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Programmable Logic Controller

Temperature Controller

XGT Series

User's Manual

XGF-TC4UD

Safety Instructions

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

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Before using the product …

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

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

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

⚠ **Warning**	This symbol indicates the possibility of serious injury or death if some applicable instruction is violated
⚠ **Caution**	This symbol indicates the possibility of severe or slight injury, and property damages if some applicable instruction is violated

Moreover, even classified events under its caution category may develop into serious accidents relying on situations. Therefore we strongly advise users to observe all precautions properly just like warnings.

- 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 for design process

⚠ Warning

- **Please install a protection circuit on the exterior of PLC so that the whole system may operate safely regardless of failures from external power or PLC.** Any abnormal output or operation from PLC may cause serious problems to safety in whole system.
  - Install protection units on the exterior of PLC like an interlock circuit that deals with opposite operations such as emergency stop, protection circuit, and forward/reverse rotation or install an interlock circuit that deals with high/low limit under its position controls.
  - If any system error (watch-dog timer error, module installation error, etc.) is detected during CPU operation in PLC, all output signals are designed to be turned off and stopped for safety. However, there are cases when output signals remain active due to device failures in Relay and TR which can't be detected. Thus, you are recommended to install an addition circuit to monitor the output status for those critical outputs which may cause significant problems.
- **Never overload more than rated current of output module nor allow to have a short circuit**. Over current for a long period time maycause a fire .
- **Never let the external power of the output circuit to be on earlier than PLC power**, which may cause accidents from abnormal output oroperation.
- **Please install interlock circuits in the sequence program for safe operations in the system when exchange data with PLC or modify operation modes using a computer or other external equipments** Read specific instructions thoroughly when conducting control operations with PLC.

Safety Instructions for design process

⚠ Caution

- **I/O signal or communication line shall be wired at least 100mm away from a high-voltage cable or power line.** Fail to follow this

Safety Instructions on installation process

⚠ 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 may be caused.
- **Before install or remove the module, be sure PLC power is off.** If not, electric shock or damage on the product may be caused.
- **Be sure that every module is securely attached after adding a module or an extension connector.** If the product is installed loosely or incorrectly, abnormal operation, error or dropping may be caused. In addition, contact failures under poor cable installation will be causing malfunctions as well.
- **Be sure that screws get tighten securely under vibrating environments.** Fail to do so will put the product under direct vibrations which will cause electric shock, fire and abnormal operation.
- **Do not come in contact with conducting parts in each module**, which may cause electric shock, malfunctions or abnormal operation.

Safety Instructions for wiring process

⚠ Warning

- **Prior to wiring works, make sure that every power is turned off.** If not, electric shock or damage on the product may be caused.
- **After wiring process is done, make sure that terminal covers are installed properly before its use.** Fail to install the cover may cause electric shocks.

⚠ Caution

- **Check rated voltages and terminal arrangements in each product prior to its wiring process.** Applying incorrect voltages other than rated voltages and misarrangement among terminals may cause fire or malfunctions.
- **Secure terminal screws tightly applying with specified torque.** If the screws get loose, short circuit, fire or abnormal operation may be caused. Securing screws too tightly will cause damages to the module or malfunctions, short circuit, and dropping.
- **Be sure to earth to the ground using Class 3 wires for FG terminals which is exclusively used for PLC**. If the terminals not grounded correctly, abnormal operation or electric shock 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.
- **Make sure that pressed terminals get tighten following the specified torque. External connector type shall be pressed or soldered using proper equipments.**

Safety Instructions for test-operation and maintenance

⚠ 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

- **Do not make modifications or disassemble each 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 equipment such as walkie-talkie or cell phones at least 30cm away from PLC**. If not, abnormal operation may be caused.
- **When making a modification on programs or using run to modify functions under PLC operations, read and comprehend all contents in the manual fully.** Mismanagement will cause damages to products and accidents.
- **Avoid any physical impact to the battery and prevent it from dropping as well.** Damages to battery may cause leakage from its fluid. When battery was dropped or exposed under strong impact, never reuse the battery again. Moreover skilled workers are needed when exchanging batteries.

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	Contents	Revised position
V 1.0	’10.4	First edition	-

※ The number of User’s manual is indicated right part of the back cover.

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Thank you for 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://eng.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,XEC CPU.
XGK CPU User's Manual (XGK-CPUA/CPUE/CPUH/CPUS/CPUU)	XGK-CPUA/CPUE/CPUH/CPUS/CPUU 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)	XGI-CPUU/CPUH/CPUS 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	XGR- CPUH/F, CPUH/T user manual describing about XGR CPU module, power module, extension drive, base, IO module, specification of extension cable and system configuration, EMC standard

Current XGF-TC4UD manual is written based on the following version.

Related OS version list

Product name	OS version
XGK-CPUH, CPUS, CPUA, CPUE, CPUU	V2.1
XGI-CPUU, CPUH, CPUS	V2.2
XGR-CPUH/F, CPUH/T	V1.3
XG5000(XG-PD)	V2.41

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Appendix ..... Appendix 1

Chapter 1 Introduction

This User Manual describes the specifications, handling and programming method of the XGF-TC4UD Temperature Controller Module (hereinafter, “TCM”) which is used in combination with the CPU modules of XGT PLC series.
The TCM converts the analog signals (temperature, voltage, current, etc.) from the external devices of PLC to i6 bit binary digital signals with signs. The module also provides transistor output or current output for temperature control through PID operation.

1.1 Features

(1) Optimized temperature control function

Temperature control function can be implemented using the built-in input/output function by setting up the PID parameters only.

(2) Universal inputs

Thermocouple, resistor temperature detector (RTD), voltage, or current inputs can be processed.

(3) Isolation between input loops

High reliability signal process can be accomplished without interference between loops.

(4) Two-types of control outputs

Current output and transistor output can be selected for control output.

(5) Operation parameter setting/monitoring using exclusive software package

Easy to use by using exclusive software package supporting enhanced user interface, which replaced previous method setting operation parameter by instruction. If you use exclusive software package, you can reduce the sequence program. And you can monitor temperature controller module easily by using [Data monitor] and [Trend monitor].

(6) Diverse control type

3 types of control type are supported and each type is as follows.
PID control: general control method using Proportional, Integral, Derivative item.
CASCADE control: control method used at 2-input 1-output
On/Off control: control method turning on/off MV based on SV

(7) Function detecting disconnection

When using temperature input range and analog input signal range 0~10mV, 0~100mV, 0~1V, you can detect disconnection of circuit.

(8) Diverse input operation functions

Supports bias, filter, extraction of a square root functions

(9) Auto-tuning function

Calculation of PID coefficient by auto-tuning is available.

1.2 Terms

1.2.1 PID control (Proportional Integral Derivative Control)

This is one of the feed-back controls keeping output in reference voltage and combination of Proportional control, Proportional-Integral control and Proportional-Derivative control. P control multiplies deviation between reference signal and current signal by P coefficient and makes the control signal. I control executes integral for deviation and adds the result to P control in parallel. D control executes derivative for deviation and adds the results to P control in parallel. It is used to measure reaction of automation system or control reaction. And it is usually used to control temperature, pressure, flow, speed of rotation and can improve the problem of PI or PD control such as transient.

1.2.2 Proportional Control

As one of the control methods, the bigger gap between target value and current value, the bigger manipulated value to return to target value. It is smoother than On/Off control.

1.2.3 On/Off Control

As one of the control methods, it reiterates turning manipulated value on/off and is called Bang Bang control. It has hysteresis characteristic so error within hysteresis range occurs.

1.2.4 Integral Action

Makes the manipulated value proportional to integral value of action signal and called I action. If you use this action, you can eliminate the remaining deviation.

1.2.5 Derivative Action

Makes the manipulated value proportional to derivative value of action signal and called D action. When action signal is getting bigger, it is used to modify action signal properly and make the control stable.

1.2.6 Cascade Control

A series of control steps are connected continuously so one control unit is controlled by other front control unit and controls other back control unit.

1.2.7 Feedback Control

It compares current value with target value and makes the current be target value by using output signal as input signal. Control that removes external disturbance is called constant value control and control whose target value changes rapidly is called variable value control. Both controls make the deviation 0. Process control, automatic control, servo device are classified as Feedback control

1.2.8 XG-TCON

Exclusive software tool to set and monitor input/control/output parameter of temperature controller

Chapter 2 Specifications

2.1 General Specifications

Table 2.1 shows the general specifications of the XGT series.

[Table 2.1] General specifications

No.	Items	Specifications				Related standards
1	Ambient temperature	0 ~ 55 ℃				
2	Storage temperature	–25 ~ +70 ℃				
3	Ambient humidity	5 ~ 95%RH (Non-condensing)				
4	Storage humidity	5 ~ 95%RH (Non-condensing)				
5	Vibration resistance	Occasional vibration			-	
		Frequency	Acceleration	Amplitude	How many times	IEC61131-2
		10 ≤ f < 57Hz	–	0.075mm	10 times each directions (X, Y and Z)	
		57 ≤ f ≤ 150Hz	9.8m/s^2(1G)	–		
		Continuous vibration				
		Frequency	Acceleration	Amplitude		
		10 ≤ f < 57Hz	–	0.035mm		
		57 ≤ f ≤ 150Hz	4.9m/s^2(0.5G)	–		
6	Shock resistance	• Peak acceleration: 147 m/s^2(15G) • Duration: 11ms • Half-sine, 3 times each direction per each axis				IEC61131-2
7	Noise resistance	Square wave Impulse noise	±1,500 V			LSIS standard
		Electrostatic discharge	4kV			IEC61131-2 IEC61000-4-2
		Radiated electromagnetic field noise	80 ~ 1,000 MHz, 10V/m			IEC61131-2, IEC61000-4-3
		Fast transient/bust noise	Segment	Power supply module	Digital/analog input/output communication interface	IEC61131-2 IEC61000-4-4
			Voltage	2kV	1kV	
8	Environment	Free from corrosive gasses and excessive dust				
9	Altitude	Up to 2,000 ms				
10	Pollution degree	Less than equal to 2				
11	Cooling	Air-cooling				

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.

2.2 Performance Specifications

Table 2.2 shows the performance specifications of the thermo-controller module.

Items	Specifications		
Control loop	4loop		
Input Type and Input Scope	thermocouple	K	-200 ~ 1300℃
			0 ~ 500℃
		J	-200 ~ 1200℃
			0 ~ 500℃
		E	-200 ~ 1000℃
		T	-200 ~ 400℃
		B	400 ~ 1800℃
		R	0 ~ 1700℃
		S	0 ~ 1700℃
		N	-200 ~ 1300℃
		C(W5Re/W26Re)	0 ~ 2300℃
		PL II	0 ~ 1300℃
		L	-200 ~ 900℃
		U	-200 ~ 600℃
	RTD	Pt100	-200 ~ 850℃
		JPt100	-200 ~ 600℃
		Pt1000	-200 ~ 800℃
	Voltage	DC mV	0 ~ 10 mV
			0 ~ 100 mV
		DC V	0 ~ 1 V
			1 ~ 5 V
			0 ~ 5 V
			0 ~ 10 V
			-5V ~ 5V
			10V ~ 10V
	Current	DC mA	4 ~ 20 mA
			0 ~ 20 mA
Input precision	See "Precision Details by Input Type [1)]" (12 types of thermocouple, 3 type of RTD, 8 voltage types, 2 current types)		
Reference junction compensation (thermocouple input)	Compensation method		Automatic compensation by RJC sensor
	Compensation error		±2.0℃
Digital output	Temperature display		0.1℃ / 1℃(chosen by setting)
	Linear display		0 ~ 1000(Decimal point movable)
	Scale display (to be set by the user)		Exclusively for voltage/current input Display range: -30000 ~ 30000, Setting range: 0 ~ 30000
Control cycle	0.2 sec/module		
Control method	PID CONTROL, ON/OFF CONTROL		
Control parameter	Target value(SV)		Setting within range according to input type (temperature unit setting)
	Proportional gain		0: ON/OFF CONTROL, REAL
	Integral time		0: Except integral control, REAL
	Derivative time		0: Except derivative control, REAL

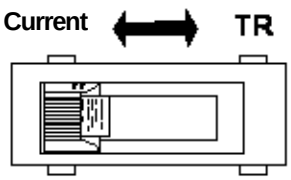
Items	Specifications				
Output	Output point		8		
	Transistor output	Rated load voltage	DC 24 V		
		Max. load current	0.1 A / Output junction		
		MAX. VOLTAGE FALL DURING ON	Below DC 0.3 V		
		CURRENT LOST DURING OFF	Below 0.1 mA		
		Response time	On ⇒ Off	Below 1 ms	
			Off ⇒ On	Below 1 ms	
		Control output cycle	0.5 ~ 120.0 sec.(Setting resolving power: 0.5 sec.)		
		Time proportional resolving power	Larger one of either 10 ms or 0.05% of the full-scale		
	Analog output	Output range	4 ~ 20 mA		
		Load resistance	Below 600Ω		
		Precision	±1.0%, room temperature (25℃)		
		Resolving power	8 ㎂		
Insulation			**Insulation method**	**Insulation pressure**	**Insulation resistance**
	Inter-channel		Trans	500 V AC, 50/60 Hz 1 min., leakage under 10 mA	500 V DC, over 10 MΩ
	Input terminal - PLC		Photo coupler		
	Between current output channels		Non-insulation		
	External power supply –output terminal				
Warm-up time	More than 20 minutes				
Access terminal	18 point terminal				
IO occupation point	Fixed: 64 points, movable: 16 points				
Power supply	5 V, DC 24 V				
Current consumed	DC 5 V : 900 mA DC 24 V : 300 mA				

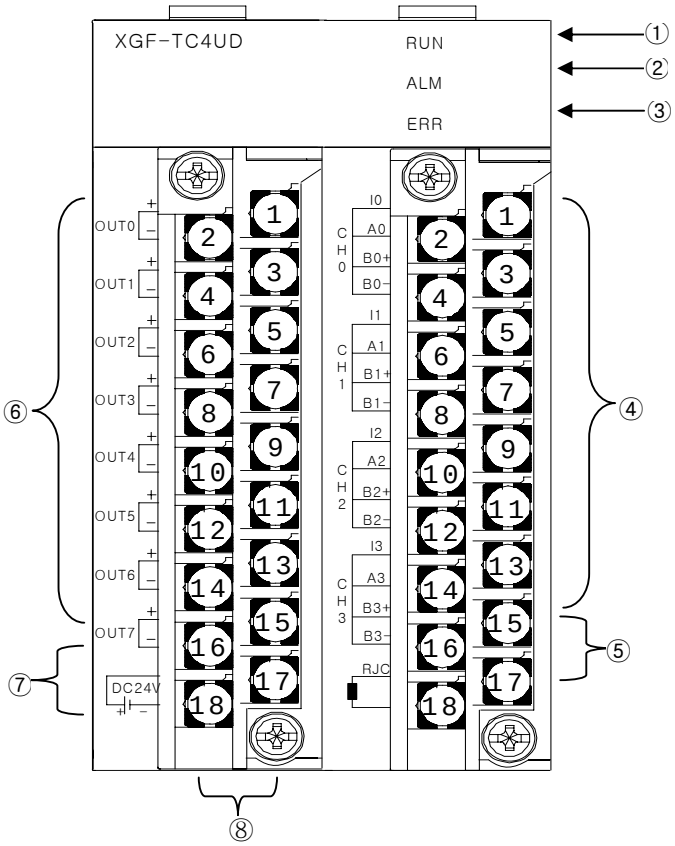
[Table 2.2] Performance specifications

Note

1) When you use the XGR system
- XGR system can be used in an extension base but not in a basic base.

2.3 Names and Functions of Major Components

No.	Description
①	RUN LED ▶ H/W functioning of module • On: Module H/W is normal • Off: DC5V disconnect or abnormal module H/W
②	ALM LED ▶ Module alarm • Off: Alarm off • On: Alarm on
③	ERR LED ▶ Module error • Off: normal • On: malfunction module H/W • Flashing: parameter setting error, temperature input sensor disconnect, malfunction of RJC sensor, channel H/W failure
④	Input terminal stand ▶ Input stand for connection with external device
⑤	Reference access point compensator ▶ The stand for the sensor to compensate the surrounding temperature when using the thermocouple input
⑥	Output stand ▶ the stand for current/transistor output for connection to an external device
⑦	External power supply terminal ▶ external DC24V supply terminal for current/transistor output
⑧	Output switch ▶ the switch for choosing transistor output ⑥ set after the output stand is removed 



2.4 Characteristics of Input and Output Conversion

2.4.1 Characteristics of Input Conversion

(1) Input Characteristics of the thermocouple

This directly connects 12 types of thermocouple sensor and the characteristics are as follows.

thermocouple type	Applying standard	Temperature range		electromotive force range (μV)
		℃	°F	
K	JIS C1602-1995	-200.0 ~ 1300.0	-328.0 ~ 2372.0	-5891 ~ 52410
		0.0 ~ 500.0	32.0 ~ 932.0	0 ~ 20644
J		-200.0 ~ 1200.0	-328.0 ~ 2192.0	-7890 ~ 69533
		0.0 ~ 500.0	32.0 ~ 932.0	0 ~ 27393
T		-200.0 ~ 400.0	-328.0 ~ 752.0	-5603 ~ 20872
B		400 ~ 1800	752 ~ 3272	787 ~ 13591
S		0 ~ 1700	32 ~ 3092	0 ~ 17947
R		0 ~ 1700	32 ~ 3092	0 ~ 20222
N		-200.0 ~ 1300.0	-328.0 ~ 2372.0	-3990 ~ 47513
E		-200.0 ~ 1000.0	-328.0 ~ 1832.0	-8825 ~ 76373
U	DIN 43710	-200.0 ~ 600.0	-328.0 ~ 1112.0	-5700 ~ 34310
L		-200.0 ~ 900.0	-328.0 ~ 1652.0	-8150 ~ 53140
C(W5Re/W26Re)	ASTM	0 ~ 2300	32 ~ 4172	0 ~ 36923
PL II		0.0 ~ 1300.0	32.0 ~ 2372.0	0 ~ 52258

(2) RTD input characteristics

It directly connects 3 types of RTD sensors and the input characteristics are as follows.

RTD type	Applying standard	Temperature range		Resistance range
		℃	°F	
Pt100	JIS C1604-1997	-200.0 ~ 850.0	-328.0 ~ 1562.0	18.52 ~ 390.48
JPt100	JIS C1604-1989	-200.0 ~ 600.0	-328.0 ~ 1112.0	17.14 ~ 317.28
Pt1000	DIN 60751	-200.0 ~ 850.0	-328.0 ~ 1562.0	185201 ~ 3904811

(3) Input characteristics of voltage/current

Analog signals are processed for 2 types of current input ranges and 8 types of voltage input ranges. The characteristics are as follows.

Input type	Input range	Scale range	Reference precision	Resolving power
DC mV input	0.00 ~ 10.00 mV	-30000 ~ 30000, IN_SMAX – IN_SMIN ≤ 30000	±0.1% ±1 digit (IN_SMAX – IN_SMIN = 1000)	1 / 16000
	0.00 ~ 100.0 mV			
DC V input	0.000 ~ 1.000 V			
	1.000 ~ 5.000 V			
	0.000 ~ 5.000 V			
	0.00 ~ 10.00 V			
	-5.000 ~ 5.000 V			
	-10.00 ~ 10.00 V			
DC mA input	4.00 ~ 20.00 mA			
	0.00 ~ 20.00 mA			

※ IN_SMAX: scale upper limit, IN_SMIN: scale lower limit (set in XG-TCON parameter)

2.4.2 Precision by Input Type

The precision by input type is as follows.

Input type	Input type	Display range	Range [℃]	Precision		Resolving power
				Room temperature (25℃)	55℃ (±100 ppm/℃)	
Thermo-couple	K	-200 ~ 1300	-200 ~ 0	±1.0	5.5	0.2℃
			0 ~ 1300	±0.5	5.0	0.1℃
		0 ~ 500	0 ~ 500	±0.5	2.0	0.1℃
	J	-200 ~ 1200	-200 ~ -100	±1.0	5.2	0.2℃
			-100 ~ 1200	±0.5	4.7	0.1℃
		0 ~ 500	0 ~ 500	±0.5	2.0	0.1℃
	E	-200 ~ 1000	-200 ~ -100	±1.0	4.6	0.2℃
			-100 ~ 1000	±0.5	4.1	0.1℃
	T	-200 ~ 400	-200 ~ -100	±1.0	2.8	0.1℃
			-100 ~ 400	±0.5	2.3	0.1℃
	B	400 ~ 1800	400 ~ 900	±2.5	7.9	1℃
			900 ~ 1800	±1.0	6.4	
	R	0 ~ 1700	0 ~ 200	±1.5	6.6	1℃
			200 ~ 1700	±1.0	6.1	
	S	0 ~ 1700	0 ~ 200	±1.5	6.6	1℃
			200 ~ 1700	±1.0	6.1	
	N	-200 ~ 1300	-200 ~ 0	±1.3	5.8	0.3℃
			0 ~ 1300	±0.6	5.1	0.1℃
	C(W)	0 ~ 2300	0 ~ 2300	±1.0	7.9	1℃
	PL II	0 ~ 1300	0 ~ 1300	±0.6	4.5	0.1℃
	U	-200 ~ 600	-200 ~ 600	±0.6	3.0	0.1℃
	L	-200 ~ 900	-200 ~ 900	±0.6	3.9	0.1℃
RTD	Pt100	-200 ~ 850	-200 ~ 850	±0.6	3.0	0.1℃
	JPt100	-200 ~ 600	-200 ~ 600	±0.6	2.4	0.1℃
	Pt1000	-200 ~ 850	-200 ~ 850	±0.6	3.0	0.1℃
Voltage	DC mV	0 ~ 10		±0.1%±1digit (input scale = 1000)	±0.3%	1 / 16000
		0 ~ 100				
	DC V	0 ~ 1V				
		1 ~ 5V				
		0 ~ 5V				
		0 ~ 10V				
		-5V ~ 5V				
		-10V ~ 10V				
Current	DC mA	4 ~ 20				
		0~ 20				

Precision in case of 55℃

<How to calculate>

Precision at room temperature + (55℃ - 25℃) × 100ppm × whole temperature range

(e.g.) K type 55℃ Precision

±[1.0 + (55℃ - 25℃) × 100ppm × 1500] = ±5.5℃

2.4.3 Characteristics of output part conversion

(1) Current output characteristics

The analog current output characteristics are as follows.

Item		Specifications
Analog output	Output point	8
	Output range	4 ~ 20 mA
	Load resistance	Below 600Ω
	Precision	±1.0%
	Resolution	8 ㎂

(2) Transistor output characteristics

Transistor output characteristics are as follows.

Item		Specifications	
Transistor output	Output point	8	
	Rated load voltage	DC 24 V	
	Max. load current	0.1 A / output access point	
	Max. voltage fall during ON	Below DC 0.3 V	
	Current lost during OFF	Below 0.1 mA	
	Response time	On -> Off	Below 1 ms
		Off -> On	Below ms
	Control output cycle	0.5 ~ 120.0 sec (set resolving power: 0.5 sec)	
	Time proportional resolving power	Larger one of 10 ms or full-scale	

2.5 Main Functions

Items	Functions		Description
Functions of input part	Input type	Choose input type	The sensor type and measurement range can be chosen.
		Handles disconnect	The set input value applies in case of input disconnect.
		External input	U device value is applied as the input.
		Scale	The input is scaled.
		Place of decimal point	The decimal point is set on the scale.
		Upper and lower limit of effective limit	The user defines the effective range of the input.
	Input alarm	Input alarm	The further upper limit, upper limit, lower limit and further lower limit are defined for alarm.
	Input processing	Square root processing	The square root of the input is taken.
		lowcut	The lowcut applies to the input.
		input bias	Bias applies to the input.
		Filter	The primary filter is used.
		Average filter	The moving average applies.
Functions of control part	Auto-tuning	AT SV	Ordinary SV and AT SV are dualized.
		AT Hysteresis	Auto-tuning considering the sensor vibration.
	Target setting	SV upper/lower limit	Caps the SV upper and lower limits.
		PV tracking	Set to go along PV to prevent sudden change of SV
	Control setting	Manual operation	Output can be given manually.
		Cascade	Cascade operation is available by linking two loops.
		On/Off control	Of/Off control is possible.
		Direct/reverse action	Direct/reverse action can be converted.
		AW	Anti-windup applies.
		Dead band	Stabilized near the target by applying DB.
		BMPL	Smooth control is available when getting out of the manual mode.
		Choose proportional source	Choose the source to perform the proportional operation between PV/EV.
		Choose differential source	Choose the source to perform differential operation between PV/EV.
	Control factor	Set control factor	Control factors can be changed as a whole set.
		Control BIAS	Bias to MV after control
Functions of output part	Basic setting	Heating/cooling	Heating/cooling/heating and cooling can be set.
		Cooling proportion setting	Proportion of heating and cooling results is set.
	Output setting Heating/ Cooling Setting	PWM output	PWM output is supported and the cycle can be set.
		Output upper/lower limit	The output value can be capped as the upper and lower limit.
		Output change limit	Limited when the output gets out of a certain range.
		Output reference	Bias after setting the reference value to the output.
		Failure output	Output can be set in case of failure.
		Forced output	Pre-set output can be done regardless of the operation result.
Alarm function	Input alarm		Alarm is set off when the upper or lower limit of the input is reached.
	Heating output alarm		Alarm is set off when the upper or lower limit of the heating output is reached.

Items	Functions	Description
	Cooling output alarm	Alarm is set off when the upper or lower limit of the cooling output is reached.
Setting maintenance	Setting maintenance	Maintains control parameters

Chapter 3 Installation and Wring

3.1 Installation

3.1.1 Conditions for Installation

Although this module has high reliability regardless of the surrounding conditions, pay attention to the following conditions to secure the reliability and stability of the system.

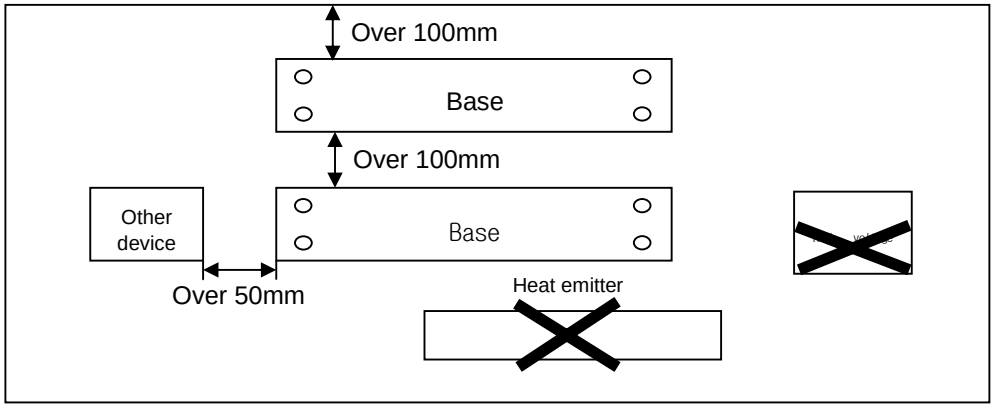
(1) Environment
- Install on a water-proof and vibration-proof control panel.
- Where there is no persistent shock or vibration
- Where there is no direct sun
- Where there is no condensation due to sudden change in the temperature
- Where the temperature is kept at 0-55℃

(2) Installation work
- Be careful so that foreign substances do not enter the PLC when you drill screw holes or do the wiring work.
- Put the module where you can easily manipulate.
- Do not install the module in the same panel as a high voltage device.
- Place the module at lest 50mm away from a duct and other nearby modules.
- Connect the module to earth where there is not much noise.

3.1.2 Cautions in Handling the Module

The following is what you need to pay attention to from when you open the module to when you install it.

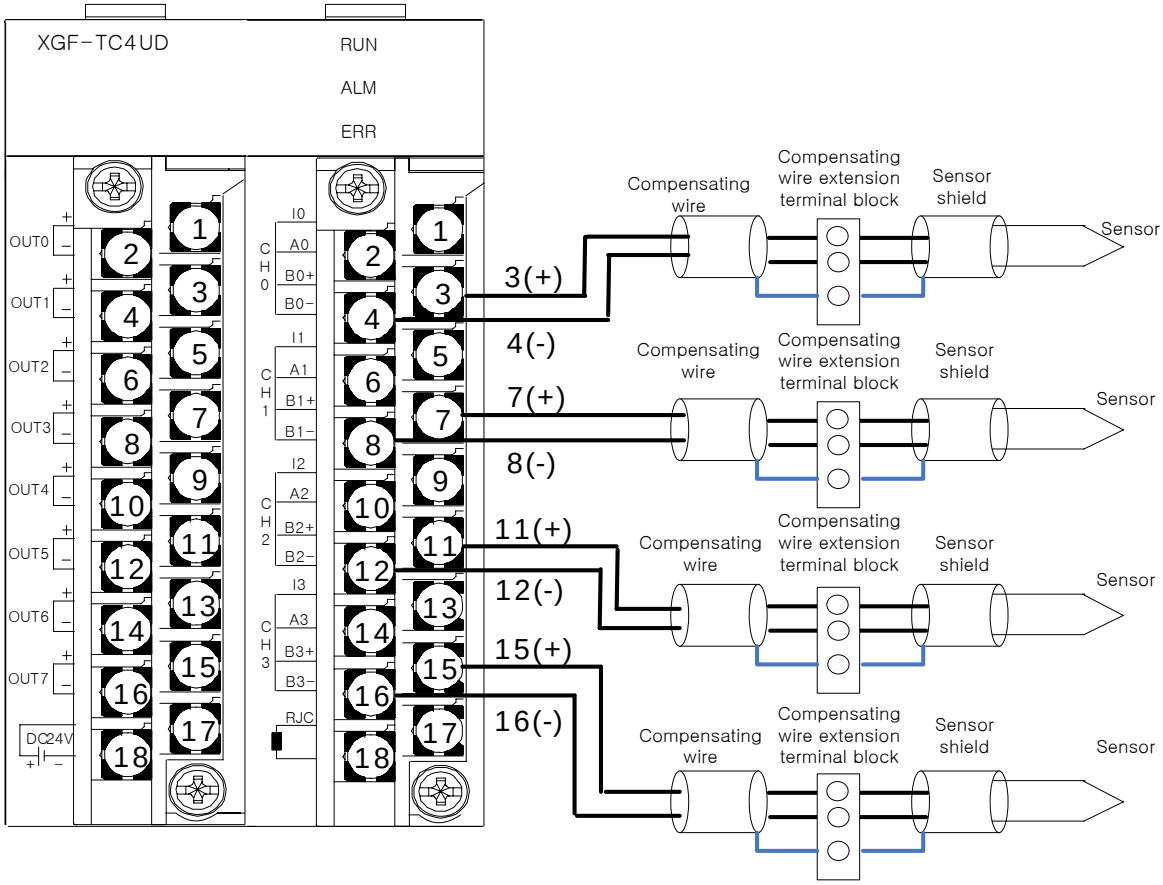
(1) Do not drop it or give a strong shock.
(2) Do not detach the PCB from the case, which might cause a failure.
(3) Be careful so that foreign substances do not enter the PLC when you drill screw holes or do the wiring work. If there is any inside, remove them.
(4) Do not mount or dismount the module while the power is on.
(5) Install the module more than 100mm away when you place the module in front of the PLC to avoid the radiating noise or heat (inside the door). Any device should be placed more than 50mm away from either side of the base.



3.2 Wring

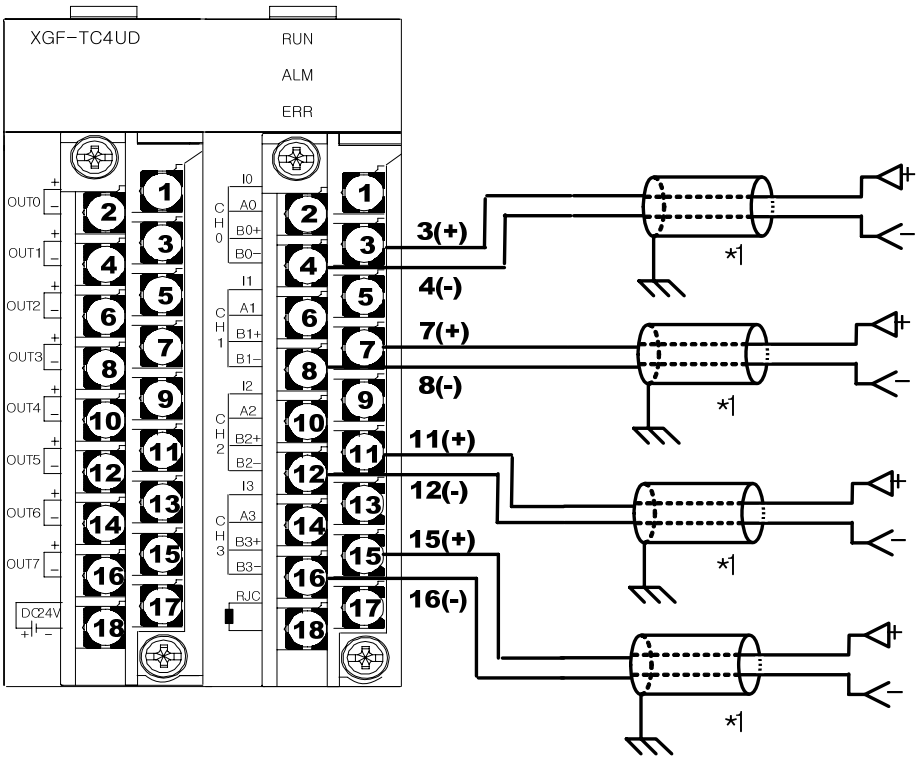
3.2.1 Wring of the Input Part

(1) Thermocouple



- Shield access to the PLC FG is possible when the sensor and the compensating wire are shielded.
- For the compensating wire, use the same type as the sensor used for the measuring.
- Use a material with even temperature Wring as the terminal block for extending the compensating wire to reduce errors.

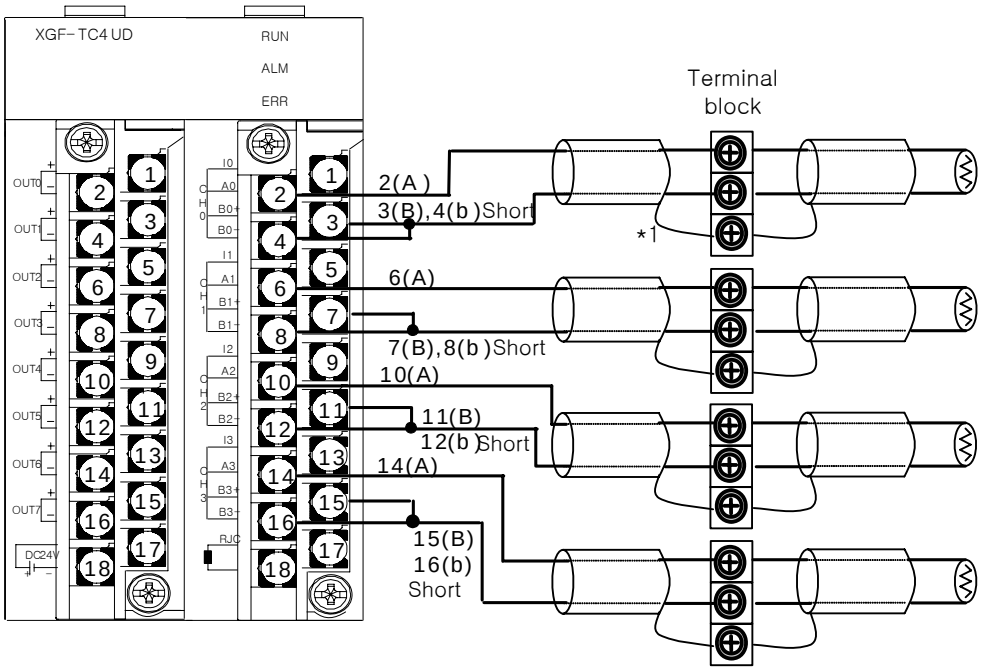
(2) Voltage Input Wiring



*1 Use a two core twisted shield wire. AWG 22 is recommended.

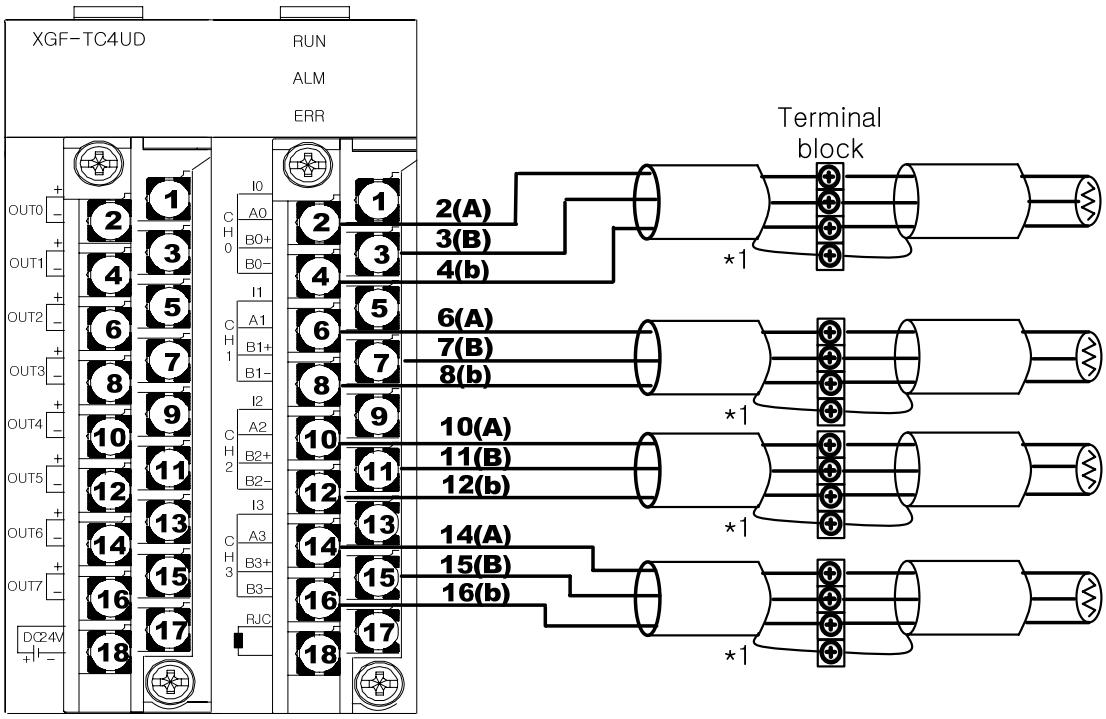
(3) Resistance Temperature Detector Input Wiring

(a) Two Core Wiring



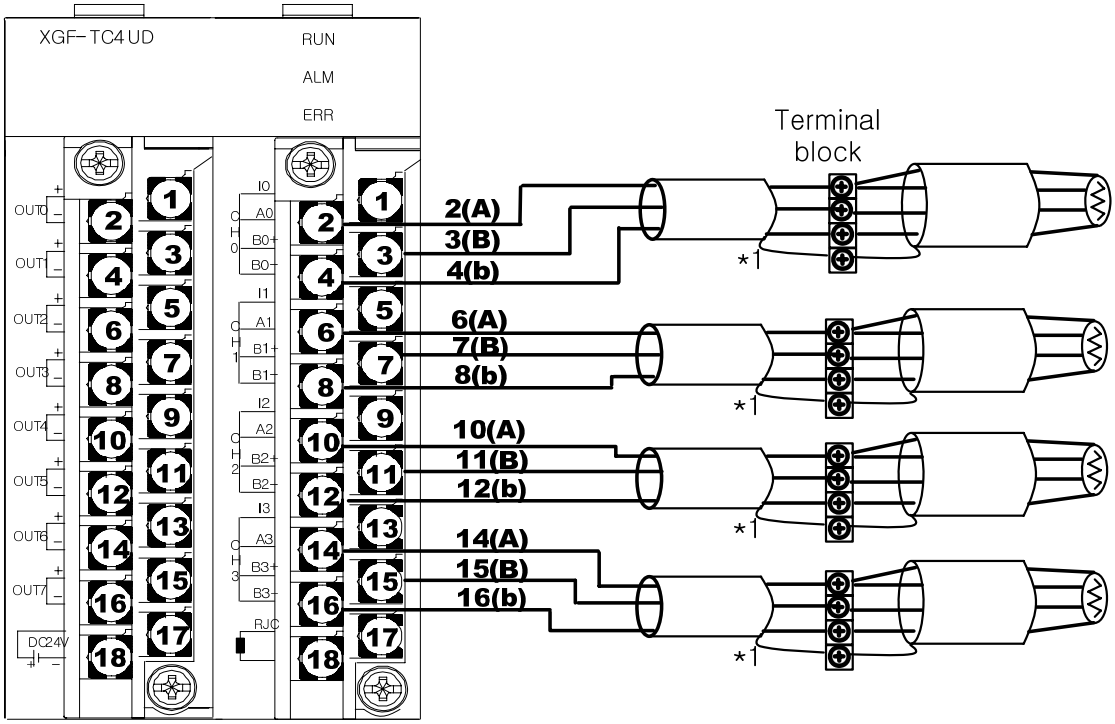
*1 Shield access to the PLC FG is possible when the sensor and the compensating wire are shielded.

(b) Three Core Wiring



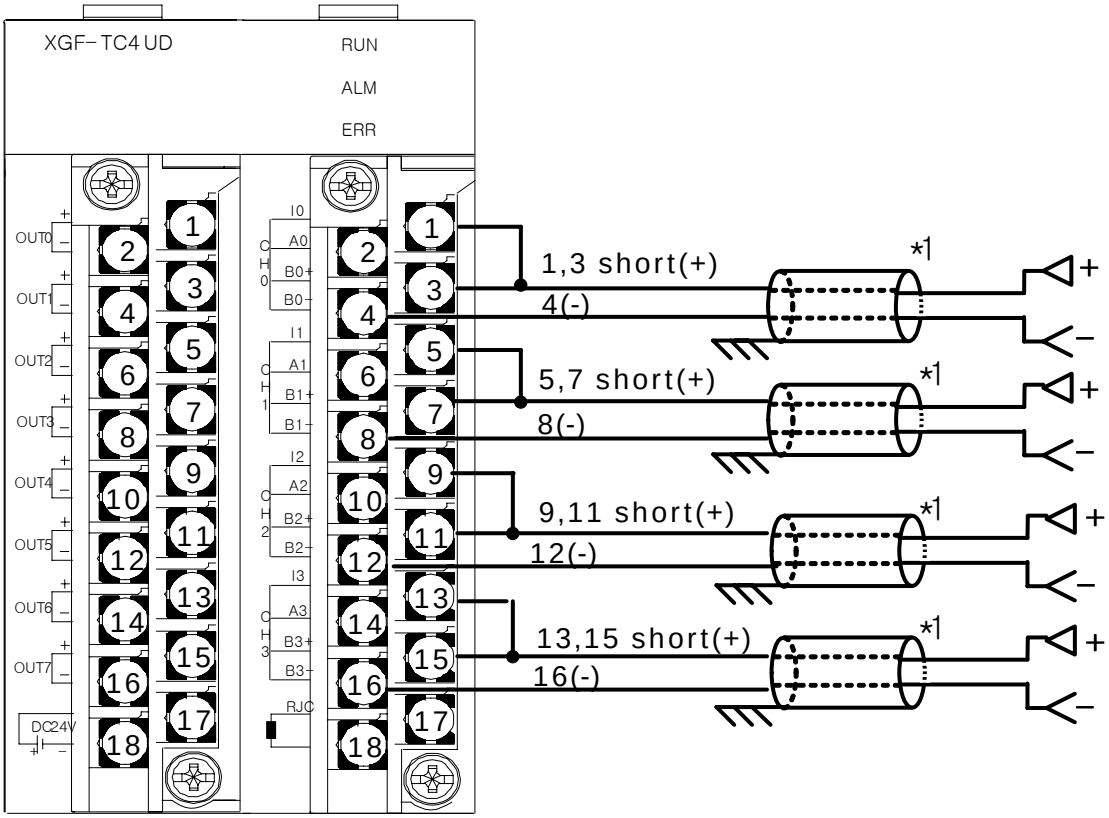
*1 Shield access to the PLC FG is possible when the sensor and the compensating wire are shielded.

(d) Four Core Wiring



*1 Shield access to the PLC FG is possible when the sensor and the compensating wire are shielded.

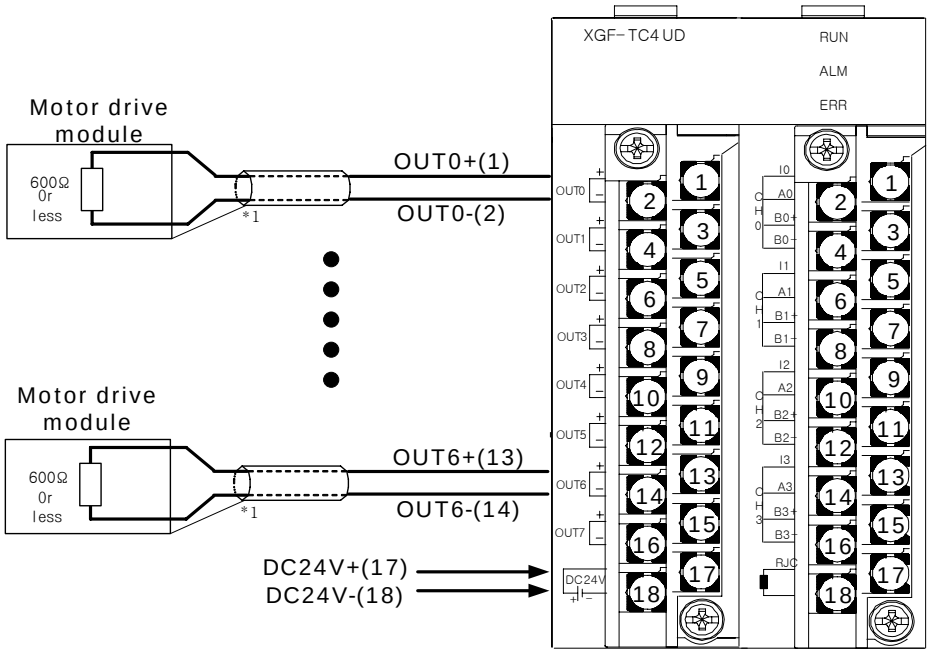
(4) Current Input Wiring



*1 Use a two core twisted shield wire. AWG 22 is recommended.

