Temperature controller with fuzzy function

REX-D SERIES

INSTRUCTION MANUAL

RKC RKC INSTRUMENT INC.

IMDRE02-E1

INTRODUCTION

Thank you for purchasing the " *REX−D series* ".
This manual describes how to use the " *REX−D series* ".
Prior to using the instruments, please carefully read this manual and fully understand the contents.
Keep this manual safely for future reference as required.

USERS OF THIS MANUAL

This manual is prepared for all personnel who use " *REX−D series* ".
This manual is also written especially for readers who have a fundamental knowledge of electrical engineering, control engineering or communication.

CAUTIONS

- This manual is subject to change without prior notice.
- Examples of figures, diagrams and numeric values used in this manual are for a better understanding of the text, but not for assuring the resultant operation.
- The contents of this manual are copy righted; all rights are reserved by RKC INSTRUMENT INC. It is prohibited to reprint or reproduce the whole or a part of this manual without the prior of RKC INSTRUMENT INC.
- " *REX−D series* "and this manual are manufactured and prepared under strict quality control before delivery.
  However, if any problems arise, please contact us directly or your nearest our sales agent.
- RKC assumes no responsibility for any of the following damage which the user or third party may suffer.
  ① Damage incurred as a result of using this product.
  ② Damage caused by product failure which cannot be predicted by RKC.
  ③ Other indirect damage.

★ *For safe operation of "REX-D series"*

1. "REX-D series" must be used under the following conditions.
   "REX-D series" is a component type and is used after mounting on an instrument panel. It is thus manufactured as a component destined for the final product, so its high-voltage blocks such as the power terminals are uncovered. Therefore, after it is installed on the final product, the final product supplier must take the necessary measures for the user to prevent touching directly the high-voltage blocks.

2. For correct and safe operation of "REX-D series", always observe the safety precautions described in this manual when performing operations, maintenance and repair work. RKC neither assures responsibility nor provides warranty for problems or accidents occurring if these precautions are not observed.

● For safe operation of "REX-D series", the following "Signal Words and Symbol Marks" are used in this manual.

<Signal Words>

WARNING : Where there are possible dangers such as electric shock, fire (burns), etc. Which could cause loss of life or injury, precautions to avoid such dangers are described.

CAUTION : These describe precautions to be taken if unit damage may result if operating procedures are not strictly followed.

NOTE : Extra notes or precautions are added to operating procedures and explanations.

<Symbol Marks>

⚠ : This mark is used when great care is needed especially for safety.

* : This mark is used to add extra notes, precautions or supplementary explanations to table and figures.

⚠ WARNING

● Wiring precautions

· If failure or error of this instrument could result in a critical accident of the system, install an external protection circuit to prevent such an accident.

· In order to prevent instrument damage or failure, protect the power line and the input/output lines from high currents by using fuses with appropriate ratings.

● Power supply

· In order to prevent instrument damage or failure, supply power of the specified rating.

· In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.

● Never use the instrument near inflammable gases.

· In order to prevent fire, explosion or instrument damage, never use this instrument at a location where inflammable or explosive gases or vapour exist.

● Never touch the inside of the instrument.

· In order to prevent electric shock or burns, never touch the inside of the instrument. Only RKC service engineers can touch the inside of the instrument to check the circuit or to replace parts. High voltage and high temperature sections inside the instrument are extremely dangerous.

● Never modify the instrument.

· In order to prevent accident or instrument failure, never modify the instrument.

● Maintenance

· In order to prevent electric shock, burns or instrument failure, only RKC service engineers may replace parts.

· In order to use this instrument continuously and safely, conduct periodic maintenance. Some parts used in this instrument have a limited service life and may deteriorate over time.

CONTENTS

CHAPTER 1

PREPARATION

REX-D SERIES
Instruction Manual

1. PREPARATION

1.1 Handling procedure

Conduct necessary work according to the following procedures:

Check of product delivered	See CHAPTER 1 "**1.2 Check of product delivered** " on page 1−3.
⬇	
Check of model codes	See CHAPTER 1 "**1.3 Model code** " on page 1−4.
⬇	
Mounting	See CHAPTER 2 "**MOUNTING AND WIRING** " on page 2−1.
⬇	
Wiring	See CHAPTER 2 "**MOUNTING AND WIRING** " on page 2−1.
⬇	
Check of input range	See CHAPTER 3 " ■ **Input type/input range display** " on page 3−5. *
⬇	
Set−value (SV) setting	See CHAPTER 3 "**3.3 Set−value (SV) changing procedure** " on page 3−6.
⬇	
Each parameter setting	See CHAPTER 3 "**OPERATION** " on page 3−1.
⬇	
Operation	

* This is a universal type controller. Prior to using the instrument, set the desired input and output types. For these settings, see " **3.4 SETUP set mode** " (page 3−7).

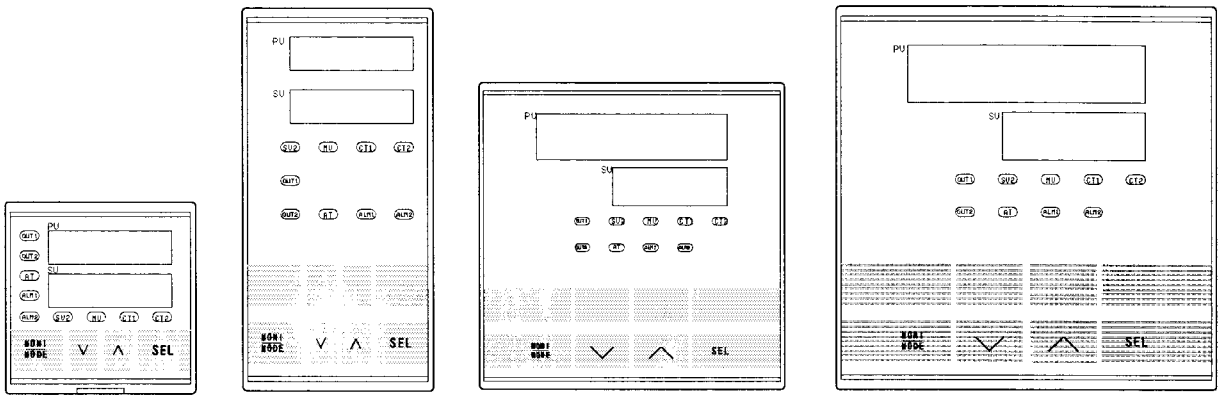
CAUTION

Connect the input signal wiring, and then turn ON the power. If the input signal wiring opens, the controller judges than input is disconnected to cause the upscale or downscale of measured−value (PV) display.

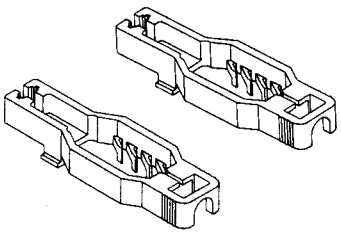
Upscale ····· For TC or RTD input
Downscale ····· For TC (To be specified when ordering), voltage or current input

1.2 Check of product delivered

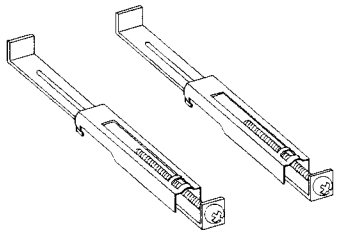
Check than the following items are delivered without damage.



Mainframe (1 unit)



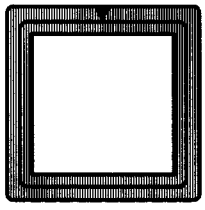
Mounting bracket for REX–D100
(2 pieces) * REX–D100 only



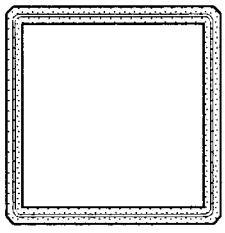
Mounting bracket (2 pieces)
* For REX–D400,D700, or D900

REX–D SERIES OPERATION MANUAL (1 copy) 〔 **IMDRE01–E** □〕

External resistor (Option)
(250 Ω ± 0.02% ± 10PPM, 0.25W or more)



Front cover
(NEMA4X,Option)



Rubber packing
(NEMA4X,Option)

1.3 Model code

Check the model code from the following list to determine if the product delivered is as desired.

■ Model code

REX-D100 model code

D100□ − □□ * □□ − □□ − □□

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

① Control action
- F : PID action with auto-tuning
- W: Heating/cooling PID action with auto-tuning *1,*2

② First control output 〔OUT1〕
- M: Relay contact
- V : Voltage pulse
- 4 : Continuous voltage *3 0 to 5V DC
- 5 : Continuous voltage *3 0 to 10V DC
- 6 : Continuous voltage *3 1 to 5V DC
- 7 : Current 0 to 20 mA DC *3
- 8 : Current 4 to 20 mA DC *3

③ Second control output 〔OUT2〕
- N : When control action is F
- M: Relay contact
- V : Voltage pulse
- 4 : Continuous voltage *3 0 to 5V DC
- 5 : Continuous voltage *3 0 to 10V DC
- 6 : Continuous voltage *3 1 to 5V DC
- 7 : Current 0 to 20 mA DC *3
- 8 : Current 4 to 20 mA DC *3

④ Alarm function
- N : No alarm function
- D : With alarm function 2-point

⑤ Heater break alarm function
- N : No heater break alarm function
- S : Heater break alarm for single-phase heater *4
- D : Heater break alarm for three-phase heater *4,*5

⑥ Contact input (Step) *1,*5
- N : No contact input
- 1 : Contact input

⑦ Analog output *1,*5
- N : No analog output
- 4 : Voltage 0 to 5V DC
- 5 : Voltage 0 to 10V DC
- 6 : Voltage 1 to 5V DC
- 7 : Current 0 to 20mA DC
- 8 : Current 4 to 20mA DC

⑧ Communication function *1,*5
- N : No communication function
- 5 : RS-485 (2-wire system)

⑨ Waterproof/dustproof specification (NEMA4X)
- N : No waterproof/dustproof construction
- 1 : Waterproof/dustproof construction

*1 If the heating/cooling PID action with auto-tuning is selected, contact input, analog output, communication function or heater break alarm for three-phase heater cannot be selected.
*2 Cooling method (air or water cooling) selection can be set in SETUP mode.
*3 If continuous voltage/current output is selected, no heater alarm function can be specified.
*4 As current transformer, either P: CTL-6-P-N or S : CTL-12-S56-10L-N is selected.
*5 Any one of contact input, analog output, heater break alarm for three-phase heater and communication function is selected.

■ Model code

REX-D700 model code

D700 □ − □ ＊ □ □ − □ − □
① ② ③ ④ ⑤ ⑥

① Control action
F : PID action with auto-tuning
W : Heating/cooling PID action with auto-tuning *1,*2

② Second control output 〔OUT2〕
N : When control action is F
M : Relay contact
V : Voltage pulse
4 : Continuous voltage *3 0 to 5V DC
5 : Continuous voltage *3 0 to 10V DC
6 : Continuous voltage *3 1 to 5V DC
7 : Current 0 to 20 mA DC *3
8 : Current 4 to 20 mA DC *3

③ Alarm function
N : No alarm function
D : With alarm function 2-point

④ Heater break alarm function *5
N : No heater break alarm function (With step function)
S : Heater break alarm for single-phase heater *4 (With step function)
D : Heater break alarm for three-phase heater *4 (With step function)

⑤ Analog output *6
N : No analog output
4 : Voltage 0 to 5V DC
5 : Voltage 0 to 10V DC
6 : Voltage 1 to 5V DC
7 : Current 0 to 20mA DC
8 : Current 4 to 20mA DC

⑥ Communication function
N : No communication function
4 : RS-422A (4-wire system)
5 : RS-485 (2-wire system)

*1 If the heating/cooling PID action with auto-tuning is selected for REX-D700, neither analog output nor heater break alarm for three-phase heater can be specified.

*2 Cooling method (air or water cooling) selection can be set in SETUP mode.

*3 If continuous voltage/current output is selected, no heater alarm function can be specified.

*4 As current transformer, either P : CTL-6-P-N or S : CTL-12-S56-10L-N is selected.

*5 If the heater break alarm function is selected in REX-D700, no communication function RS-422A can be specified.

*6 If analog output is selected in REX-D700, no heater break alarm for three-phase heater can be specified.

■ Model code

REX−D400 · D900 model code

① Control action
- F : PID action with auto−tuning
- W : Heating/cooling PID action with auto−tuning *1,*2

② Second control output 〔OUT2〕
- N : When control action is F
- M : Relay contact
- V : Voltage pulse
- 4 : Continuous voltage *3 0 to 5V DC
- 5 : Continuous voltage *3 0 to 10V DC
- 6 : Continuous voltage *3 1 to 5V DC
- 7 : Current 0 to 20 mA DC *3
- 8 : Current 4 to 20 mA DC *3

③ Alarm function
- N : No alarm function
- D : With alarm function 2−point

④ Heater break alarm function
- N : No heater break alarm function (With step function)
- S : Heater break alarm for single−phase heater *4 (With step function)
- D : Heater break alarm for three−phase heater *4,*5 (No step function)

⑤ Analog output *6
- N : No analog output
- 4 : Voltage 0 to 5V DC
- 5 : Voltage 0 to 10V DC
- 6 : Voltage 1 to 5V DC
- 7 : Current 0 to 20mA DC
- 8 : Current 4 to 20mA DC

⑥ Communication function
- N : No communication function
- 4 : RS−422A (4−wire system)
- 5 : RS−485 (2−wire system)

*1 If the heating/cooling PID action with anto−tuning is selected for REX−D400/D900, neither analog output nor communication function RS−422A can be specified.

*2 Cooling method (air or water cooling) selection can be set in SETUP mode.

*3 If continuous voltage/current output is selected, no heater alarm function can be specified.

*4 As current transformer, either P: CTL−6−P−N or S: CTL−12−S56−10L−N is selected.

*5 If the heater break alarm for three−phase heater is selected for REX−D400/D900, no contact input (step function) can be specified.

*6 If analog output is selected in REX−D400/D900, no communication function RS−422A can be specified.

■ Input range table

Group		Input type	
Temperature input	TC	K (K)	−199.9 to 999.9 °C
			−200 to 1372 °C
		J (J)	−199.9 to 999.9 °C
			−200 to 1200 °C
		T (T)	−199.9 to 400.0 °C
		R (r)	0 to 1769 °C
		S (S)	0 to 1769 °C
		B (b) *1	0 to 1820 °C
		E (E)	−200 to 1000 °C
		N (n)	0 to 1300 °C
		PL II (P)	0 to 1390 °C
		W5Re / W26Re(C)	0 to 2320 °C
		U (U)	0 to 600 °C
		L (L)	0 to 900 °C
		K (K)	−199.9 to 999.9 °F
			−330 to 2500 °F
		J (J)	−199.9 to 999.9 °F
			−330 to 2192 °F
		T (T)	−199.9 to 752.0 °F
		R (r)	0 to 3216 °F
		S (S)	0 to 3216 °F
		B (b)*1	0 to 3308 °F
		E (E)	−330 to 1832 °F
		N (n)	0 to 2372 °F
		PL II (P)	0 to 2534 °F
		W5Re / W26Re(C)	0 to 4208 °F
		U (U)	0 to 1100 °F
		L (L)	0 to 1600 °F
	RTD	JPt100 Ω	−199.9 to 510.0 °C
		Pt100 Ω	−199.9 to 660.0 °C
		JPt100 Ω	−199.9 to 950.0 °F
		Pt100 Ω	−199.9 to 999.9 °F
Voltage input	Voltage input (low)	mV, V (H)	0 to 10 mV DC
			0 to 100 mV DC
			0 to 1 V DC
	Voltage input (High)	V (H)	0 to 5 V DC
			1 to 5 V DC
			0 to 10 V DC
Current input *2		mA (I)	0 to 20 mA DC
			4 to 20 mA DC

*1 Accuracy in the range or 0 to 400 °C (0 to 800 °F): Not guaranteed.

*2 Option

MEMO

CHAPTER 2

MOUNTING AND WIRING

REX-D SERIES
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2. MOUNTING AND WIRING

⚠ WARNING

In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.

2.1 Mounting environment

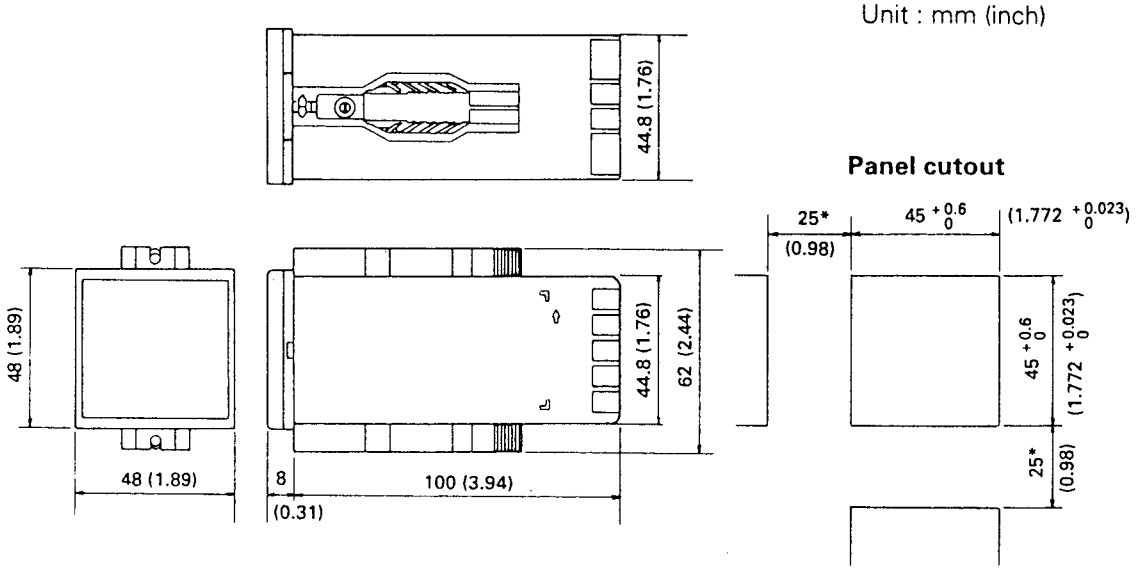
Avoid the following when selecting the mounting location.

- Ambient temperature of less than 5 °C or more than 40 °C .
- Ambient humidity of less than 20% or more than 80% RH.
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Should be used indoors where the system is not exposed to direct sunlight.
- Heat to be accumulated radiation heat.

2.2 Dimensions

■ **REX-D100**

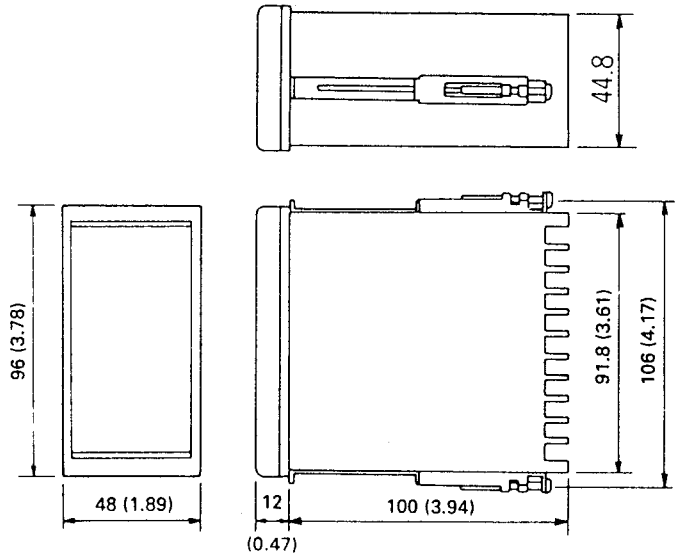
Unit : mm (inch)



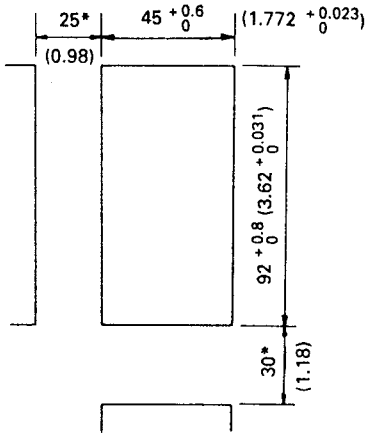
☆ Dimensions in inches are shown for reference.
* Minimum

■ REX-D400

Unit : mm (inch)

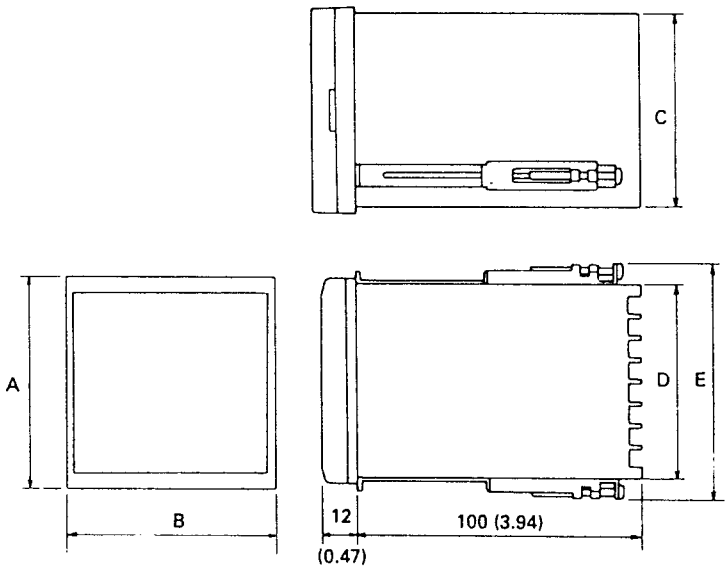


Panel cutout



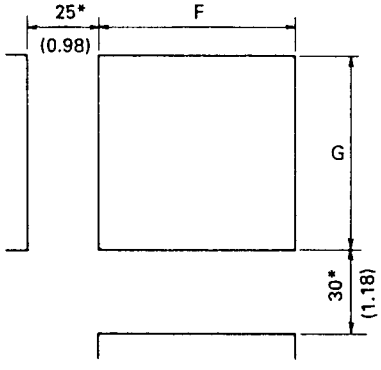
☆ Dimensions in inches are shown for reference.
* Minimum

■ REX-D700·D900



☆ Dimensions in inches are shown for reference.
* Minimum

Panel cutout



Unit : mm (inch)

Sign / Model	A	B	C	D	E	F	G
D700	72 (2.83)	72 (2.83)	67.8 (2.67)	67.8 (2.67)	82 (3.23)	68 +0.7 0 (2.677 +0.027 0)	68 +0.7 0 (2.677 +0.027 0)
D900	96 (3.78)	96 (3.78)	91.8 (3.61)	91.8 (3.61)	106 (4.17)	92 +0.8 0 (3.62 +0.031 0)	92 +0.8 0 (3.62 +0.031 0)

2.3 Mounting procedures

■ Mounting (For REX-D100)

① Make rectangular holes corresponding to the number of controllers to be mounted through the panel by referring to the panel cutout dimensions.

② Insert the controller into the panel from the panel front.

③ Insert the projections at the bottom of the bracket into the slots at the top of the controller. 〔 **Fig.1** 〕

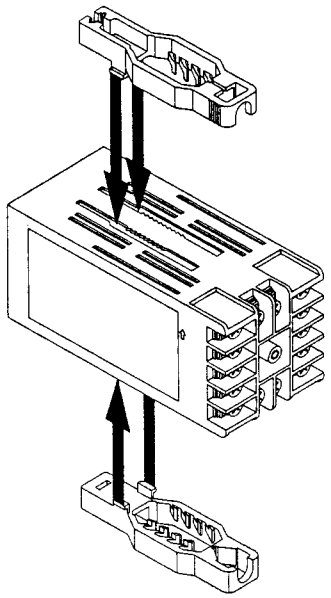


Fig.1

④ Push the mounting bracket in the arrow direction. 〔 **Fig.2** 〕

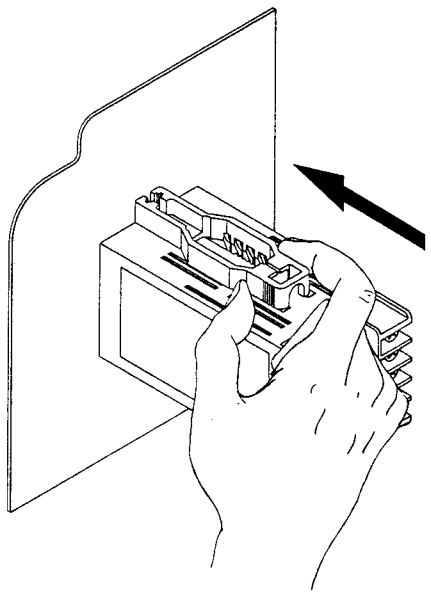


Fig.2

* Check to see if the controller is firmly fixed to the panel.

NOTE

The front of this instrument conforms to IP55 with the instrument mounter on a control panel.

⑤ Install a mounting bracket also at the bottom of the case in the same way as ③ and ④ abve.

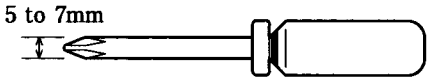
■ REX-D100 removing procedure

CAUTION

When removing the mounting bracket, use a screwdriver matching the diameter of the insertion hole. Otherwise, the mounting bracket may be damaged. Use a Phillips screwdriver as much as possible.

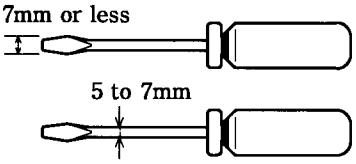
When a Phillips screwdriver is used

Use the screwdriver with a diameter of 5 to 7mm.

