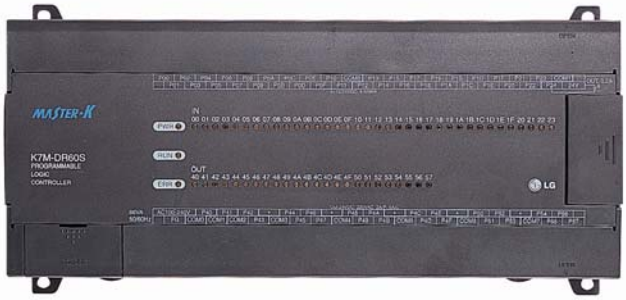
T-solution Leader in Electrics & Automation

User Manual

MASTER-K80S

LS Programmable Logic Controller



Safety Instructions

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

LS Industrial Systems

www.lsis.biz

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 be 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.

◎ Contents ◎

Chapter 1. General

1.1 How to Use This Manual

This manual includes specifications, functions and handling instructions for the MASTER-K80Sseries PLC.
This manual is divided up into chapters as follows:

Chapters	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-K80Sseries.
Chapter 3	General Specification	Describes general specifications of units used in the MASTER-K80Sseries.
Chapter 4	Names and functions	Describes each kind of manufacturing goods, titles, and main functions
Chapter 5	CPU Part	Describes each kind of manufactured goods' usage
Chapter 6	Digital Input and Output Parts	
Chapter 7	Guides on Each Function	
Chapter 8	Communications 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 and Inspection	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.
Appendix1	System Definition	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 uints and expansion modules

REMARK

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

1.2. Features

1) MASTRER-K80S series features

(1) Open network by us of communications protocol in compliance with international standard specifications.

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

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

2) MK80S series is extremely compact, to fit a wide range of applications.

(1) High speed processing

High speed processing of 0.5μs/step with an operation-dedicated processor included.

(2) Various built-in functions

The main unit can perform many functions without using separate modules.

It is possible to construct various systems just using the main unit.

- Fast Processing Applications

  -Pulse catch: Allows the main unit to read 4 inputs, each having a pulse width as small as 0.2ms

  -High speed counter: Support high-speed counting up to 1 phase 16kHz, 2 phase 8kHz.

  -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 15 ms.
- Using built-in pulse output without separate positioning module, it can control stepping motor or servo motor.
- Using RS-232C built-in port, it can connect with external devices, such as computers or monitoring devices and communicate 1:1 with MK80S or MK200S system.
- 10 points modules (K7M-DR10S, K7M-DR10S/DC, K7M-DT10S) have both of RS-232C and RS-485 port.
- It has PID control function with which it can easily constitute a system without separate module.

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

(4) It can constitute various system, using separate Cnet I/F module. (Except 10 points modules)

(5) It can easily save the user program by simple manipulation in KGLWIN.

(6) Strong self-diagnostic functions

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

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

(8) Debugging function

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

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

(9) Various program execution function

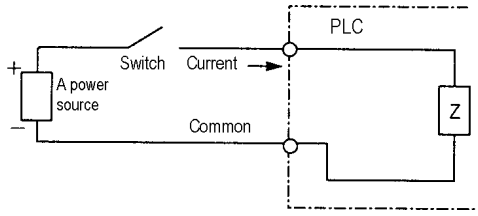
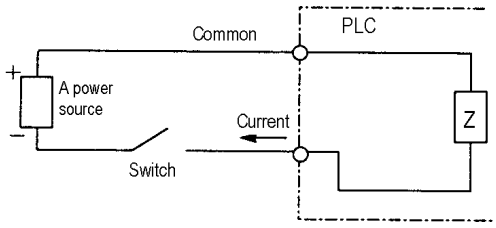
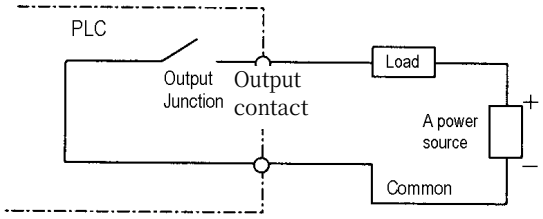
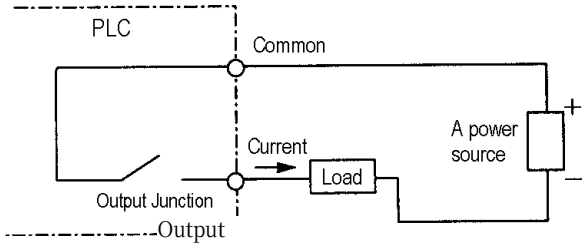
External and internal interrupt program as well as scan program can be executed by setting the execution condition.

The user can set variously the program execution mode.

1.3 Terminology

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

Terms	Definition	Remarks
Module	A standard element that has a specified function which configures the system. Devices such as I/O board, which inserted onto the mother board or base unit.	Example) CPU module Power Supply module I/O module
Unit	A single module or group of modules that perform an independent Operation as a part of PLC system.	
PLC system	A system which consists of the PLC and peripheral devices. A user program can control the system.	
KGLWIN	A peripheral device for the MASTER-K series. It executes program creation, edit, compile and debugging(A computer software for Windows 95/98).	
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(RS232C.RS422/485)	
RTC	Abbreviation of Real Time Clock. It is used to call general IC that contains clock function.	

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

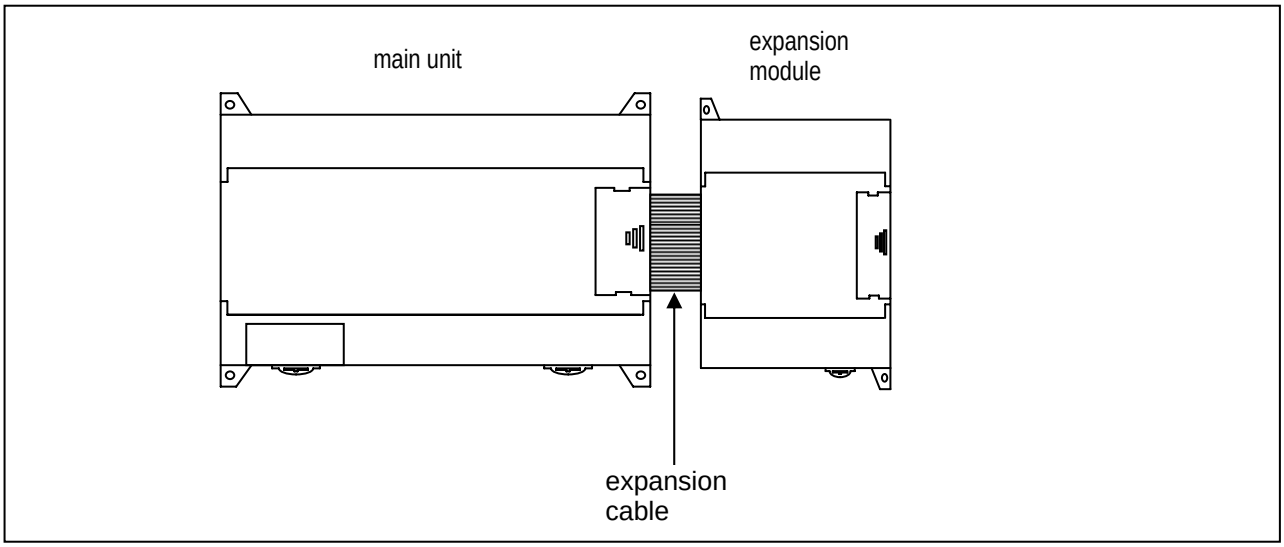
Chapter 2. System Configuration

The MASTER-K80Sseries 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			• 10-80 points	
Maximum numbers of expansion modules	Digital I/O module		• 2 modules	Total 3 modules
	A/D-D/A module		• 2 modules	
	Analog timer		• 3 modules	
	Cnet I/F module		• 1 module[1]	
Items	Main unit		• K7M-DR10S, K7M-DR20S, K7M-DR30S, K7M-DR40S, K7M-DR60S K7M-DR10S/DC, K7M-DR20S/DC, K7M-DR30S/DC, K7M-DR40S/DC, K7M-DR60S/DC, K7M-DT10S, K7M-DT20S, K7M-DT30S, K7M-DT40S, K7M-DT60S	
	Expansion module	Digital I/O module	• G7E-DR10A	
		Analog I/O module	• G7F-ADHA, G7F-AD2A	
		Analog timer	• G7F-AT2A	
	Communication 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	

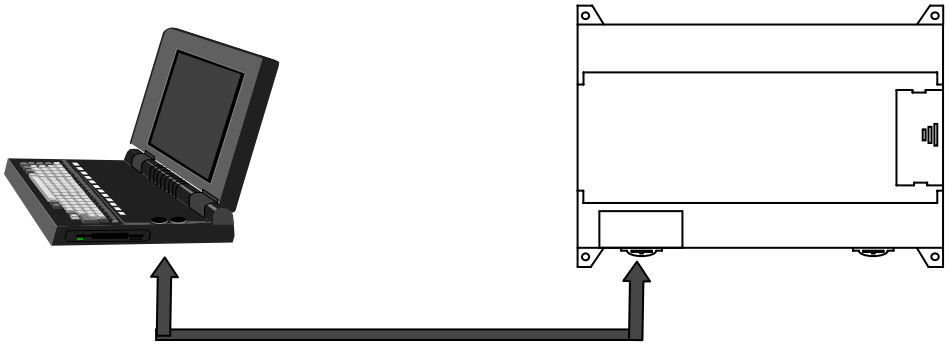
[1] Communication modules are not available for 10 points modules (K7M-DR10S, K7M-DR10S/DC, K7M-DT10S)

2.1.2 Cnet I/F system

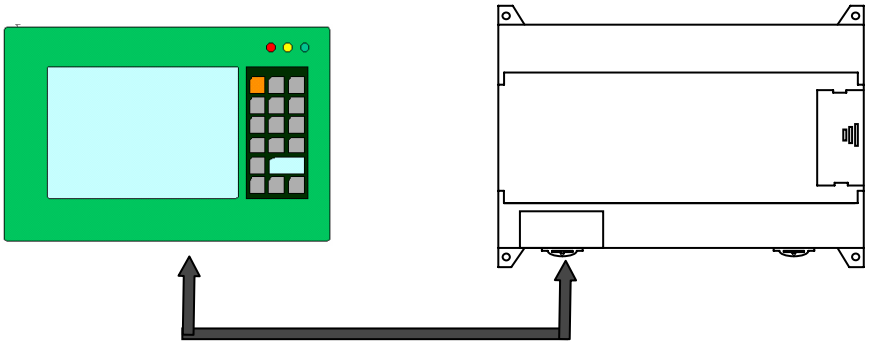
Cnet I/F System is used for communication between the main unit and external devices using RS-232C/RS-422 Interface. The K80S has a built-in RS-232C port and has also G7L-CUEB for RS-232C, G7L-CUEC for RS-422. It is possible to construct communications systems on demand. (10 points modules include RS-232C and RS-485 ports on the main module, and no external communication module is available)

1) 1:1 Communications system

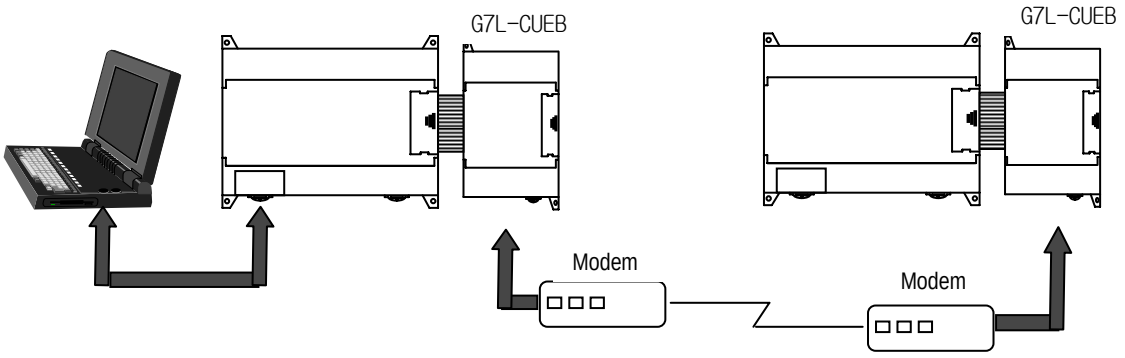
(1) 1:1 ratio of an external device (computer) to main unit using a built-in port

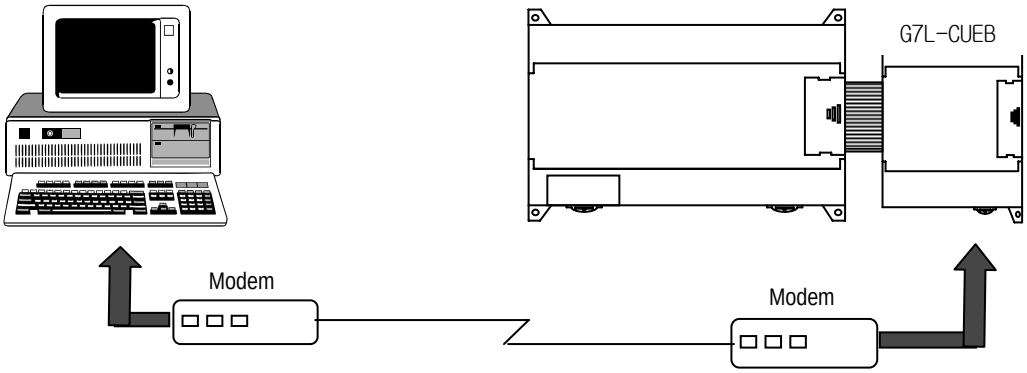


(2) 1:1 ratio of an external device (monitoring unit) to main unit using a built-in port



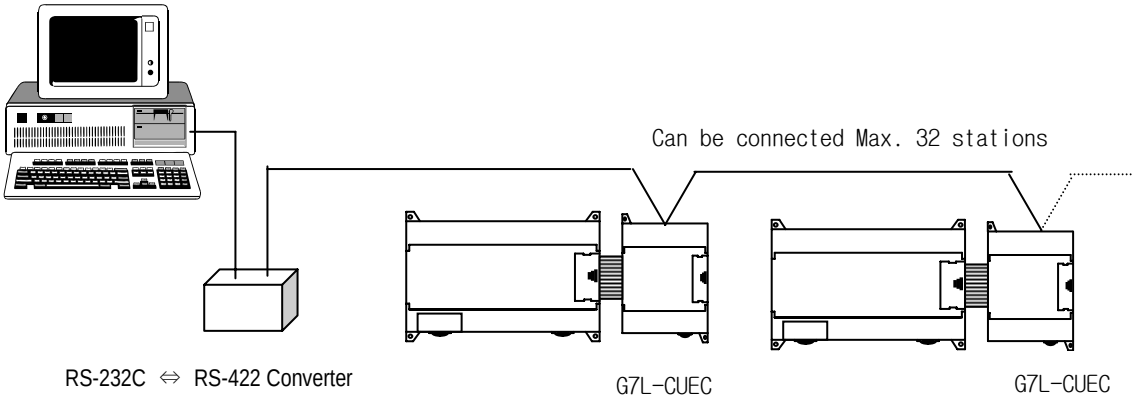
(3) RS-232C Communication over a long distance via modem by Cnet I/F modules

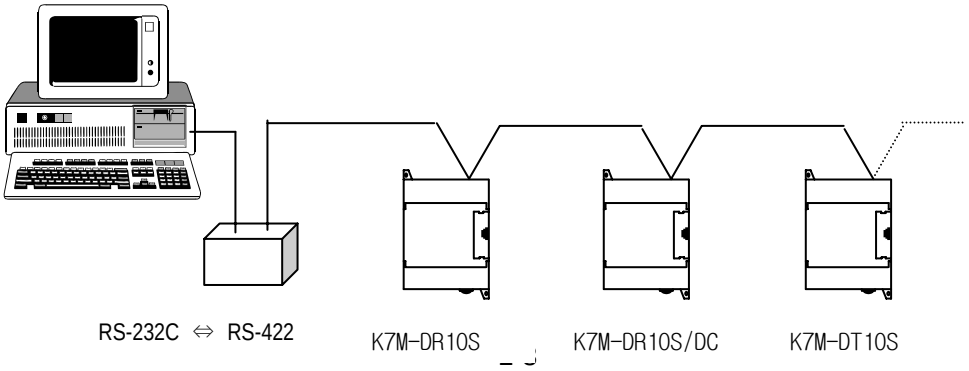




2) 1:n Communications system

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



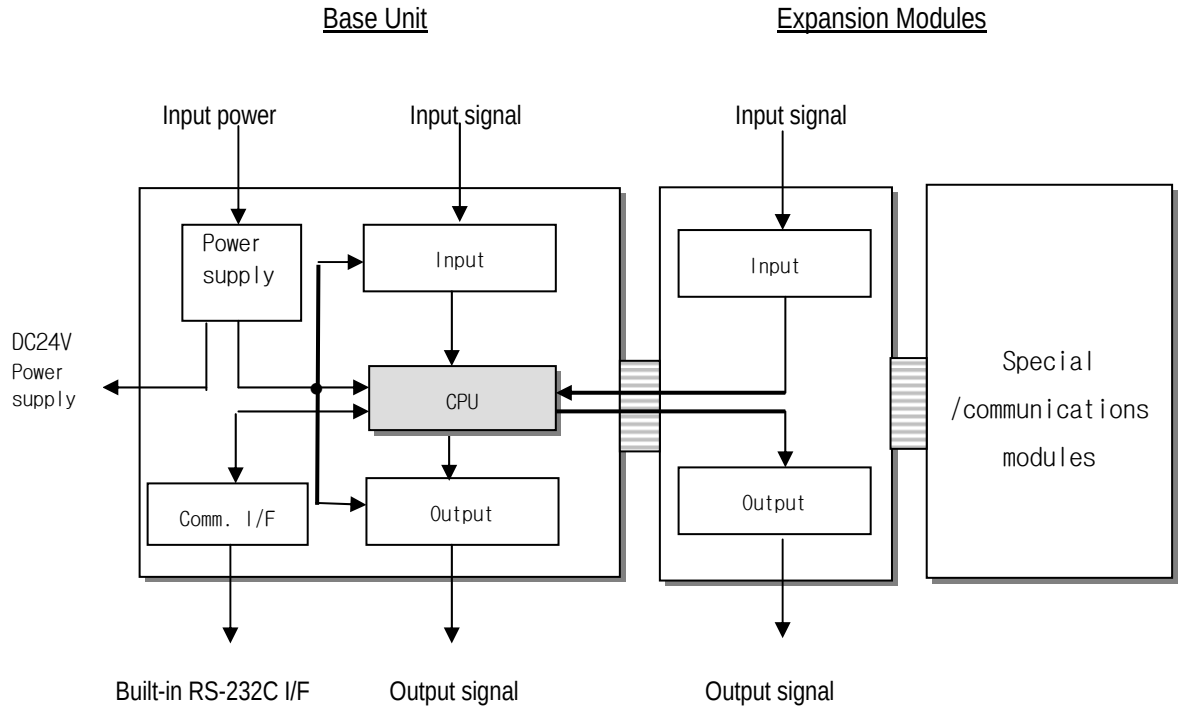


2.2 Product functional model

The following describes functional model of the MASTER-K80Sseries.

2.2.1 Product Function Block

Product function block for the K80Sseries is as follows.



Sub-system	Description
CPU	• Signal processing function · Operating system function · Application program storage / memory function · Data storage / memory function · Application program execution function
Input	• The input signals obtained from the machine/process to appropriate signal levels for processing
Output	• The output signals obtained from the signal processing function to appropriate signal levels to drive actuators and/or displays
Power Supply	• Provides for conversion and isolation of the PLC system power from the main supply
Communications Interface	• Provides the data exchange with other systems, such as KGLWIN, computers

2.2.2 K80S Series System Equipment

Section	Items	Models	Description	Remark
Basic	Base Unit	K7M-DR10S K7M-DR10S/DC K7M-DT10S	• I/O Points - 6 DC inputs / 4 relay outputs (K7M-DR10S, K7M-DR10S/DC) - 6 DC inputs / 4 TR outputs (K7M-DT10S) • Program capacity : 48 kbytes • Built-in function -High-speed counter : Phase1 16 kHz, phase2 8 kHz 1channel -pulse output : 1 × 2 kHz -pulse catch : pulse width 0.2ms, 4 points -external contact point interrupt: 0.4ms, 8points -input filter: 0 ~ 15ms (all input) -PID control function -RS-232C communication, RS-485 communication	
		K7M-DR20S K7M-DR20S/DC K7M-DT20S	• I/O Points - 12 DC inputs / 8 relay outputs (K7M-DR20S, K7M-DR20S/DC) - 12 DC inputs / 8 TR outputs (K7M-DT20S) • Program capacity : 48 kbytes • Built-in function -High-speed counter : Phase1 16 kHz, phase2 8 kHz 1channel -pulse output : 1 × 2 kHz -pulse catch : pulse width 0.2ms, 4 points -external contact point interrupt: 0.4ms, 8points -input filter: 0 ~ 15ms (all input) -PID control function -RS-232C communication	
		K7M-DR30S K7M-DR30S/DC K7M-DT30S	• I/O Points - 18 DC inputs / 12 relay outputs (K7M-DR30S, K7M-DR30S/DC) - 18 DC inputs / 12 TR outputs (K7M-DT30S) • Program capacity : 48 kbytes • Built-in function -High-speed counter : Phase1 16 kHz, phase2 8 kHz 1channel -pulse output : 1 × 2 kHz -pulse catch : pulse width 0.2ms, 4 points -external contact point interrupt: 0.4ms, 8points -input filter: 0 ~ 15ms (all input) -PID control function -RS-232C communication	

Section	Items	Models	Description	Remark
Basic	Base Unit	K7M-DR40S K7M-DR40S/DC K7M-DT40S	• I/O Points - 24 DC inputs / 16 relay outputs (K7M-DR40S, K7M-DR40S/DC) - 24 DC inputs / 16 TR outputs (K7M-DT40S) • Program capacity : 48 kbytes • Built-in function -High-speed counter : Phase1 16 kHz, phase2 8 kHz 1channel -pulse output : 1 × 2 kHz -pulse catch : pulse width 0.2ms, 4 points -external contact point interrupt: 0.4ms, 8points -input filter: 0 ~ 15ms (all input) -PID control function -RS-232C communication	
		K7M-DR60S K7M-DR60S/DC K7M-DT60S	• I/O Points - 36 DC inputs / 24 relay outputs (K7M-DR60S, K7M-DR60S/DC) - 36 DC inputs / 24 TR outputs (K7M-DT60S) • Program capacity : 48 kbytes • Built-in function -High-speed counter : Phase1 16 kHz, phase2 8 kHz 1channel -pulse output : 1 × 2 kHz -pulse catch : pulse width 0.2ms, 4 points -external contact point interrupt: 0.4ms, 8points -input filter: 0 ~ 15ms (all input) -PID control function -RS-232C communication	
Expansion module	Digital I/O module	G7E-DR10A	• I/O points -6 DC inputs / 4 relay outputs	
	A/D-D/A Composite module	G7F-ADHA	• A/D : 2 channel , D/A : 1 channel	
	A/D conversion module	G7F-AD2A	• A/D : 4 channel	
	Analog timer module	G7F-AT2A	• Points : 4points • Digital output range : 0~200	
	Communication I/F module	G7L-CUEB	• RS-232C : 1 channel	
		G7L-CUEC	• RS-422 : 1 channel	
		G7L-DBEA	• DeviceNet I/F module	
		G7L-FUEA	• FieldBus I/F module	
		G7L-PBEA	• Profibus I/F module	

Chapter 3. General Specifications

3.1 General specifications

The following shows the general specifications of the MASTER-K series.

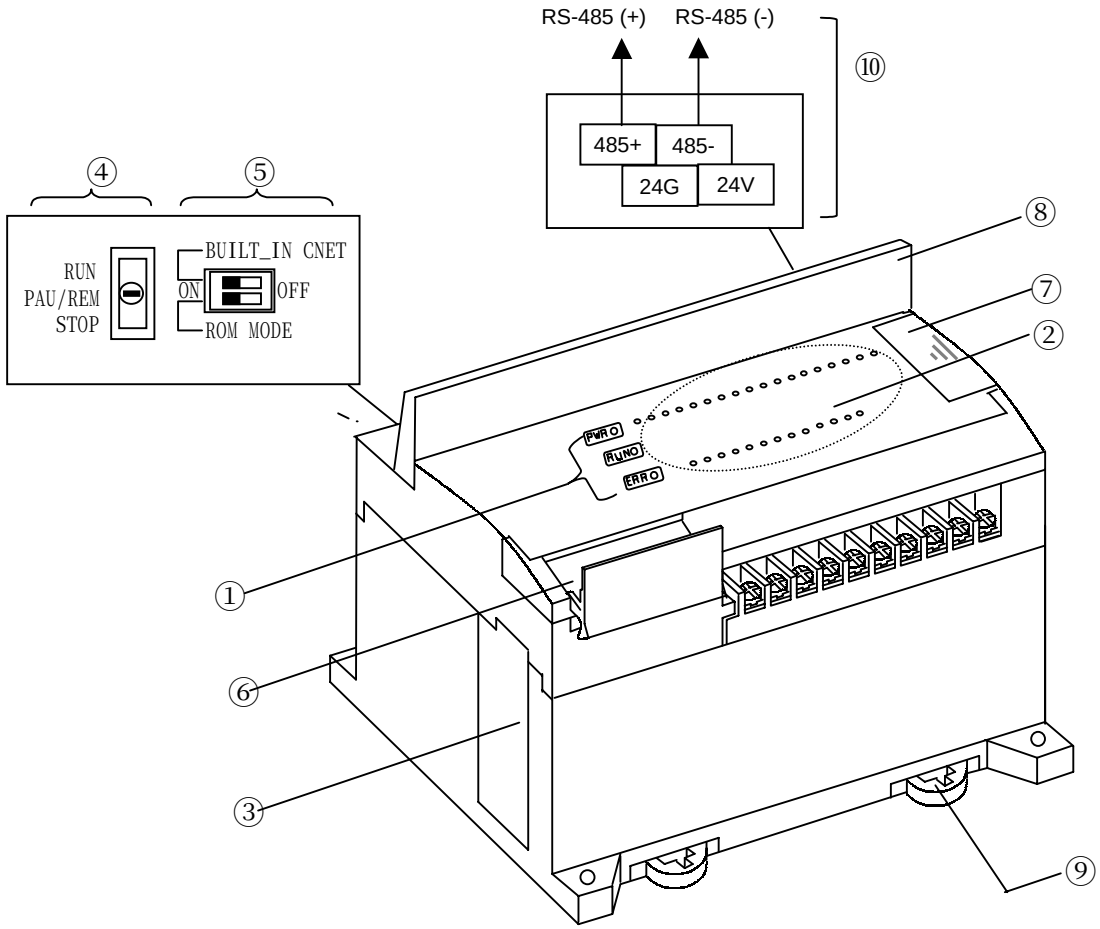
<table>
<tr><th>No.</th><th>Item</th><th colspan="7">Specifications</th><th>References</th></tr>
<tr><td>1</td><td>Operating ambient Temperature</td><td colspan="7">0 ~ 55 °C</td><td></td></tr>
<tr><td>2</td><td>Storage ambient Temperature</td><td colspan="7">–25 ~ +70 °C</td><td></td></tr>
<tr><td>3</td><td>Operating ambient Humidity</td><td colspan="7">5 ~ 95%RH, non-condensing</td><td></td></tr>
<tr><td>4</td><td>Storage ambient Humidity</td><td colspan="7">5 ~ 95%RH, non-condensing</td><td></td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibrations</td><td colspan="5">Occasional vibration</td><td colspan="2">-</td><td></td></tr>
<tr><td colspan="2">Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td><td colspan="2">Sweep count</td><td rowspan="7">IEC 61131-2</td></tr>
<tr><td colspan="2">10 ≤ f < 57Hz</td><td colspan="2">–</td><td>0.075mm</td><td colspan="2" rowspan="5">10 times for each X, Y, Z axis</td></tr>
<tr><td colspan="2">57 ≤ f ≤ 150Hz</td><td colspan="2">9.8m/s² {1G}</td><td>–</td></tr>
<tr><td colspan="5">Continuous vibration</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td></tr>
<tr><td colspan="2">10 ≤ f < 57Hz</td><td colspan="2">–</td><td>0.035mm</td></tr>
<tr><td colspan="2">57 ≤ f ≤ 150Hz</td><td colspan="2">4.9m/s² {0.5G}</td><td>–</td></tr>
<tr><td>6</td><td>Shocks</td><td colspan="7">• Maximum shock acceleration: 147 m/s² {15G}
• Duration time: 11ms
• Pulse wave: half sine pulse (3 shocks per axis, on X, Y, Z axis)</td><td>IEC 61131-2</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Noise Immunity</td><td>Square wave Impulse noise</td><td colspan="6">± 1,500 V</td><td>LGIS' Internal Standard</td></tr>
<tr><td>Electronic discharge</td><td colspan="6">Voltage: 4 kV (Discharge by contact)</td><td>IEC 61131-2, IEC 1000-4-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="6">27 ~ 500 MHz, 10 V/m</td><td>IEC 61131-2, IEC 1000-4-3</td></tr>
<tr><td rowspan="2">Fast transient & burst noise</td><td>Item</td><td>Power supply</td><td colspan="2">Digital I/O (>24V)</td><td colspan="2">Digital I/O (<24V) Analog I/O Interface</td><td rowspan="2">IEC 61131-2 IEC 1000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td colspan="2">1kV</td><td colspan="2">0.25kV</td></tr>
<tr><td>8</td><td>Atmosphere</td><td colspan="7">Free of corrosive gases and excessive dust</td><td>IEC61131-2</td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="7">Up to 2,000m</td><td></td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="7">2</td><td></td></tr>
<tr><td>11</td><td>Cooling method</td><td colspan="7">Air-cooling</td><td></td></tr>
</table>

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

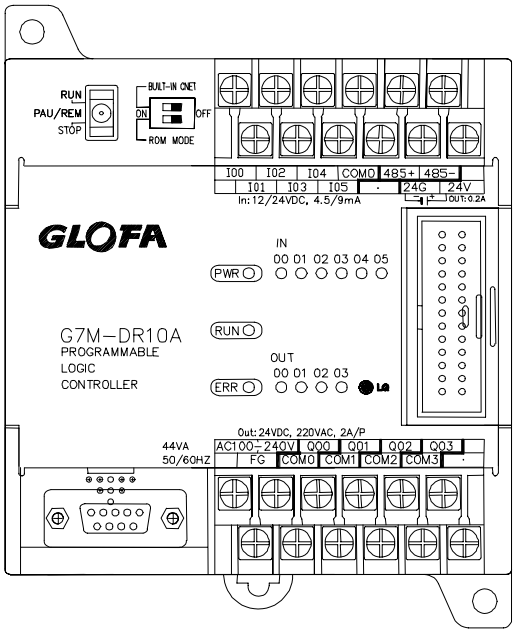
4.1 Base Unit



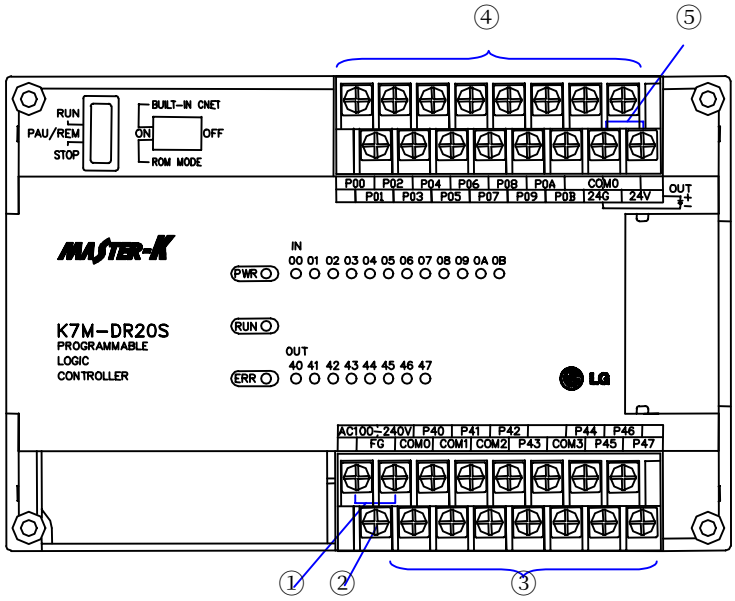
No	Name		
1	CPU Condition LED Indication	PWR LED	Indicates power supply to the system • On: When the supply is normal • Off: When the supply is abnormal
		RUN LED	Indicates base unit operation • On: Indicates local key switch or remote running mode • Off: with the following led gets off ▶ Without normal power supply to the base unit ▶ While key switch is stopped ▶ Detecting an error makes operation stop
		ERR LED	Indicates Base Units operation • On/Off of led: self-inspected error • Off: CPU is normally working.
2	I/O LED		Indicates I/O operating status
3	Folder for battery installation		Folder for back-up battery installation

No	Name	
4	Key switch mode creation	Indicates base units drive mode • RUN: Indicates program operation • STOP: Stopped program operation • PAU / REM: usage of each modules are as follows: ▶ PAUSE : temporary stopping program operation ▶ REMOTE : Indicates remote drive
5	Dip-switch memory operation	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
10	RS-485 communication terminal	Only available with 10 points modules (K7M-DR10S, K7M-DR10S/DC, K7M-DT10S)

4.1.1 10-point base unit

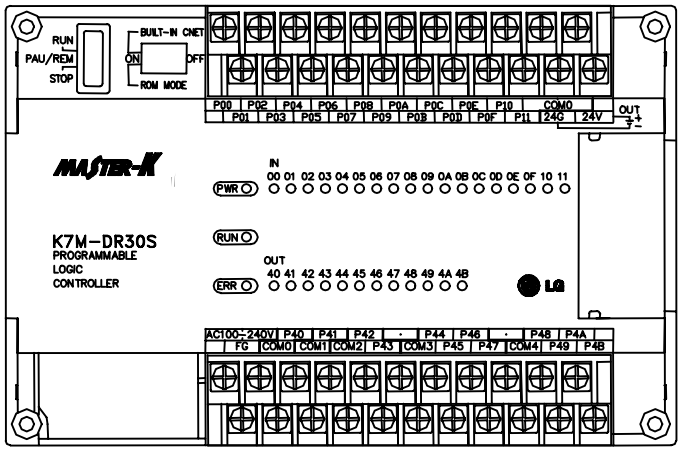


4.1.2 20-point base unit

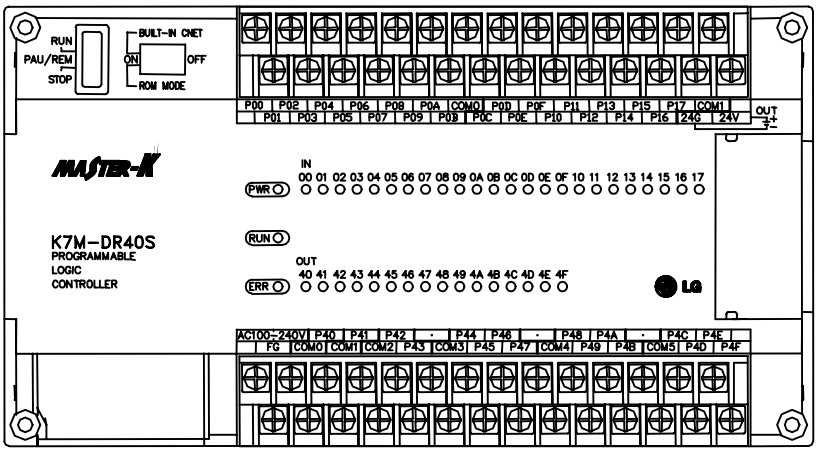


No.	Name	Usage
1	Terminal block for power supply	Terminal blocks for power supply (AC 100V ~ 240V)
2	FG circuit	Frame ground
3	Output terminal	Output connecting terminal
4	Input terminal	Output connecting terminal
5	DC24V, 24G output terminal	Service power supply for DC 24V needed place

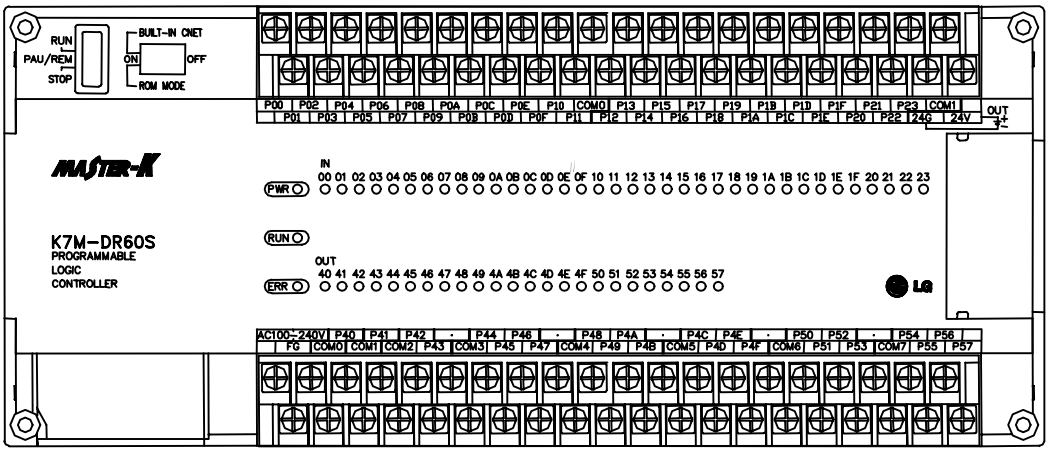
4.1.3 30-points base unit



4.1.4 40-points base unit

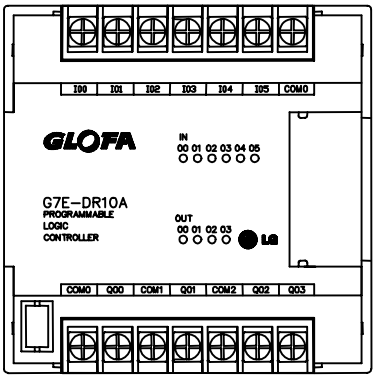


4.1.5 60-points base unit

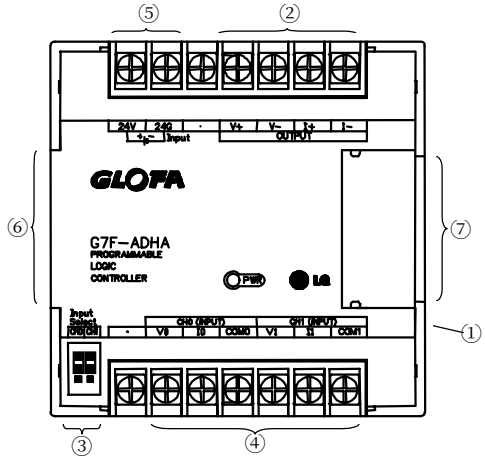


4.2 Expansion Module

4.2.1 Digital I/O Module

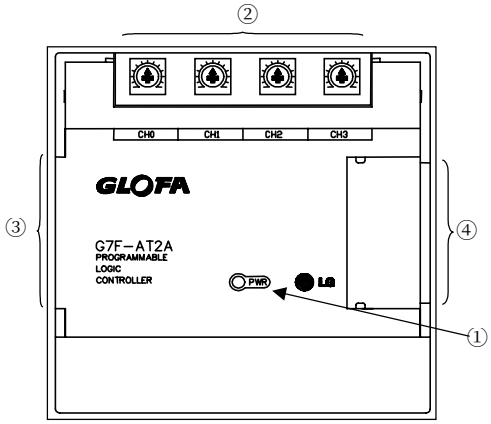


4.2.2 A/D · D/A Combination Module



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

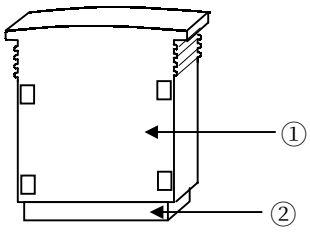
4.2.3 Analog Timer Module



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

4.2.4 Option Modules

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. K80S series have two option modules – external memory module and RTC module.