3.2.2 Wiring of the Output Part

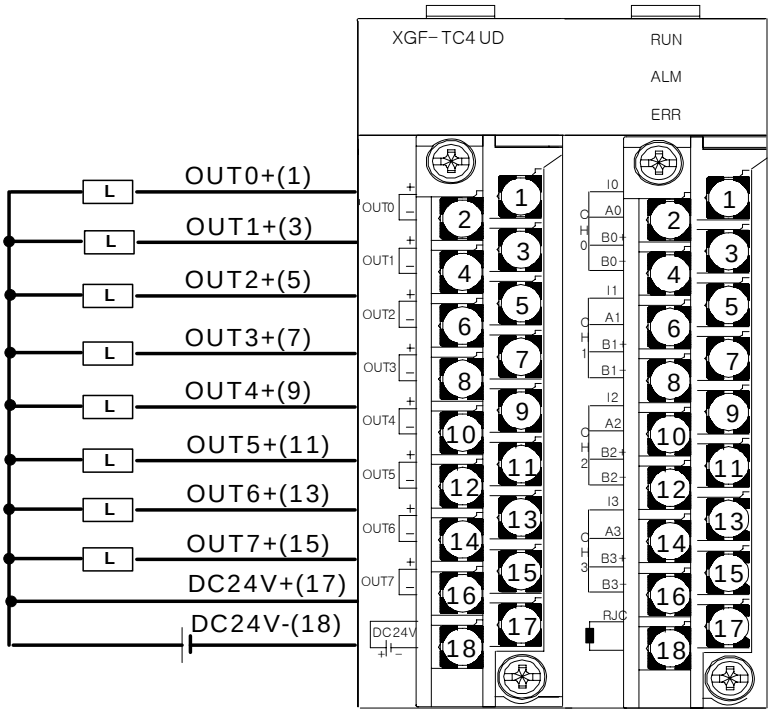
(1) Analog Output Wiring



*1 Use a two core twisted shield wire. AWG 22 is recommended.

– It is recommended you use the noise filter for the module when you use an external power supply.

(2) Transistor Output



– It is recommended you use the noise filter for the module when you use an external power supply.

Chapter 4 Configuration and Functions of Internal Memory (XGK)

4.1 U Device Area

4.1.1 U Device Area

Table 4.1 shows the U device area of the thermo-controller.

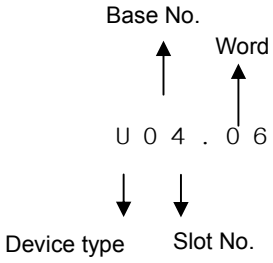
Device		Symbol	Description
Word	Bit		
U00.00	U00.00.0	_00_CH0_ACT	channel0 operating
	U00.00.1	_00_CH1_ACT	channel1 operating
	U00.00.2	_00_CH2_ACT	channel2 operating
	U00.00.3	_00_CH3_ACT	channel3 operating
	These are read-only areas and display the operating information of each channel. When the corresponding bit is On, it means the corresponding channel is operating.		
	U00.00.4	_00_CH0_BOUT	channel0 disconnect
	U00.00.5	_00_CH1_BOUT	channel1 disconnect
	U00.00.6	_00_CH2_BOUT	channel2 disconnect
	U00.00.7	_00_CH3_BOUT	channel3 disconnect
	These are read-only areas and display the disconnect of each channel. When the corresponding bit is On, it means the sensor of the corresponding channel is disconnected.		
	U00.00.8	_00_CH0_ADCERR	channel0 A/D CONVERSION error
	U00.00.9	_00_CH1_ADCERR	channel1 A/D CONVERSION error
	U00.00.A	_00_CH2_ADCERR	channel2 A/D CONVERSION error
	U00.00.B	_00_CH3_ADCERR	channel3 A/D CONVERSION error
	These are read-only areas and display the input part error of each channel. When the corresponding bit is On, it means there is an error at the input part of the channel.		
	U00.00.D	_00_CHECKSUMERR	module backup memory error
	These are read-only areas and display the backup memory error of the module. When the corresponding bit is On, it means there is an error during the backup of the module.		
	U00.00.E	_00_ERR	module error
	These are read-only areas and display the action error of the module. When the corresponding bit is On, it means there is an error about the action of the module.		
	U00.00.F	_00_RDY	module Ready
	These are read-only areas and display the action error of the module. When the corresponding bit is On, the module is on normal standby.		
U00.01	U00.01.0	_00_WR_ING	saving parameter (writing)
	These are read-only areas and display the backup action of the module. When the corresponding bit is On, the module data is being saved		
	U00.01.8	_00_RD_ING	Restoring parameter (reading)
	These are read-only areas and display the backup action of the module. When the corresponding bit is On, the module data is being restored.		

[Table 4 .1] U device area

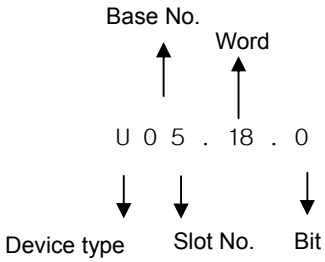
Device		Device	Description
Word	Word		
U00.02	U00.02.0	_00_CH0_ALINHH	channel0 input alarm further upper limit
	U00.02.1	_00_CH0_ALINH	channel0 input alarm upper limit
	U00.02.2	_00_CH0_ALINL	channel0 input alarm lower limit
	U00.02.3	_00_CH0_ALINLL	channel0 input alarm further lower limit
	U00.02.4	_00_CH0_ALHOH	channel0 heating output alarm upper limit
	U00.02.5	_00_CH0_ALHOL	channel0 heating output alarm lower limit
	U00.02.6	_00_CH0_ALCOH	channel0 cooling output alarm upper limit
	U00.02.7	_00_CH0_ALCOL	channel0 cooling output alarm lower limit
U00.03	U00.03.0	_00_CH1_ALINHH	channel1 input alarm further upper limit
	U00.03.1	_00_CH1_ALINH	channel1 input alarm upper limit
	U00.03.2	_00_CH1_ALINL	channel1 input alarm lower limit
	U00.03.3	_00_CH1_ALINLL	channel1 input alarm further lower limit
	U00.03.4	_00_CH1_ALHOH	channel1 heating output alarm upper limit
	U00.03.5	_00_CH1_ALHOL	channel1 heating output alarm lower limit
	U00.03.6	_00_CH1_ALCOH	channel1 cooling output alarm upper limit
	U00.03.7	_00_CH1_ALCOL	channel1 cooling output alarm lower limit
U00.04	U00.04.0	_00_CH2_ALINHH	channel2 input alarm further upper limit
	U00.04.1	_00_CH2_ALINH	channel2 input alarm upper limit
	U00.04.2	_00_CH2_ALINL	channel2 input alarm lower limit
	U00.04.3	_00_CH2_ALINLL	channel2 input alarm further lower limit
	U00.04.4	_00_CH2_ALHOH	channel2 heating output alarm upper limit
	U00.04.5	_00_CH2_ALHOL	channel2 heating output alarm lower limit
	U00.04.6	_00_CH2_ALCOH	channel2 cooling output alarm upper limit
	U00.04.7	_00_CH2_ALCOL	channel2 cooling output alarm lower limit
U00.05	U00.05.0	_00_CH3_ALINHH	channel3 input alarm further upper limit
	U00.05.1	_00_CH3_ALINH	channel3 input alarm upper limit
	U00.05.2	_00_CH3_ALINL	channel3 input alarm lower limit
	U00.05.3	_00_CH3_ALINLL	channel3 input alarm further lower limit
	U00.05.4	_00_CH3_ALHOH	channel3 heating output alarm upper limit
	U00.05.5	_00_CH3_ALHOL	channel3 heating output alarm lower limit
	U00.05.6	_00_CH3_ALCOH	channel3 cooling output alarm upper limit
	U00.05.7	_00_CH3_ALCOL	channel3 cooling output alarm lower limit
U00.06	-	_00_CH0_PV	channel0 input value
U00.07	-	_00_CH1_PV	channel1 input value
U00.08	-	_00_CH2_PV	channel2 input value
U00.09	-	_00_CH3_PV	channel3 input value
U00.10	-	_00_CH0_HOUT	channel0 heating output value
U00.11	-	_00_CH1_HOUT	channel1 heating output value
U00.12	-	_00_CH2_HOUT	channel2 heating output value
U00.13	-	_00_CH3_HOUT	channel3 heating output value
U00.14	-	_00_CH0_COUT	channel0 cooling output value
U00.15	-	_00_CH1_COUT	channel1 cooling output value
U00.16	-	_00_CH2_COUT	channel2 cooling output value
U00.17	-	_00_CH3_COUT	channel3 cooling output value

Device		Device	Description
Word	Word		
U00.18	U00.18.0	_00_CH0_RUN	channel0 operating command
	U00.18.1	_00_CH0_MAN	channel0 manual mode command
	U00.18.2	_00_CH0_ATEN	channel0 auto-tuning command
	U00.18.3	_00_CH0_EXIN	channel0 external input allowing command
U00.19	U00.19.0	_00_CH1_RUN	channel1 operating command
	U00.19.1	_00_CH1_MAN	channel1 manual mode command
	U00.19.2	_00_CH1_ATEN	channel1 auto-tuning command
	U00.19.3	_00_CH1_EXIN	channel1 external input allowing command
U00.20	U00.20.0	_00_CH2_RUN	channel2 operating command
	U00.20.1	_00_CH2_MAN	channel2 manual mode command
	U00.20.2	_00_CH2_ATEN	channel2 auto-tuning command
	U00.20.3	_00_CH2_EXIN	channel2 external input allowing command
U00.21	U00.21.0	_00_CH3_RUN	channel3 operating command
	U00.21.1	_00_CH3_MAN	channel3 manual mode command
	U00.21.2	_00_CH3_ATEN	channel3 auto-tuning command
	U00.21.3	_00_CH3_EXIN	channel3 external input allowing command
U00.22	-	_00_CH0_EXINV	channel0 external input data
U00.23	-	_00_CH1_EXINV	channel1 external input data
U00.24	-	_00_CH2_EXINV	channel2 external input data
U00.25	-	_00_CH3_EXINV	channel3 external input data
U00.26	-	_00_CH0_CSET	channel0 control set selection
U00.27	-	_00_CH1_CSET	channel1 control set selection
U00.28	-	_00_CH2_CSET	channel2 control set selection
U00.29	-	_00_CH3_CSET	channel3 control set selection
U00.30	U00.30.0	_00_WRITE	parameter backup command (write)
	U00.30.8	_00_READ	parameter restoring command (read)

(1) In device allocation, x and y respectively refer to the base number and the slot number with a module.
(2) The channel 0 conversion value of the thermo-controller mounted on base No. 0, slot No. 4 is expressed as U04.06.



(3) The channel0 operating command of a thermo-controller mounted on base No. 0 and slot No. 5 is expressed as U05.18.0. (when mounted on slot No. 10, it is U0A.18.0)



Note

U device: The memory of PLC CPU that you use to read or write a certain area (defined in the data and module that should be periodically read) of a special/ communication module in XGK PLC per each scan. The data you always read and write is allotted in this area like the conversion data of the special module. Like other devices, it can be directly used for ordinary commands such as MOV, CMP, and ADD (PUT/GET command should be used for the parameter area of the module).

4.2 Parameter Setting Area (using PUT/GET command)

- To set the parameter, we recommend you use the software package (XG-TCON) exclusively for the thermo-controller.
- Below is how to change the parameter by using the PUT/GET command in XG5000 program.

4.2.1 Parameter Setting Area

Channel				Read/ Write	Type	Description
channel0	channel1	channel2	channel3			
0	128	256	384	Read	BIT	channel status
1	129	257	385	Read	INT	sensor input value
2	130	258	386	Read	INT	Current control target
3	131	259	387	Read	INT	control output value
4	132	260	388	Read	REAL	control error
6	134	262	390	Read	WORD	auto-tuning step
9	137	265	393	Read	WORD	channel error
10	138	266	394	Read/Write	BIT	channel command
11	139	267	395	Read/Write	WORD	scale decimal point set value
12	140	268	396	Read/Write	WORD	dead zone(blind sector) set value
13	141	269	397	Read/Write	BIT	input setting
14	142	270	398	Read/Write	WORD	sensor code
15	143	271	399	Read/Write	INT	scale upper limit set value
16	144	272	400	Read/Write	INT	scale lower limit set value
18	146	274	402	Read/Write	INT	effective input upper limit set value
19	147	275	403	Read/Write	INT	effective input lower limit set value
20	148	276	404	Read/Write	INT	input alarm further upper limit set value
21	149	277	405	Read/Write	INT	input alarm upper limit set value
22	150	278	406	Read/Write	INT	input alarm lower limit set value
23	151	279	407	Read/Write	INT	input alarm further lower limit set value
24	152	280	408	Read/Write	WORD	LOWCUT set value
25	153	281	409	Read/Write	INT	input BIAS set value
26	154	282	410	Read/Write	WORD	filter factor/average frequency set value
27	155	283	411	Read/Write	WORD	filter factor/average frequency set value
28	156	284	412	Read/Write	BIT	control setting
29	157	285	413	Read/Write	INT	auto-tuning target
30	158	286	414	Read/Write	WORD	auto-tuning hysteresis set value
31	159	287	415	Read/Write	INT	control target upper limit set value
32	160	288	416	Read/Write	INT	control target lower limit set value
33	161	289	417	Read/Write	WORD	rising PV tracking set value
34	162	290	418	Read/Write	WORD	falling PV tracking set value
35	163	291	419	Read/Write	WORD	ONOFF control hysteresis set value
36	164	292	420	Read/Write	INT	heating cooling proportional value
37	165	293	421	Read/Write	WORD	heating PWM cycle setting

Channel				Read/ Write	Type	Description
channel0	channel1	channel2	channel3			
38	166	294	422	Read/Write	INT	heating output upper limit
39	167	295	423	Read/Write	INT	heating output lower limit
40	168	296	424	Read/Write	WORD	heating output change upper limit
41	169	297	425	Read/Write	INT	heating output reference value
42	170	298	426	Read/Write	INT	failure heating output setting
43	171	299	427	Read/Write	INT	heating manual output value
44	172	300	428	Read/Write	INT	heating output upper limit alarm value
45	173	301	429	Read/Write	INT	heating output lower limit alarm value
48	176	304	432	Read/Write	WORD	cooling PWM cycle setting
49	177	305	433	Read/Write	INT	cooling output upper limit
50	178	306	434	Read/Write	INT	cooling output lower limit
51	179	307	435	Read/Write	WORD	cooling output change upper limit
52	180	308	436	Read/Write	INT	cooling output reference value
53	181	309	437	Read/Write	INT	failure cooling output setting
54	182	310	438	Read/Write	INT	cooling manual output value
55	183	311	439	Read/Write	INT	cooling output upper limit alarm value
56	184	312	440	Read/Write	INT	cooling output lower limit alarm value
57	185	313	441	Read/Write	WORD	output alarm common hysteresis value
59	187	315	443	Read/Write	WORD	cool access point compensation method
60	188	316	444	Read/Write	INT	External RJC
61	189	317	445	Read	INT	cool access point compensation temperature monitoring
64	192	320	448	Read/Write	INT	target set value 0
65	193	321	449	Read/Write	INT	cycle setting 0
66	194	322	450	Read/Write	REAL	proportional factor set value 0
68	196	324	452	Read/Write	REAL	integral factor set value 0
70	198	326	454	Read/Write	REAL	differential factor set value 0
72	200	328	456	Read/Write	INT	control BIAS set value 0
73	201	329	457	Read/Write	INT	target set value 1
74	202	330	458	Read/Write	INT	cycle setting 1
75	203	331	459	Read/Write	REAL	proportional factor set value 1
77	205	333	461	Read/Write	REAL	integral factor set value 1
79	207	335	463	Read/Write	REAL	differential factor set value 1
81	209	337	465	Read/Write	INT	control BIAS set value 1
82	210	338	466	Read/Write	INT	target set value 2
83	211	339	467	Read/Write	INT	cycle setting 2
84	212	340	468	Read/Write	REAL	proportional factor set value 2
86	214	342	470	Read/Write	REAL	integral factor set value 2
88	216	344	472	Read/Write	REAL	differential factor set value 2
90	218	346	474	Read/Write	INT	control BIAS set value 2
91	219	347	475	Read/Write	INT	target set value 3
92	220	348	476	Read/Write	INT	cycle setting 3

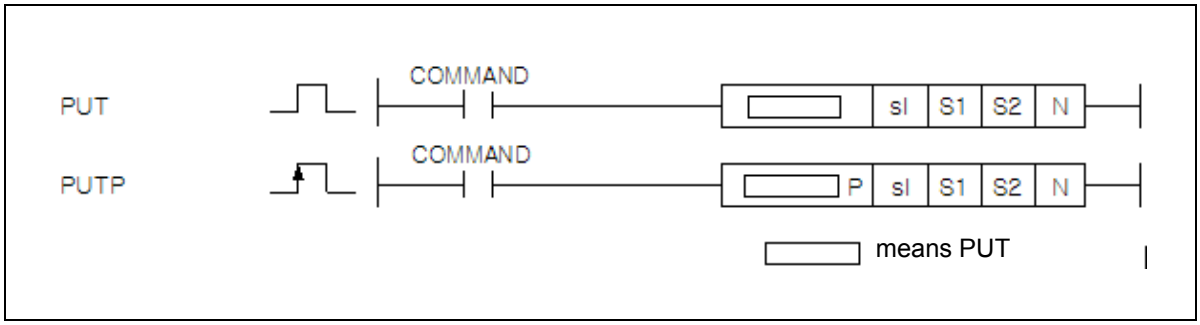
Channel				Read/ Write	Type	Description
channel0	channel1	channel2	channel3			
93	221	349	477	Read/Write	REAL	proportional factor set value 3
95	223	351	479	Read/Write	REAL	integral factor set value 3
97	225	353	481	Read/Write	REAL	differential factor set value 3
99	227	355	483	Read/Write	INT	control BIAS set value 3
100	228	356	484	Read/Write	INT	target set value 4
101	229	357	485	Read/Write	INT	cycle setting 4
102	230	358	486	Read/Write	REAL	proportional factor set value 4
104	232	360	488	Read/Write	REAL	integral factor set value 4
106	234	362	490	Read/Write	REAL	differential factor set value 4
108	236	364	492	Read/Write	INT	control BIAS set value 4
109	237	365	493	Read/Write	INT	target set value 5
110	238	366	494	Read/Write	INT	cycle setting 5
111	239	367	495	Read/Write	REAL	proportional factor set value 5
113	241	369	497	Read/Write	REAL	integral factor set value 5
115	243	371	499	Read/Write	REAL	differential factor set value 5
117	245	373	501	Read/Write	INT	control BIAS set value 5

Note) Read/Write is written based on the PLC. In case of Read, PLC reads the data from the module and in case of Write, PLC writes the data to the module

4.2.2 How to Use PUT/GET Command

(1) PUT command

Command		Areas available														step	Flag		
		PMK	F	L	T	C	S	Z	D.x	R.x	constant	U	N	D	R		error (F110)	Zero (F111)	carry (F112)
PUT(P)	sl	-	-	-	-	-	-	-	-	-	O	-	-	-	-	4~7	-	-	-
	S1	-	-	-	-	-	-	-	-	-	O	-	-	-	-				
	S2	O	-	O	-	-	-	-	-	-	O	O	O	O	O				
	N	O	-	O	-	-	-	-	-	-	O	-	-	-	-				



[Area setting]

Operand	Description	Data size
sl	The number of the slot with a special module (set as a hexadecimal number)	WORD
S1	The channel of the internal memory of a special module	WORD
S2	The first number of constant of the device where the data is stored which you want to save in the special module	WORD
N	The number of the data to be stored	WORD

[Flag set]

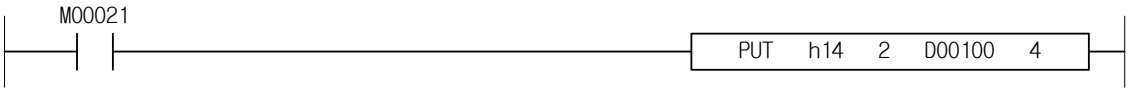
Flag	Description	Device No.
PUT/GET error	- when the special module is not in the designated slot - when the PUT/GET command has not been properly carried out	F0015 ~ F0022

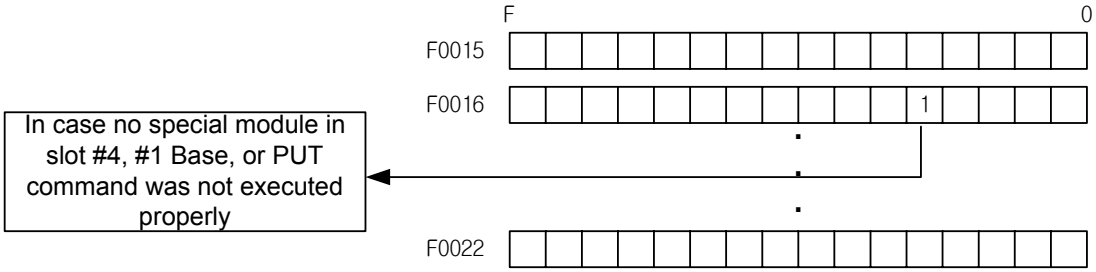
(a) This command is used when you want to use data for the special module with a memory.

(b) It uses N word data from the device designated as S2 for the memory (designated as S2) of the special module designated as sl (the slot number of the special module).

(c) When the special module is not in the place designated as sl (the slot number of the special module) of the PUT command has not been properly carried out, the bit of the corresponding place of F0015~F0022(WORD), which is PUT/GET error Flag, is set.

(d) sl (the slot number of the special module) shall be set in two places as a hexadecimal number. As shown below, for instance, in the case of h14, the number 1 refers to the number of the base and 4 the slot number.

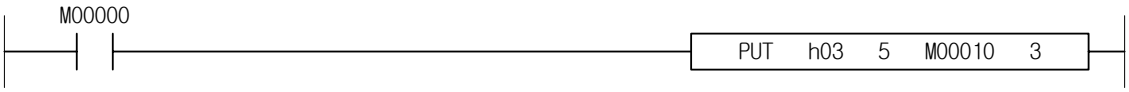


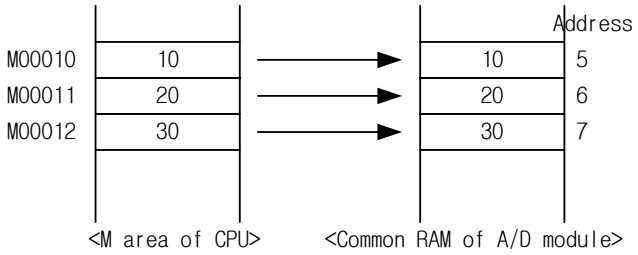


(2) Example of usage of PUT command

(a) The program that uses 40 words of D1000 ~D1039 from 10Channel to 40 channel of the special module mounted on slot number 7 of base 0 when the M00000 of the input signal is On.

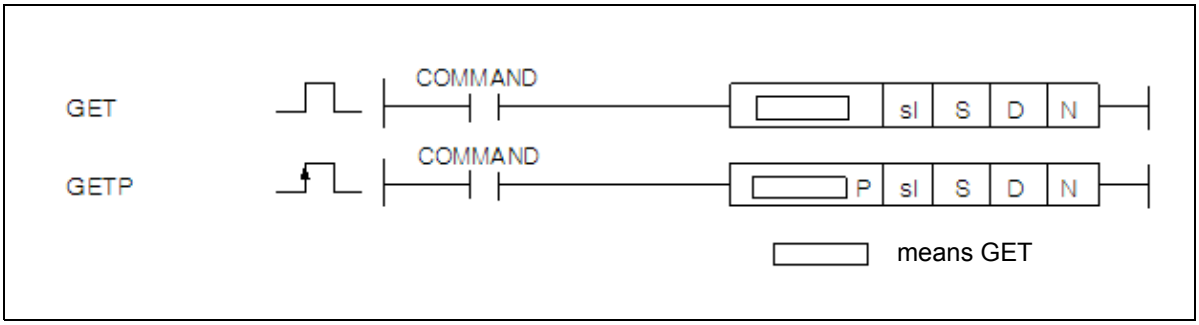
(b) The program that uses the data of 3 words between 5Channel and 7Channel of the internal memory of A/D module mounted in slot 3 of base 0 for the contents of words M00010~M00012





(3) GET command

Command		Available area														step	Flag		
		PMK	F	L	T	C	S	Z	D.x	R.x	constant	U	N	D	R		error (F110)	zero (F111)	carry (F112)
GET(P)	sl	-	-	-	-	-	-	-	-	-	O	-	-	-	-	4~7	-	-	-
	S	-	-	-	-	-	-	-	-	-	O	-	-	-	-				
	D	O	-	O	-	-	-	-	-	-	-	O	O	O	O				
	N	O	-	O	-	-	-	-	-	-	O	O	O	O	O				



[Area setting]

Operand	Description	Data size
sl	The number of the slot with a special module (set as a hexadecimal number)	WORD
S	The starting channel of the internal memory of a special module	WORD
D	The first number of the device in the CPU where the data to read will be stored	WORD
N	The number of data to read	WORD

[Flag set]

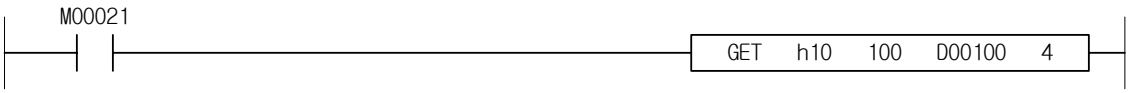
Flag	Description	Device No.
PUT/GET error	- when the special module is not in the designated slot - when the PUT/GET command has not been properly carried out	F0015 ~ F0022

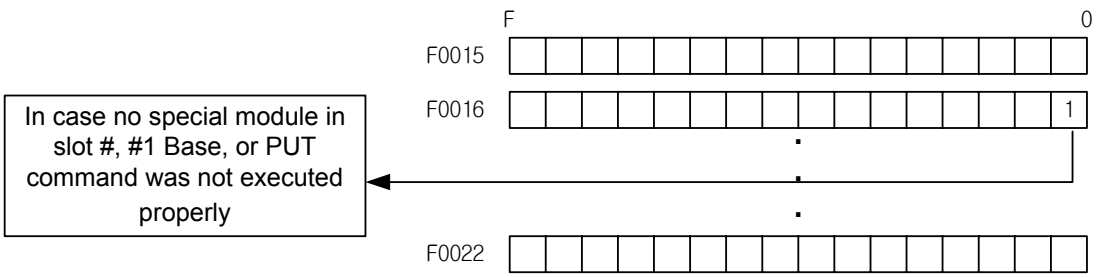
(a) This command is used when you want to read data for the special module with a memory

(b) It saves the N word data in the internal device area designated as D from the memory (designated as S: address) of the memory of the special module designated as sl (the slot number of the special module).

(c) When the special module is not in the place designated as sl (the slot number of the special module) or the GET command has not been properly carried out, the bit of the corresponding place of F0015~F0022(WORD), which is the PUT/GET error Flag, is set.

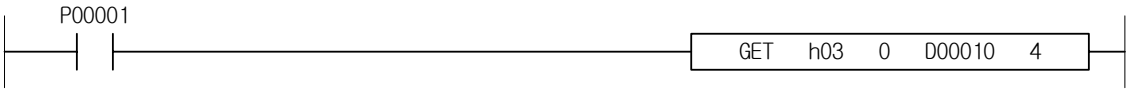
(d) sl (the slot number of the special module) shall be set in two places as a hexadecimal number. As shown below, for instance, in the case of h10, the number 1 refers to the number of the base and 0 the slot number.

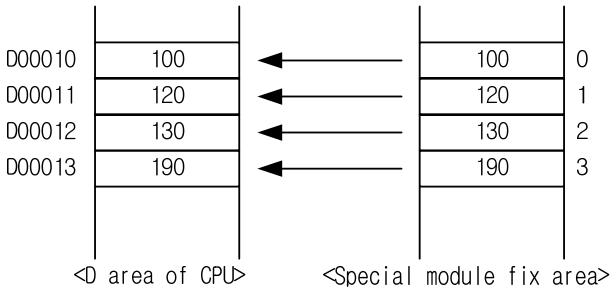




(4) Example of usage of GET command

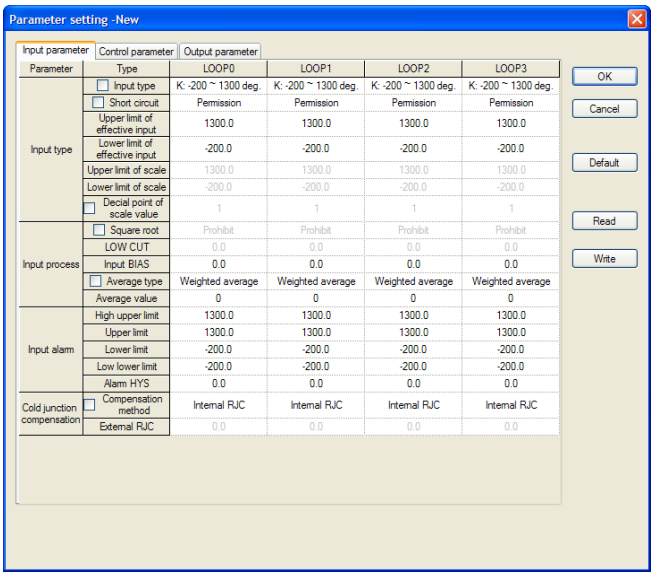
(a) It stores 4 word data between D00010 and D00013 from the internal memory 0 channel of the special module mounted in the third slot of base 0 when P0001 is on.





4.2.3 Input parameter

Below is the description of each item of the input parameter of XG-TCON software for setting parameter. The immediate following is the input parameter setting window.



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	1300.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	1300.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0
Input alarm	High upper limit	1300.0	1300.0	1300.0	1300.0
	Upper limit	1300.0	1300.0	1300.0	1300.0
	Lower limit	-200.0	-200.0	-200.0	-200.0
	Low lower limit	-200.0	-200.0	-200.0	-200.0
	Alarm HYS	0.0	0.0	0.0	0.0
Cold junction compensation	Compensation method	Internal RJC	Internal RJC	Internal RJC	Internal RJC
	External RJC	0.0	0.0	0.0	0.0

(1) Types of input

(a) Input Type

You can set the input type through the software package or XG5000. The setting can be done by using input type in the software package and by using PUT command in XG5000. For details, see Table 4.2.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
14	142	270	398	IN_TYPE	Choose input type	N/A	1 ~ 27	1	read/write

Input type		input Range	set value	effective input Range		scale decimal point place (IN_FP)
				lower limit (IN_MIN)	upper limit (IN_MAX)	
thermocouple	K	-200.0 ~ 1300.0	1	-200.0	1300.0	
		0.0 ~ 500.0	26	0.0	500.0	
	J	-200.0 ~ 1200.0	2	-200.0	1200.0	
		0.0 ~ 500.0	27	0.0	500.0	
	T	-200.0 ~ 400.0	3	-200.0	400.0	
	B	400 ~ 1800	4	400	1800	
	S	0 ~ 1700	5	0	1700	
	R	0 ~ 1700	6	0	1700	
	N	-200.0 ~ 1300.0	7	-200.0	1300.0	
	E	-200.0 ~ 1000.0	8	-200.0	1000.0	
	U	-200.0 ~ 600.0	9	-200.0	600.0	
	L	-200.0 ~ 900.0	10	-200.0	900.0	
	C(W)	0 ~ 2300	11	0	2300	
	PL II	0.0 ~ 1300.0	12	0.0	1300.0	
RTD	Pt100	-200.0 ~ 850.0	13	-200.0	850.0	
	JPt100	-200.0 ~ 600.0	14	-200.0	600.0	
	Pt1000	-200.0 ~ 850.0	15	-200.0	850.0	
Voltage	DC mV	0.00 ~ 10.00	16	0.00	10.00	2
		0.0 ~ 100.0	17	0.0	100.0	1
	DC V	0.000 ~ 1.000	18	0.000	1.000	3
		1.000 ~ 5.000	19	1.000	5.000	3
		0.000 ~ 5.000	20	0.000	5.000	3
		0.00 ~ 10.00	21	0.00	10.00	2
		-5.000 ~ 5.000	22	-5.000	5.000	3
		-10.00 ~ 10.00	23	-10.00	10.00	2
Current	DC mA	4.00 ~ 20.00	24	4.00	20.00	2
		0.00 ~ 20.00	25	0.00	20.00	

Table 4.2 Input types

(b) Processing of disconnect

The loop disconnect handling function is for detecting the disconnection of the sensor or input. The input range that provides the function of detecting a disconnection is thermocouple, RTD, DC mV, 0 ~ 1 V. The measured input value, when a disconnection is detected, is displayed as an upper limit or lower limit value. They are displayed as [disconnect] in the input of the corresponding loop in the software package. If you don't want [disconnect] displayed, set 0 in the corresponding address.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
13.0	141.0	269.0	397.0	INP.CHK	Choose disconnect detecting function	N/A	0: no 1: Yes	1	read/write

(c) Effective input upper limit/lower limit

You can set by adjusting the range you actually want to use in the input range chosen in the input type. For instance, if you want to use only the input range of 0 ~ 1000℃ in the input type of K, -200 ~ 1300℃,'1000.0'and '0.0' shall be respectively set as the input upper limit and effective input lower limit.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
18	146	274	402	IN_MAX	Effective input upper limit	℃	IN_MIN~IN_MAX	IN_MAX	read/write
19	147	275	403	IN_MIN	Effective input lower limit	℃	IN_MIN~IN_MAX	IN_MIN	read/write

(d) Scale upper limit/lower limit

The function of scale upper limit/scale lower limit setting is only available in the DC voltage/current input. The functions of scale upper limit and scale lower limit setting are for setting the display range of the input range. Let's take an example that you set effective input upper limit and effective input lower limit respectively as 5.00 and 0.00 in 0 ~ 10 mV input. In such a case, the scale upper limit and scale lower limit are respectively set as 20.00 and 0.00.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
15	143	271	399	IN_SMAX	scale upper limit	N/A	-30000 ~ 30000	IN_MAX	read/write
16	144	272	400	IN_SMIN	scale lower limit	N/A		IN_MIN	read/write

(e) Scale decimal point is only available in the DC voltage/current input like scale upper limit/lower limit setting. This is for changing the place of the decimal point of the value set in the scale upper limit/lower limit.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
11	139	267	395	IN_FP	Place of scale decimal point	N/A	0 ~ 4	IN_FP	read/write

(2) Processing of the input

(a) Processing of square roots

This function is used for converting the pressure signal of the flow meter into flow signals. Fig. 4.1 shows an example of processing square roots.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
13.1	141.1	269.1	397.1	INP.SQR	Shooter processing of square root	N/A	0: No 1: Yes	0	read/write

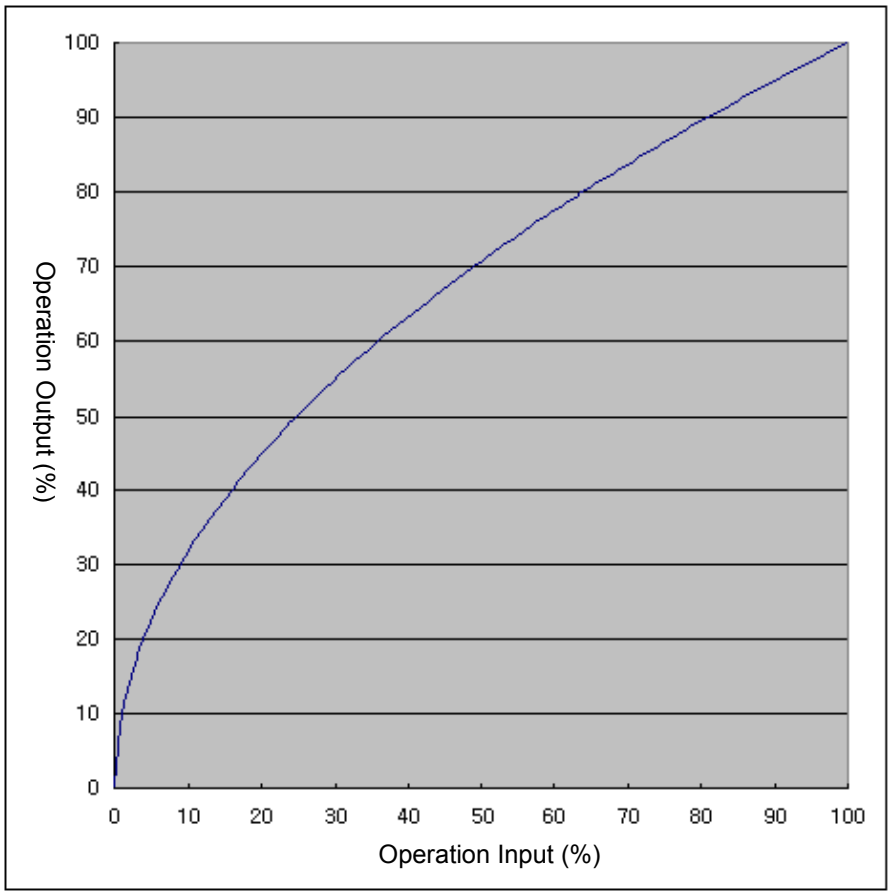


Fig. 4.1. Example of processing of a square root

(b) Low cut

This is for setting the area that is not processed with a square root. No square root applies below the low cut that has been set. Fig. 4.2 shows an example of setting the low cut at 50(5.0%).

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
24	152	280	408	IN_CUT	LOW CUT set value	%	0 ~ 50 (0 ~ 5.0%)	0	read/write

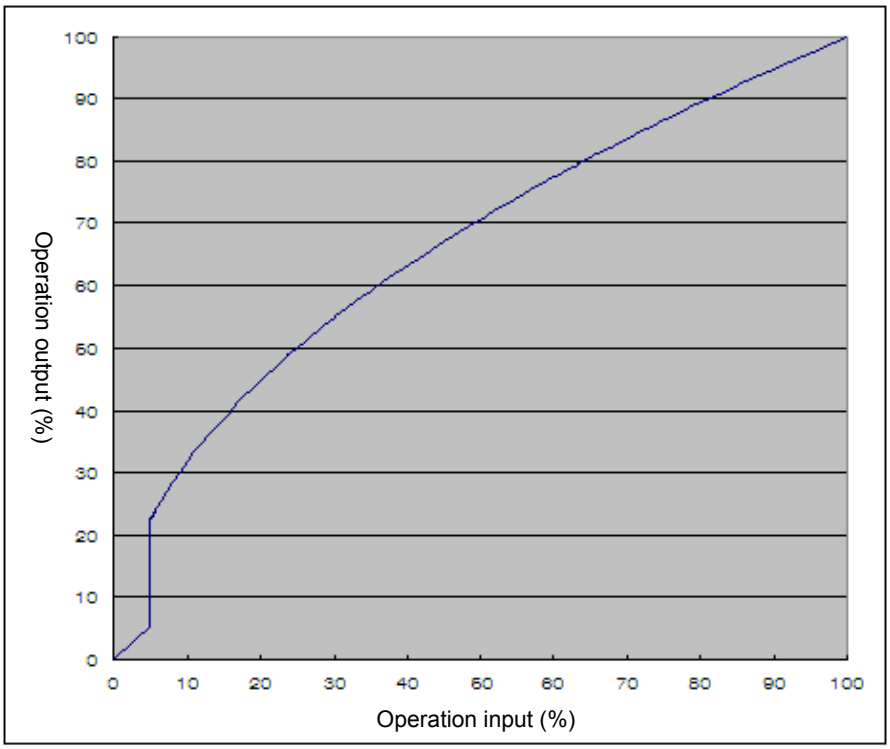


Fig. 4.2. LOW CUT setting

(c) Input BIAS

This is for adding or deducting a certain amount to or from the measured input value. If there is a difference between the measured and actual values, it can be adjusted with the input BIAS function. Adjustment can also be made when there is a difference between the loops for the same measurement point.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
25	153	281	409	IN_BIAS	input BIAS set value	Industrial Unit	-(IN_SMAX– IN_SMIN) ~ (IN_SMAX – IN_SMIN)	0	read/write

(d) Weighted average

By weighted average, you can get a stable digital output value by filtering or delaying a sudden change of the noise or input value. The weight average constant can be set for each loop by input parameter setting of the user program or XG-TCON.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
13.2	141.2	269.2	397.2	INP.AVG	Choose average	N/A	0: weighted average 1: moving average	0	read/write
26	154	282	410	IN_FILT	Average	%	0 ~ 99	0[1]	read/write

1) Setting Range: 1 ~ 99(%)

$$F[n] = (1 - \alpha) \times A[n] + \alpha \times F[n - 1]$$

F[n]: current weighted average output value
A[n]: current input conversion value
F[n-1]: previous weighted average output value
α: weighted average constant (0.01 ~ 0.99: weighted value of the previous value)

*1 If you do not set the weighted average set value at 1-99, the ALM LED flashed in a 1 second cycle. If you want to turn ALM LED on, re-set the filter set value at 1-99.

*2 In case of a weighted average set value error, the weighted average set value remains the previous value.

2) Example of voltage input

• Analog input range: DC -10 ~ 10 V, scale lower limit ~ upper limit: set at 0 ~ 30000

• The weighted average output according to α is as follows when the analog input changes to –10 V → 10 V (0 → 30000).

α Value	Weighted average output value				Remarks
		1 scan	2 scan	3 scan	
*1) 0.01	0	29700	29997	29999	Value with 1% bias to previous value
*2) 0.5	0	0	15000	22500	Value with 50% bias to previous value
*3) 0.99	0	300	597	891	Value with 99% bias to previous value

*1) 30000 output after about 4 scans
*2) 30000 output after about 23 scans
*3) 30000 output after about 1553 scans (310.6 s)

[1] Set to 0 when not averaged.

3) Example of current input

• analog input current range: DC 0 ~ 20 mA, scale lower limit ~ scale upper limit: 0 ~ 30000

• The filter output value according to α is as follows when the analog input changes to 0 mA → 10 mA (0 → 15000).

α값	Filter output value				Remarks
		1 scan	2 scan	3 scan	
*1) 0.01	0	14850	14998	14999	Value with 1% bias to previous value
*2) 0.5	0	7500	11250	13125	Value with 50% bias to previous value
*3) 0.99	0	150	298	445	Value with 99% bias to previous value

*1) 15000 output after about 4 scans

*2) 15000 output about 22 scans

*3) 15000 output after 1484 scan (296.8 s)

• If you don't use the weighted average processing function, the current input conversion value is output directly. The function is for getting data by weighting the current input conversion value and the previous input conversion value. The weighted value can be decided with the average value. If the output data is too shaky, set the weighted average constant value higher.

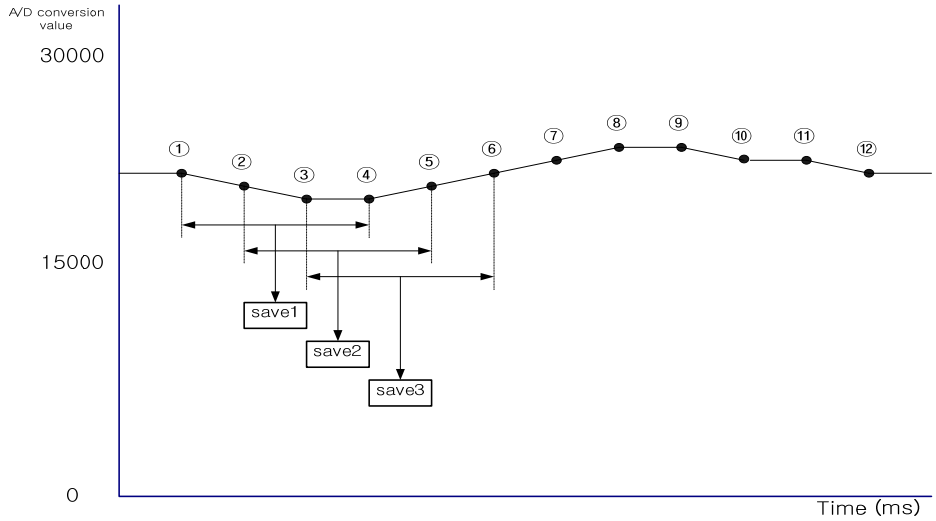
(e) Moving average

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
13.2	141.2	269.2	397.2	INP.AVG	Choose average	N/A	0: weighted average 1: moving average	0	read/write
26	154	282	410	IN_FILT	Average	N/A	0 ~ 99	0[2]	read/write

1) Setting Range: 2 ~ 99 (times)

2) The input conversion value that has been sampled as many times as designated in the setting range is stored in the memory. Then you get the average of the stored sample data. Afterwards each time the input D conversion value enters the memory that was sampled the most recently, the input conversion data that was sampled the earliest is abandoned and the average is obtained. Fig. 2.3 shows an example of setting scale lower limit ~ upper limit and moving average processing at 0 ~ 30000 and 4 respectively.

[2] This is set as 0 when you do not average-process it.



