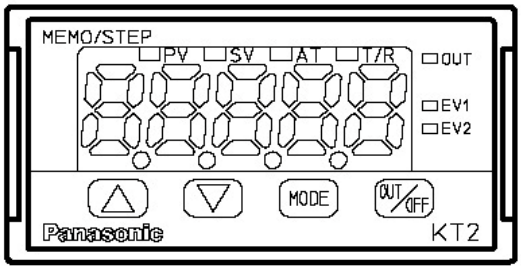
Panasonic®

TEMPERATURE CONTROLLER

KT2

INSTRUCTION MANUAL



Preface

Thank you for purchasing Panasonic® Temperature Controller KT2.
This manual contains instructions for the mounting, functions, operations and notes for operating the KT2.
For model confirmation and unit specifications, please read this manual carefully before starting operation.

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

Characters used in this manual

Indication													
Number, ℃/℉	-1	0	1	2	3	4	5	6	7	8	9	℃	℉
Indication													
Alphabet	A	B	C	D	E	F	G	H	I	J	K	L	M
Indication													
Alphabet	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Notes

- This instrument should be used in accordance with the specifications described in the manual. If it is not used in accordance with the specifications, it may malfunction or cause fire.
- Be sure to follow the warnings, cautions and notices. If warnings are not observed, serious injury or accidents may occur.
- The contents of this instruction manual are subject to change without notice.
- Care has been taken to assure that the contents of this instruction manual are correct, but if there are any doubts, mistakes or questions, please inform our sales department.
- This instrument is designed to be installed in a control panel. If it is not, measures must be taken to ensure that power terminals or other high voltage sections cannot be touched.
- 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.

Safety precautions

(Be sure to read these precautions before using our products.)

The safety precautions are classified into two categories: “Warning” and “Caution”.
Depending on circumstances, procedures indicated by ⚠ Caution may have serious consequences, so be sure to follow the directions for correct usage.

⚠ 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.

1. Installation precautions

⚠ Caution

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 or explosive gases**
- **No 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 contact with the unit**

Note: Do not install this instrument near flammable material even though the case of this instrument is made of flame-resistant resin.
Avoid setting this instrument directly on flammable material.

2. Wiring precautions

⚠ Caution

- **Use the solderless terminal with an insulation sleeve in which an M3 screw fits, when wiring the KT2.**
- **Tighten the terminal screw with the specified torque. If excessive force is applied to the screw when tightening, the terminal screw or case may be damaged.**
- **Do not apply a commercial power source to the sensor which is connected to the input terminal nor allow the power source to come into contact with the sensor.**
- **This controller does not have built-in power switch, circuit breaker or fuse. It is necessary to install them near the controller. (Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)**

3. Running and maintenance precautions

⚠ Warning

- **It is recommended that the PID auto-tuning be performed on the trial run.**
- **Do not touch live terminals. This may cause electric shock or problems in operation.**
- **Turn the power supply to the instrument OFF before retightening the terminal and cleaning. Working on or touching the terminal with the power switched ON may result in severe injury or death due to Electric Shock.**
- **Use a soft, dry cloth when cleaning the instrument. (Alcohol based substances may tarnish or deface the unit)**
- **As the display section is vulnerable, do not strike or scratch it with a hard object.**

--- CONTENTS ---

1. Model number

1.1 Model number

A K T 2 □ 1 □ □ □ 0 □

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

(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 keypad 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 ---------- 0: Not available (When both Healing/Cooling control and Serial communication are selected)
1: A1 output or A2 output (However, if Healing/Cooling control is selected, only A2 output is available. If Serial communication is selected, only A1 output is available)
2: A1 output + A2 output (When neither Healing/Cooling control nor Serial communication is selected)

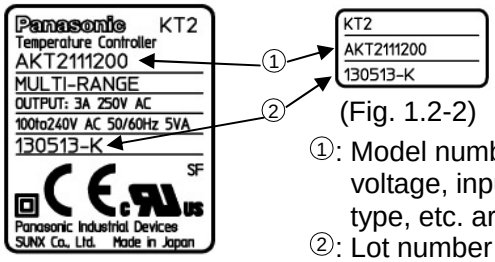
(5) Heating/Cooling control (OUT2) output: 0: Not available 1: Relay contact

(6) Serial communication ---------- Blank: Not available 1: Applied

1.2 How to read the rated label

The rated label is attached to the case and the inner assembly.

(For case) (For inner assembly)



(Fig. 1.2-1)

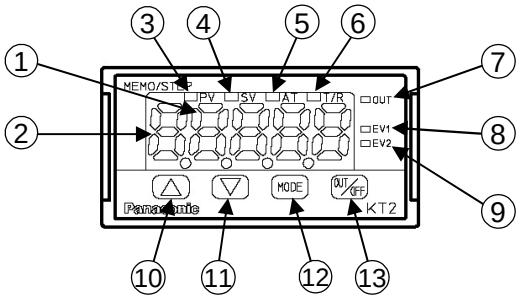
(Fig. 1.2-2)

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

②: Lot number is entered.

(Example)
Supply voltage: 100 to 240V AC
Multi-input
Relay contact output
A1 output + A2 output
Heating/Cooling control is not added
Serial communication is not added

2. Name and functions of the sections



(Fig. 2-1)

① **PV/SV display (red)**: Indicates the PV (Process variable) and SV (Main set value). During setting mode, characters and set value of each setting item are indicated alternately.

② **MEMO/STEP display (green)**: Indicates memory number during fixed value control. Indicates step number during program control.

③ **PV indicator (red)**: Lights when the PV (Process variable) is indicated.

④ **SV indicator (green)** : Lights when SV (main set value) is indicated.

⑤ **AT indicator (yellow)** : Flashes during AT (auto-tuning).

⑥ **T/R indicator (yellow)**: Flashes during Serial communication. (Lit while sending data, Unlit while receiving data)

⑦ **OUT indicator (green)**: Lights when control output or OUT1 (Heating side, Heating/Cooling control option) is ON. (For DC current output type, it flashes corresponding to the manipulated variable in 0.25 second cycles)

⑧ **EV1 indicator (red)** : Lights when Event output 1 or OUT2 (Cooling side, Heating/Cooling control option) is ON.

⑨ **EV2 indicator (red)** : Lights when Event output 2 is ON.

⑩ **Increase key (△)** : Increases the numeric value.

⑪ **Decrease key (▽)** : Decreases the numeric value.

⑫ **Mode key (MODE)** : Selects the setting mode or registers the set value. (By pressing the Mode key, the set value or selected value can be registered)

⑬ **OUT/OFF key (OUT/OFF)** : The control output OUT/OFF or program control RUN/STOP can be switched.

3. Mounting to the control panel

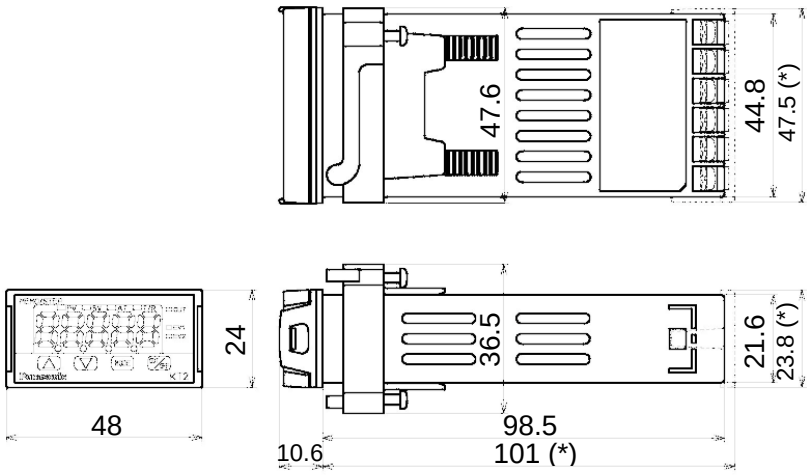
3.1 Site selection

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 or explosive gases
- No 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 contact with the controller

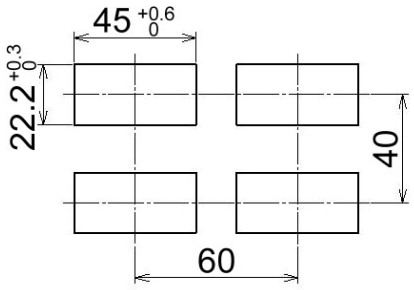
3.2 External dimensions (Unit: mm)



(*): When terminal cover is added

(Fig. 3.2-1)

3.3 Panel cutout (Unit: mm)



(Fig. 3.3-1)

3.4 Mounting

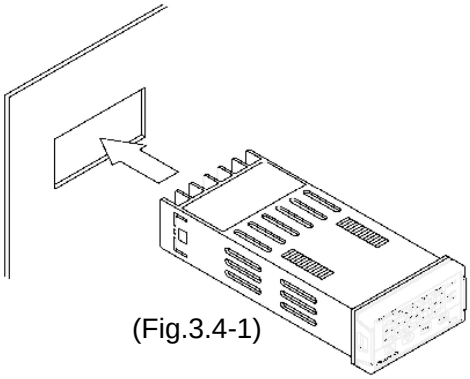
Mount the controller vertically so that dust and water do not enter, fulfilling the Dust-proof/Drip-proof specification (IP66).

Mountable panel thickness: 1 to 10mm

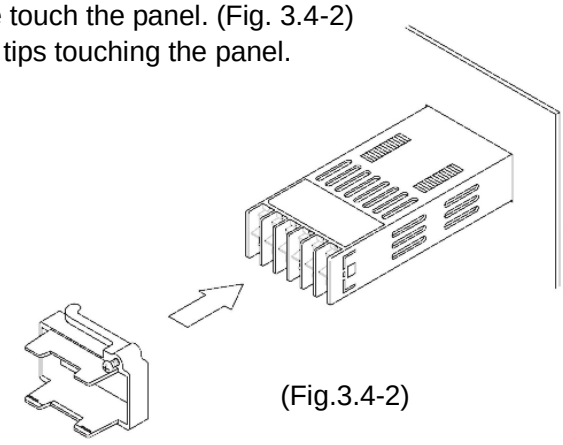
(1) Insert the controller from the front side of the panel. (Fig. 3.4-1)

(2) Insert the mounting frame until 2 tips of the frame touch the panel. (Fig. 3.4-2)

(3) Tighten screws with 3/4 rotations upon the screw tips touching the panel.



(Fig.3.4-1)

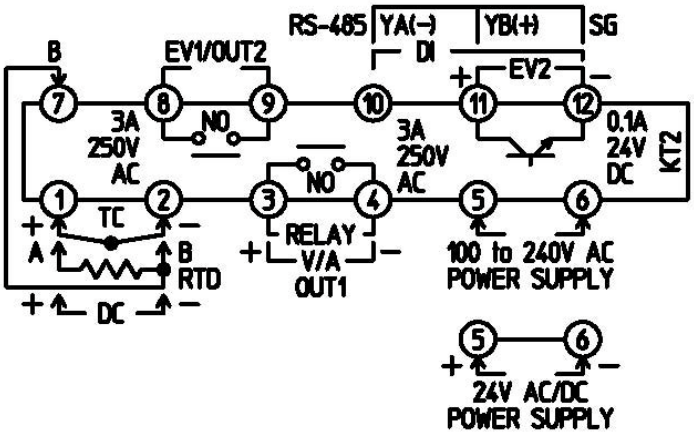


(Fig.3.4-2)

4. Wiring

⚠ Warning

Turn the power supply to the instrument off before wiring.
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)

- TC : Thermocouple input terminals
- RTD : RTD input terminals
- DC : DC current, DC voltage input terminals
  For DC current input type, connect 50Ω shunt resistor (sold separately) between input terminals.
- OUT1 : Control output or Heating output (Heating/Cooling control option) terminals
- POWER SUPPLY: Power terminals
- EV1/OUT2: Event output 1 or Cooling output (Heating/Cooling control option) terminals
- EV2 : Event output 2 terminals
- DI : DI (Digital input) terminals
  Three DI functions: SV1/SV2 external selection function, OUT/OFF (RUN/STOP) external selection and Timer function
- RS-485: Serial communication terminals

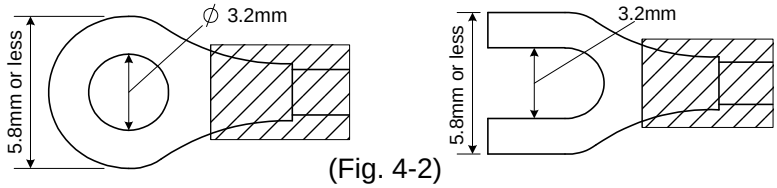
⚠ Notice

- 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 a built-in power switch, circuit breaker or fuse. Therefore, it is necessary to install them in the circuit near the external controller.
  (Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)
- **When using a 24V DC for the power source, do not confuse polarity.**
- When using a relay contact output type, externally 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.
- Do not apply a commercial power source to the sensor connected to the input terminal nor allow the power source to come into contact with the sensor.

