Panasonic®

Instruction manual **Temperature Controller KT4**

No. KT41E15 2013.05

To prevent accidents arising from the misuse of this controller, please ensure the operator receives this manual.

SAFETY PRECAUTIONS

Be sure to read these precautions before using our products.

The safety precautions are classified into categories: “Warning” and “Caution”.

⚠ Warning: Procedures which may lead to dangerous conditions and cause death or serious injury, if not carried out properly.

⚠ Caution : Procedures which may lead to dangerous conditions and cause superficial to medium injury or physical damage or may degrade or damage the product, if not carried out properly.

⚠ Warning

- When using this controller on occasions which serious injury would be expected to occur or when damage is likely to expand or proliferate, make sure to take safety measures such as installing double safety structures.
- Do not use this controller in an environment with flammable gases, or it may cause explosion.

⚠ Caution

- Fasten the electric wire with the terminal screws securely. Imperfect connection may cause abnormal heating or fumes.
- Use this controller according to the rating and environmental conditions. Otherwise abnormal heating or fumes may occur.
- Do not touch the terminals while the power is supplied to the controller, as this may cause electric shock.
- Do not disassemble or modify the controller, as this may cause electric shock or fumes.

⚠ Caution

- This instrument should be used in accordance with the specifications described in the manual. If it is not used according to the specifications, it may malfunction or cause fire.
- Be sure to follow the warnings, cautions and notices. Not doing so could cause serious injury or accidents.
- The contents of this instruction manual are subject to change without notice.
- This instrument is designed to be installed in a control panel. If not, measures must be taken to ensure that the operator cannot touch power terminals or other high voltage sections.
- Be sure to turn the power supplied to the instrument OFF before cleaning this instrument.
- Use a soft, dry cloth when cleaning the instrument. (Alcohol based substances may cause tarnishing or defacement of the unit)
- As the display section is vulnerable, do not strike or scratch it with a hard object.
- Any unauthorized transfer or copying of this document, in part or in whole, is prohibited.
- Panasonic Industrial Devices SUNX Co., Ltd. is not liable for any damage or secondary damage(s) incurred as a result of using this product, including any indirect damage.
- To pull out the inner assembly, release the hooks at the top and bottom of the instrument with thin, hard tweezers. (If the hooks are released too far, they may break, or IP 66 function could deteriorate.) Do not pull out the inner assembly except when repairing the instrument.)

1. Model number

1.1 Explanation of model number

A K T 4 □ **1** □ □ □ □ □

(1) (2) (3) (4) (5) (6) (7)

(1) Supply voltage ---------- 1: 100 to 240V AC, 2: 24V AC/DC

(2) Input type ---------- 1: Multi-input (Thermocouple, RTD, DC current and DC voltage can be selected by key operation. For DC current input, 50Ω shunt resistor (AKT4810, sold separately) must be connected between input terminals.)

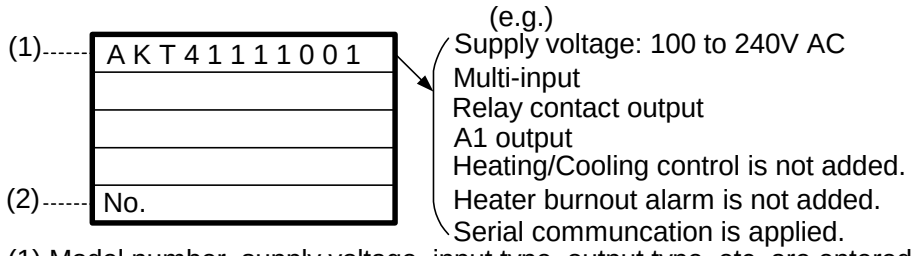
(3) Control output (OUT1) ---------- 1: Relay contact, 2: Non-contact voltage (Voltage output for SSR drive), 3: DC current

(4) Alarm output ---------- 1: A1 output, 2: A1 output + A2 output (The alarm type and Energized/Deenergized can be selected by key operation) (When A2 output is applied, Heating/Cooling control cannot be added)

(5) Heating/Cooling control (OUT2)--0: Not available, 4: Non-contact relay output
(6) Heater burnout alarm ---------- 0: Not available, 1: Available (5A), 2: Available (10A), 3: Available (20A), 4: Available (50A)
(Heater burnout alarm is not available for the DC current output)
(7) Serial communication ---------- 1: Available (The number is indicated only when the serial communication is applied.)

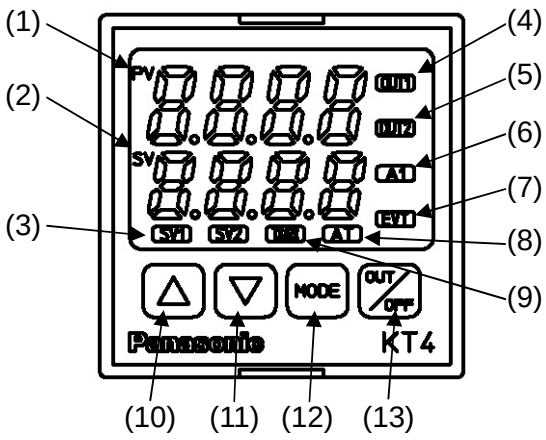
1.2 How to read the rated label

The rated label is attached to the case.
When Heater burnout alarm is added, CT rated current is written in the bracket.



(1) Model number, supply voltage, input type, output type, etc. are entered.
(2) Lot number is entered.

2. Name and functions of the sections



(Fig. 2-1)

(1) **PV display**: Indicates the PV (input value) with a red LED.
(2) **SV display**: Indicates the SV (main set value) with a green LED.
(3) **SV1 indicator**: The green LED lights when SV is indicated on the SV display.
(4) **OUT1 indicator**: When OUT1 or heating output is ON, a green LED lights. (For DC current output type, it flashes corresponding to the MV (manipulated variable) in 0.25 second cycles.
(5) **OUT2 indicator**: When OUT2 is ON, a yellow LED lights.
(6) **A1 indicator**: When A1 output is ON, a red LED lights.
(7) **EVT indicator**: When Event output (A2 output, Heater burnout alarm output) is ON, a red LED lights.
(8) **AT indicator**: While auto-tuning or auto-reset is being performed, the yellow LED flashes.
(9) **TX/RX indicator**: The yellow LED flashes while serial communication is performing.

(10) **Increase key** : Increases the numeric value.
(11) **Decrease key** : Decreases the numeric value.
(12) **Mode key** : Selects the setting mode or registers the set value.
(By pressing the Mode key, the set value can be registered)
(13) **OUT/OFF key** : The control output is turned on or off. If this key is pressed for approx. 1 second, control output OFF function works.
(To cancel the function, press the OUT/OFF key again for approx. 1 second.)

⚠ Notice

When setting the specifications and functions of this controller, connect terminals 1 and 2 for power source first, then set them referring to “5. Setup” and “7. Operation flowchart” before performing “3. Mounting to the control panel” and “4. Wiring”.

3. Mounting to the control panel

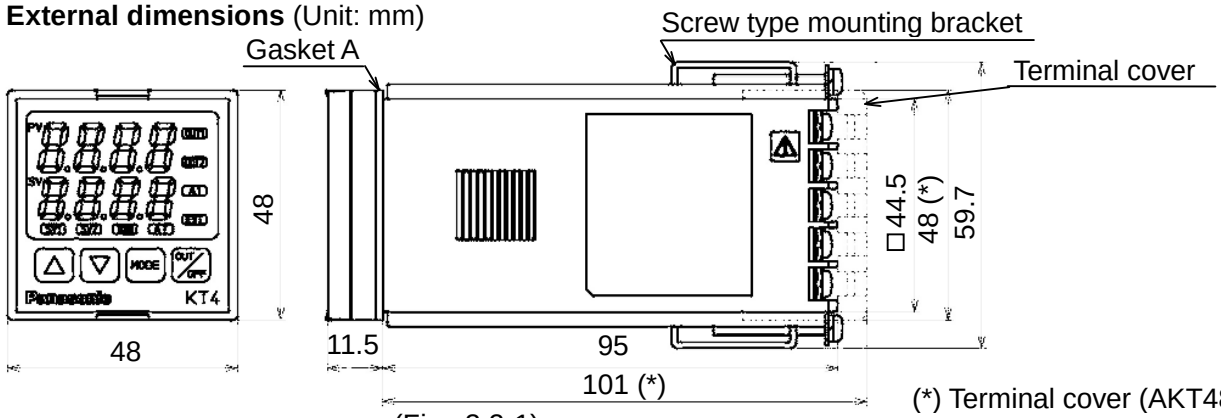
3.1 Site selection

This instrument is intended to be used under the following environmental conditions (IEC61010-1): Overvoltage category Ⅱ, Pollution degree 2

Ensure the mounting location corresponds to the following conditions:

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gases
- Few mechanical vibrations or shocks
- No exposure to direct sunlight, an ambient temperature of 0 to 50℃ (32 to 122℉) that does not change rapidly
- An ambient non-condensing humidity of 35 to 85%RH
- No large capacity electromagnetic switches or cables through which large current is flowing
- No water, oil or chemicals or where the vapors of these substances can come into direct contact with the controller

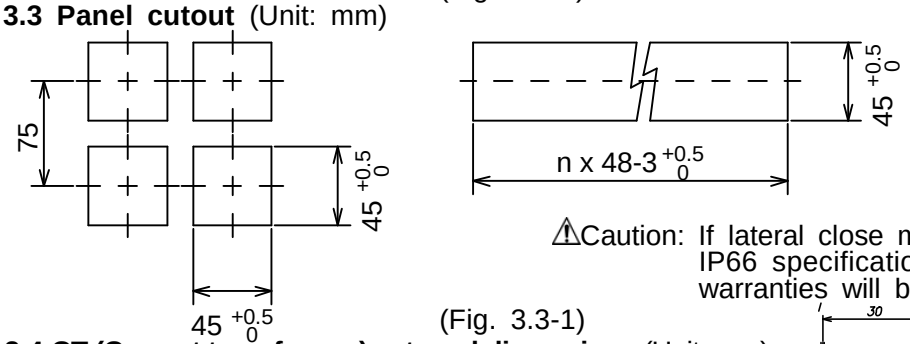
3.2 External dimensions (Unit: mm)



(*) Terminal cover (AKT4801)

(Fig. 3.2-1)

3.3 Panel cutout (Unit: mm)

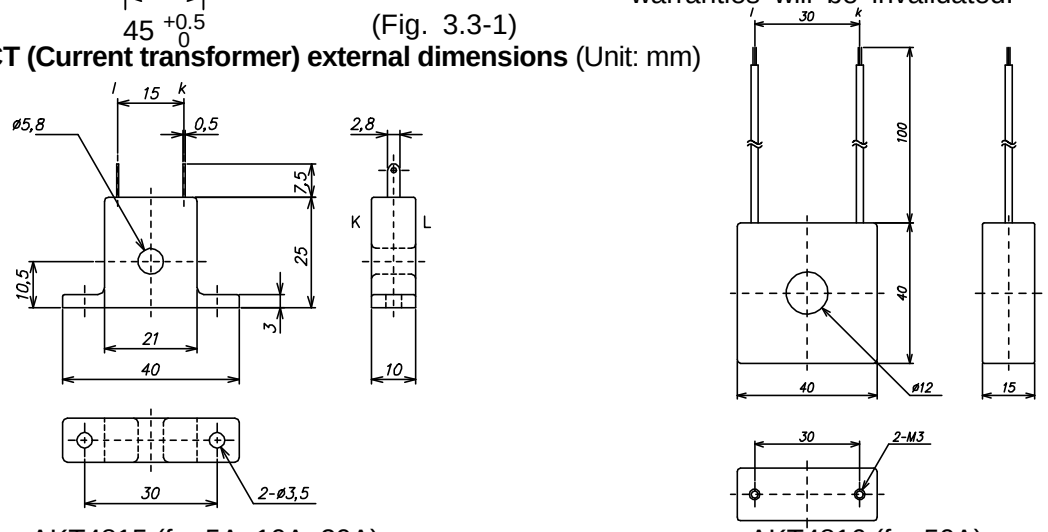


Lateral close mounting
n: Number of units mounted

⚠Caution: If lateral close mounting is used for the controller, IP66 specification may be compromised, and all warranties will be invalidated.

