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Programmable Logic Controller

XGI CPU Module

XGT Series

User's Manual

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



Safety Instructions

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

LS Industrial Systems

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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**	WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
⚠ **Caution**	CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices

- 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 PE 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 XGI-A21C, XGQ-TR1C	Ch7.2.10 Ch7.3.11
		8. PID bit flag address modified	Ch14.5
		9. Flag added	App1.1

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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

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Congratulations on purchasing PLC of LS Industrial System 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.lsis.biz/) 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	V1.00
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

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Chapter 1 Introduction

1.1 How to use the User's Manual

The User's Manual describes the specifications, performances and operations of each product necessary for using the XGT PLC System consisting of XGI series CPU modules.

The user's manual consists of the following chapters

Chapter	Title	Description
1	Introduction	Describes the structure of the manual, product features and terms.
2	System Structure	Describes the types of products available in the XGI series and the system configuration.
3	General Specifications	Describes the common specifications of modules used in the XGI series.
4	CPU Module	Describes the performance, specifications and operation of the XGI-CPU.
5	Program Structure and Operation Modes	
6	Functions of CPU Module	
7	I/O Module	Describes the specifications and directions of I/O module and power module, besides CPU module.
8	Power Module	
9	Base and Extension Cable	
10	Installation and Wiring	Describes the installation, wiring method and cautions to secure the reliability of PLC system.
11	Maintenance	Describes the checklist and methods to operate the PLC system normally for a long time.
12	Compliance with EMC Specifications	Describes how to structure a system complying with EMC Specifications
13	Troubleshooting	Describes types of potential errors that occur during the use and the troubleshooting.
14	Built-in PID	Describes how to use built-in PID funtion
Appendix 1	Flags List	Describes the types and description of flags.
Appendix 2	Dimensions	Describes the dimensions of CPU, I/O module and base.
Appendix 3	Compatibility with GLOFA	Describes the compatibility of flag with GLOFA PLC.

Note

1) Please note that the user's manual does not describe the special/communication module and programming. For the functions, please refer to the related user's manual.
2) XGI CPU is a kind of XGT PLC system and the types of CPU for XGT PLC system are as follows.
   ① XGK series: XGT PLC system consisting of CPU using Master-K language
   ② XGI series: XGT PLC system consisting of the only CPU using IEC language
   ③ XGR series: XGT PLC system consisting of duplex CPU using IEC language

1.2 Features

XGI has the following features.

1) Compact size

Realizing the innovatively compact size as maintaining the performance, it requires a smaller space.

2) High speed processing

(1) XGI-CPUUN
- Sequence command : 8.5 ns
- MOV command : 25.5 ns
- Real number operation (the operation speed of single/double preciseness is impressively improved)

Item	+	−	×	÷
Single real	119 ns	119 ns	272 ns	281 ns
Double real	281 ns	281 ns	680 ns	685 ns

(2) XGI-CPUU
- Sequence command : 28 ns
- MOV command : 84 ns
- Real number operation

Item	+	−	×	÷
Single real	392 ns	392 ns	896 ns	924 ns
Double real	924 ns	924 ns	2,240 ns	2,254 ns

(3) The data transmission speed between and among modules via base is improved at the level of nano speed.
- 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

3) Convenient Use of Analogue Data

The preciseness and stability of analogue module are increased and the module provides the following convenience.

- 'U' device exclusive for analogue data simplifies a program
- Parameter setting-based scheme makes setting possible even though the memory map of a special module is unknown.

4) System Configuration

It provides various convenient functions to meet a user's requirements.

- The filter values of I/O module are adjustable
- Output holding in an emergency
- Endurable varistor built-in relay output module
- Extending the total length of extension base to 15 meters
- Provision of system RUN contact on the power module
- Reduction of installation, commissioning and maintenance costs by the reinforced self-diagnostic function.

5) Various communication systems

The systems provide various network functions to meet user's convenience, compatibility and performance.

- A network can be established without ladder programming
- The exclusive tool(XG-PD) can set a network and monitor operation status.
- Supporting open networks with various international standards
- Exclusive network providing convenience use and optimal performance
- Network compatible with the existing products(MASTER-K,GLOFA-GM)

6) Programming/Online functions reinforced

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

- Program reinforced by symbolic variables
- Auto conversion of GLOFA program
- Extending program modification function during operation and securing the stability
- Installation and modification of a network is available during operation
- Reinforcing trend monitoring function
- User event function
- Data trace function

7) User's Convenience

With various functions supported, the user convenience is improved.

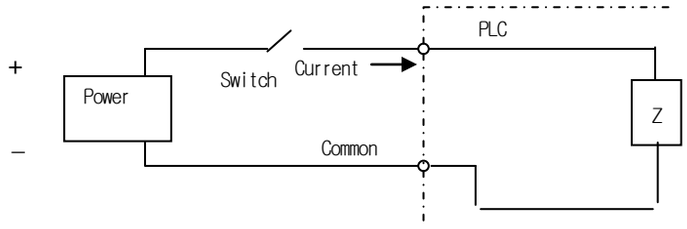
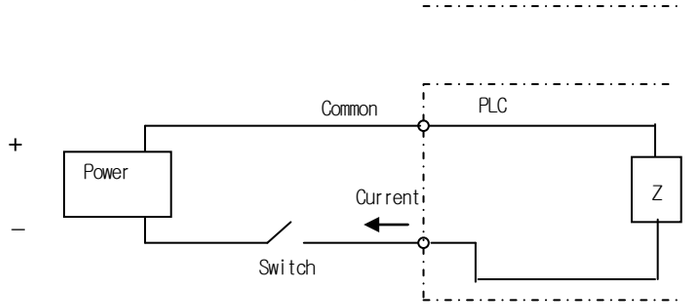
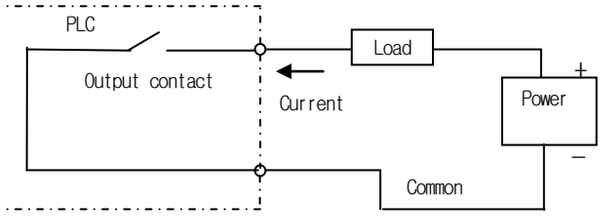
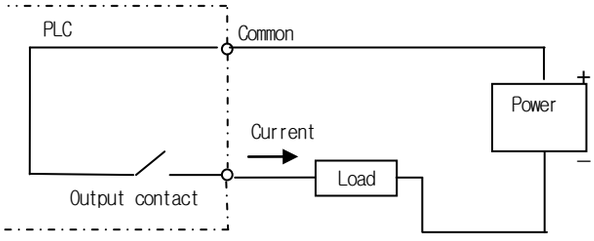
- Convenient module exchange wizard(module exchangeable with no user tool)
- System diagnostics function
- I/O module skip function
- Fault Mask settable
- Various operation histories

1.3 Terms & Definitions

The paragraph describes the terms used in the user's manual.

Term	Definition	Remarks
Module	A standard element with a specific function to structure a system such as I/O board assembled to be inserted into the motherboard base	i.e.) CPU module, power module, I/O module and etc
Unit	A module or a group of modules as the minimum unit operating in a PLC system being consisted of a PLC system as it is assembled with other module or a group of modules	i.e.) basic 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.	-
Warm 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 CPU module installed to maintain I/O states	-
Rnet	Remote Network (remote dedicated network)	
.Cnet	Computer Link Network	-
FEnet	Fast Ethernet Network	-
Pnet	Profibus-DP Network	-
Dnet	DeviceNet Network	-
Fnet	Field bus Network	
RAPIEnet	Real-time Automation Protocols for Industrial Ethernet	

Term	Definition	Remarks
RTC	As an abbreviation of Real Time Clock, it is collectively referred as a universal IC with a function of clock	-
Watchdog Timer	A timer to monitor pre-determined execution time of a program and generate a warning unless it is not complete within the time	-
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	i.e.)•%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	It means the operation condition of a program; 3 types such as constant task, internal contact task and external contact task by the input signal of external interrupt module	-

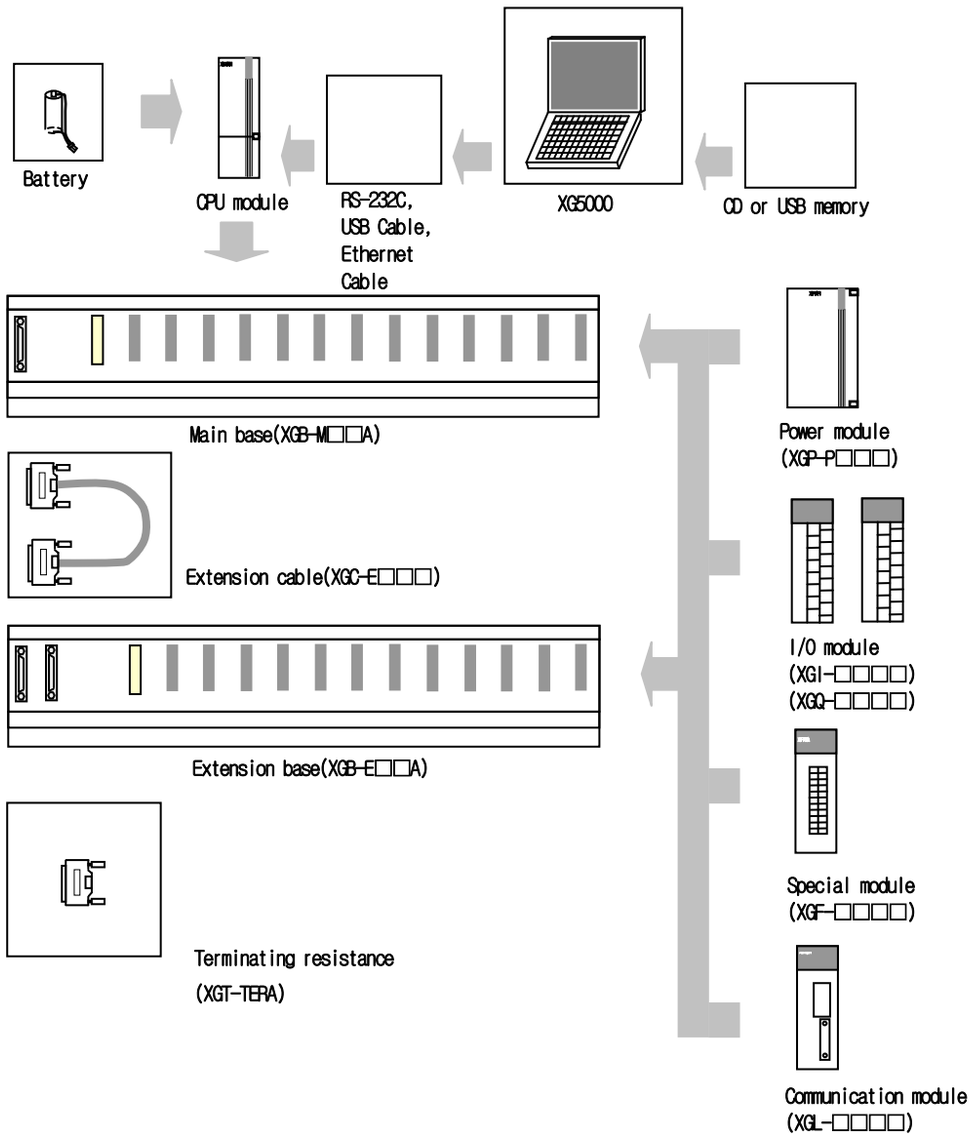
Term	Definition	Remarks
Sink input	Current flows into PLC input terminal from switch when Input Signal is ON 	Z: input impedance
Source input	Current flows into switch from PLC input terminal when Input Signal is ON 	Z: input impedance
Sink output	Current flows from load to output terminal when PLC output contact is ON 	-
Source output	Current flows from output terminal when PLC output contact is ON 	-

Chapter 2 System Configuration

XGI series are furnished with types of products to structure a basic system, computer link and network system. This chapter describes how to structure each system and the features.

2.1 XGI Series System Configuration

The system configuration of the XGI series 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 Components List

XGI Series consist of the following products.

Product	Model	Description	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 Diagnostic Input, 8 point (Current 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	• AC 220V isolated input, 8 points	-
Digital Output Module	XGQ-RY1A	• Relay output, 8 point (for 2A, single COM.)	-
	XGQ-RY1D	• Diagnostic Relay output, 8 point (for 2A, single COM.)	-
	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, Source 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	• Transistor isolated output, 8 points (2A)	-
Digital I/O Module	XGH-DT4A	• DC 24V input, 16 point (current source / sink input) • Transistor output, 16 point (for 0.1A, Sink output)	-

Product	Model	Description		Remarks
Main Base	XGB-M04A	• for 4 module installation		-
	XGB-M06A	• for 6 module installation		-
	XGB-M08A	• for 8 module installation		-
	XGB-M12A	• for 12 module installation		-
Expanded 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 module	XGP-ACF1	AC100V~240V input	-	-
	XGP-ACF2	AC100V~240V input	• DC5V: 6A	-
	XGP-AC23	AC100V~240V input	• DC5V: 8.5A	-
	XGP-DC42	DC24V Input	• DC5V: 6A	-
Extended 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		
Terminator	XGT-TERA	• Must use for base expansion		-
Dust-proof Module	XGT-DMMA	• Dust protection module for not-used slot		-
Battery	XGT-BAT	• Battery for XGT (DC 3.0V / 1,800 mAh)		-
Analog input Module	XGF-AV8A	• Voltage Input: 8 channel • DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / –10 ~ +10V		-
	XGF-AC8A	• Current Input: 8 channel • DC 4 ~ 20mA / 0 ~ 20mA		-
	XGF-AD08A	• Voltage/Current Input: 8 channels		-
	XGF-AD4S	• Voltage/Current Input: 4 channels • Insulation between channels		-
	XGF-AD16A	• Voltage/Current Input: 16 channels		-
	XGF-AW4S	• 2-wire voltage/current input: 4 –channel, insulation between channels • 2-wire transmitter driver power supported		-

Product	Model	Description	Remarks
Analog output Module	XGF-DV4A	• Voltage Output: 4 channels • DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / –10 ~ +10V	-
	XGF-DC4A	• Current Output:: 4 channels • DC 4 ~ 20mA / 0 ~ 20mA	-
	XGF-DV4S	• Current Output:: 4 channels • Insulation between channels	-
	XGF-DC4S	• Current Output:: 4 channels • Insulation between channels	-
	XGF-DV8A	• Voltage Output: 8 channels • DC 1 ~ 5V / 0 ~ 5V / 0 ~ 10V / –10 ~ +10V	-
	XGF-DC8A	• Current Output:: 8 channels • DC 4 ~ 20mA / 0 ~ 20mA	-
Analog I/O Module	XGF-AH6A	• Voltage/Current input 4 channels • Voltage/Current output 2 channels	-
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	• Temperature (T/C) Input, 4 channels, • Insulation between channels	-
RTD Input Module	XGF-RD4A	• Temperature (RTD) Input, 4 channels	-
	XGF-RD4S	• Temperature (RTD) Input, 4 channels • Insulation between channels	-
	XGF-RD8A	• Temperature (RTD) Input, 8 channels	-
Temp. control Module	XGF-TC4UD	• Control loop : 4 loops • Input(4 channels, TC/RTD/voltage/current), Output(8 channels, TR/current)	-
	XGF-TC4RT	• Control loop: 4 loops • input (4 channels, RTD), Output (8 channels, TR)	-
High speed Counter Module	XGF-HO2A	• Voltage Input type (Open Collector type) • 200kHz, 2 channel	-
	XGF-HD2A	• Differential Input type (Line Driver type) • 500kHz, 2 channel	-
	XGF-HO8A	• Voltage Input type (Open Collector type) • 200kHz, 8 channel	-

Product	Model	Description	Remarks
Positioning Module	XGF-PO3A	• Pulse output (Open Collector type), 3 axes	-
	XGF-PO2A	• Pulse output (Open Collector type), 2 axes	-
	XGF-PO1A	• Pulse output (Open Collector type), 1 axis	-
	XGF-PD3A	• Pulse output (Line Drive type), 3 axes	-
	XGF-PD2A	• Pulse output (Line Drive type), 2 axes	-
	XGF-PD1A	• Pulse output (Line Drive type), 1 axis	-
	XGF-PO4H	• Pulse output (Open Collector type), 4 axes	-
	XGF-PO3H	• Pulse output (Open Collector type), 3 axes	-
	XGF-PO2H	• Pulse output (Open Collector type), 2 axes	-
	XGF-PO1H	• Pulse output (Open Collector type), 1 axes	-
	XGF-PD4H	• Pulse output (Line Drive type), 4 axes	-
	XGF-PD3H	• Pulse output (Line Drive type), 3 axes	-
	XGF-PD2H	• Pulse output (Line Drive type), 2 axes	-
	XGF-PD1H	• Pulse output (Line Drive type), 1 axes	-
	XGF-PN8A	• Network type(EtherCat), 8 axes, LS dedicated type	-
	XGF-PN8B	• Network type(EtherCat), 8 axes, Standard type	-
Motion Control Module	XGF-M16M	• Motion dedicated net (M-II) type, 16 axes	-
	XGF-M32E	• Motion dedicated net (EtherCAT) type, 32 axes	-
Event 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	Model	Description	Remarks
FEnet Module (Optical/Elec.)	XGL-EFMF	• Fast Ethernet(optical), Master • 100/10 Mbps support	-
	XGL-EFMT	• Fast Ethernet(electrical), Master • 100/10 Mbps support	-
	XGL-ESHF	• Fast Ethernet Switch module(optical)	-
	XGL-EH5T	• Fast Ethernet Switch module(electrical)	-
RAPIEnet	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 Module	XGL-C22A	• Serial communication • RS-232C, 2 channel	-
	XGL-C42A	• Serial communication • RS-422(485), 2 channel	
	XGL-CH2A	• Serial communication • RS-232C 1 channel / RS-422(485) 1 channel	
FDEnet Module(Master)	XGL-EDMF	• Dedicated Ethernet(optical), Master • Deterministic communication support • 100/10 Mbps support	-
	XGL-EDMT	• Dedicated Ethernet(electrical), Master • Deterministic communication support • 100/10 Mbps support	
Rnet Module	XGL-RMEA	• for Rnet Master I/F (Smart I/O communication available) • Fast response speed support(against the existing Fnet module) • 1 Mbps base band • for twisted cable	-
Profibus-DP Module	XGL-PMEA XGL-PMEC	• Profibus-DP Master module	-
Pnet Slave I/F module	XGL-PSEA	• Profibus-DP Slave module	-
DeviceNet Module	XGL-DMEA	• DeviceNet Master module	-
Ethernet/IP Module	XGL-EIPT	• EtherNet/IP(electric) • 100/10 Mbps support	-
BACnet/IP I/F Module	XGL-BIPT	• BACNet/IP(electric) • 100/10 Mbps support	-
Fnet I/F module	XGL-FMEA	• Field Bus master module	-
40-point connector	1473381-1	• 40-point connector (For I/O, special module)	-

Note

1) 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.

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

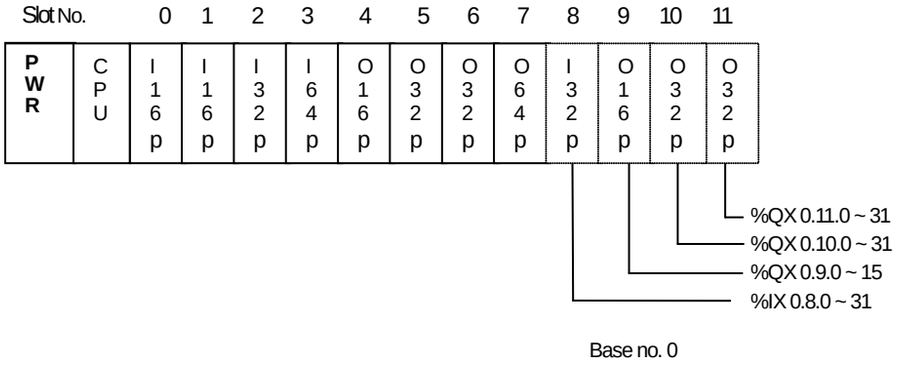
Name	Module							
	FEnet	FDEnet	Cnet	Rnet	Pnet	Dnet	RAPIEnet	IFOS module
Model	XGL-EFMT XGL-EFMF	XGL-EDMT XGL-EDMF	XGL-C22A XGL-CH2A XGL-C42A	XGL-RMEA	XGL-PMEA	XGL-DMEA	XGL-EIMF XGL-EIMT XGL-EIMH	XGL-ESHF
Applicable version	V2.0 or above	V2.0 or above	V2.1 or above	V1.0 or above	V1.0 or above	V1.0 or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

2.3 Basic System

2.3.1 Configuration of basic system

The basic system structured by linking main base and extension base features the follows.

Item	XGI-CPUU / CPUH / CPUU/D CPUUN	XGI-CPUS	XGI-CPUE
Max. extension stages	7 stages	3 stages	1 stage
Max. number of I/O module extension mounted	96 modules	48 modules	24 modules
Max. I/O point	• 16 points module : 1,536 points • 32 points module : 3,072 points • 64 points module : 6,144 points	• 16 points module : 768 points • 32 points module : 1,536 points • 64 points module : 3,072 points	• 16 points module : 384 points • 32 points module : 768 points • 64 points module : 1,536 points
Max. extension length	15m		
Allocation of I/O No. (12 slot base)	• I/O number is constantly allocated to 64 points per slot of the base. • Each slot of the base is allocated with 64 points, irrespectively of module mounted or it 's type. • The position on which a special module is mounted or the number is not limited. • Unlike digital I/O module, a special module is not allocated for any constant I/O number. • A special module is controlled by the dedicated function block and automatically allocated for the memory. • For instance, the I/O number of 12 slot base is allocated as follows.		



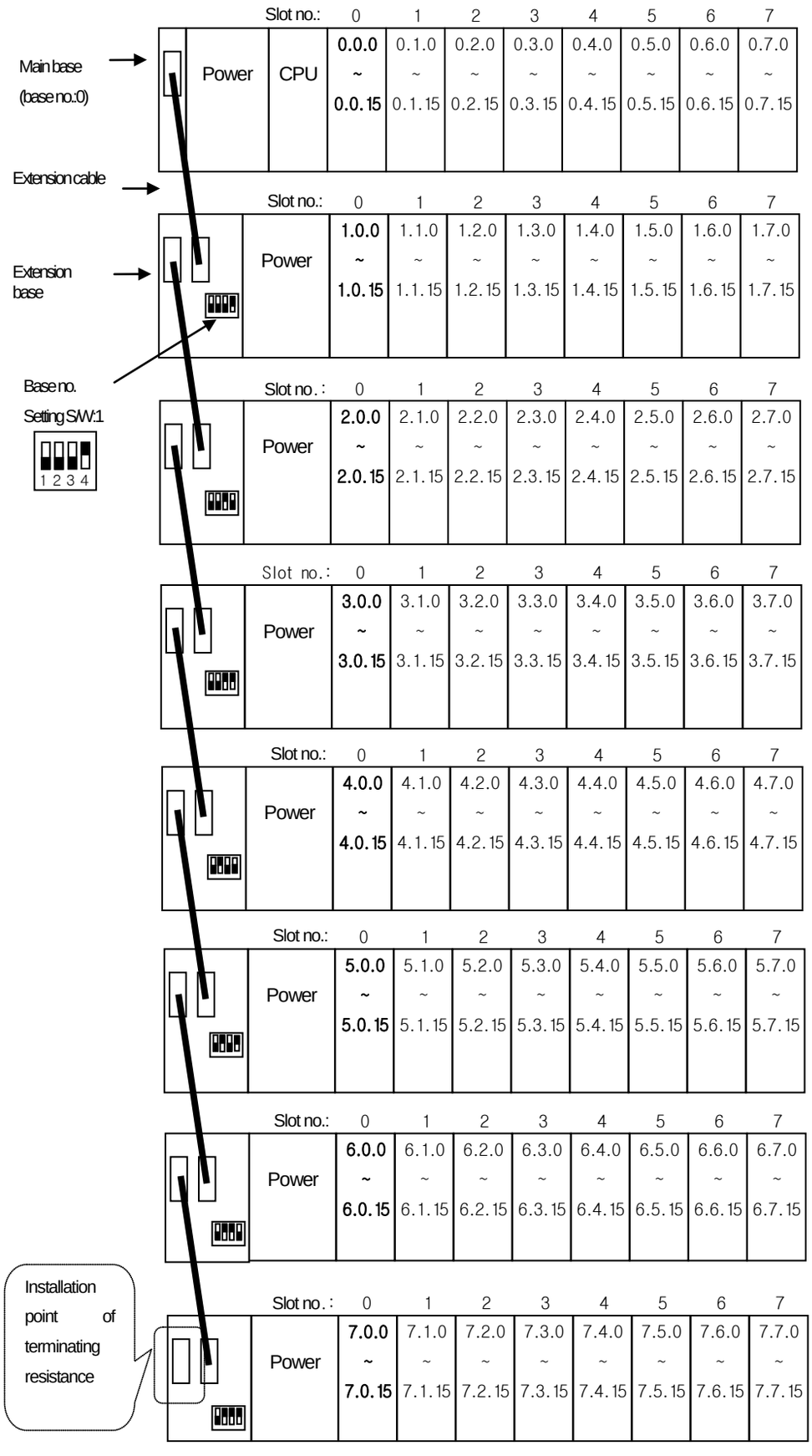
Note

1) The basis base has its base number as '0' and the extension base has a switch to set the base number.
2) Operation starts as long as the module type set as I/O parameter and the actually mounted module type coincide.

2.3.2 Max. configuration of the base system

System Configuration example

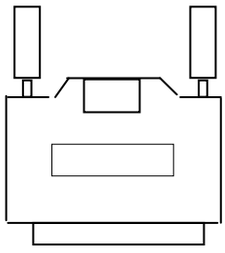
- XGI-CPUU
- 8 slot base
- if 16 point module is installed



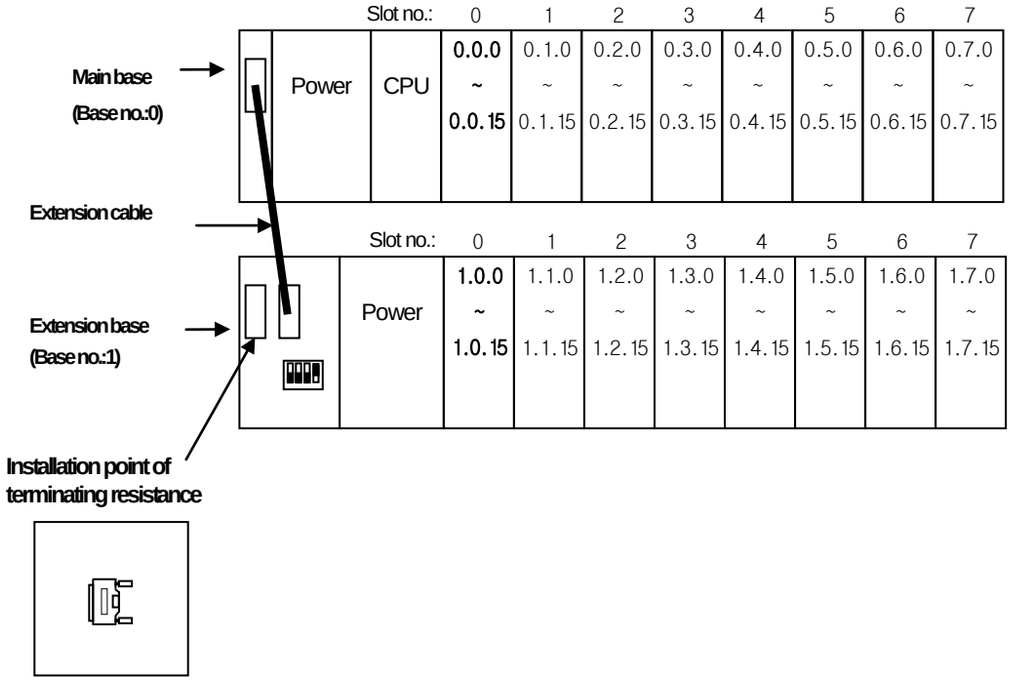
2.3.3 Connection of terminating resistance

If a system requires the main base and extension base to be connected, the terminating resistance should be attached on the extension connector(OUT) of the last extension base in order to improve the reliability. If the only main base is used, the terminating resistance does not need installing.

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.

2.3.4.1 Size of module's Data Refresh area

(Unit : WORD)

Item	Type	Refresh Size	Item	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 I/O module	XGH-DT4A	2		XGQ-TR8A/B	8
Analog input module	XGF-AC8A	22	Temperature detector 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 I/O module	XGF-AH6A	11		XGL-DMEA	16
APM module (Advanced Position module)	XGF-PO1A	2		XGL-PSEA	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-EDSF	16
	XGF-PO2H	2		XGL-RMEA	16

Item	Type	Refresh Size	Item	Type	Refresh Size
APM module (Advanced Position 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

2.3.4.2 Calculation of Data Refresh area's size

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, below modules are installed.

XGI-D28A(20 EA), XGQ-D24A(10EA), XGF-AC8A(20EA), XGF-RD4A(10EA)

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

Note

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

The XGI series support various network systems to facilitate system structure.

It provides Ethernet(FEnet.FDEnet) and Cnet for the communication between PLC and PLC or a higher system and it also provides the dedicated Ethernet(FEEnet), Profibus-DP, DeviceNet, Rnet and others as a lower control network system.

2.4.1 Inter-System network

1) Local Network

It is available to install max. 24 communication modules with no limit of Main base and Expanded base. It is desirable to install a module with much traffic relating to system operation performance on the Main base. The limitations by functions are summarized in the table below.

No. of modules by applications	Max. number of modules
Max. number of modules for high speed link	12
Max. number of P2P service modules	8
Max. number of dedicated service modules	24

*note1) P2P service : 1:1 communication

2) Computer Link (Cnet I/F) System

Cnet I/F system is designed to exchange data between/among computer, peripherals and CPU modules by using RS-232C or RS-422(or RS-485) ports of Cnet module.
For further information of Cnet module, refer to the user's manual of Cnet module.

As described in the above "Local Network", Cnet module is available to install max. 24 modules (including other communication modules), regardless Main base and Expanded base.

Cnet does not provide high speed link and it supports up to 8 modules for P2P service.

2.4.2 Relation of communication module and CPU

1) The OS version of Communication Module applicable in XGI

The available OS version of communication module in the XGI system is as follows.

	Module							
	FEnet	FDEnet	Cnet	Rnet	Pnet	Dnet	RAPIEnet	Optical ring switch
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 more	V2.0 or more	V2.1 or more	V1.0 or more	V1.0 or more	V1.0 or more	V1.0 or more	V1.0 or more

2.4.3 Remote I/O system

Smart I/O series is the network system to control the I/O module remotely installed and the network systems are Profibus-DP, DeviceNet, Rnet, Cnet and others.

1) I/O System Application by Network Types

Remote I/O modules are classified as follows.

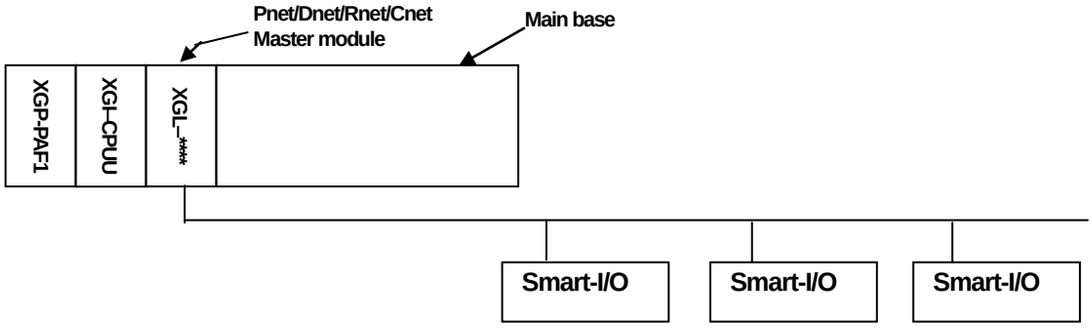
Network type (Master)	Smart IO	
	Block type	Extension type
Profibus-DP	O	O
DeviceNet	O	O
Rnet	O	O
Modbus(Cnet)	O	-
FEnet	-	O
Ethernet/IP	-	O
RAPIEnet	-	-

* The above information may vary for the performance improvement. For the accurate and latest information, refer to the manual of each network system.

2) Block type Remote I/O System

(1) System Configuration

It consists of Profibus-DP, DeviceNet and Rnet, and it can use a block type remote I/O, irrespective of series. Especially, Profibus-DP and DeviceNet are developed in accordance with the international standards, so they can be connected to other products as well as the company's Smart-I/O.



- Up to 12 units of master modules can be installed, and it can be also installed on the extension base.

(2) I/O Allocation and I/O Numbering

- Variables can be allocated to the Remote I/O by the high speed link parameters of XG-PD.
- I/O variables or internal variables can be designated as I/O.
- It is recommended to use 'I' and 'Q' areas to use forcible On/Off function and initialization reset function.
- The max. available points of I/O is 32,765.
- For how to set fast link parameters by modules, refer to the manual of each network.

Note

1) When assigning remote station number and areas, the station numbers and sending/receiving areas should not be duplicate.
2) Forcible 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>Items</th><th colspan="6">Specifications</th><th>Related standards</th></tr>
<tr><td>1</td><td>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="9">5</td><td rowspan="9">Vibration resistance</td><td colspan="5">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="9">IEC61131-2</td></tr>
<tr><td>5 ≤ f < 8.4Hz</td><td colspan="2">–</td><td>3.5mm</td><td rowspan="6">10 times each directions (X, Y and Z)</td></tr>
<tr><td>8.4 ≤ f ≤ 150Hz</td><td colspan="2">9.8m/s^2(1G)</td><td>–</td></tr>
<tr><td colspan="5">Continuous vibration</td></tr>
<tr><td>Frequency</td><td colspan="2">Acceleration</td><td>Amplitude</td></tr>
<tr><td>5 ≤ f < 8.4Hz</td><td colspan="2">–</td><td>1.75mm</td></tr>
<tr><td>8.4 ≤ f ≤ 150Hz</td><td colspan="2">4.9m/s^2(0.5G)</td><td>–</td></tr>
<tr><td>6</td><td>Shock resistance</td><td colspan="6">• Peak acceleration: 147 m/s^2(15G)
• Duration: 11ms
• Half-sine, 3 times each direction per each axis</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>LSIS standard</td></tr>
<tr><td>Electrostatic discharge</td><td colspan="5">Voltage: 4kV (Contact discharge)</td><td>IEC61131-2
IEC61000-1-2</td></tr>
<tr><td>Radiated electromagnetic field noise</td><td colspan="5">80 ~ 500 MHz, 10V/m</td><td>IEC61131-2,
IEC61000-4-3</td></tr>
<tr><td rowspan="2">Fast transient/bust noise</td><td>Segment</td><td>Power supply module</td><td colspan="2">Digital/analog input/output communication interface</td><td rowspan="2">IEC61131-2
IEC61000-1-4</td></tr>
<tr><td>Voltage</td><td>2kV</td><td colspan="2">1kV</td></tr>
<tr><td>8</td><td>Environment</td><td colspan="6">Free from corrosive gasses and excessive dust</td><td></td></tr>
<tr><td>9</td><td>Altitude</td><td colspan="6">Up to 2,000 ms</td><td></td></tr>
<tr><td>10</td><td>Pollution degree</td><td colspan="6">2 or less</td><td></td></tr>
<tr><td>11</td><td>Cooling</td><td colspan="6">Air-cooling</td><td></td></tr>
</table>

Note

1) 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.

2) 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, this state contains temporary conduction due to dew produced.

Chapter 4 CPU Module

4.1 Performance Specifications

The performance specifications of the CPU module (XGI-CPU) are as follows.

Item			Specifications						Remarks
			XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE	
Operation system			Reiterative operation, fixed cycle operation, constant scan						
I/O Control system			Scan synchronous batch processing system(refresh system), direct system by command						
Program language			Ladder Diagram, SFC (Sequential Function Chart), ST(Structured Text)						
No. of instructions	Operator		18						
	Basic function		136 types + real number operation function						
	Basic function block		43						
	Dedicated function block		Dedicated function blocks by special function modules, communication dedicated function block(P2P)						
Operation processing speed (basic command)	Basic		8.5 ns	28 ns				84 ns	/ instruction
	MOVE		25.5 ns	84 ns				252 ns	/ instruction
	Real number 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: Single real number D: Double real number
Program memory capacity			2MB	1MB		512KB	128KB	64KB	
I/O points(installable)			6,144 points				3,072 points	1,536 points	
Max. I/O memory contact			131,072 points				32,768 points		
Data memory	Symbolic variable area(A)		1,024KB (max. 512KB retain)	512KB (max. 256KB retain)			128KB (max. 64KB retain)	64KB (max. 32KB retain)	
	I variable(I)		16KB				4KB		
	O variable(Q)		16KB				4KB		
	Direct variable	M	512KB (max. 256KB retain)	256KB (max. 128KB retain)			64KB (max. 32KB retain)	32KB (max. 16KB retain)	
		R	64KB * 16 blocks		64KB * 2 blocks		64KB * 1 block	32KB * 1 block	
		W	1,024KByte		128KB		64KB	32KB	
	Flag variable	F	8KB		4KB				System flag
		K	16KB				4KB		PID flag
		L	22KB						Fast link flag
		N	42KB						P2P flag
		U	8KB				4KB	2KB	Analogue refresh flag
Flash area			2 MB, 32 blocks					1MB, 16 blocks	Controllable by R device

Item		Specifications						Remarks
		XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE	
Timer		• No point limit • Time range: 0.001~ 4,294,967.295 second(1,193 hours)						Occupying 20 bytes of symbolic variable area per point
Counter		• No point limit • Coefficient range : 64 bit expression						Occupying 8 bytes of symbolic variable area per point
Program structure	Total no. of programs	256						
	Initialization task	1						
	Fixed cycle task	32						
	Internal device task	32						
Operation mode		RUN, STOP, DEBUG						
Restart mode		Cold, Warm						
Health check function		Operation delay monitoring, memory fault, I/O fault, battery fault, power fault and etc						
Data protection in case of power failure		Retain area setting by basic parameters						
Max. base extension		7 stages				3 stages	1 stages	15 m of total length
Internal power consumption		960mA				940mA		
Weight		0.12kg						

XGI-CPUUN has Ethernet communication. Performance Specifications are as follows.

Item		Specifications XGI-CPUUN	Remarks
Ethernet	Features	1 Port	-
		10/100BASE-TX	-
		Auto negotiation (Full-duplex and half duplex)	-
		Auto MDIX Crossover	-
		Max. Support 4 channel	Support 8Kbyte each send and receive channel
		Max. Distance between nodes : 100m	-
		Max. Protocol size : 1500Byte	IP Fragmentation is not supported.
		UTP, STP, FTP cables is available	FTP, STP is recommended to prevent noise
	Service	Setting communication parameters with XG5000	-
		Loader service (XG5000 connection) supported	remote stage 1 connection with PLC is available
		LS protocol(XGT) supported.	Server function & TCP supported. UDP not supported.
		other company's protocol (MODBUS TCP/IP) supported	

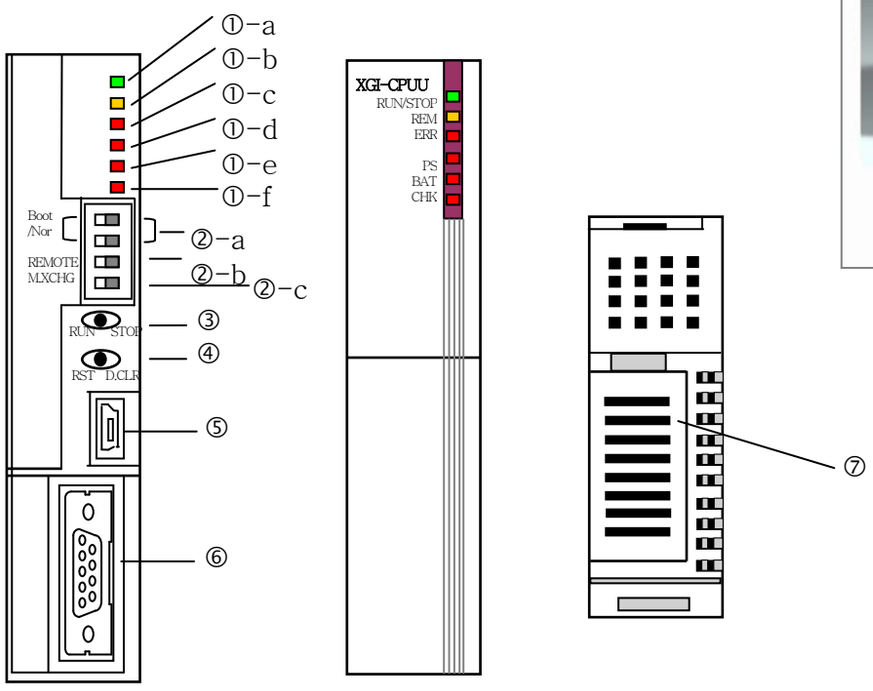
Note

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

CPU OS	XG5000	Function	Remark
V3.0	V3.1	Event input module(XGF-SOEA)	-
V3.1	V3.2	Effective conversion value, aslarm function of analog input module	-
V3.20	V3.4	Enhanced password function (in order to connect, XG5000 V3.4 or above is needed.) You can disable 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 added	-
V3.40	V3.61	Scan time of fixed cycle task flag P2P, HS enable-disable flag SOE flag	-

CPUUN OS	XG5000	Function	Remark
V1.0	V4.0	XGI-CPUUN module added	-

4.2 Names and Functions of Parts





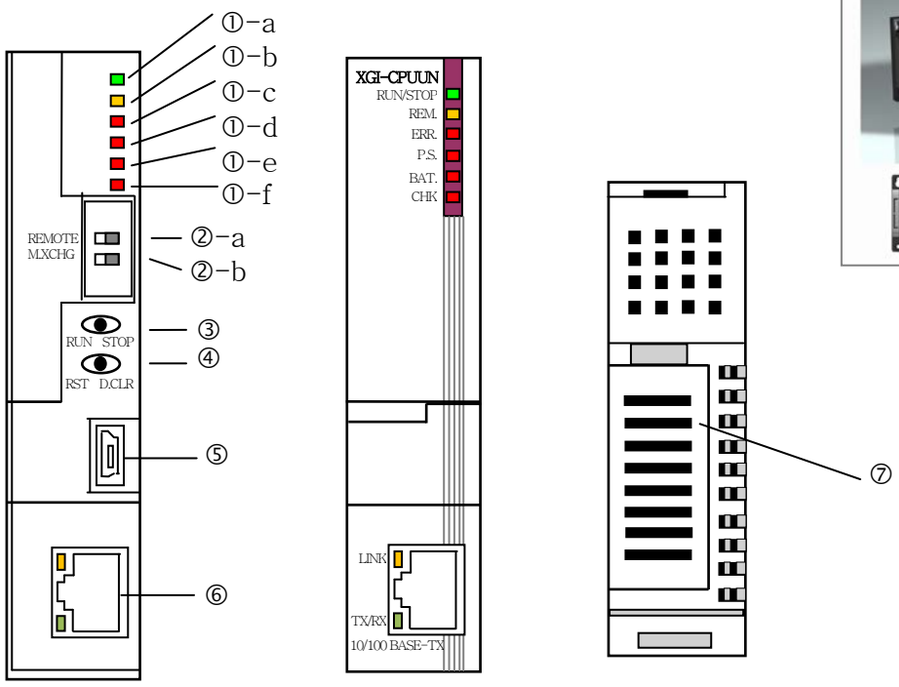
No.	Name	Description
① - a	RUN/STOP LED	Shows the operation status of the CPU module. • Green light: 'RUN' mode; the module is in operation ▶ 'RUN' operation by RUN/STOP mode switch ▶ 'Remote RUN' operation with RUN/STOP mode switch in 'STOP' • Red light: 'STOP' mode; the module is in operation ▶ 'STOP' operation by RUN/STOP mode switch ▶ 'Remote STOP' operation with Mode switch in 'STOP' ▶ If an error causing the suspension of operation is detected
① - b	REM LED	• On(yellow): remote enabled ▶ If 'REMOTE' switch is 'On'; • Off: remote disabled ▶ If 'REMOTE' switch is 'Off'

No.	Name	Description
① - c	ERR LED	• On(red): displaying an error of operation disabled • Off: displaying normal operation
① - d	PS LED (Programmable Status)	• On(red): ▶ If 'User Defined Flag' is 'On' ▶ Operation in erroneous status by 'Operation in Error Status' setting ▶ If removing the module or installing other module with 'M.XCHG' switch 'On' • Off: ▶ displaying normal operation
① - e	BAT LED	• On(red): low battery voltage • Off: normal battery level
① - f	CHK LED	• On(red): displayed if other settings but the standard setting is set (it can be added/deleted(cancelled) by parameters) ▶ If 'Module Change' switch is set to 'Module Change' ▶ If operating in 'Debug Mode' ▶ If 'Forcible On' setting ▶ If 'Fault Mask'/ 'SKIP' flag is set ▶ If a warning occurs during operation ▶ In case of power fault of extension base • Off: displayed if operating in standard setting
② - a	Boot/Nor Switch	Downloading OS before delivery • On (right side) : control in normal operation • Off (left side) : manufacturing default value; a user is not allowed to operate the switch(OS download mode) **⚠ Caution** Boot/Nor switch should be always On(right side) . If set to 'Off'(left side), it may cause the damaged module.
② - b	REMOTE Switch	Remotely controlling the operation of PLC. • On(right): every function enabled (REMOTE mode) • Off(left): remote functions disabled ▶ Program D/L, operation mode control limited ▶ Monitor and data change allowed

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>②- c</td><td>M.XCHG
(module change switch)</td><td>It replaces a module during operation.
• On (right): replacing a module
▶ A module is replaced by operating the key switch
• Off(left): module is replaced completely</td></tr>
<tr><td>③</td><td>RUN/STOP Mode switch</td><td>Setting the operation mode of the CPU module.
• STOP → RUN : execute program operation
• RUN → STOP : stop program operation

The control is prior to Remote switch control.</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”
1. When Reset switch is enabled
<table>
<tr><td>Operation</td><td>Result</td></tr>
<tr><td>move to left → return to center</td><td>Reset</td></tr>
<tr><td>move to left → keep 3 seconds or above → return to center</td><td>Overall reset</td></tr>
</table>
2. When D.Clear switch is enabled
<table>
<tr><td>Operation</td><td>Result</td></tr>
<tr><td>move to right → return to center:</td><td>General data area and retain area (M, Automatic variable) will be cleared.</td></tr>
<tr><td>move to left → keep 3 seconds or above → return to center:</td><td>General data area, retain area (M, Automatic variable) and R area will be cleared.</td></tr>
</table>
• Data clear process operates only in “STOP” operation mode.</td></tr>
<tr><td>⑤</td><td>USB connector</td><td>Connector for peripherals (XG5000 and etc): USB 1.1 supported</td></tr>
<tr><td>⑥</td><td>RS–232C connector</td><td>Connector for peripherals
• XG5000 connection: basically supported
• Modbus device connection: Modbus protocol supported
TX: Pin 7, RX: Pin 8, GND: Pin 5</td></tr>
<tr><td>⑦</td><td>Battery cover</td><td>Backup battery cover</td></tr>
</table>

The name of each part about XGI-CPUUN is as followings.





No.	Name	Description
① - a	RUN/STOP LED	Shows the operation status of the CPU module. • Green light: 'RUN' mode; the module is in operation ▶ 'RUN' operation by RUN/STOP mode switch ▶ 'Remote RUN' operation with RUN/STOP mode switch in 'STOP' • Red light: 'STOP' mode; the module is in operation ▶ 'STOP' operation by RUN/STOP mode switch ▶ 'Remote STOP' operation with Mode switch in 'STOP' ▶ If an error causing the suspension of operation is detected
① - b	REM LED	• On(yellow): remote enabled ▶ If 'REMOTE' switch is 'On'; • Off: remote disabled ▶ If 'REMOTE' switch is 'Off'

No.	Name	Description
① - c	ERR LED	• On(red): displaying an error of operation disabled • Off: displaying normal operation
① - d	PS LED (Programmable Status)	• On(red): ▶ If 'User Defined Flag' is 'On' ▶ Operation in erroneous status by 'Operation in Error Status' setting ▶ If removing the module or installing other module with 'M.XCHG' switch 'On' • Off: ▶ displaying normal operation
① - e	BAT LED	• On(red): low battery voltage • Off: normal battery level
① - f	CHK LED	• On(red): displayed if other settings but the standard setting is set (it can be added/deleted(cancelled) by parameters) ▶ If 'Module Change' switch is set to 'Module Change' ▶ If operating in 'Debug Mode' ▶ If 'Forcible On' setting ▶ If 'Fault Mask'/ 'SKIP' flag is set ▶ If a warning occurs during operation ▶ In case of power fault of extension base • Off: displayed if operating in standard setting
② - a	REMOTE Switch	Remotely controlling the operation of PLC. • On(right): every function enabled (REMOTE mode) • Off(left): remote functions disabled ▶ Program D/L, operation mode control limited ▶ Monitor and data change allowed
② - b	M.XCHG (module change switch)	It replaces a module during operation. • On (right): replacing a module ▶ A module is replaced by operating the key switch • Off(left): module is replaced completely
③	RUN/STOP Mode switch	Setting the operation mode of the CPU module. • STOP → RUN : execute program operation • RUN → STOP : stop program operation The control is prior to Remote switch control.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></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”
1. When Reset switch is enabled
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<tr><td>move to left → return to center</td><td>Reset</td></tr>
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<tr><td>move to right → return to center:</td><td>General data area and retain area (M, Automatic variable) will be cleared.</td></tr>
<tr><td>move to left → keep 3 seconds or above → return to center:</td><td>General data area, retain area (M, Automatic variable) and R area will be cleared.</td></tr>
</table>
• Data clear process operates only in “STOP” operation mode.</td></tr>
<tr><td>⑤</td><td>USB connector</td><td>Connector for peripherals (XG5000 and etc): USB 1.1 supported</td></tr>
<tr><td>⑥</td><td>Ethernet connector</td><td>Connector for peripherals
• XG5000 connection: basically supported
• TCP/IP Server connection</td></tr>
<tr><td>⑦</td><td>Battery cover</td><td>Backup battery cover</td></tr>
</table>

4.3 Battery

4.3.1 Battery specifications

Item	Specifications
Nominal Voltage / Current	DC 3.0 V / 1,800 mAh
Warranty period	5 years(at ambient temperature)
Applications	Program/data backup, RTC operation in case of power failure
Type	LiMnO2 Lithium Battery
Dimensions (mm)	ϕ 17.0 X 33.5 mm

4.3.2 Cautions for usage

1) Do not heat it up nor weld the electrode(it may reduce the life)
2) Do not measure the voltage with a tester nor short-circuit it(it may cause a fire).
3) Do not disassemble it without permission.

4.3.3 Battery life

The battery life varies depending on the duration of power failure, operation temperature range and etc. however, the XGI-CPUU is designed to use it for 5 years and longer at any environment.
If the battery voltage level is low, the CPU module generates a warning of 'Low Battery Level'. It can be checked by the LED of the CPU module, flag and error message in XG5000.
If it is occurred to a low battery level warning, please shortly change the battery.

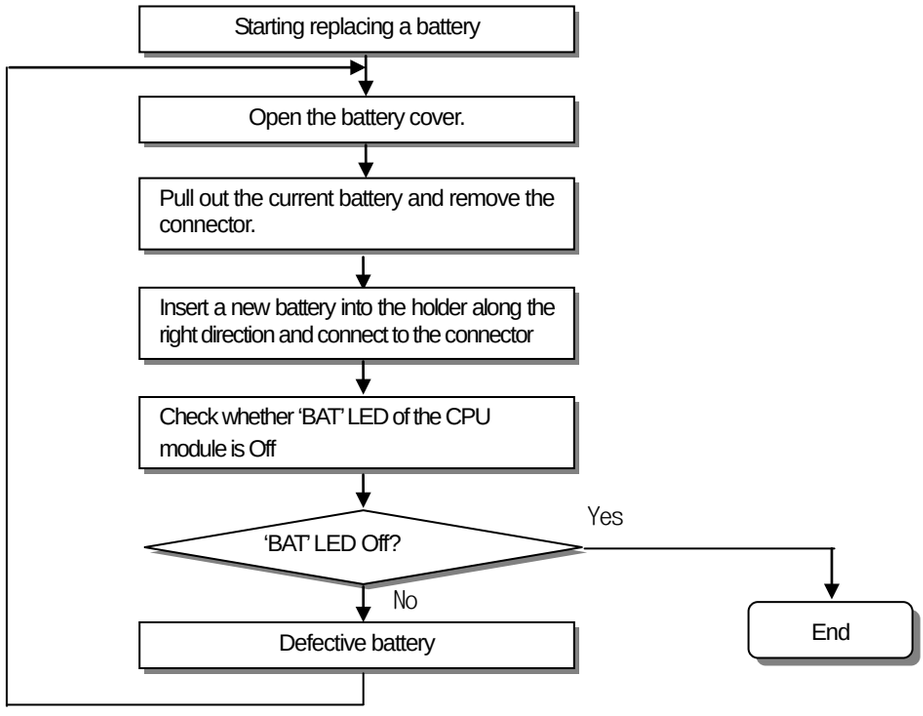
⚠ Caution

In general, it generates the warning in 5 years after the purchase, but if the current is excessively discharged due to defective battery or leakage current, it may warn it earlier. If it warns shortly after replacing a battery, the CPU module may need A/S service.

4.3.4 Replacement

A battery used as a backup power for program and data in case of power failure needs replacing regularly. The program and data is kept by the super capacity for about 30 minutes even after removing the battery, but it needs urgently replacing it as soon as possible.

Replace a battery in accordance with the following steps.



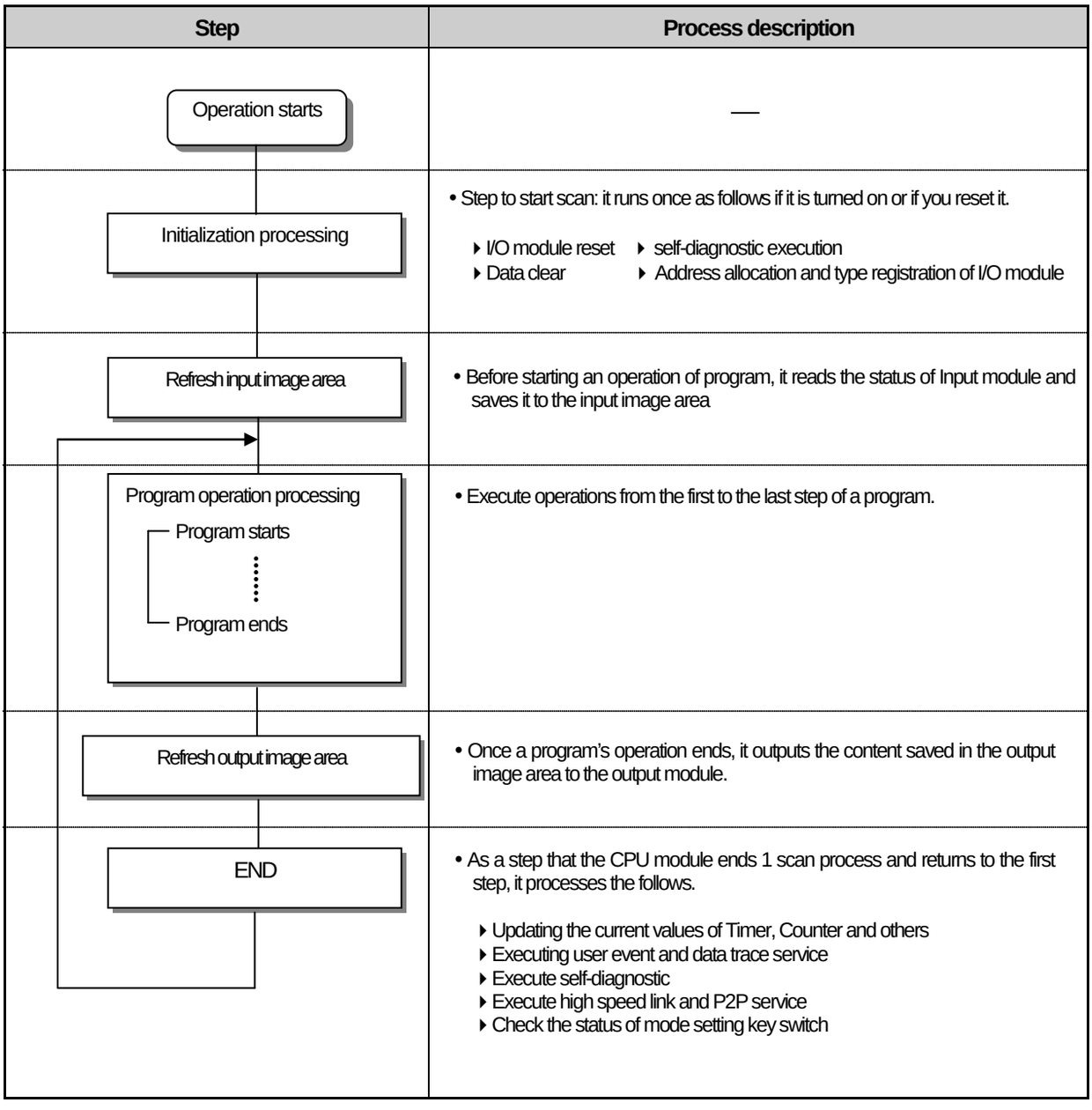
Chapter 5 Program Structure and Operation Method

5.1 Program Introduction

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 procedure can be divided as follows.



