

User Manual

MASTER-K120S

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.

SAFETY INSTRUCTIONS

To Prevent injury and property damage, follow these instructions. Incorrect operation due to ignoring instructions will cause harm or damage, the seriousness of which is indicated by the following symbols.



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 in this manual and on your equipment is as follows



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 voltage” inside the product that might cause harm or electric shock.

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 trouble could result from erroneous output or erroneous operation.

- Outside the PLC, construct mechanical damage preventing interlock circuits such as emergency stop, protective circuits, positioning upper and lower limits switches and interlocking forward/reverse operation.

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

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.) itself or I/O controller. Build a fail safe circuit exterior to the PLC that will make sure the equipment operates safely at such times. Also, build an external monitoring circuit that will monitor any single outputs that could cause serious trouble.

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

Overcurrent exceeding the rating of output module could cause fire, damage or erroneous operation.

- ▶ 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 result in erroneous output or erroneous operation.

SAFETY INSTRUCTIONS

Design Precautions



Caution

- ▶ Do not bunch the control wires or communication cables with the main circuit or power wires, or install them close to each other. They should be installed 100mm (3.94inch) or more from each other.
Not doing so could result in noise that would 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 or deterioration of 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 or drop.
- ▶ Make sure I/O and extension connector are installed correctly.
Poor connection could cause an input or output failure.
- ▶ When install the PLC in environment of much vibration, be sure to insulate the PLC from direct vibration.
Not doing so could cause electric shock, fire, and erroneous operation.
- ▶ Be sure to there are no foreign substances such as conductive debris inside the module.
Conductive debris could cause fires, damage, or erroneous operation.

SAFETY INSTRUCTIONS

Wiring Precautions



Warning

- ▶ Completely turn off the external power supply when installing or placing wiring.
Not doing so could cause electric shock or damage to the product.
- ▶ Make sure that all terminal covers are correctly attached.
Not attaching the terminal cover could result in 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.
If the terminal screws are loose, 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.
Doing so could cause 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 battery can cause overheating or cracks which could result in injury and fires.



Caution

- ▶ Do not disassemble or modify the modules.
Doing so could cause trouble, 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 a cellular phone or walky-talky more than 30cm (11.81 inch) away from the PLC
Not doing so can cause a malfunction.

Disposal Precaution



Caution

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

Revision History

Date	Code	Revision history
2002.7.	10310000380	First edition is published
2003.5.	10310000380	A revised edition is published <ul style="list-style-type: none">– Main unit and expansion modules are added– Built-in function are upgraded
2003.9	10310000380	A revised edition is published. <ul style="list-style-type: none">– Main units are added– Built-in functions are upgraded.

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Chapter 1. General

1.1 Guide to Use This Manual

This manual includes specifications, functions and handling instructions for the MASTER-K120S series PLC.

This manual is divided up into chapters as follows:

No.	Title	Contents
Chapter 1	General	Describes configuration of this manual, unit's features and terminology.
Chapter 2	System configuration	Describes available units and system configurations in the MASTER-K120S series.
Chapter 3	General Specification	Describes general specifications of units used in the MASTER-K120S series.
Chapter 4	Names of Parts	Describes each kind of manufacturing goods, titles, and main functions
Chapter 5	Power Supply / CPU	Describes each kind of manufactured goods' usage
Chapter 6	Input and Output	
Chapter 7	Usage of Various Functions	
Chapter 8	Communication Function	Describes built-in communication functions
Chapter 9	Installation and Wiring	Describes installation, wiring and handling instructions for reliability of the PLC system
Chapter 10	Maintenance	Describes the check items and method for long-term normal operation of the PLC system.
Chapter 11	Troubleshooting	Describes various operation errors and corrective actions.
Appendix 1	System Definitions	Describes parameter setting for basic I/O and communications module
Appendix 2	Flag List	Describes the types and contents of various flags.
Appendix 3	Dimensions	Shows dimensions of the main units and expansion modules

REMARK

- This manual does not describes the programming method. For their own functions, refer to the related user's manuals.

1.2. Features

1) MASTER-K120S series is extremely compact, to fit a wide range of applications and have following features.

(1) High speed processing

High speed processing of 0.1~0.9 μ s/step with an general purpose processor included .

(2) Various built-in functions

The main unit can perform many functions without using separate modules. Therefore, It is possible to construct various systems just using the main unit.

- Fast Processing Applications

- Pulse catch: Allows the main unit to read a pulse which has width as small as 10 μ s.
- High speed counter(Economic): Support high-speed counting up to 100(10)kHz for 1 phase, 50(5)kHz for 2 phase.
- External interrupts : Using in applications that have a high-priority event which requires immediate responses.

- The input filter function help reduce the possibility of false input conditions from external noise, such as signal chattering. The filter time can be programmed from 0 to 1000ms.

- Using RS-232C and RS-485 built-in port, MASTER-K120S can connects with external devices, such as personal computers or monitoring devices and communicate 1:N with MASTER-K120S system.

- Using built-in PID control function, PID control system can be constructed without using separate PID module.

- Using built-in Positioning function, position control system can be constructed without using separate position control module.(only DRT/DT type has built-in positioning function)

(3) Battery-less

The user's program can be saved permanently, because it is stored to EEPROM.

(4) When program is edited during processing, it is stored to EEPROM automatically

(5) Open network by use of communication protocols in compliance with international standard specifications.

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

(7) It can easily do On/Off of the system, using RUN/STOP switch.

(8) It can easily save the user program in EEPROM by simple manipulation in KGLWIN without using external memory.

(9) Strong self-diagnostic functions

It can detect the cause of errors with more detailed error codes.

(10) It can prevent unintentional reading and writing, using password.

(11) Debugging function(Standard type)

On-line debugging is available when 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.

(12) Various program execution function

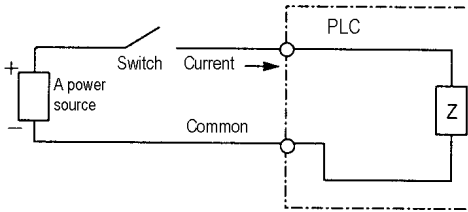
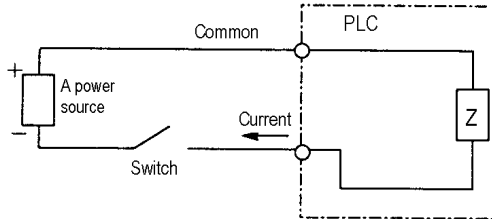
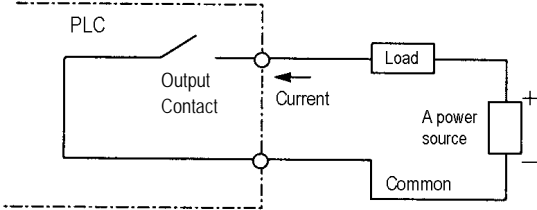
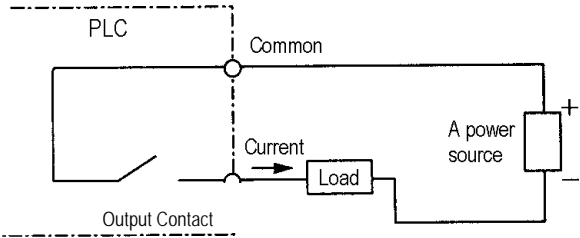
External and internal interrupt program as well as scan program can be executed by setting the execution condition.

Therefore, user can set variously program execution mode.

1.3 Terminology

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

Terms	Definition	Remarks
Module	A standard element that has a specified function which configures the system. Devices such as I/O board, which inserted onto the mother board or base unit.	Example) CPU module Power Supply module I/O module
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.	
KGLWIN	A program and debugging tool for the MASTER-K series. It executes program creation, edit, compile and debugging(A computer software).	
KLD-150S	A hand-held loader used for program creation, edit, compile and debugging for MASTER-K series.	
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.	
FAM	Abbreviation of the word 'Factory Automation Monitoring S/W'. It is used to call S/W packages for process supervision.	
Fnet	Fieldbus network	
Cnet	Computer network(RS-232C, RS-422/485)	
RTC	Abbreviation of 'Real Time Clock'. It is used to call general IC that contains clock function.	

Terms	Definition	Remarks
Sink Input	<p>Current flows from the switch to the PLC input terminal if a input signal turns on.</p> 	
Source Input	<p>Current flows from the PLC input terminal to the switch after a input signal turns on.</p> 	
Sink Output	<p>Current flows from the load to the output terminal and the PLC output turn on.</p> 	
Source Output	<p>Current flows from the output terminal to the load and the PLC output turn on.</p> 	

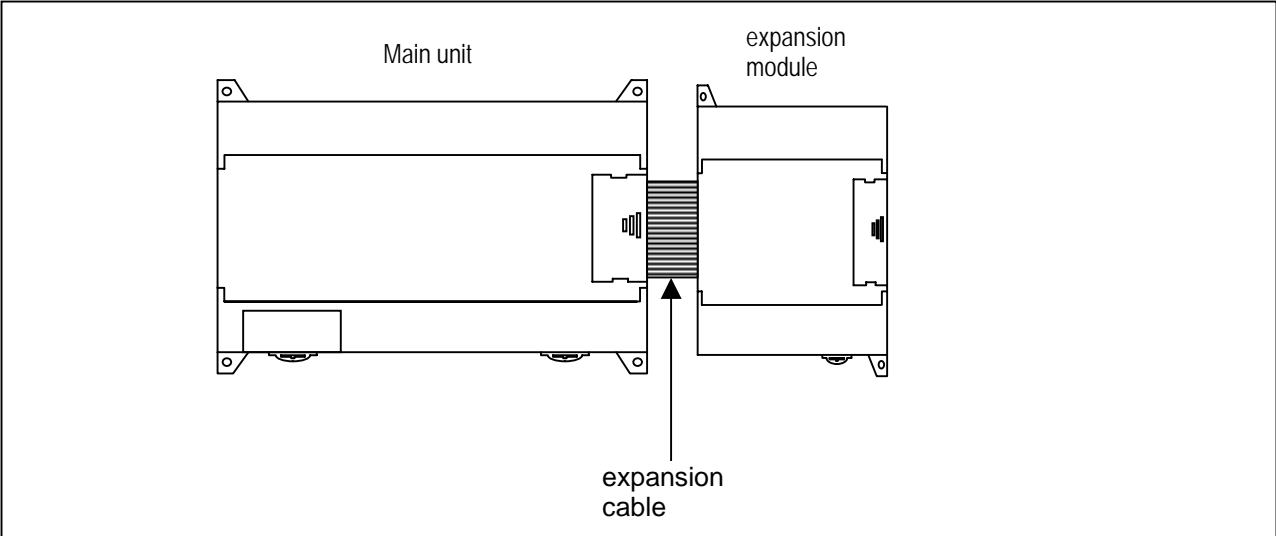
Chapter 2. System Configuration

The MASTER-K120S 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



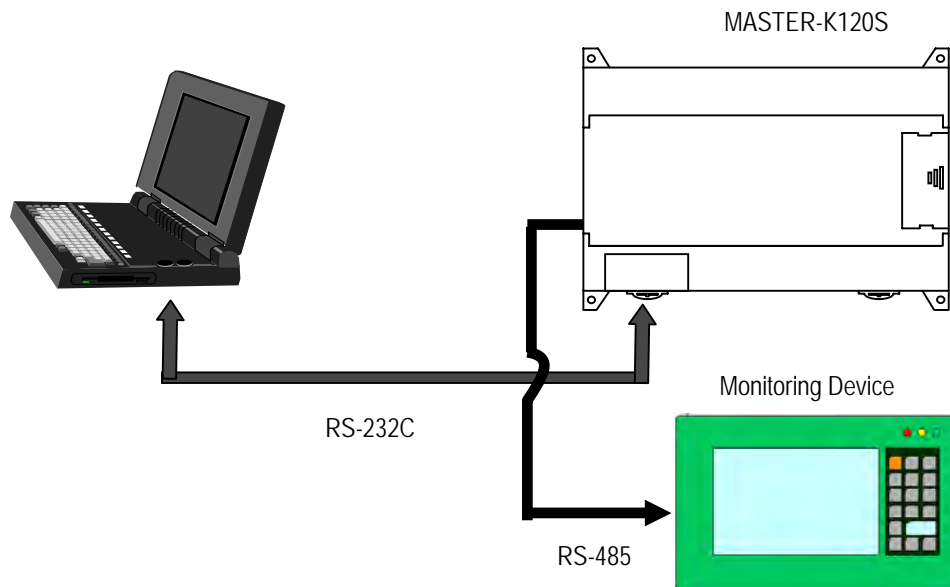
Total I/O points		• 10-120 points	
Maximum number of expansion modules	Digital I/O module	Standard	Economic
		• 3 modules	• 2 modules
		• 3 modules	• 2 modules
		• 3 modules	• 2 modules
		• 1 module	• 1 modules
Items	Main unit	Economic	• K7M-DR10/14/20/30UE
		Standard	• K7M-DR//DRT/DT20/30/40/60U
	Expansion module	Digital I/O module	• G7E-DR10A, G7E-DR20A, G7E-TR10A, G7E-DC08A, G7E-RY08A
		Analog I/O module	• G7F-ADHA, G7F-ADHB, G7F-AD2A, G7F-DA2I, G7F-DA2V
		Analog timer	• G7F-AT2A
		Resistance Temperature Detactor	• G7F-RD2A
	Communic I/F module	Cnet I/F modules	• G7L-CUEB, G7L-CUEC
		DeviceNet I/F module	• G7L-DBEA
		FieldBus I/F module	• G7L-FUEA
		Profibus I/F Module	• G7L-PBEA
	Option module	RTC	• G7E-RTCA
		Memory	• G7M-M256B

2.1.2 Cnet I/F system

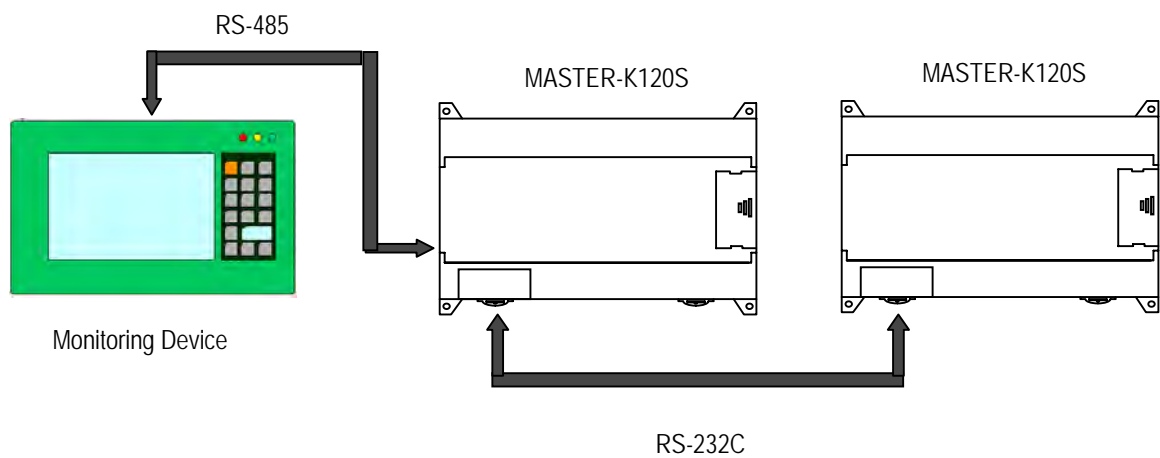
Cnet I/F System is used for communication between the main unit and external devices using RS-232C/RS-422 Interface. The MK120S has a built-in RS-232C port, RS-485 port and has also G7L-CUEB for RS-232C, G7L-CUEC for RS-422. It is possible to construct communication systems on demand.

1) 1:1 Communications system

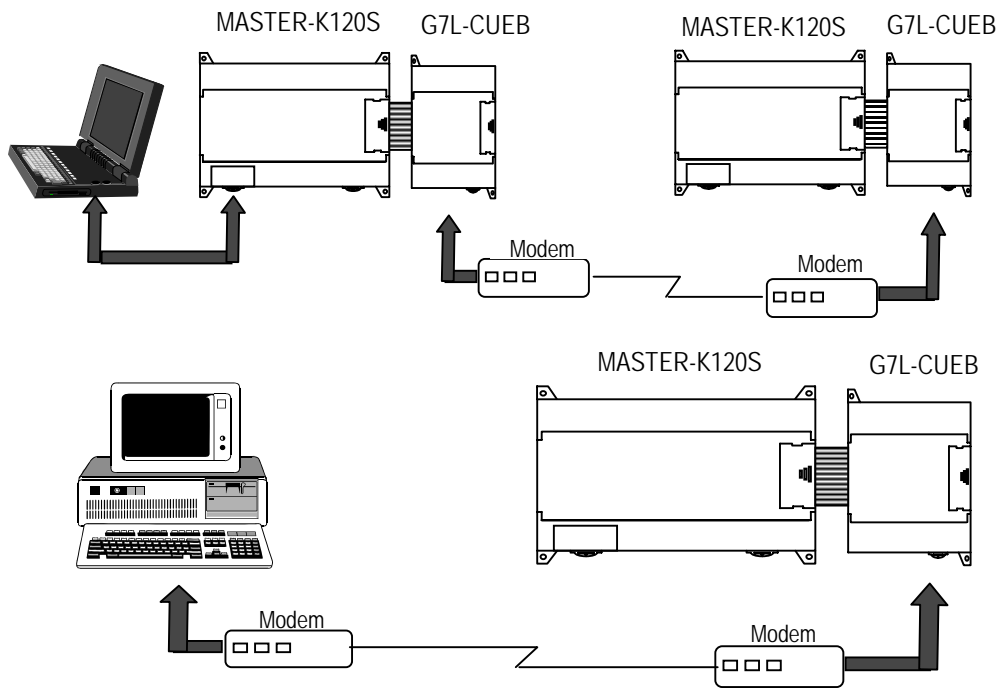
(1) 1:1 ratio of an external device (computer) to main unit using a built-in port



(2) 1:1 ratio of an external device (monitoring unit) to main unit using a built-in RS-485 port

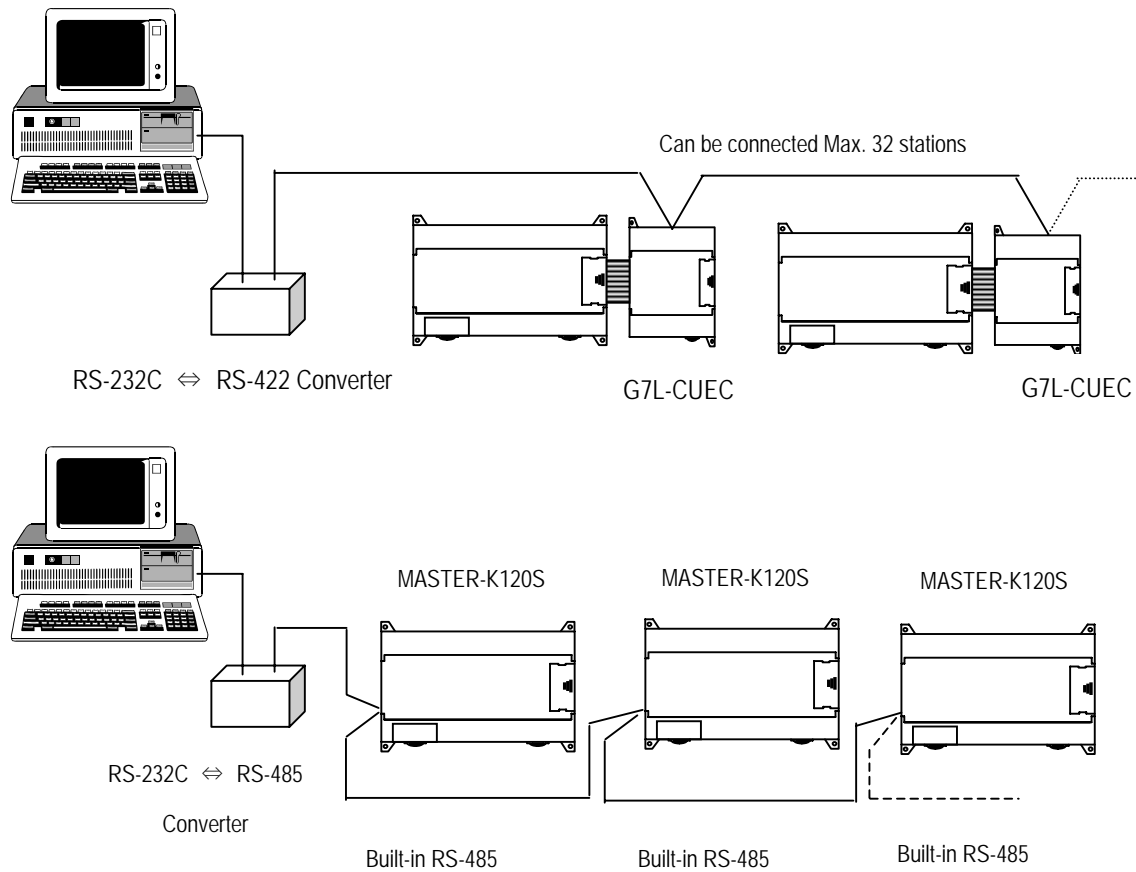


(3) RS-232C Communication over a long distance via modem by Cnet I/F modules



2) 1:n Communications system

This method can connect between one computer and multiple main units for up to 32 stations



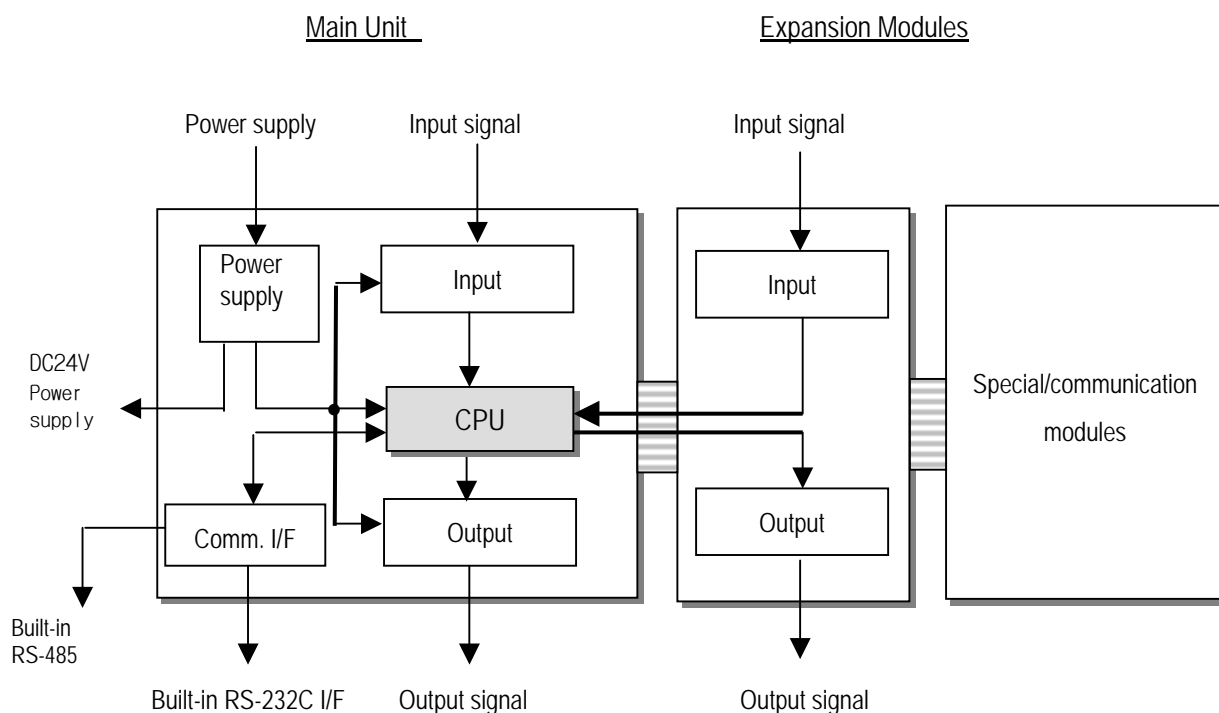
* Refer to 'chapter 8. communication function' for details.

2.2 Product Functional Model

The following describes functional model of the MASTER-K120Sseries.

2.2.1 Product Functional Block

Product function block for the K120S series is as follows.



Sub-system	Description
CPU	<ul style="list-style-type: none"> • Signal processing function - . Operating system function - . Application program storage / memory function - . Data storage / memory function - . Application program execution function
Input	<ul style="list-style-type: none"> • The input signals obtained from the machine/process to appropriate signal levels for processing
Output	<ul style="list-style-type: none"> • The output signals obtained from the signal processing function to appropriate signal levels to drive actuators and/or displays
Power Supply	<ul style="list-style-type: none"> • Provides for conversion and isolation of the PLC system power from the main supply
Communication Interface	<ul style="list-style-type: none"> • Provides the data exchange with other systems or PADT, such as KGLWIN, personal computers

2.2.2 K120S Series System Equipment Product

1) Main Unit – Standard type

Items	Models	I/O Point & Power Supply	Built-in Function	Remark
Main Unit	K7M-DR20U	12 DC inputs(24VDC) 8 relay outputs 85~264 VAC	<ul style="list-style-type: none"> • Program capacity : 10 k steps • Max. expansion : 3 modules • High-speed counter : <ul style="list-style-type: none"> - 1 Phase : 100 kHz 1channel, 20 kHz 2channel. - 2 Phase : 50 kHz 1channel, 10 kHz 1channel. • Pulse catch : pulse width 10 μs 2 points, 50 μs 6 points, • External interrupt : 10 μs 2 points, 50 μs 6 points • Input filter: 0 ~ 1000ms (can be designated with groups) • PID control function • RS-232C communication, RS-485 communication 	
	K7M-DR30U	18 DC inputs(24VDC) 12 relay outputs 85~264 VAC		
	K7M-DR40U	24 DC inputs(24VDC) 16 relay outputs 85~264 VAC		
	K7M-DR60U	36 DC inputs(24VDC) 24 relay outputs 85~264 VAC		
	K7M-DRT/DT20U	12 DC inputs(24VDC) 4/0 relay outputs 4/8 TR outputs 85~264 VAC	<ul style="list-style-type: none"> • Program capacity : 10 k steps • Max. expansion : 3 modules • High-speed counter : <ul style="list-style-type: none"> - 1 Phase : 100 kHz 1channel, 20 kHz 2channel. - 2 Phase : 50 kHz 1channel, 10 kHz 1channel. • Pulse catch : pulse width 10 μs- 2 points, 50 μs- 6 points, • External interrupt : 10 μs- 2 points, 50 μs- 6 points • Input filter: 0 ~ 1000ms (can be designated with groups) • PID control function • RS-232C communication, RS-485 communication • Positioning function <ul style="list-style-type: none"> - 2axes 100 kpps - Absolute / Incremental positioning method - Single / Repeat operation method - End / Keep / Continuous mode - Return to origin, JOG, PWM, velocity control 	
	K7M-DRT/DT30U	18 DC inputs(24VDC) 8/0 relay outputs 4/12 TR outputs 85~264 VAC		
	K7M-DRT/DT40U	24 DC inputs(24VDC) 12/0 relay outputs 4/16 TR outputs 85~264 VAC		
	K7M-DRT/DT60U	36 DC inputs(24VDC) 20/0 relay outputs 4/24 TR outputs 85~264 VAC		

2) Main Unit – Economic type

Items	Models	I/O Point & Power Supply	Built-in Function	Remark
Main Unit	K7M-DR10UE	6 DC inputs(24VDC) 4 relay outputs 85~264 VAC	<ul style="list-style-type: none"> • Program capacity : 2 k steps • Max. expansion : 2 modules • Pulse catch : pulse width 50 μs 4 points, • High-speed counter : <ul style="list-style-type: none"> - 1 Phase : 10 kHz 2channel. - 2 Phase : 5 kHz 1channel. • External interrupt : 50 μs 4 points • Input filter: 0 ~ 1000ms (can be designated with groups) • RS-232C communication • RS-485 communication(K7M-DR10/14UE only) • Built-in analog timer(K7M-DR10/14UE only) 	
	K7M-DR14UE	8 DC inputs(24VDC) 6 relay outputs 85~264 VAC		
	K7M-DR20UE	12 DC inputs(24VDC) 8 relay outputs 85~264 VAC		
	K7M-DR30UE	18 DC inputs(24VDC) 12 relay outputs 85~264 VAC		

3) Expansion Modules

Section	Items	Models	Description	Remark	
Expansion module	Digital I/O module	G7E-DR10A	● 6 DC inputs / 4 relay outputs		
		G7E-DR20A	● 12 DC inputs / 8 relay outputs		
		G7E-DC08A	● 8 DC inputs	Slim Type	
		G7E-TR10A	● 10 Transistor outputs		
		G7E-RY08A	● 8 relay outputs	Slim Type	
		G7E-DR08A	● 4 DC Input, 4 Relay output		
Special module	A/D-D/A Combination module	G7F-ADHA	● A/D : 2 channel , D/A : 1 channel		
		G7F-ADHB	● A/D : 2 channel , D/A : 2 channel	Slim Type	
	A/D conversion module	G7F-AD2A	● A/D : 4 channel		
	D/A conversion module	G7F-DA2I	● D/A : 4 channel(current output)		
		G7F-DA2V	● D/A : 4 channel(voltage output)	Slim Type	
	Analog timermodule	G7F-AT2A	● Points : 4points ● Digital output range : 0~200		
	RTD module	G7F-RD2A	● Resistance temperature detactor - 4 channel(Pt100, JPt100)	Slim Type	Standard type only
	Communication I/F module	G7L-CUEB	● RS-232C : 1 channel		
		G7L-CUEC	● RS-422 : 1 channel		
		G7L-DBEA	● DeviceNet I/F module (Slave)		Standard type only
		G7L-FUEA	● FieldBus I/F module		
		G7L-PBEA	● Profibus I/F module (Slave)		
	RTC module	G7E-RTCA	● Real Time Clock module		
	External Memory	G7M-M256B	● External Memory module		

* External memory G7M-M256 isn't supported in K120S series. Only G7M-M256B is available for K120S series.

Chapter 3. General Specifications

3.1 General Specifications

The following table shows the general specifications of the MASTER-K120S series.

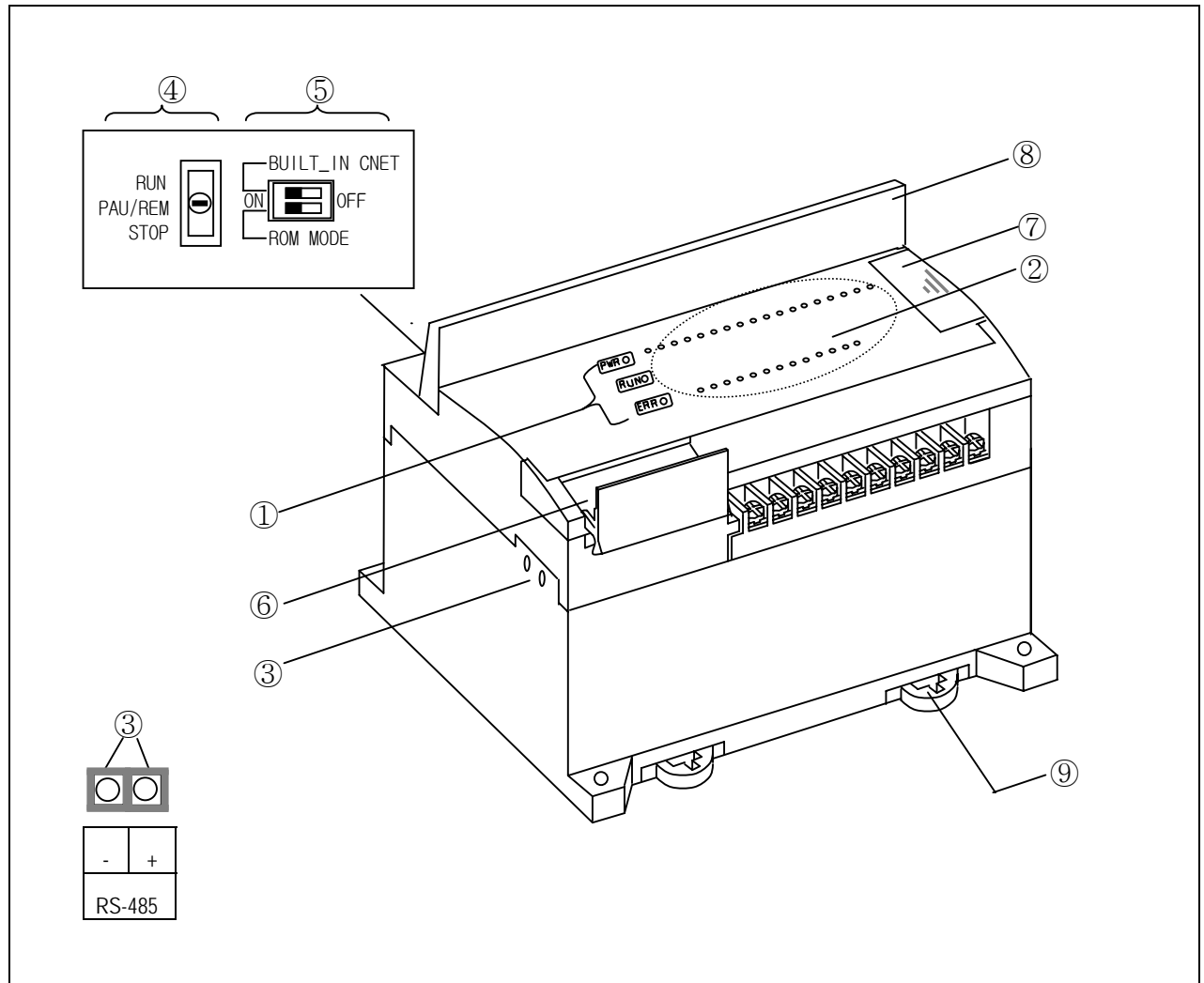
No.	Item	Specifications					References
1	Operating ambient Temperature	0 ~ 55 °C					
2	Storage ambient Temperature	−25 ~ +70 °C					
3	Operating ambient Humidity	5 ~ 95%RH, non-condensing					
4	Storage ambient Humidity	5 ~ 95%RH, non-condensing					
5	Vibrations	Occasional vibration			-		IEC 61131-2
		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	—	0.035mm			
		57 ≤ f ≤ 150Hz	4.9m/s² {0.5G}	—			
6	Shocks	<ul style="list-style-type: none">Maximum shock acceleration: 147 m/s² {15G}Duration time: 11msPulse 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				LGIS' Internal Standard
		Electronic discharge	Voltage: 4 kV (Discharge by contact)				IEC 61131-2, IEC 1000-4-2
		Radiated electromagnetic field noise	27 ~ 500 MHz, 10 V/m				IEC 61131-2, IEC 1000-4-3
		Fast transient & burst noise	Item	Power supply	Digital I/O (24V and up)	Digital I/O (less than24V) Analog I/O Interface	IEC 61131-2 IEC 1000-4-4
			Voltage	2kV	1kV	0.25kV	
8	Atmosphere	Free of corrosive gases and excessive dust					
9	Altitude	Up to 2,000m					
10	Pollution degree	2					
11	Cooling method	Air-cooling					

REMARK

- 1) IEC (International Electrotechnical Commission): An international civilian institute who establishes international standards in area of electric and electronics.
- 2) Pollution degree: An indicator, which indicates pollution degree, which determine insulation performance of equipment.
 - * Pollution degree 2 : Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation shall be expected.

Chapter 4. Names of Parts

4.1 Main Unit

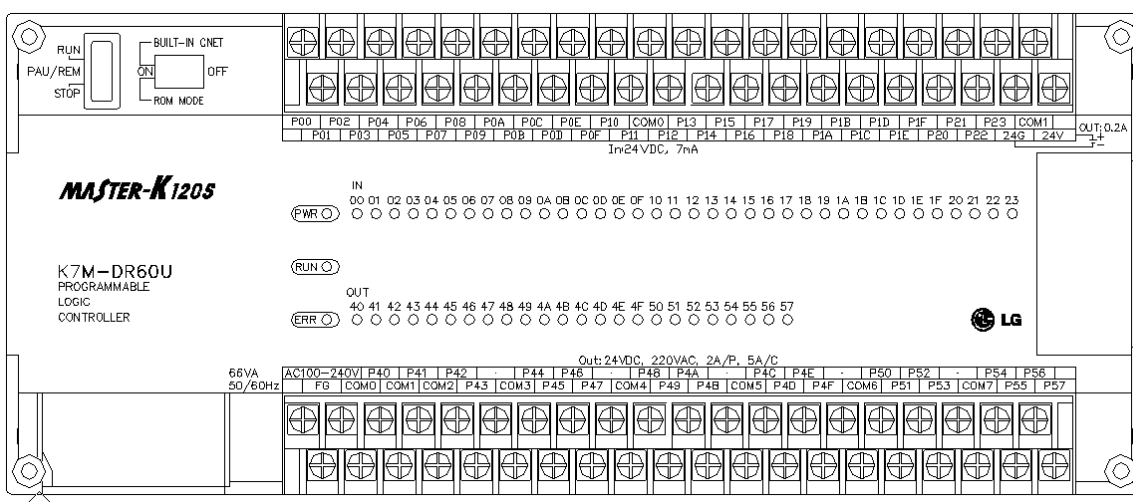


No.	Name		Description
①	CPU Condition LED	PWR LED	Indicates status of power supply to the system <ul style="list-style-type: none"> • On : When the supplied power is normal • Off : When the supplied power is abnormal
		RUN LED	Indicates operating status of main unit <ul style="list-style-type: none"> • On : Indicates local key switch or remote running mode • Off : with the followings, LED turns off <ul style="list-style-type: none"> - When the supplied power to the main unit is abnormal. - While key switch is on stop mode - Detecting an error which makes operation stop
		ERR LED	Indicates operating status of CPU <ul style="list-style-type: none"> • Flickering : self-inspected error • Off: CPU is working normal.

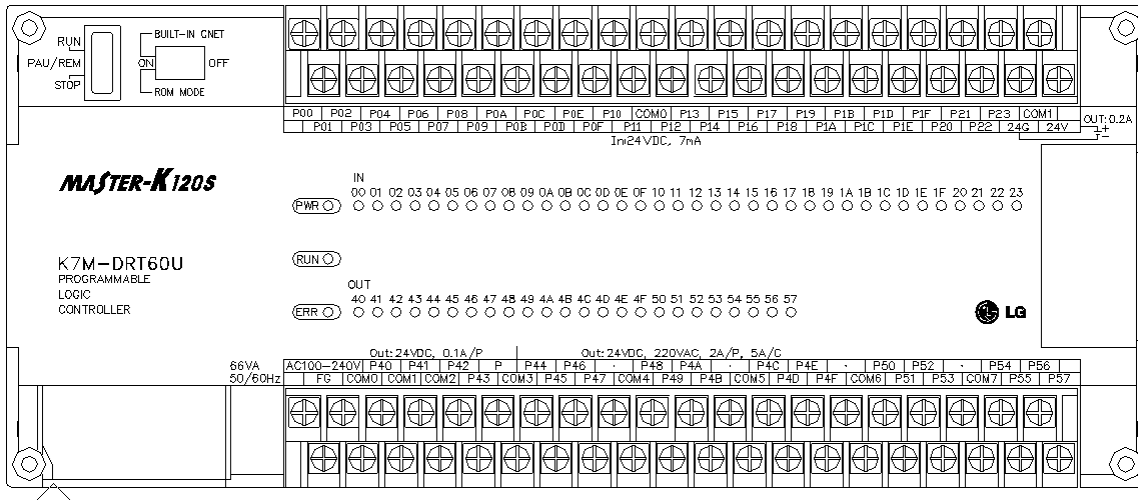
No	Name	Description
②	I/O LED	Indicates operating status of I/O
③	Built-in RS-485 connector (Except K7M-DR10/14UE)	2-pin connector for built-in RS-485 communications.
④	Key switch for mode creation (Except economic type)	Designates main unit's operation mode <ul style="list-style-type: none"> • RUN : Run program operation • STOP: Stop program operation • PAU / REM: usage of each modules are as follows: <ul style="list-style-type: none"> - PAUSE : temporary stopping program operation - REMOTE : designates remote driving
⑤	Dip-switch for Cnet I/F	See Chapter 5.
⑥	RS-232C connector	9-pin DIN connector to connect with external devices like KGLWIN
⑦	Expansion connector cover	Connector cover to connect with expansion unit
⑧	Terminal block cover	Protection cover for wiring of terminal block
⑨	Private hook DIN rail	Private part hook for DIN rail

4.1.1 60-points main unit (Standard)

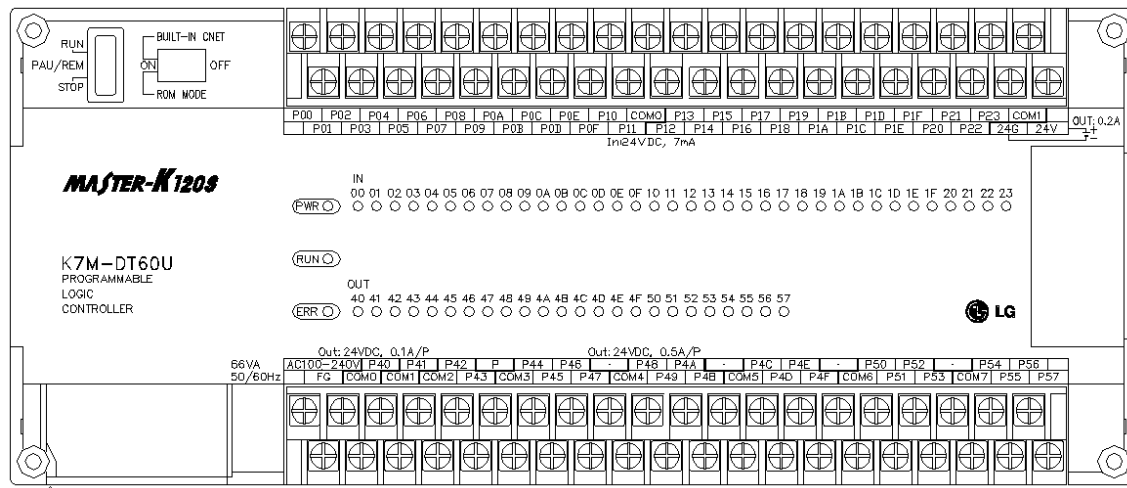
1) K7M-DR60U



2) K7M-DRT60U

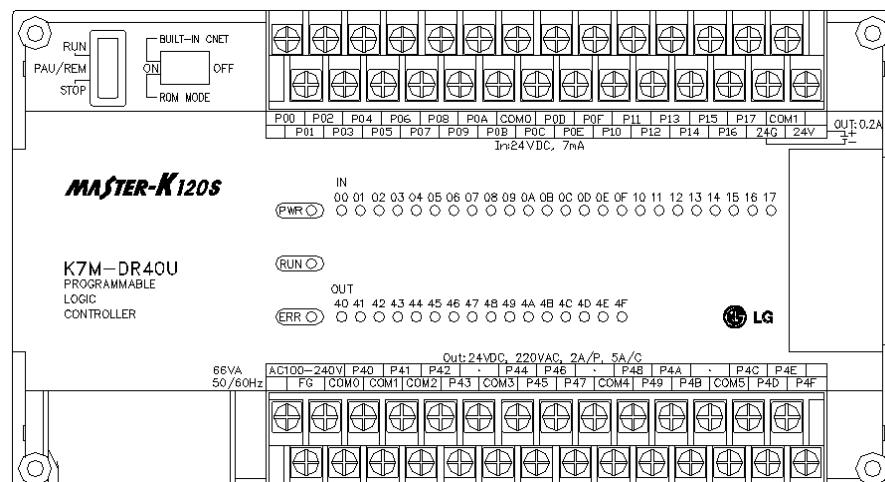


3) K7M-DT60U

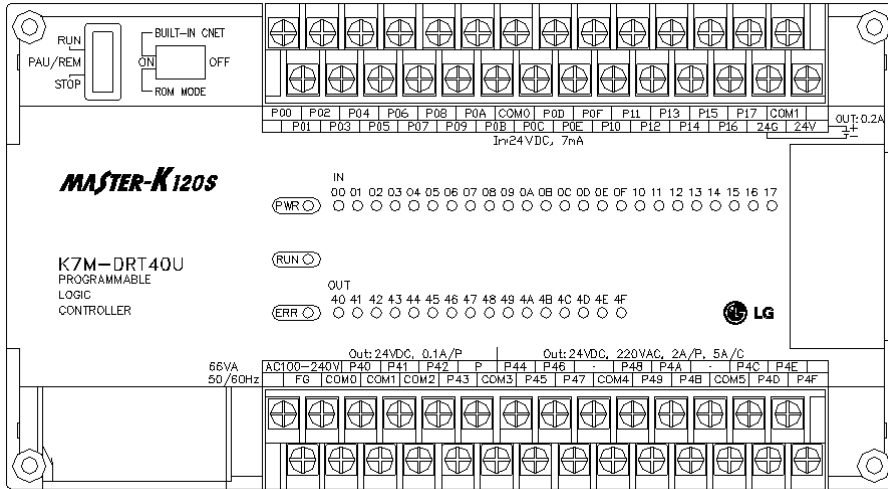


4.1.2 40-points main unit (Standard)

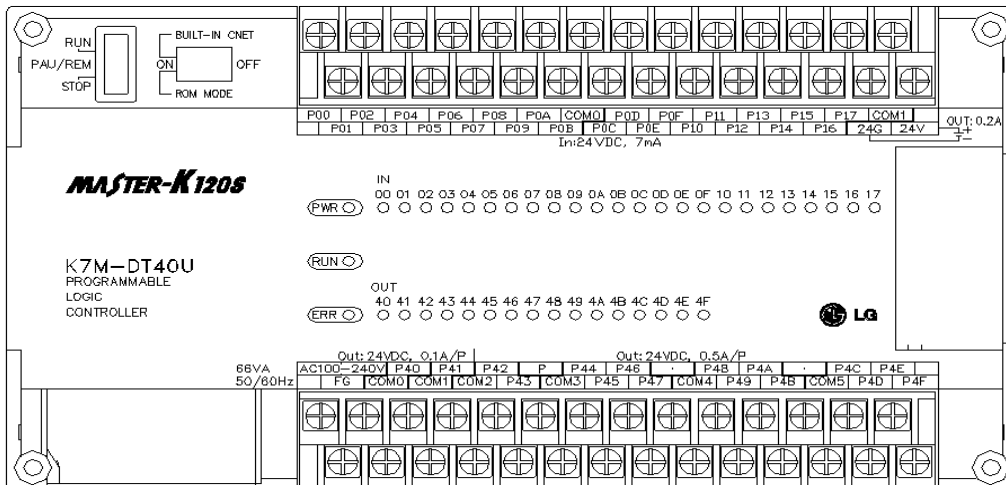
1) K7M-DR40U



2) K7M-DRT40U

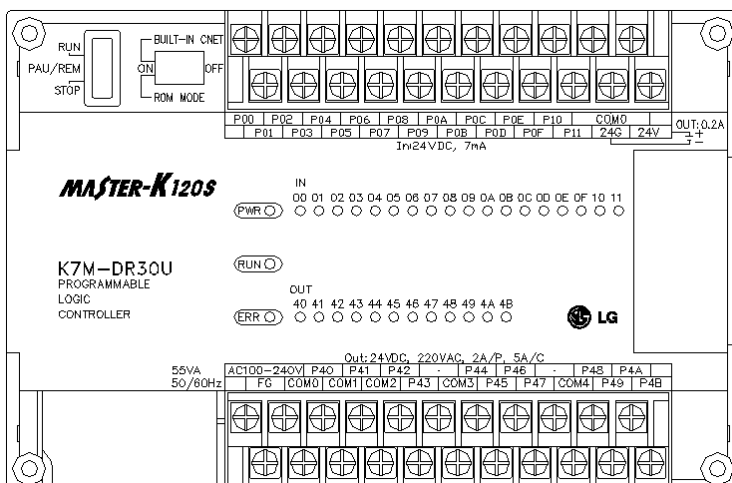


3) K7M-DT40U

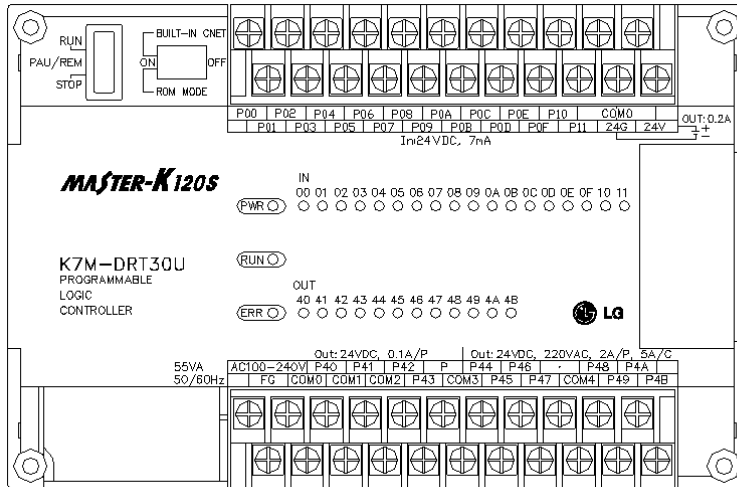


4.1.3 30-points main unit (Standard)

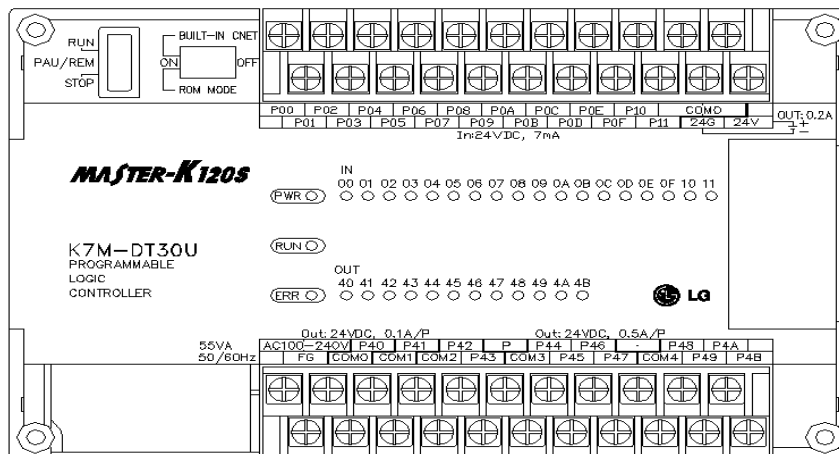
1) K7M-DR30U



2) K7M-DRT30U

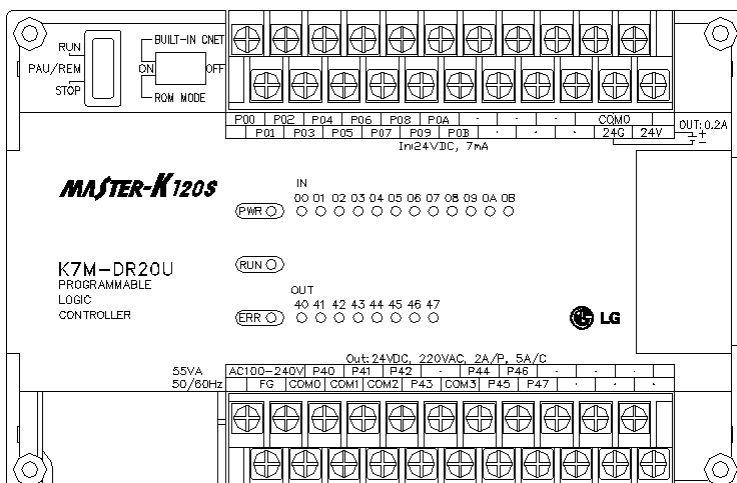


3) K7M-DT30U

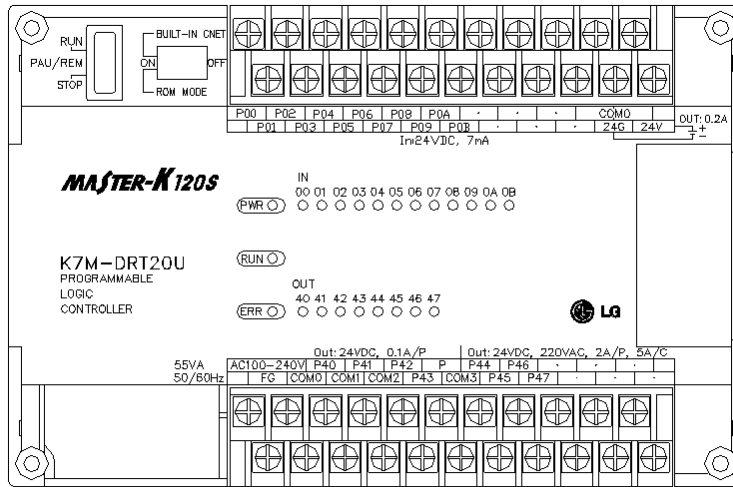


4.1.4 20-points main unit (Standard)

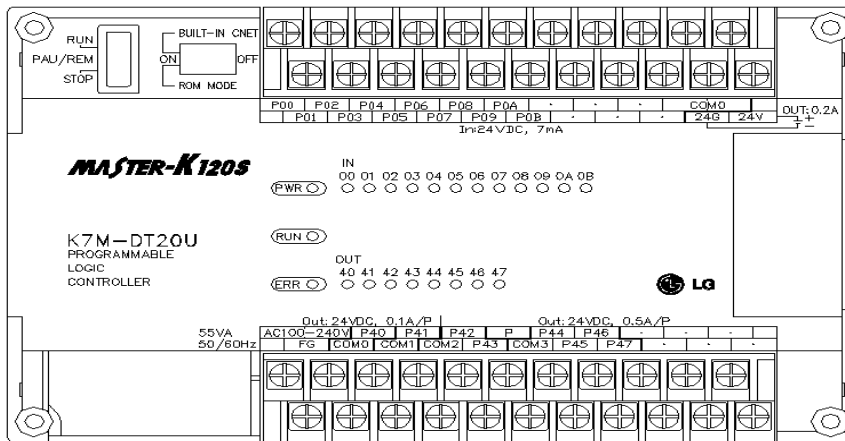
1) K7M-DR20U



2) K7M-DRT20U

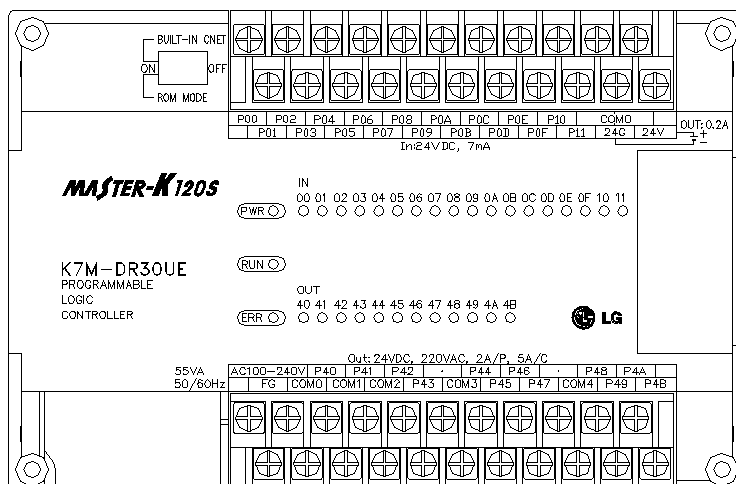


3) K7M-DT20U



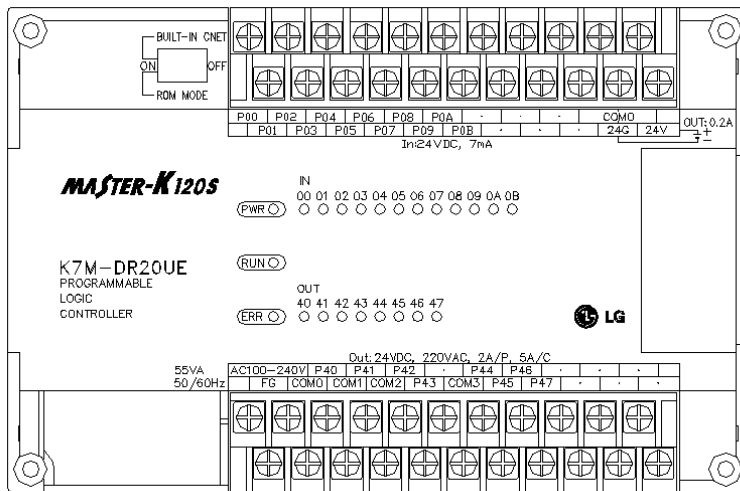
4.1.5 30-points main unit (Economic)

1) K7M-DR30UE



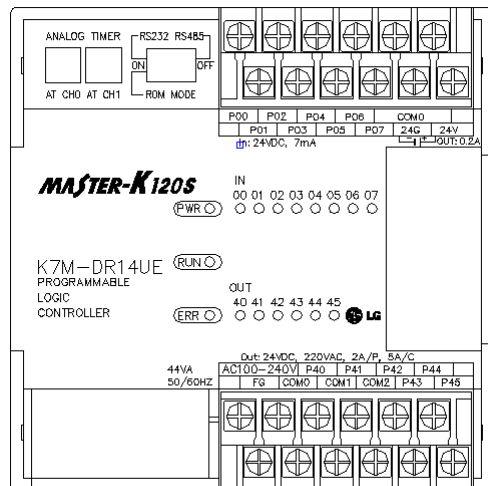
4.1.6 20-points main unit (Economic)

1) K7M-DR20UE



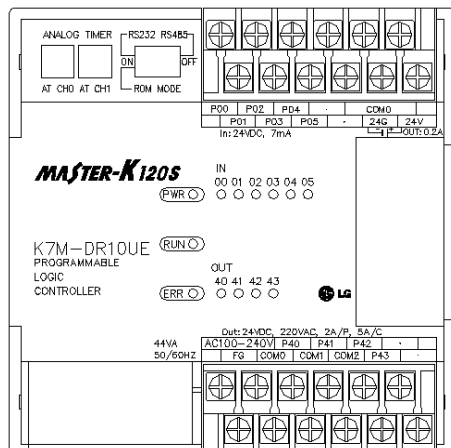
4.1.7 14-points main unit (Economic)

1) K7M-DR14UE



4.1.8 10-points main unit (Economic)

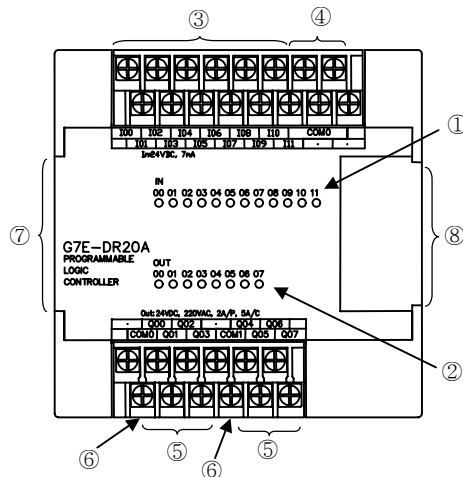
1) K7M-DR10UE



4.2 Expansion I/O Module

4.2.1 20points I/O Module

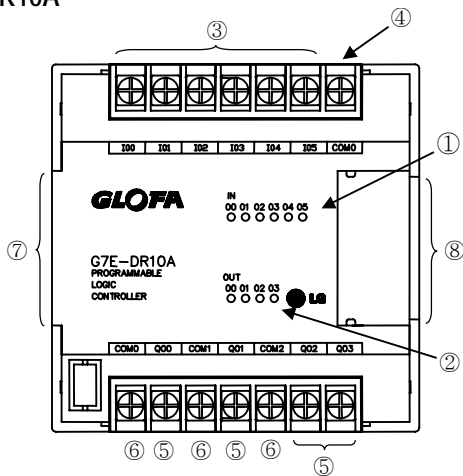
1) G7E-DR20A



No.	Names
①	Input LED
②	Output LED
③	Input contact
④	Input common terminal
⑤	Output contact
⑥	Output common terminal
⑦	Expansion cable
⑧	Expansion Cable Connecting Terminal

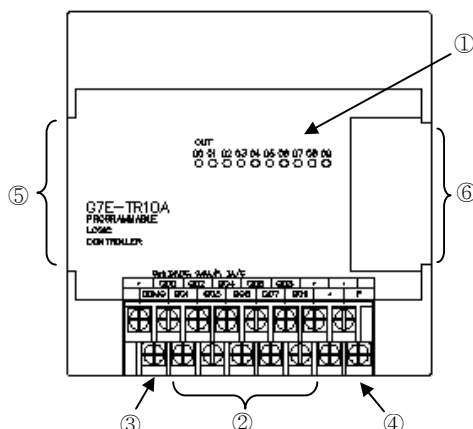
4.2.2 10points I/O Module

1) G7E-DR10A



No.	Names
①	Input LED
②	Output LED
③	Input contact
④	Input common terminal
⑤	Output contact
⑥	Output common terminal
⑦	Expansion cable
⑧	Expansion Cable Connecting Terminal

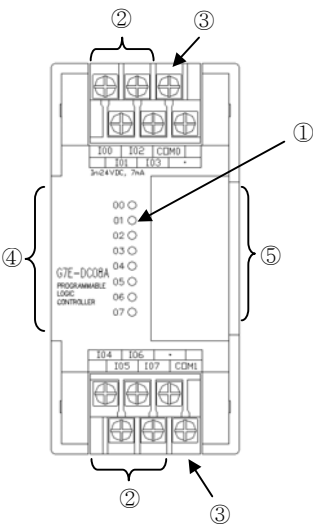
1) G7E-TR10A



No.	Names
①	Output LED
②	Output contact
③	Output common terminal
④	External Power Supply Terminal (DC24V)
⑤	Expansion cable
⑥	Expansion Cable Connecting Terminal

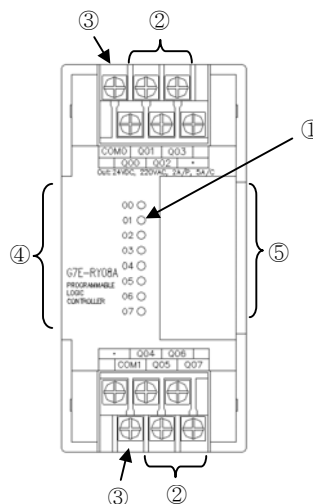
4.2.3 8points I/O Module

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

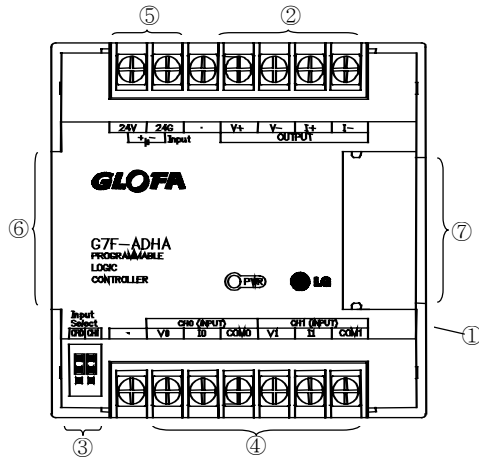


No.	Names
①	Output LED
②	Output contact
③	Output common terminal
④	Expansion cable
⑤	Expansion Cable Connecting Terminal

4.3 Special Module

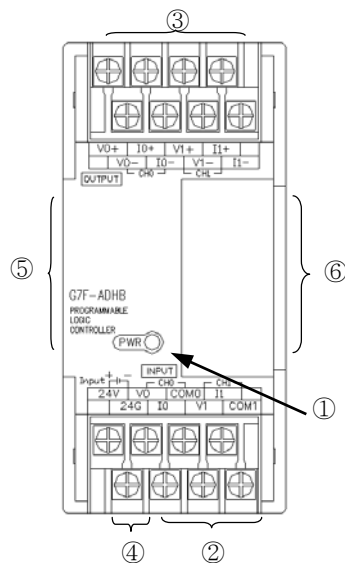
4.3.1 A/D · D/A Combination Module

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

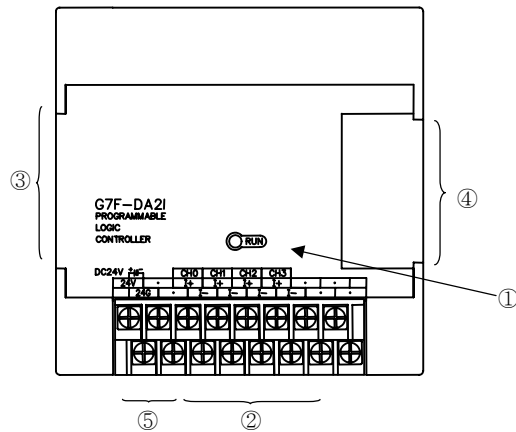
2) G7F-ADHB



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

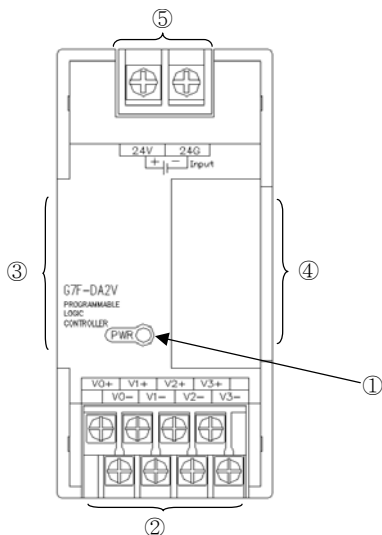
4.3.2 D/A Conversion Module

1) G7F-DA2I



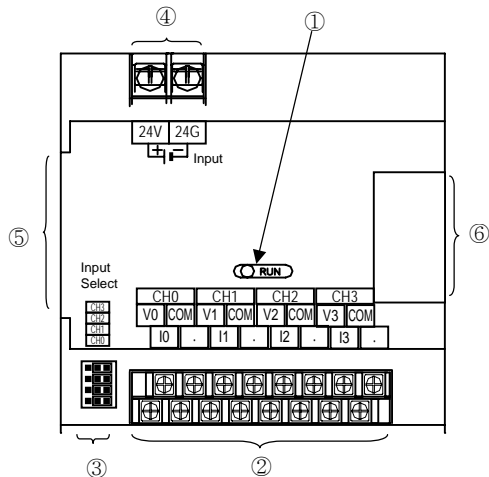
No.	Names
①	RUN LED
②	Analog Output Terminal
③	Expansion Cable
④	Expansion Cable Connecting Terminal
⑤	External Power Supply Terminal (DC24V)

2) G7F-DA2V



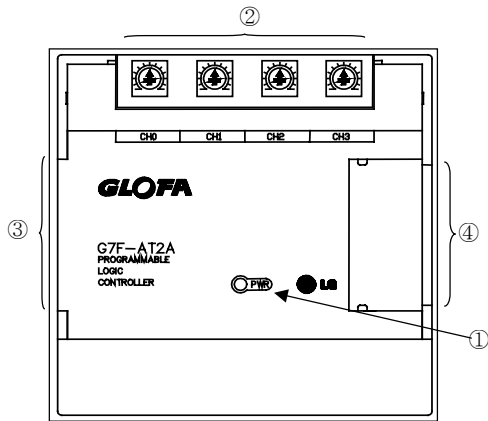
No.	Names
①	RUN LED
②	Analog Output Terminal
③	Expansion Cable
④	Expansion Cable Connecting Terminal
⑤	External Power Supply Terminal (DC24V)

4.3.3 A/D Conversion Module



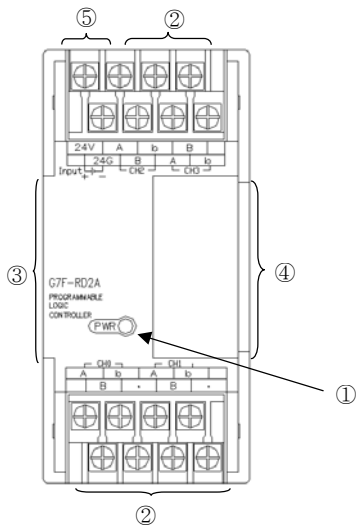
No.	Names
①	RUN LED
②	Analog Input Terminal
③	Analog Input (Voltage/current) selecting jumper pin
④	External Power Supply Terminal (DC24V)
⑤	Expansion Cable
⑥	Expansion Cable Connecting Terminal

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

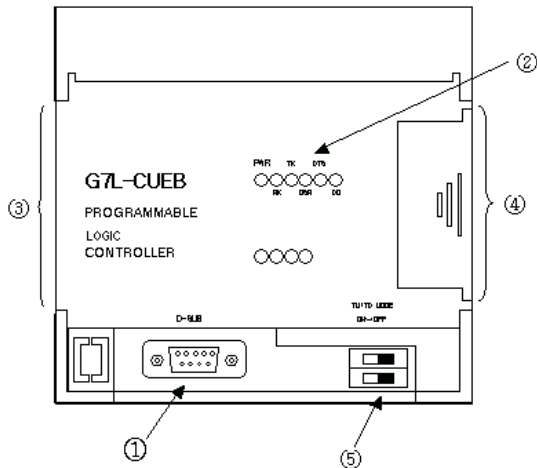


No.	Names
①	RUN LED
②	Analog Timer Volume Control Resistor
③	Expansion Cable
④	Expansion Cable Connecting Terminal

4.4 Communication I/F Module

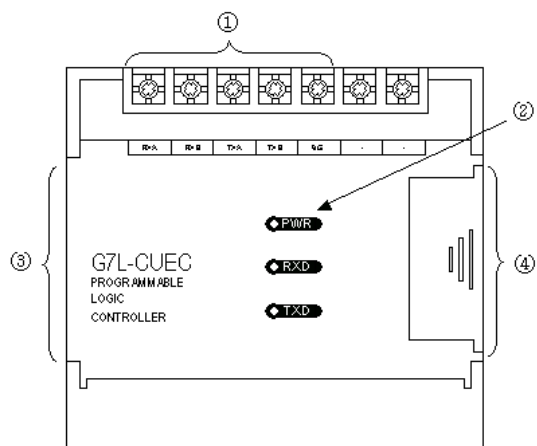
4.4.1 Cnet I/F Module

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

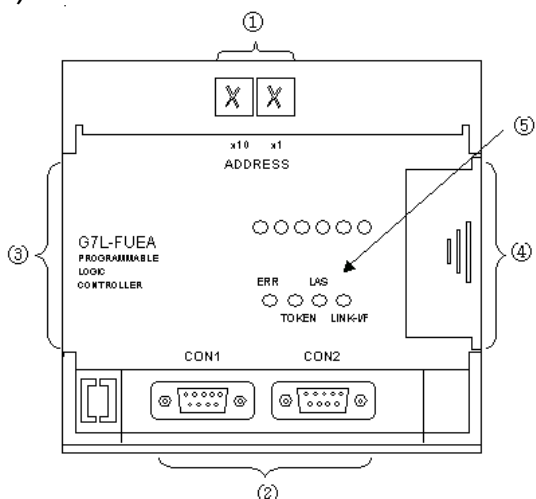
2) G7L-CUEC



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

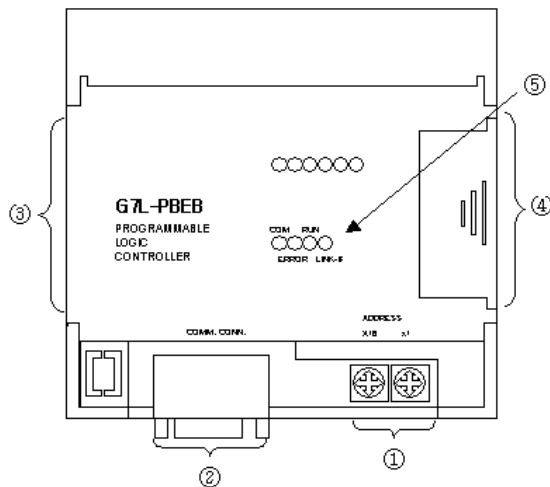
1) G7L-FUEA



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

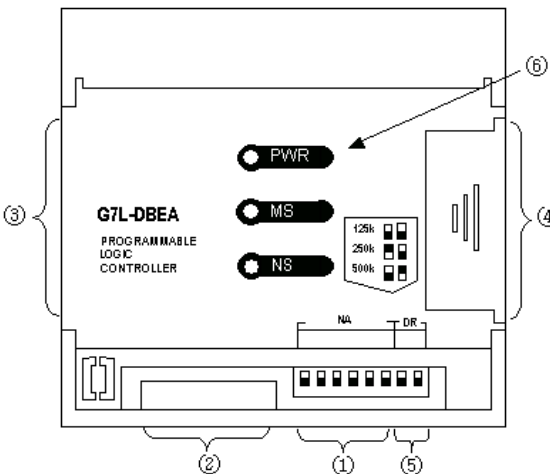
1) G7L-PBEA



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

4.4.4 DeviceNet I/F Module

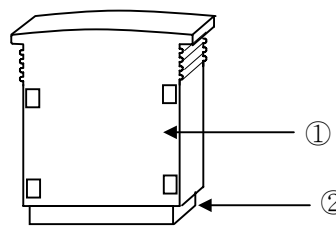
1) G7L-DBEA



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

4.5 Option Module

Option modules are attached the expansion slot of main unit or expansion unit, and supplies optional functions such as memory expansion or real time clock. MASTER-K120S series have two option modules – External memory module and RTC module.



No.	Names
①	Option module
②	Connector

Chapter 5. Power Supply / CPU

5.1 Power Supply Specifications

5.1.1. Standard Type

Items		K7M – DR/DRT/DT20U	K7M – DR/DRT/DT30U	K7M – DR/DRT/DT40U	K7M – DR/DRT/DT60U
Input	Rated voltage	85 ~ 264 VAC			
	Rated frequency	50 / 60 Hz (47 ~ 63 Hz)			
	Rated current	0.5A(110VAC)/0.25A(220VAC)		0.6A(110VAC)/0.3A(220VAC)	
	Inrush current	Up to 30A			Up to 60A
	Efficiency	65% min.(rated input/maximum load)			
	Input fuse	2A/AC250V (Time Lag Type)			
	Permitted Momentary power failure	10 ms			
Output(1)	Output voltage	DC 5V			
	Output current	1.2A		2A	
Output(2)	Output voltage	DC 24V			
	Output current	0.2A			
Power supply status indication		PWR LED On when power supply is normal			

5.1.2. Economic Type

Items		K7M – DR10UE	K7M – DR14UE	K7M – DR20UE	K7M – DR30UE
Input	Rated voltage	85 ~ 264 VAC			
	Rated frequency	50 / 60 Hz (47 ~ 63 Hz)			
	Rated current	0.3A(110VAC) / 0.15A(220VAC)		0.5A(110VAC) / 0.25A(220VAC)	
	Inrush current	Up to 30A			
	Efficiency	65% min.(rated input/maximum load)			
	Input fuse	2A/AC250V (Time Lag Type)			
	Permitted Momentary power failure	10 ms			
Output(1)	Output voltage	DC 5V			
	Output current	0.5A		1.2A	
Output(2)	Output voltage	DC 24V			
	Output current	0.2A			
Power supply status indication		PWR LED On when power supply is normal			

5.2 CPU Specifications

The following table shows the general specifications of the MASTER-K120S series

5.2.1. Standard Type

Items		Specifications				Remarks
		K7M-DR/DRT/DT20U	K7M-DR/DRT/DT30U	K7M-DR/DRT/DT40U	K7M-DR/DRT/DT60U	
Program control method		Cyclic execution of stored program, Time-driven interrupt, Process-driven interrupt				
I/O control method		Indirect mode(Refresh method), Direct by program command				
Program language		Instruction list, Ladder diagram				
Numbers of instructions		Basic : 30, Application : 277				
Processing speed		0.1μs/step				
Program capacity		10ksteps				
I/O points		20	30	40	60	
Memory device	P	P000 ~ P63F				I/O relay, TR.
	M	M000 ~ M191F				Auxiliary relay
	K	K000 ~ K31F				Keep relay
	L	L000 ~ L63F				Link relay
	F	F000 ~ F63F				Special relay
	T	100msec : T000 ~ T191 (192 points) 10msec : T192 ~ T250 (59 points) 1msec : T251 ~ T255 (5 points) -. Adjustable by parameter setting				Timer
	C	C000 ~ C255				Counter
	S	S00.00 ~ S99.99				Step controller
	D	D0000 ~ D4999				Data register
Operation modes		RUN, STOP, PAUSE, DEBUG				
Self-diagnosis functions		Detects errors of scan time, memory, I/O and power supply				
Data back-up method		Latch area back-up				
Max. expansion level		Up to 3 level (External memory or RTC module can be connected as 4th expansion module)				

(continued)

Items			Specifications				Remarks
			K7M-DR/DRT/DT20U	K7M-DR/DRT/DT30U	K7M-DR/DRT/DT40U	K7M-DR/DRT/DT60U	
Built-in Function	PID control function		Controlled by commands, Relay and PRC auto tuning, PWM output, manual output, adjustable operation scan time, Anti-windup, SV-Ramp, Delta MV, Position and Velocity algorithm				
	Cnet I/F Function		Dedicated protocol support MODBUS protocol support User defined protocol support No protocol support				RS-232C - 1port RS-485 - 1 port
	High-speed counter	Capacity	1 phase : 100 kHz-2 channel, 20 kHz-2 channel 2 phase : 50 kHz-1 channel, 10 kHz-1 channel				
		Counter function	4 different counter modes as following; - 1 phase operation mode. - 2 phase CW/CCW mode. - 2 phase Pulse + Direction mode. - 2 phase Multiplication mode(MUL4)				
		Additional function	Internal/External preset function Latch Counter function RPM function Comparison Output function				
	Positioning	Operation Specification	N0. of control axis : 2 Axis Control method : Point-to-Point, Speed Control Control unit : Pulse Positioning data : 20 data / axis(Operation step N0. 1 ~ 20)				DRT / DT Type Only
		Positioning	Positioning method : Absolute / Incremental Operation method : Single / Repeat Operation mode : End / Keep / Continuous Address range : -2,147,483,648 ~ 2,147,483,647 Speed : Max. 100kpps(setting range 5 ~ 100,000) Acceleration / Deceleration method : trapezoidal method				
		Return to Origin	Origin detection when approximate origin turns off Origin detection after deceleration when approximate origin turns on. Origin detection by approximate origin.				
		JOG	Setting range : 5~100,000 (High / Low speed)				
		Pulse catch	Minimum pulse width : 10 μ s (2 points) and 50 μ s (6 points)				
	External interrupt		10 μ s (2 points) and 50 μ s (6 points)				
	Input filter		0~1000ms(Adjustable)				
	Weight (g)			520	540	660	850

5.2.2. Economic Type

Items		Specifications				Remarks
		K7M-DR10UE	K7M-DR14UE	K7M-DR20UE	K7M-DR30UE	
Program control method		Cyclic execution of stored program, Time-driven interrupt, Process-driven interrupt				
I/O control method		Indirect mode(Refresh method), Direct by program command				
Program language		Instruction list, Ladder diagram				
Numbers of instructions		Basic : 30, Application : 269				
Processing speed		0.4μs/step				
Program capacity		2ksteps				
I/O points		10	14	20	30	
Memory device	P	P000 ~ P63F				I/O relay
	M	M000 ~ M191F				Auxiliary relay
	K	K000 ~ K31F				Keep relay
	L	L000 ~ L63F				Link relay
	F	F000 ~ F63F				Special relay
	T	100msec : T000 ~ T191 (192 points) 10msec : T192 ~ T250 (59 points) 1msec : T251 ~ T255 (5 points) -. Adjustable by parameter setting				Timer
	C	C000 ~ C255				Counter
	S	S00.00 ~ S99.99				Step controller
		D0000 ~ D4999				Data register
Operation modes		RUN, STOP, PAUSE				
Self-diagnosis functions		Detects errors of scan time, memory, I/O and power supply				
Data back-up method		Latch area back-up				
Max. expansion level		Up to 2 level (External memory or RTC module can be connected as 3th expansion module)				

(continued)

continued)

Items			Specifications				Remarks
			K7M-DR10UE	K7M-DR14UE	K7M-DR20UE	K7M-DR30UE	
Built-in Function	Cnet I/F Function		Dedicated protocol support MODBUS protocol support User defined protocol support No protocol support		RS-232C - 1port RS-485 - 1 port		RS-485 is available on K7M-DR10/14UE only
	High-speed counter	Capacity	1 phase : 10 kHz-2 channel 2 phase : 5 kHz-1 channel				
		Counter function	4 different counter modes as following; - 1 phase operation mode. - 2 phase CW/CCW mode. - 1 phase Pulse + Direction mode. - 2 phase Multiplication mode(MUL4)				
		Additional function	Internal/External preset function Latch Counter function RPM function Comparison Output function				
	Pulse catch		Minimum pulse width : 50 μ s (4 points)				
	External interrupt		50 μ s (4 points)				
	Input filter		0 ~ 1000ms(Adjustable)				
	Weight (g)			360	370	500	510

5.3 Operation Processing

5.3.1 Operation Processing Method

1) Cyclic operation

A PLC program is sequentially executed from the first step to the last step, which is called scan. This sequential processing is called cyclic operation. Cyclic operation of the PLC continues as long as conditions do not change for interrupt processing during program execution. This processing is classified into the following stages:

Stages	Processing
<pre> graph TD Start([Operation Start]) --> Init[Initialization] Init --> Refresh1[Input image area refresh] Refresh1 --> Prog[Program operation processing] subgraph ProgBox [] direction TB PStart[Program starts] PEnd[Program ends] end ProgBox --> Refresh2[Output image area refresh] Refresh2 --> EndProc[END processing] EndProc --> Refresh1 </pre>	<p>-</p> <p>• Stage for the start of a scan processing. It is executed only one time when the power is applied or reset is executed. It executes the following processing..</p> <ul style="list-style-type: none"> ▶ I/O reset ▶ Execution of self-diagnosis ▶ Data clear ▶ Allocating I/O address and type <p>Input conditions are read and stored into the input image area before starts processing.</p> <p>Program is sequentially executed from the first step to the last step Program operation processing</p> <p>The contents stored in the output image area is output to output part when operation processing of a program is finished.</p> <p>Stage for return processing after the CPU part has finished 1 scan. The END processing following processing is executed.</p> <ul style="list-style-type: none"> ▶ Self-diagnosis ▶ Change the present values of timer and counter, etc. ▶ Processing data communications between computer link module and communications module. ▶ Checking the switch for mode setting.

