

SINGLE LOOP MCU BASED DIRECT DIGITAL CONTROLLERS

REX-C9 SERIES

INSTRUCTION MANUAL

IMC912-E2

Notes:

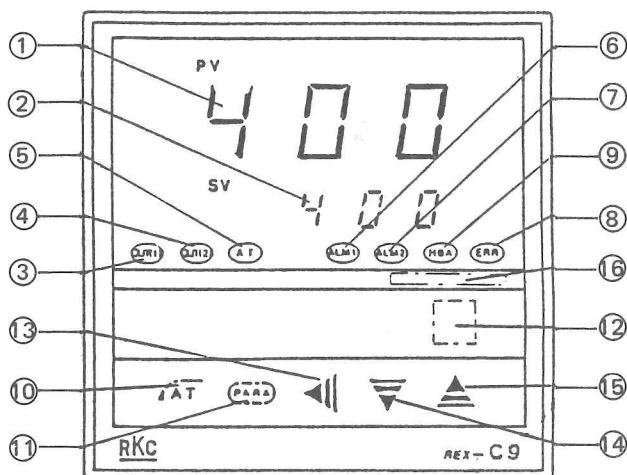
Make sure that this Instruction Manual is always readily available to personnel who use the REX-C9 series.

The contents of the Instruction Manual are subject to change without notice. If you have any questions regarding the manual, contact one of our sales people, our nearest sales office, or the place where you have purchased this controller.

Contents

1. NAME OF PARTS	1	3.3 Set data locking function	7
2. OPERATION	2	3.4 Alarm (ALM) function	8
2.1 Description of each parameter	2	3.5 Heater break alarm function	8
2.2 Each parameter setting	4	4. DIMENSIONS	8
2.3 Auto-tuning (AT) procedure	6	5. WIRING	9
2.4 Cautions for operation	6	5.1 Rear terminals	9
3. MAIN FUNCTIONS	7	5.2 Wiring example	9
3.1 Self-diagnostic function	7	5.3 Cautions for wiring	10
3.2 Overscale and underscale	7	6. SPECIFICATION	11

1. NAME OF PARTS



- ① Measured-value (PV) display unit (Green)
- ② Set-value (SV) display unit (Orange)
- ③ Heating-side control output (OUT (1)) lamp (Green)
- ④ Cooling-side control output (OUT (2)) lamp (Yellow)
- ⑤ Auto-tuning (AT) lamp (Green) (Option)
- ⑥ Alarm 1 (ALM1) lamp (Red)
- ⑦ Alarm 2 (ALM2) lamp (Red)
- ⑧ Error (ERR) lamp (Red)
- ⑨ Heater break alarm (HBA) lamp (Red) (Option)
- ⑩ Auto-tuning (AT) key (Option)
- ⑪ Parameter select key
- ⑫ Hidden key
- ⑬ Setting digit shift key
- ⑭ Set-value decrement key
- ⑮ Set-value increment key
- ⑯ Input range display

2. OPERATION

2.1 Description of each parameter

The measured-value (PV) display unit displays a measured-value with the power turned ON, and the set-value (SV) display unit displays the set-value (SV). Every time the (P̄ARA) key is pressed, parameters change as shown in the following table. (When the last parameter is displayed, it returns to the first parameter.)

At this time, the measured-value (PV) display unit displays each parameter symbol and the set-value (SV) display unit displays the relevant parameter set-value.

Measured-value (PV) display unit	Symbol	Name	Description	Setting range	Initial value prior to shipment
Measured-value			Displays measured-value. Setting is not possible.		
SV	SV	Set-value	Desired value for control Any value is settable within input range.	Within input range	0 or 0°C[°F]
CT	CT	Current transformer input	Displays input value from the current transformer.	Setting is not possible. Set heater break alarm value by referring to this value.	
AL1	AL1	Alarm 1	Sets alarm set-value of Alarm 1.	4-digit display: -1999 to +9999°C[°F] or -199.9 to +999.9°C[°F] 3-digit display: -199 to +999°C[°F] (Hysteresis band: 2 or 2.0°C[°F])	50 or 50.0°C[°F]
AL2	AL2	Alarm 2	Sets alarm set-value of Alarm 2.	4-digit display: -1999 to +9999°C[°F] or -199.9 to +999.9°C[°F] 3-digit display: -199 to +999°C[°F] (Hysteresis band: 2 or 2.0°C[°F])	50 or 50.0°C[°F]
HbA	HbA	Heater break alarm	Alarm value is set by referring to input value from the current transformer (CT).	4-digit display: 0.0 to 100.0A 3-digit display: 0.0 to 99.9A	0.0A
P	P	(Heating-side) proportional band	Set when proportional control is performed (on the heating-side).	1 to span or 0.1 to span (ON/OFF action with P set to "0" or "0.0".)	30 or 30.0°C[°F]
I	I	Integral time	Eliminates offset occurring in proportional control.	4-digit display: 1 to 3600 sec. 3-digit display: 1 to 999 sec. (I action turns OFF with I set to "0".)	240 sec
D	D	Derivative time	Prevents ripples by predicting output change, thereby improving control stability.	4-digit display: 1 to 3600 sec. 3-digit display: 1 to 999 sec. (D action turns OFF with D set to "0".)	60 sec
Ar	Ar	Anti-reset windup	Prevents overshoot and/or undershoot caused by integral action effect.	1 to 100% of (heating-side) P band (I action turns OFF with this action set to "0".)	100%
T	T	(Heating-side) proportional cycle	Sets control output cycle (on the heating-side).	1 to 100 sec.	Relay contact output : 20 sec Voltage pulse output : 2 sec

