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WATANABE ELECTRIC INDUSTRY CO., LTD.

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INSTRUCTION MANUAL

DIGITAL TEMPERATURE CONTROLLER MODEL ATC-217

Thank you for purchasing our temperature controller. First, please check that the controller delivered is as ordered, and then use it according to the following.
In addition, please always hand this instruction manual to the operator of this controller.

■ If RS-485 (Modbus) or RS-485 (Z-ASCII) communication together with the specified Model was bought, download the instruction manual for "Communication function" from our website. The detailed operation manual for this product can also be downloaded from our website.

Caution!
The contents of this manual may be subject to change without prior notice.
This manual has been carefully prepared. However, for any damage including indirect damage inflicted on you as a result of typographical errors or incorrect descriptions in this manual, or your misunderstanding, Watanabe electric industry will not bear the responsibility.

Checking specifications and accessories

Checking specifications and accessories prior to using the product, check that the Model No. delivered is the same as that when ordered.
(Model Nos. list is described on page 4. Check that all of the following accessories are delivered.)

- Temperature controller ..... 1 set
- Instruction manual ..... 1 copy
- Mounting frame ..... 1 pc.
- Packing ..... 1 pc.
- I/V unit ..... 1 pc. (Only for 4 to 20 mA DC input type) (250 Ω resistor)

Please read this section, first.

Prior to operation, carefully read "Caution for safety". In this section, important items relating to safety are described. Always observe them. Safety is classified into "Warning" and "Caution".

⚠ Warning	If incorrectly operated, death or serious injury may result.
⚠ Caution	If incorrectly operated, the operator or equipment may be damaged.

1. ⚠ Warning

1.1 Mounting and wiring

- The insulation class of this controller is as follows.Prior to mounting, check that the insulation class of this controller is as satisfied.

——— : Basically isolated ——— : Not isolated ——— : Function isolated

Power	Measured-value input
Control output 1 (Relay output)	Internal circuit
Control output 2 (Relay output)	Control output 1 (SSR drive output/current output)
Alarm output 1 (ALM1)	Control output 2 (SSR drive output/current output)
	Transfer output
	DI input (For transfer output)
Alarm output 2 (ALM2)	Communication (RS-485)
	DI input (When other than transfer output)

- If fault or defect of this controller causes a serious accident, externally install an appropriate protecting circuit.
- As this controller is not provided with a power switch and a fuse, install them on your side if needed.
  In addition, install the fuse between the main power switch and controller. (Main power switch: 2-pole breaker, Fuse rating: 250 V, 1 A)
- As power supply wires, use 600 V vinyl insulating wires or equal.
- In order to prevent equipment damage or fault, always apply the rated power supply voltage.
- In order to prevent electric shock or equipment damage, turn on the power after all of the wiring is completely finished.
- In order to prevent electric shock or equipment fire, check that there is no any obstacle near the controller and equipment before the power is turned on.
- Do not touch any terminals while the power is turned on. If so, electric shock or malfunction may result.
- Never disassemble, modify or repair the controller. If so, malfunction, electric shock or fire may result.

1.2 Maintenance

- Mount or dismount the controller after the power is turned off. If not, electric shock, malfunction or failure may result.
- In order to use the controller continuously and safely, it is recommended that periodic maintenance be conducted.
  Some parts used in the controller may have service lives or undergo secular changes.
- The warranty period of the mainframe including accessories is one year when used normally.

2. ⚠ Caution

2.1 Mounting caution

When mounting the controller, avoid the following locations where:
- the ambient temperature is not between 0°C and 50°C when used,
- the ambient humidity is not between 45% and 85% RH when used,
- a temperature change is rapid and thus dew condenses,
- corrosive gases (such as sulfurized gas or ammonia) or inflammable gases exist,
- vibration or shock is directly applied to the mainframe, (If applied, output relays may malfunction.)
- Locations subject to exposure to water, oil, chemicals, vapor or steam (if the controller is immersed in water, it must be checked by your vendor as leakage of electricity or fire may result).
- Locations subject to excessive amounts of dust, salt, or iron exposure.
- Locations subject to high induction interference where static electricity, magnetism, or noise tends to occur.
- the controller is directly exposed to the sunshine, and
- heat accumulation may be caused by radiation.

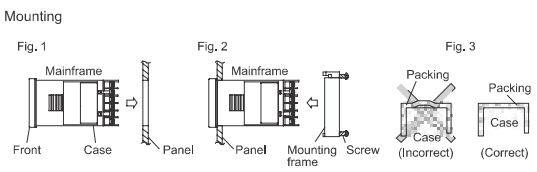
2.2 Caution when mounting on panel

- Insert the mounting frame into the panel from the rear until the mainframe is firmly secured to the panel. If any backlash still exists, slowly tighten screws at two locations until it is removed. (If strongly tightened, the mounting frame may be disengaged from the stopper.)
- The front of this controller is in water-resistant construction conforming to NEMA-4X (equivalent to IP66). However, water tightness between the controller and panel is assured by using the packing attached. Therefore, mount the controller according to the following procedure. (If incorrectly mounted, water tightness may be lost.)

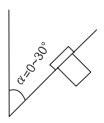
(1) As shown in Fig. 1, insert the packing into the controller case and then insert that controller into the panel.
(2) As shown in Fig. 2, tighten screws for the mounting frame or mounting bracket so that no gap may exist between the front of the controller, the packing and the panel. At this time, as shown in Fig. 3, check that there is no dislocation, disengagement or deformation of the packing.

- If the panel is not rigid, a gap exists between the packing and panel, and thus water tightness may be lost.

Mounting



Standard: Mounting on vertical panel (Horizontal controller position)
When slantly mounted: Maximum backward angle of inclination, 30°

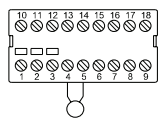


Caution !
- Do not block controller surroundings. If so, heat radiation is hindered.
- Do not block ventilation holes on the upper parts of terminals.

2.3 Wiring caution

- For thermocouple input, use specified compensating lead wires. For RTD, use lead wires with small resistance and also no resistance difference between three wires.
- In order to avoid the effect of noise induction, separate input signal wires from poser and load lines.
- Separate input signal wires from output signal wires, and use shielding wires for both of these input and output signals.
- If much noise is generated from the power source, it is recommended that an isolation transformer be added and a noise filter be used. (Ex.: ZMB22R5-11 noise filter made by TDK)
  Always install the noise filter on a grounded panel and connect the noise filter output side to the controller power supply terminals using wires as short as possible. Do not install a fuse or a switch on the noise filter output side. If so, the effect of the noise filter worsens.
- In order to eliminate noise generation, it is effective to twist controller power supply wires.
  (The shorter the twisted pitch, the more effective the noise rejection.)
- For the controller with a heater break alarm, connect the heater power and the controller power to the same power supply line.
- Some time period is required for activating the contact output after the power is turned on.
  If this output is used as a signal for activating an external interlock circuit, also use a delay relay.
- If the output relay is connected to a load with almost the same capacity as the relay, its service life may shorten. Therefore in this case, add auxiliary relays. If the frequency of output activation is high, it is recommended to select the type of SSR/SSC drive output.
  [Proportional cycle]
  For relay output: More than 30 sec
  For SSR/SSC: More than 1 sec
- When an induction load such as a magnetic switch is used as a relay output load, it is recommended that Fuji Z-WRAP be used so that the contact can be protected from surge current and thus can be used for a long period of time.
  Type: ENC241D-05A (For a voltage of 100 V)
  ENC471D-05A (For a voltage of 200 V)
  Connecting position:
  Between contacts of relay control output

[Example]



Z-WRAP connection diagram

- SSR/SSC drive output, 4 to 20 mA DC output and transfer output are not electrically isolated from the internal circuit. As thermocouple or RTD, use a non-grounded sensor.