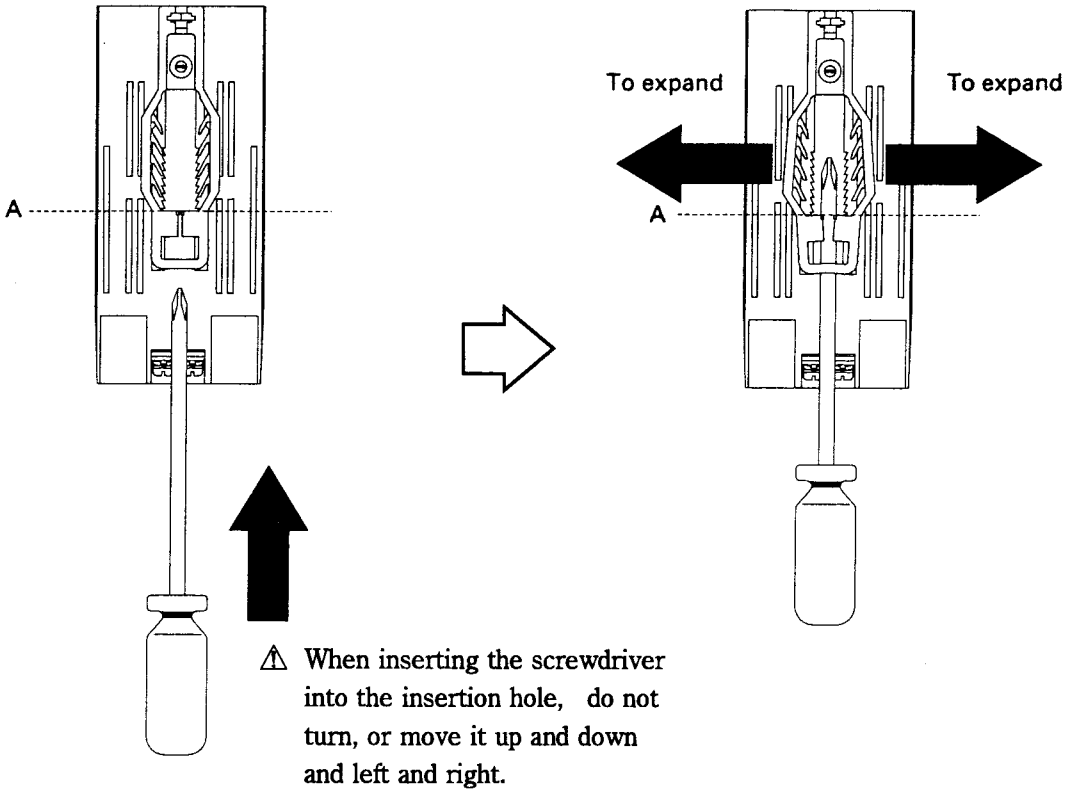


When a minus-headed screwdriver is used

Use a minus-headed screwdriver with a head width of 7mm or less and a diameter of 5 to 7mm. Insert this screwdriver into the insertion hole with the minus head faced in the vertical direction.



① Insert a Phillips screwdriver into the insertion hole at the rear of the mounting bracket. If the screwdriver head exceeds the line shown by A, the bracket expands to the left and right to disengage the self-locking hooks on the bracket from those on the case. 〔 **Fig.3** 〕



⚠ When inserting the screwdriver into the insertion hole, do not turn, or move it up and down and left and right.

Fig.3

② Pull the bracket toward you (Ⓐ), then pull it upward (Ⓑ) with the screwdriver inserted in the insertion hole. 〔 **Fig.4** 〕

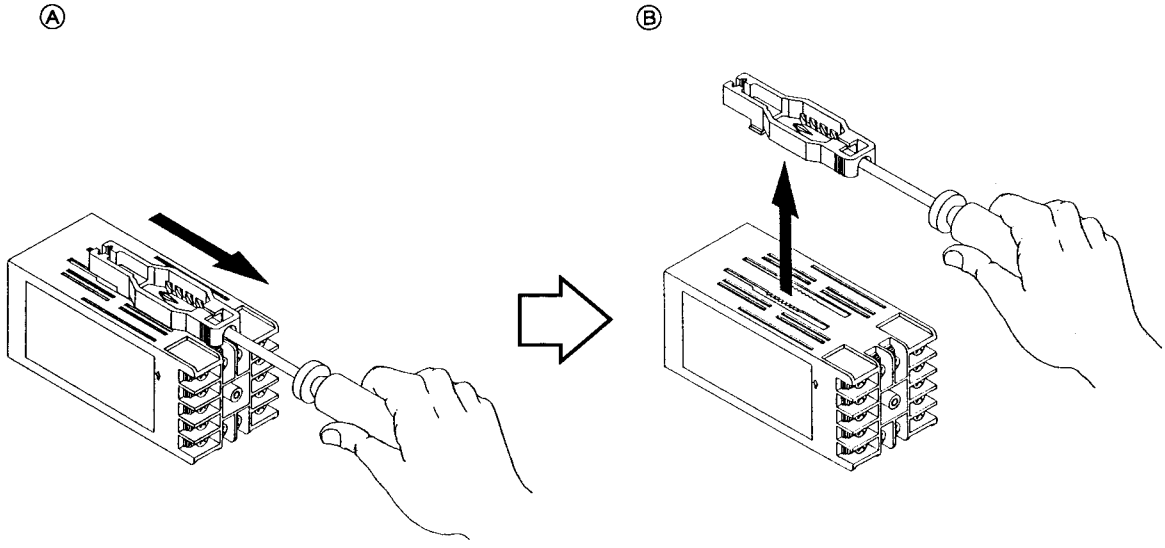


Fig.4

■ Mounting (For REX-D400/D700/D900)

① Mount the panel cutout corresponding to the number of units on the panel by referring to panel cutout dimensions.
② Insert the instrument into the panel from the front side.
③ Engage each mounting bracket with the bracket insertion slots 〔 **Fig.1** 〕 .
④ Then tighten the mounting bracket setscrew from the rear with a Phillips screwdriver 〔 **Fig.2** 〕 . Do not overtighten the bracket setscrew.
(Recommended tightening torque : 0.3N·m or less [3kgf· ㎝ or less])
⑤ Install a mounting bracket also at the bottom of the case in the same way as ③ and ④ above.

* This instrument is provided with a waterproof and dustproof rubber packing.
For details of replacing the packing due to deterioration, see CHAPTER 4 " **4.4 Replacing the waterproof and dustproof rubber packing** ". (P.4-7)

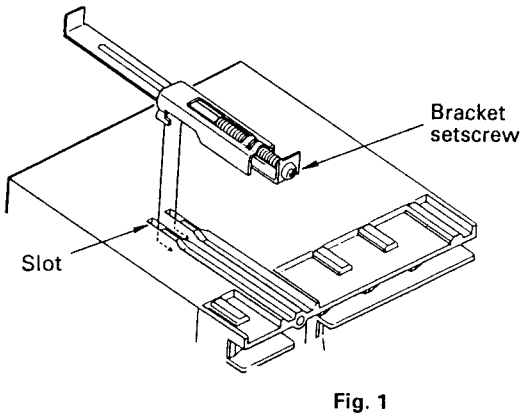


Fig. 1

NOTE
The front of this instrument conforms to IP55 with the instrument mounter on a control panel.

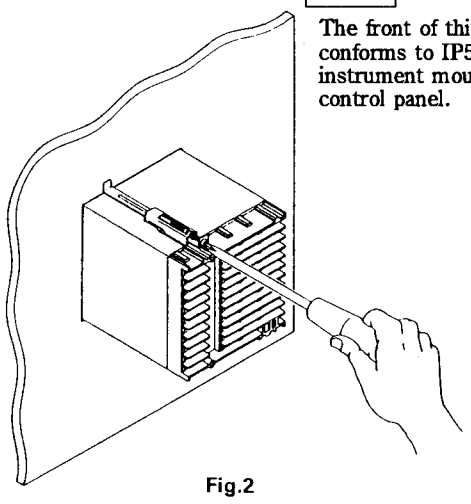


Fig.2

2.4 Cautions for wiring ⚠

⚠ WARNING

- **In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.**
- **If failure or error of this instrument could result in a critical accident of the system, install an external protection circuit to prevent such an accident.**
- **In order to prevent instrument damage or failure, protect the power line and the input/output lines from hihg currents by using fuses with appropriate ratings.**

(1) For thermocouple input, use the specified compensation wire.

(2) For RTD input, use leads with low resistance and having no resistance differences between the 3 leads.

(3) Conduct input signal wiring away from instrument power, electric equipment power and load lines as such as possible to avoid noise induction.

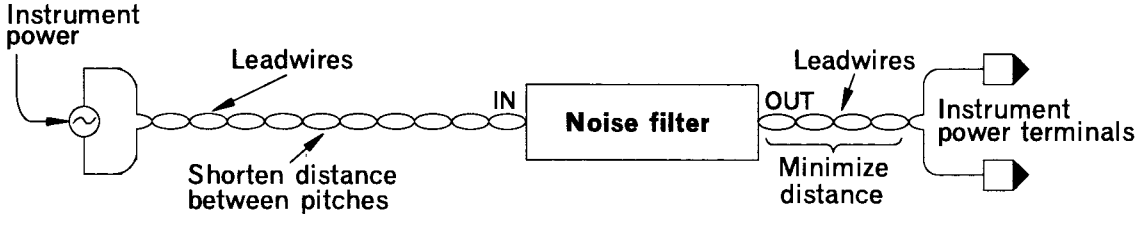
(4) Conduct instrument power wiring so as not to be influenced by noise from the electric equipment power.
If it is assumed that a noise generation source is located near the controller and the controller is influenced by noise, use a noise filter.

① To obtain a satisfactory noise filter effect, select the most suitable type after due consideration of instrument power supply voltage and filter frequency characteristics.

② For instrument power wiring, if it is assumed that noise exerts a bad influence upon the controller, shorten the distance between twisted power supply wire pitches.
(The shorter the distance between the pitches, the more effective for noise reduction.)

③ Install the noise filter on the panel which is always grounded and minimize the wiring distance between the noise filter output side and the instrument power terminals.
Otherwise, the longer the distance wiring, the less effective for noise.

④ Do not install fuses and/or switches on the filter output signal since this may lessen filter effect.



(5) For wiring, use electric wires conforming to the domestic standard of each country. For power supply wires, use 600V Polyvinyl chloride insulated wires (JIS C3307) .

(6) About 2 sec. are required as the preparation time of contact output during power−ON.
Use a delay relay when the output line, is used for an external interlock circuit.

(7) Display accuracy of current transformer (CT) input value at heater break alarm is within ± 5% of input value or ± 2A, whichever is greater. Therefore, when a heater break alarm is used, set load current flowing through the current transformer (CT) at a value to be sufficiently large.

(8) This instrument has no power supply switch nor fuses. Therefore, install them separately close to the instrument, if required.
[Recommended fuse rating : Rated voltage ; 250V Rated current ; 1A Type ; Time−lag fuse]

(9) This instrument is intended to be used under the following environmental conditions. (IEC1010)
[OVERVOLTAGE CATEGORY II , POLLUTION DEGREE 2]

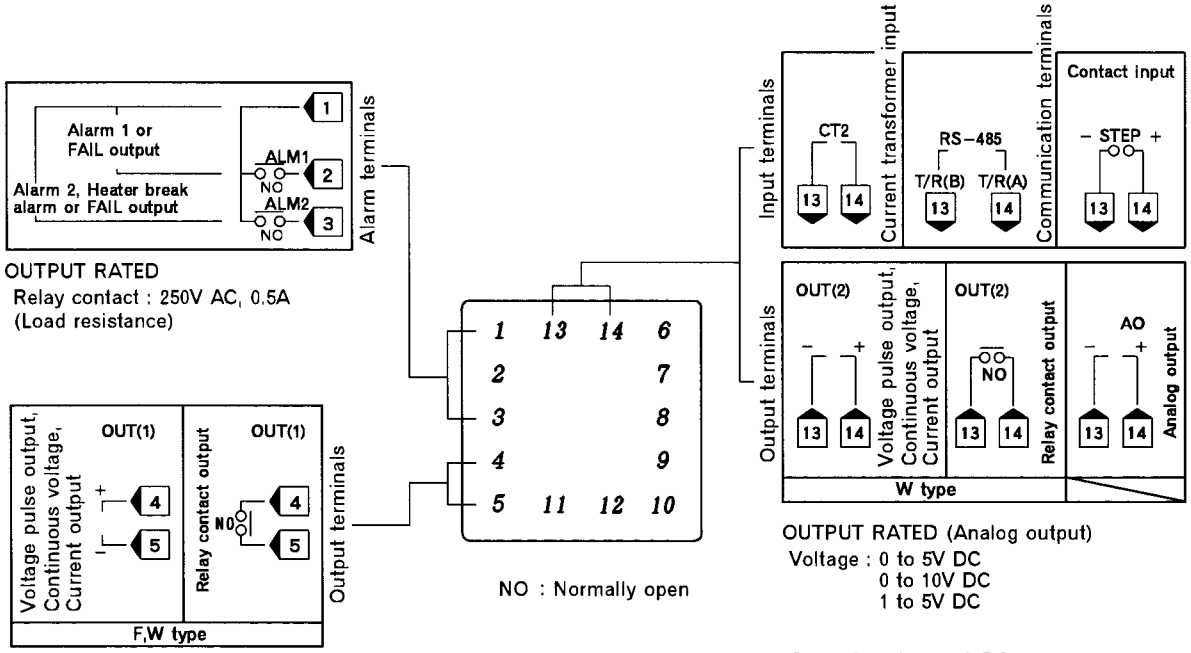
2.5 Wiring

Conduct wiring by referring to following diagrams.

■ Rear terminals (REX-D100)

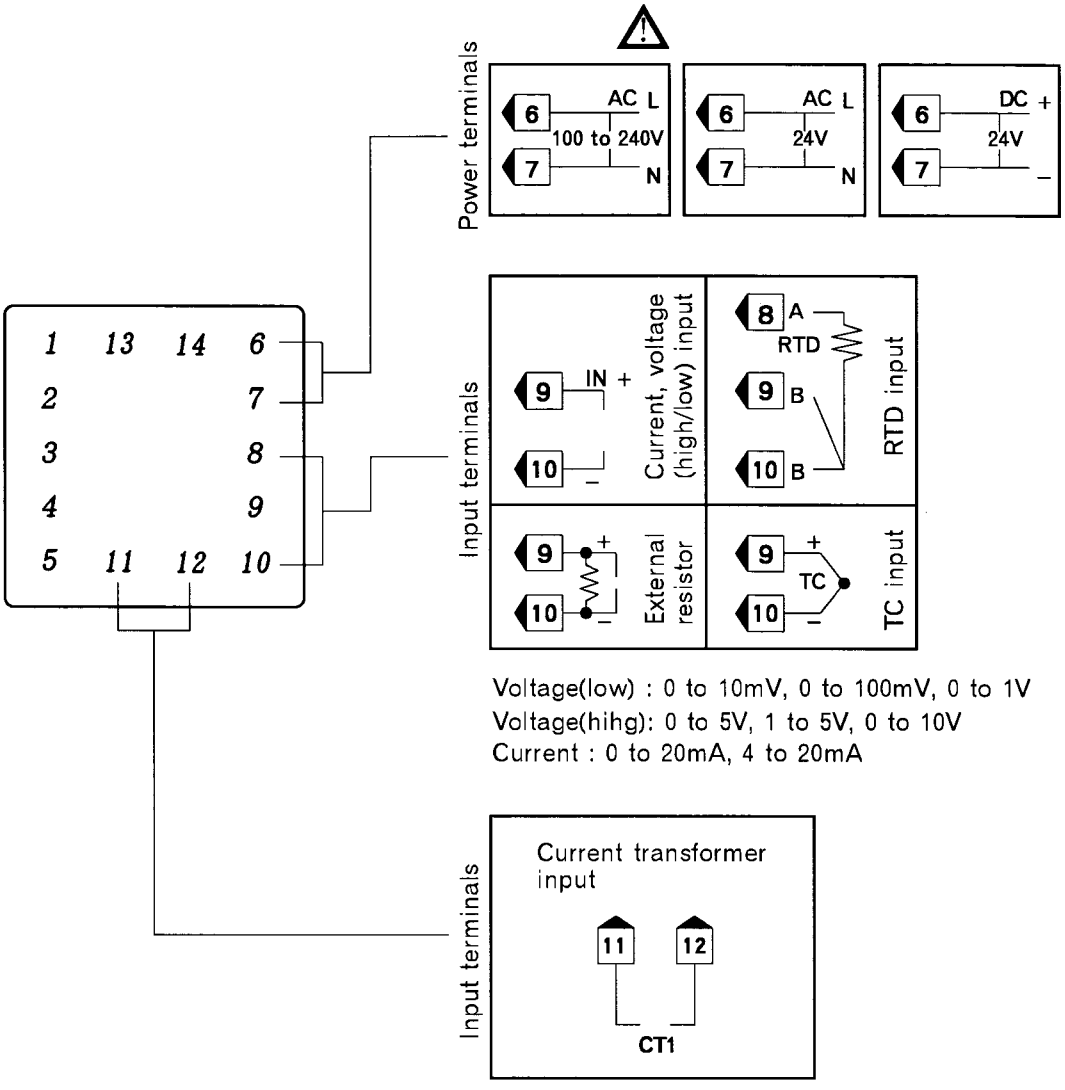
CAUTIONS

1. Select voltage (low) input or voltage (high) input by the switch in the mainframe.
2. If current input is selected, always mount the attached external resistor.
3. If the heating/cooling PID action with auto-tuning is selected, contact input, analog output, communication function or heater break alarm for three-phase heater cannot be selected.
4. Do not excessively tighten the terminal screws.
   [Recommended tighten torque : 0.4N·m (4kgf · cm)
   Maximum allowance tighten torque : 0.7N·m (7kgf · cm)]
5. Use the lug with 6.2mm wider or less.



F : PID action with auto-tuning
W : Heating/cooling PID action with auto-tuning

OUTPUT RATED (Control output)
Relay contact : 250V AC, 3A (Load resistance)
Voltage pulse : 0/12V DC
Continuous voltage : 0 to 5V DC, 0 to 10V DC, 1 to 5V DC
Current : 0 to 20mA DC, 4 to 20mA DC

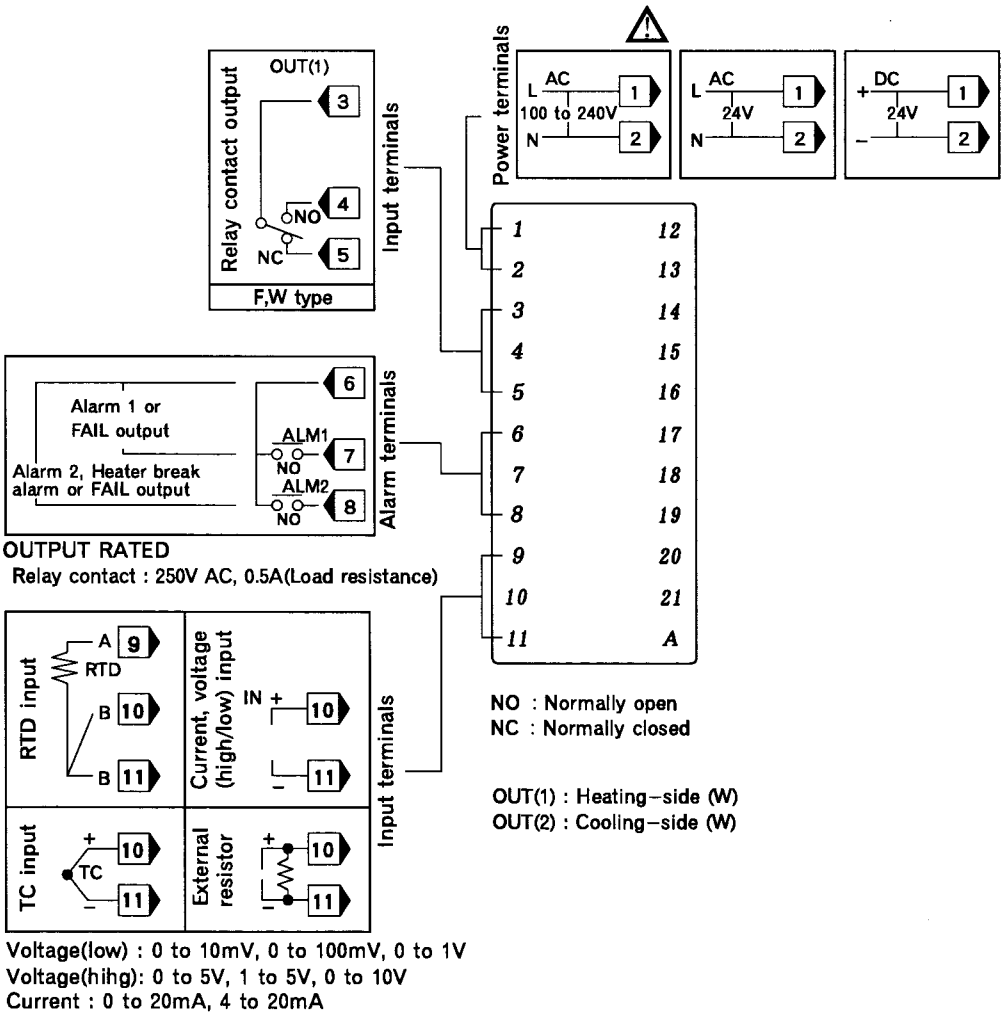


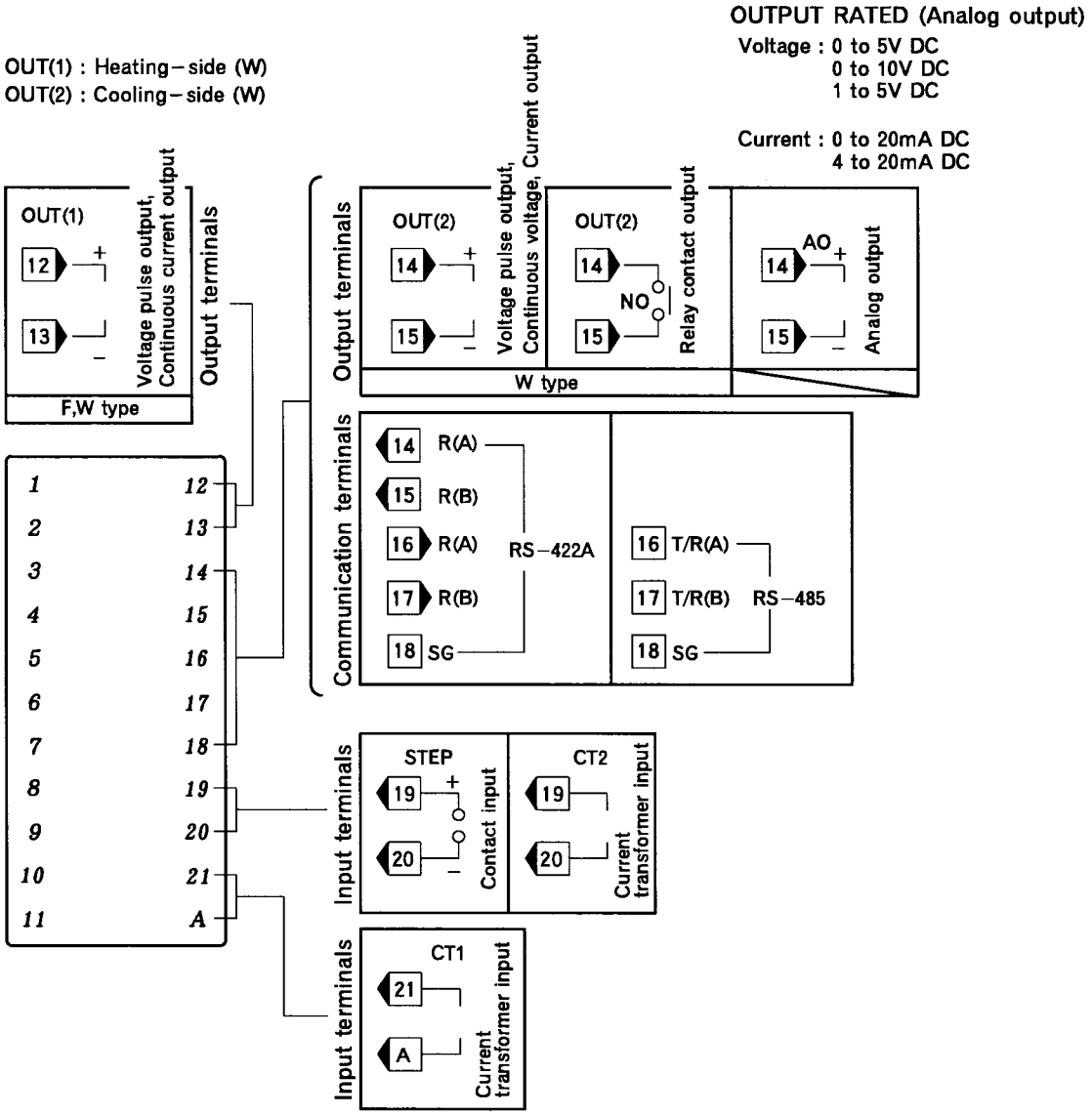
Voltage(low) : 0 to 10mV, 0 to 100mV, 0 to 1V
Voltage(hihg): 0 to 5V, 1 to 5V, 0 to 10V
Current : 0 to 20mA, 4 to 20mA

■ Rear terminals (REX−D400)

CAUTIONS

1. Select voltage (low) input or voltage (high) input by the switch in the mainframe.
2. If current input is selected, always mount the attached external resistor.
3. If the heating/cooling PID action with auto−tuning is selected for REX−D400, neither analog output nor communication function RS−422A can be specified.
4. If analog output is selected in REX−D400, no communication function RS−422A can be specified.
5. Do not excessively tighten the terminal screws.
   [Recommended tighten torque : 0.4N·m (4kgf · cm)
   Maximum allowance tighten torque : 1.0N·m (10kgf · cm)]
6. Use the lug with 6.2mm wider or less.