to "Pc" (Pc)

from "t" (t)

from "r" (T)

Measured-value (PV) display unit	Symbol	Name	Description	Setting range	Initial value prior to shipment
*6	Pc	Cooling-side proportional band	Set when proportional control is performed on the cooling-side.	1 to 1000% of heating-side proportional band.	100%
	db	Dead band	Sets control action dead band between heating and cooling-side proportional bands.	● 0 to 10°C[°F] or 0.0 to 10.0°C[°F]	0 or 0.0°C[°F]
*7	t	Cooling-side proportional cycle	Sets control output cycle on the cooling-side.	1 to 100 sec.	Relay contact output : 20 sec Voltage pulse output : 2 sec

to Measured-value

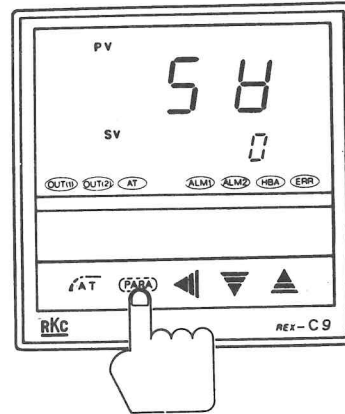
- *1, *4: Does not display when no heater break function is provided, and/or 2 alarm outputs are provided.
- *2 : Does not display when no alarm is provided.
- *3 : Does not display when no alarm is provided, one alarm output is provided and/or heater break alarm is provided.
- *3, *4: Neither of them is display simultaneously.
- *5, *7: Does not display when current output is provided.
- *6 : Control actions become ON/OFF actions for both the heating and cooling side with heating-side proportional band set to "0" or "0.0".
- : This is displayed only in the Heating/cooling control (V or W) type.

2.2 Each parameter setting

Following is an example of setting the set-value (SV) to 200°C. (For 3-digit display)

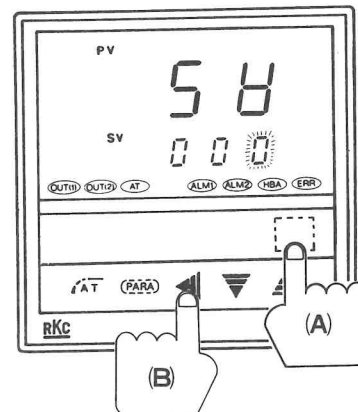
①

Press the (PARA) key to display the set-value (SV) parameter symbol (SV) on the measured-value (PV) display unit.



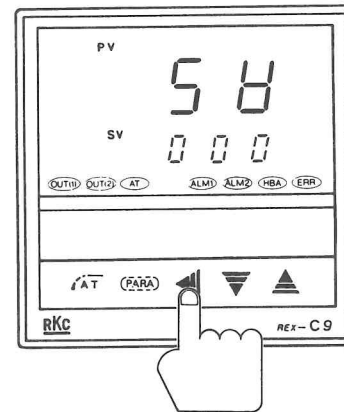
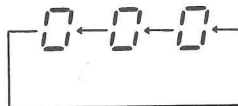
②

Press the key (B) while pressing the hidden key (A) to enter the setting mode. The least significant digit on the set-value (SV) display unit lights brightly, and other digits light dimly. The digit which lights brightly is settable.



③

Press the key to shift the digit which lights brightly up to the hundreds digit. The digit which lights brightly shifts as follows every time the key is pressed.



