

# LT230 series Digital Indicating Controller

## CHINO

### Instruction Manual

- ◆ Read this instruction manual carefully to use your controller safely and avoid troubles.
- ◆ If your controller is with optional communications interface, read the separate instruction manual (INE-315), too.

#### Checking of Model No.

Check Model No. of your controller and its specifications.

#### To agents or distributors

Make sure to pass this instruction manual to final customers.

#### To our valuable customers

Keep this instruction manual until disposing of your controller.

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■ **Model code** You can check it by keys. → Refer to [4. Troubleshooting/Maintenance].

①②③④      ⑤⑥⑦

L T 23 □ □ □ □ 00 — □ □ □ ... Size: 48 x 48 (mm)

#### ① Input signal

- 0: Universal input
- 3: Universal input for high temperature

#### ② Control output 1 (heating)

- 1: On-off pulse type
- 3: Current output type
- 5: SSR drive pulse type
- 6: Voltage output type

#### ③ Control output 2 (cooling) (option)

- 0: None
- 1: On-off pulse type
- \* This option is to be combined with the event output. Specify "1" or "3" at ⑤.

#### ④ Communications IF (option) + Remote contacts input (option)

- 0: None
- 1: 2 points of remote contacts input (DI)
- 2: RS-485
- 3: RS-485 + 2 points of remote contacts input (DI)
- \* For combination with heater disconnection (option), specify "2" (RS-485).

#### ⑤ Event + CT (option)

- 0: None
- 1: 2 points of event out put
- 3: 2 points of event output + heater disconnection (CT) \*
- \* For combination with Control output 2, 1 point of event output is only available.
- \* The combination of heater disconnection and remote contacts input is not available.

#### ⑥ Water-proof (option)

- 0: None
- 1: NEMA250 4X (equivalent to IP66)

#### ⑦ Power supply

- A: 100 to 240VAC
- D: 24VDC

\* Heater disconnection (CT) is available only when Control output 1 is pulse types.

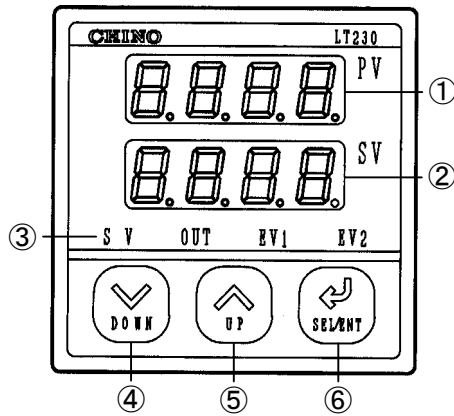
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## ■ Front view



## ■ Accessories/parts (sold separately)

### ● Accessories

Fixture	2 pieces
Instruction manual (this manual)	1 copy

### ● Parts (sold separately)

Terminal cover	
Shunt resistor for current input (250Ω)	

Name		Function	
①	Upper LED (Green)	○ : Display of measured value (PV)	■ : Display of parameter item
②	Lower LED (Red)	○ : Display of setpoint value (SV), control output value, or blank	■ : Display of monitored data (operation mode) or parameter
③	Status		
	SV (Green)	○ · ■ : It lights when SV is displayed in the lower LED display, and blinks in ramp condition	
	OUT (Green)	○ · ■ : It lights when control output (OUT) is displayed in the lower LED display	
	EV (Red)	○ · ■ : EV No. lights when any event is active	
④	∇ (down) key	○ : For selection of executing SV No.	■ : For setting of parameter or reverse stepping of mode
⑤	∧ (up) key	○ : For selection of executing SV No.	■ : For setting of parameter or stepping of mode
⑥	(Select) key	○ : For stepping of parameter item in operation mode	■ : For stepping of parameter item in each mode
	(Enter) key	○ · ■ : For storing settings into memory (in setting mode – A dot blinks.)	
	SEL 2 sec.	○ · ■ : Switching of operation screen → mode screen, Quick return of setting screens in a mode screen	

○ : Operation screen      ■ : Monitor or setting screen



# Notes on safety

## 1. Precondition for use

Your controller is designed for installation in indoor panels.

### International safety standards

- Front panel (option) NEMA250 4X (equivalent to IP66 under IEC529)  
Not available in closed installation
- CE EMC: EN61326+A1 \*  
Safety: EN61010-1+A2  
Overvoltage category II, Pollution degree 2
- UL standards UL3121-1
- CSA standards (C-UL) CSA C22.2 No. 1010

\* The displayed value and the output value equivalent to maximum  $\pm 10\%$  or  $\pm 2mV$  may vary under the test environment of EMC directive.

## Warning/Caution

### 1. Confirmation of power voltage and wirings

Confirm the power voltage and wirings before turning on the power supply.

### 2. Termination of wirings

Use crimping terminals with insulation sleeve.

### 3. Power switch

For the power supply, prepare a switch and an overcurrent protection device within 3m of your controller.

### 4. Safety measures for output

Control output or event output may not be correct due to wrong operation, malfunction, sensor abnormal or other factors.

Prepare safety measures at final products side if required.

### 5. Prohibition of repair and modification


To avoid electrical shock, fire and malfunction, other personnel than the service personnel authorized by CHINO are prohibited to repair, modify or disassemble your controller.

### 6. Turning off the power supply



When you feel or find abnormal conditions such as smelling or heating, turn off the power supply and contact your agent of CHINO Corporation.

## 2. Symbols used in your controller

- Used in your controller

Label	Name	Explanation
	Alert symbol mark	Indicates the locations where there is a risk of electrical shock or injury.

- Used in this manual

 Caution	Indicates the locations where there is a risk of electrical shock or injury.
 Note	Indicates the items that your controller may result in insufficient functioning.

## ■ Request for ensuring against risks

### 1. Environment

Make sure not to use your controllers in

- places containing corrosive gas (ex. sulfuric gas, etc.), powder or dust,
- places containing flammable or explosive gas,
- places flooded or covered with oil,
- places subject to significant change of temperature and strong wind
- places where is significantly influenced by vibration and shock
- places subject to direct sunlight and dew condensation.

### 2. Unused terminals

Make sure not to wire to unused terminals.

### 3. Inductive noise

- Make sure to separate all wirings to your controller from power line with high voltage or high current.
- Install your controller apart from equipment generating strong magnetic field, electrical field or high frequency.

### 4. Ventilation

Make sure not to block the ventilation openings to ensure the heat dissipating space for your controller.

### 5. Cleaning

When cleaning is required, make sure not to use chemicals (ex. thinner, benzene, etc.) affecting molded parts.

Use alcohol available in markets.

### 6. Safety measures at final products side

- To ensure safety in the event of malfunction of your controller, prepare separate safety measures.
- Prepare an enclosure for protection against fire when installing your controller.
- Prepare safety measures to prevent contact with terminals.