No.	Names
①	Option module
②	Connector

Chapter 5. CPU

5.1 Specifications

The following table shows the general specifications of the MASTER-K80S series

Item		Specifications					Remarks
		K7M-DR10S	K7M-DR20S	K7M-DR30S	K7M-DR40S	K7M-DR60S	
		K7M-DR10S/DC	K7M-DR20S/DC	K7M-DR30S/DC	K7M-DR40S/DC	K7M-DR60S/DC	
		K7M-DT10S	K7M-DT20S	K7M-DT30S	K7M-DT40S	K7M-DT60S	
Program control method		Cycle execution of stored program, Time-driven interrupt, Process-driven interrupt					
I/O control method		Indirect mode (Refresh method), Direct by program command					
Program language		Mnemonic, Ladder diagram					
Numbers of instructions		Basic : 30, Application : 218					
Processing speed		0.5μsec/step					
Program capacity		7ksteps					
I/O points		10	20	30	40	60	
Memory device	P	P000 ~ P13F					I/O relay
	M	M000 ~ M191F (3,072points)					Auxiliary relay
	K	K000 ~ K31F (512 points)					Keep relay
	L	L000 ~ L63F (1,024 points)					Link relay
	F	F000 ~ F63F (1,024 points)					Special relay
	T	100msec : T000 ~ T191 (192 points) 10msec : T192 ~ T255 (64 points)					Timer
	C	C000 ~ C255 (256 points)					Counter
	S	S00.00 ~ S99.99 (100×100 steps)					Step controller
	D	D0000 ~ D4999 (5,000 words)					Data register
Operation modes		RUN, STOP, PAUSE, DEBUG					
Self-diagnosis functions		Detect errors of scan time, memory, I/O, battery, and power supply					
Data back-up method		Battery-back-up					
Max. expansion level		Up to 3 level					

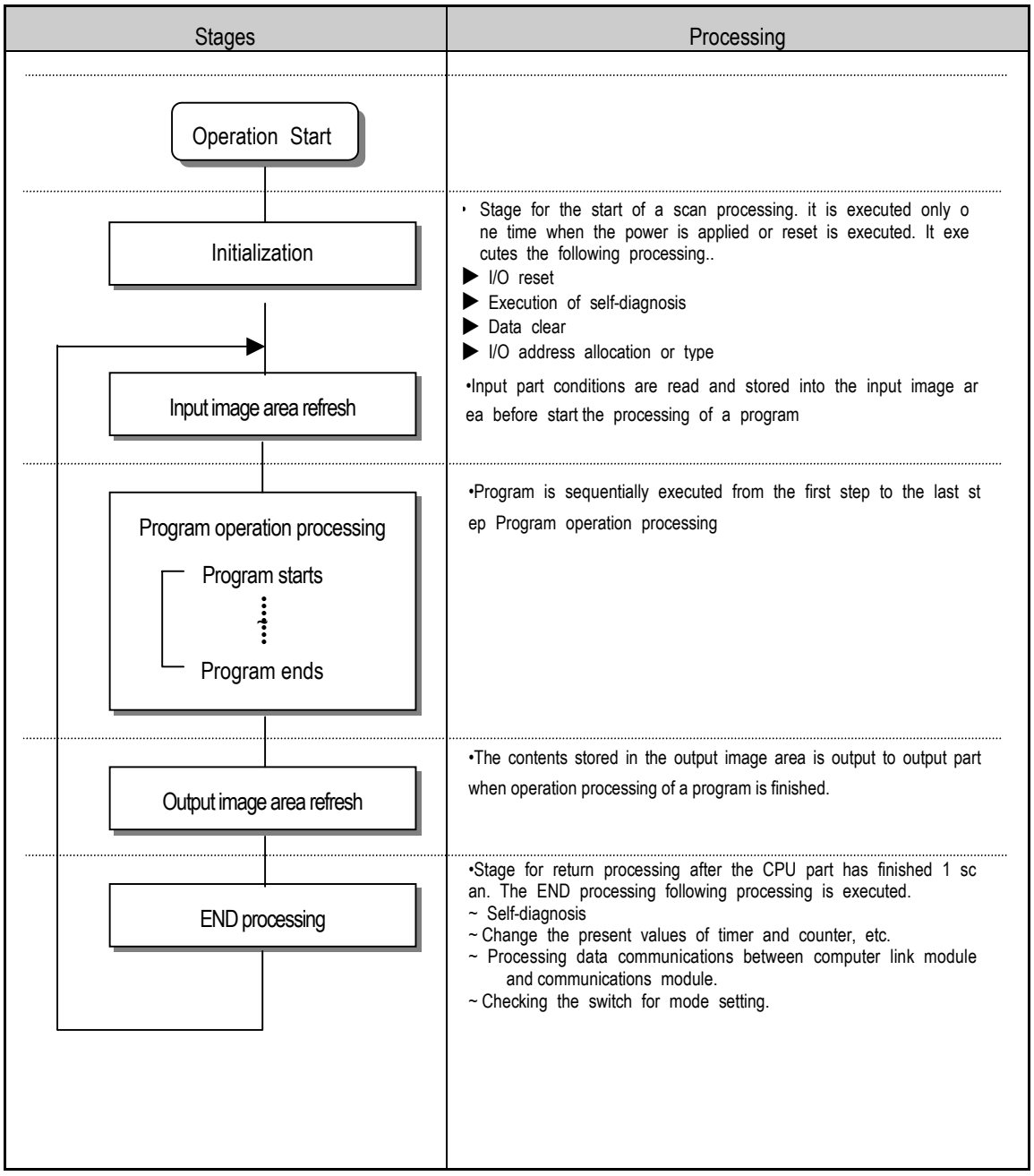
Item			Specifications	Remarks
Internal Function	PID control function		Function block control, auto tuning, forced output, adjustable operation scan time, forward/reverse operation control	
	Cnet I/F Function		Master-K exclusive protocol support MODBUS protocol support User's protocol support	Common use with KGLWIN port
	High-speed counter	Capacity	1 phase : 16 kHz, 1 channel 2 phase : 8 kHz,1 channel	
		Counter function	It has 3diffferant counter function as following; 1 phase, up/down by program 1 phase, up/down by B phase input 2 phase, up/down by phase difference	
		Multiplication function	Multiplication : 1, 2, or 4 (adjustable)	
		Data comparison function	Execute a task program when the elapsed counter value reaches to the preset value	
	Pulse catch		Minimum pulse width : 0.2msec, 8 points	
	Pulse output		2khz, 1point	Transistor output only
	External interrupt		8points, 0.4ms	
	Input filter		0~15ms	
Weight (g)	K7M-DR10S		370	
	K7M-DR20S		530	
	K7M-DR30S		550	
	K7M-DR40S		670	
	K7M-DR60S		845	
	K7M-DR10S/DC		370	
	K7M-DR20S/DC		530	
	K7M-DR30S/DC		550	
	K7M-DR40S/DC		670	
	K7M-DR60S/DC		845	
	K7M-DT10S		370	
	K7M-DT20S		540	
	K7M-DT30S		550	
	K7M-DT40S		670	
	K7M-DT60S		845	
	G7E-DR10A		230	

5.2 Operation Processing

5.2.1 Operation Processing Method

1) Cyclic operation

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



2) Time driven interrupt operation method

In time driven interrupt operation method, operations are processed not repeatedly but at every pre-set interval. Interval, in the MK80S series, can be set to between 0.001 to 6 sec. This operation is used to process operation with a constant cycle.

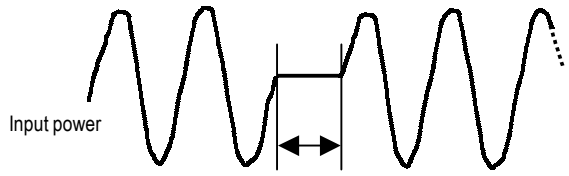
3) Event driven interrupt operation method

If a situation occurs which is requested to be urgently processed during execution of a PLC program, this operation method processes immediately the operation, which corresponds to interrupt program. The signal, which informs the CPU of those urgent conditions is called interrupt signal. The MK80S CPU has two kind of interrupt operation methods, which are internal and external interrupt signal methods.

5.2.2 Operation processing at momentary power failure occurrence

The CPU detects any momentary power failure when the input line voltage to the power supply falls down below the defined value. When the CPU detects any momentary power failure, the following operations will be executed:

1) Momentary power failure within 20 ms



Momentary power failure exceeding 2Oms

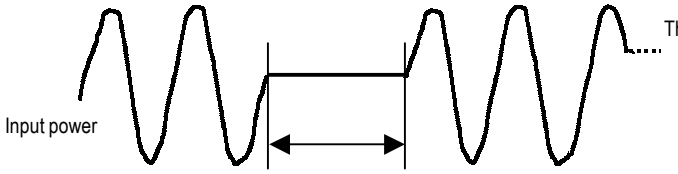
(1) The operation processing is stopped with the output retained.

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

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

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

2) Momentary power failure exceeding 20 ms



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

Momentary power failure exceeding 2Oms

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).

5.2.3 Scan Time

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

1) Expression for scan time

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

(1) Scan time = Scan program processing time + 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 ta sk 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 + Communi cations service processing time

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

2) Flag

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)

5.2.4 Scan Watchdog Timer

1) Watchdog timer is used to detect a delay of abnormal operation of sequence program (Watchdog time is set in menu of basic parameter of KGLWIN.)
2) When watchdog timer detects an exceeding of preset watchdog time, the operation of PLC is stopped immediately and al l 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 : 1~ 6,000ms(unit : 10ms)

5.2.5 Timer Processing

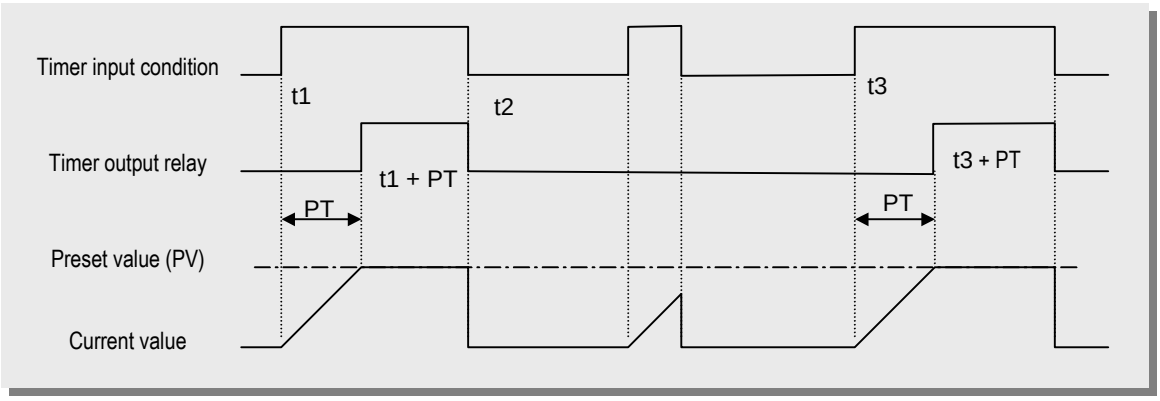
The MASTER-K series uses up count timers. There are 5 timer instructions such as on-delay (TON), off-delay (TOFF), integral (TMR), monostable (TMON), and re-triggerable (TRTG) timer.

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

1) On delay timer

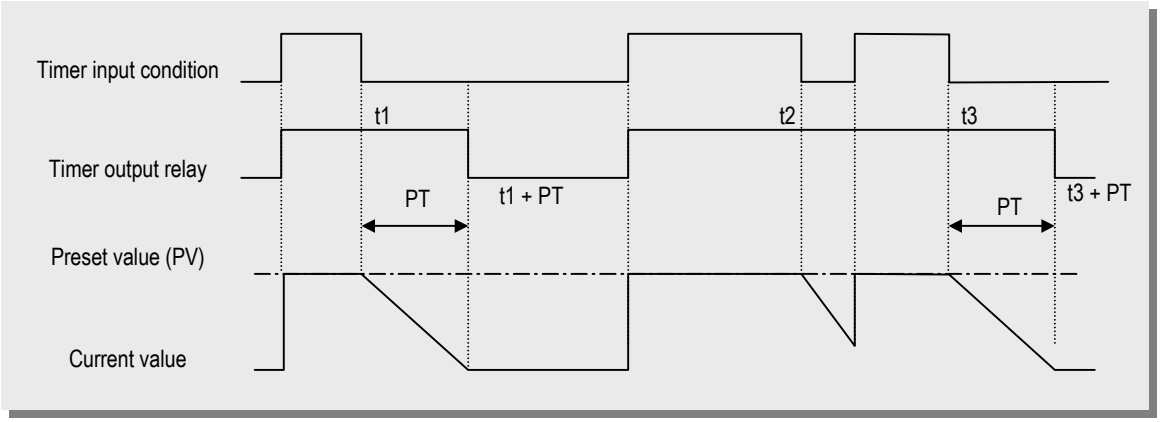
The current value of timer starts to increase from 0 when the input condition of TON instruction turns on. When the current value reaches the preset value, the timer output relay turns on.

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.

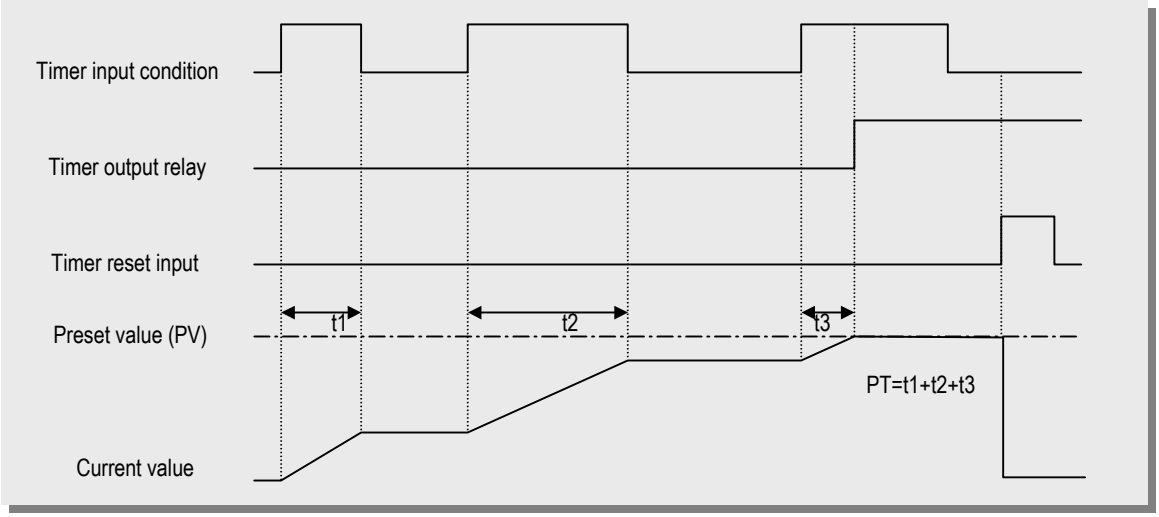


3) Integral timer

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.

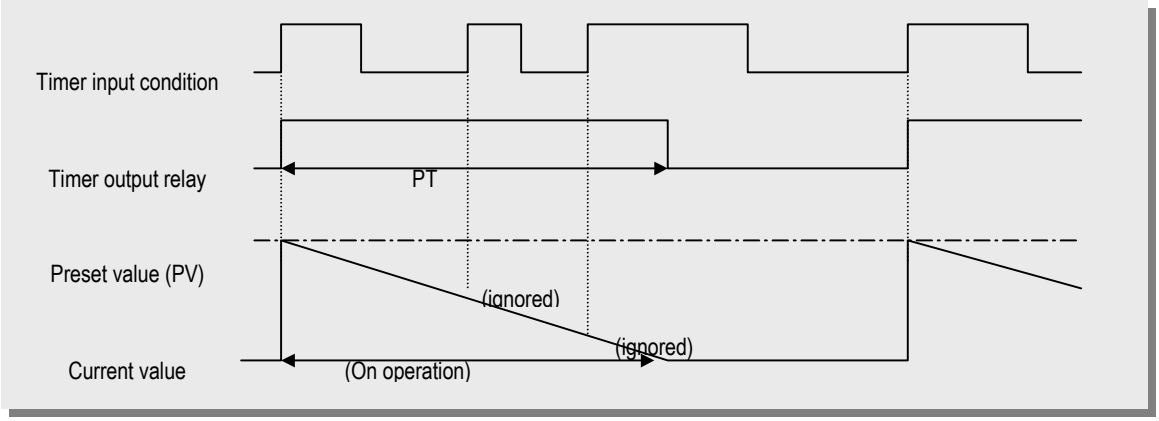
When the current value reaches preset value, the timer output relay is turned on.

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



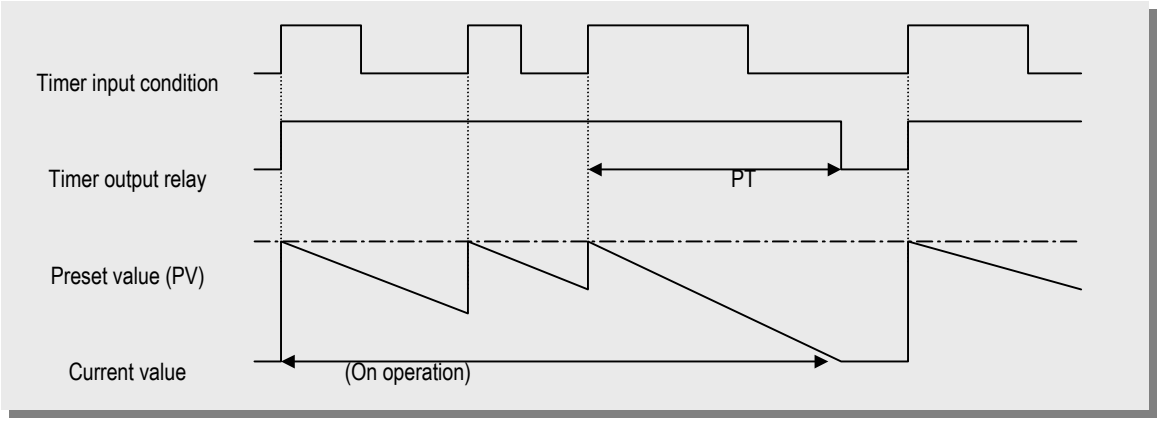
4) Monostable timer

In general, its operation is same as off-delay timer. However, the change of input condition is ignored while the timer is operating (decreasing).



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 accuracy of timer:

The Maximum timing error of timers of MASTER-K series is + 2 scan time ~ - 1 scan time.

Refer the programming manual for details.

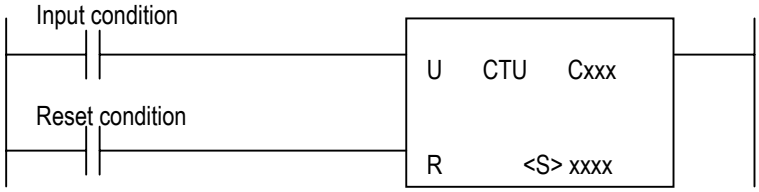
5.2.6 Counter Processing

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 maximum counter setting value is hFFFF (= 65535). The followings shows brief information for counter operation.

1) Up counter (CTU)

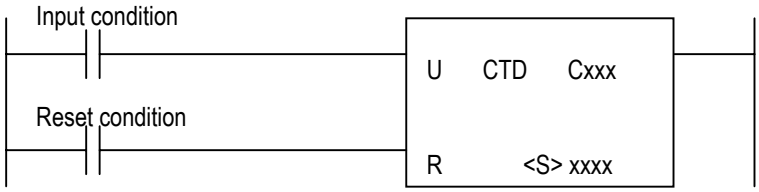
The counter output relay is turned on when the current value reaches the preset value. After the counter relay output is turned on, the current value will increase until it reaches the maximum counting value (hFFFF = 65535).

When the reset input is turned on, the counter output relay and current value is cleared as 0.



2) Down counter (CTD)

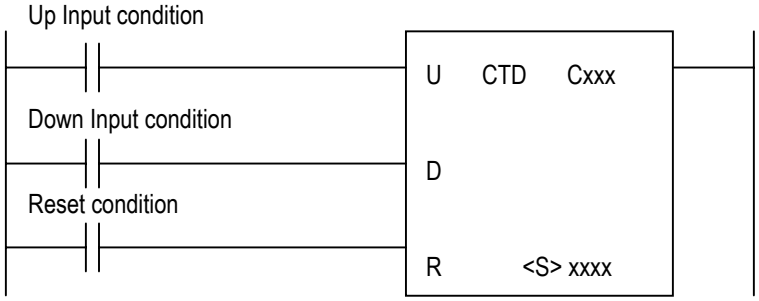
When the CPU is switched to the RUN mode, the current value is set as preset value.[1] The current value is decreased by 1 with the rising edge of counter input signal. The counter output relay is turned on when the current value reaches 0.



[1] If the retentive counter area is used for down counter, the reset input has to be turned on to initialize counter.

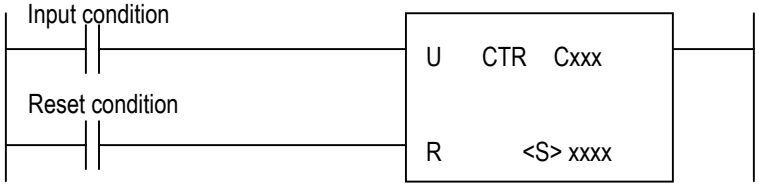
3) Up-down counter

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.



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.



REMARK

1. Maximum counting speed

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.

$$\text{Maximum counting speed } (C_{max}) = \frac{n}{100} \times \frac{1}{t_s} \text{ (times/sec)}$$

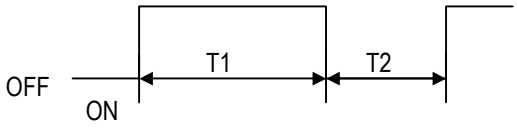
n : duty (%), t_s : scan time

2. Duty

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

If $T1 \le T2$, $n = \frac{T1}{T1+T2} \times 100\ (\%)$

If $T1 > T2$, $n = \frac{T2}{T1+T2} \times 100\ (\%)$



5.3 Program

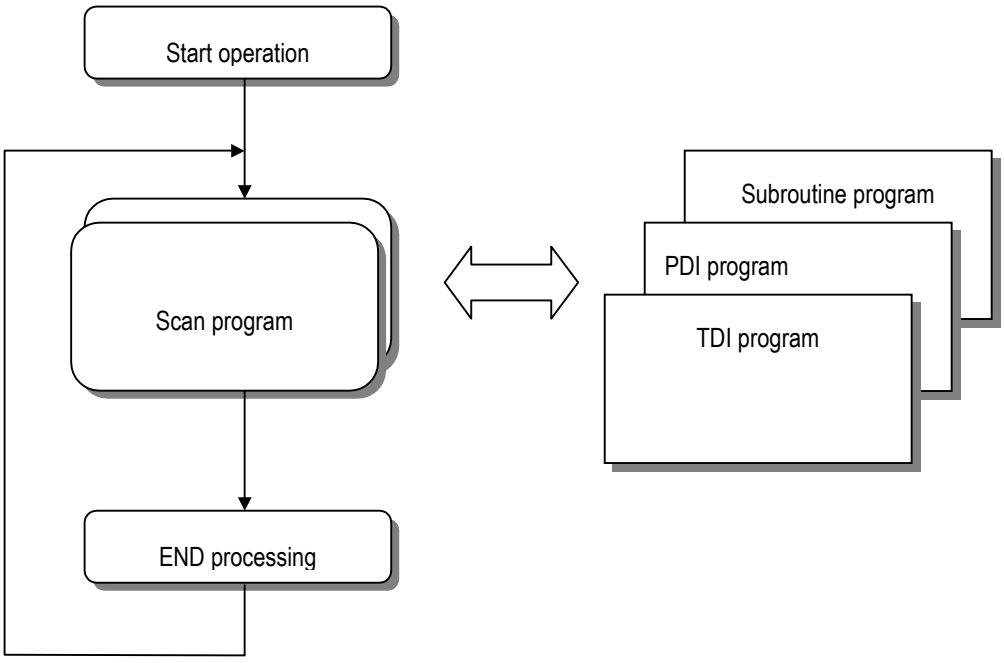
5.3.1 Classification of program

All functional elements need to execute a certain control process are called as a 'program'. In MASTER-K series, a program is stored in the RAM 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. If the scan program is not stored, the CPU cannot execute not only the scan program but also other programs.
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 only external interrupt input is applied and the corresponding interrupt routine is enabled by EI instruction.
Subroutine program	The subroutine programs are executed when they are called by the scan program with a CALL instruction.

5.3.2 Processing method

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



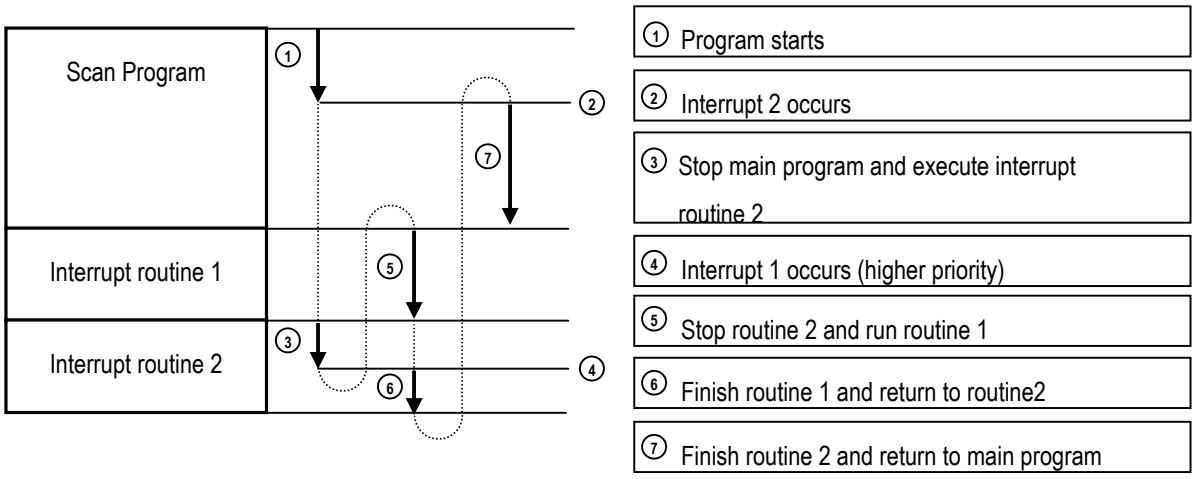
5.3.3 Interrupt function

When an interrupt occurs, the CPU module will stop the current operation and execute the corresponding interrupt routine. After finish the interrupt routine, the CPU resume the sequence program from the stopped step.
MASTER-K series provides 2 types of interrupt. The TDI (Time driven interrupt) occurs with the constant period, and PDI (Process driven interrupt) occurs with the status of external input.

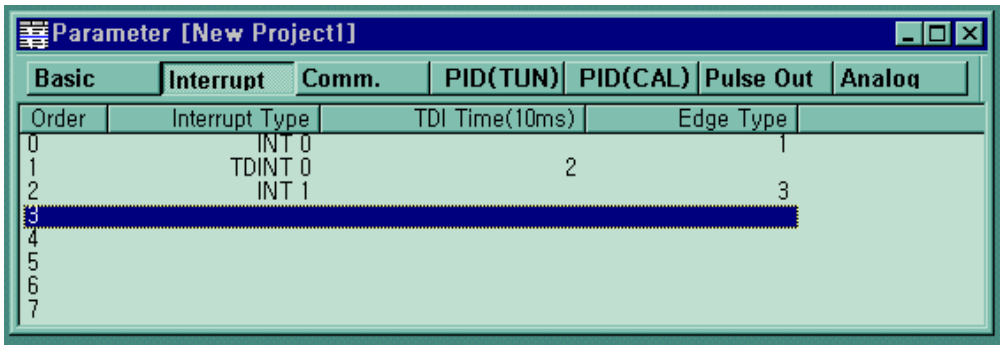
Before to use interrupt function in sequence program, the parameter setting should be done properly. Then the corresponding interrupt routine should be written after END instruction. (Refer chapter 4 for details) If interrupt routines are not matched with parameter settings, an error occurs and the operation of CPU will be stopped.

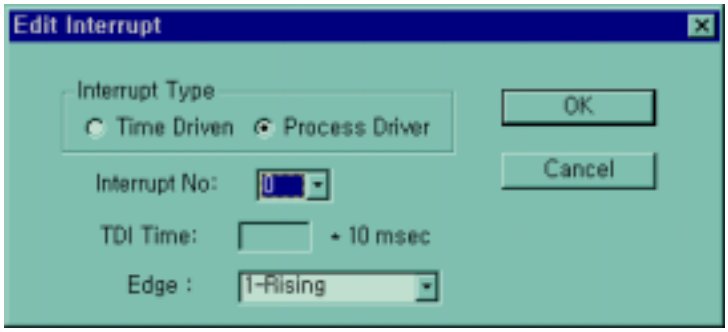
To execute an interrupt routine, use the EI instruction to enable the corresponding interrupt. The interrupt routine is not executed if an interrupt factor occurs before execution of an EI instruction. Once an interrupt is enabled with EI instruction, it keeps the enabled status until DI instruction is executed to disable the interrupt. When a CPU is turned to RUN mode, all interrupts are disabled by default.

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. The following figure shows how a CPU handles multiple interrupts.



1) parameter setting





2) 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. Otherwise, two interrupts are executed consequently.

3) Process driven interrupt

Available PDI is P000 ~ P007 (8 points) assigned in parameter setting.

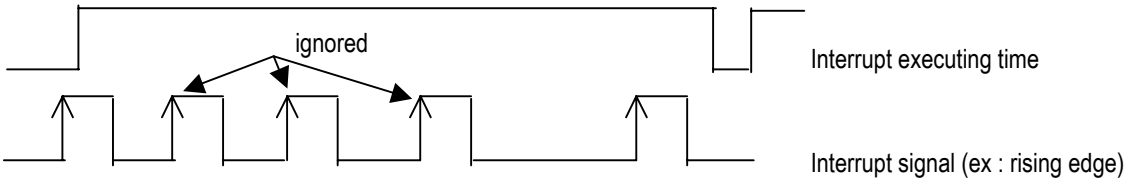
PDI occurs when the input status of P000 ~ P007 is changed from Off to On or from On to Off.

REMARK

Total available interrupt points

Time driven interrupt + process driven interrupt ≤ 8 points

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



5.3.4 Error Handling

1) Error Classification

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

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

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

2) Operation mode at error occurrence

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

(1) PLC hardware defect

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

(2) System configuration error

This error occurs when the PLC hardware configuration differs from the configuration defined in the K80S series. The system enters into the STOP state.

(3) Operation error during execution of the user programs

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

(4) External device malfunction

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

REMARK

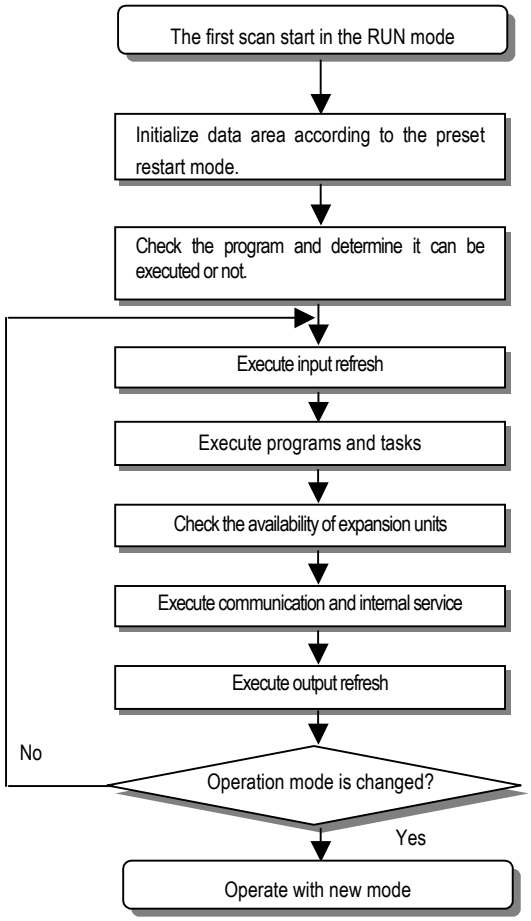
1) In occurrence of a fatal error the state is to be stored in the representative system error flags, and an ordinary error in the representative system warning flags.
2) For details of flags, refer to Appendix 2. Flag List.

5.4 Operation Modes

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

5.4.1 RUN mode

In this mode, programs are normally operated.



1) Processing when the operation mode changes.

Initialization of data area is executed when the first scan starts.

(1) If the PLC is in the RUN mode when applying the power:

(2) If the operation mode has been changed into from the STOP mode into the RUN mode : the initializati on is executed complying with the restart mode set. (cold / warm / hot)

(3) The possibility of execution of the program is decided with check on its effectiveness.

2) Operation processing contents

I/O refreshes and program operation are executed.

(1) 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.

5.4.2 STOP mode

In this mode, programs are not operated.

1) Processing when the operation mode changes.

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

2) Operation processing contents

(1) I/O refresh is executed.

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

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

5.4.3 PAUSE mode

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

1) Processing when the operation mode changes

Data area and input image are not cleared and the operating conditions just before the mode change is maint ain.

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.

5.4.4 DEBUG mode

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

1) Processing when the operation mode changes

(1) Data area is initialized at the starting time of the mode change complying with the restart mode, which has been set on

the parameters.

(2) The output image area is cleared and output refresh is executed.

2) Operation processing contents

(1) I/O refresh is executed by one time every scan.

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

3) Debug operation conditions

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

Operation conditions	Description
Executed by the one (step operation)	Executes just an operation unit (one step)
Executed to the specified breakpoint.	Executes user program until the specified step (break point)
Executed according to the device status	Execute user program until a device (bit or word) assigned is changed to the specified status
Executed by the specified scan numbe r.	Execute user program for specified number of scans

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 KGL WIN User's Manual Chapter 9.'Debugging'

5.4.5 Operation mode change

1) Operation mode change methods

The following method is used to change the operation mode.

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

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

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

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

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

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

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

REMARK

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

3) Remote operation mode change

Remote operation mode change is available only when the operation mode is set to the remote STOP mo de (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 computer link, etc.
PAU / REM	Remote STOP → Remote RUN	○	○
	Remote STOP → Remote PAUSE	X	X
	Remote STOP → DEBUG	○	○
	Remote RUN → Remote PAUSE	○	○
	Remote RUN → Remote STOP	○	○
	Remote RUN → DEBUG	X	X
	Remote PAUSE → Remote RUN	○	○
	Remote PAUSE → Remote STOP	○	○
	Remote PAUSE → Remote DEBUG	X	X
	DEBUG → Remote STOP	○	○
	DEBUG → Remote RUN	X	X
	DEBUG → Remote PAUSE	X	X

4) Remote operation mode change enable/disable

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

5.5 Functions

5.5.1 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 the PLC power supply is turned on and when an error occurs the PLC is in the RUN state. If an error is detected, the system stops operation to prevent faulty PLC operation.

2) 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. The default value is set as 200msec, and it is changeable with parameter setting. Refer the MASTER-K programming manual for details on the 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 long scan time 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 flashes. (RUN LED will be turned OFF) Therefore, when use FOR ~ NEXT or CALL instruction, insert WDT instruction to reset the watch dog timer.

3) Battery check function

When the voltage of the battery for back-up the memory IC of CPU are lower than the minimum back-up voltage, the BAT LED of CPU module will be turned on.

5.5.2 I/O Force On/Off function

It is possible to input/output a designated data regardless of the result of program operation. This function is useful to check operation of the input/output modules and wiring between the output modules and external devices.

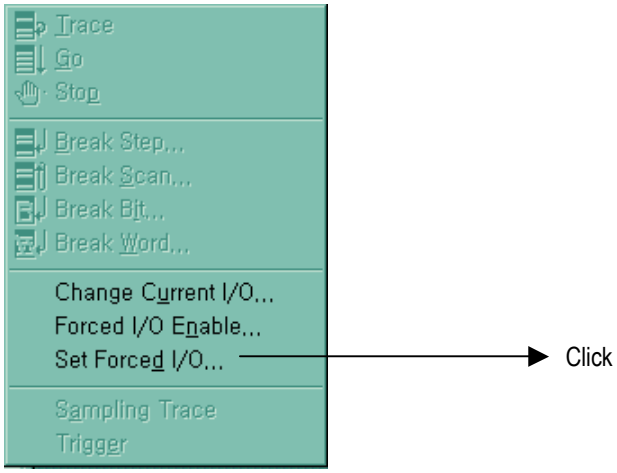
1) Force On/Off setting method.

Force on/off setting is applied to input area and output area.

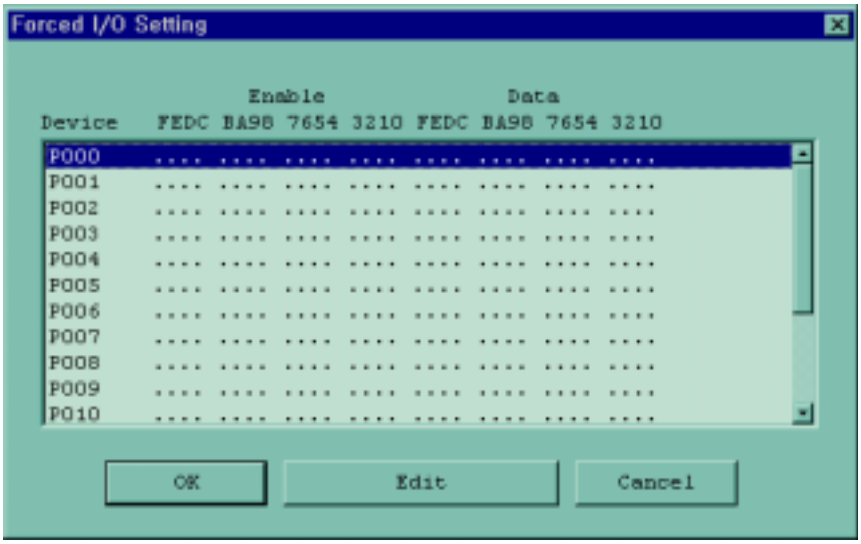
Force on/off should be set for each input and output, the setting operates from the time that Force I/O setting enable' is set.

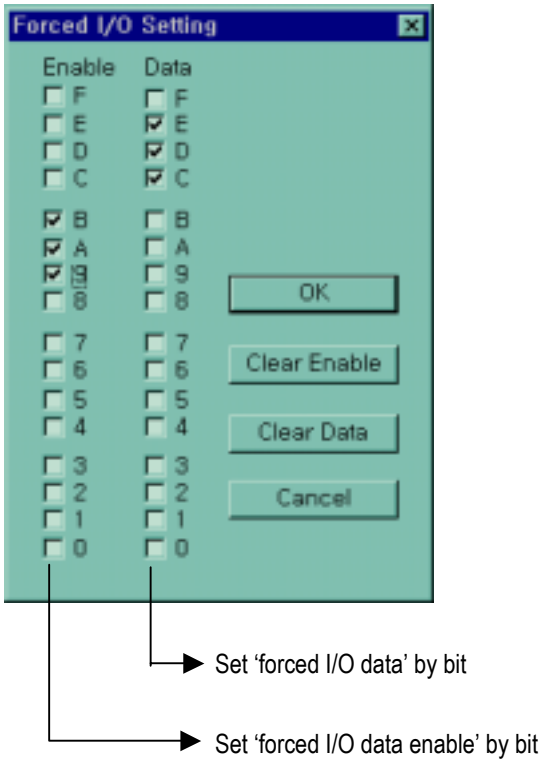
This setting can be done when I/O modules are not really loaded.

Select the 'set forced I/O' from KGLWIN

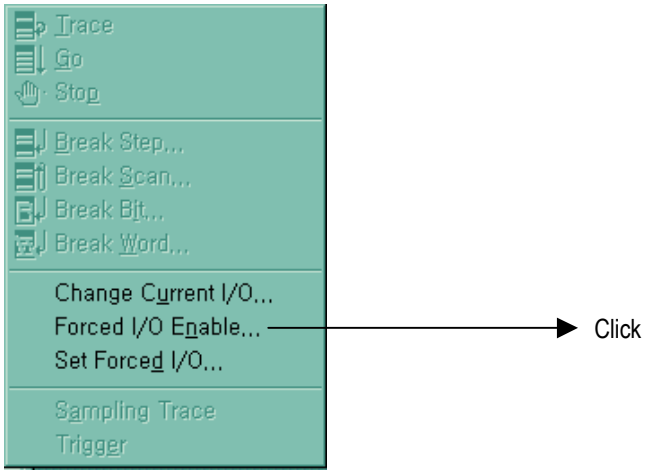


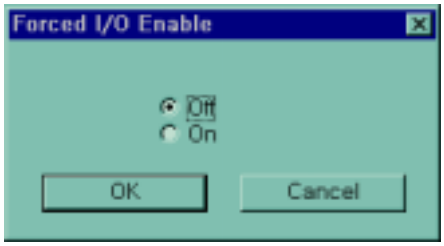
Select the I/O area and then double click.