④

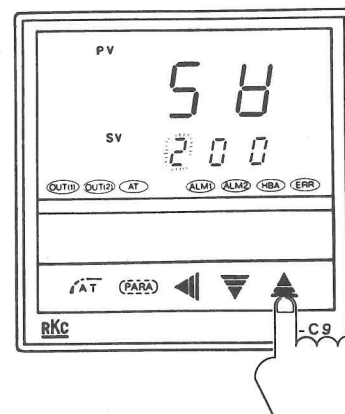
Press the key to set "2". Pressing the key increments numerals, and pressing the key decrements numerals.

●Setting range: Within input range

When minus (-) sign is set.

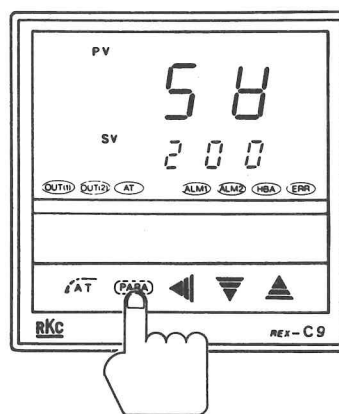
Example:

When 200 is changed to -100, shift the digit lit brightly to the hundreds digit, then press the key to decrement figures in order of 1 → 0 → -1.



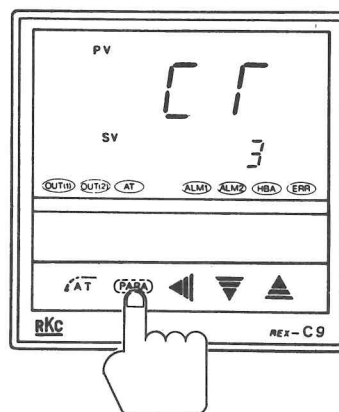
⑤

After finishing the setting, press the (P \overline{A} R \overline{A}) key. All of the set-value digits light brightly to indicate that the setting has ended.



⑥

Pressing the (P \overline{A} R \overline{A}) key again shifts to the next parameter. Repeat the procedures from ② to ⑥ to set each parameter in order.



When setting parameters other than the set-value (SV), follow the above procedures.

Notes

1. If the controller does not enter the setting mode (even if the ◀ key is pressed while pressing the hidden key), the set data may be locked.
In this case, check that internal switch No. 2 inside the controller is turned OFF. (For set data locking, see "3. MAIN FUNCTIONS")
2. This controller uses each parameter in any digit at the time it was changed.
3. This controller can shift the digit up and down when each parameter is changed.
For example, if "199°C" is necessary to be changed to "200°C", first shift the digit which lights brightly to the least significant digit, then press the ▲ key to change "9" to "0", thereby obtaining 200°C.
This procedure also applies to shift the digit down.
4. If key operation is not performed for more than 10 sec. with any parameter display by the (P \overline{A} R \overline{A}) key (including display other than measured-value and that in the set mode), display unit displays a measured-value and the set-value (SV).

2.3 Auto-tuning (AT) procedure

The auto-tuning function automatically measures, computes and sets the optimum PID constants.

This function is activated after power-ON, during temperature rise and/or when control is stabilized from any process state.

- (1) After finishing settings other than PID, perform the auto-tuning operation.
- (2) Pressing the $\overline{\text{AT}}$ key while pressing the hidden key, the AT lamp flashes to start the auto-tuning function.
- (3) If the auto-tuning has ended, AT lamp flashing stops. When the values auto-tuned are necessary to be checked, press the $\overline{\text{PARA}}$ key to display each value on the set-value (SV) display unit.
- (4) When changing the constants automatically set by the auto-tuning, change each constant in accordance with each parameter setting (See Item 2.2.)
- (5) When suspending the auto-tuning function, press the $\overline{\text{AT}}$ key while pressing the hidden key to stop AT lamp flashing, thereby releasing the auto-tuning. No PID constants at this time can be changed. (The values before the auto-tuning function is activated.)
- (6) When changing the set-value (SV) during progress in the auto-tuning function, suspend the auto-tuning to perform PID control using the values before auto-tuning start.

2.4 Cautions for operation

- (1) Do not use the auto-tuning function in a control system where hunting causes trouble.
In this case, set each PID constant appropriate to the controlled object.
- (2) Connect the measuring circuit, and then turn ON the power. If the circuit opens, the controller judges that input is disconnected to cause the upscale of measured-value display (for thermocouple input, downscale is also available only as option.)
 - Upscale For TC or RTD input
 - Downscale For TC (To be specified when ordering)
- (3) No influence is exerted upon the controller for power failure of less than 30msec. For power failure of more than 30msec., the controller performs the same operation as that at the time of power-ON after power recovery. (This applies only when alarm action is turned OFF.)