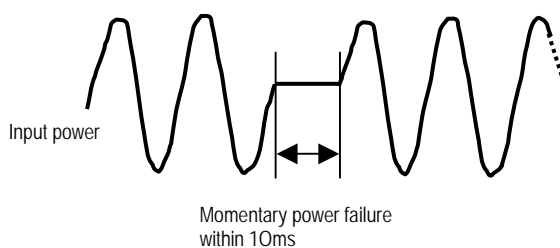
2) Interrupt operation method

If a situation occurs which is requested to be urgently processed during execution of a PLC program, this operation method processes immediately the operation, which corresponds to interrupt program. The signal, which informs the CPU of those urgent conditions is called interrupt signal. The MASTER-K120S CPU has three kind of interrupt operation methods, which are internal, external and high speed counter interrupt signal methods.

5.3.2 Operation Processing at Momentary Power Failure Occurrence

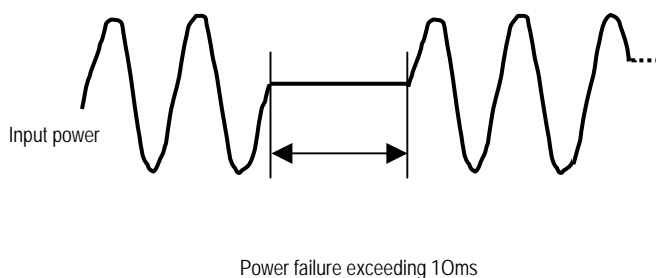
The momentary power failure occurs when the input line voltage to the power supply falls down below the rated voltage. When momentary power failure within 10ms occurs, the CPU maintain operation processing. But If it exceeds 10ms, CPU stop processing and all output turns off. And The re-start process is executed as the power is re-applied.

1) Momentary power failure within 10 ms



→ The operation processing is maintained

2) Momentary power failure exceeding 10 ms



→ The re-start process is executed as the power is re-applied.

REMARK

1) Momentary power failure

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

5.3.3 Scan Time

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

1) Expression for scan time

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

(1) Scan time = Scan program processing time + Interrupt 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.
- Interrupt program processing time = Total of the processing times 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 communications processing, etc.

2) Flags

Scan time is stored in the following system flag area.

- F50 : Maximum scan time (unit: 1 ms)
- F51 : Minimum scan time (unit: 1 ms)
- F52 : Current scan time (unit: 1 ms)

5.3.4 Scan Watchdog Timer

- 1) Watchdog timer is used to detect a delay which is attributable to abnormal operation of sequence program (Watchdog time is set in menu of basic parameter of KGLWIN.)
- 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' instruction.
'WDT' instruction make elapsed watchdog time as zero.
- 4) In order to clear watchdog error, restarting the PLC or mode change to STOP mode are available.

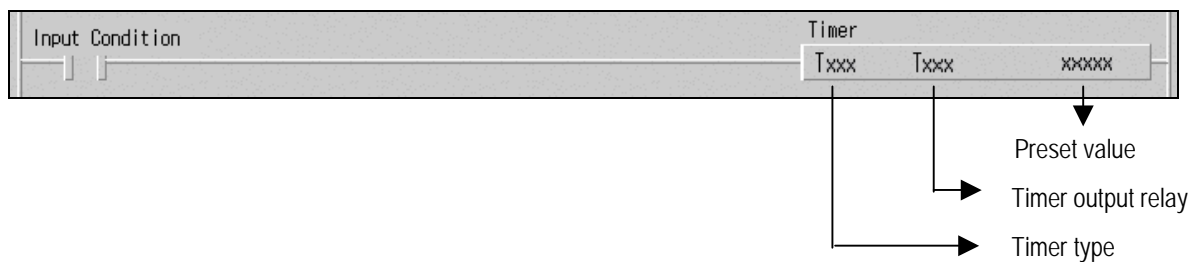
REMARK

- . Setting range of watchdog : 10 ~ 6,000ms(unit : 10ms)

5.3.5 Timer Processing

The MASTER-K series use up count timer. There are 5 timer instructions such as on-delay (TON), off-delay (TOFF), integral (TMR), monostable (TMON), and re-triggerable (TRTG) timer.

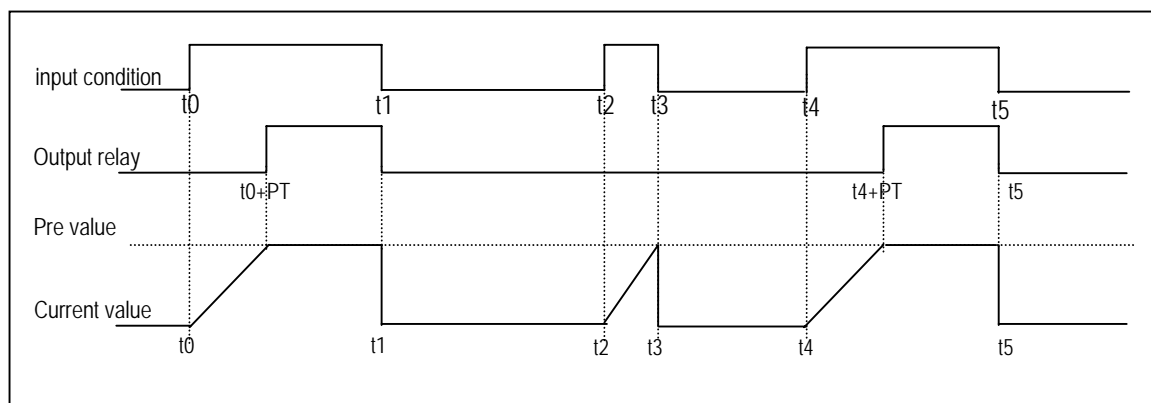
The measuring range of 100msec timer is 0.1 ~ 6553.5 seconds, 10msec timer is 0.01 ~ 655.35 seconds, and that of 1msec timer is 0.001 ~ 65.53 seconds. Please refer to the 'MASTER-K programming manual' for details.



1) On delay timer

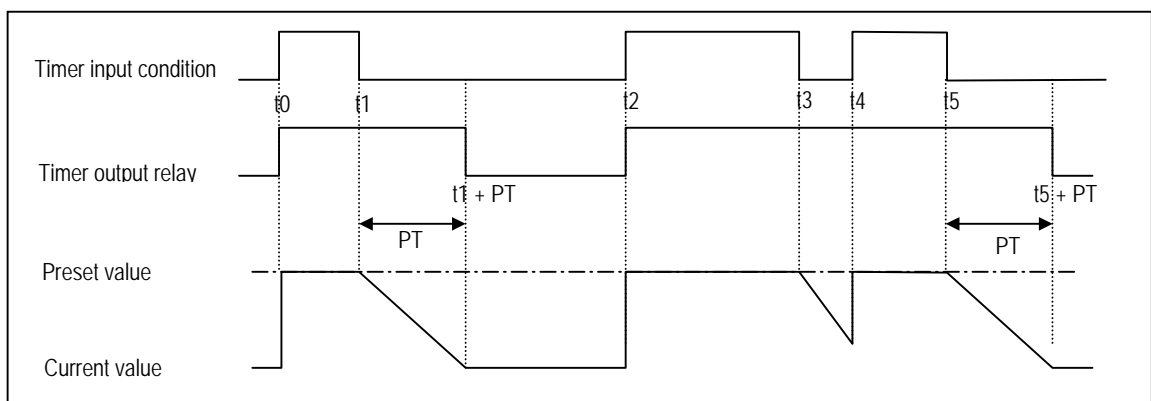
The current value of timer starts to increase from 0 when the input condition of TON instruction turns on. When the current value reaches the preset value, the timer output relay turns on.

When the timer input condition is turned off, the current value becomes 0 and the timer output relay is turned off.



2) Off delay timer

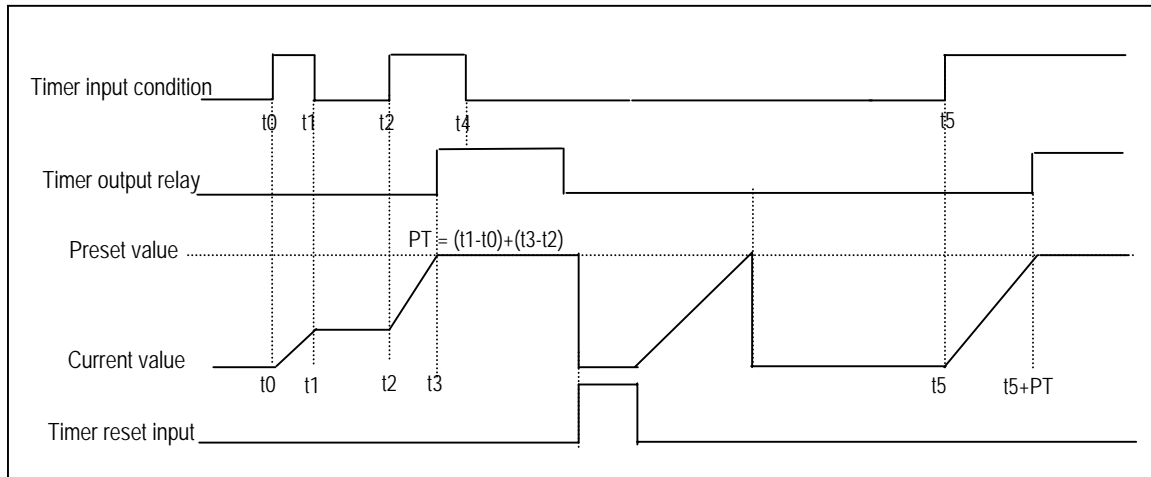
The current value of timer set as preset value and the timer output relay is turned on when the input condition of TOFF instruction turns on. When the input condition is turned off, the current value starts to decrease. The timer output relay is turned off when the current value reaches 0.



3) Integral timer

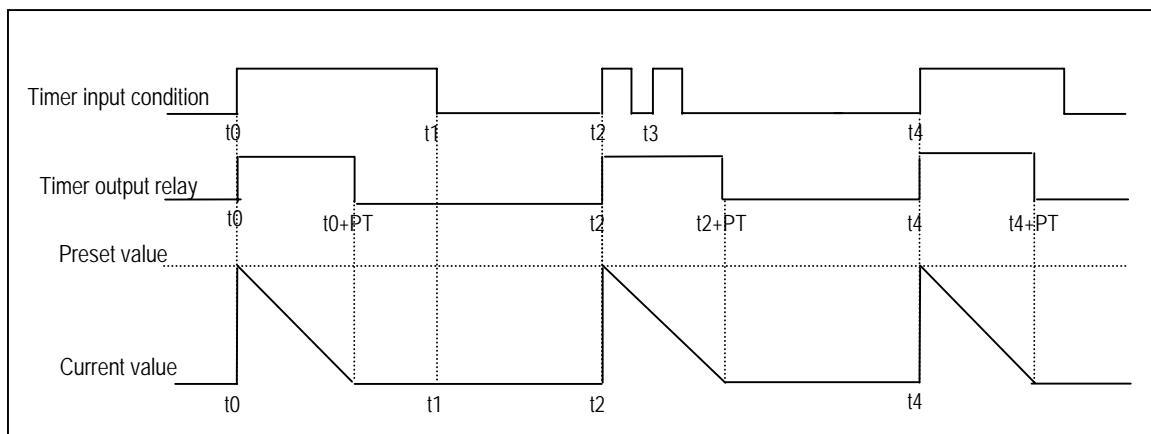
In general, its operation is same as on-delay timer. Only the difference is the current value will not be clear when the input condition of TMR instruction is turned off. It keeps the elapsed value and restart to increase when the input condition is turned on again. When the current value reaches preset value, the timer output relay is turned on.

The current value can be cleared by the RST instruction only.



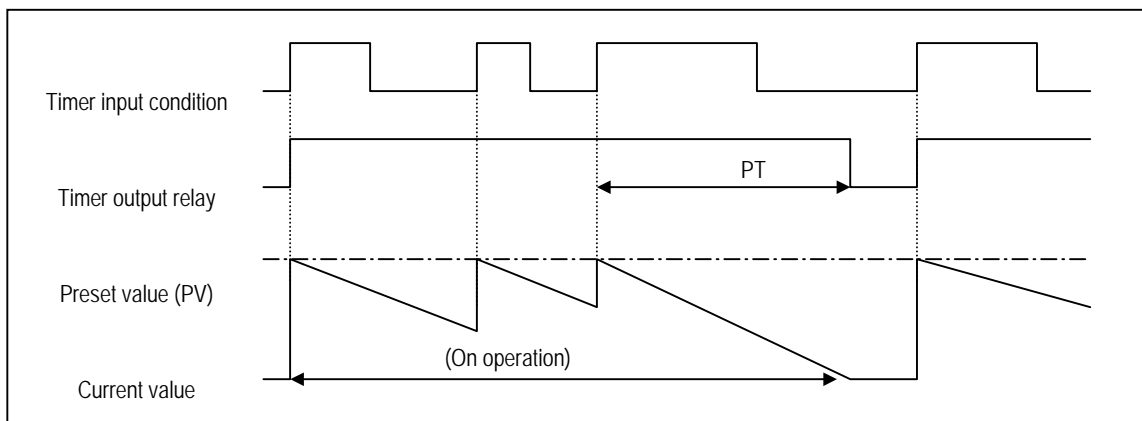
4) Monostable timer

In general, its operation is same as off-delay timer. However, the change of input condition is ignored while the timer is operating (decreasing). When current value reaches preset value the timer output relay is turned off and current value is cleared.



5) Retriggerable timer

The operation of retriggerable timer is same as that of monostable timer. Only difference is that the retriggerable timer is not ignore the input condition of TRTG instruction while the timer is operating (decreasing). The current value of retriggerable timer will be set as preset value whenever the input condition of TRTG instruction is turned on.



REMARK

The Maximum timing error of timers of MASTER-K series is '1 scan time + the time from 0 step to timer instruction'

5.3.6 Counter Processing

The counter counts the rising edges of pulses driving its input signal and counts once only when the input signal is switched from off to on. MASTER-K series have 4 counter instructions such as CTU, CTD, CTUD, and CTR. The followings shows brief information for counter operation. Refer to the 'MASTER-K Instruction Manual' for details.

1) Up counter (CTU)

- The counter output relay is turned on when the current value reaches the preset value.
- When the reset input is turned on, the counter output relay and current value is cleared as 0.



2) Down counter (CTD)

- When the CPU is switched to the RUN mode, the current value is set as preset value.
- The current value is decreased by 1 with the rising edge of counter input signal.
- The counter output relay is turned on when the current value reaches 0.



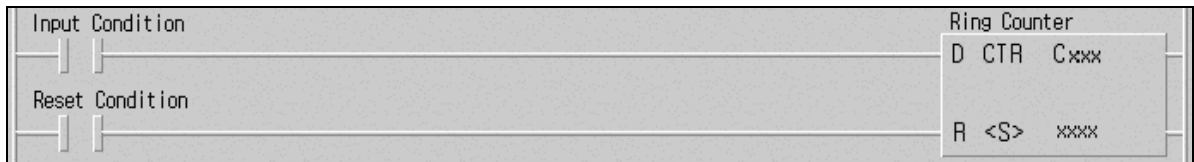
3) Up-down counter

- The current value is increased with the rising edge of up-count input signal, and decreased with the rising edge of down-count input signal.
- The counter output relay is turned on when the current value is equal or greater than the preset value otherwise off.



4) Ring counter

- The current value is increased with the rising edge of the counter input signal, and the counter output relay is turned on when the current value reaches the preset value. Then the current value and counter output relay is cleared as 0 when the next counter input signal is applied.



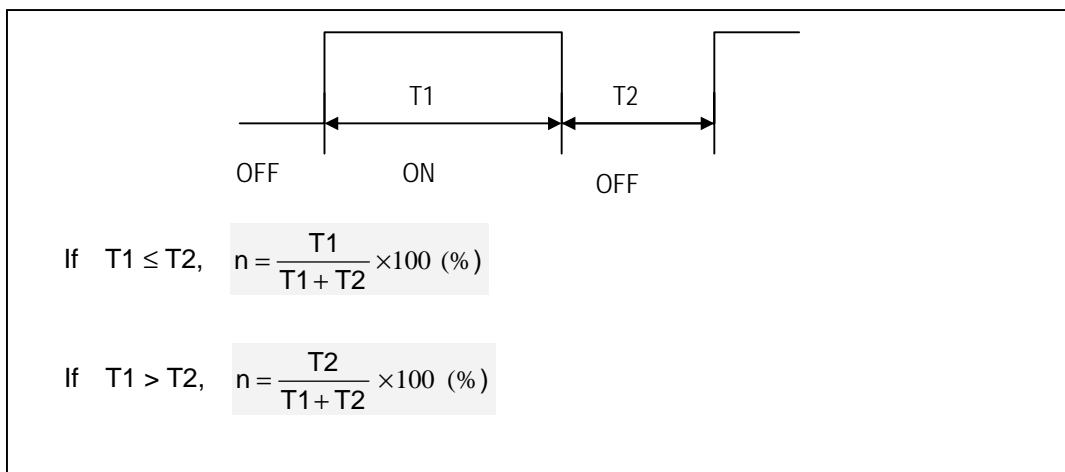
5) Maximum counting speed

- (1) The maximum counting speed of counter is determined by the length of scan time. Counting is possible only when the on/off switching time of the counter input signal is longer than scan time.

$$\text{Maximum counting speed (C}_{\max}) = \frac{n}{100} \times \frac{1}{t_s} \text{ (times/sec)} \quad \text{where, } n : \text{duty (\%)}, t_s : \text{scan time}$$

(2) Duty

Duty is the ratio of the input signal's on time to off time as a percentage.



5.4 Program

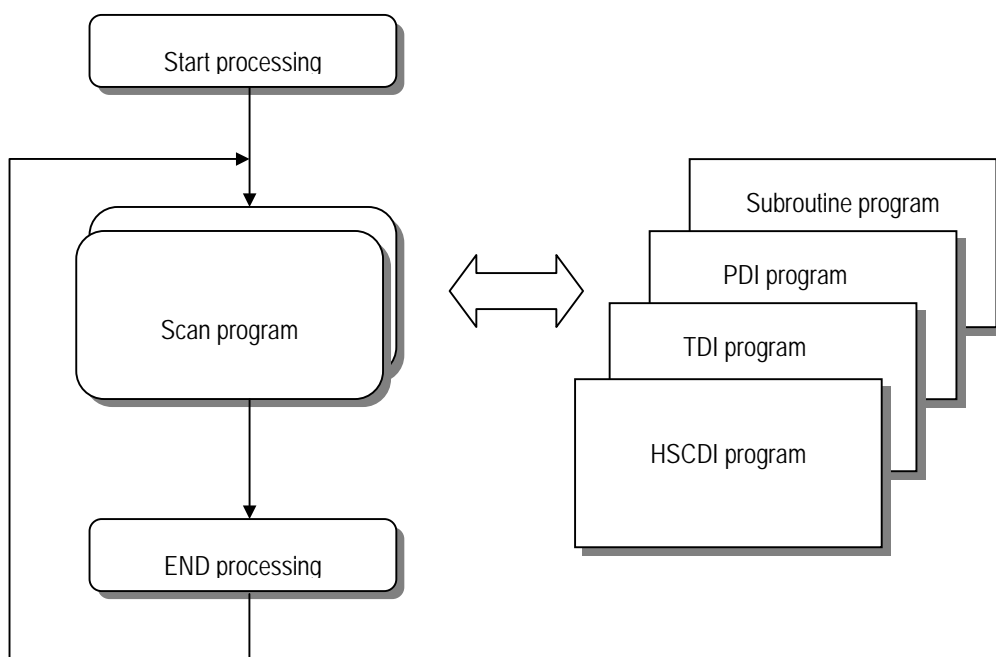
5.4.1 Classifications of Program

All functional elements need to execute a certain control process are called as a 'program'. In MASTER-K120 series, a program is stored in the EEPROM mounted on a CPU module or flash memory of a external memory module. The following table shows the classification of the program.

Program type	Description
Scan program	The scan program is executed regularly in every scan
Time-driven interrupt program (TDI)	The TDI programs are executed with a constant time interval specified with parameter setting.
Process driven interrupt program (PDI)	The PDI programs are executed when external interrupt input is applied and the corresponding interrupt routine is enabled by EI instruction.
High speed counter driven interrupt program(HSCDI)	This interrupt programs are executed when comparison task signal is applied. (Standard Type only)
Subroutine program	The subroutine programs are executed when they are called by the scan program with a CALL instruction.

5.4.2 Program Execution Procedure

The following diagram shows that how the CPU module process programs when the CPU module is powered on or switched to RUN mode.



1) Scan program

- The scan program is executed regularly in every scan from 0 step to last step.
- When interrupts has occurred, CPU pauses scan program and executes corresponding interrupt program first.
- When this interrupt program finished, scan program is to resume.

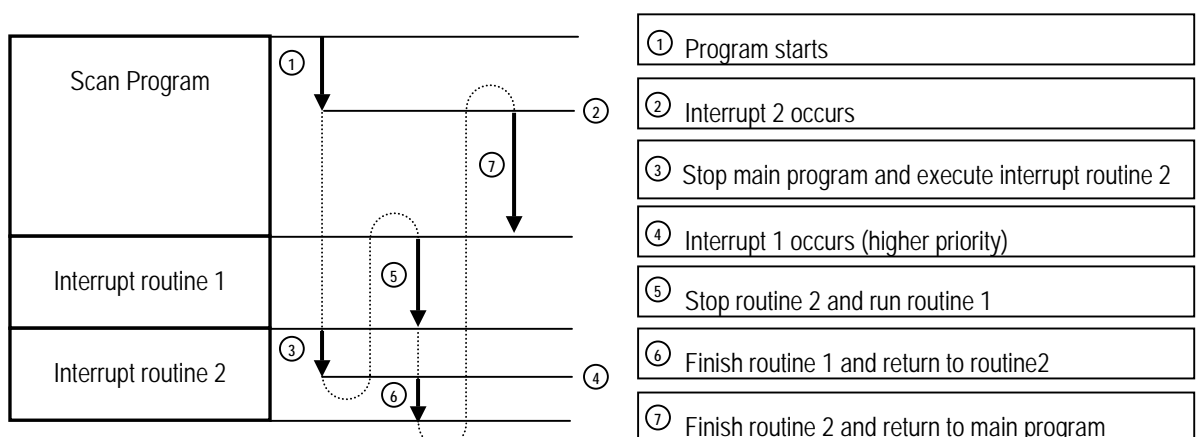
2) Interrupt program

- When an interrupt occurs, the CPU module will stop the current operation and execute the corresponding interrupt routine first. After finish the interrupt routine, the CPU resume the sequence program from the stopped step.
- MASTER-K102S series provides 3 types of interrupt.
 - The TDI (Time driven interrupt) occurs with the constant period
 - The PDI (Process driven interrupt) occurs with the status of external input.
 - The HSCDI(High speed counter driven interrupt) occur with comparison task signal from high speed counter.
 (Standard type only)

5.4.3 Interrupt Programs

1) Usage of interrupt program

- (1) Before to use interrupt function in sequence program, the parameter setting should be done properly. Then the corresponding interrupt routine should be written after END instruction. (Refer chapter 4 for details) If interrupt routines are not matched with parameter settings, an error occurs and the operation of CPU will be stopped.
- (2) To execute an interrupt routine, use the EI instruction to enable the corresponding interrupt. The interrupt routine is not executed if an interrupt factor occurs before execution of an EI instruction. Once an interrupt is enabled with EI instruction.
- (3) When multiple interrupt factors occur simultaneously, interrupt routines are executed according to the priority given to the each interrupt. If an interrupt factor that has higher priority occurs while other interrupt that has lower priority are executing, the interrupt routine of lower priority will be stopped and the interrupt of higher priority will be executed first. Following figure show how CPU handles multiple interrupts



2) parameter setting

Parameter [New Project1]							
Basic		Interrupt	CommCh0	CommCh1	PID(TUN)	PID(CAL)	P O S
Priorit...	Interrupt Type	Interrupt No.	TDI Time(10ms)		Contact...	Edge Type	HSC Ch No.
0	Time Driven	TDINT 0	100				
1	Process D...	INT 1			1	1	

Edit Interrupt

Interrupt Type

☒ Time Driven
 ☐ Process Driver
 ☐ HSC

OK

Cancel

Contact No :

0

TDI Time:

100

* 10 msec

Edge :

HSC Ch No:

* You enable to edit HSC in HSC Parameter,

3) Time driven interrupt

TDI occurs periodically with the constant interval assigned in parameter setting. The interrupt routine of TDI starts with the TDINT instruction and ends with the IRET instruction.

When multiple interrupt factors occur simultaneously, interrupt routines are executed according to the priority given to the each interrupt. If an interrupt factor has higher priority occurs while other interrupt of lower priority is executing, the interrupt routine of lower priority will be stopped and the interrupt of higher priority will be executed first. In standard types of MK120S series, Available TDI is P000 ~ P007 (8 points) assigned in parameter setting and period can be designated for each other. In economic types, Available TDI is P000 ~ P003 (4 points) .

4) Process driven interrupt

In standard types of MK120S series, Available PDI is P000 ~ P007 (8 points) assigned in parameter setting.

In the parameter setting window, TDINT indicates time driven interrupt and INT indicates process driven interrupt.

PDI occurs when the input status of P000 ~ P007 is changed from Off to On or from On to Off or both.

In economic types of MK120S series, Available PDI is P000 ~ P003 (4 points), and occurs when the input status of P000 ~ P003 is changed from Off to On. It isn't occurs falling edge of input condition.

5) HSC driven interrupt

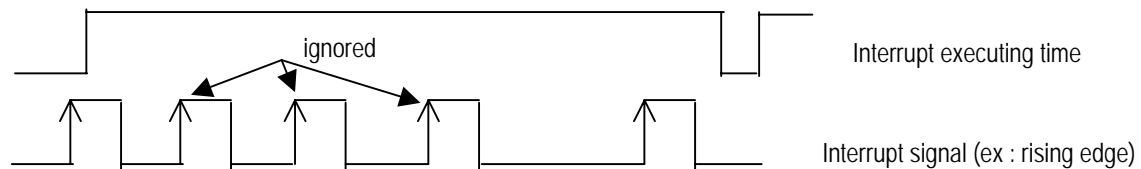
HSCDI occurs when comparison task of HSC occurs and Available HSCDI is Ch0 ~ Ch4 (4 points) .

REMARK

Total available interrupt points is 8(In standard type).

- Time driven interrupt + process driven interrupt + high speed counter driven interrupt \leq 8 points

Interrupt signal is ignored when self-interrupt occurs more than 2 times during interrupt processing is executing.



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 operation error has occurred.

(2) System configuration error

This error occurs when the PLC hardware configuration differs from the configuration defined in the K120S series. The system enters into the STOP state.

(3) Operation error during execution of the user programs

If the numeric operation error of these errors occurs during execution of the user program, 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

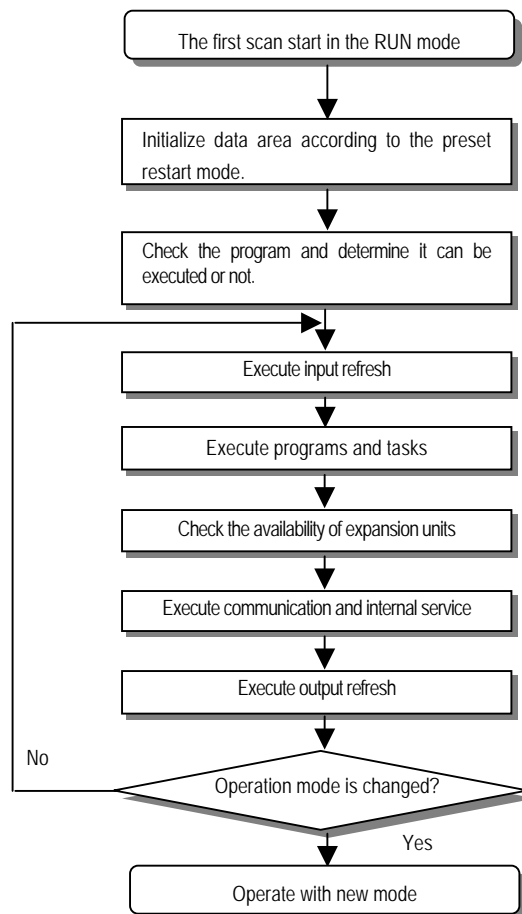
- 1) In occurrence of a error, the state is to be stored in the representative system error flag F006.
- 2) For details of flags, refer to Chapter 11. Troubleshooting.

5.5 Operation Modes

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

5.5.1 RUN Mode

In this mode, programs are normally operated.



1) Processing when the operation mode is changed.

Initialization of data area is executed when the first scan starts and The possibility of execution of the program is decided with check on its effectiveness.

2) Operation processing contents

I/O Refresh and program operation are executed.

- (1) Interrupt 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 is changed.

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 registers and input image areas are not cleared and the operating conditions just before the mode change is maintained.

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(Standard type only)

In this mode, errors of a program are searched and the operation sequence is traced. Changing into this mode is only possible from 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 input refresh is executed.

2) Operation processing contents

(1) I/O refresh is executed.

(2) Debugging process is executed complying with setting. I

(3) I/O refresh is executed after debugging process has executed to end of the program

(4) Normal or abnormal operation and mounting conditions of the loaded module are checked.

(5) Communications service or other internal operations are processed

3) Debug operation conditions

following four operation conditions can be specified.

Operation conditions	Description
executed by one command.	When executed, Stop operation after executing one instruction
executed by break-point settings.	When executed, Stop operation at designated break-point
executed by the condition of the device	When executed, Stop operation by condition of designated device's status
executed by the specified scan time	When executed, Operates specified scan time.

4) Operation method

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

(2) In interrupt programs, each task can be specified to operation enable/disable.

For detailed operation method, refer to the KGLWIN User's Manual Chapter 9.

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.(Standard type only)

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

(3) Change by the KGLWIN connected to the remote CPU module through Cnet I/F

(4) Change by the 'STOP' instruction, during program execution.

(5) Change by the KGLWIN connected to the remote CPU module through Fnet(Standard type only)

2) Operation mode change by the mode-setting switch of CPU module.(Standard type only)

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

-. If the operation mode changes from RUN mode to local RUN mode by the mode setting switch, the PLC operates continuously without stopping.

3) Mode change Remote operation

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 KGLWIN	Mode change using FAM or Cnet I/F, 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

5.6 Functions

5.6.1 Self-diagnosis

1) Functions

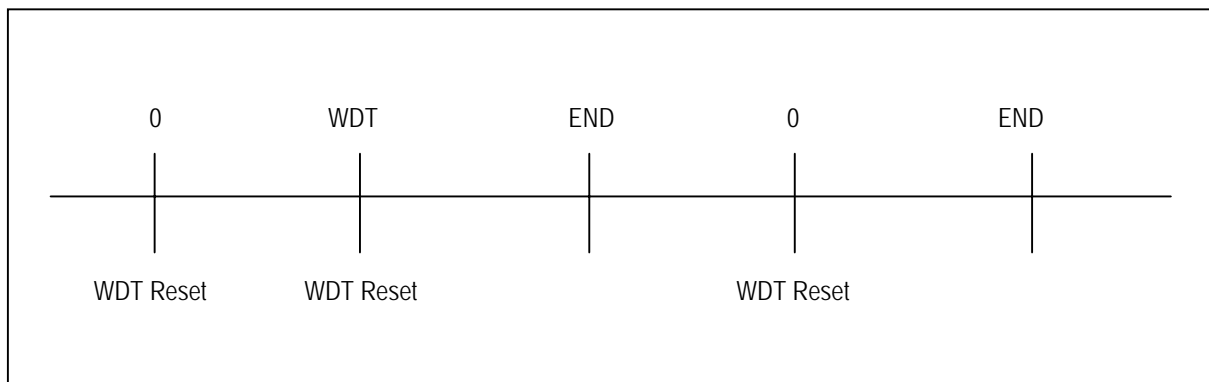
- (1) The self-diagnosis function permits the CPU module to detect its own errors.
- (2) Self-diagnosis is carried out when an error occurs during PLC power supply is turned on or operating process.
If an error is detected, the system stops operation to prevent faulty PLC operation.

2) WDT (Watch dog timer) function

The watch dog timer is an internal timer of a PLC to detect the error of hardware and a sequence program. it is changeable with parameter setting.

The CPU resets the watch dog timer before step 0 is executed (after the END processing is finished). When the END instruction has not been executed within the set value due to an error occurred in the PLC or the delay of a sequence program, the watch dog timer will times out. When a watch dog timer error is occurred, all outputs of the PLC are turned OFF, and the ERR LED of the CPU will flickers. (RUN LED will be turned OFF) Therefore, when use FOR ~ NEXT or CALL instruction, insert WDT instruction to reset the watch dog timer.

Refer the MASTER-K programming manual for details on the parameter setting.



3) I/O module check function

Mounting conditions of the loaded module are checked

4) Error history

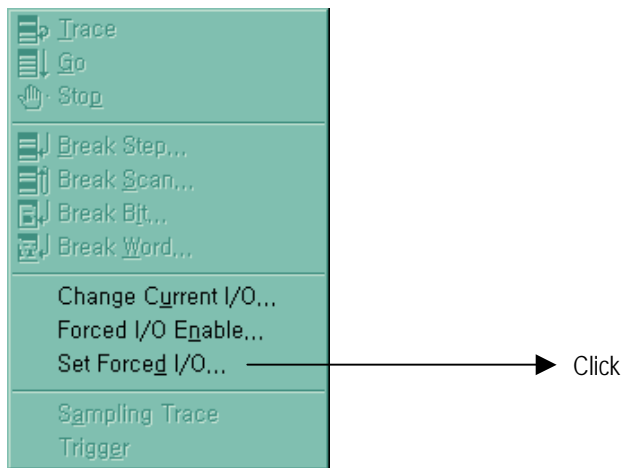
When error occurs, Corresponding error code is stored in special relay F006.

5.6.2 I/O Force On/Off function

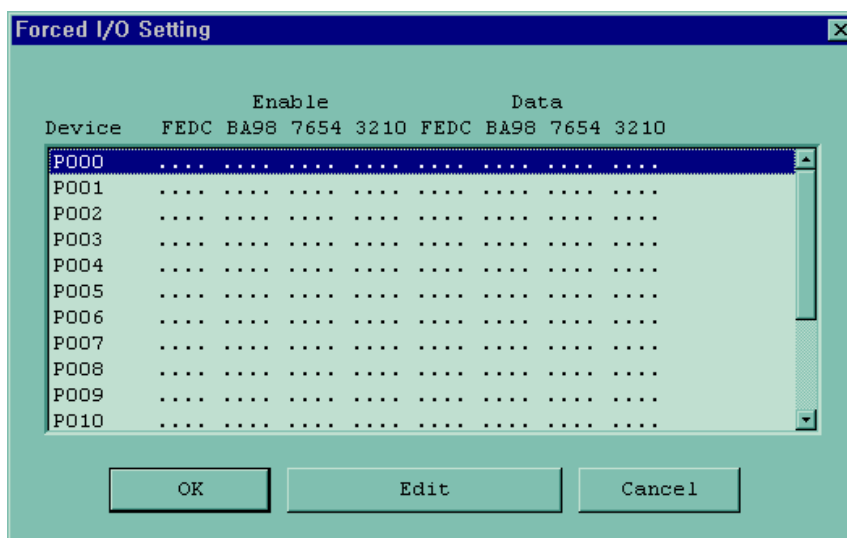
It is possible to input/output a designated data regardless of the program operation results. When used with OUTOFF instruction simultaneously, OUTOFF is prior to I/O Force On/Off.

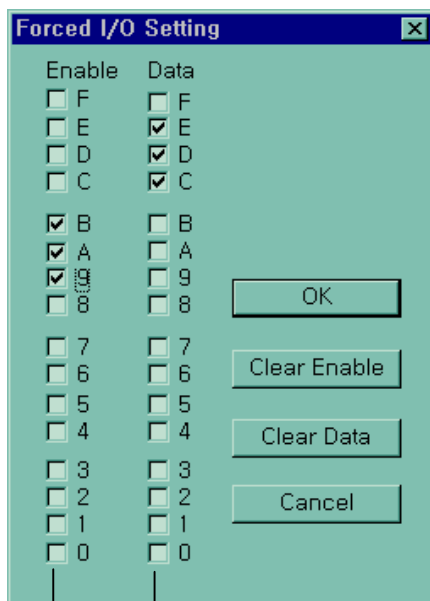
1) Forced I/O setting method.

- . I/O Force on/off setting is applied to input area and output area.
- . I/O 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.
- . Select the 'set forced I/O' from KGLWIN



- . Select the I/O area and then double click.

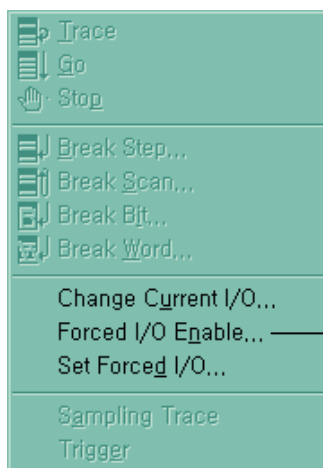




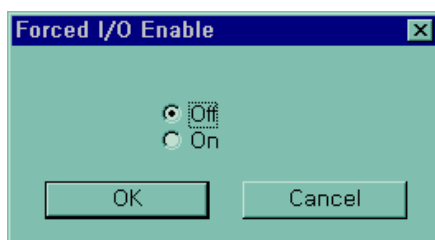
→ Set 'forced I/O data' by bit

→ Set 'forced I/O data enable' by bit

- When forced I/O set enables, forced I/O function is executing.



Click



2) Special data register for forced I/O

The contents of forced I/O setting is registered to special data register as below.

It is possible to use 'forced I/O function' to program.

Items	Special Device
All Forced I/O enable	M1910
Forced I/O enable by bit	D4700 ~ D4763
Forced I/O set data	D4800 ~ D4863

3) Force on/ off Processing timing and method

(1) Forced 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) Forced 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) Precautions

- Turning the power off and on, changes of the operation mode or operation by reset switch does not change the previous force on/off setting data. They remain within the CPU module and operation is executed with the same data.
- Forced I/O data will not be cleared even in the STOP mode.
- When setting new data, disable every I/O settings using the setting data clear function and set the new data.

REMARK

-. For detailed operation, refer to the KGLWIN user's Manual Chapter 7 'Force I/O setting.

5.6.3 Direct I/O Operation function

This function is useful when reads an input relay's state directly during execution of a program and uses in the operation, or write the operation result directly to an output relay. Direct input/output is executed by the 'IORF' instruction. If this instruction is used, the input/output image area will be directly updated and applied to the continuing operations.

REMARK

-. For detailed operation, refer to the 'MASTER-K Manual for instruction'.

5.6.4 System error history

When the system is stopped by error occurrence, the CPU stores the error occurrence time and error code to the special data register area. The most recent 16 error occurring times and error codes are stored in the special data register.

1) Special data register for error history

	Data area	Description
Device	D4901 ~ D4904	The 1 st error information, The 17 th error information
	D4905 ~ D4908	The 2 nd error information :
	:	:
	D4961 ~ D4964	The 16 th error information

2) Description of each word

Data area	Contents	Description
D4900	H0001	Error occurred point
D4901	H0305	Year : 03, Month : 5
D4902	h2812	Date : 28, Hour : 12
D4903	h3030	Minute : 30, Second : 30
D4904	h0001	Error code (h0001)

3) Clear error data

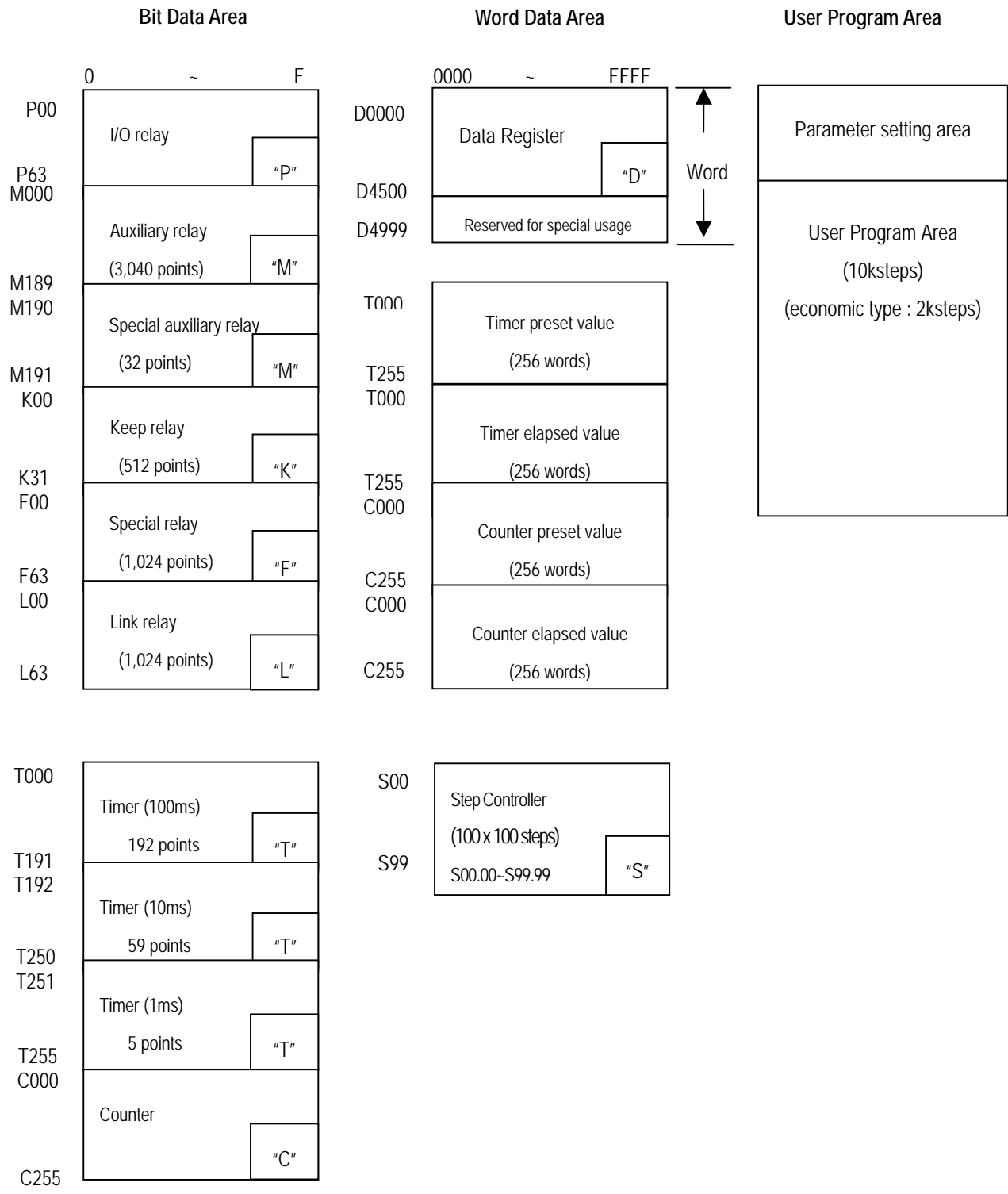
Use a 'data clear' function of KGLWIN.

REMARK

Refer to the KGLWIN user's Manual Chapter 7, for details.

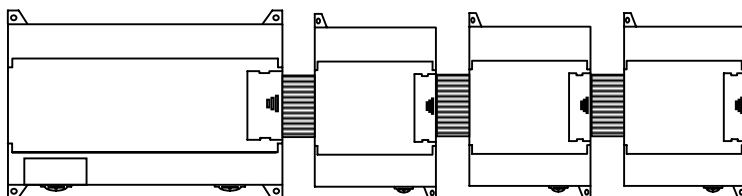
5.7 Memory Configuration

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.



5.8 I/O Address Allocation

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



Max. 3 expansion module is available in standard type.

Mounting module	Max. module can be mounted	remark
Expansion I/O module	3	2 modules in economic type
A/D, D/A conversion module	3	Not available on economic type
Analog timer module	3	
Communication module	1	

1) I/O No. allocation method

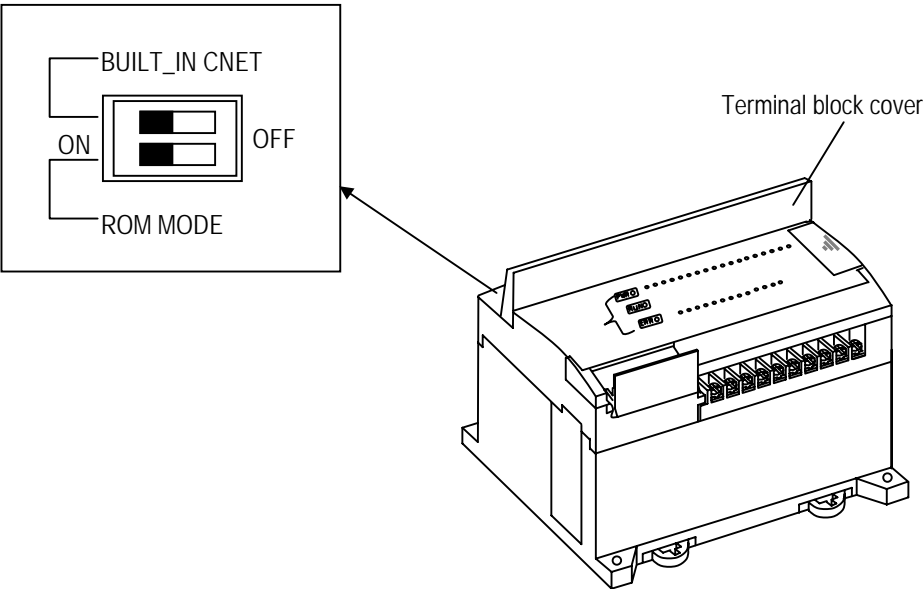
- Basically, I/O allocation is fixed point method.(the area which is not used can be used internal relay)
- The special module is not allocated.

Module	I/O	Allocation	Remark
Main	Input	P000 ~ P03F	Fixed 64 points
	Output	P040 ~ P07F	Fixed 64 points
Expansion #1	Input	P080 ~ P08F	Fixed 16 points
	Output	P090 ~ P09F	Fixed 16 points
Expansion #2	Input	P100 ~ P10F	Fixed 16 points
	Output	P110 ~ P11F	Fixed 16 points
Expansion #3	Input	P120 ~ P12F	Fixed 16 points
	Output	P130 ~ P13F	Fixed 16 points
Special		None	A/D,A/T,Communication

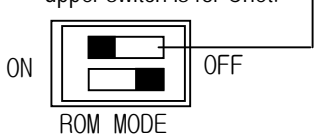
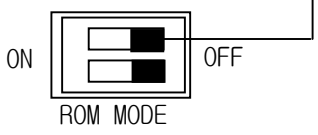
5.9 Built-in Cnet Selection Switch

5.9.1 Structure

You can see dip switches as shown when you open I/O terminal block cover.

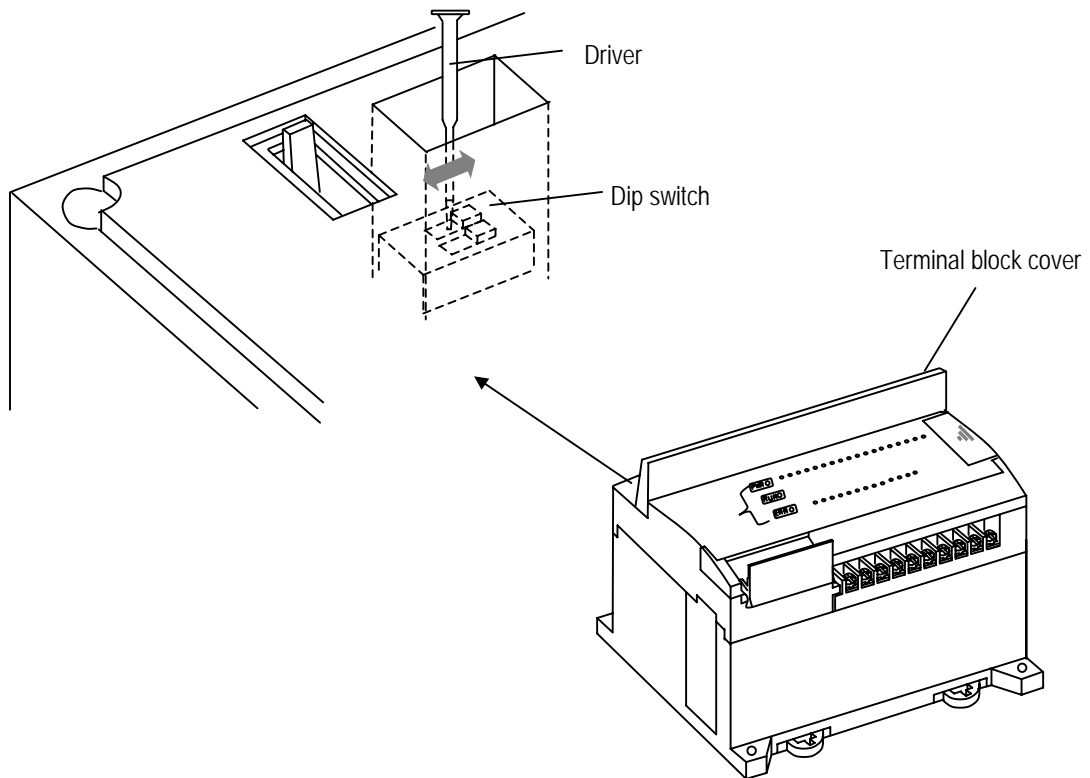


5.9.2 Usage

Dip switch position	Description
<p>upper switch is for Cnet.</p> 	Turn upper switch on to use built-in RS-232C communication
<p>Upper switch is for Cnet.</p> 	Turn upper off switch to use external communication modules.

* The lower switch is for O/S download setting. Don't handle this switch.

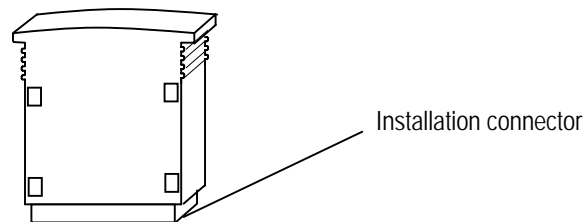
Dip switch for Built-in Cnet is placed in deep place to prevent a mistaken operation caused by terminal block cover, etc. Use a small driver to operate it.



5.10 External Memory Module

MK120S series supplies external memory module for the user to save programs safely or download a program on the system and use it in case of a program is damaged.

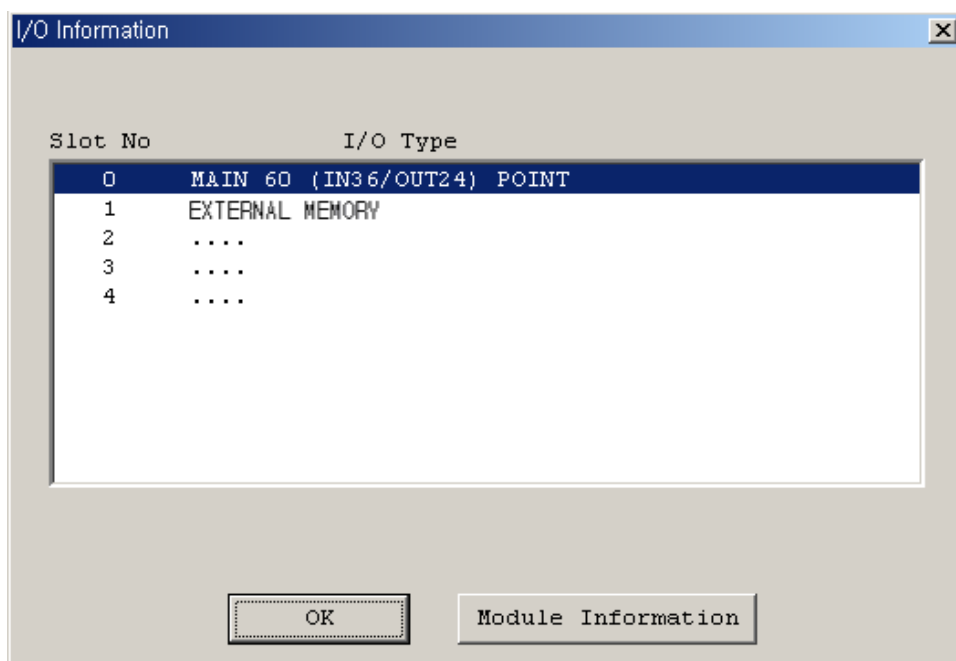
5.10.1 Structure



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 main unit is used : Connect to the expansion connector of the basic unit.
 - When expansion units are used : Connect to the expansion connector of the last connected expansion unit.
- (3) Turn the power of the main unit on.
- (4) Connect KGLWIN and PLC.
- (5) Select **Online –Read Information – I/O Information** in menu, and the following message box will displayed



- (6) Select *Online – Flash memory – Write to external memory* in menu, and the following message box will displayed.



- (7) Turn the power of the main unit off.
(8) 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 main unit off.
(2) Install the memory module
- When only main unit is used, connect to the expansion connector of the main unit And when expansion unit is used, connect to the expansion connector of the last connected expansion unit.
(3) Turn on the power of the main unit.

Through the above steps the user can operate the PLC with program stored in the external memory module.

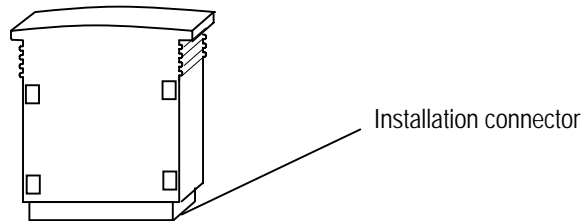
REMARK

- 1) When the PLC restarts, it always operated with the external memory module automatically if external memory is connected.
- 2) Remove after writing is finished.

5.11 RTC Module

MK120S series supplies RTC(Real Time Clock) module for the time-scheduling control. To use RTC function with K120S series, the RTC operation module should be attached to the expansion slot of main unit or expansion module. Clock operation by the RTC function is continued with a super capacitor when the CPU is powered off.

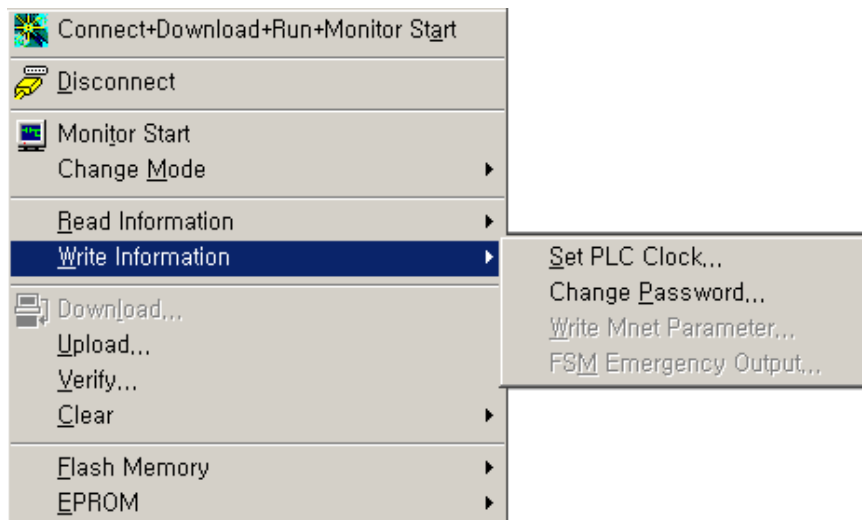
5.11.1 Structure



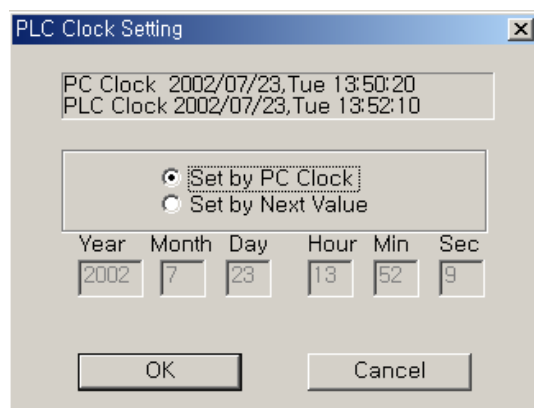
5.11.2 Usage

- 1) Read RTC data
 - (1) Read RTC data from KGLWIN

-. Select **Online –Write Information – Set PLC Clock** in menu.



-. Following message box will be displayed



(2) Read RTC data from special register

Special register Area (Word)	Description		Data (BCD format)
	Upper byte	Lower byte	
F053	Lower 2 digits of year	Month	H0207
F054	Day	Hour	H2313
F055	Minute	Second	H5020
F056	Higher 2 digits of year	Date	H2002

Example : 2002. 07. 23. 13:50:20, Tuesday

2) Write RTC data

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

The first one is using a graphic loader (KGLWIN). For detailed information, refer the user's manual of KGLWIN.

The second one is write sequence program. By switching a special bit on, user can replace the current RTC data with the reset data stored in a specified memory area. The followings are the memory address of preset data and an example program.

Data register Area (Word)	Description		Data (BCD format)
	Upper byte	Lower byte	
D4992	Lower 2 digits of year	Month	H0207
D4993	Day	Hour	H1011
D4994	Minute	Second	H5324
D4995	Higher 2 digits of year	Date	H2001

Example : 2002. 7. 10. 11:53:24, Monday

* M1904 : RTC data change bit

When the M1904 bit is switched on, the new data in D4993 ~ D4996 will be moved to F53 ~ F56. After data is moved, M1904 has to be switched off immediately because current data will be updated every scan while M1904 is on.

3) Date expression

Number	0	1	2	3	4	5	6
Date	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

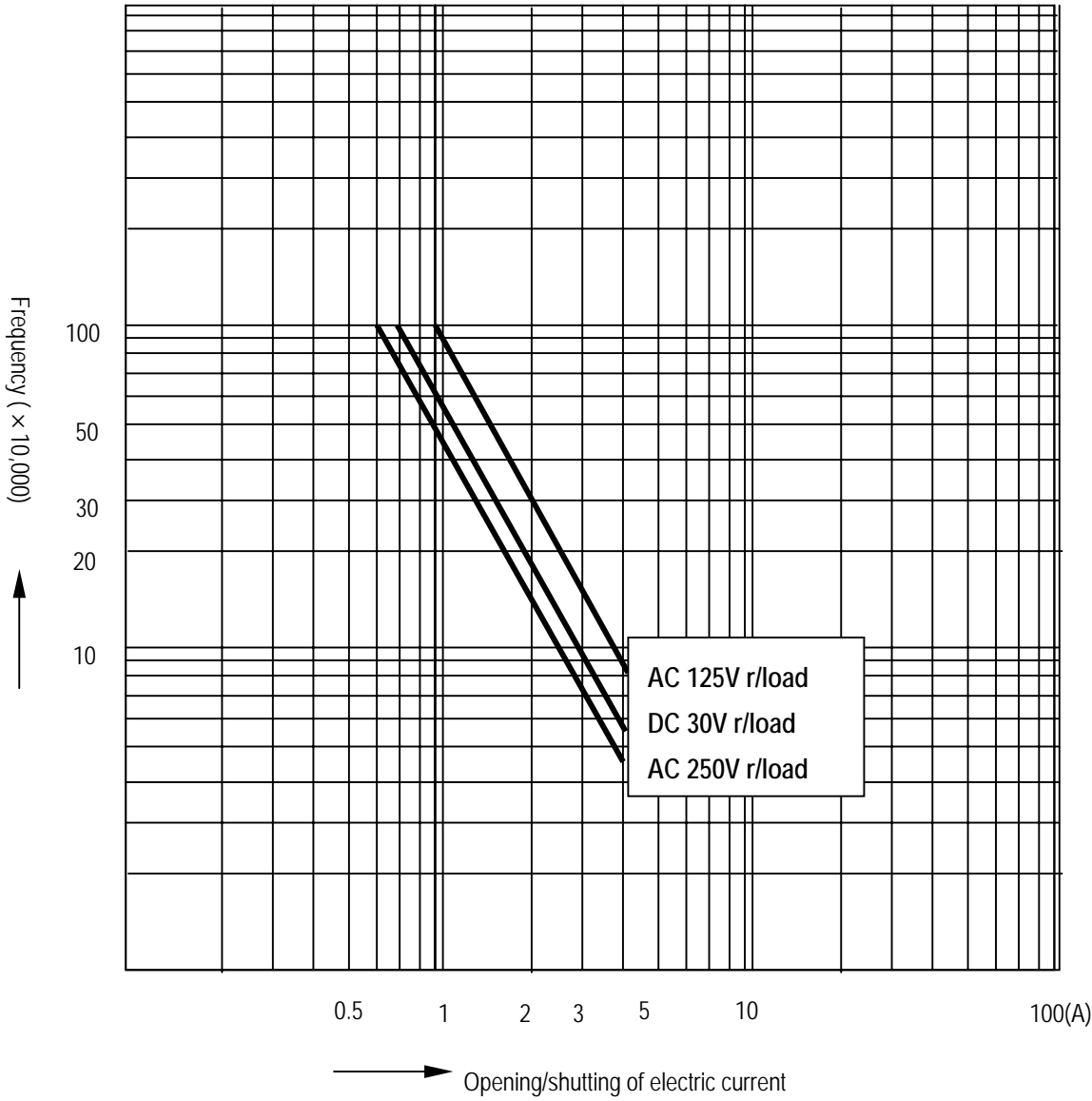
REMARK

- 1) If RTC stops or error occurs, write new data to the RTC then error is called off.
- 2) There is no written clock data in the RTC when shipped.
- 3) Before using RTC module, write clock data to the RTC first

Chapter 6 Input and Output Specification

6.1 Input / Output Specifications

Digital input that offers to MASTER-K120S 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.



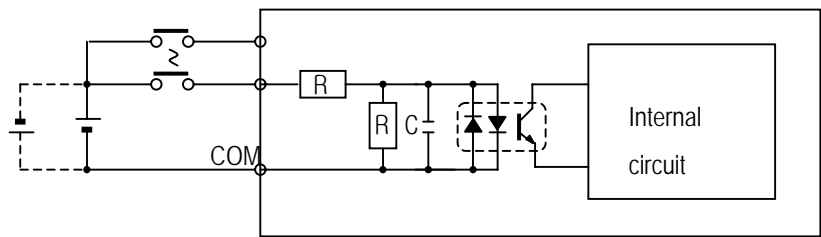
6.2 Digital Input Specification

6.2.1 Main unit

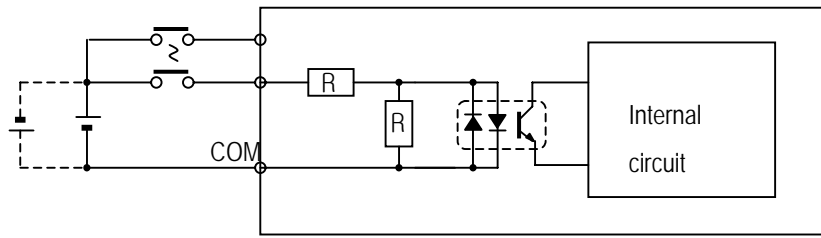
1) Specification

Model		Main unit					
		K7M-DR10UE	K7M-DR14UE	K7M-DR/DRT/DT20U K7M-DR20UE	K7M-DR/DRT/DT30U K7M-DR30UE	K7M-DR/DRT/DT40U K7M-DRT40U	K7M-DR/DRT/DT60U K7M-DRT60U
Number of input points		6 points	8 points	12 points	18 points	24 points	36 points
Insulation method		Photo coupler					
Rated input voltage		DC 24V					
Rated input current		7 mA (Standard Type P0~P3:9mA, Economic Type P0,P1:9mA)					
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 k Ω (Standard Type P0~P3:2.7 k Ω , Economic Type P0,P1:2.7 k Ω)					
Response time	Off \rightarrow On	0,1,2,5,10,20,50,100,200,500,1000ms (Default : 10ms)					
	On \rightarrow Off	0,1,2,5,10,20,50,100,200,500,1000ms (Default : 10ms)					
Common terminal		6 points / COM	8 points/COM	12 points/COM	18 points/ COM	12points/COM	18points/COM
Operating indicator		LED turns on at ON state of input					

2) Circuit diagram



Standard Type	P000 ~ P001
Economic Type	None

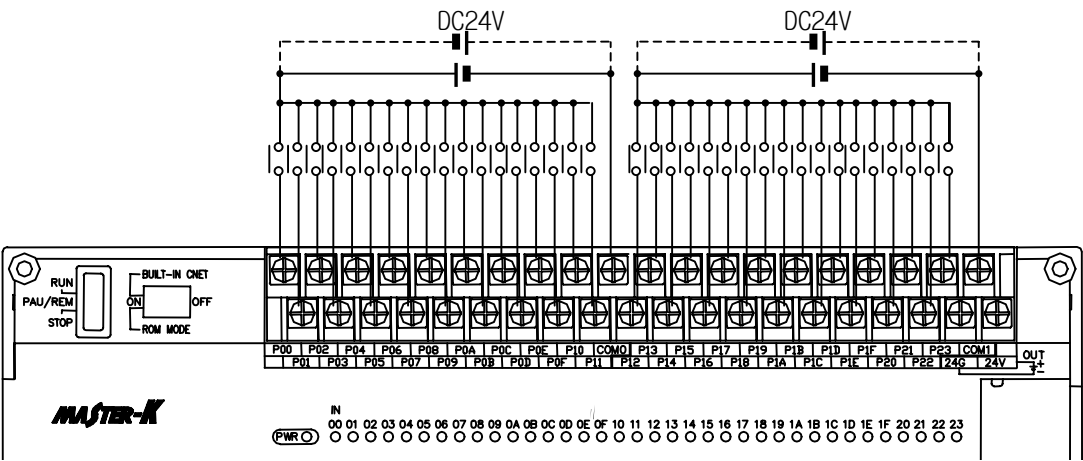


Standard Type	P002 ~
Economic Type	P000 ~

3) Input wiring

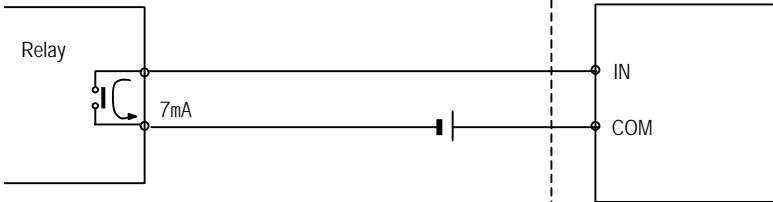
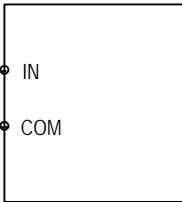
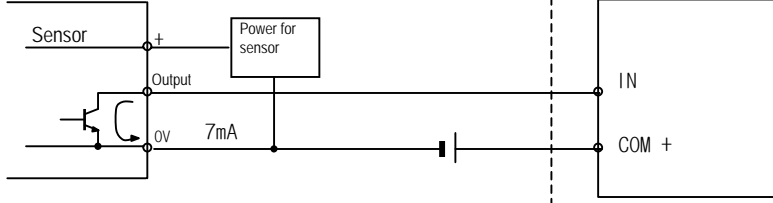
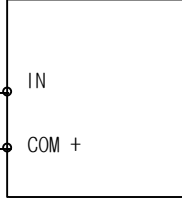
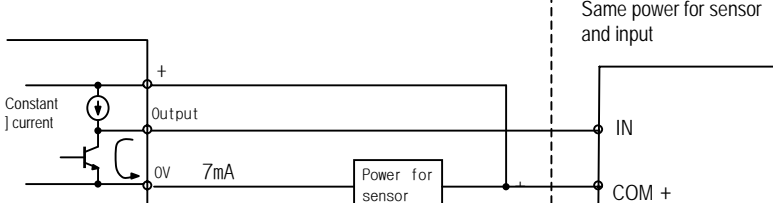
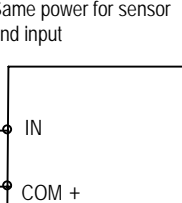
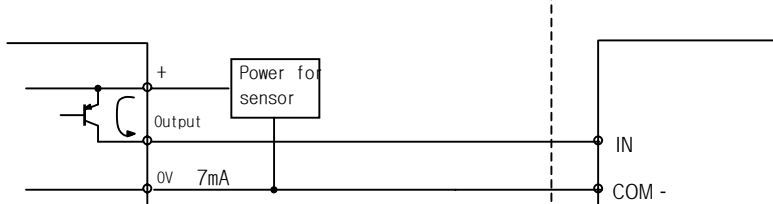
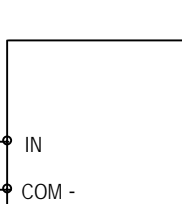
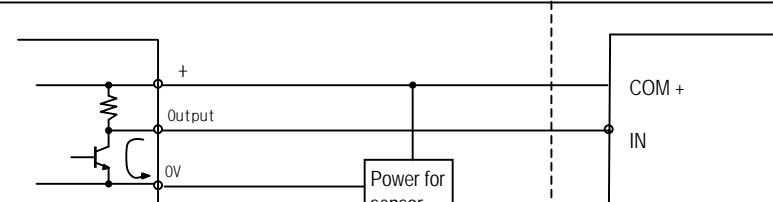
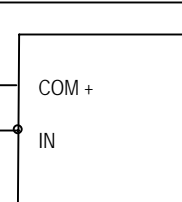
Main unit's wiring method is as follows. DC input specifications offered by MASTER-K120S is to be used for both electric current sink and electric current source.

(1) 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.

	External device	Input
Contact points		
NPN open collector output type		
NPN current output type		
PNP current output type		
Voltage output type		

6.2.2 Expansion Module

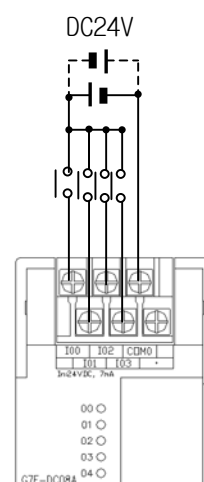
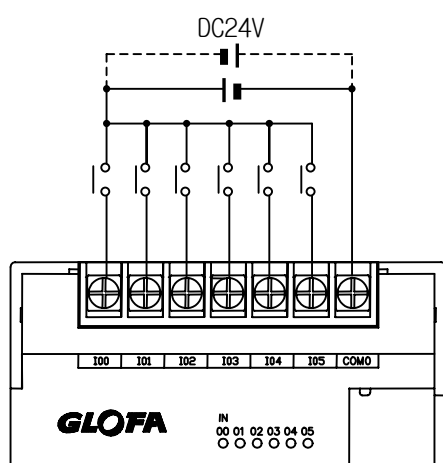
1) Specifications

Specification		Expansion Module		
		G7E-DR10A	G7E-DC08A	G7E-DR20A
Number of input points		6 points	8 points	12 points
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 k Ω		
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
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 Specification

6.3.1 Main unit (Relay Output)

1) Specification

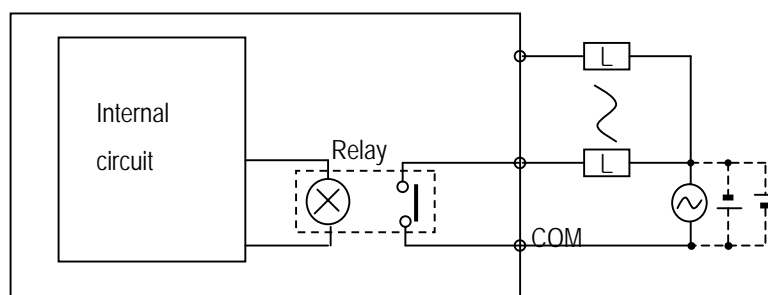
(1) Standard type

Model Specifications		Main Unit			
		K7M-DR20U (K7M-DRT20U)	K7M-DR30U (K7M-DRT30U)	K7M-DR40U (K7M-DRT40U)	K7M-DR60U (K7M-DRT60U)
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			
Current leakage when off		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 (COS Ψ = 0.7) 100,000 or more			
		AC200V / 1A, AC240V / 0.5A (COS Ψ = 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 indication		LED is on at on status of output			

(2) Economic type

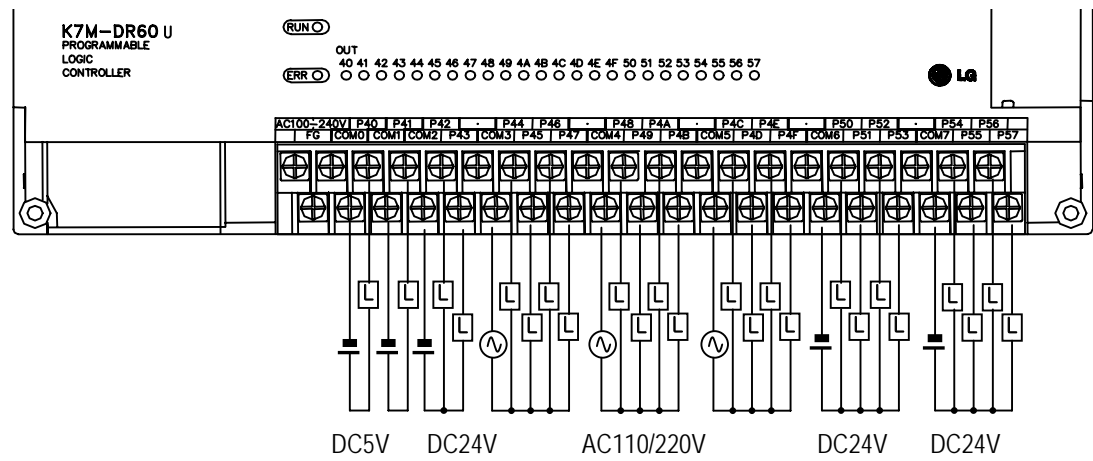
Model Specifications		Main Unit			
		K7M-DR10UE	K7M-DR14UE	K7M-DR20UE	K7M-DR30UE
Output point		4 points	6 points	8 points	12 points
Insulation method		Relay insulation			
Rated load voltage/current		DC24V / 2A (r/load), AC220V / 2A (COS Ψ = 1)/1 point , 5A / 1COM			
Min. load Voltage/current		DC5V / 1mA			
Max. load voltage/current		AC250V, DC110V			
Current leakage when off		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 (COS Ψ = 0.7) 100,000 or more			
		AC200V / 1A, AC240V / 0.5A (COS Ψ = 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 indication		LED is on at on status of output			

2) Circuit



3) Output wiring

(1) Main unit

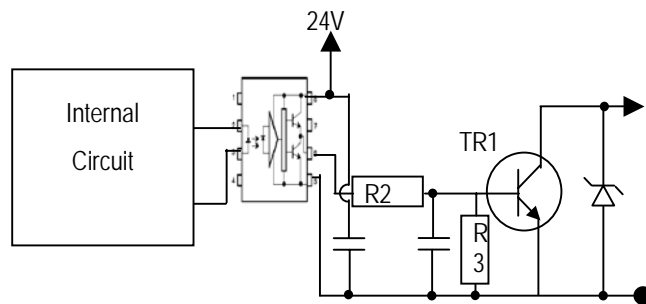


6.3.2 Main unit (TR Output : DRT/DT type only)

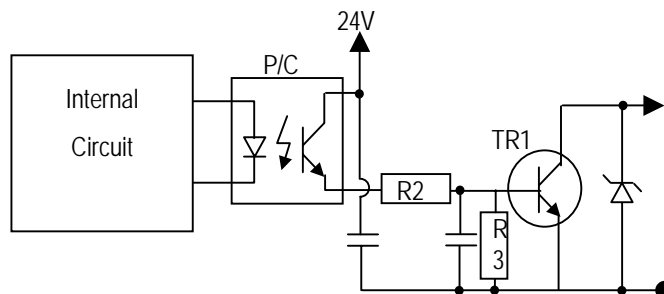
1) Specification

Model Specifications		Main Unit			
		K7M-DRT/DT20U	K7M-DRT/DT30U	K7M-DRT/DT40U	K7M-DRT/DT60U
Output point		4 points / 8 point	4 points / 12 point	4 points / 16 point	4 points / 24 point
Insulation method		Photo coupler insulation			
Rated load voltage		DC12/24V			
Operation load Voltage		DC10.2 ~ 26.4V			
Max. load current		0.5A/1 point (DRT Type P40~P43: 0.1A/1point, DT Type P40~P41 0.1A/1point)			
Current leakage when off		Less than 0.1mA			
Voltage drop when on		Less than DC0.3V			
Surge Absorber		Zener diode			
Inrush current		Less than 4A, 10ms			
Response time	Off → On	0.2 ms or lower			
	On → Off	0.2 ms or lower			
Operation indication		LED is on at on status of output			

P40, P41



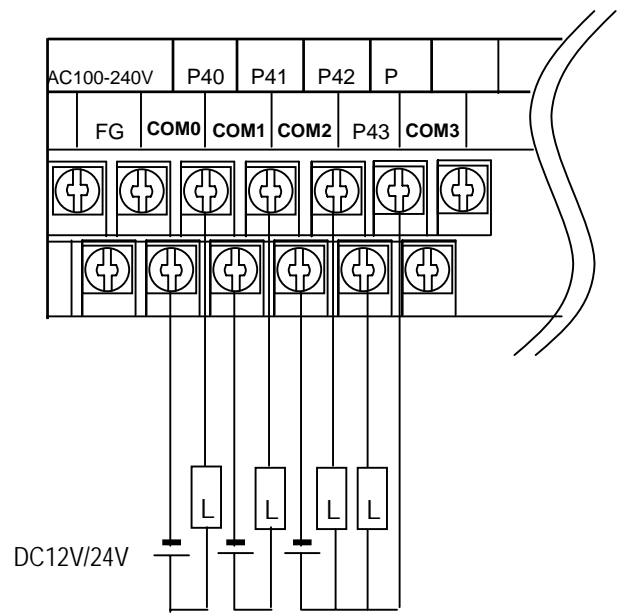
P42, P43



REMARK

- 1) Output TR P000 ~ P003 of DRT Type(K7M-DRT20/30/40/60U) are for positioning function.
- 2) They also can be used as general transistor output, but can't be used for AC load. When used for AC loads, they can be destroyed.