(Fig. 3.3-1)

3.4 CT (Current transformer) external dimensions (Unit: mm)



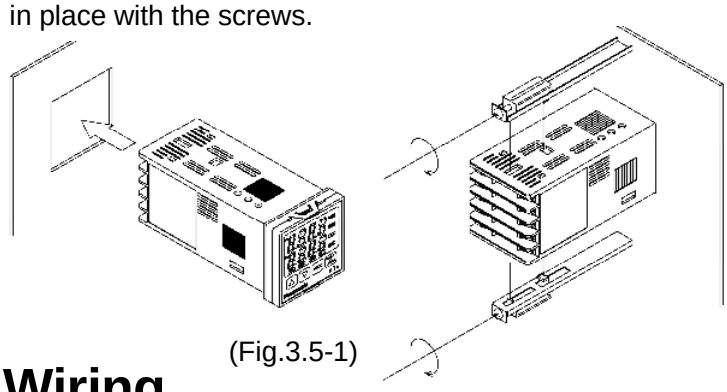
AKT4815 (for 5A, 10A, 20A)

AKT4816 (for 50A)

(Fig. 3.4-1)

3.5 Mounting

Mount the controller vertically to fulfill the Dust-proof/Drip-proof specification (IP66).
Mountable panel thickness: 1 to 8mm
Insert the controller from the front side of the panel.
Attach the mounting brackets by the holes at the top and bottom of the case and secure the controller in place with the screws.



(Fig.3.5-1)

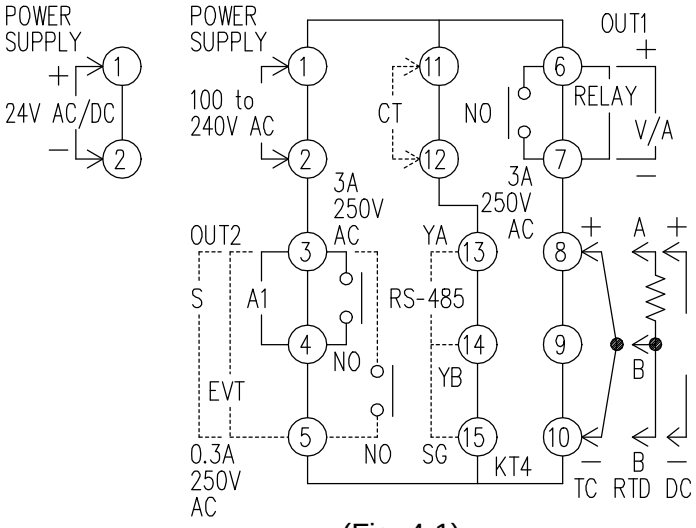
⚠ Warning

As the case is made of resin, do not use excessive force while screwing in the mounting bracket, or the case or screw type mounting bracket could be damaged.
The torque should be 0.12N•m.

4. Wiring

⚠ Warning

Turn the power supply to the instrument off before wiring or checking it.
Working on or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.



(Fig. 4-1)

- OUT1 : Control output 1 (Heating output)
- OUT2 : Control output 2 (Cooling output)
- RELAY : Relay contact output
- V/A : DC voltage output/DC current output
- S : Non-contact relay output
- A1 : Alarm 1 output
- EVT : Event output (A2 output, Heater burnout alarm output)
- CT : CT input
- TC : Thermocouple
- RTD : Resistance temperature detector
- DC : DC current, DC voltage
  For DC current input, 50Ω shunt resistor (AKT4810, sold separately) must be connected between input terminals.
- RS-485: Serial communication

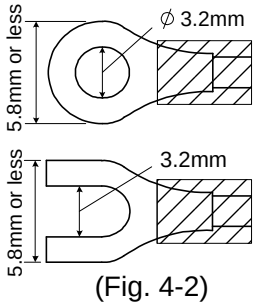
⚠ Notice

- The terminal block of the KT4 Series is designed to be wired from the left side.
  The lead wire must be inserted from the left side of the terminal, and fastened by the terminal screw.
- Dotted lines show options.
- To extend a thermocouple's lead wire, be sure to use a compensating lead wire in accordance with the sensor input specification.
  (If any other compensating lead wire is used, a temperature indication error may be caused.)
- Use the 3-wire RTD which corresponds to the input specification of this controller.
- This controller does not have built-in power switch, circuit breaker or fuse. Therefore, it is necessary to install them in the circuit externally, near the controller.
  (Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)
- For a 24V AC/DC power source, do not confuse polarity when using direct current (DC).
- When using a relay contact output type, use a relay according to the capacity of the load to protect the built-in relay contact.
- When wiring, keep input wires (thermocouple, RTD, etc.) away from AC sources or load wires to avoid external interference.
- If A2 and Heater burnout alarm are applied together, they share common output terminals.

Lead wire solderless terminal

Use a solderless terminal with an insulation sleeve in which an M3 screw fits as shown below.
The torque should be approximately 0.63N•m.

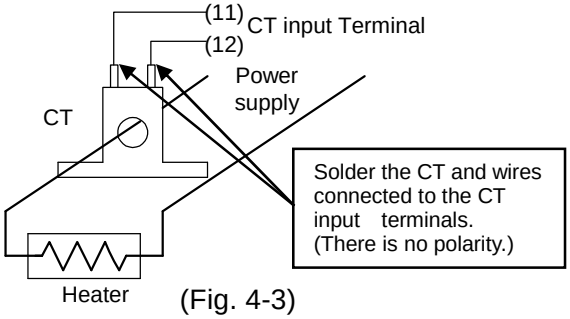
Solderless terminal	Manufacturer	Model	Tightening torque
Y type	Nichifu Terminal Industries CO.,LTD.	TMEV1.25Y-3	0.63N•m
	Japan Solderless Terminal MFG CO.,LTD.	VD1.25-B3A	
Round type	Nichifu Terminal Industries CO.,LTD.	TMEV1.25-3	
	Japan Solderless Terminal MFG CO.,LTD.	V1.25-3	



(Fig. 4-2)

Option: Heater burnout alarm

(1) **This alarm is not usable for detecting heater current under phase control.**
(2) **This alarm is not usable for detecting 3-phase heater current.**
(3) Use the current transformer (CT) provided, and pass one lead wire of the heater circuit into the hole of the CT.
(4) When wiring, keep CT wire away from AC sources or load wires to avoid the external interference.
(5) Solder the CT and wires connected to the CT input terminals. (There is no polarity.)



(Fig. 4-3)

5. Setup

Wire the power terminals only. After the power is turned on, the sensor input character and temperature unit are indicated on the PV display and the input range high limit value is indicated on the SV display for approximately 3 seconds. (Table 5-1) (If any other value is set during the scaling high limit setting, the set value is indicated on the SV display.) During this time, all outputs and the LED indicators are in OFF status. Control will then start, indicating the input value (PV) on the PV display and main set value (SV) on the SV display. (While control output OFF function is working, oFF is indicated on the PV display.)

(Table 5-1)

Sensor input	℃		℉	
	PV display	SV display	PV display	SV display
K	E C	1370	E F	2500
	E .C	400.0	E .F	750.0
J	J C	1000	J F	1800
R	r C	1760	r F	3200
S	S C	1760	S F	3200
B	b C	1820	b F	3300
E	E C	800	E F	1500
T	T .C	400.0	T .F	750.0
N	n C	1300	n F	2300
PL-Ⅱ	PL2C	1390	PL2F	2500
C (W/Re5-26)	c C	2315	c F	4200
Pt100	Pt .C	850.0	Pt .F	999.9
	Pt C	850	Pt F	1500
JPt100	JPt.C	500.0	JPt.F	900.0
	JPt C	500	JPt F	900
4 to 20mA DC	420A	Scaling high limit value	420A	Scaling high limit value
0 to 20mA DC	020A		020A	
0 to 1V DC	0 1V		0 1V	
0 to 5V DC	0 5V		0 5V	
0 to 10V DC	0 10V		0 10V	
1 to 5V DC	1 5V		1 5V	

5.1 Main setting mode

Character (PV display)	Name, Function, Setting range	Default value (SV display)
S	**SV** • Sets SV. • SV low limit to SV high limit, or Scaling low limit value to scaling high limit value	0℃

5.2 Sub-setting mode

Character (PV display)	Name, Function, Setting range	Default value (SV display)
AT	**AT setting/Auto-reset setting** • Selects auto-tuning Perform or auto-reset Perform. • If the auto-tuning is cancelled during the process, P, I and D values revert to the previous value. • When auto-tuning has not finished after 4 hours, it is cancelled automatically. • Auto-reset is cancelled in approximately 4 minutes. • Auto-reset can be performed only in PD or P action. • ---- : Auto-tuning/Auto-reset Cancel AT□□/RSET : Auto-tuning/Auto-reset Perform	----
P	**OUT1 proportional band setting** • Sets the proportional band for OUT1. • The control action becomes ON/OFF action when set to 0 or 0.0. • 0 to 1000℃(2000℉), With a decimal point: 0.0 to 999.9℃(℉), DC input: 0.0 to 100.0% [Percentage of the scaling span (scaling high limit - scaling low limit)]	10℃
P_b	**OUT2 proportional band setting** • Sets the proportional band for OUT2. OUT2 becomes ON/OFF action when set to 0.0. • Available only when Heating/Cooling control (option) is applied • 0.0 to 10.0 times (multiplying factor to OUT1 proportional band)	1.0 times
I	**Integral time setting** • Sets the integral time. • Setting the value to 0 disables the function. • Auto-reset can be performed when PD is the control action (I=0). • 0 to 1000 seconds	200 seconds
d	**Derivative time setting** • Sets the derivative time. • Setting the value to 0 disables the function. • 0 to 300 seconds	50 seconds