3. MAIN FUNCTIONS

3.1 Self-diagnostic function

① Without communication function

Self-diagnostic function	During abnormality	
	*Display	Output
Non-volatile RAM check	"E - -" flashes on the measured-value (PV) display unit.	<ul style="list-style-type: none"> Control output (Relay contact, voltage pulse) Alarm output
A/D converter check		
CPU power monitoring	The error (ERR) lamp (red) lights.	<ul style="list-style-type: none"> Control output (Current)
		Output low-limit

*Turn off the power to release the ERROR display.
If the ERROR display still appears after power is reapplied, contact our agency.

3.2 Overscale and underscale

- ① If a measured-value exceeds the high setting range limit due to input break (or shorting), etc., measured-value display starts flashing. Further, if it exceeds the high input display range limit, the measured-value (PV) display unit flashes overscale display "0000" or "000".
- ② If a measured-value falls below the low setting range limit due to input break (or shorting), etc., measured-value display starts flashing. Further, if it falls below the low input display range limit, the measured-value (PV) display unit flashes underscale display "0000" or "000".

4-digit display

Input	Type	Input display range
TC	K	-30 to +1372°C, -30 to +2502°F
	J	-30 to +1200°C, -30 to +2192°F
	N	-30 to +1300°C, -30 to +2372°F
	R, S	-30 to +1769°C, -30 to +3216°F
	B	-30 to +1820°C, -30 to +3308°F
RTD	Pt100 (JIS/IEC)	-199.9 to +649.0°C
	JPt100 (JIS)	
	Pt100 *1	-199.9 to +999.9°F
	JPt100 *2	

3-digit display

Input	Type	Input display range
TC	K	-30 to +999°C, -30 to +999°F
	J	-30 to +999°C, -30 to +999°F
	N	-30 to +999°C, -30 to +999°F
RTD	Pt100 (JIS/IEC)	-199 to +649°C, -19.9 to +99.9°C
	JPt100 (JIS)	
	Pt100 *1	-199 to +999°F, -19.9 to +99.9°F
	JPt100 *2	

*1 Conforming to JIS/IEC
*2 Conforming to JIS
IEC (International Electrotechnical Commission) is equivalent to JIS, DIN and ANSI.

3.3 Set data locking function

Set-value change and the auto-tuning function become invalid with internal switch No. 2 inside the controller turned ON. However, each set-value can be checked by the (P \bar{A} R \bar{A}) key.

Use this function for misoperation prevention after finishing the setting.

* Set data locking procedure

As shown in the following Fig., the controller can be withdrawn from its housing if it is pulled out forward while the stopper at the bottom is pushed up with fingers.

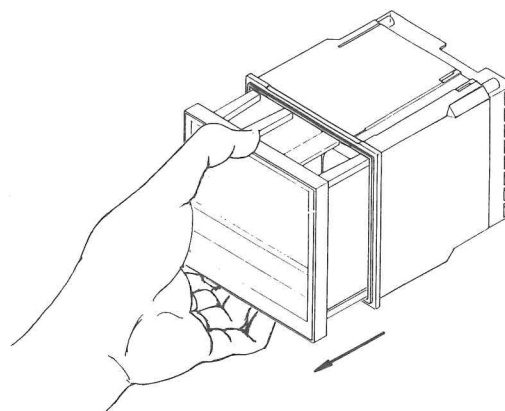


Fig. 1

Next, turn ON internal switch No. 2 at the side part of the controller. (Do not touch other switches.) (Fig. 2)

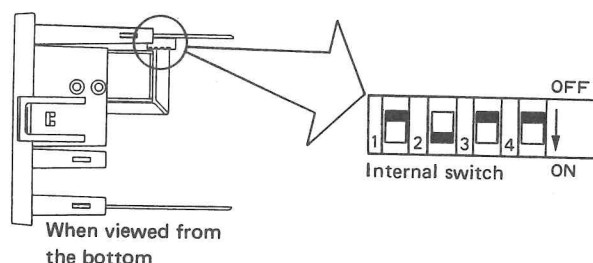


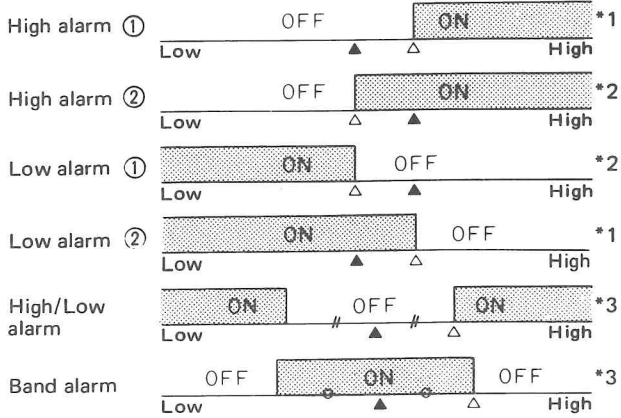
Fig. 2

Thus, the set data has been locked.
For set data locking release, turn OFF internal switch No. 2.

