Method						Protocol and Mode
Station No.	Baud Rate	Data Bit	Parity Bit	Stop Bit	Communication Channel	User Defined
1	9600	8	None	1	RS-232C null modem or RS-422/485	Slave

- Click 'Frame 0'.



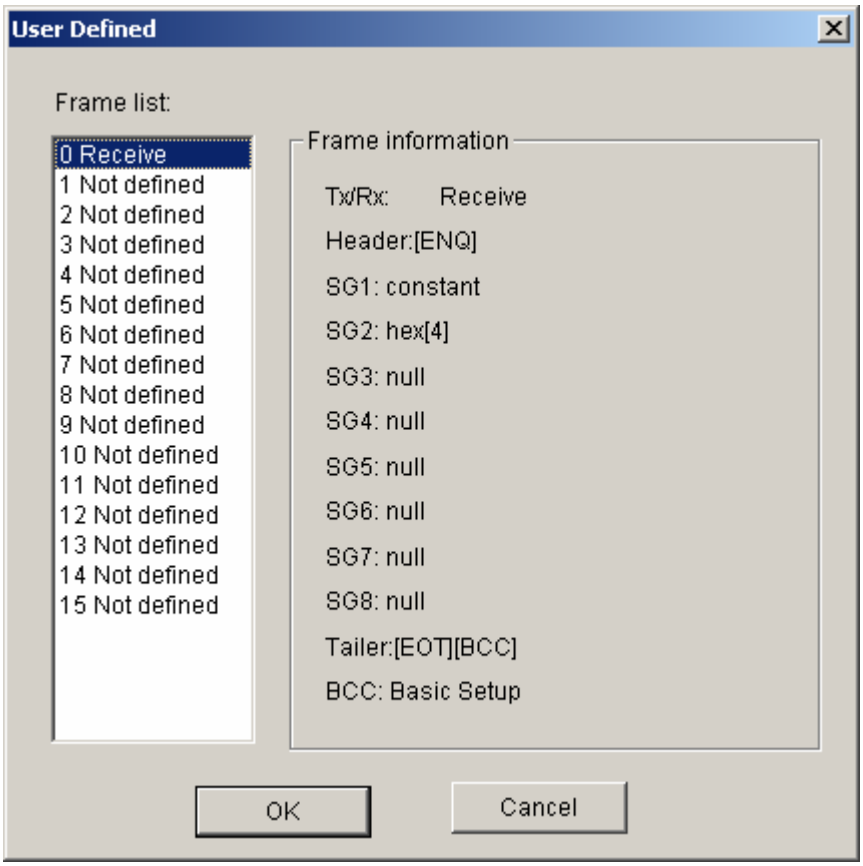
Item	Setting value
Header	[ENQ]
Tx/Rx	Receive
Segment 1	Type: CONST, Field: RCV_FRAME, ASCII Input
Segment 2	Type: ARRAY, Field: %MB0, Size: 4 Byte
Tailer	[EOT][BCC]

(4) "[BCC]" is set in tail after setting, click "BCC Setting" to activate BCC setting window, set as follows and click "OK" to close.

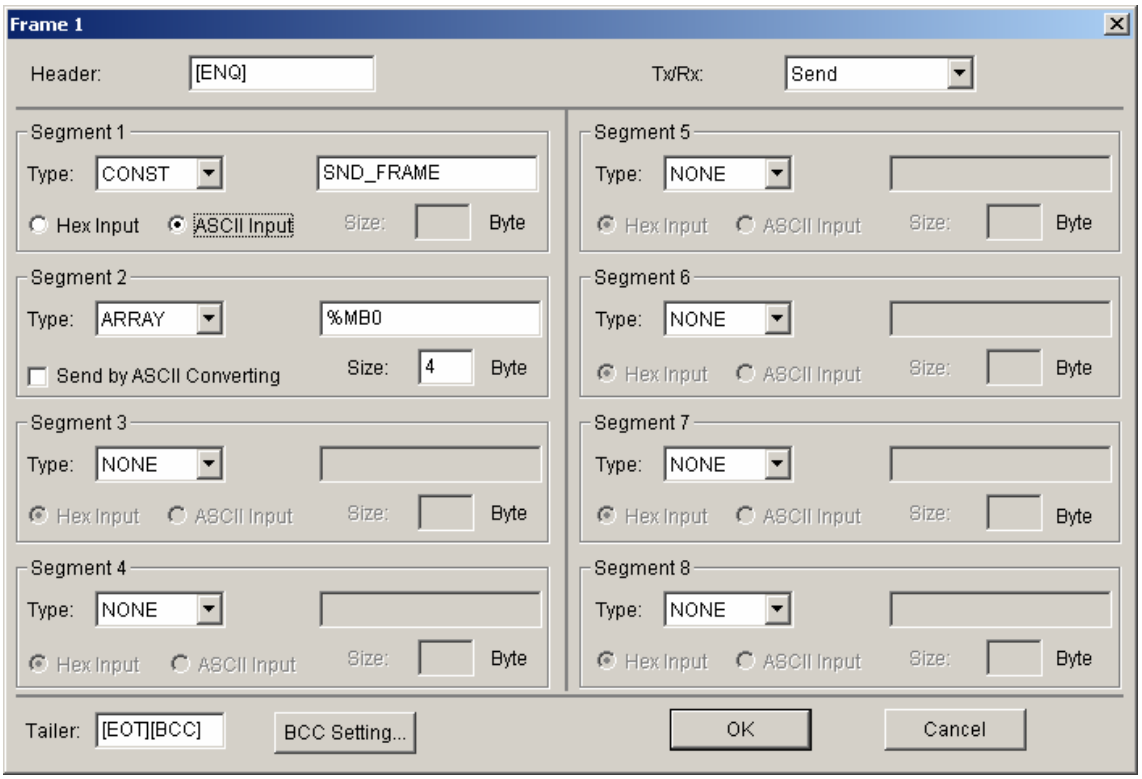


- Click 'OK' to see the Frame List.

.



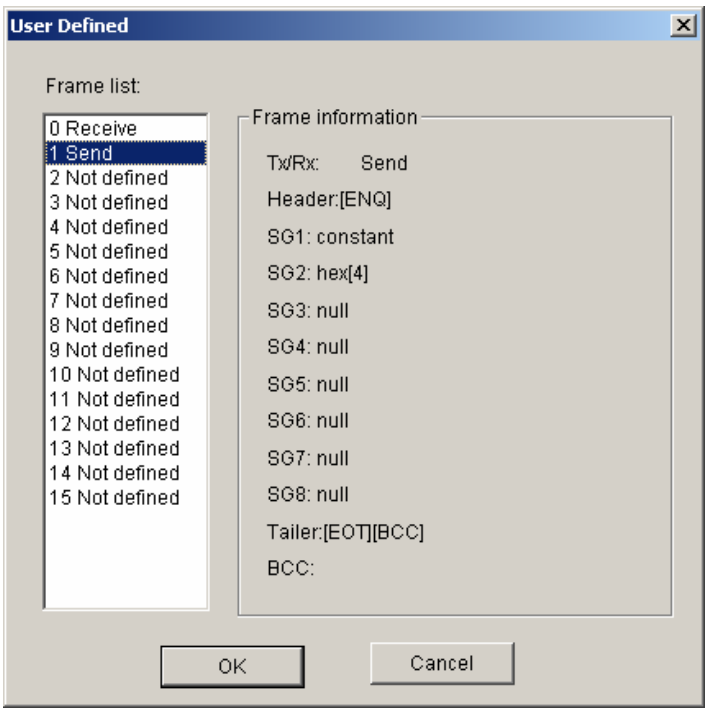
(5) Click Frame List 1 to activate the Frame 1 window and set as follows.



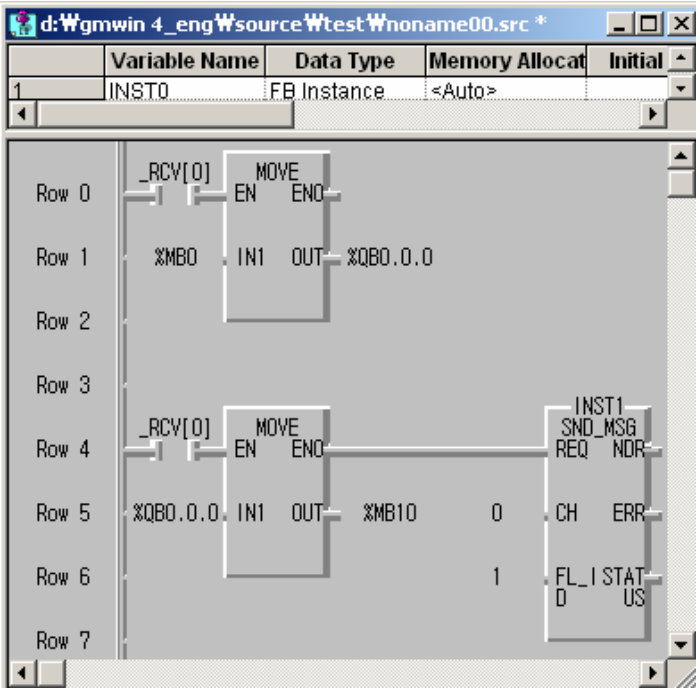
Item	Setting value
Header	[STX]
Tx/Rx	Send
Segment 1	Type: CONST, Field: SND_FRAME, ASCII Input
Segment 2	Type: ARRAY, Field: %MB10, Size: 4 Byte
Tailer	[ETX]

* Set BCC following the master station.

(6) Click 'OK' after frame setting, and then the frame is registered as below.



(7) Set up a program like the following figure and download it to the slave station GM7U. For details on program setting and downloading, refer to the GMWIN manual.



- When Frame 0 is received, it saves the value in %MB0 (refer to frame setting of Frame 1) and outputs the value to %QB0.0.0. The ouputted value of %QB0.0.0 is saved again in %MB10. If the execution is completed without errors, Frame 1 is sent from function block. Frame 1 sends 4-byte data saved in %MB10.
- If Frame 0 which is receiving frame is not received, this program is not executed.
- 'Enable Link' must be set for master and slave.

8.3 Modbus Protocol Communication

8.3.1 Introduction

GM7U built-in communication supports Modbus, the Modicon product's communication protocol. It supports ASCII mode, using ASCII (American Standard Code for Information Interchange) data and RTU (Remote Terminal Unit) mode using Hex data. Function code used in Modbus is supported by function block and especially function code 01, 02, 03, 04, 05, 06, 15, and 16. Refer to "Modicon Modbus Protocol Reference Guide"(http://www.modicon.com/techpubs/toc7.html).

8.3.2 Basic specifications

1) ASCII mode

(1) It communicates, using ASCII data.
(2) Each frame uses ': (colon: H3A)', for header, CRLF (Carriage Return-Line Feed: H0D H0A), for tail.
(3) It allows Max. 1 second interval between characters.
(4) It checks errors, using LRC.
(5) Frame structure (ASCII data)

Item	Header	Address	Function code	Data	LRC	Tail (CR LF)
Size	1 byte	2 bytes	2 bytes	n bytes	2 bytes	2 bytes

2) RTU mode

(1) It communicates, using hex data.
(2) There's no header and tail. It starts with address and finishes frame with CRC.
(3) It has at least 3.5 character times between two frames.
(4) It ignores the current frame when 1.5 character times elapse between characters.
(5) It checks errors, using 16 bit CRC.
(6) Frame structure (hex data).

Item	Address	Function code	Data	CRC
Size	1 byte	1 bytes	n bytes	2 bytes

REMARK

1) The size constituting 1 letter is 1 character. So 1 character is 8 bits that is 1 byte.

2) 1 character time means the time lapsed for sending 1 character.

Ex) 1 character time calculation at 1200 bps

1200 bps means that it takes 1 sec to send 1200 bits. To send 1 bit, 1 sec/1200 bits = 0.83 ms. Therefore 1 character time is 0.83ms * 8 bits = 6.64ms.

3) 584, 984 A/B/X executes frame division, using intervals of more than 1 sec without LRC in processing internally.

3) Address area

(1) Setting range is available from 1 to 247, but GM7U supports from 0 to 31.
(2) Address 0 is used for broadcast address. Broadcast address is all slave devices recognize and respond to like the self-address, which can't be supported by GM7U.

4) Function code area

(1) GM7U supports only 01, 02, 03, 04, 05, 06, 15, and 16 among Modicon products' function codes.
(2) If the response format is confirm+(ACK), it uses the same function code.
(3) If the response format is confirm- (NCK), it returns as it sets the 8th bit of function code as 1.

Ex) If function code is 03, (write only function code part here because only function codes are different.)

[Request]	0000 0011 (16#03)
[Confirm+]	0000 0011 (16#03)
[Confirm-]	1000 0011 (16#83)

It returns as it sets the 8th bit of function code of request frame.

5) Data area

(1) It sends data, using ASCII data (ASCII mode) or hex (RTU mode).
(2) Data is changed according to each function code.
(3) Response frame uses data area as response data or error code.

6) LRC check/CRC check area

(1) LRC (Longitudinal Redundancy Check): It works in ASCII mode. It takes 2 complement from sum of frame except header or tail to change into ASCII code,
(2) CRC (Cyclical Redundancy Check): It works in RTU mode. It uses 2-byte CRC check rules.

REMARK

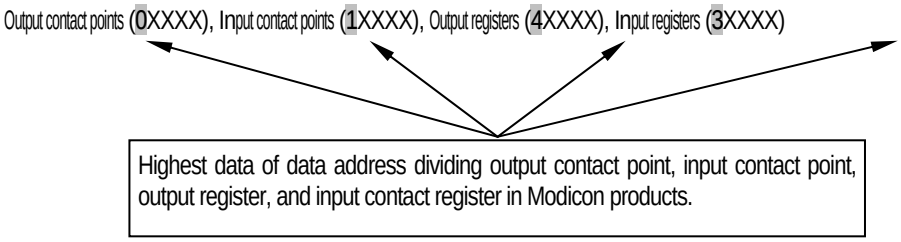
1) All numerical data can use hexadecimal, decimal, and binary type. If we convert decimal 7 and 10 into each type:
Hexadecimal: 16#07, 16#0A
Decimal: 7, 10
Binary: 2#0111, 2#1010

7) Function code types and memory mapping

Code	Function code name	Modicon PLC Data address	GLOFA-mapping	Remark
01	Read Coil Status	0XXXX(bit-output)	%MX0~%MX9999	Read bits
02	Read Input Status	1XXXX(bit-input)	%MX0~%MX9999	Read bits
03	Read Holding Registers	4XXXX(word-output)	%MW0~%MW9999	Read words
04	Read Input Registers	3XXXX(word-input)	%MW0~%MW9999	Read words
05	Force Single Coil	0XXXX(bit-output)	%MX0~%MX9999	Write bit
06	Preset Single Register	4XXXX(word-output)	%MW0~%MW9999	Write word
15	Force Multiple Coils	0XXXX(bit-output)	%MX0~%MX9999	Write bits
16	Preset Multiple Registers	4XXXX(word-output)	%MW0~%MW9999	Write words

8) Modbus addressing rules

GM7U main unit starts its address from 0 and matches with 1 of Modicon products' data address. So GM7U's address, n matches n+1 of Modicon products' address. Also, GM7U main unit has continuous M area without any division of output contact points (0XXXX), input contact points (1XXXX), output registers (4XXXX), input registers (3XXXX). This means that the output contact point 1 (0001) of Modicon products is marked as communication address 0 and the input contact point 1 (0001) of Modicon products is marked as communication address 0 in GM7U.



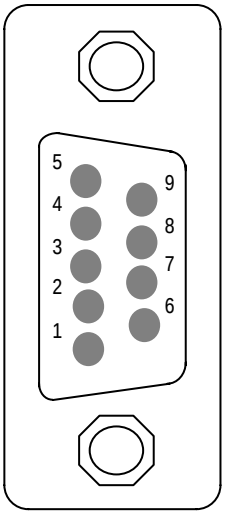
9) The size of the data in use

As for data size, GM7U main unit supports 128 bytes in ASCII mode and 256 bytes in RTU mode. The maximum size of the Modicon products is different from each other kind. So refer to "Modicon Modbus Protocol Reference Guide."

REMARK

1) GM7U main unit doesn't have any division between input and output area like Modicon PLC, when it supports Modbus protocol communication. It uses only M area. So the user must be caution to in set input and output area in M area for Modbus protocol communication.

10) Wiring



Male Type

GM7U main unit Pin no.	Connecting no. and direction	Quantum (9PIN) Pin no.	Signal
1		1	CD
2		2	RXD
3		3	TXD
4		4	DTR
5		5	SG
6		6	DSR
7		7	RTS
8		8	CTS
9		9	

For channel 2, use RS-485 connector.

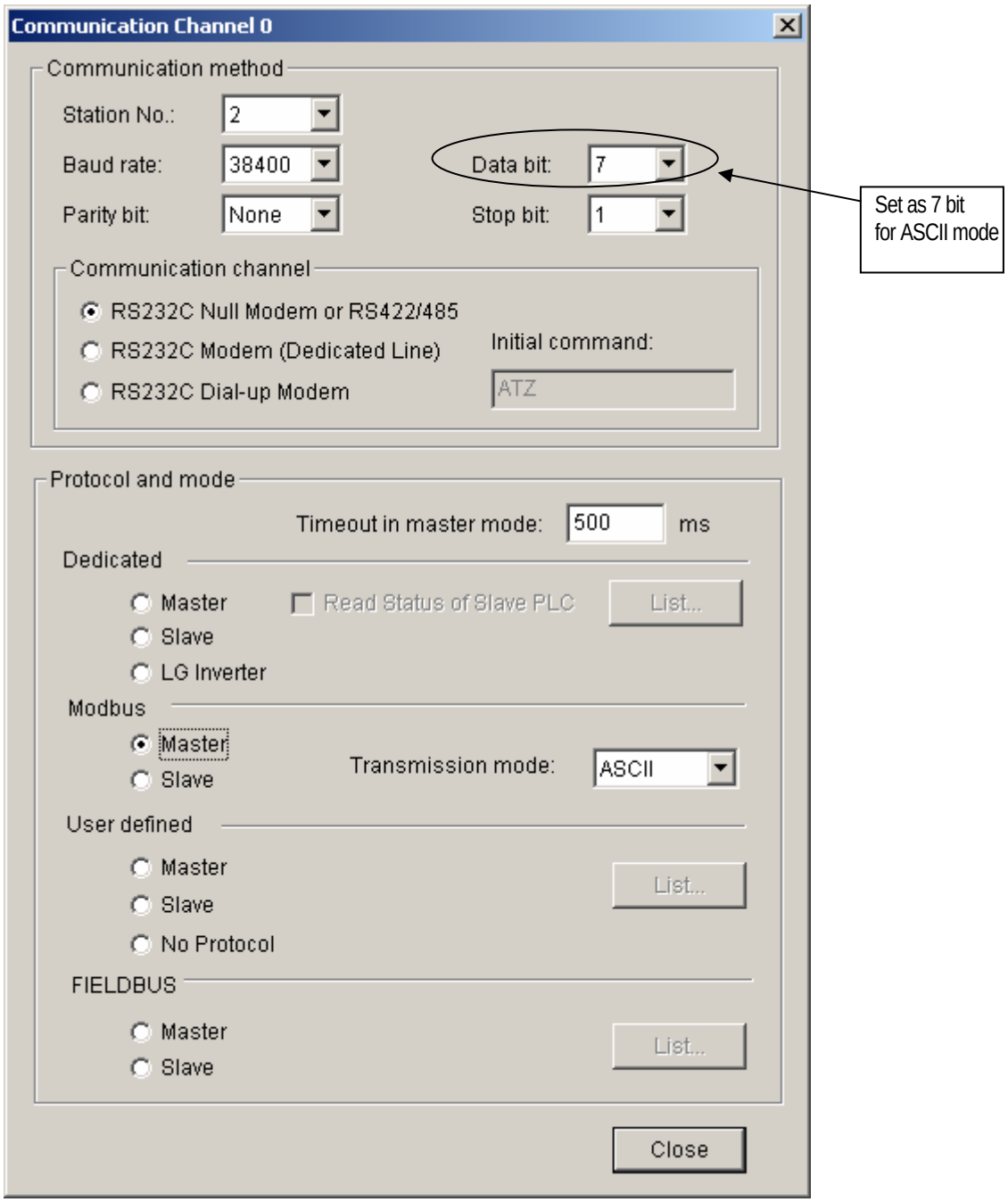
8.3.3 Parameter setting

1) Setting communication parameter

(1) Open a new project file at GMWIN.

- GM7U should be selected in PLC types.
- Open a new project file for each of the master and the slave.

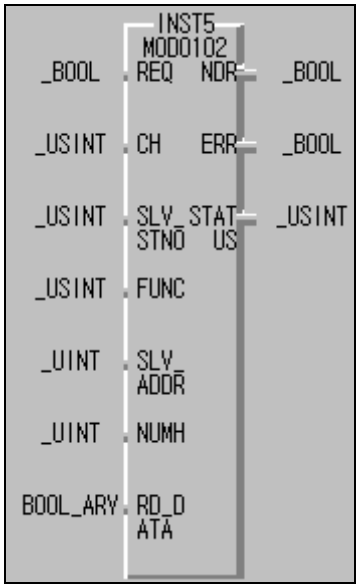
(2) Select a communication parameter at GMWIN and click to open the following window.



Item	Settings
Station No.	Set a number between 1 to 31 (Don't assign no. 0 as broadcasting station lest it may be a cause for mistaken operation)
Baud rate	Set one from 1200, 2400, 4800, 9600, 19200, 38400, or 57600 bps.
Data bit	Set 7 or 8. ASCII mode: Set as 7 bits. RTU mode: Set as 8 bits.
Parity bit	Set as one of None, Even, or Odd.
Stop bit	Set 1 or 2 bit(s). When parity bit is set: Set as 1 bit. When parity bit isn't set: Set as 2 bits.
Communication channel	● RS-232C Null Modem or RS-422/485: It's a communication channel for the communication, using GM7U main unit's built-in communication and Cnet I/F module (G7L-CUEC). ● RS232C Modem (Dedicated Line): It's to be selected for the communication, using an dedicated modem with Cnet I/F module (G7L-CUEB). ● RS232C Dial Up Modem: It's to be selected for the general communication connecting through the telephone line by dial up modem and Cnet I/F module (G7L-CUEB). Footnote) Using Cnet I/F module (G7L-CUEB) supporting RS232C, RS232C dedicated or dial-up modem communication can be done, but not through Cnet I/F module (G7L-CUEC) supporting RS422/485.
Timeout in master mode	● It's the time waiting a responding frame since the master GM7U main unit sends a request frame. ● The default value is 500ms. ● It must be set in consideration of the max. periodical time for sending/receiving of the master PLC. ● If it's set smaller than the max. send/receive periodical time, it may cause communication error.
Modbus Master/ Slave	If it is set as the master, it's the subject in the communication system. If it's set as the slave, it only responds to the request frame of the master.
Transmission mode	Select ASCII mode or RTU mode.

8.3.4 Function block

1) MOD0102

Function block	Description	
	Input	REQ: Execute function block when it's 1(rising edge) CH : Set communication channel (0 ~ 1) SLV_STNO: Input the number of the slave station FUNC: Input the function code. It supports function code 01 and 02 SLV_ADDR: The address to read from the slave station NUMH: The data size to read from the slave station
	Output	RD_DATA: A variable name to save the data that is read (The number of array is to be declared as same as or bigger than data size.). NDR: If it ends without error, output 1 and keep the value till the call for the next function block. ERR: If an error occurs, output 1 and keep the value till the call for the next function block. STATUS: When an error occurs, output an error code.

(1) Function
This is a function block that can execute either function code 01 or 02 for reading bits in Modbus protocol communication. Function code 01 reads Coil Status data and function 02 reads Input Status data.

(2) Error
It outputs error codes to output STATUS. Refer to "Error codes" for the detailed.

(3) Example of the program

- It's supposed that GM7U main unit is the master and it reads Coil Status of the station no. 17, a Modicon product.

- The master reads status of the Coil 00020 ~ 00056 of the slave station no. 17. The Coil of the slave station is supposed to be as follows and the data that are read is saved in any array variable RD_DBD of the 40 sized BOOL type.

Coil	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40
Status	X	X	X	1	1	0	1	1	0	0	0	0	1	1	1	0	1	0	1	1
Hex	1				B				0				E				B			
Coil	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20
Status	0	0	1	0	0	1	1	0	1	0	1	1	1	1	0	0	1	1	0	1
Hex	2				6				B				C				D			

<Data status of the Modicon product's Coil 00020-00059>

- The status of Coil 57, 58, 59 is redundancy.
- Data is sent starting from the low bit by byte unit. If the deficient bit of a byte is filled with 0. An example of sending the above data is as follows.

Ex1) CD 6B B2 0E 1B

Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#0 or 0	Set channel 0
SLV_STNO	16#11 or 17	Slave station
FUNC	16#01 or 1	Enter '1' when the Coil status is being read
SLV_ADDR	16#13 or 19	The start address to read from slave station - Read the no. 19 to read starting from the Coil 00020 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.
NUM	16#25 or 37	The total data size to read - Example is to be read 00020 ~ 00056, of which the total data size is 37. Input 16#25 or 37.

- Results

Variable	Value to save	Variable	Value to save	Variable	Value to save	Variable	Value to save
RD_DB0[0]	1	RD_DB0[10]	0	RD_DB0[20]	1	RD_DB0[30]	0
RD_DB0[1]	0	RD_DB0[11]	1	RD_DB0[21]	1	RD_DB0[31]	0
RD_DB0[2]	1	RD_DB0[12]	0	RD_DB0[22]	0	RD_DB0[32]	1
RD_DB0[3]	1	RD_DB0[13]	1	RD_DB0[23]	1	RD_DB0[33]	1
RD_DB0[4]	0	RD_DB0[14]	1	RD_DB0[24]	0	RD_DB0[34]	0
RD_DB0[5]	0	RD_DB0[15]	0	RD_DB0[25]	1	RD_DB0[35]	1
RD_DB0[6]	1	RD_DB0[16]	0	RD_DB0[26]	1	RD_DB0[36]	1
RD_DB0[7]	1	RD_DB0[17]	1	RD_DB0[27]	1	RD_DB0[37]	X
RD_DB0[8]	1	RD_DB0[18]	0	RD_DB0[28]	0	RD_DB0[38]	X
RD_DB0[9]	1	RD_DB0[19]	0	RD_DB0[29]	0	RD_DB0[39]	X

- The variable to which saves the previously read data must be array type. The size of array type must be the same or bigger than the data size to read. If it's smaller, the error code is marked in STATUS.
- The previously read data is saved from the array variable, RD_DB0[0].
- The remnant part of an array variable is redundancy, after the variable is filled with the previously read data.

- It assumes that GM7U main unit is the master and it reads Input Status of the station no. 17, a Modicon product.

- The master reads status of the Input 10197 ~ 10218 of the slave station no. 17. The Input of the slave station is supposed to be as follows and the data that are previously read is saved in any array variable RD_DB1 of the 24-sized BOOL type.

Input	10220	10219	10218	10217	10216	10215	10214	10213	10212	10211	10210	10209
Status	X	X	1	1	0	1	0	1	1	1	0	1
Hex	3				5				D			
Input	10208	10207	10206	10205	10204	10203	10202	10201	10200	10199	10198	10197
Status	1	0	1	1	1	0	1	0	1	1	0	0
Hex	B				A				C			

- Input coil 10219, 10220 are redundancy.
- Data is sent starting from the low bit by byte unit. If the deficient bit of a byte is filled with 0. An example of sending the above data is as follows.