# 1. Installation to a panel

## ⚠ Caution

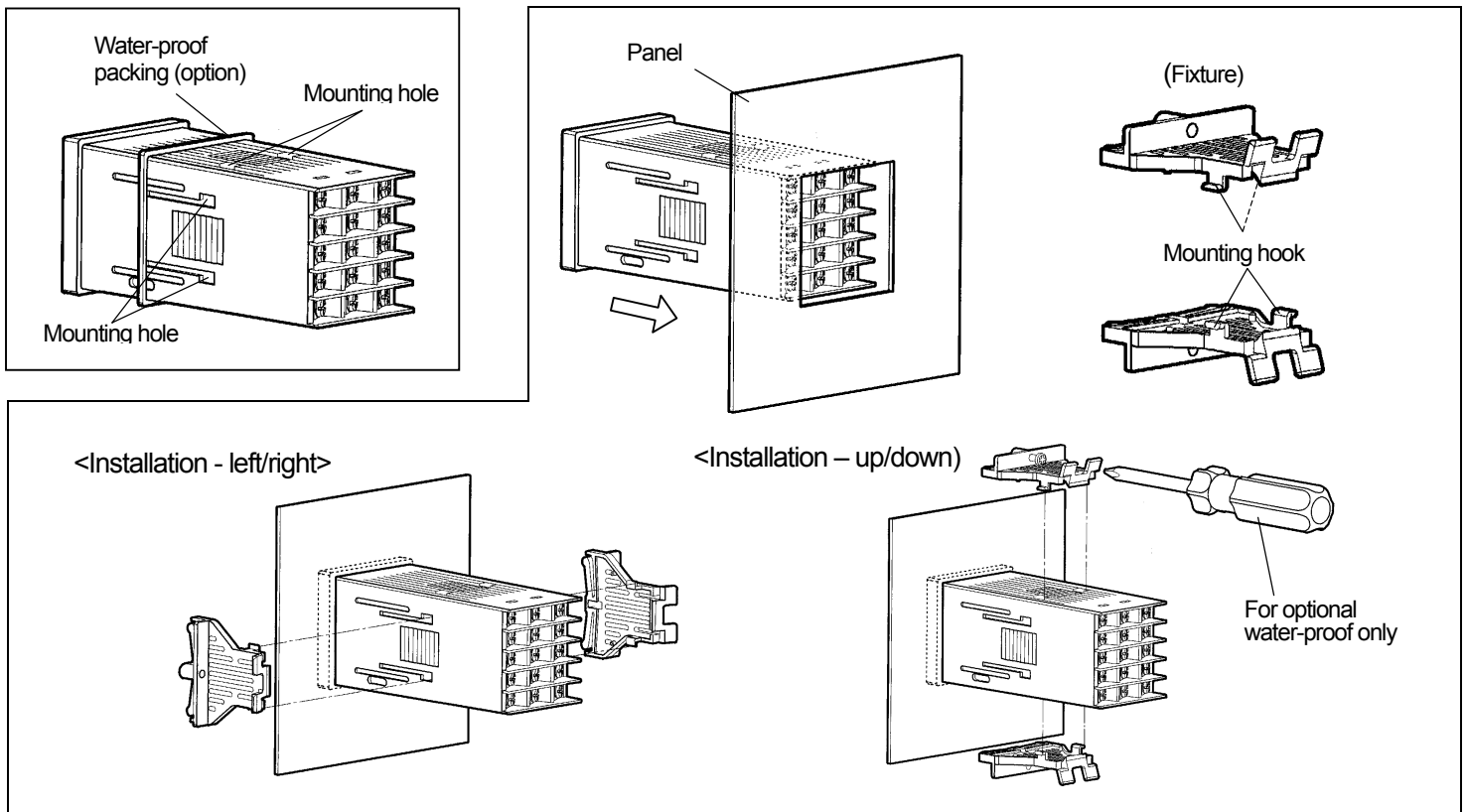
To avoid electrical shock, make sure to turn off the power supply and then install your controller to a panel.

### • Installation condition

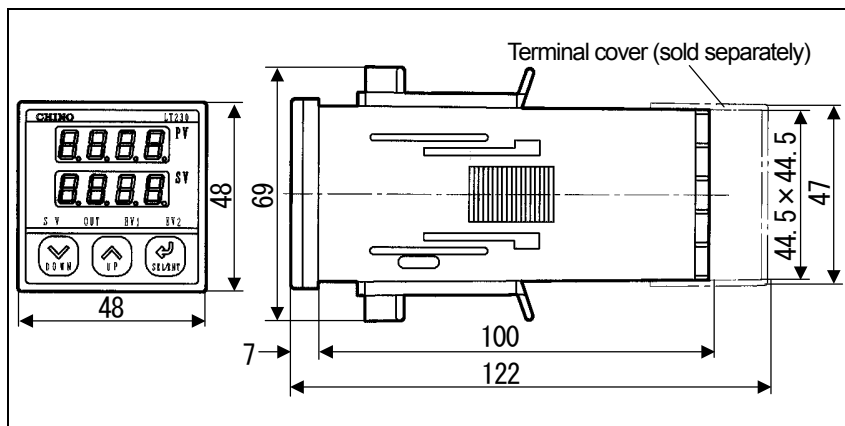
• Thickness of panel: Steel sheet of 1 to 10mm

• Installation angle: Within 10° for forward tilting and backward tilting, and within 15° for left and right

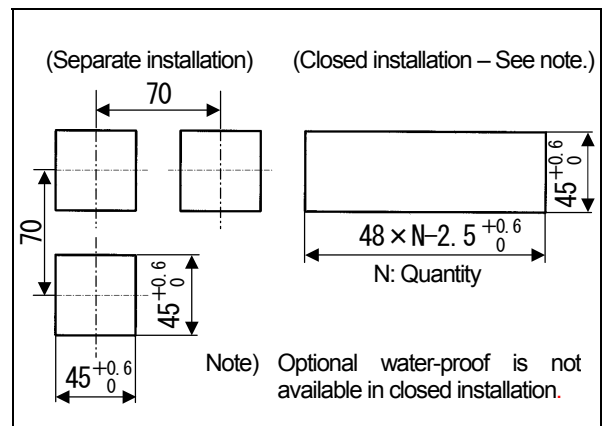
- ① Insert the terminal board side of your controller into the angular hole of the panel cutout. When your controller is with optional water-proof, mount the rubber packing attached and then insert your controller.
- ② Insert the fixtures (2 pieces attached) into the mounting holes of your controller (for up and down sides), and then push them into the panel.
- ③ For the optional water-proof only, tighten the screw of the fixture. [Tightening torque]: 0.5 to 0.7 N·m



## ■ Outside dimensions



## ■ Panel cutout



## 2. Before wirings

### ⚠ CAUTION

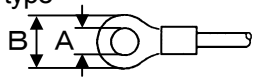
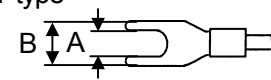
- ① To avoid electrical shock, make sure to turn off the power supply and then work all wirings.
- ② Work all wirings by only personnel who have basic knowledge of wiring and experienced the actual works.

### Note

1. Use a single-phase power supply with less noise, distortion of wave, voltage fluctuation to avoid malfunction of your controller.
2. If the power supply has noise too much, prepare a noise filter or other measures separately.

### Note

Wires and crimping terminal covered by insulation sleeve

Terminal name	Wire type	Crimping terminal covered by insulation sleeve		Tightening torque
Power terminals Relay output terminals (M3.5)	600V vinyl-insulated wires (Note)	<ul style="list-style-type: none"> <li>• O type</li> </ul> 	<ul style="list-style-type: none"> <li>• Y type</li> </ul> 	Max. 0.8N·m
Other terminals (M3.5)	See "Notes on wirings".	<ul style="list-style-type: none"> <li>• O type (Y type is usable.)</li> </ul>	* Dimension of terminal A: 3.7mm or more B: 7.0mm or less	

(Note) IEC 60227-3 ANSI/UL817, CSA C22.2 No. 49, AWG (American Wire Gauge) 16 to 22

## ■ Cautions on wirings

### 1. Power terminals

"Power supply" label is provided on the side of your controller.

Your controller may be damaged or broken if the voltage specified is not applied to.

### 2. Input terminals

#### 1) Allowable input voltage

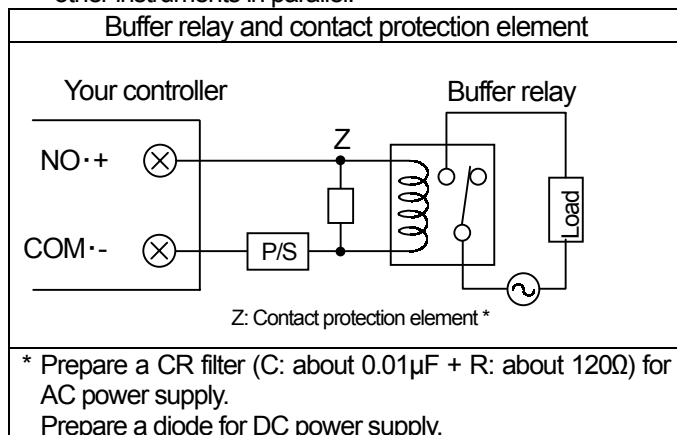
Input type	Allowable input voltage
DC voltage, thermocouple	±10VDC
Resistance thermometer	±5VDC

#### 2) Thermocouple

- Connect a thermocouple (or an extension wire) to input terminals.
- Do not connect the same thermocouple to other instruments in parallel.