3.4 Alarm (ALM) function

- (1) The action for each alarm becomes as follows.
 (▲ : Set-value (SV) △ : Alarm set-value)

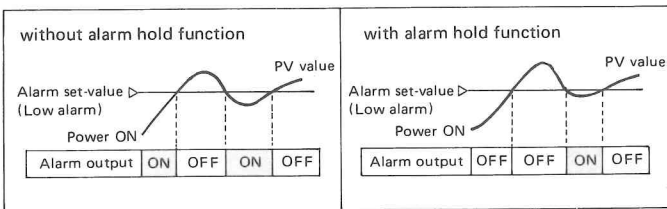
● Deviation alarm



- *1 Alarm status where the alarm set-value is set to plus (+).
- *2 Alarm status where the alarm set-value is set to minus (-).
- *3 Status where alarm is activated at 2 equal deviation points from the set-value (SV) with the alarm set-value (absolute deviation) is set.

(2) Alarm hold function

With alarm hold function, the instrument ignores alarm conditions after power-ON, generating no alarm output when the input is in the alarm zone until the input has exited once from the alarm zone.



The alarm hold action is activated when not only the power is turned ON, but also set-value (SV) is changed.

3.5 Heater break alarm function

- (1) The following two alarms are available.
- ① Alarm for heater break when control output is on and when the input value from the current transformer input (I) is smaller than the set-value. (Alarm will not function when the control output ON time is shorter than 0.5 sec.)
 - ② Alarm for melt of the relay contacts when control output is off and the input value from the current transformer input (I) is larger than the set-value. (Alarm will not function when the control output OFF time is shorter than 0.5 sec.)

(2) Heater break alarm setting

- ① Press the (P_{ARA}) key to set the parameter to " I " (current transformer input). The measured heater current is displayed in A (amperes).
- ② Next, press the (P_{ARA}) key to display " HBA " (heater break alarm). Basically, it is desirable that the heater break alarm set-value be set to about 0.85 times the current transformer input (I). However, set a value slightly smaller than the above value if power supply variation is large.

In addition, when two or more heaters are connected in parallel, set a value slightly higher than the above value (but within the I value) so that the alarm is turned ON even with one heater broken.

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

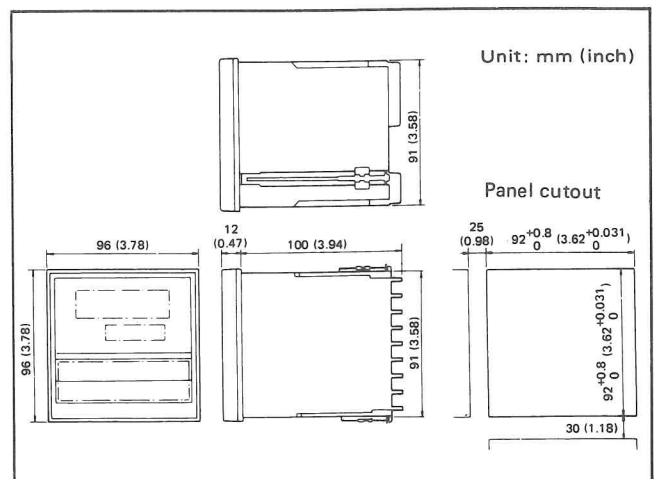
For example, when current transformer input is 20A:

HBA becomes $20(A) \times 0.85 = 17(A)$.

Therefore, the alarm set-value can be set to about 17A.

- ③ After the above setting is finished, press the (P_{ARA}) key. All the set-value digits then light up brightly to indicate that the setting is finished.