  Ex1) AC DB 35

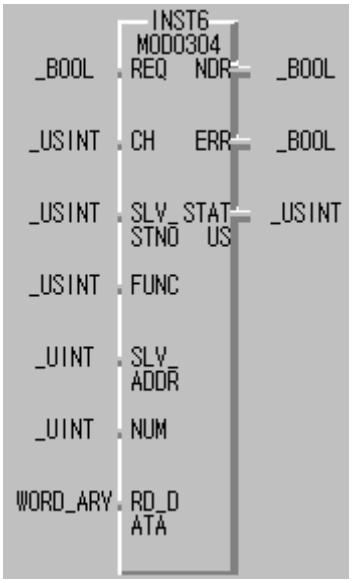
Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#1 or 1	Set channel 1
SLV_STNO	16#11 or 17	Slave station
FUNC	16#02 or 2	Enter '2' when the Coil status is being read
SLV_ADDR	16#C4 or 196	The start address to read from slave station - Read the no. 196 to read starting from the Coil 10197 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.
NUM	16#16 or 22	The total data size to read - Example is to be read 10197 ~ 10218, of which the total data size is 22. Input 16#16 or 22.

- Results

Variable	Value to save	Variable	Value to save	Variable	Value to save	Variable	Value to save
RD_DB1[0]	0	RD_DB1[6]	0	RD_DB1[12]	1	RD_DB1[18]	1
RD_DB1[1]	0	RD_DB1[7]	1	RD_DB1[13]	0	RD_DB1[19]	0
RD_DB1[2]	1	RD_DB1[8]	1	RD_DB1[14]	1	RD_DB1[20]	1
RD_DB1[3]	1	RD_DB1[9]	1	RD_DB1[15]	1	RD_DB1[21]	1
RD_DB1[4]	0	RD_DB1[10]	0	RD_DB1[16]	1	RD_DB1[22]	X
RD_DB1[5]	1	RD_DB1[11]	1	RD_DB1[17]	0	RD_DB1[23]	X

- The variable which saves the read data must be array type. The size of array type must be the same or bigger than the size of the data of read. If it's smaller, the error code is marked in STATUS.
- The previously read data is saved from the array variable, RD_DB1[0].
- The remnant part of an array variable is redundancy, after the variable is filled with the previously read data.

2) MOD0304

Function block	Description	
	Input	REQ: Execute function block when it's 1(rising edge) CH : Set communication channel (0 ~ 1) SLV_STNO: Input the number of the slave station FUNC: Input the function code. It supports function code 03 and 04 SLV_ADDR: The address to read from the slave station NUM: The data size to read from the slave station
	Output	RD_DATA: A variable name to save the data that is read (The number of array is to be declared as same as or bigger than data size.). NDR: If it ends without error, output 1 and keep the value till the call for the next function block. ERR: If an error occurs, output 1 and keep the value till the call for the next function block. STATUS: When an error occurs, output an error code.

(1) Function

This is a function block that can execute either function code 03 or 04 for reading words in Modbus protocol communication. Function code 03 reads Holding Registers and function 04 reads Input Registers.

(2) Error

It outputs error codes to output STATUS. Refer to "Error codes" for the detailed.

(3) Example of the program

- It assumes that GM7U main unit is the master and it reads the station no. 17 of a Modicon product.
- The master reads the Holding Registers 40108 ~ 40110 of the slave station no. 17. The status of the Holding Registers of the slave station is supposed to be as follows and the previously read data are saved in any array variable RD_DWO of the 40-sized WORD type.

Holding Registers	40110	40109	40108
Register status	16#0064	16#0000	16#022B

- Data is sent starting from the high byte by byte unit. An example of sending the above data is as follows.

Ex1) 02 2B 00 00 00 64

Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#0 or 0	Set channel (0, 1)
SLV_STNO	16#11 or 17	Slave station
FUNC	16#03 or 3	Enter '3' when the output register is being read
SLV_ADDR	16#6B or 107	The start address to read from slave station - Read the no. 107 to read starting from the output register 40108 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.
NUM	16#03 or 3	The total data size to read - Example is to be read 40108 ~ 40110, of which the total data size is 3. Input 16#03 or 3.

- Result

Variable	Value to save
RD_DW0 [0]	16#002B or 555
RD_DW0 [1]	16#0000 or 0
RD_DW0 [2]	16#0064 or 100
RD_DW0 [3]	X

- The variable to which saves the previously read data must be array type. The size of array type must be the same or bigger than the size of the data of read. If it's smaller, the error code is marked in STATUS.
- The previously read data is saved from the array variable, RD_DW0 [0].
- The remnant part of an array variable is redundancy, after the variable is filled with the previously read data.

- It's supposed that GM7U main unit is the master and it reads output coil data of the station no. 17, a Modicon product.

- The master reads status of the input registers 30009 of the slave station no. 17. The input coil of the slave station is supposed to be as follows and the data that are read is saved in any array variable RD_DW1 of the 2-sized WORD type.

Input Register	30009
Register status	16#000A

- Data is sent starting from the low bit by byte unit. An example of sending the above data is as follows.

Ex1) 00 0A

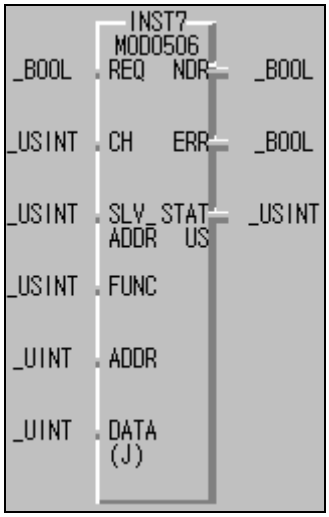
Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#1 or 1	Set channel (0, 1)
SLV_STNO	16#11 or 17	Slave station
FUNC	16#04 or 4	Enter '4' when the output register is being read
SLV_ADDR	16#08 or 8	The start address to read from slave station - Read the no. 8 to read starting from the output register 30009 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.
NUM	16#01 or 1	The total data size to read - Example is to be read 30009, of which the total data size is 1. 1 is 16#0001 in hex, so input 16#01.

- Results

Variable	Value to save
RD_DW1 [0]	16#000A or 10
RD_DW1 [1]	X

- The variable to which saves the previously read data must be array type. The size of array type must be the same or bigger than the size of the data of read. If it's smaller, the error code is marked in STATUS.
- The previously read data is saved from the array variable, RD_DW1[0].
- The remnant part of an array variable is redundancy, after the variable is filled with the previously read data.

3) MOD0506

Function block	Description	
	Input	REQ: Execute function block when it's 1(rising edge) CH : Set communication channel (0 ~ 1) SLV_ADDR: Input the number of the slave station FUNC: Input the function code. It supports function code 05 and 06 ADDR: The starting address to read from the slave station
	Output	DATA (J): A variable name to save the data to write. NDR: If it ends without error, output 1 and keep the value till the call for the next function block. ERR: If an error occurs, output 1 and keep the value till the call for the next function block. STATUS: When an error occurs, output an error code.

(1) Function

This is a function block that can execute either function code 05 or 06 for writing 1 bit (function code 05) and writing 1 word (function code 06) in Modbus protocol communication. Function code 05 does 1 bit data writing on the Output Coil. If the Input NUMH is set as 255 (or HFF), it writes 1 on the output coil. If the Input NUMH is set as 0 (or 16#00), it writes 0 on the output coil. And function 06 writes 1 word data on the Output Holding Register.

(2) Error

It outputs error codes to output STATUS. Refer to "Error codes" for the detailed.

(3) An example of the program

- It assumes that GM7U main unit is the master and it writes 1 bit data on the Coil of the station no. 17, a Modicon product.
- The master writes 1 on the Coil 00173 of the slave station no. 17, a Modicon product.

Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#0 or 0	Set channel (0, 1)
SLV_ADDR	16#11 or 17	Slave station
FUNC	16#05 or 5	Enter '5' as writes 1 bit on the Coil.
ADDR	16#AC or 172	Low byte of the starting addresses to write on the slave station. Write on the no. 172 to write on, starting from the output coil 00173 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.

- Result: The Coil 00173 turns ON. (In case of GM7U main unit, 1 is saved on the related M area.)

Coil	00173
Status	1

- It assumes that GM7U main unit is the master and it writes on 1 word at Holding Register of the station no. 17, a Modicon product.

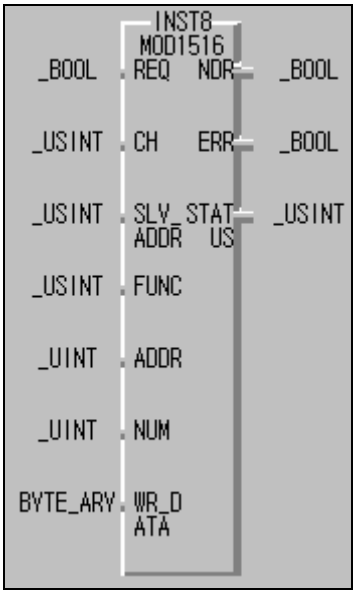
- An example of writing 3 on Holding Register 4002 of the station no. 17.

Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#1 or 1	Set channel (0, 1)
SLV_ADDR	16#11 or 17	Slave station
FUNC	16#06 or 6	Enter '6' as writes 1 word on the Holding Register.
ADDR	16#0001 or 1	Set the starting address to write on the slave station – Write on no. 1 to write on, starting from the Holding Register 40002 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.
NUM	16#03 or 3	Set the number of data to write on the slave station.. – As the example writes 3, of which hex is 16#0003. So input 16#03 for NUM

- Result: The Holding Register 40002 is saved on 16#0003. (In case of GM7U main unit, 16#0003 is saved on a related M area.)

Holding Register	40002
Register status	16#0003

4) MOD1516

Function block	Description	
	Input	REQ: Execute function block when it's 1(rising edge) CH : Set communication channel (0 ~ 1) SLV_ADDR: Input the number of the slave station FUNC: Input the function code. It supports function code 15 and 16 ADDR: The starting address to read from the slave station NUM: The data size to read from the slave station
	Output	WD_DATA: A variable name to save the data to be written. NDR: If it ends without error, output 1 and keep the value till the call for the next function block. ERR: If an error occurs, output 1 and keep the value till the call for the next function block. STATUS: When an error occurs, output an error code.

(1) Function
This is a function block that can execute either function code 15 or 16 for writing 1 bit (function code 15) and writing 1 word (function code 16) in Modbus protocol communication. Function code 15 does 1 bit by 1 bit data writing on each Coil in a sequence Coils. And Function 16 does 1 word by 1 word data writing on sequence of the Holding Registers.

(2) Error
It outputs error codes to output STATUS. Refer to "Error codes" for the detailed.

(3) Example of the program

- It's supposed that GM7U main unit is the master and it writes bits continually on the output coil of the station no. 17, a Modicon product.

- The master writes continual 10 bits, 01110011011 on the Coils 00020 of the slave station no. 17 1 bit by 1 bit. The data that is to be written are saved in any array variable WR_DB0 of the 2 sized BYTE type.

Variable	Value to save
WR_DB0 [0]	2#11001101 or 16#CD
WR_DB0 [1]	2#10000001 or 16#81

- The size of BYTE_CNT is the same as when the data to be written are converted by byte. The above data are 10 by 1 bit. They can't be filled by 1 byte. So they must be filled from the low bit, using 2 bytes. And 0 fills the remnant 6 bits. Therefore the size of BYTE_CNT is 2.
- f it is supposed that data of 1000 0001 1100 1101 are saved in the array variable, WR_DB0, the data are sent as 10 bits (01 1100 1101) at the bottom plus 6 bit of 0 at the top. For the size of the data is set as 10 bits to send and they are sent by bytes, the deficient 6 bits are filled with 0.
- Data is sent starting from the low bit by byte unit. An example of sending the above data is as follows.

Ex1) CD 01

Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#0 or 0	Set channel (0, 1)
SLV_ADDR	16#11 or 17	Slave station
FUNC	16#0F or 15	Enter '15' as bits are continually written on the output coils.
ADDR	16#13 or 19	Set the starting address to write on the slave station – Write on no. 19, starting from Holding Register 00020 in accordance with the previous no. 8) "Modbus addressing rules." The highest data of the data address doesn't need to be input., because it's automatically processed by the input value in the input FUNC of the function block.
NUM	16#0A or 10	Set the number of data to write on the slave station.. – Example is to be read from 00020, of which the total data size is 10. Input 16#0A.

- Result
  From the 2 bytes (16 bits) sent, only the low 10 bits are valid as set for its size.

Coil	00029	00028	00027	00026	00025	00024	00023	00022	00021	00020
Status	0	1	1	1	0	0	1	1	0	1

- It's supposed that GM7U main unit is the master and it writes word data continually on the Holding Registers of the station no. 17, a Modicon product.

- The master writes 000A and 0102 on the Holding Registers 40002 of the slave station no. 17. The data that is to be written are saved in any array variable WR_DB1 of the 4 sized BYTE type.

Variable	Value to save
WR_DB1 [0]	2#00001010 or 16#0A
WR_DB1 [1]	2#00000000 or 16#00
WR_DB1 [2]	2#00000010 or 16#02
WR_DB1 [3]	2#00000001 or 16#01

- The size of BYTE_CNT is the same as when the data to be written are converted by byte. The above data are 2 words that need 4 bytes. Therefore the size of BYTE_CNT is 4.
- Data is sent starting from the low word by byte unit. An example of sending the above data is as follows.

Ex1) 00 0A 01 02

Function block input	Input value	
REQ	Enter the input condition to operate	
CH	16#1 or 1	Set channel (0, 1)
SLV_ADDR	16#11 or 17	Slave station
FUNC	16#10 or 16	Enter '16' as bits are continually written on the Holding Register.
ADDR	16#01 or 1	Set the starting address to write on the slave station – Write on no. 1 to write on, starting from the Holding Register 40002 in accordance with the previous no. 8) "Modbus addressing rules." And the highest data of the data address doesn't need to be input. Because it's automatically processed by the input value of the input FUNC of the function block.
NUM	16#02 or 2	Set the number of data to write on the slave station.. – As the example writes 2, of which hex is 16#0002. Input 16#02 for NUM.

- Result

Holding Registers	40003	40002
Registers status	16#0102	16#000A

5) Error codes

CODE	Error type	Meaning
01	Illegal Function	Error in inputting function code in function block.
02	Illegal Address	Error of exceeding the area limit of reading/writing on the slave station.
03	Illegal Data Value	Error when the data value to be read from or write on the slave station isn't allowed.
04	Slave Device Failure	Error status of the slave station.
05	Acknowledge	It's a responding code of the slave station for the master station to prevent the master stations time-out error, when request command processing takes time. The master station marks an error code and waits for a certain time without making any second request.
06	Slave Device Busy	Error when request command processing takes too much time. The master should request again.
07	Time Out	Error when exceeds the time limit of the communication parameter as it communicates.
08	Number Error	Errors when data is 0 or more than 256 bytes, when the data size is bigger than the array size, or when Number and BYTE_CNT are different from each other.
09	Parameter Error	Error of setting parameters (mode, master/ slave)
10	Station Error	Error when the station number of itself and the station number set by the input parameter of the function block is the same.

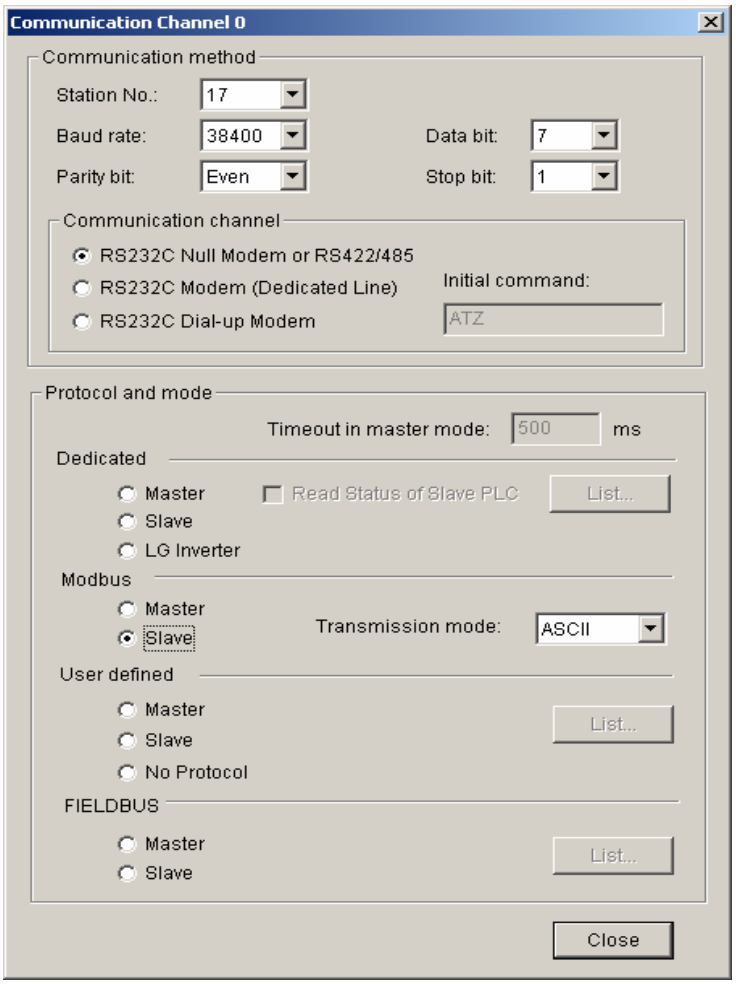
8.3.5 Example

According to the settings for the device supporting Modbus protocol, setting of GM7U basic unit is changed, but this example explains Modbus protocol communication among GM7U units.
The slave station program: This outputs the received data saved in M area through the output coil.
The master station program: It saves 16#FF (or 255) at %MW0 (It is coincided with %MX0 ~ MX15 or %MB0 ~ %MB1) in function block MOD0506 (function code 06), then reads %MX0 through MOD0102 (function code 01), and again saves 0 at %MX0 ~ %MX9 using function block MOD1516 (function code 15), then reads %MW0 through Mod0304.
The cable used in this example is same with that used for the dedicated protocol communication between GM7U's.

1) Slave station setting and a program

(1) Open a new project file and a new program for the slave station.

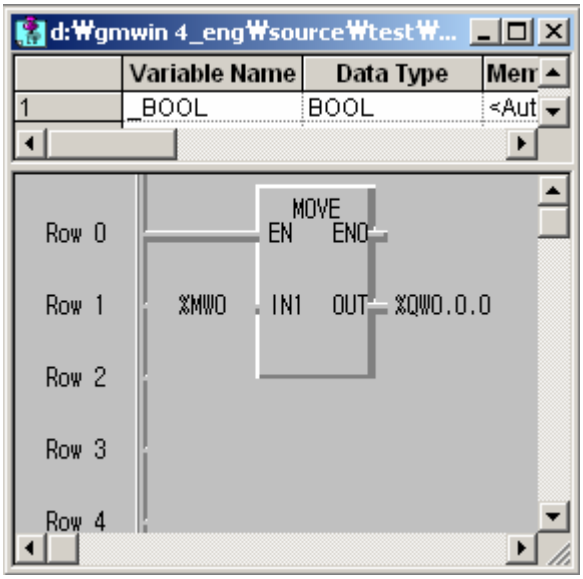
(2) Select communication parameter in GMWIN parameter and the following window opens.



– Set parameters as the following table.

Communication Method						Protocol and Mode	
Station No.	Baud Rate	Data Bit	Parity Bit	Stop Bit	Communication Channel	Modbus	Transmission Mode
17	38400	7	Even	1	RS-232C Null Modem or RS-422/485	Slave	ASCII

(3) Set up a program like the following figure and download to the slave station GM7U. For the detailed program setting and downloading, refer to GMWIN manual.

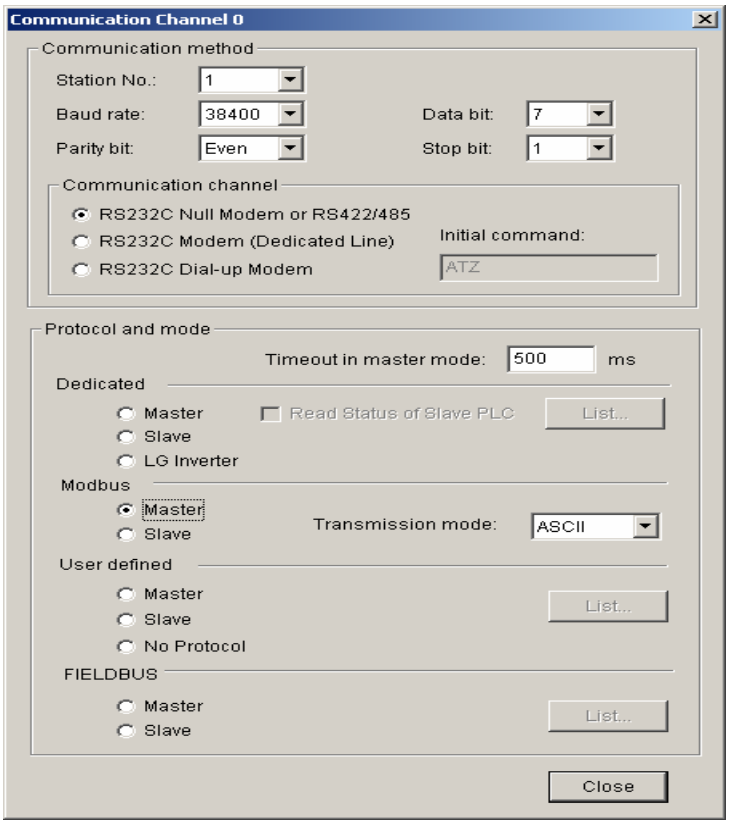


– The program of the slave is to output the data at M area to the output contact coil.

2) Setting s and the program for the master station

(1) Create a new project file and a new program for the master station.

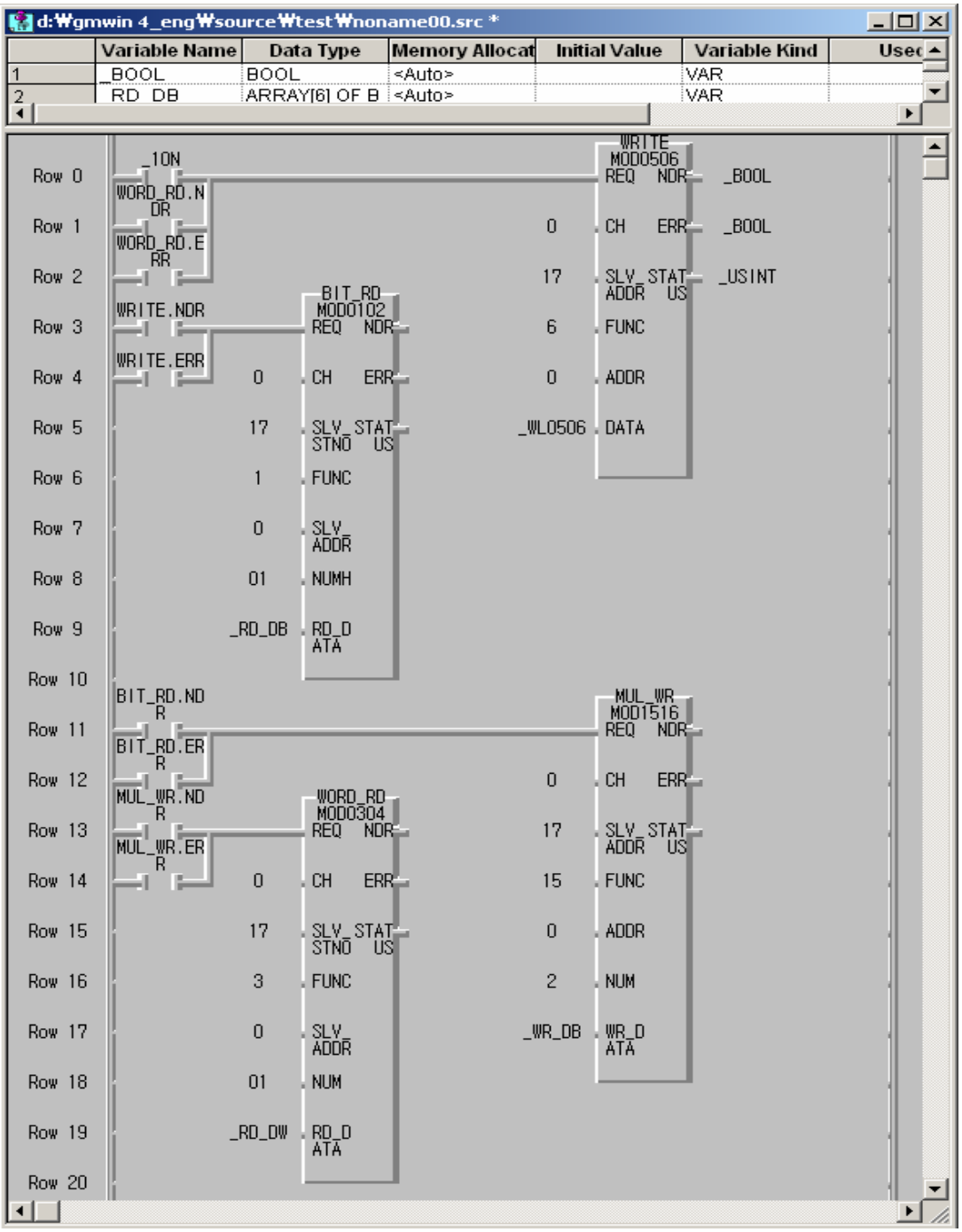
(2) Select 'Communication Parameter' in GMWIN, and following window will appear.



– Set parameters as the following table.

Communication Method						Protocol and Mode	
Station No.	Baud Rate	Data Bit	Parity Bit	Stop Bit	Communication Channel	Modbus	Transmission Mode
1	38400	7	Even	1	RS-232C Null Modem or RS-422/485	Master	ASCII

(3) Program



(4) Program description

- It saves 16#FF (or 255) at %MW0 (It is coincided with %MX0 ~ %MX15 or %MB0 ~ %MB1) in function block MOD0506 (function code 06). It then reads %MX0 through MOD0102 (function code 01), and again saves 0 at %MX0 ~ %MX9 using function block MOD1516 (function code 15), and then reads %MW0 through Mod0304.
- 8 LEDs of output contact points operate on/off continually.
- The above figure is the monitored scene of the program operation. Therefore the values appeared in _RD_DB, _RD_DW, array variables are not the initial ones, but the resulted value after executing reading.
- Variables like instance name NDR, Instance name ERR, Instance name STATUS are automatically generated when an instance variable of function block is declared.
- _1ON flag is a flag that is on for 1 scan.
- Previous function blocks' NDR output is the input condition for REQ of each function block.
- The size of _BYTE_CNT must be the same when it is converted into bytes.
- An error occurs when the size of array variable is smaller than the data to be read or to be written.

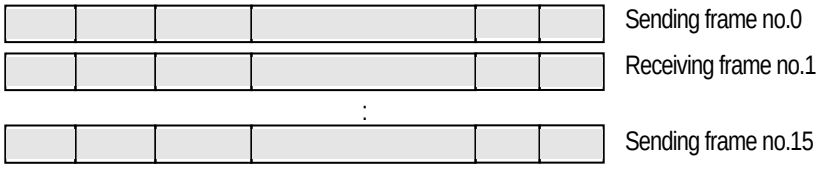
- Table of variables

Variable	Variable type	Initial value	Variable	Variable type	Initial value
_SLV_ADDR	USINT	17(16#11)	_NH0102	USINT	0(16#00)
_FUNC0102	USINT	1(16#01)	_NH0304	USINT	0(16#00)
_FUNC0304	USINT	3(16#03)	_NH0506	USINT	0(16#00)
_FUNC0506	USINT	6(16#06)	_NH1516	USINT	0(16#00)
_FUNC1516	USINT	15(16#0F)	_NL0102	USINT	1(16#01)
_AH0102	USINT	0(16#00)	_NL0304	USINT	255(16#FF)
_AH0304	USINT	0(16#00)	_NL0506	USINT	255(16#FF)
_AH0506	USINT	0(16#00)	_NL1516	USINT	10(16#0A)
_AH1516	USINT	0(16#00)	_RD_DB	BOOL-typed ARRAY [40]	{0,0,…,0}
_AL0102	USINT	0(16#00)	_RD_DW	WORD-typed ARRAY [4]	{0,0,0,0}
_AL0304	USINT	0(16#00)	_WR_DBW	BYTE-typed ARRAY [4]	{0,0,0,0}
_AL0506	USINT	0(16#00)	_BYTE_CNT	USINT	2(16#02)
_AL1516	USINT	0(16#00)			

8.4 No Protocol Communication

8.4.1 Introduction

No Protocol Communication is useful when communication between GM7U main unit and other kind of devices with user defined protocol is impossible. User defined protocol is very convenient when there are enough interval between frames or a kind of frame is less than 16. But, when the kind of frame is greater than 16 or frames are continued without interval, user defined protocol is not available. When the frames are more than 16, they can't be registered in parameter area; therefore GM7U can't transfer these frames.