F : PID action with auto-tuning
W : Heating/cooling PID action with auto-tuning

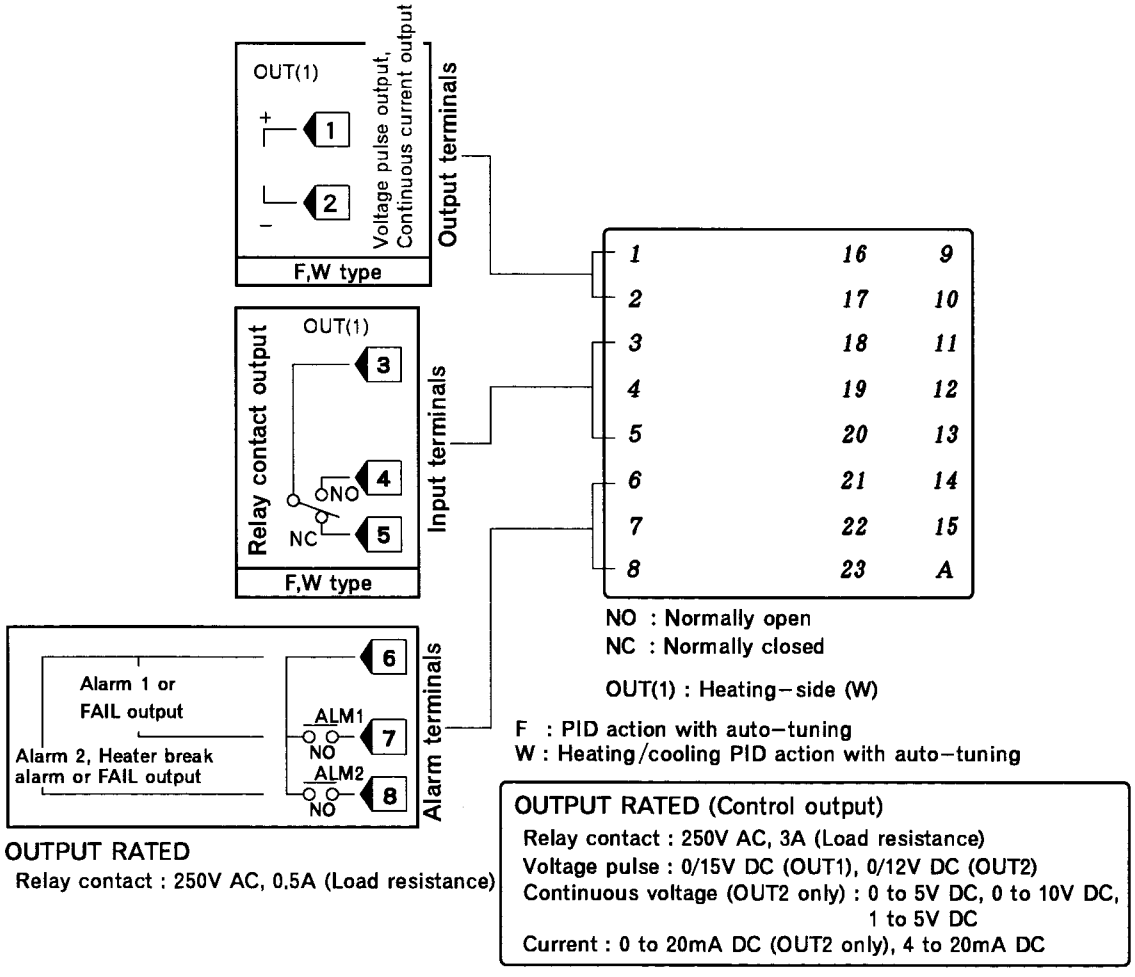
OUTPUT RATED (Control output)

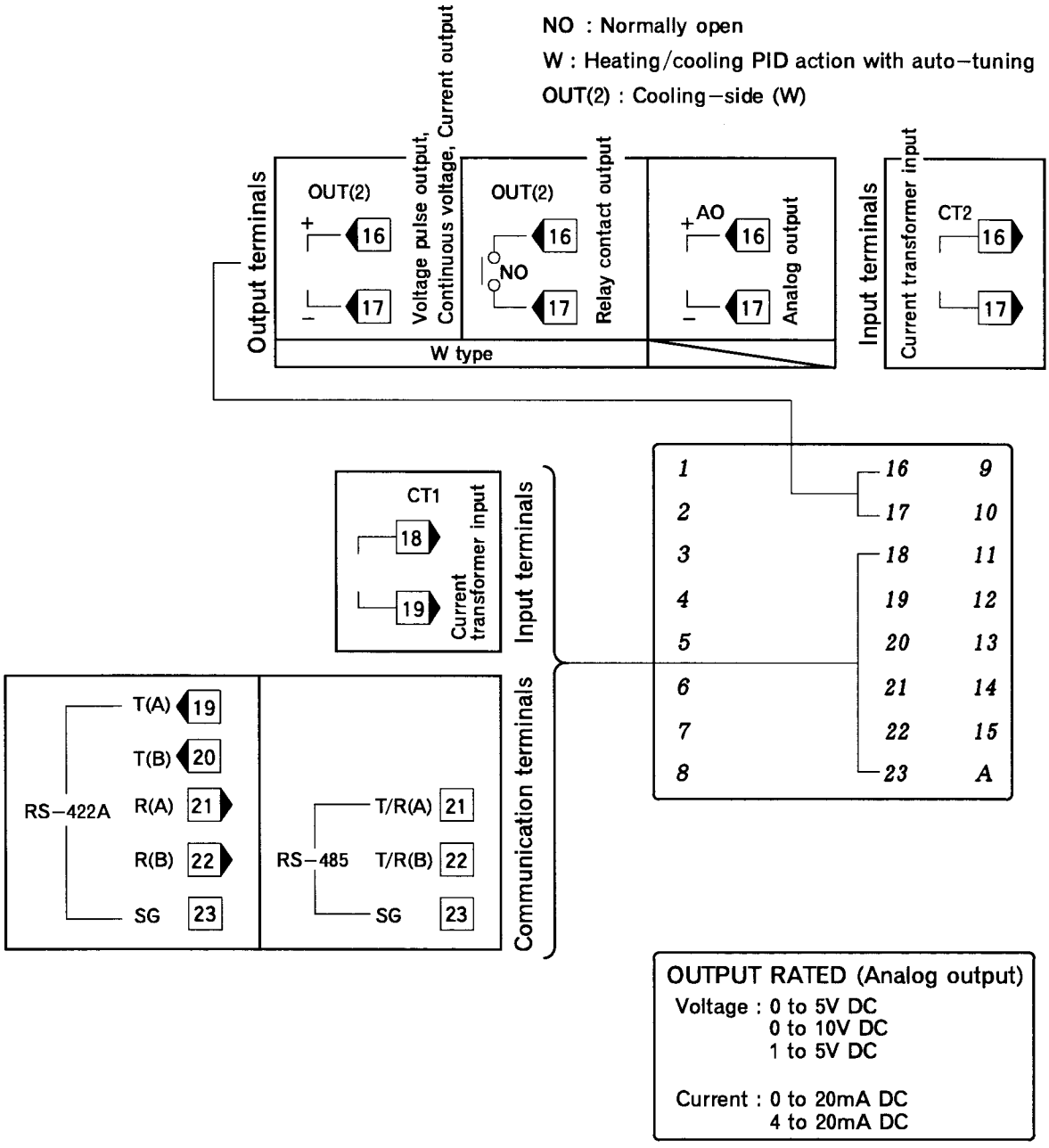
Relay contact : 250V AC, 3A (Load resistance)
Voltage pulse : 0/15V DC (OUT1), 0/12V DC (OUT2)
Continuous voltage (OUT2 only) : 0 to 5V DC, 0 to 10V DC, 1 to 5V DC
Current : 0 to 20mA DC (OUT2 only), 4 to 20mA DC

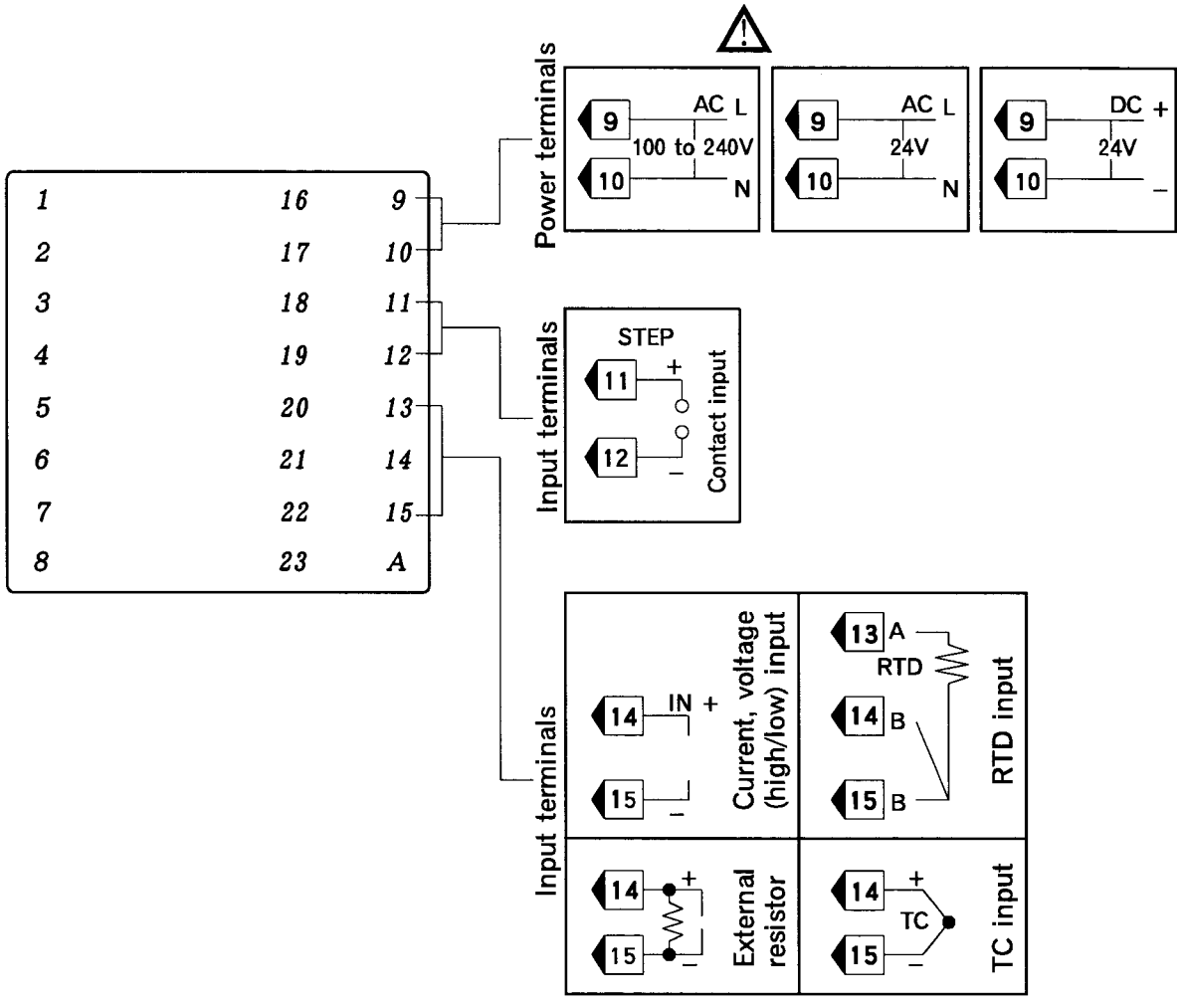
■ Rear terminals (REX−D700)

CAUTIONS

1. Select voltage (low) input or voltage (high) input by the switch in the mainframe.
2. If current input is selected, always mount the attached external resistor.
3. If the heater break alarm function is selected in REX−D700, no communication function RS−422A can be specified.
4. If analog output is selected in REX−D400, no communication function RS−422A can be specified.
5. Do not excessively tighten the terminal screws.
   [Recommended tighten torque : 0.4N·m (4kgf · cm)
   Maximum allowance tighten torque : 1.0N·m (10kgf · cm)]
6. Use the lug with 6.2mm wider or less.




NO : Normally open
W : Heating/cooling PID action with auto-tuning
OUT(2) : Cooling-side (W)
Output terminals
OUT(2)
+
16
17
−
Voltage pulse output, Continuous voltage, Current output
OUT(2)
16
NO
17
Relay contact output
AO
+
16
17
−
Analog output
W type
Input terminals
Current transformer input
CT2
16
17
CT1
18
19
Current transformer input
Input terminals
1 2 3 4 5 6 7 8
16 17 18 19 20 21 22 23
9 10 11 12 13 14 15 A
T(A) 19
T(B) 20
RS-422A R(A) 21
R(B) 22
SG 23
T/R(A) 21
RS-485 T/R(B) 22
SG 23
Communication terminals
OUTPUT RATED (Analog output)
Voltage : 0 to 5V DC
0 to 10V DC
1 to 5V DC
Current : 0 to 20mA DC
4 to 20mA DC

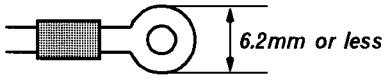


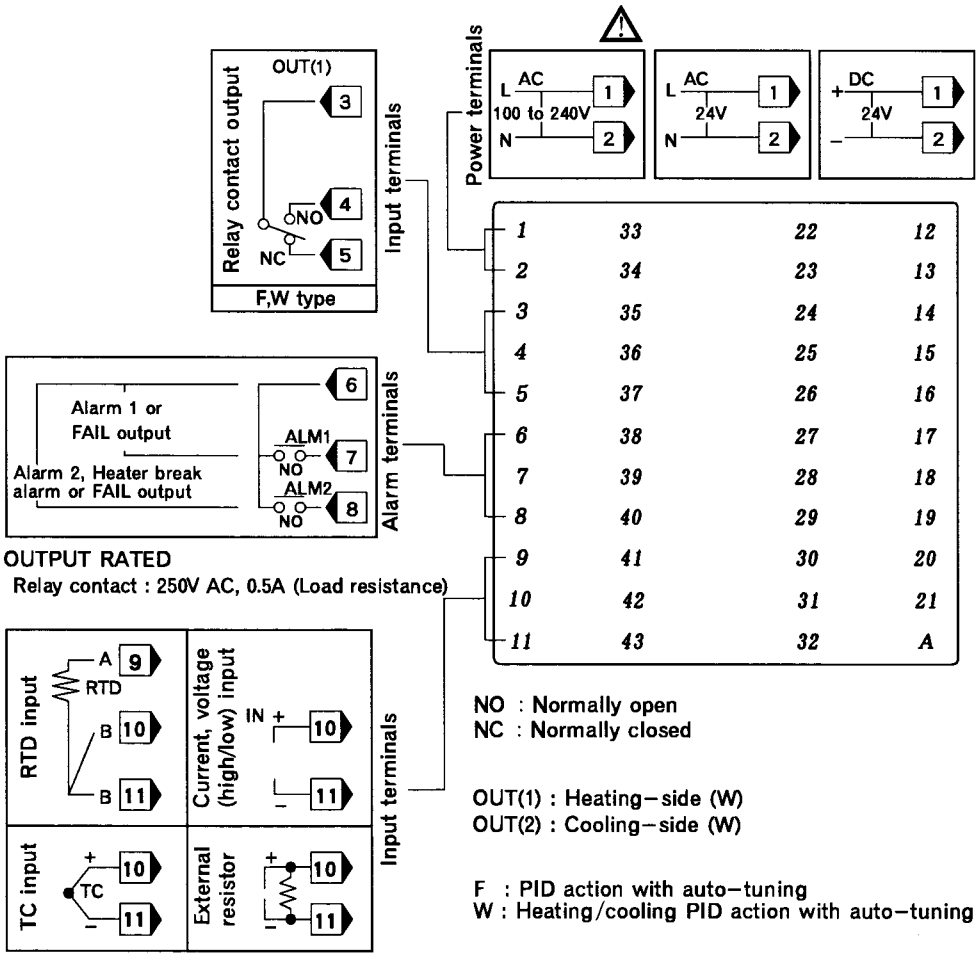
Voltage(low) : 0 to 10mV, 0 to 100mV, 0 to 1V
Voltage(hihg): 0 to 5V, 1 to 5V, 0 to 10V
Current : 0 to 20mA, 4 to 20mA

■ Rear terminals (REX-D900)

CAUTIONS

1. Select voltage (low) input or voltage (high) input by the switch in the mainframe.
2. If current input is selected, always mount the attached external resistor.
3. If the heating/cooling PID action with auto-tuning is selected for REX-D900, neither analog output nor communication function RS-422A can be specified.
4. If analog output is selected in REX-D400, no communication function RS-422A can be specified.
5. Do not excessively tighten the terminal screws.
   [Recommended tighten torque : 0.4N·m (4kgf · cm)
   Maximum allowance tighten torque : 1.0N·m (10kgf · cm)]
6. Use the lug with 6.2mm wider or less.





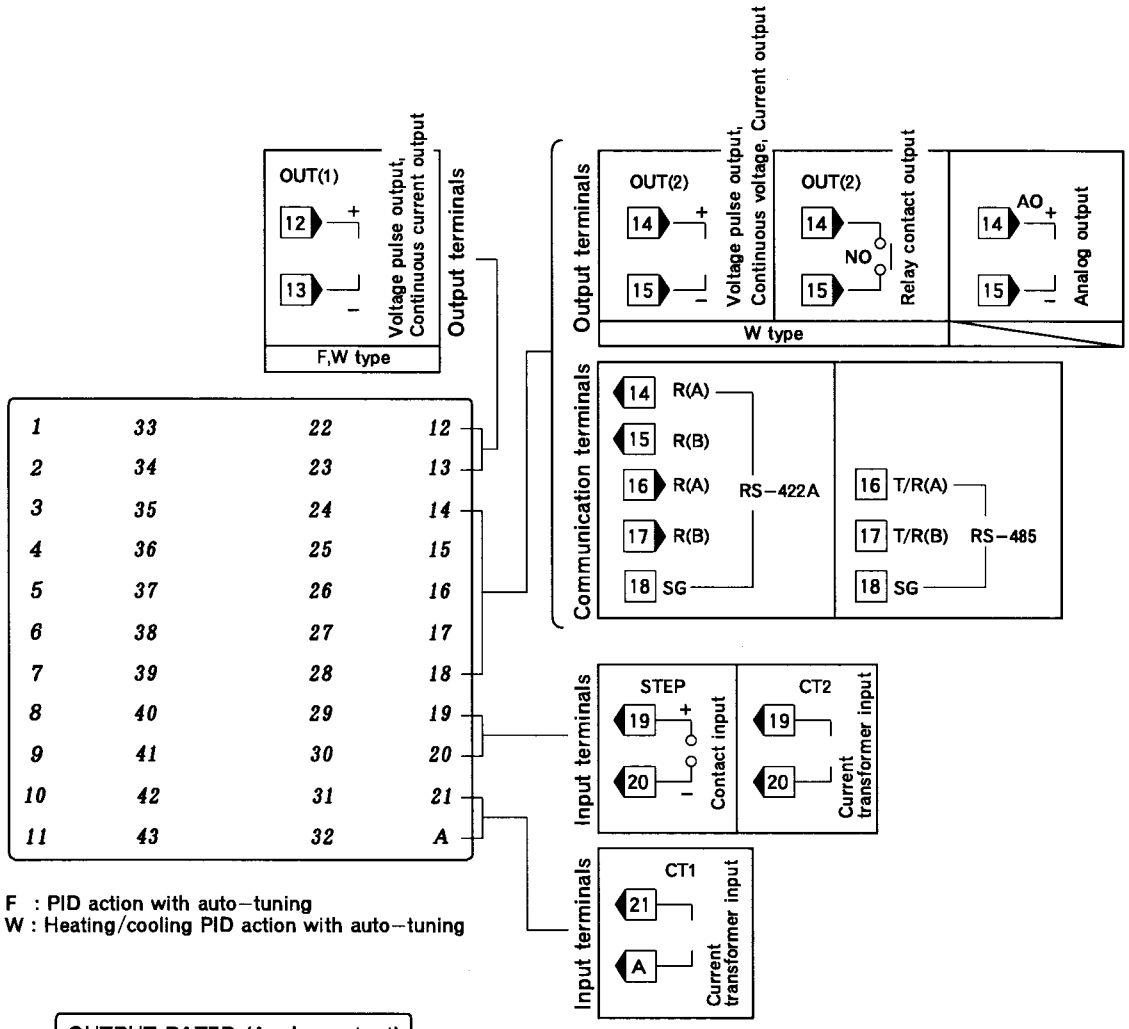
OUTPUT RATED
Relay contact : 250V AC, 0.5A (Load resistance)

NO : Normally open
NC : Normally closed

OUT(1) : Heating-side (W)
OUT(2) : Cooling-side (W)

F : PID action with auto-tuning
W : Heating/cooling PID action with auto-tuning

Voltage(low) : 0 to 10mV, 0 to 100mV, 0 to 1V
Voltage(hihg): 0 to 5V, 1 to 5V, 0 to 10V
Current : 0 to 20mA, 4 to 20mA



F : PID action with auto−tuning
W : Heating/cooling PID action with auto−tuning

OUTPUT RATED (Analog output)
Voltage : 0 to 5V DC
0 to 10V DC
1 to 5V DC

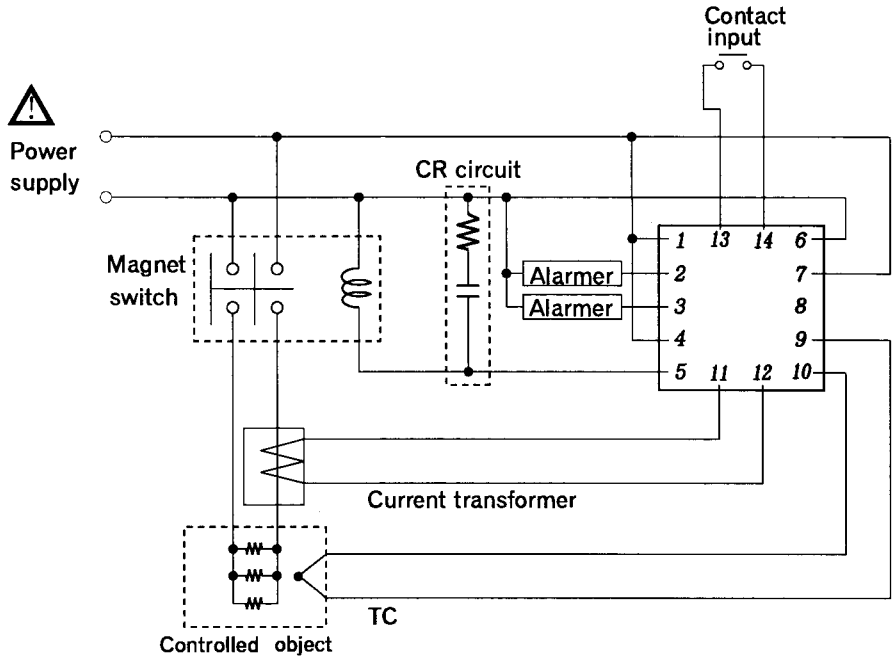
Current : 0 to 20mA DC
4 to 20mA DC

OUTPUT RATED (Control output)
Relay contact : 250V AC, 3A (Load resistance)
Voltage pulse : 0/15V DC (OUT1), 0/12V DC (OUT2)
Continuous voltage (OUT2 only) : 0 to 5V DC, 0 to 10V DC, 1 to 5V DC
Current : 0 to 20mA DC (OUT2 only), 4 to 20mA DC

2.6 Wiring example

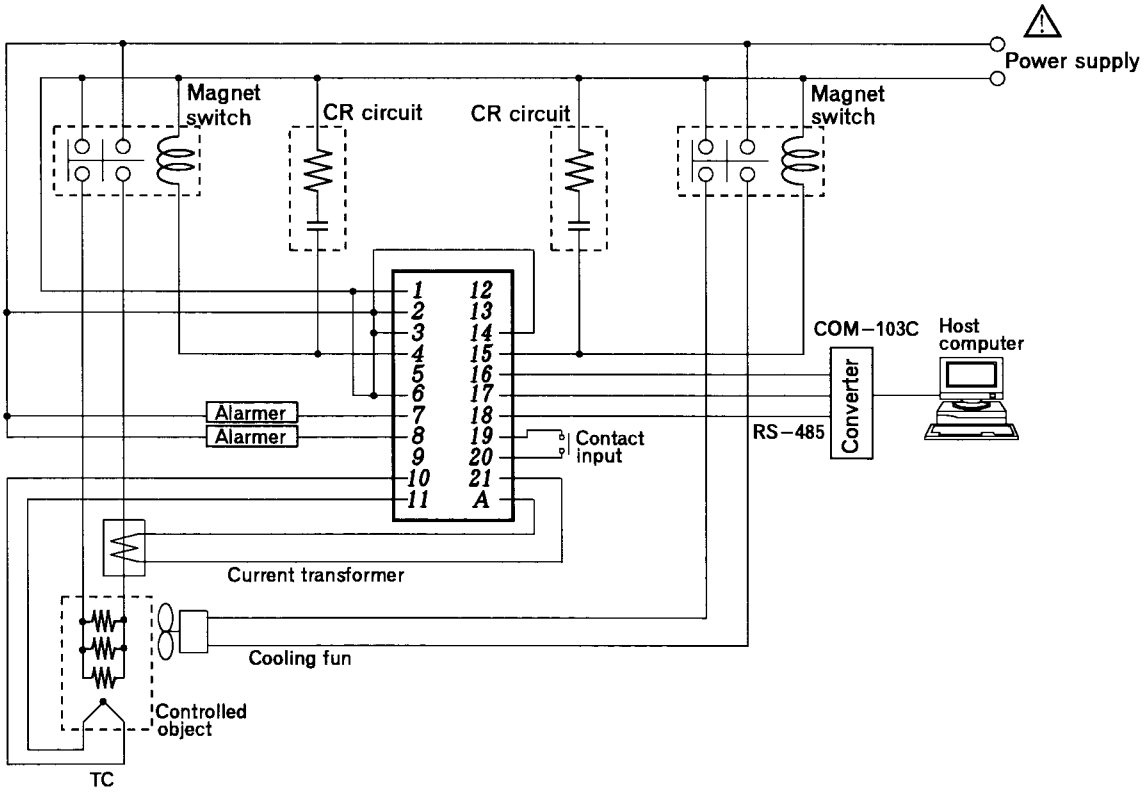
■ PID action with auto-tuning

REX-D100F-MN * DS-1N-N1



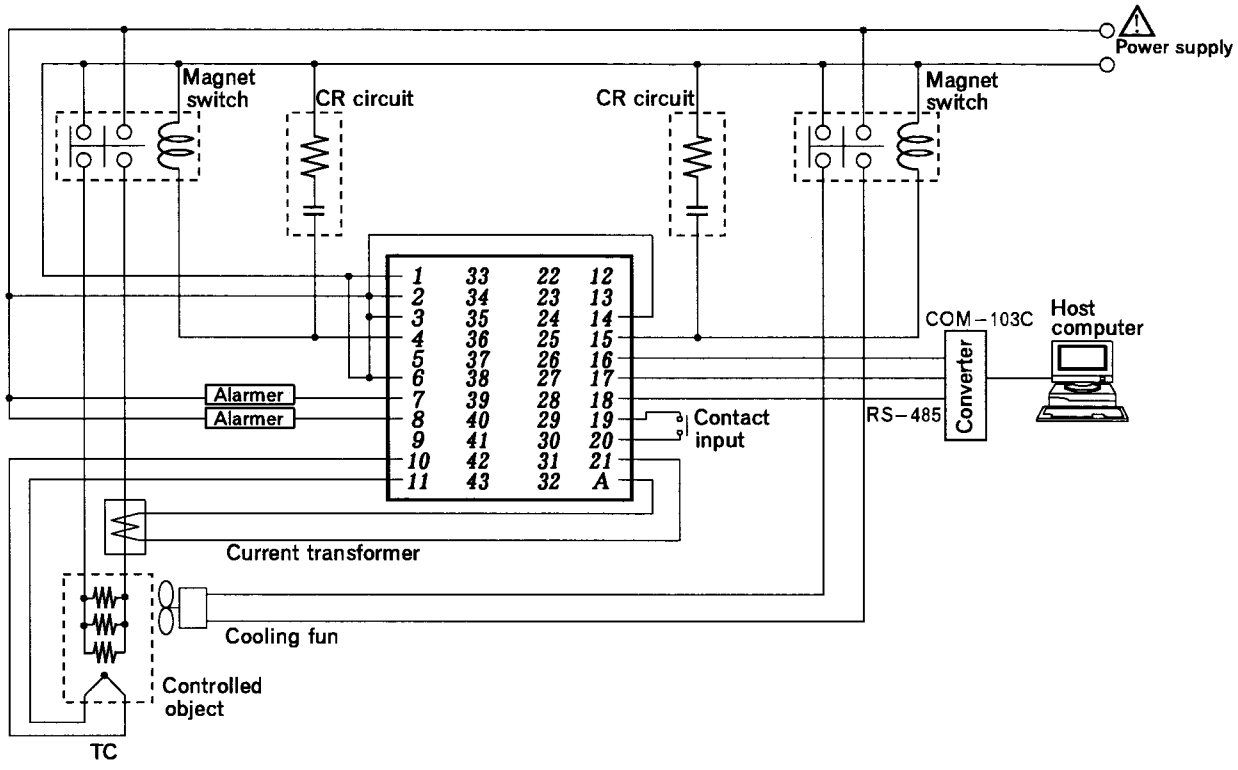
■ Heating/cooling PID action with auto-tuning

