User's Manual

Digital PID
Temperature Controller
Process Controller

VER 1.3 2020-04

48×48   96×96   48×96   72×72   96×48

1 Notice

⚡ Warning

1. Beware of Electric Shock!
2. Once controller is activated, do not touch AC power wiring terminals to avoid electric shock!
3. First to confirm power is OFF, before working on the wiring of controller power supply!
4. Before using this product, please read through this operating manual thoroughly to understand the correct usage based on the fundamentals of its conten.
5. This product can be used in industrial equipment, working terminal, measurement equipment, but not in life-saving-related medical equipment.
6. In order to ensure safety even if the temperature controller fails, please set up another alarm system or safety redundancy.

⚠ Caution

1. Before the controller transmits power, make sure that the position of the AC power assembly leg is correct. Otherwise, the controller may be seriously damaged after power transmission is initiated.
2. Before powering on, please confirm whether the power supply voltage is in accordance with the controller's specification (AC 85~265V or DC 24V.) Otherwise, the controller may be seriously damaged after power transmission is initiated.
3. Check if the wiring is connected to the terminal for the correct terminals (Input, Output.)
4. Please use crimp terminals suitable for M3 screws, as shown below:

3.2mm   3.2mm   Torque : 0.4 N.m (4kgf.cm)

5. Do not install the controller in places subject to high-frequency interference, corrosive gases, and high temperature and humidity (normal working environment: 0 ~ 50°C, 20 ~ 90% RH.).
6. To avoid noise interference, please keep the sensor wiring away from the power cord and the loading power cord.
7. When the thermocouple lead is extended, please use the compensation lead of the corresponding type to this thermocouple.
8. When the RTD lead wire is extended, please use those with lower resistance value. Use the same wire between the three Wires.

2 Basic Function Setting

2.1 Changing Input Type

2.2 SV Setting

2.3 Setting PID Values Automatically (Autotuning)

2.4 Setting PID Values Manually

2.5 Controlling With ON/OFF Action

Heat mode formula:
PV≥(SV + HYS1) → OUT1 OFF
PV≤ (SV−HYS1) → OUT1 ON
Cool mode formula:
PV≥ (SV + HYS1) → OUT1 ON
PV≤(SV−HYS1) → OUT1 OFF

2.6 Alarm Mode Setting

2.7 Alarm Value Setting

2.8 Controlling With Manual Control

In manual mode OUTL=100.0 · output=100.0% continuously.
In manual mode OUTL=20.0 · output=20.0% continuously.

3 Flow Chart of Parameter Setting

3.1 Level Operation Mode

1. LEVEL 1 enter to the LEVEL 2 :
   Hold SET key for 3 seconds then entering LEVEL 2
2. LEVEL 1 enter to the LEVEL 3 :
   Hold SET key + SHIFT key for 3 seconds then entering LEVEL 3
3. LEVEL 2 return to the LEVEL 1
   Hold SET key for 3 seconds then return to LEVEL 1
4. LEVEL 2 enter to the LEVEL 3
   Hold SET key for 3 seconds then entering to LEVEL 3
5. LEVEL 2 enter to the LEVEL 4
   On the LEVEL 2 then press SET key to find parameter "LCK modify LCK value from current value to 1111 after hold SET key + SHIFT key 3 seconds entering into LEVEL 4
6. LEVEL 3 return to the LEVEL 1
   Hold SET key + SHIFT key for 3 seconds then return to LEVEL 1
7. LEVEL 3 return to the LEVEL 2
   Hold SET key for 3 seconds then return to LEVEL 2
8. LEVEL 4 return to the LEVEL 1
   Hold SET key + SHIFT key for 3 seconds then return to LEVEL 1
9. LEVEL 4 return to the LEVEL 2
   Hold SET key for 3 seconds then return to LEVEL 2
10. Any LEVEL enter to the Fast LEVEL
    Hold DOWN key for 3 seconds then entering Fast LEVEL
11. Fast LEVEL return to the LEVEL 1
    Hold DOWN key for 3 seconds then return to LEVEL1

3.2 Level 1 (User Level) All Parameters Display

Level 1

Press SET key
- PV / SV
- OUTL — Output percentage
- AT — Auto tuning
- AL1/SOAK/HBAC — AL1 → Alarm1 set value / SOAK → Alarm1 soak time / HBAC →HBA current setting value
- AL2/SOAK/HBAC — AL2 → Alarm2 set value / SOAK → Alarm2 soak time / HBAC →HBA current setting value
- AL3/SOAK RATE/RAMP — AL3 → Alarm3 set value / SOAK → Alarm3 soak time / RATE → Slave SV rate / RAMP → SV ramp operation
- PV / SV

※ If no key is pressed within 60 seconds, it will automatically return to LEVEL 1 (user level) and display PV/SV