2.4 Caution for key operation/operation when in failure

- The alarm function, if not correctly set, is not correctly activated when any failure occurs in the controller. Therefore, always check its activation before operation.
- If an input break occurs, the display shows UUUU or LLLL. When replacing the sensor, always turn off the power.

2.5 Others

- Do not wipe dust off the controller with an organic solvent such as alcohol or benzene. In this case, use a neutral detergent.

In order to use the controller correctly

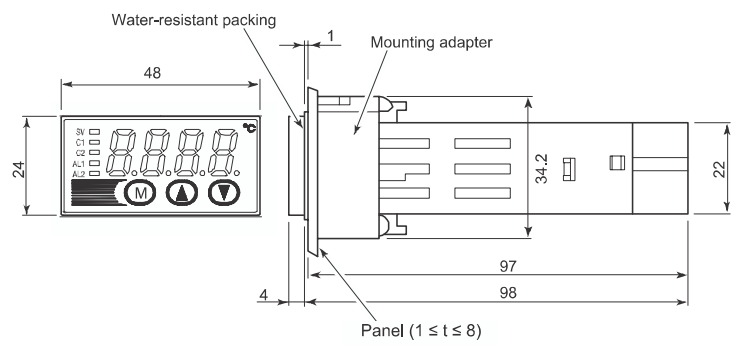
Reference items		Details
Specified Model No. check		• Check that the product with the same Model No. as that when ordered is delivered.
1	Installation/mounting	• External dimensions • Panel cutout dimensions • Mounting on panel
2	Wiring	• Terminal connection diagram
Power ON		
3	Operation	• Procedure for changing temperature setpoint
4	Display and operating procedure	• Basic operating procedure
5	Procedures for temperature and parameter settings	• Parameter list • Input/output/alarm code list
6	Function of temperature controller	
7	Correct operation	• Input sensor/input range setting • Controlling method selection • Automatic control parameter setting by auto-tuning
Operation		
8	When display is incorrect	• Display when in failure

* About 30 min. is required until the mainframe is thermally stabilized. Therefore, start measurement more than 30 min. after the power is turned on.

1 Installation/mounting

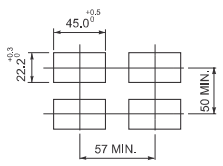
External/panel cutout dimensions (For standard type)/(For water-resistance type)

External dimensions

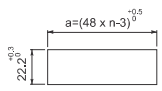


Panel cutout dimensions

When separately mounted (Unit: mm)



When closely mounted

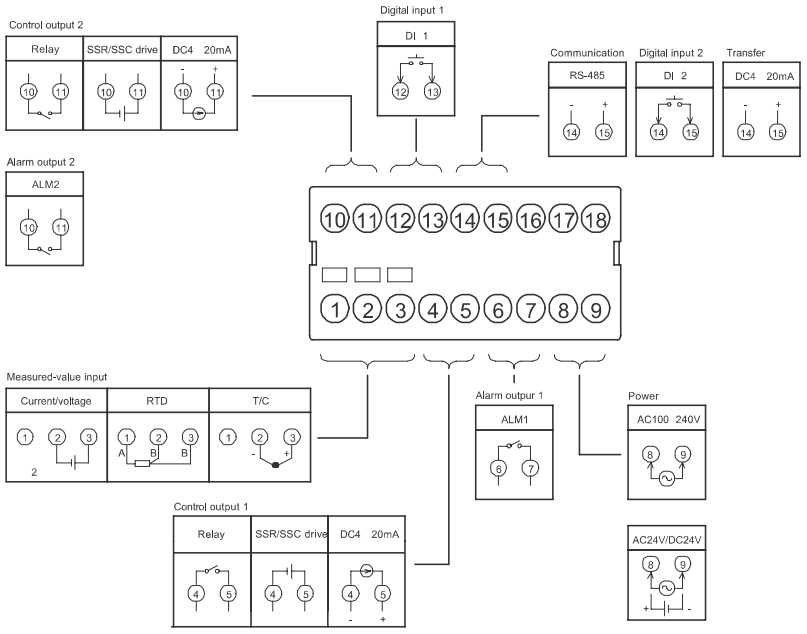


No. of units	2	3	4	5	6
a	93	141	189	237	285

Notes:
- No water-resistance effect is displayed when closely mounted.
- Use each controller at a maximum ambient temperature of 45°C when closely mounted.

2 Wiring

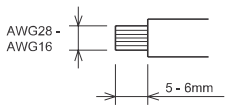
Terminal connection diagram (100 to 240 V AC) or (24 V DC/24 V AC)



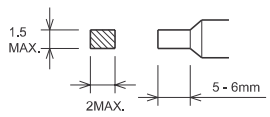
Note 1: First check the power supply voltage, and then mount the controller.
Note 2: For current input, connect the I/V unit (a resistor of 250) attached between the (2) and (3) terminals.
Note 3: Firmly tighten each terminal screw (tightening torque: 0.4 N•m).

Specified wiring materials

• Wire
Wire size
Stripped wire length from the wire end



• Solid wire terminal
Exposed conductor shape: 2 x 1.5 mm or less
Exposed conductor length: 5 to 6 mm



Recommended solid wire terminal
The following terminals or equal
Made by Nichifu
Type: TMEV TC-0.3-9.5
TMEV TC-1.25-11S
Tel. No.: 06-6911-1411

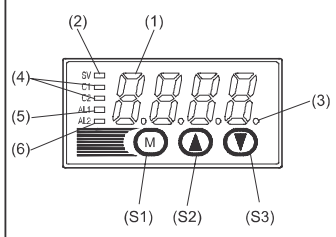
Made by Daido Terminal Manufacturing
Type: AVA-1.25L
BVA-1.25L
Tel. No.: 0857-53-1212

* Cut the conductor so as to adjust its length.

Caution
In order to prevent wire disconnection or shorting, always use any of the above wiring materials and insert each wire deep into the bottom of the terminal board.
Tightening torque: 0.4 N•m

3 Operating procedure (Read this section before operation.)

Terminal connection diagram (100 to 240 V AC) or (24 V DC/24 V AC)



Operating section

	Name	Function
(S1)	SELECT key	Used to select the parameter set mode in the 1st, 2nd or 3rd block when changed to the 1st, 2nd or 3rd block parameter.
(S2)	UP key	• Pressing this key once increases by 1. Keeping pressing this key continuously increases the numeric value. • Also used to move the parameter in the 1st, 2nd or 3rd block.
(S3)	DOWN key	• Pressing this key once increases by 1. Keeping pressing this key continuously decreases the numeric value. • Also used to move the parameter in the 1st, 2nd or 3rd block.