REX-D400W-M * DS-N-5



■ Heating/cooling PID action with auto-tuning

REX-D900W-M * DS-N-5



MEMO

CHAPTER 3

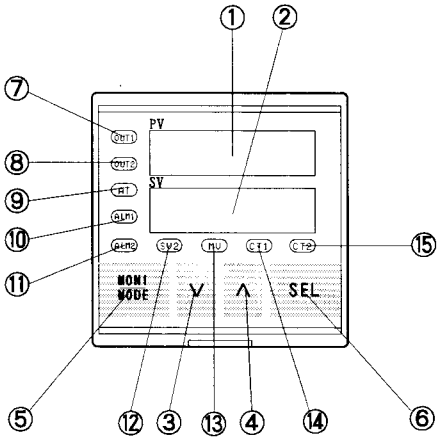
OPERATION

REX-D SERIES
Instruction Manual

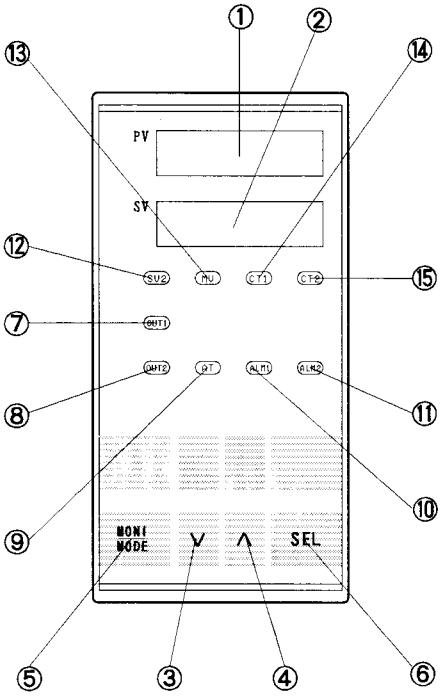
3. OPERATION

3.1 Name of parts

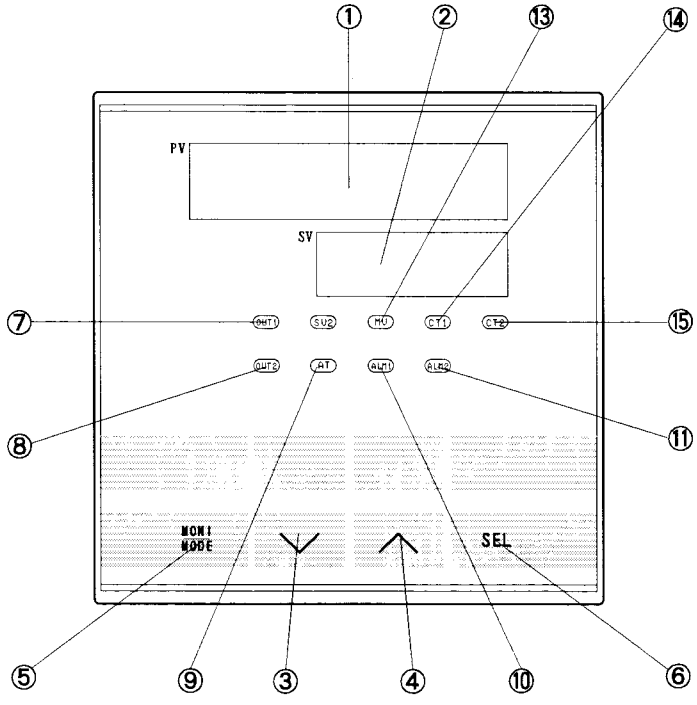
■ REX-D100



■ REX-D400



■ REX-D700·900

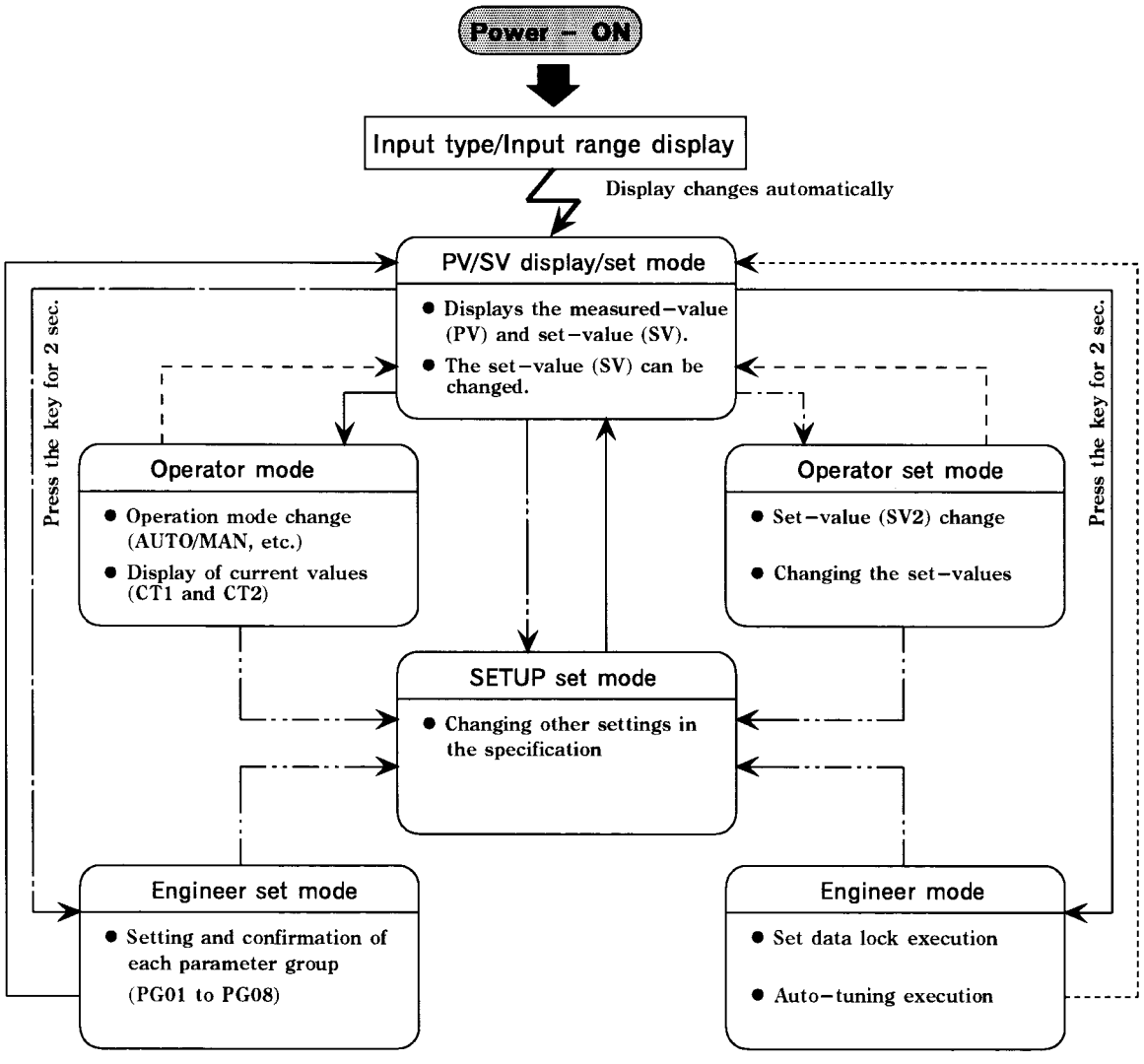


Name	Details
① **Measured-value (PV) display unit**	● Displays measured-value (PV). ● Displays various characters depending on the instrument status.
② **Set-value (SV) display unit**	● Displays set-value (SV). ● Displays input value, output value and various characters depending on the instrument status.
③ **Set-value decrement key**	● Used when the numeric value needs to be decreased for set-value change. ● Used for selecting operation mode in each mode. (▽)
④ **Set-value increment key**	● Used when the numeric value needs to be increased for set-value change. ● Used for selecting operation mode in each mode. (△)
⑤ **MONI/MODE key**	● Used when each mode is set or each mode display is changed. (MONI MODE)
⑥ **SEL key**	● Used when each mode is set or each mode display is changed. (SEL)
⑦ **Output lamp 1 [Green]**	● Lights when control output is turned ON.
⑧ **Output lamp 2 [Green]**	● Lights when cooling side output is turned ON.
⑨ **Auto-tnuing (AT) lamp [Green]**	● Flashes during auto-tuning execution.
⑩ **ALM 1 lamp [Red]**	● Lights with the first alarm turned ON. This lamp lights also when a control loop break alarm (LBA) occurs.
⑪ **ALM 2 lamp [Red]**	● Lights with the second alarm turned ON. This lamp lights also when a heater break alarm (HBA) occurs.
⑫ **SV2 lamp [Green]**	● Lights when the set-value (SV) display unit shows SV2.
⑬ **MV lamp [Green]**	● Lights during manual control. The set-value (SV) display unit shows the manual output value. The manual output value is changed by the △ or ▽ key.
⑭ **CT1 lamp [Green]**	● Lights when the set-value (SV) display unit shows CT1.
⑮ **CT2 lamp [Green]**	● Lights when the set-value (SV) display unit shows CT2.

3.2 Calling procedure in each mode

Broadly, the following six statuses are available for this instrument.

- ■ PV/SV display/set mode : Mode used to confirm and set the measured−value (PV) or set−value (SV).
- ■ Operator mode : Mode used to change operation mode or to confirm the current value.
- ■ Operator set mode : Mode used to set alarms and set−value.
- ■ Engineer mode : Mode used to execute/stop the auto−tuning function and to lock the setting.
- ■ Engineer set mode : Mode used to set and confirm various parameters.
- ■ SETUP set mode* : Mode used to select input/output and the operation mode function, etc.

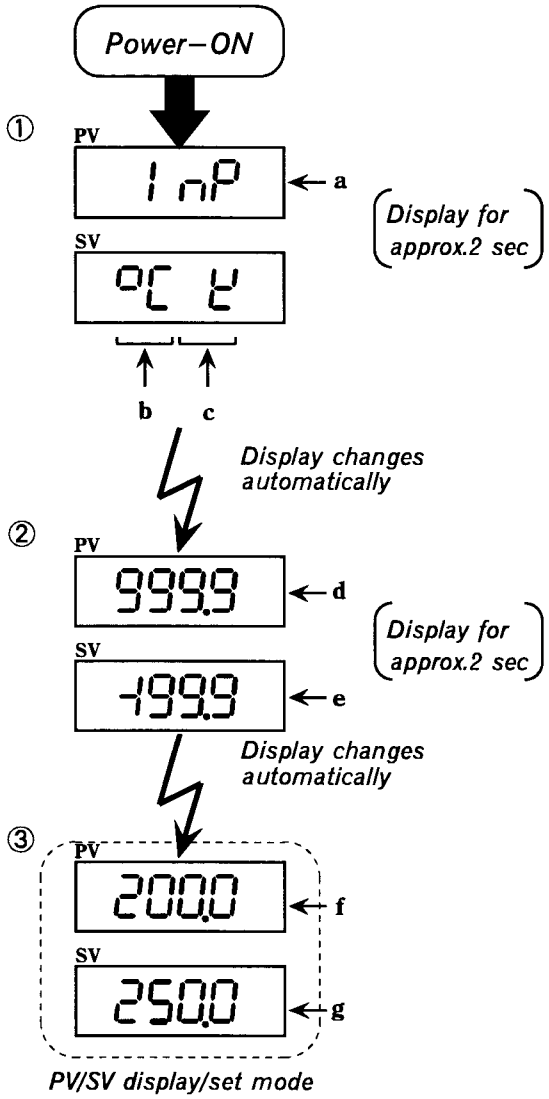


——→ *Press the* MONI MODE *key.*
−·−·−→ *Press the* SEL *key.*
−···−→ *Press the* MONI MODE *and* SEL *keys simultaneously.*
- - - - - - - → *Press the* MONI MODE *or* SEL *key.*

** The SETUP set mode accesses parameters which are not usually changed.*

■ Input type/input range display

This instrument immediately confirms input type and range following power−ON.



① Input type display

(Display for approx.2 sec)

a : Input display character (Inp)

b : Unit

Display	Unit
oC	℃
oF	℉
None	%

c : Input type

Display	Input type	
t	TC	K
J		J
L		L
E		E
n		N
T		T
U		U
r		R
S		S
b		B
W		W5Re/W25Re
P		P
JP	RTD	JPt 100
Pt		Pt 100
V	Voltage input	

② Input range display (Display for approx.2 sec)

d : High input range limit value

e : Low input range limit value

③ PV/SV display/set mode

The measured−value (PV) display unit shows the measured−value (PV), and the set−value (SV) display unit shows the set−value (SV).

In addition, the set−value (SV) can be changed. Usually set the instrument to this mode except when changing the parameter set−value.

f : Measured−value (PV) display unit

g : Set−value (SV) display unit

* For current input, see chapter 1 "■ Input range table" (P.1−7).

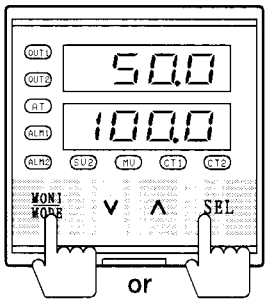
3.3 Set−value (SV) changing procedure

This instrument employs the up/down method for setting each constant. The set−value can be changed by pressing the ⋀ and ⋁ keys on the front panel.

〔 **Example** 〕 **Change the set−value (SV) to 200.0** °C

① **Set the instrument to the PV/SV display/set mode**

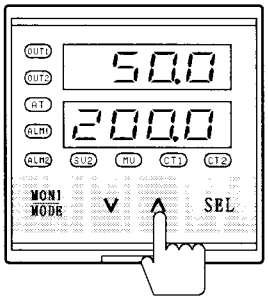
If the instrument is set to another mode, press the MONI MODE or SEL key to set the instrument to the PV/SV display/set mode.



② **Numeric value change**

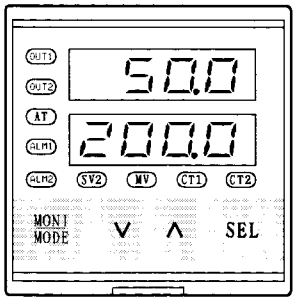
Keep pressing the ⋀ key to increase the numeric value on the set−value (SV) display unit until it reaches "200.0". Pressing the ⋀ key increases the numeric value and pressing the ⋁ key decreases the numeric value.

* Keep pressing the ⋀ or ⋁ key to increase the speed with which the numeric value changes.



③ **Setting end**

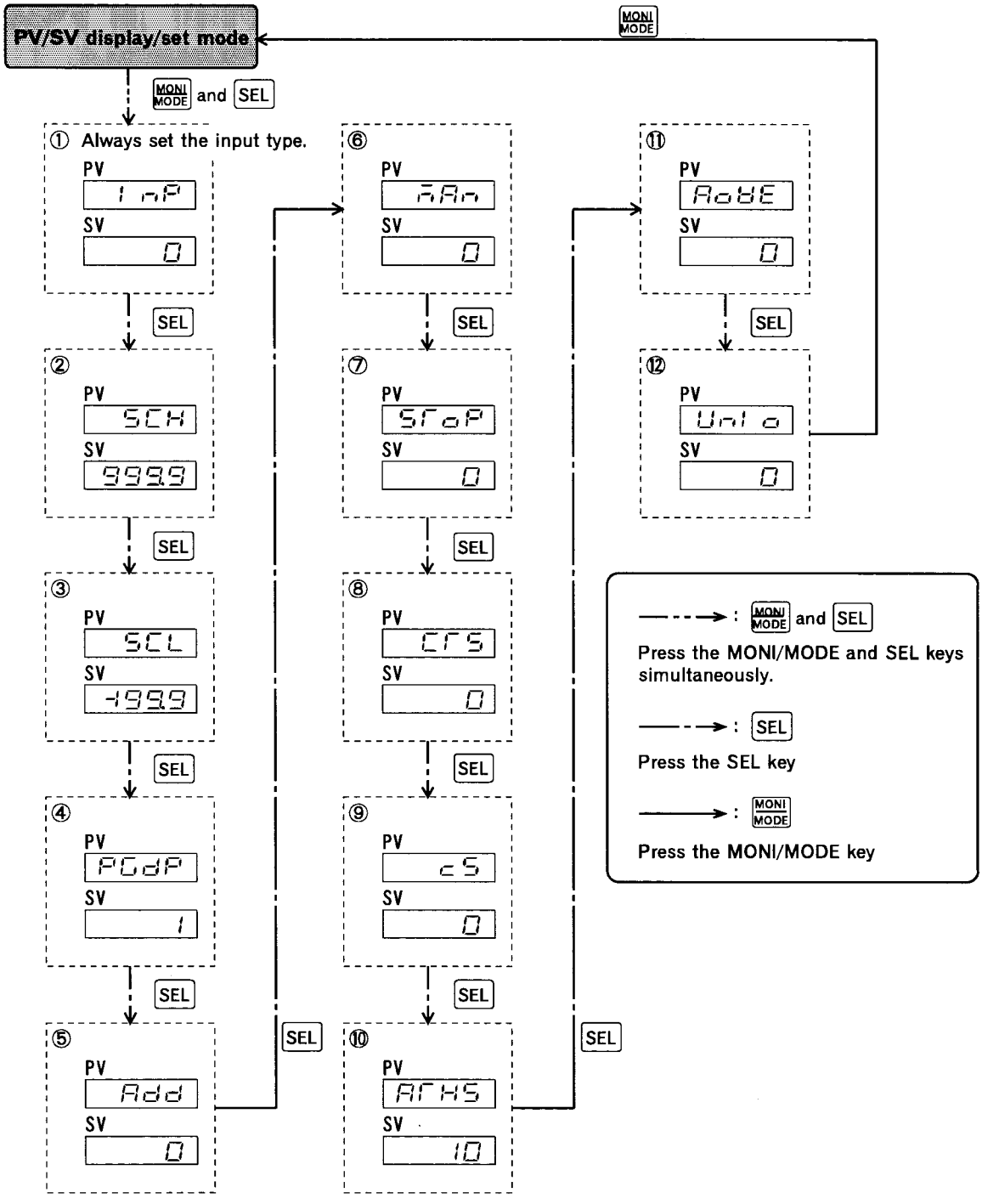
After completing the setting, release your finger from the key to make the set−value (SV) thus changed effective.



3.4 SETUP set mode

SETUP set mode is used to enter the input type, the range of each function and to enable or disable functions. The display sequence in SETUP set mode is shown below.
Display in SETUP set mode can be changed by pressing the [SEL] key.

(1) Display sequence



(2) Description of each parameter

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	① Inp	Input type selection	See the input range on page 3−10.	Selects the input type.	0
	② SCH	Scaling high−limit	Scaling low−limit to 9999	Sets the high−limit of the scaling setting range.	999.9
	③ SCL	Scaling low−limit	−1999 to scaling high−limit	Sets the low−limit of the scaling setting range.	−199.9
*1	④ PGdP	Decimal−point position selection	0: No digit below decimal−point 1: 1 digit below decimal−point 2: 2 digits below decimal−point 3: 3 digits below decimal−point	Sets the decimal−point position on the voltage/ current input scale.	1
*2	⑤ Add	Device address setting	0 to 99	Sets the communication device address of this controller.	0
	⑥ MAn	AUTO/MAN selection	0: Not provided 1: Provided	Selects whether to enable or disable the "AUTO/ MAN transfer" in oper− ator mode.	0
	⑦ SToP	Operation STOP function selection	0: Not display 1: Display	Selects whether to enable or disable the "Operation STOP function selection" in operator mode.	0
*3	⑧ CTS	CT type selection	0: CTL−6−P−N 1: CTL−12−S56−10L−N	Selects the current trans− former type.	0
*4	⑨ cS	Air cooling/ water cooling selection	0: Air cooling 1: Water cooling	Selects the cooling method for heating/cooling PID action with auto−tuning.	0
	⑩ ATHS	Auto−tuning (AT) differential gap	0 to 3600 sec	Sets the differential gap during auto−tuning.	10

(Continued on the next page.)

	Symbol	Name	Setting range	Description	Initial value prior to shipment
*5	⑪ AoVE AoVE	Action selection at input abnormality	0: Not provided 1: Output OFF *A 2: Output ON *A	Selects the action to be performed when an error occurs.	0
*6	⑫ Unl o Unlo	Universal output selection	0: Relay contact output 1: Voltage pulse output 2: Continuous current output	Selects the universal output type.	0

*1 Displayed for voltage/current input.

*2 Diplayed for the controller with the communication function.

*3 Displayed only for the controller with the heater break alarm function.
If a heater break alarm for three−phase heater is specifid, always use the same type of current transformers.

*4 Displayed only for heating/cooling PID action with auto−tuning.

*5 Not displayed for heating/cooling PID action with auto−tuning.

*6 Displayed for universal output.

*A [Output limiter low−limit] and [Output limiter high−limit] are for continuous output.

■ Input range table

Group		Input type		Input select
Temperature input	TC	K (K)	−199.9 to 999.9 °C	0
			−200 to 1372 °C	1
		J (J)	−199.9 to 999.9 °C	2
			−200 to 1200 °C	3
		T (T)	−199.9 to 400.0 °C	4
		R (r)	0 to 1769 °C	5
		S (S)	0 to 1769 °C	6
		B (b) *1	0 to 1820 °C	7
		E (E)	−200 to 1000 °C	8
		N (n)	0 to 1300 °C	9
		PL II (P)	0 to 1390 °C	10
		W5Re / W26Re(C)	0 to 2320 °C	11
		U (U)	0 to 600 °C	12
		L (L)	0 to 900 °C	13
		K (K)	−199.9 to 999.9 °F	14
			−330 to 2500 °F	15
		J (J)	−199.9 to 999.9 °F	16
			−330 to 2192 °F	17
		T (T)	−199.9 to 752.0 °F	18
		R (r)	0 to 3216 °F	19
		S (S)	0 to 3216 °F	20
		B (b) *1	0 to 3308 °F	21
		E (E)	−330 to 1832 °F	22
		N (n)	0 to 2372 °F	23
		PL II (P)	0 to 2534 °F	24
		W5Re / W26Re(C)	0 to 4208 °F	25
		U (U)	0 to 1100 °F	26
		L (L)	0 to 1600 °F	27
	RTD	JPt100 Ω	−199.9 to 510.0 °C	28
		Pt100 Ω	−199.9 to 660.0 °C	29
		JPt100 Ω	−199.9 to 950.0 °F	30
		Pt100 Ω	−199.9 to 999.9 °F	31
Voltage input	Voltage input (low)	mV, V (H)	0 to 10 mV DC	32
			0 to 100 mV DC	33
			0 to 1 V DC	34
	Voltage input *2 (High)	V (H)	0 to 5 V DC	35
			1 to 5 V DC	36
			0 to 10 V DC	37
Current input *3		mA (I)	0 to 20 mA DC	
			4 to 20 mA DC	

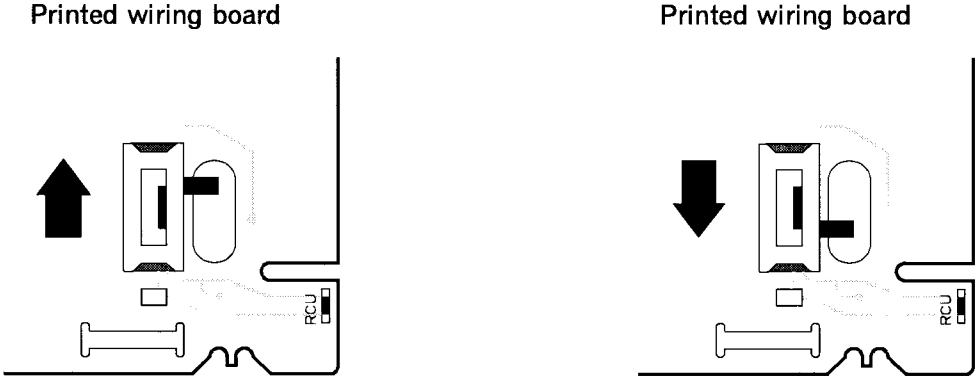
*1 Accuracy in the range of 0 to 400 °C (0 to 800 °F): Not guaranteed.