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 cycle 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.

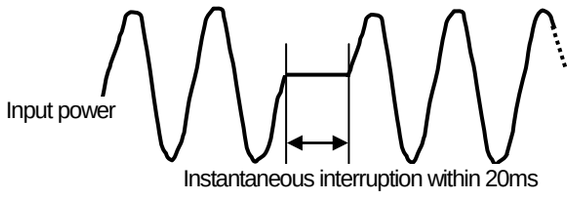
3) Fixed cycle scan (Constant Scan)

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 cycle program, it is executed synchronously as I/O is updated. The scan time of fixed cycle 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 of instantaneous interruption

The CPU module detects instantaneous interruption 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.

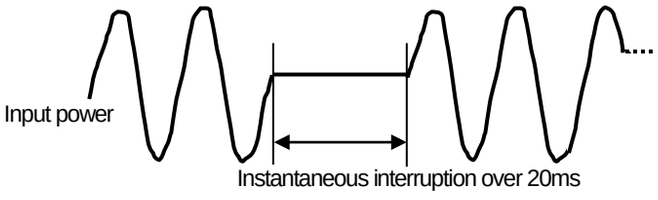
1) In case of instantaneous interruption within 20ms occurs;



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

2) In case of instantaneous interruption over 20ms occurs;

• It executes resumption process such as when it is turned on



Note

1) What is instantaneous interruption?
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 instantaneous interruption.

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.

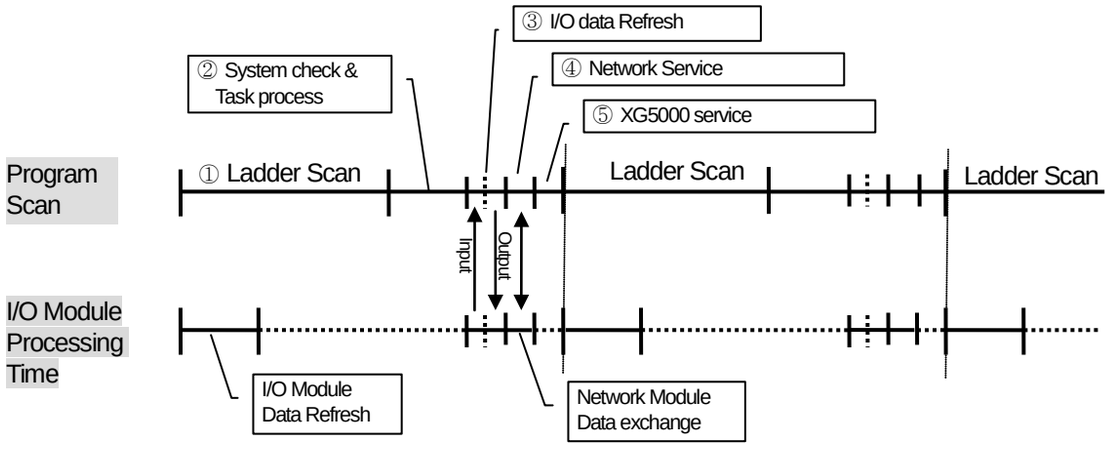
1) Operation and performance of XGI-CPUU

Program execution time, I/O data process time and communication service time are important factors affecting the 'scan time.' The XGI –CPUU 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	MPU processing time		BP Controller processing time		
	Ladder execution (32kstep)	System Task	Digital I/O module (32 points, 1module)	Analog module (8 ch, 1module)	Communication module (basic/extension) (200 byte, 1 block)
CPUUN	0.272 msec	0.2 msec	20 μs	75 μs	185 μs
CPUU/H/S	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 (μs)
② System check & Task process: 600 μs ~ 1.0 ms [varies depending on the usage of auxiliary functions]
⑤ XG5000 Service process time: 100 μs 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

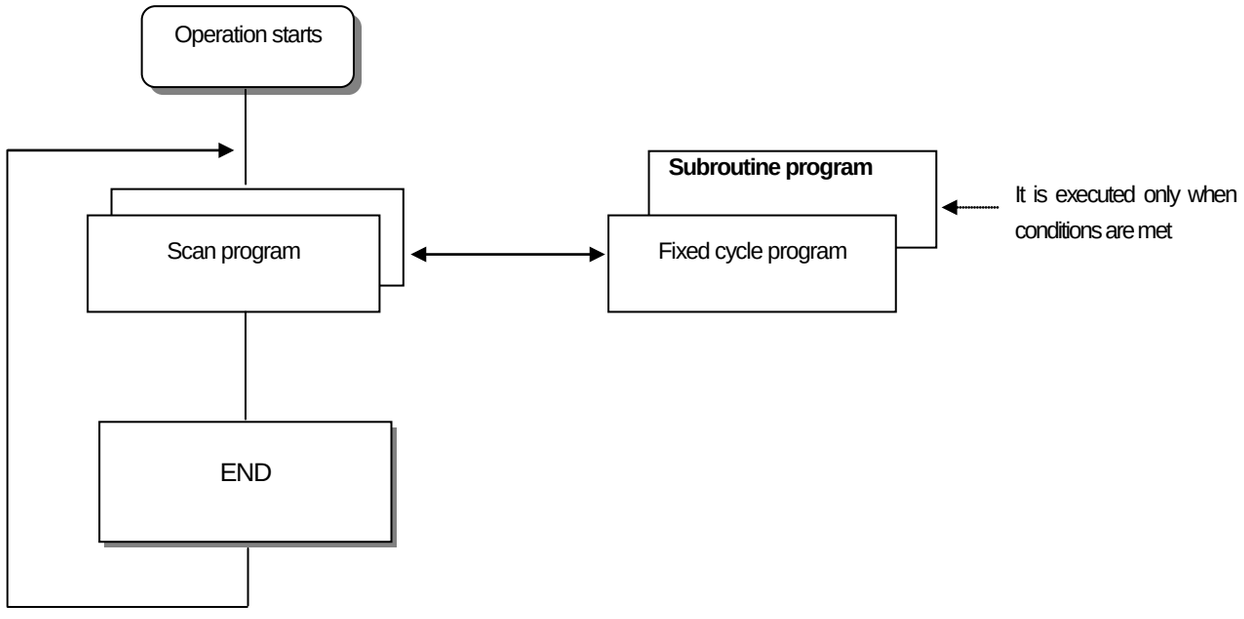
5.2.1 Program configuration

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

Functional Elements	Operation Description
Scan program	• Process a signal that repeats uniformly per scan
Fixed cycle interrupt program	• If time conditional process is required as follows, it executes the program at the fixed 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 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

It describes the program execution in case the power is turned 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) Functions

• 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

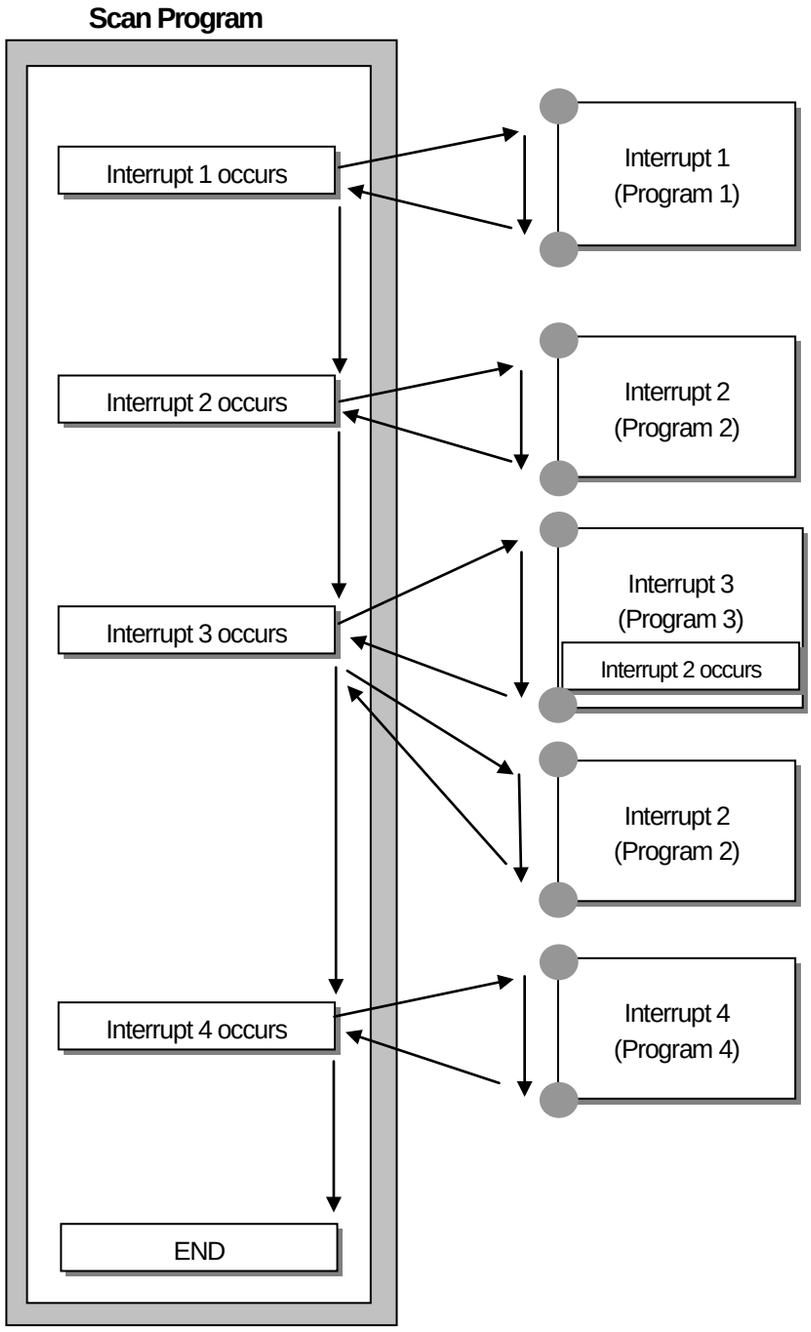
• Fixed cycle task program
▶ A program is executed at the fixed interval.

• 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.

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

5.2.3 Interrupt

To help your understanding about interrupt function, it describes how to set XG5000 program, a kind of XGT programming software briefly(for further information about the XG5000, please refer to the user's manual of XG5000).

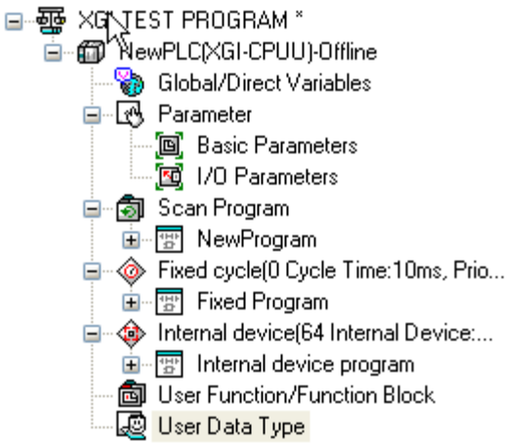


Note

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

1) Creating an interrupt program

Create a task in the project window of XG5000 as follows and add programs to be executed by each task. For further information, please refer to the user's manual of XG5000.



2) Task Types

The below table summarizes the types and functions of tasks.

Type / Spec.	Fixed cycle task (interval task)	Internal contact task (single task)
Number	32	32
Operation condition	Fixed cycle(settable up to 4,294,967.295 seconds at the unit of 1ms)	Conditions of internal device designation
Detection/execution	Cyclically execute at the pre-defined interval.	Execute by conditional search after completing scan program
Detection delay time	Delayed as long as 0.2ms to the max.	Delayed as long as the max. scan time.
Execution priority	Setting 2 ~ 7 levels (level 2 is the highest priority)	Same as the left
Task number	Assigning it between 0~31 so that it is not duplicate	Assigning it between 64~95 so that it is not duplicated

3) Processing method of task program

It describes the common processing method and cautions of task program

(1) Features of task program

• Task program does not reiteratively process like a scan program and instead, it executes only when the execution conditions occur. Make sure to remember this when creating a task program.

• For instance, if a task program with 10 seconds of fixed cycle is used with a timer and counter, the timer may have an error of 10 seconds maximum while the counter checks every 10 seconds, any counter input changed within 10 seconds is not counted.

(2) Execution priority

• If several tasks to execute are waiting, it processes from the highest priority task program. If there are several tasks of same priority, they are processed by the order which is occurred.

• 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) Correlation between scan program and task program in the initialization

• A user defined task does not operate while initialization task program is working.

• Since scan program has a low priority, stop a scan program if a task occurs and executes a task program. 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 from task program of a currently running program

• If program execution continuity is lost by executing a higher priority program, you can partially protect the task program from being executed, for a problematic part. 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'.

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

4) Processing method of fixed cycle task program

It describes the processing method when the task of task program is set at the fixed cycle.

(1) Task settings

• Set the execution cycle and priority of a task, which is the operation condition of a task program. Check the task number to manage tasks.

(2) Fixed cycle task processing
• Execute a fixed cycle task program at a pre-defined interval.

(3) Cautions for using a fixed 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. Any interruption time is ignored.

• Remember that several fixed cycle task programs are to be executed simultaneously when setting the execution cycle of a fixed cycle task program.
If using 4 fixed cycle task programs of which cycle is 2, 4, 10 and 20 seconds respectively, it may have simultaneous execution of 4 programs every 20 seconds, probably causing a longer scan time.

• You can check maximum, minimum, and current scan time of fixed cycle task with flag of fixed cycle task

_CYCLE_TASK_SCAN_TIME

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

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

5) Processing method of internal device task program

It describes the processing method of an internal device task program of which task(operation condition) execution range is extended from contact to device.

(1) Task settings

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

(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(fixed cycle, 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 instantaneous interruption

• 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 fixed cycle 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 a task occurs excessively or several tasks occur simultaneously in a scan, it may cause longer scan time or irregularity If a task setting can not be changed, check the max. 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(especially, create a fixed cycle task program so that it could be executed within 10% of the shortest task cycle among several tasks.)

(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.

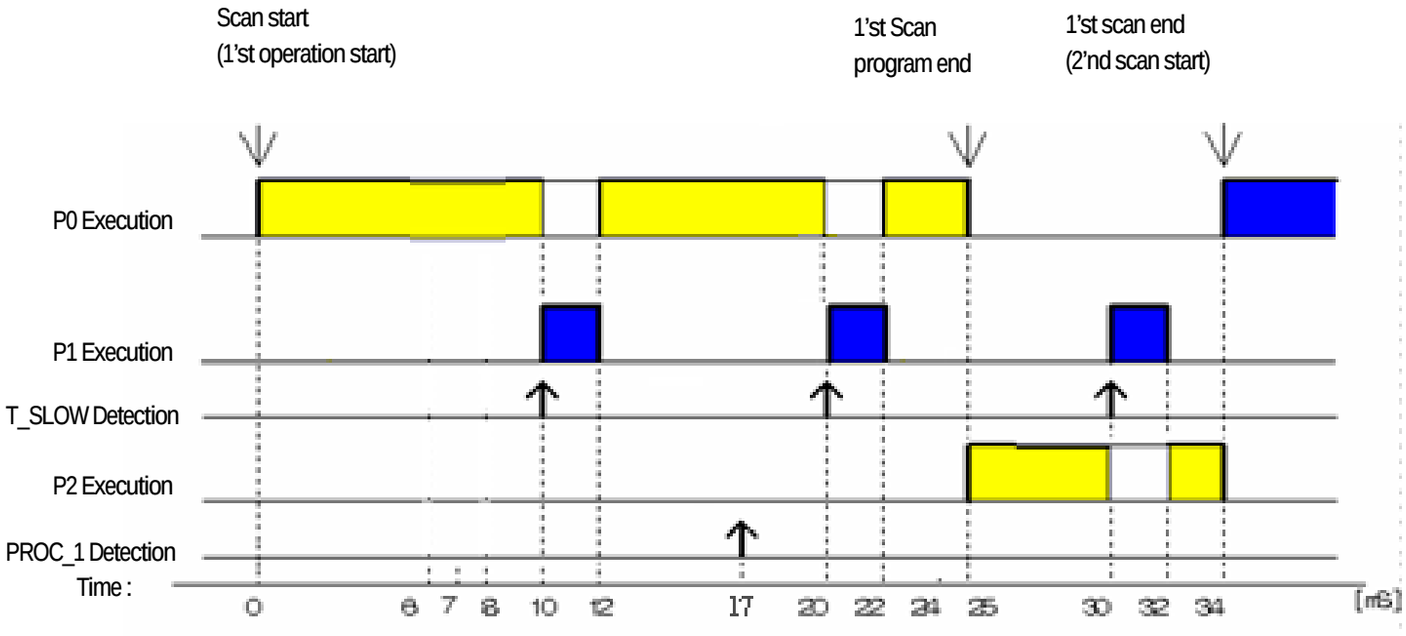
8) Program configuration and example of processing

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)
  -
- Registering a 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 occurrence: 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

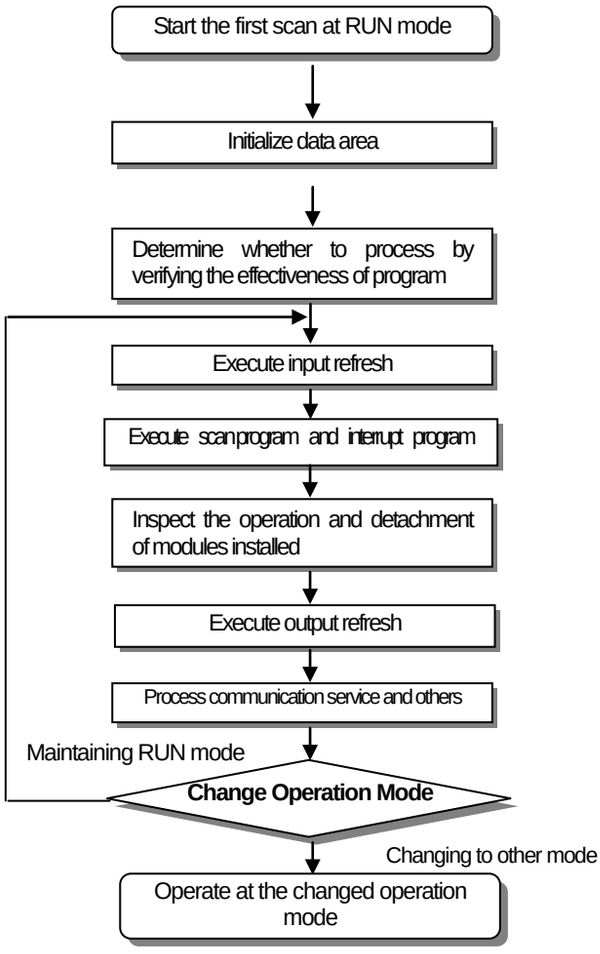
Time(ms)	Processing
0	Scan starts and the scan program P0 starts operation
0~10	Program P0 is executed
10~12	P0 stops due to the execution request for P1 and P1 is executed
17	Execution request for P2
12~20	P1 execution is complete and the suspended P0 resumes
20~22	P0 stops due to the execution request 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	Start a new scan(P2 execution starts)

5.3 Operation Mode

There are three operation modes of the CPU module; RUN mode, STOP mode and DEBUG mode.
It describes the operation process at each operation mode.

5.3.1 RUN mode

It executes a 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) Operation process
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 operations.

5.3.2 STOP mode

It stops with no program operation. Program can be transmitted through XG5000 only at remote STOP mode.

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

2) Operation process

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

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 a mode is changed
(1) At the beginning when the mode is changed, initialize the data area.
(2) Clear the output image area and execute input refresh.

2) Operation process
(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) Inspect the operation and detachment of modules installed.
(5) Process communication service and other internal operations.

3) Conditions of debug operation
There are four types of debug operation conditions and if reaching the break point, it is possible to set a different type of break point.

Operation condition	Description
Stepwise execution of operation(step over)	Upon an operation command, it executes a unit of operation and stops
Execution according to the designation of break point	Once a break point is designated in a program, it stops at the designated point
Execution according to the status of contact	If designating the contact area to monitor and the status(read, write, value), it stops when the designated operation occurs at the pre-defined contact.
Execution according to the designated scan frequency	Once designating the scan frequency to operation, it stops after operating as many as the scan frequency designated.

4) Operation method
(1) Set the debug operation conditions at XG5000 and execute the operation.
(2) The interrupt program can be set by enabled/disabled at the unit of each interrupt.
(For the details of operation, please refer to Chapter 12 Debugging in the user's manual of XG5000)

5.3.4 Changing operation mode

1) How to change an operation mode

An operation mode can be changed 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

An operation mode can be set as follows.

Operation mode switch	Remote switch	XG5000 command	Operation mode
RUN	X	X	Run
STOP	On	Run	Remote Run
		Stop	Remote Stop
		Debug	Debug Run
	Off	Mode change	Transfer(changed) 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.

Note

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. Make sure to change it only when the mode change is not remotely allowed.

5.4 Memory

The CPU module contains two types of memory that can be used by a user. One is the program memory to save a user program created to construct a system and the other one is the data memory to provide a 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(area)	Capacity					
	XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE
Whole program memory area	19M byte	10M byte			2M byte	2M byte
System area : • System program area • Backup area	2M byte	1M byte			1M byte	512Kbyte
Parameter area : • Basic parameter area • I/O parameter area • High speed link parameter area • P2P parameter area • Interrupt setting data area • Reserved area	1M byte	1M byte			512Kbyte	512Kbyte
Execution program area : • Scan program area • Task program area	4M byte	2M byte			256Kbyte	128Kbyte
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	12M byte	6M byte			768Kbyte	384Kbyte

NOTE

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(area)		Capacity					
		XGI-CPUUN	XGI-CPUU/D	XGI-CPUU	XGI-CPUH	XGI-CPUS	XGI-CPUE
Whole data memory area		4M byte	3M byte	2M byte		1M byte	512K byte
System area : • I/O data table • Forcible I/O table • Reserved area		770K byte				556K byte	238K byte
Flag area	System flag	8K byte		4K byte			
	Analogue image flag	8K byte				4K byte	2K byte
	PID flag	16K byte				4K byte	
	High speed link flag	22K byte					
	P2P flag	42K byte					
Input image area(%I)		16K byte				4K byte	
Output image area(%Q)		16K byte				4K byte	
R area(%R)		1024K byte		128K byte		64K byte	32K byte
Direct parameter area(%M)		512K byte	256K byte			64K byte	32K byte
Symbolic parameter area(max.)		1024K byte	512K byte			128K byte	64K byte
Stack area		256K byte	256K byte			64K byte	64K byte

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	Feature
Default	O	Retain settable if adding a parameter to the auto. parameter area
M	O	Retain settable into internal contact area by parameter
K	X	Contact that is kept as contact status in case of interrupt
F	X	System flag area
U	X	Analogue data register (retain not settable)
L	X	High speed link/P2P service status contact of communication module(retained)
N	X	P2P service address area of communication module(retained)
R	X	Exclusive flash memory area(retained)

Note

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 details of directions, please refer to the 'Online' in the user's manual of XG5000.

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.)

Mode / Parameter	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
- Writing by a program(recommending the initialization program)
- Writing '0' FILL and etc at 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.

- STOP Mode operation

Item	Restart Mode	Retain	M area retain	R area
Reset	Cold / Warm	Maintaining the previous value	Maintaining the previous value	Maintaining the previous value
Over all 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

- RUN Mode operation

Item	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
Over all reset	Cold / Warm	Initializing as '0'	Initializing as '0'	Maintaining the previous value

Note

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 initialization

Every device memory is cleared up as '0' at the status of memory deletion. The data value may be assigned initially depending on a system and at the moment, the initialization task should be used.

Chapter 6 Functions of CPU Module

6.1 Self-diagnostic Function

(1) The self-diagnostic is the function that the CPU module diagnoses any trouble of the PLC system.
(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

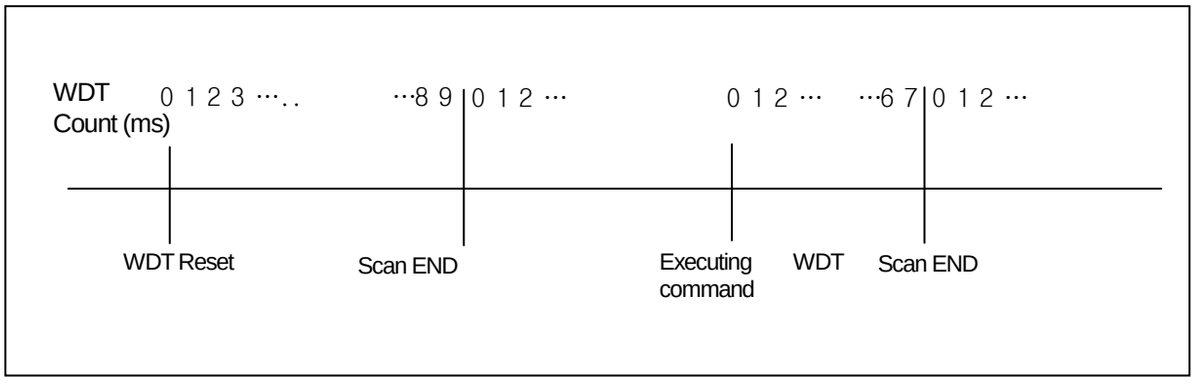
WDT(Watchdog Timer) is the function to detect any program runaway resulting from abnormal hardware/software of PLC CPU module.

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 parameter 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 restarts from 0 by initializing the overtime delay of scan watchdog time(for the details of WDT command, please refer to the chapter about commands in the manual).

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



Note

1) The range of WDT is between 10 ~ 1000ms(unit of 1ms)

6.1.2 I/O Module check

The function checks the I/O module when it starts and during operation as follows.

1) If a module that is not set in the parameter when it starts is installed or is fault; or
2) In case of the detachment of the I/O module or being in trouble during operation,

It detects an error. Then, the error lamp(ERR) on the front of the CPU module is On and the CPU stops operation.

6.1.3 Battery level check

The functions monitors battery level and detects, if any, low battery level, warning a user of it. At the moment, the warning lamp(BAT) on the front of the CPU module is On. For the details of measures, please refer to “4.3.3 Battery Life”.

6.1.4 Saving error log

The CPU module logs, if any, errors so that a user can easily analyze the error and take corrective measures. Please refer to “13.5.1 Error Codes List during CPU Operation”.

It saves each error code to the flag area.

Note

1) The results of self-diagnostic check are logged in the 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) Types of trouble

A trouble occurs mainly by the breakage of PLC, system configuration error and abnormal operation results.
‘Trouble’ can be categorized by ‘heavy fault mode’ at which the system stops for the purpose of the system safety and ‘light fault mode’ at which the system warns a user of a trouble and resumes operation.

The PLC system may have a trouble by the following causes.

- Trouble in the PLC hardware
- System configuration error
- Operation error while a user program is operating
- Error detection resulting from a fault external device

2) Operation mode when a trouble is found

If a trouble is detected, the PLC system logs the trouble message and stops or resumes operation depending on a trouble mode.

(1) Trouble in the PLC hardware
If heavy fault that the PLC may not properly work, such as CPU module, power module and others occurs, the system stops. However, the system resumes operation in case of light fault such as abnormal battery.

(2) System configuration error
It occurs when the hardware structure of PLC is not same as defined in the software. At the moment, the system stops.

(3) Operation error while a user program is operating

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 resumes operation. If an operation time exceeds the overtime delay limit or the built-in I/O module is not controlled, the system stops.

Note

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 resulting from a fault external device

It detects a fault of external device; in case of heavy fault, the system stops while it just displays a fault of the device and keeps operating in case of light fault.

Note

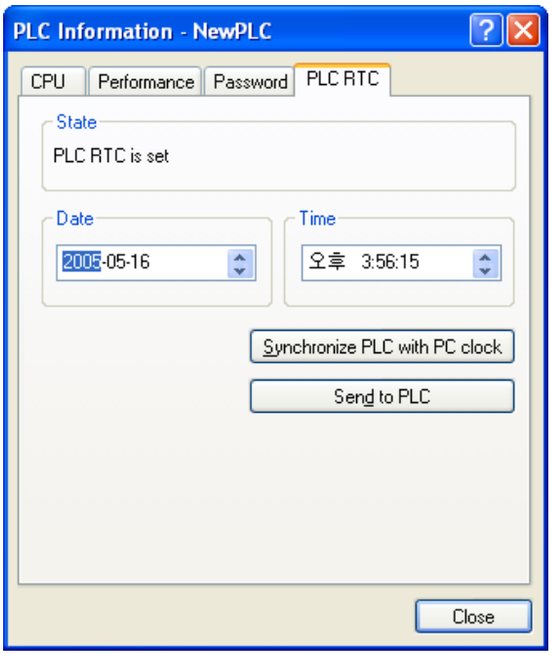
1) If a fault occurs, the fault number is saved into the flag(_ANNUM_ER).
2) If light fault is detected, the fault number is saved into the flag(_ANNUM_WAR).
3) For further information about the flags, please refer to Appendix 1. Flags List.

6.2 Clock Function

The CPU module contains a clock element(RTC), which operates by the backup battery even in case of power-off or instantaneous interruption.
By using the clock data of RTC, the time control for the operation or trouble logs of the system is available. The present time of RTC is updated to the clock-related F device per scan.

1) Read from XG5000/Setting

Click 'PLC RTC' in the online mode, 'PLC Information.'



It displays the time from the PLC RTC. If it displays the present time incorrectly, a user can fix it up by transferring the right time after manually setting the time or performing "Synchronize PLC with PC clock" method to transmit the time of PC clock connected to the PLC.

2) Clock reading by Flag

It can be monitored by flags as follows.

Flags to read the clock	Examples	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) Clock data modified by program

A user also can set the value of clock by using a program.
It is used when setting the time manually by external digital switches or creating a system to calibrate a clock periodically on 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.

Click Writing Flag	Description	Range
_RTC_TIME_USER[0]	Year	1984 ~ 2163,
_RTC_TIME_USER[1]	Month	Jan ~ Dec
_RTC_TIME_USER[2]	Date	1^{st} ~31^{st},
_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.

- No input is allowed unless time data is entered in a right format
  (However, even if the day of the week data is not correct, it is set without error detected)

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

4) How to express the day of the week

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

5) Time error

The error of RTC varies depending on the operating temperature. The following table shows the time error for a day.

Operating temp.	Max. error (sec/date)	Ordinary (sec/date)
0 °C	- 4.67 ~ 1.38	-1.46
25 °C	- 1.64 ~ 2.42	0.43
55 °C	- 5.79 ~ 0.78	-2.29

Note

1) Initially, RTC may not have any clock data.
2) When using the CPU module, first make sure to set the accurate clock data.
3) If any data out of the clock data range is written into RTC, it does not work properly.
   i.e.) 14M 32D 25H
4) RTC may stop or have an error due to abnormal battery and other causes. The error is released if a new clock data is written.
5) For further information of how to modify the clock data, please refer to the description of XGI commands

6.3 Remote Functions

The CPU module can change operation by communication, besides the key switch installed on it. 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) Types of remote operation

(1) Operation by connecting to XG5000 via USB or RS-232C port installed on the CPU module
(2) Other PLC networked on the PLC can be controlled with the CPU module connected to XG5000.
(3) The PLC operation is controlled by HMI software and other applications through the dedicated communication.

2) Remote RUN/STOP

(1) Remote RUN/STOP is the function to execute RUN/STOP remotely with the dip switch of the CPU module set to REMOTE and the RUN/STOP switch set to STOP.
(2) It is a very convenient function when the CPU module is located in a place hard to control or in case the CPU module is to run/stop from the outside.

3) Remote DEBUG

(1) Remote DEBUG is the function to control DEBUG with the dip switch of the CPU module set to REMOTE and RUN/STOP switch set to STOP.
(2) It is a very convenient function when checking program execution status or data in the debugging operation of the system.

4) Remote Reset

(1) Remote reset is the function to reset the CPU module remotely in case an error occurs in a place not to directly control the CPU module.
(2) Like the switch control, it supports 'Reset' and 'Overall Reset.'

Note

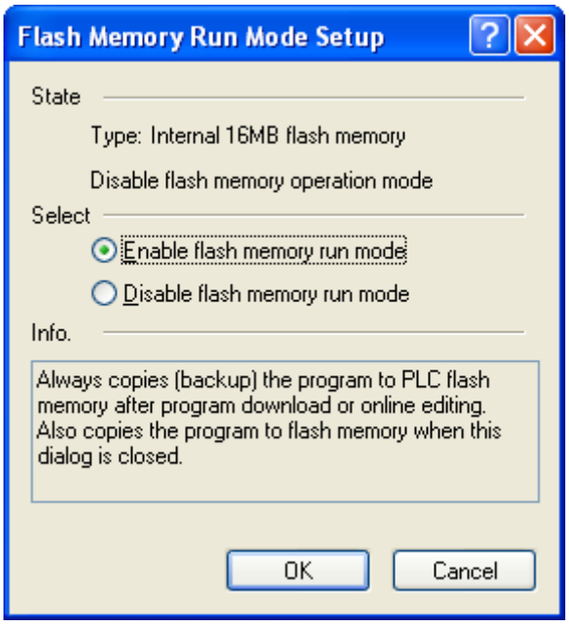
1) For the further information about remote functions, please refer to the 'Online' part in the user's manual of XG5000.

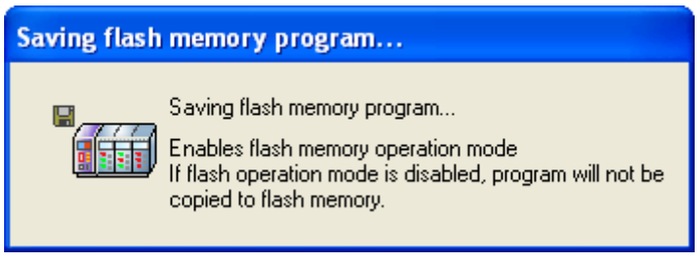
5) Flash memory operation mode

(1) What is the flash operation mode? It means that the system operates by the backup program in flash in case the data in program ram are damaged. If selecting "Flash Memory Operation Mode", it starts operation after being moved to the program memory of the CPU module when the operation mode is changed from other mode to RUN mode or when restarting.

(2) Flash Memory Operation Mode Setting

Check the operation mode setting by using 'Online → Set Flash Memory … → 'Enable flash memory run mode' and click 'OK. ' Once pressing it, it shows a dialogue box stating "Saving flash memory program …" and copies the program from user program area to flash.





Note

1) The default is 'Flash Memory Operation Mode deselected'.

2) Flash memory operation mode is maintained as 'On' as long as it is not 'Off' by XG5000.

3) Flash memory operation mode can be changed, irrespective of RUN/STOP mode.

4) Flash memory operation mode can be set by the online menu of XG5000 when executing flash 'operation mode setting' after program debugging is complete with the flash memory operation mode off.

5) If modifying during RUN with 'flash memory operation mode' set, the changed program may be applied only when it restarts as long as the program is successfully written in flash memory. Note that if the PLC restarts before a program is saved into flash memory, a program that is saved in advance, instead of the changed program, works.

6) If flash memory operation mode is changed from 'disabled' to 'enable', flash memory operation mode is applied as long as the flash memory writing is complete. In case the PLC restarts before completing program writing, "Flash memory operation mode" is released.

(3) Flash memory operation method

If restarting the PLC system or changing its operation mode to RUN, it works as follows depending on the flash operation mode setting.

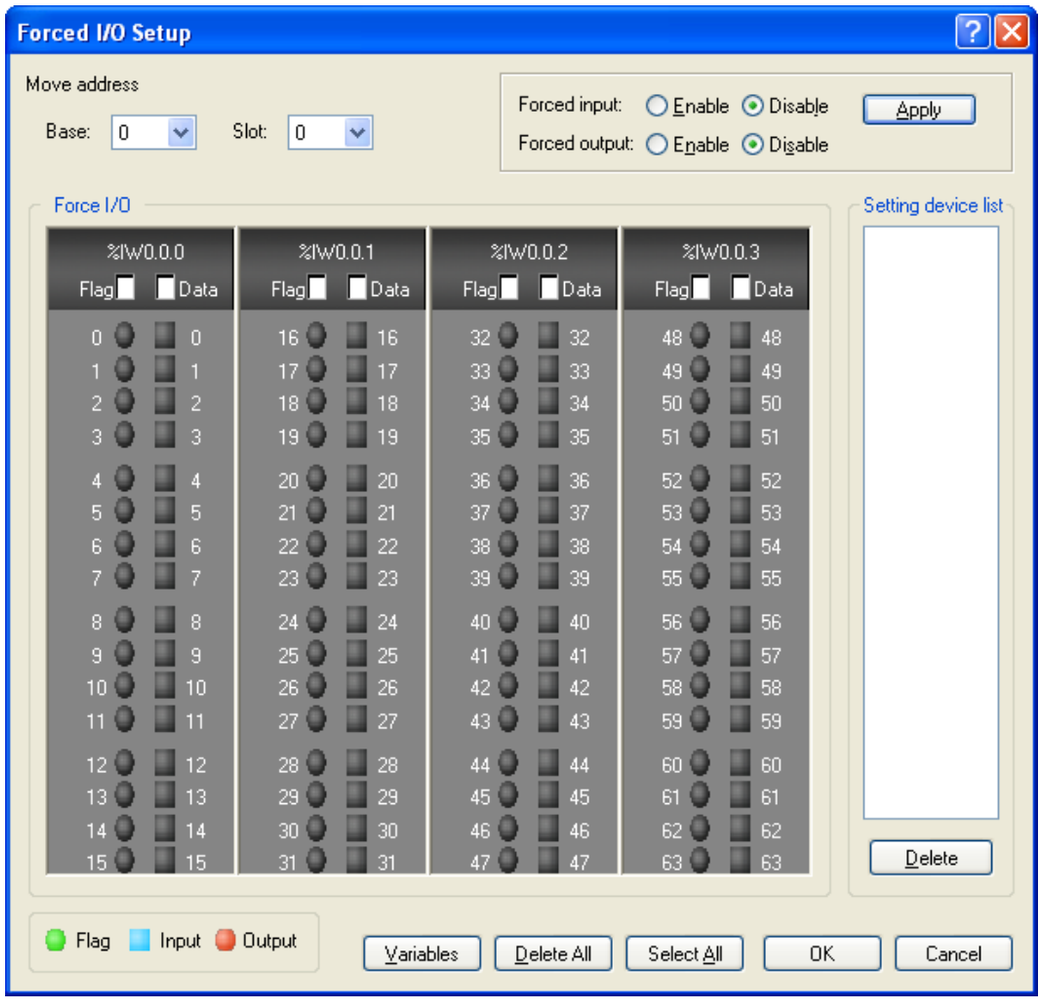
Flash memory operation mode setting	Description
On	If program memory data are damaged because flash memory and program memory are different or battery voltage is low, it downloads the program saved in flash memory to program memory.
Off	CPU understands that flash memory does not have any program and operates by the program saved in RAM.

6.4 Forcible On/Off of I/O

The forcible I/O function is used to forcibly turn on or off I/O area, irrespective of program execution results.

6.4.1 Forcible I/O Setting

Click 'Forcible I/O Setting' in online mode.



To set forcible I/O, select the flag of a contact to set and the data checkbox
To set "1", select the flag and data of a bit and then, select a flag.
To set "0", select a flag only, not the data corresponding to the bit.
If selecting 'forcible input or output enabled', the setting is applied and it works accordingly.
For further directions, please refer to the user's manual of XG5000.

Note

1) Forcible I/O setting is available only in local I/O module.
2) It can not be set in remote I/O module(smart I/O module).
3) If forcible I/O is set, "CHK LED" is On.
4) The forcible I/O set by a user is maintained even though a new program is downloaded.

6.4.2 Forcible On / Off processing time and processing method

(1) Forcible input

'Input' replaces the data of a contact set by Forcible On/Off from the data read from input module at the time of input refresh with the forcibly set data and updates input image area. Therefore, a user program can execute operation with actual input data and forcibly set data.

(2) Forcible output

'Output' replaces the data of a contact set by Forcible On/Off from the output image area data containing operation result at the time of output refresh with the forcibly set data and outputs to an output module after completing user program operation. Unlike input, the data in output image area is not changed by forcible On/Off setting.

(3) Cautions for using forcible I/O

- It works from the time when input/output are set to 'enabled/disabled' respectively after setting forcible data.
- Forcible input can be set even though actual I/O module is not installed.
- The previously set On/Off setting data are kept in the CPU module, despite of power off → on, operation mode change, program download or manipulation by reset key. However, it is deleted if overall reset is executed.
- Forcible I/O data are not deleted even in STOP mode.
- To set new data from the first, release every setting of I/O by using 'overall reset'.

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.

Note

1) For further information about the DIREC_IN,DIREC_OUT' function, please refer to the XGI Instruction manual.
2) When using the DIREC_IN,DIREC_OUT' function, the value is directly reflected, preceding forcible I/O.

6.6 Saving Operation Logs

There are four types of operation logs; Error log, Mode change log, Shut down log and System log.
It saves the time, frequency and operation of each event into memory and a user can conveniently monitor them through XG5000.
Operation log is saved within the PLC unless it is deleted by XG5000.

6.6.1 Error log

It saves error log that occurs during operation.

- Saving error code, date, time and error details.
- Saving logs up to 2,048
- Automatically released if memory backup is failed due to low battery level and etc.

6.6.2 Mode change log

It saves the change mode information and time if an operation mode is changed.

- Saving the date, time and mode change information.
- Saving up to 1,024.

6.6.3 Shut down log

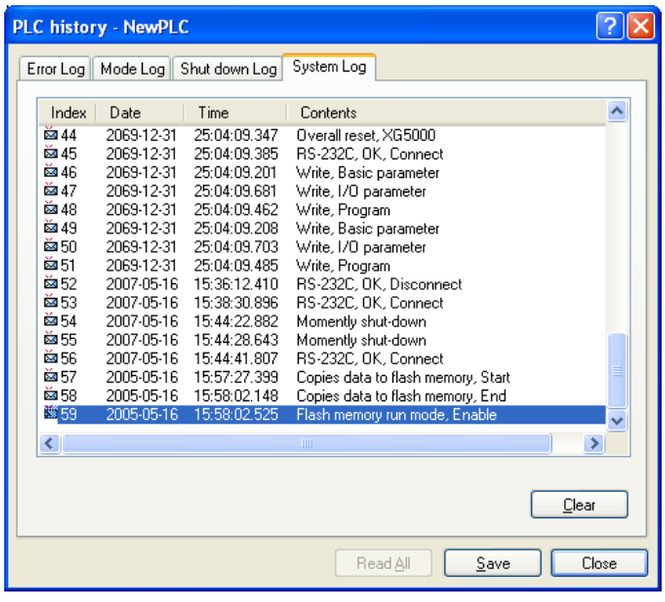
Saving power On/Off data with it's time data.

- Saving On/Off data, date and time.
- Saving up to 1,024.

6.6.4 System log

It saves the operation log of system that occurs during operation.

- Saving the date, time and operation changes
- XG5000 operation data, key switch change information
- Instantaneous interruption data and network operation
- Saving up to 2,048



Note

1) The saved data are not deleted before it is deleted by selecting a menu in XG5000.
2) If executing Read All in case logs are more than 100, the previous logs are displayed.

6.7 Diagnosing Faults of External Device

It is the flag that a user detects a fault of external device so that the suspension/warning of a system could be easily realized. If using the flag, it can display a fault of external device, instead of creating a complex program and monitor a fault position without XG5000 and source program.

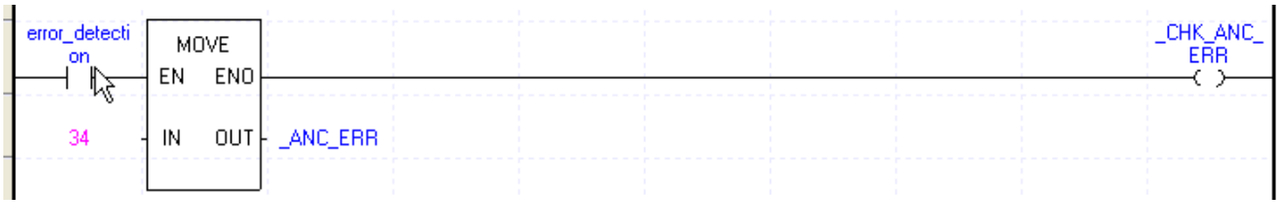
1) Detection/classification of external device fault

(1) The fault of external device is detected by a user program and it can be divided into heavy fault(error) that requires stopping the PLC operation and light fault(warning) that only displays fault status while it keeps operating.
(2) Heavy fault uses '_ANC_ERR' flag and light fault uses '_ANC_WB' flag.

2) If a heavy fault of external device is detected

(1) If a heavy fault of external device is detected in a user program, it writes the value according to error type defined in a system flag, '_ANC_ERR' by a user. Then, with _CHK_ANC_ERR flag On, 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. Then, 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 CHK LED are On, besides ERR LED.
(2) In case of a fault, a user can check the cause by using XG5000 and alternatively, check it by monitoring '_ANC_ERR' flag.
(3) To turn off ERR LED, P.S LED and CHK LED, which are On by heavy fault error flag of external device, it is necessary to reset the PLC or turn it off and on again.

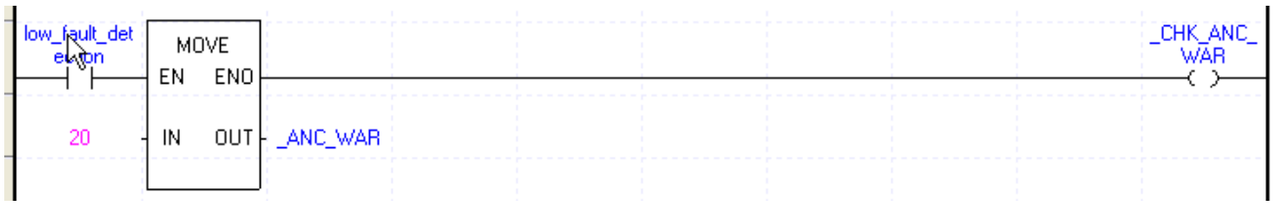
■ Example



3) If a light fault of external device is detected

(1) If a light fault of external device is detected in a user program, it writes the value according to warning type defined in '_ANC_WAR' by a user. Then, with _CHK_ANC_WAR On, it checks at the completion of a scan program. At the moment, if a warning is displayed, '_ANNUN_WAR' of '_CNF_WAR', which is the representative error flag of system 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) With _CHK_ANC_WAR OFF, P.S LED and CHK LED are off and the display, '_ANNUN_WAR' of '_CNF_WAR' is reset.

■ Example



6.8 Fault Mask Function

6.8.1 Applications and operations

- Fault mask helps a program keep operating even though a module is in trouble during operation. A module designated as fault mask normally works until a fault occurs.
- If an error occurs on a module on which fault mask is set, the module stops working but the entire system keeps working.
- If a fault occurs in a module during operation, the CPU module sets the error flag and "PS LED" on the front is "On." The error is displayed when accessing to XG5000.

6.8.2 Fault mask setting

- Fault mask can be set by the online menu of XG5000. For the details, please refer to the user's manual of XG5000.
- Fault mask can not be set by a program.

6.8.3 Releasing fault mask

Fault mask is released only by the following methods.

- Releasing the setting in the online menu of XG5000
- Releasing by overall reset
- Automatically releasing in case memory backup is failed due to low battery level and other causes

Note that the fault mask is not released even in the following cases.

- Power Off→On
- Operation mode change
- Program download
- Reset key(released only when it is pressed for 3 seconds and longer)
- Data clear

Note

1) If releasing fault mask with error flag in the CPU module not cleared although the causes of an error are eliminated, the system stops. Please check the state of error flag before releasing fault mask flag.

6.9 I/O Module Skip Function

6.9.1 Applications and operations

During operation, the I/O module skip function excludes a designated module from the operation. For the designated module, the data update and fault diagnostics of I/O data stops as soon as being designated. It is available when temporarily operating it with the fault excluded.

6.9.2 Setting and processing I/O data

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

- Input(I) image area suspends input refresh, so it maintains the value set before skip setting. However, even in the case, the image manipulation by forcible On/Off is still effective.

- The actual output of output module is Off when setting the skip function but it changes depending on a user program's operation, irrespective of skip setting. After the skip setting, the output value of output module can not be controlled by forcible On/Off.

- The skip function is identically executed even when using I/O function.

6.9.3 Releasing skip function

The I/O module skip function is released only by the method of setting.
- Releasing by the online menu of XG5000
- Releasing by overall reset
- Automatically releasing in case memory backup is failed due to low battery level and other causes

Note that the fault mask is not released even in the following cases.
- Power Off→On
- Operation mode change
- Program download
- Reset key(released only when it is pressed for 3 seconds and longer)
- Data clear

Note

1) If any fault is found in a module when releasing the skip function, the system may stop. Before releasing the skip function, make sure to release the skip with fault mask set and check the operation of a module.

6.10 Module Replacement during Operation

A module can be replaced during operation in the XGT system. However, a special attention should be paid because the module replacement during operation may cause malfunction. Make sure to follow the steps directed in the user's manual.

6.10.1 Cautions for usage

- Base and power module can not be replaced.
- Some communication modules(XGL-PMEA, XGL-DMEA) can be connected as long as network is set(using Sycon software).
- When replacing a module, align the bottom of the base and the holding part of a module before inserting it. A wrong insertion may cause 'system down.'

6.10.2 Replacing modules

A module can be replaced in two ways as follows.

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

(2) A module can be replaced by using a switch of the CPU module.
(1) Move the "Module Replacement Switch(MXCHG)" to the right(On) on the front of the CPU module.
(2) Remove the old 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 works.
(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)
Even when replacing a module again due to a fault of replaced module, it should be repeated from (1).
(6) Release fault mask and restore to the normal operation.

Note

1) During the procedure, the I/O module that is operating on a same base may cause wrong data.
2) Because of a trouble of the replaced module, a trouble of another module may be detected. It is safe to set fault mask to the entire base.

Note

1) When replacing a module, isolate the load power for the safety purpose.
2) When replacing an input module Make sure to consider the designation of input image status by using forcible On/Off and others.

⚠ Warning

Note that when installing a module with the bottom of a module not completely attached with the base, it may cause malfunction of another module.

6.11 Allocating I/O Number

I/O number allocation is to assign the address to the I/O terminal of each module to read data from an input module and output it to an output module.
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

During PLC operation, a program and part of parameters can be modified without any interruption of control.
For the details of modification, please refer to the user's manual of XG5000.

The items modifiable during operations are as follows.

- Program
- Communication parameters

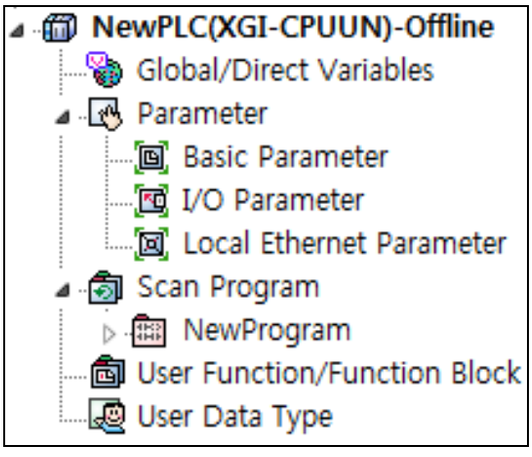
> **Note**
>
> The basic parameters and I/O parameters can not be modified during operation. If such parameters are to be modified, it is necessary to stop the operation before modification.

6.13 Local Ethernet function(XGI-CPUUN)

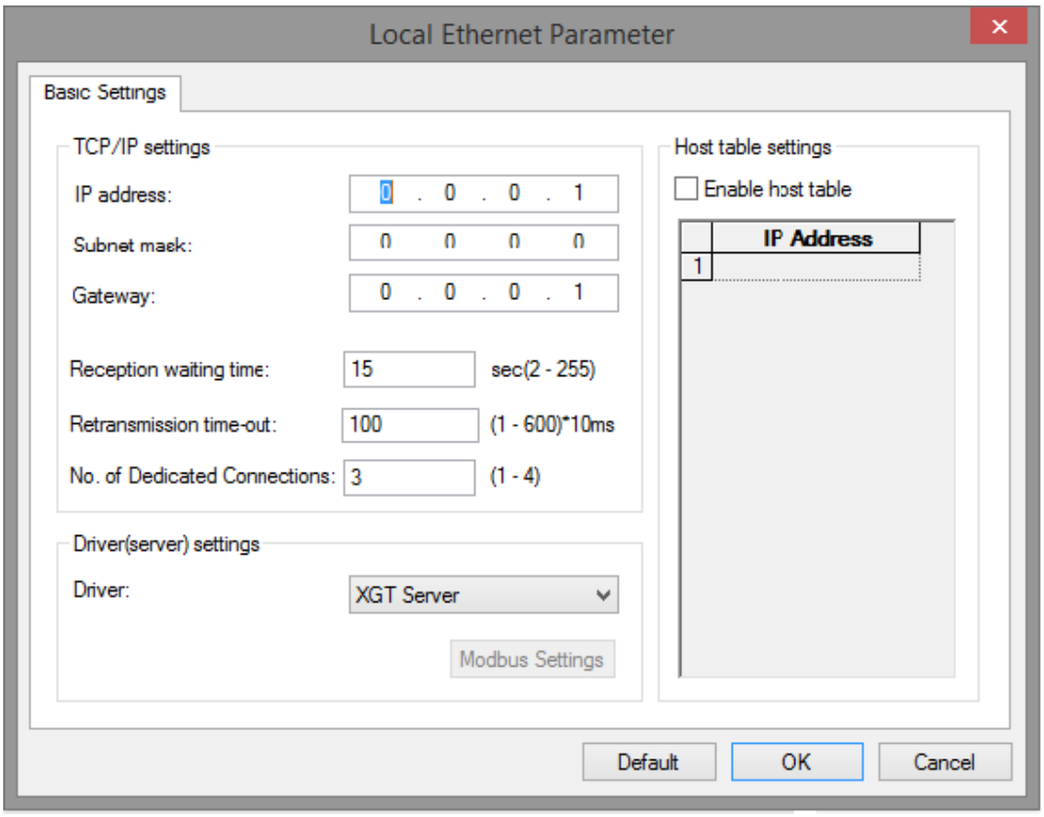
XGI-CPUUN can carry out the functions of Ethernet server using internal local Ethernet function without extra Enet I/F module.