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 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)

5. Setup procedures

5.1 Setup procedures

The setup procedures of this controller is shown below. Refer to each item for details.

(1) Initial setting : Set the Input type, Alarm type, etc. during Auxiliary function setting mode 2. (If the users' specification is the same as the default value of the KT2, initial setting is not necessary for the controller.)

↓

(2) Main setting mode: Set Step SV and Step time for Program control during Main setting mode. Refer to Chapter "6. Setup".

↓

(3) Sub setting mode : Set PID values, A1 value, etc during Sub setting mode. (If the users' PID values are the same as the default value of the KT2, it is not necessary to set them.) Refer to Chapter "6. Setup".

↓

(4) Auxiliary function setting mode 1: Set the Lock function, Communication conditions, etc. during Auxiliary function setting mode 1. (If the users' specification is the same as the default value of the KT2, it is not necessary to set them.)

↓

Run Refer to Chapter "6. Setup".

5.2 Initial setting

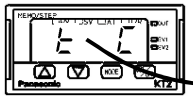
Before using this controller, it is necessary to set up the Input type, Alarm type, Control action, etc. according to the users' conditions. This is an initial setting.
Default values are set as follows.
Input: K –200 to 1370℃, Alarm 1(A1): No alarm action, Alarm 2(A2): No alarm action, Reverse (Heating) action

If the users' specification is the same as the default value of the KT2, initial setting is not necessary. Proceed to Section "6.1 Main setting mode".

■ **Turn the power supply to the instrument on**.

For approx. 3 seconds after the power is turned on, the MEMO/STEP display is turned off and the PV/SV display indicates sensor input characters and temperature unit. (Table 5.2-1)
During this time, all outputs and LED indicators are in an OFF status.

(Table 5.2-1)



Sensor input	PV/SV display	
	℃	℉
K		
J		
R		
S		
B		
E		
T		
N		
PL-Ⅱ		
C (W/Re5-26)		
Pt100		
		
JPt100		
		
4 to 20mA DC		
0 to 20mA DC		
0 to 1V DC		
0 to 5V DC		
1 to 5V DC		
0 to 10V DC		

After that, the following is indicated.

The MEMO/STEP display indicates a memory number. The PV/SV display indicates an input value (e.g. room temperature). This is the PV/SV display mode.

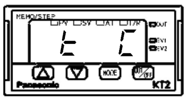
■ **Basic operation for initial setting**

Initial setting is conducted in Auxiliary function setting mode 2. To go to Auxiliary function setting mode 2, press the △ key for approx. 3 seconds while holding down the ▽ key in the PV/SV display mode.
Set or select the values with the △ or ▽ key.
Pressing the MODE key registers the values and goes to the next item.

■ **Display used for explaining setting items**

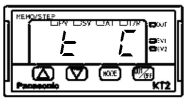
Setting items (Section "5.2 Initial setting" and setting modes from Section 6.1 to 6.3) are explained as follows.

(e.g.) Input type selection

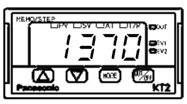
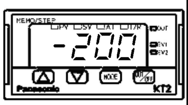

↔


↔ means that input type characters SEnS and selected value K□□C (K –200 to 1370℃) are indicated in turn.

■ **Auxiliary function setting mode 2**

Display	Item, Function, Setting range	Default value
 ↔ 	**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). The unit ℃/℉ can be selected as well. • **When changing the input from DC voltage to other inputs, remove the sensor connected to this controller first, then change input type. If the input is changed with the the sensor connected, the input circuit may break.**	K (-200 to 1370℃)

Display	Input	Range
K□□C:	K	-200 to 1370 ℃
K□ .C:		-199.9 to 400.0℃
J□□C:	J	-200 to 1000 ℃
r□□C:	R	0 to 1760 ℃
S□□C:	S	0 to 1760 ℃
b□□C:	B	0 to 1820 ℃
E□□C:	E	-200 to 800 ℃
T□ .C:	T	-199.9 to 400.0℃
n□□C:	N	-200 to 1300 ℃
PL2C:	PL-Ⅱ	0 to 1390 ℃
c□□C:	C (W/Re5-26)	0 to 2315 ℃
PT .C:	Pt100	-199.9 to 850.0℃
JPT.C:	JPt100	-199.9 to 500.0℃
PT□C:	Pt100	-200 to 850 ℃
JPTC:	JPt100	-200 to 500 ℃
K□□F:	K	-320 to 2500 ℉
K□ .F:		-199.9 to 750.0℉
J□□F:	J	-320 to 1800 ℉
r□□F:	R	0 to 3200 ℉
S□□F:	S	0 to 3200 ℉
b□□F:	B	0 to 3300 ℉
E□□F:	E	-320 to 1500 ℉
T□ .F:	T	-199.9 to 750.0℉
n□□F:	N	-320 to 2300 ℉
PL2F:	PL-Ⅱ	0 to 2500 ℉
c□□F:	C (W/Re5-26)	0 to 4200 ℉
PT .F:	Pt100	-199.9 to 999.9℉
JPT.F:	JPt100	-199.9 to 900.0℉
PT□F:	Pt100	-300 to 1500 ℉
JPTF:	JPt100	-300 to 900 ℉
420A:	4 to 20mA DC	-1999 to 9999
020A:	0 to 20mA DC	-1999 to 9999
0□1V:	0 to 1V DC	-1999 to 9999
0□5V:	0 to 5V DC	-1999 to 9999
1□5V:	1 to 5V DC	-1999 to 9999
010V:	0 to 10V DC	-1999 to 9999

Display	Item, Function, Setting range	Default value
 ↔ 	**Scaling high limit setting** • Sets scaling high limit value. • Setting range: Scaling low limit value to input range high limit value	1370℃
 ↔ 	**Scaling low limit setting** • Sets scaling low limit value. • Setting range: Input range low limit value to scaling high limit value	-200℃

Decimal point place selection | No decimal point

- Selects decimal point place.
- Available only for DC input
- 0: No decimal point
  0.0: 1 digit after decimal point
  0.00: 2 digits after decimal point
  0.000: 3 digits after decimal point

PV filter time constant setting | 0.0 seconds

- Sets PV filter time constant.
  Input fluctuation due to the noise can be reduced.
  If the value is set too large, it affects control result due to the delay of response.
- Setting range: 0.0 to 10.0 seconds

OUT1 (Heating) high limit setting | 100%

- Sets OUT1 (Heating) high limit value.
  Not available if OUT1 (Heating) is ON/OFF action
- If Heating/Cooling control option is added, OUT1 terminals are used for Heating output terminals.
- Setting range: OUT1 (Heating) low limit value to 105%
  (Setting higher than 100% is effective to DC current output type)

OUT1 (Heating) low limit setting | 0%

- Sets OUT1 (Heating) low limit value.
  Not available if OUT1 (Heating) is ON/OFF action
- If Heating/Cooling control option is added, OUT1 terminals are used for Heating output terminals.
- Setting range: –5% to OUT1 (Heating) high limit value
  (Setting less than 0% is effective to DC current output type)

OUT1 (Heating) ON/OFF action hysteresis setting | 1.0℃

- Sets ON/OFF action hysteresis for OUT1 (Heating).
- Available only when OUT1 (Heating) is ON/OFF action
- Setting range: 0.1 to 100.0℃ (℉), or 1 to 1000

EV1 output selection | A1 output

- Selects a function for EV1 output terminals.
- Not available if Heating/Cooling control option is added, since EV1 terminals are used for Cooling output terminals.
- A1: A1 output
  A2: A2 output
  or: Common to A1 and A2 output

EV2 output selection | A2 output

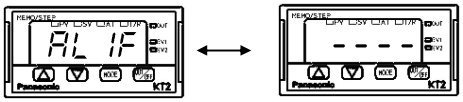
- Selects a function for EV2 output terminals.
- Not available if Serial communication option is added
- A1: A1 output
  A2: A2 output
  or: Common to A1 and A2 output

Overlap band/Dead band setting | 0.0℃

- Sets the overlap band or dead band for OUT1 (Heating side) and OUT2 (Cooling side).
  + set value: Dead band
  – set value: Overlap band
- Available only when the Heating/Cooling control option is added
- Setting range: –100.0 to 100.0℃ (℉), or 1 to 1000

OUT2 (Cooling) ON/OFF action hysteresis setting | 1.0℃

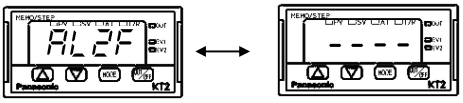
- Sets ON/OFF action hysteresis for OUT2 (Cooling side).
- Available only when the Heating/Cooling control option is added
- Setting range: 0.1 to 100.0℃ (℉), or 1 to 1000



A1 type selection — No alarm action

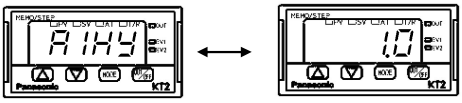
- Selects an A1 (Alarm 1) type.
- ----: No alarm action
  H□□□: High limit alarm
  L□□□: Low limit alarm
  HL□□: High/Low limits alarm
  oI d□: High/Low limit range alarm
  R4□□: Process high alarm
  rR4□: Process low alarm
  H□□u: High limit alarm with standby
  L□□u: Low limit alarm with standby
  HL□u: High/Low limits alarm with standby
  Tnr□: Timer function
  P.End: Pattern end output

If Timer function is selected, Timer function works only when Delay action type, Delay time and DI (digital input) function are set or selected.



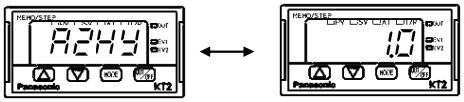
A2 type selection — No alarm action

- Selects an A2 (Alarm 2) type.
- Alarm type selection and default value are the same as those of A1 type selection.



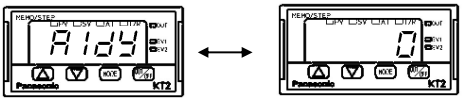
A1 hysteresis setting — 1.0℃

- Sets hysteresis for A1.
- Not available if No alarm action, Timer function or Pattern end output is selected during A1 type selection
- Setting range: 0.1 to 100.0℃(℉), or 1 to 1000



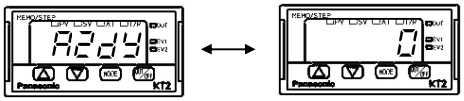
A2 hysteresis setting — 1.0℃

- Sets hysteresis for A2.
- Not available if No alarm action, Timer function or Pattern end output is selected during A2 type selection
- Setting range: 0.1 to 100.0℃(℉), or 1 to 1000



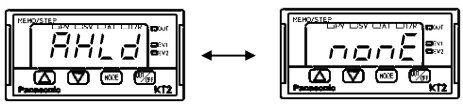
A1 action delayed timer setting — 0 seconds

- Sets action delayed timer for A1.
  When setting time has elapsed after the input enters the alarm output range, the alarm is activated.
- Not available if No alarm action, Timer function or Pattern end output is selected during A1 type selection
- Setting range: 0 to 9999 seconds



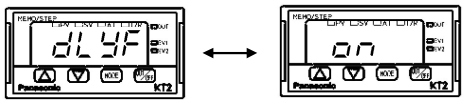
A2 action delayed timer setting — 0 seconds

- Sets action delayed timer for A2.
  When setting time has elapsed after the input enters the alarm output range, the alarm is activated.
- Not available if No alarm action, Timer function or Pattern end output is selected during A2 type selection
- Setting range: 0 to 9999 seconds



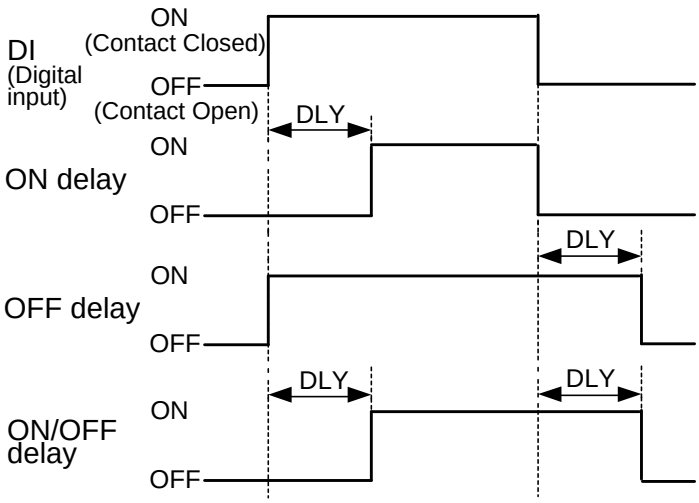
Alarm HOLD function selection — Alarm Not Holding