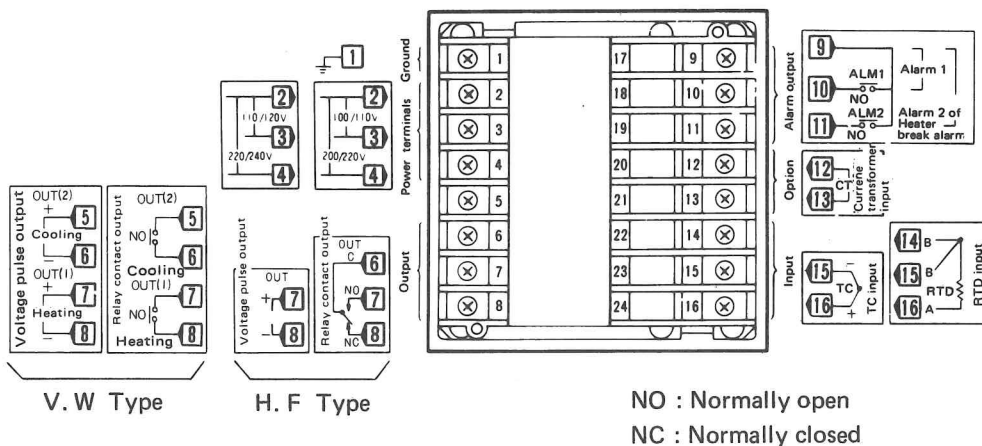
4. DIMENSIONS



* Dimension in inches are shown for reference.

5. WIRING

5.1 Rear terminals

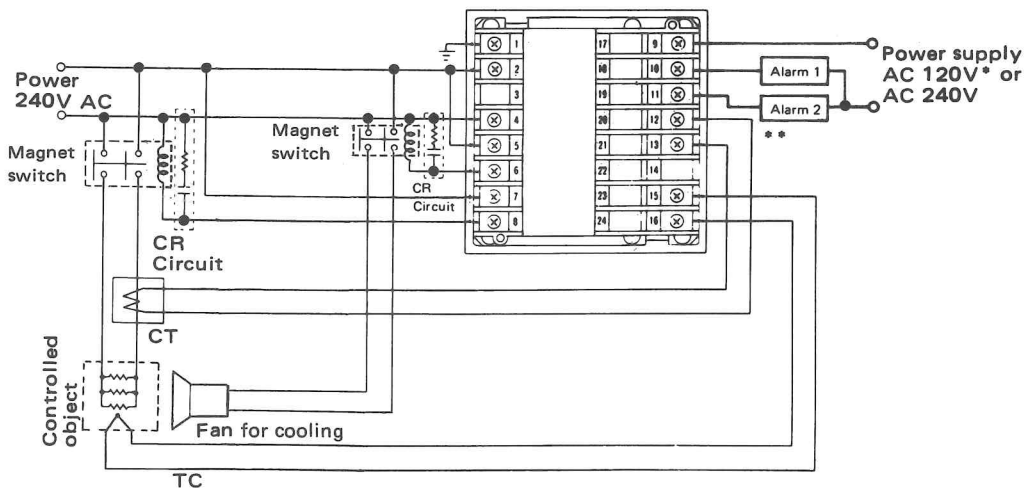


Notes

1. All of unused terminals are covered by blind patches.
2. For thermocouple input, no metal piece is attached to terminal No. 14. Instead, the temperature compensation element in the internal assembly is projected through a hole at terminal No. 14. Do not damage the above temperature compensation element when the internal assembly is removed from the case.