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





2) Special data register for forced I/O set

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.

Item	Special Device
All Forced I/O enable	M1910
Forced I/O enable by bit	D4700 ~ D4731
Forced I/O set data	D4800 ~ D4831

3) Force on/ off Processing timing and method

(1) Force Input

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

(2) Force output

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

(3) Force on off processing area

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

(4) Precautions

- Turning the power off and on, changes of the operation mode or operation by reset switch (K1000S) do es not change the previous force on/off setting data. They remain within the CPU module and operation is executed with the same data.
- Force I/O data will not be cleared even in the STOP mode.
- If a program is downloaded or its backup breaks, the force on/off setting data will be cleared. The oper ating program in memory differs from the program in the flash memory so that if operation restarts with the program in the flash memory the on/off setting data will be also cleared.
- When setting new data, disable every I/O settings using the setting data clear' function and set the new data.

REMARK

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

5.5.3 Direct I/O Operation function

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

Direct input/output is executed by use of the 'IORF' instruction. If this instruction is used, the input/output image area will be directly updated and applied to the continuing operations.

REMARK

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

5.5.4 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 latest error information
	D4905 ~ D4908	The 2nd latest error information
	:	:
	D4961 ~ D4964	The 16th latest error information

2) Description of each word

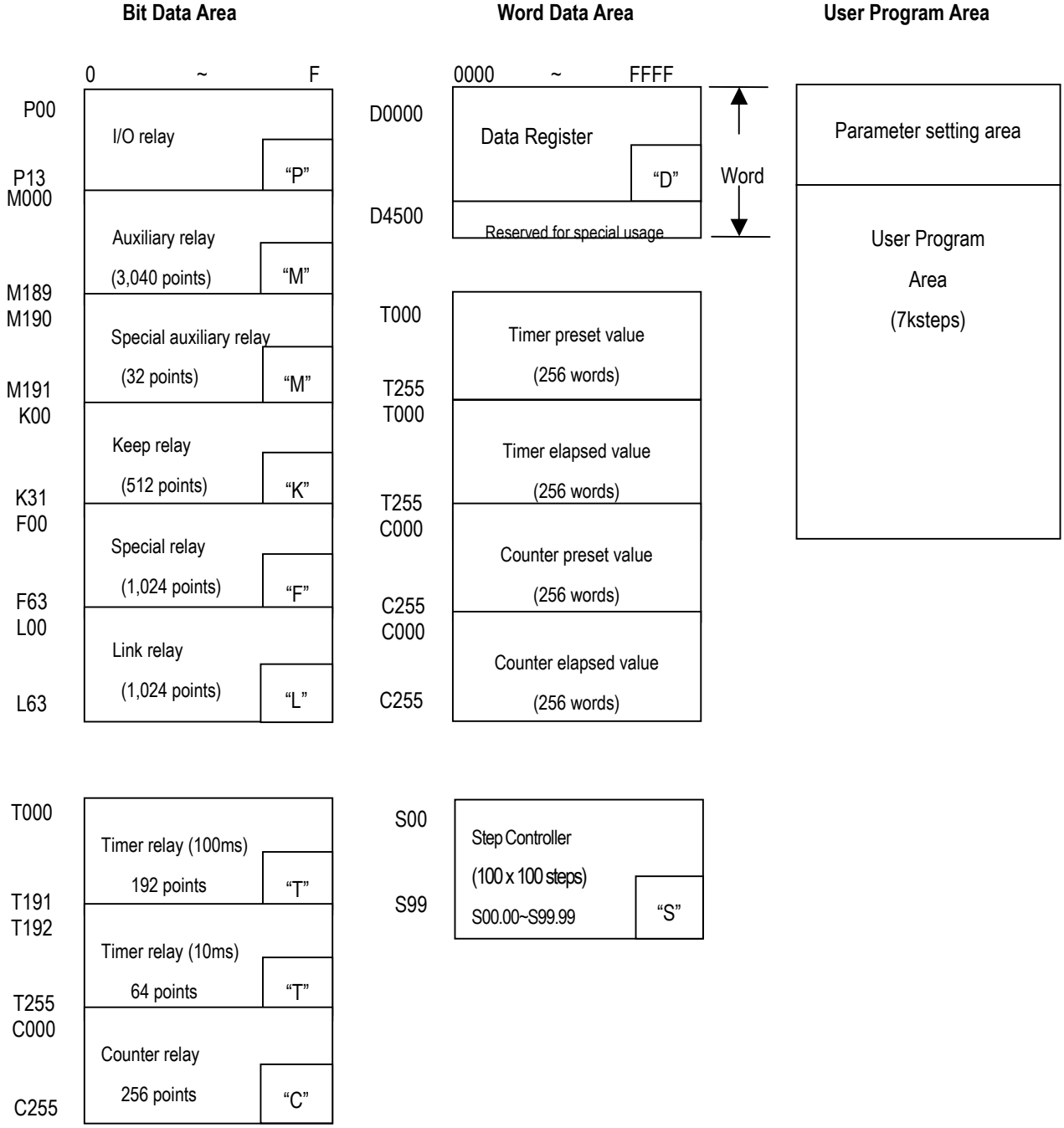
	Contents	Description
D4901	h9905	Year : 99, Month : 5
D4902	h2812	Date : 28, Hour : 12
D4903	h3030	Minute : 30, Second : 30
D4904	h0001	Error code (h0001)

3) Clear error data

Use a 'data clear' function of KGLWIN or KLD-150S

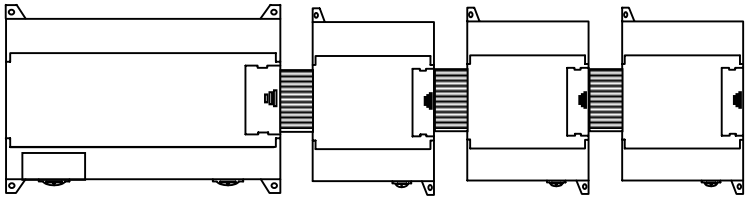
5.6 Memory Configuration

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



5.7 I/O No. Allocation Method

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

Mounting module	No. of module can be mounted	remark
Expansion I/O module	2	
A/D conversion module	2	
Analog timer module	3	
Communication module	1	

I/O No. allocation method

module		area	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 (Special)		None	A/D,A/T,Communication

Basically I/O allocation is fixed point method.(the area which is not used can be used internal relay)

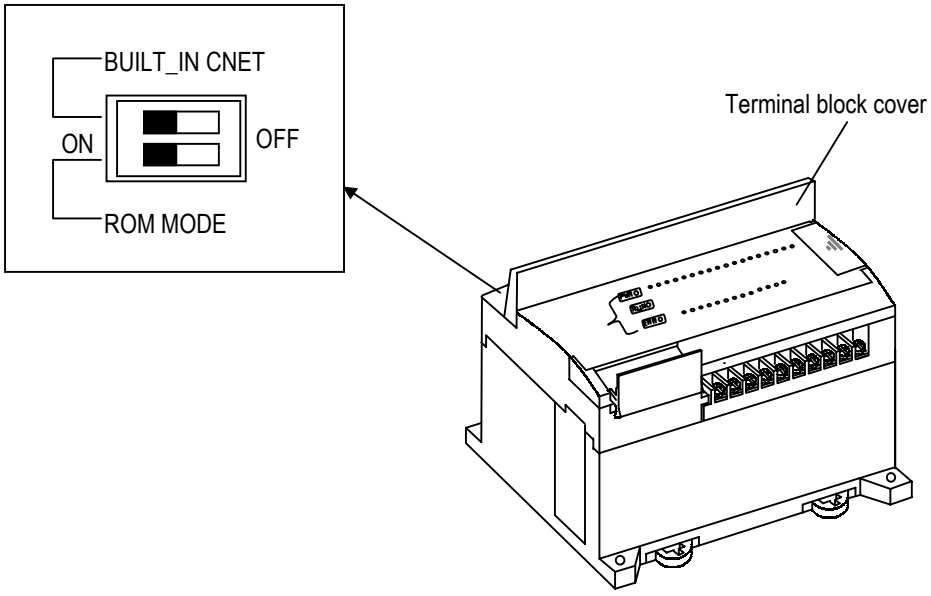
The special module is not allocated.

5.8 Built-in Flash Memory

MK80S series includes a built-in flash memory to store user program. Also, user can set the PLC automatically executes the user program of flash memory when the PLC is turned on. It is similar with the ROM operation of other PLCs, but it is different that no external memory is required.

5.8.1 Structure

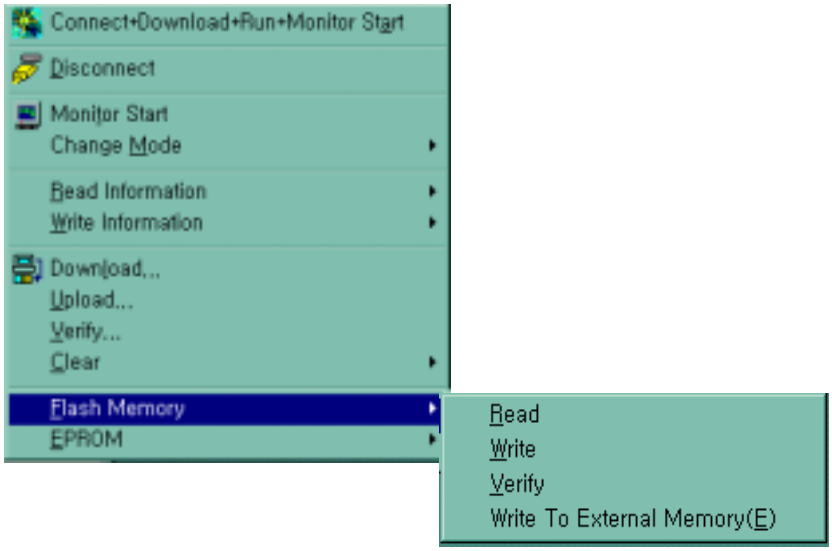
You can see dip switches as shown when you open I/O terminal block cover.



5.8.2 Usage

Set the base unit to the STOP mode.

Select the 'Flash memory' of on-line menu, the following window shows.



1) read

read the program and parameter to CPU memory from fresh memory

2) write

write the program and parameter to fresh memory from CPU memory

3) verify

verify the program and parameter between CPU memory and fresh memory

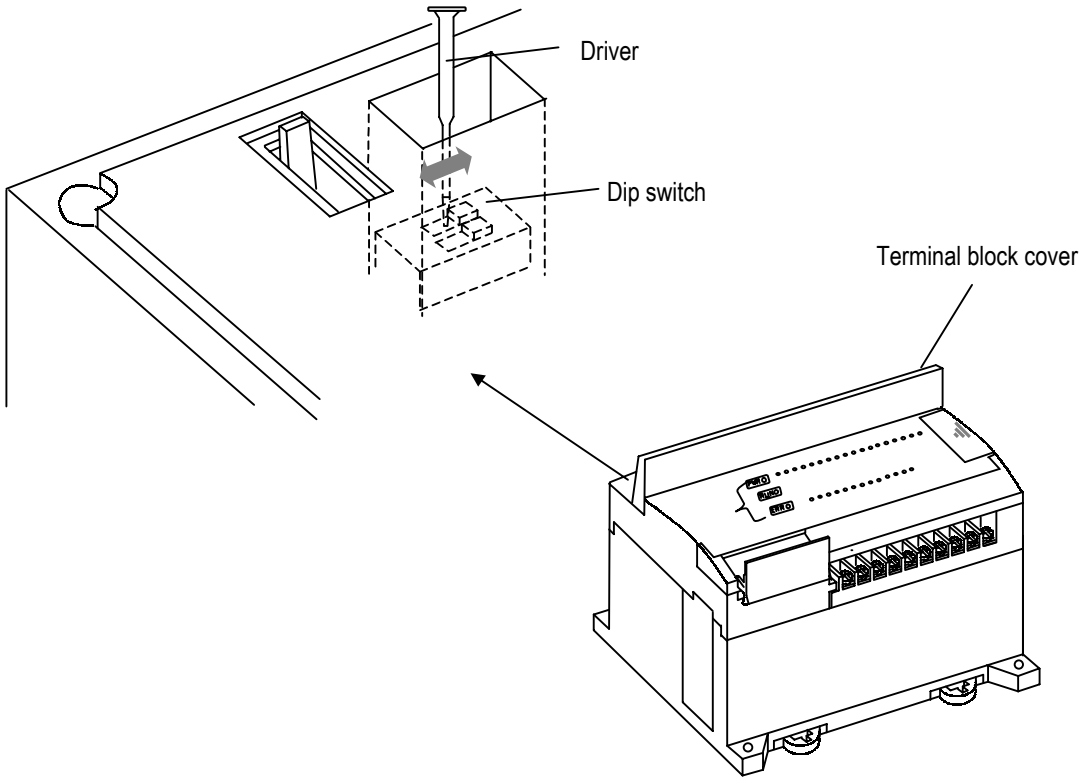
4) dip switch for operating flash memory.

Dip switch position	Description
upper switch is for Cnet. ON OFF ROM MODE	When power is on, the program saved in the flash memory operates.
Upper switch is for Cnet. ON OFF ROM MODE	CPU recognizes that there is no program in the flash memory, and starts to drive program from RAM.

REMARKS

1) The flag for flash memory operation is F00A.

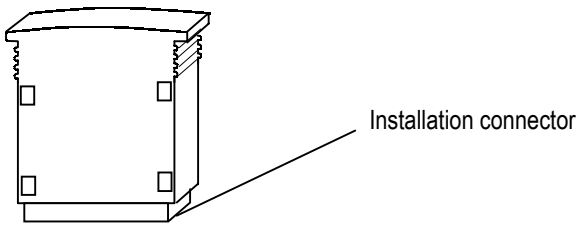
Dip switch for flash memory operation is placed in deep place to prevent a mistaken operation caused by terminal block cover, etc. Use a small driver to operate it.



5.9 External Memory Module

MK80S 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.

5.9.1 Structure



5.9.2 Usage

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

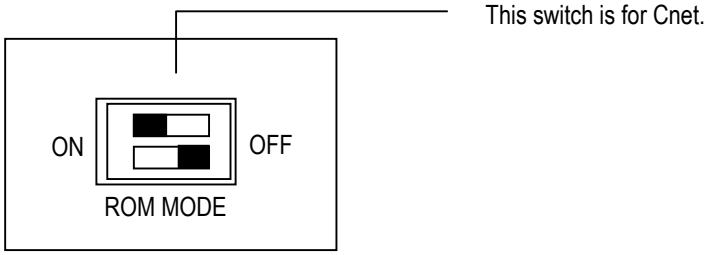
Turn the power of the base unit off.

Install the memory module.

◆ When only basic unit is used: Connect to the expansion connector of the basic unit.

◆ When expansion unit is used: Connect to the expansion connector of the last connected expansion unit.

Turn the dip switch for ROM mode setting of the base unit to OFF.



(4) Turn the power of the base unit on.

(5) Connect KGLWIN and PLC.

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

(8) Choose an item to be saved in the flash memory and press 'OK.'

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

(10) Remove the external memory module.

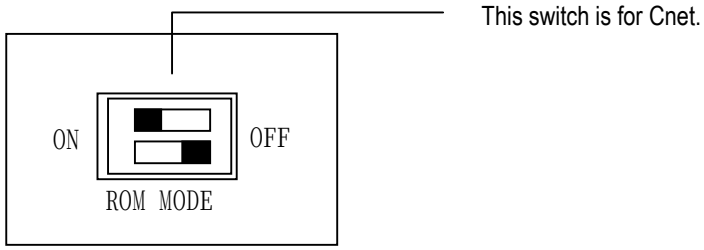
Through the above steps a user can save a program into the external memory module.

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

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

(2) Install the memory module (When only base unit is used, connect to the expansion connector of the base unit. And when expansion unit is used, connect to the expansion connector of the last connected expansion unit).

(3) Set the dip switch for ROM mode setting of the base unit to OFF position.



(4) Turn on the power of the base unit.

(5) As RUN LED and ERR. LED are on, the contents of the memory module is transferred into the program area of the base unit and ROM operation area of the flash memory. (It may take about 15 sec.)

(6) Operate according to the set operation mode.

(7) Turn off the power of the basic unit.

(8) Remove the memory module.

(9) Turn the power on.

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

REMARK

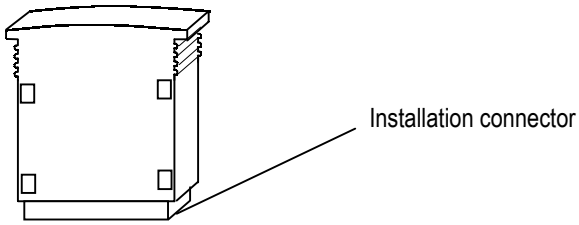
1) When the PLC is operated with the external memory module, it always operates with restart.

2) Remove after the program transfer is finished.

5.10 RTC Module

MK80S series supplies RTC(Real Time Clock) module for the time-scheduling control. To use RTC function with K80S series, the RTC operation module should be attached to the expansion slot of main unit or expansion/special function unit. Clock operation by the RTC function is continued with a battery or super capacitor when the CPU is powered off.

5.10.1 Structure



5.10.2 Usage

1) Clock Data

Clock data is the data comprised of year, month, day, hour, minute, second, and date.

Data name	Description	
Year	4 digits of the Christian Era	
Month	1 to 12	
Day	1 to 31 (A leap year is distinguished automatically)	
Hour	0 to 23 (24 hours)	
Minute	0 to 59	
Second	0 to 59	
Date	0	Sunday
	1	Monday
	2	Tuesday
	3	Wednesday
	4	Thursday
	5	Friday
	6	Saturday

2) Precision

Max. 1.728 second per day (general temperature)

Remark

1. The RTC data does not have factory default setting. Please write a correct RTC data before using RTC function first time.
2. If unreasonable RTC data is written to the CPU, the RTC function may operate abnormally.

   Example : 13 (month) 32 (day)

3) Read / write RTC data

a) Read RTC data

The current RTC data

Memory Area (Word)	Description		Data (BCD format)
	Upper byte	Lower byte	
F053	Lower 2 digits of year	Month	h9812
F054	Day	Hour	h2219
F055	Minute	Second	h3746
F056	Higher 2 digits of year	Date	h1902

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

b) Write RTC data

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

The first one is using a handy loader (KLD-150S) or graphic loader (KGL-WIN). For detailed information, refer the user's manual of KLD-150S or KGL-WIN.

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

4) The preset RTC data

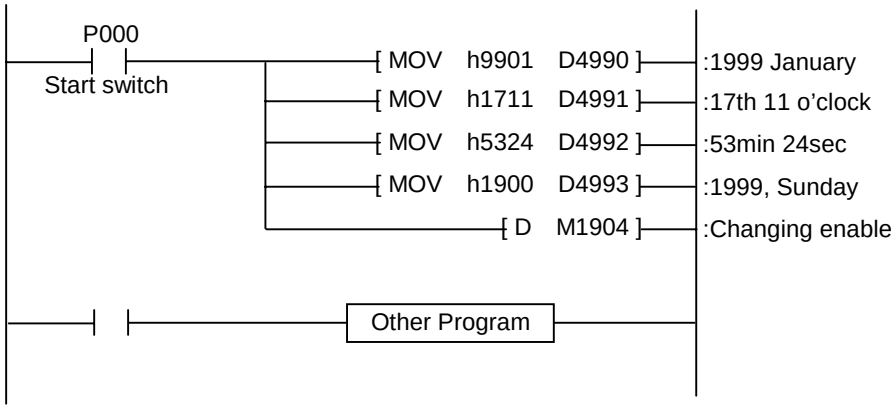
Memory Area (Word)	Description		Data (BCD format)
	Upper byte	Lower byte	
D4990	Lower 2 digits of year	Month	h9901
D4991	Day	Hour	h1711
D4992	Minute	Second	h5324
D4993	Higher 2 digits of year	Date	h1900

Example : 1999. 1. 17. 11:53:24, Sunday

M1904 : RTC data change bit

When the M1904 bit is switched on, the new data in D4990 ~ D4993 (K1000S : D9990 ~ D9993) 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.

<Example program>



5.11 Battery

1) Specifications

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

2) Handling Instructions

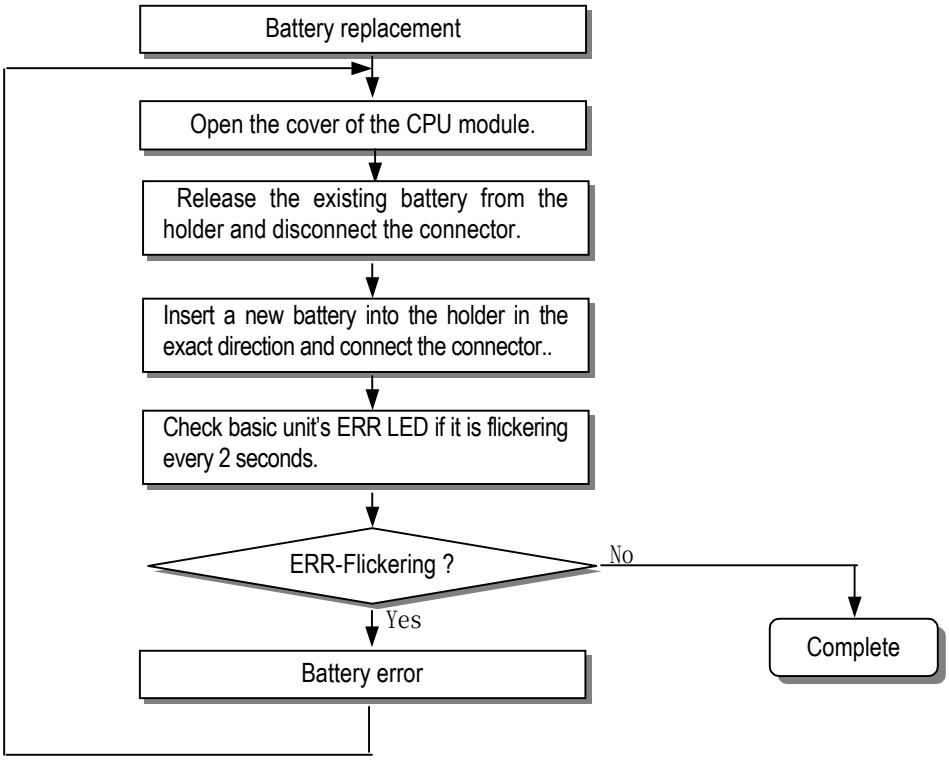
(1) Don't heat or solder its terminals.

(2) Don't measure its voltage with a tester or short circuit.

(3) Don't disassemble.

3) Battery Replacement

Backup battery needs periodic exchange. In case of battery replacement at power off, the built-in super capacitor backup the program and retain variables about 30 minutes. However, it is recommended to complete the battery replacement as soon as possible, or turn on the base unit during battery replacement.

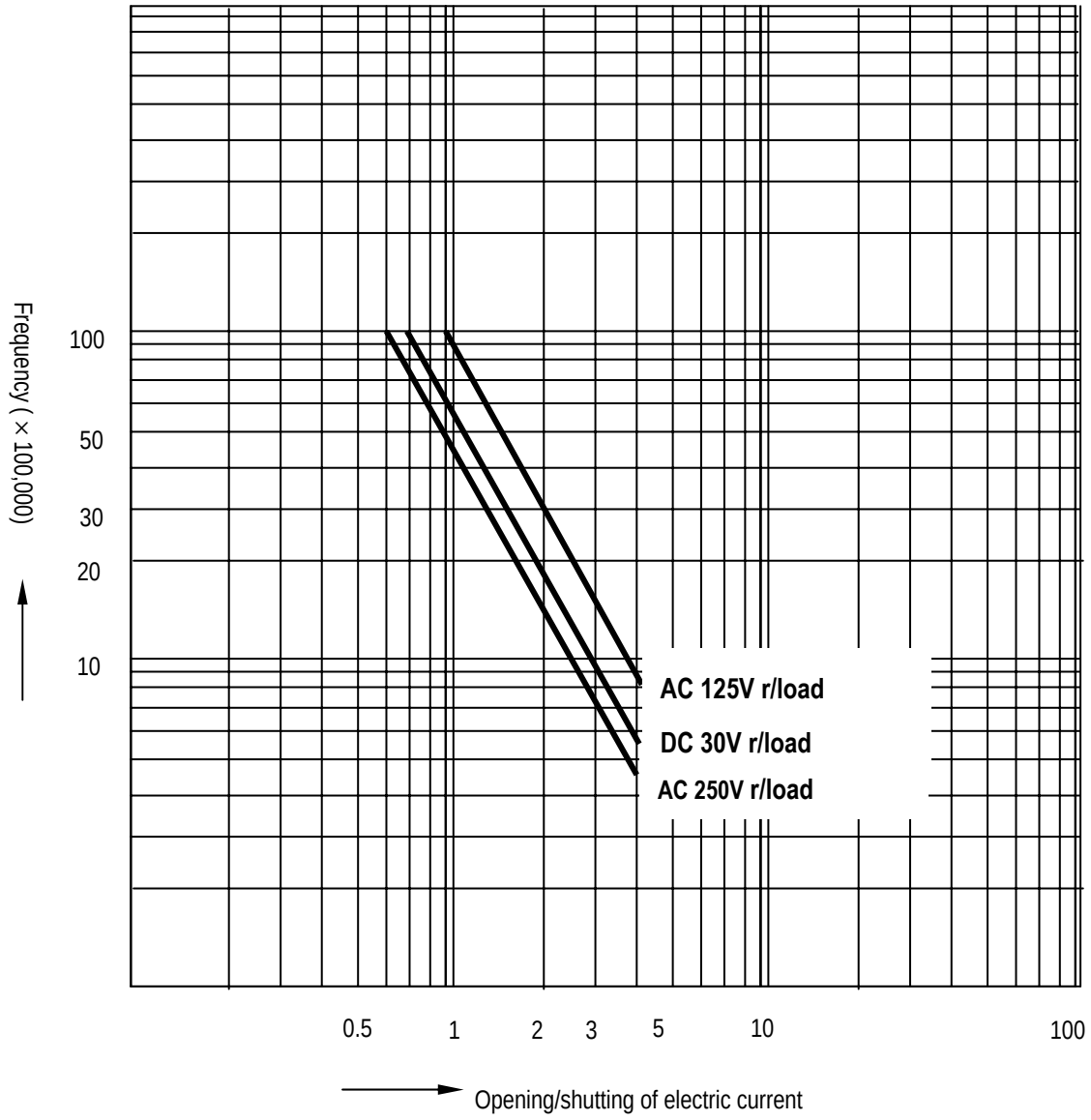


Chapter 6 Input and Output Modules

6.1 Input / Output Specifications

Digital input that offers to MASTER-K80S 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

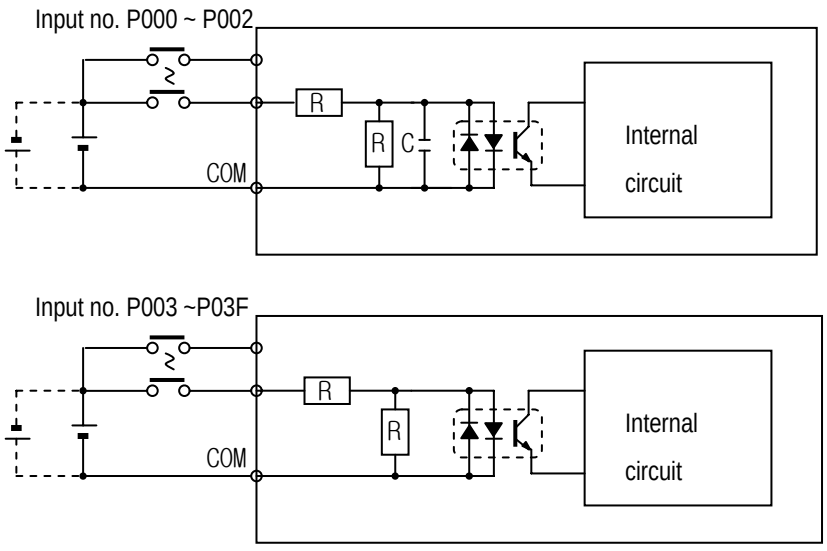
6.2.1 Base unit

1) Specification

Specification \ Model	Base unit				
	K7M-DR10S	K7M-DR20S	K7M-DR30S	K7M-DR40S	K7M-DR60S
	K7M-DR10S/DC	K7M-DR20S/DC	K7M-DR30S/DC	K7M-DR40S/DC	K7M-DR60S/DC
	K7M-DT10S	K7M-DT20S	K7M-DT30S	K7M-DT40S	K7M-DT60S
Number of input points	6 points	12 points	18 points	24 points	36 points
Insulation method	Photo coupler				
Rated input voltage	DC24V				
Rated input current	7mA (P000 ~ P002 : 16mA)				
Operating voltage range	DC10.2 ~ 28.8V (ripple: less than 5%)				
Max. simultaneous input points	100% simultaneously On				
On voltage / On current	DC19 V or higher/ 5.7 mA or higher (P000 ~ P002 : 12.7mA or higher)				
Off voltage / Off current	DC6 V or lower / 1.8 mA or lower (P000 ~ P002 : 4mA or lower)				
Input impedance	Approx. 3.3 kΩ (P000~P002: approx. 1.5 kΩ)				
Response time Off → On	15ms or less *1				
Response time On → Off	15ms or less *1				
Common terminal	6 points / COM	12 points / COM	18 points / COM	12 points / COM	16 points / COM
Operating indicator	LED turns on at ON state of input				

*1 : It is possible to select from 1ms to 15ms by 1ms at KGLWIN.

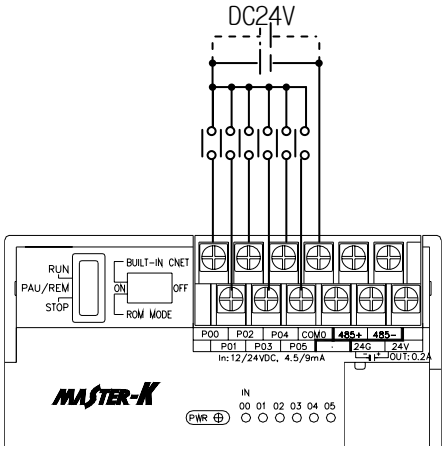
2) Circuit diagram



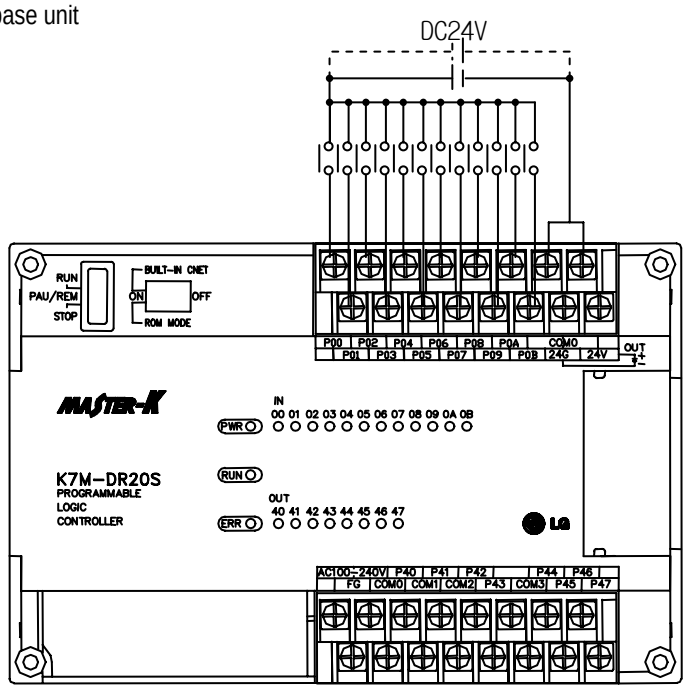
3) Input wiring

Base unit's wiring method is as follows. DC input specifications offered by K80S is to be used for both electric current sink and electric current source.

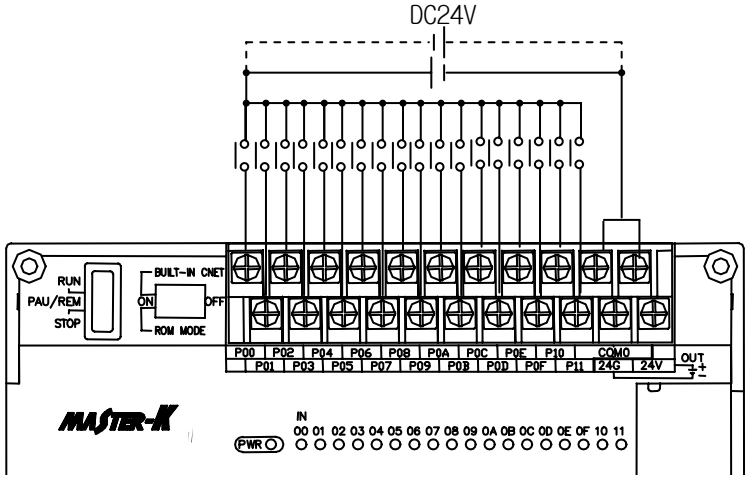
(1) 10-points base unit



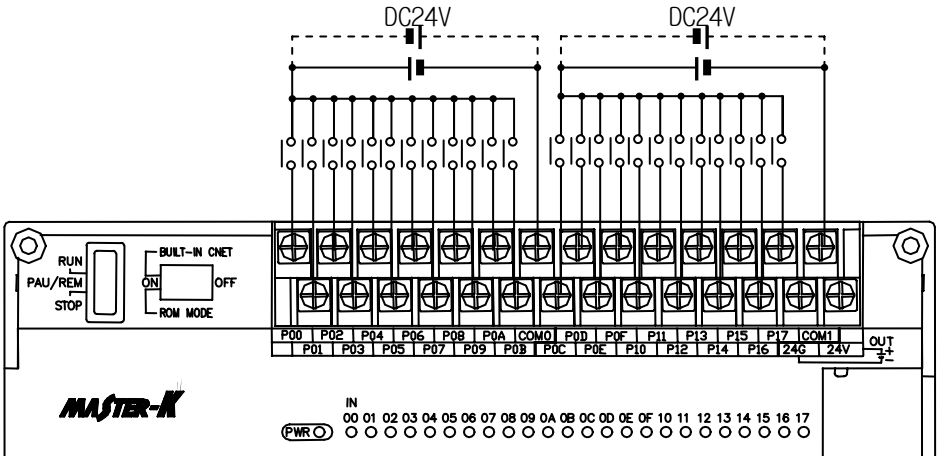
(2) 20-points base unit



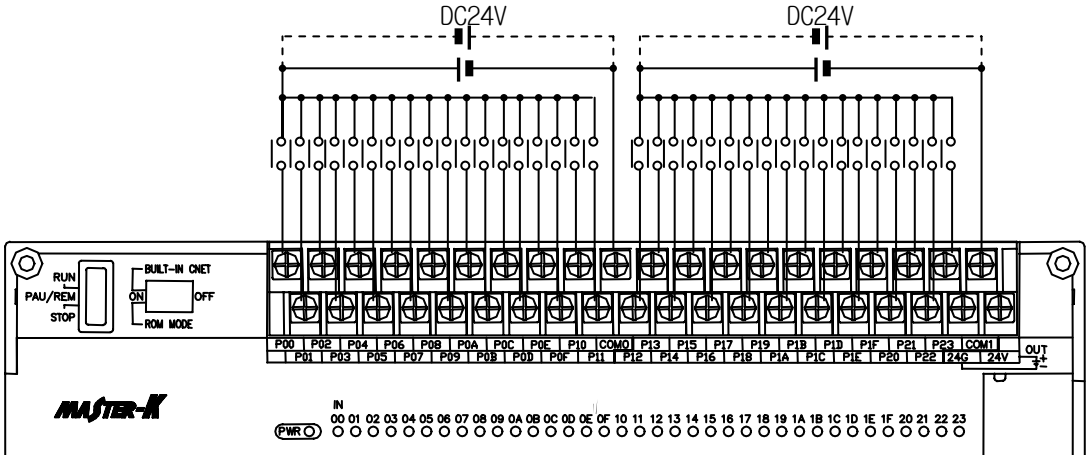
(3) 30-point base unit



(4) 40-point base unit

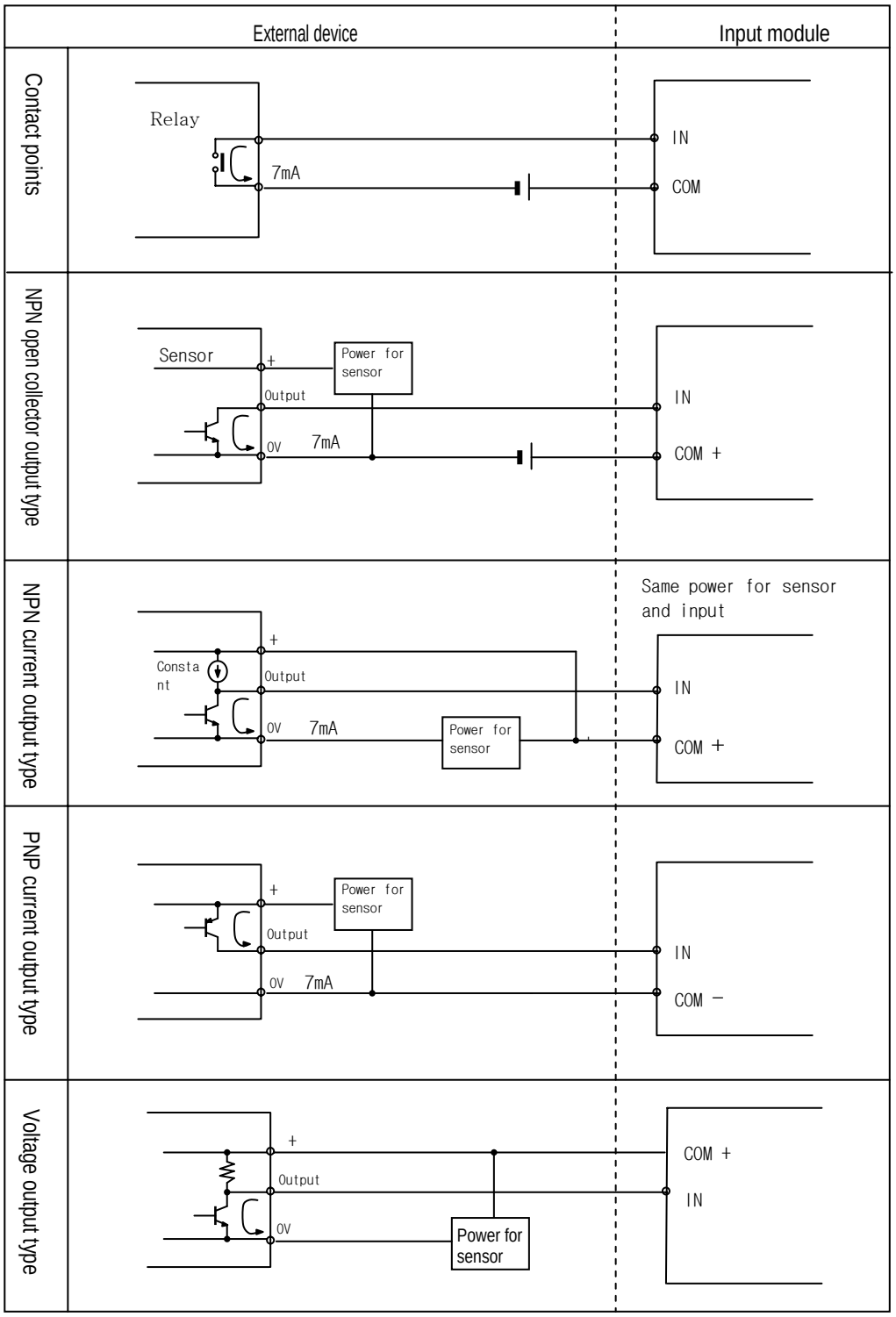


(5) 60-point base unit



4) Example of external devices.