- Selects whether alarm HOLD function for A1 or A2 is used or not used.
- This setting item is common to A1 and A2.
  Not available if No alarm action, Timer function or Pattern end output is selected during A1 or A2 type selection.
- nonE: Alarm Not Holding
  HoLd: Alarm Holding



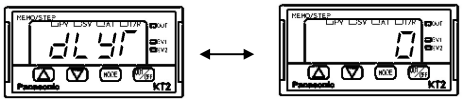
Delay action type selection | ON delay

- Selects a delay action type for Timer function.
- Available only when Timer function is selected during A1 or A2 type selection.
- on□□: ON delay
  oFF□: OFF delay
  onoF: ON/OFF delay



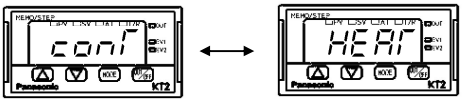
DLY: Delay time setting

(Fig. 5.6-1)



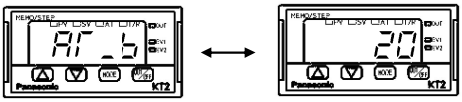
Delay time setting | 0 seconds

- Sets delay time for the Timer function.
- Available only when Timer function is selected during A1 or A2 type selection.
- Setting range: 0 to 9999 seconds



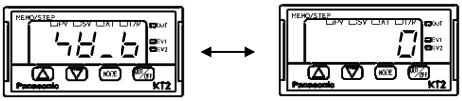
Direct/Reverse control action selection | Reverse (Heating)

- Selects Reverse (Heating) or Direct (Cooling) control action.
- HEAt: Reverse (Heating) action
  cooL: Direct (Cooling) action



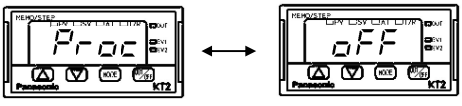
AT bias setting | 20℃

- Sets bias value when performing auto-tuning.
  See page 22 for PID auto-tuning.
- Not available for DC input
- Setting range: 0 to 50℃ (0 to 100℉) or 0.0 to 50.0℃ (0.0 to100.0℉)



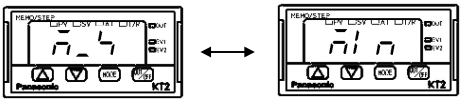
Setting item not used

This item is indicated when Serial communication option is added. However, this cannot be used.



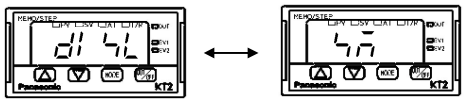
OUT/OFF key function selection | Control output OUT/OFF function

- Selects whether OUT/OFF key is used for control output OUT/OFF function (Fixed value control) or for program control RUN/STOP function.
- oFF□: Control output OUT/OFF function (Fixed value control)
  Proc: Program control RUN/STOP function



Step time unit selection | Hour:Minute

- Selects Step time unit for the program control function.
- Not available if control output OUT/OFF function (Fixed value control) is selected during [OUT/OFF key function selection].
- HI nn: Hour:Minute
  MEc□: Minute:Second



DI (Digital input) function selection | SV1/SV2 external selection function

- Selects DI function whether it is used as SV1/SV2 external selection function, OUT/OFF (RUN/STOP) external selection function or Timer function.

If SV1/SV2 external selection function is selected;

SV1 or SV2 can be switched by external contact. However, this function is not available if Program control function is selected during OUT/OFF key function selection.

Between DI terminals Open: SV1
Between DI terminals Closed: SV2

If OUT/OFF(RUN/STOP) external selection function is selected;

Control output OUT/OFF (Fixed value control) or Program control RUN/STOP can be switched by external contact.

Fixed value control

Between DI terminals Open: OUT (Control allowed)
Between DI terminals Closed: OFF (Control prohibited, control output OFF)

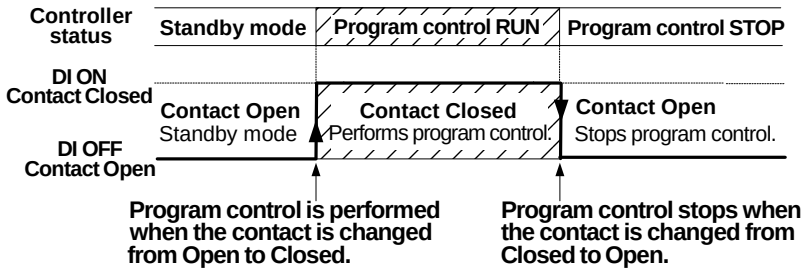
Program control

Program control RUN/STOP can be switched if the following operation is conducted during program control standby.

Between DI terminals from Open to Closed: RUN (program control run)

Between DI terminals from Closed to Open: STOP (program control stop)

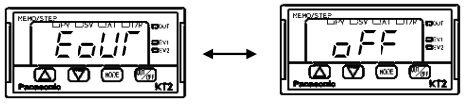
If DI terminal contact is changed from Closed to Open while pattern end output is turned on after program control ended, pattern end output is turned off.



If Timer function is selected;

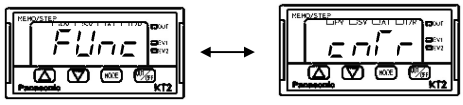
Timer counting starts by the external contact, and after the set delay time has passed, the selected event output is turned on.

- Not available if Serial communication option is applied.
- : SV1/SV2 external selection function
  : OUT/OFF(RUN/STOP) external selection function
  : Timer function



Output status selection when input abnormal | Output OFF

- Selects the output status of OUT1 and EV1/OUT2 when DC input is overscale or underscale. See “Input abnormality indication” (p.28).
- Available only for DC current output type with DC input
- : OUT1 outputs OFF(4mA) or OUT1(Heating) low limit value. EV1/OUT2: OFF
  : OUT1 outputs a value between OFF(4mA) and ON(20mA), or outputs a value between OUT1(Heating) low limit value and OUT1 (Heating) high limit value. EV1/OUT2: ON



Controller/Converter function selection | Controller

- Selects whether to use the KT2 as a controller or a converter.

If the KT2 is switched from a converter to a controller, control parameters which were automatically set when converter function was selected are maintained as they were. Therefore correct the values when using the KT2 as a controller.

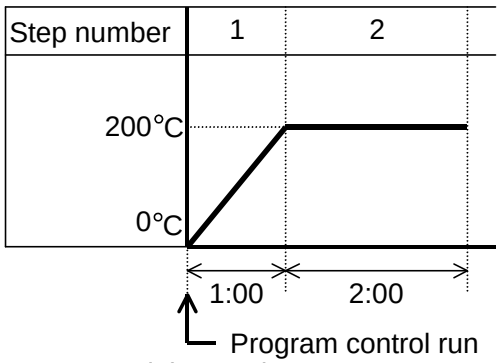
- Available only for DC current output type
- : Controller
  : Converter

6. Setup

6.1 Main setting mode

To go to the main setting mode, press the MODE key in the PV/SV display mode.
Set each setting item with the △ or ▽ key, and register the value with the MODE key.
In the main setting mode, indicated setting items are different depending on the instrument status.

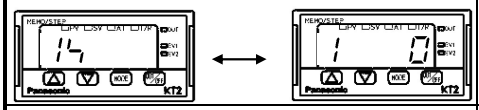
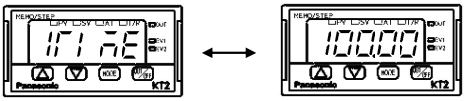
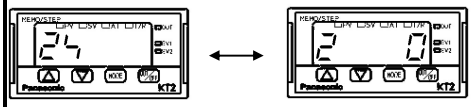
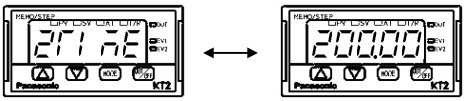
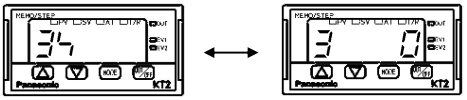
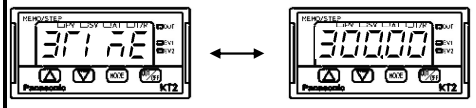
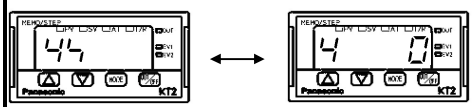
- Fixed value control
  Setting items SV1 and SV2 will be indicated.
- Program control
  Step SV and step time from Step 1 to Step 9 will be indicated.

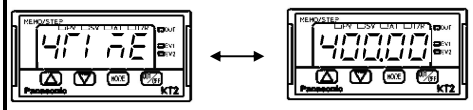
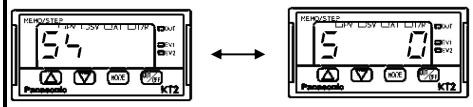
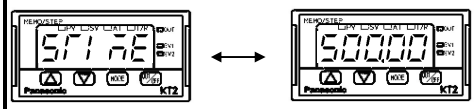
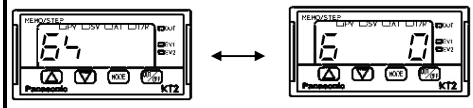
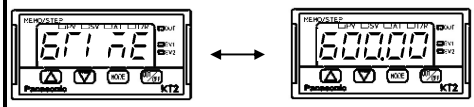
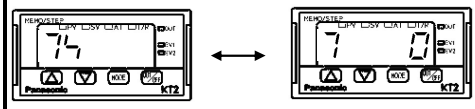
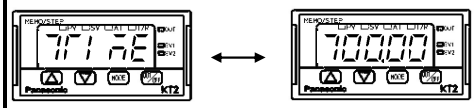
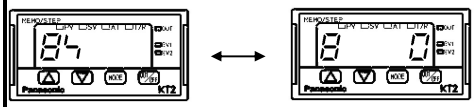
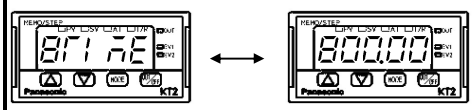
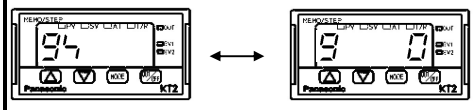
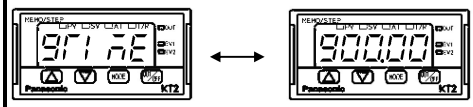


(Fig.6.1-1)

This program pattern shows that the temperature rises to 200℃ for 1 hour and stays at 200℃ for 2 hours.

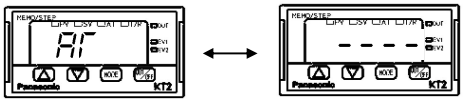
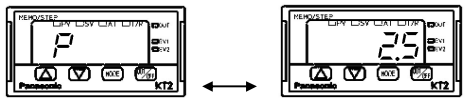
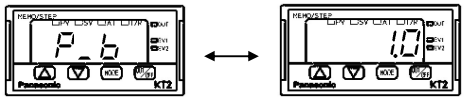
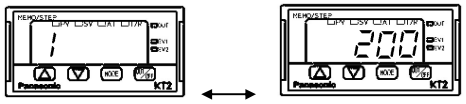
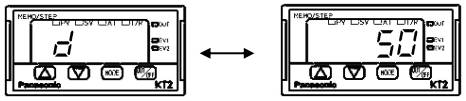
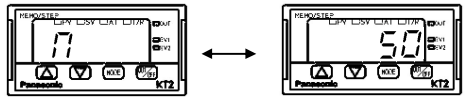
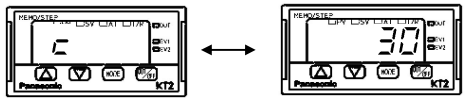
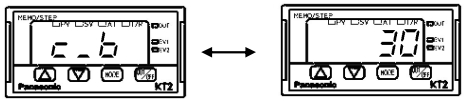
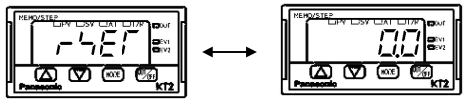
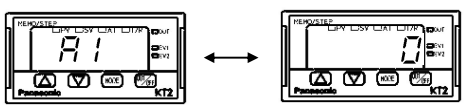
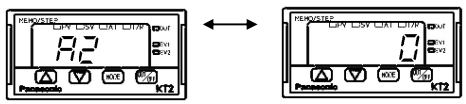
In this case,
Step 1 SV: 200℃
Step 1 time (1 hour): 01:00
Step 2 SV: 200℃
Step 2 time (2 hours): 02:00

Display	Item, Function, Setting range	Default value
	**SV1 (step 1 SV) setting** • Sets SV1 or step 1 SV. • Scaling low limit value to Scaling high limit value	0℃
	**Step 1 time setting** • Sets step 1 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**SV2 (step 2 SV) setting** • Sets SV2 or step 2 SV. • Available when SV1/SV2 external selection function is selected during DI (digital input) function selection or when program control function is selected during OUT/OFF key function selection. • Scaling low limit value to Scaling high limit value	0℃
	**Step 2 time setting** • Sets step 2 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 3 SV setting** • Sets step 3 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃
	**Step 3 time setting** • Sets step 3 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 4 SV setting** • Sets step 4 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃

	**Step 4 time setting** • Sets step 4 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 5 SV setting** • Sets step 5 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃
	**Step 5 time setting** • Sets step 5 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 6 SV setting** • Sets step 6 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃
	**Step 6 time setting** • Sets step 6 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 7 SV setting** • Sets step 7 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃
	**Step 7 time setting** • Sets step 7 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 8 SV setting** • Sets step 8 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃
	**Step 8 time setting** • Sets step 8 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00
	**Step 9 SV setting** • Sets step 9 SV. • Available only when program control function is selected during OUT/OFF key function selection • Scaling low limit value to Scaling high limit value	0℃
	**Step 9 time setting** • Sets step 9 time. • Available only when program control function is selected during OUT/OFF key function selection • Setting range: 00:00 to 99:59	00:00

6.2 Sub setting mode

To go to the Sub setting mode, press the MODE key while holding down the △ key in the PV/SV display mode. Set each setting item with the △ or ▽ key, and register the value with the MODE key.

