NAiS

Instruction manual Temperature Controller KT7

To prevent accidents arising from the misuse of this controller, please ensure the operator using it 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 according to the specifications described in this manual. If it is not used according to the specifications, it may malfunction or cause fire.
- Be sure to follow the warnings, cautions and notice. If not, it 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. (If paint thinner is used, it might deform or tarnish 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.
- Tatsuno Matsushita Electric Works, Ltd. is not liable for any damages or secondary damages incurred as a result of using this product, including any indirect damages.

1. Model number

1.1 Explanation of model number

A K T 7 1 1 0

(1) (2) (3) (4) (5)

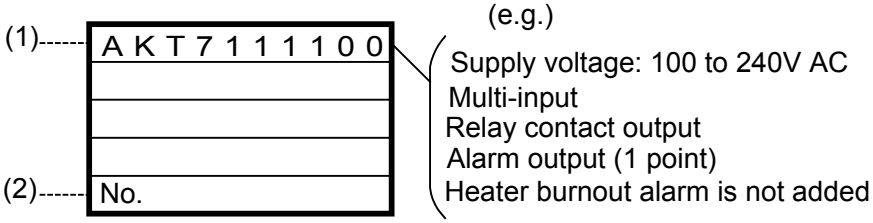
(1) Supply voltage ---------- 1: 100 to 240V AC, 2: 24V AC/DC
(2) Input type ---------- 1: Multi-input (Thermocouple, RTD, DC current and DC voltage can be selected by key operation)
(3) Control output (OUT) ---------- 1: Relay contact, 2: Non-contact voltage, 3: DC current
(4) Alarm output ---------- 1: Alarm output (1 point) (The alarm action and Energized /Deenergized can be selected by key operation)
(5) 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)

1.2 How to indicate the rated label

The rated label is put on the case.

When Heater burnout alarm is added, CT rated current is written in the bracket.

(e.g.)



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

(2) Lot number is entered.

2. Name and functions of the sections

(1) EVT indicator
A red LED lights up when Event output [Alarm, Loop break alarm or Heater burnout alarm (Option)] is ON.

(2) OUT indicator
When OUT output is ON, a green LED lights up.
For DC current output type, this blinks corresponding to the output manipulated variable.

(3) AT indicator
A yellow LED blinks while PID auto-tuning is being performed.

(4) PV display
Indicates the input value (PV) with a Red LED.

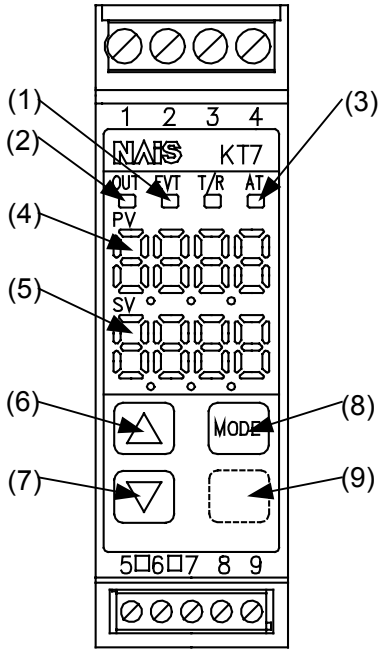
(5) SV display
Indicates the setting value (SV) with a Green LED.

(6) Increase key
Increases the numeric value.

(7) Decrease key
Decreases the numeric value.

(8) Mode key
Selects the setting mode or registers the setting value.
(By pressing the Mode key, the setting value can be registered)

(9) Sub mode key
Brings up Auxiliary function setting mode 2 with the Mode key.



(Fig. 2-1)

⚠ Notice

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

3. Mounting to control panel

3.1 Site selection

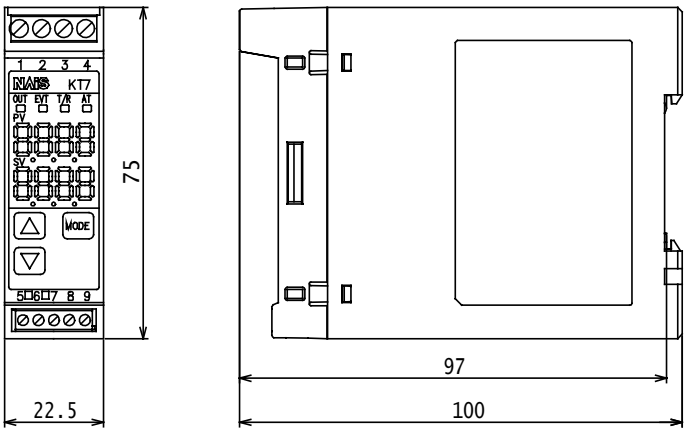
This instrument is intended to be used under the following environmental conditions (IEC61010-1): Overvoltage category Ⅱ, Pollution degree 2

Mount the controller in a place with:

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gasses
- 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

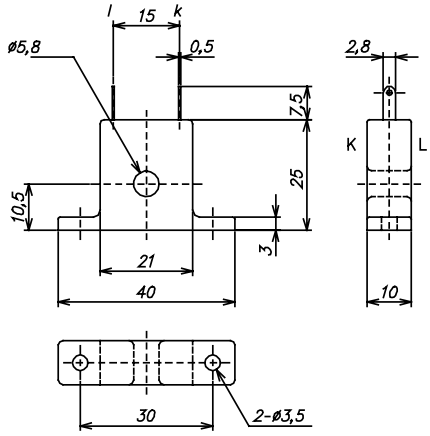
contact with the controller

3.2 External dimension

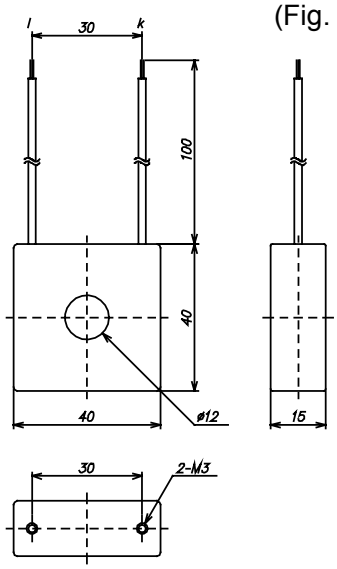


(Fig. 3.2-1)

3.3 CT (Current transformer) external dimension



AKT4815 (for 20A)



AKT4816 (for 50A)

(Fig. 3.3-1)

3.4 Mounting to DIN rail

⚠ Caution

Mount the DIN rail horizontally.

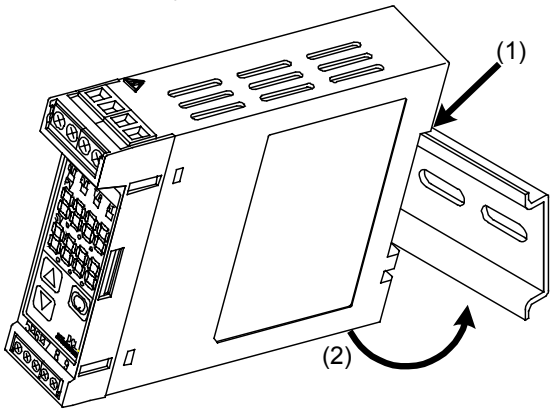
When DIN rail is mounted vertically, be sure to use commercially available fastening plates at the end of KT7 series. Mount the KT7 series to the DIN rail so that the KT7 series cannot move.

However, if the DIN rail is mounted horizontally in a position susceptible to vibration or shock, the fastening plates must be used as well.