#### 3) Resistance thermometer

- Use a 3-core cord with same resistance per each wire to avoid measurement error.
- Do not connect the same resistance thermometer to other instruments in parallel.



### 3. Control/Event output terminals

#### 1) On-off pulse output

- Contact ratings
  - (Resistive load) 3A (100 to 240VAC, 30VDC \*)
  - (Inductive load) 1.5A (100 to 240VAC, 30VDC \*)
- \* Minimum load 5VDC 10mA or more
- Electrical life of relay 1 hundred thousand times
- Buffer relay and contact protection element → See the left figure.

Make sure to connect a load through a buffer relay.

To extend the life of relay contact, mount a contact protection element in parallel to the coil of the buffer relay.

#### 2) Current output

- Load resistance 600Ω or less

#### 3) SSR drive pulse output

- On/off voltage 12VDC ± 20%/0.8VDC or less

#### 4) Voltage output

- Output resistance About 10Ω
- Load resistance 50kΩ or more

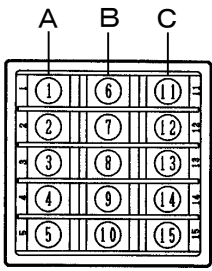
#### 5) Event output

- Contact ratings
  - (Resistive load) 3A (100 to 240VAC 30VDC \*)
  - (Inductive load) 1.5A (100 to 240VAC 30VDC \*)
- Electrical life 1 hundred thousand times
- \* Minimum load 5VDC 10mA or more
- \* The relay is not replaceable. Make sure to use a buffer relay.

### 4. Mounting of terminal cover (sold separately)

A terminal cover (option) is available for avoiding electrical shock. If you have it, mount (push) the cover when all wirings are completed.

# 3. Terminal arrangement



Line A		Line B		Line C		
①	Control output 1	⑥	Communications interface	⑪	Event output	Event output
②		⑦		⑫		
③	Measuring input	⑧		Remote contacts input 2 points	⑬	Power supply
④		⑨	CT input		⑭	
⑤		⑩		⑮		

\* Make sure not to use unused terminals for relaying.

## Line A Input/ Control output1

### 1) Measuring input

No.	Voltage (current *)	Thermocouple	Resistance thermometer
③			A
④	+	+	B
⑤	-	-	B

\* Connect a shunt resistor (250Ω/sold separately) between + and -.

### 2) Control output 1 (heating)

No.	On-off pulse type	SSR drive pulse type Current output type Voltage output type
①	COM	+
②	NO	-

## Line B Communications/ Remote contacts input /CT

No.	DI (option)	CT (option)	
⑥	SA	Communications I/F RS-485	
⑦	SB		
⑧	SG		
⑨	DI1+	CT	CT input
⑩	DI2+	CT	

## Line C Event output /Control output 2/ Power supply

### 1) Event output/Control output 2

No.	Event output option	Control output 2 option
⑪	EV1	EV1
⑫	EV2	NO
⑬	COM12	COM

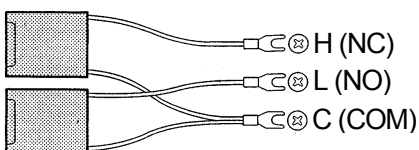
### 2) Power supply

No.	AC	DC
⑭	L (Live)	+
⑮	N (Neutral)	-

## Contact protection element (option)

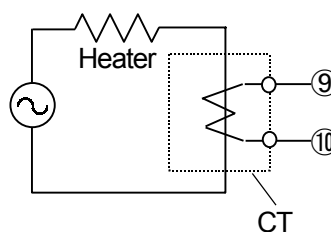
Mount a contact protection element for on-off pulse type.

- For light load (less than 0.2A)  
CX-CR1 (0.01μF + 120Ω)
- For heavy load (more than 0.2A)  
CX-CR2 (0.5μF + 47Ω)

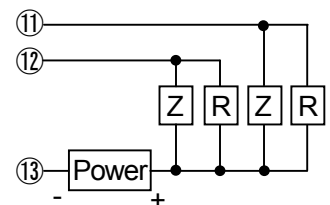


## Basic connection

### 1. CT input



### 2. Event output



[R] Buffer relay [Z] Contact protection element

# 4. Troubleshooting/Maintenance

## 4.1 Troubleshooting

Trouble		Check/Cause/Action
Not operated at all		① Is the rated power (100 to 240V AC, 24VDC) supplied to the power terminals?
		② Is the connection to the power terminals (L, N / +, -) correctly?
		③ Turn off the power supply and then turn it on again. If the operation is normal, CPU may be malfunctioned by electrical noise. In this case, prepare measures to suppress the noise.
Control operation abnormal	No control output	"Run/Ready" may be set at [rEdy]. Set it to [rUn].
	Late transition	The set value of "Output variation limiter" may be low. Set it to be higher.
	Stable at above to setpoint	The control may be P and D only due to low set value of "ARW-H". Set it to be higher.
	Stable at below to setpoint	The control may be P and D only due to low set value (minus value) of "ARW-L". Set it to be higher.
	Control result not stable	① The derivative time may be too short. Set it to be long. ② The derivative time may be too long. Set it to be short.
	Overshooting	Set the "targeted value filter" to ON.
Measured value abnormal	Not stable	1) Are input terminals connected securely? 2) Is the input signal (sensor) stable? 3) Make sure that a sensor (thermocouple or resistance thermometer) is not connected in parallel to other instruments.
	Not correct	1) Is the input type correct? 2) Is the "engineering unit" correct? 3) For the thermocouple input, is a thermocouple or an extension wire connected to the input terminals?
Incorrect settings	SV stopped on its way	The set value of "SV limiter L" or "SV limiter H" may be not correct.
	SV rising or falling	"SV rising ramp" or "SV falling ramp" has been set. (If it has been set, its ramp operation functions at the selection of SV No., the change of SV, etc.)
	Key not accepted	Keys may be locked.

## 4.2 Displays and operation for troubles

Display	Explanation	Operation		Action
		Event output	Control output	
----	Over-range	High limit event → ON	"PV error output"	① Is the "Input type" correct?
----	Under-range	Low limit event → ON	"PV error output"	② Is the input signal (sensor) normal?
E r 0 1	Zero data abnormal	Fail → ON	"PV error output"	Your controller may be in trouble. Turn off the power supply and then turn it on again. If it is still in trouble, contact your agent of CHINO Corporation.
E r 0 2	RJ data abnormal		Control continued *1	
E r 0 3	A/D conversion error		"PV error output"	
E r 0 4	Calibration data abnormal		Control continued *2	

\*1: Control continues without reference junction compensation. \*2: Control continues on non-calibration condition.

## 4.3 Control at power recovery

### 1) Short power interruption

For the short power interruption within 20msec, the normal operation continues.

### 2) When recovery

The control operation is determined by the selection in "Control at power recovery" of Mode 5. In case of " [ 0 n t ]", the control operation before power interruption or power off is continued. In case of " r E d H", the control output becomes to the value of "Preset out".

### ■ How to check the type

- Press [←] key more than 2 seconds. and then press [↵] key to move to Mode 1.
- Press [←] key for several times until "Model confirmation 1" appears. 3-digit figure ("A" mentioned below) is displayed.
- Press [←] key again to appear "Model confirmation 2" or "Model confirmation 3". 3-digit figure of "B" or "C" is displayed.  
MODEL LT23■■■■■■■■—■■■■  
          A   B   C
- You can verify Model No. by the above A, B and C.

### ■ Life of components

The followings are the life of components used in.