3.3 Level 2 (PID Level) All Parameters Display

Level 2

Press SET key
- P1 — Main output proportional band
- I1 — Main output integral time
- D1 — Main output derivative time
- AT.VL — Auto tuning offset value
- CYT1 — Main output control cycle
- HYS1 — Hysteresis for main output
- P2 — sub output proportional band
- I2 — sub output integral time
- D2 — sub output derivative time
- CYT2 — sub output control cycle
- HYS2 — Hysteresis for sub output
- GAP1 — Control gap (for main output)
- GAP2 — Control gap (for sub output)
- LCK — Function or level lock
- P1

※ If no key is pressed within 60 seconds, it will automatically return to LEVEL 1 (user level) and display PV/SV

3.4 Level 3 (Input Level) All Parameters Display

Level 3

Press SET key
- INP1 — Input type selection
- ANL1 — main output zero calibration
- ANH1 — main output span calibration
- DP — Decimal point position
- LSPL — Input scale low
- USPL — Input scale high
- ANL2 — sub output zero calibration
- ANH2 — sub output span calibration
- ALD1 — Alarm1 mode selection
- ALT1 — Alarm1 time setting
- ALD2 — Alarm2 mode selection
- ALT2 — Alarm2 time setting
- ALD3 — Alarm3 mode selection
- ALT3 — Alarm3 time setting
- HYSA — Hysteresis setting
- CLO1 — Main output zero calibration
- CHO1 — Main output span calibration
- CLO2 — sub output zero calibration
- CHO2 — sub output span calibration
- CLO3 — Retransmission zero calibration
- CHO3 — Retransmission span calibration
- RHTC/RUCY — RHTC → Dehumidification temperature / RUCY → Motor valve operating time
- RHPO/WAIT — RHPO → Dehumidification manipulated value / WAIT → Program execution standby temperature
- SETA — Alarm special function setting
- PSL — Protocol selection
- BITS — Data format
- IDNO — Controller station
- BAUD — Baud rate
- SVOS — SV bias
- PVOS — PV bias
- UNIT — Input unit
- PVFT — PV digital filter
- PV2 — remote function or motor valve feedback value
- OUD — Control action selection
- OPAD — Super SV function enable
- HZ — Power frequency
- UNIT

※ If no key is pressed within 60 seconds, it will automatically return to LEVEL 1 (user level) and display PV/SV

3.5 Level 4 (Setting Level) All Parameters Display

Level 4

Press SET key
- SET1 — Parameters Hide/Display
- SET2 — Parameters Hide/Display
- SET3 — Parameters Hide/Display
- SET4 — Parameters Hide/Display
- SET5 — Parameters Hide/Display
- SET6 — Parameters Hide/Display
- SET7 — Parameters Hide/Display
- SET8 — Parameters Hide/Display
- SET9 — Parameters Hide/Display
- SET0 — Parameters Hide/Display
- INP2 — sub input type selection
- OUTY — Hardware drive selection
- PROG — Program function enable
- SET1

※ If no key is pressed within 60 seconds, it will automatically return to LEVEL 1 (user level) and display PV/SV

3.6 Fast Level All Parameters Display

- controller provides a fast parameter access operation, easy for users to quickly access communication group, program group, motor valve group related parameters
- Enter fast level : press down key for 3 seconds at any level
- Leave fast level : press down key for 3 seconds at fast level

Any Level

Press key 3 seconds
- INP1 — Input type selection
- RUCY — Motor valve traveling time
- CYT1 — Motor valve action interval time
- HYSM — Motor valve action main adjustment
- HYS1 — Motor valve action sub adjustment
- PMAC — Automatic valve position adjustment
- RH.TC — Dehumidification temperature
- RH.PO — Dehumidification manipulated value
- RH.TM — dehumidification time
- OPFT — Output filter
- PV2 — remote function or motor valve feedback value
- MOLH — Motor valve action zero calibration
- MOLL — Motor valve action span calibration
- PSL — Protocol selection
- BITS — Data format
- IDNO — Controller station
- BAUD — Baud rate
- W_MD — EEPROM protection
- MLNB — Piece linear compensation segment select
- COMP — Piece linear compare value
- OFFS — Piece linear offset value
- HBOP — Output percentage of trigger HBA
- TRCL — Main input TC/RTD zero calibration
- TRCH — Main input TC/RTD span calibration
- TP_K — reserve
- PVOH — PV bias(for span)
- INP1

※ If no key is pressed within 60 seconds, it will automatically return to LEVEL 1 (user level) and display PV/SV

3.7 Level Operation Diagram

Power ON → Level 1 (User Level)

- press SET + SHIFT key 3 seconds → Level 3 (Input Level)
- press SET key 3 seconds → Level 2 (PID Level)
- press SET + SHIFT key 3 seconds
- press SET key 3 seconds
- press SET key 3 seconds → Level 4 (SET Level)

Level 1~Level 4 → press DOWN key 3 seconds → Fast Level

※ If no key is pressed within 60 seconds, it will automatically return to LEVEL 1 (user level) and display PV/SV.

3.8 Data Lock Function

LCK provides a parameter protection function to prevent the first line operator from touching or modifying important parameters.
Conversely, when the parameter cannot be modified, please make sure that the set value of LCK.