Display unit

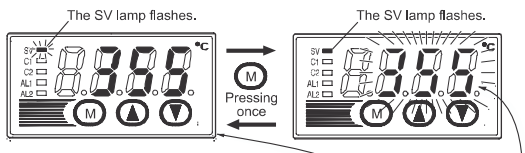
	Name	Function
(1)	Display of measured value (PV)/setpoint (SV)/parameter name or parameter setting	1) Displays measured value (PV) or setpoint (SV) in the operation/standby state. 2) Displays parameter name or parameter setpoint when it is set. 3) Displays warning (when in failure). For the display when in failure, refer to "8, Read this section when the display is abnormal". 4) Flashes during SV display in the standby state. 5) Displays the setpoint (SV) and "SV-X" (X: 1 to 3) alternately while SV is being displayed with the SV select function used.
(2)	Setpoint (SV) indicator	1) Lights when the setpoint (SV) is displayed. 2) Flashes during measured-value (PV) in the standby state.
(3)	Display of auto-tuning/self-turning	Flashes during PID auto-tuning or self-tuning.
(4)	Control output indicator	C1: Lights with control output 1 turned on. C2: Lights with control output 2 turned on. Note 1)
(5)	Alarm output 1 (ALM1) indicator Note 1)	Lights when alarm output 1 is activated, or flashes during ON delay operation.
(6)	Alarm output 2 (ALM2) indicator Note 1)	Lights when alarm output 2 is activated or flashed during ON delay operation.

Note 1): Control output 2 and alarm function are optional.

4 Display and operating procedure

When on standby

• Turns on STby in the 1st block.



• Action during standby operation
(Output)
Neither control outputs (1 and 2) nor alarm outputs (all) are output.
However, the control signal is output by the control method (P-n1) when in input failure.

Caution When on standby, no mainframe failure alarm is output.

[Control]: No control is performed.
[Display]: The SV lamp flashes during PV display.
The SV displayed value flashes during SV display.

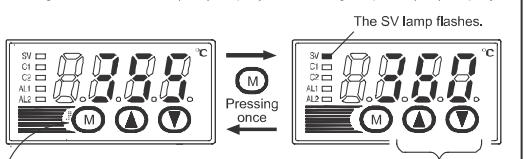
Caution No display flashes while the 1st, 2nd or 3rd block is being displayed.

[Setting]: It is possible to set SV values and parameters.

Selected by the STby setting in the 1st block.

During operation

1 Setpoint (SV) change



Caution To be automatically registered 3 sec after the data is set.

2 Movement to the 1st, 2nd or 3rd block

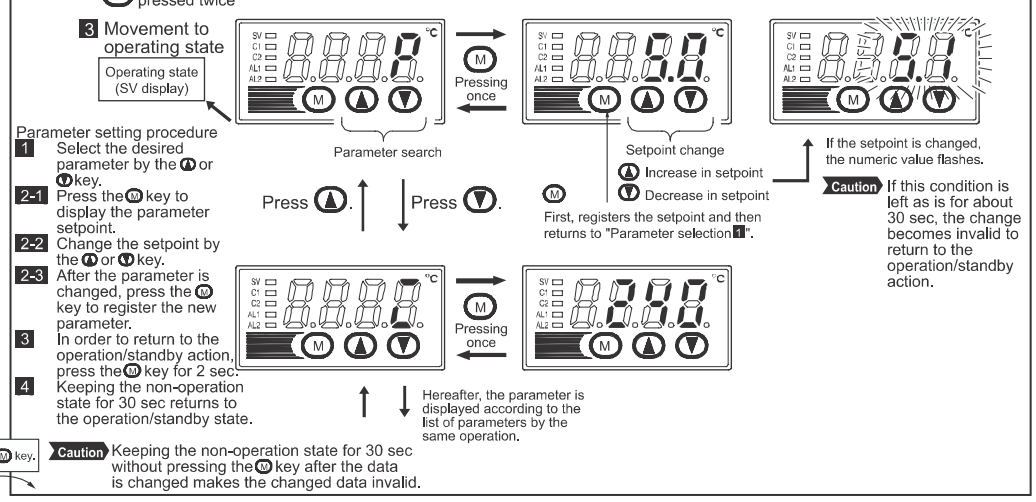
If (M) is pressed, it is possible to move the present block.

Caution The moving block is selected according to the lapse of time when (M) is pressed.

(M) pressing time	Moving block
For about 1 sec	1st block
For about 3 sec	2nd block
For about 5 sec	3rd block

Selected by the (M) key.

During parameter setting



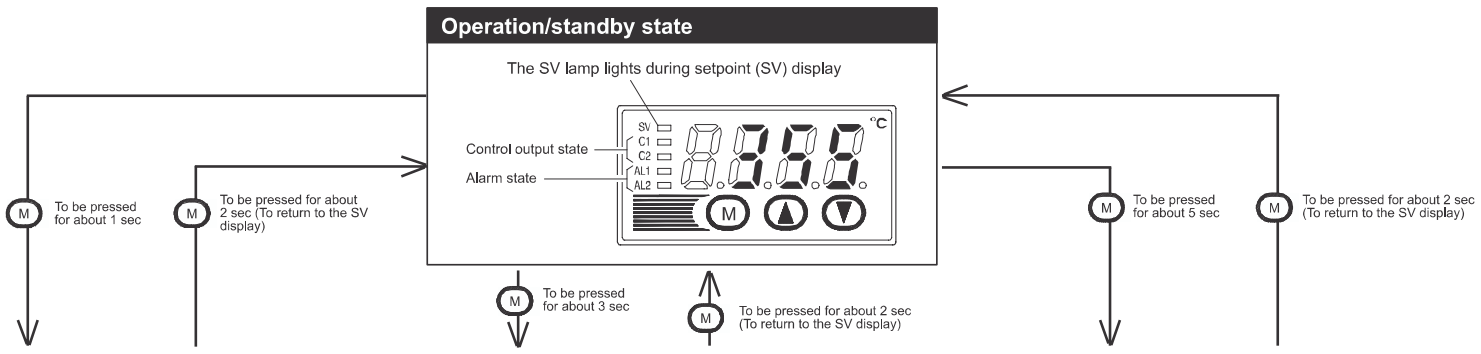
Parameter setting procedure
1 Select the desired parameter by the ▲ or ▼ key.
2-1 Press the (M) key to display the parameter setpoint.
2-2 Change the setpoint by the ▲ or ▼ key.
2-3 After the parameter is changed, press the (M) key to register the new parameter.
3 In order to return to the operation/standby action, press the (M) key for 2 sec.
4 Keeping the non-operation state for 30 sec returns to the operation/standby state.

Caution Keeping the non-operation state for 30 sec without pressing the (M) key after the data is changed makes the changed data invalid.

5 Temperature setting and parameter setting procedures

Some parameters may not be displayed depending on the Model No. Selected when ordered

Operation/standby state



Parameters in the 1st block

	Parameter display symbol	Parameter	Description	Initial value when shipped	Remarks
SToY	STbY	Standby setting	Selects control RUN/standby. ON: Control on standby (Output OFF, Alarm OFF) OFF: Control in operation	OFF	
ProG	ProG	Ramp/soak control	OFF: Stop rUn: Start HLd: Temporary stop	OFF	
LACH	LACH	Alarm latch released	Alarm latch is released. 1: Alarm latch released.	0	
AT	AT	Auto-turning	0: Stop 1: St'd type AT start 2: Low PV type AT start	0	
TM-1	TM-1	Timer 1 display	Time display screen during timer activation (Unit: sec)	-	
TM-2	TM-2	Timer 2 display		-	
AL 1	AL1	Alarm 1 setpoint	Setting of Alarm 1 setpoint Settable within input range. (Alarm action type: Displayed by 1 to 10.)	10	Table 3 Note 1
A1-L	A1-L	Alarm 1 low setpoint	Setting of Alarm 1 low setpoint Settable within input range. (Alarm action type: Displayed by 16 to 31.)	10	Table 3 Note 1
A1-H	A1-H	Alarm 1 high setpoint	Setting of Alarm 1 high setpoint Settable within input range.	10	Table 3 Note 1
AL2	AL2	Alarm 2 setpoint	Setting of Alarm 2 setpoint Settable within input range. (Alarm action type: Displayed by 1 to 10.)	10	Table 3 Note 1
A2-L	A2-L	Alarm 2 low setpoint	Setting of Alarm 2 low setpoint Settable within input range. (Alarm action type: Displayed by 16 to 31.)	10	Table 3 Note 1
A2-H	A2-H	Alarm 2 high setpoint	Setting of Alarm 2 high setpoint Settable within input range.	10	Table 3 Note 1
LoC	LoC	Key lock	Specifies whether the parameter setting is changed or not.	0	

	All parameters		SV	
	Front key	Communication	Front key	Communication
0	○	○	○	○
1	×	○	×	○
2	×	○	○	○
3	○	×	○	×
4	×	×	×	×
5	×	×	○	×

○: Can be set. ×: Cannot be set.