Component	Expected life
Control relay (On-off pulse)	100,000 times *1
Relay for event (option)	
Electrolytic capacitor in power circuit	3 years (30°C) *2

\*1: By inserting a contact protection element and low load current, the life becomes longer.

\*2: In the environment where temperature is high, the life becomes shorter.

# 5. Specifications

## 5.1 Standard specifications

### 1) Input specifications

Input type: T/C ... B, R, S, N, K, E, J, T, U, L, WRe5-WRe26, W-WRe26, PtRh40-PtRh20, Platine II

RTD ... Pt100, JPt100

DC voltage ... 0 to 5V

DC current ... 4 to 20mA (by adding a shunt resistor 250Ω)

Rated measuring accuracy:  $\pm 0.25\% \pm 1$  digit (See the right upper table in Chapter 9 for details.)

RJ compensation accuracy: At ambient 13 to 33°C ...  $\pm 1.0^\circ\text{C}$   
At ambient -10 to 50°C ...  $\pm 2.0^\circ\text{C}$

Sampling period: Approx. 0.5 second

Burnout: Up scale (T/C, RTD)

Allowable signal source resistance: thermocouple ... 250Ω or less  
DC voltage... 1KΩ or less  
RTD ... 10Ω or less (per wire)

Input resistance: DC voltage, thermocouple ... 1MΩ or more

Maximum common mode voltage: 30VAC

CMRR (thermocouple): 130dB

SMRR (thermocouple): 50dB

### 2) Control specifications

Control switching period: About 0.5 second

Control output: Heating output/PID system, To be specified from the following 4 types, Cooling output (option) is only 1 type of ①.

① On-off pulse type ...

Contact ratings: See "Cautions on wirings" in Chapter 2.

Pulse cycle: 1 to 180 seconds (1 second increments)

② Current output type ... 4 to 20mA (600Ω or less)

③ SSR drive pulse type ...

Output signal: 12VDC  $\pm 20\%$  (Max 20mA) at ON  
0.8VDC or less at OFF

Pulse cycle: 1 to 180 seconds (1 second increments)

④ Voltage output type ... 0 to 10VDC

(Output resistance ... About 10Ω,

Load resistance ... 50kΩ or more)

### 3) General specifications

Rated supply voltage: 100 to 240VAC 50/60Hz or 24VDC (Class 2 power source)

Allowable power voltage: 90 to 264VAC / 24VDC ( $\pm 10\%$ )

Power consumption: Maximum about 10VA / about 6W

Operating condition: As shown in the following table.

Item	Reference operating condition	Normal operating condition
Ambient temperature	23 $\pm$ 2°C	-10 to 50°C *1
Ambient humidity	55 $\pm$ 5%RH *2	20 to 90%RH *2
Power voltage	100VAC $\pm 1\%$ , 24VDC	90 to 264VAC, 24VDC $\pm 10\%$
Power frequency	50/60Hz $\pm 1\%$	50/60Hz $\pm 2\%$
Mounting angle	Up/down ... $\pm 3^\circ$	Up/down ... $\pm 10^\circ$
Installation altitude	Less than 2000m	Less than 2000m
Vibration, Impact	0m/s <sup>2</sup> , 0m/s <sup>2</sup>	2.0m/s <sup>2</sup> , 0m/s <sup>2</sup>

\*1: Less than 40°C for closed installation

\*2: No dew condensation is allowed.

Warming up: More than 30 minutes

Power failure: Parameters are maintained by EEPROM.

Insulation resistance: Between primary terminal (\*3) - secondary terminal (\*4) 500VDC, 20MΩ or more

Withstand voltage: Between primary terminal (\*3) - secondary terminal (\*4) 1500VAC, 1 minute

\*3: Terminals for AC power supply, control output and event relay output

\*4: Terminals other than mentioned above and DC power supply.

Front and case: Front... Non-flammable ABS

Case... Non-flammable polycarbonate resin

Weight: Approx. 200g

### 4) Event specification

Event calculation: 2point

Output point: Relay output, 2 points (option)

Event type: Absolute value, deviation, absolute value deviation, output value (High limit/low limit and standby enable/disable is selectable in these events.), FAIL, heater disconnection(option), timer function

### 5) Transportation and storage\* condition

Ambient temperature: -20 to 60°C

Ambient humidity: 5 to 95%RH (no dew condensation)

Vibration: 0 to 4.9m/s<sup>2</sup> (10 to 60Hz)

Impact: 400m/s<sup>2</sup> or less

\*The above is under the condition of shipment from the factory

## 5.2 Options

### 1) Communications interface / Remote contacts input

Communications type: RS-485

Protocol: MODBUS (RTU mode/ASCII mode selectable) and private Function: Settings/data transmission, digital transmission or digital remote, to be specified

Transmission speed: 9600/19200 bps

Remote contacts Input: 2 points

(No-voltage contacts or transistor open collector)

(Remote contacts rating... 5VDC or more, 1mA or more)

Function: ① SV No. selection, ② Run/ready switching, ③ Timer start, ④ Remote/local switching is selectable by settings.

### 2) Heater disconnection (CT)

Input signal: 5.0 to 50.0 A AC (50Hz/60Hz)

Measuring accuracy:  $\pm 5\%$ FS  $\pm 1$  digit

Recommended CT: Model CTL-6-S-H

### 3) Event output

Output point: Relay output, 2 points

Contact ratings: See "Cautions on wirings" in Chapter 2.

4) Water-proof ... Not available in closed installation

Front panel protection: NEMA 250 4X (equivalent to IEC529 IP66)

Panel installation: See Chapter 1 "Installation to a panel".

## 5.3 Parts (Separate purchase is required.)

### 1) Contact protection element ... To be mounted externally

Type	Specification	Open/close current	Application
CX-CR1	0.01μF + 120Ω	0.2A or less	For light load
CX-CR2	0.5μF + 47Ω	0.2A or more	For heavy load