ARW	**ARW setting** • Sets ARW (anti-reset windup). • Available only when PID is the control action. • 0 to 100%	50%
c	**OUT1 proportional cycle setting** • Sets proportional cycle for OUT1. • Not available for ON/OFF action or DC current output type. **With the relay contact type, if the proportional cycle time is decreased, the frequency of the relay action increases and the life of the relay contact is shortened.** • 1 to 120 seconds	Relay contact output: 30 seconds Non-contact voltage output: 3 seconds
c_b	**OUT2 proportional cycle setting** • Sets proportional cycle for OUT2. • Not available if OUT2 is ON/OFF action • Available only when Heating/Cooling control (option) is applied • 1 to 120 seconds	3 seconds
A1	**A1 value setting** • Sets action point for A1 output. Setting the value to 0 or 0.0 disables the function (except process high alarm and process low alarm). Refer to (Table 5.2-1). • Not available if No alarm action is selected during A1 type selection	0℃
A2	**A2 value setting** • Sets action point for A2 output. Setting the value to 0 or 0.0 disables the function (except process high alarm and process low alarm). Refer to (Table 5.2-1). • Available only when A2 (option) is added • Not available if No alarm action is selected during A2 type selection	0℃
H□□ and measured current value are indicated alternately.	**Heater burnout alarm value setting** • Sets the heater current value for Heater burnout alarm. • Available only when Heater burnout alarm (option) is added. • When OUT1 is OFF, heater current value shows the same value as when OUT1 was on. • Setting the value to 0.0 disables the function. • It is recommended to set approx. 80% of the heater current value (set value) considering the voltage fluctuation of power supply. • Upon returning to set limits, the alarm will stop. • Rating 5A : 0.0 to 5.0A Rating 10A: 0.0 to 10.0A Rating 20A: 0.0 to 20.0A Rating 50A: 0.0 to 50.0A	0.0A

(Table 5.2-1)

Alarm type	Setting range	
High limit alarm	– (Input span) to input span℃ (℉)	*1
Low limit alarm	– (Input span) to input span℃ (℉)	*1
High/Low limits alarm	0 to input span℃ (℉)	*1
High/Low limit range alarm	0 to input span℃ (℉)	*1
Process high alarm	Input range low limit value to input range high limit value	*2
Process low alarm	Input range low limit value to input range high limit value	*2
High limit alarm with standby	– (Input span) to input span℃ (℉)	*1
Low limit alarm with standby	– (Input span) to input span℃ (℉)	*1
High/Low limits alarm with standby	0 to input span℃ (℉)	*1

• When input has a decimal point, negative low limit value is –199.9, and positive high limit value is 999.9.
• All alarm types except process alarm are ±deviation setting from the SV.
*1: For DC input, the input span is the same as the scaling span.
*2: For DC input, input range low (or high) limit value is the same as scaling low (or high) limit value.

5.3 Auxiliary function setting mode 1

Character (PV display)	Name, Function, Setting range	Default value (SV display)
Lock	**Set value lock selection** • Locks the set values to prevent setting errors. The setting item to be locked depends on the selection. • When Lock 1 or Lock 2 is selected, PID Auto-tuning or Auto-reset cannot be carried out. • ---- (Unlock): All set values can be changed. Loc1 (Lock 1): None of the set values can be changed. Loc2 (Lock 2): Only main setting mode can be changed. Loc3 (Lock 3): All set values except Input type can be changed. However, they return to their previous value after power is turned off because they are not saved in the non-volatile memory. Be sure to select Lock 3 when changing the set value frequently via communication function. (If the value set by the communication function is the same as the value before the setting, the value will not be written in the non-volatile memory.) **Do not change any setting item in Auxiliary function setting mode 2. If any item in the mode is changed, it will affect other setting items such as the SV and Alarm value.**	Unlock status

SH	**SV high limit setting** • Sets the SV high limit. • SV low limit to input range high limit value. For DC input, SV low limit to scaling high limit value (The placement of the decimal point follows the selection)	1370℃
SL	**SV low limit setting** • Sets the SV low limit. • Input range low limit value to SV high limit. For DC input, scaling low limit value to SV high limit (The placement of the decimal point follows the selection)	–200℃
So	**Sensor correction setting** • Sets the correction value for the sensor. • –100.0 to 100.0℃ (℉) For DC input, –1000 to 1000 (The placement of the decimal point follows the selection)	0.0℃
cSoL	**Communication protocol selection** • Selects the communication protocol. • Available only when Serial communication (option) is applied. • Not available if nonL is indicated • Modbus ASCII mode: AodA, Modbus RTU mode: Aodr	AodA
cAno	**Instrument number setting** • Sets the instrument number. (Communication cannot be carried out unless an instrument number is individually set when communicating by connecting plural instruments in serial communication.) • Available only when Serial communication (option) is added. • 0 to 95	0
cSoP	**Communication speed selection** • Selects a speed to be equal to the speed of the host computer. • Available only when Serial communication (option) is added. • 2400bps: 24, 4800bps: 48, 9600bps: 96, 19200bps: 192	9600bps
cAPr	**Parity selection** • Selects the parity. • Not available if Serial communication (option) is not added or if nonL is selected during the Communication protocol selection. • No parity: nonE, Even parity: EvEn, Odd parity: odd	Even parity
cSoF	**Stop bit selection** • Selects the stop bit. • Not available if Serial communication (option) is not added or if nonL is selected during the Communication protocol selection. • 1 or 2	1

5.4 Auxiliary function setting mode 2

Character (PV display)	Name, Function, Setting range	Default value (SV display)
SEnS	**Input type selection** • The input type can be selected from thermocouple (10 types), RTD (2 types), DC current (2 types) and DC voltage (4 types), and the unit ℃/℉ can be selected as well.	K (–200 to 1370℃)

K	–200 to 1370℃:	tC	K	–320 to 2500 ℉:	tF
	–199.9 to 400.0℃:	t.C		–199.9 to 750.0℉:	t.F
J	–200 to 1000 ℃:	JC	J	–320 to 1800 ℉:	JF
R	0 to 1760 ℃:	rC	R	0 to 3200 ℉:	rF
S	0 to 1760 ℃:	SC	S	0 to 3200 ℉:	SF
B	0 to 1820 ℃:	bC	B	0 to 3300 ℉:	bF
E	–200 to 800 ℃:	EC	E	–320 to 1500 ℉:	EF
T	–199.9 to 400.0℃:	t.C	T	–199.9 to 750.0℉:	t.F
N	–200 to 1300 ℃:	nC	N	–320 to 2300 ℉:	nF
PL-Ⅱ	0 to 1390 ℃:	PL2C	PL-Ⅱ	0 to 2500 ℉:	PL2F
C (W/Re5-26)	0 to 2315 ℃:	cC	C (W/Re5-26)	0 to 4200 ℉:	cF
Pt100	–199.9 to 850.0℃:	Pt.C	Pt100	–199.9 to 999.9℉:	Pt.F
JPt100	–199.9 to 500.0℃:	JPt.C	JPt100	–199.9 to 900.0℉:	JPt.F
Pt100	–200 to 850 ℃:	PtC	Pt100	–300 to 1500℉:	PtF
JPt100	–200 to 500 ℃:	JPtC	JPt100	–300 to 900 ℉:	JPtF
4 to 20mA	–1999 to 9999:	420A			
0 to 20mA	–1999 to 9999:	020A			
0 to 1V	–1999 to 9999:	0 1V			
0 to 5V	–1999 to 9999:	0 5V			
1 to 5V	–1999 to 9999:	1 5V			
0 to 10V	–1999 to 9999:	0 10V			

SrLH	**Scaling high limit setting** • Sets scaling high limit value. • Available only for DC input type • Scaling low limit value to input range high limit value (The placement of the decimal point follows the selection)	9999

SCLL	**Scaling low limit setting** • Sets scaling low limit value. • Available only for DC input type • Input range low limit value to scaling high limit value (The placement of the decimal point follows the selection)	–1999
dP	**Decimal point place selection** • Selects decimal point place. • Available only for DC input • No decimal point: 0 1 digit after decimal point: 00.0 2 digits after decimal point: 0.00 3 digits after decimal point: 0.000	No decimal point
FILT	**PV filter time constant setting** • Sets PV filter time constant. (If the value is set too large, it affects control result due to the delay of response) • 0.0 to 10.0 seconds	0.0 seconds
oLH	**OUT1 high limit setting** • Sets the high limit value of OUT1. • Not available for ON/OFF action • OUT1 low limit value to 105% (Setting higher than 100% is effective to DC current output type)	100%
oLL	**OUT1 low limit setting** • Sets the low limit value of OUT1. • Not available for ON/OFF action. • –5% to OUT1 high limit value (Setting less than 0% is effective to DC current output type)	0%
HYS	**OUT1 ON/OFF action hysteresis setting** • Sets ON/OFF action hysteresis for OUT1. • Available only when the control action is ON/OFF action • 0.1 to 100.0℃ (℉) For DC input, 1 to 1000 (The placement of the decimal point follows the selection)	1.0℃
cACT	**OUT2 action mode selection** • Selects OUT2 action from air cooling, oil cooling and water cooling. • Not available if OUT2 is ON/OFF action or if Heating/Cooling control (option) is not added. • Air cooling: AIr, oil cooling: oIL, water cooling: WAtr	Air cooling
oLHb	**OUT2 high limit setting** • Sets the high limit value of OUT2. • Not available if OUT2 is ON/OFF action or if Heating/Cooling control (option) is not added. • OUT2 low limit value to 100%	100%
oLLb	**OUT2 low limit setting** • Sets the low limit value of OUT2. • Not available if OUT2 is ON/OFF action or if Heating/Cooling control (option) is not added. • 0% to OUT2 high limit value	0%
db	**Overlap band/Dead band setting** • Sets the overlap band or dead band for OUT1 and OUT2. + set value: Dead band – set value: Overlap band • Not available if OUT2 is ON/OFF action or if Heating/Cooling control (option) is not added. • –100.0 to 100.0℃ (℉) For DC input, –1000 to 1000 (The placement of the decimal point follows the selection)	0.0℃
HYSb	**OUT2 ON/OFF action hysteresis setting** • Sets ON/OFF action hysteresis for OUT2. • Available only when Heating/Cooling control (option) is added. • 0.1 to 100.0℃ (℉), For DC input, 1 to 1000 (The placement of the decimal point follows the selection)	1.0℃
AL 1F	**A1 type selection** • Selects an A1 type. No alarm action : ---- High limit alarm : H Low limit alarm : L High/Low limits alarm : HL High/Low limit range alarm: oI d Process high alarm : PH Process low alarm : rPH High limit alarm with standby : H b Low limit alarm with standby : L b High/Low limits alarm with standby : HL b	No alarm action