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



6.2.2 Expansion Module

1) Specifications

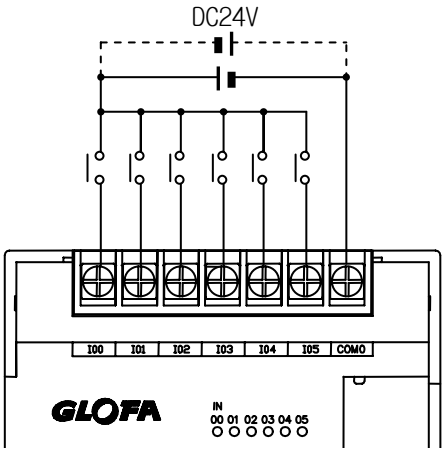
Specification \ Model		Expansion Module
		G7E-DR10A
Number of input points		6 points
Insulation method		Photo coupler
Rated input voltage		DC12 / 24V
Rated input current		4.5 / 9 mA
Operating voltage range		DC10.2 ~ 28.8V (ripple: less than 5%)
Max. Simultaneous input points		100% simultaneously On
On voltage / On current		DC9.5V or higher/ 3.5 mA or higher
Off voltage / Off current		DC5V or lower / 1.8 mA or lower
Input impedance		Approx. 2.7 kΩ
Response time	Off → On	15ms or less *1
	On → Off	15ms or less *1
Common terminal		6 points / com
Operating indicator		LED turns on at ON state of input

*1 : It's possible to select from 1ms to 15ms by 1ms at KGLWIN.

2) Circuit diagram

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

3) Input wiring



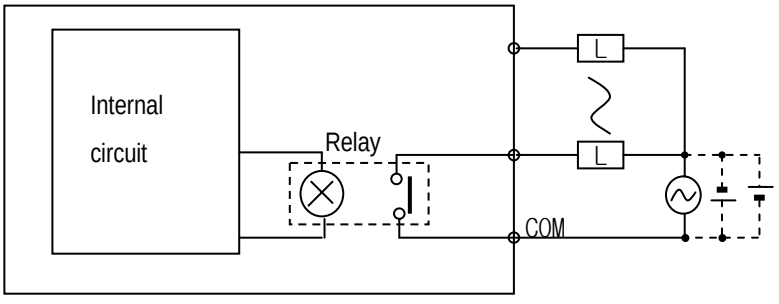
6.3 Digital Output Specification

6.3.1 Base unit (Relay Output)

1) Specification

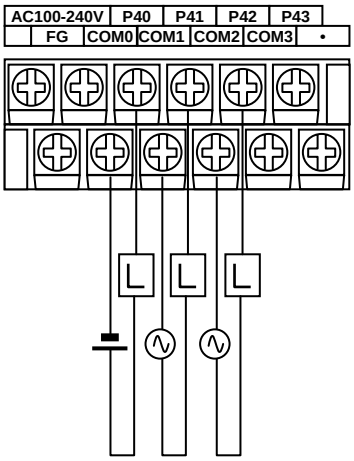
Model / Specifications		Base Unit				
		K7M-DR10S	K7M-DR20S	K7M-DR30S	K7M-DR40S	K7M-DR60S
		K7M-DR10S/DC	K7M-DR20S/DC	K7M-DR30S/DC	K7M-DR40S/DC	K7M-DR60S/DC
Output point		4 points	8 points	12 points	16 points	24 points
Insulation method		Relay insulation				
Rated load voltage/current		DC24V / 2A (r/load), 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/hr				
Surge Absorber		None				
Life	Mechanical	More than 20,000,000				
	Electrical	Rated on/off voltage/current load 100,000 or more				
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 or more				
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 or more				
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100,000 or more				
Response time	Off → On	10 ms or less				
	On → Off	12 ms or less				
Common method		1 point/ 1COM, 2 points/ 1COM, 4 points/1COM				
Operation indication		LED is on at on status of output				

2) Circuit

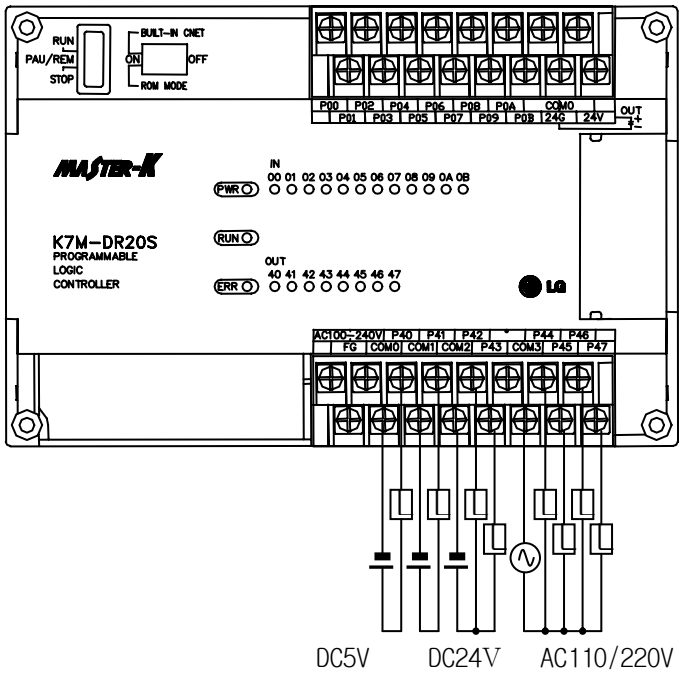


3) Output wiring

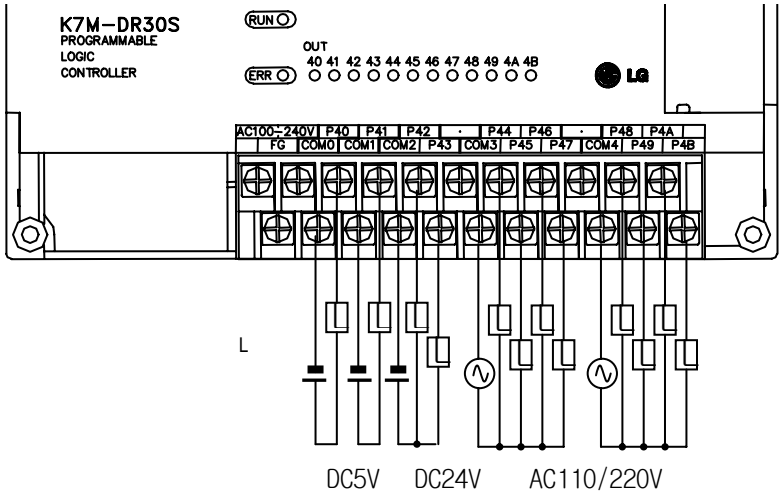
(1) 10-points base unit



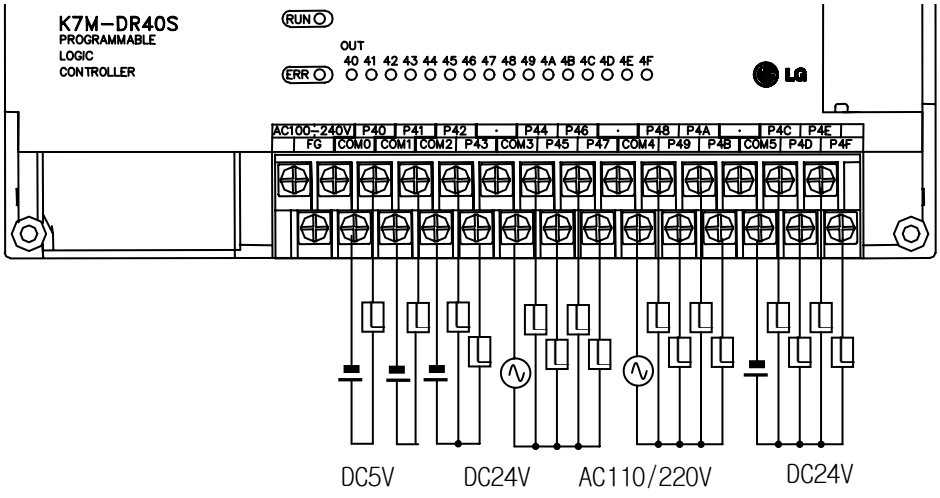
(2) 20-points base unit



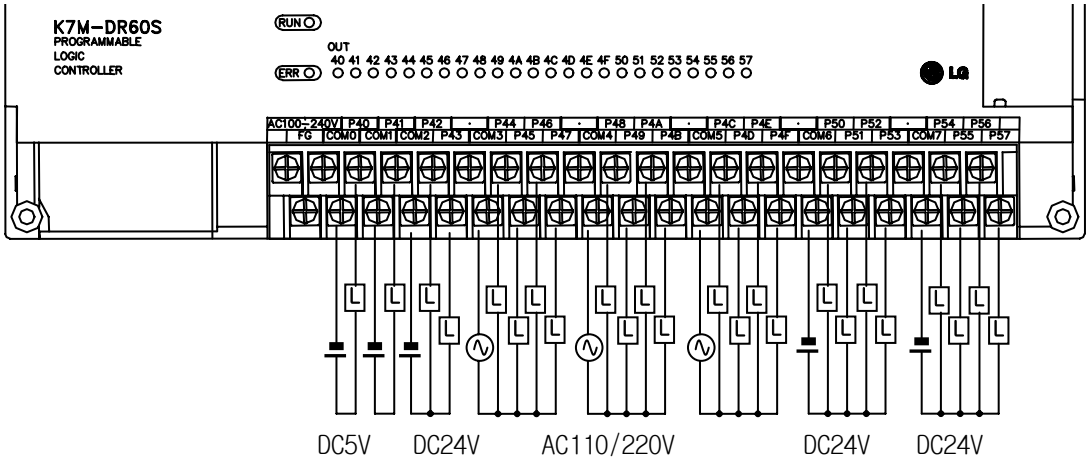
(2) 30-point base unit



(3) 40-point base unit



(4) 60-point base unit

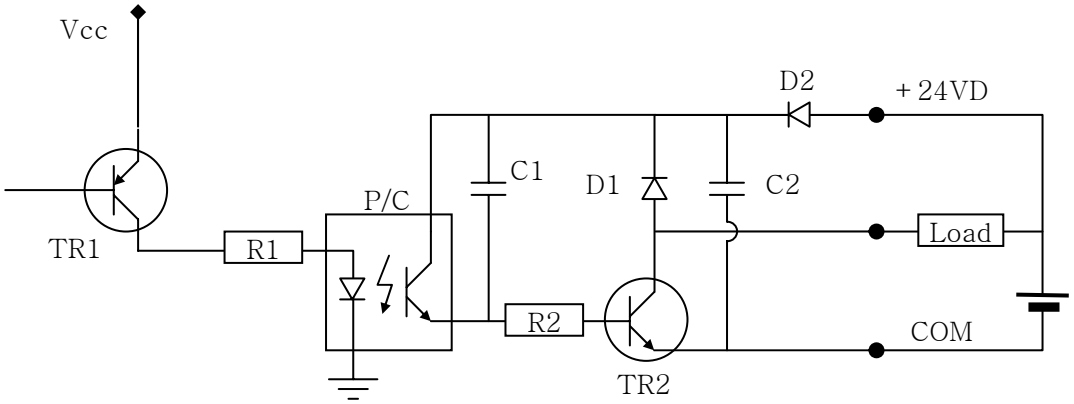


6.3.2 Base unit (Transistor Output)

1) Specification

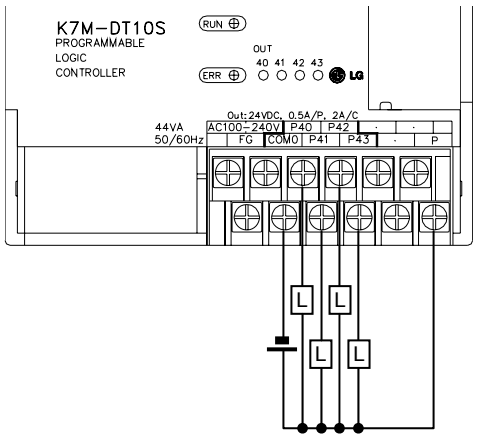
Specifications \ Model		Base Unit				
		K7M-DT10S	K7M-DT20S	K7M-DT30S	K7M-DT40S	K7M-DT60S
Output point		4 points	8 points	12 points	16 points	24 points
Insulation method		Photo Coupler insulation				
Rated load voltage/current		DC12 / 24V				
Operating load voltage		DC10.2 ~ 26.4V				
Max. load current		0.5A / 1point, 3A / 1COM				
Current leakage when off		0.1mA or less				
Voltage drop when turn on		1.5V or less (Max. load)				
Max. Inrush Current		4A, 10mA				
Surge Absorber		Clamp DIode				
Response time	Off → On	2 ms or less				
	On → Off	2 ms or less				
Common method		4 point/ 1COM	8 point/ 1COM	8 point/ 1COM 4 point/ 1COM	8 point/ 1COM (x2)	8 point/ 1COM (x3)
Operation indication		LED is on at on status of output				

2) Circuit

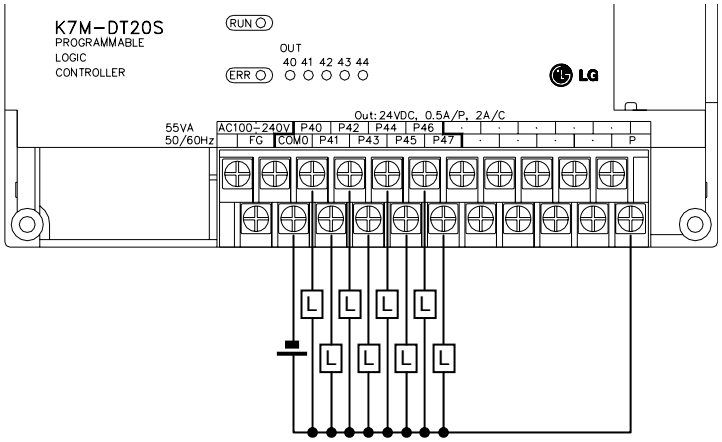


(3) Wiring Diagram

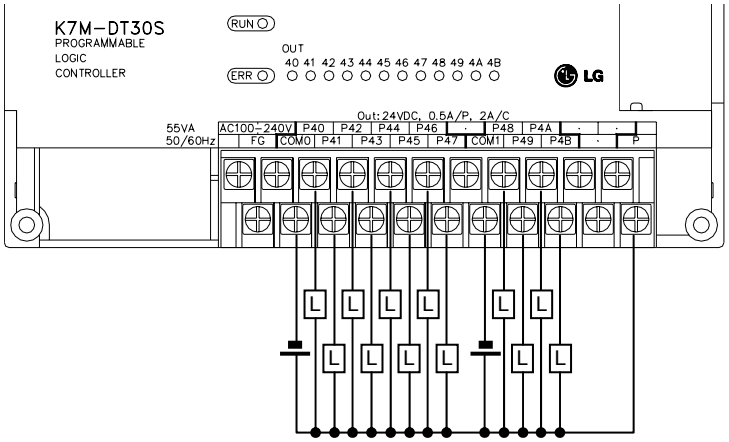
1) 10-point base unit



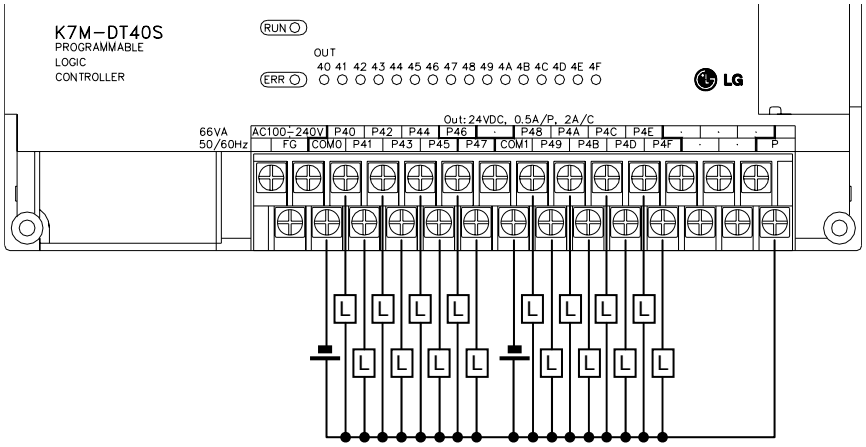
2) 20-point base unit



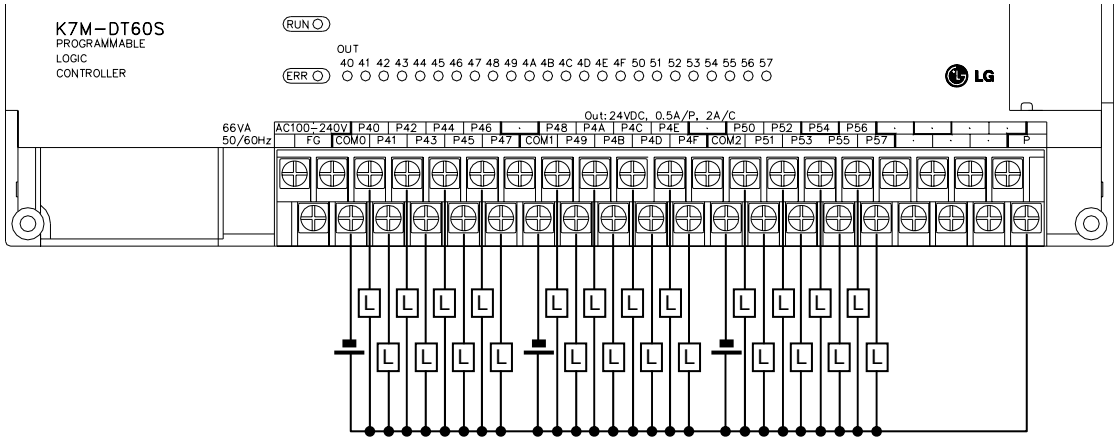
3) 30-point base unit



4) 40-point base unit



5) 60-point base unit



6.3.3 Expansion Module

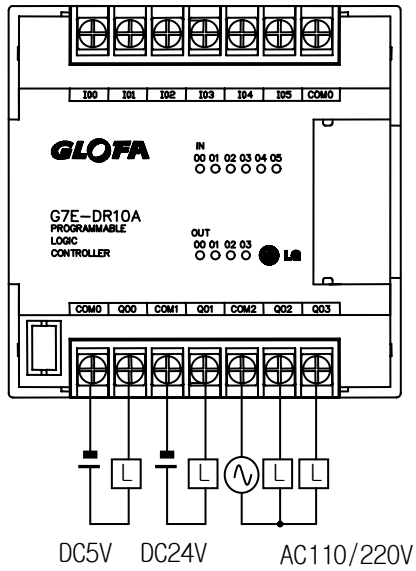
1) Specifications

Specifications \ Model		Expansion Module
		G7E-DR10A
Output point		4 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/hr
Surge Absorber		None
Life	Mechanical	More than 20,000,000
	Electrical	Rated on/off voltage/current load 100,000 or more
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 or more
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 or more
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100,000 or more
Response time	Off → On	10 ms or less
	On → Off	12 ms or less
Common method		1 point/ 1COM, 2 points/ 1COM
Operation indication		LED is on at on status of output

2) Circuit

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

3) Output wiring



REMARK

1) Refer to 7.2 'Special Functions' for the special function units

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 MK80S. The built-in high speed counter of MK80S(hereafter called HSC) has the following features;

3 counter functions as followings
- 1-phase up / down counter : Up / down is selected by user program
- 1-phase up / down counter : Up / down is selected by external B phase input
- 2-phase up / down counter : Up / down is automatically selected by the phase difference between A-phase and B.

Multiplication (1, 2, or 4) with 2-phase counter
- 2-phase pulse input multiplied by one : Counts the pulse at the leading edge of A-phase.
- 2-phase pulse input multiplied by two : Counts the pulse at the leading / falling edge of A-phase.
- 2-phase pulse input multiplied by four : Counts the pulse at the leading / falling edge of A-phase and B

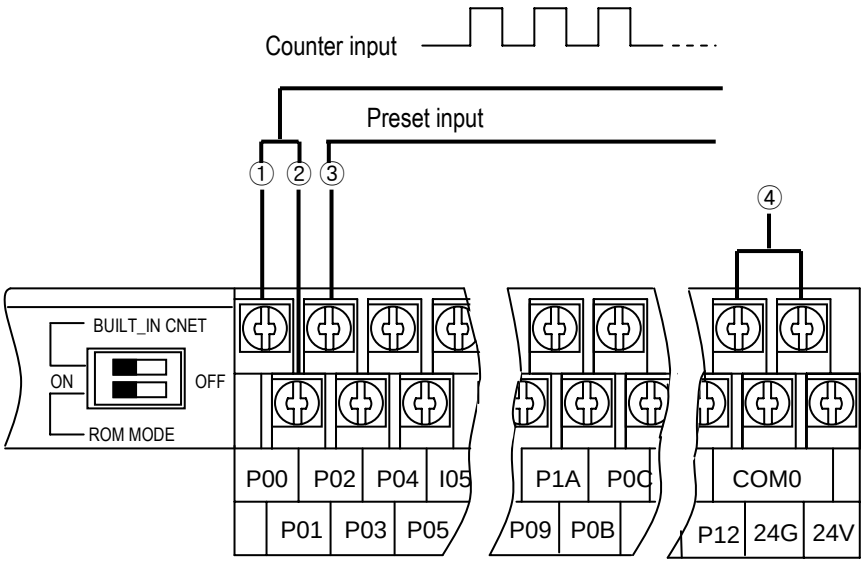
1) Performance Specifications

Items		Specifications
Input signal	Types	A-phase, B-phase, Preset
	Rated level	24VDC (15mA)
	Signal type	Voltage input
Counting range		0 ~ 16,777,215 (Binary 24 bits)
Max. counting speed		1-phase 16kHz/ 2-phase 8kHz
Up / Down selection	1-phase	Sequence program or B-phase input
	2-phase	Auto-select by phase difference of A-phase and B
Multiplication		1, 2, or 4
Preset input		Sequence program or external preset input

2) Input specification

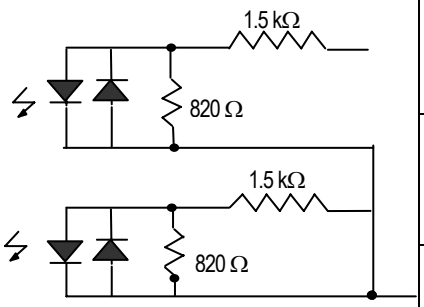
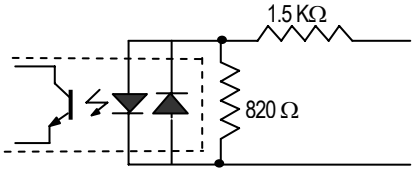
Items		Specifications
A / B phase	Rated input	24VDC (15mA)
	On voltage	14VDC or higher
	Off voltage	2.5VDC or lower
Preset input	Rated input	24VDC (15mA)
	On voltage	19VDC or higher
	Off voltage	6V or lower
	On delay time	Less than 1.5ms
	Off delay time	Less than 2ms

3) Names of wiring terminals



No.	Terminal No.	Names	Usage
①	P00	ϕ A 24V	A Phase input terminal
②	P01	ϕ B 24V	B Phase input terminal
③	P02	Preset 24V	Preset input terminal
④	COM0	Common input	Common terminal

4) External interface circuit

I/O	Internal circuit	Terminal No.	Signal name	Operation	Input warranted voltage
Input		P00	A-phase pulse Input (DC24V)	On	14 ~ 26.4 V
				Off	2.5V or lower
		P01	B-phase pulse Input (DC24V)	On	14 ~ 26.4 V
				Off	2.5V or lower
		COM0	COM (input common)	——	
Input		P02	Preset input (DC24V)	On	19 ~ 26.4 V
				Off	6V or lower
		COM0	COM (input 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 MK80S, take the following precautions against wiring noise.

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

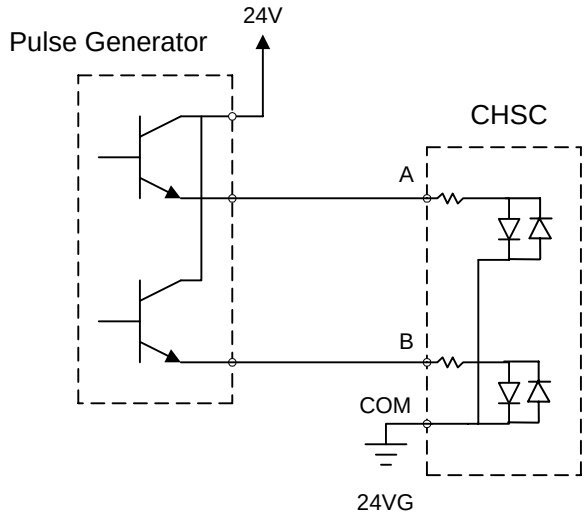
(2) Do not run a twisted pair cable in parallel with power cables or other I/O lines which may generate noise.

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

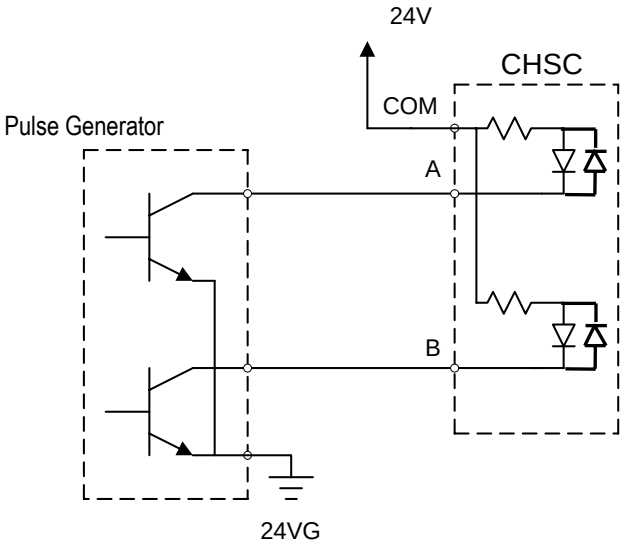
(4) For 1-phase input, connect the count input signal only to the phase A input; for 2-phase input, connect to phases A and B.

6) Wiring example

(1) Voltage output pulse generator

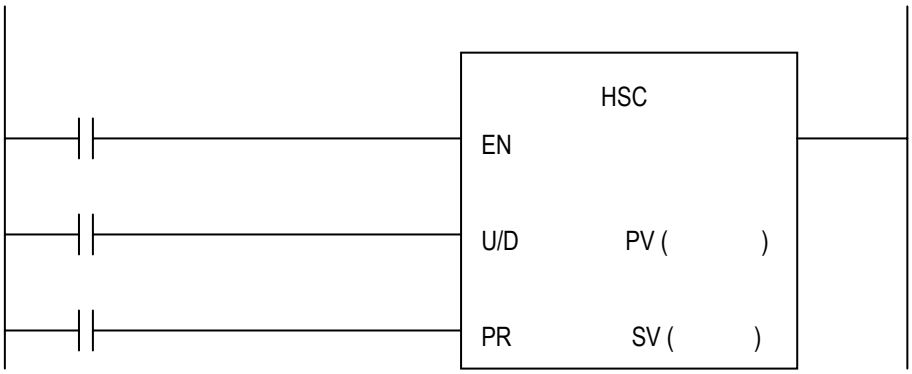


(2) open collector output pulse generator



7) Instruction

When use the built-in high speed counter of K80S, the HSC instruction should be used. The instruction format of HSC is as following;



When the value of operation mode (D4999), PV or SV is not proper, the instruction error flag (F110) turns on and the HSC instruction is not executed.

Operation mode (D4999)		Input terminal			Multiplication	Description
		A phase	B phase	Preset		
1 phase	h1000	Pulse input	–	–	–	U/D : Set by sequence program PR : Set by sequence program
	h1010	Pulse input	–	Preset input	–	U/D : Set by sequence program PR : Set by preset input
	h1100	Pulse input	U/D input	–	–	U/D : Set by U/D input PR : Set by sequence program
	h1110	Pulse input	U/D input	Preset input	–	U/D : Set by U/D input PR : Set by preset input
2 phase	h2001	A-phase input	B-phase input	–	1	PR : Set by sequence program 1 multiplication
	h2002	A-phase input	B-phase input	–	2	PR : Set by sequence program 2 multiplication
	h2004	A-phase input	B-phase input	–	4	PR : Set by sequence program 4 multiplication
	h2011	A-phase input	B-phase input	Preset input	1	PR : Set by preset input 1 multiplication
	h2012	A-phase input	B-phase input	Preset input	2	PR : Set by preset input 2 multiplication
	h2014	A-phase input	B-phase input	Preset input	4	PR : Set by preset input 4 multiplication

Remark	
The U/D and PR input of sequence program must be programmed with dummy input even they are set as external input. When the PR and/or U/D is set as external input, the input conditions of sequence program is ignored.	

1) EN input (Counter enable)
   When the EN input turns on, the counter starts counting pulse. When the EN is off, the counting is stopped and the current value of high speed counter is cleared as 0.

2) U/D input (Up/down)
   When the U/D input is off, the high speed counter operates as up counter. When the U/D is off, it operates as down-counter.

3) PR input (Preset)
   When the PR input is on, the current value of high speed counted is replaced with the preset value (PV).

4) Output relay (F0170)
   The F070 bit will be turn on when the current value of high speed counter (F18 : lower word, F19 : upper word) is equal of greater than the set value (SV).

5) Carry flag (F0171)
   The carry flag turns on when the current value of high speed counter is underflow (0 → 16,777,215) during down counting or overflow (16,777,215 → 0) during up counting.

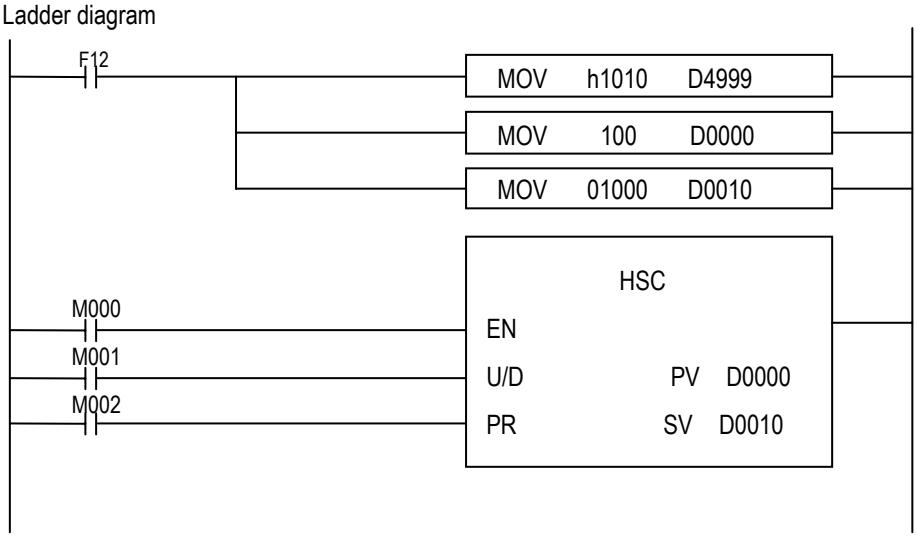
6) Current value
   The current value of high speed counter is stored at two words, F18 and F19. The lower word is stored at F18, and upper word is stored at F19.

8) example program

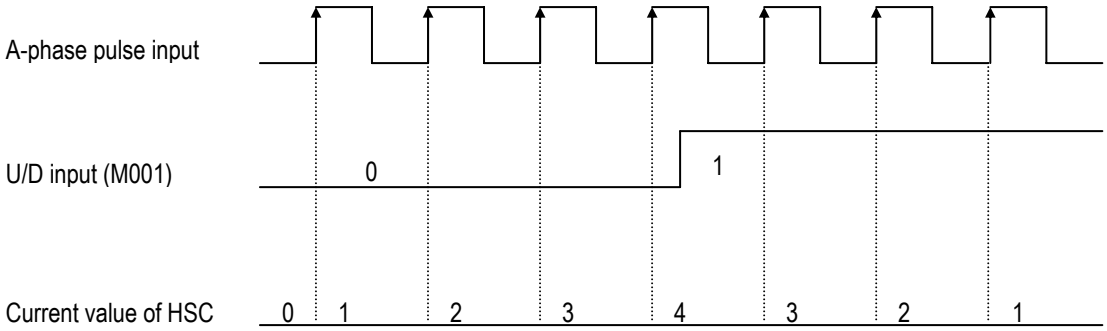
(1) 1-phase operation mode (U/D by program : D4999 = h1010)

U/D : set by sequence program (M001)
PR : set by external PR input

Ladder diagram



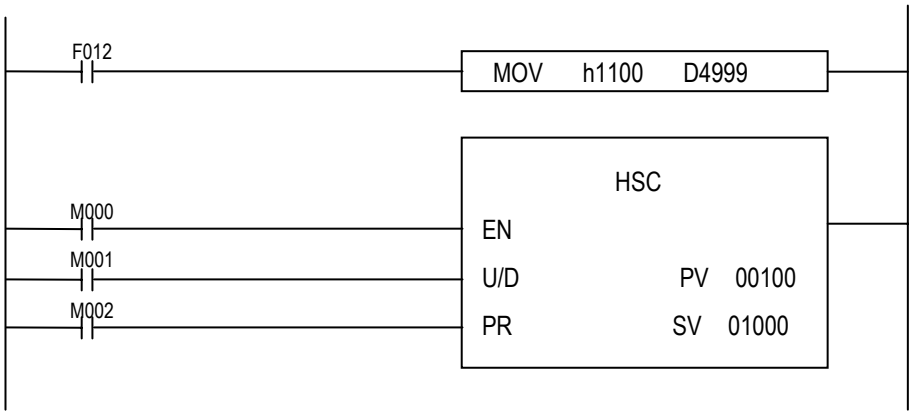
Time chart



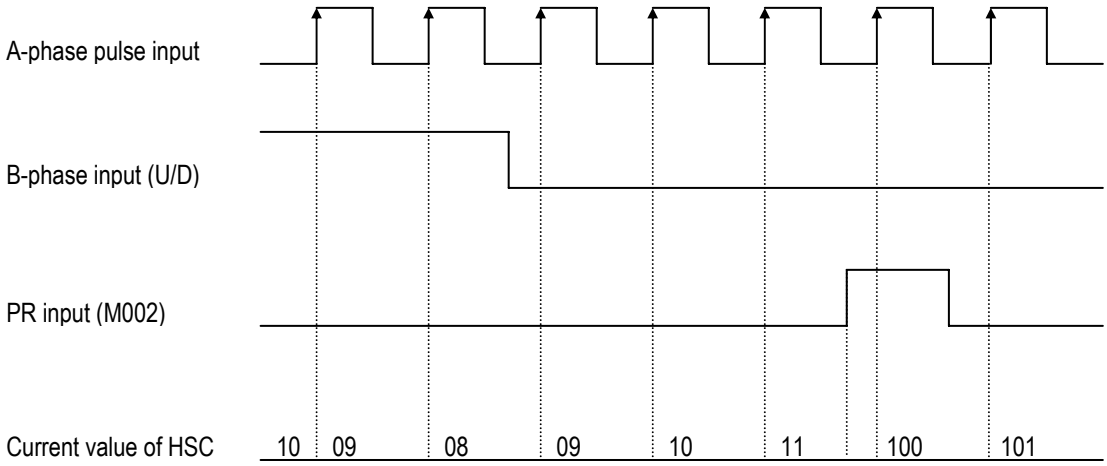
(2) 1-phase operation mode (U/D by B phase : D4999 = h1100)

U/D : set by external input (B-phase input)
PR : set by sequence program (M002)

Ladder diagram



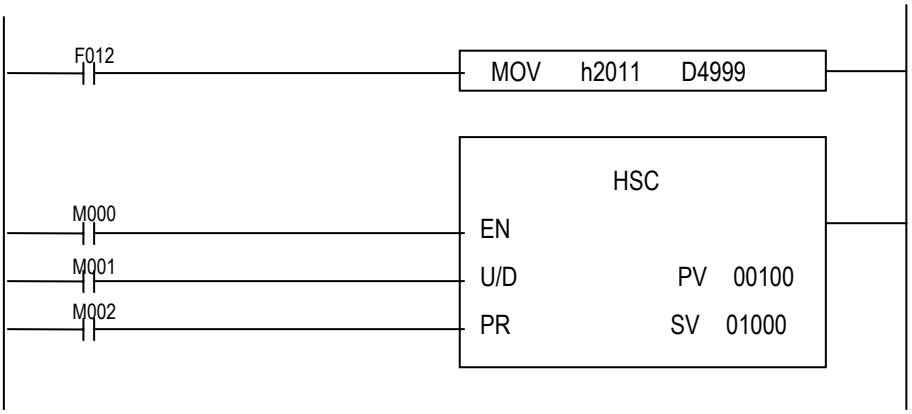
Time chart



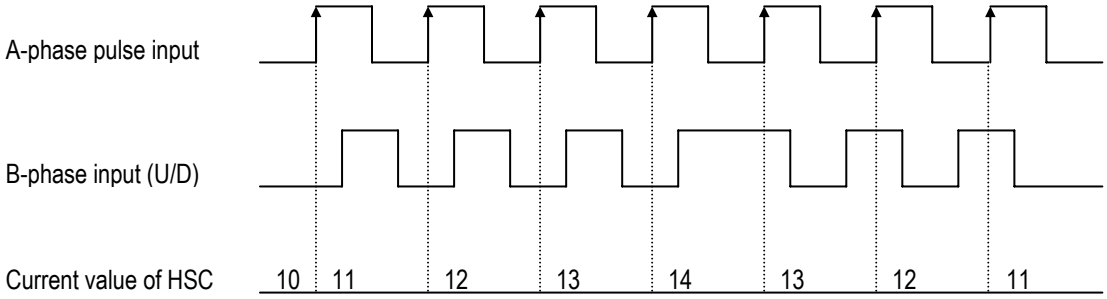
(3) 2-phase operation mode (1 Multiplication Operation : D4999 = h2011)

U/D : set automatically by the phase difference between A and B phase
PR : set by external PR input
Multiplication : 1

Ladder diagram



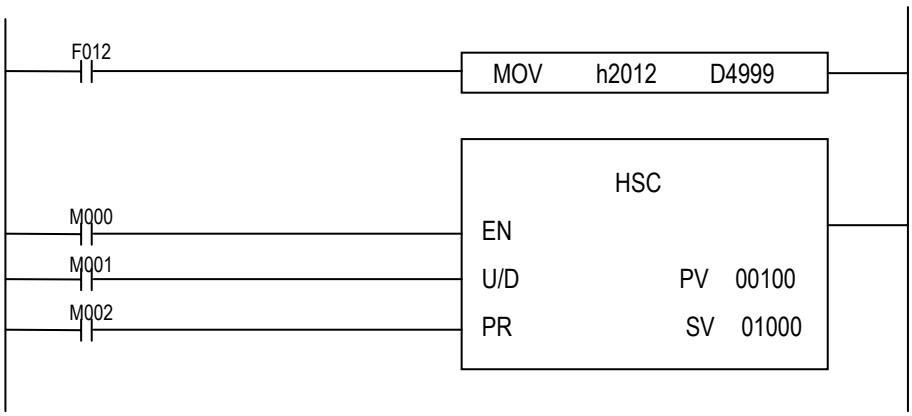
Time chart



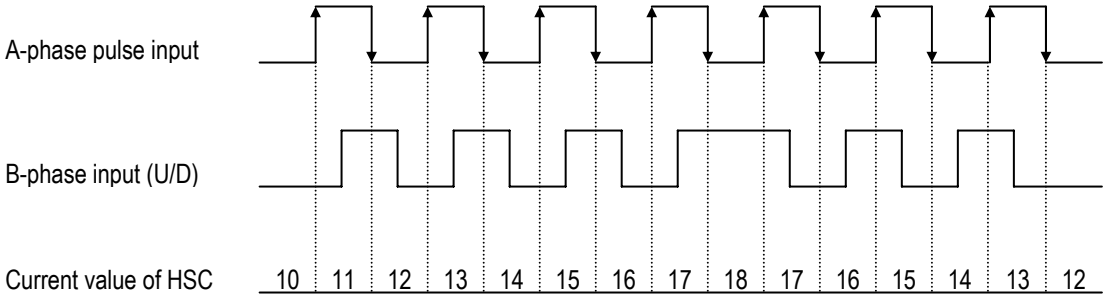
4) 2-phase operation mode (2 Multiplication Operation : D4999 = 2012)

U/D : set automatically by the phase difference between A and B phase
PR : set by external PR input
Multiplication : 2 times

Ladder diagram



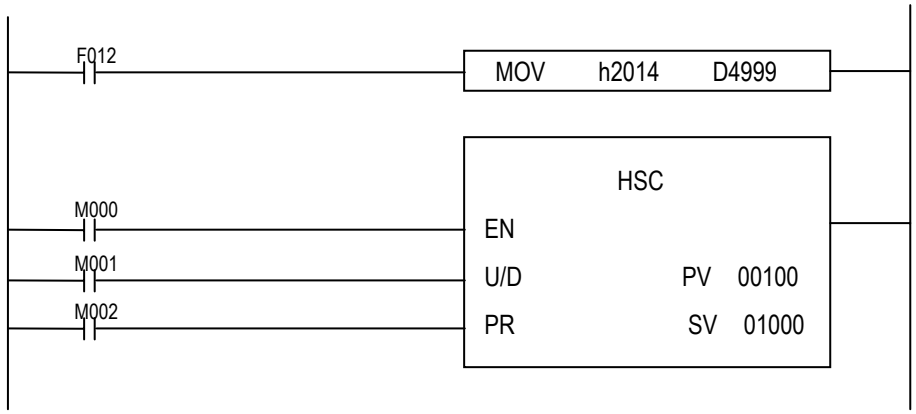
Time chart



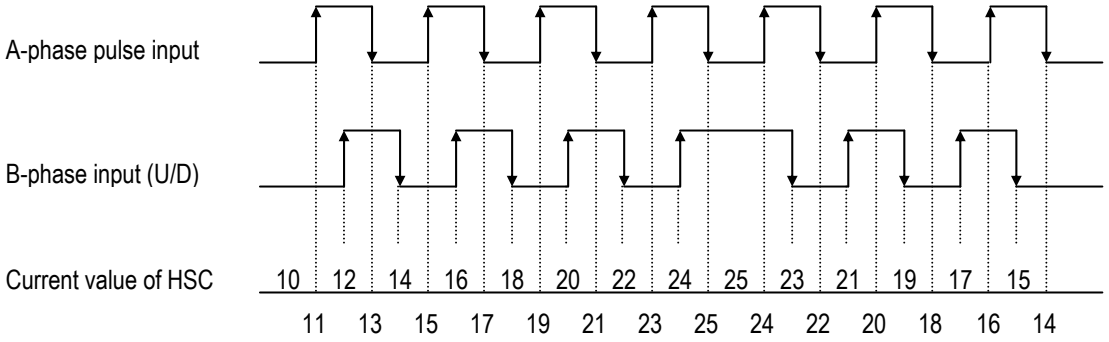
(5) 2-phase operation mode (4 Multiplication Operation : D4999 = h2014)

U/D : set automatically by the phase difference between A and B phase
PR : set by external PR input
Multiplication : 4 times

Ladder diagram



Time chart

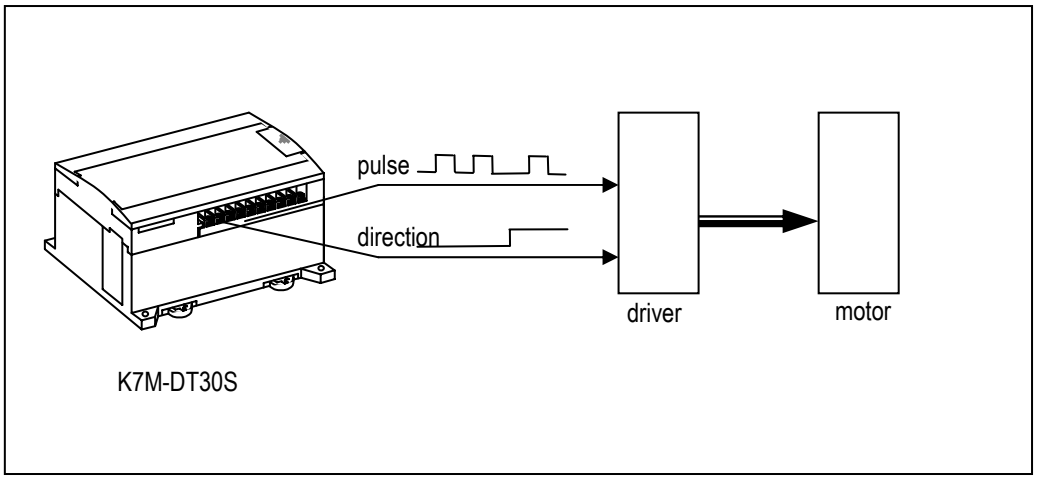


7.1.2. Pulse Output Function

In the transistor output type of MK80S, the pulse output function - maximum 2Kpps - is internalized. By using this function with stepping motor or servo motor driver, MK80S is applicable to a simple positioning system.

