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Programmable Logic Control

XGI CPU Module

XGT Series **User Manual**

XGI-CPUUN
XGI-CPUU/D
XGI-CPUU
XGI-CPUH
XGI-CPUS
XGI-CPUE

Safety Instructions

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

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Before using the product …

For your safety and effective operation, please read the safety instructions thoroughly before using the product.

- Safety Instructions should always be observed in order to prevent accident or risk with the safe and proper use the product.

- Instructions are separated into “Warning” and “Caution”, and the meaning of the terms is as follows;

⚠ **Warning**	This symbol indicates the possibility of serious injury or death if some applicable instruction is violated
⚠ **Caution**	This symbol indicates the possibility of slight injury or damage to products if some applicable instruction is violated

- The marks displayed on the product and in the user’s manual have the following meanings.

  ⚠ Be careful! Danger may be expected.

  ⚠ Be careful! Electric shock may occur.

- The user’s manual even after read shall be kept available and accessible to any user of the product.

Safety Instructions when designing

⚠Warning

- **Please, install protection circuit on the exterior of PLC to protect the whole control system from any error in external power or PLC module.** Any abnormal output or operation may cause serious problem in safety of the whole system.
  - Install applicable protection unit on the exterior of PLC to protect the system from physical damage such as emergent stop switch, protection circuit, the upper/lowest limit switch, forward/reverse operation interlock circuit, etc.
  - If any system error (watch-dog timer error, module installation error, etc.) is detected during CPU operation in PLC, the whole output is designed to be turned off and stopped for system safety. However, in case CPU error if caused on output device itself such as relay or TR can not be detected, the output may be kept on, which may cause serious problems. Thus, you are recommended to install an addition circuit to monitor the output status.

- **Never connect the overload than rated to the output module nor allow the output circuit to have a short circuit**, which may cause a fire.

- **Never let the external power of the output circuit be designed to be On earlier than PLC power**, which may cause abnormal output or operation.

- **In case of data exchange between computer or other external equipment and PLC through communication or any operation of PLC (e.g. operation mode change), please install interlock in the sequence program to protect the system from any error**. If not, it may cause abnormal output or operation.

Safety Instructions when designing

⚠ Caution

- **I/O signal or communication line shall be wired at least 100mm away from a high-voltage cable or power line.** If not, it may cause abnormal output or operation.

Safety Instructions when designing

⚠ Caution

- **Use PLC only in the environment specified in PLC manual or general standard of data sheet.** If not, electric shock, fire, abnormal operation of the product or flames may be caused.
- **Before installing the module, be sure PLC power is off.** If not, electric shock or damage on the product may be caused.
- **Be sure that each module of PLC is correctly secured.** If the product is installed loosely or incorrectly, abnormal operation, error or dropping may be caused.
- **Be sure that I/O or extension connecter is correctly secured.** If not, electric shock, fire or abnormal operation may be caused.
- **If lots of vibration is expected in the installation environment, don't let PLC directly vibrated.** Electric shock, fire or abnormal operation may be caused.
- **Don't let any metallic foreign materials inside the product**, which may cause electric shock, fire or abnormal operation.

Safety Instructions when wiring

⚠ Warning

- **Prior to wiring, be sure that power of PLC and external power is turned off.** If not, electric shock or damage on the product may be caused.

- **Before PLC system is powered on, be sure that all the covers of the terminal are securely closed.** If not, electric shock may be caused

⚠ Caution

- **Let the wiring installed correctly after checking the voltage rated of each product and the arrangement of terminals.** If not, fire, electric shock or abnormal operation may be caused.

- **Secure the screws of terminals tightly with specified torque when wiring.** If the screws of terminals get loose, short circuit, fire or abnormal operation may be caused.

- **Surely use the ground wire of Class 3 for FG terminals, which is exclusively used for PLC**. If the terminals not grounded correctly, abnormal operation may be caused.

- **Don't let any foreign materials such as wiring waste inside the module while wiring,** which may cause fire, damage on the product or abnormal operation.

Safety Instructions for test-operation or repair

⚠ Warning

- **Don't touch the terminal when powered**. Electric shock or abnormal operation may occur.
- **Prior to cleaning or tightening the terminal screws, let all the external power off including PLC power.** If not, electric shock or abnormal operation may occur.
- **Don't let the battery recharged, disassembled, heated, short or soldered**. Heat, explosion or ignition may cause injuries or fire.

⚠ Caution

- **Don't remove PCB from the module case nor remodel the module.** Fire, electric shock or abnormal operation may occur.
- **Prior to installing or disassembling the module, let all the external power off including PLC power.** If not, electric shock or abnormal operation may occur.
- **Keep any wireless installations or cell phone at least 30cm away from PLC**. If not, abnormal operation may be caused.

Safety Instructions for waste disposal

⚠ Caution

- **Product or battery waste shall be processed as industrial waste.** The waste may discharge toxic materials or explode itself.

Revision History

Version	Date	Remark	Chapter
V1.0	’06.12	First Edition	-
V1.1	’07.10	Built-in PID Function added	CH13
V1.2	’09.10	1. XGI-CPUS added	CH2.3.1, CH4.1, CH8.1
		2. Product list modified	CH2.2
		3.XGF-SOEA added	CH7.5
V1.5	’10.03	1. Product list modified	Ch2.2, Ch2.4.3
		2. Supported functions according to OS version	Ch4.1
		3. Description on Reset/D.Clear switch added	Ch4.2
		4. Wiring diagram of Smart Link added	Ch7.6.3
		5. Flag added (indicated version to decimal places _OS_VER_PATCH)	App1.1
		6. Typos fixed	Ch1.1, Ch1.2, Ch1.3, Ch3.1, Ch5.1.3, Ch5.2.3, Ch8.1, Ch11.2, Ch14.7
V1.6	’10.08	1. XGI-CPUE, XGI-CPUU/D added	Ch2.2, Ch2.3.1, Ch4.1, Ch5.1.3, Ch5.4.1, Ch5.4.2, Ch8.1, Ch14.1, Ch14.5
V1.7	’13.01	1. Product list modified	Ch2.2
		2. Size of data refresh area added	Ch2.3.4
		3. General specification typos fixed	Ch3.1
		4. Supported functions according to CPU OS Ver. added	Ch4.1
		5. XGI-CPUS memory typos fixed	Ch4.1, Ch5.4.2
		6. Fixed cycle task’s flag information added	Ch5.2.3
		7. Digital I/O module added	Ch7.2.10
		XGI-A21C, XGQ-TR1C	Ch7.3.11
		8. PID bit flag address modified	Ch14.5
		9. Flag added	App1.1

Version	Date	Remark	Chapter
V1.8	’14.07	1. XGI –CPUUN added	Ch2.2, 2.3, Ch4.1 Ch5.1.3, 5.4.1, 5.4.2 Ch 8.1 Ch14.1, 14.5
V 1.9	‘15.09	1. Circuit configuration modified 2. Smart Link Model name modified 3. Rated input voltage modified 4. Terminology modified (FG → PE) 5. CPU Processing Speed Unit changed (us → ns) 6. List of Configuration Products updated	Ch7.2, 7.3, 7.4, 7.5 Ch7.6 Ch8.2 Ch8.3, 9.1, 9.2, 10.2, 12.1 Ch1.2, 4.1 Ch2.2
V 2.0	‘16.03	1. Smart Link manual supplemented	Ch7.6
V 2.1	’20.05	LSIS to change its corporate name to LS ELECTRIC	Entire
V2.2	’24.06	Warranty period changed	BackCover

Thank you for purchasing PLC of LS ELECTRIC Co., Ltd.
Before use, make sure to carefully read and understand the User's Manual about the functions, performances, installation and programming of the product you purchased in order for correct use and importantly, let the end user and maintenance administrator to be provided with the User's Manual.

The User's Manual describes the product. If necessary, you may refer to the following description and order accordingly. In addition, you may connect our website (http://www.ls-electric.com/) and download the information as a PDF file.

Relevant User's Manuals

Title	Description
XG5000 User's Manual (for XGK, XGB)	XG5000 software user manual describing online function such as programming, print, monitoring, debugging by using XGK, XGB CPU
XG5000 User's Manual (for XGI, XGR)	XG5000 software user manual describing online function such as programming, print, monitoring, debugging by using XGI, XGR CPU
XGK/XGB Instructions & Programming User's Manual	User's manual for programming to explain how to use instructions that are used PLC system with XGK, XGB CPU.
XGI/XGR/XEC Instructions & Programming User's Manual	User's manual for programming to explain how to use instructions that are used PLC system with XGI, XGR CPU.
XGK CPU User's Manual (XGK-CPUA/CPUE/CPUH/CPUS/CPUU /CPUUN/CPUHN/CPUSN)	User manual describing about XGK CPU module, power module, base, IO module, specification of extension cable and system configuration, EMC standard
XGI CPU User's Manual (XGI-CPUU/CPUH/CPUS/CPUE/CPUU/D CPUUN)	User manual describing about XGI CPU module, power module, base, IO module, specification of extension cable and system configuration, EMC standard
XGR redundant series User's Manual	User manual describing about XGR CPU module, power module, extension drive, base, IO module, specification of extension cable and system configuration, EMC standard

Current user manual is written based on the following version.

Related OS version list

Product name	OS version
XGI-CPUUN	V1.0
XGI-CPUU, CPUH, CPUS, CPUE, CPUU/D	V3.3
XGK-CPUU, CPUH, CPUA, CPUS, CPUE	V3.5
XGR-CPUH/F, CPUH/T	V1.8
XG5000	V4.0

◎ TABLE OF CONTENTS ◎

Chapter 1.Overview

1.1 How to use

This User's Manual provides the information for the specification·performance and operation method of each product required to use a PLC system configured by XGI series CPU modules.

The configuration of User's Manual is as follows.

Chapter	Item	Content
Chapter 1	Overview	This chapter describes the configuration of this manual, product features, and terminology.
Chapter 2	System configuration	Describes the product type and system configuration method to be used for XGI series.
Chapter 3	General specifications	Shows the common specification of each module used for XGI series.
Chapter 4	Specifications of the CPU module	Describes the performance· specification and operation method of XGI-CPU.
Chapter 5	Program Configuration and Operation Method	
Chapter 6	Function of CPU module	
Chapter 7	I/O Module	Describes the specification and the method to use I/O module and power module except CPU module.
Chapter 8	Power supply module	
Chapter 9	Base ·and Extension Cable	
Chapter 10	Installation and Wiring.	Describes the installation, wiring method and notices to secure the reliability of PLC system.
Chapter 11	Maintenance	Describes the checking items and methods to run the PLC system normally for a long time.
Chapter 12	EMC Standard	Describes system configuration following EMC specification.
Chapter 13	Troubleshooting	Describes various errors and action methods occurred while using a system.
Chapter 14	Built-in PID function	Describes on the built-in PID function and how to use it.
Appendix 1.	List of flags	Describes various type of each flag and its description.
Appendix 2.	External dimension	Shows the outer dimension of CPU, I/O module and Base.
Appendix 3.	Compatibility with GLOFA	Explain using compatibility of flag with GLOFA PLC.

Notes

1) This user's manual does not describe the special/Communication module module and program writing method.
For the corresponding function, please refer to the related user's manual.
2) XGI CPU is one of the XGT PLC system and CPU types of XGT PLC system are as follows.
① XGK series: XGT PLC system that consists of CPU using Master-K Language.
② XGI series: XGT PLC system that consists of CPU using IEC Language.
③ XGR series: XGT PLC system that consists of dual CPU using IEC Language.

1.2 Characteristics

XGI system have the following features.

1) Compact size

It is easy to install in a small space by realizing a compact size for performance.

2) High speed processing

(1) XGI-CPUUN

- Sequence instruction: 8.5 ns
- MOV instruction 25.5 ns
- Real operation: The operation speed for the single real number and double real number is profoundly improved

Classification	+	−	×	÷
Short Real number	119 ns	119 ns	272 ns	281 ns
Long Real number	281 ns	281 ns	680 ns	685 ns

(2) XGI-CPUU

- Sequence instruction: 28 ns
- MOV instruction : 84 ns
- Real operation

Classification	+	−	×	÷
Short Real number	392 ns	392 ns	896 ns	924 ns
Long Real number	924 ns	924 ns	2,240 ns	2,254 ns

(3) Improvement of data transfer speed between modules through base.

- 16 point I/O module data process: 200 ns ~ 800 ns
- Analogue 1 Ch data process: 200 ns ~ 800 ns
- 1 KB communication module data process: 12,800 ns
- Parallel process by I/O data auto refresh during programming

(4) Using 32Bit Micro Processor

3) Convenience to use Analog Data

Analog module enforced the precision and stability and provides the convenience as below.

- Program simplification by providing analog data dedicated 'U ' device.
- Setting without memory map of special module is available by providing parameter setting method.

4) System configuration

Various convenient functions are provided to meet the demands of users.

- Filter value adjustment of input module
- Emergency Output Hold Function
- Varistor built-in relay output module with strong durability
- Total extension length of expanded base shall be 15m.
- Provision of system RUN contact on the power module
- Cost efficiency of setup, startup and maintenance/repair by enforced self-diagnosis function

5) Various communication system

Provides various network function to satisfy both the user convenience and compatibility.

- A network can be connected without ladder programming
- Network setting and operation status monitoring by dedicated tool(XG-PD)
- Supports Open network of various international specification
- Dedicated network to provide the ease in use and optimal performance
- Network compatibility with the existing products (MASTER-K, GLOFA-GM)

6) Enforcement of program and online function

Programming time is minimized by convenient programming and the control system of facilities can be complete with no stop of the system.

- Available of ladder and text (Mnemonic) method
- Enforcement of symbolic program
- Automatic conversion of GLOFA program
- Available to modify the program during operation and secure the stability
- Available to install and change the network during operation
- Enforcement of trend monitoring function
- User event function
- Data trace function

8) User's convenience

Various functions are provided for user's convenience.

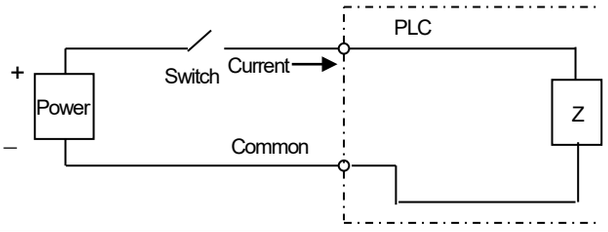
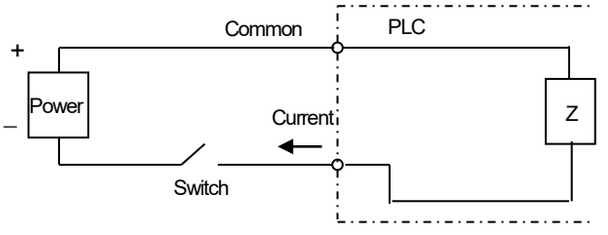
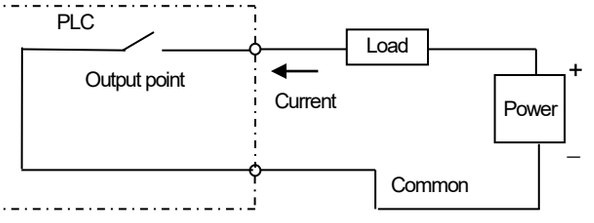
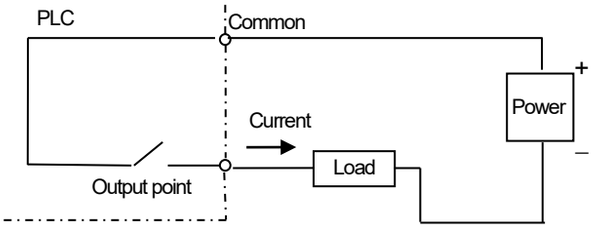
- Module Changing Wizard function. (User's tool is unnecessary.)
- System Diagnosis function
- Skip I/O function
- Fault Mask function
- Various Operation History

1.3 Terminology

Describes the terms used in the user's manual

Terminology	Definition	Remarks
Module	A device like I/O board assembled to insert in a motherboard or base as a standardized factor having the regular function to configure the system.	Ex) CPU Module, Power module, I/O module
Unit	A single module or or group of module or that perform an independent operation as a part of a PLC system.	Ex) Main unit, Extension unit
PLC System	A system consisting of PLC and peripherals structured to be controlled by a user's program	-
XG5000	Programming tool creating, editing and debugging a program	-
Cold restart	It initializes every data(variable· programs of I/O image area, internal register, timer and counter) automatically or manually to the designated status and restarts PLC system and user's program.	-
Warn Restart	With a function notifying a user's program of power off, it restarts a user-designated data and program after power off	-
I/O image area	Internal memory area of the CPU module which used to hold I/O status.	-
Rnet	Remote Network (remote dedicated network)	-
Cnet	Computer Network	-
FEnet	Fast Ethernet Network	-
Pnet	Profibus-DP Network (Field bus Network)	-
Dnet	DeviceNet Network	-

Terminology	Definition	Remarks
Fnet	Field bus Network	-
RAPIEnet	Real-time Automation Protocols for Industrial Ethernet	-
RTC	As an abbreviation of Real Time Clock, it is collectively referred as a universal IC with a function of clock.	-
Watchdog Timer	It is a function to set the predetermined execution time of the program and to generate an alarm when the processing is not completed within the specified time, indicating that there is an error in the PLC operation.	-
Function	Operation unit to immediately output operation results for an input such as four arithmetical operations and comparative operations, instead of memorizing within commands	-
Function block	Operation unit memorizing operation results within commands such as timer and counter and using the results memorized for several scans	-
Direct Variable	Variables used without name and type of them separately declared such as I, Q and M areas	예)•%IX0.0.2 •%QW1.2.1 •%MD1234 etc
Symbolic variable	A variable of which name, type and others are declared and used by a user. For instance, if declared such as 'INPUT_0' =%IX0.0.2, 'RESULT'=%MD1234, a program can be used with the name of 'INPUT_0' and 'RESULT', instead of %IX0.0.2 and %MD1234.	-
GMWIN	Peripheral for GLOFA-GM series creating, editing, compiling and debugging a program	-
Task	There are three type of tasks. (cycle time task, internal device task, external device task by external interrupt module's input signal)	-

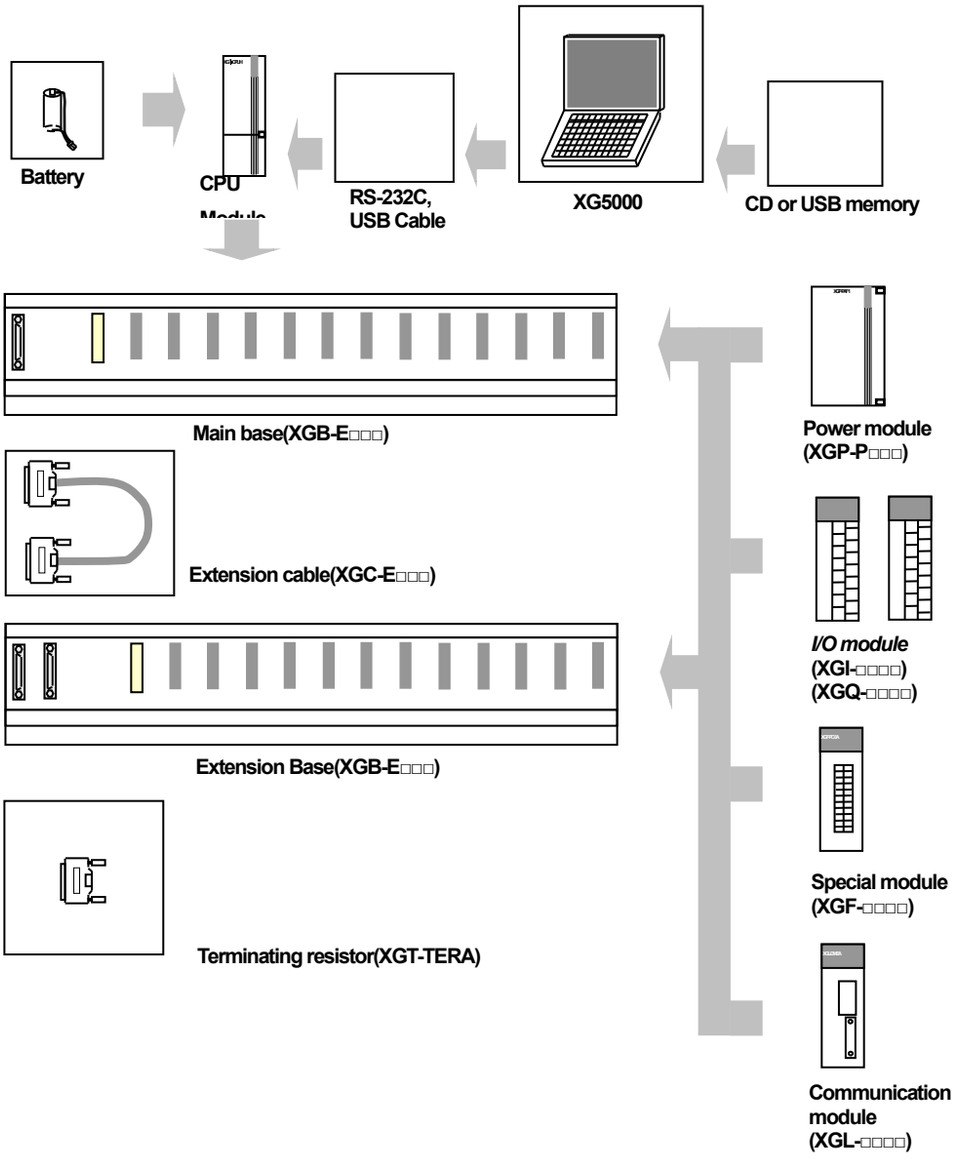
Terminology	Definition	Remarks
Sink input	Current flows into PLC input terminal from switch when input signal turns on. 	Z: Input impedance
Source Input	Current flows from the PLC input terminal to the switch when input signal turns on. 	-
Sink Output	Current flows from the load to the output terminal and the PLC output turn on. 	-
Source Output	Current flows from output terminal when PLC output contact is ON 	-

Chapter 2 System Configuration

XGI series are equipped with various products proper for basic system, computer link and network system configuration. Here describes the configuration method of each system and its features.

2.1 XGI Series System Configuration

XGI series System Configuration is as follows.



Recommendations of selecting USB Cable (To avoid disconnection with XG5000)

1. Recommend that the company's USB Cable(USB-301A) which is shielded and shorter than 3m.
2. Recommend using USB Hub when connecting up to the PC poor at Noise.

2.2 Product List

The product configuration of XGI series is as below.

Product	Type	Content	Remarks
CPU Module	XGI-CPUUN	•CPU module(max. I/O points : 6,144, Program capacity: 2MB)	-
	XGI-CPUU/D	•CPU module(max. I/O points : 6,144, Program capacity: 1MB)	-
	XGI-CPUU	•CPU module(max. I/O points : 6,144, Program capacity: 1MB)	-
	XGI-CPUH	• CPU module(max. I/O points : 6,144, Program capacity: 512KB)	-
	XGI-CPUS	• CPU module(max. I/O points : 3,072, Program capacity: 128KB)	-
	XGI-CPUE	• CPU module(max. I/O points : 1,536, Program capacity: 64KB)	-
Digital input module	XGI-D21A	• DC 24V Input, 8 point (Current source / sink input)	-
	XGI-D21D	• DC 24V Diagnosis Input, 8 point (Current source / sink input)	-
	XGI-D22A	• DC 24V Input, 16 point (Current source / sink input)	-
	XGI-D24A	• DC 24V Input, 32 point (Current source / sink input)	-
	XGI-D28A	• DC 24V Input, 64 point (Current source / sink input)	-
	XGI-D22B	• DC 24V Input, 16 point (Current source input)	-
	XGI-D24B	• DC 24V Input, 32 point (Current source input)	-
	XGI-D28B	• DC 24V Input, 64 point (Current source input)	-
	XGI-A12A	• AC 110V Input, 16 point	-
	XGI-A21A	• AC 220V Input, 8 point	-
	XGI-A21C	• 220V isolated input, 8 point	-
Digital output module	XGQ-RY1A	• Relay output, 8 point (for 2A, single COM.)	-
	XGQ-RY1D	• Diagnostic Relay output, 8 point (for 2A)	-
	XGQ-RY2A	• Relay output, 16 point (for 2A)	-
	XGQ-RY2B	• Relay output, 16 point (for 2A), Varistor attached	-
	XGQ-TR2A	• Transistor output, 16 point (for 0.5A, sink output)	-
	XGQ-TR4A	• Transistor output, 32 point (for 0.1A, sink output)	-
	XGQ-TR8A	• Transistor output, 64 point (for 0.1A, sink output)	-
	XGQ-TR2B	• Transistor output, 16 point (for 0.5A, sink output)	-
	XGQ-TR4B	• Transistor output, 32 point (for 0.1A, source output)	-
	XGQ-TR8B	• Transistor output, 64 point (for 0.1A, source output)	-
	XGQ-SS2A	• Triac output 16 point (for 0.6A)	-
	XGQ-TR1C	• Isolated transistor output, 8 point (for 2A, sink output)	-
Digital input/output mixed module	XGH-DT4A	• DC 24V input, 16 point(source/sink) • Transistor output, 16 point (for 0.1A,sink output)	-

Product	Type	Content		Remarks
Main base	XGB-M04A	• for 4 module installation		-
	XGB-M06A	• for 6 module installation		-
	XGB-M08A	• for 8 module installation		-
	XGB-M10A	• for 10 module installation		-
	XGB-M12A	• for 12 module installation		-
Extension base	XGB-E04A	• for 4 module installation		-
	XGB-E06A	• for 6 module installation		-
	XGB-E08A	• for 8 module installation		-
	XGB-E12A	• for 12 module installation		-
Power supply module	XGP-ACF1	AC100V~ 240V Input	• DC5V: 3A, • DC24V: 0.6A	-
	XGP-ACF2	AC100V~ 240V Input	• DC5V: 6A	-
	XGP-AC23	AC200V~ 240V Input	• DC5V: 8.5A	-
	XGP-DC42	DC24V / 0V Input	• DC5V: 6A	-
Extension cable	XGC-E041	• length : 0.4 m		Total extension distance should not exceed 15m
	XGC-E061	• length : 0.6 m		
	XGC-E121	• length : 1.2 m		
	XGC-E301	• length : 3.0 m		
	XGC-E501	• length : 5.0 m		
	XGC-E102	• length : 10 m		
	XGC-E152	• length : 15 m		
Terminating resistor	XGT-TERA	• Must use terminating resistor when connecting extension base		-
Dust proof module	XGT-DMMA	• Dust protection module for unused slot		-
Battery	XGT-BAT	• Battery for XGT(DC 3.0V/1,800 mAh)		-

Product		Type	Content	Remarks
Special module	Analog input module	XGF-AV8A	•Power Input: 8 channel(DC1~5V/0~5V/0~10V/–10 ~ +10)	-
		XGF-AC8A	• current input: 8 channel(DC 4 ~ 20mA / 0 ~ 20mA)	-
		XGF-AD8A	• Voltage/current input: 8 channel	-
		XGF-AD4S	• Voltage/current input: 4 channel, isolation between channels	-
		XGF-AD16A	• Voltage/current input: 16 channel	-
		XGF-AW4S	• 2-wire voltage/current input: 4 channel, isolation between channels • 2-Wire transmitter driver power supported	-
	Analog output module	XGF-DV4A	• voltage output: 4 channel • DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / –10 ~ +10V	-
		XGF-DC4A	• Current output: 4 채널 (DC 4 ~ 20mA / 0 ~ 20mA)	-
		XGF-DV4S	• voltage output: 4 channel, isolation between channels	-
		XGF-DC4S	• Current output: 4 channel, isolation between channels	-
		XGF-DV8A	• voltage output: 8 channel(DC 1~5V/0~5V/0~10V/–10~+10)	-
		XGF-DC8A	• Current output: 8 channel(DC 4 ~ 20mA / 0 ~ 20mA)	-
	Analog input/output mixed module	XGF-AH6A	• Voltage/current input 4 channel • Voltage/current output 2 channel	-
	HART I/F analog input module	XGF-AC4H	• Current input 4 channel, HART I/F, DC 4 ~ 20mA	-
	HART I/F analog output module	XGF-DC4H	• Current output 4 channel, HART I/F, DC 4 ~ 20mA	-
	Thermocouple input module	XGF-TC4S	• Thermocouple input, 4 channel, isolation between channels	-
	RTD input module	XGF-RD4A	• RTD input 4 channel	-
		XGF-RD4S	• RTD input, 4 channel, isolation between channels	-
		XGF-RD8A	• RTD input 8 channel	-
	Temperature control module	XGF-TC4UD	• Control loop: 4 loop • Input(4 channel, TC/RTD/Voltage/Current), Output(8 channel, TR/current)	-
		XGF-TC4RT	• Control loop : 4 loop • Input(4 channel, RTD), Output(4 channel, TR)	-
	High speed counter module	XGF-HO2A	• Voltage input type(Open Collector), • 200KHz, 2 channel	-
		XGF-HD2A	• Differential input type(Line Driver), • 500KHz, 2 channel	-
		XGF-HO8A	• Voltage input type(Open Collector), • 200KHz, 8 channel	-

Product		Type	Content	Remarks
Special module	Positioning module	XGF-PO3A	• Pulse output(Open Collector), 3 axes	-
		XGF-PO2A	• Pulse output(Open Collector), 2 axes	-
		XGF-PO1A	• Pulse output(Open Collector), 1 axes	-
		XGF-PD3A	• Pulse output(Line Driver), 3 axes	-
		XGF-PD2A	• Pulse output(Line Driver), 2 axes	-
		XGF-PD1A	• Pulse output(Line Driver), 1 axes	-
		XGF-PO4H	• Pulse output(Open Collector), 4 axes	-
		XGF-PO3H	• Pulse output(Open Collector), 3 axes	-
		XGF-PO2H	• Pulse output(Open Collector), 2 axes	-
		XGF-PO1H	• Pulse output(Open Collector), 1 axes	-
		XGF-PD4H	• Pulse output(Line Driver), 4 axes	-
		XGF-PD3H	• Pulse output(Line Driver), 3 axes	-
		XGF-PD2H	• Pulse output(Line Driver), 2 axes	-
		XGF-PD1H	• Pulse output(Line Driver), 1 axes	-
		XGF-PN8A	• Network type(EtherCAT), 8 axes, LS dedicated	-
		XGF-PN8B	• Network type(EtherCAT), 8 axes, standard	-
	Motion control module	XGF-M16M	• Motion dedicated network(M-II), 16 axes	-
		XGF-M32E	• Motion dedicated network(EtherCAT), 32 axes ,standard	-
	Evnet input module	XGF-SOEA	• DC 24V input, 32 point, Sequence of Event module	-
	Data log module	XGF-DL16A	• USB 2.0, CF2001, Max 16GB •32 points (input: 22 points, output 10 points)	-

Product		Type	Content	Remarks
Communication module	FEnet I/F module (Optical/electric)	XGL-EFMF	• Fast Ethernet(광), Master • 100/10 Mbps supported	-
		XGL-EFMT	• Fast Ethernet(electric), Master • 100/10 Mbps supported	-
		XGL-ESHF	• Fast Ethernet Switch module(optical)	-
		XGL-EH5T	• Fast Ethernet Switch module(electric)	-
	RAPIEnet I/F module	XGL-EIMT	• Communication Module between PLCs (electrical), 100 Mbps Industrial Ethernet supported	-
		XGL-EIMF	• Communication Module between PLCs (Optical), 100 Mbps Industrial Ethernet supported	-
		XGL-EIMH	• Communication Module between PLCs (electrical/ Optical), 100 Mbps Industrial Ethernet supported	-
		XGL-ES4T	•Communication Module between PLCs (electrical), 100 Mbps Industrial Ethernet supported • RAPIEnet switch	-
	Cnet I/F Module	XGL-C22A	• Serial communication •RS-232C, 2 channels	-
		XGL-C42A	• Serial communication •RS-422(485), 2 channels	
		XGL-CH2A	• Serial communication •RS-232C 1 channel / RS-422(485) 1 channel	
	FDEnet I/F module(Master)	XGL-EDMF	• Dedicated Ethernet(optical), Master • Deterministic communication supported • 100/10 Mbps supported	-
		XGL-EDMT	• Dedicated Ethernet(electric), Master • Deterministic communication supported • 100/10 Mbps supported	-
	Rnet I/F Module	XGL-RMEA	• Rnet master module	-
	Profibus-DP I/F module	XGL-PMEA XGL-PMEA	•Profibus-DP Master module	-
	Pnet Slave I/F module	XGL-PMEA	•Profibus-DP, Slave module	-
	DeviceNet I/F module	XGL-DMEA	• DeviceNet master module	-
	EtherNet/IP I/F module	XGL-EIMT	•EtherNet / IP(electric) • 100/10 Mbps supported	-
	BACnet/IP I/F module	XGL-BIPT	• BACnet/IP (electric) • 100/10 Mbps supported	-
	Fnet I/F module	XGL-PMEA	• Field Bus master module	-
Etc	40 point connector	1473381,1	• 40 point connector (for input/Output and special module)	-

Notes

For the further information about active coupler, optical converter, repeater and block type remote module, which are network devices, refer to the user's manual of network.

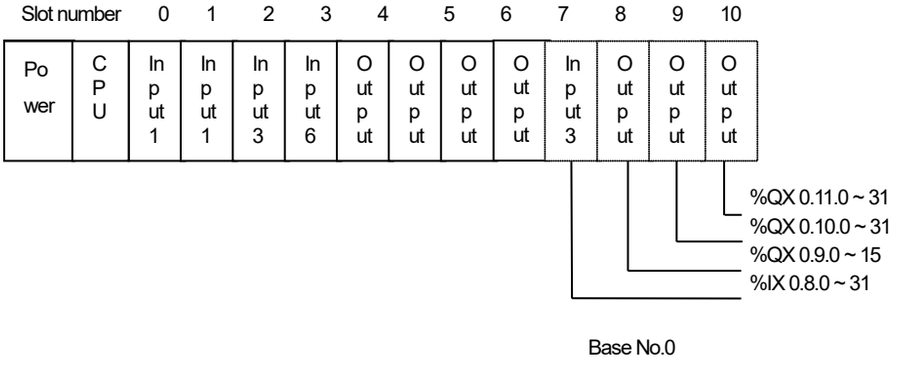
O/S version of communication module applicable to XGI system is as follows.

Classification	Module							
	FEnet	FDEnet	Cnet	Rnet	Pnet	Dnet	RAPIEnet	IFOS module
Product name	XGL-EFMT XGL-EFMF	XGL-EDMT XGL-EDMF	XGL-C22A XGL-CH2A XGL-C42A	XGL-RMEA	XGL-PMEA	XGL-DMEA	XGL-EIMF XGL-EIMT XGL-EIMH	XGL-ESHF
Applicable version	V2.0 or higher	V2.0 or higher	V2.1 or higher	V1.0 or higher	V1.0 or higher	V1.0 or higher	V1.0 or higher	V1.0 or higher

2.3 Basic System

2.3.1 Configuration of Basic System

The features of Basic system consisted by connecting the main base and expanded base by a cable are as follows.

Classification	XGI-CPUU / CPUH / CPUU/D / CPUUN	XGI-CPUS	XGI-CPUE
Maximum number of extension stages	7 stages	3 stages	1 stages
Maximum number of I/O modules to be installed	96 module	48 module	24 module
Maximum I/O score	•In case the 16-point module is installed: 1,536 points •In case the 32-point module is installed: 3,072 points •In case the 64-point module is installed: 6,144 points	•In case the 16-point module is installed: 768 points •In case the 32-point module is installed: 1,536 points •In case the 64-point module is installed: 3,072 points	•In case the 16-point module is installed: 384 points •In case the 32-point module is installed: 768 points •In case the 64-point module is installed: 1,536 points
Maximum extension distance	15m		
	•I/O number is constantly allocated to 64 points per slot of the base. • Each slot of base is allocated by 64 points regardless module installation and type. •There is no restriction in the installation and of special module and the number of modules to be used. •A fixed I/O number is not assigned to the special module unlike digital I/O module. •A special module is controlled by the dedicated function block and automatically allocated for the memory. •The example of I/O number of 12 slot base is allocated as follows.  		

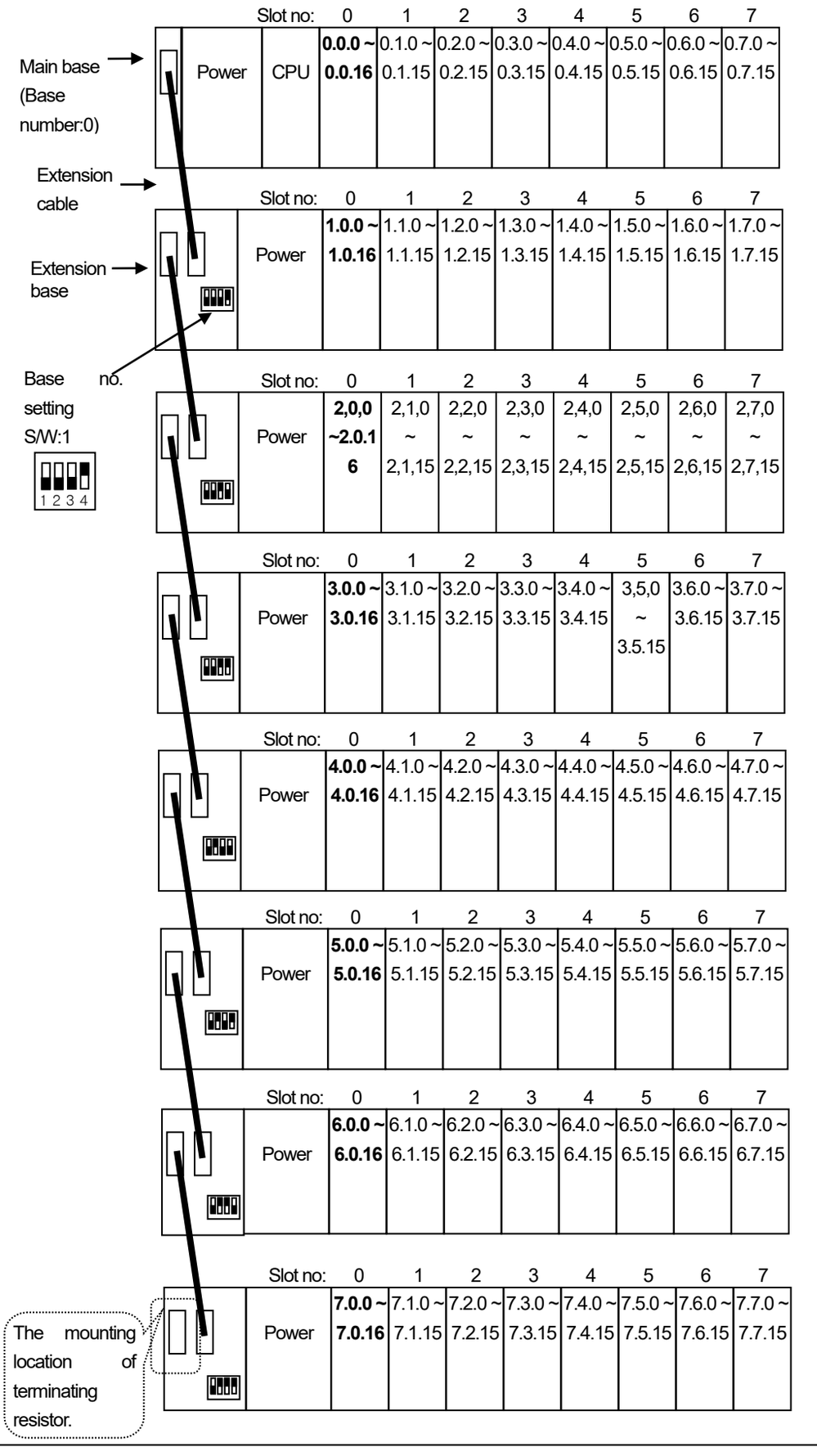
Notes

1) Base number of main base is '0' fixed, and a switch to specify base number is installed on the extension base.
2) The operation will start only when the type of module set as the I/O parameter and the type of actually installed module are the same.

2.3.2 Max. Configuration of Basic System

System configuration example 2

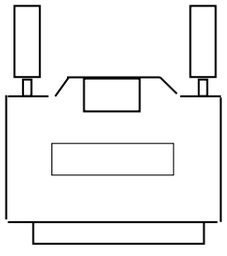
- XGI-CPUU
- 8 slot base
- When installing 16 point module



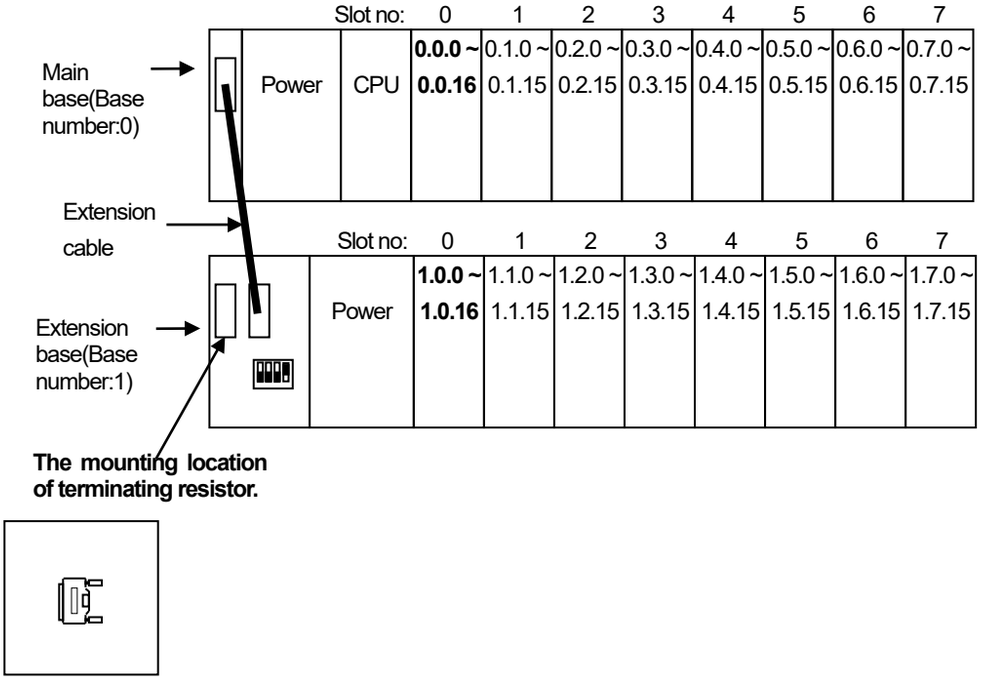
2.3.3 Terminating resistor connection

When an extension base is connected, a terminating resistor must installed for the system reliability on the extension connector (OUT) of the last extension base. When using only the main base, it is not necessary to install a terminating resistor.

1) Structure



2) Installation Position



2.3.4 Module selection when configuring basic system

When configuring basic system, you must consider about size of each module's Data Refresh area Data Refresh area is used for data transmission between CPU and modules in XGK/XGI CPU system. Data Refresh area is allocated to CPU memory, irrespective of module's operation. You must consider about maximum size of Data Refresh area.

If it exceeds 1,024 words, system doesn't operate properly.

(1) Size of each module's data refresh area

(Unit : WORD)

Product	Type	Refresh size	Product	Type	Refresh size
Digital input module	XGI-A12A	1	Digital output module	XGQ-RY1A	1
	XGI-A21A	1		XGQ-RY2A	1
	XGI-A21C	1		XGQ-RY2B	1
	XGI-D21A	1		XGQ-SS2A	1
	XGI-D22A/B	1		XGQ-TR1C	1
	XGI-D24A/B	2		XGQ-TR2A/B	2
	XGI-D28A/B	4		XGQ-TR4A/B	4
Digital Input/output module	XGH-DT4A	2		XGQ-TR8A/B	8
Analog input module	XGF-AC8A	22	Temperature input module	XGF-RD4A	30
	XGF-AV8A	22		XGF-RD4S	30
	XGF-AD8A	22		XGF-TC4S	30
	XGF-AD16A	21		XGF-RD8A	23
	XGF-AD4S	12	Temperature control module	XGF-TC4RT	31
	XGF-AW4S	12		XGF-TC4UD	31
	XGF-AC4H	11	High speed counter module	XGF-HO2A	25
Analog output module	XGF-DC8A	11		XGF-HD2A	25
	XGF-DV8A	11		XGF-HO8A	25
	XGF-DC4A	11	SOE Module	XGF-SOEA	2
	XGF-DV4A	11	Data log module	XGF-DL16A	32
	XGF-DC4S	11	Communication module	XGL-EFMT	16
	XGF-DV4S	11		XGL-EFMF	16
	XGF-DC4H	7		XGL-ESHF	16
Analog Input/ output module	XGF-AH6A	11		XGL-DMEA	16
Position control module	XGF-PO1A	2		XGL-PMEA	16
	XGF-PO2A	2		XGL-PMEA	16
	XGF-PO3A	2		XGL-PMEC	16
	XGF-PD1A	2		XGL-EDMT	16
	XGF-PD2A	2		XGL-EDMF	16
	XGF-PD3A	2		XGL-EDST	16
	XGF-PO1H	2		XGL-EDMF	16
	XGF-PO2H	2		XGL-RMEA	16

(Unit : WORD)

Product	Type	Refresh size	Product	Type	Refresh size
Position control module	XGF-PO3H	2	Communication module	XGL-FMEA	16
	XGF-PO4H	2		XGL-C22A	16
	XGF-PD1H	2		XGL-C42A	16
	XGF-PD2H	2		XGL-CH2A	16
	XGF-PD3H	2		XGL-EIMT	16
	XGF-PD4H	2		XGL-EIMH	16
	XGF-PN8A	3		XGL-EIMF	16
	XGF-PN8B	3		XGL-ES4T	16
	XGF-M16M	1		XGL-BBM	16
	XGF-M32E	4		XGL-EIPT	16

(2) Size of each module's Data Refresh area

1) Limit of Data Refresh area's size

Sum of Data Refresh area's size installed in system ≤ 1,024 words

2) Example

In a system, XGI-D28A(20 EA), XGQ-D24A(10EA), XGF-AC8A(20EA) and XGF-RD4A(10EA) modules are installed.

➔ (4 * 20) + (2 * 10) + (22 * 20) + (30 * 10) = 840 WORD ≤ 1,024 WORD

Notes

1) Sum of Data Refresh area's size must not exceed 1,024 words.

2) If size of Data Refresh area exceeds 1,024 words, XGK/I system doesn't operate properly.

2.4 Network system

XGK series provides various network system for easy system configuration.

This provides Ethernet (FEnet,FDEnet) and Cnet for communication between PLC and upper system or between PLCs and provides a dedicated Ethernet(FDEnet), Profibus-DP, DeviceNet, Rnet etc. as lower control network system.

2.4.1 Inter-system network

2.4.1.1 Local Network

It is available to install max. 24 communication module without any constraint of Main base and Extension base. It is recommended to install the module with lots of communication capacity in Main base considering system operation and performance. The constraints by function are shown on the table as below.

Classification by purpose	Maximum number of installation
Module No. to set max. high speed link	12
Module No. to set max.P2P service	8
Module No. to set max. Dedicated service	24

*Note 1) P2P service : 1 to 1 communication

2.4.1.2 Computer Link (Cnet I/F) System

Cnet I/F system is the system to carry out the data communication between computer or various external equipment and CPU module by using RS-232C, RS-422 (or RS-485) port of Cnet module.
For further information of Cnet module, please refer to Cnet Module user's manual.

As mentioned on the above "Local Network", Cnet module is available to install max. 24 bases (including other communication module) regardless Main base and Extension base.

Cnet does not provide high speed link but supports P2P service up to 8.

2.4.2 OS Version of communication module

2.4.2.1 O/S version of communication module applicable to XGI system

O/S version of communication module applicable to XGI system is as follows.

Classification	Module							
	FEnet	FDEnet	Cnet	Rnet	Pnet	Dnet	RAPIEnet	Optical ring switch module
Product name	XGL-EFMT XGL-EFMF	XGL-EDMT XGL-EDMF	XGL-C22A XGL-CH2A XGL-C42A	XGL-RMEA	XGL-PMEA	XGL-DMEA	XGL-EIMF XGL-EIMT XGL-EIMH	XGL-ESHF
Available OS version	V2.0 or higher	V2.0 or higher	V2.1 or higher	V1.0 or higher	V1.0 or higher	V1.0 or higher	V1.0 or higher	V1.0 or higher

2.4.3 Remote I/O System

This is the network system to control I/O module installed at far distance. Network system such as Profibus-DP, DeviceNet, Rnet, Cnet Smart I/O module series are applied.

2.4.3.1 Remote I/O System Application by Network Type

Smart I/O modules are classified as follows.

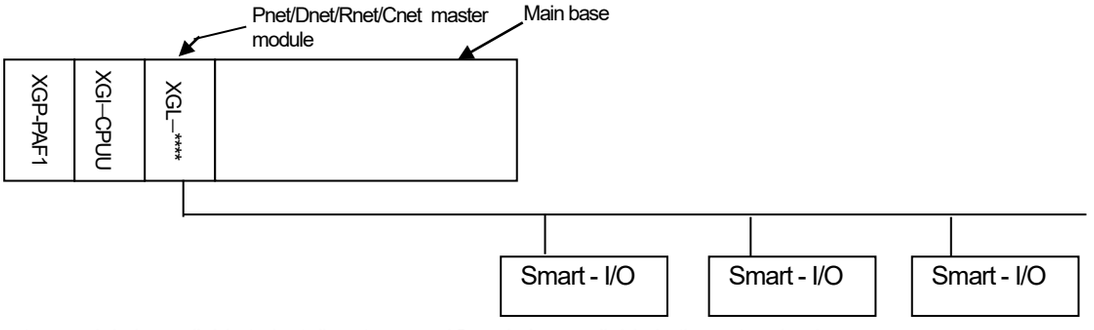
Network type (master)	Smart I/O	
	Block type	Extension type
Profibus-DP	O	O
DeviceNet	O	O
Rnet	O	O
Modbus(Cnet)	O	-
FEnet	-	O
Ethernet/IP	-	O
RAPIEnet	-	-

* The above description is subject to change for function improvement. For more information, please refer to each network system manual.

2.4.3.2 Block type Remote I/O System

1) System configuration

This system is configured by Profibus-DP, DeviceNet and Rnet and it is available to use block type Remote I/O regardless of the series. Profibus-DP and DeviceNet were developed based on International Standard which enables to connect with Smart-I/O of our company as well as the product of other manufacturer.



- Master module is available to install up to max. 12 and also available in the extension base.

2) I/O allocation method and I/O no. assignment

- Variables can be allocated to the Remote I/O by the high speed link parameters of XG5000.
- I/O variables or internal variables can be designated as input and output.
- "I" or "Q" area is recommended to use the forced ON/OFF function and initial reset function.
- The max. available points of I/O is 32,765.
- For the setting method of high speed link parameter per module, please refer to user's manual of each network.

Notes

1) When assigning remote station number and areas, the station numbers and sending/receiving areas should not be duplicate.
2) Force On/Off I/O service is provided only when assigning I/O by I/O variables. (%IW,%QW) A special attention should be paid when assigning I/O by using internal variables (%MW).

Chapter 3 General specifications

3.1 General Specifications

The general specifications of the XGT series are as follows.

<table>
<tr><th>No.</th><th>Item</th><th colspan="6">Specification</th><th>Related specifications</th></tr>
<tr><td>1</td><td>Operating ambient temperature</td><td colspan="6">0 ~ 55 °C</td><td></td></tr>
<tr><td>2</td><td>Storage temperature</td><td colspan="6">–25 ~ +70 °C</td><td></td></tr>
<tr><td>3</td><td>Ambient humidity</td><td colspan="6">5 ~ 95%RH (Non-condensing)</td><td></td></tr>
<tr><td>4</td><td>Storage humidity</td><td colspan="6">5 ~ 95%RH (Non-condensing)</td><td></td></tr>
<tr><td rowspan="8">5</td><td rowspan="8">Vibration resistance</td><td colspan="4">In case of occasional vibration</td><td>-</td><td></td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td><td>Times</td><td rowspan="8">IEC61131-2</td></tr>
<tr><td>5 ≤ f < 8.4 Hz</td><td colspan="2">–</td><td>3.5mm</td><td rowspan="5">10 times for each direction of X, Y and Z</td></tr>
<tr><td>8.4 ≤ f ≤ 150 Hz</td><td colspan="2">9.8m/s²(1G)</td><td>–</td></tr>
<tr><td colspan="4">In case of continuous vibration</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td></tr>
<tr><td>5 ≤ f < 8.4 Hz</td><td colspan="2">–</td><td>1.75mm</td></tr>
<tr><td>8.4 ≤ f ≤ 150 Hz</td><td colspan="2">4.9m/s²(0.5G)</td><td>–</td></tr>
<tr><td>6</td><td>Shock resistance</td><td colspan="6">•Maximum shock acceleration: 147㎨ (15G)
• Duration : 11ms
• Pulse waveform: Half-sine (3 times for each direction of X, Y and Z)</td><td>IEC61131-2</td></tr>
<tr><td rowspan="5">7</td><td rowspan="5">Noise resistance</td><td>Square wave impulse noise</td><td colspan="5">±1,500 V</td><td>Test standard of LS ELECTRIC</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="5">Voltage : 4kV (contact discharging)</td><td>IEC61131-2
IEC61000-4-2</td></tr>
<tr><td>Radiation field noise</td><td colspan="5">80 ~ 1000 ㎒, 10 V/m</td><td>IEC61131-2,
IEC61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient /Burst noise</td><td>Classification</td><td>Power module</td><td colspan="3">Digital/Analog Input/Output, Communication Interface</td><td rowspan="2">IEC61131-2
IEC61000-4-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td colspan="3">1kV</td></tr>
<tr><td>8</td><td>Operating atmosphere</td><td colspan="6">Free from corrosive gases and excessive dust</td><td></td></tr>
<tr><td>9</td><td>Operating altitude</td><td colspan="6">Up to 2,000m</td><td></td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="6">Less than equal to 2</td><td></td></tr>
<tr><td>11</td><td>Cooling method</td><td colspan="6">Air cooling</td><td></td></tr>
</table>

Notes

IEC (International Electrotechnical Commission)
: An international nongovernmental organization which promotes internationally cooperated standardization in electric/electronic field, publishes international standards and manages applicable estimation system related with.

Pollution degree
: An index indicating pollution degree of the operating environment which decides insulation performance of the devices. For instance, Pollution degree 2 indicates the state generally that only non-conductive pollution occurs. However, temporary conduction occurs in this state due to dew formation.

Chapter 4. CPU Module

4.1 Performance Specification

Performance specifications of high performance CPU module (XGI CPU) are as follows.

Item			Products						Remarks
			XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE	
Operation Method			Scan program: Cyclic operation, Fixed scan Task program: Initialization, cycle time, Internal contact						
I/O control method			Scan synchronous batch processing method (Refresh method),Directed by program instruction						
Program language			Ladder Diagram, Sequential Function Chart, Structured Text						
Number of instruction	Operator		18						
	Basic function		136 types + real number operation function						
	Basic function block		43						
	Special function block		Dedicated function blocks by special modules, dedicated function block for communication module(P2P)						
Operation processing speed(Basic instruction)	Basic		8.5 ns/command	28 ns/command				84 ns/command	
	MOVE		25.5 ns/command	84 ns/command				252 ns/command	
	Real operation		±: 119 ns(S), 281 ns(D) x : 272 ns(S), 680 ns(D) ÷ : 281 ns(S), 685 ns(D)	±: 392 ns(S), 924 ns(D) x : 896 ns(S), 2,240 ns(D) ÷ : 924 ns(S), 2,254 ns(D)				±: 1,442 ns(S), 2,870 ns(D) x : 1,948 ns(S), 4,186 ns(D) ÷ :1,974 ns(S), 4,200 ns(D)	S: Short Real number D: Long Real number
Program memory capacity			2MB	1MB		512KB	128KB	64KB	
I/O Point(Installation available)			6,144 points				3,072 points	1,536 points	
Max. I/O memory contact			131,072 points				32,768 points		
Data memory	Automatic variable area(A)		1,024KB (Up to 512KB retainable)	512KB (Up to 256KB retainable)			128KB (Up to 64KB retainable)	64KB (Up to 32KB retainable)	
	Input variable(I)		16KB				4KB		
	Output variable(Q)		16KB				4KB		
	Direct Variable	M	512KB (Up to 256KB retainable)	256KB (Up to 128KB retainable)			64KB (Up to 32KB retainable)	32KB (Up to 16KB retainable)	
		R	64KB * 16 block		64KB * 2 block		64KB X 1 block	32KB X 1 block	
		W	1,024KB		128KB		64KB	32KB	Same area as
	Flag variable	F	8KB		4KB				System flag
		K	16KB				4KB		PID operation area
		L	22KB						High speed link flag
		N~~	42KB						P2P parameter
		U	8KB				4KB	2KB	Analog data refresh area

Item		Products						Remarks
		XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE	
FLASH area		2 MB, 32 block					1 MB, 16 block	Controllable using R device
Timer		•No limit in points •Time range: 0.001~ 4,294,967.295sec(1,193hour)						Occupying 20 bytes of automatic variable area per point
Counter		•No limit in points •Counting range: 64 bit range						Occupying 8 bytes of automatic variable area per point
Configuration of program	Total number of program	256						
	Initial task	1						
	Cycle task	32						
	Internal device task	32						
Operation mode		RUN, STOP, DEBUG						
Restart mode		Cold, Warm						
Self-diagnosis function		Detection of operation delay, memory error, I/O error, battery error, power error, etc						
Back-up method		Retain area setting in basic parameter						
Maximum extension base		7 stages				3 stages	1 stages	Total length 15m
Internal consumption current		960mA				940mA		
Weight		0.12kg						

XGI-CPUUN has built-in Ethernet communication. The Performance specifications of the XGT series are as follows.

Item		Products	Remarks
		XGI-CPUUN	
Ethernet	Characteristics	1 Port	-
		10/100BASE-TX	-
		Auto negotiation (Full-duplex and half duplex)	-
		Auto MDIX Crossover	-
		Max. 4 Channel supported	Supports 8KByte each send/receive per channel
		Up to 100M distance between nodes	-
		Maximum 1500Byte protocol size	IP Fragmentation is not supported.
		Use UTP, STP, FTP cable	STP and FTP are recommended in noisy environments.
	Service	CPU communication parameter setting in XG5000	-
		The loader service (XG5000) is supported	Support remote 1 connection function
		Own protocol support (XGT) - Dedicated communication	Server function support(client function not supported) TCP supported UDP not supported
		Third-party protocol support(MODBUS TCP/IP)	

Notes

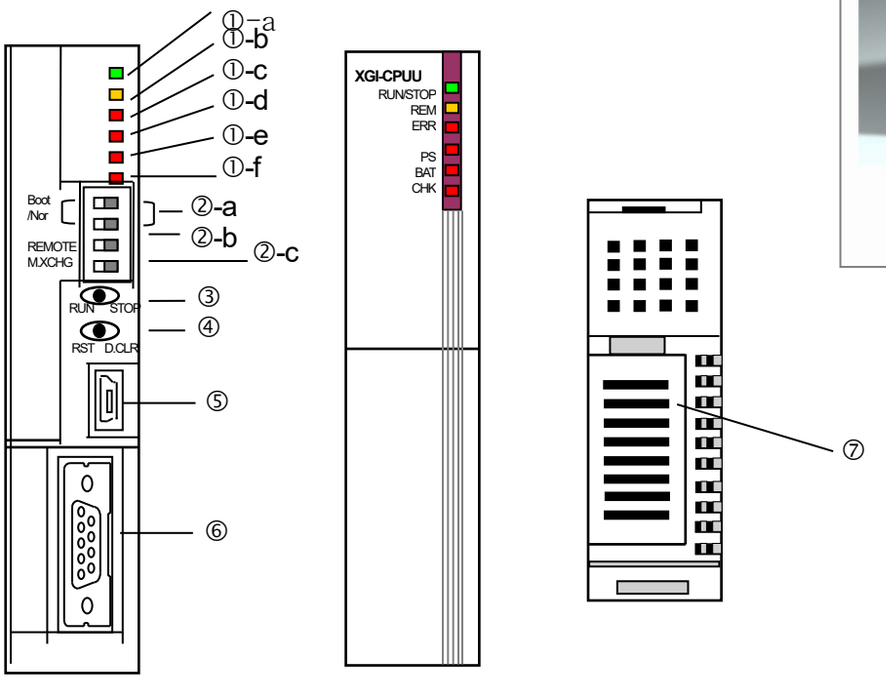
- Supported functions according to CPU OS version: the following OS version and XG500 version is needed for each function

CPU OS version	XG5000 version	Function	Note
V3.0	V3.1	Event input module(XGF-SOEA)	-
V3.1	V3.2	Analog input module function(effective conversion value, alarm function)	-
V3.20	V3.4	Enhanced password function (in order to connect XG5000 V3.4 or higher is needed.) Disable setting of the Reset/D.Clear switch Version information is indicated to two decimal places(_OS_VER_PATCH flag added)	-
V3.30	V3.6	XGI-CPUE / CPUU/D types are added	-
V3.40	V3.61	Scan time flag of fixed cycle task P2P, HS enable-disable flag SOE flag	-

CPUUN OS version	XG5000 version	Function	Note
V1.0	V4.0	XGI-CPUUN types are added	-

4.2 Name of each part and function

Each part's function and name of XGI-CPUU/D, XGI-CPUU, XGI-CPUH, XGI-CPUS and XGI-CPUE is as follows.



No.	Name	Usage
①-a	RUN/STOP LED	Indicates the operating status of the CPU module •Green On: indicates 'in operation' by 'RUN' mode state ▶ 'RUN' operation by RUN/STOP mode switch ▶ 'Remote RUN' operation with RUN/STOP mode switch in 'STOP' • Red On: indicates 'in operation' by 'STOP' mode state ▶ 'RUN' operation by RUN/STOP mode switch ▶ 'Remote STOP' operation with Mode switch in 'STOP' ▶ If detect an error stopping operation
①-b	REM LED	• ON (Yellow): indicates 'remote enabled' ▶ When the REMOTE' switch is 'Off' • On: indicates 'remote disabled' ▶ When the REMOTE' switch is 'Off'

No.	Name	Usage
①-c	ERR LED	• On(Red): indicates the case of an error that cannot be operated • On: Indicates 'no error'
①-d	PS LED (Programmable Status)	• On(Red): ▶ When the 'User Defined Flag' is 'On' ▶ When operating in the error state by setting the 'operation proceeding in the error' ▶ When the module is detached or other module is installed in the state that 'M.XCHG' switch is 'On' • On: ▶ Indicates 'no error'
①-e	BAT LED	• ON (Red): When battery voltage is lowered • On: No battery error
①-f	CHK LED	•On(red): indicates the setting is different from standard setting.(it can be added/deleted (canceled) by parameters) ▶ When 'Module change' switch is set as 'Module change'. ▶ When operating in 'DEBUG mode ▶ 'Forced ON' setting status ▶ If 'Error mask' or 'SKIP' flag is set. ▶ If warning occurs during operation. ▶ Extension base power error • Off: Displayed if operating in standard setting
②-a	Boot/Nor switch	It is used to download O/S before shipping. • On (right): executes control action in normal operation mode. • Off (left): used for manufacturing, user's operation prohibited(O/S Download mode) **Caution** Boot/Nor switches should be both set in On (right) side. If it is set to off (left), it may cause damage to the module.
②-b	Remote allowable switch	Limit PLC operation PLC operation by remote connection. • On (right): all function enabled (REMOTE mode) • Off (left): Remote function limited ▶ D/L of program, Operation mode control limited ▶ Monitor, data change operation enabled

<table>
<tr><th>No.</th><th>Name</th><th>Usage</th></tr>
<tr><td>②-c</td><td>M.XCHG
(Module change switch)</td><td>Used in case of performing the module change during operation.
• On (right): executes the module change
▶ Available to change the module only by key switch operation
• Off (left): completes the module change</td></tr>
<tr><td>③</td><td>Run/ Stop mode Switch</td><td>Sets the operation mode of CPU module
• STOP → RUN: Run the program operation
• RUN → STOP: Stop the program operation

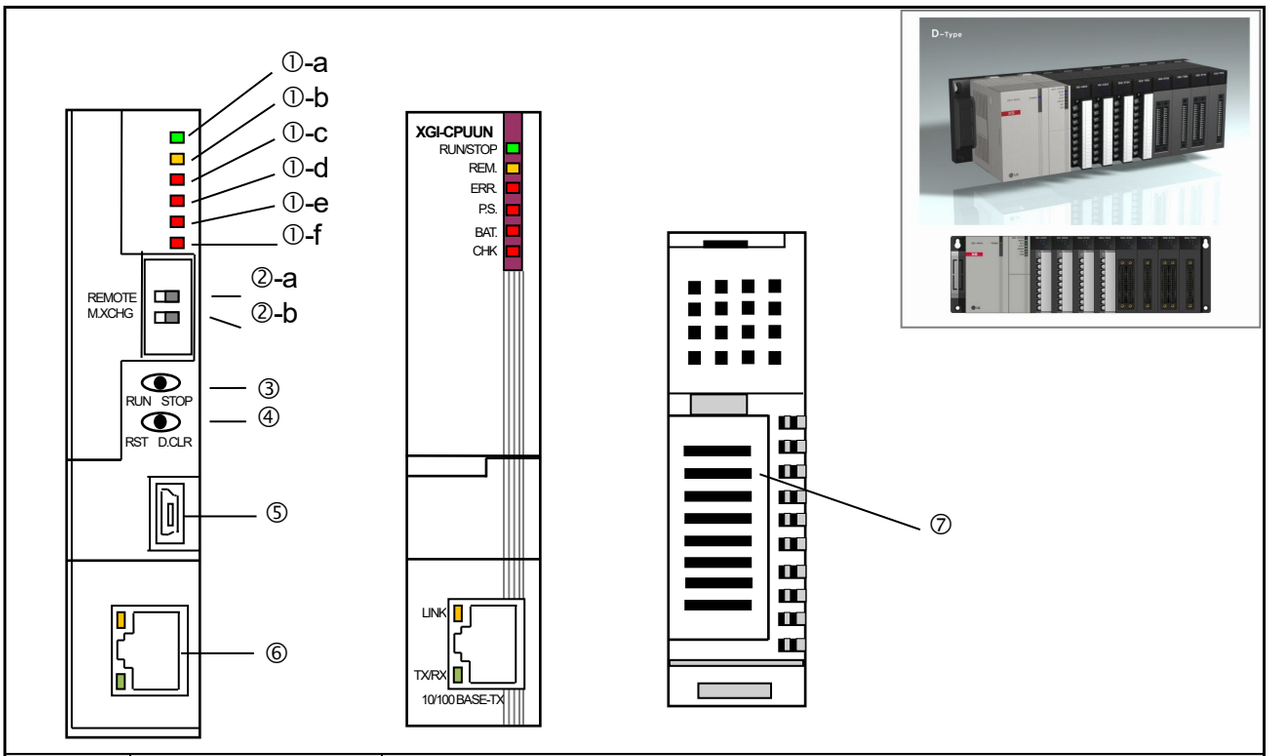
Operates prior to REMOTE switch.</td></tr>
<tr><td>④</td><td>Reset/ D.Clear switch</td><td>You can enable/disable Reset/D.Clear switch in “XG5000→Basic Parameter→Basic Operation Setup”

• When is not set ”Disable reset switch”
<table><tr><th>Operation</th><th>Result</th></tr><tr><td>Move to left → return to center</td><td>Reset</td></tr><tr><td>Move to left →hold for more than 3 seconds →return to center</td><td>Overall reset</td></tr></table>
• When is not set ”Disable D.Clear reset switch”
<table><tr><th>Operation</th><th>Result</th></tr><tr><td>Move to right → return to center</td><td>General data area and retain setting area (M, Automatic variable) will be cleared</td></tr><tr><td>Move to right →hold for more than 3 seconds →return to center</td><td>General data area, retain setting area (M, Automatic variable) and R area will be cleared.</td></tr></table>
•DATA CLEAR acts only in “STOP” operation mode</td></tr>
<tr><td>⑤</td><td>USB connector</td><td>A connector to connect with peripherals (XG5000 etc.) (USB 1.1 support)</td></tr>
<tr><td>⑥</td><td>RS–232C connector</td><td>A connector to connect with peripherals
• XG5000 connection: support
• Modbus device connection: Modbus protocol support
TX: Pin 7, RX: Pin 8,GND: Pin 5</td></tr>
<tr><td>⑦</td><td>Battery built-in cover</td><td>Cover for mounting backup battery</td></tr>
</table>

Notes

When using the communication service using the RS-232C connector, abnormal CPU operation may occur due to the inflow of external noise, so be careful of the external environment when using.

Each part's function and name of XGI-CPUUN is as follows.



No.	Name	Usage
①-a	RUN/STOP LED	Indicates the operating status of the CPU module •Green On: indicates 'in operation' by 'RUN' mode state ▶ 'RUN' operation by RUN/STOP mode switch ▶ 'Remote RUN' operation with RUN/STOP mode switch in 'STOP' • Red On: indicates 'in operation' by 'STOP' mode state ▶ 'STOP' operation by RUN/STOP mode switch ▶ 'Remote STOP' operation with Mode switch in 'STOP' ▶ If detect an error stopping operation
①-b	REM LED	• ON (Yellow): indicates 'remote enabled' ▶ When the REMOTE' switch is 'Off' • Off: indicates 'remote disabled' ▶ When the REMOTE' switch is 'Off'
①-c	ERR LED	• On(Red): indicates the case of an error that cannot be operated • Off: Indicates 'no error'

No.	Name	Usage
①-d	PS LED(Programmable Status)	• On(Red): ▶ When the 'User Defined Flag' is 'On' ▶ When operating in the error state by setting the 'operation proceeding in the error' ▶ When the module is detached or other module is installed in the state that 'M.XCHG' switch is 'On' • Off: ▶ Indicates 'no error'
①-e	BAT LED	• ON (Red): When battery voltage is lowered • Off: No battery error
①-f	CHK LED	•On(red): indicates the setting is different from standard setting.(it can be added/deleted (canceled) by parameters) ▶ When 'Module change' switch is set as 'Module change'. ▶ When operating in 'DEBUG mode ▶ 'Forced ON' setting status ▶ If 'Error mask' or 'SKIP' flag is set. ▶ If warning occurs during operation. ▶ Extension base power error • Off: Displayed if operating in standard setting
②-a	Remote allowable switch	Limit PLC operation PLC operation by remote connection. • On (right): all function enabled (REMOTE mode) • Off (left): Remote function limited ▶ D/L of program, Operation mode control limited ▶ Monitor, data change operation enabled
②-b	M.XCHG (module change switch)	Used in case of performing the module change during operation. • On (right): executes the module change ▶ Available to change the module only by key switch operation • Off (left): completes the module change

<table>
<tr><th>No.</th><th>Name</th><th>Usage</th></tr>
<tr><td>③</td><td>RUN/STOP mode switch</td><td>Sets the operation mode of CPU module
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Operates prior to REMOTE switch.</td></tr>
<tr><td>④</td><td>Reset/ D.Clear switch</td><td>You can enable/disable Reset/D.Clear switch in “XG5000→Basic Parameter→Basic Operation Setup”

• When is not set ”Disable reset switch”
<table><tr><th>Operation</th><th>Result</th></tr><tr><td>Move to left → return to center</td><td>Reset</td></tr><tr><td>Move to left →hold for more than 3 seconds →return to center</td><td>Overall reset</td></tr></table>
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<tr><td>⑤</td><td>USB connector</td><td>A connector to connect with peripherals (XG5000 etc.) (USB 1.1 support)</td></tr>
<tr><td>⑥</td><td>Ethernet connector</td><td>A connector to connect with peripherals
• XG5000 connection: support
• TCP/IP server connection</td></tr>
<tr><td>⑦</td><td>Battery built-in cover</td><td>Backup Battery built-in cover</td></tr>
</table>

4.3 Battery

4.3.1 Battery specifications

Item	Specification
Nominal voltage/current	DC 3.0 V / 1,800 mAh
Warranty	5 years(at ambient temperature)
Usage	Program and data backup, RTC operation in case of power off
Specification	Manganese Dioxide lithium battery
Dimensions (mm)	ϕ 17.0 X 33.5 mm

4.3.2 Cautions for using

Do not charge, dismantle, heat up, short, or solder the battery.
Improper handling of the battery may result in injury or fire due to heat generation, blowout or ignition.

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4.3.3 Battery life

A battery's life may be different depending on the conditions of blackout time, service temperature, etc. (Ambient temperature use : At least 5 years of use)
If battery is getting low, CPU Module will trigger, 'battery voltage low warning'. It is available to check it through CPU module LED and flag or error message of XG5000.
When the battery voltage drop warning occurs, replace the battery immediately.

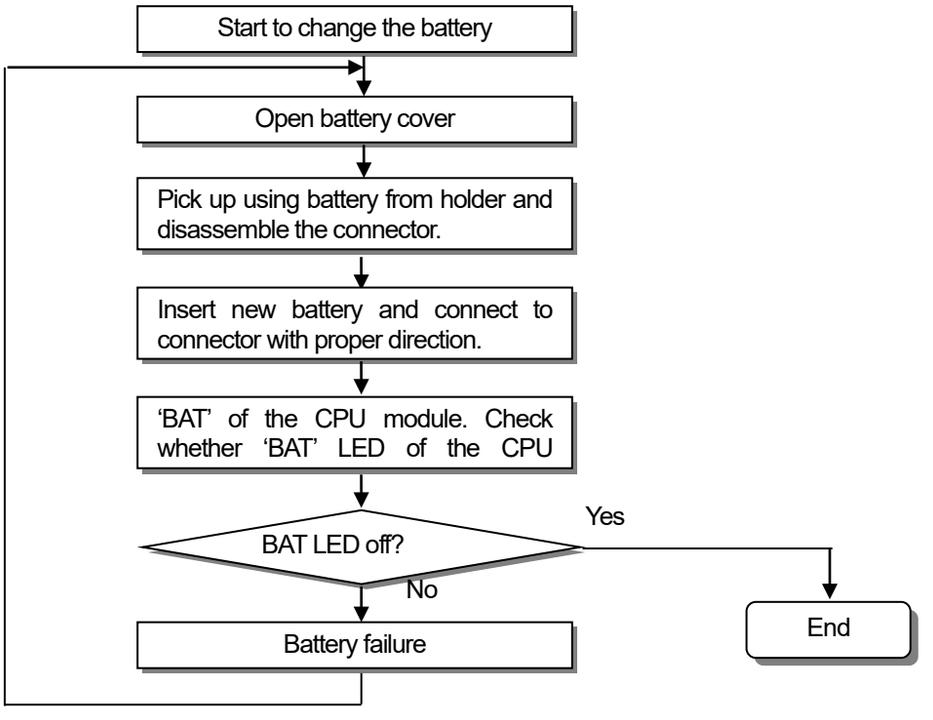
Notes

In general, the battery warning occurs 5 years after purchasing but it may occur earlier due to a poor battery or excessive current discharge caused by leakage current etc. If the warning occurs again within the short time after battery change, you need to request A/S service for CPU module.