A2TY	**A2 type selection** • Selects an A2 type. • Available only when A2 (option) is added • Action selection and default value are the same as those of A1 type selection.	No alarm action
A1LA	**A1 action Energized/Deenergized selection** • Selects Energized/Deenergized status for A1. • Not available if No alarm action is selected during A1 type selection • Energized: nonL Deenergized: rEVS	Energized
A2LA	**A2 action Energized/Deenergized selection** • Selects Energized/Deenergized status for A2. • Not available if No alarm is selected during A2 type selection or if A2 (option) is not added • Action selection and default value are the same as those of A1 action Energized/ Deenergized selection.	Energized
A1HY	**A1 hysteresis setting** • Sets hysteresis for A1. • Not available if No alarm action is selected during A1 type selection • 0.1 to 100.0℃(℉) For DC input, 1 to 1000 (The placement of the decimal point follows the selection)	1.0℃
A2HY	**A2 hysteresis setting** • Sets hysteresis for A2. • Not available if No alarm is selected during A2 type selection or if A2 (option) is not added • Setting range and default value are the same as those of A1 hysteresis setting.	1.0℃
A1dY	**A1 action delayed timer setting** • Sets action delayed timer for A1. When setting time passes after the input enters alarm output range, the alarm is activated. • Not available if No alarm action is selected during A1 type selection • 0 to 9999 seconds	0 seconds
A2dY	**A2 action delayed timer setting** • Sets action delayed timer for A2. When setting time passes after the input enters alarm output range, the alarm is activated. • Not available if No alarm is selected during A2 type selection or if A2 (option) is not added • Setting range and default value are the same as those of A1 action delayed timer setting.	0 seconds
conF	**Direct/ Reverse control action selection** • Selects either Reverse (Heating) or Direct (Cooling) control action. • Reverse (Heating): HEAT Direct (Cooling): cooL	Reverse (Heating) action
AT_b	**AT bias setting** • Sets bias value during PID auto-tuning. • Not available if input type is DC current or DC voltage. • 0 to 50℃ (0 to 100℉), or 0.0 to 50.0℃ (0.0 to 100.0℉)	20℃
SU_b	**Setting item not used**: This item is indicated when Serial communication (option) is added. However, this cannot be used.	
EoUT	**Output status selection when input abnormal** • Selects the output status of OUT1 and OUT2 (option) when DC input is overscale or underscale. See “Input abnormality indication” on pages 17, 18. • Available only for DC current output with DC input • oFF: OFF(4mA) or OUT1(OUT2) low limit on: Outputs a value between OFF(4mA) and ON(20mA) or between OUT1(OUT2) low limit value and OUT1(OUT2) high limit value, depending on a deviation.	Output OFF
mAnU	**OUT/OFF key function selection** • Selects whether OUT/OFF key is used for control output OUT/OFF function or for Auto/Manual control function. • oFF(OUT/OFF function) mAnU (Auto/Manual control function)	OUT/OFF function

ARW function

ARW (Anti-reset windup) prevents overshoot caused by the integral action. The smaller the ARW value, the less the overshoot caused by the integral action in the transition status, however it takes time until stabilization.

Sensor correction function

This corrects the input value from the sensor. When a sensor cannot be set at a location where control is desired, the sensor measuring temperature may deviate from the temperature in the controlled location. When controlling with plural controllers, the accuracy of sensors affects the control. Therefore, sometimes the measured temperature (input value) does not concur.
In such a case, the control can be set at the desired temperature by adjusting the input value of sensors.

Energized/Deenergized

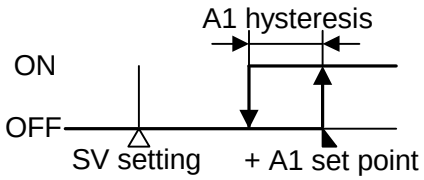
When [Alarm action Energized] is selected, the alarm output (between terminals 3-4, or 3-5) is conducted (ON) while the alarm output indicator is lit.

The alarm output is not conducted (OFF) while the alarm output indicator is not lit.

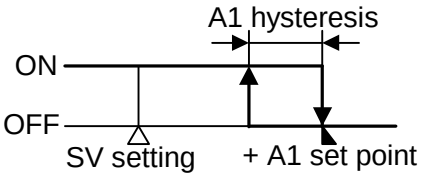
When [Alarm action Deenergized] is selected, the alarm output (between terminals 3-4, or 3-5) is not conducted (OFF) while the alarm output indicator is lit.

The alarm output is conducted (ON) while the alarm output indicator is not lit.

[This function is not available for the Heater burnout alarm (optional).]



High limit alarm (When Energized is set)
(Fig. 5.4-1)



High limit alarm (When Deenergized is set)
(Fig. 5.4-2)

5.5 Auto/Manual control function

Name, Function
Auto/Manual control function • If Auto/Manual control function is selected in the OUT/OFF key function selection, Automatic or Manual control function can be switched by pressing the OUT/OFF key in the PV/SV display mode. If control action is switched from automatic to manual or vice versa, balanceless-bumpless function works to prevent rapid change of manipulated variable. When automatic control is switched to manual control, the 1st decimal point from the right flashes on the SV display, and the output manipulated variable (MV) on the SV display can be increased or decreased by pressing ▲ or ▼ key to perform the control. By pressing the OUT/OFF key again, the mode reverts to the PV/SV display mode (automatic control). (Whenever the power to the controller is turned on, automatic control starts.)

5.6 Control output OFF function

Character (PV display)	Name, Function
oFF	**Control output OFF function** • A function to pause the control action or turn the control output of the unused instrument of the plural units OFF even if the power to the instrument is supplied. [oFF] is indicated on the PV display while the function is working. • **Once the control output OFF function is enabled, the function cannot be released even if the power to the instrument is turned OFF and ON again.** **To cancel the function, press the OUT/OFF key again for approx. 1 second.**

5.7 Output manipulated variable (MV) indication

Name, function
Output manipulated variable indication • **In the PV/SV display mode, press the MODE key for approx. 3 seconds.** Keep pressing the MODE key until the output manipulated variable appears, though the main setting mode appears temporarily during the process. (The SV display indicates output manipulated variable and a decimal point flashes in 0.5 second cycles.) If the MODE key is pressed again, the mode reverts to the PV/SV display.

6. Running

After the unit is mounted to the control panel and wiring is completed, operate the unit following the procedures below.

(1) Turn the power supply to the KT4 Series ON.

- For approx. 3sec after the power is switched ON, the sensor input character and the temperature unit are indicated on the PV display and input range high limit value is indicated on the SV display. See (Table 5-1). (If any other value has been set during the scaling high limit setting, the SV display indicates it.) During this time, all outputs and LED indicators are in OFF status.
- After that, control starts indicating input value(PV) on the PV display, and main set value(SV) on the SV display.
- While the Control output OFF function is working, oFF is indicated on the PV display.

(2) Input each set value, referring to "5. Setup".

(3) Turn the load circuit power ON.

Control action starts so as to keep the control target at the main set value (SV).

7. Operation flowchart

Outline of operation procedure

Operation before running

[STEP 1 Initial setting] : Set Input type, Alarm type, Control action, etc. in Auxiliary function setting mode 2.

↓

[STEP 2 Adjusting item] : Set PID values and Alarm values in the Sub setting mode.

↓

[STEP 3 Lock setting] : Set the Set value Lock, SV high limit and SV low limit in Auxiliary function setting mode 1 (If Step 3 is not necessary, skip this step.)

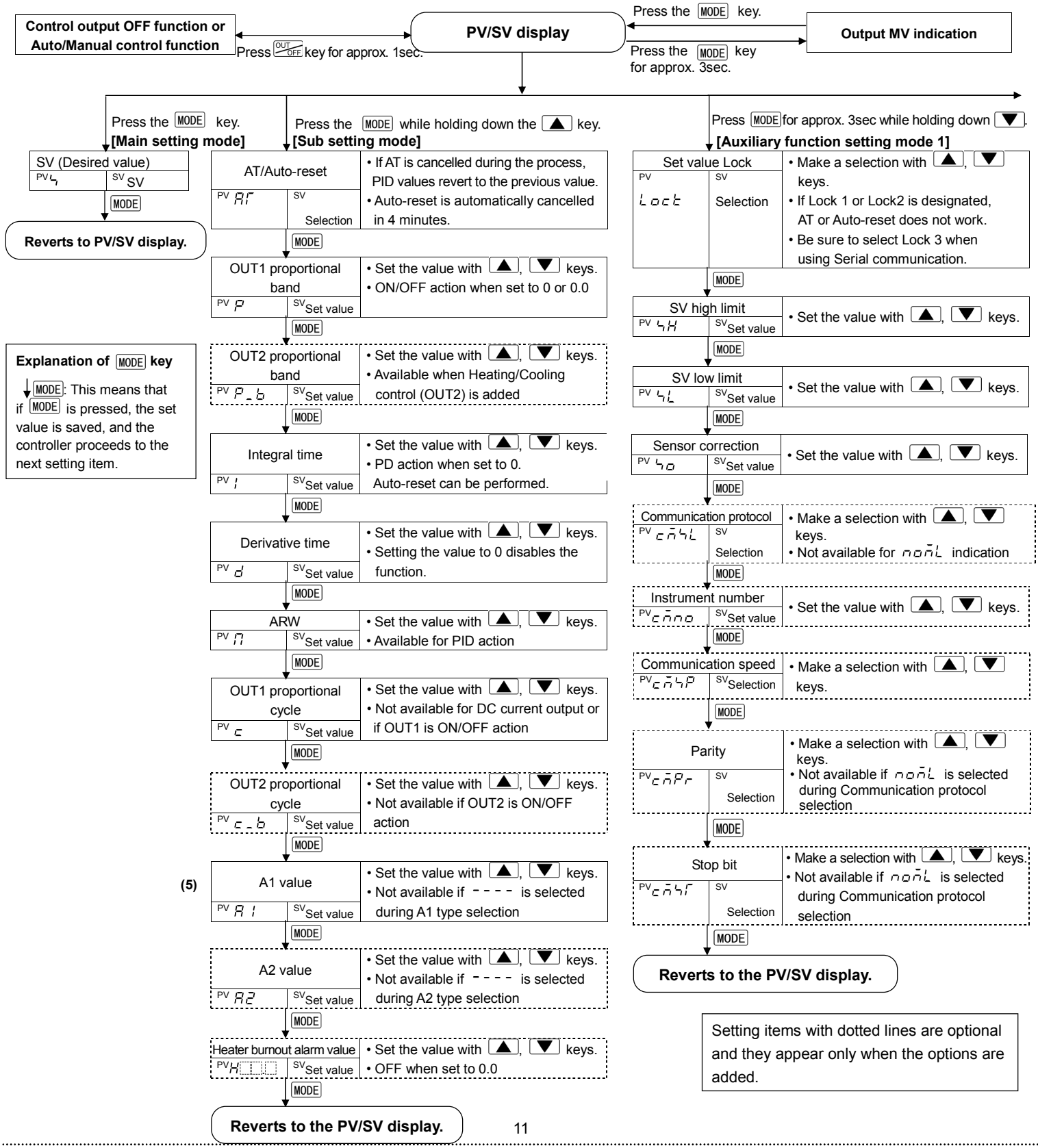
↓

[STEP 4 Run setting] : Set SV (desired value) in the Main setting mode.

Alarm 1 (A1) setting procedure
[Numbers (1) to (5) are indicated on the flowchart.]