LCK	Level_1 USER_Level	Level_2 PID Level	Level_3 INPUT_Level	Level_4 SET_Level	Descriptions
0000	○	○	○	X	All parameters of Level 1, 2 & 3 are able to be modified (Factory default setting)
1111	○	○	X	○	All parameters of Level 1, 2 & 4 are able to be modified
0100	○	○	X	X	All parameters of Level 1, 2 are able to be modified
0110	○	X	X	X	Only parameters of Level 1 and LCK can be modified
0001	X	X	X	X	Only SV, LCK can be modified
0101	X	X	X	X	Only LCK can be modified
Other	○	○	○	X	Once jumping to other levels, LCK will be automatically restored to 0000

○ : able to enter   X : unable to enter

4 Alarm Mode

▲ : SV   △ : Alarm set value   X : 1 / 2 / 3 (There are up to 3 sets of alarms)

ALDX	Alarm mode	Description
0	No alarm function	Not drive any alarm relays and the corresponding LED lamp.
1	Deviation high (With hold action)	Formula: PV≥ (SV+ALX) → Alarm ON / PV≥ (SV+ALX−HYSA) → Alarm OFF
2	Deviation low (With hold action)	※ ALX must to be set to a negative value. Formula: PV≤ (SV+ALX) → Alarm ON / PV≥ (SV+ALX+HYSA) → Alarm OFF
3	Deviation high/low (With hold action)	Formula: PV≥ (SV+ALX) → Alarm ON / PV≤ (SV−ALX) → Alarm ON / PV≤ (SV+ALX−HYSA) → Alarm OFF / PV≥ (SV−ALX+HYSA) → Alarm OFF
4	Band (With hold action)	Formula: PV≥ (SV+ALX) → Alarm ON / PV≤ (SV−ALX) → Alarm ON / PV≤ (SV+ALX−HYSA) → Alarm OFF / PV≥ (SV−ALX+HYSA) → Alarm OFF
5	Process high (With hold action)	Formula: PV≥ ALX → Alarm ON / PV≤ (ALX−HYSA) → Alarm OFF
6	Process low (With hold action)	Formula: PV≤ ALX → Alarm ON / PV≥ (ALX+HYSA) → Alarm OFF
7	Segment execute alarm	When SEG=ALX alarm ON. ※ This mode only available in program type controller
8	System error	The Alert action, when PV displays error message
9	HBA (Heater Break Alarm)	Activated conditions : 1. Heater current is less the HBAC set value 2. OUT1 manipulated value exceed HBOP set value 3. Conditions of 1 & 2 above are established and continue to exceed 20 seconds. ※ This mode only available in ALD1or ALD2
10	SOAK_A	This mode only available in ALD3
11	Deviation high	Formula: PV≥ (SV+ALX) → Alarm ON / PV≥ (SV+ALX−HYSA) → Alarm OFF
12	Deviation low	※ ALX must to be set to a negative value
13	Deviation high/low	Formula: PV≥ (SV+ALX) → Alarm ON / PV≥ (SV−ALX) → Alarm ON / PV≤ (SV+ALX) → Alarm OFF / PV≥ (SV−ALX) → Alarm OFF
14	Band	Formula: PV≥ (SV+ALX) → Alarm ON / PV≤ (SV−ALX) → Alarm ON / PV≥ (SV−ALX) → Alarm OFF / PV< (SV−ALX) → Alarm OFF
15	Process high	Formula: PV≥ ALX → Alarm ON / PV≤ (ALXH−HYSA) → Alarm OFF
16	Process low	Formula: PV≤ ALX → Alarm ON / PV≥ (ALX+HYSA) → Alarm OFF
17	Program run	SETA.4=0 When program execution, alarm action / SETA.4=1 When program end, alarm action / ※ This mode only available in program type controller
18	System normal	The Alert action, when system in normal condition (no-error message)
19	SOAK_B	Boot completed, the alarm is OFF, when PV≥target SV start the timer, alarm is turned ON and the control function keep ON in timed out. If the RAMP function is used, even if the RAMP SV has not reached the target SV, the timer will start counting as long as the condition PV≥target SV is met.

※ This mode only available in ALD1 or ALD2
※ In this mode, the time format is fixed to "hour.minute"

SOAK_A: Boot completed, the alarm is ON, when PV≥target SV start the timer, alarm and control function are turned OFF in timed out. If the RAMP function is used, even if the RAMP SV has not reached the target SV, the timer will start counting as long as the condition PV≥target SV is met.

5 Modification of Input Signal

5.1 Input modify to thermocouple

Jumper Position	Software Setting
Plug 2 pcs of Jumper in the middle slot as shown	Parameter set as "INP1=K1~L"

5.2 Input modify to RTD

| Jumper Position	Software Setting
Plug 2 pcs of Jumper in the left slot as shown	Parameter set as "INP1=PT1~PT3"

6 Troubleshooting

This chapter describes error displays and procedures to follow when problems occur.