[Fig. 2.3] Moving average

save 1 = (① + ② + ③ + ④) / 4

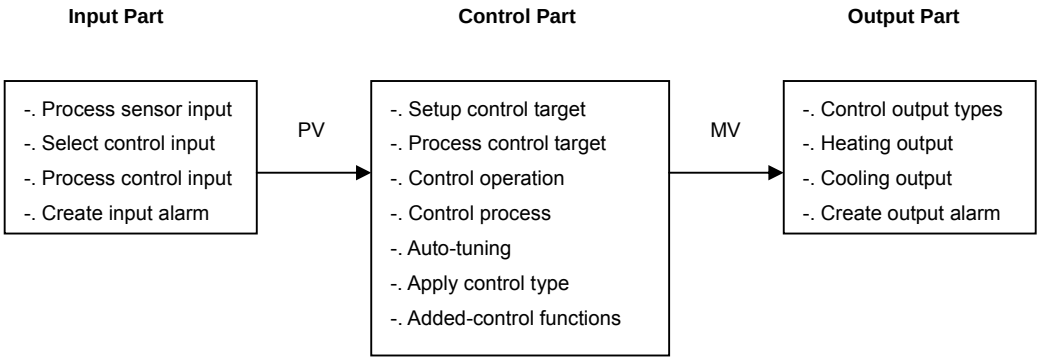
save 2 = (② + ③ + ④ + ⑤) / 4

save 3 = (③ + ④ + ⑤ + ⑥) / 4

4.2.4 Control parameter

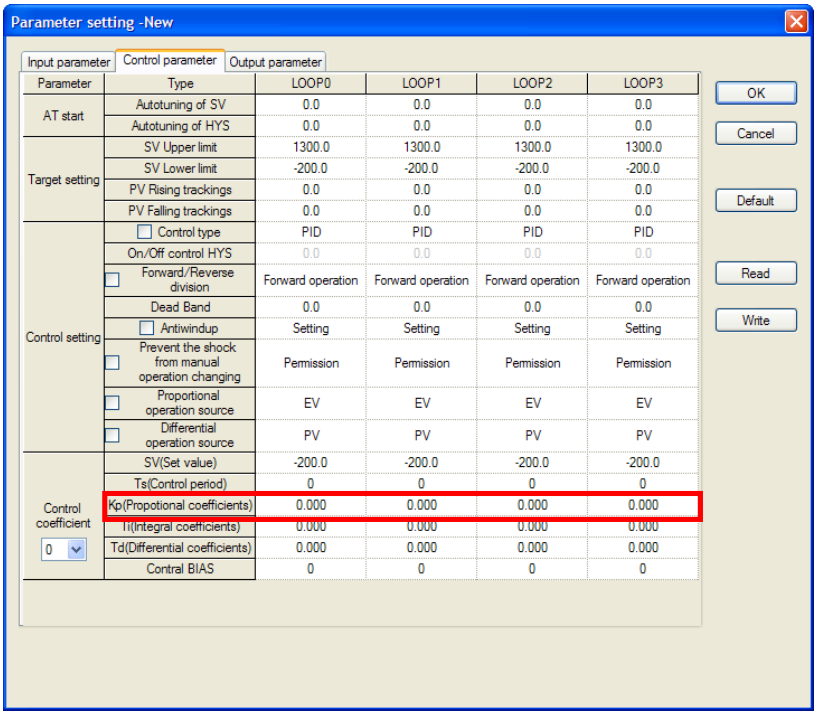
The thermo-controller module realizes PID control, which stands for Proportional (P), Integral (I) and Differential (D) and stabilizes the system according to the control target by adjusting the energy supplied to the system through the three mathematical operations after comparing the control target and the current status of the system.

The first goal of the control function, in general, is adjusting and stabilizing the target to the desired status as soon as possible. To meet the target, the input and output environment of the control system should be formed and the factors of P, I and D and the control target should be set according to the characteristics of the system. The control system is completed when other additional functions are set considering the system. The control part consists as follows including the input and output parts.



(1) Control target setting

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
64	192	320	448	SV0	SV[control target] 0	PV Unit	SV lower limit~ SV upper limit	0	read/write
73	201	329	457	SV1	SV[control target] 1	PV Unit	SV lower limit~ SV upper limit	0	read/write
82	210	338	466	SV2	SV[control target] 2	PV Unit	SV lower limit~ SV upper limit	0	read/write
91	219	347	475	SV3	SV[control target] 3	PV Unit	SV lower limit~ SV upper limit	0	read/write
100	228	356	484	SV4	SV[control target] 4	PV Unit	SV lower limit~ SV upper limit	0	read/write
109	237	365	493	SV5	SV[control target] 5	PV Unit	SV lower limit~ SV upper limit	0	read/write



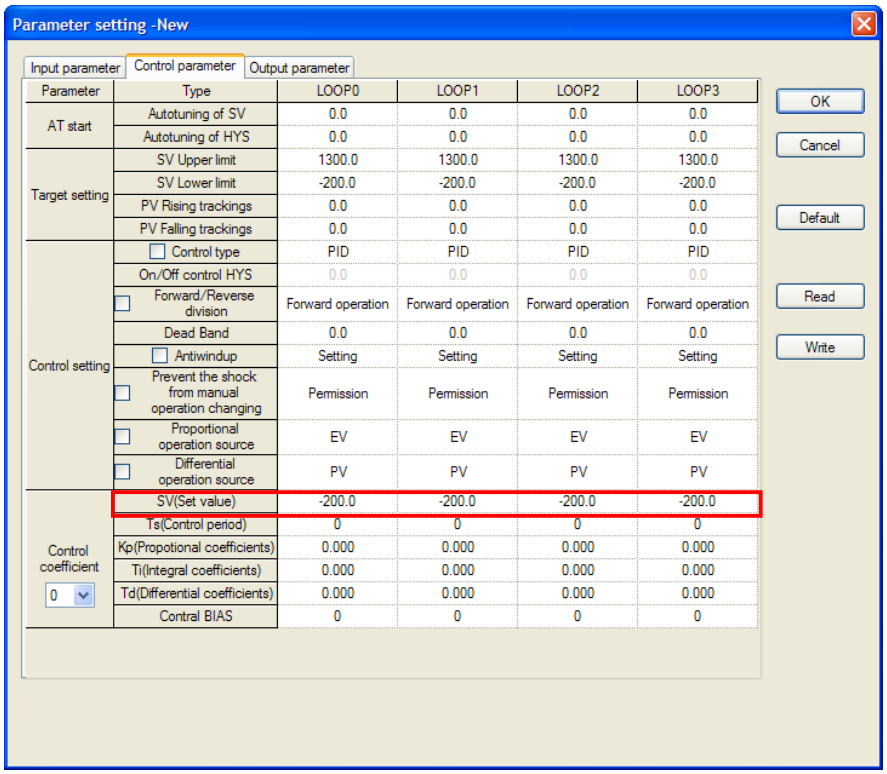
The control target, which is often referred to as SV (Set point Value), is the state expressed in a number which you want the state of the control system to move to for stabilization. For example, if you want to adjust a certain system temperature to 30 degrees, 30 is the control target. This value has the same unit as that measured in the sensor. If the sensor measures 30 as 3000, the control target also should be expressed as 3000. When the control target is settled, the control operation should be repeated unlimitedly until the system state becomes the same as SV.

As the thermo-controller provides 6 control sets, you can set and convert 6 types of control target.

(2) Processing of the control target

(a) SV upper limit/lower limit setting

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
31	159	287	415	SV_MAX	SV upper limit	PV Unit	SV lower limit ~PV upper limit	0	read/write
32	160	288	416	SV_MIN	SV lower limit	PV Unit	PV lower limit ~SV upper limit	0	read/write



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

As state above, since the control target is the state of the system that the user wants, it can also be changed when the user wants so. The SV upper/lower limit can be set in order to prevent an error that might occur during change of the user's control target. An error can also be prevented even when there are multiple users by blocking the state that cannot be physically reached. The control target is limited by the SV upper/lower limit.

(b) PV rising/falling tracking

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
33	161	289	417	PV_TUP	PV rising tracking	PV Unit	0~10000	0	read/write
34	162	290	418	PV_TDN	PV falling tracking	PV Unit	0~10000	0	read/write

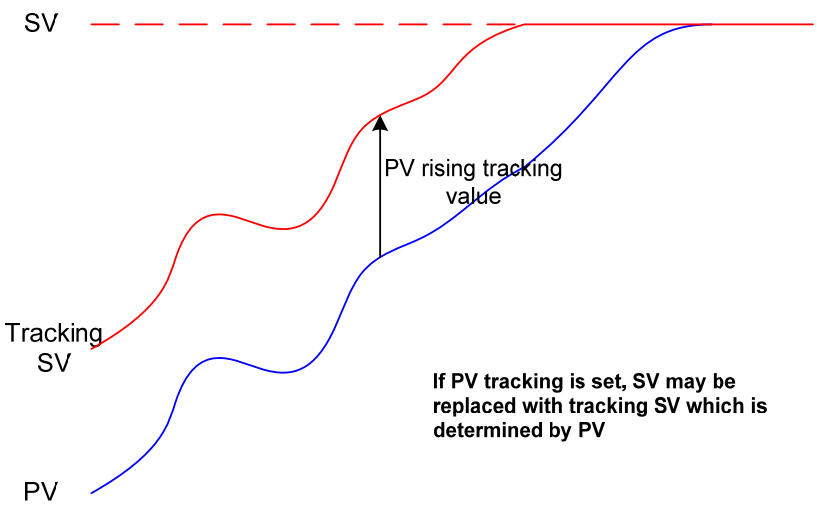
Parameter setting -New

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

OK | Cancel | Default | Read | Write

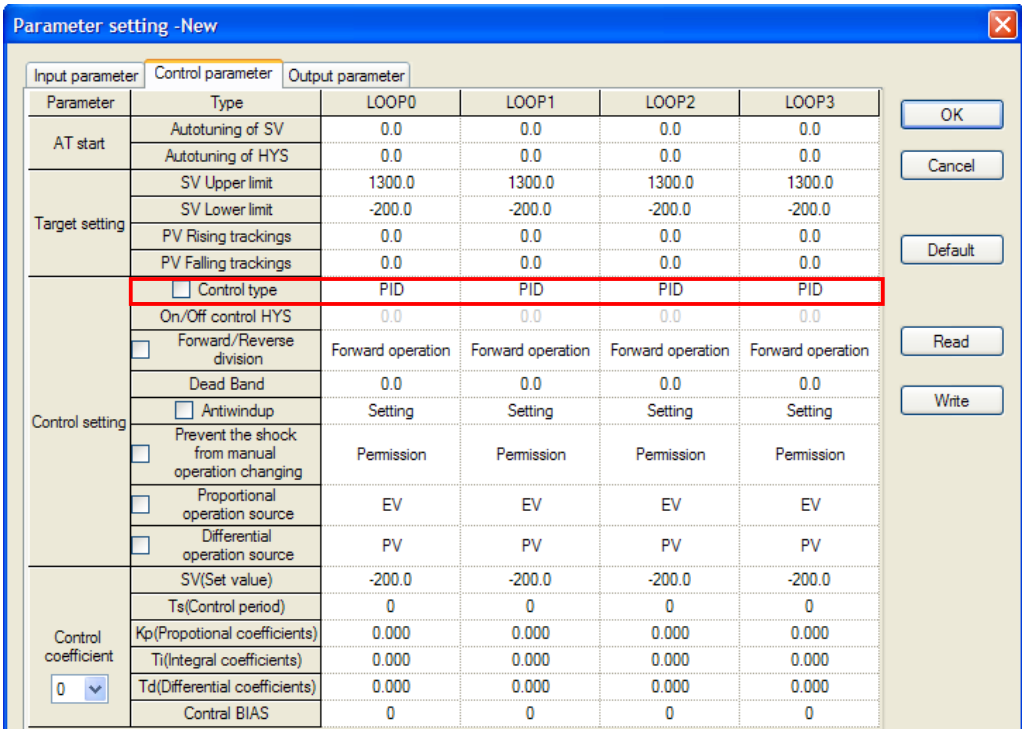
PV tracking is for enabling PV to smoothly reach the target by creating dynamic SV for the output of the driving part to gradually increase by temporarily adjusting SV to near PV when the large output has an adverse effect on the driving part with the difference between the SV and PV being considerable. PV rising tracking and PV falling tracking respectively act in the rising and falling PV sections. The set value is used as the pulling interval.



(3) Type of control

The type of control provided by the thermo-controller divides into PID, CASCADE and ON-OFF. Each operation applies according to the code set to the control type.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
10.4~5	138.4~5	266.4~5	385.4~5	CTRL.TYPE	control type	code	0: PID 1: CASCADE 2: ONOFF	0	read/write



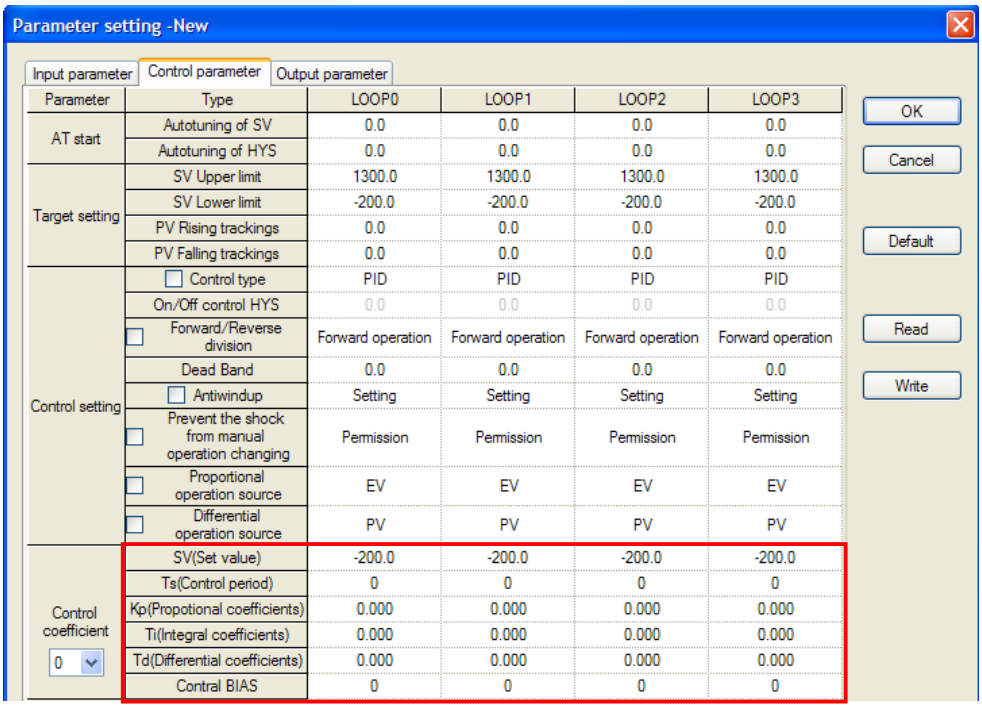
Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

(a) PID control

The table below shows the control factors related to PID control.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
65	193	321	449	TS0	TS[control cycle] 0	200ms	0~65535 (x 200ms)	0	read/write
74	202	330	458	TS1	TS[control cycle] 1	200ms	0~65535 (x 200ms)	0	read/write
83	211	339	467	TS2	TS[control cycle] 2	200ms	0~65535 (x 200ms)	0	read/write
92	220	348	476	TS3	TS[control cycle] 3	200ms	0~65535 (x 200ms)	0	read/write
101	229	357	485	TS4	TS[control cycle] 4	200ms	0~65535 (x 200ms)	0	read/write
110	238	366	494	TS5	TS[control cycle] 5	200ms	0~65535 (x 200ms)	0	read/write

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
66	194	322	450	KP0	KP[proportional factor] 0	MV/PV	0~10000	0	read/write
75	203	331	459	KP1	KP[proportional factor] 1	MV/PV	0~10000	0	read/write
84	212	340	468	KP2	KP[proportional factor] 2	MV/PV	0~10000	0	read/write
93	221	349	477	KP3	KP[proportional factor] 3	MV/PV	0~10000	0	read/write
102	230	358	486	KP4	KP[proportional factor] 4	MV/PV	0~10000	0	read/write
111	239	367	495	KP5	KP[proportional factor] 5	MV/PV	0~10000	0	read/write
68	196	324	452	TI0	TI[integral factor] 0	Sec	0~10000	0	read/write
77	204	333	461	TI1	TI[integral factor] 1	Sec	0~10000	0	read/write
86	214	342	470	TI2	TI[integral factor] 2	Sec	0~10000	0	read/write
95	223	351	479	TI3	TI[integral factor] 3	Sec	0~10000	0	read/write
104	232	360	488	TI4	TI[integral factor] 4	Sec	0~10000	0	read/write
113	241	369	497	TI5	TI[integral factor] 5	Sec	0~10000	0	read/write
70	198	326	454	TD0	TD[differential factor] 0	Sec	0~10000	0	read/write
79	206	335	463	TD1	TD[differential factor] 1	Sec	0~10000	0	read/write
88	216	344	472	TD2	TD[differential factor] 2	Sec	0~10000	0	read/write
97	225	353	481	TD3	TD[differential factor] 3	Sec	0~10000	0	read/write
106	234	362	490	TD4	TD[differential factor] 4	Sec	0~10000	0	read/write
115	243	371	499	TD5	TD[differential factor] 5	Sec	0~10000	0	read/write
72	200	328	456	BIAS0	control BIAS 0	PV Unit	-10000~10000	0	read/write
81	208	337	465	BIAS0	control BIAS 1	PV Unit	-10000~10000	0	read/write
90	218	346	474	BIAS0	control BIAS 2	PV Unit	-10000~10000	0	read/write
99	227	355	483	BIAS0	control BIAS 3	PV Unit	-10000~10000	0	read/write
108	236	364	492	BIAS0	control BIAS 4	PV Unit	-10000~10000	0	read/write
117	245	373	501	BIAS0	control BIAS 5	PV Unit	-10000~10000	0	read/write



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

In the PID operation (or single PID), P, I and D are calculated and added up. The related glossary is as follows.

T_s(Ts): sampling type (control cycle)
K_p(Kp): proportional factor
T_i(Ti): integral constant
T_d(Td): differential constant
SV : The target that the objective to be controlled should reach
PV : current state of the objective to be controlled, detected by the sensor
EV : current error of the objective to be controlled, (SV –PV)
MV : control input or controller output.
MV_p(MVp) : proportional factor of MV
MV_i(MVi) : integral factor of MV
MV_d(MVd) : differential factor of MV
Bias : control bias

PID control operation is as follows.

$$EV = SV - PV \qquad (7.4.1)$$

$$MV_p = K_p EV \qquad (7.4.2)$$

$$MV_i = \frac{K_p}{T_i} \int EV\, dt \qquad (7.4.3)$$

$$MV_d = K_p T_d \frac{dEV}{dt} \qquad (7.4.4)$$

$$MV = MV_p + MV_i + MV_d + Bias \qquad (7.4.5)$$

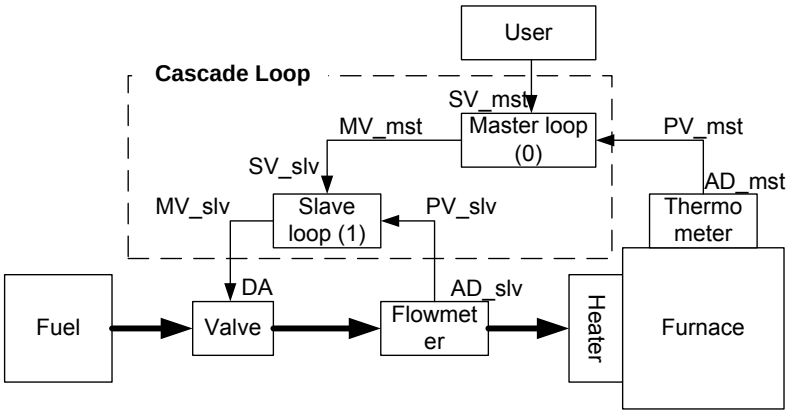
Although the integral and differential terms of the expressions above make the interpretation difficult, if we approach it conceptually, P is the result of multiplying the control error EV by Kp and I is the result of adding the P operation result per cycle and dividing it with Ti. That is why the smaller Ti the wider the integral operation is. For D operation, the change of the cycle P operation result is multiplied by Td. The results of the 3 factors operated like this are added up to the control bias to create MV as shown in expression 7.4.5.

(b) CASCADE operation

Cascade PID operation is used for 2input 1output operation by adding the medium state to the single PID operation. In terms of the structure, the master loop and slave loop are configured by using two PID loops. Then the MV of the master loop is used as the SV of the slave loop. When the user sends a desired target state (SV_mst) to the master loop, the master loop sends the corresponding medium target (SV_slv) to the slave loop to adjust the current state (PV_mst) to the target state (SV_mst). The slave loop adjusts the medium state (PV_slv) to the medium target (SV_slv).

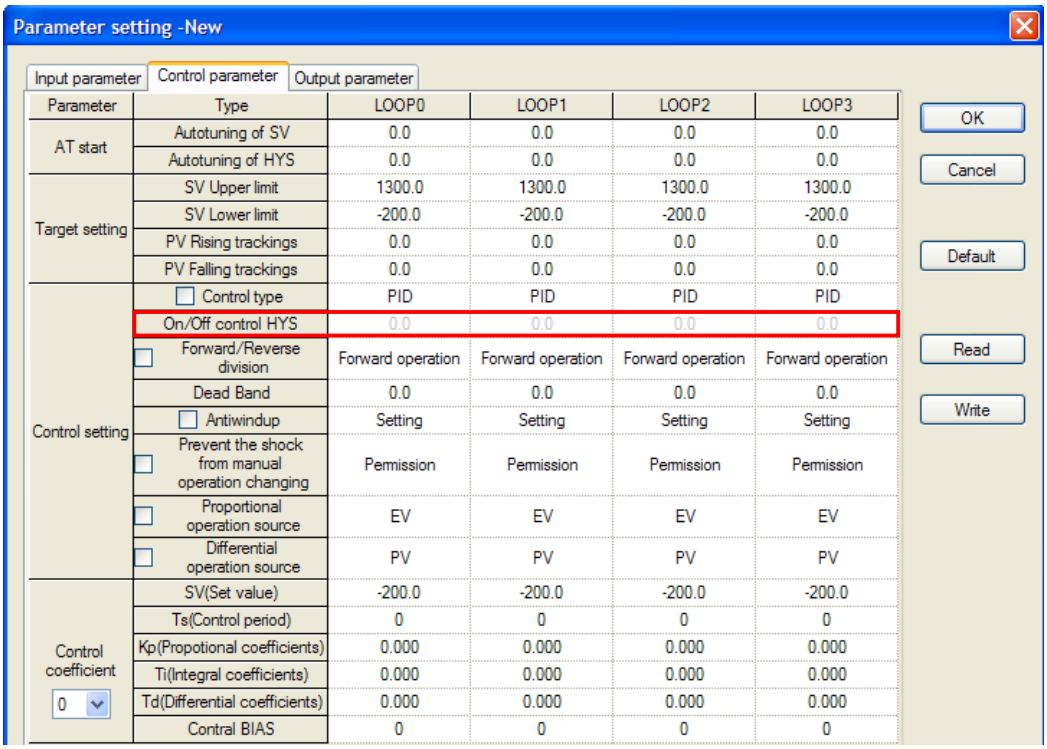
One example is the system that controls the temperature by adjusting the input of fuel. The final target (SV_mst) that the user wants is the temperature. If the controller can measure the current temperature (PV_mst) and the current fuel input (PV_slv) in the system, the cascade loop can be configured.

The master loop checks the current temperature (PV_mst), calculates the fuel input target (SV_slv) and sends it to the slave loop. The slave loop checks the fuel input (PV_slv) and meets the fuel input target (SV_slv) through flow control.



(c) On/Off control

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
35	163	291	419	ONOF_HYS	ON-OFF control hysteresis	PV Unit	0~10000	0	read/write



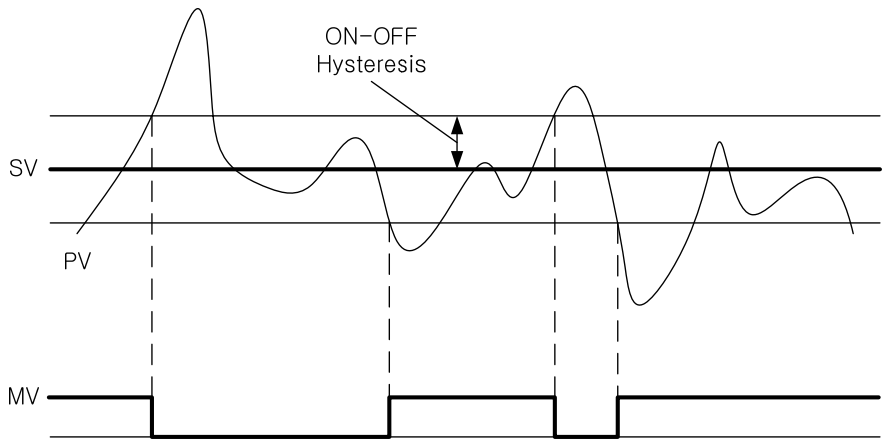
Parameter setting -New

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

OK | Cancel | Default | Read | Write

On-Off operation turns On MV when PV is smaller than SV, which the user set, and turns it off otherwise. It is like the heating that turns on when it is cold and turns off when it is warm. On-Off hysteresis applies here to filter the noise of the sensor that measures PV. In on-off operation, MV exists as on or off. In the case of a thermo-controller, when it is on, the maximum value is the output and when it is off, the minimum value is the output. The on-off operation is as follows.

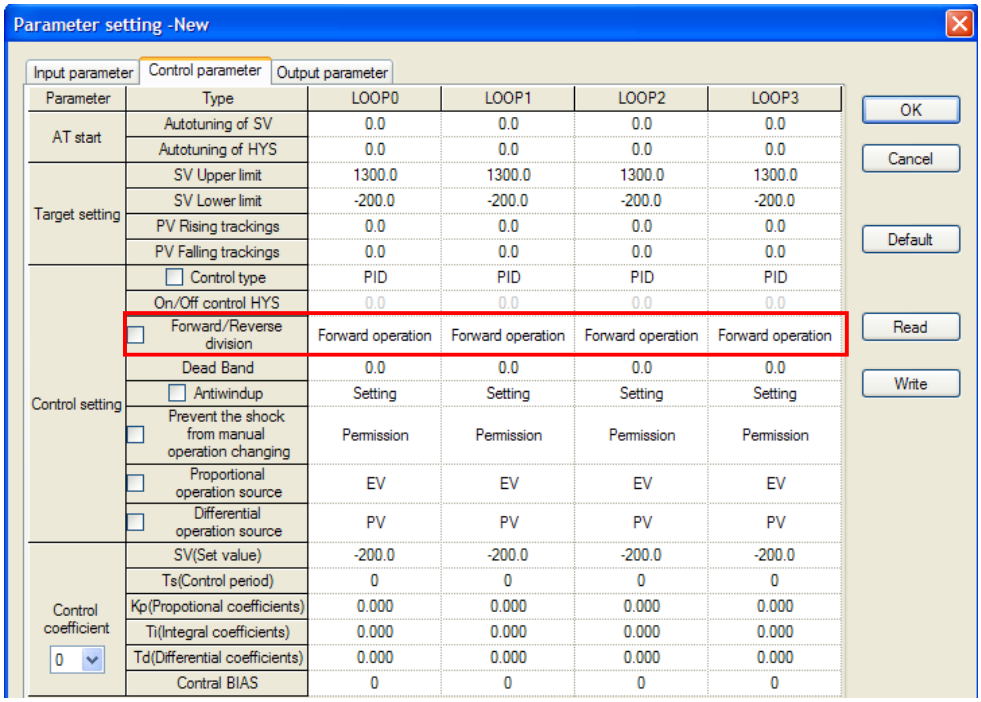


(4) Control processing method

Below are the control methods in addition to the basic control operation functions of the thermo-controller.

(a) Direct action and reverse action

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
10.0	138.0	266.0	385.0	CTRL.REV	Direct/ reverse	code	0: direct action 1: reverse action	0	read/write



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

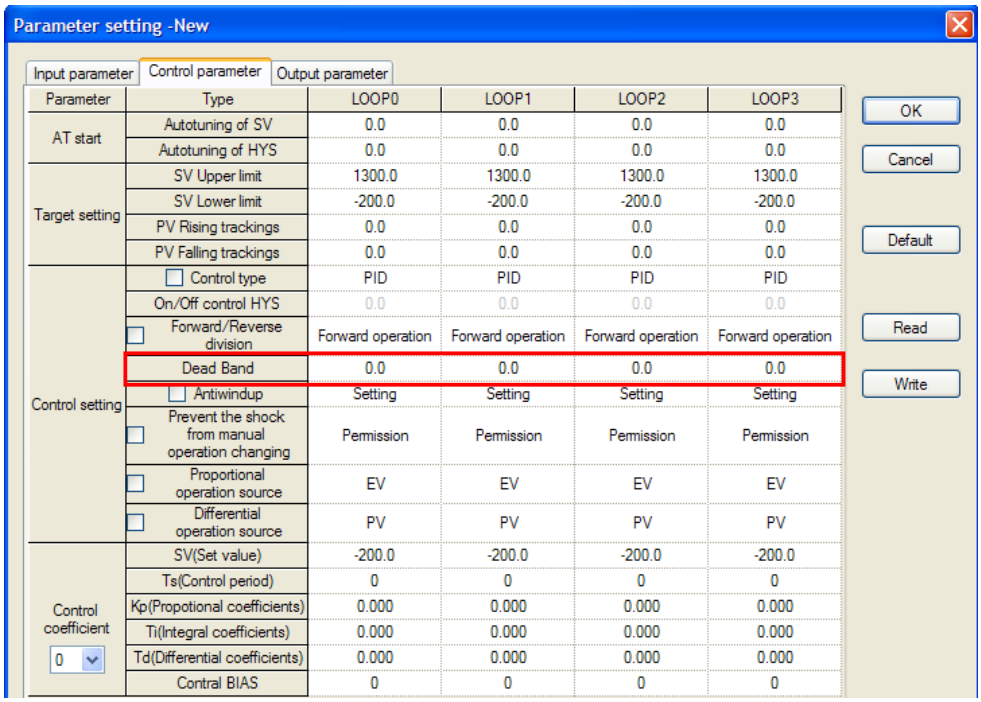
The action control divides into direct and reverse action control. There is no standard as to which of the two is defined as basic, so the user needs to keep in mind the standard of direct action by manufacturer and model. The direct action and reverse action control are defined as follows.

Direct action system: PV rises when control **output(MV) rises**
Reverse action system: PV falls when control **output(MV)rises**

A heater and a cooler are good examples. As the control output that is transmitted to the heater rises, the temperature rises, so the heating system falls into the direct action system. By contrast, the temperature falls when the control output rises, so a cooling system falls into the reverse action system. Therefore it is recommended you adjust the direct action and reverse action setting according to the characteristics of the system configured.

(b) Dead zone (as the set value)

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
12	140	268	396	DB	dead zone	PV Unit	0~10000	0	read/write

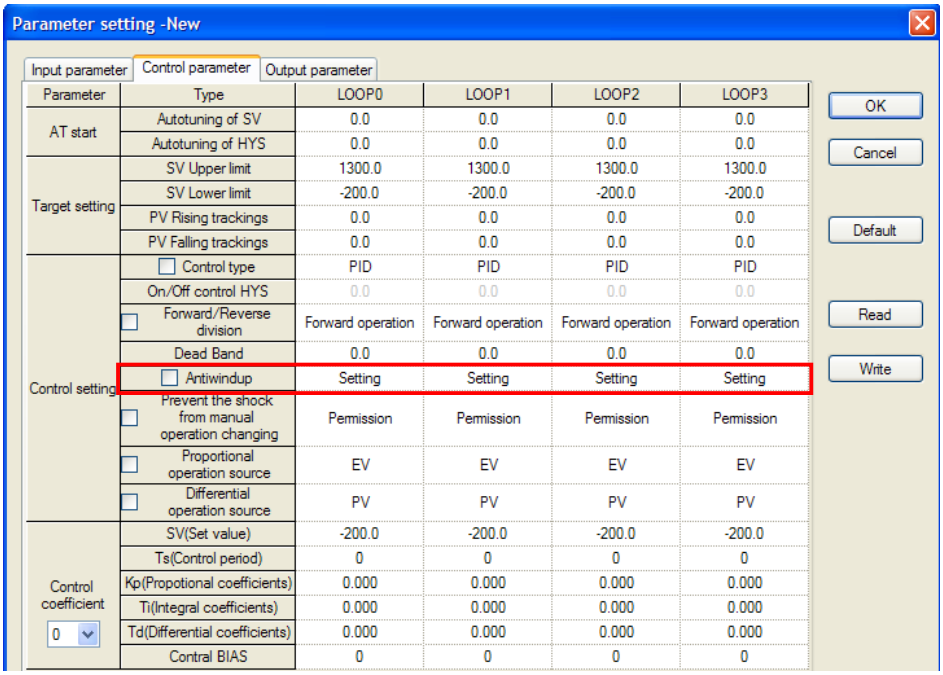


Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

The dead zone (blind sector) operates according to the value set to the corresponding parameter. It does not operate when set to 0. The dead zone is set as much as the set value upward and downward from SV. When PV is between (SV-set value) ~ (SV+set value), the control error is 0. This function enables operating of the driving part to be stable after the system becomes stable, but there might be a delay in detecting a change such as an external disturbance.

(c) Overload prevention

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
10.1	138.1	266.1	385.1	CTRL.AW2D	Overload prevention	code	0: setting 1: no	0	read/write

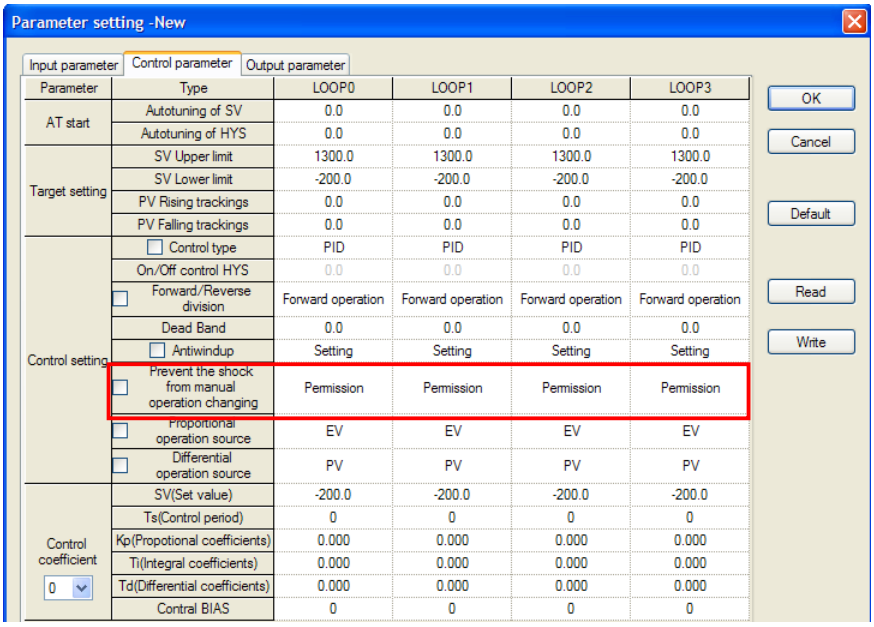


Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

Overload might happen due to an increase of the EV when SV is changed or when the system control is initiated. The function of preventing the overload can be set. When P operation source is PV, this might not normally operate.

(d) Non-impact manual escape

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
28.0	156.0	284.0	412.0	CTP.BMPL	Non-impact manual escape	code	0: yes 1: no	0	read/write

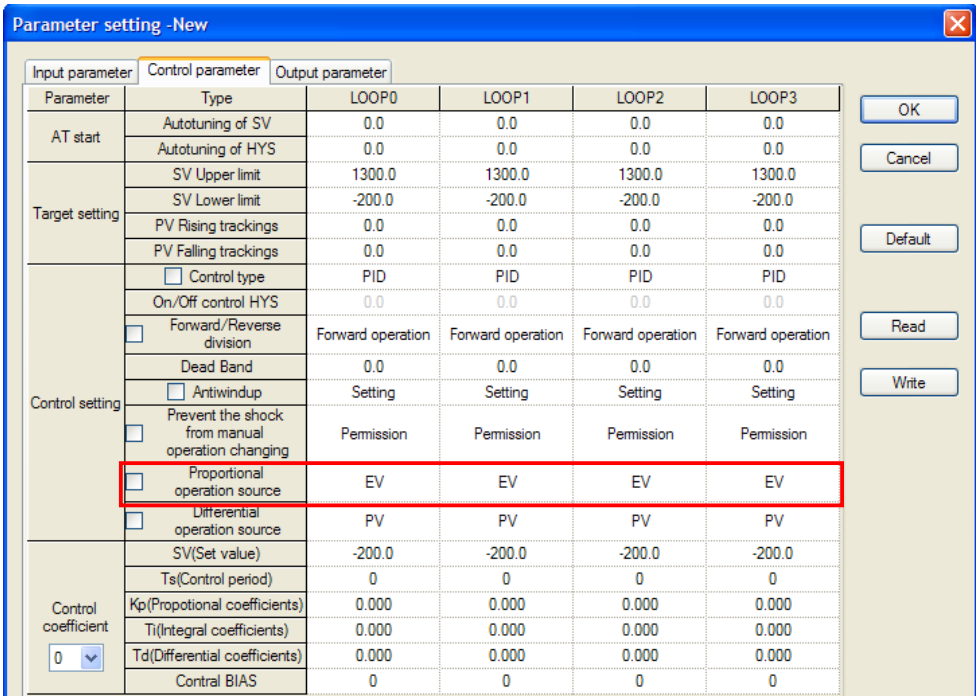


Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

There can be mode change from the automatic mode to the manual mode or vice versa due to the user's command. This is for finding the smooth starting point when the manual mode turns into the automatic mode.
The output of the manual mode is instantly divided to replace P and I operations for the previous output, so the control process can be smoothly linked. When the difference between the modes is too large, it might not be overcome.

(e) Selection of the proportional operation source

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
28.1	156.1	284.1	412.1	CTP.P_PV	Choose proportional operation source	code	0: EV 1: PV	0	read/write

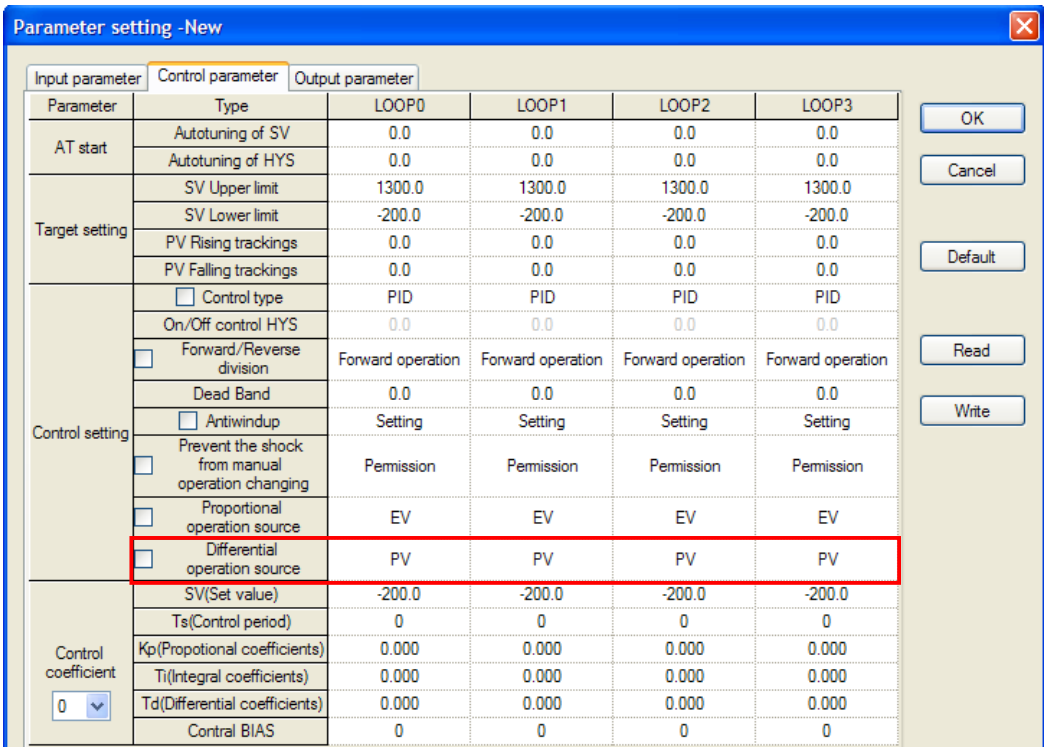


Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

This is for deciding which to use as the source to operate the proportional operation. In general, EV is used, but when PV wants slow and smooth pursuit of SV, the source is turned into PV. When PV is used as the source, the integral term declines according to the increase of the state of the system and maintains the balance, so the delay factor considerably occurs and the responsiveness might be low due to external disturbance.

(f) Selection of the differential operation source

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
28.2	156.2	284.2	412.2	CTP.D_EV	Choose differential operation source	code	0: PV 1: EV	0	read/write

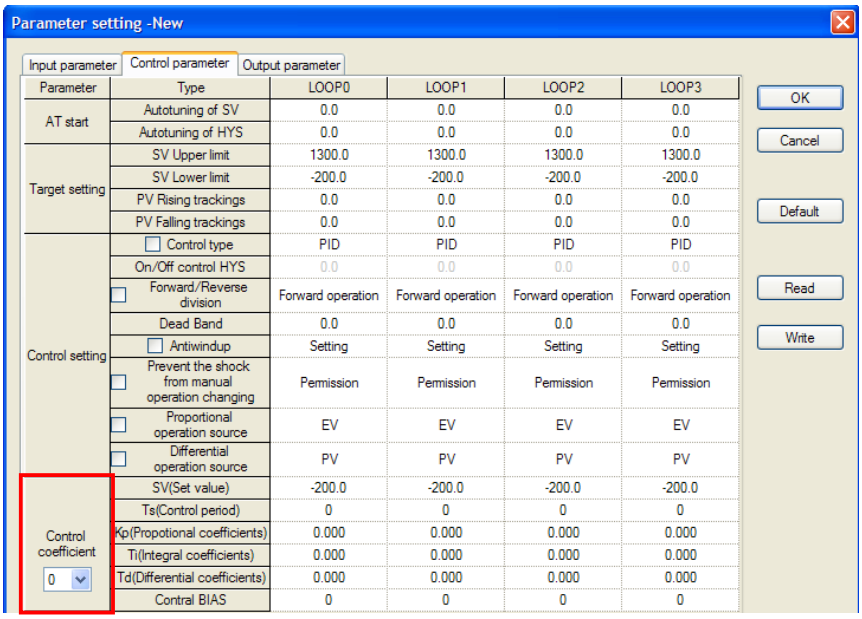


The differential operation is for measuring the change of the EV. If the SV is constant, the change of EV has the opposite sign of the change of PV, but has the same amount. But when the user changes the SV, the EV sharply changes without a large impact on PV. PV is therefore used as the differential operation source to prevent sharp increase or decrease of the driving output following SV change. The signs are different according to the direction of change of EV and PV.

(g) Control set selection

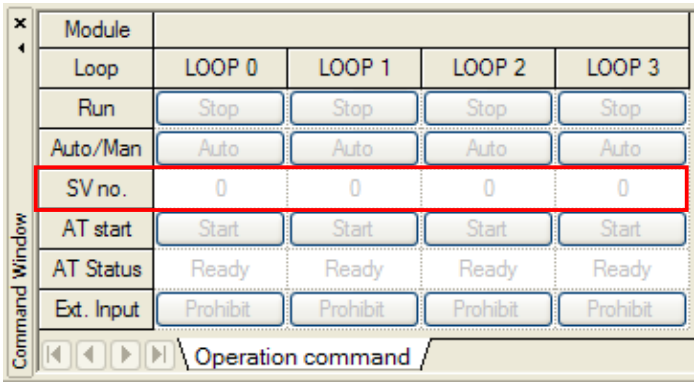
Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
Ubs.26	Ubs.27	Ubs.28	Ubs.29	ref_Cno	Choose control set	N/A	0 ~ 5	0	read/write

Note) Ubs.26~Ubs.29 indicates the U device area



SV, Ts, Kp, Ti, Td, control BIAS, which should be most frequently changed during PID operation and tuning, can be grouped to form a single control set, and up to 6 sets can be created and used. Each set description setting can be set in the parameter setting window, and when the set applies to the operating, it can be performed during stop or operating in the module status window.

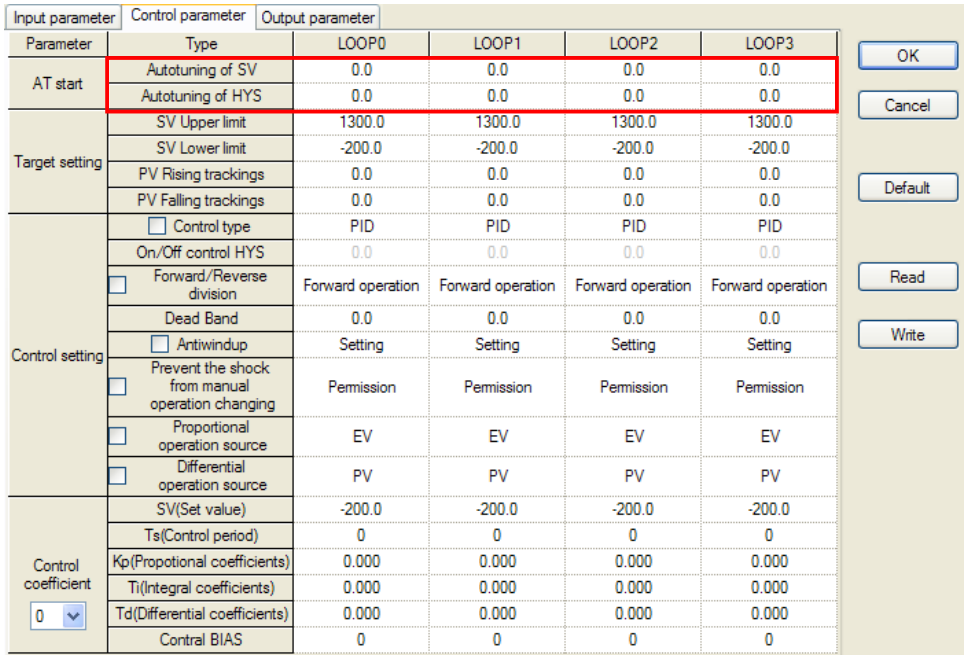
It can be used when repeated or cyclical change for control operation is needed.