2) Output wiring



6.3.3 Expansion Module

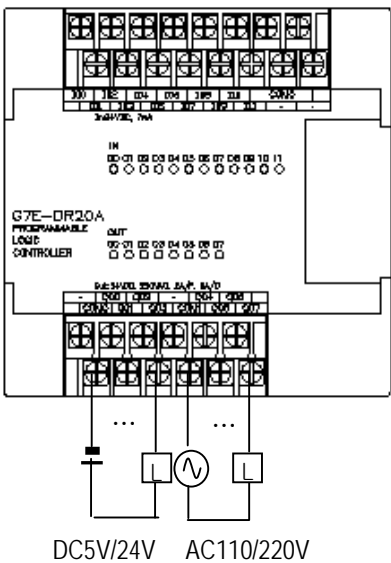
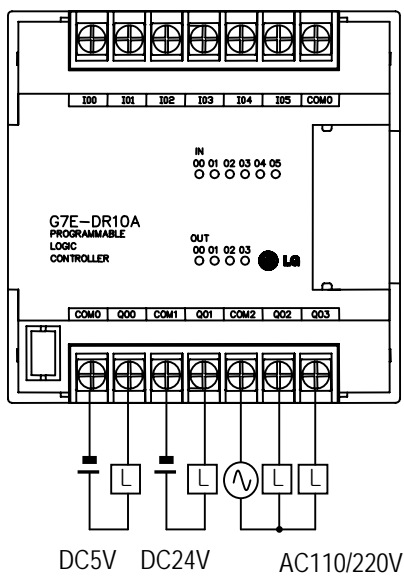
1) Specifications

Specifications \ Model		Expansion Module			
		G7E-DR10A	G7E-DR08A	G7E-RY08A	G7E-DR20A
Output point		4 points			8 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			
Current leakage when off		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 (COS Ψ = 0.7) 100,000 or more			
		AC200V / 1A, AC240V / 0.5A (COS Ψ = 0.35) 100,000 or more			
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100,000 or more			
Response time	Off \rightarrow On	10 ms or lower			
	On \rightarrow Off	12 ms or lower			
Operation indication		LED is on at on status of output			

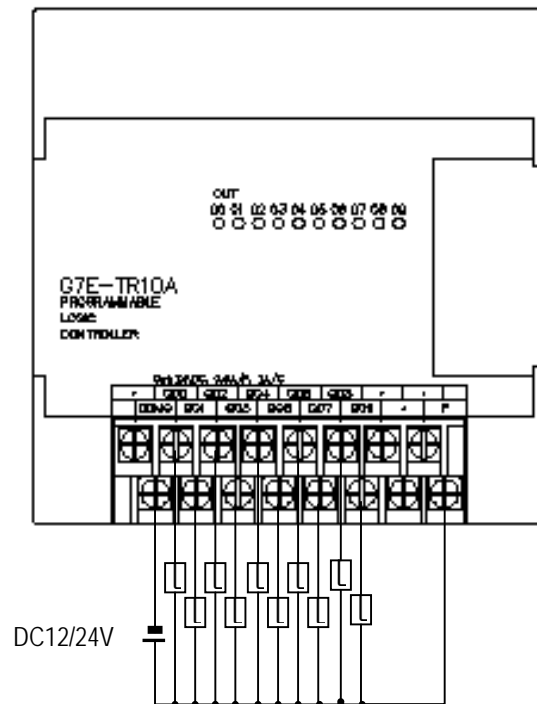
2) Circuit

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

3) Output wiring



Specifications \ Model		Expansion 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
Current leakage when off		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 method		10 points/ 1COM,
Operation indication		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 MASTER-K120S. The built-in high speed counter of MASTER-K120S(hereafter called HSC) has the following features;

Function		Description
Counter format		<ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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

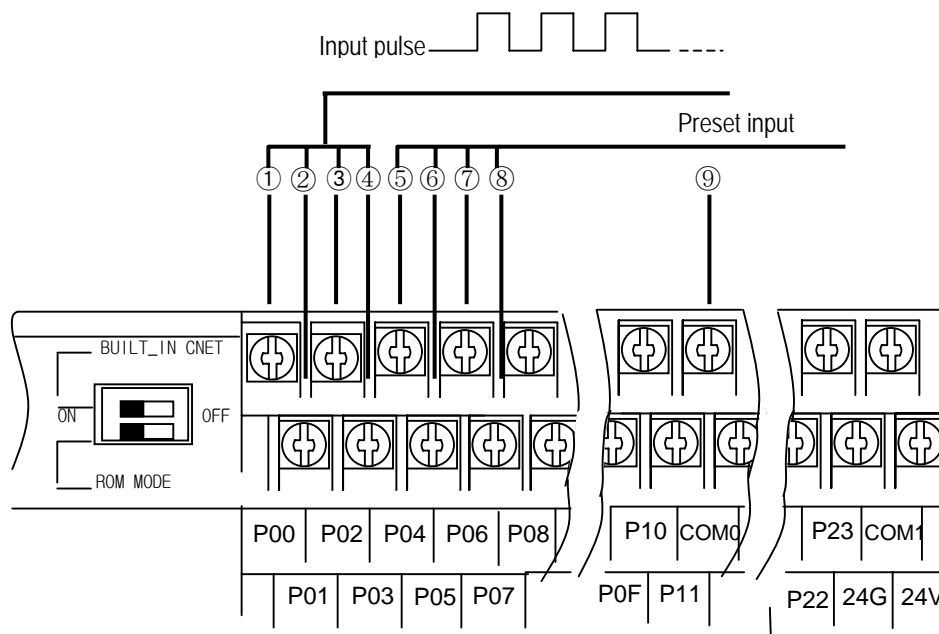
1) Performance Specifications

Items		Specifications	
Points		Standard Type	Economic Type
		1 phase : 4 points, 2 Phase : 2 points	1 phase : 2 points, 2 Phase : 1 points
Max. counting speed		1-phase 100kHz/ 2-phase 50kHz (Ch0, Ch1) 1-phase 20kHz/ 2-phase 10kHz (Ch2, Ch3)	1-phase 10kHz/ 2-phase 5kHz (Ch0, Ch1)
Input types		A-Phase, B-Phase, Preset input	
Counting ranges		from -2,147,483,648 to 2,147,483,647(Binary 32 bits)	
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 μs or lower
				Off delay time	200 μs or lower

3) Names of wiring terminals



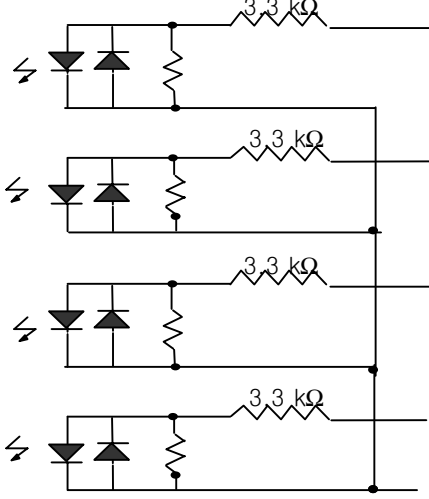
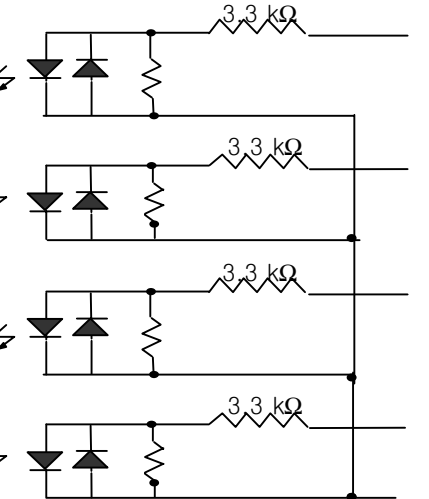
No.	Terminal No.	Names		Usage	
		1Phase	2Phase	1Phase	2Phase
①	P00	Ch0 Input	Ch0 A Phase Input	Counter input terminal	A Phase Input terminal
②	P01	Ch1 Input	Ch0 B Phase Input	Counter input terminal	B Phase Input terminal
③	P02	Ch2 Input	Ch2 A Phase Input	Counter input terminal	A Phase Input terminal
④	P03	Ch3 Input	Ch2 B Phase Input	Counter input terminal	B Phase Input terminal
⑤	P04	Ch0 Preset 24V	Ch0 Preset 24V	Preset input terminal	Preset input terminal
⑥	P05	Ch1 Preset 24V	-	Preset input terminal	-
⑦	P06	Ch2 Preset 24V	Ch2 Preset 24V	Preset input terminal	Preset input terminal
⑧	P07	Ch3 Preset 24V	-	Preset input terminal	-
⑨	COM0	Input Common		Input common terminal	

< Standard Type >

No.	Terminal No.	Names		Usage	
		1Phase	2Phase	1Phase	2Phase
①	P00	Ch0 Input	Ch0 A Phase Input	Counter input terminal	A Phase Input terminal
②	P01	Ch1 Input	Ch0 B Phase Input	Counter input terminal	B Phase Input terminal
③	P02	Ch0 Preset 24V	Ch0 Preset 24V	Preset input terminal	Preset input terminal
④	P03	Ch1 Preset 24V	-	Preset input terminal	-

< Economic Type >

4) External interface circuit

I/O	Internal circuit	Terminal No.	Signal name		Operation	Input warranted voltage
			1Phase	2Phase		
Input		P00	Ch0 Input pulse	Ch0 A Phase Input	On	20.4~28.8V
					Off	6V or lower
		P01	Ch1 Input pulse	Ch0 B Phase Input	On	20.4~28.8V
					Off	6V or lower
		P02	Ch2 Input pulse	Ch2 A Phase Input	On	20.4~28.8V
					Off	6V or lower
		P03	Ch3 Input pulse	Ch2 B Phase Input	On	20.4~28.8V
					Off	6V or lower
		COM 0	Common			
Input		P04	Ch0 Preset input	Ch0 Preset input	On	20.4~28.8V
					Off	6V or lower
		P05	Ch1 Preset input	-	On	20.4~28.8V
					Off	6V or lower
		P06	Ch2 Preset input	Ch2 Preset input	On	20.4~28.8V
					Off	6V or lower
		P07	Ch3 Preset input	-	On	20.4~28.8V
					Off	6V or lower
		COM 0	Common			

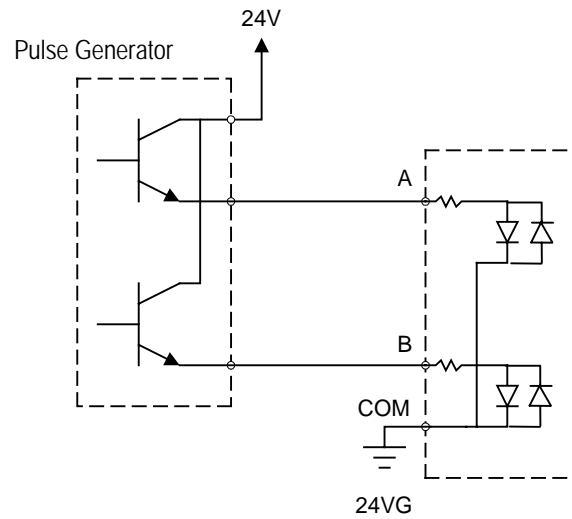
5) Wiring instructions

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 MASTER-K120S, take the following precautions against wiring noise.

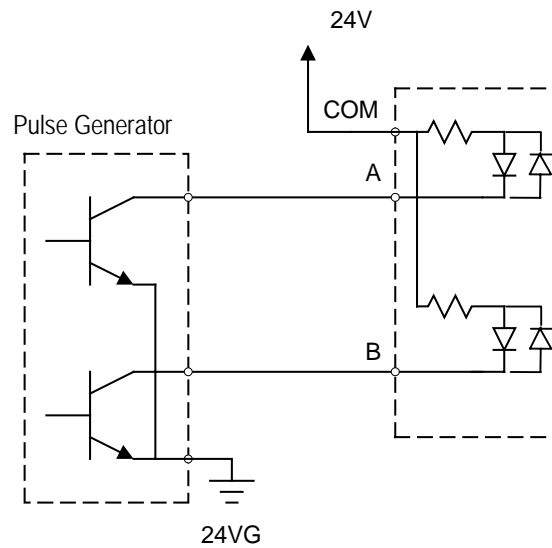
- (1) Be sure to use shielded twisted pair cables. Also provide Class 3 grounding.
- (2) Do not run a twisted pair cable in parallel with power cables or other I/O lines which may generate noise.
- (3) Before applying a power source for pulse generator, be sure to use a noise-protected power supply.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

HSCAST	High speed counter											No. of steps	Flag		
Instruction	Available device												Error (F110)	Zero (F111)	Carry (F112)
	M	P	K	L	F	T	C	S	D	#D	integer				
S											○	7/9	○		
SV	○	○	○	○	○	○	○		○	○	○				
CV	○	○	○	○		○	○		○	○					

Input condition															
HSCST S SV CV															
Flag set								Designation							
Error (F110)	Error flag turns on when designating area is over							S	Channel which is designated at parameter(0~3)						
								SV	Set value (binary 32 bits) Range : (-2,147,483,648 ~ 2,147,483,647)						
								CV	Current value of HSC stored area						

■ HSCST S SV CV

(1) Functions

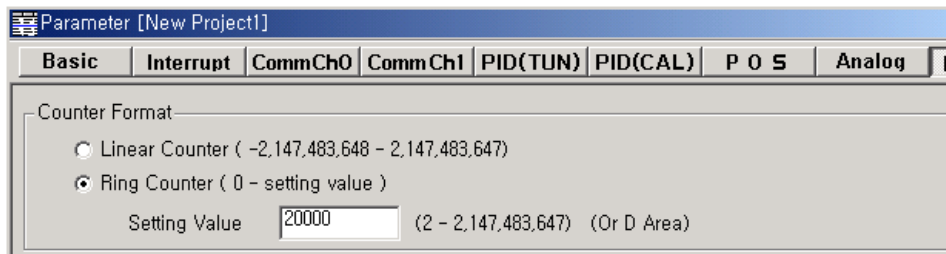
- When input condition turns on, corresponding high speed counter is enabled.
- When input condition turns off, high speed counter stop counting and turns output point off . The current value is retained.
- The high speed counter can counts from -2,147,483,648 to 2,147,483,647(binary 32bits).
- When 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

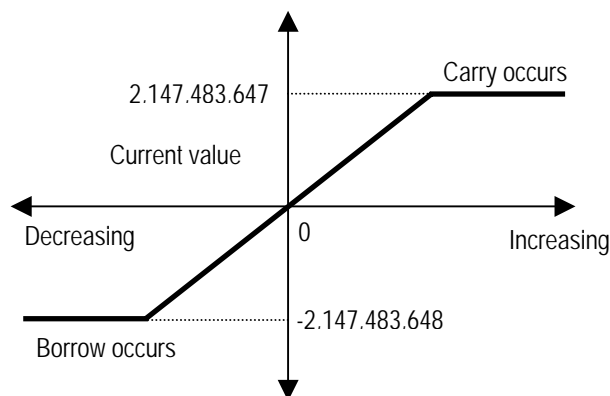
8) Parameter Setting

(1) Format setting



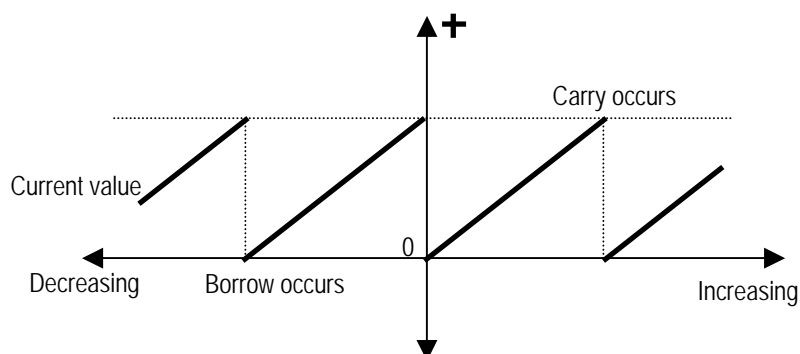
(a) Linear counter

- If HSC is designate as Linear counter, it can counts from -2,147,483,648 to 2,147,483,647.
- The carry flag F18*(* is channel number) turns on when the current value of high speed counter is overflow during up counting and HSC stop counting.
- The borrow flag F19*(* is channel number) turns on when the current value of high speed counter is underflow during down counting and HSC stop counting.
- Carry and borrow flags can be reset by preset operation and HSC can re-starts its operation.

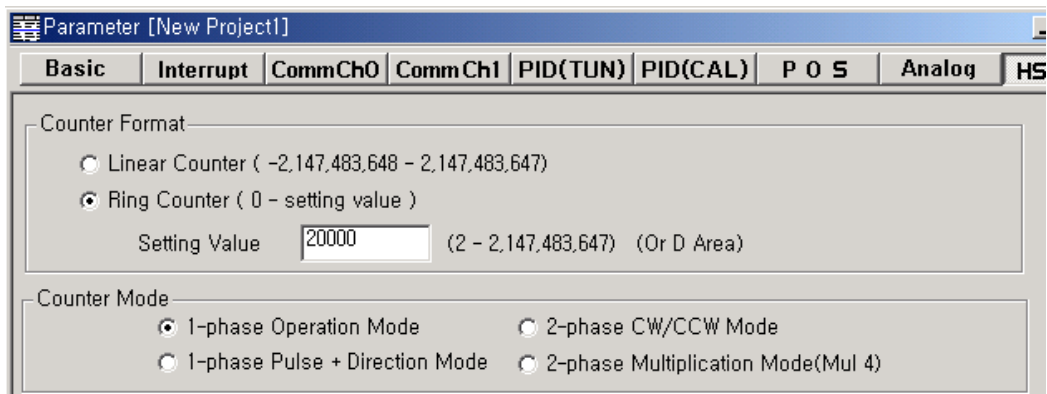


(b) Ring counter

- 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.

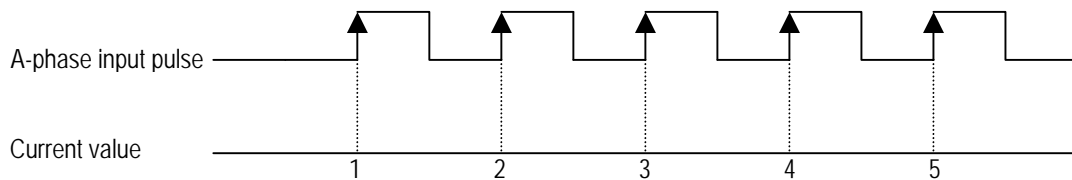


(2) Mode setting



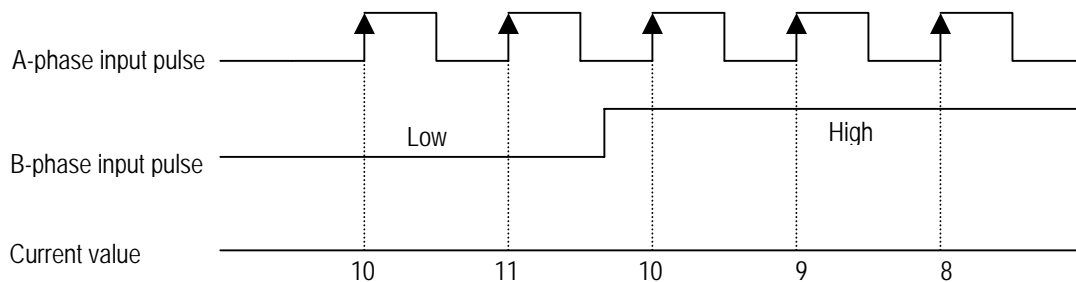
(a) 1-phase operation mode

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



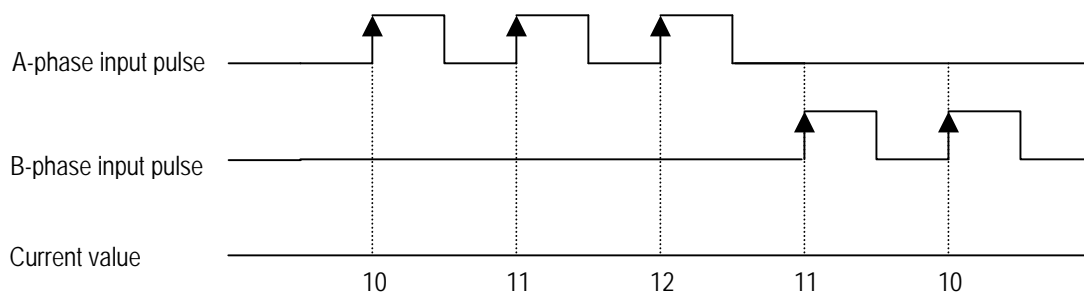
(b) 1-phase pulse + direction mode

- 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 A-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)

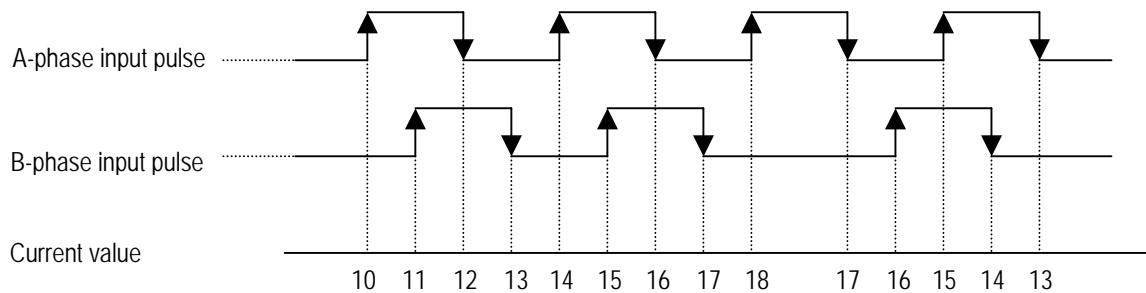
- Up or Down is set automatically by the phase difference between A and B phase.

- Up counter

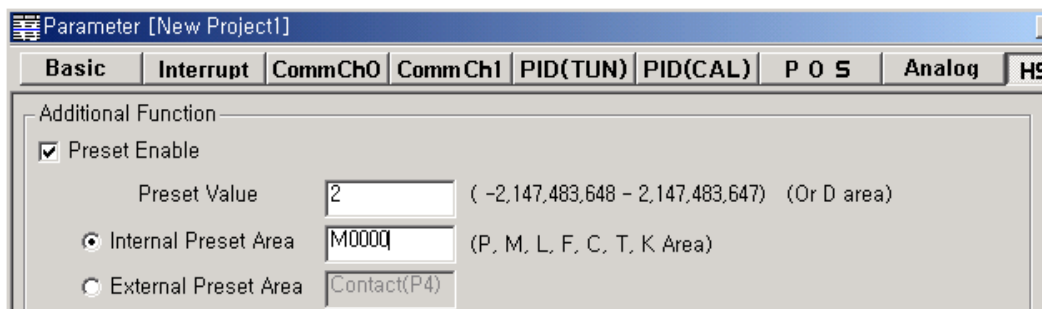
- At the rising edge of A-Phase pulse when B-phase is 'low'.
- At the falling edge of A-Phase pulse when B-phase is 'high'.
- At the rising edge of B-Phase pulse when A-phase is 'high'.
- At the falling edge of B-Phase pulse when A-phase is 'low'.

- 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



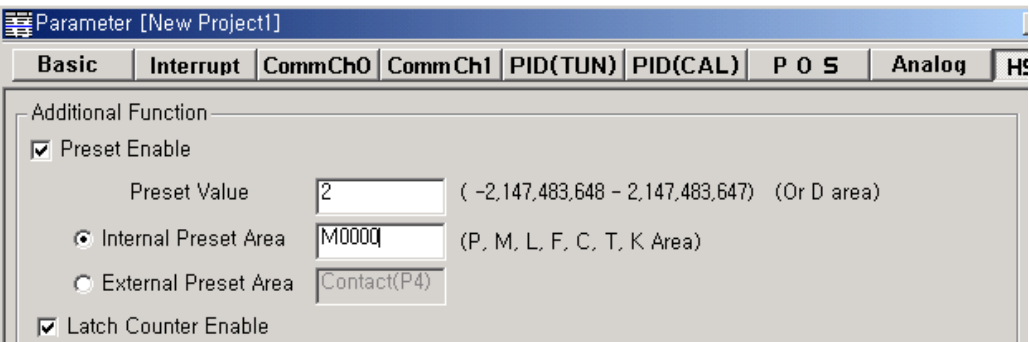
(a) Internal Preset

- 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.

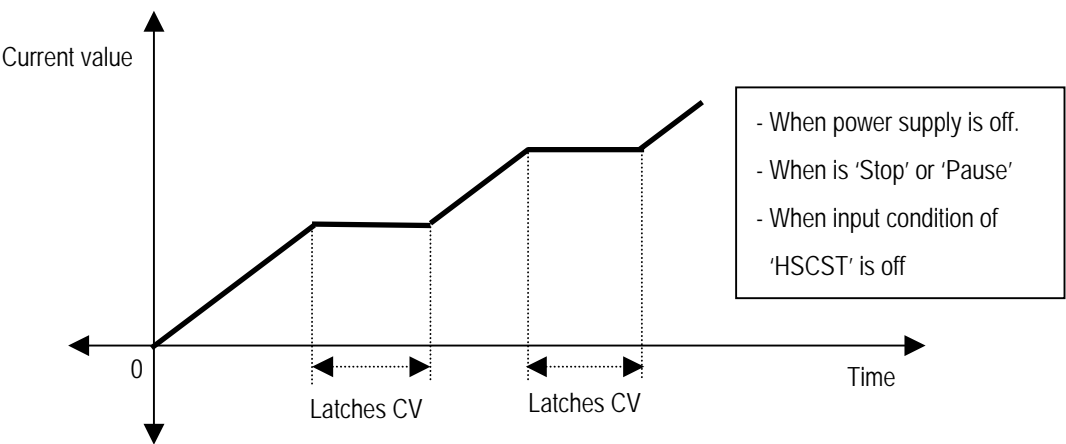
(b) External Preset

- Set external preset area and preset value.
- External devices are fixed as following
Ch0 : P4, Ch1 : P5, Ch2 : P6, Ch3 : P7
- Current value of high speed counter is replaced with preset value at the rising edge of external preset device.

(4) Latch Counter setting



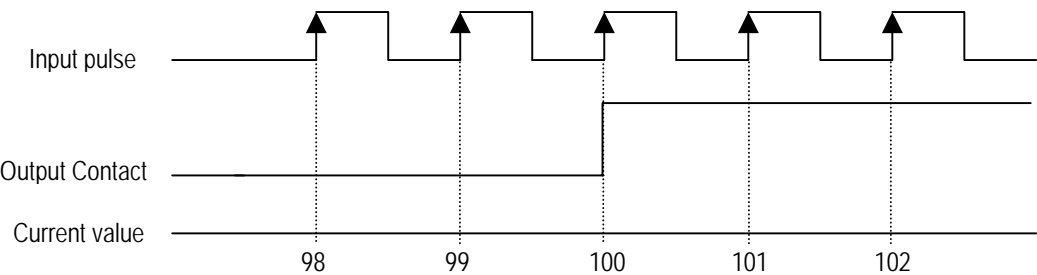
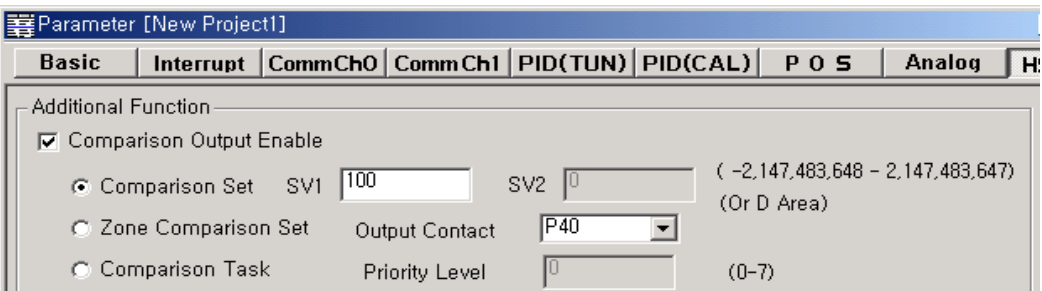
If this function is enabled, Current value of high speed counter is always retained.



(5) Comparison Output setting

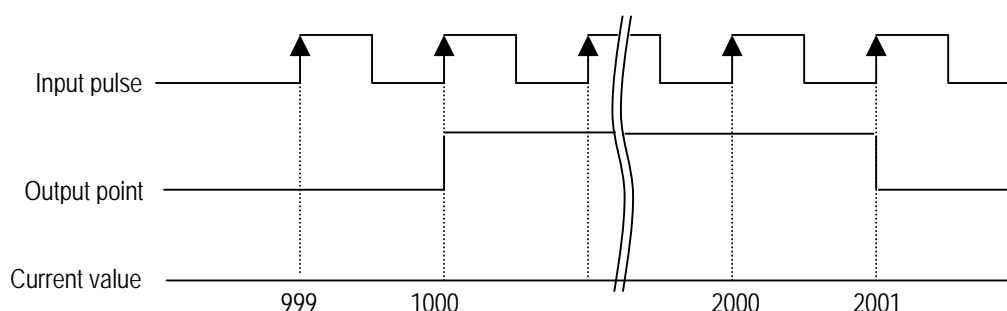
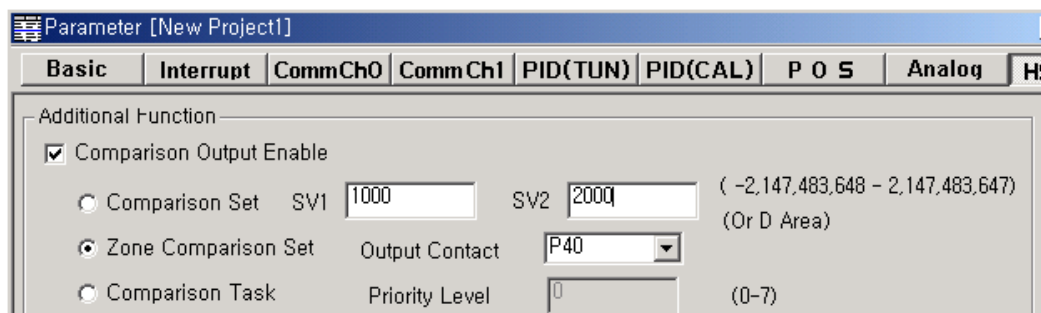
(a) Comparison set

- When current value of HSC is equal to SV1, corresponding output point turns on.
- P40 ~ P47 are available for comparison output point.



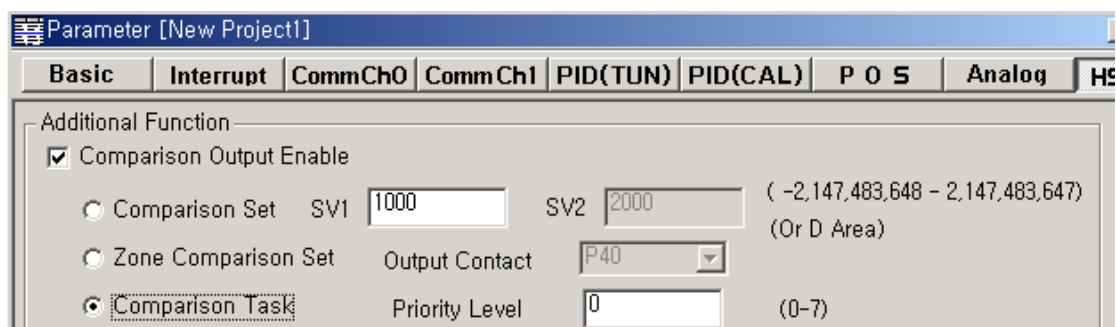
(b) Zone Comparison Set

- When current value of HSC isn't less than SV1 and more than SV2, corresponding output point turns on.
- P40 ~ P47 are available for comparison output point.
- If SV2 is less than SV1, SV2 setting error(h'12) occurs and zone comparison set is disabled.



(c) Comparison Task

- If Comparison Task is selected in parameter window, corresponding interrupts is enabled.
- When current value of HSC is equal to SV1, corresponding interrupt program is executed.
- For the details about programming, refer to 'KGLWIN User's Manual'.

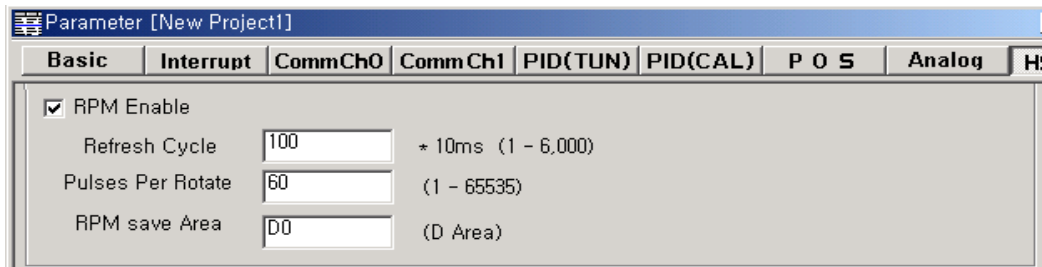


Parameter [New Project1]							
Basic	Interrupt	CommCh0	CommCh1	PID(TUN)	PID(CAL)	P O S	Analog
Priorit...	Interrupt Type	Interrupt No.	TDI Time(10ms)	Contact...	Edge Type	HSC Ch No.	
0	HSC	INT 0					Ch 0
1	Time Driven	TDINT 1	10				
2	Process D...	INT 2		2	2		

Chapter 7 Usage of Various Functions

(6) RPM setting

- Can calculate RPM of input pulse
- RPM is stored in designated device.

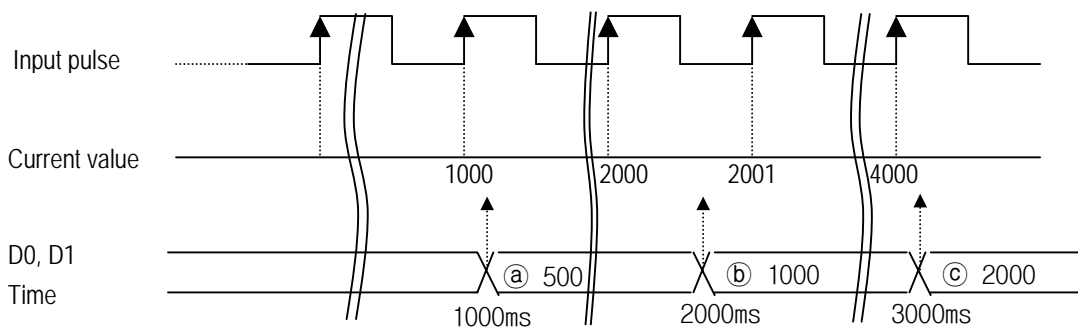


- The RPM is expressed as:

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

(a) Examples of Program

- Refresh cycle : 1000ms, Pulses per rotate : 60, RPM save area : D0



- (a) Last value = 500(Assumption), Current value = 1000

$$\text{RPM} = \{ (1000 - 500) * 60,000 \} / \{ 60 * 1000 \} = 500$$

- (b) Last value = 1000, Current value = 2000

$$\text{RPM} = \{ (2000 - 1000) * 60,000 \} / \{ 60 * 1000 \} = 1000$$

- (c) Last value = 2000, Current value = 4000

$$\text{RPM} = \{ (4000 - 2000) * 60,000 \} / \{ 60 * 1000 \} = 2000$$

9) Programming example

(1) Parameter setting

- Channel : Ch0
- Counter format : Ring counter (0 ~ 100,000)
- Counter mode : 2-phase multiplication mode
 - P0 : A-phase pulse input, P1 : B-phase pulse input
- Preset
 - Preset type : internal preset (M100)
 - Preset value : 0
- Last counter setting
 - None
- Comparison output
 - Output mode : Zone comparison set
 - SV1 : 10,000 SV2 : 20,000
 - Output point : P43
- RPM setting
 - Refresh cycle : 100(*10ms)
 - Pulses per rotate : 60
 - RPM save area : D100

Basic	Interrupt	CommCh0	CommCh1	PID(TUN)	PID(CAL)	P O S	Analog	H
Counter Format <input type="radio"/> Linear Counter (-2,147,483,648 ~ 2,147,483,647) <input checked="" type="radio"/> Ring Counter (0 ~ setting value) Setting Value <input type="text" value="100000"/> (2 ~ 2,147,483,647) (Or D Area)								
Counter Mode <input checked="" type="radio"/> 1-phase Operation Mode <input type="radio"/> 2-phase CW/CCW Mode <input type="radio"/> 1-phase Pulse + Direction Mode <input type="radio"/> 2-phase Multiplication Mode(Mul 4)								
Additional Function <input checked="" type="checkbox"/> Preset Enable Preset Value <input type="text" value="0"/> (-2,147,483,648 ~ 2,147,483,647) (Or D area) <input checked="" type="radio"/> Internal Preset Area <input type="text" value="M0100"/> (P, M, L, F, C, T, K Area) <input type="radio"/> External Preset Area <input type="text" value="Contact(P4)"/> <input checked="" type="checkbox"/> Latch Counter Enable <input checked="" type="checkbox"/> Comparison Output Enable <div> <input type="radio"/> Comparison Set SV1 <input type="text" value="10000"/> SV2 <input type="text" value="20000"/> (-2,147,483,648 ~ 2,147,483,647) (Or D Area) </div> <div> <input checked="" type="radio"/> Zone Comparison Set Output Contact <input type="text" value="P43"/> </div> <div> <input type="radio"/> Comparison Task Priority Level <input type="text" value="0"/> (0-7) </div> <input checked="" type="checkbox"/> RPM Enable Refresh Cycle <input type="text" value="100"/> * 10ms (1 ~ 6,000) Pulses Per Rotate <input type="text" value="60"/> (1 ~ 65535) RPM save Area <input type="text" value="D100"/> (D Area)								

(2) Programming

- When M0 turns on, HSC starts its operation
- If current value is not less than 50,000, F170 turns on.
- Current value is saved in D0(double word).



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 Function

In the main unit, 4(economic type) or 8(standard type) points of pulse catch input contact points are internalized. Through using this contact point, short pulse signal short can be taken which can not be executed by general digital input.

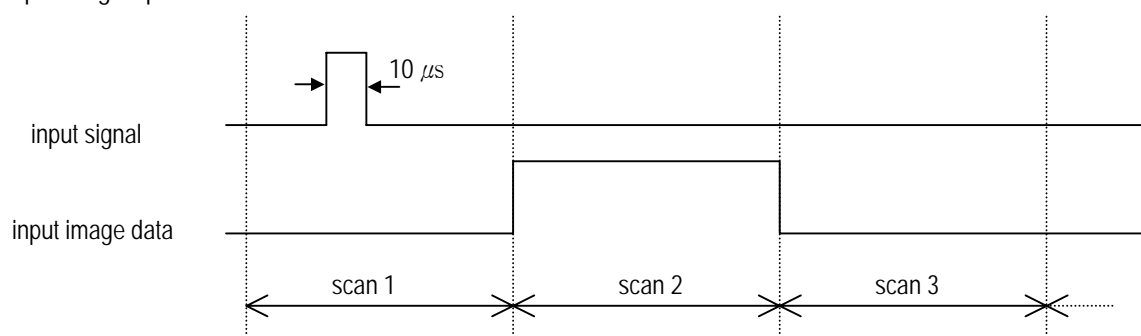
1) Usage

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 $10\ \mu\text{s}$ min. can be detected.

2) Minimum input pulse width.

Type	Standard	Economic
$10\ \mu\text{s}$	2 points (P0, P1)	None
$50\ \mu\text{s}$	6 points (P2 ~ P7)	4 points (P0 ~ P3)

3) Operating Explanation

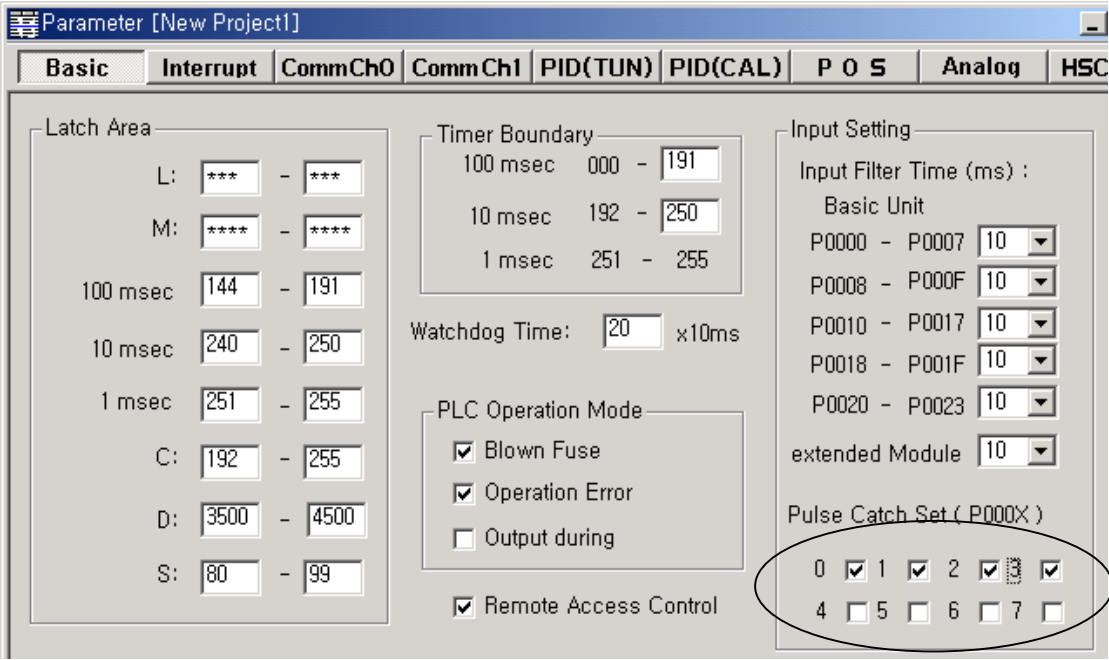


step	executing contents
scan1	CPU senses input when pulse signal, min. $10\ \mu\text{s}$, is input, then saves the status.
scan2	used to turn on the region of input image
scan3	used to turn off the region of input image

4) using method

- (1) click twice the basic parameter on the project window of KGLMIN
- (2) Select no. to use for pulse catch input of the basic parameter window.

For details of KGLWIN refers to the manual.



Remark

- 1) Pulse catch input contact points 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.

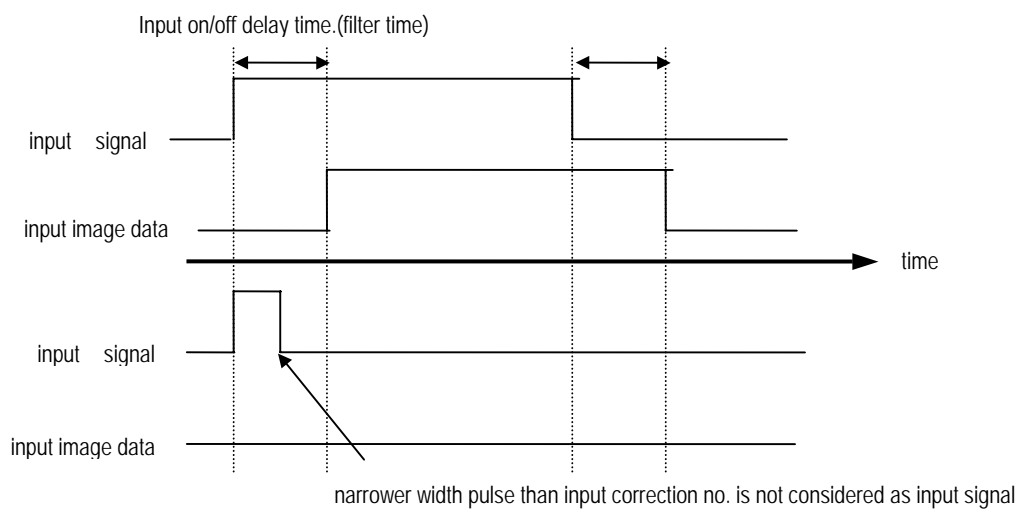
7.1.3 Input Filter Function

External input of MASTER-K120S selects input on/off delay time from the range of 0-1000ms of KGLWIN. Credibility secured system may be established by adjustment of input correction no. through using environment.

1) Usage

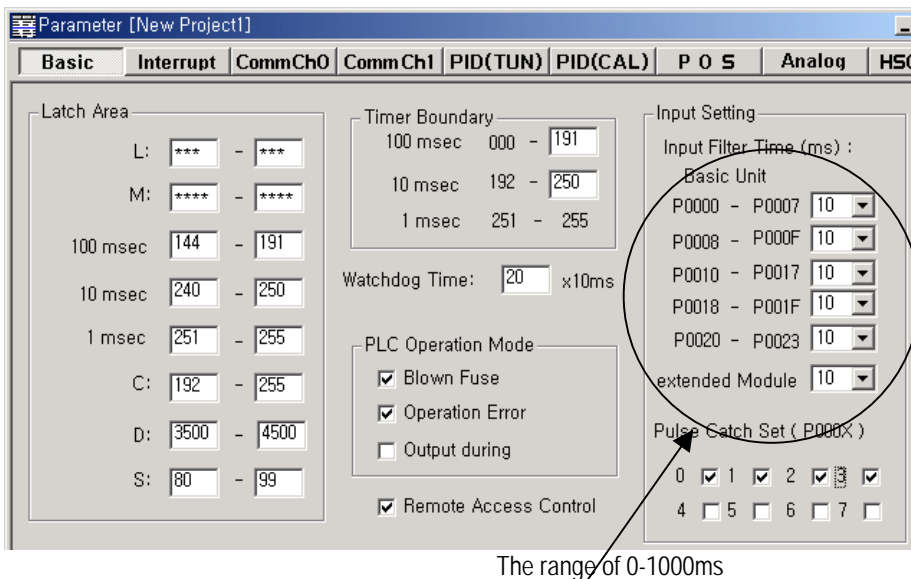
Input signal status affects to the credibility of system in where noise occurs frequently or pulse width of input signal affects as a crucial factor. In this case the user sets up the proper input on/off delay time, then the trouble by miss operation of input signal may be prevented because the signal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

2) Operating Explanation



3) Using method

- (1) Click twice the basic parameter on the project window of KGLWIN.
- (2) The value of filter can be set up as one of 0,1,2,5,10,20,50,100,200,500,1000ms to the input on/off delay time of the basic parameter window.(Input on/off delay time is set up as default value of 10ms)
- (3) Set up input on/off delay time is conformed to all input is used.



7.1.4 External Interrupt Function

MASTER-K120S Series can perform max 4(economic) or 8(standard) points of external contact interrupt by using input of main unit without special interrupt module.

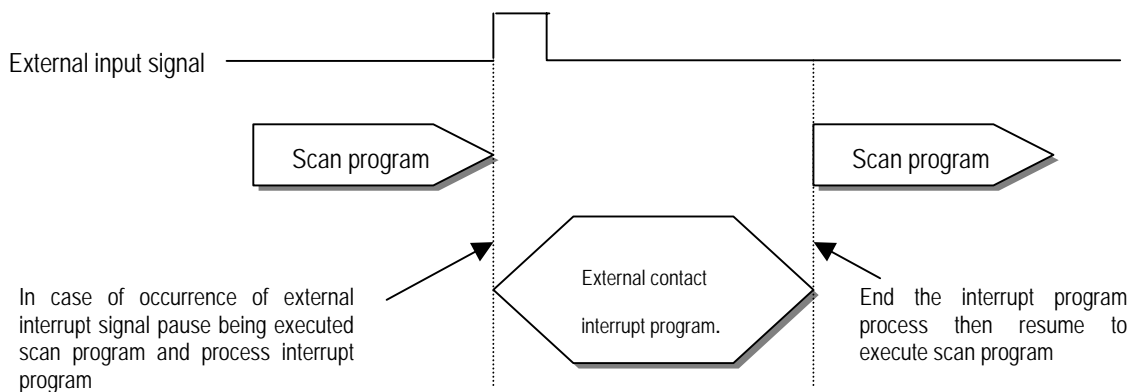
1) Usage

This function is useful to execute a high speed execution regardless of scan time.

2) Minimum processing time.

Type	Standard	Economic
10 μ s	2 points (P0, P1)	None
50 μ s	6 points (P2 ~ P7)	4 points (P0 ~ P3)

3) Operating explanation

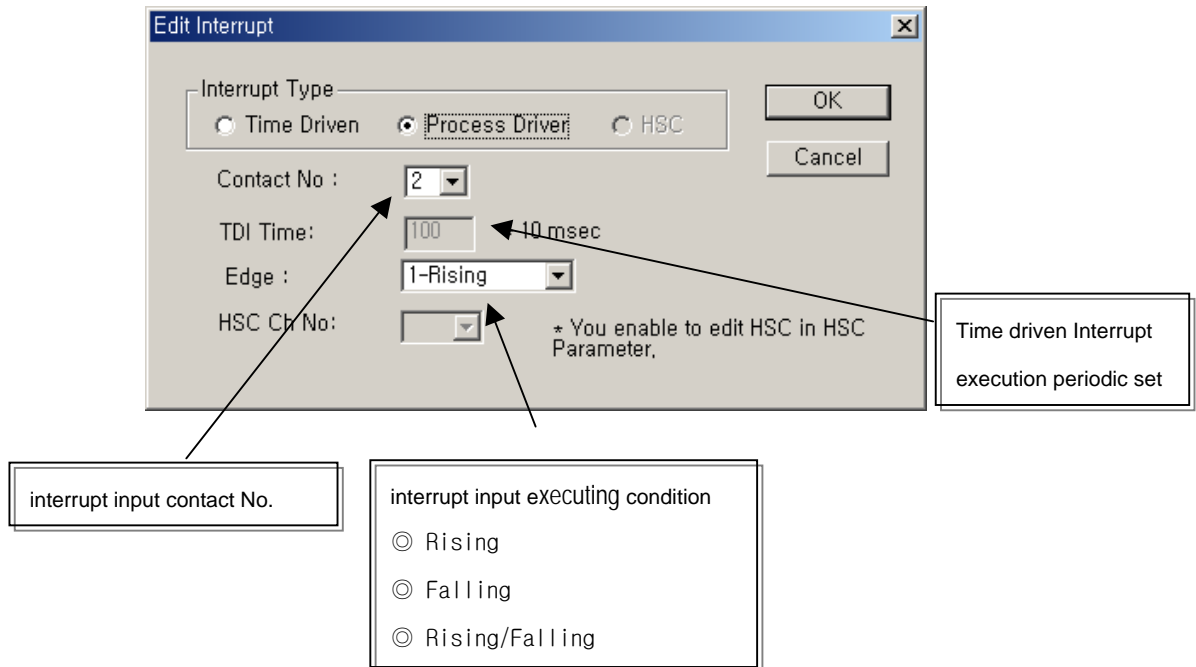


4) Function

- (1) Max. 8 points can be used to external interrupt input within P000 ~ P007. (P000~P003 for economic type)
- (2) The no. of external interrupt is decreased by using other interrupt (time driven interrupt and HSC driven task)
- (3) The execution conditions of external interrupt is divided into following 3 kinds.
 - Rising edge : Interrupt occurs at rising edge of external Interrupt contact point.
 - Falling edge : Interrupt occurs at falling edge of external Interrupt contact point.
 - Rising & falling edge : Interrupt occurs at both edge of external Interrupt contact point.
- (4) In the economic type, falling edge and rising & falling edge interrupt are not available.

5) Usage

- (1) Click twice the parameter on the project window of KGLWIN.
- (2) Designate contact point, no. of priority and movement condition of the task program which is moved by interrupt inputting.



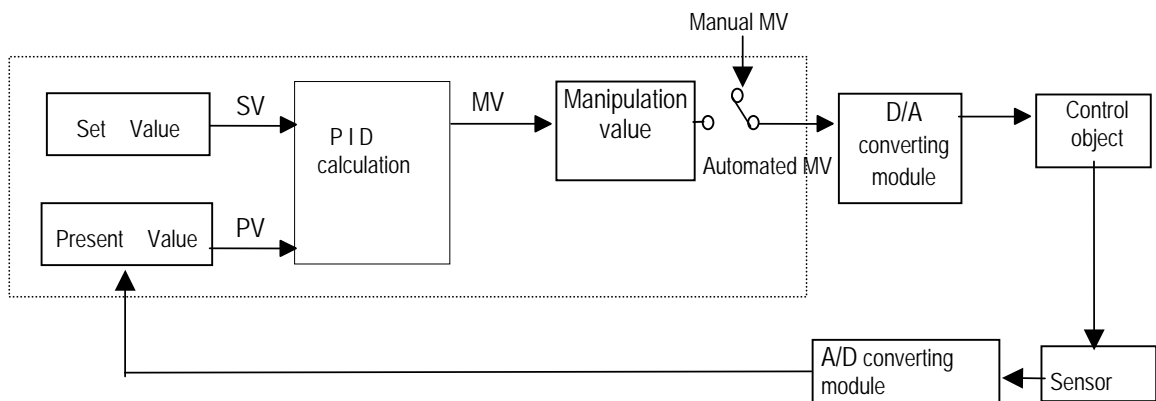
- (3) For the details , refer to KGLWIN manual.

7.1.5 PID control function(Standard type only)

1) Introduction

This chapter will provide information about the built-in PID (Proportional Integral Derivative) function of MASTER-K120S main unit. The MASTER-K120S series does not have separated PID module like MASTER-K300S and MASTER-K1000S 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 MASTER-K120S is as following;

- the PID function is integrated into the CPU module. Therefore, all PID control action can be performed with instruction (PID8, PID8AT) 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)

- ① P action means a control action that obtain a manipulate value which is proportional to the deviation
(E : the difference between SV and PV)
- ② The deviation (E) is obtained by difference between SV and PV and the formula of deviation is as following;

$$MV = K_p \times [SV - PV] \quad \text{where, } K_p : \text{the proportional constant (gain), } SV : \text{set value, } PV : \text{present value}$$

- ③ When E happens, MV by P operation is like Fig.7.1

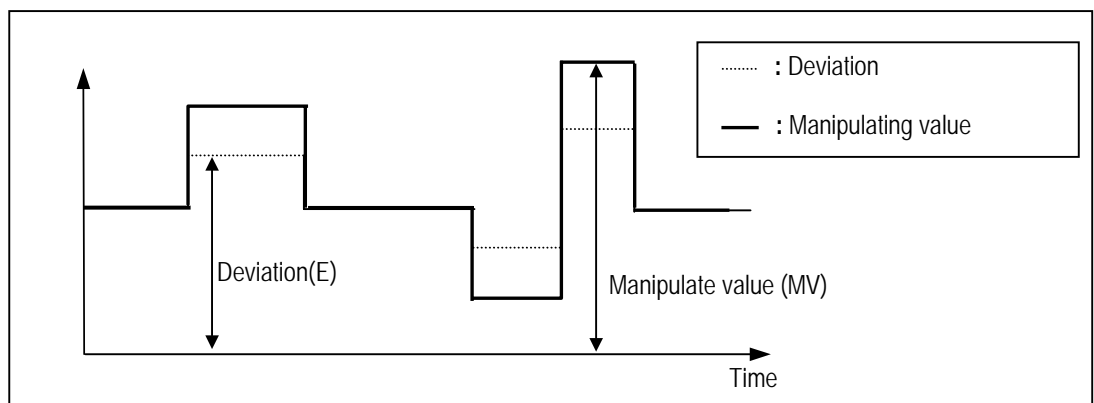


Fig 7.1 MV by P operation

- ④ If the K_p is too large, the PV reaches to the SV swiftly, but it may causes a bad effect like oscillations.
- ⑤ If the K_p 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.
- ⑥ 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.
- ⑦ 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

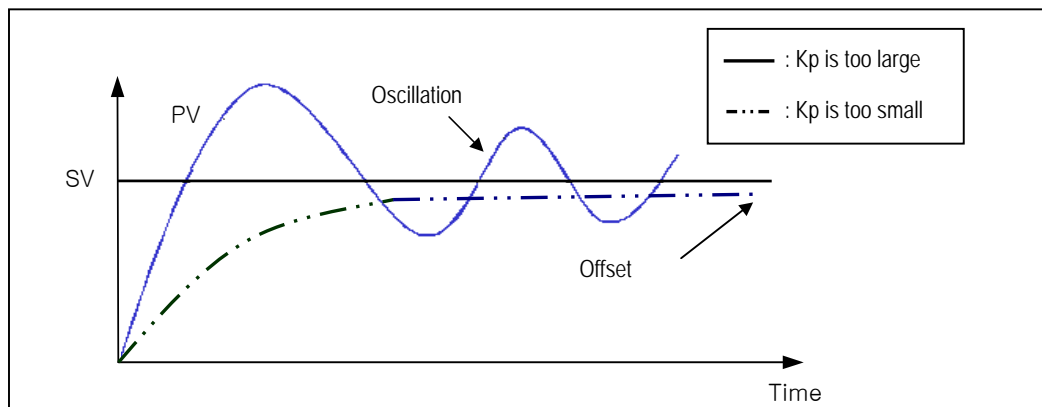


Fig. 7.2 The relation between Proportional constant (K_p) and present value (PV)

(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 T_i .

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

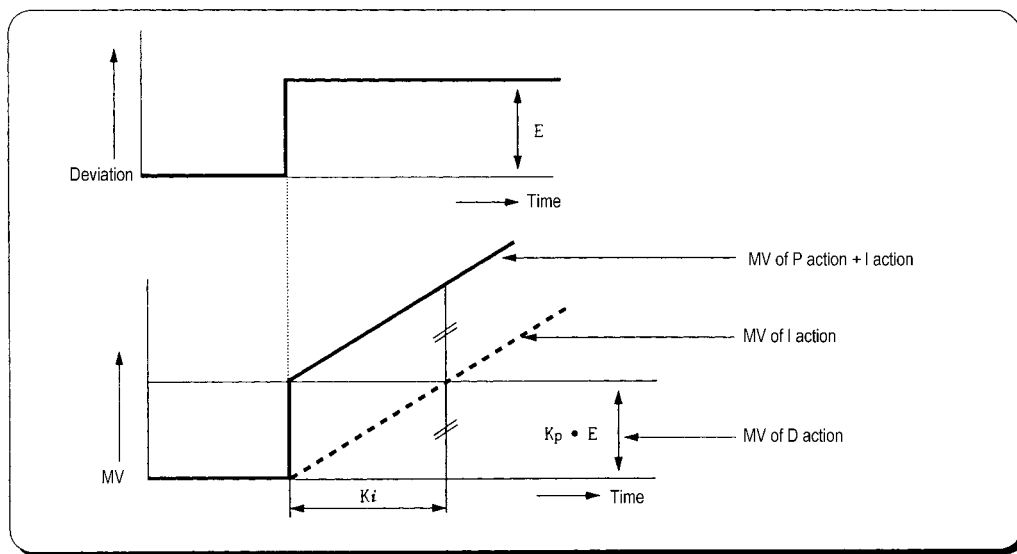


Fig. 7.3 The integral action with constant deviation

- ③ The expression of I action is as following;

$$MV = \frac{K_p}{T_i} \int E dt$$

As shown in the expression, Integral action can be made stronger or weaker by adjusting integration time (T_i) 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.

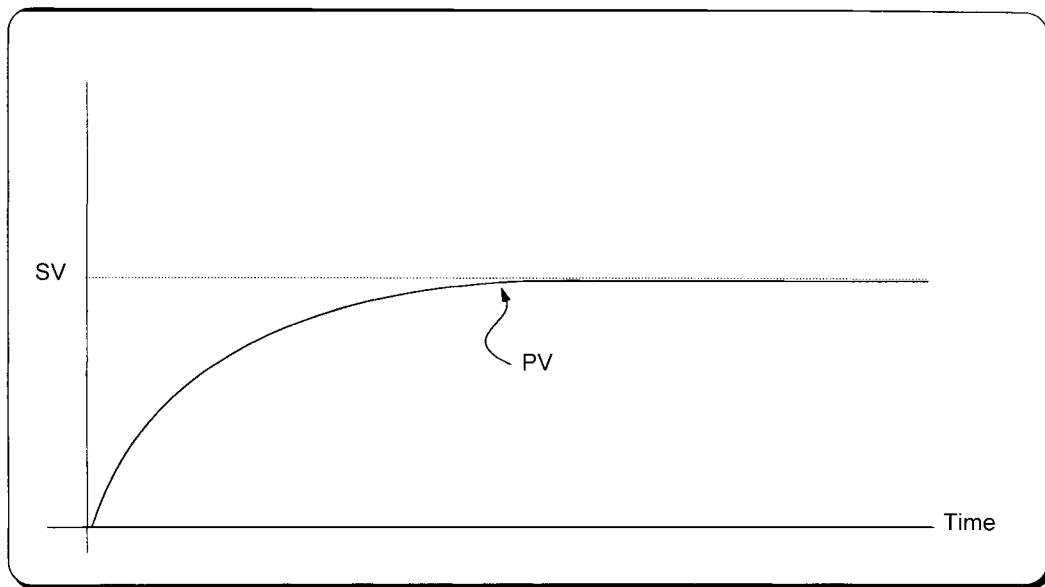


Fig. 7.4 The system response when a long integration time given

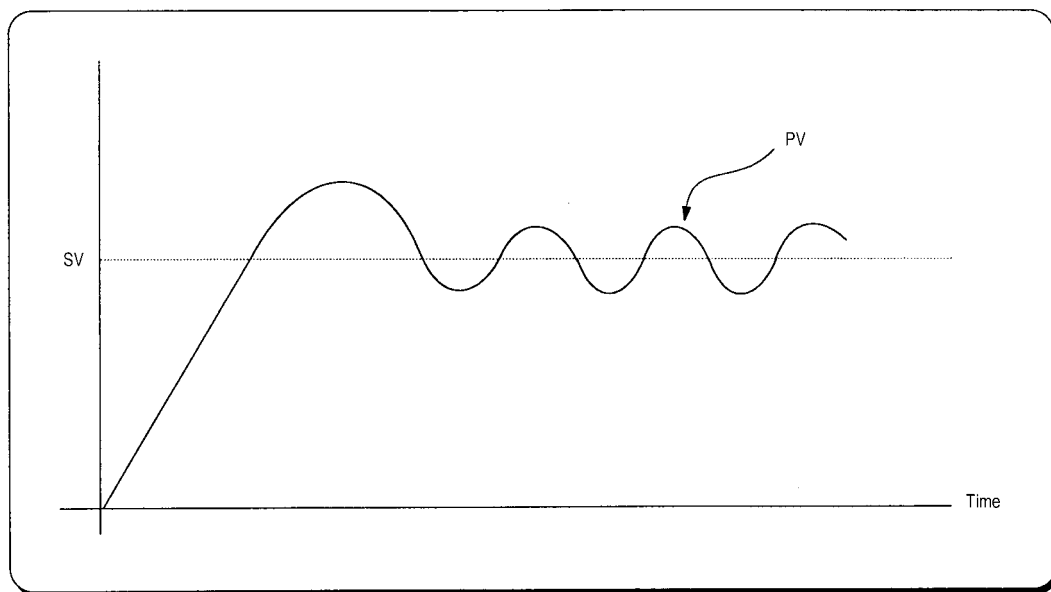


Fig. 7.5 The system response when a short integration time given

(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 T_d .

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

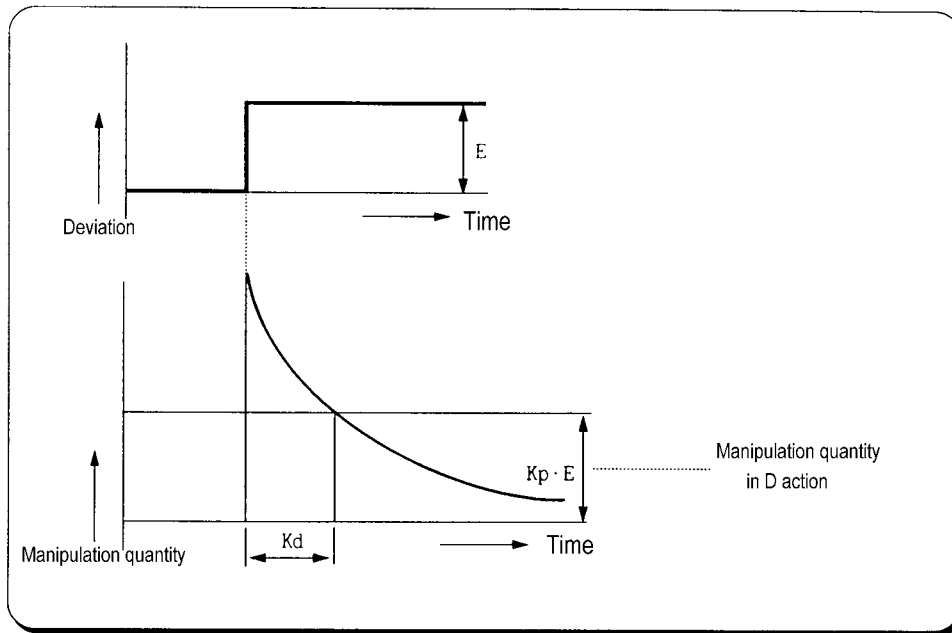


Fig. 7.6 Derivative action with a constant deviation

- ⑥ The expression of D action is as following;

$$MV = K_p \times T_d \frac{dE}{dt}$$

- 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.

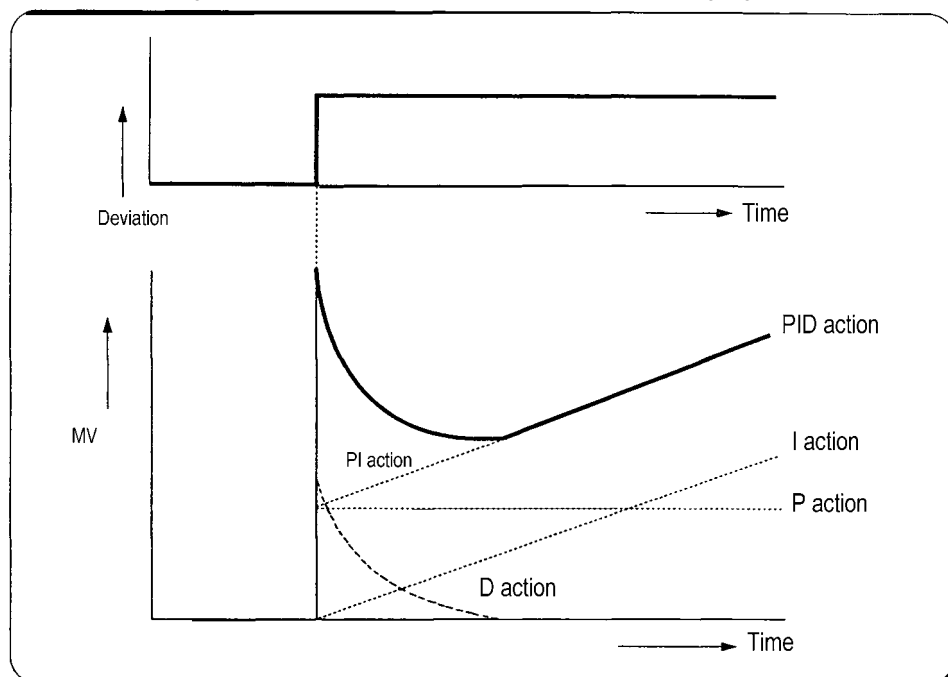


Fig. 7.7 PID action with a constant deviation

(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.

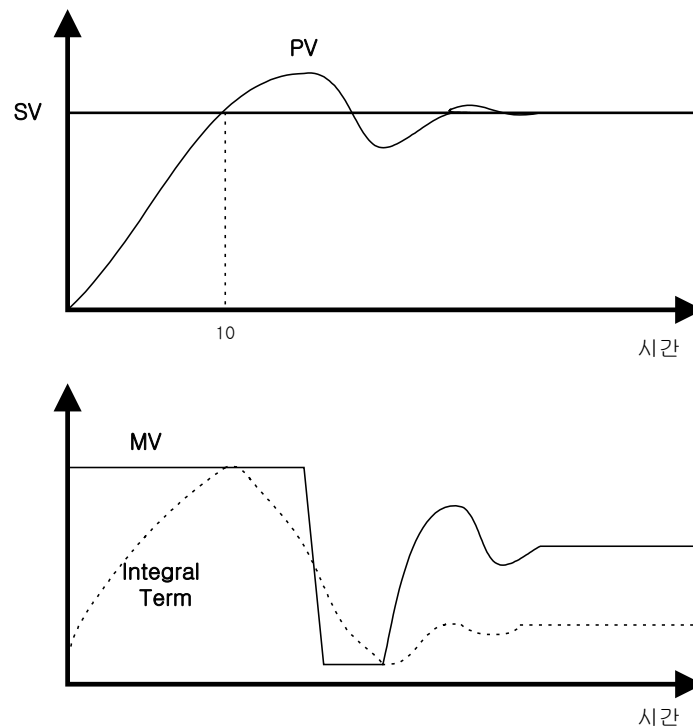


Fig. 7.8 Example of integral windup

(2) Realization of PID control on the PLC

In this chapter, it will be 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;

$$P(n) = K[SV(n) - PV(n)]$$

n : sampling number K : proportional gain constant

b : reference value SV : set value PV : present value

(b) I control

The continuous formula of I control is as following;

$$I(t) = \frac{K}{T_i} \int_0^t e(s) ds \quad : \text{integral term}$$

K : proportional gain constant T_i : integral time

e(s) : deviation value

By derivation about t, we can obtain;

$$\frac{dI}{dt} = \frac{K}{T_i} e \quad \text{where, } e = (SV - PV) : \text{deviation value}$$

The digitized formula is as following;

$$\frac{I(n+1) - I(n)}{h} = \frac{K}{T_i} e(n) \quad \text{where, } h : \text{sampling period}$$

$$I(n+1) = I(n) + \frac{Kh}{T_i} e(n)$$

(c) D control

The continuous formula of derivative term is as following;

$$\frac{Td}{N} \times \frac{d}{dt} D + D = -KTd \frac{dy}{dt}$$

N : high frequency noise depression ration

y : the object to be controlled (PV)

(3) Instruction and parameter setting

For the PID operation of MASTER-K120S, following 2 instructions are included in the KGLWIN software.

No.	Name	Description
1	PID8	Perform the PID operation
2	PID8AT	Perform the auto tuning operation

(4) parameter setting and explanation

(a) PID8 instruction parameter setting and explanation.

PID(Cal) Item Edit

Scan Time: (1~100 or D Area)

Operation Mode:
(0:Auto 1: Man or DArea)

Man OP range: (0~4000 or D Area)

Output Limit Value

Min : (0~4000 or D Area)

Max : (0~4000 or D Area)

High Frequency Noise Removal Ratio:
(1~10 or D Area)

Propotional Gain:
(1~10000 or D Area)

Derivative time : (0 ~ 20000 or D Area)

Integral Time: (0 ~ 20000 or D Area)

D Area Range : D0 ~ D4999

Mode Command Set

☐ Derivative ☐ Integral

☐ Propotional ☐ PWM

PWM set

Period (10~100 or DArea)

Contact PArea (P40 ~ P57)

SV Ramp : (0~4000 or D영역)

Δ MV : (0~4000 or D영역)

BIAS Value: (0~4000 or D Area)

PV(Current): (D Area)

SV(Target): (0~4000 or D Area)

PID Algorithm

☒ verocity ☐ positioning

OK Cancel

① Scan time

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

Select automatic or manual operating mode

③ Manual operate range

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

④ Output limit value

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

⑤ High frequency noise removal ratio

high frequency noise removal ratio is used for derivative control operation, and shows the ratio of high frequency noise depression. If there is a lot of high frequency noise in the control system, select the value as higher value.

Otherwise, leave the 1. The range of parameter is 0 ~ 10 and it is not scaled up, so input the designated value directly.(it is possible that parameter value designates 'D' area also)

⑥ Proportional gain

The MASTER-K120S can handle only integer, not the floating point type. Therefore, to enhance the accuracy of PID operation, the PID8 instruction is designed to input the P_GAIN data as the 100 times scaled up. For example, if the designated P_GAIN is 98, actual input data of P_GAIN should be 9800. If the designated P_GAIN is 10.99, input 1099 to the P_GAIN.

⑦ Derivative time and integral time

I_TIME and D_TIME are 10 times scaled up. For example, input 18894 if the designated I_TIME value is 1889.4. The range of actual input is 0 ~ 20000. (it is possible that parameter value designates 'D' area also)

⑧ Mode command set

In MASTER-K120S, only the following 7 operation modes are available. Other operation modes, such as PD or I, are not permitted.

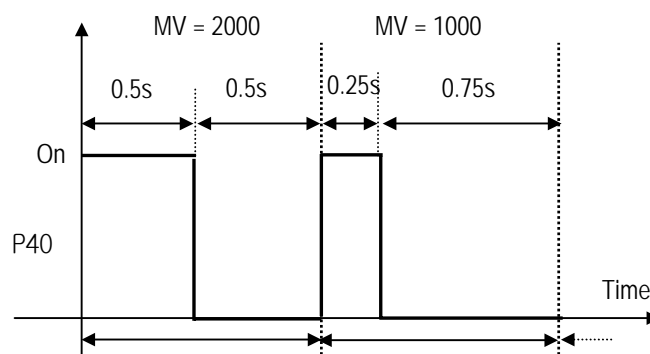
No.	EN_P	EN_I	EN_D	PWM output	Operation
1	1 (enable)	0 (disable)	0 (disable)	0 (disable)	P operation
2	1 (enable)	1 (enable)	0 (disable)		PI operation
3	1 (enable)	1 (enable)	1 (enable)		PID operation
4	1 (enable)	0 (disable)	0 (disable)	1 (enable)	P operation/PWM output
5	1 (enable)	1 (enable)	0 (disable)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

⑨ PWM set

PWM(Pulse Width Modulation) is a output method which changes on-off duty of output pulses by calculated manipulation value. Fig 7.9 shows example of PWM output. Using PWM output, PID control system can be constructed easily without D/A conversion module and power regulator.

When PWM is designates , 'scan time' item is disabled and 'PWM' items can be designated. In this case, scan time is set to designated PWM output period. The range of PWM output period is 1 ~ 10 seconds, and actual input range is 10 ~ 100. PWM output point is only available for output contact of main unit.

Example) PWM output period : 1s, Output contact : P40, MV limit range : 0~4000

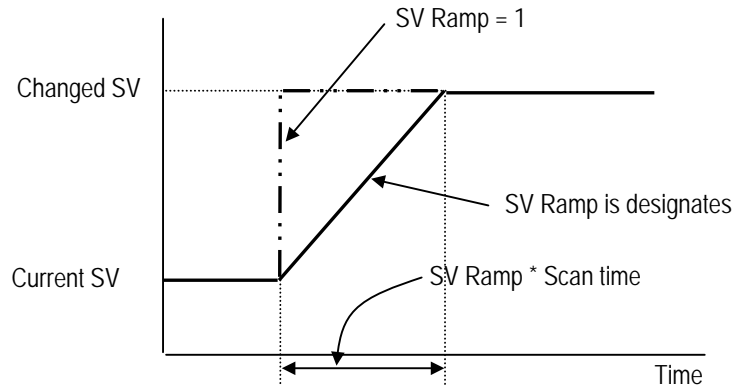


⑩ SV Ramp

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 SV-ramp is set to 1000 and SV changed from 1000 to 3000 during operation, it changes 2 every scan and reach 3000 after 1000 scan time.



⑪ Delta MV

This is useful when wants to limit maximum change of manipulation value.