6.13.1 Local Ethernet Parameter Settings.

Make a new 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	Description
IP address	Specify the IP Address of the applicable CPU module.
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.
Reception waiting time	If there is no request during the specified time from the host PC or MMI 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.
Retransmission time-out (10 ㎳)	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. (Applicable station considers it as a data missing.) (available range is 10 ㎳ ~ 6000 ㎳) * **Note** : 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.
Number of dedicated connections	Number of TCP dedicated services accessible at a time. (Max.4)

(2) Driver(Server) setting

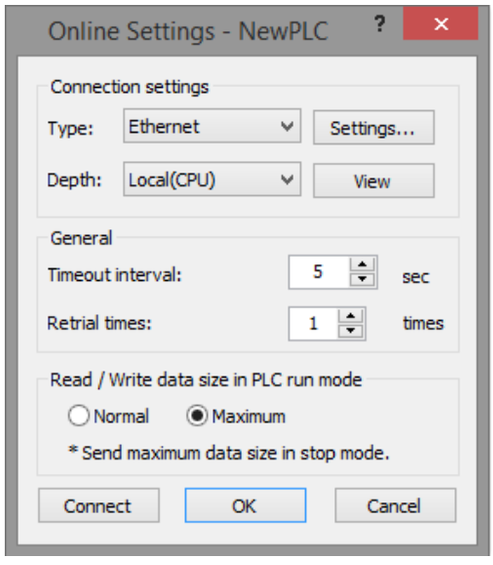
Classification	Description
XGT server	Set when operated as dedicated communication server (slave)
Modbus TCP/IP server	Set when operated as Modbus server driver (slave)

(3) Host table setting

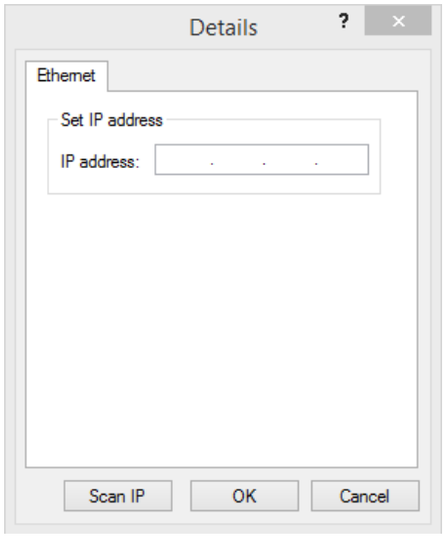
Classification	Description
Enable host table	Access allowed to applicable module of IP address registered in host table (unregistered client(IP address) is prohibited from connection when enabled)

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.

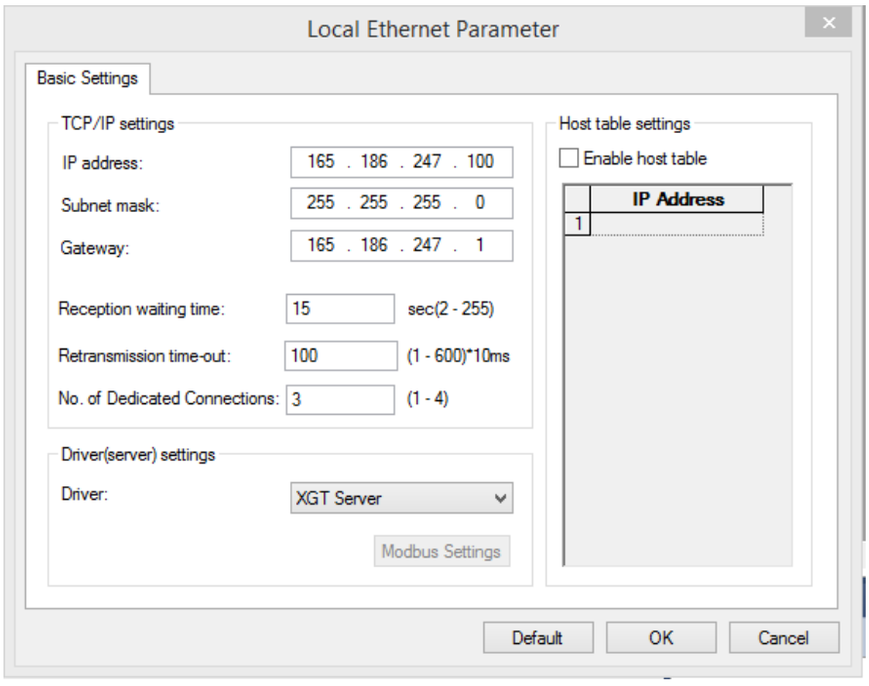


Click the setting button to specify Ethernet IP. Click OK after specify the Ethernet IP set before.
User can find the IP information available now.



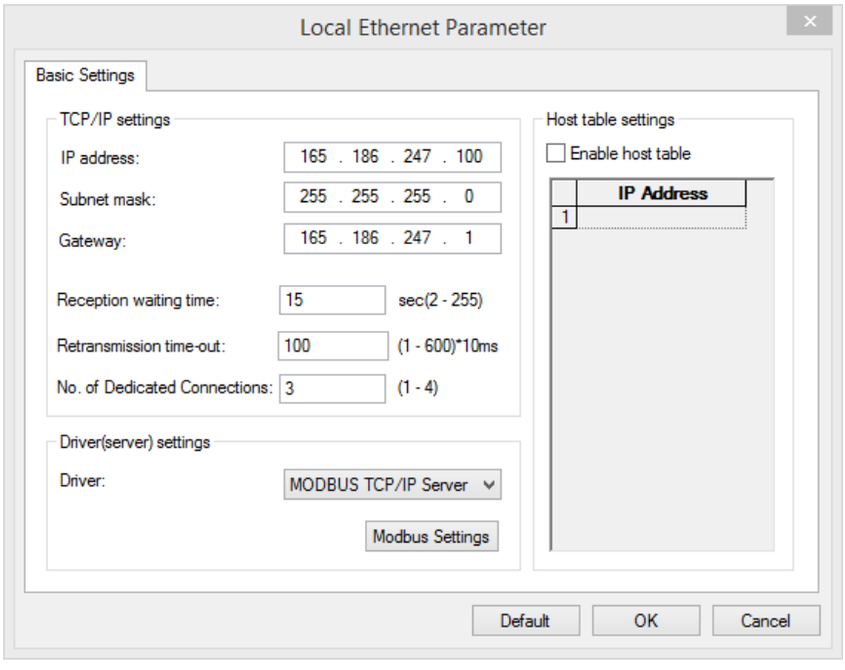
6.13.3 Local Ethernet connection with XGT Server.

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

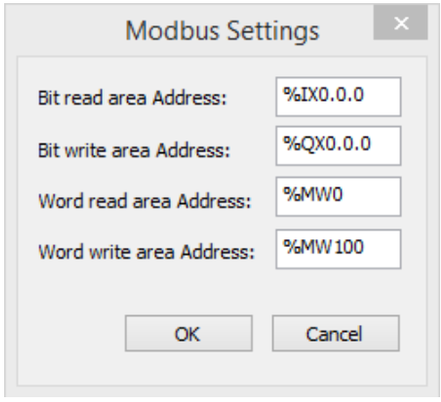


6.13.4 Local Ethernet connection with TCP/IP Server.

Set the Local Ethernet Parameters as shown below figure. User can use it as a Modbus server



Below figure is about Modbus settings. .



Note

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.

Chapter 7 I/O Module

7.1 Cautions for Selecting Module

It describes the cautions when selecting digital I/O modules used for the XGI series.

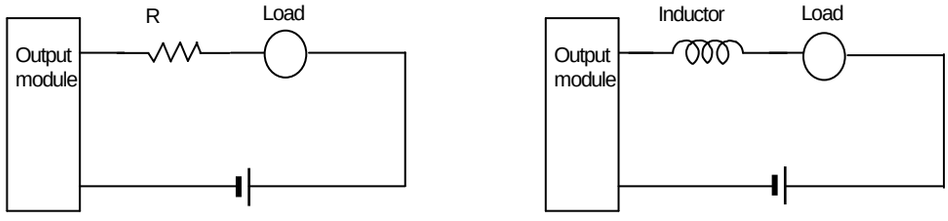
1) There are two digital input types; current sink input and current source input
Since the wiring method of external input power varies in a DC input module, it should be selected considering the specifications of input connectors.

2) The max. simultaneous input point varies depending on a module type. That is, it may be different, depending on input voltage and ambient temperature. Please review the specifications of input module to apply before use.

3) In case of an application for highly frequent switching or inductive load switching, the relay output module may have a shorter life, so it needs a transistor module or triac output module, instead of it.

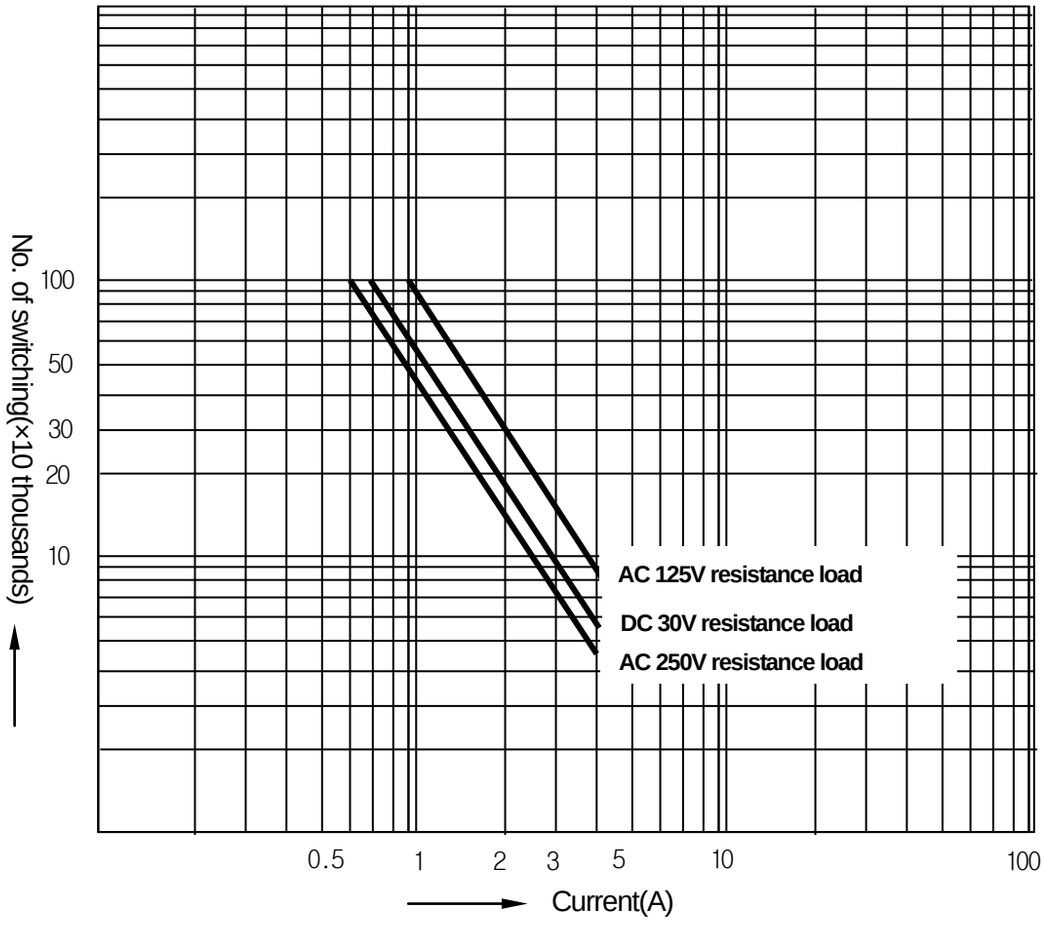
4) If an output module operates an inductive load(L), the max. On/Off frequency should be limited to On per 1 second and Off per 1 second, each.

5) In case a counter timer using DC/DC converter is used as a load in an output module, setting the average current may cause a trouble because it may have inrush current in case of On or a certain cycle during operation. Therefore, if using the foresaid load, it is necessary to connect resistance or inductor parallel to load or alternatively use a module of which max. load current is large.

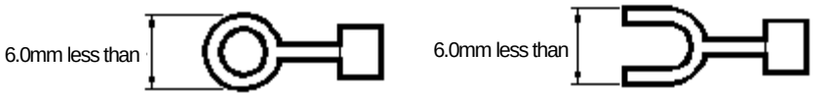


6) A fuse in an output module can not be replaced. That's why it is intended to prevent external wiring from being damaged when the output of a module is short-circuited. Therefore, the output module may not be protected. If an output module is destructed in any other fault mode save for short-circuit, a fuse may not work.

7) The following figure shows the relay life of relay output module.
It also shows the max. life of relay used for relay output.



8) A clamped terminal with sleeve can not be used for the XGI terminal strip. The clamped terminals suitable for terminal strip are as follows(JOR 1.25-3:Daedong Electricity).



9) The cable size connected to a terminal strip should be 0.3~0.75 ㎟ stranded cable and 2.8 ㎜ thick. The cable may have different current allowance depending on the insulation thickness.

10) The coupling torque available for fixation screw and terminal strip screw should follow the table below.

Coupling position	Coupling torque range
IO module terminal strip screw(M3 screw)	42 ~ 58 N·㎝
IO module terminal strip fixation screw(M3 screw)	66 ~ 89 N·㎝

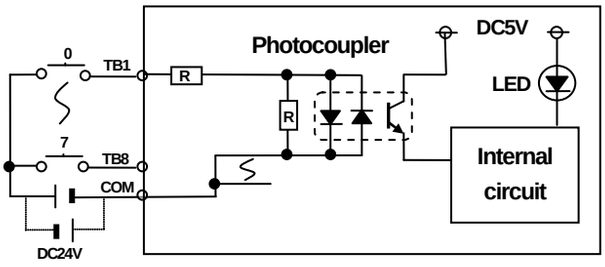
11) Transistor output module(XGQ-TR4A, XGQ-TR8A) supports terminal protector function.
Thermal Protector is the function to prevent overload and overheat.

7.2 Digital Input Module Specifications

7.2.1 8 point DC24V input module (source/sink type)

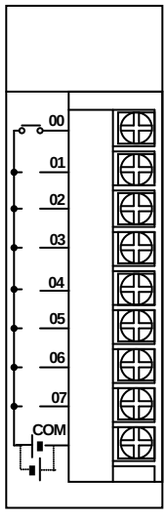
Spec. \ Module type		DC Input module XGI-D21A
Input point		8 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		None
On voltage / On current		DC19V and higher / 3 mA and higher
Off voltage / Off current		DC11V and lower / 1.7 mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		16 point/ COM
Suitable cable size		Stranded cable between 0.3~0.75 ㎟ (2.8mm and smaller outer dia.)
Suitable clamped terminal		R1.25-3 (Sleeve built-in clamped terminal is not available)
Current consumption(㎃)		20mA
Operation display		LED On with Input On
External connection method		9 point Terminal strip connector (M3 X 6 screws)
Weight		0.1 kg

Circuit diagram



*** COM : TB9**

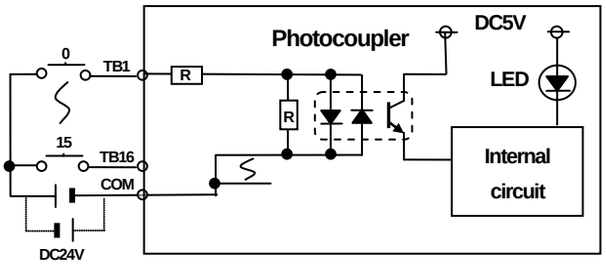
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	COM



7.2.2 16 point DC24V input module (source/sink type)

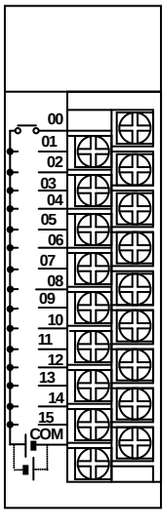
Spec. \ Module type		DC Input module XGI-D22A
Input point		16 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		None
On voltage / On current		DC 19V and higher / 3mA and higher
Off voltage / Off current		DC 11V and lower / 1.7mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Insulation withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		16 point/ COM
Suitable cable size		Stranded cable between 0.3~0.75 ㎟ (2.8mm and smaller outer dia.)
Suitable clamped terminal		R1.25-3 (Sleeve built-in clamped terminal is not available)
Current consumption(㎃)		30mA
Operation display		LED On with Input On
External connection method		18 point Terminal strip connector (M3 X 6 screws)
Weight		0.12 kg

Circuit diagram



* COM : TB17

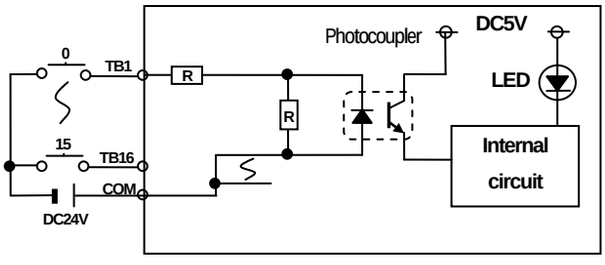
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



7.2.3 16 point DC24V input module (source type)

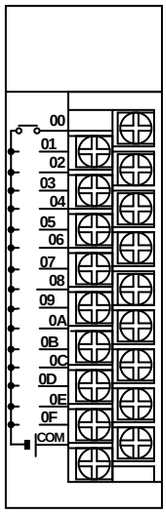
Spec. \ Module type		DC Input module XGI-D22B
Input point		16 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		None
On voltage / On current		DC 19V and higher / 3mA and higher
Off voltage / Off current		DC 11V and lower / 1.7mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Insulation withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		16 point/ COM
Suitable cable size		Stranded cable between 0.3~0.75 ㎟ (2.8mm and smaller outer dia.)
Suitable clamped terminal		R1.25-3 (Sleeve built-in clamped terminal is not available)
Current consumption(㎃)		30mA
Operation display		LED On with Input On
External connection method		18point Terminal strip connector (M3 X 6 screws)
Weight		0.12 kg

Circuit diagram



* COM : TB17

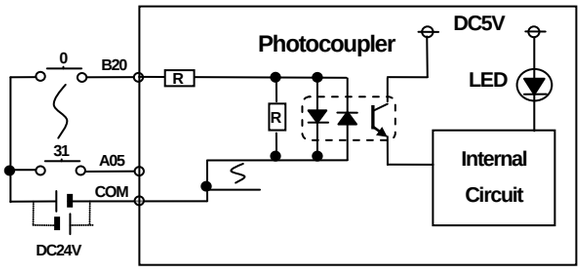
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



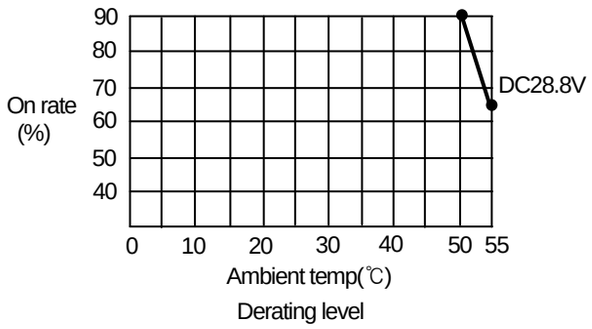
7.2.4 32 point DC24V input module (source/sink type)

Spec. \ Module type		DC Input module
		XGI-D24A
Input point		32 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		Refer to the below derating level
On voltage / On current		DC 19V and higher / 3mA and higher
Off voltage / Off current		DC 11V and lower / 1.7mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Insulation withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		32points / COM
Suitable cable size		0.3 ㎟
Current consumption(㎃)		50mA
Operation display		LED On with Input On
External connection method		40point connector
Weight		0.1 kg

Circuit diagram

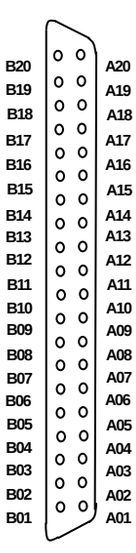


* COM : B02, B01, A02, A01



Derating level

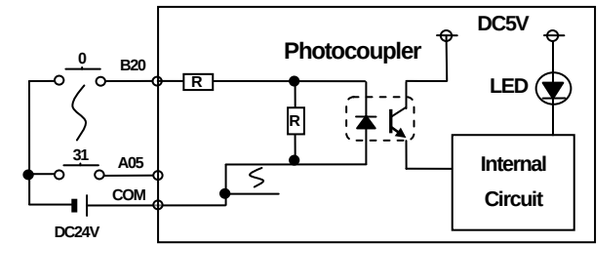
No	Contact	No	Contact
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	COM	A02	COM
B01	COM	A01	COM



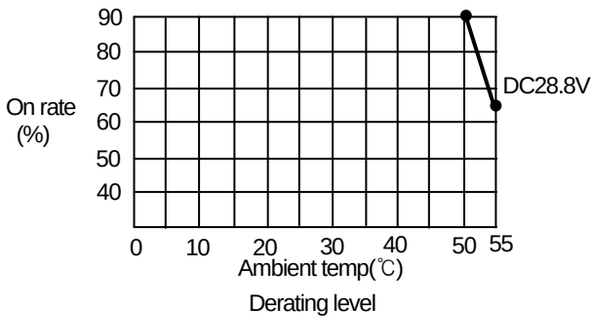
7.2.5 32 point DC24V input module (source type)

Spec. \ Module type		DC Input module XGI-D24B
Input point		32 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		Refer to the below derating level
On voltage / On current		DC19V and higher / 3 mA and higher
Off voltage / Off current		DC 11V and lower / 1.7mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Insulation withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		32 points / COM
Suitable cable size		0.3 ㎟
Current consumption(㎃)		50mA
Operation display		LED On with Input On
External connection method		40point connector
Weight		0.1 kg

Circuit diagram

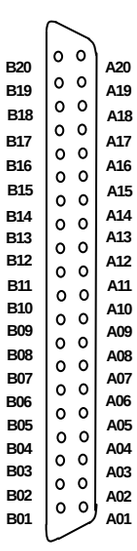


*** COM : B02, B01, A02, A01**



Derating level

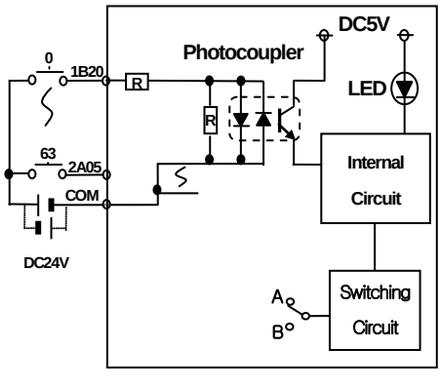
No	Contact	No	Contact
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	COM	A02	COM
B01	COM	A01	COM



7.2.6 64 point DC24V input module (source/sink type)

Spec. \ Module type		DC Input module
		XGI-D28A
Input point		64 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		Refer to the below derating level
On voltage / On current		DC 19V and higher / 3mA and higher
Off voltage / Off current		DC 11V and lower / 1.7mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Insulation withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		32point / COM
Suitable cable size		0.3 ㎟
Current consumption(㎃)		60mA
Operation display		LED On with Input On (32point LED on by switching)
External connection method		40point connector × 2
Weight		0.15 kg

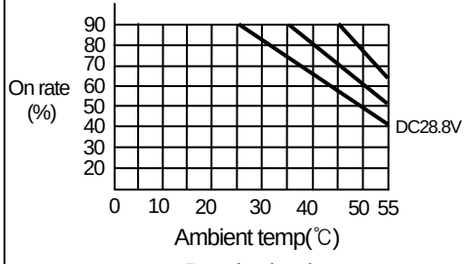
Circuit diagram



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

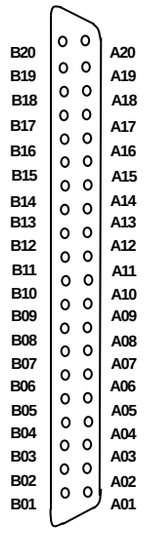
A: Displaying 0~31

B: Displaying 32~63



Derating level

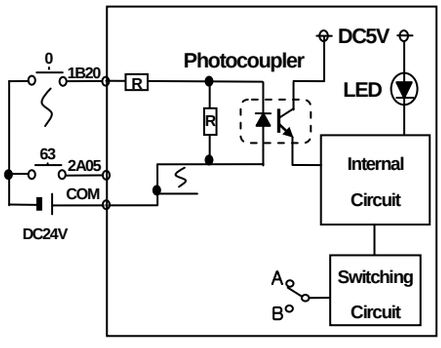
No	Contact	No	Contact	No	Contact	No	Contact
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	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)

Spec. \ Module type		DC Input module XGI-D28B
Input point		64 points
Insulation method		Photo coupler insulation
Rated input voltage		DC24V
Rated input current		Approx. 4 ㎃
Voltage range		DC20.4~28.8V (5% and lower ripple rate)
Input derating		Refer to the below derating level
On voltage / On current		DC 19V and higher / 3mA and higher
Off voltage / Off current		DC 11V and lower / 1.7mA and lower
Input resistance		Approx. 5.6 kΩ
Response time	Off → On	1ms/3ms/5ms/10ms/20ms/70ms/100ms(Set by CPU Parameter) Initial value:3ms
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/100ms (Set by CPU Parameter) Initial value:3ms
Insulation withstand voltage		AC560V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 ㏁ and higher by Insulation ohmmeter
Common method		32 points / COM
Suitable cable size		0.3 ㎟
Current consumption(㎃)		60mA
Operation display		LED On with Input On (32point LED on by switching)
External connection method		40point connector × 2
Weight		0.15 kg

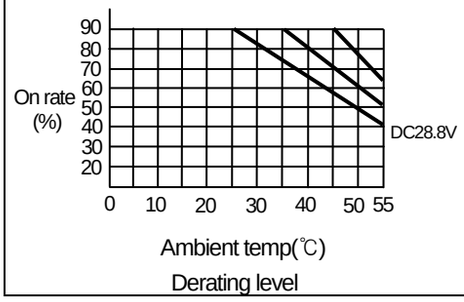
Circuit diagram



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

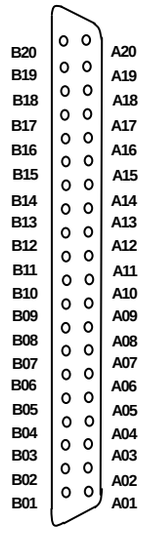
A: Displaying 0~31

B: Displaying 32~63



Derating level

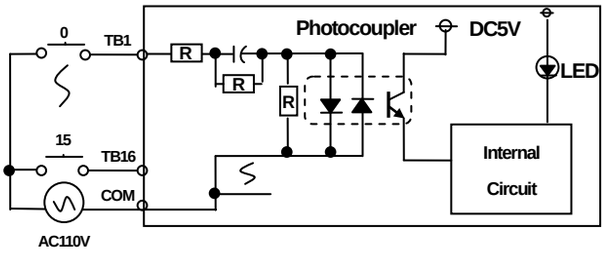
No	Contact	No	Contact	No	Contact	No	Contact
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	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



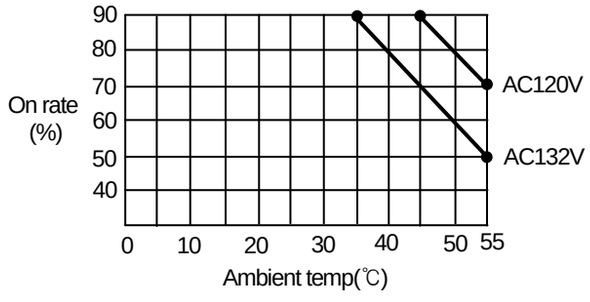
7.2.8 16 point AC110V input module

Spec. \ Module 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) (5% and lower distortion)
Rated input current		Approx. 8 mA (AC100,60 Hz) , approx. 7 mA (AC100,50 Hz)
Inrush current		Max. 200 mA 1 ms and lower(AC132V)
Input derating		Refer to the below derating level
On voltage / On current		AC80V and higher / 5 mA and higher(50 Hz,60 Hz)
Off voltage / Off current		AC30V and lower / 1 mA and lower (50 Hz,60 Hz)
Input resistance		Approx. 12 kΩ(60 Hz), approx. 15 kΩ(50 Hz)
Response time	Off → On	15 ms and lower(AC100V 50 Hz,60 Hz)
	On → Off	25 ms and lower(AC100V 50 Hz,60 Hz)
Insulation withstand voltage		AC1780V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 MΩ and higher by Insulation ohmmeter
Common method		16 point/ COM
Suitable cable size		Stranded cable between 0.3~0.75 mm² (2.8mm and smaller outer dia.)
Suitable clamped terminal		R1.25-3 (Sleeve built-in clamped terminal is not available)
Current consumption(mA)		30mA
Operation display		LED On with Input On
External connection method		18point Terminal strip connector (M3 X 6 screws)
Weight		0.13 kg

Circuit diagram

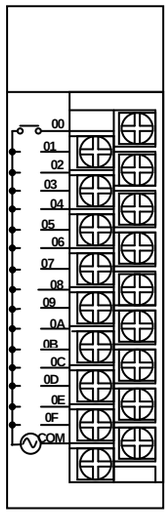


* COM : TB17



Derating level

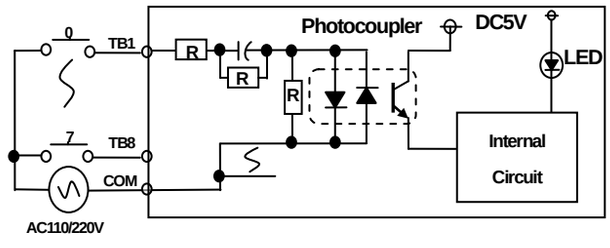
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



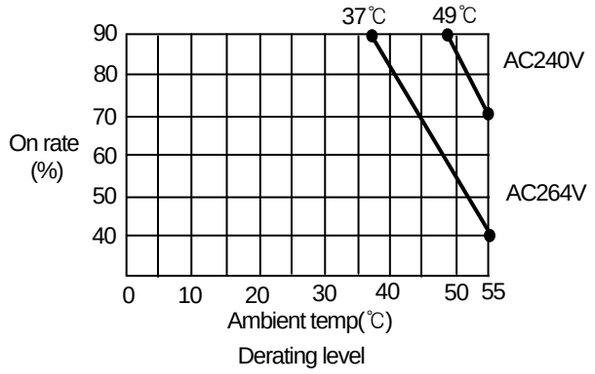
7.2.9 8 point AC220V input module

Spec. \ Module type		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) (5% and lower distortion)
Rated input current		Approx. 17 mA (AC200,60 Hz) , approx. 14 mA (AC200,50 Hz)
Inrush current		Max. 500 mA 1 ms and lower(AC264V)
Input derating		Refer to the below derating level
On voltage / On current		AC80V and higher / 5 mA and higher(50 Hz,60 Hz)
Off voltage / Off current		AC30V and lower / 1 mA and lower (50 Hz,60 Hz)
Input resistance		Approx. 12 kΩ(60 Hz), approx. 15 kΩ(50 Hz)
Response time	Off → On	15 ms and lower(AC200V 50 Hz,60 Hz)
	On → Off	25 ms and lower(AC200V 50 Hz,60 Hz)
Insulation withstand voltage		AC2830V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 MΩ and higher by Insulation ohmmeter
Common method		8 points / COM
Suitable cable size		Stranded cable between 0.3~0.75 mm² (2.8mm and smaller outer dia.)
Suitable clamped terminal		R1.25-3 (Sleeve built-in clamped terminal is not available)
Current consumption(mA)		20mA
Operation display		LED On with Input On
External connection method		9point Terminal strip connector (M3 X 6 screws)
Weight		0.13 kg

Circuit diagram

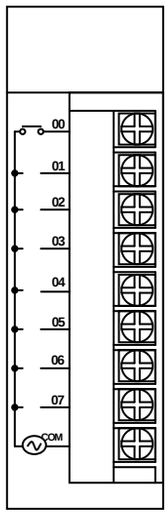


* COM : TB9



Derating level

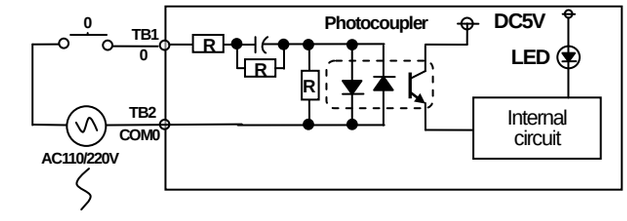
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	COM

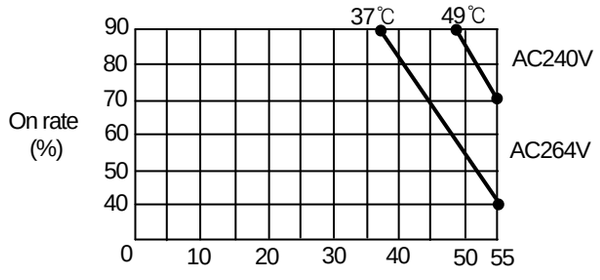


7.2.10 8 point AC220V isolated input module

Spec. \ Module type		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) (5% and lower distortion)
Rated input current		Approx. 17 mA (AC200,60 Hz) , approx. 14 mA (AC200,50 Hz)
Inrush current		Max. 500 mA 1 ms and lower(AC264V)
Input derating		Refer to the below derating level
On voltage / On current		AC80V and higher / 5 mA and higher (50 Hz,60 Hz)
Off voltage / Off current		AC30V and lower / 1 mA and lower (50 Hz,60 Hz)
Input resistance		Approx. 12 kΩ(60 Hz), approx. 15 kΩ(50 Hz)
Response time	Off → On	15 ms and lower(AC200V 50 Hz, 60 Hz)
	On → Off	25 ms and lower(AC200V 50 Hz, 60 Hz)
Insulation withstand voltage		AC2830V rms/3 Cycle (altitude 2000m)
Insulation resistance		10 MΩ and higher by Insulation ohmmeter
Common method		1 point / COM
Suitable cable size		Stranded cable between 0.3~0.75 mm² (2.8mm and smaller outer dia.)
Suitable clamped terminal		R1.25-3 (Sleeve built-in clamped terminal is not available)
Current consumption(mA)		20mA
Operation display		LED On with Input On
External connection method		18 point Terminal strip connector (M3 X 6 screws)
Weight		0.13 kg

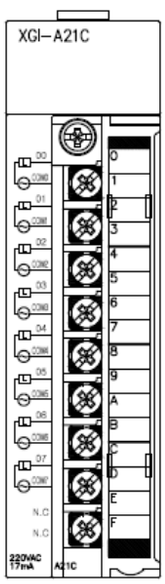
Circuit diagram





Derating level

Terminal block	Contact
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

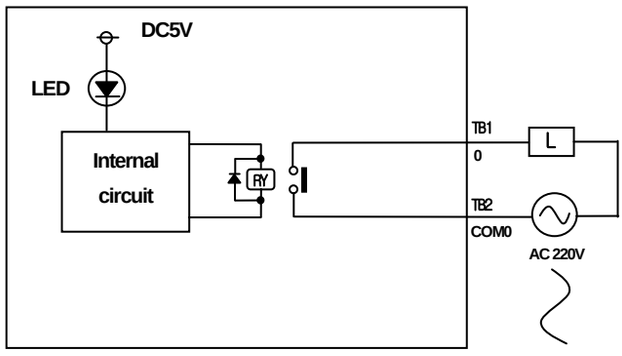


7.3 Digital Output Module Spec.

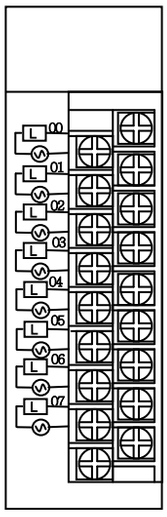
7.3.1 8 point relay output module

Spec. \ Module type		Relay output module XGQ-RY1A
Output point		8 points
Insulation method		Relay insulation
Rated load voltage/current		DC24V 2A(resistance load) / AC220V 2A(COSΨ = 1)
Min. load voltage / current		DC5V / 1mA
Max. load voltage / current		AC250V, DC125V
Leakage current at Off		0.1mA (AC220V, 60Hz)
Max. switching frequency		3,600 times/hr
Surge killer		None
Life	Mechanical	20 million and more times
	Electrical	Rated load voltage/current 100 thousand and more times
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100 thousand and more times
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100 thousand and more times
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100 thousand and more times
Response time	Off → On	10 ms and lower
	On → Off	12 ms and lower
Common method		1 point/ 1COM (Independent contact)
Current consumption		260mA (when every point is On)
Operation display		LED On with output On
External connection method		18 point Terminal strip connector (M3 X 6 screws)
Weight		0.13kg

Circuit diagram



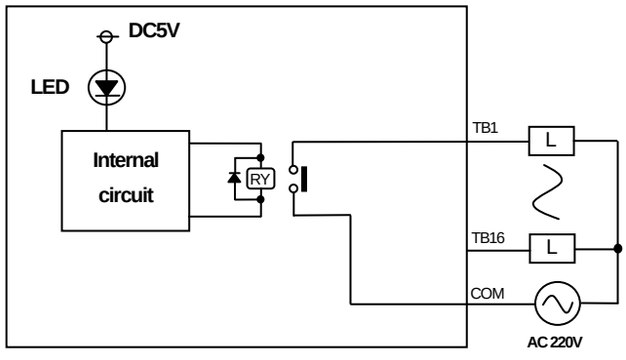
Terminal block	Contact
TB1	0
TB2	COM
TB3	1
TB4	COM
TB5	2
TB6	COM
TB7	3
TB8	COM
TB9	4
TB10	COM
TB11	5
TB12	COM
TB13	6
TB14	COM
TB15	7
TB16	COM
TB17	NC
TB18	NC



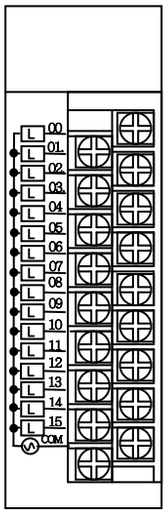
7.3.2 16 point relay output module

Spec. \ Module type		Relay output module
		XGQ-RY2A
Output point		16 points
Insulation method		Relay insulation
Rated load voltage/current		DC24V 2A(resistance load) / AC220V 2A(COSΨ = 1)
Min. load voltage / current		DC5V / 1mA
Max. load voltage / current		AC250V, DC125V
Leakage current at Off		0.1mA (AC220V, 60Hz)
Max. switching frequency		3,600 times/hr
Surge killer		None
Life	Mechanical	20 million and more times
	Electrical	Rated load voltage/current 100 thousand and more times
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100 thousand and more times
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100 thousand and more times
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100 thousand and more times
Response time	Off → On	10 ms and lower
	On → Off	12 ms and lower
Common method		16 point/ 1COM
Current consumption		500mA (when every point is On)
Operation display		LED On with output On
External connection method		18point Terminal strip connector (M3 X 6 screws)
Weight		0.17kg

Circuit diagram



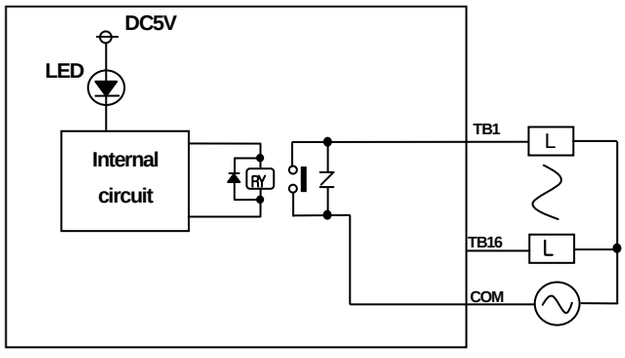
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



7.3.3 16 point relay output module (Surge Killer built-in type)

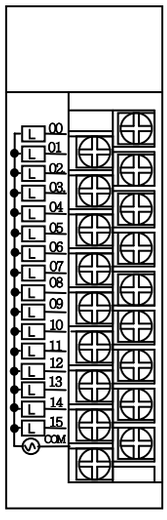
Module type / Spec.		Relay output module
		XGQ-RY2B
Output point		16 points
Insulation method		Relay insulation
Rated load voltage/current		DC24V 2A(resistance load) / AC220V 2A(COSΨ = 1)
Min. load voltage / current		DC5V / 1mA
Max. load voltage / current		AC250V, DC125V
Leakage current at Off		0.1mA (AC220V, 60Hz)
Max. switching frequency		3,600 times/hr
Surge killer		Varistor (387 ~ 473V), C.R absorber
Life	Mechanical	20 million and more times
	Electrical	Rated load voltage/current 100 thousand and more times
		AC200V / 1.5A, AC240V / 1A (COSΨ = 0.7) 100 thousand and more times
		AC200V / 1A, AC240V / 0.5A (COSΨ = 0.35) 100 thousand and more times
		DC24V / 1A, DC100V / 0.1A (L / R = 7ms) 100 thousand and more times
Response time	Off → On	10 ms and lower
	On → Off	12 ms and lower
Common method		16 point/ 1COM
Current consumption		500mA (when every point is On)
Operation display		LED On with output On
External connection method		18 point Terminal strip connector (M3 X 6 screws)
Weight		0.19kg

Circuit diagram



* COM : TB17

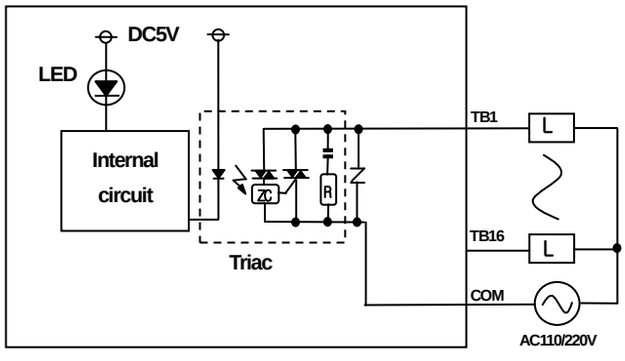
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



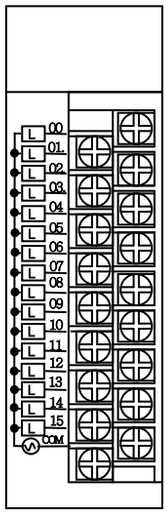
7.3.4 16 point Triac output module

Spec. \ Module 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
Leakage current at Off		2.5 mA (AC 220V 60 Hz)
Max. inrush current		20A / Cycle and lower
Max. voltage drop at On		AC 1.5V and lower (2A)
Surge killer		Varistor (387 ~ 473V), C.R absorber
Response time	Off → On	1 ms and shorter
	On → Off	0.5 Cycle + 1 ms and shorter
Common method		16 point/ 1 COM
Current consumption		300 mA (when every point is On)
Operation display		LED On with output On
External connection method		18point Terminal strip connector (M3 X 6 screw)
Weight		0.2 kg

Circuit diagram



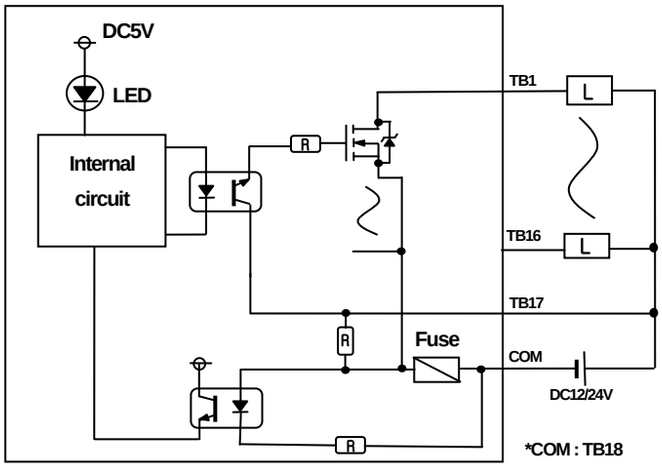
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	NC



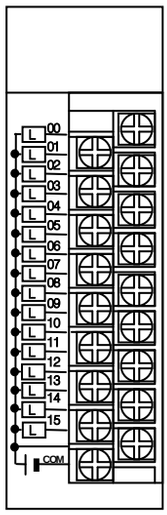
7.3.5 16 point transistor output module (sink type)

Spec. \ Module type		Transistor output module
		XGQ-TR2A
Output point		16 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.5A / 1point, 4A / 1COM
Leakage current at Off		0.1mA and lower
Max. inrush current		4A / 10 ms and lower
Max. voltage drop at On		DC 0.3V AND LOWER
Surge killer		Zener diode
Fuse		4A×2(not replaceable)(Fuse cap.:50A)
Fuse disconnection display		Yes(If a fuse is burnt out, it transfers a signal to CPU and LED is on) If external power supply is off, fuse status is not detected.
Response time	Off → On	1 ms and shorter
	On → Off	1 ms and shorter (Rated load, resistance load)
Common method		16 point/ 1COM
Current consumption		70mA (when every point is On)
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with output On
External connection method		18point Terminal strip connector
Weight		0.11kg

Circuit diagram



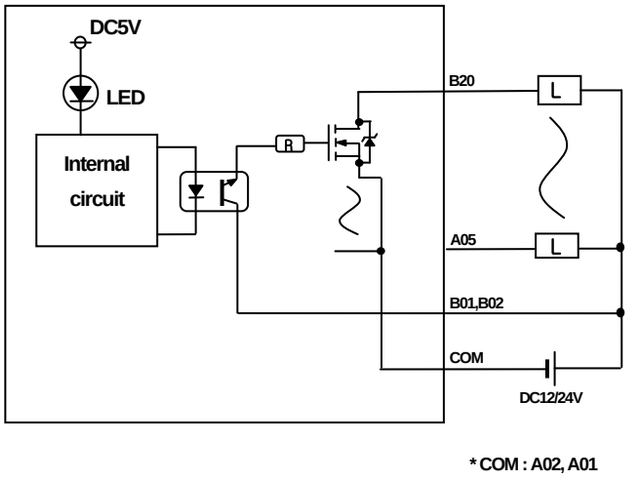
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	DC24V
TB18	COM



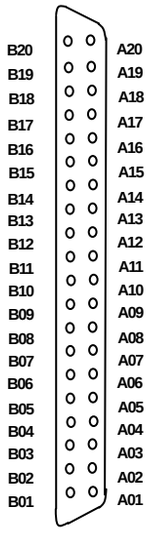
7.3.6 32 point transistor output module(sink type)

Spec. \ Module type		Transistor output module XGQ-TR4A
Output point		32 point
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.1A / 1point, 2A / 1COM
Leakage current at Off		0.1mA and lower
Max. inrush current		0.7A / 10 ms and lower
Max. voltage drop at On		DC 0.2V and lower
Surge killer		Zener diode
Response time	Off → On	1 ms and shorter
	On → Off	1 ms and shorter (Rated load, resistance load)
Common method		32 points / 1COM
Current consumption		130mA (when every point is On)
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with Input On
External connection method		40 Pin Connector
Suitable cable size		0.3 ㎟
Weight		0.1 kg

Circuit diagram



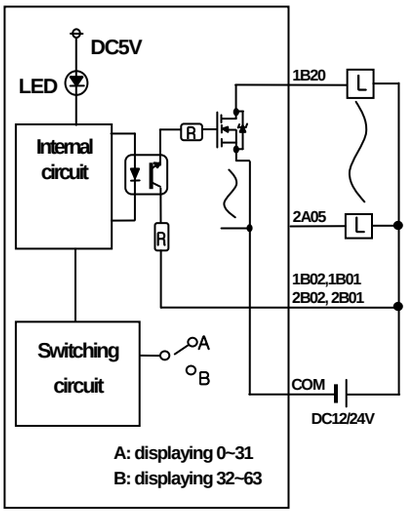
No	Contact	No	Contact
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	DC12/ 24V	A02	COM
B01		A01	COM



7.3.7 64 point transistor output module (sink type)

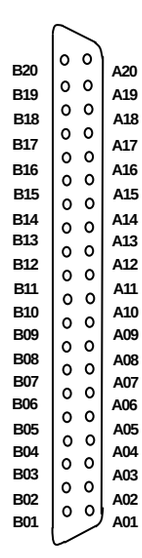
Spec. \ Module type		Transistor output module
		XGQ-TR8A
Output point		64 points
Insulation system		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.1A / 1point, 2A / 1COM
Leakage current at Off		0.1mA and lower
Max. inrush current		0.7A / 10 ms and lower
Max. voltage drop at On		DC 0.2V and lower
Surge killer		Zener diode
Response time	Off → On	1 ms and shorter
	On → Off	1 ms and shorter (Rated load, resistance load)
Common method		16 point/ 1COM
Current consumption		230mA (when every point is On)
Common method		32 points / COM
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with Input On (32point LED on by switching)
External connection method		40 Pin Connector × 2
Suitable cable size		0.3 ㎟
Weight		0.15 kg

Circuit diagram



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

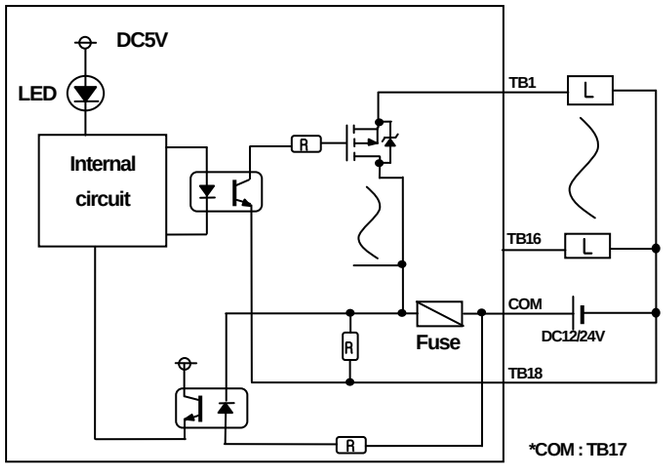
No	Contact	No	Contact	No	Contact	No	Contact
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	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	12/24 VDC	1A02	COM1	2B02	12/24 VDC	2A02	COM2
1B01		1A01		2B01		2A01	



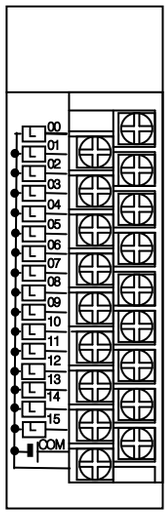
7.3.8 16 point transistor output module (source type)

Module type / Spec.		Transistor output module
		XGQ-TR2B
Output point		16 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.5A / 1point, 4A / 1COM
Leakage current at Off		0.1mA and lower
Max. inrush current		4A / 10 ms and lower
Max. voltage drop at On		DC 0.3V AND LOWER
Surge killer		Zener diode
Fuse		4A×2(not replaceable)(Fuse cap.:50A)
Fuse disconnection display		Yes(If a fuse is burnt out, it transfers a signal to CPU and LED is on)
Response time	Off → On	1 ms and shorter
	On → Off	1 ms and shorter (Rated load, resistance load)
Common method		16 point/ 1COM
Current consumption		70mA (when every point is On)
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with output On
External connection method		18point Terminal strip connector
Weight		0.12kg

Circuit diagram



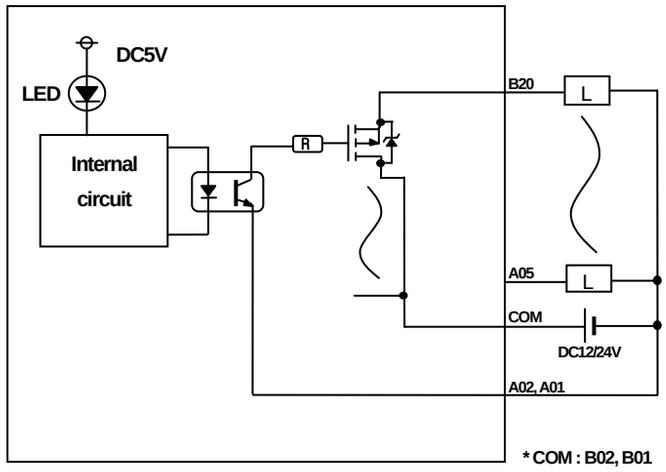
Terminal block	Contact
TB1	0
TB2	1
TB3	2
TB4	3
TB5	4
TB6	5
TB7	6
TB8	7
TB9	8
TB10	9
TB11	10
TB12	11
TB13	12
TB14	13
TB15	14
TB16	15
TB17	COM
TB18	0V



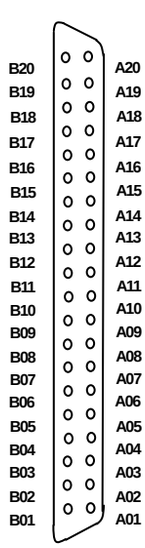
7.3.9 32 point transistor output module (source type)

Spec. \ Module type		Transistor output module
		XGQ-TR4B
Output point		32 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.1A / 1point, 2A / 1COM
Leakage current at Off		0.1mA and lower
Max. inrush current		4A / 10 ms and lower
Max. voltage drop at On		DC 0.3V AND LOWER
Surge killer		Zener diode
Response time	Off → On	1 ms and shorter
	On → Off	1 ms and shorter (Rated load, resistance load)
Common method		32points / 1COM
Current consumption		130mA (when every point is On)
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with Input On
External connection method		40 Pin Connector
Suitable cable size		0.3 ㎟
Weight		0.1 kg

Circuit diagram



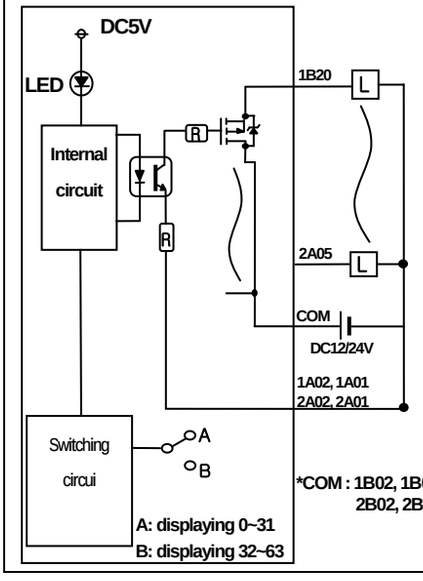
No	Contact	No	Contact
B20	0	A20	16
B19	1	A19	17
B18	2	A18	18
B17	3	A17	19
B16	4	A16	20
B15	5	A15	21
B14	6	A14	22
B13	7	A13	23
B12	8	A12	24
B11	9	A11	25
B10	10	A10	26
B09	11	A09	27
B08	12	A08	28
B07	13	A07	29
B06	14	A06	30
B05	15	A05	31
B04	NC	A04	NC
B03	NC	A03	NC
B02	COM	A02	0V
B01		A01	



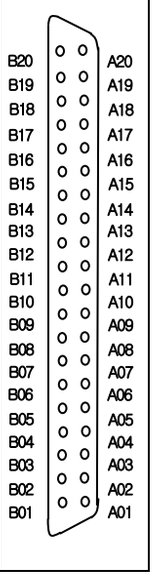
7.3.10 64 point transistor output module (source type)

Spec. \ Module type		Transistor output module
		XGQ-TR8B
Output point		64 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		0.1A / 1point, 2A / 1COM
Leakage current at Off		0.1mA and lower
Max. inrush current		4A / 10 ms and lower
Max. voltage drop at On		DC 0.3V and lower
Surge killer		Zener diode
Response time	Off → On	1 ms and shorter
	On → Off	1 ms and shorter (Rated load, resistance load)
Common method		32point / 1COM
Current consumption		230mA (when every point is On)
Common method		32point / COM
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with Input On (32 point LED ON by switching)
External connection method		40 Pin Connector × 2
Suitable cable size		0.3 ㎟
Weight		0.15 kg