Note 1:
Setting range: 0 to 100% FS (For absolute value alarm)
-100 to 100% FS (For deviation alarm)

Note 2:
Do not set the setpoint of parameters "TC" and "TC2" to "0".

Parameters in the 2nd block

	Parameter display symbol	Parameter	Description	Initial value when shipped	Remarks
P	P	Proportional band	Setting range: 0.0 to 999.9% Two-position action if set to "0"	5.0	
I	I	Integral time	Setting range: 0 to 3200 sec Integral action turned off if set to "0"	240	
d	D	Derivative time	Setting range: 0.0 to 999.9 sec Derivative action turned off if set to "0"	60.0	
HYS	HYS	Hysteresis width with two-position action taken	Setting range: 0 to 50% FS	1	
CooL	CooL	Proportional band coefficient on cooling side	Sets proportional band coefficient on cooling side. (Setting range: 0.0 to 100.0) ON-OFF action if set to "0"	1.0	
db	db	Proportional band shift on cooling side	Shifts output value on cooling side. (Setting range: -50.0 to 50.0%)	0.0	
CTrL	CTrL	Control method	Selects control method. (Selection: PID, FUZZY, SELF)	PID	
TC	TC	Proportional cycle of Control output 1	Sets proportional cycle of Control output 1. (Setting range: 1 to 150 sec)	30/2	Note 2
TC2	TC2	Proportional cycle of Control output 2	Sets proportional cycle of Control output 2. (Setting range: 1 to 150 sec)	30/2	Note 2
P-n2	P-n2	Input type setting	Input type	As specified when ordered	Table 1
P-SL	P-SL	Low range setting	Low input range setting (Setting range: -1999 to 9999)	As specified when ordered	Table 2
P-SU	P-SU	High range setting	High input range setting (Setting range: -1999 to 9999)	As specified when ordered	Table 2
P-dP	P-dP	Decimal-point position setting	Selects the decimal-point position of PV/SV. (Setting range: 0 to 2) 0: No decimal-point displayed "1" "2"	As specified when ordered	Table 2
PVOF	PVOF	PV offset	Shifts the input value (PV) display. (Setting range: -10 to 10% FS)	0	
P-dF	P-dF	Input filter constant	Time constant (sec) (Setting range: 0.0 to 900.0)	5.0	
AL1	ALM1	Alarm type 1	Alarm action setting (Setting range: 0 to 34)	0/5	Table 3
AL2	ALM2	Alarm type 2		0/9	Table 3
STAT	STAT	Present ramp/soak position	Displays progress of this program. This parameter is only displayed but cannot be set.	-	
PTn	PTn	Ramp/soak pattern selection	Selects ramp/soak pattern. 1: Executes 1st to 4th segments. 2: Executes 5th to 8th segments. 3: Executes 1st to 8th segments.	1	
SV-1 to SV-8	SV-1 to SV-8	1st desired value to 8th desired value	Sets desired value (SV) in each ramp section. (Setting range: 0 to 100% FS)	0%FS	
TM1r to TM8r	TM1r to TM8r	Time in 1st ramp section to Time in 8th ramp section	Sets time in each section. (Setting time: 0 to 99h: 59 min.)	0.00	
TM1S to TM8S	TM1S to TM8S	Time in 1st soak section to Time in 8th soak section	Sets time in each section. (Setting time: 0 to 99h: 59 min.)	0.00	

Parameters in the 3rd block

	Parameter display symbol	Parameter	Description	Initial value when shipped	Remarks
P-n1	P-n1	Control method setting	Specifies control method.	0	
SV-L	SV-L	Low SV limit setting	Settable low SV limit value (Setting range: 0 to 100% FS)	0%FS	
SV-H	SV-H	High SV limit setting	Settable high SV limit value (Setting range: 0 to 100% FS)	100%FS	
dLY1	dLY1	Alarm 1 ON delay setting	Sets alarm output ON delay time. (Setting range: 0 to 9999 sec)	0	
dLY2	dLY2	Alarm 2 ON delay setting		0	
A1hY	A1hY	Alarm 1 hysteresis setting	Sets alarm output ON-OFF hysteresis width. (Setting range: 0 to 50% FS)	1	
A2hY	A2hY	Alarm 2 hysteresis setting		1	
A1oP	A1oP	Alarm 1 option setting	Alarm optional function. (Setting range: 000 to 111) Digit in ones place: Alarm latch function Digit in tens place: Mainframe failure alarm Digit in hundreds place: De-energized output	000	
A2oP	A2oP	Alarm 2 option setting		000	
dI-1	dI-1	DI1 action setting	Sets DI1 action. (Setting range: 0 to 12)	0(OFF)	
dI-2	dI-2	DI2 action setting	Sets DI2 action. (Setting range: 0 to 12)	0(OFF)	
STno	STno	Station No.	Sets communication station No. (Setting range: 0 to 255)	1	
CoM	CoM	Parity setting	Sets parity. (Setting range: 0 to 2) Baud rate: 9600 bps fixed	0	
PYP	PYP	PYX input type	Sets PYX type used in PYP communication. (Initial value: K, 0 to 400°C)	34	
Ao-T	Ao-T	Transfer output type setting (Setting range: 0: PV/1: SV/2: MV/3: DV)	Sets signal type to be output from transfer output.	0 (PV value)	
Ao-L	Ao-L	Low transfer output scaling value (Setting range: 0 to 100%)	Sets base side of transfer output scaling.	0%	
Ao-H	Ao-H	High transfer output scaling value (Setting range: 0 to 100%)	Sets span side of transfer output scaling.	100%	
dSP1 to dP13	dSP1 to dSP13	Parameter skipping	Specifies parameter masking.		

6 Function of temperature controller

6-1 ON/OFF (two-position) control

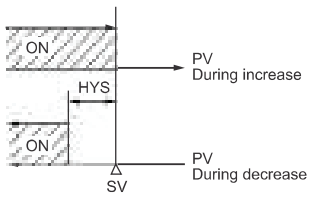
- Output is turned on or off only by the difference between PV and SV.
- In order to perform two-position control, it is set to be parameter P = "0".
- In order to prevent output chattering as PV ≈ SV, set a deadband (hysteresis). (Factory set value: HYS = "1")

- Examples of parameter settings and control actions

[Ex. 1] Reverse action

Parameter	Setpoint
P	0.0
Pn-1	0 (or 1)
HYS	Any value

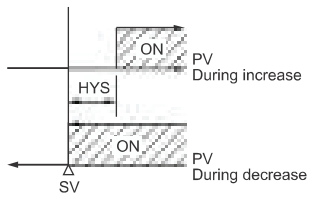
Relationship between PV and SV	Output
PV>SV	OFF
PV<SV	ON



[Ex. 2] Direct action

Parameter	Setpoint
P	0.0
Pn-1	2 (or 3)
HYS	Any value

Relationship between PV and SV	Output
PV>SV	ON
PV<SV	OFF



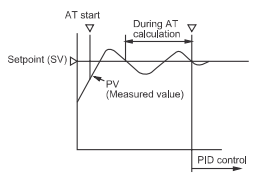
6-2 Auto-tuning

Output is turned on or off only by the difference between PV and SV.
The auto-tuning function is such that the controller itself automatically measures, calculates and then sets PID constants most suitable for the process at that time. Activate this function after input range (P-SL, P-SU or P-dP), setpoint (SV), alarm setting (AL1 or AL2) and proportional cycle (CT) are set.