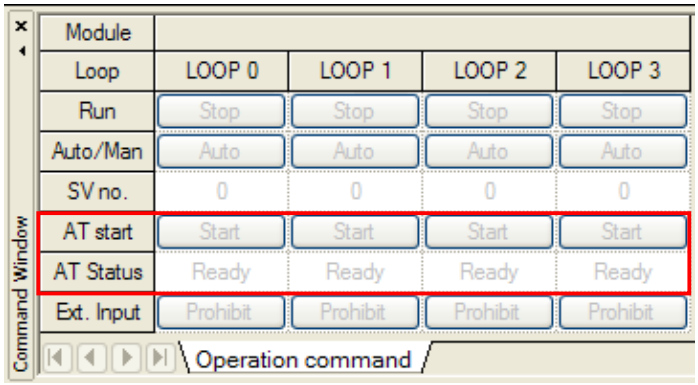


(5) Auto-tuning

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
Ubs.18.2	Ubs.19.2	Ubs.20.2	Ubs.21.2	ref_COMM .ATEN	auto-tuning starts	code	0: stop 1: starts	0	read/write
0.1	128.1	256.1	284.1	STAT.AT	auto-tuning status	code	0: stop 1: tuning	0	read
0.2	128.2	256.2	284.2	STAT.ATFAIL	auto-tuning failure notification	code	0: normal 1: failure	0	read
6	134	262	390	AT_STEP	auto-tuning stage	code	0 ; ready ~ 8: completed	0	read
29	157	285	413	AT_SV	auto-tuning target	PV Unit	SV lower limit ~SVupper limit	0	read/write
30	158	286	414	AT_HYS	auto-tuning hysteresis	PV Unit	0~10000	0	read/write

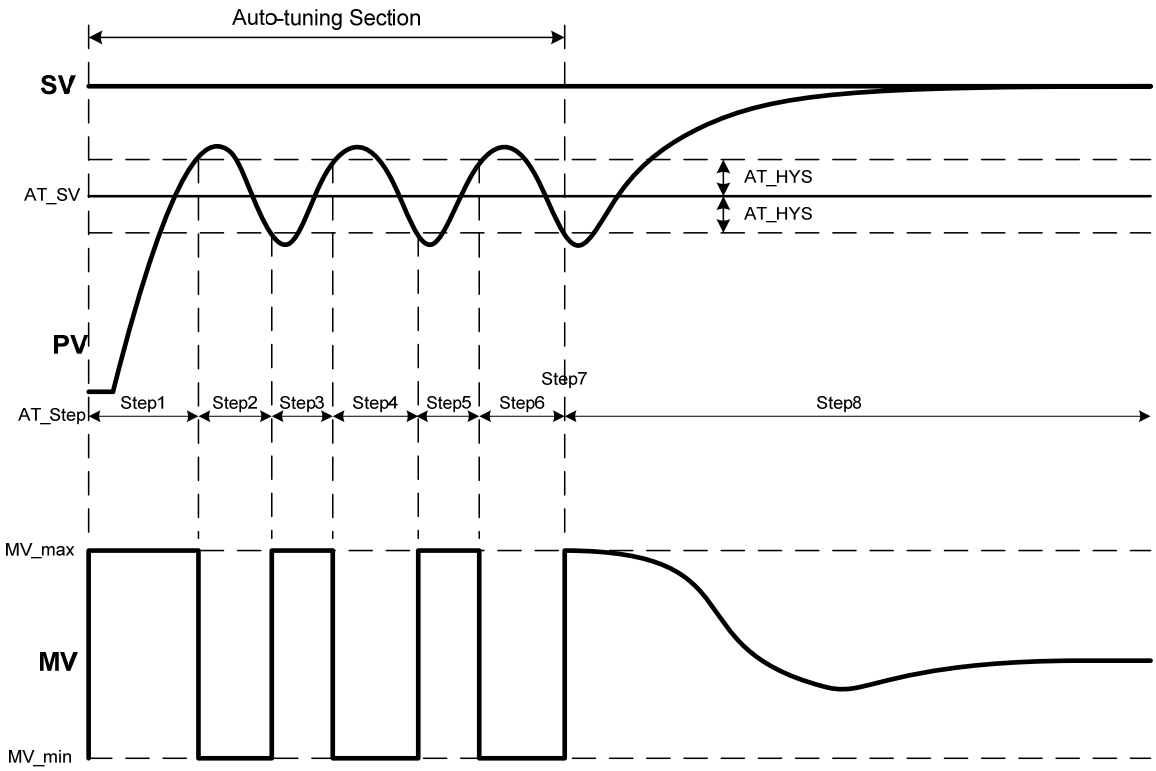
Note) Ubs.18.2~Ubs.21. indicates bit address of U device area.





The auto-tuning is for finding the proper PID factor and the operation cycle after observing the response of the system through operating during the pulse when the PID control system is formed. For auto-tuning, AT_SV should be set first. This value is the SV that is only used for auto-tuning. This value cannot be changed during auto-tuning and when auto-tuning ends, AT_SV is not used. When you set AT_HYS, it should be as small as possible and over the noise of the sensor. If the AT_HYS is too small, it might cause a failure of auto-tuning and if it is too large, it impedes the precision of auto-tuning.
Lastly, MV_max and MV_min are determined by output parameter setting. MV_max follows the maximum limit setting of HOUT and MV_min is used by adding a negative sign to the maximum value of the cooling output.
The maximum heating condition is MV_max and the maximum cooling condition is MV_min by combining the output parameters set by the user. Afterwards see if there is any step that is skipped (except step 7) while watching the increase of the auto-tuning step after bring down the auto-tuning start command. Step1, 3, and 5 are the sections that the controller reaches AT_SV+AT_HYS with the maximum output and Step2, 4, and 6 are the sections that the controller reaches AT_SV-AT_HYS with the minimum output. Step 7 is the moment (about 0.2 second) when the control factor is calculated as a result of the previous steps, so might not be observed. Step 8 means completed auto-tuning and normal operating section. Therefore most of the cases when any step escapes observation are when the system responds to the noise due to the AT_HYSsetting being too small. In such a case, raise AT_HYS and try again.

The figure below is a graph of the auto-tuning. If the linear characteristics of the sensor and the driving part are maintained, overshoot can be prevented by performing auto-tuning of AT_SV and operating it with SV.
The parameters created when auto-tuning is completed are Ts, Kp, Ti, and Td, which are written on the module automatically as soon as they are calculated. The previous parameters are deleted, so do not forget to save them before auto-tuning.



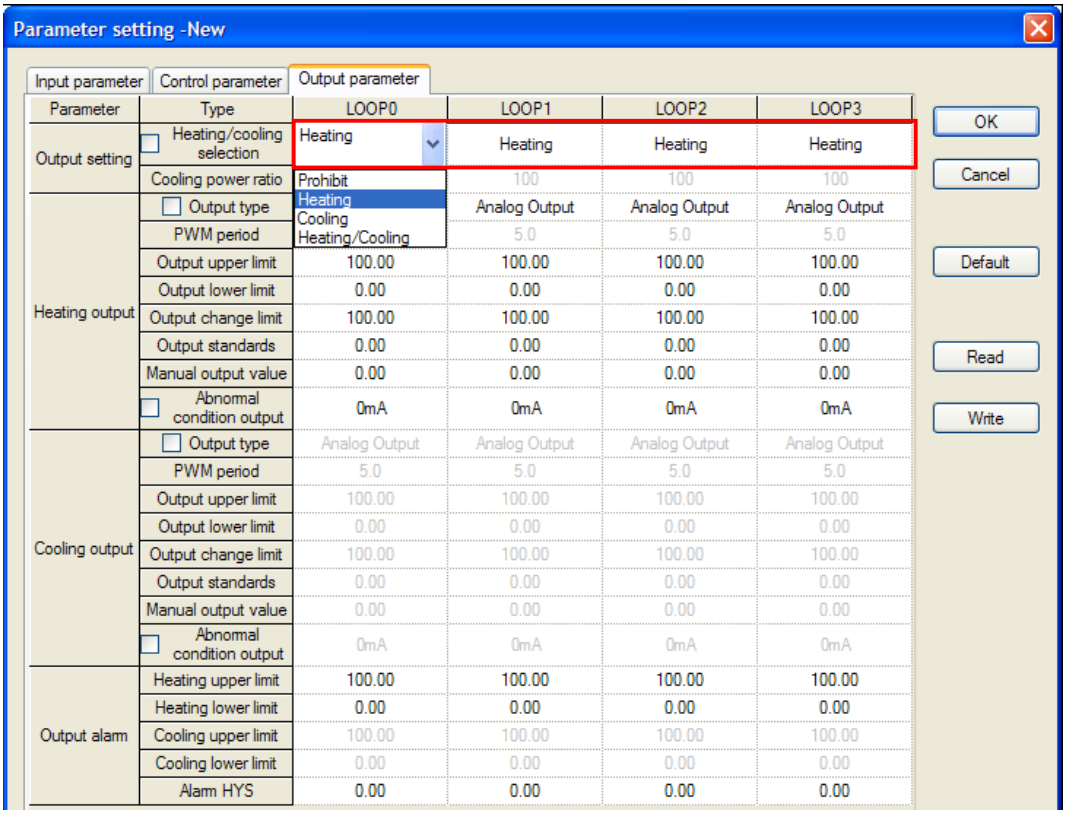
4.2.5 output parameter

(1) Output setting

(a) Heating/cooling selection

The output can be set as heating, cooling, and heating/cooling.

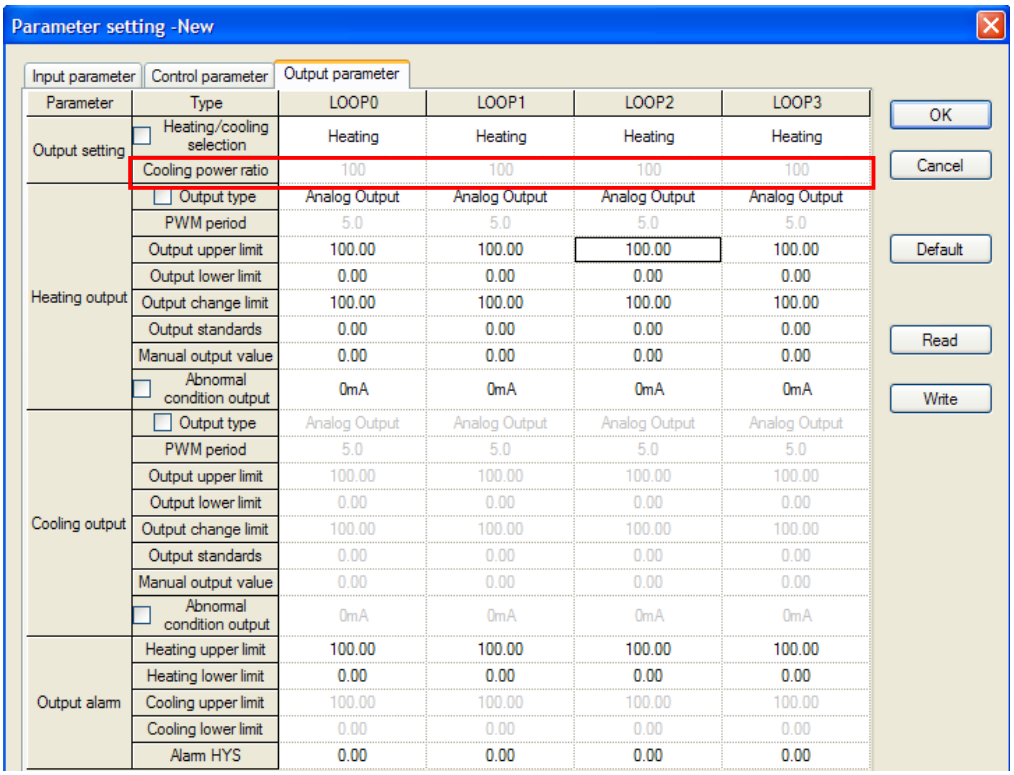
Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
10.2	138.2	266.2	394.2	CTRL.HSEL	Choose heating/ cooling	N/A	0: no 1: heating 2: cooling 3: heating/ cooling	0	read/write



(b) Cooling output proportion

The proportion of cooling to heating output is set.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
36	164	292	420	HC_RATE	Cooling output proportion setting	%	0~100	0	read/write

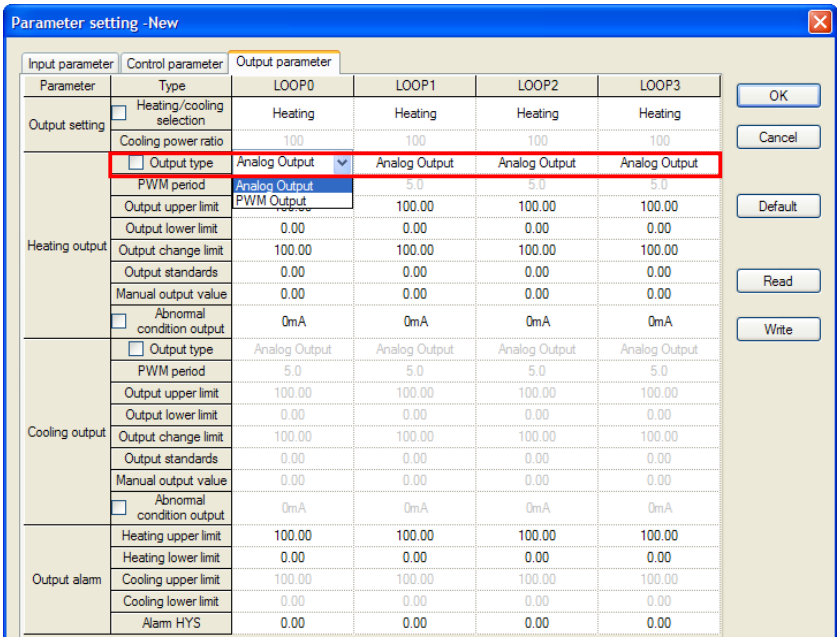


(2) Heating output

(a) Output type

You can set analog output or PWM output.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
10.6	138.6	266.6	394.6	CTRL.HTY	output type selection	N/A	0: analog output 1: PWM output	0	read/write

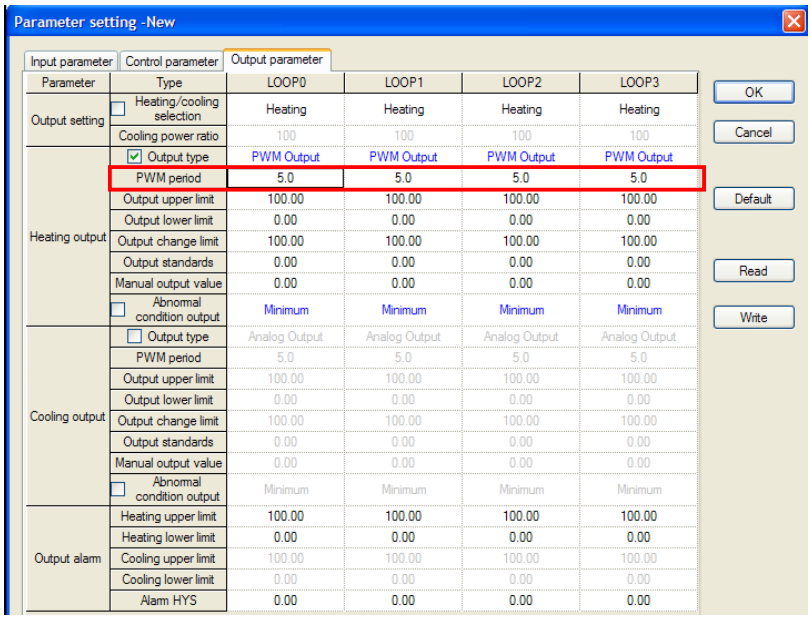


(b) PWM cycle setting

The pulse output cycle to be used for PWM output can be set.

The setting range is 5(0.5sec)~1200(120.0sec).

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
37	165	293	421	H_PTIME	PWM cycle	sec	5~1200 (0.5~120.0[sec])	0	read/write



(c) Output upper/lower limit

Output upper/lower limit setting is limiting the upper/lower limit of the analog output value input by the user. When the value input by the user is greater than the value set in the output upper limit during output upper/lower limit setting, the output upper limit is output and otherwise, the output lower limit is output.

1) Output upper limit

The setting range is'-5.00~105.00.'

The actual setting range is 'output lower limit~105.00.'

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
38	166	294	422	H_MAX	output upper limit	%	-5.00~105.00	0	read/write

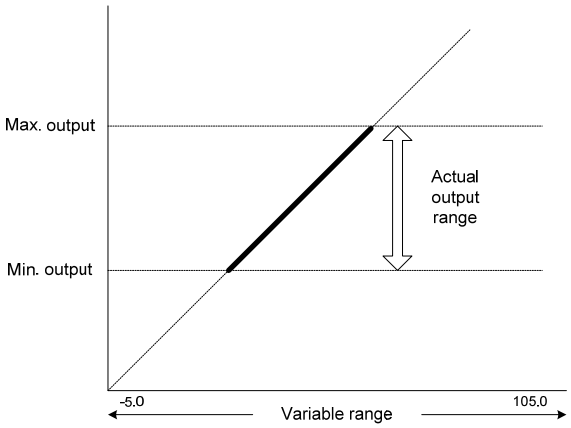
2) Output lower limit

The setting range is'-5.00~105.00.'

The actual setting range is '-5.00~output upper limit.'

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
39	167	295	423	H_MIX	output lower limit	%	-5.00~105.00	0	read/write

3) The analog output value during output upper/lower limit setting is as follows.

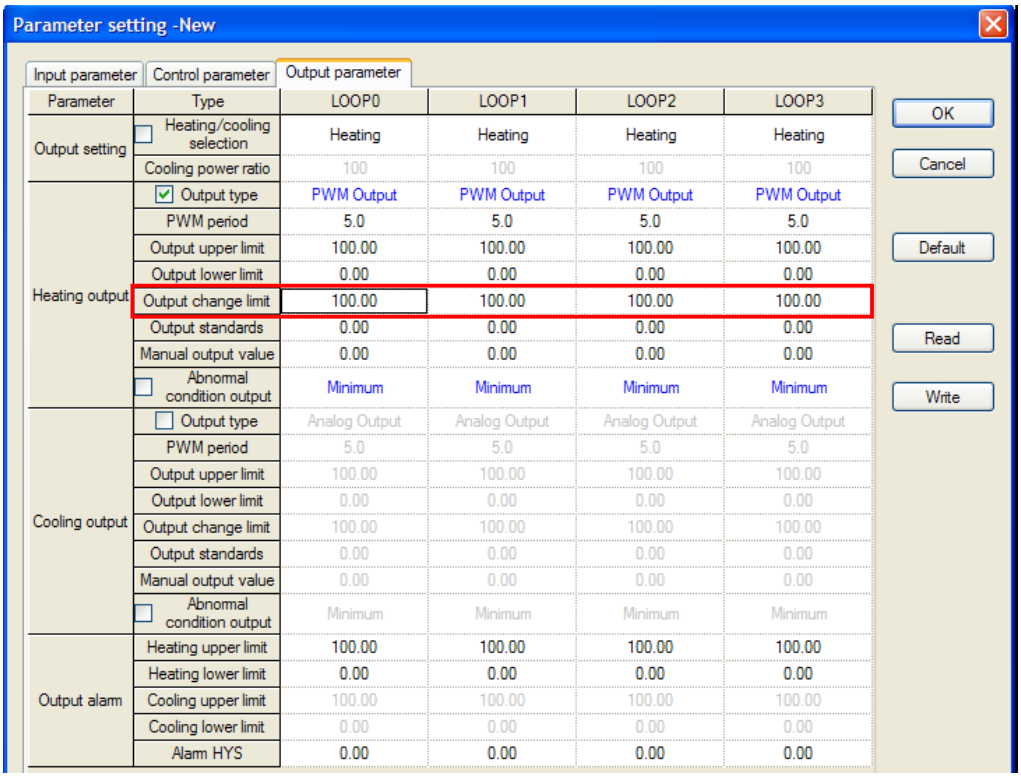


(d) Limit of output change

This is for preventing a sharp change of the output.

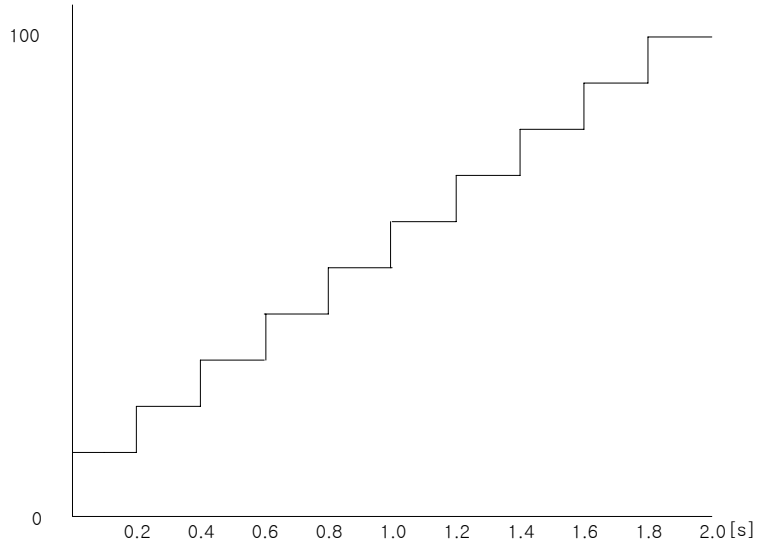
Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
40	168	296	424	H_DMAX	Output change limit	%	0.00~100.00	0	read/write

1) output change limit: the setting range is‘0.00~100.00.’
2) You can set the parameter as follows.
a) Set the heating cooling of output setting as heating in the output parameter window.
b) Enter the set value in the output change limit in the heating output.



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Output setting	Heating/cooling selection	Heating	Heating	Heating	Heating
	Cooling power ratio	100	100	100	100
Heating output	Output type	PWM Output	PWM Output	PWM Output	PWM Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Cooling output	Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Output alarm	Heating upper limit	100.00	100.00	100.00	100.00
	Heating lower limit	0.00	0.00	0.00	0.00
	Cooling upper limit	100.00	100.00	100.00	100.00
	Cooling lower limit	0.00	0.00	0.00	0.00
	Alarm HYS	0.00	0.00	0.00	0.00

3) The analog output value in output change limit is as follows.
Analog output value: 0 → 100
Output change limit: 10



(e) Output reference

Set the reference of the output to go out without output.

Set the output that can stabilize the system without control.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
41	169	297	425	H_REF	Output reference	%	-50.00~50.00	0	read/write

(f) Manual output value

The analog output value is output as the manual output analog output value input by the user. To output as the manual output value, automatic/manual should be set as the manual in the module status window.

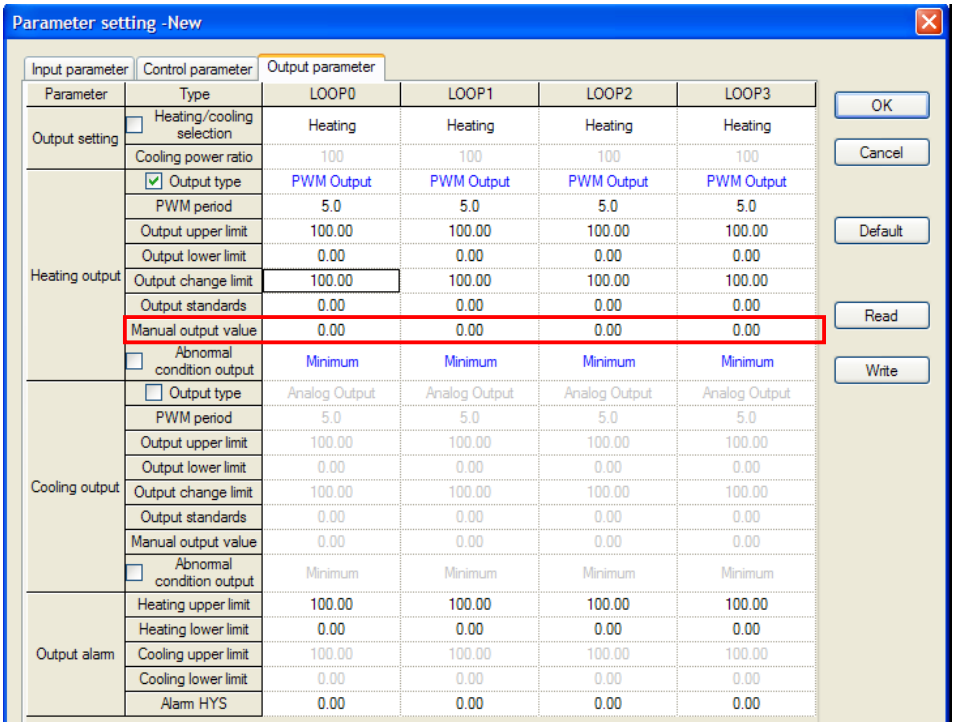
Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
43	171	299	427	H_MAN	manual output value	%	-5.00~105.00	0	read/write

1) Manual output value range: the setting range is'-5.00~105.00.'

2) You can set the parameter as follows.

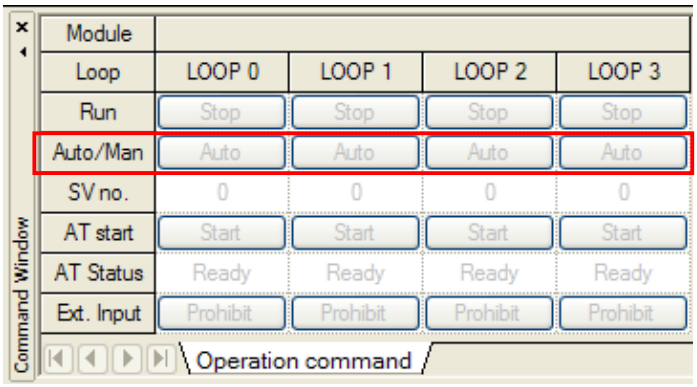
a) Set the heating cooling selection as heating in the output parameter window.

b) Enter the set value in the manual output value of the heating output.



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Output setting	Heating/cooling selection	Heating	Heating	Heating	Heating
	Cooling power ratio	100	100	100	100
Heating output	Output type	PWM Output	PWM Output	PWM Output	PWM Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Cooling output	Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Output alarm	Heating upper limit	100.00	100.00	100.00	100.00
	Heating lower limit	0.00	0.00	0.00	0.00
	Cooling upper limit	100.00	100.00	100.00	100.00
	Cooling lower limit	0.00	0.00	0.00	0.00
	Alarm HYS	0.00	0.00	0.00	0.00

c) Set automatic/manual as manual in the module status window.

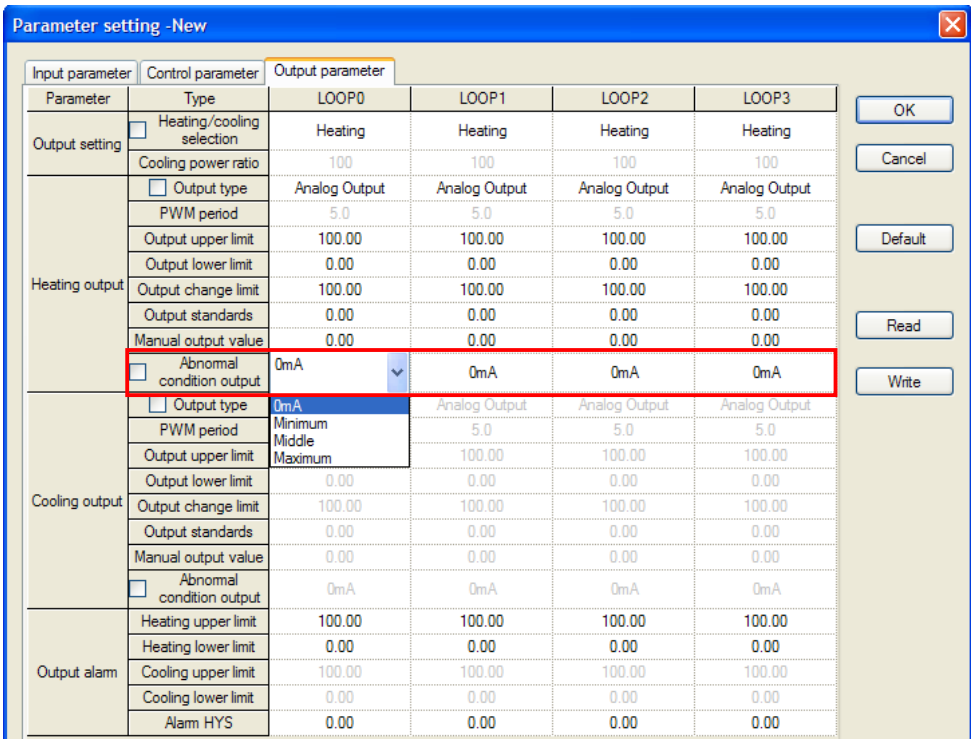


(g) Failure output value

The value to be output in case of an error of the thermo-controller module can be set.

The failure output value setting can be set as 'OmA/minimum/medium/maximum.'

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
42	170	298	426	H_EOUT	Failure output value	N/A	0: 0mA 1: min. 2: med. 3: max.	0: 0mA	read/write

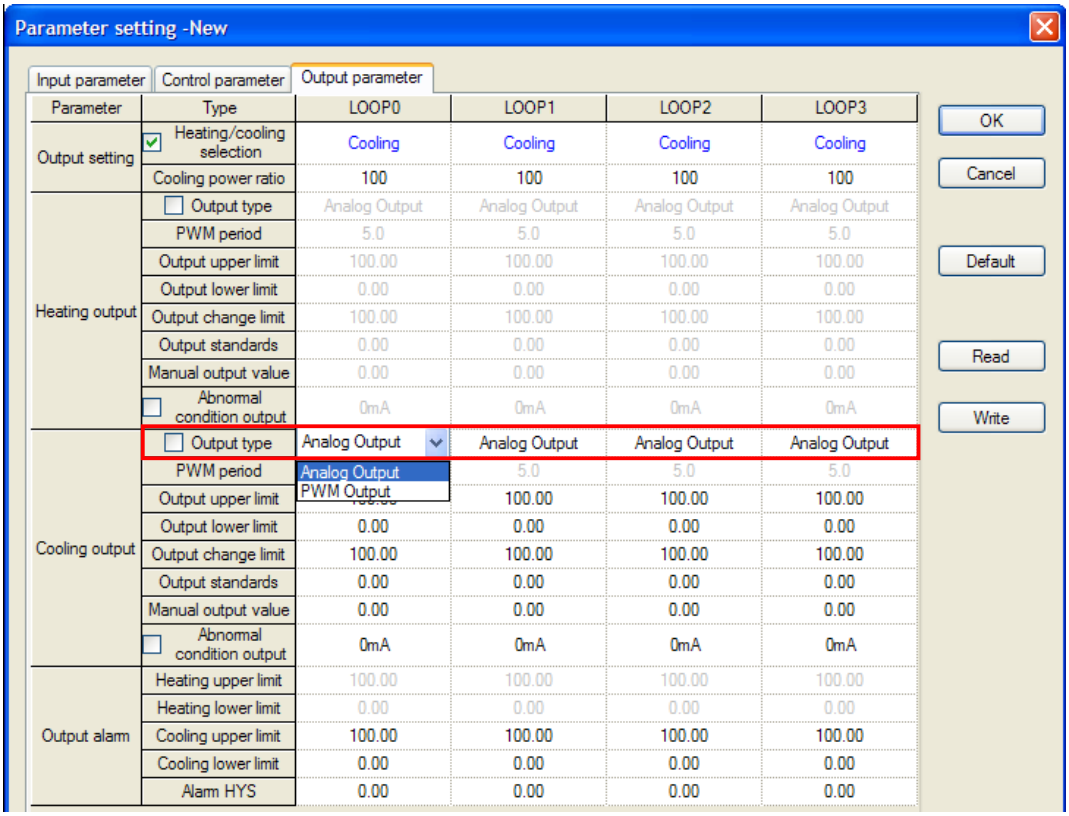


(3) Cooling output

(a) Output type

The output can be set as the analog output or PWM output.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
10.7	138.7	266.7	394.7	CTRL.CTY	Choose output type	N/A	0: analog output 1: PWM output	0	read/write

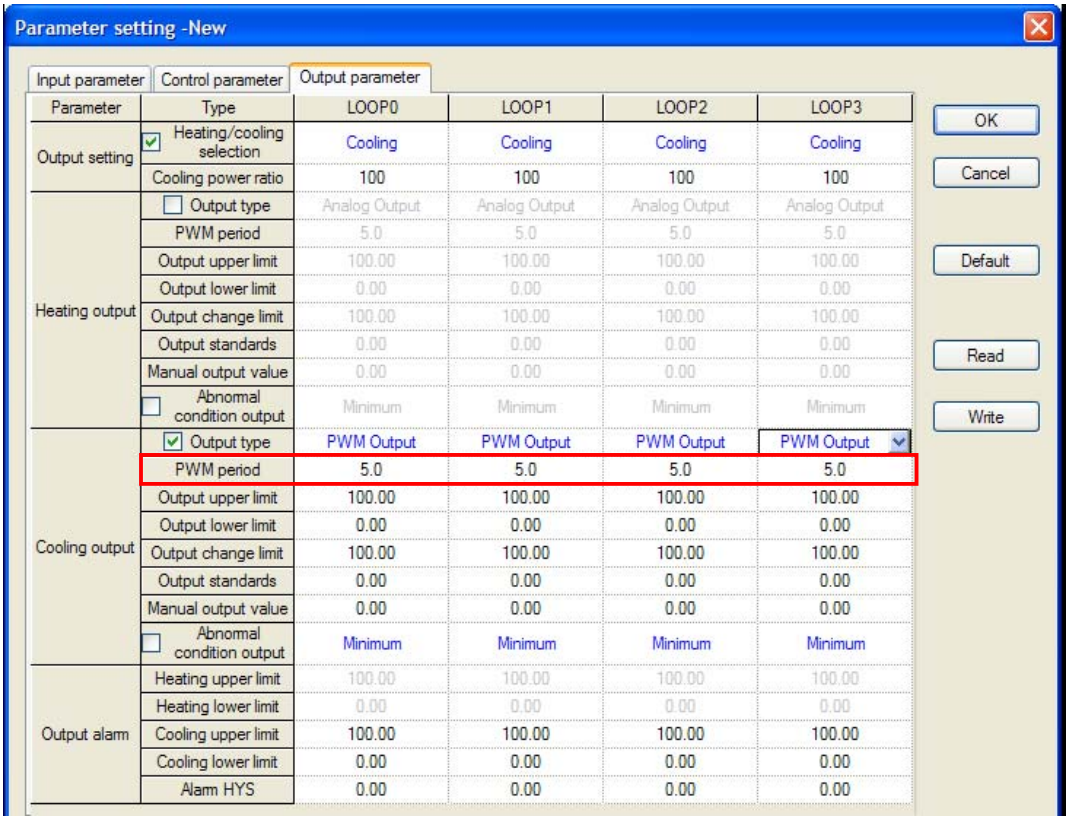


(b) PWM cycle setting

The pulse output cycle to be used for PWM output can be set.

The setting range is 5(0.5sec)~1200(120.0sec).

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
48	176	304	432	C_PTIME	PWM cycle	sec	5~1200 (0.5~120.0 [sec])	0	read/write



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Output setting	Heating/cooling selection	Cooling	Cooling	Cooling	Cooling
	Cooling power ratio	100	100	100	100
Heating output	Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Cooling output	Output type	PWM Output	PWM Output	PWM Output	PWM Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Output alarm	Heating upper limit	100.00	100.00	100.00	100.00
	Heating lower limit	0.00	0.00	0.00	0.00
	Cooling upper limit	100.00	100.00	100.00	100.00
	Cooling lower limit	0.00	0.00	0.00	0.00
	Alarm HYS	0.00	0.00	0.00	0.00

(c) Output upper/lower limit

The output upper/lower limit setting is for limiting the upper/lower limit of the analog output value for the value input by the user.

If the value set by the user is greater than the value set in the output upper limit in output upper/lower limit setting, the output upper limit is output and otherwise the output lower limit is output.

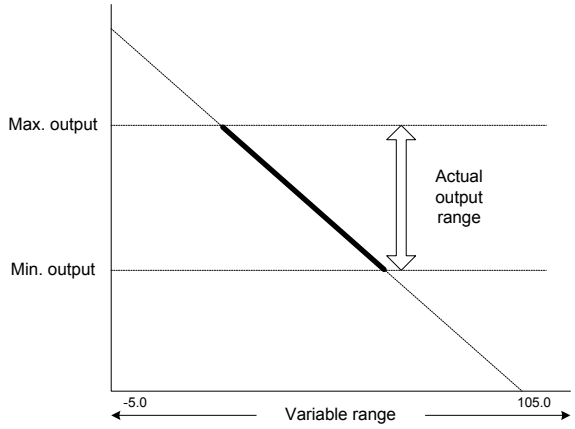
1) Output upper limit: the setting range is '-5.00~105.00.'
The actual setting Range is 'output lower limit~105.00.'

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
49	177	305	433	C_MAX	output upper limit	%	-5.00~105.00	0	read/write

2) Output lower limit: the setting range is '-5.00~105.00.'
The actual setting Range is '-5.00~output upper limit.'

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
50	178	306	434	C_MIN	output lower limit	%	-5.00~105.00	0	read/write

3) The analog output value in output upper/lower limit setting is as follows.

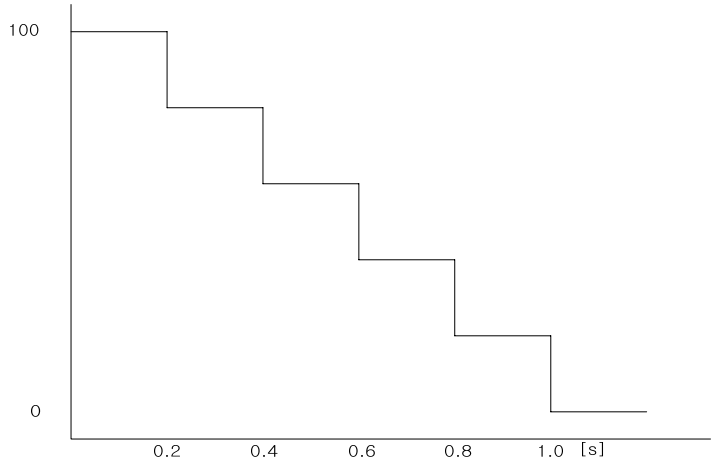


(d) Limiting output change

This is for limiting the output change to prevent the driving part by preventing a sharp change of the output.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
51	179	307	435	C_DMAX	output change limit	%	0.00~100.00	0	read/write

1) Limiting output change: the setting range is‘0.00~100.00.’
2) You can set the parameter as follows.
3) The analog output value in output change limit is as follows.
Analog output value: 100 → 0
Output change limit: 20



(e) Output reference

The reference of the output to go out without output can be set.
The output that can stabilize the system without control can be set.

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
52	180	308	436	C_REF	output reference	%	-50.00~50.00	0	read/write

(f) Manual output value

The analog output value can be output as the manual output value input by the user.
To be output as the manual output value, automatic/manual should be set as manual in the module status window.

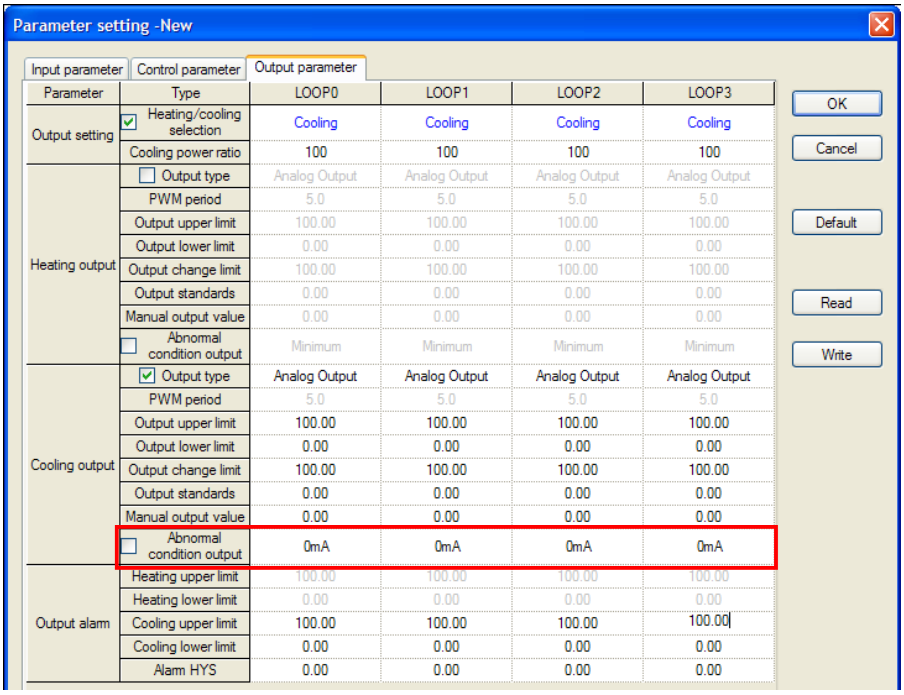
Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
54	182	310	438	C_MAN	manual output value	%	-5.00~105.00	0	read/write

1) Manual output value Range: The setting range is‘-5.00~105.00.’

(g) Failure output value

The value to be output in case of an error of the thermo-controller module is set.
The failure output value setting can be set as ‘OmA/minimum/medium/maximum.’

Address (decimal)				Symbol	Description	Unit	Range	Initial value	Attributes
LOOP 0	LOOP 1	LOOP 2	LOOP 3						
53	181	309	437	C_EOUT	Failure output value	N/A	0: 0mA 1: min. 2: med. 3: max.	0: 0mA	read/write



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Output setting	☑ Heating/cooling selection	Cooling	Cooling	Cooling	Cooling
	Cooling power ratio	100	100	100	100
Heating output	☐ Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	☐ Abnormal condition output	Minimum	Minimum	Minimum	Minimum
Cooling output	☑ Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	☐ Abnormal condition output	0mA	0mA	0mA	0mA
Output alarm	Heating upper limit	100.00	100.00	100.00	100.00
	Heating lower limit	0.00	0.00	0.00	0.00
	Cooling upper limit	100.00	100.00	100.00	100.00
	Cooling lower limit	0.00	0.00	0.00	0.00
	Alarm HYS	0.00	0.00	0.00	0.00

4.2.6 Other Functions

(1) Alarm

(a) Input alarm

The input alarm setting is [further upper limit], [upper limit], [lower limit], and [further lower limit]. When the digital output value is out of the input alarm setting value range, the alarm flag is set off. Otherwise, the flag is terminated. You can also set the termination condition of the alarm flag by using [alarm HYS].

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0
Input type	☐ Input type	K: -200 ~ 1300 deg.
	☐ Short circuit	Permission
	Upper limit of effective input	1300.0
	Lower limit of effective input	-200.0
	Upper limit of scale	1300.0
	Lower limit of scale	-200.0
	☐ Decial point of scale value	1
Input process	☐ Square root	Prohibit
	LOW CUT	0.0
	Input BIAS	0.0
	☐ Average type	Weighted average
	Average value	0
Input alarm	High upper limit	1300.0
	Upper limit	1300.0
	Lower limit	-200.0
	Low lower limit	-200.0
	Alarm HYS	0.0
Cold junction compensation	☐ Compensation method	Internal RJC
	External RJC	0.0

1) When the digital output value is 350.0℃ -> upper limit Flag On

2) When the digital output value is 295.0℃ -> upper limit Flag On

As the alarm HYS is set at 10.0 in the example above, the digital output value should be below 290.0℃ for the upper limit flag to turn off.

3) When the digital output value is -210.0℃ -> lower limit, further lower limit Flag On

4) When the digital output value is -195℃ -> lower limit, further lower limit Flag On(kept)

As the alarm HYS is set at 10.0 in the example above, the digital output value should be below -190.0℃ for the further lower limit flag to turn off

5) When the digital output value is -150℃ => lower limit Flag On, further lower limit Flag Off

(2) Output alarm

The alarm is set off when out of the value set by the user. The output alarm setting does not affect the analog output value.
For setting, enter the set value in the heating upper limit, heating lower limit, cooling upper limit, cooling lower limit in the output alarm of the output parameter window.
For there to be a hysteresis on the borderline of the alarms, set the entry and escape points separately.

Chapter 5 Configuration and Functions of Internal Memory (XGI/XGR)

5.1 Global Variables (Data Area)

5.1.1 Global Variables (Data Area)

Table 5.1 shows the U device area of the thermo-controller.

Global variables	Data type	Description
_xxyy_CH0_ACT	BOOL	channel0 operating
_xxyy_CH1_ACT	BOOL	channel1 operating
_xxyy_CH2_ACT	BOOL	channel2 operating
_xxyy_CH3_ACT	BOOL	channel3 operating
_xxyy_CH0_BOUT	BOOL	channel0 disconnect
_xxyy_CH1_BOUT	BOOL	channel1 disconnect
_xxyy_CH2_BOUT	BOOL	channel2 disconnect
_xxyy_CH3_BOUT	BOOL	channel3 disconnect
_xxyy_CH0_ADCERR	BOOL	channel0 A/D conversion error
_xxyy_CH1_ADCERR	BOOL	channel1 A/D conversion error
_xxyy_CH2_ADCERR	BOOL	channel2 A/D conversion error
_xxyy_CH3_ADCERR	BOOL	channel3 A/D conversion error
_xxyy_CHECKSUMERR	BOOL	module backup memory error
_xxyy_ERR	BOOL	module error
_xxyy_RDY	BOOL	module Ready
_xxyy_WR_ING	BOOL	parameter backup (writing)
_xxyy_RD_ING	BOOL	parameter restoring (reading)
_xxyy_CH0_ALINHH	BOOL	channel0 input alarm further upper limit
_xxyy_CH0_ALINH	BOOL	channel0 input alarm upper limit
_xxyy_CH0_ALINL	BOOL	channel0 input alarm lower limit
_xxyy_CH0_ALINLL	BOOL	channel0 input alarm further lower limit
_xxyy_CH0_ALHOH	BOOL	channel0 heating output alarm upper limit
_xxyy_CH0_ALHOL	BOOL	channel0 heating output alarm lower limit
_xxyy_CH0_ALCOH	BOOL	channel0 cooling output alarm upper limit
_xxyy_CH0_ALCOL	BOOL	channel0 cooling output alarm lower limit
_xxyy_CH1_ALINHH	BOOL	channel1 input alarm further upper limit
_xxyy_CH1_ALINH	BOOL	BOOL channel1 input alarm upper limit
_xxyy_CH1_ALINL	BOOL	channel1 input alarm lower limit
_xxyy_CH1_ALINLL	BOOL	channel1 input alarm further lower limit
_xxyy_CH1_ALHOH	BOOL	channel1 heating output alarm upper limit
_xxyy_CH1_ALHOL	BOOL	channel1 heating output alarm lower limit
_xxyy_CH1_ALCOH	BOOL	channel1 cooling output alarm upper limit
_xxyy_CH1_ALCOL	BOOL	channel1 cooling output alarm lower limit

[Table 5. 1] U device area

- In device assignment, xx represents the number of the base with a module and yy the number of the slot with a module.