Circuit diagram



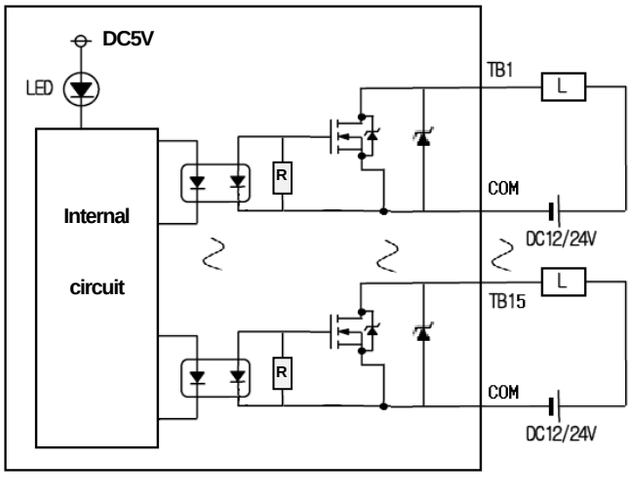
No	Contact	No	Contact	No	Contact	No	Contact
1B20	0	1A20	16	2B20	32	2A20	48
1B19	1	1A19	17	2B19	33	2A19	49
1B18	2	1A18	18	2B18	34	2A18	50
1B17	3	1A17	19	2B17	35	2A17	51
1B16	4	1A16	20	2B16	36	2A16	52
1B15	5	1A15	21	2B15	37	2A15	53
1B14	6	1A14	22	2B14	38	2A14	54
1B13	7	1A13	23	2B13	39	2A13	55
1B12	8	1A12	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	



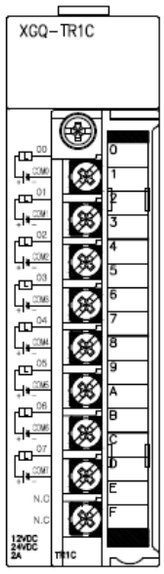
7.3.11 8 point transistor isolated output module

Spec. \ Module type		Transistor output module
		XGQ-TR1C
Output point		8 points
Insulation method		Photo coupler insulation
Rated load voltage		DC 12 / 24V
Operating load voltage range		DC 10.2 ~ 26.4V
Max. load current		2A / 1 point
Leakage current at Off		0.1mA and lower
Max. inrush current		4A / 10 ms and lower
Max. voltage drop at On		DC 0.3V and lower
Surge killer		Zener diode
Response time	Off → On	3 ms and shorter
	On → Off	10 ms and shorter (Rated load, resistance load)
Common method		1 point/ 1COM
Current consumption		100mA (when every points On)
External power supply	Voltage	DC12/24V ± 10% (4 Vp-p and lower ripple voltage)
	Current	10mA and lower (if connected to DC24V)
Operation display		LED On with output On
External connection method		18point Terminal strip connector
Weight		0.11kg

Circuit diagram



Terminal block	Contact
TB1	P0
TB2	COM0
TB3	P1
TB4	COM1
TB5	P2
TB6	COM2
TB7	P3
TB8	COM3
TB9	P4
TB10	COM4
TB11	P5
TB12	COM5
TB13	P6
TB14	COM6
TB15	P7
TB16	COM7
TB17	NC
TB18	NC



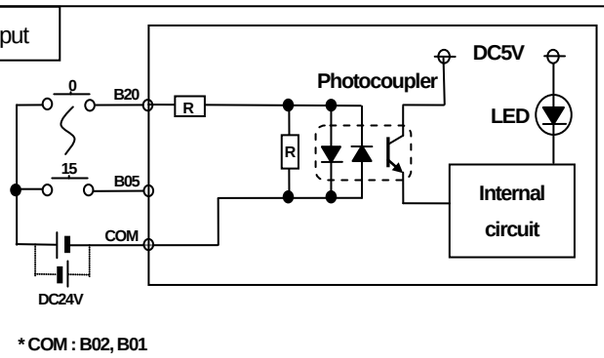
7.4 Digital I/O Module Specifications

7.4.1 32 point (DC input · transistor output) I/O combined module

XGH-DT4A					
Input			**Output**		
Input point		16 points	Output point		16 points
Insulation method		Photo coupler insulation	Insulation method		Photo coupler insulation
Rated input voltage		DC 24V	Rated load voltage		DC 12 / 24V
Rated input current		Approx. 4 ㎃	Operating load voltage range		DC 10.2 ~ 26.4V
Operating voltage range		DC20.4~28.8V (5% and lower ripple rate)	Max. load current		0.1A / 1point, 1.6A / 1COM
Withstand voltage		AC560Vrms/3Cycle(altitude2000m)	Leakage current at Off		0.1mA and lower
On voltage/On current		DC 19V and higher / 3mA and higher	Max. inrush current		0.7A / 10 ms and lower
Off voltage/Off current		DC 11V and lower / 1.7mA and lower	Surge killer		Zener diode
Input resistance		Approx. 5.6 kΩ	Max. voltage drop at On		DC 0.2V and lower
Response time	Off→ On	1ms/3ms/5ms/10ms/20ms/70ms/ 100ms(set by CPU parameter) Initial value:3ms	Response time	Off→ On	1 ms and shorter
	On → Off	1ms/3ms/5ms/10ms/20ms/70ms/ 100ms(set by CPU parameter) Initial value:3ms		On → Off	1 ms and shorter (Rated load, resistance load)
Common method		16 point/ COM	Common method		16 point/ 1COM
Operation display		LED On with input On	Operation display		LED On with output On
Current consumption(㎃)		110mA (when ever point is on)			
External connection method		40 Pin Connector × 1			
Weight		0.1 kg			

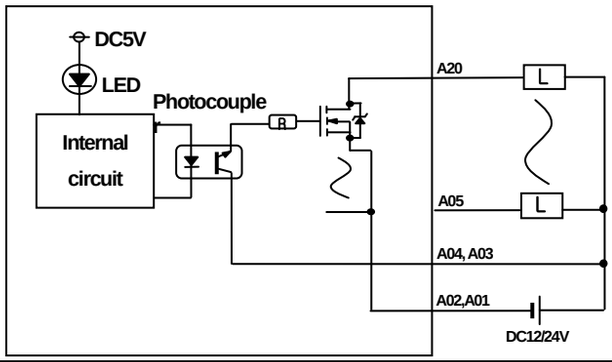
External connection

Input

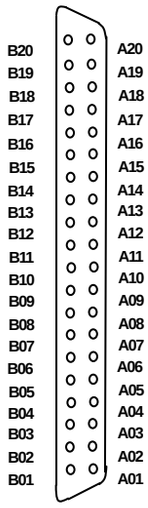


* COM : B02, B01

Output



No	Contact	No	Contact
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	

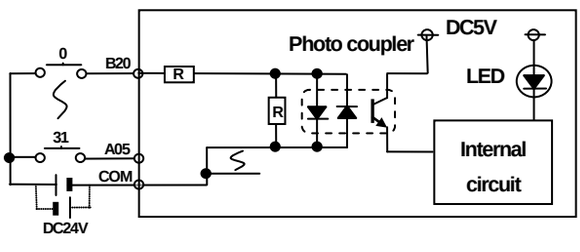


7.5 Event Input Module

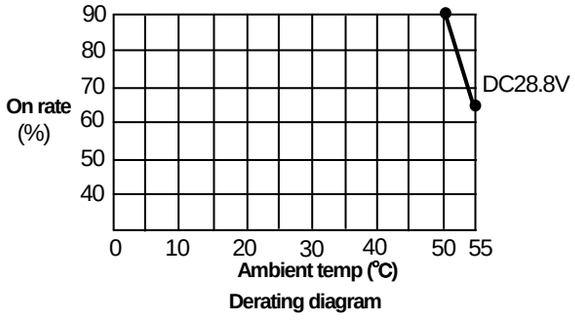
7.5.1 Event Input Module (Source/Sink type)

Specification		XGF-SOEA
Input point		32 point
Insulation method		Photo coupler insulation
Memory size		Records 1Mbit event information (300 event information per XGF-SOEA module)
Precision		1 ms (±2ms : error between modules)
Rated input voltage		DC24V
Rated input current		About 4mA
Used voltage range		DC20.4 ~ 28.8V (within ripple rate 5%)
On voltage/On current		DC19V or above / 3 mA or above
Off voltage/ Off current		DC11V or less / 1.7 mA or less
Input resistance		About 5.6 kΩ
Response time	Off → On	H/W delay (10㎲: Normal) + input filter time (user setting: 0~100ms) + CPU scan time delay (50㎲)
	On → Off	H/W delay (84㎲: Normal) + input filter time (user setting: 0~100ms) + CPU scan time delay (50㎲)
Working voltage		AC560V rms/3 Cycle (Altitude 2000m)
Insulation resistance		Insulation resistance 10 ㏁ or above (DC500V)
COMM method		32 point / COM
Current consumption (A)		0.7(MAX)
Operation indicator		LED is on when input is on
External connection method		40 pin connector
Size		27x98x90
Weight		0.2 kg

Circuit configuration

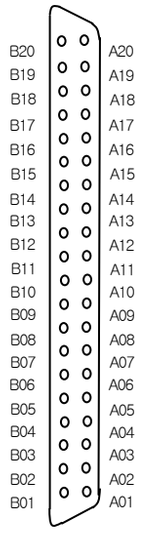


* COM : B02, B01



Derating diagram

No	Contact	No	Contact
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 Modules 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)

Model	Specification	No. of Pins
XGI-D24A/B	DC input 32 point module	40 Pin Connector × 1
XGI-D28A/B	DC input 64 point module	40 Pin Connector × 2
XGQ-TR4A	TR output 32 point module(sink type)	40 Pin Connector × 1
XGQ-TR8A	TR output 64 point module(sink type)	40 Pin Connector × 2
XGQ-TR4B	TR output 32 point module(source type)	40 Pin Connector × 1
XGQ-TR8B	TR output 64 point module(source type)	40 Pin Connector × 2
XGF-SOEA	Event input module	40 Pin Connector × 1

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 to confirm the differences between TG7-1H40CA and TG7-1H40S)

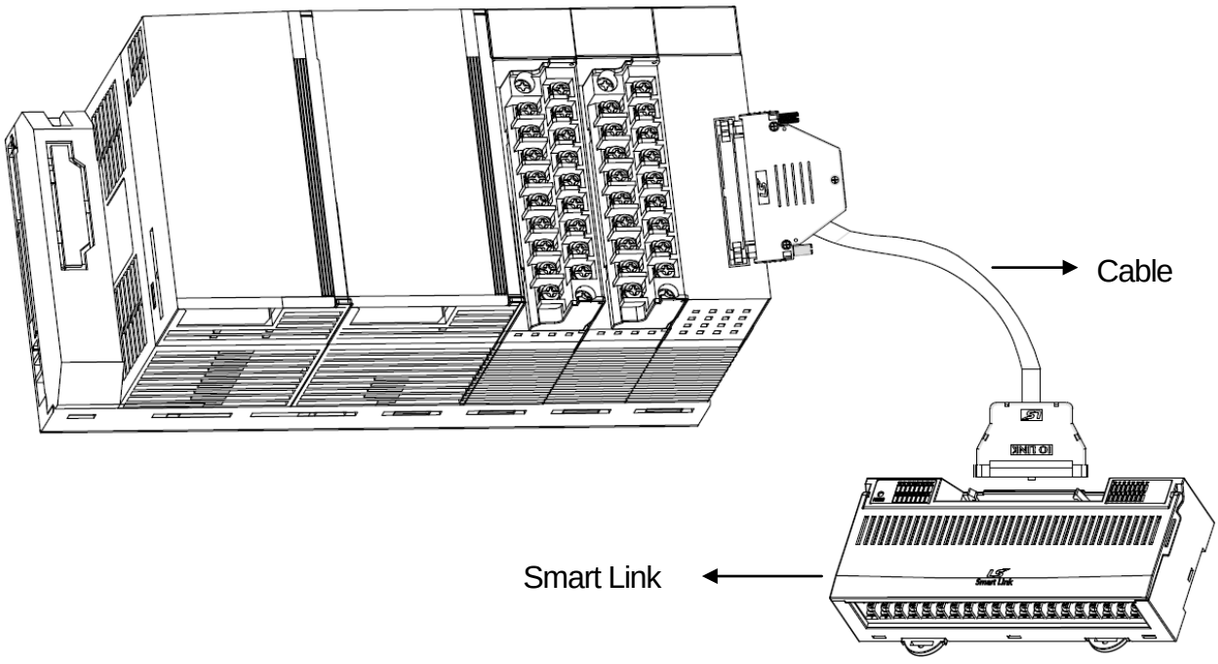
	Model	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (Common 20Pin Added)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
Relay board	R32C-NS5A-40P (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	XGI-SOEA
	Cable	Description	Sets	1	1	2	2	1	1	2	2	1
TG7-1H40S /TG7-1H40CA	C40HF-05PB-1B	PLC,CABLE ASS'Y,40p-40p,0.5m	0.5	❶	❶	❷	❷	❶	❶	❷	❷	❶
	C40HF-10PB-1B	PLC,CABLE ASS'Y,40p-40p,1m	1.0	❶	❶	❷	❷	❶	❶	❷	❷	❶
	C40HF-15PB-1B	PLC,CABLE ASS'Y,40p-40p,1.5m	1.5	❶	❶	❷	❷	❶	❶	❷	❷	❶
	C40HF-20PB-1B	PLC,CABLE ASS'Y,40p-40p,2m	2.0	❶	❶	❷	❷	❶	❶	❷	❷	❶
	C40HF-30PB-1B	PLC,CABLE ASS'Y,40p-40p,3m	3.0	❶	❶	❷	❷	❶	❶	❷	❷	❶
R32C-NS5A-40P (SINK)	C40HF-05PB-1	PLC,CABLE ASS'Y,40p-40p,0.5m	0.5	❶		❷						
	C40HF-10PB-1	PLC,CABLE ASS'Y,40p-40p,1m	1.0	❶		❷						
	C40HF-15PB-1	PLC,CABLE ASS'Y,40p-40p,1.5m	1.5	❶		❷						
	C40HF-20PB-1	PLC,CABLE ASS'Y,40p-40p,2m	2.0	❶		❷						
	C40HF-30PB-1	PLC,CABLE ASS'Y,40p-40p,3m	3.0	❶		❷						
R32C-PS5A-40P (Source)	C40HF-05PB-XGP1	PLC,CABLE ASS'Y,40p-40p,0.5m	0.5		❶		❷					
	C40HF-10PB-XGP1	PLC,CABLE ASS'Y,40p-40p,1m	1.0		❶		❷					
	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		❷					
	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

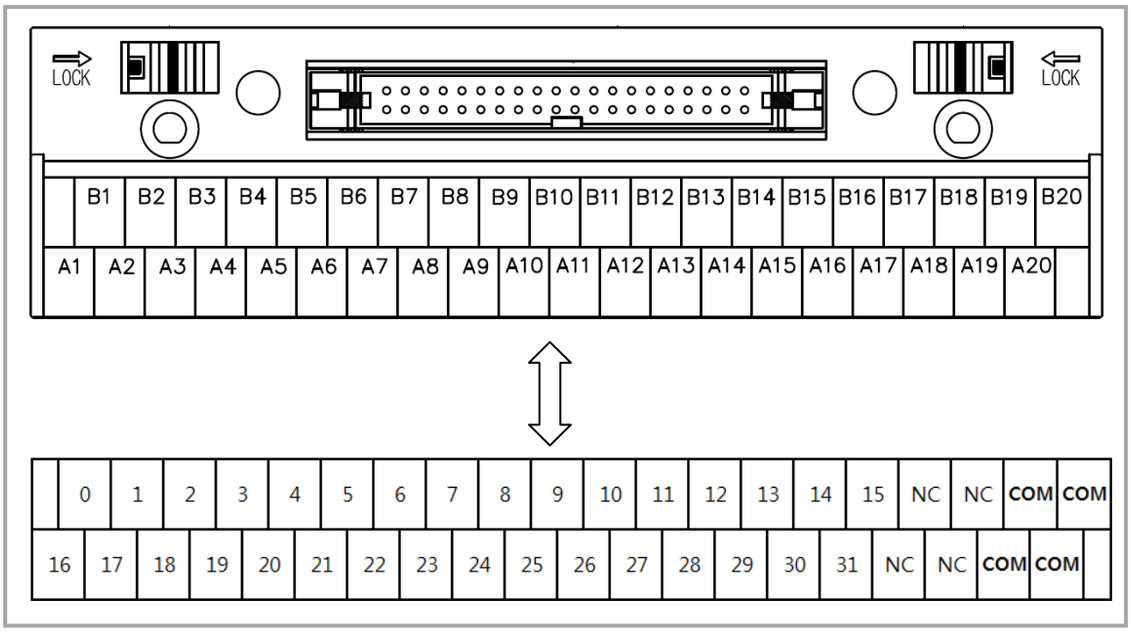
(1) XGI-D24A/B

1) Applicable Smart Link

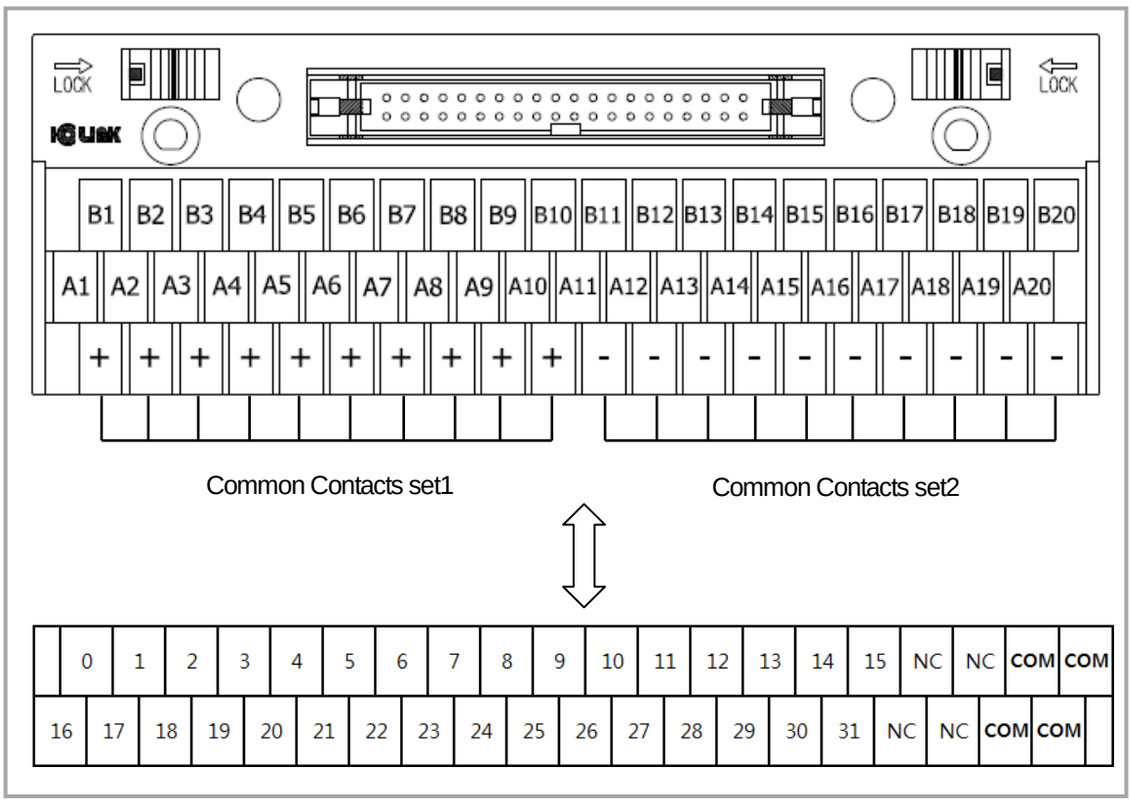
	Model	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (Common 20Pin Added)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m

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

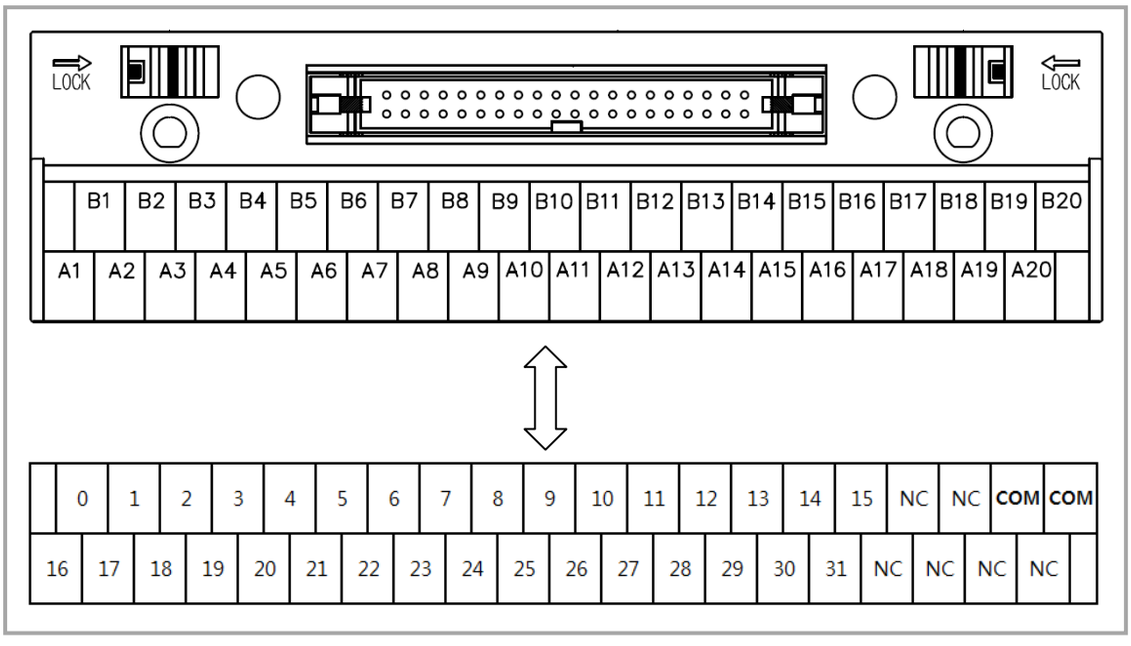
(2) XGI-D28A/B

1) Applicable Smart Link

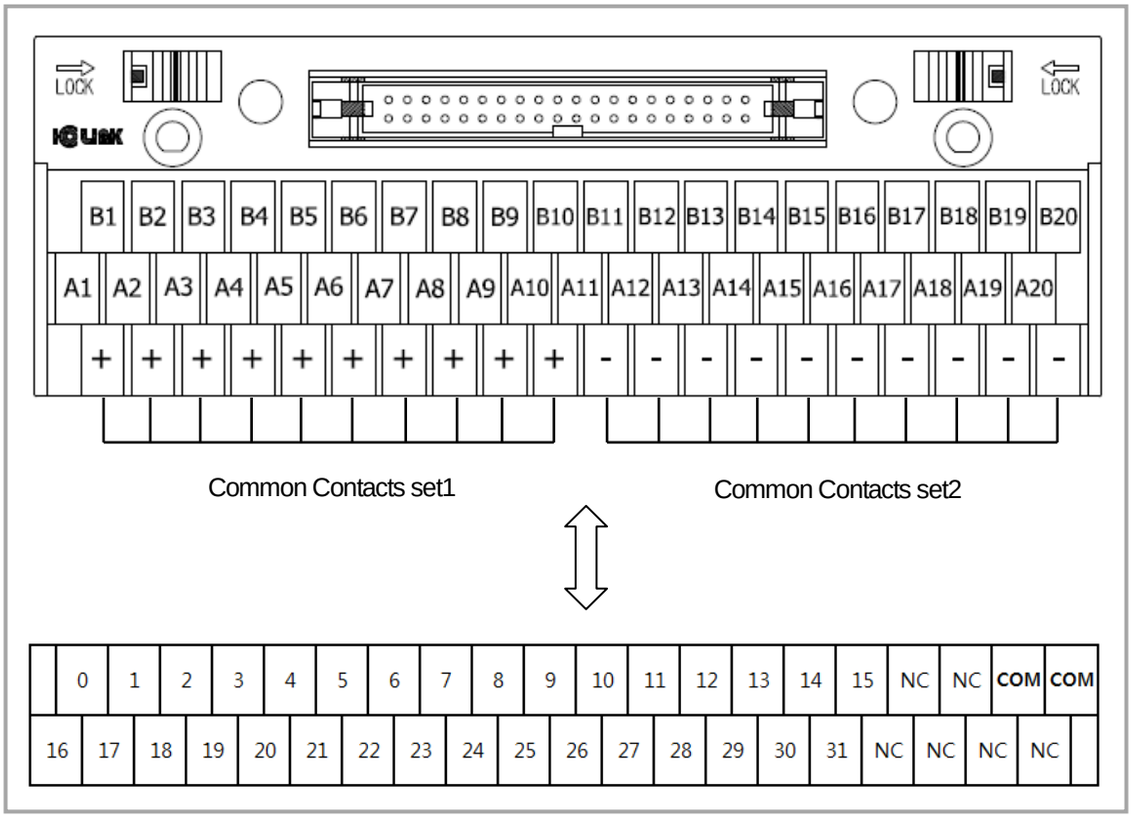
	Model	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (Common 20Pin Added)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m

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

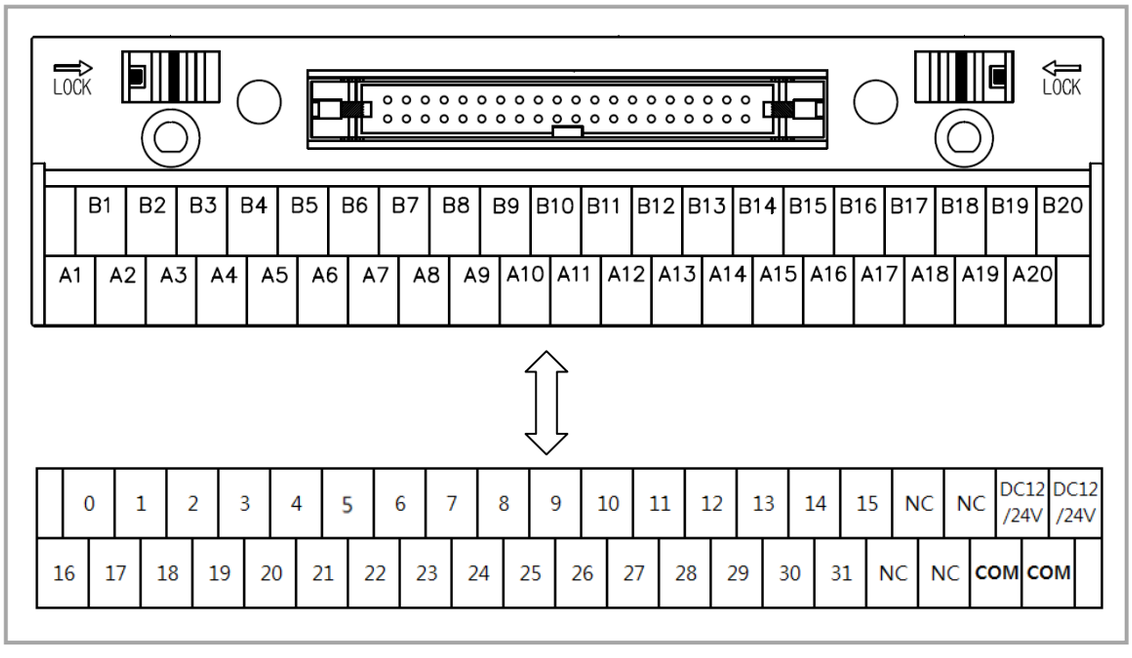
(3) XGQ-TR4A/8A

1) Applicable Smart Link

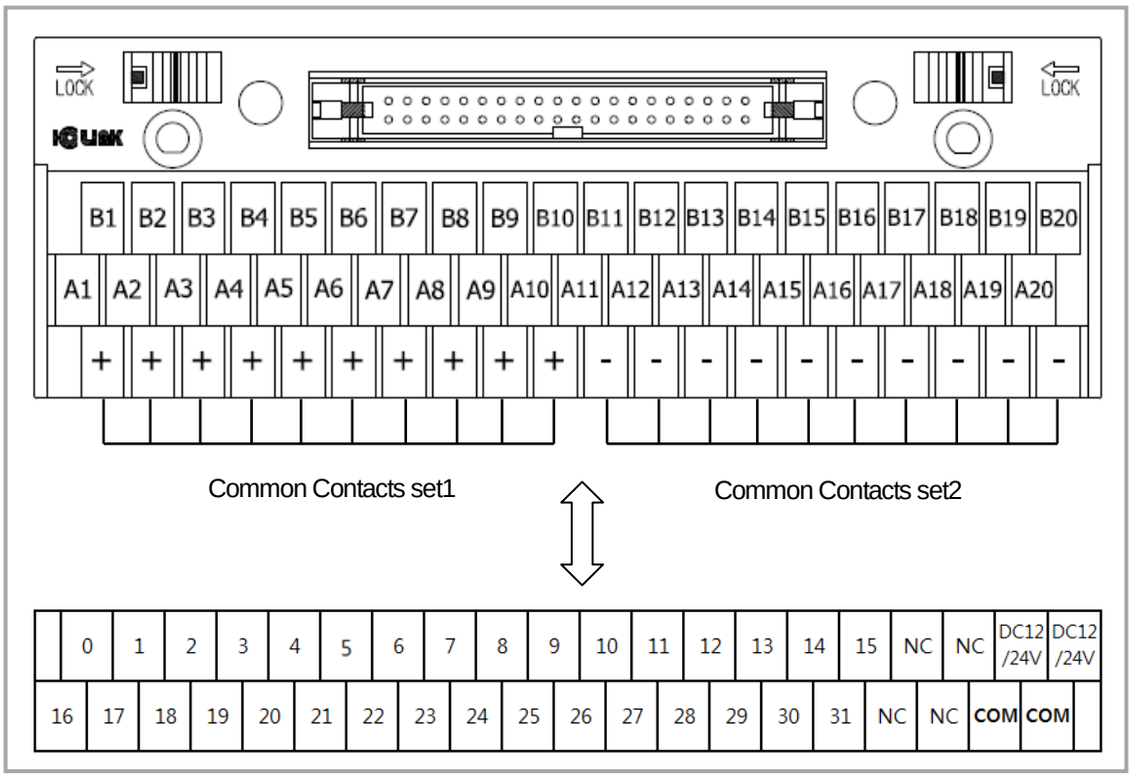
	Model	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (Common 20Pin Added)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
Relay board	R32C-NS5A-40P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

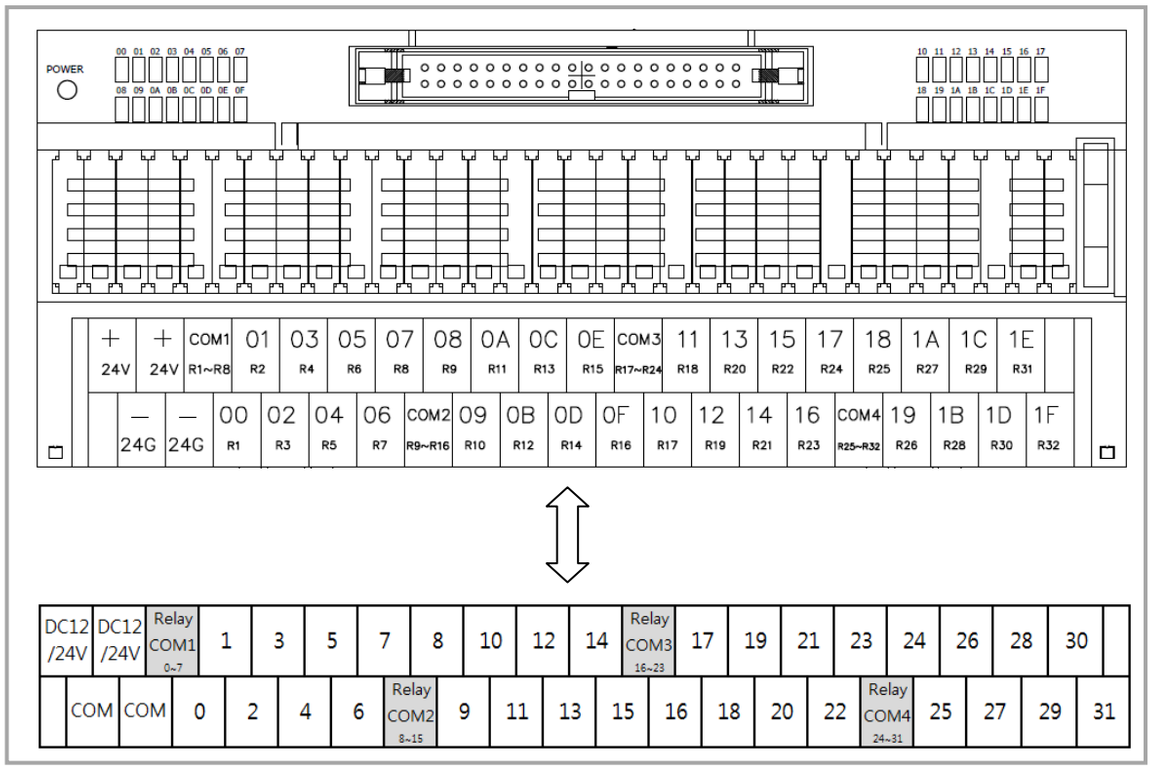
(a) TG7-1H40S



(b) TG7-1H40CA



(c) R32C-NS5A-40P



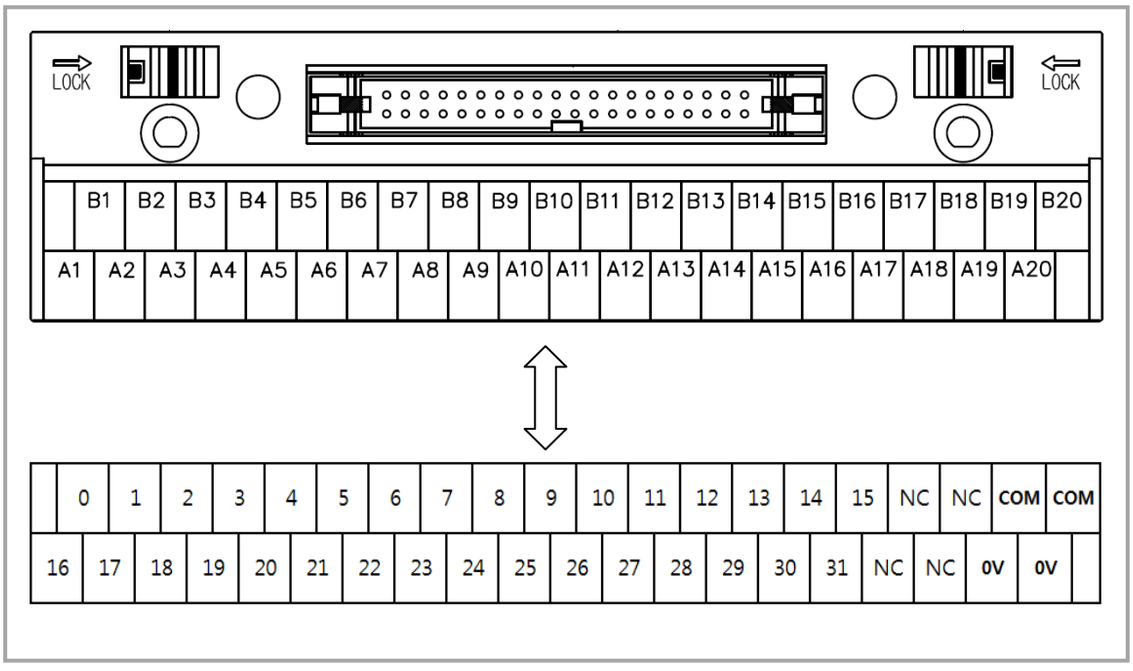
(4) XGQ-TR4B/8B

1) Applicable Smart Link

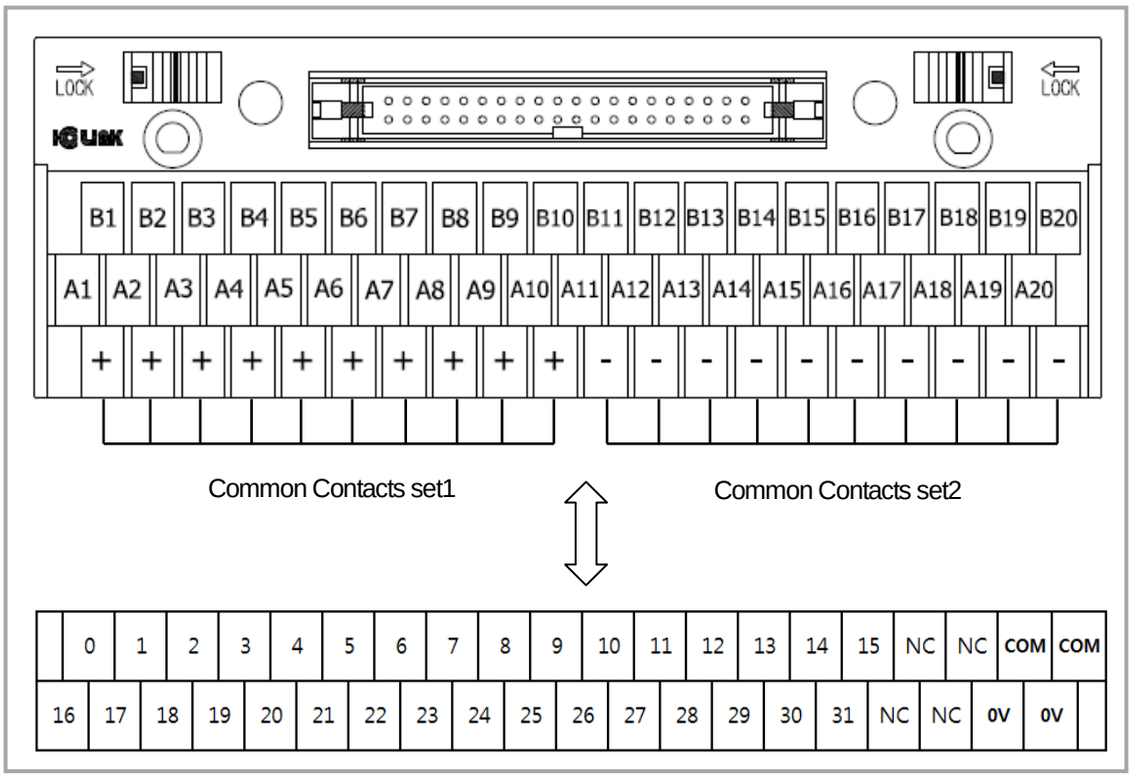
	Model	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (Common 20Pin Added)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
Relay board	R32C-PS5A-40P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

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

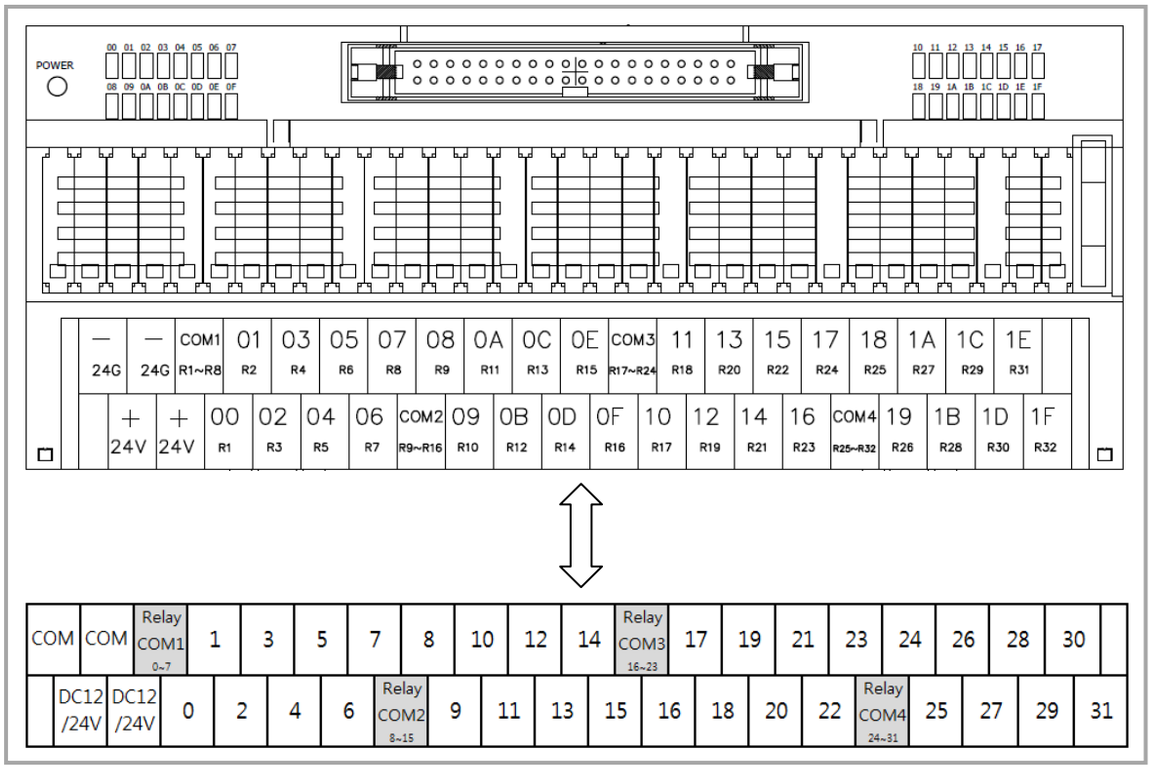
(a) TG7-1H40S



(b) TG7-1H40CA



(c) R32C-PS5A-40P



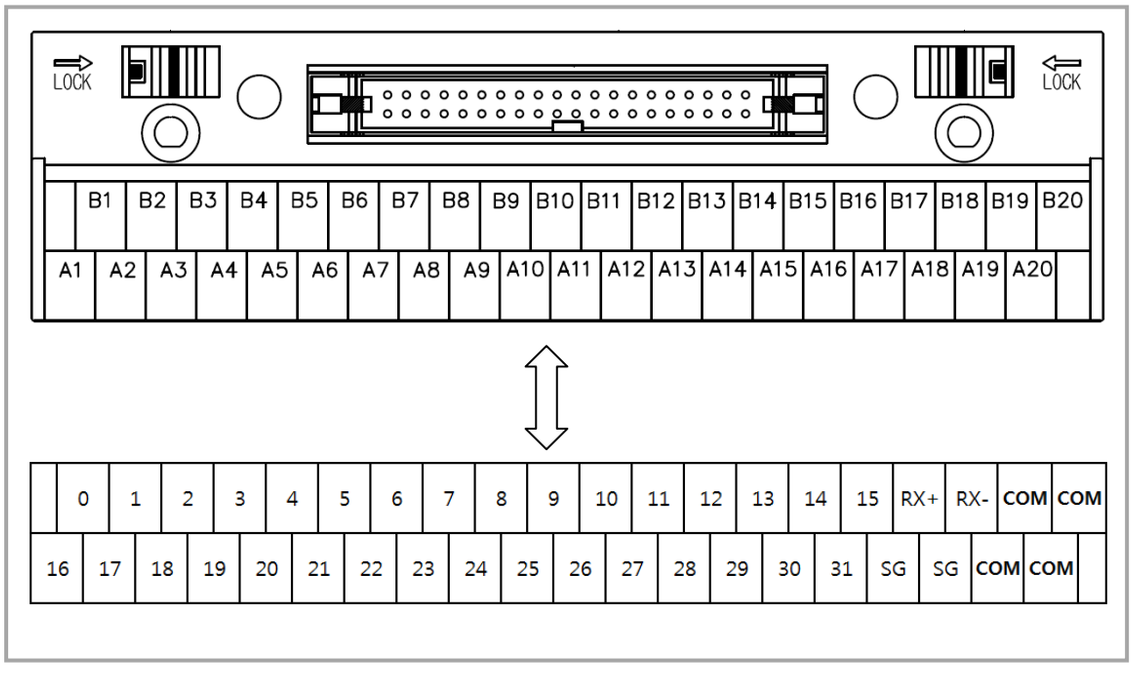
(5) XGF-SOEA

1) Applicable Smart Link

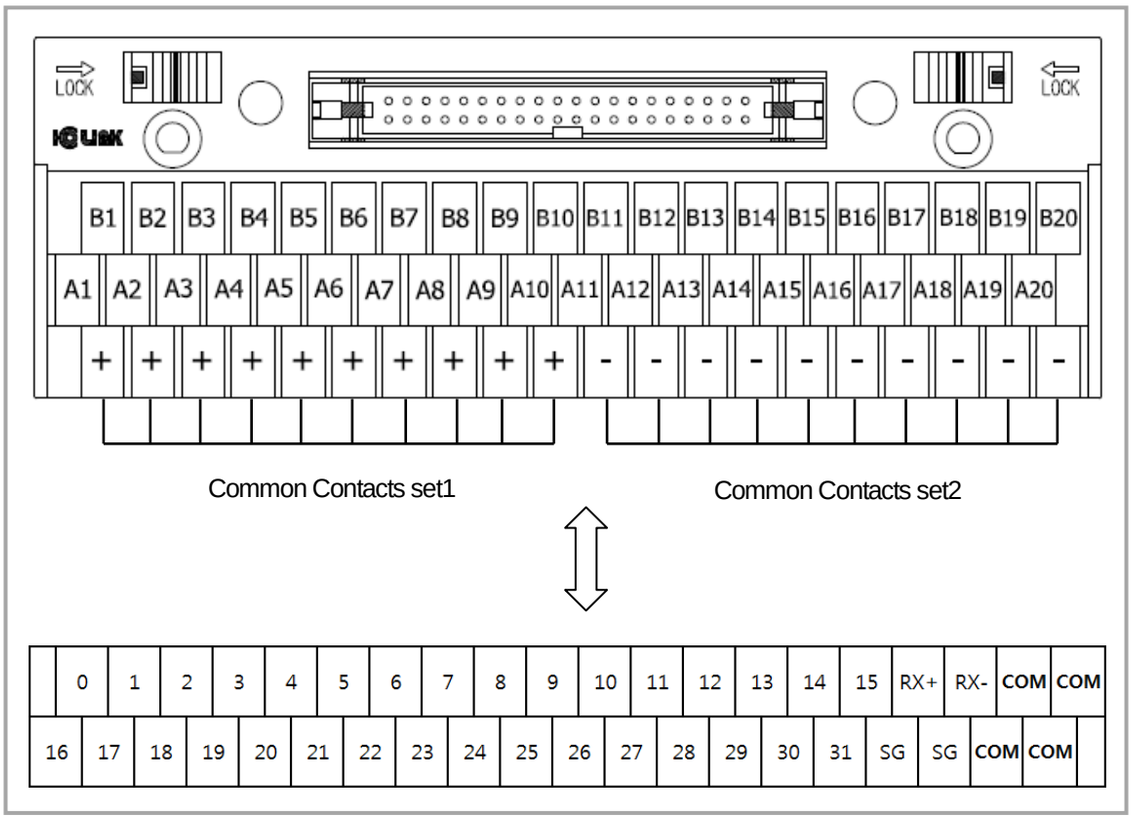
	Model	Cable	Length of Cable
Terminal board	TG7-1H40S	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m
	TG7-1H40CA (Common 20Pin Added)	C40HF-05PB-1B	0.5m
		C40HF-10PB-1B	1m
		C40HF-15PB-1B	1.5m
		C40HF-20PB-1B	2m
		C40HF-30PB-1B	3m

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

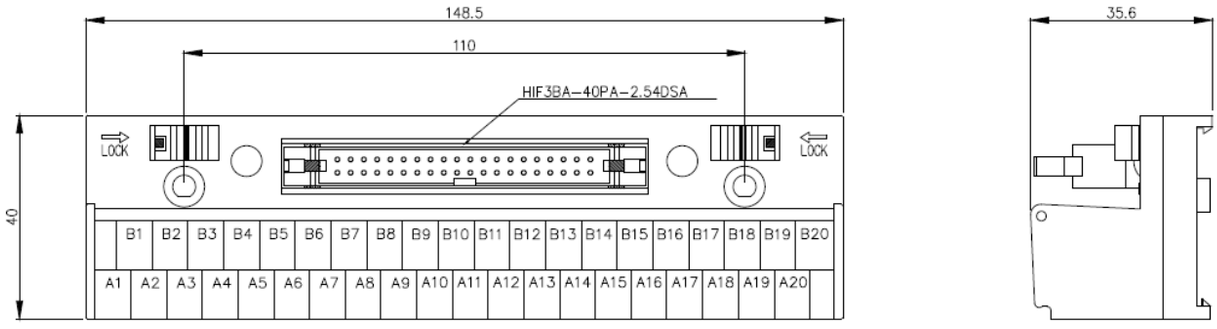
7.6.6 Smart Link Specifications & Dimensions

(1) TG7-1H40S

1) Specifications

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

2) Dimensions(mm)

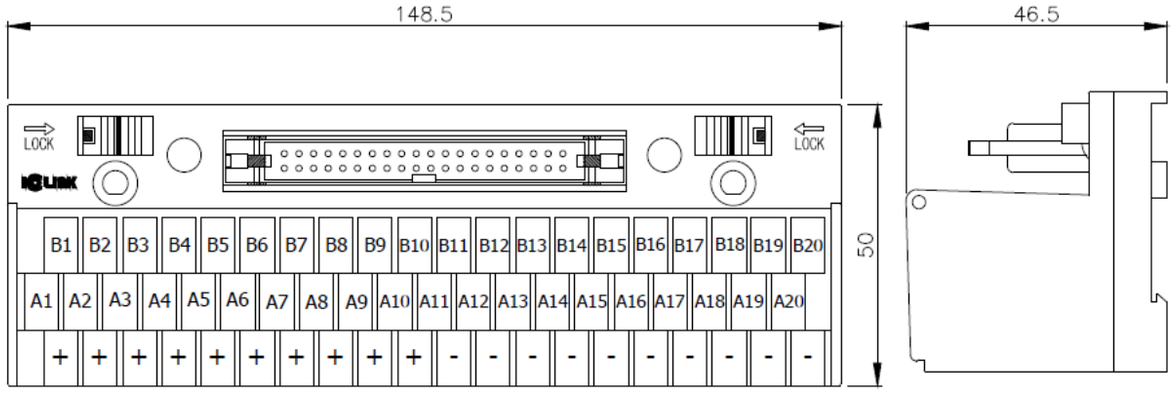


(2) TG7-1H40CA

1) Specifications

Rated Voltage		125V AC / 24V DC
Rated Current	IO	1A
	Common	10A (Total)
Insulation resistance		100MΩ (DC 500V)
Withstanding Voltage		AC500V 1min
Applicable Wire		AWG22-16 (MAX / 1.5 ㎟)
Contact Screw		M3 X 10L
Screw Torque		1.2N • m(12Kgf • cm)
Ambient Temperature		-10℃ ~ +50℃ (Non-condensing)
Terminal Block & Cover		Modified PPO
Protective Cover		Polycarbonate
PCB		Epoxy 1.6t

2) Dimensions(mm)



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

1) Specifications

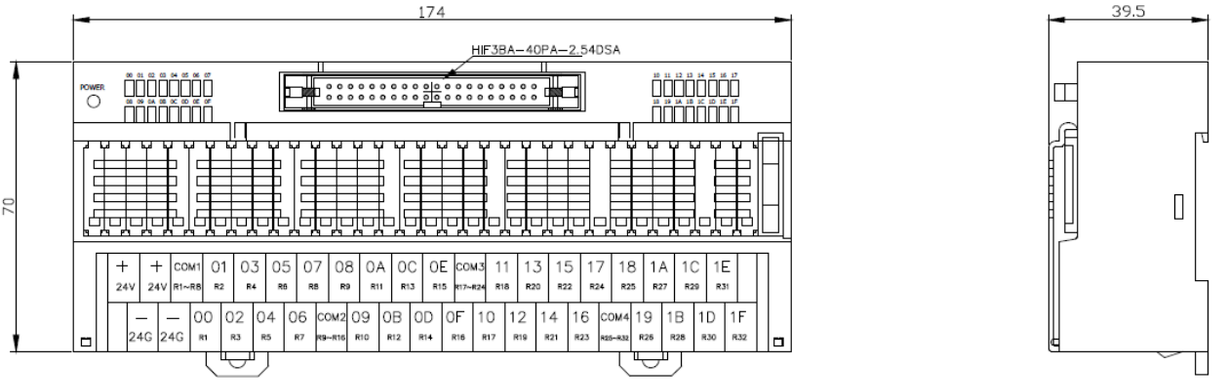
(a) Relay Board

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

(b) Relay

Specification		PA1a-24V
Contact	Arrangement	1a
	Nominal switching capacity	5A 250V AC / 5A 30V DC
	Max. switching current	5A
	Max. switching voltage	250V AC / 110V DC
Coil	Rated Voltage	24V DC
	Pick-up voltage	16.8V
	Drop-out voltage	1.2V DC
	Coil resistance	3,200Ω
	Rated operation power	180mW
Surge voltage between contact and coil		4,000V
Initial breakdown voltage Between contact and coil		2,000V rms

2) Dimensions(mm)



Chapter 8 Power Module

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

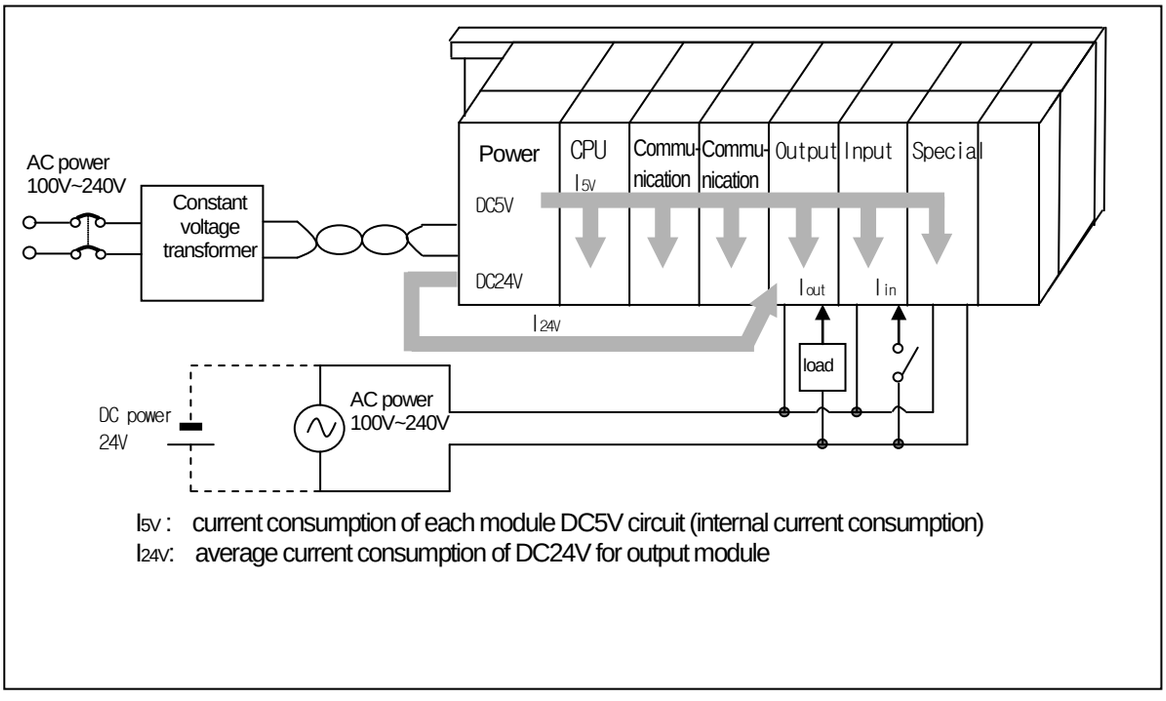
8.1 Selection

The selection of power module is determined by the current that input power 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 are installed on a same base with the power module.
If it exceeds the rated output capacity of power module, the system does not properly work.
Select a power module by considering the power current of each module when structuring a system.
- 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)

Item	Model	Current consumption	Item	Model	Current consumption
CPU module	XGI-CPUUN	960	Analog input module	XGF-AV8A	380
	XGI-CPUH,U,U/D	960		XGF-AC8A	380
	XGI-CPUS/E	940		XGF-AD4S	580
DC24V input module	XGI-D21A	20		XGF-AD8A	380
	XGI-D22A	30		XGF-AD16A	580
	XGI-D22B	30	Analog output module	XGF-DV4A	190 (250)
	XGI-D24A	50		XGF-DC4A	190 (400)
	XGI-D24B	50		XGF-DV8A	190 (250)
	XGI-D28A	60		XGF-DC8A	243 (400)
	XGI-D28B	60		XGF-DV4S	200 (500)
AC110V input module	XGI-A12A	30		XGF-DC4S	200 (200)
AC220V input module	XGI-A21A	20	High speed counter module	XGF-HO2A	270
Relay output module	XGQ-RY1A	250		XGF-HD2A	330
	XGQ-RY2A	500	Positioning module	XGF-PO3A	400
	XGQ-RY2B	500		XGF-PO2A	360
TR output module	XGQ-TR2A	70		XGF-PO1A	340
	XGQ-TR2B	70		XGF-PD3A	820
	XGQ-TR4A	130		XGF-PD2A	750
	XGQ-TR4B	130		XGF-PD1A	510
	XGQ-TR8A	230	Thermocouple input module	XGF-TC4S	610
	XGQ-TR8B	230	RTD input module	XGF-RD4A	490
Triac output module	XGQ-SS2A	300		XGF-RD4S	490
I/O mixed module	XGH-DT4A	110	Motion control module	XGF-M16M	640
Cnet I/F module	XGL-C22A	330	FEnet I/F module (Optical/electrical)	XGL-EFMF	650
	XGL-C42A	300		XGL-EFMT	420
	XGL-CH2A	340	FDEnet I/F module (Master)	XGL-EDMF	650
Pnet I/F module	XGL-PMEA	560		XGL-EDMT	420
Dnet I/F module	XGL-DMEA	440	RAPIEnet I/F module	XGL-EIMF	670
Rnet I/F module	XGL-RMEA	410		XGL-EIMT	330
Temperature controler module	XGF-TC4UD	770		XGL-EIMH	510
Optical ring switch module	XGL-ESHF	1,200	-	-	-

( ) means the current consumption for external DC24V.