Setting range is 0 ~ 4000 and default value is 4000.

⑫ Bias

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.

⑬ SV(Target) and PV(Current)

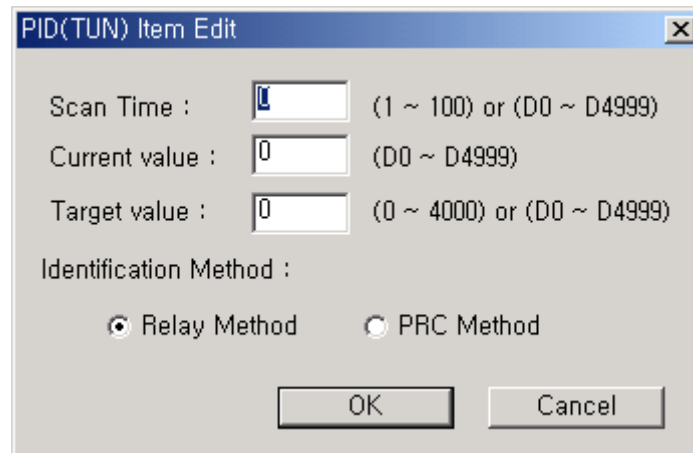
SV (setting value : the designated value) and PV (process value : present value) of MK120S PID operation have the range 0 ~ 4000. The range is set with the consideration of the resolution of A/D and D/A module of MK120S series (12bits) and offset value.

⑭ PID Algorithm

In MASTER-K120S, 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(Δn) required from previous manipulate value(MV_{n-1}), But positioning form calculates an absolute manipulate value(MV_n) 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) PID8AT instruction parameter setting and explanation.



① Scan time

S_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 Control target(SV)

SV (set value : the designated value) and PV (process value : present value) of MASTER-K120S 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 MASTER-K120S 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.

③ a) 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.

③ b) 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.

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

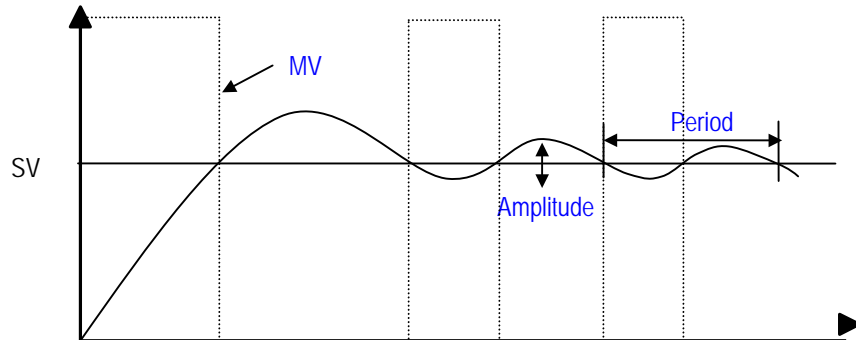
Therefore, SV should be 1500,

③ Tuning method

The MASTER-K120S perform auto-tuning operation in two methods. One is relay response method and the other is process reaction curve method.

① 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.

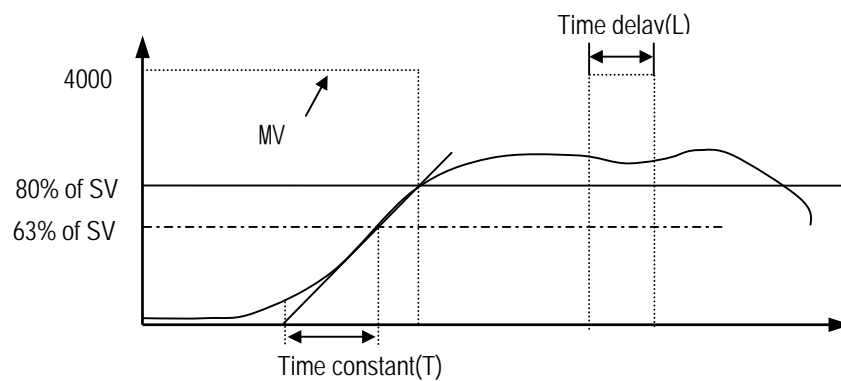


② Process reaction curve method (PRC method).

- PID parameters are obtained by step response of process.
- It is useful for 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.



Chapter 7 Usage of Various Functions

5) instruction

(1) PID8

PID8	PID Control
------	-------------

Instruction	Available device											No. of Steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
n									○		○	5	○		
S1									○						

PID8nS1

Flag set

Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed.
--------------	---

Designation

n	Registration No. at parameter(0~7)
S1	Execution status registration area

■ PID8 n S1

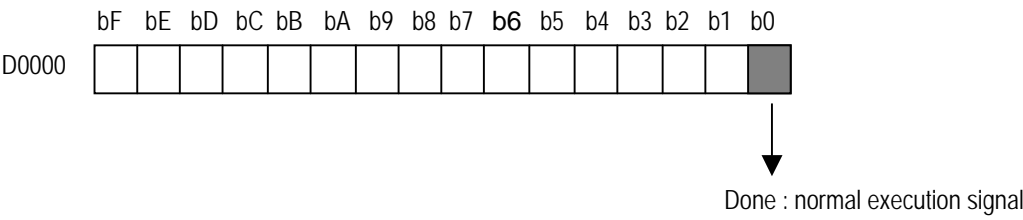
a) Usage

- when the condition of execution is on, PID operation executes.
- 'n' is registration No.at parameter(0 ~ 7)

b) Example program

M0000PID800002D0000

- When the input condition M0 turns on, PID operation executes at no.2 parameter.
- PID execution status registrate D0000 and the output value of control result registrate D0001
- If SV Ramp is designated, current SV is registrate D0005



(2) PID8AT

PID8AT	PID Auto Tuning
--------	-----------------

Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
n									○		○	5	○		
S1									○						

<div>PID8AT n S1</div>															
Flag set								Designation							
Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed.							n	Registration No. at parameter(0~7)						
								S1	Execution status registration area						

■ PID8AT n S1

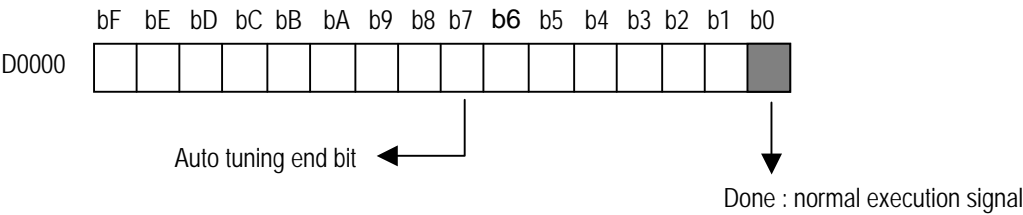
a) Usage

- when the condition of execution is on, PID auto tuning operation executes and calculates P,I,D constant
- 'n' is registration No.at parameter(0 ~ 7)
- S1 is execution status and P,I,D constant registration area

b) Example program

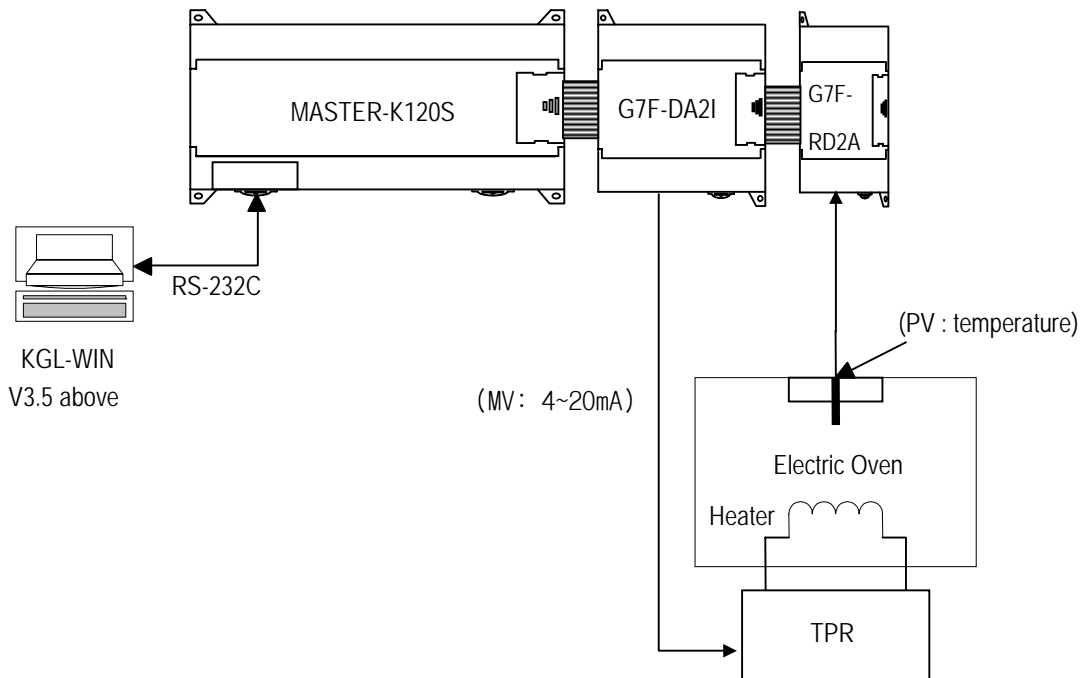
<div>M0000 PID8AT 00002 D0000</div>															
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

- When the input condition M0 turns on, PID operation executes at no.2 parameter.
- PID execution status stores D0000 and the output value of control result stores D0001 and P,I,D constant sequentially store D002(P),D003(I),D004(D)



6) Program Example

(1) System configuration



(2) In case of using PID function only

The screenshot shows the PID(Cal) Item Edit dialog box. The Scan Time parameter is disabled (indicated by a dotted line). The PWM set section is active (indicated by a dotted line). The Mode Command Set section shows the Derivative, Integral, and Propotional checkboxes are unchecked, and the PWM checkbox is checked. The PWM set section shows the Period and Contact parameters are set to 0. The SV Ramp parameter is set to 1. The PID Algorithm section shows the verocity radio button is selected.

When PWM set is selected, Scan time parameter is disabled and this value is ignored

When PWM is designated, this window is activated and PID function operates by PWM period

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

- Measure current temperature (-200~600°C) by RTD module then digital conversion value(0 ~ 4000) is stored to D4780
- 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) operation parameters

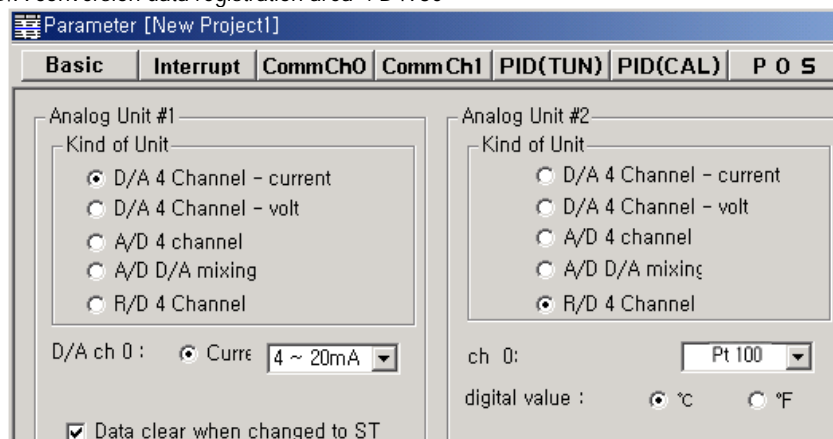
- Scan time : S_TIME=5 (sampling time = 0.5 seconds)
- Auto / Manual operation setting : Auto
- Output limit : Max. = 4000, Min = 0
- High frequency noise removal ratio : 10
- SV setting : 1300(60°C), 1350(70°C), 1400(80°C), 1500(100°C)
- Current value setting : D4780(Digital value of RTD module Ch0)
- BIAS setting : 0 (If only P control is used, input proper value other 0)
- EN_P, EN_I, EN_D setting: input proper values
- PWM setting : If enabled, input proper values.
- SV Ramp setting : Input proper values.
- Delta MV setting : Input proper values.
- PID Algorithm setting : Select proper algorithm.

c) RTD module setting

- Channel setting : use channel 0
- RTD Type setting : Pt100
- Digital conversion data registration area : D4780

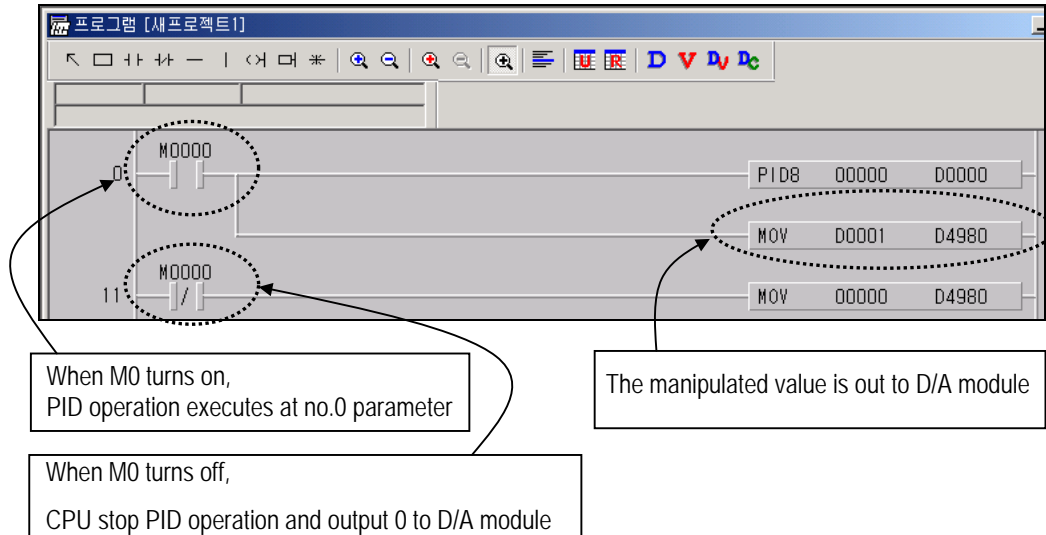
d) D/A module setting

- Channel setting : use channel 0
- output range setting: DC 4 ~ 20 mA
- D/A conversion data registration area : D4980



e) Program Explanation

- When the input condition M0 turns on, PID operation executes at no.0 parameter.
- PID execution status registrate D0000 and the output value of control result registrate D0001
- If SV Ramp is designated, current SV is registrate D0005
- D/A module converts the MV to analog signal and output to the actuator (power converter).
- When the input condition M0 turns off, output 0 to the D/A conversion module.



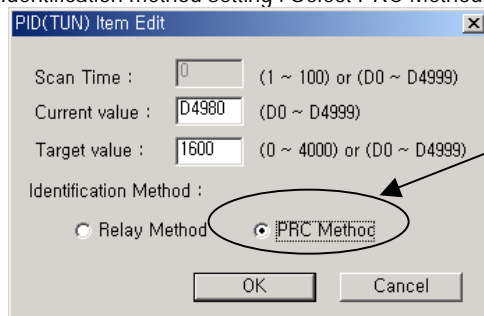
(3) In case of using combined function of PID operation and Auto tuning.

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

- Measure current temperature (-200~600°C) by RTD module then digital conversion value(0 ~ 4000) is stored to D4780
- PID8AT instruction will calculate manipulate value (MV : 0 ~ 4000) based on the SV and PV from RTD module. Simultaneously, the PID8AT instruction will calculate P,I and D parameters.
- The END bit of auto tuning status device will be 1 when the auto tuning is completed. Then, MASTER-K120S will start PID operation with PID parameters that are calculated by A/T module.

b) Auto tuning parameters

- Scan time : S_TIME=5 (sampling time = 0.5 seconds)
- SV setting : 1300(60°C), 1350(70°C), 1400(80°C), 1500(100°C)
- Current value setting : D4780(Digital value of RTD module Ch0)
- Identification method setting : Select PRC Method



When selected, the scan time
fixed to 1 sec.

c) operation parameters

- Scan time : S_TIME=5 (sampling time = 0.5 seconds)
- Auto / Manual operation setting : Auto
- Output limit : Max. = 4000, Min = 0
- High frequency noise removal ratio : 10
- SV setting : 1300(60°C), 1350(70°C), 1400(80°C), 1500(100°C)
- Current value setting : D4780(Digital value of RTD module Ch0)
- BIAS setting : 0 (If only P control is used, input proper value other 0)
- EN_P, EN_I, EN_D setting: input proper values
- PWM setting : If enabled, input proper values.
- SV Ramp setting : Input proper values.
- Delta MV setting : Input proper values.
- PID Algorithm setting : Select proper algorithm.

PID(Cal) Item Edit

Scan Time: (1~100 or D Area)

Operation Mode:
(0:Auto 1: Man or DArea)

Man OP range: (0~4000 or D Area)

Output Limit Value

Min: (0~4000 or D Area)

Max: (0~4000 or D Area)

High Frequency Noise Removal Ratio:
(1~10 or D Area)

Proportional Gain:
(1~10000 or D Area)

Derivative time: (0 ~ 20000 or D Area)

Integral Time: (0 ~ 20000 or D Area)

D Area Range : D0 ~ D4999

Mode Command Set

☐ Derivative ☐ Integral

☐ Propotional ☐ PWM

PWM set

Period: (10~100 or DArea)

Contact: PArea (P40 ~ P57)

SV Ramp: (0~4000 or D영역)

Δ MV: (0~4000 or D영역)

BIAS Value: (0~4000 or D Area)

PV(Current): (D Area)

SV(Target): (0~4000 or D Area)

PID Algorithm

☒ verocity ☐ positioning

OK Cancel

As a result of PID8AT execution, Proportional gain(P), Derivative time(D), Integral time(I) are stored D0102, D0103, D0104.

d) RTD module setting

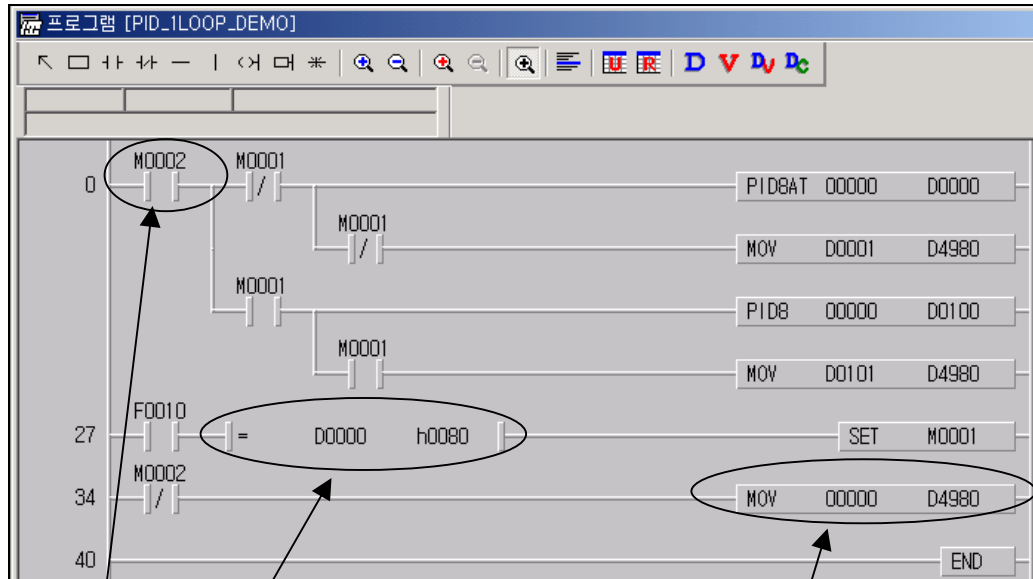
- Channel setting : use channel 0
- RTD Type setting : Pt100
- Digital conversion data registration area : D4780

e) D/A module setting

- Channel setting : use channel 0
- output range setting: DC 4 ~ 20 mA
- D/A conversion data registration area : D4980

f) Program Explanation

- When the input condition M2 turns on, PID auto tuning operation executes at no.0 parameter.
- When auto tuning finished, PID operation executes with calculated P,I,D parameter.
- PID execution status registrate D0000 and the output value of control result registrate D0001
- If SV Ramp is designated, current SV is registrate D0005
- D/A module converts the MV to analog signal and output to the actuator (power converter).
- When the input condition M2 turns off, output 0 to the D/A conversion module



When M0002 turns on, auto tuning starts.
Calculated P,I,D parameters are saved to D0002, D0003, D0004

When auto tuning ends,
M0001 turns on and PID control starts.

When M0002 turns off,
Output 0 to D4980

6) Error code list

(1) PID8AT

Error Code	Description	Corrective action
H0100	Scan time setting range error	Set scan time to available setting range
H0200	PV setting range error	Set PV setting to available setting range
H0300	SV setting range error	Set SV to available setting range SV If PRC identification method is selected, check current PV is less than SV.(SV should be greater than PV)

(2) PID8

Error Code	Description	Corrective action
H0100	Scan time setting range error	Set scan time to available setting range
H0200	Manual operation range error	Set manual operation value to available setting range
H0300	Output limit value error(Min.)	Set minimum output limit value to available setting range and Set it less than maximum output limit value
H0400	Output limit value error(Max.)	Set maximum output limit value to available setting range and Set it greater than minimum output limit value
H0500	High frequency noise removal ratio setting error	Set this parameter to available setting range
H0600	Mode command set error	Available mode command set are P, PI, PID(PWM for each), On-Off only.
H0700	PWM period setting error	Set PWM period to available setting range
H0800	P gain setting error	Set P gain period to available setting range
H0900	I time setting error	Set I time period to available setting range
H0A00	D time setting error	Set D time period to available setting range
H0B00	Bias setting error	Set Bias to available setting range
H0C00	PV setting range error	Set PV to available setting range
H0D00	SV setting range error	Set SV to available setting range
H0E00	SV Ramp setting error	Set SV Ramp to available setting range
H0F00	Delta MV setting error	Set Delta MV to available setting range
H1000	PID algorithm setting error	Check PID algorithm setting
H1100	Operation mode setting error	Available operation mode is 0 or 1

7.2 Special module

The special module and allocated data registers are as followings.

Data Register	Expansion	Item						
		Combination module		A/D Conversion module	D/A Conversion module		Analog timer	RTD input module
		G7F-ADHA	G7F-ADHB	G7F-AD2A	G7F-DA2I	G7F-DA2V	G7F-AT2A	G7F-RD2A
D4980	#1	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 D/A value	CH0 D/A value	CH0 A/T value	CH0 Temperature
D4981		CH1 A/D value	CH1 A/D value	CH1 A/D value	CH1 D/A value	CH1 D/A value	CH1 A/T value	CH1 temperature
D4982		CH0 D/A value	CH0 D/A value	CH2 A/D value	CH2 D/A value	CH2 D/A value	CH2 A/T value	CH2 temperature
D4983		-	CH1 D/A value	CH3 A/D value	CH3 D/A value	CH3 D/A value	CH3 A/T value	CH3 temperature
D4984	#2	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 D/A value	CH0 D/A value	CH0 A/T value	CH0 temperature
D4985		CH1 A/D value	CH1 A/D value	CH1 A/D value	CH1 D/A value	CH1 D/A value	CH1 A/T value	CH1 temperature
D4986		CH0 D/A value	CH0 D/A value	CH2 A/D value	CH2 D/A value	CH2 D/A value	CH2 A/T value	CH2 temperature
D4987		-	CH1 D/A value	CH3 A/D value	CH3 D/A value	CH3 D/A value	CH3 A/T value	CH3 temperature
D4988	#3	CH0 A/D value	CH0 A/D value	CH0 A/D value	CH0 D/A value	CH0 D/A value	CH0 A/T value	CH0 temperature
D4989		CH1 A/D value	CH1 A/D value	CH1 A/D value	CH1 D/A value	CH1 D/A value	CH1 A/T value	CH1 temperature
D4990		CH0 D/A value	CH0 D/A value	CH2 A/D value	CH2 D/A value	CH2 D/A value	CH2 A/T value	CH2 temperature
D4991		-	CH1 D/A value	CH3 A/D value	CH3 D/A value	CH3 D/A value	CH3 A/T value	CH3 temperature

RTD input module store digital conversion value of temperature value to data registers as below

Expansion	Temperature				Digital conversion value			
	Ch 0	Ch 1	Ch 2	Ch 3	Ch 0	Ch 1	Ch 2	Ch 3
#1	D4980	D4981	D4982	D4983	D4780	D4781	D4782	D4783
#2	D4984	D4985	D4986	D4987	D4784	D4785	D4786	D4787
#3	D4988	D4989	D4990	D4991	D4788	D4789	D4790	D4791

Remark

- 1) Offset/gain value can't be changed, it is fixed.
- 2) Analog inputting is set the current since this is manufactured.
- 3) Extend to use max.3 Modules

7.2.1 A/D · D/A Combination module

1) Performance specification

The performance specification of the analog mixture module are following.

Item		Specifications	
		G7F-ADHA	G7F-ADHB
Analog Input	Input range	Voltage	DC 0 ~ 10V (input resistance more than 1 MΩ)
		Current	DC 0 ~ 20 mA (input resistance 250 Ω)
			DC 4 ~ 20 mA (input resistance 250 Ω) Classified by parameter
	Digital output	12Bit(0~4000)	
	Voltage/Current selection	1.Setting by jumper pin for V/I selection on upper part of product (Up: voltage, Down: Current)	
		1.Setting by dipswitch for V/I selection on left side of product (Left voltage, Right: Current)	
		2. Voltage/current selected by KGLWIN parameter 3. When current input is used, short the V and I terminal	
	No. of channel	2 Channels/ 1 module	
Analog output	Absolute max. input	Voltage	DC +12V
		Current	DC +24 mA
	Output range	Voltage	DC 0 ~ 10V (External load resistance 2 kΩ ~ 1 MΩ)
		Current	DC 0 ~ 20 mA (External load resistance 510 Ω)
			DC 4 ~ 20 mA (External load resistance 510 Ω) Classified by parameter
	Digital Input	12Bit(0~4000)	
Common	Voltage/Current selection	Separated from terminal	
	No. of channel	1Channel / 1 module	1Channel / 2 module
	Absolute max. output	Voltage	DC +12V
		Current	DC +24 mA
	Max. resolution	Voltage	DC0 ~ 10V : 2.5 mV (1/4000)
		Current	DC0 ~ 20 mA: 5 μA (1/4000)
			DC4 ~ 20 mA: 6.25 μA (1/3200)
	Accuracy	± 0.5% [Full scale]	
	Max. conversion speed	1 ms/CH + scan time	
	Isolation	Photo coupler insulation between I/O terminals and PLC power supply (No isolation between channels)	
	Connect terminal	9 Points terminals *2	8 Points terminals *2
	Internal current Consumption	20 mA	
	External power supply	DC 21.6 ~ 26.4V	
		80 mA	95 mA
	Weight	240g	180g

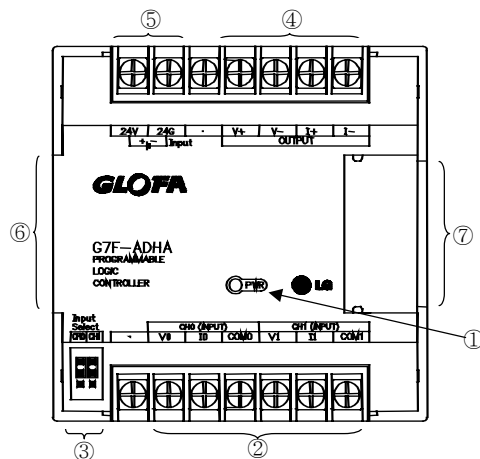
Remark

- 1) Offset/gain value can't be changed, it is fixed.
- 2) Analog inputting is set the current since this is manufactured.
- 3) Extend to use max.3 Modules

2) Names of parts and functions

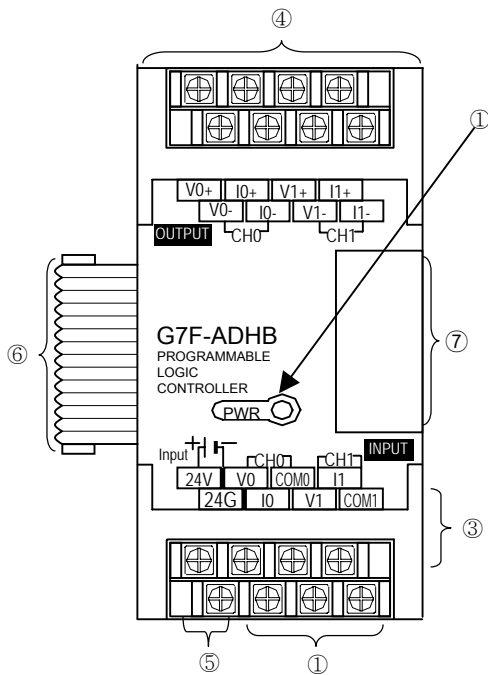
Explain about names of parts and functions

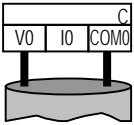
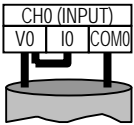
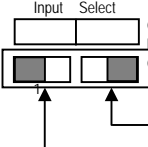
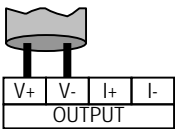
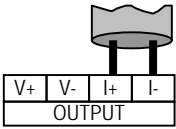
(1) G7F-ADHA



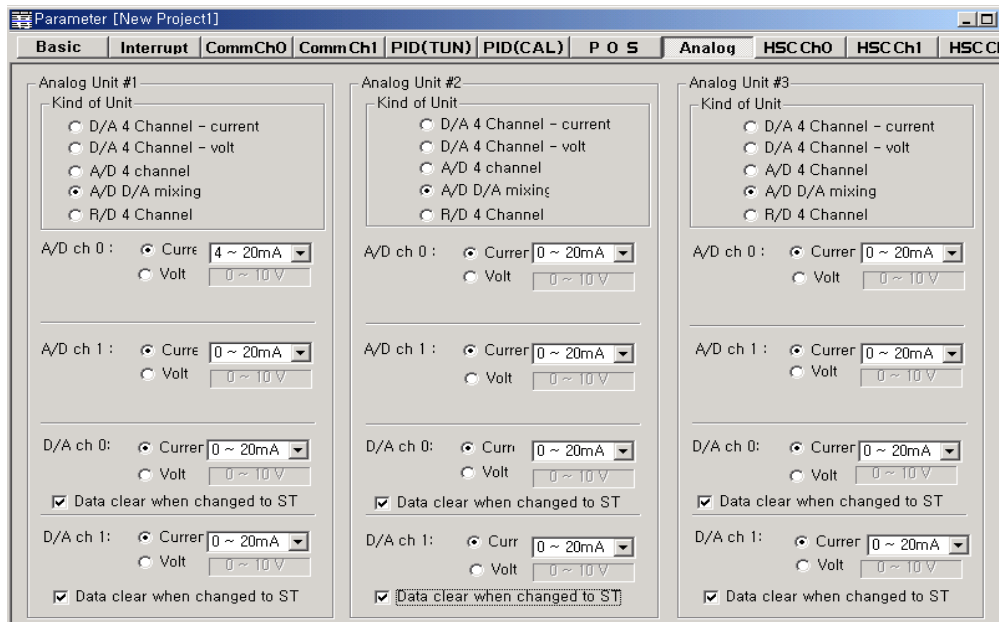
No	Contents.
①	RUN LED Indicate the operating status the G7F-ADHA
②	Analog input terminal <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Voltage Input </div> <div style="text-align: center;"> Current input </div> </div> <p>When current input is used, short the V and I terminal.</p>
③	Jumper pin of analog input <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Input Select <p>Right is CH.1 selecting left is CH. 0 selecting</p> </div> <div style="text-align: center;"> Voltage Input <p>Connect upper parts by jumper pins</p> </div> <div style="text-align: center;"> Current Input <p>Connect lower parts by jumper pins.</p> </div> </div>
④	Analog output terminal <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Voltage output <p>OUTPUT</p> </div> <div style="text-align: center;"> Current output <p>OUTPUT</p> </div> </div> <p>Only one type of output (Current or Voltage) is available on a module</p>
⑤	External power input terminal External voltage 24VDC needs to this terminal.
⑥	Extension cable This cable is used to connect while analog mixture module is used..
⑦	Extension cable connector The connector connects extension cable when extended module is used.

(2) G7F-ADHB



No	Contents.
①	<p>RUN LED</p> <p>Indicate the operating status the G7F-ADHB</p>
②	<p>Analog input terminal</p> <div><p>Voltage Input</p></div> <div><p>Current input</p></div> <p>When current input is used, short the V and I terminal.</p>
③	<p>Dip switch of analog input</p>  <p>Right : current input Left : voltage input</p>
④	<p>Analog output terminal</p> <div><p>Voltage output</p></div> <div><p>Current output</p></div> <p>Only one type of output (Current or Voltage) is available on a module</p>
⑤	<p>External power input terminal</p> <p>External voltage 24VDC needs to this terminal.</p>
⑥	<p>Extension cable</p> <p>This cable is used to connect while analog mixture module is used..</p>
⑦	<p>Extension cable connector</p> <p>The connector connects extension cable when extended module is used.</p>

3) Parameter setting

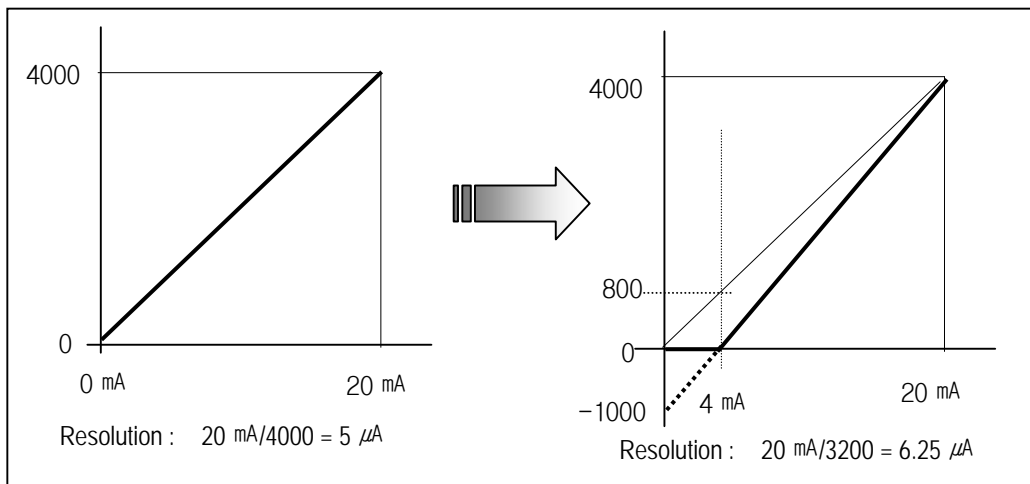


(1) Scaling function

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 equipament' range is not matched each other.

(MASTER-K120S series converts range automatically as following : 0 ~ 20mA \Leftrightarrow 4 ~ 20mA)



Conversion method is as below

- scaling conversion value (A/D conversion) = [(data of 0 ~ 20 mA) - 800] x 4000/3200

example) in case of 8 mA input at range 0 ~ 20 mA

before the scaling conversion : 8 mA / 5 μA = 1600

after the scaling conversion : (1600 - 800) x 1.25 = 1000

- scaling conversion value (D/A conversion) = [(data of 4 ~ 20 mA) x 3200/4000] + 800

example) in case of '1000' output at range 4 ~ 20 mA

current output value before the scaling conversion : 1000 x 5 μA = 5 mA

current output value after the scaling conversion : (1000 x 0.8) + 800 = 1600

1600 x 5 μA = 8 mA

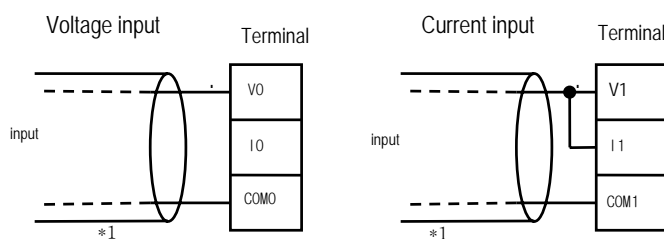
4) Wiring

(1) Caution for wiring

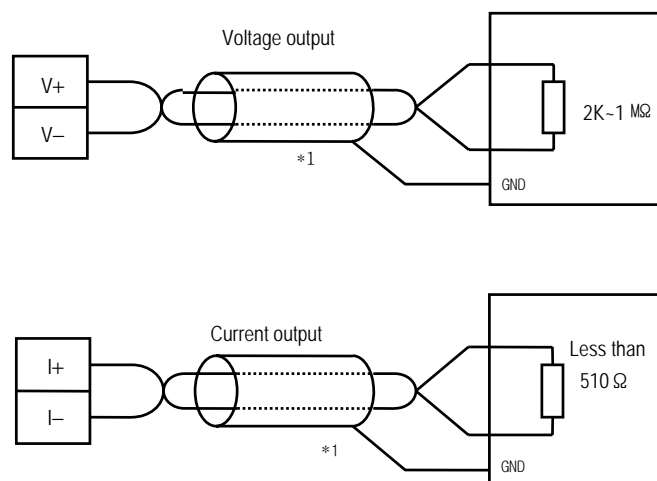
- Make sure that external input signal of the mixture module of AC and analog I/O is not affected by induction noise or occurs from the AC through using another cable.
- Wire is adopted with consideration about peripheral temperature and electric current allowance. Thicker than Max. size of wire AWG22 (0.3 mm²) 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

a) Analog input



b) Analog output



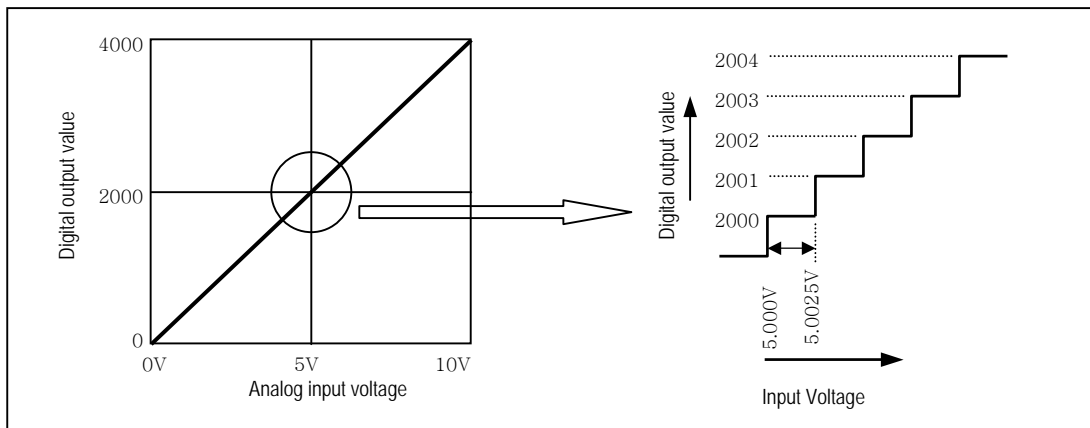
*1 : Be sure to use two-core twisted shield wire.

* Be careful to use that analog output is 1 channel.

5) I/O conversion characteristics

(1) Analog input characteristics

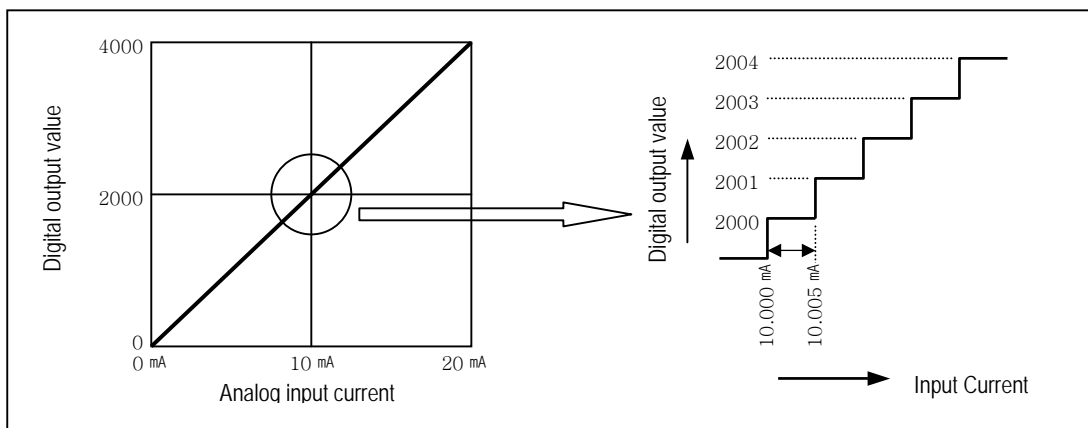
a) Voltage input



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

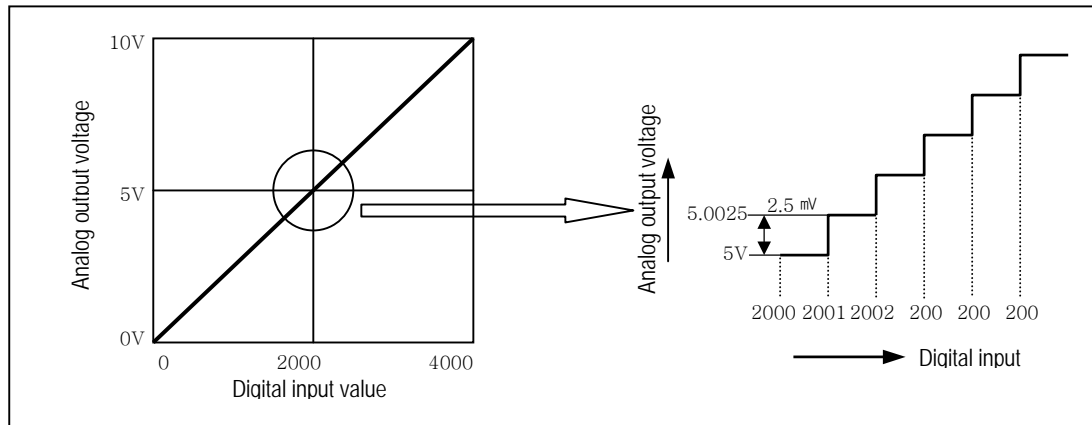


A/D conversion characteristics (Current input)

Current input 0mA becomes output 0, 10mA does 2000 and 20mA does 4000. therefore input $5 \mu\text{A}$ equals to digital amount 1, but value less than $5 \mu\text{A}$ can't be converted. So abandon it.

(2) Analog output characteristics

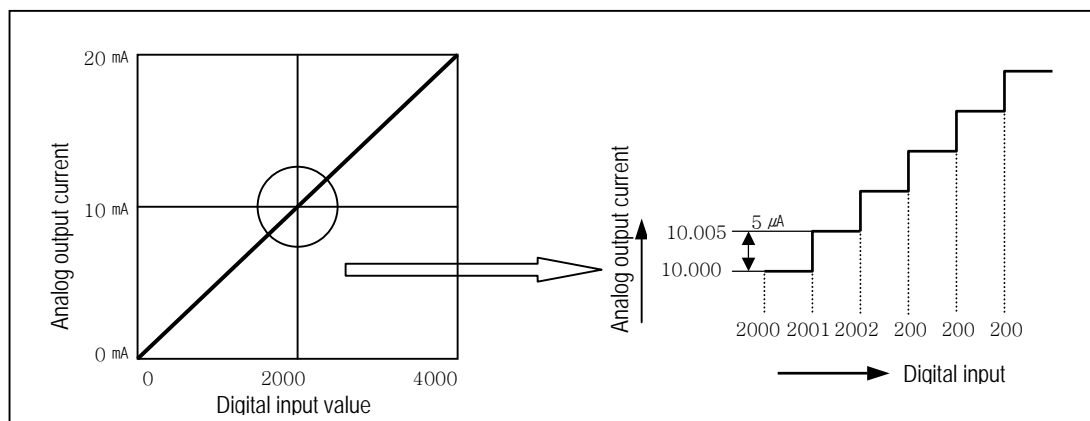
a) Voltage output



D/A conversion characteristic (voltage 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.

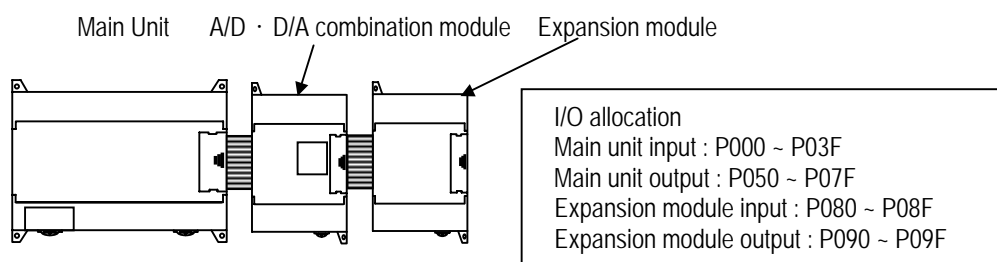
6) Program example

(1) Distinction program of A/D conversion value

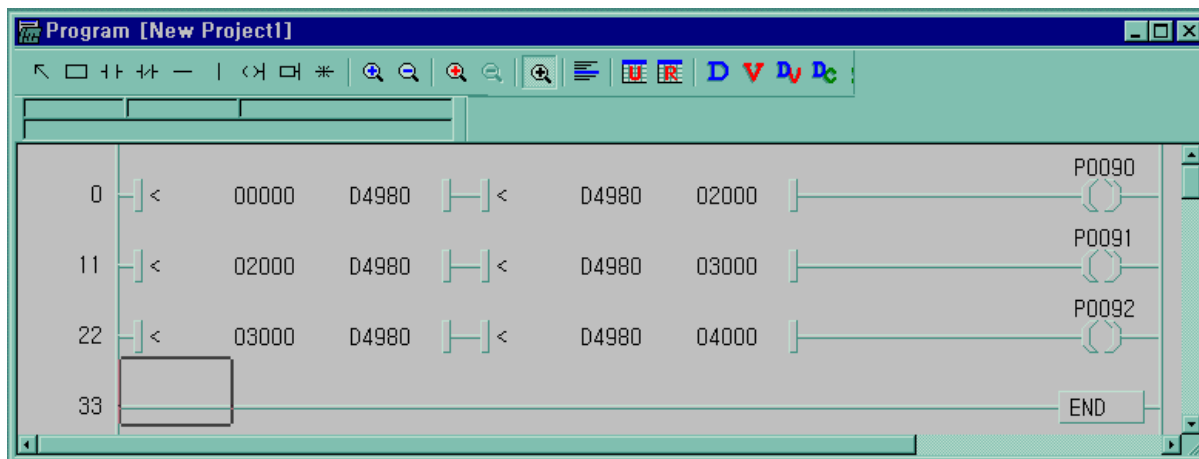
a) Program explanation

- When digital value of channel 0 is less than 2000, P090 is on.
- when digital value of channel 0 is more than 3000, P091 is on.
- When digital value of channel 0 is more or same than 2000 or lesser than 3000, P092 is on.

b) System configuration



c) Program



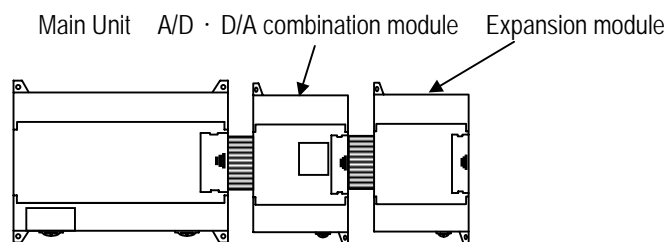
Chapter 7 Usage of Various Functions

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

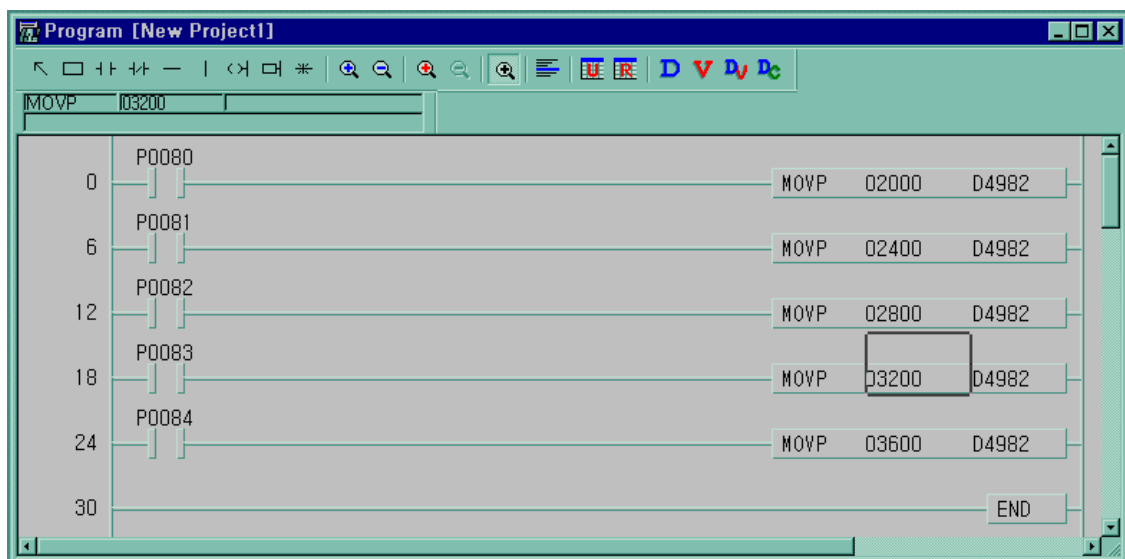
a) Program explanation

- When P80 becomes On, 2000 (5V) is output.
- When P81 becomes On, 2400 (6V) is output.
- When P82 becomes On, 2800 (7V) is output.
- When P83 becomes On, 3200 (8V) is output.
- When P84 becomes 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.

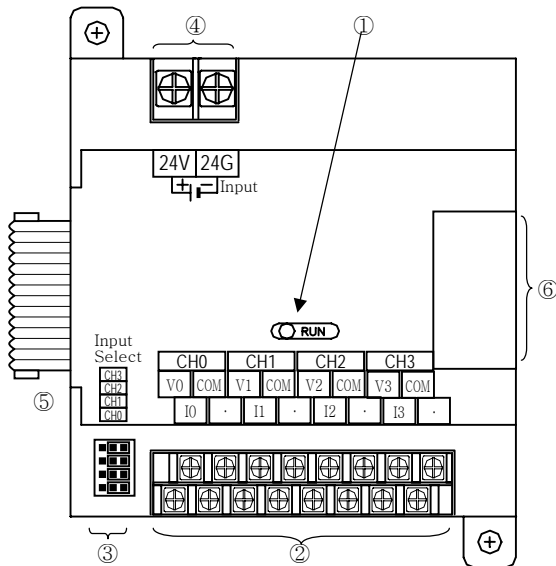
Item		Specifications
Analog input	Voltage	0 ~ 10VDC (input resistance 1 MΩ)
	Current	DC 4 ~ 20 mA (input resistance 250 Ω) DC 0 ~ 20 mA (input resistance 250 Ω))
	Voltage/Current Selection	- Setting by input terminal (When current input is used, short the V and I terminal) - Voltage/Current is selected by KGLWIN parameter
Digital output		12bit binary (0 ~ 4000)
Maximum resolution	0 ~ 10VDC	2.5 mV (1/4000)
	DC 0 ~ 20 mA	5 μA (1/4000)
	DC 4 ~ 20 mA	5 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		4channels/1module
Isolation		Between input terminal and PLC power supply : Photo coupler isolation (No isolation between channels)
Terminal connected		2 points/16 points terminal block
Current Consumption	+5V	100mA
External Power supply	Voltage	DC 21.6 ~ 26.4V
	Current consumption	100 mA
Weight		300g

Remark

- Offset/Gain value can't be changed, because it is fixed
- Analog inputting is set the current since this is manufactured.
- It is possible to use to extend max.3 modules

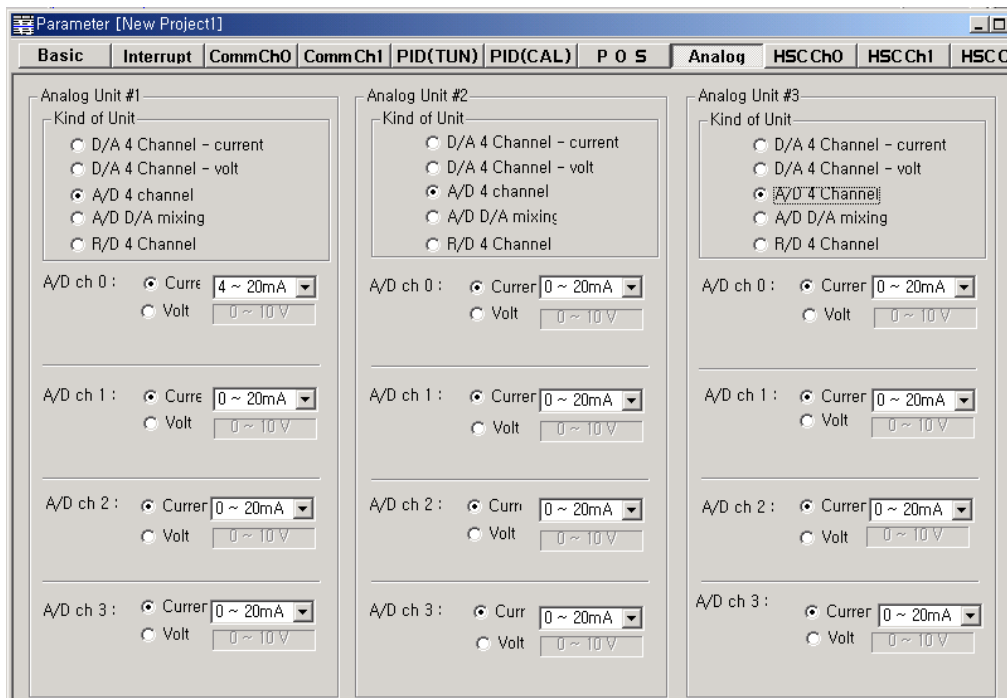
2) Names of parts and functions

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



No	Contents
①	<div>RUN LED</div> <div>Indicate the operating status the G7F-AD2A</div>
②	<div>Analog input terminal</div> <div><div>Voltage input</div><div>Current input</div><div>▶ When current input is used, short the V and I terminal.</div></div>
③	<div>Jumper pin of analog input</div> <div><div>Input Select</div><div>Voltage input</div><div>Current input</div><div>Connect left parts by jumper pins</div><div>Connect right parts by jumper pins</div></div>
④	<div>External power input terminal</div> <div>▶ External voltage 24VDC needs to this terminal.</div>
⑤	<div>Extension cable</div> <div>▶ This cable is used to connect while analog input module is used..</div>
⑥	<div>Extension cable connector</div> <div>▶ The connector connects extension cable when extended module is used.</div>

3) Parameter setting



(1) Scaling function

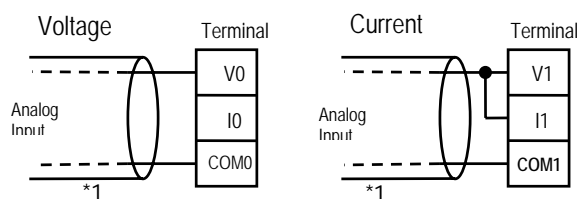
The scaling function is the same that of A/D, D/A combination module.

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. Thicker than Max. size of wire AWG22 (0.3 mm²) 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

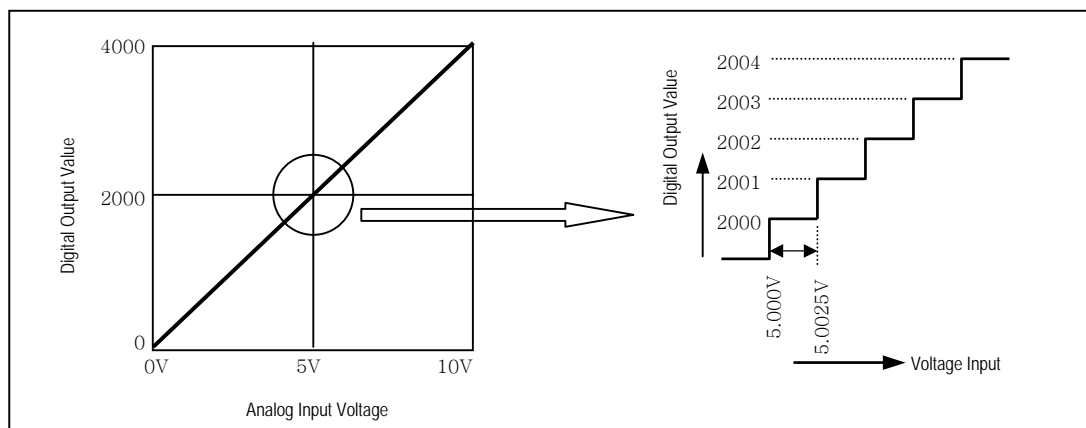


*1 : Be sure to use two-core twisted shield wire.

5) Analog/Digital conversion characteristics

(1) Analog input characteristics

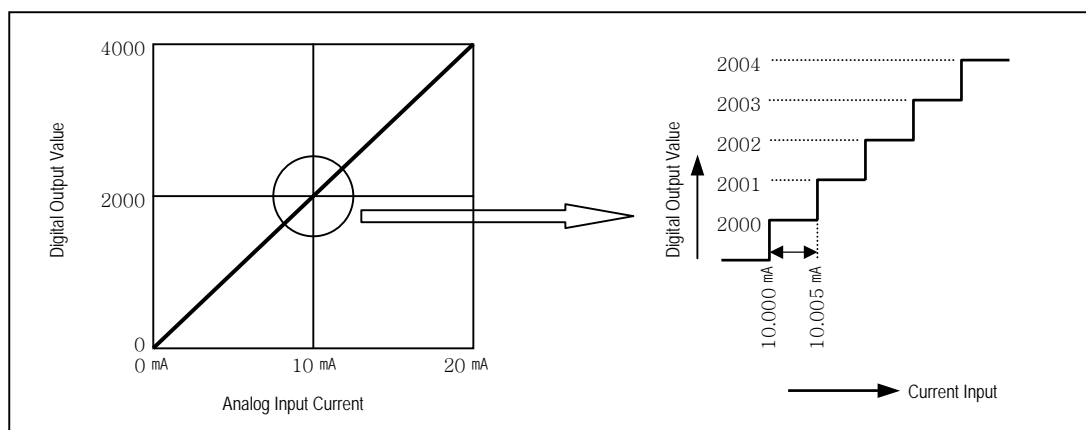
a) Voltage input



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 mA)

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

6) Program example

(1) Distinction program of A/D conversion value(Analog input range: DC4 ~ 20 mA, 0~10VDC)

(a) Program explanation

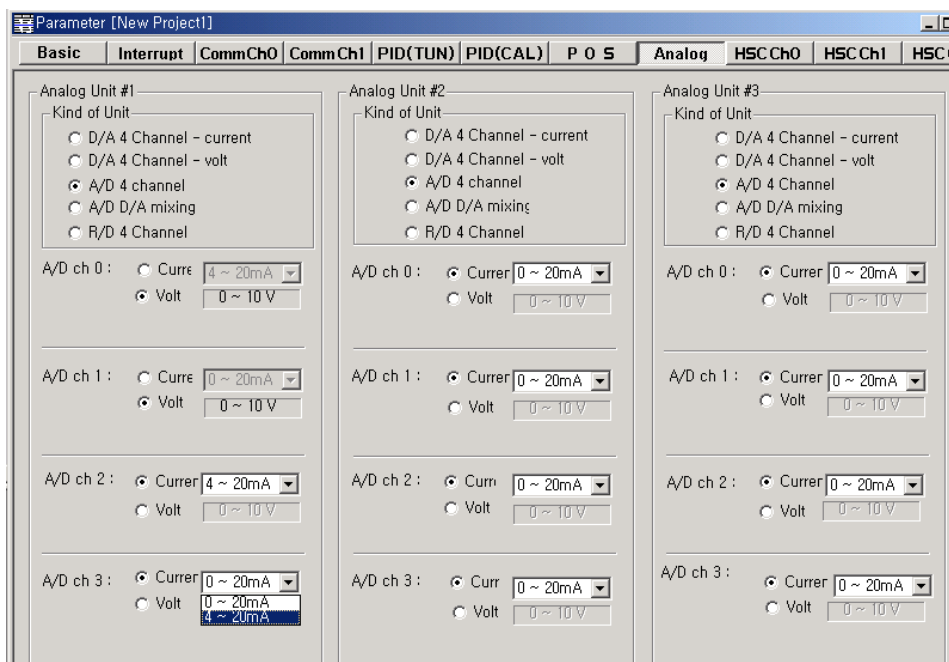
- When digital value of channel 0 is the same or more than 2000 and the same or less than 3000, P090 is on.
- When digital value of channel 1 is the same or more than 2000 and the same or less than 3000, P091 is on.
- When digital value of channel 2 is the same or more than 2000 and the same or less than 3000, P092 is on.
- When digital value of channel 3 is the same or more than 2000 and the same or less than 3000, P093 is on.

(b) System configuration

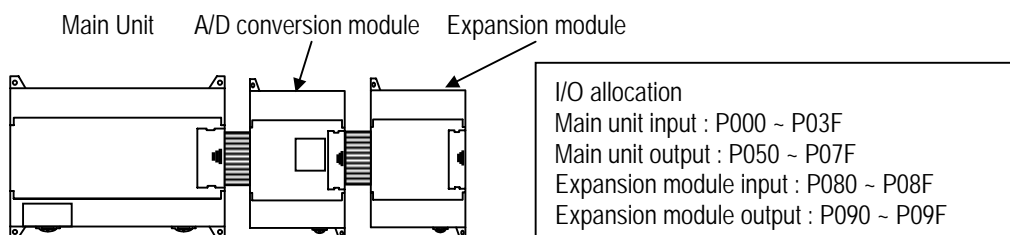
① Analog input

- channel "0", "1" : Voltage input (0 ~ 10VDC)
- channel "2", "3" : Current input (DC 4 ~ 20 mA)

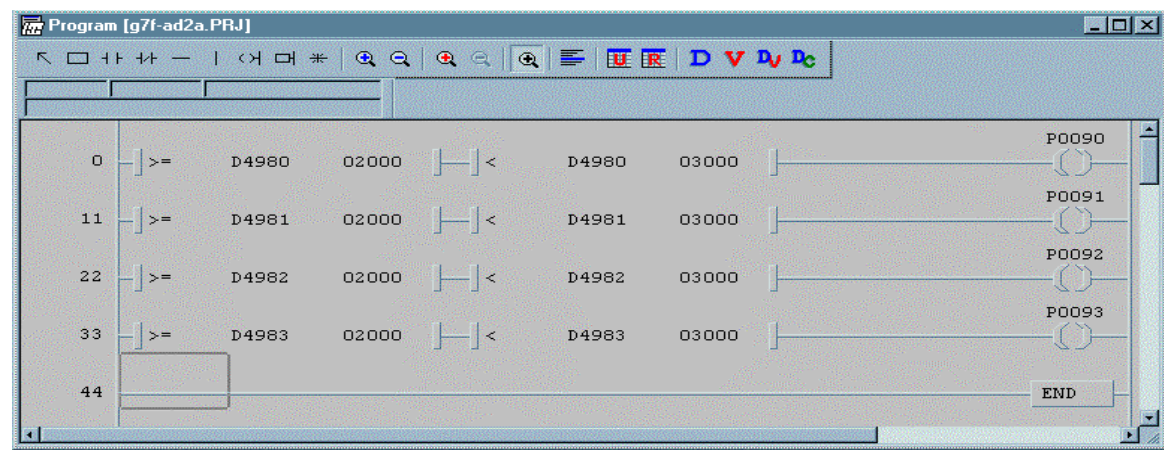
② Parameter setting



③ System configuration



(c) Program



7.2.3 D/A Conversion module

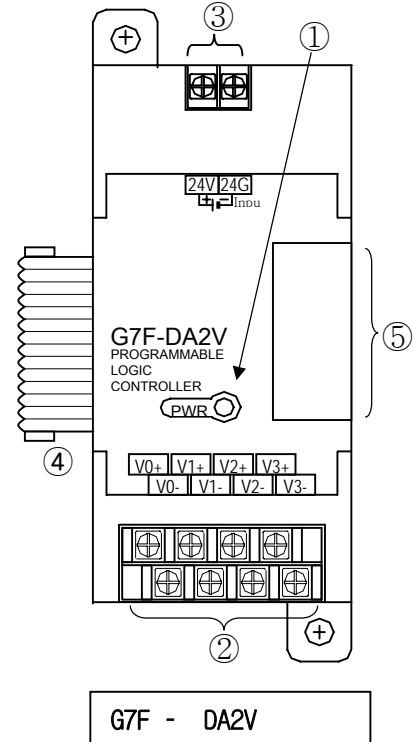
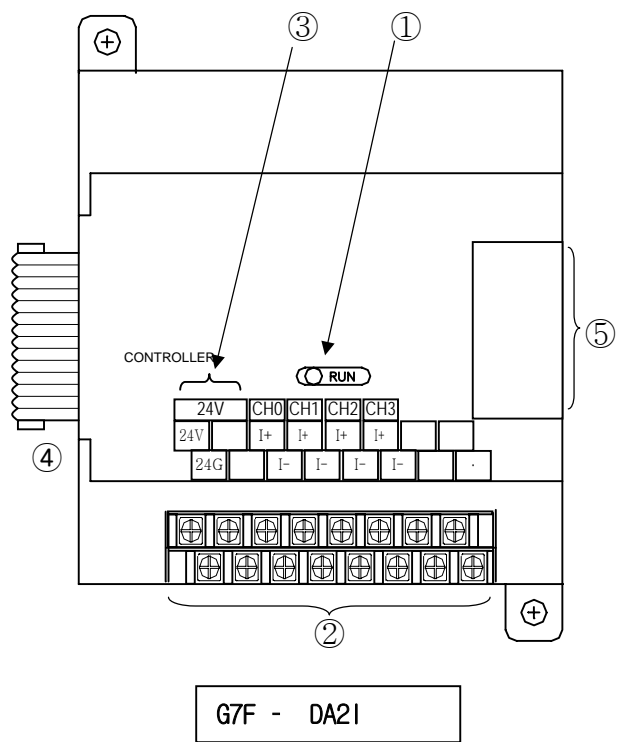
1) Performance specifications

The performance specifications of the analog output module are following.

Item		Specifications	
		G7F-DA2I	G7F-DA2V
Output Range		DC 0 ~ 20 mA(Load resistance 510 Ω) DC 4 ~ 20 mA(Load resistance 510 Ω) Classified by parameter	DC 0 ~ 10V(Lod resistance 2 kΩ ~ 1 MΩ)
Digital Output		12bit (0 ~ 4000)	
Number of output		4channels/1module	
Max. absolute output		DC +24 mA	DC 12V
Maximum resolution		DC 0 ~ 20 mA : 5 μA (1/4000)	2.5 mV (1/4000)
		DC 4 ~ 20 mA : 6.25 μA (1/3200)	
Overall accuracy		± 0.5% [Full Scale]	
Max. conversion speed		0.5 ms/CH + scan time	1 ms/CH + scan time
Isolation		Between input terminal and PLC power supply: Photo coupler isolation (No isolation between channels)	
Terminal connected		16 points terminal block	8 points terminal block * 2
Current Consumption		20mA	15mA
External Power supply	Voltage	DC 21.6 ~ 26.4V	
	Current consumption	80 mA	90 mA
Weight		280g	160g

2) Names of parts and functions

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



①	RUN LED
	Indicate the operating status the G7F-DA2I
②	Analog output terminal
	Current output
③	External power input terminal
	▶ External voltage 24VDC needs to this terminal.
④	Extension cable
	▶ This cable is used to connect while analog output module is used..
⑤	Extension cable connector
	▶ The connector connects extension cable when extended module is used.

3) Parameter setting

Parameter [New Project1]

Basic Interrupt CommCh0 CommCh1 PID(TUN) PID(CAL) P O S Analog HSCCh0 HSCCh1 HSCCh2

Analog Unit #1

Kind of Unit

- ☒ D/A 4 Channel - current
- ☐ D/A 4 Channel - volt
- ☐ A/D 4 channel
- ☐ A/D D/A mixing
- ☐ R/D 4 Channel

D/A ch 0 : ☒ Curr 4 ~ 20mA

☒ Data clear when changed to ST

D/A ch 1 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

D/A ch 2 : ☒ Curr 4 ~ 20mA

☒ Data clear when changed to ST

D/A ch 3 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

Analog Unit #2

Kind of Unit

- ☒ D/A 4 Channel - current
- ☐ D/A 4 Channel - volt
- ☐ A/D 4 channel
- ☐ A/D D/A mixing
- ☐ R/D 4 Channel

D/A ch 0 : ☒ Curr 0 ~ 20mA

☐ Data clear when changed to ST

D/A ch 1 : ☒ Curr 0 ~ 20mA

☐ Data clear when changed to ST

D/A ch 2 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

D/A ch 3 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

Analog Unit #3

Kind of Unit

- ☒ D/A 4 Channel - current
- ☐ D/A 4 Channel - volt
- ☐ A/D 4 channel
- ☐ A/D D/A mixing
- ☐ R/D 4 Channel

D/A ch 0 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

D/A ch 1 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

D/A ch 2 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

D/A ch 3 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

Analog Unit #1

Kind of Unit

- ☒ D/A 4 Channel - current
- ☐ D/A 4 Channel - volt
- ☐ A/D 4 channel
- ☐ A/D D/A mixing
- ☐ R/D 4 Channel

D/A ch 0 : ☒ Curr 4 ~ 20mA

☒ Data clear when changed to ST

D/A ch 1 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

D/A ch 2 : ☒ Curr 4 ~ 20mA

☒ Data clear when changed to ST

D/A ch 3 : ☒ Curr 0 ~ 20mA

☒ Data clear when changed to ST

1) Specify the kind of special module

2) Set Output type of each channel

5) Scaling function

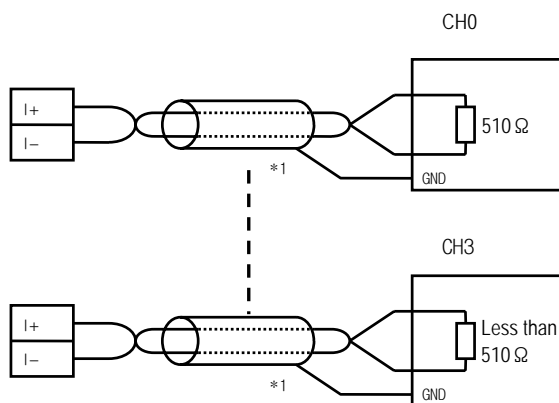
The scaling function is the same that of A/D, D/A combination module.

6) 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 mm²) 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.

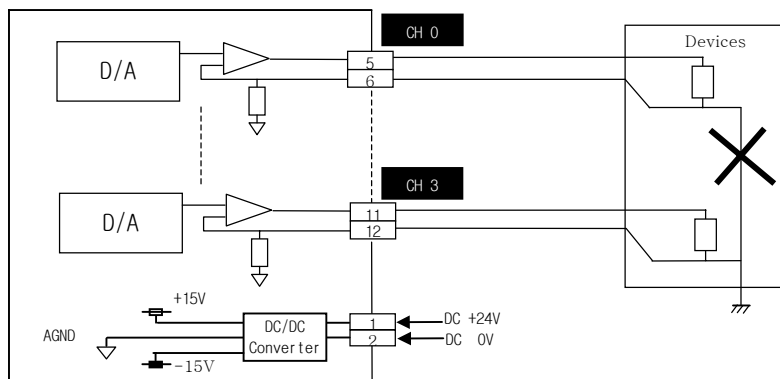
(2) Wiring



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

Remark

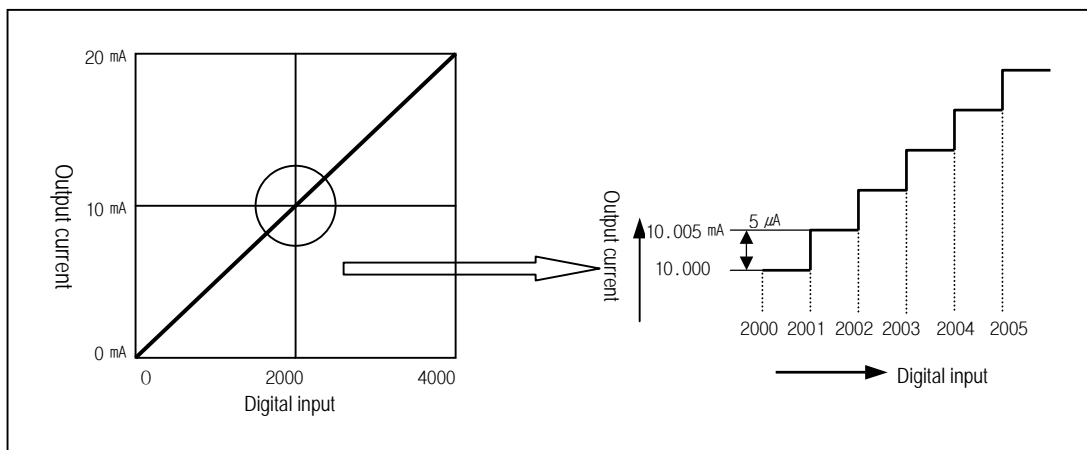
- The common grounding with other devices is permitted when D/A conversion module is used as current output type.



7) Digital/Analog conversion characteristics

(1) G7F-DA2I

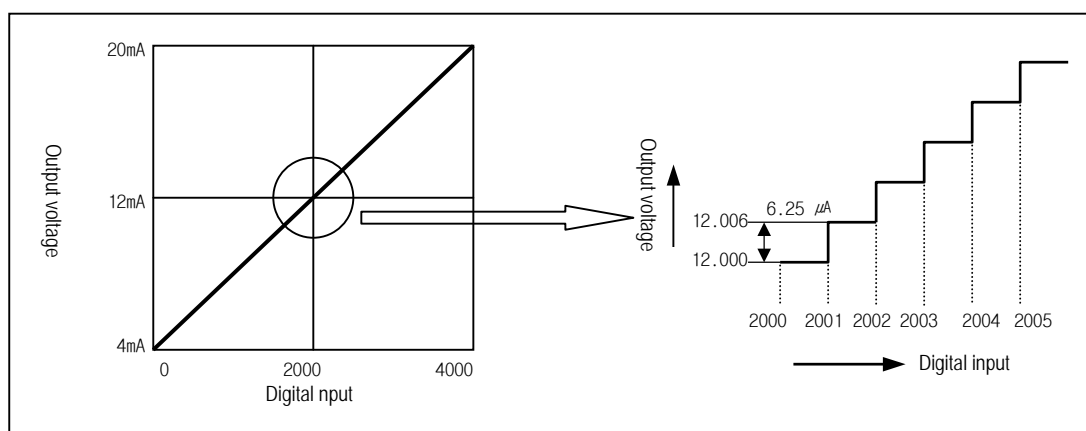
a) 0~20mA output



D/A conversion characteristics(Current output)

Digital amount 0 outputs analog amount 0mA, 4000 does 20mA. Digital input 1 equals to $5 \mu\text{A}$ 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 $6.25 \mu\text{A}$ of analog amount.

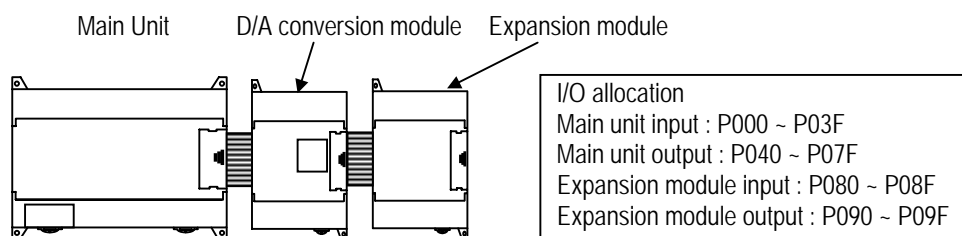
8) Program example

(1) Program which controls speed of inverter by analog output voltage of 5 steps(0 ~ 20mA output)

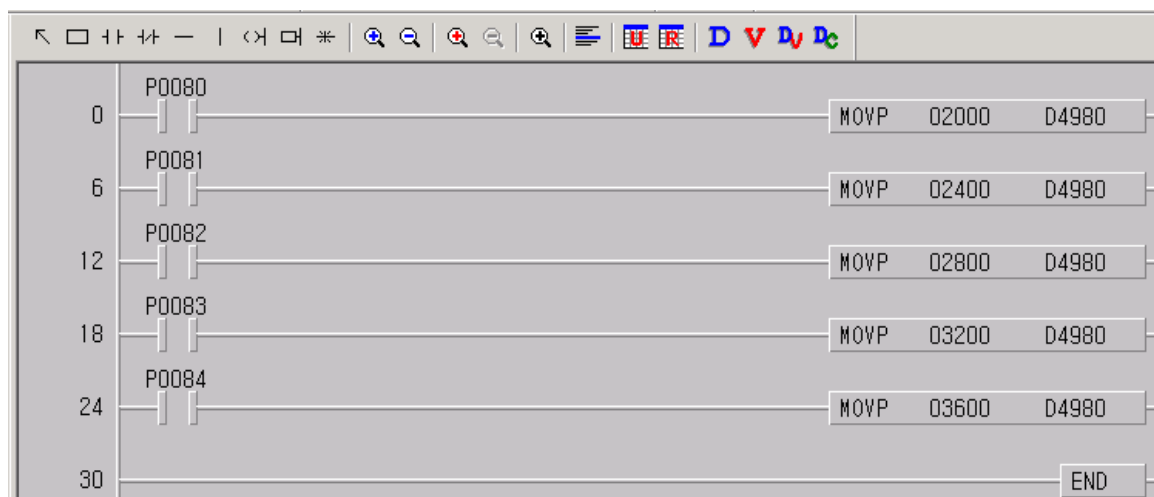
a) Program explanation

- When P80 becomes On, 2000 (10mA) is output.
- When P81 becomes On, 2400 (12mA) is output.
- When P82 becomes On, 2800 (14mA) is output.
- When P83 becomes On, 3200 (16mA) is output.
- When P84 becomes On, 3600 (18mA) is output.

b) System configuration



c) Program



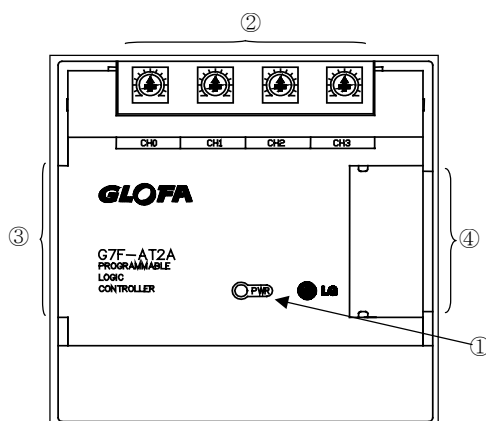
7.2.4 Analog timer

1) Performance specification

The performance specification of the analog timer module are following.