Also, if there are no intervals between frames, GM7U can't find end of frame.
To overcome these defects of user defined protocol, GM7U provide 'No Protocol Communication '.
In the No Protocol Communication, frames are designated by commands, not by parameter setting. So maximum of 128 frames can be designated when using this communication mode. This section explains No Protocol Communication setting & usage.

1) Sending data

- Command: DSND
- Sends stored data in designated device at the rising edge of input condition.
- Data and the number of character must be stored in designated device before they are sent.

2) Receiving data

- Command: DRCV
- Saves received data to pre-defined receiving devices when designated ending condition is occurs.
- The ending condition can be designated by following two methods.
  - By received number of character.
  - By designated last byte. It is useful when there is no interval between received frames.

No Protocol Communication supports HEX communication. In ASCII communication, h31323334 is saved in the received device when the received device is h1234. To send data ABCD, save h41424344 in the send device and use the DRCV function block.

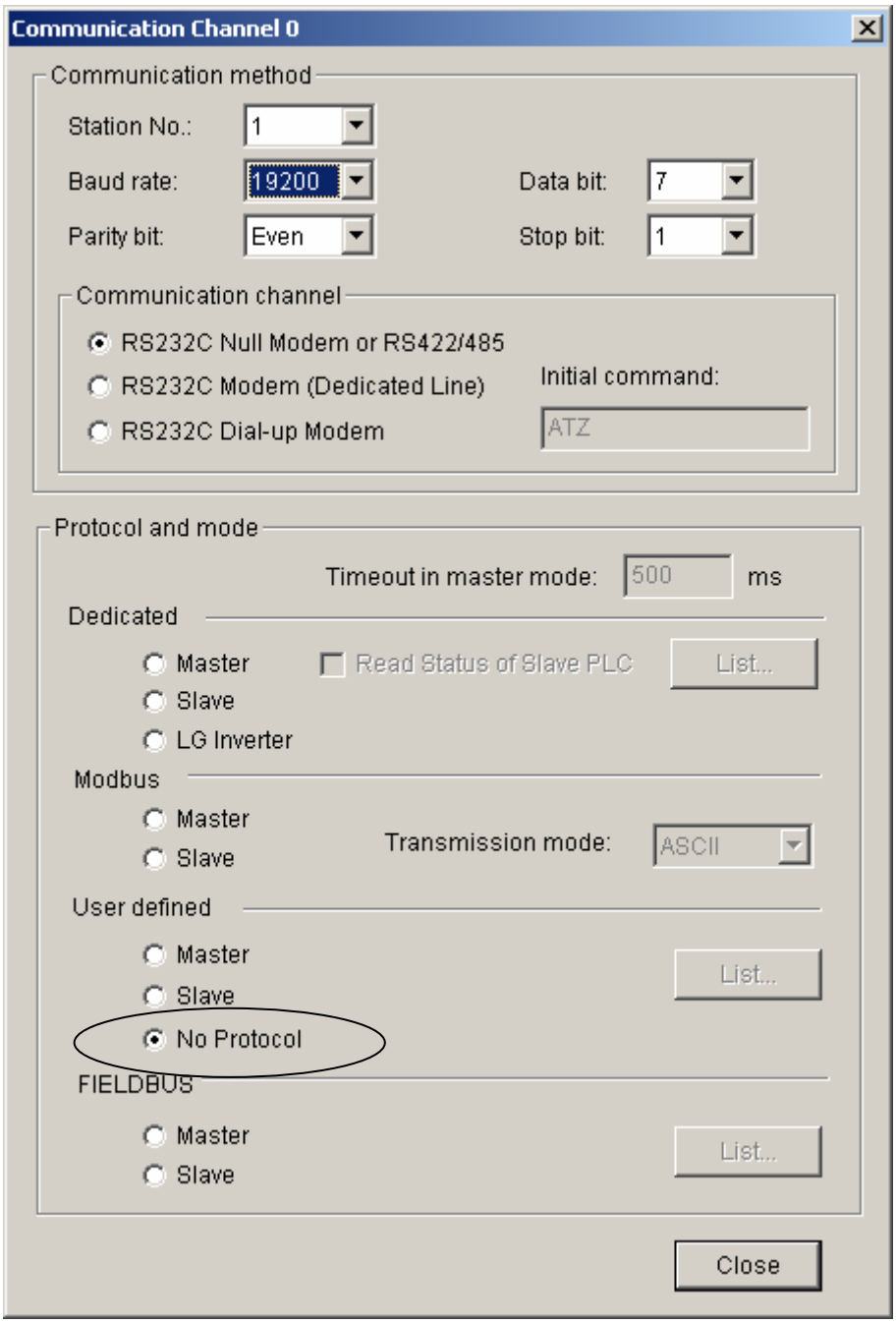
To convert the HEX value to ASCII value, use ASC function block, for ASCII to HEX, use HEX function block. This chapter describes about No Protocol Communication.

8.4.2 Parameter setting

1) Communication parameter setting

(1) Open a new project file from GMWIN and select 'GM7U' for PLC type.

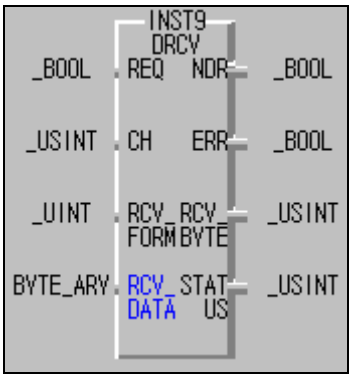
(2) Select 'Communication Parameter' in GMWIN.



- Set the communication methods and channel (Refer to the section 'Dedicated Communication')
- Select 'No protocol', and then parameter setting is finished.

8.4.3 Function block

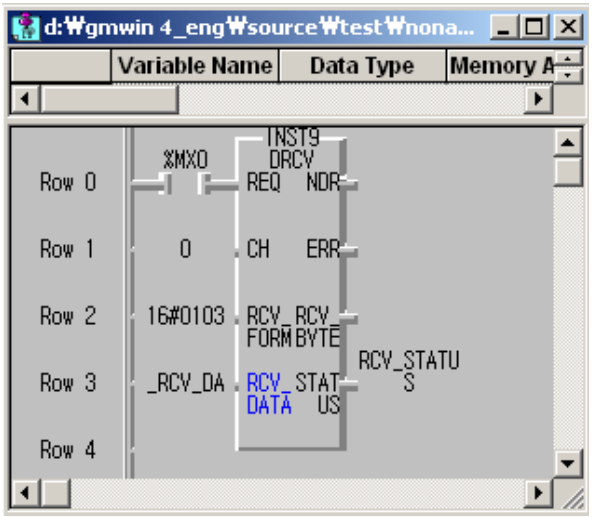
1) No protocol receiving function block (DRCV)

Function block	Description	
	Input	REQ: Execute function block at the rising edge CH: Set communication channel (0 ~ 1) RCV_FORM: Set receiving method - When the high byte is H00: receive the frame that the size is designated in the low byte - When the high byte is H01: receive the same data that is designated in the low byte.
	Output	RCV_DATA : A variable name saving the data receive (the no. of array should be equal or more than the data size) NDR: When it ends without error, this is set to 1 and remains 1 until the next request for function block. ERR: When an error occurs, this is set to 1 and remains 1 until the next request for the function block. STATUS : When an error occurs, this displays an error code RCV_BYTE: The number of the received byte

(1) Function

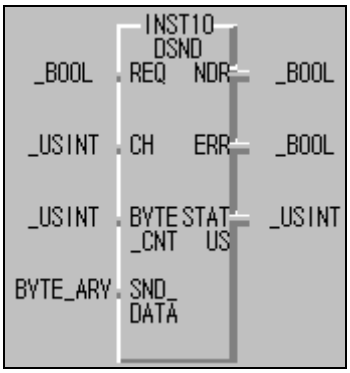
- For No Protocol Communication, the received data is saved in RCV_DATA array under the condition that they are received following the RCV_FORM. The length of the received data is saved in RCV_BYTE, and it is only executed when the input condition is On.
- NDR is On when the low byte is receiving the same length of frame as it is specified, when the high byte of RCV_FORM is h00. That is, if h000A is designated, NDR is On when 10 bytes of frame is received.
  NDR is On when the low byte is receiving the same length of frame as it is specified, when the high byte of RCV_FORM is h01. That is, if h0104 is designated, it searches H04 in the received frame and receives the data from the start point to H04, and then NDR is On.
- The communication status is saved in 'SS' .

(2) Program example



- When the execution condition %MX0 is on, when the format of RCV_FORM frame (ETX(h03) is received, they are saved in _RCV_DA following the received order.
- When NDR is on, the total bytes of the received frames are saved in RCV_BYTE.

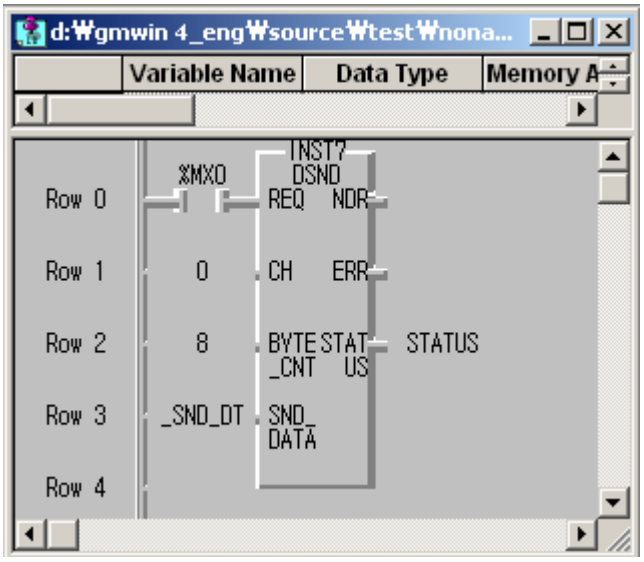
2) No protocol sending function block (DSND)

Function block	Description	
	Input	REQ: Execute function block at the rising edge CH: Set communication channel (0 ~ 1) BYTE_CNT: The byte no. of data to send SND_DATA: A variable name saving the data to send (the no. of array should be equal or more than the data size)
	Output	NDR: When it ends without error, this is set to 1 and remains 1 until the next request for function block. ERR: When an error occurs, this is set to 1 and remains 1 until the next request for the function block. STATUS : When an error occurs, this displays an error code

(1) Function

- When the execution condition turns On, the data is sent as many as they are designated as BYTE_CNT.
- The communication status is saved in STATUS
- When sending is completed, NDR is On for 1 scan, but if there is an error ERR Bit remains On for 1 scan.
- Error codes are saved in STATUS when errors occurred.

(2) Example program



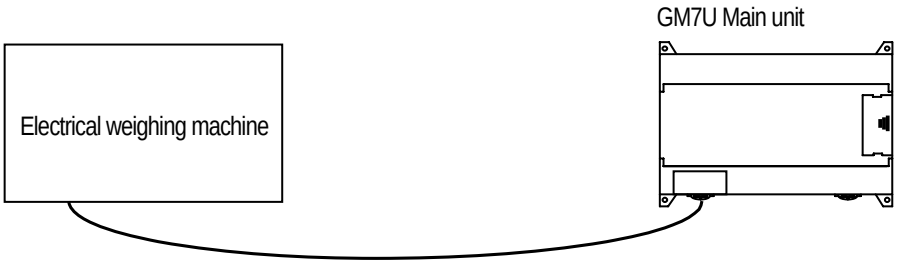
- When the execution condition %MX000 is on, the saved data in _SND_DT is sent by 8 bytes via communication channel o.

3) Error codes

Code	Error	Description
06	Parameter Error	Communication parameter setting error
08	Slave Device Busy	Slave device is busy
09	Frame Type Error	The number of sending byte is set over 255

8.4.4 Example

No Protocol Communication is useful to send or receive the unfixed data. This example assumes that an electrical weighing machine sends unfixed data. GM7U can communicate with it using No Protocol Communication.



For No Protocol Communication, one of following end condition is designated. One is the size of the received data, and the other is the the received data setting that is the some with pre-defined data.

This example assumes that the received data's tail is EOT. If there is no tail in the received data, all of the received data must be registered first in the DRCV function block.

Assume that the received data from a barcode is as follow.

"ENQ (1Byte) + Station No.(1Byte') + Weighing data(1~10 Words) + EOT(1Byte)"

When the above frame is received, the receiving condition format is set as h0104, and the moment when EOT is received the received framed is saved into the designated device. It checks the station and the data size and decides whether to use the received data. After that, it sends the data using the DSND function block when it is needed to respond.

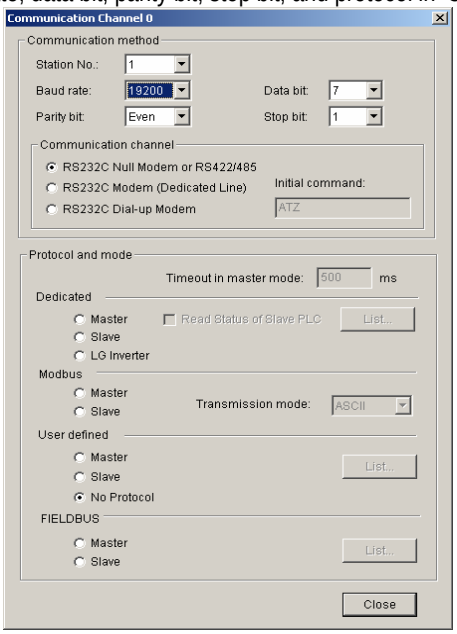
Assume that the sending data format is as follow.

"ACK (1Byte) + Station No.(1Byte') + OK(2Bytes) + EOT(1Byte)"

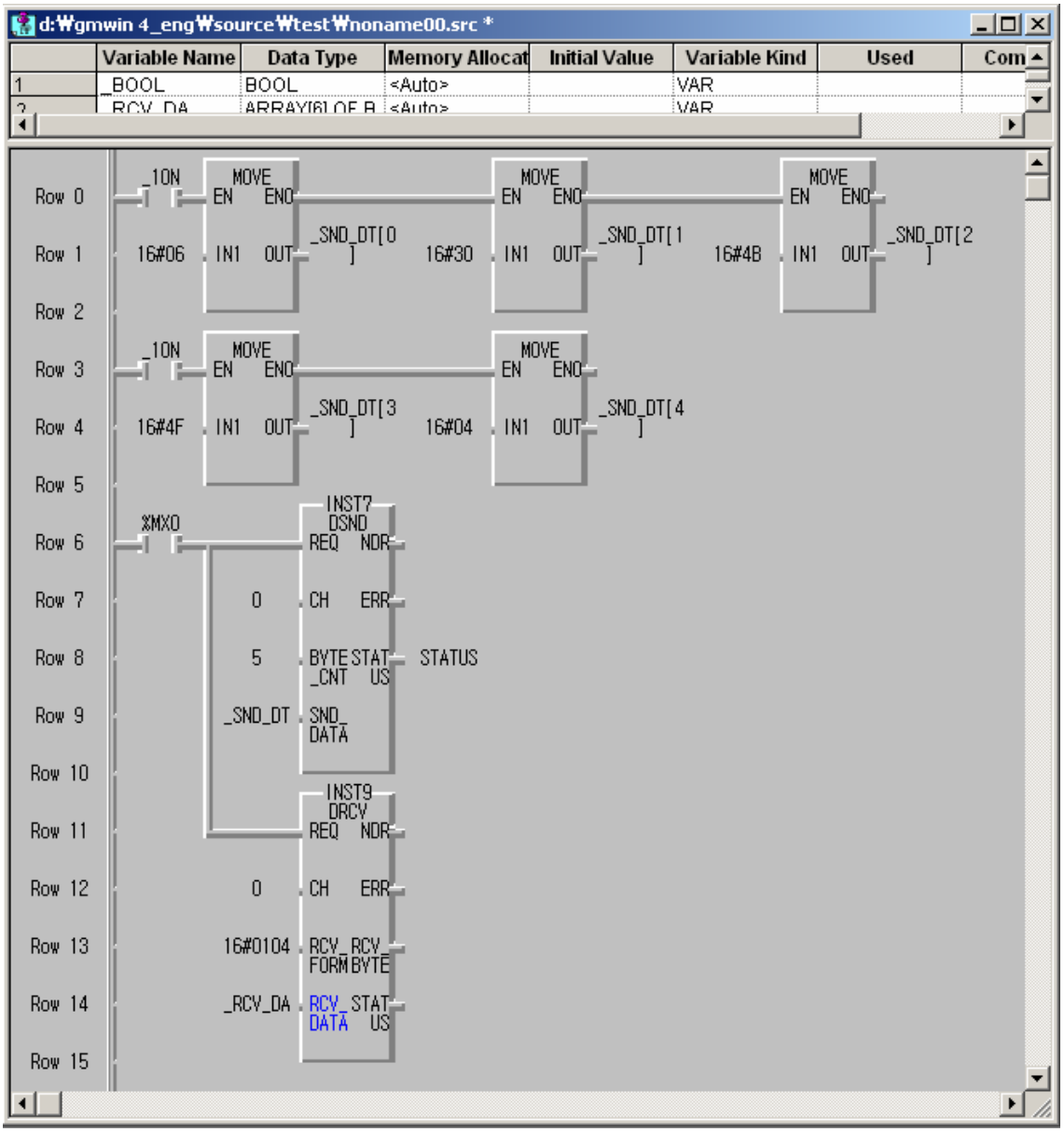
In this example describes when the data range (1~10 word) is 1 word.

1) Communication parameter setting

- Open a new project file from GMWIN, and select 'GM7U' for the PLC type.
- Designate baud rate, data bit, parity bit, stop bit, and protocol in 'Communication method'.



2) Program



- The data to be sent is saved in _SND_DT: “ACK + 0 + OK + ETX”
- When h04 (EOT) is received via CH 1, the weight data is saved in _RCV_DT by the DRCV function block.
- DSND sends 5 bytes that is saved in _SND_DT by _SND_DT function block.

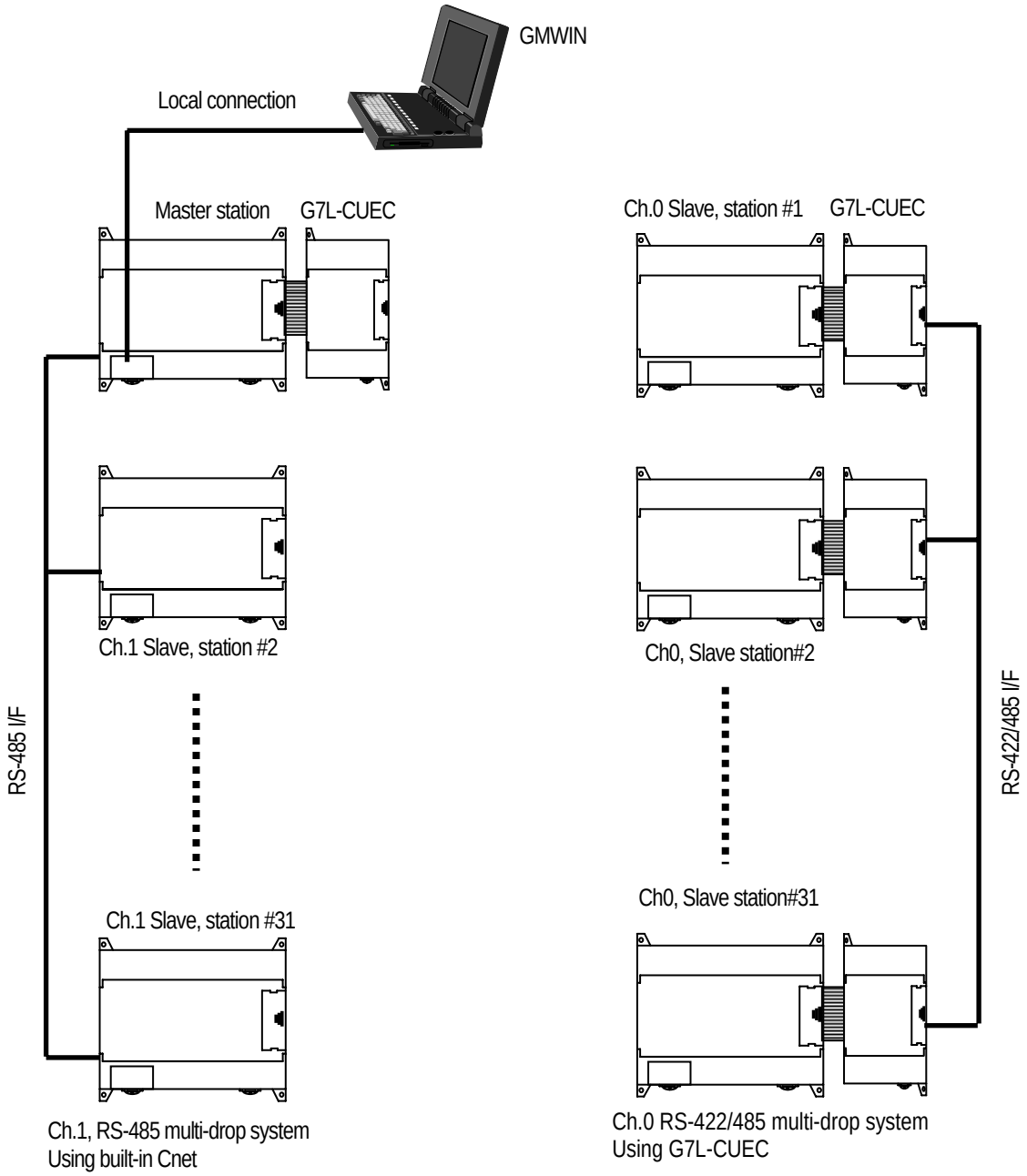
8.5 Remote Connection and Communication I/F Module

8.5.1 Remote connection

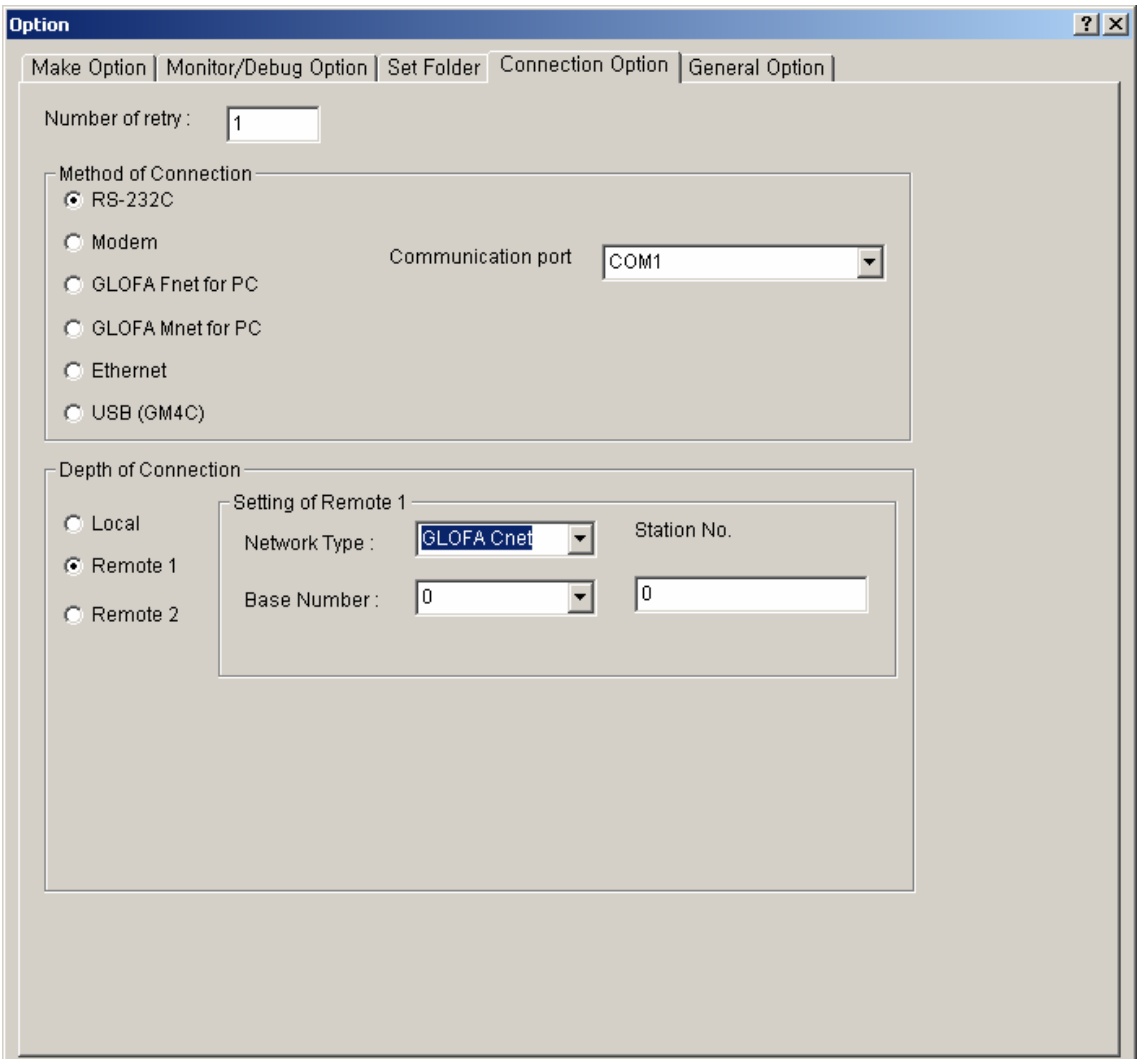
GM7U series can connect to other PLC by built-in Cnet interface or communication I/F modules.

1) Remote connection by built-in Cnet I/F

Remote connection by built-in Cnet I/F is available by dedicated communication protocol only.
If GMWIN and Master station is connected physically, it can connect to each slave station using remote connection function.