Recommended fastening plate

Matsushita electric works, LTD.	Fastening plate ATA4806

(1) Hook (1) of KT7 series on the upper side of the DIN rail. (Fig. 3.4-1)
(2) Making the (1) part of the KT7 series as a support, fit the lower part of the KT7 series to the DIN rail. KT7 series will be completely fixed to DIN rail with a “Click” sound. (Fig. 3.4-1)



(Fig. 3.4-1)

4. Wiring connection

⚠ Warning

Turn the power supplied to the instrument OFF before wiring or checking it.
Working or touching the terminal with the power switched ON may result in Electric Shock causing severe injury or death.

⚠ Caution

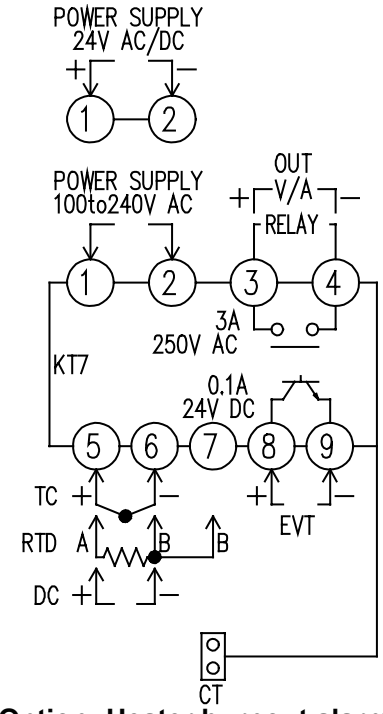
- Do not leave wire chips in the KT7 series when wiring, because they could cause fire, malfunction and trouble.
- Insert the connecting cable into the designated connector securely. Otherwise malfunction due to imperfect contact may occur.
- Connect the AC power wire to the designated terminal as is written in this instruction manual, otherwise it may burn and damage the KT7 series.
- Tighten the terminal screw with the specified torque. If not, it may damage the terminal screw and deform the case.
- Use thermocouple and compensating lead wire that fit sensor input specification of this unit.
- Use the 3-wire RTD that corresponds to the sensor input specification of this unit.
- When using DC voltage and current input types, do not confuse the polarity when wiring.
- When using a 24V AC/DC for the power source, do not confuse the polarity when it is DC.
- Keep input wires (Thermocouple, RTD, etc) away from power source and load wires to avoid external interference.
- To prevent the unit from harmful effects of the unexpected level noise, it is recommended that a surge absorber be installed between the electromagnetic switch coils.
- This unit does not have built-in power switch, circuit breaker or fuse. Therfore, it is necessary to install them in the circuit near the external unit.
  (Recommended fuse: Time-lag fuse, rated voltage 250V AC□rated current 2A)

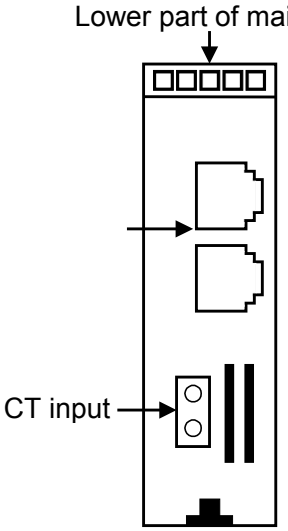
Note

Tighten the terminal screw properly referring to the table below.

Terminal screw	Terminal No.	Torque
M2.6	1 to 4	Max. 0.5N•m
M2.0	5 to 9	Max. 0.25N•m

Terminal arrangement



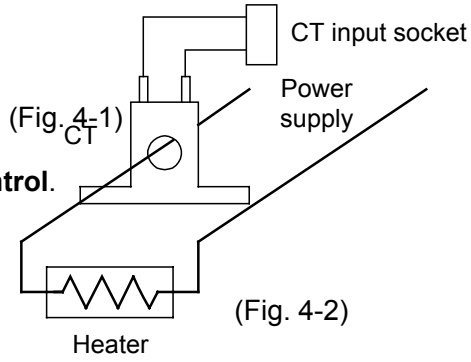


- OUT : Control output
- RELAY: Relay contact output
- V/A : DC voltage output/ DC current output
- EVT : Event output (Activates when Alarm, Loop break alarm or Heater burnout alarm [option] is ON)
- TC : Thermocouple
- RTD : Resistance temperature detector
- DC : DC current or DC voltage

Option: Heater burnout alarm

This alarm is not available for detecting current under phase control.

Use the current transformer (CT) provided, and pass a lead wire of the heater circuit into a hole of the CT. When wiring, keep the CT wire away from AC sources or load wires to avoid the external interference.



(Fig. 4-1)

(Fig. 4-2)

5. Setup

Wire the power terminals only. After the power is turned on, the sensor input characters and temperature unit are indicated on the PV display and the input range high limit value is indicated on the SV display for approx. 3 seconds (Table 5-1).
(If any other value is set in the scaling high limit value, it is indicated on the SV display.)
During this time all outputs and the LED indicators are in OFF status.
Control will then start and the input value will be indicated on the PV display and setting value will be indicated on the SV display.

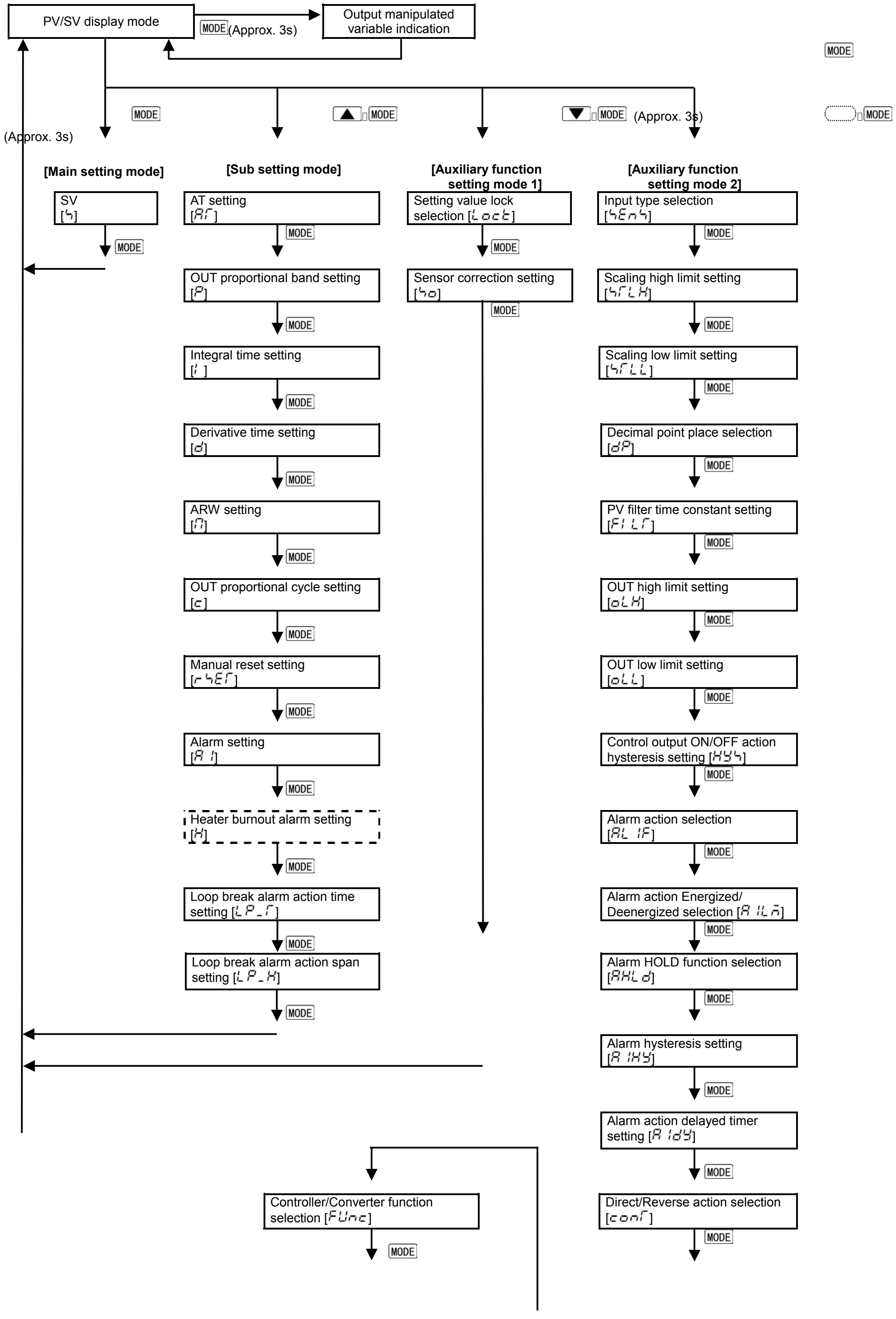
(Table 5-1)