Item	Specification
Number of channels	4
Output value range	8 Bit (Digital output range: 0 ~ 200)
Setting type	Setting by variable resistance
Accuracy of timer	± 2.0% (Accuracy about max. value)
Operation method	Storing data register automatically
Internal current consumption	50 mA
Number of module installment	Max 3 modules
Weight	200g

2) Names of parts and functions



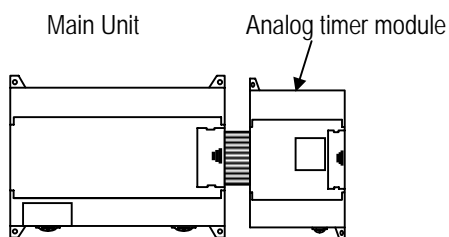
No.	Name	Contents
①	RUN LED	Indicate the operating status the G7F-AT2A. On: normal operating Off: DC 5V power off or the G7F-AT2A module fault
②	Channel	Setting up the length of timer through variable resistance to every channel.
③	Extension cable	
④	Extension cable connection terminal	

3) Program example

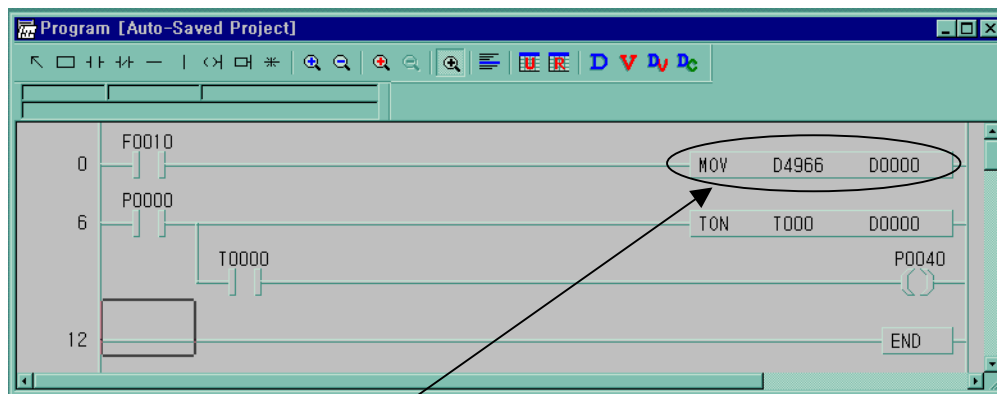
(1) Program explanation

Program which controls on-delay time of output contact point within 0 to 20 sec. By analog timer module.

(2) System configuration



(3) Program



A/T conversion data is moved D000 always

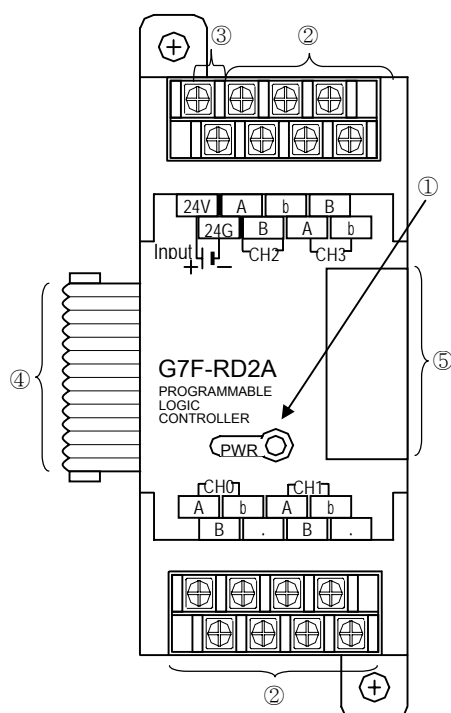
7.2.5 RTD input module(Standard type only)

1) Performance specification

The performance specification of the RTD input module are following.

Item		Specification
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 to 4,000 Detected temperature value : -2000 to 6000 (one digit after point * 10)
Burn out detection		Each of three wires at every channel has detection function.
Accuracy		± 0.5% [Full Scale]
Maximum conversion speed		40 scan / 1 module
Number of temperature input device points		4Channel / 1module
Insulation method		Photo-coupler insulation between the input terminal and the PLC power supply (non-insulation between channels)
Connection terminal block		8-point terminal block * 2
Current consumption		25 mA
External power supply	Voltage	DC21.6 ~ 26.4V
	Current	70 mA
Weight		240g

2) Names of parts and functions



No	Name	Contents
①	RUN LED	Indicate the operating status the G7F-RD2A
②	RTD input terminal	Terminal which connects Pt100 or JPt100
③	External power input terminal	External voltage 24VDC needs to this terminal
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.

Explain about names of parts and functions

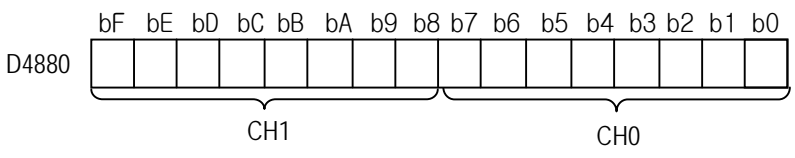
3) Parameter setting

The image shows a software interface for configuring three analog units. Each unit (Analog Unit #1, #2, and #3) has a 'Kind of Unit' section with five radio button options: 'D/A 4 Channel - current', 'D/A 4 Channel - volt', 'A/D 4 channel', 'A/D D/A mixing', and 'R/D 4 Channel'. Below this, each unit has four channels (ch 0 to ch 3). Each channel has a dropdown menu set to 'Pt 100' and two radio buttons for 'digital value' in either '°C' or '°F'.

4) Digital conversion value register

Ch.	Detected Temperature value	Digital conversion value	Data register	Remark
0	D4980	D4780	D4880	Special module #1
1	D4981	D4781		
2	D4982	D4782		
3	D4983	D4783	D4881	
0	D4984	D4784	D4882	Special module #2
1	D4985	D4785		
2	D4986	D4786		
3	D4987	D4787	D4883	
0	D4988	D4788	D4884	Special module #3
1	D4989	D4789		
2	D4990	D4790		

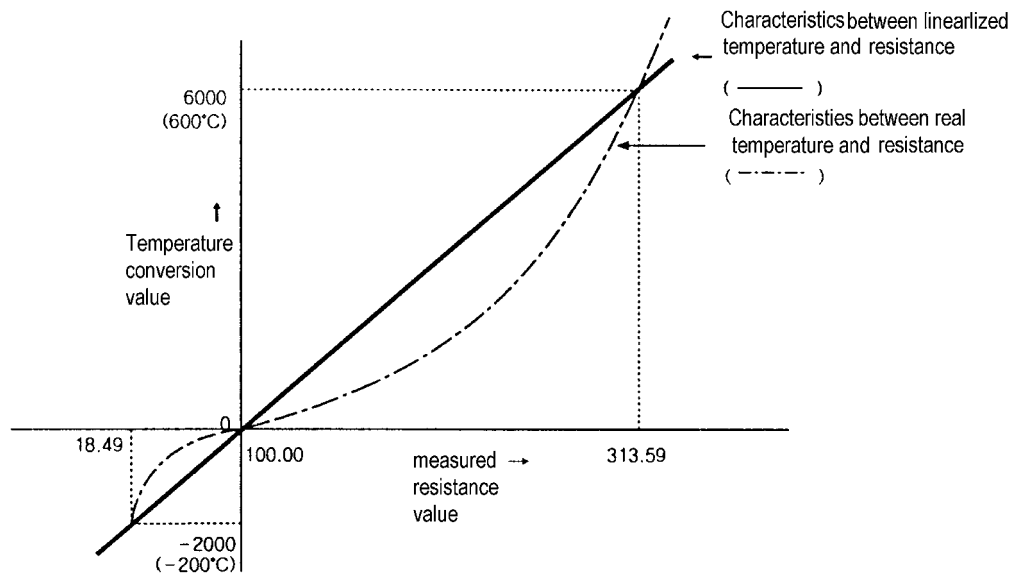
5) Error code (D4880 ~ D4885)



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 A 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)

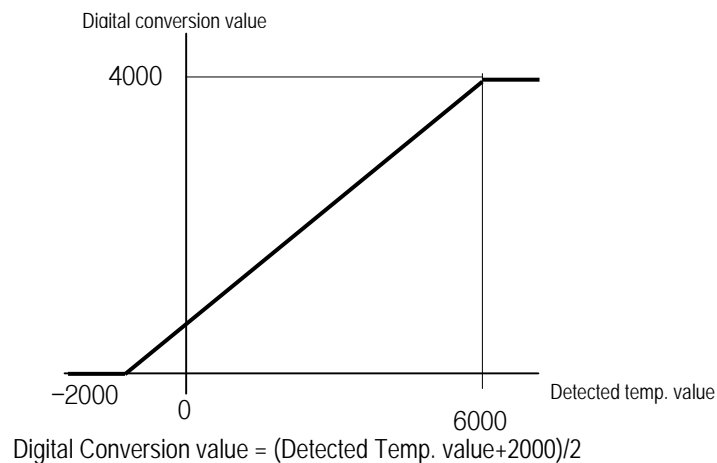
6) Temperature conversion characteristics

The RTD input module, as shown below, linearizes 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)



Example) Assume that Detected temperature value(D4980) is 2345, then real temperature = 234.5°C, 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		<p>- 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.</p>
3-wire type		
4-wire type		
No wiring		

*1 : Pt

*2: Shield wire

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 mm²) 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-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		<p>□ wire resistance ≤ 10Ω</p> <p>□ wire resistance ≤ 10Ω</p> <p>□ wire resistance ≤ 10Ω</p>
3-wired type		<p>The difference between the resistance values of the wires ① and ② : 1Ω or less</p> <p>The difference between the resistance values of the wires ② and ③ : 1Ω or less</p>
4-wired type		<p>The difference between the resistance values of the wires ③ and ① : 1Ω or less</p>

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.

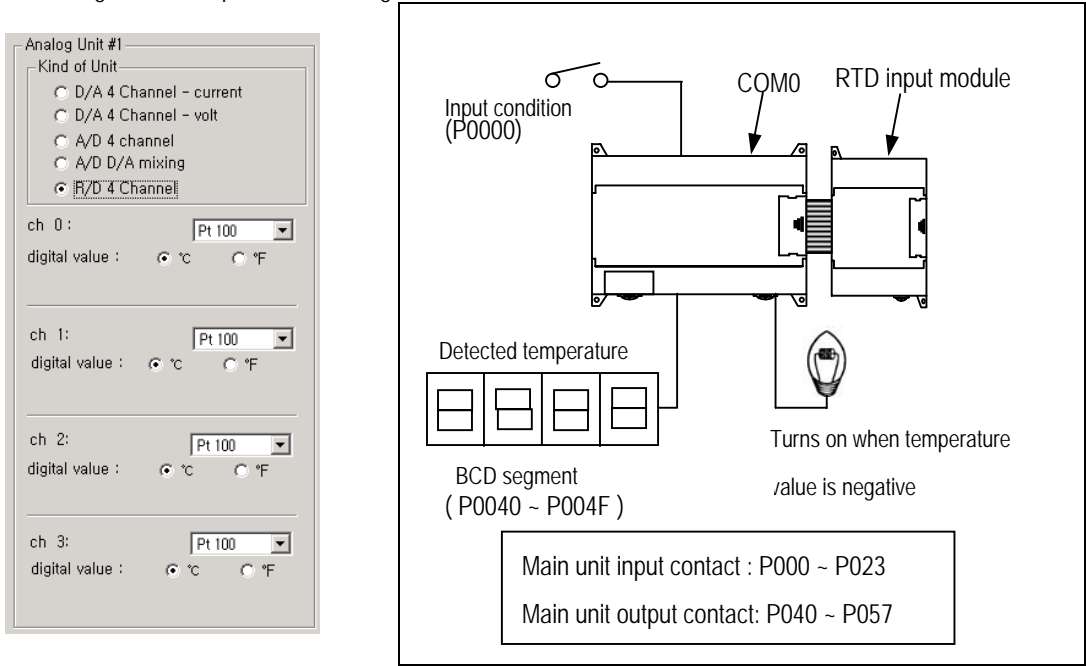
10) Program example

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

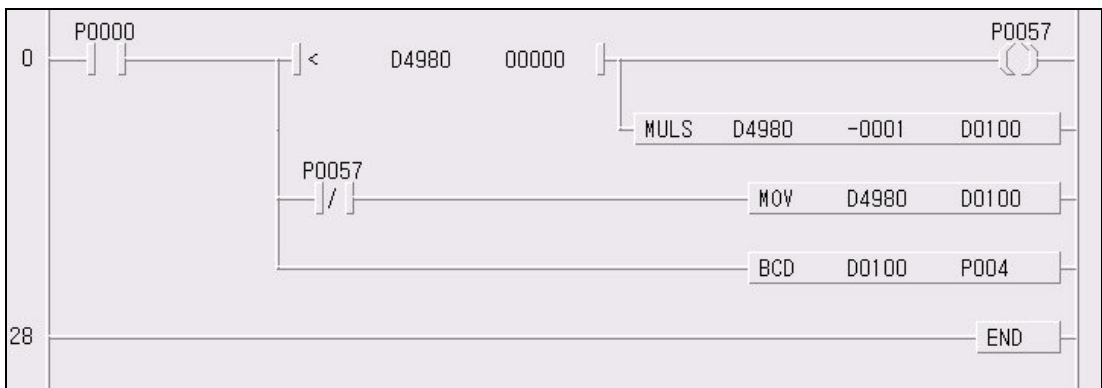
a) Program explanation

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

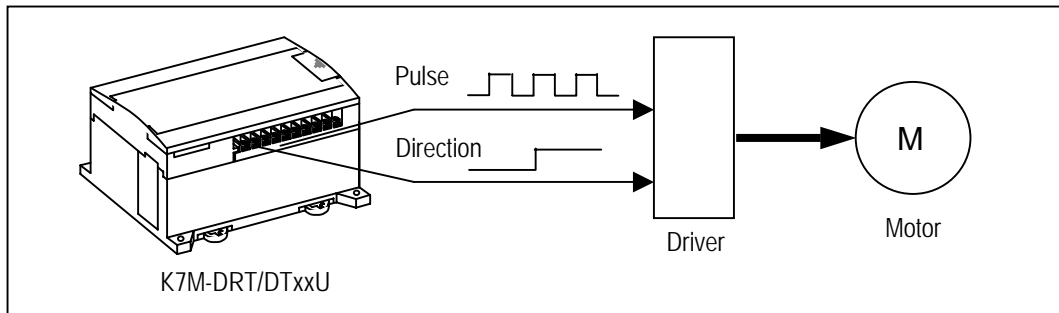


c) Program



7.3 Positioning Function(DRT/DT type only)

The DRT/DT type of MASTER-K120S 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.

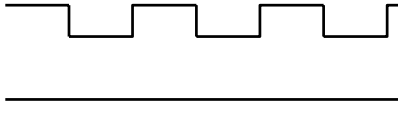
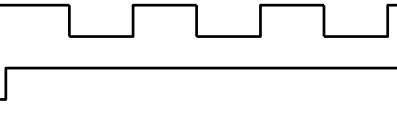


7.3.1 Specification

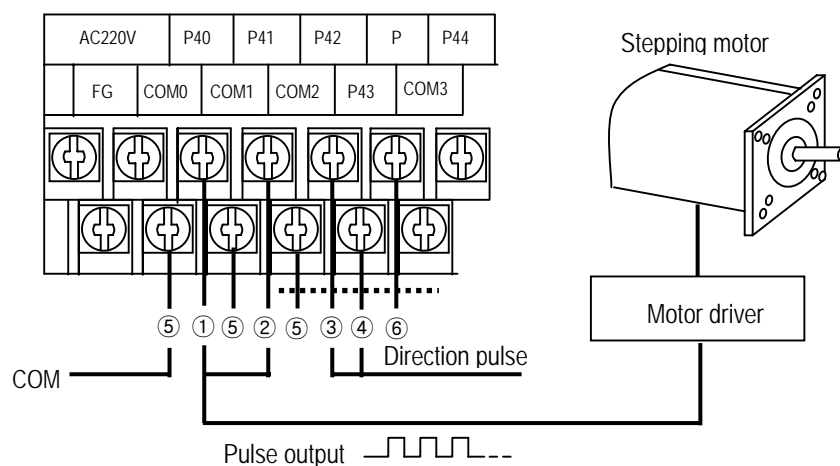
1) Performance Specification

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 ms(unit of 1ms) Deceleration time : 0 ~ 10,000 ms(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 ms	
	Method	1 : Origin detection when approximate origin turns off
		2 : Origin detection after deceleration when approximate origin turns on.
JOG	Speed	High speed : Speed setting range: 5 ~ 100,000pps
		Low speed : Speed setting range: 5 ~ 100,000pps
	3 : Origin detection by approximate origin	
PWM Output		Period setting range: 1 ~ 20,000 ms
		Duty setting range: 0 ~ 100%

2) Output Specification(P40, P41)

Signal Name	Rated load voltage	Load voltage range	Max. load current	Max. voltage drop during On
Positioning	DC 12/24V	DC 10.2 ~ 26.4V	100 mA	≤DC 0.3V
CW/Pulse CCW/Direction	Forward direction		Reverse direction	
				

3) Names of wiring terminal

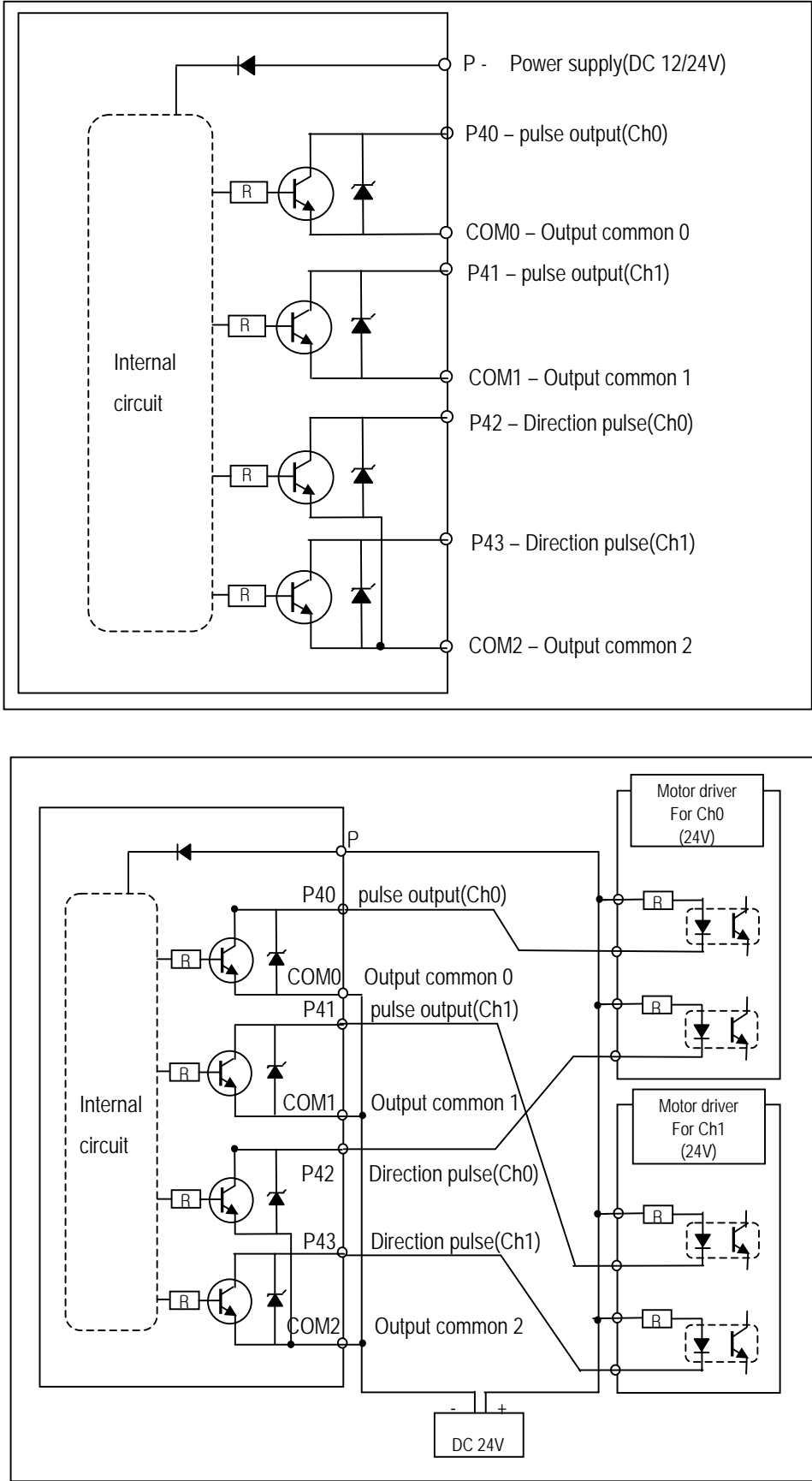


No.	Terminal No.	Name	Usage
①	P040	Positioning(Ch0)	Pulse output terminal
②	P041	Positioning(Ch1)	Pulse output terminal
③	P042	Direction pulse(Ch0)	Direction output terminal
④	P043	Direction pulse(Ch1)	Direction output terminal
⑤	COM0,COM1,COM2	Common	Common terminal
⑥	P	24V	External 24V supply terminal

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.

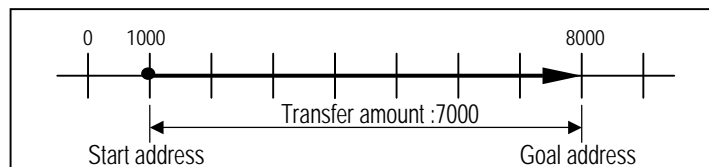
(1) Position control

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

A) Control by Absolute method (Absolute coordinate)

- ① Positioning control from start address to goal address (the address assigned by positioning data).
- ② Positioning control is carried out based on the address assigned (origin address) by return to origin.
- ③ 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 ($7000=8000-1000$).

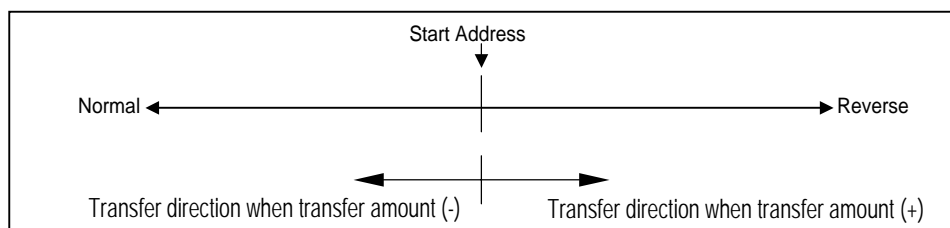


• Parameter setting

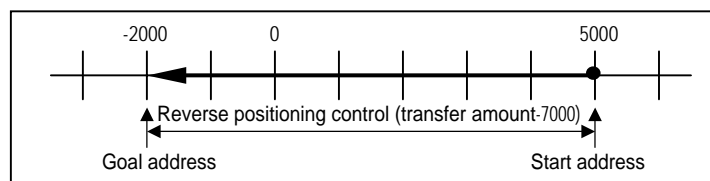
Items of positioning data	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed(pps)	Dwell time(ms)
Setting	1	Absolute	End	Single	8,000	5,000	100

B) Control by Incremental method (Relative coordinate)

- ① Positioning control as much as the goal transfer amount from start address.
- ② 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

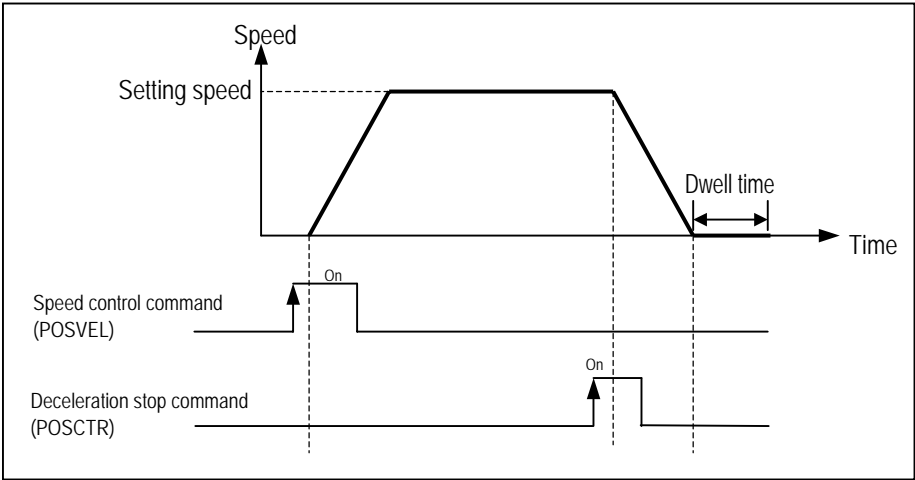
Items of positioning data	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed(pps)	Dwell time(ms)
Setting	1	Incremental	End	Single	-7,000	5,000	100

(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 '7.3.4 Instruction' for details.

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

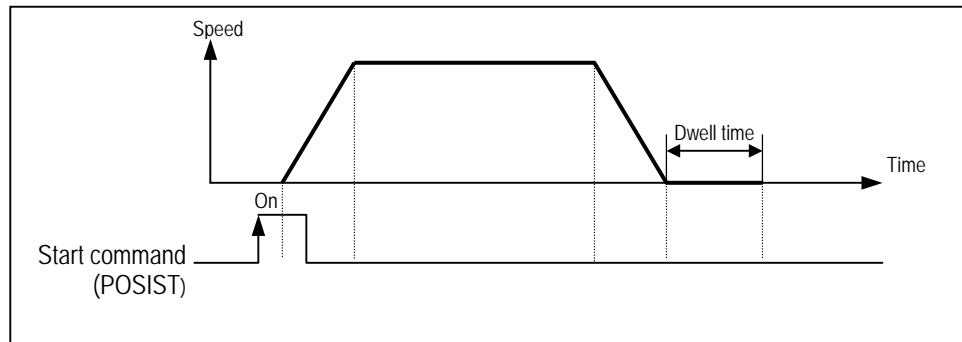
- Step No. can be assigned within 1 ~ 20

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

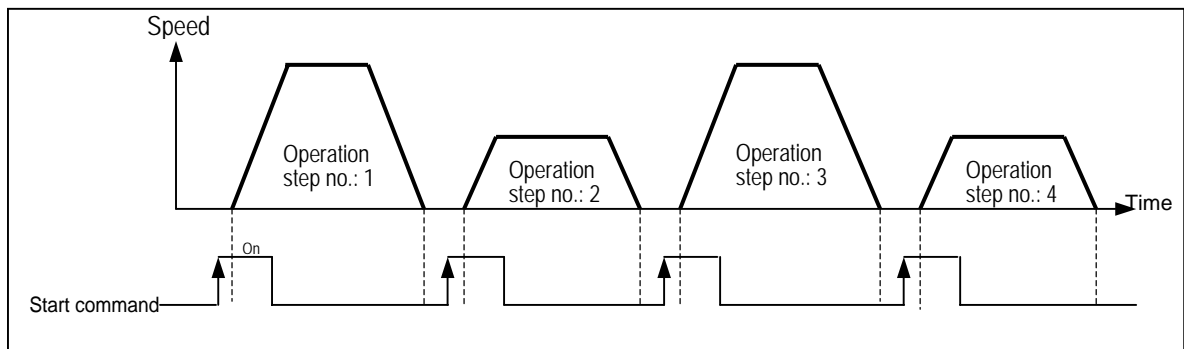
3) Operation Mode

(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



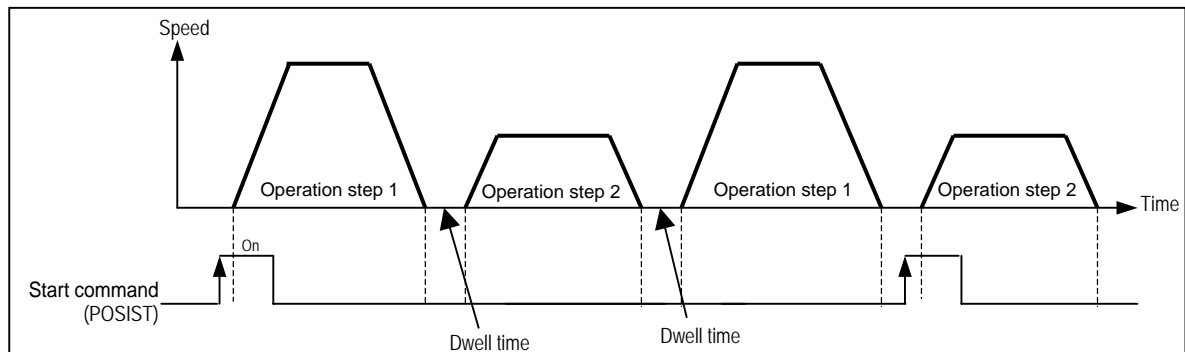
• Parameter setting

No. of program start command	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed (pps)	Dwell time (ms)
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



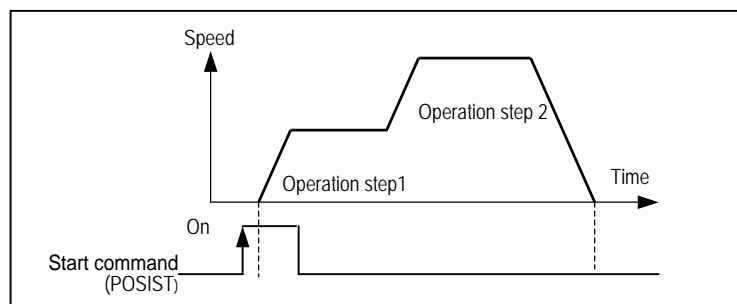
• Parameter setting

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

(3) Continuous Operation

- A) With one time Start 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

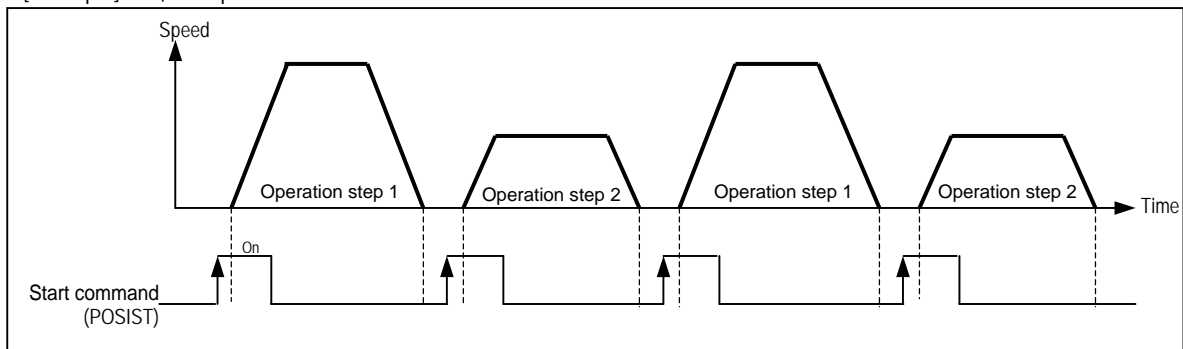
No. of program start command	Step No.	Coordinate	Operation mode	Operation method	Goal address	Speed (pps)	Dwell time (ms)
1	1	Absolute	Continuous	Single	10,000	50,000	10
	2	Absolute	End	Single	20,000	20,000	10

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 (ms)
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 '7.3.4 Instruction' for details.

(2) Indirect start(POSIST)

- This is used to operate by setting the operation step no. by parameter.
- Refer to the '7.3.4 Instruction' 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 '7.3.4 Instruction' 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 '7.3.4 Instruction' 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 '7.3.4 Instruction' 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.

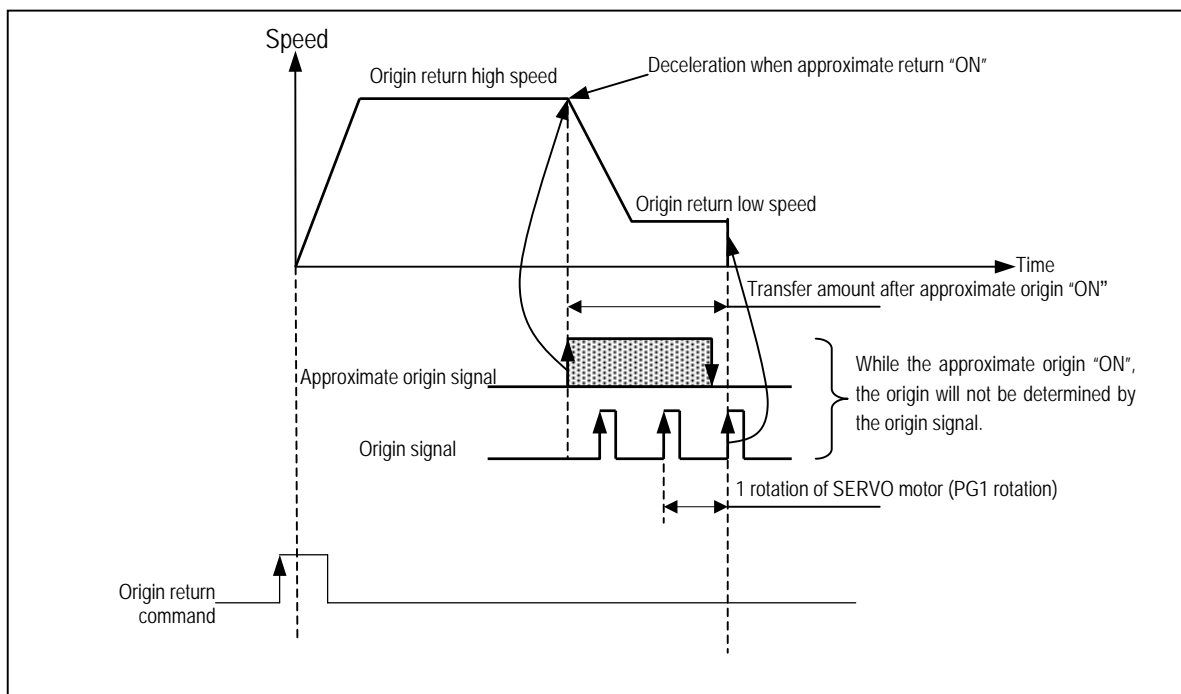
(1) Origin return method

- 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.

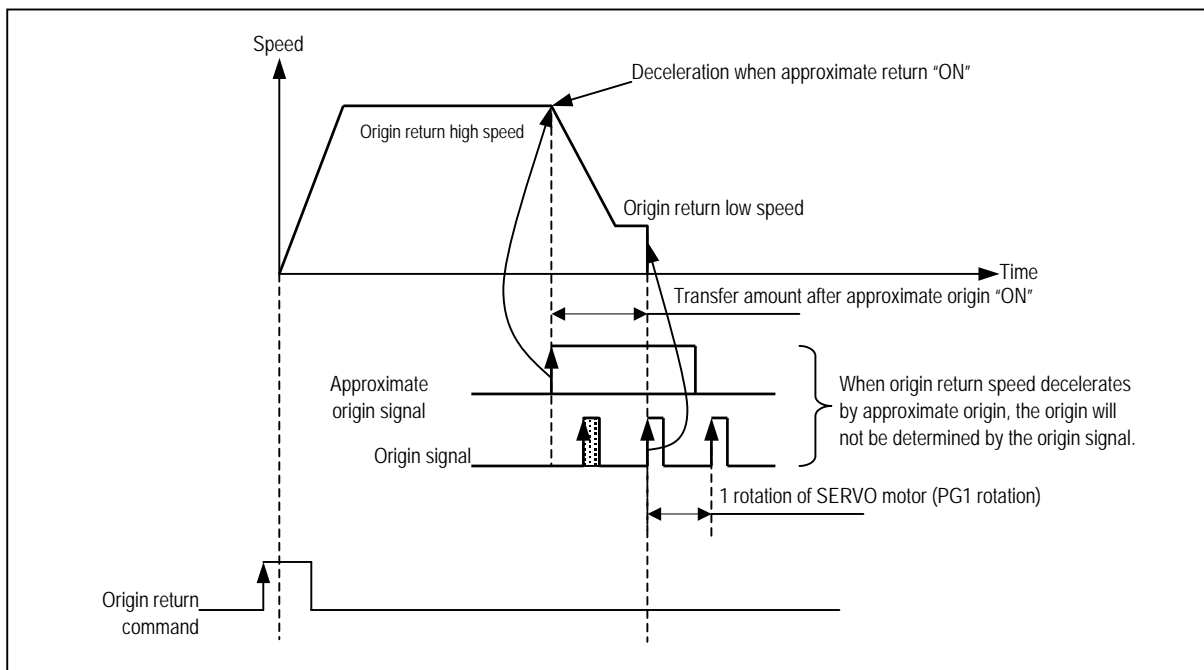
- (A) It accelerates to the setting origin return direction and acts by origin return high speed.
- (B) In this case, if approximate origin as external input is entered, it decelerates and acts by origin return low speed.
- (C) If origin signal as external input is entered after the approximate origin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



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

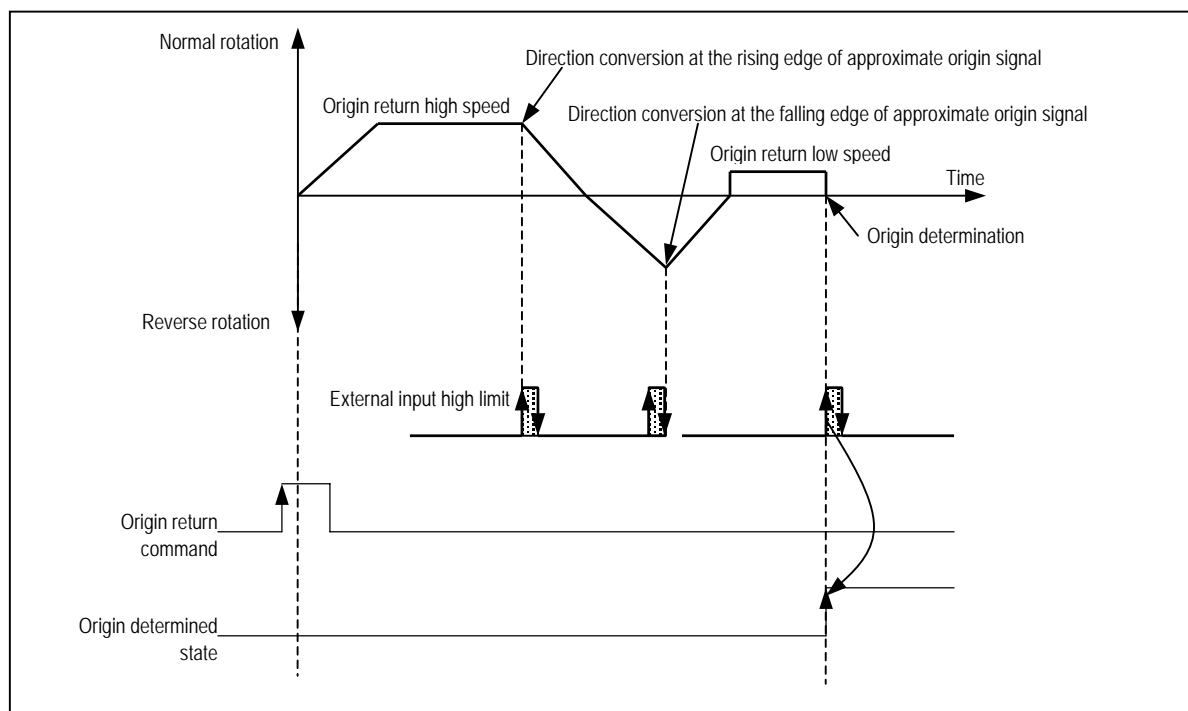
This is the method using the approximate origin and origin signal and the action by origin return command is as follows.

- (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)

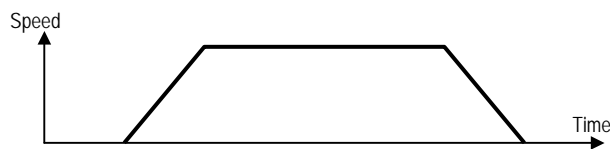
(1) JOG operation

- 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.

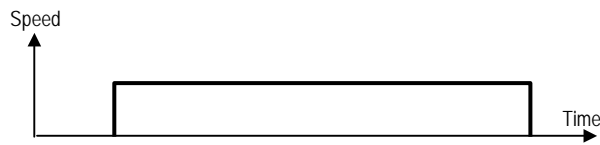
(2) Acceleration/Deceleration Processing and Jog speed

(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 ↑)

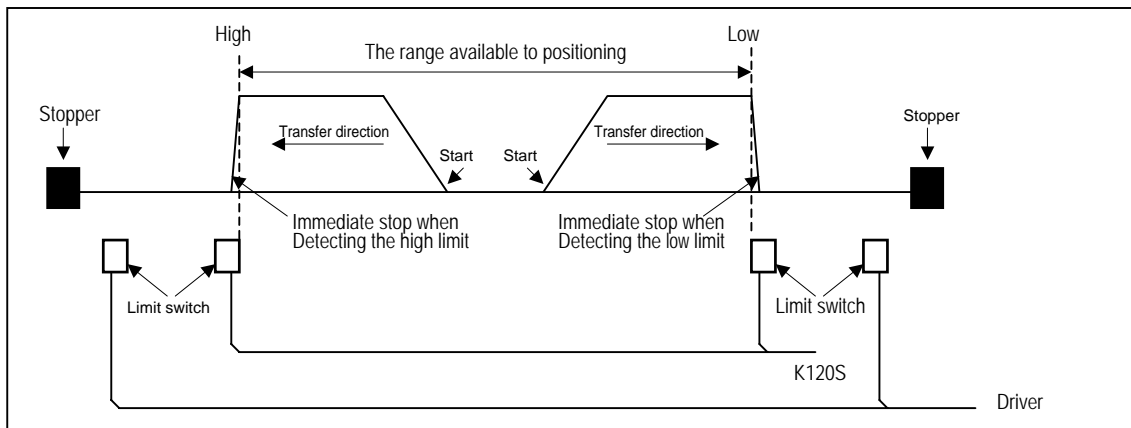
- This is used to change the operation speed from operation data of step no. in operation of each axis
- This command is used only in Acceleration and Constant speed section from operation pattern.
- Setting range is 5 ~ 100,000
- This command can be used in position control and speed control.

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 KGLWIN 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.
 - F284(Ch0) Off : External input stroke Low limit has not detected, On : External input stroke Low limit has detected
 - F285(Ch0) Off : External input stroke High limit has not detected, On : External input stroke High limit has detected
 - F304(Ch1) Off : External input stroke Low limit has not detected, On : External input stroke Low limit has detected
 - F305(Ch1) Off : External input stroke High limit has not detected, On : External input stroke High limit has detected

Point

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 function(After Mode)

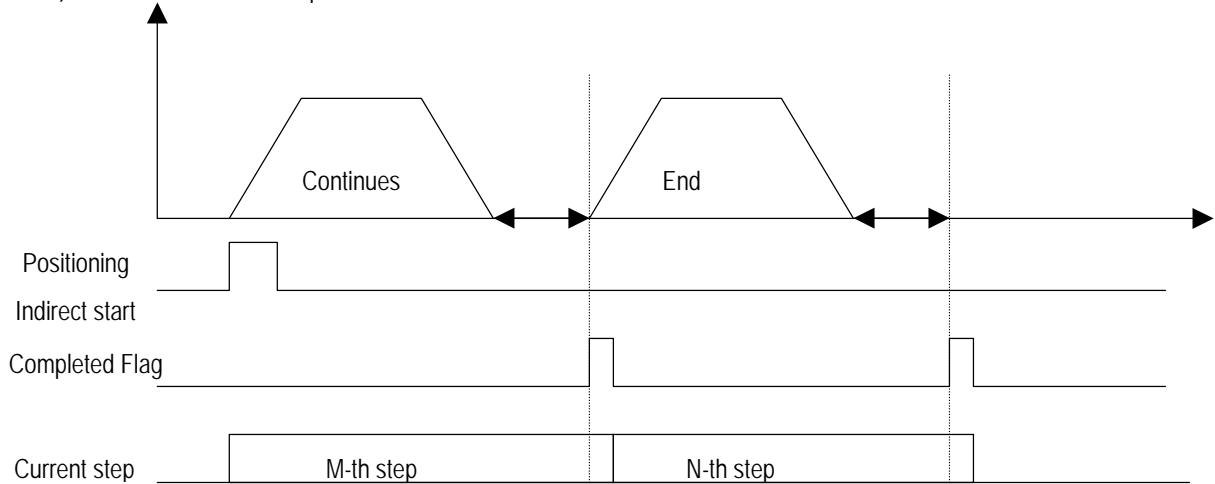
This function made to set "M Code Set" bit, if "M Code Enable" bit was "On" when positioning was completed. And Then "M code Set" bit must reset for run to the next step.

- Used special relay.

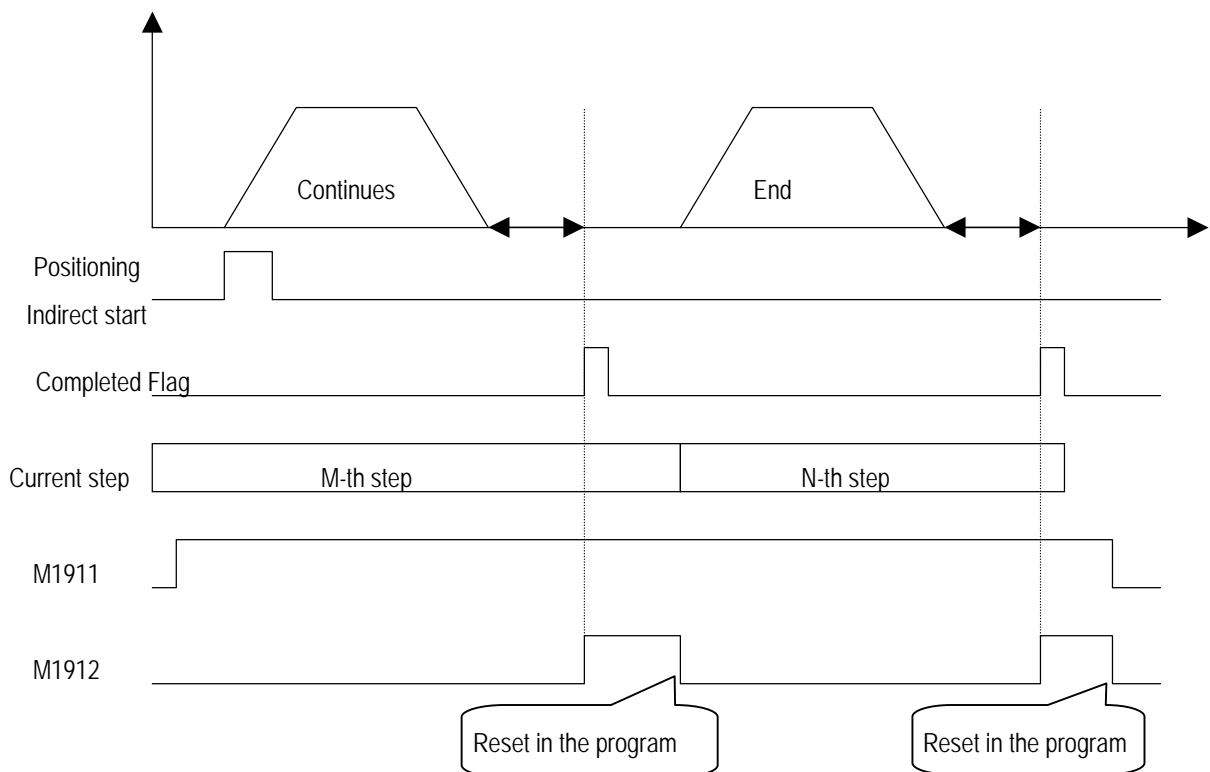
Device	Description	Remark
M1911	M Code Enable Bit(Ch0)	On : Set up "M Code" function
M1912	M Code Set Bit(Ch0)	If positioning complete then "set"
M1913	M Code Enable Bit(Ch1)	On : Set up a "M Code" function
M1914	M Code Set Bit(Ch1)	If positioning complete then "set"

• Timing diagram

1) Unused the M Code Output



2) Use the M Code



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

The screenshot displays two panels, Ch 0 and Ch 1, for parameter setting. A dashed oval on the Ch 0 panel encloses the 'Basic parameter' section, which includes:

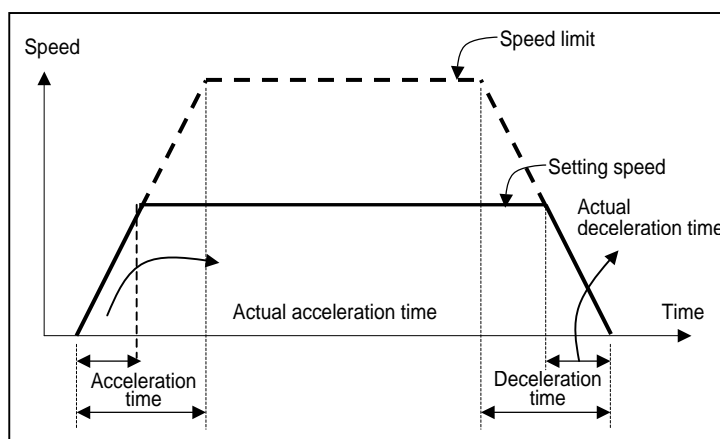
- Accel Time: 500 ms (0-10,000 Or D Area)
- Decel Time: 500 ms (0-10,000 Or D Area)
- Backlash comp: 0 pulse (0-1,000 Or D Area)
- Bias Speed: 5 pps (5-100,000 Or D Area)
- Speed Limit: 100000 pps (5-100,000 Or D Area)

An arrow points from this section to a label 'Basic parameter'.

(1) Basic parameter

(A) Acceleration/Deceleration time

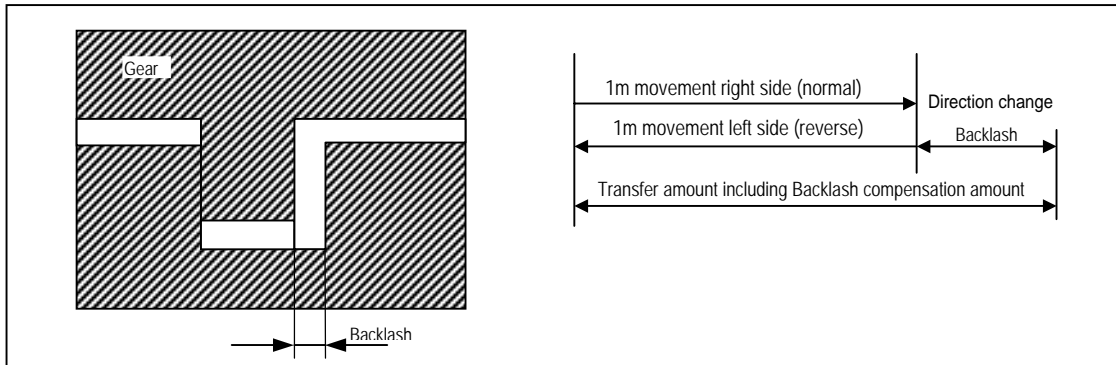
- This is applied at the starting/ending point of positioning operation, return to origin high speed, and JOG high speed operation
- The setting range is 0 ~ 10,000 (unit: 1ms) for each axis.
- When set to zero, operates constant speed.
 - ① Acceleration time : the time required to reach from speed "0"(stop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

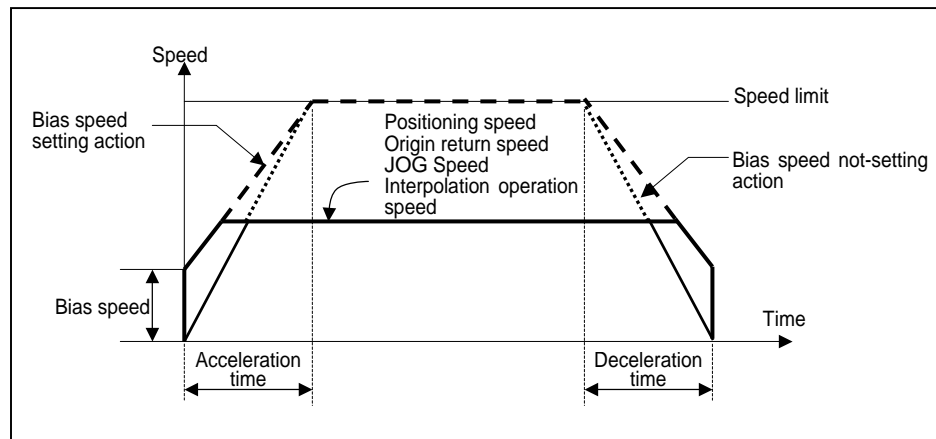
(B) Backlash Compensation Amount

- 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

Origin Return		
Origin Return Method	<input checked="" type="radio"/> DOG/HOME(OFF)	DOG P(005)
	<input type="radio"/> DOG/HOME(ON)	HOME P(004)
	<input type="radio"/> Approximated Contact	
High Speed	<input type="text" value="5000"/>	pps (5-100,000 Or D Area)
Low Speed	<input type="text" value="500"/>	pps (5-100,000 Or D Area)
Dwell Time	<input type="text" value="0"/>	*1 ms (0-10,000 Or D Area)

(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	P0005	P0007
Origin	P0004	P0006

(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 \geq origin return high speed \geq origin return low speed \geq 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 ms)

(3) JOG speed

JOG Speed

High

5000

pps (5-100,000 Or D Area)

Low

1000

pps (5-100,000 Or D Area)

(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

Data List

Step	Cordi	Pattern	Method	REP	Step	Positioning ...	Speed	Dwell
1	ABS	End	SIN	0	0	0	0	0
2	ABS							0
3	ABS							0
4	ABS							0
5	ABS							0
6	ABS							0
7	ABS							0
8	ABS							0
9	ABS							0
10	ABS							0
11	ABS							0
12	ABS							0
13	ABS							0
14	ABS							0
15	ABS							0
16	ABS							0
17	ABS							0
18	ABS							0
19	ABS							0
20	ABS							0

Pulse Output Edit

Coordinates

☒ ABS

☐ INC

Pattern

☒ End

☐ KEEP

☐ CONT

Method

☒ Single

☐ Repeat

Repeat Step : (1 - 20)

Address :

(-2,147,483,648 - 2,147,483,647) (Or D Area)

Speed :

pps (1-100,000 Or D Area)

Dwell :

ms (0-10,000 Or D Area)

OK

Cancel

Cancel

(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

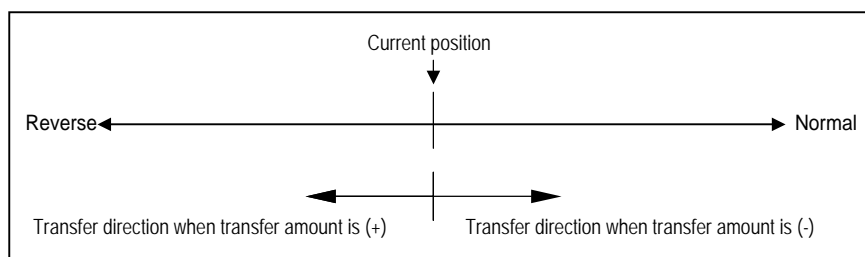
- The coordinate of position data includes **Absolute** and **Incremental**

(A) Absolute Coordinate (Control by Absolute method)

- This carries out the positioning control from the current position to the goal position (the goal position assigned by positioning data).
- Positioning control is carried out based on the assigned position of origin return or POSPRS command (origin address).
- 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)

- This carries out the positioning control as much as goal transfer amount from the current position.
- 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 ms).
- 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)

POSIST	Positioning Indirect Start
--------	----------------------------

Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	5	○		
n	○	○	○	○	○	○	○		○	○	○				

<div> <div>Input condition</div> <div>Positioning Indirect Start Channel</div> <div>Starting Step No.</div> </div> <div> <div></div> <div>POSIST</div> <div>n</div> <div>S</div> </div>															
Flag set								Designation							
Error (F110)		Error flag turns on when designating area is over and the instruction isn't executed						S	Channel which is designated at parameter(0~1)						
								n	Starting step No.(0~20)						
									When designated as 0, starting step is increased automatically						

■ POSIST S n

(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 turns on, Ch.0 starts positioning from Step no.1

M0000	POSIST 00000 00001
-------	--------------------

2) JOG Operation(POSJOG)

POSIST	Positioning Indirect Start
--------	----------------------------

Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	7	○		
n1	○	○	○	○	○	○	○								
n2	○	○	○	○	○	○	○								

Input Condition		JOG Operation	Channel	Direction	Speed
		POSJOG	S	n1	n2
Flag set		Designation			
Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed	S	Ch. for JOG operation(0~1)		
		n1	Direction(0 : Forward, 1: Backward)		
		n2	Speed (0 : Low speed,1: High speed)		

■ POSJOG S n1 n2

(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 M0000 turns on, Ch.1 starts JOG operation by designated direction(M0001) and speed(M0002)
- When input condition turns off, Ch.1 stops JOG operation.

M0000		POSJOG	00001	M0001	M0002

3) Positioning Control Instruction(POSCTR)

POSCTR	Positioning control instruction														
Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	5	○		
n1	○	○	○	○	○	○	○	○	○	○	○				

Input Condition		Positioning Control		Channel	Instruction Designation
		POSCTR		S	n1
Flag set		Designation			
Error (F110)	Error flag turns on when designating area is over	S	Channel designation(0~1)		
		n1	Control instruction designation 0: Deceleration stop. 1:Emergency stop. 2: Error reset		

■ POSCTR S n1

(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 M0000 turns on, Ch.1 stops positioning after deceleration.

M0000	POSCTR 00001 00000
-------	--------------------

4) Current position preset (POSPRS)

POSPRS	Current position preset														
Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	5/7	○		
SV1	○	○	○	○	○	○	○	○	○	○	○				

Input Condition

Position Preset

POSPRS

Channel

S

Preset Value

SV1

Flag set

Error (F110)	Error flag turns on when designating area is over
--------------	---

Designation

S	Channel designation(0~1)
SV1	Preset value designation (-2,147,483,648 ~ 2,147,483,647)

■ POSPRS S SV1

(1) Functions

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

(2) Example program

- When input condition M0000 turns on, Address of Ch.0 is changed to 100,000.

M0000


POSPRS

00000

0000100000

6) Speed control operation (POSVEL)

POSVEL	Speed control operation														
Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	7/9	○		
n1	○	○	○	○	○	○	○	○							
SV	○	○	○	○	○	○	○		○	○	○				

Input Condition		Speed Control	Channel	Direction	Speed
		POSVEL	S	n1	SV
Flag set		Designation			
Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed	S	Ch. for speed control(0~1)		
		n1	Operation direction(0:Forward, 1:Reverse)		
		SV	Speed (5 ~ 100,000pps)		

■ POSVEL S n1 SV

(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(M0000) turns on, Ch. 0 starts speed control by designated direction(M0001) and 10kpps.
- Speed can be changed by POSSOR instruction.
- Operation stops after deceleration by POSCTR instruction.

M0000	POSVEL 00000	M0001	0000010000
-------	--------------	-------	------------

7) Speed override (POSSOR)

POSSOR	Speed override instruction
--------	----------------------------

Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	5/7	○		
SV	○	○	○	○	○	○	○		○	○	○				

<div> <div>Input Condition</div> <div>Speed Override</div> <div>Channel</div> <div>Speed</div> </div> <div>POSSOR S SV</div>															
Flag set								Designation							
Error (F110)		Error flag turns on when designating area is over and the instruction isn't executed						S		Ch. for speed override(0~1)					
								SV		Speed (5 ~ 100,000pps)					

■ POSSOR S SV

(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(M0000) turns on, Operation speed of Ch. 0 is changed to 10kpps.

<div> <div>M0000</div> <div>POSSOR 00000 0000010000</div> </div>															
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

8) Positioning direct start(POSDST)

POSDST	Positioning direct start
--------	--------------------------

Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	9/11/13	○		
n1	○	○	○	○	○	○	○	○							
SV1	○	○	○	○	○	○	○		○	○	○				
SV2	○	○	○	○	○	○	○		○	○	○				

Input Condition	Positioning Direct Start	Channel	Coordinate	Address	Speed
	POSDST	S	n1	SV1	SV2

Flag set		Designation	
Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed	S	Ch. for positioning direct start(0~1)
		n1	Absolute/Incremental coordinate designation (0:Absolute, 1:Incremental)
		SV1	Positioning address (-2,147,483,648 ~ 2,147,483,647)
		SV2	Positioning speed (0 ~ 100,000pps)

■ POSDST S n1 SV1 SV2

(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(M0000) turns on, Ch. 0 outputs 100,000 pulses by designated coordinate(M0001), forward direction and speed of 10kpps.
- Acceleration/deceleration time is applied by corresponding parameter

M0000	POSDST 00000	M0001	0000100000	0000010000
-------	--------------	-------	------------	------------

9) Return to origin(POSORG)

POSORG	Return to origin
--------	------------------

Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
S											○	7	○		
n1	○														
SV	○														

Input Condition 	Return to Origin POSORG	Channel S	Direction n1	Address SV								
플래그 Set <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Error (F110)</td> <td>Error flag turns on when designating area is over and the instruction isn't executed</td> </tr> </table>		Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed	영역설정 <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">S</td> <td>Ch. for origin return(0~1)</td> </tr> <tr> <td>n1</td> <td>Operation direction(0:Forward, 1:Reverse)</td> </tr> <tr> <td>SV</td> <td>Address (5 ~ 100,000pps)</td> </tr> </table>			S	Ch. for origin return(0~1)	n1	Operation direction(0:Forward, 1:Reverse)	SV	Address (5 ~ 100,000pps)
Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed											
S	Ch. for origin return(0~1)											
n1	Operation direction(0:Forward, 1:Reverse)											
SV	Address (5 ~ 100,000pps)											

■ POSORG S n1 SV

(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(M0000) turns on, Ch. 0 operates return to origin function by designated direction and address
- After return to origin operation, position address become the value in D0002 and D0003.



7.3.5 Flag list and Error codes

1) Flag list

Device	Function	Description
F0280	Operating flag	Operation status of Ch0 (0: stop, 1:Busy)
F0281	Error status	Error status of Ch0 (0: normal, 1: error)
F0282	End of positioning	Indicates end of operation for Ch0 (0: operating, 1: End) *1Scan On
F0283	End of Origin return	Indicates end of origin return operation of Ch0(0:operating, 1: End)
F0284	Low limit detection	Indicates stroke low limit detection of Ch0
F0285	High limit detection	Indicates stroke high limit detection of Ch0
F0286	Emergency stop status	Indicates emergency stop status Ch0 (0: enable, 1: Disable)
F0287	Output prohibition	Output prohibition of Ch0 (0: enable, 1: disable)
F0288	Direction	Operation direction of Ch0 (0: Forward, 1: Backward)
F0289	Acceleration	Accelerating Ch0
F028A	Constant speed	Constant speed operation of Ch0
F028B	Deceleration	Decelerating Ch0
F028C	Dwelling	Dwelling Ch0
F0290	Position control	Position control operation of Ch0
F0291	Speed control	Speed control operation of Ch0
F0292	Return to origin	Return to origin operation of Ch0
F0293	JOG low speed	JOG low speed operation of Ch0
F0294	JOG high speed	JOG high speed operation of Ch0
F0295	PWM operation	PWM output operation of Ch0
F0300	Operating flag	Operation status of Ch1 (0: stop, 1:Busy)
F0301	Error status	Error status of Ch1 (0: normal, 1: error)
F0302	End of positioning	Indicates end of operation for Ch1 (0: operating, 1: End) *1Scan On
F0303	End of Origin return	Indicates end of origin return operation of Ch1(0:operating, 1: End)
F0304	Low limit detection	Indicates stroke low limit detection of Ch1
F0305	High limit detection	Indicates stroke high limit detection of Ch1
F0306	Emergency stop status	Indicates emergency stop status Ch1(0: enable, 1: Disable)
F0307	Output prohibition	Output prohibition of Ch1(0: enable, 1: disable)
F0308	Direction	Operation direction of Ch1(0: Forward, 1: Backward)
F0309	Acceleration	Accelerating Ch1
F030A	Constant speed	Constant speed operation of Ch1
F030B	Deceleration	Decelerating Ch1
F030C	Dwelling	Dwelling Ch1

Device	Function	Description
F0310	Position control	Position control operation of Ch1
F0311	Speed control	Speed control operation of Ch1
F0312	Return to origin	Return to origin operation of Ch1
F0313	JOG low speed	JOG low speed operation of Ch1
F0314	JOG high speed	JOG high speed operation of Ch1
F0315	PWM operation	PWM output operation of Ch1
F0320~ F032F	Current Step No.	Current step No. of Ch0
F0330~ F033F	Error code	Error code of Ch0
F0340~ F035F	Current address	Current position address of Ch0
F0360~ F037F	Current speed	Current speed of Ch0
F0400~ F040F	Current Step No.	Current step No. of Ch0
F0410~ F041F	Error code	Error code of Ch0
F0420~ F043F	Current address	Current position address of Ch0
F0440~ F045F	Current speed	Current speed of Ch0
M1911	M Code Enable Bit(Ch0)	On : Set up "M Code" function
M1912	M Code Set Bit(Ch0)	If positioning complete then "set"
M1913	M Code Enable Bit(Ch1)	On : Set up a "M Code" function
M1914	M Code Set Bit(Ch1)	If positioning complete then "set"

2) Error code

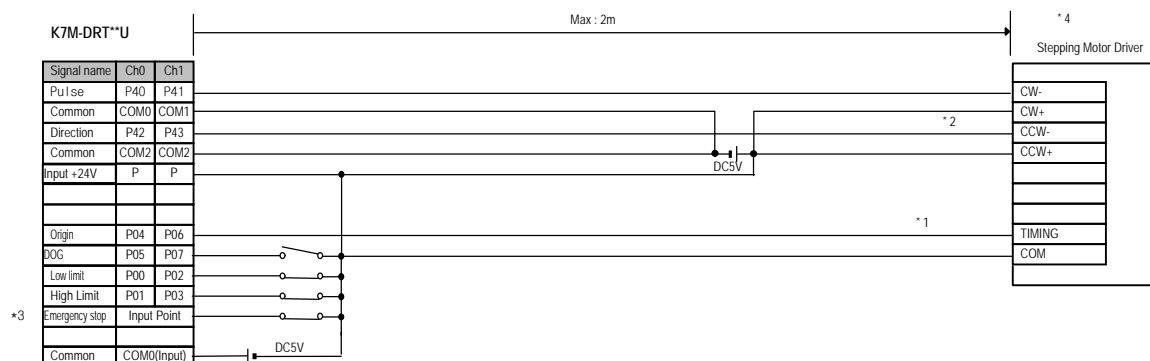
Error code	Condition	Operation	Corrective action
H10	Acceleration time of basic parameter is out of range	Stop	Set Acceleration time within 0~10,000 range
H11	Deceleration time of basic parameter is out of range	Stop	Set Deceleration time within 0~10,000 range
H12	Speed limit of basic parameter is out 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.
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

Chapter 7 Usage of Various Functions

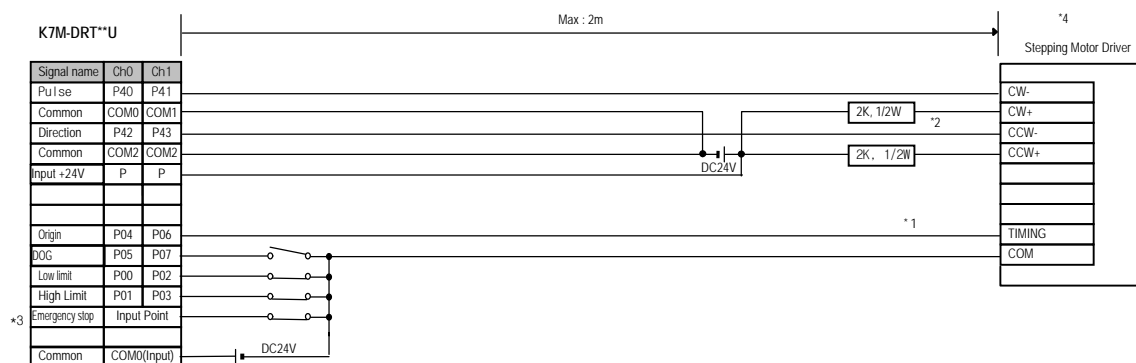
Error code	Condition	Operation	Corrective action
H44	POSSOR command can't be executed during decelerating	Operating	Check if positioning is in the decelerating section when POSSOR signal occur.
H45	POSORG command can't be executed during operation	Operating	Check if positioning operation is executing 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 driver (Open Collector)

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

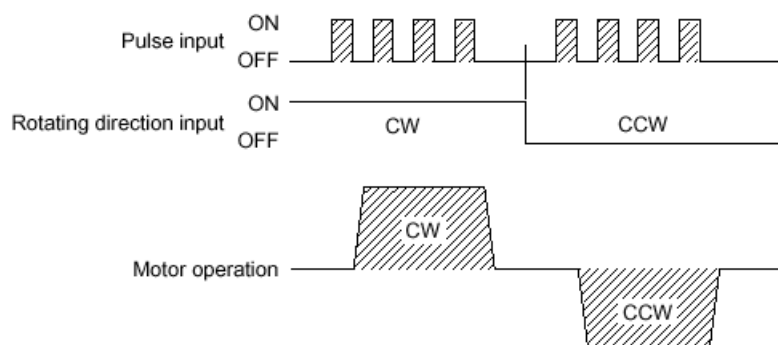


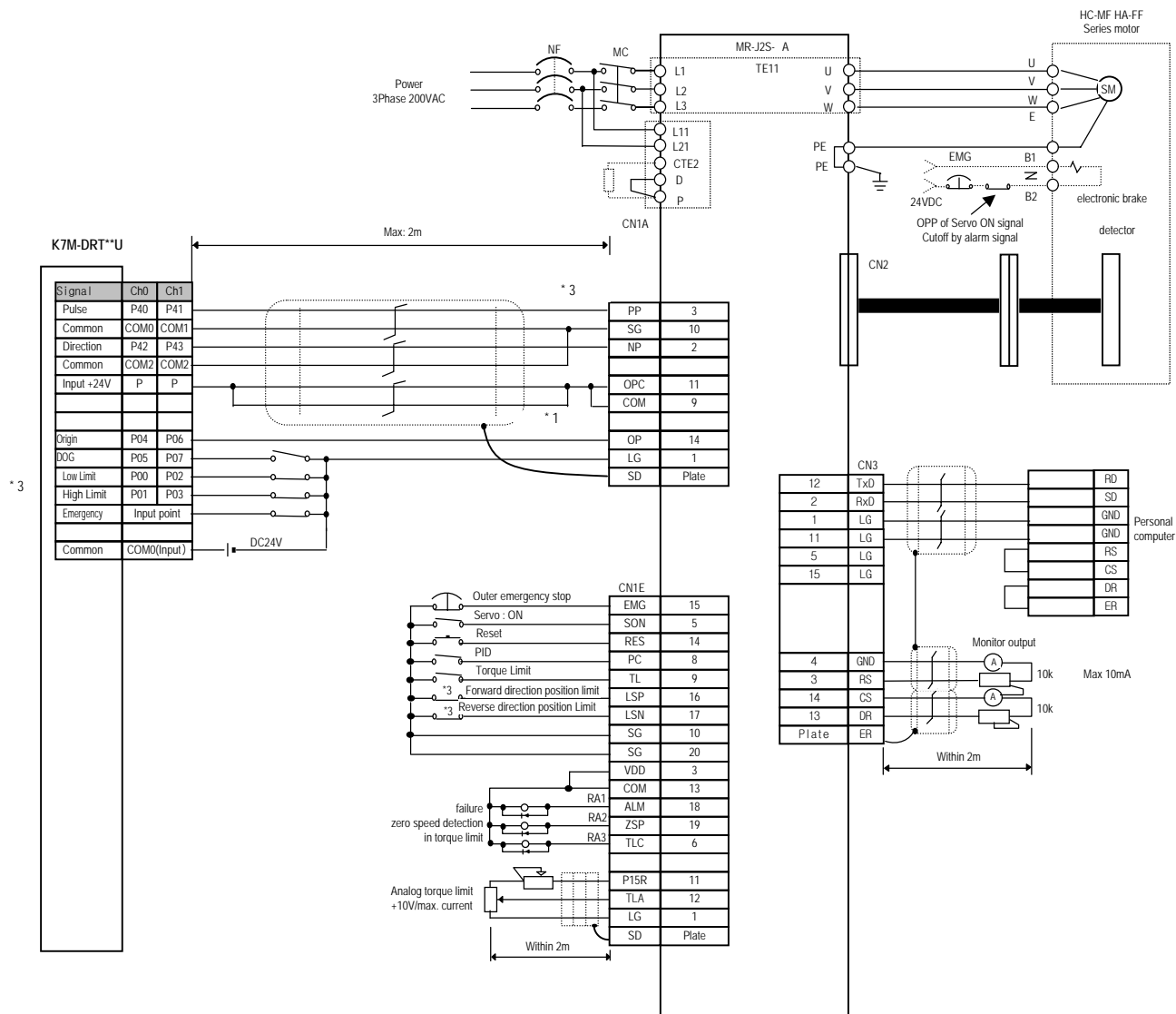
2) Wiring with stepping motor driver (DC 24V)



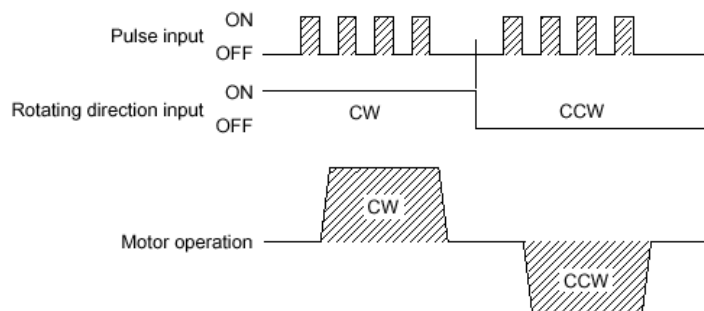
Remark

- 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 K120S 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 K120S 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.

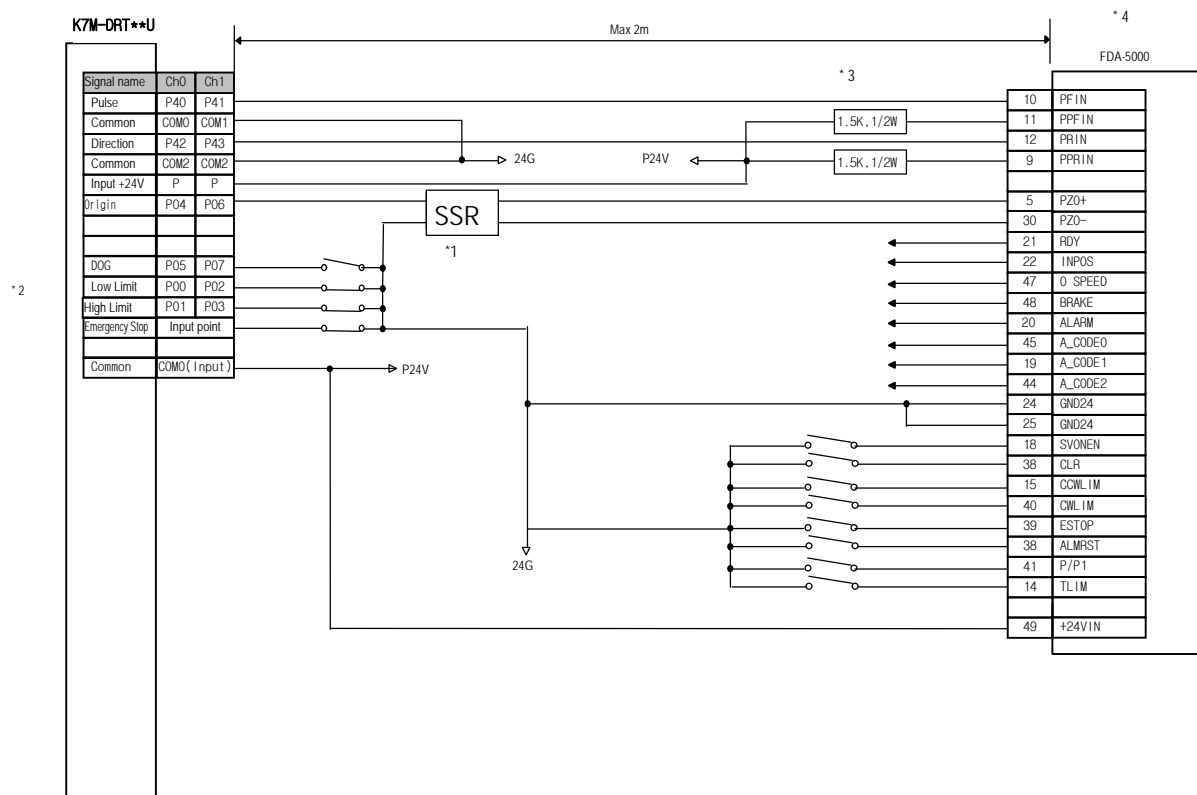




- 1) The rated input for the origin of K120S is DC 24V.
- 2) Input points for origin, approximate origin point, and upper/lower limit signal are fixed but, if they're not used you are able to use them general input point. You can use emergency stop with the command(POSCTR)
- 3) Positioning phase of K120S is as follow: Set the input mode of a step mode driver to 1 phase input mode is determined by rotating direction input.

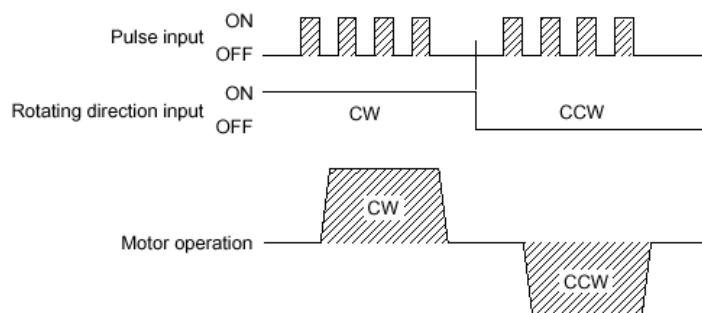


4) Wiring with Servo motor driver(FDA-5000 AC Servo Driver)



Remark

- 1) The rated input for the origin of K120S is DC 24V. Linedriver 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 K120S 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

MASTER-K120S's built-in Cnet communication uses only MASTER-K120S main unit for a dedicated communication. 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.

