CP4, CP8

Digital temperature controllers

Operating manual

42/61-75 EN

Rev. 00

Instruction Manual

Micro-controller
Model: CP4, CP8

INP–TN2PXWABB-E

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Operating manual 42/61-75 EN
Revision 00
Edition 02.02

Thank you for your purchasing "ABB Digital Temperature Controller."Please check that the product is exactly the one you ordered and use it according to the following instructions.

NOTICE
The contents of this document may be changed in the future without prior notice.
We paid the utmost care for the accuracy of the contents. However, we are not liable for direct and indirect damages resulting from incorrect descriptions, omission of information, and use of information in this document.

The related documents

Contents	Title	Document No.
Specifications	Catalogue (Data sheets)	10/61-1.12
Operation	Operation Manual	42/61-75

SAFETY PRECAUTIONS

Read before using

Before using this product, the user is requested to read the following precautions carefully to ensure the safety. Safety precautions must be taken by every user to prevent an accident. The safety requirements are classified into "warning" and "caution" according to the following interpretation :

Warning	Suggesting that the user's mishandling can result in personal death or serious injury.
Caution	Suggesting that the user's mishandling can result in personal injury or damage to the property.

WARNING Over-temperature Protection

"Any control system design should take into account that any part of the system has the potential to fail".

"For temperature control systems, continued heating should be considered the most dangerous condition, and the machine should be designed to automatically stop heating if unregulated due to the failure of the control unit or for any other reason".

The following are the most likely causes of unwanted continued heating:

1) Controller failure with heating output constantly on
2) Disengagement of the temperature sensor from the system
3) A short circuit in the thermocouple wiring
4) A valve or switch contact point outside the system is locked to keep the heat switched on.

In any application where physical injury or destruction of equipment might occur, we recommend the installation of independent safety equipment, with a separate temperature sensor, to disable the heating circuit in case of overheating.

The controller alarm signal is not designed to function as a protective measure in case of controller failure.

1. Warning

1.1 Installation and wiring

- This equipment intends to be installed with the following conditions.

Operating temperature	-10 to 50 [°C]	
Operating humidity	90%RH or less (Non condensing)	
Overvoltage category	II	Conforming to IEC1010-1
Pollution degree	2	

- Preserve the creepage and clearance as shown below between the temperature sensor and the location which indicates or generates the voltages as shown in the following table.
  Failure to maintain these minimum distances would invalidate the EN 61010 safety approval.

Voltage used or generated by the other assemblies	Clearance (mm)	Creepage (mm)
Up to 50Vrms or Vdc	0.2	1.2
Up to 100Vrms or Vdc	0.2	1.4
Up to 150Vrms or Vdc	0.5	1.6
Up to 300Vrms or Vdc	1.5	3.0
Above 300Vrms or Vdc	Contact with sales office.	

Hazardous voltage

- If the voltage shown above exceeds 50Vdc(i.e. hazardous voltage), the basic insulation is required between all terminals of this equipment and the ground, and supplementary insulation is required for the alarm output.
  Required isolation of this equipment is shown below. Be sure check that the overvoltage category of the equipment satisfies your requirements before installation.

MAINS-INPUTS	BASIC insulation
MAINS-OUTPUTS	BASIC insulation
inputs - outputs (relay, alarm output)	BASIC insulation
inputs - outputs (SSR drive, 4-20mA DC)	Non-insulation

- If there is a danger of a serious accident resulting from a failure or a defect in this unit, provide the unit with an appropriate external protective circuit to prevent an accident.
- The unit is normally supplied without a power switch and fuses.
  Make wiring so that the fuse is placed between the main power supply switch and this equipment. (main power supply: 2 pole breaker, fuse rating: 250V, 1A)
- When wiring the power supply terminal, use insulated cable for use up to 600V.
- To avoid the damage and failure of equipment, supply the power voltage fitting to the rating.
- To avoid an electric shock and equipment failure, do not turn ON the power before all wiring is completed.
- Be sure to check that the distance is kept to avoid electric shock or firing before turning the power ON.
- Keep away from terminals while the circuit is energized in order to avoid an electric shock and a malfunction.
- Never attempt to disassemble, fabricate, modify, or repair this unit because tampering with the unit may result in a malfunction, electric shock, or a fire.

1.2 Maintenance precautions

- Be sure to turn off the power before this unit is installed or removed in order to avoid an electric shock, malfunction, and fault.
- Regular maintenance is recommended a longer service life of this unit. Some parts of this unit have a limited life span, or they will be deteriorated with the lapse of time.
- One-year warranty is guaranteed for this unit including accessories, provided that the unit is properly used.

2. ⚠ Caution

2.1 Cautions on installation

Avoid the following places for installation.

- a place where the ambient temperature may reach beyond the range of from 0 to 50˚C while in operation.
- a place where the ambient humidity may reach beyond the range of from 45 to 85% RH while in operation.
- a place where a change in the ambient temperature is so rapid as to cause condensation.
- a place where corrosive gases (sulfide gas and ammonia gas, in particular) or combustible gases are emitted.
- a place where the unit is subject directly to vibration or shock.
- a place exposed to water, oil, chemicals, steam and vapor.
  (if immersed with water, take the inspection by ABB to avoid an electrical shock and firing)
- a place where the unit is exposed to dust, salt air, or air containing iron particles.
- a place where the unit is subject to intereference with static electricity, magnetism, and noise.
- a place where the unit is exposed to direct sunlight.
- a place where the heat may be accumulated due to the radiation of heat.

2.2 Caution on installation on panel

- For PXW5/7/9, install 2 pieces of mounting fixtures; one in the upper position and the other in the lower position, by tightening screws with a standard screwdriver to a torque of about 14.7 N-cm . (Take care not to tighten the screws excessively because the casing is made of plastic.)