Display	Item, Function, Setting range	Default value
	**AT (Auto-tuning) selection** • Selects auto-tuning Perform/Cancel. Not available for program control standby status and for control actions other than PID action. • ----: AT Cancel AT□□: AT Perform	AT Cancel
	**OUT1 (Heating) proportional band setting** • Sets the proportional band for OUT1 (Heating side). • ON/OFF action when set to 0.0. • Setting range: 0.0 to 110.0% [Percentage of the scaling span (scaling high limit-scaling low limit)]	2.5%
	**OUT2 (Cooling) proportional band setting** • Sets the proportional band for OUT2 (cooling side). • ON/OFF action when set to 0.0. • Not available if Heating/Cooling control option is not added or if OUT1 (Heating side) is ON/OFF action • Setting range: 0.0 to 10.0 times OUT1 (Heating) proportional band	1.0 times
	**OUT1 (Heating) integral time setting** • Sets the integral time. • Setting the value to 0 disables the function. (PD action) • Not available if OUT1 (Heating) is ON/OFF action • Setting range: 0 to 1000 seconds	200 seconds
	**OUT1 (Heating) derivative time setting** • Sets the derivative time. • Setting the value to 0 disables the function. (PI action) • Not available if OUT1 (Heating) is ON/OFF action • Setting range: 0 to 300 seconds	50 seconds
	**ARW setting** • Sets the ARW (anti-reset windup). • Available only for PID action. • Setting range: 0 to 100%	50%
	**OUT1 (Heating) proportional cycle setting** • Sets OUT1 (Heating) proportional cycle. • Sets the proportional cycle. • Not available for DC current output type or if OUT1 (Heating) is ON/OFF action. • Setting range: 1 to 120 seconds	Relay contact: 30sec Non-contact voltage: 3sec DC current: Not available
	**OUT2 (Cooling) proportional cycle setting** • Sets OUT2 (Cooling) proportional cycle. • Not available if Heating/Cooling control option is not added or if cooling output is ON/OFF action. • Setting range: 1 to 120 seconds	30 seconds
	**Manual reset setting** • Sets reset value manually. • Available only for P or PD action. • ±Proportional band converted value (For DC input, the placement of the decimal point follows the selection.)	0.0℃
	**A1 value setting** • Sets A1 action point. Setting the value to 0 or 0.0 disables the function (except process high alarm and process low alarm). • Not available if No alarm action, Timer function or Pattern end output is selected during A1 type selection • Setting range: See (Table 6.2-1).	0℃
	**A2 value setting** • Sets A2 action point. Setting the value to 0 or 0.0 disables the function (except process high alarm and process low alarm). • Not available if No alarm action, Timer function or Pattern end output is selected during A2 type selection • Setting range: See (Table 6.2-1).	0℃

(Table 6.2-1)

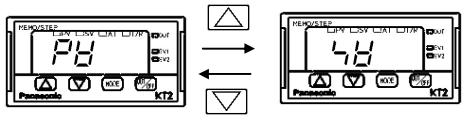
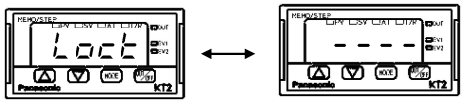
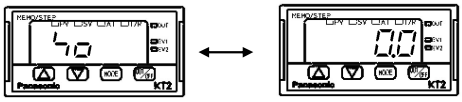
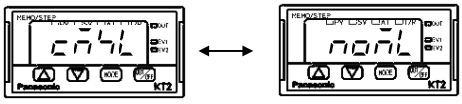
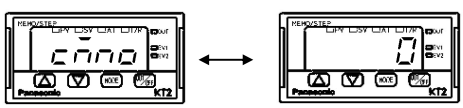
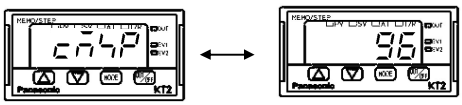
Alarm type	Setting range
High limit alarm	-(Scaling span) to Scaling span
Low limit alarm	-(Scaling span) to Scaling span
High/Low limits alarm	0 to Scaling span
High/Low limit range alarm	0 to Scaling span
Process high alarm	Scaling low limit to Scaling high limit value
Process low alarm	Scaling low limit 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 alarm w/standby	0 to Scaling span

For the inputs with a decimal point, the negative low limit value is -199.9, and the positive high limit value is 999.9.

All alarm actions except for the Process alarm are a ± deviation setting from the SV (main set value).

6.3 Auxiliary function setting mode 1

To go to Auxiliary function setting mode 1, press the MODE key for approx. 3 seconds while holding down the ▽ key in the PV/SV display mode.
Set each setting item with the △ or ▽ key, and register the value with the MODE key.

Display	Item, Function, Setting range	Default value
	**PV/SV indication selection** • PV indication (PV□□) or SV indication (SV□□) can be selected. PV indication with △ key, SV indication with the ▽ key • During input burnout, the PV/SV display flashes "- - - -" or "----" even if SV is indicated on the display.	PV indication
	**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 cannot be carried out. • Because there is limited non-volatile memory, be sure to select Lock 3 when the set value is changed frequently via communication function. • - - - - (Unlock): All set values can be changed. Loc1 (Lock 1): None of the set values can be changed. Loc2 (Lock 2): SV1 and SV2 can be changed during fixed value control. Step SV and step time can be changed during program control. Other setting items cannot be changed. Loc3 (Lock 3): All set values except input type and Controller/ Converter function can be changed. However, changed values revert to their previous value after the power is turned off because they are not saved in the non-volatile memory. (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
	**Sensor correction setting** • Sets the correction value for the sensor. PV after sensor correction =Current PV + (Sensor correction value) • Setting range: –100.0 to 100.0℃ (℉) DC input: –1000 to 1000	0.0℃
	**Communication protocol selection** • Selects the communication protocol. • Available only when the Serial communication option is applied. • noNL : Unavailable rodA: Modbus ASCII mode rodr: Modbus RTU mode	Modbus ASCII
	**Instrument number setting** • Sets the instrument number individually to each instrument when communicating by connecting plural instruments in Serial communication. • Available only when Serial communication option is added. • Setting range: 0 to 95 (However, number of connectable units: Max. 31 units)	0
	**Communication speed selection** • Selects a communication speed to be equal to the speed of the host computer. • Available only when Serial communication option is added. • □□24: 2400bps □□48: 4800bps □□96: 9600bps □192: 19200bps	9600bps

7. Running

7.1 Start running.

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

(1) Turn the power supply to the KT2 ON.

For approx. 3sec after the power is switched ON, the sensor input characters and the temperature unit are indicated on the PV/SV display. See (Table 5.2-1) on page 8.

During this time, all outputs and LED indicators are in an OFF status.

After that, control starts, indicating the following, depending on the controller status.

- **Fixed value control status**

  Control starts, indicating memory number on the MEMO/STEP display and PV (process variable) or SV (main set value) on the PV/SV display. (If PV indication is selected during PV/SV indication selection, PV is indicated. If SV indication is selected during PV/SV indication selection, SV is indicated.)

- **Program control standby status**

  The MEMO/STEP display is turned off, and the PV/SV display indicates input value or "STBY".
  (If PV indication is selected during PV/SV indication selection, PV is indicated. If SV indication is selected during PV/SV indication selection, "STBY" is indicated.)

- **Program control run status**

  The MEMO/STEP display indicates step number, and the PV/SV display indicates input value or current step temperature. (If PV indication is selected during PV/SV indication selection, PV is indicated. If SV indication is selected during PV/SV indication selection, current step temperature is indicated.)

- **When control output OFF function is working;**

  The MEMO/STEP display is turned off, and the PV/SV display indicates "oFF".

(2) Input each set value.

Input each set value, referring to “6. Setup”.

(3) Turn the load circuit power ON.

The controller starts as follows depending on the setting.

- **Fixed value control**

  Control starts so as to keep the control target at the SV.

- **Program control**

  Program control run

  To perform program control run, press the OUT/OFF key. At this time the program control starts with PV start.

  PV start: When the program control starts, SV and step time are advanced to the PV, then the program control is performed.

  (e.g.) PV is assumed to be 100℃ in the program pattern of Section “6.1 Main setting mode”.
  If the program control is performed, the step SV advances from 0℃ to 100℃, and the step time also advances from 1:00 to 0:30.

  Program control stop

  To stop program control, press the OUT/OFF key for approx. 1 second. The program control stops, and the controller reverts to the program control standby mode.

  Action after power is restored

  If power failure occurs during the program control run, the control resumes from the point at which power failure occurred.

  If power failure occurs during program control standby mode, the control resumes from the program control standby mode.

  Progressing time error after power is restored: Within ±1 minute regardless of step time unit

- **Converter**

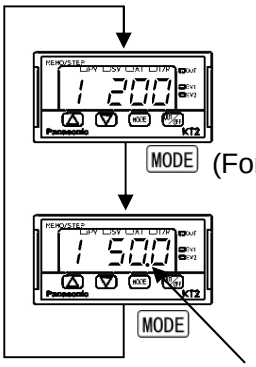
  In the case of DC current output type, each input value (thermocouple, RTD, DC current, DC voltage) is converted to 4 to 20mA DC and outputted.

  Input/output response is approx. 1 second.

  When using an alarm action, select Process alarm during A1, A2 type selection.

7.2 MV (Control output manipulated variable) indication

To indicate MV, hold down the MODE key for approx. 3 seconds in the PV/SV display mode.
Keep pressing the MODE key until MV appears, though SV1 (step 1 SV) setting item appears during the process.

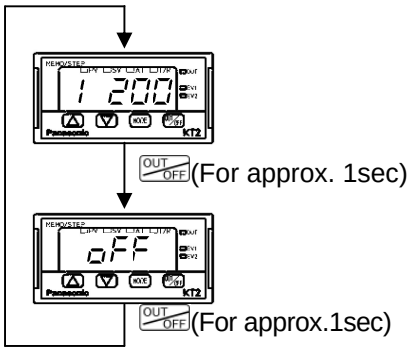


PV/SV display mode
Hold down the MODE key for approx. 3 seconds.
Keep pressing the MODE key until MV appears, though SV1 (step 1 SV) setting item appears during the process.

MV (Control output manipulated variable) indication
The MEMO/STEP display indicates a memory number during fixed value control and a step number during program control.
The PV/SV display indicates MV.
While MV is being indicated, the 1st decimal point from the right flashes in 0.5 second cycles.
To release MV indication function, press the MODE key again or turn the power supply to the KT2 OFF, then ON.

7.3 Control output OFF function

This is a function to pause the control action or to turn the control output of the unused instrument of the plural units OFF even if the power to the instrument is supplied.
To turn the control output OFF, press the OUT/OFF key for approx. 1 second in the PV/SV display mode.