### 2) Shunt resistor for current input ... To be mounted externally

• Resistance ... 250Ω

• Maximum allowable continuous current ... 25mA

• Type ... EZ-RX250

### 3) Terminal cover ... To be mounted externally/nonflammable

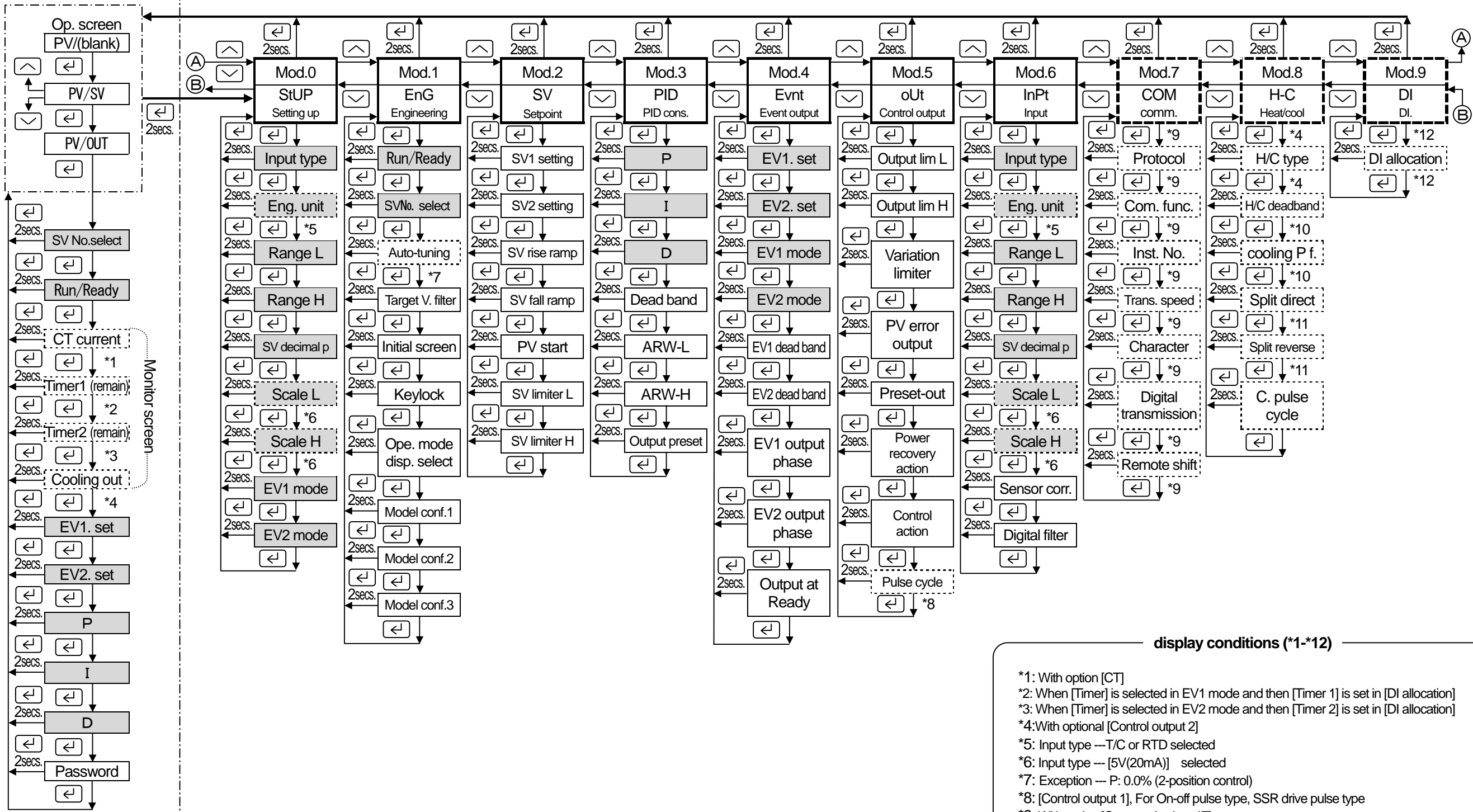


# 6.PARAMETER DIRECTORY

[Operation Mode]

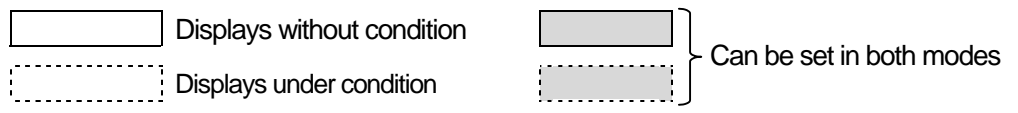
[Setting Mode]

(Some modes are not appeared by a password)



**display conditions (\*1-\*12)**

- \*1: With option [CT]
- \*2: When [Timer] is selected in EV1 mode and then [Timer 1] is set in [DI allocation]
- \*3: When [Timer] is selected in EV2 mode and then [Timer 2] is set in [DI allocation]
- \*4: With optional [Control output 2]
- \*5: Input type --- T/C or RTD selected
- \*6: Input type --- [5V(20mA)] selected
- \*7: Exception --- P: 0.0% (2-position control)
- \*8: [Control output 1], For On-off pulse type, SSR drive pulse type
- \*9: With option [Communications IF]
- \*10: H / C type --- [Cool. P] selected
- \*11: H / C type --- [SPLi] selected
- \*12: With option [Remote contacts input]



The screen displayed is changed by the setting of the operation mode screen.

# 7. List of parameters

Mode No.	Parameter	Symbol	Setting range	Default
1	Run/ready	r-rd	rUn/rdy	rUn
	SV No. select	SVno	1/2	1
	Auto-tuning	At	End/Strt	End
	Target value filter	SFLT	oFF/on	oFF
	Initial screen	Scrn	SV/oUt/bLnK	SV
	Keylock	LoCK	0/1/2/3/4	0
	Ope. mode disp. Sel	dSP	ALL/dSP1/2/3/4	dSP1
	Model conf. 1	ndL1	Lt23■■■■□□□□	Model No. at shipment
	Model conf. 2	ndL2	Lt23□□□■-□□□	
Model conf. 3	ndL3	Lt23□□□□□-■■■		
2	SV1 *3	SV1	Within SV limiter L, H	0
	SV2 *3	SV2	Within SV limiter L, H	0
	SV rise ramp *3	SLPU	0 to 9999/min	0
	SV fall ramp *3	SLPd	0 = No ramp	0
	PV start	PVSt	OFF/on	oFF
	SV limiter L *3	SVLL	L < H (within scale L, H)	Scale L, H
	SV limiter H *3	SVLH		
3	P	PdP	0.0 to 999.9% 0.0 = 2 position (On/off)	50%
	I	PdI	0 to 9999 sec., 0 = off	60 sec.
	D	PdD	0 to 9999 sec., 0 = off	15 sec.
	PID deadband	db	0.0 to 9.9%(PID) 0.1 to 9.9%(On/off)	0.0% 0.5%
	ARW-L	ARWL	-100.0 to 0.0%	-1000%
	ARW-H	ARWH	0.0 to 100.0%	1000%
	Output preset	oPrS	-100.0 to 100.0%	500%
4	EV1 setting *4	EV1	-1999 to 9999:PV,DEV 0 to 9999: DEV  *3 -199.9 to 999.9:MV 1 to 9999sec:Timer 0.0 to 50.0:CT	4000
	EV2 setting *4	EV2		4000
	EV1 mode	EVnd	1 to 19 See 11.	1
	EV2 mode	EV2nd	Event mode and output	1
	EV1 deadband *4	EVdb	0.0 to 999.9 *3 0.00 to 99.99 :MV,CT	2.0 0.20 (MV,CT)
	EV2 deadband *4	EV2db		
	EV1 output phase	EVnr	noML/rEV	noML
	EV2 output phase	EV2nr		
5	Event output at Ready	Erdy	CALC/OFF	CALC
	Output limiter L	oL-L	-5.0 to 100.0% L<H	00%
	Output limiter H	oL-H	0.0 to 105.0% L<H	1000%
	Variation limiter	oSL	0.1 to 100.0%	1000%
	PV error output	PErD	-5.0 to 105.0%	00%
	Preset-out	PoUt	-5.0 to 105.0%	00%
	Power recovery action	PYon	Cont/rEdy	Cont
	Control action	oMod	rEV/dir	rEH
Pulse cycle	PULS	1 to 180 sec.	30sec.	

Mode No.	Parameter	Symbol	Setting range	Default
6	Input type	inPt	1 to 16,18 → List of input types	5
	Engineering unit	UnIt	°C/°F	°C
	Range L *3	rnoL	Within scale L, H	-200 *6
	Range H *3	rnoH	L < H	1370 *6
	Linear decimal point *5	SDdP	0 to 3	0 *6
	Scale L *3	SCLL	-1999 to 9999	00
	Scale H *3	SCLH		1000
	Sensor correction *3	Pb rA	-199.9 to 999.9	00
	Digital filter	PFLT	0.0 to 99.9 sec.	0.1sec.
	7	Protocol	PtCL	rTU/ASCI/PriV
Communications function		FUnC	CoM/rEM/trS/trS2	CoM
Instrument No.		AdRS	1 to 99	1
Transmission speed		rRtE	9600/19.2k	9600
Character		CHAR	1 to 10	5
Digital transmission		dtrS	PV/SV	PV
Remote shift *3		rb rA	-199.9 to 999.9	00
8	Heat/Cool type	HCEY	CoL .P/SPLt	CoLP
	H/C deadband	HCDb	-50.0 to 50.0%	00%
	Cooling P factor	Coal	0.00 to 10.00 0=on/off	100
	Split direct	SPLd	0.0 to 60.0%	00%
	Split reverse	SPLr	40.0 to 100.0%	1000%
	C. pulse cycle	CPUL	1 to 180 sec.	30sec.
9	DI allocation	dI	1 to 6	1

■ Set the parameters in Mode 0 first. The parameters in Mode 0 exist in Mode 4 and Mode 6.

\*1: Refer to the separate instruction manual for communications interface.

\*2: For the details, read [ ■ Heating/cooling control in "9. Setting of parameters"].