4.3.4 How to change the battery

The battery used for program backup or data backup at power out needs the regular change. Even if the battery is removed, program and power-out keeping data shall be kept for 30 minutes by super capacity but it is required to change the battery as fast as possible.

The procedures to replace the battery are as below.



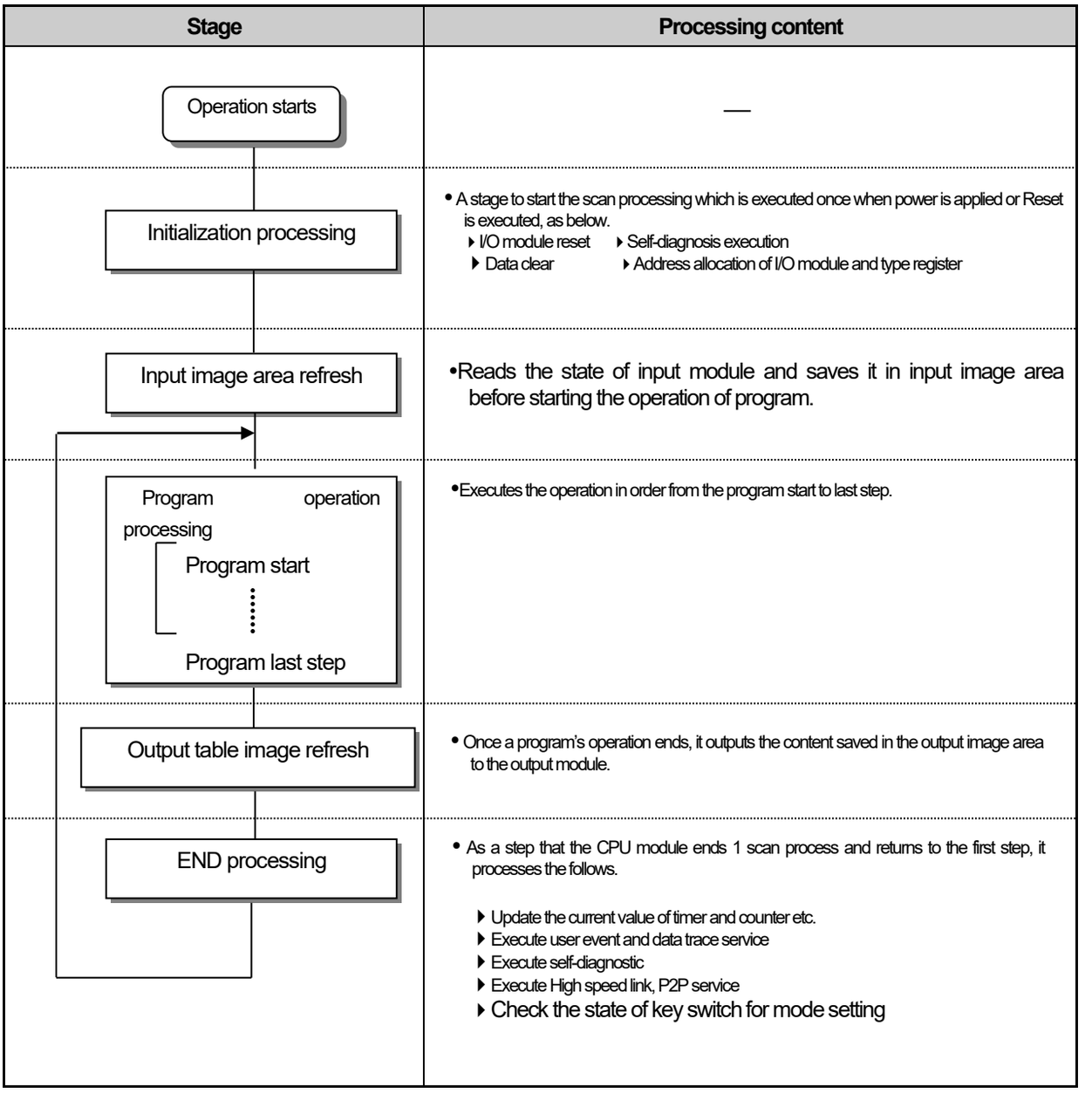
Chapter 5 Program Configuration and Operation Method

5.1 Program Instruction

5.1.1 Program operation methods

1) Cyclic operation (Scan)

It executes a program created by the basic program operation method of the PLC from the first to the last step cyclically and the procedure is called 'Program Scan.' And the series of process is called cyclic operation.
The processing is divided per stages as below.



2) Interrupt operation (fixed cycle, internal device operation)

It temporarily stops a currently executing program operation and immediately processes an operation corresponding to the interrupt program in case an urgent event occurs during the operation of PLC program.
The signal notifying the CPU module about the emergency is called 'Interrupt signal' and there are fixed period operations that are executed at every fixed time.
In addition, there is also internal device operation program that works depending on the change in the status of an internally designated device.

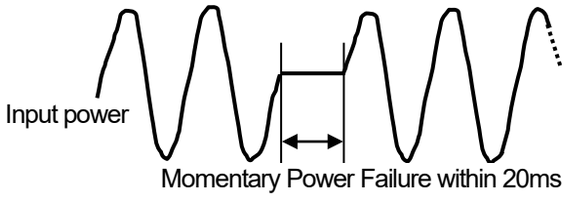
3) Fixed period scan (Constant Scan)

The operation executes a scan program at a fixed time. It executes every scan programs, waits for a moment and resumes program scan at a pre-defined time. Unlike fixed period program, it is executed synchronously as I/O is updated.
The scan time of fixed period operation is displayed as a pure program processing time subtracting waiting time.
If the scan time is longer than the pre-defined 'fixed cycle', '_CONSTANT_ER' flag is 'On'.

5.1.2 Operation Processing during Momentary Power Failure

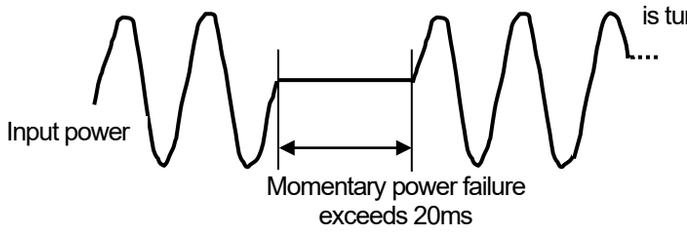
The CPU module detects Momentary Power Failure when the voltage of input power supplied to the power module is lower than the nominal value.
If the CPU module detects instantaneous interruption, it processes operation as follows.

1) In case of instantaneous interruption within 20ms occurs



(1) It stops an operation with the output holding at the momentary power failure.
(2) It continues the operation once the momentary power failure is removed
(3) The output voltage of power module is maintained within the specified value.
(4) Even though an operation stops due to momentary power failure, timer measurement and interrupt timer measurements still work normally.

2) In case of Momentary Power Failure over 20ms occurs



• It executes resumption process such as when power is turned on.

Notes

1) What is momentary power failure?
It means the status that the power supply voltage specified in the PLC is out of the allowable variance range and falls, and especially, a short term interruption(several ms ~ dozens of ms) is called momentary power failure.

5.1.3 Scan time

The time required to complete it from the first step 0 to the next step 0 of a program, that is, a time taken for a control operation is called 'scan time.' It is directly related to the control performance of the system.

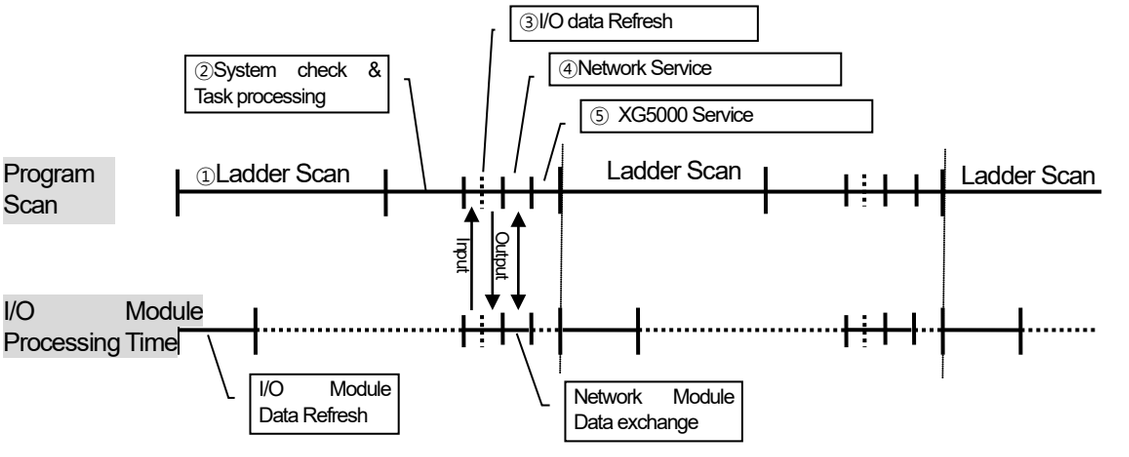
1) Operation and performance of XGI

Program execution time, I/O data process time and communication service time are important factors affecting the 'scan time.' The XGI CPU impressively reduces scan time by means of the improved data reception performance through ladder program execution and backplane, ladder program execution by MPU and parallel execution of I/O data scan etc.

Type	Program processing time		Module processing time		
	Ladder execution (32kstep)	System Task	I/O module (32 points, 1 module)	Analog module (8 ch, 1 module)	Communication module(Main/Extension) (200 byte, 1 block)
CPUUN	0.272 msec	0.2 msec	20 usec	75 usec	185 usec
CPUU,H,S,U/D	0.896 msec	0.6 msec			
CPUE	2.688 msec	0.8 msec			

2) Calculation of scan time

The CPU module executes controls along the following steps. A user can estimate the control performance of a system that the user is to structure from the following calculation.



(1) Scan time = ① Scan program process + ② System check & Task process + ③I/O data Refresh + ④ Network Service + ⑤ XG5000 Service + ⑥ User Task Program process

① Scan program process = no. of program steps created x 0.028 (㎲)

② System check & Task process: 600 ㎲ ~ 1.0 ms [varies depending on the usage of auxiliary functions].

⑤ XG5000 Service process time: 100 ㎲ at the max data monitor

⑥ Task Program process time: Sum of task processing time that occurs within a scan; the time calculation by task programs are as same as that of scan program.

(2) Example

The scan time of a system consisting of CPU (program 16kstep) + 32 points, 6 I/O modules + 6 analogue modules + 4 communication modules (200 bytes 8 blocks per module) is as follows.

Scan time(㎲) = ladder execution time + system processing time + digital module I/O processing time + analogue I/O processing time
+ communication module processing time + XG5000 Service processing time
= (16000 x 0.028) + (600) + (20 x 6) + (75 x 6) + (185 x 8 x 4) + (100)
= 7638 ㎲
= 7.6 ㎳

(However, if monitor screen is changed, scan time increases temporarily. If connecting by “Max. USB Writing”, it is 6ms; if connecting by “Normal USB Writing”, it is 1.6ms.)

2) Scan time monitor

(1) Scan time is saved into the following flag(F) areas.
_SCAN_MAX : max. value of scan time(unit of 0.1ms)
_SCAN_MIN : min. value of scan time(unit of 0.1ms)
_SCAN_CUR : current value of scan time (unit of 0.1ms)

5.2 Program Execution

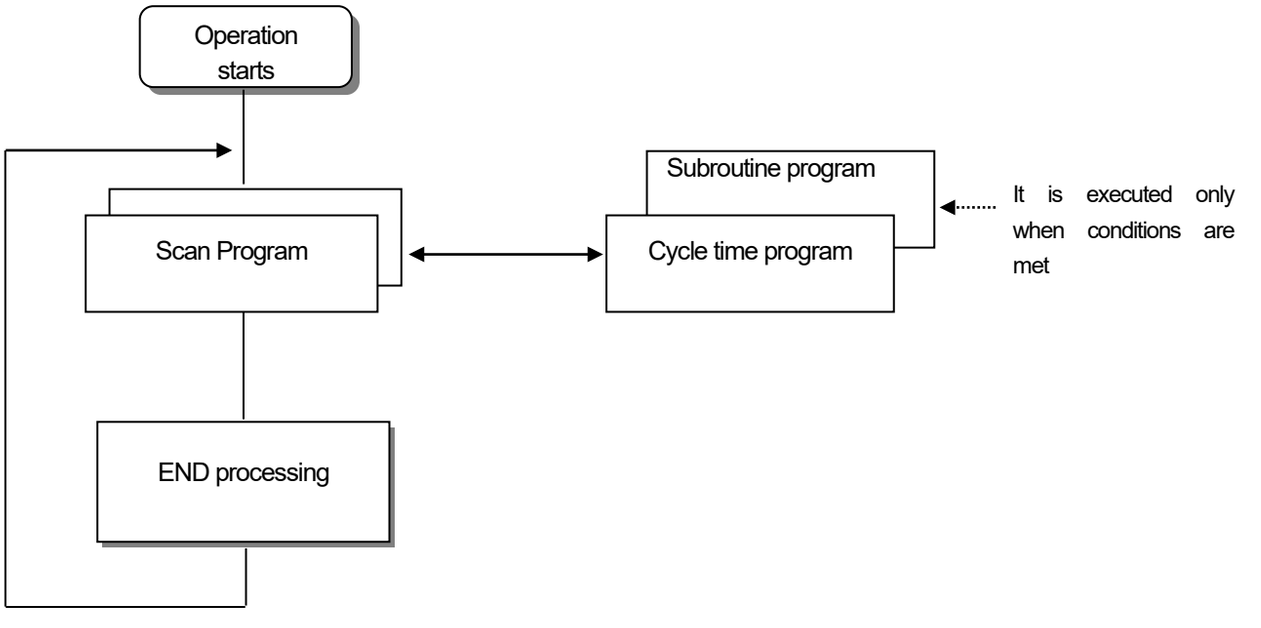
5.2.1 Program Configuration

Program consists of every functional element necessary for executing a specific control and is saved into the internal RAM or a flash memory of the CPU module.
The functional elements can be categorized as follows.

Functional elements	Operation processing content
Scan Program	• Processing of signal that repeats regularly every 1 scan.
Fixed cycle interrupt program	• If time conditional process is required as follows, it executes the program at the fixed time interval. ▸ If requiring faster process than the average processing time of a scan ▸ If requiring longer time interval than the average processing time of a scan ▸ If a process is to be executed at a fixed time interval.
Subroutine program	• Executed only when a specific condition is met (if the input condition of CALL command is On)

5.2.2 Program Execution Method

It describes the program execution in case the power is turn on or the key switch of the CPU module is RUN.
The program processes an operation according to the following configuration.



1) Scan Program

(1) Function

- It cyclically executes an operation from the first step 0 to the last step according to the sequences that the program is created in order to process a signal that repeats uniformly per scan.
- If the execution conditions of fixed cycle interrupt or interrupt by input module are met during the operation of scan program, it suspends the currently running program and executes the interrupt program.

2) Interrupt Program

(1) Function

- To process internal/external signals that occur irregularly/regularly, it suspends the operation of scan program and processes the function preferentially.

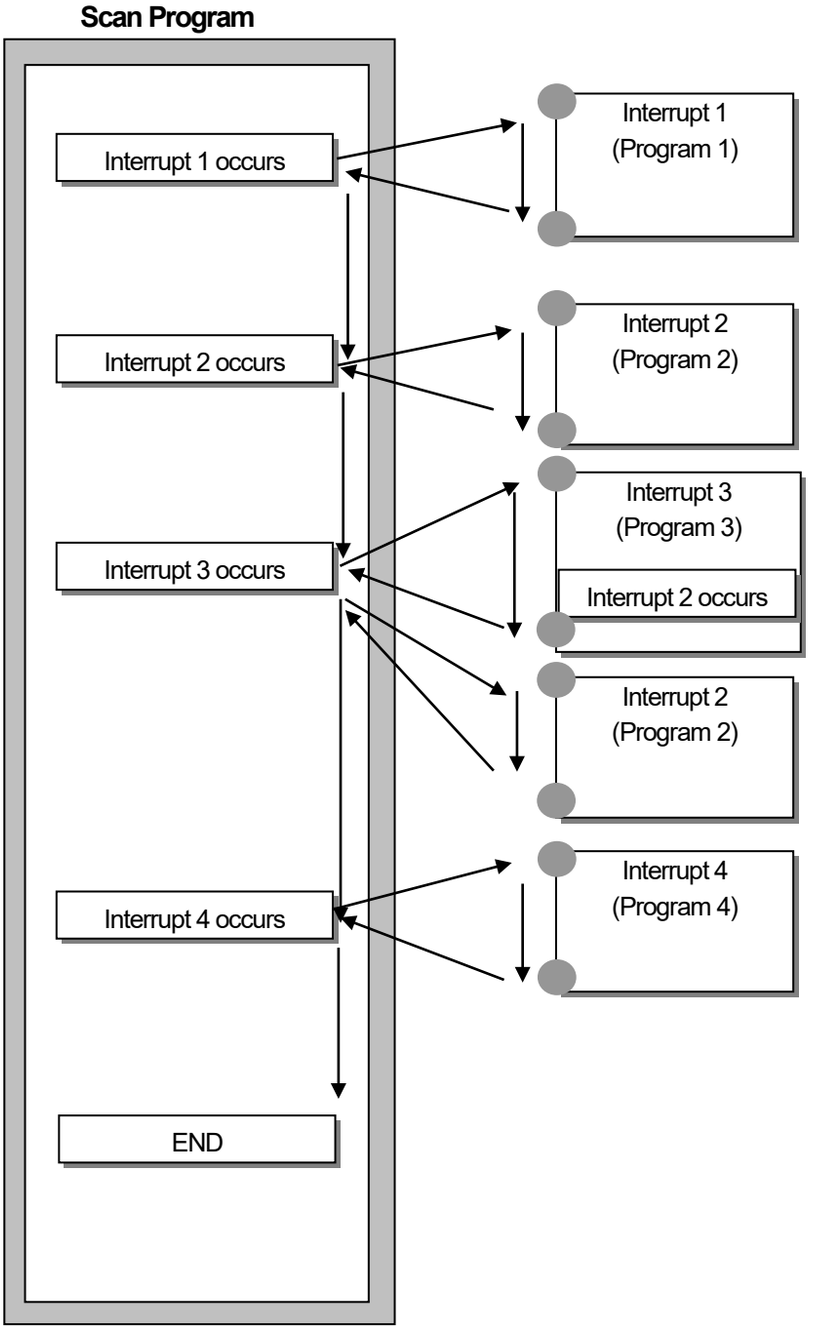
(2) Types

- Task program is divided into the two types
  - ▶ Fixed cycle task program: available up to 32
  - ▶ Internal device task program: available up to 32
- Fixed cycle task program
  - ▶ A program is executed at the fixed interval.
- Internal device task program
  - ▶ If any operation condition of an internal device occurs, it executes the program
  - ▶ The operation condition of the device is executed after processing the scan program.

Notes
1) For further information about interrupt program, please refer to 5.2.3 Interrupt.

5.2.3 Interrupt

How to set XG5000 of XGT programming S/W will be described below simply to help understand interrupt function. (Refer to XG5000 manual for details on XG5000.)

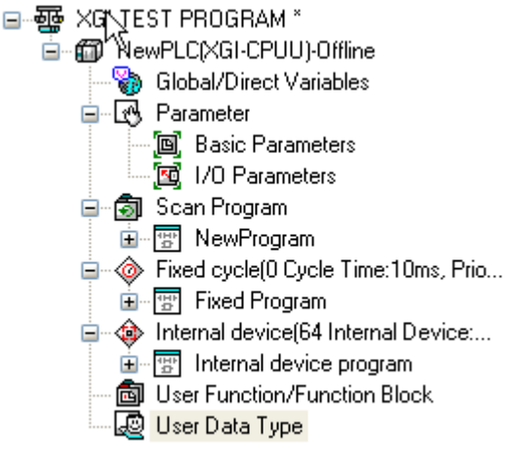


Notes

Every interrupt become to disabled status when the power is turned on.

1) How to prepare Interrupt Program

Create a task in the project window of XG5000 as follows and add programs to be executed by each task. Refer to XG5000 manual for more details.



2) Task Types

Types and functions of tasks are as specified below.

Type / Specifications	Cycle task (Interval task)	Internal contact (Single task)
Quantity	32	32
Start condition	Cycle time((up to 4,294, 967. 295 second available in 1ms unit)	Internal device's designated conditions
Detection and execution	Executed periodically per setting time	Executed by searching for condition after scan program completed.
Detection delay time	Max. 0.2 ms delayed	Delayed as much as max. scan time
Execution priority	Setting 2 ~ 7 levels (level 2 is the highest priority)	As specified in the left
Task no.	With 0~31 range without user duplication	Assigning it between 64~95 so that it is not duplicated

3) Processing methods of task program

Common processing method and precautions for task program will be described.

(1) Features of task program

- Task program does not repeat every scan differently from scan program but perform execution only when its conditions are met. Task program shall be considered of this point.
- For example, if timer and counter are used for cycle time task program with a cycle of 10 seconds, tolerance of the timer can be maximum 10 seconds. And since the counter checks its input status every 10 seconds, any input changed within 10 seconds will not be counted.

(2) Execution priority

- If several tasks to execute are waiting, it processes from the highest priority task program. When the same priority tasks are waiting, execute consecutively.
- The task priority is applied to only each task.
- Please set the priority of task program considering program features, importance level and urgency demanding execution.

(3) Process delay time

The delay of task program processing occurs due to the following factors. Make sure to consider them when setting a task or creating a program.

- Task detection delay (please refer to the details of each task)
- Program execution delay due to the execution of preceding task program

(4) Relationship between initialization, scan program and task program

- A user defined task does not operate while initialization task program is working.
- Since scan program's priority is the lowest, task program will be preferably processed with the scan program stopped if task occurs. Therefore, if tasks frequently occur during 1'st 1 scan or intensively and intermittently occur, a scan time may increase unreasonably. A special attention should be paid when setting the conditions of task.

(5) Protection of currently running program from task program

If continuity of program execution might be lost while performed, by a task program with higher priority, the task program can be partially prevented from execution. At the moment, a program can be protected by application function commands of 'DI (task program operation disabled)' or 'EI (task program operation enabled)'

- Insert the application function command, 'DI' into the beginning position of a section to be protected and the application function command, 'EI' to the position to cancel it. Initialization task is not affected by the application function commands of 'DI' and 'EI'.

Notes
1) If task program priority is duplicate set, a program works according to the creation order.

4) Processing method of cycle task program

When task program's task (operation condition) is set to cyclic cycle, its processing is as described below.

(1) Task settings

Specify execution cycle and priority of the task which will be operation condition of the task program to execute. Check the task number for task management.

(2) Cycle task processing
Execute cycle task program applicable at specified time intervals (execution cycle).

(3) Cautions for using a cycle task program

- If a same task program is to be executed when a fixed cycle task program is in operation or waiting for execution, a new task is ignored.
- Only for a moment when the operation mode is RUN, a timer requiring executing a fixed cycle program is counted. The shutdown time power failure time shall be all ignored

• When setting cycle task program's execution cycle, consider that execution request of several cycle task programs may occur at a time.
If 4 cycle task programs are used with a cycle of 2, 4, 10 and 20 seconds, execution request of 4 cycle task programs will occur at a time every 20 seconds, causing a problem to increase the scan time in a moment.

Maximum, minimum, and current scan time of cycle task can be checked with flag of cycle task.

_CYCLE_TASK_SCAN_TIME

Initial value of minimum scan time flag is 16#ffff. It can verify cycle task is not used, or never executed.

Caution
1) Note that if the total time length during which cycle task programs are executed simultaneously is longer than the specified time length when several cycle task occur simultaneously, a short cycle task may not be successfully executed. 2) The only cycle task of which cycle is longer than scan cycle can be guaranteed for the cycle task.

5) Processing method of internal device task program

When execution range of task program's task (operation condition) is extended from the contact to device, the extended internal device task program will be processed as described below.

(1) Setting items in task

•Set the conditions and priority of a device which is the operation condition of a task program to execute. Check the task number for task management.

(2) Internal device task processing

• After a scan program is executed in the CPU module, the task is processed as long as the conditions of devices that are the operation conditions of internal device task program are met according to the priority.

(3) Cautions for using internal device task program

• Internal device task program is executed at the moment when a scan program is completely executed. Therefore, although a scan program or task program (fixed cycle, external contact) generates the execution conditions of internal device task program, it is not immediately executed and instead, it is executed at the moment when a scan program is executed completely.

• The execution request of internal device task program surveys the conditions of execution when a scan program is completely executed. Therefore, if the execution conditions of internal device task occur and disappear by a scan program or task program(cycle time, external contact) during'1 scan', a task is not executed because it is not detected at the moment when the execution conditions are surveyed.

6) Task processing in momentary power failure

- When resuming operation due to a long instantaneous interruption, ignore any waiting task and tasks that occur during the interruption and process the only tasks from the moment of starting operation.
- If an interruption is within 20ms, a task that was waiting is executed once the interruption is removed. Any cycle task, interrupt task that is duplicated during the interruption is ignored.

7) Verification of task program

After creating a task program, verify it in accordance with the followings.

(1) Is the task set properly?

If task occurs more than needed or several tasks occur in one scan, scan time may lengthen or be irregular. When unable to change the tasks setting, verify maximum scan time.

(2) Is the task priority well arranged?

A low priority task program may not be processed in a specified time due to a delay from a higher priority task program. The case may be, since the next task occurs with a preceding task delayed, it may cause task collision. The priority should be set in consideration of urgency of task, execution time and etc.

(3) Is the task program created as short as possible?

A longer execution time of task program may cause a longer scan time or irregularity. In addition, it may cause task program collision. Make sure to set the execution time as short as possible. The scan time of the cyclic task program should be made shorter than the cyclic setting time of the corresponding task, and it should be made as small as possible (recommended within 5ms).

(4) Doesn't the program for the highest priority task need to be protected during the execution of program?

If a different task breaks into a task program execution, it completes a current task and then, operates from a task with the highest priority among waiting tasks. In case it is prohibited that a different task breaks into a scan program, it can be protected by using 'DI'/'EI' application functional commands. It may cause a trouble while processing a global parameter process commonly used with other program or a special or communication module.

8) Program configuration and example of processing

First of all, register task and program as follows.

- Registering a task:
  - T_SLOW (fixed cycle : = 10ms, Priority := 3)
  - PROC_1 (internal contact : = M0, Priority := 5)
  -

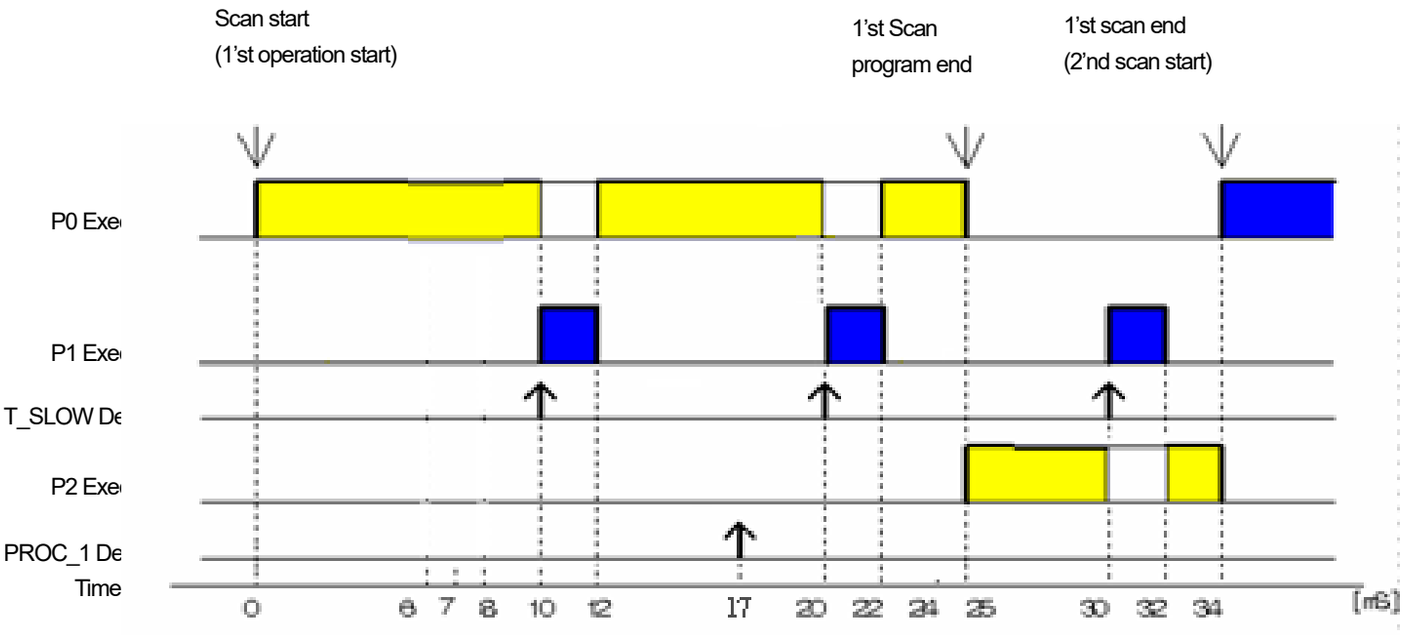
Register program:

- Program –> P0 (scan program)
- Program –> P1 (operating by task T_SLOW)
- Program –> P2 (operating by task PROC_1)
-

Then, if the program execution time and the occurrence time of external interrupt signal are same,

- Execution time of each program: P0 = 21ms, P1 = 2ms and P2 = 7ms, respectively

• PROC_1 occurs During a scan program, the program is executed as follows.



: Execution without program interruption

: Instant stopping during program execution

: Delay of program execution

• Processing by time period

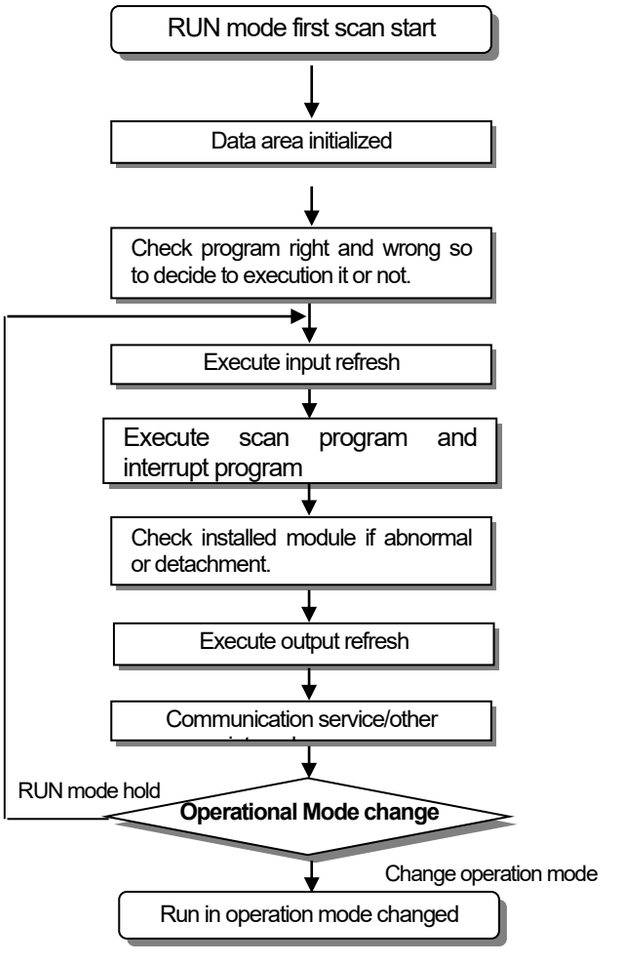
Time(ms)	Detail
0	Scan starts and the scan program P0 starts operation
0~10	Program P0 is executed
10~12	P0 stops due to the execution request for P1 and P1 is executed
17	Execution request for P2
12~20	P1 execution is complete and the suspended P0 resumes
20~22	P0 stops due to the execution request for P1 and P1 is executed
22~25	As P1 execution is complete, the suspended P0 is completely executed.
25	Check the execution request for P2 at the moment when scan program (P0) is complete and execute P2.
25~30	Execute program P2
30~32	P2 stops due to the execution request for P1 and P1 is executed
32~34	As P1 execution is complete, the suspended P2 is completely executed.
34	New scan starts (P0 starts to execute)

5.3 Operation Mode

CPU module's operation status is classified into Run mode, Stop mode and Debug mode.
This describes the operation processing of each operation mode.

5.3.1 Run mode

It is executed program operation normally.



1) Processing when a mode is changed
At the beginning, the data area is initialized and it determines whether to execute it by verifying the effectiveness of program.

2) The contents of operation processing
Execute I/O refresh and program operation.

(1) Execute the interrupt program by detecting the operation conditions of interrupt program.
(2) Inspect the operation and detachment of modules installed.
(3) Process communication service and other internal operation.

5.3 2 Stop Mode

It is the mode in Stop status without program operation. Program transfer is available only in remote STOP mode via XG5000.

1) Processing when changing the mode
Remove the output image area and execute refresh. Therefore, every output data are changed to off state.

2) The contents of operation processing

(1) Execute I/O refresh.
(2) Inspect the operation and detachment of modules installed.
(3) Process communication service and other internal operation.

5.3 3 Debug Mode

As a mode to find any error from a program or trace an operation procedure, the mode can be changed only from STOP mode. In the mode, a user can verify a program while checking the program execution and data.

1) Processing when changing the mode
(1) Initializes the data area at the beginning of mode change.
(2) Clear the output image area and execute input refresh.

2) The contents of operation processing
(1) Execute I/O refresh.
(2) Debugging operation depending on the settings.
(3) After completing debugging operation to the end of the program, it executes output refresh.
(4) Check the normal operation and detachment of modules' installation.
(5) Process communication service and other internal operations.

3) Conditions of debug operation
There are 4 conditions for Debug operation and in case that it reaches break point, it is available to set other type of break point.

Operation condition	Description
Execute by one operation unit (step over)	With operation instruction, it executes one operation unit and then stops.
Execute according to Break Point	If break point is assigned in Program, it stops at the assigned break point.
Execute according to the state of contact point	If the contact area desired to watch and the state (Read, Write, Value) desired to stop are assigned, it stops when the assigned operation occurs at the assigned contact point.
Execute according to scan times	Once designating the scan frequency to operation, it stops after operating as many as the scan frequency designated.

4) Operation method
(1) After setting Debug operation condition at XG5000, execute the operation.
(2) Interrupt Program is available to set whether or not to operate (Enable/Disable) by each Interrupt unit.
(Refer to Chapter 12. Debugging in XG5000 user's manual for more details.

5.3.4 Changing operation mode

1) Operation Mode Change Method

The method to change operation mode are as follows.

(1) Mode change by the mode key of the CPU module
(2) Change by accessing the programming tool (XG5000) to a communication port of CPU
(3) Change of a different CPU module networked by XG5000 accessed to a communication port of CPU
(4) Change by using XG5000, HMI and computer link module, which are networked.
(5) Change by 'STOP' command while a program is operating.

2) Types of operation mode

The operation mode setting is as follows.

Operation mode Switch	Remote allowable switch	XG5000 command	Operation mode
RUN	X	X	Run
Stop	ON	RUN	Remote RUN
		Stop	Remote STOP
		Debug	Debug Run
	OFF	Executing mode change	Previous Operation mode
RUN → STOP	X	-	Stop

(1) Remote mode can be changed with 'Remote: On' and 'Mode switch: Stop'
(2) To change the remote 'RUN' mode to 'Stop' by switch, move the switch (STOP) → RUN → STOP.

Notes

1) If changing the remote 'RUN' mode to 'RUN' mode by switch, the PLC is continuously operating without suspension.
2) Editing during RUN is possible in the 'RUN' mode by switch, but the mode change by XG5000 is restricted. This should be set only in case that remote mode change is not allowed.

5.4 Memory

The CPU module contains two types of memory that can be used by a user. One is Program Memory that saves the user program written by the user to build the system, and the other is Data Memory that provides the device area to save the data during operation.

5.4.1 Program memory

The storage capacity and data area type of the program memory are as follows.

Item	Capacity					
	XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE
Whole program memory area	19MB	10MB			2MB	2MB
System area: • System program area • Backup area	2MB	1MB			1MB	512KB
Parameter area : • Basic parameter area • I/O parameter area • High speed link parameter area • P2P parameter area • Interrupt setting data area • Reserved area	1MB	1MB			512KB	512KB
Execution program area: • Scan program area • Task program area	4MB	2MB			256KB	128KB
Program storage area • Scan program backup area • Task program area • Upload area • User-defined function/Function block area • Parameter initialization data area • Preserved parameter designation data area • Reserved area	12MB	6MB			768KB	384KB

Notes

1) If you download the project programmed by the others except XGI-CPUUN, the program capacity can increase compared to its original program capacity.
2) It can be bigger than 1MB when you download the project programmed by XGI-CPUU/D to the XGI-CPUUN. In contrast, it can be smaller than 1MB when you download the project programmed by XGI-CPUUN to the XGI-CPUU/D.
3) The size of project capacity depends on how to program the project.

5.4.2 Data memory

The storage capacity and data area type of the data memory are as follows.

Item		Capacity					
		XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE
Whole data memory area		**4MB**	**3MB**	**2MB**		**1MB**	**512KB**
System area: • I/O data table • Forcible I/O table • Reserved area		770KB				556KB	238KB
FLAS H area	System flag	8KB		4KB			
	Analogue image flag	8KB				4KB	2KB
	PID flag	16KB				4KB	
	High speed link flag	22KB					
	P2P flag	42KB					
Input image area (%I)		16KB				4KB	
Output image area(%Q)		16KB				4KB	
R/W area(%R/%W)		1024KB		128KB		64KB	32KB
Direct variable area(%M)		512KB	256KB			64KB	32KB
Symbolic variable area(Maximum)		1024KB	512KB			128KB	64KB
Stack area		256KB	256KB			64KB	64KB

5.4.3 Data retain area setting

If the data necessary for operation or the data that occur during operation are to be kept for use even when the PLC stops and resumes operation, the default (auto.) parameter retain is to be used. Alternatively, a part of the M area device may be used as the retain area by parameter setting.

The following table summarizes the features of retain settable device.

Device	Retain setting	Characteristic
Default	O	Enable retain setting when adding variable to automatic variable area
M	O	Enable retain setting in parameter by internal contact point area
K	X	Device keeping the device state during power shutdown Use PID Parameter area(Refer to 14.5 Flag Configuration)
F	X	System flag area
U	X	Analog data register(Retain disabled))
L	X	High speed link/P2P service status contact of communication module(retained) (Refer to appendix 1.2)
N	X	P2P service address area of communication module(retained)
R	X	Exclusive flash memory area(retained)

Notes

1) K, L, N and R devices are basically retained.
2) K, L and N devices can be deleted in the memory deletion window of PLC deletion, an online menu of XG5000.
3) For more information, refer to the Online section of the XG 5000 user's manual.
4) Default and M devices data used as the retain area is retained by the battery in the backup memory and R and W devices data is retained by the flash memory.

1) Data initialization by restart mode

There are 3 restart mode related parameters; default, initialization and retain parameter and the initialization methods of each parameter are as follows in the restart mode. (Restart mode sets the parameters when it starts in a run mode.)

Module / Variable value	Cold	Warm
Default	Initializing as '0'	Initializing as '0'
Retain	Initializing as '0'	Maintaining the previous value
Initial value	Initializing as a user-defined value	Initializing as a user-defined value
Retain & initialization	Initializing as a user-defined value	Maintaining the previous value

- Retain: It means the case of setting the Symbolic variable area (A) or direct variable (M) as a retain. Direct variable(R/W) retain the previous value without reference to Cold/Warm restart mode.

2) Operation in the data retain area

Retain data can be deleted as follows.

- D.CLR switch of the CPU module
- RESET switch of the CPU module (3 seconds and longer: Overall Reset)
- RESET by XG5000 (Overall Reset)
- Deleting memory at STOP mode by XG5000
- Write by Program (initialization program recommended)
- Writing '0' FILL from XG5000 monitor mode

D.CLR clear does not work at RUN mode. To do it, after make sure to change to STOP mode. In addition, the default area can be also initialized when clearing by D.CLR switch.
When instantaneously operating D.CLR, the only retain area is deleted. If maintaining D.CLR for 3 seconds, 6 LEDs blink and at the moment, if the switch returns, even R area data are also deleted.

For the maintenance or reset (clear) of the retain area data according to the PLC operation, refer to the following table.

- When operating in stop mode

Classification	Restart mode	Retain	M area retain	R area
Reset	Cold/ Warm	Maintaining the previous value	Maintaining the previous value	Maintaining the previous value
Overall reset	Cold/ Warm	Initializing as '0'	Initializing as '0'	Maintaining the previous value
DCLR	Cold/ Warm	Initializing as '0'	Initializing as '0'	Maintaining the previous value
DCLR (3sec)	Cold/ Warm	Initializing as '0'	Initializing as '0'	Initializing as '0'
STOP→RUN	Cold	Initializing as '0'	Initializing as '0'	Maintaining the previous value
	Warm	Maintaining the previous value	Maintaining the previous value	Maintaining the previous value

- When operating in RUN mode

Classification	Restart mode	Retain	M area retain	R area
Reset	Cold	Initializing as '0'	Initializing as '0'	Maintaining the previous value
	Warm	Maintaining the previous value	Maintaining the previous value	Maintaining the previous value
Overall reset	Cold/ Warm	Initializing as '0'	Initializing as '0'	Maintaining the previous value

Notes

1) The terms and definitions for 3 types of variables are as follows.
(1) Default variable: a variable not set to maintain the initial/previous value
(2) Initialization(INIT) variable: a variable set to maintain the initial value
(3) Retain variable: a variable set to maintain the previous value

3) Data Initialize

In case of Memory Delete state, the memory of all device shall be cleared as '0' In case of giving the data value at the beginning according to system, please use the initialization task.

Chapter 6 Functions of CPU Module

6.1 Self-diagnosis function

(1)Self-diagnosis function means the function that CPU module diagnoses the error of PLC system itself.
(2) It detects any trouble when turning on the PLC system or any trouble is found during the operation, avoid the system from malfunctioning and taking preventive measures.

6.1.1 Scan watchdog timer

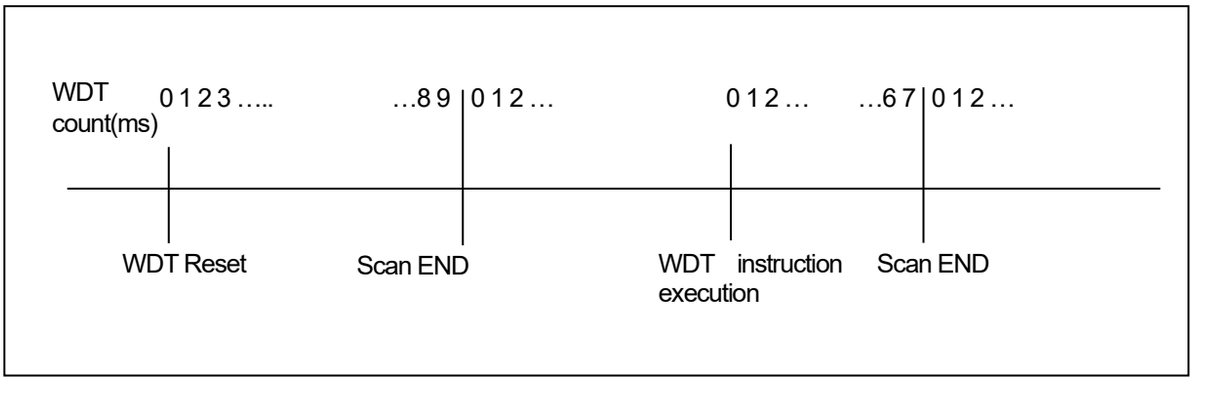
WDT (Watchdog Timer) is the function to detect any program runaway resulting from abnormal hardware/software of PLC CPU module.

1) WDT is a timer used to detect an operation delay from abnormal user program. The detection time of WDT is set in the Basic operations settings section of XG5000.

2) WDT monitors any scan overtime during operation and if it detects any overtime delay, it immediately suspends the PLC operation and turns off every output.

3) If it is expected that programming a specific part (using FOR ~ NEXT command, CALL command and etc) may have an overtime delay of scan watchdog timer while executing a user program, you can clear the timer by using 'WDT' command.
'The 'WDT' command initializes the scan Watchdog time and restarts measuring time from 0. (for the details of WDT command, please refer to the chapter about commands in XGK/XGB Instruction and programing manual).

4) To release a watchdog error, Power on again, operate manual reset switch or change the mode to STOP mode.



Notes

The range of WDT is between 10 ~ 1000ms(unit of 1ms)
(Default time : XG5000 V3.67 or higher = 500ms, V3.66 or lower = 50ms)

6.1.2 I/O Module check

This function is to check the error state of I/O module at the time of start or during operation.

1) In case that the module different from parameter setting is built-in at the time of start or it occurs the error.
1) In case I/O module is removed or occurs the error during operation

The error state is detected and warning lamp (ERR) in front of CPU module and then CPU stops to operate.

6.1.3 Battery Voltage check

If battery voltage falls less than memory backup voltage CPU module detects it and informs of it. The warning lamp(BAT) in front of CPU module shall be ON. For further information, please refer to “4.3.3 Battery life”.

6.1.4 Error History Save Function

CPU module has the function that records the error history and analyzes the cause of the error to take a proper action if the error occurs. (Please refer to “13.5.1 Error Codes List during CPU Operation”.)

It saves each error code to the flag area.

Notes

1) All results of self-diagnosis shall be recorded in flag area.
2) For the details of self-diagnostic and troubleshooting against errors, please refer to 13.5.1 Error Codes List during CPU Operation of Chapter 13. Troubleshooting.

6.1.5 Troubleshooting

1) Fault types

The error occurs by PLC itself error, error in system configuration or error detection from operation results.
The error is classified by critical error mode that stops the operation for the system safety and minor error mode that informs of the error occurrence warning to the user and continues the operation.

The failures of the PLC system are mainly caused by the below.

- PLC hardware error
- Error in system configuration
- Operation error during execution of user programs
- Errors detection caused by external device failure

2) Operation mode when occurring error

If error occurs, PLC system records the error comments in flag and stops to operate or continues the operation according to error mode.

(1) PLC hardware error
In case of critical error that the normal operation of PLC such as CPU module, power module is disabled, the system ‘stop’s and in case of minor error such as battery error, it continues to operate.

(2) Error in system configuration
This error occurs when hardware configuration of PLC is different from the configuration identified in software, and the system stops.

(3) Operation error during user program executing
In case of numerical operation error as a trouble occurring while a user program is operating, error flag (_ERR) and error latch flag(_LER) are displayed and the system continues to operate. While performing the operation, if the operation time exceeds the

scan watchdog time or the built-in I/O module cannot be controlled normally, the system stops.

Notes

Error latch flag is maintained as long during a scan program if an error occurs in scan program. Every time a command is executed, error flag is cleared and set just after a command generating an error is executed.

(4) Error detection by external device error

This is to detect the error of external control device by PLC user program. In case of critical error, the system stops but in case of minor error, the system indicates the error state only and continues to operate.

Notes

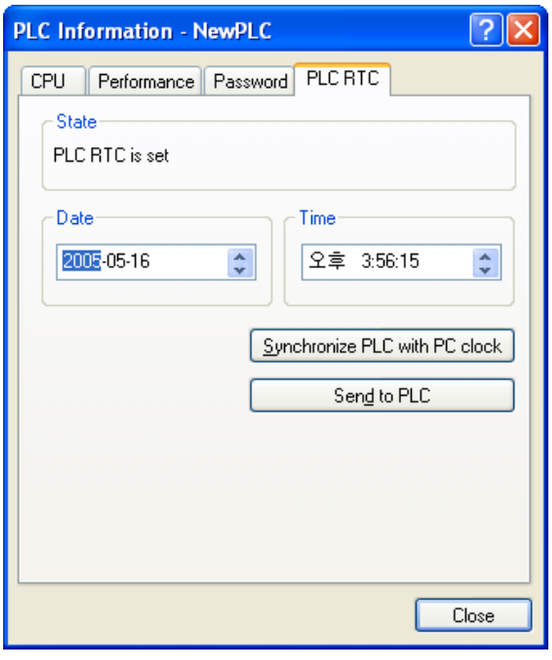
1) When critical error occurs and detects, the fault number is saved into the flag (_ANNUM_ER).
2) When minor error is detected, the fault number is saved into the flag (_ANNUM_WAR).
3) For further information on the Flag, please refer to Appendix 1 Flag List.

6.2 Clock

CPU module has a built-in clock device (RTC). RTC continues the clock action by battery backup even in case of power off or Momentary Power Failure.
It is available to perform the time management such as operation history or failure history of system by using a clock data of RTC. The current time of RTC can be updated in F device related to the clock every scan.

1) Read from XG5000 and Setting

Click 'PLC RTC' from 'PLC information' in the online mode.



The time of PLC RTC is displayed. If the time of PLC RTC is wrong, you can adjust the time correct by setting the time directly to transmit to PLC or selecting 'Synchronize with PC clock' that transmits the time of PC connected to PLC.

2) Read by RTC Read Flag

The flag can be monitored as shown in the table below.(Thursday, June 18, 2015 9:47:38)

Flags to read the clock	Example	Description
_RTC_TIME[0]	16#15	RTC TIME[Year]
_RTC_TIME[1]	16#06	RTC TIME[Month]
_RTC_TIME[2]	16#18	RTC TIME[Date]
_RTC_TIME[3]	16#09	RTC TIME[Hour]
_RTC_TIME[4]	16#47	RTC TIME[Minute]
_RTC_TIME[5]	16#38	RTC TIME[Second]
_RTC_TIME[6]	16#04	RTC TIME[Day]
_RTC_TIME[7]	16#20	RTC TIME[Age]

3) RTC Data Modification by Program

It is available for the user to set the RTC value by program.
This function is used when setting the time manually through external Digit switch or making the system that corrects the time periodically through network.

In the 'RTC-SET' function block, input a value into the below flag area and insert the time in a clock in scan END.

Flags for RTC writing	Content	Setting range
_RTC_TIME_USER[0]	Year	1984 ~ 2163
_RTC_TIME_USER[1]	Mon.	Jan ~ Dec
_RTC_TIME_USER[2]	Sun.	1(day), ~ 31 (day)
_RTC_TIME_USER[3]	Hour	0~23 hrs
_RTC_TIME_USER[4]	Minute	0 ~ 59 minutes
_RTC_TIME_USER[5]	Second	0 ~ 59 seconds
_RTC_TIME_USER[6]	Day	0 ~ 6
_RTC_TIME_USER[7]	Age	19 ~ 21

Alternatively, instead of using function blocks, it is also possible to enter clock data into the above area and turn on '_RTC_WR' in order to input the time.

- In case that time data does not match with the form, the value is not allowed to write.
  (But if the week does not match, it shall be set as it is without error detection.)

- After writing the clock data, check whether it is rightly set by monitoring Reading RTC device.

4) Weekday Expression Method

numbers	0	1	2	3	4	5	6
Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

5) Time error

The RTC's error may be different depending on usual temperature. Time tolerance according to temperature per day was indicated on the table as below.

Operation temperature	Max error (second/day)	Normal case(second/day)
0 °C	- 4.67 ~ 1.38	-1.46
25 °C	- 1.64 ~ 2.42	0.43
55 °C	- 5.79 ~ 0.78	-2.29

Notes

1) RTC may not have the clock data written at first.
2) When using a CPU module, you must set the clock data correctly at first.
3) In case that the data out of range of clock data is written in RTC, it may not work normally.
   Example) 14M 32D 25H
4) RTC may stop or occur error because of battery error. If new clock data is written in RTC, the error shall be cleared.
5) For more information about the time date modification by program, refer to the XGI Instructions user's manual.

6.3 Remote Functions

CPU module may change operation by communication as well as by key switches mounted on the module. To operate it remotely, it is necessary to set 'REM' switch (no. 2 dip switch of 4 pin dip switch) of the CPU module 'ON' and move 'RUN/STOP' switch to 'STOP' position.

1) Type of remote operation

(1) Operated by connecting XG5000 through USB or RS-232C port mounted in CPU module.
(2) Available to operate other PLC connected to the network of PLC in the state that XG5000 is connected to CPU module.
(3) The PLC operation is controlled by HMI software and other applications through the dedicated communication.

2) Remote RUN/STOP

(1) Remote RUN/STOP performs RUN/STOP when the deep switch of the CPU module is in the REMOTE position and the RUN/STOP switch is in the STOP position.
(2) It is convenient when CPU module is located at a position hard to control or when CPU module within control panel is to control RUN/STOP function remotely

3) Remote DEBUG

(1) Remote DEBUG is the function to perform DEBUG operation in the state that deep switch of CPU module is in REMOTE position and the RUN/STOP switch is in the STOP position. DEBUG operation means the function performed according to the operation condition assigned for program operation.
(2) Convenient function in case of checking the execution state of program or the contents of each data from Debugging work.

4) Remote Reset

(1) Remote Reset is the function to reset a CPU module by remote operation in case that the error occurs in the place not possible to operate a CPU module.
(2) This supports 'Reset' and "Overall Reset' as like an operation by switch.

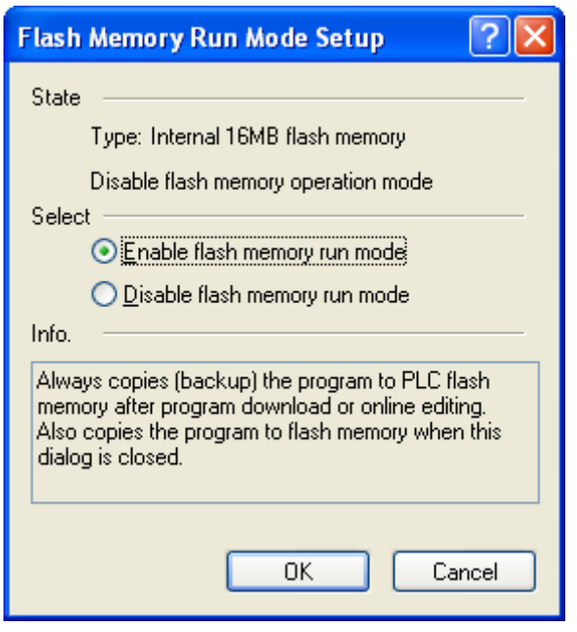
Notes
1) For operation method of Remote Function, please refer to 'Online' part from XG5000 user's manual.

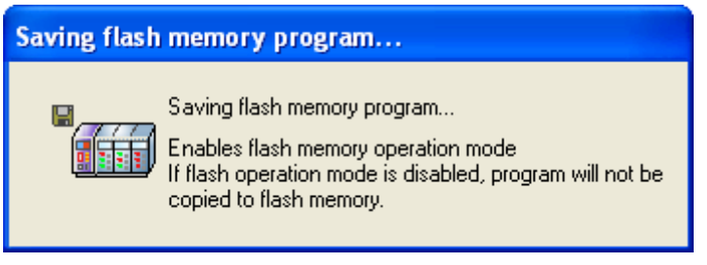
5) Flash memory operation mode 1

(1) What is the flash operation mode? When the data in the program RAM (RAM) is damaged, it means operating with the program back-up in the flash. If "Flash memory operation mode setting" is selected, operation starts after being transferred to the program memory of the CPU module when the operation mode changes to RUN in restart or other modes.

(2) Flash Memory Operation Mode Setting

Online → Set Flash Memory → Check the 'Enable flash memory operation mode' → Click OK.
When you click OK, "Saving flash memory program… "Window appears and the program is copied from the user program area to flash.





Notes

1) Initial mode is Disable flash memory run mode.

2) Set Enable flash memory run mode at once, it keeps the mode On until change to Off on the XG5000.

3) Change of the flash memory operation mode is available regardless of RUN/STOP Mode.

4) Flash memory operation mode setting is On in the XG5000 online menu in case of flash memory operation mode setting after program debugging is completed with the flash memory operation mode setting Off.

5) In the case of online modification in the state of “Flash memory operation mode”, the changed program is applied upon restart only when the program is normally written to the flash memory. If the PLC is restarted before the program is saved in the flash memory, it operates with the flash memory program which saved before error instead of the changed program.

6) If the flash memory operation mode is changed from off to on, the flash memory operation mode is applied only when the flash memory write is completed. If the PLC restarts before the program write is complete, the “flash memory operation mode” is canceled.

(3) Flash memory operation method

If you want to change the restart or operation mode the PLC system to RUN, depending on the setting of the flash operation mode, it works as follows.

Flash Memory Operation Mode Setting	Operation contents
ON	If contents of the flash memory and program memory is different or if the contents of program memory is damaged due to decreasing in the battery voltage, then operation after downloading the program stored in the flash memory to program memory.
OFF	The CPU recognizes that there is no program in the flash memory and operates with the program stored in the internal RAM.

(4) The saving data in flash memory mode

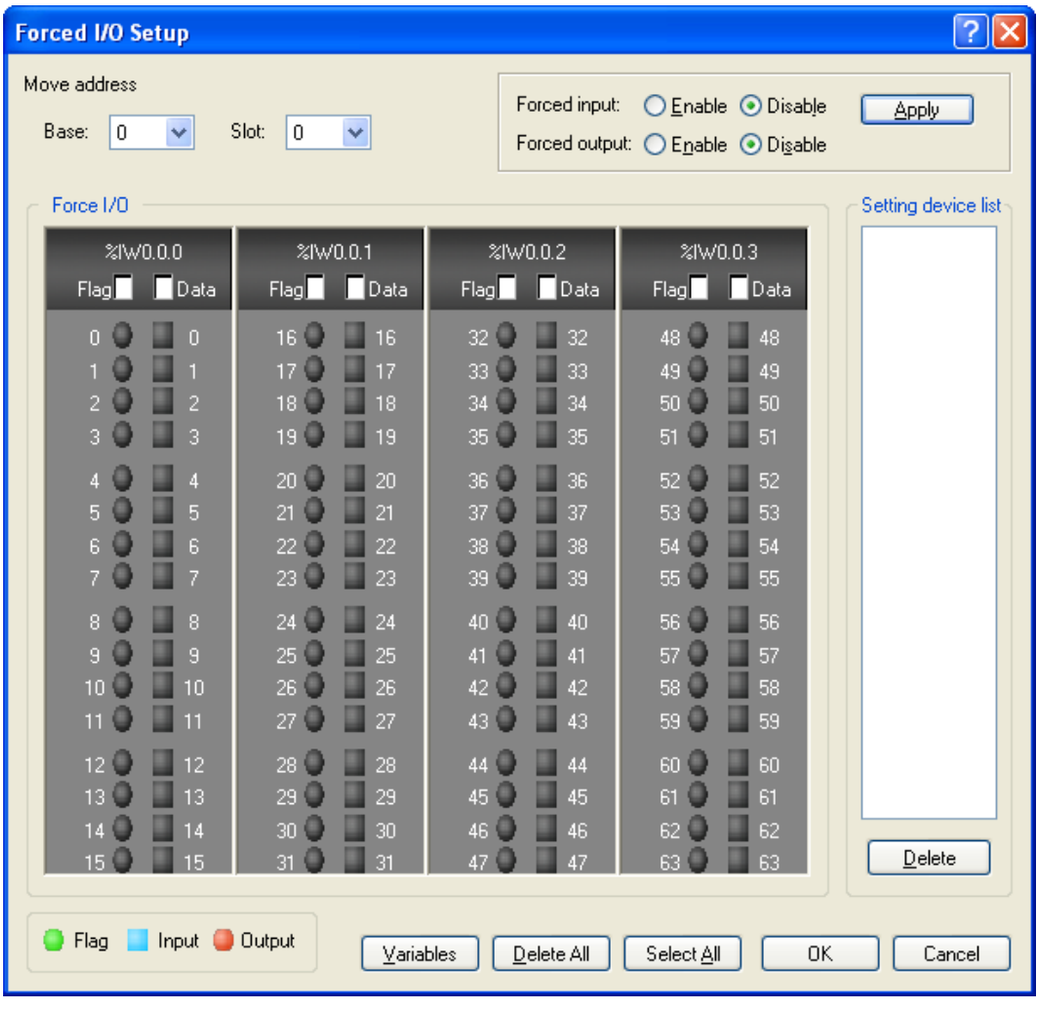
CPU Mode	Saved data
Run	Local Ethernet Parameter
	Communication parameter
Stop	Program change
	Basic parameter
	Local Ethernet Parameter
	Communication parameter
	Special parameter
	Automatic variable
	Comment
Modification during run	Program change
	Automatic variable
	Comment

6.4 Forced I/O On/Off Function

The forced I/O function is used to turn On/Off I/O areas by force regardless of the results of program execution.

6.4.1 Forced I/O setup Method

Click 'Forced I/O setup' in online mode.



To set Forced I/O, select the proper flag of a contact and data check box of data.
To set "1", select the flag and data of a bit and then and then select a flag
To set "0", select a flag only, not the data corresponding to the bit.
The setting is applied when forced input or output is enabled.
For further information of setting method, please refer to the XG5000 user's manual

Notes

1) The Forced I/O setting is only available for the local I/O module.
2) It can not be set in remote I/O module (Smart I/O module).
3) The "CHK LED" is turned On if Forced I/O is selected.
4) The set forced I/O is kept even if a new program is downloaded.

6.4.2 Forced On/Off Execution Point and Execution Method

(1) Forced Input

Input replaces the data of contact point set as forced On/Off from the data read in input module at the time of input refresh with the forced setting data and updates the input image area. Therefore, the user program operates with actual input data and with forced setting data.

(2) Forced output

Output replaces the data of contact point set as forced On/Off from the data of output image area having the operation result, at the time of output refresh after completion of user program operation execution, with the forced setting data and makes prints in output module. In case of output other than input, the data of output image area does not change by forced On/Off setting.

(3) Notices in using forced I/O function

- It work from the time of setting each I/O 'Enable' after setting the forced data.
- Although the actual I/O modules are not equipped, the forced input can be set.
- Even if there are power Off -> On, operation mode change, program downloading and operation by reset key, previous On/Off setting data is kept in CPU module. Forced I/O data shall be cleared when operating Overall reset.
- Even in Stop mode, Force I·O data is not removed.
- To set new data from the beginning, it is necessary to deselect all settings of I/O by using' Delete All' option.

6.5 Direct I/O Operation

By refreshing I/O contact by means of 'DIREC_IN, DIREC_OUT' function, it can be conveniently used when directly reading the state of input contact while a program is being executed to use for operation or directly outputting operation results to input contacts.

Notes

1) For further information of DIREC_IN, DIREC_OUT function, please refer to XGI Instruction manual.
2) When DIREC_IN, DIREC_OUT Function is used, the value is applied immediately and it is prior to Forced I/O.

6.6 Saving Operation History

There are 4 types of operation history; error history, mode conversion history, power down history and system history.
The occurrence time, frequency, operating details of each event are saved in the memory and you can conveniently monitor the data through XG5000. Operation history is kept saving in PLC unless it is deleted by XG5000 etc.

6.6.1 Error History

It saves the error history occurred during operation.

- Save the error code, date, time, error details.
- Save up to 2,048 EA.
- Automatic release in case memory backup is broken by battery voltage falling.

6.6.2 Mode Conversion History

It saves the information on the changed mode and time when changing the operation mode.

- Saves the date, time, mode conversion contents
- Save up to 1,024 EA.

6.3.3 Power Shutdown History

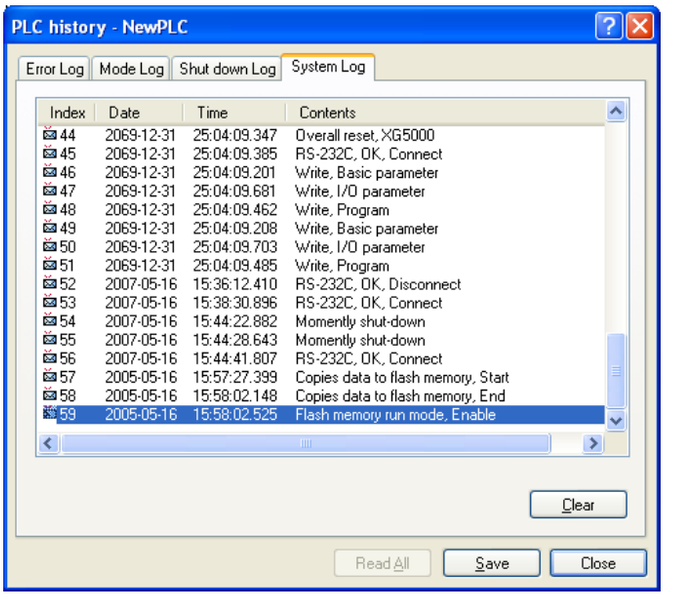
It saves the time that the power is on or off with ON/OFF information.

- Save ON/OFF information, date and time
- Save up to 1,024 EA.

6.6.4 System History

It saves the operation history of the system occurred during operation.

- Save the date, time and operation change contents
- Save XG5000 operation information and key switch change information
- Save momentary power failure and network operation status
- Save up to 2,048 EA.



Notes

1) The saved information will not be deleted before selecting the menu from XG5000 to delete.
2) If the index number saved is over 100, select Read All to check previous history.

6.7 External Device Error Diagnosis

This is the flag provided so that the user can detect the error of external device and realize the stop and warning of system easily. By using this flag, it enables to indicate the error of external device without preparing the complicated program and monitor the error position without XG5000 or source program.

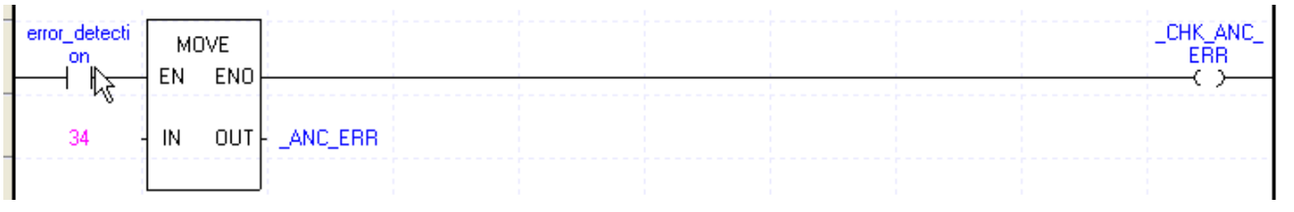
1) Detection and classification of external device error

(1) The error of external device is detected by the user program and classified by critical error that needs to stop the PLC operation and minor error (warning) that continues the PLC operation and only indicates the error state, according to the contents of detected error.
(2) For critical error, '_ANC_ERR flag' is used and for minor error, '_ANC_WAR flag' is used.

2) Detecting critical error of external device

(1) If a critical error of external device is detected in a user program, it writes the error type according to error type defined in a system flag 'ANC_ERR' and turn On CHK_ANC_ERR flag. Then it checks at the completion of a scan program. At the moment, if a fault is displayed, it is displayed in '_ANNUN_ER' of '_CNF_ER', which is the representative error flag. Therefore the PLC turns off every output module (depending on the output control setting of basic parameter) and it has the same error status with PLC fault detection. At the moment, P.S LED and ERR LED are On.
(2) If the error occurs, the user can find the cause of error by using a XG5000 or by monitoring '_ANC_ERR flag'.
(3) To turn off ERR LED and P.S LED , which are On by critical error flag of external device, it is necessary to reset the PLC or turn it off and on again.

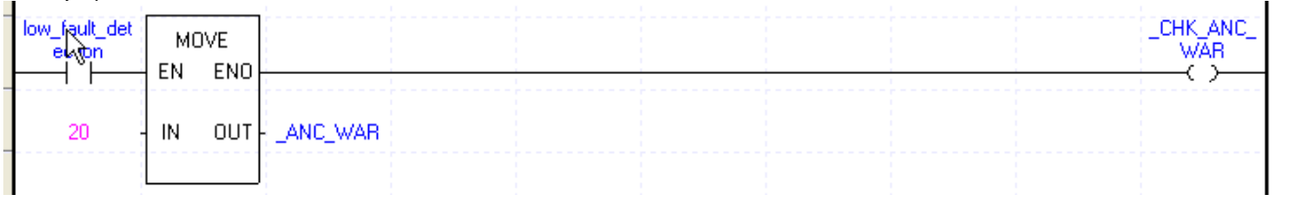
■ Example)



3) Detecting minor error of external device

(1) If a minor error of external device is detected in a user program, it writes the error type according to error type defined in a system flag 'ANC_ERR' and turn On CHK_ANC_WAR flag. If a warning is displayed by checking at the time of completion of the scan program, '_ANNUM_WAR' of '_CNF_WAR', which is the representative system warning flag, is On. At the moment, P.S LED and CHK LED are On.
(2) If a warning occurs, a user can check the causes by using XG5000. Alternatively, a user can check the causes by directly monitoring '_ANC_WAR' flag.
(3) When _CHK_ANC_WAR flag is OFF, P.S LED and CHK LED are off and the display of '_ANNUN_WAR' on '_CNF_WAR' is reset.

Example)



6.8 Fault Mask Function

6.8. 1 Applications and Operations

- Fault Mask is the function to continue the program execution even if the module error occurs during operation. The module assigned as Fault Mask shall be operated normally before error occurs.
- If the error occurs in the module where the Fault Mask is set, the corresponding module stops the operation but the whole system continues the operation.
- If the module error occurs during operation, CPU module will set the error flag and the front “PS LED” shall be “on”. If connecting XG5000, you can see the error state.

6.8. 2 Fault Mask Setting Method

- Fault mask can be set by the online menu of XG5000. For the details, please refer to the XG5000 user’s manual.
- Fault mask cannot be set by a program. Only fault mask flag monitoring is possible by program.
  (Refer to Appendix 1 Flag List)

6.8. 3 Release of Fault Mask

The Fault Mask is released only by the following methods.

- Setting release from online menu of XG5000.
- Releasing by overall reset.
- Automatic release in case memory backup is broken by battery voltage falling.

The Fault Mask shall not be released in the following cases. Please be careful

- Power Off → On
- Change of operation mode
- Program download
- Operation of reset key (However, if it is longer than 3 seconds, release it)
- Data clear

Notes

If releasing the Fault Mask in the state that error flag of CPU module is not deleted even if the cause of error occurrence is removed, the system stops. Before releasing the Fault Mask flag, check the state of error flag.

6.9 I/O Module Skip

6.9.1 Applications and Operations

I/O module skip function is a function to exclude a designated module from operation during operation. For the assigned module, it is disabled to update I/O data or diagnose the error from the assigned moment. It is allowed to use only in case of temporary operation excluding the error part.

6.9. 2 Setting Method and I/O Data Processing

- It can be set at the unit of I/O module.
  (For further information of setting method, please refer to the XG5000 user's manual)

- As Input (I) image area stops input refresh, it keeps the value before skip setting. But, at this time. it is effective to operate the image by forced On/Off.

- Actual output of output module shall be OFF in case of skip setting but output (Q) image area is changed according to the user program operation regardless of skip setting. It is not allowed to operate output value of output module by forced On/Off after skip setting.

- The execution of skip function is same when using direct I/O function.

6.9. 3 Release of Skip Function

The skip of I/O module shall be released only by the same method as setting.
- Setting release from online menu of XG5000.
- Releasing by overall reset.
- Automatic release in case memory backup is broken by battery voltage falling.

The Fault Mask shall not be released in the following cases. Cares should be taken.
- Power Off → On
- Change of operation mode
- Program download
- Operation of reset key (However, if it is longer than 3 seconds, release it)
- Data clear

Notes

1) When releasing a skip, if the error occurs in the corresponding module, the system may stop. Release the skip while the fault mask is set to confirm the normal operation of the module, and then release the skip.

6.10 Changing Module during Operation

XGK system enables to change the module during operation. But, as the change of module during operation may occur the abnormal operation of whole system, special attention should be taken. Just follow the procedure assigned in this user's manual.

6.10. 1 Notices in Using

- Not allowed to change the base and power module.
- Some part of communication module (XGL-PMEA, XGL-DMEA) needs the network setting (Sycon used) for communication.
- In case of module change, match the joint part of the lower part of base and module correctly before inserting. A wrong insertion may cause system down.

6.10. 2 Replacing modules

There are 2 kinds of module change method.

(1) Using "Module changing wizard" of XG5000.
For further information, please refer to the XG5000 user's manual.

(2) Module replacement can be performed using the switch of the CPU module.
(1) Set "Module change switch (M.XCHG)" in front of CPU module as right (ON).
(2) Remove the module. (PS LED is On)
(3) Install a new module. (PS LED is Off when successfully installing a module).
(4) Check whether a new module successfully operates.
(5) Move the "Module Replacement Switch (MXCHG)" to the left(Off)

(3) A module can be also manually replaced by using XG5000.
(1) Set fault mask to a slot to replace a module by XG5000.
(2) Set skip to a slot to replace a module by XG5000.
(3) Replace a module.
(4) Release the skip setting of a part by XG5000.
(5)Check the operation (by detail error flag: please refer to Appendix 1)
If there is a problem with the replacement module and you want to replace it with another module again, you must follow the procedure from (1) again.
(6) Release fault mask and restore to the normal operation.