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

8.2 Specifications

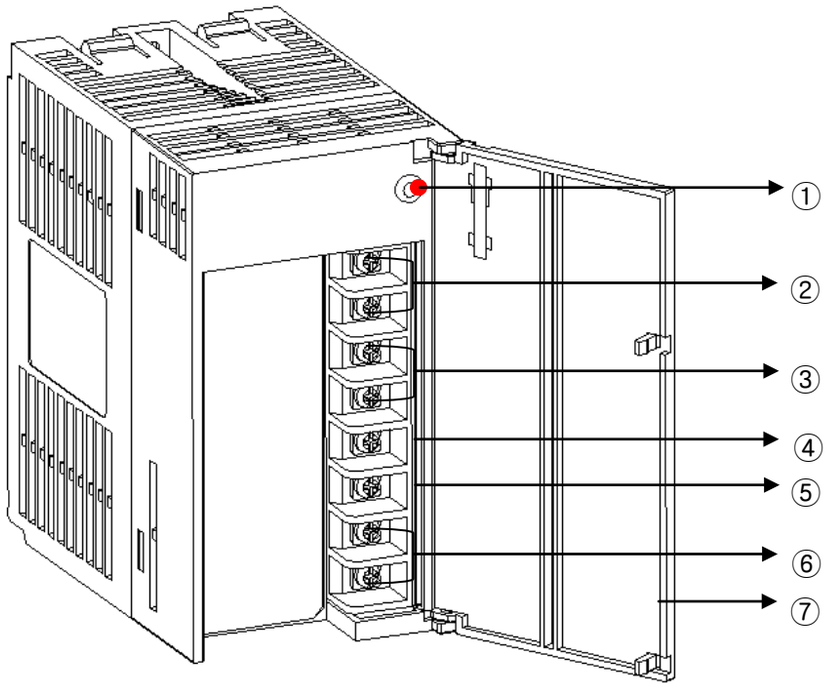
Item		XGP-ACF1	XGP-ACF2	XGP-AC23	XGP-DC42
Input	Rated input voltage	AC110/220V		AC220V	DC24V
	Input voltage range	AC85V ~ AC264V		AC170V ~ AC264V	-
	Input frequency	50 / 60 Hz (47 ~ 63 Hz)			-
	Inrush current	20A$_{Peak}$ and lower			80A$_{Peak}$ and lower
	Efficiency	65% and higher			60% and higher
	Input fuse	Built in(not replaceable by a user), UL standard product(Slow Blow Type)			
	Allowed instantaneous interruption	10 ms and shorter			
Output 1	Output voltage	DC5V (±2%)			DC5V (±2%)
	Output current	3 A	6 A	8.5 A	6A
	Overcurrent protection	3.2A and higher	6.6 A and higher	9A and higher	6.6 A and higher
	Overvoltage protection	5.5V ~ 6.5V			
Output 2	Output voltage	DC24V (±10%)	-		-
	Output current	0.6 A			
	Overcurrent protection	0.7 A and higher			
	Overvoltage protection	None			
Relay Output	Application	RUN contact(refer to 8.3)			
	Rated switching voltage/current	DC24V, 0.5A			
	Min. switching load	DC5V,1 ㎃			
	Response time	Off→On/ On→Off : 10 ㎳ and lower/12 ㎳ and lower			
	Life	Mechanical life: 20 million and more times, electrical life: rated switching current: 100 thousand and more times			
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		0.4 kg		0.6 kg	0.5 kg

Note

1) Allowable instantaneous interruption time
   The time that the normal output voltage is maintained(normal operation) with the input voltage of AC110/220V lower than the rated value(AC85/170V)
2) Overcurrent protection
   (1) If a current over the rated level is allowed on DC5V, DC24V circuit, an overcurrent protective system cuts off the circuit, suspending the system.
   (2) If there is any overcurrent, the system should be restarted after eliminating the causes such as low current capacity, short-circuit and etc.
3) Overvoltage protection
   If a voltage over the rated value is allowed to DC5V, the overvoltage voltage protective system cuts it off, suspending the system.

8.3 Parts' Names

It describes the names and applications of parts of the power module.



NO.	Name	Application
1	Power LED	LED to display DC5V power
2	DC24V, 24G terminal	Supplying power to a module requiring DC24V ▶ DC24V is not supplied to XGP-ACF2 and XGP-AC23.
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 turns to STOP.
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 : connecting to AC100~240V ▶ XGP-AC23 : connecting to AC200~240V ▶ XGP-DC42 : connecting to DC24V
7	Terminal cover	Terminal strip protection cover

8.4 Example of Current Consumption/Power Calculations

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

Type	Model	No.	Voltage	
			5V	24V
CPU module	XGI-CPUU	1	0.96A	-
12 Slot basic base	XGB-M12A	-	-	-
Input module	XGI-D24A	4	0.2A	-
Output module	XGQ-RY2A	4	2.0A	-
FDEnet module	XGL-EDMF	2	1.3A	-
Profibus-DP	XGL-PMEA	2	1.12A	-
Current consumption	Calculation		0.96+0.2+2+1.3+1.12	-
	Result		5.58A	-
Power consumption	Calculation		5.58×5V	-
	Result		27.9W	-

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 XGP-ACF1 (for 5V:3A) is used, the system does not work properly.

Chapter 9 Base and Extension Cable

9.1 Specifications

9.1.1 Main base

The Main base contains Power module, CPU module, I/O module, Special module and Communication module.

Item \ Model	XGB-M12A	XGB-M08A	XGB-M06A	XGB-M04A
No. of I/O modules installed	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)			
Weight (kg)	0.54	0.42	0.34	0.28

9.1.2 Expansion base

The expansion base contains Power module, I/O module, Special module and Communication module.

Item \ Model	XGB-E12A	XGB-E08A	XGB-E06A	XGB-E04A
No. of I/O modules installed	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 screws)			
Screw size for PE connection	(+)PHM 3 X 6 washer(ϕ 5)			
Weight (kg)	0.59	0.47	0.39	0.33

9.1.3 Extended cable

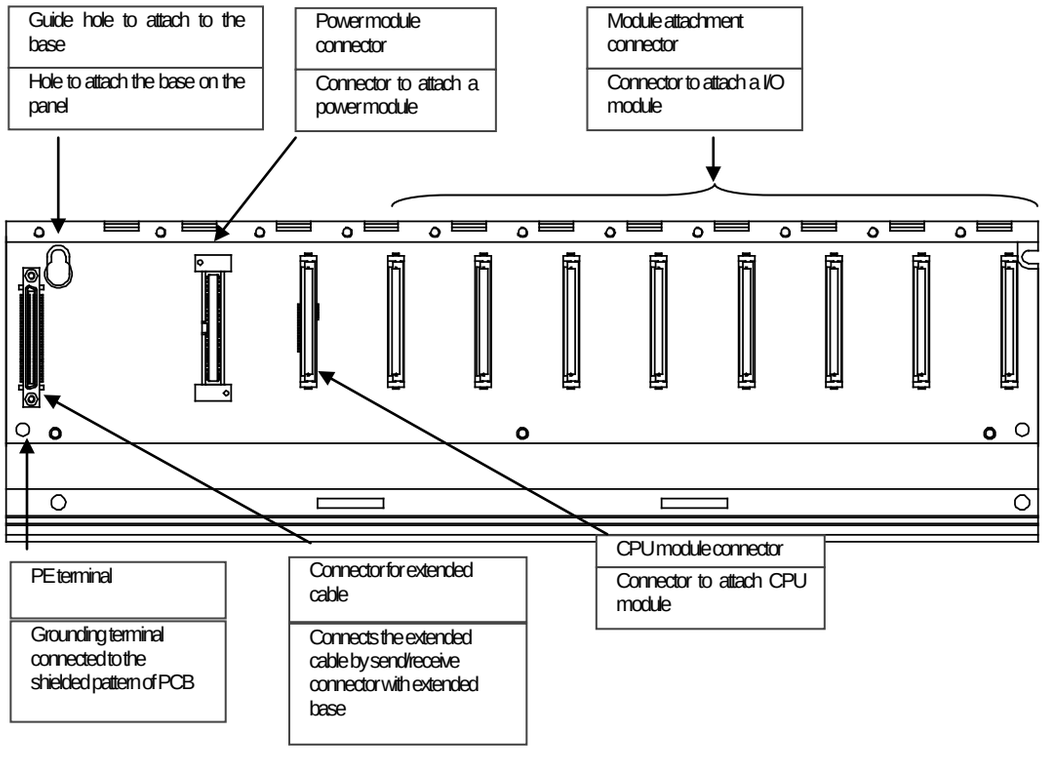
Item \ Model	XGC-E041	XGC-E061	XGC-E121	XGC-E301	XGC-E501	XGC-E102	XGC-E152
Length (m)	0.4	0.6	1.2	3	5	10	15
Weight (kg)	0.15	0.16	0.22	0.39	0.62	1.2	1.8

Note

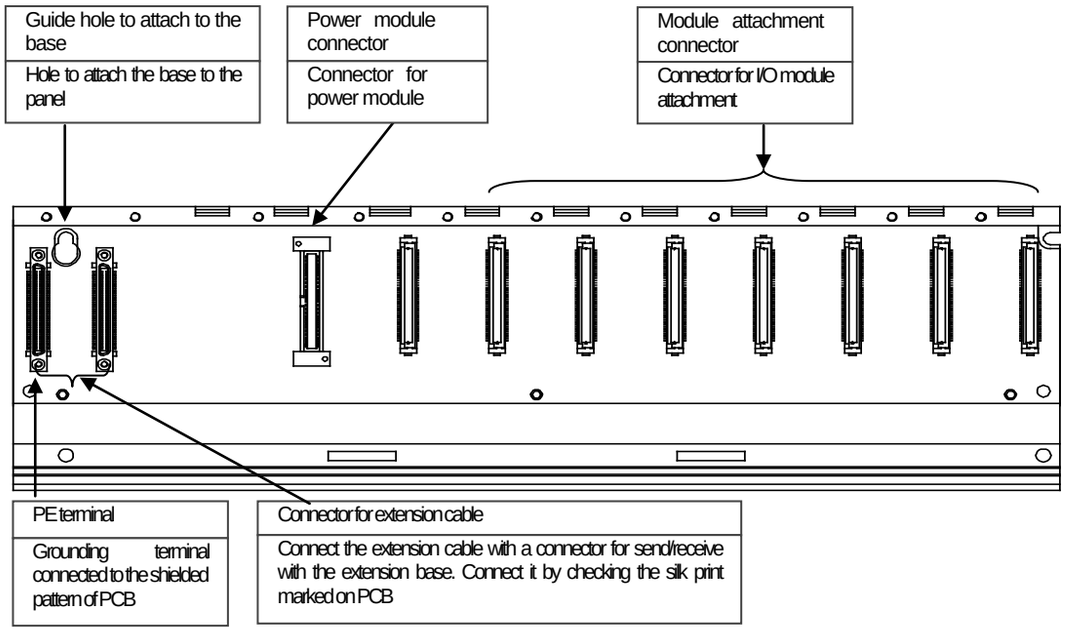
If using a combination with extended cable, it should not be longer than 15m.

9.2 Parts' Names

9.2.1 Main base



9.2.2 Expansion base



Chapter 10 Installation and Wiring

10.1 Installation

10.1.1 Installation environment

The system keeps a high reliability, irrespective of the installation environment. However, to guarantee the reliability and stability, make sure to keep the following cautions.

1) Environmental conditions

(1) Install in a control panel resisting to moisture and vibration.
(2) Free of any continuous impact or vibration.
(3) Not exposed to direct sunrays.
(4) No condensation from sudden temperature fluctuation.
(5) Ambient temperature range between 0 ~ 55℃.
(6) Relative humidity between 5 ~ 95%.
(7) Free of any corrosive gas or flammable gas.

2) Installation construction

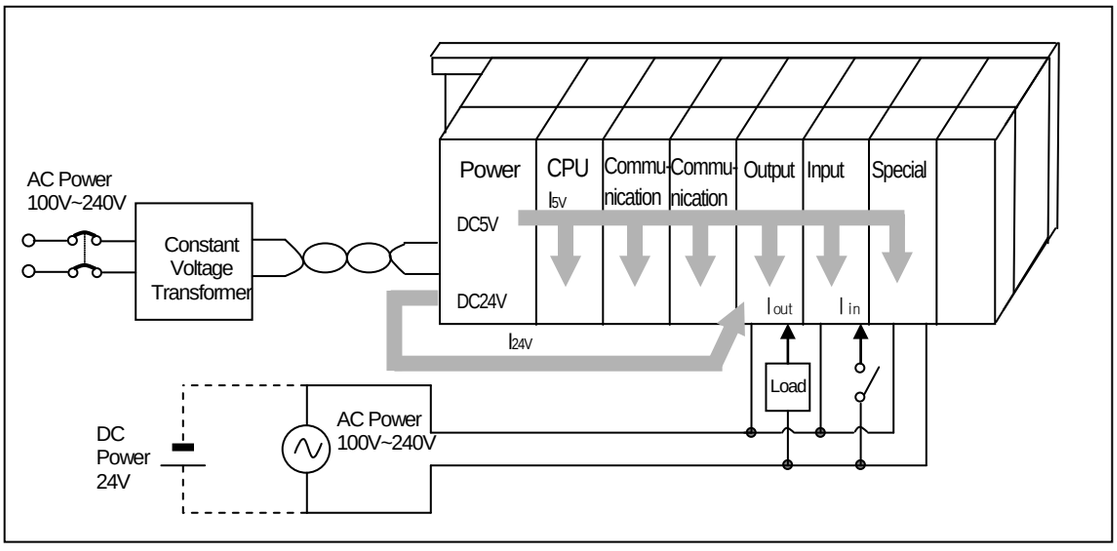
(1) When boring a screw hole or executing wiring construction, any wiring impurities should not be inserted to the PLC.
(2) The system should be installed in a place easily accessible.
(3) Do not install the system on a same panel of a high voltage device.
(4) It should be 50mm and more away from wiring 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} : power 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) Power consumption of special module power assembly

- $W_S = I_{5V} \times 5 + I_{24V} \times 24 + I_{100V} \times 100$ (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 : power consumption of the entire PLC system (the above calculated value)
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 Cautions for handling

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. It may cause a trouble.
- 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.

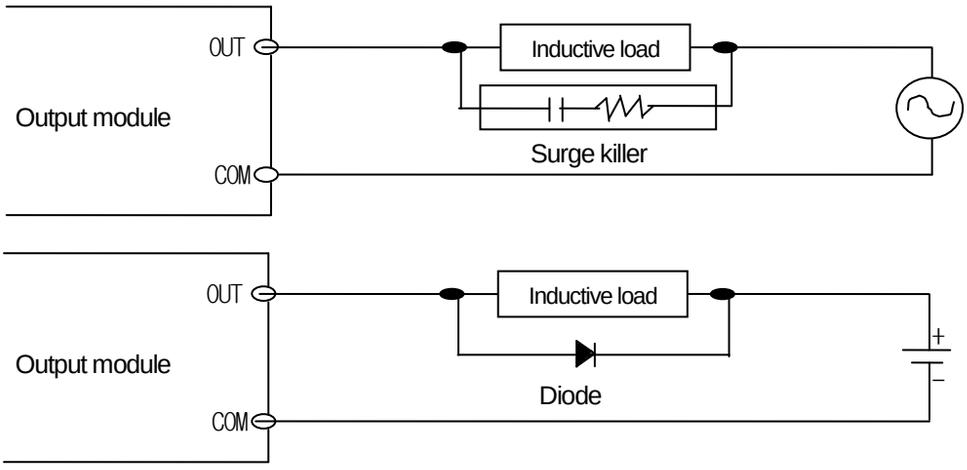
(1) Recheck the I/O module specifications.
The input module may be affected by input voltage while the output module may be subject to breakage, destruction or a fire if the voltage over the max. switching capacity is allowed.

(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 (+) o f 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.

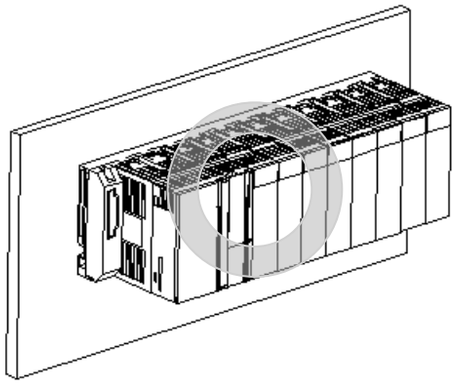
(2) Please do not install it vertically or horizontally for the ventilation purpose.

(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

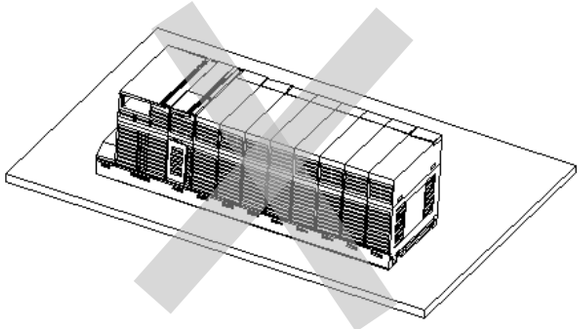
(4) If necessary, please install a wiring duct. However, please keep the following cautions.

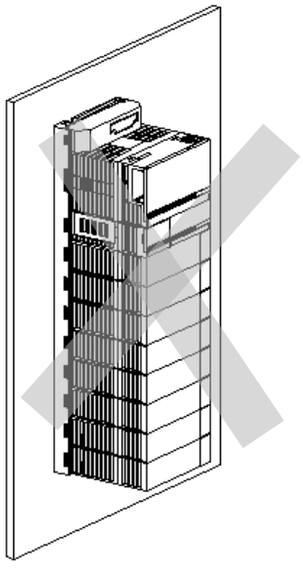
- If installing on the top of PLC, maintain the height of a wiring duct 50mm more than for better ventilation. In addition, maintain the distance from the top of PLC so that the hook on the top of the base can be pressed.
- If installing on the bottom of it, let optical or coaxial cable be connected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

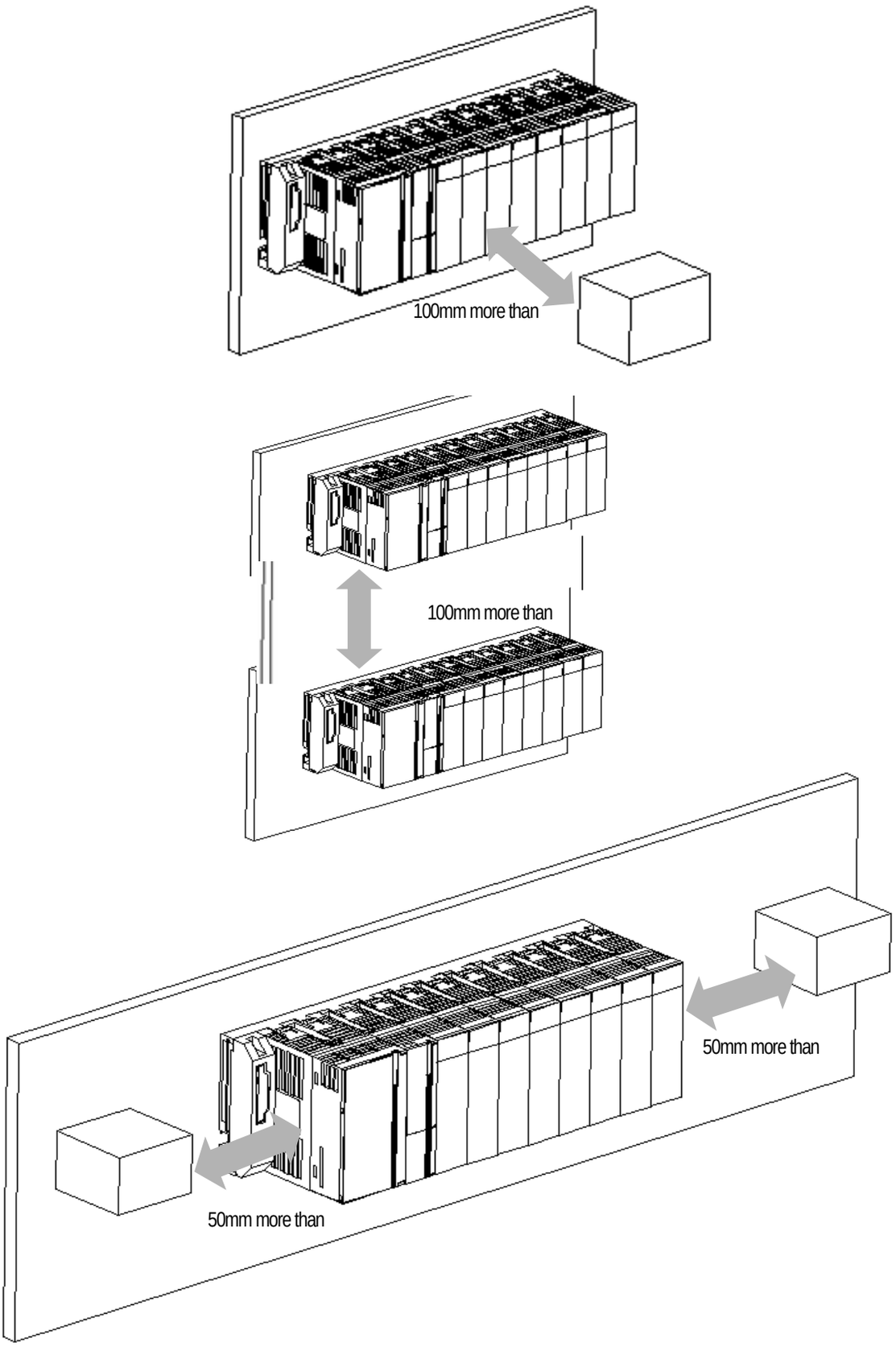


(6) Please do not install it to the direction as presented below.





(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.

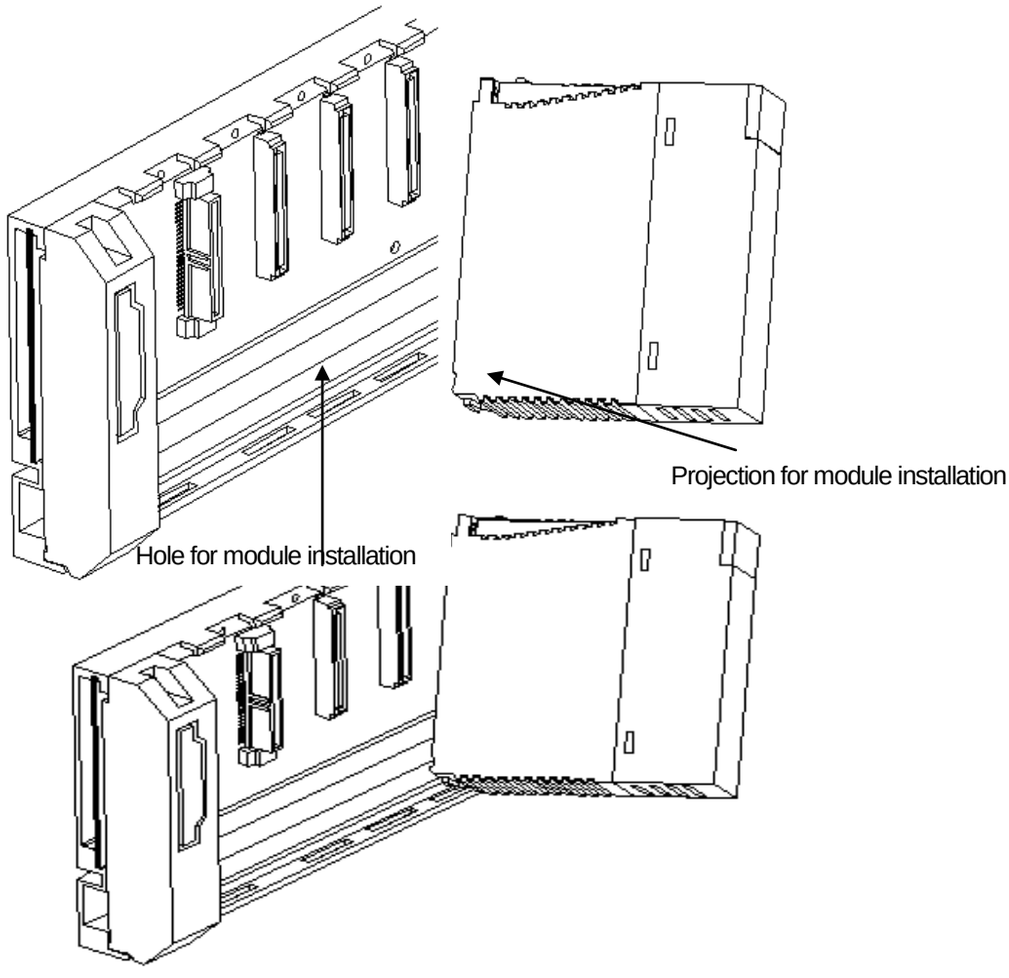


10.1.3 Attachment/Detachment of modules

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

1) Attachment

- 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.

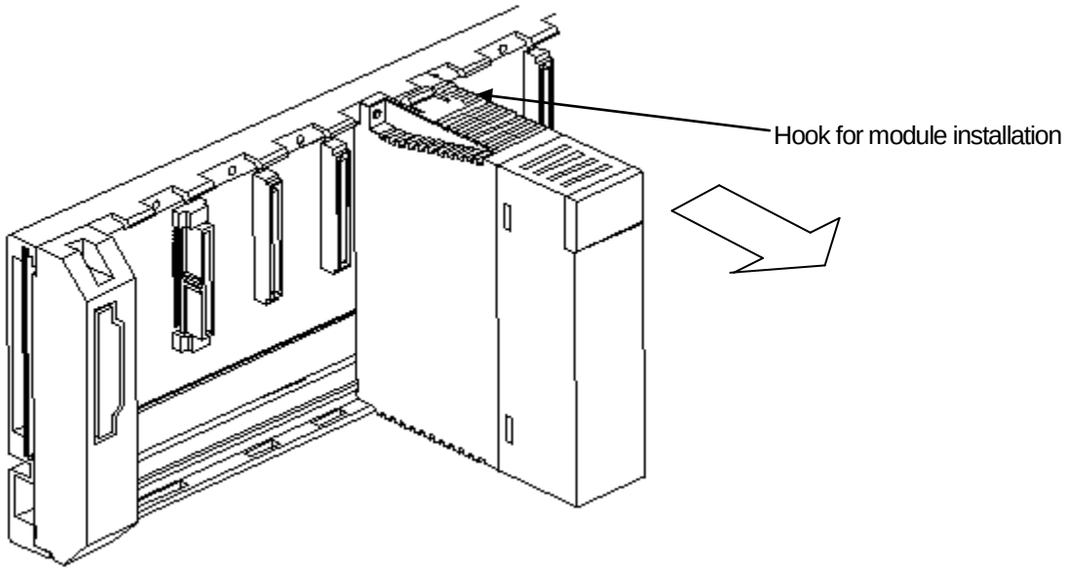


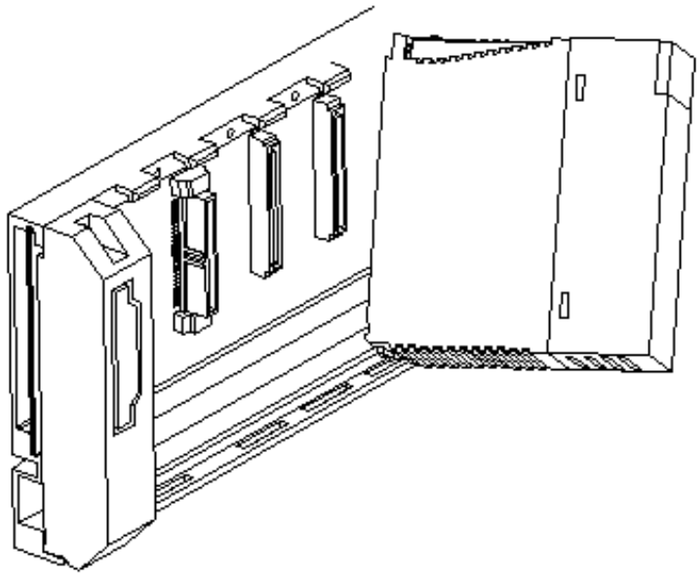
Note

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

- 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.





Note

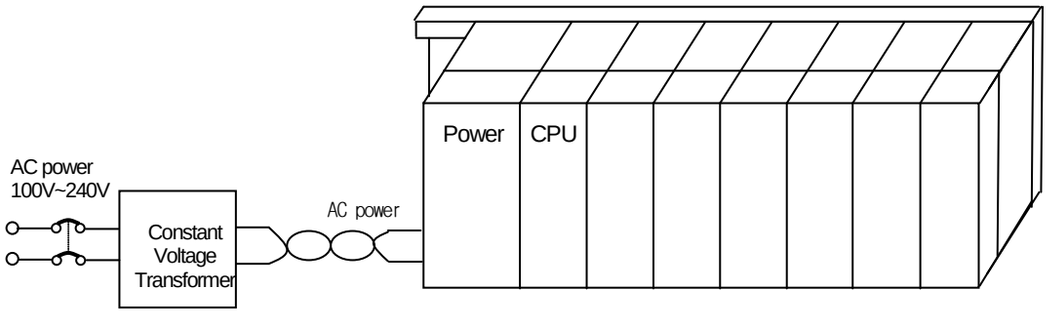
1) When detaching a module, please press the hook to detach it from the base and then, isolate the projection for module installation from the hole for module installation. At the moment, if trying to detach it forcibly, the hook or projection may be damaged.

10.2 Wiring

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

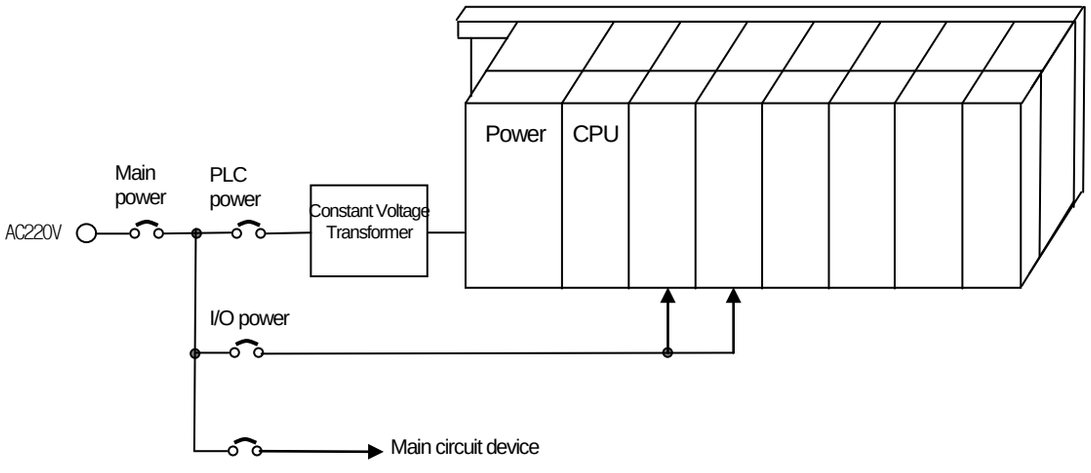
10.2.1 Power wiring

1) Connect a constant voltage transformer when the power variance is larger than the specified range.



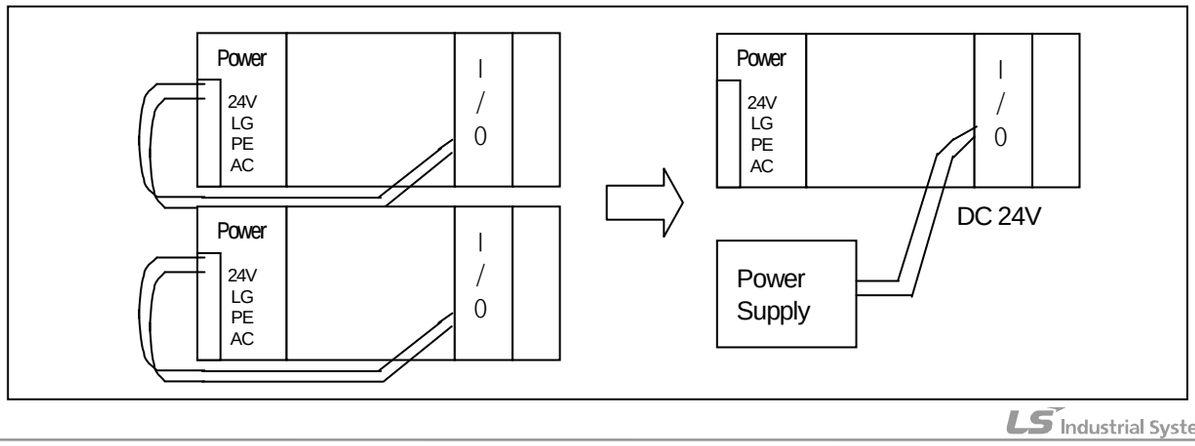
2) Connect the power source of which inter-cable or cable-ground noise is small.
(If a large one is connected, make sure to connect to an insulation transformer)

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



4) If using DC24V of the power module

- Do not connect DC24V of several power modules in parallel. It may cause the destruction of a module.
- If a power module can not meet the DC24V output capacity, supply DC24V externally as presented below.

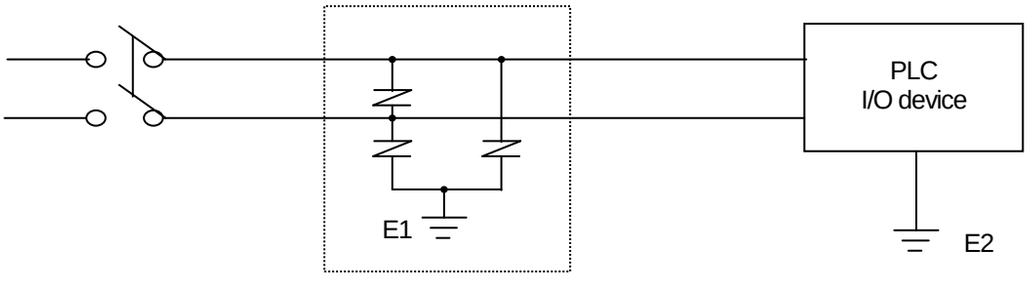


5) AC110V/AC220V/DC24V cables should be compactly twisted and connected in the shortest distance.

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

Note

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.

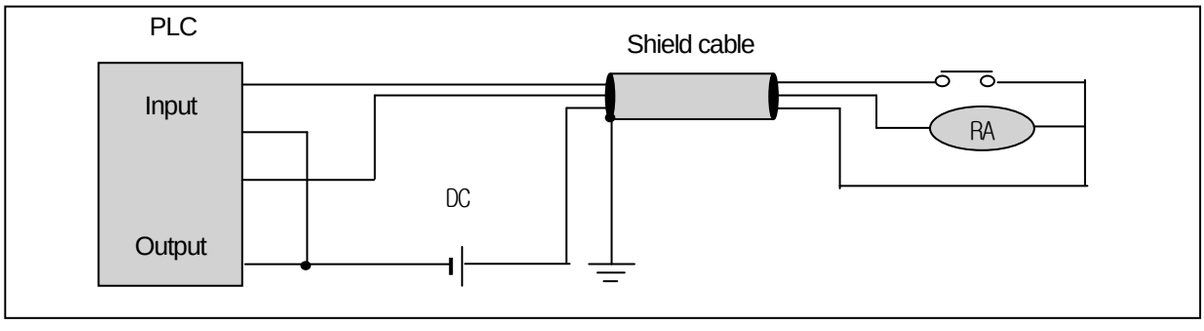
10.2.2 I/O Device wiring

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 can not 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.

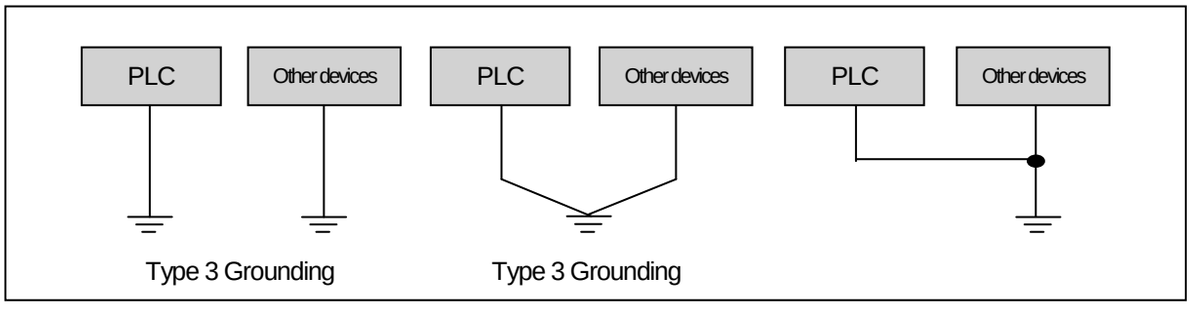
For a long distance wiring over 200m, please refer to 12.4 Cases in Chapter 12 because it is expected that accident may occur due to leakage current due to inter-cable capacity.

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)

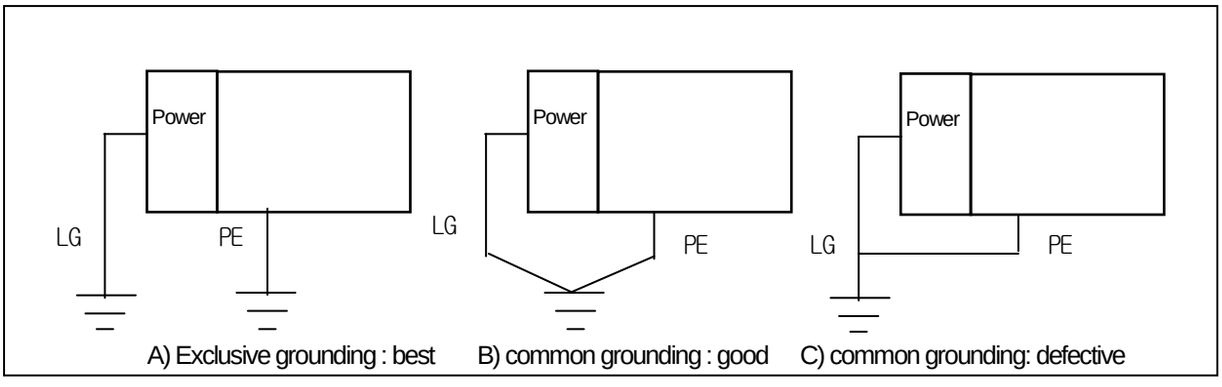
3) If the exclusive grounding is not possible, use the common grounding as presented in B) of the figure below.



A) Exclusive grounding : best B) common grounding : good C) common grounding: defective

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 grounding : best B) common grounding : good C) common grounding: defective

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

10.2.4 Specifications of wiring cable

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)
Analogue I/O	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

To maintain PLC in the best condition, please execute the following routine and periodic inspections.

11.1 Repairs and Maintenance

The I/O module mainly consists of semiconductor elements, so its life is almost semi permanent. However, such elements may be affected by the environment, so they should be periodically inspected and maintained. Please refer to the following checklist for the items to be checked once or twice every 6 months.

Checklist		Judgment basis	Actions
Power supply		Within the power variance range (less than –15% / +10%)	Adjust the power within the allowable voltage variance range.
I/O power		I/O specifications of each module	Adjust the power within the allowable voltage variance range.
Environment	Temperature	0 ~ + 55 °C	Adjust the temperature and humidity conditions properly.
	Humidity	5 ~ 95%RH	
	Vibration	None	Use vibration-preventive rubber or other measures.
Shakes of modules		Should not have shake	Every module should be protected from shaking.
Loose terminal screw		No looseness	Tighten any loose screw.
Spare parts		Check whether the amount and conditions of spare parts are proper	Replenish insufficient parts and improve the storage condition.

11.2 Routine Inspection

The following items should be routinely inspected.

Checklist		Check point	Judgment basis	Actions
Attachment of the base		Check any loose screw	Screws should be firmly tightened.	Tightening
Attachment of I/O module		• Check the screws are firmly tightened • Check any separation of module cover	Should be firmly tightened.	Check screw
Attachment of terminal strip and extension cable		Loosen screw	No looseness	Tightening
		Proximity with clamped terminal	Proper spacing	Calibration
		Connector of extension cable	Connector should be tightened	Calibration
Display LED	Power LED	Check whether it is LED ON	LED On (off is error)	Please refer to chapter 14
	RUN LED	Check whether it is LED ON in RUN state	LED On (off or blinking is error)	
	STOP LED	Check whether it is LED Off in RUN state	Blinking is error	
	Input LED	Check whether LED On or Off	LED On with input ON and LED Off with input off	
	Output LED	Check whether LED On or Off	LED On with output ON and LED Off with output off	

11.3 Periodic Inspection

Please take a measure by checking the following items once or twice every 6 months.

Checklist		Check method	Judgment basis	Actions
Environment	Temperature	Measure by thermometer/hygrometer Measure corrosive gas	0 ~ 55 °C	Adjusting according to the general spec.(the environment in panel)
	Humidity		5 ~ 95%RH	
	Contamination level		Free of corrosive gas	
PLC status	Looseness/shake	Try to move each module	Should be firmly attached	Tightening
	Built-in dust/impurities	Visual inspection	No built-in dust/impurities	-
Connection status	Looseness	Tightening with a screwdriver	No loosened screws	Tightening
	Proximate of clamped terminal	Visual inspection	Proper spacing	Calibration
	Loosened connector	Visual inspection	No looseness	Tightening connector screws
Check power voltage		Check the voltage of input terminal by using a tester	AC100~240V:AC85~ 264V DC24V:DC19.2 ~ 28.8V	Change the power supplied
Battery		Check the battery replacement timing and voltage drop	• Check the total interruption time and warranty period • No battery voltage drop display	A battery should be replaced if it passes the warranty period despite of no display
Fuse		Visual inspection	• No fusing	Regularly replace it because element may be deteriorated by inrush current.

Chapter 12 Compliance with EMC Specifications

12.1 Requirements Complying with EMC Specifications

EMC Directions describe “Do not emit strong electromagnetic wave to the outside: Emission” and “Do not have an influence of electromagnetic wave from the outside: Immunity”, and the applicable products are requested to meet the directions. The chapter summarizes how to structure a system using XGT PLC to comply with the EMC directions. The description is the data summarized for the requirements and specifications of EMC regulation acquired by the company but it does not mean that every system manufactured according to the description meets the following specifications. The method and determination to comply with the EMC directions should be finally determined by the system manufacturer self.

12.1.1 EMC specifications

The EMC specifications affecting the PLC are as follows.

Specification	Test items	Test details	Standard value
EN50081-2	EN55011 Radiated noise * 2	Measure the wave emitted from a product.	30~230 MHz QP : 50 dBμV/m * 1 230~1000 MHz QP : 57 dBμV/m
	EN55011 conducted noise	Measure the noise that a product emits to the power line.	150~500 kHz QP : 79 dB Mean : 66 dB 500~230 MHz QP : 73 dB Mean : 60 dB
EN61131-2	EN61000-4- Electrostatic immunity	Immunity test allowing static electricity to the case of a device.	8 kV Air discharge 6 kV Contact discharge
	EN61000-4-4 Fast transient burst noise	Immunity test allowing a fast noise to power cable and signal cable.	Power line : 2 kV Digital I/O : 1 kV Analogue I/O, signal lines : 1 kV
	EN61000-4-3 Radiated field AM modulation	Immunity test injecting electric field to a product.	10Vm, 26~1000 MHz 80% AM modulation@ 1 kHz
	EN61000-4-12 Damped oscillatory wave immunity	Immunity test allowing attenuation vibration wave to power cable.	Power line : 1 kV Digital I/O(24V and higher) : 1 kV

* 1 : QP: Quasi Peak, Mean : average value

* 2 : PLC is a type of open device(installed on another device) and to be installed in a panel.
For any applicable tests, the system is tested with the system installed in a panel.

12.1.2 Panel

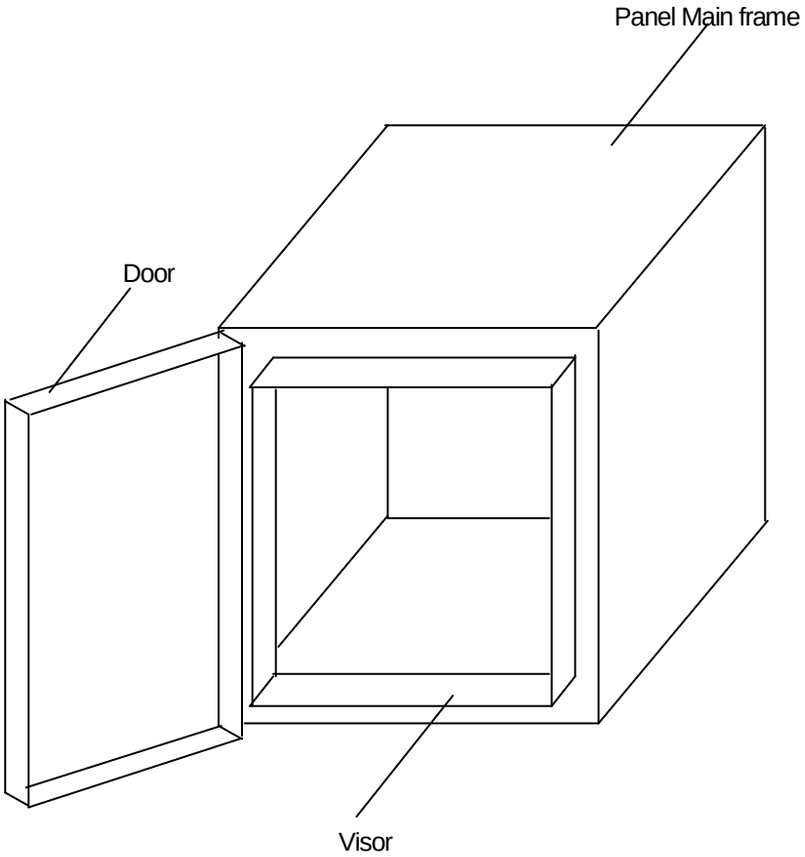
The PLC is a kind of open device(installed on another device) and it should be installed in a panel. It is because the installation may prevent a person from suffering from an accident due to electric shock as the person contacts with the product(XGT PLC) and the panel can attenuates the noise generating from the PLC.

In case of XGT PLC, to restrict EMI emitted from a product, it should be installed in a metallic panel. The specifications of the metallic panel are as follows.

1) Panel

The panel for PLC should be installed and manufactured as follows.

(1) The panel should be made of SPCC(Cold Rolled Mild Steel)
(2) The plate should be 1.6mm and thicker
(3) The power supplied to the panel should be protected against surge by using insulated transformer.
(4) The panel should be structured so that electric wave is not leaked outside. For instance, make the door as a box as presented below. The main frame should be also designed to be covered the door in order to restrict any radiating noise generated from the PLC.



(5) The inside plate of panel should have proper conductivity with a wide surface as possible by eliminating the plating of the bolt used to be mounted on the main frame in order to secure the electric contact with the frame.

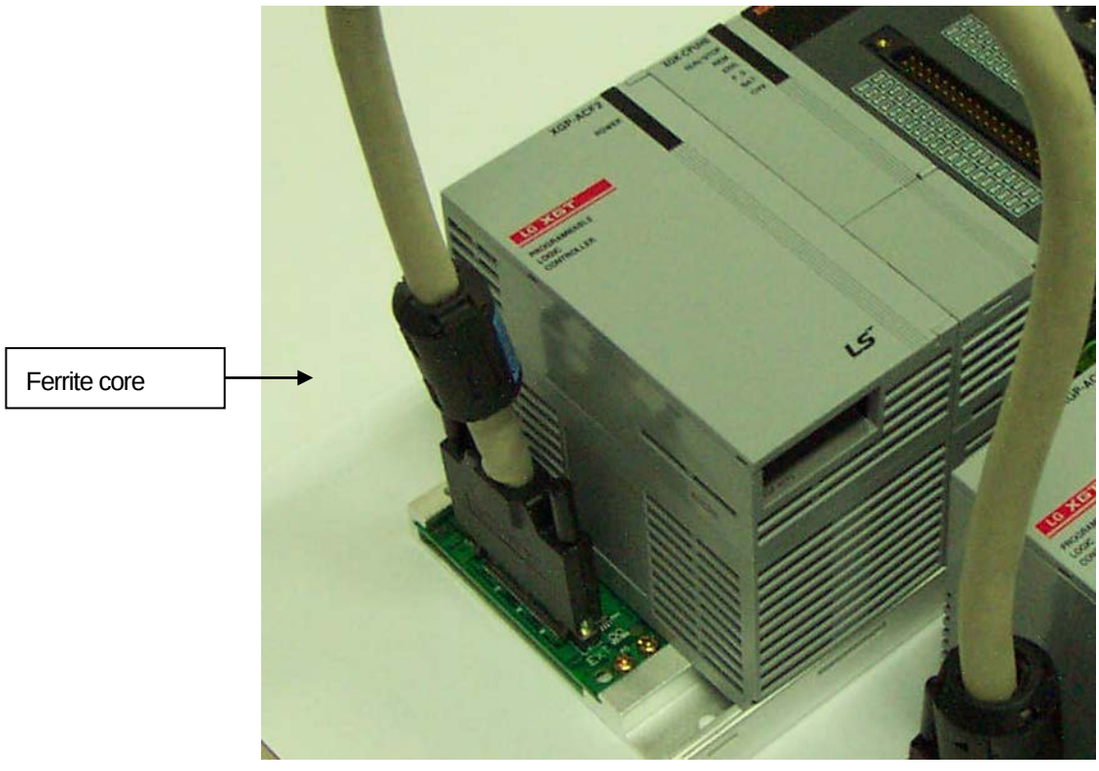
2) Power cable and grounding cable

The grounding/power cable of PLC should be treated as follows.

(1) The panel should be grounded with a thick wire() to secure a lower impedance even in high frequency.
(2) LG(Line Ground) terminal and PE(Protective Earth) terminal functionally let the noise inside the PLC flow into the ground, so a wire of which impedance is low should be used.
(3) Since the grounding cable itself may generate noise, thick and short wiring may prevent it serving as an antenna.

12.1.3 Cable

1) Extension cable treatment
The extension cable of XGT series is with fast electric signal. Therefore, high frequency noise wave is emitted from the extension cable. To comply with the CE specifications, please attach the ferrite core on the extension cable as presented in the figure.



Mode	Manufacturer	Remarks
CU1330D	E Tech Electronics	-
ZCAT3035-1330	TDK	-

2) Fixing a cable in the panel
If the extension cable of XGT series is to be installed on the metallic panel, the cable should be 1cm and more away from the panel, preventing the direct contact.
The metallic plate of panel may shield noise from electromagnetic wave while it a cable as a noise source is close to the place, it can serve as an antenna. Every fast signal cable as well as the extension cable needs proper spacing from the panel.

12.2 Requirements Complying with Low Voltage Direction

The low voltage direction requires a device that operates with AC50~1000V, DC 75 ~ 1500V to have proper safety. The followings summarize the cautions for installing and wiring PLC of the XGT series to comply with the low voltage directions. The description is the data based on the applicable requirements and specifications as far as we know but it does not mean that every system manufactured according to the description meets the following specifications. The method and determination to comply with the EMC directions should be finally determined by the system manufacturer self.

12.2.1 Specifications applicable to XGT series

XGT series follow the EN6100-1(safety of the device used in measurement/control lab).
XGT series is developed in accordance with the above specifications, even for a module operating at the rated voltage higher than AC50V/DC75V.

12.2.2 Selection of XGT series PLC

(1) Power module
The power module of which rated input voltage is AC110/220V may have dangerous voltage(higher than 42.4V peak) inside it, so any CE mark compliance product is insulated between the primary and the secondary.

(2) I/O module
The I/O module of which rated voltage is AC110/220V may have dangerous voltage(higher than 42.4V peak) inside it, so any CE mark compliance product is insulated between the primary and the secondary. The I/O module lower than DC24V is not applicable to the low voltage directions.

(3) CPU Module, Base unit
The modules use DC5V, 3.3V circuits, so they are not applicable to the low voltage directions.

(4) Special module, Communication module
The modules use the rated voltage less than DC 24V, so they are not applicable to the low voltage directions.

Chapter 13 Troubleshooting

The chapter describes types of potential errors that occur while operating the system, causes of errors, how to detect them and corrective measures.

13.1 Basic Troubleshooting Procedure

To improve the reliability of a system, it is important to take a corrective measure promptly if a trouble occurs as well as to use highly reliable devices. To operate a system immediately, it is the most important to quickly detect potential causes of a trouble and take corrective measures. To troubleshoot the system correctly, make sure to take the following cautions and procedures.

1) Check by visual inspection

Please check the followings visually.

- Operation status(Stop, Run)
- Power On/Off status
- I/O device status
- Wiring status(I/O wiring, extension and communication cable)
- Check the status of each display(POWER LED, RUN/STOP LED, I/O LED and etc), connect to peripherals and check the operation condition and program

2) Check any abnormality

Please observe how a fault changes by executing the followings.