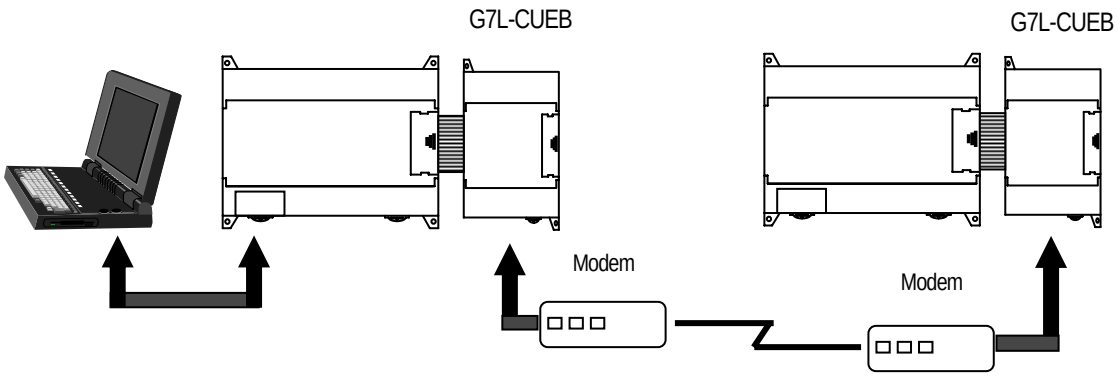
- Open a new project file from GMWIN
- After selecting Menu-Project-Option, click 'Connection Option'



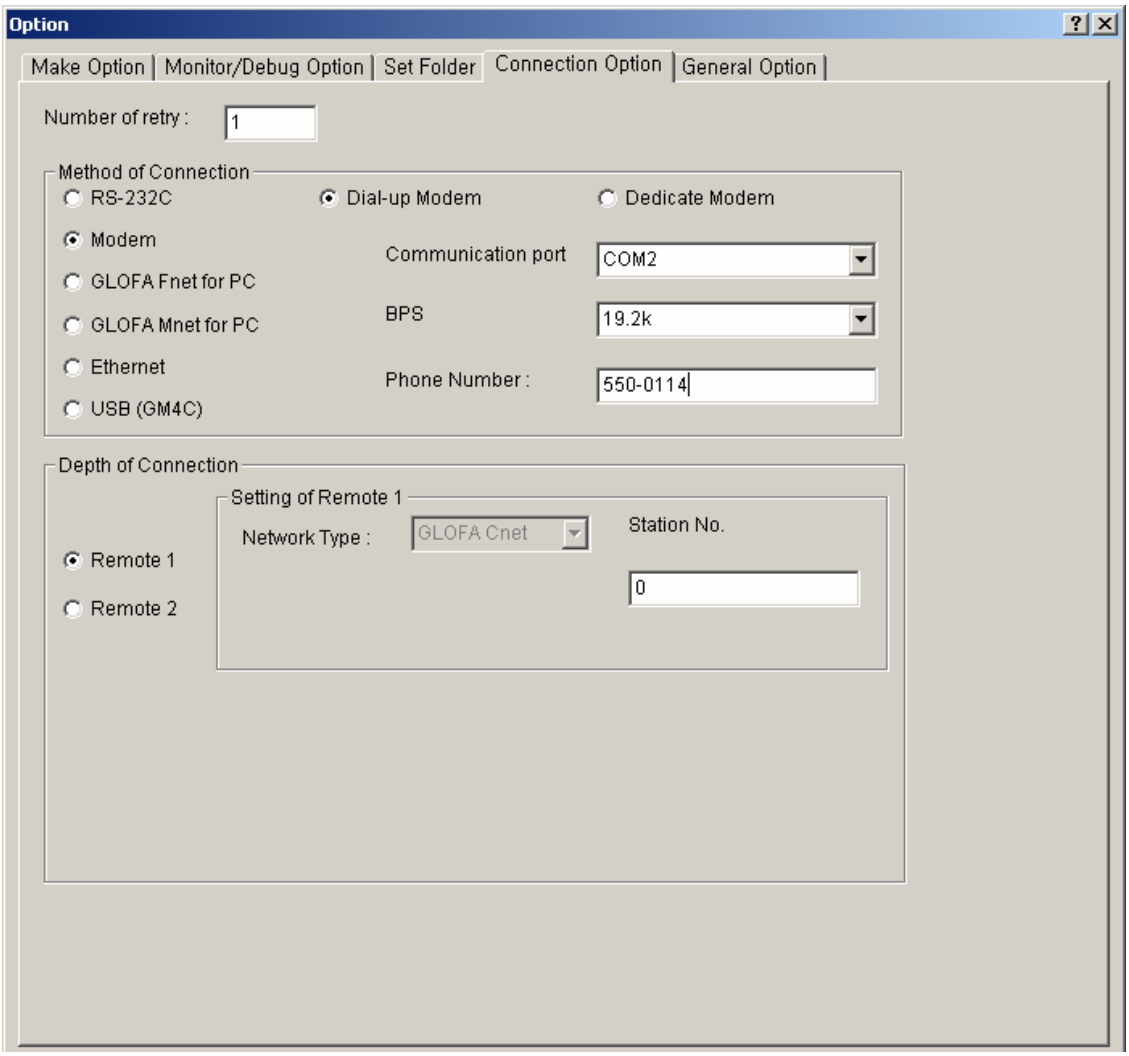
- Click 'Remote 1' in Depth of Connection
  - -. Type: select GLOFA Cnet.
  - -. Base: select '0'.
  - -. Station No.: input slave station number to connect
- The remote connection is completed by clicking 'OK', and then the message, 'Remote 1/GM7U/Local Run', will be displayed.
- Remote connection is available by dedicated protocol only, and when the master station is connected by local communication.

2) Remote connection by modem

Remote connection by modem is available by G7L-CUEB I/F module.
In this time, TM/TC switch of G7L-CUEB module must be set to 'On'.

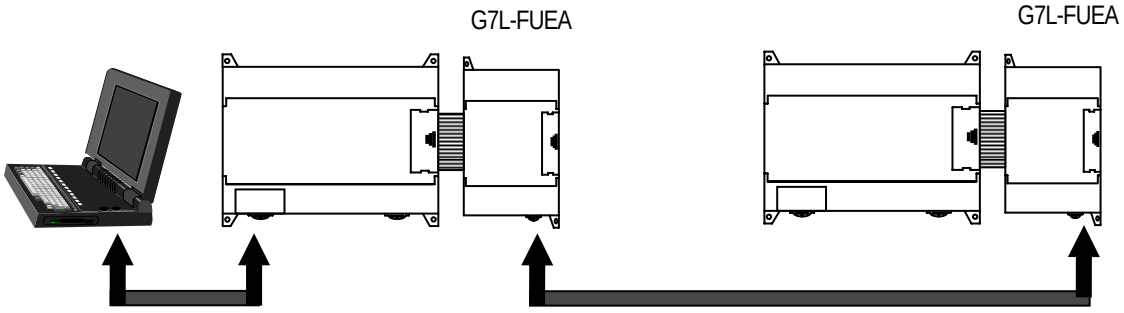


- Dedicated modem and dial-up modem are both available, and connection options of GMWIN are as below.

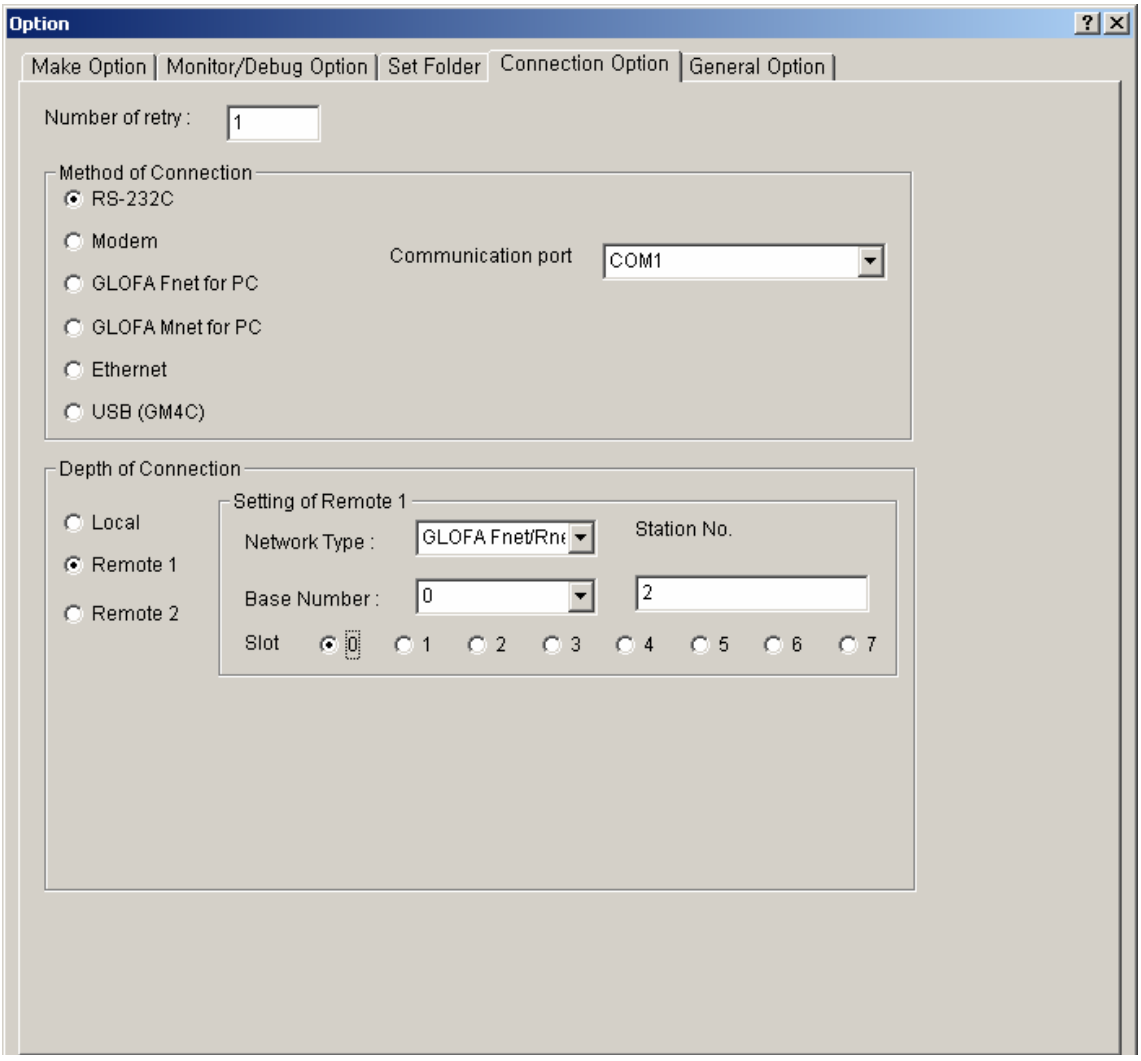


Select Dial-up Modem or Dedicated Modem in Method of Connection, and enter BPS and phone number (Dial-up Modem).

3) Remote step 1 and step 2 connection by Fnet I/F module



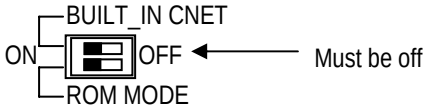
- Remote connection by Fnet interface is available by setting connection options in GMWIN.



- Select 'Remote 1' for Depth of Connection and 'GLOFA Fnet/Rnet' for Network Type.
- Select 0 for Base Number and Slot, and enter the Fnet module's station number.
- Connecting to GM6, GM4, GM3 via Fnet is also available, and please refer to the Fnet user's manual for more information.

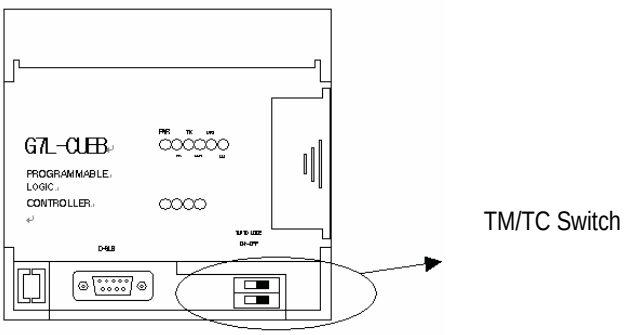
8.5.2 Communication I/F module

GM7U series support various kinds of communication I/F module.
In this time, Built-In Cnet in main unit must be set to 'Off' as below and only one communication module can be extended



1) Usage of G7L-CUEB

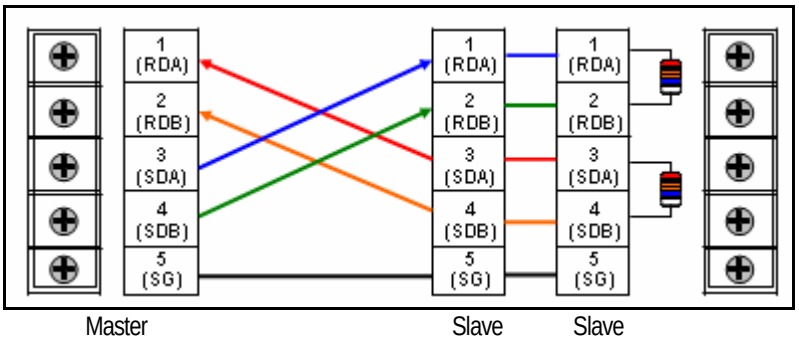
Using G7L-CUEB, GM7Ucan connect to other PLC by dedicated modem or dial-up modem



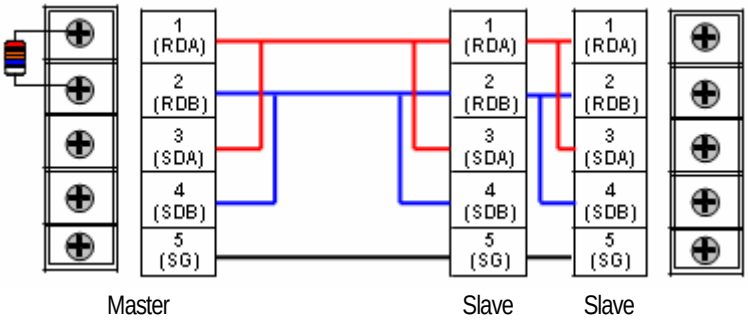
- Set TM/TC switch to 'On' when uses remote connection function
- Set TM/TC switch to 'Off' when uses data communication function
- Data communication and remote connection function are not allowed simultaneously
- Data communication mode supports every communication protocol but In remote connection function supports dedicated protocol only.

2) Usage of G7L-CUEC

Channel 0 can be used as RS-422/485 I/F by using G7L-CUEC I/F module.
Operating method is same as built-in Cnet interface and wiring is as below.



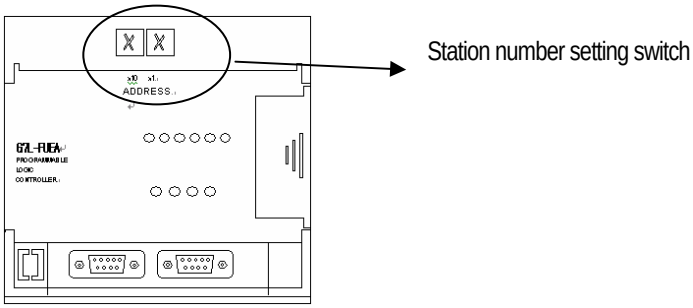
Wiring Example : RS-422 I/F



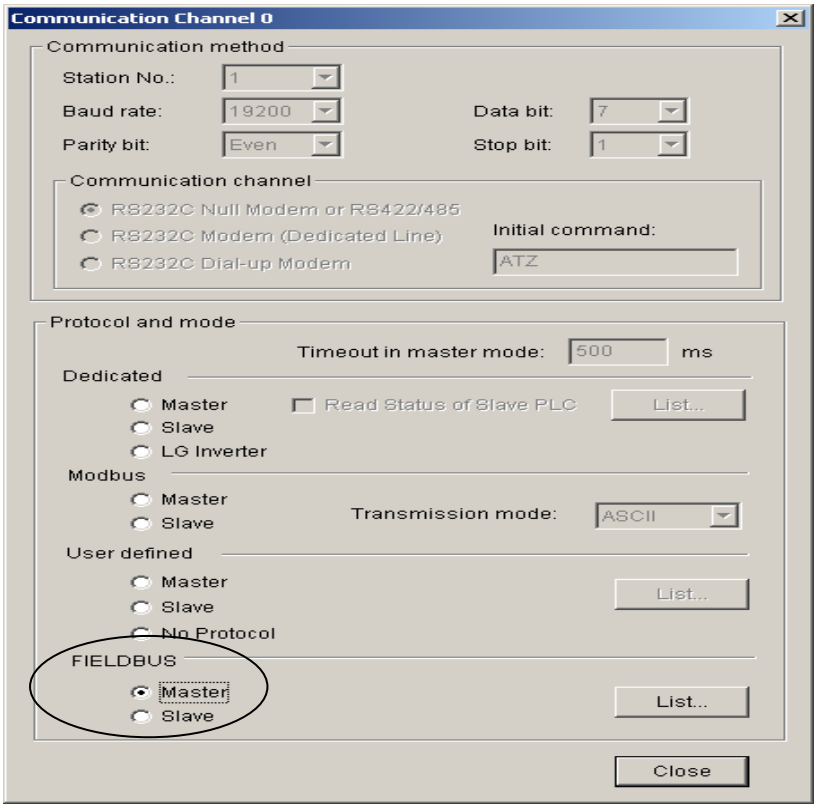
Wiring Example : RS-485 I/F

3) Usage of G7L-FUEA/RUEA

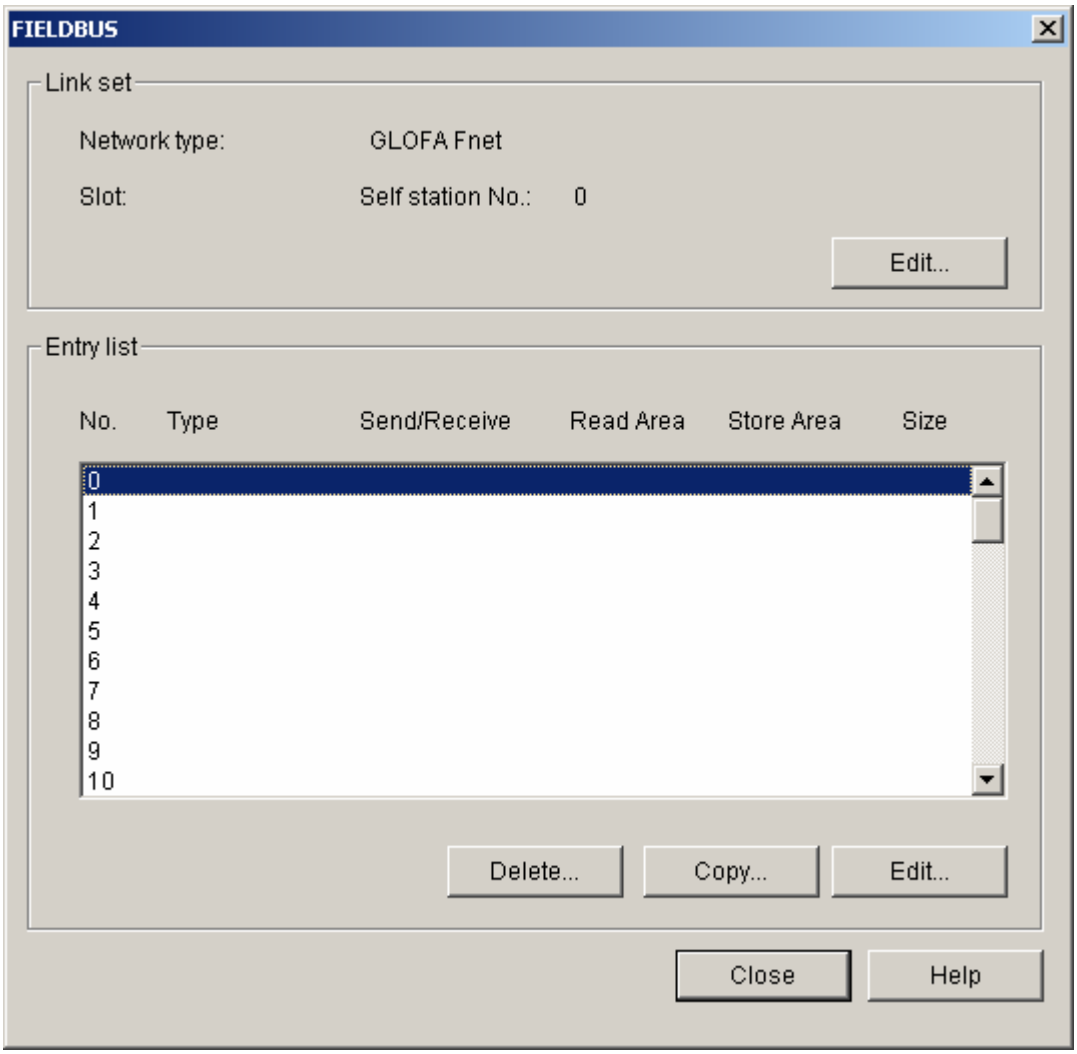
G7L-FUEA and G7L-RUEA are Field Bus Interface module of LSIS and they support High speed link communication service by parameter setting. But communication by command(Read, Write) are not available



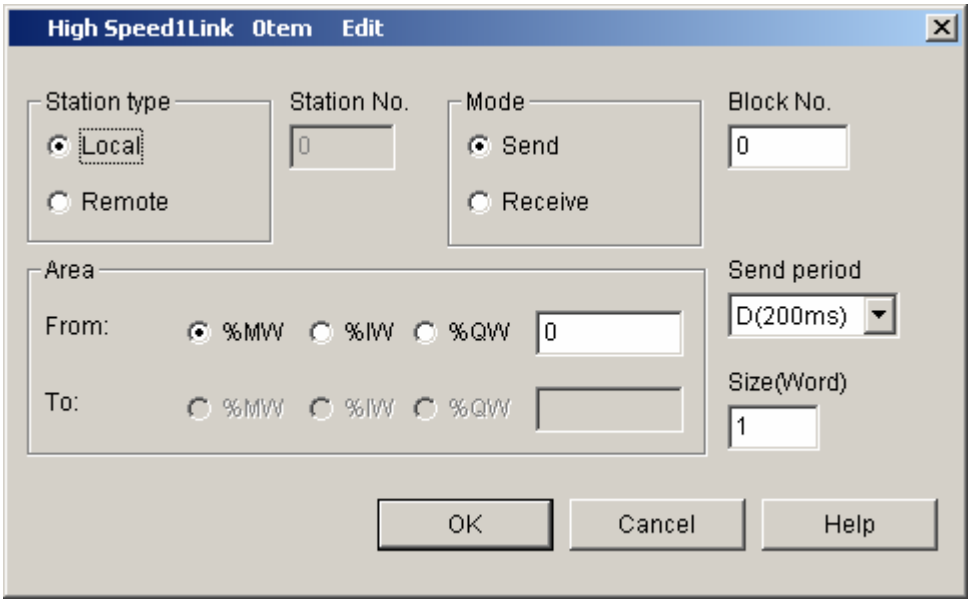
- After selecting communication parameter from GMWIN, select Master in FIELDBUS as below.



- Click 'List', and open the High Speed Link Edit window.



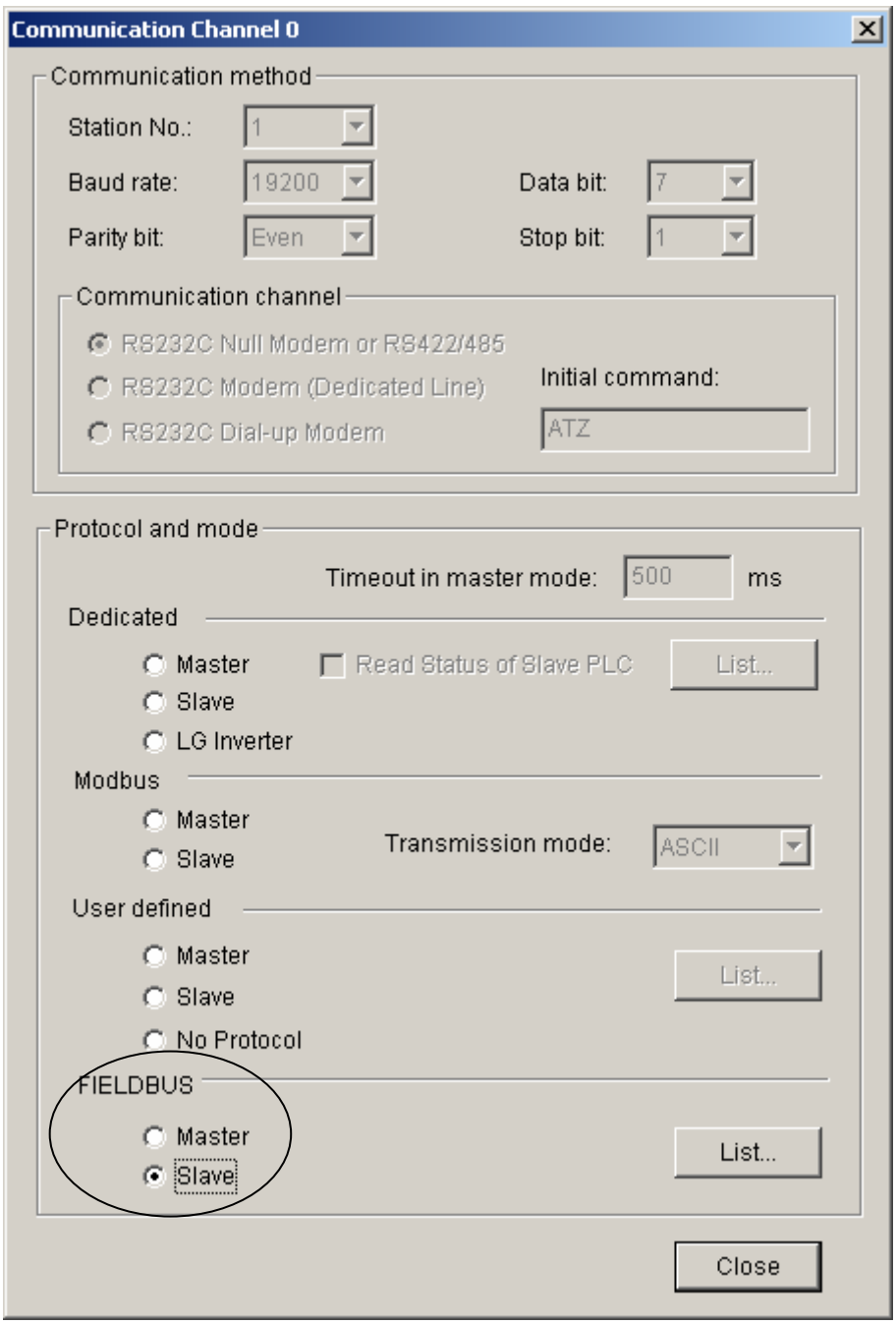
- Designate self-station No. and set link items after selecting Entry List
- For the details, refer to the Fnet user's manual.



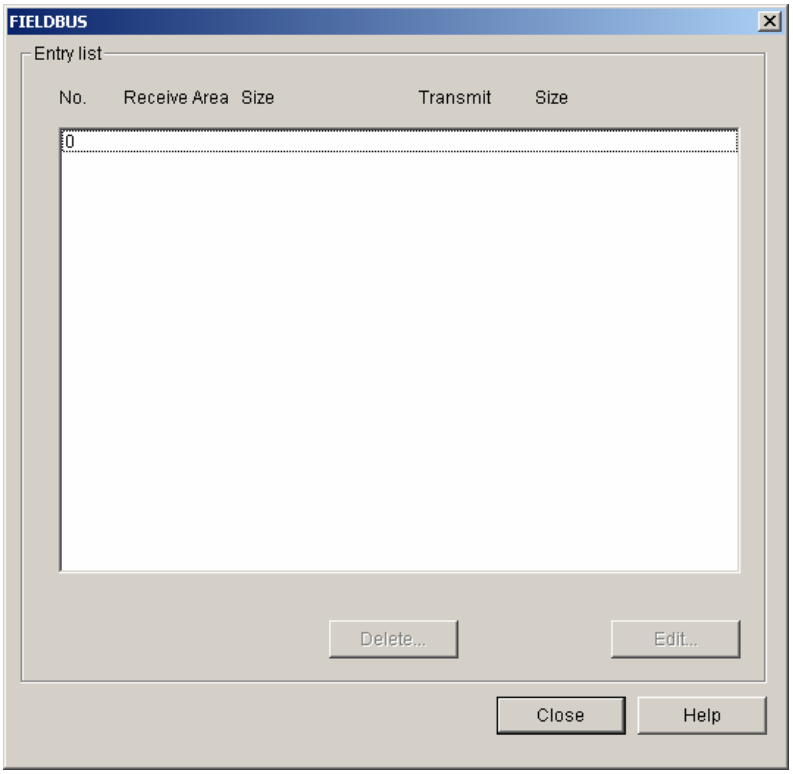
4) Usage of G7L-PBEA/DBEA

G7L-PBEA is a communication module for Pnet I/F, and G7L-DBEA is for DeviceNet I/F. Both modules provide slave function only.