Notes

1) During this process, the I/O module operating on the same base may momentarily generate erroneous data.
2) Other modules on the same base may be faulty due to an abnormality in the replaced module. It is safe to set a fault mask on the entire device.

Notes

1) When replacing the module, take safety into consideration and cut off the load power before implementing it.
2) When replacing the input module, consider the designation of the input image status using forced On/Off, etc.

⚠ Warning

When installing the module, it may cause an abnormal operation if the lower connection is not mounted on the base completely.

6.11 I/O No. Allocation Method

The allocation of I/O No. is to give the address to the I/O terminal of each module in order to read the data from input module and print the data to output module when performing the operation.
The I/O number allocation is related with base number, slot position and module type. The number is allocated by the fixed method in the XGI-CPUU.

To view the examples, please refer to “2.3 Basic System.”

6.12 Program Modification during Operation

It is available to modify program or some parameter without stopping the control operation during PLC operation.
For further information, please refer to XG5000 user’s manual.

The items available to modify during operation are as below.

- Modify program
- Modify communication parameter

Notes

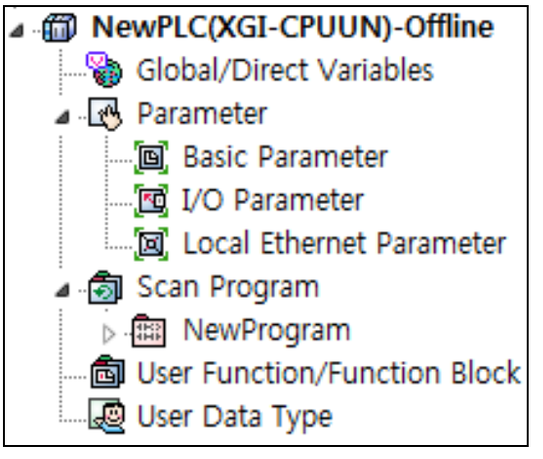
Basic parameters and IO parameters cannot be modified during operation. If parameter modification is necessary, modify it after stopping the operation.

6.13 Local Ethernet function (XGI-CPUUN)

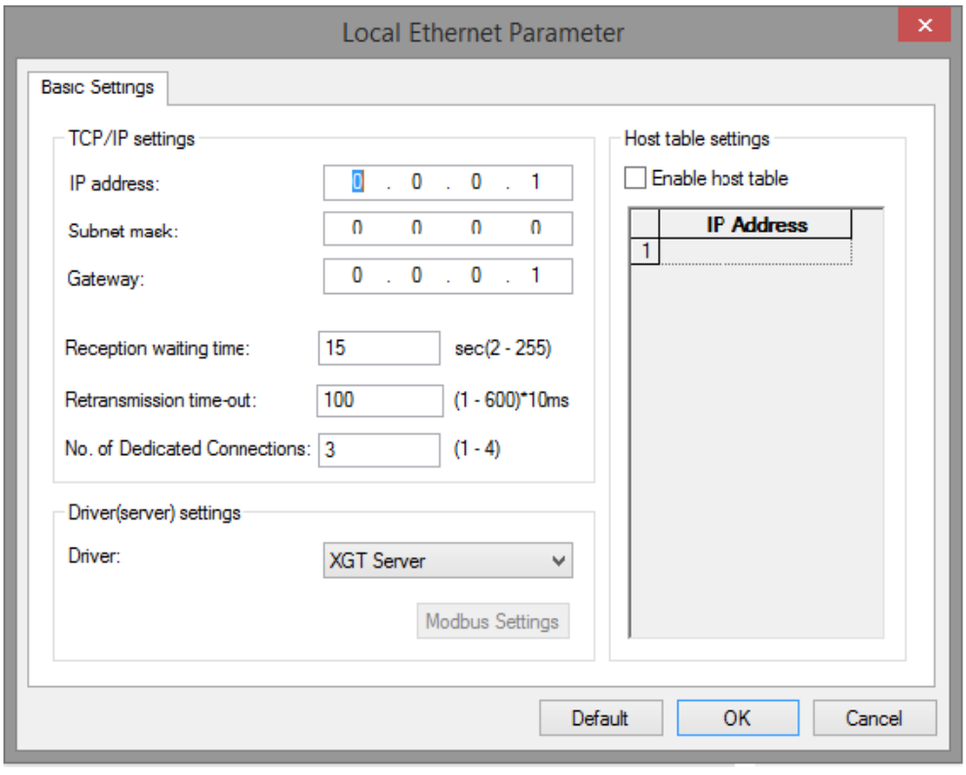
XGI-CPUUN can carry out the functions of Ethernet server using internal local Ethernet function without extra Enet I/F module.

6.13.1 Local Ethernet Parameter Settings

Make a new in project. Then user can see Local Ethernet Parameters as shown below figure.



If user selects Local Ethernet Parameter item, Local Ethernet Parameter setting window will be displayed.



To use the Local Ethernet function, user should set the parameters.

(1) TCP/IP setting

Classification	Content
IP address	Set the IP address to be assigned to the CPU module as a server. * Precautions: There can be a communications disruption if you set more than 2 servers as a same IP
Subnet mask	Value necessary to check if destination station is on the same network of the applicable station.
Gateway	IP address of Gateway or Router to transmit/receive data through the public network or a network different from the network where the applicable FEnet module is included.
Receive Standby time(sec)	If there is no request during the specified time from the host PC or HMI(Human Machine Interface) connected for dedicated communication, it will end the dedicated service connection regardless of normal ending procedures supposing that the higher level system is with error. This time is used in dedicated service to reset the channel when any error occurs on the destination station or the cable is disconnected. (available range is 2 ~ 255 sec)
Retransmission time(10ms)	It is the time it takes CPU to send a data to the destination station if the destination station does not answer the data sent by applicable station during setting time. (available range is 10 ㎳ ~ 6000 ㎳) * Precautions: Retransmission time-out should be set depending on the network situation. If the setting time is too long, it takes a long time to resend a data in case of data missing. This will deteriorate the network performance. But if the setting time is too short, there is a chance to make a frequent disconnection or increase the load to the network.
No. of Dedicated Connections	Number of TCP dedicated services accessible at a time. (Up to 4 can be set)

(2) Driver (Server) setting

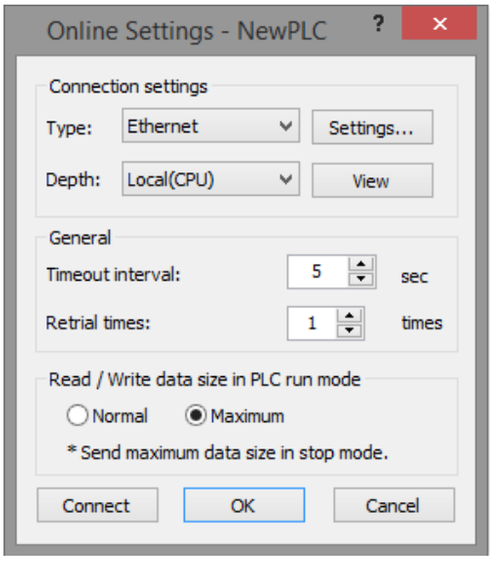
Classification	Content
XGT server	It is set when operated as dedicated communication server.
Modbus TCP/IP server	It is set when it operates as the Modbus server driver.

(3) Host table setting

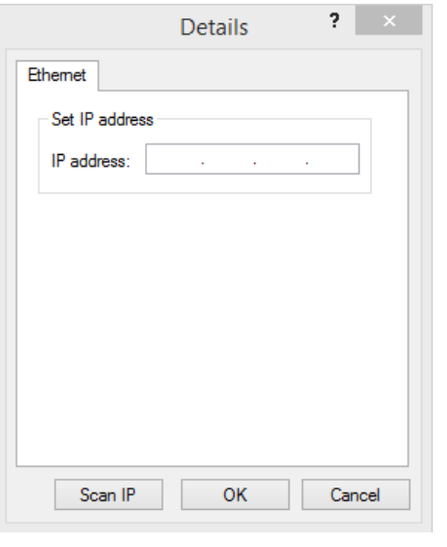
Classification	Content
Enable host table	Access allowed to applicable module of IP address registered in host table. Unregistered client (IP address) is prohibited from connection when enabled.

6.13.2 Local Ethernet Connection with XG5000

After finishing Local Ethernet Parameter settings, download the settings to the CPU, then user can connect to XG5000.
Select Online Settings and set the options as shown below figure.
Select XG5000 connection setting and select the following options for connection option setting.

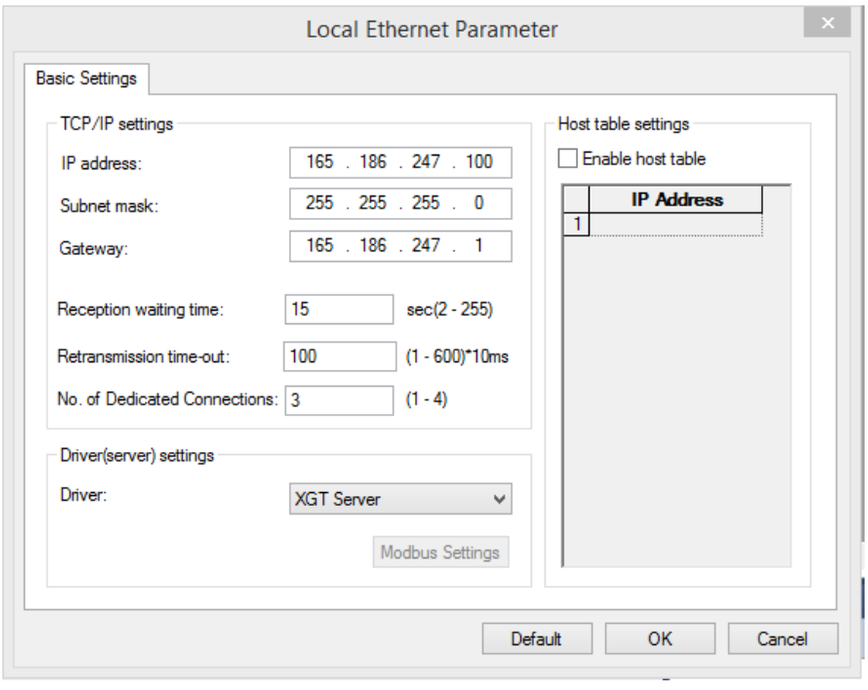


After that, press the Set button to display the detailed setting screen as shown below. Enter the IP address of the local Ethernet parameter previously set and click OK. Also, if you click the Find IP button, you can see the IP information currently available for access.



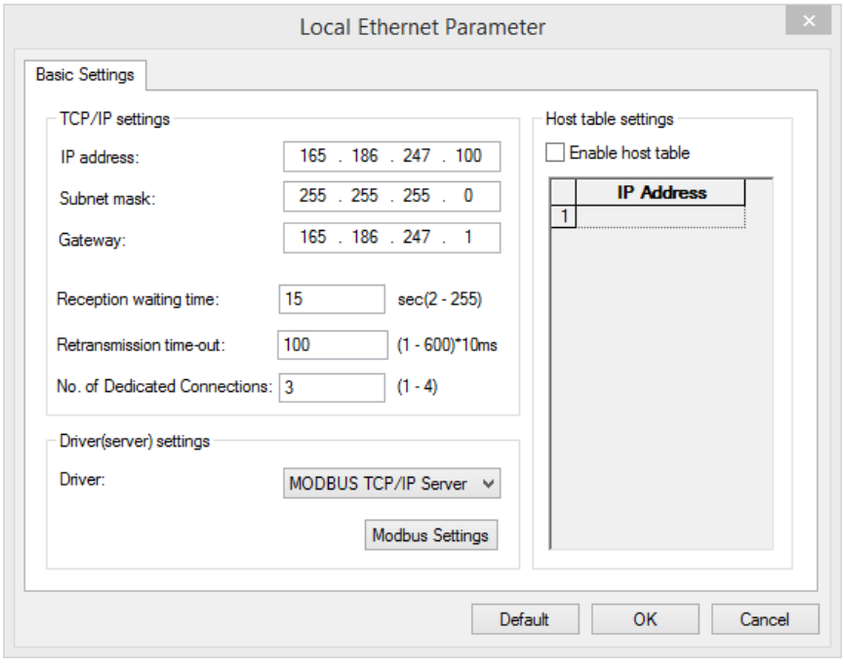
6.13.3 Local Ethernet Connection with XGT Server

Set the Local Ethernet Parameters as shown below figure. User can use it as a XGT Server (LS ELECTRIC dedicated Protocol Communication).

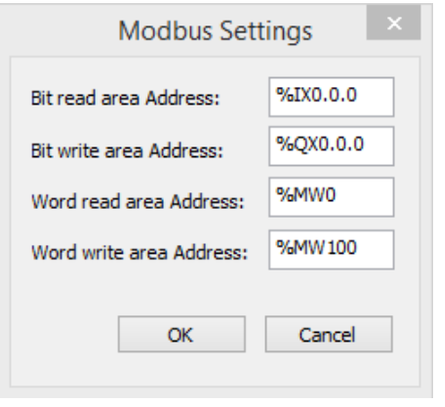


6.13.4 Local Ethernet Connection with TCP / IP Server

If the driver (server) setting is set to Modbus TCP/IP server as below in the local Ethernet parameter, it operates as a Modbus server at the request of the client using Modbus protocol.



Below figure is about Modbus settings.



Notes

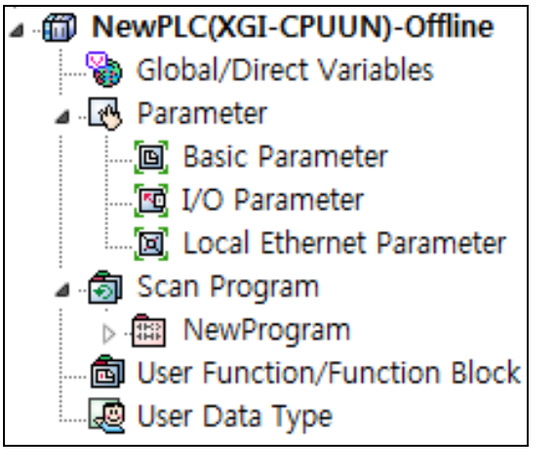
1) Modbus TCP/IP server connection function allows RST packet transmission depending on the network condition. (TCP/IP protocol) So the user devices connecting to CPU module should have RST packet process.
2) Connection to user devices can be disconnected for retransmission time-out. Retransmission time-out = retransmission time-out value(set in the Local Ethernet Parameter window) x 30ms
3) Too much Network loads can affect a scan time. So user should consider appropriate network loads for CPU scan time.

6.14 Transmit/receive bandwidth expansion: Backplane common RAM expansion (XGI-CPUUN)

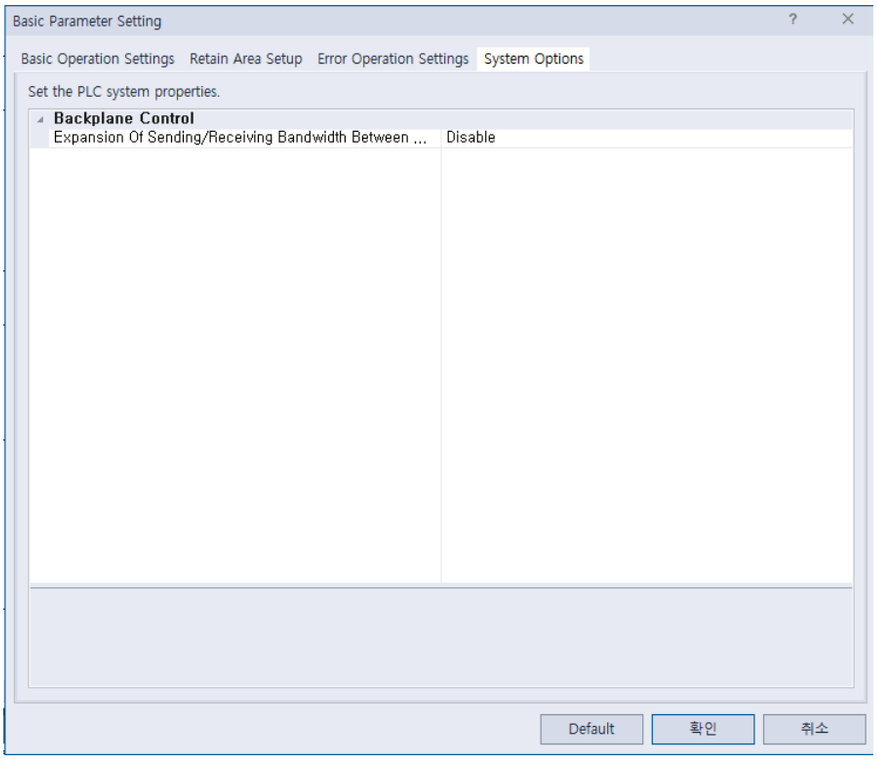
XGI-CPUUN can expand the common RAM of the backplane using the system option function to enable large-capacity data exchange.

6.14.1 Parameter setting for sending/receiving bandwidth expansion between CPU/modules

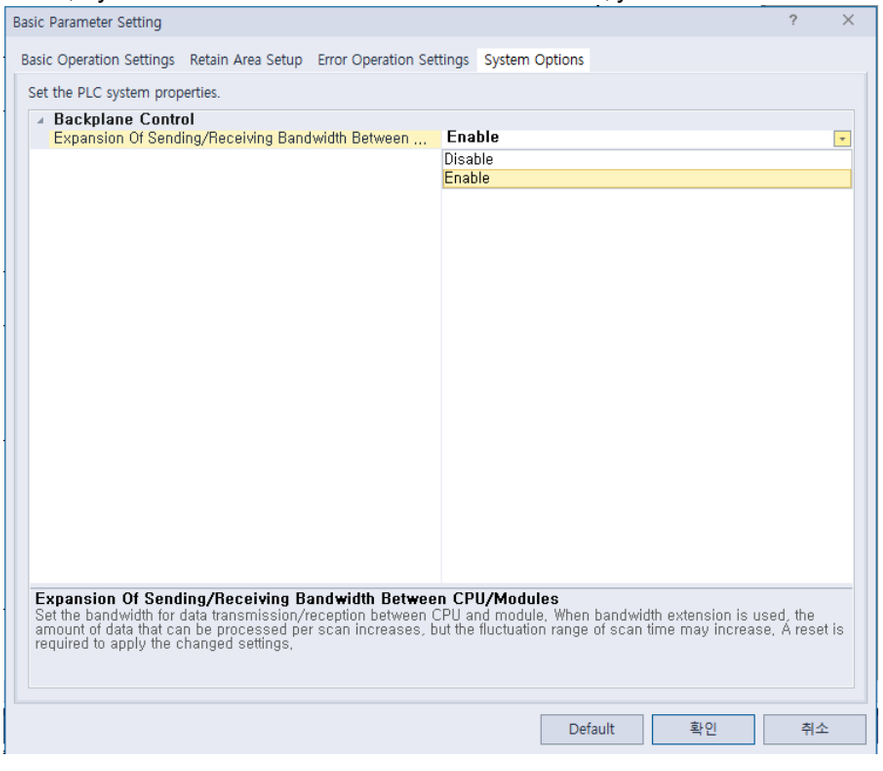
If you create a new project in XG5000, you can see basic parameter items as below.



If you select the basic parameter parameter item and click the system option tab, the following setting window appears.

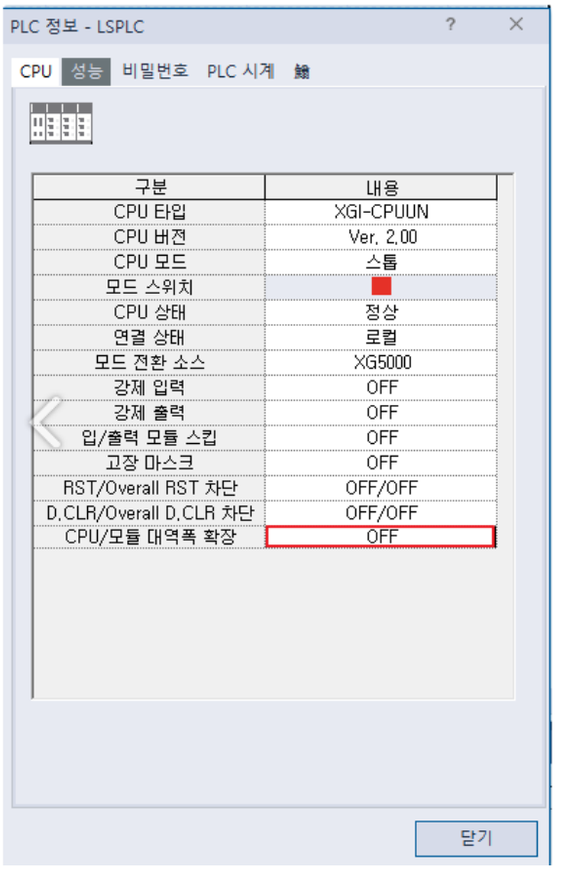


Disabled by default. Therefore, if you want to use the Bandwidth Extension feature, you must select Enabled.

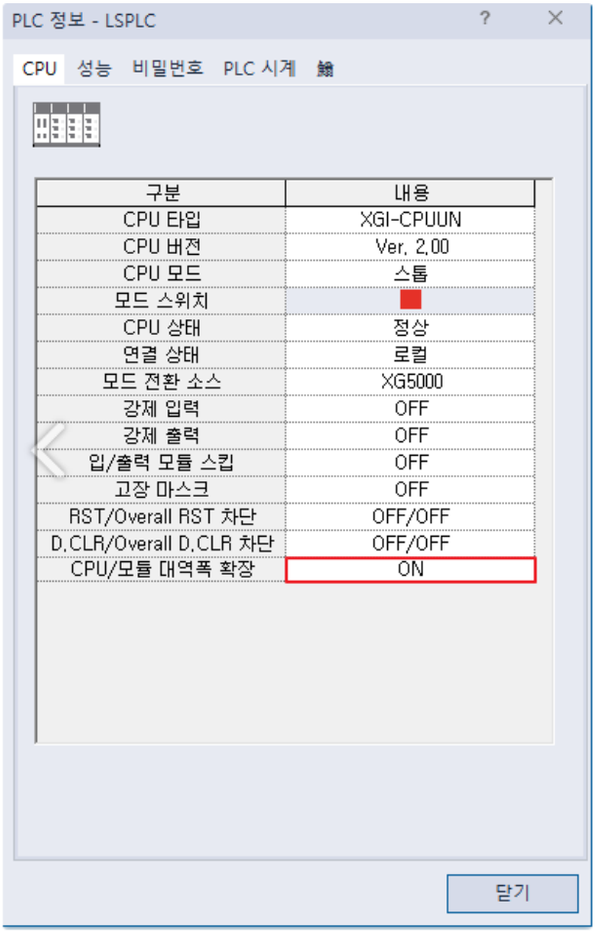


6.14.2 Check the current CPU/module transmit/receive bandwidth is extended in the PLC information

After completing the parameter setting of 6.14.1 for sending/receiving bandwidth expansion between PUs/modules normally, after downloading to the CPU, you can check if the sending/receiving bandwidth has been expanded in the performance tab of Read PLC Information.
A CPU reset must be performed in order for the bandwidth extension to take effect.
- Initial state not applied



- The state in which parameter settings have been applied. After applying, be sure to reset the CPU.



Notes

1) Even if the function setting of CPU/module transmission/reception bandwidth expansion (backplane common RAM expansion) function setting of the basic parameter is changed, if the CPU is not reset, the setting value is not reflected in the PLC information and operates in the previous mode.
2) The function can be checked when using the communication module. (XGF-EFMTB V8.70 or later)
3) Smart expansion is possible up to 127 stations.
4) When applying the function, the scan time may increase. Caution should be exercised when applied to systems that are sensitive to scan time.

Chapter 7 I/O Module

7.1 Cautions for Selecting Module

Here describes the notices when selecting digital I/O module used for XGI series.

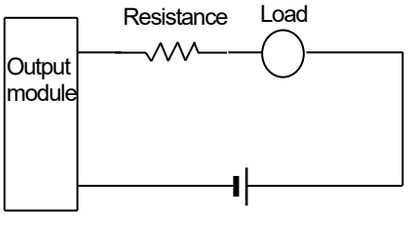
(1) For the type of digital input, there are two types such as current sink input and current source input.
For DC input module, as the wiring method of external input power varies according to such input type, consider the specification of input connecting device when selecting.

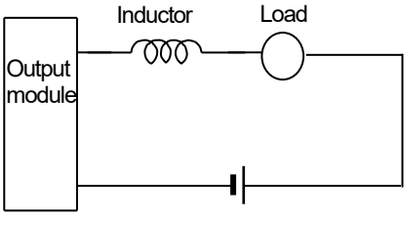
(2) Max. Simultaneous input point depends on the module type. It depends on the input voltage and ambient temperature. Be sure to check specifications of input module before use.

(3) In case that open/close frequency is high or it is used for conductive load open/close, use Transistor output module or triac output module as the durability of Relay Output Module shall be reduced.

(4) For output module to run the conductive (L) load, max. open/close frequency should be used by 1second On, 1 second Off.

For output module, in case that counter timer using DC/DC Converter as a load was used, Inrush current may flow in a certain cycle when it is ON or during operation. In this case, if average current is selected, it may cause the failure. Accordingly, if the previous load was used, it is recommended to connect resistor or inductor to the load in serial in order to reduce the impact of Inrush current or use the large module having a max. load current value.

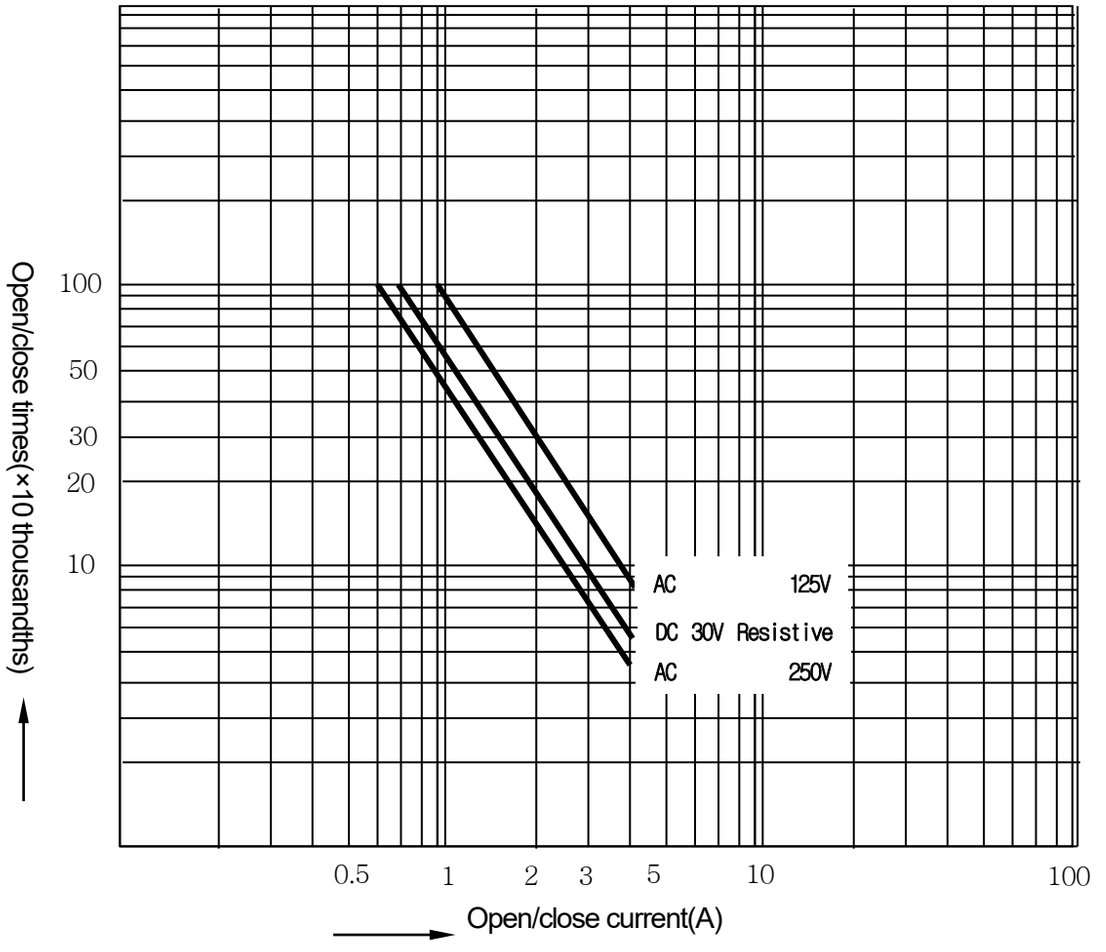




(6) For output module, fuse is not possible to change. This is to prevent of burnout of external wiring in case of short circuit of module output. This may not protect output module. In case that output module is destroyed in error mode except short circuit, fuse may not work.

(7) Relay life of Relay output module is shown as below.

Max. life of Relay used in Relay output module is shown as below.



(8) XGK terminal block is not allowed to use solder less terminal attached with sleeve. The clamped terminals suitable for terminal strip are as follows. (JOR 1.25-3:Daedong Electricity).

(9) The cable size connected to terminal block should be twisted pair 0.3~0.75 ㎟, thickness less than 2.8 ㎜. As cable varies the allowable current by insulation thickness, cares should be taken.

(10) The attachment torque of fixed screw of module and the screw of terminal block should be within the range as below.

Attachment part	Attachment Torque range
I/O module terminal block screw (M3 screw)	42 ~ 58 N·㎝
I/O module terminal block fixed screw (M3 screw)	66 ~ 89 N·㎝

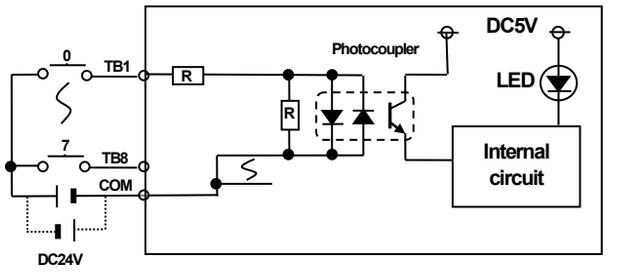
(11) Transistor output module (XGQ-TR4A, XGQ-TR8A) has Thermal Protector Function.
Thermal Protector Function is the protection function for overload and overheats.

7.2 Digital Input Module Specification

7.2.1 8 point DC24V Input Module(Source/Sink type)

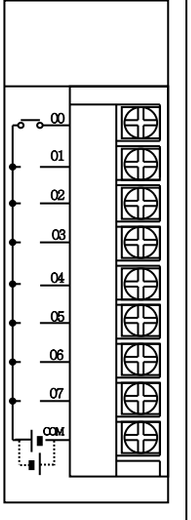
Specifications \ Type		DC input module XGI-D21A
Input point		8 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		None
On voltage / On current		DC19V or higher / 3 mA or higher
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		16 point/COM
Proper cable size		Twisted pair 0.3~0.75 ㎟ (external diameter 2.8mm or less)
Applicable solderless terminal		R1.25-3 (not allowed to use a sleeve attached compressed terminal.)
Current consumption (㎃)		20mA
Operating indicator		Input On LED On
External connection method		9 point terminal block connector (M3 X 6 screw)
Weight		0.1 kg

Circuit configuration



* COM : TB9

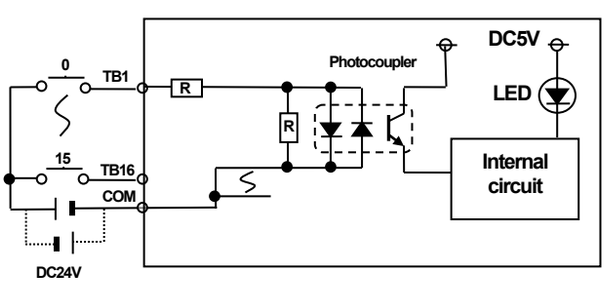
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	COM
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-



7.2.2 16 point DC24V Input Module(Source/Sink type)

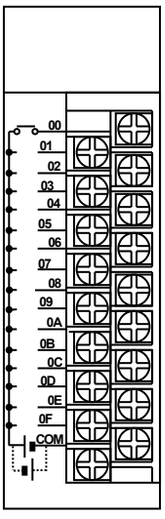
Specifications \ Type		DC input module XGI-D22A
Input point		16 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		None
On voltage / On current		DC15V or higher / 3 mA or higher
Off voltage / Off current		DC12V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		16 point/COM
Proper cable size		Twisted pair 0.3~0.75 ㎟ (external diameter 2.8mm or less)
Applicable solderless terminal		R1.25-3 (not allowed to use a sleeve attached compressed terminal.)
Current consumption (㎃)		30mA
Operating indicator		Input On LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.12 kg

Circuit configuration



* COM : TB17

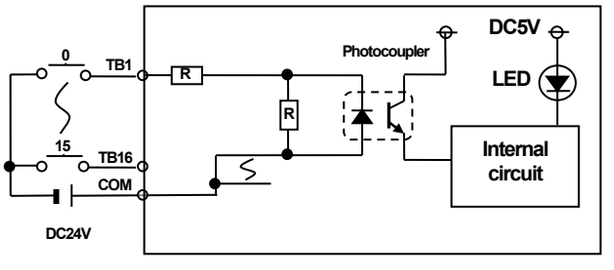
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



7.2.3 16 point DC24V Input Module(Source type)

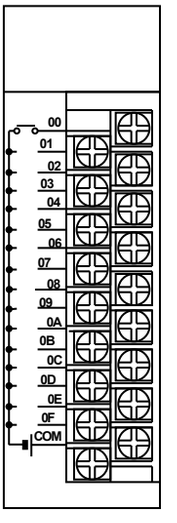
Specifications \ Type		DC input module XGI-D22B
Input point		16 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		None
On voltage / On current		DC19V or higher / 3 mA or higher
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		16 point/COM
Proper cable size		Twisted pair 0.3~0.75 ㎟ (external diameter 2.8mm or less)
Applicable solderless terminal		R1.25-3 (not allowed to use a sleeve attached compressed terminal.)
Current consumption (㎃)		30mA
Operating indicator		Input On LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.12 kg

Circuit configuration



* COM : TB17

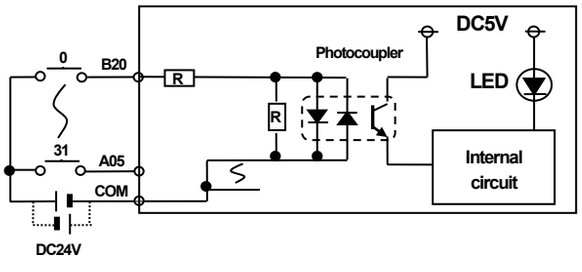
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



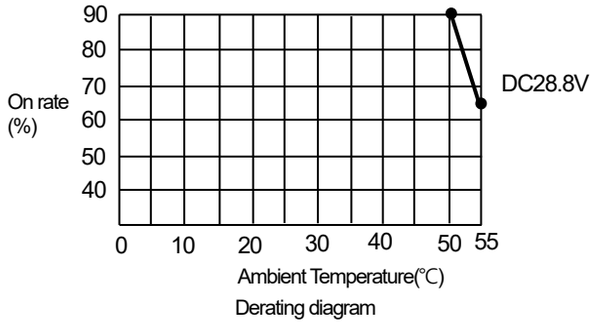
7.2.4 32 point DC24V Input Module(Source/Sink type)

Specifications \ Type		DC input module XGI-D24A
Input point		32 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		DC19V or higher / 3 mA or higher
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		32 point/COM
Proper cable size		0.3 ㎟
Current consumption (㎃)		50mA
Operating indicator		Input On LED On
External connection method		40 point connector
Weight		0.1 kg

Circuit configuration

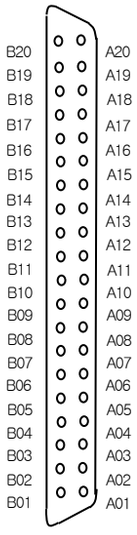


* COM : B02, B01, A02, A01



Derating diagram

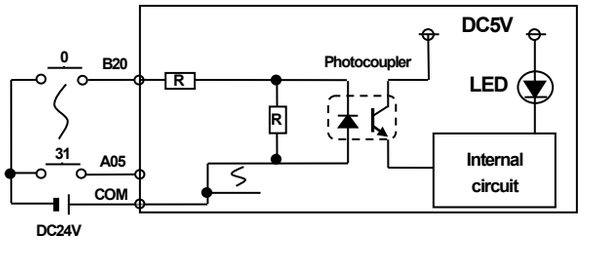
No	Contact Point	No	Contact Point
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	COM	A02	COM
B01	COM	A01	COM



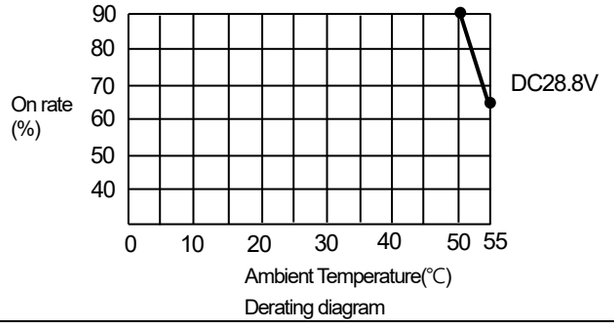
7.2.5 32 point DC24V Input Module (Source type)

Specifications \ Type		DC input module XGI-D24B
Input point		32 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		DC19V or higher / 3 mA or higher
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		32 point/COM
Proper cable size		0.3 ㎟
Current consumption (㎃)		50mA
Operating indicator		Input On LED On
External connection method		40 point connector
Weight		0.1 kg

Circuit configuration

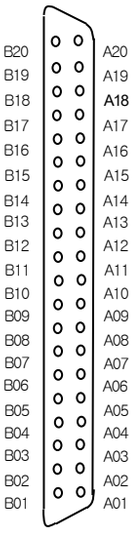


* COM : B02, B01, A02, A01



Derating diagram

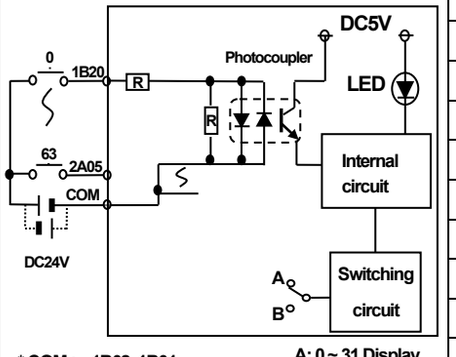
No	Contact Point	No	Contact Point
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	COM	A02	COM
B01	COM	A01	COM

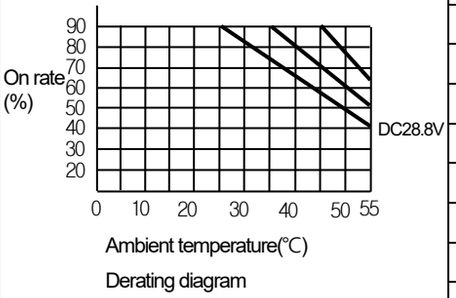


7.2.6 64 point DC24V Input Module (Source/Sink type)

Specifications \ Type		DC input module
		XGI-D28A
Input point		64 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		DC19V or higher / 3 mA or higher
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		32 point/COM
Proper cable size		0.3 ㎟
Current consumption (㎃)		60mA
Operating indicator		Input On, LED On (32 point LED On by switch operation)
External connection method		40 point connector×2ea
Weight		0.15 kg

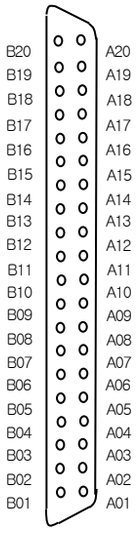
Circuit configuration





Derating diagram

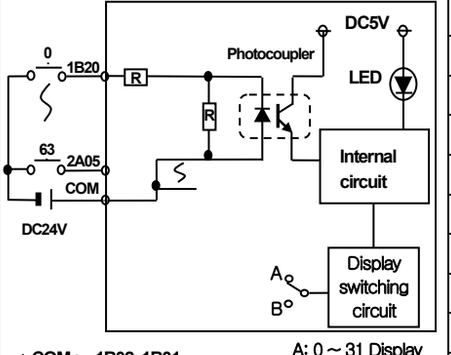
No	Contact Point	No	Contact Point	No	Contact Point	No	Contact Point
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	24	2B12	40	2A12	56
1B11	9	1A11	25	2B11	41	2A11	57
1B10	10	1A10	26	2B10	42	2A10	58
1B09	11	1A09	27	2B09	43	2A09	59
1B08	12	1A08	28	2B08	44	2A08	60
1B07	13	1A07	29	2B07	45	2A07	61
1B06	14	1A06	30	2B06	46	2A06	62
1B05	15	1A05	31	2B05	47	2A05	63
1B04	NC	1A04	NC	2B04	NC	2A04	NC
1B03	NC	1A03	NC	2B03	NC	2A03	NC
1B02	COM	1A02	NC	2B02	COM	2A02	NC
1B01	COM	1A01	NC	2B01	COM	2A01	NC



7.2.7 64 point DC24V Input Module (Source type)

Specifications \ Type		DC input module XGI-D28B
Input point		64 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		About 4 ㎃
Operation voltage range		DC20.4~28.8V (within ripple rate 5%)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		DC19V or higher / 3 mA or higher
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms(set by CPU parameter) default: 3ms
Dielectric withstanding voltage		AC560V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 ㏁ or higher by insulation resistor
Common method		32 point/COM
Proper cable size		0.3 ㎟
Current consumption (㎃)		60mA
Operating indicator		Input On, LED On (32 point LED On by switch operation)
External connection method		40 point connector×2ea
Weight		0.15 kg

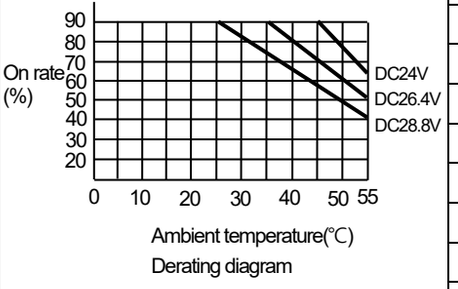
Circuit configuration



* COM : 1B02, 1B01 / 2B02, 2B01

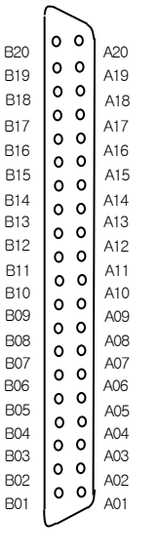
A: 0 ~ 31 Display

B: 32 ~ 63 Display



Derating diagram

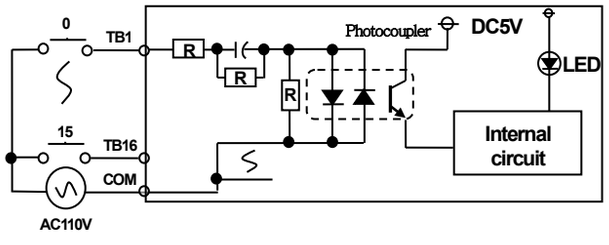
No	Contact Point	No	Contact Point	No	Contact Point	No	Contact Point
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	24	2B12	40	2A12	56
1B11	9	1A11	25	2B11	41	2A11	57
1B10	10	1A10	26	2B10	42	2A10	58
1B09	11	1A09	27	2B09	43	2A09	59
1B08	12	1A08	28	2B08	44	2A08	60
1B07	13	1A07	29	2B07	45	2A07	61
1B06	14	1A06	30	2B06	46	2A06	62
1B05	15	1A05	31	2B05	47	2A05	63
1B04	NC	1A04	NC	2B04	NC	2A04	NC
1B03	NC	1A03	NC	2B03	NC	2A03	NC
1B02	COM	1A02	NC	2B02	COM	2A02	NC
1B01	COM	1A01	NC	2B01	COM	2A01	NC



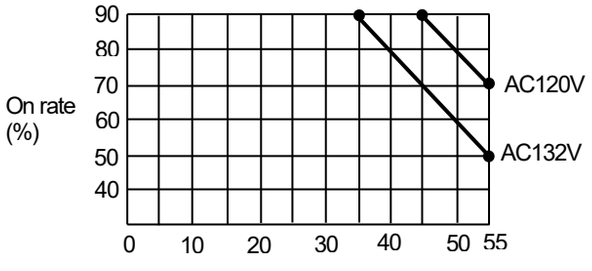
7.2.8 16 point AC110V Input Module

Specifications \ Type		AC Input module XGI-A12A
Input point		16 points
Insulation method		Photo coupler insulation
Rated input voltage		AC100-120V(+10/-15%) 50/60 Hz(±3 Hz) (distortion rate < 5%)
Rated input current		About 8 mA (AC100,60 Hz) , About 7 mA (AC100,50 Hz)
Inrush current		Max. 200 mA 1 ms (AC132V)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		AC80V or higher / 5 mA or higher (50 Hz, 60 Hz)
Off voltage / Off current		AC30V or lower / 1 mA or lower (50 Hz, 60 Hz)
Input resistance		About 12 kΩ(60 Hz), About 15 kΩ(50 Hz)
Response time	Off → On	15 ms or less(AC100V 50 Hz,60 Hz)
	On → Off	25 ms or less(AC100V 50 Hz,60 Hz)
Dielectric withstanding voltage		AC1780V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 MΩ or higher by insulation resistor
Common method		16 point/COM
Proper cable size		Twisted pair 0.3~0.75 ㎟ (external diameter 2.8mm or less)
Applicable solderless terminal		R1.25-3 (not allowed to use a sleeve attached compressed terminal.)
Current consumption (mA)		30mA
Operating indicator		Input On LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.13 kg

Circuit configuration

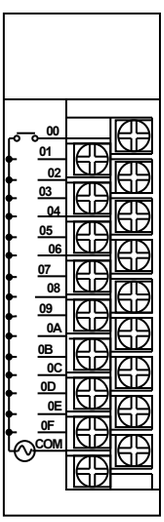


* COM : TB17



Derating diagram

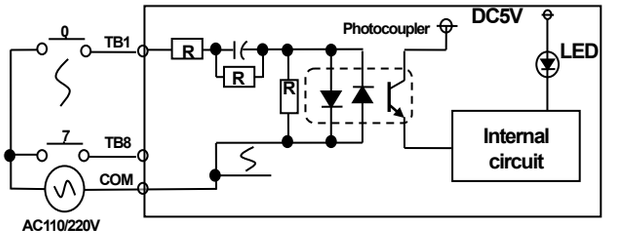
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



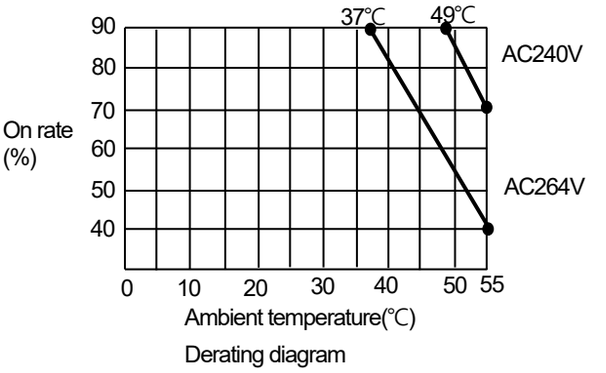
7.2.9 8 point AC220V Input Module

Specifications \ Model name		AC Input Module XGI-A21A
Input point		8 points
Insulation method		Photo coupler insulation
Rated input voltage		AC100-240V(+10/-15%) 50/60 Hz(±3 Hz) (distortion rate < 5%)
Rated input current		About 17 mA (AC200,60 Hz) , About 14 mA (AC200,50 Hz)
Inrush current		Max. 500 mA 1 ms (AC264V)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		AC80V or higher / 5 mA or higher (50 Hz, 60 Hz)
Off voltage / Off current		AC30V or lower / 1 mA or lower (50 Hz, 60 Hz)
Input resistance		About 12 kΩ(60 Hz), About 15 kΩ(50 Hz)
Response time	Off → On	15 ms or less(AC200V 50 Hz,60 Hz)
	On → Off	25 ms or less(AC200V 50Hz,60Hz)
Dielectric withstanding voltage		AC2830V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 MΩ or higher by insulation resistor
Common method		8 point/COM
Proper cable size		Twisted pair 0.3~0.75 mm² (external diameter 2.8mm or less)
Applicable solderless terminal		R1.25-3 (not allowed to use a sleeve attached compressed terminal.)
Current consumption (mA)		20mA
Operating indicator		Input On LED On
External connection method		9 point terminal block connector (M3 X 6 screw)
Weight		0.13 kg

Circuit configuration

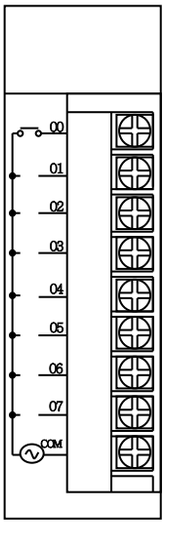


* COM : TB9



Derating diagram

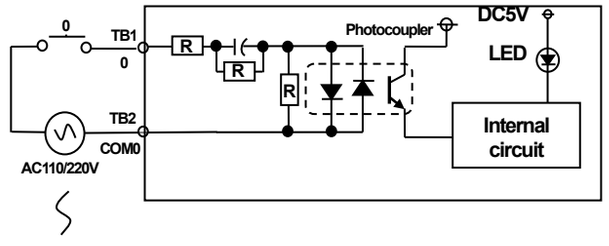
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	COM
-	-
-	-
-	-
-	-
-	-
-	-
-	-
-	-

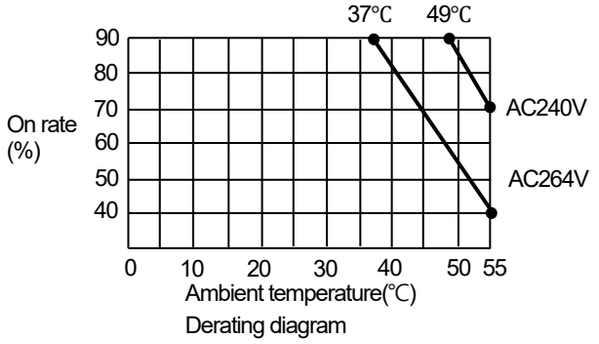


7.2.10 8 point AC220V Input Module (Isolated contact point)

Specifications \ Model name		AC Input Module XGI-A21C
Input point		8 points
Insulation method		Photo coupler insulation
Rated input voltage		AC100-240V(+10/-15%) 50/60 Hz(±3 Hz) (distortion rate < 5%)
Rated input current		About 17 mA (AC200,60 Hz) , About 14 mA (AC200,50 Hz)
Inrush current		Max. 500 mA 1 ms (AC264V)
Input Derating		Refer to the below Derating diagram.
On voltage / On current		AC80V or higher / 5 mA or higher (50 Hz, 60 Hz)
Off voltage / Off current		AC30V or lower / 1 mA or lower (50 Hz, 60 Hz)
Input resistance		About 12 kΩ(60 Hz), About 15 kΩ(50 Hz)
Response time	Off → On	15 ms or less(AC200V 50 Hz,60 Hz)
	On → Off	25 ms or less(AC200V 50Hz,60Hz)
Dielectric withstanding voltage		AC2830V rms/3 Cycle (Altitude 2,000m)
Insulation resistor		10 MΩ or higher by insulation resistor
Common method		1 point/COM
Proper cable size		Twisted pair 0.3~0.75 ㎟ (external diameter 2.8mm or less)
Applicable solderless terminal		R1.25-3 (not allowed to use a sleeve attached compressed terminal.)
Current consumption (mA)		20mA
Operating indicator		Input On LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.13 kg

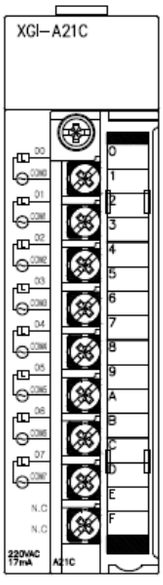
Circuit configuration





Derating diagram

Terminal block	Contact point name
TB1	0
TB2	COM0
TB3	1
TB4	COM1
TB5	2
TB6	COM2
TB7	3
TB8	COM3
TB9	4
TB10	COM4
TB11	5
TB12	COM5
TB13	6
TB14	COM6
TB15	7
TB16	COM7
TB17	NC
TB18	NC

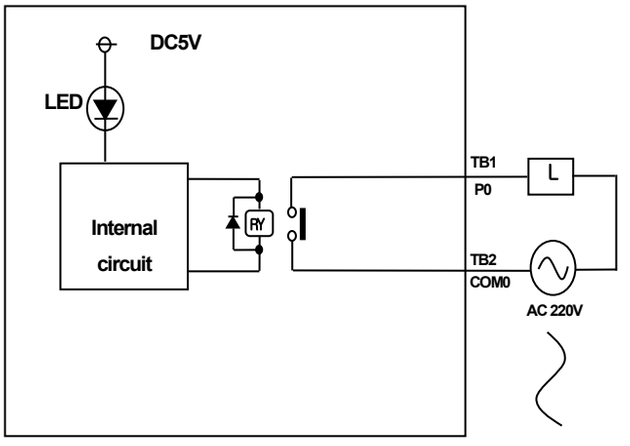


7.3 Digital output module specification

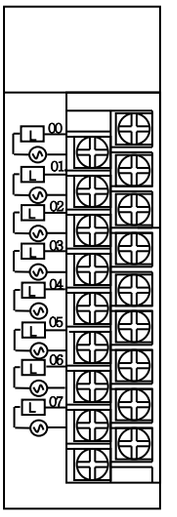
7.3.1 8 point relay output module

Specification \ Type		Relay output module
		XGQ-RY1A
Output point		8 points
Insulation method		Relay insulation
Rated load voltage/current		DC24V 2A(resistive load) / AC220V 2A(COSΨ = 1)
Min.load voltage/current		DC5V, 1mA
Max. load voltage/current		AC250V 2A, DC125V 2A
Off leakage current		0.1mA (AC220V, 60Hz)
Max. On/Off frequency		3,600 times/hr
Surge absorber		None
life span	Mechanical	20 millions times or higher
	Electrical	Rated load voltage / Current 100,000 times or more
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or higher
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or higher
		DC24V / 1A, DC100V / 0.1A (L, R = 7ms) 100,000 times or higher
Response time	Off → On	10ms or less
	On → Off	12ms or less
Common method		1 point / 1COM (isolated contact point)
Current consumption		260mA (when all point On)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.13kg

Circuit configuration



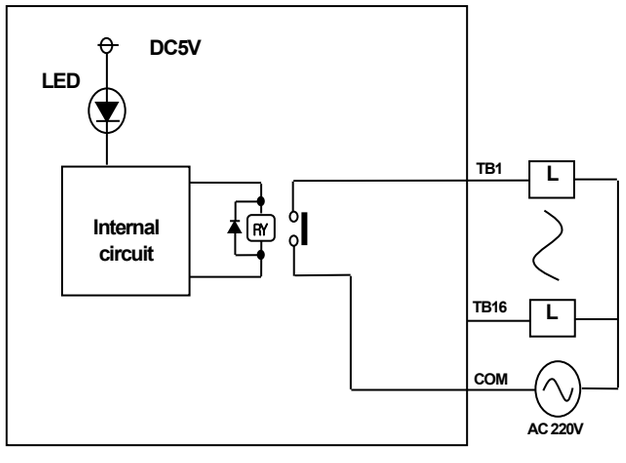
Terminal block	Contact point name
TB1	0
TB2	COM0
TB3	1
TB4	COM1
TB5	2
TB6	COM2
TB7	3
TB8	COM3
TB9	4
TB10	COM4
TB11	5
TB12	COM5
TB13	6
TB14	COM6
TB15	7
TB16	COM7
TB17	NC
TB18	NC



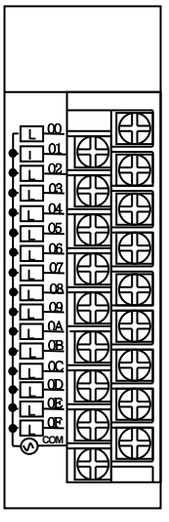
7.3.2 16 point relay output module

Specification \ Type		Relay output module
		XGQ-RY2A
Output point		16 points
Insulation method		Relay insulation
Rated load voltage/current		DC24V 2A(resistive load) / AC220V 2A(COSΨ = 1)
Min.load voltage/current		DC5V 1mA
Max. load voltage/current		AC250V 2A, DC125V 2A
Off leakage current		0.1mA (AC220V, 60Hz)
Max. On/Off frequency		3,600 times/hr
Surge absorber		None
life span	Mechanical	20 millions times or higher
	Electrical	Rated load voltage / Current 100,000 times or more
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or higher
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or higher
		DC24V / 1A, DC100V / 0.1A (L, R = 7ms) 100,000 times or higher
Response time	Off → On	10ms or less
	On → Off	12ms or less
Common method		16 point / 1COM
Current consumption		500mA (when all point On)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.17kg

Circuit configuration



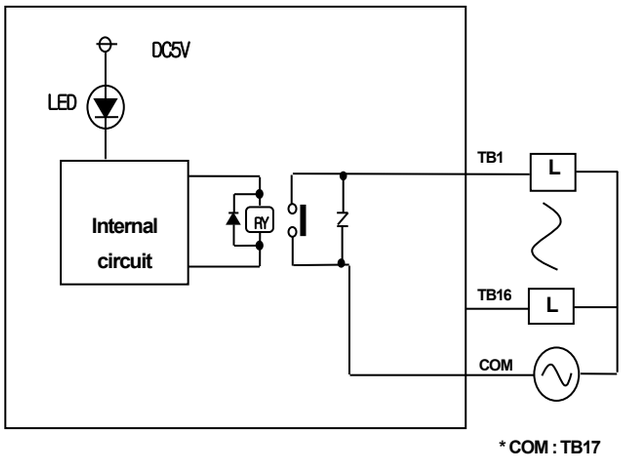
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



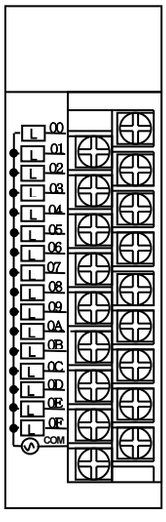
7.3.3 16 point Relay Output Module (Surge Killer Type)

Specification \ Type		Relay output module
		XGQ-RY2B
Output point		16 points
Insulation method		Relay insulation
Rated load voltage/current		DC24V 2A(resistive load) / AC220V 2A(COSΨ = 1)
Min.load voltage/current		DC5V 1mA
Max. load voltage/current		AC250V 2A, DC125V 2A
Off leakage current		0.1mA (AC220V, 60Hz)
Max. On/Off frequency		3,600 times/hr
Surge absorber		Varistor (387 ~ 473V), C.R absorber
life span	Mechanical	20 millions times or higher
	Electrical	Rated load voltage / Current 100,000 times or more
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100,000 times or higher
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100,000 times or higher
		DC24V / 1A, DC100V / 0.1A (L, R = 7ms) 100,000 times or higher
Response time	Off → On	10ms or less
	On → Off	12ms or less
Common method		16 point / 1COM
Current consumption		500mA (when all point On)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.19kg

Circuit configuration



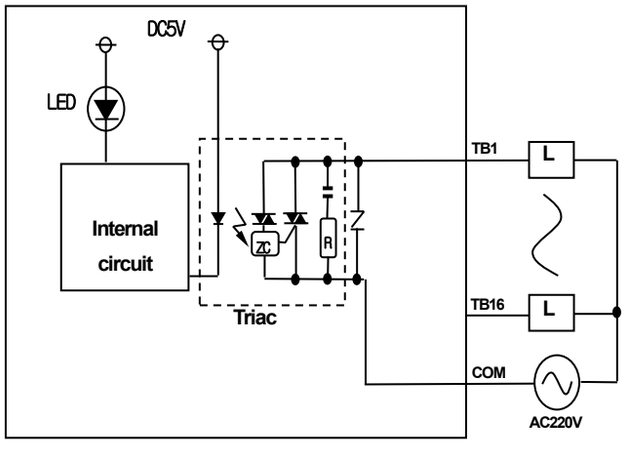
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



7.3.4 16 point triac output module

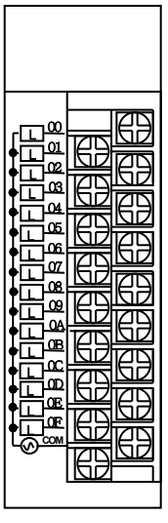
Specification \ Type		Triac output module
		XGQ-SS2A
Output point		16 points
Insulation method		Photo coupler insulation
Rated load voltage		AC 100-240V (50 / 60 Hz)
Max. load voltage		AC 264V
Max. load current		0.6A / 1 point 4A / 1COM
Min. load current		20 mA
Off leakage current		2.5 mA (AC 220V 60 Hz)
Max. Inrush current		20A / cycle or less
Max. voltage drop (On)		AC 1.5V or less(2A)
Surge absorber		Varistor (387 ~ 473V), C.R absorber
Response time	Off → On	1ms or less
	On → Off	0.5 Cycle + 1ms or less
Common method		16 point/ 1 COM
Current consumption		300 mA (when all point On)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector (M3 X 6 screw)
Weight		0.2 kg

Circuit configuration



*COM : TB17

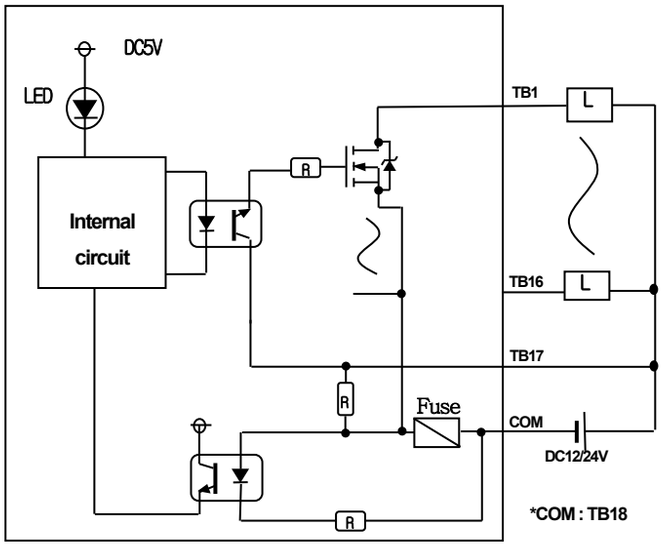
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



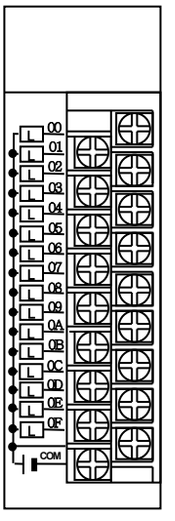
7.3.5 16 point transistor output module (Sink type)

Specification \ Type		TR output module
		XGQ-TR2A
Output point		16 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 12V / 26.4V
Max. load current		0.5A / 1 point, 4A / 1COM
Off leakage current		0.1mA or less
Max. Inrush current		4A/ 10 ms or less
Max. voltage drop (On)		DC 0.3V or less
Surge absorber		Zener diode
Fuse		4A×2ea(no change) (fuse shutdown capacity:50A)
Fuse cutoff indication		Yes (when fuse cutoff, LED turn On and transmit the signal to CPU) External power supply Off, not detected Fuse cutoff
Response time	Off → On	1ms or less
	On → Off	1ms or less(Rated load, resistive load)
Common method		16 point / 1COM
Current consumption		70mA (when all point On)
External power supply	Voltage	DC12/24V ± 10% (ripple voltage 4Vp-p or less)
	Current	10mA or less (DC24V connection)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector
Weight		0.11kg

Circuit configuration



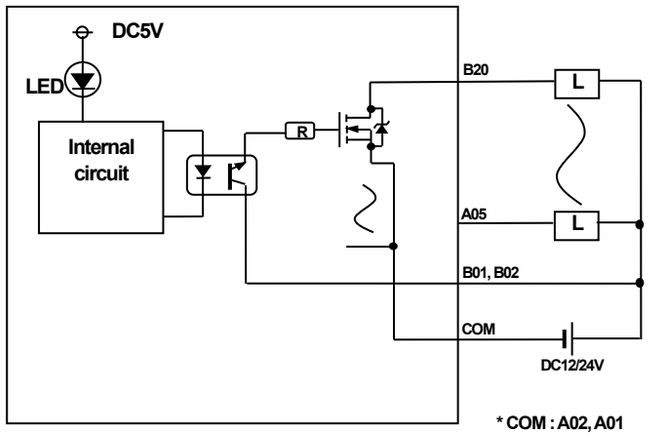
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	DC24V
TB18	COM



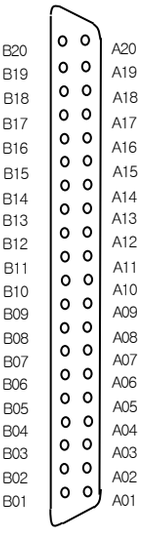
7.3.6 32 point transistor output Module(Sink type)

Specifications \ Type		TR output module XGQ-TR4A
Output point		32 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.1A / 1 point, 2A / 1COM
Off leakage current		0.1mA or less
Max. Inrush current		0.7A / 10ms or less
Max. voltage drop (On)		DC 0.2V or less
Surge absorber		Zener diode
Response time	Off → On	1ms or less
	On → Off	1ms or less(Rated load, resistive load)
Common method		32 point / 1COM
Current consumption		130mA (when all point On)
External power supply	Voltage	DC12/24V ± 10% (ripple voltage 4Vp-p or less)
	Current	10mA or less (DC24V connection)
Operating indicator		Input On LED On
External connection method		40 Pin Connector
Cable size		0.3 ㎟
Weight		0.1 kg

Circuit configuration



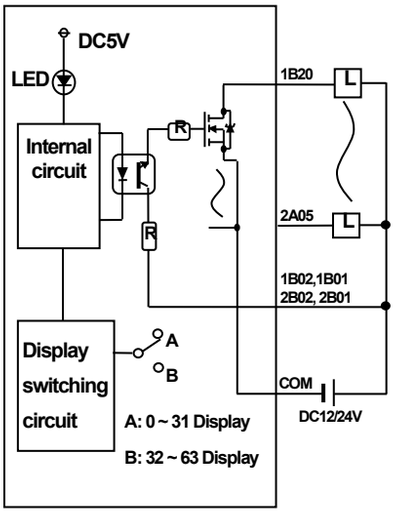
No	Contact Point	No	Contact Point
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	DC12/ 24V	A02	COM
B01		A01	COM



7.3.7 64 point transistor output module (Sink type)

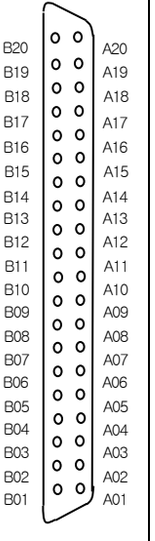
Specifications \ Type		TR output module
		XGQ-TR8A
Output point		64 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 12.2~ 26.4V
Max. load current		0.1A / 1 point, 2A / 1COM
Off leakage current		0.1mA or less
Max. Inrush current		0.7A / 10ms or less
Max. voltage drop (On)		DC 0.2V or less
Surge absorber		Zener diode
Response time	Off → On	1ms or less
	On → Off	1ms or less(Rated load, resistive load)
Common method		16 point / 1COM
Current consumption		230mA (when all point On)
Common method		32 point/COM
External power supply	Voltage	DC12/24V ± 10% (ripple voltage 4Vp-p or less)
	Current	10mA or less (DC24V connection)
Operating indicator		Input On, LED On (32 point LED On by switch operation)
External connection method		40 point connector×2ea
Cable size		0.3 ㎟
Weight		0.15 kg

Circuit configuration



*COM : 1A02, 1A01
2A02, 2A01

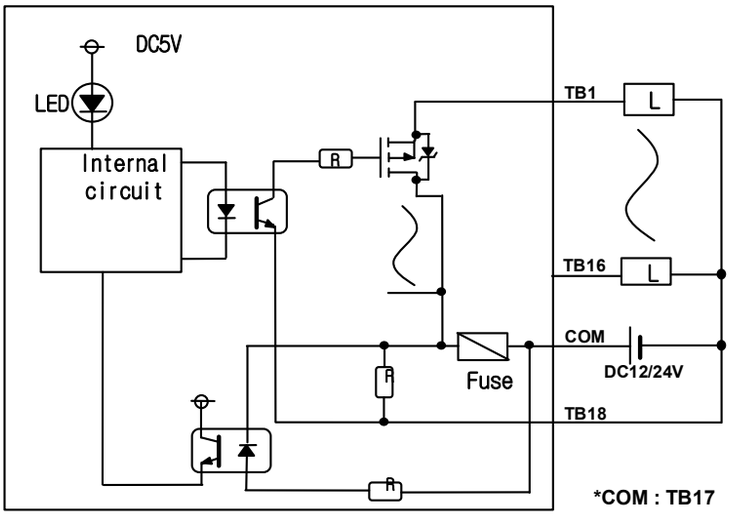
No	Contact Point	No	Contact Point	No	Contact Point	No	Contact Point
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	24	2B12	40	2A12	56
1B11	9	1A11	25	2B11	41	2A11	57
1B10	10	1A10	26	2B10	42	2A10	58
1B09	11	1A09	27	2B09	43	2A09	59
1B08	12	1A08	28	2B08	44	2A08	60
1B07	13	1A07	29	2B07	45	2A07	61
1B06	14	1A06	30	2B06	46	2A06	62
1B05	15	1A05	31	2B05	47	2A05	63
1B04	NC	1A04	NC	2B04	NC	2A04	NC
1B03	NC	1A03	NC	2B03	NC	2A03	NC
1B02	12/24V	1A02	COM1	2B02	12/24V	2A02	COM2
1B01	DC	1A01		2B01	DC	2A01	



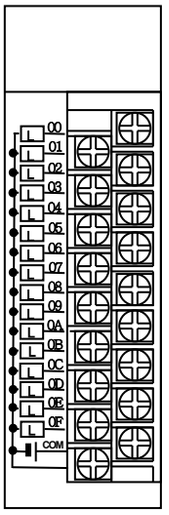
7.3.8 16 point transistor output module (Source type)

Specification \ Type		TR output module
		XGQ-TR2B
Output point		16 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 12.2~ 26.4V
Max. load current		0.5A / 1 point, 4A / 1COM
Off leakage current		0.1mA or less
Max. Inrush current		4A / 10ms or less
Max. voltage drop (On)		DC 0.3V or less
Surge absorber		Zener diode
Fuse		4A×2ea(no change) (fuse shutdown capacity:50A)
Fuse cutoff indication		Yes (when fuse cutoff, LED turn On and transmit the signal to CPU)
Response time	Off → On	1ms or less
	On → Off	1ms or less(Rated load, resistive load)
Common method		16 point / 1COM
Current consumption		70mA (when all point On)
External power supply	Voltage	DC12/24V ± 10% (ripple voltage 4Vp-p or less)
	Current	10mA or less (DC24V connection)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector
Weight		0.12kg

Circuit configuration



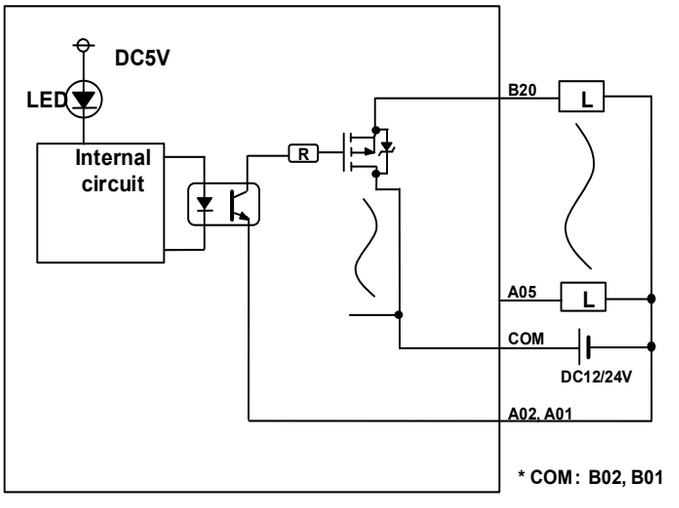
Terminal block	Contact point name
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	0V



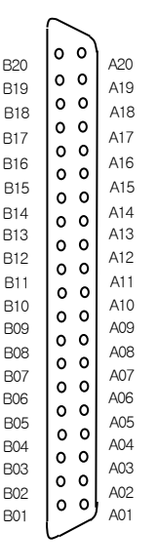
7.3.9 32 point transistor output module (Source type)

Specifications \ Type		TR output module XGQ-TR4B
Output point		32 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 12.2~ 26.4V
Max. load current		0.1A / 1 point, 2A / 1COM
Off leakage current		0.1mA or less
Max. Inrush current		4A / 10ms or less
Max. voltage drop (On)		DC 0.3V or less
Surge absorber		Zener diode
Response time	Off → On	1ms or less
	On → Off	1ms or less(Rated load, resistive load)
Common method		32 point / 1COM
Current consumption		130mA (when all point On)
External power supply	Voltage	DC12/24V ± 10% (ripple voltage 4Vp-p or less)
	Current	10mA or less (DC24V connection)
Operating indicator		Input On LED On
External connection method		40 Pin Connector
Cable size		0.3 ㎟
Weight		0.1 kg

Circuit configuration



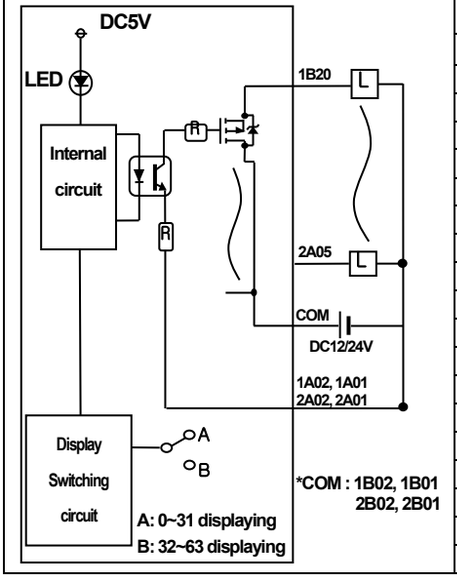
No	Contact Point	No	Contact Point
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	COM	A02	0V
B01		A01	