1) Usage of the Pulse Output

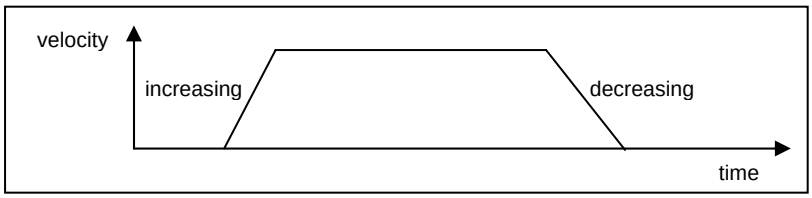
Transistor output type of MK80S outputs the signals of pulse and direction in an output contact point through the instruction (PULSOUT). The outputted pulse is connected to motor driver it is controlled position in the following figure.



Choose a mode from the pulse out function by parameter setting and operate following 3 modes

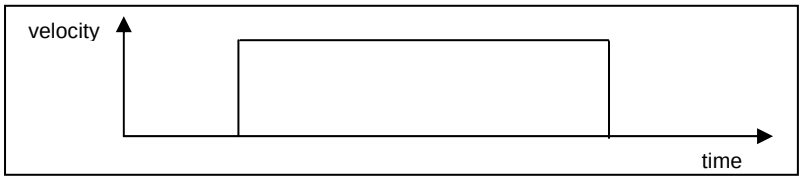
(1) Trapezoidal operation

The pulse output function operates in order of acceleration – uniform velocity – deceleration.



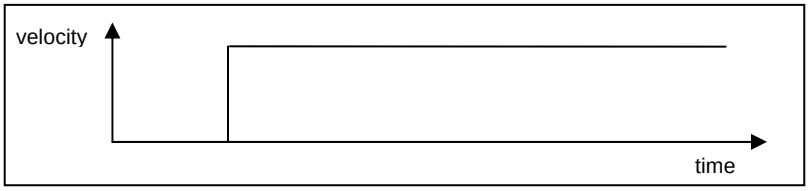
(2) Uniform velocity operation

Operates with the uniform velocity without increasing/decreasing operation



(3) Infinite operation

Operate infinitely without an increasing/decreasing operation until meet the emergency stop command.



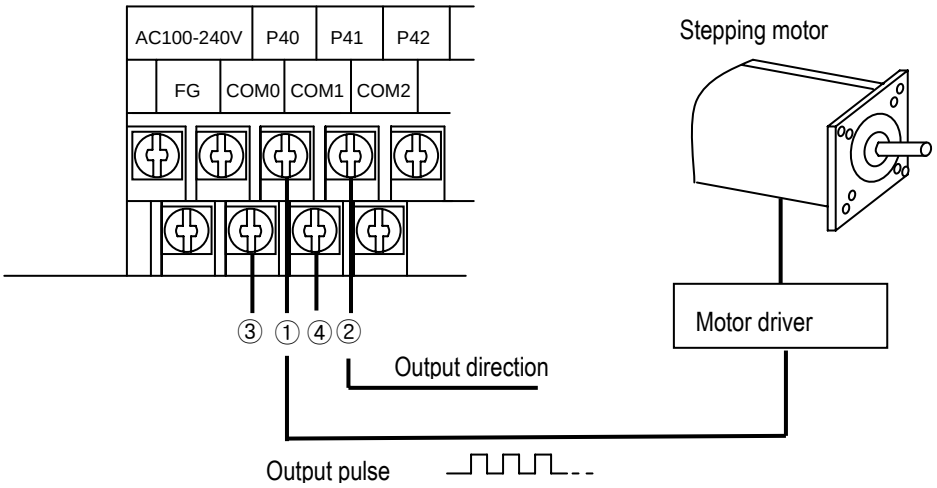
2) Functional Specification

Item	Specification
No. of output	1 point
Output type	Pulse
Output velocity	Max 2Kpps, Min 50pps
Output pulse	0 ~ 2147483647
Execution type of the increasing/decreasing velocity	Designation of acceleration
Type of the direction designation	Right/opposite direction pulse output
Load power supply	DC 12V/24V
Usable range of the load power supply	DC10.2 ~ 26.4V
Maximum load current	150mA
Initiative electric current	Less than 0.4A, 10ms
Maximum power dropdown under On	Less than DC 0.5V
Electric current leakage under Off	Less than 0.1mA
On delayed time	Less than 1ms
Off delayed time	Less than 1ms

Remark

1) Several points can be used for the pulse output point if they are not output at the same time. Thus it is possible that right direction pulse is output as P040, opposite direction pulse is output as P041.

3) Names of parts

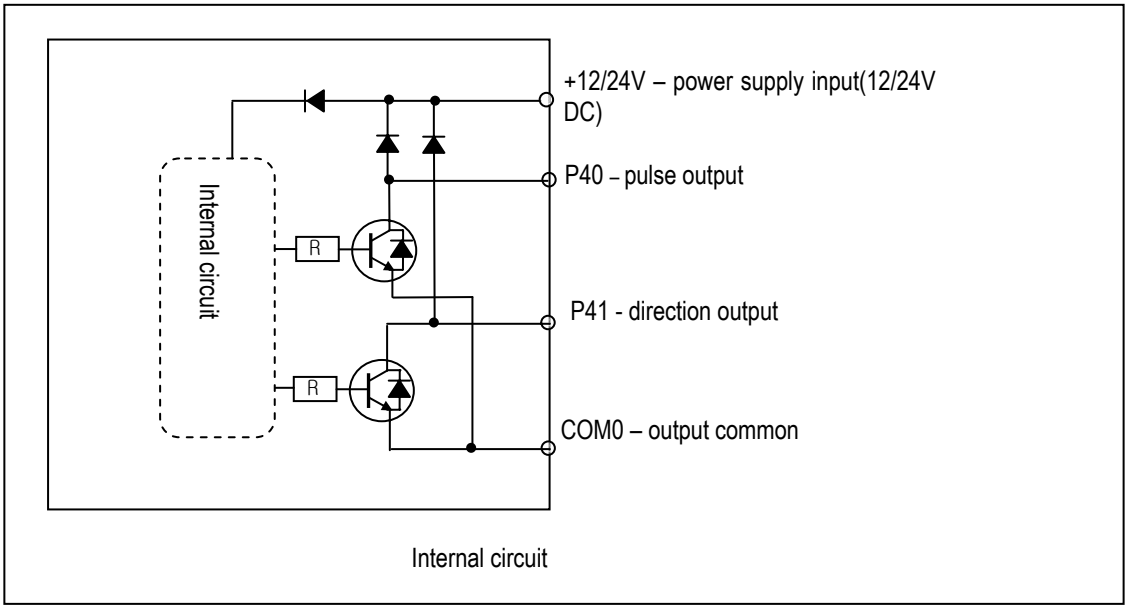


No.	Terminal No.	Names	Usage
①	P40	Pulse output	Pulse output terminal of right direction
②	COM0	Common	Pulse output common terminal
③	P41	Direction output	Direction output terminal
④	COM0	Common	Direction output common terminal

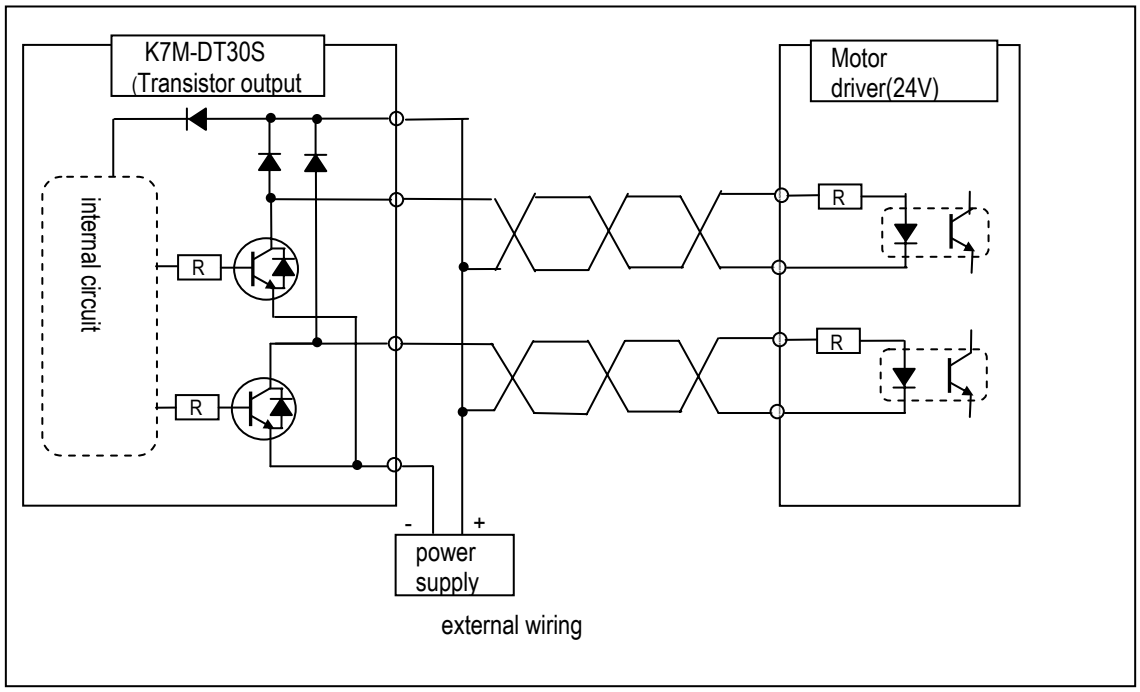
Remark

If the motor drive is not input direction, but is input right/opposite direction pulse (the opposite direction pulse can be output through using 2 instruction (PULSOUT) to P41 contact point

4) Internal circuit and external wiring



Internal circuit



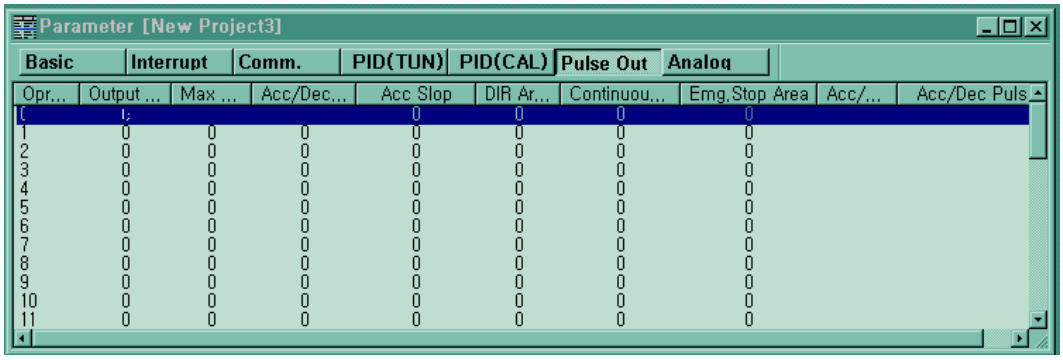
external wiring

Remark

Be careful about the counter plan of the noise during the wiring in the pulse output.
1) Use twisted pair shields wire for wiring and execute 3rd contact point.
2) Be sure to separate from the power supply line and I/O lines on which noise usually occurs.
3) Length of wire should be as short as possible.
4) Be sure to use the stable power supply for the pulse output and separate it from I/O power supply.

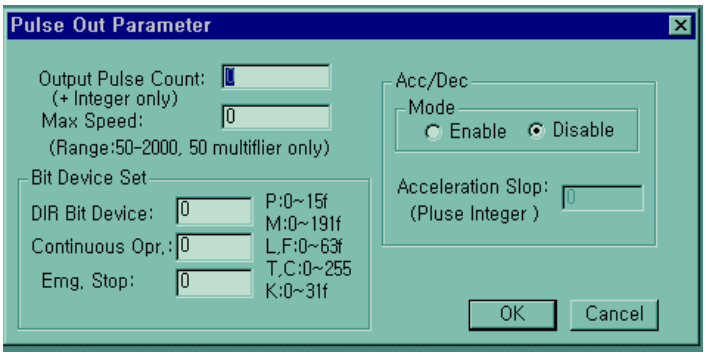
5) The setting of pulse out parameter

The setting of pulse out parameter set KGLWIN. Setting windows is as below.



It is possible to set 40 operational pattern.

When click the pattern no. parameter setting window is displayed as bellow



6) parameter explanation

(1) operational pattern No.

operation pattern No. is each pulse out pattern No. Max. 40 patterns can be set

(2) Output pulse count

It sets output pulse number.(The setting range : 0 ~ 42944967295)

(3) Max speed

It sets operational speed at normal section (The setting range : 50 ~ 2000pps, 50multiflier only)

(4) Acceleration/ Deceleration mode

Acceleration/ Deceleration mode is designation of increasing/decreasing velocity operation

Disable : uniform velocity operation enable : increasing/decreasing velocity operation

(5) Acceleration/deceleration slop

Acceleration slop is available in case that acceleration/deceleration mode is enable
This is slop that pulse frequency reach to maximum pulse frequency from '0' pulse. (only integer)

(6) Bit device set

a) Direction contact signal

setting of contact for direction signal output

b) continuous operation
setting of contact for infinitive operation

c) emergency stop
setting of contact for emergency stop

(7) The number of acceleration pulse
Automatically calculate at KGL-WIN if the maximum pulse and slop are set by user
Calculation method is as below

The number of acceleration pulse = [(maximum pulse – 50) / 50 +(maximum pulse – 100) / 50 + ····· +
(100 / 50) + (50 / 50)] x acceleration slop x 2

ex) maximum pulse : 1000pps , acceleration slop : 1

The number of acceleration pulse = [(1000 – 50) / 50 + (900 – 50) / 50 + ····· +(100 /50) + (50 /50)] x 1 x 2
= 380 (deceleration pulse is also 380)

(8) acceleration time
Automatically calculate at KGL-WIN if the maximum pulse and slop are set by user.
Calculation method is as below

acceleration time = [[(maximum pulse – 50) / 50] x acceleration slop x 10

ex) maximum pulse : 1000pps , acceleration slop : 1
acceleration time = [[(1000 – 50) / 50] x 1 x 10 = 380ms (deceleration time is also 380ms)

Remark

Acceleration slop and deceleration slop of MK80S pulse output are set up as the same. Set up proper value by the sort of motor because if a/d slop increases, the arrival time to the designated max. Cycle also increases.

7) pulse out operation explanation

Condition 1)

Set up as acceleration slop = 1, max. frequency = 1000, no of pulse out = 5000.

← If as acceleration slop = 1, 1 pulse is output on the 1st step (velocity: 50pps).
Pulse velocity is 50pps, so time consuming is 20ms.

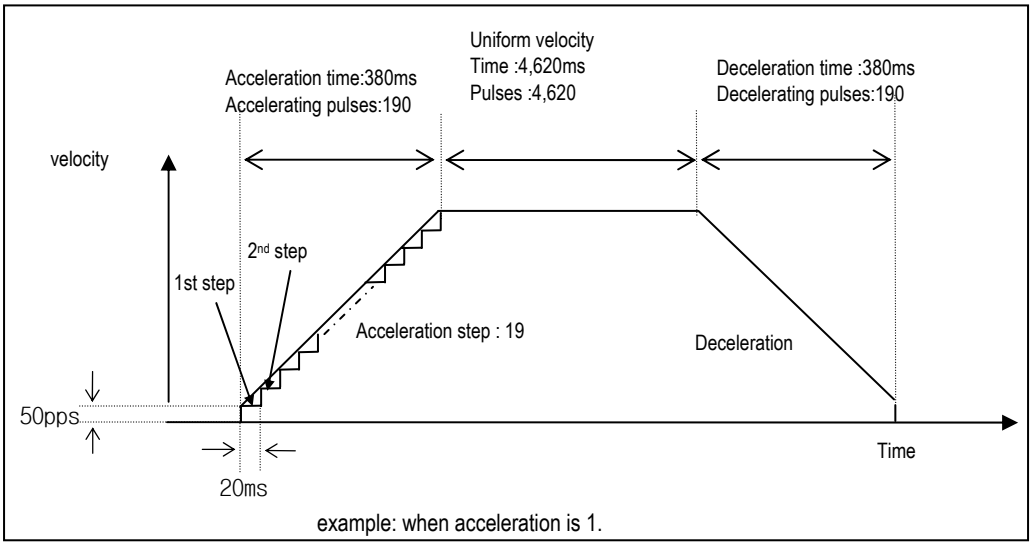
↑ 2 pulses are output on the 2nd step (velocity: 100pps) and time consumes 20ms

→ By calculation in the same way, the time to reach to 1000pps is
20ms x (20-1) = 380ms, and the no. of output pulses are 1+2+3...+18+19 = 190 units.

↓ Decreasing velocity inclination is 1, thus 190 units of pulses are needed.

° The no. of pulses in the uniform velocity region are 5000-190-190=4,620 units.

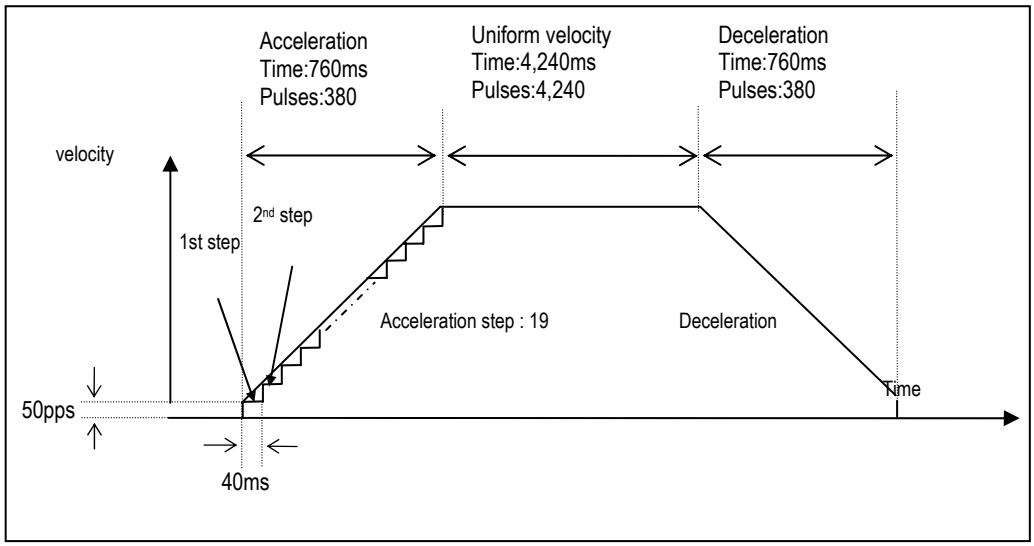
± Whole spent time is 50,380ms



example: when acceleration is 1.

Condition 2
Set up as acceleration slop = 2, max. frequency = 1000, no of pulse out = 5000.

← If I/D velocity inclination is 2, 2 pulses are output on the 1st step(velocity: 50pps).
Pulse velocity is 50pps. So time consuming is 40ms.
↑ 4 pulses are output on the 2nd step(velocity: 100pps) and time consumes 20ms
→ By calculation in the same way, the time to reach to 1000pps is 40ms * (20-1) = 760ms,
and the no. of output pulses are 2+4+6...+36+38 = 380 units.
↓ Decreasing velocity inclination is 2, thus 380 units of pulses are needed.
° The no. of pulses in the uniform velocity region are 5000-380-380=4,240 units.
± Whole spent time is 57,600ms



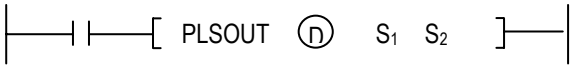
Example) Acceleration is 2.

Remark

If the acceleration slop goes bigger, the increasing time and pulse go bigger by direct proportion to inclination. Then be careful of an occurring of the instruction error when the no. of a/d pulse becomes bigger than the no. of whole pulse.

8) instruction

Instructions		Available Device											Steps	Flag		
		M	P	K	L	F	T	C	S	D	#D	Inte-ger		Error (F110)	Zero (F111)	Carry (F112)
DUTY	n									O		O	7	O		
	S_1	O	O	O	O		O	O		O	O					
	S_2		O													

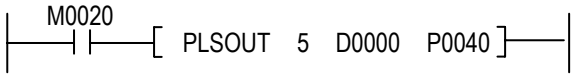


n	Pattern no.
S_2	Output pulse count no.
S_3	Output pulse contact

(1) Functions

- 'n' designates pattern no. which is registered at parameter.
- S1 designates device name which will be stored output pulse count no. and error code .(3 word)
- S2 designates output device (output P area) .

(2) example of program



when the M0020 is 'On' ,it outputs the pulse at 5 pattern to P0040.

It stores the output pulse count no. at D0000 and D0001.

It stores error information at D0002.

All output area is designated for pulse output contact , but it can't designate over 2 contact at the same time.

(3) instruction Error List

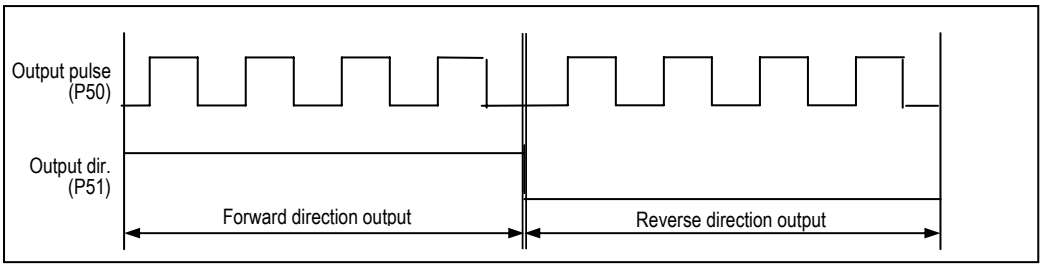
Error status	Contents	Treatment
00	Normal	-
01	Other PLSOUT instruction pulsating.	Change the other PLCOUT program.
02	Velocity designation error (more than 2000, not a multiple of 50, designated 0)	Velocity designation adjustment
03	The no. of a/c velocity pulse is bigger than no. of all pulse is to output.	Acceleration adjustment
04	No output contact point where is designated to the pulse output	Output contact point designation
05	No output contact point where is designated to the direction output	Output contact point designation

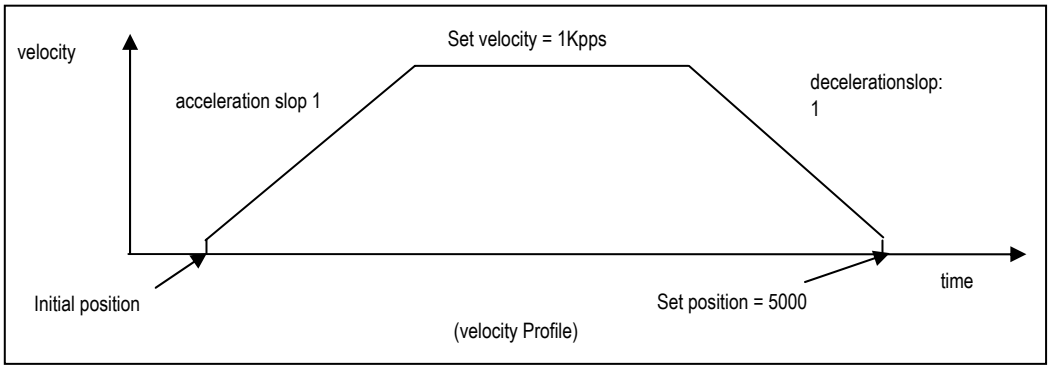
9) Output Direction

Input type of servo motor driver or stepping motor driver is subdivided into 2. Output direction of control can be selected in the pulse output parameter.

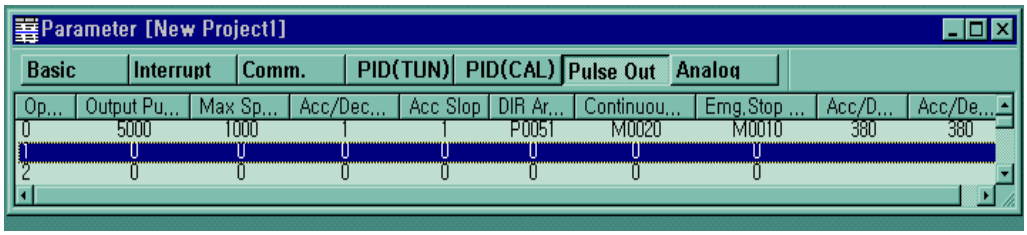
(1) Selecting method of output direction

a) When driver gets input forward direction pulse and reverse direction pulse contact point, and the forward/reverse direction signals one levels.

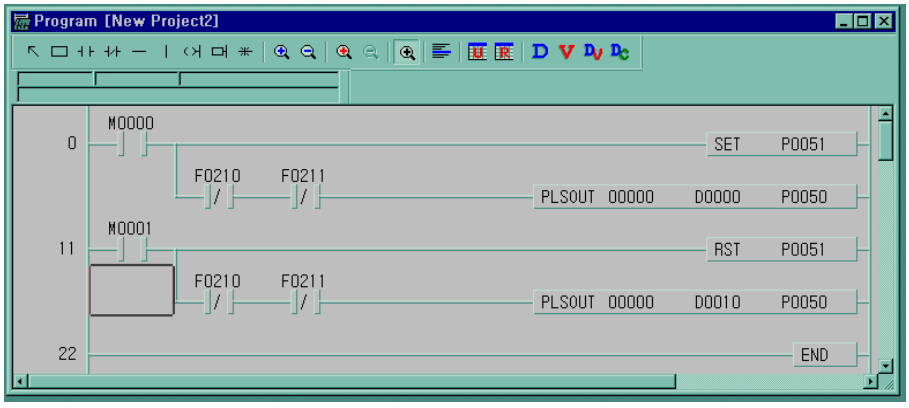




Parameter setting



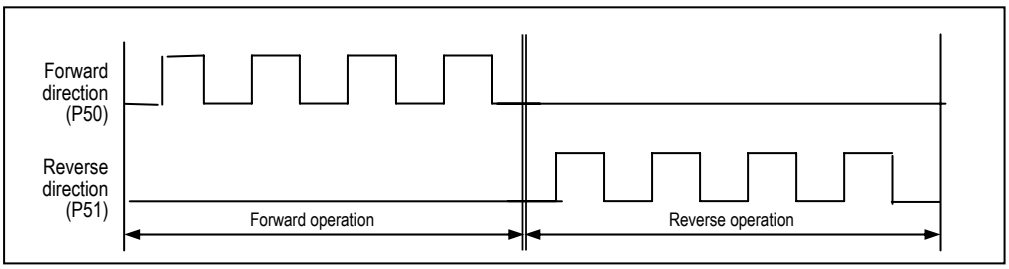
Direction contact designates P51.

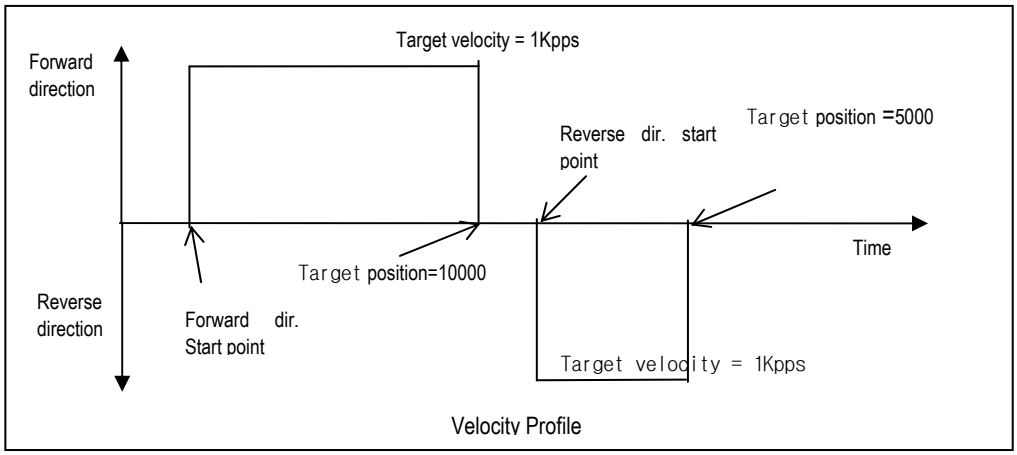


(Example of a program)

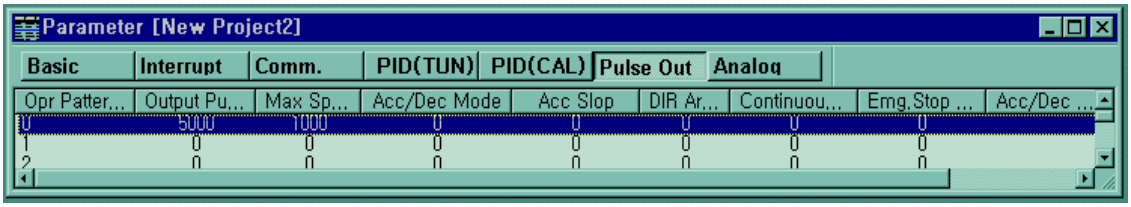
When the M000 is on, direction contact 'P51' is set, and pulse outputs at pattern '0'(forward direction output)
When the M001 is on, direction contact 'P51' is reset, and pulse outputs at pattern '0'(reverse direction output)
Be careful If direction bit use another purpose , pulse output operates abnormally.

b) Driver gets input forward direction pulse and reverse direction pulse through different contact points.

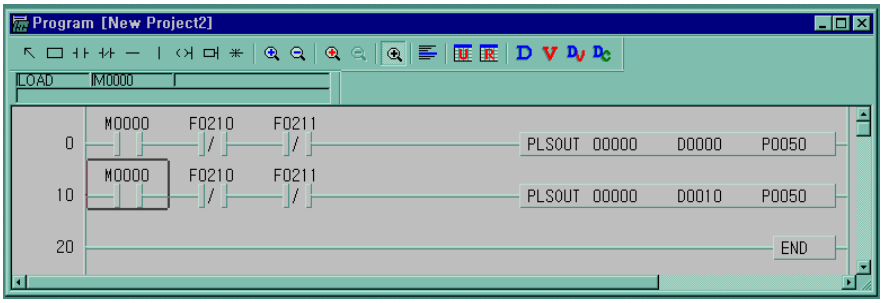




Parameter setting



Program



F210 turns on while the pulse output is operating.

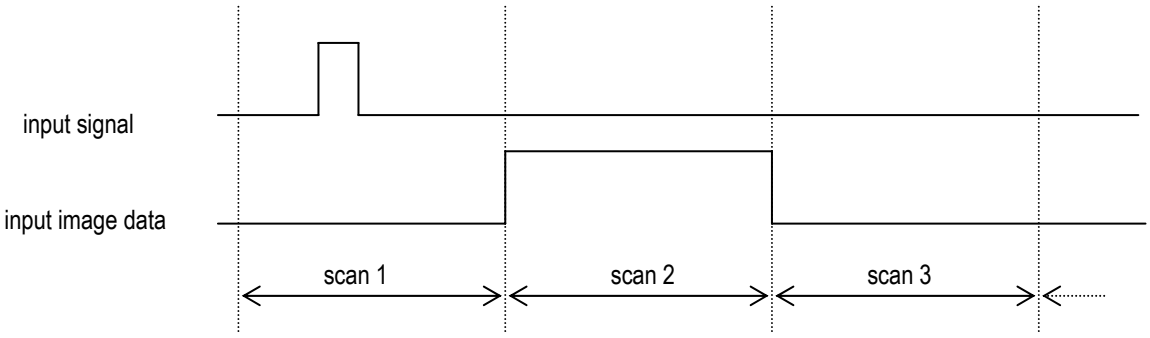
7.1.3. Pulse Catch Function

In the base unit, 8 points of pulse catch input contact points(P000 ~ P007) are internalized. Through using this contact point short pulse signal, short as 0.2ms, 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 0.2ms min can be detected.

2) Operating Explanation



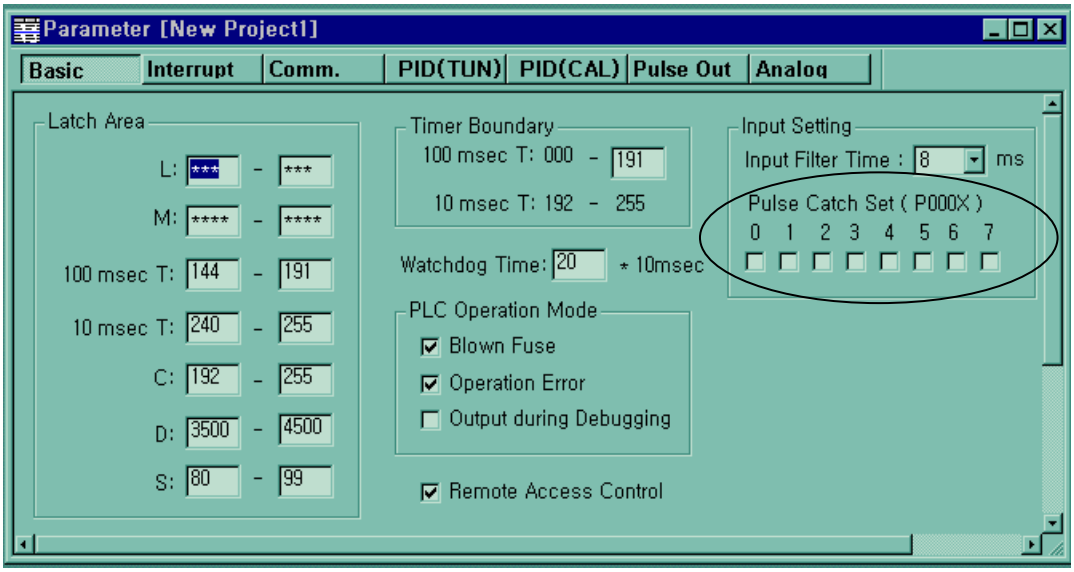
step	executing contents
scan1	CPU senses input when pulse signal, min. 0.2ms, is input, then saves the status.
scan2	used to turn on the region of input image
scan3	used to turn off the region of input image

3) 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) 8 points can be used to designate the pulse catch input. The input address is from P000 to P007.
2) General digital input operates if it is not designated as pulse catch input.

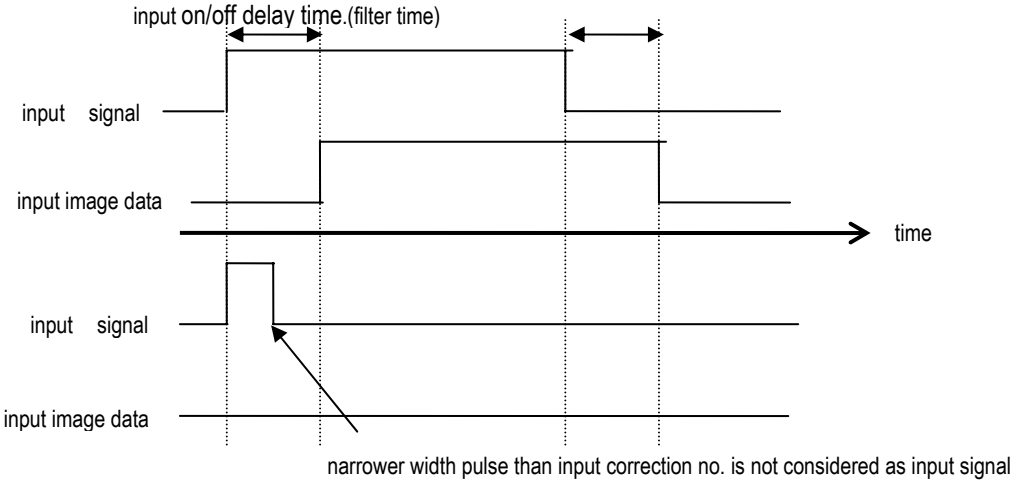
7.1.4. Input Filter Function

External input of MK80S selects input on/off delay time from the range of 0-15ms 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

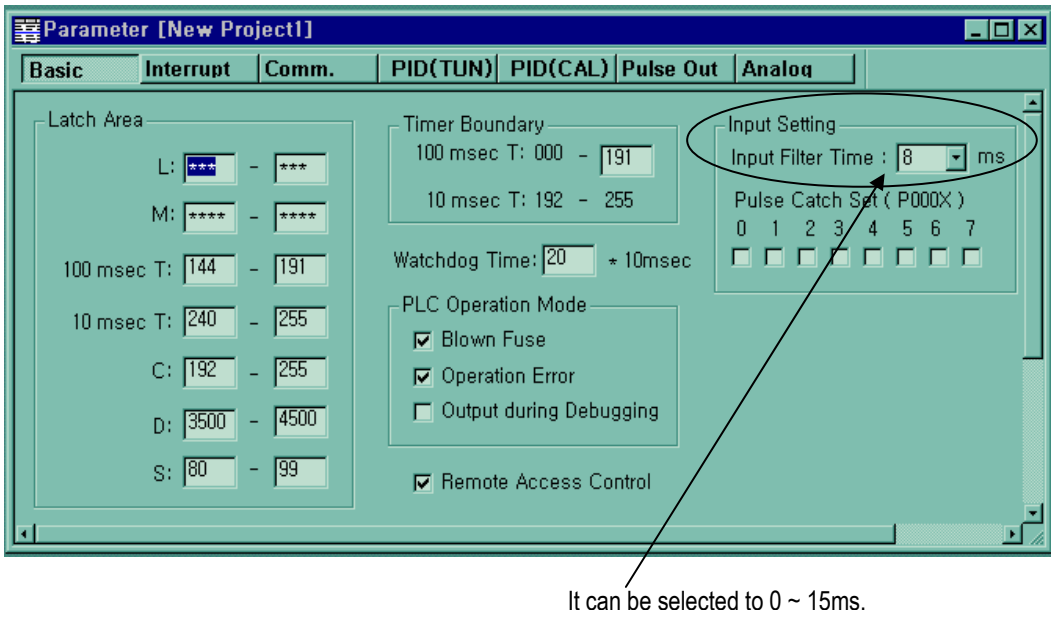


3) Using method

(1) Click twice the basic parameter on the project window of KGLWIN.