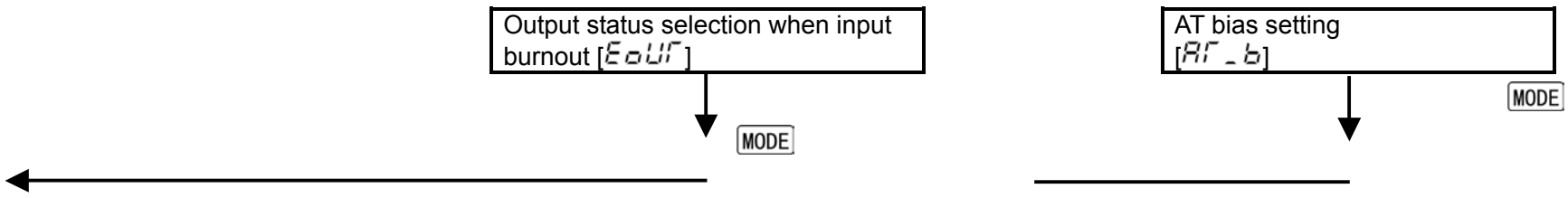
Input type	Input range		Resolution
K	–200 to 1370 ℃	–320 to 2500 ℉	1℃ (℉)
	–199.9 to 400.0℃	–199.9 to 750.0℉	0.1℃ (℉)
J	–200 to1000 ℃	–320 to1800 ℉	1℃ (℉)
R	0 to 1760 ℃	0 to 3200 ℉	1℃ (℉)
S	0 to 1760 ℃	0 to 3200 ℉	1℃ (℉)
B	0 to 1820 ℃	0 to 3300 ℉	1℃ (℉)
E	–200 to 800 ℃	–320 to 1500 ℉	1℃ (℉)
T	–199.9 to 400.0℃	–199.9 to 750.0℉	0.1℃ (℉)
N	–200 to 1300 ℃	–320 to 2300 ℉	1℃ (℉)
PL-Ⅱ	0 to 1390 ℃	0 to 2500 ℉	1℃ (℉)
C(W/Re5-26)	0 to 2315 ℃	0 to 4200 ℉	1℃ (℉)
Pt100	–199.9 to 850.0 ℃	–199.9 to 999.9℉	0.1℃ (℉)

*1: Input range and decimal point place can be changed.

	–200 to 850 ℃	–300 to 1500 ℉	1℃ (℉)
JPt100	–199.9 to 500.0 ℃	–199.9 to 900.0℉	0.1℃ (℉)
	–200 to 500 ℃	–300 to 900 ℉	1℃ (℉)
4 to 20mA DC	–1999 to 9999 *1,*2		1
0 to 20mA DC	–1999 to 9999 *1,*2		1
0 to 1V DC	–1999 to 9999 *1		1
0 to 5V DC	–1999 to 9999 *1		1
1 to 5V DC	–1999 to 9999 *1		1
0 to 10V DC	–1999 to 9999 *1		1

5.1 Setup flow chart





: Press the MODE while the ▲ key is being pressed.

(Approx. 3s): Press the MODE for 3 seconds while the ▼ key is being pressed.

(Approx. 3s): Press the MODE for 3 seconds while the ◌ key is being pressed.

When setting a value or selecting an item in the setting modes, use the ▲ or ▼ key.

There are some setting characters which are not indicated depending on the specification.

5.2 Main setting mode

Character	Name, Description, Setting range	Default value
SV	**SV** • Sets the value for controlled object. • Setting range: Scaling low limit value to scaling high limit value (For DC voltage and current inputs, the placement of the decimal point follows the selection)	0℃

5.3 Sub setting mode

Character	Name, Description, Setting range	Default value
AT	**AT setting** • Performs PID auto-tuning. However when PID auto-tuning has not finished after 4 hours, PID auto-tuning is cancelled automatically. • PID auto-tuning cancellation: ---- PID auto-tuning performance: AT	----
P	**OUT proportional band setting** • Sets the proportional band. • The control action becomes ON/OFF action when set to 0.0 • Setting range: 0.0 to 110.0%	2.5%
I	**Integral time setting** • Sets the integral time. • Setting the value to 0 disables the function. • This setting item is not indicated for ON/OFF action. • Setting range: 0 to 1000 seconds	200 seconds
d	**Derivative time setting** • Sets the derivative time. • Setting the value to 0 disables the function. • This setting item is not indicated for ON/OFF action. • Setting range: 0 to 300 seconds	50 seconds
n	**Anti-reset windup setting** • Sets anti-reset windup. • Available only for PID action. • Setting the value to 0 disables the function. • Setting range: 0 to 100%	50%
c	**OUT proportional cycle setting** • Sets the proportional cycle value for the control output (OUT). • Not available for ON/OFF action or DC current output • Setting range: 1 to 120 seconds	30 seconds or 3 seconds
rSET	**Manual reset setting** • Sets the reset value manually. • Available only for P and PD action. • ±Proportional band converted value (For DC voltage and current inputs, the placement of the decimal point follows the selection)	0.0
A1	**Alarm setting** • Sets the action point for the alarm output. • Setting the value to 0 or 0.0 disables the function. (excluding Process high and Process low alarms) When Loop break alarm and Heater burnout alarm are applied together, the output is common. • Not available if No alarm action is selected in the Alarm action selection. • See (Table 5.3-1). (For DC voltage and current inputs, the placement of the decimal point follows the selection)	0℃

H	**Heater burnout alarm setting** • Sets the heater current value for Heater burnout alarm. • Setting the value to 0.0 disables the function. • Self-holding is not available for the alarm output. When alarm and Loop break alarm are applied together, the output is common. • Available only when Heater burnout alarm is added. • Rating 5A : 0.0 to 5.0A Rating 10A: 0.0 to 10.0A Rating 20A: 0.0 to20.0A Rating 50A: 0.0 to 50.0A	0.0A
LP_T	**Loop break alarm action time setting** • Sets the action time to assess the Loop break alarm. • Setting the value to 0 disables the function. • When alarm and Heater burnout alarm are applied together, the output is common. • Setting range: 0 to 200 minutes	0 minutes
LP_H	**Loop break alarm action span setting** • Sets the action span to assess the Loop break alarm. • Setting the value to 0 disables the function. • When alarm and Heater burnout alarm are applied together, the output is common. • Setting range Thermocouple and RTD inputs: 0 to 150℃ (℉) or 0.0 to 150.0℃ (℉) DC voltage and current inputs: 0 to 1500 (The placement of the decimal point follows the selection)	0℃

(Table 5.3-1)

Alarm action type	Setting range
High limit alarm	–(Scaling span) to scaling span
Low limit alarm	–(Scaling span) to scaling span
High/Low limits alarm	0 to scaling span
High/Low limit range alarm	0 to scaling span
Process high alarm	Scaling low limit value to scaling high limit value
Process low alarm	Scaling low limit value to scaling high limit value
High limit alarm with standby	–(Scaling span) to scaling span
Low limit alarm with standby	–(Scaling span) to scaling span
High/Low limits with standby	0 to scaling span

Negative low limit value is –199.9 or –1999.