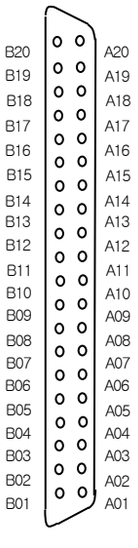
7.3.10 64 point transistor output module (Source type)

Specifications \ Type		TR output module
		XGQ-TR8B
Output point		64 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 12.2~ 26.4V
Max. load current		0.1A / 1 point, 2A / 1COM
Off leakage current		0.1mA or less
Max. Inrush current		4A / 10ms or less
Max. voltage drop (On)		DC 0.3V or less
Surge absorber		Zener diode
Response time	Off → On	1ms or less
	On → Off	1ms or less(Rated load, resistive load)
Common method		32 point / 1COM
Current consumption		230mA (when all point On)
Common method		32 point/COM
External power supply	Voltage	DC12/24V ± 10% (ripple voltage 4Vp-p or less)
	Current	10mA or less (DC24V connection)
Operating indicator		Input On, LED On (32 point LED On by switch operation)
External connection method		40 point connector×2ea
Cable size		0.3 ㎟
Weight		0.15 kg

Circuit configuration



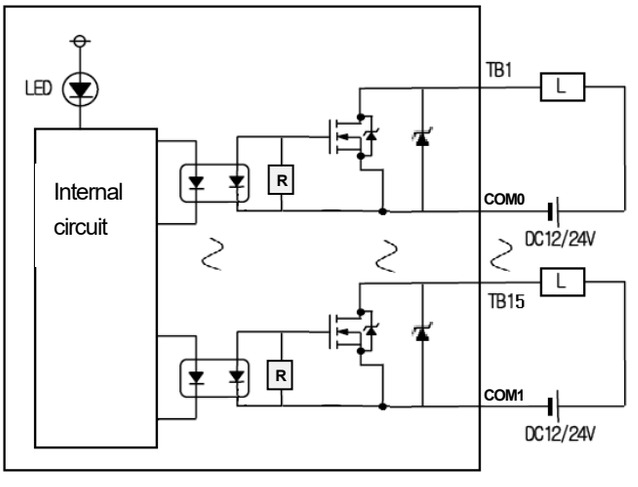
No	Contact Point	No	Contact Point	No	Contact Point	No	Contact Point
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	24	2B12	40	2A12	56
1B11	9	1A11	25	2B11	41	2A11	57
1B10	10	1A10	26	2B10	42	2A10	58
1B09	11	1A09	27	2B09	43	2A09	59
1B08	12	1A08	28	2B08	44	2A08	60
1B07	13	1A07	29	2B07	45	2A07	61
1B06	14	1A06	30	2B06	46	2A06	62
1B05	15	1A05	31	2B05	47	2A05	63
1B04	NC	1A04	NC	2B04	NC	2A04	NC
1B03	NC	1A03	NC	2B03	NC	2A03	NC
1B02	COM	1A02	0V	2B02	COM	2A02	0V
1B01		1A01		2B01		2A01	



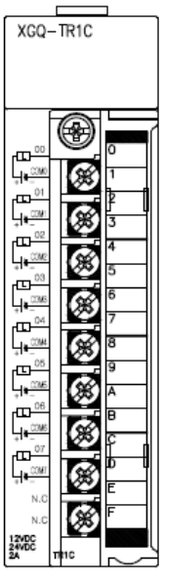
7.3.11 8 point transistor output module (isolated contact point)

Specification \ Type		TR output module
		XGQ-TR1C
Output point		8 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12V / 24V
Load voltage range		DC 12.2~ 26.4V
Max. load current		2A / 1 point
Off leakage current		0.1mA or less
Max. Inrush current		8A / 10ms or less
Max. voltage drop (On)		DC 0.3V or less
Surge absorber		Zener diode
Response time	Off → On	3ms or less
	On → Off	10ms or less(Rated load, resistive load)
Common method		1 point / 1COM
Current consumption		100mA (when all point On)
Operating indicator		Output On, LED On
External connection method		18 point terminal block connector
Weight		0.11kg

Circuit configuration



Terminal block	Contact point name
TB1	0
TB2	COM0
TB3	1
TB4	COM1
TB5	2
TB6	COM2
TB7	3
TB8	COM3
TB9	4
TB10	COM4
TB11	5
TB12	COM5
TB13	6
TB14	COM6
TB15	7
TB16	COM7
TB17	NC
TB18	NC



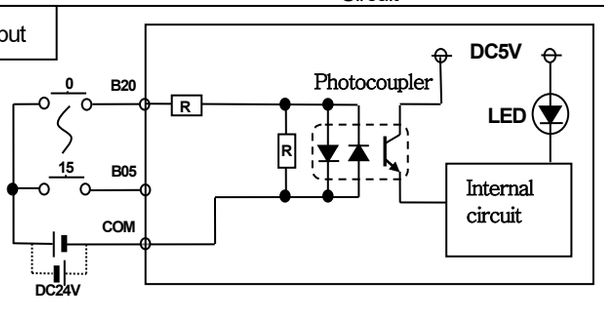
7.4 Digital I/O hybrid module specification

7.4.1 32 point (DC Input · Transistor Output) I/O hybrid module

XGH-DT4A					
Input			**Output**		
Input point		16 points	Output point		16 points
Insulation method		Photo coupler isolation	Insulation method		Photo coupler isolation
Rated input voltage		DC 24V	Rated load voltage		DC 12V / 24V
Rated input current		About 4 ㎃	Load voltage range		DC 12.2~ 26.4V
Operation voltage range		DC20.4~28.8V (ripple rate < 5%)	Max. load current		0.1A / 1 point, 1.6A / 1COM
Dielectric withstanding voltage		AC560Vrms/3Cycle(altitude: 2000m)	Off leakage current		0.1mA or less
On voltage/On current		DC19V or higher / 3 mA or higher	Max. Inrush current		0.7A/ 10 ms or less
Off voltage/Off current		DC11V or less / 1.7 mA or less	Surge absorber		Zener diode
Input resistance		About 5.6 kΩ	Max. voltage drop (On)		DC 0.2V or less
Response time	Off→ On	1ms/3ms/5ms/10ms/20ms/70ms/ 100ms (set by CPU parameter)Default:3ms	Response time	Off→ On	1ms or less
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/ 100ms (set by CPU parameter)Default:3ms		On → Off	1 ms or less (Rated load, resistive load)
Common method		16 point/COM	Common method		16 point / 1COM
Operating indicator		LED ON when input is ON	Operating indicator		LED ON when output is ON
Current consumption (㎃)		110mA (when all points On)			
External connection method		40 Pin connector×1ea			
Weight		0.1 kg			

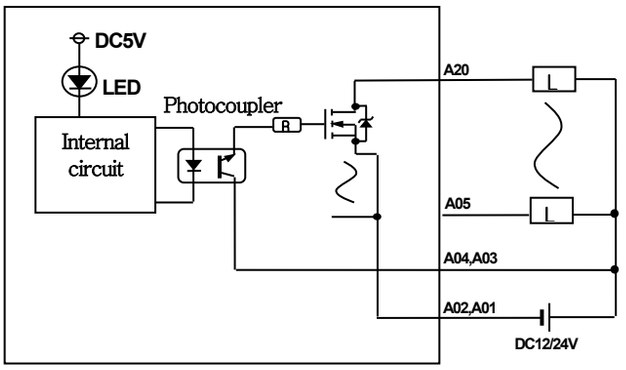
Circuit

Input



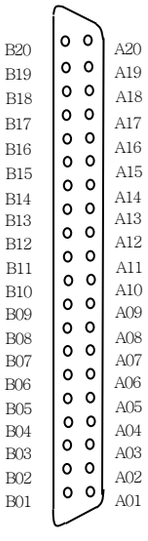
* COM : B02, B01

Output



External

No	Contact Point	No	Contact Point
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	DC12/ 24V
B03	NC	A03	
B02	COM	A02	0V
B01		A01	

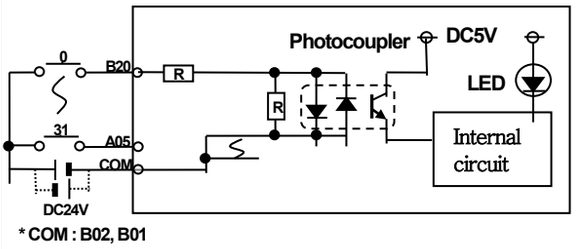


7.5 Event Input Module Specification

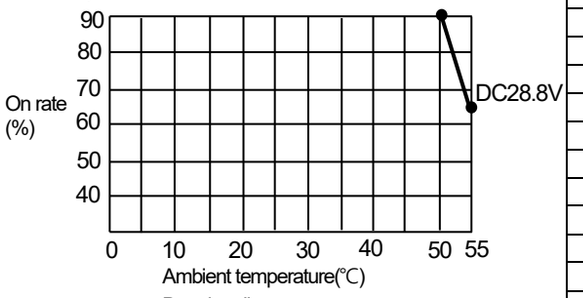
7.5.1 Event Input Module (Source/Sink type)

Item		XGF-SOEA
Input point		32 point/COM
Insulation method		Photo coupler insulation
Memory size		1Mbit. Records 1Mbit event information (300 event information per XGF-SOEA module)
Event time		Internal time : PLC time External time : External time server time
Resolution(Precision)		Internal time :1ms (precision : ±2ms) External time :1ms (precision : ±0.5ms)
Rated input voltage		DC24V (DC 20.4 ~ 28.8V)
Rated input current		About 4mA
On voltage/On current		DC19V or more / 3 mA or more
Off voltage / Off current		DC11V or less / 1.7 mA or less
Input filter	Time	1 ~ 100ms
	Mode	Steady State, Integrating
Input chattering		Counter: 2~127, Timer: 0.000~10.000 sec
Response time	Off → On	H/W delay(10㎲: Normal) + Input filter time + Module processing time(100㎲)
	On → Off	H/W delay(84㎲: Normal) + Input filter time + Module processing time(100㎲)
Insulation resistor		Insulation resistance 10 MΩ or above (DC500V)
Internal current consumption(A)		0.7(MAX)
Operation display		LED is on when input is on
External connection method		40 point connector
Size		27x98x90
Weight		0.2 kg

Circuit configuration

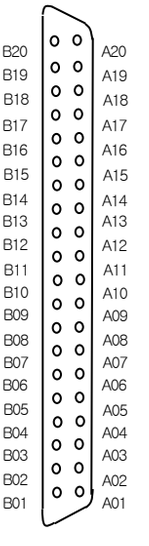


* COM : B02, B01



Derating diagram

No	Contact Point	No	Contact Point
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	RX+	A04	SG
B03	RX-	A03	SG
B02	COM	A02	COM
B01	COM	A01	COM



7.6 Smart Link

7.6.1 Module accessible to Smart Link

From digital I/O modules used for XGT Series, the modules accessible to Smart Link are as follows.
32 point modules need a Connector (40 Pin x 1), 64 point modules need 2 connectors(40 Pin x 2)

Product name	Specification	No. of pins
XGI-D24A/B	DC input 32 point module	40 pin connector×1ea
XGI-D28A/B	DC input 64 point module	40 pin connector×2ea
XGQ-TR4A	TR output 32 point module(sink type)	40 pin connector×1ea
XGQ-TR8A	TR output 64 point module(sink type)	40 pin connector×2ea
XGQ-TR4B	TR output 32 point module(source type)	40 pin connector×1ea
XGQ-TR8B	TR output 64 point module(source type)	40 pin connector×2ea
XGF-SOEA	Event input module	40 pin connector×1ea

7.6.2 Smart Link Components

The company prepares smart link products for the convenience of using our Connector type I/O modules.
For further information, please refer to the data sheet contained in a smart link product.
(Refer to 7.6.6 1to confirm the differences between TG7-1H40CA 1and 1TG7-1H40S)

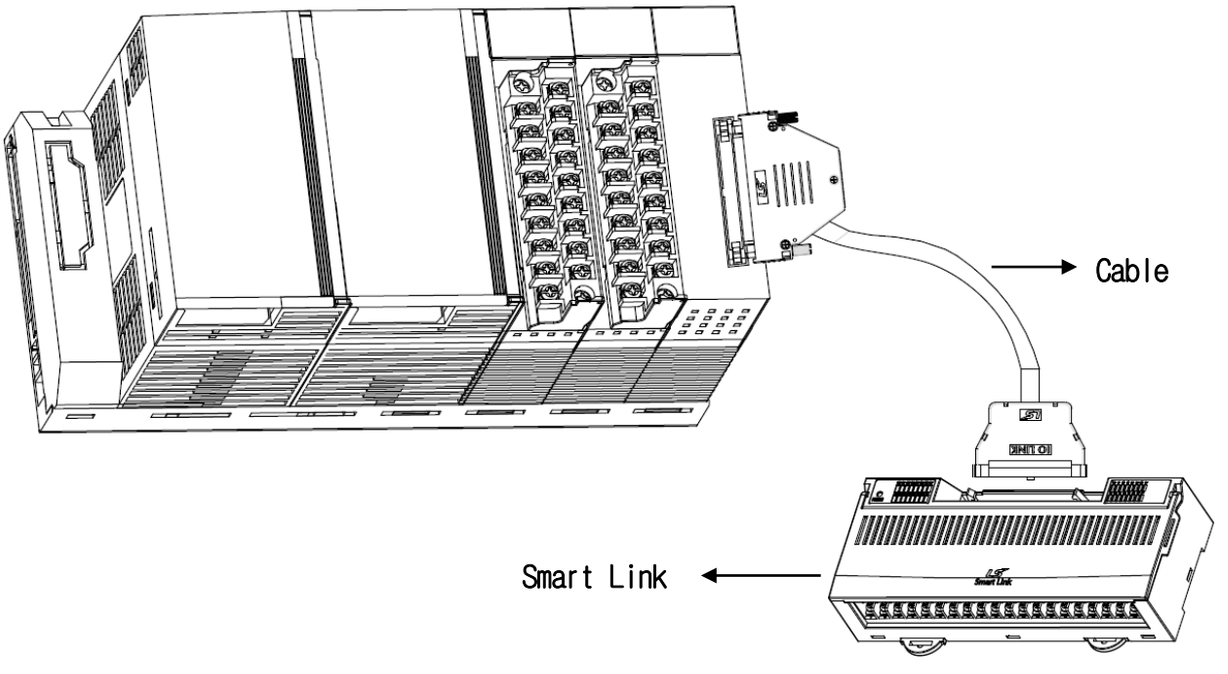
	Product name	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (20Pin Common assembled)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
Relay board	R32C-NS5A-40P (sink type)	C40HF-05PB-1	0.5m
		C40HF-10PB-1	1m
		C40HF-15PB-1	1.5m
		C40HF-20PB-1	2m
		C40HF-30PB-1	3m
	R32C-PS5A-40P (Source type)	C40HF-05PB-XGP1	0.5m
		C40HF-10PB-XGP1	1m
		C40HF-20PB-XGP1	2m

7.6.3 Smart Link Mapping Table

❶ : Module using 1ea Cable , ❷ : Module using 2ea Cable

LS Smart Link Mapping Table				XGT PLC (Digital I/O Module)									
			Length (m)	XGQ-TR4A	XGQ-TR4B	XGQ-TR8A	XGQ-TR8B	XGI-D24A	XGI-D24B	XGI-D28A	XGI-D28B	XGH-DT4A	XGF-SOEA
	Cable	Description	Sets	1	1	2	2	1	1	2	2	1	1
TG7-1H40S /TG7-1H40CA	C40HF-05PB-1B	PLC,CABLE ASS'Y,40p-40p,0.5m	0.5	❶	❶			❶	❶			❶	❶
	C40HF-10PB-1B	PLC,CABLE ASS'Y,40p-40p,1m	1.0	❶	❶			❶	❶			❶	❶
	C40HF-15PB-1B	PLC,CABLE ASS'Y,40p-40p,1.5m	1.5	❶	❶			❶	❶			❶	❶
	C40HF-20PB-1B	PLC,CABLE ASS'Y,40p-40p,2m	2.0	❶	❶			❶	❶			❶	❶
	C40HF-30PB-1B	PLC,CABLE ASS'Y,40p-40p,3m	3.0	❶	❶			❶	❶			❶	❶
R32C-NS5A-40P (SINK)	C40HF-05PB-1	PLC,CABLE ASS'Y,40p-40p,0.5m	0.5	❶									
	C40HF-10PB-1	PLC,CABLE ASS'Y,40p-40p,1m	1.0	❶									
	C40HF-15PB-1	PLC,CABLE ASS'Y,40p-40p,1.5m	1.5	❶									
	C40HF-20PB-1	PLC,CABLE ASS'Y,40p-40p,2m	2.0	❶									
	C40HF-30PB-1	PLC,CABLE ASS'Y,40p-40p,3m	3.0	❶									
R32C-PS5A-40P (Source)	C40HF-05PB-XGP1	PLC,CABLE ASS'Y,40p-40p,0.5m	0.5		❶								
	C40HF-10PB-XGP1	PLC,CABLE ASS'Y,40p-40p,1m	1.0		❶								
	C40HF-15PB-XGP1	PLC,CABLE ASS'Y,40p-40p,1.5m	1.5										
	C40HF-20PB-XGP1	PLC,CABLE ASS'Y,40p-40p,2m	2.0		❶								
	C40HF-30PB-XGP1	PLC,CABLE ASS'Y,40p-40p,3m	3.0										

7.6.4 Smart Link Connection



7.6.5 Smart Link Connection Diagram

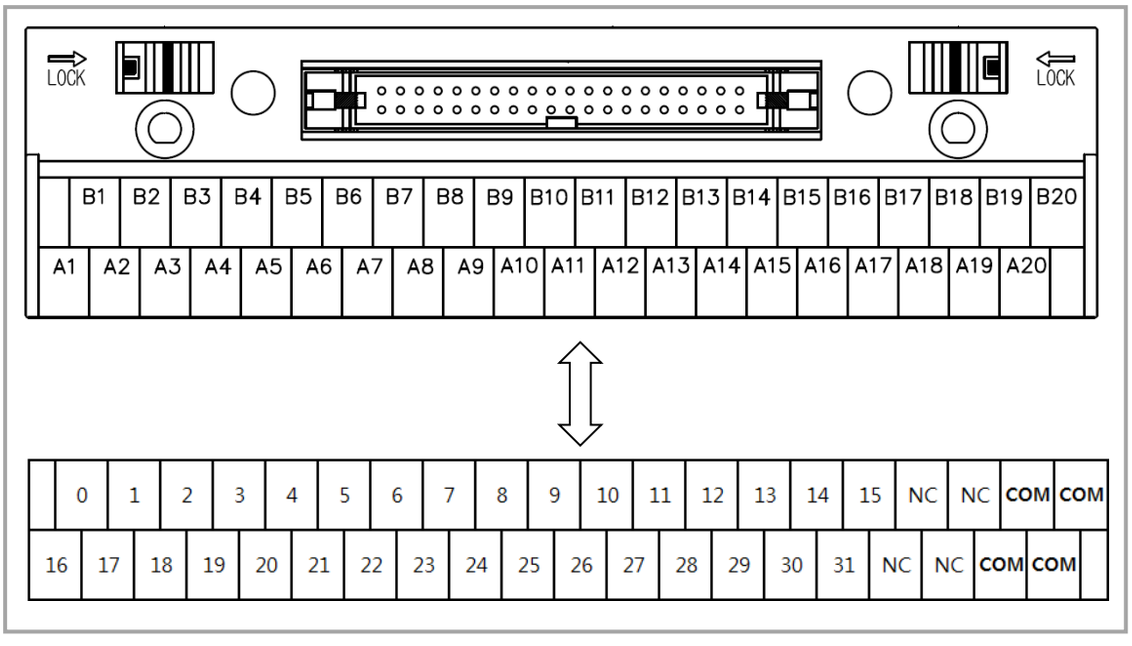
(1) XGI-D24A/B

1) Applicable Smart Link

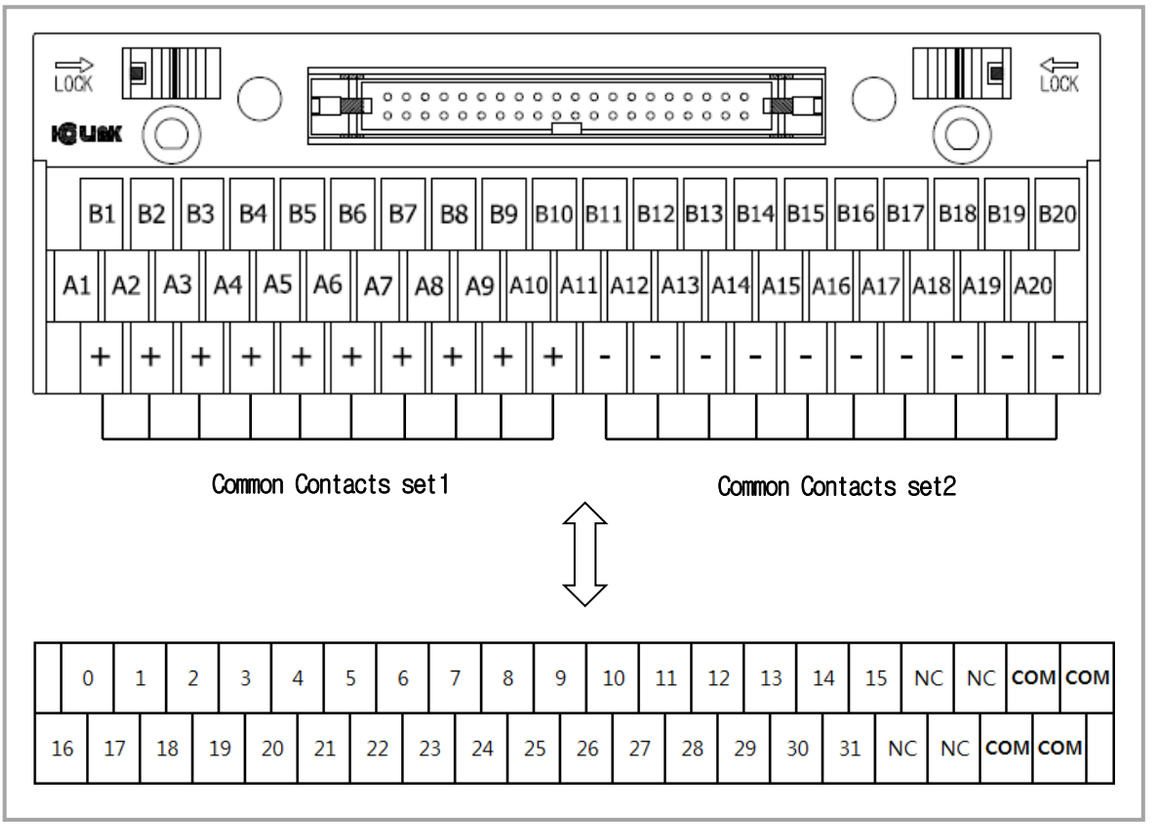
	Product name	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (20Pin Common assembled)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m

2) Connection diagram (XGI-D24A/B)

(a) **TG7-1H40S**



(b) **TG7-1H40CA**


LOCK
LOCK
B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18 A19 A20
+ + + + + + + + + + - - - - - - - - - -
Common Contacts set1
Common Contacts set2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 NC NC COM COM
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 NC NC COM COM

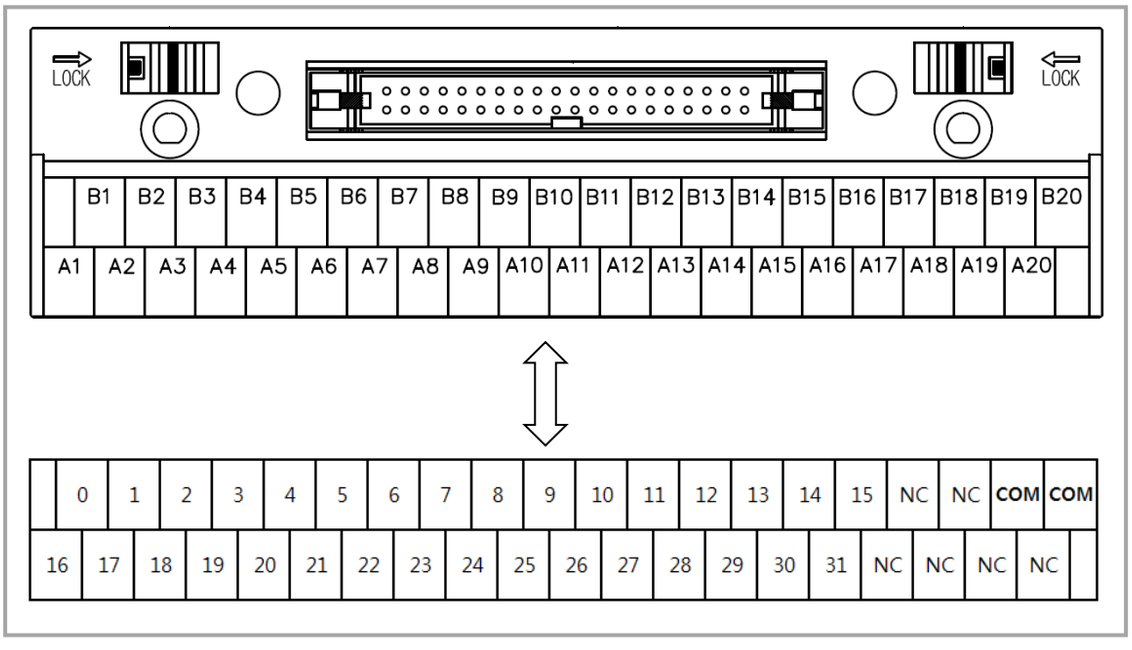
(2) XGI-D28A/B

1) Applicable Smart Link

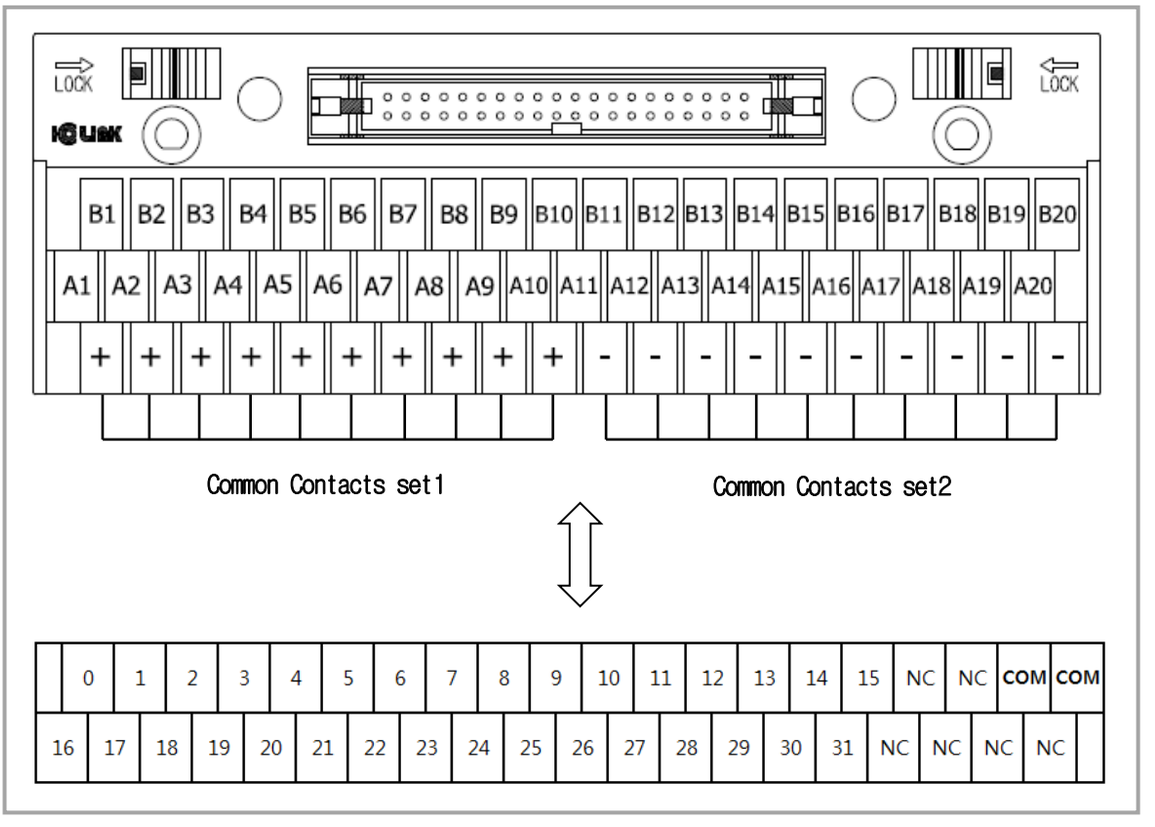
	Product name	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (20Pin Common assembled)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m

2) Connection diagram (XGI-D28A/B)

(a) **TG7-1H40S**



(b) **TG7-1H40CA**


LOCK
LOCK
B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18 A19 A20
+ + + + + + + + + + - - - - - - - - - -
Common Contacts set1
Common Contacts set2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 NC NC COM COM
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 NC NC NC NC

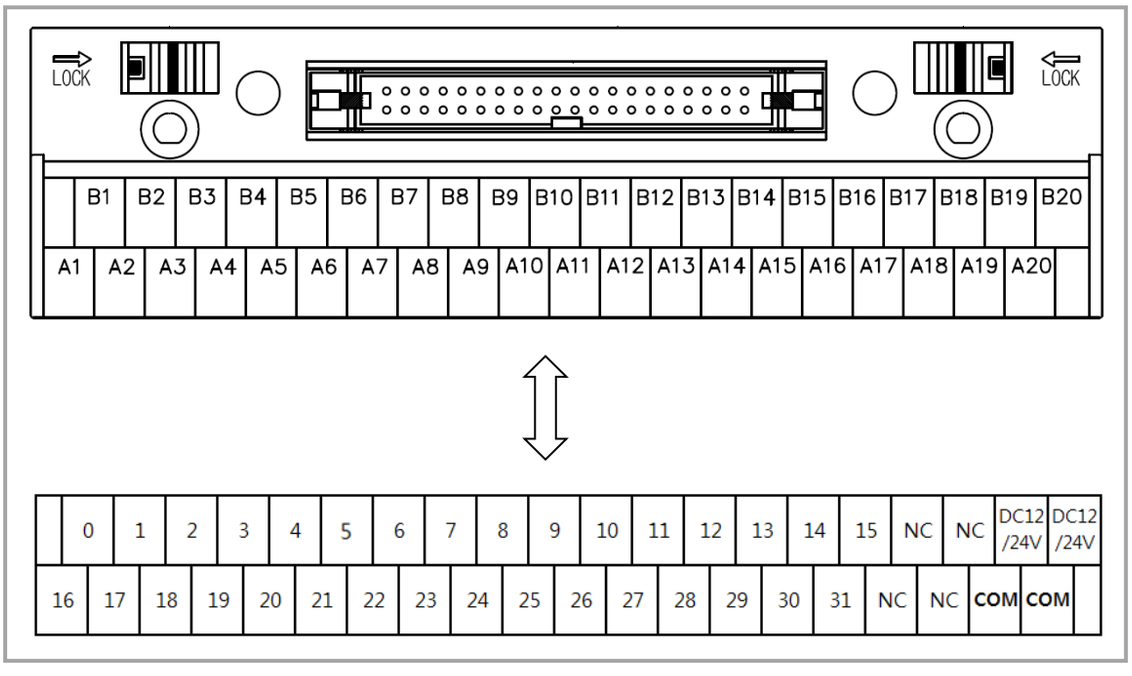
(3) XGQ-TR4A/8A

1) Applicable Smart Link

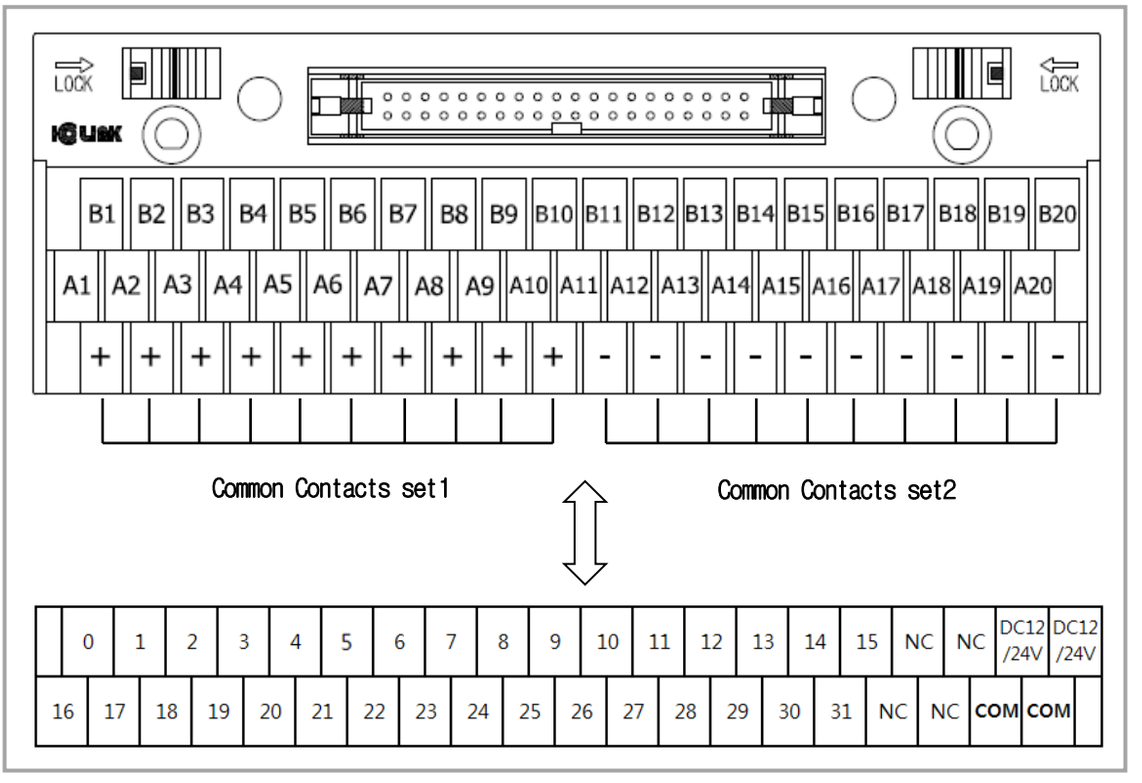
	Product name	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (20Pin Common assembled)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
Relay board	R32C-NS5A-40P (sink type)	C40HF-05PB-1	0.5m
		C40HF-10PB-1	1m
		C40HF-15PB-1	1.5m
		C40HF-20PB-1	2m
		C40HF-30PB-1	3m

2) Connection diagram (XGQ-TR4A/8A)

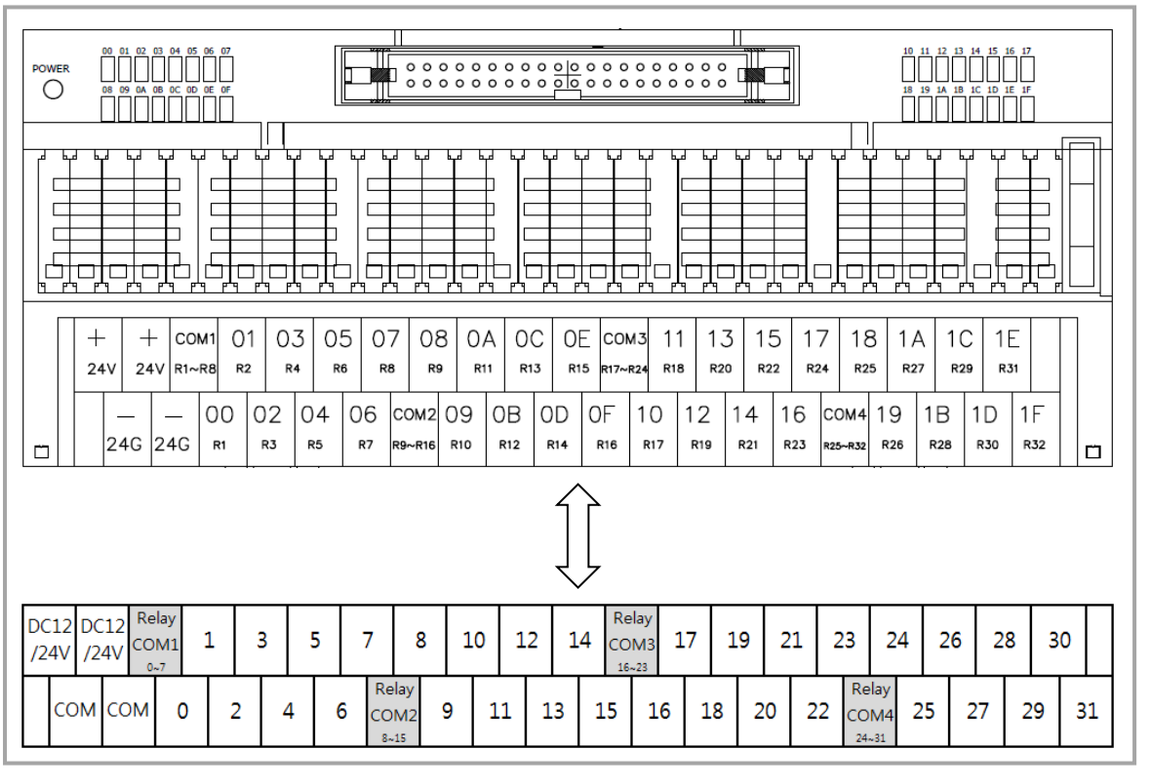
(a) **TG7-1H40S**



(b) **TG7-1H40CA**



(c) **R32C-NS5A-40P**



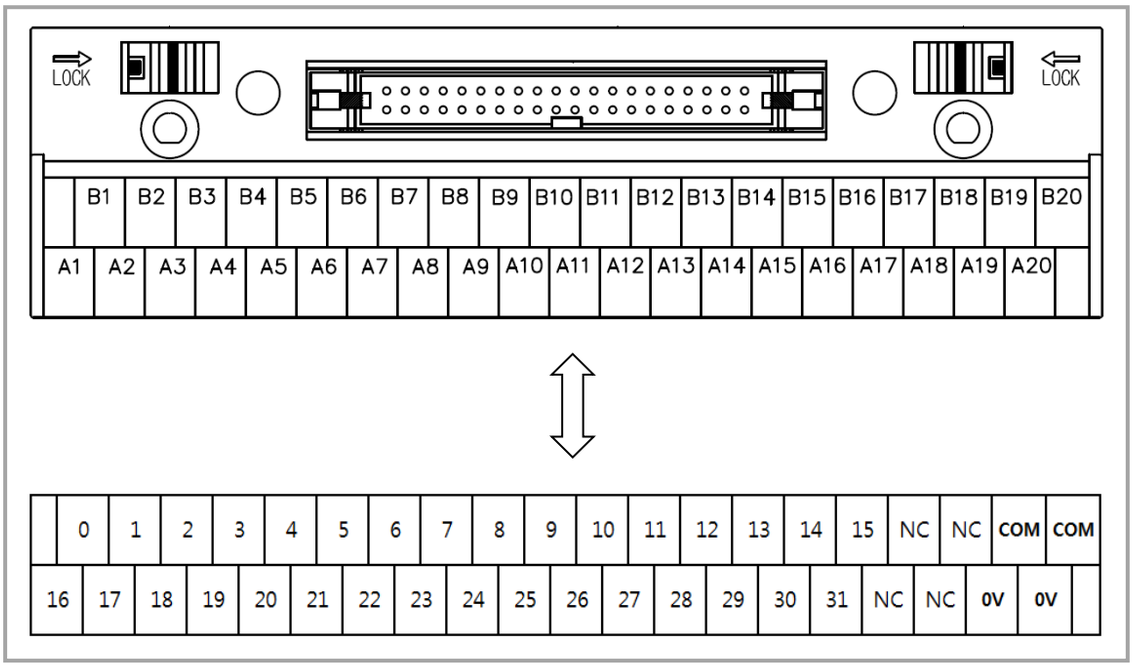
(4) XGQ-TR4B/8B

1) Applicable Smart Link

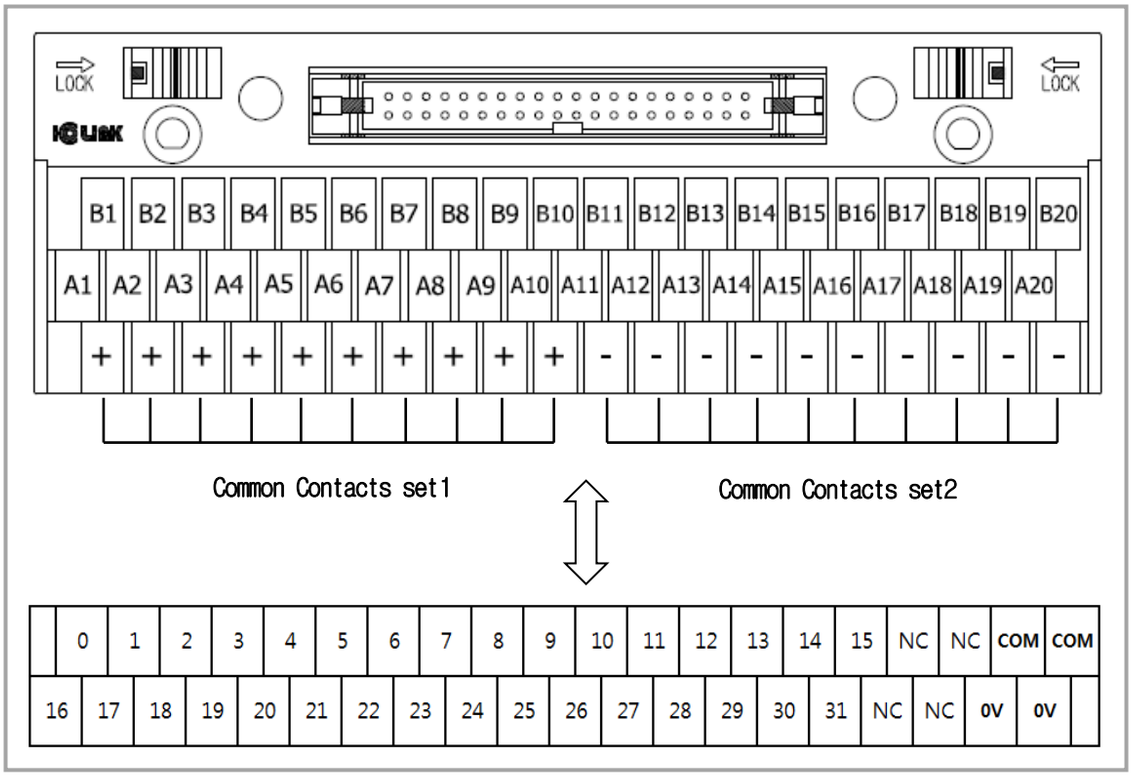
	Product name	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (20Pin Common assembled)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
Relay board	R32C-PS5A-40P (Source type)	C40HF-05PB-XGP1	0.5m
		C40HF-10PB-XGP1	1m
		C40HF-20PB-XGP1	2m
		-	-
		-	-

2) Connection diagram (XGQ-TR4B/8B)

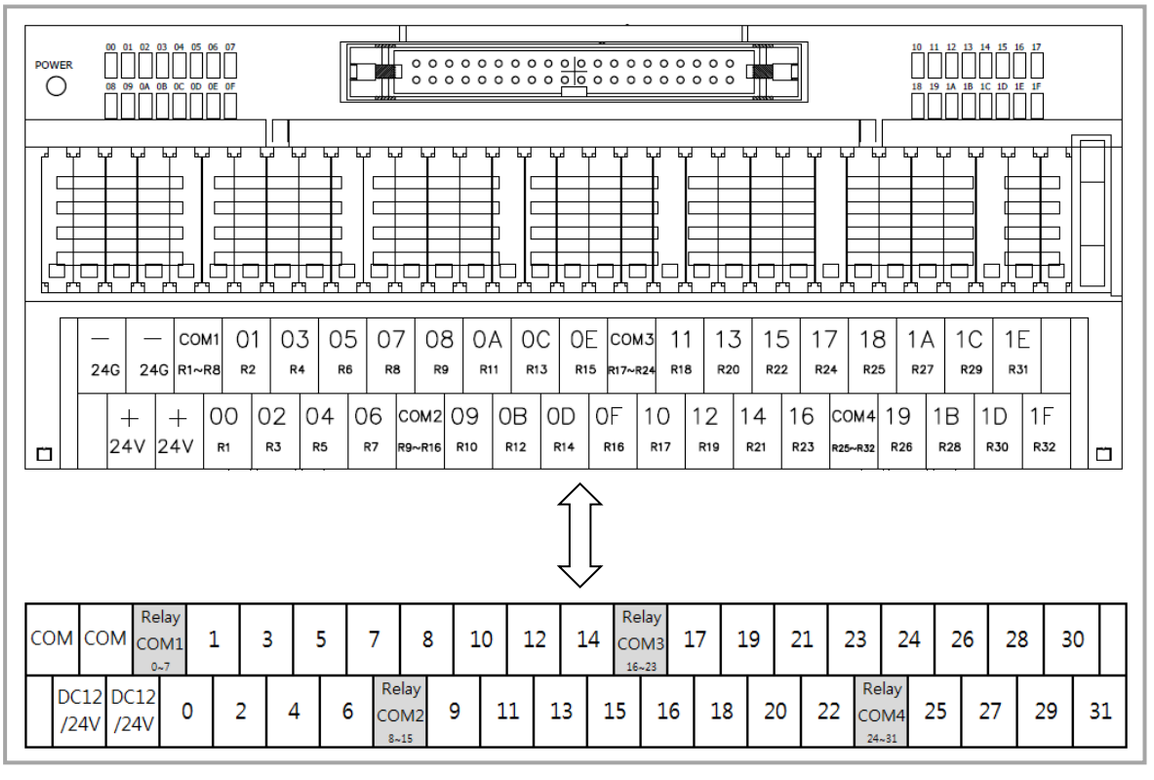
(a) **TG7-1H40S**



(b) **TG7-1H40CA**



(c) **R32C-PS5A-40P**



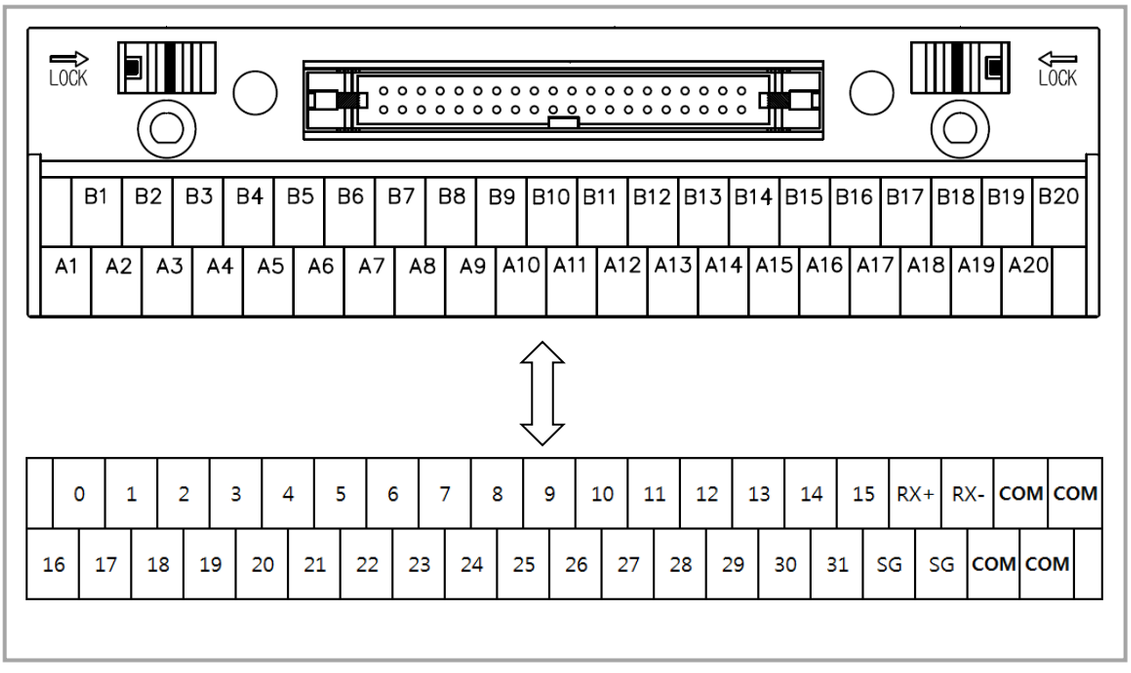
(5) XGF-SOEA

1) Applicable Smart Link

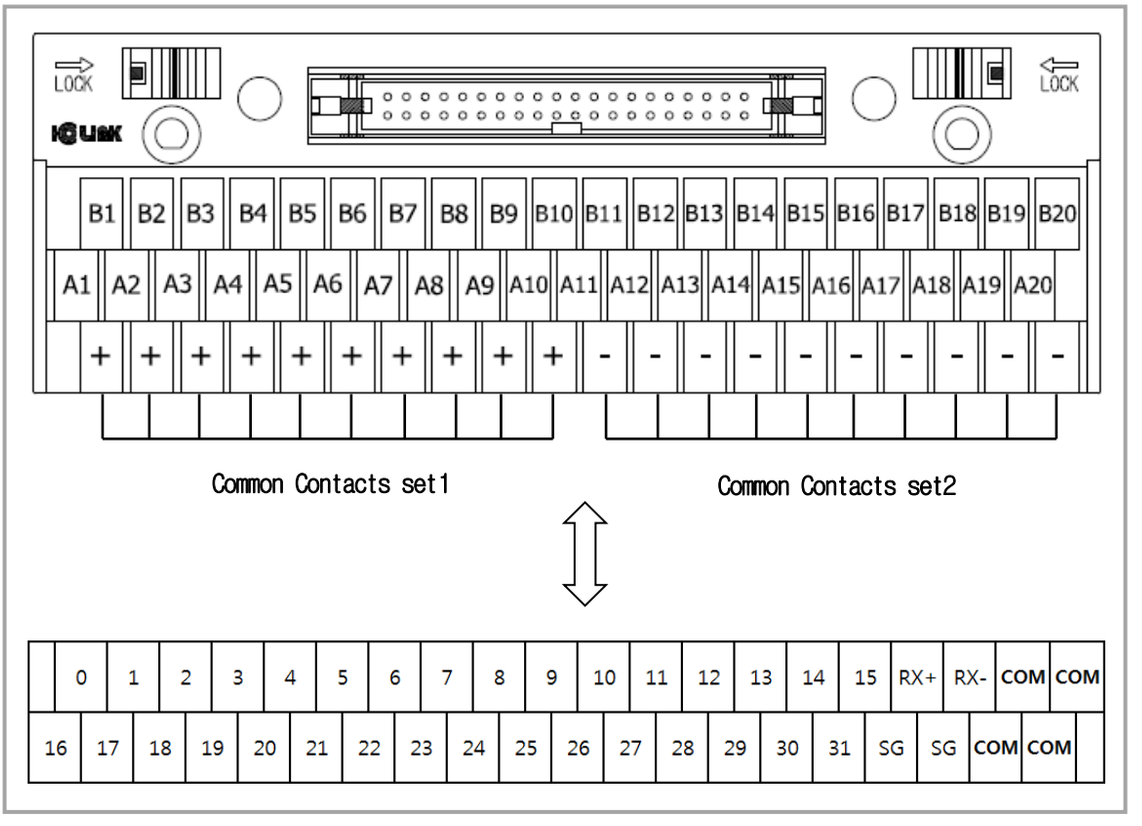
	Product name	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (20Pin Common assembled)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m

2) Connection diagram (XGF-SOEA)

(a) **TG7-1H40S**



(b) **TG7-1H40CA**


LOCK
LOCK
B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20
A1 A2 A3 A4 A5 A6 A7 A8 A9 A10 A11 A12 A13 A14 A15 A16 A17 A18 A19 A20
+ + + + + + + + + + - - - - - - - - - -
Common Contacts set1
Common Contacts set2
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 RX+ RX- COM COM
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 SG SG COM COM

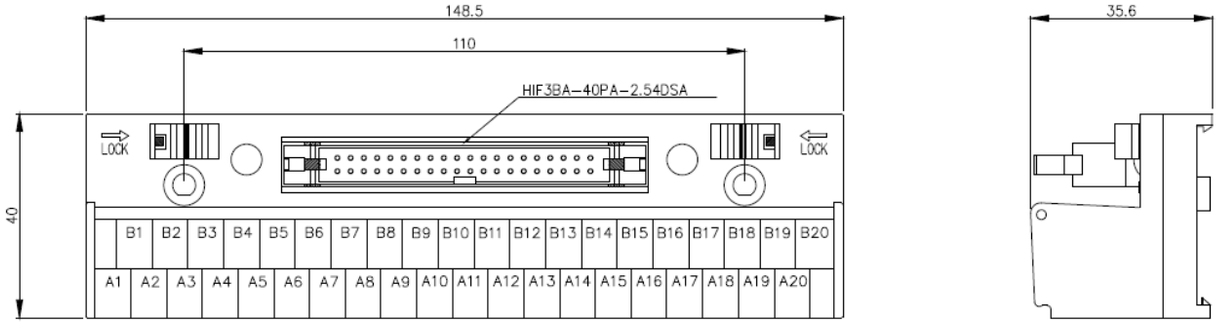
7.6.6 Smart Link Specifications and Dimensions

(1) TG7-1H40S

1) Specifications

Rated voltage	AC, DC 125V
Rated current	1A
Withstanding Voltage	600V 1min
Insulation resistor	100MΩ(DC 500V)
Cable	1.25 ㎟ /MAX
T/B screw	M3 X 10L
Screw torque	1.2N • m(12Kgf • cm)
Case	Modified PPO(Noryl)(UL 94V-0)

2) Dimension (mm)

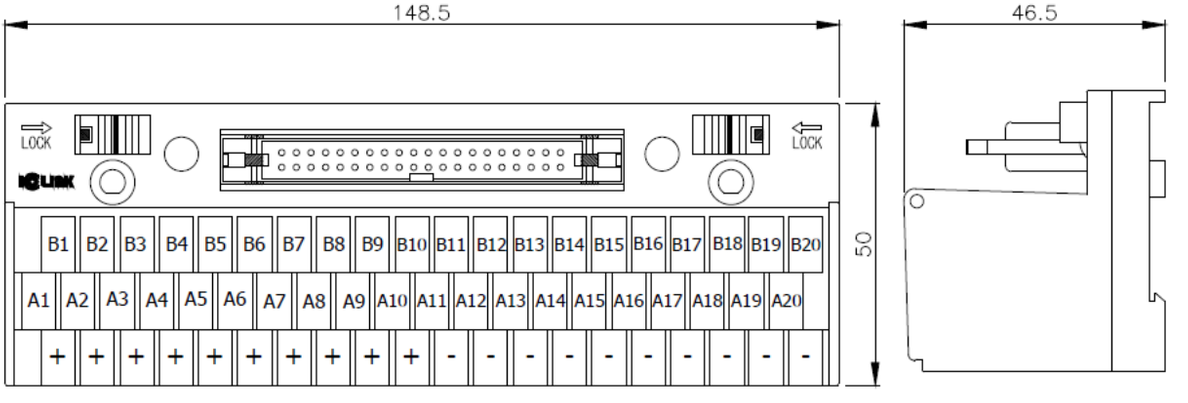


(2) TG7-1H40CA

1) Specifications

Rated voltage		125V AC / 24V DC
Rated current	**IO**	1A
	Common	10A (Total)
Insulation resistor		100MΩ (DC 500V)
Withstand voltage		AC500V 1min
Wire		AWG22-16 (MAX / 1.5 ㎟)
Terminal Screw		M3 X 10L
Screw torque		1.2N • m(12Kgf • cm)
Ambient temperature		-10℃ ~ +50℃ (Non-condensing)
Terminal block and cover		Modified PPO
Protective cover		Polycarbonate
PCB		Epoxy 1.6t

2) Dimension (mm)



(3) R32C-N(P)S5A-40P

1) Specifications

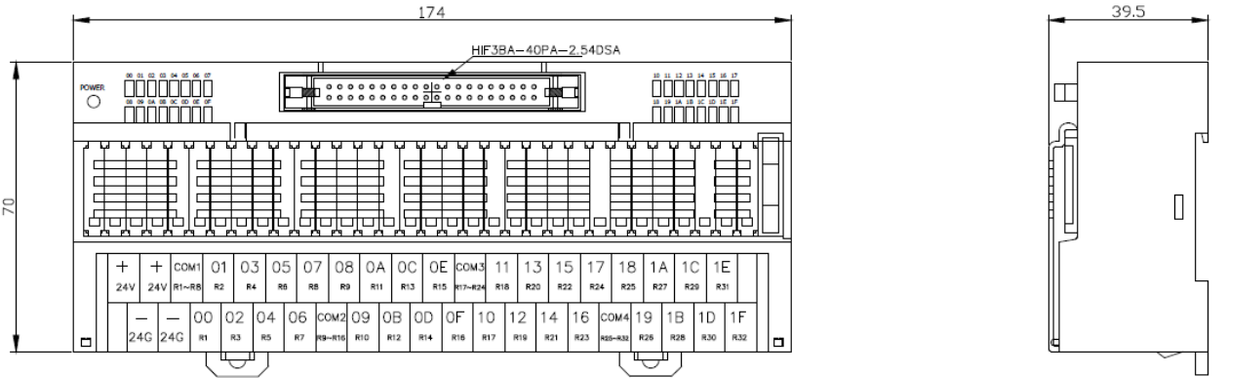
(A) Relay board

Case	Modified PPO
Protective cover	Polycarbonate
PCB	Epoxy 1.6t / 2oz
Wire	AWG22-16 (MAX / 1.5 ㎟)
Terminal Screw	M3 X 8L
Screw torque	1.2N • m(12Kgf • cm)
Ambient temperature	-10℃ ~ +50℃ (Non-condensing)

(B) Relay

Item		PA1a-24V
Contact Point	**Contact configuration**	1a
	Rated voltage	5A 250V AC / 5A 30V DC
	Max. Inrush current	5A
	Max. switching voltage	250V AC / 110V DC
Coil	**Rated voltage**	24V DC
	Operation voltage	16.8V
	Release Voltage	1.2V DC
	Coil resistance	3,200Ω
	Rating power consumption	180mW
Lightning surge voltage		4,000V
Withstand voltage		2,000Vrms

2) Dimension (mm)



Chapter 11 Power Module

Here describes the selection method, type and specification of power module.

11.1 Selection Method

Power Module selection of power module is determined by the current that input Power Module voltage and power module should supply to the system, that is, the sum of current consumption of digital I/O module, special module and communication module that Current Consumption installed on a same base with the power module. If it exceeds the rated output capacity of Power Module module, the system does not properly work. In case of system configuration, consider the current consumption current into of each module before selecting the power module module.

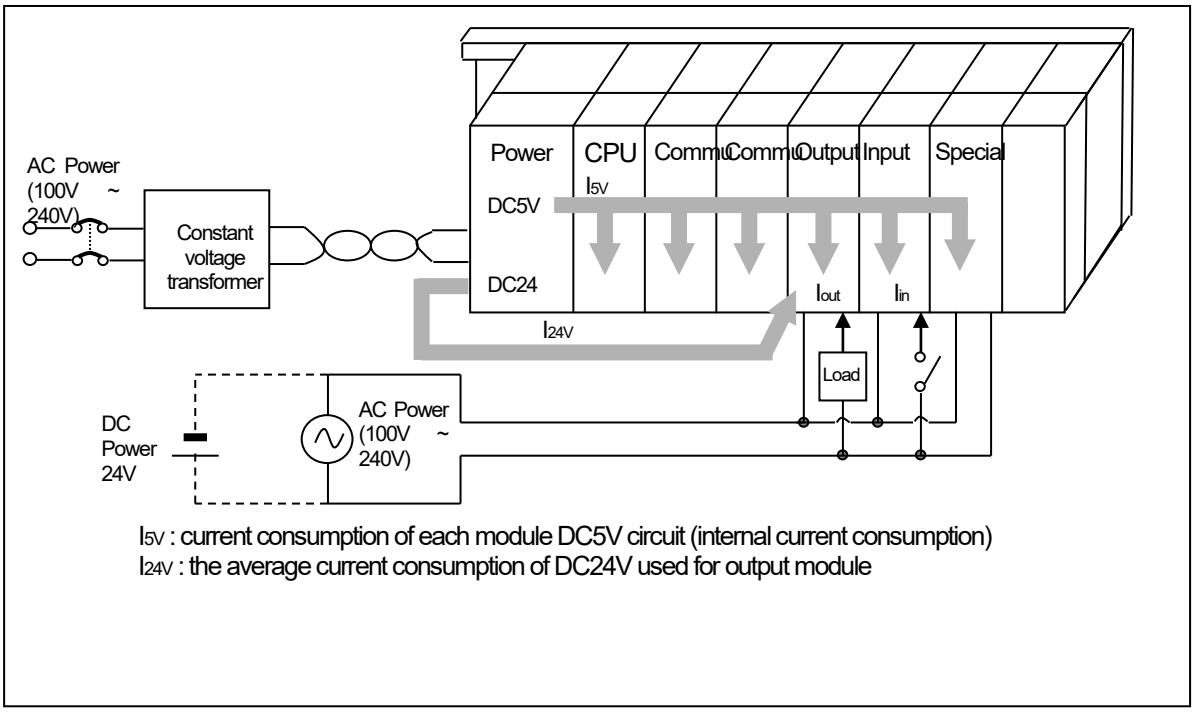
- For consumption current of each module, refer to user manual or data sheet of each module.

(1) Current consumption by modules (DC 5V) (Unit: mA)

Product	Type	Current consumption	Product	Type	Current consumption
CPU Module	XGI-CPUZ7	1400	Analog input	XGF-AV8A	420
	XGC-CPUX7	1400		XGF-AC8A	420
	XGI-CPUZ5	1400			
	XGI-CPUZ3	1400		XGF-AD4S	610
	XGI-CPUUN	960		XGF-AD8A	420
	XGI-CPUH,/UN	960		XGF-AD16A	420
	XGI-CPUS/E	940	2-wire analog input	XGF-AW4S	180(480)
DC24V Input	XGI-D21A	20	Analog output	XGF-DV4A	190 (140)
	XGI-D22A/B	30		XGF-DC4A	190 (210)
	XGI-D24A/B	50		XGF-DV8A	190 (180)
	XGI-D28A/B	60		XGF-DC8A	190 (300)
AC110V Input	XGI-A12A	30		XGF-DV4S	200 (150)
AC220V Input	XGI-A21A/C	20		XGF-DC4S	200 (220)
Relay output	XGQ-RY1A	260	Analog input/output mixed	XGF-AH6A	770
	XGQ-RY2A/B	500	HART analog input	XGF-AC4H	340
Transistor output	XGQ-TR1C	100	HART analog output	XGF-DC4H	200(220)
	XGQ-TR2A/B	70	High speed counter input	XGF-HO2A	270
	XGQ-TR4A/B	130		XGF-HD2A	330
	XGQ-TR8A/B	230	Multi-channel High speed counter input	XGF-HO8A	600
Triac output	XGQ-SS2A	300	Positioning	XGF-PO1H	400
Input/output mixed	XGH-DT4A	110		XGF-PO2H	410
Built-in Diagnosis function Input	XGI-D21D	60		XGF-PO3H	420
Built-in Diagnosis function output	XGQ-RY1D	400		XGF-PO4H	430
Cnet I/F	XGL-C22B	420		XGF-PD1H	520
	XGL-C42B	520		XGF-PD2H	600
	XGL-CH2B	480		XGF-PD3H	850
FEnet I/F	XGL-EFMTB	560/900		XGF-PD4H	890
	XGL-EFMFB	750/740	Positioning(Network)	XGF-PN4B	500
	XGL-EFMHB	670/670		XGF-PN8A/B	500

Product	Type	Current consumption	Product	Type	Current consumption
Ethernet electric switch	XGL-EH5T	700		XGF-PN16B	900
Pnet I/F	XGL-PMEB	500	Motion control	XGF-M32E	900
	XGL-PSEA	410	Thermo couple input	XGF-TC4S	610
	XGL-PSRA	600	RTD input	XGF-RD4/8A	450
Dnet I/F	XGL-DSEB	350		XGF-RD4S	783
	XGL-DMEB	350	Main base	XGB-M12A	230
Rnet I/F	XGL-RMEB	410		XGB-M10A	220
Fnet	XGL-FMEA	410		XGB-M08A	220
BACnet/IP	XGL-BIPT	400		XGB-M06A	200
EtherNet/IP	XGL-EIPT	400		XGB-M04A	200
Temperature controller module	XGF-TC4UD	900(300)	Extension base	XGB-M12E	190
	XGF-TC4RT	310(28)		XGB-M08E	180
Evnet input save	XGF-SOEA	700		XGB-M06E	180
Data log	XGF-DL16A	530		XGB-M04E	180

( ) means the current consumption for external DC24V.



I_{5V} : current consumption of each module DC5V circuit (internal current consumption)
I_{24V} : the average current consumption of DC24V used for output module

11.2 Specifications

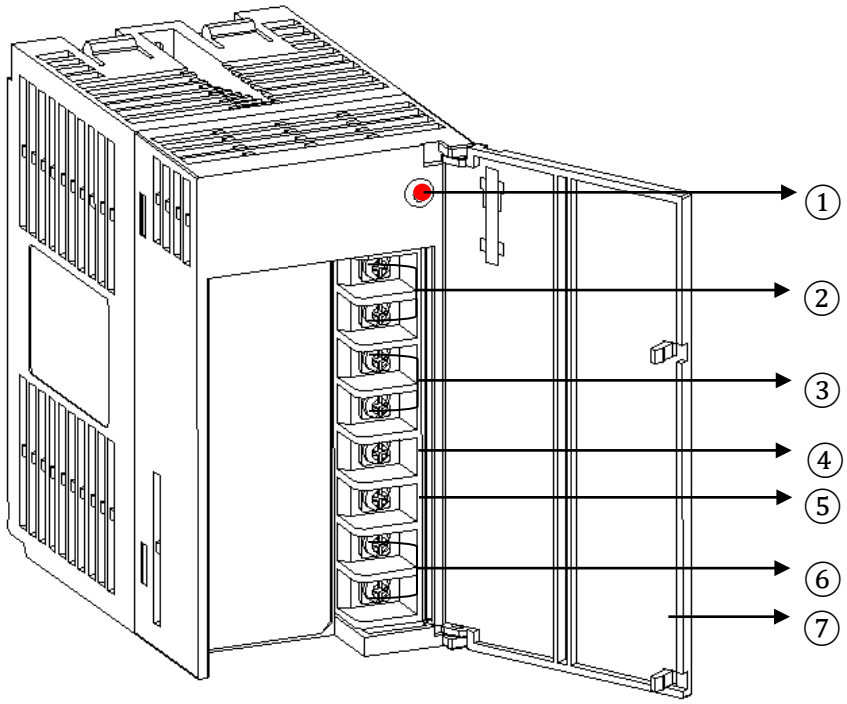
Item		XGP-ACF1	XGP-ACF2	XGP-AC23	XGP-AC24	XGP-SAC24 (SELV)	XGP-AC14	XGP-DC42	XGP-DC44
Input	Rated input voltage	AC110/220V		AC220V			AC110V	DC24V	
	Input voltage range	AC85V ~ AC264V		AC170V ~AC264V			AC85V~ AC132V	DC19.2V ~ 28.8V	
	Input frequency	50 / 60 Hz (47 ~ 63 Hz)						-	
	Power Consumption	185VA		330VA	140VA	180VA	180VA	39VA	57VA
	Inrush current	80APeak or less			20APeak or less			120APeak or less	
	Efficiency (or more)	65%			80%			60%	75%
	Input fuse	Built in (not replaceable by a user), UL standard product (Slow Blow Type)							
	Permitted momentary power failure	10 ms or less							
Output 1	Output voltage	DC5V (±2%)							
	Output current	3 A	6 A	8.5 A	10A			6A	9A
	Over current protection	3.2A or higher	6.6 A or higher	9A or higher	11.2 or higher			6.6 A or higher	9.5 A or higher
	Over voltage protection	5.5V ~ 6.5V							
Output 2	Output voltage	DC24V(±10%)	-					-	
	Output current	0.6 A							
	Over current protection	0.7 A or higher							
	Over voltage protection	None							
Relay Output	Usage	RUN contact(refer to chapter 8.3)							
	Rated switching Voltage/current	DC24V, 0.5A							
	Min. switching load	DC5V, 1 ㎃							
	Response time	Off→On/ On→Off: 10 ㎳ or less/12 ㎳ or less							
	Life span	Mechanical life:20 million and more times, electrical life: Rated switching voltage/current load 100,000 times or more							
Voltage status display		LED On when output voltage is normal							
Available cable size		0.75 ~ 2 mm^2							
Available clamped terminal		RAV1.25-3.5,RAV2-3.5							
Weight(kg)		0.32		0.36	0.4		0.36	0.32	0.36

Notes

1) The DC24V output voltage of the XGP-ACF1 product is guaranteed above the minimum load current (0.15A). In the case of no load, over rated voltage may be output.
2) Allowable Momentary Power Failure Time
   The time that input voltage keeps normal output voltage (normal operation) in the state that AC110/220V voltage is below rated value (AC85 / 170V).
3) Over current protection
   (1) If the current over the standard flows in DC5V, DC24V circuit, the over current protection device shutdowns the circuit to stop the system.
   (2) In case of over current, remove the causes such as lack of current capacity or short circuits etc. and then restart the system.
4) Over voltage protection
   If the voltage over the standard is applied in DC5V circuit, the over voltage protection device shutdowns the circuit to stop the system.
5) If an input higher than the rated input is applied to the power module, the system may be damaged, so Use it within the rated input range.
6) The condition of XGP-AC14/AC24 inrush current is when the On/Off cycle is more than 10 seconds with Cold Start at AC264V maximum load. If the On/Off cycle is less than 10 seconds, the inrush current may exceed 20A.
7) The XGP-SAC24 product is SELV power

11.3 Part names

Here describes the names of each part and its purpose of Power module.



NO.	Name	Usage
1	Power LED	DC5V power display LED
2	DC24V, 24G terminal	Power supply to the module required for DC24V in output module ▶ Only XGP-ACF1 does provide DC24V.
3	RUN terminal	Displaying RUN state of a system ▶ Off when the stop error of CPU occurs. ▶ It is Off when the mode of CPU is changed to STOP mode.
4	PE terminal	Grounding terminal to prevent electric shock.
5	LG terminal	Grounding terminal of power filter
6	Power input terminal	Power input terminal ▶ XGP-ACF1, XGP-ACF2: AC100 ~ 240V connection ▶ XGP-AC23, XGP-(S)AC24: AC200 ~ 240V connection ▶ XGP-AC14: AC85 ~ 132V connection ▶ XGP-DC42, XGP-DC44: DC24V connection
7	Terminal cover	Terminal block protection cover

11.4 Example of Current Consumption/Power Calculations

It describes which power module should be used for the XGT system with the following module.

Type	Model name	Number of installation	Voltage system	
			5V	24V
CPU Module	XGI-CPUH	1	0.96A	-
Main base 12 slot	XGB-B12M	1	0.23A	-
Input module	XGI-D24A	4	0.2A	-
Output module	XGQ-RY2A	4	2.0A	-
FEnet module	XGL-EFMTB	2	1.12A	-
Profibus-DP	XGL-PMEB	2	1.0A	-
Current consumption	Calculation (Current consumption of each modules x Number of installation)		0.96+0.23+0.2+2+1.12+1.0	-
	Result		5.51A	-
Power consumption	Calculation		5.51×5V	-
	Result		27.55W	-

Since the current consumption calculation for 5V displays 5.58V, XGP-ACF2 (for 5V:6A) or XGP-AC23 (for 5V:8.5A) should be used. If used XGP-ACF1(5V:3A), the system does not operate.

Chapter 9 Base and Extension Cable

9.1 Specifications

9.1.1 Main base

The basic base mounts the power module, CPU module, I/O module, special module, and communication module.

Item \ Type	XGB-M12A	XGB-M10A	XGB-M08A	XGB-M06A	XGB-M04A
No. of I/O modules installation	12	10	8	6	4
Dimensions (mm)	426 X 98 X 19	375 X 98 X 19	318 X 98 X 19	264 X 98 X 19	210 X 98 X 19
Hole distance to attach panel	406 X 75	355 X 75	298 X 75	244 X 75	190 X 75
Hole size to attach panel	ϕ 4.5 (using M4 screw)				
Screw size for PE connection	(+)PHM 3 X 6 washer(ϕ 5)				
current consumption(A)	0.23	0.22	0.22	0.2	0.2
Weight(kg)	0.54	0.48	0.42	0.34	0.28

9.1.2 Extension base

The extension base mounts the power module, CPU module, I/O module, special module, and communication module.