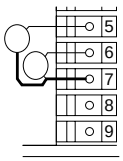
2.3 Precautions in wiring connection

- For the thermocouple sensor type, use thermocouple extension wires for wiring.
  For the RTD type, use a wiring material with a small lead wire resistance and no resistance differentials among three wires.
- Keep input lines away from power line and load line to avoid the influence from noise induced.
- For the input and output signal lines, be sure to use shielded wires and keep them away from each other.
- If a noise level is excessive in the power supply, the additional installation of an insulating transformer and the use of a noise filter are recommended. (example: ZMB22R5-11 Noise Filter manufactured by TDK)
  Make sure that the noise filter is installed to a place such as a panel that is properly grounded. The wiring between the noise filter output terminal and the instrument power supply terminal should be made as short as possible. None of fuses or switches should be installed to the wiring on the noise filter output side because the filter effect will be degraded by such a installation.
- A better anti-noise effect can be expected by using stranded power supply cable for the instrument. (The shorter the stranding pitch is, the better the anti-noise effect can be expected.)
- For the unit with heater break alarm (burn-out, in the heater), use the same power line for connection of the power supplies for the heater and the controller.
- A setup time is required for the contact output when the power is turned on. If the contact output is used as a signal for an external interlock circuit, use a delay relay at the same time.
- Use the supplemental relay since the life is shortened if full capacity load is connected to the output relay. SSR/SSC drive output type is preferred if the output operations occur frequently.
  [Proportional interval] relay output: 30 seconds or more, SSR/SSC: one second or more.]
- If inductive load such as magnetic switches connected as a relay output load, it is recommended to use a varistor to protect a contact from switching serge and keep a longer life.

  Model : Siemens S05K150/Q69X3030 (Voltage at relay: 115V AC)
  Siemens S05K300/Q69X3035 (Voltage at relay: 230V AC)

  Where to install : Connect it between contacts of the relay control output.

  Example: CP4



- The SSR/SSC-driven output, and output of 4 to 20 mA DC, is not electrically insulated from internal circuits.
  Use a non-grounded sensor for resistance bulb or thermocouple.

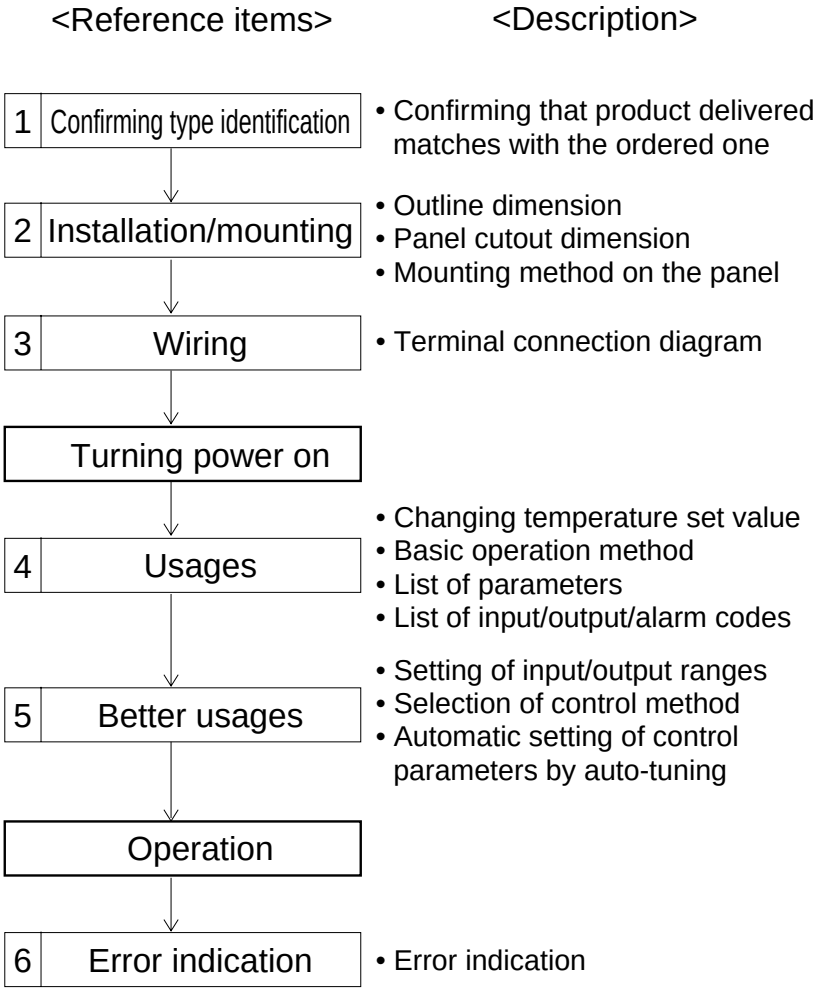
2.4 Requirement for key operation/operation in abnormalities

- Prior to the operation, be sure to check alarm functions, since a failure in the proper setting will result in a failure in the proper output of an alarm in case of an abnormality.
- A display of UUUU or LLLL will appear in case of a break in the input. Be sure to turn off the power when a sensor is replaced.

2.5 Others

- Do not use organic solvents such as alcohol and benzine to wipe this unit. Use a neutral detergent for wiping the unit.

For normal usage

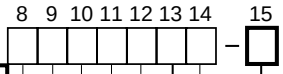


* Wait for about 30 minutes until the controller stabilizes thermally: the operation e.g. measurement should be started 30 minutes after the power is turned on.