*2 If the voltage (high) input is used, change the switch in the mainframe. (**Fig.1**)

*3 If a current input of 0 to 20mA is used, select a voltage (high) input 0 to 5V, and if a current input of 4 to 20mA is used, select a valtage (high) input of 1 to 5V.
In either case, connect an external resistor (250 Ω ± 0.02% ± 10PPM, more than 0.25W) .

● **Switch selection**

⚠ WARNING
In order to prevent electric shock and instrument failure, always turn OFF the power, then pull out the internal chassis.



For voltage (low) input **For voltage (high) input**

Fig.1

CAUTIONS

1. No data is backed up when the power supply is turned off during setting change.

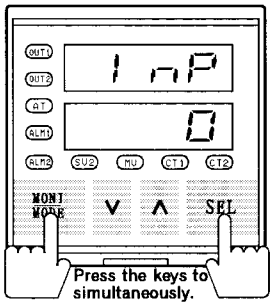
2. If the setting is changed during auto−tuning, the auto−tuning function is suspended.

(3) Procedures for changing the setting

〔 Example 〕 When the scaling high-limit (SCH) is set to 400.0

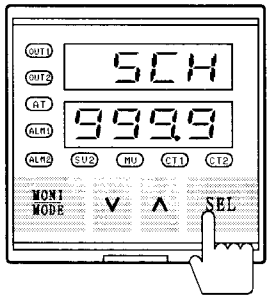
① Call up SETUP set mode

Press the MONI MODE and SEL keys simultaneously to call up SETUP set mode. First, " Input type selection (InP) " is displayed.



② Set to the scaling high-limit (SCH)

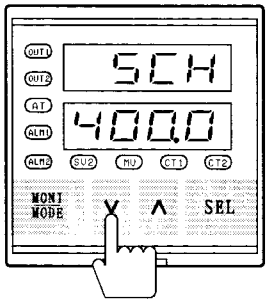
Press the SEL key to call up the scaling high-limit (SCH). The measured-value (PV) display unit shows "SCH ", and the set-value (SV) display unit shows the numeric value.
Next, press the SEL key to validate the setting.



③ Numeric value change

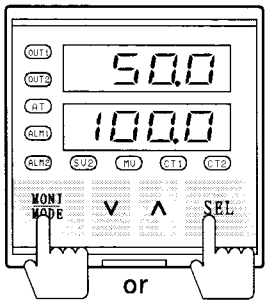
Keep pressing the ▽ key to decrease the numeric value on the set-value (SV) display unit until it reaches "400.0 ". Pressing the △ key increases the numeric value, and pressing the ▽ key decreases the numeric value. Next, press the SEL key to validate the setting.

* Keep pressing the △ or ▽ key to increase the speed with which the numeric value changes.



④ Setting end

After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode.

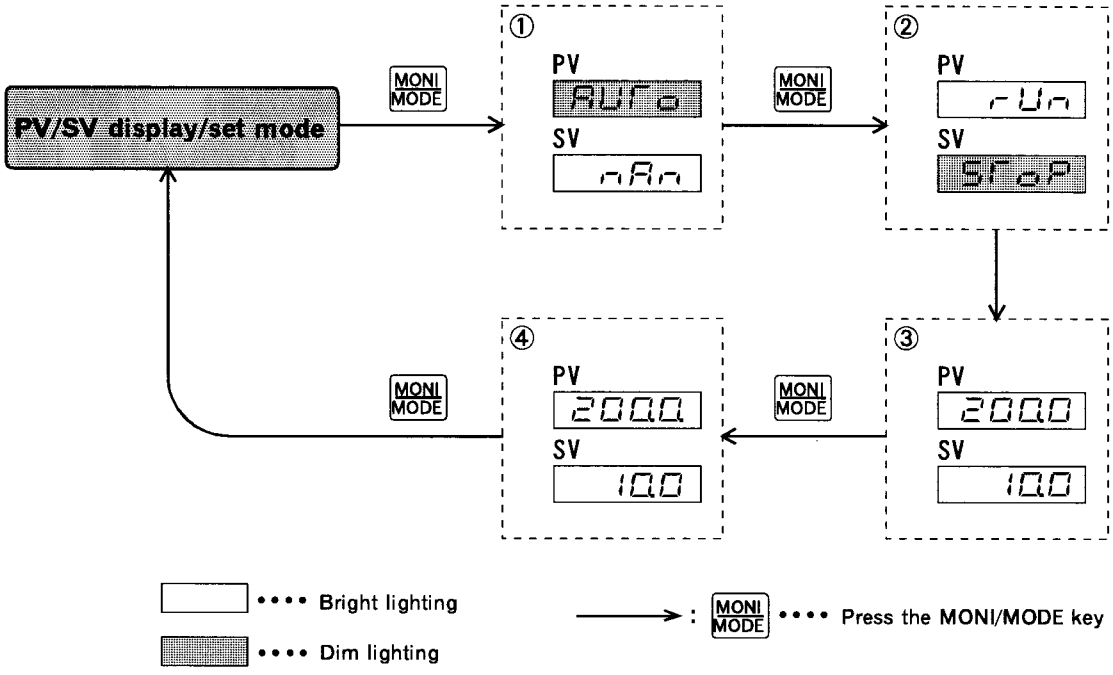


(The above figure shows that the instrument is in PV/SV display/set mode)

3.5 Operator mode

Operator mode is used to change each operation mode or to monitor and confirm the current value.
The display sequence in operator mode is shown below.
Press the MONI/MODE key to change the display in operator mode.

(1) Display sequence



① **AUTO/MAN transfer** 〔 Displayed only when there is AUTO/MAN transfer 〕

Automatic or manual control is selected. (In the above figure, " Manual (MAN) " is selected)

② **RUN/STOP transfer** 〔 Displayed only when there is RUN/STOP transfer 〕

RUN or STOP is selected. (In the above figure, " RUN " is selected)

* If the instrument is stopped by " RUN/STOP " transfer when an alarm is output due to instrument failure, both alarm output and control output are turned off.
(The same status as at power−OFF)

③ **Displayed of the current transformer input value (CT1)**

〔 Displayed only when the instrument has the heater break alarm for single−phase heater or heater break alarm for three−phase heater 〕

Displays the value input to the current transformer used when the instrument has the heater break alarm function on the set−value (SV) display unit.

Display range : 0.0 to 100.0 A

* The CT1 lamp lights when the current transformer input value (CT1) is displayed.

④ Displayed of the current transformer input value (CT2)

〔 Displayed only when the instrument has the heater break alarm for three−phase heater 〕

Displays the value input to the current transformer used when the instrument has the heater break alarm for three−phase on the set−value (SV) display unit.

Display range : 0.0 to 100.0 A

* The CT2 lamp lights when the current transformer input value (CT2) is displayed.

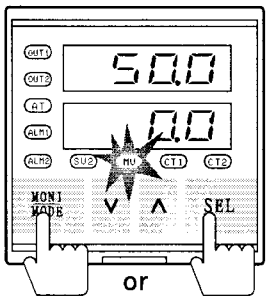
(2) Procedure for setting the manipulated output value (MV) in MAN mode

Manipulated output (MV) in MAN mode is manually set in PV/SV display/set mode.

〔 **Display examples** 〕

① Set the instrument to the PV/SV display/set mode

If the instrument is set to another mode, press the MONI MODE or SEL key to set the instrument to the PV/SV display/set mode.

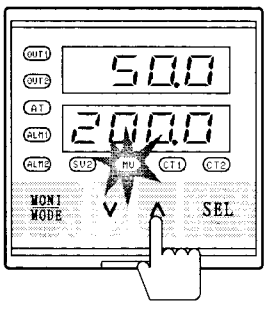


* At this time, the MV lamp lights. The manipulated output value (MV) is displayed on the set−value (SV) display unit.

② Numeric value change

Pressing the ⩓ key increases the manipulated output value (MV) on the set−value (SV) display unit, and pressing the ⩔ key decreases the value.

After setting the numeric value, release your finger from the key to make the setting effective.



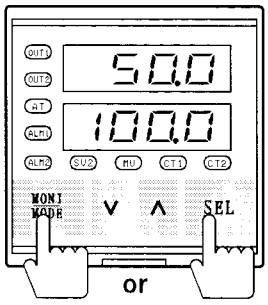
* Keep pressing the ⩓ or ⩔ key to increase the speed with which the numeric value changes.

(3) Procedure for changing operator mode

〔 Example 〕 Change operation from RUN to STOP

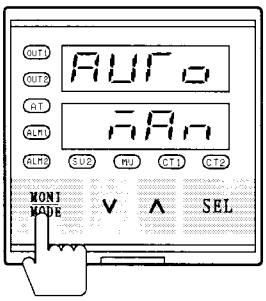
① Set the instrument to the PV/SV display/set mode

If the instrument is set to another mode, press the MONI MODE or SEL key to set the instrument to the PV/SV display/set mode.



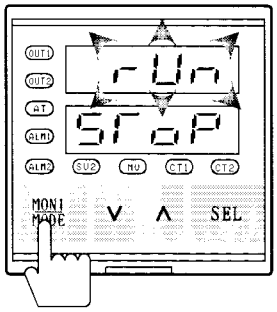
② Set the instrument to operator mode

Press the MONI MODE key with the instrument set to PV/SV display/set mode to set the instrument to operator mode. First, " AUTO/MAN transfer " is displayed.



③ Set the instrument to " RUN/STOP transfer."

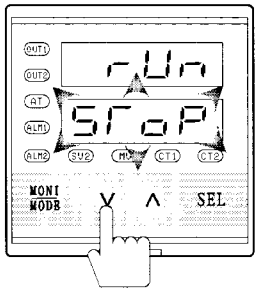
Press the MONI MODE key to call up " RUN/STOP transfer ". The side that is brightly lit is selected.



Bright lighting

④ Set to STOP

Press the ▽ key to change the operation from RUN to STOP. Then press the MONI MODE key to validate the setting.

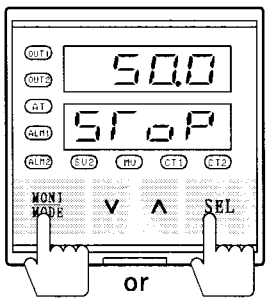


Bright lighting

* Pressing the △ key changes the display on the set−value (SV) display unit to that on the measured−value (PV) display unit. Pressing the ▽ key does the reverse.

⑤ Setting end

After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode.

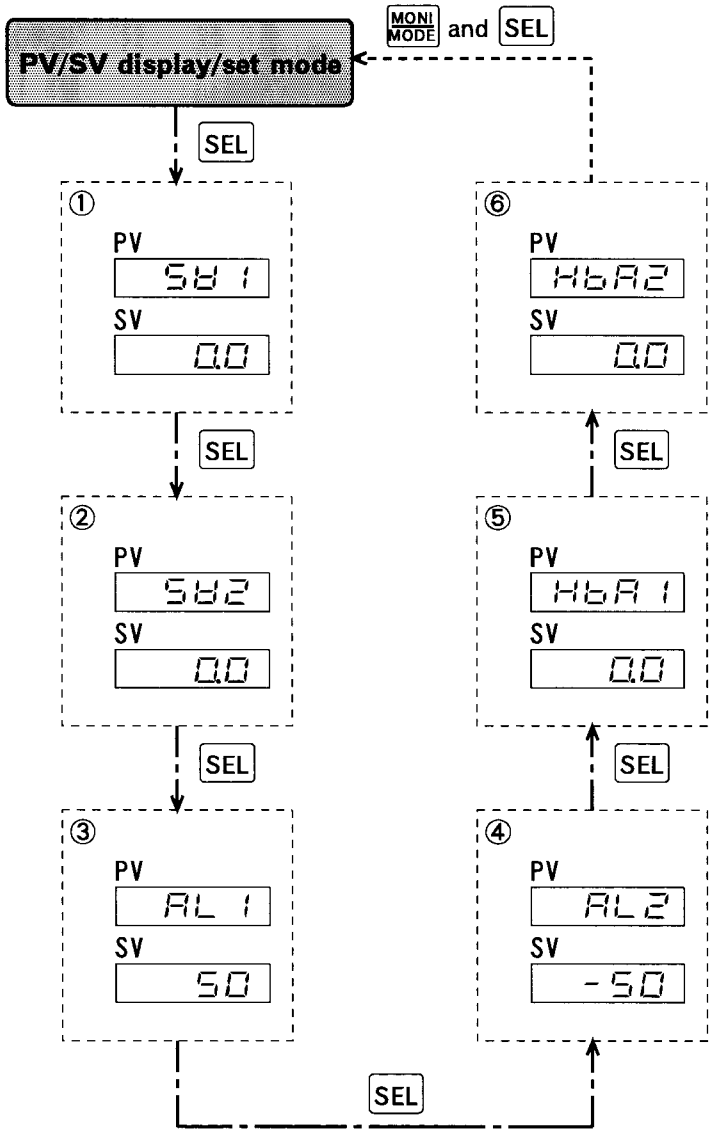


(The above figure shows that the instrument is in PV/SV display/set mode)

3.6 Operator set mode

Operator set mode is used to change the set–value (SV) which is the control target and the alarm set–value. The display sequence in the operator set mode is shown below.
The display within operator set mode is changed by pressing the SEL key, while the numeric value of each setting is changed by pressing the ∧ and ∨ keys.

(1) Display sequence



——→: MONI/MODE and SEL
Press the MONI/MODE and SEL keys simultaneously.

- - - - →: SEL
Press the SEL key

(2) Description of each parameter (Operator set mode)

Each parameter in the operator set mode is shown below. Every time the [SEL] key is pressed, each parameter changes in the following order.
(Returns to PV/SV display/set mode after completing one round.)

	Symbol	Name	Setting range	Description	Initial value prior to shipment
*1	① SV 1 SV1	Set-value	· Scaling low-limit to scaling high-limit (-1999 to 9999)	This is the control target and can be set within the input range.	0(0.0)
*2	② SV2 SV2	Step set-value	· Scaling low-limit to scaling high-limit (-1999 to 9999)	This is another control target and is changed to the set-value (SV1) by contact input.	0(0.0)
	③ AL 1 AL1	First alarm set-value	**Deviation alarm** High alarm, low alarm :-span to +span High and low alarm :-span to +span (Absolute value setting) **Band alarm**: -span to +span (Absolute value setting) **Process alarm** High/low SV alarm :Same as the input range High/low PV alarm :Same as the input range	Sets the first alarm set-value.	50(50.0)
	④ AL2 AL2	Second alarm set-value		Sets the second alarm set-value.	-50(-50.0)
*3	⑤ HbA 1 HbA1	Heater break alarm value (HBA1)	0.0 to 100.0A (0.0:HBA1 OFF)	*A Set by referring to the current transformer input value (CT).	0.0
*4	⑥ HbA2 HbA2	Heater break alarm value (HBA2)	0.0 to 100.0A (0.0:HBA2 OFF)		

*1 Display in stop mode manual mode, or when the contacts are closed at contact input.

*2 Display in stop mode manual mode, or when the contacts are opened at contact input.

*3 Displayed only when the instrument has a heater break alarm.

*4 Displayed when heater break alarm for three-phase heater is selected.

*A ● Set heater break alarm set-value to a value about 85% current transformaer input value (CT). However, when power supply variations are large, set the alarm to a slightly smaller value. In addition, when two or more heaters are connected in parallel, set the alarm to a slightly larger value so that it is activated even with only one heater is broken (However, within the value of CT).

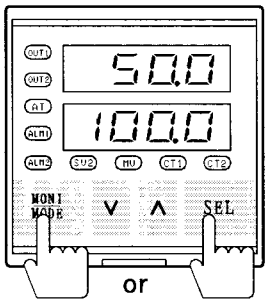
● When the heater break alarm set-value is set to " 0.0 " or the current transformer is not connected, the heater break alarm is turned OFF.

(3) Procedures for changing the setting

〔 **Examples** 〕 **When the 1st alarm (AL1) is set to −150.0** °C

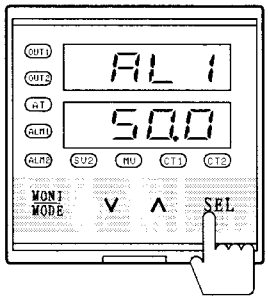
① Set the instrument to the PV/SV display/set mode

If the instrument is set to another mode, press the MONI MODE or SEL key to set the instrument to the PV/SV display/set mode.



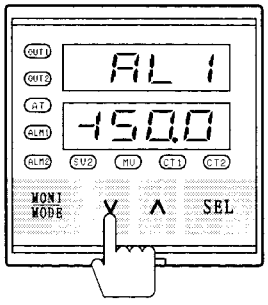
② Set the instrument to the 1st alarm (AL1) setting

Press the SEL key in PV/SV display/set mode to display the 1st alarm (AL1). The measured−value (PV) display unit shows "AL 1", and the set−value (SV) display unit shows the numeric value.



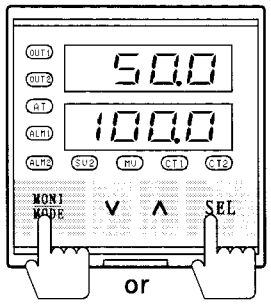
③ Numeric value change

Keep pressing the ⩛ key to decrease the numeric value on the set−value (SV) display unit until it reaches "−150.0". Pressing the ⩓ key increases the numeric value, and pressing the ⩛ key decreases the numeric value. Next, press the SEL key to validate the setting.



④ **Setting end**

After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode.



(The above figure shows that the instrument is in PV/SV display/set mode)

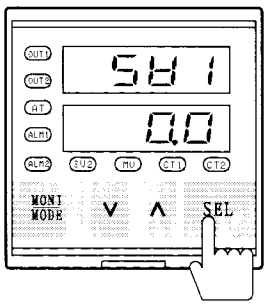
(4) Changing the set−value (SV1) in operation STOP mode

Usually, the set−value (SV) display unit shows the set−value (SV1) in PV/SV display/set mode and thus the setting can be changed. However, when operation STOP is set, the set−value (SV) display unit shows "STOP" in PV/SV display/set mode and thus the setting cannot be changed.
To change the set−value (SV1) in operation STOP mode, set the instrument to operator set mode.
The procedure for changing set−value (SV1) is shown below.

〔 **Example** 〕 **Change the set−value (SV) to 200.0** °C

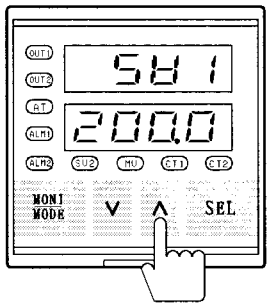
① **Set the instrument to operator set mode**

Press the SEL key in PV/SV display/set mode to set the instrument to operator set mode.
First, " Set−value (SV1) " is displayed. The measured−value (PV) display unit shows "SH 1" and the set−value (SV) display unit shows the numeric value.



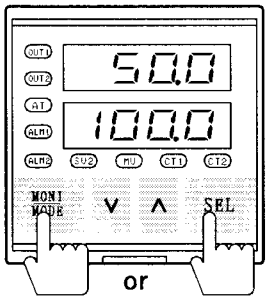
② **Numeric value change**

Keep pressing the ⋀ key to increase the numeric value on the set-value (SV) display unit until it reaches "200.0". Pressing the ⋀ key increases the numeric value and pressing the ⋁ key decreases the numeric value. Next, press the SEL key to validate the setting.



③ **Setting end**

After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode.

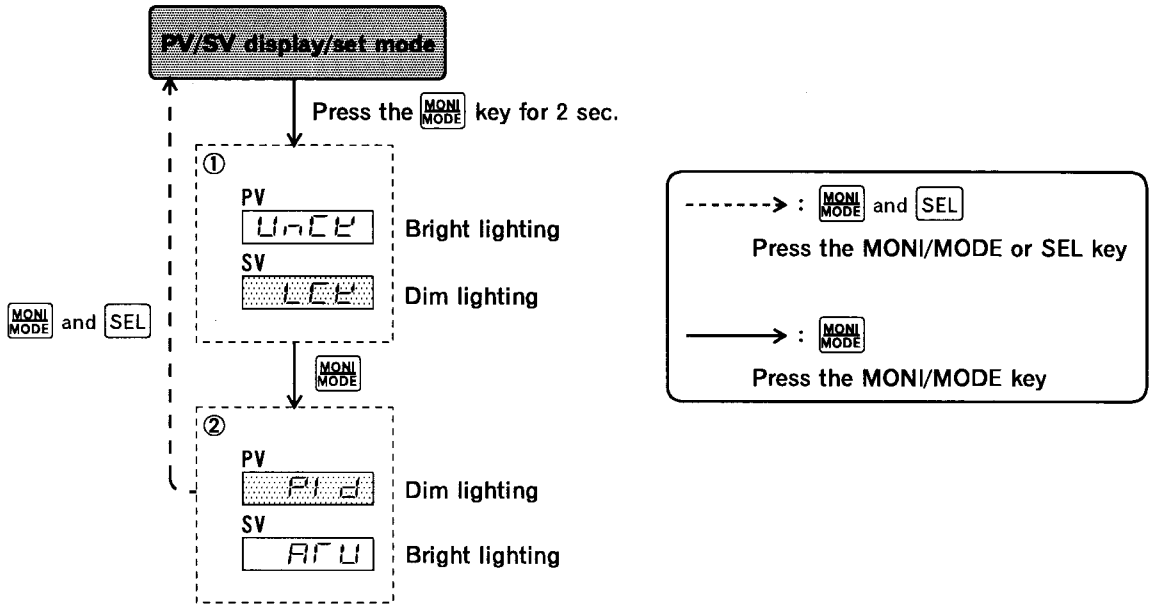


(The above figure shows that the instrument is in PV/SV display/set mode)

3.7 Engineer mode

Engineer mode is used to lock the set data and to switch PID/auto−tuning (AT). The display sequence in engineer mode is shown below.
The display within engineer mode can be changed by pressing the MONI/MODE key.

(1) Display sequence



① Set data unlock (UnCK)/lock (LCK) transfer

Select whether the set data lock function is invalid (unlock) or valid.
(In the above figure, " Unlock " is selected.)

* Any mode other than PV/SV display/set mode, operator mode or engineer mode is not displayed when the set data is locked. In addition, after locking the set data, only the operator mode and engineer mode can be changed.

② PID/auto−tuning (AT) transfer

Select PID control or auto−tuning (AT). If the auto−tuning function is selected, the instrument immediately starts this function. After the auto−tuning function is completed, the instrument is automatically transferred to PID control.
(In the above figure, " Auto−tuning (AT) " is selected.)

* If the auto−tuning function is activated, the auto−tuning lamp flashes.

NOTE

After changing the engineer mode setting, the setting becomes valid when the MONI/MODE key is pressed.

(2) Requirements for auto−tuning (AT)

Auto−tuning (AT) is the function of automatically measuring, computing and setting the optimum PID constants. The requirements for auto−tuning (AT) start and suspension are described in the following.
Auto−tuning (AT) is started/stopped by " PID/auto−tuning (AT) transfer " in the engineer mode (See page 3−23).

① Requirements for auto−tuning (AT) start

Start auto−tuning (AT) when all the following conditions are satisfied:

- In the operator mode
  - AUTO/MAN transfer → AUTO mode
  - Operation execution RUN/STOP transfer → execution (RUN)
- Input value should not be abnormal.

② Requirements for auto−tuning (AT) suspension

- If the AT cycle does not reach 1.5 cycles about 9 hours after auto−tuning (AT) start, an auto−tuning (AT) error occurs and this function is stopped automatically
- When set−value (SV) is changed
- When PV bias is changed
- When high or low output limiter value is changed
- When the input type is changed
- When the direct/reverse action is changed
- When input value becomes abnormal
- When power failure occurs

NOTES

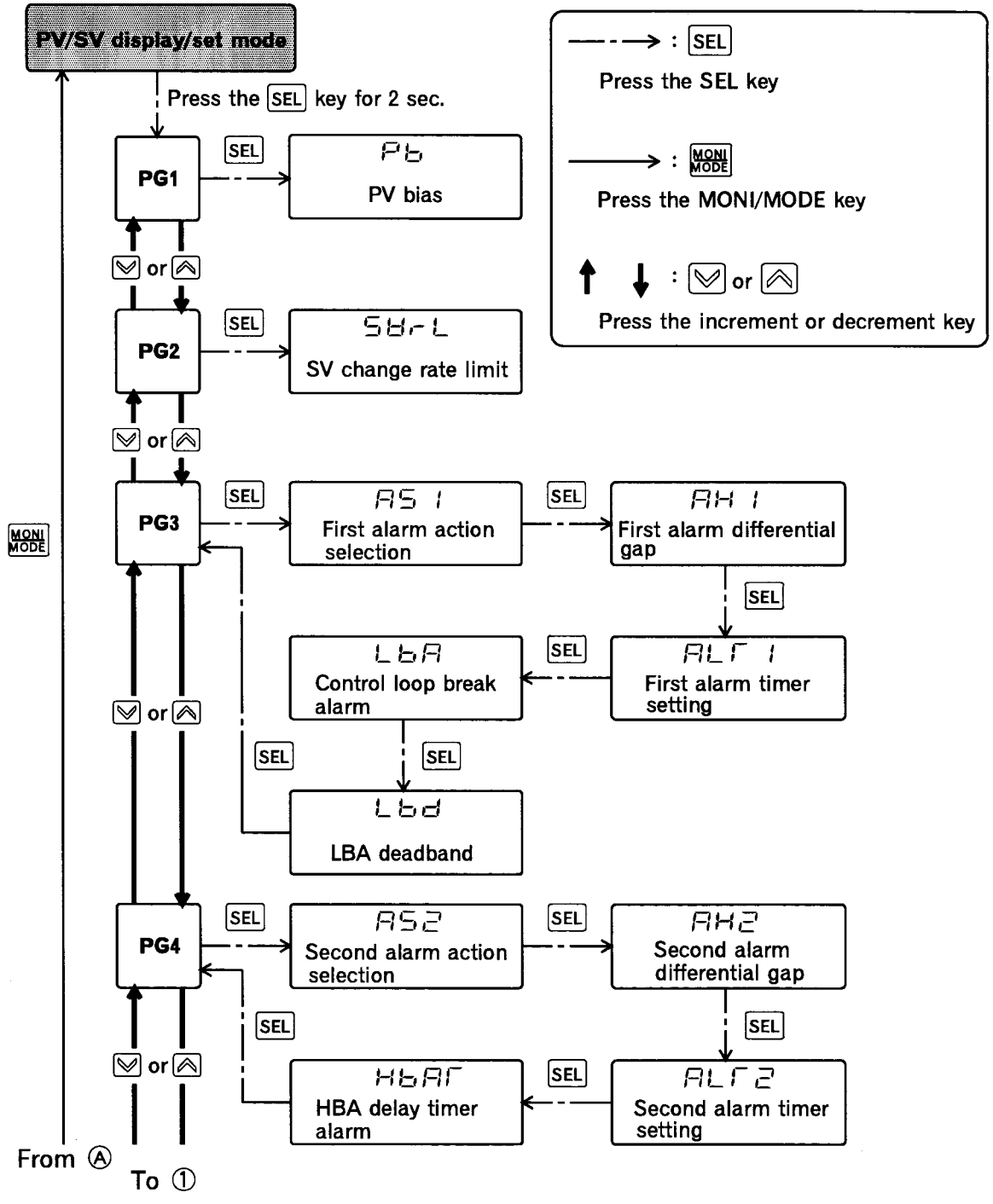
1. If the auto−tuning (AT) suspension condition is established, the auto−tuning (AT) function is immediately suspended to be changed to PID control.
   The PID constants at this time are the same as before starting auto−tuning (AT).
   In addition, even if the auto−tuning (AT) function is completed, it is automatically transferred to PID control.