(2) The value of filter can be set up as unit of 1ms to the input on/off delay time of the basic parameter window.(Input on/off delay time is set up as default value of 8ms)

(3) Set up input on/off delay time is conformed to all input is used.



7.1.5 PID control function

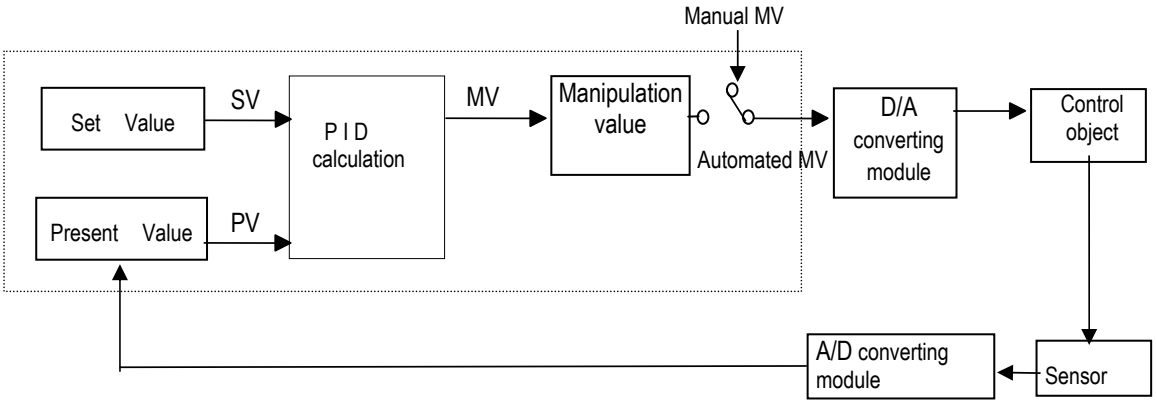
1) Introduction

This chapter will provide information about the built-in PID (Proportional Integral Differential) function of MK80S Basic Unit. The MK80S series does not have separated PID module like MK300S and MK1000S series, and the PID function is integrated into the Basic 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 differential (D).

The characteristics of the PID function of MK80S 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 module.
- Forward / reverse operations are available
- P operation, PI operation, PID operation and On/Off operation can be selected easily.
- 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.



<Figure 1-1> Block diagram of PID control system

2) Specification

(1) Control operation

a) Proportional operation (P operation)

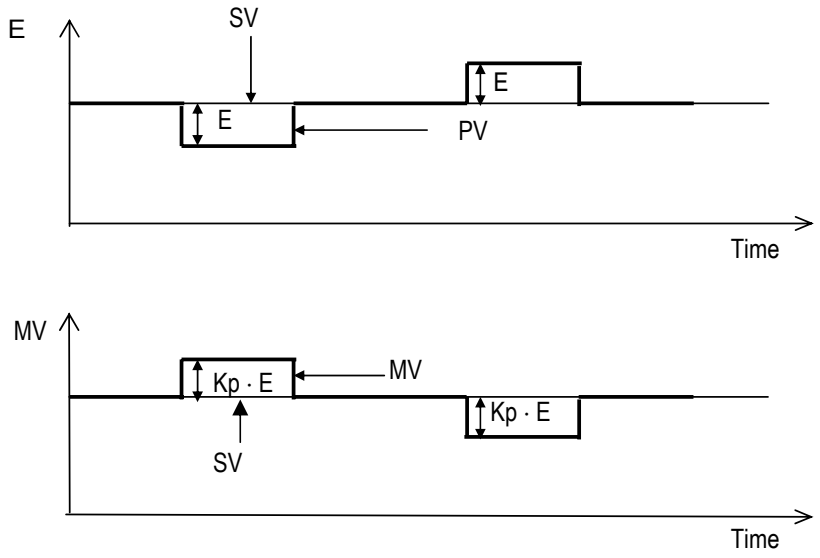
(a) P action means a control action that obtain a manipulate value which is proportional to the deviation (E : the difference between SV and PV)

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

$$MV = Kp \times [b \times SV - PV]$$

Kp : the proportional constant (gain)
b: reference value
SV: set value
PV: present value

(c) When E happens, MV by P operation is like <Fig 2-1>



<Fig 2-1> MV by P operation

(d) If the Kp is too large, the PV reaches to the SV swiftly, but it may causes a bad effect like oscillations shown in the Fig. 2.2.

(e) If the Kp is too small, oscillation will not occur. However, the PV reaches to the SV slowly and an offset may appear between PV and SV shown in the Fig. 2.3.

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

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

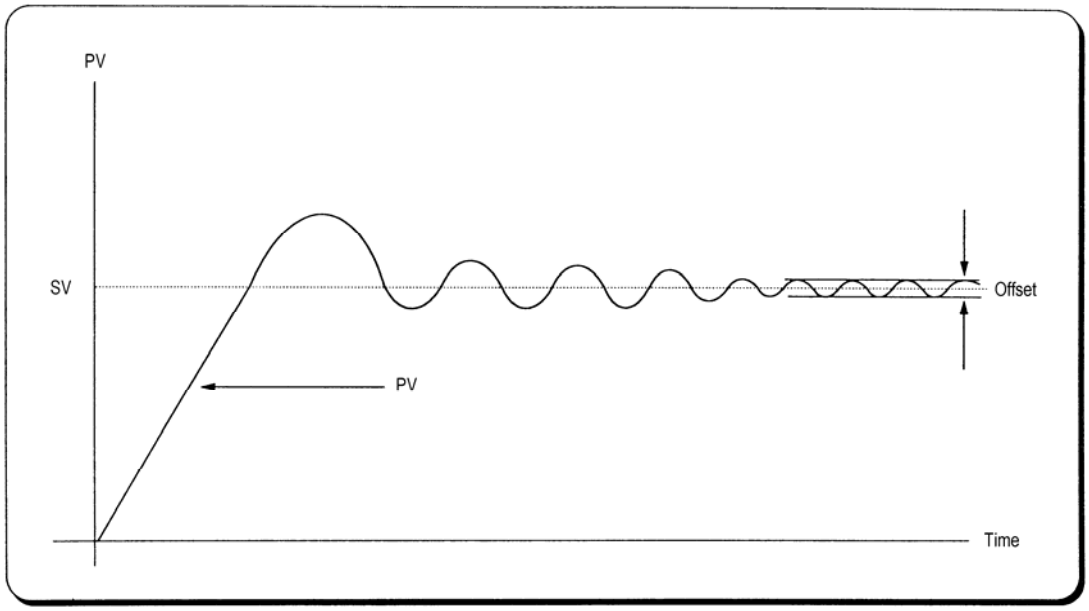


Fig. 2.2 When the proportional constant (Kp) is large

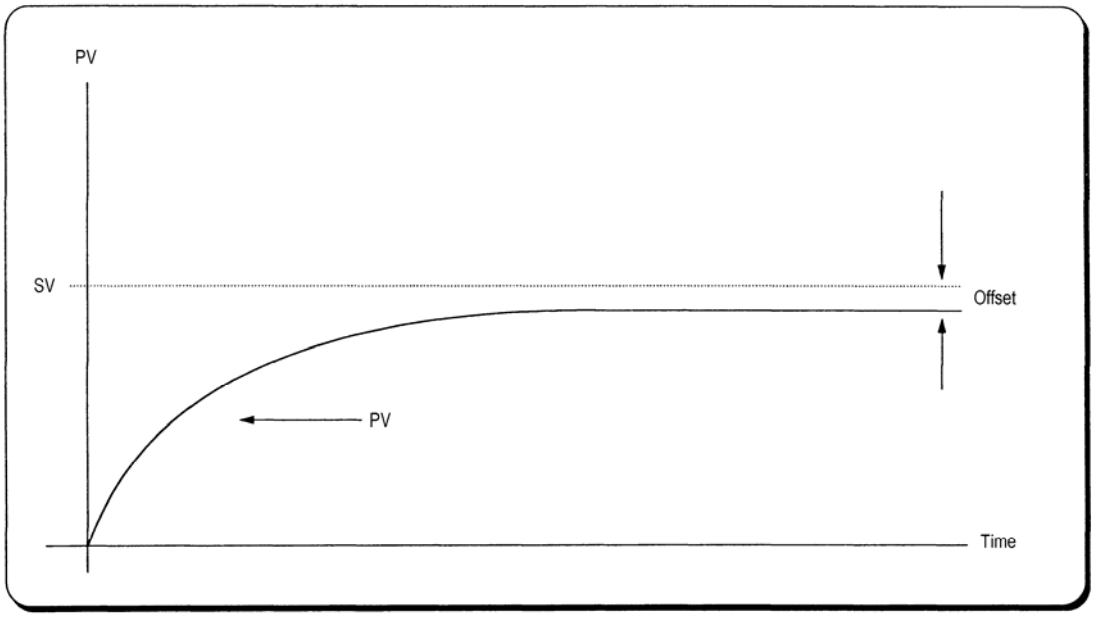


Fig. 2.3 When the proportional constant (Kp) is small

b) Integral operation (I operation)

(a) With integral operation, the manipulate value (MV) is increased or decreased continuously in accordance time in order to eliminate the deviation between the SV and PV. When the deviation is very small, the proportional operation can not produce a proper manipulate value and an offset remains between PV and SV. The integral operation can eliminate the offset value even the deviation is very small.
The period of the time from when the deviation has occurred in I action to when the MV of I action become that of P action is called Integration time and represented as Ti.

(b) Integral action when a constant deviation has occurred is shown as the following Fig. 2.4.

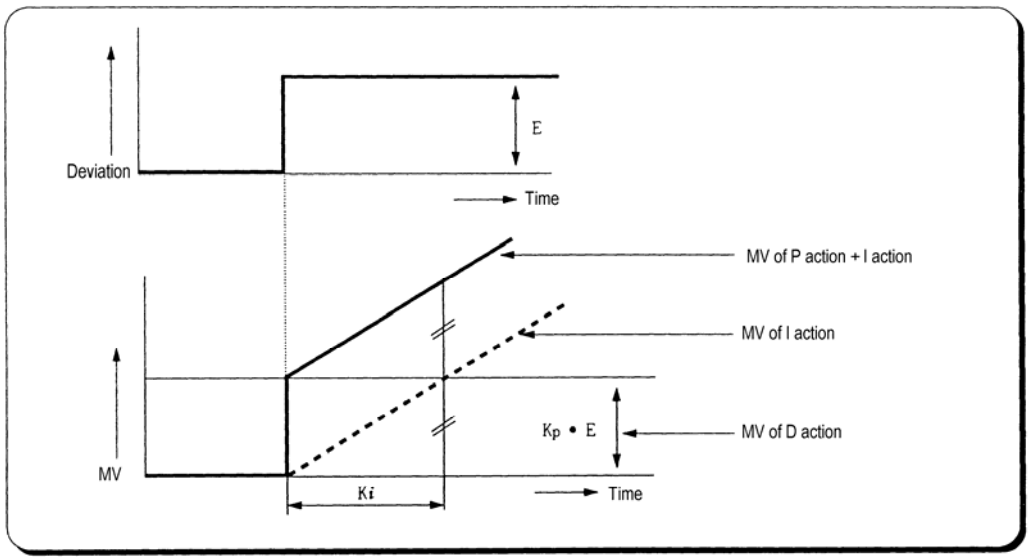


Fig. 2.4 The integral action with constant deviation

(c) The expression of I action is as following;

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

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

That is, the more the integration time (the longer the integration time) as shown in Fig. 2.5, 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. 2.6, 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.

(d) 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.

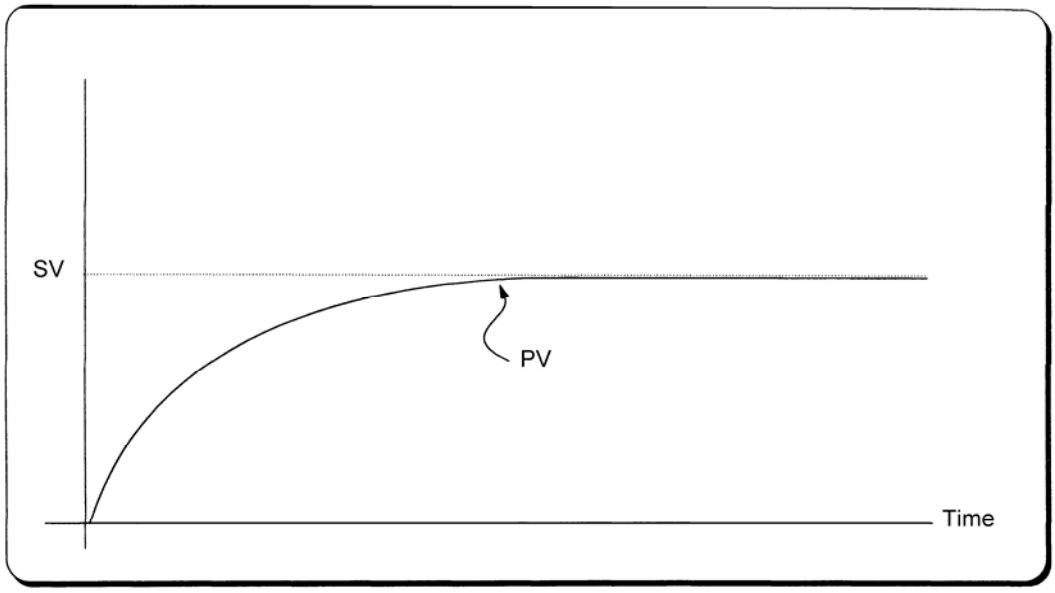


Fig. 2.5 The system response when a long integration time given

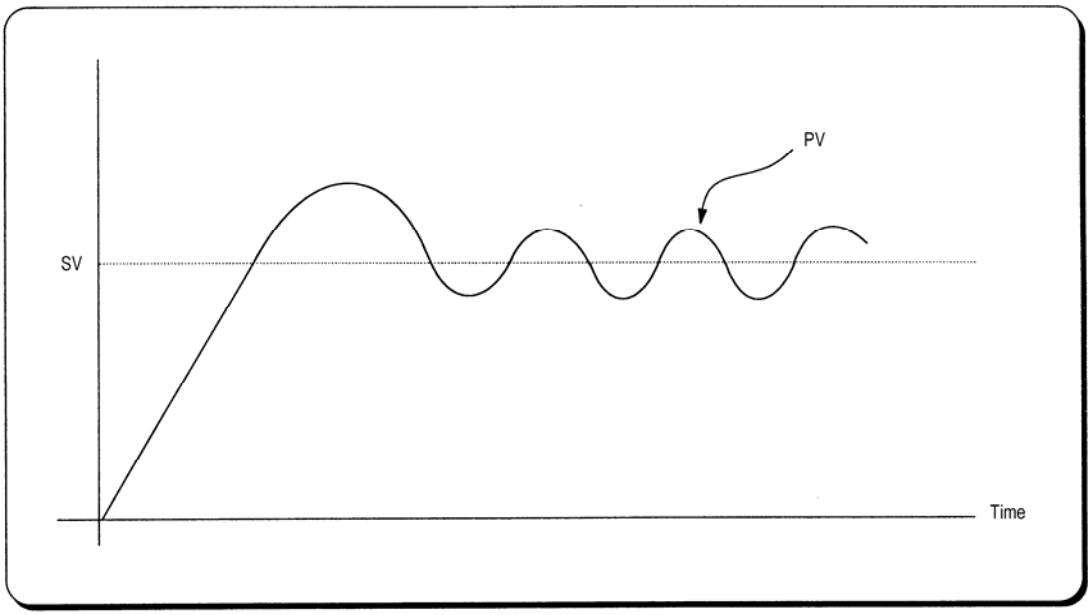


Fig. 2.6 The system response when a short integration time given

c) Derivative operation (D action)

(a) 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.

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

(b) 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 Kd.

(c) The D action when a constant deviation occurred is shown as Fig. 2.7.

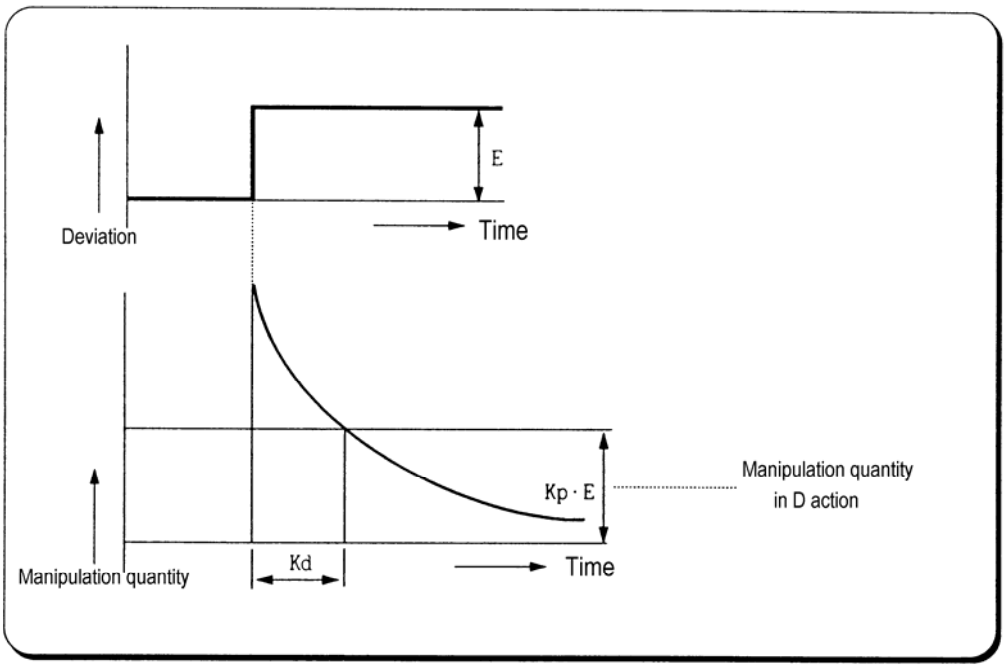


Fig. 2-7 Derivative action with a constant deviation

(d) The expression of D action is as following;

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

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

d) PID action

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

(b) PID action when a given deviation has occurred is shown as the following Fig. 2.8.

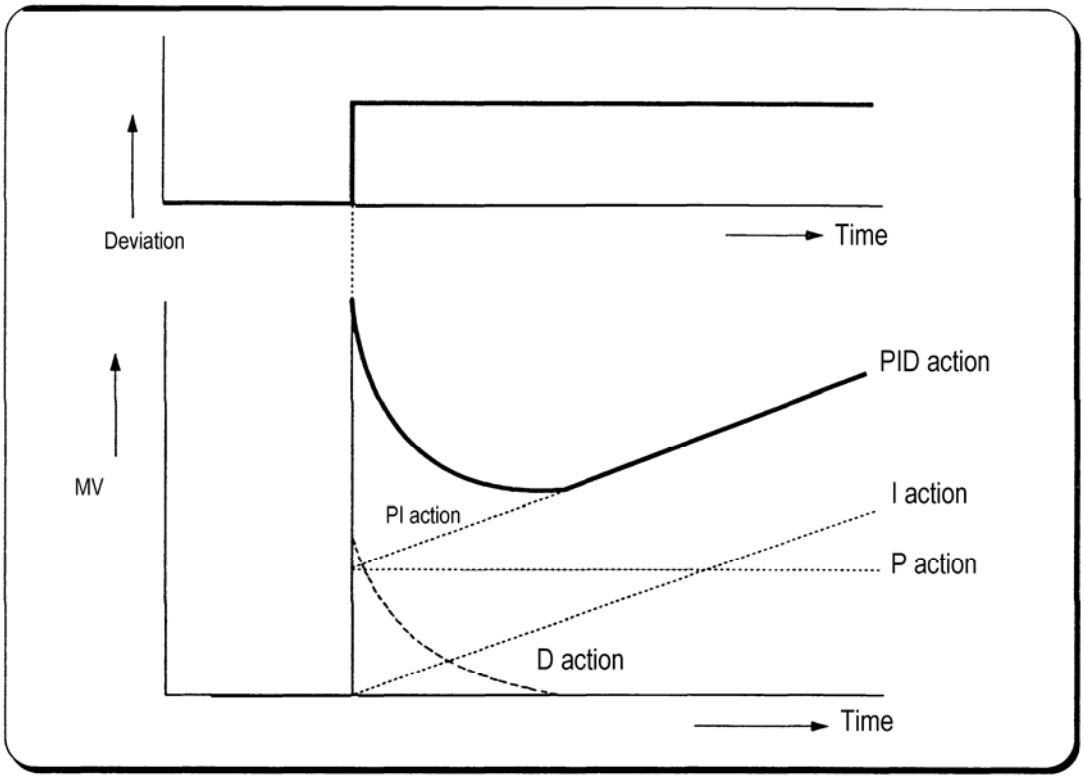


Fig. 2-8 PID action with a constant deviation

e) Forward / Reverse action

(a) PID control has two kind of action, forward action and reverse action. The forward action makes the PV reaches to SV by outputting a positive MV when the PV is less than SV.

(b) A diagram in which forward and reverse actions are drawn using MV, PV and SV is shown as Fig. 2.9.

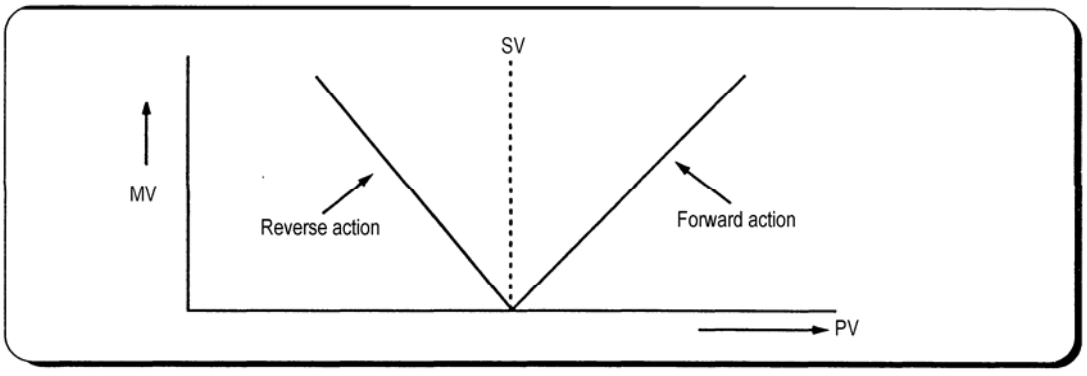


Fig. 2-9 MV of forward / reverse action

(c) Fig 2.10 shows examples of process control by forward and reverse actions, respectively.

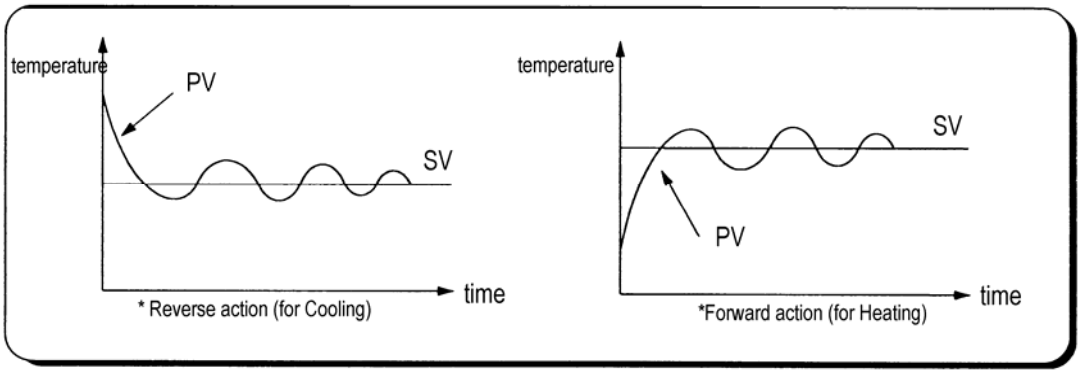


Fig. 2-10 PV of forward / reverse action

f) Reference value

In general feedback control system shown as the Figure 2-10, the deviation value is obtained by the difference of PV and SV. P, I, and D operations are performed based on this deviation value. However, each of P, I, and D operations use different deviation values according to the characteristics of each control actions. The expression of PID control is as following;

$$MV = K\left[Ep + \frac{1}{Ti}\int_0^t Ei(s)ds + Td\frac{dEd}{dt} \right]$$

MV : Manipulate value
K: Proportional gain
Ti: Integral time
Td: Derivative time
Ep: Deviation value for proportional action
Ei: Deviation value for integral action
Ed: Deviation value for derivative action

The deviation values of P, I, and D action is described as following equations;

$$Ep = b \times SV - PV$$
$$Ei = SV - PV$$
$$Ed = -PV$$

The b of the first equation is called as reference value. It can be varied according to the load disturbance of measurement noise.

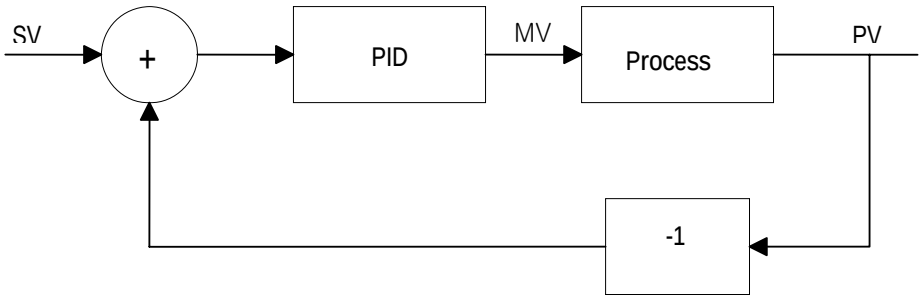


Fig. 2-11 Diagram of simple feedback system

The figure 2.11 shows the variation of PV according to the several different reference values (b). As shown in the Fig. 2.11, the small reference value produces small deviation value, and it makes the control system response be slow.
In general, control system is required to be adaptable to various external / internal changes. Especially, it should shows a stable transient response with the sudden change of the SV to be robust to load disturbances and/or measurement noise.

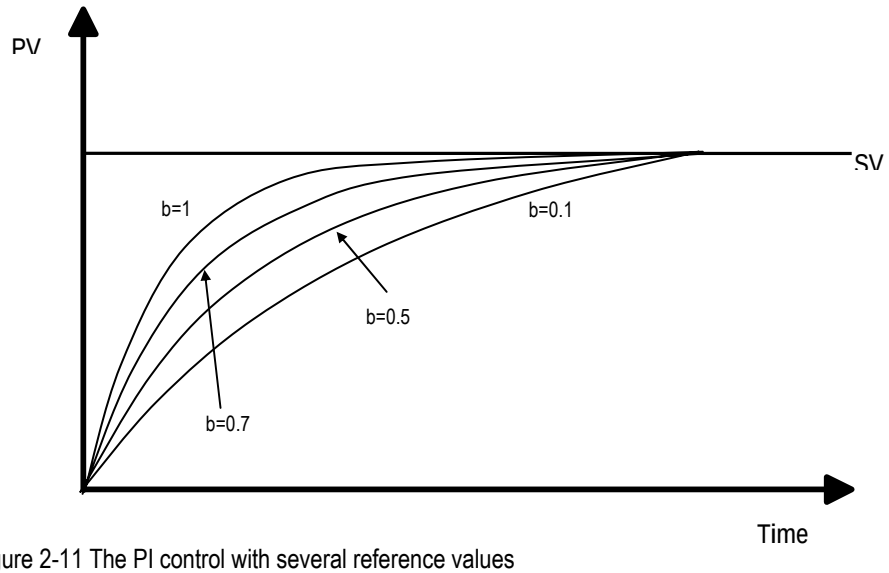
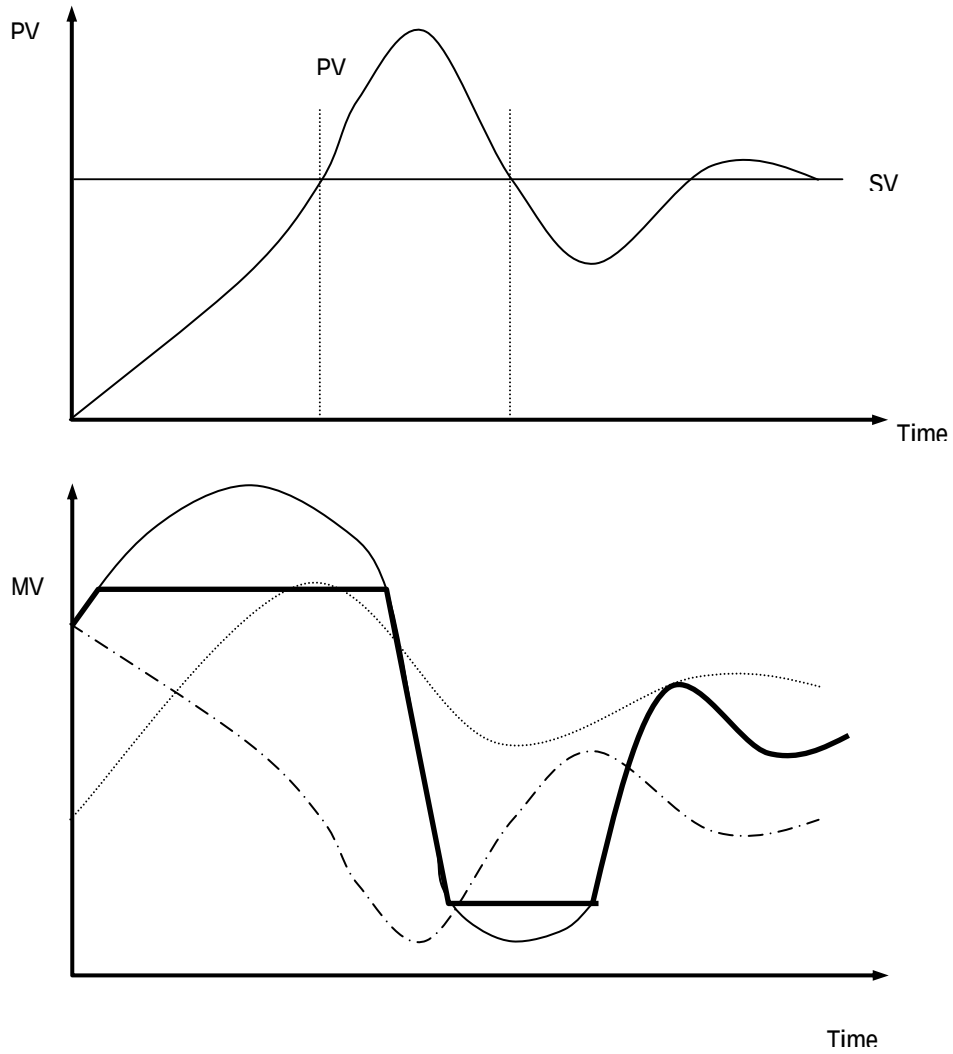


Figure 2-11 The PI control with several reference values

g) 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. 2-12 shows the PV and MV of PI control system when the windup occurs. As shown as the Fig. 2-12, 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 mis-operation of devices can cause windup of actuator.



There are several methods to avoid the windup of actuator. The most popular two methods are adding another feedback system to actuator, and using the model of actuator. The Fig. 2-13 shows the block diagram of the anti-windup control system using the actuator model.

As shown in the Fig. 2-13, the anti-windup system feedback the multiplication of gain (1/Tt) and Es to the input of integral term. The Es is obtained as the difference value between actuator output (U) and manipulation value of PID controller (MV). The Tt of the feedback gain is tracking time constant, and it is in inverse proportion with the resetting speed of integral term. Smaller Tt will cancel the windup of actuator faster, but too small Tt can cause anti-windup operation in derivative operation. The Fig. 2-14 shows several Tt value and PV in the PI control system.

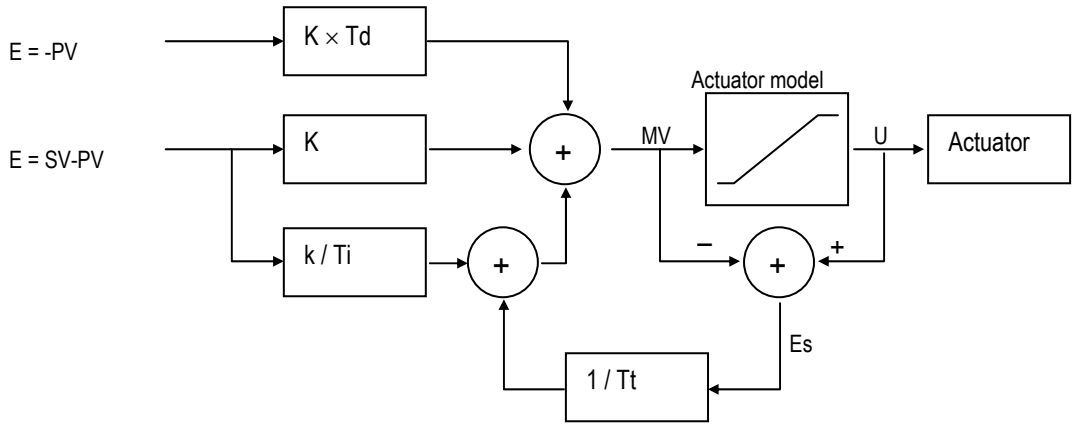


Fig. 2-13 The block diagram of anti-windup control system

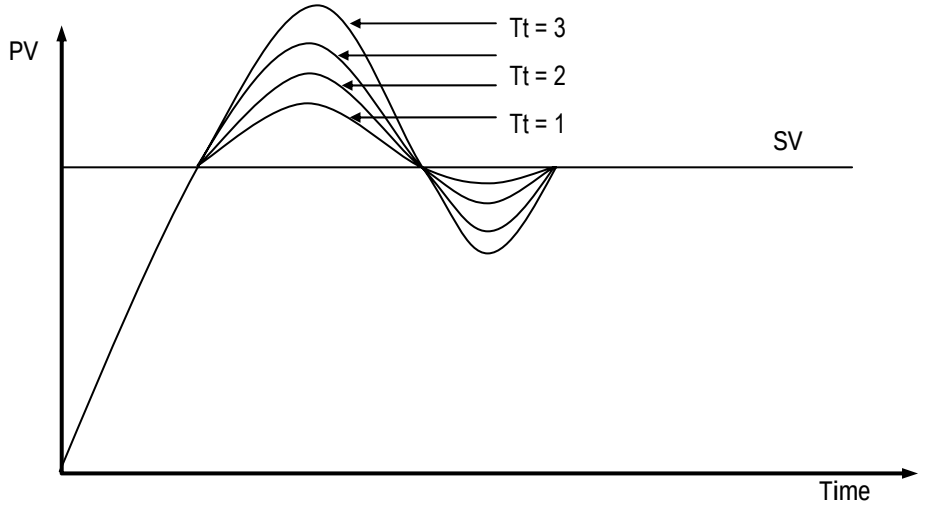


Fig. 2-14 The PV output characteristics with different Tt values.

(2) Realization of PID control on the PLC

In this chapter, it will described that how to get the digitized formula of the P, I, and D terms. Then, the pseudo code of PID control will be shown.

a) P control

The digitized formula of P control is as following;

$$P(n) = K\left[b \times SV(n) - PV(n)\right]$$ 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;

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

K : proportional gain constant
Ti : integral time
e(s) : deviation value
By deviation about t, we can obtain;

$$\frac{dI}{dt} = \frac{K}{Ti} e$$ e = (SV – PV) : deviation value

The digitized formula is as following;

$$\frac{I(n+1) - I(n)}{h} = \frac{K}{Ti} e(n)$$ h : sampling period

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

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)

The digitized formula is as following (Use Tustin approximation method)

$$D(n) = \frac{2Td - hN}{2Td + hN} D(n-1) - \frac{2KTdN}{2Td + hN} \left[y(n) - y(n-1) \right]$$

d) Pseudo code of PID control

The pseudo code of PID control is as following;

- Step 1 : Get constants that are used for PID operation

$Bi = K \times \frac{h}{Ti}$: integral gain

$$Ad = \frac{(2 \times Td - N \times h)}{(2 \times Td + N \times h)}$$: derivation gain

$$Bd = \frac{(2 \times K \times N \times Td)}{(2 \times Td + N \times h)}$$

$A0 = \frac{h}{Tt}$: anti-windup gain

- Step 2 : Read SV and PV value
  PV = adin(ch1)
- Step 3: Calculate the proportional term.
  P = K × (b × SV – PV)
- Step 4 : Update the derivative term. (initial value of D = 0)
  D = As × D – Bd × (PV – PV_old)
- Step 5 : Calculate the MV. (initial value of I = 0)
  MV = P + I + D
- Step 6 : Check the actuator is saturated or not.
  U = sat(MV, U_low, U_high)
- Step 7 : Output the MV value to the D/A module
- Step 8 : Update the integral term.
  I = I + bi × (SV – PV) + A0 × (U – MV)
- Step 9 : Update the PV_old value.
  PV_old = PV

3) Instruction and parameter setting

For the PID operation of MK80S, following 2 instruction are included in the KGLWIN software. (version 2.0 or later)

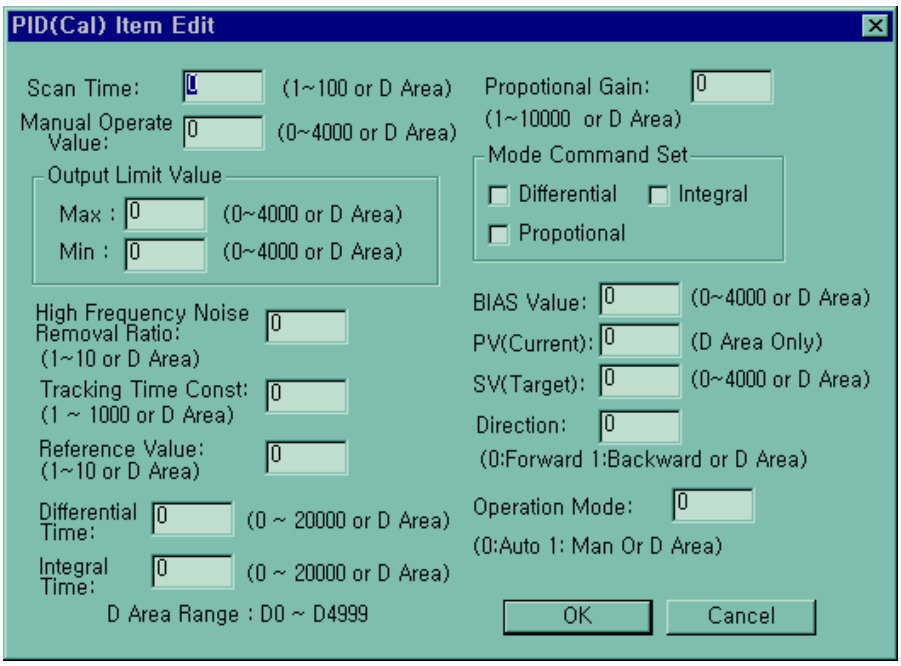
No.	Name	Description
1	PID8	Perform the PID operation
2	PID8AT	Perform the auto tuning operation

Remarks

1.Refer the KGLWIN manual for the parameter setting.