- Move the key switch to STOP and turn it On/Off

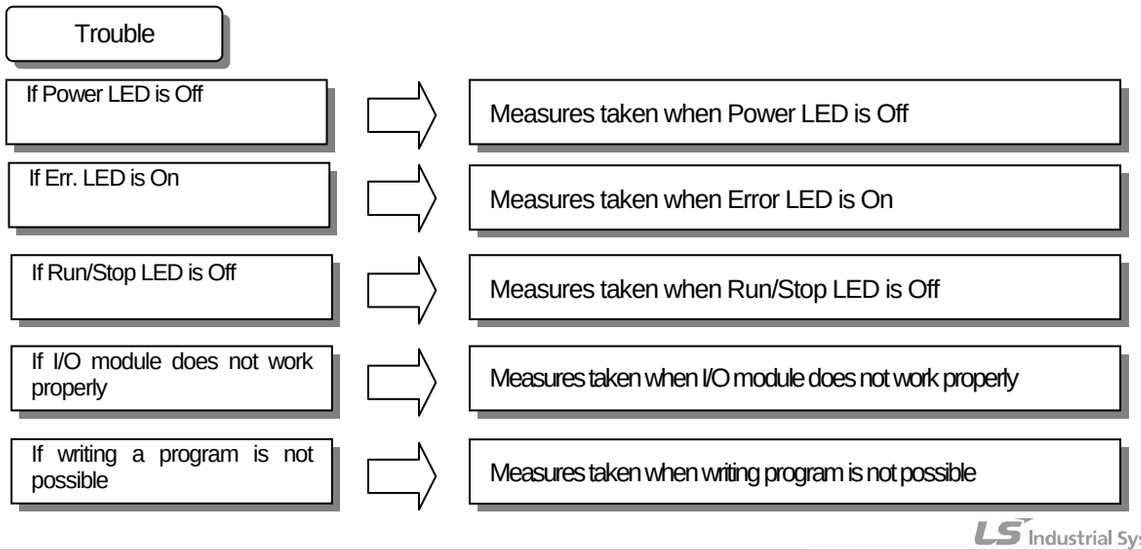
3) Restricting Range

Estimate by which factor a fault occurs by the following methods.

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

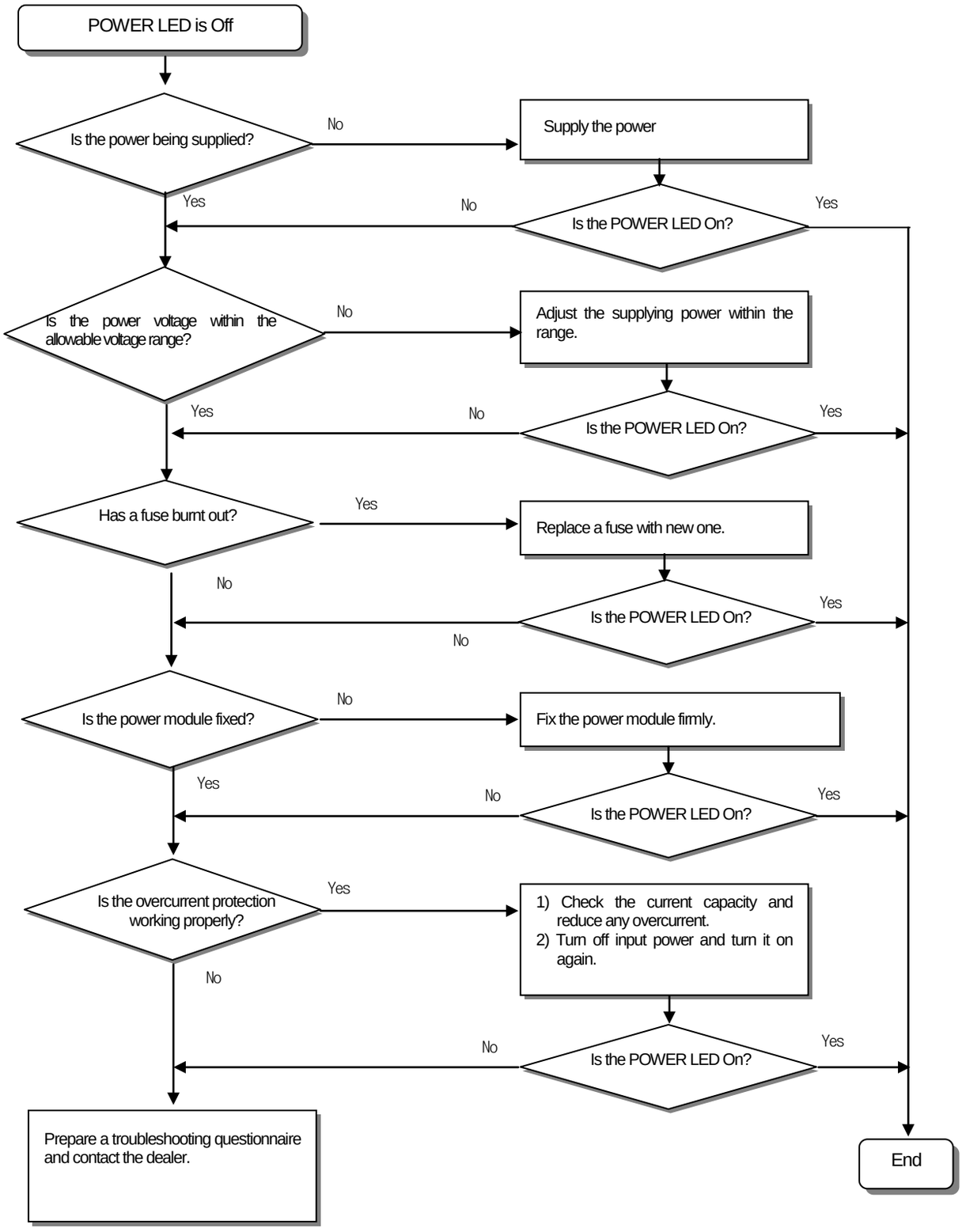
13.2 Troubleshooting

The above stated detection methods, description for error codes and measures are explained by phenomenon.



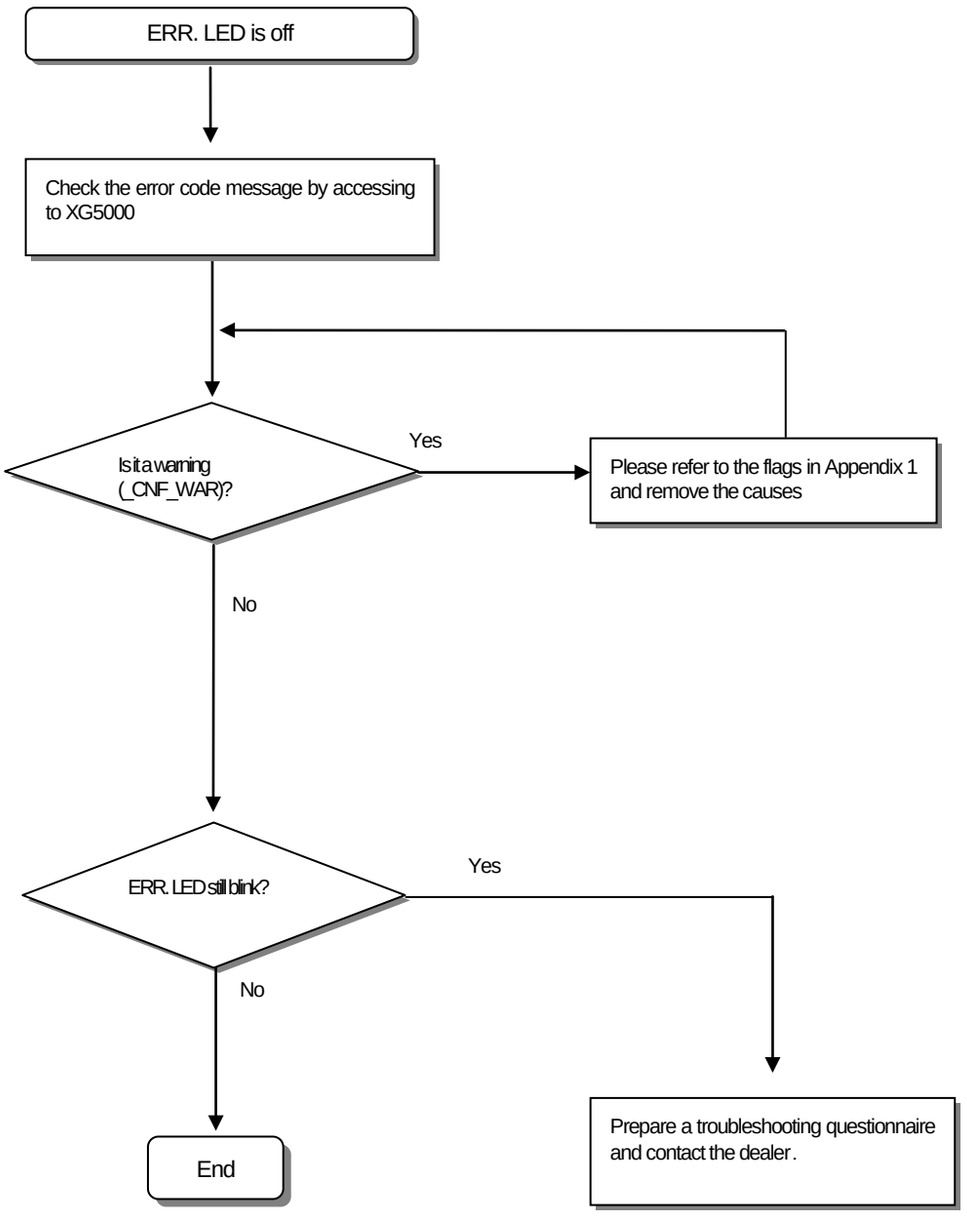
13.2.1 Action when POWER LED is off

The paragraph describes the orders of taking a measure if POWER LED is Off when turning it on or during operation.



13.2.2 Action when ERR. LED is on.

The paragraph describes the orders of taking a measure if ERR. LED is On when turning it on, starting operation or operating.

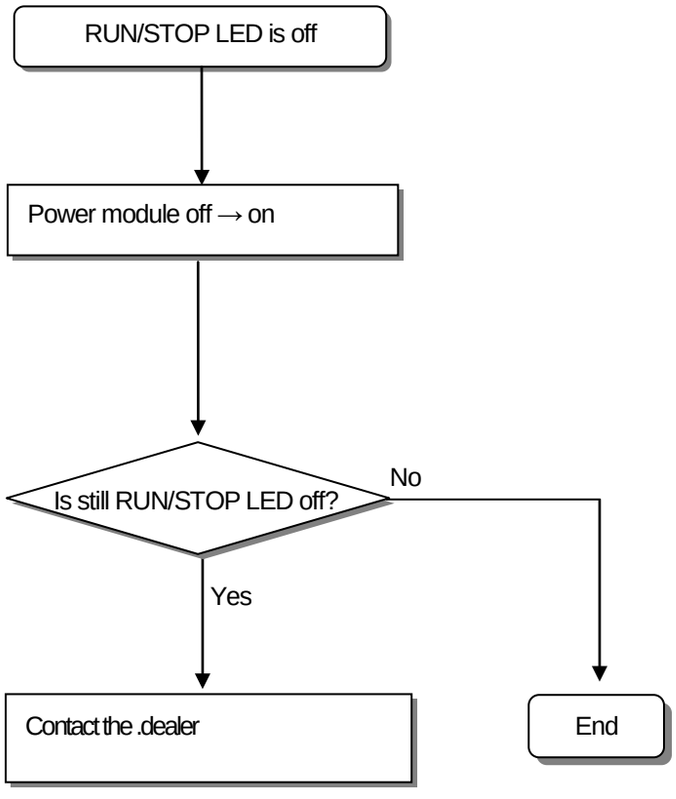


Note

If warning error occurs, the PLC system does not stop but it is necessary to check the error message and take a corrective measure. Or it may cause an error.

13.2.3 Action when RUN/STOP LED is off

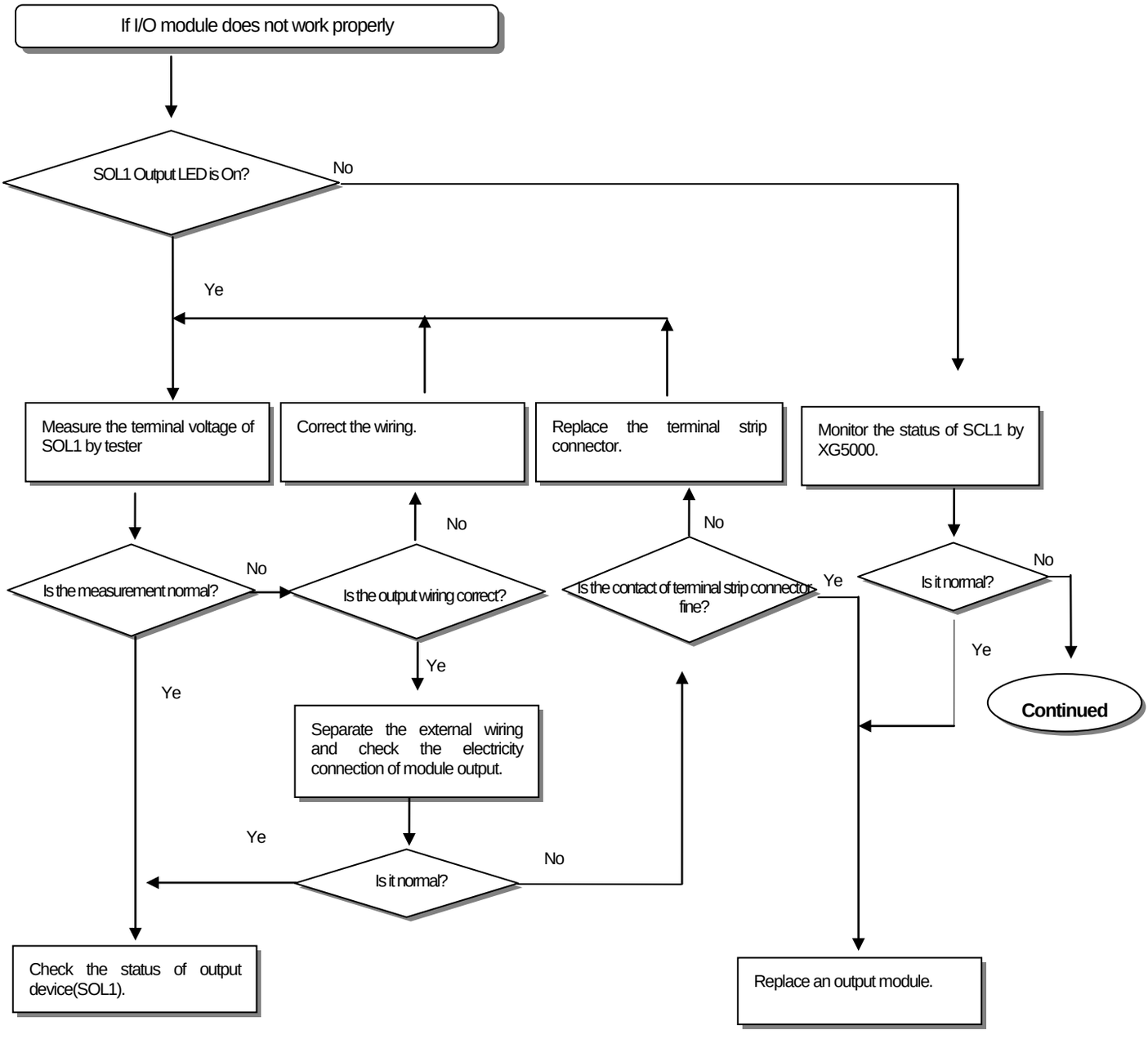
The paragraph describes the orders of taking a measure if RUN/STOP LED is Off when turning it on, starting operation or operating.

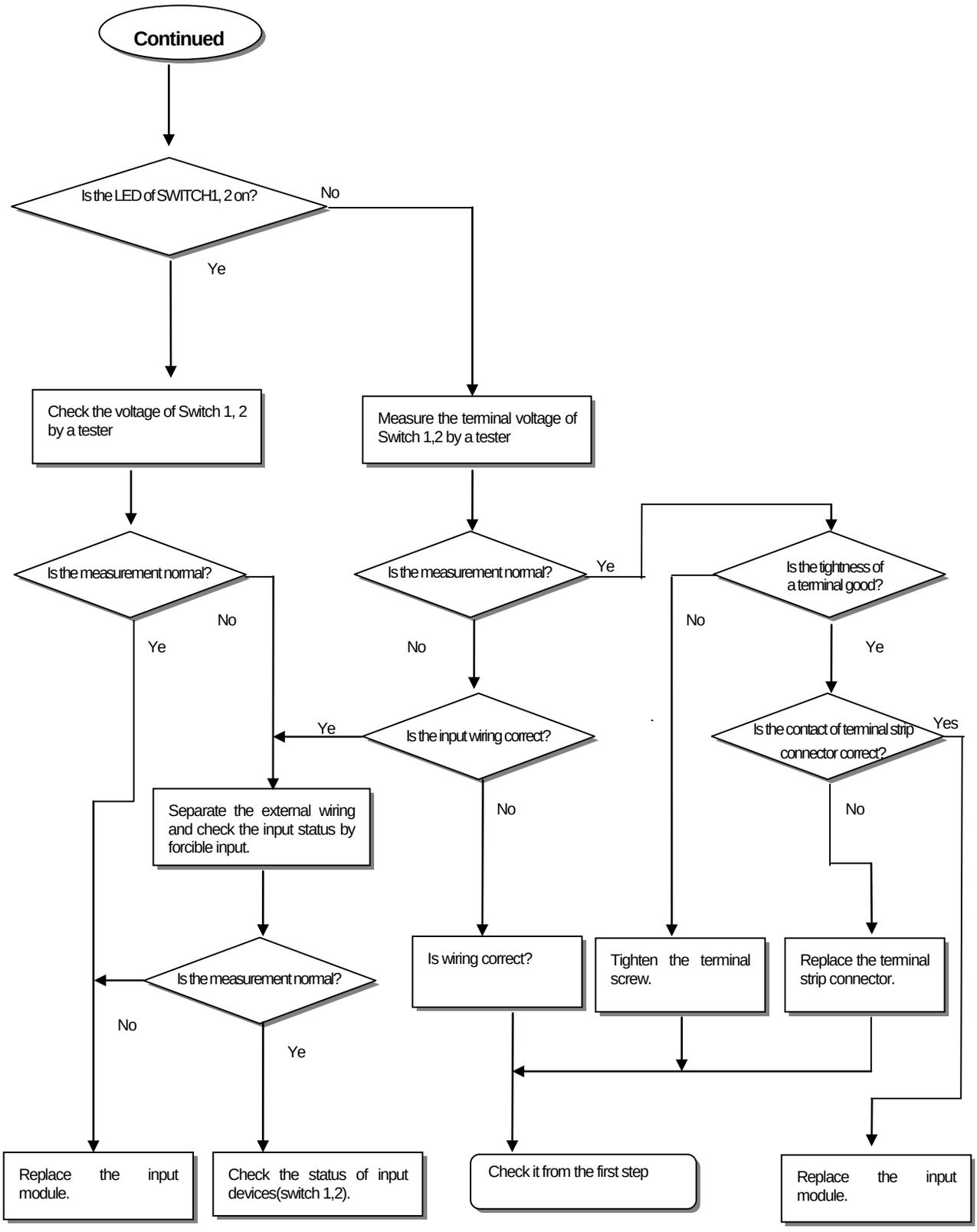


13.2.4 Acton when I/O module does not work properly

For the orders of taking measures when I/O module does not properly work during operation, the paragraph explains it with the following illustration.

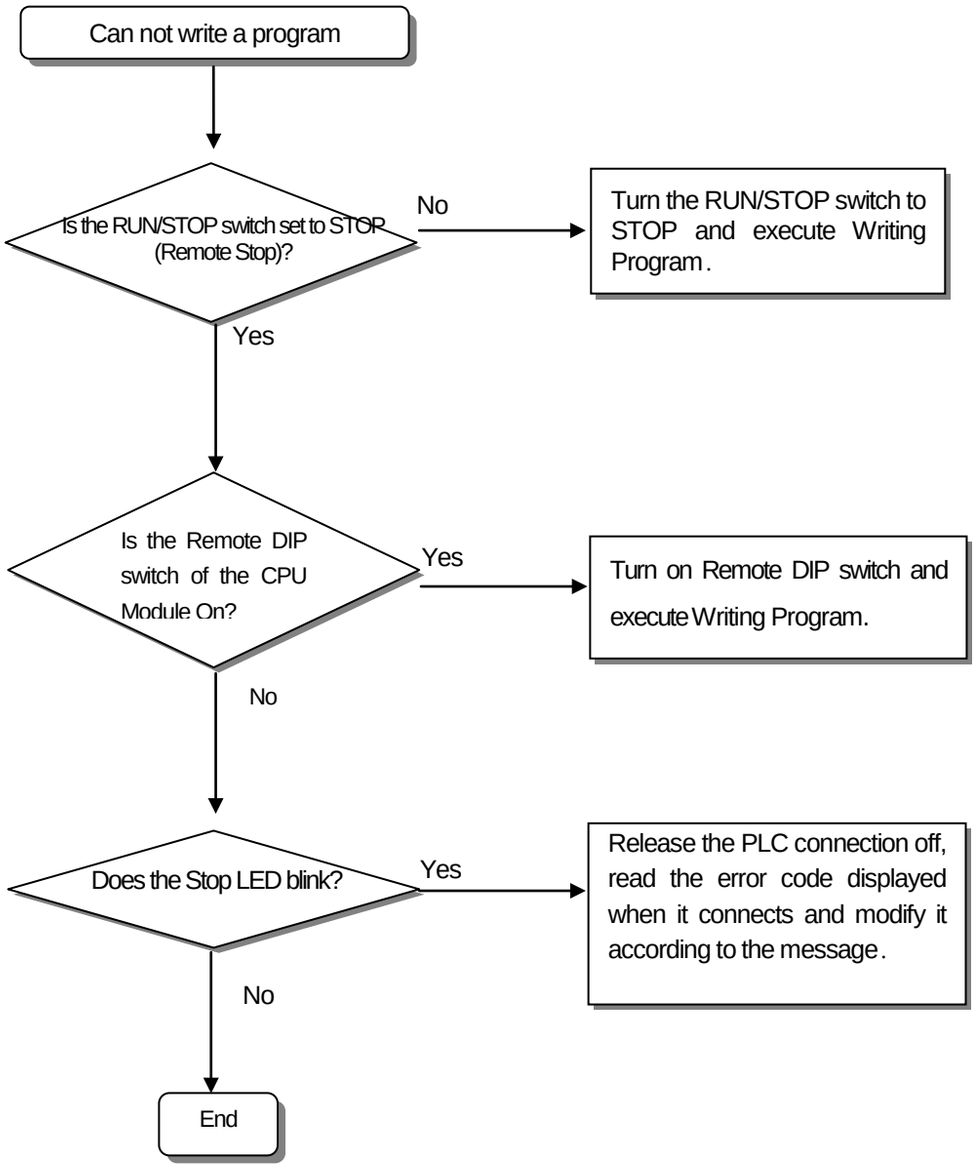





Continued
Is the LED of SWITCH1, 2 on?
No
Ye
Check the voltage of Switch 1, 2 by a tester
Measure the terminal voltage of Switch 1,2 by a tester
Is the measurement normal?
No
Ye
Is the measurement normal?
Ye
No
Is the tightness of a terminal good?
No
Ye
Ye
Is the input wiring correct?
Is the contact of terminal strip connector correct?
Yes
No
No
Separate the external wiring and check the input status by forcible input.
Is the measurement normal?
No
Ye
Is wiring correct?
Tighten the terminal screw.
Replace the terminal strip connector.
Replace the input module.
Check the status of input devices(switch 1,2).
Check it from the first step
Replace the input module.

13.2.5 Action when writing program is not possible

It describes the orders of taking a measure when writing a program into the CPU Module is not possible.



13.3 Troubleshooting Questionnaires

If any trouble is found while using the XGI series, please fill out the form and call to fax it to us.

• For an error relating to special/communication modules, fill out the questionnaires attached in the user's manual of the product.

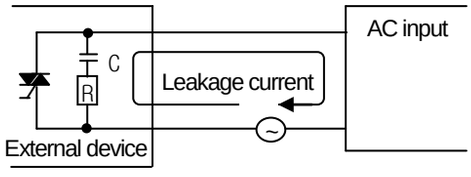
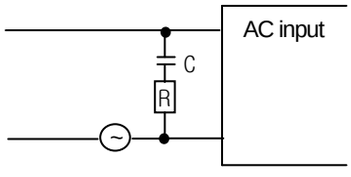
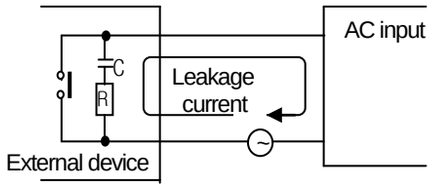
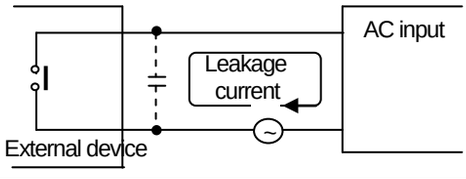
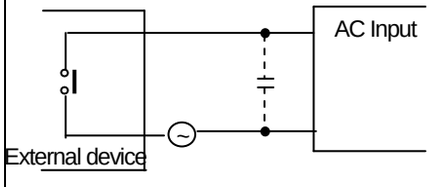
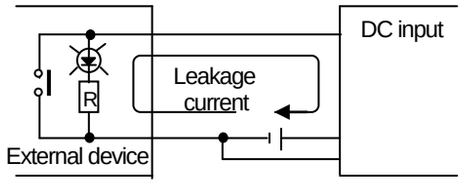
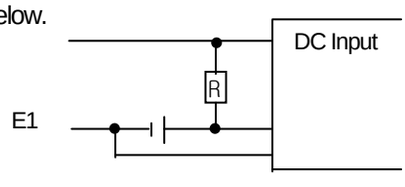
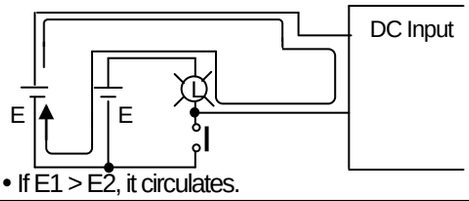
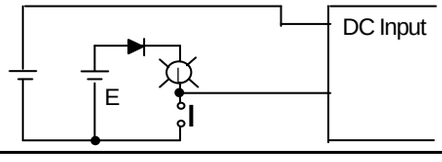
1. Customer's Contact Number: TEL) _____
   FAX) _____
2. Model : ( )
3. Details of the Product
   – Details of the CPU module : – OS version ( ), – Product's serial number ( )
   – XG5000 Version number used for program compiling : ( )
4. Brief description of a device and system :
5. Modules using the CPU module :
   – Operation by key switch ( ), – Operation by XG5000 or Communication ( )
   – Memory module operation ( )
6. STOP LED On of the CPU module? Yes( ), No( )
7. Error message generated from the XG5000 :
8. Measures taken against the error code in the above 7 :
9. Other troubleshooting measures against the error :
10. Features of the error
    • Reiterative( ) : Periodic( ), Relating to a specific sequence level( )
      Relating to the environment( )
    • Intermittent( ) : Approx. interval of the error occurrence :
11. Detail description for the erroneous phenomena :
12. Configuration of the applied system :

13.4 Cases

It describes trouble types and measures for circuits.

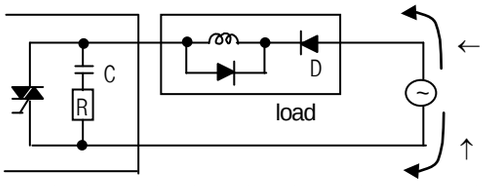
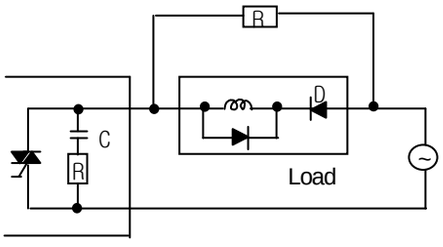
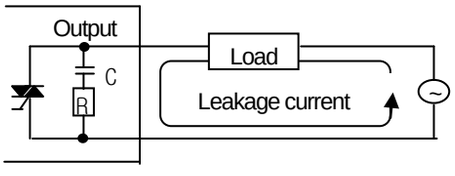
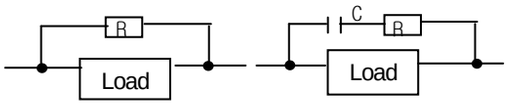
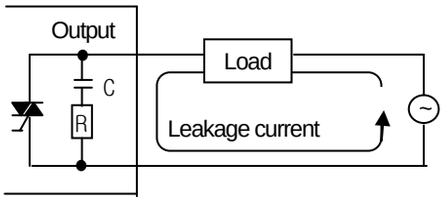
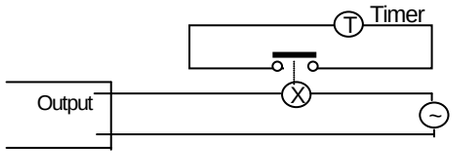
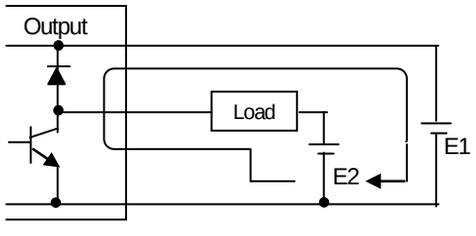
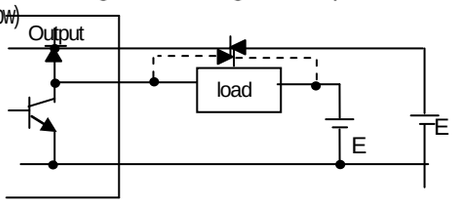
13.4.1 Trouble types and measures of input circuit

The followings describe the examples and measures of troubles.

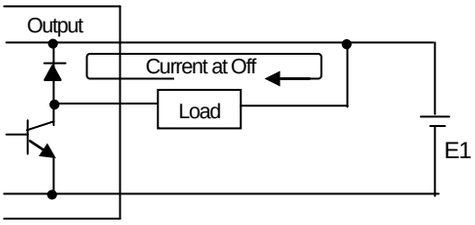
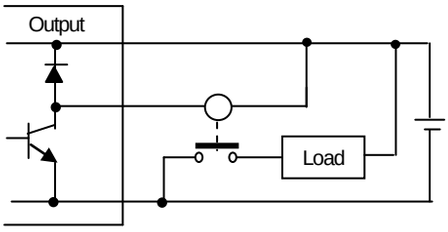
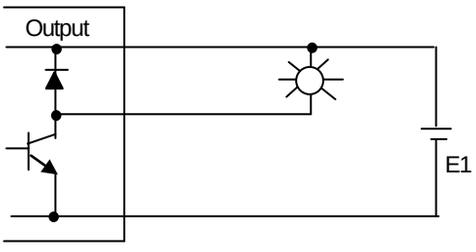
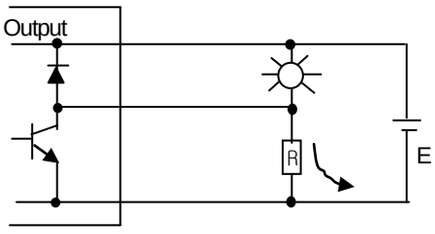
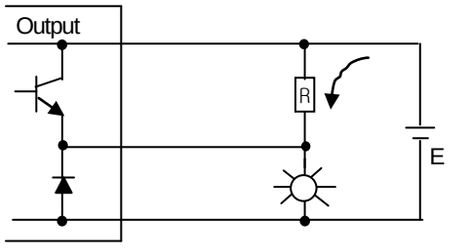
Phenomena	Causes	Measures
Input signal can not be off	Leakage current of an external device (if operating by proximate switch and others) 	• Connect a proper resistance or capacitor so that the voltage between terminals of input module is below the return voltage.  • CR value is determined by the value of leakage current. – Recommended value C : 0.1 ~ 0.47uF R : 47 ~ 120 Ω (1/2W) Or, separate a circuit completely and install another display circuit.
Input signal can not be off(it could be that a neon lamp is still on)	Leakage current of an external device(operation by a limit switch with neon lamp) 	
Input signal can not be off	leakage current from the capacity between wires of wiring cable 	• Install the power on an external device as presented below. 
Input signal can not be off	Leakage current of an external device(operation by a switch with LED mark) 	• Connect a proper resistance so that the voltage between input module terminal and common terminal is higher than off voltage as presented below. 
Input signal can not be off	• Circulating current by using plural different power sources  • If E1 > E2, it circulates.	• Change plural to singular power • Connecting to a circulating current preventive diode(figure below) 

13.4.2 Trouble types and measures of output circuit

The followings describe the examples and measures of troubles.

Phenomena	Causes	Measures
Excessive voltage is allowed to load when output contact is off	• If load contains half-wave rectification(solenoid valve may have it) • 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√2 .  Note) when using it as the above, the output element does not have any problem but the performance of diode(D) in load may be reduced, probably causing a trouble.	• Connect a dozens ~ several hundreds kΩ resistor to a load in parallel. 
Load can not be off	• Leakage current from surge absorbing circuit connected to an output element in parallel 	• Connect a dozens of kΩ resistor or CR of which impedance is equal to the resistance to load in parallel. Note) If the length of wiring from output module to load is long, it may have leakage current from capacity of cables. 
Abnormal time when load is a C-R type timer	• Leakage current from surge absorbing circuit connected to an output element in parallel. 	• Operate the C-R type timer by mediating a relay. • Use other one but a C–R type timer. Note) A timer's internal circuit may have half-wave rectification 
Load can not be off(DC)	• Circulating current resulting from two different power source  • It circulates if E1< E2. • It also circulates even when E1 is Off(E2 is On).	• Adjusting plural to singular power source. • Connecting to circulating current preventive diode(figure below)  Note) If load is relay and others, it needs connecting a counter voltage absorbing diode as a dotted line in the figure.

Trouble types and measures of output circuit(continued)

Phenomena	Causes	Measures
Off response from load takes a longer time.	• Overcurrent at Off If a large current load such as solenoid(time constant L/R is large) is directly operated by transistor output.  • Since current is allowed through diode when transistor output is off, it may be delayed for 1 second and longer depending on load.	• Insert a magnetic connector and others of which time constant is small as presented in the figure and operate load by the contact 
Output transistor is destructed.	Inrush current of glow lamp  As soon as it lights up, it may have 10 times and higher inrush current.	• To restrict inrush current, it should allow dark current that is 1/3 ~ 1/5 of the rated current of glow lamp.  Sink type transistor output  source type transistor output

13.5 Error Codes List

13.5.1 Error codes during CPU operation

Code	Error causes	Measures(restart mode after the measure)	Operation status	LED status	Diagnostic timing
2	Abnormal Data Bus	Contact A/S service if it still exists after turning it on again	Fault	Blink according to LED orders	When turning it on
3	Abnormal Data RAM	Contact A/S service if it still exists after turning it on again	Fault	Blink according to LED orders	When turning it on
4	Abnormal Click IC(RTC)	Contact A/S service if it still exists after turning it on again	Fault	ERR : On	When turning it on
6	Abnormal program memory	Contact A/S service if it still exists after turning it on again	Fault	ERR : On	When turning it on
10	Abnormal USB IC	Contact A/S service if it still exists after turning it on again	Fault	ERR : On	When turning it on
11	Abnormal backup RAM	Contact A/S service if it still exists after turning it on again	Fault	ERR : On	When turning it on
12	Abnormal backup Flash	Contact A/S service if it still exists after turning it on again	Fault	ERR : On	When turning it on
13	Abnormal base information	Contact A/S service if it still exists after turning it on again	STOP	ERR : On	When turning it on Converting to RUN mode
22	The program of backup flash is defective	Restart after modifying the program of backup flash	Fault	ERR : On	Reset Converting to RUN mode
23	If a program to execute is not normal	Operate after program is reloaded Replace a battery in case of abnormal battery After a program is reloaded, check the storage condition and if any fault is found, replace the CPU module.	STOP	ERR : On	Reset Converting to RUN mode
24	Abnormal I/O parameter	Restart after I/O parameter is reloaded Replace a battery in case of defective battery After I/O parameter is reloaded, check the storage condition and if any fault is found, replace the CPU module.	STOP	ERR : On	Reset Converting to RUN mode
25	Abnormal basic parameter	Restart after basic parameter is reloaded Replace a battery in case of defective battery After basic parameter is reloaded, check the storage condition and if any fault is found, replace the CPU module.	STOP	ERR : On	Reset Converting to RUN mode
30	The module set in parameter and the actually installed module do not coincide	Check the wrong slot position by XG5000, modify a module or parameter and then, restart. Reference flag: module type inconsistence error flag	STOP (RUN)	ERR : On (P.S. : On)	Converting to RUN mode
31	Module detachment or module addition during operation	Check any detached/added slot position by XG5000, modify the installment and restart(according to parameter) Reference flag: module attachment error flag	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
32	Fuse of a module holding a fuse is burnt out during operation	Check the position of a slot of which fuse is burnt out by XG5000, replace a fuse and restart(according to parameter) Reference flag: fuse disconnection error flag	STOP (RUN)	ERR : On (P.S. : On)	When scan ends

Code	Error causes	Measures(restart mode after the measure)	Operation status	LED status	Diagnostic timing
33	IO module data can not be successfully accessed during operation	Check the position of a slot with access error by XG5000, replace the module and restart(according to parameter) Reference flag: I/O Module Write/Read error flag	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
34	Special/link module data can not be successfully accessed during operation	Check the position of a slog with access error by XG5000, replace the module and restart(according to parameter) Reference flag: Special/Link Module interface error	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
39	CPU is incompletely closed or in trouble	System is closed abnormally due to noise or abnormal hardware 1) Contact A/S service if it still exists after turning it on again 2) Take a measure against noise	STOP	RUN: On ERR : On	Always
40	The scan time of a program exceeds the scan delay watchdog time designated by parameter during operation	Check the scan delay watchdog time designated by parameter, modify parameter or program and restart	STOP	RUN: On ERR : On	When program is executed
41	Operation error while executing user program	Eliminating an operation error → reload the program and restart(check) If STOP: Check the details of operation error by XG5000 and modify the program If RUN: refer to the error steps of F area	STOP (RUN)	ERR : On (CHK: blink)	When program is executed
42	Exceeding the specified stack range during program	Restart	STOP	RUN: On ERR : On	When program is executed
44	Use of Timer Index error	Modify the timer index program, reload and start	STOP (RUN)	RUN: On ERR : On	When scan ends
50	Error of external device is detected by a user program during operation	Repair a fault device by referring to error detection flag of external device and restart(according to parameter)	STOP (RUN)	ERR : On (P.S. : On)	When scan ends
60	E_STOP function execution	Eliminate the causes of error operating E_STOP function in the program and turn it on again.	STOP	RUN: On ERR : On	When program is executed
500	Data memory backup is not possible	Turn it on again if battery is normal. It is converted to STOP mode in Remote Mode	STOP	ERR : On	Reset
501	Abnormal clock data	Reset the time by XG5000 if battery is normal.	-	CHK: On	Always
502	Low battery voltage	Replace a batter with the power on	-	BAT: On	Always

Note

1) Error No. 2 through 13 from “Error Codes during CPU Operation” can be checked in our A/S Service Center.

2) The other errors of which number is 22 and lower can be checked by using the error log of XG5000.

Chapter 14 Built-in PID Function

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

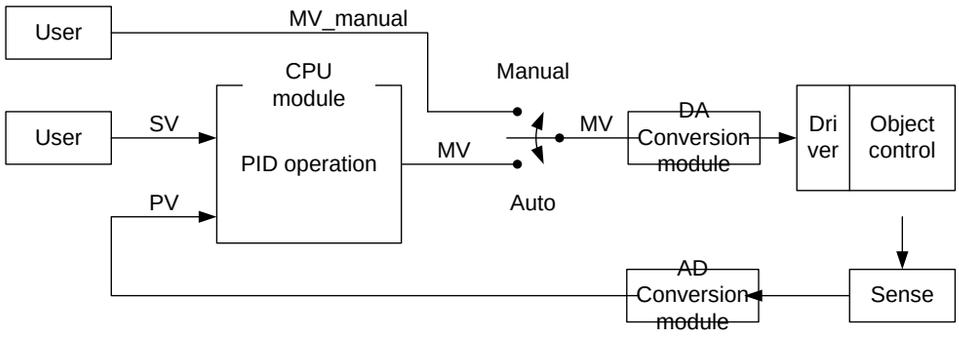
14.1 Features

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

(1) It can execute precise control operation.
(2) It has a fast operation cycle up to 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) Symbol variable function facilitates setting and monitoring.
(5) It supports forward/reverse operation process.
(6) Strong dual anti windup prevents effective over/under shoot.
(7) It may be operated by external device (HMI).
(8) It protects the system by restricting the max. variance of PV.
(9) It protects the drive by restricting the max. variance, max value and min value of MV.
(10) Auto-tuning function is used for PID control.
(11) Cascade PID control is available.

14.2 PID Control

PID Control compares the value measured at detection (process value) to the pre-determined value, adjusts outputs (control signal) to eliminate, if any, an error between two values, making the current value to the target value, in order to maintain the state of an object to control be a pre-determined value (target value).



As presented in the above figure, PLC functions as a control in a whole control system while sensor and driver are used to detect an object to control and drive the system, respectively.
When a sensor detects the current state of an object to control and delivers it to a control, PLC executes an operation of output and delivers it to a driver. Meanwhile, a driver drives the object according to the output. Finally, a sensor detects the changed state and re-sends it to PLC, forming a closed loop.
A procedure circulating a control loop repeats at the unit of several seconds and hundreds of microseconds and the time is called control cycle.

14.3 PID Control Operation

14.3.1 Terms used

It describes the terms necessary to explain PID control operation.

SV	: Set value to which an object to control should reach
T_s(Ts)	: Sampling time (control cycle)
K_p(Kp)	: Proportional constant
T_i(Ti)	: Integral time constant
T_d(Td)	: Differential time constant
PV	: Current state of an object to control, which is detected by a sensor
E	: Error of an object to control, which is expressed in (SV – PV)
MV	: Control input or control's 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 equation

PID Equation may be expressed from equation (14.3.1) through equation (14.3.5).

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

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

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

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

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

Error is a mathematical expression indicating how far the current system is out of a user's desirable state.
For instance, assuming that a user wishes to maintain water in an electric kettle at 50℃ and the temperature of water is 35℃, SV and PV are 50℃ and 35℃, respectively and **error E is 15, the difference between SV and PV**. The control executes PID operation according to the error.
Note that MV totally consists of each component of P, I and D, that is, MV_p, MV_i and MV_d, as presented in figure (14.3.5). namely, if subtracting D from PID control equation, it results in PI control; alike, if subtracting I and D, it results in P control.

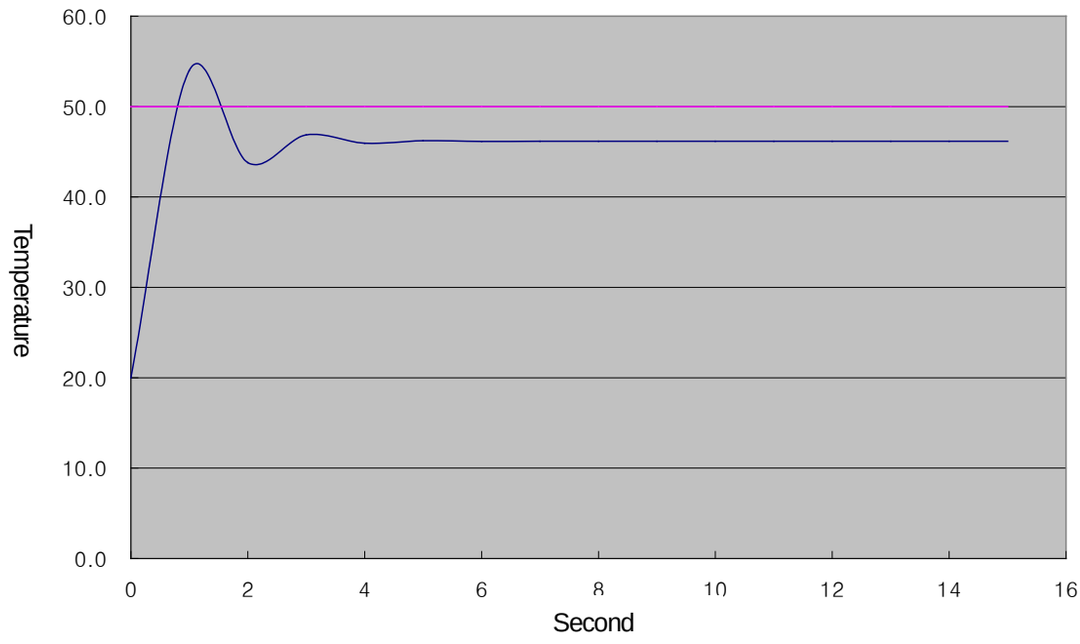
14.3.3 P control

As seen in the equation (14.3.7), MV of P control consists of proportional operation, MV_p only. The term is applicable as a type multiplying proportional coefficient by error. A user should adjust the coefficient according to the system and as larger it is set, as more it is sensitive to error.

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

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

When applying P control to a temporary virtual system, the control tendency features as below.
The following system is made to help you understand; it may be different with the actual temperature (control) system.



In the above simulation, SV is 50.0 and the above tendency is gained by adjusting K_p value properly. The above system shows a stable state in 4 seconds after being operated at 20℃ and it is maintained at 46.2℃, so the residual drift is 3.8℃(about 7.6%). As such, the reason why P control has a permanent residual drift is because as closer PV approaches to SV, as smaller error (E) is, reducing MV, so it maintains state balance at equilibrium point (in the example, 46.2℃). PI control is used to supplement the residual drift intrinsically existing in P control.

14.3.4 PI control

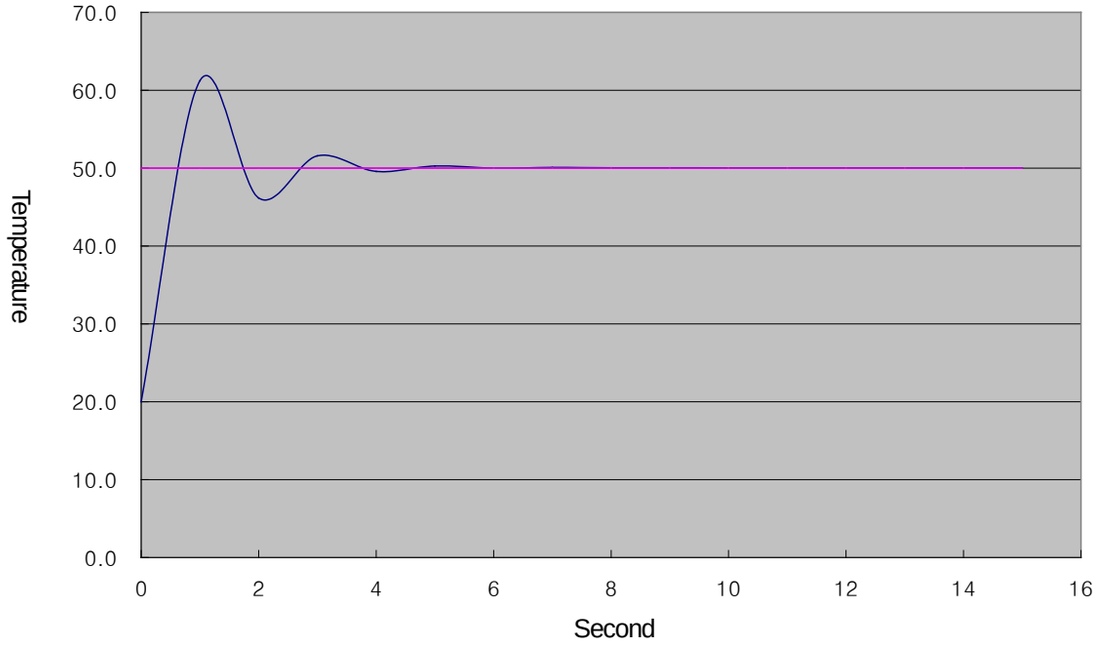
PI (proportional-integral) control is calculated by summing up proportional term and integral term as seen in the equation (14.3.10). To reduce the residual drift, a disadvantage of proportional term, PI control uses integration of the error.

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

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

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

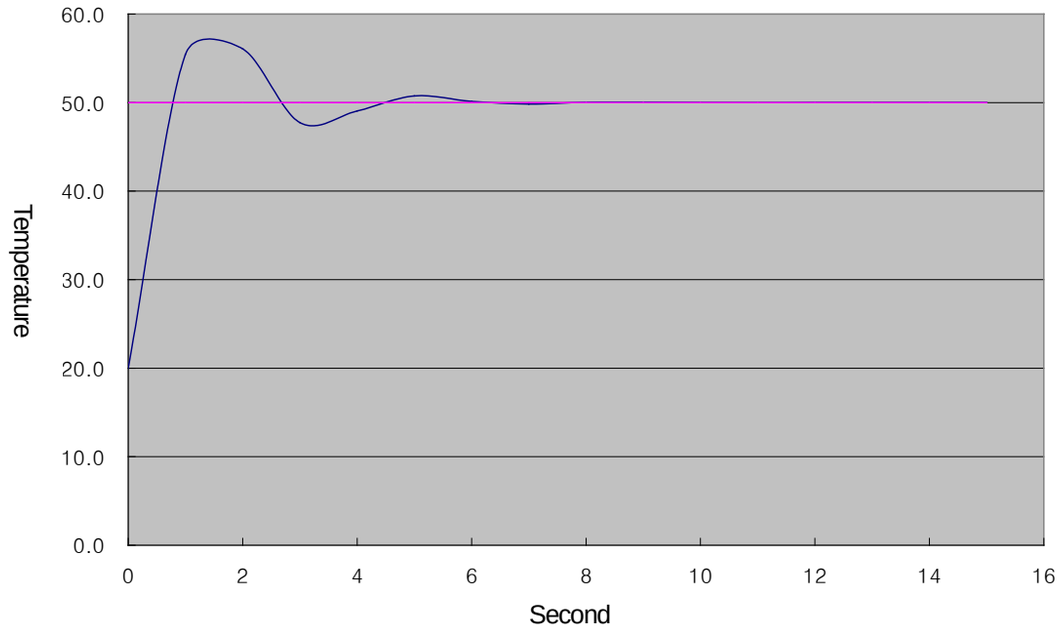
Even though error is uniform, the integral is accumulated as time goes on if applying integral calculus until the error is eliminated. Therefore, PI control may be used to supplement the residual drift intrinsically existing in P control. Note that Ti, the integral time constant is the denominator of integral term, so it represents that integral effect is larger as smaller the value of Ti. The following graph shows the results of PI control to P control application system.



As a result of adding integral effect, the residual drift disappears and the system is converged to 50℃ accurately. However, the temperature temporarily increased more than a desirable temperature, for which it increased up to 61.2℃ and dropped, deepening overshoot. Excessive overshoot may overburden the system or make it unstably, so it is necessary to relieve the overshoot through proper coefficient tuning or improve it by means of PIC control applying differential effect.

14.3.5 PID control

PID control relieves the vibration of PI control by adding differential effect to PI control as expressed in equation (14.3.1) through (14.3.5). The effect is working when the system's state is changed after comparing to the previous state, irrespective of the error of system. However, it is necessary to install a filter on the sensor's input and set the differential coefficient small to prevent differential effect from operating against a small change as much as a system noise. In case of an actual system, it is common to use 0.001 ~ 0.1.



14.4 PID Instruction

14.4.1 PID loop state

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

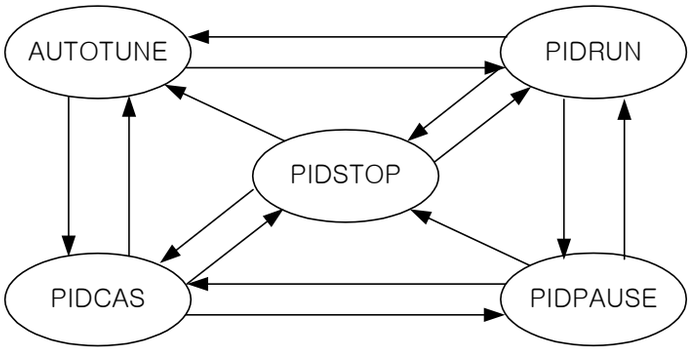
(1) PIDSTOP is the state in which output (MV) is MV_min, its internal state is initialized and user setting is maintained. In the state, it is not possible to access to PIDPAUSE state.

(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). These values are updated as soon as Auto-tuning ends, so it loses the previous coefficients.

(3) PIDRUN is the state in which PID loop normally executes control operation. MV is outputted by PID operation and it executes every scan operation independently, so it applies every setting that is changed during the procedure. In case "contact front of PIDRUN instruction is ON", it enters PIDRUN state, or if there is PIDRUN instruction in ladder program and PIDxx_REM_RUN is ON, it may enter PIDRUN state.

(4) PIDCAS is the state in which two loops form a master loop and a slave loop respectively, executing control operation. It is possible to enter PIDCAS state by using PIDCAS instruction after setting these two loops in a way like PIDRUN, and data are exchanged between loops as the internal connection necessary for two loops are automatically created. Loops that operate by cascade are indicated in a state flag, PIDxx_STATE and in the state, remote operation PIDxx_REM_RUM bit does not work.

(5) PIDPAUSE is the state in which output, internal state and user setting are maintained and the control operation stops. To enter PIDPAUSE state, it is necessary to turn on PIDxx_PAUSE bit or use PIDPAUSE instruction. However, it is possible to enter PIDPAUSE as long as the previous state is PIDRUN.

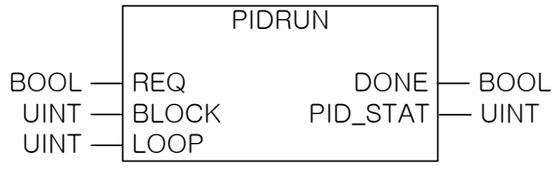


14.4.2 PID instruction group

PID instruction group includes four instructions; PIDRUN, PIDCAS, PIDINIT and PIDPRMT.
Actually, every operation of PID function is wholly taken by PIDRUN or PIDCAS instruction. PIDINIT and/or IDPPMT instructions works as long as it exists on a ladder program with PIDRUN or PIDCAS instruction, and both exist for the use convenience of PIDRUN or PIDCAS instruction.

(1) PIDRUN

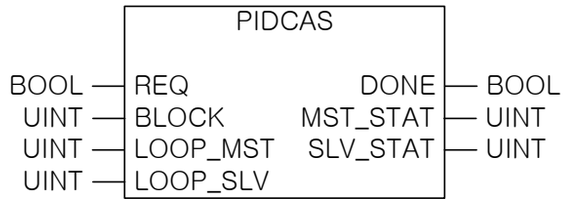
PIDRUN, as a basic PID control instruction, is the instruction taking charge of single PID loop control.



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 the instruction to execute 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 shows the operation information on master/slave loops, _PID[B]_[L]STATE.

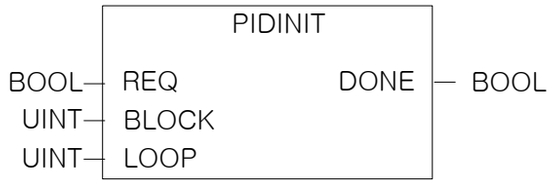
Notes

Cascade Operation

Basically, master loop inputs its MV to SV of slave loop during operation while slave loop executes its operation by using SV receiving from master loop.
Besides, both loops always mutually observe part of operation information on each loop (i.e. conversion from/to windup, manual mode and/or auto mode conversion).