Item \ Type	XGB-E12A	XGB-E08A	XGB-E06A	XGB-E04A
No. of I/O modules installation	12	8	6	4
Dimensions (mm)	426 X 98 X 19	318 X 98 X 19	264 X 98 X 19	210 X 98 X 19
Hole distance to attach panel	406 X 75	298 X 75	244 X 75	190 X 75
Hole size to attach panel	ϕ 4.5 (using M4 screw)			
Screw size for PE connection	(+)PHM 3 X 6 washer(ϕ 5)			
Current consumption(A)	0.19	0.18	0.18	0.18
Weight(kg)	0.59	0.47	0.39	0.33

9.1.3 Extension cable

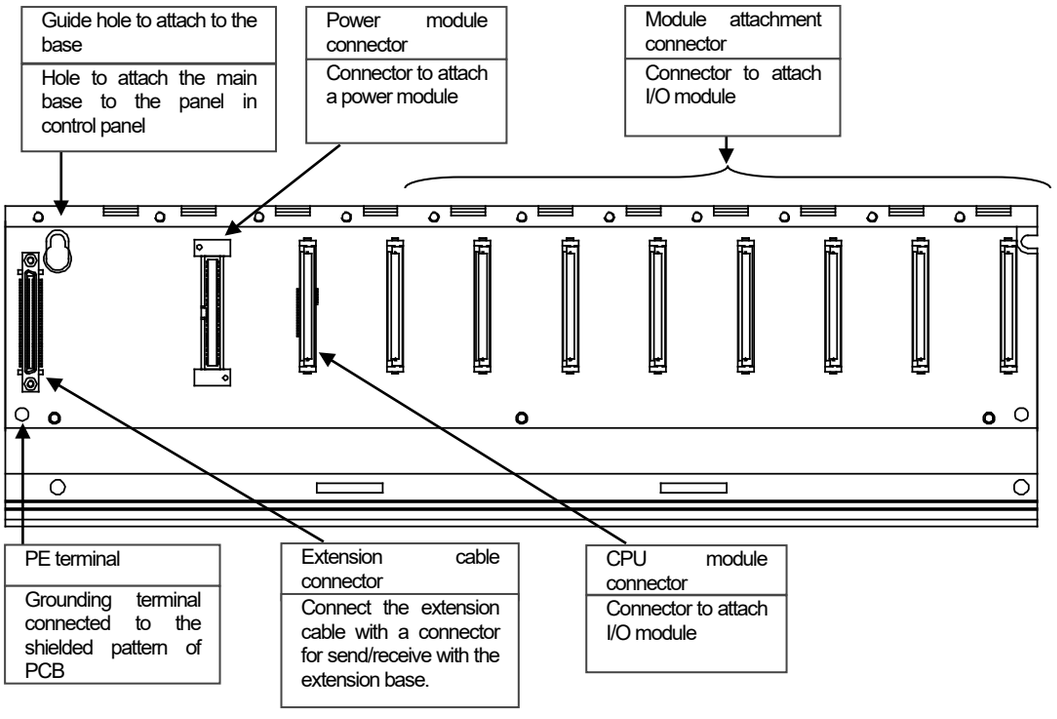
Item \ Type	XGC-E041	XGC-E061	XGC-E121	XGC-E301	XGC-E501	XGC-E102	XGC-E152
Length(m)	0.4	0.6	1.2	3	5	10	15
Weight(kg)	0.15	0.16	0.22	0.39	0.62	1.2	1.8

Notes

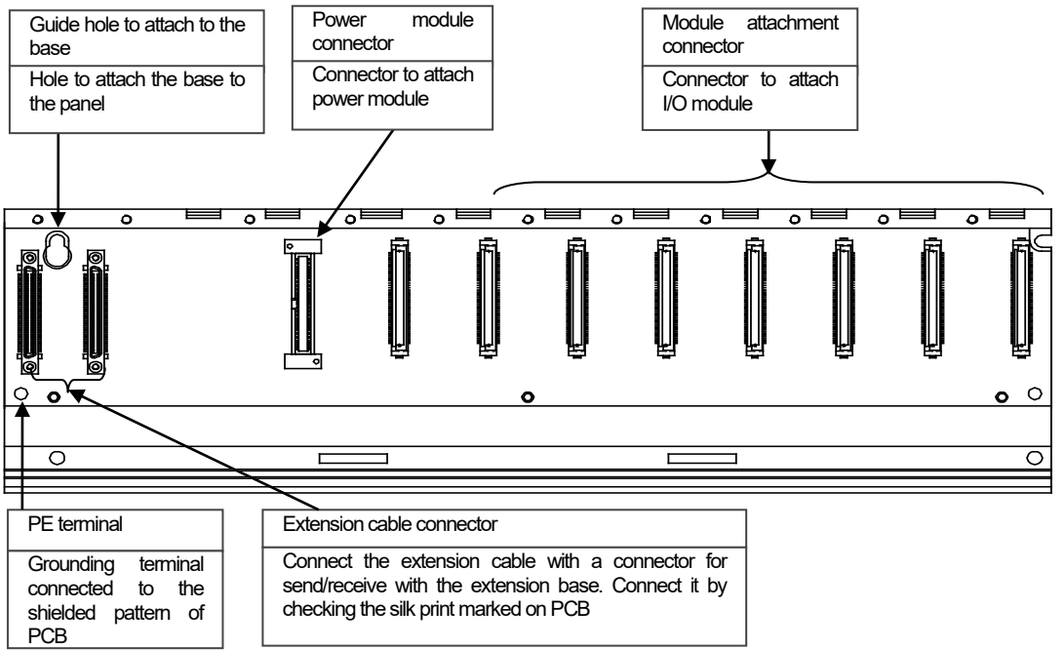
If using a combination with extension cable, it should not be longer than 15m.

9.2 Part Names

9.2.1 Main base



9.2.2 Extension base



Chapter 10 Installation and Wiring

10.1 Installation

10.1.1 Installation Environment

This equipment has a high reliability regardless the installation environment. However, to guarantee the reliability and stability, make sure to keep the following cautions.

1) Environment Condition

(1) Install in a control panel resisting to moisture and vibration.
(2) Free of any continuous impact or vibration.
(3) Do not expose directly to the sun.
(4) No condensation from sudden temperature fluctuation.
(5) Ambient temperature range between 0 ~ 55°C.
(6) Relative humidity between 5 ~ 95%.
(7) Free of any corrosive gas or flammable gas.

2) Installation construction

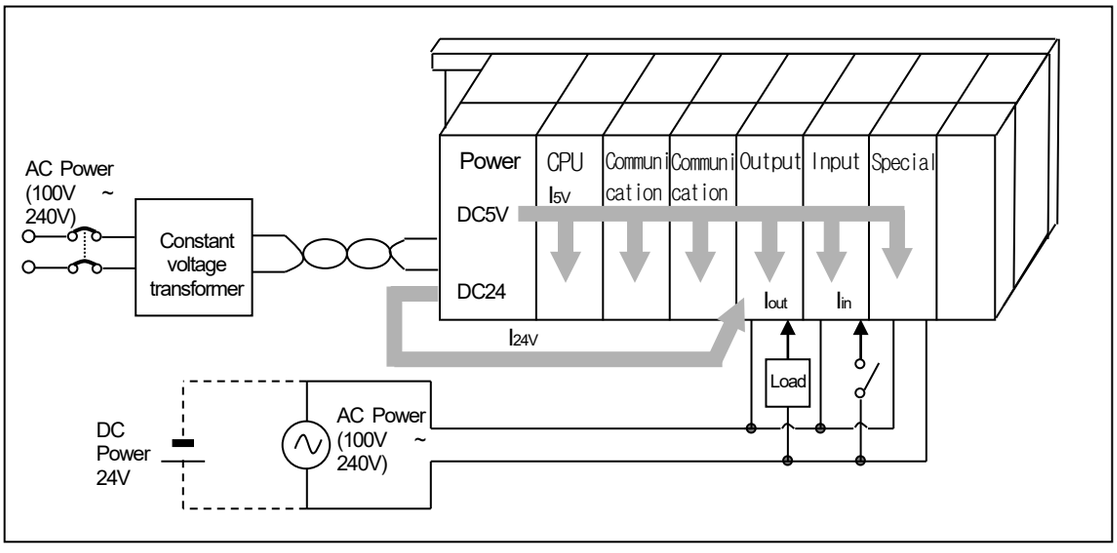
(1) When boring a screw hole or executing wiring construction, any wiring impurities should not be inserted to the PLC.
(2) The system should be installed in a place easily accessible.
(3) Do not install the system on a same panel of a high voltage device.
(4) It should be 50mm and more away from wiring duct or proximate modules.
(5) Grounding on a position where noise is lower than the specified level.

3) Heat protective design of control panel

(1) If installing the PLC in an air-tight control panel, it needs heat-protective (control) design considering the heat from the PLC as well as other devices. If ventilating by vent or fan, inflow of dust or gas may affect the performance of the PLC system.
(2) Install a filter or use a closed heat exchanger.

The following shows the calculation of PLC system's power consumption requiring heat protective design.

4) Power Consumption block diagram of the PLC system



5) Power consumption of each part

(1) Power consumption of power module

The power conversion efficiency of power module is about 70% and the other 30% is gone with heat; 3/7 of the output power is the pure power consumption. Therefore, the calculation is as follows.

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

I_{5V} : current consumption of each module DC5V circuit (internal current consumption)

I_{24V}: the average current consumption of DC24V used for output module (current consumption of simultaneous On point)

If DC24V is externally supplied or a power module without DC24V is used, it is not applicable.

(2) Sum of DC5V circuit current consumption

The DC5V output circuit power of the power module is the sum of power consumption used by each module.

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

(3) DC24V average power consumption (power consumption of simultaneous On point)

The DC24V output circuit's average power of the power module is the sum of power consumption used by each module.

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

(4) Average power consumption by output voltage drop of the output module (power consumption of simultaneous On point)

- $W_{out} = I_{out} \times V_{drop} \times$ output point X simultaneous On rate (W)

I_{out} : output current(actually used current) (A)

V_{drop} : voltage drop of each output module (V)

(5) Input average power consumption of input module (power consumption of simultaneous On point)

- $W_{in} = I_{in} \times E \times$ input point X simultaneous On rate (W)

I_{in}: input current (root mean square value in case of AC) (A)

E : input voltage (actually used voltage) (V)

6) Current consumption of Special module power

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

The sum of power consumption calculated by each block is the power consumption of the entire PLC system.

- $W = W_{PW} + W_{5V} + W_{24V} + W_{out} + W_{in} + W_s$ (W)

Calculate the heats according to the entire power consumption (W) and review the temperature increase within the control panel.

The calculation of temperature rise within the control panel is displayed as follows.

T = W / UA [°C]
W : Total current consumption of PLC system(the value obtained on the above)
A : surface area of control panel [m^2]
U : if equalizing the temperature of the control panel by using a fan and others - - - 6
If the air inside the panel is not ventilated - - - - - - - - - - 4

10.1.2 Handling Precautions

It describes the cautions for handling from unpacking to installation.

- Please do not drop it or apply excessive force on it.
- Please do not separate PCB from the case. Doing so may cause failure of the module and/or printed-circuit board.
- During wiring, a special attention should be paid so that impurities such as wiring remainder should not be inserted into the top of a module. If impurities are found, immediately remove them.

1) Cautions for handling I/O module

It describes the cautions for installing or handling I/O module.

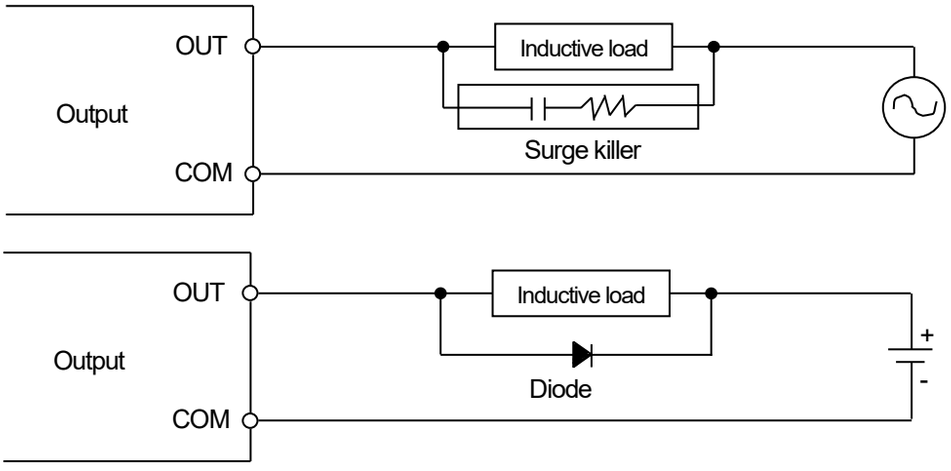
(1) Recheck the I/O module specifications.
The input module may be affected by input voltage while the output module may be subject to breakage, destruction or a fire if the voltage over the max. Switching capacity is allowed.

(2) Available cable type
Cable should be selected in consideration of ambient temperature and allowable current; the min. size of cable should be AWG22 (0.3mm^2) and higher.

(3) Environment
If I/O module wiring is close to heating sources or materials or the wiring is directly contacted with oils for a long time during wiring, it may cause short-circuit, destruction or malfunction.

(4) Polarities
Please make sure to check the polarities of modules of which terminal block is polarized before allowing the power.

(5) Wiring
- When I/O wiring is executed with high voltage or power cable, it may cause inductive fault, probably leading to malfunction or trouble.
- No cable should not be arranged front of I/O operation display (LED) (I/O display may be hidden, hindering the interpretation)
- If an output module is connected to inductive load, please make sure to connect a surge killer or diode to load in parallel. Please connect the cathode side of a diode to (+) of the power.



(6) Terminal strip

Please check the tightness of terminal strip and prevent any wiring impurities (remainder) from being inserted into the PLC when processing terminal strip wiring or screw hole making. It may cause malfunction or trouble.

(7) Besides the above, it is prohibited to apply excessive impact on I/O module or separating PCB board from the case.

2) Cautions for installing the base

It describes the cautions when installing the PLC on the control panel and others.

(1) A proper distance between the top of a module and structure/parts should be secured to facilitate ventilation and module replacement.

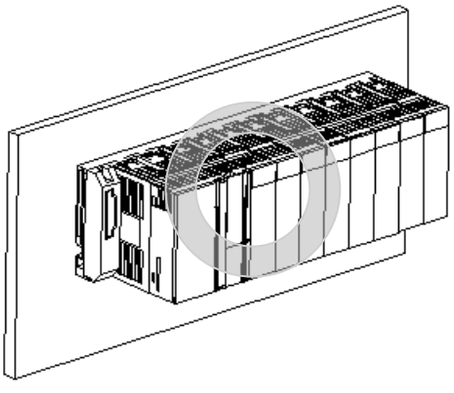
(2) Please do not install it vertically or horizontally for the ventilation purpose.

(3) Please use a different panel or secure a proper distance if there is vibration source from a large electronic contact or no-fuse breaker

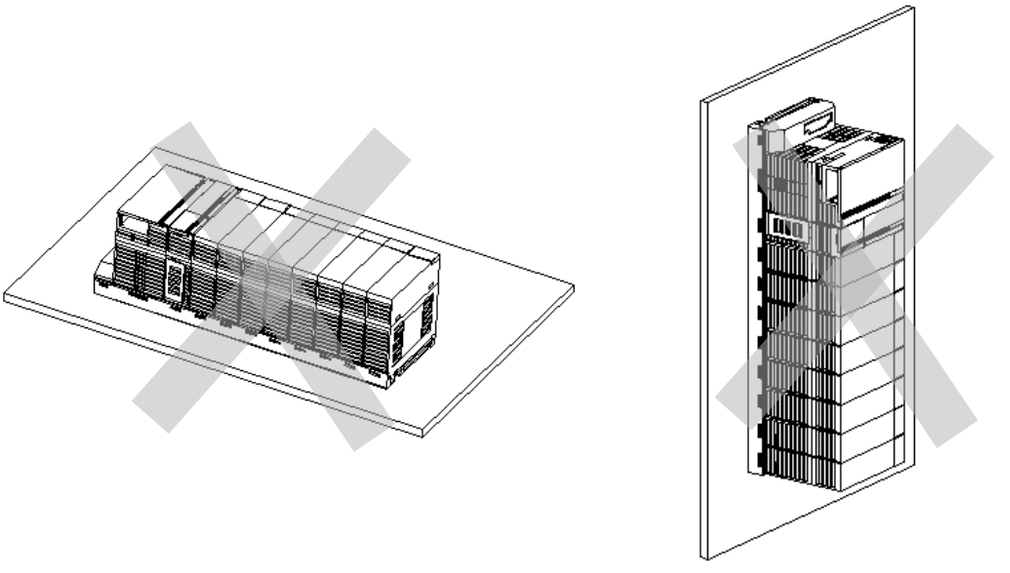
(4) If necessary, please install a wiring duct. But cares should be taken for the following notices in case the dimension of the upper or lower part of PLC is smaller than that of Figure 10.1.

- If installing on the top of PLC, maintain the height of a wiring duct 50mm more than for better ventilation. In addition, maintain the distance from the top of PLC so that the hook on the top of the base can be pressed.
- If installing on the bottom of it, let optical or coaxial cable be connected and consider the minimum radius of the cable.

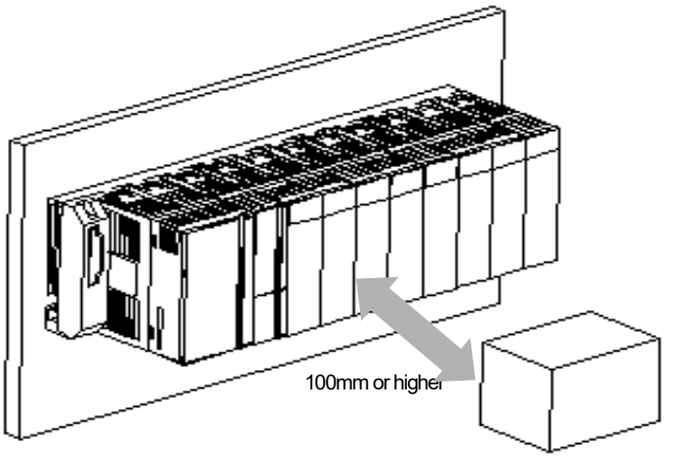
(5) Please install the PLC along the well-ventilated direction as presented below for the heat prevention purpose.

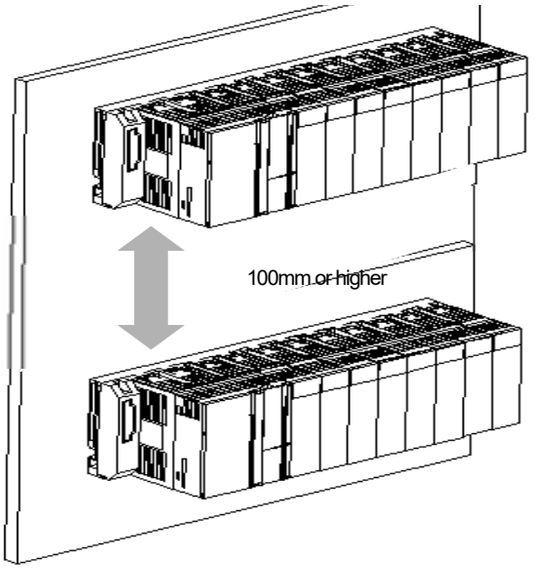


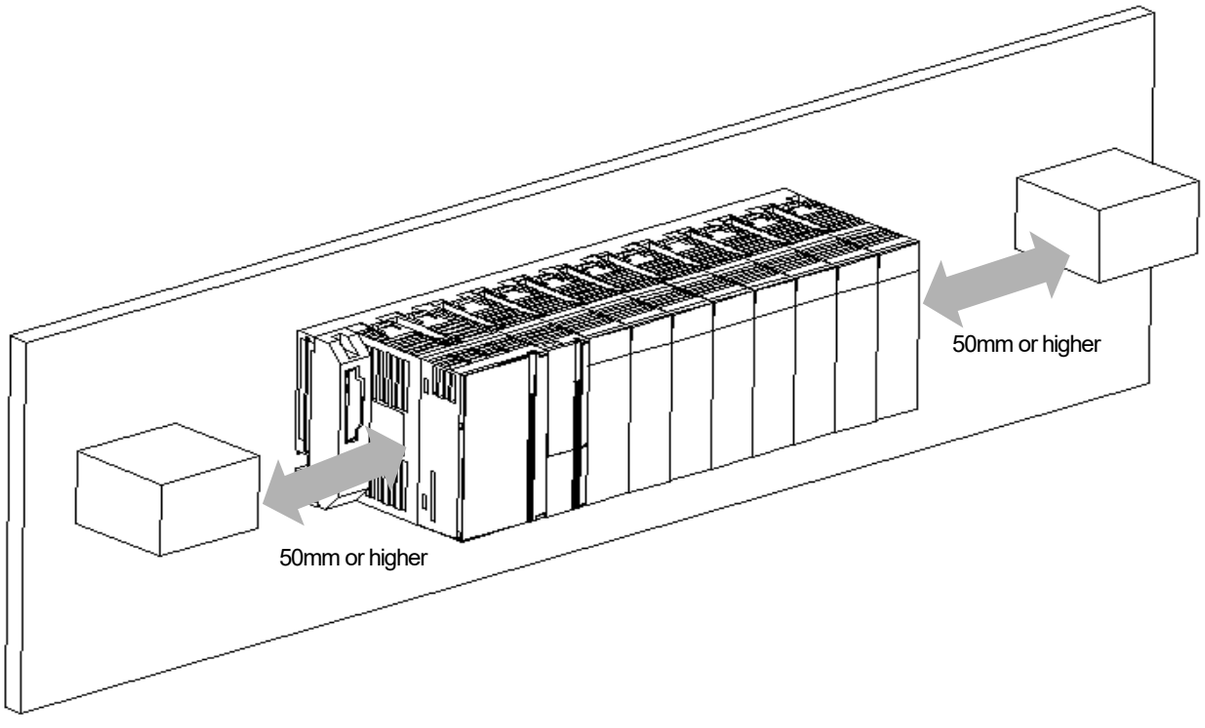
(6) Please do not install it to the direction as presented below.



(7) To avoid any influence of radiating noise or heat, please install the PLC and other devices (relay, electronic contact) with a spacing secured as presented below.





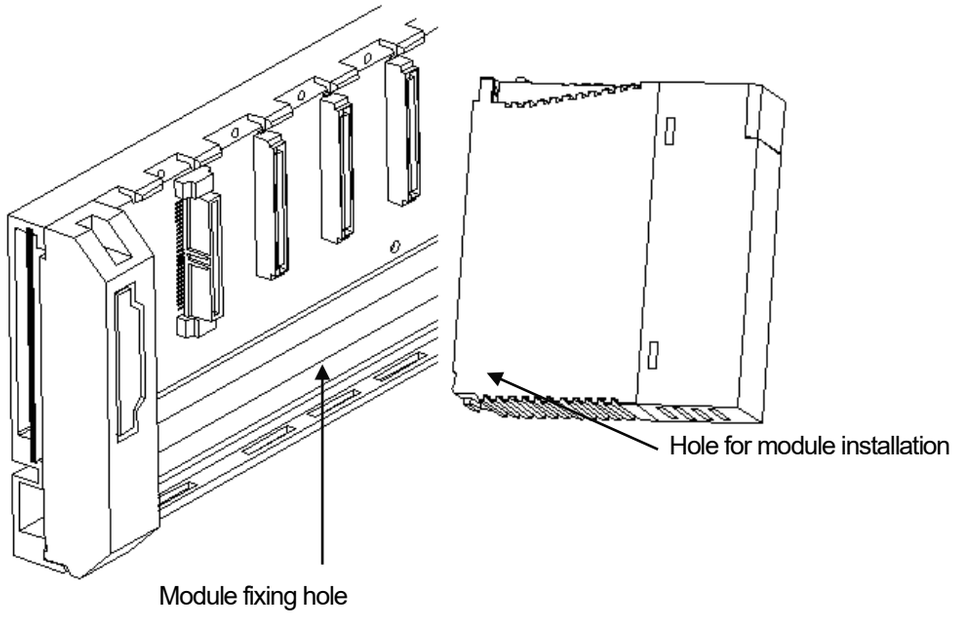


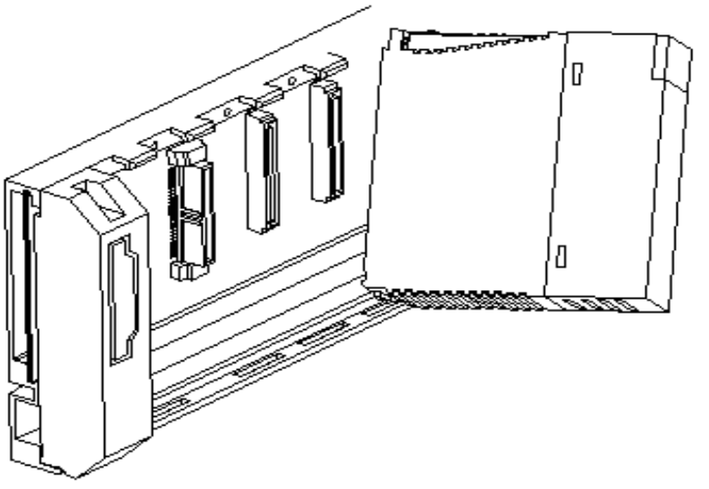
10.1.3 Attachment/Detachment of Module

It describes how to attach or detach a module on the base.

1) Module mounting

- Please insert the fixation projection on the bottom of a module to the hole of module installation of the base.
- Please fix it on the base by pushing the top of a module and tight it by using the module fixation screw.
- Please try to pull the top of a module to check whether it is tightly fixed on it.



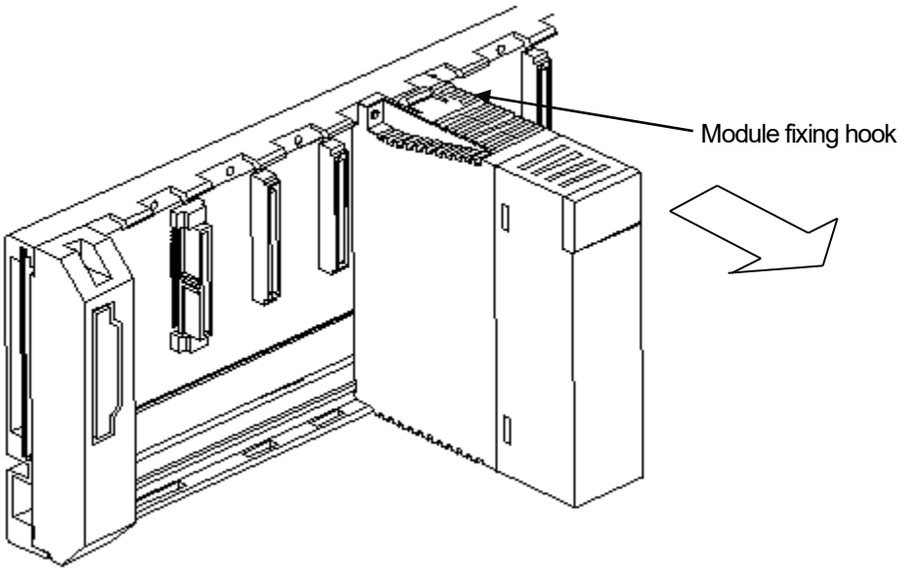


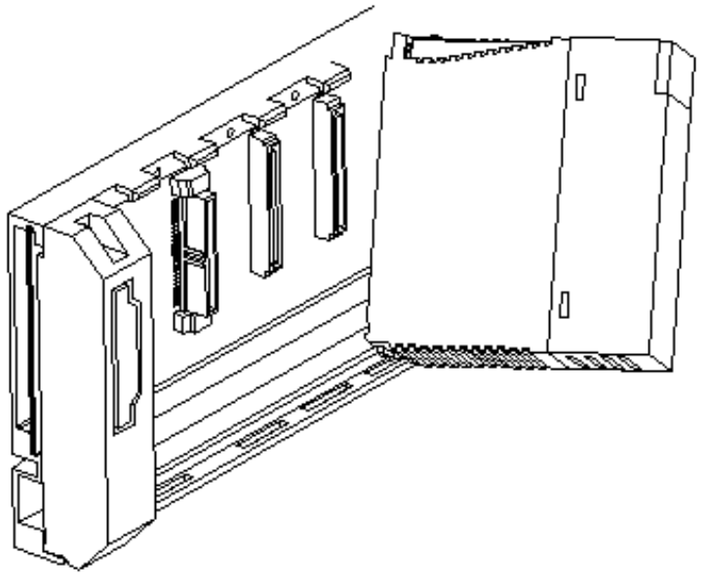
Notes

1) A module should be installed by inserting the projection for module installation to the hole for module installation. If applying an excessive force, a module may be broken.

2) Detachment of module

- Please unscrew the fixation screw on the top of a module.
- Please press the hook for module installation with a module held by both hands.
- Please pull the bottom of a module toward the top while pressing the hook.
- Lifting up the module, please detach the projection for module installation from the hole for module installation.





Notes

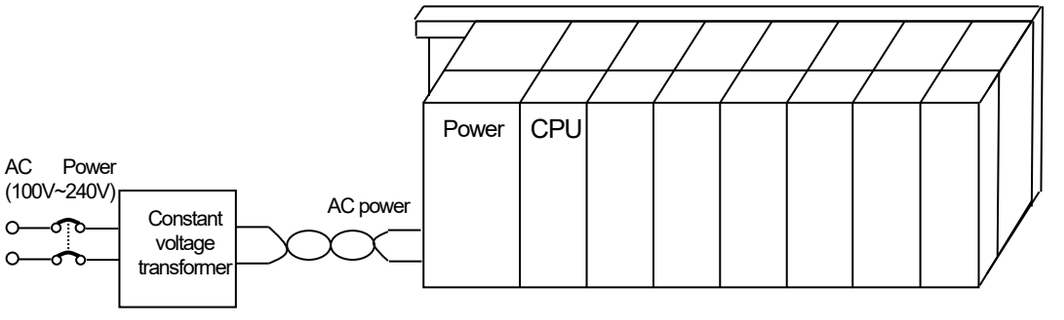
1) When detaching a module, please press the hook to detach it from the base and then, isolate the projection for module installation from the hole for module installation. At the moment, if trying to detach it forcibly, the hook or projection may be damaged.

10.2 Wiring

It describes the important information about wiring when using the system.

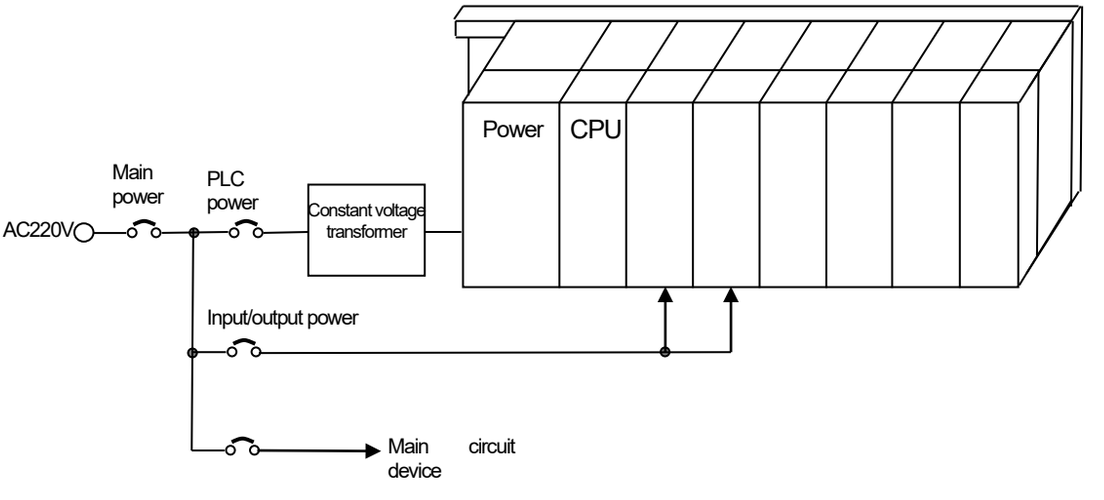
10.2.1 Power Wiring

1) In case voltage regulation is larger than specified, connect constant voltage transformer.



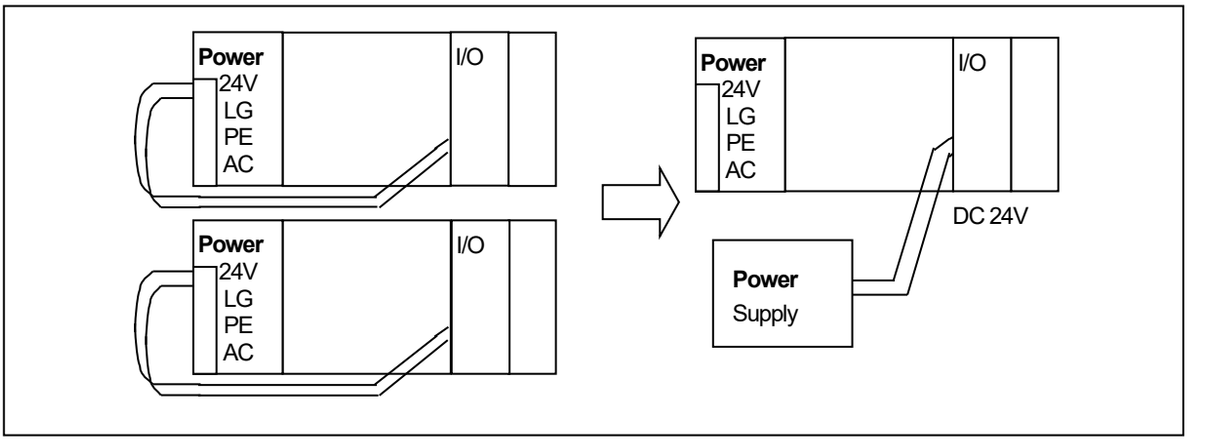
2) Connect the power source of which inter-cable or cable-ground noise is small.
(When there is much noise, connect insulated transformer.)

3) Isolate the PLC power, I/O devices and power devices as follows.



4) In case of using a DC24V output of Power Module

- Do not connect DC24V of several power modules in parallel. If connected in parallel, the module may be broken.
- If a power module cannot meet the DC24V output capacity, supply DC24V externally as presented below.

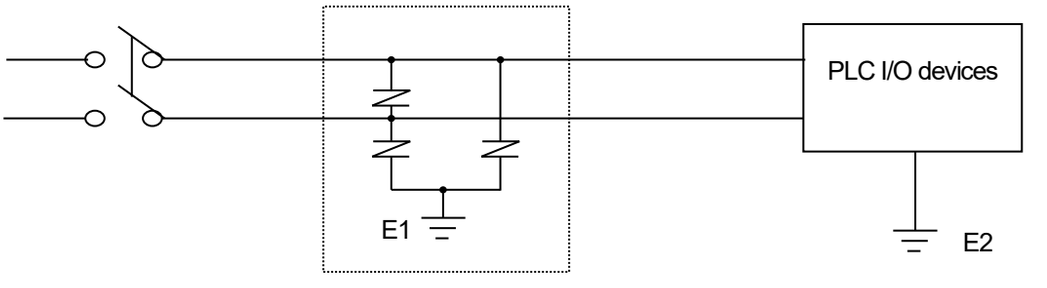


5) AC110V/AC220V/DC24V cables should be compactly twisted and connected in the shortest distance.

6) AC110V/AC220V cable should be as thick as possible (2mm^2) to reduce voltage drop.

AC110V/ DC24V cables should not be installed close to main circuit cable (high voltage/high current) and I/O signal cable. They should be 100mm away from such cables.

7) To prevent surge from lightning, use the lightning surge absorber as presented below.



Surge absorber to prevent lighting

Notes

1) Isolate the grounding (E1) of lightning surge absorber from the grounding (E2) of the PLC.
2) Select a lightning surge absorber type so that the max. Voltage may not the specified allowable voltage of the absorber.

8) When noise may be intruded inside it, use an insulated shielding transformer or noise filter.

9) Wiring of each input power should be twisted as short as possible and the wiring of shielding transformer or noise filter should not be arranged via a duct.

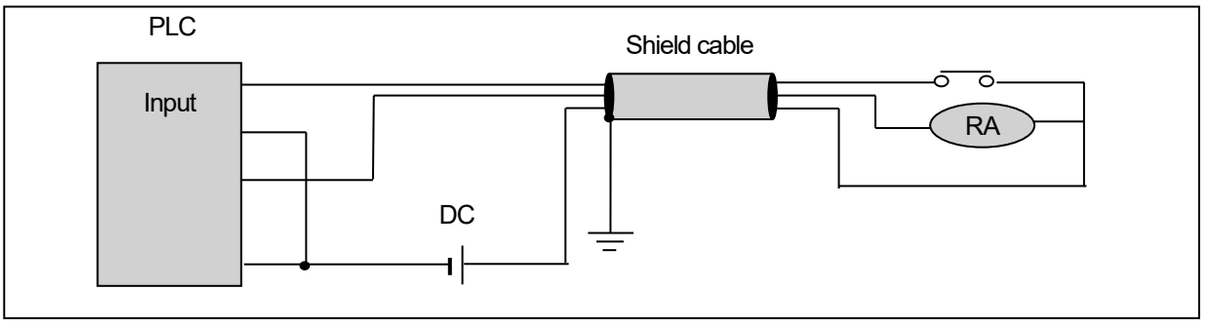
10.2.2 I/O Module wiring

1) The size of I/O device cable is limited to 0.3~2 mm^2 but it is recommended to select a size (0.3 mm^2) to use conveniently.

2) Please isolate input signal line from output signal line.

3) I/O signal lines should be wired 100mm and more away from high voltage•high current main circuit cable.

4) Batch shield cable should be used and the PLC side should be grounded unless the main circuit cable and power cable cannot be isolated.



5) When applying pipe-wiring, make sure to firmly ground the piping.

6) The output line of DC24V should be isolated from AC110V cable or AC220V cable.

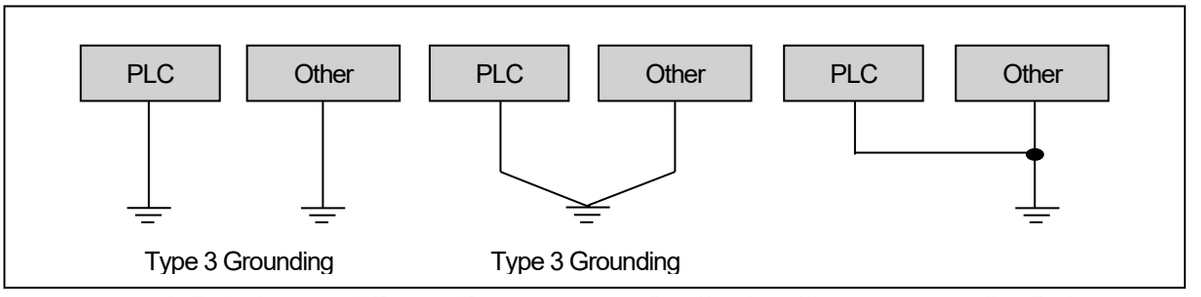
For a long distance wiring over 200m, please refer to 12.4 Cases in Chapter 12 because it is expected that accident may occur due to leakage current due to inter-cable capacity.

10.2.3 Grounding wiring

1) The PLC contains a proper noise measure, so it can be used without any separate grounding if there is a large noise. However, if grounding is required, please refer to the followings.

2) For grounding, please make sure to use the exclusive grounding.
For grounding construction, apply type 3 grounding (grounding resistance lower than 100 Ω)

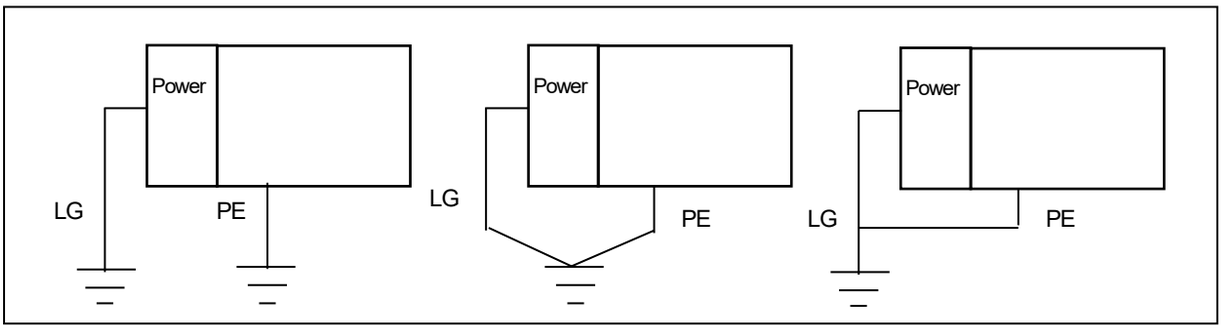
3) If the exclusive grounding is not possible, use the common grounding as presented in B) of the figure below.



A) Exclusive ground: Best B) common grounding: Good C) common grounding: Bad

4) Use the grounding cable more than 2 mm^2. To shorten the length of the grounding cable, place the grounding point as close to the PLC as possible.

5) Separately ground the LG of the power module and the PE of the base board.



A) Exclusive ground: Best B) common grounding: Good C) common grounding: Bad

6) If any malfunction from grounding is detected, separate the PE of the base from the grounding.

10.2.4 Cable Specification for Wiring

The specifications of cable used for wiring are as follows.

Types of external connection	Cable specification (mm^2)	
	lower limit	Upper limit
Digital input	0.18 (AWG24)	1.5 (AWG16)
Digital output	0.18 (AWG24)	2.0 (AWG14)
Analog input	0.18 (AWG24)	1.5 (AWG16)
Communication	0.18 (AWG24)	1.5 (AWG16)
Main power	1.5 (AWG16)	2.5 (AWG12)
Protective grounding	1.5 (AWG16)	2.5 (AWG12)

Chapter 11 Maintenance and Repair

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

11.1 Maintenance and Inspection

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

Check Items		Judgment	Action
Power supply		Within change rate of input voltage (Within –15% / +10%)	Change the power so that it should be within the allowable voltage range.
Power supply for input/output		Input/output specification of each module	Hold it with the allowable range of each module.
Operating atmosphere	Temperature	0 ~ + 55℃	Adjust the operating temperature and humidity with the defined range.
	Humidity	5 ~ 95%RH	
	Vibration	No vibration	Use vibration resisting rubber or the vibration prevention method.
Play of modules		No play allowed	Securely enrage the hook.
Check the connecting screws		Screws should not be loose.	Retighten terminal screws.
Spare parts		Check the number of Spare parts and their Store conditions	Cover the shortage and improve the conditions.

11.2 Daily inspection

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

Check Items		Check Points	Judgment	Action
Base attachment state		Check the screws.	Screws should not be loose.	Retighten Screws.
I/O module attachment state		• Check if the attached screw of module is tightened completely • Check if the upper cover of module is detachment.	Complete tightening	Check screw
Connection state of terminal block and extension cable		Check the connecting screws	Screws should not be loose.	Retighten Screws.
		Check the distance between solderless terminals.	Proper clearance should be provided.	Check screw
		Extension cable connector	Connector should not be loose.	Check screw
Indicator LED	Power LED	Check LED ON	On(Off indicates an error)	Refer to chapter 14
	Run LED	Check that the LED is On during Run.	On (flickering or Off indicates an error)	Refer to chapter 14
	STOP LED	Check that the LED is Off during Run.	Flickering indicates an error	Refer to chapter 14
	Input LED	Check that the LED turns On and Off	LED On with input ON and LED Off with input off	Refer to chapter 14
	Output LED	Check LED turns On and Off	LED On with output ON and LED Off with output off	Refer to chapter 14

11.3 Periodic Inspection

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

Check Items		Checking Methods	Judgment	Action
operating atmosphere	Ambient temperature	Measured with a thermometer/hygrometer measure corrosive gas	0 ~ 55 °C	Adjust to meet general specification (environment standard in control panel)
	Ambient humidity		5 ~ 95%RH	
	Pollution degree		There should be no corrosive gases	
PLC Status	Looseness, Ingress	Try moving each module.	The module should be mounted securely.	Retighten Screws.
	Dust or foreign material	Visual checks	No dust or foreign material	-
Connection status	Loose terminal screws	Re-tighten screws	Screws should not be loose.	Tighten
	Distance between terminals	Visual checks	Proper clearance	Check screw
	Loose connectors	Visual checks	Screws should not be loose.	Retighten connector mounting screws
Line voltage check		Measure voltage between input terminals	AC100~240V:AC85~ 264V DC24V:DC19.2 ~ 28.8V	Change supply power
Battery		Check the battery replacement timing and voltage drop	• Check total shutdown time and warranty • No indication of battery voltage drop	Change the battery if exceeded warranty without battery capacity indication
Fuse		Visual checks	• Not to be melted	Even if it is not melted, the element is deteriorated by inrush current, so replace it regularly.

Chapter 12 Compliance with EMC Specifications

12.1 Requirements for Conformance to EMC Directive

The EMC Directive specifies the products must 'be so constructed that they do not cause excessive electromagnetic interference (emissions) 'and 'are not unduly affected by electromagnetic interference (immunity)'. The applicable products are requested to meet these requirements. This section summarizes the precautions on conformance to the EMC Directive of the machinery assembled using XGT PLC series. The details of these precautions are based on the requirements and the applicable standards control. However, LSIS will not guarantee that the overall machinery manufactured according to these details conforms to the below-described directives. The method of conformance to the EMC directive and the judgment on whether or not the machinery conforms to the EMC Directive must be determined finally by the manufacturer of the machinery

12.1.1 EMC Standard

The standards applicable to the EMC Directive are listed below.

Specifications	Test item	Test details	Standard value
EN50081-2	EN55011 Radiated noise * 2	Electromagnetic emissions from the product are measured	30~230 ㎒ QP : 50 dB㎶/m * 1 230~1000 ㎒ QP : 57 dB㎶/m
	EN55011 conducted noise	Electromagnetic emissions from the product to the power line is measured.	150~500 ㎑ QP :79 dB Mean : 66 dB 500~230 ㎒ QP : 73 dB Mean : 60 dB
EN61131-2	EN61000-4-2 Electrostatic immunity	Immunity test in which static electricity is applied to the case of the equipment	Voltage : 4kV (contact discharging)
	EN61000-4-4 Fast transient burst noise	Immunity test in which burst noise is applied to the power line and signal lines	Power line: 2 ㎸ Digital /O : 1 ㎸ Analog I/O, signal lines: 1 ㎸
	EN61000-4-3 Radiated field AM modulation	Immunity test in which field is irradiated to the product	10Vm, 26~1000 ㎒ 80%AM modulation@ 1 ㎑
	EN61000-4-12 Damped oscillatory wave immunity	Immunity test in which a damped oscillatory wave is superimposed on the power line	Power line: 1 ㎸ Digital I/O (24V or higher): 1 ㎸

* 1: QP: Quasi-peak value, Mean: Average value

* 2: The PLC is an open type device (device installed to another device) and must be installed in a control panel.
The test was conducted while installed in the panel.

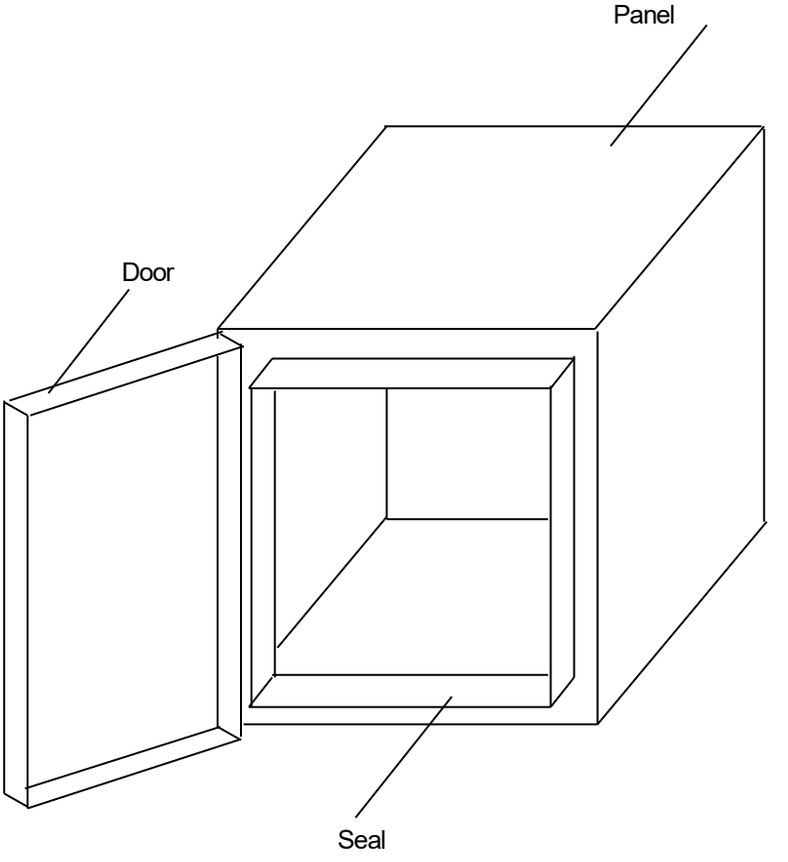
12.1.2 Control Panel

The PLC is an open type device (device installed to another device) and must be installed in a control panel. This is because an accident such as electric shock does not occur when a person comes into contact with the product (XGT PLC), and the noise generated in the PLC has the effect of attenuating the control panel.
In the case of XGT PLC, it is necessary to install on a metal control panel in order to suppress electromagnetic waves (EMI) emitted from the product.
The specifications for the control panel are as follows

1) Control Panel

The PLC control panel must have the following features.

(1) Use SPCC (Cold Rolled Mild Steel) for the control panel.
(2) The steel plate should be thicker than 1.6mm.
(3) Use isolating transformers to protect the power supply from external surge voltage.
(4) The control panel must have a structure which the radio waves does not leak out. For example, make the door as a box-structure so that the panel body and the door are overlapped each other. This structure reduces the surge voltage generate by PLC.



(5) To ensure good electrical contact with the control panel or base plate, mask painting and weld so that good surface contact can be made between the panel and plate.

2) Connection of power and earth wires
Earthing and power supply wires for the PLC system must be connected as described below.

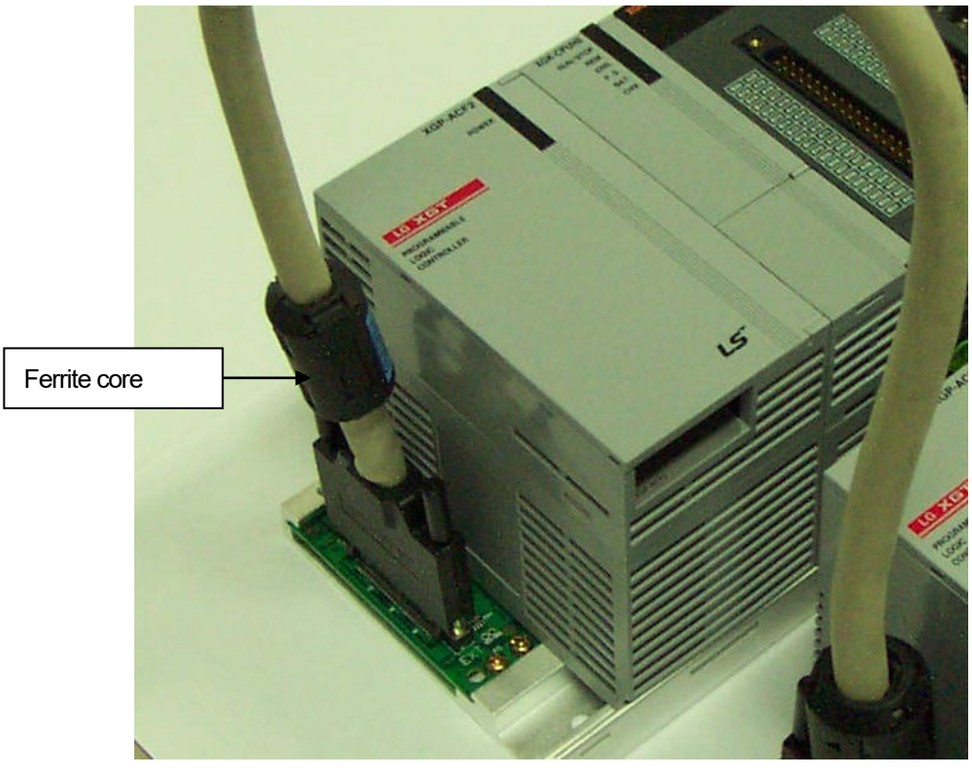
(1) Earth the control panel with a thick wire so that a low impedance connection to ground can be ensured even at high frequencies.
(2) The function of LG (Line Ground) and FG (Frame Ground) terminals is to pass the noise generated in the PLC system to the ground so an impedance that is as low as possible must be ensured.
(3) The earthing wire itself can generate the noise, so wire as short and thick to prevent from acting as an antenna.

3) Ferrite core
If the cable is exposed outside the control panel, it is recommended to use it for noise attenuation when the shielding effect of the shielded cable is insufficient.

12.1.3 Cable

1) Extension cable processing

High-speed electrical signals flow through the extension cables of the XGT series. Therefore, high frequency noise waves are radiated from this extension cable. To ensure CE conformity, attach ferrite cores as shown below to the extension cable.



Type	Vendor	Note
CU1330D	E tech	-
ZCAT3035-1330	TDK	-

2) How to fix the cable in the panel

When fixing the extension cable of the XGT series to the metal control panel, keep the extension cable at least 1 cm so that the extension cable does not directly contact the metal plate.

The metal plate of the control panel has a shielding effect that blocks noise from radio waves, but it can also be a good antenna if a cable that is a source of noise is connected nearby. The transmission cable for high speed signals, not limited to the extension cable, needs to be kept as far as possible from the metal plate of the control panel

12.2 Requirement to Conform to the Low-Voltage Directive

The low-voltage directive requires each device that operates with the power supply ranging from 50V to 1000VAC and 75V to 1500VDC to satisfy the safety requirements. Cautions and installation and wiring of the series PLC XGT series to conform to the low-voltage directive are described in this section. However, LSIS will not guarantee that the overall machinery manufactured according to the details conforms to the below-described directives. The method of conformance to the EMC directive and compliance to the EMC Directive must be determined by the manufacturer of the machinery.

12.2.1 Standards applicable to XGT series

The XGT PLC complies with EN6100-1 (safety of equipment used in measurement and control laboratories.
XGT series PLCs have been developed in accordance with the above standards for modules operating at rated voltage of AC50V / DC75V or higher.

12.2.2 Selection of XGT Series PLC

1) Power module
There are dangerous voltages (higher than 42.4V peak) inside the power supply modules of the Rated input voltage AC110/ 220Vtes. Therefore, the CE mark-compliant models feature enhanced insulation strong primary and secondary windings.

2) I/O module
There are dangerous voltages (voltages higher than 42.4V peak) inside the I/O modules of the AC110/220V rated I/O voltages. Therefore, the CE mark-compliant models are enhanced in insulation internally between the primary and secondary. The I/O modules of DC24V or less rating are out of the low-voltage directive application range.

3) CPU, Base module
The above modules are using DC5V and 3.3V circuits inside, so they are out of the low-voltage directive application range.

4) Special, Communication module
Special and communication modules are DC24V or less in rated voltage, therefore they are out of the low-voltage directive application range.

Chapter 13 Troubleshooting

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

13.1 Basic Procedure of Troubleshooting

System reliability not only depends on reliable equipment but also on short downtimes in the event of fault.
To start the system promptly, it is more important to find the trouble occurring cause promptly and take the necessary action. The basic items to comply when taking this trouble shooting are as follows.

1) Visual check

Check the following points.

- Machine operation state (STOP, RUN)
- Power supply state
- I/O device state
- Wiring state (I/O cable, extension and communication cable)
- After checking the indication state of each indicator (Power LED, Run LED, Stop LED, I/O LED etc.), connect the peripheral device and check PLC operation state and program contents.

(2) Error Check

Observe any change in the error conditions during the following.

- Switch to the STOP position, and then turn the power on and off.

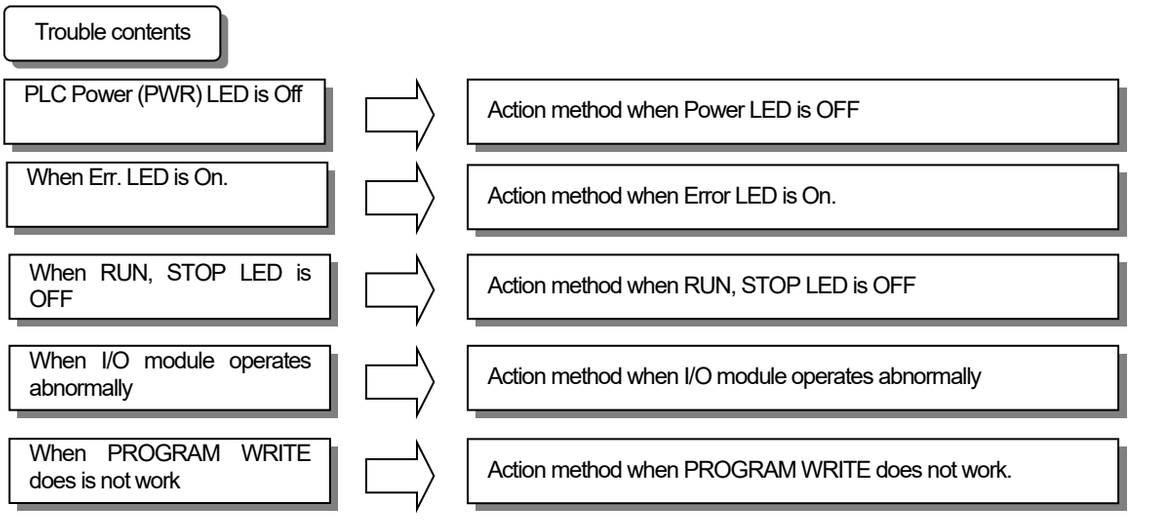
3) Restricting Range

Estimate what is the trouble cause using the above method.

- Is it from the PLC or external factor? Is it from the PLC or external factor?
- I/O module or others?
- Is it from PLC program?

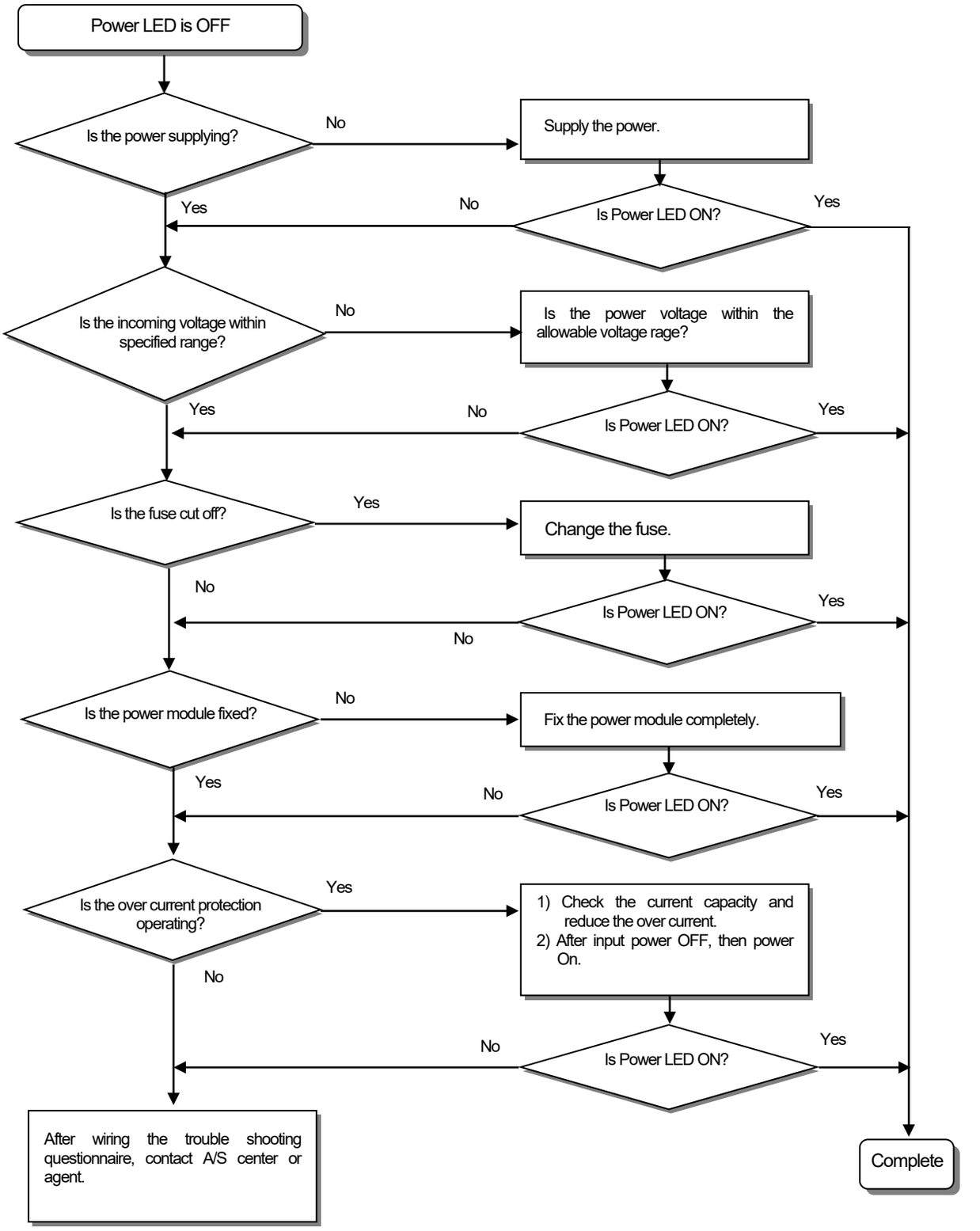
13.2 Troubleshooting

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



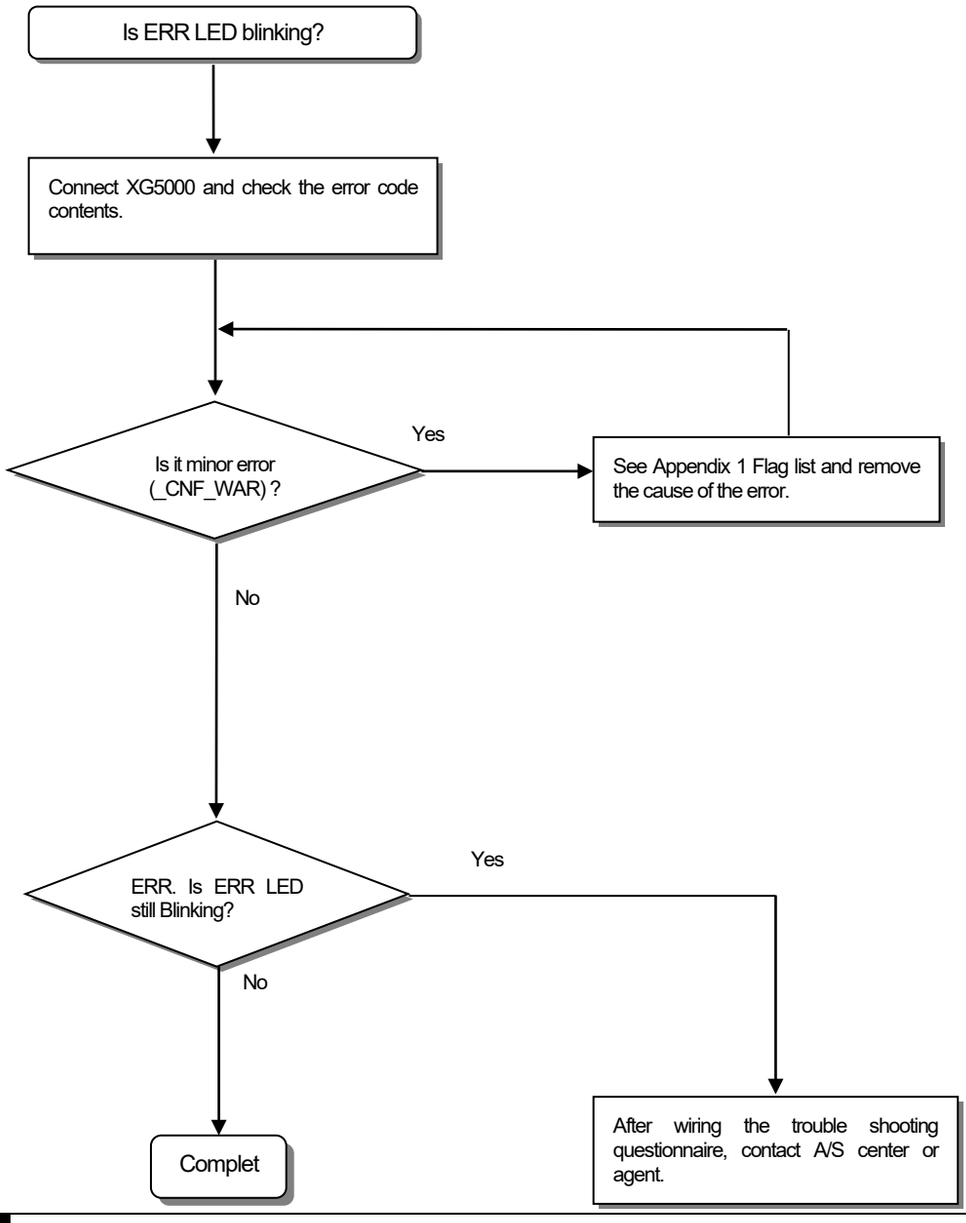
13.2.1 Action when Power LED is OFF

Here describes the action procedure when Power LED is OFF while supplying the power or during operation.



13.2. 2 Action when ERR LED is blinking

Here describes the action procedure when ERROR LED is blinking in case of power supply, or when operation starts, or during operation.

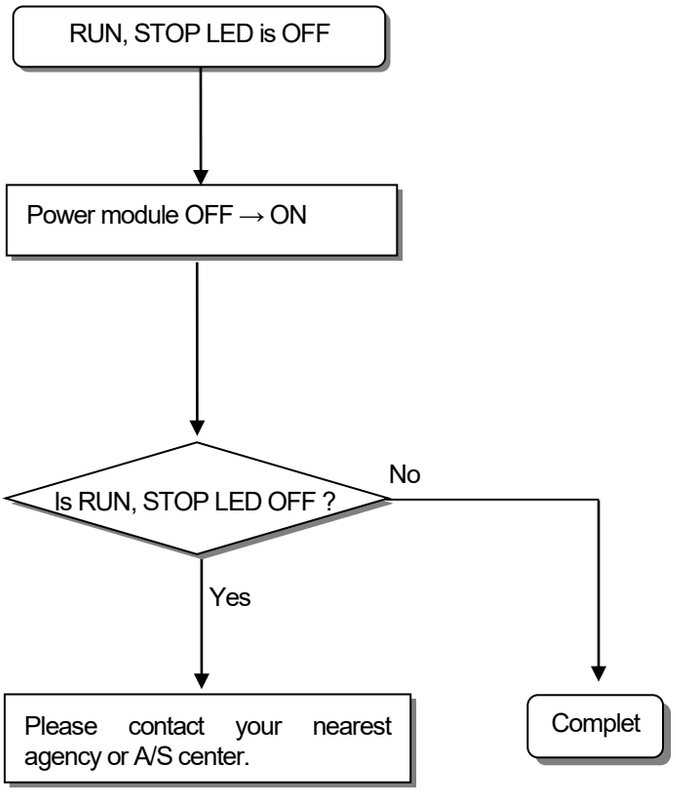


Notes

In case of minor error, PLC system does not stop but you should check the error contents promptly and take an action. If not, it may cause the critical error.

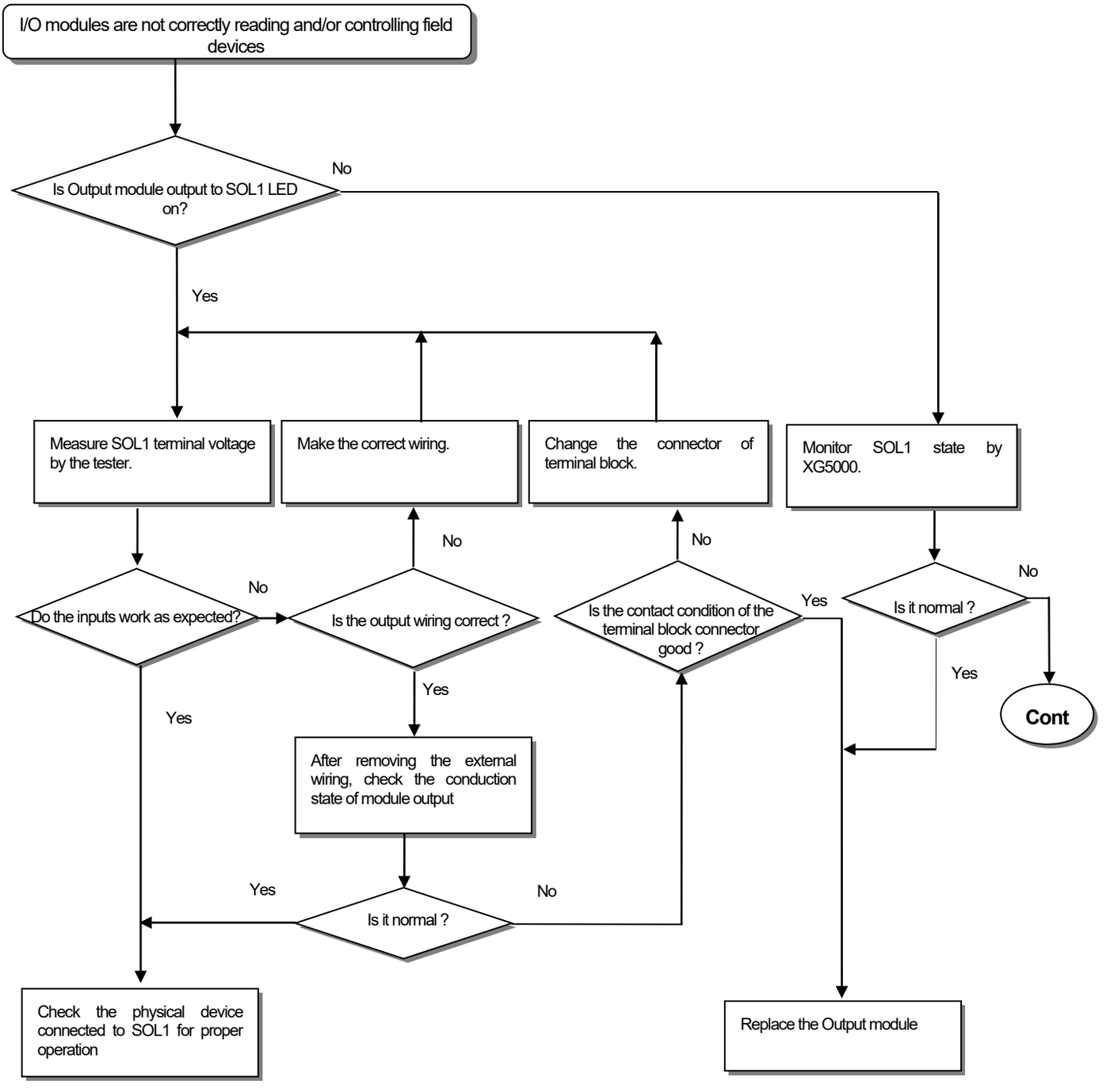
13.2.3 Action when Run, Stop LED is OFF

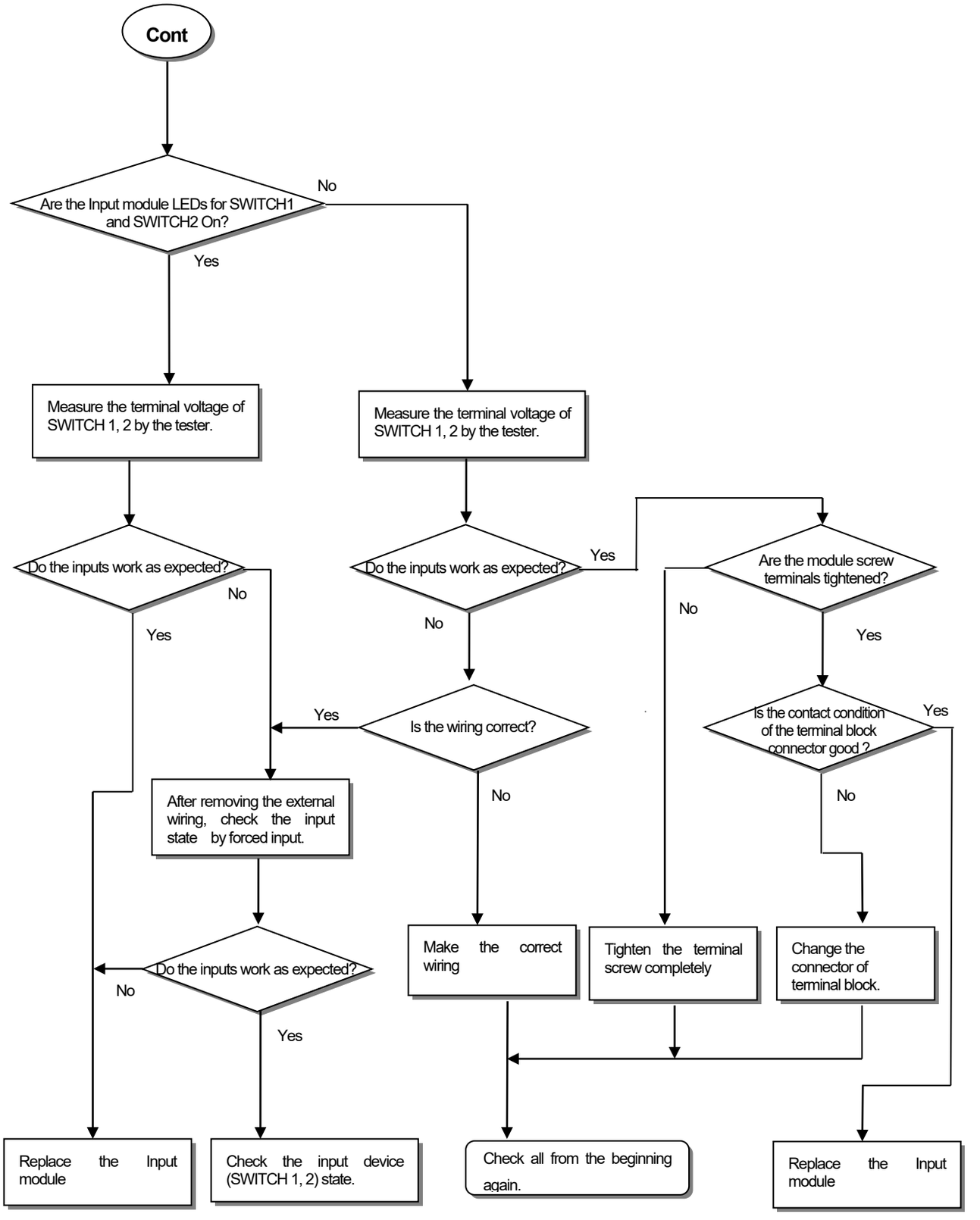
Here describes the action procedure when RUN, STOP LED is OFF in case of power supply, when operation starts or during operation.