\*3: The decimal point position changes by the setting of input type and linear decimal point.

\*4: The deadband is initialized by resetting of EV mode.

\*5: For thermocouple or resistance input, the linear decimal point can not be changed. (display only)

\*6: The range changes by the setting of input type.

# 8. Description of parameters

This chapter describes parameters requiring explanation.

Parameter	Function
Run/ready	For selection of control output. 0000... Preset-out value is displayed in "OUT". "AT" cannot be executed. 0001 is displayed instead of "SV". 0002... Normal control output
Initial screen	This selective screen appears when the power is turned on or the screen returns to the operation screen from the setting screen. The lower LED displays either SV, OUT or with blank.
PV start	It effects when SV rising/SV falling ramp is set. When a trigger signal* applies to SV, SV starts from the point of PV. * At turning on the power, changing SV No., changing SV, or switching 0003 to 0002
SV limiter	For limiting the setting range of SV
PID deadband	$P \neq 0$ : In this deadband, the response of the control output becomes dull due to non-linearized deviation. $P = 0$ : Deadband of 2-position control
ARW (Anti-reset windup)	For PID control range. This parameter is set to SV by % of SV range. The control out of the ARW range becomes PD control. (The ARW effects to reduce overshoot.)
Output preset	Normally P action controls the calculated output to 50% when the deviation is 0. The calculated output can be set optionally by this parameter.
EV deadband	The gap from the event activation to reset.
EV output phase	0004... Event activation: Relay on, reset: Relay off 0005... Event activation: Relay off, reset: Relay on
Event output at Ready	0006... The event judgment continues even at Ready. 0007... The event judgment becomes off at Ready
Output limiter	The control output is limited within the set value of L and H.
Variation limiter	The control output is updated per control changing period (about 0.5 sec.). Its variation is limited within the set value.
PV error output	This output is for abnormal measured value(PV)*. *Over-range, under-range and Er01, Er03.
Preset-out	The control output value during Ready.
Power recovery action	For control action when the power is turned on from off (or from power failure to recovery). 0008... Continues previous control conditions. 0009... Becomes the "Preset out".
Control action	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Reverse action</p> </div> <div style="text-align: center;"> <p>Direct action</p> </div> </div>
Pulse cycle	Applicable to pulse type (On-off pulse type, SSR drive pulse type) control output 1 (heating) The output is based on the time ratio of on to off. This parameter is for the setting of this 1 cycle. The new parameter effects from the next cycle.
Engineering unit	For selection of engineering unit (°C or °F) for converting into temperature when thermocouple or resistance thermometer is selected as the input type.

Parameter	Function																					
Range	Minimum value L and maximum value H of the measuring range can be set within the input range selected in the input type. This width (between H and L) becomes 100% of the proportion band P.																					
Linear decimal point	The setpoint value (SV) is a figure up to 4 digits and cannot be added with decimal point. For the input types of DC voltage and DC current, the decimal point can be set by this parameter.																					
Scale	The parameter is for the input types of DC voltage and DC current. The scale with an actual industrial quantity can be set corresponding to Range L and H.																					
Sensor correction	This function is to correct the measured value (PV) by adding a correction value to the measured value. It can be also used to adjust the measured value to have same display as other equipment.																					
Digital filter	This function is, by applying the first-order lag computation to the measured value, to reduce the variation of the measured value (PV) due to noise interference. 																					
Cooling pulse cycle	Applicable to control output 2 (cooling) This parameter is for the setting of 1-cycle time of on and off of the output.																					
DI Allocation	The list below is for selecting the functions of DI1 and DI2. <table border="1" style="margin: 10px auto;"> <thead> <tr> <th>Set value</th> <th>DI1</th> <th>DI2</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>SV1/2</td> <td>Run/Ready</td> </tr> <tr> <td>2</td> <td>Timer1</td> <td>Run/Ready</td> </tr> <tr> <td>3</td> <td>Timer1</td> <td>SV1/2</td> </tr> <tr> <td>4</td> <td>Timer1</td> <td>Timer2</td> </tr> <tr> <td>5</td> <td>Run/Ready</td> <td>Remote/Local</td> </tr> <tr> <td>6</td> <td>Timer1</td> <td>Remote/Local</td> </tr> </tbody> </table> * Remote/Local is effective to the optional communications.	Set value	DI1	DI2	1	SV1/2	Run/Ready	2	Timer1	Run/Ready	3	Timer1	SV1/2	4	Timer1	Timer2	5	Run/Ready	Remote/Local	6	Timer1	Remote/Local
Set value	DI1	DI2																				
1	SV1/2	Run/Ready																				
2	Timer1	Run/Ready																				
3	Timer1	SV1/2																				
4	Timer1	Timer2																				
5	Run/Ready	Remote/Local																				
6	Timer1	Remote/Local																				

# 9. Setting of parameters

## 9.1 LED display of alphabetical characters

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z

## 9.2 Settings

### Note Start to set from Mode 0.

Make sure to set in the order of parameters in Mode 0 (setup). If the settings are in the wrong order, the parameters previously set may return to the default values.

### 1 Selection of parameter items

Parameter items in operation mode ... Press repeatedly to display the parameter item you want to set.

Parameter items in setting mode ... 1) Press more than 2 secs. to shift to the setting mode. Press or to select Mode number.  
2) Press repeatedly to display the parameter item you want to set.

### 2 Settings (selection)

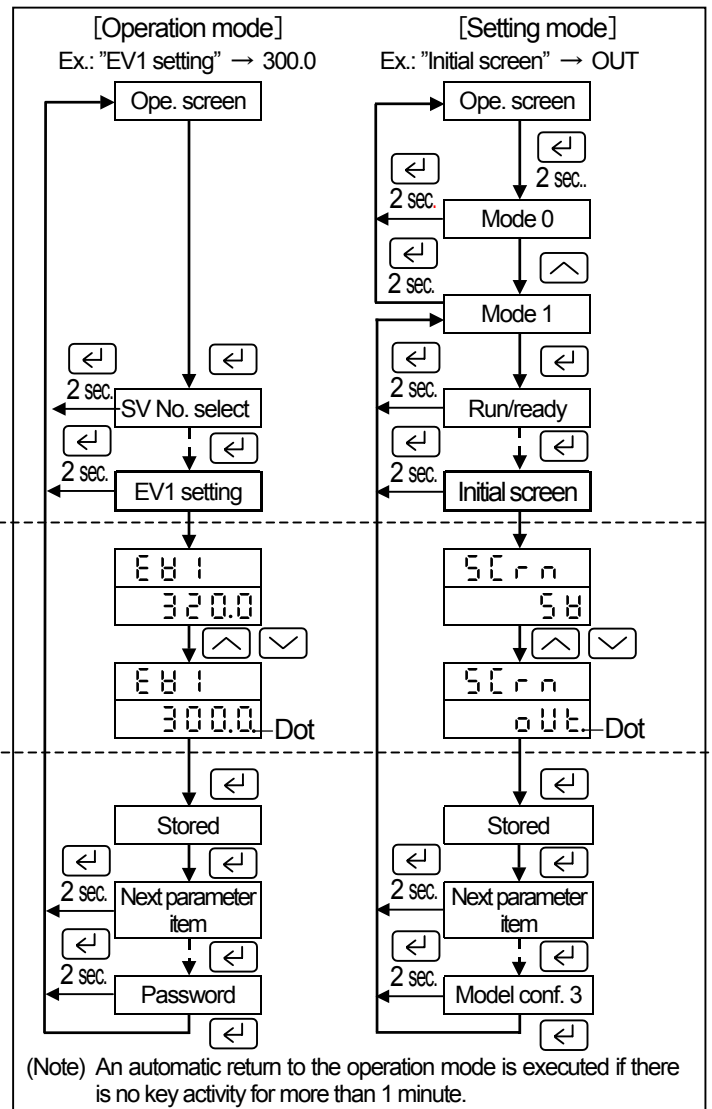
By pressing or , a numerical figure or a sub-parameter item is changed, and a dot blinks.