Symbol	Text	description	Solution
in1E	IN1E	Input1 Error	Check whether input loop is opened or wiring is incorrect.
UUU1	UUU1	PV is above USPL	Check whether the input value or input type is correct or not.
nnn1	NNN1	PV is below LSPL	Check whether the input value or input type is correct or not.
CJor	CJOR	Ambient temperature over range(>50°C)	Decrease ambient temperature
Aut-F	AUTF	Auto-tunning failure	Manually set the PID value
AdCF	ADCF	A/D convert failed	send for repair.
RAoF	RAMF	EEPROM failed	send for repair.
CJCE	CJCE	Cold junction diode failure	send for repair.
t-rSF	TRSF	Transmission hardware failure	send for repair.
FbEr	FBER	Motor valve potentiometer feedback error	1. check the potentiometer feedback wiring 2. send for repair.

7 Parts Description

❶		PV	Indicating PV (measured value) and character information such as parameter codes or error codes (Red)
❷		SV	Indicating SV (target set value) or parameter values (Green)
❸	LED	OUT1	Lamp lit when OUT1 is activated (Green)
		OUT2	Lamp lit when OUT2 is activated (Green)
		AT	Lamp lit when Auto tuning is activated (Orange)
		AL1	Lamp lit when Alarm 1 is activated (Red)
		AL2	Lamp lit when Alarm 2 is activated (Red)
		AL3	Lamp lit when Alarm 3 is activated (Red)
		MAN	Lamp lit when controller in manual mode or get error condition (Orange)
		PRO	When the program is executed, this light is on (orange)
		OUT1%	OUT1% bar-graph indicator (Green)
❹	Keypad	SET	For parameter call-up and set value registration
		A/M	Auto manual transfer
		SHIFT	Shift digits when changing settings
		DOWN	Decrease numerals
		UP	Increase numerals
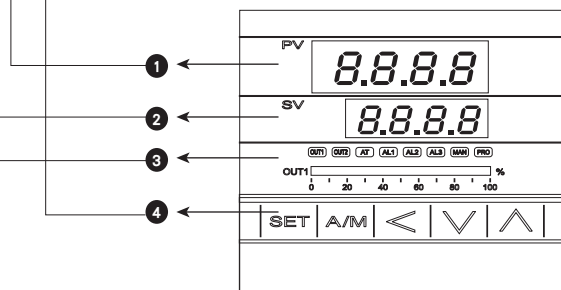
8 Installation

8.1 48x48 Dimensions
(Unit: mm)
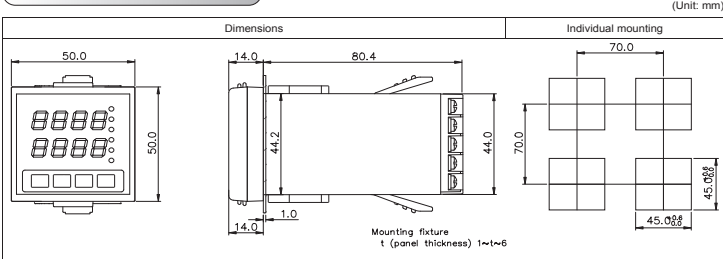
8.2 96x48 Dimensions
(Unit: mm)
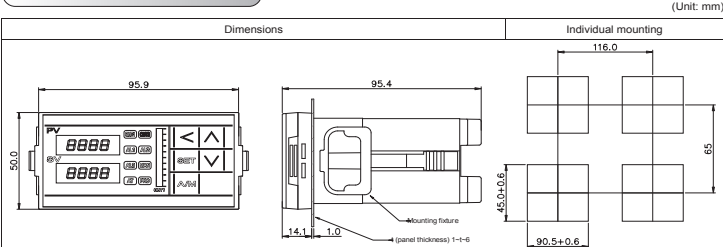
8.3 72x72 Dimensions
(Unit: mm)
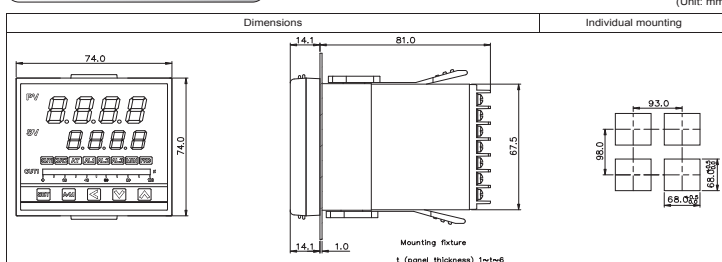
8.4 48x96 Dimensions
(Unit: mm)
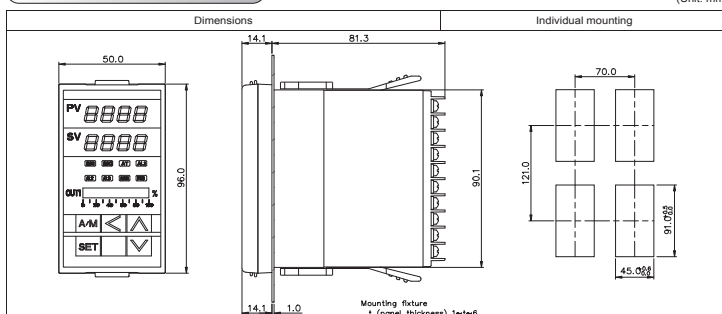
8.5 96x96 Dimensions
(Unit: mm)
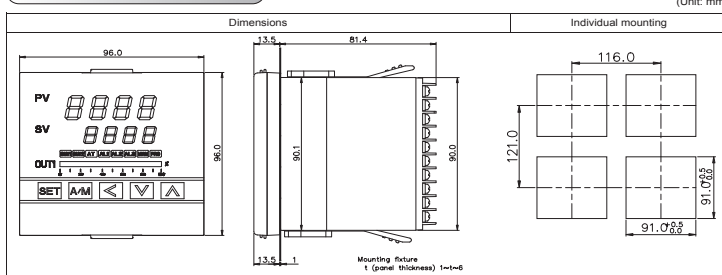
9 Terminal Arrangement