Positive high limit value is 999.9 or 9999.

5.4 Auxiliary function setting mode 1

Character	Name, Description, Setting range	Default value
Lock	**Setting value lock selection** • Locks the setting value to prevent setting errors. The setting item to be locked depends on the designation. • When Lock 1 or Lock 2 is designated, PID auto-tuning cannot be carried out. • ---- (Unlock): All setting values can be changed. Loc1 (Lock 1): None of setting values can be changed. Loc2 (Lock 2): Only main setting mode can be changed. Loc3 (Lock 3): All setting values can be changed except Controller/Converter function selection. However they return to their former value after power is turned off because they are not saved in the non-volatile memory.	Unlock

	Sensor correction setting • Sets the sensor correction value for the sensor. • Thermocouple and RTD inputs: –100.0 to 100.0℃ (℉) DC voltage and current inputs: –1000 to 1000 (The placement of the decimal point follows the selection)	0.0℃

5.5 Auxiliary function setting mode 2

Character	Name, Description, Setting range	Default value
	Input type selection • The input type can be selected from thermocouple (22 types), RTD (8 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℃ –199.9 to 400.0℃ J –200 to 1000 ℃ R 0 to 1760 ℃ S 0 to 1760 ℃ B 0 to 1820 ℃ E –200 to 800 ℃ T –199.9 to 400.0℃ N –200 to 1300 ℃ PL-Ⅱ 0 to 1390 ℃ C (W/Re5-26)0 to 2315 ℃ Pt100 –199.9 to 850.0℃ JPt100 –199.9 to 500.0℃ Pt100 –200 to 850 ℃ JPt100 –200 to 500 ℃ 4 to 20mA –1999 to 9999: 0 to 20mA –1999 to 9999: 0 to 1V –1999 to 9999: 0 to 5V –1999 to 9999: 1 to 5V –1999 to 9999: 0 to 10V –1999 to 9999: K –320 to 2500 ℉ –199.9 to 750.0℉ J –320 to 1800 ℉ R 0 to 3200 ℉ S 0 to 3200 ℉ B 0 to 3300 ℉ E –320 to 1500 ℉ T –199.9 to 750.0℉ N –320 to 2300 ℉ PL-Ⅱ 0 to 2500 ℉ C (W/Re5-26) 0 to 4200 ℉ Pt100 –199.9 to 999.9℉ JPt100 –199.9 to 900.0℉ Pt100 –300 to 1500℉ JPt100 –300 to 900 ℉	
	Scaling high limit setting • Sets the scaling high limit value. • Setting range: Scaling low limit value to input range high limit value (For DC voltage and current inputs, the placement of the decimal point follows the selection.)	1370℃
	Scaling low limit setting • Sets the scaling low limit value. • Input range low limit value to scaling high limit value (For DC voltage and current inputs, the placement of the decimal point follows the selection.)	–200℃
	Decimal point place selection • Selects decimal point place. • Available only for DC input. • No decimal point, 1 digit after decimal point 2 digits after decimal point, 3 digits after decimal point	No decimal point
	PV filter time constant setting • Sets PV filter time constant. (If the setting value is too large, it affects control result due to the delay of response) • Setting range: 0.0 to 10.0 seconds	0.0 seconds
	OUT high limit setting • Sets the control output high limit value. • Not available for ON/OFF action. • Setting range: OUT low limit value to 105% (Setting greater than 100% is effective to DC current output type)	100%

oLL	**OUT low limit setting** • Sets the control output low limit value. • Not available for ON/OFF action. • Setting range: –5% to OUT high limit value (Setting less than 0% is effective to DC current output type)	0%
HYS	**OUT ON/OFF action hysteresis setting** • Sets the ON/OFF action hysteresis for the control output. • Available only when the control action is ON/OFF action (P=0) • Setting range Thermocouple and RTD inputs: 0.1 to 100.0℃(℉) DC voltage and current inputs : 1 to 1000 (The placement of the decimal point follows the selection)	1.0℃
AL 1F	**Alarm action selection** • Selects an alarm action type. No alarm action : ---- High limit alarm action : H Low limit alarm action : L High/Low limits alarm action : HL High/Low limit range alarm action : oI d Process high alarm action : AS Process low alarm action : rAS High limit alarm action with standby : H u Low limit alarm action with standby : L u High/Low limits alarm action with standby: HL u	No alarm action
A 1Ln	**Alarm action Energized/Deenergized selection** • Selects the alarm action Energized/Deenergized. • Not available if No alarm action is selected in the Alarm action selection. • Energized: non Deenergized: rEV	Energized
AHLd	**Alarm HOLD function selection** • Selects whether alarm HOLD function is [Used] or [Not used]. If alarm HOLD function is set to [Used], once the alarm functions, alarm output remains until the power is turned off. • Not available if No alarm action is selected in the Alarm action selection • Alarm HOLD [Not used]: nonE Alarm HOLD [Used] : HoLd	Alarm HOLD [Not used]
A 1HY	**Alarm hysteresis setting** • Sets the alarm hysteresis. • Not available if No alarm action is selected in the Alarm action selection • Setting range Thermocouple and RTD inputs: 0.1 to 100.0℃(℉) DC voltage and current inputs: 1 to 1000 (The placement of the decimal point follows the selection)	1.0℃
A 1dY	**Alarm action delayed timer setting** • Sets the alarm action delayed time. When the setting time has passed after the input enters alarm output range, alarm output activates. • Not available if No alarm action is selected in the Alarm action selection. • Setting range: 0 to 9999 seconds	0 seconds
conF	**Direct/Reverse selection** • Selects Reverse (heating) or Direct (cooling) control action. • Reverse (Heating) action : HEAT Direct (Cooling) action : cooL	Reverse (Heating) action

AT_b	**AT bias setting** • Set bias value during PID auto-tuning. • Not available if DC voltage or current input is selected in the Input type selection and when action is not PID, either. • Setting range: 0 to 50℃ (0 to 100℉) or 0.0 to 50.0℃ (0.0 to 100.0℉)	20℃
Func	**Controller/ Converter function selection** • Selects controller or converter function. • This setting item is indicated only when the control output is DC current output type. • Controller function : cntr Converter function : cnvt	Controller function
EoUt	**Output status selection when input burnout** • Selects whether the OUT output is turned OFF or not when DC input is overscale or underscale. • Available only for DC current output type with DC input. • oFF (Output OFF) on (Output ON)	Output OFF

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 with the same setting value. In such a case, the control can be set at the desired temperature by adjusting the input value of sensors.

Loop break alarm

The alarm will be activated when the process variable (PV) does not **rise** to the span within the time it takes to assess the Loop break alarm after the manipulated variable has reached 100% or the output high limit value.

The alarm will also be activated when the process variable (PV) does not **fall** to the span within the time it takes to assess the Loop break alarm after the manipulated variable has reached 0% or the output low limit value.

When the control action is Direct (Cooling), read "**fall**" for "**rise**" and vice versa.