5.2 Wiring example

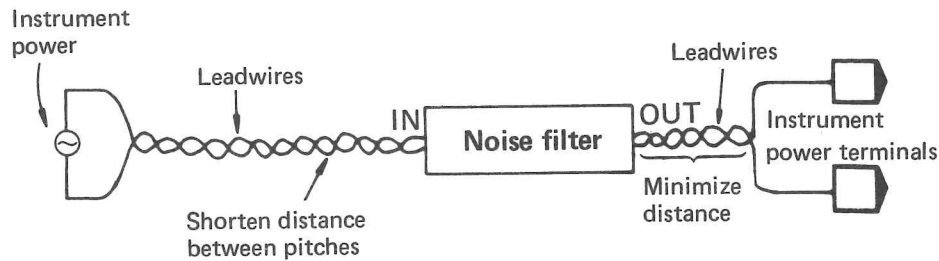
REX-C9 □ SC-MM * 2



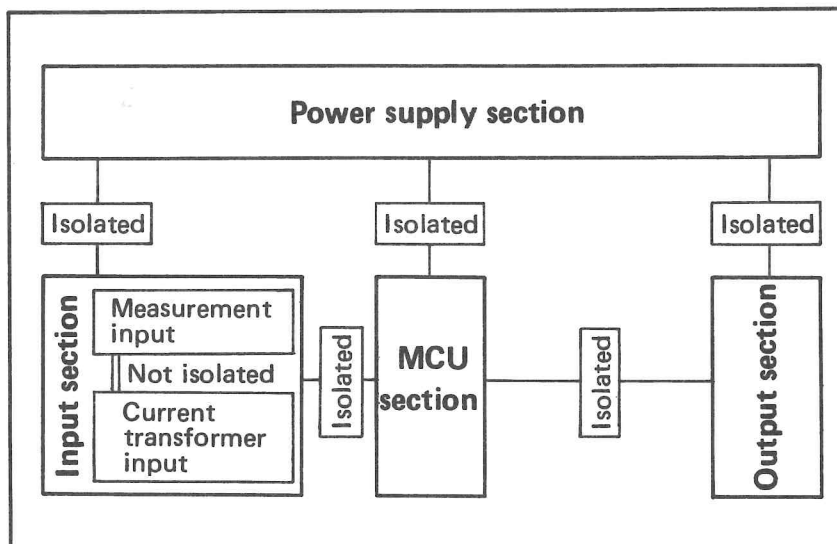
*for UL-approval
**Heater break alarm

5.3 Cautions for wiring

- (1) Conduct input signal wiring away from instrument, electric equipment power and load lines as such as possible to avoid noise induction.
- (2) 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 (select the filter by checking instrument power supply voltage.)
 *Sufficient effect may not be obtained depending on the filter. Therefore, select the filter by referring to its frequency characteristic, etc.
 - ① 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.)
 - ② Install the noise filter on the panel which is always grounded and minimize the wiring distance between the noise filter output side and the controller power terminals.
 Otherwise, the longer the distance between output side and instrument power terminals, the less effective for noise.
 - ③ Do not install fuses and/or switches on the filter output signal since this may lessen filter effect.



- (3) For wiring, use wires conforming to the domestic standard of each country.
 (For instrument grounding, use wires with nominal sectional area of 1.25 to 2.0 mm², and securely ground the instrument at the minimum distance.)
- (4) About 1 to 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.
- (5) The figures below show the REX-C9 circuit configuration. When connecting wires, note that the power, input, MCU and output circuits are isolated independently, while the inside of the input and output circuits are not isolated.



REX-C9 circuit configuration

6. SPECIFICATION

(1) Input

Influence of external resistance	Approx. 0.4 $\mu\text{V}/\Omega$ (For TC input)
Influence of input lead	Approx. 0.0075%/ Ω of reading (For RTD input)
Display accuracy	Within $\pm(0.5\%$ of displayed value +1 digit) or $\begin{cases} \pm 3^\circ\text{C} [\pm 6^\circ\text{F}] & \text{(for TC input)} \\ \pm 2^\circ\text{C} [\pm 3^\circ\text{F}] & \text{(For RTD input)} \end{cases}$ * Whichever is greater.

* Input scale range

4-digit display

Input	Type	Scale range	
TC	K	0 to 1372°C,	0 to 2502°F
	J	0 to 1200°C,	0 to 2192°F
	N	0 to 1300°C,	0 to 2372°F
	R, S	0 to 1769°C,	0 to 3216°F
	B	0 to 1820°C,	0 to 3308°F
RTD	Pt100 (JIS/IEC)	-199.9 to +649.0°C	
	JPt100 (JIS)		
	Pt100 *1	-199.9 to +999.9°F	
	JPt100 *2		

For thermocouple inputs, R, S and B, display accuracy and setting accuracy differ from those of other thermocouple inputs.

R, S . . . Within $\pm 5^\circ\text{C} (10^\circ\text{F})$ for the range of 0 to 199°C (0 to 399°F).

B Out of the guaranteed range for the range of 0 to 399°C (0 to 799°F)

3-digit display

Input	Type	Scale range	
TC	K	0 to 999°C,	0 to 999°F
	J	0 to 999°C,	0 to 999°F
	N	0 to 999°C,	0 to 999°F
RTD	Pt100 (JIS/IEC)	-199 to +649°C,	-19.9 to +99.9°C
	JPt100 (JIS)		
	Pt100 *1	-199 to +999°F,	-19.9 to +99.9°F
	JPt100 *2		

*1 . . . Conforming to JIS/IEC

*2 . . . Conforming to JIS

IEC (International Electrotechnical Commission) is equivalent to JIS, DIN and ANSI.