⚠ Caution
When implementing wiring for the controller power supply, please make sure that the power supply is turned off to avoid electric shock!
Do not touch the live parts, such as the terminals, while the power is on. Otherwise death or serious injury may be resulted from short circuit of the contact electrode.

9.1 48x48 Terminal Arrangement
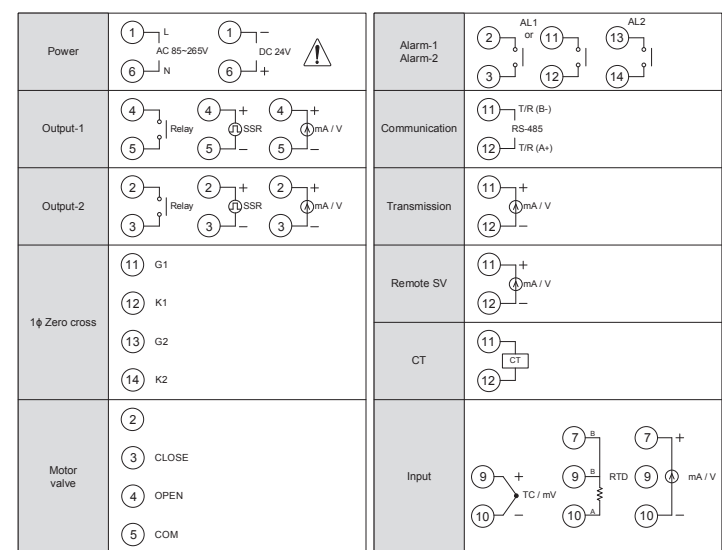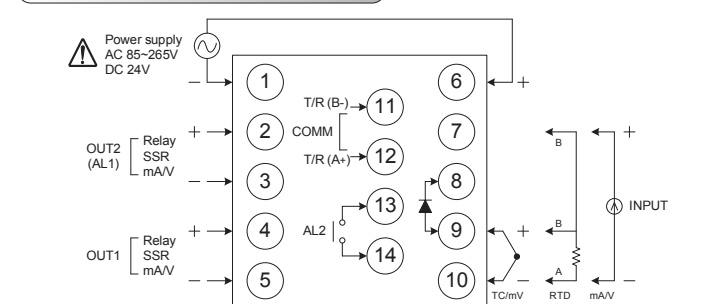
9.2 96x48 Terminal Arrangement