MASTER-K120S 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 MASTER-K's) system configuration (MASTER-K120S main unit : RS-232C)

Remark

MASTER-K120S built-in communication function supports Cnet communication without any separate Cnet I/F module. It must be used under the following instructions.

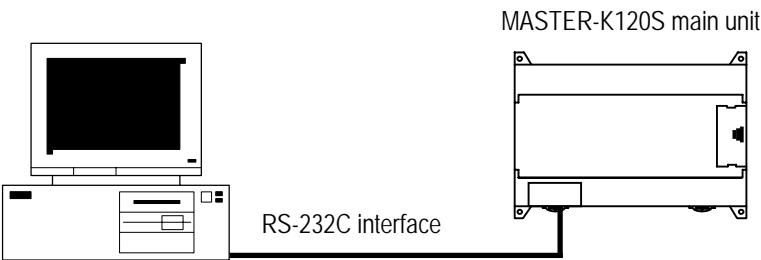
- 1) Channel 0 of MASTER-K120S main unit supports 1:1 communication only. For 1:N system having master-slave Format, use RS-485 communication in channel 1 or MASTER-K120S main unit with G7L-CUEC module connected. G7L-CUEC module supports RS-422/485 protocol.
- 2) RS-232C communication cable for MASTER-K120S main unit is different from RS-232C cable for KGLWIN 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.
It's possible to set baud rate type and station No. in KGLWIN.

8.1.2 System configuration method

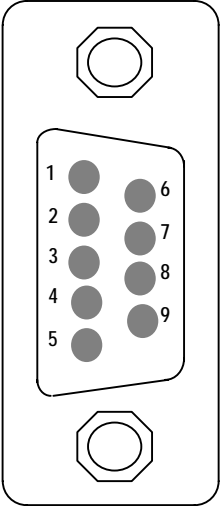
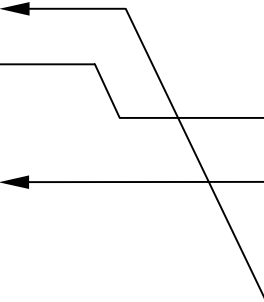
According to the method of connection, the system using MASTER-K120S built-in communication can be composed.

1) Connecting system configuration (link between MASTER-K's)

- (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.

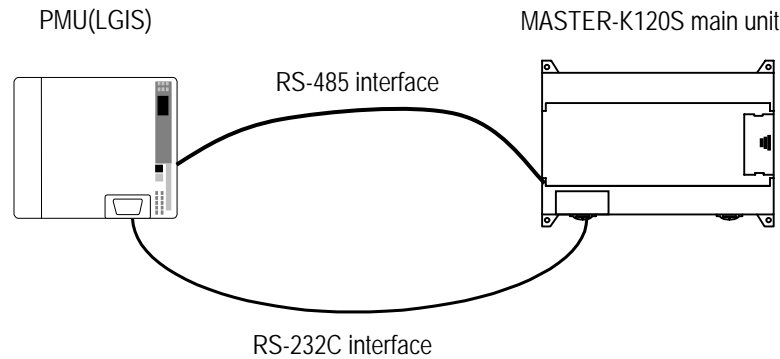


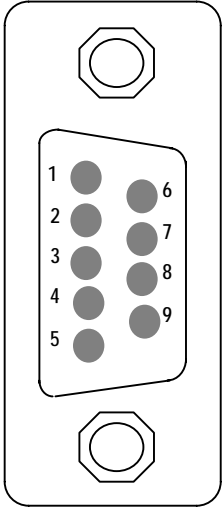
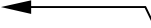
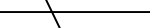
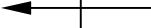


b) Wiring method

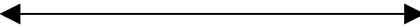
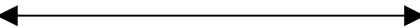
 Female Type	PC	Pin assignment And direction	MASTER-K120S main unit	
	Pin No.		Pin No.	Signal
	1		1	5V
	2		2	RXD1
	3		3	TXD1
	4		4	RXD2
	5		5	SG
	6		6	5V
	7		7	TXD2
	8		8	SG
	9		9	SG

TXD1, RXD1 are for loader communication and TXD2, RXD2 are for Cnet

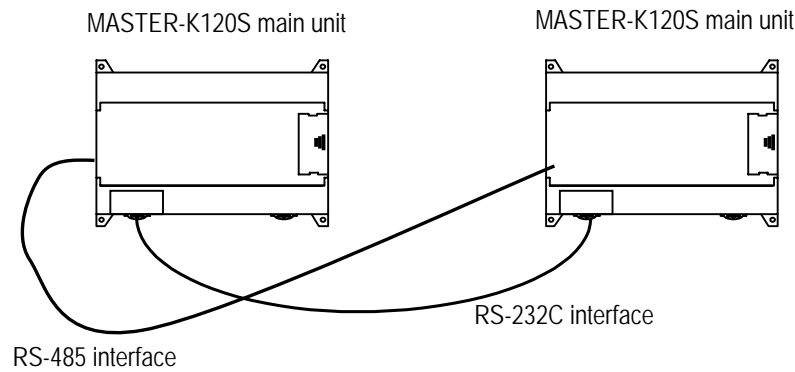
(2) 1:1 connection with a monitoring device like PMU

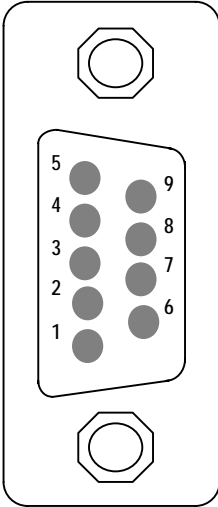
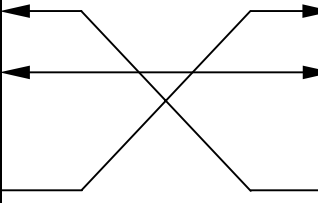


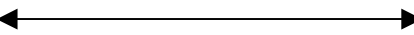
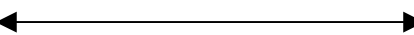
 Female Type	PMU	Pin assignment and direction	MASTER-K120S main unit	
	Pin No.		Pin no.	Signal
	1		1	5V
	2		2	RXD1
	3		3	TXD1
	4		4	RXD2
	5		5	SG
	6		6	5V
	7		7	TXD2
	8		8	SG
	9		9	SG

PMU	Connection method and signal direction	MASTER-K120S main unit
485+		485+
485-		485-

(3) 1:1 connection with other MASTER-K120S



 Male Type	MASTER-K120S main unit	Pin assignment and direction	MASTER-K120S main unit	
	Pin no.		Pin no.	Signal
	1		1	5V
	2		2	RXD1
	3		3	TXD1
	4		4	RXD2
	5		5	SG
	6		6	5V
	7		7	TXD2
	8		8	SG
	9		9	SG

MASTER-K120S main unit	Connection method and signal direction	MASTER-K120S main unit
485+		485+
485-		485-

8.1.3 Frame Structure

1) Base Format

- (1) Request frame(external communication device → MASTER-K120S main unit), (Max. 256 Bytes)

Header (ENQ)	Station number	Command	Command type	Structurized data area	Tail (EOT)	Frame check (BCC)
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- (2) ACK Response frame (MASTER-K120S main unit → external communication device, when receiving data normally)
(max. 256 Bytes)

Header (ACK)	Station number	Command	Command type	Structurized data area or null code	Tail (ETX)	Frame check (BCC)
-----------------	-------------------	---------	-----------------	-------------------------------------	---------------	----------------------

- (3) NAK Response frame (MASTER-K120S main unit → external communication device,
when receiving data abnormally) (max. 256 Bytes)

Header (NAK)	Station number	Command	Command type	Error code (ASCII 4 Byte)	Tail (ETX)	Frame check (BCC)
-----------------	-------------------	---------	--------------	---------------------------	---------------	----------------------

Remark			
1) Used control codes are as follows. Be familiar with the following control codes. Because they are importantly used 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

Remark

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

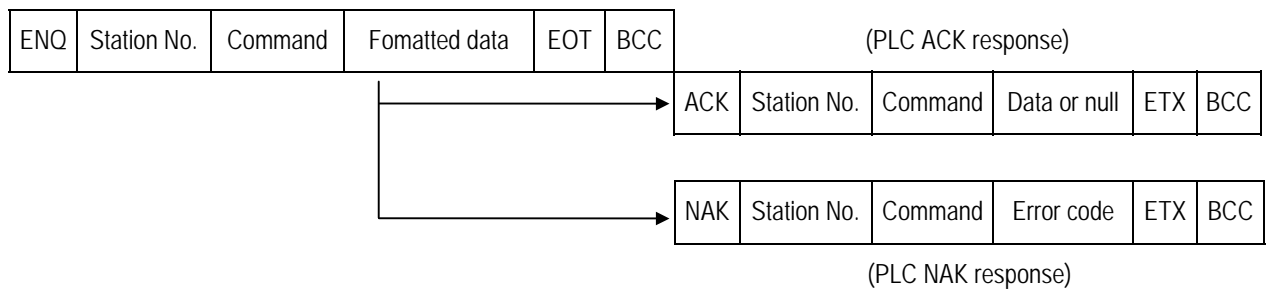
The terms in hexadecimal are as follows.

- 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

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

2) Sequence of command frame

(1) Sequence of command request frame



8.1.4 List of commands

Classification Items		Command				Treatment
		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.

Classification Item	Command				Treatment
	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

MASTER-K120S 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 variable

- Available types of device

Device Name	Explanation	Read/Write	Bit/Byte/Word Assignment
P	Input/Output relay	Available	All
M	Auxiliary relay	Available	All
L	Link relay	Available	All
K	Keep relay	Available	All
C	Counter	Available	All(Current value when Word)
T	Timer	Available	All(Current value when Word)
D	Data Register	Available	Byte, Word
S	Step relay	Available	Byte, Word
F	Special relay	Read Only	All

- When variable is used, attach '%' (25H) in front of the marking characters.

Data type	Marking characters	Examples
Bit	X(58H)	%PX000, %MX000, %LX000, %KX000, %CX000, %TX000, %FX000
Byte	B(42H)	%PB000, %MB000, %LB000, %KB000, %CB000, %TB000, %FB000
Word	W(57H)	%PW000, %MW000, %LW000, %KW000, %CW000, %TW000, %FW000, %DW000, %SW000

Remark

- 1) Timer/Counter used in bit command means contact point values.(word command means current values.)
- 2) Data register and Step relay can uses only word or byte commands.
- 3) In byte type commands, address is doubled
For example, D1234 is addressed to '%D1234' in word type, and is addressed to '%2468' in byte type.

8.1.6 Execution of commands

1) Individual reading of device(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
Ex. of frame	ENQ	H20	R(r)	SS	H01	H06	%MW100		EOT	BCC
ASCII value	H05	H3230	H52(72)	H5353	H3031	H3036	H254D57313030		H04	

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

Item	Explanation
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. For example, the BCC of the above frame is gotten as below: H05+H32+H30+H72+H53+H53+H30+H31+H30+H36+H25+H4D+H57+H31+H30+H30+H04 =H03A4 Therefore BCC value is A4.
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 (Length of device name)	This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01(ASCII value:3031) to H10(ASCII value:3130). For example, if the device name is %MW0, it has 4 characters to be H04 as its length. If %MW000 characters to be H06.
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.

Remark

'H' of example frame represents hex value, and is unnecessary during preparing real frame.

(3) Response format (ACK response)

Format name	Header	Station No.	Command	Command type	Number of blocks	Number of data	data	Tail	Frame check
Ex. of 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	Explanation												
BCC	When 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 added to BCC, and sent.												
Number of data	<p>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) included in device name of computer request Format.</p> <ul style="list-style-type: none">Number of data in accordance with its data type is as follows: <table><tr><th>Data type</th><th>Available variable</th><th>Number of data</th></tr><tr><td>Bitl(X)</td><td>%(P,M,L,K,T,C,F)X</td><td>1</td></tr><tr><td>Byte(B)</td><td>%(P,M,L,K,T,C,D,S,F)B</td><td>1</td></tr><tr><td>Word(W)</td><td>%(P,M,L,K,T,C,D,S,F)W</td><td>2</td></tr></table>	Data type	Available variable	Number of data	Bitl(X)	%(P,M,L,K,T,C,F)X	1	Byte(B)	%(P,M,L,K,T,C,D,S,F)B	1	Word(W)	%(P,M,L,K,T,C,D,S,F)W	2
Data type	Available variable	Number of data											
Bitl(X)	%(P,M,L,K,T,C,F)X	1											
Byte(B)	%(P,M,L,K,T,C,D,S,F)B	1											
Word(W)	%(P,M,L,K,T,C,D,S,F)W	2											
Data	In data area, there are the values of hex data converted to ASCII code saved.												

Ex.1

The fact that 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.

Ex.2

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

- 1) If data type is Bit, data read is indicated by bytes of hex. Namely, if Bit value is 0, it indicated by H00, and if 1, by H01.

(4) Response format (NAK response)

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

Item	Explanation
BCC	When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC.
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 when 1 WORD from M20 and 1 WORD from P001 address of station No.1 are read and BCC value is checked. Also it is supposed that H1234 is entered in M20, and data of H5678 is entered in P001.

① Computer request format (PC → MASTER-K120S main Unit)

Format name	Header	Station No.	Command	Command type	Number of blocks	Variable length	Format name	Device length	Format name	Tail	Frame check
Ex. of frame	ENQ	H01	r	SS	H02	H05	%MW20	H06	%PW001	EOT	BCC
ASCII value	H05	H3031	H72	H5353	H3032	H3035	H254D57 3230	H3036	H25505730 3031	H04	

② For ACK response after execution of command(PC ← MASTER-K120S main Unit)

Format name	Header	Station No.	Command	Command type	Number of blocks	Number of data	Data	Number of data	Data	Tail	Frame check
Ex. of frame	ACK	H01	r	SS	H02	H02	H1234	H02	H5678	ETX	BCC
ASCII value	H06	H3031	H72	H5353	H3032	H3032	H31323334	H3032	H35363738	H03	

- ③ For NAK response after execution of command(PC ← MASTER-K120S main Unit)

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

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
Ex. of frame	ENQ	H10	R(r)	SB	H06	%MW100	H05	EOT	BCC
ASCII value	H05	H3130	H52(72)	H5342	H3036	H254D57313030	H3035	H04	

Remark

- 1) Number of data specifies the number to read according to the type of data. Namely, if the data type of device is word and number is 5, it means that 5 words should be read.
- 2) Max. of %MW in number of data can be used up to 120(240bytes).
- 3) Protocol of RSB doesn't have number of blocks.
- 4) R(r)SB command of bit devices is not available.

Item	Explanation
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.
Device length (Length of device name)	This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01(ASCII value:3031) to H10(ASCII value:3130).
Device name	Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lowercase, and '%' only are allowable to be entered.

(3) MASTER-K120S Main unit response format (MASTER-K120S of ACK response)

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

Item	Explanation						
BCC	When 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 added to BCC, and sent.						
Number of data	<div>It means byte number of hex type, and is converted into ASCII. This number is determined by multiplying the data number of computer request Format by the data size(in below table) according to memory type(B,W,D) included in variable name of computer request Format.</div> <table><tr><th>Data type</th><th>Available device</th><th>Data size</th></tr><tr><td>WORD(W)</td><td>%(P,M,L,K,F,T,C,D,S)W</td><td>2</td></tr></table>	Data type	Available device	Data size	WORD(W)	%(P,M,L,K,F,T,C,D,S)W	2
Data type	Available device	Data size					
WORD(W)	%(P,M,L,K,F,T,C,D,S)W	2					
Data	.In data area, there are the values of hex data converted to ASCII code saved.						

Ex.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.

Ex.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.

(4) Response format (NAK response)

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

Item	Explanation
BCC	When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and 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 2 WORDs from M000 of station No. 10 is read and BCC value is checked. Also it is supposed that data in M000 and in M001 is as follow:

{

 M000 = H1234
 M001 = H5678

① Computer request format (PC → MASTER-K120S Main Unit)

Format name	Header	Station No.	Command	Command type	Device length	Device name	Number of data	Tail	Frame check
Frame (Example)	ENQ	H0A	r	SB	H06	%MW000	H02	EOT	BCC
ASCII value	H05	H3041	H72	H5342	H3036	H254D5730 3030	H3032	H04	

② For ACK response after execution of command(PC ← MASTER-K120S Main Unit)

Format name	Header	Station No.	Command	Command type	Number of data	Data	Tail	Frame check
Frame (Example)	ACK	H0A	r	SB	H04	12345678	ETX	BCC
ASCII value	H06	H3041	H72	H5342	H3034	H3132333435363738	03	

③ For NAK response after execution of command(PC ← MASTER-K120S Main Unit)

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

3) Individual writing of device(W(w)SS)

(1) Introduction

This is a function that writes the PLC device memory directly specified in accord with 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 (Example)	ENQ	H20	W(w)	SS	H01	H06	%MW100	H00E2		EOT	BCC
ASCII value	H05	H3230	H57(77)	H5353	H3031	H3036	H254D5731 3030	H30304 532		H04	

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

Item	Explanation
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.
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(Name length of device)	This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01(ASCII value:3031) to H10(ASCII value:3130).
device	Address to be actually read is entered. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, and '%' only are allowable to be entered.
Data	If the value to be written in %MW100 area is H A, the data Format must be H000A. If the value to be written in %MW100 area is H A, the data Format must be H000A. In data area, the ASCII value converted from hex data is entered.

Ex.1

If type of data to be currently written is WORD, the data is H1234, ASCII code converted value of this is "31323334" and this content must be entered in data area. Namely, most significant value must be sent first, least significant value last.

Remark

- 1) Device data types of each block must be the same.
- 2) If data type is Bit, the data to be written is indicated by bytes of hex. Namely, if Bit value is 0, it must be indicated by H00(3030), and if 1, by H01(3031).

(3) Response format (ACK response)

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

Item	Explanation
BCC	When 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 added to BCC, and sent.

(4) Response format (NAK response)

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

Item	Explanation
BCC	When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and 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 "HFF" is written in M230 of station No. 1 and BCC value is checked.

① Computer request format (PC → MASTER-K120S main unit)

Format name	Header	Station No.	Command	Command type	Number of blocks	Device Length	Device Name	Data	Tail	Frame check
Frame (Example)	ENQ	H01	w	SS	H01	H06	%MW230	H00FF	EOT	BCC
ASCII value	H05	H3031	H77	H5353	H3031	H3036	H254D5732 3330	H30304646	H04	

② For ACK response after execution of command(PC ← MASTER-K120S main unit)

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

③ For NAK response after execution of command(PC ← MASTER-K120S main Unit)

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

4) Continuous writing of device(W(w)SB)

(1) Introduction

This is a function that directly specifies PLC device memory and continuously writes data from specified address as much as specified length.

(2) Request format

Format name	Header	Station No.	Command	Command type	Device Length	Device	Number of data (Max.128 Byte)	Data	Tail	Frame check
Frame (Example)	ENQ	H10	W(w)	SB	H06	%MW100	H02	H11112222	EOT	BCC
ASCII value	H05	H3130	H57(77)	H5342	H3036	H254D57 313030	H3032	H31313131 32323232	H04	

Remark

- 1) Number of data specifies the number according to the type of device. Namely, if the data type of device is WORD, and number of data is 5, it means that 5 WORDs should be written.
- 2) Number of data can be used up to 240Bytes(120 Words).

Item	Explanation
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.
Device length(Name length of variable)	This indicates the number of name's characters that means device, which is allowable up to 16 characters. This value is one of ASCII converted from hex type, and the range is from H01(ASCII value:3031) to H10(ASCII value:3130).
device	Address to be actually read. This must be ASCII value within 16 characters, and in this name, digits, upper/lower case, and '%' only are allowable to be entered.

(3) Response Format (ACK response)

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

Item	Explanation
BCC	When 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 added to BCC, and sent.

(4) Response Format (NAK response)

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

Item	Explanation
BCC	When command is lowercase(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and 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 2 byte H'AA15 is written in D000 of station No. 1 and BCC value is checked.

① Computer request Format (PC → MASTER-K120S main unit)

Format name	Header	Station No.	Command	Command type	Device Length	Device	Number of data	Data	Tail	Frame check
Frame (Example)	ENQ	H01	w	SB	H06	%DW0000	H01	HAA15056F	EOT	BCC
ASCII value	H05	H3031	H77	H5342	H3036	H254457303030	H3031	H414131353 0353646	H04	

② For ACK response after execution of command (PC ← MASTER-K120S main unit)

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

③ For NAK response after execution of command(PC ← MASTER-K120S main unit)

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

5) Monitor register(X##)

(1) Introduction

Monitor register can separately register up to 10 in combination with actual variable reading command, and carries out the registered one through monitor command after registration.

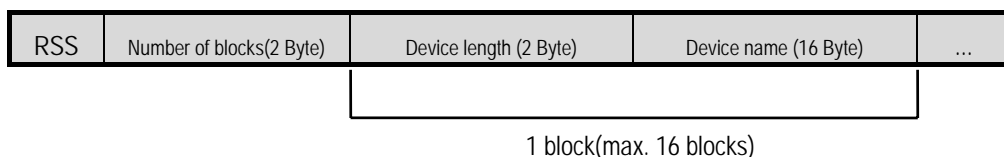
(2) PC request Format

Format name	Header	Station No.	Command	Registration No.	Registration Format	Tail	Frame check
Frame (Example)	ENQ	H10	X(x)	H09	Refer to registration Format	EOT	BCC
ASCII value	H05	H3130	H58(78)	H3039	[※]	H04	

Item	Explanation
BCC	When command is lowercase(x), only one lower byte of the value resulted by adding 1 byte each to ASCII values from ENQ to EOT is converted into ASCII, added to BCC.
Register No.	This can be registered up to 10(0 to 9, H00-H09), and if an already registered No. is registered again, the one currently being executed is registered.
Register Format	This is used to before EOT in command of Formats of separate reading of variable, continuous reading, and named variable reading.

※ Register Format : Register Format of request Formats must select and use only one of the followings.

① Individual reading of device



② Continuous reading of device

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

(3) Response Format (ACK response)

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

Item	Explanation
BCC	When 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 added to BCC, and sent.

(4) Response Format (NAK response)

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

Item	Explanation
BCC	When command is one of lower case(r), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and 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 device M000 of station NO. 1 is monitor registered.

① Computer request Format (PC → MASTER-K120S main unit)

Format name	Header	Station No.	Command	Registration No.	Registration Format				Tail	Frame check
					R##	Number of blocks	Device length	Device name		
Frame (Example)	ENQ	H01	x	H01	RSS	H01	H06	%MW000	EOT	BCC
ASCII value	H05	H3031	H78	H3031	H525353	H3031	H3036	H255457 303030	H04	

② For ACK response after execution of command(PC ← MASTER-K120S main unit)

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

③ For NAK response after execution of command (PC ← MASTER-K120S main unit)

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

6) Monitor 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 (Example)	ENQ	H10	Y(y)	H09	EOT	BCC
ASCII value	H05	H3130	H59(79)	H3039	H03	

Item	Explanation
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 command is lower case(y), only one lower byte of the value resulted by adding 1 byte each to ASCII values from ENQ to EOT is converted into ASCII, added to BCC.

(3) 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 (Example)	ACK	H10	Y(y)	H09	H01	H04	H9183AABB	ETX	BCC
ASCII value	H06	H3130	H59(79)	H3039	H3031	H3034	H3931383341 414242	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 (Example)	ACK	H10	Y(y)	H09	H04	H9183AABB	ETX	BCC
ASCII value	H06	H3130	H59(79)	H3039	H3034	H3931383341414242	H03	

(4) Response Format (NAK response)

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

Item	Explanation
BCC	When command is lowercase(y), only one lower byte of the value resulted by adding 1 Byte each to ASCII values from NAK to ETX is converted into ASCII and added to BCC, and 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 registered device No. 1 of station No. 1 is read. and BCC value is checked. And it is supposed that device M000 is registered and the number of blocks is 1.

① Computer request Format (PC → MASTER-K120S Main Unit)

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

② For ACK response after execution of command (PC ← MASTER-K120S Main Unit)

Format name	Header	Station No.	Command	Registration No.	Number of Blocks	Number of data	Data	Tail	Frame check
Frame (Example)	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 ← MASTER-K120S Main Unit)

Format name	Header	Station No.	Command	Registration No.	Error code	Tail	Frame check
Frame (Example)	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 (Example)	ENQ	H0A	R(r)	ST	EOT	BCC
ASCII value	H05	H3041	H52(72)	H5354	H04	

Item	Explanation
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) Response Format (ACK response)

Format name	Header	Station No.	Command	Command type	PLC status data (Hex 20 Byte)	Tail	Frame check
Frame (Example)	ACK	H0A	R(r)	ST	Status data Format	ETX	BCC
ASCII value	H06	H3041	H52(72)	H5354	[※1]	H03	

Item	Explanation
BCC	When 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 added to BCC, and sent.

※1 PLC status data: data Format is 20 bytes in hex Format and converted into ASCII code. Its contents are constituted as below table after converting ASCII code into hex data.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Null				CPU	Ver.	CPU	null	connection	Null										
				Type		No.	Mode												

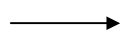
• CPU Type

CPU Type	K120S	K80S	K200SA	K200SB	K200SC	K300S	K1000S
Code	42	41	3A	3B	3C	33	32

• Version No.

Ex) Bit

0	0	0	1	0	0	1	0
---	---	---	---	---	---	---	---



Version 1.2

• CPU Mode

Ex) Bit

-	-	-	0	0	0	0	-
---	---	---	---	---	---	---	---

Bit 1	Bit 2	Bit 3	Bit 4
Stop Mode	Run Mode	PAUSE Mode	DEBUG Mode

• Connection

Ex) Bit

-	-	-	-	-	-	0	0
---	---	---	---	---	---	---	---

Bit 0	Bit 1
Local connection	Remote connection

(4) Response Format (NAK response)

Format name	Header	Station No.	Command	Command type	Error code (Hex 2 Byte)	Tail	Frame check
Frame (Example)	NAK	H0A	R(r)	ST	H1132	ETX	BCC
ASCII value	15	3041	5272	5354	31313332	03	

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

* 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 MASTER-K120S Main unit of station No. 1 is read.

① Computer request Format (PC → MASTER-K120S 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 ← MASTER-K120S 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 ← MASTER-K120S Main Unit)

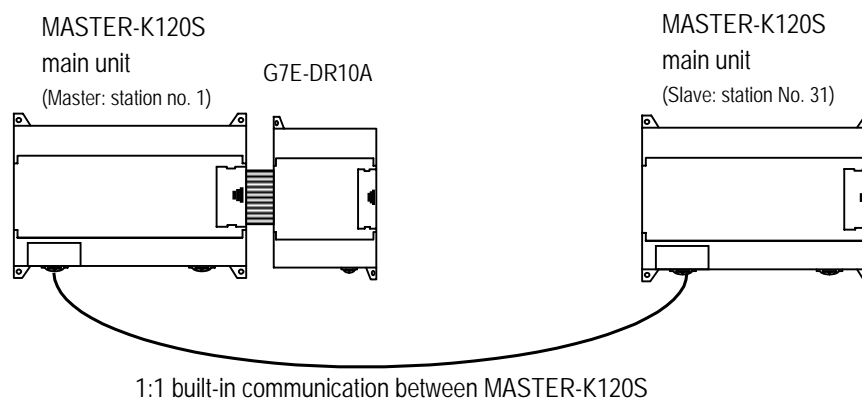
Format name	Header	Station No.	Command	Command type	Error code	Tail	Frame check
Frame (Example)	NAK	H01	R(r)	ST	Error code (2)	ETX	BCC
ASCII value	H15	H3031	H52(72)	H5354	Error code (4)	H03	

8.1.7 1:1, 1:n Built-in communication between MASTER-K120S's

1) Introduction

1:1 built-in communication between MASTER-K120S'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 KGLWIN can easily constitute this system. Communication protocol currently applied is the same with Cnet I/F used for MASTER-K. Main functions are following.

- It can organize device area into 64 data access blocks by WORD unit, and set a communication time-out limit for each block.
- 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 KGLWIN.



This communication cabling map is the same for (3) 1:1 Connecting with other MASTER-K120S in 8.1.2 "System configuration method using built-in communication."

2) Parameter setting

(1) Communication Parameter Setting

- Open a new project file from KGLWIN
 - MASTER-K120S must be selected as PLC type.
- After selecting communication parameter from KGLWIN and clicking twice, this window comes up.

(a) When uses Ch.0 : Built-in RS-232C or External Cnet I/F module

The screenshot shows the 'Parameter [New Project1]' dialog box with the 'CommCh0' tab selected. The 'Communication' dropdown is set to 'Enable'. Under 'Communication Method', 'Station Number' is 0, 'Baud Rate' is 19200, 'Data Bit' is 8, 'Parity Bit' is None, and 'Stop Bit' is 1. Under 'Communication Channel', 'RS232C Null Modem or RS422/485' is selected. The 'Protocol and Mode' section shows 'Timeout in Master Mode' as 500 ms, 'Dedicated' mode with 'Master' selected, 'Modbus' mode with 'Master' selected, and 'Transmission' set to 'ASCII'. 'User Defined' and 'FIELDBUS' modes are also visible with 'List' buttons.

(b) When uses Ch.1 : Built-in RS-485

The screenshot shows the 'Parameter [New Project1]' dialog box with the 'CommCh1' tab selected. The 'Communication' dropdown is set to 'Enable'. Under 'Communication Method', 'Station Number' is 0, 'Baud Rate' is 19200, 'Data Bit' is 8, 'Parity Bit' is None, and 'Stop Bit' is 1. Under 'Communication Channel', 'RS485' is selected. The 'Protocol and Mode' section shows 'Timeout in Master Mode' as 500 ms, 'Dedicated' mode with 'Slave' selected, 'Modbus' mode with 'Slave' selected, and 'Transmission' set to 'ASCII'. 'User Defined' and 'FIELDBUS' modes are also visible with 'List' buttons.

- Set according to the following table

Item	Contents
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	<ul style="list-style-type: none"> • RS232C null modem or RS422/485: can be selected as a communication channel when communication is processed by built-in functions of MASTER-K120S 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). <p>* Notes: RS232C dedicated modem and RS232C dial-up modem communication can be processed only by Cnet I/F module (G7L-CUEC) supporting RS-232C, not Cnet I/F module (G7L-CUEC) supporting RS-422/485.</p>
Timeout in Master Mode	<ul style="list-style-type: none"> • It's an interval waiting after sending request frame from Master MASTER-K120S 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	Master MASTER-K120S can read from and write on Slave MASTER-K120S.
Read status of slave PLC	can be select especially when you read Slave MASTER-K120S 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.

Protocol and Mode

Timeout in Master Mode: 500 ms

Dedicated

☒ Master ☐ Read Status of Slave PLC

☐ Slave

Modbus

☐ Master ☐ Slave Transmission: ASCII

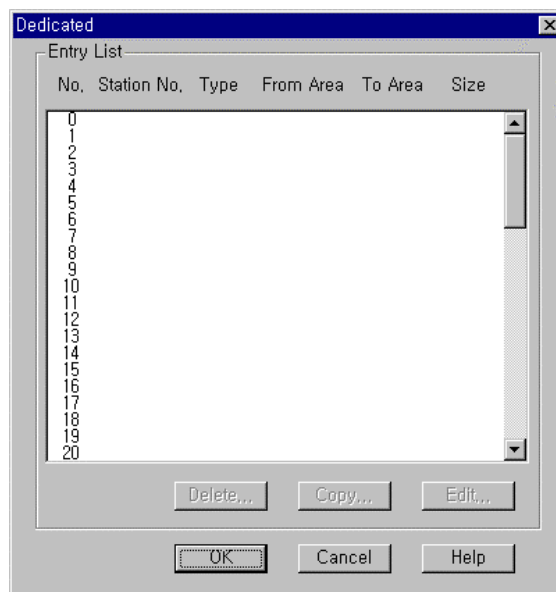
User Defined

☐ Master ☐ Slave ☐ No Protocol

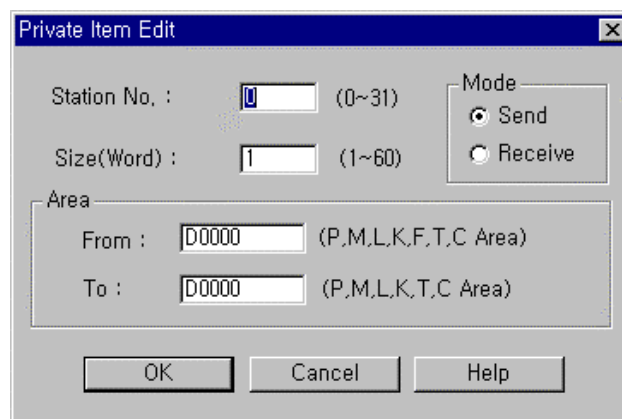
FIELDBUS

☐ Master ☐ Slave

- Click the 'List' button to open the registration list window.



- Total 64 data blocks can be assigned. But it's not possible to set a register number.
- Sending and receiving data size can be set up to 60 Words.
- Set device area
 - Sending: reading device area P,M,L,K,T,C,D,S saving device area : P,M,L,K,T,C,D,S
 - Receiving : reading device area P,M,L,K,T,C,D,S saving device area : P,M,L,K,T,C,D,S
- Designate station no., size, mode, area in following windows.



- Station no. : set the number of the slave or opponent station.
- Mode : click 'send' for writing data on the slave station, or 'receive' for reading from it.
- Size : data size for reading and writing of the master station can be specified up to 60 words.
- Area:

Item	Sending mode	Receiving mode
Area(from)	that is in the master station to temporarily save the data to be written.	that is in the slave station for the data to be read.
Area(to)	that is in the slave station to write the data.	that is in the master station to temporarily save the data to be read.

3) Flag related with operating status

(1) Sending/receiving error count for each station (total 32 stations)

Error code is saved following area according to station

Station	Device	Station	Device	Remarks
0,1	D4400	16,17	D4408	Each device contains the Information of 2 station The information of each station is saved in 1byte.
2,3	D4401	18,19	D4409	
4,5	D4401	20,21	D4410	
6,7	D4403	22,23	D4411	
8,9	D4404	24,25	D4412	
10,11	D4405	26,27	D4413	
12,13	D4406	28,29	D4414	
14,15	D4407	30,31	D4415	

Error code

Error code	Contents	Remarks
1	Timeout error for response	
2	Received NAK	

(2) Sending/receiving error contents of each station (total 32 stations)

Error count number is saved following area according to station

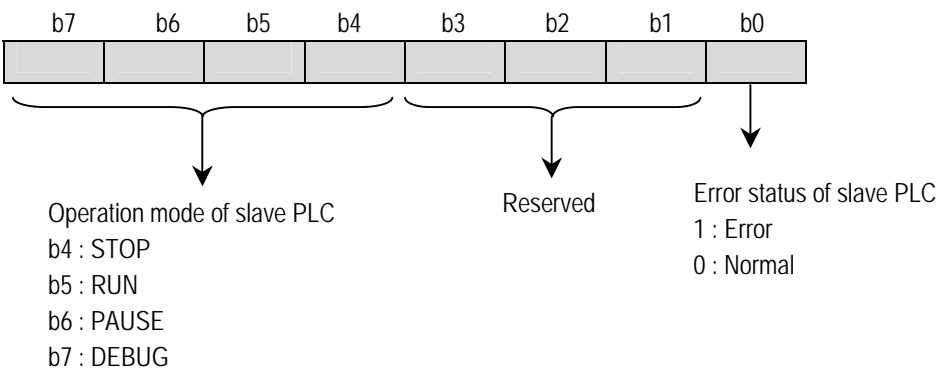
Station	Device	Station	Device	Remarks
0,1	D4416	16,17	D4424	Each device contains the Information of 2 station The information of each station is saved in 1byte.
2,3	D4417	18,19	D4425	
4,5	D4418	20,21	D4426	
6,7	D4419	22,23	D4427	
8,9	D4420	24,25	D4428	
10,11	D4421	26,27	D4429	
12,13	D4422	28,29	D4430	
14,15	D4423	30,31	D4431	

(3) Slave PLC mode and error contents of each station (total 32 stations)

Error Information of PLC is saved following area according to station

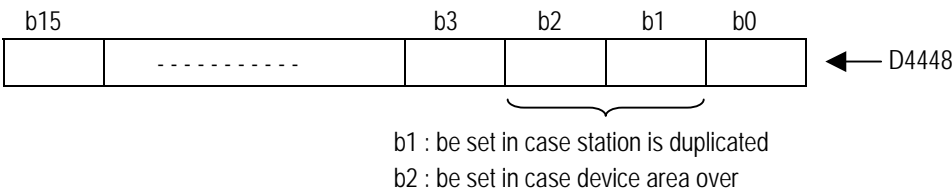
Station	Device	Station	Device	Remarks
0,1	D4432	16,17	D4440	Each device contains the Information of 2 station The information of each station is saved in 1byte.
2,3	D4433	18,19	D4441	
4,5	D4434	20,21	D4442	
6,7	D4435	22,23	D4443	
8,9	D4436	24,25	D4444	
10,11	D4437	26,27	D4445	
12,13	D4438	28,29	D4446	
14,15	D4439	30,31	D4447	

• Error bit



(4) Status flag of the master PLC

Status Information of master PLC is saved in D4448

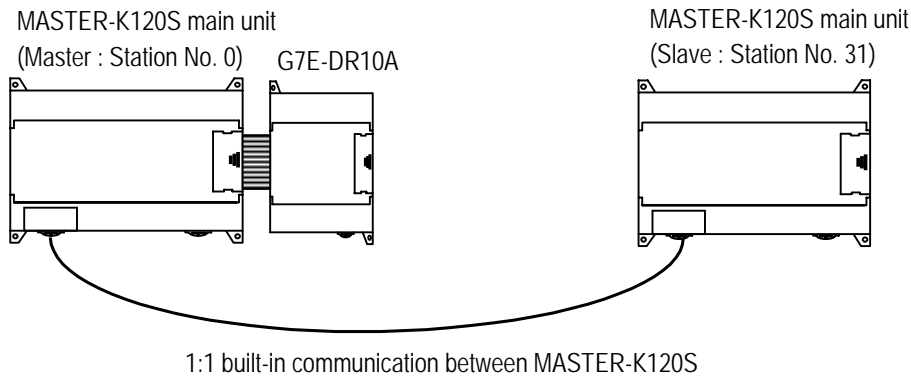


(5) Max/min/current sending/receiving cycle of set parameter

Contents: the interval between after sending and before receiving

	Saved area (Channel 0)	Saved area(Channel 1)
Max.	D4449 – D4450	D4349 – D4350
Min.	D4451 – D4452	D4351 – D4352
Current	D4453 – D4454	D4353 – D4354

4) Example



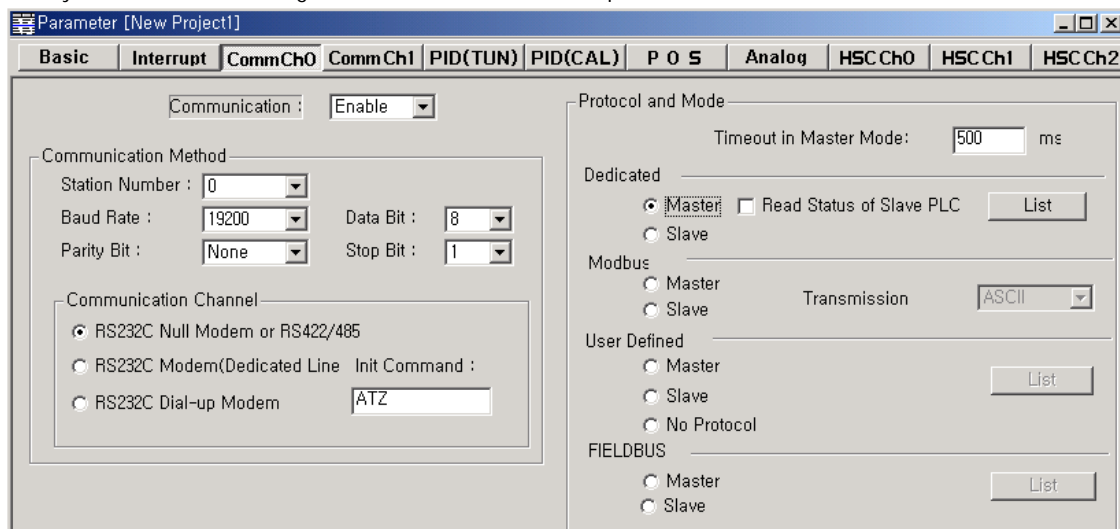
- Device M000 is increased by program per 1 second.
- Writing M000 to output area P004 of slave
- Reading slave's output area P004
- Writing it to master's output area P009

The following example uses the above diagram to explain the operation of MASTER-K120S main unit.

- The data of the master MASTER-K120S main unit is increased by INCP instruction and sent to be written on the output contact point P004 of the slave MASTER-K120S main unit. And in return, the master MASTER-K120S main unit reads the data that is written on the output contact point of the slave MASTER-K120S to write them on the output contact point of extended digital input/output module, G7E-DR10A.

(1) Setting communication parameter of the master station and its program

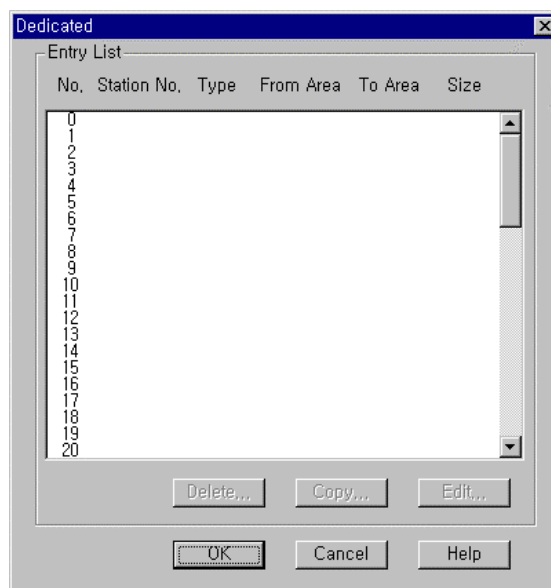
- ① Work on the master station 0.
- ② Open a new project file and a new program for the master station.
- ③ Double click parameter item for parameter settings. If you click the Comm. button in parameter window in KGLWIN, you can see the following window of the communication parameter.



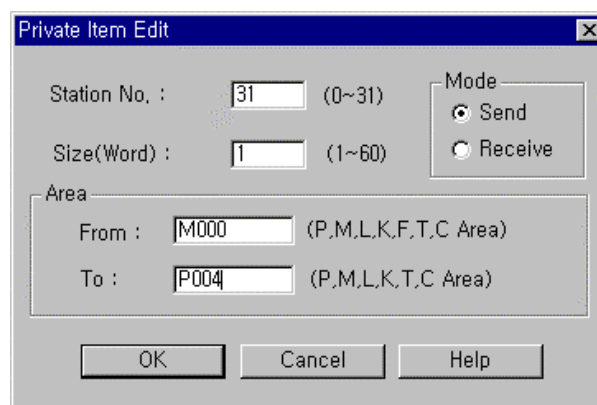
- ④ Set parameters as the following table.

Communication Method							Protocol and mode	
Comm-unication	Station no.	Baud rate	Data bit	Parity bit	Stop bit	Communication channel	Timeout	Dedicated
Enable	0	19200	8	None	1	RS232C null modem or RS422/485	500ms	Master

- ⑤ Click 'List' button to activate registration list window



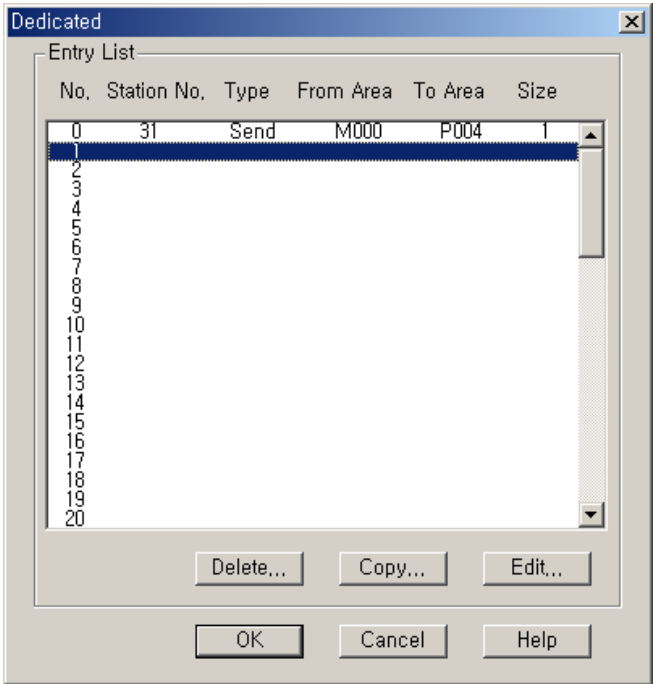
- ⑥ double click list number '0' in 'List' window , then following window for 'Private 1 item 0 edit' is open



- ⑦ Set parameters like the following table and click 'OK' button.

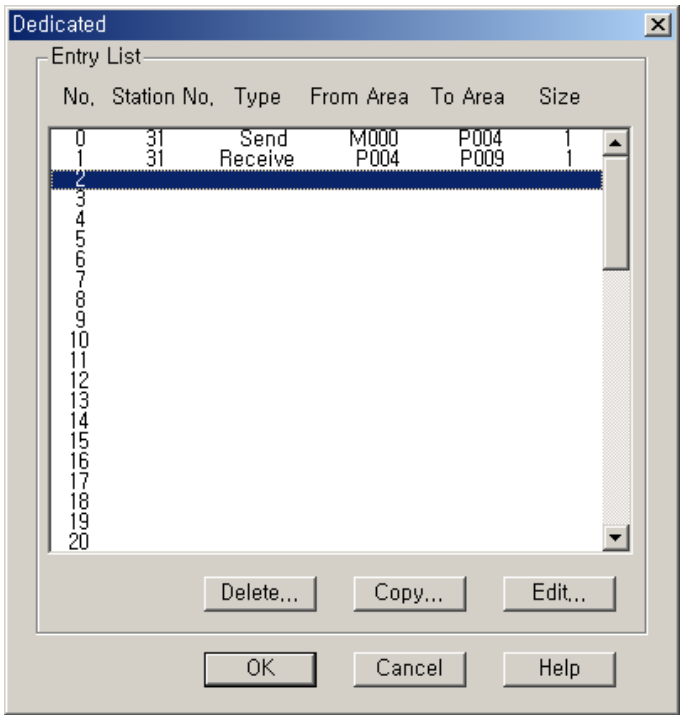
Station No.	Size	Mode	Area to read(From)	Area to save(to)
31	1	Send	M000 (See the above)	P004 (See the above)

⑧ The registration list '0' registered in the registration list can be confirmed through a window like the following.

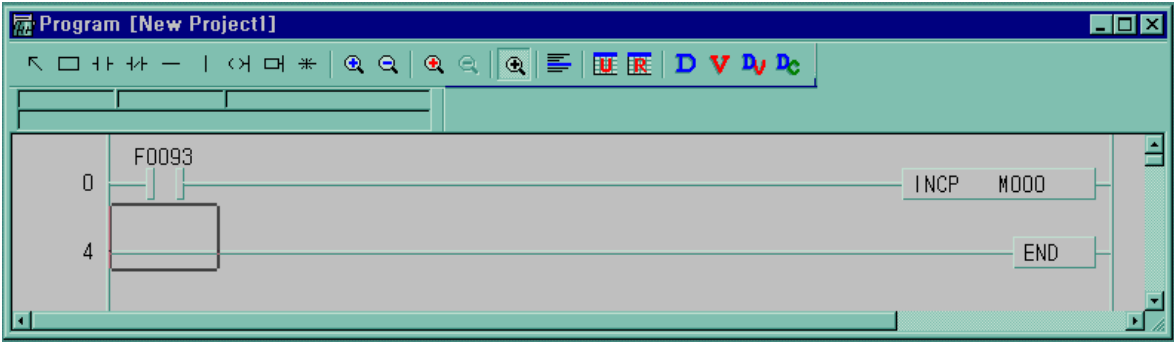


⑨ Double click the No. 1 for receive parameter setting and Set parameters like the following table and click 'OK' button.

Station No.	Size	Mode	Area to read(From)	Area to save(to)
31	1	Receive	P004 (See the above)	P009 (See the above)

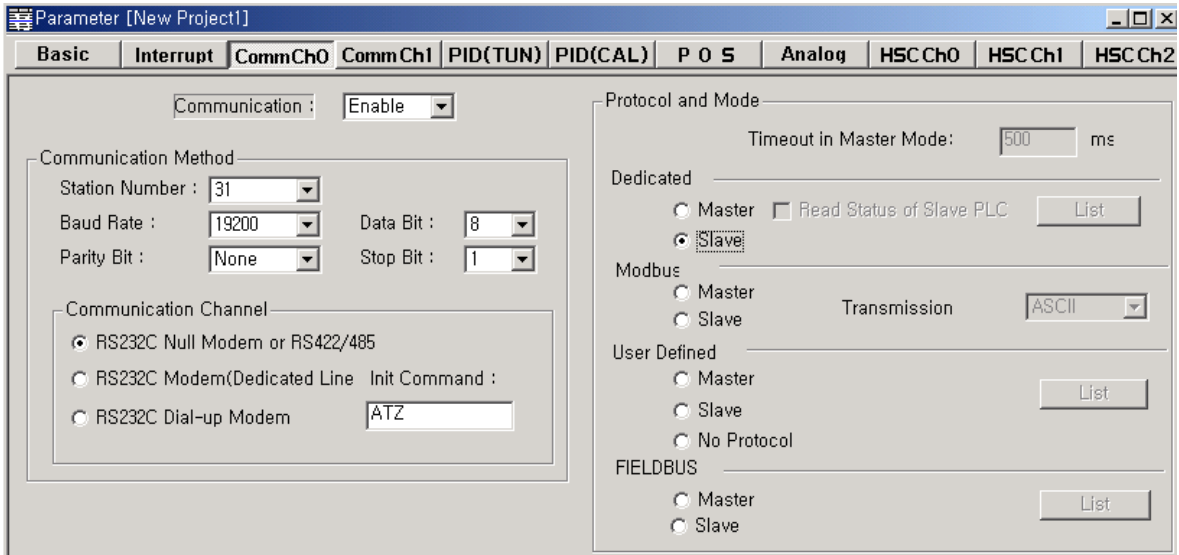


(2) Program



(2) Parameter setting for slave station.

① Set parameters as the following table.



Communication Method							Protocol and mode	
Commu- nication	Station no.	Baud rate	Data bit	Parity bit	Stop bit	Communication channel	Timeout	Dedicated
Enable	31	19200	8	None	1	RS232C null modem or RS422/485	-	slave

- ② Slave station does not need program.
- ③ Baud rate, parity bit, data bit, stop bit setting must be same with master station.

8.1.8 Error code

Error code	Error type	Error condition and causes	Treatment
H0001	PLC system error	Interface with PLC is impossible.	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 commands.
H0031	Command type error	Wrong command type that is to use characters like wSS, wSB using other letters from "SS" or "SB"	Check command type
H1132	Device memory error	Set wrong device memory other than P,M,L,K,T,C,F,D,S	Check device type
H1232	Data size error	The number of data in execution is 0 or bigger than 128 bytes.	Correct length of data (If data type is bite, the number of data must be from 1 ~ 128.)
H2432	Data type error	When use other characters than x (X), w (W) at MASTER-K120S. When use b (B), d (D) at MASTER-K120S. Ex1) Use commands like %DB or %DD.	Check data type and execute again.
H7132	Device request Format error	When omit %.	Check Format, correct and execute again.
H2232	Area exceeding error	When exceed assigned area. Ex1) MX2000 or %DW5000	Correct the size within the assigned area and execute again.
H0190	Monitor execution error	Exceeding limit of register No.	Rearrange the monitor register no. not to go over than 9 and reset.
H0290	Monitor register error	Exceeding limit of register No.	Rearrange 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 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 communication ports of RS-232C. reset
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.	Rearrange send frame not to go over 256 bytes.
H6050	Syntax error	BCC error	Check if BCC is right.

8.2 User Defined Protocol Communication

8.2.1 Introduction

User Defined Protocol Communication allows users who do communication between MASTER-K120S main unit and other kind of device to define the other company's protocol at MASTER-K 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, MASTER-K120S main unit executes the communication with the other kind of device through the defined protocol.

For this, protocol frame must be defined in KGLWIN (Version 2.0 or higher). And exact knowledge about the contents of the protocol defined by the user is vital in making the communication possible. KGLWIN can download a user defined protocol frame into MASTER-K120S 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

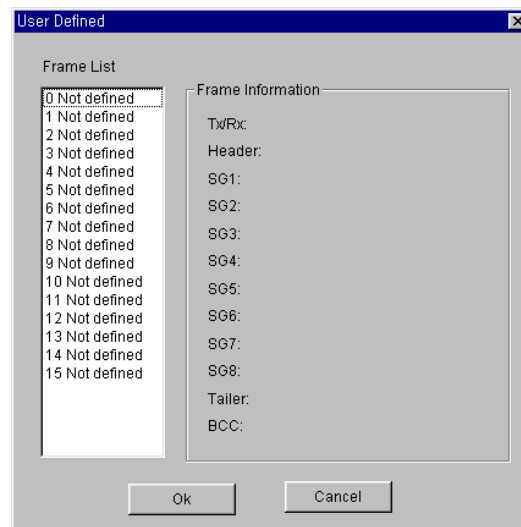
- (1) Open a new project file from KGLWIN and select K120S as PLC type
- (2) After setting communication parameter at KGLWIN. Double click it to activate this window.

- (3) Set according to the following table.

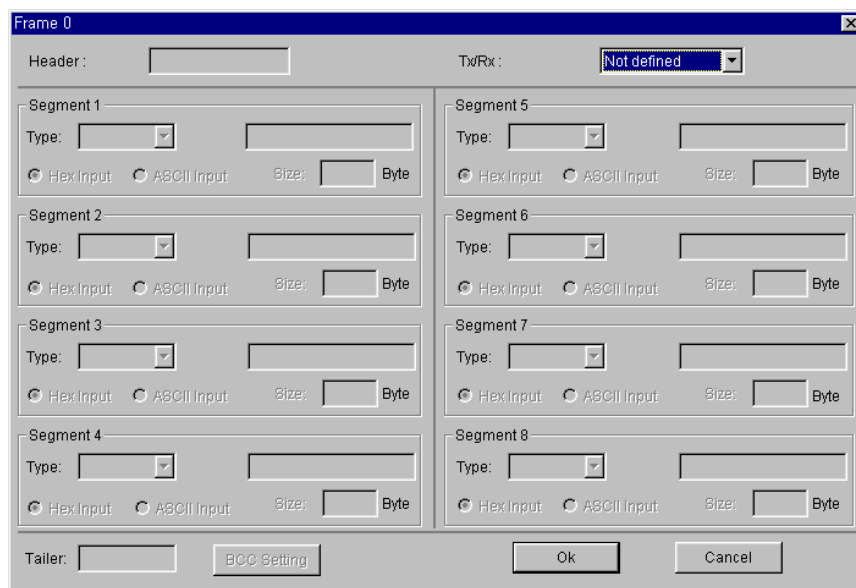
Communication Method							Protocol and mode	
Communi- cation	Station no.	Baud rate	Data bit	Parity bit	Stop bit	Communication channel	Timeout	User defined
Enable	0	19200	8	None	1	RS232C null modem or RS422/485	500ms	Master

2) Setting frame

(1) Click "List" button to activate the following window.



(2) Select one of 1 ~ 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

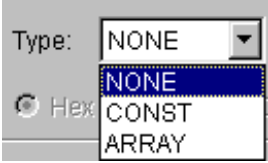

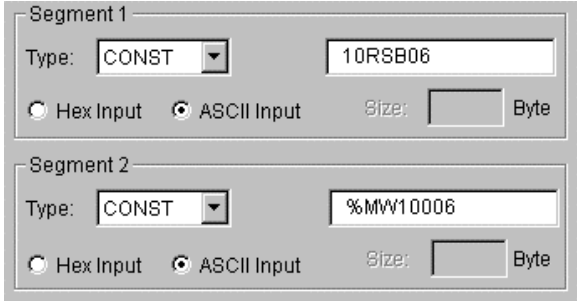
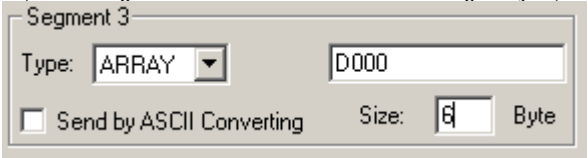
- Not defined : It is the initial value that doesn't declare a frame format.

- 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
	<p>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.</p>
	<p>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. As an dedicated protocol communication, 10RSB06%MW10006 is a frame to execute reading 6 word data from M100 at the slave station no. 16.</p> <p>Ex1) 10RSB06%MW10006</p>  <p>If the segment is declared as ARRAY type, designate transmitting device (P,M,L,K, F,T,C,D) and number of transmitting. The unit is byte</p> <p>Ex2) If you want to transmit D000 ~ D003, the setting is as below. (transmitting device : D000 , number of transmitting : 6 bytes)</p> 

Item	Contents
<input type="radio"/> Hex Input <input checked="" type="radio"/> 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
<input type="checkbox"/> Send by ASCII Converting <input type="checkbox"/> Receive by Hex Converting	If ARRAY 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: <input type="text"/> 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) [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

- 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)

Tailer:

- 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 2 nd data to the data before the data marked as [BCC] and input the result to the [BCC] area
	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 When masking by AND method, using a value, HFF : &FF

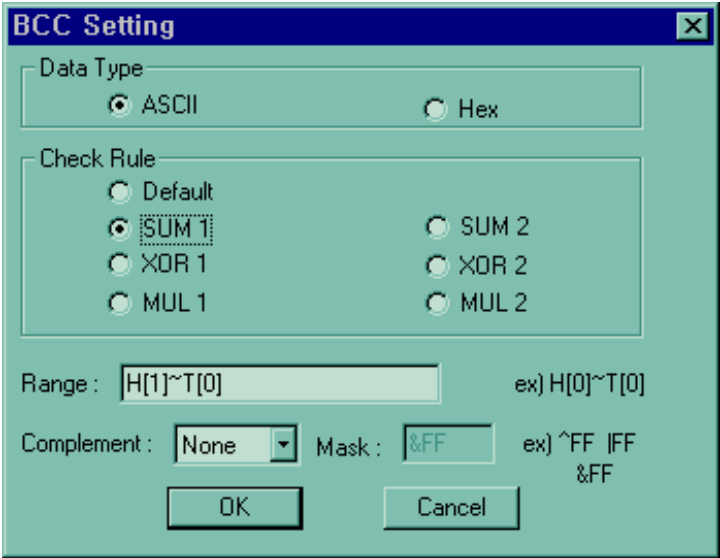
- Frame size
 - ASCII communication : max. 128 bytes
 - Hex communication : max. 256 bytes
- Link relay (L)
 - It's a flag to indicate whether a user defined frame is received in the order set by the user.
 - If the received frame is matched with the declared frame in frame list number 3, L003 starts blinking (0 → 1 → 0).
- When frame receiving is done, MASTER-K120S 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.

BCC calculation 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 41	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	$05 \wedge 31 \wedge 32 \wedge 33 \wedge 34 \wedge 04 = 05$	05 31 32 33 34 04 30 35	05 31 32 33 34 04 05
Hex Input	$05 \wedge 12 \wedge 34 \wedge 04 = 27$	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	$05 \times 31 \times 32 \times 33 \times 34 \times 04 = 60$	05 31 32 33 34 04 36 30	05 31 32 33 34 04 60
Hex Input	$05 \times 12 \times 34 \times 04 = 20$	05 12 34 04 32 30	05 12 34 04 20

④ Complement setting : Complement calculation as below

example> 1's and 2's Complements of D3

bit 7							bit 0
1	1	0	1	0	0	1	1

= h D3 (sum check value)

bit 7							bit 0
0	0	1	0	1	1	0	0

1' complement = h 2C (the last sum check value)

bit 7							bit 0
0	0	1	0	1	1	0	1

2' complement = 1' complement + 1 = h 2D (the last sum check

⑤ Mask setting : Masking method is as below

bit 7							bit 0
1	1	0	1	0	0	1	1

= h D3 (sum check value)

bit 7							bit 0
1	1	1	1	1	1	1	1

= h FF (masking value)

bit 7							bit 0
1	1	0	1	0	0	1	1

AND masking = h D3

bit 7							bit 0
1	1	0	1	0	0	1	1

OR masking = h FF

bit 7							bit 0
0	0	1	0	1	1	0	0

Exclusive OR masking = h 2C

8.2.3 Instruction

1) User defined communication instruction(SNDCOM)

SNDCOM	User defined communication instruction
--------	--

Instruction	Available Device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
Ch											○	7	○		
n1	○	○	○	○	○	○	○		○	○	○				
D	○	○	○	○					○	○					

Input Condition

User defined Communication Channel Frame list Status

SNDCOM Ch n1 D

Flag Set

Designation

Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed
--------------	--

Ch	Designated communication channel
n1	Frame lists which is designated at parameter
D	Device which the communication status is stored

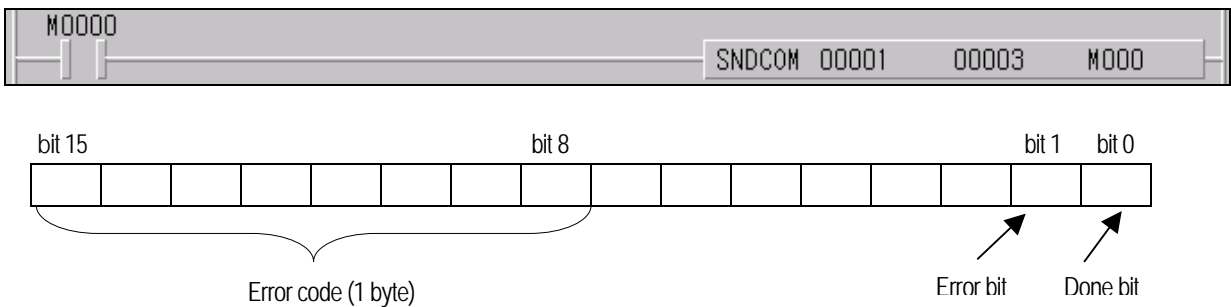
■ SNDCOM Ch n1 D

(1) Function

- When the execution condition is on, the communication starts with protocol at parameter which is designated early.
- 'Ch' is communication channel and 'n' is a frame number at parameter which is designated
- 'D' is a device which the communication status is stored.

(2) example of program

- When input condition is on, channel 1 stars communication with protocol at user defined parameter number 3.
- The communication state is stored M000 and the format of M000 lis as below



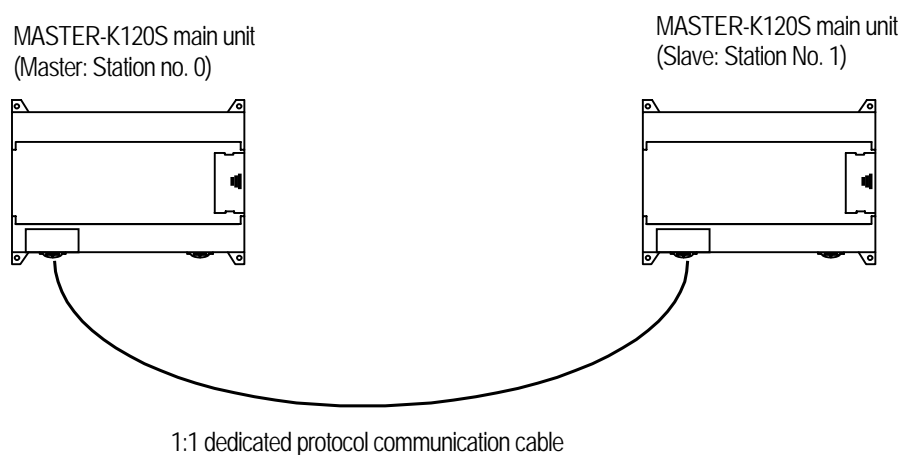
- Done bit : When transfer is completed normally, this bit turns on during 1 scan.
- Error bit : When communication error occurs, this bit turns on.
- Error code : When error bit turns on, the error code is stored.

3) Error code

Code	Error type	explanation
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 of Usage

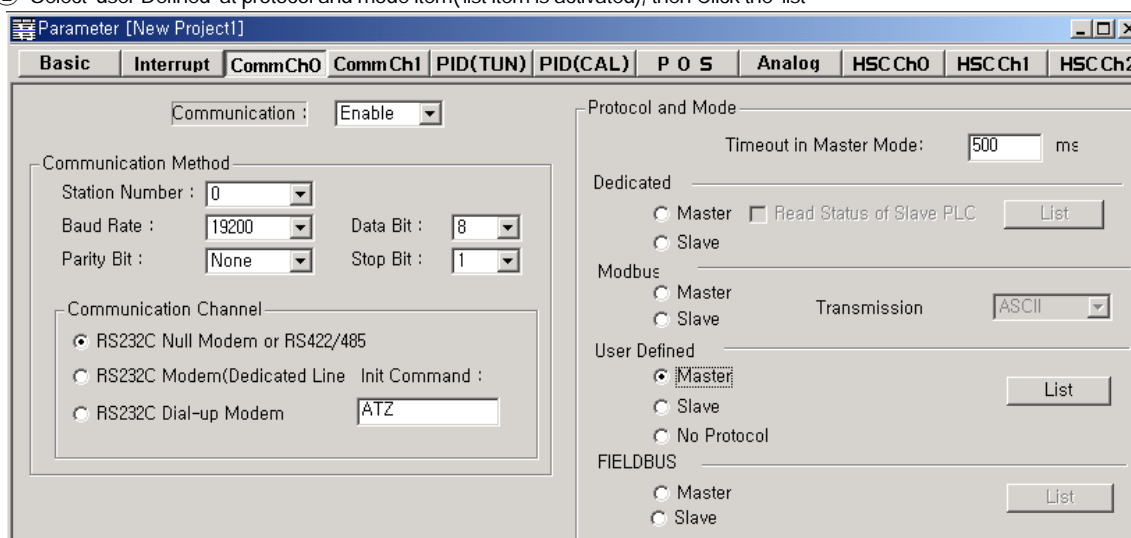
This example is supposed that there's a communication between MASTER-K120S's by the user-defined protocol. The system configuration is as follows and the cable is the same with the one of 1:1 dedicated protocol communication.



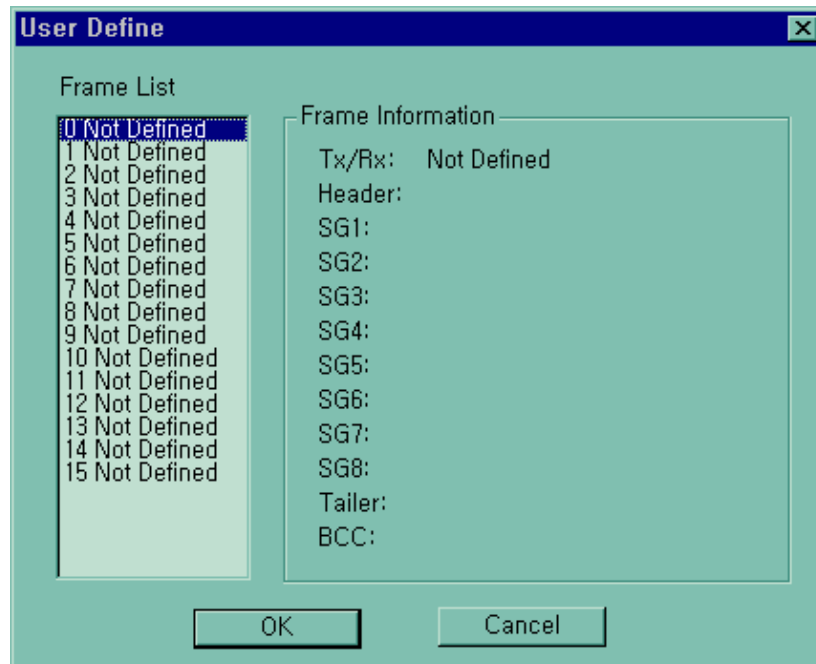
The data in M area of the master station is sent to the slave station and the slave station saves received data in M area, output as direct variable, and sends the data back to the master. This process repeats between the master and the slave.

1) The Programming and setting communication parameter of the master station

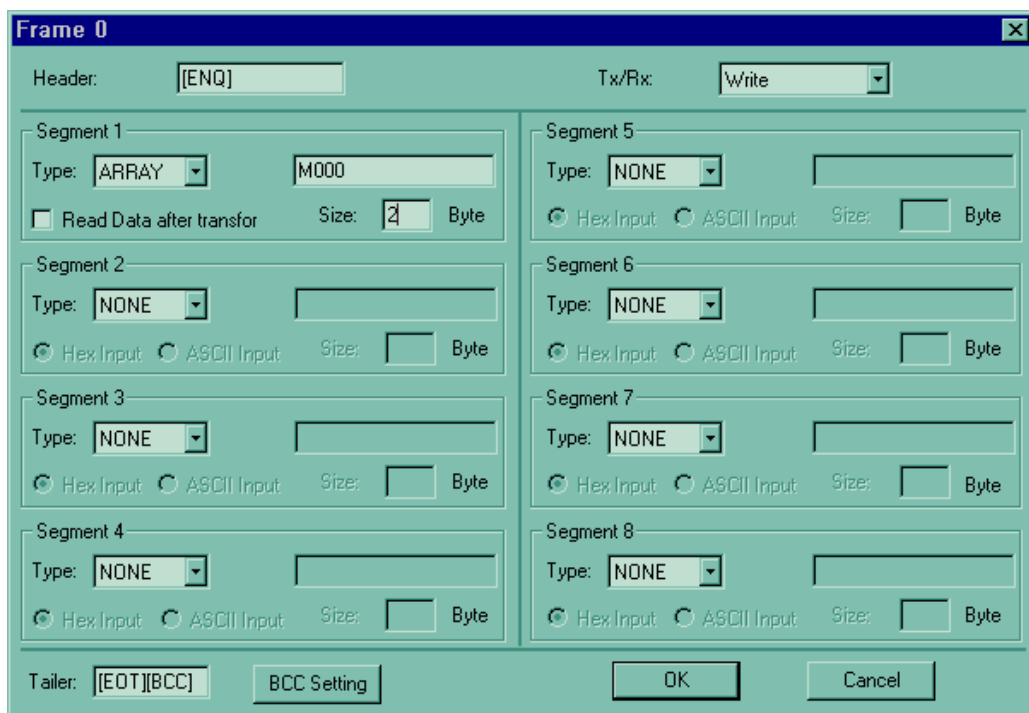
- ① Select the communication parameter and then select communication method and communication channel.
- ② Select 'user Defined' at protocol and mode item('list item is activated), then Click the 'list'




- ③ Double click the number '0'



- ④ Designate the header, segment, send/receive, tail as below and then click the BCC Setting



- ⑤ Designate BCC Setting as below and Click the OK button, then you can see the frame list window which is designated



BCC Setting

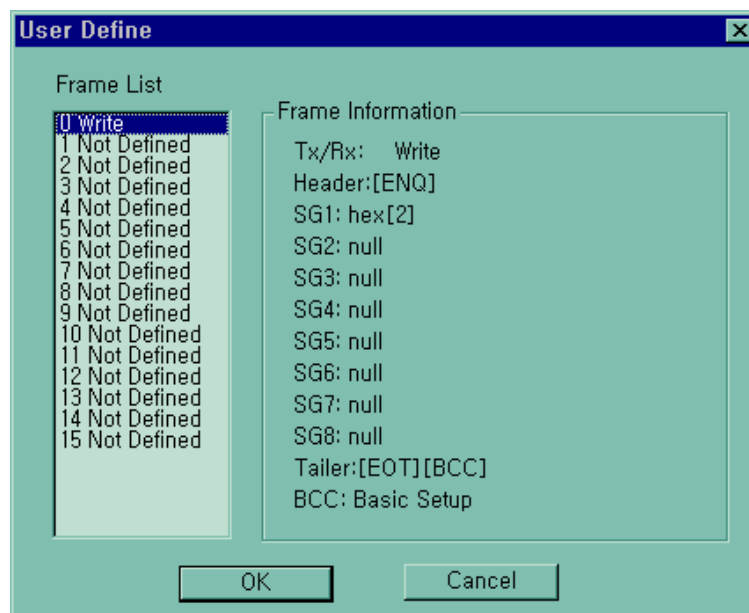
Data Type
☒ ASCII ☐ Hex

Check Rule
☒ Default ☐ SUM 1 ☐ SUM 2
☐ XOR 1 ☐ XOR 2
☐ MUL 1 ☐ MUL 2

Range : ex) H[0]~T[0]

Complement : Mask : ex) ^FF IFF &FF

OK Cancel



User Define

Frame List

0	Write
1	Not Defined
2	Not Defined
3	Not Defined
4	Not Defined
5	Not Defined
6	Not Defined
7	Not Defined
8	Not Defined
9	Not Defined
10	Not Defined
11	Not Defined
12	Not Defined
13	Not Defined
14	Not Defined
15	Not Defined

Frame Information

Tx/Rx: Write
 Header:[ENQ]
 SG1: hex[2]
 SG2: null
 SG3: null
 SG4: null
 SG5: null
 SG6: null
 SG7: null
 SG8: null
 Tailer:[EOT][BCC]
 BCC: Basic Setup

OK Cancel

- ⑥ Double click the number 1 frame

Frame 1

Header: [ENQ] Tx/Rx: Read

Segment 1
Type: ARRAY M000
☒ Read Data after transfer Size: 2 Byte

Segment 2
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Segment 3
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Segment 4
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Segment 5
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Segment 6
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Segment 7
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Segment 8
Type: NONE
☒ Hex Input ☐ ASCII Input Size: 1 Byte

Tailor: [EOT][BCC] BCC Setting OK Cancel

- ⑦ BCC Setting method is same frame 0.
- ⑧ After the frame setting and BCC setting completes, click the OK button.
- ⑨ You can see the frame list window which is designated as below.

User Define

Frame List

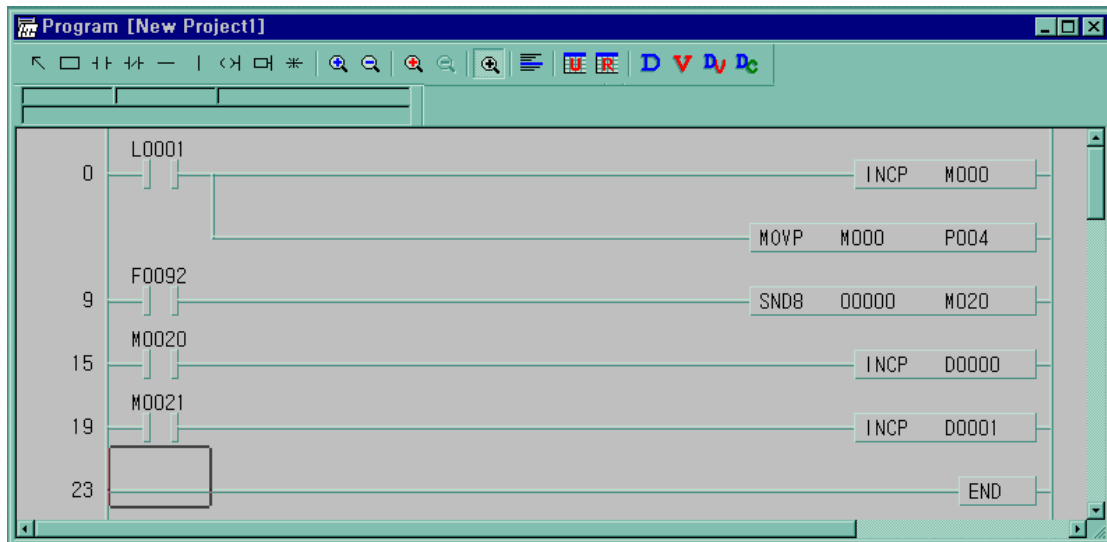
- 0 Write
- 1 Read
- 2 Not Defined
- 3 Not Defined
- 4 Not Defined
- 5 Not Defined
- 6 Not Defined
- 7 Not Defined
- 8 Not Defined
- 9 Not Defined
- 10 Not Defined
- 11 Not Defined
- 12 Not Defined
- 13 Not Defined
- 14 Not Defined
- 15 Not Defined

Frame Information

Tx/Rx: Read
Header: [ENQ]
SG1: hex[2]
SG2: null
SG3: null
SG4: null
SG5: null
SG6: null
SG7: null
SG8: null
Tailor: [EOT][BCC]
BCC: .

OK Cancel

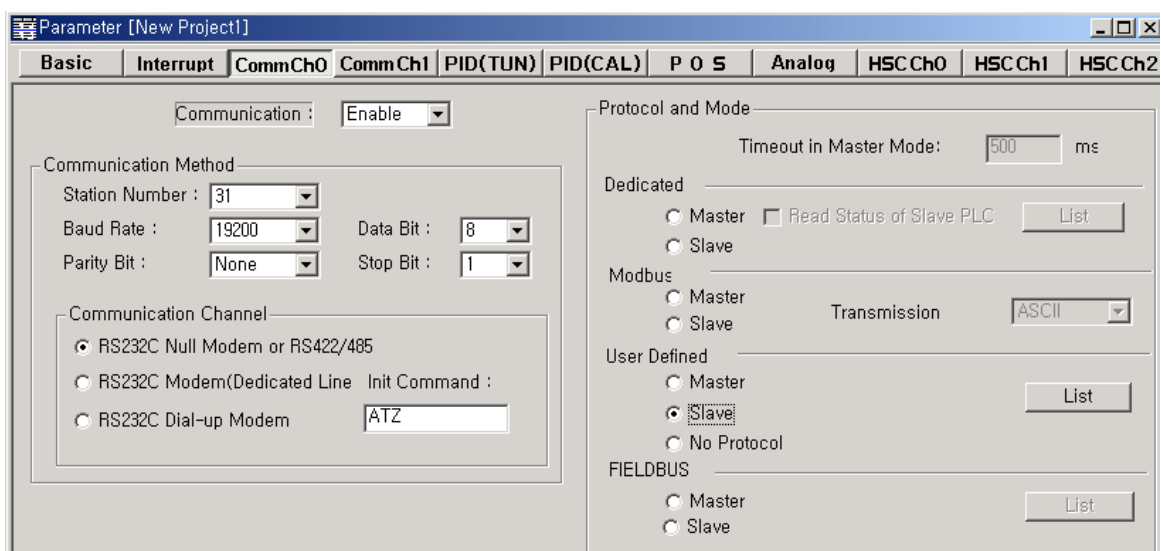
⑧ Program



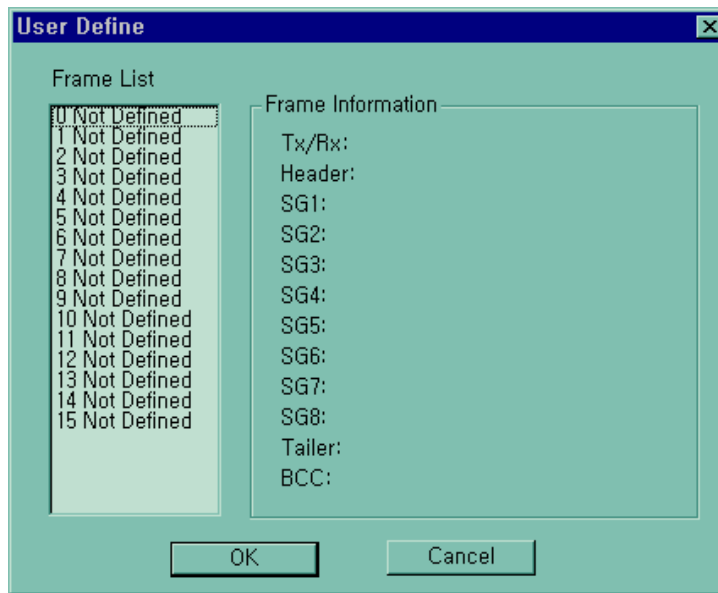
- When the data is received at frame no. 1, link relay L001 turns on during 1 scan. At that moment, M000 increases and the value of M000 moves output relay P004.
- The new value of M000 is sending again every 1 second period (F092 is 1second period flag)
- The number of sending normally stores D000.
- When error occurs, the number of sending error stored in D001.