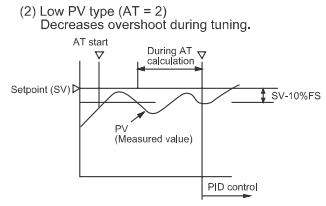
Start activating the auto-tuning function

Select the parameter AT; set "1" or "2" and then press the (M) key. Thus, the auto-tuning function starts activating and as a result the decimal point at the lower right of the display unit starts flashing.
If this function ends, the decimal point at the lower right stops flashing and the parameter AT is automatically set to "0".

(1) Standard type (AT = 1)



(2) Low PV type (AT = 2)
Decreases overshoot during tuning.



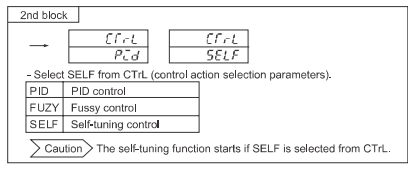
(a) PID constants automatically set after the auto-tuning function stops activating normally are retained even if the power is turned off.
If the power is turned off while the auto-tuning function is being activated, activate this function from the beginning again. (No PID values change.)
(b) As the controller performs ON/OFF control (two-position control) while the function is being activated, PV may widely change depending on processes. For a process in which a wide change in PV is not permitted, do not use the function. In addition, do not use the function in processes having quick responses such as pressure control and flow control.
(c) If the auto-tuning function does not terminate after a lapse of more than 4 hours, it is considered that the function is not normally activated.
In such a case, re-check input wiring and such parameters as control output action (direct or reverse) and input sensor type.
(d) When SV is widely changed; the input range (P-SL/P-SU/P-dP) was changed or controlled-object operation was changed, re-execute the function.
(e) PV acts as in Fig. (1) or (2) while the function is being activated.
(f) Also when the fuzzy control type is selected, execute the function.
(g) If the parameter AT needs to be re-set, set "0" once and then re-set the parameter.

6-3 Self-tuning

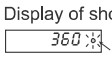
1) Function
- This is the function to perform control while automatically calculating PID constants which satisfy the requirements of the controlled object and set temperature (SV).
- Use this function when no high controllability is required, but time and labor to activate the auto-tuning function need to be saved whenever the requirements of the controlled object vary. However, when high controllability is required, select PID or fuzzy control and then obtain PID values by activating the auto-tuning function.

2) Setting to use self-tuning
(1) Turn on the power of this controller and then set the SV value.
(2) Select SELF (self-tuning) from CTrL (control action selection).
(3) Turn off the power once.
(4) Turn on the power of this controller and that of equipment used in the controlled object. Turn on the power of the equipment simultaneously with or earlier than that of the controller. (No correct tuning can be made if the power of the controller is turned on earlier than the equipment.)
(5) The self-tuning function starts activating. The decimal point in the ones place on the SV display unit flashed during self-tuning.

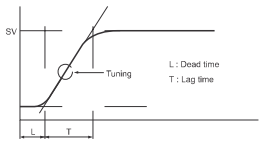
Note:
If the self-tuning setting needs to be done once more from the beginning, set CTrL (control action) selection to PID (PID control) once and then re-set this function according to the above steps.



3) Display of showing self-tuning



The decimal point at the lower right flashes during self-tuning.



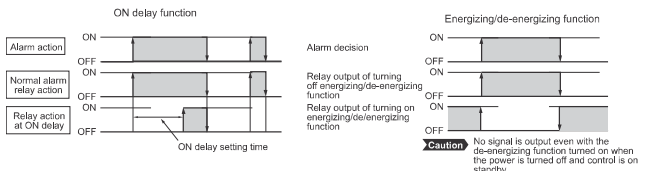
4) Requirements for executing self-tuning
The self-tuning function is executed if any of the following requirements is satisfied.
(1) If at a temperature rise when the power is turned on.
(2) If at a temperature rise when SV is changed (To be executed only when judged to be necessary).
(3) Stabilized control is disturbed, and this disturbed state is assumed to continue.

5) Cases where no self-tuning is executed
- The self-tuning function is not executed in any of the following cases.
(1) Control is on standby.
(2) Now in two-position control. (P = 0)
(3) Now in auto-tuning.
(4) Now in ramp/soak action.
(5) Now in input failure.
(6) When in dual output setting ("P - n1").
(7) When any of P, I, D and Ar is set manually.
- The self-tuning function is suspended in any of the following cases.
(1) SV is changed.
(2) The self-tuning function does not terminate after a lapse of more than 9 hours following its start.

6) Caution:
- In order to correctly activate the self-tuning function, turn on the power of the final control element (actuator) earlier than the controller.
- Do not change the SV value while the function is being executed.
- If PID constants are determined once and no SV is changed, no self-tuning function is executed when the power is turned on next time.
- If no control is performed smoothly even with the function executed, change this control to PID control (CTrL = PID) and then execute the auto-tuning function.

6-4 Alarm function (Option)

1) Alarm types
- The following alarm types are available.
Absolute value alarm, Deviation alarm,
High/low alarm and Range alarm
(For details, see "Table 3 List of alarm action type codes".)



2) Alarm function

No.	Function name	Function	Parameter to be set
1	Hysteresis function	Action dead band (hysteresis) can be set to alarm action.	Alarm 1: A1hy Alarm 2: A2hy
2	ON delay function	Alarm is turned on after the requirements for alarm ON are satisfied and then the ON delay setting time elapses.	Alarm 1: dLy1 Alarm 2: dLy2
3	Alarm latch function	Function to hold the alarm ON state if turned on once. This alarm latch can be released by any of the following.	Alarm 1: A1oP Alarm 2: A2oP
		i) Turn on the power of the temperature controller again.	
		ii) Turn off the alarm latch setting once.	
		iii) Release the latch on the alarm latch release screen.	LACH
		iv) Release the latch by DI input.	dC-1, dC-2
		v) Release the latch via communication.	
4	Failure alarm function	The alarm relay is turned on when a failure occurs in the controller. (For details, see "Display when in failure".)	Alarm 1: A1oP Alarm 2: A2oP
5	Energizing/ de-energizing function	Function to send the energized or de-energized alarm output to the alarm relay. (When this function is turned on, the energized alarm output is sent to the alarm relay.)	Alarm 1: A1oP Alarm 2: A2oP

Combining alarm functions
Alarm functions 1 and 2 (ALM1 and ALM2) have functions which can be used in combination or not. Refer to the following table.
O : Functions which can be used in combination
x : Functions which cannot be used in combination

	Normal alarm	Alarm with HOLD function	Timer function
Alarm latch	O	O	x
Energizing/de-energizing	O	O	O
On delay	O	Note 1	x
Mainframe failure alarm	O	O	x

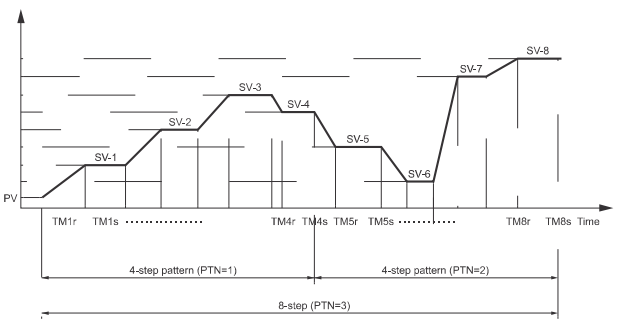
Caution Before the function to hold the alarm ON state is released, it is immediately released if entered into the alarm OFF zone. However, after this function is released, the ON delay action is taken if entered into the alarm ON zone.