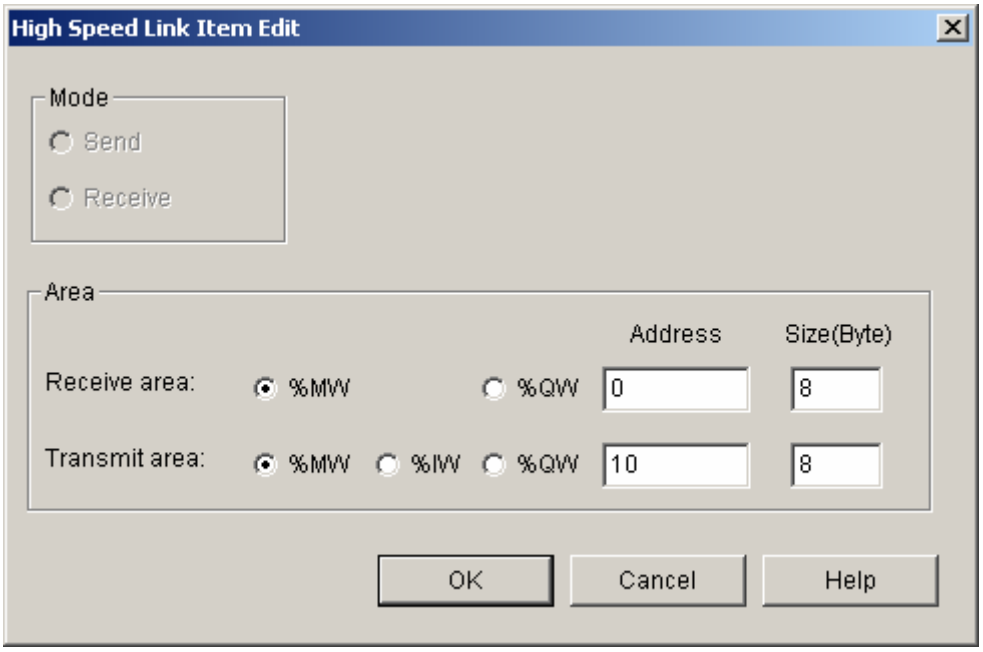
- After selecting Communication Parameters, select 'Slave' for FIELDBUS.



- Click 'List', and open Entry list.



- Click the item 0, and set the Receive area and Transmit area.
- For Pnet, maximum sending/receiving data size is 244 byte.
- For Devicenet, maximum size of sending data is 30 bytes, and receiving data is 32 bytes.
- For details, refer to the Pnet/Devicenet user's manuals.



Chapter 9. Installation and Wiring

9.1 Installation

9.1.1 Installation environment

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

1) Environment requirements

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

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

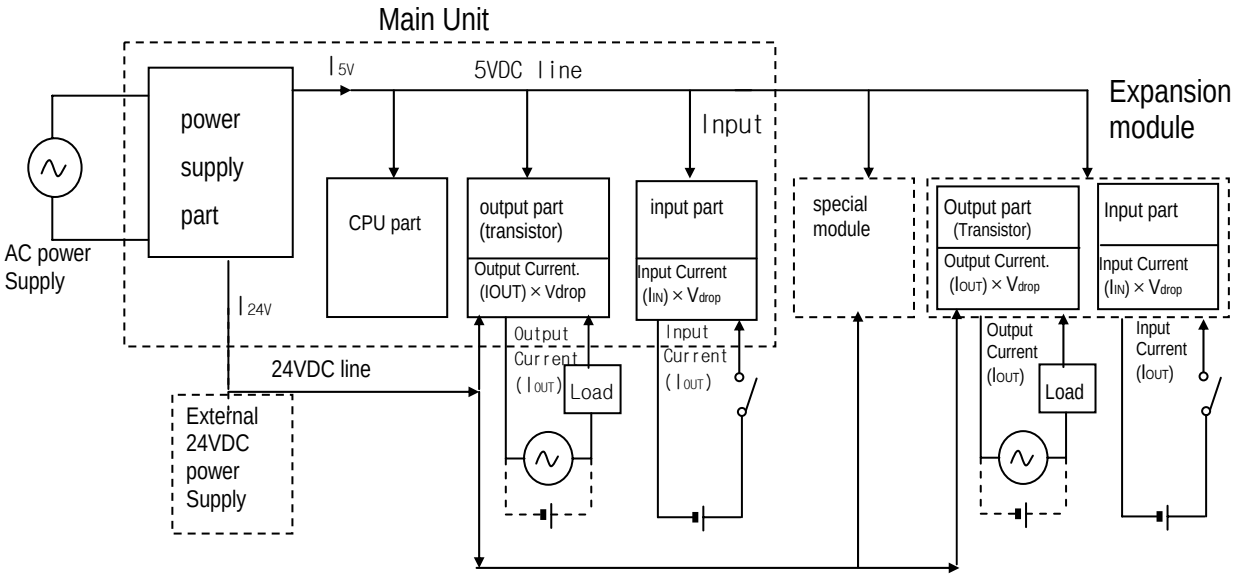
2) Precautions during installing

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

3) Heat protection design of control box

(1) When installing the PLC in a closed control box, be sure 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.
(3) The following shows the procedure for calculating the PLC system power consumption.

4) Power consumption block diagram of PLC systems



5) Power consumption of each part

(1) Power consumption of a power supply part

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

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

  where, I5v: 5VDC circuit current consumption of each part

  I24v: 24VDC circuit average current consumption of output part (with points simultaneously switched ON).

  Not for 24VDC power supplied from external or power supply part that has no 24VDC output.

(2) Total 5VDC power consumption

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

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

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

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

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

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

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

  I_{out} : output current (actual operating current) (A)

  V_{drop} : voltage dropped across each output load (V)

(5) Average power consumption of input parts (with points simultaneously ON)

- $W_{in} = I_{in} \times E \times$ input points $\times$ the rate of points switched on simultaneously (W)

  I_{in} : input current (effective value for AC) (A)

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

(6) Power consumption of the special module

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

(7) 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)

(8) 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 [m^2]

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

if control panel air is not circulated 4

9.1.2 Handling instructions

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

1) Main unit or Expansion Module handling instructions

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

(1) I/O specifications re-check

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

(2) Used wire

Select the wire with due consideration of ambient temperature and rated current. Its minimum specifications should be AWG24(0.18 ㎟) or more.

(3) Environment

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

(4) Polarity

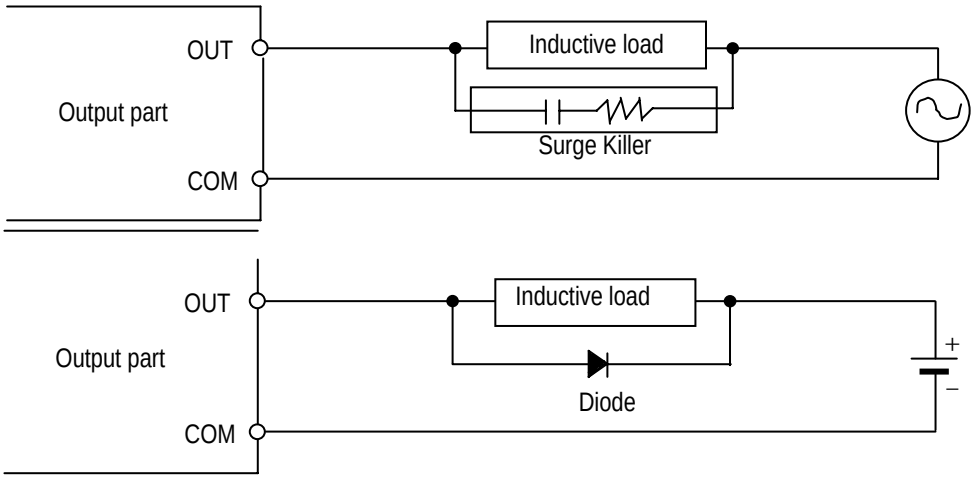
Before applying the power to part that has polarities, be sure to check its polarities.

(5) Terminal block

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

(6) Wiring

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



(7) Be cautious that strong shock does not applied to the I/O part.

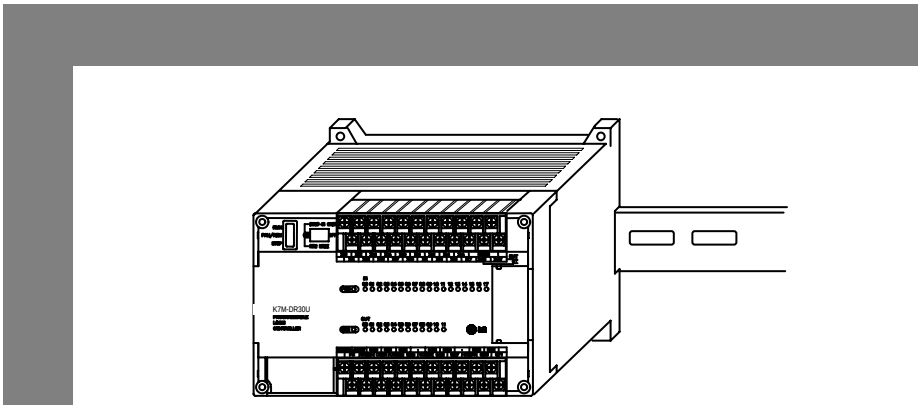
(8) Do not separate the PCB from its case.

2) Mounting instructions

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

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

(2) Make sure that GM7U is installed in figure below for most effective heat radiation.



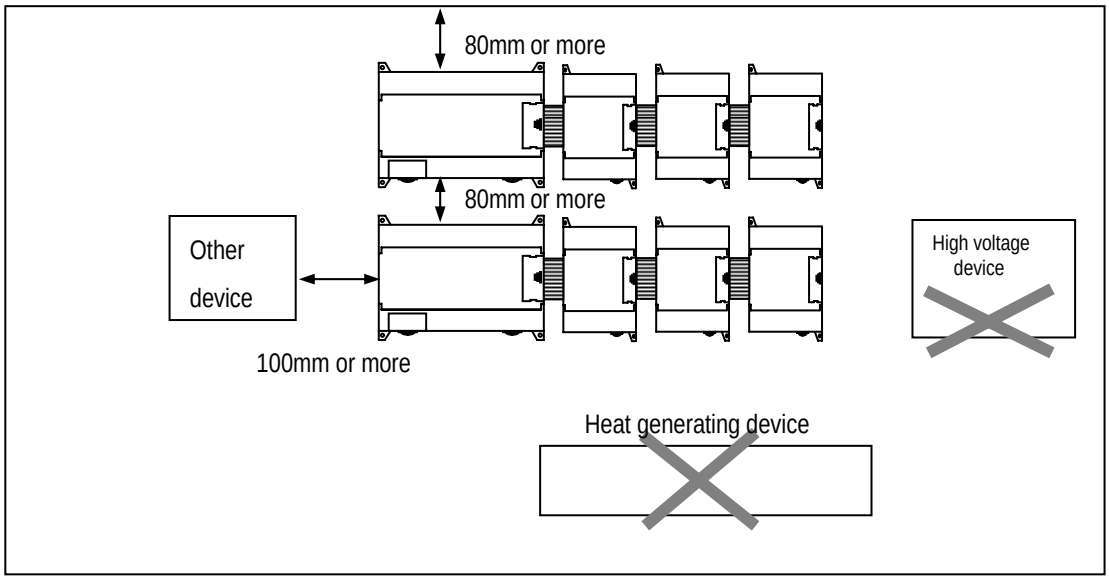
(3) Do not mount the base board together with a large-sized electromagnetic contact or no-fuse breaker, which produces vibration, on the same panel. Mount them on different panels, or keep the unit or module away from such a vibration source

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

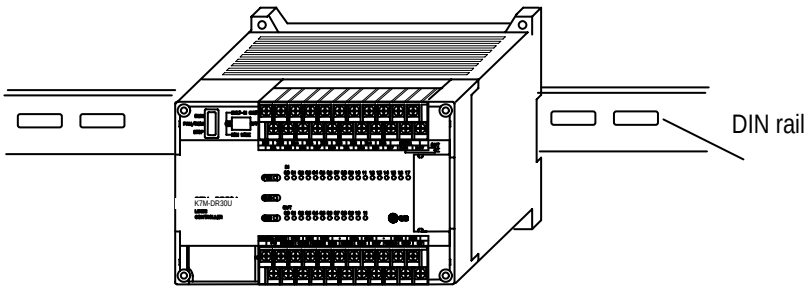
If the clearances are less than those in Fig below, follow the instructions shown below

- If the wire duct is mounted on the upper part of the PLC, make the wiring duct clearance 50 ㎜ 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 ㎜ or more clearances between it and parts. Left or right clearance and clearance from other device in the left or right side should be 100 ㎜ or more.



(6) GM7U has hooks for DIN rail (width 3.5 mm) in the base unit and expansion modules.

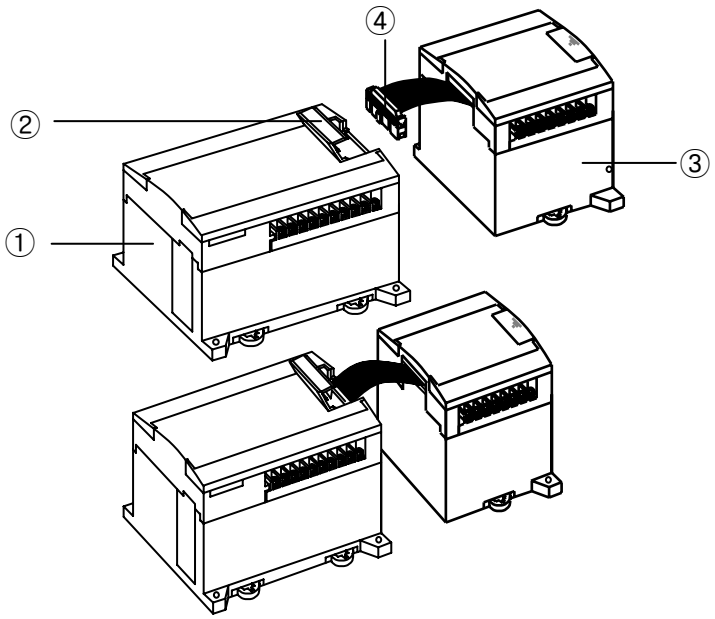


9.1.3 Connection of expansion module

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

(1) Open the connector cover of the main unit.

(2) Insert the connector of the expansion module to the connector of the base unit.



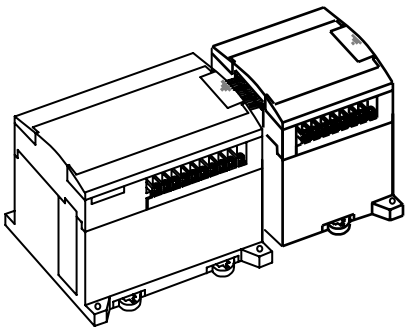
①: Main unit

②: Connector cover

③: expansion module

④: expansion cable

(3) Close the connector cover of the main unit.



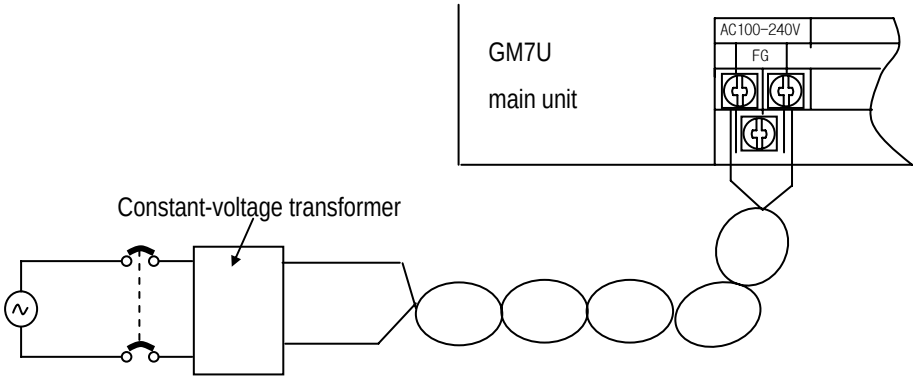
9.2 Wiring

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

9.2.1 Power supply wiring

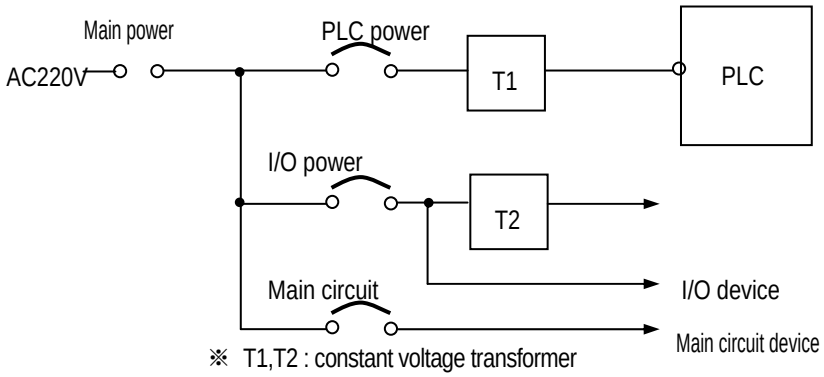
(1) When voltage fluctuations are larger than the specified value, connect a constant-voltage transformer.

(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) Connect a power supply hat has less noise (if there are lots of noise, use insulated transformer).

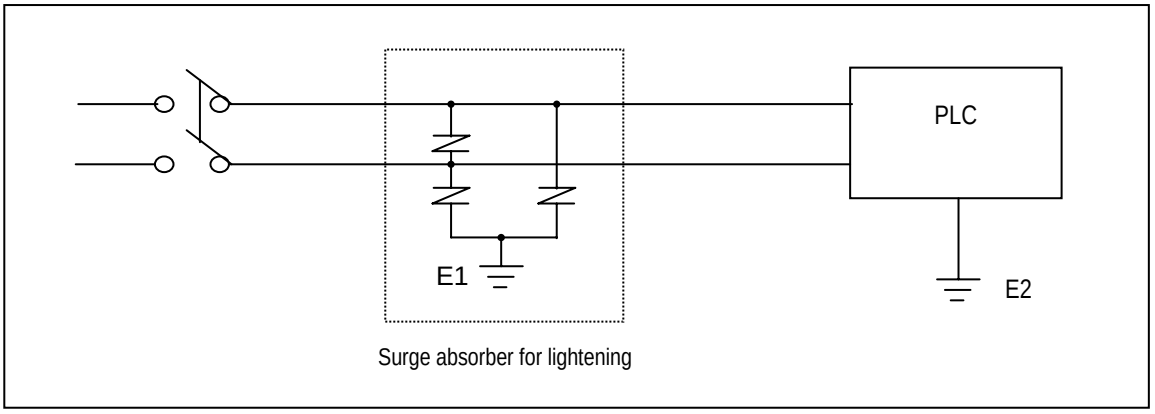
(4) When wiring, separate the PLC power supply from those for I/O and power device as shown below.



(5) To minimize voltage drop, use the thickest (max. 2 ㎟) wires possible

(6) Do not bundle the 100 VAC and 24VDC cables with main-circuit (high voltage, large current) wires or the I/O signal wires. If possible, provide more than 80 ㎜ distance between the cables and wires.

(7) As a measure against very large surge(e.g. due to lightening),connect a surge absorber as shown below.



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

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

REMARK

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.

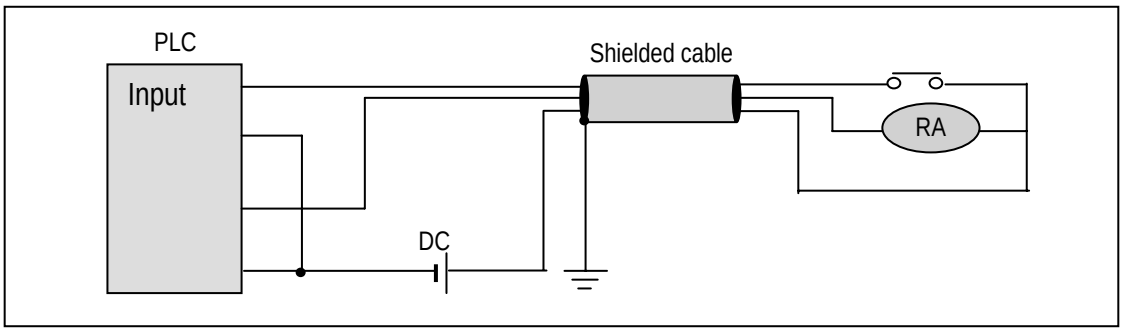
9.2.2 Input and output devices wiring

(1) Applicable size of wire to the terminal block connector is 0.18 to 2 ㎟. However, it is recommended to use wire of 0.5 ㎟ for convenience.

(2) Separate the input and output lines.

(3) I/O signal wires must be at least 80 ㎜ away from high voltage and large current circuit wires.

(4) When the I/O signal wires cannot be separated from the main circuit wires and power wires, ground on the PLC side with batch-shielded cables. Under some conditions it may be preferable to ground on the other side.



(5) If wiring has been done with of piping, ground the piping.

(6) Separate the 24VDC I/O cables from the 110VAC and 220VAC cables.

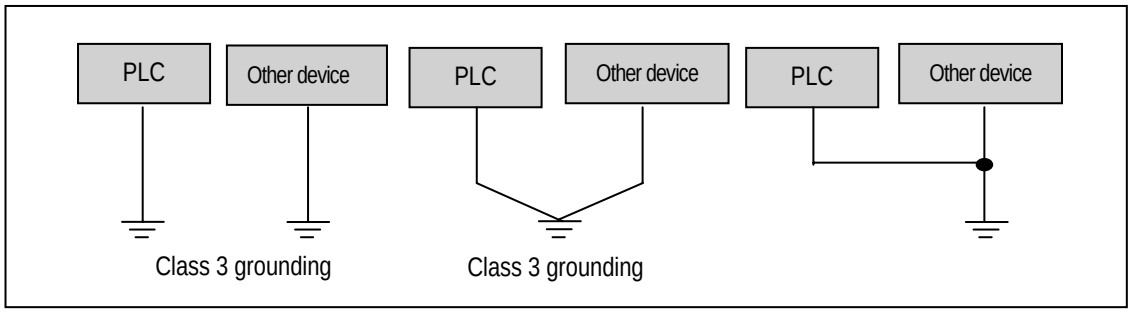
(7) If wiring over 200m or longer distance, trouble can be caused by leakage currents due to line capacity.
Refer to the section '11.4 Troubleshooting Examples.'

9.2.3 Grounding

(1) This PLC has sufficient protection against noise, so it can be used without grounding except for special much noise. However, when grounding it should be done conforming to below items.

(2) Ground the PLC as independently as possible. Class 3 grounding should be used (grounding resistance 80 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 ㎟(14AWG) or thicker grounding wire. Grounding point should be as near as possible to the PLC to minimize the distance of grounding cable.

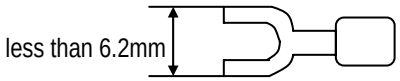
9.2.4 Cable specifications for wiring

The specifications for wiring is as follows:

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

- Be sure to use solderless terminal for power supply and I/O wiring.
- Be sure to use M3 type as terminal screw.
- Make sure that terminal screw is connected by 6～9 ㎏ · ㎝ torque..
- Be sure to use fork shaped terminal screw as shown below.

cable solderless terminal (fork shaped)



Chapter 10. Maintenance

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

10.1 Maintenance and Inspection

The I/O module mainly consist of semiconductor devices and its service life is semi-permanent. 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	Countermeasure
Ambient environment	Temperature	0 ~ + 55°C	Adjust the operating temperature and humidity with the defined range.
	Humidity	5 ~ 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 10%	Hold it with the allowable range.
Spare parts		Check the number of Spare parts and their Store conditions	Cover the shortage and improve the conditions

10.2 Daily Inspection

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

Check Items		Check Points	Judgement	Countermeasure
Connecting conditions of terminal block or extension cable		check for loose mounting screws	Screws should not be loose	Retighten Screws
		Check the distance between solderless terminals	Proper clearance should be provided	Correct
LED status	PWR LED	Check that the LED is ON	ON(OFF indicates an error)	See chapter 11
	Run LED	Check that the LED is ON during Run	ON (flickering indicates an error)	See chapter 11
	ERR LED	Check that the LED is OFF during Run	OFF(ON indicates an error)	See chapter 11
	Input LED	Check that the LEO turns ON and OFF	ON when input is ON, OFF when input is off	See chapter 11
	Output LED	Check that the LEO turns ON and OFF	ON when output is ON, OFF when output is off	See chapter 11

10.3 Periodic Inspection

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

Check Items		Checking Methods	Judgment	Countermeasure
Ambient Environment	Ambient temperature	-. Measure with thermometer and hygrometer -. measure corrosive gas	0 ~ 55 °C	Adjust to general standard (Internal environmental standard of control section)
	Ambient Humidity		5 ~ 95%RH	
	Ambience		There should be no corrosive gases	
PLC Conditions	Looseness, Ingress	The module should be move the unit	The module should be mounted securely.	Retighten screws
	dust or foreign material	Visual check	No dust or foreign material	
Connecting conditions	Loose terminal screws	Re-tighten screws	Screws should not be loose	Retighten
	Distance between terminals	Visual check	Proper clearance	Correct
	Loose connectors	Visual check	Connectors should not be loose.	Retighten connector mounting Screws
Line voltage check		Measure voltage between input terminals	*85 ~ 264V AC *10.2 ~ 28.8V DC	Change supply power
Fuse		Visual check	No melting disconnection	If fuse melting disconnection, change the fuse periodically because a surge current can cause heat

Chapter 11. Troubleshooting

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

11.1 Basic Procedures of Troubleshooting

System reliability not only depends on reliable equipment but also on short downtimes in the event of faults. The short discovery and corrective action is needed for speedy operation of system. The following shows the basic i nstructions for troubleshooting.

1) Visual checks

Check the following points.

- Machine operating condition (in stop and operating status)
- Power On/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, ERR. LED and I/O LED).

  After checking them, connect 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.

- Switch to the STOP, and then turn the power on and off.