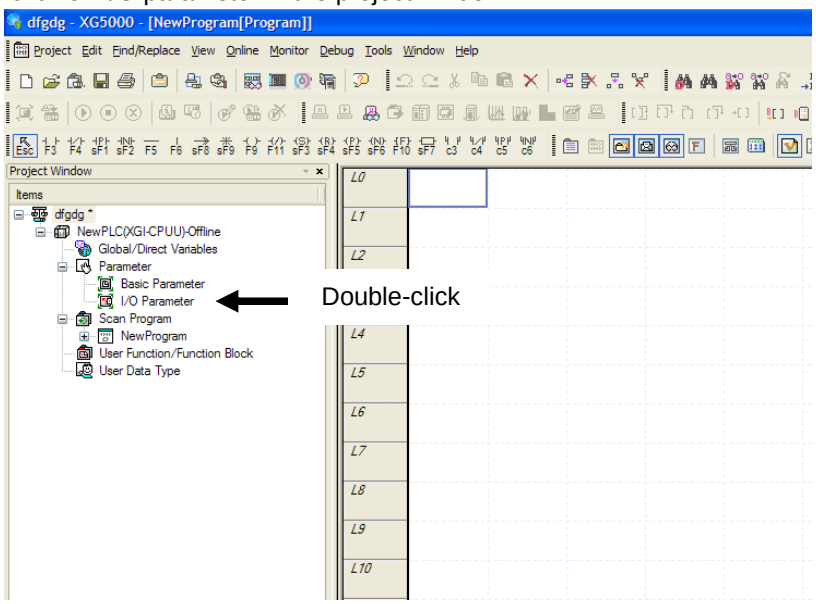
Global variables	Data type	Description
_xxyy_CH2_ALINHH	BOOL	channel2 input alarm further upper limit
_xxyy_CH2_ALINH	BOOL	channel2 input alarm upper limit
_xxyy_CH2_ALINL	BOOL	channel2 input alarm lower limit
_xxyy_CH2_ALINLL	BOOL	channel2 input alarm further lower limit
_xxyy_CH2_ALHOH	BOOL	channel2 heating output alarm upper limit
_xxyy_CH2_ALHOL	BOOL	channel2 heating output alarm lower limit
_xxyy_CH2_ALCOH	BOOL	channel2 cooling output alarm upper limit
_xxyy_CH2_ALCOL	BOOL	channel2 cooling output alarm lower limit
_xxyy_CH3_ALINHH	BOOL	channel3 input alarm further upper limit
_xxyy_CH3_ALINH	BOOL	channel3 input alarm upper limit
_xxyy_CH3_ALINL	BOOL	channel3 input alarm lower limit
_xxyy_CH3_ALINLL	BOOL	channel3 input alarm further lower limit
_xxyy_CH3_ALHOH	BOOL	channel3 heating output alarm upper limit
_xxyy_CH3_ALHOL	BOOL	channel3 heating output alarm lower limit
_xxyy_CH3_ALCOH	BOOL	channel3 cooling output alarm upper limit
_xxyy_CH3_ALCOL	BOOL	channel3 cooling output alarm lower limit
_xxyy_CH0_PV	WORD	channel0 input value
_xxyy_CH1_PV	WORD	channel1 input value
_xxyy_CH2_PV	WORD	channel2 input value
_xxyy_CH3_PV	WORD	channel3 input value
_xxyy_CH0_HOUT	WORD	channel0 heating output value
_xxyy_CH1_HOUT	WORD	channel1 heating output value
_xxyy_CH2_HOUT	WORD	channel2 heating output value
_xxyy_CH3_HOUT	WORD	channel3 heating output value
_xxyy_CH0_COUT	WORD	channel0 cooling output value
_xxyy_CH1_COUT	WORD	channel1 cooling output value
_xxyy_CH2_COUT	WORD	channel2 cooling output value
_xxyy_CH3_COUT	WORD	channel3 cooling output value
_xxyy_CH0_RUN	BOOL	channel0 operating command
_xxyy_CH0_MAN	BOOL	channel0 manual mode command
_xxyy_CH0_ATEN	BOOL	channel0 auto-tuning command
_xxyy_CH0_EXIN	BOOL	channel0 external input allowing command
_xxyy_CH1_RUN	BOOL	channel1 operating command
_xxyy_CH1_MAN	BOOL	channel1 manual mode command
_xxyy_CH1_ATEN	BOOL	channel1 auto-tuning command
_xxyy_CH1_EXIN	BOOL	channel1 external input allowing command
_xxyy_CH2_RUN	BOOL	channel2 operating command
_xxyy_CH2_MAN	BOOL	channel2 manual mode command
_xxyy_CH2_ATEN	BOOL	channel2 auto-tuning command
_xxyy_CH2_EXIN	BOOL	channel2 external input allowing command
_xxyy_CH3_RUN	BOOL	channel3 operating command
_xxyy_CH3_MAN	BOOL	channel3 manual mode command
_xxyy_CH3_ATEN	BOOL	channel3 auto-tuning command
_xxyy_CH3_EXIN	BOOL	channel3 external input allowing command
_xxyy_CH0_EXINV	BOOL	channel0 external input data
_xxyy_CH1_EXINV	BOOL	channel1 external input data
_xxyy_CH2_EXINV	BOOL	channel2 external input data
_xxyy_CH3_EXINV	BOOL	channel3 external input data
_xxyy_CH0_CSET	WORD	channel0 control set selection
_xxyy_CH1_CSET	WORD	channel1 control set selection
_xxyy_CH2_CSET	WORD	channel2 control set selection
_xxyy_CH3_CSET	WORD	channel3 control set selection
_xxyy_WRITE	BOOL	parameter backup command (writing)
_xxyy_READ	BOOL	parameter restoring command (reading)

5.1.2 How to Use Global Variables

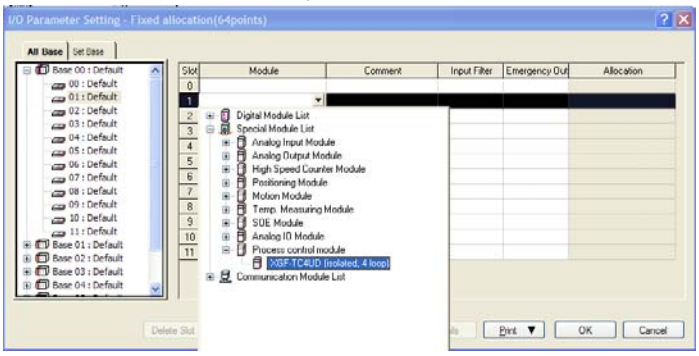
(1) Registration of the I/O Parameter

- Register the module you want to use with I/O parameter.

(a) Double click on I/O parameter in the project window.



(b) Choose XGF-TC4UDmodule in the I/O parameter window.

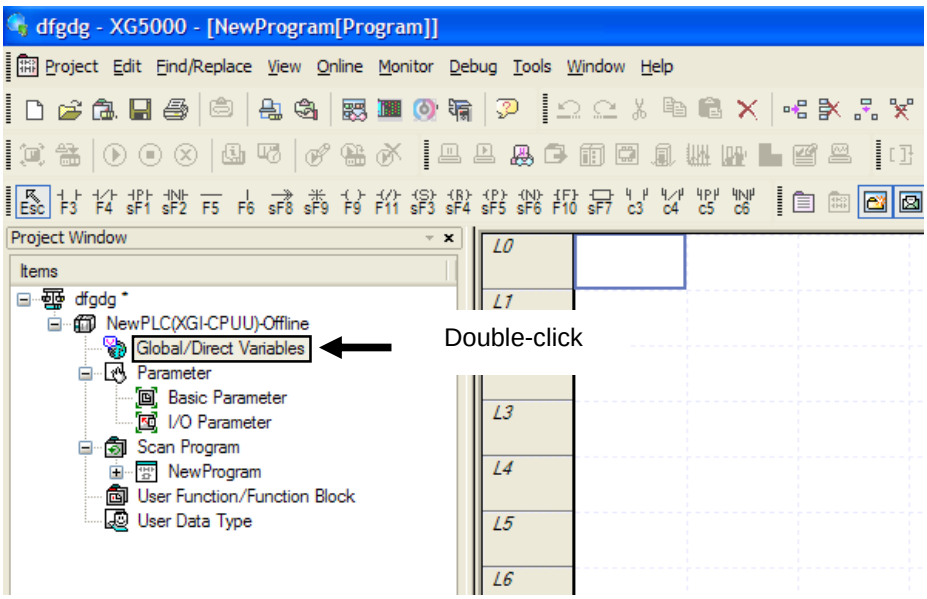


(d) Click on [Ok].

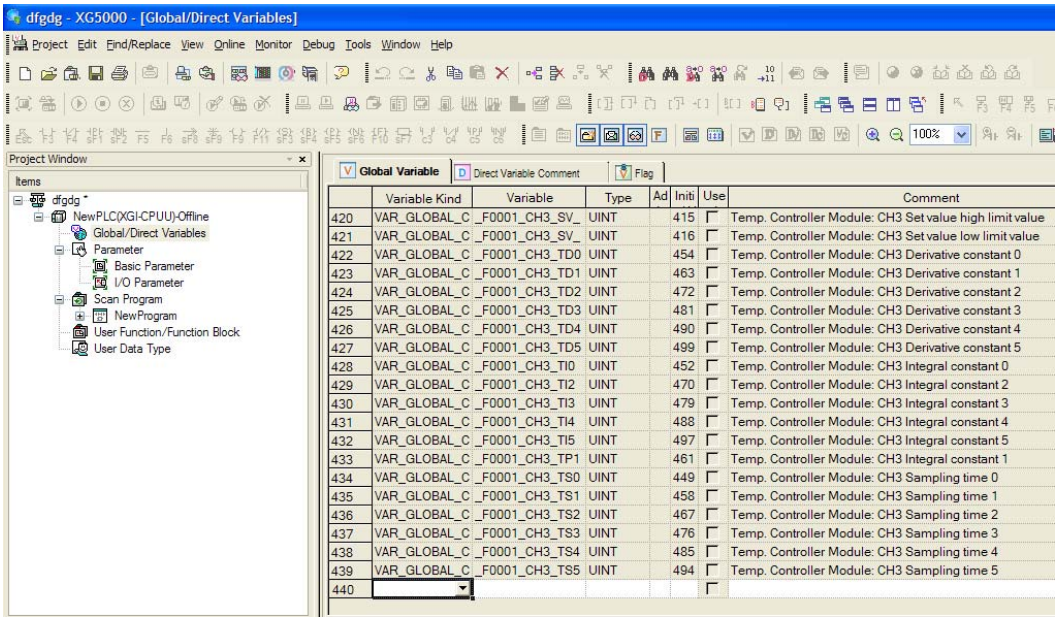
(e) Click on [Y].

- The global variable of the module set in I/O parameter is automatically registered.

(f) Check automatic registration of global variables.



(g) Registered global variables

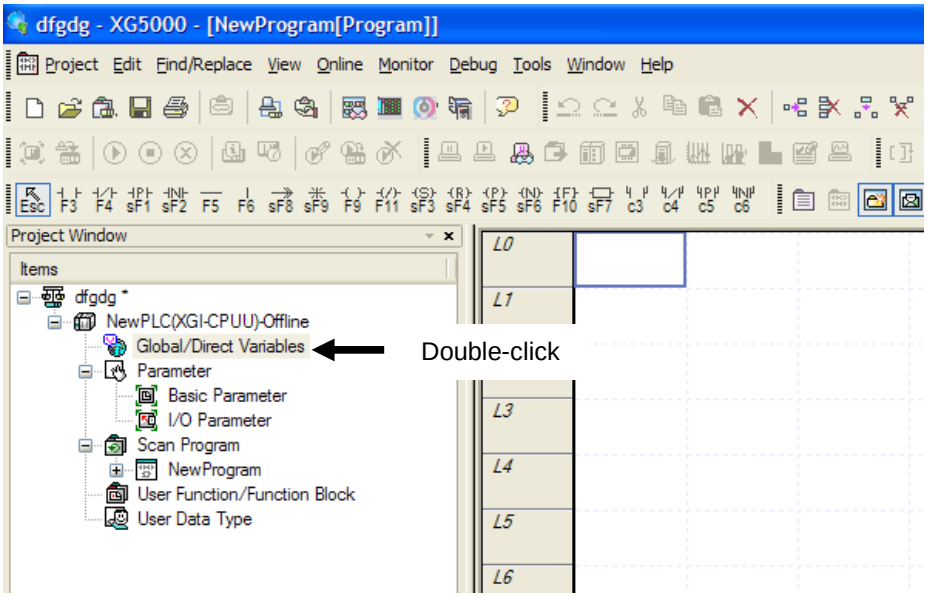


	Variable Kind	Variable	Type	Ad	Initi	Use	Comment
420	VAR_GLOBAL_C	_F0001_CH3_SV_	UINT		415		Temp. Controller Module: CH3 Set value high limit value
421	VAR_GLOBAL_C	_F0001_CH3_SV_	UINT		416		Temp. Controller Module: CH3 Set value low limit value
422	VAR_GLOBAL_C	_F0001_CH3_TD0	UINT		454		Temp. Controller Module: CH3 Derivative constant 0
423	VAR_GLOBAL_C	_F0001_CH3_TD1	UINT		463		Temp. Controller Module: CH3 Derivative constant 1
424	VAR_GLOBAL_C	_F0001_CH3_TD2	UINT		472		Temp. Controller Module: CH3 Derivative constant 2
425	VAR_GLOBAL_C	_F0001_CH3_TD3	UINT		481		Temp. Controller Module: CH3 Derivative constant 3
426	VAR_GLOBAL_C	_F0001_CH3_TD4	UINT		490		Temp. Controller Module: CH3 Derivative constant 4
427	VAR_GLOBAL_C	_F0001_CH3_TD5	UINT		499		Temp. Controller Module: CH3 Derivative constant 5
428	VAR_GLOBAL_C	_F0001_CH3_TI0	UINT		452		Temp. Controller Module: CH3 Integral constant 0
429	VAR_GLOBAL_C	_F0001_CH3_TI2	UINT		470		Temp. Controller Module: CH3 Integral constant 2
430	VAR_GLOBAL_C	_F0001_CH3_TI3	UINT		479		Temp. Controller Module: CH3 Integral constant 3
431	VAR_GLOBAL_C	_F0001_CH3_TI4	UINT		488		Temp. Controller Module: CH3 Integral constant 4
432	VAR_GLOBAL_C	_F0001_CH3_TI5	UINT		497		Temp. Controller Module: CH3 Integral constant 5
433	VAR_GLOBAL_C	_F0001_CH3_TP1	UINT		461		Temp. Controller Module: CH3 Integral constant 1
434	VAR_GLOBAL_C	_F0001_CH3_TS0	UINT		449		Temp. Controller Module: CH3 Sampling time 0
435	VAR_GLOBAL_C	_F0001_CH3_TS1	UINT		458		Temp. Controller Module: CH3 Sampling time 1
436	VAR_GLOBAL_C	_F0001_CH3_TS2	UINT		467		Temp. Controller Module: CH3 Sampling time 2
437	VAR_GLOBAL_C	_F0001_CH3_TS3	UINT		476		Temp. Controller Module: CH3 Sampling time 3
438	VAR_GLOBAL_C	_F0001_CH3_TS4	UINT		485		Temp. Controller Module: CH3 Sampling time 4
439	VAR_GLOBAL_C	_F0001_CH3_TS5	UINT		494		Temp. Controller Module: CH3 Sampling time 5
440							

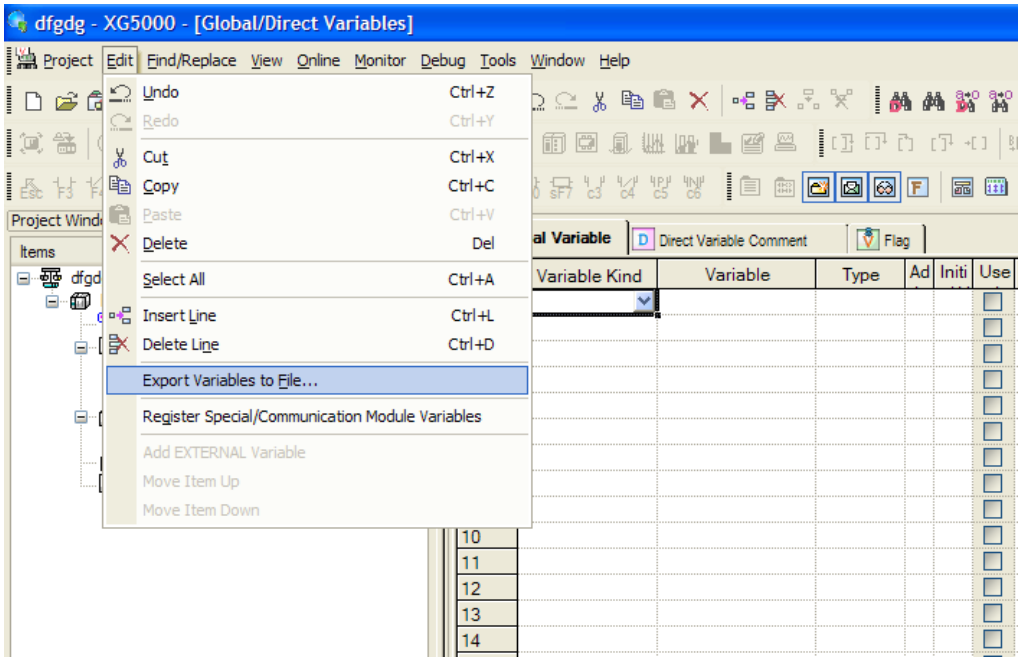
(2) Registration of global variables

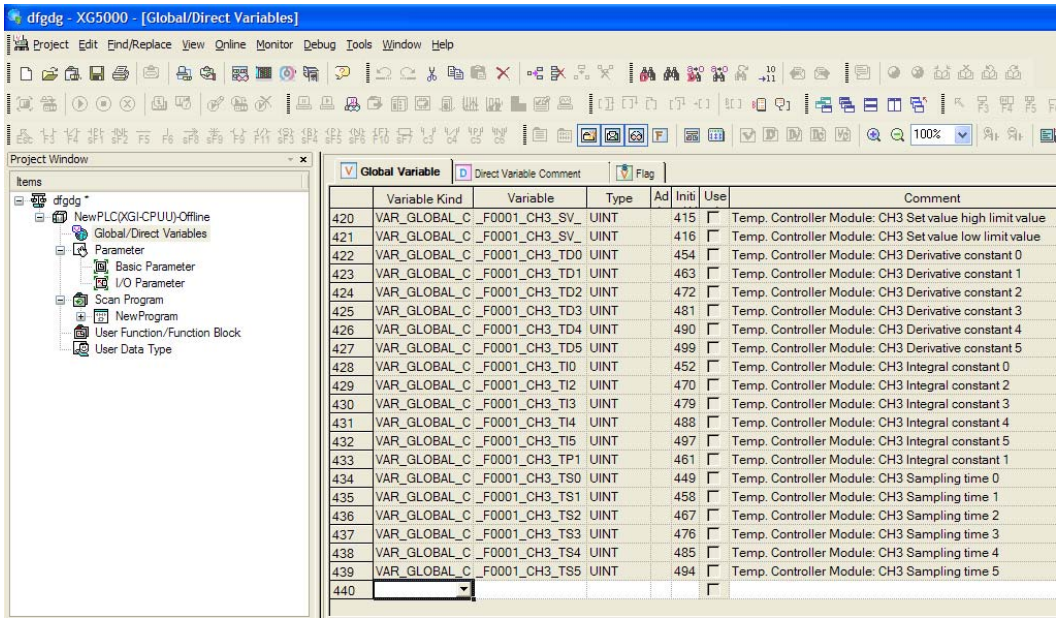
- Register the global variable of the module set in I/O parameter.

(a) Double-click on the global/direct variables in the project window.



(b) Choose [Main menu]-[Edit]-[Automatic registration of special module variables].



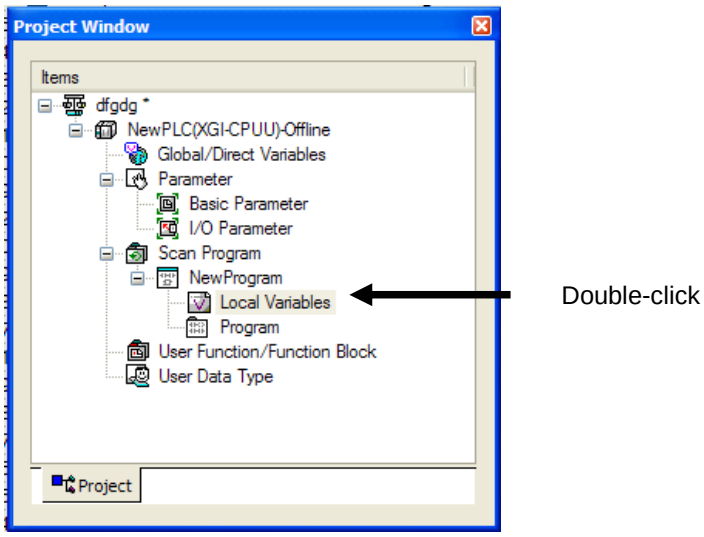


	Variable Kind	Variable	Type	Ad	Initi	Use	Comment
420	VAR_GLOBAL_C	_F0001_CH3_SV_	UINT		415		Temp. Controller Module: CH3 Set value high limit value
421	VAR_GLOBAL_C	_F0001_CH3_SV_	UINT		416		Temp. Controller Module: CH3 Set value low limit value
422	VAR_GLOBAL_C	_F0001_CH3_TD0	UINT		454		Temp. Controller Module: CH3 Derivative constant 0
423	VAR_GLOBAL_C	_F0001_CH3_TD1	UINT		463		Temp. Controller Module: CH3 Derivative constant 1
424	VAR_GLOBAL_C	_F0001_CH3_TD2	UINT		472		Temp. Controller Module: CH3 Derivative constant 2
425	VAR_GLOBAL_C	_F0001_CH3_TD3	UINT		481		Temp. Controller Module: CH3 Derivative constant 3
426	VAR_GLOBAL_C	_F0001_CH3_TD4	UINT		490		Temp. Controller Module: CH3 Derivative constant 4
427	VAR_GLOBAL_C	_F0001_CH3_TD5	UINT		499		Temp. Controller Module: CH3 Derivative constant 5
428	VAR_GLOBAL_C	_F0001_CH3_TI0	UINT		452		Temp. Controller Module: CH3 Integral constant 0
429	VAR_GLOBAL_C	_F0001_CH3_TI2	UINT		470		Temp. Controller Module: CH3 Integral constant 2
430	VAR_GLOBAL_C	_F0001_CH3_TI3	UINT		479		Temp. Controller Module: CH3 Integral constant 3
431	VAR_GLOBAL_C	_F0001_CH3_TI4	UINT		488		Temp. Controller Module: CH3 Integral constant 4
432	VAR_GLOBAL_C	_F0001_CH3_TI5	UINT		497		Temp. Controller Module: CH3 Integral constant 5
433	VAR_GLOBAL_C	_F0001_CH3_TP1	UINT		461		Temp. Controller Module: CH3 Integral constant 1
434	VAR_GLOBAL_C	_F0001_CH3_TS0	UINT		449		Temp. Controller Module: CH3 Sampling time 0
435	VAR_GLOBAL_C	_F0001_CH3_TS1	UINT		458		Temp. Controller Module: CH3 Sampling time 1
436	VAR_GLOBAL_C	_F0001_CH3_TS2	UINT		467		Temp. Controller Module: CH3 Sampling time 2
437	VAR_GLOBAL_C	_F0001_CH3_TS3	UINT		476		Temp. Controller Module: CH3 Sampling time 3
438	VAR_GLOBAL_C	_F0001_CH3_TS4	UINT		485		Temp. Controller Module: CH3 Sampling time 4
439	VAR_GLOBAL_C	_F0001_CH3_TS5	UINT		494		Temp. Controller Module: CH3 Sampling time 5
440							

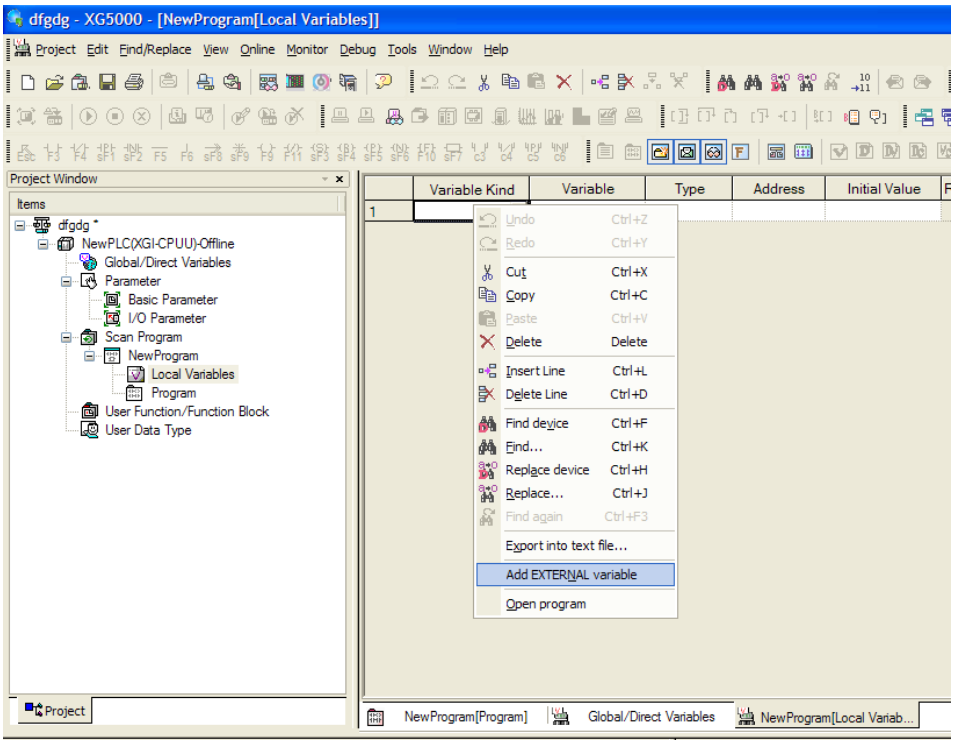
(3) Local variable registration

- Of the global variables registered in (b), the variable you want to use should be registered as the local variable.

(a) Double-click on the local variable of the program where you want to use the global variable in the scan program below.

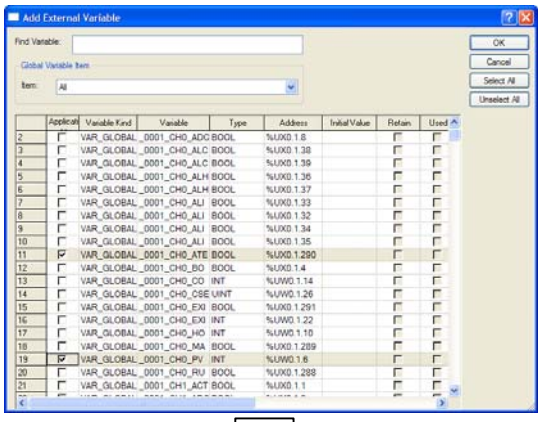


(b) Click the right button of the mouse in the local variable window on the right to choose “Add external variable.”



(c) Check the variable you want to add in the “Add external variable” window below and choose [Ok].

- The following is an example where auto-tuning command (_01_CH0_ATEN) of channel 0 and channel0 input value (_01_CH0_PV) have been chosen.

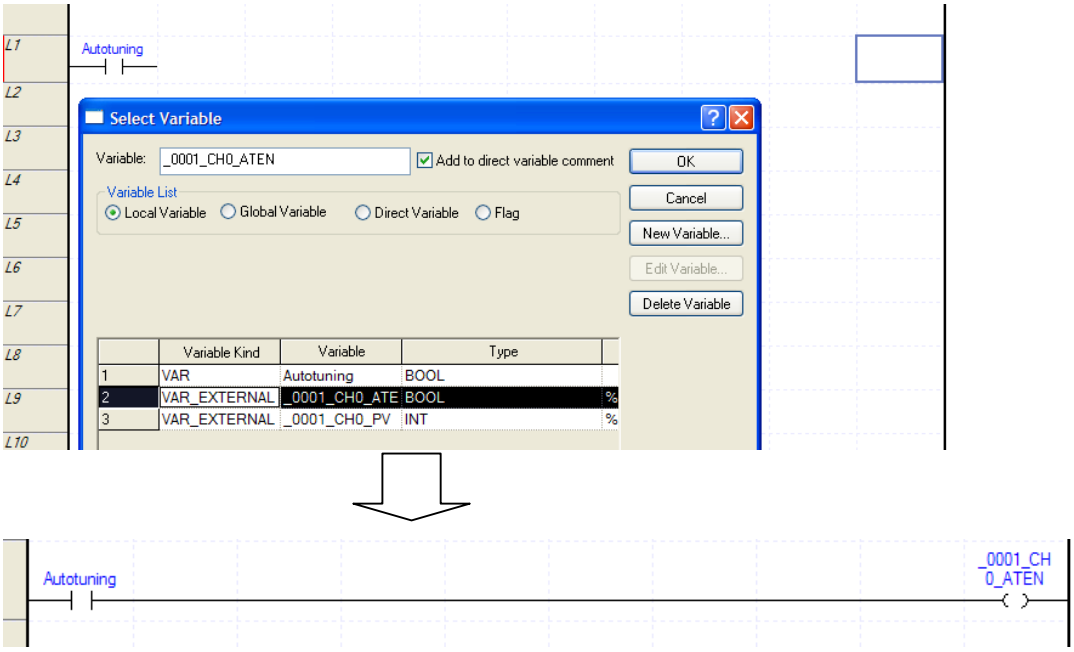


	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	Comment
1	VAR_EXTERNAL	_0001_CH0_ATE	BOOL	%UX0.1.290		☐	☐	Temp. Controller: CH0 auto-tuning c
2	VAR_EXTERNAL	_0001_CH0_PV	INT	%UW0.1.6		☐	☐	Temp. Controller: CH0 input value
3						☐	☐	
4						☐	☐	

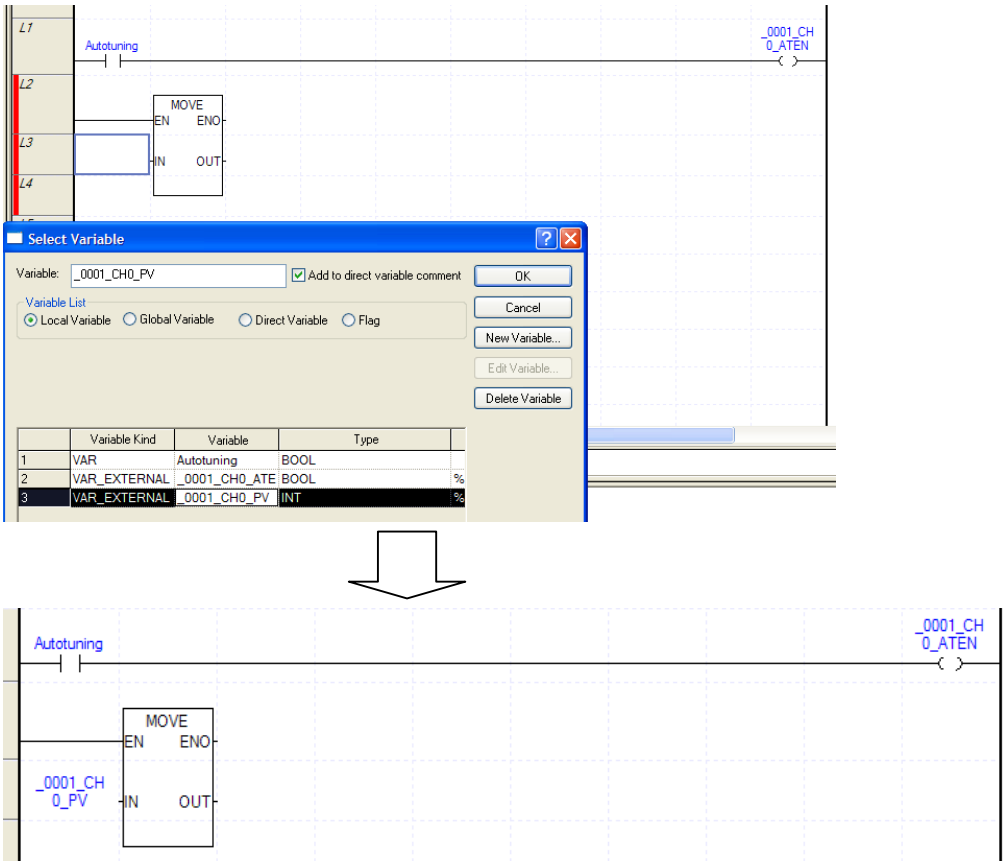
(4) How to use the local variable in the program

- Adds the global variable added in (3) in the local program.

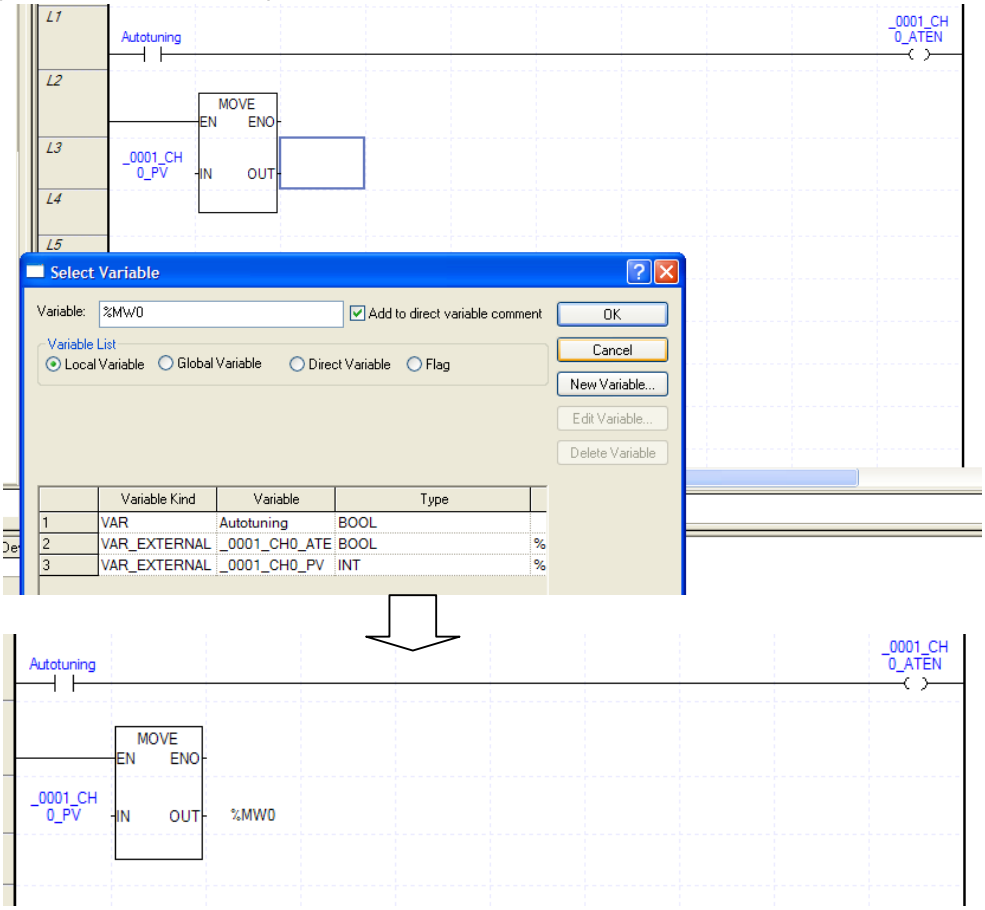
(a) Put in the access point for starting auto-tuning in the ladder program as below, choose the coil, choose [Channel 0 auto-tuning command] in the variable selection window below and then click on Ok.



(b) As in (a), choose the input variable to move channel0 input value (_01_CH0_PV) to the %MO area by using the MOVE function.



(c) Enter %MO as the output variable.



5.2 PUT/GET Function Block Area (Parameter Area)

5.2.1 PUT/GET Function Block Area (Parameter Area)

Table 5.2 shows the PUT/GET function block use area of the thermo-controller.

[Table 5. 2] PUT/GET function block area

Global variables	Read/ Write	Type	Description
_Fxxyy_CHn_STAT	Read	BIT	channel status
_Fxxyy_CHn_IN	Read	INT	sensor input value
_Fxxyy_CHn_SV	Read	INT	Current control target
_Fxxyy_CHn_MV	Read	INT	control output value
_Fxxyy_CHn_EV	Read	REAL	control error
_Fxxyy_CHn_AT_STEP	Read	WORD	Auto-tuning step
_Fxxyy_CHn_ERR	Read	WORD	channel error
_Fxxyy_CHn_CTRL	Read/Write	BIT	channel command
_Fxxyy_CHn_IN_PF	Read/Write	WORD	scale decimal point set value
_Fxxyy_CHn_DB	Read/Write	WORD	Dead zone set value
_Fxxyy_CHn_INP	Read/Write	BIT	input setting
_Fxxyy_CHn_IN_TYPE	Read/Write	WORD	sensor code
_Fxxyy_CHn_IN_SMAX	Read/Write	INT	scale upper limit set value
_Fxxyy_CHn_IN_SMIN	Read/Write	INT	scale lower limit set value
_Fxxyy_CHn_IN_MAX	Read/Write	INT	Effective input upper limit set value
_Fxxyy_CHn_IN_MIN	Read/Write	INT	Effective input lower limit set value
_Fxxyy_CHn_IN_HHAL	Read/Write	INT	input alarm further upper limit set value
_Fxxyy_CHn_IN_HAL	Read/Write	INT	input alarm upper limit set value
_Fxxyy_CHn_IN_LAL	Read/Write	INT	input alarm lower limit set value
_Fxxyy_CHn_IN_LLAL	Read/Write	INT	input alarm further lower limit set value
_Fxxyy_CHn_IN_CUT	Read/Write	WORD	LOWCUT set value
_Fxxyy_CHn_IN_BIAS	Read/Write	INT	input BIAS set value
_Fxxyy_CHn_IN_FILT	Read/Write	WORD	filter factor/average frequency set value
_Fxxyy_CHn_IN_ALHYS	Read/Write	WORD	Alarm hysteresis set value
_Fxxyy_CHn_CTP	Read/Write	BIT	control setting
_Fxxyy_CHn_AT_SV	Read/Write	INT	auto-tuning target
_Fxxyy_CHn_AT_HYS	Read/Write	WORD	auto-tuning hysteresis set value
_Fxxyy_CHn_SV_MAX	Read/Write	INT	control target upper limit set value
_Fxxyy_CHn_SV_MIN	Read/Write	INT	control target lower limit set value
_Fxxyy_CHn_PV_TUP	Read/Write	WORD	rising PV tracking set value
_Fxxyy_CHn_PV_TDN	Read/Write	WORD	falling PV tracking set value
_Fxxyy_CHn_ONOF_HYS	Read/Write	WORD	ONOFF control hysteresis set value
_Fxxyy_CHn_HC_RATE	Read/Write	INT	heating cooling proportional value
_Fxxyy_CHn_H_PTIME	Read/Write	WORD	heating PWM cycle setting
_Fxxyy_CHn_H_MAX	Read/Write	INT	heating output upper limit
_Fxxyy_CHn_H_MIN	Read/Write	INT	heating output lower limit
_Fxxyy_CHn_H_DMAX	Read/Write	WORD	heating output change upper limit
_Fxxyy_CHn_H_REF	Read/Write	INT	heating output reference value
_Fxxyy_CHn_H_EOUT	Read/Write	INT	failure heating output setting
_Fxxyy_CHn_H_MAN	Read/Write	INT	heating manual output value
_Fxxyy_CHn_H_HAL	Read/Write	INT	heating output upper limit alarm value
_Fxxyy_CHn_H_LAL	Read/Write	INT	heating output lower limit alarm value
_Fxxyy_CHn_C_PTIME	Read/Write	WORD	Cooling PWM cycle setting
_Fxxyy_CHn_C_MAX	Read/Write	INT	Cooling output upper limit
_Fxxyy_CHn_C_MIN	Read/Write	INT	Cooling output lower limit
_Fxxyy_CHn_C_DMAX	Read/Write	WORD	Cooling output change upper limit
_Fxxyy_CHn_C_REF	Read/Write	INT	Cooling output reference value
_Fxxyy_CHn_C_EOUT	Read/Write	INT	Failure cooling output setting
_Fxxyy_CHn_C_MAN	Read/Write	INT	Cooling manual output value
_Fxxyy_CHn_C_HAL	Read/Write	INT	Cooling output upper limit alarm value

Global variables	Read/ Write	Type	Description
_Fxxyy_CHn_C_LAL	Read/Write	INT	Cooling output lower limit alarm value
_Fxxyy_CHn_HC_ALHYS	Read/Write	WORD	output alarm common hysteresis value
_Fxxyy_CHn_SV0	Read/Write	INT	target set value 0
_Fxxyy_CHn_TS0	Read/Write	INT	cycle setting 0
_Fxxyy_CHn_KP0	Read/Write	REAL	proportional factor set value 0
_Fxxyy_CHn_TI0	Read/Write	REAL	integral factor set value 0
_Fxxyy_CHn_TD0	Read/Write	REAL	differential factor set value 0
_Fxxyy_CHn_BIAS0	Read/Write	INT	control BIAS set value 0
_Fxxyy_CHn_SV1	Read/Write	INT	target set value 1
_Fxxyy_CHn_TS1	Read/Write	INT	cycle setting 1
_Fxxyy_CHn_KP1	Read/Write	REAL	proportional factor set value 1
_Fxxyy_CHn_TP1	Read/Write	REAL	integral factor set value 1
_Fxxyy_CHn_TD1	Read/Write	REAL	differential factor set value 1
_Fxxyy_CHn_BIAS1	Read/Write	INT	control BIAS set value 1
_Fxxyy_CHn_SV2	Read/Write	INT	target set value 2
_Fxxyy_CHn_TS2	Read/Write	INT	cycle setting 2
_Fxxyy_CHn_KP2	Read/Write	REAL	proportional factor set value 2
_Fxxyy_CHn_TI2	Read/Write	REAL	integral factor set value 2
_Fxxyy_CHn_TD2	Read/Write	REAL	differential factor set value 2
_Fxxyy_CHn_BIAS2	Read/Write	INT	control BIAS set value 2
_Fxxyy_CHn_SV3	Read/Write	INT	target set value 3
_Fxxyy_CHn_TS3	Read/Write	INT	cycle setting 3
_Fxxyy_CHn_KP3	Read/Write	REAL	proportional factor set value 3
_Fxxyy_CHn_TI3	Read/Write	REAL	integral factor set value 3
_Fxxyy_CHn_TD3	Read/Write	REAL	differential factor set value 3
_Fxxyy_CHn_BIAS3	Read/Write	INT	control BIAS set value 3
_Fxxyy_CHn_SV4	Read/Write	INT	target set value 4
_Fxxyy_CHn_TS4	Read/Write	INT	cycle setting 4
_Fxxyy_CHn_KP4	Read/Write	REAL	proportional factor set value 4
_Fxxyy_CHn_TI4	Read/Write	REAL	integral factor set value 4
_Fxxyy_CHn_TD4	Read/Write	REAL	differential factor set value 4
_Fxxyy_CHn_BIAS4	Read/Write	INT	control BIAS set value 4
_Fxxyy_CHn_SV5	Read/Write	INT	target set value 5
_Fxxyy_CHn_TS5	Read/Write	INT	cycle setting 5
_Fxxyy_CHn_KP5	Read/Write	REAL	proportional factor set value 5
_Fxxyy_CHn_TI5	Read/Write	REAL	integral factor set value 5
_Fxxyy_CHn_TD5	Read/Write	REAL	differential factor set value 5
_Fxxyy_CHn_BIAS5	Read/Write	INT	control BIAS set value 5

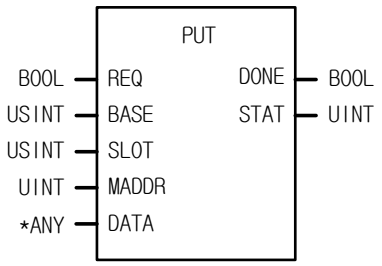
Note) Read/Write is written based on PLC.

"n" of "~_CHn_~" indicates the channel and n= 0, 1, 2, 3.

5.2.2 PUT/GET function block

(1) PUT function block

PUT
Write data in special module

Function block	Description
	**input** REQ : Execute function when 1 BASE : Place base SLOT : Place slot MADDR : module address DATA : data to save in module **output** DONE : output of 1 during normal functioning STAT : error information

*ANY: Of ANY Type, WORD, DWORD, INT, USINT, DINT, and UDINT Type are available.

■ **Function**

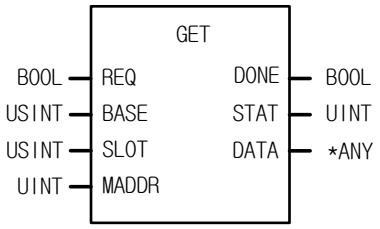
Read data from the special designated module.

Function block	input(ANY) Type	Description
PUT_WORD	WORD	Save WORD data in the designated module address (MADOR).
PUT_DWORD	DWORD	Save DWORD data in the designated module address (MADOR).
PUT_INT	INT	Save INT data in the designated module address (MADOR).
PUT_UINT	UINT	Save UINT data in the designated module address (MADOR).
PUT_DINT	DINT	Save DINT data in the designated module address (MADOR).
PUT_UDINT	UDINT	Save UDINT data in the designated module address (MADOR).

(2) GET function block

GET

Read special module data

Function block	Description
	**input** REQ : Execute function when 1 BASE : Place base SLOT : Place slot MADDR : module address 512(0x200) ~ 1023(0x3FF) **output** DONE : output of 1 during normal functioning STAT : error information DATA : data read from module

*ANY: Of ANY Type, WORD, DWORD, INT, USINT, DINT, and UDINT Type are available.

■ **Function**

Read data from the designated special module.

Function block	input(ANY) Type	Description
GET_WORD	WORD	Read WORD data in the designated module address (MADOR).
GET_DWORD	DWORD	Read DWORD data in the designated module address (MADOR).
GET_INT	INT	Read INT data in the designated module address (MADOR).
GET_UINT	UINT	Read UINT data in the designated module address (MADOR).
GET_DINT	DINT	Read DINT data in the designated module address (MADOR).
GET_UDINT	UDINT	Read UDINT data in the designated module address (MADOR).