Caution for alarm

No.	Caution	Item/Classification
1	Be careful that the ON delay action is taken even when a mainframe failure alarm occurs.	Mainframe failure alarm
2	The mainframe failure alarm occurs also in the range Err state (Err display). (Also on standby)	Alarm when Err is displayed
3	Also when the display shows "LLLL", or "UUUU", the alarm function is normally activated.	
4	Alarm action type code Nos. 12 to 15 are compatible with lower Nos. 24 to 27. Therefore, it is recommended that Nos. 24 to 27 be used. In addition, if any of alarm action type code Nos. 12 to 15 is selected, set the ALM setting parameter to ALM2, dLy2 or A2hy.	Alarm action type code
5	The ON delay, de-energizing or latch function cannot be used for HB alarm.	HB alarm
6	Alarm setpoint can be set only to a minimum value of -199.9 from display restrictions.	Alarm setpoint
7	If the alarm action type is changed, the alarm setpoint may vary (, but this is not abnormal).	
8	Be careful that all of the alarms are not output when on standby.	Alarm when on standby
9	No mainframe failure alarm is output when on standby.	
10	The HOLD function is valid even when the PV value is in the hysteresis zone when the power is turned on.	

6-5 Ramp/Soak function (Option)

(Function)
Function to automatically change the setting (SV) with time, as shown in the following Fig., along the preset pattern.
This function enables the setting to be programmed in 4-ramp/soak × 2 patterns or 8-ramp/soak × 1 pattern. The first ramp starts from the measured value (PV) just before the program is executed.



(Setting)
- Select the executing pattern from PTn (ramp/soak pattern select parameters).
- The ramp pattern changes during ramp/soak execution.
(It does not change even if changed during RUN.)

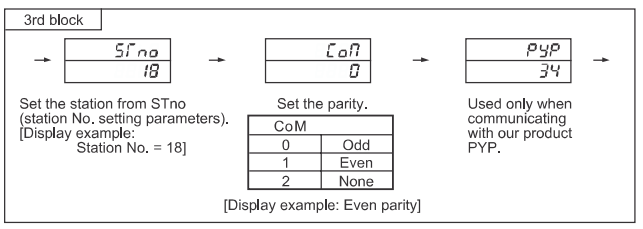
PTn	Pattern	No. of steps
1	1	4
2	2	4
3	1+2	8

Caution:
- If the standby action is taken during ramp/soak execution, ramp/soak stops. No ramp/soak is re-executed even if returned to normal operation again.

6-6 Communication function (Option)

1) Function
- Enables internal data read/write via RS-485 communication.

2) In order to use this function, the following three parameters need to be set.

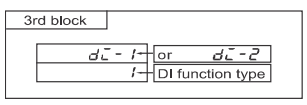


3) Caution:
- Station No. from 0 to 255 is settable. (No communication is conducted if set to 0.)
- The parity can be changed, but turn on the power again if changed.
- The baud rate is fixed to 9600 bps.
- No communication can be conducted if the communication protocol differs.

6-7 External contact input (Di function) (Option)

1) Function
- The following functions are available as the Di function.
(1) SV selection
(2) Control RUN/Standby selection
(3) Ramp/Soak RUN/RESET selection
(4) Auto-tuning start
(5) Alarm latch release
(6) Timer start

2) In order to use the Di function,
- Select the desired function from the di-1 and di-2 parameters.



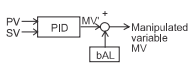
3) List of Di function types

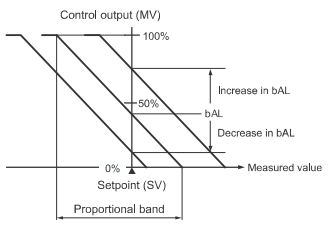
Setting range	Function	Description
1	Setpoint (SV) selection	It is possible to select Front SV↔ SU-1, SU-2 or SU-3.
2	Control RUN/Standby	Control stops on standby and SV flashes.
3	Auto-tuning (St'd) start	Start/Stop is selected by DI rise or fall.
4	Auto-tuning (low PV) start	
5	All/alarm latch release	It is possible to release the alarm latch. (If no alarm is latched, there is no action change.)
6	Alarm 1 latch release	
7	Alarm 2 latch release	
9	ALM1 relay timer activation	The ON/OFF delay timer can be activated. The timer remaining time can be checked from the timer 1 or 2 display parameter (1st block).
10	ALM2 relay timer activation	
12	Ramp/Soak RUN/RESET	It is possible to RUN/RESET the ramp/soak by Di rise or fall.

6-8 bAL/Ar function

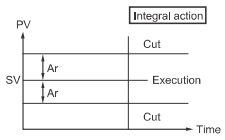
(The bAL and Ar parameters are not displayed when shipped. For displaying them, re-set them according to the following selection procedure.)
(1) The bAL/Ar function has a role of restricting overshoot.
(2) Controllability may worsen depending on setpoints. Usually, no operation is required.
(3) Ar (anti-reset windup) is automatically calculated and then is set by executing the auto-tuning (AT) function.

1 bAL
The " bAL " value is added to the result of PID computation (MV') performed by PV and SV and then is output (MV).





2 Ar
This restricts the range to take integral action.
Integral range: SV ± Ar
No integral action is taken if out of the range.



bAL/Ar display ↔ Non-display

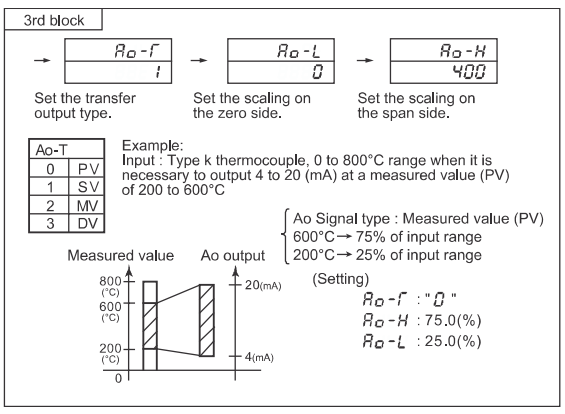
1 Non-display → Display
(1) Display "dSP3" in the 3rd block parameters to set a "present value of -128".
(2) Display "dSP4" in the 3rd block parameters to set a "present value of -1".

2 Display → Non-display
(1) Display "dSP3" in the 3rd block parameters to set a "present value of +128".
(2) Display "dSP4" in the 3rd block parameters to set a "present value of +1".

6-9 Transfer function (Option)

1) Function
- Function to externally output any of the following output types such as 4 to 20 mA DC, etc.

2) In order to use this function, the following three parameters need to be set.



3) Caution:
- Do not conduct the setting so as to be Ao-L >= Ao-H.

7 In order to use the temperature controller correctly

1 Input setting

* Not required if specified when ordered.

(1) Does the input type match the sensor used?

Select the desired sensor from Table 1 and then set it to the parameter P-n2.