3) Narrow down the possible causes of the trouble, i.e.:

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

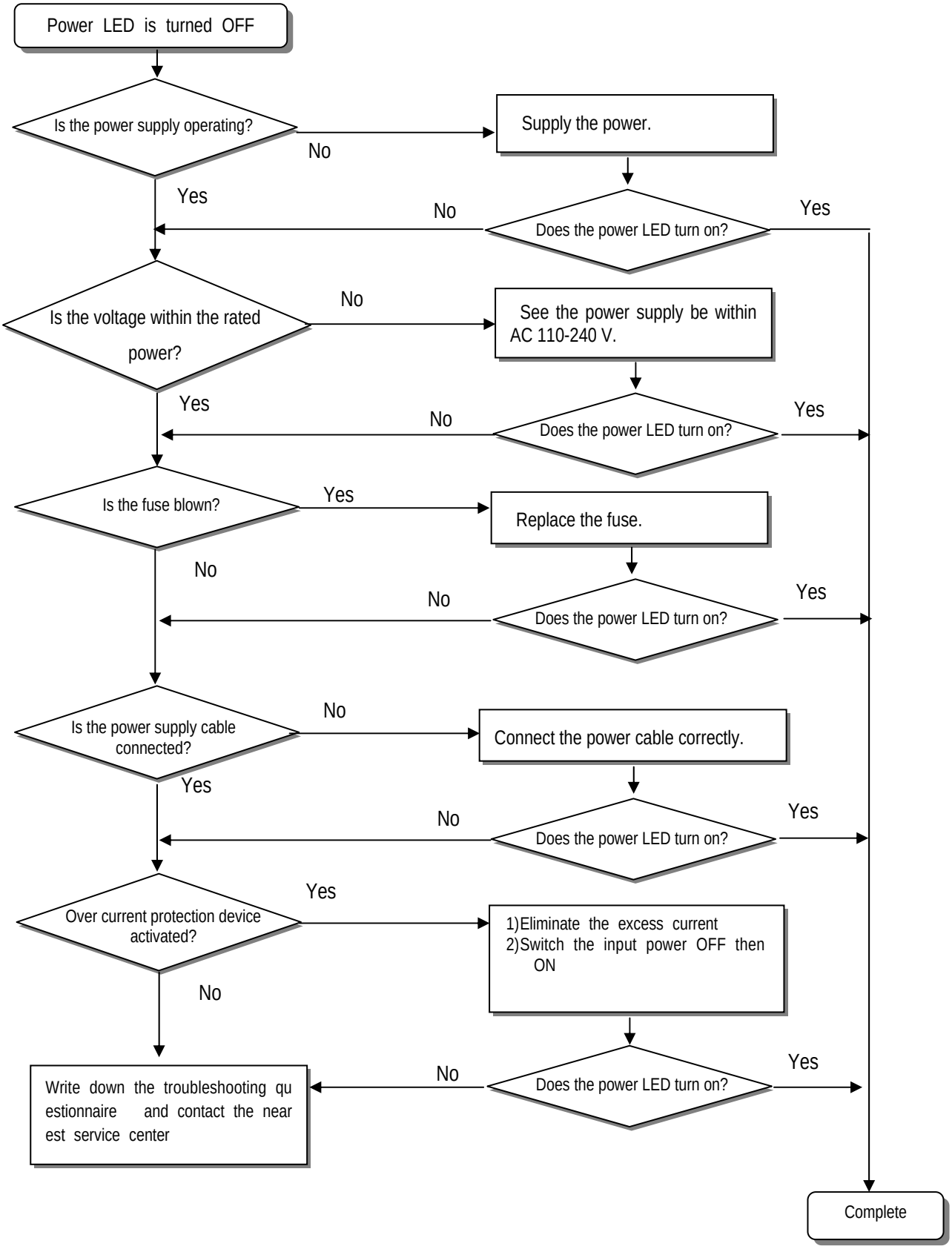
11.2 Troubleshooting

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

Is the power LED turned OFF?	Flowchart used when the POWER LED is turned OFF
Is the ERR LED flickering?	Flowchart used when the ERR LED is flickering
Are the RUN LED turned OFF?	Flowchart used when the RUN turned OFF.
I/O module doesn't operate pro perly	Flowchart used when the output load of the output module doesn't turn on.
Program cannot be written	Flowchart used when a program can't be written to the PLC

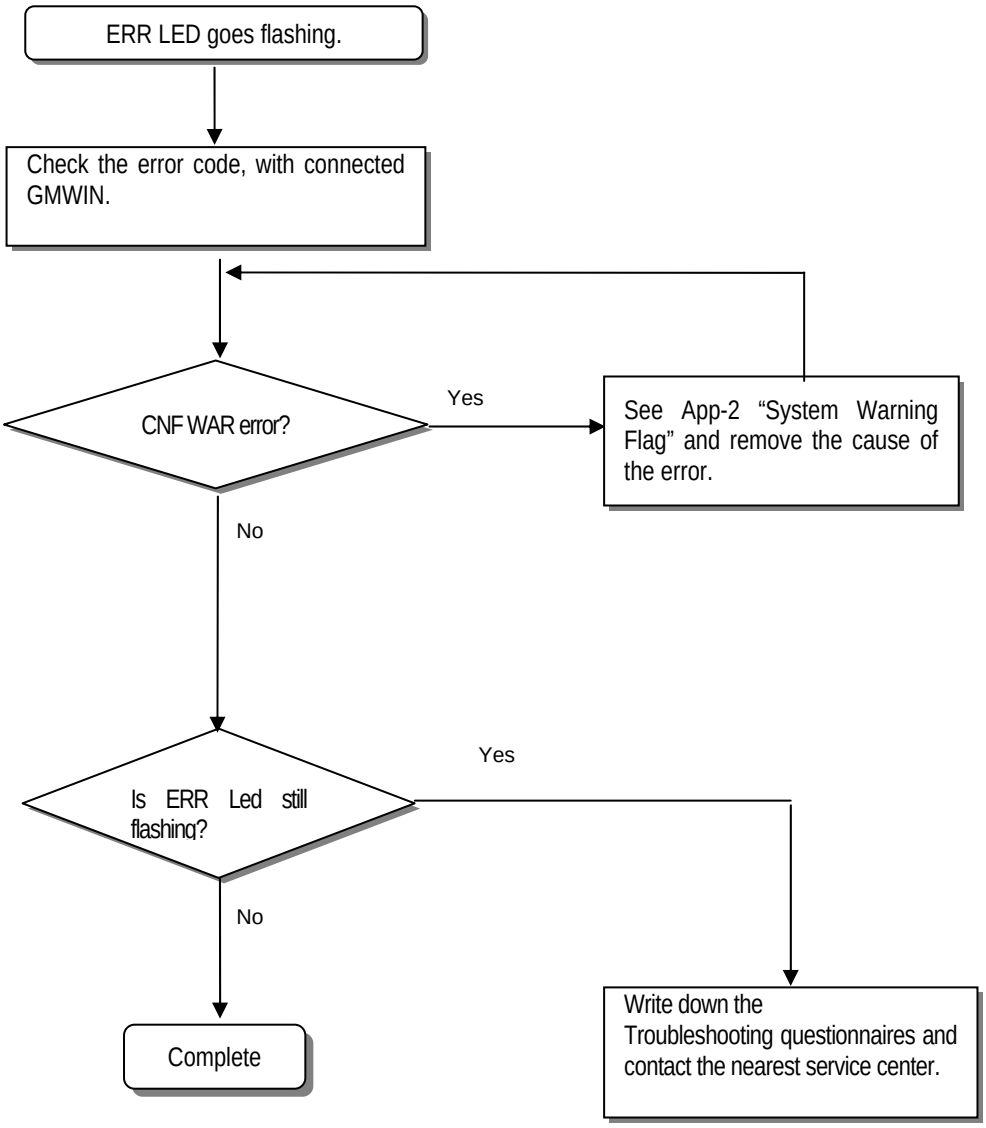
11.2.1 Flowchart for when the "POWER" LED turned off

The following flowchart explains corrective action procedure used when the power is supplied or the power LED turns off during operation.



11.2.2 Flowchart for when the "ERROR" LED is flashing

The following flowchart explains corrective action procedure use when the power is supplied starts or the ERR LED is flickering during operation.

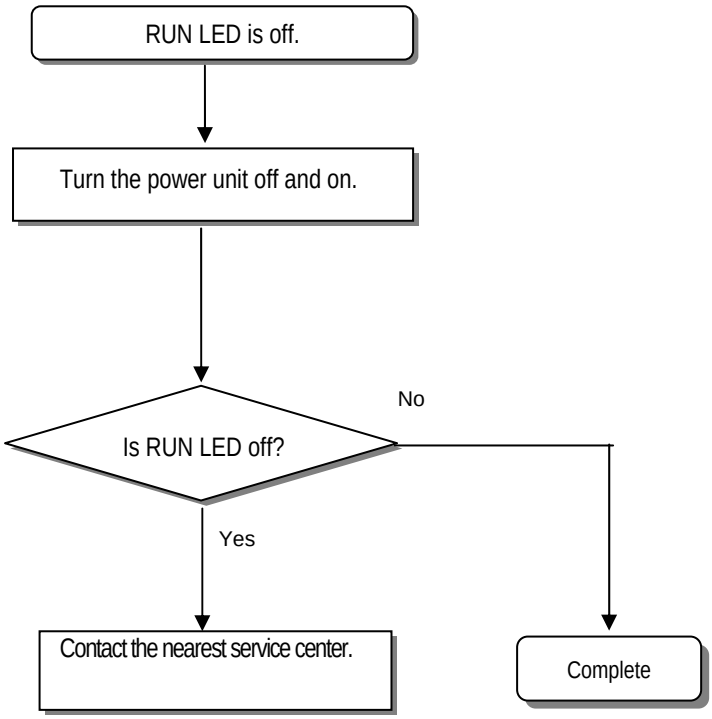


REMARK

Though CNF WAR appears, PLC system doesn't stop but corrective action is needed promptly. If not, it may cause the system failure.

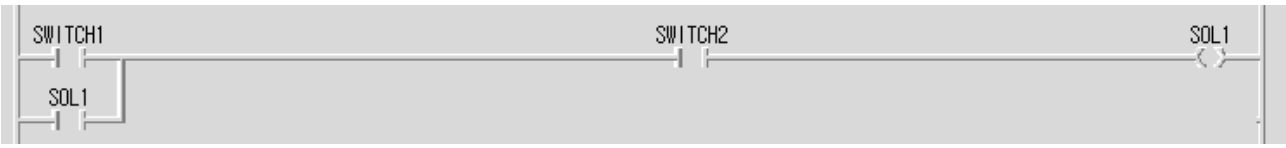
11.2.3 Flowchart for when the “RUN” LED is turned off

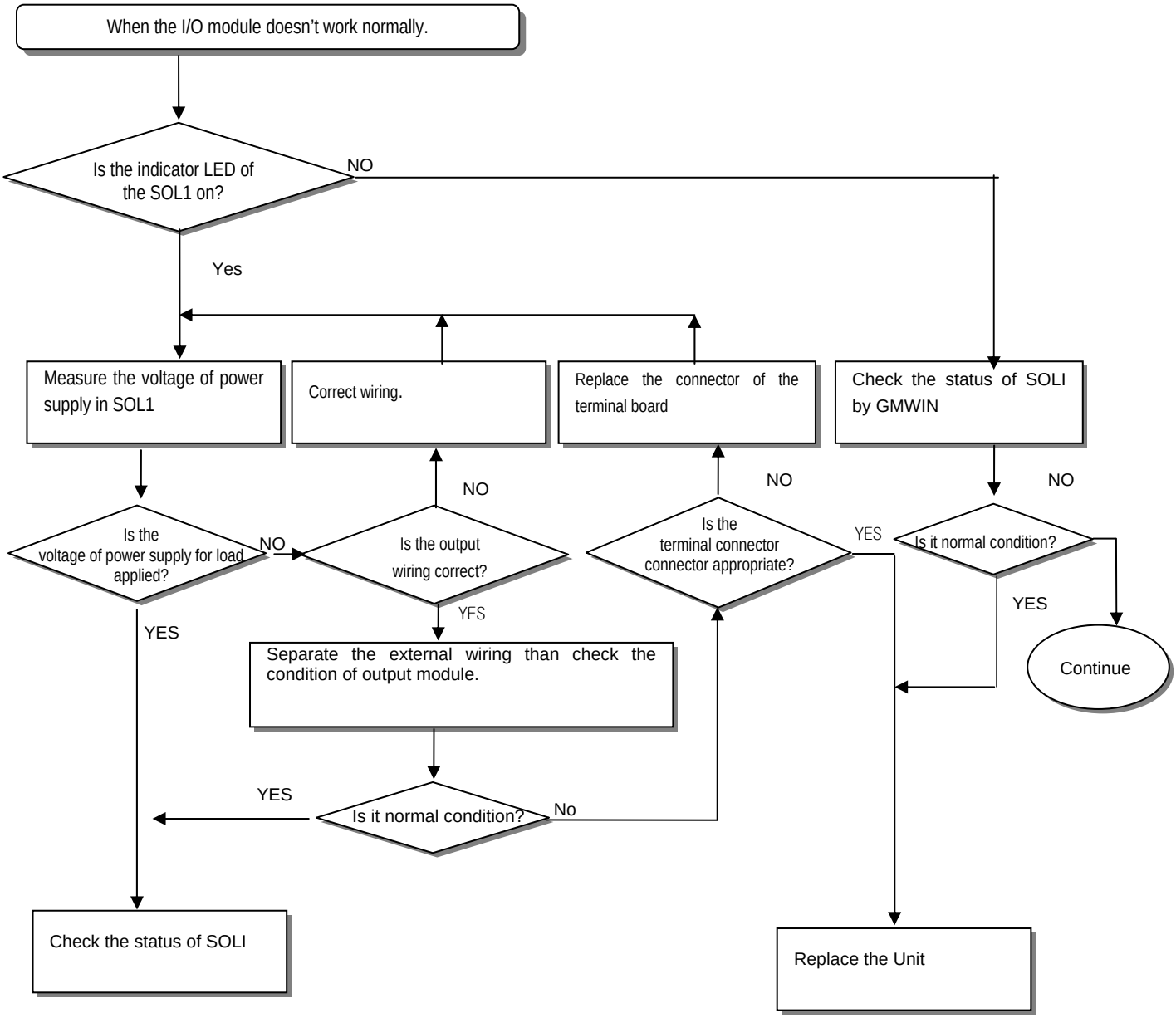
The following flowchart explains corrective action procedure to treat the lights-out of RUN LED when the power is supplied, operation starts or operation is in the process.

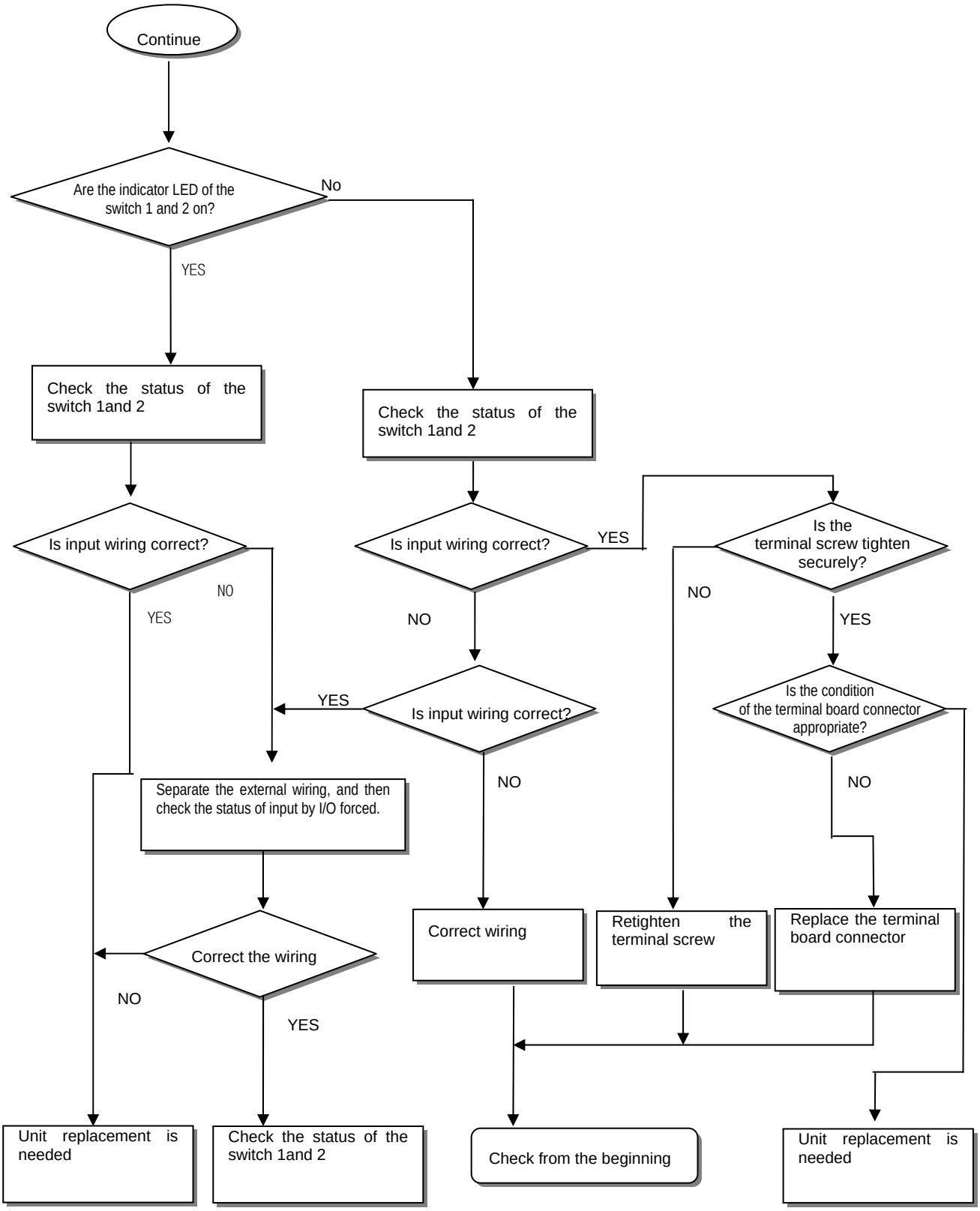


11.2.4 Flowchart for when the I/O devices does not operate normally

The following flowchart explains corrective action procedure used when the I/O module doesn't operate normally.

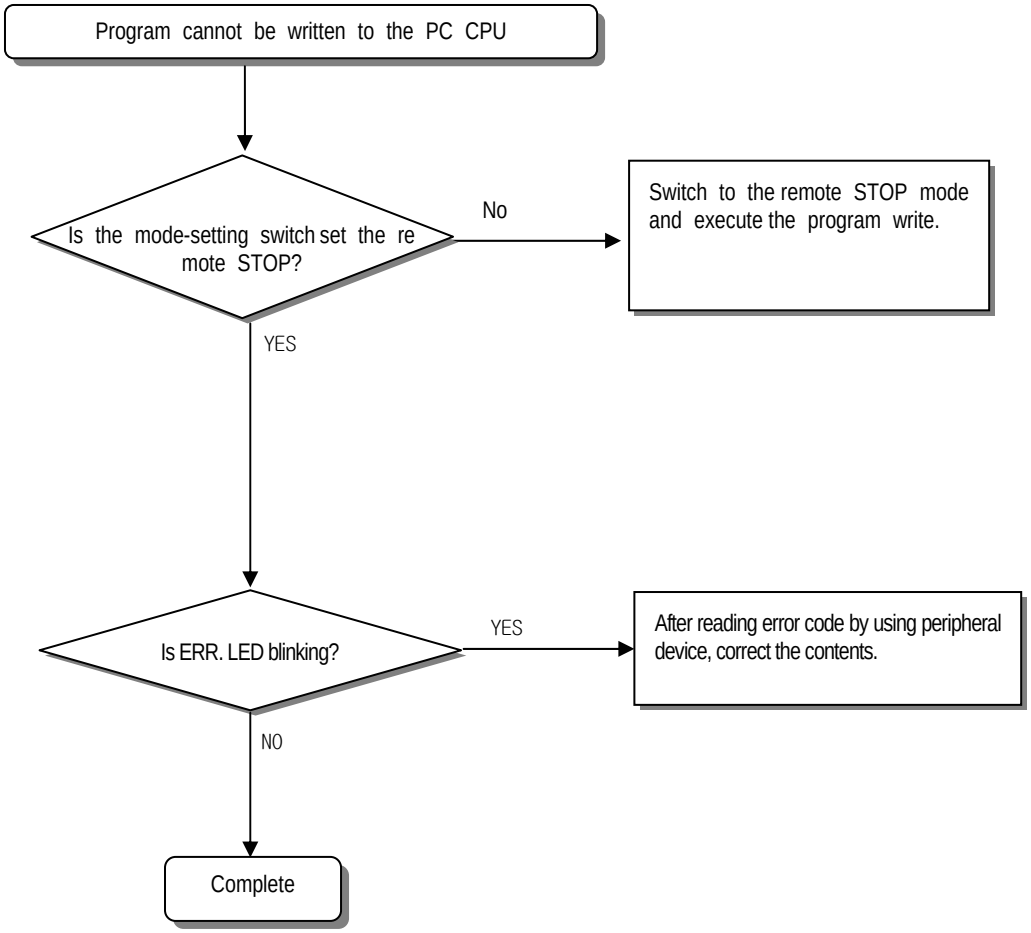





Continue
Are the indicator LED of the switch 1 and 2 on?
No
YES
Check the status of the switch 1and 2
Check the status of the switch 1and 2
Is input wiring correct?
NO
YES
Is input wiring correct?
YES
NO
Is the terminal screw tighten securely?
NO
YES
Is input wiring correct?
YES
NO
Is the condition of the terminal board connector appropriate?
NO
Separate the external wiring, and then check the status of input by I/O forced.
Correct the wiring
NO
YES
Correct wiring
Retighten the terminal screw
Replace the terminal board connector
Unit replacement is needed
Check the status of the switch 1and 2
Check from the beginning
Unit replacement is needed

11.2.5 Flowchart for when unable to write a program to the CPU

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



11.3 Troubleshooting Questionnaire

When problems occur during the operation of the GM7U series, please write down this questionnaires and contact the service center via telephone or fax.

• For errors relating to special or communication modules, use the questionnaire included in the user's manual of the unit.

1. Telephone & FAX No
   Tell)
   FAX)
2. Using equipment model:
3. Details of using equipment
   CPU model:
   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. The kind of the base unit:
– Operation by the mode setting switch ( ),
– Operation by the GMWIN or communications ( ),
– External memory module operation ( ),

6. Is the ERR. 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. Characteristics of the error
• Repetitive( ): Periodic( ), Related to a particular sequence( ), Related to environment( )
• Sometimes( ): General error interval:

12. Detailed Description of error contents:

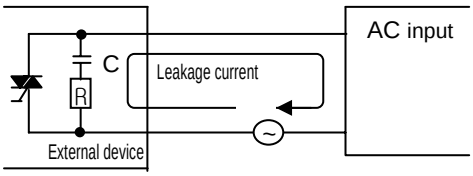
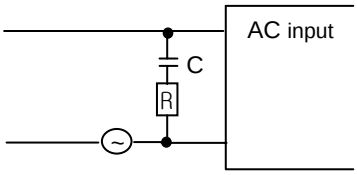
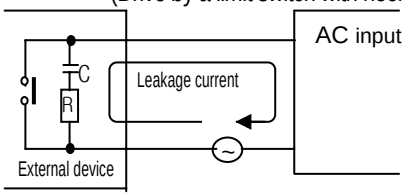
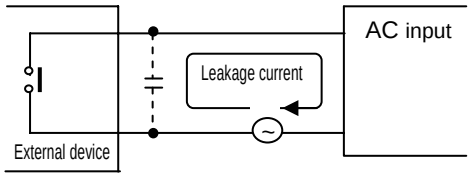
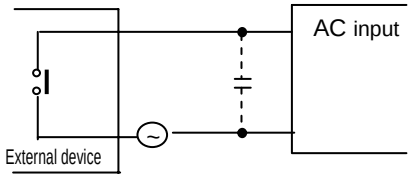
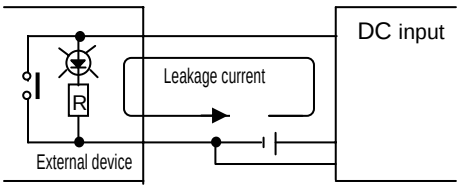
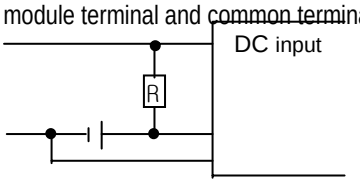
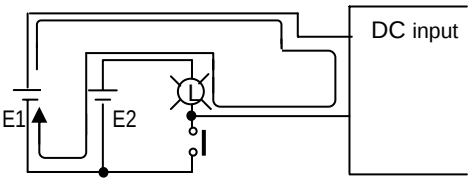
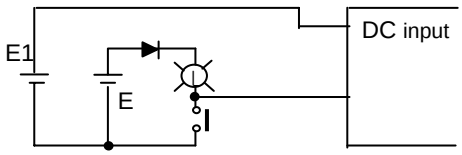
13. Configuration diagram for the applied system:

11.4 Troubleshooting Examples

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

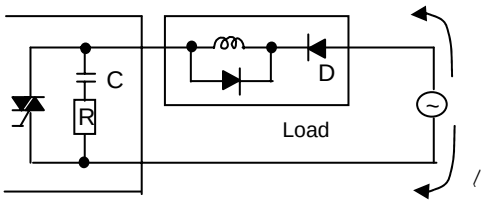
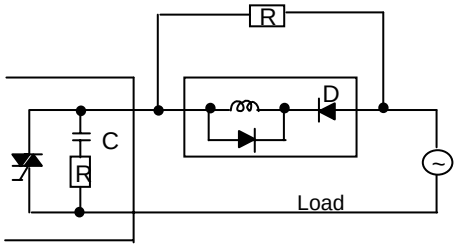
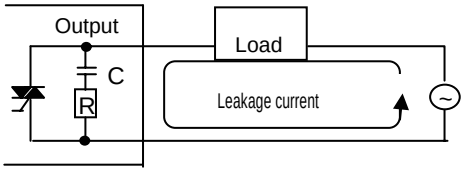
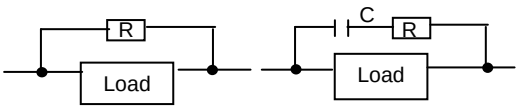
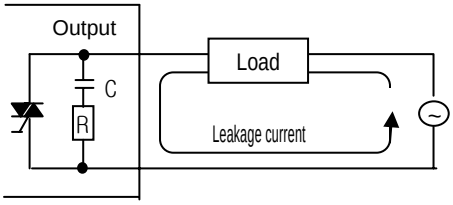
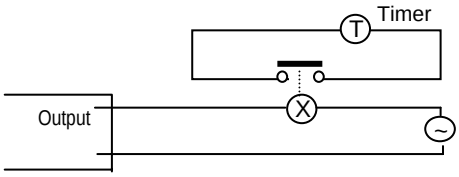
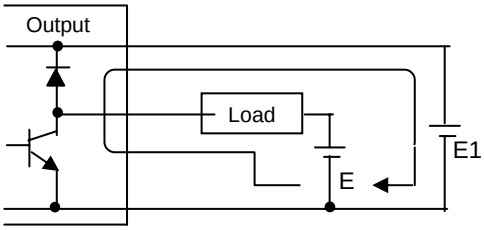
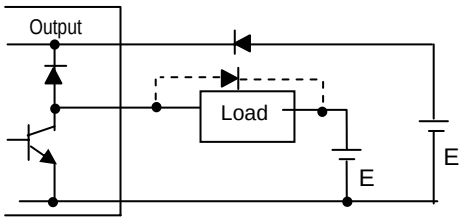
11.4.1 Input circuit troubles and corrective actions

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

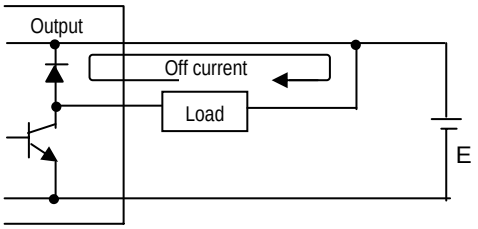
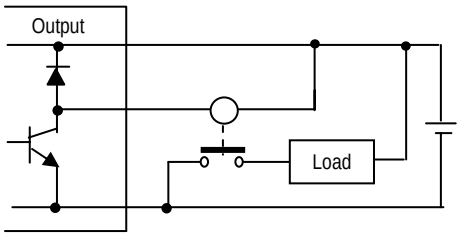
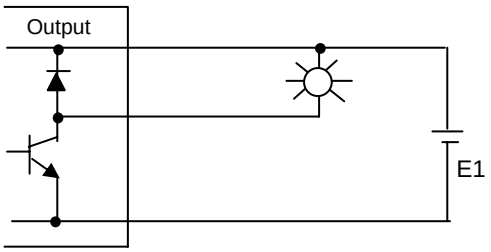
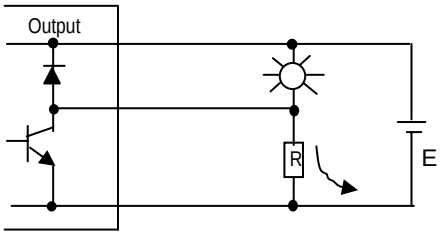
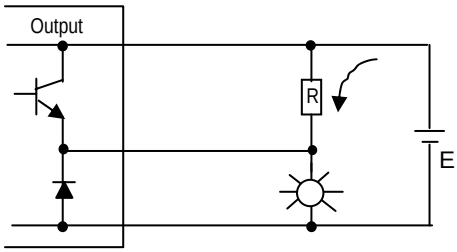
Condition	Cause	Corrective Actions
Input signal doesn't turn off.	Leakage current of external device (Such as a drive by non-contact switch)  	• Connect an appropriate register and capacity, which will make the voltage lower across the terminals of the input module. 
Input signal doesn't turn off. (Neon lamp may be still on)	Leakage current of external device (Drive by a limit switch with neon lamp)  	• CR values are determined by the leakage current value. – Recommended value C : 0.1 ~ 0.47 μF R: 47 ~ 120 Ω (1/2W) Or make up another independent display circuit.
Input signal doesn't turn off.	Leakage current due to line capacity of wiring cable.  	• Locate the power supply on the external device side as shown below. 
Input signal doesn't turn off.	Leakage current of external device (Drive by switch with LED indicator)  	• Connect an appropriate register, which will make the voltage higher than the OFF voltage across the input module terminal and common terminal. 
Input signal doesn't turn off.	• Sneak current due to the use of two different power supplies.  • E1 > E2, sneaked.	• Use only one power supply. • Connect a sneak current prevention diode. 