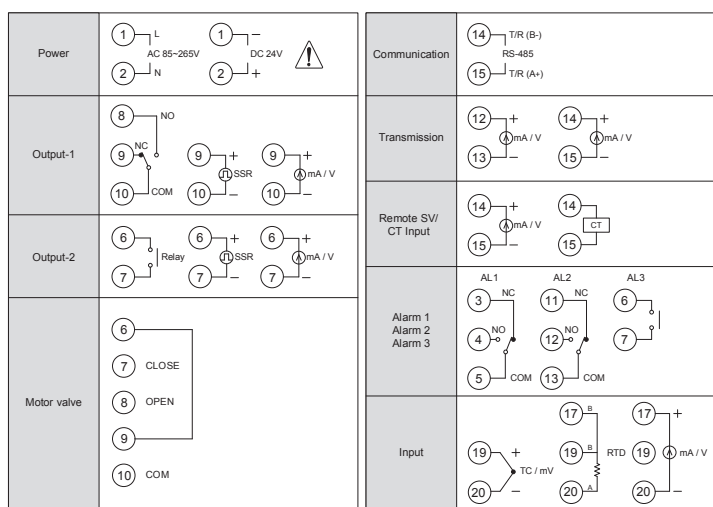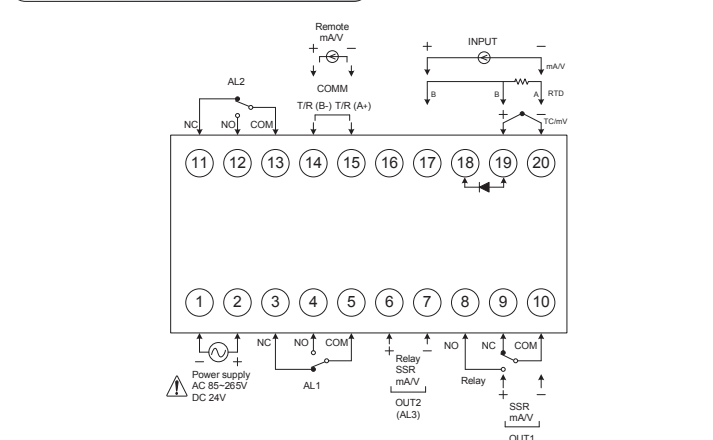
9.3 72x72 Terminal Arrangement
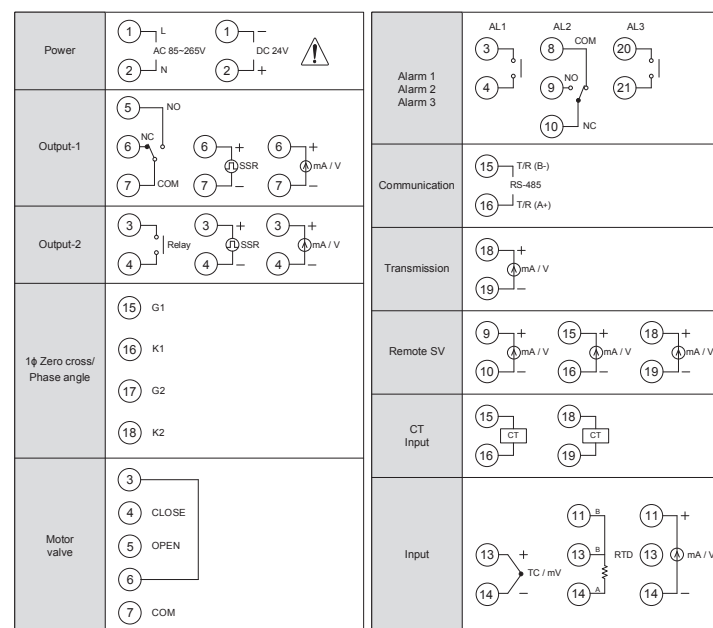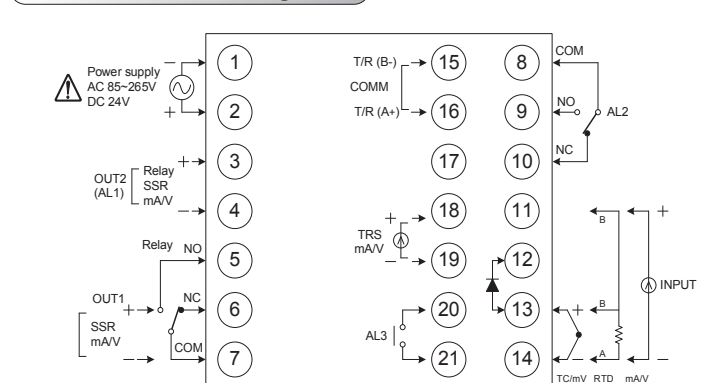
9.4 48x96 Terminal Arrangement
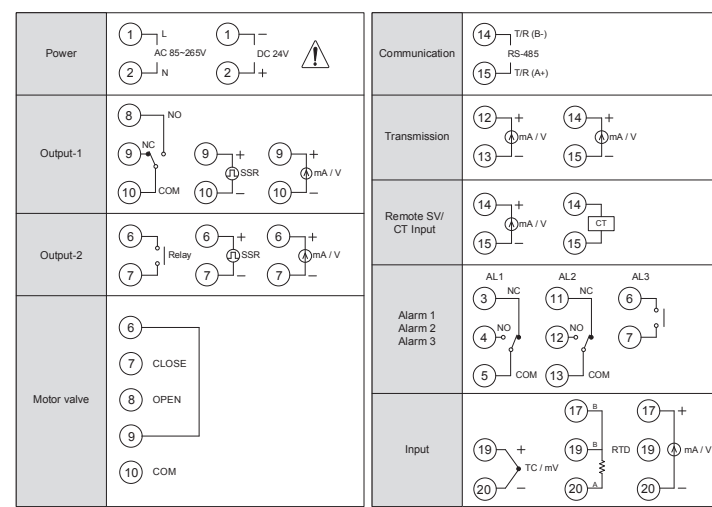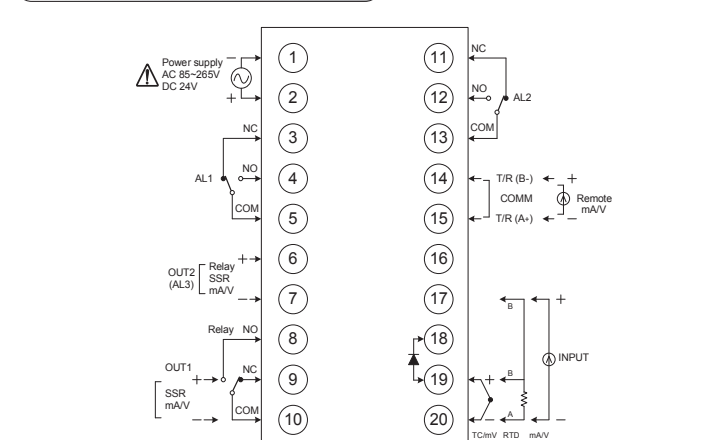
9.5 96x96 Terminal Arrangement
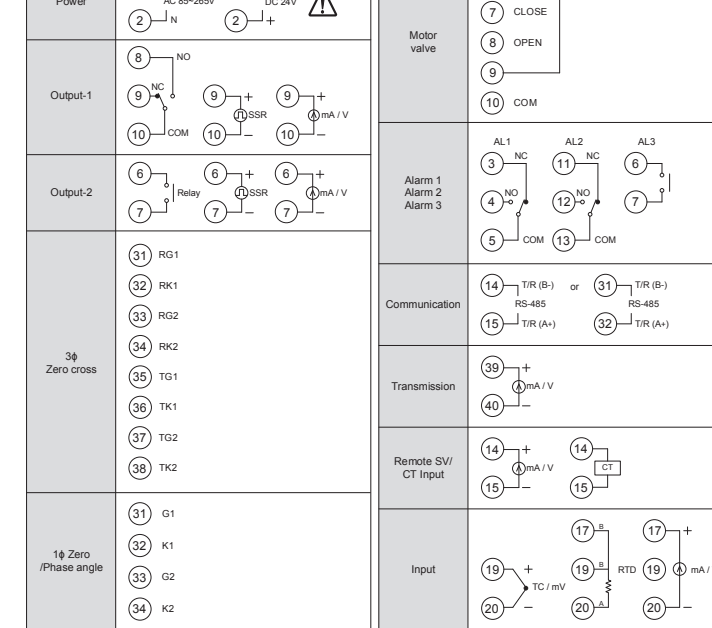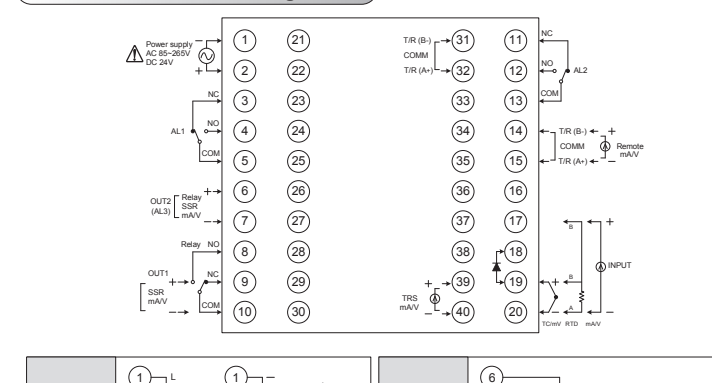
10 Specifications