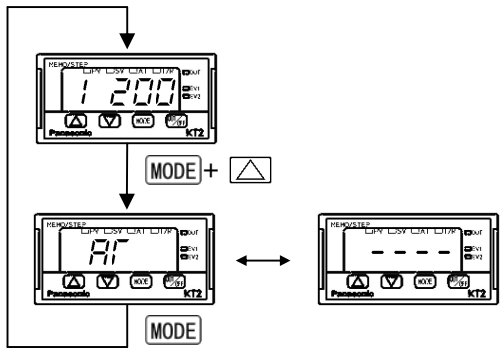


PV/SV display mode
Press the OUT/OFF key for approx. 1 second.

Control output OFF
The MEMO/STEP display is switched off and the PV/SV display indicates oFF. 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.

7.4 Auto-tuning (AT) Perform/Cancel

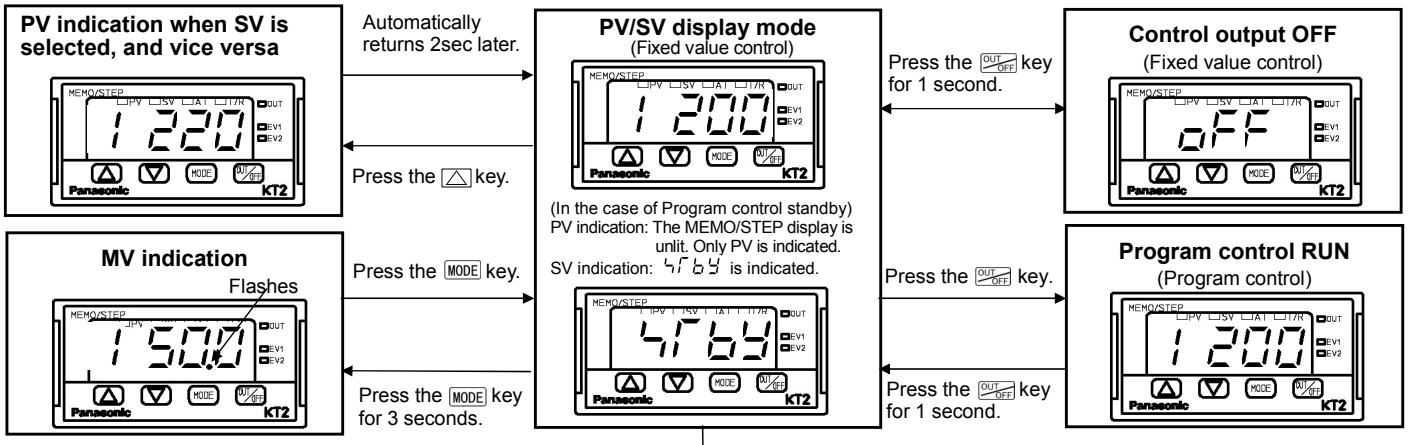
Auto-tuning Perform/Cancel can be selected during AT selection in the Sub setting mode.



PV/SV display mode
Press the MODE key while holding down the △ key.

AT selection in the Sub setting mode
Select Auto-tuning Perform (AT□) with the △ key and Auto-tuning Cancel (----) with the ▽ key, then press the MODE key.
The AT indicator flashes while performing auto-tuning.
If Auto-tuning is cancelled during the process, P, I, D, ARW values return to the previous values.
If PID auto-tuning does not finish in 4 hours after starting, PID auto-tuning is cancelled automatically.

8. Operation flowchart



Press the MODE key. **[Main setting mode]**

Press the MODE key while holding down the △ key. **[Sub setting mode]**

Press the MODE while holding down the ▽ for 3sec. **[Auxiliary function setting mode 1]**

[Main setting mode]

SV1 (Step 1 SV) MEMO/STEP 1 PV/SV SV1	
↓ MODE	
Step 1 time MEMO/STEP 1 PV/SV Set value	
↓ MODE	
SV2 (Step 2 SV) MEMO/STEP 2 PV/SV SV2	
↓ MODE	
Step 2 time MEMO/STEP 2 PV/SV Set value	
↓ MODE	
Step 3 SV MEMO/STEP 3 PV/SV Step 3 SV	
↓ MODE	
Step 3 time MEMO/STEP 3 PV/SV Set value	
Each time the MODE key is pressed, the setting item is switched. / Set SV and time for the necessary step.	
Step 9 SV MEMO/STEP 9 PV/SV Step 9 SV	
↓ MODE	
Step 9 time MEMO/STEP 9 PV/SV Set value	
↓ MODE	
Reverts to the PV/SV display.	

[Sub setting mode]

AT PV/SV AT, Selection	• If AT is cancelled during the process, PID values return to previous values.
↓ MODE	
OUT1 (Heating) proportional band PV/SV P, Set value	• Set the value with the △, ▽ keys. • ON/OFF action when set to 0.0
↓ MODE	
OUT2 (Cooling) proportional band PV/SV P_b, Set value	• Set the value with the △, ▽ keys. • Not available when OUT1 is ON/OFF action
↓ MODE	
OUT1 (Heating) integral time PV/SV I, Set value	• Set the value with the △, ▽ keys. • Setting the value to 0 disables the function.
↓ MODE	
OUT1 (Heating) derivative time PV/SV d, Set value	• Set the value with the △, ▽ keys. • Setting the value to 0 disables the function.
↓ MODE	
ARW PV/SV AR, Set value	• Set the value with the △, ▽ keys. • Available only for PID action
↓ MODE	
OUT1 (Heating) proportional cycle PV/SV c, Set value	• Set the value with the △, ▽ keys. • Not available for DC current output type or if OUT1 is ON/OFF action.
↓ MODE	
OUT2 (Cooling) proportional cycle PV/SV c_b, Set value	• Set the value with the △, ▽ keys. • Not available if OUT2 is ON/OFF action.
↓ MODE	
Manual reset PV/SV rSET, Set value	• Set the value with the △, ▽ keys. • Available only for P and PD action.
↓ MODE	
(5) A1 value PV/SV A1, Set value	• Set the value with the △, ▽ keys. • Not available if ----, Anr□ or P.End is selected during A1 type selection.
↓ MODE	
A2 value PV/SV A2, Set value	• Set the value with the △, ▽ keys. • Not available if ----, Anr□ or P.End is selected during A2 type selection.
↓ MODE	
Reverts to the PV/SV display.	

[Auxiliary function setting mode 1]

PV/SV indication PV/SV PV or SV	• Select PV or SV with the △, ▽ keys.
↓ MODE	
Set value lock PV/SV Lock, Selection	• Make a selection with the △, ▽ keys. • If Lock 1 or Lock 2 is selected, AT does not work. • Be sure to select Lock 3 when using Serial communication.
↓ MODE	
Sensor correction PV/SV So, Set value	• Set the value with the △, ▽ keys.
↓ MODE	
Communication protocol PV/SV cPrL, Selection	• Make a selection with the △, ▽ keys.
↓ MODE	
Instrument number PV/SV cnno, Set value	• Set the value with the △, ▽ keys.
↓ MODE	
Communication speed PV/SV cSPd, Selection	• Make a selection with the △, ▽ keys.
↓ MODE	
Reverts to the PV/SV display.	

Explanation of key

- ↓ MODE : This means that if the MODE key is pressed, the set value is saved, and the controller proceeds to the next setting item.
- If the MODE key is pressed for approx. 3sec, the controller reverts to the PV/SV display mode from any mode.

Character indication

- Characters and set (selected) value of the setting item are indicated on the PV/SV display alternately.
- Setting items with dotted lines are optional and they appear only when the options are added.

Alarm 1 (A1) setting procedures (Numbers (1) to (5) are indicated on the flowchart.)

(1) Select an alarm type during [A1 type selection].
[If ----, Anr□ or P.End is selected, (2) to (5) are not indicated.]
(2) Set A1 hysteresis during [A1 hysteresis setting].
(3) Set A1 action delayed timer during [A1 action delayed timer].
(If input enters alarm action range and setting time has elapsed, the alarm is activated.)
(4) Select if the alarm output is held or not during [Alarm HOLD function selection] (common to A1, A2).
(5) Set A1 action point during [A1 value setting].

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

Input type (Character indication) and range

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

Alarm type

- (High limit alarm): The alarm action is a ±deviation setting from the SV. The alarm is activated if the input value reaches the high limit alarm value.
- (Low limit alarm): The alarm action is a ±deviation setting from the SV. The alarm is activated if the input value goes under the low limit alarm value.
- (High/Low limits alarm): Combines High limit and Low limit alarm actions. When input value reaches high limit alarm value or goes under the low limit alarm value, the alarm is activated.
- (High/Low limit range alarm): When input value is between the high limit alarm value and low limit alarm value, the alarm is activated.
- (Process high alarm), (Process low 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.
- (High limit alarm with standby), (Low limit alarm with standby)
- (High/Low limits alarm with standby)
  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.)
- (Timer function): If external signal enters, timer counting starts, and the action selected during Delay action type selection is outputted after the set delay time has elapsed.
- (Pattern end output): When the program ends normally, pattern end output is turned on. The output is maintained until it is released with the OUT/OFF key.

Press ▽ key for 3sec while holding down the △ key.

[Auxiliary function setting mode 2]

Input type PV/SV, Selection	• Make a selection with the △, ▽ keys. • Default value: K
Scaling high limit PV/SV, Set value	• Set the value with the △, ▽ keys. • Default value: 1370℃
Scaling low limit PV/SV, Set value	• Set the value with the △, ▽ keys. • Default value: -200℃
Decimal point place PV/SV, Selection	• Make a selection with the △, ▽ keys. • Available only for DC input
PV filter time constant PV/SV, Set value	• Set the value with the △, ▽ keys.
OUT1 (Heating) high limit PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available if OUT1 is ON/OFF action
OUT1 (Heating) low limit PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available if OUT1 is ON/OFF action
OUT1 (Heating) ON/OFF action hysteresis PV/SV, Set value	• Set the value with the △, ▽ keys. • Available only when OUT1 is ON/OFF action
EV1 output PV/SV, Selection	• Make a selection with the △, ▽ keys. • Not available if Heat/Cool control option is added
EV2 output PV/SV, Selection	• Make a selection with the △, ▽ keys. • Not available if Serial communication option is added
Overlap/Dead band PV/SV, Set value	• Set the value with the △, ▽ keys. • Available only when Heat/Cool control option is added
OUT2 (Cooling) ON/OFF action hysteresis PV/SV, Set value	• Set the value with the △, ▽ keys. • Available when Heat/Cool control option is added and when OUT2 is ON/OFF action
(1) A1 type PV/SV, Selection	• Make a selection with the △, ▽ keys. • Default value: ----
A2 type PV/SV, Selection	• Make a selection with the △, ▽ keys. • Default value: ----
(2) A1 hysteresis PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available if ----, or is selected during A1 type selection
A2 hysteresis PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available if ----, or is selected during A2 type selection
(3) A1 action delayed timer PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available if ----, or is selected during A1 type selection
A2 action delayed timer PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available if ----, or is selected during A2 type selection
(4) Alarm HOLD function PV/SV, Selection	• Make a selection with the △, ▽ keys. • Common setting item for A1 and A2 Not available if ----, or is selected during A1 or A2 type selection.
Delay action type selection PV/SV, Selection	• Make a selection with the △, ▽ keys. • Available only when is selected during A1 or A2 type selection.
Delay time PV/SV, Set value	• Set the value with the △, ▽ keys. • Available only when is selected during A1 or A2 type selection.
Direct/Reverse control PV/SV, Selection	• Make a selection with the △, ▽ keys. • Default value: REAT (Reverse control action)
AT bias PV/SV, Set value	• Set the value with the △, ▽ keys. • Not available for DC input.
Setting item not used PV/SV, Set value	• Do not set this item even if is indicated on the PV/SV display.
OUT/OFF key function PV/SV, Selection	• Make a selection with the △, ▽ keys. • Selects fixed value control or program control.
Step time unit PV/SV, Selection	• Make a selection with the △, ▽ keys. • Not available if is selected during OUT/OFF key function selection
DI (Digital input) function PV/SV, Selection	• Make a selection with the △, ▽ keys. • Not available if Serial communication option is added
Output status selection when input abnormal PV/SV, Selection	• Make a selection with the △, ▽ keys. • Available only for DC current output type with DC input
Controller/Converter PV/SV, Selection	• Make a selection with the △, ▽ keys. • Available only for DC current output type

Reverts to the PV/SV display.