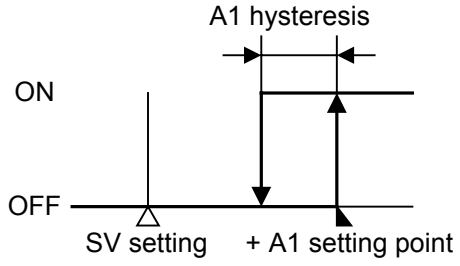
Energized/Deenergized function

When [alarm action energized] is selected, the alarm output (between terminals 8-9) 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.

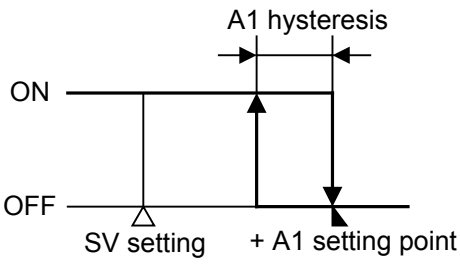
When [alarm action deenergized] is selected, the alarm output (between terminals 8-9) is not conducted (OFF) while the alarm output indicator is lit.

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



High limit alarm (When Energized is set)

(Fig. 5.5-1)



High limit alarm (When Deenergized is set)

(Fig. 5.5-2)

5.6 Output manipulated variable indication

Name and Description
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 shows up, though the main setting mode appears temporarily during the process. (The SV display indicates output manipulated variable and the 1st decimal point from the right blinks in a 0.5 second cycle) If the MODE key is pressed again, the mode reverts to the PV/SV display.

6. Converter function

> **⚠ Caution**
> • When using this controller as a converter, take 1 second into consideration since input/output response time is approx. 1 second.
> • When switching from converter function to controller function, the control parameter and values set by converter function are held even if the function is switched to controller function.
> So, correct the control parameter and values which are set by converter function to the value necessary for the controller function after switching to the controller function.

The converter function of this instrument converts each input (thermocouple, RTD, DC voltage and DC current inputs) value to “4 to 20mA DC” and outputs it using the control parameter of the controller.

When this instrument is used as a converter, follow the process (1) to (7) described below.
After the process (1) to (7) is finished, this instrument can be used as a converter.
(1) Wire and connect this controller (Power, Input and Output).
(2) Turn the power of this controller ON.
(3) Bring up “Auxiliary function setting mode 2” by pressing the ⬭ and MODE key (for approx. 3s).
(4) Select the sensor type from “Input type selection (SEnS)”.
(5) Set the high limit of the value that is going to be converted during “Scaling high limit setting (SrLH)”.
(6) Set the low limit of the value that is going to be converted during “Scaling low limit setting (SrLH)”.
(7) Select converter (cnvr) from “Control/ Converter function selection (Func)”.
• To activate the alarm action by Converter function, set the alarm action to Process alarm action.

If converter function is selected from “Controller/Converter function selection” in Auxiliary function setting mode 2, the parameter below is automatically set. (Table 6-1)
However, this is applied only to the DC current output type.
(Table 6-1)

Setting item	Setting value	Setting item	Setting value
SV	Scaling low limit	Alarm setting	0
Proportional band	100.0%	Loop break alarm action time	0 seconds
Integral time	0 seconds	Loop break alarm action span	0
Derivative time	0 seconds	Direct/Reverse action selection	Direct action
Manual reset setting	0.0		

7. Running

After mounting and wiring in the control panel (DIN rail) are finished, running is started in the following manner.

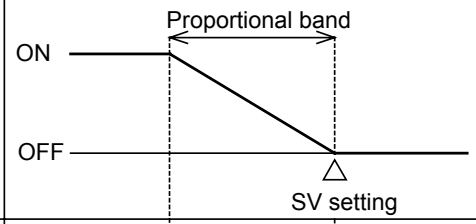
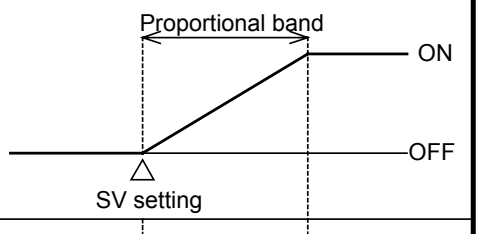
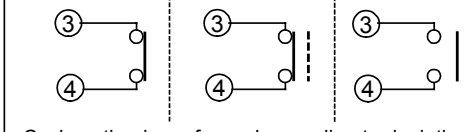
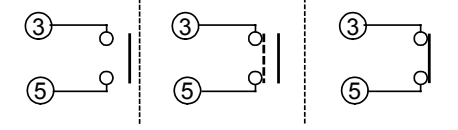
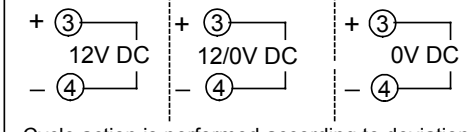
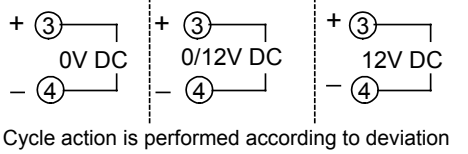
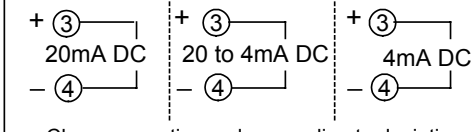
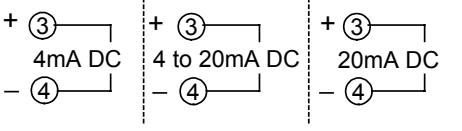
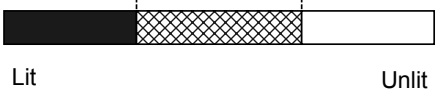
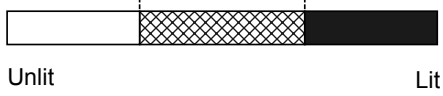
(1) Turn the power supply to the KT7 Series ON.
For approx. 3s after power is turned on, the character of the sensor type and temperature unit are indicated on the PV display, and the rated maximum value is indicated on the SV display.
See [Table 5-1].
(If any other value is set in the scaling high limit value setting, SV display indicates it)
During this time, all outputs and LED indicators are in OFF status.
After that, PV display indicates actual temperature and SV display indicates the main setting value.

(2) Input each setting value.
Input each setting value, referring to “5. Setup”.

(3) Turn the load circuit power ON.
Starts the control action so as to keep temperature of the controlled object at the main setting value.

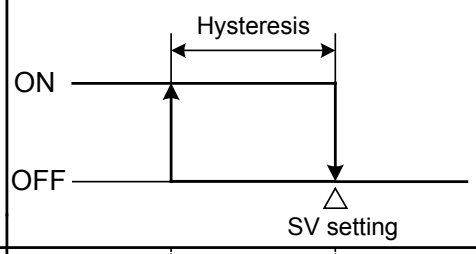
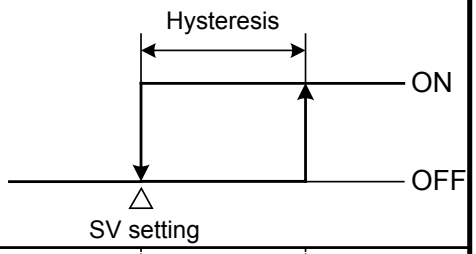
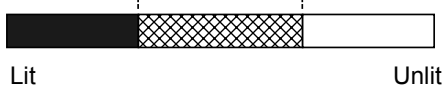
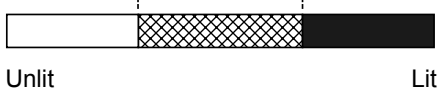
8. Action explanation