Model	48x48	96x48	72x72	48x96	96x96
Supply Voltage	AC 85 ~ 265V, DC 24V(Optional Functions)				
Power Frequency	50/60 Hz				
Power Consumption	Approximately 6VA				
Memory	Non-Volatile Memory EEPROM				
Sensor Input ※ Please refer to Input Range Table	Cold junction compensation diode external Accuracy : 0.1%				
	Cold junction compensation diode internal Accuracy : 0.3%				
	Sample time : 50ms				
	Thermocouple: (K·J·R·S·B·E·N·T·W·PL‖·L)				
	RTD: PT100				
	DC Linear Analog Input:0~20mA · 4~20mA				
	0~1V · 0~5V · 0~10V · 0~2V · 1~5V · 2~10V				
	0~25mV · 0~50mV · 0~70mV				
Output	OUT1 Relay	1a	1a	1a	1c	1c
		1a SPST-NO, 250 VAC, 5A (resistive load), electrical life: 100,000 operations				
		1c SPDT-NO, 250 VAC, 5A (resistive load), electrical life: 50,000 operations				
		SPDT-NC, 250 VAC, 2A (resistive load), electrical life: 20,000 operations				
	OUT2 Relay	SPST-NO, 250 VAC, 5A (resistive load), electrical life: 100,000 operations				
	SSR Driver	On: 24 V OFF :0V max. load current: 20mA, with short circuit protection circuit				
	linear	4~20mA,0~20mA, 0~5V,0~10V, 1~5V,2~10V				
Control Method	ON-OFF or P · PI · PID control				
Alarm	Alarm 1	1a	1a	1a	1c	1c
		1a SPST-NO, 250 VAC, 5A (resistive load), electrical life: 100,000 operations				
		1c SPDT-NO, 250 VAC, 5A (resistive load), electrical life: 50,000 operations				
		1c SPDT-NC, 250 VAC, 2A (resistive load), electrical life: 20,000 operations				
	Alarm 2	SPST-NO, 250 VAC, 5A (resistive load), electrical life: 100,000 operations				
	Alarm 3	SPST-NO, 250 VAC, 5A (resistive load), electrical life: 100,000 operations				
Dimension (mm)	W48 x H48 x D95	W96 x H48 x D95	W72 x H72 x D95	W48 x H96 x D95	W96 x H96 x D95
weight	Appox.120g	Appox.170g	Appox.150g	Appox.170g	Appox.230g