13.2.4 Action when I/O Module does not work normally

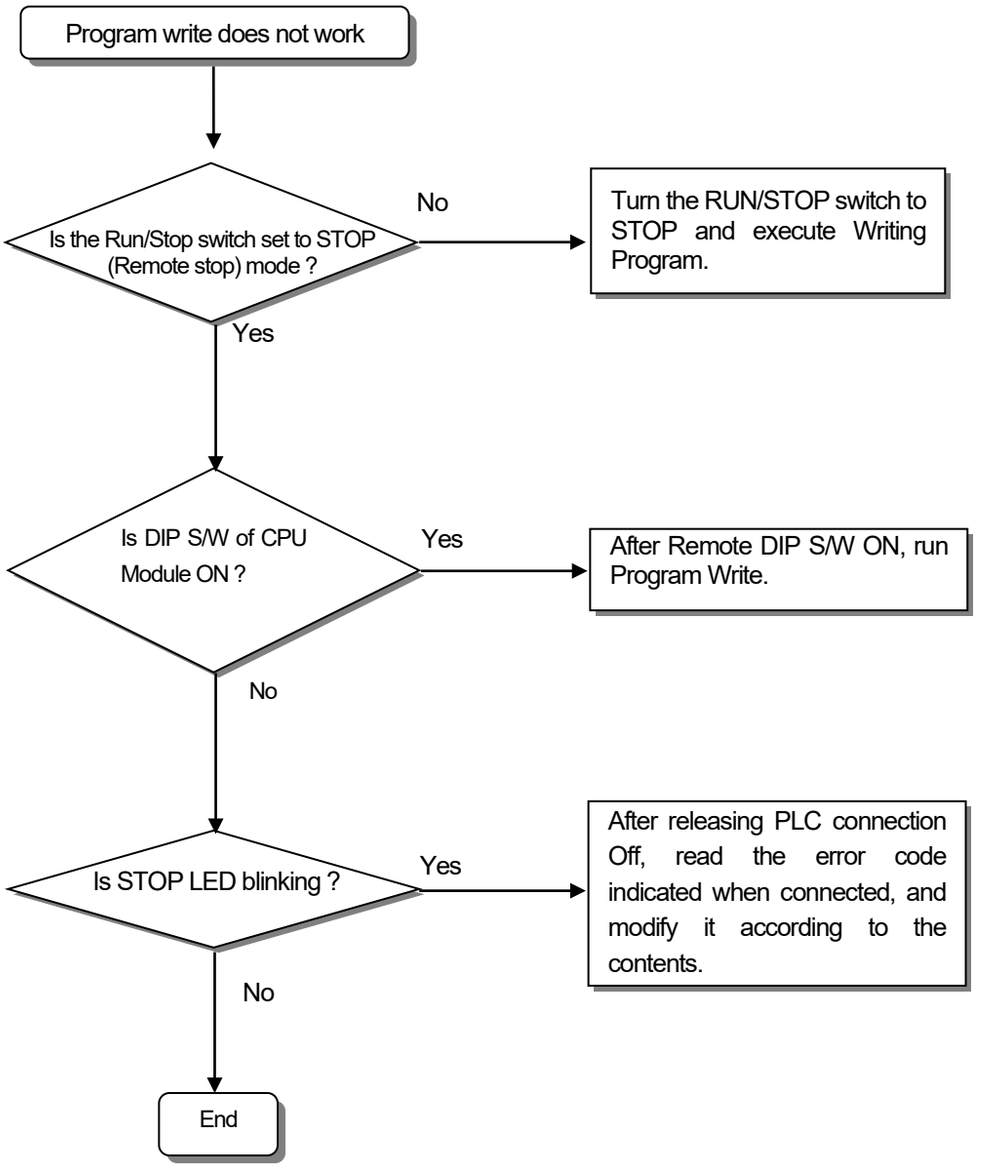
Here describes the action procedure when I/O Module does not work normally during operation, as shown on the program example below.




Cont
Are the Input module LEDs for SWITCH1 and SWITCH2 On?
No
Yes
Measure the terminal voltage of SWITCH 1, 2 by the tester.
Measure the terminal voltage of SWITCH 1, 2 by the tester.
Do the inputs work as expected?
No
Yes
Do the inputs work as expected?
Yes
No
Are the module screw terminals tightened?
No
Yes
Is the wiring correct?
Yes
No
Is the contact condition of the terminal block connector good ?
Yes
No
After removing the external wiring, check the input state by forced input.
Do the inputs work as expected?
No
Yes
Make the correct wiring
Tighten the terminal screw completely
Change the connector of terminal block.
Replace the Input module
Check the input device (SWITCH 1, 2) state.
Check all from the beginning again.
Replace the Input module

13.2.5 Action when Program Write does not work

Here describes the action procedure when Program write does not work in CPU Module.



13.3 Questionnaire for Troubleshooting

If the trouble occurs when using XGK series, fill in the following questionnaire and then contact customer's service center by phone or FAX.
• For errors relating to special or communication modules, use the questionnaire included in the User's manual of the module.

1. Customer's Contact Number: TEL) _____
FAX) _____
2. Model: ( )
3. Applied Module details
– Details of the CPU module: – OS version No. ( ), – Serial No. ( )
– XG5000 Version number used for program compiling : ( )
4. Brief description of a device and system :
5. STOP LED On of the CPU module:
– Operation by key switch ( ) – Operation by the XG5000 or communications ( )
– Memory module operation ( )
6. Stop LED of the CPU module turn On? Yes( ), No( )
7. Error message content by XG5000:
8. Action method for the error code in the article 7:
9. Trouble shooting method for other error action:
10. Characteristics of the error
• Repetitive ( ): Periodic ( ), Related to a particular sequence ( )
environment related( )
• Intermittent ( ): General error interval:
11. Detailed description for the error phenomena:

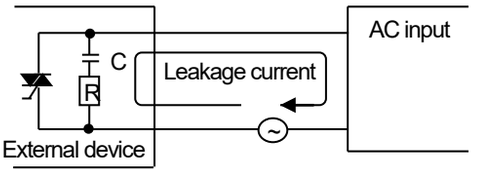
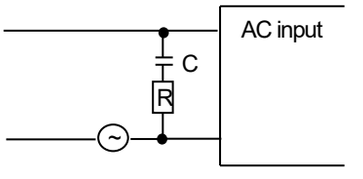
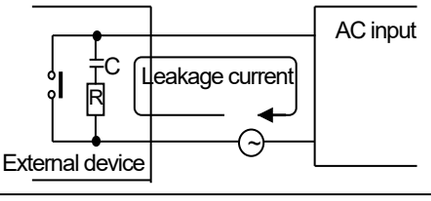
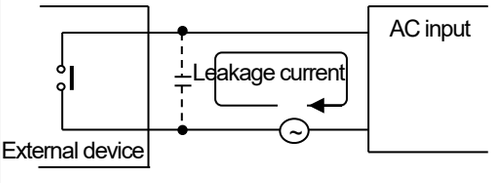
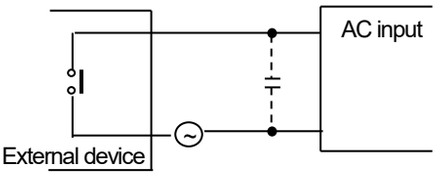
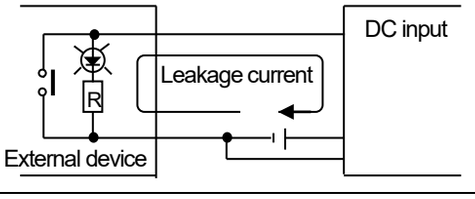
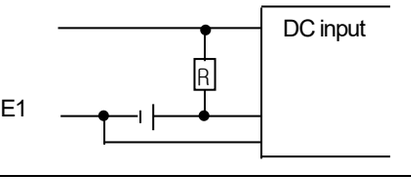
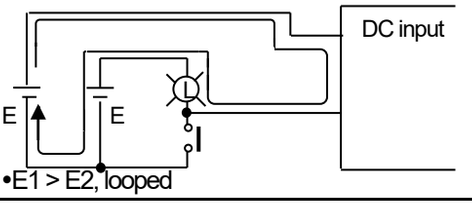
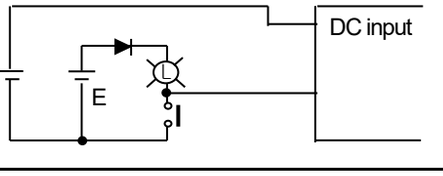
12. Configuration diagram of applied system:

13.4 Cases

Here describes the trouble type and measures for each circuit.

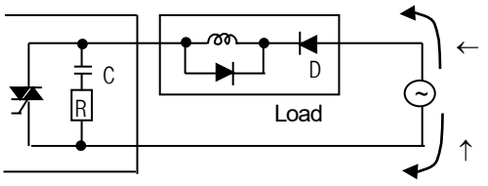
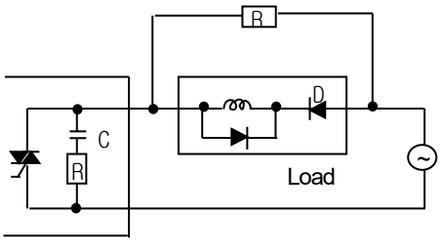
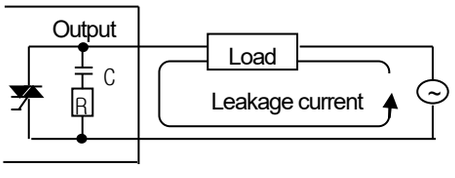
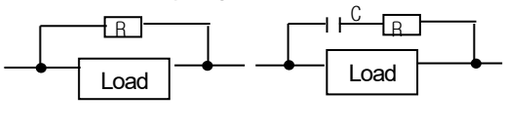
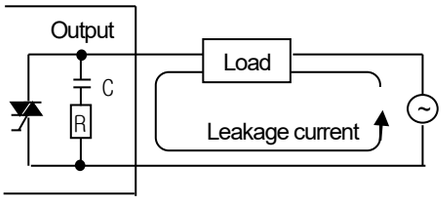
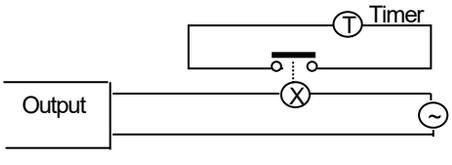
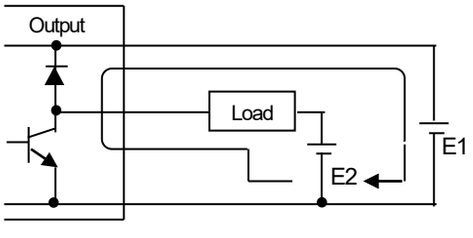
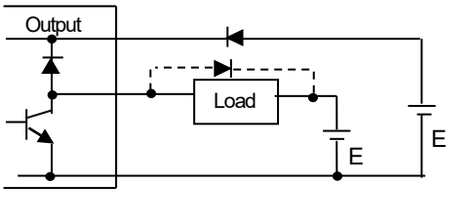
13.4.1 Input Circuit Error Type and Corrective Actions

Here describes the trouble examples of input circuit and its measures.

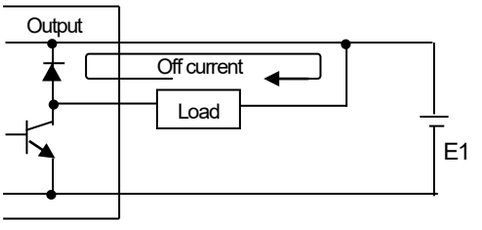
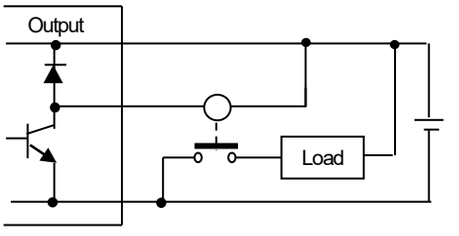
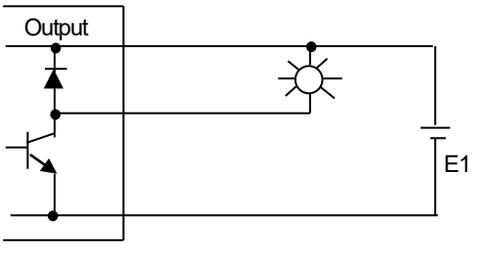
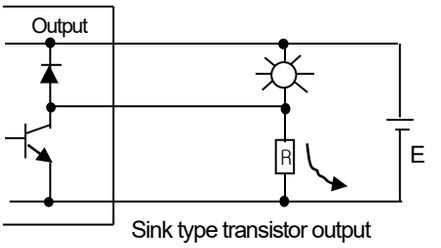
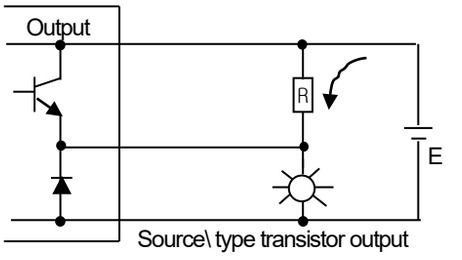
Symptom	Causes	Measures
Input signal doesn't turn off.	Leakage current of external device (Such as a drive by proximity switch) 	• Connect the proper resistance and capacity so that the voltage between terminals of input module is below return voltage. 
Input signal doesn't turn off (Neon lamp may be still on)	Leakage current of external device (run by limit switch with neon lamp) 	•CR values are determined by the leakage current value. – Recommended value C : 0.1 ~ 0.47 μF R : 47 ~ 120 Ω (1/2W) or make up another independent display circuit.
Input signal not OFF	Leakage current due to line capacity of wiring cable. 	•Install the power on the external device as below. 
Input signal not OFF	Leakage current of external device (Drive by switch with LED indicator) 	•Connect an appropriate register, which will make the voltage higher than the OFF voltage across the input module terminal and common terminal. 
Input signal not OFF	• Loop current due to the use of two different power supplies. 	• Use only one power supply. •Connect a loop current prevention diode. (Figure below) 

13.4.2 Output Circuit Error Type and Corrective Actions

Here describes the trouble examples of output circuit and its measures.

Symptom	Causes	Measures
Over voltage applied to the load if case of output contact OFF	•Load is half-wave rectified inside (in some cases, it is true of a solenoid) • If the polarity is ←, C is charged while the voltage + power voltage charged to C is allowed to both ends of diode(D). When the polarity is ↑. The max. voltage is approx. $2\sqrt{2}$. Max. voltage is about $2\sqrt{2}$.  Note) If used as above, output element does not make trouble but the function of diode (D) built-in the load becomes low which causes the trouble.	• Connect registers of tens to hundreds KΩ across the load in parallel. 
The load doesn't turn off.	• Leakage through a surge suppressor connected in parallel to the load. 	•Connect C and R across the load, which are of registers of tens KΩ. When the wiring distance from the output module to the load is long, there may be a leakage current due to the line capacity. 
When the load is C–R type timer, time constant fluctuates.	• Leakage through a surge suppressor connected in parallel to the load. 	• Drive the relay using a contact and drive the C–R type timer using the since. • Use other timer than the C–R contact some timers. Note) Have half-ware rectified internal circuits therefore, be cautious. 
The load does not turn off. (for DC)	• Sneak current due to the use of two different power supplies.  • E1< E2, looped • E1 is off (E2 is on), looped.	• Use only one power supply. • Connect a sneak current prevention diode.  If the load is the relay, etc, connect a counter-electromotive voltage absorbing code as shown by the dot line.

Output circuit troubles and corrective actions (continued).

Symptom	Causes	Measures
The load off response time is long.	• Over current at off state The large solenoid current fluidic load (L/R is large) such as is directly driven with the transistor output.  • The off response time can be delayed by one or more second as some loads make the current flow across the diode at the off time of the transistor output.	•Insert a small L/R magnetic contact and drive the load using the same contact. 
Output transistor is destroyed.	Surge current of the white lamp on.  As soon as it lights up, it may have 10 times and higher inrush current.	• To suppress the surge current make the dark current of 1/3 to 1/5 rated current flow.  Sink type transistor output  Source\ type transistor output

13.5 Error Code List

13.5.1 Error Codes List during CPU Operation.

Code	Cause of error	Action (Restart Mode After Action)	Run Status	LED status	Diagnostics point
2	Data Bus Error	A / S request if repeated on power up	Error	Whole LEDs blink in regular order	Power on
3	Data RAM Error	A / S request if repeated on power up	Error	Blink in full LED order	Power on
4	Clock IC (RTC) Error	A / S request if repeated on power up	Error	ERR : ON	Power on
6	Program memory error	A / S request if repeated on power up	Error	ERR : ON	Power on
10	USB IC error	A / S request if repeated on power up	Error	ERR : ON	Power on
11	backup RAM Error	A / S request if repeated on power up	Error	ERR : ON	Power on
12	backup Flash Error	A / S request if repeated on power up	Error	ERR : ON	Power on
13	Base information error	A / S request if repeated on power up	Stop	ERR : ON	Power on RUN mode change
22	Backup flash memory program error	Restart after modifying program of backup Flash	Error	ERR : ON	Reset RUN mode switching
23	Program execution error	Start after reloading the program Change battery if it has a problem. Check the preservation status after program reloading and if error occurs, change the CPU module.	STOP	ERR : ON	Reset RUN mode switching
24	I/O parameter error	Battery change if battery has a problem. Battery change if battery has a problem. Check the preservation status after I/O parameter reloading and if error occurs, change the CPU module.	STOP	ERR : ON	Reset RUN mode switching
25	Basic parameter error	Start after reloading Basic parameter, Change battery if it has a problem. Check the preservation status after Basic parameter reloading and if error occurs, change the CPU module.	STOP	ERR : ON	Reset RUN mode switching
30	Module set in parameter and the installed module does not match.	After checking the wrong position of slot by XG5000, modify the module or parameter and then restart. Reference flag: module type mismatch error flag	STOP (RUN)	ERR : ON (P.S.: ON)	RUN mode switching
31	Module falling during operation or additional setup	After checking the position of falling/adding slot by XG5000, modify the installation status of module and then restart (according to parameter). Reference flag: Module detach error flag Module detach error flag	STOP (RUN)	ERR : ON (P.S.: ON)	Scan end
32	Fuse cutoff of fuse built-in module during operation	After checking the position of slot where the fuse cutoff occurs by XG5000, change the fuse and then restart (according to parameter). Reference flag: Fuse break error flag	STOP (RUN)	ERR : ON (P.S.: ON)	Scan end

Code	Cause of error	Action (Restart Mode After Action)	Run Status	LED status	Diagnostics point
33	Data of I/O module does not access normally during operation.	After checking the position of slot where the access error occurs by XG5000, change the module and restart (according to the parameter). Reference flag: I / O module read / write error flag	STOP (RUN)	ERR : ON (P.S.: ON)	Scan end
34	Normal access of special/link module data during operation not available.	Check the location of the slot where access error occurred with XG5000, replace the module and restart (according to the parameter).Refer to flag:	STOP (RUN)	ERR : ON (P.S.: ON)	Scan end
39	Abnormal stop of CPU or malfunction	Abnormal system shutdown due to noise or hardware failure 1) If it occurs repeatedly when power reinput, request service center 2) Noise measures	STOP	_RUN ON ERR : ON	Always
40	Scan time of program during operation exceeds the scan watchdog time designated by parameter.	After checking the scan watchdog time designated by parameter, modify the parameter or the program and then restart.	STOP	RUN:ON ERR : ON	In operation
41	Operation error occurs while running the user program.	Remove operation error → reload the program and restart (check). When STOP: Correct the program by checking the operation error details with XG5000. When RUN: Refer to error step of F area	STOP (RUN)	ERR : ON (CHK: blink)	In operation
42	The stack exceeds the normal range while running the program	Restart	STOP	RUN:ON ERR : ON	In operation
44	Timer index user error	After reloading a timer index program modification, start	STOP (RUN)	RUN:ON ERR : ON	Scan end
50	Detecting critical error of external device by user program during operation	Repair and restart the wrong device by referring to the fault detection flag of the external device (according to the parameter).	STOP (RUN)	ERR : ON (P.S.: ON)	Scan end
60	E_STOP function executed	Remove the error factor that triggered the E_STOP function in the program and turn the power on again	STOP	RUN:ON ERR : ON	In operation
500	Data memory backup not possible	If the battery is OK, turn the power back on. Switch to STOP mode in remote mode	STOP	ERR : ON	Reset
501	Clock data abnormal	If there is no problem with the battery, resetting the time with a device such as XG5000.	-	CHK:ON	Always
502	Low battery voltage	Battery change in the state of power input.	-	BAT:ON	Always

Notes

1) Check the error No. 2 ~ 13 in the “Error code during CPU operation” at the AS center.

2) Error number 22 or less can be confirmed using the error history of XG5000.

Chapter 14 Built-in PID Function

This chapter describes the XGI Series CPU built-in PID function.

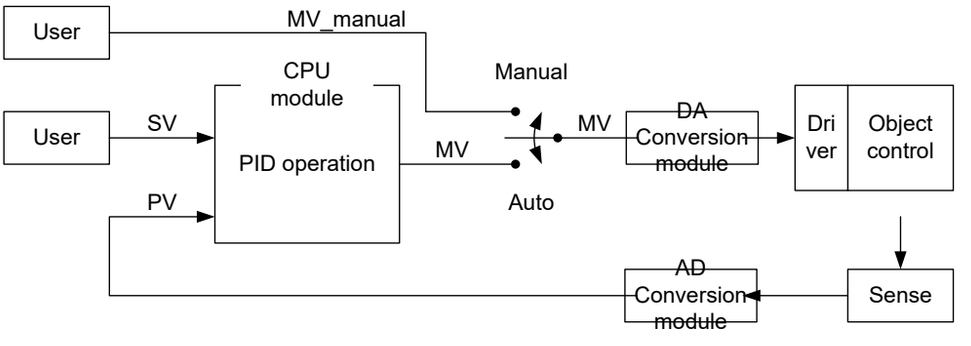
14.1 Characteristics

The features of PID function built-in XGI-CPUU are as follows

(1) Enables high-precision control operation.
(2) Supports a high-speed operation cycle of 0.6ms
(3) XGI CPUU, H, U/D can operate totally 256 loops by using 32 loops in 8 blocks.
XGI CPUS, E can operate totally 64 loops by using 32 loops in 2 blocks.
(4) Provides a symbol Variable function for easy setting and monitoring.
(5) Supports the forward and reverse processes.
(6) Effectively prevents over/undershoot by means of powerful dual anti-windup.
(7) Allows operation by external equipment (HMI).
(8) Protects the system by limiting the maximum variation of PV
(9) Protects the driver by limiting the maximum variation, maximum value and minimum value of MV.
(10) Enables PID control by the Auto-tuning function.
(11) Enables the cascade PID control

14.2 PID control

PID control is a control method to keep the state of the control object at the Set Value. In case there exists an error between the preset Set Value and the value measured by the detector (current value), the controller operates to adjust the output (control signal) so that the current value can reach the Set Value.



As illustrated in the figure above, the PLC functions as a controller for the whole control system. The sensor and driver are used respectively for the current value detection and driving of the control object.
The sensor detects the current value of the control object and transmits them to the controller, the PLC transfers the proper output to the driver, the driver drives the control object according to the controller output, then again the sensor detects the changed current value and transmits them to the PLC (Closed Loop Control). The process of going around the control loop once is repeated at intervals ranging from a few seconds to hundreds of microseconds. The time taken is called the control cycle.

14.3 PID Control Operation

14.3.1 Terms

Below are the terms used to describe the PID control operation.

SV : The target value which the control object value should reach
T_s (Ts) : Sampling time (Control cycle)
K_p (Kp) : Proportional coefficient
T_i (Ti) : Integral time constant
T_d (Td) : Differential time constant
PV : Current value of the control object, which is detected by the sensor
E : Current error of the control object, which is represented by (SV – PV)
MV : Control input or controller output
MV_p (MVp) : Proportional component of MV
MV_i (MVi) : Integral component of MV
MV_d (MVd) : Differential component of MV

14.3.2 PID expressions

PID expressions are as follows.

$$E = SV - PV \qquad (14.3.1)$$

$$MV_p = K_p E \qquad (14.3.2)$$

$$MV_i = \frac{K_p}{T_i} \int E\, dt \qquad (14.3.3)$$

$$MV_d = K_p T_d \frac{dE}{dt} \qquad (14.3.4)$$

$$MV = MV_p + MV_i + MV_d \qquad (14.3.5)$$

An error is a mathematical expression that tells about how far the current system is from the state desired by the user.

Here is an example; a user wants the water in a electric pot to be kept at 50 ℃ and the current water temperature is 35 ℃. Then, SV is 50 ℃, PV is 35 ℃. The error (E) is 15 ℃, the difference between SV and PV. Upon detection of the error, the controller performs PID operation. Note that, as shown in (14.3.5), MV is the sum of the P, I and D components (MV_p, MV_i, and Mv_d). Therefore, if the D component is on the PID control expression, then the PI control results and, if the I and D components are excluded, then P control results.

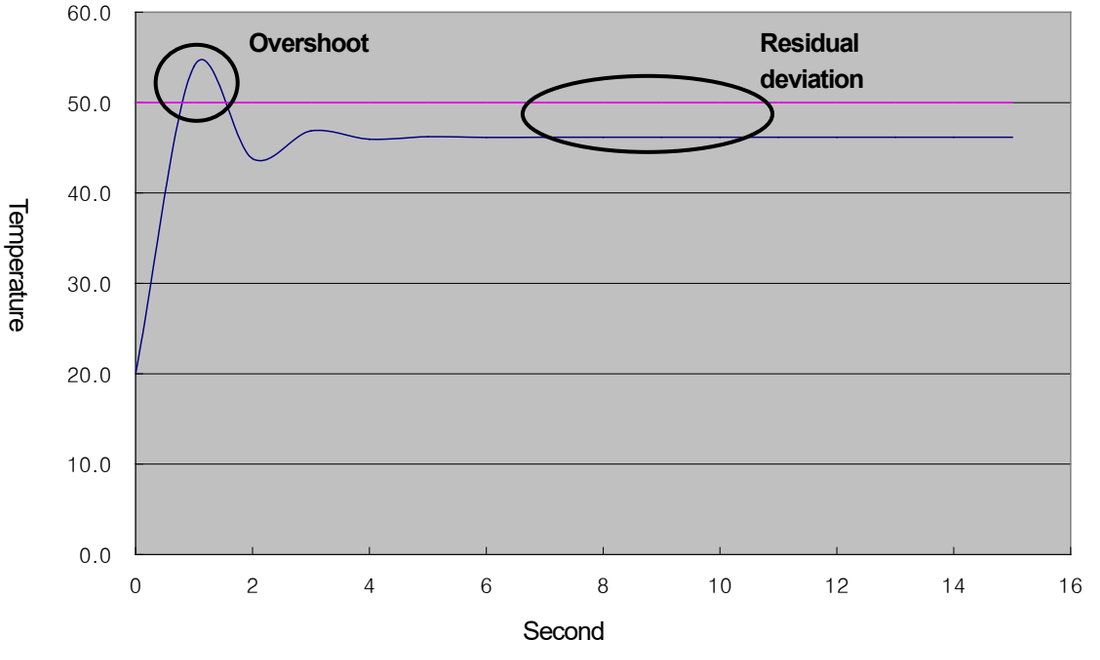
14.3.3 P control

As shown in the following expression (14.3.7), MV in P control is composed of the proportional term operation MV_p only. The proportional term operates in the form of the multiplication of the error by the proportional coefficient. The user must set the proportional coefficient properly according to the system. The greater the proportional coefficient is set, the more sensitive the system becomes to the error.

$$MV_p = K_p E \qquad (14.3.6)$$

$$MV = MV_p \qquad (14.3.7)$$

The development of P control of any virtual system has the following characteristics.
The virtual system below is designed for better understanding by the user, but may be different from an actual temperature system.



In the simulation above, SV is 50.0. The K_p value is properly adjusted to obtain the PV development above.

Four seconds after the operation starts at the initial temperature of 20 ℃, the system settles into the stable state and thereafter remains constant at 46.2 ℃. The offset is 3.8 ℃ (around 7.6%). The reason there exists a permanent offset in P control is that, as PV approaches SV, the E gets smaller and also MV gets smaller and comes into equilibrium at the equilibrium point with K_p at the equilibrium point (46.2℃ above). The offset (residual deviation) in the P controller can be compensated by using PI control.

Proportional gain(Kp)	Result
Decrease	The time to reach the Target value (SV) becomes longer.
Increase	The time to reach the Target value (SV) becomes shorter. (However, if the value increases too much depending on the system, there is a risk of overshoot.)

14.3.4 PI control

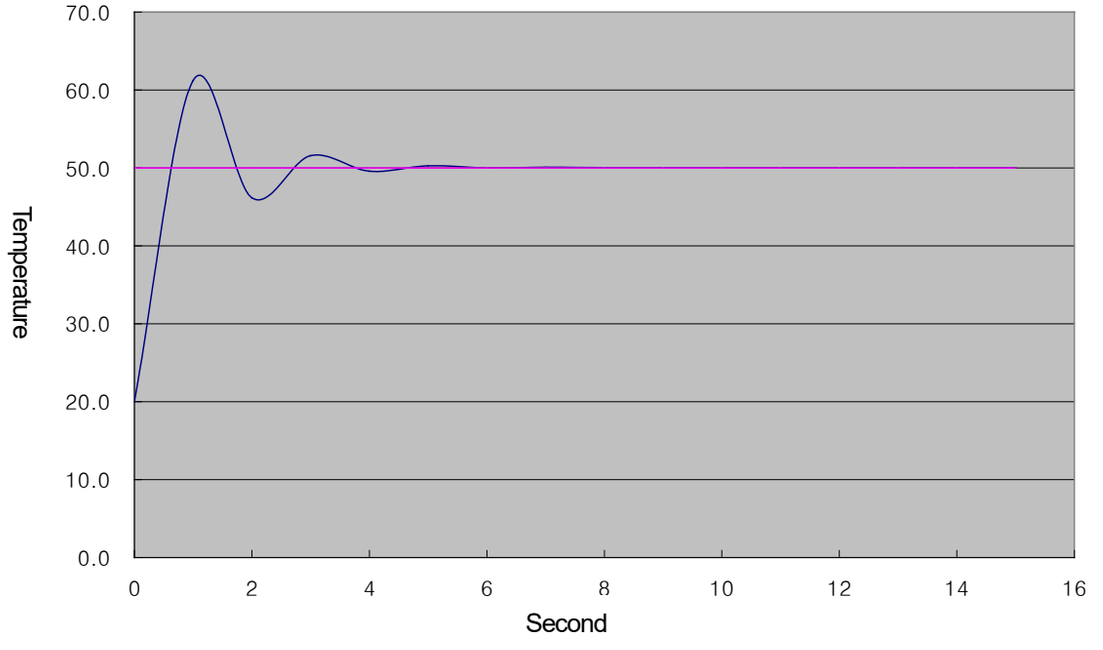
As shown in the following expression (14.3.10), PI (Proportional-Integral) control is calculated as the sum of the proportional and integral terms. To reduce the offset, the shortcoming of the proportional term, PI control uses the integrated error.

$$MV_p = K_p E \qquad (14.3.8)$$

$$MV_i = \frac{K_p}{T_i}\int E\,dt \qquad (14.3.9)$$

$$MV = MV_p + MV_i \qquad (14.3.10)$$

If the error, though constant, is integrated until it is reduced to zero, the integral amount is accumulated over time. Therefore the PI controller can be used to compensate for the offset characteristic of P control. It should be noted that the integral time constant (Ti) is the denominator of the integral term, therefore, the smaller the Ti value, the larger the integral effect. The following graph shows the result of PI control of the previously described P controlled system.

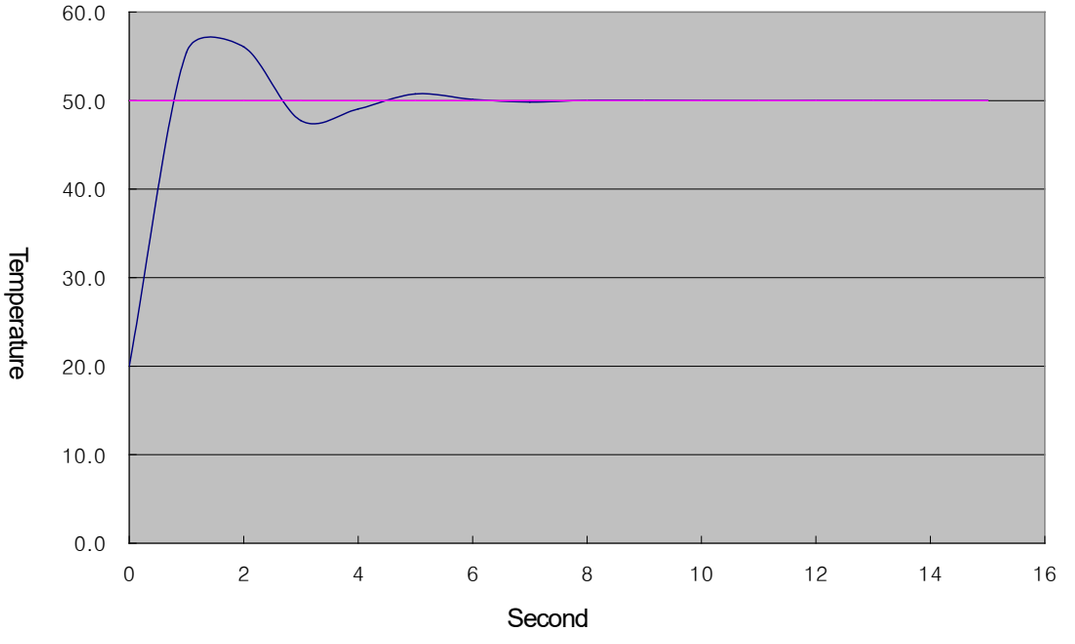


As a result of adding the integral effect, the offset disappears and the system converges exactly to 50 ℃. At the initial control, however, there occurs an overshoot in which the temperature rises to 61.2 ℃ and then falls. An excessive overshoot imposes a burden on the system or, in some cases, unstabilizes the system, therefore, it should be reduced through proper coefficient tuning or can be improved through PID control using the integral effect.

Integral time(Ti)	Result
Decrease	Removing residual deviation (However, if the value increases too much depending on the system, there is a risk of overshoot.)
Increase	The effect of removing residual deviation is decrease.

14.3.5 PID control

As shown by (14.3.1) ~ (14.3.5), PID control reduces vibration during PI control by adding the differential effect to PI control. The differential effect operates only when the system state changes, regardless of the system error value. When the PV measurement signal at the system sensor is not clean or mixed with noise, however, an undesired differential effect is created and causes an unstable operation of the heater or pump. To be sure that the differential effect is not caused by such trivial changes as noise in the system, it is required to install a filter at the sensor input and set the differential coefficient to a low value. In case of an actual system, it is common to set the differential coefficient between 0.001 ~ 0.1.



Derivative time(Td)	Result
Decrease	Decrease vibration damping effect
Increase	Increase vibration damping effect (However, if the value increases too much depending on the system, the system is unstable)

14.4 PID Commands

14.4.1 PID loop States

A PID loop has 5 states: PIDSTOP, AUTOTUNE, PIDRUN, PIDCAS, and PIDPAUSE.

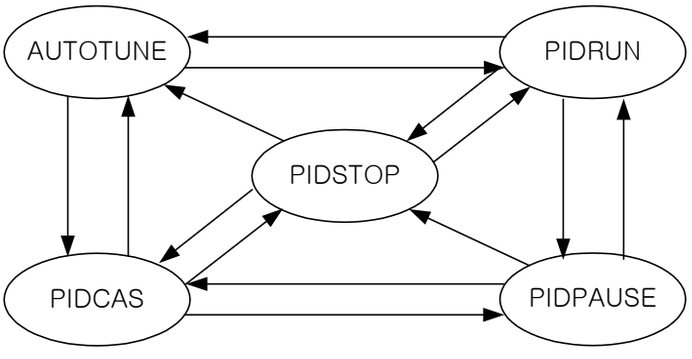
(1) PIDSTOP is a state in which the output (MV) is represented by MV_min, the internal states are initialized, and user settings are maintained.
Under this condition, it is impossible to enter into PIDPAUSE.

(2) AUTOTUNE is the state that is immediately executed when a user turns on _PID[B]_[L]AT_EN bit either PIDRUN or PIDCAS. If among PIDSTOP, _PID[B]_[L]AT_EN is on, it goes into AUTOTUNE state when it goes toward PIDRUN and PIDCAS. Once AUTOTUNE is complete, PIDRUN or PIDCAS state is restored. AUTOTUNE checks a system's response for a series of inputs and finds PID coefficient (K_p, T_i, T_d) and operation cycle (T_s). Upon completion of the Auto, those values are updated and the previous coefficients are lost.

(3) PIDRUN is a state in which the PID loop executes a normal control operation. MV by PID operation is output and the changed settings are all applied since each scan operation is executed independently. If the contact in front of the PIDRUN command is set to On or if the PIDRUN command exists on the ladder program and PIDxx_REM_RUN is set to On, then it enter into PIDRUN.

(4) PIDCAS is a state in which two loops (master and slave loops) execute a control operation. Setting the two loops in the same way as with PIDRUN and then using the PIDCAS command enables to enter into PIDCAS, and the internal connection necessary for the inter working between the two loops is automatically generated allowing data exchange between the loops. Loops operated in cascade are displayed in the state flag PIDxx_STATE, under which state the remote operation PIDxx_REM_RUM bit does not operate.

(5) PIDPAUSE is a state in which output, internal states and user settings are all maintained and the control operation is paused. Setting PIDxx_PAUSE bit to On or using the PIDPAUSE command enables to enter into PIDPAUSE. However, it is possible to enter PIDPAUSE as long as the previous state is PIDRUN.

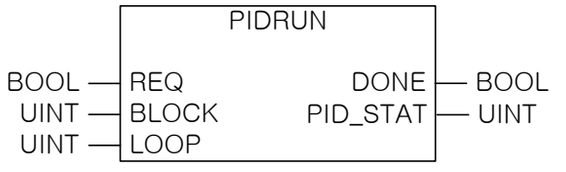


14.4.2 PID command group

The PID command group includes 4 instructions: PIDRUN, PIDCAS, PIDINIT, and PIDPRMT. All operations of the PID function are performed by the PIDRUN or PIDCAS command. PIDINIT and PIDPPMT instructions works as long as it exists on a ladder program with PIDRUN or PIDCAS instruction. They are for the convenience in using the PIDRUN or PIDCAS command.

(1) PIDRUN

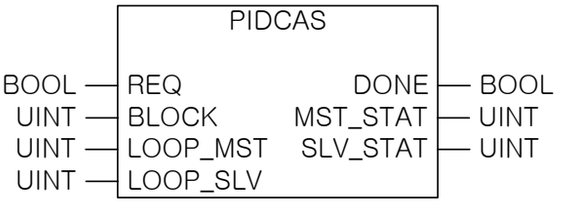
PIDRUN is the most basic PID control command that executes single PID loop control.



If inputting block number (0 ~ 7) into BLOCK and loop number (0 ~ 31) into LOOP, a loop of the block is selected. PID_STAT displays the operation information for a PID loop, _PID[B]_[L]STATE.

(2) PIDCAS

PIDCAS is a command to implement a cascade control using two loops.



If inputting block number (0 ~ 7) into BLOCK, master loop number (0 ~ 31) into LOOP_MST and slave loop number (0 ~ 31) into LOOP_SLV, the master and slave of the block are selected. At the moment, the block number of both loops should be same. MST_STAT/SLV_STAT display the operation information on master/slave loops, _PID[B]_[L]STATE.

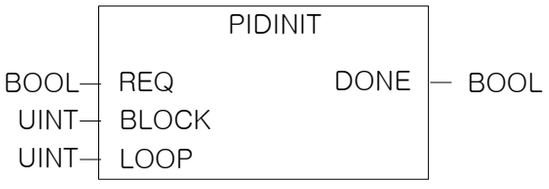
Notes

Cascade calculation

Basically, the master loop inputs its MV into SV of the slave loop during operation, while the slave loop executes its operation using the SV value input through the master loop.
In addition, the two loops observe each other's operation information (wind-up, manual mode, auto mode change, etc).

(3) PIDINIT

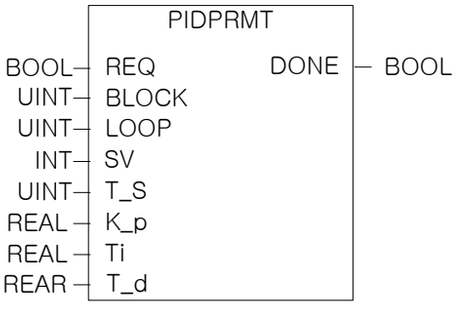
It initializes setting and status of applicable PID loop. At the moment, the initialized area is the setting and state of the designated block [B] and loop[L], and 0 is inputted to every setting of the loop(bit is off).



If inputting block number (0 ~ 7) into BLOCK and loop number (0 ~ 31) into LOOP, a loop of the block is selected.

(4) PIDPRMT

PIDPRMT changes the major settings of PIDRUN including SV, T_s, K_p, T_i and T_d to user-defined values.



If inputting block number (0 ~ 7) into BLOCK and loop number (0 ~ 31) into LOOP, a loop of the block is selected.

14.5 PID Flag Configuration.

The table shows the flag configuration when using the built-in PID function for XGI. **(For details, refer to the description of common bits and individual data areas)**

Symbol	K device value	Data type	Contents	Note
PID[B][L]MAN	%KX[0+16800B +L]	BIT	PID Output Select (0:Auto, 1:Manual)/(0: auto, 1: manual)	**PID monitor**
PID[B][L]PAUSE	%KX[32+16800B +L]	BIT	PID pause (0: STOP/RUN, 1: PAUSE)	**PID monitor**
PID[B][L]REV	%KX[64+16800B +L]	BIT	PID Operation select (0:Forward, 1:Reverse)/forward/reverse division	**PID monitor**
PID[B][L]AW2D	%KX[96+16800B +L]	BIT	PID Anti Wind-up2 (0:Enable, 1:Disable)	
PID[B][L]REM_RUN	%KX[128+16800B +L]	BIT	PID Remote RUN bit for HMI (,0:STOP 1:RUN)	
PID[B][L]P_on_PV	%KX[160+16800B +L]	BIT	PID proportional calculation source select (0: ERR, 1: PV)	**PID monitor**
PID[B][L]D_on_ERR	%KX[192+16800B +L]	BIT	PID differential calculation source select(0:PV, 1:ERR)	**PID monitor**
PID[B][L]AT_EN	%KX[224+16800B +L]	BIT	PID auto-tuning command setting (0:Disable, 1:Enable)	**PID monitor**
PID[B][L]MV_BMPL	%KX[256+16800B +L]	BIT	MV Non-impact Conversion for PID Mode Conversion (A/M) (0:Disable, 1:Enable)/Non-impact manual escape	**PID monitor**
PID[B][L]SV	%KW[24+1050B+32L]	INT	PID Set Value (SV)	**PID monitor**
PID[B][L]T_s	%KW[25+1050B+32L]	WORD	PID control cycle(T_s)[0.1ms]	**PID monitor**
PID[B][L]K_p	%KD[13+525B+16L]	REAL	PID P - Constant (K_p)	**PID monitor**
PID[B][L]T_i	%KD[14+525B+16L]	REAL	PID I - constant (T_i)[sec]	**PID monitor**
PID[B][L]T_d	%KD[15+525B+16L]	REAL	PID D – constant (T_d)[sec]	**PID monitor**
PID[B][L]d_PV_max	%KW[32+1050B+32L]	WORD	PID Max. delta_PV Limit	**PID monitor**
PID[B][L]d_MV_max	%KW[33+1050B+32L]	WORD	PID Max. delta_MV Limit	**PID monitor**
PID[B][L]MV_max	%KW[34+1050B+32L]	INT	PID MV maximum value limit/MV upper limit	**PID monitor**
PID[B][L]MV_min	%KW[35+1050B+32L]	INT	PID MV minimum value limit/MV lower limit	**PID monitor**
PID[B][L]MV_man	%KW[36+1050B+32L]	INT	PID Manual MV	**PID monitor**
PID[B][L]STATE	%KW[37+1050B+32L]	WORD	PID State	
PID[B][L]ALARM0	%KX[592+16800B+512L]	BIT	PID Alarm 0 (1:T_s setting is small)	
PID[B][L]ALARM1	%KX[593+16800B+512L]	BIT	PID Alarm 1 (1:K_p is 0)	
PID[B][L]ALARM2	%KX[594+16800B+512L]	BIT	PID Alarm 2 (1:delta PV is limited)	
PID[B][L]ALARM3	%KX[595+16800B+512L]	BIT	PID Alarm 3 (1:delta MV is limited)	
PID[B][L]ALARM4	%KX[596+16800B+512L]	BIT	PID Alarm 4 (1:MV max. value is limited)	
PID[B][L]ALARM5	%KX[597+16800B+512L]	BIT	PID Alarm 5 (1:MV min. value is limited)	
PID[B][L]ALARM6	%KX[598+16800B+512L]	BIT	PID Alarm 6 (1:AT abnormal cancel state)	
PID[B][L]ALARM7	%KX[599+16800B+512L]	BIT	PID Alarm 7	
PID[B][L]STATE0	%KX[600+16800B+512L]	BIT	PID State 0 (0:PID_STOP, 1:PID_RUN)	
PID[B][L]STATE1	%KX[601+16800B+512L]	BIT	PID State 1 (0:AT_STOP, 1:AT_RUN)	
PID[B][L]STATE2	%KX[602+16800B+512L]	BIT	PID State 2 (0:AT_UNDONE, 1:DONE)	
PID[B][L]STATE3	%KX[603+16800B+512L]	BIT	PID State 3 (0:REM_STOP, 1:REM_RUN)	
PID[B][L]STATE4	%KX[604+16800B+512L]	BIT	PID State 4 (0:AUTO_OUT, 1:MAN_OUT)	
PID[B][L]STATE5	%KX[605+16800B+512L]	BIT	PID State 5 (0:CAS_STOP, CAS_RUN)	
PID[B][L]STATE6	%KX[606+16800B+512L]	BIT	PID State 6 (0:SLV/SINGLE, 1:CAS_MST)	
PID[B][L]STATE7	%KX[607+16800B+512L]	BIT	PID State 7 (0:AW_STOP, 1:AW_ACT)	
PID[B][L]PV	%KW[38+1050B+32L]	INT	PID Current Value (PV)	**PID monitor**
PID[B][L]PV_old	%KW[39+1050B+32L]	INT	PID previous PV (PV_old)	
PID[B][L]MV	%KW[40+1050B+32L]	INT	PID Manipulated Value (MV)	
PID[B][L]MV_BMPL_val	%KW[41+1050B+32L]	WORD	PID no impulse operation memory	
PID[B][L]ERR	%KD[21+525B+16L]	DINT	PID Control Error Value	
PID[B][L]MV_p	%KD[22+525B+16L]	REAL	PID P component of the MV	
PID[B][L]MV_i	%KD[23+525B+16L]	REAL	PID I component of the MV	
PID[B][L]MV_d	%KD[24+525B+16L]	REAL	PID D component of the MV	
PID[B][L]DB_W	%KW[50+1050B+32L]	WORD	PID **deadband** setting (operate after stabilization)/Dead-zone	**PID monitor**
PID[B][L]Td_lag	%KW[51+1050B+32L]	WORD	PID Differential function Lag Filter /differential filter value	**PID monitor**
PID[B][L]AT_HYS_val	%KW[52+1050B+32L]	WORD	PID auto-tuning hysteresis setting / Auto tuning HYS	**PID monitor**
PID[B][L]AT_SV	%KW[53+1050B+32L]	INT	PID auto-tuning SV setting	**PID monitor**
PID[B][L]AT_step	%KW[54+1050B+32L]	WORD	PID auto-tuning state display (User setting disable)	
PID[B][L]INT_MEM	%KW[55+1050B+32L]	WORD	PID internal memory (User setting disable)	

* □: User setting disable area
* B : XGI CPUU,H,U/D PID block number [0~7] (XGI CPUS, E PID block number [0~1])
* L:PID loop number [0~31]
* PID monitor: Flag that can be operated in the PID monitor window without registering it in the variable monitor window (refer to XG5000 manual for how to use PID monitor)

%KX[0+16800B] ~ %KX[287+16800B] area is the common bit area of the block PID loop. The bit states and settings of the loops are collectively arranged in the front part of the PID block. The maximum number of 32 loops that can be used by the corresponding PID function - bits comprise a double word each loop states and settings of each loop are stored in each bit order.

% KW0024 ~ % KW0055 is the individual data area for PID Block 0, Loop 0, where the settings and states of Loop 0 are stored. In this area are stored the settings for corresponding PID Loop (SV, dPV_max, MV_man, T_s, Kp, Ti, Td, MV_max, MV_min, dMV_max) and, while the PID function is performed, the states for corresponding PID loops summarizes the features of stored (PV, ETC, MV, MV_rvs, ERR, MVp, Mvi, MVd, PV). By writing data into the set memory area, the user can change the PID setting at any time even during operation and obtain the corresponding results in the next cycle.

% KW0056 ~ % KW1047 is the memory part of Loops 1 ~ 31 that are in the same form as Loop 0. Each loop independently works and may execute independent operation like the application of cascade. In addition, please refer to the K device memory configuration in the latter part of this manual for an understanding of the accurate memory location of PID.

For performance improvement of the product, the location and order of the memory area is subject to change without prior notice.

Notes

1) PID Memory statement 's format
   PID[B][L]MAN B: Block, L : loop
   Ex) _PID3_05MAN: means MAN bit of block 3 and loop 5.

2) Common bit area
   Ex) _PID3_25PAUSE: because of block 3 and loop 25, it represents the location of %KX[32+16800B+L] = %KX50457.

3) Individual Data Area
   Ex) _PID5_30SV: because of block 5 and loop 30, it represents the location of %KW[24+1050B+32L]

14.5.1 Common bit area

The common bit area is the part that contain all bit data for the 32 loops. All information 32 loops have for a signal item is combined to take the form of 32 bit double word and the nth bit provides information on the nth loop. m is the hexadecimal value of loop number n.

(1) _PID[B]_[L]MAN (PID MANual operation enable) **- Setting area**

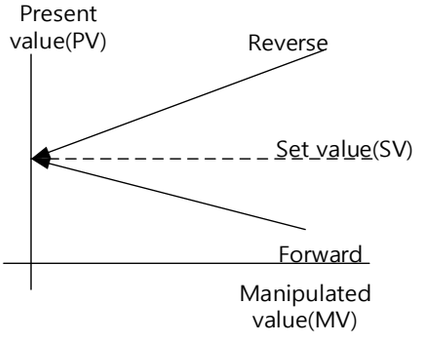
K device area: %KX[0+16800B+L]
Data unit: BIT
This allows you to determine whether the PID function of the nth loop will operate in Auto or in Manual.
In the automatic mode, the MV value is output by PID operation, and in the manual mode, the MV value set by the user is output without performing PID operation. At this time, the value saved by the user in the _PID[B]_[L]MV_man area is output.
Initial value: Off(auto mode)

(2) _PID[B]_[L]PAUSE (PID PAUSE mode) **- Setting area**

K device area: %KX[32+16800B+L]
Data unit: BIT
When the corresponding bit is On, the control operation of the nth PID loop is PAUSE (stopped).
Even when switching from PAUSE to RUN again, the control continues to operate.
Therefore, if the system state changes from the PAUSE state and enters the RUN state again, unexpected results may be displayed. Therefore, please use the PAUSE function carefully.
Initial value: Off(PAUSE cancelled)

(3) _PID[B]_[L]REV (PID REVerse operation) **- Setting area**

K device area: %KX [64+16800B+L]
Data unit: BIT
This allows you to set the control system as Forward system or Reverse system.
1) Forward: This is an operation to control the current value as the target value while the current value is smaller than the target value. (Heating)
2) Reverse: This is an operation to control the current value as the target value while the current value is greater than the target value. (Cooling)
Initial value: Off (Forward operation)



Notes

PID[B][L]PAUSE
(1) Putting the PID loop into PAUSE by using PID[B]_[L]PAUSE or PIDPAUSE command brings all operations to a stop and outputs the last calculation values before PAUSE. If the system state is changed but proper control is not exercised, the control system may produce an unexpected result. So, be very careful when using the PAUSE function.
(2) In the first PLC scan, PIDRUN performs initialization to turn the PAUSE bit to Off. If PLC is turned on in PAUSE, it quits the PAUSE mode and enters into the STOP or Run mode.

(4) _PID[B]_[L]AW2D (PID Anti Wind-up 2 Disable) **- Setting area**

K device area: %KX[96+16800B+L]
Data unit: BIT
If this bit is turned OFF , The Anti Wind-up2 function is inactivated.
The Anti Wind-up function is described in detail in 14.6.
Initial value: Off(Enable)

(5) _PID[B]_[L]REM_RUN (PID REMote RUN) **- Setting area**

K device area: %KX[128+16800B+L]
Data unit: BIT
This is the external operation command of the PIDRUN instruction
This is the external operation command of PIDRUN and has the same effect as when the contact of PIDRUN is turned on/ off.
PIDRUN performs an OR operation of the “PIDRUN input condition” contact and the corresponding bit in order to decide whether to perform the operation.
Using this function enables you to assign the operation contact of PIDRUN to a fixed address, facilitating easier use of external input/output devices such as HMI.
Initial value: Off (STOP)

(6) _PID[B]_[L]P_on_PV (PID P on PV) **- Setting area**

K device area: %KX[160+16800B+L]
Data unit: BIT
This sets the P operation source of the corresponding PID loop to PV. P operation is performed on ERR or PV. P operation using PV is relatively slow moving to stable state rather using ERR under the unstable instantaneous control due to initial response or disturbance. This implies that the change in output is slow and a heavy load is not imposed on the driver.
But, with the change in the range of the internal operation value, the Anti Wind-up function does not operate.
If the bit is off, PID executes P operation with ERR in [Default] state and in case of on, it executes P operation with PV value.
Initial value: Off(P operation with ERR value)

(7) _PID[B]_[L]D_on_ERR (PID D on ERRor) **- Setting area**

K device area: %KX [192+16800B+L]
Data unit: BIT
This sets the D operation source of the corresponding PID loop to ERR. D operation is performed on ERR or PV. In case of D operation using ERR, D response shows a dramatic change at the moment SV is changed by the user and an excessive input may be applied to the driver. Therefore, the initial setting is set by using PV. This bit is turned on when performing D operation using ERR.
Initial value: Off (D operation with PV value)

Notes

PID[B][L]REM_RUN

This bit is stored in the K device even though the PLC stops. If the PLC is stopped and restarted with this bit On (eg. power failure), the system is initialized at the first scan and then PIDRUN operates.

(8) _PID[B]_[L]AT_EN (PID Auto-tuning enable) **- Setting area**

K device area: %KX[224+16800B+L]
Data unit: BIT
It auto-tuning (AT) the PID loop. The approximate T_s (operation cycle) and PID coefficients (K_p, T_i, T_d) of the system are determined through AT. PID[B]_[L]HYS_val items must be set before starting AT.
The AT function is described in detail in 14.6.
Initial value: Off(Disable)

(9) _PID[B]_[L]MV_BMPL (PID MV Bumpless changeover) **- Setting area**

K device area: %KX[256+16800B+L]
Data unit: BIT
This allows to not only determine an appropriate MV value through operation so that MV can continue smoothly when the corresponding PID loop changes from manual to auto output mode, but also reflect the MV value to the internal state so as to stabilize MV. This function shows an algorithm difference between single operation and cascade operation, but both operations are performed by this bit.
If the corresponding bit (in cascade operation, the corresponding bit of the master loop) is On, Bumpless changeover is performed.
Initial value: Off(Disable)

Notes

PID[B][L]AT_EN

This bit is initialized as Off when the PLC changes to Run mode. If the PLC is stopped and restarted with this bit On (eg. power failure), the system is initialized at the first scan but does not enter into AT mode again. Since there is no change in the PID settings, the system operates in the state before the PLC stops.

PID[B][L]MV_BMPL

Assuming that the manual output value is 1000 and the auto value output of 2000 is required, the driver receives the value of 1000 for system operation and instantly receives 2000 at the time of mode conversion. If the corresponding bit is On, the corresponding PID loop outputs 1000 at the time of mode conversion and performs an operation in order that the output gradually increases to 2000.

14.5.2 Individual data area

The individual data area of block B and loop L is %KW[24+1050B+32L] ~ %KW[55+1050B+32L].

(1) _PID[B]_[L]SV (PID Set-point value) **- Setting area**

K device area: %KW[24+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This is the SV setting part of the corresponding loop.
As described in the previous section, this is used to set the system state as desired by the user. The system state is displayed in numeral and must be input after converted to PV according to the system gain.
In case of a system in which PV is sensed as 5000 at the temperature of 50℃, if the temperature is controlled at 50℃, SV is set to 5000.

(2) _PID[B]_[L]T_s (PID Sampling time) **- Setting area**

K device area: %KW[25+1050B+32L]
Data unit: WORD [0 ~ 65535]
This sets the sampling time of the corresponding loop.
The sampling time is a time cycle in which a control operation is performed. This can be set in the range of 0.1msec to 6553.5ms in the unit of 0.1msec; an integer value of 1 is assigned for each 0.1ms. If 100ms of sampling time is required, 1000 is input to _PID[B]_[L].
If the user sets the sampling time to 0, the scan cycle control mode is also set. In this case, as a control operation occurs in each scan, a full speed control operation is performed in the current environment.
When the current scan speed is exceeded due to the too short sampling time, The ALARM bit of _PID[B]_[L]STATE is displayed.

(3) _PID[B]_[L]K_p (PID Proportional gain) **- Setting area**

K device area: %KD[13+525B+16L]
Data unit: REAL [-3.40282347e+38 ~ -1.17549435e-38, 0, 1.17549435e-38 ~ 3.40282347e+38]
This sets the proportional constant (K_p) for the corresponding loop. As K_p is multiplied into the P, I, D (Proportional, Integral, Differential) terms, As K_p increases, the proportional and differential effects increase, and the integral effect decreases.
If the setting value of _PID[B]_[L]K_p is 0, P control is not performed and it can be set in the range of short real number (REAL).
For further information refer to 14.3.

Notes

PID[B][L]SV

PID changes the output (MV) through several times of operations until SV equals PV. So, when SV is 0, PIDRUN may be seen as inoperable.
If SV of a simple heater with the current temperature of 20℃ and PV of 2000 (20℃) is set to 0, PID will output 0 as MV and will not output until PV goes below 0 (0℃).

(4) _PID[B]_[L]T_i (PID integral time gain) **- Setting area**

K device area: %KD[14+525B+16L]
Data unit: Set the integral time constant (T_i) of the loop as REAL [-3.40282347e+38 ~ -1.17549435e-38, 0, 1.17549435e-38 ~ 3.40282347e+38]. As T_i divides the I (integral) term,As the T_i increase the integral effect is decrease.
If the setting value of _PID[B]_[L] T_i is 0, I control is not performed and it can be set in the range of short real number (REAL).
For further information refer to 14.6.

(5) _PID[B]_[L]T_d (PID derivative time gain) **- Setting area**

K device area: %KD[15+525B+16L]
Data unit: Set the differential time constant (T_d) of the loop as REAL [-3.40282347e+38 ~ -1.17549435e-38, 0, 1.17549435e-38 ~ 3.40282347e+38]. As T_d is multiplied into the D (differential) term, the T_d increase, the differential effect increase. If the setting value of _PID[B]_[L] T_d is 0, D control is not performed and it can be set in the range of short real number (REAL).
For further information refer to 14.6.

(6) _PID[B]_[L]dPV_max (PID delta PV maximum limit) **- Setting area**

K device area: %KW[32+1050B+32L]
Data unit: WORD [0 ~ 65535]
This limits the PV variation of the corresponding loop.
PV does not always reflect the exact system state. Unwanted signals caused by sensor malfunction, noise or disturbance can be mixed and reflected in PV. Like this, PV often undergoes a sudden change and causes a large change in PID output. To prevent it, if PV is changed over the value set in _PID[B]_[L]dPV_max, it protect it primarily, avoiding any change exceeding the value. Meanwhile, if _PIDn_dPV_max is set too small, the system change is slowly reflected and the convergence time takes longer. Therefore, setting should be made according to the system features.
If this is set to 0, the function does not operate.

(7) _PID[B]_[L]dPV_max (PID delta MV maximum limit) **- Setting area**

K device area: %KW[33+1050B+32L]
Data unit: WORD [0 ~ 65535]
This limits the MV variation of the corresponding loop.
A sudden change in the output of the control system may cause a system instability or impose a heavy load on the driver resulting in failure or unstable operation. To prevent this, this item limits the controller output variation.
If this is set to 0, the function does not operate.

(8) _PID[B]_[L] MV_man (PID MV maximum limit) - Setting area

K device area: %KW[34+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This limits the maximum MV value of the corresponding loop.
This prevents overload and system errors by limiting the maximum value of the controller output transferred to the output equipment.
This also prevents the transfer of an unwanted value by overflow.

(9) _PID[B]_[L] MV_min (PID MV minimum limit) - Setting area

K device area: %KW[35+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This limits the minimum MV value of the corresponding loop.
This prevents system errors by limiting the minimum value of the controller output transferred to the output equipment.
This also prevents the transfer of an unwanted value by overflow.

(10) _PID[B]_[L] MV_man (PID manual MV variable) - Setting area

K device area: %KW[36+1050B+32L]
Data unit: INT [-32768 ~ 32767]
When the corresponding loop is set to manual operation, this designates MV.
If _PID[B]_[L]MAN of common bit area is ON, PID[B]_[L]MV_man value is output as MV value of the loop.

(11) _PID[B]_[L] status (PID State) - Setting disable

K device area: %KW[37+1050B+32L]
Data unit: WORD [h00 ~ hff] or BIT
This displays the state or abnormalities of the corresponding loop.
This is located at the address %KW[37+1050B+32L] and each of the 16 bits has its own meaning.
Only some of the 16 bits are currently in use.
STATE turns On when the corresponding operation occurs and returns Off when it is cleared.
The low 8 bits of STATE(_PID[B]_[L]ALARM 0 ~ _PID[B]_[L]ALARM 7) indicates kinds of abnormal state of a loop while the high 8 bits of STATE(_PID[B]_[L]STATE 0 ~ _PID[B]_[L]STATE 7) indicates the control state of a loop.
Each bit is assigned as follows.
PID[B][L]ALARM 0:Indicates the operation is skipped because T_s setting is set too small.
PID[B][L]ALARM 1:Indicates the K_p value is 0.
PID[B][L]ALARM 2:Indicates the PV variance is limited.
PID[B][L]ALARM 3:Indicates the MV variance is limited.
PID[B][L]ALARM 4:Indicates the MV Max. is limited.
PID[B][L]ALARM 5:Indicates the MV Min is limited.
PID[B][L]ALARM 6:Indicates the abnormally canceled during AT.
PID[B][L]STATE 0:Indicates the PID operation. (Valid in case of PLC run)
PID[B][L]STATE 1:Indicates the PID AT is being performed.
PID[B][L]STATE 2:Indicates the PID AT is completed.
PID[B][L]STATE 3:Indicates the remote operation by _PID[B]_[L]REM_RUM bit.
PID[B][L]STATE 4:Indicates that the PID mode is manual output mode.
PID[B][L]STATE 5:Indicates that the PID loop belongs to cascade.
PID[B][L]STATE 6:Indicates that the PID loop belongs to cascade master loop.
PID[B][L]STATE 7:Indicates Anti Wind-up operation during PID operation.

(12) _PID[B]_[L]PV (PID Process variable) **- I/O area**

K device area: %KW[38+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This displays the PV of the corresponding loop
PV is an indicator of the current state of the system. In general, the input from the sensor is stored on the U device of the CPU via an input device such as A/D conversion module: At each scan, this value should be transferred to _PIDn_PV using a command such as MOV. Please refer to the program examples in the latter part of this manual.

(13) _PID[B]_[L]PV_old (PID Previous PV) **- Setting disable**

K device area: %KW[39+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This is used internally for differential and integral operations at a step prior to the PV state of the corresponding loop. This can be referred to when necessary. Input of a random value will lead to a malfunction.

(14) _PID[B]_[L]MV (PID Manipulated output variable) **- I/O area**

K device area: %KW[40+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This displays the MV of the corresponding loop.
MV is a signal source for system driver. Contrary to the description of _PID_PV in (12), this values is transferred at each scan to the U device using a command such as MOV and then used as a system startup input via an output device such as D/A conversion module.
Please refer to the program examples in the latter part of this manual.

(15) _PID[B]_[L]MV_BMPL_val (PID MV Bumpless changeover Value) **- Setting disable**

K device area: %KW[41+1050B+32L]
Data unit: WORD [0 ~ 65535]
This save the information necessary for the Bumpless changeover operation of the corresponding loop.
The corresponding memory is automatically set and input by PID-internal operation and this value should not be set by the user.

Notes

Bumpless Change Over

When the PID controller is converted to manual output mode and back again to auto output mode, the output is increased again from 0 as in a freshly started control system. This causes a mode changing impact to the system. In other words, when a certain output is applied to the system in manual mode, and when it is switched to automatic mode, the output rises from 0 again.
To avoid this, the MV_BMPL function is used; when the current system is converted to auto mode with the corresponding bit authorized, this senses the system's last state in manual mode and lets the control output continue smoothly from that point. Furthermore, with the master loop MV_BMPL in cascade control authorized, the master loop senses the state of the slave loop and generates a smoothly continuing control output.

(16) _PID[B]_[L]ERR (PID Error value) - Setting disable

K device area: %KD[21+525B+16L]
Data unit: DINT [-2747483648 ~ 2747483647]
This is the current error value of the corresponding loop.
An error value in PID is defined as SV – PV. This is used as an indicator of how far the current state is from the desired state. If the error is 0, it means the control system reaches its desired state. The control system can be considered ideal if, when a control starts, the error rapidly decreases in the transient state and, when it reaches the normal state, vibration is minimized and the offset (the error in the stable state) is kept at 0.

(17) _PID[B]_[L]MV_p (PID MV Proportional component) - Setting disable

K device area: %KD[22+525B+16L]
Data unit: REAL [-3.40282347e+38 ~ -1.17549435e-38, 0, 1.17549435e-38 ~ 3.40282347e+38]
This displays the proportional control value of the corresponding loop.
If the error of the current system is known, its integral and differential control output values can also be calculated independently. Comparing the 3 output values enables to determine the exact operational state of the control system and PID control. MV is the sum of MV_p, MV_i, and MV_d.

(18) _PID[B]_[L]MV_i (PID MV Integral component) - Setting disable

K device area: %KD[23+525B+16L]
Data unit: Set the integral control of loop as REAL [-3.40282347e+38 ~ -1.17549435e-38, 0, 1.17549435e-38 ~ 3.40282347e+38].

(19) _PID[B]_[L]MV_d (PID MV Differential component) - Setting disable

K device area: %KD[24+525B+16L]
Data unit: Set the differential control of loop as REAL [-3.40282347e+38 ~ -1.17549435e-38, 0, 1.17549435e-38 ~ 3.40282347e+38].

(20) _PID[B]_[L]DB_W (PID DeadBand Width) - Setting area

K device area: %KW[50+1050B+32L]
Unit: WORD, Setting Range [0 ~ 5000]
This sets the deadband of the corresponding loop. It is set only as a positive value, and operates in the area as much as the set value above and below SV.
In other words, when PV enters [SV – DB_W] ~ [SV + DB_W], SV is substituted for PV value (cannot be checked from outside). If this value set 0, the corresponding function does not operate.

Notes

Deadband
This is used to let PV fully approach SV during system control so as to eliminate fine output variations due to fine state changes. In PID control, if a value is entered into DB_W, a dead band as much as that value is formed above and below SV. If PV follows SV into the deadband during control, ERR is forcibly calculated as 0 and, as far as PV remains in this area, the MV variation stops. This has the same effect as stopping the controller for a while in the stabilization area and helps avoiding a heavy load on the driver during stabilization operation. It is recommended to fully stabilize the system before use in the area to be set as the deadband. Otherwise, when entering the deadband, the controller experiences a temporary output excess.

(21) _PID[B]_[L]Td_lag (PID Td lag filter) **- Setting area**

K device area: %KW[51+1050B+32L]
Data unit: WORD [0 ~ 65535]
This sets the primary delay filter for the corresponding loop so as to allow the differential effect acting as an instantaneous impact to act more slowly and continuously. If the corresponding value is set high, the differential effect becomes smoother and, if it set to 0, the corresponding function does not operate. The differential value leads the system output to low vibration and helps avoid a heavy load on the driver.

(22) _PID[B]_[L]AT_HYS_val (PID Auto-tuning Hysteresis value) **- Setting area**

K device area: %KW[52+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This sets a directional deadband appropriate for AT. The _PIDn_AT_HYS_val value operates differently as a upper deadband when PV increases and as a lower deadband when PV decreases. Proper setting of this value is critical for successful AT. Setting _PIDn_AT_HYS_val is described in 10.7.4.

(23) _PID[B]_[L]AT_SV (PID Auto-tuning SV) **- Setting area**

K device area: %KW[53+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This separately sets AT_SV to be used as SV for AT of the corresponding loop. AT enables PV to vibrate 3 times up and down around AT_SV.

(24) _PID[B]_[L]AT_step (PID Auto-tuning step) **- Setting disable**

K device area: %KW[54+1050B+32L]
Data unit: INT [-32768 ~ 32767]
This displays the AT operation state of the corresponding loop. _PID[B]_[L]AT_step has values from 0 to 7; 0 indicates “before AT operation” and 7 indicates “AT operation completed”. 1, 3 and 5 indicate the PV-increasing areas and 2, 4 and 6 indicate the PV-decreasing area.

Caution

1) **Setting disable**: It is prohibited to set any item with the indication of – Setting prohibited among the items described in the above common bit area and individual loop area. The corresponding area not only provides the user with operational information but also stores information necessary for operations. A random setting of the corresponding area causes the malfunction of the control system.
2) **I/O area**: _PID[B]_[L]PV and _PID[B]_[L]MV are **– I/O area** respectively, so it is necessary to connect to external devices(A/D, D/A and others).

Notes

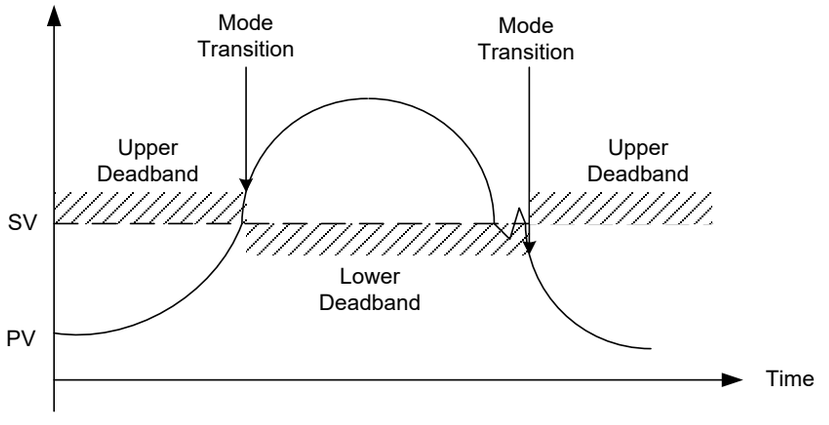
Transient and Steady States

1) Transient State : A state which the control system starts its control operation and reaches the desired control state. There often occurs an instantaneous output variation and, while the integral value approaches stability, there may occur a vibration or overshoot.

2) Steady States : A state which the control system pass the transient states and reaches the desired control state. Vibration is eliminated, there may occur an offset and there is little change in the output value.

Upper / Lower Deadbands

When the analog output of the sensor is converted into a digital signal by means of an AD device, much of the signal is mixed with noise. The PID control command executes Auto-tuning using this converted value; it enables PV to increase and decrease 3 times up and down at SV. In the course of this process, if noise is input at the time when SV equals PV, a single up and down conversion is incorrectly perceived as multiple conversions. This is the same effect as the chattering of the digital switch. To overcome this, the PID controller uses a unidirectional deadband (Hysteresis); when the PV value of the system increases toward SV, the set deadband value operates in the upper part of SV and when the PV value passes SV and decreases, the set deadband value operates only in the lower part of SV



14.6 Convenient Additional Functions of PID Command

This section describes additional functions that can be conveniently used in combination with the PID command.

14.6.1 Various PID-based control methods

Commonly used among PID controls are P control, PI control, PD control and PID control. When a certain feature (mostly stabilization) is required, ID control, I control or D control is often used though they are somehow more complicated. To implement these various controls, PIDRUN includes functions that enable or disable controls by P, I, and D, respectively.

For instance, in case of P control, it may control P controller by setting _PID[B]_[L]Ti and _PID[B]_[L]Td as 0. In case of PI control, only setting _PID[B]_[L]Kp, _PID[B]_[L]Ti and input 0 in _PID[B]_[L]Td. In case of ID control, only setting _PID[B]_[L]Ti, _PID[B]_[L]Td and input 0 in _PID[B]_[L]Kp.

Likewise, In case of ID control, substitutes each ID control coefficient to _PID[B]_[L]Ti, _PID[B]_[L]Td and input 0 in _PID[B]_[L]Kp. However, One special thing is that, in case of ID control, setting _PID[B]_[L] to 0 theoretically results in the controller 's 0 output. (Refer to Expressions 14.3.2 ~ 14.3.5) Actually, however, PIDRUN, if 0 is input to _PID[B]_[L], internally calculates as MVp = 0 and K_p = 1, thus enabling ID, I control and D control.

14.6.2 Operation and function of Anti wind – up

PIDRUN provides 2 Wind-up prevention functions: Anti Wind-up 1 and Anti Wind-up 2. The more basic of the two, Anti Wind-up 1 operates for all I-related controls¬ - I control, PI control, ID control and PID control - and cannot be cleared.