1 Confirming type specification

Model Configuration

Controller CP8, Format 48×96mm: V61718A-
Controller CP4, Format 96×96mm: V61716A-



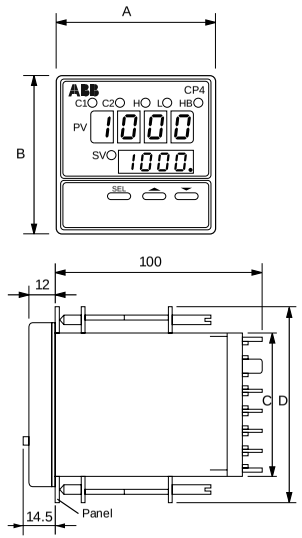
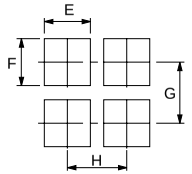
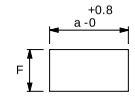
Digit	Hardware specification	Preconfigured as	
8	<Input signal>		
	Thermocouple / RTD, Pt-100 3 wire type (°C and °F possible)	RTD, PT100 3 wire type (°C)	N
	4 - 20mA DC / 1 - 5 V DC	4 - 20mA DC	B
9	<Control output 1>		
	Relay contact output	Reverse action	A
	SSR or SSC drive output	Reverse action	C
	4 - 20mA DC output	Reverse action	E
10	<Control output 2>		
	None		Y
	Relay contact output	Direct action	B
	SSR or SSC drive output	Direct acton	D
	4 - 20mA DC output	Direct action	F
11	<Optional specificatoin 1>		
	8 ramps/soaks		4
	Two alarms+8 ramps/soaks		5
	Heater break alarm+8 ramps/soaks		6
	Two alarms+heater break alarm+8 ramps/soaks		7
12	<Power supply>		
	100 to 240 V AC		V
	24 V AC+DC		B
13	<Non standard specification 1>		
	Standard specification		0
	Others		?
14	<Waterproof construction>		
	None		0
	NEMA 4X		D
15	Version number		?

NOTE:
Only a few of all possible coding combinations are available.
See our price list and catalog to identify the available combinations.

2 Installation/mounting

Outline and Panel Cutout Dimensions (Standard type)

(Unit: mm)

Model	Outline dimensions	Panel cutout dimensions
CP4, CP8		When installing "n" numbers of units:  In the grouped installation of CP8 *Note) See the note below.* Grouping 

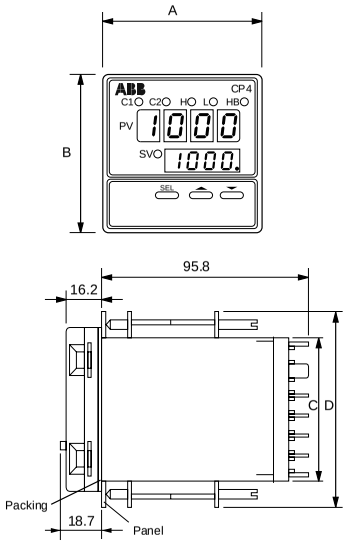
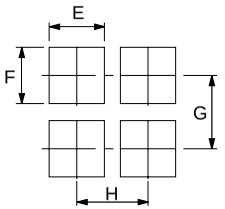
Panel thickness: 1 to 8 mm

Number of units	2	3	4	5	6
a	93	141	189	237	285

Model	A	B	C	D	E	F	G	H
CP8	48	96	90.5	114.5	45 $^{0.6}_{-0}$	92 $^{0.8}_{-0}$	116MIN	50MIN
CP4	96	96	90.5	114.5	92 $^{0.8}_{-0}$	92 $^{0.8}_{-0}$	116MIN	100MIN

Outline and Panel Cutout Dimensions (Waterproof type)

(Unit: mm)

Model	Outline dimensions	Panel cutout dimensions
Waterproof type CP4, CP8 (special-version)		When installing "n" numbers of units: 

Panel thickness: 1 to 8 mm

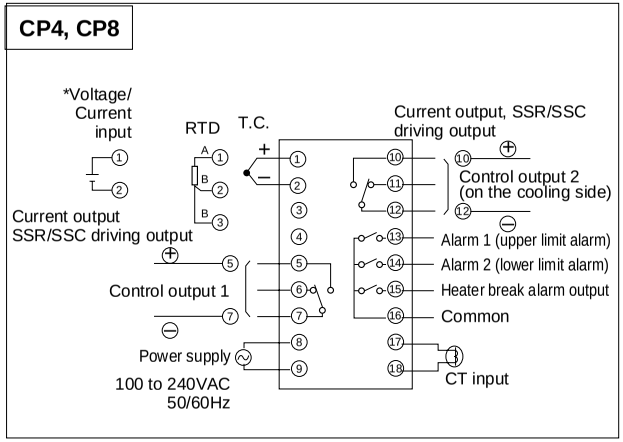
Model	A	B	C	D	E	F	G	H
CP8	52.5	100.5	90.5	114.5	45 $^{0.6}_{-0}$	92 $^{0.8}_{-0}$	120MIN	92MIN
CP4	100.5	100.5	90.5	114.5	92 $^{0.8}_{-0}$	92 $^{0.8}_{-0}$	120MIN	140MIN

Note) Caution in the grouped installation: For those models using 200-VAC power supply or higher, the installation of a fan is recommended for the radiation of heat. For the unit to be installed in the vertical group mode, maximum 100-VAC power supply can be used.

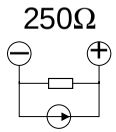
3 Wiring

Terminal Connection (for 100 to 240 VAC)

CP4, CP8



* When allowing an input of 4 to 20 mA DC, install a 250-Ω resistor (accessory) before using the unit.