9. PID auto-tuning

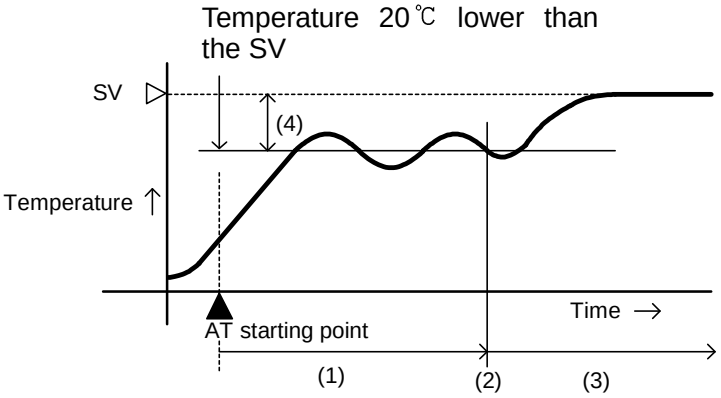
In order to set each value of P, I, D and ARW automatically, the auto-tuning process should be made to fluctuate to obtain an optimal value.

⚠ Notice

- Perform auto-tuning during trial run.
- During auto-tuning, none of the setting items can be set.
- If auto-tuning starts during program control run, auto-tuning performs with SV at which auto-tuning starts. The step time does not progress until auto-tuning ends.
- If power failure occurs during auto-tuning, auto-tuning stops.
- For DC input, the AT process will fluctuate around the SV for conditions of (A), (B) and (C) below.
- 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.

(A) In the case of a large difference between the SV and processing temperature 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.

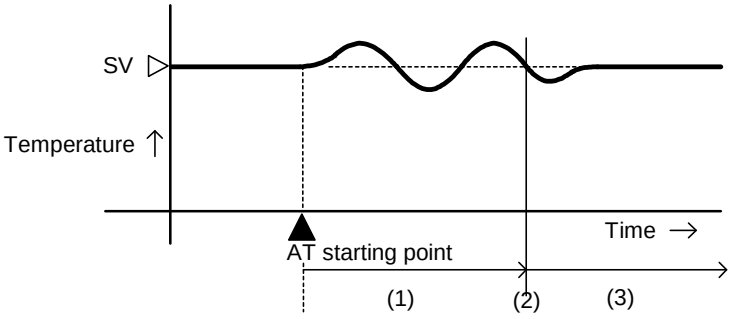


(1) Calculating PID constant
(2) PID constant calculated
(3) Controlled by the PID constant set by auto-tuning.
(4) AT bias value

(Fig. 9-1)

(B) In the case of a stable control

The AT process will fluctuate around the SV.

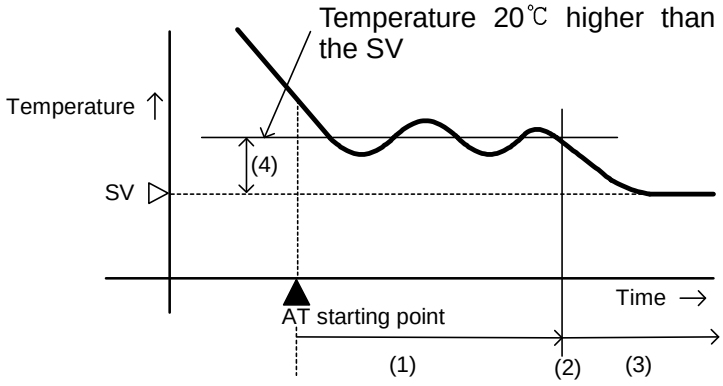


(1) Calculating PID constant
(2) PID constant calculated
(3) Controlled by the PID constant set by auto-tuning.

(Fig. 9-2)

(C) In the case of a large difference between the SV and processing temperature 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.

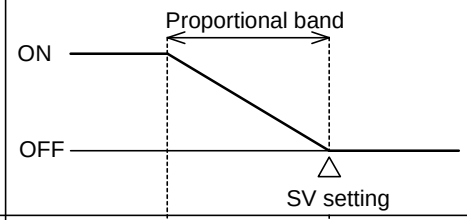
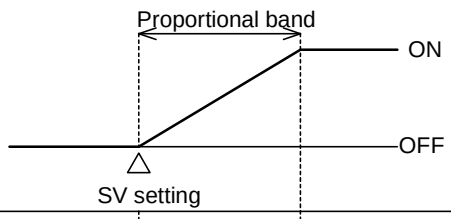
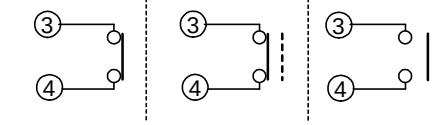
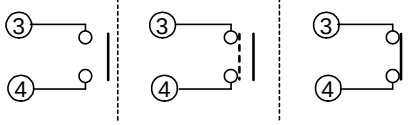
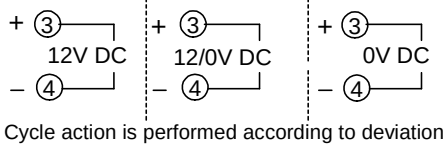
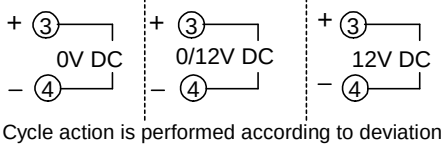
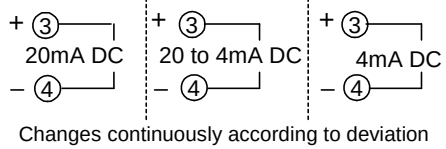
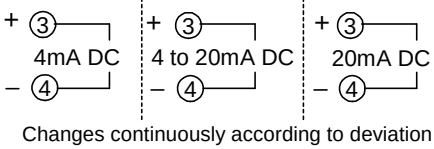
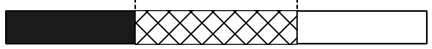
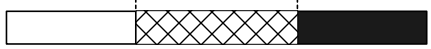


(1) Calculating PID constant
(2) PID constant calculated
(3) Controlled by the PID constant set by auto-tuning.
(4) AT bias value

(Fig. 9-3)

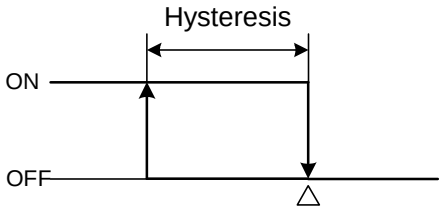
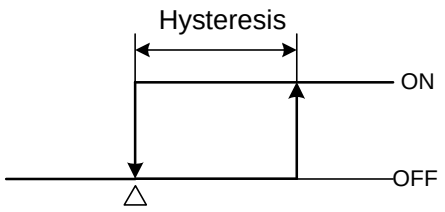
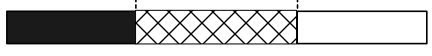
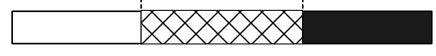
10. Action explanation

10.1 OUT1 (Heating) action

	Heating (Reverse) action	Cooling (Direct) action
Control action		
Relay contact output (OUT1)	 Cycle action is performed according to deviation	 Cycle action is performed according to deviation
Non-contact voltage output (OUT1)	 Cycle action is performed according to deviation	 Cycle action is performed according to deviation
DC current output (OUT1)	 Changes continuously according to deviation	 Changes continuously according to deviation
Indicator (OUT) Green		

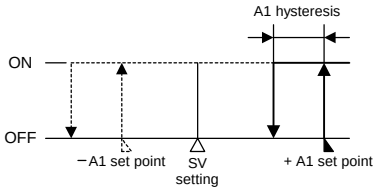
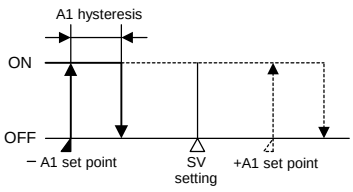
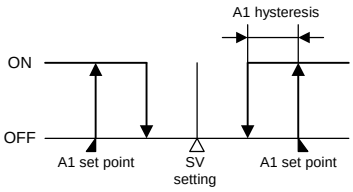
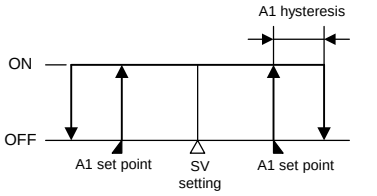
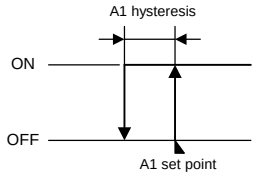
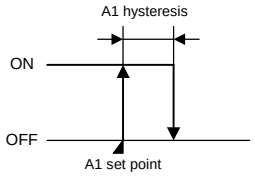
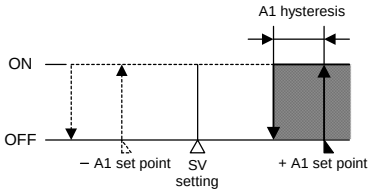
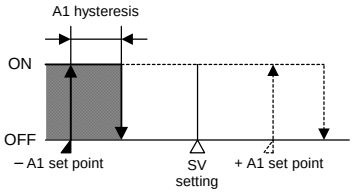
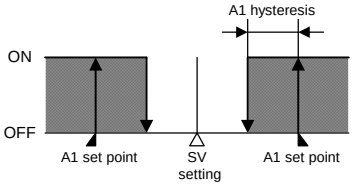
: Acts ON or OFF.

10.2 OUT1 (Heating) ON/OFF action

	Heating (Reverse) action	Cooling (Direct) action
Control action		
Relay contact output (OUT1)		
Non-contact voltage output (OUT1)		
DC current output (OUT1)		
Indicator (OUT) Green		

: Acts ON or OFF.

10.3 A1, A2 action

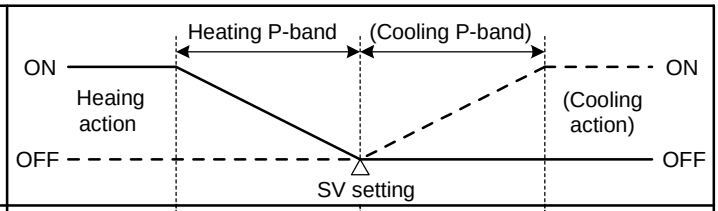
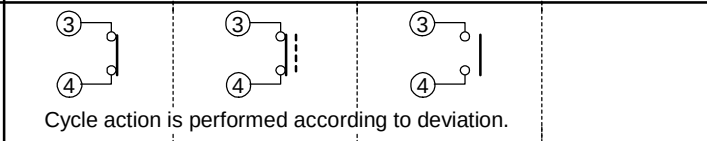
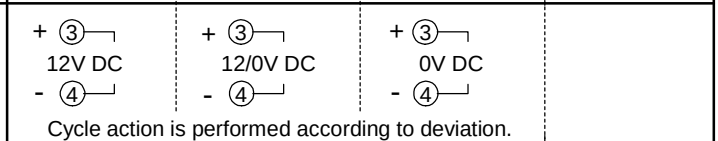
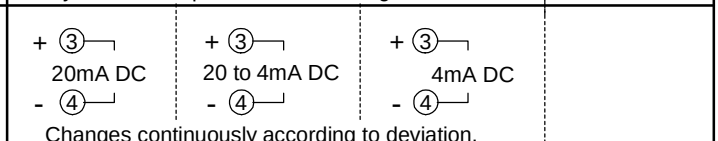
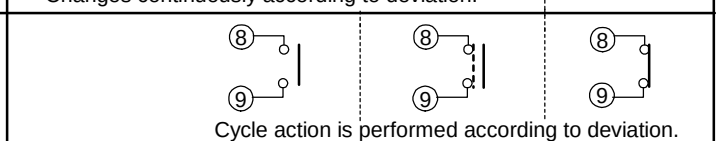
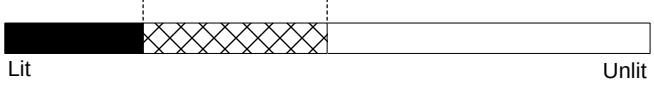
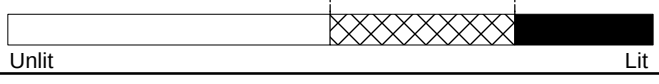
	High limit alarm	Low limit alarm	High/Low limits alarm
Alarm action			
	High/Low limit range alarm	**Process high alarm**	**Process low alarm**
Alarm action			
	High limit alarm with standby	**Low limit alarm with standby**	**High/Low limits alarm with standby**
Alarm action			

: Standby functions in this section.

Terminals 8 & 9 are for the user's own Alarm (or Timer/Pattern end output) indicator, which correlates directly with the EV1 indicator.

Terminals 11 & 12 are for the user's own Alarm (or Timer/Pattern end output) indicator, which correlates directly with the EV2 indicator.