Model	48x48	96x48	72x72	48x96	96x96
TRS	Re-transmitted Signal	4~20mA · 0~20mA · 0~5V · 0~10V · 1~5V · 2~10V				
	Source of Re-transmission	SV - PV				
	Accuracy	0.1%				
	Resolution	14 bit				
Remote SV	Signal	4~20mA · 0~20mA · 0~5V · 0~10V · 1~5V · 2~10V				
	Resolution	18 bit				
	controlled by	SV				
Motor valve	Signal	1KΩ · 560Ω				
	Resolution	18 bit				
	controlled by	PV2				
Communi cation	Interface	RS-485 Half duplex4 Communication MAX. 31 units, MAX. distance 1200 meters				
	Protocol	Modbus RTU , TAIE				
	Parity bit	NONE, ODD, EVEN				
	Data bit	8 bit				
	Stop bit	1 or 2 bit				
	Baud rate	2400,4800,9600,19200,38400,57600,115200 bps				
Operating Environment Temperature/Humidity	0 ~ 50°C (in the case of no freezing or condensation) / 20% ~ 90% RH					
Storage Environment Temperature	-25 ~-65°C (in the case of no freezing or condensation)					

11 Order Information

Output 1	Output 2	Alarm	TRS	Remote	COMM	Input type	Power	Accessories
1	0	1	0	0	0	01	A	N
0 None	0 None	0 None	0 None	0 None	0 None	See input Range type code	A AC 85~265V DC 24V	N None
1 Relay	1 Relay	1 1 Set	1 4~20mA	1 4~20mA	1 TTL		B DC 24V	T Terminal Cover
2 Voltage Pulse (SSR Drive)	2 Voltage Pulse (SSR Drive)	2 2 Sets	2 0~20mA	2 0~20mA	2 RS-485			V IP65
3 4~20mA	3 4~20mA	3 3 Sets	A 0~5V	A 0~5V				W Terminal Cover +IP65
4 0~20mA	4 0~20mA	A HBA	B 0~10V	B 0~10V				
B 0~10V	B 0~10V	B HBA+AL2	C 1~5V	C 1~5V				
C 1~5V	C 1~5V	C HBA+AL2+AL3	D 2~10V	D 2~10V				
D 2~10V	D 2~10V			M Motor valve control feedback				
5 SCR zero cross control								
6 3*SCR zero cross control								
7 Motor valve control								
8 1*SCR phase angle control								

※ Block means optional functions with additional charge
※ HBA : Heater Break Alarm (HBA must use AL1 as alarm relay)
※ Boxed-in items are optional functions, which shall incur extra charges.
※ Boxed-in items are optional functions, which shall incur extra charges.

12 Input Type Table

Input Range Table

Types of input		Code	Range °C	Range °F
Thermocouple	K1	01	-50.0~600.0	-58.0~999.9
	K2	02	-50~1200	-58~2192
	J1	03	-50.0~400.0	-58.0~752.0
	J2	04	-50~1200	-58~2192
	R	05	-50~1760	-58~3200
	S	06	-50~1760	-58~3200
	B	07	-50~1820	-58~3308
	E	08	-50~900	-58~1652
	N	09	-50~1300	-58~2372
	T1	10	-199.9~400.0	-199.9~752.0
	T2	11	-199~400	-199~400
	W	12	-50~2320	-58~4208
	PL	13	-50~1200	-58~2192
	L	14	-50~800	-58~1472

Types of input		Code	Range °C	Range °F
RTD	PT1	15	-199.9~850.0	-199.9~999.9
	PT2	16	-199~850	-326~1562
	PT3	17	0~850	32~1562
Linear	AN1	18	0~25mV	
		19	0~50mV	-1.999~9.999
		20	0~20mA	-19.99~99.99
	AN2	21	0~1V	-199.9~999.9
		22	0~2V	-1999~9999
		23	0~5V	
		24	0~10V	
	AN3	25	0~70mV	
		26	4~20mA	
	AN4	27	10~50mV	
		28	1~5V	
		29	2~10V	

TYPE	Thermocouple														RTD		
Kind	K1	K2	J1	J2	R	S	B	E	N	T1	T2	W	PL‖	L	PT1	PT2	PT3
Code	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17

TYPE	LINEAR											
	AN1			AN2				AN3		AN4		
Code	18	19	20	21	22	23	24	25	26	27	28	29
Range	0~25mV	0~50mV	0~20mA	0~1V	0~2V	0~5V	0~10V	0~70mV	4~20mA	10~50mV	1~5V	2~10V

4 kinds of choices: -1.999~9.999, -199.9~999.9, -19.99~99.99, -1,999~9,999