2) Setting and program of slave station

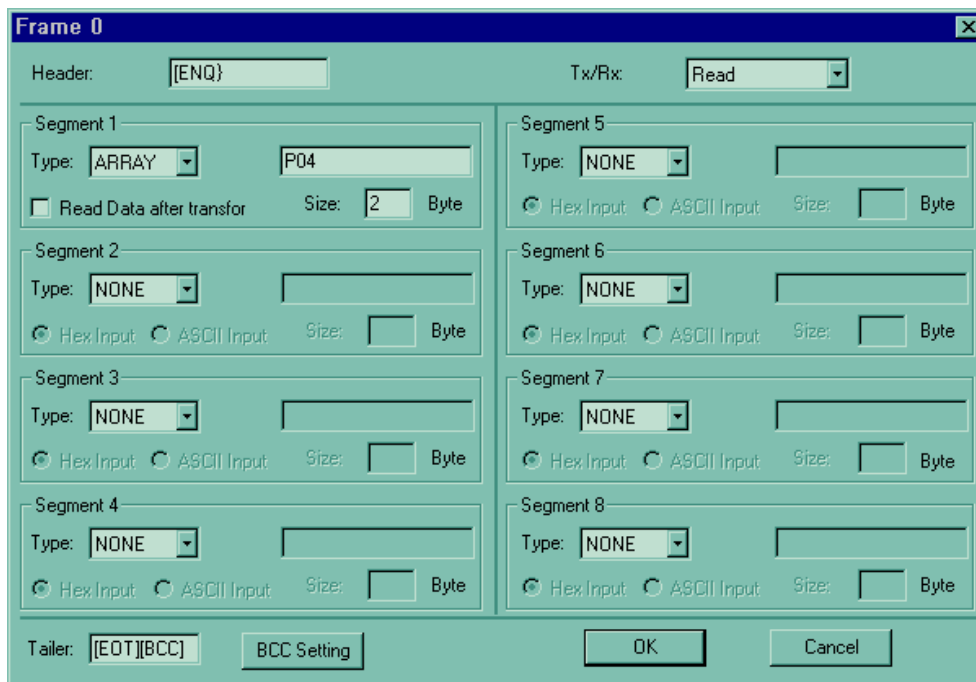
- ① Make the new project file and setting new parameter.
- ② Click the list after set the communication method and communication channel.



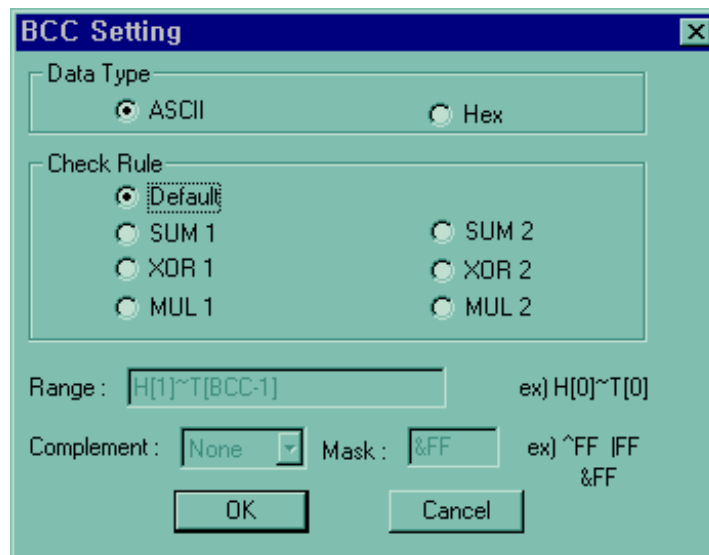
- ③ Double click the frame list number '0'



- ④ Click the BCC Setting after set the header , segment , tail as below.



- ⑤ Click the OK button after BCC setting as below. Then you can see the frame list which is designated.



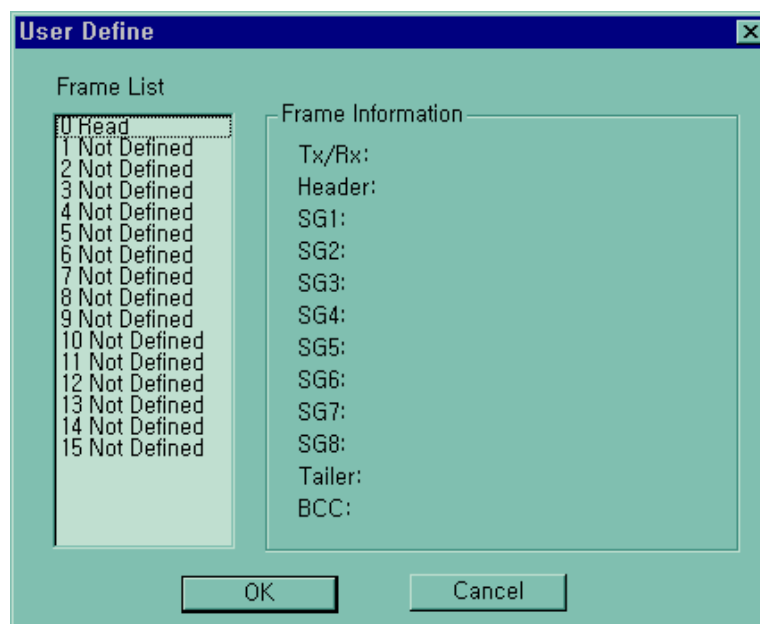
BCC Setting

Data Type
☒ ASCII ☐ Hex

Check Rule
☒ Default ☐ SUM 1 ☐ SUM 2
☐ XOR 1 ☐ XOR 2
☐ MUL 1 ☐ MUL 2

Range: ex) H[0]~T[0]

Complement: Mask: ex) ^FF |FF &FF



User Define

Frame List

0	Head
1	Not Defined
2	Not Defined
3	Not Defined
4	Not Defined
5	Not Defined
6	Not Defined
7	Not Defined
8	Not Defined
9	Not Defined
10	Not Defined
11	Not Defined
12	Not Defined
13	Not Defined
14	Not Defined
15	Not Defined

Frame Information

Tx/Rx:
 Header:
 SG1:
 SG2:
 SG3:
 SG4:
 SG5:
 SG6:
 SG7:
 SG8:
 Tailer:
 BCC:

- ⑥ Set the frame number '1' as below and click the BCC Setting

Frame 1

Header: [ENQ] Tx/Rx: Write

Segment 1
Type: ARRAY P04
☐ Read Data after transfer Size: 2 Byte

Segment 2
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Segment 3
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Segment 4
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Segment 5
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Segment 6
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Segment 7
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Segment 8
Type: NONE
☒ Hex Input ☐ ASCII Input Size: Byte

Tailer: [EOT][BCC] BCC Setting OK Cancel

- ⑦ BCC Setting method is same as master station.

BCC Setting

Data Type
☒ ASCII ☐ Hex

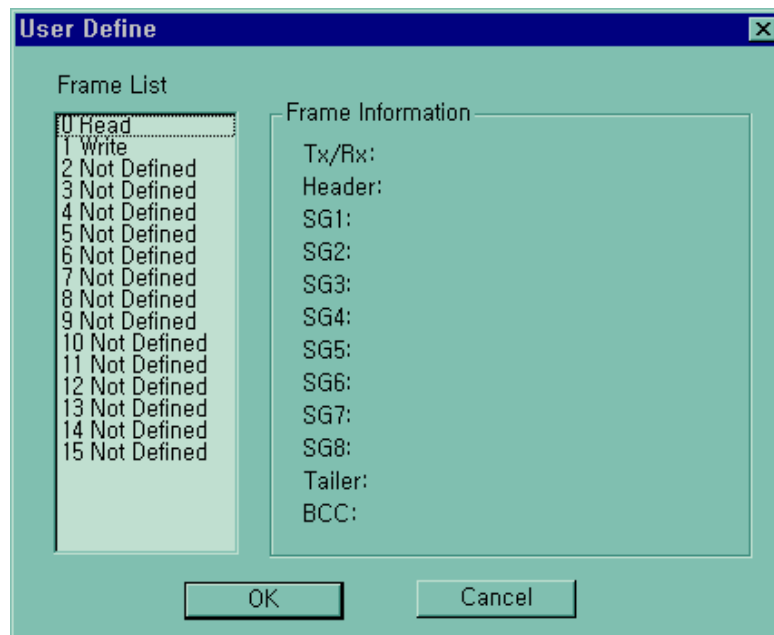
Check Rule
☒ Default
☐ SUM 1 ☐ SUM 2
☐ XOR 1 ☐ XOR 2
☐ MUL 1 ☐ MUL 2

Range: H[1]~T[BCC-1] ex) H[0]~T[0]

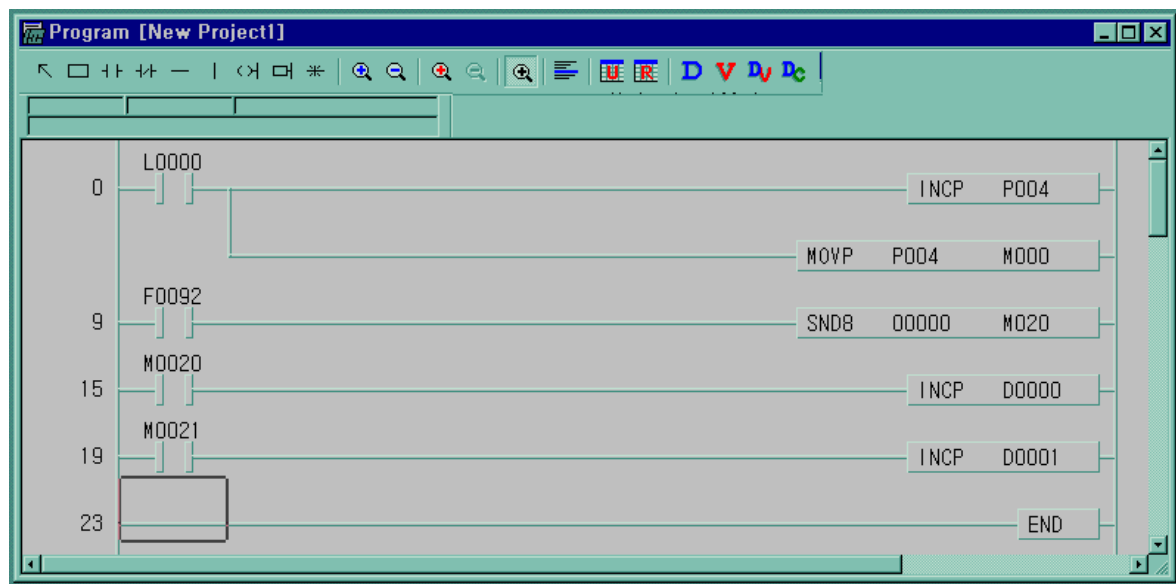
Complement: None Mask: &FF ex) ^FF IFF &FF

OK Cancel

- ⑧ After the frame setting and BCC setting completes, click the OK button.
- ⑨ You can see the frame list window which is designated as below



- ⑩ Program



- When the data is received at frame no. 0, link relay L000 turns on during 1 scan. At that moment P004 increases and the value of P004 moves M000.
- The new value of P004 is sending again every 1 second period (F092 is 1second period flag)
- The number of sending normally is stored in D000.
- When error occurs the number of sending error is stored in D001.

8.3 Modbus Protocol Communication

8.3.1 Introduction

MASTER-K120S built-in communication supports Modbus, the Modicon product's communication protocol. It supports ASCII mode, using ASCII data and RTU mode using Hex data. Function code used in Modbus is supported by instruction and especially function code 01, 02, 03, 04, 05, 06, 15 and 16. Refer to "Modicon Modbus Protocol Reference Guide"

8.3.2 Basic Specification

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) Calculation of 1 character time at 1200 bps.
 1200 bps means that it takes 1 second to send 1200 bits. To send 1 bit, $1 \text{ sec}/1200 \text{ bits} = 0.83 \text{ ms}$.
 Therefore 1 character time is $0.83 \text{ ms} * 8 \text{ bits} = 6.64 \text{ ms}$.
- 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 MASTER-K120S supports from 0 to 31.
- (2) Address 0 is used for broadcast address. Broadcast address is all slave device recognize and respond to like the self-address, which can't be supported by MASTER-K120S.

4) Function code area

- (1) MASTER-K120S 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, (we write here only function code part. Because only function codes are different.)

[Request]	0000 0011 (H03)
[Confirm+]	0000 0011 (H03)
[Confirm-]	1000 0011 (H83)

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 : H07, H0A or 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	Remark
01	Read Coil Status	0XXXX(bit-output)	Read bits
02	Read Input Status	1XXXX(bit-input)	Read bits
03	Read Holding Registers	4XXXX(word-output)	Read words
04	Read Input Registers	3XXXX(word-input)	Read words
05	Force Single Coil	0XXXX(bit-output)	Write bit
06	Preset Single Register	4XXXX(word-output)	Write word
15	Force Multiple Coils	0XXXX(bit-output)	Write bits
16	Preset Multiple Registers	4XXXX(word-output)	Write words

• MASTER-K120S Mapping

Bit area		Word area	
Address	Data area	Address	Data area
h0000	P area	h0000	P area
h1000	M area	h1000	M area
h2000	L area	h2000	L area
h3000	K area	h3000	K area
h4000	F area	h4000	F area
h5000	T area	h5000	T area(current value area)
h6000	C area	h6000	C area(current value area)
		h7000	S area
		h8000	D area

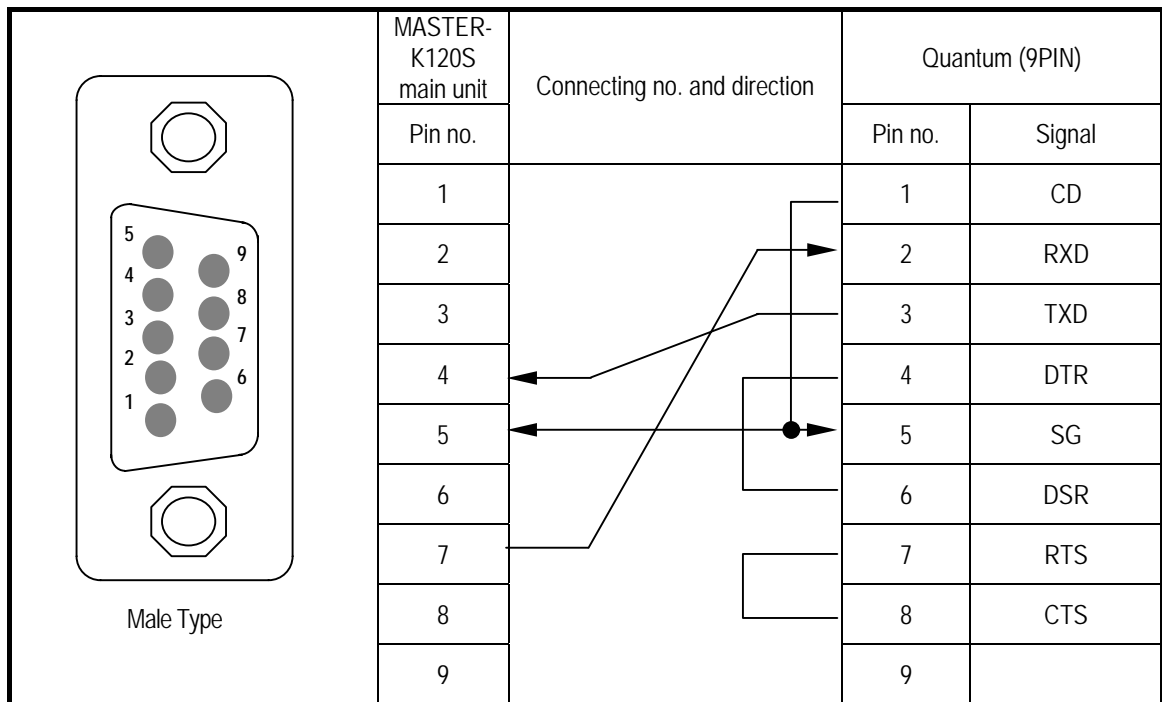
8) Modbus addressing rules

MASTER-K120S main unit starts its address from 0 and matches with 1 of Modicon products' data address. So MASTER-K120S's address n matches $n+1$ of Modicon products' address. 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 MASTER-K120S.

9) The size of using data

As for data size, MASTER-K120S 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."

10) Map of wiring



- Use RS-485 connector when using channel 2.

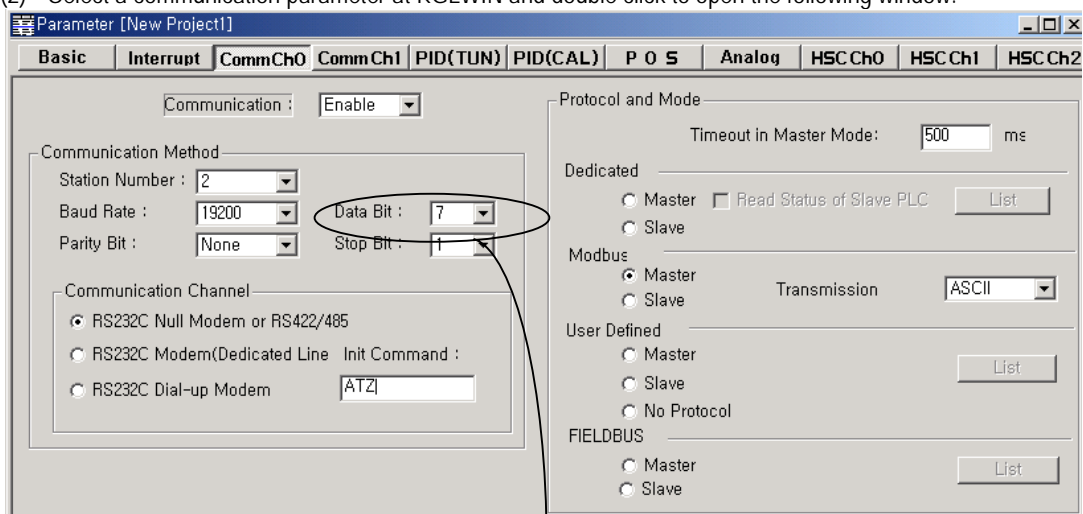
8.3.3 Parameters Setting

1) Setting communication parameter

(1) Open a new project file at KGLWIN.

- K120S 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 KGLWIN and double click to open the following window.



If communication mode is ASCII, Be sure to set 7bit

(3) Set the contents as follows.

Item	Setting contents
Station No.	Set a number between 0 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	<ul style="list-style-type: none"> • RS232C Null Modem or RS422/485 : It's a communication channel for the communication, using MASTER-K120S 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). • S232C 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). • Note : 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.
Time out in Master Mode	<ul style="list-style-type: none"> • It's the time waiting a responding frame since the master MK80S 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 Instruction and example

1) MODBUS communication instruction(MODCOM)

MODCOM	MODBUS communication
--------	----------------------

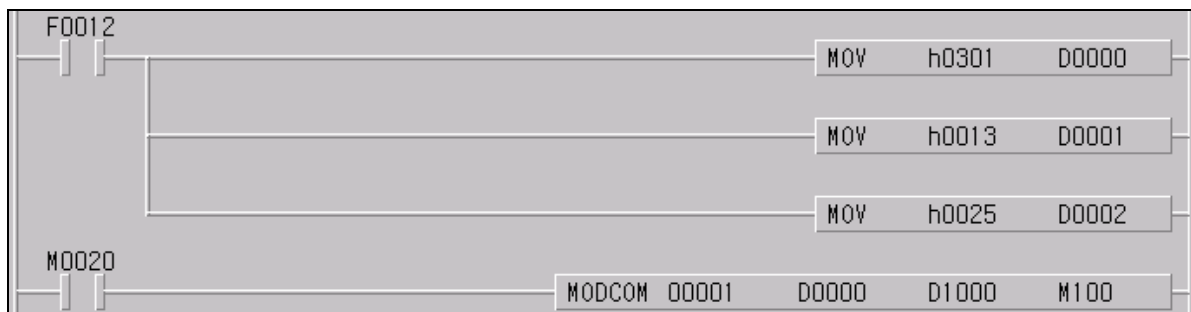
Instruction	Available device											No. of steps	Flag		
	M	P	K	L	F	T	C	S	D	#D	integer		Error (F110)	Zero (F111)	Carry (F112)
Ch											○	7	○		
S1	○	○	○	○	○	○	○		○	○					
S2	○	○	○	○		○	○		○	○					
S3	○	○	○	○		○	○		○	○					

Input Condition		MODBUS Communication Channel		SND/RCV Parameter	SND/RCV Data	Status
		MODCOM	Ch	S1	S2	S3
Flag		Designation				
Error (F110)	Error flag turns on when designating area is over and the instruction isn't executed	Ch	Designated communication channel			
		S1	Device which is registered communication parameter			
		S2	Device which stored communication data			
		S3	Device which stored communication status			

■ MODCOM Ch S1 S2 S3

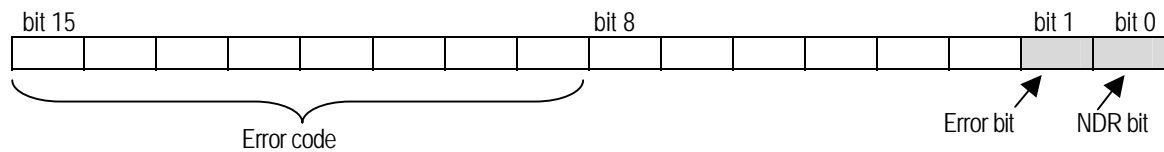
(1) Example program

- Designate slave station No. , function code, address, No. of reading
- When input condition(M0020) turns on, MODBUS communication starts.
- Receiving data are stored D1000, and communication status is stored to M100



- When operates as slave, MASTER-K120S responses to master station without commands. And When operates as master, MASTER-K120S sends data in S1 with MODBUS protocol at rising edges of execution condition.

- S3 format is as below.



- NDR : when the communication ends normally, this bit turns on during 1 scan.
- Error bit : when communication error occurs, this bit turns on during 1 scan. At that time error code stores bit 8 ~ bit 15.
- Error code is as follow

Code	Error type	Meaning
01	Illegal Function	Error in inputting function code in instruction.
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 station 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
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 S1 of instruction are the same.

Remark

- . In MASTER-K120S series, the 'MODBUS' command which has been used in MK80S series can be used. In this case, communication channel is fixed to channel 0.

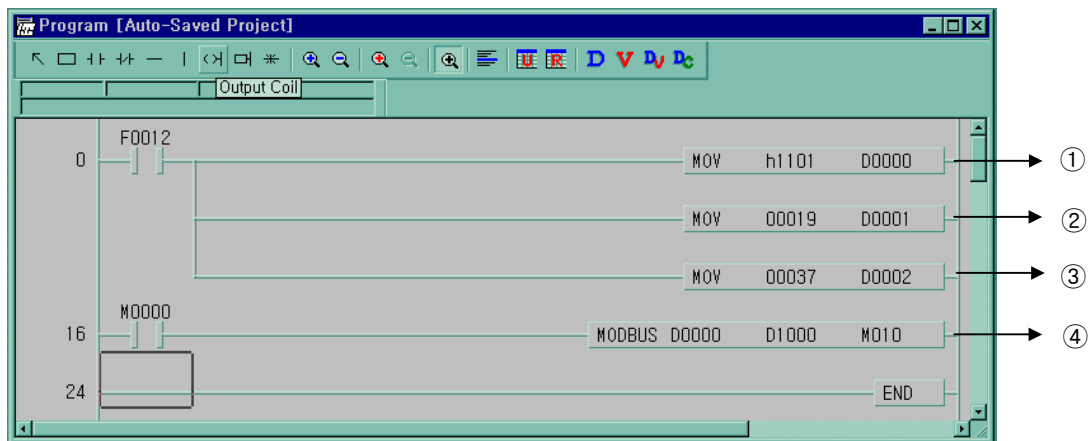
2) Example program 1

It's supposed that MASTER-K120S 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 D1000

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			

- The status of Coil 57, 58, 59 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 Following example 1.

Example 1) CD B2 0E 1B



- ① It designates slave station and function code (No. of station : h11(17) , function code : h01)
- ② Address setting
 - Address '0' at MODBUS protocol means address '1' actually .So if you want to designate address '20' , write address '19'
- ③ Reading number setting (Reading number is 37 from 20 to 56.)
- ④ This is MODBUS Communication instruction.
 - 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.
 - The data transmission starts lower byte. The remnant part of byte is filled with '0'
- ⑤ Stored data at D1000,D1001,D1002 are :

Device	Stored data
D1000	h CD 6B
D1001	h B2 CE
D1002	h 00 1B

3) Example program 2

It's supposed that MASTER-K120S main unit is the master and it reads Coil Status of the station no. 17, a Modicon product.

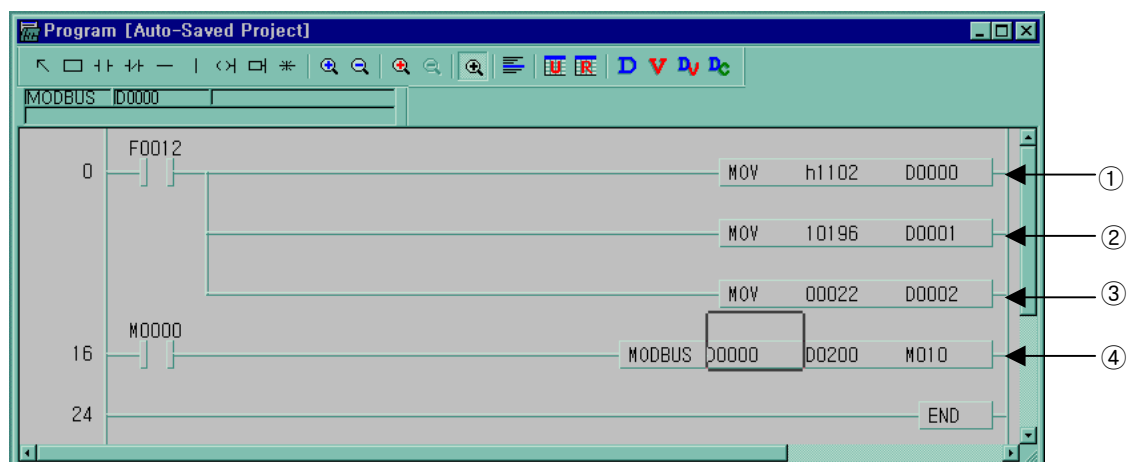
The master reads status of the input contact 10197 ~ 10218 of the slave station no. 17.

The input contact of the slave station is supposed to be as follows and the data that are read is saved in M015.

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			

- The status of input contact 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.

Example 2) AC DB 35

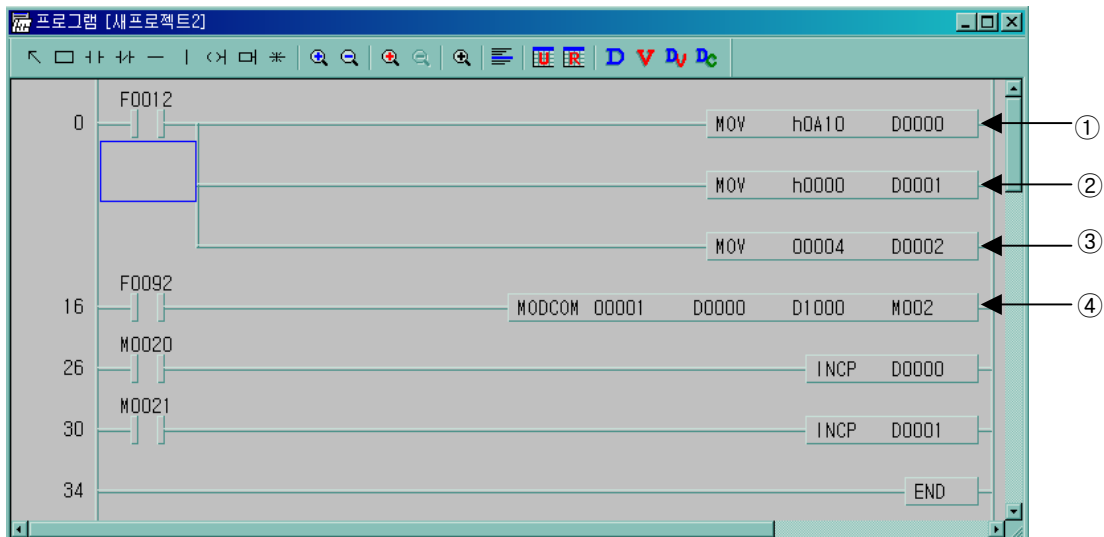


- ① : It designates slave station and function code (No. of station : h11(17) , function code : h02)
- ② : Address setting
Address '0' at MODBUS protocol means address '1' actually .So if you want to designate address '10197' , write address '10196'
- ③ : Reading number setting (Reading number is 22 from 10197 to 10220.)
- ④ : This is MODBUS Communication instruction.
The data transmission starts lower byte. The remnant part of byte is filled with '0'
- ⑤ Stored data at D200,D201 are :

Device	Stored data
D200	h AC DB
D201	h 00 35

4) Example program 3

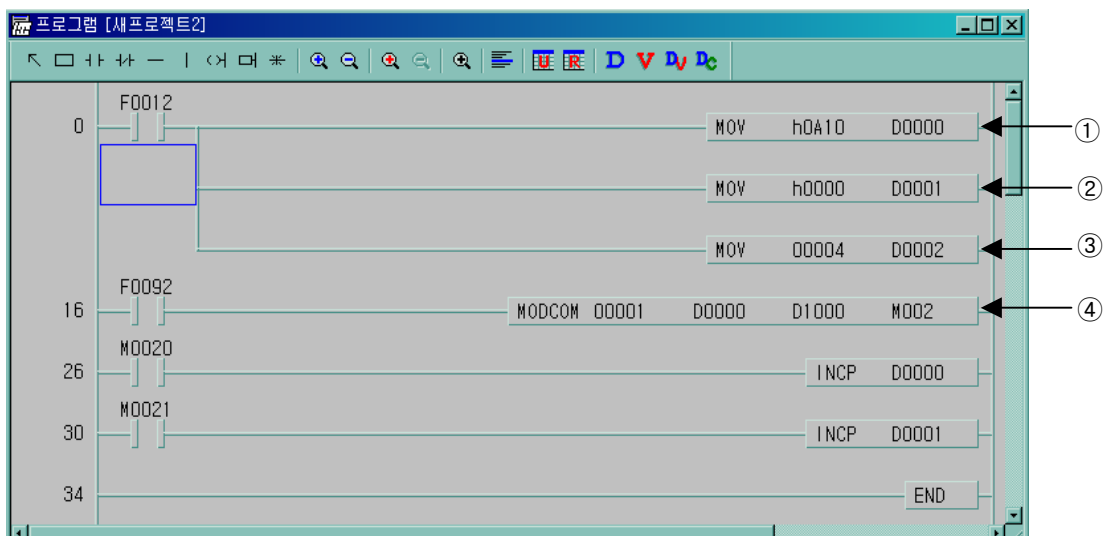
The master writes data D1000 ~ D1003 to contact 40000 of the slave station no. 10.



- ① : It designates slave station and function code (No. of station : h0A(10) , function code : h10)
- ② : Address setting
Address '0' of function code '16' at MODBUS protocol means address '40000' actually.
- ③ : Writing number setting (Writing number is 4)
- ④ : This is MODBUS Communication instruction.

5) Example program 4

The master writes data in D1000 to contact 40000 of the slave station no. 10.



- ① : It designates slave station and function code (No. of station : h0A(10) , function code : h06)
- ② : Address setting
Address '0' of function code '16' at MODBUS protocol means address '40000' actually.
- ③ : Writing number setting (Writing number is 1)
- ④ : This is MODBUS Communication instruction.

8.4 No Protocol Communication

8.4.1 Introduction

No protocol communication is useful when communication between MASTER-K120S 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 kinds of frame are more than 16, they can't be registered in parameter area, therefore MASTER-K120s can't transfer these frames. Also, if there are no interval between frame, MASTER-K120S can't find end of frame.

To overcome these defects of user defined protocol, MASTER-K120S provide 'No Protocol Communication'.

In the No Protocol Communication, frames are designated by commands, not by parameter setting. So Max. 128 frames can be designated when using this communication mode. This section explains No protocol Communication setting & usage.

1) Sending Data

Input Condition	No protocol Communication	Channel	No. of Sending byte	Sending Byte Area	Status
	DSND	00000	00010	D0100	M000

- 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.
- Operands
 - (a) First operand – Designates communication channel
 - (b) Second operand – Number of data to sending (Unit of byte)
 - (c) Third operand – Starting address of devices which stores sending data
 - (d) Fourth operand – Device address which indicates communication status.

2) Receiving Data

Input Condition	No protocol Communication	Channel	Receive Format	Receiving Data Storing Area	Status
	DRCV	h0001	h0003	D0100	M010

- 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 kinds.
 - By number of character which is received.
 - By designated last byte. It is useful when there is no interval between received frames.
- Supports hexadecimal type.
- Operands
 - (a) First operand – Designates communication channel
 - (b) Second operand – Designates receiving format
 - (c) Third operand – Starting address of devices which stores receiving data
 - (d) Fourth operand – Device which indicates end of receiving

- Receiving format can be designated as below.

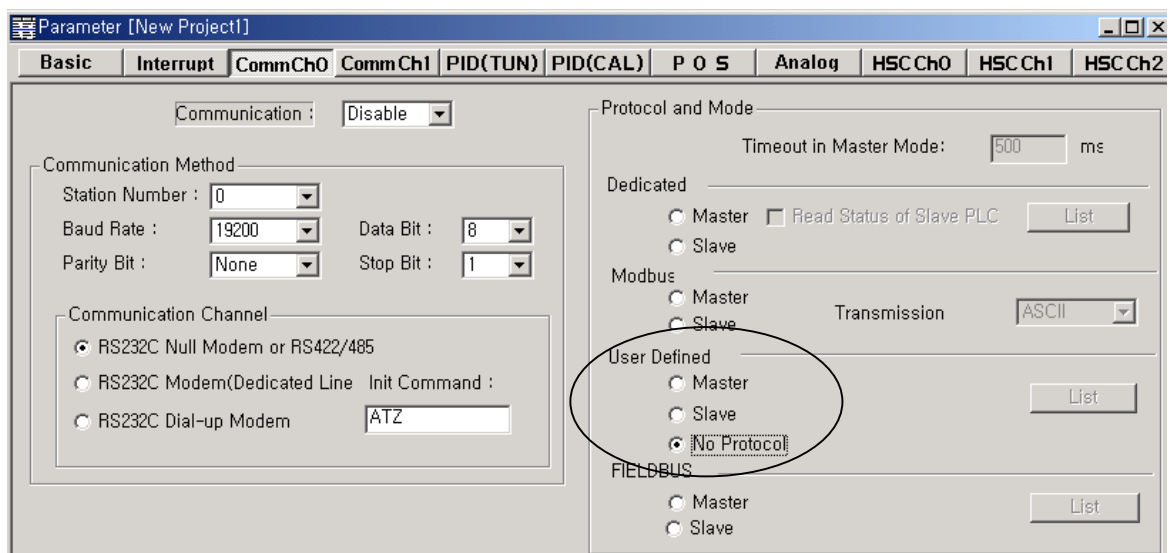
Upper byte(hex)	Lower byte(hex)
H00(Receiving by Length of frame)	H03 (Receives when length of frame data is 3)
H01(Receiving by last byte)	H03 (Receives when last frame data is 03(ETX))

- When designated as length of frame : Stores received data to devices when number of received byte is equal to designated lower byte value of receiving format.(Setting range : 1~255)
- When designated last byte : Stores received data to devices when receives designated ending byte.

8.4.2 Parameter setting

1) Setting Communications Parameter

- Open a new project file from KGLWIN and select MK120S as PLC type
- After selecting communication parameter at KGLWIN. Double click it to activate this window



- Set the communication methods and channel (Refer to Chapter 8.1.7 for details.)
- Click 'No protocol', then parameter setting is finished

8.4.3 Instructions

1) No protocol receive(DRCV)

DRCV	No protocol receive
------	---------------------

Instruction	Available Device											No. of step	Flag		
	M	P	K	L	F	T	C	S	D	#D	Integer		Error (F110)	Zero (F111)	Carry (F112)
Ch											○	9	○		
Cw	○	○	○	○	○	○	○		○	○	○				
D	○	○	○	○		○	○		○	○					
SS	○	○	○	○		○	○		○	○					

Input Condition

No protocol Communication Channel

Receive Format

Receiving Data Storing Area

Status

DRCV

Ch

CW

D

SS

Flag

Error (F110)

Error flag turns on, when designating area is over.

Designation

Ch

Designated communication channel

CW

Designated format of receiving frame

D

Device address which is stored communication data

SS

Device address which is displayed communication status

■ DRCV Ch Cw D SS

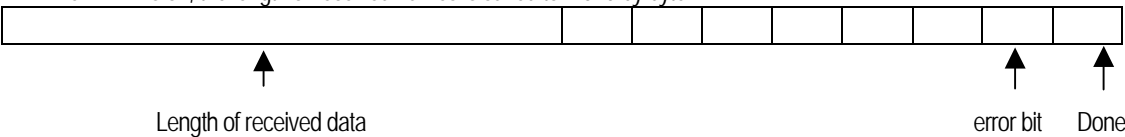
(1) Function

- When the execution condition is on, the communication starts with No protocol.
- Received data is stored in device 'D'
- If received data is not match to the designated format by 'Cw', data is not saved to 'D'
- The communication status is saved in 'SS' .

(2) Example program



- When the execution condition M0000 is on, the communication starts with channel 1
- When 'EXT(h'03)' is received, Received frames are saved to D0100
- When NDR is on, the length of received frames is saved to M010 by byte.



1) No protocol send(DSND)

DSND	No protocol send
------	------------------

Instruction	Available Device											No. of step	Flag		
	M	P	K	L	F	T	C	S	D	#D	Integer		Error (F110)	Zero (F111)	Carry (F112)
Ch											○	9	○		
n	○	○	○	○	○	○	○		○	○	○				
S	○	○	○	○		○	○		○	○					
SS	○	○	○	○		○	○		○	○					

Input Condition	No protocol Communication	Channel	No. of Sending byte	Sending Byte Area	Status
<input type="checkbox"/>	DSND	Ch	n	S	SS

Flag	Designation
Error (F110)	Error flag turns on, when designating area is over.
Ch	Designated communication channel
n	Number of data to sending by bytes
S	Device address which is stored communication data
SS	Device address which is displayed communication status

■ DSND Ch n S SS

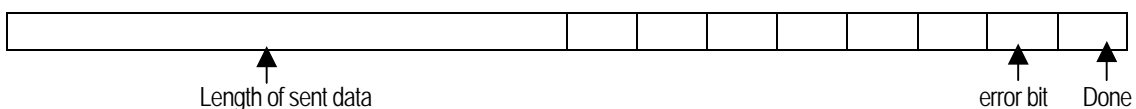
(1) Function

- When the execution condition is on, the No protocol communication starts
- 'n' represents the number of data to send (unit of byte) and Sending data is stored in device 'D'
- 'Ch' is designated communication channel and Communication status is saved in 'SS'.

(2) Example program

P0040	DSND	00000	00010	D0100	M000
-------	------	-------	-------	-------	------

- When the execution condition P0040 is on, the communication starts with channel 1
- Length of sending data which is stored in D0100 is 10 byte and the communication status is stored in M000.

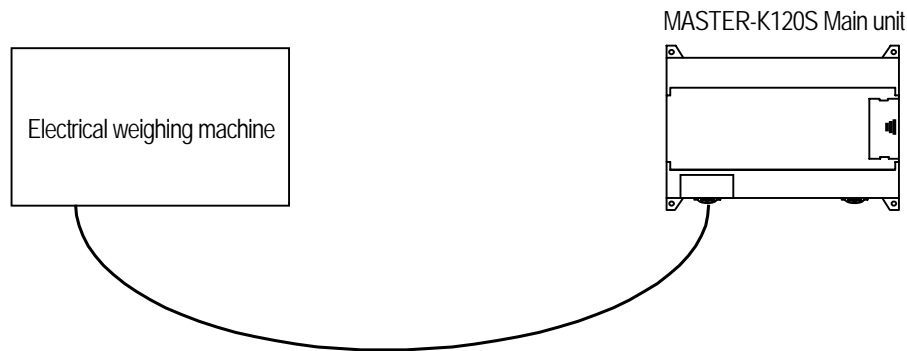


(3) Error code

Code	Error	Description
06	Parameter Error	Communication parameter setting error
08	Slave Device Busy	Slave device is busy
09	Frame Type Error	Size of sending byte is out of range

8.4.4 Examples

Assume that a electrical weighing machine sends data which has unfixed size continuously. MASTER-K120S can communicates with it using no protocol.



For no protocol communication, one of following ending condition is designated. One is size of received data and the other is whether it has some pre-defined data.

In this example, assume that received data is as following.

" ENQ(1Byte) + Station No.(1Byte) + Data(1~10 Words) + EOT(1Byte)"

When above frame is received, Received framed is saved to designated device If designated 'Receiving Format(Cw)' is h0104. and decides if use these data or not. After that, sends data which is in sending device if required.

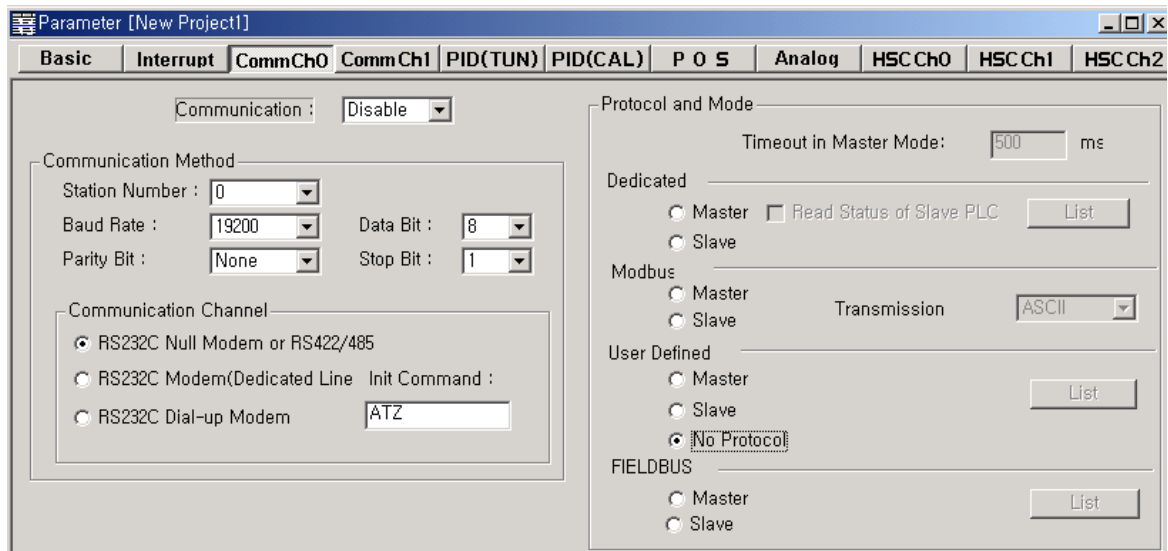
Assume that the sending data format is as following.

" ACK(1Byte) + Station No.(1Byte) + OK(2Bytes) + EOT(1Byte)"

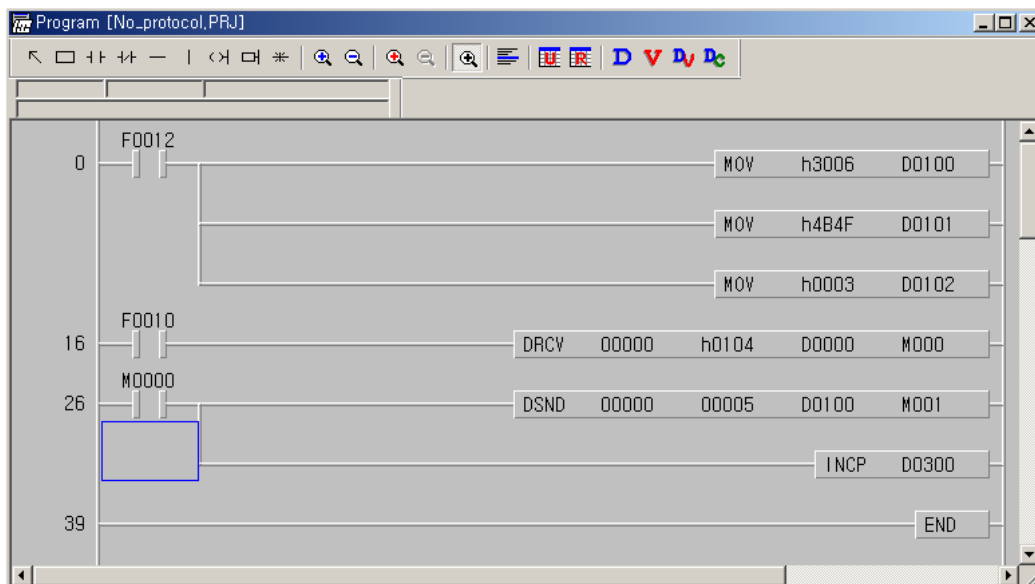
In this example the size of received data is 1 word.

1) Communication Parameter Setting

- Open a new project file from KGLWIN
 - K120S must be selected as PLC type.
- After selecting communication parameter from KGLWIN and clicking twice, this window comes up.
- Designate baud rate, data bit, parity bit, stop bit, and protocol.



2) Program



- Save sending data to D0100 : "ack + 0 + OK + ETX"
 - If h'04(EOT) is received, h3004 is saved to D0000, and Weight data to D0111(1 Word)
- Sending 5bytes in D0100 using DSND instruction

8.5 Remote connection and communication I/F module

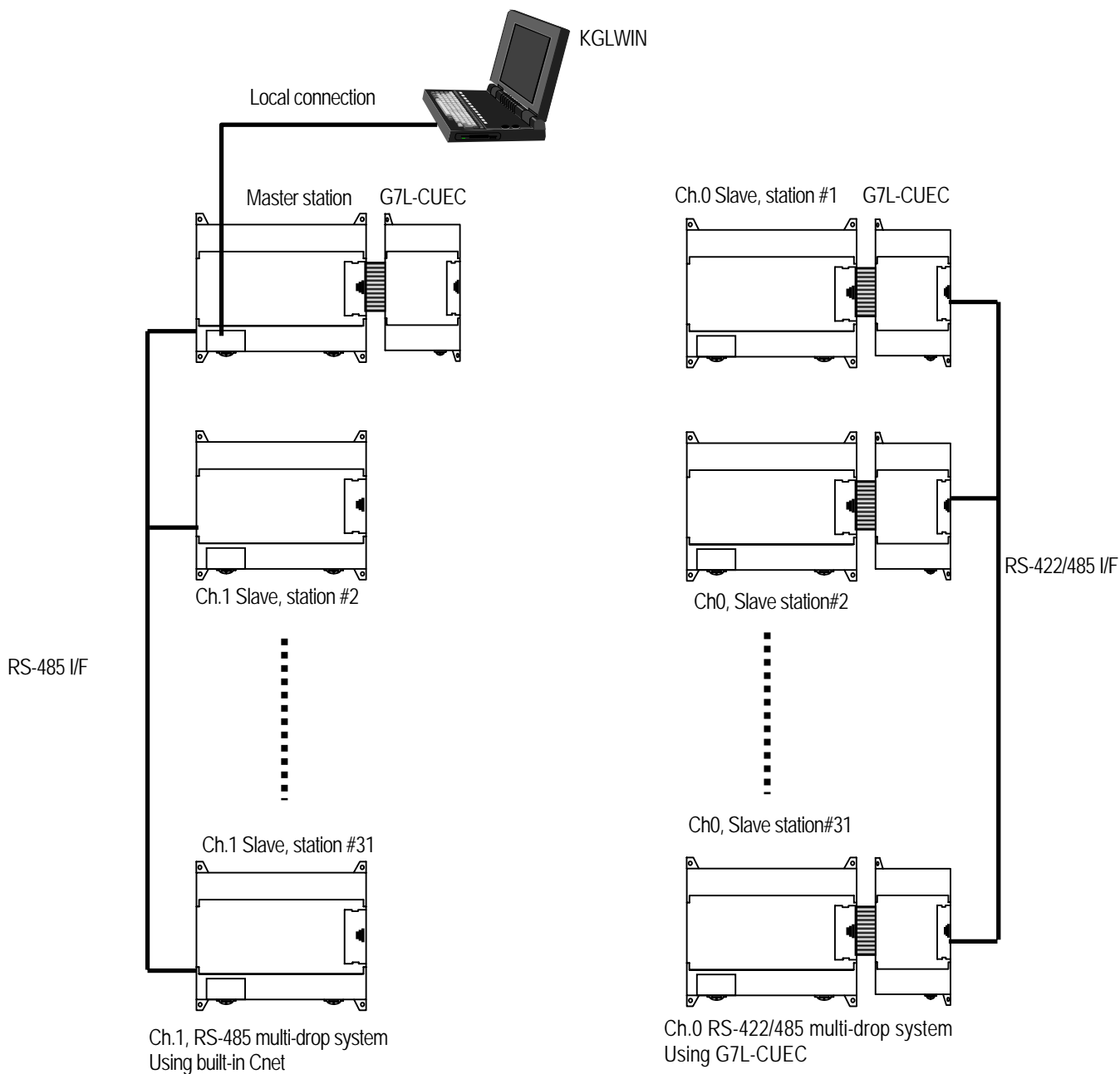
8.5.1 Remote connection

MASTER-K120S series can connect to other PLC by built-in Cnet interface or communication I/F modules.

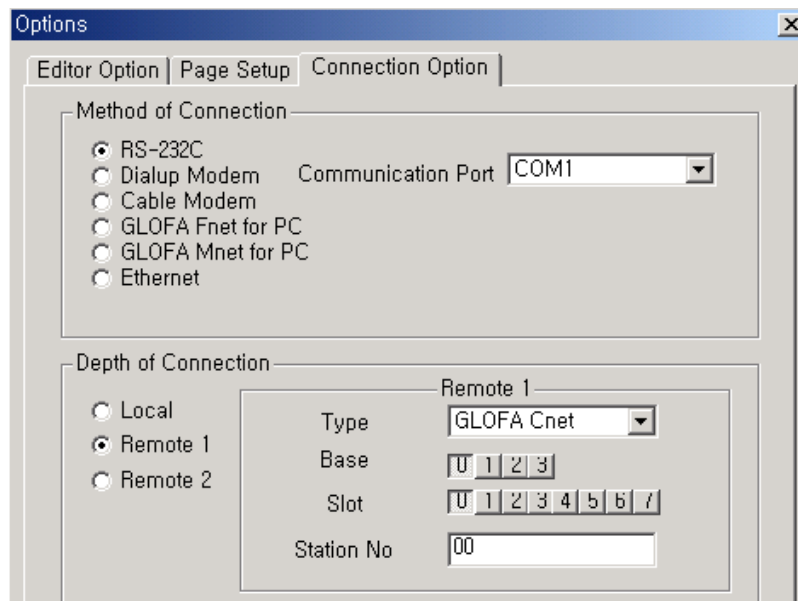
1) Remote connection by built-in Cnet I/F

Remote connection by built-in Cnet I/F is available by dedicated communication protocol only.

If KGLWIN and Master station is connected physically, it can connect to each slave station using remote connection function.



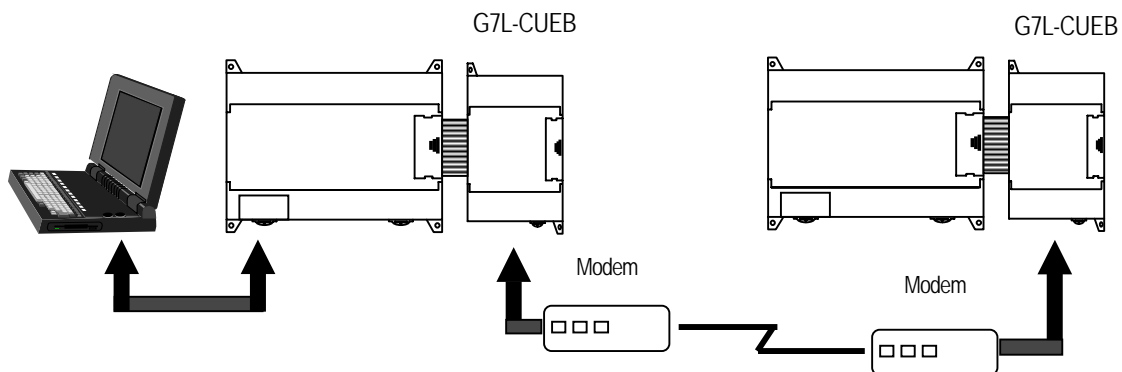
- Open a new project file from KGLWIN
- After selecting menu-project-option, click 'connection option'



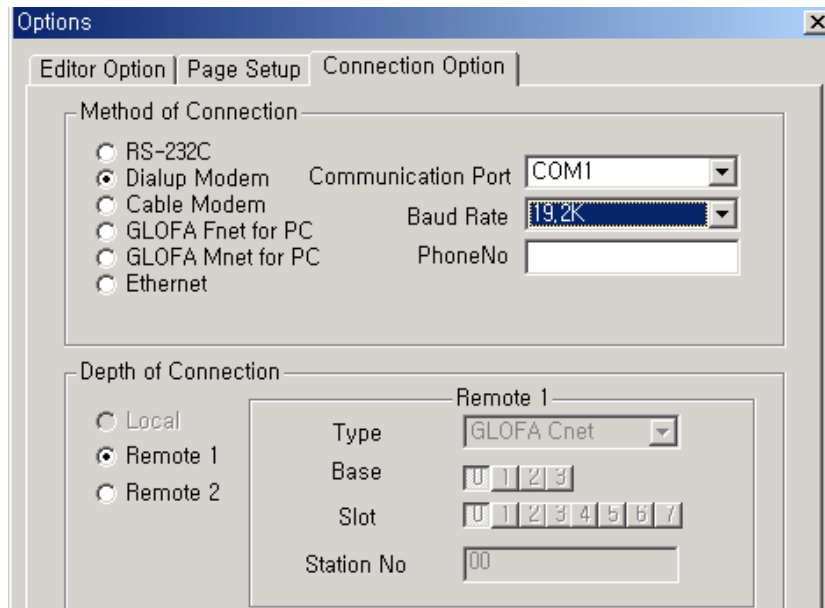
- Click 'Remote 1' in depth of connection
 - Type : Select GLOFA Cnet.
 - Base : Select '0'.
 - Slot : set to 0 when uses channel 0, and '1' when uses channel 1
 - Station No. : Input slave station number to connect
- Click 'OK'
- Remote connection is available by dedicated protocol only

2) Remote connection by modem

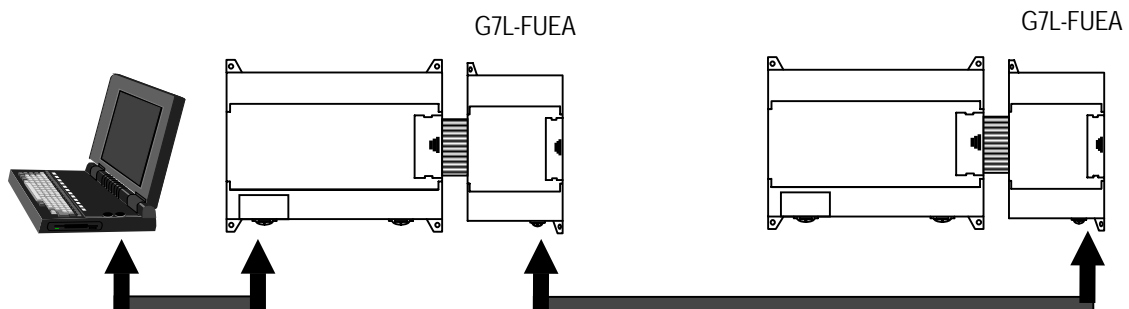
Remote connection by modem is available by G7L-CUEB I/F module.
In this time, TM/TC switch of G7L-CUEB module must be set to 'On'.



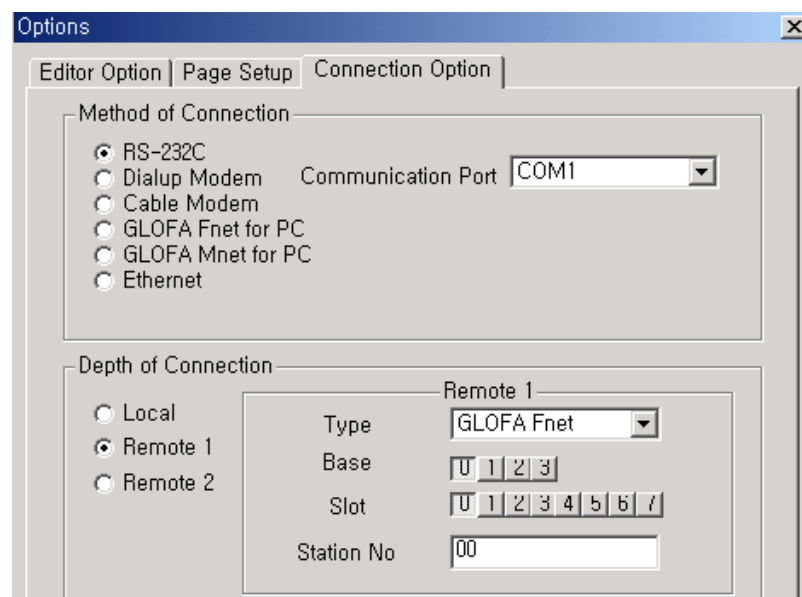
- Dedicated modem and dial-up modem are both available and Set connection option of KGLWIN as below.



3) Remote connection by Fnet I/F module



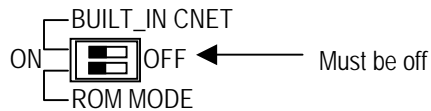
- Remote connection by Fnet interface is available by setting connection option of KGLWIN as below



8.5.2 Communication I/F module

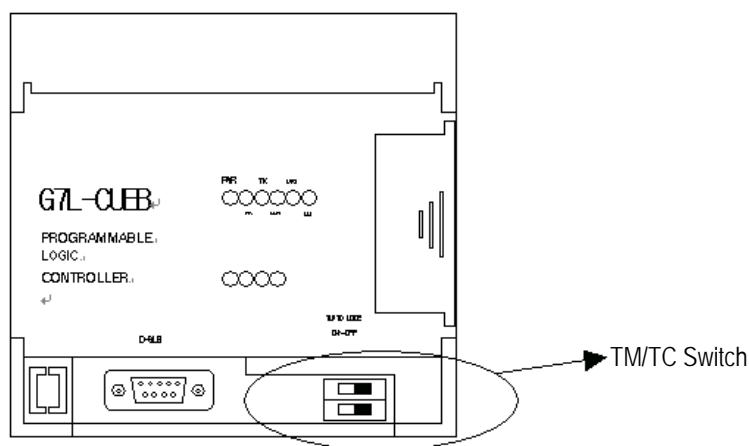
MASTER-K120S series supports various kinds of communication I/F module.

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, MASTER-K120S can connect to other PLC by dedicated modem or dial-up modem

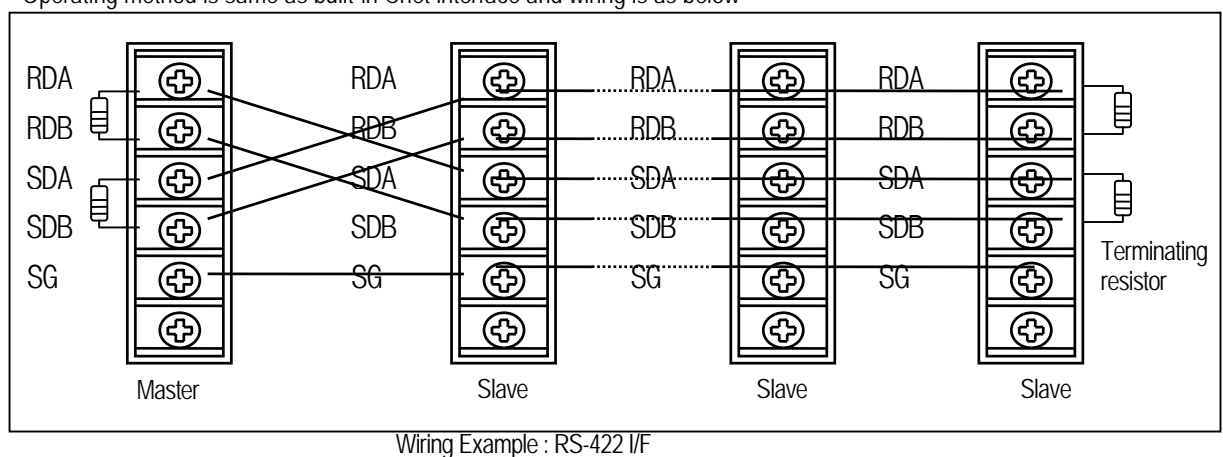


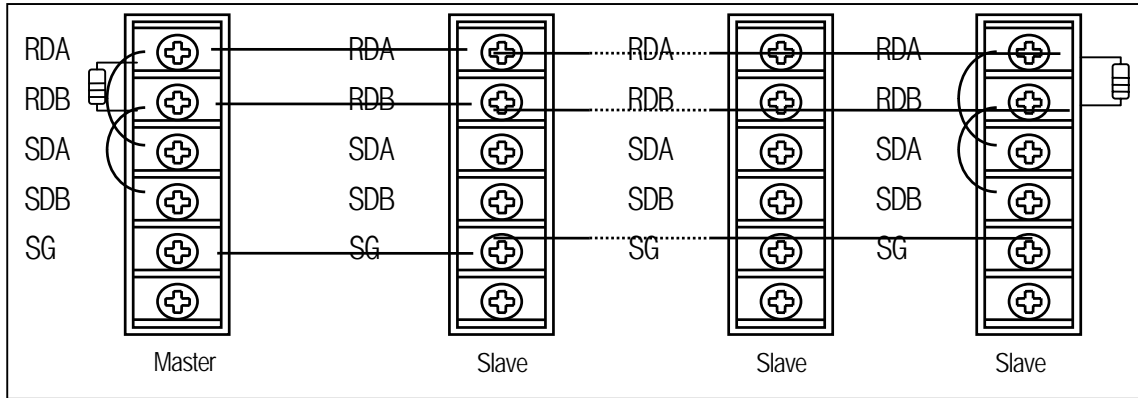
- Set TM/TC switch to 'On' when uses remote connection function
- Set TM/TC switch to 'Off' when uses data communication function
- Data communication and remote connection function are not allowed simultaneously
- Data communication mode supports every communication protocol but In remote connection 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

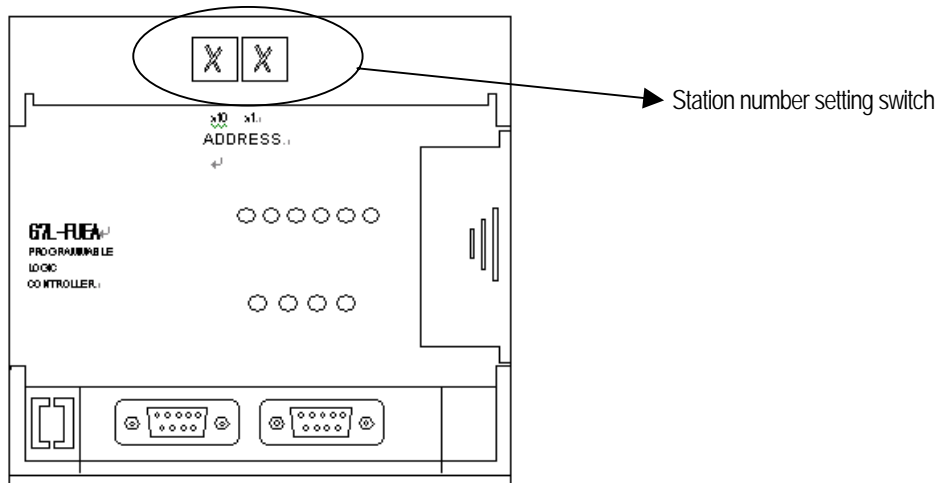




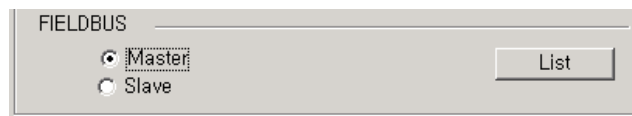
Wiring Example : RS-485 I/F

3) Usage of G7L-FUEA/RUEA

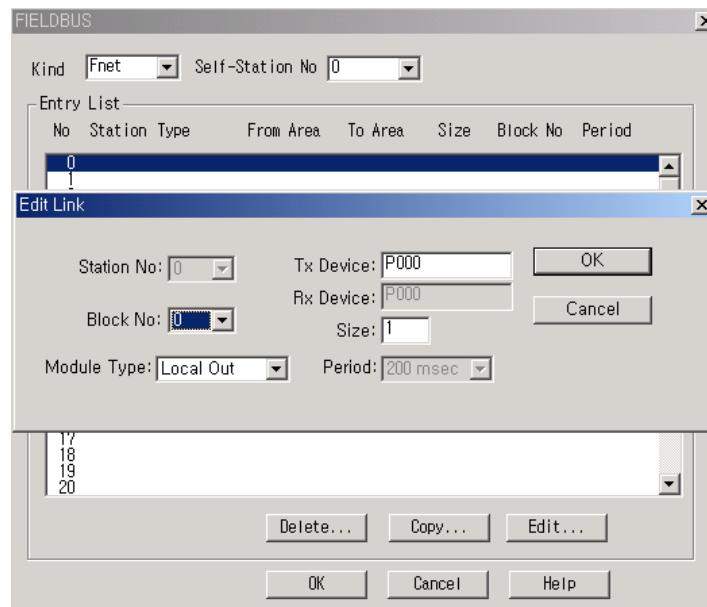
G7L-FUEA and G7L-RUEA are Field Bus Interface module of LGIS and they support High speed link communication service by parameter setting. But communication by command(Read, Write) are not available



- After selecting communication parameter from KGLWIN and select FIELDBUS MASTER as below



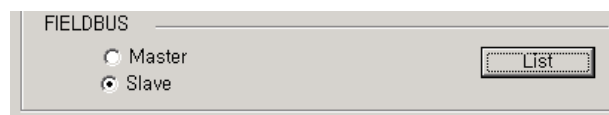
- Clicking List button then this window comes up.
- Designate self-station No. and set link items after double clicking entry list
- For the details, refer to User's manual of Fnet I/F module



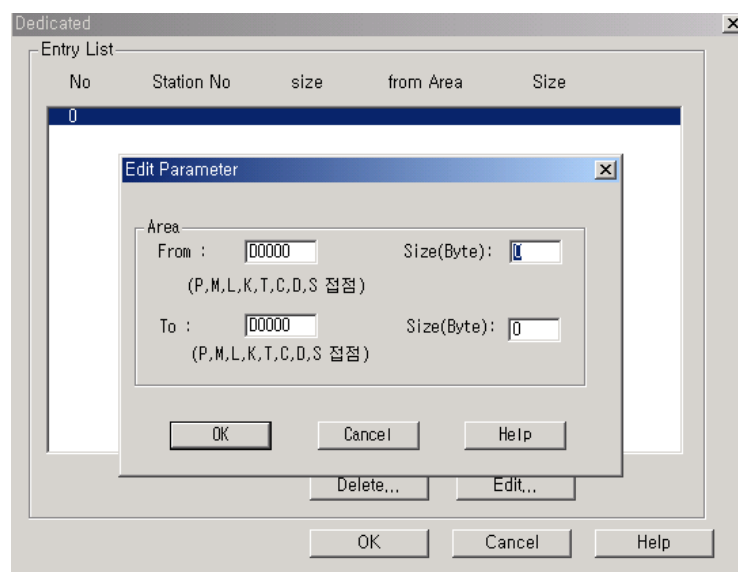
4) Usage of G7L-PBEA/DBEA

G7L-PBEA support profibus slave function only and G7L-DBEA supports DeviceNet slave interface function only.

- After selecting communication parameter from KGLWIN and select FIELDBUS slave as below



- Clicking List button then this window comes up.
- After double clicking entry list 0, designate from/to area
- Pnet For maximum Sending/Receiving data size is 244 byte and that of DeviceNet are 30/32 byte.
- For the details, refer to corresponding User's manual



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 °C
- (6) Relative humidity outside the range of 5 to 95 %
- (7) Corrosive or flammable gases

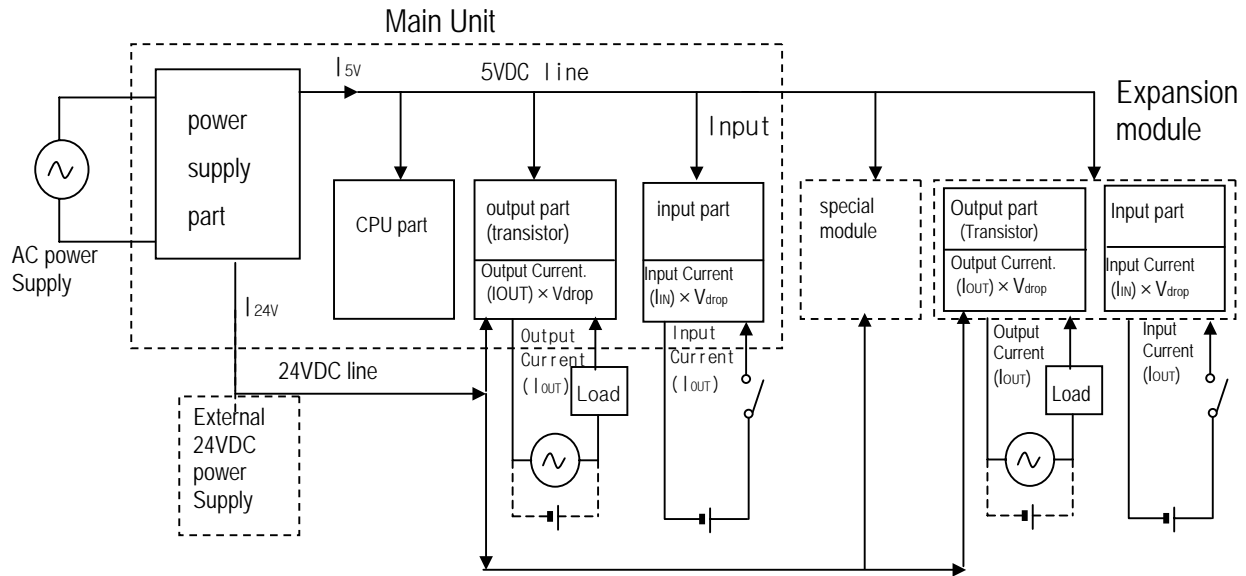
2) Precautions during installing

- (1) During drilling or wiring, do not allow any wire scraps to enter into the PLC.
- (2) Install it on locations that are convenient for operation.
- (3) Make sure that it is not located on the same panel that high voltage equipment located.
- (4) Make sure that the distance from the walls of duct and external equipment be 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, I_{5v} : 5VDC circuit average current consumption of each part

I_{24v} : 24VDC circuit average current consumption of output part (with points simultaneously switched ON).

Not for 24VDC power supplied from external or power supply part that has no 24VDC output.

(2) Total 5VDC power consumption

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

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

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

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

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

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

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

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

(5) Average power consumption of input parts (with points simultaneously ON)

- $W_{in} = I_{in} \times E \times \text{input points} \times \text{the rate of points switched on simultaneously}$ (W)

I_{in} : input current (effective value for AC) (A)
 E : input voltage (actual operating voltage) (V)

(6) Power consumption of the special module

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

(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:

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

$$\begin{cases} W : \text{Power consumption of the entire PLC system (obtained as shown above)} \\ A : \text{Control panel inside surface area [m}^2\text{]} \end{cases}$$

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

if control panel air is not circulated 4

9.1.2 Handling Instructions

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

1) Main unit or Expansion Module handling instructions

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

(1) I/O specifications re-check

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

(2) Used wire

Select the wire with due consideration of ambient temperature and rated current. Its minimum specifications should be AWG24(0.18 mm²) or more.

(3) Environment

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

(4) Polarity

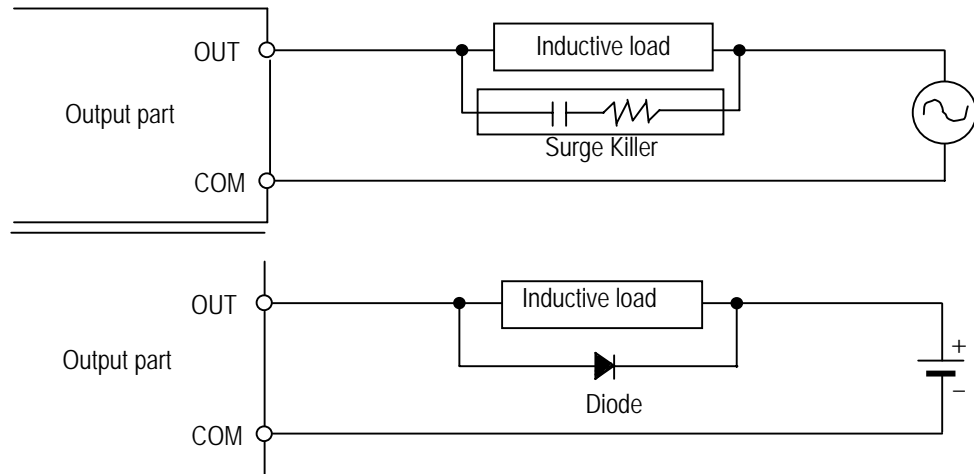
Before applying the power to part that has polarities, be sure to check its polarities.

(5) 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.



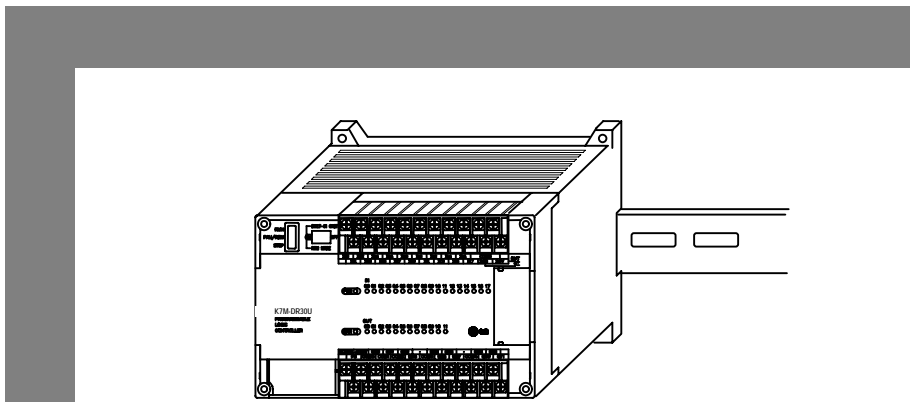
(7) Be cautious that strong shock does not applied to the I/O part.

(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 MASTER-K120S is installed in figure below for most effective heat radiation.