10.4 Heating/Cooling control action (Heating/Cooling control option)

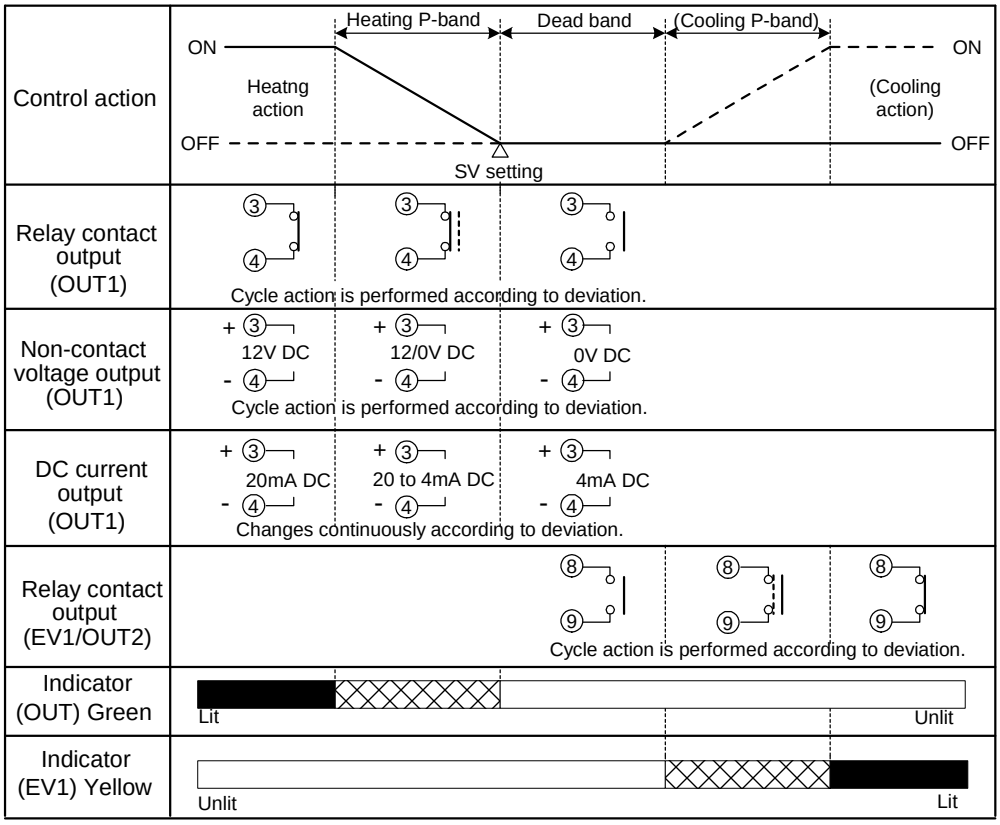
Control action	
Relay contact output (OUT1)	
Non-contact voltage output (OUT1)	
DC current output (OUT1)	
Relay contact output (EV1/OUT2)	
Indicator (OUT) Green	
Indicator (EV1) Yellow	

: Acts ON (lit) or OFF (unlit).

——— : Represents Heating control action.

– – – – : Represents Cooling control action.

10.5 Heating/Cooling control action (When setting dead band) (Heating/Cooling control option)

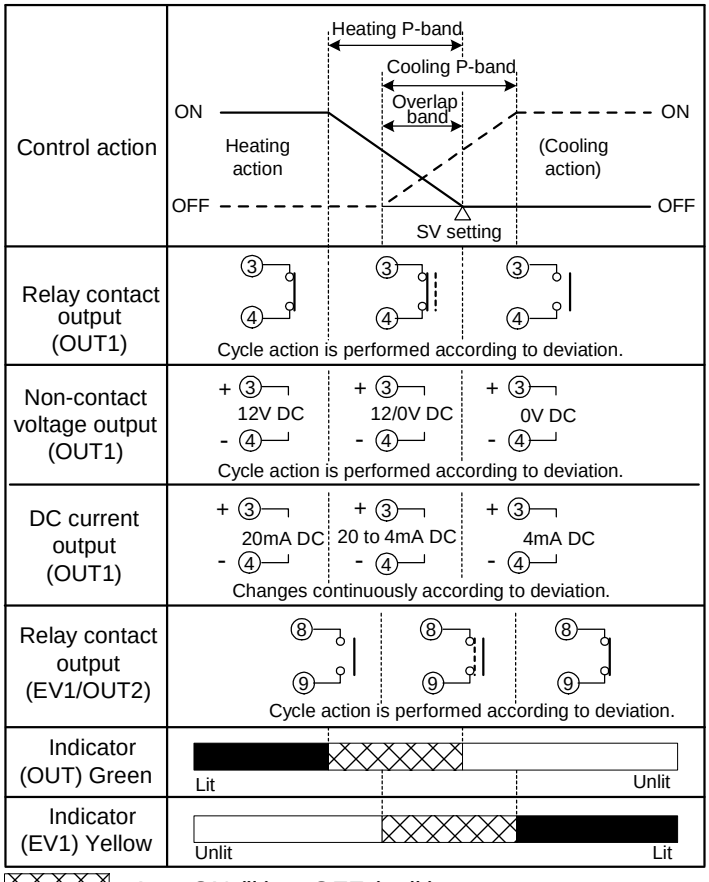


: Acts ON (lit) or OFF (unlit).

——— : Represents Heating control action.

– – – – : Represents Cooling control action.

10.6 Heating/Cooling control action (When setting overlap band) (Heating/Cooling control option)

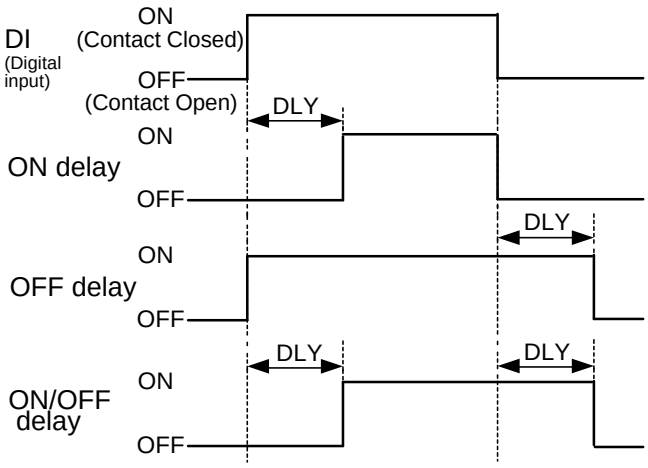


: Acts ON (lit) or OFF (unlit).

——— : Represents Heating control action.

– – – – : Represents Cooling control action.

10.7 Timer action



DLY: Delay time setting

11. Specifications

11.1 Standard specifications

Mounting : Flush
Setting : Input system using membrane sheet key
Display PV/SV display : Red LED 4 digits, character size, 8.7 x 5 mm (H x W)
MEMO/STEP display: Green LED 1 digit, character size, 8.7 x 5 mm (H x W)

Accuracy (Setting and Indication):
Thermocouple : Within±0.2% of each input span±1 digit, or within ±2℃(4℉), whichever is greater
However R, S input, 0 to 200℃ (400℉): Within ±6℃ (12℉)
B input, 0 to 300℃ (600℉): Accuracy is not guaranteed
K, J, E, T, N input, less than 0℃ (32℉): Within ±0.4% of input span±1 digit or within ±4℃ (8℉), whichever is greater
RTD : Within ±0.1% of each input span ±1 digit, or within ±1℃ (2℉), whichever is greater
DC current : Within ±0.2% of each input span ±1 digit
DC voltage : Within ±0.2% of each input span ±1 digit

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, 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: Externally install 50Ω shunt resistor.
Allowable input current (50mA DC or less)
DC voltage : 0 to 1V DC Input impedance (1MΩ or more)
Allowable input voltage (5V DC 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 DC or less)
Allowable signal source resistance (100Ω or less)

Control output (OUT)
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 Max. 40mA DC (short circuit protected)
DC current : 4 to 20mA DC, Load resistance, Max. 550Ω

Event output 1 (EV1), Event output 2 (EV2)
One type can be selected from 10 alarm types (including No alarm action), Timer function and Pattern end output.
Alarm setting range : See (Table 6.2-1) on page 17.
Action : ON/OFF action
Hysteresis TC, RTD input : 0.1 to 100.0℃ (℉)
DC current, voltage input: 1 to 1000 (The placement of the decimal point follows the selection)
A1, A2 delayed timer function: 0 to 9999 seconds
Alarm output HOLD function: Once the alarm is activated, the alarm output is maintained until the power supply to the instrument is turned off.
Timer function : 0 to 9999 seconds
Pattern end output : Pattern end output is turned on when the program ends normally.
EV1 (Relay contact 1a) : Control capacity, 3A 250V AC (resistive load)
1A 250V AC (inductive load cosø=0.4)
Electrical life, 100,000 cycles
EV2 (Open collector) : Control capacity, 0.1A (maximum) 24V DC
Residual voltage: 1.5V or less

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
OUT1 (Heating) proportional band : 0.0 to 110.0% (ON/OFF action when set to 0.0)
OUT1 (Heating) Integral time : 0 to 1000sec (OFF when set to 0)
OUT1 (Heating) Derivative time : 0 to 300sec (OFF when set to 0)
OUT1 (Heating) proportional cycle : 1 to 120sec (Not available for DC current output type)
ARW : 0 to 100%
Manual reset : ±Proportional band converted value
OUT1 (Heating) ON/OFF action hysteresis: 0.1 to 100.0℃ (℉), or 1 to 1000
OUT1 (Heating) output limit : 0 to 100% (DC current output type: –5 to 105%)

DI (Digital input)

DI (Digital input) has 3 functions.

- **SV1/SV2 external selection function**

  SV1 or SV2 can be switched by external contact. However, this function is not available if Program control function is selected during OUT/OFF key function selection.

  DI terminals between 10 and 12 Open: SV1

  DI terminals between 10 and 12 Closed: SV2

- **OUT/OFF (RUN/STOP) external selection function**

  Control output OUT/OFF (Fixed value control) or Program control RUN/STOP can be switched.

  [Fixed value control]

  DI terminals between 10 and 12 Open: OUT (Control allowed)

  DI terminals between 10 and 12 Closed: OFF (Control prohibited, control output OFF)

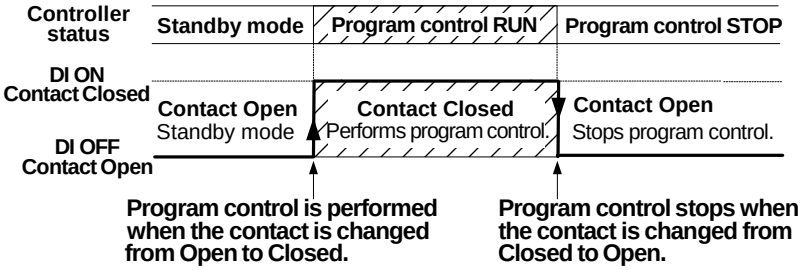
  [Program control]

  Program control RUN/STOP can be switched if the following operation is conducted during program control standby.

  Between DI terminals from Open to Closed: RUN (program control run)

  Between DI terminals from Closed to Open: STOP (program control stop)

  If DI terminal contact is changed from Closed to Open while pattern end output is turned on after program control ended, pattern end output is turned off.



Circuit current when closed: 6mA

- **Timer function**

  Timer counting starts by the external contact, and after the set delay time has elapsed, the selected event output is turned on.

Program control function

If program control function is selected during OUT/OFF key function selection, 1 pattern 9 steps program control can be performed.

To start program control, press the OUT/OFF key during program control standby.

(To stop the program control, press the OUT/OFF key for approx. 1 second again.)

Progressing time error: Within ±1 minute

Pattern end output: Pattern end output can be selected by keypad.

Converter function

If Converter function is selected during Controller/Converter function selection, the following control parameters are automatically set, and the controller can be used as a converter. (However, available only for DC current output type). Input/output response is approx. 1 second.

SV1 (main set value): Scaling low limit value, OUT1 (Heating) integral time: 0, OUT1 (Heating) derivative time: 0, OUT1 (Heating) proportional band: 100.0%, Manual reset: 0.0, A1 value: 0, A2 value: 0, Direct/Reverse action: Direct action

Attached functions

[Set value lock] Locks set values to prevent setting errors.

[Sensor correction] The PV is corrected when the temperatures in the controlled location differs from those of the sensor location.

[PV filter] Reduces the effect of noise by putting first order lag filter in the PV.

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

[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 the instrument, and always maintains the same status as when the reference junction is located at 0℃ (32℉).

[Burnout]

When the thermocouple or RTD input is burnt out, OUT1 and EV1/OUT2 (Heating/Cooling control option) are turned off [for DC current output type, OUT1 (Heating) low limit value], and PV/SV display flashes "- - - -".