(3) PIDINIT

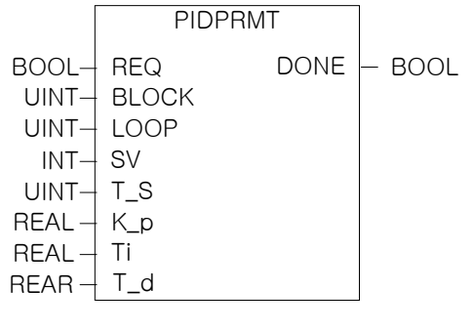
It initializes the setting and state of a PID loop. At the moment, the initialized area is the setting and state of the designated block[B] and loop[L], and 0 is inputted to every setting of the loop(bit is off.



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.

Symbol	K device area	Data type	Description
PID[B][L]MAN	%KX[0+16800B+L]	BIT	Select PID output (0: auto, 1: manual)
PID[B][L]PAUSE	%KX[32+16800B+L]	BIT	PID Pause (0: STOP/RUN 1:PAUSE)
PID[B][L]REV	%KX[64+16800B+L]	BIT	Select PID operation (0: forward, 1:reverse)
PID[B][L]AW2D	%KX[96+16800B+L]	BIT	Prohibit PID Anti Wind-up2 (0:allowed, 1:prohibited)
PID[B][L]REM_RUN	%KX[128+16800B+L]	BIT	PID remote (HMI) execution bit (0:STOP, 1:RUN)
PID[B][L]P_on_PV	%KX[160+16800B+L]	BIT	Select PID proportional calculation source (0:ERR, 1:PV)
PID[B][L]D_on_ERR	%KX[192+16800B+L]	BIT	Select PID differential calculation source (0:PV, 1:ERR)
PID[B][L]AT_EN	%KX[224+16800B+L]	BIT	Set PID auto-tuning (0:Disable, 1:Enable)
PID[B][L]MV_BMPL	%KX[256+16800B+L]	BIT	MV non-impact conversion when converting PID mode(A/M) (0:Disable, 1:Enable)
PID[B][L]SV	%KW[24+1050B+32L]	INT	PID target value (SV)
PID[B][L]T_s	%KW[25+1050B+32L]	WORD	PID operation cycle (T_s)[0.1ms]
PID[B][L]K_p	%KD[13+525B+16L]	REAL	PID P – constant (K_p)
PID[B][L]T_i	%KD[14+525B+16L]	REAL	PID I - constant (T_i)[sec]
PID[B][L]T_d	%KD[15+525B+16L]	REAL	PID D – constant (T_d)[sec]
PID[B][L]d_PV_max	%KW[32+1050B+32L]	WORD	PID PV variation limit
PID[B][L]d_MV_max	%KW[33+1050B+32L]	WORD	PID MV variation limit
PID[B][L]MV_max	%KW[34+1050B+32L]	INT	PID MV max. value limit
PID[B][L]MV_min	%KW[35+1050B+32L]	INT	PID MV min. value limit
PID[B][L]MV_man	%KW[36+1050B+32L]	INT	PID manual output (MV_man)
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:PV variation limited)
PID[B][L]ALARM3	%KX[595+16800B+512L]	BIT	PID Alarm 3 (1:MV variation limited)
PID[B][L]ALARM4	%KX[596+16800B+512L]	BIT	PID Alarm 4 (1:MV max. value limited)
PID[B][L]ALARM5	%KX[597+16800B+512L]	BIT	PID Alarm 5 (1:MV min. value limited)
PID[B][L]ALARM6	%KX[598+16800B+512L]	BIT	PID Alarm 6 (1:AT abnormal cancellation 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 Present value (PV)
PID[B][L]PV_old	%KW[39+1050B+32L]	INT	PID previous present value (PV_old)
PID[B][L]MV	%KW[40+1050B+32L]	INT	PID Output value (MV)
PID[B][L]MV_BMPL_val	%KW[41+1050B+32L]	WORD	PID non-impact operating memory
PID[B][L]ERR	%KD[21+525B+16L]	DINT	PID control error

Symbol	K device area	Data type	Description
PID[B][L]MV_p	%KD[22+525B+16L]	REAL	PID output P component
PID[B][L]MV_i	%KD[23+525B+16L]	REAL	PID output I component
PID[B][L]MV_d	%KD[24+525B+16L]	REAL	PID output D component
PID[B][L]DB_W	%KW[50+1050B+32L]	WORD	PID deadband setting (operating after stabilizing)
PID[B][L]Td_lag	%KW[51+1050B+32L]	WORD	PID differential function Lag filter
PID[B][L]AT_HYS_val	%KW[52+1050B+32L]	WORD	PID auto-tuning hysterisis setting
PID[B][L]AT_SV	%KW[53+1050B+32L]	INT	PID auto-tuning SV setting
PID[B][L]AT_step	%KW[54+1050B+32L]	WORD	PID auto-tuning state indication (setting by user prohibited)
PID[B][L]INT_MEM	%KW[55+1050B+32L]	WORD	PID internal memory (setting by user prohibited)

* ☐ : Area prohibited from user's setting
* 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]

%KX[0+16800B] ~ %KX[287+16800B] area is the common bit area of the block PID loop. The bit state and settings of each bit are collected and arranged on the front of each PID block. Therefore, 32 bits, the max. no. of loops that PID function may use in a block is collected, forming a double-word, and the state and setting of each bit are saved in good order of bits.

%KW0024 ~ %KW0055 area is the individual data area for PID block 0 and loop 0, where the setting and state of block 0 and loop 0 are saved. The loop setting for the PID loop such as SV, dPV_max, MV_man, T_s, Kp, Ti, Td, MV_max, MV_min and dMV_max are saved in the area, and during the execution of PID function, the state of PID loops such as PV, ETC, MV, MV_rvs, ERR, MVp, MVi, MVd and PV are also saved. A user may change PID setting simply by writing data on the memory and get the result reflected to the next cycle.

%KW0056 ~ %KW1047 area is the memory of loop 1 through 31 with the format of block 0 & loop 0. Each loop independently works and may execute auxiliary operation like the application of cascade. Additionally, the K device memory configuration mentioned in the end of user's manual may help you understand the memory location of PID.

The location and order of the memory area as mentioned above may change without prior notice to improve the product performance.

Notes

1) PID memory statement format
   PID[B][L]MAN B: block, L : loop
   i.e.) _PID3_05MAN : means MAN bit of block 3 and loop 5.

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

3) Individual data area
   i.e.) _PID5_30SV : because of block 5 and loop 30, it represents the location of %KW[24+1050B+32L] = %KW6234.

14.5.1 Common bit area

Common bit area is the part that gathers every data consisting of bits for each of 32 loops. It has a double word format of 32 bits as the information on 32 loops for an item; n th bit means the information on the n th loop. m is the value that the loop number, n is converted to a hexadecimal.

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

K DEVICE AREA : %KX [0+16800B+L]
Data unit : BIT
It determines whether PID function of n th loop is operated manually or automatically(AUTO/MANUAL).
AUTO state outputs the results that PID operation is normally executed while MANUAL state does not execute PID operation and instead, it outputs a use desirable temporary value. At the moment, the output is generated as _PID[B]_[L]MV_man, which is the value a user wishes.
If a bit is off, it is set as [Default] AUTO.

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

K DEVICE AREA : %KX [32+16800B+L]
Data unit : BIT
It makes n th PID loop in pause state.
If converting PAUSE to RUN state again, it continuously controls. Therefore, since control system may result in unexpected results if the system state is changed in PAUSE, PAUSE function should be carefully used.
If the bit is off, [Default] PAUSE is cancelled.

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

K DEVICE AREA : %KX64+16800B+L]
Data unit : BIT
It sets whether a control system is forward system or reverse system.
If system state ascends when system input rises, it is called forward system; if it descends when it increases, it is called reverse system.
In case of boiler, the temperature rises as the system input increases, so it is a forward system. On the other hand, in case of cooling system, the temperature drops as the system input rises, so it is a reverse system.
If the bit is off, it is set as [Default] Forward system.

Notes

PID[B][L]PAUSE

If making PID loop in PAUSE state by using PID[B]_[L]PAUSE and PIDPAUSE instruction, every operation stops and it outputs the last calculation before PAUSE state. In the case, if system state is changed, the control system may show unexpected results due to improper control, so PAUSE function should be carefully used.
In the first scan of PLC, since PIDRUN instruction executes initialization, in which PAUSE bit is off, it escapes from PAUSE and turns STOP or RUN state if turning on PLC in PAUSE state.

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

K DEVICE AREA : %KX[96+16800B+L]
Data unit : BIT
If the bit is off when a user does not want it, Anti Wind-up2 function is deactivated.
The function of Anti wind-up is detailed in 14.6.
If the bit is off, [Default] Anti Wind-up2 function is enabled.

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

K DEVICE AREA : %KX[128+16800B+L]
Data unit : BIT
It is the external operation instruction of PIDRUN.
Being used as an external operation instruction, it functions alike the effect that PIDRUN instruction contact is on/off. Indeed, PIDRUN instruction executes OR operation of "PIDRUN instruction's input condition" contact and the bit to determine whether to execute the operation. If using the function, PIDRUN instruction's operation contact may be assigned to a fixed address, so a user may conveniently use external I/O devices such as HMI.
If the bit is off, [Default] (if contact is off), PIDRUN instruction stops.

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

K DEVICE AREA: %KX[160+16800B+L]
Data unit : BIT
It sets the P operation source of PID loop as PV. P operation is operated with ERR or PV, and P operation using PV is relatively slow moving to stable state, rather using ERR, in an unstable state of instantaneous control due to initial response or disturbance. It means that output fluctuation is not steep and consequently, it does not overburden the driver. However, since the range of internal operation value changes, Anti Wind-up function does not work.
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.

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

K DEVICE AREA : %KX[192+16800B+L]
Data unit : BIT
It sets the D operation source of PID loop as ERR. D operation is operated with ERR or PV, and D operation using ERR may cause excessive input to a driver instantly because D response may have sudden change as SV is changed by a user. To prevent it, D operation uses PV and the default is also set to be D operation using PV. If using ERR without the algorithm, the bit should be on. If the bit is off, PID executes D operation with PV in [Default] state, and in ON state, it executes D operation with ERR value.

Notes

PID[B][L]REM_RUN

The bit is saved in K device even though PLC stops, so if PLC stops and operates with the bit ON (i.e. power failure), the system is initialized from the first scan and then, PIDRUN instruction operates.

(8) _PID[B]_[L]AT_EN (PID AutoTuning ENable) **- Setting area**

K DEVICE AREA : %KX[224+16800B+L]
Data unit : BIT
It auto-tunes the PID loop. AT finds out T_s (operation cycle) and PID coefficients (K_p, T_i and T_d) approximately. Before operating AT, it is necessary to set PID[B]_[L]HYS_val item and the functions of AT is detailed in 14.6.
If the bit is off, [Default] AT function is disabled and AT is executed at the ascending edge.

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

K DEVICE AREA : %KX[256+16800B+L]
Data unit : BIT
It calculates MV through operation, reflects it into the internal state and stabilizes MV so that MV is to be smoothly continued as soon as the PID loop is converted from manual output mode to auto output mode. The function is different in algorithm for single operation and cascade operation but both operate with the bit.
If the bit is on (the bit of master loop in case of cascade), it executes Bumpless changeover. In case of off, [Default] Bumpless changeover function is disabled.

Notes

PID[B][L]AT_EN

The bit is initialized to off as soon as PLC is turned to RUN mode, so when PLC stops and operates with the bit on(i.e. power failure), the system is initialized from the first scan and then, it does not go to AT mode again. At the moment, PID setting does not have any change, so the system operates with the state before PLC stops.

PID[B][L]MV_BMPL

For instance, assuming that manual output value is 1000, it is turned to auto output and 2000 output is to be generated, a driver operates the system with 1000 and instantly receives 2000 at the moment of mode conversion. Then, if the bit is ON, the PID loop outputs at the moment of conversion, gradually increases and operates it so that 2000 is to be outputted.

14.5.2 Individual data operation

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]
It sets SV of a loop.
As described in the previous chapter, it is the system state that a user wishes. The state is indicated with numbers and it should be converted, based on PV along the system's gain and inputted accordingly.
For instance, if temperature is 50℃, SV should be set to 5000 when controlling the temperature at 50℃ in a system in which PV is sensed for 5000.

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

K DEVICE AREA : %KW[25+1050B+32L]
Data unit : WORD [0 ~ 65535]
It sets the sampling time of a loop.
Sampling time is the cycle of control operation and represents the time cycle of control operation. The sampling time may be set, at least, from 0.1ms up to 6553.5 ms in 0.1ms, and it is also set at the unit of 1 integer per 0.1ms. That is, if setting the sampling time to 100ms, input 1000 to _PID[B]_[L]T_.
Especially, if a user sets the sampling time to 0, it is set in scan cycle control mode and control operation is executed every scan, so the max. speed control operation is executed in the current environment.
If it exceeds the current scan speed due to two short sampling time, _PID[B]_[L]STATE alarm bit 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]
It sets the proportional constant(K_p) of a loop. K_p is multiplied by P, I and D(Proportional, integral and differential) among PID control effects, so if K_p is increasing, differential effect is also larger while integral effect is reduced.
Especially, if _PID[B]_[L]K_p setting is 0, it does not execute P control. For details, refer to 14.6.
K_p can be set within the range of real number(REAL).

Notes

PID[B][L]SV

PID changes the output (MV) through several operations until SV=PV. Therefore, if SV is 0, PIDRUN seems not to operate. For instance, if the current temperature is 20 degrees and the SV of simple heater of which PV is 2000 (20 degrees) is set to 0, PID outputs 0 as its MV and will not output until PV is cooled down to 0 (0 degrees).

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

K DEVICE AREA : %KD[14+525B+16L]
Data unit : REAL [-3.40282347e+38 ~ -1.17549435e-38 , 0 , 1.17549435e-38 ~ 3.40282347e+38]
It sets the integral time constant (T_i) of a loop. T_i divides I (integra) term out of PID control effects, so if T_i is increasing, the integral effect is reduced.
Especially, if _PID[B]_[L]T_i setting is 0, it does not execute I control and for details, refer to 14.6.
T_i may be set to the range of real number (REAL).

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

K DEVICE AREA : %KD[15+525B+16L]
Data unit : REAL [-3.40282347e+38 ~ -1.17549435e-38 , 0 , 1.17549435e-38 ~ 3.40282347e+38]
It sets the differential time constant(T_d). T_d is multiplied by D(differential) term out of PID control effects, so if T_d is increasing, differential effect is increasing.
Especially, if _PID[B]_[L]T_d setting is 0, it does not execute D control and for details, refer to 14.6.
T_d may be set to the range of real number(REAL).

(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]
It sets the PV variation of a loop.
In an actual control, PV does not always reflect the accurate state of system. In detail, PV may be reflected with undesirable signals such as sensor's malfunction, noise and disturbance. 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. On the other hand, if _PID[B]_[L]dPV_max is set to small, the convergence time may take longer because system's change is reflected late, make sure to set it suitable for the characteristics of a system.
Especially, if the value is set to 0, the function does not work.

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

K DEVICE AREA : %KW[33+1050B+32L]
Data unit : WORD [0 ~ 65535]
It limits the MV variation of a loop.
If control system is rapidly changed, system may not be stabilized or be subject to trouble or unstable operation due to overload on a driver. To prevent it, it limits the output variation of a control. Especially, if the value is set to 0, the function does not operate.

(8) _PID[B]_[L]MV_max (PID MV MAXimum limit) **- Setting area**

K DEVICE AREA : %KW[34+1050B+32L]
Data unit : INT [-32768 ~ 32767]
It limits the max value of MV of a loop.
It prevents overload by limiting the max. output of a control delivered to output device and cuts off any system error. In addition, it prevents any overflow or other undesirable value from being delivered.

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

K DEVICE AREA : %KW[35+1050B+32L]
Data unit : INT [-32768 ~ 32767]
It limits the min. value of MV of a loop.
It prevents overload by limiting the min. output of a control delivered to output device and cuts of any system error. In addition, it prevents any overflow or other undesirable value from being delivered.

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

K DEVICE AREA : %KW[36+1050B+32L]
Data unit : INT [-32768 ~ 32767]
It designates MV if a loop is set as a manual operation. The value set here outputs the value of PID[B]_[L]MV_man as the MV of a loop if _PID[B]_[L]MAN of common bit area is on.

(11) _PID[B]_[L]STATE (PID STATE) **- Setting disabled**

K DEVICE AREA : %KW[37+1050B+32L]
Data unit : WORD [h00 ~ hff] or BIT
It indicates the state of abnormal state of a loop.
It is located at the address of %KW[37+1050B+32L] while each bit(16) has 16 meanings respectively. At present, a part of them are used, among 16 bits.
STATE is on only for a moment that the related operation occurs while the operation is cancelled, it returns to off.
The low 8 bits of STATE(_PID[B]_[L]ALARM 0 ~ _PID[B]_[L]ALARM 7) represent 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.
Assignment of each bit is as follows.
PID[B][L]ALARM 0 : skipping an operation because T_s setting is too small.
PID[B][L]ALARM 1 : K_p is 0.
PID[B][L]ALARM 2 : PV variation is limited.
PID[B][L]ALARM 3 : MV variation is limited.
PID[B][L]ALARM 4 : MV max. value is limited.
PID[B][L]ALARM 5 : MV min. value is limited.
PID[B][L]ALARM 6 : abnormally canceled during AT.
PID[B][L]STATE 0 : PID operation is in progress(effective in case of PLC run)
PID[B][L]STATE 1 : PID AT is in progress.
PID[B][L]STATE 2 : PID AT is complete.
PID[B][L]STATE 3 : PID is operating remotely by _PID[B]_[L]REM_RUM bit.
PID[B][L]STATE 4 : PID mode is manual output mode.
PID[B][L]STATE 5 : PID loop belongs to cascade.
PID[B][L]STATE 6 : PID loop is the cascade master loop.
PID[B][L]STATE 7 : Anti Wind-up is operating 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]
It represents the PV of a loop.
PV is the indicator showing the current state of the system and the input from sensor is saved into U device of CPU via input devices such as Analog input module. The value should be moved to _PID[B]_[L]PV by using instructions such as MOV every time it scans. Refer to the examples described in the end of the user's manual.

(13) _PID[B]_[L]PV_old (PID previous PV) **- Setting disabled**

K DEVICE AREA : %KW[39+1050B+32L]
Data unit : INT [-32768 ~ 32767]
It is used for integral/differential operation to the previous PV state of a step of the related loop and it is recommended to refer to it, if necessary. If inputting a temporary value, it may be subject to 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]
It represents MV of a loop.
MV is a signal source to drive a system and conversely as described in 12) _PID_PV, it is delivered to U device by using instruction such as MOV every time it scans and it is used as the input of system drive via output devices such as Analog output module. Also, refer to the examples of program.

(15) _PID[B]_[L]MV_BMPL_val (PID MV BuMPLess changeover VALue) **- Setting disabled**

K DEVICE AREA : %KW[41+1050B+32L]
Data unit : WORD [0 ~ 65535]
A loop saves the information necessary for operating Bumpless changeover. The memory is automatically set and inputted by means of PID internal operation while it is prohibited for a user to set the value.

Notes

Bumpless Change Over

In case PID control returns to auto output mode after being converted to manual output mode, it increases the output from 0 like a control system that is newly started, by which the system is subject to mode conversion impact. That is, a certain output is allowed in manual mode and as soon as it is converted to auto mode, the output rises from 0 again. To prevent the mode conversion impact, it uses MV_BMPL function, which detects the last state of manual mode of the current system during the mode conversion and induces it to continue the control output from the part smoothly. By expanding it, master loop detects the slave loop state with master loop MV_BMPL allowed and creates the control output to be smoothly continued.

(16) _PID[B]_[L]ERR (PID ERRor value) - Setting disabled

K DEVICE AREA : %KD[21+525B+16L]
Data unit : DINT [-2747483648 ~ 2747483647]
It represents the current error of a loop.
In PID, error is defined as SV – PV. It is used as an indication how far the current state is distance from the desirable state, and if error is 0, it means that the control system state reaches the desirable state. Therefore, ideal control system can be defined that if control starts, error is rapidly reduced from its excessive state and reaches to the normal state, the vibration is minimized and the residual drift(stable state error) is maintained as 0.

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

K DEVICE AREA : %KD[22+525B+16L]
Data unit : REAL [-3.40282347e+38 ~ -1.17549435e-38 , 0 , 1.17549435e-38 ~ 3.40282347e+38]
It represents the proportional control value of a loop. If the current system error is known, proportional, integral and differential control outputs can be independently calculated. By comparing three outputs, the operation state of control system and PID control may be accurately comprehended while MV is calculated with the sum of MV_p, MV_i and MV_d.

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

K DEVICE AREA : %KD[23+525B+16L]
Data unit : REAL [-3.40282347e+38 ~ -1.17549435e-38 , 0 , 1.17549435e-38 ~ 3.40282347e+38]
It displays the integral control value of a loop.

(19) _PID[B]_[L]MV_d (PID MV Derivative component) - Setting prohibited

K DEVICE AREA : %KD[24+525B+16L]
Data unit : REAL [-3.40282347e+38 ~ -1.17549435e-38 , 0 , 1.17549435e-38 ~ 3.40282347e+38]
It displays the differential control value of a loop.

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

K DEVICE AREA : %KW[50+1050B+32L]
Data unit : WORD [0 ~ 65535]
It sets the deadband of a loop. The only positive value is available and it operates within the area set up and down the SV. That is, if PV is within the section of [SV – DB_W] ~ [SV + DB_W], it is necessary to substitute SV for PV(can not checked externally). If setting the value to 0, the function does not work.

Notes

Deadband
It is used to eliminate small output flunctuation resulting from small change of state as PV approaches to SV. If inputting a value into DB_W during PID control, a deadband is formed as much as up/down of SV. If PV follows SV and enters the inside of deadband during control, ERR is forcibly calculated as 0 and the change of MV stops as long as PV remains in the section. That is, it's like the pause to control in a stable section and through it, a driver receives input uniformly while it operate stably and helps it not to be overburdened. It is recommended to use it after the system is properly stablized in a section set as deadband. The reason is because a control may suffer from temporary transient phenomena while entering into the deadband.

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

K DEVICE AREA : %KW[51+1050B+32L]
Data unit : WORD [0 ~ 65535]
It sets the primary delay filter, based on the differential calculation, of a loop and makes the differential effect reacting as an instant impact more smooth and constantly. If setting it higher, it may result in more smooth differential output. If setting it as 0, the function does not work. It is normally used to avoid excessive force on drivers as the system output slightly vibrates by differential vibration.

(21) _PID[B]_[L]AT_HYS_val (PID Autotuning HYSteresis value) **- Setting area**

K DEVICE AREA : %KW[52+1050B+32L]
Data unit : INT [-32768 ~ 32767]
It sets a proper directional deadband during AT of a loop. _PID[B]_[L]AT_HYS_val value operates as a high deadband when PV increases or as a low deadband when PV decreases. Successful AT results depend on setting it properly. How to set _PID[B]_[L]AT_HYS_val is described in 14.7.4.

(22) _PID[B]_[L]AT_SV (PID Autotuning SV) **- Setting area**

K DEVICE AREA : %KW[53+1050B+32L]
Data unit : INT [-32768 ~ 32767]
During AT of a loop, AT_SV used for SV is separately set. AT vibrates 3 times up and down around AT_SV.

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

K DEVICE AREA : %KW[54+1050B+32L]
Data unit : INT [-32768 ~ 32767]
It displays the AT operation state of the loop. _PID[B]_[L]AT_step may have a value between 0 ~ 7; 0 indicates AT operation is not started while 7 indicates AT operation is complete. And, 1, 3 and 5 are PV increasing section and 2, 4 and 6 are the PV decreasing section.

⚠ Caution

1) **Setting prohibited** : 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 area not only displays operation information to a user but also saves the information necessary for operation, so the control system may malfunction if setting it temporarily.
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

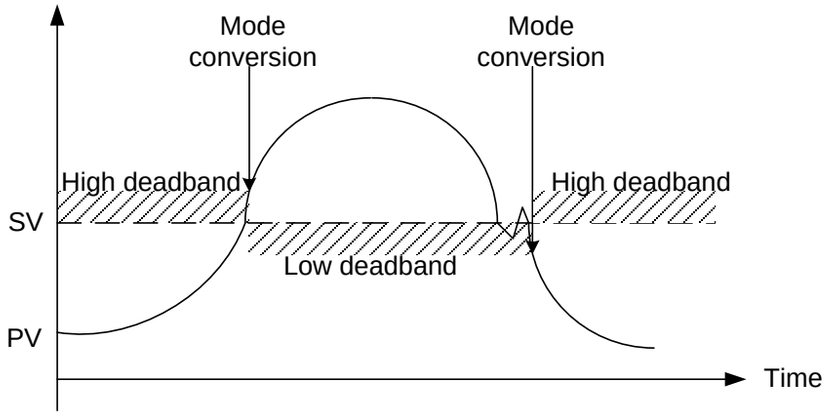
Transient state and normal state

1) Transient state : the state that a control system starts controlling and searching for a desirable control state. It may have sudden output fluctuation, and as a step in which integral value is stabilized, it may have vibration and overshoot.

2) Normal state : the state that a control system reaches a desirable state via transient state. Vibration is completely eliminated but it may have residual drift and output has little change.

High / low deadband

If analog component of a sensor is converted to digital via AD device, almost signals may have even a part of noise component. The PID control instruction executes auto-tuning by using the converted value, during which it increases and decreases PV from SV 3 times. During the procedure, if noise is inputted at a moment of SV=PV, there is high/low convergence once but it may recognize it as several conversions. That is, it's like a digital switch's chattering. To overcome it, PID control uses unidirectional deadband (hysteresis), with which the deadband value is applicable only for high section of SV when the system's PV increases toward SV, and vice versa.



14.6 Convenient Functions of PID Instruction

The chapter describes additional functions that may be conveniently used with PID instructions.

14.6.1 Various control methods including PID

The most commonly used PID controls are P control, PD control and PID control. Meanwhile, if expecting several characteristics(mostly stabilization), ID control, I control and D control, which are slightly complicate than the above-listed controls, are often used. To enable various controls, PIDRUN instructions support the function to allow or prohibit such controls by P, I and D components.
For instance, in case of P control, it may be structured by setting _PID[B]_[L]Ti and _PID[B]_[L]Td as 0. If PI control is desired, set _PID[B]_[L]Kp and _PID[B]_[L]Ti only and input 0 to _PID[B]_[L]Td. Then, if you wish to use ID control, set _PID[B]_[L]Kp as 0 and set the remaining _PID[B]_[L]Ti and _PID[B]_[L]Td.
Likewise, ID control sets 0 to _PID[B]_[L]Kp and substitutes each ID control coefficient to _PID[B]_[L]Ti and _PID[B]_[L]Td. However, interestingly, ID control has 0 output theoretically once setting 0 to _PID[B]_[L]Kp(refer to equation 14.3.2 through 14.3.5). In addition, actual PIDRUN instruction calculates MVp = 0 and K_p = 1 internally if inputting 0 to _PID[B]_[L]Kp, enabling ID control, I control and D control.

14.6.2 Operation and function of Anti Wind – up

PIDRUN instruction supports two wind-up prevention functions; Anti Wind-up 1 and Anti Wind-up 2. The former one that is basically supported may work for controls including I control, PI control, ID control and PID control and may not be cancelled. The operation principle is to limit MVi(integral result) to _PID[B]_[L]MV_max and _PID[B]_[L]MV_min.
On the other hand, Anti Wind-up 2 is organically connected MVp(proportional term result). If only with MVp, MV may reach ± (_PID[B]_[L]MV_max) because of a large system error, MVi maintains the previous value without any calculation. Therefore, if an error is large, it induces PV to move to SV only with MVp, not integral nor differential, resumes I control and prevents MVi from being excessively accumulated. On the other hand, a user may cancel an operation if Anti Wind-up 2 makes _PID[B]_[L]AW2D bit on the common bit area ON. And, like PI control and PID control, it works for a control accompanying with P control and I control.

14.6.3 Operation and function of Auto-tuning

PIDRUN instruction has the AT function that tests a system through several basic settings and 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 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 14.7.4 and induce the AT operation accordingly.

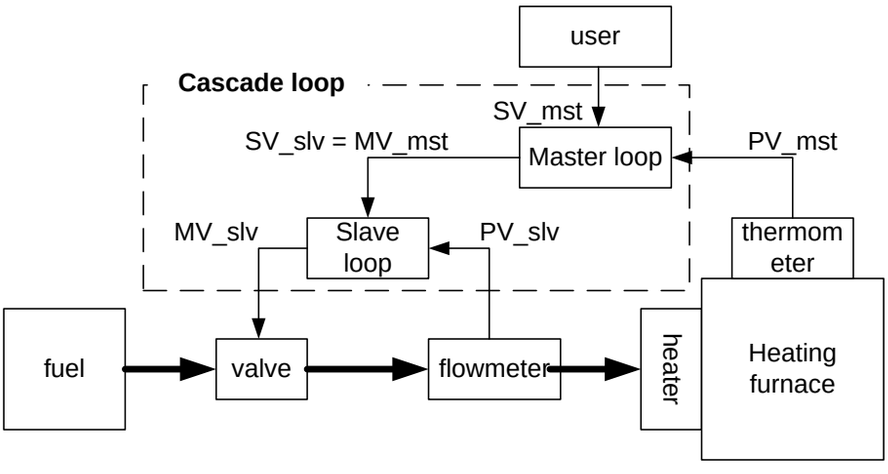
Notes

Auto-tuning

At the moment when a series of works end, AT may automatically substitutes _PID[B]_[L]T_s, _PID[B]_[L]K_p, _PID[B]_[L]T_i and _PID[B]_[L]T_d, which are calculated, to the corresponding positions, so a user must note that _PID[B]_[L]T_s, _PID[B]_[L]K_p, _PID[B]_[L]T_i and _PID[B]_[L]T_d that are used before are to be eliminated.

14.6.4 Operation and function of cascade

PIDCAS instruction executes CASCADE PID control by operating two PID loops. In general, CASCADE PID control is used for chemical process or temperature control through fuel and at the moment, two loops used are called master and slave, respectively. For instance, assuming temperature control through fuel's flowrate, in case of single loop PID control, it opens fuel valve and control fuel's flow, with which it controls the temperature of heating furnace. Therefore, a single PID loop is a system to indirectly control temperature. As such, the application of cascade PID requires installing fuel's flowmeter on a system, which is divided into flow control and temperature control. That is, slave loop controls a flow by using a valve while master loop controls temperature by using the flow. In the case, master loop delivers a desirable flow to slave loop, which monitors, in turn, the flowmeter so that fuel is supplied as much as flow needed by master loop and controls flow by using a valve. Simply, slave loop operates only with the target flow received from master, irrespectively of temperature.
Now, looking into the cascade operation, master loop measures temperature(PV_mst) at relatively later cycle than slave loop, calculates the flow value(MV_mst) calculated for a desirable temperature(SV_mst) and delivers it to slave loop.
Slave loop sets the flow value(MV_mst) received from master as its target(SV_slv), measures the fuel input at more frequency than master loop and adjusts the valve open/close(MV_slv).
Therefore, cascade plays a role to deliver the MV(MV_mst) of master loop to SV of slave loop(SV_slv) with two loop operated.
If slave loop is converted to manual output state, master output is not used, so 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. At the moment when slave loop is converted to auto output mode again, master loop is also converted to auto output mode, when if _PID[B]_[L]MV_BMPL is on, it exchanges state data between two loops, smoothly executing the conversion.
If slave loop is caught in anti-windup, master loop operates in PIDPAUSE mode. As such, despite of anti-windup, if it increases or decreases the target slave value(SV_mst), the second windup for the entire cascade loop is prevented. The function operates in accordance with the conditions without setting and _PID[B]_[L]PAUSE bit is not on.



Notes

Cascade system's auto-tuning

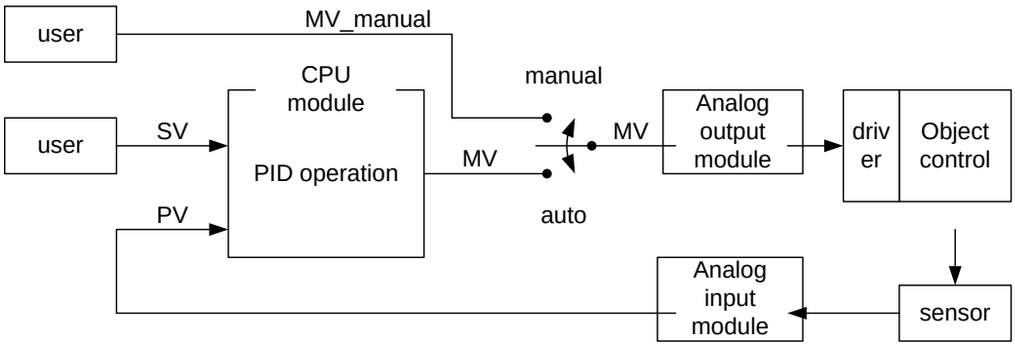
Cascade system's AT auto-tunes slave loop first and then, it does master loop. However, to auto-tune slave loop, it is necessary to anticipate how much SV the slave lop receives from master loop, and if setting the value as AT_SV, the slave loop operates as an independent loop. AT performance depends on the anticipated value. Once it starts working properly after the AT of slave loop, it executes AT of master loop.

14.7 Directions of PID Instructions

The chapter describe the directions of PID instructions.
Please refer to the manual for the details on CPU, special module and XG5000 functions.

14.7.1 Hardware Configuration

The example system is structure as follows.

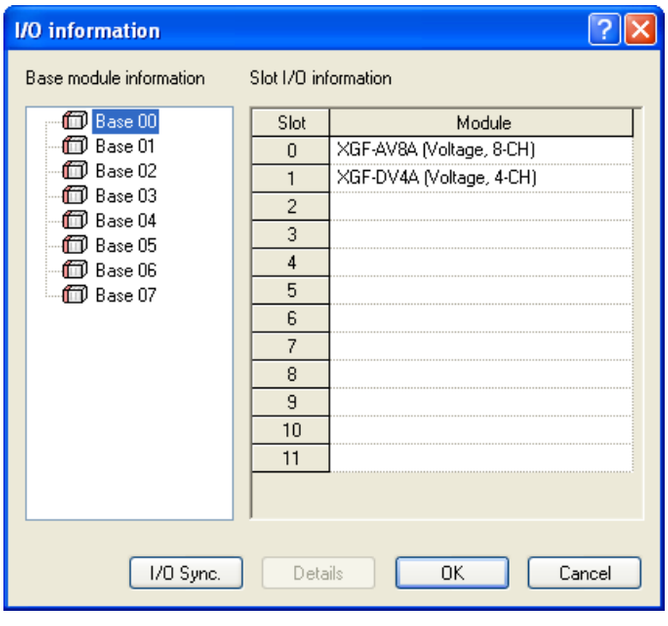


(1) CPU (XGI-CPUU)

CPU is a PID control because PID operation is executed here. A control receives the data sensed by an input module, calculates the output through operation and delivers it to an output module. At the moment, a user should connect I/O and design(tune) the inside of PID control. In general, input and output use Analog input modules and Analog output modules, respectively.

(2) Analog module and parameter registration

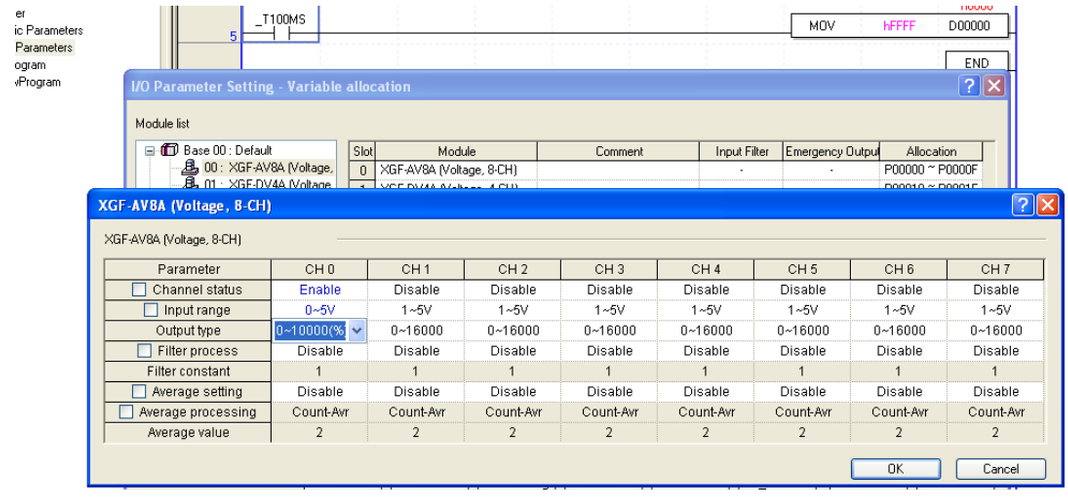
To use Analog module, it is necessary to register them to a project and set them properly. First of all, install analog modules and use the I/O synchronization function of I/O information module to register them.



Once a module is registered, it is necessary to register a parameter to use among the parameters assigned to the module, as the global parameter.

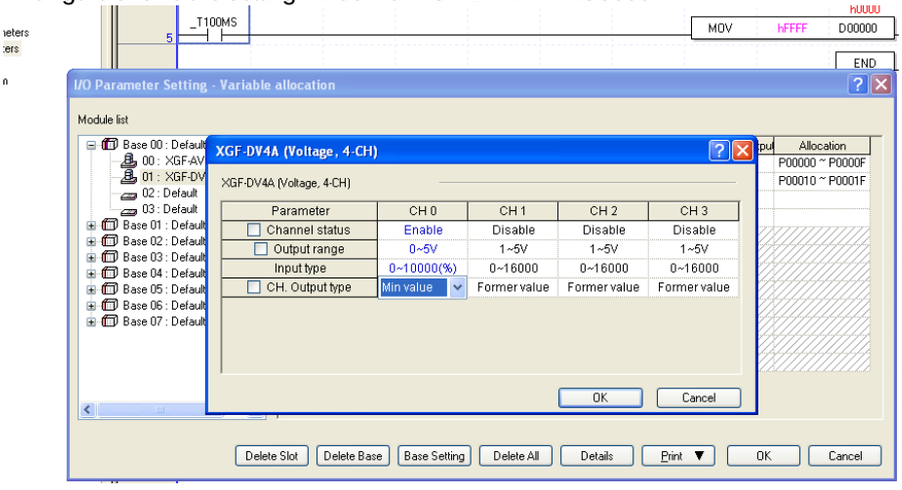
(3) Analog input module (XGF-AV8A)

It functionally receives the state of an object to control from a sensor and delivers it to CPU. Analog input module channel 0 receives 0 ~ 5 V as its input and delivers the output, a digital value to PLC. Then, XGF-AV8A has 8 channels(CH0 ~ CH7). AGF-AV8A setting may be changed in the I/O parameter setting window, which appears when selecting I/O parameter in 'Parameter' item of project window. Change CH 0 to 'Operate' and set the input range to 0 ~ 5V(set along a sensor). Output data type is the PV of PID control, and the range of the value for PID control is to be set between 0 ~ 1000.
Now, the 0 ~ 5 signal detected from a sensor during Analog input module operation is converted to a digital value between 0 ~ 1000, which is x2000, and it is delivered to PLC.
The following figure shows the setting window of XGF-AV8A in XG5000.



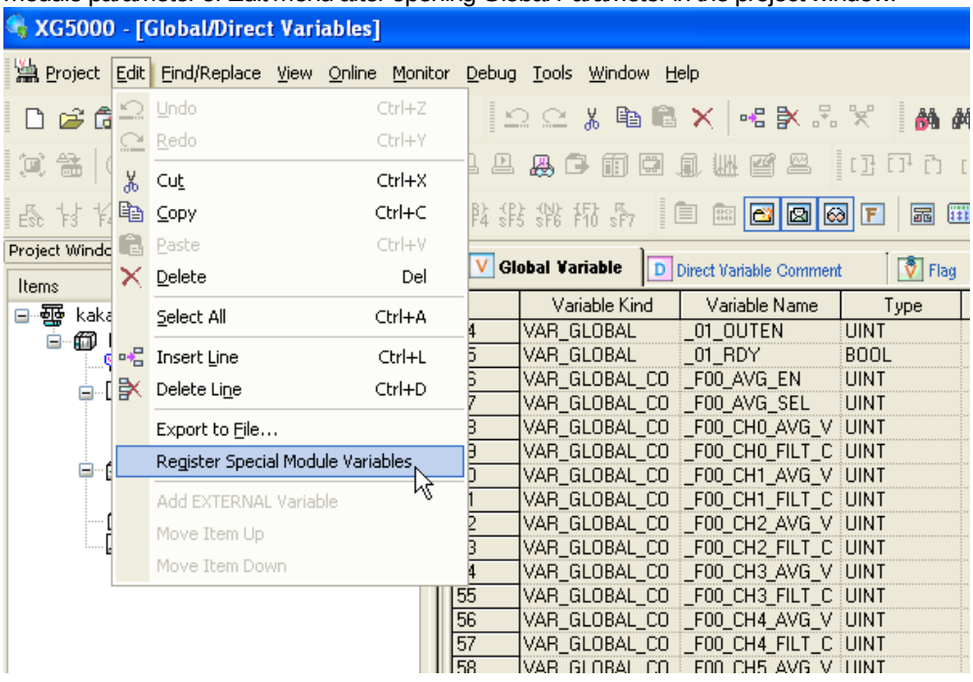
(4) Analog output module (XGF-DV4A)

Analog output module functionally converts the control output digital value, which is created by PLC's control operation, to 4mA ~ 20mA and delivers it to a drive of an object to control. XGF-DV4A model has totally 4 channels and like XGF-AC8A, it may be changed in the I/O parameter setting window. It is necessary to change CH0 to 'Operate' and set the output range to 0 ~ 5V (set along a driver). The MV digital output of 0 ~ 1000, which is created by PID control operation is reduced as small as 1/2000 and it is delivered to the signal of the driver.
The figure shows the setting window of XGF-DV4A in XG5000.

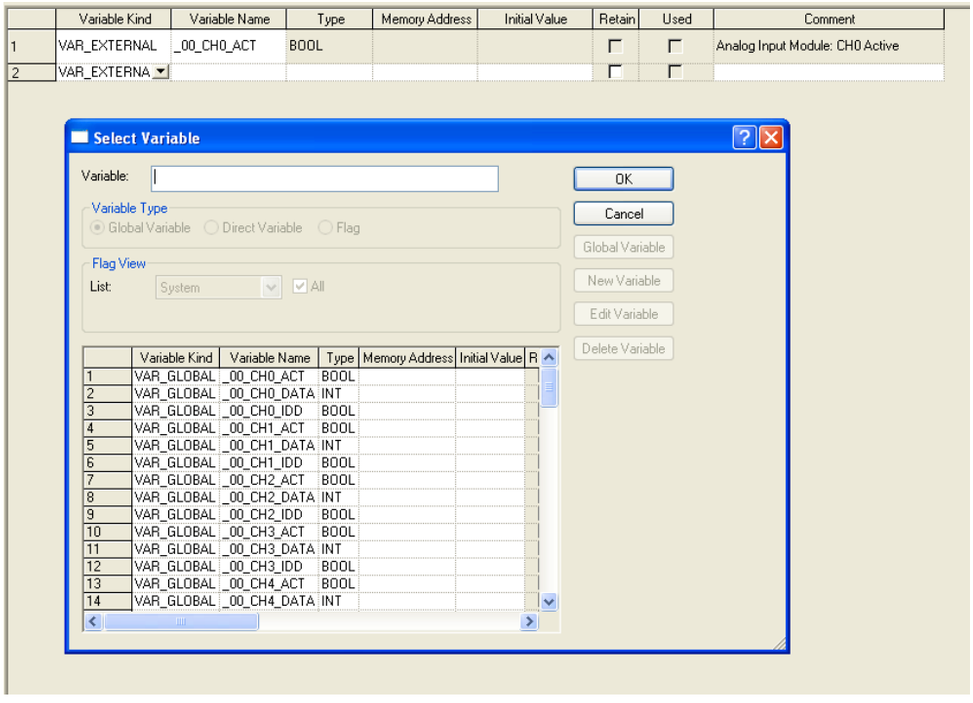


(5) Register parameter

To approach Analog input module and Analog output module, it is necessary to register the parameter of each module prior to use. A parameter of every special module installed may be automatically registered through the auto registration of special module parameter of Edit menu after opening Global Parameter in the project window.



Among them, select parameters necessary for executing the ladder program and register them as the local parameters.



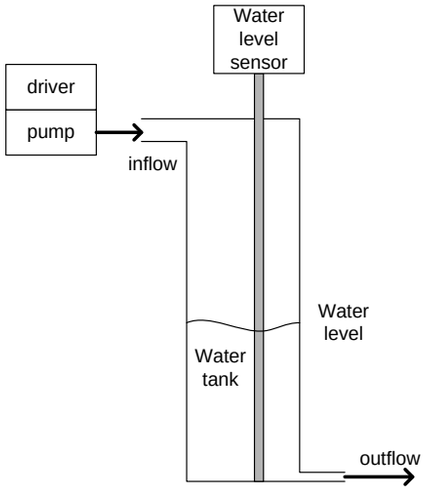
(6) Sensor and driver

Besides Analog output module, sensor and driver are media to deliver a state to a control from an object to control and deliver the output of a control to an object to control from a control. Therefore, the output created by a sensor should be used as an input of Analog input module while the output created by Analog output module should be used as the input of driver. For instance, if a sensor is current type of 4mA ~ 20mA, it should be Analog input module type of 4mA ~ 20mA. In addition, if a driver is voltage

type of 0V ~ 5V, Analog output module should be also voltage type of 0V ~ 5V.
The output of Analog output module is used as a drive signal of a driver. If it is used directly as the motive power of driver, PLC may be subject to malfunction.

(7) Object to control

The system uses water level control system as its object to control. The water level system is designed to supply water to a water tank of which bottom is slightly open and maintain a desirable water level. The water in a tank uniformly flows out and the increase/decrease of water depends on the water inflow by means of a pump. The structure of the water control system is as follows.



14.7.2 Program example 1

The figure shows a program example to execute PID control by using Analog input module and Analog output module. (but, PID constant and SV value are set in the parameter monitor window in the program)



L1 : delivers Analog input data to PV of PIDRUN instruction by using constant On contact.

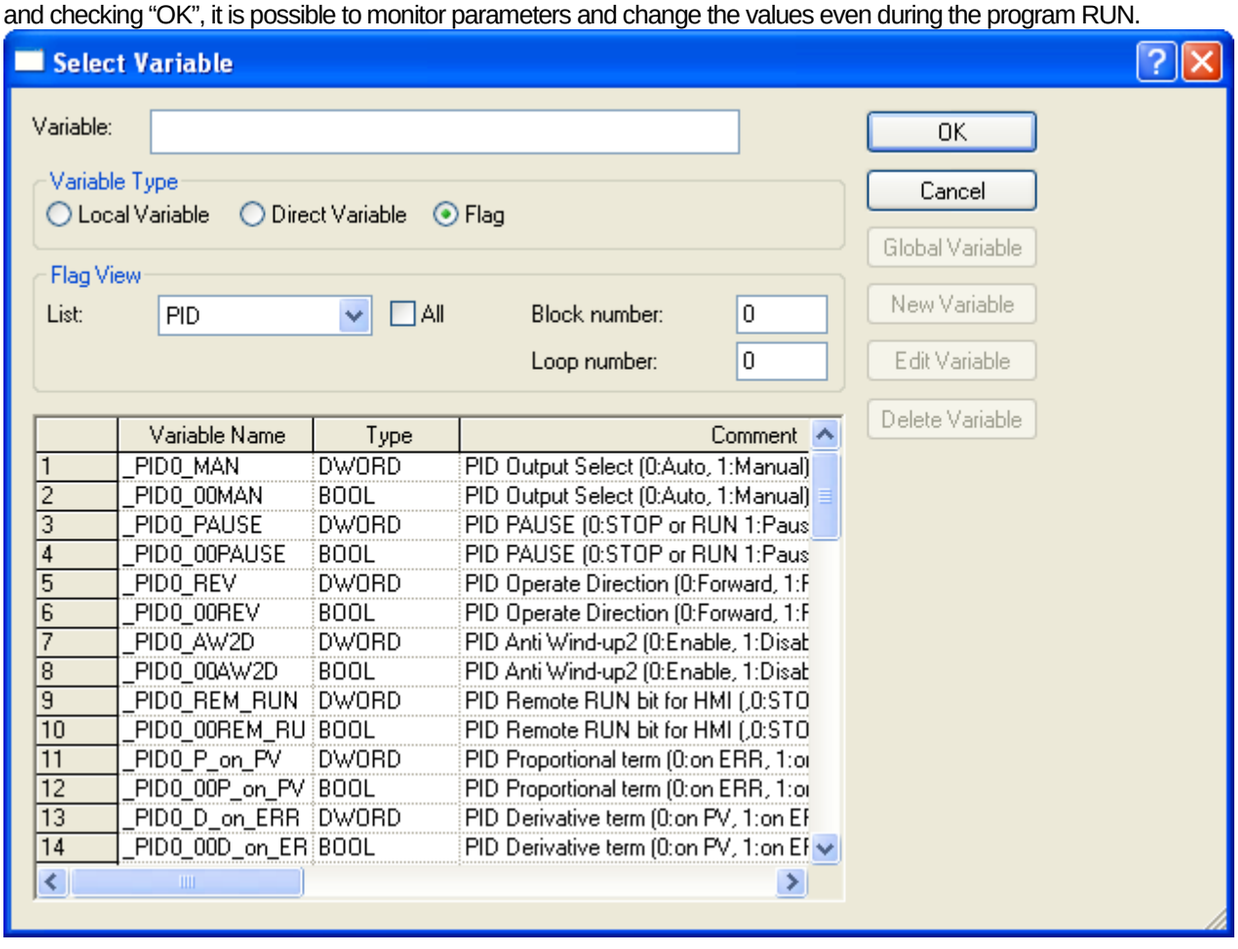
L5 : If %MX0 bit is on, it executes the control operation of PIDRUN block 0 and loop 0 and if it is complete, it activates D/A output. If D/A output is deactivated, the module outputs the value set when it is registered.

L10 : Delivers MV output of PIDRUN instruction to Analog output data by using constant ON contact.

14.7.3 PID control

(1) Register parameter monitor

Register PID parameters in the parameter monitor window and execute control setting.
If clicking the right button of mouse in the parameter monitor window and selecting, “Register in Parameter/Comment”, it is possible to view “Select Parameter/Device” window. If selecting PID in “List”, canceling “View All” and inputting 0 to “Block No.” and “Parameter No.”, a user can see the parameter to save the setting and state of block 0 and loop 0. If selecting all parameters and checking “OK”, it is possible to monitor parameters and change the values even during the program RUN.

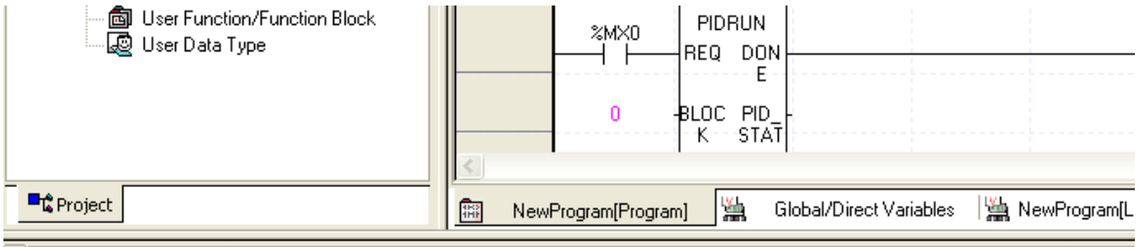


(2) Getting SV

To set SV, it is necessary to know PV conversion value of a system that a user desires. Simply, if a user desires to maintain the water level at 250mm, it searches for the PV value indicating 250mm. The value can be found by numerical analysis but it is more accurate to check it by using the response of an object to control experimentally. In the system, it was analyzed that PV outputs 8333 when the water level is 250mm, but as a result of operating it actually, the sensor output value was 8250. The cause of the error must be attributable to inaccurate sensor, error of measurement reference point and others. Therefore, 8250, the value actually measured should be used as the state value of water level 250mm. The value is also used as SV when controlling 250mm.

(3) Control setting

Download the previously created program to PLC and start monitoring. Then, set the parameters registered to the parameter monitor window. The following figure shows the view of example program's parameter monitor window.

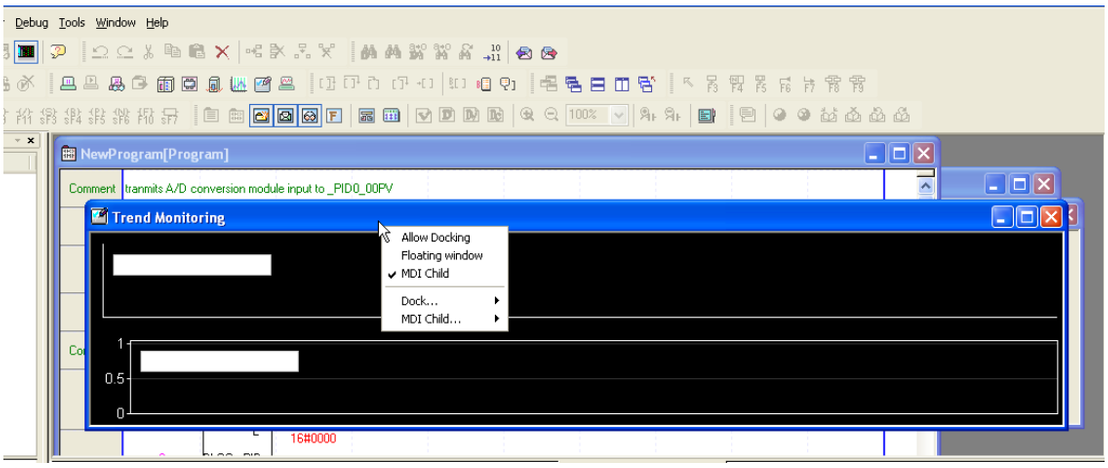


	PLC	Program	Variable/Device	Value	Type	Device/Variable	Comment
1	NewPLC	NewProgram	INST		PIDRUN		
2	NewPLC	NewProgram	INST.REQ		BOOL		
3	NewPLC	NewProgram	INST.BLOCK		UINT		
4	NewPLC	NewProgram	INST.LOOP		UINT		
5	NewPLC	NewProgram	INST.DONE		BOOL		
6	NewPLC	NewProgram	INST.PID_STAT		WORD		
7	NewPLC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

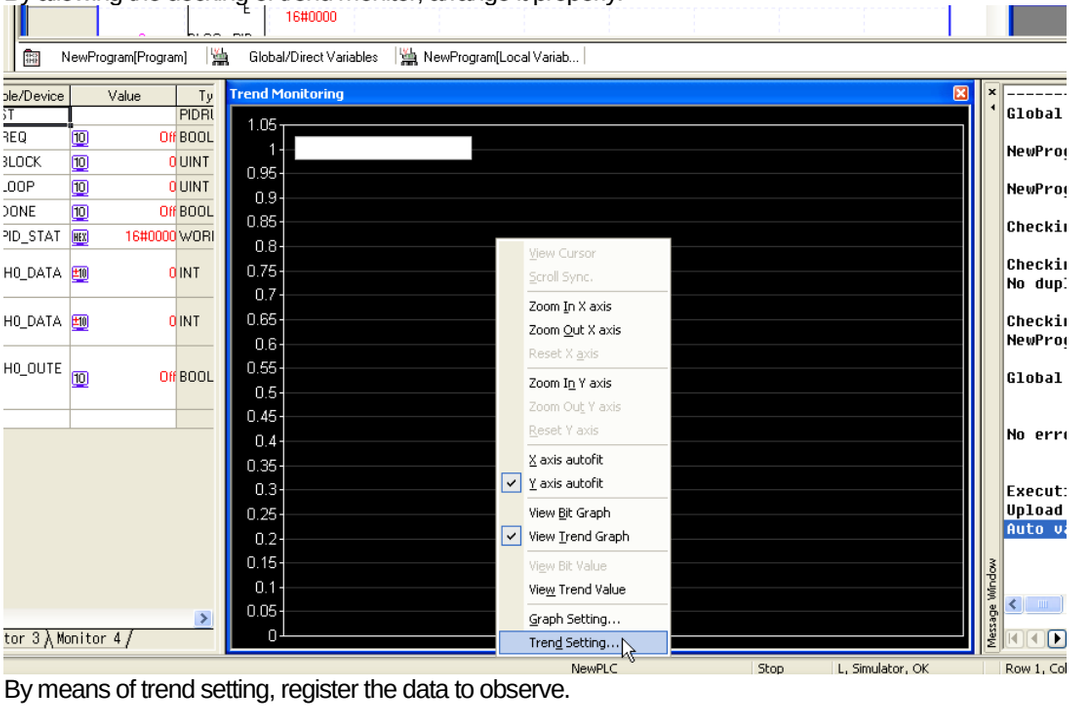
Settings include three; SV, K_p and MV_max.
SV is set to 8250, which is actually measured and Kp is given with 5 temporarily.
MV_max is an item to limit the max. value of MV and is set to 1000 in accordance with ADC / DAC module.