8.1 OUT action

	Heating (Reverse) action	Cooling (Direct) action
Control action		
Relay contact output	 Cycle action is performed according to deviation	 Cycle action is performed according to deviation
Non-contact voltage output	 Cycle action is performed according to deviation	 Cycle action is performed according to deviation
DC current output	 Changes continuously according to deviation	 Changes continuously according to deviation
Indication (OUT) Green		

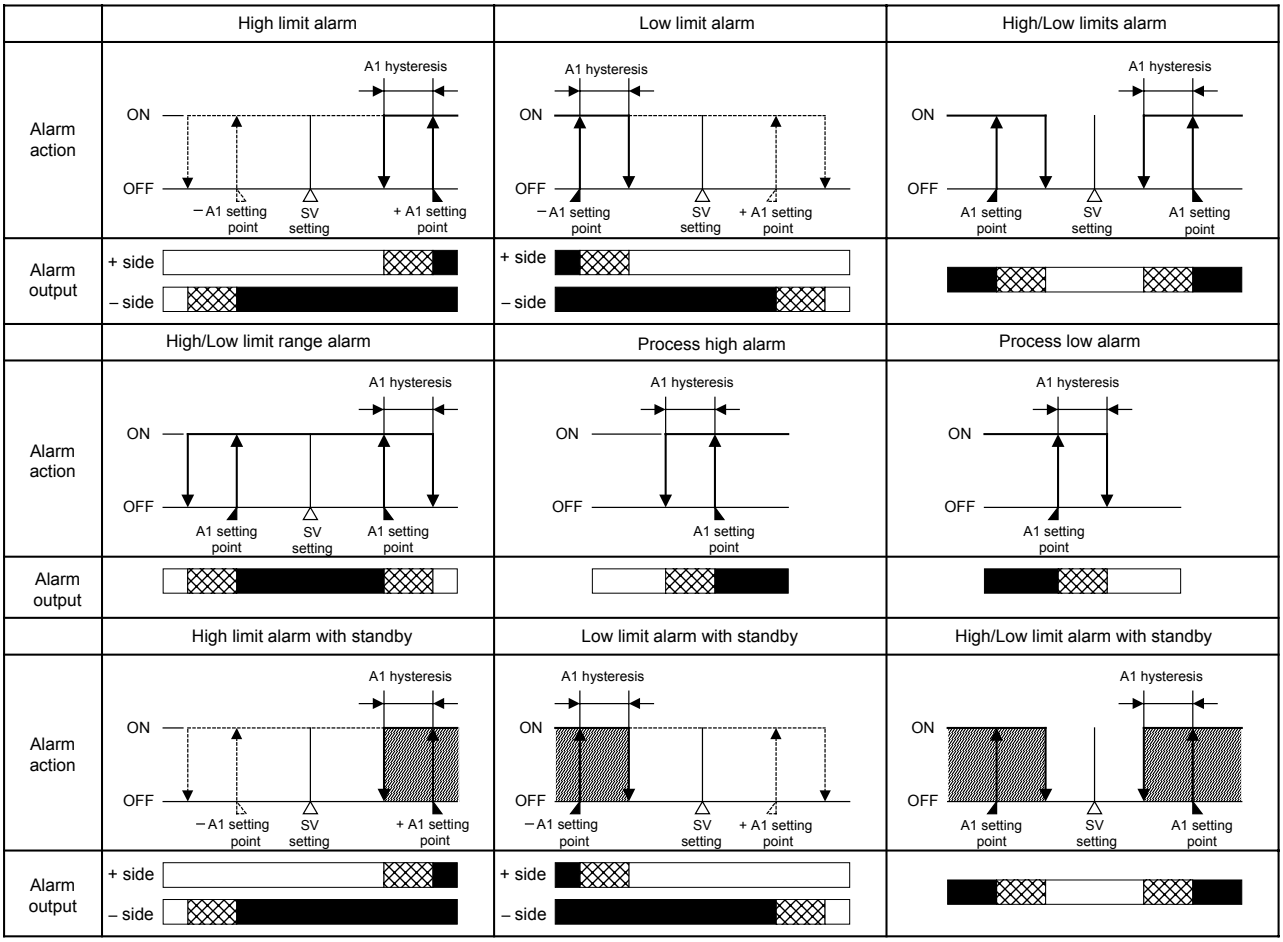
part : Acts ON or OFF.

8.2 OUT ON/OFF action

	Heating (reverse) action	Cooling (direct) action
Control action		
Relay contact output		
Non-contact voltage output		
DC current output		
Indication (OUT) Green		

part: Acts ON or OFF.

8.3 EVT (Alarm) action



: Event (EVT) output terminals between 8 and 9 is ON.

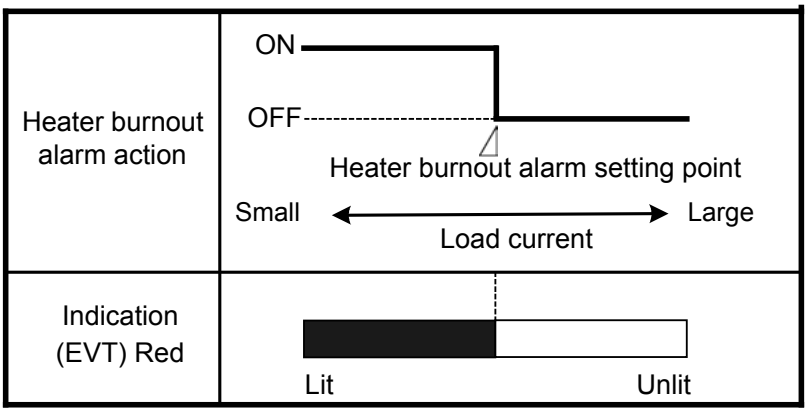
: Event (EVT) output terminals between 8 and 9 is ON or OFF.

: Event (EVT) output terminals between 8 and 9 is OFF.

: Standby functions in this section.

Event (EVT) output indicator lights up when output terminals between 8 and 9 is ON, and goes out when between them is OFF.

8.4 EVT (Heater burnout alarm) action



: Event (EVT) output terminals between 8 and 9 is ON

: Event (EVT) output terminals between 8 and 9 is OFF

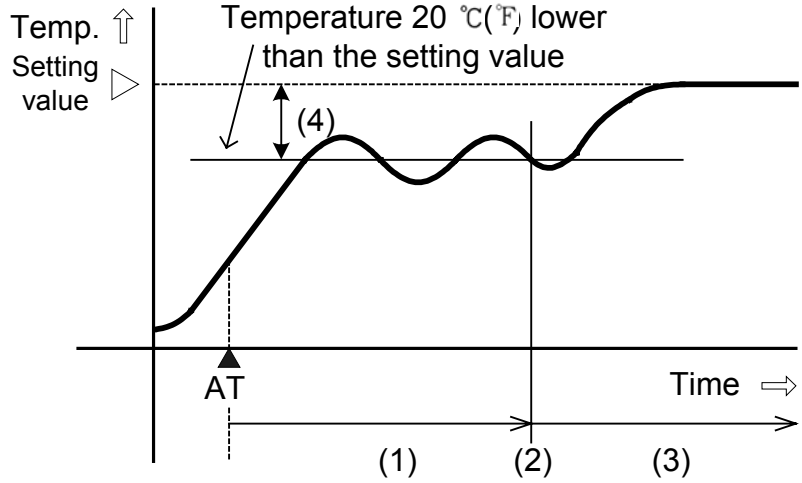
Event (EVT) output indicator lights up when output terminals between 8 and 9 is ON and goes out when between them is OFF.

9. PID auto-tuning of this controller

In order to set each P, I, D values and ARW automatically, this system gives a fluctuation to the controlled object to get an optimal value.
One of 3 types of fluctuation below is automatically selected.