[Warm-up indication]: After the power supply to the instrument is turned on, the sensor input characters and temperature unit are indicated on the PV/SV display for approx. 3 seconds.

[Temporary PV/SV indication] If the Increase key is pressed during the PV/SV display mode, then the opposite value to the value selected during PV/SV indication selection is indicated temporarily. The value automatically reverts to the previous value in 2 seconds.

[Input abnormality indication]

Output status selection when input abnormal	Contents and Indication	Output status					
		Controller				Converter	
		OUT1		OUT2		OUT1	
		Direct	Reverse	Direct	Reverse	Direct	Reverse
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	ON	ON (20mA) or OUT1 high limit value	OFF (4mA) or OUT1 low limit value
oFF		OFF (4mA) or OUT1 low limit value			OFF		
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	OFF	OFF(4mA) or OUT1 low limit value	ON (20mA) or OUT1 high limit value
oFF			OFF(4mA) or OUT1 low limit value	OFF			

[Output status selection when input abnormal] is available only for DC input and DC current output. For other inputs and outputs except for DC input and DC current output, the output status will be the same as when OFF is selected during [Output status selection when input abnormal].

(*): Outputs a value between OFF (4mA) and ON (20mA) or between OUT1 (Heating side) low limit value and OUT1 (Heating side) high limit value, depending on 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℉

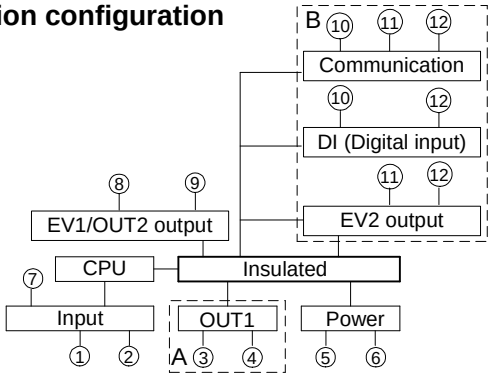
Indication range and Control range for thermocouple inputs other than the above:
Input range low limit value –50℃ (100℉) to Input range high limit value +50℃ (100℉)

DC input

Indication range: Scaling low limit value–Scaling span x 1% to Scaling high limit value– Scaling span x 10%
However, "- - - - -" or "- - - - -" flashes when the range of –1999 to 9999 is exceeded.
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/SV 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/SV display indicates the value corresponding with 0mA or 0V input.

Circuit insulation configuration



When OUT1 is non-contact voltage output or DC current output, A is not insulated from B.

A: Terminals 3, 4
B: Terminals 10, 11, 12

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. 5VA
Ambient temperature : 0 to 50℃ (32 to 122℉)
Ambient humidity : 35 to 85%RH (no condensation)
Weight : Approx. 120g

External dimensions : 48 x 24 x 98.5mm (W x H x D)
Case (Material, Color) : Flame-resistant resin, Ash gray
Accessories included : Instruction manual 1 copy, Mounting frame 1 piece
Accessories sold separately: Shunt resistor 1 piece (50Ω) : AKT4810
Terminal cover 1 piece : AKT2801

11.2 Optional specifications

Heating/Cooling control (option)

OUT2 (Cooling) proportional band: 0.0 to 10.0 times OUT1 proportional band (ON/OFF action when set to 0.0)
OUT2 (Cooling) Integral time and OUT2 (Cooling) derivative time are the same as those of OUT1 action.
OUT2 (Cooling) proportional cycle: 1 to 120 seconds
Overlap band/Dead band setting range
TC, RTD input: -100.0 to 100.0℃ (℉)
DC current, voltage input: -1000 to 1000 (The placement of the decimal point follows the selection)
OUT2 (Cooling) output ON/OFF action hysteresis setting
TC, RTD input: 0.1 to 100.0℃ (℉)
DC current, voltage input: 1 to 1000 (The placement of the decimal point follows the selection)
Output: Relay contact 1a, Control capacity 3A 250V AC (resistive load), 1A 250V AC (inductive load cosø=0.4)

Serial communication (option)

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

Communication method : Half-duplex
Cable length : Maximum communication distance 1,000m
Cable resistance: Within 50Ω (The terminator is not necessary or 120Ω or more on the PLC side.)
Communication line : EIA RS-485
Number of connectable units: Maximum 31 units
Communication speed : 9600bps (2400, 4800, 9600, 19200bps) Selectable by keypad
Synchronous system : Start-stop sychronization
Instrument number : 0 (0 to 95) Selectable by keypad
Communication protocol : Modbus ASCII (Modbus ASCII, Modbus RTU) Selectable by keypad
Code form : ASCII (Modbus ASCII), Binary (Modbus RTU) (*)
Error detection : Parity, LRC (Modbus ASCII), CRC (Modbus RTU) (*)
Error correction : Command request repeat system
Data format Start bit: 1 bit Data bit: 7 bits (Modbus ASCII), 8 bits (Modbus RTU) (*)
Parity: Even (Modbus ASCII), No parity (Modbus RTU) (*), Stop bit: 1 bit
(*): Automatically selected upon selecting the communication protocol.)

12. Troubleshooting

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

12.1 Indication

Problem	Presumed cause and solution
The PV/SV display is indicating [oFF].	• Control output OFF function is working. To release the function, press the OUT/OFF key for approx. 1 second.
The PV/SV display is indicating [STBY].	• This is program standby status. If Program control function is selected during OUT/OFF key functon selection and if SV is selected during PV/SV indication selection, "STBY" is indicated during program standby. If PV is selected during PV/SV indication selection, the PV is indicated.
The PV/SV display is flashing [ ].	• Burnout of Thermocouple, RTD or disconnection of DC voltage (0 to 1V DC). Change each sensor. **How to check whether the sensor is burnt out** [Thermocouple] If the input terminals of the instrument are shorted and if a value around room temperature is indicated, the instrument is likely to be operating normally, however, the sensor may be burnt out. [RTD] If approximate 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 terminals of the instrument are 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 signal source for 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 terminals 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 terminals 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 whether the input signal wires of thermocouple, RTD or DC voltage (0 to 1V DC) are securely connected to the instrument input terminal. Ensure that the sensor terminals are connected to the instrument input terminals securely.
The PV/SV display is flashing [- - - -].	• Check whether the input signal wires for DC voltage (1 to 5V DC) or DC current (4 to 20mA DC) are securely connected to the instrument input terminals. • Check whether the polarity of thermocouple or compensating lead wire is correct. Check whether codes (A, B, B) of the RTD agree with the instrument terminals. Ensure that they are wired properly.
The PV/SV display keeps indicating the value which was set during Scaling low limit setting.	• 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 terminals 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 terminals 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 lead wire terminals for DC voltage (0 to 5V DC, 0 to 10V DC) or DC current (0 to 20mA DC) are securely connected to the instrument input terminals.
The indication of the PV/SV display is abnormal or unstable.	• Check whether the sensor input and temperature unit (℃ or ℉) setting are correct. Set the sensor input and the temperature unit (℃ or ℉) properly. • Sensor correcting value is unsuitable. Set it to a suitable value. • 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/SV display is indicating [Err 1].	• Internal memory is defective. Contact the agent or Panasonic Industrial Devices SUNX Co., Ltd.

12.2 Key operation

Problem	Presumed cause and solution
• Unable to set the SV1, P, I, D, proportional cycle or alarm. • The values do not change by the △, ▽ keys.	• A set value lock mode (Lock 1 or Lock 2) has been selected. Release the lock mode. • PID auto-tuning is performing. Cancel auto-tuning. • No alarm action, Timer function or Pattern end output has been selected during A1, A2 type selection. Select an alarm type after checking the selection.
SV2 cannot be set.	• SV1/SV2 external selection function has not been selected during DI (Digital input) function selection. Select SV1/SV2 external selection function after checking the selection. Not available if Serial communication option is applied.
The setting indication does not change within the input range even if the △, ▽ keys are pressed, and new values are unable to be set.	• Scaling high or low limit value in Auxiliary function setting mode 2 may be set at the point where the value does not change. Set it to a suitable value in Auxiliary function setting mode 2.

12.3 Control

Problem	Presumed cause and solution
Temperature does not rise.	• Sensor is out of order. Replace the sensor. • Check whether sensor or actuator is securely connected to the input or output terminals of the instrument. • Ensure that the wiring of sensor and actuator are correct.
The control output remains in an ON status.	• OUT1(Heating) low limit value in Auxiliary function setting mode 2 is set to 100% or higher. Set it to a suitable value.
The control output remains in an OFF status.	• OUT1(Heating) high limit value in Auxiliary function setting mode 2 is set to 0% or less. Set it to a suitable value.
Program control ends soon even if it is performed.	• Step time has been set to 00:00. Set the step time.
Timer does not work.	• Check whether Delay action type or Delay time is set properly. Ensure that the value is set or selected properly. • Check whether Timer function has been selected during DI (Digital input) function selection. Select the Timer function after checking. If Serial communication option is applied, DI (Digital input) function selection is not available.

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

13. Character table

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[Main setting mode]

Indication	Setting item	Default value	Data
1SP1	SV1 (step 1 SV)	0℃	
1TM1	Step 1 time	00:00	
2SP1	SV2 (step 2 SV)	0℃	
2TM1	Step 2 time	00:00	
3SP1	Step 3 SV	0℃	
3TM1	Step 3 time	00:00	
4SP1	Step 4 SV	0℃	
4TM1	Step 4 time	00:00	
5SP1	Step 5 SV	0℃	
5TM1	Step 5 time	00:00	
6SP1	Step 6 SV	0℃	
6TM1	Step 6 time	00:00	
7SP1	Step 7 SV	0℃	
7TM1	Step 7 time	00:00	
8SP1	Step 8 SV	0℃	
8TM1	Step 8 time	00:00	
9SP1	Step 9 SV	0℃	
9TM1	Step 9 time	00:00	

[Sub setting mode]

Indication	Setting item	Default value	Data
ATUN	AT (Auto-tuning)	AT Cancel	
P	OUT1 (Heating) proportional band	2.5%	
P_b	OUT2 (Cooling) proportional band	1.0 times	
I	OUT1 (Heating) integral time	200 seconds	
d	OUT1 (Heating) derivative time	50 seconds	
ARW	ARW	50%	
c	OUT1 (Heating) proportional cycle	Relay contact: 30sec Non-contact: 3sec DC current: Unavailable	
c_b	OUT2 (Cooling) proportional cycle	30 seconds	
rSET	Manual reset	0.0℃	
A1	A1 value	0℃	
A2	A2 value	0℃	

[Auxiliary function setting mode 1]

Indication	Setting item	Default value	Data
PV/SV	PV/SV indication	PV indication	
Lock	Set value lock	Unlock	
Sn□□	Sensor correction	0.0℃	
cnnL	Communication protocol	Modbus ASCII	
cnno	Instrument number	0	
cnnP	Communication speed	9600bps	

[Auxiliary function setting mode 2]

Indication	Setting item	Default value	Data
InPt	Input type	K: -200 to 1370℃	
rrLH	Scaling high limit value	1370℃	
rrLL	Scaling low limit value	-200℃	
dP□□	Decimal point place	No decimal point	
FILr	PV filter time constant	0.0 seconds	
oLH□	OUT1 (Heating) high limit	100%	
oLL□	OUT1 (Heating) low limit	0%	
HYS□	OUT1 (Heating) ON/OFF action hysteresis	1.0℃	
E1nL	EV1 output	A1 output	
E2nL	EV2 output	A2 output	
db□□	Overlap band/Dead band	0.0℃	
HYSb	OUT2 (Cooling) ON/OFF action hysteresis	1.0℃	
AL1F	Alarm 1 (A1) type	No alarm action	
AL2F	Alarm 2 (A2) type	No alarm action	
A1HY	Alarm 1 (A1) hysteresis	1.0℃	
A2HY	Alarm 2 (A2) hysteresis	1.0℃	
A1dY	A1 action delayed timer	0 seconds	
A2dY	A2 action delayed timer	0 seconds	
AHLd	Alarm HOLD function	Alarm Not Holding	
dLYF	Delay action type	ON delay	
dLYt	Delay time	0 seconds	
cont	Direct (Cooling)/Reverse (Heating) control	Reverse (Heating)	
AT_b	AT bias	20℃	
Sn_b	Setting item not used		
Proc	OUT/OFF key function	Control output OUT/OFF	
tn_□	Step time unit	Hour:Minute	
dI nL	DI (Digital input) function	SV1/SV2 external selection	
EoUt	Output status selection when input abnormal	Output OFF	
FUnc	Controller/Converter function	Controller function	

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Pursuant to the directive 2004/108/EC, article 9(2)
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