(1) Parameter setting and explanation

a) PID8 instruction parameter setting and explanation.



(a) Scan time

scan time is the period of reading data (sampling), and also 10 times scaled up. Generally, it should be synchronized with external trigger input (EN input of function block) to perform proper PID operation. The range of sampling time is 0.1 ~ 10 seconds, and actual input range is 0 ~ 100.

(b) Manual operate value

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

(c) 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)

Be careful. if designating 'D' area value and designating value directly over 10 , system operate abnormally.

(d) Tracking time constant

TT (tracking time constant) parameter is used to designate anti_reset windup operation. The range of TT is 0.01 ~ 10 and the actual input range that are 100 times scaled up is 0 ~ 1000

(e) Reference value

Reference value may be useful parameter according to the control system type, especially velocity, pressure, or flux control system. The Reference value input is also 10 times scaled up, and the actual range is 0 ~ 10.

(f) Differential 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)

(g) Proportional gain

The MK80S 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.

(h) Mode command set

In MK80S, only the following 4 operation modes are available. Other operation modes, such as PD or I, are not permitted.

No.	EN_P	EN_I	EN_D	Operation
1	1 (enable)	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	0 (disable)	0 (disable)	0 (disable)	On/Off operation

(i) Bias value

The Bias data is used for the compensation of offset in the proportional control.

(j) SV(Target)

SV (setting value : the designated value) and PV (process value : present value) of MK80S 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 MK80S series (12bits) and offset value.

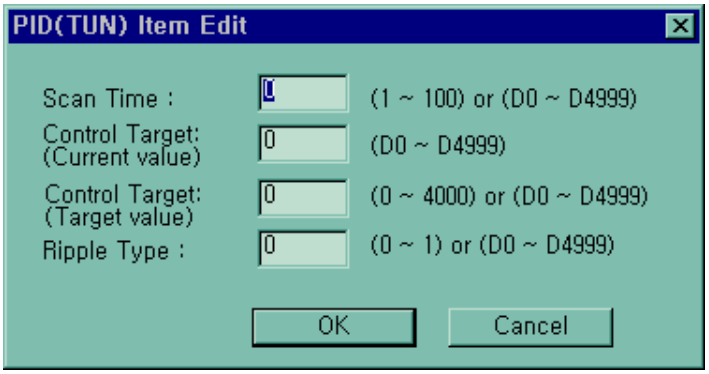
The following table shows error codes and descriptions of PID8 instruction.

Error code (STAT output)	Description	Countermeasure
0	Normal operation	
1	SV is out of range	Change the SV within 0 ~ 4000
2	MVMAN is out of range	Change the MVMAN within 0 ~ 4000
3	P_GAIN is out of range	Change the P_GAIN within 0 ~ 10000
4	I_TIME is out of range	Change the I_TIME within 0 ~ 20000
5	D_TIME is out of range	Change the D_TIME within 0 ~ 20000
6	S_TIME is out of range	Change the S_TIME within 0 ~ 100
7	REF is out of range	Change the REF within 0 ~ 10
8	TT is out of range	Change the TT within 0 ~ 1000
9	N is out of range	Change the N within 0 ~ 1000
10	EN_I and/or EN_D is set as 1 when EN_P is 0	Only P, PI, and PID controls are available. Please change the setting of EN_P, EN_I, and EN_D.

Remark

1. Please be careful to input 100 times scaled up values for P_GAIN and TT.
2. I_TIME, D_TIME, S_TIME, and REF are 10 times scaled up, not 100 times.

b) PID8AT instruction parameter setting and explanation.



(a) Scan time

S_TIME is the period of reading data (sampling), and 10 times scaled up for more precious operation. Generally, it should be synchronized with external trigger input to perform proper PID operation.
The range of sampling time is 0.1 ~ 10 seconds, and actual input range is 0 ~ 100.

(b) Control target(SV)

SV (setting value : the designated value) and PV (process value : present value) of MK80S 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 MK80S 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. For example, assume that PID control is used for temperature control with Pt100 (operation range : 0 °C ~ 250 °C), and the goal value is 100 °C. The equivalent digital output of A/D module (voltage output range : 1 ~ 5V) is 1600 if the A/D module outputs 0 (1V) with 0 °C, and 4000(5V) with 250 °C. Therefore, the input of SV should be 1600, not 2.

(c) Ripple type

The MK80S perform auto-tuning operation based on the frequency response method. PID parameters are obtained by On/Off operation during 1 cycle of PV variation. The RIPPLE parameter shows at which cycle the CPU module will perform auto-tuning operation. If 0 is selected, the CPU will get PID parameters during the first cycle of PV variation. If 1 is selected, the second cycle will be used. (refer Fig. 3-1 for detailed information) Other choice of RIPPLE parameter is not allowed. In general case, select 1 for proper auto-tuning operation. The On/Off operation will be occur at the 80% of PV value.

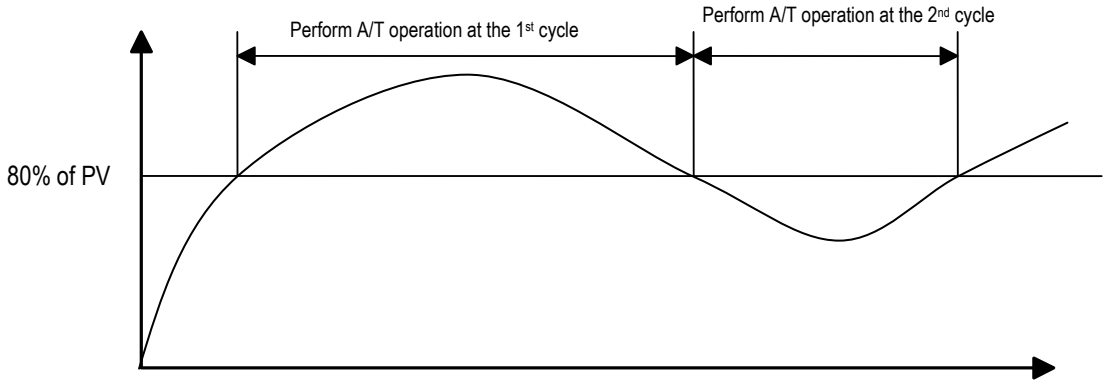


Fig.3-1 The ripple parameter

c) Error codes of auto-tuning function block (PID8AT)

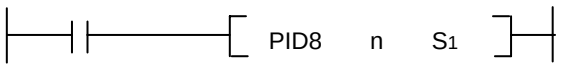
The following table shows error codes and descriptions of PID8AT instruction.

Error code (STAT output)	Description	Countermeasure
0	Normal operation	
1	SV is out of range	Change the SV within 0 ~ 4000
2	PV is out of range	It may caused by fault of A/D module. Check the A/D module.
3	S_TIME is out of range	Change the S_TIME within 0 ~ 100
32	Ripple is out of range	Change the Ripple to 0 Or 1.

2) instruction

(1) PID8

Instruction		Available device											Step no.	Flag		
		M	P	K	L	F	T	C	S	D	#D	Integer		Error (F110)	Zero (F111)	Carry (F112)
PID8	n									O		O	5	O		
	S1									O						



Flag Set

Error (F110)	It turns 'on' when designation area is over and the instruction isn't executed.

Designation area

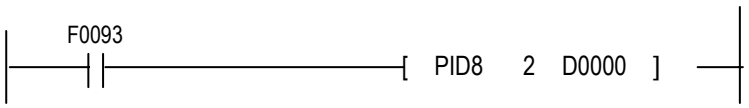
n	Registration No. at parameter(0~7)
S1	execution status registration area

ν PID8(PIDCalculation)

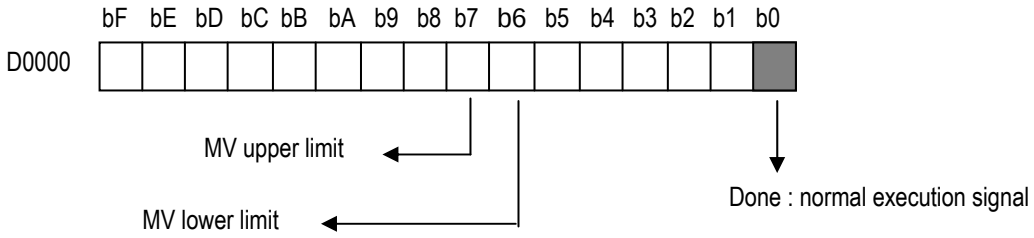
a) Usage

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

b) Example program

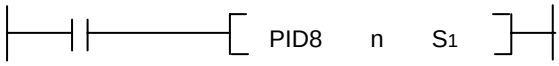


- When the input condition F0093(1second clock) is rising edge(off⏐ on) PID operation executes at no.2 parameter.
- PID execution status registrate D0000 and the output value of control result registrate D0001



(2) PID8AT

Instruction		Available device											Step no.	Flag		
		M	P	K	L	F	T	C	S	D	#D	Integer		Error (F110)	Zero (F111)	Carry (F112)
PID8	n									O		O	5	O		
	S1									O						



Flag Set

Error (F110)	It turns 'on' when designation area is over and the instruction isn't executed.

Designation area

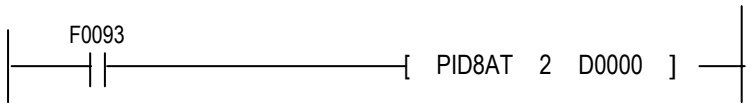
n	Registration No. at parameter(0~7)
S1	execution status registration area

ν PID8AT(PID auto tuning Calculation)

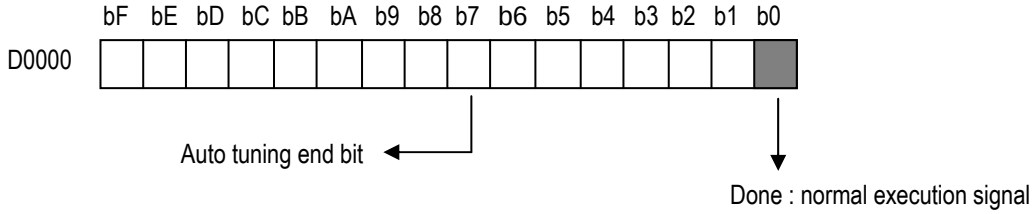
a) Usage

- when the condition of execution is on, PID auto tuning operation executes.(only rising edge condition) 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

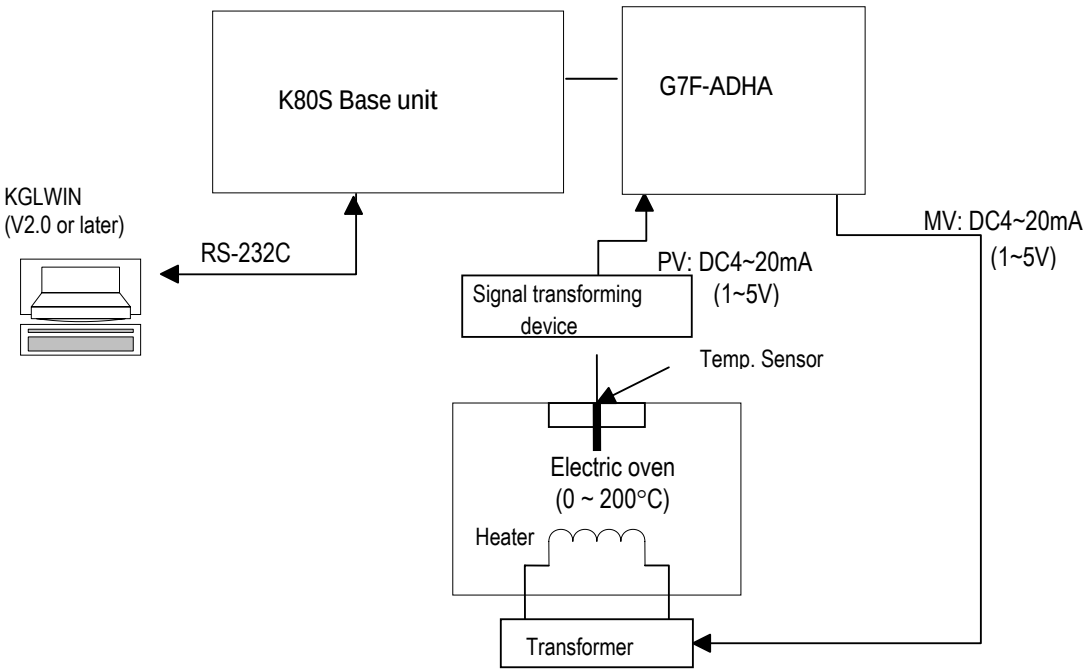


- When the input condition F0093(1second clock) is rising edge(off⏐ on) PID operation executes at no.2 parameter.
- PID execution status stores D0000 and the output value of control result stores D0001 and P,I,D constant sequentially store D003(P),D004(I),D005(D)



6) Program Example

(1) System configuration



(2) Initial setting

a) PID operation parameters

- ► Auto / Manual operation setting : Auto
- ► Forward / Reverse operation : Forward
- ► SV setting : 960(60°C),1120(70°C),1280(80°C),1600 (100°C)
- ► Current value setting : D4980(AD conversion value of AD module Ch1)
- ► BIAS setting : 0 (If only P control is used, input proper value other 0)
- ► EN_P, EN_I, EN_D setting: EN_P=1, EN_I=1, EN_D=1 (PID operation)
- ► REF=10 , TT=1000 , N=1
- ► MV_MAX, MV_MIN, MVMAN: MV_MAX=4000, MC_MIN=0, MAMAN=2000
- ► S_TIME : S_TIME=100 (sampling time = 10 seconds)

b) Auto-tuning parameters

- ► PV setting: : 960(60°C),1120(70°C),1280(80°C),1600 (100°C)
- ► S_TIME: S_TIME=100 (sampling time = 10 seconds)
- ► Current value setting : D4980(AD conversion value of AD module Ch1)
- ► wave select : designation value=1

c) A/D module setting

- ► Channel setting : use channel 1
- ► input range setting : DC 4 ~ 20 mA
- ► A/D conversion data registration area : D4980
- ► Output data type: – 48 ~ 4047

d) D/A module setting

- ► output range setting: DC 4 ~ 20 mA
- ► D/A conversion data registration area : D4982

(3) Program Explanation

a) Use only PID operation (without A/T function)

(a) Convert the measured temperature (0 ~ 250°C) to current signal (4 ~ 20mA), and input the current signal to the channel 1 of A/D module. Then, the A/D module converts the analog signal to digital value (0 ~ 4000)

(b) PID8 instruction will calculate manipulate value (MV : 0 ~ 4000) based on PID parameter settings (P_GAIN, I_TIME, D_TIME, etc.) and PV from A/D module. Then, the calculated MV is output to the channel 0 of D/A module.

(c) D/A module will convert the MV (0 ~ 4000) to analog signal (4 ~ 20mA) and output to the actuator (power converter).

b) Use PID operation with A/T function

(a) Convert the measured temperature (0 ~ 250°C) to current signal (4 ~ 20mA), and input the current signal to the channel 0 of A/D module. Then, the A/D module converts the analog signal to digital value (0 ~ 4000)

(b) A/T function block will calculate manipulate value (MV : 0 ~ 4000) based on the SV and PV from A/D module. Simultaneously, the A/T module will calculate P,I and D parameters.

(c) The END output of A/T module will be 1 when the A/T operation is completed. Then, PID module will start operation with PID parameters that are calculated by A/T module.

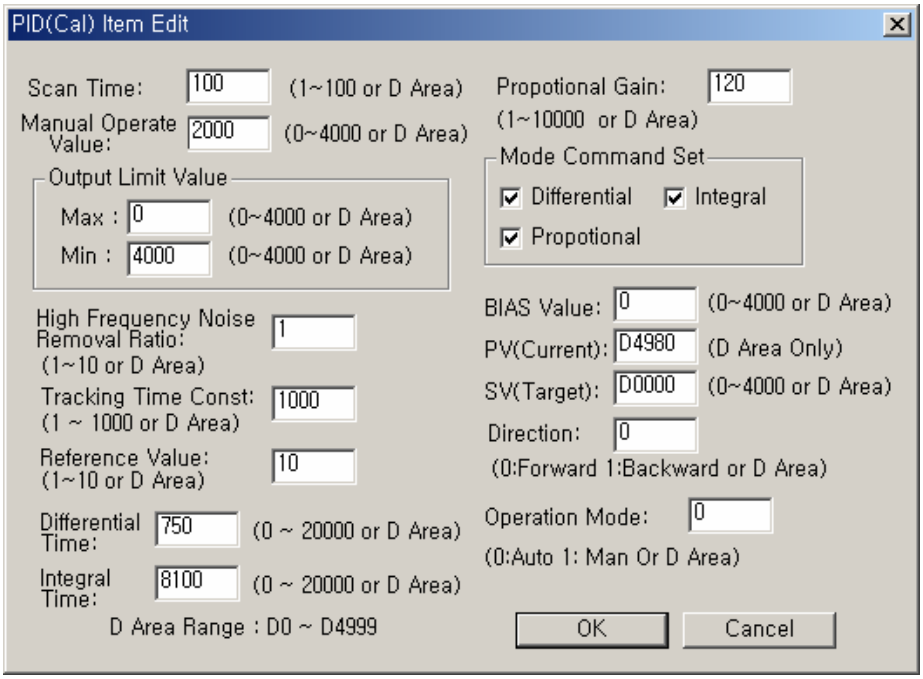
(d) D/A module will convert the MV (0 ~ 4000) to analog signal (4 ~ 20mA) and output to the actuator (power converter).

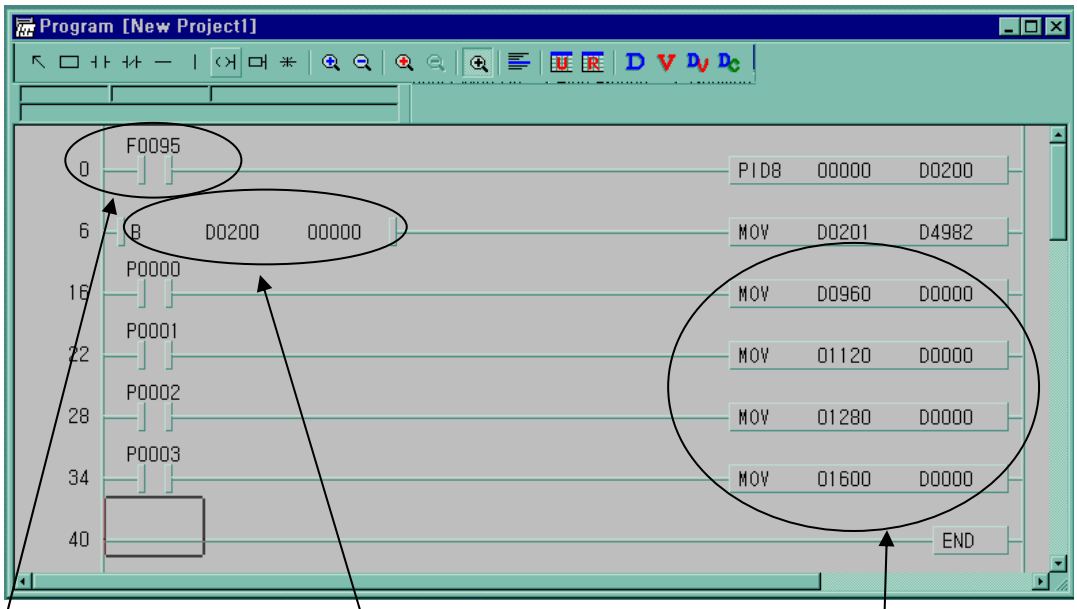
Remark

G7F-ADHA module is supplied 2channels for A/D exchange and 1channel for D/A exchange module.

(4) parameter setting and Program

a) In case of using PID function only.





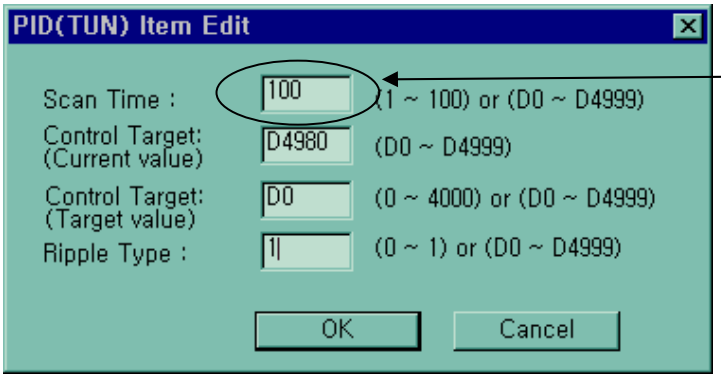
PID execution completes at 10 second each time
At that time bit 0 of D200 turns on and output MV value.

F095 is 10 second clock
PID execution scan time is equal to input clock certainly

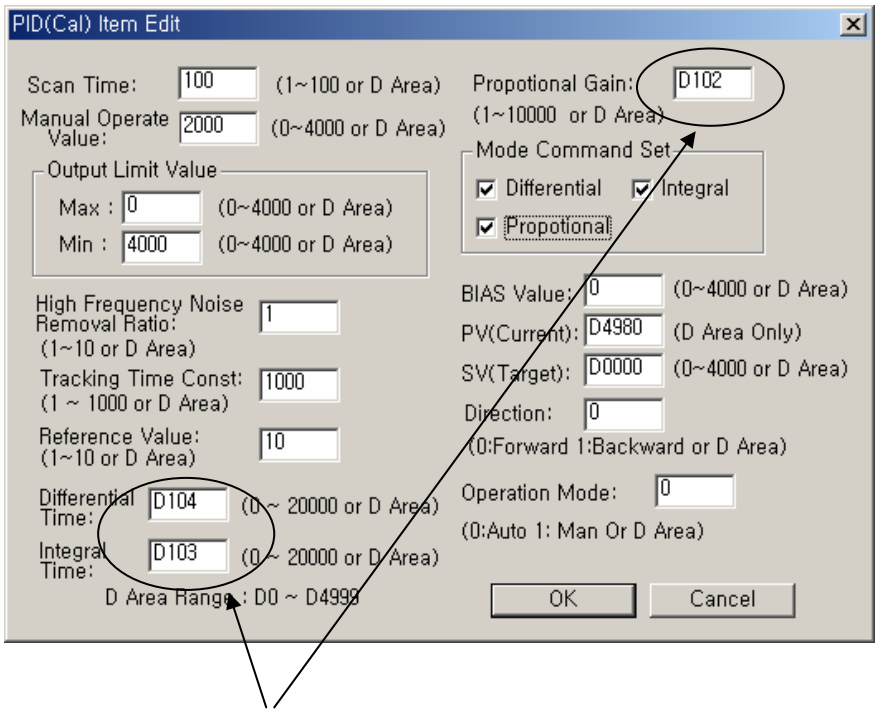
Data move for SV setting value.
This value is moved before the PID instruction execution

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

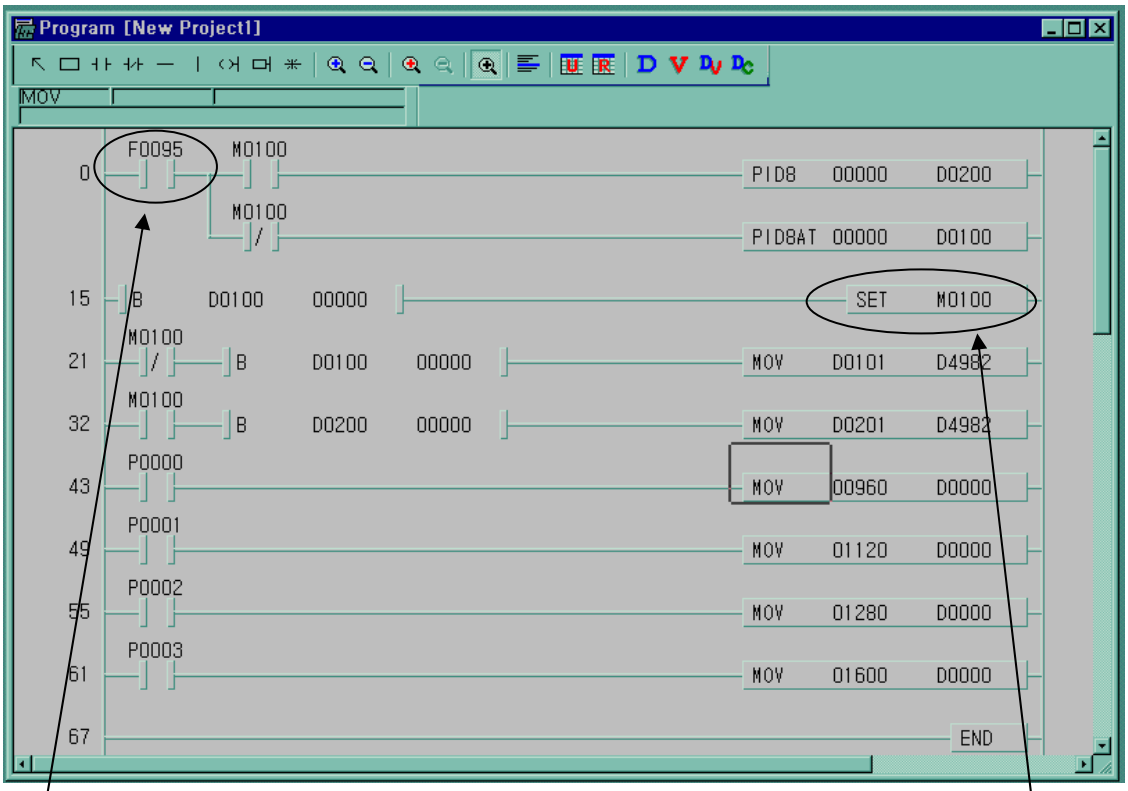
This program is an example of PID operation performing with computed P,I,D values by the auto tuning performing. It is performed in 80% of auto tuning SV, PID process is performed from 80% of SV.



PID execution scan time should be equal to input clock certainly



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



PID8 and PID8AT input period should be equal to execution scan time which is designated at parameter

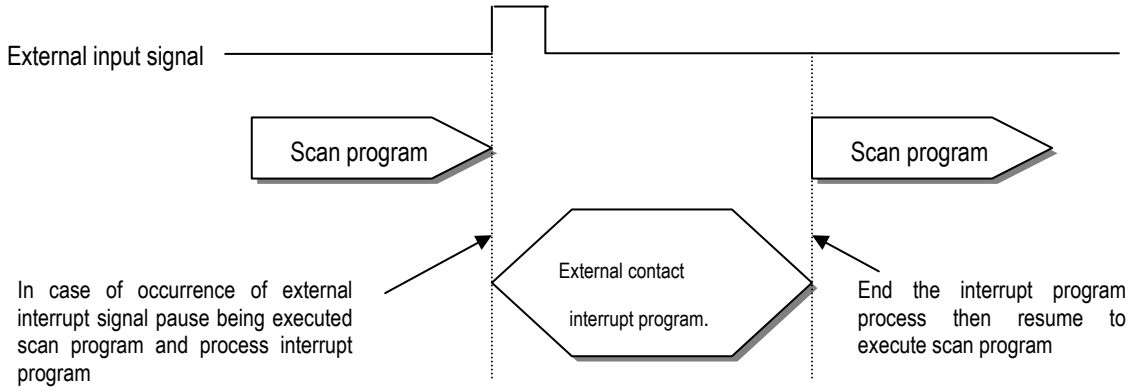
When PID auto tuning ends, M100 turns on

7.1.6 External Interrupt Function

In MK80S Series can perform max 8 points of external contact interrupt by using input of base unit without special interrupt module.

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

2) Operating explanation



3) Function

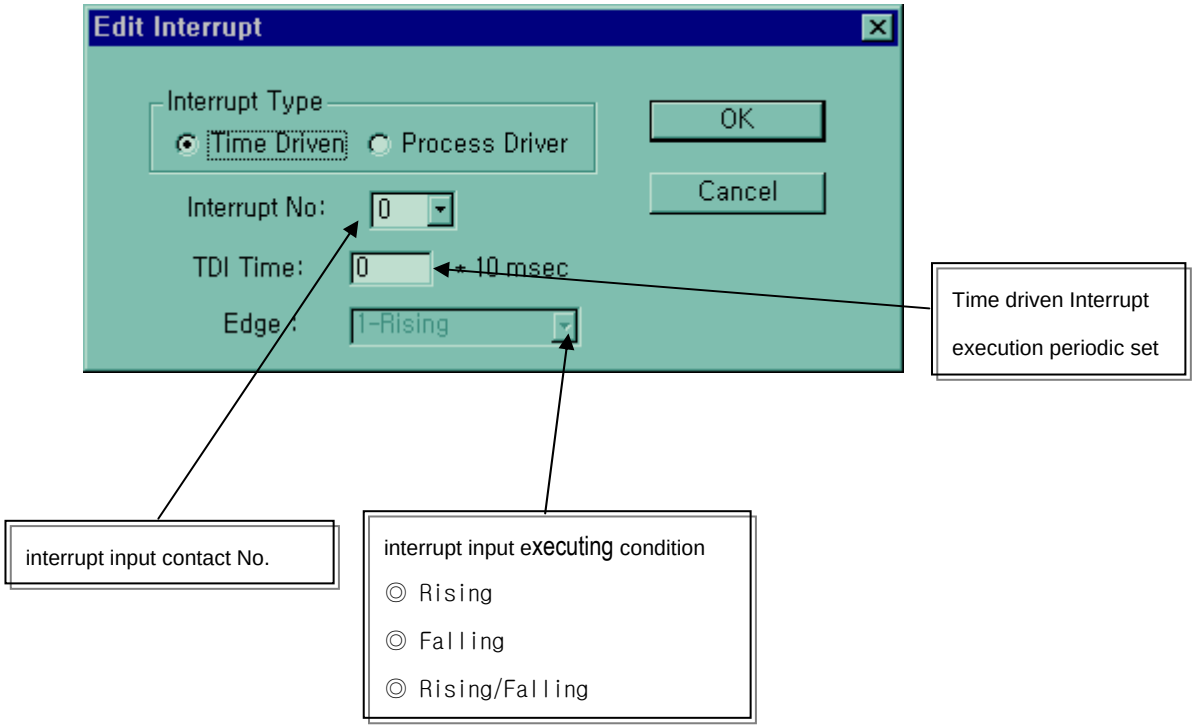
(1) Max. 8 points can be used to external interrupt input within P000 ~ P007

(2) Inputting 8points of base unit are set functions like following.

	00	01	02	03	04	05	06	07
High speed counter	A-phase Input	B-phase Input	Preset Input	-	-	-	-	-
External interrupt	●	●	●	●	●	●	●	●
Time driven task	-	-	-	-	-	-	-	-
8points are available								

(3) Max, 8points of external contact interrupt are available to use. But the no. of them is decreased by using other interrupt (time driven interrupt)

(4) Designate contact point, no. of priority and movement condition of the task program which is moved by interrupt inputting.



(5) For the details , refer to KGLWIN manual.

7. 2 Special module

7.2.1 A/D · D/A Combination module

1) Performance specification

The performance specification of the analog mixture module are following.

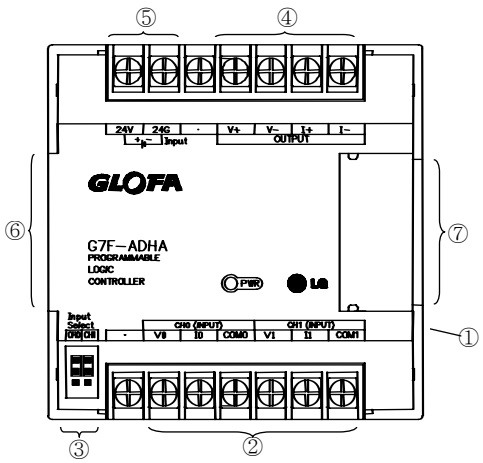
Item		Specifications		
Analog Input	Input range	Voltage	DC 0～10V (input resistance more than 1 MΩ)	
		Current	DC 0～20 mA (input resistance 250Ω)	Classified by parameter
			DC 4～20 mA (input resistance 250Ω)	
	Digital output	12Bit(-48~4047)		
	Voltage/Current selection	1.Setting by jumper pin for V/I selection on upper part of product (Up: voltage, Down: Current) 2. Voltage/current selected by KGL-WIN parameter 3. When current input is used, short the V and I terminal		
	No. of channel	2Channels		
	Absolute max. input	Voltage	DC +12V	
		Current	DC +24 mA	
Analog output	Output range	Voltage	DC 0～10V (External load resistance 2 kΩ～1 MΩ)	
		Current	DC 0～20 mA (External load resistance 510Ω)	Classified by parameter
			DC 4～20 mA (External load resistance 510Ω)	
	Digital Input	12Bit(-48~4047)		
	Voltage/Current selection	Separated from terminal		
	No. of channel	1Channel		
	Absolute max. output	Voltage	DC +12V	
		Current	DC +24 mA	
Common	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	2 ms/CH + scan time		
	Isolation	Photo coupler insulation between I/O terminals and PLC power supply (No isolation between channels)		
	Connect terminal	9 Points 2 terminals		
	Internal current Consumption	20 mA		
	External power supply	DC 21.6 ～ 26.4V, 80 mA		
	Weight	240g		

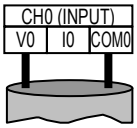
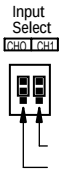
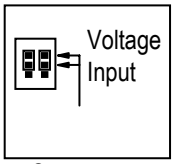
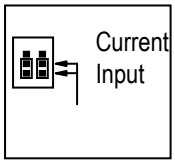
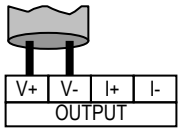
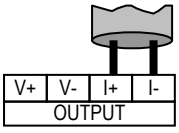
Remark

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.2 Modules

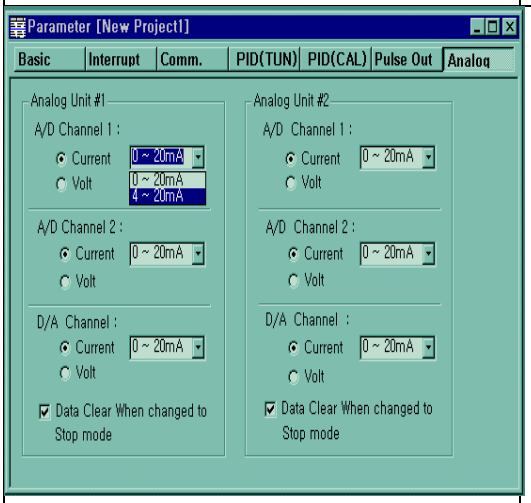
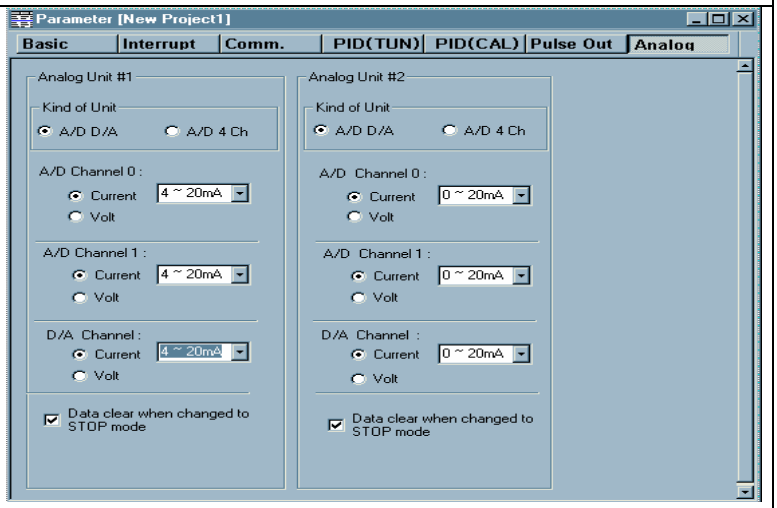
2) Names of parts and functions

Explain about names of parts and functions



No	Contents.
①	RUN LED Indicate the operating status the G7F-ADHA
②	Analog input terminal Voltage Input  Current input  When current input is used, short the V and I terminal.
③	Jumper pin of analog input  Right is CH.1selecting left is CH. 0 selecting  Connect upper parts by jumper pins  Connect lower parts by jumper pins.
④	Analog output terminal Voltage output  Current output  ▶ Only one type of output (Current or Voltage)is available on a module
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.

3) Parameter setting

The same or less than KGLWIN V2.13	The same or more than KGLWIN V2.14
	

4) Reading A/D conversion value & Writing D/A conversion value

A/D conversion value and D/A conversion value stores special data register as following.

The table which is shown below is possible to use under the same or less than K80S CPU ROM V1.3.

Special data register	Explanation	Remark
D4980	A/D conversion value of channel 0 stores	A/D. D/A combination module #1
D4981	A/D conversion value of channel 1 stores	
D4982	D/A conversion value set	
D4983	A/D conversion value of channel 0 stores	A/D. D/A combination module #2
D4984	A/D conversion value of channel 1 stores	
D4985	D/A conversion value set	

The table which is shown below is possible to use under the same or more than K80S CPU ROM V1.4.

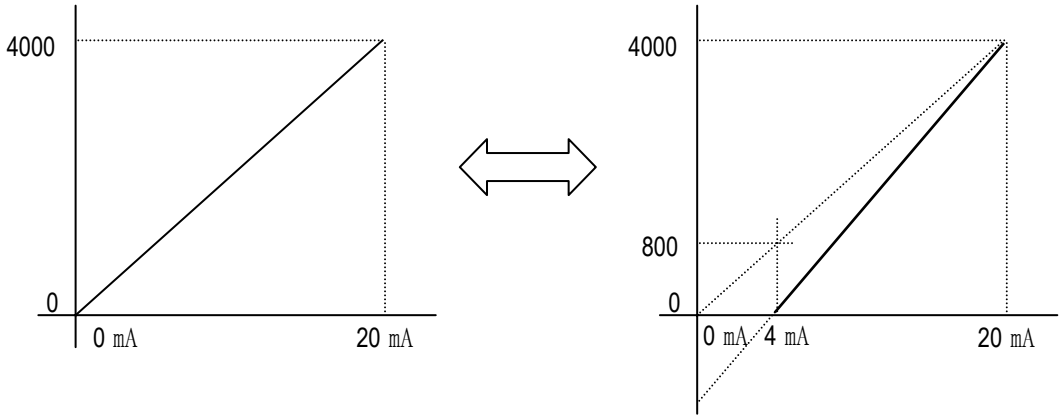
Special data register	Explanation	Remark
D4980	A/D conversion value of channel 0 stores	A/D. D/A combination module #1
D4981	A/D conversion value of channel 1 stores	
D4982	D/A conversion value stores	
D4983	unused	
D4984	A/D conversion value of channel 0 stores	A/D. D/A combination module #2
D4985	A/D conversion value of channel 1 stores	
D4986	D/A conversion value stores	
D4987	unused	

5) Scaling function

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

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

(MK80S series converts range automatically as following : 0 ~ 20mA √ 4 ~ 20mA)



► Conversion method is as below

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

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

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

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

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

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

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

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

1600 x 5 ㎂ = 8 ㎃

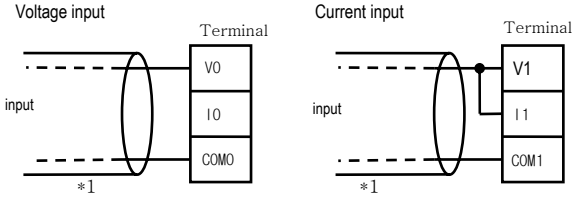
6) Wiring

(1) Caution for wiring

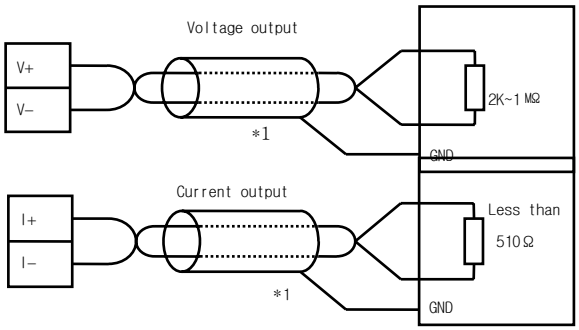
- ▶ Make sure that external input signal of the mixture module of AC and analog I/O is not affected by induction noise or occurs from the AC through using another cable.
- ▶ Wire is adopted with consideration about peripheral temperature and electric current allowance. Thicker than Max. size of wire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



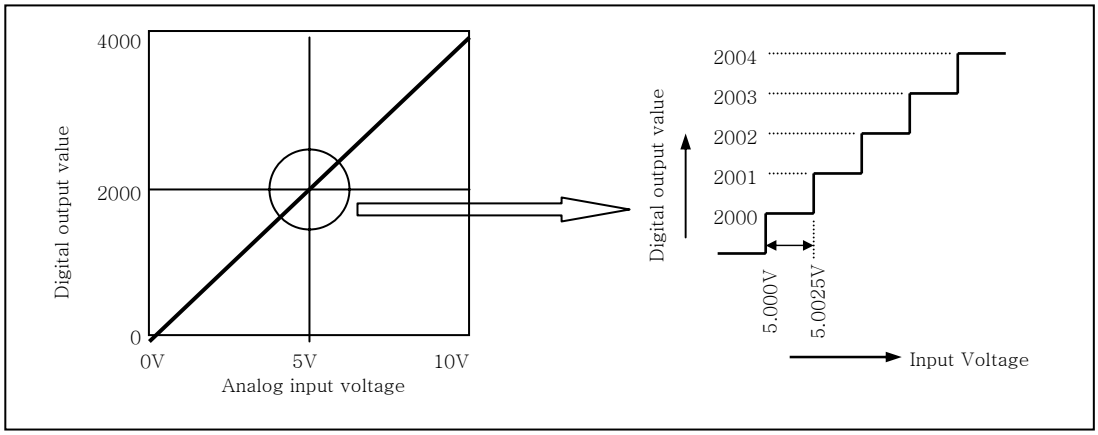
*1 : Be sure to use two-core twisted shield wire.