(1) When the difference between the setting value and processing temperature is large as the temperature rises.

When AT bias is set to 20℃(℉), a fluctuation is applied at the temperature 20℃(℉) lower than the setting value.

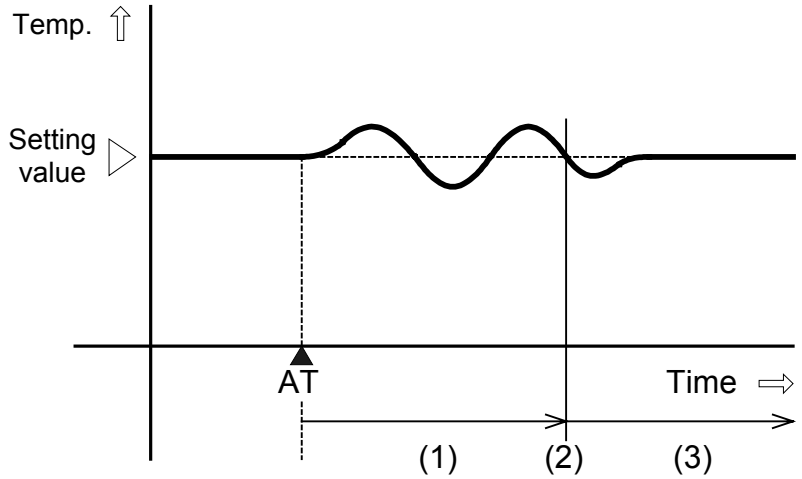


(1): Calculating PID constant
(2): PID contatnt calculated
(3): Controlled by the PID constant set by auto-tuning.
(4): AT bias value

▲AT : Auto-tuning starting point

(2) When the control is stable

Fluctuation is applied at the setting value.

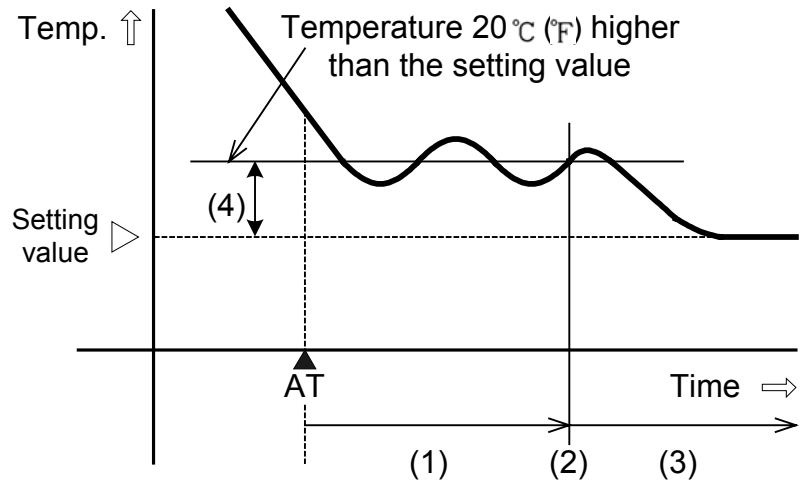


(1): Calculating PID constant
(2): PID constant calculated
(3): Controlled by PID constant set by auto-tuning

▲AT: Auto-tuning starting point

(3) When the difference between the setting value and processing temperature is large as the temperature falls

When AT bias is set to 20℃(℉), fluctuation is applied at the temperature 20℃(℉) higher than the setting value.



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

▲ AT: Auto-tuning starting point

10. Specifications

10.1 Standard specification

Model name : Temperature controller
Mounting method : DIN rail mounting method
Setting method : Input system using membrane sheet key
Display
PV display : Red LED 4 digits, character size 7.4 x 4mm (H x W)
SV display : Green LED 4 digits, character size 7.4 x 4mm (H x W)
Input
Thermocouple : K, J, R, S, B, E, T, N, PL-Ⅱ, C (W/Re5-26) External resistance: 100Ω or less
However, for thermocouple B, 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 50Ω
[Connect 50Ω shunt resistor (AKT4811, sold separately) between input terminals 5 and 6]
Allowable input current: 50mA or less
DC voltage :

	0 to 1V DC	0 to 5V DC, 1 to 5V DC, 0 to 10V DC
Input impedance	1MΩ or greater	100kΩ or greater
Allowable input voltage	5V or less	15V or less
Allowable signal source resistance	2kΩ or less	100Ω or less

Accuracy (Setting and Indication)
Thermocouple : Within ±0.2% of input span ±1 digit, or ±2℃ (4℉) whichever is greater
R, S input 0 to 200℃ (0 to 400℉): Within ±6℃ (12℉)
B input 0 to 300℃ (0 to 600℉): Accuracy is not guaranteed.
K, J, E, N input, less than 0℃ (32℉): Within ±0.4% of input span ±1 digit
RTD : Within ±0.1% of input span ±1 digit, or within ±1℃ (2℉) whichever is greater
DC voltage : Within ±0.2% of input span ±1 digit
DC current : Within ±0.2% of input span ±1 digit
Input sampling period : 0.25 seconds
Control
Control action
- PID action (with auto-tuning function)
- PI action: When derivative time is set to 0
- PD action (with manual reset function): When integral time is set to 0
- P action (with manual reset function): When derivative and integral time are set to 0
- ON/OFF action: When proportional band is set to 0

OUT proportional band : 0.0 to 110.0% (ON/OFF action when set to 0.0)
Integral time : 0 to 1000 seconds (Off when set to 0)
Derivative time : 0 to 300 seconds (Off when set to 0)
OUT proportional cycle: 1 to 120 seconds
ARW : 0 to 100%
Manual reset : ±Proportional band converted value
Output limit : 0 to 100% (DC current output type: –5 to 105%)
(Not available for ON/OFF action)
Hysteresis : Thermocouple and RTD inputs: 0.1 to 100.0℃ (℉)
DC voltage and current inputs: 1 to 1000
(The placement of the decimal point follows the selection)

Control output (OUT)
- Relay contact: 1a, Control capacity 3A 250V AC (Resistive load)
1A 250V AC (Inductive load COS ø =0.4)

Electrical life, 100,000 times

- Non-contact voltage (for SSR drive): 12□□, □V DC Max. 40mA (Short circuit protected)
- DC current: 4 to 20mA DC, Load resistance: Max. 550Ω

Output accuracy: Within ±0.3% of output span

Resolution : 12000

EVT output

• Alarm output [Common output with Loop break alarm and Heater burnout alarm (option)]

The alarm action point is set by ± deviation to the main setting (excluding Process alarm) and when input exceeds the range in ± deviation setting (excluding Process alarm) to the main setting, alarm (EVT) turns ON or OFF (High/Low limit range alarm).

When Deenergized is selected in the Energized/Deenergized selection, alarm (EVT) activates conversely.

Setting accuracy : The same as indication accuracy

Action : ON/OFF action

Hysteresis : Thermocouple and RTD inputs: 0.1 to 100.0℃(℉)

DC voltage and current inputs: 1 to 1000 (The placement of the decimal point follows the selection)

Output : Open collector, Control capacity 24V DC 0.1A (Max.)

Alarm output action : One alarm action is selectable from below by front key operation.
High limit, Low limit, High/Low limits, High/Low limit range, Process high, Process low, High limit with standby, Low limit with standby, High/Low limits with standby and No alarm action

Energized/Deenergized: Alarm (EVT) output Energized/Deenergized can be selected.

	Energized	Deenergized
Red (EVT) LED	Lights	Lights
EVT output	ON	OFF

Alarm HOLD function selection: Once the alarm is activated, alarm output is held until the power is turned off.