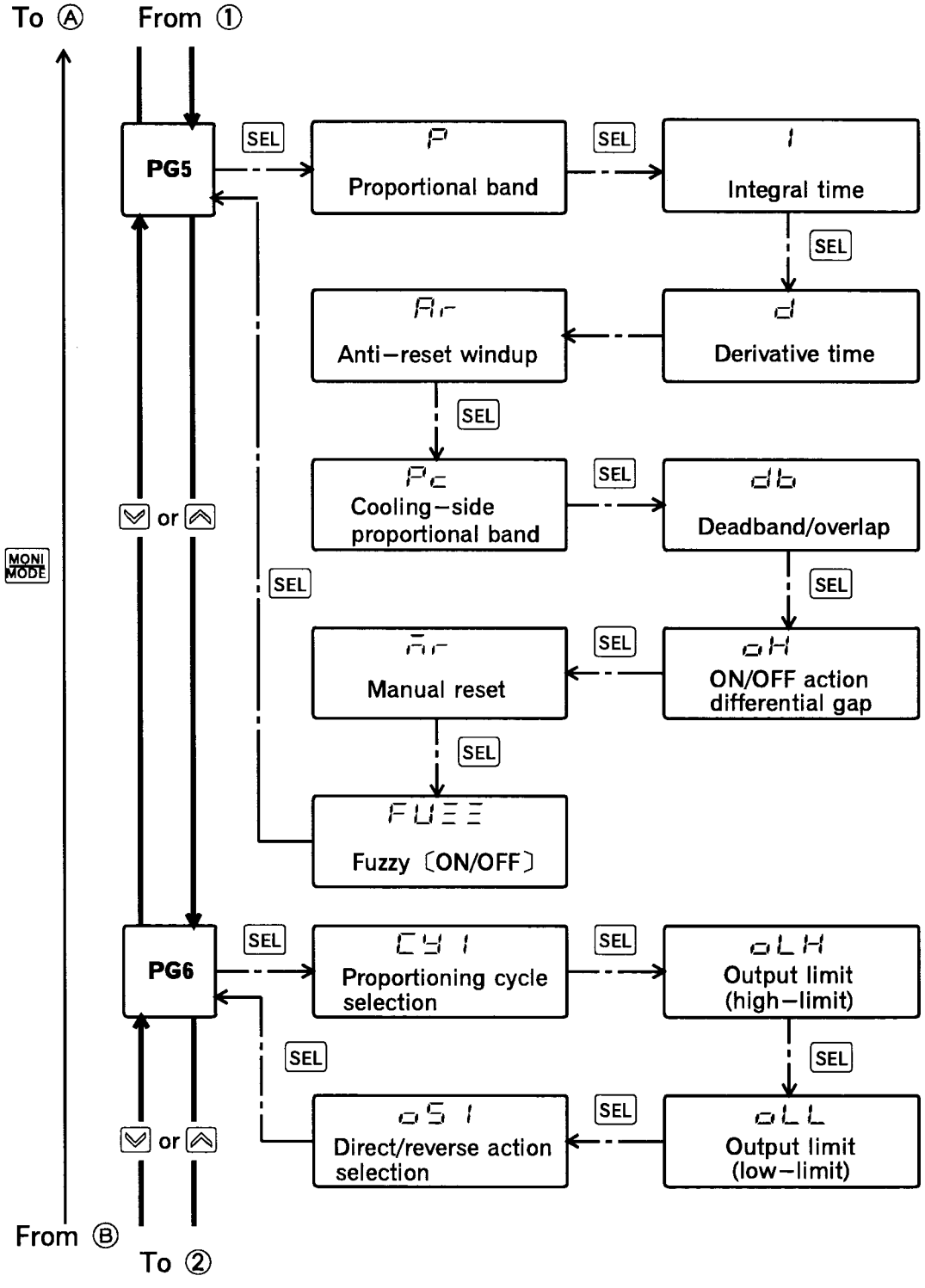
2. Even if the auto−tuning function is activated while manipulated output is limited by the output limiter (See **3.8 Engineer set mode** [P.3−25]), no optimum PID constants may be obtained.

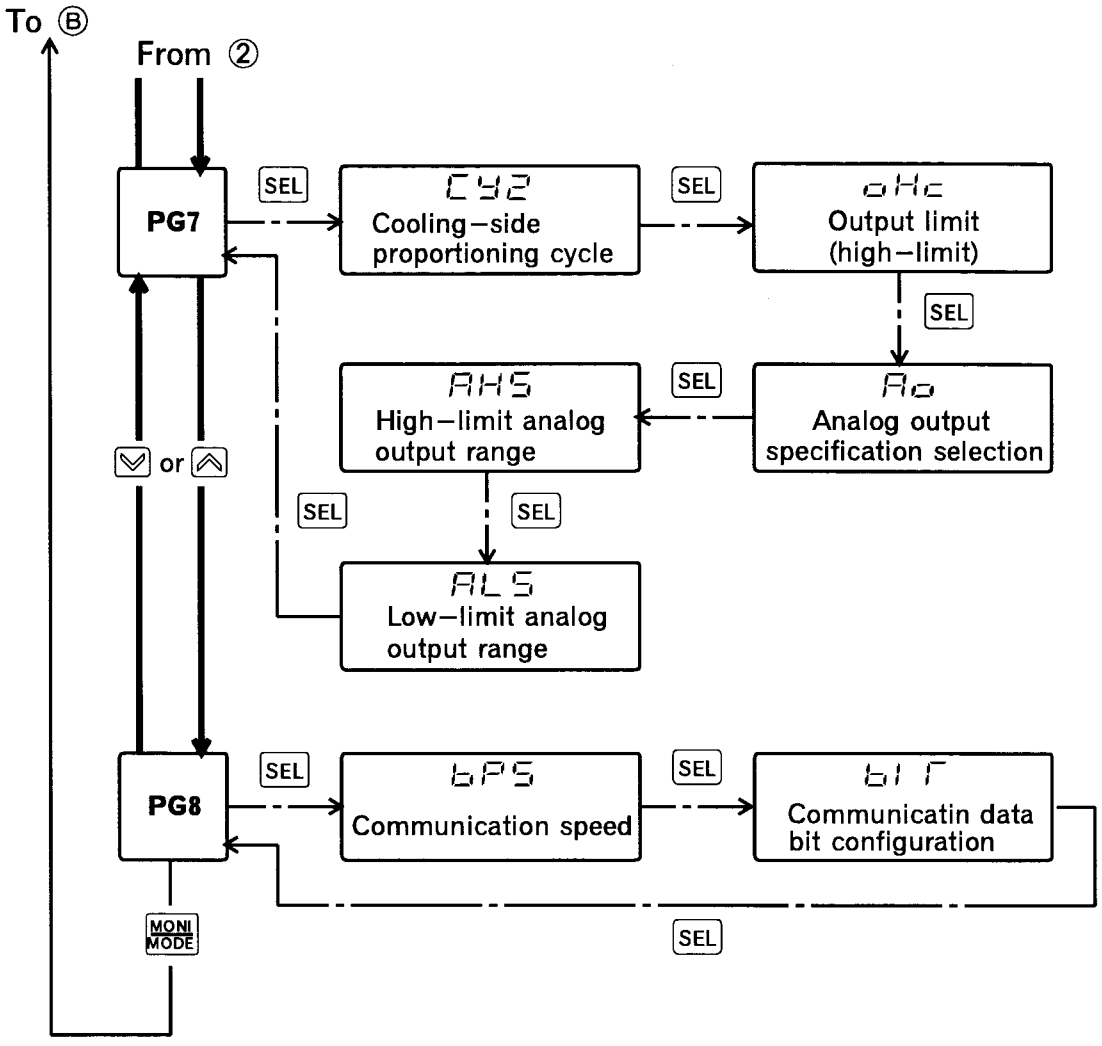
3.8 Engineer set mode

Engineer set mode is used to set the control action, input/output, alarms, operation selection of additional functions and the presence or absence of the functions.
The parameter group (PG) list in engineer set mode is shown below. Display within engineer set mode can be changed by pressing the ∧ , ∨ or SEL key.

(1) List of parameter groups (PG)




To Ⓐ
From ①
PG5
SEL
P
Proportional band
I
Integral time
d
Derivative time
Ar
Anti−reset windup
Pc
Cooling−side proportional band
db
Deadband/overlap
oH
ON/OFF action differential gap
Mr
Manual reset
FUZZ
Fuzzy (ON/OFF)
or
MONI MODE
PG6
Cy1
Proportioning cycle selection
oLH
Output limit (high−limit)
oLL
Output limit (low−limit)
oS1
Direct/reverse action selection
From Ⓑ
To ②


To Ⓑ
From ②
PG7
SEL
C42
Cooling–side proportioning cycle
SEL
oHc
Output limit (high–limit)
SEL
Ao
Analog output specification selection
SEL
AHS
High–limit analog output range
SEL
SEL
ALS
Low–limit analog output range
or
PG8
SEL
bPS
Communication speed
SEL
bIT
Communicatin data bit configuration
SEL
MONI MODE

(2) Description of parameter groups (PG)

[Parameter group (PG1)] PV setting section

Symbol	Name	Setting range	Description	Initial value prior to shipment
PG 1 PG1	Parameter group 1		The first characters of parameter group (PG1). They are also displayed first when the instrument is set to engineer set mode.	
Pb Pb	PV bias	Temperature input −1999(−199.9) to 9999(999.9) °C [°F] Voltage input −1999 to 9999 (The decimal−point position is the same as that of PV.)	Sensor correction is made by adding bias value to measured−value (PV).	0(0.0)

[Parameter group (PG2)] SV setting section

Symbol	Name	Setting range	Description	Initial value prior to shipment
PG 2 PG2	Parameter group 2		The first characters of parameter group (PG2).	
SHrL SVrL	SV change rate limit	Temperature input 0(0.0) to input span or 9999(999.9) °C [°F]/min Voltage input 0.0 to 100.0%/min of span	Setting amount of set−value (SV) change per one minute when the set−value (SV) is change.	0(0.0)

[Parameter group (PG3)] Alarm section 1

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	PG 3 PG3	Parameter group 3		The first characters of parameter group (PG3).	
*1	AS 1 AS1	First alarm action selection	See *A	Selects first alarm action.	5
*1	AH 1 AH1	First alarm differential gap	Temperature input 0 (0.0) to 100 (100.0) °C [°F] Voltage input 0.0 to 10.0% of span	Sets first alarm differential gap.	Temperature input 2(2.0) Voltage input 0.2
*1	ALT 1 ALT1	First alarm timer setting	0 to 600 sec	Sets time until alarm is turned ON after measured-value (PV) enters first alarm area.	0
*2	LbA LbA	Control loop break alarm (LBA)	0 to 7200 sec (0:LBA OFF)	Set control loop break alarm set-value. Control loop break alarm turns OFF with this alarm set to "0".	0
*2	Lbd LbD	LBA deadband (LBD)	Temperature input 0 to 9999 °C [°F] (0: LBD OFF) Voltage input 0 to 100% of span	Displays the set-value in the area where no LBA is output. If it is set to "0", no LBA deadband is activated.	0

*1 Displayed only when the alarm function is provided.

*2 Not displayed in heating/cooling PID action with the auto-tuning function.

*A 0 : Alarm OFF
1 : High-limit SV alarm
2 : Low-limit SV alarm
3 : High-limit PV alarm
4 : Low-limit PV alarm
5 : Deviation high alarm
6 : Deviation low alarm
7 : Deviation high/low alarm (Absolute-value setting)
8 : Band alarm (Absolute-value setting)
9 : High-limit PV alarm (With hold action)
10 : Low-limit PV alarm (With hold action)
11 : Deviation high alarm (With hold action)
12 : Deviation low alarm (With hold action)
13 : Deviation high/low alarm (With hold action) (Absolute-value setting)
14 : FAIL alarm

[Parameter group (PG4)] Alarm section 2

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	PG 4 PG4	Parameter group 4		The first characters of parameter group (PG4).	
*1	AS2 AS2	Second alarm action selection	See *A	Selects second alarm action.	6
*1	AH2 AH2	Second alarm differential gap	Temperature input 0(0.0) to 100(100.0) °C [°F] Voltage input 0.0 to 10.0% of span	Sets second alarm differential gap.	Temperature input 2(2.0) Voltage input 0.2
*1	ALT2 ALT2	Second alarm timer setting	0 to 600 sec	Sets timer until alarm is turned ON after measured-value (PV) enters second alarm area.	0
*2	HbAT HbAT	HBA delay timer	0 to 600 sec	Set to the time until a heater break alarm is turned ON after a heater break occurs.	3

*1 Displayed only when the alarm function is provided.

*2 Displayed only when the heater break (HBA) function is provided.

*A 0 : Alarm OFF
1 : High-limit SV alarm
2 : Low-limit SV alarm
3 : High-limit PV alarm
4 : Low-limit PV alarm
5 : Deviation high alarm
6 : Deviation low alarm
7 : Deviation high/low alarm (Absolute-value setting)
8 : Band alarm (Absolute-value setting)
9 : High-limit PV alarm (With hold action)
10 : Low-limit PV alarm (With hold action)
11 : Deviation high alarm (With hold action)
12 : Deviation low alarm (With hold action)
13 : Deviation high/low alarm (With hold action) (Absolute-value setting)
14 : FAIL alarm

[Parameter group (PG5)] Control section

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	PG 5 PG5	Parameter group 5		The first characters of parameter group (PG5).	
*1	P P	Proportional band	Temperature input 0(0.0) to input span or 9999(9999) °C [°F] Voltage input 0.0 to 100% of span	Set when PI or PID control is parformed. For heating/cooling PID action: Proportional band setting on the heating-side.	Temperature input 30(30.0) Voltage input 3.0
*2	I I	Integral time	OFF, 1 to 3600 sec	Eliminates offset occurring in proportional control.	240
*2	d d	Derivative time	OFF, 1 to 3600 sec	Prevents ripples by predicting output change, thereby improving control stability.	60
	Ar Ar	Anti-reset wind-up (ARW)	1 to 100% of proportional band	Prevents overshoot and/or undershoot caused by integral action effect.	100
*3	Pc Pc	Cooling-side proportional band	1 to 3000% of proportional band	Sets cooling-side proportional band when heating/cooling PID action is performed.	100
*3 *4	db db	Deadband/ overlap	Temperature input −10(−10.0) to 10(10.0) °C [°F] Voltage input −10.0 to 10.0% of span	Sets control deadband between heating-side and cooling-side proportional bands. Minus (−) setting results in overlap.	0(0.0)
	oH oH	ON/OFF action differential gap	Temperature input 0(0.0) to 50(50.0) °C [°F] Voltage input 0.0 to 10.0% of span	Set the differential gap during ON/OFF action.	Temperature input 2(2.0) Voltage input 0.2
	Mr Mr	Manual reset	−50.0 to 50.0% (Heating/cooling −100.0 to 100.0%)	Corrects the manipulated variable (MV) to eliminate the offset occurring in proportional control.	0.0
	FUZZ FUZZ	Fuzzy	ON/OFF	Selects fuzzy function ON/OFF.	ON

*1 When set to 0(0.0), the controller is in ON/OFF action.

*2 The setting can be changed even in ON/OFF action, but is not activated.

*3 Acivated only during heating/cooling PID action with the auto-tuning function.
The setting can be changed even in ON/OFF action, but is not activated.

*4 If the overlap setting exceeds the proportional band on the heating or cooling side, the controller sets the overlap value to the proportional band on the heating or cooling side, whichever is smaller.
If manual output is specified, the overlap value can be changed, but the data becomes invalid.

[Parameter group (PG6)] Output section 1

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	PG 6 PG6	Parameter group 6		The first characters of parameter group (PG6).	
*1	CY 1 CY1	Proportioning cycle	1 to 100 sec	Sets control output cycle. For heating/cooling PID: Heating−side proportioning cycle.	20
	oLH oLH	Output limit (high−limit)	Output limit (low−limit) to 105.0% (Heating/cooling 0.0 to 105.0%)	High−limit of manipulated output value (MV). For heating/cooling PID action: Output limit (high−limit) on the heating−side output.	105.0
*2	oLL oLL	Output limit (low−limit)	−5.0% to output limit (high−limit)	The high−limit of manipulated output value (MV) on the cooling side for the heating/cooling PID action with auto−tuning.	−5.0
*2	oS 1 oS1	Direct/reverse action selection	0 : Direct action 1 : Reverse action	Selects direct or reverse control action.	1

*1 Not displayed in ON/OFF action and for continuous voltage or current output.
A heater break alarm may malfunction at a low low load factor (short ON time) depending on the input timing of a measured signal to the CT. (The alarm occurs even if no heater breaks.)
In this case, set the proportioning cycle to more than 4 sec.

*2 Not displayed in heating/cooling PID action with the auto−tuning function.

[Parameter group (PG7)] Output section 2

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	PG 7 PG7	Parameter group 7		The first characters of parameter group (PG7).	
*1	CY2 CY2	Cooling−side Proportioning cycle	1 to 100 sec	Sets cooling−side output cycle for heating/cooling PID action.	20
*2	oHc oHc	Output limit (high−limit)	0.0 to 105.0% (Cooling−side output)	The high−limit of manipulated output value (MV) on the heating/cooling PID action.	105.0
*2	Ao Ao	Analog output specification selection	0: Measured−value (PV) 1: Deviation 2: Set−value (SV) 3: Control output (Heating−side) 4: Heater current value (CT1)	Selects analog output type.	0
*3	AHS AHS	High−limit analog output range	Specification selection 0,2: Scaling low−limit to scaling high−limit 1: −span (−1999) to span (9999) 3: 0.0 to 100.0% 4: 0.0 to 100.0A	Sets high−limit of analog output range.	
*3	ALS ALS	Low−limit analog output range	Specification selection 0,2: Scaling low−limit to scaling high−limit 1: −span (−1999) to span (9999) 3: 0.0 to 100.0% 4: 0.0 to 100.0A	Sets low−limit of analog output range.	

*1 Displayed if the control output is reley contact output or voltage pulse output.
A heater break alarm may malfunction at a low low load factor (short ON time) depending on the input timing of a measured signal to the CT. (The alarm occurs even if no heater breaks.)
In this case, set the proportioning cycle to more than 4 sec.

*2 Displayed only during heating/cooling PID action with the auto−tuning function.

*3 Displayed only for analog output. [Option]

[Parameter group (PG8)] Communication section

	Symbol	Name	Setting range	Description	Initial value prior to shipment
	PG 8 PG8	Parameter group 8		The first characters of parameter group (PG8).	
*	bPS bPS	Communi-cation speed	0: 1200bps 3: 9600bps 1: 2400bps 4: 19200bps 2: 4800bps	Selects communication speed.	3
*	bIT bIT	Communi-cation data bit configuration	See *A	Selects data bit config-uration during communi-cation.	0

* Not displayed when there is no communication function.

*A

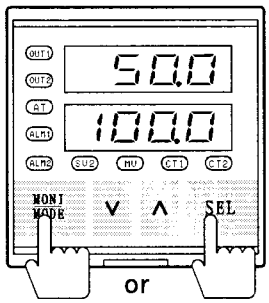
Setting	Parity bit	Data bit [bit]	Stop bit [bit]
0	None	8	1
1	None	8	2
2	Even	7	1
3	Even	7	2
4	Odd	7	1
5	Odd	7	2

(3) Procedures for changing the setting

〔 Example 〕 When the proportional band (P) of the parameter group (PG5) is set to 100.0.

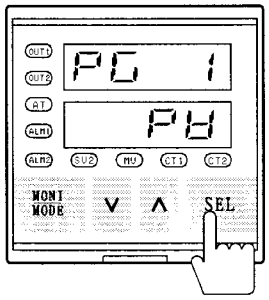
① Set the instrument to the PV/SV display/set mode

If the instrument is set to another mode, press the MONI MODE or SEL key to set the instrument to the PV/SV display/set mode.



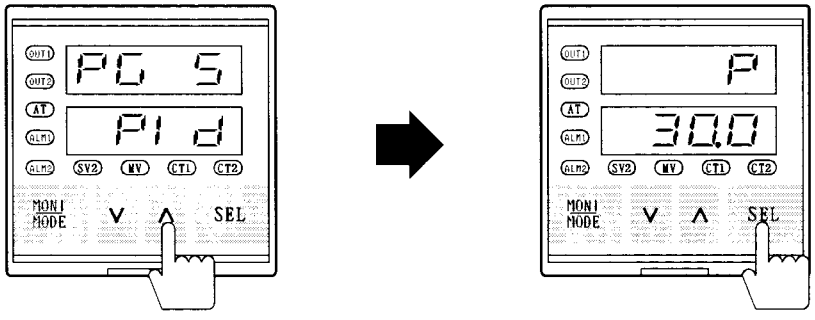
② Call up engineer set mode

Press the SEL key for 2 sec. with the controller set to PV/SV display/set mode to call up engineer set mode. First, " Parameter group (PG1) " is displayed.



③ Set the parameter group (PG5)

Press the ^ key to call up the parameter group (PG5).
Next, press the SEL key to display the proportional band (P). The measured−value (PV) display unit shows "P " and the set−value (SV) display unit shows the numeric value.

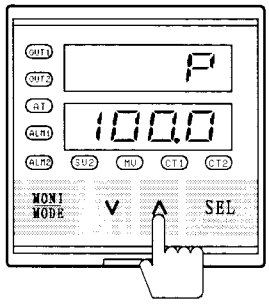


④ Numeric value change

Keep pressing the ∧ key to increase the numeric value on the set−value (SV) display unit until it reaches " 100.0 ".

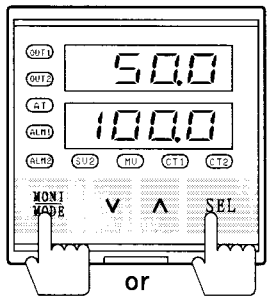
Next, press the SEL key to validate the setting.

* Keep pressing the ∧ or ∨ key to increase the speed with which the numeric value changes.



⑤ Setting end

After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode.



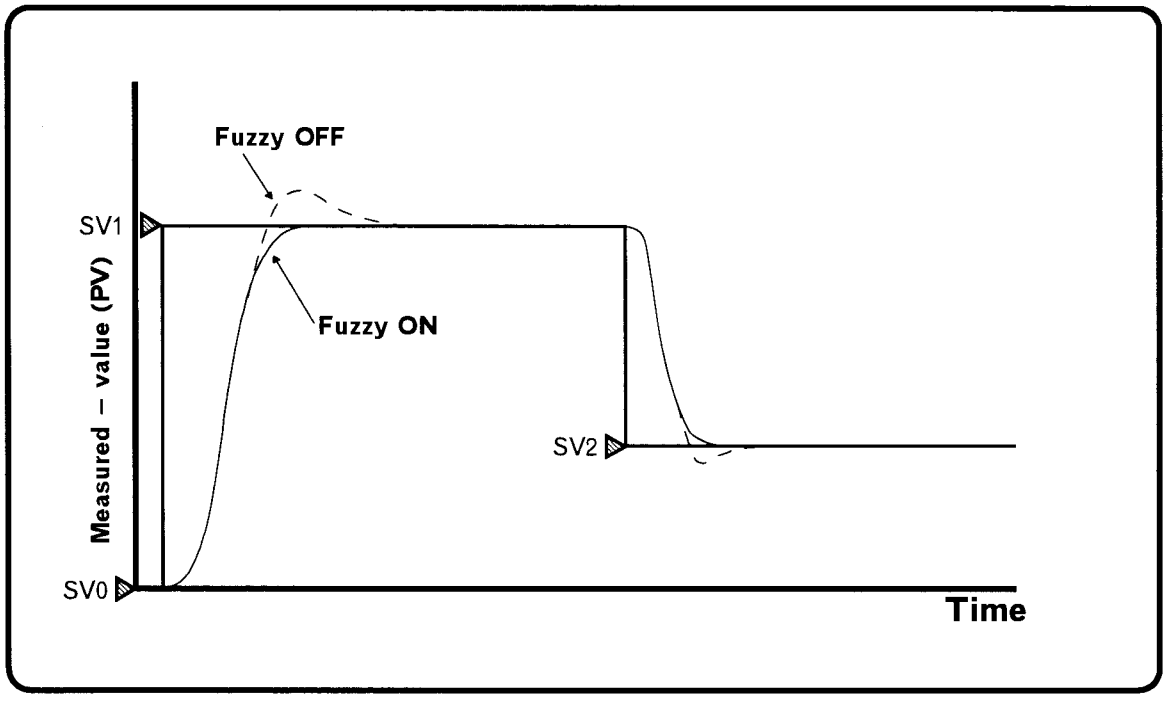
(The above figure shows that the instrument is in PV/SV display/set mode)

3.9 Features of fuzzy function

(1) Features of fuzzy function

The fuzzy function effectively restricts overshoot or undershoot occurring just when operation is started or the set−value is changed.

Response characteristic when fuzzy control is used.



CAUTION

The fuzzy function corrects the PID computation result in order to restrict overshoot or undershoot, but the basic response waveforms (slow rise, oscillation trend, etc.) are determined by PID control. Also, PID constants suitable for almost all controlled objects are determined by auto−tuning (AT), but these may occasionally not be the optimum values. For an extremely slow rise or oscillating control response even if overshoot or undershoot is restricted, turn off the fuzzy function once, then manually adjust the PID constants.