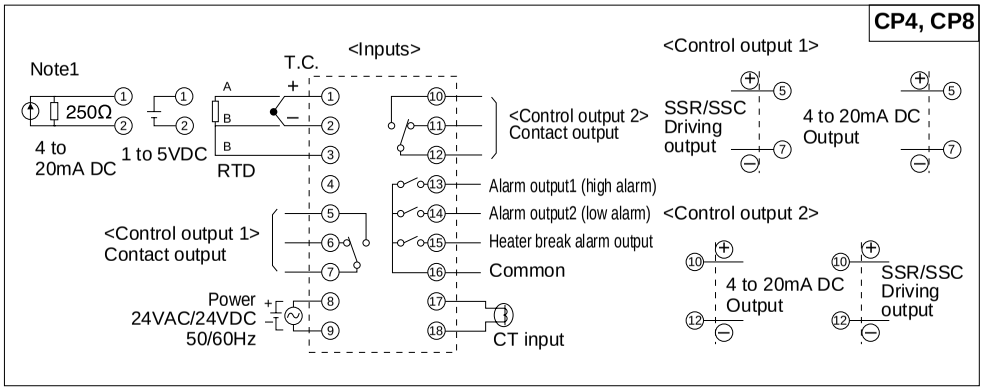


Terminal Connection (for 24VAC/24VDC)

Warning

Be sure to use the rated voltage power supply and polarity.
This type can be used for 24 VAC and 24 VDC power supply only.
Do not use for 100 to 240 VAC power supply.

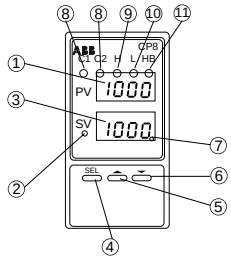
CP4, CP8



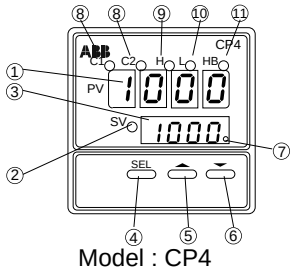
Note 1: Use the 250Ω resistance (accessory).

4 Usage (Read before using)

Name of Functional Parts and Functions



Model : CP8



Model : CP4

Name	Function
① Measured value (PV) display	Displays measured value (PV).
② Set value (SV) indication lamp	The lamp stays on while a set value (SV) is displayed.
③ Set value (SV) parameter display	Displays a set value (SV), or parameter symbol or code when setting various parameters.
④ SELECT key	The key for switching to the 1st, the 2nd or the 3rd block parameter, for moving parameters within the 1st block or for switching the display between parameter and the data at the 2nd and the 3rd block.
⑤ UP key	•The numerical value is increased by one by pressing the key once. The numerical value keeps on increasing by pressing the key continuously. •For moving parameters within the 2nd and the 3rd block.
⑥ DOWN key	•The numerical value is decreased by one by pressing the key once. The numerical value keeps on decreasing by pressing the key continuously. •For moving parameters within the 2nd and the 3rd block.
⑦ Auto-tuning indicator	The indicator blinks while the PID auto-tuning is being performed.
⑧ Control output indication lamp	C1: Stays on while the control output 1 is ON. C2: Stays on while the control output 2 is ON.
⑨ Alarm upper limit indication lamp (optional)	Comes on when the upper limit alarm is activated. It blinks while the alarm value is being set.
⑩ Alarm lower limit indication lamp (optional)	Comes on when the lower limit alarm is activated. It blinks while the alarm value is being set.
⑪ Heater failure alarm indication lamp (optional)	Comes on when the heater failure alarm is generated. It blinks while the detection operating value point is being set.

[Table 1] Input type codes

Parameter: P-n2

Group	Input type	Code (P-n2)
I	RTD	
	· Pt100 (IEC)	1
	Thermocouple	
	· J	2
	· K	3
	· R	4
	· B	5
	· S	6
	· T	7
	· E	8
	· N	12
	· PL-II	13

Group	Input type	Code
II	1 to 5VDC, 4 to 20mA	16

* In the case of 4-20 mA DC input, use an 250-Ω outboard resistor to input 1-5 VDC.

Note 1) Code may be changed to another that is in the same group.

[Table 2] Input range (Standard range)

Parameters: P-SL, P-SU

		Range of measurement (°C)	Range of measurement (°F)
RTD (IEC)	Pt100Ω	0 to 150	32 to 302
	Pt100Ω	0 to 300	32 to 572
	Pt100Ω	0 to 500	32 to 932
	Pt100Ω	0 to 600	32 to 1112
	Pt100Ω	-50 to 100	-58 to 212
	Pt100Ω	-100 to 200	-148 to 392
	Pt100Ω	-150 to 600	-238 to 1112
	Pt100Ω	-150 to 850	-238 to 1562
Thermo-couple	J	0 to 400	32 to 752
	J	0 to 800	32 to 1472
	K	0 to 400	32 to 752
	K	0 to 800	32 to 1472
	K	0 to 1200	32 to 2192

		Range of measurement (°C)	Range of measurement (°F)
Thermo-couple	R	0 to 1600	32 to 2912
	B	0 to 1800	32 to 3272
	S	0 to 1600	32 to 2912
	T	-199 to 200	-328 to 392
	T	-150 to 400	-238 to 752
	E	0 to 800	32 to 1472
	E	-199 to 800	-328 to 1472
	N	0 to 1300	32 to 2372
	PL-Ⅱ	0 to 1300	32 to 2372
DC voltage	DC1 to 5V	-1999 to 9999 (Scaling is possible)	

Note 1) Except for the following, the input accuracy is ±0.5% FS ±1 digit ±1°C (Input accuracy does not be guaranteed for the ranges of measurement other than in the table above.)
R thermocouple 0 to 500°C
B thermocouple 0 to 400°C
} : *in these ranges, this controller may display an incorrect process value due to the characteristic of the sensor.*

Note 2) In case a measuring range of -150 to 600°C or -150 to 850°C is used for resistance bulb input, temperatures below -150°C does not be indicated correctly. Therefore, "LLLL" does not appear despite a continuous fall below -150°C.