Numerical figure ... Press or to change. For forwarding setting figures, press either key continuously.

Sub-item selection ... Press or to select.

### 3 Storage

By pressing , the dot disappears and the parameter set is stored into memory.



#### Ref. 1 Change of executed SV

The SV being executed is SV1 or SV2 based on the setting of "SV No. select".

- Shift to the operation screen with .
- By pressing or , a dot blinks in the SV.
- Press or to set to the value you desire.
- By pressing , the dot disappears and the SV newly set is stored into memory.

#### Ref. 2 Password

Appearance or disappearance of screens in the setting mode can be set by numeric figures up to 4 digits. (○: Appearance)

Mode No.	Password		
	0	180	1000
0, 1	X	○	○
2 to 9	X	X	○

- The default is "1000". By entering any figures other than 3 figures above, the password being set can be hidden. Until any of 3 figures above is entered, the previous password is valid.

#### Ref. 3 Keylock

In the operation mode, you can select screens, in which the settings are disabled to change. See the 10.Operation 3

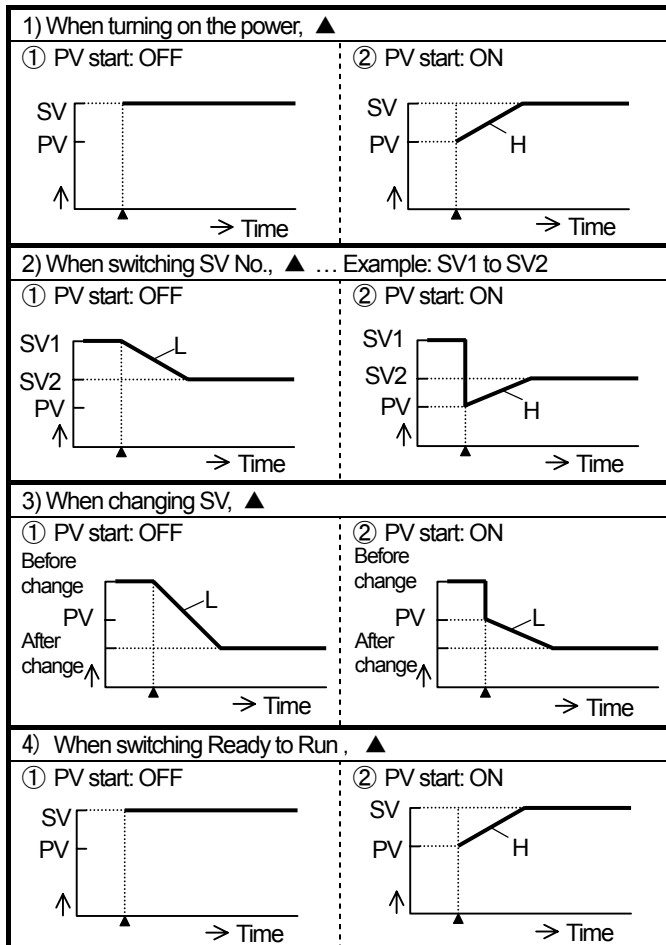
#### Ref. 4 Initialization

All parameters are initialized by the following procedure. While pressing and simultaneously, turn on the power.

## List of input types

Input type	Selection Symbol		Input type		Accuracy ratings	Detailed specification	
	Standard	High temp.	°C	°F			
T/C	B	1	1	0 to 1820	32 to 3300	±0.3% ±1 digit	Less than 400°C: not specified Less than 800°C: ±0.6%
	R	2	2	0 to 1760	32 to 3200	±0.25% ±1 digit	Less than 400°C: ±0.5% ± 1 digit  For less than 0°C, ±0.5% ± 1 digit
	S	3	3	0 to 1760	32 to 3200		
	N	4	4	0 to 1300	32 to 2350		
	K	5	5	-200 to 1370	-300 to 2450		
	E	6	—	-199.9 to 700.0	-300 to 1250		
	J	7	—	-199.9 to 900.0	-300 to 1650		
	T	8	—	-199.9 to 400.0	-300 to 700		
	U	9	—	-199.9 to 400.0	-300 to 700		
	L	10	—	-199.9 to 900.0	-300 to 1650		
	WRe5-WRe26	—	11	0 to 2310	32 to 4190	±0.5% ±1 digit	Less than 400°C: ±0.5% ± 1 digit
	W-WRe26	—	12	0 to 2310	32 to 4190		
PtRh40-PtRh20	—	13	0 to 1880	32 to 3400	±0.5% ±1 digit	Less than 400°C: not specified Less than 800°C: ±1.5%	
Platinel II	—	14	0 to 1390	32 to 2500			
RTD	Pt100	15	15	-199.9 to 850.0	-300 to 1500	±0.25% ±1 digit	
	JPt100	16	16	-199.9 to 649.0	-300 to 1200		
DC voltage	5V	18	18	0.000 to 5.000			

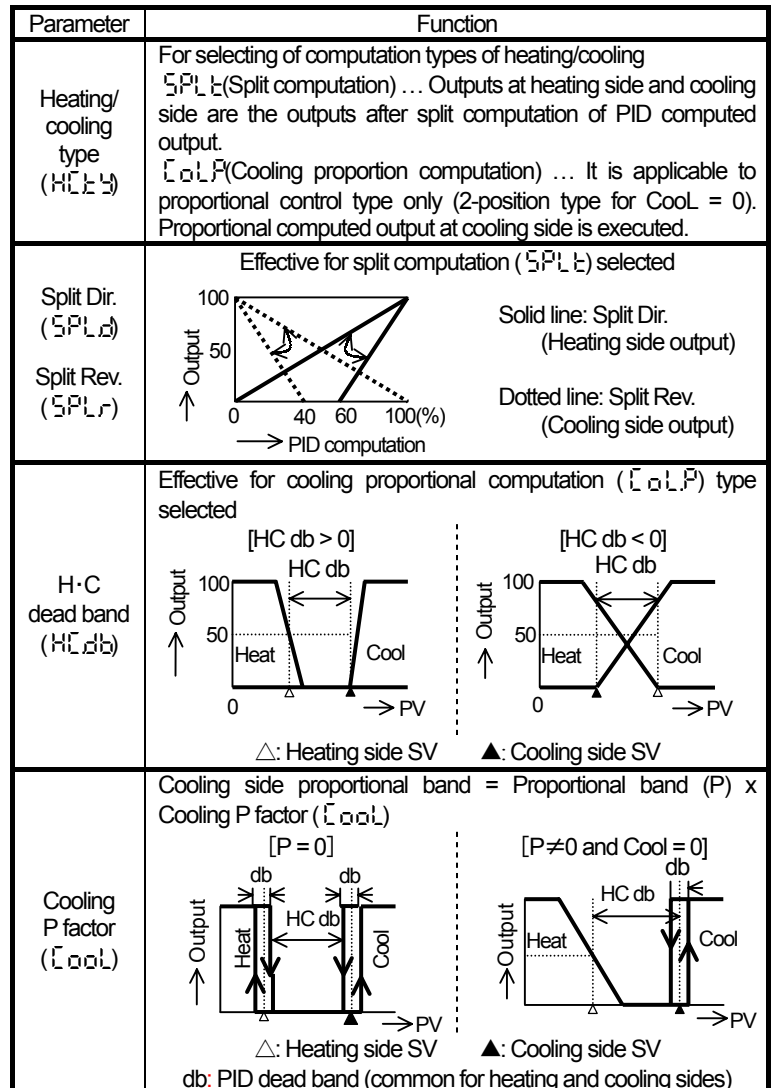
## SV ramp and PV start



H: Rising ramp set value L: Falling ramp set value

\* The SV ramp operation is not backed up for power interruption.

## Heating/Cooling control (Option)



# 10. Operation

## 1 Control output

"Run" or "Ready" \* is selectable in control output.

- "Run/Ready" is in Operation mode or Mod E.1.
- Press or to select "r 1 r" or "r E d", and then press .