Example: For a type T thermocouple, set P-n2 to '7'.

Note: It is possible to change RTD/thermocouple, but not possible to change 1 to 5 V DC (4 to 20 mA DC) to RTD/thermocouple, and vice versa.

⇨

(2) Is the input range set to that appropriate to the sensor used?

Table 2 shows standard ranges of each sensor.
Select the temperature range appropriate to the equipment used, and then set the low limit to P-SL and the high limit to P-SU.

Example: When at the temperature range of 0 to 800 (°C), set 0 to P-SL and 800 to P-SU.

Note: It is also possible to set any range out of the standard ranges, but it is recommended that the standard ranges be set.

Note: There are no standard ranges for an input of 1 to 5V DC (4 to 20 mA DC). Low/high limits can be freely set. (Within the range between -1999 and 9999, and High limit > Low limit)

Note:
Set the input sensor type (P-n2) and input range (P-SL/P-SU) in advance of any other settings. If these parameters are changed, other parameters may change but this is not abnormal.
Check all of the parameters.

2 Control setting

* Read this section if not controlled as desired.

(1) What is the purpose of control? (Heated or cooled?)

Purpose	Action	Description	Procedure
Heated	Reverse action	The amount of manipulated output becomes smaller as measured value increases.	⇨ Set the parameter P-n1 to '0' or '1'. (See Table 4.)
Cooled	Direct action	The amount of manipulated output becomes larger as measured value increases.	⇨ Set the parameter P-n1 to '2' or '3'. (See Table 4.)

⇨

(2) What type of control is used? (ON/OFF, PID or Fussy?)

Type of control	Description	Procedure
ON/OFF control (Two-position control)	Output is either ON (100%) or OFF (0%). (Suitable for cases where inconvenient if the output is frequently closed or opened.)	⇨ Set '0.0' to parameter P. * See "7-1 ON/OFF control".
PID control	Output is computed by PID parameters to output it from 0 to 100% with proportional cycle (TC) set to 100%. Stable control without any offset is performed.	⇨ Select 'PID' from parameter CTrL. Manually execute the auto-tuning function. Optimum PID constants are automatically calculated. (PID constants can also be set.) * See 7-2 "Auto-tuning".
Fuzzy control	Fuzzy computation is added to PID to perform control with less overshoot.	⇨ Select 'FUZy' from parameter CTrL. Execute the auto-tuning function. (Same as PID control)
Self-tuning	Control is performed while PID parameters are being automatically calculated so as to satisfy the requirements for control.	⇨ Select 'SELF' from parameter CTrL.

8 Read this section when display is incorrect.

Display when error occurs

This controller has the display function which informs the operator of any error. If an error occurs, immediately remove the cause. Then, turn off the power once and turn it on again.

Display	Cause	Control output
UUUU	(1) Thermocouple sensor breaks. (2) RTD sensor (A) wire breaks. (3) PV indicated value is more than range high-limit +5% FS.	(1) When burnout direction is set to low limit (St'd). OFF, or 4 mA or less (2) When burnout direction is set to high limit. ON, or 20 mA or more
LLLL	(1) RTD sensor B or C breaks. (2) RTD sensor (between A and B or A and C) is shorted. (3) PV indicated value is less than range low-limit -5% FS. (4) Voltage input wire(s) breaks or are shorted.	
LLLL	(1) PV indicated value is less than -199.9. Note: For RTD, no LLLL is displayed even at less than -199.9.	Control continues. Burnout occurs at less than -5% FS.
Err (SV flickering display)	When P-SL/P-SU is inappropriately set	OFF or less than 4 mA
FALF	Mainframe failure	Unstable (Immediately stop the use of the controller.) (Contact your nearest our sales agent or our directly.)

[Table 1] Table of input codes

Parameter: P-n2

Type	Input type	Code (P-n2)
I	RTD	
	• JPt100 (Old JIS)	0
	• Pt100 (New JIS)	1
	T/C	
	• J	2
	• K	3
	• R	4
	• B	5
	• S	6
	• T	7
	• E	8
	• N	12
	• PL-II	13
II	DC 1 to 5 V, 4 to 20 mA	16

* For an input of 4 to 20 mA DC, use an external resistor with 250Ω to convert it to 1 to 5 V DC.

Note 1: The code can be changed within the same type.

[Table 2] Table of input ranges (St'd)

Parameter: P-SL P-SU P-dP

Input type		Measuring range (°C)	With decimal point (°C)
RTD (Old JIS)	JPt100 Ω	0 to 150	o
	JPt100 Ω	0 to 300	o
	JPt100 Ω	0 to 500	o
	JPt100 Ω	0 to 600	o
	JPt100 Ω	-50 to 100	o
	JPt100 Ω	-100 to 200	o
	JPt100 Ω	-150 to 600	o
RTD JIS (IEC)	Pt100 Ω	0 to 150	o
	Pt100 Ω	0 to 300	o
	Pt100 Ω	0 to 500	o
	Pt100 Ω	0 to 600	o
	Pt100 Ω	-50 to 100	o
	Pt100 Ω	-100 to 200	o
	Pt100 Ω	-150 to 600	o
	Pt100 Ω	-150 to 850	x
T/C	J	0 to 400	o
	J	0 to 800	o
	K	0 to 400	o
	K	0 to 800	o
	K	0 to 1200	x
	R	0 to 1600	x
	B	0 to 1800	x
	S	0 to 1600	x
	T	-150 to 200	o
	T	-150 to 400	o
	E	0 to 800	o
	E	-150 to 800	o
	N	0 to 1300	x
	PL-II	0 to 1300	x
DC voltage	DC1 to 5V	-1999 to 9999 (Scaling enabled)	

Note1: Input accuracy: ±0.5%FS±1digit (RTD)
±0.5%FS±1digit±1℃ (T/C)
In the range of 0 to 500℃(for Type R T/C)or 0 to 400℃(for type B T/C), no correct display may be made from sensor characterstics.
Note2: For RTD,no LLLL is displayed even at less than -150℃.
Note3: If used at any range of less than the minimum range described in the above table,no input accuracy is warranted.

[Table 3] Table of alarm action type codes

Parameter: ALM1 ALM2

	ALM1	ALM2	Alarm type	Action diagram
	0	0	No alarm	PV
Absolute value alarm	1	1	High absolute value alarm	AL1 AL2 PV
	2	2	Low absolute value alarm	AL1 AL2 PV
	3	3	High absolute value alarm (with HOLD function)	AL1 AL2 PV
	4	4	Low absolute value alarm (with HOLD function)	AL1 AL2 PV
Deviation alarm	5	5	High deviation alarm	AL1 AL2 SV PV
	6	6	Low deviation alarm	AL1 AL2 SV PV
	7	7	High/low deviation alarm	AL1 AL2 AL1 AL2 SV PV
	8	8	High deviation alarm (with HOLD function)	AL1 AL2 SV PV
	9	9	Low deviation alarm (with HOLD function)	AL1 AL2 SV PV
	10	10	High/low deviation alarm (with HOLD function)	AL1 AL2 AL1 AL2 SV PV
Range alarm	11	11	Range high/low deviation alarm (ALM1/2 independent action)	AL1 AL2 AL1 AL2 SV PV
	-	12	Range high/low absolute value alarm	AL2 AL1 PV
	-	13	Range high/low deviation alarm	AL2 AL1 SV PV
	-	14	Range high absolute value/low deviation alarm	AL2 SV AL1 PV
	-	15	Range high deviation/low absolute value alarm	AL1 AL2 SV PV