(2) Setting

	Range	Resolution	Accuracy
Set-value (SV)	Same as input range.	1°C [$^{\circ}\text{F}$] or 0.1°C [$^{\circ}\text{F}$]	Within $\pm(0.5\%$ of set value (SV) +1 digit) $\begin{cases} \pm 3^\circ\text{C} [6^\circ\text{F}] & \text{(For TC input)} \\ \pm 2^\circ\text{C} [3^\circ\text{F}] & \text{(For RTD input)} \end{cases}$ * Whichever is greater.
Heating-side proportional band (P)	1 to span or 0.1 to span	1°C [$^{\circ}\text{F}$] or 0.1°C [$^{\circ}\text{F}$]	Within $\pm 0.5\%$ of setting range
Cooling side proportional band (Pc)	1 to 1000% of heating-side P band.	1%	
Integral time (I)	4-digit display: 1 to 3600 sec.	1 sec.	
Derivative time (D)	3-digit display: 1 to 999 sec.		
Anti-reset windup	1 to 100% of P	1%	
Dead band	0 to 10°C [$^{\circ}\text{F}$] or 0.0 to 10.0°C [$^{\circ}\text{F}$]	1°C [$^{\circ}\text{F}$] or 0.1°C [$^{\circ}\text{F}$]	
Heating-side proportional cycle	1 to 100 sec.	1 sec.	
Cooling-side proportional cycle	1 to 100 sec.	1 sec.	

(3) Output

Control output		250V AC 3A (Resistive load) H, F type: 1 "c" contact V, W type: 1 "a" contact Electrical life: 300,000 times or more (Rated load)
	Voltage pulse output	0/12V DC (load resistance 800 Ω or more)
	Current output	4 to 20mA DC, 0 to 20mA DC (load resistance 600 Ω or less)

(4) Alarm

Type	Deviation alarm	
Action	High alarm, Low alarm, High/Low alarm, Band alarm	
Setting range	-1999 to +9999 or 199.9 to +999.9 (3-digit display: -199 to +999)	
Setting resolution	Same as set-value (SV)	
Setting accuracy		
Hysteresis	2 or 2.0°C [$^{\circ}\text{F}$]	
Output	No. of points	Energized alarm: 2 points, max.
	Rating	Relay contact: 125V AC 0.6A * 250V AC 1A (Resistive load) 1 "a" contact Electrical life: 50,000 times or more (Rated load)
Additional function	Hold action	

*for UL-approval

(5) Options

Heater break alarm	Input	CT input
	Setting accuracy	Within $\pm 5\%$ of set value or $\pm 2A$ (Whichever is greater.)
	Output	Relay contact; 125V AC 0.6A * 250V AC 1A (Resistive load) 1 "a" contact Electrical life: 50,000 times or more (Rated load)

* for UL-approval

(6) Other specifications

Power supply voltage	(a) 100/110V and 200/220V AC (50/60 Hz common use) (b) 110/120V and 220/240V AC (50/60 Hz common use) * Specify either (a) or (b)
Allowable voltage variation	Within $\pm 10\%$ of rating
Power consumption	6VA or less
Allowable ambient temp.	0 to 50°C (32 to 122°F)
Allowable relative humidity	45 to 85% RH
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
Dielectric strength	Between measuring and grounding terminals; For 1 min. at 1000V AC Between power and grounding terminals; For 1 min. at 1500V AC
Weight	Approx. 550g (1.21 lb)

(7) Model No.

The REX-C9 Model No. is shown inside the controller.

Model	Suffix Code	Description	
REX-C9	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> - <input type="checkbox"/> <input type="checkbox"/> * <input type="checkbox"/>	96 x 96mm sized Direct Digital Controller	
Control Action	H	PID action	
	F	PID action with auto-tuning	
	V	Heating/Cooling PID action	
	W	Heating/Cooling PID action with auto-tuning.	
Alarm Action	N	Not supplied	
	S	1 point alarm action	
	D	2 point alarm action	
Input	C	Thermocouple input	
	R	RTD input	
Control output (heating-side)	M	Relay contact output	
	V	Voltage pulse output	
	R	Current output	
Control output (cooling-side)	M	Relay contact output	
	V	Voltage pulse output	
	R	Current output	
Option	Analog input (Heater Break Alarm)	N	Not supplied
		2	Heater break alarm function.

RKC RKC INSTRUMENT INC.

IMC912-E2

HEAD OFFICE: 16-6, KUGAHARA 5-CHOME, OHTA-KU TOKYO JAPAN
 PHONE: 03-751-8111 (+81 3 751 8111)
 TELEX : 0246-8818 RKCTOK J
 CABLE : RKCRIKAROL
 FAX : 03-754-3316 (+81 3 754 3316)

MAR. '90. 2,000 (P)