The operation principle is to limit MVi(integral result) to _PID[B]_[L]MV_max and _PID[B]_[L]MV_min. Anti Wind-up 2 is organically connected to MVp (the proportional term results) In case MV reaches ±(_PID[B]_[L]MV_max) on MVp only, regardless of the MVi and MVd values, due to a large system error, Mvi does not perform a calculation but keeps the previous value. In case the error is large, PV is brought near SV (operating point) by MVp, not by Mvi or MVd, and then I control is resumed to prevent and excessive value from being entered into Mvi. The operation of Anti Wind-up 2 can be cleared by the user by setting the _PID[B]_[L]AW2D bit on the common bit area to On. This function operates only when P controller and I controller run the same time like PI, PID control.

14.6.3 Operation and function of Auto-tuning

PIDRUN has an AT function that enables to test operate the system though several basic settings and calculate _PIDn_T_s, _PIDn_K_p, _PIDn_T_i and _PIDn_T_d appropriate for the system. The values such as _PID[B]_[L]MV_min, _PID[B]_[L]MV_max, _PID[B]_[L]AT_HYS_val and _PID[B]_[L]AT_SV should be set before AT while the AT function sets MV three times in good order of _PID[B]_[L]MV_max and _PID[B]_[L]MV_min, operates it, checks the system's state(PV) response, measures the time and vibration degree to reach to the AT target value(AT_ST) and finally, calculates _PID[B]_[L]T_s, _PID[B]_[L]K_p, _PID[B]_[L]T_i and _PID[B]_[L]T_d suitable for the measurements.

To calculate the accurate tuning value, refer to the AT setting described in 14.7.6 and running the AT operation accordingly.

Notes

Auto-tuning

Auto-tuning is the _PID[B]_[L]T_s,_PID[B]_[L]K_p,_PID[B]_[L]T_i and _PID[B]_[L]T_d obtained at the end of this series of work and is automatically assigned to each location, so previously used _PID[B]_[L]T_s,_PID[B]_[L]K_p,_PID[B]_[L]T_i and _PID[B]_[L]T_d will disappear and please be careful.

14.6.4 Operation and function of cascade

PDCAS performs cascade PID control through sequential operation of two PID loops.
Generally, cascade PID control is used for temperature control through chemical process or fuel control; the two loops used here are called master loop and slave loop. As an example of temperature control through fuel flow, in case of a single loop PID control, the fuel valve is opened and closed to control the fuel flow and consequently control the temperature of the heating furnace.

In this case, equipping the system with a fuel flow meter enables cascade PID control that consists of flow control and temperature control. The slave loop controls the flow using the valve and the master loop controls temperature using the flow. The master loop transfers the desired flow to the slave loop, while the slave loop monitors the flow meter and adjusts the flow using the valve.so that fuel corresponding to the flow desired by the master loop is injected. The slave loop operates on the flow Set Value set by the master loop, regardless of temperature.

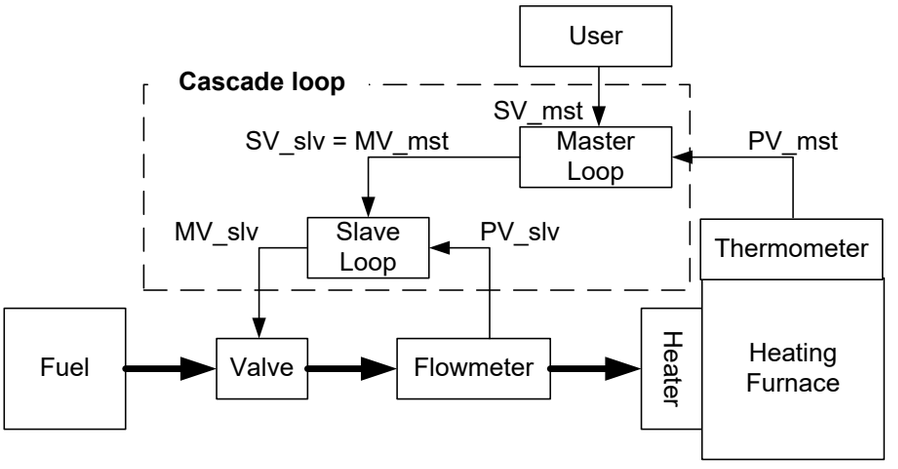
In terms of the internal cascade operation, the master loop measures the temperature (PV_mst) in a more delayed manner than the slave loop and transfers the flow value (MV_mst) computed for the user's desired temperature (MV_mst) to the slave loop.
The slave loop sets the flow value (MV_mst) transferred from the master loop as the Set Value (SV_slv) and measures the fuel injection amount (PV_slv) in a more frequent manner than the master loop in order to control the valve opening and closing (MV_slv). Therefore , cascade functions to transfer MV (MV_mst) of the master loop to SV (SV _slv) of the slave loop when two loops are in operation.

If the slave loop is converted to manual output mode, the master output is not used and the master loop is also converted to manual output mode. At the moment, the manual mode _PID[B]_[L]MAN bit is not on in the master loop. If the slave loop is converted to auto output mode again, the master loop is also turned to auto output mode. If _PID[B]_[L]MV_BMPL is set to On, state data is exchanged between the two loops to ensure a smooth conversion.

If the slave loop is in Anti Wind-up mode, the master loop operates in PIDPAUSE mode. When there is a need to increase or decrease the slave Set Value (SV_mst) despite the occurrence of anti wind-up, this a function prevents the occurrence of 2nd wind-up for the whole cascade loop. This function always operates according to the corresponding conditions and the _PID[B]_[L]PAUSE bit is not turned On.

PIDCAS command performs cascade PID control through sequential operation of two PID loops. In general, cascade PID control is used for temperature control through chemical processes or fuel, and the two loops used at this time are called master and slave loops, respectively. For example, for temperature control through the flow of fuel, in the case of single loop PID control, the fuel valve is opened to control the flow of fuel, and through this, the temperature of the furnace is controlled. Therefore, it can be seen as a system in which a single PID loop controls temperature indirectly through flow. If cascade PID is applied in such a case, the system can be divided into a flow control part and a temperature control part by installing a flow meter of fuel. In other words, the slave loop controls the flow rate using a valve, and the master loop controls the temperature using the flow meter. The master loop transfers the desired flow to the slave loop, while the slave loop monitors the flow meter and adjusts the flow using the valve by fuel corresponding to the flow desired by the master loop is injected. The slave loop operates only with the target flow rate from the master regardless of temperature.

Now In terms of the internal cascade operation, the master loop measures the temperature (PV_mst) in a more delayed manner than the slave loop and transfers the flow value (MV_mst) computed for the user's desired temperature (MV_mst) to the slave loop. The slave loop sets the flow value (MV_mst) transferred from the master loop as the target value (SV_slv) and measures the fuel injection amount (PV_slv) in a more frequent manner than the master loop in order to control the valve opening and closing (MV_slv). Therefore, cascade plays the role of transferring the MV (MV_mst) of the master loop to the SV (SV_slv) of the slave loop while both loops are operating.
If the slave loop converted to manual output mode, the master output is not used and the master loop is also converted to manual output mode. At this time, manual mode _PID[B]_[L]MAN bit is not ON in the master loop. If the slave loop is converted to auto output mode again, the master loop is also turned to auto output mode.If _PID[B]_[L]MV_BMPL is set to On, state data is exchanged between the two loops to ensure a smooth conversion.
If the slave loop is in Anti Wind-up mode, the master loop operates in PIDPAUSE mode. When there is a need to increase or decrease the slave Set Value (SV_mst) despite the occurrence of anti wind-up, this function prevents the occurrence of 2nd wind-up for the whole cascade loop. This function always operates according to the corresponding conditions and the _PID[B]_[L]PAUSE bit is not turned On.



Notes

Cascade system's auto-tuning

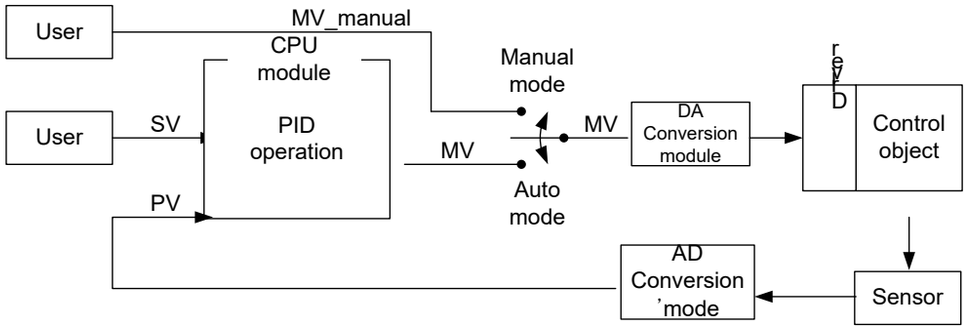
In case of AT of a cascade system, AT of the slave loop precedes AT of the master loop. For AT of the slave loop, it is required to predict how much SV the slave loop receives from the master loop and setting AT_SV to this value enables the slave loop to operate as an independent loop. AT performance may differ according to the predicted value.

14.7 How to Use Built-in PID Control Function

This section describes how to use built-in PID control function.
For detailed description of the functions of the CPU, specific modules and XG5000, refer to the corresponding manuals

14.7.1 Hardware Configuration

The example system has a configuration as shown below.

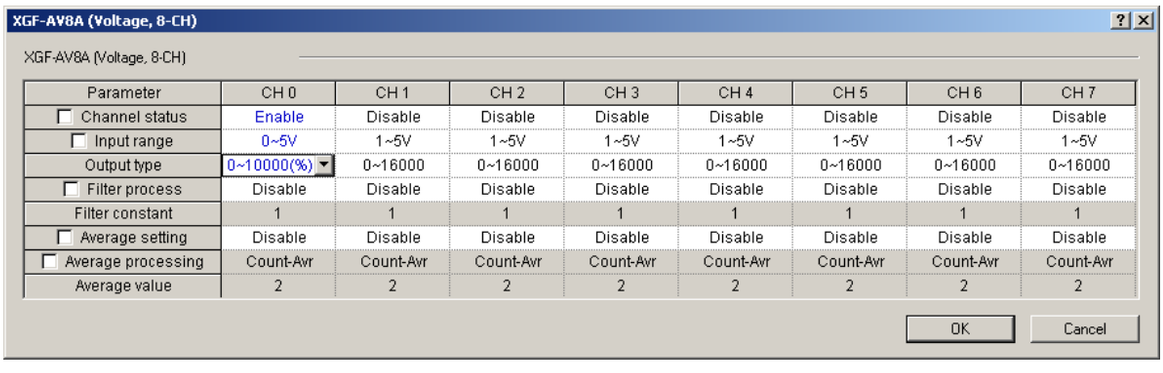


(1) CPU (XGI-CPUU)

The CPU is where PID operation occurs and so can be called "PID controller". The controller receives data from the input module, calculates a proper output through operation, and then transfers it to the output module. What the user should do is to connect input and output and design the interior of the PID controller (tuning). Generally, analog input module and analog output module modules are used for input and output, respectively.

(2) Analog Input Module (XGF-AV8A)

This functions to receive the state of the control object from the sensor and transfer it to the CPU module. The analog input module channel 0 enables to receive a voltage of 0 V ~ 5 V as input and transfer its digital value to the PLC as output. There are 8 channels (CH 0 ~ CH 7) in XGF-AV8A The setting for XGXGF-AV8A can be changed through the I/O parameter setting window that appears when selecting I/O Parameter from the parameter items in the project window. Channel 0 is changed to "Enable" mode and the input range is set to 0 ~ 5 V (according to the sensor). The output data type is the PV value of the PID controller. For PID control, the range of its value is set to 0 ~ 10000.
The 0 ~ 5 V signal detected from the sensor during analog input module operation is converted 2,000 times to a digital value of 0 ~ 10000 and then transferred to the PLC.
The following figure is the setting screen of XGF-AV8A in XG5000.

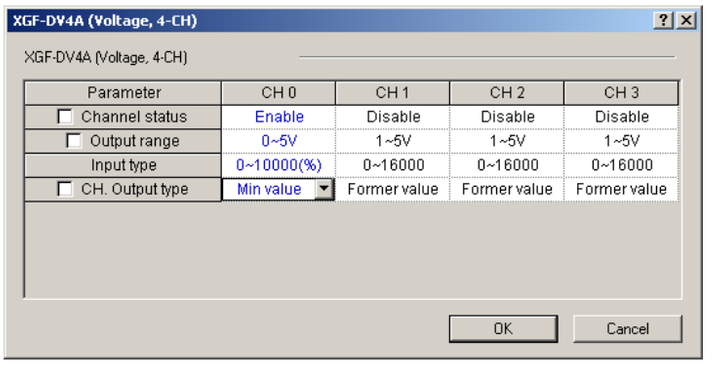


(3) Analog output Module (XGF-DV4A)

The analog output module converts a controller output digital value generated through control operation in the PLC to 4mA ~ 20mA and transfers it to the driver of the control object. The XGF-DV4A model has 4 channels and its setting can be changed through the I/O parameter setting window, as in XGXGF-AV8A. Channel 0 is changed to "Enable" mode and the output range is set to 0 ~ 5V

(according to the driver). The 0 ~ 10000 MV digital output generated through PID control operation is reduced to 1/2000 and then transferred to the signal of the driver.

The following figure is the setting screen of XGF-DV4A in XG5000.



(4) Sensor and Driver

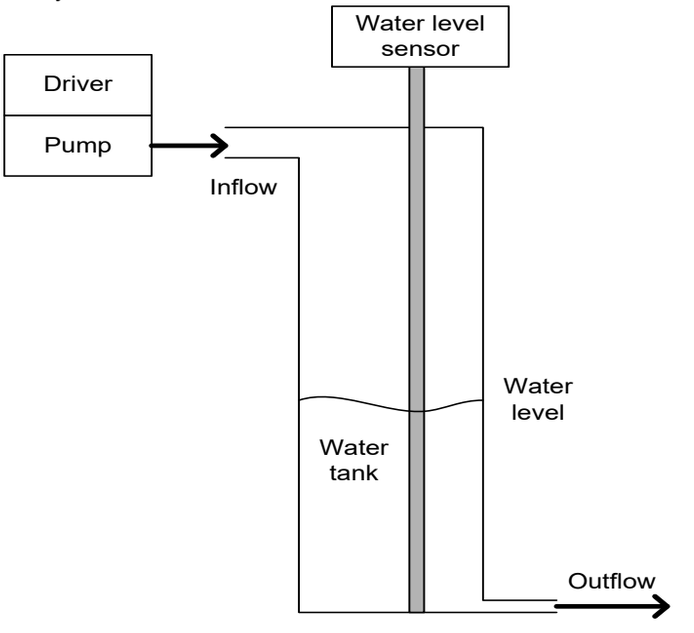
Along with the analog output module and analog input module, the sensor and driver respectively function as the media to transfer the state of the control object to the controller and transfer the controller output to the control object. The output generated from the sensor connect to input of the analog input module and the output generated from the analog output module should be connect to input of the driver. For an easy example, if the sensor's current type is 4mA ~ 20mA, the analog input module's current mode should be 4mA ~ 20mA and if the driver's voltage mode is 0V ~ 5V, the analog output module's voltage mode should be 0V ~ 5V.

The output of the analog output module used as the driving signal of the driver. If it is used directly as the motive power of driver, PLC may be subject to malfunction.

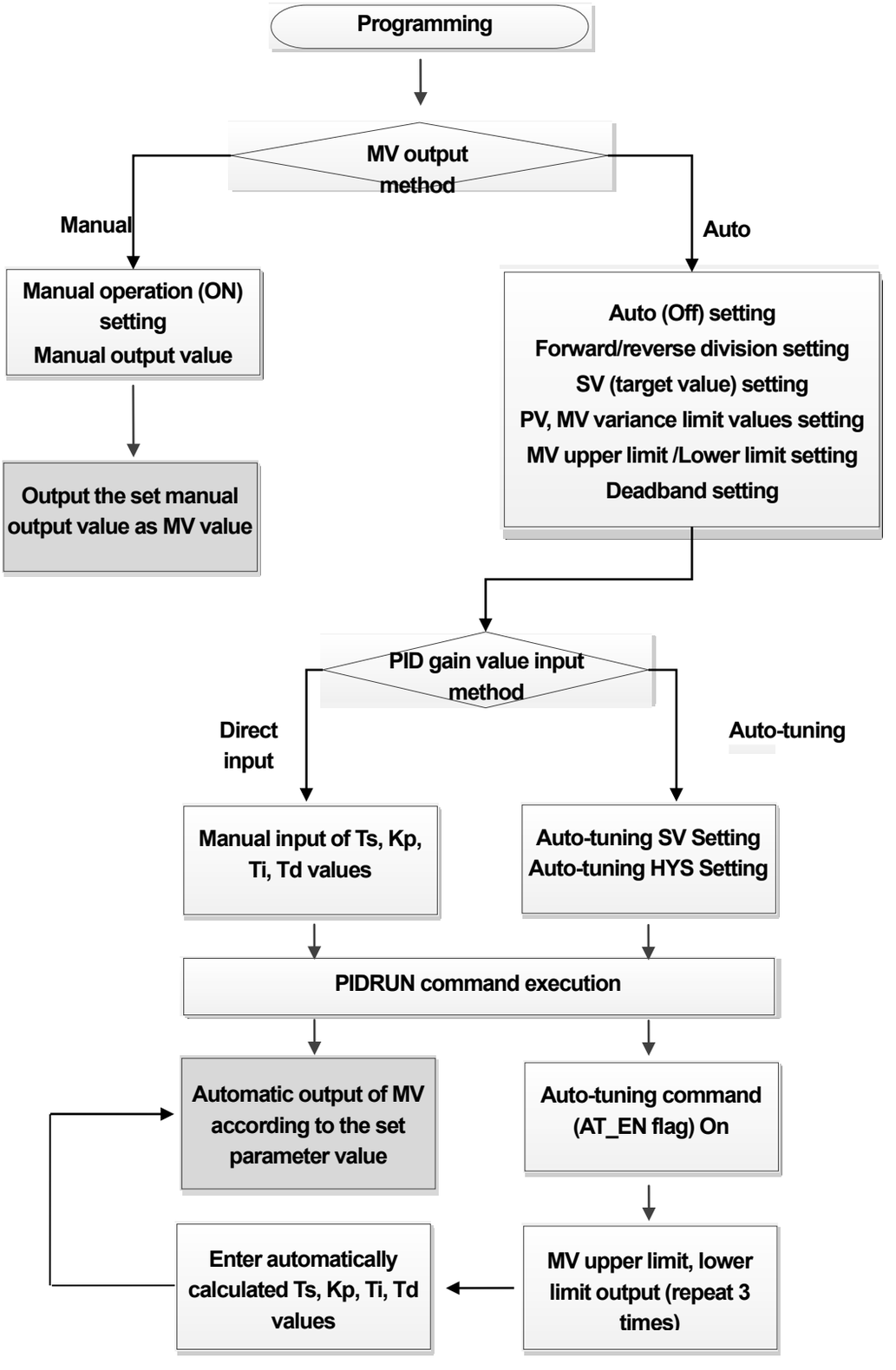
(5) Control Object

The current system uses a water level control system as the control object. A water level control system is a system to maintain a desired water level by pumping water into a water tank whose lower part has a small opening for outflow of water.

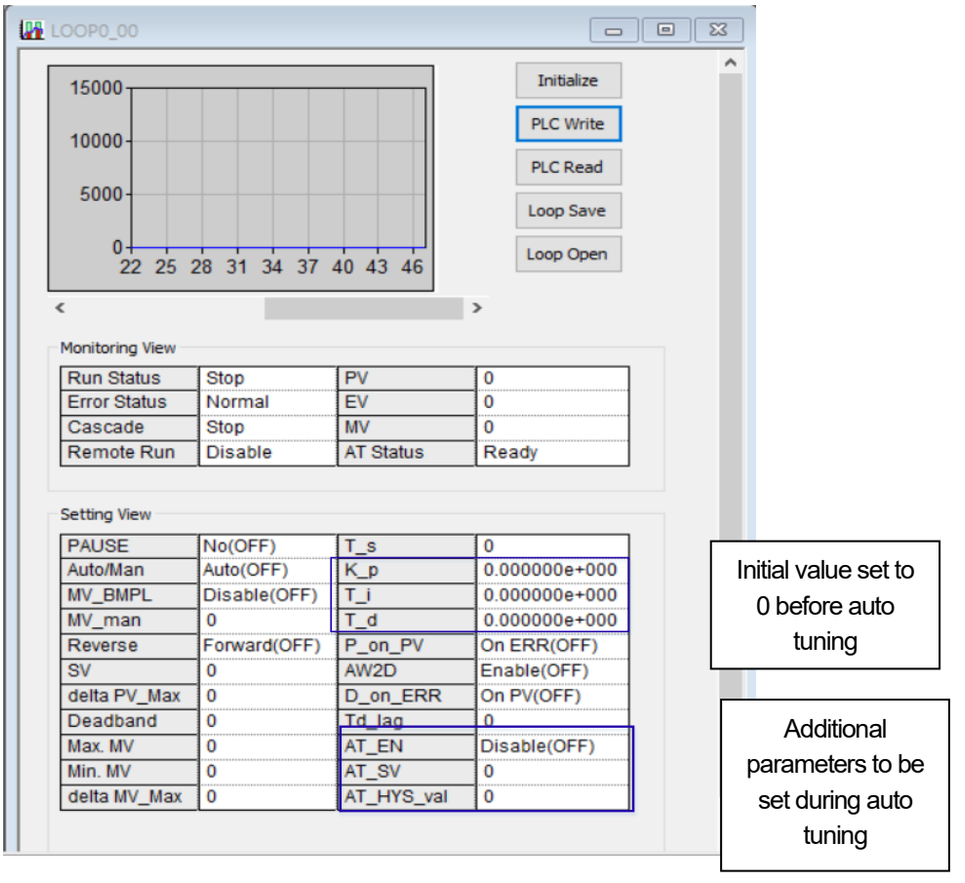
The water in the tank flows out at a constant rate. The decision to increase or decrease the water level is based on the water inflow. The structure of a water level control system is as follows.



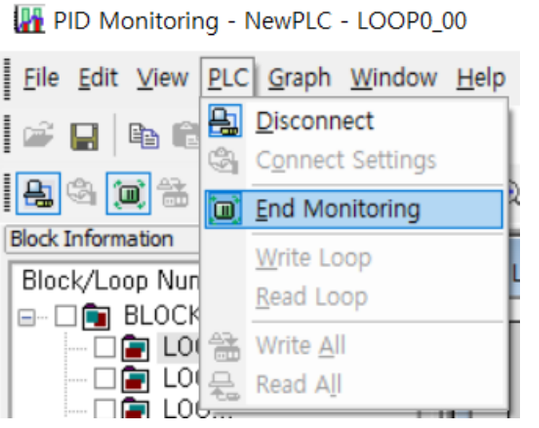
14.7.2 Built-in PID Control Function Flow



14.7.3 How to set Parameters through PID monitor



(Caution, to write the set parameter values to PLC, the monitor must be in the disabled state.)



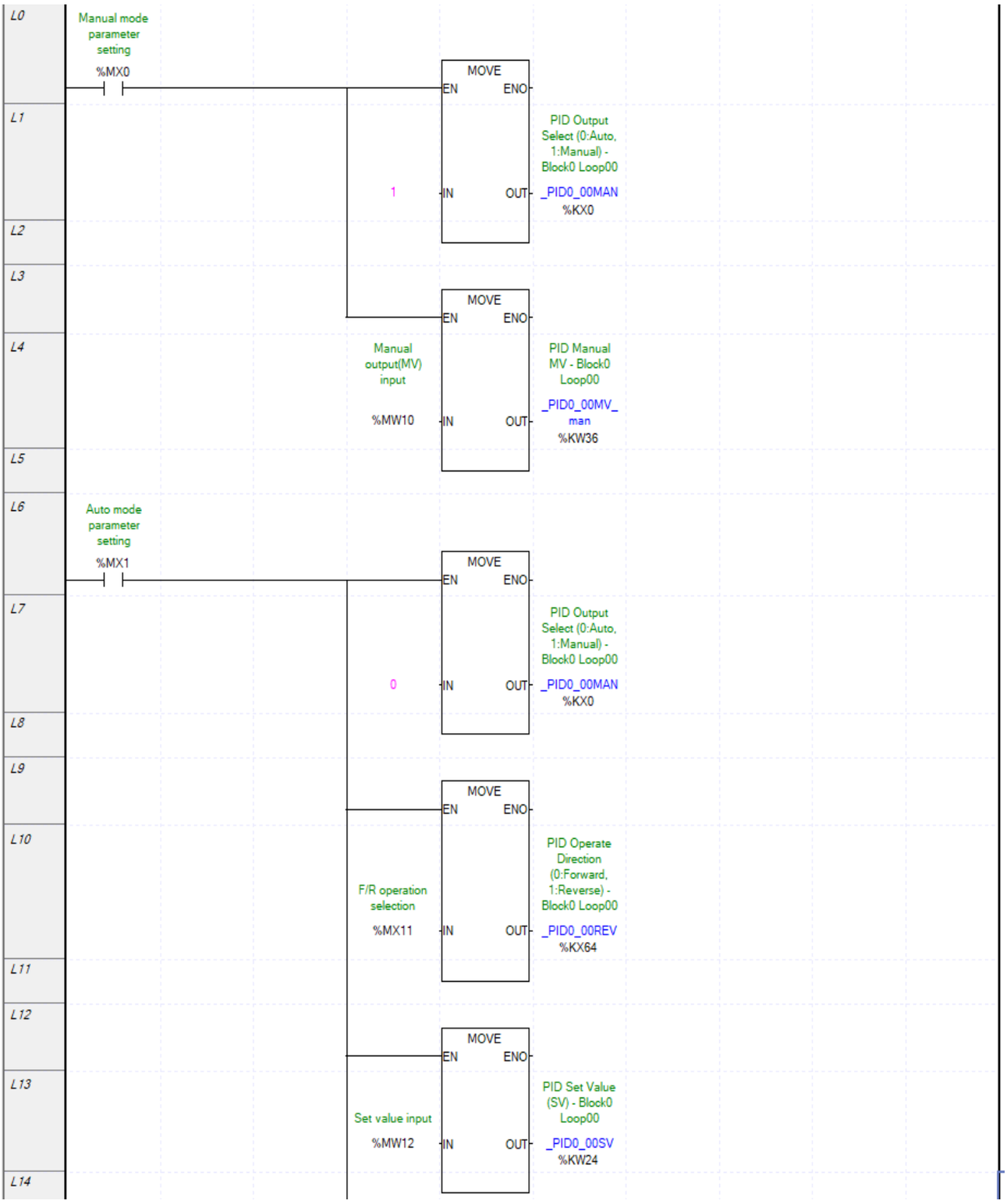
*** Other parameter setting methods.**

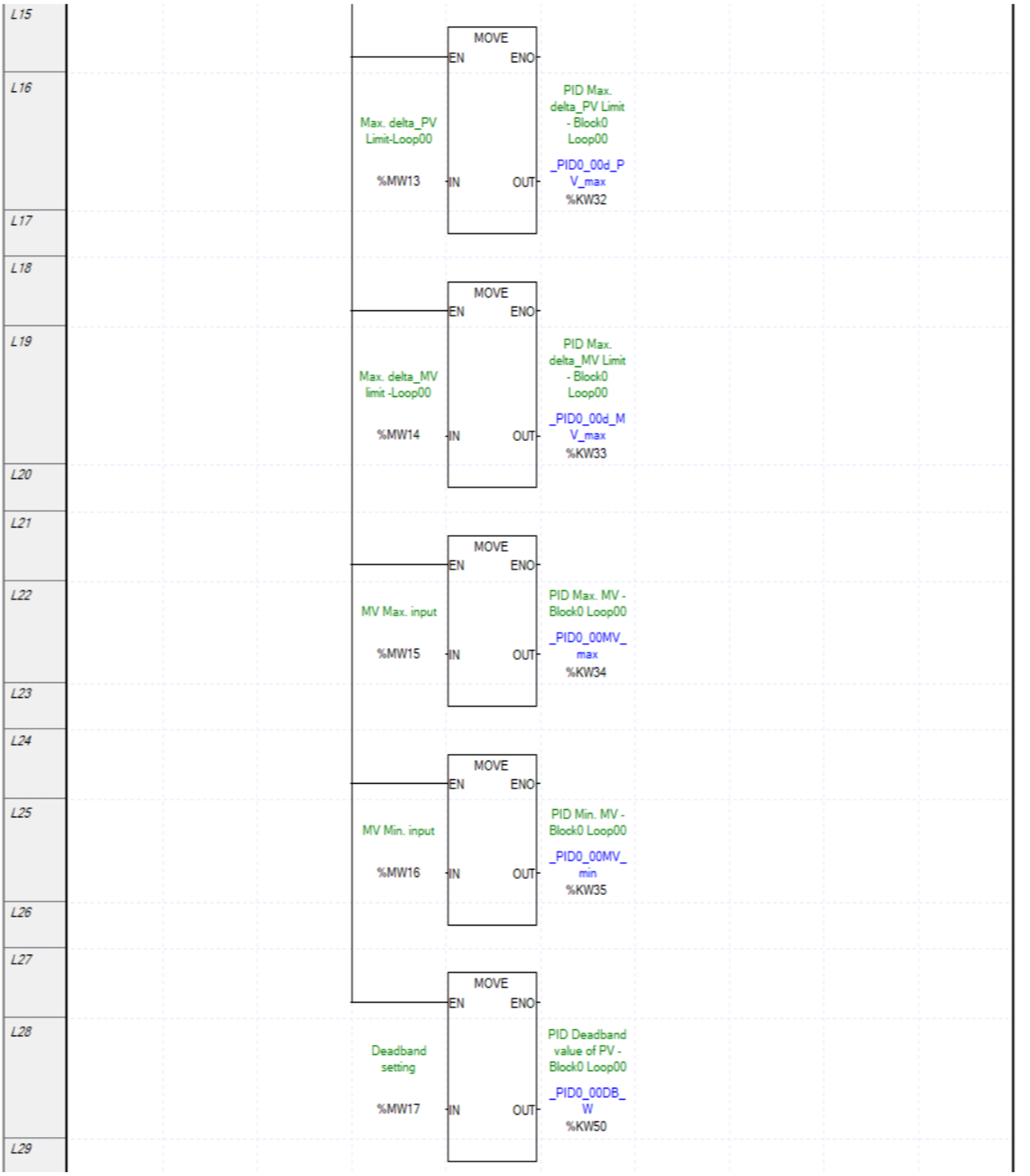
1) Using the variable monitor (register the desired parameters in the variable monitor and enter the value)
2) Using command (PID PRMT) (Only Block, Loop, SV, Ts, Kp, Ti, Td can be set)

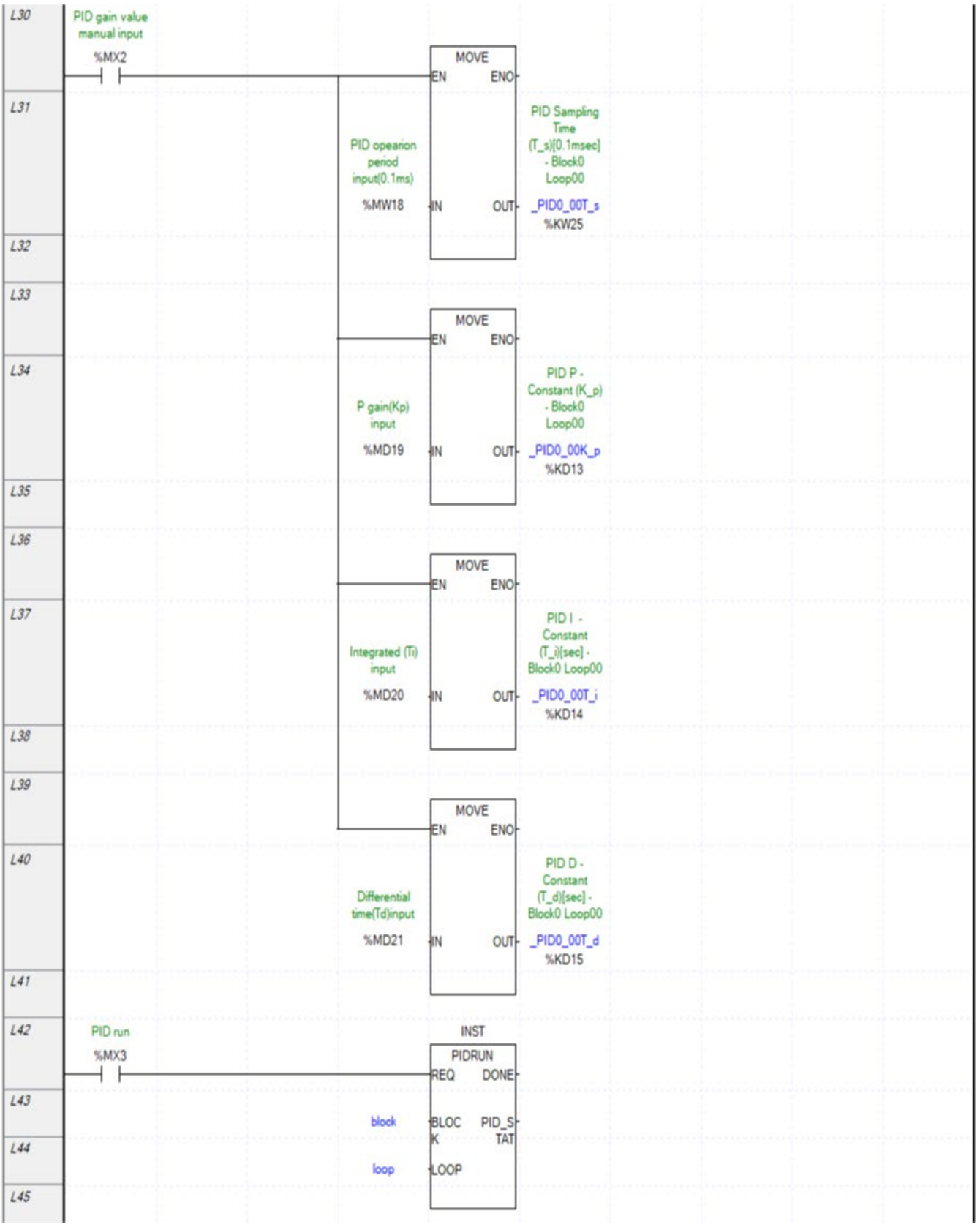
14.7.4 Program example1

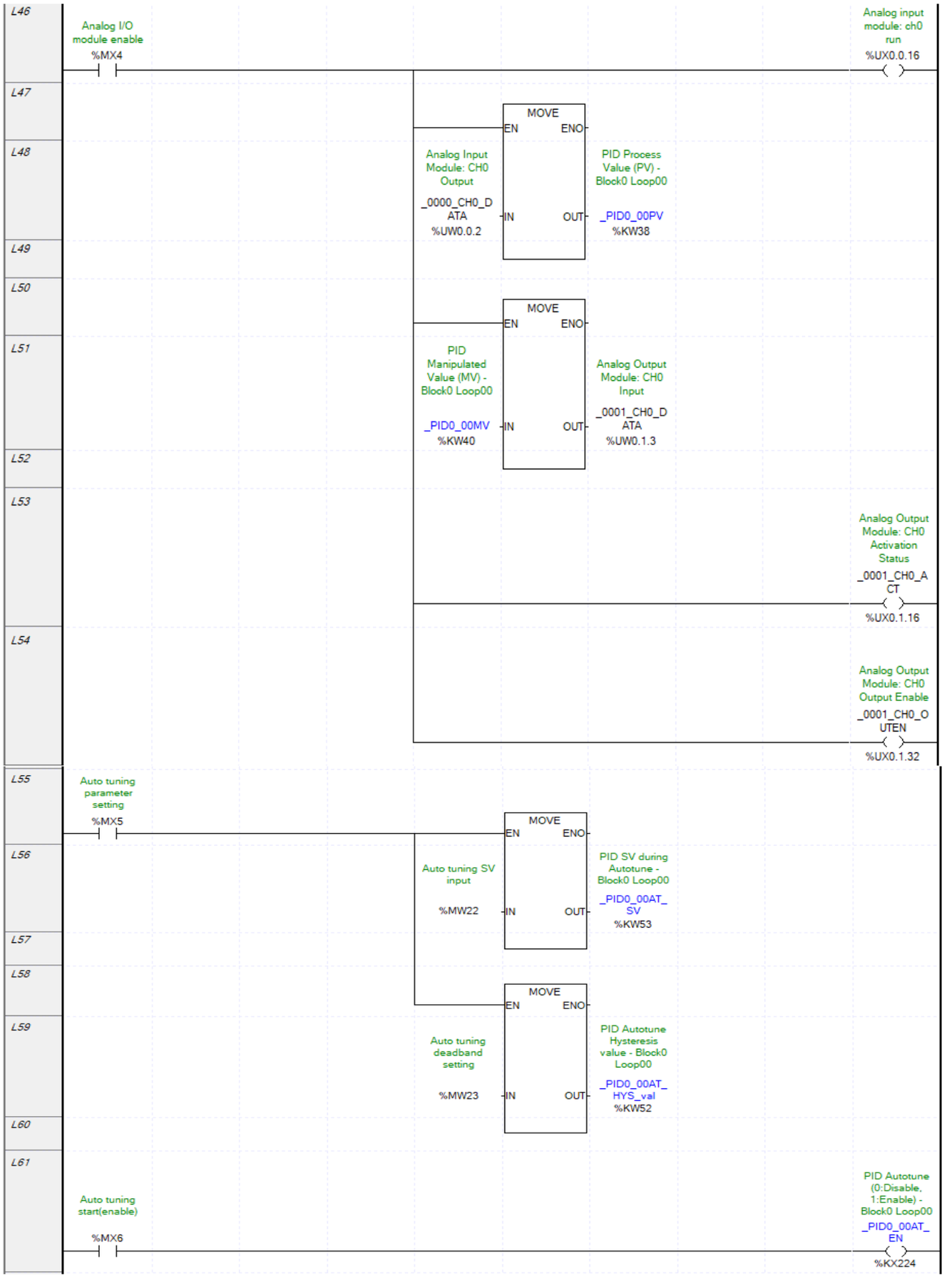
(1) LD Program

The following figure is an example of a program that performs PID control using A/D conversion module and D/A conversion module.




L15
L16
L17
L18
L19
L20
L21
L22
L23
L24
L25
L26
L27
L28
L29
MOVE
EN
ENO
Max. delta_PV Limit-Loop00
%MW13
IN
OUT
PID Max. delta_PV Limit - Block0 Loop00
_PID0_00d_PV_max
%KW32
MOVE
EN
ENO
Max. delta_MV limit -Loop00
%MW14
IN
OUT
PID Max. delta_MV Limit - Block0 Loop00
_PID0_00d_MV_max
%KW33
MOVE
EN
ENO
MV Max. input
%MW15
IN
OUT
PID Max. MV - Block0 Loop00
_PID0_00MV_max
%KW34
MOVE
EN
ENO
MV Min. input
%MW16
IN
OUT
PID Min. MV - Block0 Loop00
_PID0_00MV_min
%KW35
MOVE
EN
ENO
Deadband setting
%MW17
IN
OUT
PID Deadband value of PV - Block0 Loop00
_PID0_00DB_W
%KW50

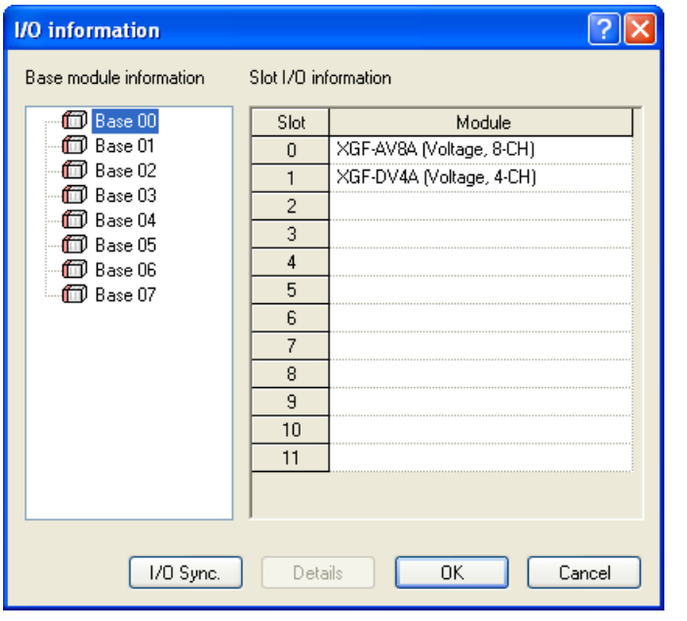

L30
PID gain value manual input
%MX2
MOVE
EN
ENO
L31
PID Sampling Time (T_s)[0.1msec] - Block0 Loop00
PID opearion period input(0.1ms)
%MW18
IN
OUT
_PID0_00T_s
%KW25
L32
L33
MOVE
EN
ENO
L34
PID P - Constant (K_p) - Block0 Loop00
P gain(Kp) input
%MD19
IN
OUT
_PID0_00K_p
%KD13
L35
L36
MOVE
EN
ENO
L37
PID I - Constant (T_i)[sec] - Block0 Loop00
Integrated (Ti) input
%MD20
IN
OUT
_PID0_00T_i
%KD14
L38
L39
MOVE
EN
ENO
L40
PID D - Constant (T_d)[sec] - Block0 Loop00
Differential time(Td)input
%MD21
IN
OUT
_PID0_00T_d
%KD15
L41
L42
PID run
%MX3
INST
PIDRUN
REQ
DONE
L43
block
BLOCK
PID_STAT
L44
loop
LOOP
L45


L46
Analog I/O module enable
%MX4
Analog input module: ch0 run
%UX0.0.16
L47
MOVE
EN
ENO
L48
Analog Input Module: CH0 Output
_0000_CH0_DATA
%UW0.0.2
IN
OUT
PID Process Value (PV) - Block0 Loop00
_PID0_00PV
%KW38
L49
L50
MOVE
EN
ENO
L51
PID Manipulated Value (MV) - Block0 Loop00
_PID0_00MV
%KW40
IN
OUT
Analog Output Module: CH0 Input
_0001_CH0_DATA
%UW0.1.3
L52
L53
Analog Output Module: CH0 Activation Status
_0001_CH0_ACT
%UX0.1.16
L54
Analog Output Module: CH0 Output Enable
_0001_CH0_OUTEN
%UX0.1.32
L55
Auto tuning parameter setting
%MX5
MOVE
EN
ENO
L56
Auto tuning SV input
%MW22
IN
OUT
PID SV during Autotune - Block0 Loop00
_PID0_00AT_SV
%KW53
L57
L58
MOVE
EN
ENO
L59
Auto tuning deadband setting
%MW23
IN
OUT
PID Autotune Hysteresis value - Block0 Loop00
_PID0_00AT_HYS_val
%KW52
L60
L61
Auto tuning start(enable)
%MX6
PID Autotune (0:Disable, 1:Enable) - Block0 Loop00
_PID0_00AT_EN
%KX224

(2) Analog I/O module and variable registration method

1) Analog I/O module registration method

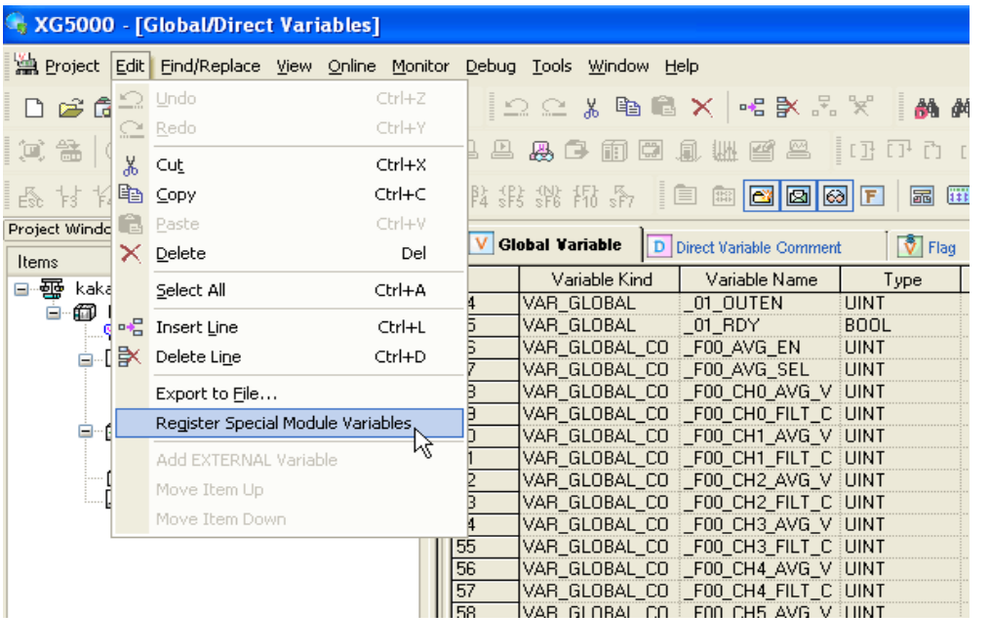
To use analog input and output modules, you need to register them in the project and set them appropriately. First, install the module, connect it, and then use the I/O synchronization function of the I/O information menu to register the module.



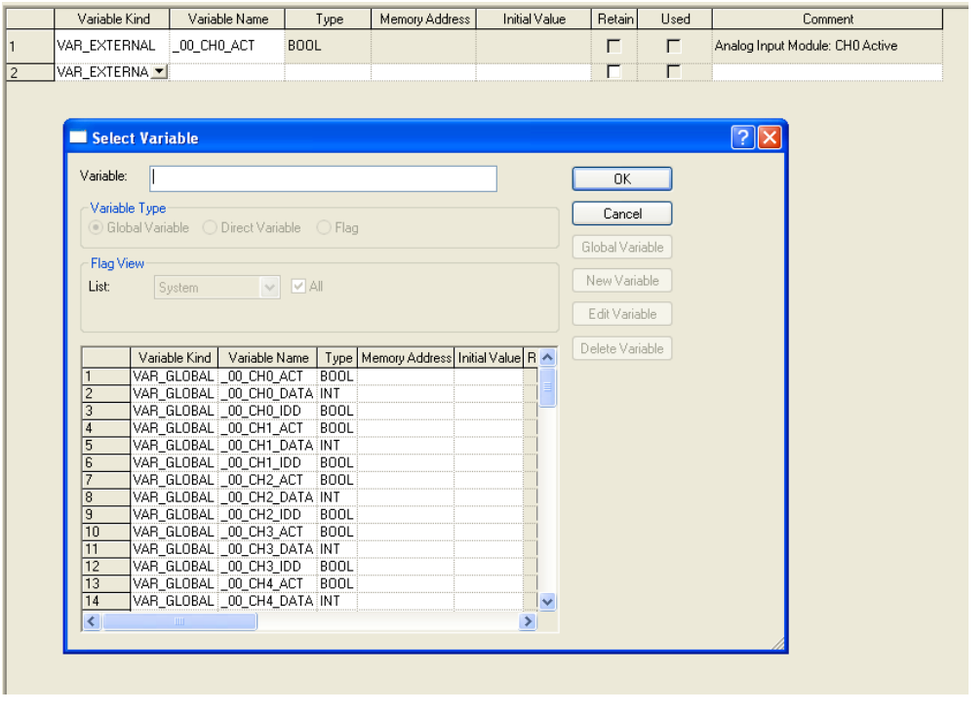
When module registration is complete, register the variable to be used among the variables assigned to the module as global variables.

2) Analog I/O module variable registration method

To access the analog input module and analog output module, register and use the variables of each module. After opening the global variable item in the project window, you can automatically register the variables of all installed special modules through automatic registration of special module variables in the edit menu.



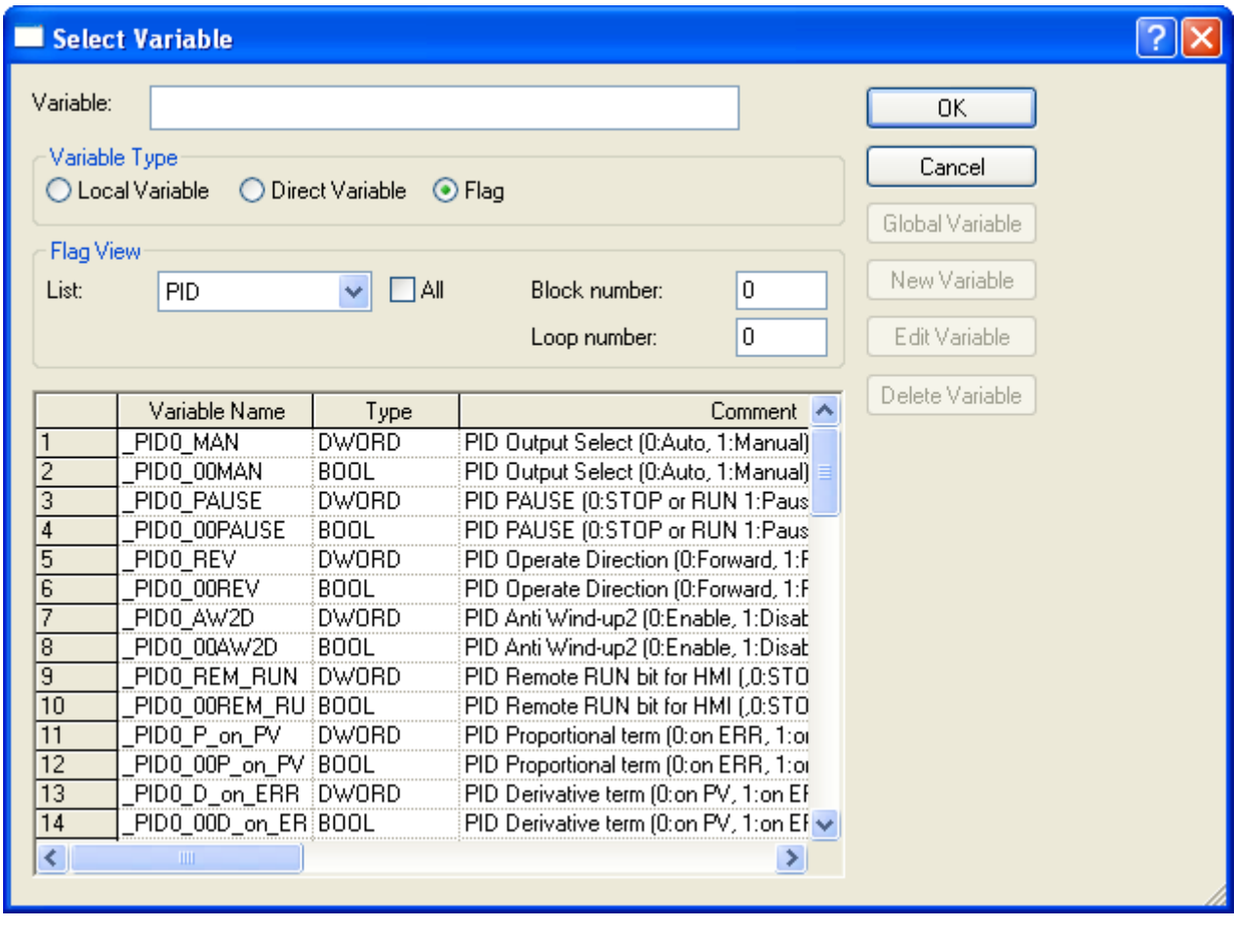
Among these, select the variables necessary to execute the ladder program and register them as local variables.



14.7.5 PID control (Variable monitor and Trend monitor)

(1) Register parameter in variable monitor

Control settings is performed by registering PID variables in the “Variable Monitor” window. Clicking the right button of the mouse and then selecting “Register in Variable/Command” in the Variable Monitor window allows you to see the “Variable/Device Select” window. If you select PID in the “List” field, clear the “All” view, and enter 0 in both “Block No.” and “Parameter No.”, you will see all the settings for block 0 and loop 0 and the variables to save the state. Selecting all variables and then clicking “Confirm” enables you to monitor the variables or change their values even when the program is in “RUN” mode.

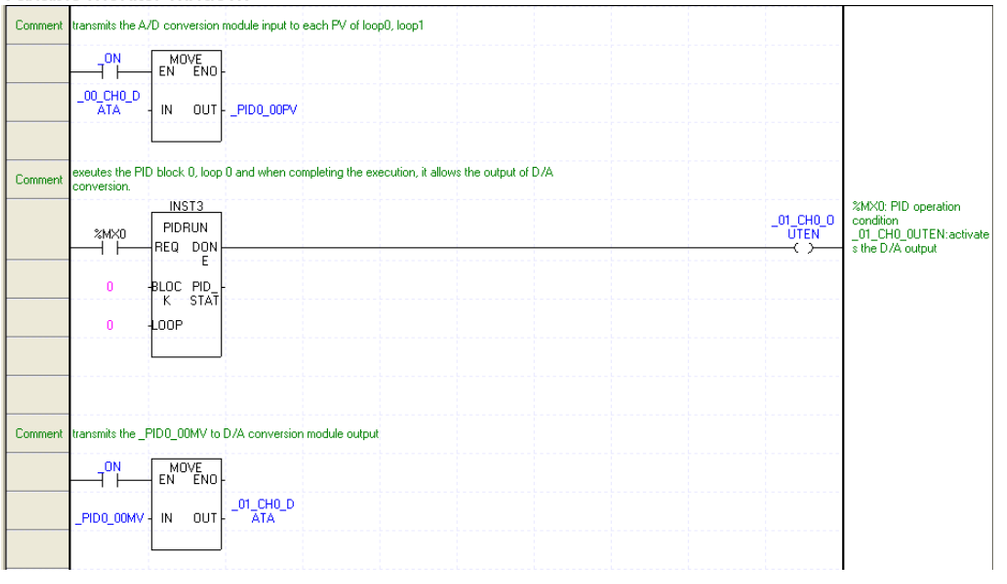


(2) SV Calculation

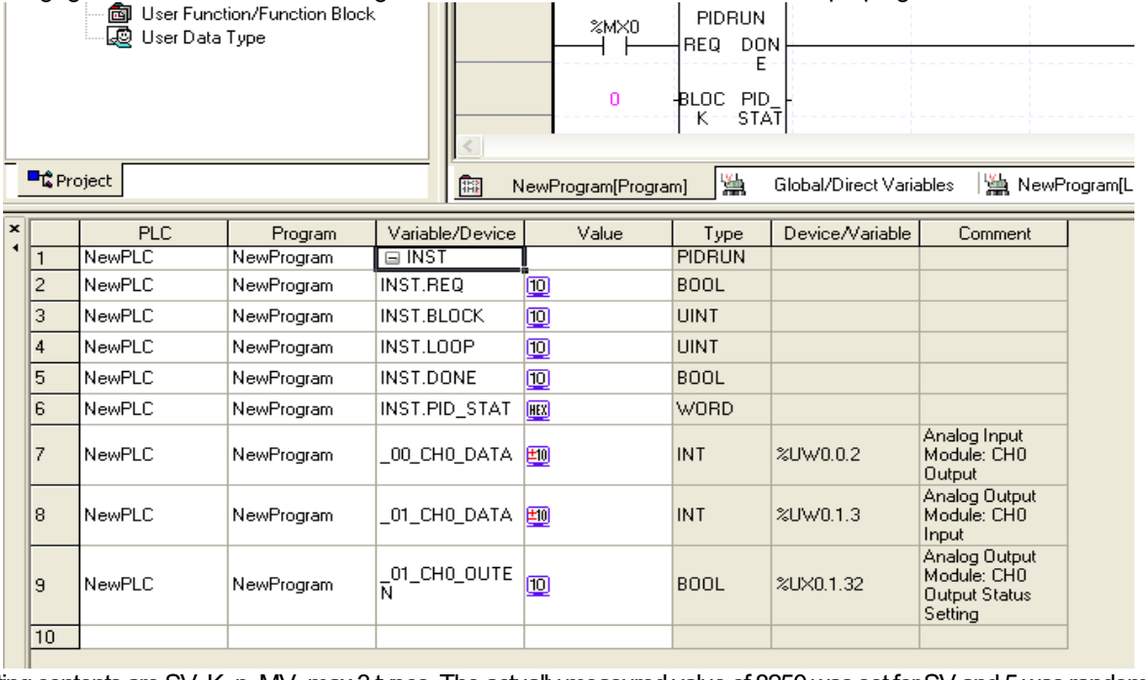
In order to set SV, the PV value of the system desired by the user should be determined. To put it easily, in order to maintain the water high speed 250mm, the PV value for 250mm should be determined. This value can be determined through numerical analysis of the system but it will be more exactly determined by experimenting with the reaction of the control object. In this system, it was analyzed that when the water level is 250mm, PV outputs a value of 8333, but as a result of actual operation, when the water level is 250mm, the sensor output value was 8250. The reasons for such an error are the inaccuracy of the sensor, the error of the measuring base point, etc. So, the actually measured value of 8250 should be used as the state value when the water level is 250mm. This value will be used as the SV value for control of 250mm.

(3) Control setting

After the previously developed program is downloaded to the PLC, then monitoring begins. The next step is to set the variables registered in the Variable Monitor window.



The following figure shows the screen of settings in the Variable Monitor window of the example program.

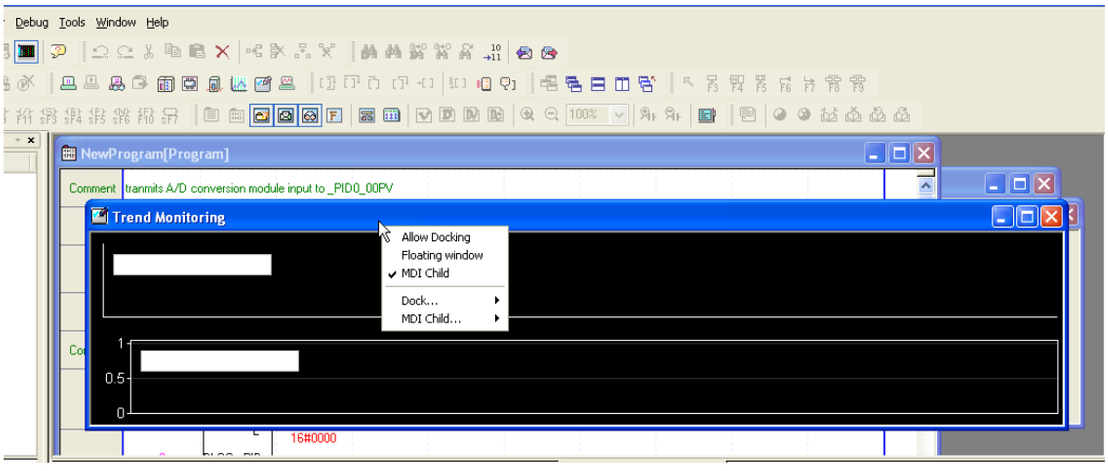


	PLC	Program	Variable/Device	Value	Type	Device/Variable	Comment
1	NewPLC	NewProgram	INST		PIDRUN		
2	NewPLC	NewProgram	INST.REQ	10	BOOL		
3	NewPLC	NewProgram	INST.BLOCK	10	UINT		
4	NewPLC	NewProgram	INST.LOOP	10	UINT		
5	NewPLC	NewProgram	INST.DONE	10	BOOL		
6	NewPLC	NewProgram	INST.PID_STAT	HEX	WORD		
7	NewPLC	NewProgram	_00_CH0_DATA	±10	INT	%UW0.0.2	Analog Input Module: CH0 Output
8	NewPLC	NewProgram	_01_CH0_DATA	±10	INT	%UW0.1.3	Analog Output Module: CH0 Input
9	NewPLC	NewProgram	_01_CH0_OUTEN	10	BOOL	%UX0.1.32	Analog Output Module: CH0 Output Status Setting
10							

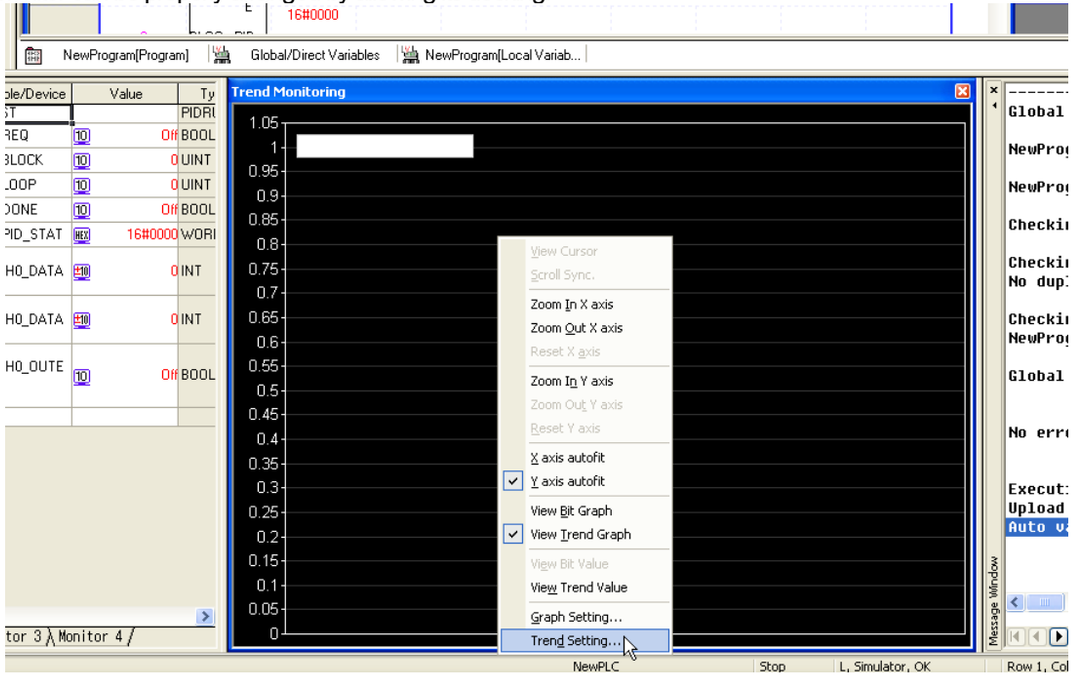
The setting contents are SV, K_p, MV_max 3 types. The actually measured value of 8250 was set for SV and 5 was randomly selected for Kp. MV_max, an item to limit the maximum value of MV, was set to 10000 according to the analog module.

(4) Observation of Control States Using the Trend Monitor

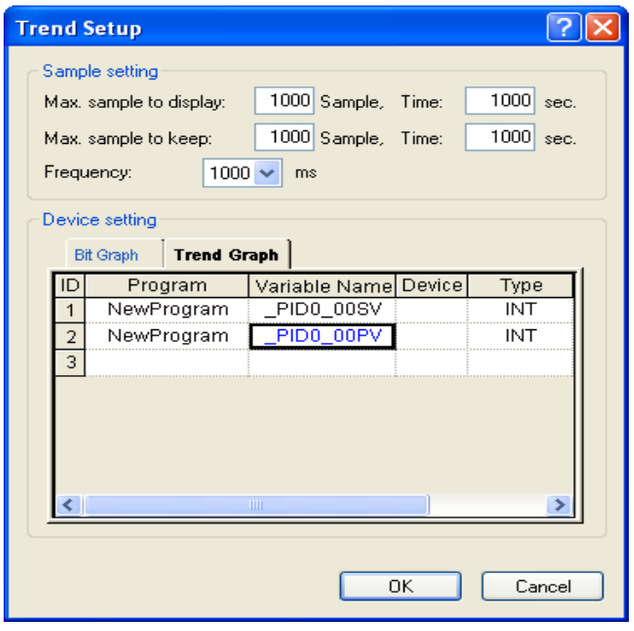
Enable the trend monitor, one of the monitor functions of XG5000.



The trend monitor can be properly arranged by allowing its docking.



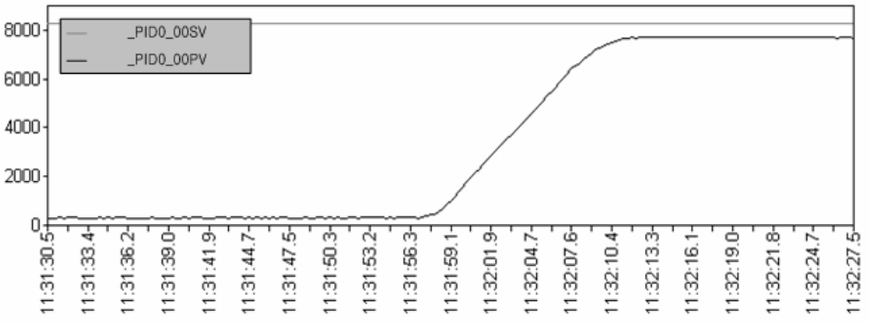
Data to be observed are registered through the trend setting.



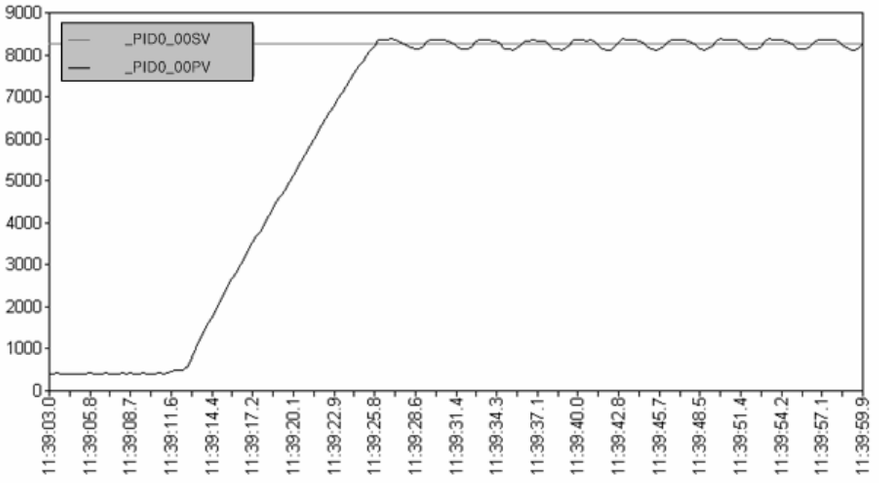
Set the monitoring period to 200ms and select the trend graph tab at the bottom to register the variables you want to monitor such as SV and PV of block 0 and loop 0.

(5) Program Execution (Here an example is given to show how to find a parameter manually. For auto tuning, refer to 14.7.6)

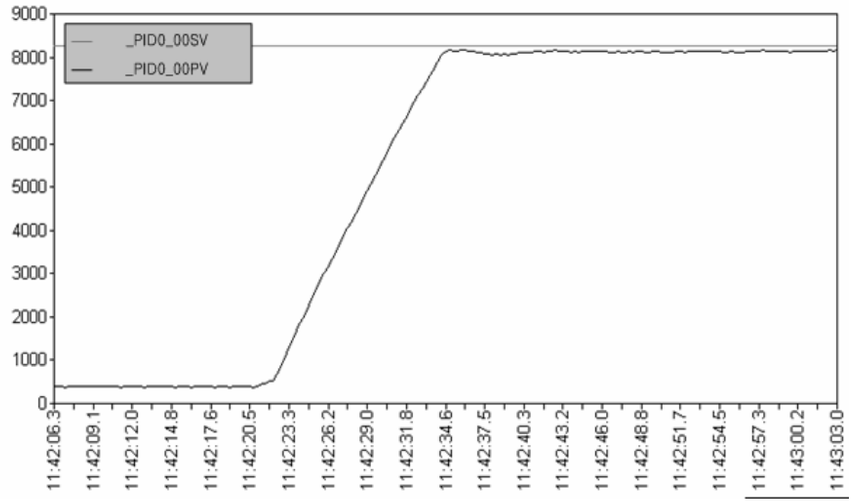
When the contact (% MX0) is turned On, the system starts up.



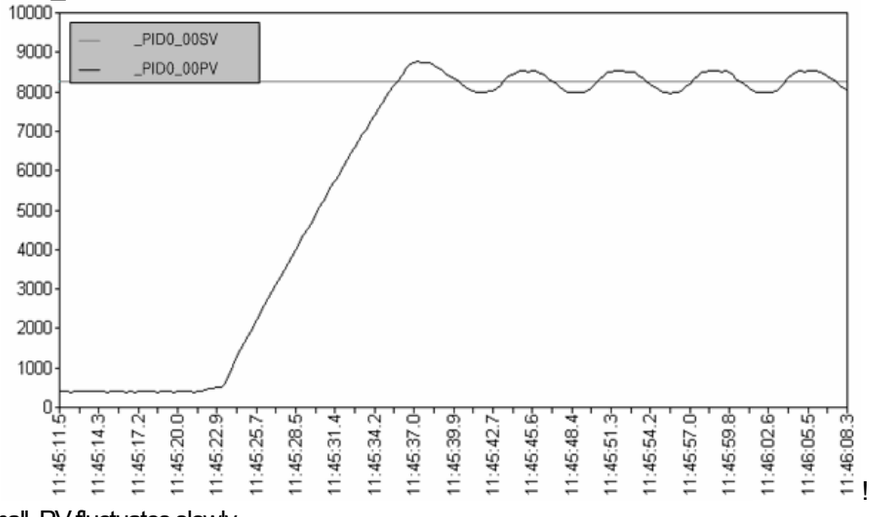
After increasing K_p to 100, the system is started again. Because K_p is set too large, the system vibrates in a permanent regularly.



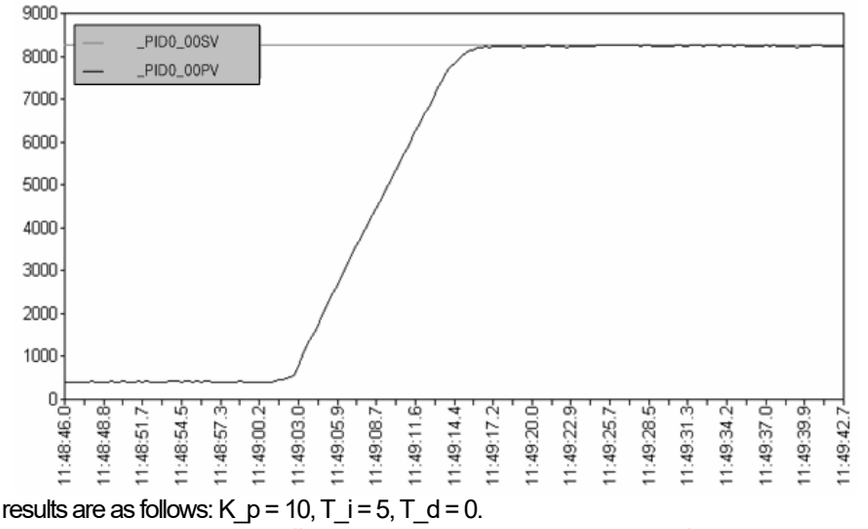
Set as follows: K_p = 20, T_i = 100



Because the T_i value is too large, the steady state offset lasts long and there occurs a slight overshoot.
Set as follows: K_p = 10, T_i = 1.



Because T_i is too small, PV fluctuates slowly.
Set as follows: K_p = 10, T_i = 5 This is a satisfactory result.



Therefore, the tuning results are as follows: K_p = 10, T_i = 5, T_d = 0.
The current system is a slow system that allows sufficient control even with PI, so it only performs PI control.
For PID control (additional D control), refer to Appendix 14.8.

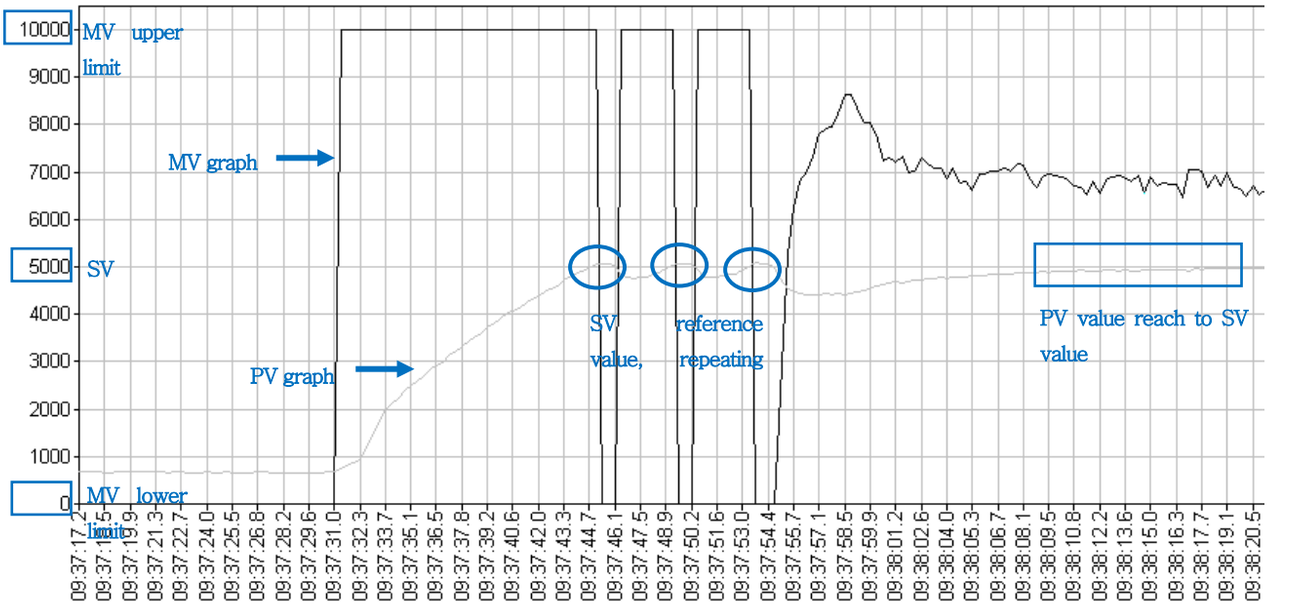
14.7.6 How to use Auto-tuning

Basically, it operates normally when the PV of the system before auto-tuning is smaller than the AT_SV value in reverse control. In the case of Forward control, on the contrary, it operates normally when the PV value of the system before auto-tuning is greater than the AT_SV value.. Total step consists of 7 steps (AT step is 0 in PIDSTOP status) The current step of the loop can be known by looking at _PID[B]_[L]AT_step.. In other words, in the PIDSTOP state, AT starts at 0 in the AT step, and increases in sequence (automatically) from 1, and AT is terminated in step 7. Therefore, malfunction may occur if the user operates the step arbitrarily.