5.2.3 Example of Use of PUT/GET function block

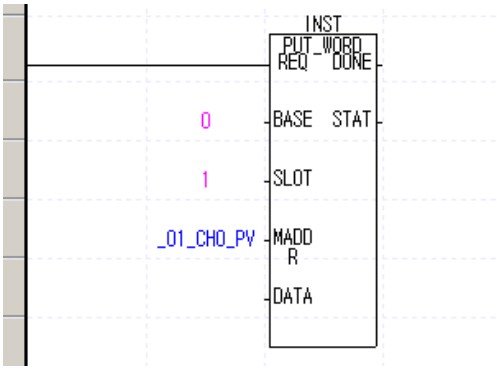
(1) Example of use of PUT function block

- An example of registering the channel0 auto-tuning target variable in the order of registration of 6.2.1 Global variables and then using it in the local program.

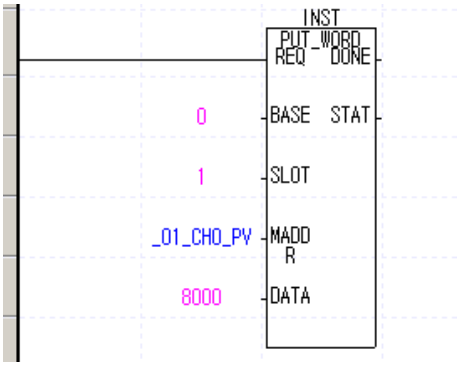
(a) Bring channel0 auto-tuning target [_F01_CH0_AT_SV] to the local variable window.

	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	Comment
1	VAR_EXTERNAL	_0001_CH0_ATEN	BOOL	%UX0.1.290		☐	☐	Temp. Controller: CH0 auto-tuning co
2	VAR_EXTERNAL	_0001_CH0_PV	INT	%UW0.1.6		☐	☐	Temp. Controller: CH0 input value
3	VAR	Autotuning	BOOL			☐	☐	
4	VAR_EXTERNAL_CONS	_F0001_CH0_AT_SV	UINT		29	☐	☐	Temp. Controller Module: CH0 Set val

(b) Add PUT_WORD function block to the local program and choose _F01_CH0_AT_SV as the MADDR input variable.



(c) Enter auto-tuning target as the data variable.
(Below is an example of entering 8000 as the target.)



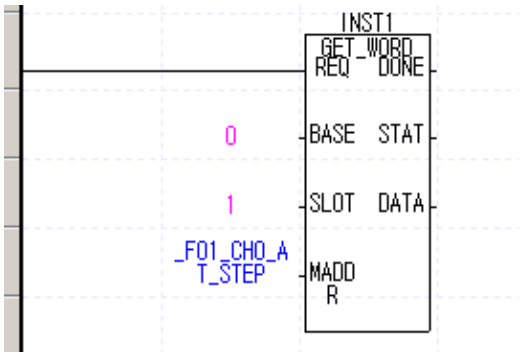
(2) Example of using the GET function block

- An example of registering the channel0 auto-tuning step variable in the order of registration of 6.2.1 Global variables and then using it in the local program

(a) Bring channel0 auto-tuning step [_F01_CH0_AT_STEP] variable to the local variable window.

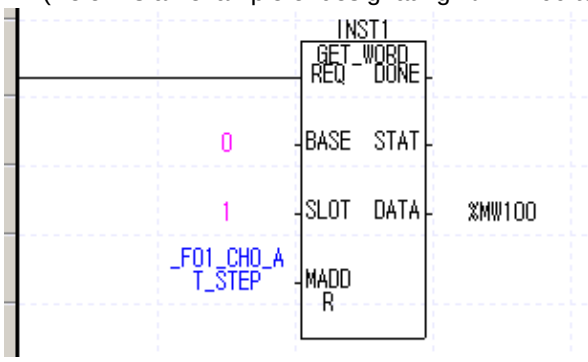
	Variable Kind	Variable	Type	Address	Initial Value	Retain	Used	Comment
1	VAR	Autotuning	BOOL			☐	☑	
2	VAR	INST	PUT_WORD			☐	☐	
3	VAR_EXTERNAL	_0001_CH0_ATEN	BOOL	%UX0.1.290		☐	☑	Temp. Controller: CH0 auto-tuning command
4	VAR_EXTERNAL	_0001_CH0_PV	INT	%UW0.1.6		☐	☑	Temp. Controller: CH0 input value
5	VAR_EXTERNAL_CONS	_F0001_CH0_AT_STEP	UINT		6	☐	☐	Temp. Controller Module: CH0 Auto-tuning step
6	VAR_EXTERNAL_CONS	_F0001_CH0_AT_SV	UINT		29	☐	☐	Temp. Controller Module: CH0 Set value on auto-tuning

(b) Add GET_WORD function block to the local program and choose _F01_CH0_AT_STEP as the MADDR input variable.



(c) Designate the address to which you want to move the channel0 auto-tuning step value as the data variable.

(Below is an example of designating %MW100 to move the step.)



Chapter 6 Software Package (XG-TCON)

6.1 Introduction

6.1.1 Features of XG-TCON

(1) The software package with the functions for the operation and monitoring of the XGT Series Temperature Controller Module.
(2) This package provides a function for independent operation of the temperature controller separate from the XG5000.
(3) Enables fast and easy parameter setting and data monitoring.
(4) Supports convenient GUI for users to begin temperature control without developing ladder program.
(5) Each project is provided with 0 ~ 7 bases and 0 ~ 11 slots, for up to 48 module installation and supports edition, monitoring and control simultaneously.
(6) Diverse messages are provided for easy program edit and testing.

6.1.2 Functions of XG-TCON

In principle, the XG-TCON runs in PC environment. It is an exclusive software package developed for fast and easy operation of temperature controller through communication with the XGK, XGI or XGR series CPU.
Major functions of the XG-TCON are as follows.
(1) Read/write module parameters
(2) Edit/save module parameters
(3) Monitor control data
(4) Plot control data
(5) Monitor module status
(6) Display module operation history

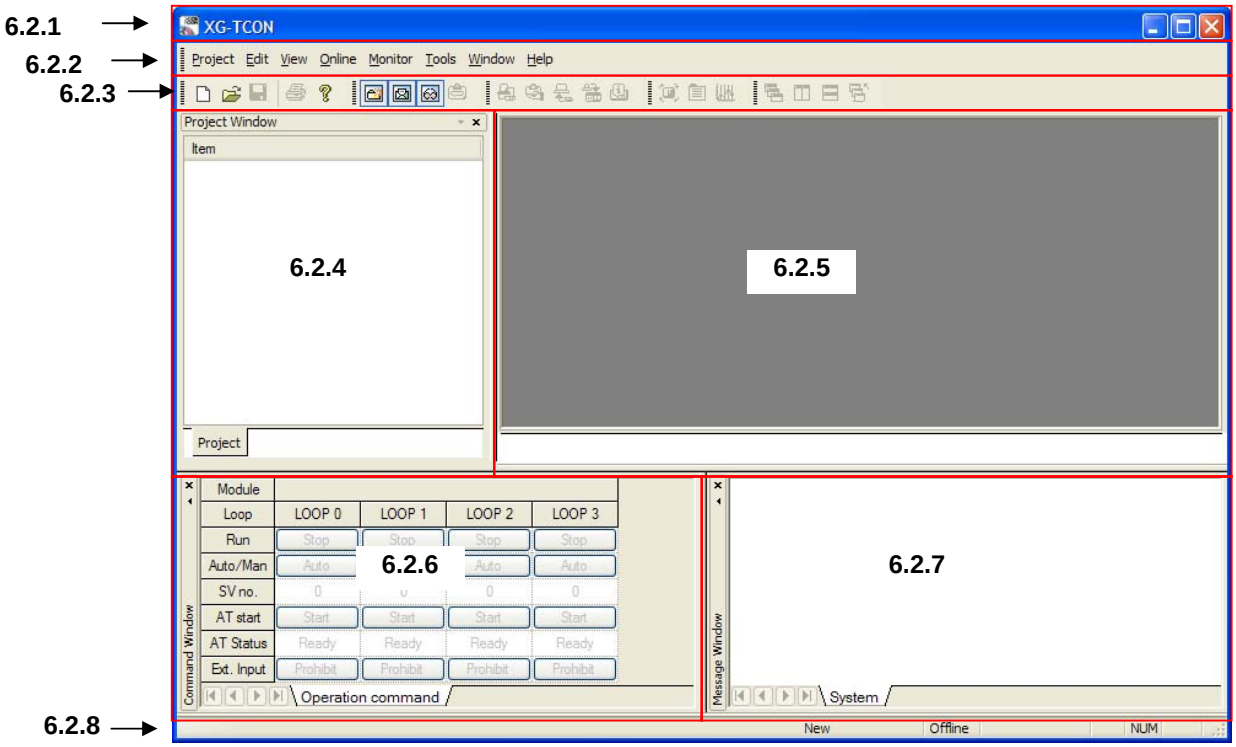
6.1.3 Files Created with XG-TCON

Following files are created in the course of creation and edit of a project by user.

(1) <filename>.tpj: the project file created by user when saving the project.
(2) <filename>.tpm: the module file created by user when saving the module.
(3) <filename>.tpl: the file for the loop created by user when saving the loop.
(4) <filename>.csv: user-created project is periodically saved. This file is created by selecting [Begin Data Save] in the trend graph.

6.2 Main Screen

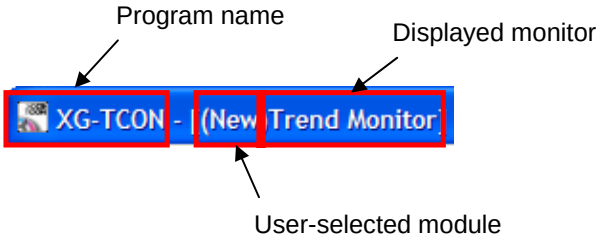
This Chapter describes the elements, windows, and popup menus in the main screen.
The figure below shows the initial screen of the XG-TCON at opening.



The zones are defined as follows, and described in detail in the respective sectors.

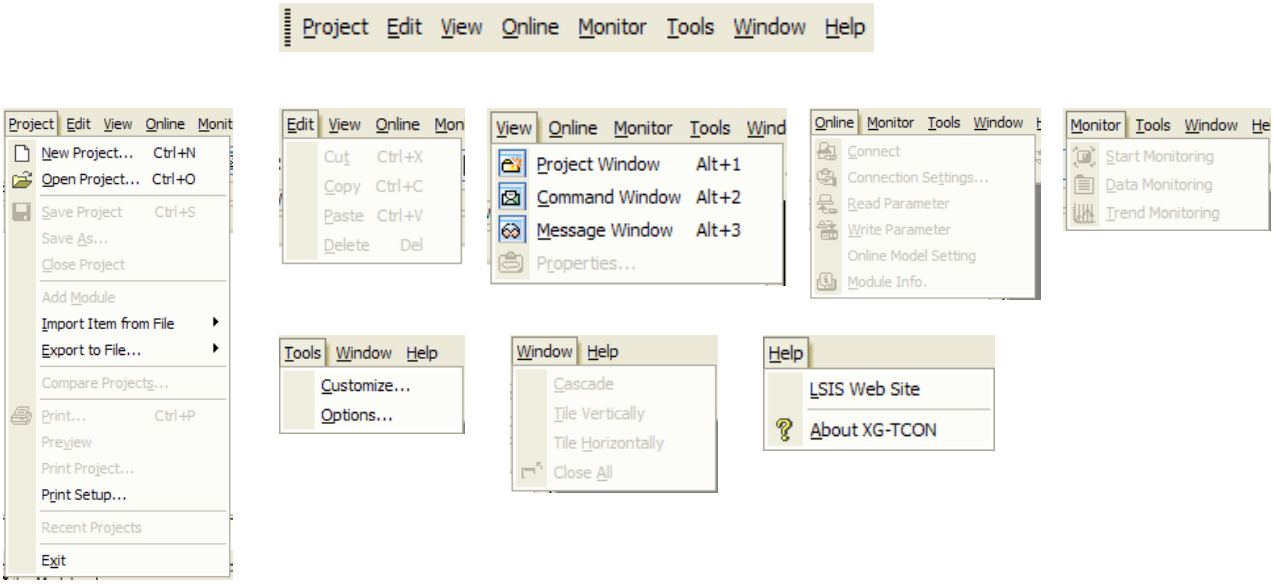
6.2.1 Title

Shows the title and name of the active module of the XG-TCON.
XG-TCON's title is displayed as follows according to the Windows application;



6.2.2 Menu

Basic menus are provided for convenient program operation.
Selecting the menu, following commands will appear. The commands can be executed with mouse or keyboard. Some commands support short-cut key or tool for simple selection.



(1) Project

The Project menu supports the functions for creating project and printing.

(a) New Project (tool bar)

Opens [New Project] dialog.

(b) Open Project (tool bar)

Opens [Open] dialog. Past projects saved in memory device can be retrieved.

(c) Save Project (tool bar)

Saves present project. If not project is open, or after saving, this menu is disabled.

(d) Save As

Opens [Save As] dialog. The present project is maintained and a copy is saved under different project name.

(e) Close Project

Closes present project. This menu is disabled if no project is open. If the present project has not been saved, the dialog [XG-TCON: project window will be closed. Will you save the project?] will appear.

(f) Add Module

Opens [Add Module] dialog. Create a new module in the project. If currently in connection, this menu is disabled.

(g) Read Item from File

Placing cursor on this menu will activate 5 selections of Module / Loop 0 / Loop 1 / Loop 2 / Loop 3, and all these 5 items open respective [Open] dialog. File extensions are tpm / tpl / tpl / tpl / tpl, respectively. If a project is selected, this menu is disabled. It will be enabled only when module and parameter are selected.

(h) Save Item in File (tool bar)

[Save As] dialog will open. Disabled if no project is open, and the current project window will save the selected modules and parameters under different name. When saving modules, all the modules and parameters are saved in a .tpm file. When saving a loop, the parameter setting of the loop is saved in a .tpl file.

(i) Compare Projects

Opens [Compare Project] dialog. Compares the present project in the screen and a saved project. Disabled if no project is open.

(j) Print (tool bar)

Opens [Print] dialog supported in the Windows. Data monitor and trend monitor can be printed. Disabled if no monitor is in the main screen.

(k) Print Preview

Opens [Print Preview] window. Print previews for data monitor and trend monitor can be checked before printing. Disabled if no monitor is in the main screen.

(l) Print Project

Opens [Print project] dialog for printing project data. Disabled if not project is open.

(m) Setup Printer

Opens [Setup Printer] dialog. Supports the printer setting dialog of the Windows OS.

(n) Exit

Exits from XG-TCON. If the present project has not been saved, [XG-TCON: project window will be closed. Will you save it?] dialog appears.

(2) Edit

(a) Cut

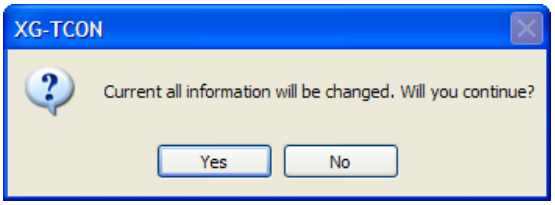
Cut can be executed when 2 or more modules have been registered. Cut modules can be pasted into other projects.

(b) Copy

The modules registered in the parameter can be copied. All the parameters of the module are copied into other projects or modules.

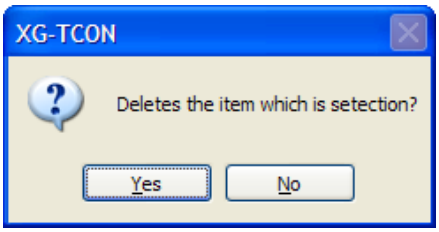
(c) Paste

Enabled after Copy or Cut command has been executed. Copied or cut module can be pasted. Disabled if Coy or Cut command has not been executed. When trying to paste to a module, following dialog appears for confirmation.



(d) Delete

When 2 or more modules have been set up in the project, and the modules or parameters to be deleted are selected, this menu is enabled. Disabled if the project is selected or there is only one module.



(3) View

(a) Project Window (tool bar)

Enable or Disable of project window can be selected.

Enabled Disabled

(b) Command Window (tool bar)

Enable or Disable of command window can be selected.

Enabled Disabled

(c) Message Window (tool bar)

Enable or Disable of message window can be selected.

Enabled Disabled

(d) Register Information (tool bar)

Opens [Register Information] or [Setting] dialog for the project, module, or parameter selected by the user.

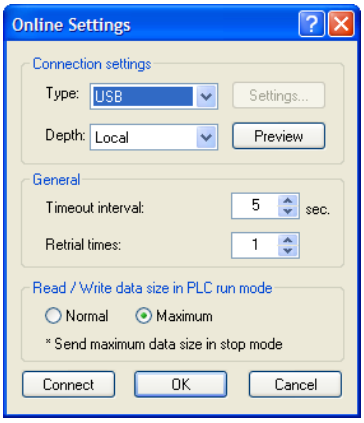
(4) Online

(a) Connect/Disconnect (tool bar)

Connects the XG-TCON and user-defined PLC. When disconnected, 'Connect' is displayed and of connected, 'Disconnect' will appear. If click this while in connection, [Connect] dialog will appear, and if clicked while in disconnect, the connection is isolated.

(b) Connection Setting (tool bar)

Same as the [Connection Setting] dialog of the XG5000.



(c) Read (tool bar)

Reads the parameter data stored in the present temperature controller module.

(d) Write (tool bar)

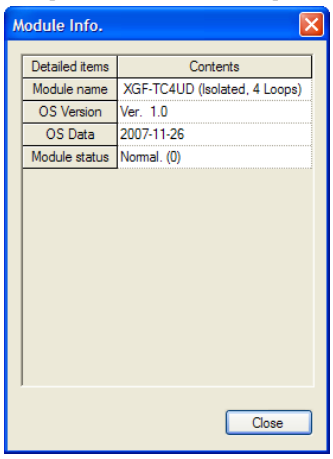
Saves the present parameter data in the temperature controller module.

(e) Online Module Setting (tool bar)

Search the existing (installed) modules and register them in the XG-TCON. All the existing data are deleted, and the data read from the present module is displayed on the parameter window of the newly registered module.

(f) Module Information (tool bar)

Opens [Module Information] dialog.



(5) Monitor

(a) Start Monitoring/Stop Monitoring (tool bar)

When not in monitoring, “Start Monitoring” is displayed, and when in monitoring, “Stop Monitoring” is displayed. These two buttons are toggle switches, and if Start Monitoring is clicked, monitoring begins, and vice versa.

(b) Data Monitoring (tool bar)

Enabled when the XG-TCON is in connection with a PLC. The data monitor window of the focused module appears in the main screen.

(c) Trend Monitoring (tool bar)

Enabled when the XG-TCON is in connection with a PLC. The trend monitor window of the focused module appears in the main screen.

(6) Tools

(a) User Defined

[Use Defined Tool] dialog opens to allow user to define tools or commands.

(b) Options

[Option] dialog opens to allow user to edit XG-TCON environment.

(7) Window

(a) Cascade Arrangement (tool bar)

The active windows in the main screen are arranged in cascade form.

(b) Horizontal Arrangement (tool bar)

The active windows in the main screen are arranged horizontally.

(c) Vertical Arrangement (tool bar)

The active windows in the main screen are arranged vertically.

(d)Close All (tool bar)

All the active monitoring windows in the main screen are closed.

(e)(Module Name)(Data, Trend) Monitoring

All the windows in the main screen are registered, and activated if checked.

(8) Help

(a) Help for Software Package (tool bar)

Opens [Help] dialog.

(b) LS Industrial Systems website

Run Internet browser and access to www.lsis.biz.

(c) XG-TCON Information (tool bar)

Opens [XG-TCON Information] dialog.

6.2.3 Tool Bar

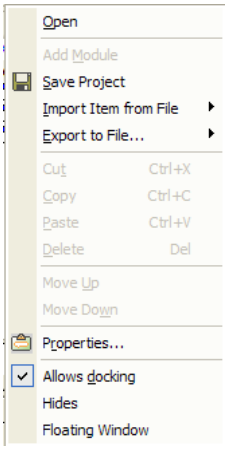
Frequently used menus can be selected easily.

Frequently used menus of XG-TCON are provided with short-cut icons in the same shapes as the tool bar in the XG5000.

Icon	Menu	Icon	Menu	Icon	Menu
	New Project		Connect		Data Monitoring
	Open Project		Disconnect		Trend Monitoring
	Save Project		Set-up Connection		Cascade Arrangement
	XG-TCON Information		Read		Vertical Arrangement
	Project Window		Write		Horizontal Arrangement
	Module Status Window		Module Information		Close All
	Module Status History Window		Start Monitoring		
	Register Information		Stop Monitoring		

6.2.4 Project Window

(1) Popup Menu



(a) Open
Opens [Project Register Information] dialog. Project name and description can be edited.

(b) Add Module
Opens [Add Module] dialog in which module name, base and slot setting and description can be edited. Disabled while in connected.

(c) Save Project
Saves project.

(d) Read Items from File
Reads modules (*.tpm) or parameters (*.tpl).

(e) Save Items in File
Saves module (*.tpm) or parameter (*.tpl).

(f) Cut
Cuts off modules.

(g) Paste
Cut or copied modules can be pasted. When pasting to a project, a module having the existing data is created. However, when pasting to a module, existing parameter information is overwritten.

(h) Register Information
Opens [Project Register Information] dialog in which project name and description can be edited.

(i) Allow Docking
Usable for window movement or docking with another window. To enable docking, the checkbox must be checked.

(j) Hide
Hides project window.

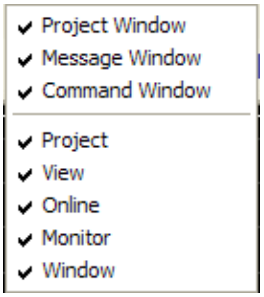
(k) Floating Window

Changes project window into a window. In this state, docking is disabled.

6.2.5 Main Screen

In the main screen, user can display windows for monitoring or plotting data.

The main screen is where user can open data monitoring and trend monitoring windows. Each module can have one data monitoring window and one trend monitoring window. Multiple modules may open multiple data and trend monitoring windows in the main screen. When working with multiple windows, a window can be selected with the tab on the bottom screen. Each tab and title bar has respective module name. When the project is closed, the main screen is empty. The context menu (right mouse button click) in the main screen is as follows.



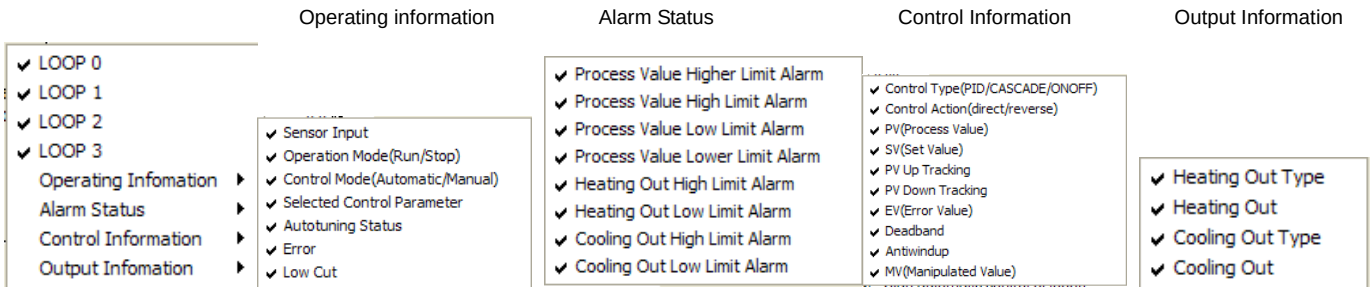
(1) Data Monitoring Window

This window shows major operating information of XG-TCON, and read-only is allowed. When a new project is created, this window has empty columns, and reads and displays module state at Start Monitoring command. The variables in this window are indicated in black or red if the memory value is 0 or non-zero, respectively. Exceptionally, sensor input, heating output, and cooling output variables are indicated in blue when normal or in red when erroneous.

	Type	LOOP 0	LOOP 1	LOOP 2	LOOP 3
Operation information	Sensor input	0.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃
	Operation	Stop	Stop	Stop	Stop
	Automatic/Manual operation	Auto	Auto	Auto	Auto
	Control setting	0	0	0	0
	Automatic tuning status	Ready	Ready	Ready	Ready
	Operation error	Normal	Normal	Normal	Normal
	LOW CUT Operation	Prohibit	Prohibit	Prohibit	Prohibit
Alarm condition	Input High upper limit	Normal	Normal	Normal	Normal
	Input upper limit	Normal	Normal	Normal	Normal
	Input lower limit	Normal	Normal	Normal	Normal
	Input Low lower limit	Normal	Normal	Normal	Normal
	Heating upper limit	Normal	Normal	Normal	Normal
	Heating lower limit	Normal	Normal	Normal	Normal
	Cooling upper limit	Normal	Normal	Normal	Normal
	Cooling lower limit	Normal	Normal	Normal	Normal
Control information	Control type	PID	PID	PID	PID
	Forward/Reverse operation	Forward	Forward	Forward	Forward
	PV(Control Input)	0.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃
	SV(Control target)	0.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃
	PV rising tracking	Prohibit	Prohibit	Prohibit	Prohibit
	PV falling tracking	Prohibit	Prohibit	Prohibit	Prohibit
	EV(Control error value)	0.000000	0.000000	0.000000	0.000000
	Dead Band	Prohibit	Prohibit	Prohibit	Prohibit
	Prevention of nover-intergal operation	Setting	Setting	Setting	Setting
	MV(Control output)	0.00	0.00	0.00	0.00
Output information	Heating output type	Analog	Analog	Analog	Analog
	Heating output	0.00%	0.00%	0.00%	0.00%
	Cooling output type	Analog	Analog	Analog	Analog
	Cooling output	0.00%	0.00%	0.00%	0.00%

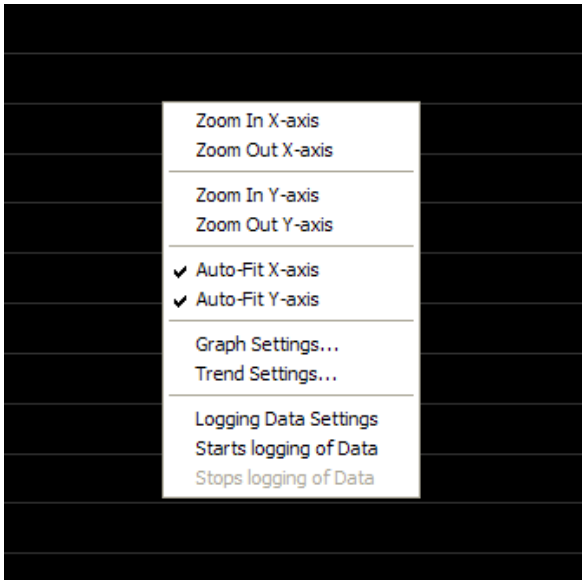
(a) Data Monitor Popup Window

The context menu which appears in the Data Monitoring window by clicking mouse right button is shown below. Active menus are checked and disabled menus are unchecked. Enable/Disable is toggled by selecting. At first appearance, 4 loops, operation information, alarm status, control information, and output information are all checked.



(2) Trend Monitoring Window

Trend monitoring window shows a part of TC4UD operation data in graphic display.
The PV(IN), SV, HOUT and COUT of each loop can be easily registered.



The context menu items in the Trend Monitoring window are as follows.

(a) Zoom in X-axis
X-axis is zoomed in. Disabled at the maximum magnification.
(b) Zoom out X-axis
X-axis is zoomed out. Disabled at the minimum magnification.
(c) Zoom in Y-axis
Y-axis is zoomed in. Disabled at the maximum magnification.
(d) Zoom out Y-axis
Y-axis is zoomed out. Disabled at the minimum magnification.
(f) Auto Fit X-axis
Zoom in to the maximum magnification of the X value to be displayed in the screen.
(g) Auto Fit Y-axis
Zoom in to the maximum magnification of the Y value to be displayed in the screen.
(h) Graph Setting
Opens [Graph Setting] dialog.

(i) Trend Setting
Opens [Trend Setting] dialog.
(j) Logging Data Settings
Opens [Data Save Setting] dialog.
(k) Starts Logging of data
Begins saving data. “Being saved…” message is displayed at top trend screen during the saving. This menu is disabled during saving operation.
(l) Stop Logging of data
Stops data saving operation. Enabled during data saving operation only.

Note Logging data

Data is stored in *.cvs file supported by Excel program. The data storage format is as shown below.

	A	B	C	D
1	msec	0_PV	1_SV	0_HOUT
2	0	500	1000	1000
3	200	300	1000	2000
4	400	200	1000	100

6.2.6 Command Window

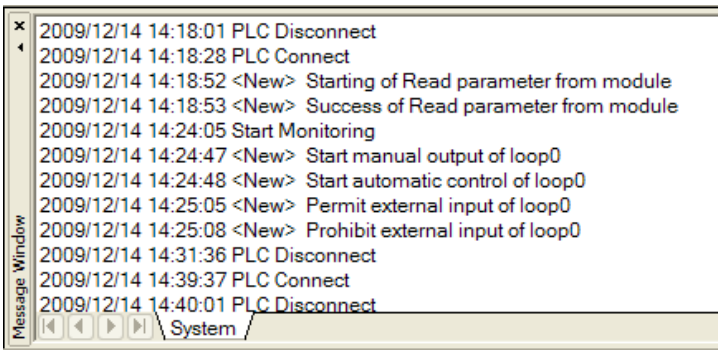
This window monitors Loop operation and support existing settings.

① Module	New (XGF-TC4UD, Base0, Slot1)			
② Loop	LOOP 0	LOOP 1	LOOP 2	LOOP 3
③ Run	Stop	Stop	Stop	Stop
④ Auto/Man	Auto	Auto	Auto	Auto
⑤ SV no.	0	0	0	0
⑥ AT start	Start	Start	Start	Start
⑦ AT Status	Ready	Ready	Ready	Ready
⑧ Ext. Input	Prohibit	Prohibit	Prohibit	Prohibit

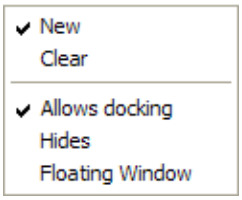
(1) Module
Shows the information of the module selected by the user.
(2) Loop
Shows LOOP0 ~ 4.
(3) Operation
The button to run the operation of the Loop. Toggles Start/Stop by clicking.
(4) Auto/Manual
Toggle button for automatic and manual outputs. In manual output mode, the value entered in the control parameter by the user is outputted.
(5) Control Set
Support six control coefficient from 0 to 5.
(6) Auto Tuning
Starts auto tuning of the Loop. Toggles start/stop by clicking.
(7) Tuning Condition
Shows present tuning condition. When auto tuning is stopped, zero (preparation) step is displayed. During operation, one of the steps from 1 to 8 is displayed, where the 8th step is displayed with ‘Completed.’
(8) External Input
This button allows external inputs. Toggles Allow or Prohibit by clicking.

6.2.7 Message Window

Various statuses of the XG-TCON are informed with messages.



Shows the history of the statues changes of all the modules registered in the project. Up to 2,000 items can be displayed, classified by module. Context menu is shown below.



(1) New, New1 (check/uncheck)
New and New1 are the names of the modules registered by the user. Check/uncheck in the check box shows or hides the module name from the history window.

(2) Delete
Disabled if there is not history in the module status history window, or enabled if there in. Deletes all the history from the module status history window.

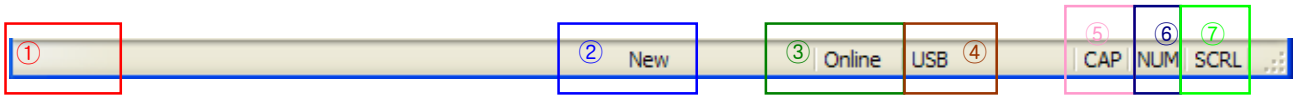
(3) Allow Docking
Usable for window movement or docking with another window. Enabled if checked, or disabled if unchecked.

(4) Hide
Hides the project window.

(5) Floating Window
Changes the project window to window pane. In this state, Allow Docking menu is disabled.

6.2.8 Status Bar

Shows online status of the module and brief description of menu.



The status bars shows followings.

(1) Maintains ‘Ready’ during operation. Shows information on the tool bar on which the cursor is placed.

(2) Show the name of the module presently selected.

(3) Shows current communication status. ‘Online’ when connected with PLC, or ‘Offline’ when disconnected.

(4) Shows the current connection method.

(5) Toggles Caps Lock key.

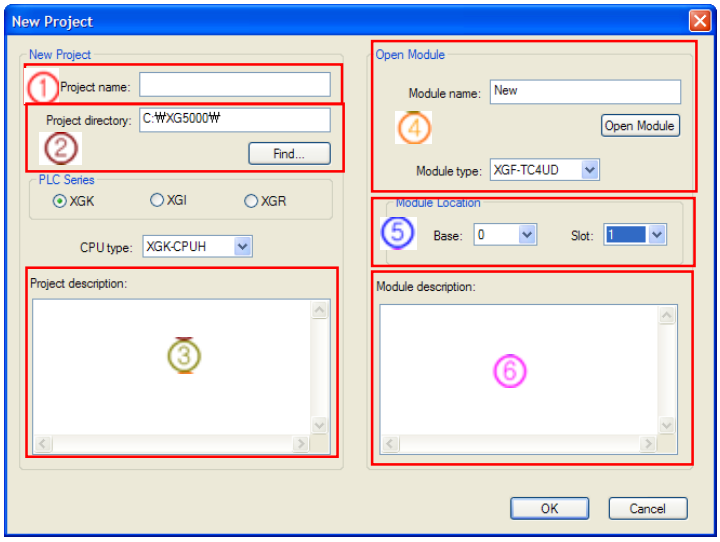
(6) Toggles Num Lock key.
Toggles Scroll Lock key.

6.3 Screen Components

This Chapter describes the dialog boxes which appear by menu selection.

6.3.1 New Project Dialog

This dialog box is for creating new projects with project name as the folder and file names. Created a new folder with the project name and create project file under the name of [Project Name].tpj.



(1) Project Name

Project name can be entered. 100 characters can be entered in the module, except special characters (\ /: * ? “ < > |).

(2) Project Location

The initial value of project location can be modified in the “Default folder for creating new projects’ of [Tools] → [Option], or designated a folder using [Find(F)] menu. Unless for a special purpose, project name will be used as the folder name.

(3) Project Description

Project description can be entered with up to 30,000 characters. [ENTER] changes lines, and horizontal and vertical scroll bars are provided.

(4) Register Existing Module

[Module Name] enables user to create a module name with up to 100 characters. [Open] enables opening previously stored modules.

(5) Module Location

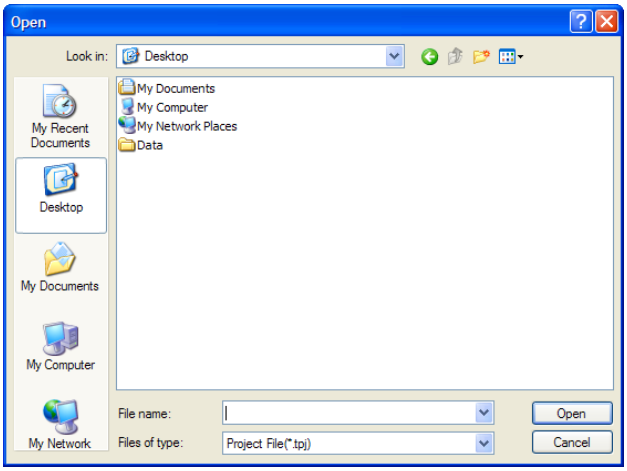
Module location can be designated using base and slot numbers.

(6) Module Description

Same as the Project Description.

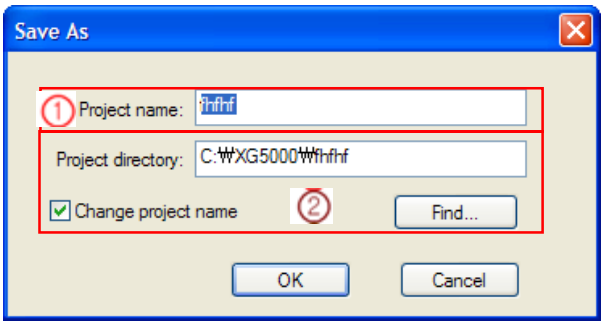
6.3.2 Open Project

This dialog is used for opening the project files, module files, or parameter files previously stored. When the [Open Project] menu is selected from project and tool bar, the project files with .tpj extension only can be opened. If [Read Items from File'] is selected, *.tpm or *.tpl files can be opened.



6.3.3 Save As

Save presently open project under different name. New folder can be designated with [Find(F)] menu. Project name and location can be defined with up to 100 characters. Special characters (\ /: * ? " < > |) are not supported.



(1) Project Name

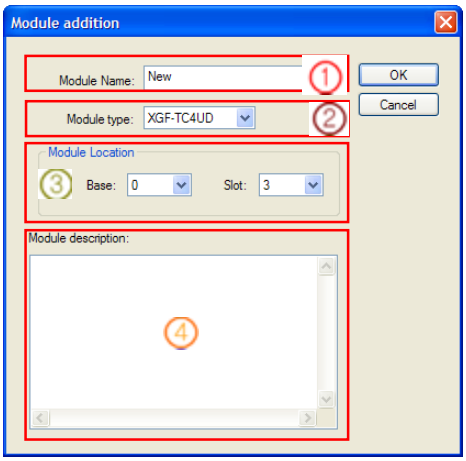
Enter the new name of the project to be saved with.

(2) Project Location

Enter the location of the project to be stored under a different name, or select desired folder with [Find(F)]. If the checkbox before the [Change project name too], the name of the project to be stored will be changed too. If unchecked, the present project name is maintained.

6.3.4 Add Module

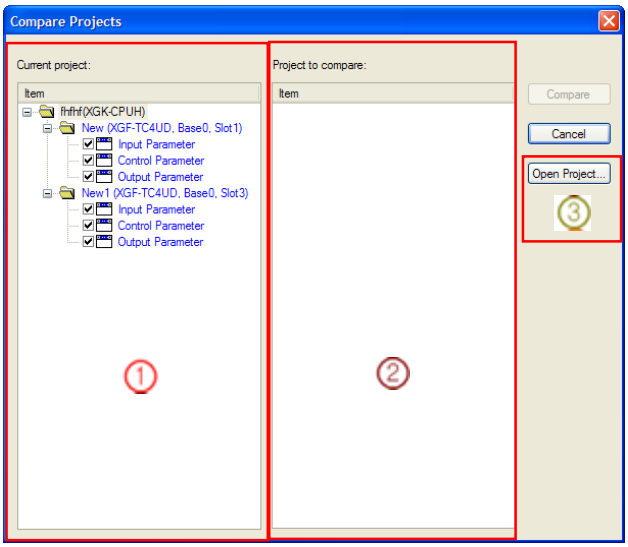
Modules can be added to [New Project] or [Previously Saved Project].



(1) Module Name
User can name the module with up to 100 characters.
(2) Module Type
Type of the module to be added is defined.
(3) Module Location
Module can be located by base and slot numbers.
(4) Module Description
Module can be described with up to 30,000 characters.
[ENTER] changes text lines.

6.3.5 Compare Projects

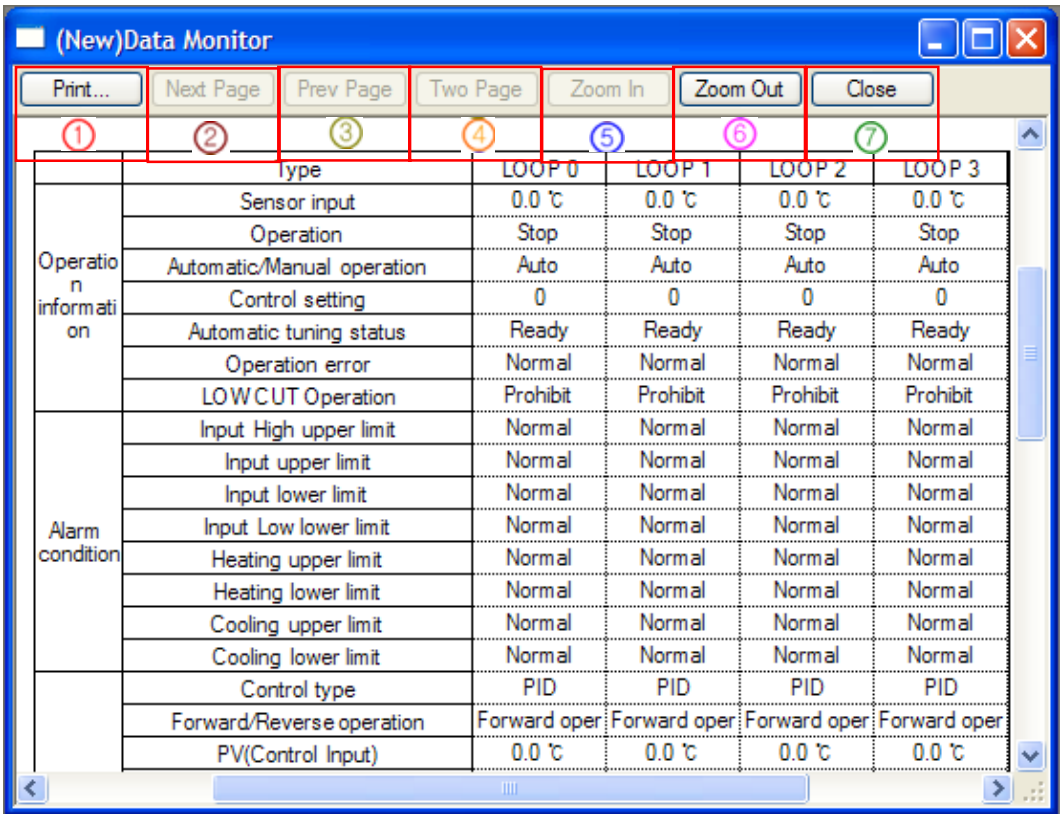
Compares the present project with another and shows the result. [Open File] button calls Open dialog with which user can open another project. When another project is opened, [Compare] button will be activated. Click this button to compare the projects and display the results in the [Module Status History] window.



(1) Present Project
The project presently opened in the XG-TCON.
(2) Project to be compared
The project opened for comparison.
(3) Open File
Click this [Open File] button to open the project for comparison.

6.3.6 Print Preview Window

[Print Preview] changes the XG-TCON screen to print preview screen. This window is in accordance with that of the Windows OS. Select Print to start printing, select [Next Page] to go to the next page, or [Prev Page] to go back to the previous page. [Two Pages] shows 2 pages in the same screen. [Zoom In/Out] shows enlarged or reduced image. [Close] returns to the XG-TCON screen.

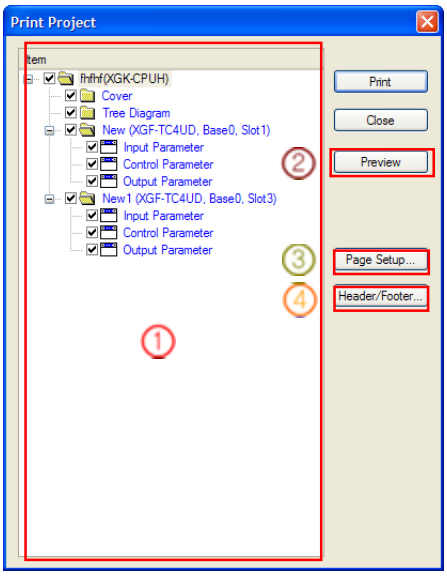


	Type	LOOP 0	LOOP 1	LOOP 2	LOOP 3
Operation information	Sensor input	0.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃
	Operation	Stop	Stop	Stop	Stop
	Automatic/Manual operation	Auto	Auto	Auto	Auto
	Control setting	0	0	0	0
	Automatic tuning status	Ready	Ready	Ready	Ready
	Operation error	Normal	Normal	Normal	Normal
	LOW CUT Operation	Prohibit	Prohibit	Prohibit	Prohibit
Alarm condition	Input High upper limit	Normal	Normal	Normal	Normal
	Input upper limit	Normal	Normal	Normal	Normal
	Input lower limit	Normal	Normal	Normal	Normal
	Input Low lower limit	Normal	Normal	Normal	Normal
	Heating upper limit	Normal	Normal	Normal	Normal
	Heating lower limit	Normal	Normal	Normal	Normal
	Cooling upper limit	Normal	Normal	Normal	Normal
	Cooling lower limit	Normal	Normal	Normal	Normal
	Control type	PID	PID	PID	PID
	Forward/Reverse operation	Forward oper	Forward oper	Forward oper	Forward oper
	PV(Control Input)	0.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃

(1) Print
Shows print dialog.
(2) Next
Go to the next page.
(3) Previous
Go to the previous page.
(4) 2 Pages
Shows 2 pages in the same screen.
(5) Zoom-in
Zoom in the print preview image.
(6) Zoom out
Zoom out the print preview image.
(7) Close
Shows print dialog.

6.3.7 Print Project

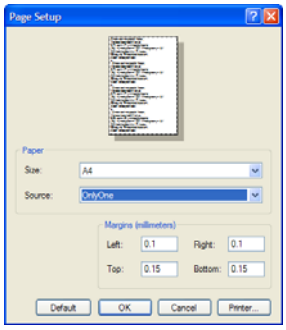
This function enables printing the desired items of the project.
Select (check) the desired items and click Print button to start printing.



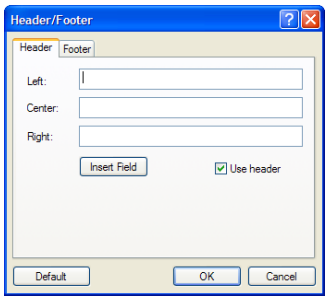
(1) Items
Items can be selected for printing by checking the check boxes.

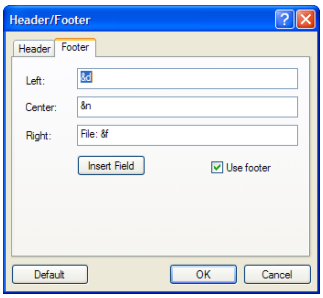
(2) Print Preview
Same as the [3.8 Print Preview Window].

(3) Page Setting
Print page options can be defined.



(4) Header/Footer
Header and footer options can be defined.