Note 3) If the resistance bulb or thermocouple is used at a temperature below the lowest value in the measurement range, the input accuracy cannot be guaranteed.

[Table 4] Control action codes

Parameter: P-n1

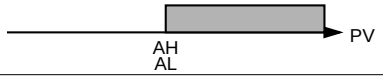
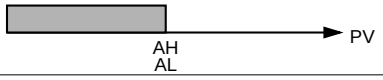
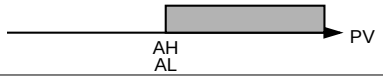
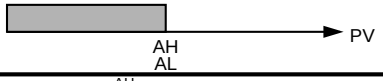
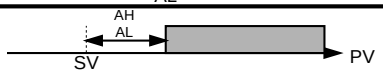
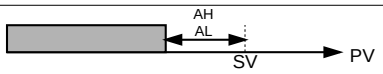
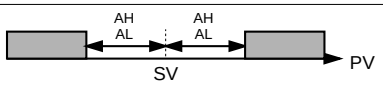
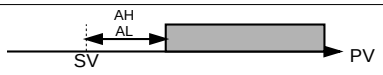
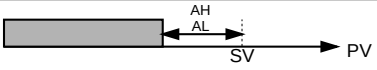
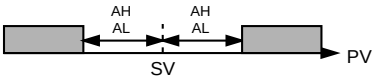
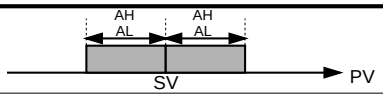
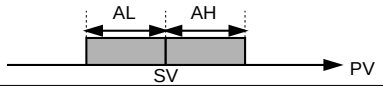
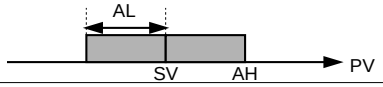
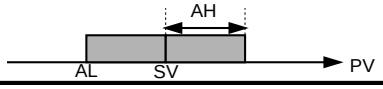
Code (P-n1)	Output type	Control action		Burn-out direction	
		Output 1	Output 2	Output 1	Output 2
0	Single	Reverse action	---	Lower limit	---
1				Upper limit	
2		Direct action		Lower limit	
3				Upper limit	
4	Dual	Reverse action	Direct action	Lower limit	Lower limit
5				Upper limit	
6				Lower limit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

[Burn-out direction]
Output direction if input is outside range or has an error.
Lower limit: OFF or 4mA or less
Upper limit: ON or 20mA or more

[Caution for dual output form]
(option)
(1) ID operation can not be set separately for heating/cooling.
(2) Setting the heating side to two position operation will set the cooling side to the same operation.
(3) If set to CooL=0.0, cooling side takes ON/OFF operation. In this case, ON/OFF operation hysteresis is fixed (0.5%FS).

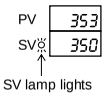
[Table 3] Alarm action type codes

Parameters: P-AH, P-AL

	ALM1 (P-AH)	ALM2 (P-AL)	Alarm type	Action diagram
	0	0	No alarm	
Absolute value alarm	1	1	High alarm	
	2	2	Low alarm	
	3	3	High alarm (with hold)	
	4	4	Low alarm (with hold)	
Deviation alarm	5	5	High alarm	
	6	6	Low alarm	
	7	7	High/Low alarm	
	8	8	High alarm (with hold)	
	9	9	Low alarm (with hold)	
	10	10	High/Low alarm (with hold)	
Zone alarm	11	11	High/Low deviation alarm (ALM 1/2 independent action)	
	—	12	High/Low absolute alarm	
	—	13	High/Low deviation alarm	
	—	14	High absolute/ Low deviation alarm	
	—	15	High deviation/ Low absolute alarm	

Note 1) When you change alarm type, check the alarm set value. A change of alarm action type may cause the alarm set value to be changed, but this is not a malfunction.

Operating state (PV/SV indication)



• SV lamp lights, indicating measurement value(PV) and setting value(SV).

To change temperature setting value (SV)

1) Press ▲ or ▼ keys to change value.

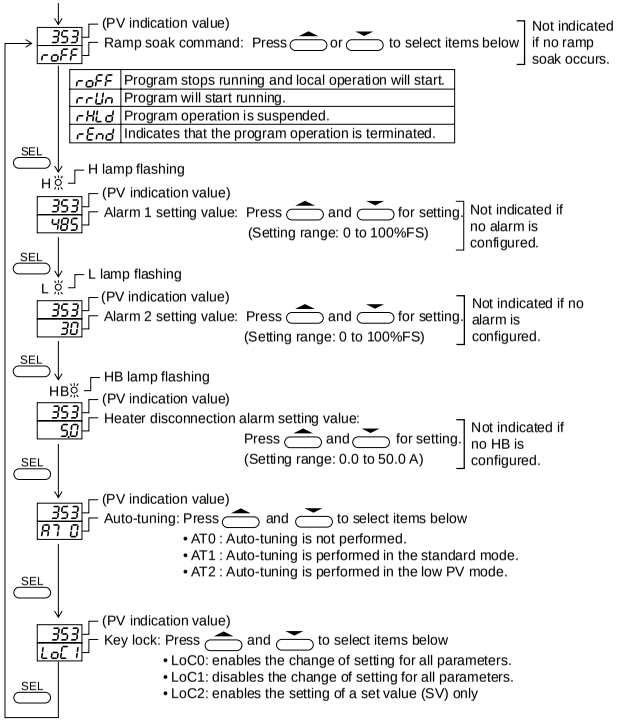
2) Press SEL key or keep it for 3 seconds to register the value.