\* The output at "Ready" is the value set by "Preset out" in Mod E.5. (Default value is 0.0%.)

## 2 Operation mode

### 1) Operation screen

PV/Blank ... Measured value (PV) only is displayed.

PV/SV ... Setpoint value (SV) being used is displayed in the lower display. "r E d" is displayed in "Ready".

PV/OUT ... Output value (OUT) is displayed in the lower display. Dot blinks during execution of Auto-tuning (AT).

### 2) SV No. selection, Run/ready switching

The selection of SV1 to SV2 and the switching of functions (Ref. 1) can be executed.

### 3) Monitor screen

CT current ... The current value of CT is displayed.

Timer remaining time ... The remaining time of timer event is displayed. The elapsed time after event ON is displayed up to -1999 seconds by counting down from the event setpoint.

Cooling out ... The output value at cooling side in heating/cooling control is displayed.

## 3 Keylock and operation mode screen

The list below shows the settings of the keylock and the operation mode screen in Mode 1.

- Keylock: Some of screens (x) for unchangeable setting are selectable.
- Operation mode screen: Some of screens (x) without display are selectable.

Kind	Keylock					Operation mode screen					
	0	1	2	3	4	ALL	1	2	3	4	
Screen											
Operation mode	PV/(blank)						x	x	x		
	PV/SV					x					
	SV No. selection			x	x	x		x	x	x	
	Run/ready				x	x					
	Monitor screen								x	x	x
	EV setting			x	x	x				x	x
	P/I/D			x	x	x			x	x	x
Setting mode		x	x	x	x						

## 4 Auto-tuning

### 1) Auto-tuning

This function is for automatic tuning of PID constants.

- "Auto-tuning" is in Mod E.1.
- Press or to select "5 t r t", and then press . "Auto-tuning" starts and the display becomes its progressing screens (STEP 1 to 4).
- For cancellation of "Auto-tuning", select END, and then press .

## 5 Targeted value filter

### 1) Targeted value filter

This is a function suppressing overshoot. Control is executed by computing an optimum SV.

### 2) ON/OFF of "Targeted value filter"

"Targeted value filter" is in "Mod E.1", and ON (enable) or OFF (disable) is selectable. Press by selecting "d r" to enable this function.

## 6 PID control

### 1) P (Proportional) action

- This is a basic action of PID control. It affects responsiveness and stability. The proportional action only results in offset.
- By setting the proportion band wider, the control stability becomes better due to smaller amplitude of cycling and longer cycle time, but the responsiveness becomes worse.

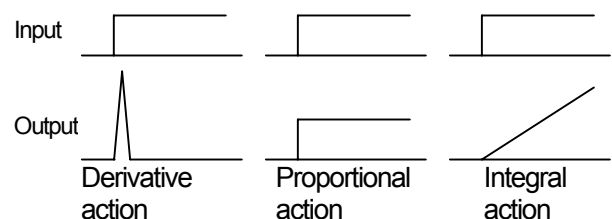
### 2) I (Integral) action

- This action can eliminate offset resulted from the proportional action, but the stability becomes worse because phase delays.
- By setting the integral time shorter (stronger integral action), the responsiveness becomes better but overshoot becomes larger.





### 3) D (Derivative) action

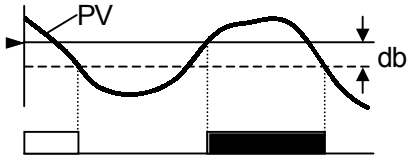
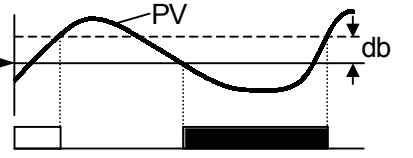
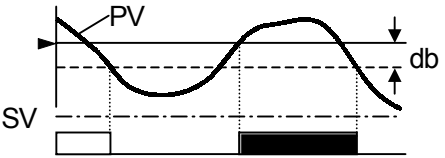
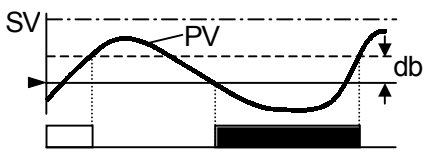
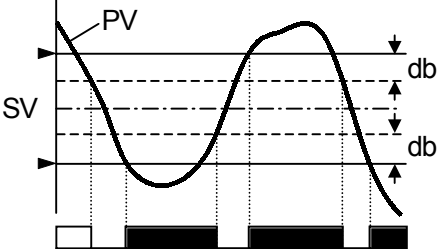
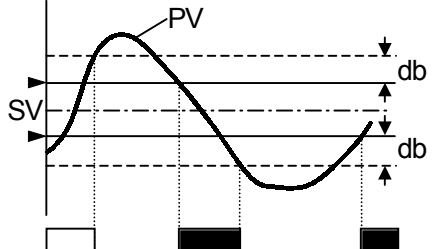
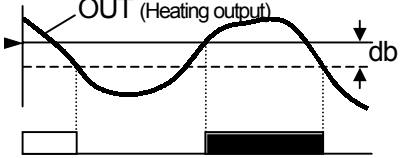
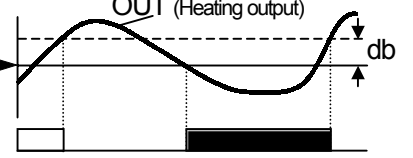
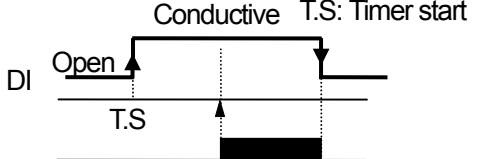
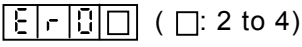
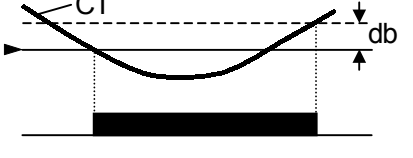
- This action compensates the delay of phase due to dead time or delay factor. However, because the gain increases in high frequency area, its strength has a limit.
- By setting the derivative time longer, the response to large deviation becomes faster and the cycle is shortened. However, for deviation with high frequency, the stability becomes worse.

### 4) Relation of input and output of PID action



# 11.Event mode and output

View-point	 ①	① Judgment output only with standby set to "OFF" ② Judgment output not related to "ON/OFF" of standby	Symbol	 , 	Event set value
	 ②			db	Event deadband

Event mode [Mode No.]	Set value and output	Event mode [Mode No.]	Set value and output
Absolute value high limit (PV) [5] No standby [7] with standby		Absolute value low limit (PV) [6] No standby [8] with standby	
Deviation high limit (DEV) [1] No standby [3] with standby		Deviation low limit (DEV) [2] No standby [4] with standby	
Absolute value deviation high limit ( DEV ) [13] No standby [15] with standby		Absolute value deviation low limit ( DEV ) [14] No standby [16] with standby	
Output value high limit (MV) [9] No standby [11] with standby		Output value low limit (MV) [10] No standby [12] with standby	
Timer [18]		Fail [19]	An output is generated if the upper display indicates the followings.  (□: 2 to 4)
Note) Remote contacts input (DI) necessary *1: Allocate the remote contacts input (DI) to Timer 1 or Timer 2. Timer 1 is for EV1 and Timer 2 is for EV2.		Heater disconnection (CT) [17]	
		* 1 The judgment is not executed when relay ON time shorter than 300msec. *2 "0" is set, no judgment is executed.	

\* The relation of the event judgment output and the relay output at terminals is determined by the setting of the EV output phase.

## Allocation of remote contacts input (DI)

DI function	DI input	
	OFF	ON
SV1/2	From ON to OFF: SV1	From OFF to ON: SV2
Run/Ready	From ON to OFF: Run	From OFF to ON: Ready
Timer 1	Timer 1: Reset	Timer 1: Starts count.
Timer 2	Timer 2: Reset	Timer 2: Starts count.
R/L	Local	Remote

\* Operation by DI or keys is effective, but is depended on the last operation status.