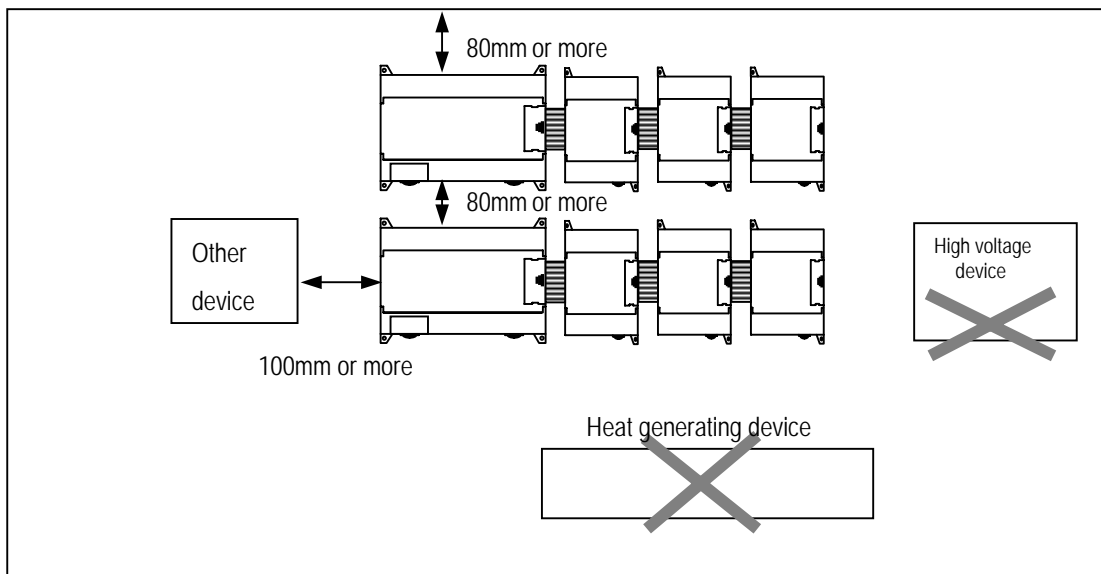
- (3) Do not mount the base board together with a large-sized electromagnetic contact or no-fuse breaker, which produces vibration, on the same panel. Mount them on different panels, or keep the unit or module away from such a vibration source

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

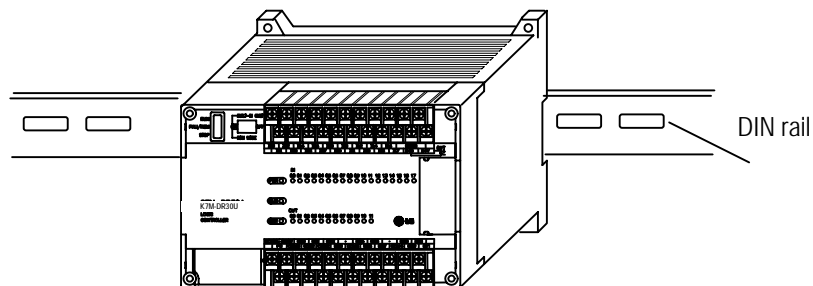
If the clearances are less than those in Fig below, follow the instructions shown below

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

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



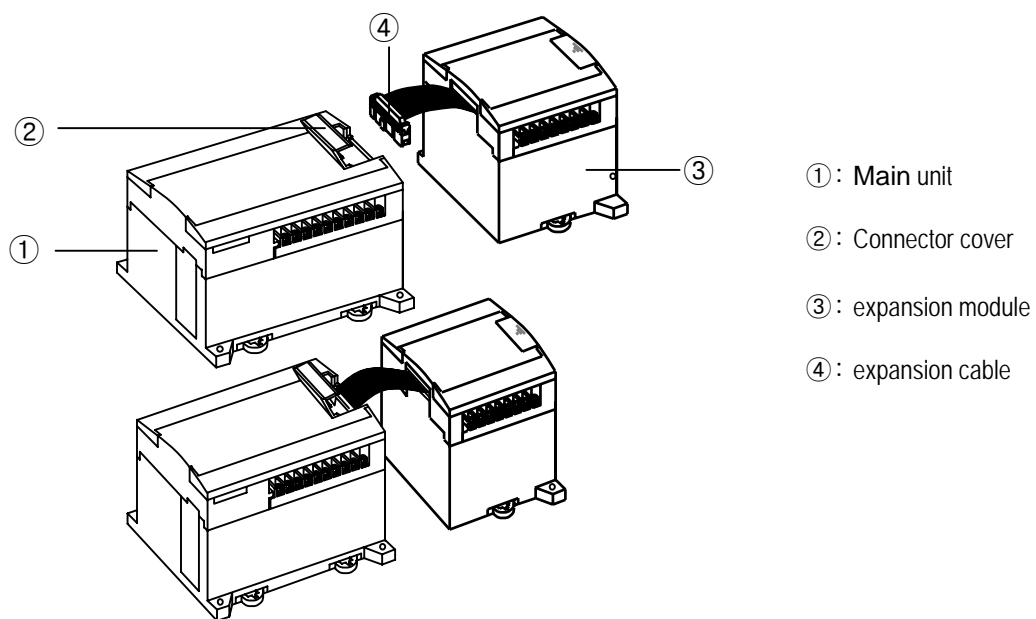
(6) MASTER-K120S has hooks for DIN rail in the base unit and expansion modules.



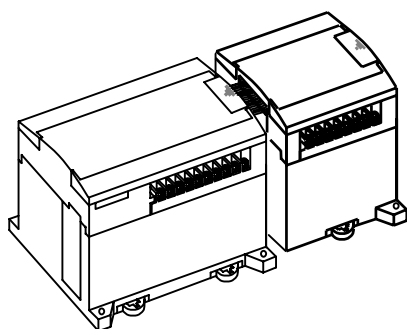
9.1.3 Connection of expansion module

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.



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

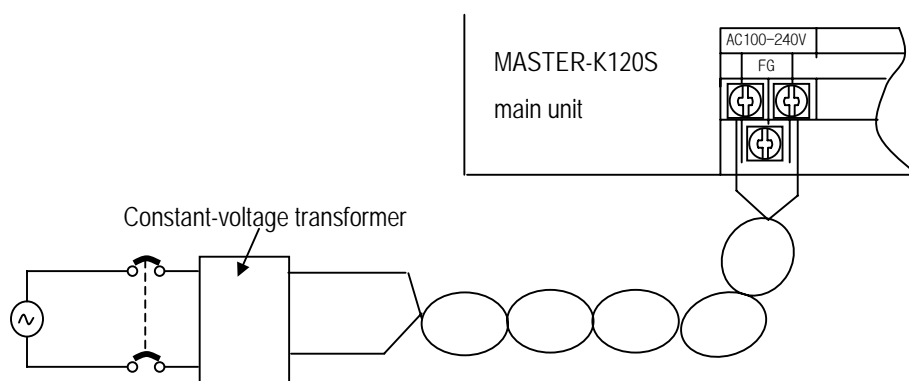


9.2 Wiring

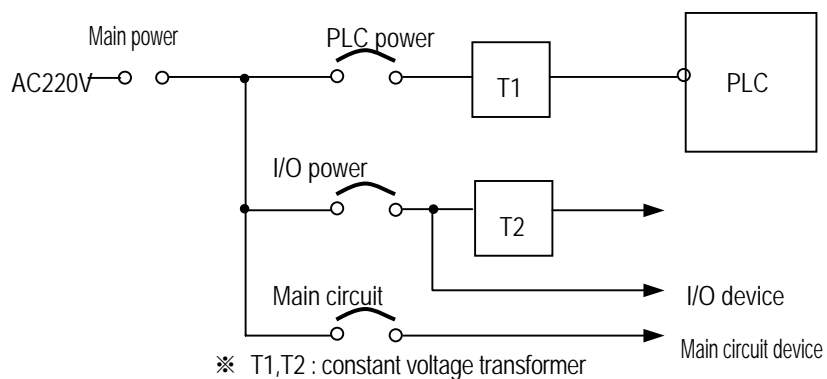
The followings explains the wiring instructions for use of the system.

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)

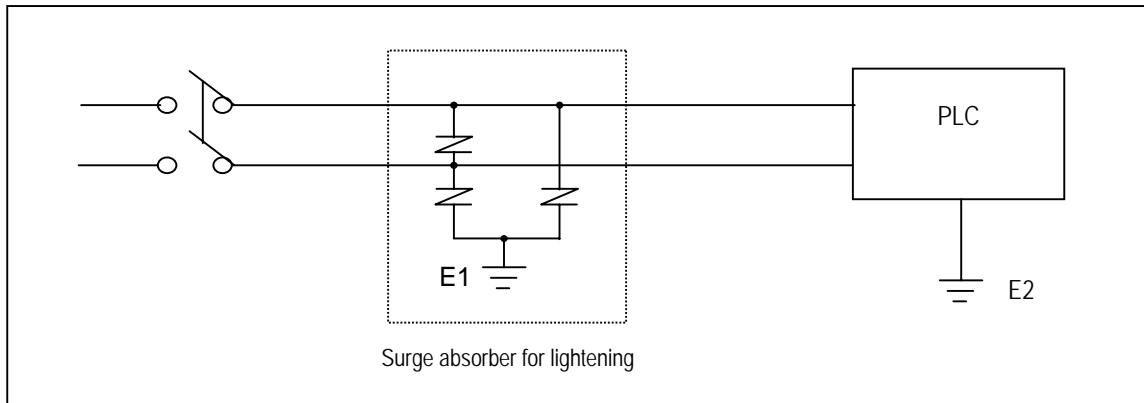


- (4) When wiring, separate the PLC power supply from those for I/O and power device as shown below.



- (5) To minimize voltage drop, use the thickest (max. 2 mm²) wires possible
- (6) Do not bundle the 100 VAC and 24VDC cables with main-circuit (high voltage, large current) wires or the I/O signal wires.
If possible, provide more than 80 mm distance between the cables and wires.

(7) As a measure against very large surge(e.g. due to lightning),connect a surge absorber as shown below.



(8) Use 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.

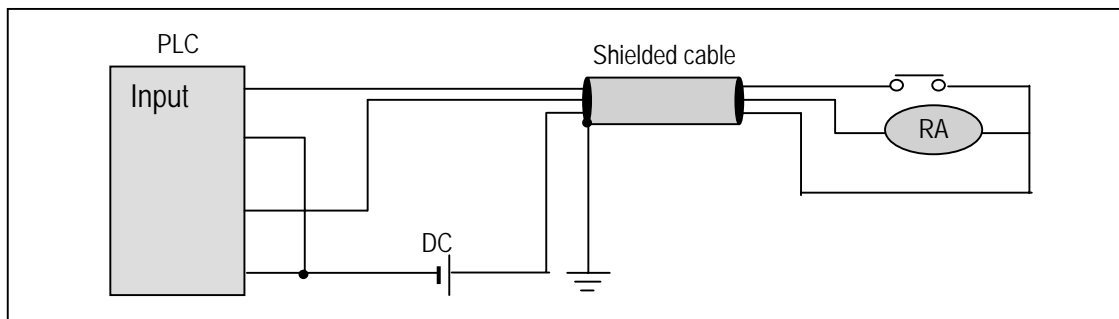
9.2.2 Input and Output Devices Wiring

(1) Applicable size of wire to the terminal block connector is 0.18 to 2 mm². However, it is recommended to use wire of 0.5 mm² for convenience.

(2) Separate the input and output lines.

(3) I/O signal wires must be at least 100 mm(3.94 in) away from high voltage and large current circuit wires.

(4) When the I/O signal wires cannot be separated from the main circuit wires and power wires, ground on the PLC side with batch-shielded cables. Under some conditions it may be preferable to ground on the other side.



(5) If wiring has been done with of piping, ground the piping.

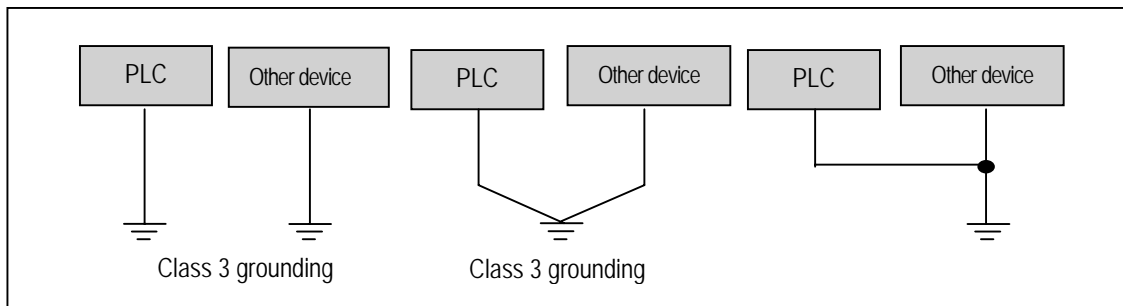
(6) Separate the 24VDC I/O cables from the 110VAC and 220VAC cables.

(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 $80\ \Omega$ 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

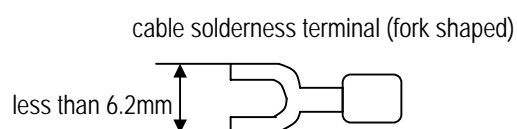
- (4) Use $2\ \text{mm}^2$ (14AWG) or thicker grounding wire. Grounding point should be as near as possible to the PLC to minimize the distance of grounding cable.

9.2.4 Cable Specifications for wiring

The specifications for wiring is as follows:

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

- Be sure to use 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 $6\sim 9\ \text{kg} \cdot \text{cm}$ torque..
- Be sure to use fork shaped terminal screw as shown below.



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	Corrective Actions
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	Corrective Actions
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	Corrective Actions
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 *20~28V 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 instructions 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.

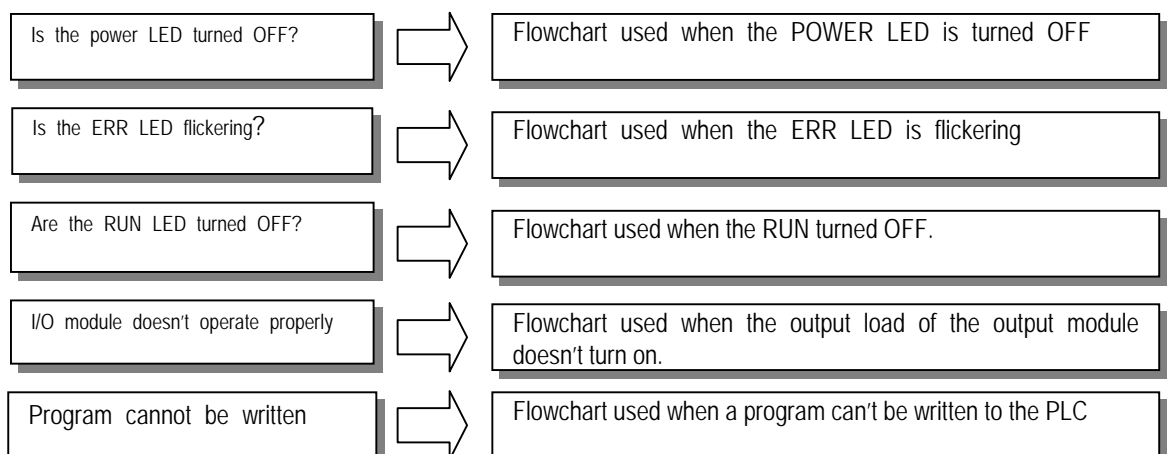
- Switch to the STOP position, and then turn the power on and off.

3) Narrow down the possible causes of the trouble where the fault lies, i.e.:

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

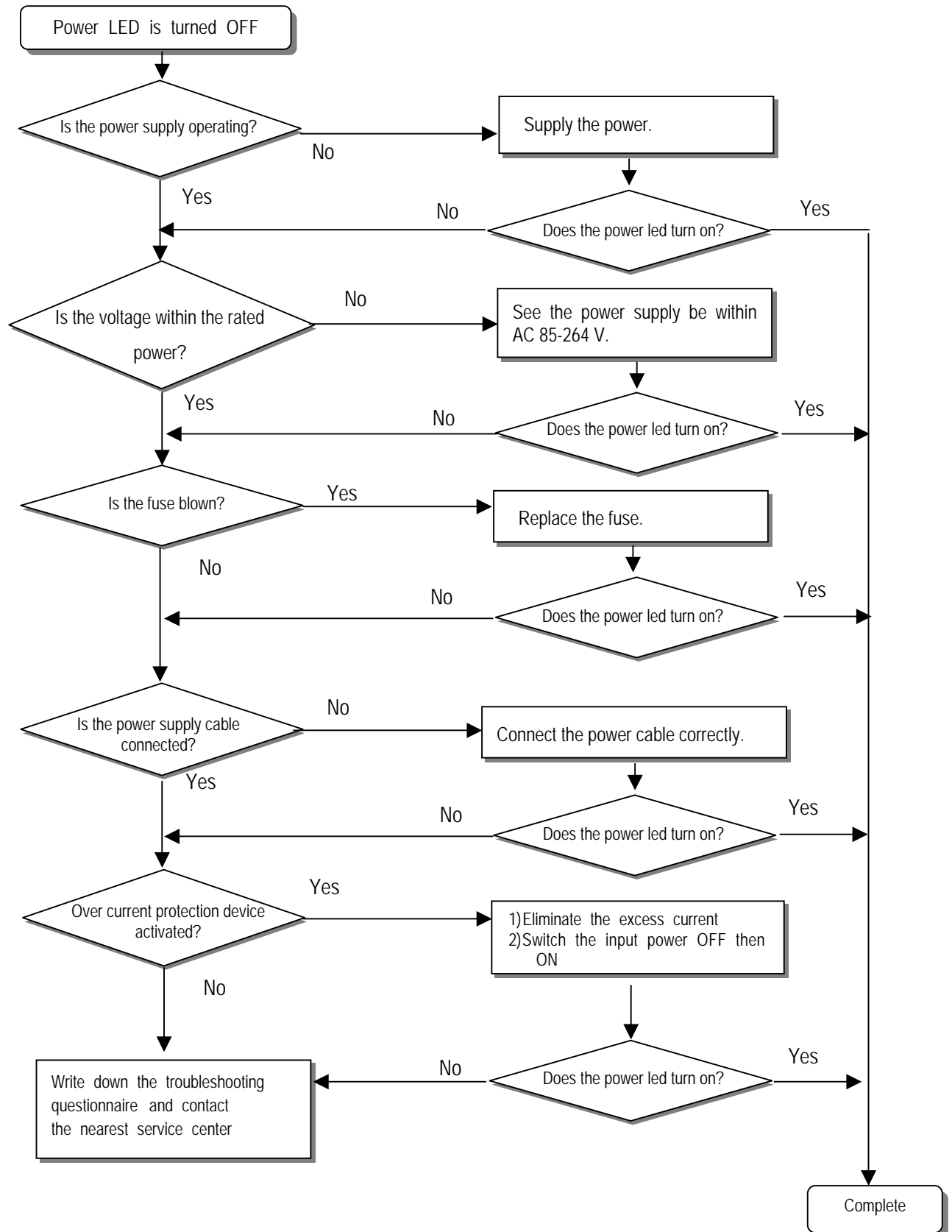
11.2 Troubleshooting

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



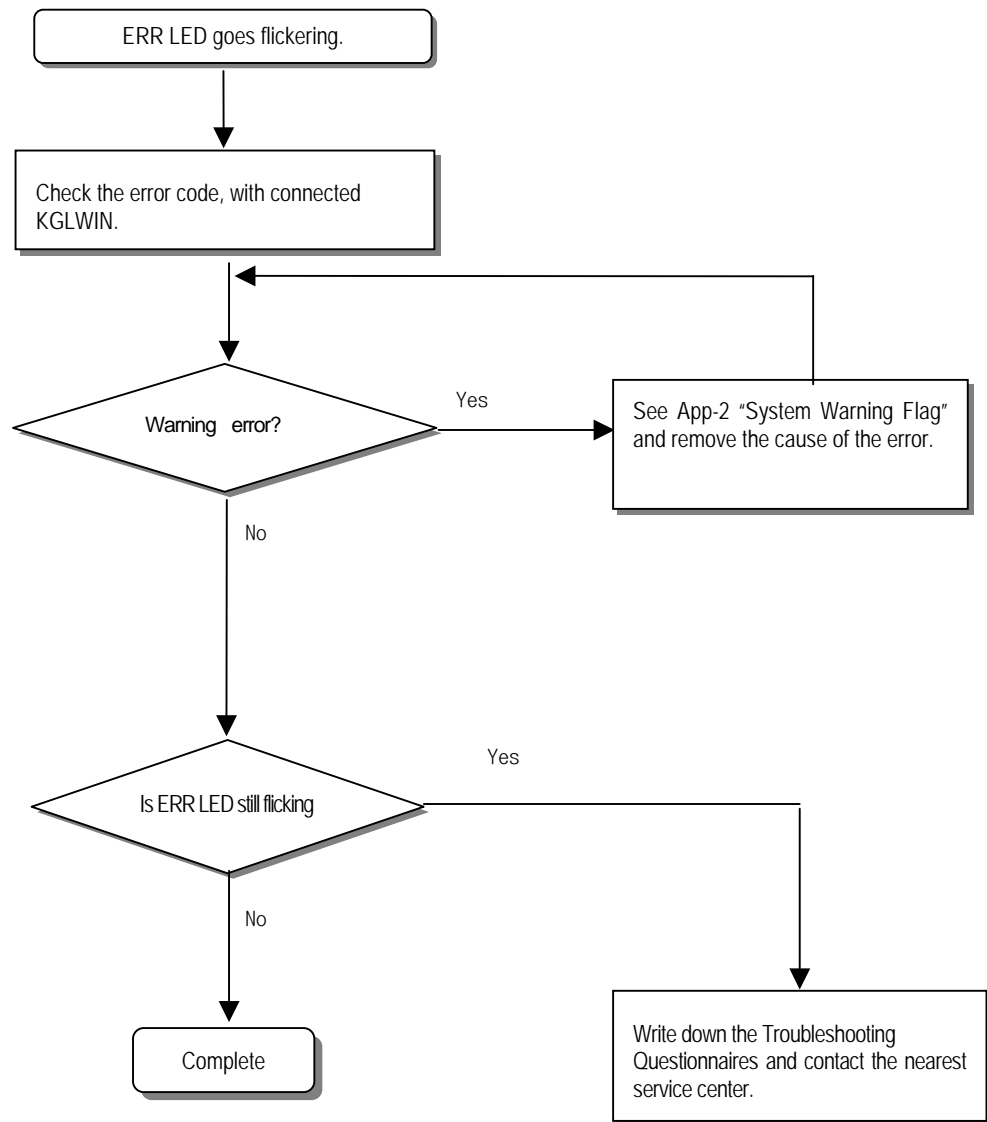
11.2.1 Troubleshooting flowchart used when the POWER LED turns OFF.

The following flowchart explains corrective action procedure used when the power is supplied or the power led turns off during operation.



11.2.2 Troubleshooting flowchart used when the ERR LED is flickering

The following flowchart explains corrective action procedure use when the power is supplied starts or the ERR LED is flickering during operation.

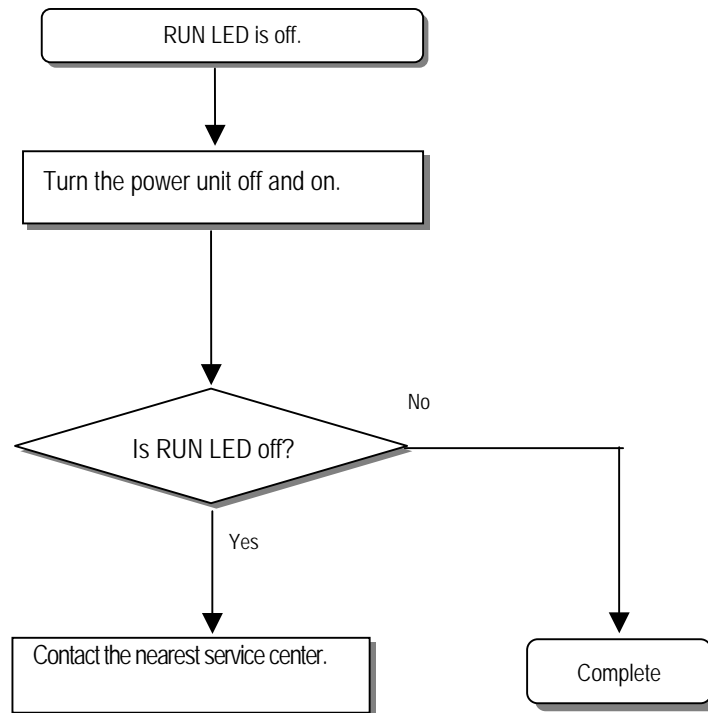


REMARK

Though warning error appears, PLC system doesn't stop but corrective action is needed promptly. If not, it may cause the system failure.

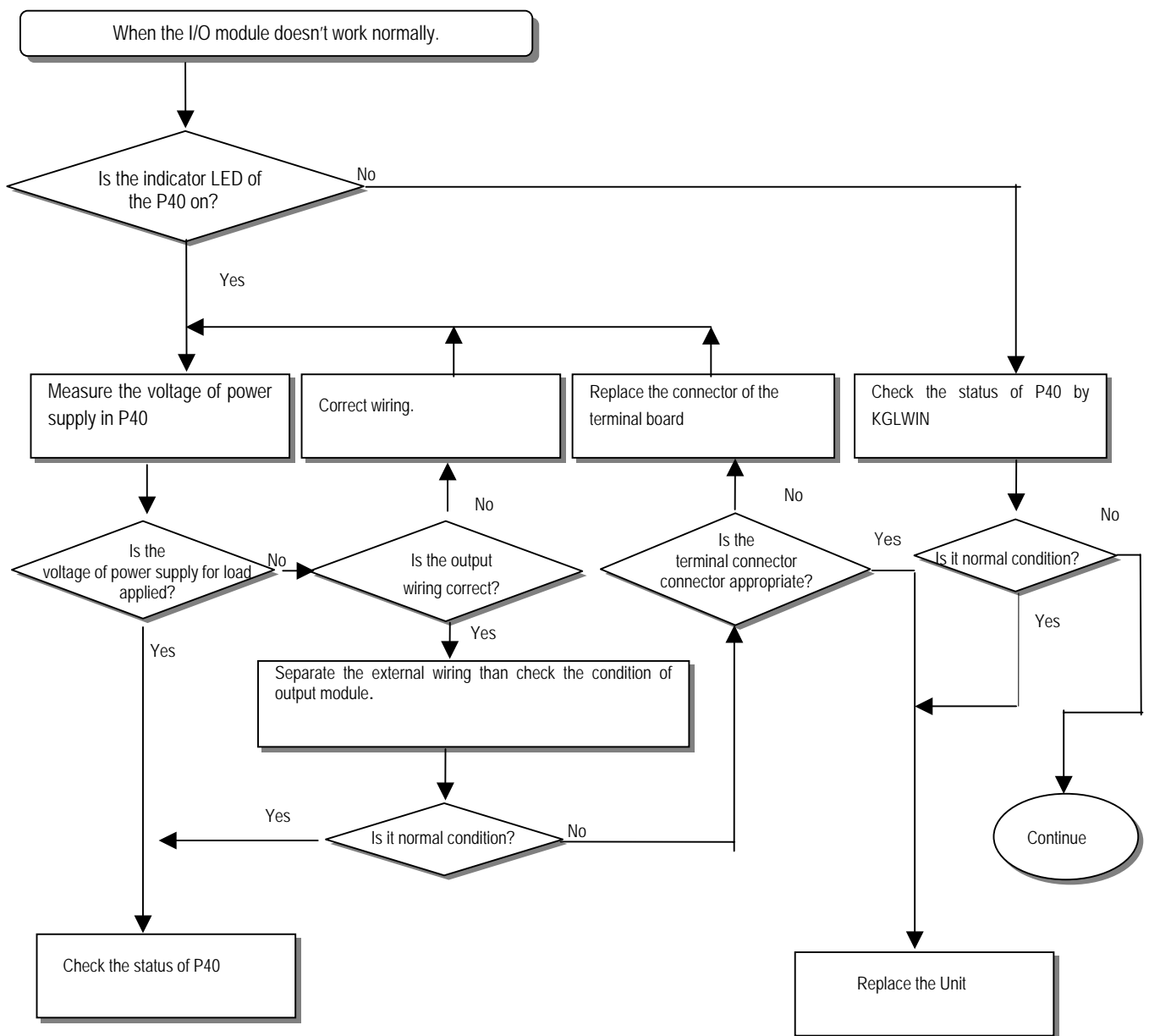
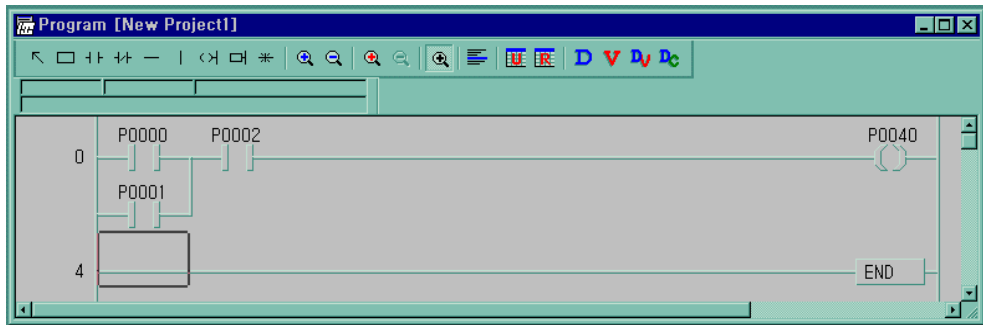
11.2.3 Troubleshooting flowchart used when the RUN LED turns off.

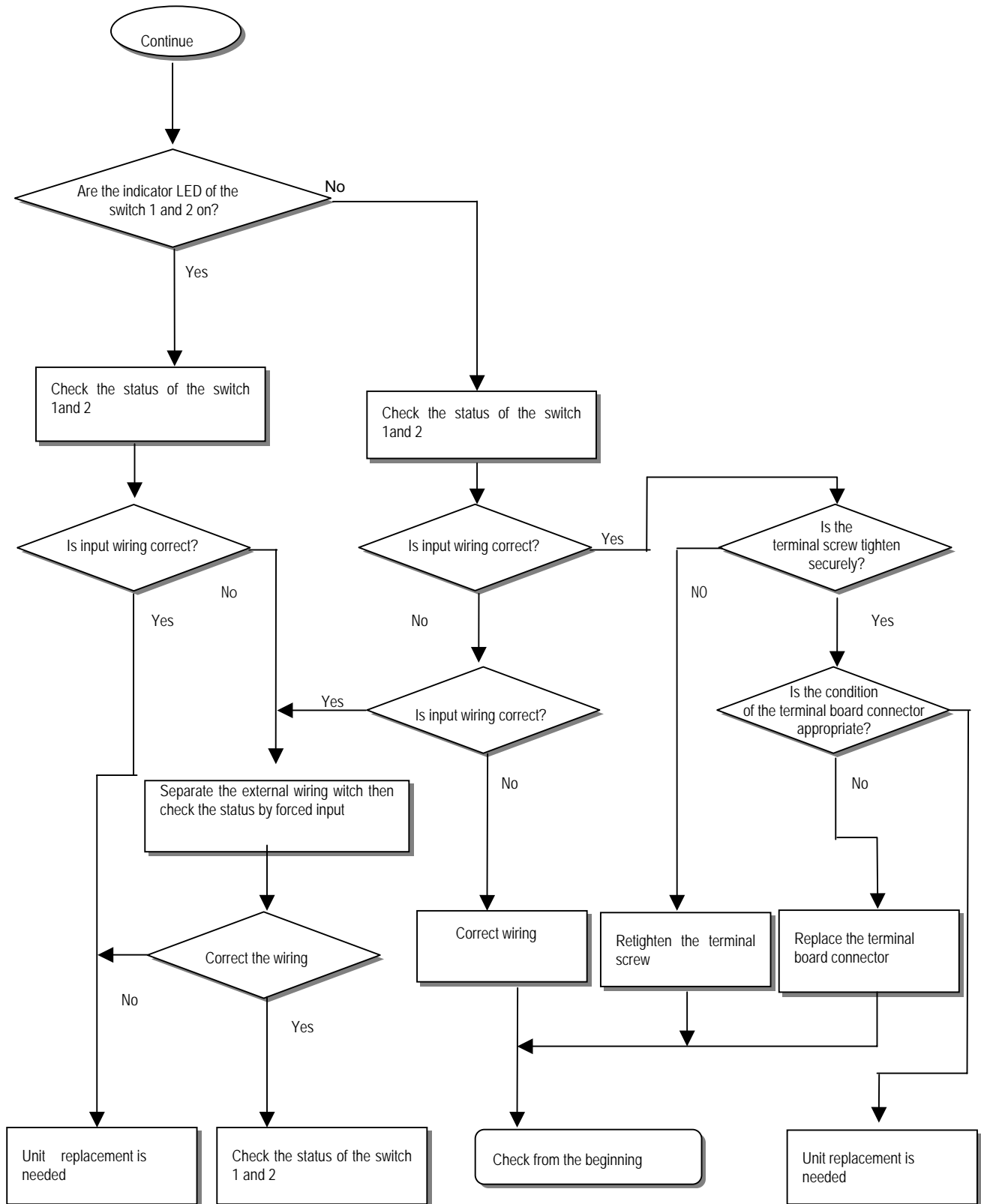
The following flowchart explains corrective action procedure to treat the lights-out of RUN LED when the power is supplied, operation starts or operation is in the process.



11.2.4 Troubleshooting flowchart used when the I/O part doesn't operate normally.

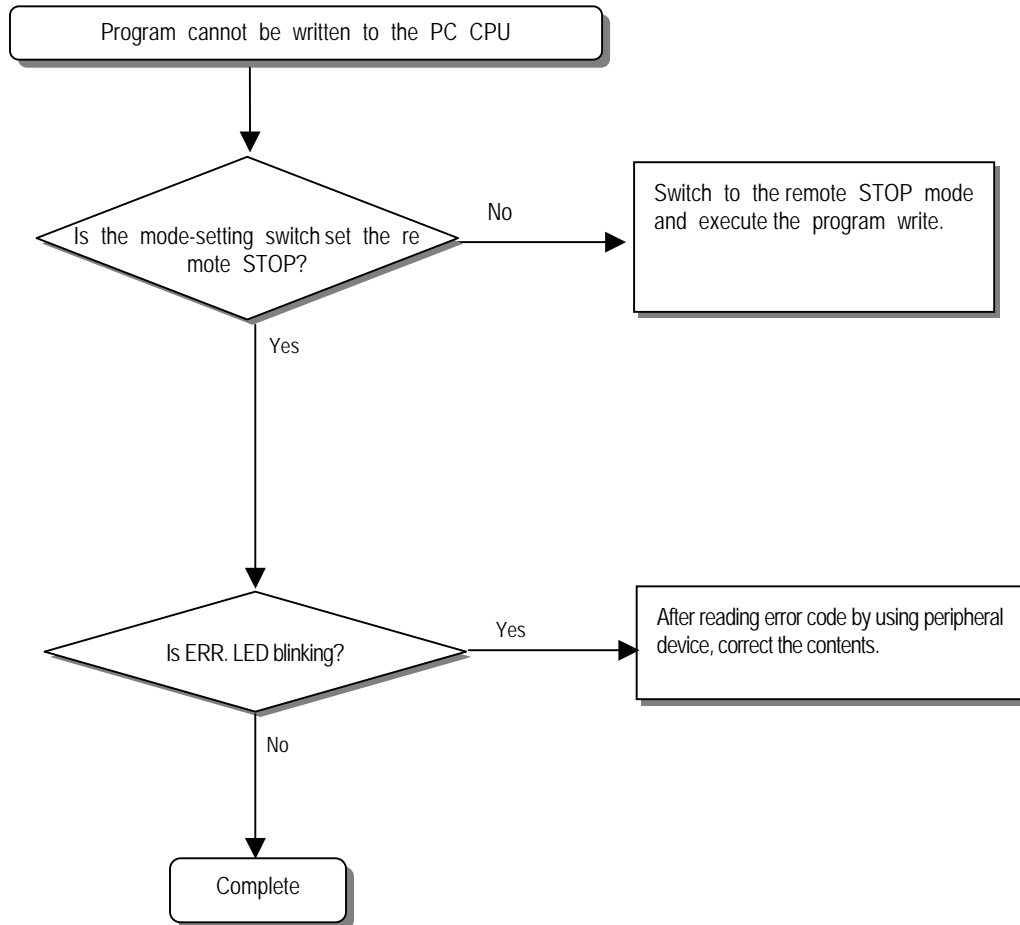
The following flowchart explains corrective action procedure used when the I/O module doesn't operate normally.





11.2.5 Troubleshooting flowchart used when a program cannot be written to the CPU part

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 have been met during operation of the MASTER-K120S series, please write down this Questionnaires and contact the service center via telephone or facsimile.

- 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.()

KGLWIN 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 KGLWIN or communications (),
- External memory module operation (),

6. Is the ERR. LED of the CPU module turned ON? Yes(), No()

7. KGLWIN 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:

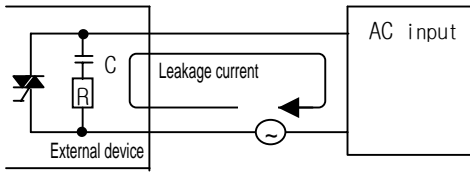
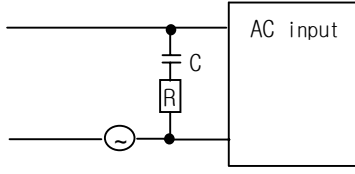
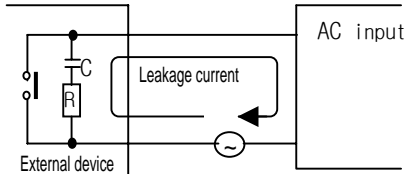
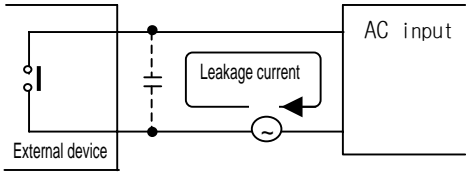
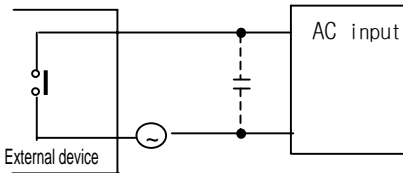
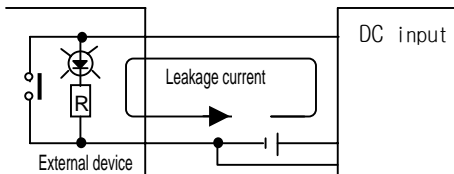
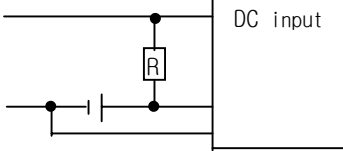
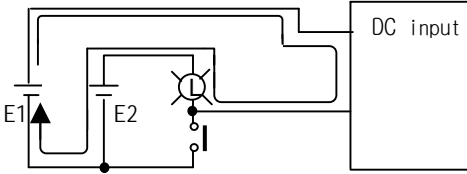
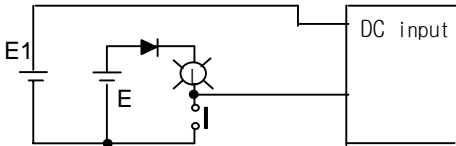
13. Configuration diagram for the applied system:

11.4 Troubleshooting Examples

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

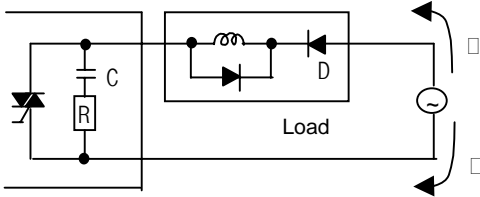
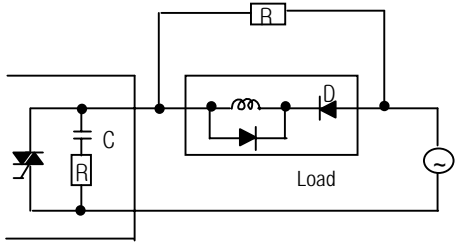
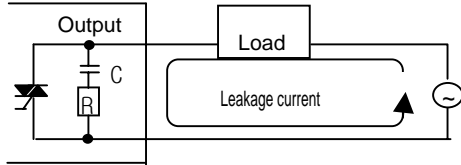
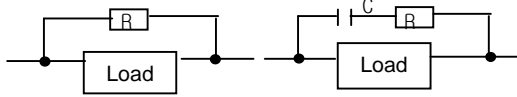
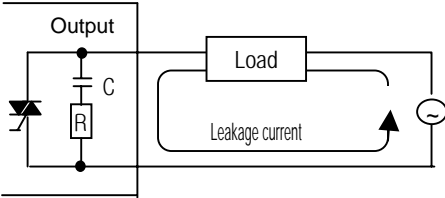
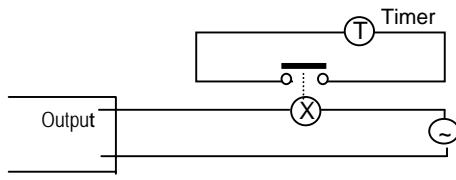
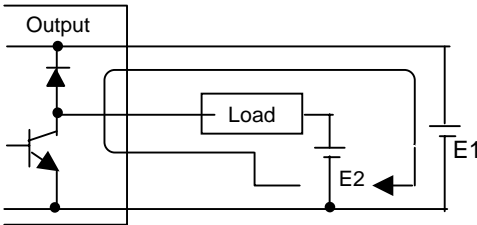
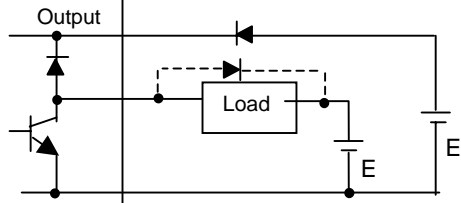
11.4.1 Input circuit troubles and corrective actions

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

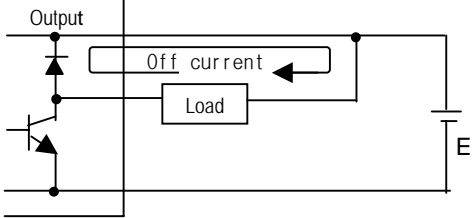
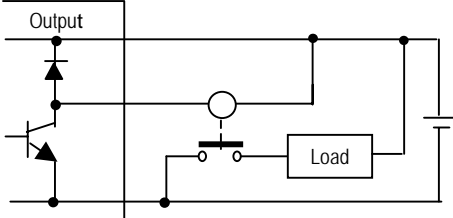
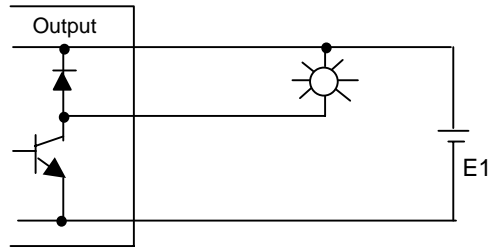
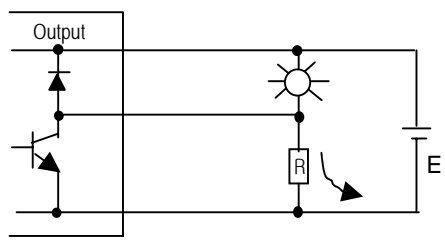
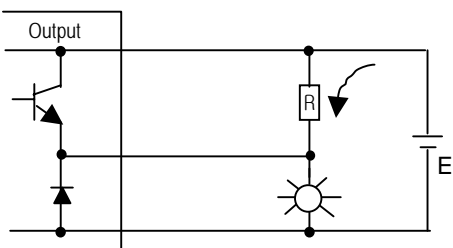
Condition	Cause	Corrective Actions
Input signal doesn't turn off.	Leakage current of external device (Such as a drive by non-contact switch) 	<ul style="list-style-type: none"> Connect an appropriate register and capacity, which will make the voltage lower across the terminals of the input module. 
Input signal doesn't turn off. (Neon lamp may be still on)	Leakage current of external device (Drive by a limit switch with neon lamp) 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Sneak current due to the use of two different power supplies.  <ul style="list-style-type: none"> E1 > E2, sneaked. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> • 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. $2\sqrt{2}$.  <p>*) 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.</p>	<ul style="list-style-type: none"> • Connect registers of tens to hundreds $K\Omega$ across the load in parallel. 
The load doesn't turn off.	<ul style="list-style-type: none"> • Leakage current by surge absorbing circuit, which is connected to output element in parallel. 	<ul style="list-style-type: none"> • Connect C and R across the load, which are of registers of tens $K\Omega$. 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.	<ul style="list-style-type: none"> • Leakage current by surge absorbing circuit, which is connected to output element in parallel. 	<ul style="list-style-type: none"> • 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-wave rectified internal circuits therefore, be cautious. 
The load does not turn off.	<ul style="list-style-type: none"> • Sneak current due to the use of two different power supplies.  <p>$E1 < E2$, sneaks. E1 is off (E2 is on), sneaks.</p>	<ul style="list-style-type: none"> • Use only one power supply. • Connect a sneak current prevention diode.  <p>If the load is the relay, etc, connect a counter-electromotive voltage absorbing code as shown by the dot line.</p>

Output circuit troubles and corrective actions (continued).

Condition	Cause	Corrective actions
The load off response time is long.	<ul style="list-style-type: none"> Over current at off state [The large solenoid current fluidic load (L/R is large) such as is directly driven with the transistor output.  <ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Insert a small L/R magnetic contact and drive the load using the same contact. 
Output transistor is destroyed.	<p>Surge current of the white lamp</p>  <p>A surge current of 10 times or more when turned on.</p>	<ul style="list-style-type: none"> To suppress the surge current make the dark current of 1/3 to 1/5 rated current flow.  <p>Sink type transistor output</p>  <p>Source type transistor output</p>

11.5 Error code list

Error Code	Message	CPU state	Message	Cause	Corrective Actions
0001h	Internal system error	Stop	System Error	Fault of some area of operating ROM, or H/W defect	Contact the service center.
0002h	OS ROM error	Stop	OS ROM Error	Internal system ROM is defected	Contact the service center.
0003h	OS RAM error	Stop	OS RAM Error	Internal system RAM is defected	Contact the service center.
0004h	Data RAM error	Stop	DATA RAM Error	Data RAM is defected	Contact the service center.
0005h	Program RAM error	Stop	PGM RAM Error	Program RAM is defected	Contact the service center.
0006h	Gate array error	Stop	G/A Error	Defect of dedicated LSI for sequence instruction processing	Contact the service center.
0007h	Sub rack power down error	Stop	Sub Power Error	Extension Rack Power down or Error	Check the power of the extension rack
0008h	OS WDT error	Stop	OS WDT Error	CPU OS watch dog error	Turn the power off and restart the system. Contact the service center.
0009h	Common RAM error	Stop	Common RAM Error	Common RAM interface error	Contact the service center.
000Ah	Fuse break error	Continue (stop)	I/O Fuse Error	Break of fuse used in output units or Mixed I/O	Check the fuse LED of the unit. Turn the power off and replace the fuse.
000Bh	Instruction code error	Stop	OP Code Error	Instructions unreadable by the CPU are included. (during execution)	Contact the service center.
000Ch	Flash memory error(during execution)	Stop	User Memory Error	Read to/Write from the inserted Flash memory is not performed.	Check and replace the flash memory.
0010h	I/O slot error	Stop	I/O Slot Error	<input type="checkbox"/> Mounting/dismounting of I/O units during operation, or connection fault <input type="checkbox"/> I/O unit defect or extension cable defect	<input type="checkbox"/> Turn the power off and mount the unit firmly, and restart the system. <input type="checkbox"/> Replace the I/O unit or extension cable.
0011h	Maximum I/O error	Stop	MAX I/O Error	Points of mounted I/O units overrun the maximum I/O points. (FMM mounting number over error, MINI_MAP over...)	Replace the I/O unit.
0012h	Special card interface error	Stop	Special I/F Error	Special Card Interface error	Contact the service center.
0013h	FMM 0 I/F error	Stop	FMM 0 I/F Error	FMM 0 I/F Error	Contact the service center.
0014h	FMM 1 I/F error	Stop	FMM 1 I/F Error	FMM 1 I/F Error	Contact the service center.
0015h	FMM 2 I/F error	Stop	FMM 2 I/F Error	FMM 2 I/F Error	Contact the service center.
0016h	FMM 3 I/F error	Stop	FMM 3 I/F Error	FMM 3 I/F Error	Contact the service center.
0020h	Parameter Error	Stop	Parameter Error	A written parameter has changed, or checksum error	Correct the content of the parameter.
0021h	I/O Parameter Error	Stop (continue)	I/O Parameter Error	When the power is applied or RUN starts, I/O unit reservation information differs from the types of real loaded I/O units.	Correct the content of the parameter, or reallocate or replace the I/O unit.
0022h	Maximum I/O Over	Stop	I/O PARA Error	The point of the reserved I/O information or real loaded I/O units overruns the maximum I/O point.	Correct the content of the parameter.
0023h	FMM 0 Parameter Error	Stop	FMM 0 PARA Error	FMM 0 Parameter Error	Correct the parameter.
0024h	FMM 1 Parameter Error	Stop	FMM 1 PARA Error	FMM 1 Parameter Error	Correct the parameter.
0025h	FMM 2 Parameter Error	Stop	FMM 2 PARA Error	FMM 2 Parameter Error	Correct the parameter.

(continued)

Error Code	Error	CPU state	Message	Cause	Corrective Actions
0026h	FMM 3 Parameter Error	Stop	FMM 3 PARA Error	FMM 3 Parameter Error	Correct the parameter.
0030h	Operation Error	Stop	Operation Error	<ul style="list-style-type: none"> A digit of other than 0 to 9 has met during BCD conversion. An operand value is outside the defined operand range. 	Correct the content of the error step.
0031h	WDT Over	Continue (stop)	WDT Over Error	Scan time has overrun the watch dog time.	Check the maximum scan time of the program and modify the program or insert programs.
0032h	Error of Program Change during run.	Stop	PGM Change Error	An error has occurred at program change during run. (NO SBRT, JME and END ...)	Program replacement has not been completed during run. (JMP ~ JME, FOR ~ NEXT, CALLx and SBRTx ...)
0033h	Program Check Error	Continue	Code Check Error	An error has occurred while checking a program.	Correct the error.
0040h	Code Check Error	Stop	Code Check Error	An instruction unreadable by the CPU is included.	Correct the error step.
0041h	Missing the END instruction in the program.	Stop	Miss END Error	The program does not have the END instruction.	Insert the END instruction at the bottom of the program.
0042h	Missing the RET instruction in the program.	Stop	Miss RET Error	The subroutine does not has the RET instruction at its bottom.	Insert the END instruction at the bottom of the program.
0043h	Missing the SBRT instruction in the subroutine program.	Stop	Miss SBRT Error	The subroutine does not has the SBRT instruction.	Insert the SBRT instruction.
0044h	The JMP ~ JME instruction error	Stop	JMP(E) Error	The JMP ~ JME instruction error	Correct the JMP ~ JME instruction.
0045h	The FOR ~ NEXT instruction error	Stop	FOR-NEXT Error	The FOR ~ NEXT instruction error	Correct the FOR ~ NEXT instruction.
0046h	The MCS ~ MCSCLR instruction error	Stop	MCS-MCSCLR Error	The MCS ~ MCSCLR instruction error	Correct the MCS ~ MCSCLR instruction.
0047h	The MPUSH ~ MPOP instruction error	Stop	MPUSH ~ MPOP Error	The MPUSH ~ MPOP instruction error	Correct the MPUSH ~ MPOP instruction
0048h	Dual coil error	Stop	DUAL COIL Error	Timer or counter has been duplicated.	Correct timer, counter.
0049h	Syntax error	Stop	Syntax Error	Input condition error, or too much use of LOAD or AND(OR) LOAD.	Check and correct the program.

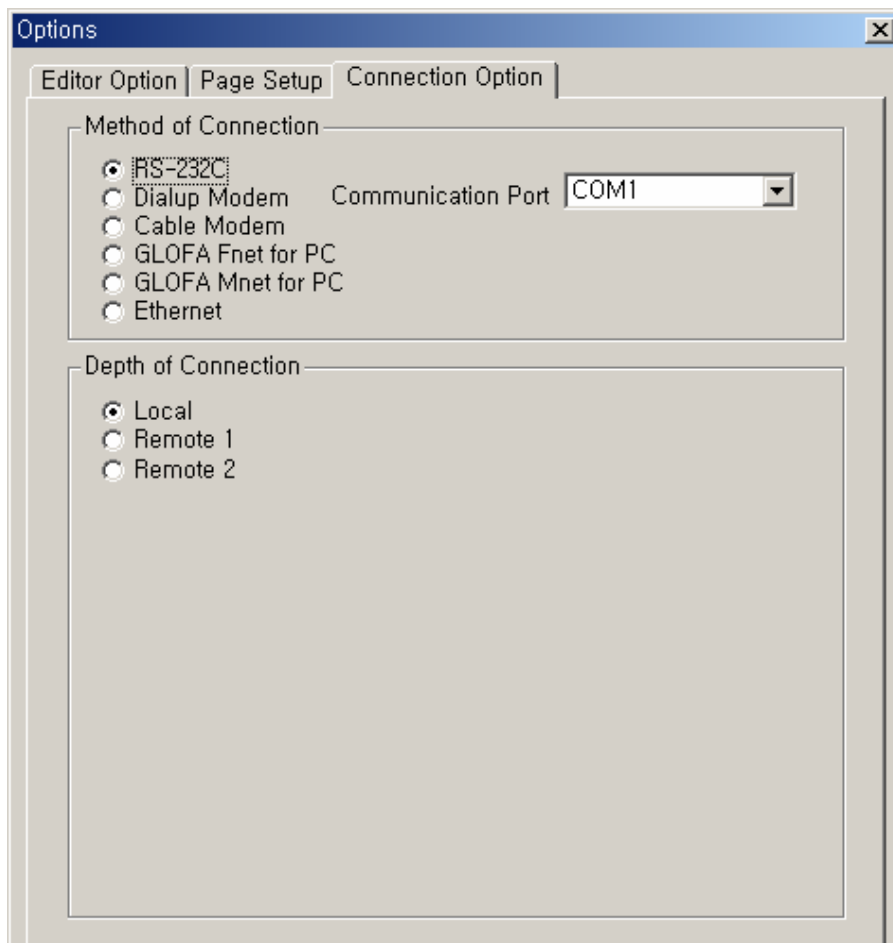
Appendix 1. System Definitions

1) Option

(1) Connect Option

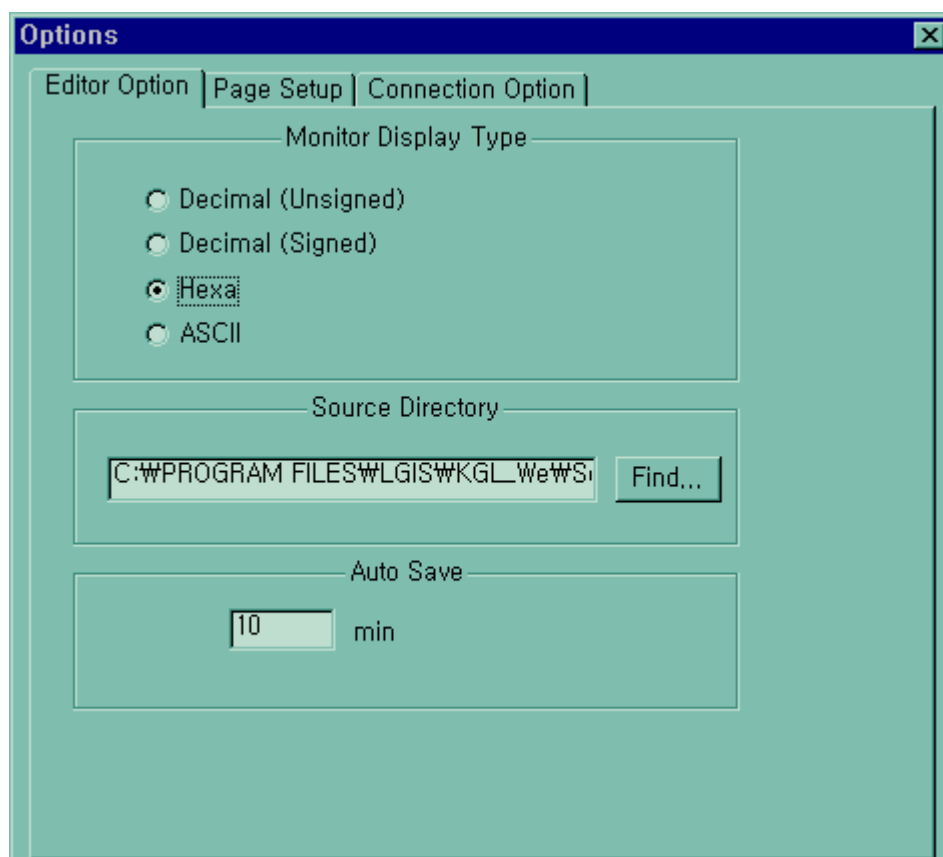
You should set the communication port (COM1 ~ 4) to communicate with PLC.

- Select the *Project-Option-Connection Option* in menu.
- Default Connection is RS-232C interface.
- For the detail information about **Connection Option**, refer to KGLWIN Manual.



(2) Editor option

- Monitor display type
 - Select the desired type in the monitor display type(4 types).
- Source File Directory :
 - You can set directories for the files to be created in KGLWIN.
 - In Source Directory, KGLWIN saves source program files of program, parameter etc.
- Auto save
 - This function is to set the time interval for Auto saving (Range : 0 ~60 min)
 - Automatically saved file is saved in the current directory.
 - The file is automatically deleted when the program window is closed. Therefore if a program cannot be saved by "Program Error" before program is not saved, you can recover some program by loading auto saved file.
 - This function is to set the time interval for Auto saving.
 - When set to 0, auto save function is disabled.



(3) Page setup

You can select print option when the project print out .(margin, cover, footer)

Options

Editor Option

Page Setup

Connection Option

Margin

Top

5

mm

Bottom

0

mm

Left

5

mm

Right

10

mm

Cover

☒ Title

☒ Company

☒ Author

☒ Date

☒ Description

Footer

☒ Footer

☐ Company

☐ Author

☐ Date

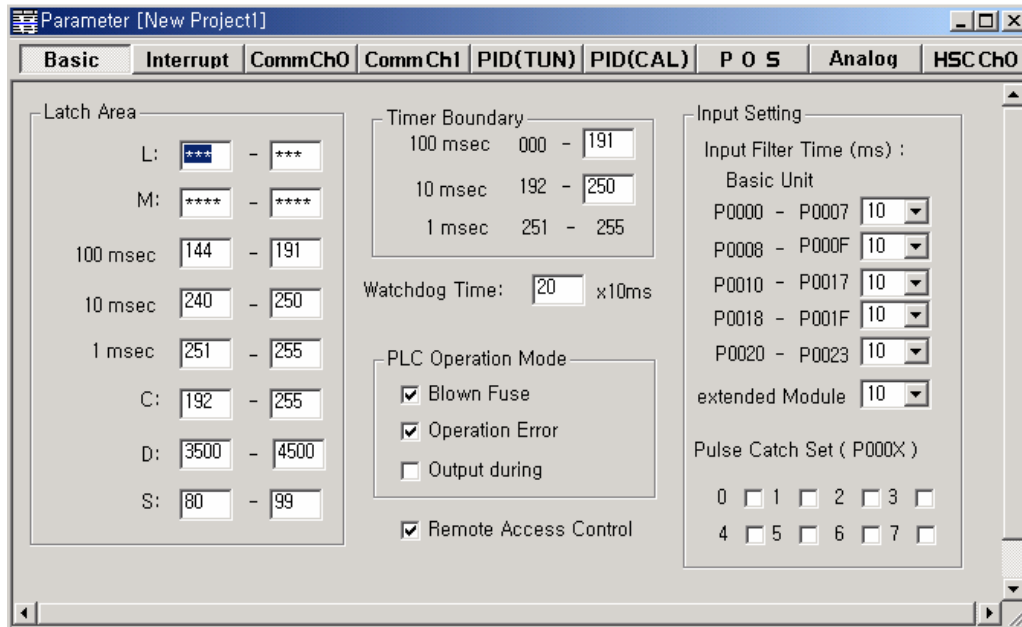
☐ Page

LG Industrial systems Co,

2) Basic Parameters

The basic parameters are necessary for operation of the PLC.

Set the 'Latch area', 'Timer boundary', 'Watchdog timer', 'PLC operation mode', 'Input setting', 'Pulse catch'



(1) Latch area setting

Set the retain area on the inner device.

(2) Timer boundary setting

Set the 100ms/10ms/1ms timer boundary.

(If 100ms and 10ms timer are set, the rest of timer area is allocated 1ms automatically)

(3) Watchdog timer setting

For the purpose of the watch of normal program execution ,.

This parameter is used to set the maximum allowable execution time of a user program in order to supervisor its normal or abnormal operation. (Setting range is 10ms ~ 6000ms)

(4) Input setting

set the input filter constant and input catch contact point

(5) Remote access control setting

When this parameter is set, the operation mode of PLC system can be changed by remote access with FAM or communication module.

Appendix 2. Flag List

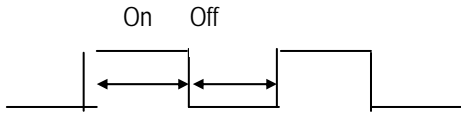
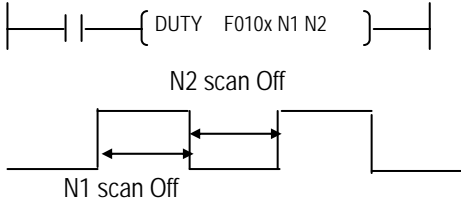
1) Special relay (F)

This flag is useful to edit user program.

Relay	Function	Description
F0000	RUN mode	Turns on when the CPU in the RUN mode.
F0001	Program mode	Turns on when the CPU in the Program mode
F0002	Pause mode	Turns on when the CPU in the Pause mode
F0003	Debug mode	Turns on when the CPU in the Debug mode
F0006	Remote mode	Turns on when the CPU in the Remote mode
F0007-F000B	Unused	
F000C	User memory installation	Turns on when a user memory is installed.
F000D	RTC installation	Turns on when a RTC module is installed.
F000E	Unused	
F000F	Execution of the STOP instruction	Turns on when the STOP instruction is being operated.
F0010	Always On	Always On
F0011	Always Off	Always Off
F0012	1 Scan On	1 Scan On
F0013	1 Scan Off	1 Scan Off
F0014	Scan toggle	Scan toggle
F0015 to F001F	Unused	
F0020	1 step run	Turns on when the 1 step run is operated in the Debug mode.
F0021	Breakpoint run	Turns on when the breakpoint run is operated in the Debug mode.
F0022	Scan run	Turns on when the scan run is operated in the Debug mode.
F0023	Coincident contact value run	Turns on when the coincident contact run is operated in the Debug mode.
F0024	Coincident word value run	Turns on when the coincident word run is operated in the Debug mode.
F0025 to F002F	Unused	
F0030	Fatal error	Turns on when a fatal error has occurred.
F0031	Ordinary error	Turns on when an ordinary error has occurred.
F0032	WDT Error	Turns on when a watch dog timer error has occurred.
F0033	I/O combination error	Turns on when an I/O error has occurred. (When one or more bit(s) of F0040 to F005F turns on)
F0034 to F0038	Unused	
F0039	Normal backup operation	Turns on when the data backup is normal.
F003A	RTC data error	Turns on when the RTC data setting error has occurred.
F003B	Program editing	Turns on during program edit while running the program.
F003C	Program edit error	Turns on when a program edit error has occurred while running the program.
F003D to F003F	Unused	

Appendix 2 Flag List

(Continued)

Relay	Function	Description
F0040 to F005F	I/O error	When the reserved I/O module (set by the parameter) differs from the real loaded I/O module or a I/O module has been mounted or dismantled, the corresponding bit turns on.
F0060 to F006F	Storing error code	Stores the system error code, (See Section 2.9)
F0070 to F008F	Unused	
F0090	20-ms cycle clock	<p>Turning On/Off is repeated with a constant cycle.</p> 
F0091	100-ms cycle clock	
F0092	200-ms cycle clock	
F0093	1-sec cycle clock	
F0094	2-sec cycle clock	
F0095	10-sec cycle clock	
F0096	20-sec cycle clock	
F0097	60-sec cycle clock	
F0098 to F009F	Unused	
F0100	User clock 0	<p>Turning On/Off is repeated as many times as the scan specified by Duty instruction.</p> 
F0101	User clock 1	
F0102	User clock 2	
F0103	User clock 3	
F0104	User clock 4	
F0105	User clock 5	
F0106	User clock 6	
F0107	User clock 7	
F0108 to F010F	Unused	
F0110	Operation error flag	Turns on when an operation error has occurred.
F0111	Zero flag	Turns on when the operation result is "0".
F0112	Carry flag	Turns on when a carry occurs due to the operation.
F0113	All outputs off	Turns on when an output instruction is executed.
F0115	Operation error flag (Latch)	Turns on when an operation error has occurred.(Latch)
F0116	Overflow error flag	Turns on when overflow has occurred.
F0117 to F011F	Unused	
F0120	LT flag	Turns on if $S_1 < S_2$ when using the CMP instruction.
F0121	LTE flag	Turns on if $S_1 \leq S_2$ when using the CMP instruction.
F0122	EQU flag	Turns on if $S_1 = S_2$ when using the CMP instruction.
F0123	GT flag	Turns on if $S_1 > S_2$ when using the CMP instruction.
F0124	GTE flag	Turns on if $S_1 \geq S_2$ when using the CMP instruction.
F0125	NEQ flag	Turns on if $S_1 \neq S_2$ when using the CMP instruction.
F0126 to F013F	Unused	
F0140 to F014F	FALS No.	The error code generated by FALS instruction is stored to this flag.
F0150 to F016F	Unused	
F0170 to F173	HSC output bit	Turn on when the current value of HSC reaches setting value
F0180 to F183	Carry flag for HSC	Turn on when carry is occurred on the HSC current value

Appendix 2 Flag List

(Continued)

Relay	Function	Description
F190 to F193	Borrow flag for HSC	Turn on when borrow is occurred on the HSC current value
F200 to F20F	Unit ID	
F0210 to F021F	HSC error code	Stores error of HSC Ch0
F0220 to F022F	HSC error code	Stores error of HSC Ch1
F0230 to F023F	HSC error code	Stores error of HSC Ch2
F0240 to F024F	HSC error code	Stores error of HSC Ch3
F0250 to F027F	Unused	
F0280 to F045F	Positioning flags	Refer to 7.3.5 Flag list and error code
F0500 to F050F	Maximum scan time	Stores the maximum scan time.
F0510 to F051F	Minimum scan time	Stores the minimum scan time.
F0520 to F052F	Present scan time	Stores the present scan time.
F0530 to F053F	Clock data (year/month)	Clock data (year/month)
F0540 to F054F	Clock data (day/hour)	Clock data (day/hour)
F0550 to F055F	Clock data (minute/second)	Clock data (minute/second)
F0560 to F056F	Clock data (day of the week)	Clock data (day of the week)
F0570 to F058F	Unused	
F0590 to F059F	Storing error step	Stores the error step of the program.
F0600 to F063F	Unused	

2) Internal relay (M)

Relay	Function	Description
M1904	Write Time	Write time to RTC when this bit turns on
M1910	Forced I/O enable	Enables forced I/O

Appendix 2 Flag List

3) Data relay (D)

When communication function is used, its status are stored in D register, and they can be monitored. And If correspond communication function is unused, these flags can be used as general data register.

(1) When FNET module is connected

Relay	Keyword	Function	Description
D4500 D4502	_C0STNOL _C0STNOH	Communications module station No.	Indicates the number which is set on communications module station switch. Fnet : Station switch No. marked on the front of communications module.
D4504	_C0TXECNT	Communications frame sending error	Increments by one whenever sending error of communications frame occurs. Connection condition of network is evaluated by this value.
D4505	_C0RXECNT	Communications frame receiving error	Increments by one whenever receiving error of communications frame occurs. Connection condition of network is evaluated by this value.
D4506	_C0SVCFCNT	Communications service processing error	Increments by one whenever communications service fails. Connection condition of network and overall communication quantity and program stability can be evaluated by this value.
D4507	_C0SCANMX	Maximum communications scan time (unit : 1 ms)	Indicates the maximum time that is spent until every station connected to network has the token at least one time and sends a sending frame.
D4508	_C0SCANAV	Average communications scan time (unit : 1 ms)	Indicates the average time that is spent until every station connected to network has the token at least one time and sends a sending frame.
D4509	_C0SCANMN	Minimum communications scan time (unit : 1 ms)	Indicates the minimum time that is spent until every station connected to network has the token at least one time and sends a sending frame.
D4510	_C0LINF	Communications module system information	Indicates operation state of communications module with a word.
D4510.B	_C0CRDER	System error (error = 1)	Indicates communications module hardware or system O/S error.
D4510.C	_C0SVBSY	Insufficient common RAM (Insufficient = 1)	Indicates that service cannot be offered due to insufficient common RAM.
D4510.D	_C0IFERR	Interface error (error = 1)	Indicates that interface with communications modules has been stopped.
D4510.E	_C0INRING	In-ring (IN_RING = 1)	Indicates that the communications module can communicates with other station or not.
D4510.F	_C0LNKMOD	Operation mode (RUN=1)	Indicates that operation mode of communications module is in the normal operation mode or test mode.

Appendix 2 Flag List

(2) When communication mode is dedicated master mode (Channel 0)

Relay	Function	Relay	Function
D4400	Communication Error Code of station 0 and 1	D4432	Mode and Error of Slave station 0 and 1
D4401	Communication Error Code of station 2 and 3	D4433	Mode and Error of Slave station 2 and 3
D4401	Communication Error Code of station 4 and 5	D4434	Mode and Error of Slave station 4 and 5
D4403	Communication Error Code of station 6 and 7	D4435	Mode and Error of Slave station 6 and 7
D4404	Communication Error Code of station 8 and 9	D4436	Mode and Error of Slave station 8 and 9
D4405	Communication Error Code of station 10 and 11	D4437	Mode and Error of Slave station 10 and 11
D4406	Communication Error Code of station 12 and 13	D4438	Mode and Error of Slave station 12 and 13
D4407	Communication Error Code of station 14 and 15	D4439	Mode and Error of Slave station 14 and 15
D4408	Communication Error Code of station 16 and 17	D4440	Mode and Error of Slave station 16 and 17
D4409	Communication Error Code of station 18 and 19	D4441	Mode and Error of Slave station 18 and 19
D4410	Communication Error Code of station 20 and 21	D4442	Mode and Error of Slave station 20 and 21
D4411	Communication Error Code of station 22 and 23	D4443	Mode and Error of Slave station 22 and 23
D4412	Communication Error Code of station 24 and 25	D4444	Mode and Error of Slave station 24 and 25
D4413	Communication Error Code of station 26 and 27	D4445	Mode and Error of Slave station 26 and 27
D4414	Communication Error Code of station 28 and 29	D4446	Mode and Error of Slave station 28 and 29
D4415	Communication Error Code of station 30 and 31	D4447	Mode and Error of Slave station 30 and 31
D4416	Error count of station 0 and 1		
D4417	Error count of station 2 and 3		
D4418	Error count of station 4 and 5		
D4419	Error count of station 6 and 7		
D4420	Error count of station 8 and 9		
D4421	Error count of station 10 and 11		
D4422	Error count of station 12 and 13		
D4423	Error count of station 14 and 15		
D4424	Error count of station 16 and 17		
D4425	Error count of station 18 and 19		
D4426	Error count of station 20 and 21		
D4427	Error count of station 22 and 23		
D4428	Error count of station 24 and 25		
D4429	Error count of station 26 and 27		
D4430	Error count of station 28 and 29		
D4431	Error count of station 30 and 31		

Appendix 2 Flag List

(3) When communication mode is dedicated master mode (Channel 1)

Relay	Function	Relay	Function
D4300	Communication Error Code of station 0 and 1	D4332	Mode and Error of Slave station 0 and 1
D4301	Communication Error Code of station 2 and 3	D4333	Mode and Error of Slave station 2 and 3
D4301	Communication Error Code of station 4 and 5	D4334	Mode and Error of Slave station 4 and 5
D4303	Communication Error Code of station 6 and 7	D4335	Mode and Error of Slave station 6 and 7
D4304	Communication Error Code of station 8 and 9	D4336	Mode and Error of Slave station 8 and 9
D4305	Communication Error Code of station 10 and 11	D4337	Mode and Error of Slave station 10 and 11
D4306	Communication Error Code of station 12 and 13	D4338	Mode and Error of Slave station 12 and 13
D4307	Communication Error Code of station 14 and 15	D4339	Mode and Error of Slave station 14 and 15
D4308	Communication Error Code of station 16 and 17	D4340	Mode and Error of Slave station 16 and 17
D4309	Communication Error Code of station 18 and 19	D4341	Mode and Error of Slave station 18 and 19
D4310	Communication Error Code of station 20 and 21	D4342	Mode and Error of Slave station 20 and 21
D4311	Communication Error Code of station 22 and 23	D4343	Mode and Error of Slave station 22 and 23
D4312	Communication Error Code of station 24 and 25	D4344	Mode and Error of Slave station 24 and 25
D4313	Communication Error Code of station 26 and 27	D4345	Mode and Error of Slave station 26 and 27
D4314	Communication Error Code of station 28 and 29	D4346	Mode and Error of Slave station 28 and 29
D4315	Communication Error Code of station 30 and 31	D4347	Mode and Error of Slave station 30 and 31
D4316	Error count of station 0 and 1		
D4317	Error count of station 2 and 3		
D4318	Error count of station 4 and 5		
D4319	Error count of station 6 and 7		
D4320	Error count of station 8 and 9		
D4321	Error count of station 10 and 11		
D4322	Error count of station 12 and 13		
D4323	Error count of station 14 and 15		
D4324	Error count of station 16 and 17		
D4325	Error count of station 18 and 19		
D4326	Error count of station 20 and 21		
D4327	Error count of station 22 and 23		
D4328	Error count of station 24 and 25		
D4329	Error count of station 26 and 27		
D4330	Error count of station 28 and 29		
D4331	Error count of station 30 and 31		

Appendix 2 Flag List

(4) D register for Forced I/O setting

I/O	Forced I/O designation register	Forced I/O data register
P000	D4700	D4800
P001	D4701	D4801
P002	D4702	D4802
P003	D4703	D4803
P004	D4704	D4804
P005	D4705	D4805
P006	D4706	D4806
P007	D4707	D4807
P008	D4708	D4808
P009	D4709	D4809
P010	D4710	D4810
P011	D4711	D4811
P012	D4712	D4812
P013	D4713	D4813
P014	D4714	D4814
P015	D4715	D4815
P016	D4716	D4816
P017	D4717	D4817
P018	D4718	D4818
P019	D4719	D4819
P020	D4720	D4820
P021	D4721	D4821
P022	D4722	D4822
P023	D4723	D4823
P024	D4724	D4824
P025	D4725	D4825
P026	D4726	D4826
P027	D4727	D4827
P028	D4728	D4828
P029	D4729	D4829
P030	D4730	D4830
P031	D4731	D4831
P032	D4732	D4832
~ P063	~ D4763	~ D4863

(5) System error history(when RTC module is attached)

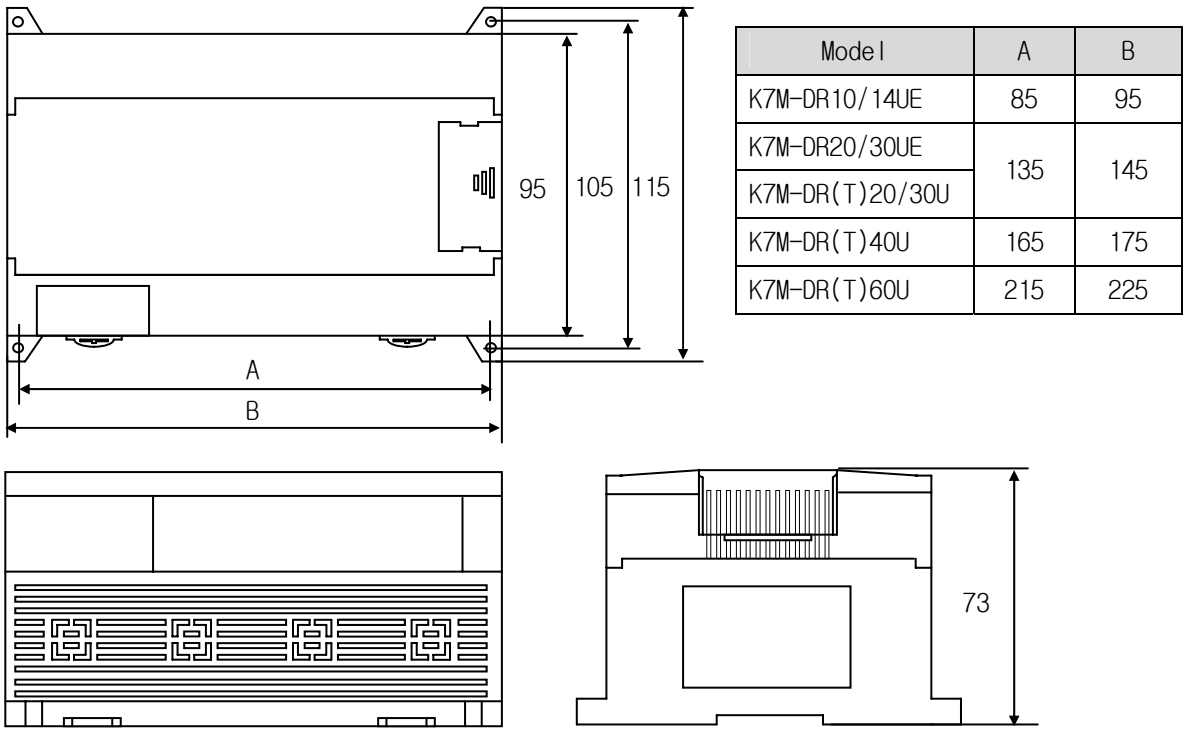
Relay	Description
D4900	Error pointer
D4901	Year, Month
D4902	Day, Time
D4903	Minute, Second
D4904	Error code

(6) Clock data

Relay	Description
D4990	Year, Month
D4991	Day, Time
D4992	Minute, Second
D4993	Day of week, Century

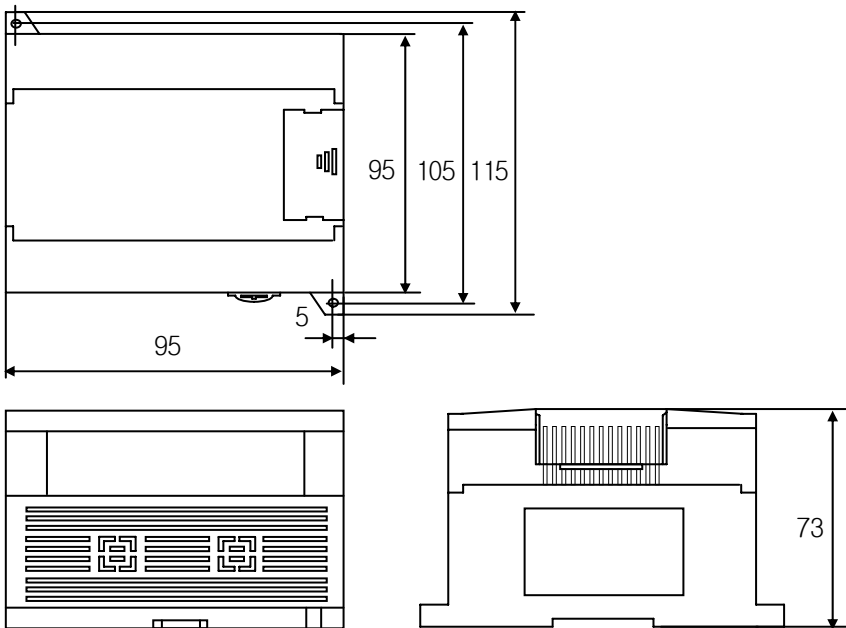
Appendix 3 External Dimensions (unit: mm)

1) Main unit



2) Extension module

(1) Standard type



(2) Slim type(G7E-DC08A,G7E-RY08A,G7F-ADHB,G7F-DA2V,G7F-RD2A)