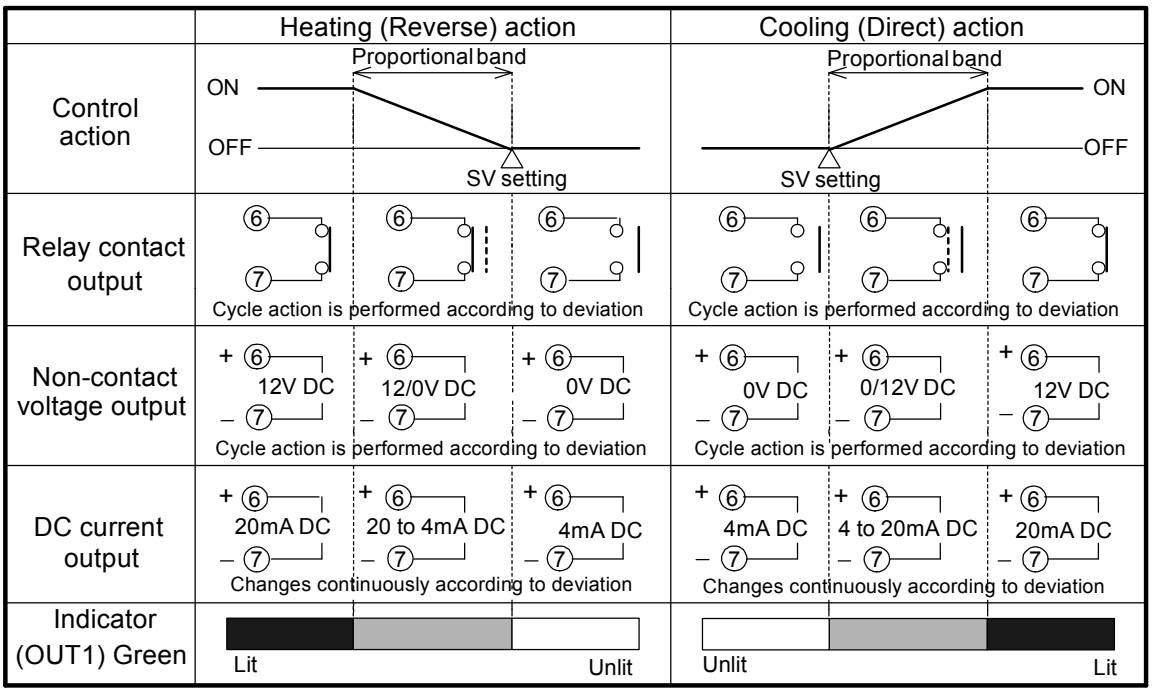
(1) [A1 type]: Select an Alarm 1 type.
[If an alarm type except for ---- is selected, items (2) to (5) are indicated and they can be set if necessary.]
(2) [A1 action Energized/Deenergized]: Select Alarm 1 contact output ON (Energized: noAL) or OFF (Deenergized: rEVS).
(3) [A1 hysteresis]: Set A1 hysteresis.
(4) [A1 action delayed timer]: Set A1 action delayed time.
(If input enters alarm action range and setting time has passed, the alarm is activated.)
(5) [A1 value]: Set an action point of A1 output.

[Note] If an alarm type is changed, the alarm set value becomes 0 (0.0). Therefore it is necessary to reset it.



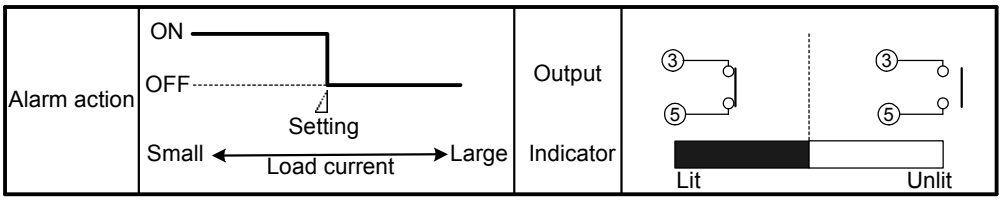
8. Action explanation

8.1 OUT1 action

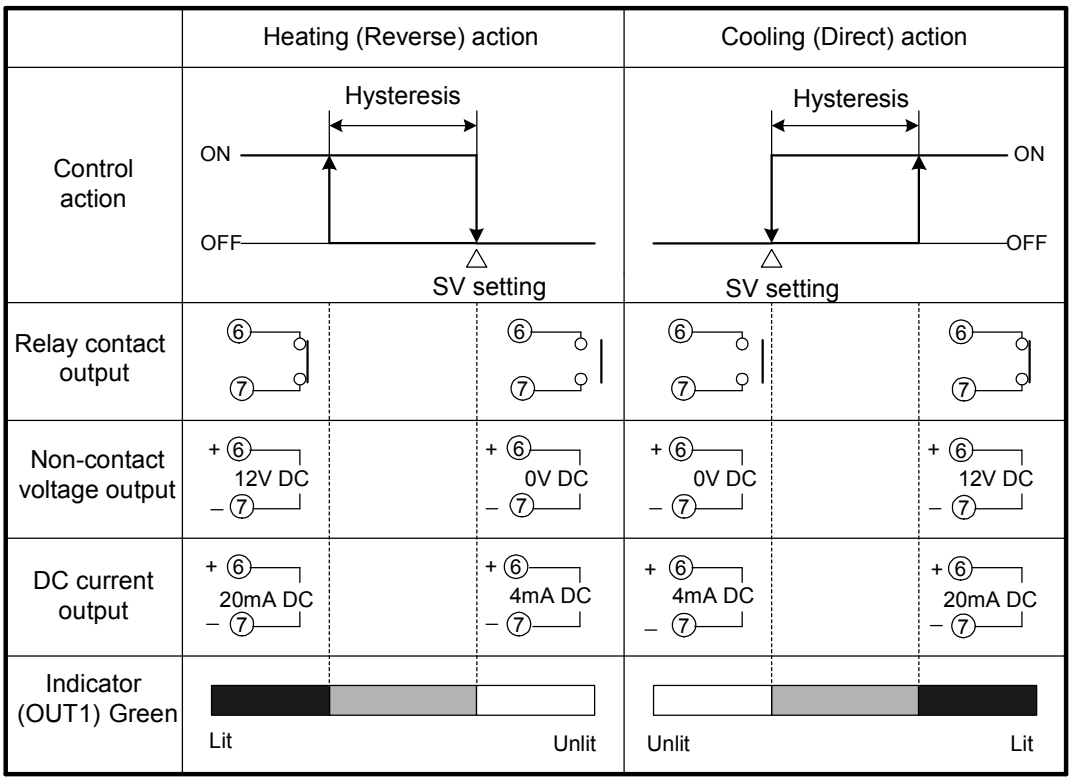


: Acts ON or OFF.

8.2 EVT (Heater burnout alarm) action



8.3 OUT1 ON/OFF action



: Acts ON or OFF.

Input type (character indication) and range

K	–200 to 1370℃:	1.C	K	–320 to 2500 ℉:	2.F
	–199.9 to 400.0℃:	400.C		–199.9 to 750.0℉:	750.F
J	–200 to 1000 ℃:	1.C	J	–320 to 1800 ℉:	2.F
R	0 to 1760 ℃:	1.C	R	0 to 3200 ℉:	3.F
S	0 to 1760 ℃:	1.C	S	0 to 3200 ℉:	3.F
B	0 to 1820 ℃:	1.C	B	0 to 3300 ℉:	3.F
E	–200 to 800 ℃:	1.C	E	–320 to 1500 ℉:	2.F
T	–199.9 to 400.0℃:	400.C	T	–199.9 to 750.0℉:	750.F
N	–200 to 1300 ℃:	1.C	N	–320 to 2300 ℉:	2.F
PL-Ⅱ	0 to 1390 ℃:	1.C	PL-Ⅱ	0 to 2500 ℉:	2.F
C(W/Re5-26)	0 to 2315 ℃:	2.C	C(W/Re5-26)	0 to 4200 ℉:	4.F
Pt100	–199.9 to 850.0℃:	850.C	Pt100	–199.9 to 999.9℉:	999.F
JPt100	–199.9 to 500.0 ℃:	500.C	JPt100	–199.9 to 900.0℉:	900.F
Pt100	–200 to 850 ℃:	1.C	Pt100	–300 to 1500℉:	2.F
JPt100	–200 to 500 ℃:	1.C	JPt100	–300 to 900℉:	2.F
4 to 20mA DC	–1999 to 9999:	4-20A			
0 to 20mA DC	–1999 to 9999:	0-20A			
0 to 1V DC	–1999 to 9999:	0 1V			
0 to 5V DC	–1999 to 9999:	0 5V			
1 to 5V DC	–1999 to 9999:	1 5V			
0 to 10V DC	–1999 to 9999:	0 10V			

Alarm type

High limit alarm: The alarm action is ±deviation setting from the SV. The alarm is activated if the input value reaches the high limit set value. Character indication: H

Low limit alarm: The alarm action is ±deviation setting from the SV. The alarm is activated if the input value goes under the low limit set value. Character indication: L

High/Low limits alarm: Combines High limit and Low limit alarm actions. When input value reaches high limit set value or goes under the low limit set value, the alarm is activated. Character indication: HL

High/Low limit range alarm: When input value is between the high limit set value and low limit set value, the alarm is activated. Character indication: in d

Process alarm: Within the scale range of the controller, alarm action points can be set at random and if the input reaches the randomly set action point, the alarm is activated.
Character indication: Process high alarm AH, Process low alarm rAH

Alarm with standby function: When the power to the controller is turned on, even if the input enters the alarm action range, the alarm is not activated. (If the controller is allowed to keep running, once the input exceeds the alarm action point, the standby function will be released.)
Character indication:
High limit alarm with standby : H u
Low limit alarm with standby : L u
High/Low limits alarm with standby : HL u

Press the ▲ and ▼ keys for approx. 3 seconds.