Cautions in the setting

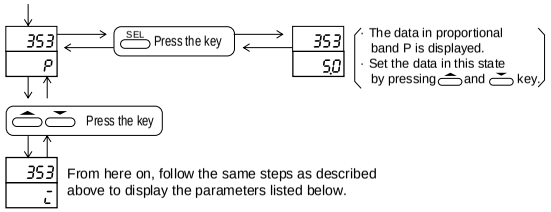
- ○ After setting data, the data is automatically registered in 3 seconds. The data can be registered as well by pressing the SEL key.
- ○ If the data setting is left as it is for about 30 seconds, the display is automatically returned to the operating state (PV/SV) display.
- ○ Where none of optional functions are incorporated into the unit, optional function parameters will be skipped without appearing on the display.

SEL 3 sec. ⇕ SEL 3 sec. | SEL 7 sec. ⇕ SEL 3 sec. | SEL 9 sec. ⇕ SEL 3 sec.

The 1st block parameters

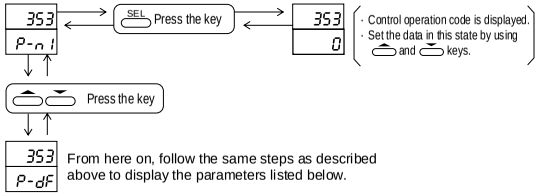


The 2nd block parameters



	Parameter display code	Description	Setting range(setting unit)	Reference
P	P	Proportional band (ON/OFF control at 0.0)	0.0 to 999.9%FS	
c	I	Integral action time	0 to 3200 sec.	
d	D	Derivative action time	0.0 to 999.9 sec.	
TC	TC	Proportional time cycle of control output 1	1 to 150 sec.	Note 5, *3
HYS	HYS	Insensitive zone	0 to 50%FS (engineering unit)	
TC2	TC2	Proportional time cycle of control output 2	1 to 150 sec.	Note 5, *6
CooL	Cool	Proportional band coefficient on the cooling side	0.0 to 100.0 times	*5
db	db	Shifting the proportional band on the cooling side	-50 to 50% (MV)	*5
bAL	bAL	Manual reset value	–100.0 to 100.0%	*4
Ar	Ar	Anti-reset wind up	0.0 to 100.0%FS (engineering unit)	*4
P-n2	P-n2	Input type setting	0 to 16	Table 1
P-SL	P-SL	Setting of lower limit in the range	-1999 to 9999 (engineering unit) Note 3, Note 4	Table 2
P-SU	P-SU	Setting of upper limit in the range	-1999 to 9999 (engineering unit) Note 3, Note 4	Table 2
P-dP	P-dP	Setting of decimal point position	0 to 2 Note 2, Note 3 (0: No decimal point; 1; 2)	
P-AH	P-AH	Alarm type, Alarm type 1	0 to 11	Table 3, *2
P-AL	P-AL	Alarm type, Alarm type 2	0 to 15	Table 3, *2
PVOF	PVOF	PV offset	-10 to 10%FS (engineering unit)	
STAT	STAT	The current position of the program	Can not be set	*1
SU-1 to SU-4	SV-1 to SV-4	Target value in the 1st ramp to Target value in the 4th ramp	0 to 100%FS (engineering unit)	*1
TM1r to TM4r	TM1r to TM4r	Segment time in the 1st ramp to Segment time in the 4th ramp	0:00 to 99:59	*1
TM1S to TM4S	TM1S to TM4S	Segment time in the 1st soak to Segment time in the 4th soak	0:00 to 99:59	*1
Mod	MOD	Ramp SV mode	0 Note 1	*1

The 3rd block parameters



	Parameter display code	Description	Setting range (Setting unit)	Reference
P-n1	P-n1	Specifying control operation	0 to 19	Table 4
P-dF	P-dF	Input filter (Time constant)	0.0 to 900.0 sec.	
P-An	P-An	Alarm insensitive zone	0.0 to 50.0%FS (engineering unit)	*1
FUZY	FUZY	Specifying control method	OFF: PID control ON : FUZZY control	
dSP1 to dSP7	dSP1 to dSP7	Specifying parameter mask	0 to 255	Note 1

Note 1) If you miss setting to dSP1 to dSP7, any parameters that you want to see don't appear.
Before you change them, record the current value of them.
Take care enough to change them.
**1: Not indicated without alarm.*

Method of setting temperature and parameter

Note 1) Always set to 0 before using.
Note 2) 2 is valid only if voltage and current are applied.
Note 3) When P-SL/P-SU/P-dP is changed, check that all the parameters including the SV are properly assigned. (They may have change)
Note 4) Set values so that P-SL < P-SU.
Note 5) The setting of 0 is for current output. Don't set 0 at contact or SSR driving output. It is recommended more than 30 at contact or more than 1 at SSR driving output.
**1: Not indicated without ramp/soak.*
**2: Not indicated without alarm.*
**3: Not indicated for current output.*
**4: Not indicated at shipment from factory.*
**5: Not indicated without control output 2.*
**6: Indicated only when control output 2 is relay or SSR drive output.*

5 Useful usage of this equipment

1 Setting the input

* Skip this procedure if specified when you order.