(2) Activation of fuzzy function

When the fuzzy function is turned " ON " (ON prior to factory shipment), fuzzy inference start and stop [**NOTE** ②] are repeated every time fuzzy operation [**NOTE** ①] is started.
(" PID + fuzzy control " is performed.)

However, if fuzzy operation is started while the fuzzy inference start conditions [**NOTE** ③] are not satisfied, no fuzzy inference is started. (PID control is performed.)

If the fuzzy inference suspension conditions [**NOTE** ④] are satisfied during fuzzy inferring, the fuzzy inference at that time is suspended. (Transferred from " PID + fuzzy control to PID control ")

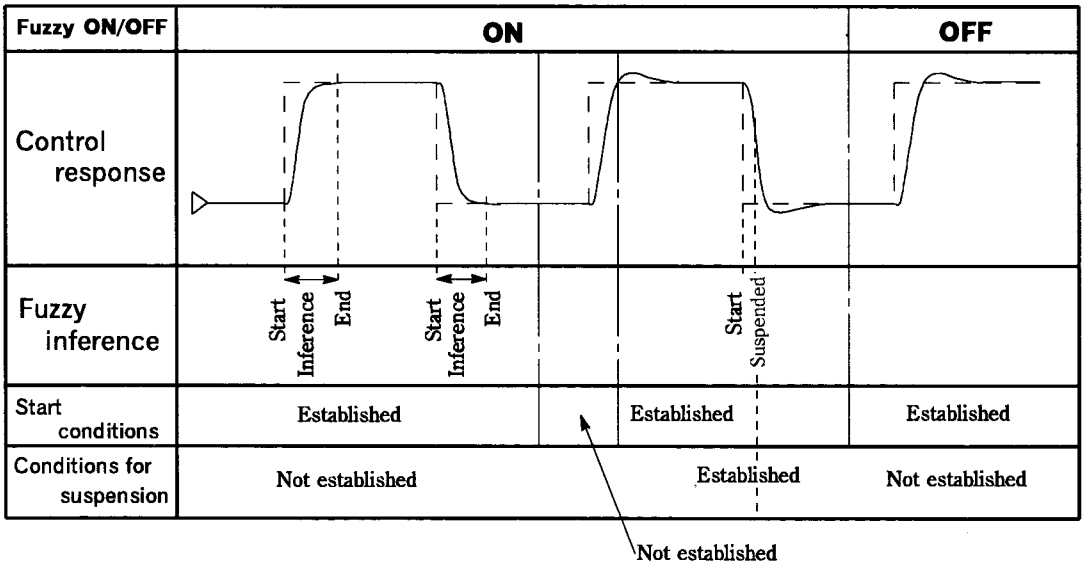
NOTE

① Start operation

- Set−value change
- Power−ON
- Transfer from operation STOP mode to operation RUN mode

② Fuzzy inference termination

If the deviation reaches 1% of the deviation while starting fuzzy operation, the fuzzy inference terminates.



③ Fuzzy inference start conditions

- Fuzzy function ON/OFF → ON
- AUTO/MAN transfer → AUTO
- PID/auto−tuning (AT) transfer → PID control
- Proportional band (P) should not be set to 0
- Integral time (I) should not be set to OFF
- The rate of SV change limiter should be set to 0
- Input value should not be abnormal ("oooo" or "uuuu")

④ Conditions for suspending fuzzy inference

- Fuzzy function ON/OFF → OFF
- Operation RUN/STOP → STOP
- AUTO/MAN transfer → MAN
- PID/auto−tuning (AT) transfer → Auto−tuning (AT)
- When the PID constants are changed
  [Proportional band (P), Cooling proportional band (Pc), Integral time (I), Derivative time (D)]
- When the output limiter high or low limit is changed
- When the PV bias is changed
- When the input type is changed
- When the direct/reverse action is transferred
- When input becomes abnormal ("oooo" or "uuuu")
- When power failure occurs

3.10 Cautions for operation

(1) Operation RUN/STOP

As the controller does not have a power swich, it is ready to operate when the power is turned ON. However, there are certain settings which may not operate correctly if changed during operation RUN. Therefore, first stop the controller by operation " RUN/STOP " (P.3−14) in operator mode, then change each setting. The items which can be set in operation STOP mode are those set in SETUP set mode. Therefore for details, see " **2.7 SETUP set mode** " (P.3−7).
Start when executed from operation STOP begins from an output of 0%.

(2) Operation during operation RUN

- When the set−value (SV) needs to be changed, see " **3.3 Set−value (SV) changing procedure** " (P.3−6).
- When each operation mode needs to be changed, see " **3.5 Operator mode** " (P.3−14).
- When the alarm set−value needs to be changed, see " **3.6 Operator set mode** " (P.3−18).
- When set data lock or PID/auto−tuning transfer needs to be enabled, see " **3.7 Engineer mode** " (P.3−23).
- When control action, input/output, alarms and other functions need to be activated, enabled or disabled, see " **3.8 Engineer set mode** " (P.3−25).

(3) Precautions for operation STOP

- In PV/SV display/set mode, the measured−value (PV) display unit shows the measured−value (PV), and the set−value (SV) display unit shows "STOP".
- If " No display of operation RUN/STOP " is set in " **3.4 SETUP set mode** " (P.3−7), then the " RUN/STOP transfer " display is not shown.

CHAPTER 4

MAINTENANCE

REX-D SERIES
Instruction Manual

4. MAINTENANCE

4.1 Maintenance and inspection

Always perform the following maintenance and inspection, to use this instrument under the best conditions.

Sensor	● Confirm that the sensor is installed correctly. ● Replace the sensor before deterioration of its characteristics. ● Confirm that there is no wire break nor shorting.
Instrument	● Confirm that the data satisfying the requirements is set. ● Confirm that the instrument operates normally. ● Confirm that the installation direction is correct. ● Confirm that communication is conducted normally during communication.
Output and load circuit	● For the relay contact output type, inspect control output relay burning, wear and tear and imperfect contact. If the control output relay is deteriorated, replace the relay. ● For the continuous voltage output and voltage pulse output types, confirm output voltage. In addition, confirm the operation of actuators connected externally. ● For the current output type, confirm output current. In addition, confirm the operation of actuators connected externally. ● Confirm no load is disconnected. ● Confirm the wiring is correct. ● Confirm no imperfect contact exists.

4.2 Troubleshooting

When taking troubleshooting measures, follow the steps described below for the measures marked with "⚠".

⚠ WARNING

- **These measures should be taken by qualified experienced electricians.**
- **In order to prevent electric shock, always check that the power is turned OFF before starting electrical connection.**

Instrument trouble, causes and measures considered to be general are described in the following tables.
For any trouble occurring due to causes other than the following, contact your agent where you purchased the instrument or directly us after confirming the Model No. and specifications.

	Trouble	Cause	Measures
Display	No display appears	The internal assembly is not inserted into the case correctly	⚠ Insert the internal assembly into the case correctly.
		Power supply terminal connection not correct	⚠ Connect the terminals correctly by referring to CHAPTER 2 "**2.5 Wiring**" (Page 2−9).
		Normal power supply voltage not supplied	⚠ Apply the normal power supply voltage by referring to CHAPTER 6 "6.10 General specification" (Page 6−10).
	Display is abnormal	Noise source present near the instrument	⚠ Separate the noise source from the instrument.
	Measured−value (PV) display differs from the actual value	A PV bias is set	⚠ Set the PV bias to "0" by referring to CHAPTER 3 "**3.8 Engineer set mode**" (Page 3−25). However, this is limited only to when the PV bias setting can be changed.
Control	Control is abnormal	Normal power supply voltage is not supplied	⚠ Apply the normal power supply voltage by referring to CHAPTER 6 "6.10 General specification" (Page 6−10).
		Break of sensor and input lead wires	⚠ Turn off the power or stop the operation by "Run/stop transfer" referring to CHAPTER 3 "**3.5 Operator mode**" (Page 3−14) and repair the sensor or replace it.
		Proper sensor is not used	⚠ Check the sensor and use it satisfying the specification.
		Sensor wiring improperly conducted	⚠ Conduct sensor wiring correctly by referring to CHAPTER 2 "**2.5 Wiring**" (Page 2−9).
		Sensor insertion depth is insufficient	⚠ Check whether sensor is inserted loosely. If yes, fully insert the sensor.
		Sensor insertion position is not appropriate	⚠ Insert the sensor at the specified location.
		Input signal wires are not separated from instrument power and/or load wires	⚠ Separate the former from the latter.
		Noise source is present near the wiring	⚠ Separate the noise source from the wiring.

	Trouble	Cause	Measures
Control		Inappropriate PID constants	Set the correct PID constants.
		The minus or plus sides of heating and cooling−side outputs are connected to actuators in common for heating/cooling PID action	⚠ Separate each output.
	Auto−tuning (AT) function not activated	Requirements for performing the auto−tuning (AT) function are not satisfied	Satisfy the requirements for performing the auto−tuning (AT) function by referring to CHAPTER 3 " **(2) Requirements for auto−tuning (AT)** " (Page 3−24).
	Auto−tuning suspended	Requirements for suspending the auto−tuning (AT) function are established	Identify causes for auto−tuning (AT) suspension by referring to CHAPTER 3 " **(2) Requirements for auto−tuning (AT)** " (Page 3−24) and then remove them. Thus, execute the auto−tuning (AT) function again.
	No optimun PID constants ob−tained even after auto−tuning (AT) function execution	The auto−tuning (AT) func−tion does not matcgh the characteristic of controlled object	Set PID constants manaully.
Operation	Output does not become more than (or less than) a specific value	The output change rate limit is set	Change the output limit setting by referring to CHAPTER 3 " **[Parameter group (PG7)] Output section 2** " (Page 3−33). However, this is limited only to the case where output limit setting may be changed.
	No operation performed * Excluding the case where communication is conducted	" 0 (Not displayed) " is set at " Operation STOP function selection " of SETUP set mode	Set " Operation STOP function selection " to " 1 (Display) " by referring to CHAPTER 3, " **3.4 SETUP set mode** " (Page 3−7).
	No setting change can be made by key operation	Set data is locked	Set the " Set data unlock/lock transfer " to the " unlock " by referring to CHAPTER 3, " **3.7 Engineer mode** " (Page 3−23).
	Set−value (SV) does not become more than (or less than) a spe−cific value	The range of scaling differs	Change the range of scaling by referring to CHAPTER 3 " **3.4 SETUP set mode** " (Page 3−7) only if it can be changed.

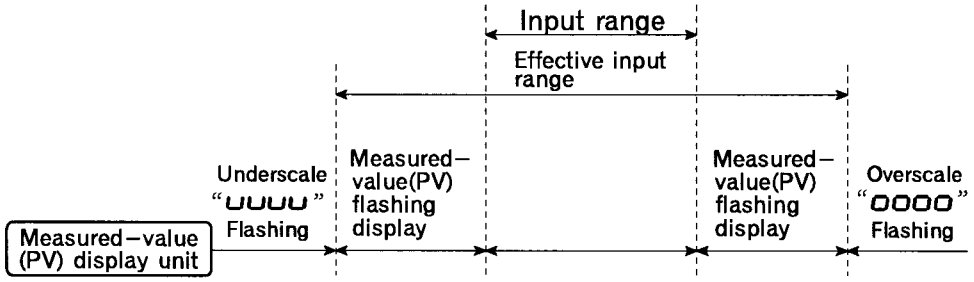
	Trouble	Cause	Measures
Operation	Set-value (SV) does not change immediately when the set-value (SV) is changed	The SV change rate limit is set	Set the " SV change rate limit"to " 0.0 " by referring to CHAPTER 3 " 3.8 Engineer set mode " (Page 3-25). However, this is limited only to the case where the setting change rate limit may be changed.
Others	Alarm action is abnormal	Alarm action is different from the specification	Change the action by referring to CHAPTER 3, " **3.8 Engineer set mode** " (Page 3-25) after the specification is confirmed.
		Alarm differential gap setting is inappropriate	Set the appropriate differential gap by referring to CHAPTER 3 " **3.8 Engineer set mode** " (Page 3-25).
		The alarm timer is set	Change the timer setting by referring to CHAPTER 3 " **3.8 Engineer set mode** " (Page 3-25). This is limited only to the case where the alarm timer setting may be changed.

4.3 Display at abnormality ⚠

■ For input abnormality

Display	Details	Action (output)	Measures
Measured-value (PV) Flashing	Input abnormality (Measured-value(PV) rose above the high input range limit or fell below the low input range limit.)	●Action at input abnormality If overscale or downscale occurs in the controller, the controller takes the action for input abnormality set as a result of action selection mode for input abnormality.	**⚠WARNING** **In order to prevent electric shock, prior to replacing the sensor, always turn OFF the power.** Check input type, range, sensor and sensor connection.
0000 Flashing	Overscale (Measured-value(PV) is beyond the effective input range.)		
UUUU Flashing	Underscale (Measured-value(PV) is below the effective input range.)		

Each status at input abnormality is shown in the following :

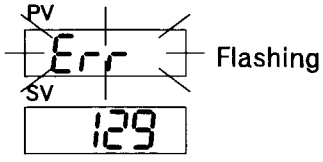


■ Self-diagnostic function

If an error is detected by the self-diagnostic function, the PV display unit flashes "Err ", and the SV display unit shows the error code.
If two or more errors occur simultaneously, the total summation of these error codes is displayed.

Error code	Details	Action (output)	Measures
1	Adjusted data destroyed	Outputs are all turned OFF	Turn OFF the power once. If an error occurs after the power is turned ON again, contact your nearest RKC sales office or agent from which you bought the controller.
2 or 4	RAM error		
128	Input error		

〔 Example 〕 If the adjusted data is destroyed and an input error occurs simultaneously



The PV display unit flashes "Err" and the SV display unit shows the number 129 : 1 (adjusted data destroyed) plus 128 (input error).

4.4 Replacing the waterproof and dustproof rubber packing

⚠ WARNING

- **In order to prevent electric shock, always turn off the power supply befor replacing the rubber packing.**
- **In order to prevent electric shock, and instrument failure, always turn off the power supply before pulling out the internal chassis.**
- **In order to prevent injury or instrument failure, do not touch the internal printed circuit board.**

If the waterproof and dustproof rubber packing deteriorates, contact your nearest RKC sales office or agent from which you bought the controller.

Type	Parts code	Remarks
REX-D100	KD100-35	For the board
REX-D100	KD100-310	For the case
REX-D400	KF400N-32	For the board
REX-D400	KD400-35	For the case
REX-D700	KF700N-32	For the board
REX-D700	KD700-34	For the case
REX-D900	KD900N-32	For the board
REX-D900	KD900-35	For the case

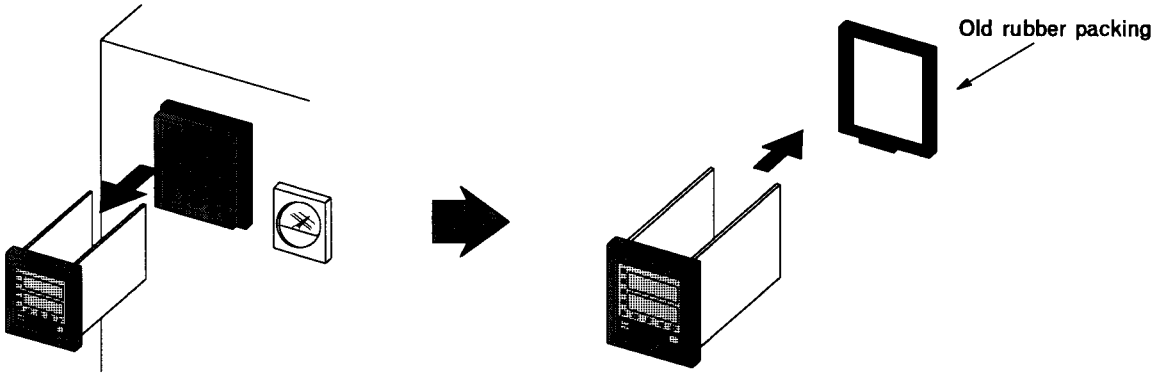
■ Replacement of dustpoof and waterproof rubber packing

CAUTION

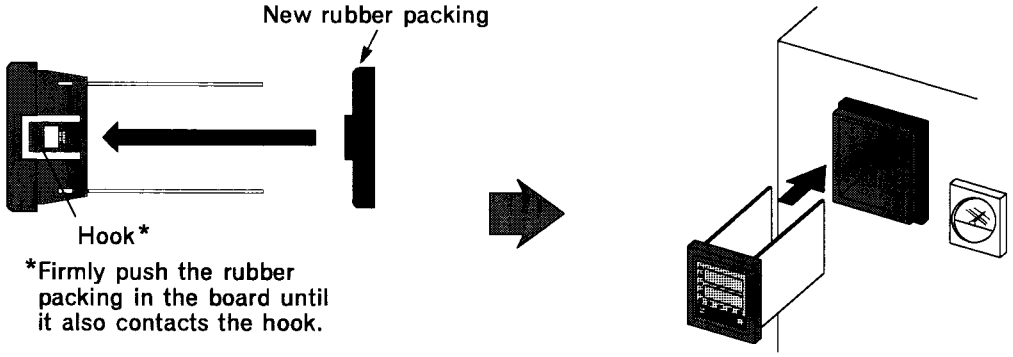
Prior to replacing the rubber packing, first confirm that no water remains, then turn on the power supply. If the water remains, shorting may result.

● For the board

① Pull the internal assembly out of the case, then remove the old rubber packing.

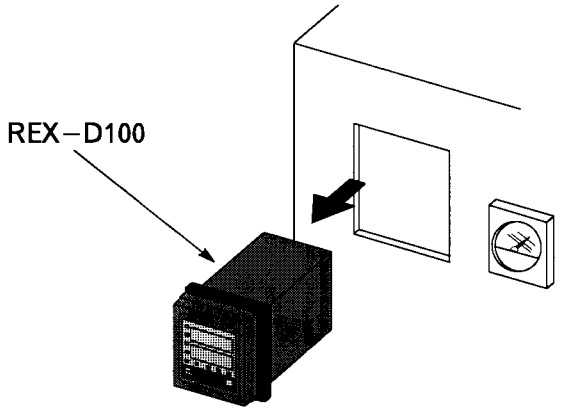


② Replace the old rubber packing with a new one, then put the internal chassis in the case.

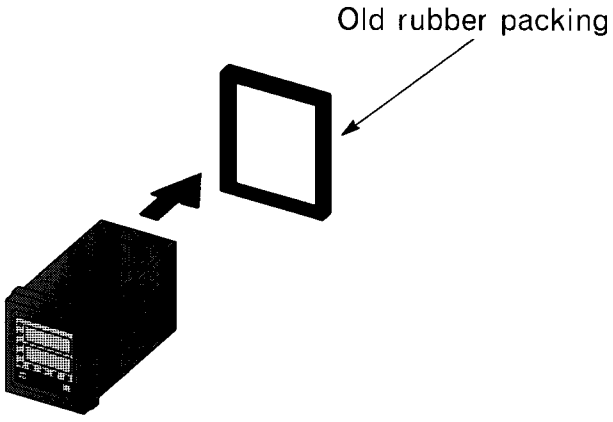


● **For the case**

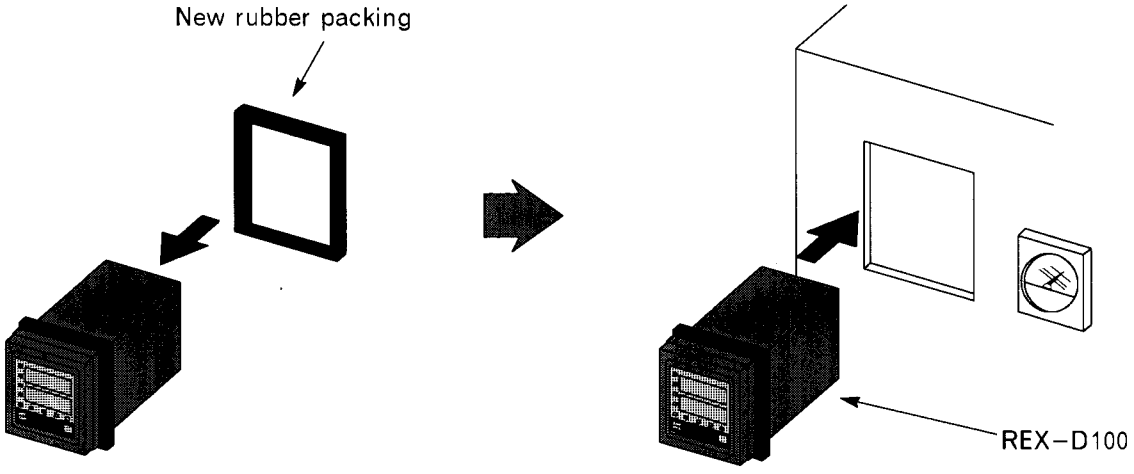
① Disconnect the wiring from the rear terminal board and also remove the mounting bracket from the instrument case, then remove the instrument from the panel.



② Remove the old packing from this instrument.



③ Firmly push the new rubber packing into the instrument, then re−mount the intrument in the panel.



MEMO

CHAPTER 5

OPTION

REX-D SERIES
Instruction Manual

5. OPTION

5.1 External resistor (shunt resistor for current input)

(1) Prior to connecting external resistor (shunt resistor for current input)

If the current input specification is selected, it becomes necessary to change voltage input and also to connect an external resistor (shunt resistor for current input 〔 250 Ω ± 0.02% ± 10PPM, more than 0.25W 〕).

If a current input of 0 to 20 mA is used, select a voltage (high) input of 0 to 5V, or if a current input of 4 to 20 mA is used, select a voltage (high) input of 1 to 5V. In either case, connect an external resistor (shunt resistor for current input 〔 250 Ω ± 0.02% ± 10PPM, more than 0.25W 〕) between the input terminals at the rear of the controller case. The setting procedure for current input is described in the following.

(2) Setting procedure

⚠ WARNING

- **In order to prevent electric shock, and instrument failure, always turn off the power supply before pulling out the internal chassis.**
- **In order to prevent injury or instrument failure, do not touch the internal printed circuit board.**

〔 **Example of changing the setting** 〕 When changing to a current input of 0 to 20 mA

① Turn **OFF** the power. ⚠

Next, connect the external resistor between the No.9 and No.10 input terminals at the rear of the case (for REX-D100). However for REX-D400/D900, connect the external resistor between the No.10 and No.11 input terminals, or for REX-D700, between the No.14 and No.15 input terminals.

REX-D100

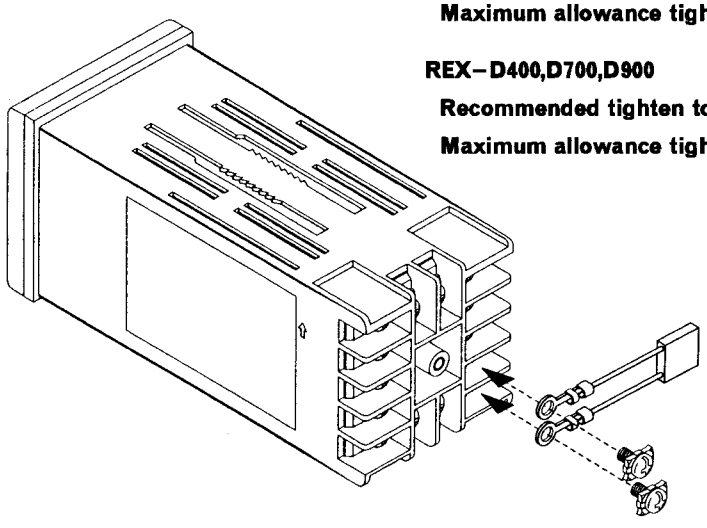
Recommended tighten torque : 0.4N·m (4kgf· cm)

Maximum allowance tighten torque : 0.7N·m (7kgf· cm)

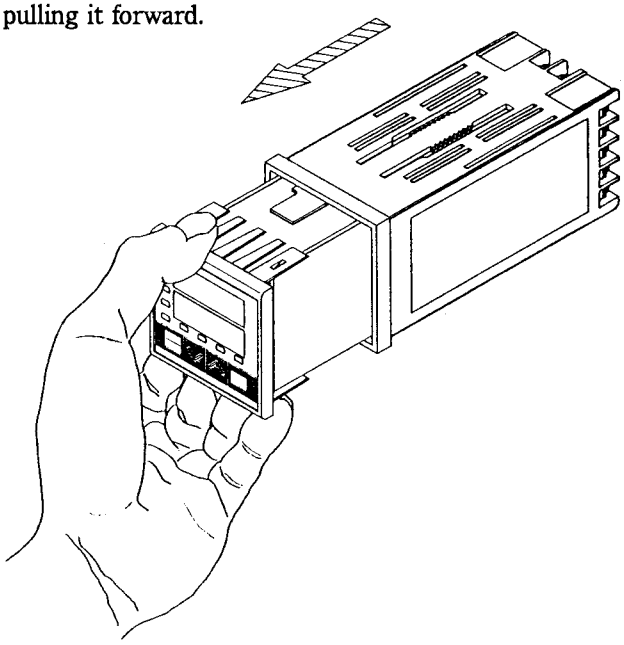
REX-D400,D700,D900

Recommended tighten torque : 0.4N·m (4kgf· cm)

Maximum allowance tighten torque : 1.0N·m (10kgf· cm)



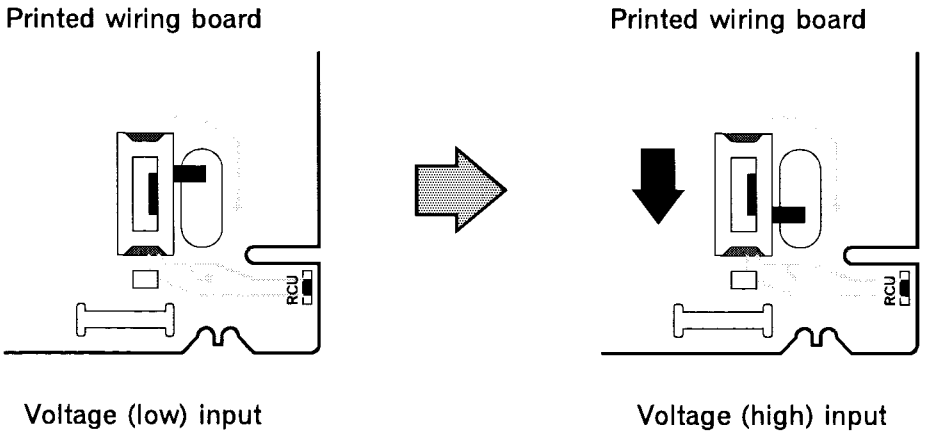
② Remove the internal assembly from the case by pressing the latch located at the bottom of the front panel and pulling it forward.