[Auxiliary function setting mode 2]

Input type	PV: sEnS / SV: Selection	• Make a selection with the ▲, ▼ keys. • Default value: K C
Scaling high limit	PV: SCLH / SV: Set value	• Set the value with the ▲, ▼ keys. • Available for DC current, DC voltage input
Scaling low limit	PV: SCLL / SV: Set value	• Set the value with the ▲, ▼ keys. • Available for DC current, DC voltage input
Decimal point place	PV: dP / SV: Selection	• Make a selection with the ▲, ▼ keys. • Available for DC current, DC voltage input
PV filter time constant	PV: FILT / SV: Set value	• Set the value with the ▲, ▼ keys.
OUT1 high limit	PV: oLH / SV: Set value	• Set the value with the ▲, ▼ keys. • Not available for ON/OFF action
OUT1 low limit	PV: oLL / SV: Set value	• Set the value with the ▲, ▼ keys. • Not available for ON/OFF action
OUT1 ON/OFF action hysteresis	PV: HYS / SV: Set value	• Set the value with the ▲, ▼ keys. • Available for ON/OFF action
OUT2 action mode	PV: cAct / SV: Selection	• Make a selection with the ▲, ▼ keys. • Available if Heat/Cool control (OUT2) is added
OUT2 high limit	PV: oLHb / SV: Set value	• Set the value with the ▲, ▼ keys. • Available if Heat/Cool control (OUT2) is added
OUT2 low limit	PV: oLLb / SV: Set value	• Set the value with the ▲, ▼ keys. • Available if Heat/Cool control (OUT2) is added
Overlap/Dead band	PV: db / SV: Set value	• Set the value with the ▲, ▼ keys. • Available only when Heat/Cool control (OUT2) is added
OUT2 ON/OFF action hysteresis	PV: HYSb / SV: Set value	• Set the value with ▲, ▼ keys. • Available only when Heat/Cool control (OUT2) is added

MODE

(1) A1 type — PV: AL 1F / SV: Selection
• Make a selection with the ▲, ▼ keys.
• Default value: ----

MODE

A2 type — PV: AL2F / SV: Selection
• Make a selection with the ▲, ▼ keys.
• Available when A2 is added

MODE

(2) A1 action Energized/ Deenergized — PV: A1LA / SV: Selection
• Make a selection with the ▲, ▼ keys.
• Not available if ---- is selected during A1 type selection

MODE

A2 action Energized/ Deenergized — PV: A2LA / SV: Selection
• Make a selection with the ▲, ▼ keys.
• Not available if ---- is selected during A2 type selection

MODE

(3) A1 hysteresis — PV: A1HY / SV: Set value
• Set the value with the ▲, ▼ keys.
• Not available if ---- is selected during A1 type selection

MODE

A2 hysteresis — PV: A2HY / SV: Set value
• Set the value with the ▲, ▼ keys.
• Not available if ---- is selected during A2 type selection

MODE

(4) A1 action delayed timer — PV: A1dY / SV: Set value
• Set the value with the ▲, ▼ keys.
• Not available if ---- is selected during A1 type selection

MODE

A2 action delayed timer — PV: A2dY / SV: Set value
• Set the value with the ▲, ▼ keys.
• Not available if ---- is selected during A2 type selection

MODE

Direct/Reverse control — PV: conT / SV: Selection
• Make a selection with the ▲, ▼ keys.
• Default value: HEAT

MODE

AT bias — PV: AT_b / SV: Set value
• Set the value with the ▲, ▼ keys.
• Available for thermocouple, RTD input

MODE

Setting item not used — PV: Hb_b / SV: Set value
• Do not set this item even if Hb_b is indicated on the PV display.

MODE

Output status selection when input abnormal — PV: EoUT / SV: Selection
• Make a selection with the ▲, ▼ keys.
• Available only when input is DC current and DC voltage with DC current output.

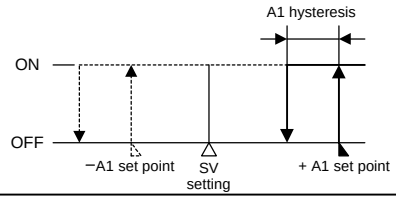
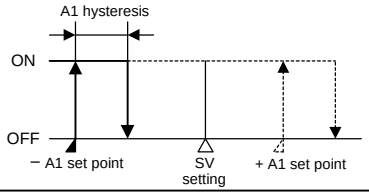
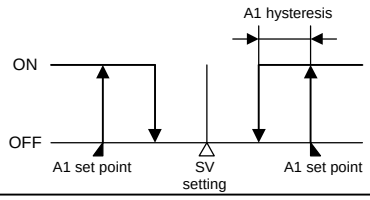
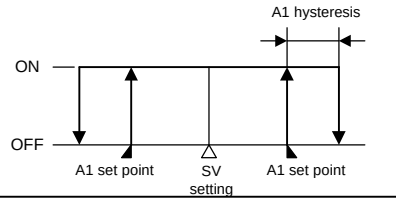
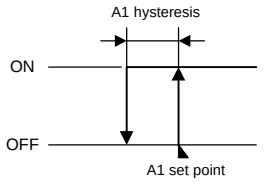
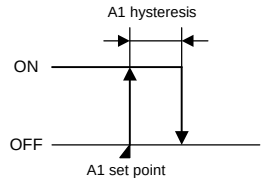
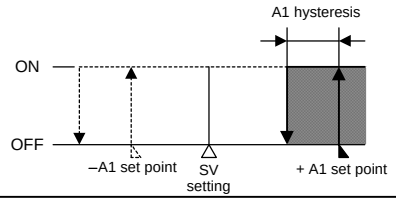
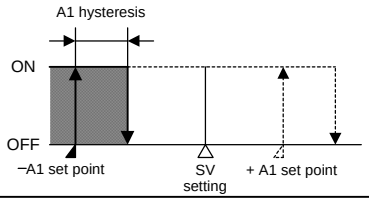
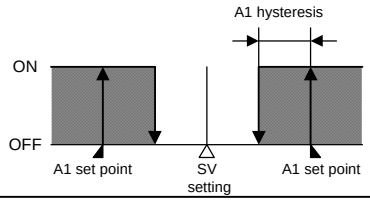
MODE

OUT/OFF key function — PV: AAnU / SV: Selection
• Make a selection with the ▲, ▼ keys.

MODE

Reverts to the PV/SV display.

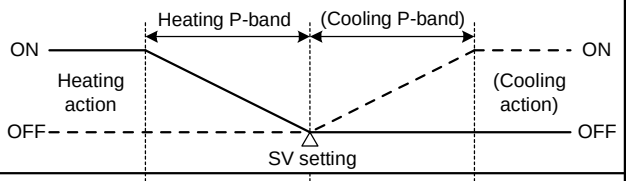
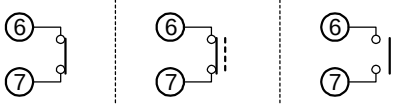
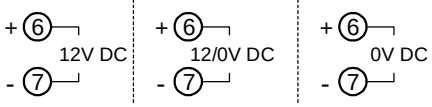
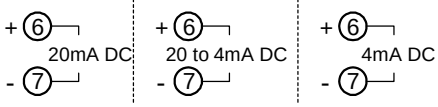
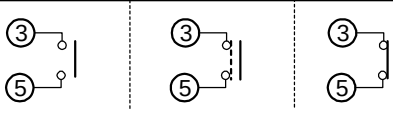
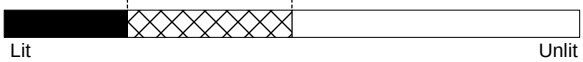
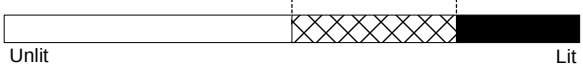
8.4 A1 and A2 action

	High limit alarm	Low limit alarm	High/Low limits alarm
Alarm action			
	High/Low limit range alarm	Process high alarm	Process low alarm
Alarm action			
	High limit alarm with standby	Low limit alarm with standby	High/Low limit alarm with standby
Alarm action			

: Standby functions in this section.

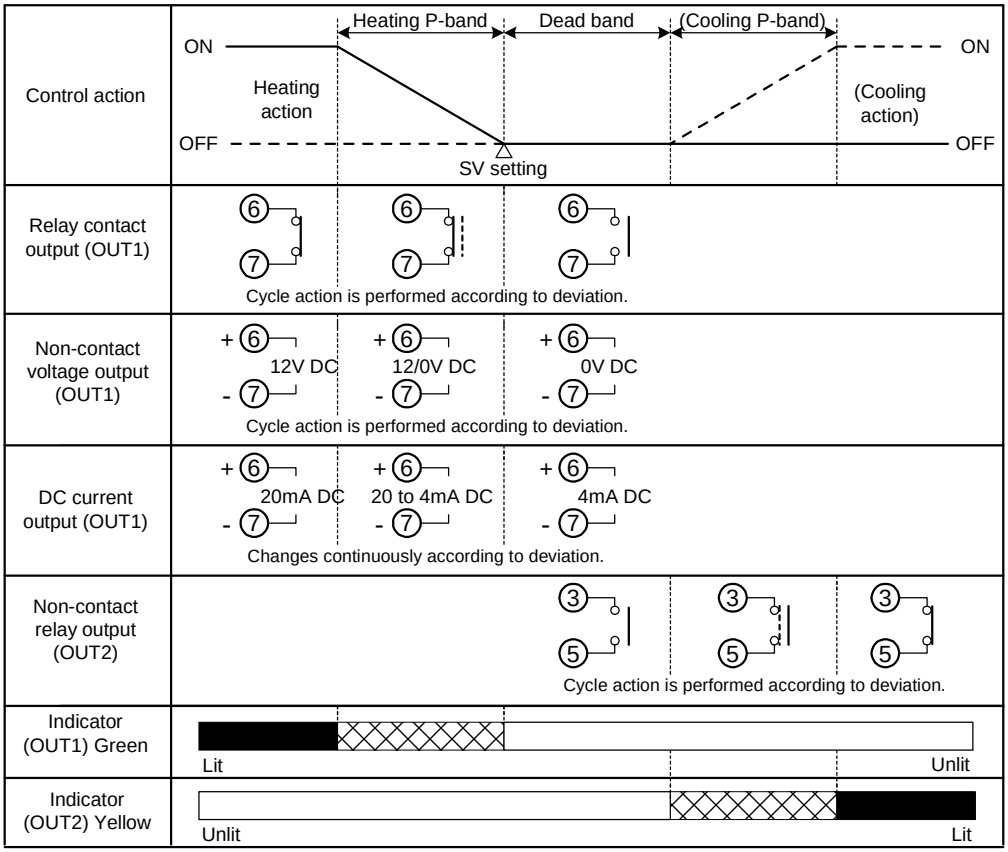
Terminals 3 & 4 are for the user's own Alarm 1 indicator, which correlates directly with the A1 indicator.
Terminals 3 & 5 are for the user's own Alarm 2 (or Heater burnout alarm) indicator, which correlates directly with the EVT indicator.