① Is the input sensor type same as what you use ?

Select the sensor you use from those in Table 1, and set it in the parameter P-n2.	
(Example)	For T thermocouple, set P-n2 to "7".
(Note)	Changing between resistance bulb and thermocouple is allowed, though that between 1 to 5VDC (4 to 20mA DC) and thermocouple/resistance bulb is not allowed.

② Is setting of input temperature range suitable for the sensor you use?

Standard range to each sensor is shown in Table 2. Select the temperature range suitable for the equipment you use, set lower/upper limit values to P-SL/P-SU respectively.	
(Example)	Temperature range 0 to 800 [˚C] set P-SL and P-SU to 0 and 800 respectively.
(Note)	Standard range is recommended to set though other setting is available.
(Note)	No standard range is given if 1 to 5VDC(4 to 20mA DC) are input. Any upper/lower limits can be set (-1999 to 9999, and lower limit< upper limit)

2 Setting of controls

* Read if the control doesn't work as you expect.

① Objective of control (heating or cooling applied?)

Objective	Operation scheme	Description	Method
Heating	Reverse	Increased measurement value will decrease operational output value.	Set parameter P-n1 to 0 or 1. (Refer to Table 4)
Cooling	Direct	Increased measurement value will increase operational output value.	Set parameter P-n1 to 2 or 3. (Refer to Table 4)

② Types of control (ON/OFF, PID, fuzzy)

Type of control	Description	Method
ON/OFF control (2 position control)	Output takes either ON (100%) or OFF (0%). (Suitable when frequent output switching is inconvenient.)	Parameter P is set to 0.0. *Refer to “5-1 ON/OFF control”
PID control	Output is calculated with PID parameters, outputting 0 to 100% with setting proportional period (TC) as 100%. Control with less overshoot is available.	Perform the auto-tuning to automatically calculate an optimal PID (manual operation is also available). *Refer to “5-2 Auto-tuning”.
Fuzzy control	Fuzzy operation is added to PID providing control with less overshoot.	Set the parameter FUZY to ON. Perform the auto-tuning (same as PID control).

5-1 ON/OFF (two position) control

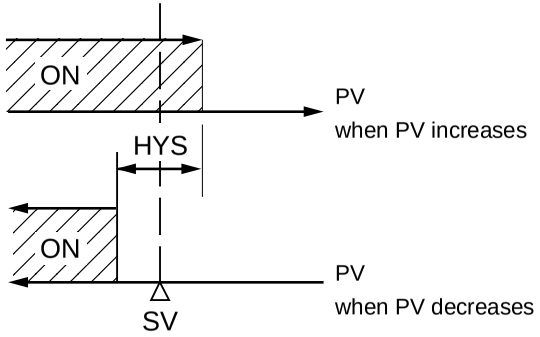
- Output ON/OFF is determined according to which of PV or SV is larger.
- Set parameter P to 0 for selecting the two-position control.
- Set the operation insensitive zone (hysteresis) to avoid an output chattering near PV ≒ SV. (setting at shipping: HYS=1)

- Parameter setting and operation example

Example 1: Reverse action

Parameter	Setting value
P	0.0
P-n1	0 (or 1)
HYS	Any value

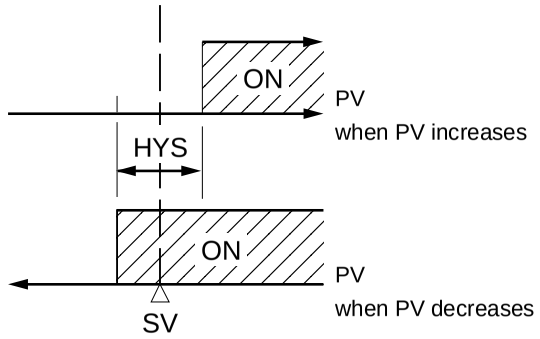
Relationship of PV and SV	Output
PV＞SV	OFF
PV＜SV	ON



Example 2: Direct action

Parameter	Setting value
P	0.0
P-n1	2 (or 3)
HYS	Any value

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



5-2 Auto-tuning (AT)

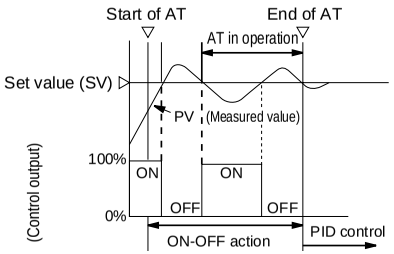
The auto-tuning is automatic measurement, computation, and setting of the P.I.D. constant that are performed by the micro-controller. Prior to the auto-tuning, complete the setting of input range (P-SL, P-SU, P-dP), a set value (SV), alarm setting (H,L), and proportional time cycle (TC).

How to start the auto-tuning

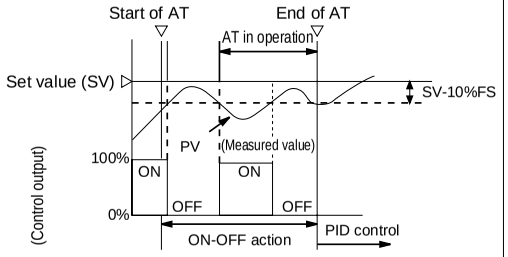
Set the parameter, AT to either "1" or "2" by using ⌃ or ⌄ key. The auto-tuning starts automatically after 3 seconds. Then the point indicator at the lower right will start blinking. When auto-tuning ends, parameter AT is automatically set to 0 after flashing at decimal point of digit 1 disappears.