11.4.2 Output circuit troubles and corrective actions

The following describes possible troubles with input circuits, as well as their 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 solenoid) •When the polarity of the power supply is as shown in ①, C is charged. When the polarity is as shown in ②, the voltage charged in C plus the line voltage are applied across D. Max. voltage is approx. $2\sqrt{2}$.  *) 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 doesn't 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, sneaks. E1 is off (E2 is on), sneaks.	• Use only one power supply. • Connect a sneak current prevention diode.  If the load is the relay, etc, connect a counter-electromotive voltage absorbing code as shown by the dot line.

Output circuit troubles and corrective actions (continued).

Condition	Cause	Corrective actions
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

11.5 Error Code List

Error	Cause	Corrective action	Operation status	ERR. LED Flickering cycle	Diagnosis time	Restart mode
2	OS ROM error	Contact the A/S center if it continuously occurs when the power is re-applied.	Defect	0.4 sec.	When power is applied.	–
3	OS RAM error	Contact the A/S center if it continuously occurs when the power is re-applied.	Defect	0.4 sec.	When power is applied.	–
4	IC (RTC) error	Contact the A/S center if it continuously occurs when the power is re-applied.	Defect	0.4 sec.	When power is applied.	–
5	Fault processor	Contact the A/S center if it continuously occurs when the power is re-applied.	Defect	0.4 sec.	When power is applied.	–
6	Program memory fault	Contact the A/S center if it continuously occurs when the power is re-applied.	Defect	0.4 sec.	When power is applied.	–
7	Data memory fault	Contact the A/S center if it continuously occurs when the power is re-applied.	Defect	0.4 sec.	When power is applied.	–
10	Watch dog error due to RE-apply the powe r	Re-apply the power	Reset	–	During run	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_TYER_N, IO_TYER [n]) and correct the in corrective slot, and restart 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 restart 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 restart 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 (_SP_IFER, _IP_IFER_N, _IP_IFER [n]) and restart the system.	STOP	0.4 sec.	When scan completes During execution of program	Cold

Error	Cause	Corrective action	Operation status	ERR LED Flickering cycle	Diagnosis time	Restart mode
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 restart the program.	STOP	0.4 sec.	During execution of program	Cold
41	Unreadable instructions in the user program.	Re-load the program and restart it.	STOP	0.4 sec.	During execution of program	Cold
50	External device fatal error.	Refer to the external device fatal error. Flag (ANNUN_ER, _ANC_ERR [n]) and correct the fault devices and then restart 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 restart the system (cold restart).	STOP	–	During execution of program	–
100	Communications module configuration error	If the number of computer 4 communications 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 batter has no error.	RUN	2 sec.	When power is applied. When scan completes	Cold
501	RTC data error	If the battery has no error, reset the time using the SMWIN.	RUN	2 sec.	When power is applied. When scan completes	–

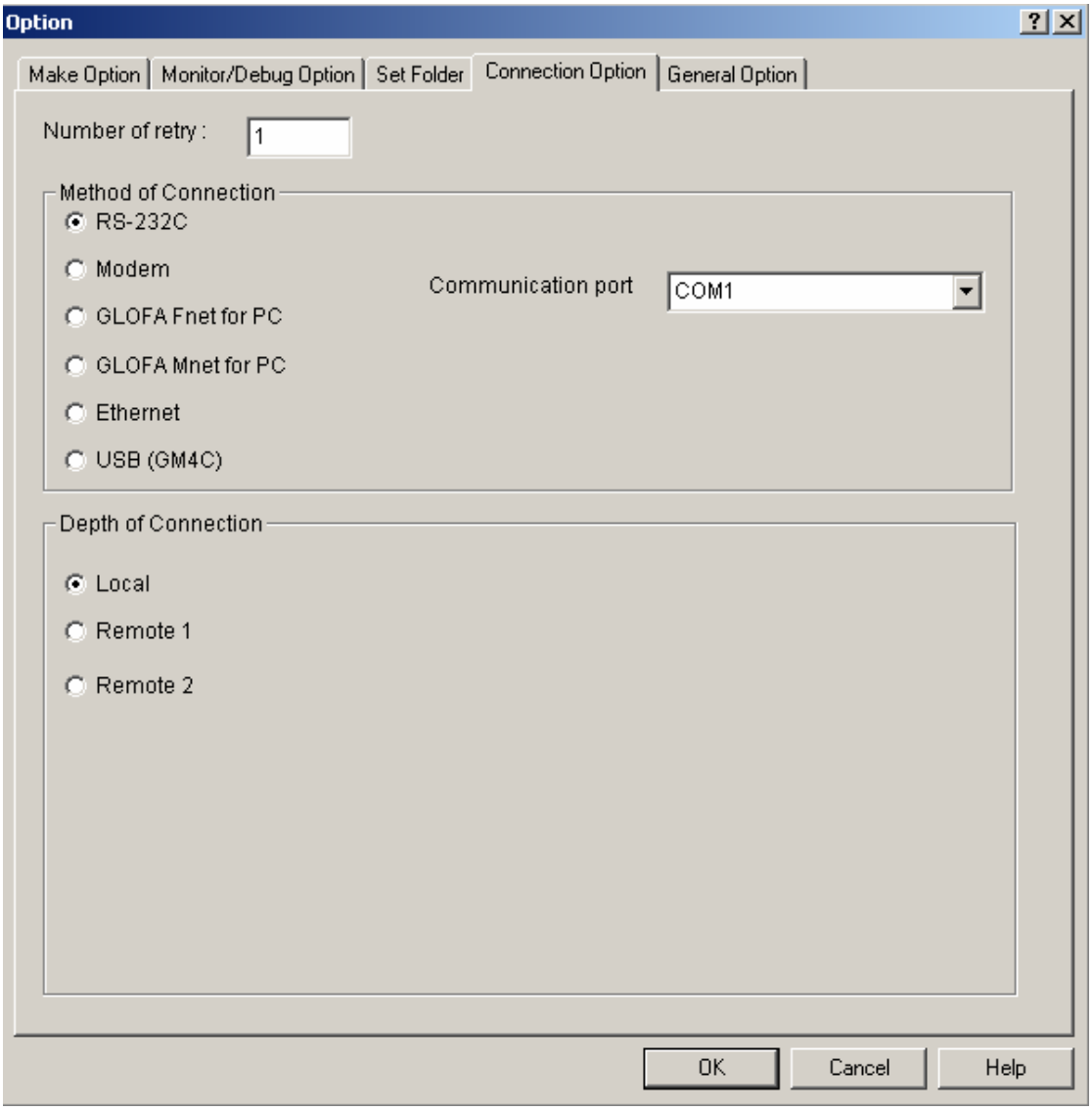
Appendix 1. System Definitions

1) Option

(1) Connection Option

You should set the communication port (COM1～4) to communicate with PLC.
- Select the *Project-Option-Connection Option* in menu.
- Default Connection is RS-232C interface.

For details, refer to the GMWIN manual.

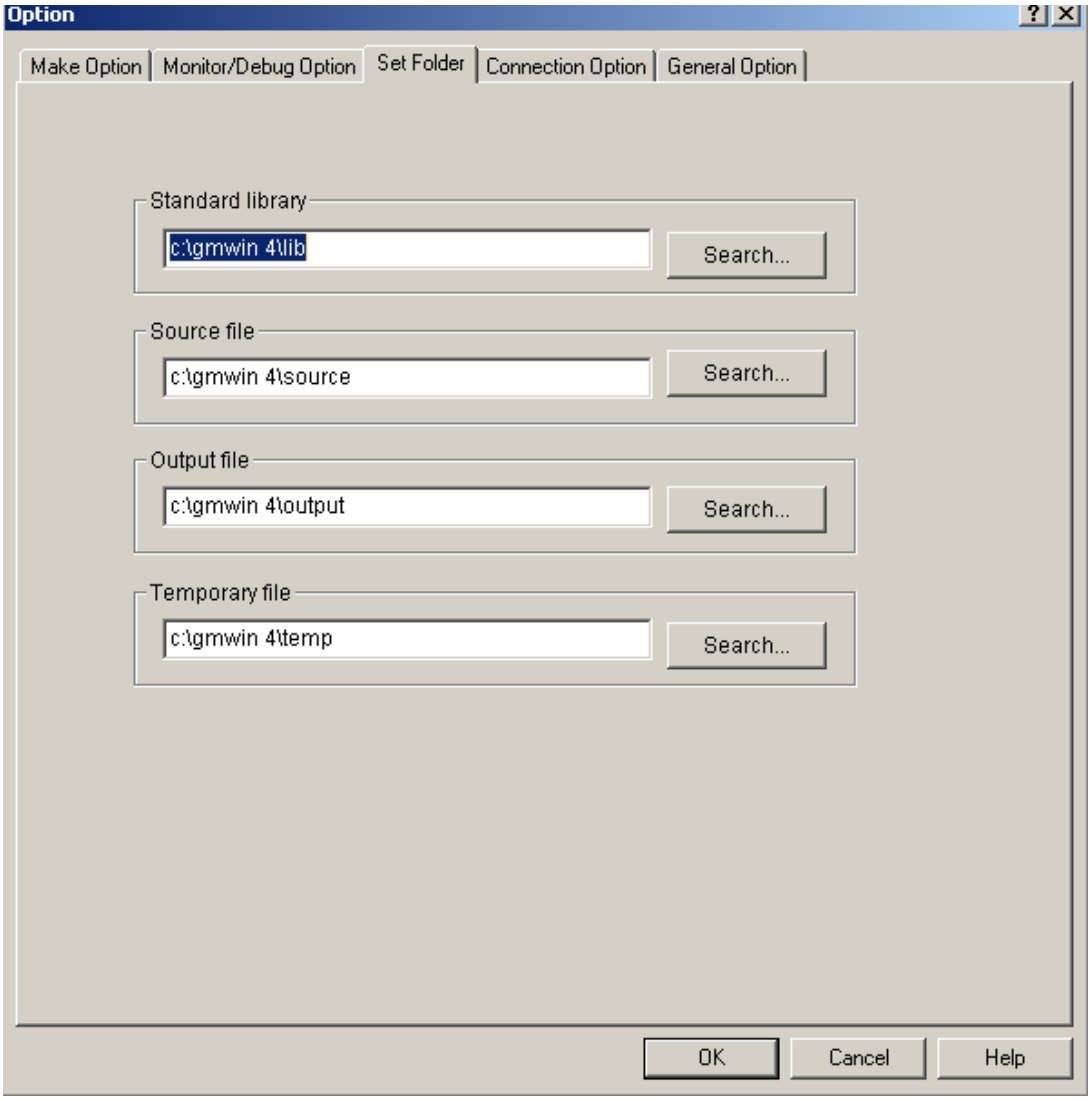


(2) Set Folder

You can set directories for the files to be created in GMWIN.

- Standard library: Libraries for GMWIN are located in this directory, and User Defined Libraries also do.
- Source file: In Source File Directory, GMWIN saves source program files of program, function, function block and etc.
- Output file: Object files are saved in this directory, which are created when source file is compiled.
- Temporary file: GMWIN saves temporary file in this directory during the execution. For detailed descriptions refers to GMWIN manual.

For details, refer to the GMWIN manual.

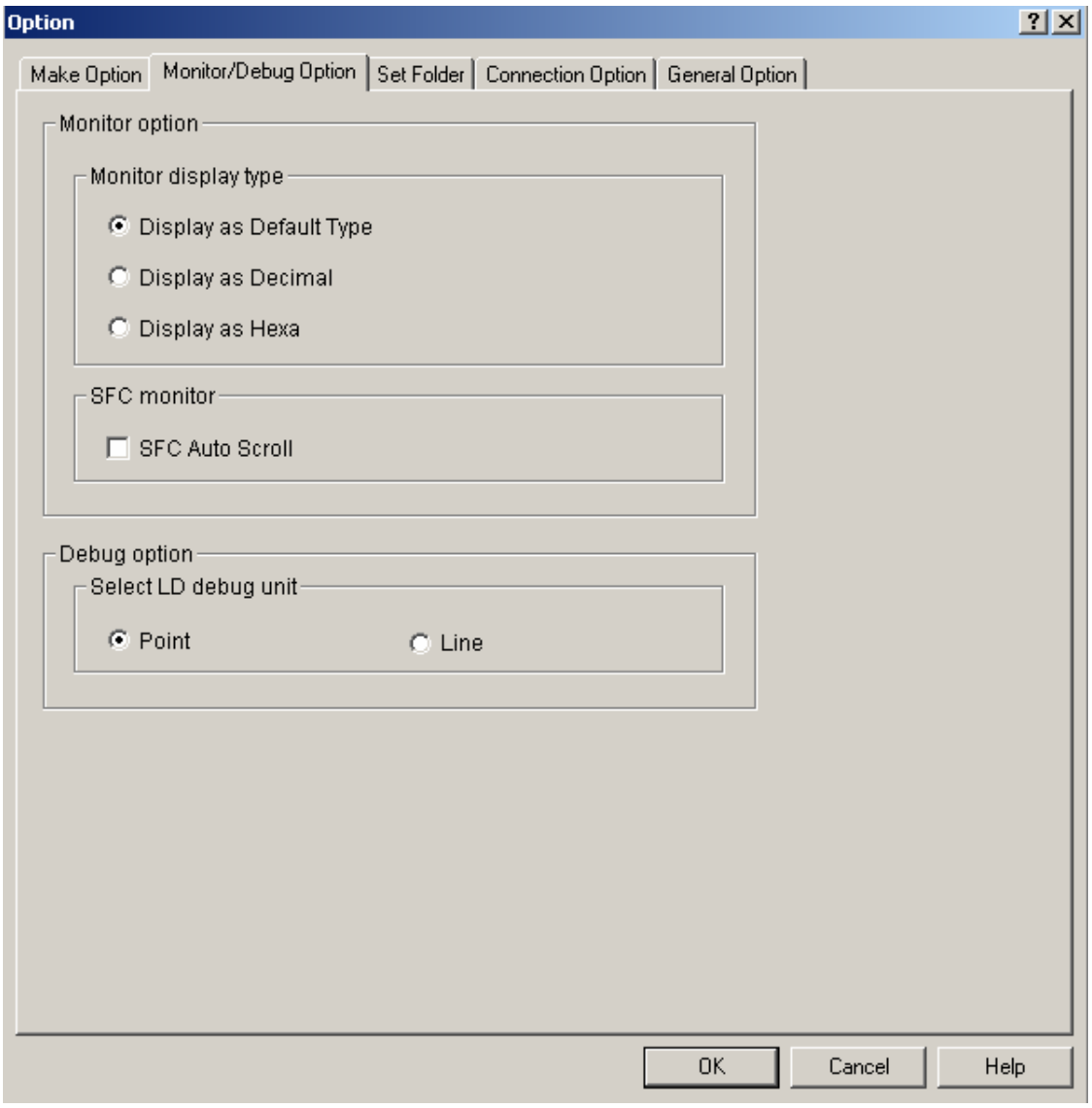


(3) Monitor/Debug Option

To set the whole options for monitoring,

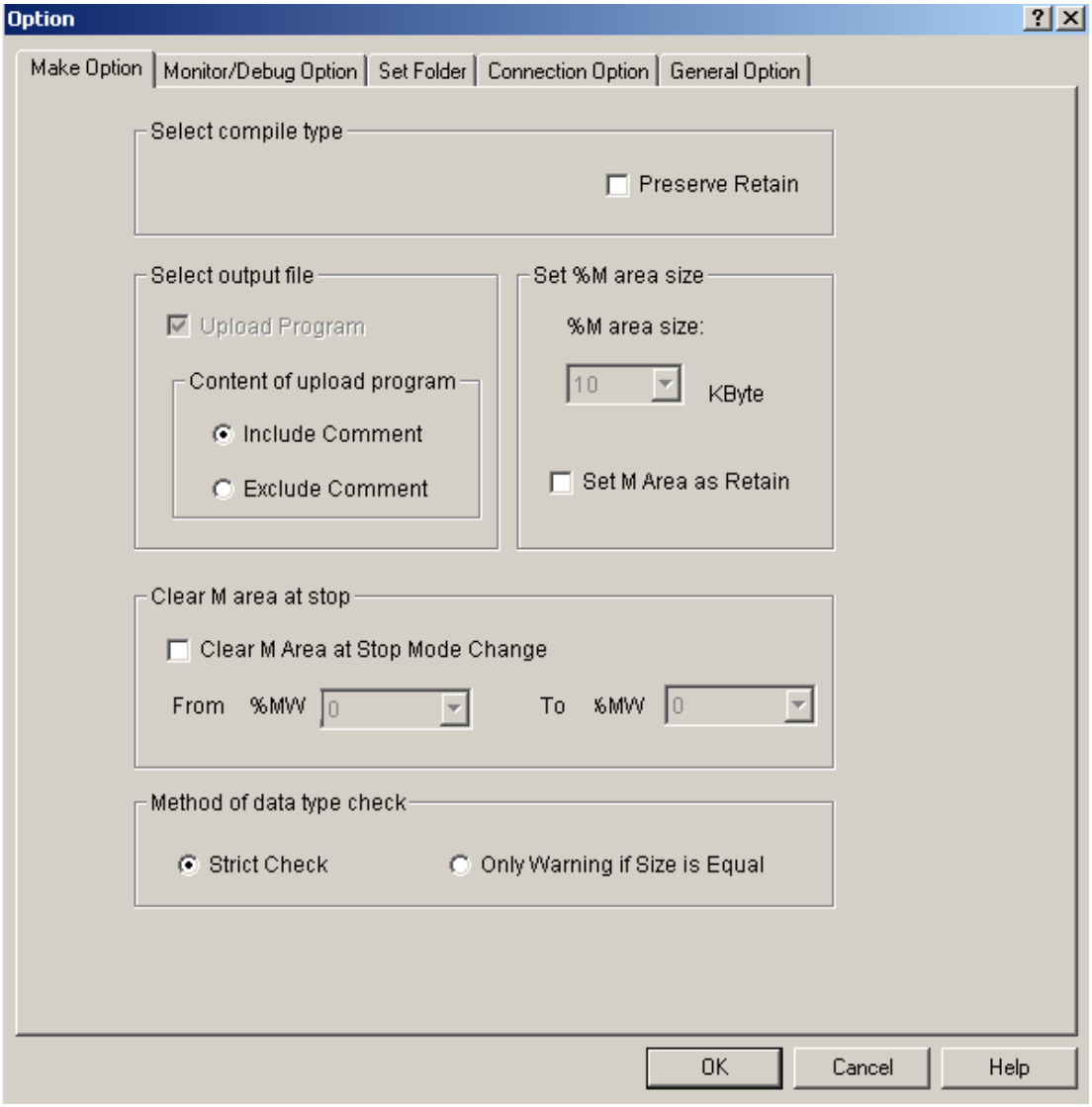
- Monitor display type: displays monitor variables.
- SFC monitor: Automatically scrolls following the monitoring position.
- Debug option: When you debug LD, you can select the *Point* or *Line* in *Debug option* menu.

If you select *Point* option, the debugging for the program is executed by one point. If you select *Line* option, the debugging for the program is executed by one line.



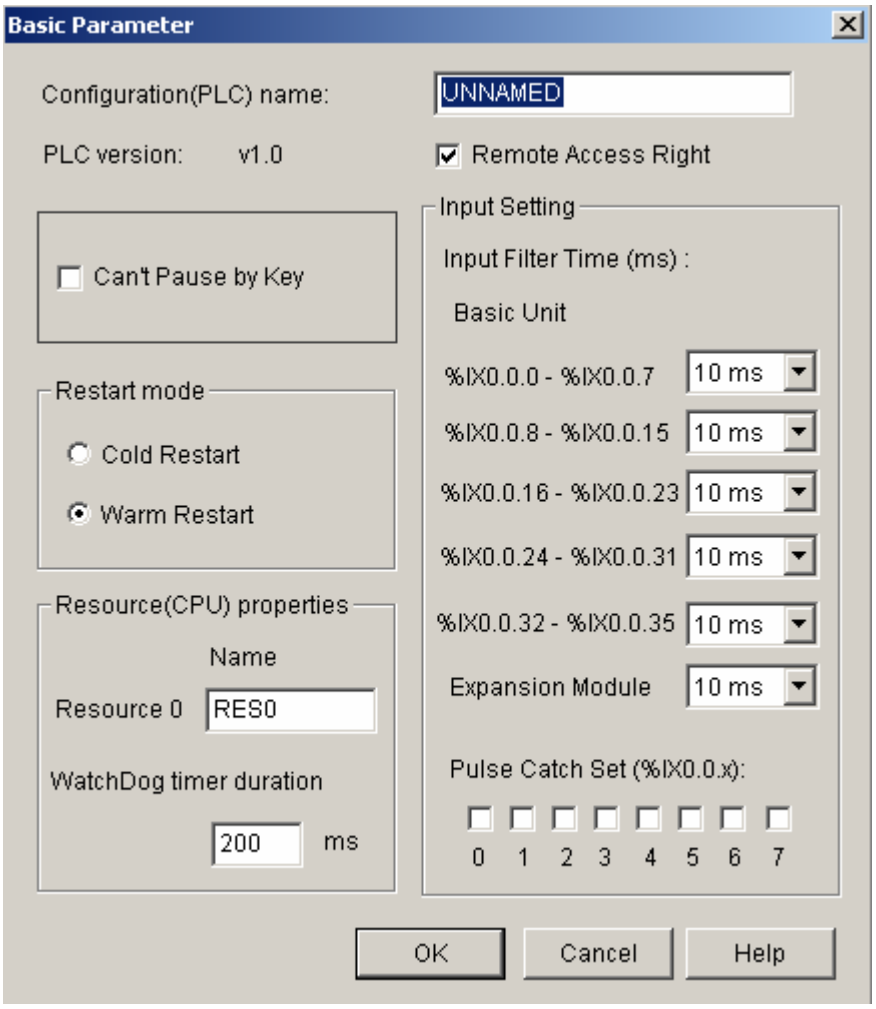
(4) Make Option

- Select Project-Option-Make Option in the menu.
- Select compile type
  - If *Preserve Retain* is selected the retain variables are saved when the PLC restarts with warm mode.
- Clear M area at stop
  - Clears the specified %M area in *Stop* mode.



2) Basic Parameter

The basic parameters are necessary for the operation of the PLC and used to allocate memory, set the restart mode and watchdog timer duration, 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) 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.

(4) Resource(CPU) properties

- 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 GM7U series, therefore, only the resource 0 is valid.

(5) WatchDog timer duration

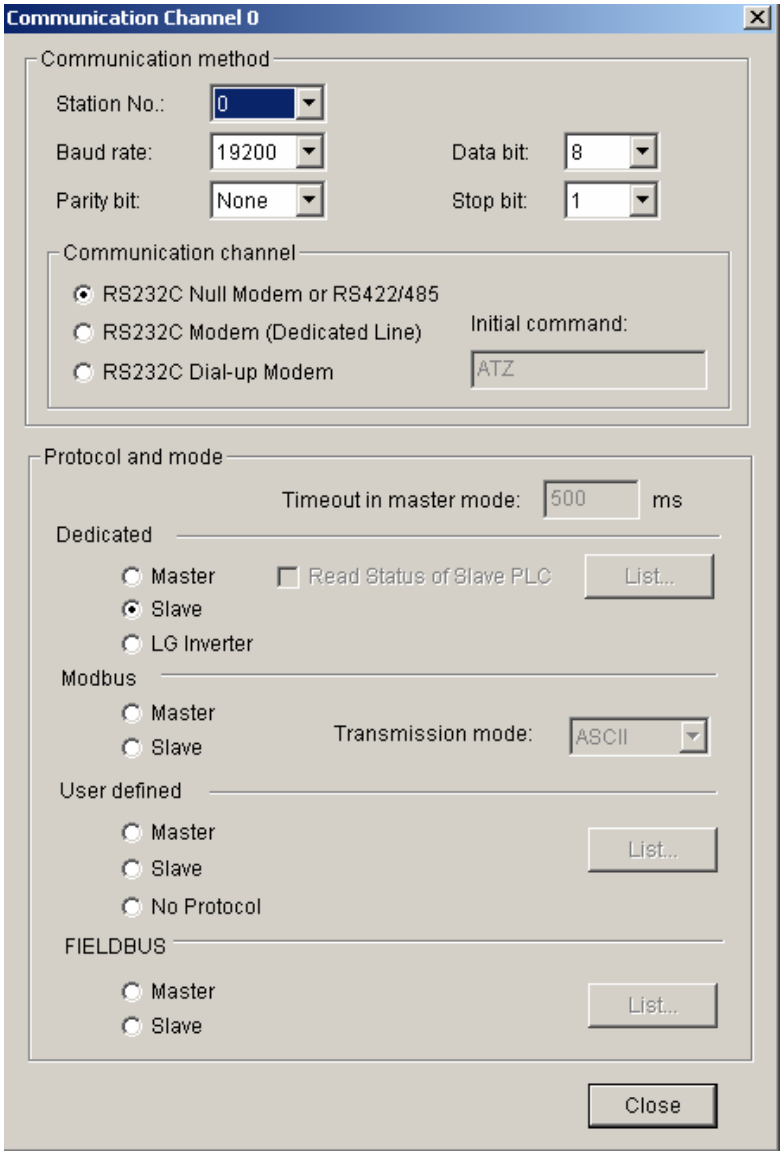
- This parameter is used to set the maximum allowable execution time of a user program in order to supervisor its normal or abnormal operation.
- Only one CPU module can be mounted in the GM7U series, therefore, scan watch dog is valid to only the resource 0.

(6) Input Setting

- It's used to select contact point that will be used for setting input filter or as input pulse catch.

3) Communication parameter

This is a communication parameter to set regular sending/receiving stations, data and cycles to send and receive repeatedly. (For the detail information about Communication parameter, refer to 7.1.7 "Communication parameter setting")



(1) Station No.: 0 to 31

(2) Baud Rate: 1200,2400,4800,9600,19200,38400,57600bps.