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

7) I/O converstion characteristics

(1) Analog input characteristics

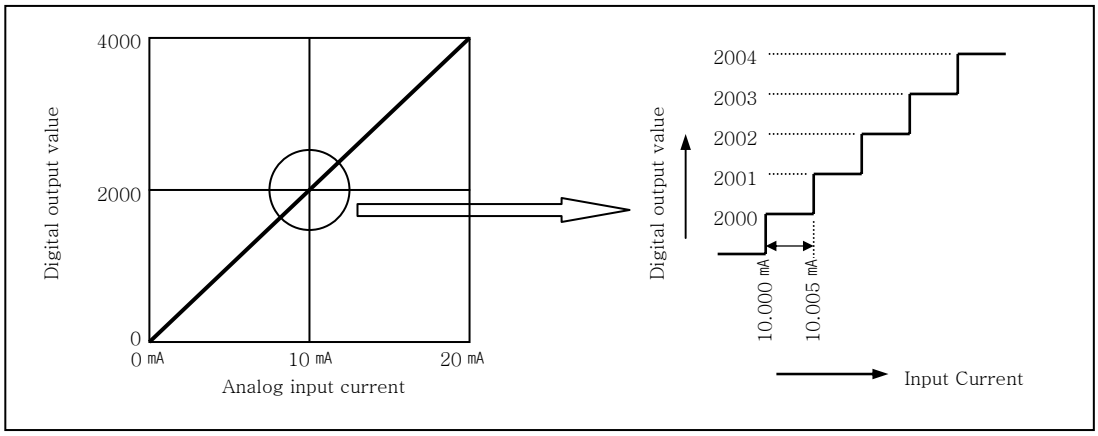
a) Voltage input



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

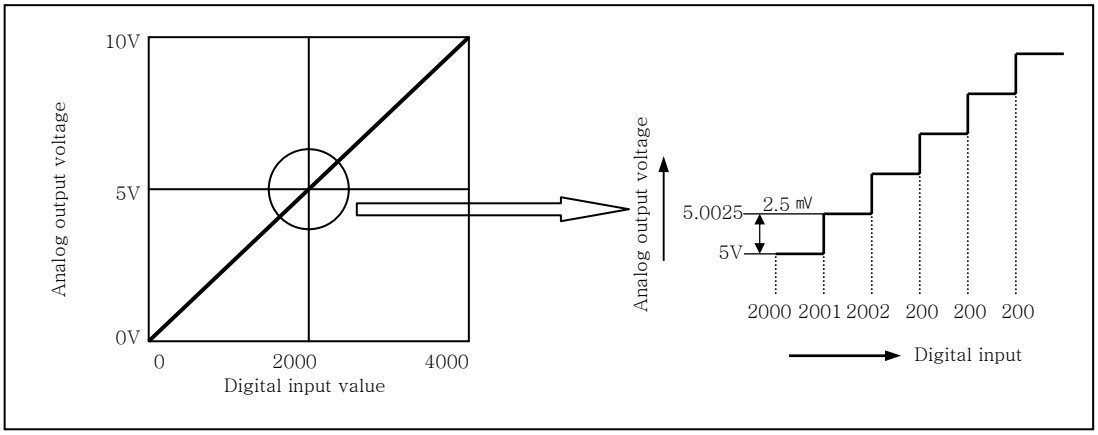


A/D conversion characteristics (Current input)

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

(2) Analog output characteristics

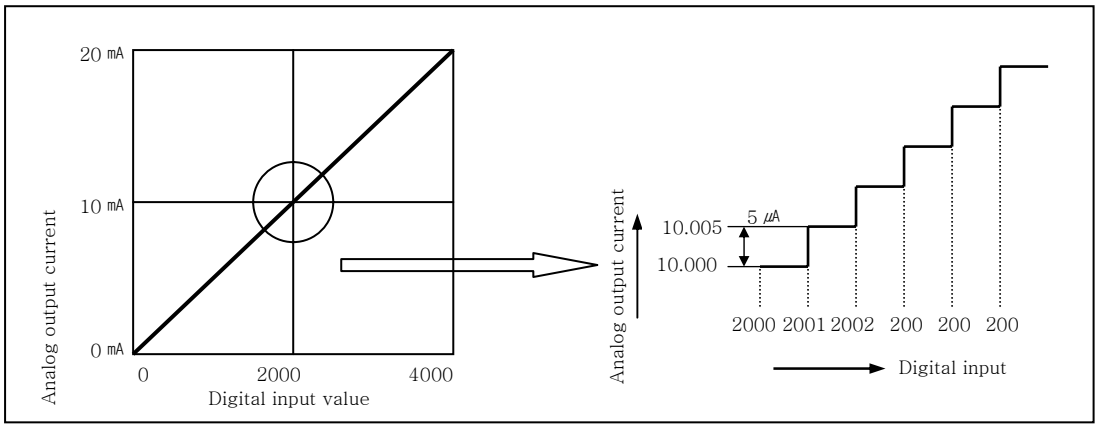
a) Voltage output



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.

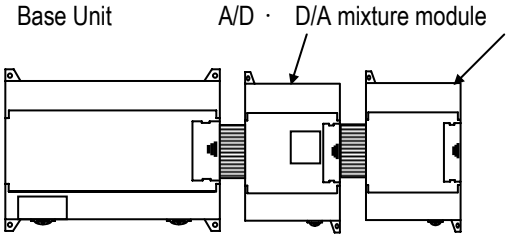
8) Program example

(1) Distinction program of A/D conversion value

a) Program explanation

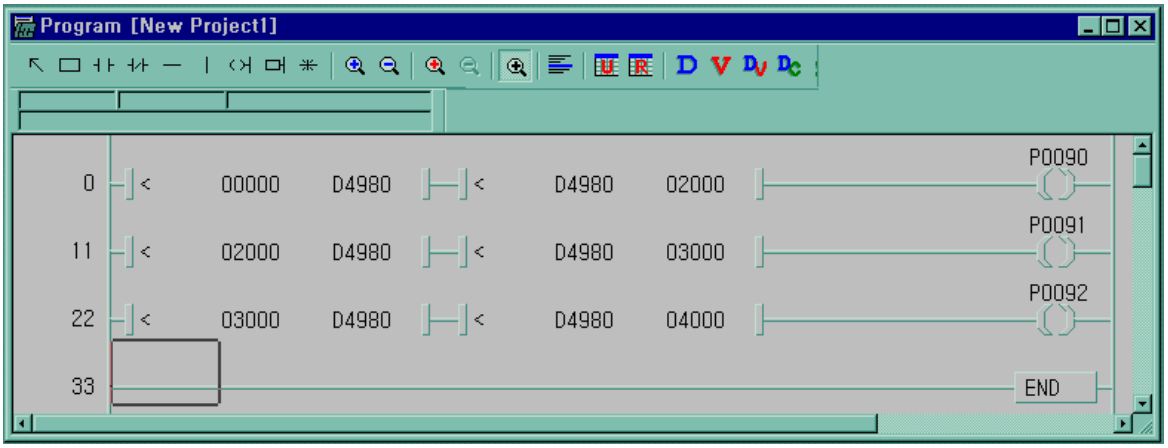
- When digital value of channel 0 is less than 2000, P090 is on.
- when digital value of channel 0 is more than 3000, P091 is on.
- When digital value of channel 0 is more or same than 2000 or lesser than 3000, P092 is on.

b) System configuration



I/O allocation
Base unit input : P000 ~ P03F
Base unit output : P050 ~ P07F
A/D · D/A mixture module : P080 ~ P08F
Expansion unit output : P090 ~ P09F

c) Program



(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.

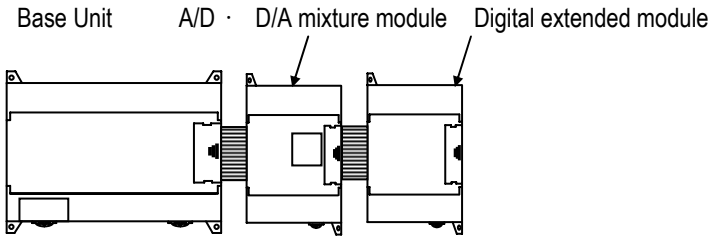
-. When P81 becomes On, 2400 (6V) is output.

-.When P82 becomes On, 2800 (7V) is output.

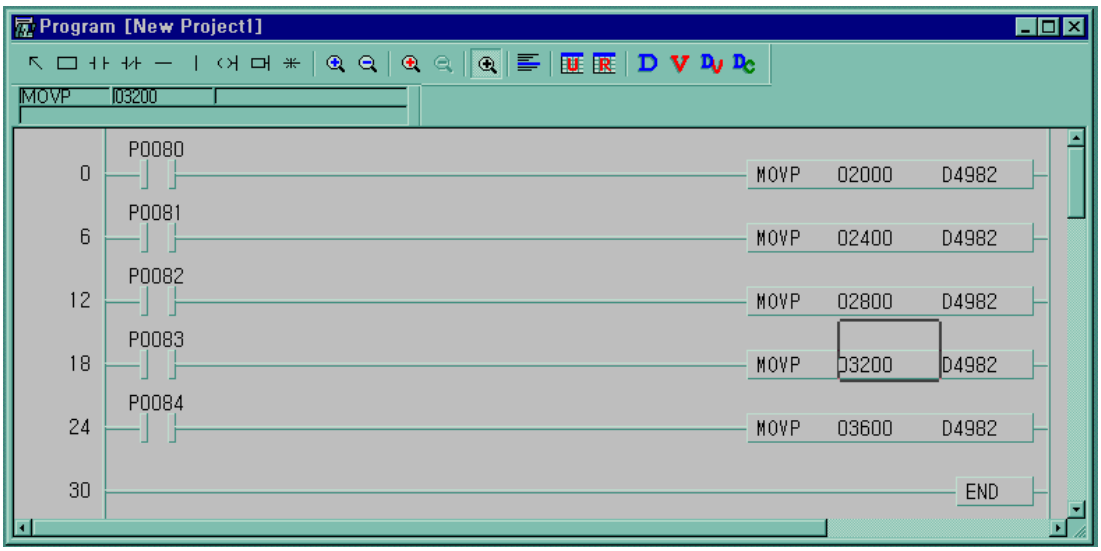
-.When P83 becomes On, 3200 (8V) is output.

-.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.

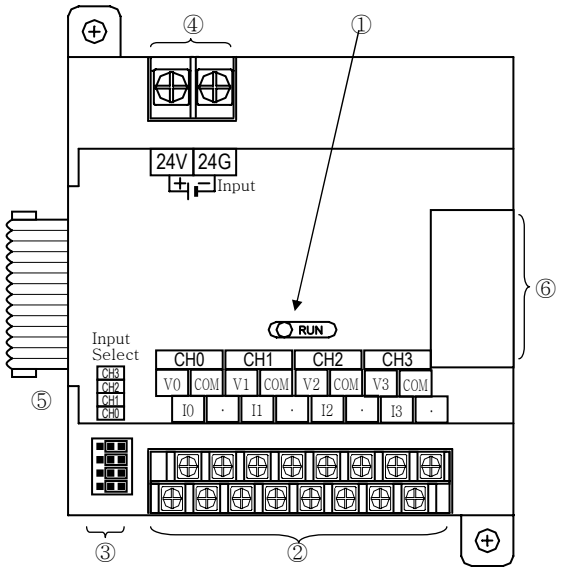
Item		Specifications
Analog input	Voltage	0～10VDC (input resistance more than 1 ㏁)
	Current	DC 4～20 ㎃ (input resistance 250Ω) DC 0～20 ㎃ (input resistance 250Ω) (Classified by parameter)
	Voltage/Current Selection	-.Setting by input terminal (When current input is used, short the V and I terminal) - Voltage/Current is selected by KGL-WIN parameter
Digital output		12bit binary (0～4000)
Maximum resolution	0～10VDC	2.5 ㎷ (1/4000)
	DC 0～20 ㎃	5 ㎂ (1/4000)
	DC 4～20 ㎃	6.25 ㎂ (1/3200)
Overall accuracy		±0.5% [Full Scale]
Max. conversion speed		2 ㎳/CH + scan time
Max. absolute input		Voltage : ±15V, Current : ±25 ㎃
Number of analog input point		4channels/module
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 ㎃
Weight		200g

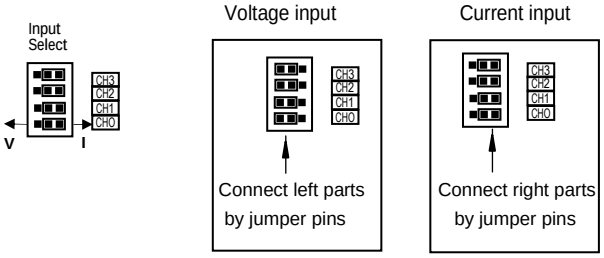
Remark

- ▶ 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.2 Modules
- ▶ The A/D conversion module is possible only to use in more than K80S ROM V1.4, KGL-WIN V2.14

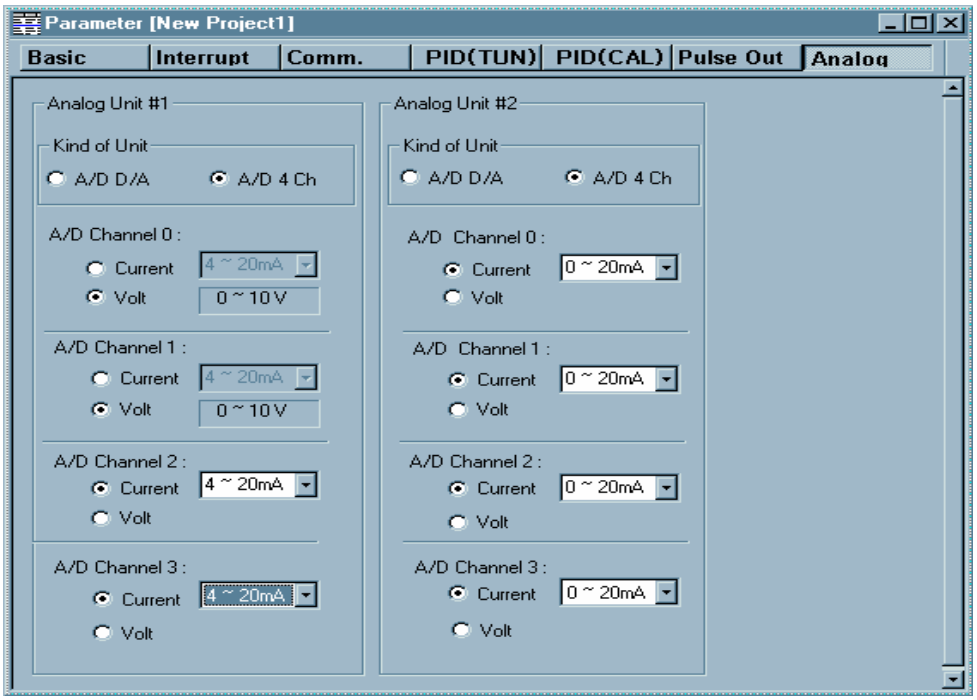
2) Names of parts and functions

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



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

3) Parameter setting



4) Reading A/D conversion value

A/D conversion value stores special data register as following.

* It is possible to use A/D conversion module more than K80S ROM V1.4

Special data register	Explanation	Remark
D4980	A/D conversion value of channel 0 stores	Expansion A/D conversion module #1
D4981	A/D conversion value of channel 1 stores	
D4982	A/D conversion value of channel 2 stores	
D4983	A/D conversion value of channel 3 stores	
D4984	A/D conversion value of channel 0 stores	Expansion A/D conversion module #2
D4985	A/D conversion value of channel 1 stores	
D4986	A/D conversion value of channel 2 stores	
D4987	A/D conversion value of channel 3 stores	

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.

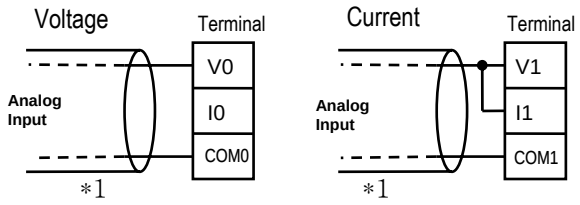
▶ Wire is adopted with consideration about peripheral temperature and electric current allowance. Thicker than Max. size of wire AWG22 (0.3 ㎟) is better.

▶ 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

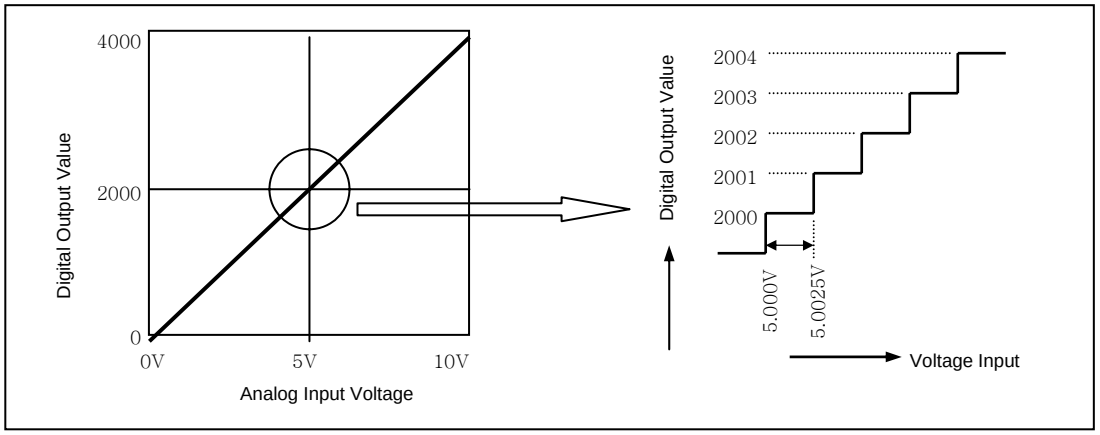


*1 : Be sure to use two-core twisted shield wire.

7) Analog/Digital conversion characteristics

(1) Analog input characteristics

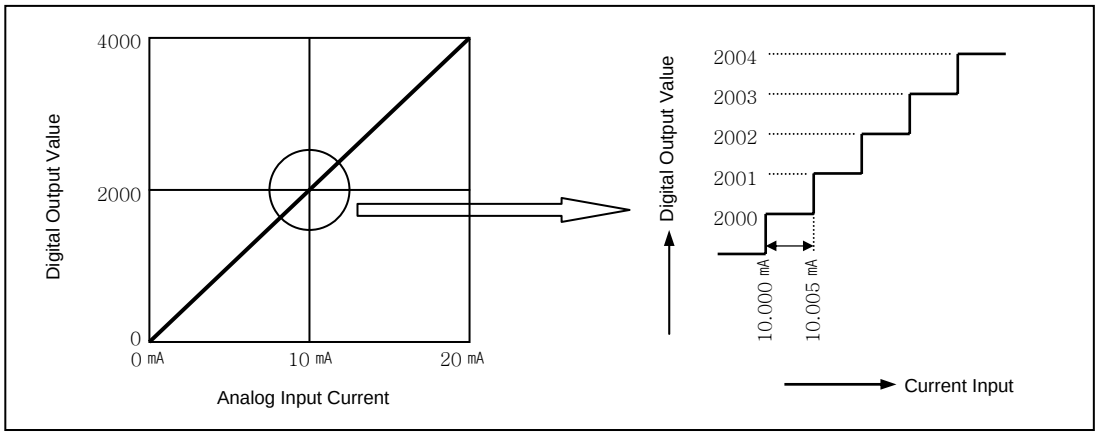
a) Voltage input



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 μA equals to digital amount 1, but value less tan 5 μA can't be converted. So abandon it.

8) Program example

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

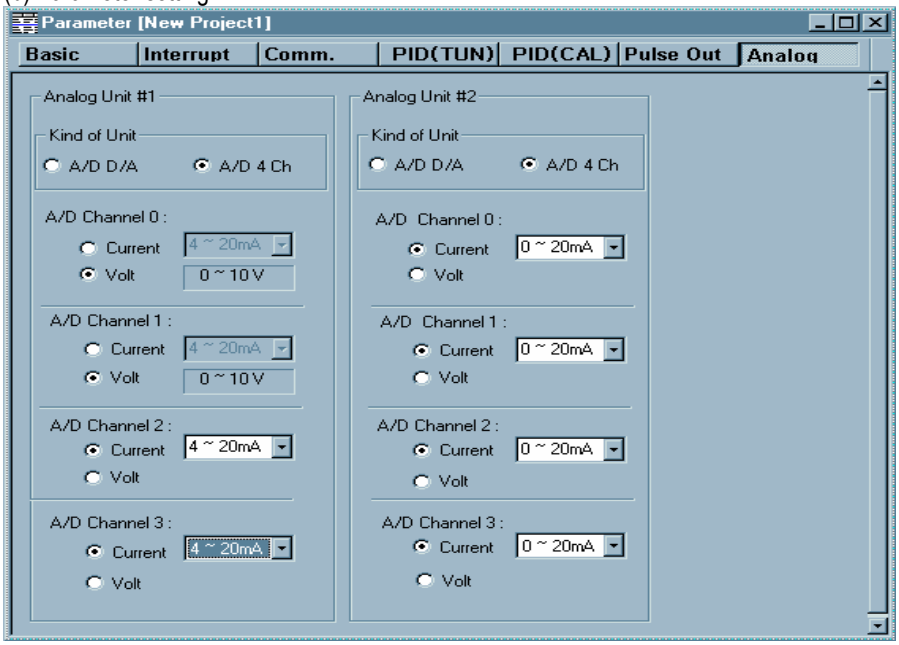
b) System configuration

(a) Analog input

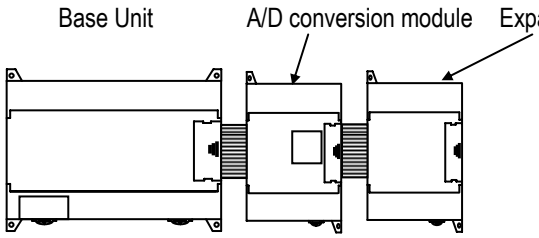
channel "0", "1" : Voltage input(0 ～ 10VDC)

channel "2", "3" : Current input(DC 4 ～ 20 ㎃)

(b) Parameter setting

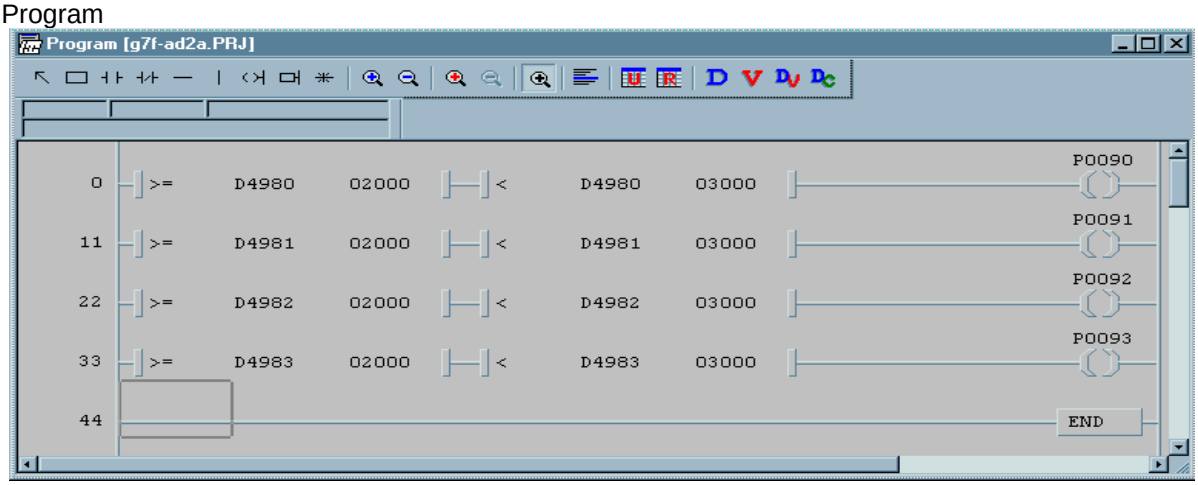


(c) System configuration



I/O allocation
Base unit input : P000 ~ P03F
Base unit output : P050 ~ P07F
A/D conversion module : P080 ~ P08F
Expansion unit output : P090 ~ P09F

c) Program



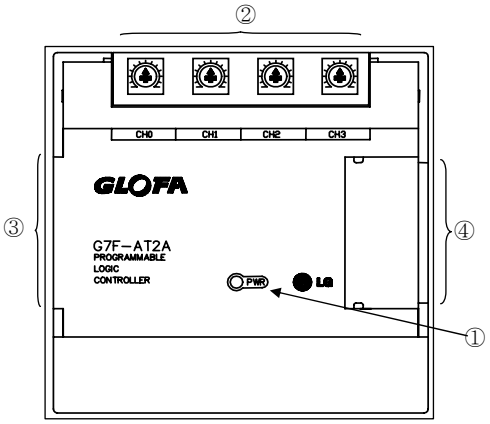
7.2.3 Analog timer

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) Reading A/T conversion value

A/T conversion value stores special data register as following.

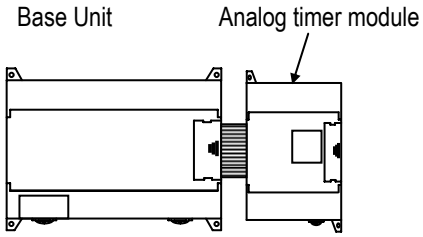
Special data register	Explanation	remark
D4966	A/T conversion value of channel 1 stores	Expansion A/T module #1
D4967	A/T conversion value of channel 2 stores	Expansion A/T module #1
D4968	A/T conversion value of channel 3 stores	Expansion A/T module #1
D4969	A/T conversion value of channel 4 stores	Expansion A/T module #1
D4970	A/T conversion value of channel 1 stores	Expansion A/T module #2
D4971	A/T conversion value of channel 2 stores	Expansion A/T module #2
D4972	A/T conversion value of channel 3 stores	Expansion A/T module #2
D4973	A/T conversion value of channel 4 stores	Expansion A/T module #2
D4974	A/T conversion value of channel 1 stores	Expansion A/T module #3
D4975	A/T conversion value of channel 2 stores	Expansion A/T module #3
D4976	A/T conversion value of channel 3 stores	Expansion A/T module #3
D4977	A/T conversion value of channel 4 stores	Expansion A/T module #3

4) Program example

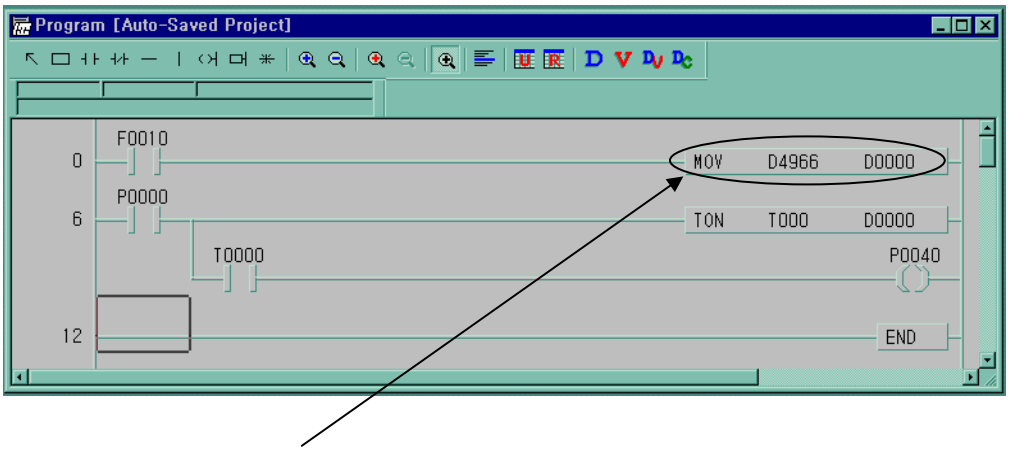
(1) Program explanation

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

Chapter 8 Communication Function

8.1 Dedicated Protocol Communication

8.1.1 Introduction

MK80S's built-in Cnet communication uses only MK80S base 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.

MK80S base 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 (MK80S base unit: RS-232C)

Remark

MK80S built-in communication function supports Cnet communication without any separate Cnet module. It must be used under the following instructions.

1) MK80S base unit supports 1:1 communication only. for 1:N system having master-slave Format, use MK80S base unit with G7L-CUEC module connected. G7L-CUEC module supports RS-422/485 protocol. (10-point main unit includes RS-485 communication terminal, so 1:N system can be configured without G7L-CUEC module)
2) RS-232C communication cable for MK80S base unit is different from RS-232C cable for KGL_WIN in pin arrangement and from the cable for Cnet module, too. The cable can't be used without any treatment. For the detailed wiring method, refer to 8.1.2.
3) It's possible to set baud rate type and M area size in KGL_WIN. For the detailed information, refer to the appendix or KGLWIN manual.

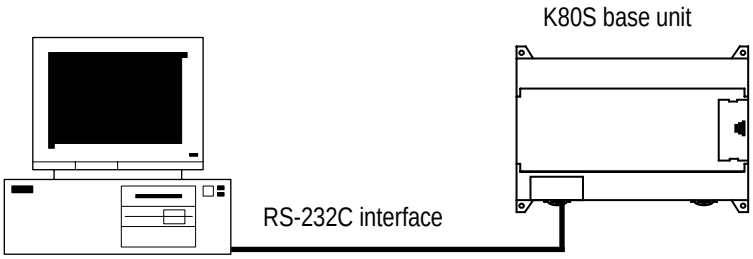
8.1.2 System configuration method

According to the method of connection, the system using MK80S built-in communication can be composed.

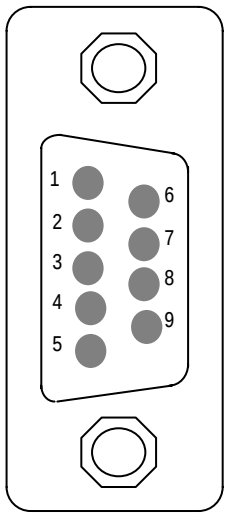
1) Connecting system configuration (link between MASTER-K's)

(1) 1:1 connection with general PC

a) Communication program made by C or BASE computer language on the user's computer, or utility program like MMI software can be used.



b) Wiring method

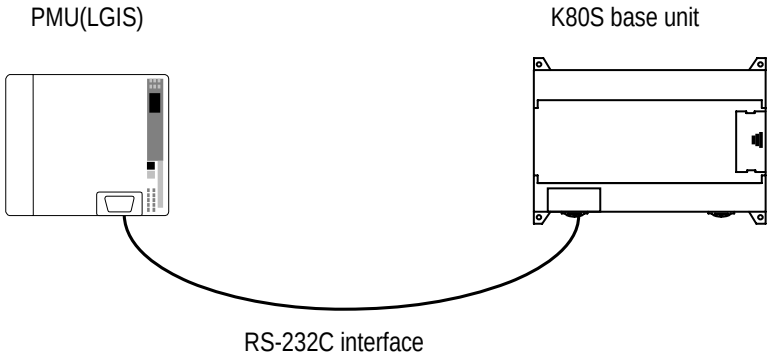


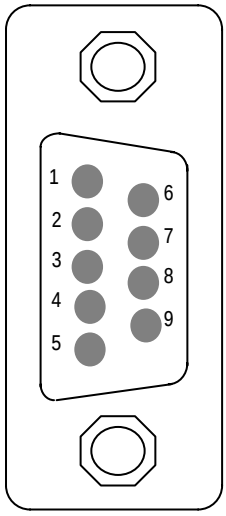
Female Type

PC	Pin assignment And direction	MK80S base 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





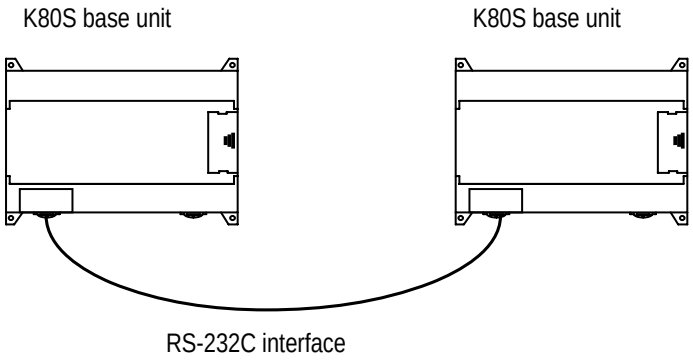
Female Type

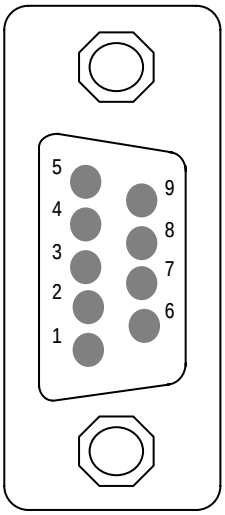
PMU Pin No.	Pin assignment and direction	MK80S base unit Pin no.	Signal
1		1	5V
2	←	2	RXD1
3	→	3	TXD1
4	→	4	RXD2
5	←	5	SG
6		6	5V
7	→	7	TXD2
8		8	SG
9		9	SG

.

(3) 1:1 connection with other MK80S

For the detailed information, refer to 8.1.7 “1:1 Dedicated Protocol Communication.”





Male Type

MK80S base unit	Pin assignment and direction	MK80S base 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

8.1.3 Frame Structure

1) Base Format

(1) Request frame(external communication device → MK80S base unit)

(Max. 256 Bytes)

Header (ENQ)	Station number	Command	Command type	Structurized data area	Tail (EOT)	Frame check (BCC)

(2) ACK Response frame (MK80S base 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 (MK80S base unit → external communication device, when receiving data abnormally)

(max. 256 Bytes)

Header (NAK)	Station	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.

[Control codes]

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.

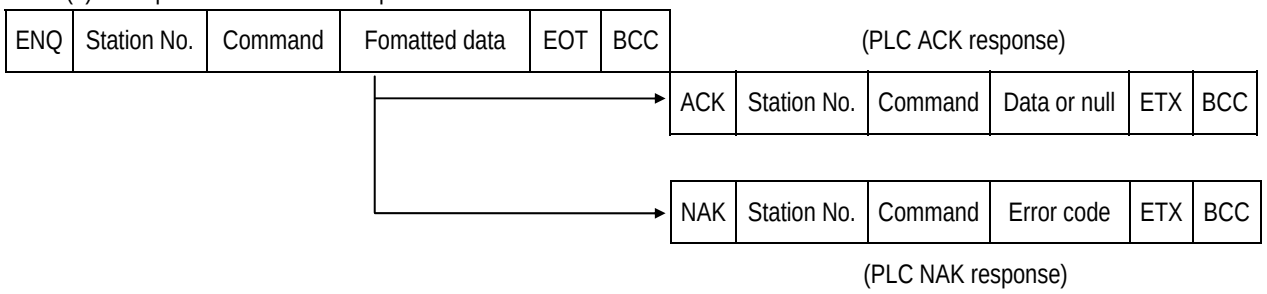
- Station No.
- When the main command is R(r) or W (w) and the command type is numerical (means a data type)
- All of the terms indicating size of all data in the Formatted data area.
- Monitoring registration and command registration number of execution commands.
- All contents of data

Remark

1) 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

Command list for communication.

Division / Item		Command				Treatment
		Main command		Command type		
		Code	ASCII code	Code	ASCII code	
Reading device	Individual reading	r(R)	H72 (H52)	SS	5353	Reads device of Bit, Word and type.
	Continuos reading	r(R)	H72 (H52)	SB	5342	Reads device Word in block unit. (Continuous reading Bit is unavailable)
Writing device	Individual reading	w (W)	H77 (H57)	SS	5353	Writes data to device of Bit and Word type.
	Continuos reading	w(W)	H77 (H57)	SB	5342	Writes data to 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. (For detailed flag contents, refer to MK80S manual).

Division / 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

1) MK80S base unit identifies capitals or small letters for main commands, but not for the others.

2) If it's a main command in capitals, it calculates BCC value. But if it's not, it doesn't. Therefore, when BCC for frame check is used, main commands must be in small letters.

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 : P,M,L,K,C,T,D,S,F
- 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
Word	W(57H)	%PW000, %MW000, %LW000, %KW000, %CW000, %TW000, %FW000, %DW000, %SW000

Device Name	Explanation	Read/Write	Bit/Word Assignment
P	Input/Output relay	Available	Both
M	Auxiliary relay	Available	Both
L	Link relay	Available	Both
K	Keep relay	Available	Both
C	Counter	Available	Both
T	Timer	Available	Both
D	Data Register	Available	Word Only
S	Step relay	Available	Word Only
F	Special relay	Read Only	Both

Remark

1) Timer/Counter used in word command means current values.

2) Data register and Step relay can uses only word commands.

3) When Link module is used, Link relay must not written.(it cause communication error)

8.1.6 Execution of commands

1) Individual reading of device(RSS)

(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(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). 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

1) Numerical data of frame(Ex.) is hex value, and "H" is unnecessary during preparing real frame.
2) Device data type of each must be same. If data type of the first block is WORD, and the second block is BIT, error occurs.

(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	Number of data means byte number of hex type, and is converted into ASCII. This number is determined according to data type(X,W) included in device name of computer request Format. Number of data in accordance with its data type is as follows:
Data	• In data area, there are the values of hex data converted to ASCII code saved.

Data type	Available variable	Number of data
Bitl(X)	%(P,M,L,K,T,C,F)X	1
Word(W)	%(P,M,L,K,T,C,D,S,F)W	2

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.

← Computer request format (PC → MK80S Base Unit)

Format name	Header	Station No.	Command	Command type	Number of blocks	Variable length	Format name	Devicelength	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	H254D573230	H3036	H255057303031	H04	

↑ For ACK response after execution of command(PC ← MK80S Base 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	

→ For NAK response after execution of command(PC ← MK80S Base Unit)

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

Frame check BCC is automatically calculated internally.

2) Continuous reading(RSB) 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 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 64.
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(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 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) MK80S Base Unit response format (MK80S 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	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.
Data	.In data area, there are the values of hex data converted to ASCII code saved.

Data type	Available device	Data size
WORD(W)	%(P,M,L,K,F,T,C,D,S)W	2

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

Computer request format (PC → MK80S Base 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	

For ACK response after execution of command(PC ← MK80S Base 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	

For NAK response after execution of command(PC ← MK80S Base 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.

Computer request format (PC → MK80S Base 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	

For ACK response after execution of command(PC ← MK80S Base 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	

For NAK response after execution of command(PC ← MK80S Base 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(WSB)

(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	H100	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 64.

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.

Remark

1) Protocol of WSB doesn't have the number of blocks.

(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.