• Loop break alarm output (Common output with Alarm and Heater burnout alarm [Option])

Detects heater burnout, sensor burnout, and abnormality at operation end.

Setting range: Loop break alarm action time setting: 0 to 200 minutes

Loop break alarm action span setting

Thermocouple and RTD inputs: 0 to 150℃(℉) or 0.0 to 150.0℃(℉)

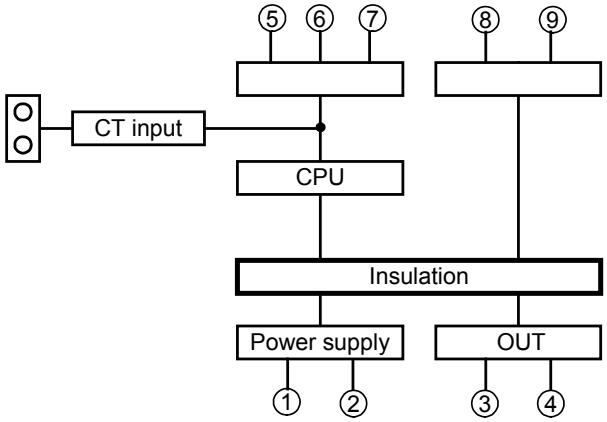
DC voltage and current inputs : 0 to 1500

(The placement of the decimal point follows the selection)

Output: Open collector, Control capacity, 24V DC 0.1A (Max.)

Converter function: See “6. Converter function”

Insulation • Dielectric strength: Circuit insulation configuration



Insulated resistance: 10MΩ or greater 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

Power consumption : Approx. 6VA

Ambient temperature: 0 to 50℃

Ambient humidity : 35 to 85%RH (no condensation)

Weight : Approx.120g

External dimension : 22.5 x 75 x 100mm (W x H x D)

Material : Flame resistant resin (Case)
Color : Ash gray (Case)
Attached function

[Setting value lock]
[Sensor correction]
[Power failure countermeasure]
The setting data is backed up in non-volatile IC memory.
[Self diagnosis]
The CPU is monitored by a watchdog timer, and when any abnormal status is found on the CPU, the controller is switched to warm-up status with all outputs turned off.
[Automatic cold junction temperature compensation] (Only thermocouple input)
This detects the temperature at the connection terminal between the thermocouple and the instrument and always keeps it on the same status as when the reference junction is located at 0℃ (32℉).
[Input burnout indication]
Thermocouple and RTD inputs
If the input value exceeds the Indication range high limit value, the PV display blinks "- - - -", and if the input value exceeds the Indication range low limit value, the PV display blinks "_ _ _ _". If the input value exceeds the Control range, OUT is turned OFF (for DC current output type, OUT low limit value).
(However, for manual control, it outputs the preset manipulated variable)

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℉
K	–200 to 1370℃	–250 to 1420℃	–250 to 1420℃
	–320 to 2500℉	–370 to 2550℉	–370 to 2550℉
J	–200 to 1000℃	–250 to 1050℃	–250 to 1050℃
	–320 to 1800℉	–370 to 1850℉	–370 to 1850℉
R□S	0 to 1760℃	–50 to 1810℃	–50 to 1810℃
	0 to 3200℉	–50 to 3250℉	–50 to 3250℉
B	0 to 1820℃	–50 to 1870℃	–50 to 1870℃
	0 to 3300℉	–50 to 3350℉	–50 to 3350℉
E	–200 to 800℃	–250 to 850℃	–250 to 850℃
	–320 to 1500℉	–370 to 1550℉	–370 to 1550℉
N	–200 to 1300℃	–250 to 1350℃	–250 to 1350℃
	–320 to 2300℉	–370 to 2350℉	–370 to 2350℉
PL-Ⅱ	0 to 1390℃	–50 to 1440℃	–50 to 1440℃
	0 to 2500℉	–50 to 2550℉	–50 to 2550℉
C(W/Re5-26)	0 to 2315℃	–50 to 2365℃	–50 to 2365℃
	0 to 4200℉	–50 to 4250℉	–50 to 4250℉
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℃	–206 to 550℃	–206 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℉

DC current and voltage inputs
If the PV exceeds Indication range high limit value, the PV display blinks "- - - -", and if the PV exceeds the Indication range low limit value, the PV display blinks "- - - -".
Indication range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value + Scaling span x 10%]
However, if the input value exceeds the range –1999 to 9999, the PV display blinks "- - - -" or "- - - -".
Control range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value + Scaling span x 10%]
DC input burnout: When DC input is burnt out, PV display blinks "- - - -" 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 corresponding value for which 0mA or 1V is inputted.

[Burnout]
When the thermocouple or RTD input is burnt out, OUT is turned off and PV display blinks "- - - -" (for DC current output type, OUT low limit value).

Accessories included: Instruction manual 1 copy
When the option Heater burnout alarm is added: Wire harness 3m, 1 length
When the option Heater burnout alarm is added:
For rating 5A, 10A, 20A CT (AKT4815) 1 piece
For rating 50A CT (AKT4816) 1 piece
Accessories sold separately: For DC current input, 50Ω shunt resistor (AKT4811) 1 piece

10.2 Optional specifications

Heater burnout alarm
Watches the heater current with CT (Current transformer) and detects the burnout.
When this option is added, this option shares common output with Alarm output and Loop break alarm.
This option cannot be applied to DC current output type.
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: ±5% of the rated value
Action : ON/OFF action
Output : Open collector
Control capacity, 24V DC 0.1A (Max.)

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
"- - - -" is blinking on the PV display.	• Sensor (Thermocouple, RTD and DC voltage 0 to 1V DC input) is burnt out. Change the sensor for new one. • Is the lead wire of the sensor (Thermocouple, RTD and DC voltage 0 to 1V DC input) securely connected? Connect it to the input terminal properly.
The indication on the PV display does not change.	• Check if the input signal source for DC voltage (0 to 10V DC) and DC current (0 to 20mA DC) is normal. • Is the input signal wire for the DC current (0 to 20mA DC) and DC voltage 0 to 10V DC securely connected to the input terminal of this controller? Connect the sensor lead wire securely to the input terminal of this controller.
"- - - -" is blinking on the PV display.	• Check if the input signal source for sensor (DC current "4 to 20mA DC" and DC voltage "1 to 5V DC" input) is normal. • Is the input signal wire of DC current 4 to 20mA DC and DC voltage1 to 5V DC securely connected to the terminal

	of this instrument? Connect the input signal wire securely to the terminal of the instrument.
The indication on the PV display is abnormal or unstable.	• Is designation of the sensor (input) correct? Set the correct sensor (input). • Is the polarity of the sensor input correct? Wire it correctly. • Temperature unit (℃/℉) is mistaken. Set the correct unit. • AC may be leaking into the input of this controller from the thermocouple or RTD connected to the measured object. Keep AC from leaking into the input of this controller from the thermocouple or RTD of the measured object.
"Err 1" is indicated on the PV display.	• Internal memory is defective. Contact our agency or us.

11.2 Key operation

Problem	Presumed cause and solution
• Setting values do not change even if the ▲ or ▼ key is pressed during setting mode	• Lock 1 or Lock 2 is selected in setting value lock selection. Cancel the Lock mode. • PID auto-tuning is performing. Cancel PID auto-tuning.
• The setting indication does not change in the input range even if the ▲, ▼ keys are pressed, and unable to set the value.	• The value of scaling high limit setting or low limit setting in auxiliary function setting mode 2 may be set at the point the value does not change. Set the proper value.

• If you have any inquiries, please consult our agency or the shop where you purchased the unit.

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