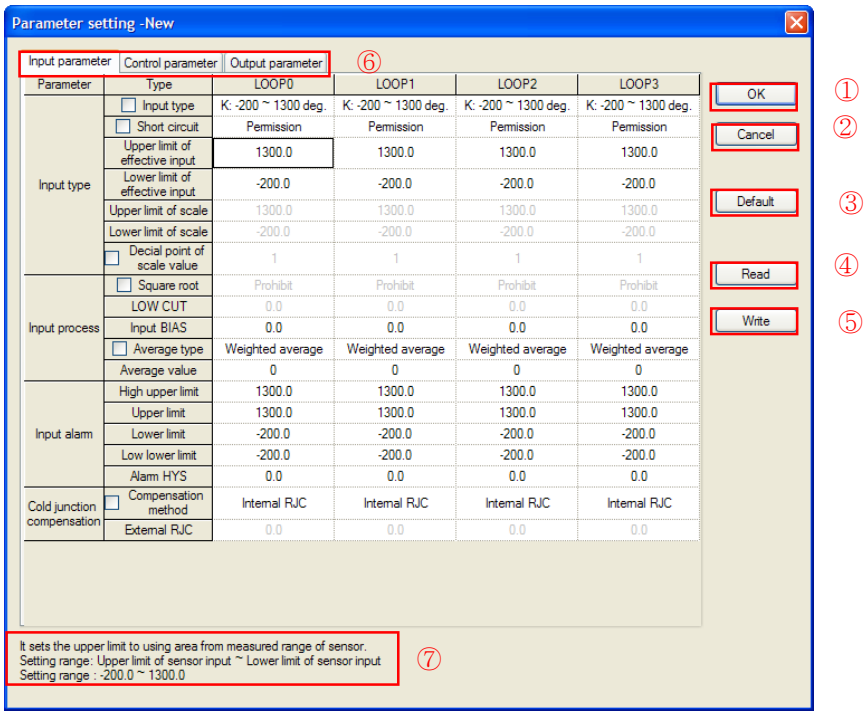




6.3.8 Parameter Register Information

This dialog box is for parameter setting. Input/control/output parameters can be entered by selecting respective tab. Parameter variables are indicated in black for default values. Blue for other than default values, or red for error.

(1) Parameter Common



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	1300.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	1300.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0
Input alarm	High upper limit	1300.0	1300.0	1300.0	1300.0
	Upper limit	1300.0	1300.0	1300.0	1300.0
	Lower limit	-200.0	-200.0	-200.0	-200.0
	Low lower limit	-200.0	-200.0	-200.0	-200.0
	Alarm HYS	0.0	0.0	0.0	0.0
Cold junction compensation	Compensation method	Internal RJC	Internal RJC	Internal RJC	Internal RJC
	External RJC	0.0	0.0	0.0	0.0

(a) Confirm
Applies the settings in the parameter dialog to the project

(b) Cancel
Cancels all the changes made in the dialog and return to the previous step

(c) Default Setting
Initializes all the settings in the dialog

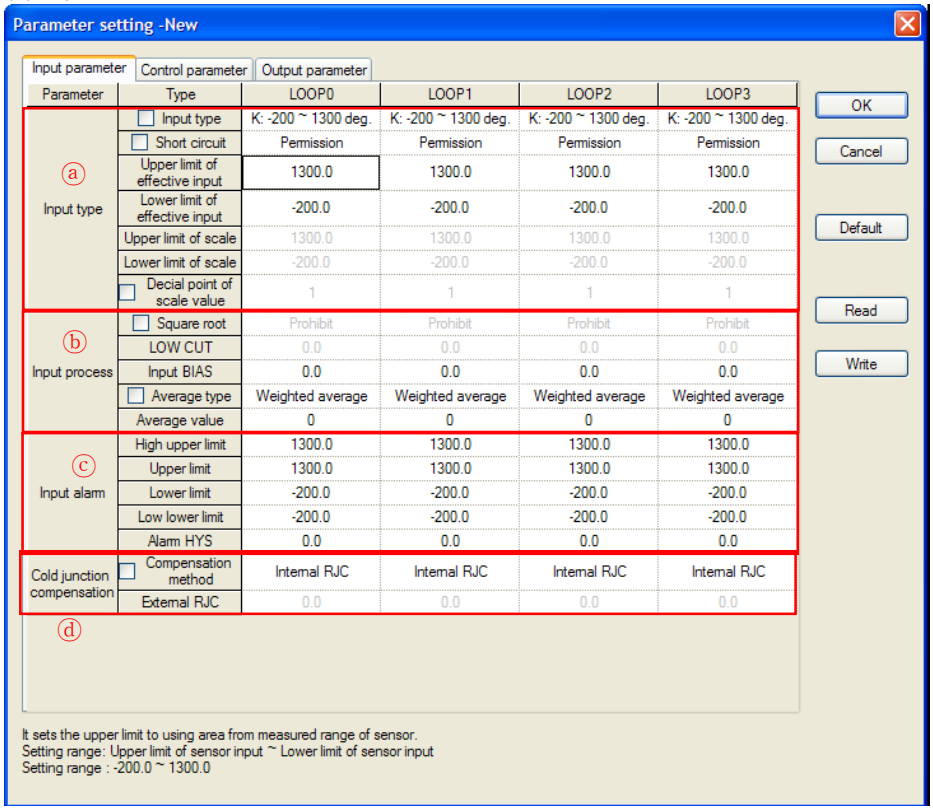
(d) Read
Reads the parameters of the respective module and display them in the parameter window (supported during connection only)

(e) Write
Transmits the changes made in the parameter window to the module (supported during connection only)

(f) Tab
Select input, output or output parameter tab to open the respective window

(g) Parameter Description
Describes the variable briefly.

(2) Input Parameters



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	1300.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	1300.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0
Input alarm	High upper limit	1300.0	1300.0	1300.0	1300.0
	Upper limit	1300.0	1300.0	1300.0	1300.0
	Lower limit	-200.0	-200.0	-200.0	-200.0
	Low lower limit	-200.0	-200.0	-200.0	-200.0
	Alarm HYS	0.0	0.0	0.0	0.0
Cold junction compensation	Compensation method	Internal RJC	Internal RJC	Internal RJC	Internal RJC
	External RJC	0.0	0.0	0.0	0.0

(a) Input Types

1) Input Types

Type	Min.	Max.	Type	Min.	Max.
K, N	-200.0	1300.0	PT100, PT1000	-200.0	850.0
J	-200.0	1200.0	JPT100	-200.0	600.0
T	-200.0	400.0	DC 0 ~ 10mV	0.00	10.00
B	400	1800	DC 0 ~ 100mV	0.0	100.0
S, R	0	1700	DC 0 ~ 1V	0.000	1.000
E	-200.0	1000.0	DC 1 ~ 5V	1.000	5.000
U	-200.0	600.0	DC 0 ~ 5V	0.000	5.000
L	-200.0	900.0	DC 0 ~ 10V	0.00	10.00
C	0	2300	DC -5 ~ 5V	-5.000	5.000
PL2	0.0	1300.0	DC -10 ~ 10V	-10.00	10.00
DC 4 ~ 20mA	4.00	20.00	DC 0 ~ 20mA	0.00	20.00

2) Open Line
If enabled, the sensor is opened physically and treated as an error. If disabled, even real line open will not be treated as open nor error.

3) Effective Input Upper Limit

An INT type, defining the upper limit of the applicable range of the sensor measurement. This limit should be between the maximum to minimum input of the sensor, and higher than the Effective Input Lower Limit.

4) Effective Input Lower Limit

An INT type, defining the lower limit of the applicable range of the sensor measurement. This limit should be between the maximum to minimum input of the sensor, and lower than the Effective Input Upper Limit.

5) Scale Upper Limit

An INT type. For temperature type, same as the effective input upper limit, and set up the upper limit in the voltage and current input scale. Setting range is 'Scale Upper Limit > Lower Limit + 30000' within -30000 ~ 30000.

6) Scale Lower Limit

An INT type. For temperature type, same as the effective input lower limit, and set up the lower limit in the voltage and current input scale. Setting range is 'Scale Lower Limit < Upper Limit - 30000' within -30000 ~ 30000.

7) Scale Decimal Point

Used only for voltage and current, to set up the decimal point of the upper and lower limits of scale, within the range of 0(x1) ~ 4(x0.0001).

(b) Process Input

1) Root Square

Extract the square root of the input. If the input value is a minus, the minus sign will be applied the same.

2) Low Cut

A USINT type, which can be entered only when square root is allowed. After extracting the square root, the value less than the LOW CUT% of the entire input range is treated as zero input. Setting range is 0(0%) ~ 50(5.0%).

3) Input Bias

An INT type, which sets bias to input values. Setting range is less than the entire input range within -30000 ~ 30000.

4) Average Type

Sets up the type of the averaging filter applied to input values. The types include weighted and moving average.

5) Average Value

A USINT type, which sets up the constant for the averaging filter. Setting range is (Weighted Average: 0(0%) ~99(99%), Moving Average 0(0 times) ~ 99(99 times)).

(c) Input Alarm

1) Average Value

A USINT type, which sets up the factor for the averaging filter. Setting range is (Weighted Average: 0(0%) ~99(99%), Moving Average 0(0 times) ~ 99(99 times)).

2) Up-Upper Limit

An INT type, which sets input up-upper limit alarm value to apply input alarm HYS. The setting range is between the lower to upper limit of scale within input range and above the low-lower and lower limit.

3) Upper limit

An INT type, which sets input upper limit alarm value to apply input alarm HYS. The setting range is between the lower to upper limit of scale within input range and above the low-lower and lower limit.

4) Lower Limit

An INT type, which sets input lower limit alarm value to apply input alarm HYS. The setting range is between the lower to upper limit of scale within input range and below the up-upper and upper limit.

5) Low-Lower Limit

An INT type, which sets input low-lower limit alarm value to apply input alarm HYS. The setting range is between the lower to upper limit of scale within input range and below the up-upper and upper limit.

6) Alarm HYS

A USINT type, which sets the hysteresis to be used commonly for the 4 input alarms (up-upper, upper, lower, low-lower limits). Setting range is between [Scale Upper Limit] - [Scale Lower Limit].

(d) Cold Contact Compensation

1) Alarm HYS

A USINT type, which sets the hysteresis to be used commonly for the 4 input alarms (up-upper, upper, lower, low-lower limits). Setting range is between [Scale Upper Limit] - [Scale Lower Limit].

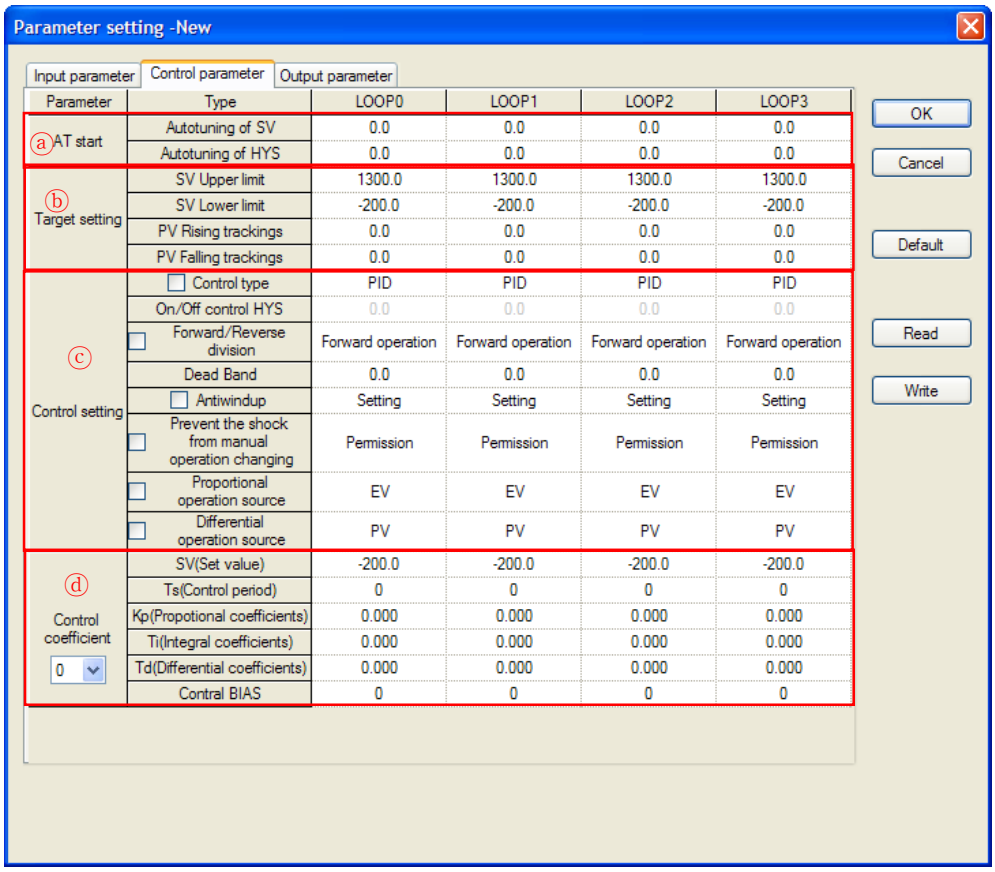
2) Compensation Method

Sets up the compensation method for TC (temperature) series sensors excluding the B type and RTD type of temperature input. The type includes internal RJC, external RJC, and RJC no-compensation.

3) External RJC

An INT type, which sets the external compensation value for the external RJC compensation method (B type, RTD, voltage, current inputs are not available). Setting range is -120(-12.0) ~ 1250(125.0).

(3) Control Parameter



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
ⓐ AT start	Autotuning of SV	0.0	0.0	0.0	0.0
	Autotuning of HYS	0.0	0.0	0.0	0.0
ⓑ Target setting	SV Upper limit	1300.0	1300.0	1300.0	1300.0
	SV Lower limit	-200.0	-200.0	-200.0	-200.0
	PV Rising trackings	0.0	0.0	0.0	0.0
	PV Falling trackings	0.0	0.0	0.0	0.0
ⓒ Control setting	Control type	PID	PID	PID	PID
	On/Off control HYS	0.0	0.0	0.0	0.0
	Forward/Reverse division	Forward operation	Forward operation	Forward operation	Forward operation
	Dead Band	0.0	0.0	0.0	0.0
	Antiwindup	Setting	Setting	Setting	Setting
	Prevent the shock from manual operation changing	Permission	Permission	Permission	Permission
	Proportional operation source	EV	EV	EV	EV
	Differential operation source	PV	PV	PV	PV
ⓓ Control coefficient 0	SV(Set value)	-200.0	-200.0	-200.0	-200.0
	Ts(Control period)	0	0	0	0
	Kp(Propotional coefficients)	0.000	0.000	0.000	0.000
	Ti(Integral coefficients)	0.000	0.000	0.000	0.000
	Td(Differential coefficients)	0.000	0.000	0.000	0.000
	Contral BIAS	0	0	0	0

(a) Auto Tuning

1) Auto Tuning SV

An INT type, which sets up the SV value for use in Auto Tuning. By setting different value from SV, overshoot in Auto Tuning can be prevented. Setting range is between the Effective Input Upper Limit ~ Effective Input Lower Limit.

2) Auto Tuning HYS

A USINT type, which sets up the hysteresis to be applied in Auto Tuning. Setting range is between the 'SV Upper Limit ~ SV lower Limit.'

(b) Target Setting

1) SV Upper Limit

An INT type, which sets up the upper limit of the SV[Control Target]. Setting range is between the Effective Input Upper Limit ~ Effective Input Lower Limit and same or less than the SV Lower Limit.

2) SV Lower Limit

An INT type, which sets p the lower limit of the SV[Control Target]. Setting range is between the Effective Input Upper Limit ~ Effective Input Lower Limit and same or less than the SV Upper Limit.

3) PV Rise Tracking

A USINT type, which sets the SV as the current (PV + PV Rise Tracking) when SV has large difference from PV. Disables if the setting value is 0. Setting range is between Scale Upper Limit and Scale Lower Limit.

4) PV Fall Tracking

A USINT type, which sets the SV as the current (PV - PV Rise Tracking) when SV has large difference from PV. Disables if the setting value is 0. Setting range is between Scale Upper Limit and Scale Lower Limit.

(c) Control Setting

1) Control Type

Select PID, CASCADE, or On-Off control.

2) ON/OFF Control HYS

A USINT type, which sets the hysteresis for use in ON-OFF type control. Setting range is between Scale Upper Limit and Scale Lower Limit.

3) Normal-Reverse Classification

Normal operation is defines as the system where heating output has to be increased to raise the PV, and the reverse operation is defines as the system where heating output has to be increased to lower the PV.

4) Blind Sector (Dead Zone)

A USINT type, which sets up the upper-lower SV blind sector (dead zone) radius. Setting range is between Input Upper Limit and Input Lower Limit.

5) Anti Reset Wind-up

Prevents overshoot with anti reset wind up which may be caused by starting up, disturbance, or sudden change of SV.

6) Shockproof Manual-to-Auto Change

Protects drive gear by mitigating impact in changing from manual to automatic operation.

7) Proportional Operation Source

Selects the source for use in proportional operation. If PV is set up as the proportional operation source, anti reset wind up function may fail. If the function fail, block the function.

8) Differential Operation Source

Selects the source for use in differential operation. If PV is set up as the differential operation source, smoother result can be obtained.

(d) Control Coefficients

1) SV[Control Target]

An INT type, which sets up the desired control target value. Setting range is between SV Upper Limit and SV Lower Limit.

2) Ts[Control Period]

Sets up operation period. However, if set to 0, it is recognized as 1(200msec). Setting range is 1(200msec) ~ 65535(13107sec) or 0(200msec).

3) Kp[Proportional Coefficient]

A REAL(float) type, which sets up proportional coefficient. Setting range is 0.0 ~ 100.0 and negative numbers cannot be entered.

4) Ti[Integral Coefficient]

A REAL(float) type, which sets up the coefficient of integration. Can be set up with any real number. Integration speed is proportional to this coefficient. Recommended setting range is 0(0.0) ~ 500(50.) and negative numbers cannot be entered.

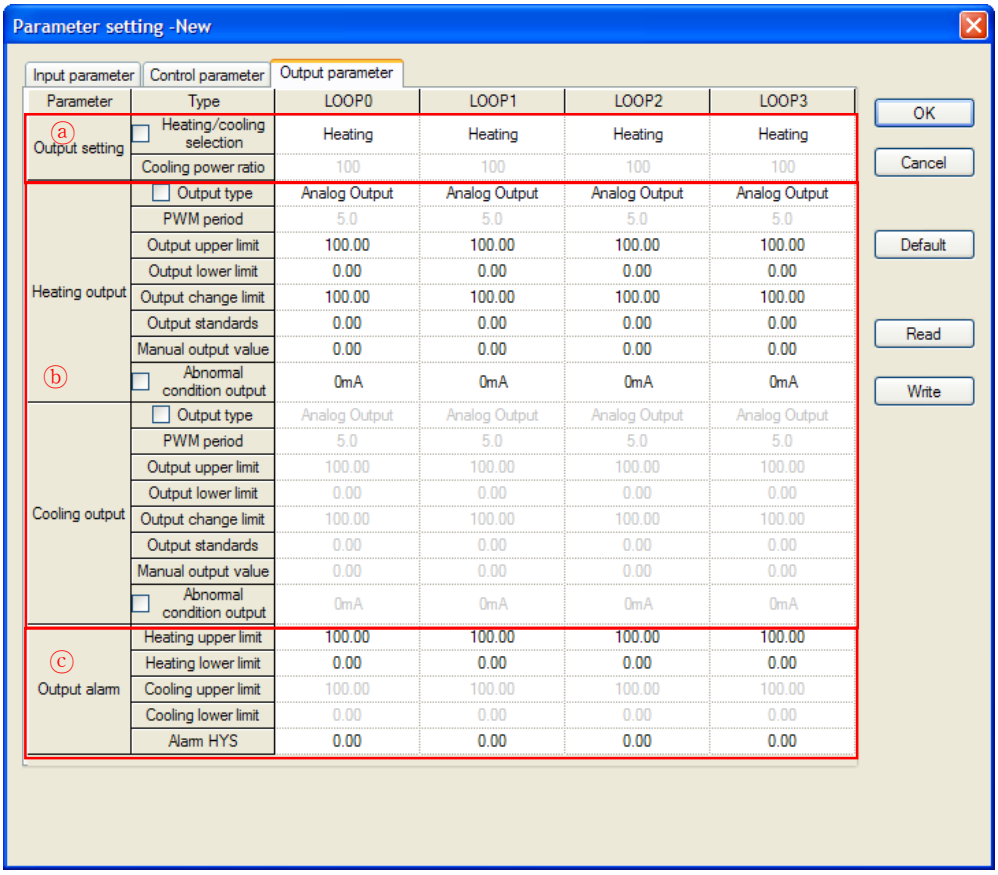
5) Td[Differential Coefficient]

A REAL(float) type, which sets up the differential coefficient. Can be set up with any real number. Setting range is 0.0 ~ 0.1.

6) Control BIAS

An INT type, which sets up the bias to the load side transmit MV after control operation. Setting range is -1000 ~ 1000.

(4) Output Parameters



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
ⓐ Output setting	Heating/cooling selection	Heating	Heating	Heating	Heating
	Cooling power ratio	100	100	100	100
Heating output ⓑ	Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	0mA	0mA	0mA	0mA
Cooling output	Output type	Analog Output	Analog Output	Analog Output	Analog Output
	PWM period	5.0	5.0	5.0	5.0
	Output upper limit	100.00	100.00	100.00	100.00
	Output lower limit	0.00	0.00	0.00	0.00
	Output change limit	100.00	100.00	100.00	100.00
	Output standards	0.00	0.00	0.00	0.00
	Manual output value	0.00	0.00	0.00	0.00
	Abnormal condition output	0mA	0mA	0mA	0mA
ⓒ Output alarm	Heating upper limit	100.00	100.00	100.00	100.00
	Heating lower limit	0.00	0.00	0.00	0.00
	Cooling upper limit	100.00	100.00	100.00	100.00
	Cooling lower limit	0.00	0.00	0.00	0.00
	Alarm HYS	0.00	0.00	0.00	0.00

(a) Output Setting

1) Heating Cooling Selection

Sets up the operation of the heating output terminal, cooling output terminal, and heating/cooling output terminal.

2) Cooing Output Ratio

A USINT type, which sets up the cooling output creation ratio to heating output. Setting range is 0(0%) ~ 100(100%).

(b) Heating/Cooling Output

1) Output Type

Sets up the output type of the Heating/Cooling output terminal. Analog setting will provide 4 ~ 20mA, or PWM setting will provide pulse output.

2) PWM Period

A USINT type, which sets up the pulse output period used in PWM output. Setting range is 5(0.5sec) ~ 1200(120.0sec).

3) Output Upper Limit

An INT type, which sets up the upper limit value of heating/cooling output. Setting range is -5 ~ 105 for analog or 0 ~ 100 for PWM, above output lower limit.

4) Output Lower Limit

An INT type, which sets up the lower limit value of heating/cooling output. Setting range is -5 ~ 105 for analog or 0 ~ 100 for PWM, below output upper limit.

5) Output Variation Rate Limit

A USINT type, which sets up the allowable range of per period rise and fall of heating/cooling output. Setting range is -5 ~ 105 for analog or 0 ~ 100 for PWM, above the lower limit of heating output.

6) Output Reference

An INT type, which adjusts the reference of the heating/cooling output.
Setting range is -5000(-50.00) ~ 5000(50.00).

7) Manual Output Value

An INT type, which sets up the output value of heating/cooling in manual mode.

8) Abnormal Condition Output

Sets up the output value under abnormal condition. 0mA, Minimum, Median or Maximum can be selected.

(c) Output Alarm

1) Heating Upper Limit

An INT type, which sets up the upper limit of heating output. Setting range is 0(0.00) ~ 100(100.00).

2) Heating Lower Limit

An INT type, which sets up the lower limit of heating output. Setting range is 0(0.00) ~ 100(100.00).

3) Cooling Upper Limit

An INT type, which sets up the upper limit of cooling output. Setting range is 0(0.00) ~ 100(100.00).

4) Cooling Lower Limit

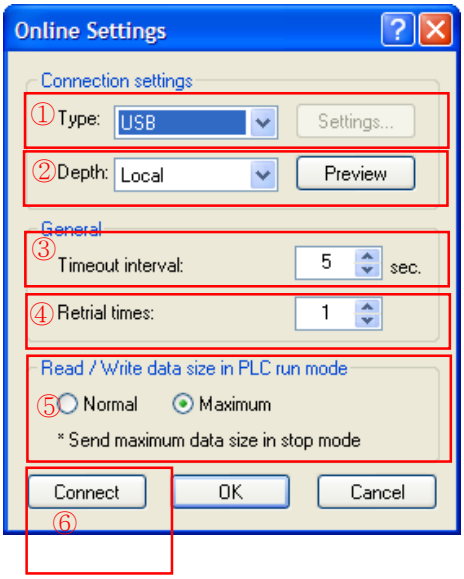
An INT type, which sets up the lower limit of cooling output. Setting range is 0(0.00) ~ 100(100.00).

5) Alarm HYS

A USINT type, which sets up the hysteresis used for heating and cooling alarm. Setting range is 0(0.00) ~ 100(100.00).

6.3.9 Connection Setting

User can set up connection between PLC and XG-TCON in this dialog box.



(1) Connection Method

Sets up connection method with PLC. RS-232C, USB, Ethernet, and Modem connection are supported. The tree connection methods except the USB need further setting by selecting [Setting].

(2) Connection Steps

Sets up connection steps with PLC, which can be local, remote 1 step, or remote 2 steps. Select [View] to see the image of the connection step.

(3) Timeout at Communication Failure

Timeout is triggered if communication with PLC fails to be resumed within the set up time.

(4) Number of Retrials at Communication Failure

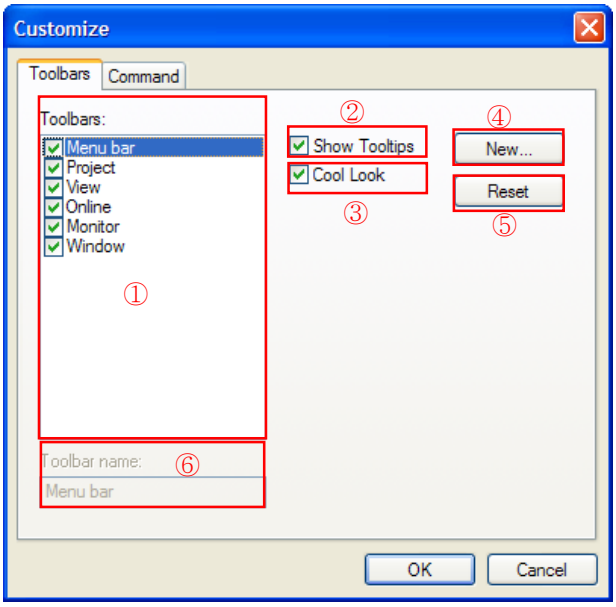
Sets up the number of retrials at communication failure with PLC.

(5) Read/Write Data Size in Run Mode

Sets up the size of the data transmission frame. This option applies only when the PLC operation is in RUN mode. In other modes, data is transmitted at the largest frame size.

6.3.10 Customize

This function enables to created new tool bar, or show or hide tool bar.



(1) Tools (tool bar)
Checking/unchecking the check box in front of the items shows/hides the respective item.

(2) Show Tool Tip
If checked, name of the tool bar will be displayed when mouse cursor is placed on the tool bar registered in the menu.

(3) Cool Type
If checked, the boundary between tool bars is displayed.

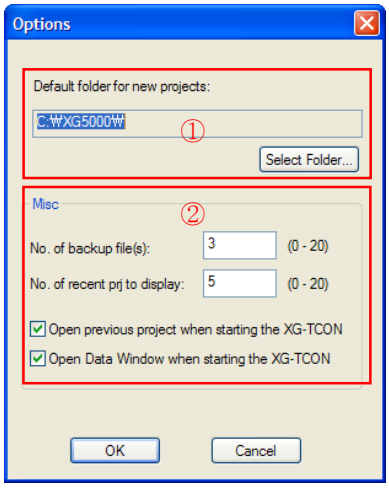
(4) New Tools
Creates new tool bars.

(5) Reset
After modifying tool bar, clicking Reset will initialize the tool bars.
If mouse cursor is placed on the tool bar created with [New Tools], [Reset] will be changed to [Delete], selecting which will delete the new tool bar.

(6) Tool Bar Name
Shows the name of the selected tool bar. If the tool bar created with [New Tools] is selected, its name can be changed here.

6.3.11 Option Dialog

Basic options of project can be set up in this dialog.



(1) Default Folder for Newly Created Project

Designates the default folder which will be created in addition to the new project. User cannot enter the folder name, but use [Find] menu to designate it.

(2) Others

[No. of Backup Files]: number of backup files can be set up.

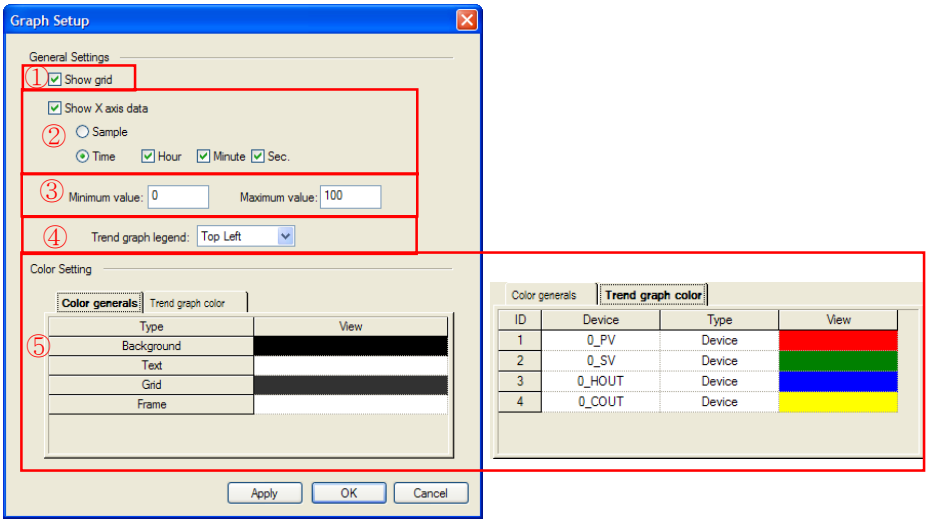
[Show Recent Project Files]: number of the files to be indicated for the recent project can be defined.

[Open Previous Project at Start-up]: if checked, the previous project is opened at starting up the XG-TCON.

[Open Data Monitoring Window at Start-up]: if checked, data monitoring window is activated when new project is created.

6.3.12 Graph Setting

Display configuration of the trend monitoring window can be set up in this dialog.



(1) Show Grid

Show/hide grid of the trend monitoring screen.

(2) Show X-axis Data

Show/hide X-axis data, and X-axis data can be displayed by the No. of samples or time.

(3) Min., Max. Graph Value

Minimum and maximum values of the Y-axis in the graph for zoom in/out can be set up.

(4) Trend Graph Index Position

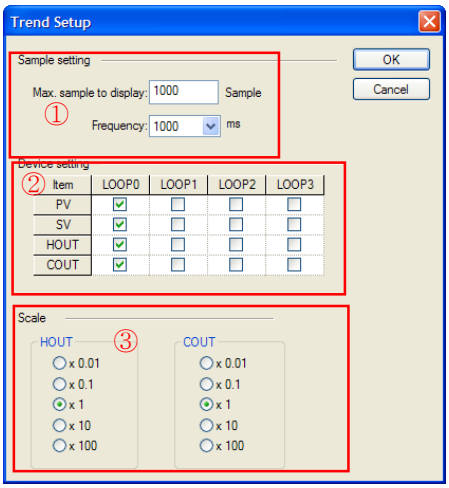
The default position of the trend graph index is top left screen, which can be changed.

(5) Color Setting

Using the graph color general and trend graph color tab, graph or trend graph color can be selected.

6.3.13 Trend Setting

Trend monitoring operation can be set up in this dialog.
The PV(IN), SV, HOUT, and COUT of each loop can be easily registered, or view in graphs by selecting with check marks.



(1) Sample Setting

Maximum number of the samples indicated on the X-axis and the monitoring cycle can be set up. No. of samples is between 10 ~ 65535, and the cycle can be 200ms, 300ms, 400ms, 500ms, 1000ms, 2000ms, 3000ms, 4000ms, or 5000ms.

(2) Register Devices

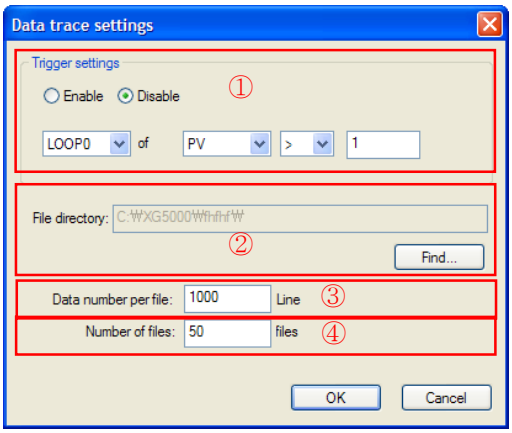
The devices shown in the trend graph can be selected.

(3) Magnificent

The magnificent of HOUT and COUT can be set up. The HOUT and COUT are zoomed in/out regardless of the graph setting.

6.3.14 Logging Data Setting

The location and point of time at which the data sampled from trend monitor are saved in a file.



(1) Auto Start-up Condition

Sets up automatic starting conditions. If [Prohibit] is selected, auto start-up condition is saved without writing. If [Apply] is selected, automatic saving begins if the conditions are the same as those of the respective loop.

(2) File Location

Specifies the location (folder) for data saving using [Find] menu. The default folder is the folder where the present project is stored.

(3) No. of Data per File

Specifies number of data to be saved in a file, from minimum one line to maximum 10,000 lines.

(4) No. of Files for Continuous Saving

Specifies the number of files for saving, from minimum one to maximum 100.

6.3.15 Error Code

- The software package provides following error codes.

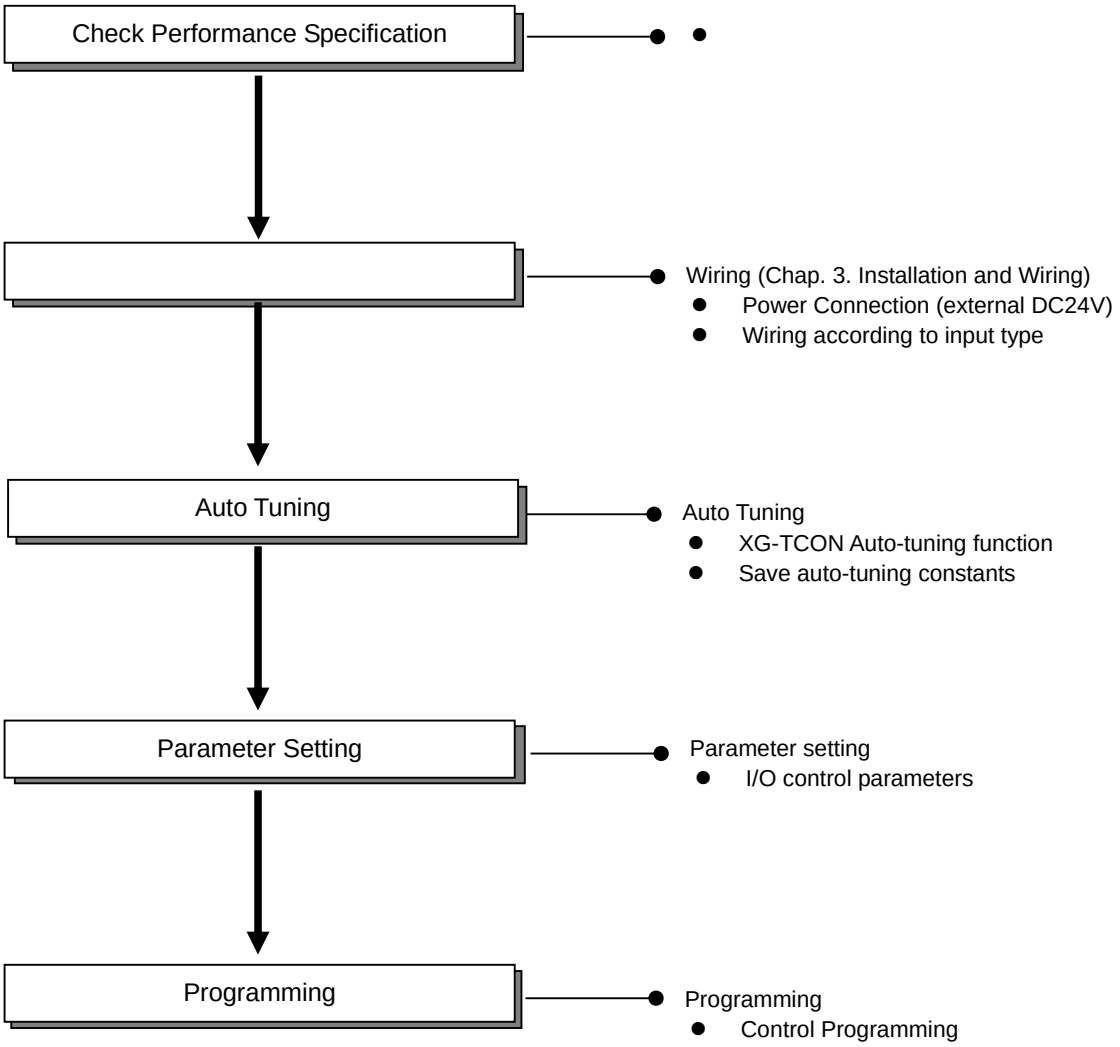
Error	Description of Error	RUN_LE	ALM_RE	ERR_L
10	ASIC internal register initialization error	OFF	OFF	ON
11	ASIC internal RAM read/write error	OFF	OFF	ON
12	ASIC internal register read/write error	OFF	OFF	ON
20	Backup memory checksum error	OFF	OFF	ON
30	Overtime in access from module to refresh write area	OFF	OFF	ON
31	Address error in access from module to refresh write area	OFF	OFF	ON
32	Overtime in access from module to refresh read area	OFF	OFF	ON
33	Address error in access from module to refresh read area	OFF	OFF	ON
40	PLC CPU error	ON	OFF	1s flash
50	Parameter setting range excess error	ON	OFF	1s flash
60	AD converter H/W error	ON	OFF	1s flash
70	RJC sensor isolated from terminal	ON	OFF	1s flash
80	IC sensor isolated from CPU board	ON	OFF	1s flash
90	Input line open	ON	OFF	1s flash
100	Input type setting error	ON	OFF	1s flash
101	Effective input upper limit setting error	ON	OFF	1s flash
102	Effective input lower limit setting error	ON	OFF	1s flash
103	Scale upper limit setting error	ON	OFF	1s flash
104	Scale lower limit setting error	ON	OFF	1s flash
105	Scale decimal point setting error	ON	OFF	1s flash
110	LOW CUT setting error	ON	OFF	1s flash
111	Input BIAS setting error	ON	OFF	1s flash
112	Average setting error	ON	OFF	1s flash
120	Input alarm up-upper limit setting error	ON	OFF	1s flash
121	Input alarm upper limit setting error	ON	OFF	1s flash
122	Input alarm lower limit setting error	ON	OFF	1s flash
123	Input alarm low-lower limit setting error	ON	OFF	1s flash
124	Alarm HYS setting error	ON	OFF	1s flash
130	Cold contact compensation method setting error	ON	OFF	1s flash
131	Cold contact external RJC setting error	ON	OFF	1s flash
200	Auto Tuning SV setting error	ON	OFF	1s flash
201	Auto Tuning HYS setting error	ON	OFF	1s flash

Error Code	Description of Error	RUN_LED	ALM_RED	ERR_LED
210	SV upper limit setting error	ON	OFF	1s flash
211	SV lower limit setting error	ON	OFF	1s flash
212	PV rise tracking setting error	ON	OFF	1s flash
223	PV fall tracking setting error	ON	OFF	1s flash
220	Control type setting error	ON	OFF	1s flash
221	ON/OFF control HYS setting error	ON	OFF	1s flash
222	Blind sector (dad zone) setting error	ON	OFF	1s flash
2n0	SV(control target) setting error	ON	OFF	1s flash
2n1	Kp(P-coefficient) setting error	ON	OFF	1s flash
2n2	Ti(I-coefficient) setting error	ON	OFF	1s flash
2n3	Td(D-coefficient) setting error	ON	OFF	1s flash
2n4	Control bias setting error	ON	OFF	1s flash
230	Control coefficient setting error	ON	OFF	1s flash
300	Cooling output ratio setting error	ON	OFF	1s flash
310	Heating output PWM cycle setting error	ON	OFF	1s flash
311	Heating output upper limit setting error	ON	OFF	1s flash
312	Heating output lower limit setting error	ON	OFF	1s flash
313	Heating output variation limit setting error	ON	OFF	1s flash
314	Heating output reference setting error	ON	OFF	1s flash
315	Heating output manual value setting error	ON	OFF	1s flash
316	Heating output abnormal output setting error	ON	OFF	1s flash
320	Cooling output PWM cycle setting error	ON	OFF	1s flash
321	Cooling output upper limit setting error	ON	OFF	1s flash
322	Cooling output lower limit setting error	ON	OFF	1s flash
323	Cooling output variation limit setting error	ON	OFF	1s flash
324	Cooling output reference setting error	ON	OFF	1s flash
325	Cooling output manual value setting error	ON	OFF	1s flash
326	Cooling output abnormal output setting error	ON	OFF	1s flash
330	Heating upper limit setting error	ON	OFF	1s flash
331	Heating lower limit setting error	ON	OFF	1s flash
332	Cooling upper limit setting error	ON	OFF	1s flash
333	Cooling lower limit setting error	ON	OFF	1s flash
334	Alarm HYS setting error	ON	OFF	1s flash

※ n stands for the loop number.

Chapter 7 Programming (for XGK)

7.1 Pre-operation Setting-up Procedure



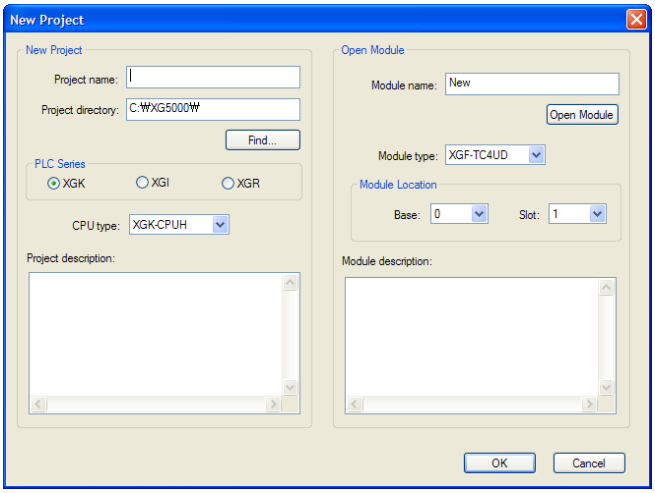
7.2 Sample Program

- Below is a sample program for temperature control with a temperature controller mounted in slot #2.

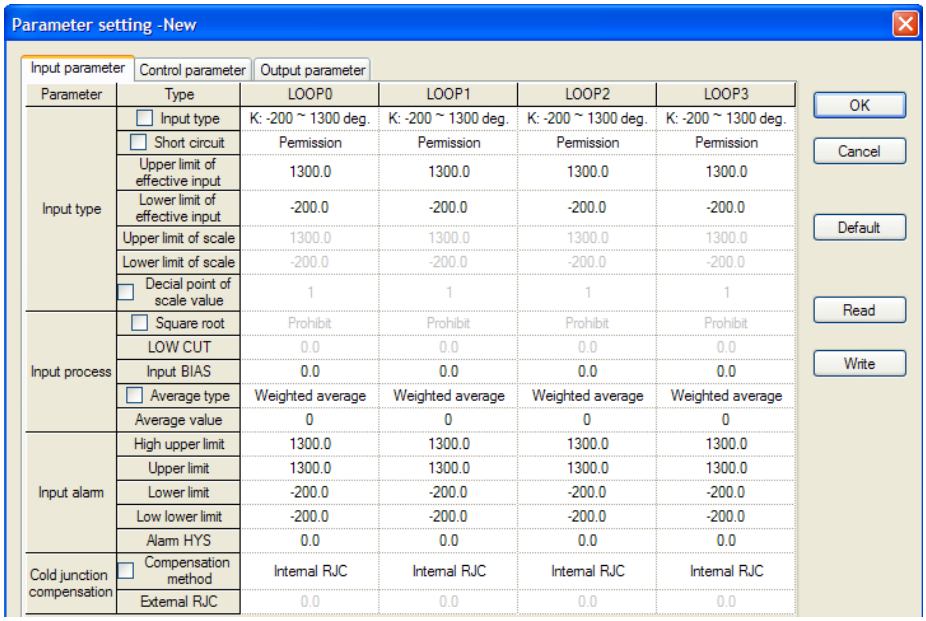
7.2.1 Auto Tuning

- This section describes auto tuning method.

(1) In the XG-TCON software window, select [Connect] after creating a new project.



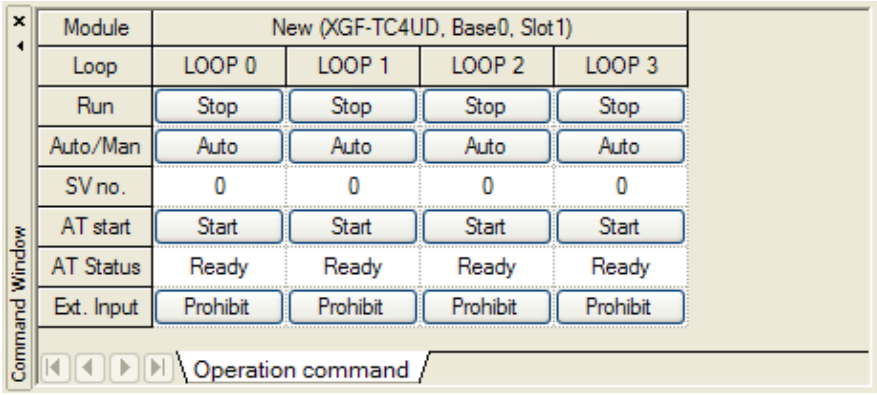
(2) In the project window, select Input Parameter to call parameter setting window shown below.



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	1300.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	1300.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0
Input alarm	High upper limit	1300.0	1300.0	1300.0	1300.0
	Upper limit	1300.0	1300.0	1300.0	1300.0
	Lower limit	-200.0	-200.0	-200.0	-200.0
	Low lower limit	-200.0	-200.0	-200.0	-200.0
	Alarm HYS	0.0	0.0	0.0	0.0
Cold junction compensation	Compensation method	Internal RJC	Internal RJC	Internal RJC	Internal RJC
	External RJC	0.0	0.0	0.0	0.0

(3) In the parameter setting window, set up input and output types. Select Write button to save the parameter setting in the temperature controller.