In order to avoid overlapping content, proceed with the contents of 14.7.5 (5) above and then proceed with the following. Set AT_SV. In general case, set AT_SV same as SV. However, during auto tuning, the system vibrates so that the PV exceeds the AT_SV value, so if this process is not suitable for the system, set the appropriate AT_SV value.

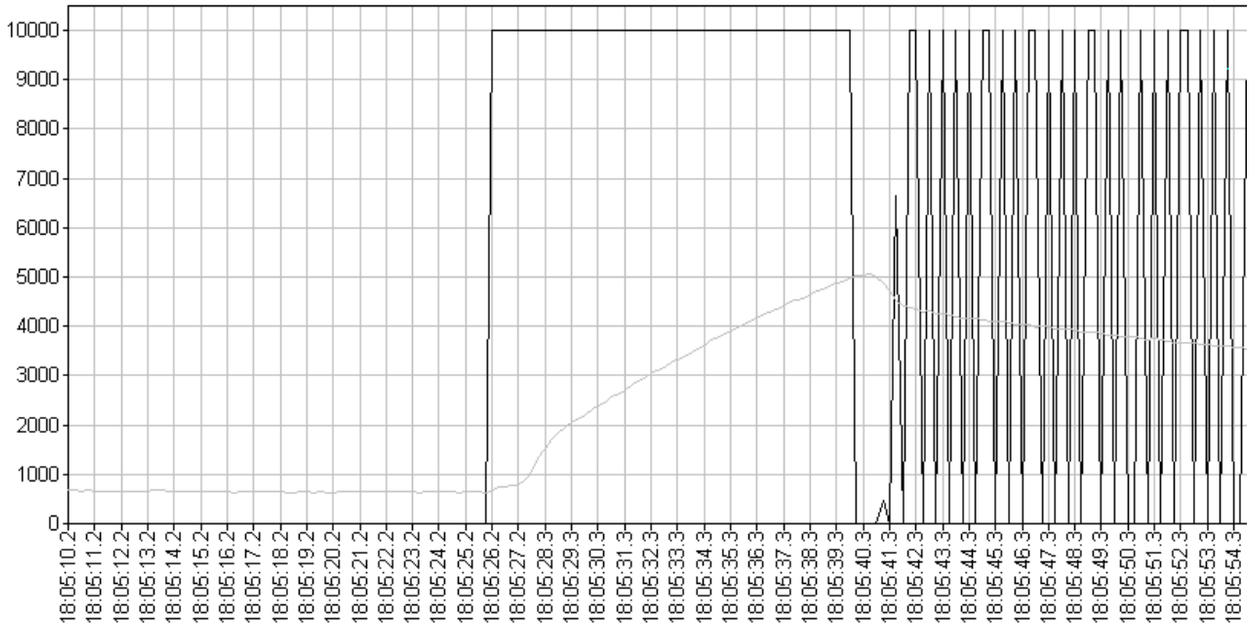
Next, set _PID[B]_[L]MV_min and _PID[B]_[L]MV_max. Each value is considered the minimum/maximum output of the system. During auto tuning, these two values are output alternately in 3 cycles. For example, if _PID[B]_[L]MV_min = 0, _PID[B]_[L]MV_max = 10000, the MV value delivered to the motor or heater repeats 0 →10000 → 0 output 3 times. If there is a risk that such a sudden change puts a burden on the system, set _PID[B]_[L]dMV.

Now set the _PID[B]_[L]HYS_val value. This value is used only during auto tuning. It is a dead band that occurs when PV reaches a value near SV, and occurs above the reference when rising and below the reference when falling. In other words, if SV is 5000 and _PID[B]_[L]HYS_val is 100, increase PV by maintaining MV as _PID[B]_[L]MV_max up to 5100 (SV + _PID[B]_[L]HYS_val), after that, the MV is kept at _PID[B]_[L]MV_min up to 4900 (SV-_PID[B]_[L]HYS_val) and tuning is performed while decreasing PV.



- MV graph : For auto-tuning, the MV upper limit and MV lower limit are output three times.
- PV graph: Repeats the ascending and descending operation 3 times based on the SV value by the change of the MV value.

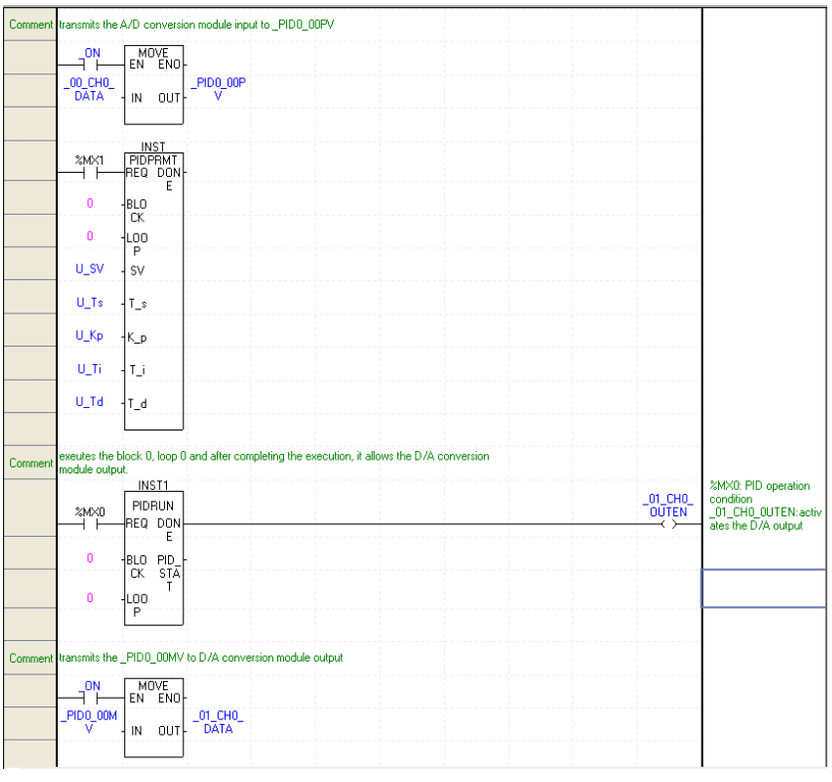
The above graph is the water level waveform obtained by setting the appropriate _PID[B]_[L]HYS_val setting value (50 in the figure), and the square waveform should appear 3 times in MV as above.



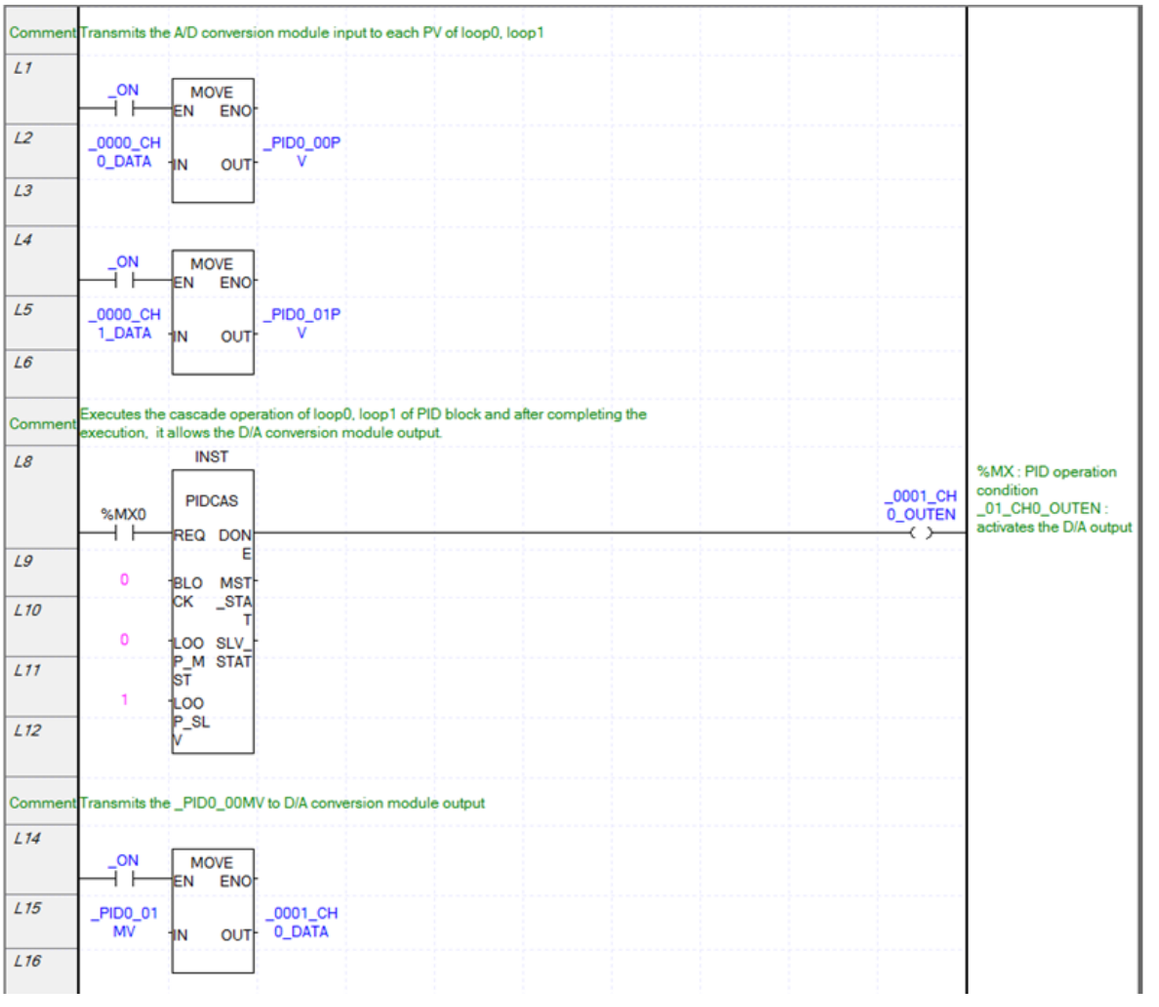
The above graph is the water level waveform obtained because the _PID[B]_[L]HYS_val setting is too small (10 in the figure). If the 3 square wave does not appear clearly on the MV as above, correct AT operation cannot be guaranteed. In addition, if an excessively large _PID[B]_[L]HYS_val value is added, the side effect of slowing down the system may occur.

14.7.7 Program Example 2

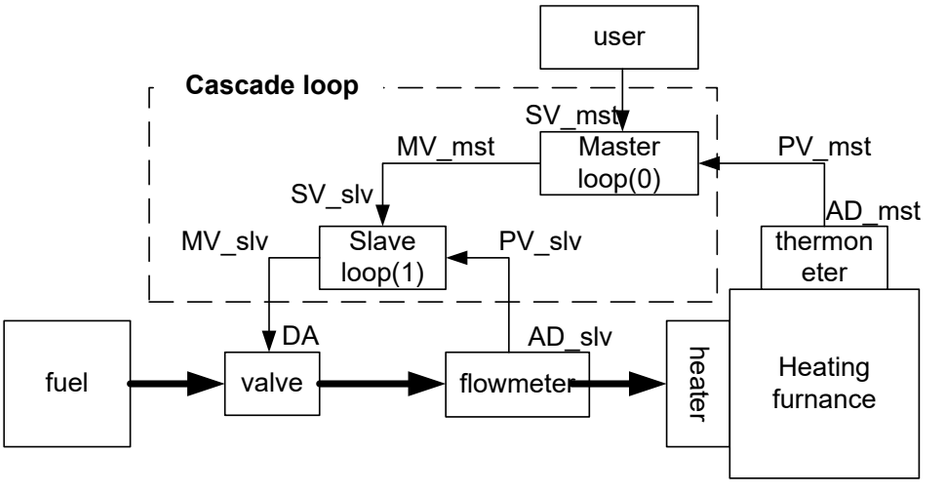
The following figure is a program when changing main PID constant value and SV value setting part in the program.
When PIDPRMT contact (%MX01) is turned on, user-specified U_SV, U_Ts, U_Kp, U_Ti, U_Td values are entered as PID parameters, and you can use the monitor window as described in 14.7.3 above.



14.7.8 Cascade operation



The ladder program above is a program that performs cascade operation based on the block diagram below.



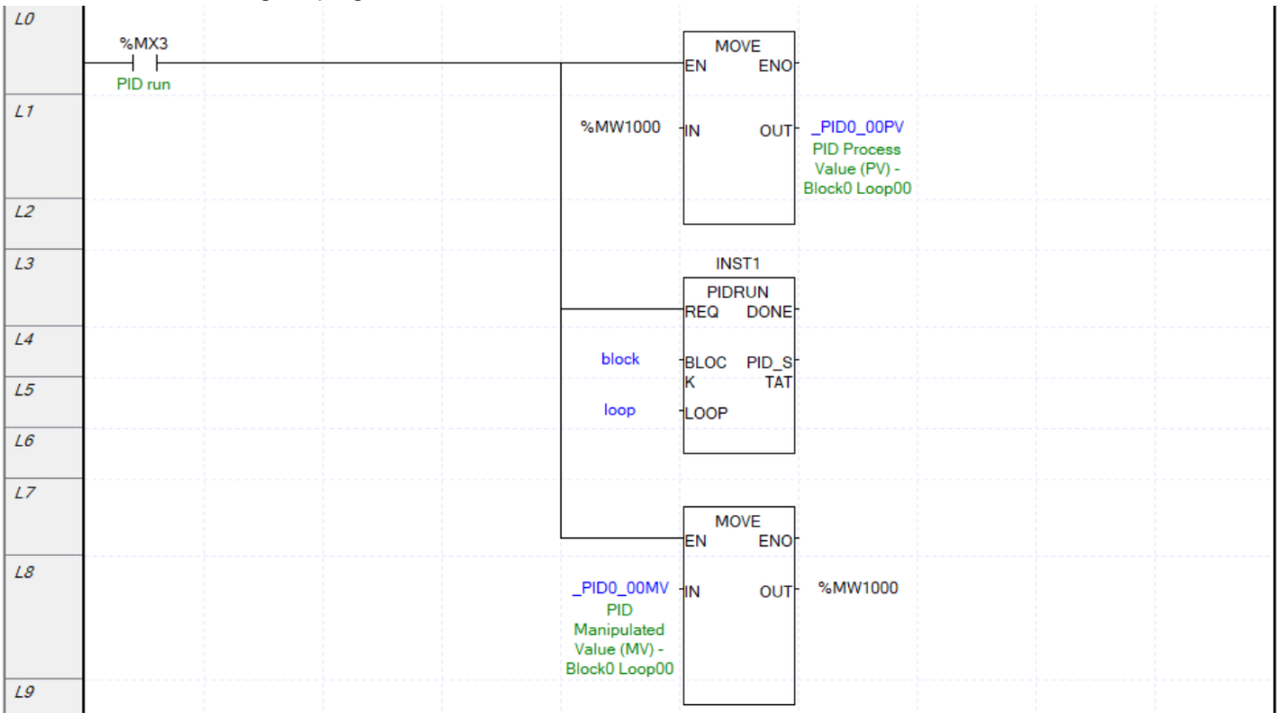
The block diagram above is a heating system that measures the temperature of the furnace and maintains the desired temperature by properly supplying fuel to the heater when viewed only by considering the master loop. Here, in order to control the signal going to the fuel valve, a flow meter is installed to form a slave loop, when the master loop gives a fuel command with an arbitrary value, a constant flow of fuel is supplied by the operation of the slave loop.

14.8 Appendix

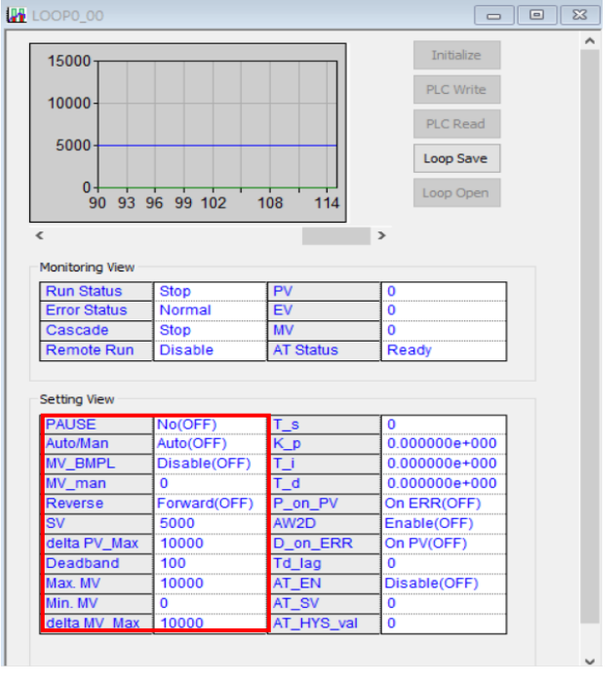
In order to check the function of PID, the system must be configured. However, by using the simulator function of XG5000, you can check the functions of various PID parameters without configuring the system. You can improve your understanding of PID control. (However, in the program below, PV and MV are output with the same value.)

14.8.1 PID control program example (simulation)

Start the simulator after writing the program as shown below.

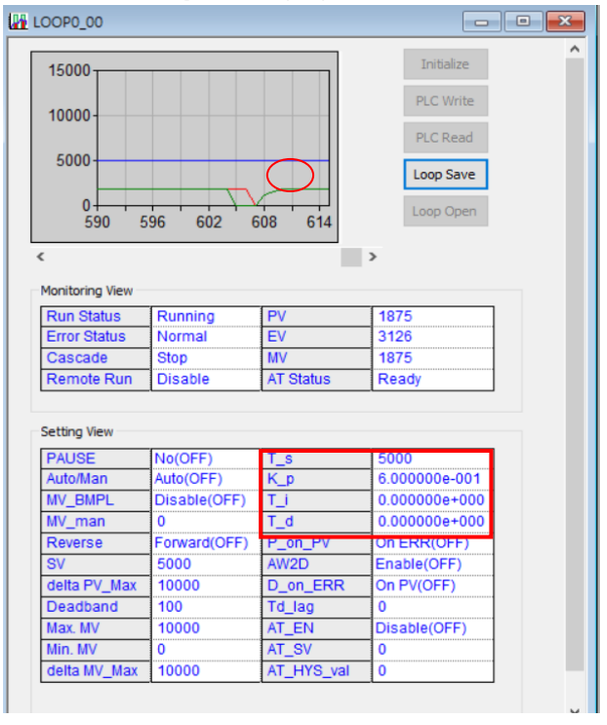


Open the PID monitor window, set the basic setting parameters as follows, and then write to PLC.

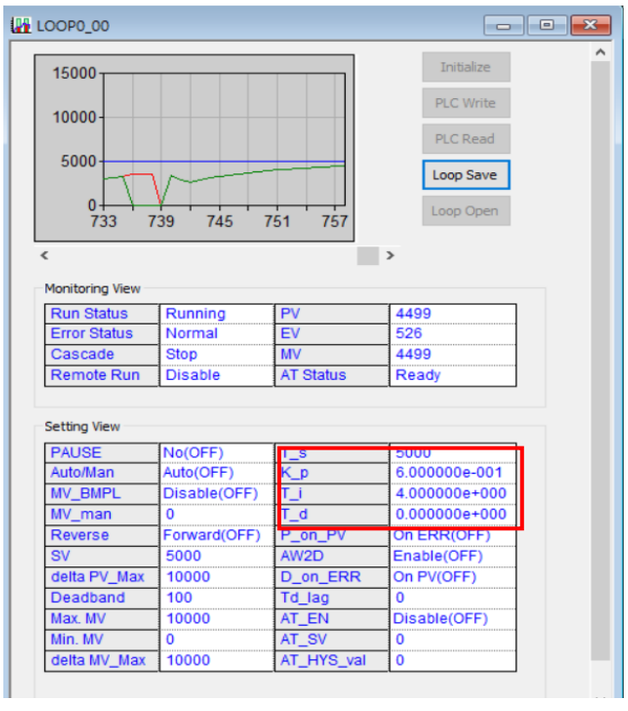


Set the control period to 500ms (5000). Next, set the Kp (proportional coefficient) value to 0.6 and then operate PIDRUN.

You can see that the system (PV) did not reach the target value (SV) and a certain residual deviation occurred.

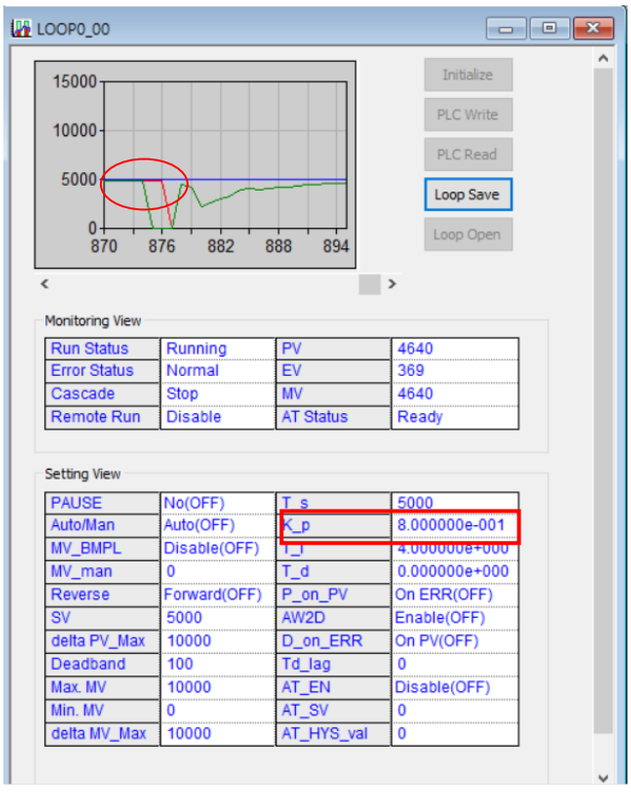


Set the Ti (Integral Coefficient) value to 4 to remove residual deviation. See that the system is getting closer to the target value.



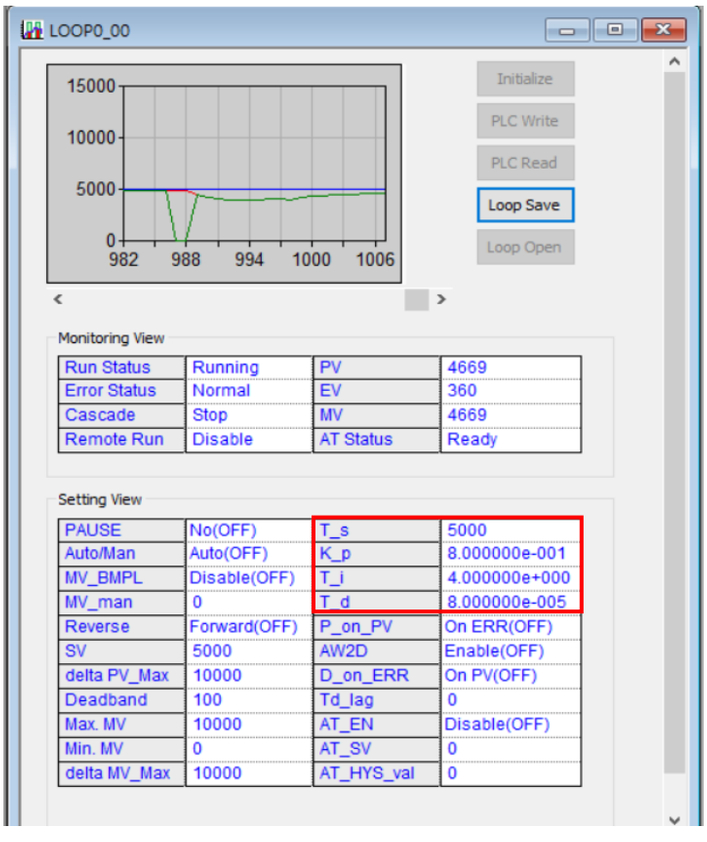
This time, let's change the Kp value to 0.6 → 0.8 so the system can reach the target value more quickly.

Although the arrival time was faster than before, the system was initially unstable



In order to stabilize the initial unstable system, the Td (differential coefficient) value was set to 0.00008.

As a result, the initial system stabilized.



Appendix 1 Flag List

Appendix 1.1 Flag List

1) Mode and state

Flag Name	TYPE	Memory	Content	Description
_SYS_STATE	DWORD	%FD0	PLC mode and states	Displays the operation mode and operation status of the system.
_RUN	BOOL	%FX0	RUN	Indicates operation state of PLC module.
_STOP	BOOL	%FX1	STOP	
_ERROR	BOOL	%FX2	ERROR	
_DEBUG	BOOL	%FX3	DEBUG	
_LOCAL_CON	BOOL	%FX4	Local control	It displays the status that can change the operation mode only by mode key or GMWIN.
_BASE_EMASK_INFO	DWORD	%FD477	Base fault mask information	Displays base fault mask information.
_REMOTE_CON	BOOL	%FX6	Remote mode on	Remote control mode.
_RUN_EDIT_ST	BOOL	%FX8	Edit during running	Downloading the program during edit during running.
_RUN_EDIT_CHK	BOOL	%FX9		Internal processing during edit during running..
_RUN_EDIT_DONE	BOOL	%FX10		Edit during running completed.
_RUN_EDIT_NG	BOOL	%FX11		Abnormal completion during edit during running.
_CMOD_KEY	BOOL	%FX12	Operation mode change	Operation mode change by key
_CMOD_LPADT	BOOL	%FX13		Operation mode change by local PADT
_CMOD_RPADT	BOOL	%FX14		Operation mode change by remote PADT
_CMOD_RLINK	BOOL	%FX15		Operation mode change by remote communication module
_FORCE_IN	BOOL	%FX16	Forced input	Indicates that forced On/Off for input contact is in progress.
_FORCE_OUT	BOOL	%FX17	Forced output	Indicates that forced On/Off for output contact is in progress.
_SKIP_ON	BOOL	%FX18	I/O SKIP	Executing I / O SKIP
_EMASK_ON	BOOL	%FX19	Error mask	Executing Error mask
_MON_ON	BOOL	%FX20	Executing monitor	Executing monitor
_USTOP_ON	BOOL	%FX21	Stopped by STOP function.	Stop after scan completion by STOP function during RUN mode.
_ESTOP_ON	BOOL	%FX22	Stopped by ESTOP function.	Immediate stop by ESTOP function during RUN mode operation
_INIT_RUN	BOOL	%FX24	Performing initialization task.	Indicates during executing initial program which is programmed by user.
_PB1	BOOL	%FX28	Program code 1	Program code 1 is selected.
_PB2	BOOL	%FX29	Program code 2	Program code 2 is selected.
_BASE_INFO	ARRAY	%FW150	Base information	Display the base information.
_RTC_WR	BOOL	%FX16384	Data write and read in RTC.	Data write and read in RTC.
_SCAN_WR	BOOL	%FX16385	Initializing the value of scan.	Initializing the value of scan.

Flag Name	TYPE	Memory	Content	Description
_CHK_ANC_ERR	BOOL	%FX16386	External critical error request	Request of fatal error detection from external device
_CHK_ANC_WAR	BOOL	%FX16387	External light error request	Request of minor error detection from external device
_BASE_SKIP_INFO	DWORD	%FD478	Base Skip information	Display the base skip information.
_INIT_DONE	BOOL	%FX16400	Initialization task completion.	If this flag is set by user's initial program, it is started to execution of scan program after initial program completion.
_KEY	DWORD	%FD43	Current key	Indicates the current state of the local key.
_FUSE_ER_PMT	BOOL	%FX15232	Setting continue running when a fuse error occurs.	Setting continue running when a fuse error occurs.
_CP_ER_PMT	BOOL	%FX15235	Setting continue running when communication module error occurs.	Setting continue running when communication module error occurs.
_IO_ER_PMT	BOOL	%FX15233	Setting continue running when IO module error occurs.	Setting continue running when IO module error occurs.
_SP_ER_PMT	BOOL	%FX15234	Setting continue running when special module error occurs.	Display setting continue running when special module error occurs.
_INIT_RUN	BOOL	%FX24	Executing the initial task	Display executing the initial task.

2) System error

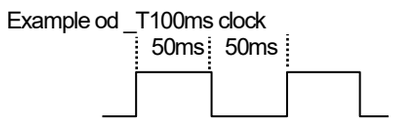
Flag Name	TYPE	Memory	Content	Description
_CNF_ER	DWORD	%FD1	System errors(critical error)	Handles error flags about non-operation fault error as below.
_IO_TYER	BOOL	%FX33	Module type mismatch error	Representative flag displayed when I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location. (Refer to _IO_TYER_N, _IO_TYER[n])
_IO_DEER	BOOL	%FX34	Module detachment error	Representative flag displayed when the module configuration for each slot is changed while running.(Refer to _IO_DEER_N, _IO_DEER[n])
_FUSE_ER	BOOL	%FX35	Fuse cutoff error	Representative flag displayed when the fuse of module is cut off.(Refer to _FUSE_ER_N, _FUSE_ER[n])
_IO_TYER_N	WORD	%FW90	Slot number of mismatched module type	When I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong position, displayed as the lowest slot number after detecting these mismatch error in slot locations.
_IO_DEER_N	WORD	%FW91	Module detached slot no.	When slot module configuration is changed while PLC running, displayed as the lowest slot number after detecting these detachment error in slot locations.
_FUSE_ER_N	WORD	%FW92	Slot number of fuse cut off	When a fuse equipped module is cut off, displayed as the lowest slot number after detecting this error in slot locations.
_ANNUM_ER	BOOL	%FX38	Critical fault detection error in external device	Representative flag displayed when critical fault error detected by user program is recorded in _ANC_ERR[n].
_BPRM_ER	BOOL	%FX40	Basic Parameter	It is abnormal to the basic parameter.
_IOPRM_ER	BOOL	%FX41	IO parameter	It is abnormal to the IO configuration parameter.
_SPPRM_ER	BOOL	%FX42	Special module parameter error	It is abnormal to the special module parameter.
_CPPRM_ER	BOOL	%FX43	Communication module parameter error	It is abnormal to the communication module parameter.
_PGM_ER	BOOL	%FX44	Program error	Indicates that there is problem with user-made program checksum.

Flag Name	TYPE	Memory	Content	Description
_FUSE_ERR	WORD	%FW112	Fuse cutoff error	Display fuse cutoff error.
_CODE_ER	BOOL	FX45	Program Code error	Indicates that while user program is running, the program code can't be interpreted.
_SWDT_ER	BOOL	%FX46	CPU abnormal ends.	Displayed when the saved program gets damages by an abnormal end of CPU or program cannot work.
_BASE_POWER_ER	BOOL	%FX47	Power error	The base power supply is abnormal.
_WDT_ER	BOOL	%FX48	Scan watchdog error	Indicates that the program scan time exceeds the scan watchdog time specified by a parameter.
_IO_DEERR	WORD	FW104	Module detachment error	Display module detachment error.
_IO_TYERR	WORD	%FW96	Module type mismatch error	Display module type mismatch error.

3) System Warning

Flag Name	TYPE	Memory	Content	Description
_CNF_WAR	DWORD	%FD2	System warning	Representative flag displayed the system warning state.
_RTC_ER	BOOL	%FX64	RTC error	Indicates that RTC data is abnormal
_P2P_WAR	BOOL	%FX84	P2P parameter error - representative flag	Display P2P parameter error - representative flag
_EIP_TAG_WAR	BOOL	%FX95	EtherNet/IP TAG information error	Display EtherNet/IP TAG information error.
_HS_WAR	BOOL	%FX72	High-speed Link parameter error - representative flag	Display High-speed Link parameter error - representative flag
_HS_WAR_W	WORD	%FW58	High-speed Link parameter error - whole information	Display High-speed Link parameter error - whole information
_AB_SD_ER	BOOL	%FX67	Abnormal operation stop	Stop by abnormal operation.
_TASK_ER	BOOL	%FX68	Task collision	It is collided to the task.
_BAT_ER	BOOL	%FX69	Battery error	Battery condition is abnormal.
_ANNUM_WAR	BOOL	%FX70	External device fault	Indicates that the minor fault in the external device is detected.
_P2P_WAR_W	WORD	%FW59	P2P parameter error - whole information	Display P2P parameter error - whole information
_BASE_INFO_ER	BOOL	%FX49	Base information error	It is occurred to abnormality in the main base information.
_HS_WARn	BOOL	%FX928	High speed link-- Parameter	It is abnormal to the high speed link parameter n.(n: 1~12)
_P2P_WARn	BOOL	%FX944	P2P - parameter	It is abnormal to the P2P parameter n. (n: 1~8)
_CONSTANT_ER	BOOL	%FX92	Fixed period error	Fixed period error
_ANC_ERR	WORD	%FW1026	Critical fault information of external device	Critical fault of external device is detected by user program, and that error is saved at this zone as numbers which can identify 16 error types.
_ANC_WAR	WORD	%FW1027	Minor error information in external device	Minor fault in external device is detected by user program, and the bit position of the occurred error is displayed as an integer in occurrence order.
_SLOT_EMASK_INFO	WORD	%FW958	Slot Fault Mask information	Display slot fault mask information.
_SLOT_SKIP_INFO	WORD	%FW966	Slot Skip information	Display slot Skip information.

4) User flag

Flag Name	TYPE	Memory	Content	Description
_T20MS	BOOL	%FX144	20ms cycle clock	Clock signal used in user program reverses On/Off per a half cycle Reversal of signal is processed after the scan is completed, so the clock signal may be delayed or distorted according to the program execution time. Please use more enough long clock signal than PLC scan time. The clock signal begins from the Off state at the beginning of the initialization program and scan program. 
_T100MS	BOOL	%FX145	100ms cycle clock	
_T200MS	BOOL	%FX146	200ms cycle clock	
_T1S	BOOL	%FX147	1s cycle clock	
_T2S	BOOL	%FX148	2s cycle clock	
_T10S	BOOL	%FX149	10s cycle clock	
_T20S	BOOL	%FX150	20s cycle clock	
_T60S	BOOL	%FX151	60s cycle clock	
_ON	BOOL	%FX153	Ordinary time On	Always On state flag, used when writing user program.
_OFF	BOOL	%FX154	Ordinary time Off	Always Off state flag, used when writing user program.
_1ON	BOOL	%FX155	1'st scan On	Only 1'st scan On after operation start
_1OFF	BOOL	%FX156	1'st scan Off	Only 1'st scan Off after operation start
_STOG	BOOL	%FX157	Scan toggle	On/Off toggle flag per every scan when user program is working. (On state for first scan)

5) Operation result flag

Flag Name	TYPE	Memory	Content	Description
_ERR	BOOL	%FX176	Operation error flag	Operation error flag on the basis of operation function (FN) or function block (FB), is renewed every time operation works.
_LER	BOOL	%FX181	Operation error latch flag	Operation error latch flag on the basis of program block (PB), the error indication which occurs while program block running keeps until the program ends. It is available to delete by a program.
_ARY_IDX_ERR	BOOL	%FX28864	Error flag of array index range over	Error flag displayed when exceeding the setting array numbers.
_ARY_IDX_LER	BOOL	%FX28896	Latch error flag of array index range over	Latch error flag displayed when exceeding the setting array numbers.
_ALL_OFF	BOOL	%FX179	All output Off	On when all outputs are Off

6) System operation status information

Flag Name	TYPE	Memory	Content	Description
_CPU_TYPE	WORD	%FW44	Indicates CPU Type Information.	Displays the operation mode and operation status information
_CPU_VER	WORD	%FW45	CPU version.	Display CPU version number.
_OS_VER	DWORD	%FD23	OS version.	Display System OS version number.
_OS_VER_PATCH	DWORD	%FD89	OS patch version	Displays OS version to two decimal places.
_OS_DATE	DWORD	%FD24	OS date	Display OS date.
_SCAN_MAX	WORD	%FW50	Maximum scan time	Indicates max. scan time during operation. Unit:0.1ms
_SCAN_MIN	WORD	%FW51	Minimum scan time	Indicates min. scan time during operation. Unit:0.1ms
_SCAN_CUR	WORD	%FW52	Current scan time	Indicates current scan time during operation. Unit:0.1ms
_RTC_TIME[0]	BYTE	%FB106	RTC TIME[Year]	Indicates PLC Clock data(Year).
_RTC_TIME[1]	BYTE	%FB107	RTC TIME[Month]	Indicates PLC Clock data(Month).
_RTC_TIME[2]	BYTE	%FB108	RTC TIME[Date]	Indicates PLC Clock data(Date).
_RTC_TIME[3]	BYTE	%FB109	RTC TIME[Time]	Indicates PLC Clock data(Hour).
_RTC_TIME[4]	BYTE	%FB110	RTC TIME[Minute]	Indicates PLC Clock data(Minute).
_RTC_TIME[5]	BYTE	%FB111	RTC TIME[Second]	Indicates PLC Clock data(Second).
_RTC_TIME[6]	BYTE	%FB112	RTC TIME[Day]	Indicates PLC Clock data(Day).
_RTC_TIME[7]	BYTE	%FB113	RTC TIME[Hundred year]	Indicates PLC Clock data(Hundred year).
_RTC_DATE	WORD	%FW136	Current date of RTC	Indicated on the basis of 1.Jan.1984.
_RTC_WEEK	WORD	%FW137	Current a day of the week of RTC	Indicates a day of the week.(0:Mon, 1:Tue, 2:Wed, 3:Thu, 4:Fri, 5:Sat, 6:Sun)
_RTC_TOD	DWORD	%FD69	Current time in RTC (ms unit)	Indicates a data for the time of the day on the basis of 00:00:00 (unit : ms).
_RBANK_NUM	WORD	%FW158	Block number which is currently being used	Display block number which is currently being used
_AC_F_CNT	UINT	%FW13	Calculation of momently shut-down count	Report of momently shut-down count during RUN mode operation.
_FALS_NUM	WORD	%FW14	FALS number	Displays the number of FALS.
_SOE_LOG_CNT	WORD	%FW1786	SOE event occurrence count	Increase SOE event count.
_SOE_LOG_ROTATE	WORD	%FW1787	SOE event rotate information	Increases when 3000 events are exceeded
_SOE_READ_LOG_CNT	WORD	%FW1784	SOE events count read by the user	Increase SOE event count read by using SOE_RD function block.
_SOE_READ_LOG_ROTATE	WORD	FW1785	SOE event rotate information read by the user	Increase when SOE event count read by using SOE_RD function block reaches 3000.
_HS_ENABLE_STATE	ARRAY	%FX15840	HS enable/disable current status	Display HS enable/disable current status.
_HS_REQ	ARRAY	%FX16480	HS enable/disable request	Changes the state of high speed link enable/disable.
_HS_REQ_NUM	ARRAY	%FX16496	Setting enable/disable for high speed link	Display setting enable/disable for high speed link
_P2P_ENABLE_STATE	ARRAY	%FX15872	P2P enable/disable current status	Display P2P enable/disable current status.
_P2P_REQ	ARRAY	%FX16512	P2P enable/disable request	Changes the state of P2P enable/disable.

Flag Name	TYPE	Memory	Content	Description
_P2P_REQ_NUM	ARRAY	%FX16528	Setting P2P enable/disable	Display setting P2P enable/disable.
_CYCLE_TASK_SCAN_TIME	ARRAY	%FW190	Scan time of fixed cycle task	Indicates max, min and current scan time of fixed cycle task.
_CYCLE_TASK_SCAN_WR	BOOL	%FX16392	Initialize scan value of fixed cycle task	Initialize scan value of fixed cycle task.
_SOCKET_CLOSE_COUNTER	ARRAY	%FW996	CLOSE count of each sockets	Disconnection count with client per socket.
_RTC_TIME_USER[0]	BYTE	%FB2068	Time to set (year)	Change RTC information data(Year).
_RTC_TIME_USER[1]	BYTE	%FB2069	Time to set (month)	Change RTC information data(Month).
_RTC_TIME_USER[2]	BYTE	%FB2070	Time to set (Date)	Change RTC information data(Date).
_RTC_TIME_USER[3]	BYTE	%FB2071	Time to set (hour)	Change RTC information data(Hour).
_RTC_TIME_USER[4]	BYTE	%FB2072	Time to set (minute)	Change RTC information data(minute).
_RTC_TIME_USER[5]	BYTE	%FB2073	Time to set (second)	Change RTC information data(second).
_RTC_TIME_USER[6]	BYTE	%FB2074	Time to set(day)	Change RTC information data(day).
_RTC_TIME_USER[7]	BYTE	%FB2075	Time to set (age)	Change RTC information data(Year).
_PLC_OPERATING_TIME	DWORD	%FD498	PLC Operation Time	PLC Operation Time(Sec) / Normal Type CPU
_PLC_OPERATING_TIME	DWORD	%FD501	PLC Operation Time	PLC Operation Time(Sec) / N Type CPU
_SOCKET1_ERR_CNT	DWORD	%FD504	Error frame counter 1	Local Ethernet Socket 1 error counter
_SOCKET2_ERR_CNT	DWORD	%FD505	Error frame counter 2	Local Ethernet Socket 2 error counter
_SOCKET3_ERR_CNT	DWORD	%FD506	Error frame counter 3	Local Ethernet Socket 3 error counter
_SOCKET4_ERR_CNT	DWORD	%FD507	Error frame counter 4	Local Ethernet Socket 4 error counter

Appendix 1.2 Link Flag (L) List

The data link flag (L) is described below.

[Table 1] link Flag List according to High speed link no. (High speed link no. 1 ~ 12)

Flag Name	Type	Memory	Content	Description
_HSn_RLINK	Bit	Refer to XG5000 global/direct Variables High speed link	All stations of high speed link parameter No. n operate normally.	Indicates that all stations operate normally as the parameter set from the high speed link. It becomes On in the following conditions. 1. When all stations set in parameter are in RUN mode and there is no error. 2. When all data blocks set in parameter communicate normally. 3. When the parameter set for each station setting in parameter communicates normally When Run_link becomes On, it will be maintained until it is stopped using link disable.
_HSn_LTRBL	Bit		Indicates abnormal state after _HS1RLINK ON	This flag becomes On when the communication status between the station set for the parameter and the data block is as follows while _HSmRLINK flag is On. 1. When the station set in the parameter is not in RUN mode. 2. When stations set in parameter is error. 3. If the communication status of the data block set in the parameter is not good. Link trouble becomes On when the condition of 1, 2 and 3 occur, and it becomes Off when the condition returns to normal.
_HSn_STATEk (k=000~127)	Bit Array		Indicates the overall status of No. k block in high speed link parameter	Indicates the overall status of communication information for each data block of the set parameter. HS1STATEk=HS1MODk&_HS1TRXk&(~_HSnERRk)
_HSn_MODk (k=000~127)	Bit array		Operation mode of No. K block station in high speed parameter No. n	Indicates the operation mode of the station set for k data block of the parameter.
_HSn_TRXk (k=000~127)	Bit array		Display of normal communication with No. k block station in high speed link parameter no. n.	Indicates whether the communication status of k data block in the parameter is carried out smoothly, as it is set, or not.
_HSn_ERRk (k=000~127)	Bit array		Operation mode of No. K block station in high speed parameter No. n	Indicates whether an error occurred in the communication status of k data block in the parameter or not.
_HSn_SETBLOCKk	Bit array		Indicates the overall status of No. k block in high speed link parameter No. n.	Indicates the k data block setting status in the parameter.

Notes

High speed link number	Address in L area	Note
1	L000000~L00049F	Comparing with High speed link 1 from [Table 1], the flag address of different high speed link station no. is as follows by a simple calculation formula. ∗Calculation formula: Address in L area = L000000 + 500 x (high speed link number– 1) f you want to use HS link flag for program and monitoring, you can use the flag map registered in XG5000.
2	L000500~L00099F	
3	L001000~L00149F	
4	L001500~L00199F	
5	L002000~L00249F	
6	L002500~L00299F	
7	L003000~L00349F	
8	L003500~L00399F	
9	L004000~L00449F	
10	L004500~L00499F	
11	L005000~L00549F	

k is the block number and the information of 128 blocks from 000 to 127 is shown as a total of 8 words, including 1 word for every 16 blocks.
For example, in case of mode information (_HS1MOD), the information of block 0 to block 15 is shown in L00010, and the block information of 16~31, 32~47, 48~63, 64~79, 80~95, 96~111 and 112~127 is shown ,the mode information of L00011, L00012, L00013, L00014, L00015, L00016 and L00017 is shown respectively. Therefore, the mode information of block number 55 is shown in L000137.

[Table 2] Link Flag List according to P2P Service setting P2P parameter (n): 1 ~ 8 , P2P block (xx): 0 ~63

Flag Name	Type	Memory	Content	Description
_P2Pn_NDRxx	Bit	Refer to XG5000 global/direct variables P2P link	P2P parameter n, xx Block service normal end	P2P parameter n, xx Block service normal end
_P2Pn_ERRxx	Bit		P2P parameter n, xx Block service abnormal end	P2P parameter n, xx Block service abnormal end
_P2Pn_STATUSxx	WORD		Error code when P2P parameter n, xx Block service abnormal end.	Display error code when P2P parameter n, xx Block service abnormal end.
_P2Pn_SVCCNTxx	Double word		P2P parameter n, xx Block service normal execution count	Display P2P parameter n, xx Block service normal execution count.
_P2Pn_ERRCNTxx	Double word		P2P parameter n, xx Block service abnormal execution count	Display P2P parameter n, xx Block service abnormal execution count.

Appendix 1.3 Communication Flag (P2P) List

Communication register list according to P2P No. P2P parameter (n): 1 ~ 8 , P2P block (xx): 0 ~63

Memory	Flag	Type	Content	Description
N00000	_PnBxxSN	WORD	P2P parameter n,xx Block destination station number	Save P2P parameter n,xx Block destination station number. If the destination station number is used on XG-PD, it can be modified during Run using P2PSN command.
N00001 ~ N00004	_PnBxxRD1	Device structure	P2P parameter n,xx Block read area device 1	Saves P2P parameter n,xx Block read area device 1.
N00005	_PnBxxRS1	WORD	P2P parameter n,xx Block read area size 1	Saves P2P parameter n,xx Block read area size 1.
N00006 ~ N00009	_PnBxxRD2	Device structure	P2P parameter n,xx Block read area device 2	Save P2P parameter n,xx Block read area device 2.
N00010	_PnBxxRS2	WORD	P2P parameter n,xx Block read area size 2	Save P2P parameter n,xx Block read area size 2.
N00011 ~ N00014	_PnBxxRD3	Device structure	P2P parameter n,xx Block read area device 3	Saves P2P parameter n,xx Block read area device 3.
N00015	_PnBxxRS3	WORD	P2P parameter n,xx Block read area size 3	Saves P2P parameter n,xx Block read area size 3.
N00016 ~ N00019	_PnBxxRD4	Device structure	P2P parameter n,xx Block read area device 4	Save P2P parameter n,xx Block read area device 4.
N00020	_PnBxxRS4	WORD	P2P parameter n,xx Block read area size 4	Save P2P parameter n,xx Block read area size 4.
N00021 ~ N00024	_PnBxxWD1	Device structure	P2P parameter n,xx Block save area device 1	Save P2P parameter n,xx Block save area device 1
N00025	_PnBxxWS1	WORD	P2P parameter n,xx Block save area Size 1	Save P2P parameter n,xx Block save area Size 1.
N00026 ~ N00029	_PnBxxWD2	Device structure	P2P parameter n,xx Block save area device 2	Save P2P parameter n,xx Block save area device 2.
N00030	_PnBxxWS2	WORD	P2P parameter n,xx Block save area size 2	Save P2P parameter n,xx Block save area size 2.
N00031 ~ N00034	_PnBxxWD3	Device structure	P2P parameter n,xx Block save area device 3	Save P2P parameter n,xx Block save area device 3
N00035	_PnBxxWS3	WORD	P2P parameter n,xx Block save area size 3	Save P2P parameter n,xx Block save area Size 3.
N00036 ~ N00039	_PnBxxWD4	Device structure	P2P parameter n,xx Block save area device 4	Save P2P parameter n,xx Block save area device 4.
N00040	_PnBxxWS4	WORD	P2P parameter n,xx Block save area size 4	Save P2P parameter n,xx Block save area size 4.

Notes

1) N area shall be set automatically when setting P2P parameter by using XG-PD and available to modify during RUN by using P2P dedicated command.
2) N area has a different address classified according to P2P parameter setting no., block index. The area not used by P2P service as address is divided, can be used by internal device.

Appendix 1.4 Reserved Words

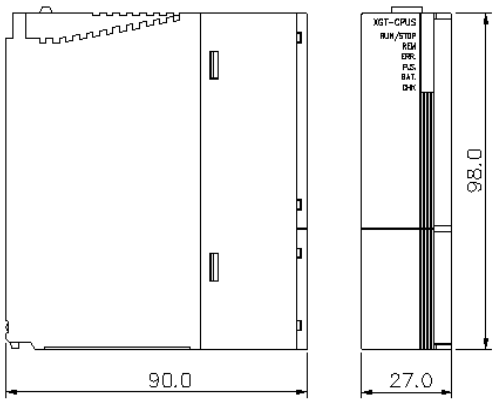
The reserved words are predefined words to use in the system. Therefore, it is impossible to use them as the identifier.

Reserved Words
ACTION ... END_ACTION
ARRAY ... OF
AT
CASE ... OF ... ELSE ... END_CASE CONFIGURATION ... END_CONFIGURATION
Data type Name
DATE#, D# DATE_AND_TIME#, DT#
EXIT
FOR ... TO ... BY ... DO ... END_FOR
FUNCTION ... END_FUNCTION
FUNCTION_BLOCK ... END_FUNCTION_BLOCK
Function block names
IF ... THEN ... ELSIF ... ELSE ... END_IF
OK
Operator (IL Language) Operator (ST Language)
PROGRAM
PROGRAM ... END_PROGRAM
REPEAT ... UNTIL ... END_REPEAT
RESOURCE ... END_RESOURCE
RETAIN
RETURN
STEP ... END_STEP
STRUCTURE ... END_STRUCTURE
T#
TASK ... WITH
TIME_OF_DAY#, TOD#
TRANSITION ... FROM... TO ... END_TRANSITION
TYPE ... END_TYPE
VAR ... END_VAR VAR_INPUT ... END_VAR VAR_OUTPUT ... END_VAR VAR_IN_OUT ... END_VAR VAR_EXTERNAL ... END_VAR
VAR_ACCESS ... END_VAR
VAR_GLOBAL ... END_VAR
WHILE ... DO ... END_WHILE
WITH

Appendix 2 Dimensions (Unit: mm)

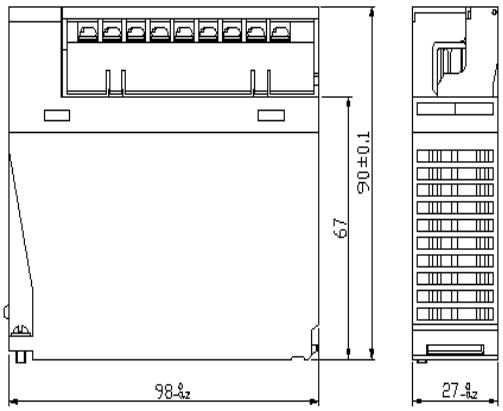
1) CPU module

XGI-CPUx

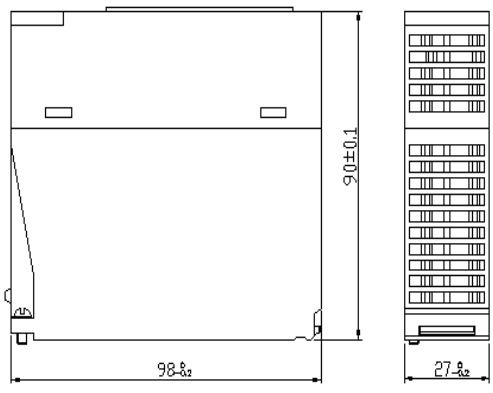


2) I/O module

I/O Module (Terminal Block type)

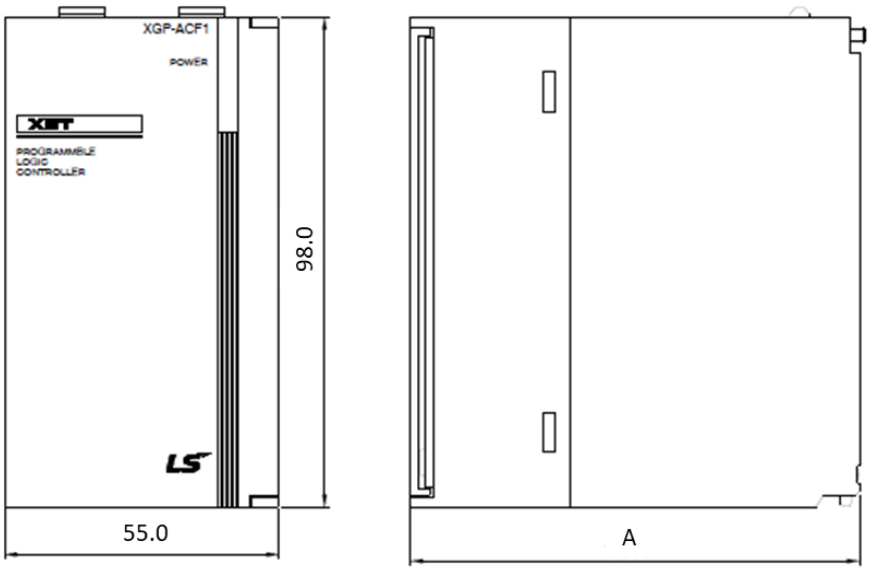


I/O Module (Connector type)



3) Power Module

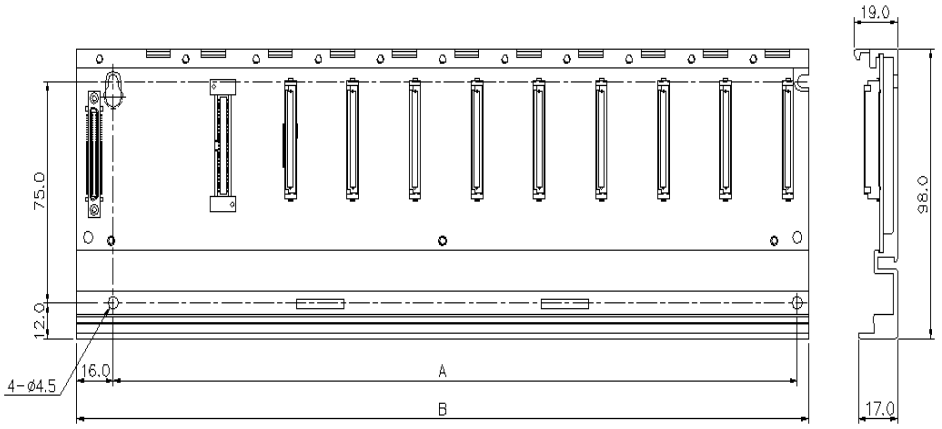
Power Module



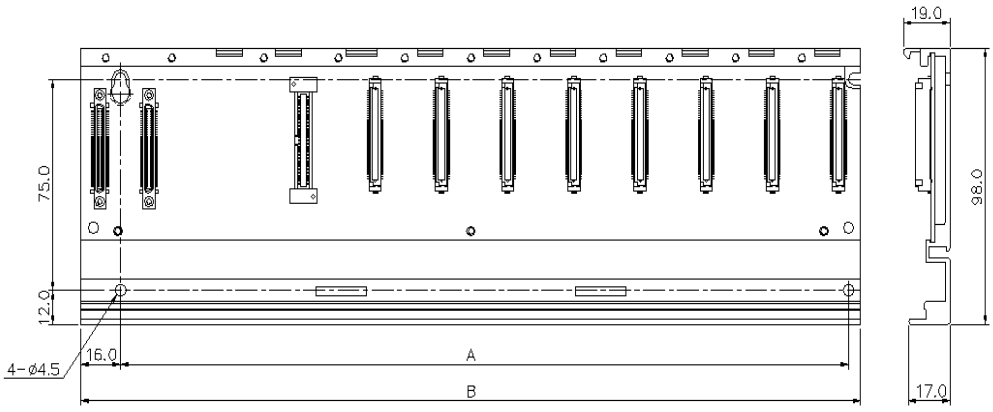
Classification	A(MM)
XGP-ACF1/ACF2/DC42	90.0
XGP-AC23/ AC24/14	110
XGP-SAC24/DC44	130

4) Main/Expansion Base

Main Base



Expansion Base



Classification	A	B
XGB-M04A/XGB-E04A	190	210
XGB-M06A/XGB-E06A	244	264
XGB-M08A/XGB-E08A	298	318
XGB-M12A/XGB-E12A	406	426

Appendix 3. Compatibility with GLOFA

Appendix 3.1 Compatibility of Flag

Classification	GM4C	XGI	Type	Contents	Description
User Flag	_LER	_LER	BOOL	Operation error Latch flag	Operation error latch flag which is on the basis of program block (PB), the error indication which occurs while program block running keeps until the program ends. It is available to delete by a program.
	_ERR	_ERR	BOOL	Operation error flag	Operation error flag which is on the basis of operation function(FN) or function block(FB), it is renewed every time operation works.
	_T20MS	_T20MS	BOOL	20ms clock	Clock signal used in user program reverses On/Off per a half cycle Please use more enough long clock signal than PLC scan time. Clock signal starts from Off condition when initialization program starts or scan program starts.
	_T100MS	_T100MS	BOOL	100ms clock	
	_T200MS	_T200MS	BOOL	200ms clock	
	_T1S	_T1S	BOOL	1second clock	
	_T2S	_T2S	BOOL	2second clock	
	_T10S	_T10S	BOOL	10second clock	
	_T20S	_T20S	BOOL	20second clock	
	_T60S	_T60S	BOOL	60second clock	
	_ON	_ON	BOOL	Ordinary time On	Always On state flag, used when writing a user program.
	_OFF	_OFF	BOOL	Ordinary time Off	Always Off state flag, used when writing a user program.
	_1ON	_1ON	BOOL	1'st scan On	First scan On flag, operated after starting the operation.
	_1OFF	_1OFF	BOOL	1'st scan Off	First scan Off flag, operated after starting the operation.
	_STOG	_STOG	BOOL	Reversal every scan (scan toggle)	On/Off reversed per scan when user program is working. (On state for first scan)
	_INIT_DONE	_INIT_DONE	BOOL	Complete of initial program	When this flag is set by user-written initialization program, scan program starts operation after initialization program ends.
	_RTC_DATE	_RTC_DATE	DATE	Current date of RTC	Indicates day data on the basis of 1.Jan.1984.
	_RTC_TOD	_RTC_TOD	TOD	Current time of RTC	Indicates a data for the time of the day on the basis of 00:00:00 (unit: ms)
	_RTC_WEEK	_RTC_WEEK	UINT	Current a day of the week of RTC	XGT - 0:Sun, 1:Mon, 2:Tue, 3:Wed, 4:Thu, 5:Fri, 6:Sat GLOFA - 0:Mon, 1:Tue, 2:Wed, 3:Thu, 4:Fri, 5:Sat, 6:Sun

Classification	GM4C	XGI	Type	Contents	Description
System Error Rep. flag	_CNF_ER	-	WORD	System error (heavy fault)	Handles error flags about fault of operation stop as below.
	_CPU_ER	_CPU_ER	BOOL	CPU Configuration error	Error flag occurred when normal operation cannot be done due to diagnosis error of CPU Module. (Refer to "_SYS_ERR" for more error contents)
	_IO_TYER	_IO_TYER	BOOL	Mismatched module type error	Representative flag displayed when I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location. (Refer to "_IO_TYER_N, _IO_TYER[n]")
	_IO_DEER	_IO_DEER	BOOL	Module detachment error	Representative flag displayed when the module configuration for each slot is changed while running. (Refer to "_IO_DEER_N, _IO_DEER[n]")
	_FUSE_ER	_FUSE_ER	BOOL	Fuse error	Representative flag displayed when the fuse of module is cut off. (Refer to "_FUSE_ER_N, _FUSE_ER[n]")
	_IO_RWER	_IO_RWER	BOOL	I/O module reading/writing error(fault)	Representative flag displayed when it cannot normally read and write I/O module of each slot module. (Refer to "_IP_RWER_N, _IO_RWER[n]")
	_SP_IFER	_IP_IFER	BOOL	Special/communication module interface error(fault)	Representative flag displayed when it is impossible to interface normally due to failure to initialize special/communication module or abnormal operation of these modules. (Refer to "_IP_IFER_N, _IP_IFER[n]")
	_ANNUN_ER	_ANNUM_ER	BOOL	Heavy fault detection error in external device	Representative flag displayed when heavy error detected by user program is recorded in "_ANC_ERR[n]" .
	-	-	-	-	-
	_WD_ER	_WDT_ER	BOOL	Scan watchdog error	Indicates that the program scan time exceeds the scan watchdog time specified by a parameter.
	_CODE_ER	_CODE_ER	BOOL	Program code error	Indicates that while user program is running, the program code can't be interpreted.
	_STACK_ER	-	BOOL	Stack overflow error	Indicates that while program running, stack of program exceeds normal limits.
	_P_BCK_ER	_PGM_ER	BOOL	Program error	Indicates that program memory is destroyed or program cannot operate normally. (Refer to "_DOMAIN_ST")
Fault Mask flag	_CNF_ER_M	-	BYTE	System error clear (heavy fault)	Handles error flags about error clear as below.
	_ANNLN_ER_M	-	BOOL	Error clear	Detects heavy fault of external device. When "_ANNLN_ER" occurs, if it is operated to ignore it, this flag is set

Classification	GM4C	XGI	Type	Contents	Description
Module Fault Mask Flag	_BASE_M[n]	_BASE_M[n]	BOOL ARRAY	Fault mask setting on base unit	Used to continue run even if there is a problem in the base or module mounted to base while running. Set the base position to mask.
	_SLOT_M[n]	_SLOT_M[n]	BYTE ARRAY	Fault mask setting on slot unit	Used to continue run even if there is a problem in the mounted module while running. Set the slot position to mask.
Module Skip Flag	_BASE_S[n]	_BASE_S[n]	BOOL ARRAY	Skip setting on base unit	Used to rule out a specified extended base while running. If this flag is set, CPU prevents access of the extended base. It is available to change an extended base, power and module while running.
	_SLOT_S[n]	_SLOT_S[n]	BYTE ARRAY	Skip setting on slot unit	Used to rule out a specified extended base while running. If this flag is set, CPU prevents access of the extended base.

Classification	GM4C	XGI	Type	Contents	Description
System warning Rep. Flag	_CNF_WAR	_CNF_WAR	WORD	System warning (light fault)	Handles warning flag about continuation operation as below
	_RTC_ERR	_RTC_ERR	BOOL	RTC data error	Indicates that RTC data is abnormal.
	_D_BCK_ER	_D_BCK_ER	BOOL	Data backup error	Indicates that cold restart starts operation instead of hot or warm restart program, since data memory is destroyed by backup error. It is possible to use in the initialization program and it is reset automatically after completing the initialization program.
	_H_BCK_ER	-	BOOL	Hot restart disabled error	Indicates that restart operation(warm or cold) is done according to a parameter, instead of hot restart operation, since it exceeds hot restart time during power recovery or the operation data (required for hot restart operation) is not backup normally. It is possible to use in the initialization program and it is reset automatically after completing the initialization program.
	_AB_SD_ER	_AB_SD_ER	BOOL	Abnormal Shutdown	This flag is used by initial program, and is reset automatically after initial program completion It is included to program stopping by 'ESTOP' function
	_TASK_ERR	_TASK_ERR	BOOL	Task collision (Fixed cycle, external task)	Indicates that an identical task operates in duplicate. (please refer to "_TC_BMAP[n]", "_TC_CNT[n]")
	_BAT_ERR	_BAT_ERR	BOOL	Battery error	Indicates that when battery voltage for backup of user program and data memory is below the standard.
	_ANNUN_WR	_ANNUN_WR	BOOL	Light fault detection of external device	Representative flag displayed when light fault detected by user program is recorded in "_ANC_WB[n]"
	-	-	-	-	-
	_HSPMT1_ER	-	BOOL	High speed link-parameter 1 error	When high speed link enables, if it is abnormal to high speed link parameter, Indicates that high speed link can't be executed. This flag is reset when high speed link disables.
	_HSPMT2_ER	-	BOOL	High speed link-parameter 2 error	
	_HSPMT3_ER	-	BOOL	High speed link-parameter 3 error	
	_HSPMT4_ER	-	BOOL	High speed link-parameter 4 error	

Classification	GM4C	XGI	Type	Contents	Description
System error and warning detailed flag	_IO_TYER_N	_IO_TYER_N	UINT	Mismatched module type slot number	When I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location, it is displayed as the lowest slot number after detecting these mismatch error in slot locations.
	_IO_TYERR[n]	_IO_TYER0~ _IO_TYER7	BYTE	Mismatched module type location	When I/O configuration parameter for each slot is not matched with practical module configuration or a specific module is applied in the wrong location, it displays the detected slot location on Bit-map.
	_IO_DEER_N	_IO_DEER_N	UINT	Module detachment slot number	When slot module configuration is changed while PLC running, it is displayed as the lowest slot number after detecting these detachment error in slot locations.
	_IO_DEERR[n]	_IO_DEER0~ _IO_DEER7	BYTE	Module detachment location	When slot module configuration is changed while PLC running, it displays the detected slot location on bit-map.
	_FUSE_ER_N	_FUSE_ER_N	UINT	Fuse cutoff slot number	When a fuse equipped to a module is cut off, it is displayed as the lowest slot number after detecting this error in slot locations.
	_FUSE_ERR[n]	_FUSE_ER0	BYTE	Fuse cutoff slot location	When a fuse equipped to a module is cut off, it displays the detected slot location on bit-map.
	_IO_RWER_N	_IO_RWER_N	UINT	I/O module reading / writing error slot number	When it is not possible to read/write the I/O module each slot modules, it is displayed as the lowest slot number after detecting this error in slot locations.
	_IO_RWERR[n]	_IO_RWER0	BYTE	I/O module reading / writing error slot location	When it is not possible to read/write the I/O module each slot modules, it displays the detected slot location on bit-map.
	_SP_IFER_N	_IP_IFER_N	UINT	Special / link module interface error slot number	When it is not possible to initialize special/link module of each slot module or to interface normally due to module malfunction, it is displayed as the lowest slot number after detecting this error in slot locations.
	_SP_IFERR[n]	_IP_IFER_0	BYTE	Special / link module interface error slot location	When it is not possible to initialize special/link module of each slot module or to interface normally due to module malfunction, it displays the detected slot location on bit-map.
	_ANC_ERR[n]	_ANC_ERR	UINT	Heavy fault detection of external device	Heavy fault of external device is detected by user program, and that error is saved at this zone as numbers which can identify 16 error types. (“0”value is not available.)
	_ANC_WAR[n]	_ANC_WAR	UINT	Light fault detection of external device	When detecting “_ANC_WB[n]” warning by user program, the bit location of the occurred error from “_ANC_WAR[0]” is displayed as an integer in occurrence order.

Classification	GM4C	XGI	Type	Contents	Description
System error and warning detailed flag	_ANC_WB[n]	_ANC_WB[n]	BIT	Light fault detection bit-map of external device	Light fault of external device (detected by user program) is saved on bit-map. ("0"value is not available.)
	_TC_BMAP[n]	-	BIT	Task Collision Bit-map	Displayed on bit-map when same task is operating or is ready for operation.
	_TC_CNT[n]	-	UINT	Task Collision Counter	Displays task collision counter when task collision occurs while user program execution
	_BAT_ER_TM	_BAT_ER_TM	DATE & TIME	Battery voltage drop time	Displays first battery voltage drop time. It is reset when it returns to normal condition.
	_AC_F_CNT	_AC_FAIL_CNT	UINT	Instant power cutoff count occurred	Indicates the instant power cutoff count which occurred while RUN mode operation.
	_AC_F_TM[n]	_AC_F_TM[n]	DATE & TIME	Instant power cutoff history	Saves instant power cutoff date/time, which can be saved up to 16 from the most recent event.
	_ERR_HIS[n]	_ERR_HIS[n]	-	Error occurrence history	Error occurrence time and error code are saved up to 16 from the most recent event. . Stop-time : DATE&TIME (8 Byte) . Error code : UINT (2 Byte)
	_MODE_HIS[n]	_MODE_HIS[n]	-	Change history of RUN mode	Run mode change time, run mode and restart mode are saved up to 16 from the most recent event. . Change time : DATE&TIME (8 Byte) . Run mode : UINT (2 Byte) . Restart : UINT (2 Byte)
	-	_SYS_HIS[n]	-	System history	It displays system connection state, program modification history, communication Enable/Disable state and etc, which is saved up to 2000 from the most recent event.

Classification	GM4C	XGI	Type	Contents	Description
System operation state flag	_CPU_TYPE	_CPU_TYPE	UINT	CPU type information	Indicates the type information of PLC CPU
	_VER_NUM	_OS_VER	UINT	OS Version Number	OS version number of PLC CPU
	_MEM_TYPE	-	UINT	Memory module type	Program memory module type (0:unmounted, 1~5:Type)
	_SYS_STATE	-	WORD	PLC mode and running state	Indicates operation mode and operation state of the system.
		_LOCAL_CON		Local control	Indicates that operation mode can be changed by mode key or GMWIN only
		_STOP		STOP	Indicates running state of CPU module.
		_RUN		RUN	
		-		PAUSE	
		_DEBUG		DEBUG	
		_CMOD_KEY		Running mode change factor	Change the running mode by key
		_CMOD_LPADT		Running mode change factor	Change the running mode by GMWIN
		_CMOD_RPADT		Running mode change factor	Change the running mode by remote GMWIN
		_CMOD_RLINK		Running mode change factor	Change the running mode by communication
		_USTOP_ON		Stopped by STOP function	While RUN mode operation, stopped after scan completion by STOP function
		_FORCE_IN		Forced input	Indicates that a forced On/Off for the input contact is running.
		_FORCE_OUT		Forced output	Indicates that a forced On/Off for the output contact is running.
		_ESTOP_ON		Stopped by ESTOP function	While RUN mode operation, stopped immediately by ESTOP function
		-		-	-
		-		Monitor on execution	Indicates that external monitor is running about program and variable.
		_REMOTE_CON		Remote mode On	Indicates that it is operated by remote mode.

Classification	GM4C	XGI	Type	Contents	Description
System operation state flag	_PADT_CNF	-	BYTE	GMWIN connection state	Indicates the connection state of CPU module and GMWIN
		-		Local GMWIN connection	Bit indicated connection state of local GMWIN
		-		Remote GMWIN connection	Bit indicated connection state of remote GMWIN
		-		Remote communication connection	Bit indicated connection state of remote communication
	_RST_TY	-	BYTE	Restart mode information	Please refer to “4.5.1 Restart mode”
		-		Cold restart	
		-		Warm restart	
		-		Hot restart	
	_INIT_RUN	_INIT_RUN	BOOL	Initialization is running	Indicates that user-written initialization program is running.
	_SCAN_MAX	_SCAN_MAX	UINT	Max. Scan Time (ms)	Indicates Max. scan time while running.
	_SCAN_MIN	_SCAN_MIN	UINT	Min. Scan Time(ms)	Indicates Min. scan time while running.
	_SCAN_CUR	_SCAN_CUR	UINT	Current Scan Time(ms)	Indicates current scan time data which is being renewed.
	_RTC_TIME[n]	_RTC_DATE _RTC_WEEK _RTC_TOD	BYTE	Current time	The current BCD data of RTC (1.Jan.1984 ~ 31.Dec.2083) _RTC_TIME[0] : year, _RTC_TIME[1] : month, _RTC_TIME[2] : day, _RTC_TIME[3] : time, _RTC_TIME[4] : minute, _RTC_TIME[5] : second _RTC_TIME[6] : day of the week, _RTC_TIME[7] : not used day of the week XGT - 0:Sun, 1:Mon, 2:Tue, 3:Wed, 4:Thu, 5:Fri, 6:Sat GLOFA - 0:Mon, 1:Tue, 2:Wed, 3:Thu, 4:Fri, 5:Sat, 6:Sun
	_SYS_ERR	-	UINT	Error type	-

Warranty

1. Warranty Period

The product you purchased will be guaranteed for 36 months from the date of manufacturing.

2. Scope of Warranty

(1) The initial diagnosis of faults is basically conducted by your company. However, upon your request, our company or our service network can undertake this task for a fee. If the cause of the fault lies with our company, this service will be provided free of charge.

(2) This warranty only applies if the product is used under normal conditions according to the specifications and precautions described in the handling instructions, user manuals, catalogs, and caution labels.

(3) Even within the free warranty period, the following cases will be subject to paid repairs:

1) Replacement of consumable and life-limited parts (e.g., relays, fuses, electrolytic capacitors, fans, LCDs, batteries, etc.)

2) Failures or damages caused by improper storage, handling, negligence, or accidents by the customer

3) Failures resulting from the customer's hardware or software design

4) Failures due to modifications without our consent
(Repairs will be refused, even for a fee, if recognized as modified or repaired outside our company)

5) Failures that could have been avoided if the customer's equipment, in which our product is incorporated, had safety devices required by legal regulations or common industry standards

6) Failures that could have been prevented if maintenance and replacement of consumable parts were performed normally according to the handling instructions or user manuals

7) Failures and damages to the product caused by using connected equipment or inappropriate consumables

8) Failures caused by external factors such as fire, abnormal voltage, force majeure, and natural disasters such as earthquakes, lightning, salt damage, wind, and flood damage

9) Failures due to reasons that could not be predicted with the scientific and technical standards at the time of our shipment

10) Other failures, damages, or defects recognized as the responsibility of your company

Environmental Policy

LS ELECTRIC Co., Ltd supports and observes the environmental policy as below.

Environmental Management

LS ELECTRIC considers the environmental preservation as the preferential management subject and every staff of LS ELECTRIC use the reasonable endeavors for the pleasurably environmental preservation of the earth.

About Disposal

LS ELECTRIC' PLC unit is designed to protect the environment. For the disposal, separate aluminum, iron and synthetic resin (cover) from the product as they are reusable.

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