• Setpoint 2-point alarm codes

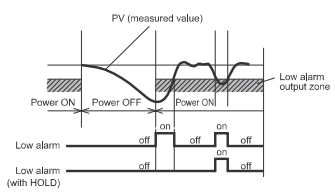
	ALM1	ALM2	Alarm type	Action diagram
Upper/ lower limit alarm	16	16	High/low absolute value alarm	A1-L A2-L A1-H A2-H PV
	17	17	High/low deviation alarm	A1-L A2-L A1-H A2-H SV PV
	18	18	High absolute value/low deviation alarm	A1-L A2-L SV A1-H A2-H PV
	19	19	High deviation/low absolute value alarm	A1-H A2-H A1-L A2-L SV PV
	20	20	High/low absolute value alarm (with HOLD function)	A1-L A2-L A1-H A2-H PV
	21	21	High/low deviation alarm (with HOLD function)	A1-L A2-L A1-H A2-H SV PV
	22	22	High absolute value/low deviation alarm (with HOLD function)	A1-L A2-L SV A1-H A2-H PV
	23	23	High deviation/low absolute value alarm (with HOLD function)	A1-H A2-H A1-L A2-L SV PV
Range alarm	24	24	Range high/low absolute value alarm	A1-L A2-L A1-H A2-H PV
	25	25	Range high/low deviation alarm	A1-L A2-L A1-H A2-H SV PV
	26	26	Range high absolute value/low deviation alarm	A1-L SV A2-L A1-H A2-H PV
	27	27	Range high deviation/low absolute value alarm	A1-H A2-H A1-L A2-L SV PV
	28	28	Range high/low absolute value alarm (with HOLD function)	A1-L A2-L A1-H A2-H PV
	29	29	Range high/low deviation alarm (with HOLD function)	A1-L A2-L A1-H A2-H SV PV
	30	30	Range high absolute value/low deviation alarm (with HOLD function)	A1-L A2-L SV A1-H A2-H PV
	31	31	Range high deviation/low absolute value alarm (with HOLD function)	A1-H A2-H A1-L A2-L SV PV

• Timer codes

	ALM1	ALM2	Alarm type	Action diagram
Timer	32	32	ON delay timer	DI OUT dLY1 dLY2
	33	33	OFF delay timer	DI OUT dLY1 dLY2
	34	34	ON/OFF delay timer	DI OUT dLY1 dLY2 dLY1 dLY2

Point What is HOLD function?

Function which does not immediately raise an alarm even if a measured value is within the alarm range when the power is turned on, but raises the alarm if within the alarm range again after being out of the alarm range once.



Notes:
- If the alarm action type is changed, check the alarm setpoint. If changed, the alarm setpoint may also change, but this is no abnormal.
- After the alarm type is changed, turn the power on and off.
- Alarm action type codes 12 to 15 are output to the ALM2 relay.

[Table 4] Table of control action type codes

Parameter: P-n1

Code (P-n1)	Output type	Control action		Burnout direction	
		Output 1	Output 2	Output 1	Output 2
0	Single	Reverse action	—	Low limit	—
1				High limit	
2		Direct action		Low limit	
3				High limit	
4	Dual	Reverse action	Direct action	Low limit	Low limit
5				High limit	
6				Low limit	High limit
7				High limit	
8		Direct action		Low limit	Low limit
9				High limit	
10				Low limit	High limit
11				High limit	
12		Reverse action	Reverse action	Low limit	Low limit
13				High limit	
14				Low limit	High limit
15				High limit	
16		Direct action		Low limit	Low limit
17				High limit	
18				Low limit	High limit
19				High limit	

[What is burnout direction?]
Output direction when input is out of the range or is abnormal.
High limit: OFF or less than 4 mA
High limit: ON or more than 20 mA

[Caution for dual output type] (Option)
(1) It is impossible to independently set the ID action to heating/cooling.
(2) If two-position control is performed on the heating side, it is also performed on the cooling side.
(3) If set to Cool = 0.0, ON/OFF control is performed on the cooling side.
In this case, ON/OFF control hysteresis is fixed (0.5% FS).
Note:
If input burnout occurs even on standby, the signal is output as instructed by this parameter.

Specifications

Power supply voltage:	100 V AC (-15%) to 240 V AC (+10%) 50/60 Hz 24 V AC 50/60 Hz, 24 V DC
Power consumption:	Less than 6 VA (at 100 V AC) Less than 8 VA (at 240 V AC/24 V AC/24 V DC)
Relay contact output:	1 'a' contact 220 V AC/30 V DC, 3A (Resistive load)
SSR/SSC drive output *1:	At ON, 15 V DC (12 to 16 V DC)
(Voltage pulse output)	At OFF, Less than 0.5 V DC Maximum current, Less than 20 mA DC Load resistance, More than 600 Ω
4 to 20 mA DC output *1:	Allowable load resistance, 100 to 500 Ω
Alarm output: (Two points max.)	Relay contact (1 'a' contact) 220 V AC/30 V DC, 1 A (Resistive load)
Communication function:	Transmission method/half-duplex, bit serial, start-stop
(RS-485 interface) *2	Transmission speed, 9600 bps Communication protocol, Conforming to Modbus RTU or Z-ASCII (PXR protocol) Transmission distance, 500 m max. (Total connection length) Connectable No. of units, 31
External contact input:	No. of input points, 2 max. Input contact capacity, 5 V DC/2 mA
Transmission output:	4 to 20 mA DC Allowable load resistance, Less than 500 Ω Accuracy, ±0.3% FS (At ambient temp. of 23°C)
Operating/storage temp.:	-10°C to 50°C, 90% RH (No dew-condensing) -10°C to 45°C (when closely mounted) -20°C to 60°C (storage temp.)

*1 A communication converter is required when connected to a personal computer. (To be separately prepared) (Recommended item)
Model SI-30A (Isolated type) made by Line-eye. Tel. No. 075-693-0161
Model KS485 (Non-isolated type) made by Systemsacom. Tel. No. 03-5623-5933

For checking specified Model No.

List of ATC-217 Models

ATC - 217 - X X - X X - X X

Input signal
- T T/C °C
- P RTD Pt 100Ω 3-wire system °C
- J RTD JPt100Ω 3-wire system °C
- A DC4 to 20mA
- V DC1 to 5V

Power supply
- 1 AC 100V(-15%) ~ 240V(+10%)
- 2 AC 24V(±10%) 50/60Hz, DC 24V(±10%)

Control output 1
- 1 Relay contact output
- 2 SSR/SSC drive output 15 V DC
- 3 DC4 to 20 mA DC output

Control output 2
- 1 None
- 2 Relay contact output
- 3 SSR/SSC drive output 15 V DC
- 4 4 to 20 mA DC output

Additional specs. 1
- 1 None
- 2 With alarm 1-point
- 3 With 8-ramp/soak
- 4 With alarm 1-point + 8-ramp/soak
- 5 With alarms 2-point
- 6 With alarm 2-point + 8-ramp/soak

Additional specs. 2
- 1 None
- 2 RS-485 (Modbus) communication
- 3 RS-485 (Z-ASCII) communication
- 4 Transfer output + External contact input 1-point
- 5 Transfer output
- 6 External contact inputs 2-point
- 7 RS-485 (Modbus) communication + External contact input 1-point
- 8 RS-485 (Z-ASCII) communication + External contact input 1-point

Note 1: Cannot be combined with "With alarms 2-point".
Note 2: Cannot be combined with "Control output 2".
Note 3: Cannot be combined with "Control output 2/power supply voltage of 24 V/with alarms 2-point/with alarms 2-point + 8-ramp/soak.