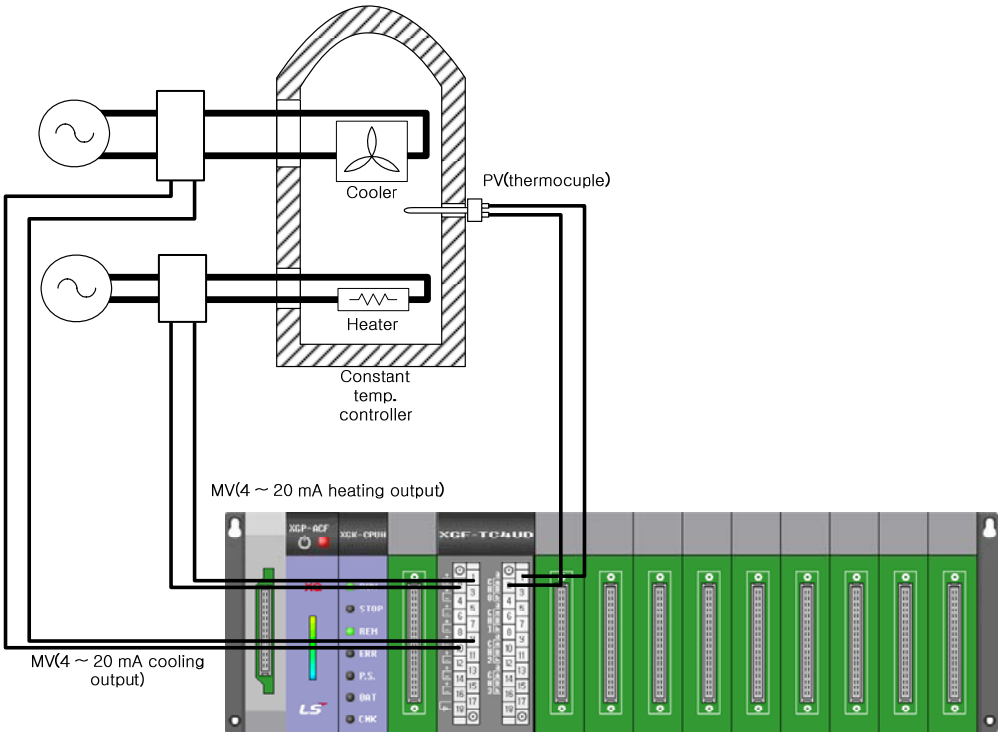
(4) In the operation reference window in bottom left, select the operation of the respective loop and select Start Auto Tuning.



(5) When “Completed” appears in the tuning section, open the #2 parameter setting window and select Write button to save the auto tuning constants in the temperature controller.

7.2.2 Temperature Control Program

- Below is an exemplary system where, the temperature of the temperature control chamber is measured with the T-type thermocouple connected to loop 0, and perform heating/cooling output control to maintain the temperature in the chamber at 200℃±10℃.



(1) Input Parameter Setting

- Select T-type of the thermocouple for the input type of the LOOP0.

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0
Input type	Input type	T: -200 ~ 400 deg.
	Short circuit	Permission
	Upper limit of effective input	400.0
	Lower limit of effective input	-200.0
	Upper limit of scale	400.0
	Lower limit of scale	-200.0
	Decial point of scale value	1

(2) Control Parameter Setting

- Set the dead band to 100(10.0℃)
- Set the SV (control target) to 2000(200.0℃)
- Set the Kp (proportional coefficient) to 1000(1.000)
- Set the Ti (integral coefficient) to 1000(1.000)
- When using auto tuning, set up with the value detected by auto tuning

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0
AT start	Autotuning of SV	0.0
	Autotuning of HYS	0.0
Target setting	SV Upper limit	400.0
	SV Lower limit	-200.0
	PV Rising trackings	0.0
	PV Falling trackings	0.0
Control setting	Control type	PID
	On/Off control HYS	0.0
	Forward/Reverse division	Forward operation
	Dead Band	10.0
	Antiwindup	Setting
	Prevent the shock from manual operation changing	Permission
	Proportional operation source	EV
	Differential operation source	PV
Control coefficient 0	SV(Set value)	200.0
	Ts(Control period)	0
	Kp(Propotional coefficients)	1.000
	Ti(Integral coefficients)	1.000
	Td(Differential coefficients)	0.000
	Contral BIAS	0

(3) Output Parameter Setting

- In the output setting, select Heating/Cooling.

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Output setting	Heating/cooling selection	Heating/Cooling	Heating	Heating	Heating
	Cooling power ratio	100	100	100	100

(4) Operation

- Select Connect from online menu, and select Write in the (3) Parameter Setting Window.

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	T: -200 ~ 400 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	400.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	400.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0

OK | Cancel | Default | Read | Write

- After writing, select Stop of loop0 from the operation command in the module state window to change to the operation state.

Command Window

Module	New (XGF-TC4UD, Base0, Slot1)			
Loop	LOOP 0	LOOP 1	LOOP 2	LOOP 3
Run	Run	Stop	Stop	Stop
Auto/Man	Auto	Auto	Auto	Auto
SV no.	0	0	0	0
AT start	Start	Start	Start	Start
AT Status	Ready	Ready	Ready	Ready
Ext. Input	Prohibit	Prohibit	Prohibit	Prohibit

Operation command

- The temperature controller will provide cooling output (Ch 1) when the present temperature exceeds 200℃, or heating output (Ch 0) when the present temperature is below 200℃.

(5) Data Monitor

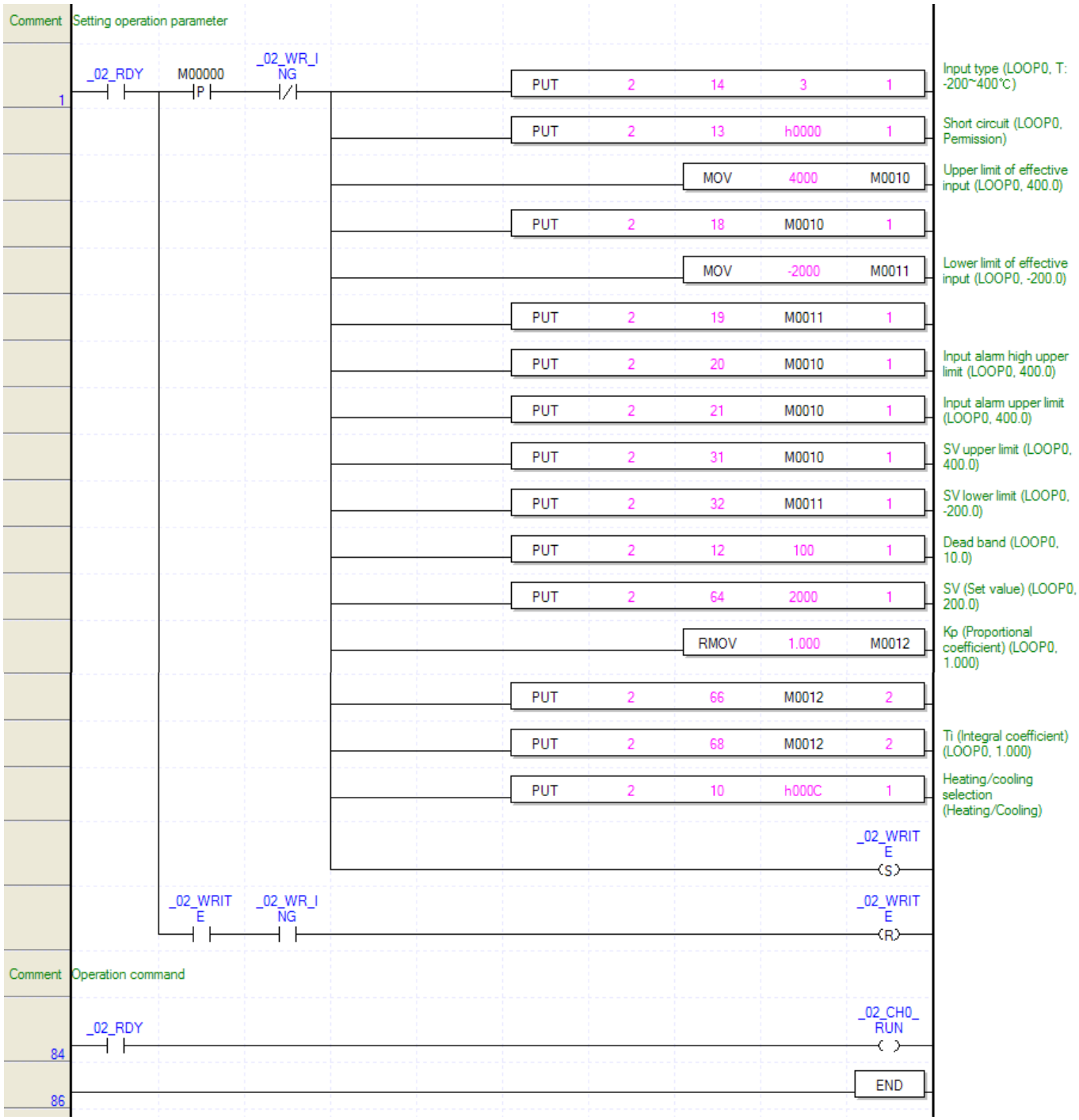
- Select [Monitor]-[Data Monitor] to check control status.

	Type	LOOP 0	LOOP 1	LOOP 2	LOOP 3
Operation information	Sensor input	[Burn-out]	0.0 ℃	0.0 ℃	0.0 ℃
	Operation	Run	Stop	Stop	Stop
	Automatic/Manual operation	Auto	Auto	Auto	Auto
	Control setting	0	0	0	0
	Automatic tuning status	Ready	Ready	Ready	Ready
	Operation error	[70]	Normal	Normal	Normal
	LOW CUT Operation	Prohibit	Prohibit	Prohibit	Prohibit
Alarm condition	Input High upper limit	Normal	Normal	Normal	Normal
	Input upper limit	Normal	Normal	Normal	Normal
	Input lower limit	Alarm	Normal	Normal	Normal
	Input Low lower limit	Alarm	Normal	Normal	Normal
	Heating upper limit	Normal	Normal	Normal	Normal
	Heating lower limit	Alarm	Normal	Normal	Normal
	Cooling upper limit	Normal	Normal	Normal	Normal
	Cooling lower limit	Normal	Normal	Normal	Normal
Control information	Control type	PID	PID	PID	PID
	Forward/Reverse operation	Forward operation	Forward operation	Forward operation	Forward operation
	PV(Control Input)	[Burn-out]	0.0 ℃	0.0 ℃	0.0 ℃
	SV(Control target)	-200.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃
	PV rising tracking	Prohibit	Prohibit	Prohibit	Prohibit
	PV falling tracking	Prohibit	Prohibit	Prohibit	Prohibit
	EV(Control error value)	0.000000	0.000000	0.000000	0.000000
	Dead Band	Prohibit	Prohibit	Prohibit	Prohibit
	Prevention of nover-intergal operation	Setting	Setting	Setting	Setting
	MV(Control output)	0.00	0.00	0.00	0.00
Output information	Heating output type	Analog Output	Analog Output	Analog Output	Analog Output
	Heating output	0.00%	0.00%	0.00%	0.00%
	Cooling output type	Analog Output	Analog Output	Analog Output	Analog Output
	Cooling output	0.00%	0.00%	0.00%	0.00%

7.2.3 Sample Program using PUT/GET Command

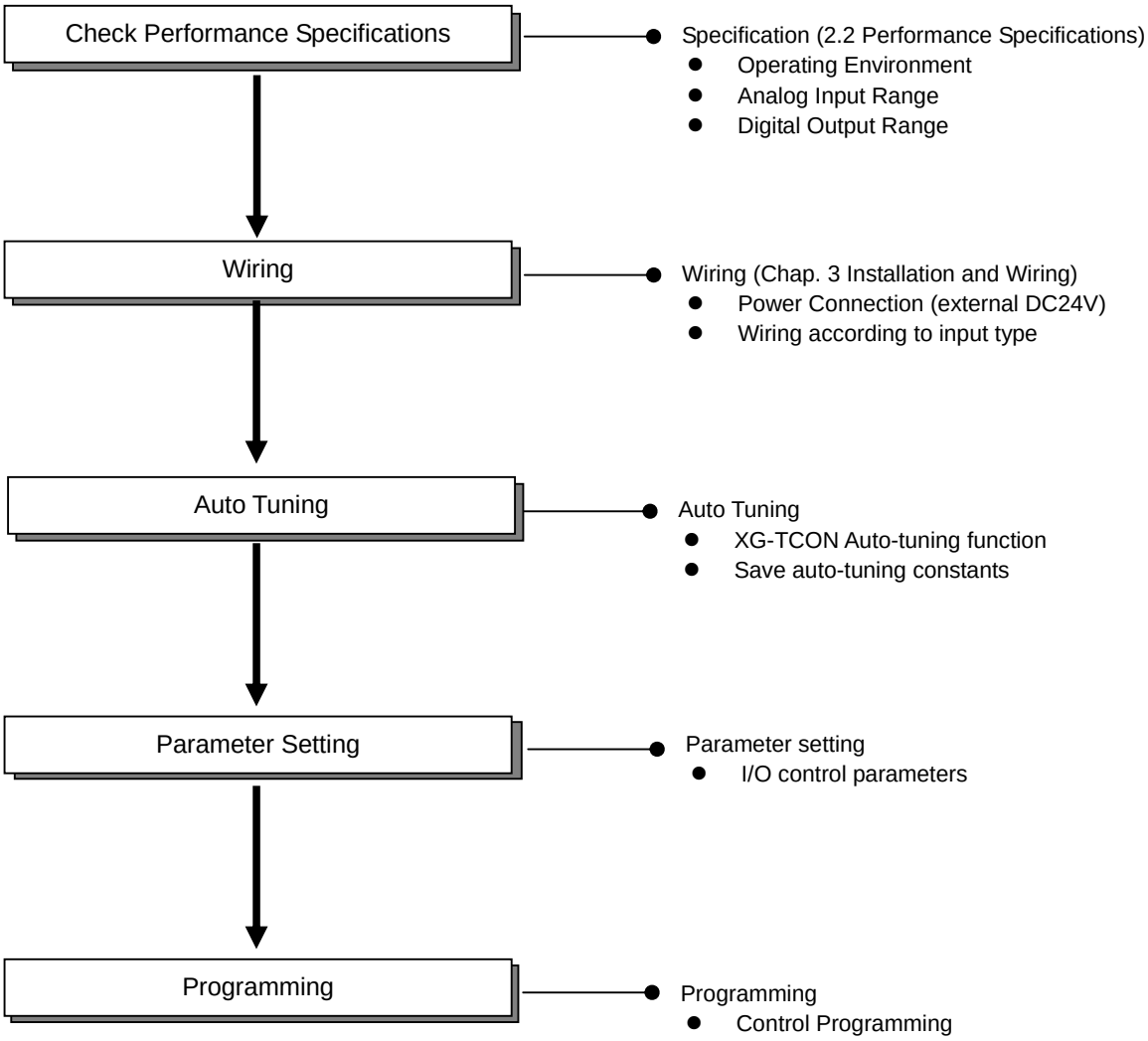
- Below is an exemplary program to change parameters using PUT/GET command.
- The U device contacts and description required for using PUT/GET command are as follows.

Device Name		Symbol Name	Description
Word	Bit		
U00.01	U00.01.0	_00_WR_ING	Parameter being saved (writing)
	Read only area which shows backup operation of the module. If the respective bit is On, the module data is being written for saving.		
	U00.01.8	_00_RD_ING	Parameter being retrieved (reading)
	Read only area which shows backup operation of the module. If the respective bit is ON, the module data is being retrieved.		
U00.30	U00.30.0	_00_WRITE	Parameter save command (write)
	U00.30.8	_00_READ	Parameter restore command (read)


Comment
Setting operation parameter
1
_02_RDY
M00000
P
_02_WR_ING
PUT 2 14 3 1
Input type (LOOP0, T: -200~400℃)
PUT 2 13 h0000 1
Short circuit (LOOP0, Permission)
MOV 4000 M0010
Upper limit of effective input (LOOP0, 400.0)
PUT 2 18 M0010 1
MOV -2000 M0011
Lower limit of effective input (LOOP0, -200.0)
PUT 2 19 M0011 1
PUT 2 20 M0010 1
Input alarm high upper limit (LOOP0, 400.0)
PUT 2 21 M0010 1
Input alarm upper limit (LOOP0, 400.0)
PUT 2 31 M0010 1
SV upper limit (LOOP0, 400.0)
PUT 2 32 M0011 1
SV lower limit (LOOP0, -200.0)
PUT 2 12 100 1
Dead band (LOOP0, 10.0)
PUT 2 64 2000 1
SV (Set value) (LOOP0, 200.0)
RMOV 1.000 M0012
Kp (Proportional coefficient) (LOOP0, 1.000)
PUT 2 66 M0012 2
PUT 2 68 M0012 2
Ti (Integral coefficient) (LOOP0, 1.000)
PUT 2 10 h000C 1
Heating/cooling selection (Heating/Cooling)
_02_WRITE
S
_02_WRITE
_02_WR_ING
_02_WRITE
R
Comment
Operation command
84
_02_RDY
_02_CH0_RUN
86
END

Chapter 8 Programming (for XGI/XGR)

8.1 Pre-operation Setting-up Procedure



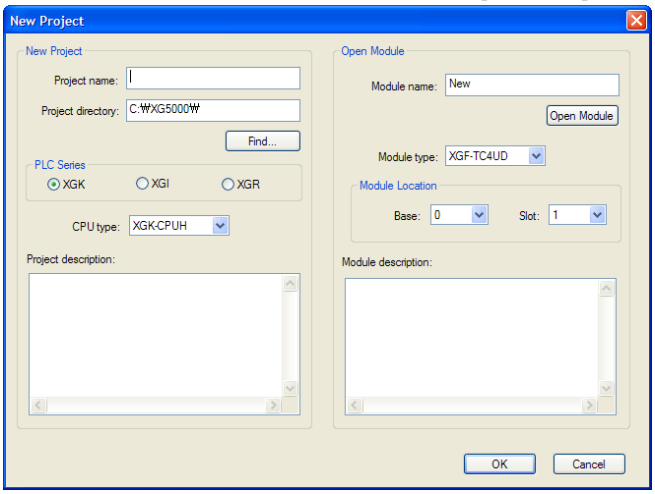
8.2 Sample Program

- Below is a sample program for temperature control with a temperature controller mounted in slot #2.

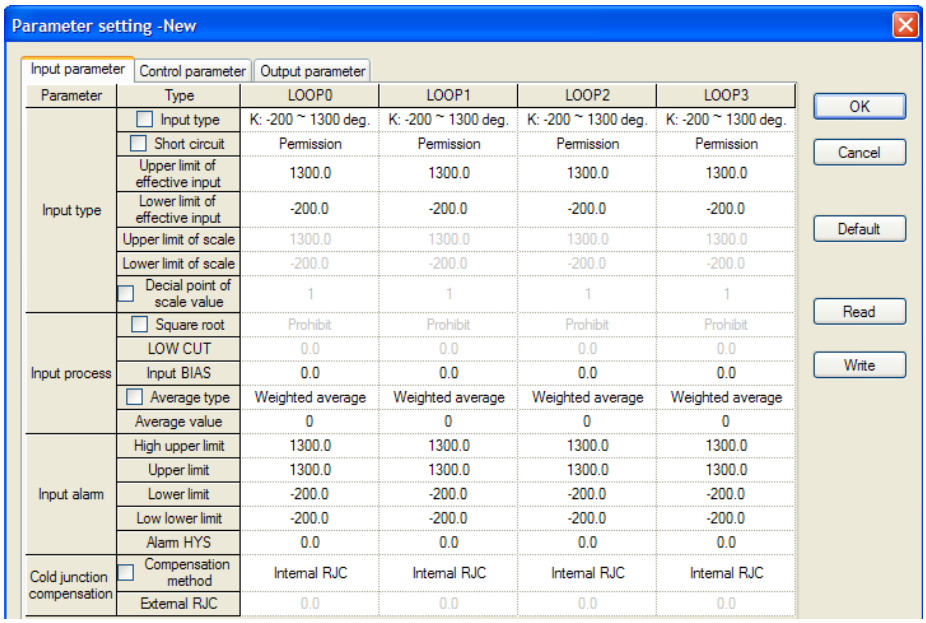
8.2.1 Auto Tuning

- This section describes auto tuning method.

(1) In the XG-TCON software window, select [Connect] after creating a new project.



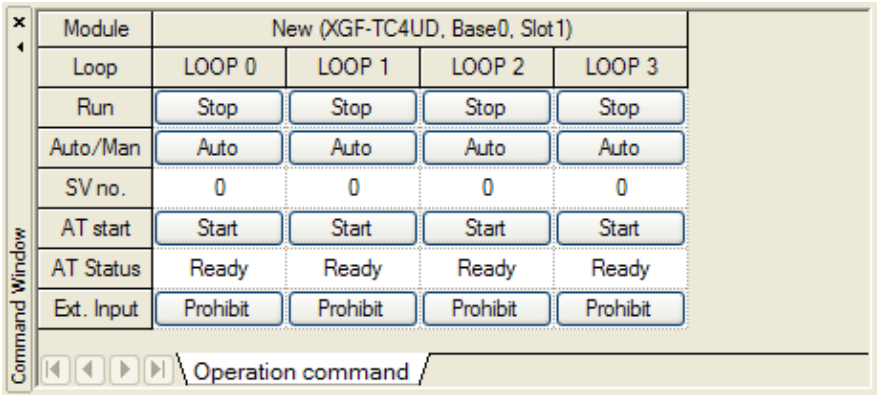
(2) In the project window, select Input Parameter to call parameter setting window shown below.



Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	1300.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	1300.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0
Input alarm	High upper limit	1300.0	1300.0	1300.0	1300.0
	Upper limit	1300.0	1300.0	1300.0	1300.0
	Lower limit	-200.0	-200.0	-200.0	-200.0
	Low lower limit	-200.0	-200.0	-200.0	-200.0
	Alarm HYS	0.0	0.0	0.0	0.0
Cold junction compensation	Compensation method	Internal RJC	Internal RJC	Internal RJC	Internal RJC
	External RJC	0.0	0.0	0.0	0.0

(3) In the parameter setting window, set up input and output types. Select Write button to save the parameter setting in the temperature controller.

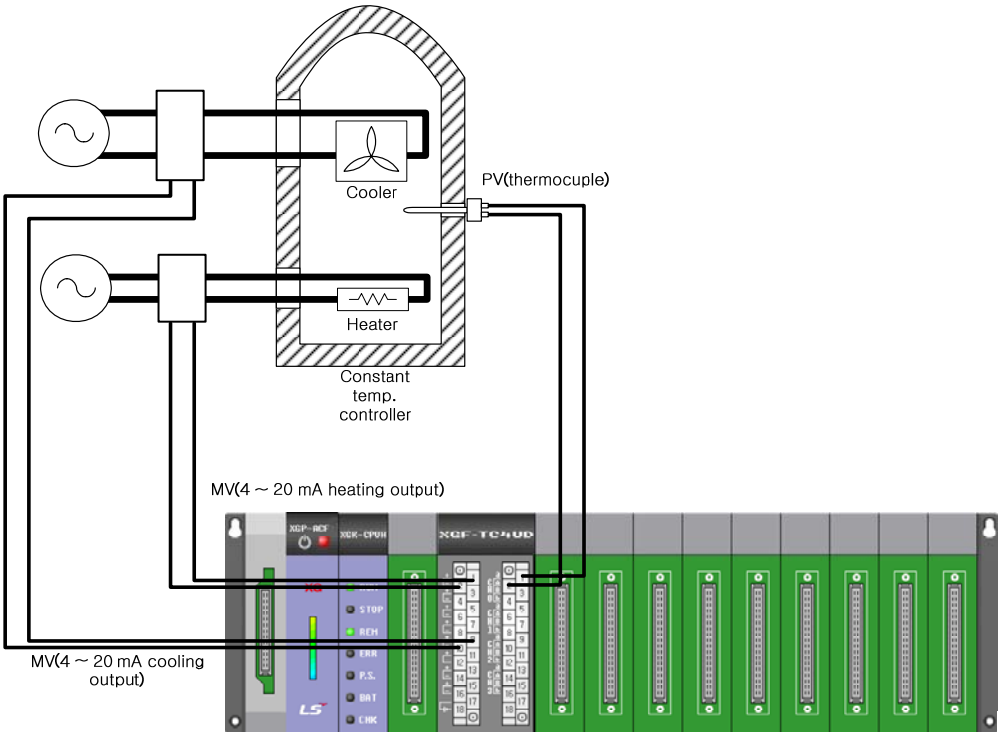
(4) In the operation reference window in bottom left, select the operation of the respective loop and select Start Auto Tuning.



(5) When “Completed” appears in the tuning section, open the #2 parameter setting window and select Write button to save the auto tuning constants in the temperature controller.

8.2.2 Temperature Control Program

- Below is an exemplary system where, the temperature of the temperature control chamber is measured with the T-type thermocouple connected to loop 0, and perform heating/cooling output control to maintain the temperature in the chamber at 200℃±10℃.



(1) Input Parameter Setting

- Select T-type of the thermocouple for the input type of the LOOP0.

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0
Input type	Input type	T: -200 ~ 400 deg.
	Short circuit	Permission
	Upper limit of effective input	400.0
	Lower limit of effective input	-200.0
	Upper limit of scale	400.0
	Lower limit of scale	-200.0
	Decial point of scale value	1

(2) Control Parameter Setting

- Set the blind sector to 100(10.0℃)
- Set the SV (control target) to 2000(200.0℃)
- Set the Kp (proportional coefficient) to 1000(1.000)
- Set the Ti (integral coefficient) to 1000(1.000)
- When using auto tuning, set up with the value detected by auto tuning

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0
AT start	Autotuning of SV	0.0
	Autotuning of HYS	0.0
Target setting	SV Upper limit	400.0
	SV Lower limit	-200.0
	PV Rising trackings	0.0
	PV Falling trackings	0.0
Control setting	Control type	PID
	On/Off control HYS	0.0
	Forward/Reverse division	Forward operation
	Dead Band	10.0
	Antiwindup	Setting
	Prevent the shock from manual operation changing	Permission
	Proportional operation source	EV
	Differential operation source	PV
Control coefficient 0	SV(Set value)	200.0
	Ts(Control period)	0
	Kp(Propotional coefficients)	1.000
	Ti(Integral coefficients)	1.000
	Td(Differential coefficients)	0.000
	Contral BIAS	0

(3) Output Parameter Setting

- In the output setting, select Heating/Cooling.

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Output setting	Heating/cooling selection	Heating/Cooling	Heating	Heating	Heating
	Cooling power ratio	100	100	100	100

(4) Operation

- Select Connect from online menu, and select Write in the (3) Parameter Setting Window.

Input parameter | Control parameter | Output parameter

Parameter	Type	LOOP0	LOOP1	LOOP2	LOOP3
Input type	Input type	T: -200 ~ 400 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.	K: -200 ~ 1300 deg.
	Short circuit	Permission	Permission	Permission	Permission
	Upper limit of effective input	400.0	1300.0	1300.0	1300.0
	Lower limit of effective input	-200.0	-200.0	-200.0	-200.0
	Upper limit of scale	400.0	1300.0	1300.0	1300.0
	Lower limit of scale	-200.0	-200.0	-200.0	-200.0
	Decial point of scale value	1	1	1	1
Input process	Square root	Prohibit	Prohibit	Prohibit	Prohibit
	LOW CUT	0.0	0.0	0.0	0.0
	Input BIAS	0.0	0.0	0.0	0.0
	Average type	Weighted average	Weighted average	Weighted average	Weighted average
	Average value	0	0	0	0

OK
Cancel
Default
Read
Write

- After writing, select Stop of loop0 from the operation command in the module state window to change to the operation state.

Command Window

Module	New (XGF-TC4UD, Base0, Slot1)			
Loop	LOOP 0	LOOP 1	LOOP 2	LOOP 3
Run	Run	Stop	Stop	Stop
Auto/Man	Auto	Auto	Auto	Auto
SV no.	0	0	0	0
AT start	Start	Start	Start	Start
AT Status	Ready	Ready	Ready	Ready
Ext. Input	Prohibit	Prohibit	Prohibit	Prohibit

Operation command

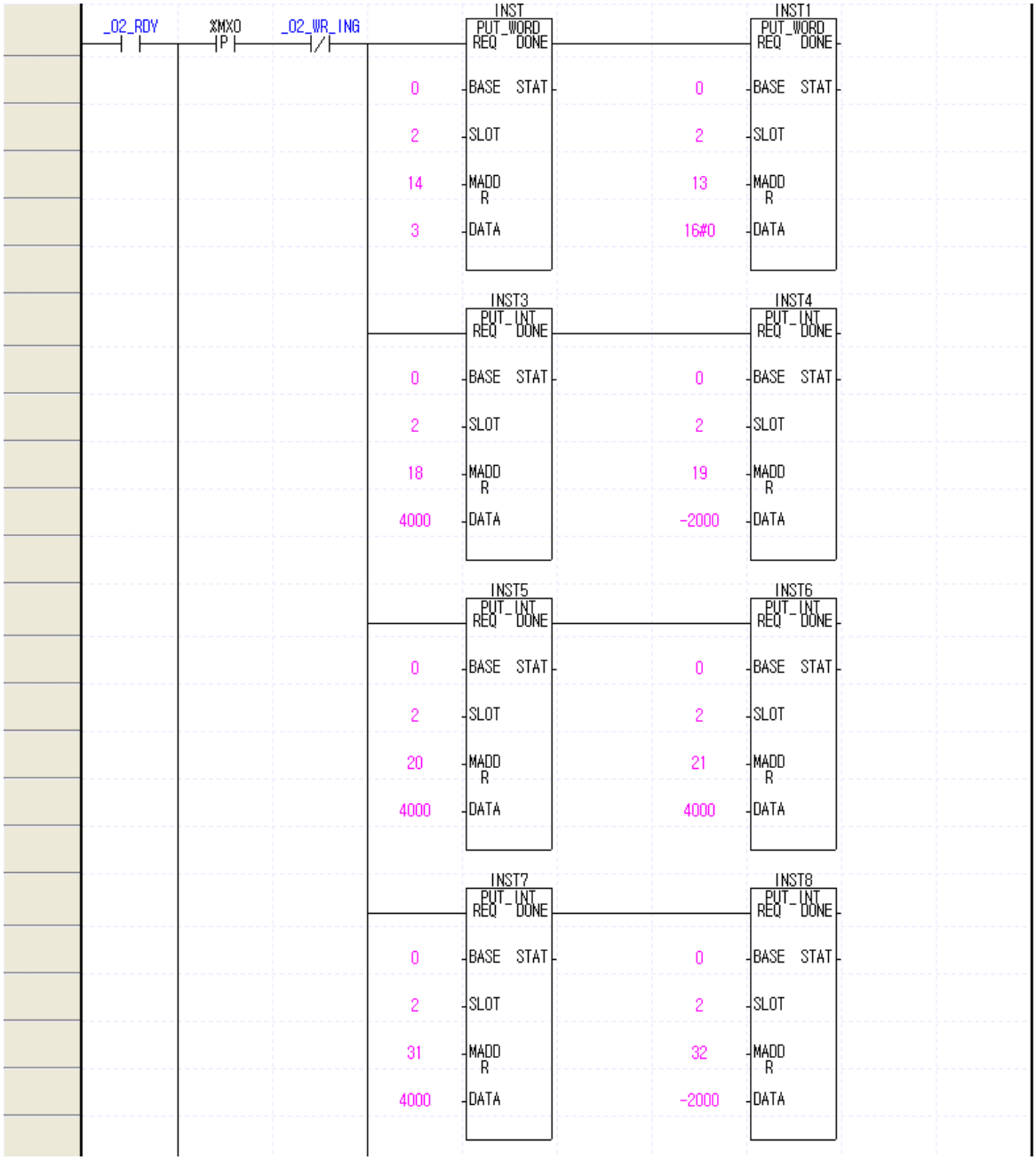
- The temperature controller will provide cooling output (Ch 1) when the present temperature exceeds 200℃, or heating output (Ch 0) when the present temperature is below 200℃.

(5) Data Monitor

- Select [Monitor]-[Data Monitor] to check control status.

	Type	LOOP 0	LOOP 1	LOOP 2	LOOP 3
Operation information	Sensor input	[Burn-out]	0.0 ℃	0.0 ℃	0.0 ℃
	Operation	Run	Stop	Stop	Stop
	Automatic/Manual operation	Auto	Auto	Auto	Auto
	Control setting	0	0	0	0
	Automatic tuning status	Ready	Ready	Ready	Ready
	Operation error	[70]	Normal	Normal	Normal
	LOW CUT Operation	Prohibit	Prohibit	Prohibit	Prohibit
Alarm condition	Input High upper limit	Normal	Normal	Normal	Normal
	Input upper limit	Normal	Normal	Normal	Normal
	Input lower limit	Alarm	Normal	Normal	Normal
	Input Low lower limit	Alarm	Normal	Normal	Normal
	Heating upper limit	Normal	Normal	Normal	Normal
	Heating lower limit	Alarm	Normal	Normal	Normal
	Cooling upper limit	Normal	Normal	Normal	Normal
	Cooling lower limit	Normal	Normal	Normal	Normal
Control information	Control type	PID	PID	PID	PID
	Forward/Reverse operation	Forward operation	Forward operation	Forward operation	Forward operation
	PV(Control Input)	[Burn-out]	0.0 ℃	0.0 ℃	0.0 ℃
	SV(Control target)	-200.0 ℃	0.0 ℃	0.0 ℃	0.0 ℃
	PV rising tracking	Prohibit	Prohibit	Prohibit	Prohibit
	PV falling tracking	Prohibit	Prohibit	Prohibit	Prohibit
	EV(Control error value)	0.000000	0.000000	0.000000	0.000000
	Dead Band	Prohibit	Prohibit	Prohibit	Prohibit
	Prevention of nover-intergal operation	Setting	Setting	Setting	Setting
	MV(Control output)	0.00	0.00	0.00	0.00
Output information	Heating output type	Analog Output	Analog Output	Analog Output	Analog Output
	Heating output	0.00%	0.00%	0.00%	0.00%
	Cooling output type	Analog Output	Analog Output	Analog Output	Analog Output
	Cooling output	0.00%	0.00%	0.00%	0.00%

8.2.3 Sample Program



Chapter 9 Diagnosis

9.1 Error Code

Error Code	Error Description	RUN_LED	ALM_RED	ERR_LED
10	ASIC internal register initialization error	OFF	OFF	ON
11	ASIC internal RAM read/write error	OFF	OFF	ON
12	ASIC internal register read/write error	OFF	OFF	ON
20	Backup memory checksum error	OFF	OFF	ON
30	Excess time for module contacting refresh write area	OFF	OFF	ON
31	Address error for module contacting refresh write area	OFF	OFF	ON
32	Excess time for module contacting refresh read area	OFF	OFF	ON
33	Address error for module contacting refresh read area	OFF	OFF	ON
40	PLC CPU error	ON	OFF	1s flash
50	Parameter setting range exceeded error	ON	OFF	1s flash
60	AD converter H/W error	ON	OFF	1s flash
70	RJC sensor isolated from terminal	ON	OFF	1s flash
80	IC sensor isolated from CPU board	ON	OFF	1s flash
90	Input wire open	ON	OFF	1s flash
100	Input type setting error	ON	OFF	1s flash
101	Effective input upper limit setting error	ON	OFF	1s flash
102	Effective input lower limit setting error	ON	OFF	1s flash
103	Scale upper limit setting error	ON	OFF	1s flash
104	Scale lower limit setting error	ON	OFF	1s flash
105	Scale decimal point setting error	ON	OFF	1s flash
110	LOW CUT setting error	ON	OFF	1s flash
111	Input BIAS setting error	ON	OFF	1s flash
112	Mean value setting error	ON	OFF	1s flash
120	Input alarm up-upper limit setting error	ON	OFF	1s flash
121	Input alarm upper limit setting error	ON	OFF	1s flash
122	Input alarm lower limit setting error	ON	OFF	1s flash
123	Input alarm low-lower limit setting error	ON	OFF	1s flash
124	Alarm HYS setting error	ON	OFF	1s flash
130	Cold contact compensation method setting error	ON	OFF	1s flash
131	Cold contact external RJC setting error	ON	OFF	1s flash
200	Auto tuning SV setting error	ON	OFF	1s flash
201	Auto tuning HYS setting error	ON	OFF	1s flash
210	SV upper limit setting error	ON	OFF	1s flash
211	SV lower limit setting error	ON	OFF	1s flash
212	PV rise tracking setting error	ON	OFF	1s flash
223	PV fall tracking setting error	ON	OFF	1s flash
220	Control type setting error	ON	OFF	1s flash
221	ON/OFF control HYS setting error	ON	OFF	1s flash
222	Blind section setting error	ON	OFF	1s flash
2n0	SV (control target) setting error	ON	OFF	1s flash
2n1	Kp (proportional coefficient) setting error	ON	OFF	1s flash

※ n stands for the loop number.

Error Code	Error Description	RUN_LED	ALM_RED	ERR_LED
2n2	Ti (integral coefficient) setting error	ON	OFF	1s flash
2n3	Td (derivative coefficient) setting error	ON	OFF	1s flash
2n4	Control BIAS setting error	ON	OFF	1s flash
230	Control coefficient setting error	ON	OFF	1s flash
300	Cooling output ratio setting error	ON	OFF	1s flash
310	Heating output PWM period setting error	ON	OFF	1s flash
311	Heating output upper limit setting error	ON	OFF	1s flash
312	Heating output lower limit setting error	ON	OFF	1s flash
314	Heating output reference setting error	ON	OFF	1s flash
315	Heating output manual output setting error	ON	OFF	1s flash
316	Heating abnormal state output setting error	ON	OFF	1s flash
320	Cooling output PWM period setting error	ON	OFF	1s flash
321	Cooling output upper limit setting error	ON	OFF	1s flash
322	Cooling output lower limit setting error	ON	OFF	1s flash
324	Cooling output reference setting error	ON	OFF	1s flash
325	Cooling output manual output setting error	ON	OFF	1s flash
326	Cooling abnormal state output setting error	ON	OFF	1s flash
330	Heating upper limit setting error	ON	OFF	1s flash
331	Heating lower limit setting error	ON	OFF	1s flash
332	Cooling upper limit setting error	ON	OFF	1s flash
333	Cooling lower limit setting error	ON	OFF	1s flash
334	Alarm HYS setting error	ON	OFF	1s flash

※ n stands for the loop number.

9.2 Diagnosis

9.2.1 RUN LED is OFF

Checklist	Action
Is the temperature module correctly installed in the base?	Install temperature module correctly in the base.
Does the power module have sufficient capacity?	Calculate power consumption rates of the modules and review system constitution.
Mew, replaced temperature module works correctly.	Turn power ON and OFF again. If the problem persists, the module may have problem. Contact nearest dealer.

9.2.2 ALM LED is ON

Checklist	Action
Does the input value exceed the value entered in the input alarm?	In the temperature controller module software package, check [Alarm Status] to take countermeasures.
Does the output value exceed the value entered in the output alarm?	In the temperature controller module software package, check [Alarm Status] to take countermeasures.

9.2.3 ERR LED is ON

Checklist	Action
N/A	Turn power ON and OFF again. If the problem persists, the module may have problem. Contact nearest dealer.

9.2.4 ERR LED flashes at 1 second intervals

Checklist	Action
Is there any parameter setting out of the allowable range?	In the temperature controller module software package, check error code in the [Operation Error] of the [Operation Information] to take countermeasures.

9.2.5 A/D Converted value is not changed

Checklist	Action
Is the loop whose A/D conversion value was not changed was set to [Operation]?	If it is set to [Stop], change it to [Operation].
Is the loop input terminal wiring correct?	See 3.2 for correct wiring.

9.2.6 The digital output is not in relation with the analog input value.

Checklist	Action
Are the types of the analog inputs to the loops in accordance with the designated types?	Check the analog input types. Correct it if necessary.
Is the loop input terminal wiring correct?	See 3.2 for correct wiring.
Does the environment provide noise?	Process with weighted average method or moving average method.

9.2.7 Out of Control.

Checklist	Action
Is the loop set in [Operation]?	If it is set to [Stop], change it to [Operation].
Is the designated [Control Type] appropriate?	Of the [PID], [CASCADE] or [ON/OFF], check that desired control type is set up.
Are the PID [control coefficients] appropriately set up?	If the set up control coefficient is inappropriate, calculate the coefficient through [Auto Tuning].
Is the wiring of the control output terminal correct?	See 3.2.2 to check that heating/cooling output terminals are correctly connected with respective line.

9.2.8 Checking Temperature Controller Module Status with Software Package

Using the [Module Information] function of the software package, name, OS version, date of OS, and status of the module can be checked.

(1) Procedure

[Online] -> [Module Information]

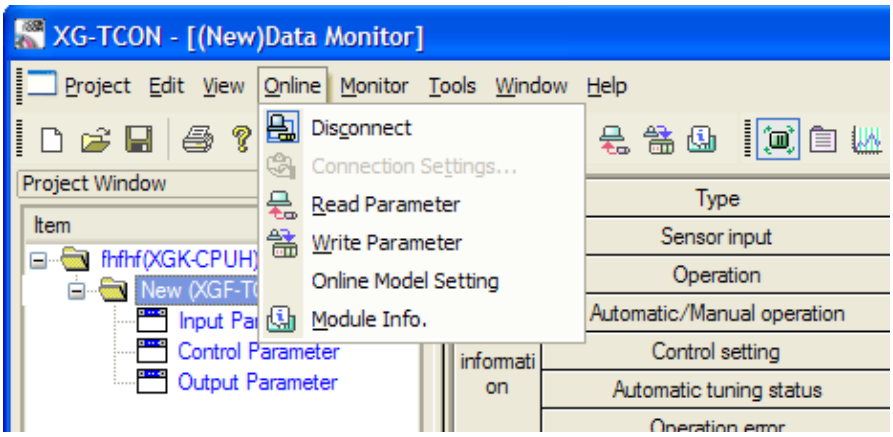
(2) Module Information

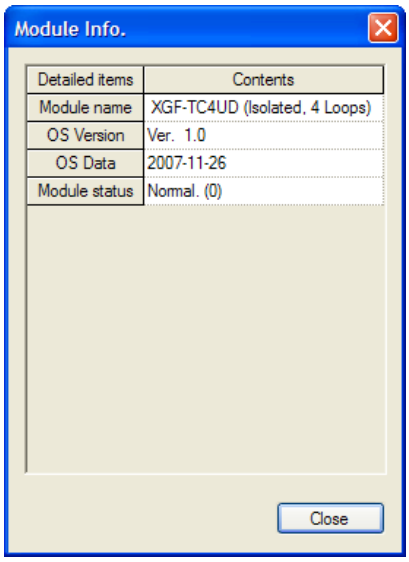
(a) Module Name: shows the information of the present module.

(b) OS version: shows the OS version of the temperature controller module.

(c) OS date: shows the date of the OS release of the temperature controller module.

(e) Module status: shows present error code. (see Table 9.1 for error codes)

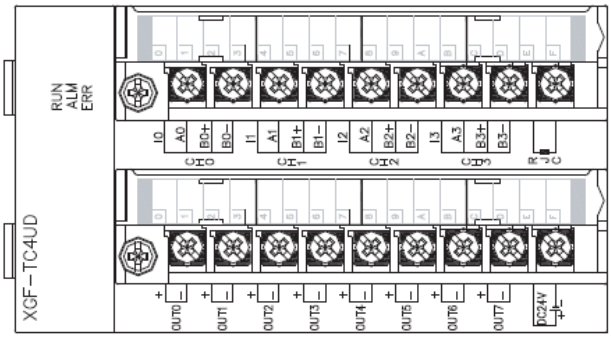


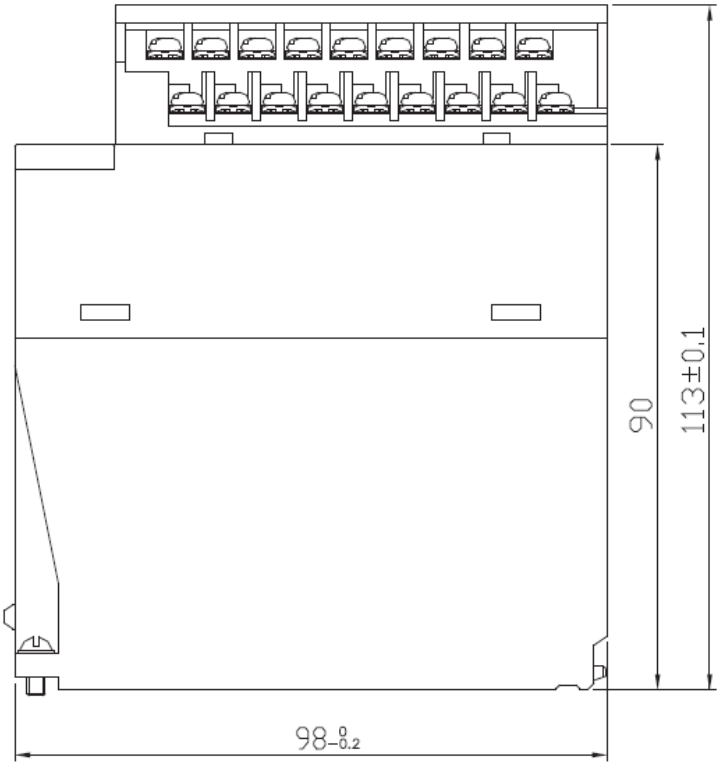


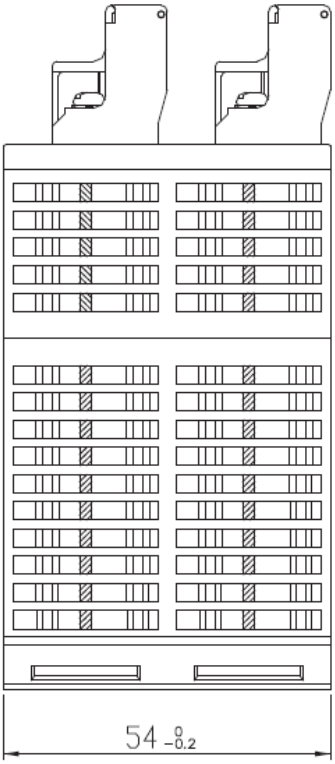
Appendix 1 Dimension

1) Dimension of XGF-TC4UD

Unit: mm







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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