(3) Data bit: 7 or 8 bits

(4) Parity bit: None, Even, odd

(5) Stop bit: 1 or 2 bit(s)

(6) Communication channel

- RS-232C Null Modem or RS-422/485: Select this channel to communicate through GM7U base unit or Cnet I/F module (G7L-CUEC).
- RS-232C modem(Dedicated Line): Select this channel to communicate through Cnet I/F module (G7L-CUEB).
- RS-232C dial-up modem: Select this channel to communicate dial-up modem for modem communication, using Cnet I/F module (G7L-CUEB)

REMARK
RS-232C modem(Dedicated Line) and RS232C dial up modem communication can be executed under RS-232C I/F module(G7L-CUEB)

(7) Master/slave: Select master to be major in the communications system.

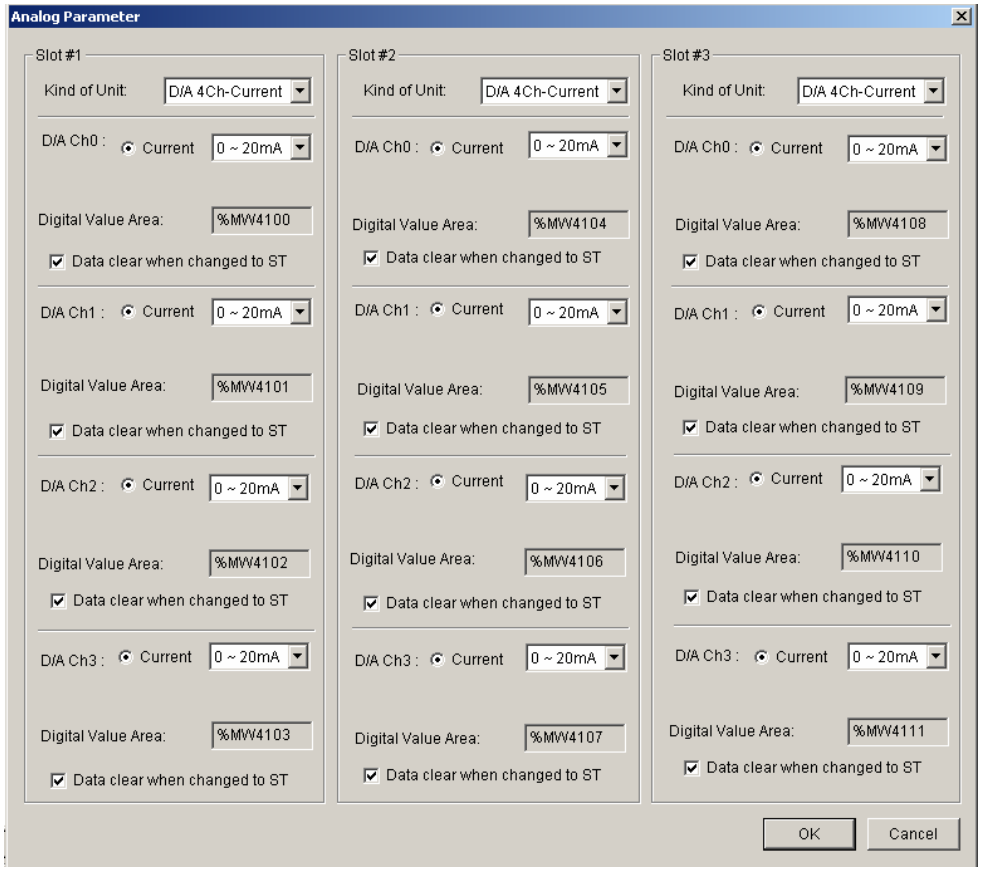
(8) Time out

- The value of default is 500ms.
- Set the maximum cycle time for sending and receiving of the master PLC.
- It may cause of communication error that lower setting value than maximum cycle time for sending and receiving.

(9) Reading slave PLC status.

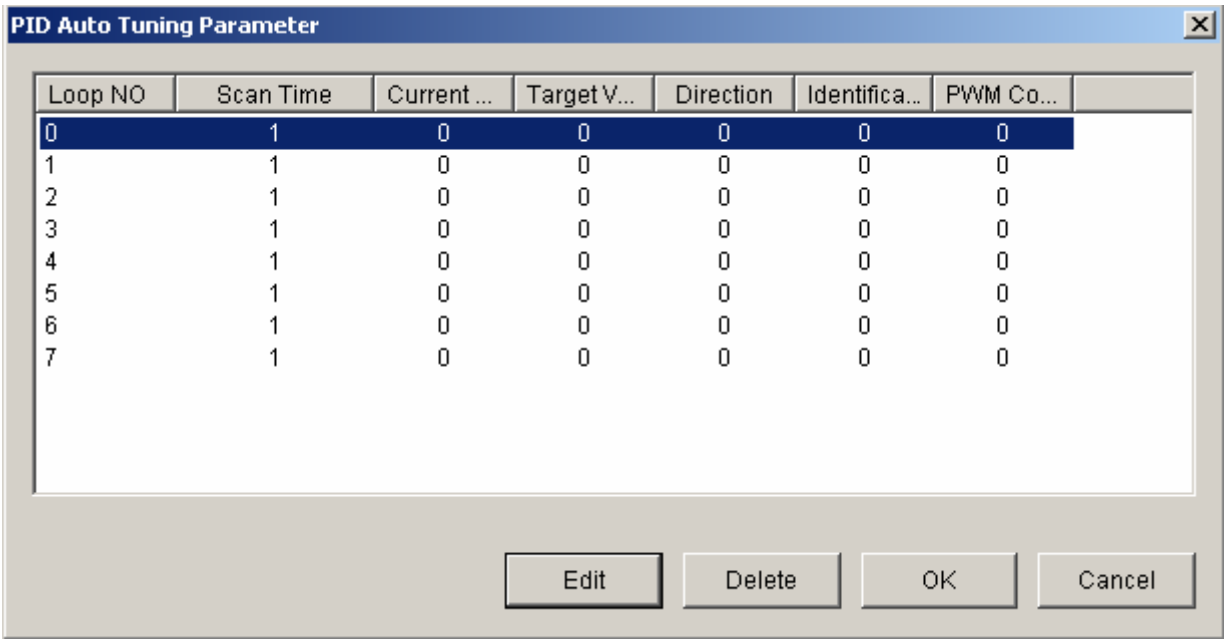
- Select to read GM7U base unit status as slave designated. But do not choose this except for the monitoring of the slave status. It may cause to drop down the communication speed.

4) Special parameters



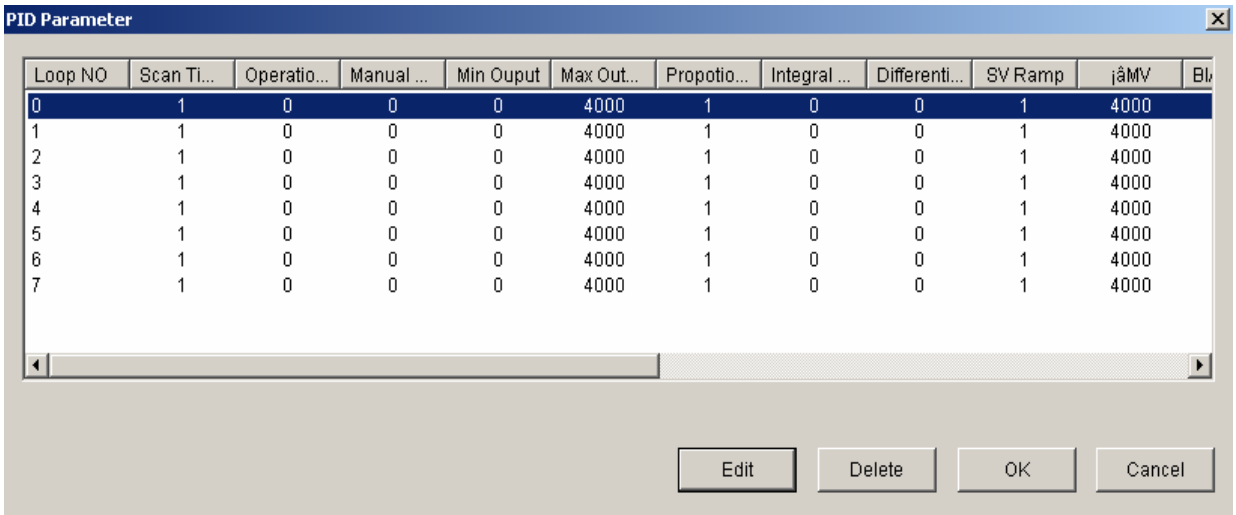
5) PID parameters

(1) PID Auto Tuning Parameter



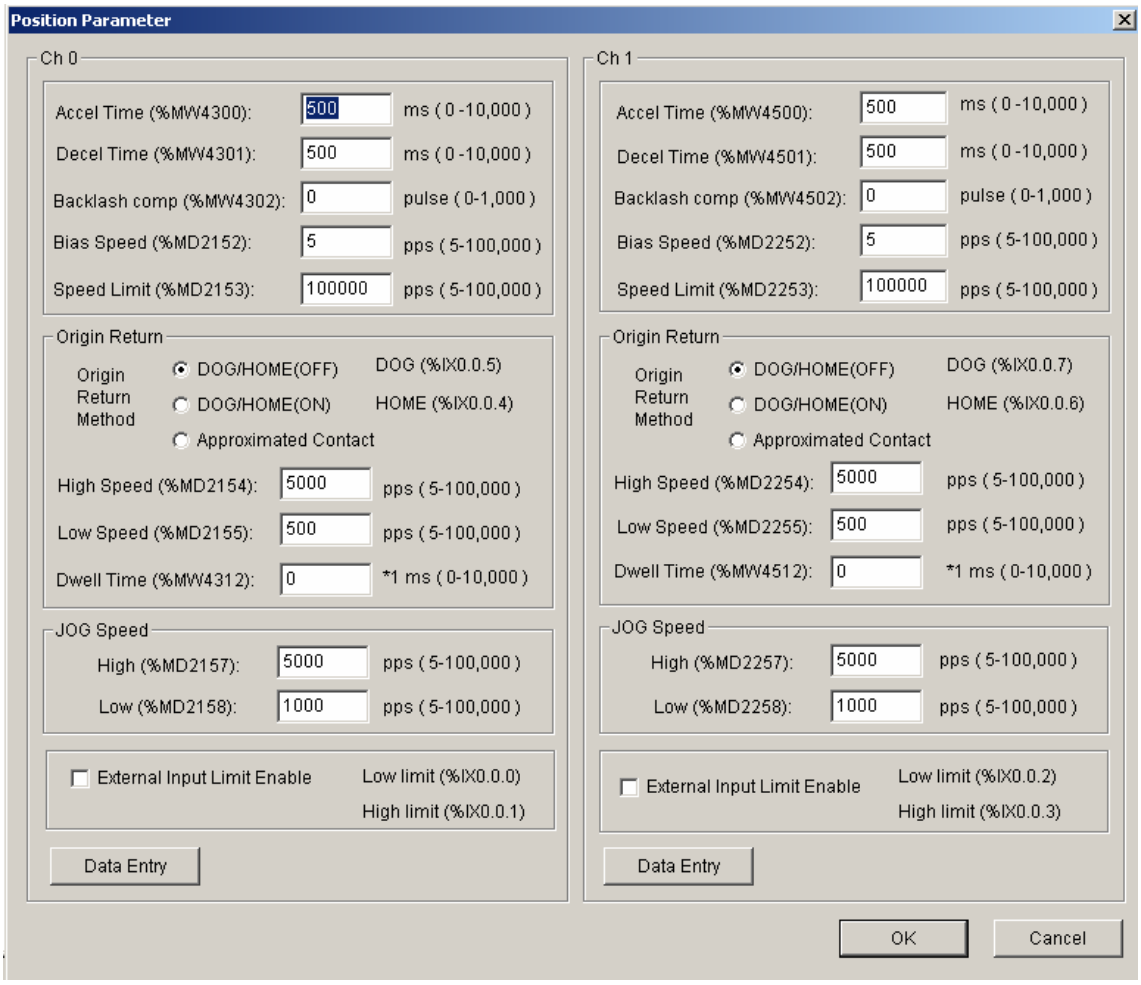
Loop NO	Scan Time	Current ...	Target V...	Direction	Identifica...	PWM Co...
0	1	0	0	0	0	0
1	1	0	0	0	0	0
2	1	0	0	0	0	0
3	1	0	0	0	0	0
4	1	0	0	0	0	0
5	1	0	0	0	0	0
6	1	0	0	0	0	0
7	1	0	0	0	0	0

(2) PID Parameter

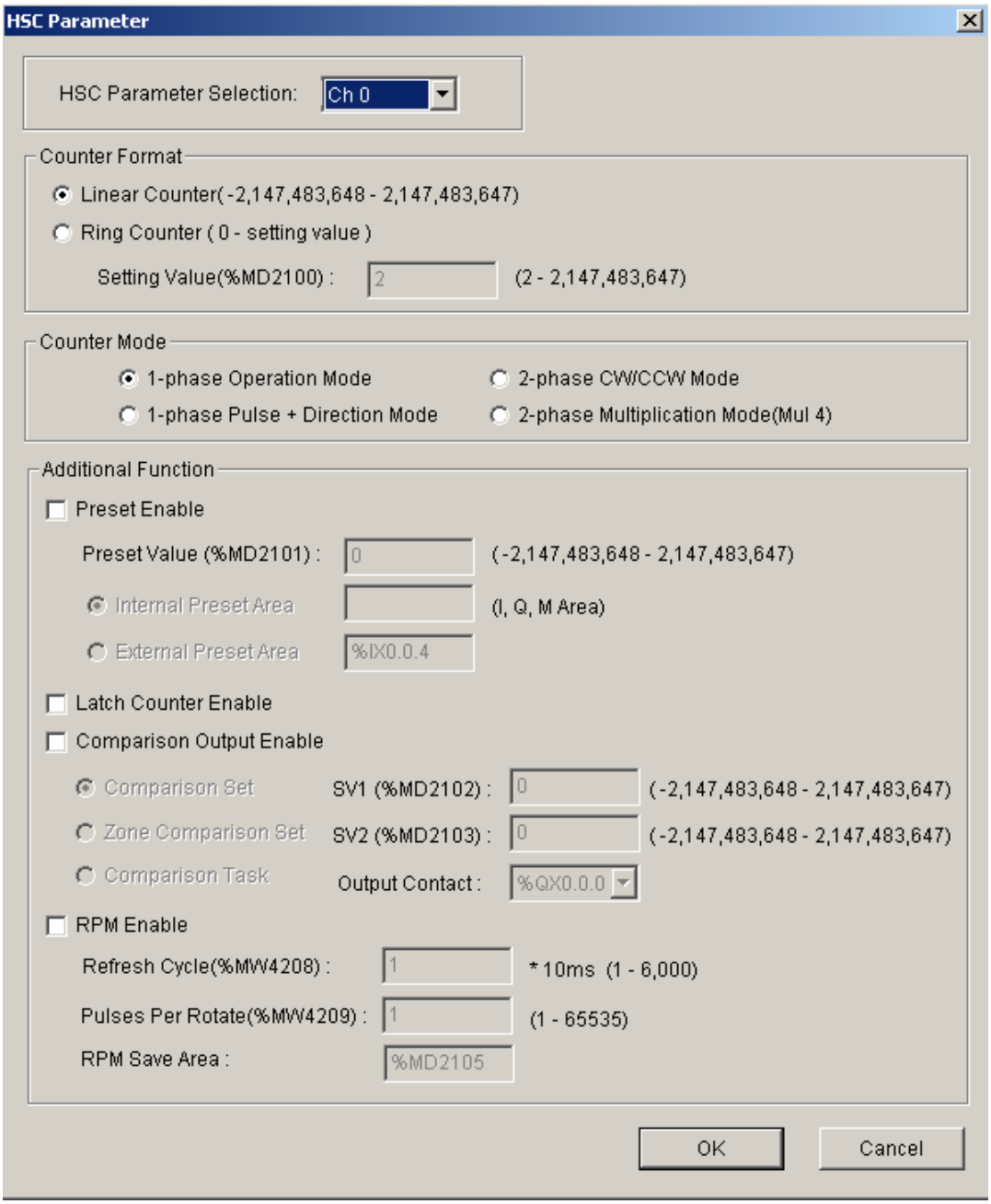


Loop NO	Scan Ti...	Operatio...	Manual ...	Min Ouput	Max Out...	Propotio...	Integral ...	Differenti...	SV Ramp	¡âMV	Bl
0	1	0	0	0	4000	1	0	0	1	4000	
1	1	0	0	0	4000	1	0	0	1	4000	
2	1	0	0	0	4000	1	0	0	1	4000	
3	1	0	0	0	4000	1	0	0	1	4000	
4	1	0	0	0	4000	1	0	0	1	4000	
5	1	0	0	0	4000	1	0	0	1	4000	
6	1	0	0	0	4000	1	0	0	1	4000	
7	1	0	0	0	4000	1	0	0	1	4000	

6) Position Parameter

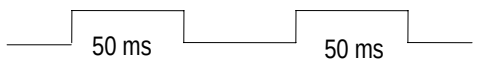


7) High Speed Counter Parameter



Appendix 2. Flag Lists

1) User flag lists

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 ms 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 ms Clock	
_T200MS *	BOOL	–	200 ms Clock	
_T1S *	BOOL	–	1s Clock	
_T2S *	BOOL	–	2s Clock	
_T10S *	BOOL	–	10s Clock	
_T20S *	BOOL	–	20s clock	
_T60S *	BOOL	–	60s 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)

REMARK

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.
2) RTC related flags could be used if only the optional module for RTC is installed.

2) System error flag lists

Keyword	Type	Bit No.	Name	Description
_CNF_ER	WORD	Represent--ative keyword	System error (fatal error)	This flag handles the following operation stop error flags in batch.
_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])
_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/com-munications 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.
_STACK_ER	BOOL	Bit 10	Stack overflow error	This flag indicates that the stack is used out of its capacity(Overflow)
_P_BCK_ER	BOOL	Bit 11	Program error	This flag indicates that program execution is impossible due to destroyed memory or program error.

3) System warning flag lists

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 error.
_D_BCK_ER	BOOL	Bit 1	Data backup error	This flag indicates
_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	Communica-tion Parameter 1 error	This representative flag detects error of each Communication parameter when the Communication has been enabled and indicates that Communication cannot be executed. It will be reset when the Communication is disabled.

4) Detailed system error and warning flag lists

Keyword	Type	Data setting range	Name	Description
_IO_RWER_N	UINT	0 to 15	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.
_ANC_ERR[n]	UINT	n: 0 to 7	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 127	External device ordinary error bit map	The user program detects ordinary error of external device and the errors are indicated on a bit map. (The number 0 is not allowed)
_TC_BMAP[n]	BIT	n: 0 to 7	Task collision bit map	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 bit map.
_TC_CNT[n]	UINT	n: 0 to 7	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)

* Marked flags can be used while the RTC option module is in use.

5) System operation status information flag lists

Keyword	Type	Data setting range	Name	Description
_CPU_TYPE	UNIT	0 to 16	System type	GM1: 0, GM2: 1, (GM3: 2, GM4: 3) (FSM: 5,6)
_VER_NUM	UNIT	-	O/S version No.	System O/S version No.
_MEM_TYPE	UNIT	1 to 5	Memory module type	Type of program memory module (0: Unloading state, type: 0 to 5)
_SYS_STATE	WORD	Repre-sentative 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 change switch 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 mode change switch
		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	BYTE	Repre-sentative 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 communicatio ns connection	Remote communications connection state

* Marked flags can be used while the RTC option module is in use.

System operation status information flag lists (continued)

Keyword	Type	Data setting range	Name	Description
_RST_TY	BYTE	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	BOOL	-	During initialization	An initialization program written by the user is being executed
_SCAN_MAX	UNIT	-	Maximum scan time (ms)	Maximum scan time is written during operation.
_SCAN_MIN	UNIT	-	Minimum scan time (ms)	Minimum scan time is written during operation.
_SCAN_CUR	UNIT	-	Present scan time (ms)	Present scan time is continuously updated during operation.
_RTC_TIME[n]*	BCD	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	UNIT	Error code	Error type	See the Section 12.5 Error Code List

* Marked flags can be used while the RTC option module is in use.

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 2	Program error	Checks and indicates Program error
		-	-	-
		Bit 4	Communication parameter error	Checks and indicates High speed link parameter error

(2) Operation mode change switch status information

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

Appendix 3. Function / Function Block Lists

1) Function lists

Name	Function	Size of PB (Byte) *1	Size of library (Byte) *2	Processing speed (μs) *3
				GM7U
ABS (int)	Absolute value operation	36	-	2.0
ADD (int)	Addition	24	-	1.5
AND (word)	Logical multiplication	16	-	1.0
DIV (int)	Division	24	-	2.5
DIV (dint)	Division	24	-	3.3
EQ (int)	Equality' comparison	20	-	1.3
LIMIT (int)	To output upper and lower limits	24	848	4.8
MAX (int)	To output the maximum input value	24	1076	5.9
MOVE	To cop data	8	-	0.5
MUL (dint)	Multiplication	24	-	3.3
MUL (int)	Multiplication	24	-	2.5
ROL	To rotate left	20	136	3.7
BCD_TO_DINT	Conversion of BCD type into DINT	12	264	8.5
BCD_TO_INT	Conversion of BCD type into INT type	12	160	6.9
BCD_TO_SINT	Conversion of BCD type into SINT type	12	108	5.3
BYTE_TO_SINT	Conversion of BYTE type into SINT type	8	-	0.5
DATE_TO_STRING	Conversion of DATE type into string	32	314	20.8
DINT_TO_INT	Conversion of DINT pe into INT type	48	-	2.2
DINT_TO_BCD	Conversion of DINT type into BCD type	12	156	8.8
DT_TO_DATE	Conversion of DT type into DATE type	16	4	1.1
DT_TO_TOD	Conversion of DT type into TOD type	16	12	1.4
DT_TO_STRING	Conversion of DT type into string	36	620	21.0
DWORD_TO_WORD	Conversion of DWORD type into WORD	8	-	0.5
INT_TO_DINT	Conversion of INT type into DINT type	12	-	0.7
INT_TO_BCD	Conversion of INT type into BCD type	12	100	7.2
NUM_TO_STRING (int)	Conversion of number into string	24	580	15.9
SINT_TO_BCD	Conversion of SINT type into BCD type	12	76	5.9
STRING_TO_INT	Conversion of string info NT type	12	1264	28.9
CONCAT	To concatenate strings	48	172	5.9
DELETE	To delete string	40	172	6.9
EQ (str)	'Equality' comparison	32	948	8.3
FIND	To find a string	24	220	7.9
INSERT	To insert a string	48	160	8.9
LEFT	To obtain the left part of a string	36	100	6.4
LEN	To obtain the length of a string	12	40	4.5
LIMIT (str)	To output upper or lower limits	60	794	8.9
MAX (str)	To output the maximum input value	52	1076	8.4
MID	To obtain the middle part of a string	40	188	7.1
REPLACE	To replace a string with another	52	288	7.9
RIGHT	To obtain the hr part of a scan	36	164	6.9
ADD_TIME (time)	Time addition	20	148	5.6
DIV_TIME (i1=time)	Time division	20	152	6.9

REMARK

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 lists when programs are written with IL (instruction List) language.
   If programs are written with LD (Ladder diagram), the following differences occur.
   (1) 16 bytes 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 sec will be added.

2) Function block lists

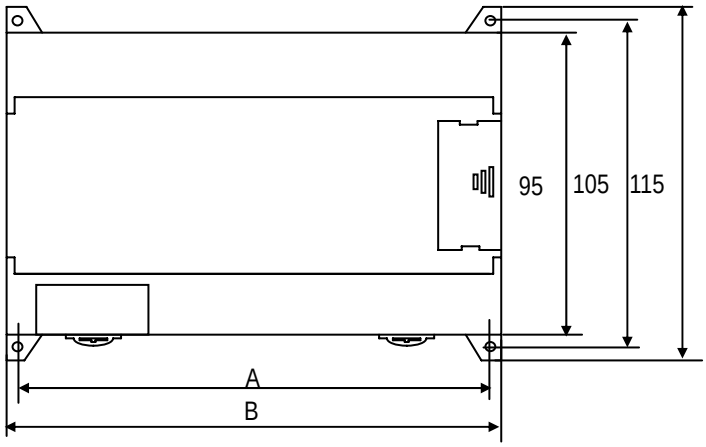
Name	Function	Size of PB (Byte)∗2	Size of library		Processing speed (μs) *4
			Size (Byte)∗3	Size of Instance memo∗ 3	GM7U
CTU	Addition counter	24	92	6	3.8
CTUD	Addition/subtraction counter	32	168	6	4.4
F_TRIG	Descending edge detection	16	28	1	2.6
RS	Preference reset table	20	44	2	3.2
TON	ON delay timer	20	182	20	4.8

REMARK

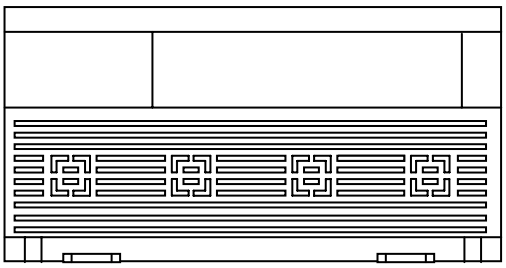
1) The items marked with '∗' has following meaning.
   ∗ 1: The size of the program memory which a program occupies when it uses the function once
   ∗ 2: The size of the program memory which a program occupies only one time though it uses the friction many times
   ∗ 3: The size of the program memory 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.

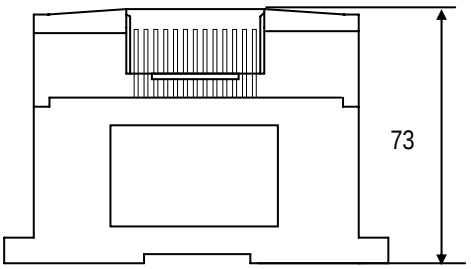
Appendix 4. External Dimensions (unit: mm)

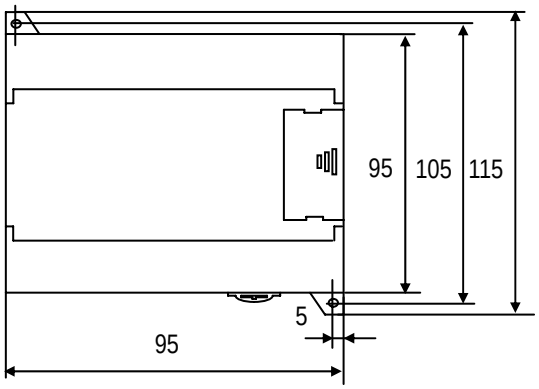
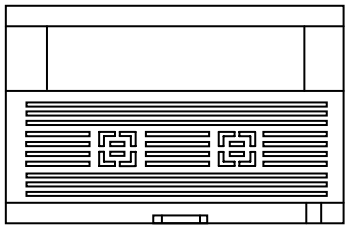
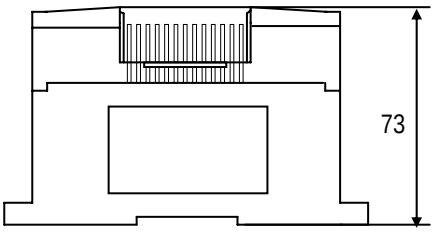
1) Base unit



Items	A	B
G7M-DR/DRT/DT20U	135	145
G7M-DR/DRT/DT30U	135	145
G7M-DR/DRT/DT40U	165	175
G7M-DR/DRT/DT60U	215	225





2) Extension modules

(1) Standard type