8.5 Heating/Cooling control action

Control action	
Relay contact output (OUT1)	 Cycle action is performed according to deviation.
Non-contact voltage output (OUT1)	 Cycle action is performed according to deviation.
DC current output (OUT1)	 Changes continuously according to deviation.
Non-contact relay output (OUT2)	 Cycle action is performed according to deviation.
Indicator (OUT1) Green	
Indicator (OUT2) Yellow	

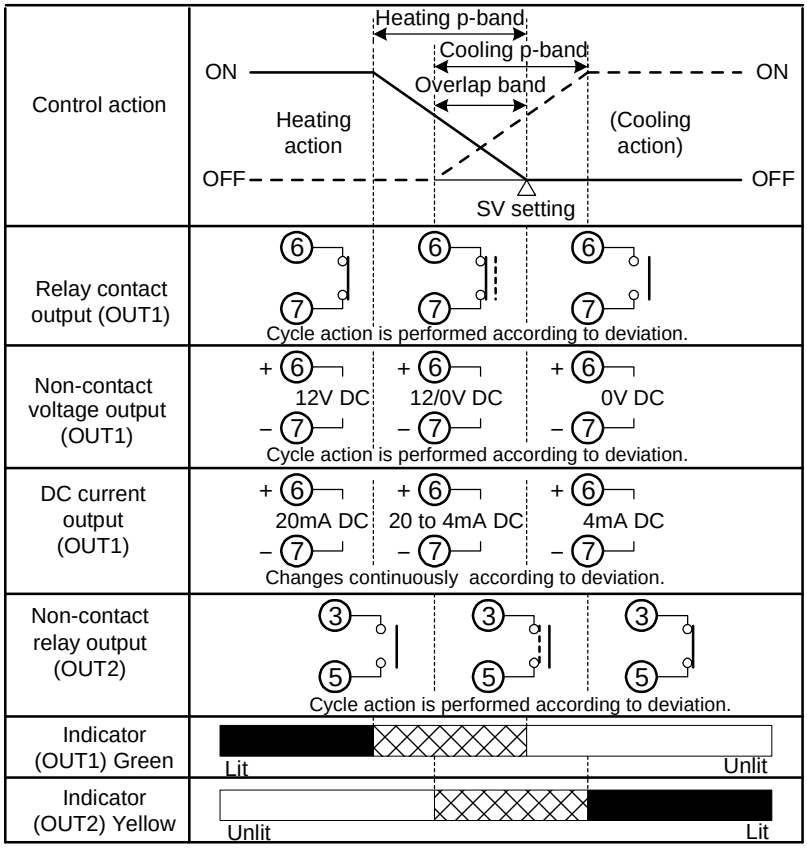
: Acts ON (lit) or OFF (unlit).
——— : Represents Heating control action.
------ : Represents Cooling control action.

8.6 Heating/Cooling control action (when setting dead band)



▨ : Acts ON (lit) or OFF (unlit).
——— : Represents Heating control action.
– – – : Represents Cooling control action.

8.7 Heating/Cooling control action (when setting overlap band)



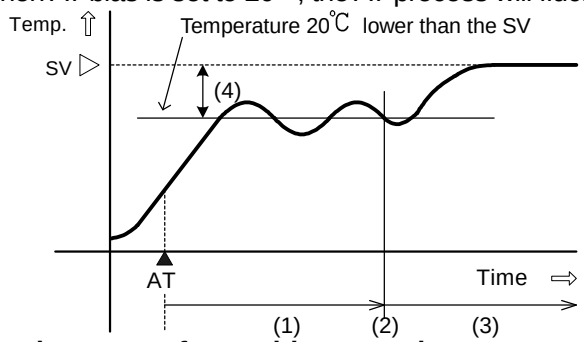
▨ : Acts ON (lit) or OFF (unlit).
——— : Represents Heating control action.
– – – : Represents Cooling control action.

9. PID auto-tuning of this controller

In order to set each value of P, I, D and ARW automatically, the auto-tuning process should be made to fluctuate to obtain an optimal value. One of 3 types of fluctuation below is automatically selected.
Sometimes the auto-tuning process will not fluctuate if auto-tuning is performed at or near room temperature. Therefore auto-tuning might not finish normally.

(1) In the case of a large difference between the SV and processing temperature (PV) as the temperature is rising

When AT bias is set to 20℃, the AT process will fluctuate at the temperature 20℃ lower than the SV.

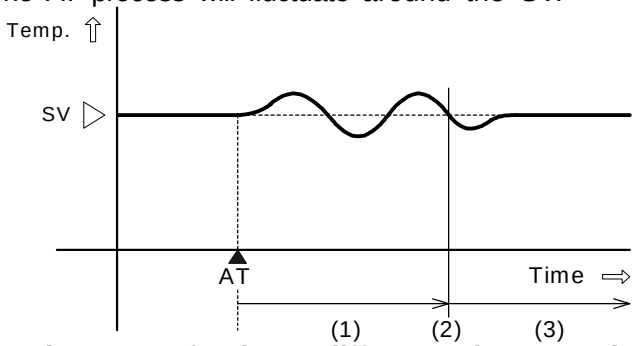


(1): Calculating PID constant
(2): PID contatnt calculated
(3): Controlled by the PID constant set by auto-tuning.
(4): AT bias value

▲AT: Auto-tuning starting point

(2) In the case of a stable control

The AT process will fluctuate around the SV.

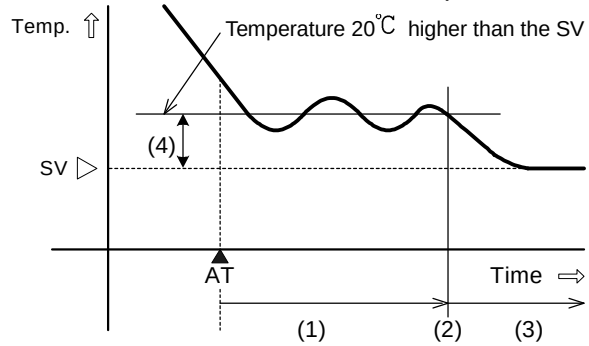


(1): Calculating PID constant
(2): PID constant calculated
(3): Controlled by the PID constant set by auto-tuning

▲AT: Auto-tuning starting point

(3) In the case of a large difference between the SV and processing temperature (PV) as the temperature is falling.

When AT bias is set to 20℃, the AT process will fluctuate at the temperature 20℃ higher than the SV.



(1): Calculating PID constant
(2): PID constant calculated
(3): Controlled by the PID constant set by auto-tuning
(4): AT bias value

▲ AT: Auto-tuning starting point

10. Specifications

10.1 Standard specifications

Mounting : Flush

Setting : Input system using membrane sheet key

Display
- PV display : Red LED 4 digits, character size 10.2 x 4.9 mm (H x W)
- SV display : Green LED 4 digits, character size 8.8 x 4.9 mm (H x W)

Accuracy (Setting and Indication):

Thermocouple : Within ±0.2% of each input span ±1digit, or within ±2℃(4℉), whichever is greater
However, for R, S input, 0 to 200℃ (400℉): Within ±6℃ (12℉)
B input, 0 to 300℃ (600℉): Accuracv is not guaranteed
K, J, E, T, N input, less than 0℃ (32℉): Within ±0.4% of input span ±1digit

RTD : Within ±0.1% of each input span ±1digit, or within ±1℃ (2℉), whichever is greater

DC current : Within ±0.2% of each input span ±1digit

DC voltage : Within ±0.2% of each input span ±1digit

Input sampling period : 0.25 seconds

Input

Thermocouple : K, J, R, S, B, E, T, N, PL-Ⅱ, C(W/Re5-26) External resistance, 100Ω or less (However, for B input: External resistance, 40Ω or less)

RTD : Pt100, JPt100, 3-wire system
Allowable input lead wire resistance (10Ω or less per wire)

DC current : 0 to 20mA DC, 4 to 20mA DC
Input impedance: External shunt resistor (AKT4810) 50Ω
Allowable input current (50mA or less)

DC voltage : 0 to 1V DC Input impedance (1MΩ or more)
Allowable input voltage (5V or less)
Allowable signal source resistance (2kΩ or less)

: 0 to 5V DC, 1 to 5V DC, 0 to 10V DC Input impedance (100kΩ or more)
Allowable input voltage (15V or less)
Allowable signal source resistance (100Ω or less)

Control output (OUT1)

Relay contact : 1a, Control capacity 3A 250V AC (resistive load)
1A 250V AC (inductive load cosø=0.4)
Electrical life, 100,000 cycles
Non-contact voltage (For SSR drive): 12^{+2}_{0}V DC maximum 40mA (short circuit protected)
DC current : 4 to 20mA DC, Load resistance, maximum 550Ω

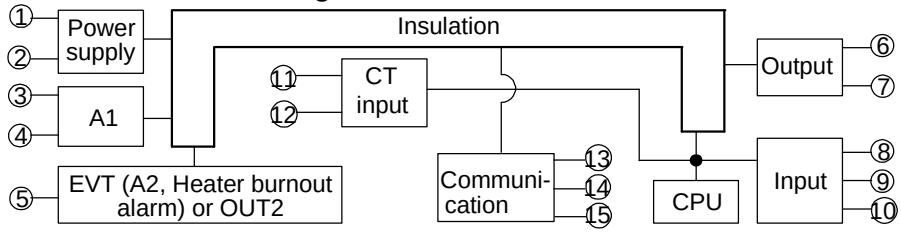
A1 output

Action : ON/OFF action
Hysteresis : 0.1 to 100.0℃ (℉), or 1 to 1000
Output : Relay contact, 1a
Control capacity, 3A 250V AC (resistive load)
Electrical life, 100,000 cycles

Control action

PID action (with auto-tuning function)
PI action: When derivative time is set to 0
PD action (with auto-reset function): When integral time is set to 0
P action (with auto-reset function): When both derivative and integral times are set to 0.
ON/OFF action: When proportional band is set to 0 or 0.0
OUT1 proportional band : 0 to 1000℃ (2000℉), 0.0 to 999.9℃ (℉) or 0.0 to 100.0%
(ON/OFF action when set to 0 or 0.0)
Integral time : 0 to 1000sec (OFF when set to 0)
Derivative time : 0 to 300sec (OFF when set to 0)
OUT1 proportional cycle : 1 to 120sec (Not available for DC current output type)
ARW : 0 to 100%
OUT1 output hysteresis : 0.1 to 100.0℃ (℉), or 1 to 1000
OUT1 output limit : 0 to 100% (DC current output type: –5 to 105%)

Circuit insulation configuration



If OUT1 is non-contact voltage output or DC current output, insulation test must not be carried out between OUT1 and Communication because OUT1 is not insulated from Communication.

Insulation resistance : 10MΩ or more, at 500V DC
Dielectric strength : 1.5kV AC for 1 minute between input terminal and power terminal
1.5kV AC for 1 minute between output terminal and power terminal
Supply voltage : 100 to 240V AC 50/60Hz, 24V AC/DC 50/60Hz
Allowable voltage fluctuation: 100 to 240V AC: 85 to 264V AC, 24V AC/DC: 20 to 28V AC/DC
Power consumption : Approx. 8VA
Ambient temperature : 0 to 50℃ (32 to 122℉)
Ambient humidity : 35 to 85%RH (no condensation)
Weight : Approx. 200g
External dimension : 48 x 48 x 96.5mm (W x H x D) (Including gasket)
Material : Flame-resistant resin (Case)
Color : Ash gray (Case)
Attached function : **[Set value lock], [Sensor correction], [Auto/manual control switching], [Input abnormality indication]**

Output status selection when input abnormal	Contents and Indication	Output status			
		OUT1		OUT2	
		Direct action	Reverse action	Direct action	Reverse action
on	Overscale Measured value has exceeded Indication range high limit value. "----" flashes.	ON (20mA) or OUT1 high limit value (*)	OFF (4mA) or OUT1 low limit value	OFF or OUT2 low limit value	ON or OUT2 high limit value (*)
oFF		OFF (4mA) or OUT1 low limit value			OFF or OUT2 low limit value
on	Underscale Measured value has dropped below Indication range low limit value. "----" flashes.	OFF (4mA) or OUT1 low limit value	ON (20mA) or OUT1 high limit value (*)	ON or OUT2 high limit value (*)	OFF or OUT2 low limit value
oFF			OFF (4mA) or OUT1 low limit value	OFF or OUT2 low limit value	

Only for DC input and DC current output type, [Output status selection when input abnormal] is available. For other inputs and outputs except for DC input and DC current output, the output status will be the same one as when OFF is selected during [Output status selection when input abnormal]. For manual control, the preset MV (manipulated variable) is outputted.