	When auto-tuning is not performed or when it is cancelled	Standard type (auto-tuning on the basis of SV)	Low PV type (auto-tuning on the basis of SV·10%FS)
Setting code (AT)	0	1	2

①Standard type (AT=1)



②Low PV type (AT=2) :Overshoot decreases when tuning is performed.



(a) The P.I.D. parameter calculated by auto-tuning, will be retained even if the power is turned off. If, however, the power is turned off in the auto-tuning, you must restart the auto-tuning.

(b) The PV may be changed greatly depending on the process, because the control output is ON/OFF action in the auto-tuning. So, do not use the auto-turning if the process does not allow a significant variation of PV.
Also, the auto-tuning should not be used in a quick-responsive process such as pressure control and flow control.

(c) If the auto-tuning fails to complete in four hours, an abnormality in the auto-tuning may be suspected. In this case, recheck the wiring, control output operations (nomal and reverse action), and parameters such as the input sensor type.

(d) Carry out the auto-tuning again when the SV is significantly changed, parameter P-SL, P-SU or P-dP is changed or a controlled equipment operation is changed.

(e) Figures ① and ② show the behavior of PV during the auto-tuning.

(f) Perform the auto-tuning also when fuzzy control is selected in the control type setting.

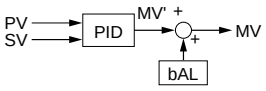
5-3 bAL and Ar function

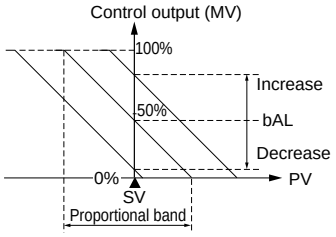
Note: The parameters bAL and Ar disappear at shipment.
You need to set to appear below,"Switching bAL and Ar to appear or to disappear.

1) These are functions to suppress overshoot.
2) If they aren't optimum value, sometime you don't get the good control. Usually it is not necessary to set them.
3) "Ar" is automatically calculated and set by "Auto tuning".

1 bAL

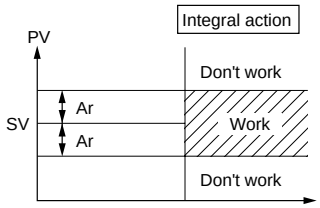
This is added as offset to MV' that PID calculates from PV and SV.
This is MV after calculation above.





2 Ar

The "Ar" limits the integral range.The integral range is SV ± Ar.
Integral action don't work when PV is out of the range of SV ± Ar.



Switching bAL and Ar to appear or to disappear

1 Switch to appear

① Display the "dSP2" of the third block parameter and then subtract 128 from current value.
② Display the "dSP3" of the third block parameter and then subtract 1 from current value.

2 Switch to disappear

① Display the "dSP2" of the third block parameter and then add 128 to current value.
② Display the "dSP3" of the third block parameter and then add 1 to current value.

6 Read if the indication is abnormal.

Displays in abnormalities

This unit has a display function to indicate several abnormalities. If an abnormality occurs, eliminate the cause of abnormality immediately. After the cause is eliminated, turn off the power once before the power is turned on.

Display	Cause	Control output
UUUU	① when the thermocouple sensor is burnt out. ② when the RTD (A) is burnt out. ③ when the PV value exceeds the upper limit value of the range + 5% FS.	① when the burn-out control output is set for the lower limit (standard): OFF or 4 mA or less ② when the burn-out control output is set for the upper limit: ON or 20 mA or larger
LLLL	① when the RTD (B or C) is burnt out. ② when the RTD (between A and B, or between A and C) is shorted. (Note) ③ when the PV value is below the lower limit value of the range -5% FS. ④ when the 1 to 5 VDC wiring is opened or shorted.	
LLLL	① when a PV value is below -199.9.	The control is continued. *Note) The control is continued until the value reaches -5% FS or less.* *The burn-out will take place when the value reaches -5% FS or less.*
HB lamp ON	The heater is burnt out.	The control is continued.
Err	When P-SL/P-SU setting is improper.	OFF or 4mA or less
FAL 1	Fault in the unit	Undefined (Don't use this controller immediately.)

Note : In case a measuring range of -150 to 600°C or -150 to 850°C is used for resistance bulb input, control will be continued without "LLLL" display.

Specification

Power voltage:	100 (-15%) to 240 VAC (+10%), 50/60Hz or 24VDC/24 VAC (±10%), 50/60Hz
Power consumption:	15VA or less/240VAC
Sensor input:	Thermocouple, 3-wire resistance bulb, 1 to 5VDC
Control method:	PID or fuzzy PID or ON/OFF (two positions)
Relay output:	SPDT contact, 230 VAC/30 VDC 3A (resistive load) mechanical life ; 10 million times or over (no load) electrical life ; 100 thousands times or over (rating load)
SSR/SSC driving output: (voltage pulse output)	ON: 15 to 30 VDC OFF: 0.5V DC or less maximum current ; 60mA or less SSR/SSC driving output for control outputs 1 and 2: 60mA or less in total
DC4-20mA output:	Allowable load resistor 600Ω or less
Alarm output:	Relay contact (SPDT contact) 230 VAC/30 VDC 1A (resistive load)
Heater disconnection alarm output:	Relay contact (SPDT contact) 230 VAC/30 VDC 1A (resistive load)
Operating ambient temperature:	-10 to 50°C
Operating ambient humidity:	90%RH or less (no condensation)
Preservation temperature:	-20 to 60°C
Operating environmental condition:	Overvoltage category II, pollution degree 2 Warm-up time: 30 minutes or more

Subject to technical changes.

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Subject to technical changes
Printed in the Fed. Rep. of Germany
42/61-75 EN Rev. 00
Edition 02.02