③ Change voltage input from LOW to HIGH by turning the internal switch position from voltage (low) input to voltage (high) input. For REX−D100/D700, the internal switch is located on the left printed wiring board when viewed from the front, or for REX−D400/D900, on the right printed wiring board when viewed from the front.

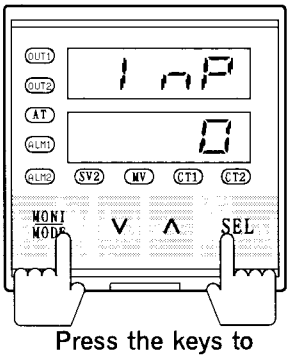
⚠ WARNING

● **In order to prevent electric shock and instrument failure, always turn off the power supply before pulling out the internal chassis.**



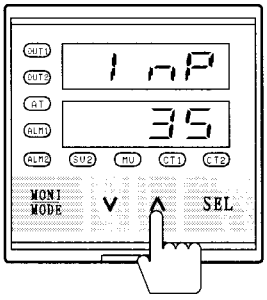
④ Put the internal chassis into the case, then turn ON the power. As a result, the input type and range are displayed. (See " **Input type/input range display** " on page 3−5.)

⑤ Next, simultaneously press the MONI MODE and SEL keys to call up SET UP set mode.
First, " Input type selection (I nP) " is displayed.



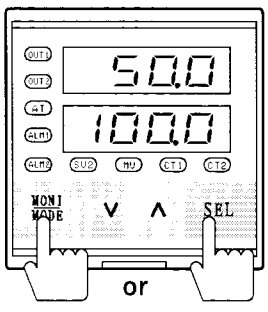
Press the keys to simultaneously.

⑥ Keep pressing the ^ keys to increase the numeric value on the set-value (SV) display unit.
Press the v key to set the input to a voltage (high) input of 0 to 5V (input selection: 35).
For input selection, see " **Input range table** " on page 3-10.
(Whenever the numeric value is set, this setting becomes valid if SEL key is pressed.
(low
left
prin



* (Keep pressing the ^ or v key to increase the speed with which the numeric value changes.
Pressing the ^ key increases the numeric value and pressing the v key decreases the numeric value.

⑦ After the setting is completed, press the MONI MODE or SEL key to set the instrument to the desired mode. (Figure : PV/SV display/set mode)



or

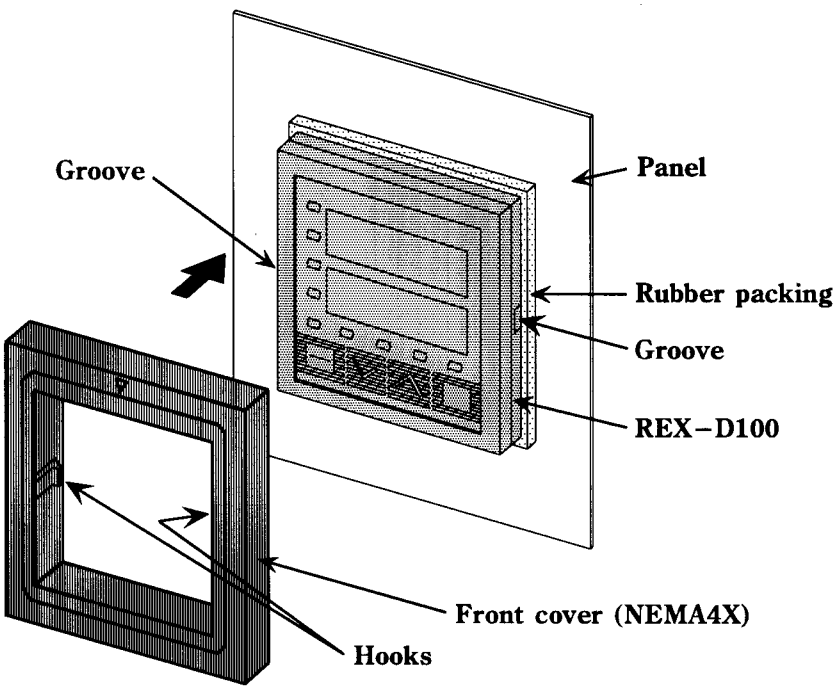
Put *follow the same steps for setting REX-D400/D700/D900.*
ran

5.2 Front cover (NEMA4X)

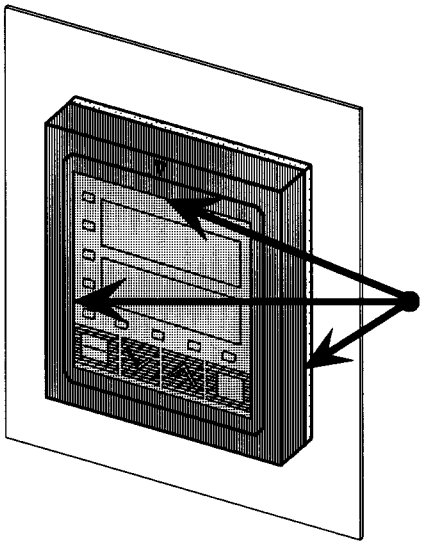
(1) Mounting

① Check that the REX−D100 is firmly fixed to the panel.

② Push the hooks inside the front cover into the grooves in the case until a click sound is produced. At this time, firmly fix the front cover to the instrument front so that no gaps exist between the front cover and rubber packing, and between the front cover and instrument front.



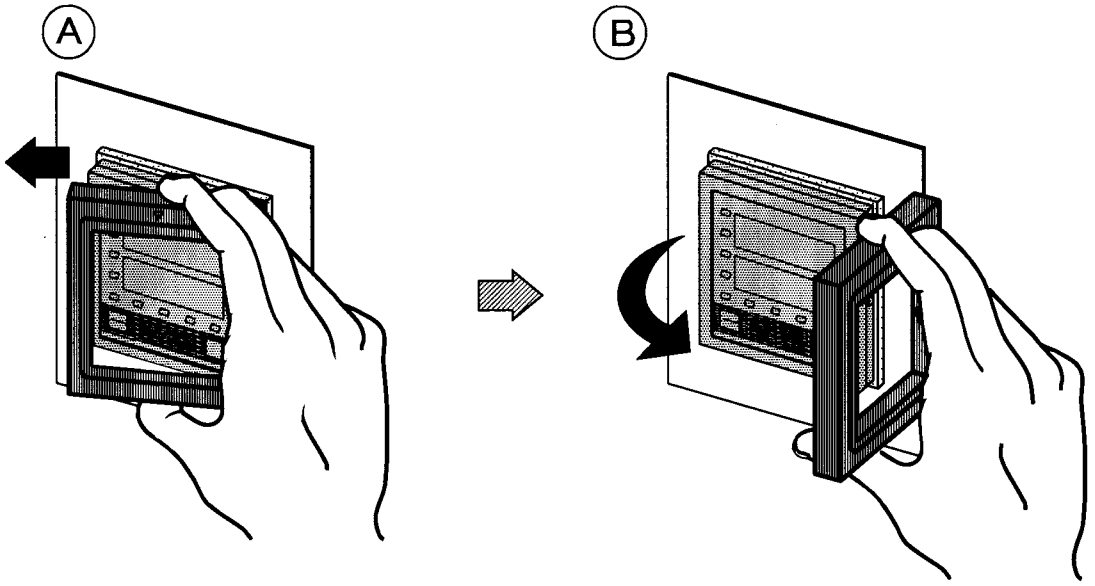
● **With the front cover (NEMA4X) attached to the instrument front**



Check that no gaps exist between the front cover and rubber packing, and between the front cover and instrument front.

(2) Dismounting

Push the front cover to the left while pushing it from the top and bottom to disengage the hook at the left from the groove (Ⓐ). The front cover can also be pushed to the right first under this condition to dis engage the hook at the right from the groove.
Next, disengage the other hook from the relevant groove to remove the front cover (Ⓑ).



(3) MAINTENANCE

If the rubber packing or the rubber packing at the rear of the front cover conforming to NEMA4X deteriorates, place orders of new rubber packings with your nearest RKC sales office or agent from which you bought these rubber packings.

Name	Parts code
Front cover (NEMA4X)	KD100 – 316
Rubber packing (NEMA4X)	KD100 – 315

CHAPTER 6

SPECIFICATION

REX-D SERIES
Instruction Manual

6. SPECIFICATIONS

6.1 Input

(1) Input type

(a) Thermocouple input group

① Thermocouple input type : K, J, R, S, B, E, T, N, PL II , W5Re/W26Re, U, L
② Signal source resistance effect : Approx. 0.4 μ V/ Ω
③ Input impedance : Approx. 1M Ω
④ Action at input break : Specify any of upscale or downscale

(b) RTD input group

① RTD input type : Pt100, JPt100
② Sensor current : Approx. 300 μ A
③ Allowable input lead : 10 Ω or less
④ Action at input break : Upscale
⑤ Action at input shorting : Downscale

(c) DC voltage (low) input group

① DC voltage (low) input type : 0 to 10mV DC, 0 to 100mV DC, 0 to 1V DC
② Input impedance : Approx. 1M Ω
③ Allowable input voltage : Within ± 5V
④ Action at input break : Upscale

(d) DC Voltage (high) input group

① DC voltage (high) input type : 0 to 5V DC, 1 to 5V DC, 0 to 10V DC
② Input impedance : Approx. 1M Ω or more
③ Allowable input voltage : Within ± 15V
④ Action at input break : Indicates value near 0

(e) DC current input group

① DC current input type : 0 to 20mA DC (0 to 5V DC), 4 to 20mA DC (1 to 5V DC)

* For using current input, select voltage (high) input and connect an external resistor.

(2) Accuracy

(a) Measuring accuracy : ± (0.3% of span + 1 digit)

* However, a temperature of less than 400 °C (752 °F) for B input or less than 32 °F for N, PL II or W5Re/W26Re is not within the guaranteed accuracy range.
For TC input, pay attention to cold−junction temperature guaranteed error.

(b) Cold junction temperature compensation error : Within ± 1.5 °C (From 0 to 50 °C)

(3) Sampling cycle : 500 ms

(4) PV bias

(a) Setting range : −1999 to 9999 (−199.9 to 999.9) °C 〔°F〕

(b) Setting resolution : 1 (0.1) °C 〔°F〕

6.2 Display function

(1) Measured−value (PV) display unit : 4−digit, 7−segment LED (Green)

(2) Set−value (SV) display unit : 4−digit, 7−segment LED (Orange)

(3) Action display : LED (Red, green)

6.3 Setting

(1) Setting range : Set−value (SV)

(a) Thermocouple input : Same as input range

(b) RTD input : Same as input range

(c) Voltage/Current input : Depending on the scaling

(2) Setting resolution

(a) Thermocouple input : 1 °C 〔°F〕 or 0.1 °C 〔°F〕

(b) RTD input : 1 °C 〔°F〕 or 0.1 °C 〔°F〕

(c) Voltage/Current input : Depending on input range

(3) Setting limit : High−limit : Any input range value
Low−limit : Any input range value

(4) SV change rate limit : Common to rise and fall

(a) Temperature input : 0.0 to input span (0 to input span)/min

(b) Voltage input : 0.0 to 100.0%/min of span (OFF at a set value of 0.00)

6.4 Control

(1) Control action type

(a) ON/OFF action : Differential gap :0 to 50 (0.0 to 50.0) ℃ 〔℉〕 or 0.0 to 10.0% of span

(b) PID control : Proportional band (P) : 0 (0.0) and 1 (0.1) to Setting limiter span or 0.0 to 100.0% of setting limiter span

* Control action turns to ON/OFF action when set to 0 (0.0).
* For heating/cooling PID action with auto−tuning, both the heating and cooling sides are set to ON/OFF action at a set−value of 0 (0.0).
(However, the cooling side cannot be set independently to ON/OFF control.)

Integral time (I) : OFF and 1 to 3600 sec (Integral time is turned OFF if set to OFF.)

Derivative time (D) : OFF and 1 to 3600 sec
(Derivative time is turned OFF if set to OFF.)

Proportioning cycle : 1 to 100 sec (Valid for relay or voltage pulue output)

Output limit (high−limit) : −5.0 to 105.0%

〔For heating/cooling PID action with auto−tuning, the controller has the cooling−side output limiter high−limit setting independent of the heating side.〕

Output limit (low−limit) : −5.0 to 105.0%

Output limit (high−limit) > Output limit (low−limit)

〔For heating/cooling PID action with auto−tuning, the output limiter low−limits are fixed at 0.0% for both the heating and cooling sides.〕

Manual reset : −50.0 to 50.0%

* Valid when integral action is turned OFF.
* Heating/cooling PID action with auto−tuning −100.0% to 100.0%

Fuzzy function : ON or OFF

Anti−reset windup (ARW) : 1 to 100% of proportional band

* Valid when the fuzzy function is turned OFF.
(Fixed at 100% when the fuzzy function is turned ON.)

(c) Heating/cooling PID action with auto−tuning

Cooling−side proportional band : 1 to 3000% of heating−side proportional band

* Invalid if heating−side proportional band is set to 0 (0.0), and as a result both the heating and cooling sides are set to ON/OFF control.

〔However, the cooling−side cannot be set independently to ON/OFF control.〕

Deadband/overlap : −10 to 10 (−10.0 to 10.0) °C 〔°F〕 or −10.0 to 10.0% of span

* If the overlap setting exceeds the propor−ional band on the heating orcooling side, the controller sets the overlap value to the proportional band on the heating or cooling side, Whichever is smaller.
If manual output is specified, the overlap value can be changed, but the data becomes invalid.

Cooling−side proportioning cycle : 1 to 100 sec

(2) Auto−tuning function

(a) Display : LED (Green)

(b) AT cycle : 1.5 cycles (At the end of auto−tuning (AT), PID action is automatically started.)

(c) Requirements for auto−tuning (AT) start

① In the operator mode

- AUTO/MAN transfer → AUTO mode
- Operation execution RUN/STOP transfer → execution (RUN)

② Input value should not be abnormal

(d) Requirements for auto−tuning (AT) suspension

- If the AT cycle does not reach 1.5 cycles about 9 hours after auto−tuning (AT) start, an auto−tuning (AT) error occurs and this function is stopped automatically.
- When set−value (SV) is changed
- When PV bias is changed
- When high or low output limiter value is changed
- When the input type is changed
- When the direct/reverse action is changed
- When input value becomes abnormal
- When power failure occurs

(3) Control cycle : 500 ms

(4) Direct/reverse action selection : Can be changed by the setting.

〔For heating/cooling PID action with auto−tuning, fixed to reverse action.〕

6.5 Control output

(1) Current output : 0 to 20mA DC (REX−D100 only), 4 to 20mA DC (All models)

(a) Allowable load resistance : 600 Ω or less

(b) Output impedance: 5M Ω or more

(c) Resolution : 10 bits or more

(2) Continuous voltage output : 0 to 5V DC, 0 to 10V DC , 1 to 5V DC

* Continuous voltage output cannot be specified for the first controt output (OUT1) of REX−D400/ D700/D900.

(a) Allowable load resistance : 1k Ω or more

(b) Output impedance : 0.1 Ω or less

(c) Resolution : 10 bits or more

(3) Voltage pulse output : First control output (OUT1)

(a) Voltage pulse : ① REX−D100 (0/12V DC)
② REX−D400,D700,D900 (0/15V DC)

(b) Allowable load resistance : ① REX−D100 (600 Ω or more)
② REX−D400,D700,D900 (1k Ω or more)

(c) Cycle : 1 to 100 sec variable

Second control output (OUT2)

(a) Voltage pulse : 0/12V DC

(b) Allowable load resistance : 600 Ω or more

(c) Cycle : 1 to 100 sec variable

(4) Relay contact output : 250V AC, 3A (Resistive load)

(a) Electrical life : 300,000 time or more (Rated load)

(b) Cycle : 1 to 100 sec variable (Resolution : 1 sec)

(c) Contact : ① Heating−side : REX−D100 (1a contact) , REX−D400, D700,D900 (1c contact)
② Cooling−side : All models (1a contact)

6.6 Manual control

(1) AUTO/MAN selection : " Used " or " Not used " can be selected.

(2) Setting

(a) Setting range : −5.0 to 105.0% (Heating/coolig PID action with auto−tuning−105.0 to 105.0%)

* Any value exceeding the output limiter high−limit and low−limit values cannot be set.

(b) Allowable load resistance : 0.1%

(3) Display

(a) Setting display : The SV display unit shows the MV value during manual peration.

(b) Action display : The MAN LED lights.

(4) Balanceless/bumpless : Balanceless and bumpless in both directions during manual ↔ Auto transfer

* However, if there is a deviation exceeding the proportional band, output in auto−tuning (AT) may not match that in manual mode when manual mode is transferred to auto−tuning (AT).

(5) Output at power−ON : Started from output limiter low−limit

[For heating/cooling PID action with auto−tuning, both outputs on the heating and cooling sides are started from 0%]

6.7 Output stop function

(1) Action selection : " Used " or " Not used " can be selected.

(2) Action : Both control output and alarm output are turned OFF.
(Same as the state at power−OFF)
* Output at power−ON starts from the output limiter low−limit.

(3) Display : The SV display unit shows " STOP " in STOP mode.

6.8 Alarm function

(1) No. of alarm point : 2 points (Each is independent)

(2) Alarm types : High−limit SV alarm, Low−limit SV alarm, High−limit PV alarm, Low−limit PV alarm, High−limit deviation alarm, Low−limit deviation alarm, Deviation High/Low alarm, Band alarm

(3) Setting range

(a) SV alarm : Same as input range

(b) PV alarm : Same as input range

(c) Deviation alarm : −span to +span

(d) Deviation High/Low alarm : −span to +span (Absolute−value setting)

(e) Band alarm : −span to +span (Absolute−value setting)

(4) Differential gap : 0.0 to 10.0 (0 to 10) °C 〔°F〕 or 0.0 to 10.0% of span

(5) Alarm timer : 0 to 600 sec

(6) Hold action functions

(a) Enable/disable can be selected

(b) At power−ON : Hold action : No alarm is activated even if PV value is in the alarm−ON area.

Release of hold action : The hold action is released if PV value is in OFF area.

(c) When set value (SV) is changed : Hold action : No alarm is activated even if PV value enters the alarm−ON area as a result of SV change.

* No hold action is activated even if the SV value is changed in the alarm−ON area.

Release of hold action : The hold action is released if PV value is in the alarm−OFF area.

* No hold action is provided for high−limit/low−limit SV value alarm and within−range alarm.

(7) Output

(a) Relay contact output 1a contact

(b) 250V AC, 0.5A (Resistive load)

(c) 2−point independent output (Common to COM)

(d) Electrical life : 50,000 time or more

6.9 Self-diagnostic function

(1) Check item

(a) Input value check

(b) CPU power monitoring

(c) Watch-dog timer

(2) Display in trouble : All displays are extinguished.

(3) Output in trouble : All outputs : OFF

[If an error occurs, the PV display unit flashes "E r r " and the SV display unit shows the error code if the display function is activated.]

6.10 General specification

(1) Insulation resistance: Between measuring and grounding terminals : 20M Ω or more at 500V DC

Between power and grounding terminals : 20M Ω or more at 500V DC

(2) Dielectric resistance : Between measuring and grounding terminals : 1 minute at 1000V AC

Between power and grounding terminals : 1 minute at 1500V AC

(3) Power supply voltage : 90 to 264V AC (Rated : 100 to 240V AC) [Including power supply variation] (Common 50/60Hz)

21.6 to 26.4V AC (Rated : 24V AC) [Including power supply variation] (Common 50/60Hz)

21.6 to 26.4V DC (Rated : 24V DC) [Ripple factor : Less than 10% P-P]

(4) Power comsumption: 90 to 264V AC : 11VA or less (REX-D100)
12VA or less (REX-D400,D700,D900)

21.6 to 26.4V AC : 7VA or less (REX-D100)
7.5VA or less (REX-D400,D700,D900)

21.6 to 26.4V DC : 180mA or less (REX-D100)
200mA or less (REX-D400,D700,D900)

(5) Power failure effect : No influence even under power failure of less than 20 msec.
However, for power failure exceeding that time, the controller is set to the initial state.

(6) Warm−up time : 60 minutes or more

(7) Memory back up : Backup by EEP−ROM

Stored data retention time : Approx. 10 years

Re−writing life : Approx. 100,000 times

* However, these vary depending on the product storage period, storage environment, and operating condition.

(8) Weight : REX−D100 (Approx. 180g)
REX−D400 (Approx. 250g)
REX−D700 (Approx. 285g)
REX−D900 (Approx. 360g)

(9) Accessories: Mounting brackets, 2pcs (1 set)

6.11 Working environment conditions (Normal operating conditions)

(1) Ambient temperature : 5 to 40 °C

(2) Ambient humidity : 20 to 80% (RH)

(3) Operating environment : There should be neither corrosive gases nor much dust

(4) Power supply voltage : ± 10% of rating

(5) Power supply frequency : ± 5% of rating

(6) Magnetic field : 400AT/m or less

(7) Warm−up time : 60 minutes or more

6. SPECIFICATIONS (ADDITIONAL FUNCTION)

6.12 Analog output function

(1) No. of output point : 1 point

(2) Output types : Measured−value (PV)
Deviation value (DEV)
Set−value (SV)
Control output (Heating−side)
Heater current (CT1)

(3) Output signal : DC voltage input : 0 to 5V DC, 0 to 10V DC, 1 to 5V DC
DC current input : 0 to 20mA DC, 4 to 20mA DC

[Output impedance/allowable load resistance]

Output signal	Output impedance	Allowable load resistance
0 to 5V DC	0.1 Ω or less	0.1k Ω or more
0 to 10V DC		
1 to 5V DC		
0 to 20mA DC	5M Ω or more	600 Ω or less
4 to 20mA DC		

(4) Analog output range

(a) Measured−value (PV)

(b) Deviation of measured−value (PV) from set−value (SV)

(c) Set−value (SV)

(d) Control output (Heating−side)

(5) Output resolution : 10 bit or more

(6) Output accuracy : ± 0.3% of span

(7) Ripple : ± 0.1% of span, 1mV or less (Resistive load)

6.13 Contact input function

(1) No. of input point : 1 point

(2) Input type : Dry contact input

(a) 500k Ω or more : Open

(b) 10 Ω or less : Close

(3) Function : Step function [Transfer of set−values (SV1) and (SV2)]

(a) Transfer method : The contact is opened for set−value (SV1).
The contact is closed for set−value (SV2).

(b) Display : SV2 LED lights if set−value (SV2) is selected.

6.14 Communication function

(1) Interface

① EIA standard Based on RS−422A (Other than REX−D100)
② EIA standard Based on RS−485

(2) Connection method

① 4−wire system, half−duplex multi−drop connection (Specification conforming to RS−422A) *1
② 2−wire system, half−duplex multi−drop connection (Specification conforming to RS−485)

*1 Other than REX−D100

(3) Communication distance

① RS−422A : 1km (max)
② RS−485 : 1km (max)

* However, communication distance varies slightly with the surroundings such as cables, etc.

(4) Synchronous method : Start/stop synchronous type

(5) Communication speed : 1200bps, 2400bps, 4800bps, 9600bps, 19200bps

(6) Data type

① Start bit: 1
② Data bit : 7 or 8
③ Parity bit : None or 1 (Odd number or even number)
④ Stop bit : 1 or 2

(7) Transmission control procedure : ANSI X3.28 subcategory 2.5, A4
Polling / selection type

(8) Error control

① Vertical parity (With parity bit selected)
② Horizontal parity (BCC check)

(9) Block length : Within 16 bytes

(10) Maximum connection

① RS−422A : 32 sets including a host computer

* However, 32 sets may not always be connected depending on host−computer driver performance.

② RS−485 : 32 sets including a host computer

(11) Communication code : JIS/ASCII 7-bit code

(12) Details of terminals:

① RS-422A (4-wire system)

Terminal No.			Signal name	Signal direction Controller ↔ HOST	Remarks
D400	D700	D900			
18	23	18	SG	———	Signal ground
14	19	14	T(A)	———→	Send data
15	20	15	T(B)	———→	Send data
16	21	16	R(A)	←———	Receive data
17	22	17	R(B)	←———	Receive data

② RS-485 (2-wire system)

Terminal No.				Signal name	Signal direction Controller ↔ HOST	Remarks
D100	D400	D700	D900			
	18	23	18	SG	———	Signal ground
14	16	21	16	T(A)	←———→	Send data/Receive data
13	17	22	17	T(B)	←———→	Send data/Receive data

6.15 Heater break alarm function

(1) Input : Current transformer input : Specify either heater break alarm for single−phase heater or heater break alarm for three−phase heater.

- ● CTL−6−P−N (0 to 30A)
- ● CTL−12−S56−10L−N (0 to 100A)

* Specify either one of current transformers.
For heater break alarm for three−phase heater, always use the same current transformer.

(2) Display accuracy : ± 5% of input value or 2A (Within the value whichever is the greater)

(3) Setting range : 0.0 to 100.0A

(4) Heater break alarm display : ALM2 lamp flashing (Red)

* When current value is displayed, the current value and "AL2" are alternately displayed.

(5) Output : Relay contact output

① 250V AC, 0.5A (Resistive load)
② Electrical life : 50,000 time or more
③ 1a contact

(6) HBA delay timer : 0 to 600 sec

6.16 Control loop break alarm

(1) Setting range

(a) LBA time setting : 0 to 7200 sec (If set to 0 sec, a control loop break alarm is turned OFF.)

(b) LBA deadband : 0 to 9999 °C 〔°F〕 or 0 to 100% of span (If set to 0, no LBA deadband is activated.)

(2) Setting resolution

(a) LBA time setting : 1 sec

(b) LBA deadband : 1 °C 〔°F〕 or 1%

(c) LBA deadband differential gap : 0.8 °C 〔°F〕 or 0.8% of span (fixed)

(d) Display : The ALM display lights if a control loop break alarm (LBA) is turned ON.

(e) Output : Relay contact output

① 250V AC, 0.5A (Resistive load)
② Electrical life : 50,000 time or more
③ 1a contact

MEMO

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