(*) Outputs a value between OFF(4mA) and ON(20mA) or between OUT1(OUT2) low limit value and OUT1(OUT2) high limit value, depending on a deviation.

Thermocouple and RTD input

Input	Input range	Indication range	Control range
K, T	–199.9 to 400.0℃	–199.9 to 450.0℃	–205.0 to 450.0℃
	–199.9 to 750.0℉	–199.9 to 850.0℉	–209.0 to 850.0℉
Pt100	–199.9 to 850.0℃	–199.9 to 900.0℃	–210.0 to 900.0℃
	–200 to 850℃	–210 to 900℃	–210 to 900℃
	–199.9 to 999.9℉	–199.9 to 999.9℉	–211.0 to 1099.9℉
	–300 to 1500℉	–318 to 1600℉	–318 to 1600℉
JPt100	–199.9 to 500.0℃	–199.9 to 550.0℃	–206.0 to 550.0℃
	–200 to 500℃	–207 to 550℃	–207 to 550℃
	–199.9 to 900.0℉	–199.9 to 999.9℉	–211.0 to 999.9℉
	–300 to 900℉	–312 to 1000℉	–312 to 1000℉

Indication range and Control range for the thermocouple inputs except the above:
[Input range low limit value – 50℃ (100℉)] to [input range high limit value + 50℃ (100℉)]

DC current and voltage input

Indication range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value +Scaling span x 10%]
(If the input value is out of the range –1999 to 9999, the PV display flashes " " or " ")

Control range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value +Scaling span x 10%]

DC input disconnection: When DC input is disconnected, PV display flashes " " for 4 to 20mA DC and 1 to 5V DC inputs, and " " for 0 to 1V DC input.
For 0 to 20mA DC, 0 to 5V DC and 0 to 10V DC inputs, the PV display indicates the value corresponding with 0mA or 0V input.

[Burnout]: When the thermocouple or RTD input is burnt out, OUT1 is turned OFF (for DC current output type, OUT1 low limit value) and PV display flashes " ".

[Self-diagnosis]: The CPU is monitored by a watchdog timer, and when an abnormal status is found on the CPU, the controller is switched to warm-up status.

[Automatic cold junction temperature compensation] (Only thermocouple input type)
This detects the temperature at the connecting terminal between the thermocouple and instrument, and always keeps it set to the same status as when the reference junction is located at 0℃ (32℉).

[Power failure countermeasure]:
The setting data is backed up in the non-volatile memory.

[Warm-up indication]
After the power supply to the instrument is turned on, the sensor input character and temperature unit are indicated on the PV display and input range high limit value is indicated on the SV display for 3 seconds.
For DC current and voltage inputs, the scaling high limit value is indicated.

Accessories included: Screw type mounting bracket 1 set, Instruction manual 1 copy
CT (Current transformer); For rating 5A, 10A, 20A (AKT4815) 1 piece
For rating 50A, (AKT4816) 1 piece

Accessories sold separately: Terminal cover (AKT4801) 1 piece, 50Ω shunt resistor (AKT4810) 1 piece

10.2 Optional specifications

Alarm 2 (A2)
If A2 and Heater burnout alarm are applied together, they utilize common output terminals.
Action : ON/OFF action
Hysteresis : 0.1 to 100.0℃ (℉), or 1 to 1000
Output : Relay contact, 1a Control capacity, 3A 250V AC (Resistive load)
Electrical life, 100,000 cycles

Heater burnout alarm (including sensor burnout alarm)
Watches the heater current with CT (current transformer), and detects the burnout.
This alarm is also activated when indication is overscale and underscale.
(To detect Heater burnout, a CT for 50A can also be used for 5A, 10A and 20A ratings, however, this is not suitable for small ampere ratings due to a low degree of accuracy. For a 20A rating or less, use a CT designated for 20A.)
This option cannot be applied to DC current output type.
If A2 and Heater burnout alarm are applied together, they utilize common output terminals.
Rating : 5A, 10A, 20A, 50A (Must be specified)
Setting range : 5A, 0.0 to 5.0A (Off when set to 0.0) 10A, 0.0 to 10.0A (Off when set to 0.0)
20A, 0.0 to 20.0A (Off when set to 0.0) 50A, 0.0 to 50.0A (Off when set to 0.0)
Setting accuracy: Within ±5% of the rated value
Action : ON/OFF action
Output : Relay contact, 1a Control capacity, 3A 250V AC (Resistive load)
Electrical life, 100,000 cycles

Heating/Cooling control (OUT2)

- OUT2 side
  Proportional band: 0.0 to 10.0 times OUT1 proportional band (ON/OFF action when set to 0.0)
  Proportional cycle: 1 to 120 seconds
- Overlap band/Dead band setting range
  Thermocouple, RTD inputs: –100.0 to 100.0℃ (℉)
  DC current, DC voltage inputs: –1000 to 1000 (The placement of the decimal point follows the selection)
- OUT2 output ON/OFF action hysteresis setting
  Thermocouple, RTD inputs: 0.1 to 100.0℃ (℉)
  DC current, DC voltage inputs: 1 to 1000 (The placement of the decimal point follows the selection)
- Integral and derivative times are the same as those of OUT1.
- OUT2 action mode selection function
  Air cooling (linear characteristic), Oil cooling (1.5th power of the linear characteristic),
  Water cooling (2nd power of the linear characteristic)
- Output: Non-contact relay, Control capacity; 0.3A 250V AC

Serial communication

The following operations can be carried out from the external computer.
(1) Reading and setting of SV, PID and various set values
(2) Reading of the PV and action status
(3) Change of the functions

Cable length	: Max. communication distance 1000m, Cable resistance; Within 50Ω
Communication interface	: EIA RS-485
Communication method	: Half-duplex communication start stop synchronous
Communication speed	: 2400, 4800, 9600, 19200bps (Selectable by keypad operation)
Parity	: Even, Odd and No parity (Selectable by keypad operation)
Stop bit	: 1, 2 (Selectable by keypad operation)
Communication protocol	: Modbus RTU, Modbus ASCII (Selectable by keypad operation)
Connectable number of units	: Maximum 31 units to 1 host computer
Communication error detection	: Parity, checksum (LRC, CRC)

11. Troubleshooting

If any malfunctions occur, refer to the following items after checking the power supply to the controller.

11.1 Indication

Problem	Presumed cause and solution
PV display is indicating [oFF].	• Control output OFF function is working. Press the OUT/OFF key for approx. 1 second to release the function.
[- - - -] is flashing on the PV display.	• Thermocouple, RTD or DC voltage (0 to 1V DC) is burnt out. Change each sensor. **How to check whether the sensor is burnt out** [Thermocouple] If the input terminal of the instrument is shorted, and if a value around room temperature is indicated, the instrument is likely to be operating normally, however, sensor may be burnt out. [RTD] If approx. 100Ω of resistance is connected to the input terminals between A-B of the instrument and between B-B is shorted, and if approximate 0℃ (32℉) is indicated, the instrument is likely to be operating normally, however, the sensor may be burnt out. [DC voltage (0 to 1V DC)] If the input terminal of the instrument is shorted, and if a scaling low limit value is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. • Check whether the input terminals of thermocouple, RTD or DC voltage (0 to 1V DC) are securely mounted to the instrument input terminals. Connect the sensor terminal to the instrument input terminal securely.
[- - - -] is flashing on the PV display.	• Check whether the input signal source of DC voltage (1 to 5V DC) or DC current (4 to 20mA DC) is disconnected. **How to check whether the input signal wire is disconnected** [DC voltage (1 to 5V DC)] If the input to the input terminal of the instrument is 1V DC and if a scaling low limit value is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. [DC current (4 to 20mA DC)] If the input to the input terminal of the instrument is 4mA DC and if a scaling low limit value is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. • Check if the input signal wire of DC voltage (1 to 5V DC), DC current (4 to 20mA DC) is securely connected to the instrument input terminals. Connect the signal lead wire to the instrument input terminal securely.

[- - - -] is flashing on the PV display.	• Check whether the polarity of thermocouple or compensating lead wire is correct. • Check whether codes (A, B, B) of RTD agree with the instrument input terminals. Ensure that they are wired properly.
The PV display keeps indicating the value which was set during scaling low limit value.	• Check whether the input signal source for DC voltage (0 to 5V DC, 0 to 10V DC) and DC current (0 to 20mA DC) is disconnected. **How to check whether the input signal wire is disconnected** [DC voltage (0 to 5V DC, 0 to 10V DC)] If the input to the input terminal of the instrument is 1V DC and if a value corresponding to 1V DC is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. [DC current (0 to 20mA DC)] If the input to the input terminal of the instrument is 1mA DC and if a value corresponding to 1mA DC is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. • Check whether the input terminal of DC voltage (0 to 5V DC, 0 to 10V DC) and DC current (0 to 20mA DC) is securely mounted to the instrument input terminals. Ensure that DC input terminals are mounted to the instrument input terminals securely.
The indication of PV display is abnormal or unstable.	• Check whether sensor input or temperature unit (℃ or ℉) is correct. Select the sensor input and temperature unit (℃ or ℉) properly. • Sensor correcting value is unsuitable. Set it to a suitable value. • Check whether the specification of the sensor is correct. Set the sensor to the proper specification. • AC leaks into the sensor circuit. Use an ungrounded type sensor. • There may be equipment that interferes with or makes noise near the controller. Keep equipment that interferes with or makes noise away from the controller.
The PV display is indicating [Err 1].	• Internal memory is defective. Contact our agency or us.

11.2 Key operation

Problem	Presumed cause and solution
• Unable to set the SV, P, I, D, proportional cycle or alarm setting • The values do not change by ▲, ▼ keys.	• Set value lock (Lock 1 or Lock 2) has been selected. Release the lock selection. • During PID auto-tuning or auto-reset. In the case of PID auto-tuning, cancel auto-tuning. It takes approximately 4 minutes until auto-reset is finished.
The setting indication does not change in the input range even if the ▲, ▼ keys are pressed, and new values are unable to be set.	• SV high or low limit value in the Auxiliary function setting mode 1 may be set at the point where the value does not change. Set it to a suitable value while in the Auxiliary function setting mode 1.

11.3 Control

Problem	Presumed cause and solution
Temperature does not rise.	• Sensor is out of order. Change the sensor. • Check whether the sensor is securely mounted to the instrument input terminal. Check whether control output terminals are securely mounted to the actuator input terminals. Mount the sensor or control output terminal securely. • Ensure that the wiring of sensor or control output terminal is correct.
The control output remains in an ON status.	• OUT1 or OUT2 low limit value is set to 100% or higher during Auxiliary function setting mode 2. Set it to a suitable value.
The control output remains in an OFF status.	• OUT1 or OUT2 high limit value is set to 0% or less during Auxiliary function setting mode 2. Set it to a suitable value.

For all other malfunctions, please contact our main office or dealers.

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