(4) Control state observance using trend monitor

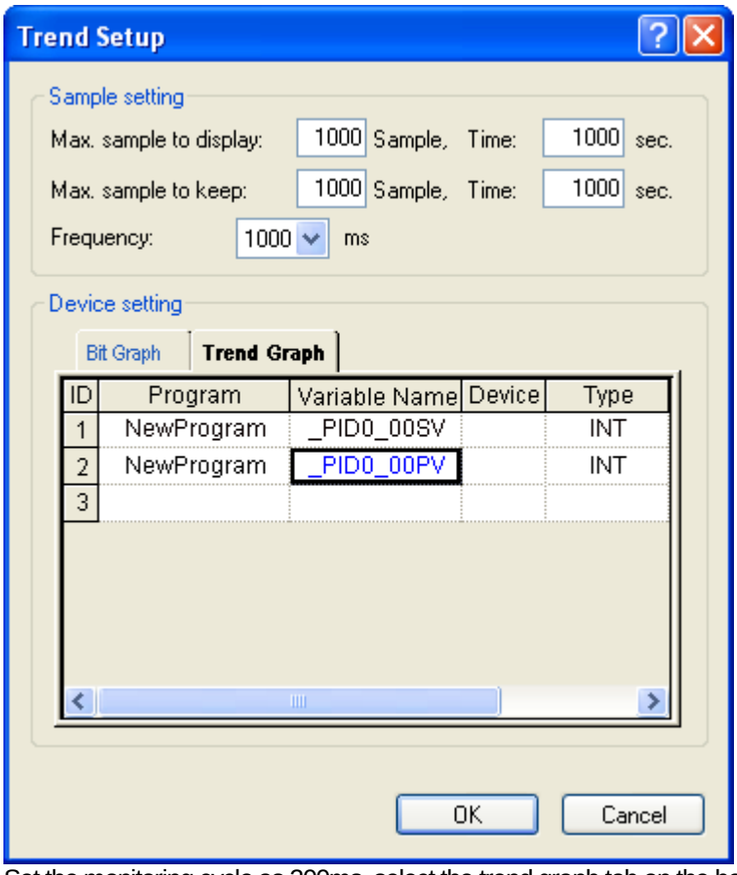
It activates trend monitor among the monitor functions of XG5000.



By allowing the docking of trend monitor, arrange it properly.



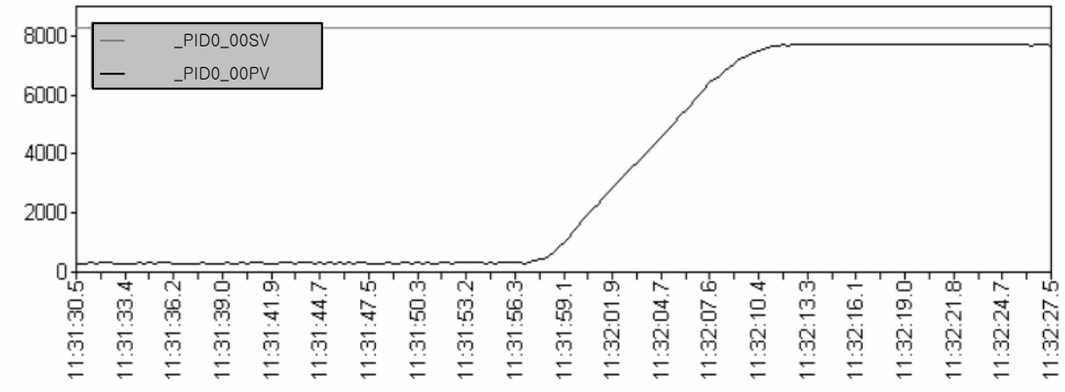
By means of trend setting, register the data to observe.



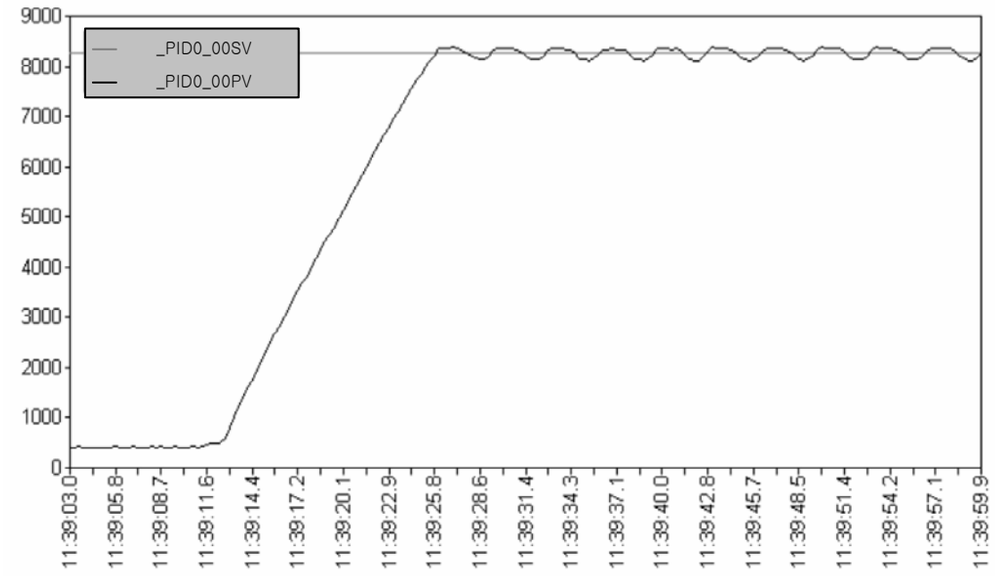
Set the monitoring cycle as 200ms, select the trend graph tab on the bottom and register the parameters to monitor such as SV and PV of block 0 and loop 0.

(5) Program execution (here, an example is introduced to show how to find a parameter manually and for auto tuning, refer to 14.7.4)

If contact (%MX0) is ON, the system starts operating.

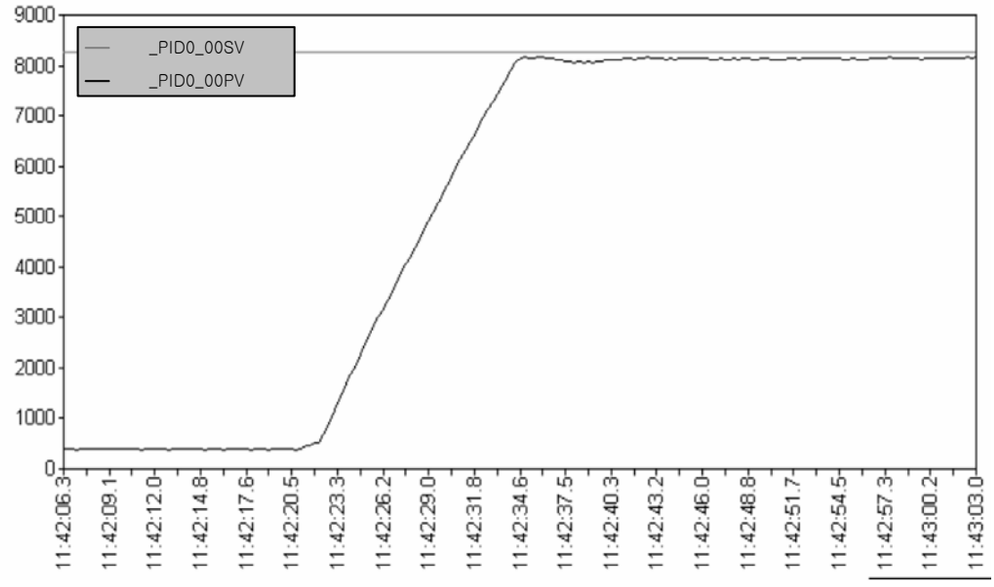


Increase K_p to 100 and restart it.



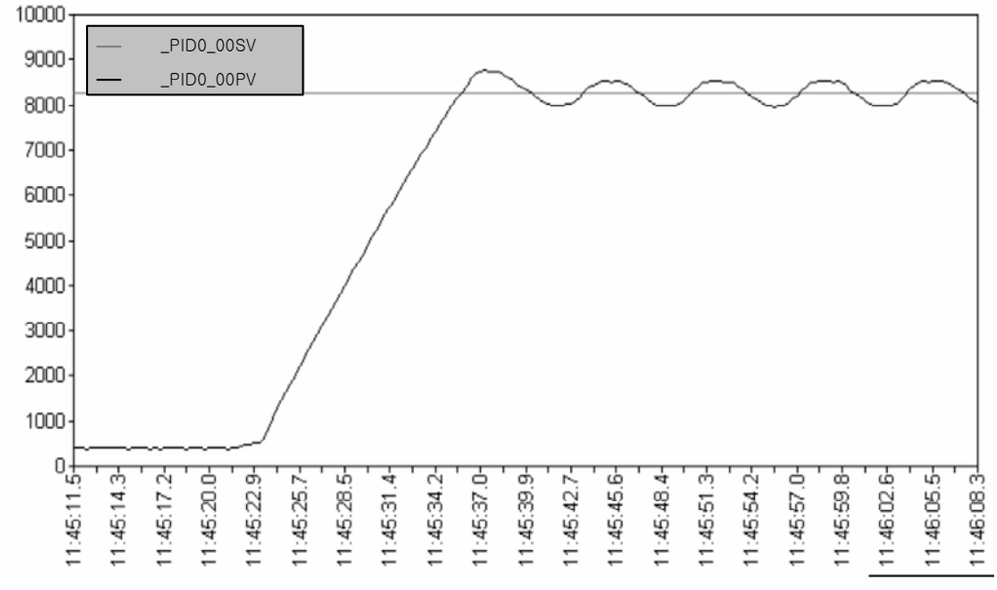
It can be found that it uniformly and permanently vibrates due to too large K_p.

Set 'K_p = 20, T_i = 100'.



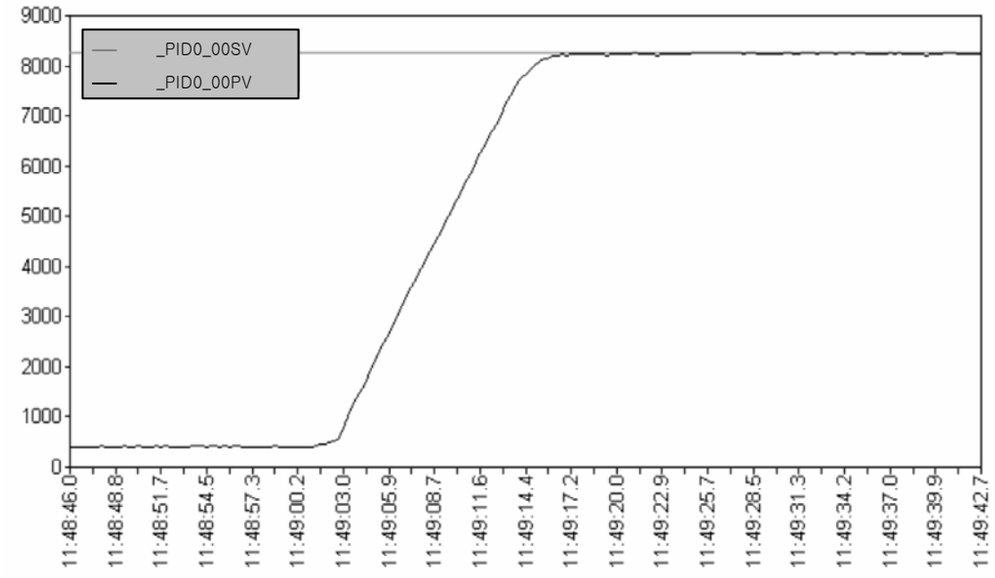
Due to too large T_i , the normal state residual drift lasts and there is a slight overshoot.

Set K_p = 10, T_i =1.



Due to too small T_i, PV is slowly fluctuating.

Set K_p = 10, T_i = 5.

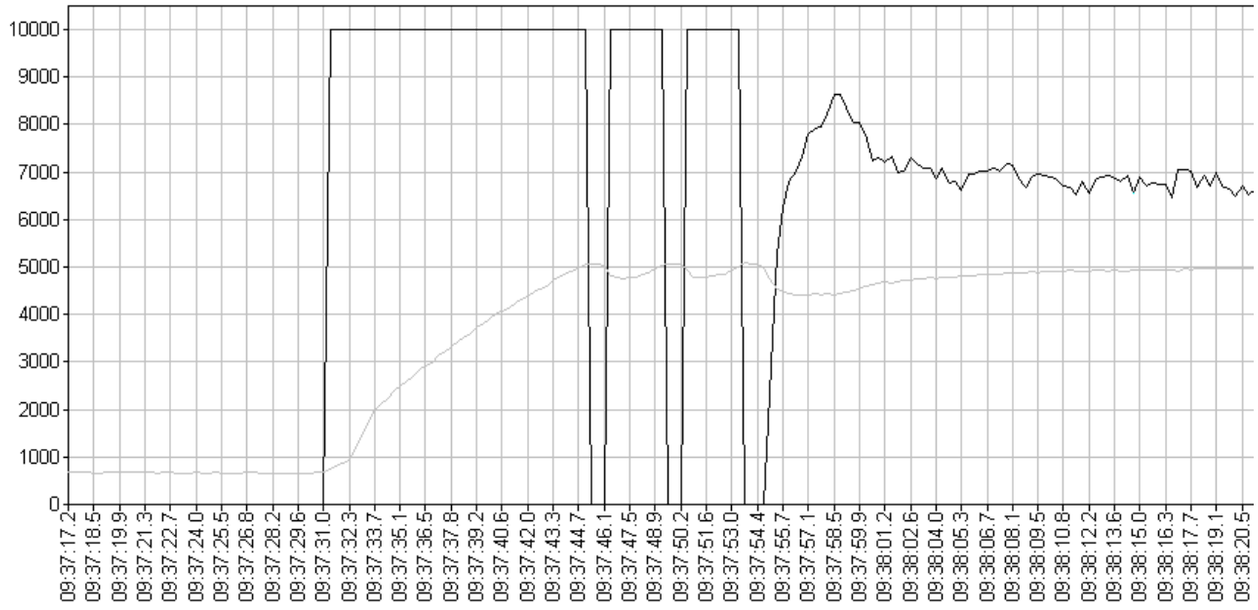


It shows the satisfactory results.

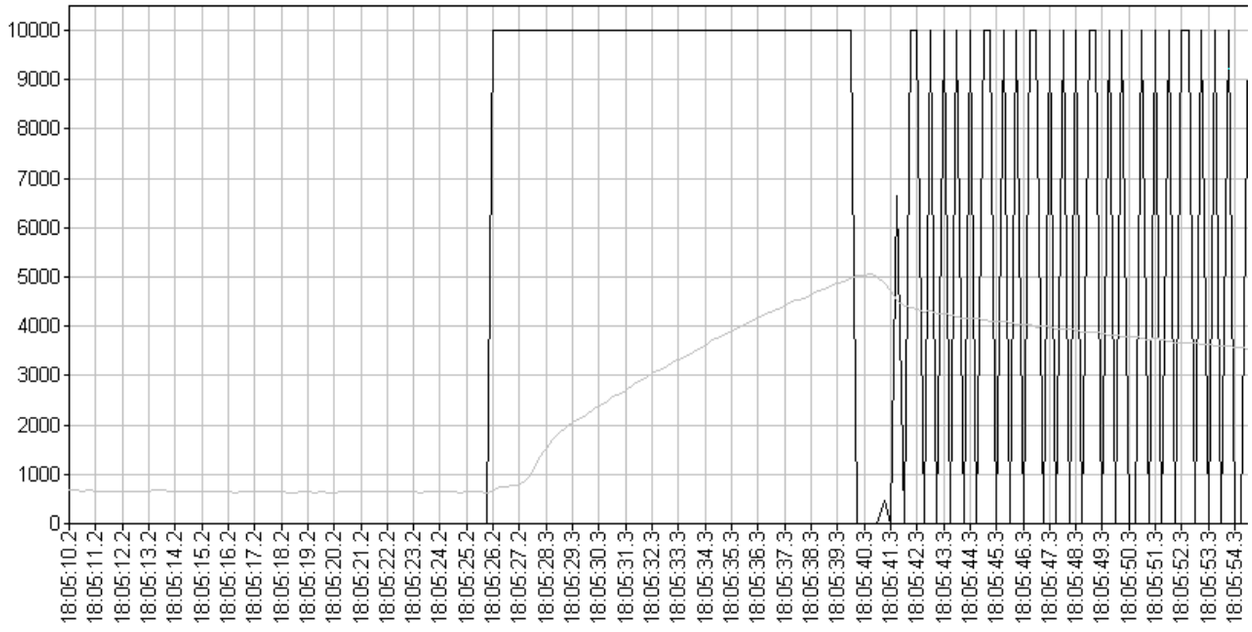
The current system is the system slow enough to control only with PI, so it executes PI control only.
Therefore, tuning results are K_p = 10, T_i = 5, T_d = 0.

14.7.4 AT (Auto-tuning) operation

While using and operating the system described in the above 14.7.3, especially using AT function, check the setting of AT. The basic AT function may operate with the system not operated, that is, when the system has a PV less than _PID[B]_[L]AT_SV (smaller one in case of reverse operation). Basically, AT executes different operation by stages while step increases form 0 to 7 and the step of the current loop can be checked by _PID[B]_[L]AT_step. In PIDSTOP state, AT step is 0 but once AT starts, it increases (automatically) from 0 up to 7, at which AT stops. Therefore, it may be subject to malfunction if a user manipulates the steps.
To avoid duplicate, apply the setting after trying to execute up to (4) of the above 14.7.3.
Now, set _PID[B]_[L]AT_SV. Although _PID[B]_[L]SV value was already set in the above, PV vibrates the system during AT so to be over _PID[B]_[L]SV, so it is necessary to set a SV value suitable for the case harmful to the system into _PID[B]_[L]AT_SV. In other cases, make sure to set _PID[B]_[L]AT_SV like _PID[B]_[L]SV. _PID[B]_[L]AT_SV value is used only during AT and once AT is complete, it automatically operates the system, based on _PID[B]_[L]SV.
Next, set _PID[B]_[L]MV_min and _PID[B]_[L]MV_max. In AT, _PID[B]_[L]MV_min and _PID[B]_[L]MV_max are respectively regarded as the min./max. outputs of the system. During AT, both values change in 3 cycles, depending on the system speed(how fast PV approaches SV). For instance, in case of _PID[B]_[L]MV_min = 0, _PID[B]_[L]MV_max = 10000, the system operation signal(MV) that is delivered to motor or heater repeats the output, 0 → 10000 → 0 three times. As such, in case there is any possibility that a sudden change overburden the system, it is necessary to set _PID[B]_[L]dMV.
Then, set _PID[B]_[L]HYS_val, which is used only during AT. As a deadband that occurs when PV approaches SV, it occurs higher than the reference during ascent while it does lower than the reference during descent. That is, if SV is 5000 and _PID[B]_[L]HYS_val is 100, AT increases PV by maintaining MV as _PID[B]_[L]MV_max up to 5100 (SV + _PID[B]_[L]HYS_val) and then, it maintains MV as _PID[B]_[L]MV_min up to 4900 (SV - _PID[B]_[L]HYS_val), executing tuning while reducing PV.



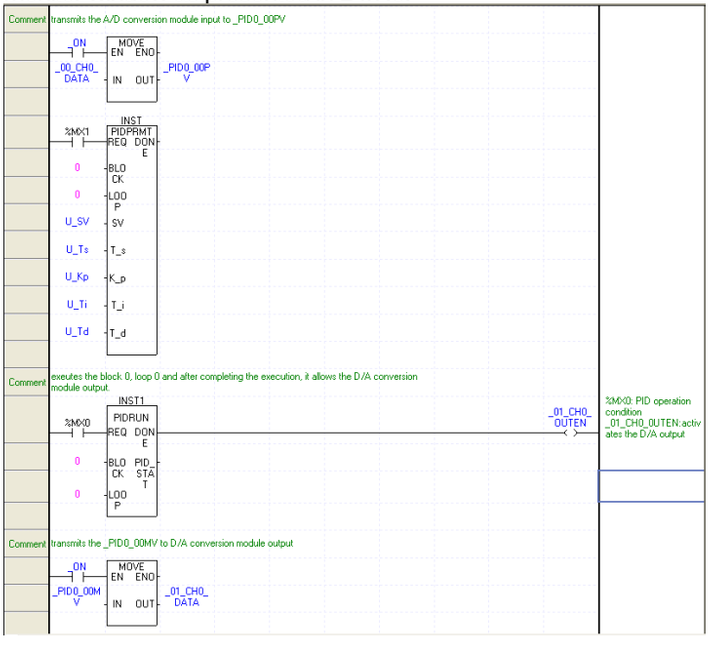
The above graph is the water level waveform gained by setting _PID[B]_[L]HYS_val value (50 in the example) properly and MV should have 3 square waveforms as seen in the figure.



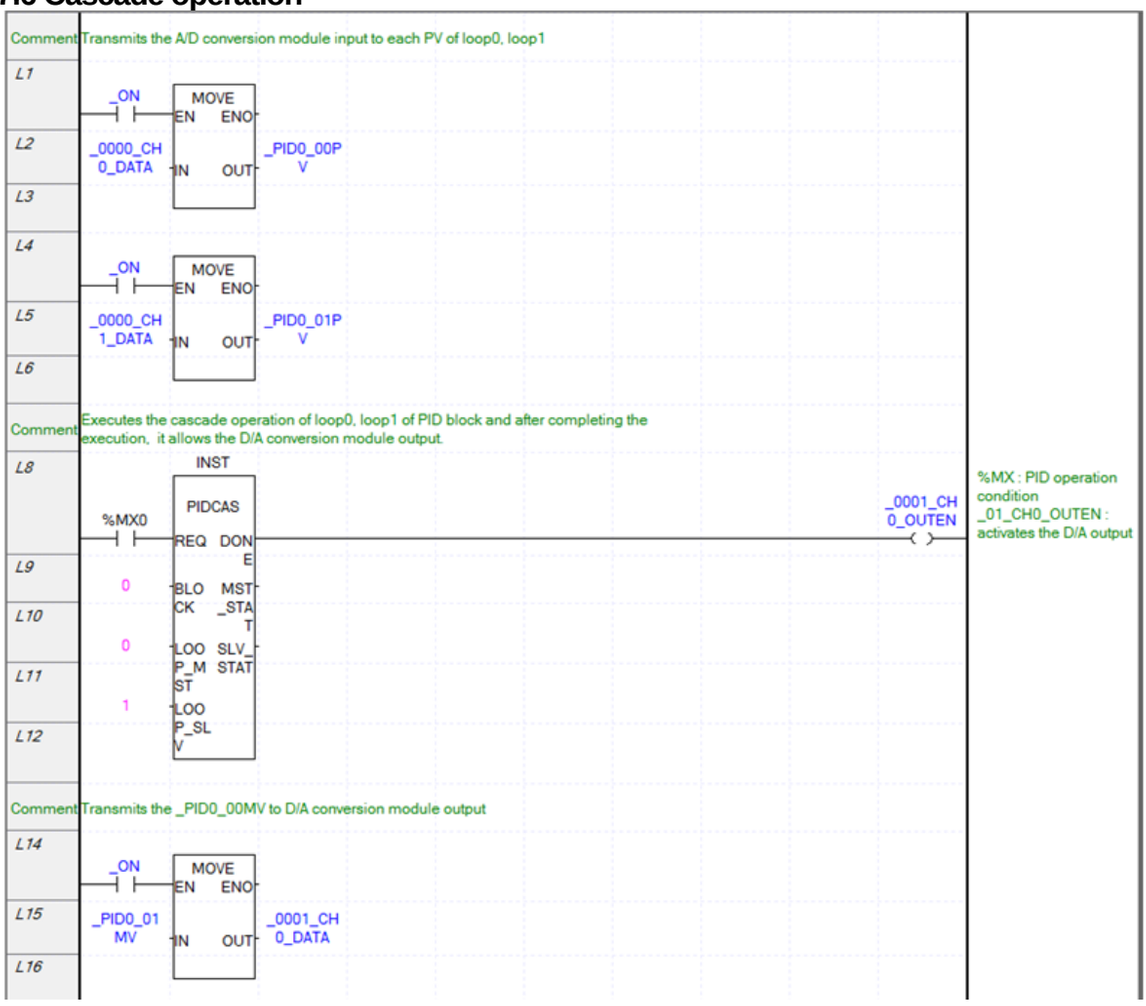
In the above graph, _PID[B]_[L]HYS_val is set too small (10 in the figure), so if no.3 square wave form on MV, which is gained from the water level waveform, is not clear, accurate AT operation may not be secured. In addition, too large _PID[B]_[L]HYS_val is inputted, the system may slow down disadvantageously.

14.7.5 Program example 2

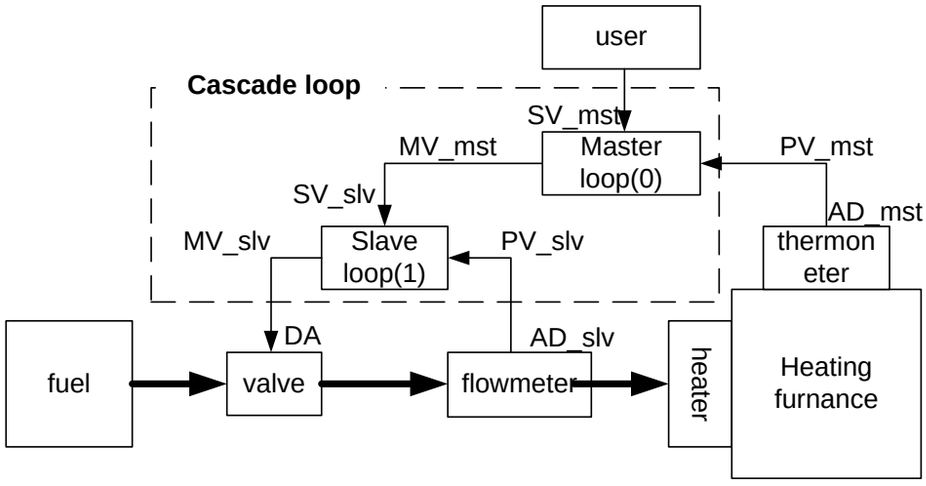
The figure shows the program that PID constant and SV setting are changed in the program. If PIDPRMT contact (%MX01) is on, user defined values like U_SV, U_Ts, U_Kp, U_Ti and U_Td are inputted as PID parameters and it is also allowed to use monitor window as presented in 14.7.3.



14.7.6 Cascade operation



The above ladder program is the view of cascade configuration, based on the following block diagram.



The above block diagram is the system to measure the temperature of heating furnace, supply fuel to the heater and maintain a desirable temperature.
Also, to control the signal delivered to fuel valve more actively, if installing a flowmeter and structuring a slave loop, it supplies a uniform fuel on the operation of slave loop when master loop instructs a temporary value of fuel.

Appendix 1 Flags List

Appendix 1.1 Flags List

1) The Flags of operation mode and state

Flags Name	Type	Device	Contents	Description
_SYS_STATE	DWORD	%FD0	PLC Mode and operation state	Indicates PLC mode and operation state of system.
_RUN	BOOL	%FX0	Run	Run state
_STOP	BOOL	%FX1	Stop	Stop state
_ERROR	BOOL	%FX2	Error	Error state
_DEBUG	BOOL	%FX3	Debug	Debug state
_LOCAL_CON	BOOL	%FX4	Local control	Indicates operation mode changeable state only by the Mode key and XG5000.
_BASE_EMASK_INFO	DWORD	%FD477	Base Fault Mask information	Base Fault Mask information
_REMOTE_CON	BOOL	%FX6	Remote Mode On	It is Remote control mode
_RUN_EDIT_ST	BOOL	%FX8	Editing during Run	Editing program download during Run
_RUN_EDIT_CHK	BOOL	%FX9		Internal edit processing during Run
_RUN_EDIT_DONE	BOOL	%FX10		Edit is done during Run
_RUN_EDIT_NG	BOOL	%FX11		Edit is ended abnormally during Run
_CMOD_KEY	BOOL	%FX12	Operation mode change	Operation mode changed by key
_CMOD_LPADT	BOOL	%FX13		Operation mode changed by local PADT
_CMOD_RPADT	BOOL	%FX14		Operation mode changed by Remote PADT
_CMOD_RLINK	BOOL	%FX15		Operation mode changed by Remote communication module
_FORCE_IN	BOOL	%FX16	Forced Input	Forced On/Off state about input contact
_FORCE_OUT	BOOL	%FX17	Forced Output	Forced On/Off state about output contact
_SKIP_ON	BOOL	%FX18	Input/Output Skip	I/O Skip on execution
_EMASK_ON	BOOL	%FX19	Fault mask	Fault mask on execution
_MON_ON	BOOL	%FX20	Monitor on execution	Monitor on execution
_USTOP_ON	BOOL	%FX21	Stopped by STOP function	Stopped after scan completion by 'STOP' function while RUN mode operation.
_ESTOP_ON	BOOL	%FX22	Stopped by ESTOP function	Instantly stopped by 'ESTOP' function while RUN mode operation.
_INIT_RUN	BOOL	%FX24	Initialization task on execution	User defined Initialization program on execution.
_PB1	BOOL	%FX28	Program Code 1	Selected program code 1
_PB2	BOOL	%FX29	Program Code 2	Selected program code 2
_BASE_INFO	ARRAY	%FW150	Slot information in the base[Base 0]	Slot information in the base[Base 0]
_RTC_WR	BOOL	%FX16384	RTC data writing	RTC data writing
_SCAN_WR	BOOL	%FX16385	Scan value initialization	Initialize the scan value

Flags Name	Type	Device	Contents	Description
_CHK_ANC_ERR	BOOL	%FX16386	Request of the external heavy fault	Request of heavy fault detection from external device.
_CHK_ANC_WAR	BOOL	%FX16387	Request of the external light fault	Request of light fault detection from external device.
_BASE_SKIP_INFO	DWORD	%FD478	Base Skip information	Base Skip information
_INIT_DONE	BOOL	%FX16400	Initialization task execution 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 state	Indicates current state of local key
_FUSE_ER_PMT	BOOL	%FX15232	Continue running when a fuse error occurs	Continue running when a fuse error occurs
_CP_ER_PMT	BOOL	%FX15235	Continue running when a communication module error occurs	Continue running when a communication module error occurs
_IO_ER_PMT	BOOL	%FX15233	Continue running when an I/O module error occurs	Continue running when an I/O module error occurs
_SP_ER_PMT	BOOL	%FX15234	Continue running when a special module error occurs	Continue running when a special module error occurs
_INIT_RUN	BOOL	%FX24	Executing the initial task	Executing the initial task

2) The flags of system error

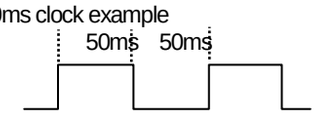
Flags Name	Type	Device	Contents	Description
_CNF_ER	DWORD	%FD1	System error(heavy fault error)	Handles error flags about non-operation fault error as below.
_IO_TYER	BOOL	%FX33	Error when Module type mismatched	Representative flag displayed when I/O configuration parameter for each slot is not matched 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	Slot number of module detachment	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 to module is cut off, displayed as the lowest slot number after detecting this error in slot locations.
_ANNUM_ER	BOOL	%FX38	Heavy fault detection error in external device	Representative flag displayed when heavy fault error detected by user program is recorded in "_ANC_ERR[n]".
_BPRM_ER	BOOL	%FX40	Basic parameter error	It is abnormal to the basic parameter.
_IOPRM_ER	BOOL	%FX41	I/O parameter error	It is abnormal to the I/O 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.

Flags Name	Type	Device	Contents	Description
_PGM_ER	BOOL	%FX44	Program error	Indicates that there is problem with user-made program checksum.
_FUSE_ERR	WORD	%FW112		
_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.	Indicates that base power 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 detach error on the base[Base 0]	Module detach error on the base[Base 0]
_IO_TYERR	WORD	%FW96	Error when module does not match on the base[Base 0]	Error when module does not match on the base[Base 0]

3) The flags of system warning

Flag Name	Type	Device	Contents	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	P2P parameter error - representative flag
_EIP_TAG_WAR	BOOL	%FX95	Warning:EtherNet/IP TAG information	Warning: EtherNet/IP TAG information
_HS_WAR	BOOL	%FX72	HS link parameter error - representative flag	HS link parameter error - representative flag
_HS_WAR_W	WORD	%FW58	HS link parameter error - whole information	HS link parameter error - whole information
_AB_SD_ER	BOOL	%FX67	Stop by operation error	Stopped by abnormal operation
_TASK_ER	BOOL	%FX68	Task collision	It is collided to the task
_BAT_ER	BOOL	%FX69	Battery error	It is to the error in the battery state
_ANNUM_WAR	BOOL	%FX70	External device fault	Indicates that the light fault in the external device is detected.
_P2P_WAR_W	WORD	%FW59	P2P parameter error - whole information	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 error	It is abnormal to the high speed link parameter n. (n: 1~12)
_P2P_WARn	BOOL	%FX944	P2P parameter error	It is abnormal to the P2P parameter n. (n: 1~8)
_CONSTANT_ER	BOOL	%FX92	Fixed cycle fault	Fixed cycle fault
_ANC_ERR	WORD	%FW1026	Heavy fault information 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.
_ANC_WAR	WORD	%FW1027	Light fault information of external device	Light 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	Slot Fault Mask information
_SLOT_SKIP_INFO	WORD	%FW966	Slot Skip information	Slot Skip information

4) User's Flags

Flag Name	Type	Device	Contents	Description
_T20MS	BOOL	%FX144	20ms cycle 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 clock example 
_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	Reversal every scan	On/Off reversed flag per every scan when user program is working. (On state for first scan)

5) The flags of operation result

Flags Name	Type	Device	Contents	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	Overflow error flag array index range	Error flag displayed when exceeding the setting array numbers.
_ARY_IDX_LER	BOOL	%FX28896	Overflow error latch flag array index range	Error latch flag displayed when exceeding the setting array numbers.
_ALL_OFF	BOOL	%FX179	All output Off	"On" only in case of all output is "Off"

6) The flags of the information of the system operation state

Flags Name	Type	Device	Contents	Description
_CPU_TYPE	WORD	%FW44	CPU Type Information.	Indicates the operation mode and operation State information
_CPU_VER	WORD	%FW45	CPU version	Indicates CPU version number
_OS_VER	DWORD	%FD23	OS version	Indicates OS version number
_OS_VER_PATCH	DWORD	%FD89	OS patch version	Indicates OS version to second decimal places.
_OS_DATE	DWORD	%FD24	OS date	Indicates OS distribution date
_SCAN_MAX	WORD	%FW50	Max. scan time	Indicates max. scan time during operation Unit:0.1ms
_SCAN_MIN	WORD	%FW51	Min. 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[Hour]	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[Age]	Indicates PLC Clock data(Age).
_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 of RTC(unit : ms)	Indicates a data for the time of the day on the basis of 00:00:00 (unit : ms).
_RBANK_NUM	WORD	%FW158	Active block no.	Indicates active block no.
_AC_F_CNT	UINT	%FW13	Instant power failure count occurred	Indicates the instant power cutoff count which occurred while running mode operation.
_FALS_NUM	WORD	%FW14	FALS number	Indicates the number of False
_SOE_LOG_CNT	WORD	%FW1786	SOE event count occurred	Increase when SOE event is occurred
_SOE_LOG_ROTATE	WORD	%FW1787	Rotate information of SOE event	Increase when SOE event count exceed 3000
_SOE_READ_LOG_CNT	WORD	%FW1784	SOE event count read by user	Increase SOE event count read by using SOE_RD function block
_SOE_READ_LOG_ROTATE	WORD	%FW1785	Rotate information of SOE event count read by user	Increase when SOE event count read by using SOE_RD function block is 3000
_HS_ENABLE_STATE	ARRAY	%FX15840	Current state of high speed link enable/disable	Indicates the state of high speed link enable/disable
_HS_REQ	ARRAY	%FX16480	Request of high speed link enable/disable	Changes the state of high speed link enable/disable
_HS_REQ_NUM	ARRAY	%FX16496	Configuration of high speed link enable/disable	Indicates configuration of high speed link enable/disable
_P2P_ENABLE_STATE	ARRAY	%FX15872	Current state of P2P enable/disable	Indicates the state of P2P enable/disable
_P2P_REQ	ARRAY	%FX16512	Request of P2P enable/disable	Changes the state of P2P enable/disable

Flags Name	Type	Device	Contents	Description
_P2P_REQ_NUM	ARRAY	%FX16528	Configuration of P2P enable/disable	Indicates configuration of 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	Fixed cycle task initialize scan value	Fixed cycle task initialize scan value
_SOCKET_CLOSE_COUNTER	ARRAY	%FW996	Count of CLOSE times (Each of sockets)	Count of disconnection times with Client (Each of sockets)
_RTC_TIME_USER[0]	BYTE	%FB2068	Watch information data	Indicates watch information data(Year).
_RTC_TIME_USER[1]	BYTE	%FB2069		Indicates watch information data(Month)
_RTC_TIME_USER[2]	BYTE	%FB2070		Indicates watch information data(Date).
_RTC_TIME_USER[3]	BYTE	%FB2071		Indicates watch information data(Hour)
_RTC_TIME_USER[4]	BYTE	%FB2072		Indicates watch information data(Minute).
_RTC_TIME_USER[5]	BYTE	%FB2073		Indicates watch information data(Second)
_RTC_TIME_USER[6]	BYTE	%FB2074		Indicates watch information data(Day).
_RTC_TIME_USER[7]	BYTE	%FB2075		Indicates watch information data(Age).

Appendix 1.2 Link Flags(L) List

Here describes data link communication Flags(L).

[Table 1] Communication Flag List according to High speed link no. (High speed link no. 1 ~ 12)

Keyword	Type	Device	Contents	Description
_HSn_RLINK	Bit	Refer to XG5000 Global /Direct Variables (High Speed Link)	High speed link parameter "n" normal operation of all station	Indicates normal operation of all station according to parameter set in High speed link, and On under the condition as below. 1. In case that all station set in parameter is RUN mode and no error, 2. All data block set in parameter is communicated normally, and 3. The parameter set in each station itself is communicated normally. Once RUN_LINK is On, it keeps On unless stopped by LINK_DISABLE.
_HSn_LTRBL	Bit		Abnormal state after _HSn_RLINK ON	In the state of _HSmRLINK flag On, if communication state of the station set in the parameter and data block is as follows, this flag shall be On. 1. In case that the station set in the parameter is not RUN mode, or 2. There is an error in the station set in the parameter, or 3. The communication state of data block set in the parameter is not good. LINK TROUBLE shall be On if the above 1, 2 & 3 conditions occur, and if the condition return to the normal state, it shall be Off again.
_HSn_STATEk (k=000~127)	Bit Array		High speed link parameter "n", k block general state	Indicates the general state of communication information for each data block of setting parameter. HS1STATEk=HS1MODk&_HS1TR X k&(~_HSnERRk)
_HSn_MODk (k=000~127)	Bit Array		High speed link parameter "n", k block station RUN operation mode	Indicates operation mode of station set in k data block of parameter.
_HSn_TRXk (k=000~127)	Bit Array		Normal communication with High speed link parameter "n", k block station	Indicates if communication state of k data of parameter is communicated smoothly according to the setting.
_HSn_ERRk (k=000~127)	Bit Array		High speed link parameter "n", k block station operation error mode	Indicates if the error occurs in the communication state of k data block of parameter.
_HSn_SETBLOCKk	Bit Array		High speed link parameter "n", k block setting	Indicates whether or not to set k data block of parameter.

Notes

High Speed Link no.	L area address	Remarks
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 : L area address = L000000 + 500 x (High speed link no. – 1) In case of using high speed line flag for Program and monitoring, you can use the flag map registered in XG5000 conveniently.
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 means block no. and appears 8 words by 16 per 1 word for 128 blocks from 000~127.
For example, mode information (_HS1MOD) appears from block 0 to block 15 for L00010, and block 16~31, 32~47, 48~63, 64~79, 80~95, 96~111, 112~127 information for L00011, L00012, L00013, L00014, L00015, L00016, L00017. Thus, mode information of block no. 55 appears in L000137.

[Table 2] Communication Flag List according to P2P Service Setting

P2P parameter no.(n) : 1~8, P2P block(xx) : 0~63

Keyword	Type	Device	Contents	Description
_P2Pn_NDRxx	Bit	Refer to XG5000 Global /Direct Variables (P2P)	P2P parameter n, xx Block service normal end	Indicates P2P parameter n, xx Block service normal end
_P2Pn_ERRxx	Bit		P2P parameter n, xx Block service abnormal end	Indicates P2P parameter n, xx Block service abnormal end
_P2Pn_STATUSxx	Word		P2P parameter n, xx Block service abnormal end error Code	Indicates error code in case of P2P parameter n, xx Block service abnormal end
_P2Pn_SVCCNTxx	Double word		P2P parameter n, xx Block service normal count	Indicates P2P parameter n, xx Block service normal count
_P2Pn_ERRCNTxx	Double word		P2P parameter n, xx Block service abnormal count	Indicates P2P parameter n, xx Block service abnormal count

Appendix 1.3 Communication Flags(P2P) List

Link Register List according to P2P No. P2P Parameter No. (n) : 1~8, P2P Block(xx) : 0~63

No.	Flags	Type	Contents	Description
N00000	_PnBxxSN	Word	P2P parameter n, xx block another station no	Saves another station no. of P2P parameter 1, 00 block. In case of using another station no. at XG-PD, it is possible to edit during RUN by using P2PSN command.
N00001 ~ N00004	_PnBxxRD1	Device structure	Area device 1 to read P2P parameter n, xx block	Saves area device 1 to read P2P parameter n, xx block.
N00005	_PnBxxRS1	Word	Area size 1 to read P2P parameter n, xx block	Saves area size 1 to read P2P parameter n, xx block.
N00006 ~ N00009	_PnBxxRD2	Device structure	Area device 2 to read P2P parameter n, xx block	Saves area device 2 to read P2P parameter n, xx block.
N00010	_PnBxxRS2	Word	Area size 2 to read P2P parameter n, xx block	Saves area size 2 to read P2P parameter n, xx block.
N00011 ~ N00014	_PnBxxRD3	Device structure	Area device 3 to read P2P parameter n, xx block	Saves area device 3 to read P2P parameter n, xx block.
N00015	_PnBxxRS3	Word	Area size 3 to read P2P parameter n, xx block	Saves area size 3 to read P2P parameter n, xx block.
N00016 ~ N00019	_PnBxxRD4	Device structure	Area device 4 to read P2P parameter n, xx block	Saves area device 4 to read P2P parameter n, xx block.
N00020	_PnBxxRS4	Word	Area size 4 to read P2P parameter n, xx block	Saves area size 4 to read P2P parameter n, xx block.
N00021 ~ N00024	_PnBxxWD1	Device structure	Area device 1 to save P2P parameter n, xx block	Saves area device 1 to save P2P parameter n, xx block.
N00025	_PnBxxWS1	Word	Area size 1 to save P2P parameter n, xx block	Saves area size 1 to save P2P parameter n, xx block.
N00026 ~ N00029	_PnBxxWD2	Device structure	Area device 2 to save P2P parameter n, xx block	Saves area device 2 to save P2P parameter n, xx block.
N00030	_PnBxxWS2	Word	Area size 2 to save P2P parameter n, xx block	Saves area size 2 to save P2P parameter n, xx block.
N00031 ~ N00034	_PnBxxWD3	Device structure	Area device 3 to save P2P parameter n, xx block	Saves area device 3 to save P2P parameter n, xx block.
N00035	_PnBxxWS3	Word	Area size 3 to save P2P parameter n, xx block	Saves area size 3 to save P2P parameter n, xx block.
N00036 ~ N00039	_PnBxxWD4	Device structure	Area device 4 to save P2P parameter n, xx block	Saves area device 4 to save P2P parameter n, xx block.
N00040	_PnBxxWS4	WORD	Area size 4 to save P2P parameter n, xx block	Saves area size 4 to save P2P parameter n, xx block.

Notes

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.

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

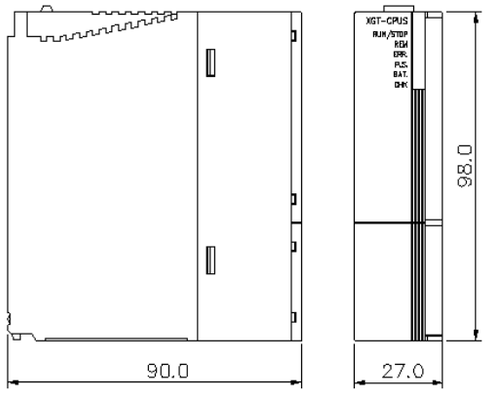
The reserved words are predefined words to use in the system.
Therefore, it is impossible to use them as the identifier.

Reserved Words
ACTION ... END_ACTION
ARRAY ... OF
AT
CASE ... OF ... ELSE ... END_CASE CONFIGURATION ... END_CONFIGURATION
Name of Data Type
DATE#, D# DATE_AND_TIME#, DT#
EXIT
FOR ... TO ... BY ... DO ... END_FOR
FUNCTION ... END_FUNCTION
FUNCTION_BLOCK ... END_FUNCTION_BLOCK
Names of Function Block
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)

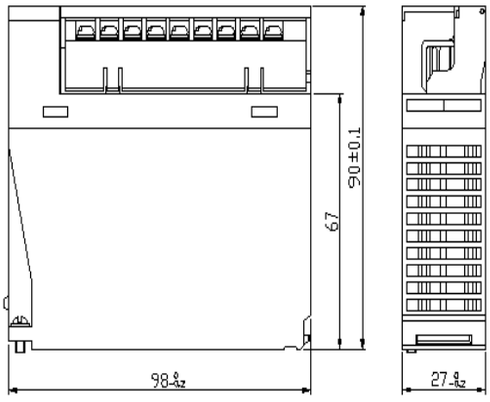
1) CPU module

XGI-CPUU

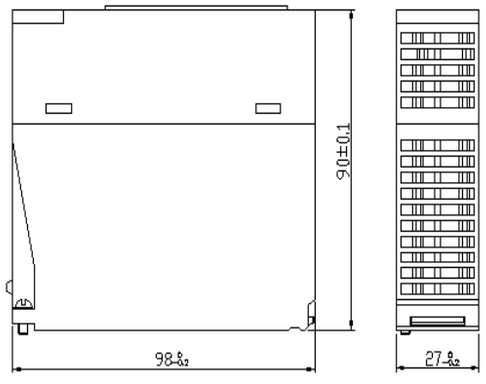


2) I/O module

I/O Module (Terminal Block type)

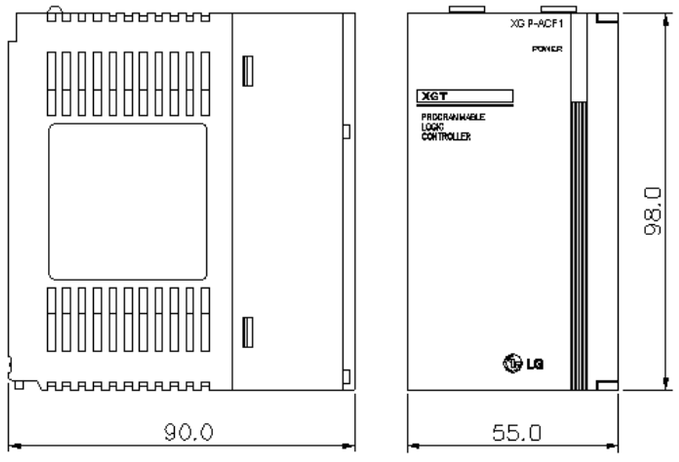


I/O Module (Connector type)



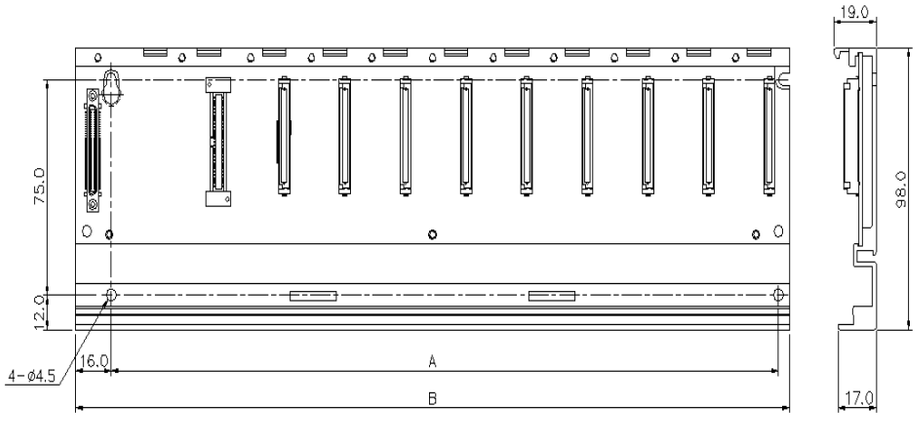
3) Power Module

Power Module

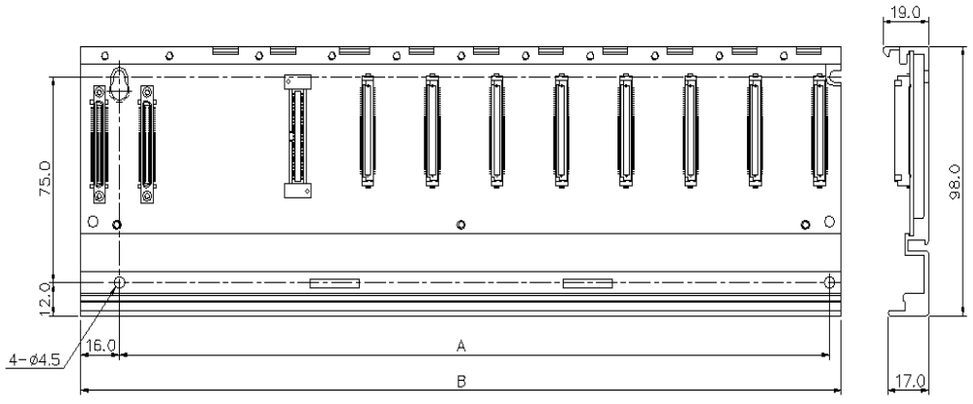


4) Main/Expansion Base

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 18 months from the date of manufacturing.

2. Scope of Warranty

Any trouble or defect occurring for the above-mentioned period will be partially replaced or repaired. However, please note the following cases will be excluded from the scope of warranty.

(1) Any trouble attributable to unreasonable condition, environment or handling otherwise specified in the manual,
(2) Any trouble attributable to others' products,
(3) If the product is modified or repaired in any other place not designated by the company,
(4) Due to unintended purposes
(5) Owing to the reasons unexpected at the level of the contemporary science and technology when delivered.
(6) Not attributable to the company; for instance, natural disasters or fire

3. Since the above warranty is limited to PLC unit only, make sure to use the product considering the safety for system configuration or applications.

Environmental Policy

LS Industrial Systems Co., Ltd supports and observes the environmental policy as below.

Environmental Management

LS Industrial Systems considers the environmental preservation as the preferential management subject and every staff of LS Industrial Systems use the reasonable endeavors for the pleasurably environmental preservation of the earth.

About Disposal

LS Industrial Systems' 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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LS Industrial Systems

10310000832

■ **HEAD OFFICE**
LS tower, Hogye-dong, Dongan-gu, Anyang-si, Gyeonggi-do 1026-6, Korea http://eng.lsis.biz
Tel : (82-2)2034-4870/Fax : 82-2-2034-4648 e-mail : cshwang@lsis.biz

■ **LS Industrial Systems Tokyo Office _ Tokyo, Japan**
Address: 16FL. Higashi-Kan. Akasaka Twin Tower 17-22, Akasaka.Monato-ku Tokyo 107-8470. Japan
Tel : 81-3-3582-9128/Fax : 81-3-3582-2667 e-mail : jschuna@lsis.biz

■ **LS Industrial Systems(ME) FZE _ Dubai, U.A.E.**
Address : Jafza View Tower Lob 19, Room 205 Along Sheikh Zayed Road Jebel Aali Free Zone Dubai, United Arab Emirates
Tel : 971-4-886-5360/Fax : 971-4-886-5361 e-mail : jungyongl@lsis.biz

■ **LS Industrial Systems Shanghai Office _ Shanghai, China**
Address : Room E-G. 12FL Hiamin Empire Plaza. No.726. West. Yan'an Road Shanghai 200050. P.R. China e-mail : liyong@lsis.com.cn
Tel : 86-21-5237-9977(609)/Fax : 89-21-5237-7189

■ **LS Industrial Systems Beijing Office _ Beijing, China**
Address : B-Tower 17FL. Beijing Global Trade Center B/D. No. 36. East BeisanHuan-Road. DongCheng-District. Beijing 100013. P.R. China
Tel : 86-10-5825-6027(666)/Fax : 86-10-5825-6028 e-mail : xunmj@lsis.com.cn

■ **LS Industrial Systems Guangzhou Office _ Guangzhou, China**
Address : Room 1403.14FL. New Poly Tower. 2 Zhongshan Liu Road.Guangzhou.P.R China
Tel : 86-20-8328-6754/Fax : 86-20-8326-6287 e-mail : chenxs@lsis.com.cn

■ **LS Industrial Systems Chengdu Office _ Chengdu, China**
Address : 12FL. Guodong Buiding. No.52 Jindun Road Chengdu.610041. P.R. China
Tel : 86-28-8612-9151(9226)/Fax : 86-28-8612-9236 e-mail : comysb@lsis.biz

■ **LS Industrial Systems Qingdao Office _ Qingdao, China**
Address : YinHe Bldg. 402 Room No. 2P Shandong Road, Qingdao-City,Shandong-province 266071, P.R. China
Tel : 86-532-8501-6068/Fax : 86-532-8501-6057 e-mail : wangzy@lsis.com.cn

■ **LS Industrial Systems Europe B.V. , Netherlands**
Address : 1st. Floor, Tupolevlaan 48, 1119NZ, Schiphol-Rijk, The Netherlands
Tel : +31 (0)20 654 1420/Fax : +31 (0)20 654 1429 e-mail : junshickp@lsis.biz

■ **Wuxi LS Industrial Systems Co., Ltd _ Wuxi, China**
Address : 102-A. National High & New Tech Industrial Development Area. Wuxi. Jiangsu. 214028. P.R. China
Tel : 86-510-8534-6666/Fax : 86-510-8534-4078 e-mail : caidx@lsis.com.cn

■ **Dalian LS Industrial Systems Co., Ltd. _ Dalian, China**
Address : No. 15. Liaohexi 3-Road. Economic and Technical Development zone. Dalian 116600. China
Tel : 86-411-273-7777/Fax : 86-411-8730-7560 e-mail : cuibx@lsis.com.cn

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