

REX-F9 SERIES

INSTRUCTION MANUAL

IMF917-E3

► NOTE ◀

Make sure that this Instruction Manual is always readily available to personnel who use the REX-F9 series.

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

Also keep this manual with much care for future reference.

* See the "Communication Instruction Manual" for detail of the communication.

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► USERS OF THIS MANUAL ◀

This manual is prepared for all personnel who use REX-F9 series. This manual is also written especially for readers who have a fundamental knowledge of electrical engineering, control engineering or communication.

► CAUTIONS ◀

- The contents of this manual may 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-F9 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 damages 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 damages.

► MARKING CAUTIONS ◀

For safe operation of "REX-F9", 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.

1. PRODUCT CHECK

Check whether the delivered product is as specified by referring to the following model code list.

Model code

REX-F9 □□□-□□*□□-□□-□□
 ①②③ ④⑤ ⑥⑦ ⑧⑨ ⑩

① Control action

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

② Alarm action [#D]

- N : No first alarm
- S : 1 point alarm action
- D : 2 point alarm action

③ Input range

- C : Thermocouple input
- R : RTD input
- : Voltage or Current output (See signal code table.)

④ First control output[OUT(1)](Heating side)

- M : Relay contact output V : Voltage pulse output
- R : Current output [#B]
- E : Continuous voltage output [#B]
- G : Trigger(for triac driving)
- T : Triac output

⑤ Second control output[OUT(2)](Cooling side)

- No symbol : When control action is H or F type.
- M : Relay contact output V : Voltage pulse output
- R : Current output [#C]
- E : Continuous voltage output [#C]
- T : Triac output

⑥ Analog input [option]

(External setpoint or heater break alarm)

- N : Not supplied
- : External setpoint function(See signal code table.)
- H : Heater break alarm function [#D]

⑦ Contact output [option]

- N : Not supplied
- 1 : Step, remote/auto, remote auto/manual [#A]

⑧ Analog output 1 (or control output) [option]

- N : Not supplied
- : See signal code table. [#B]

⑨ Analog output 2 (or control output) [option]

- N : Not supplied
- : See signal code table. [#C]

⑩ Communication function [option]

- N : Not supplied
- 2 : RS-422A serial communication function [#A]

<Signal code>

- 1: 0 to 10 mV DC 2: 0 to 100 mV DC 3: 0 to 1 V DC
- 4: 0 to 5 V DC 5: 0 to 10 V DC 6: 1 to 5 V DC
- 7: 0 to 20 mA DC 8: 4 to 20 mA DC 9: Others

#: The functions paired with the same alphabet are only selectable either of them.

Accessories

- Mounting brackets (2 pcs.)
- Instruction manual [IMF917-E3] (1 copy)

2. MOUNTING

WARNING

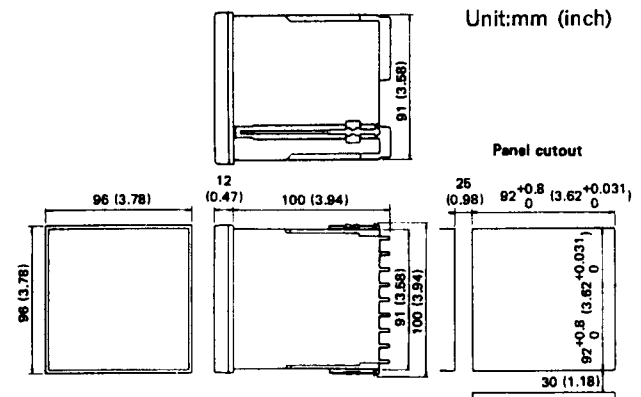
- In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.

2.1 Cautions for mounting

Avoid the following when selecting the mounting location.

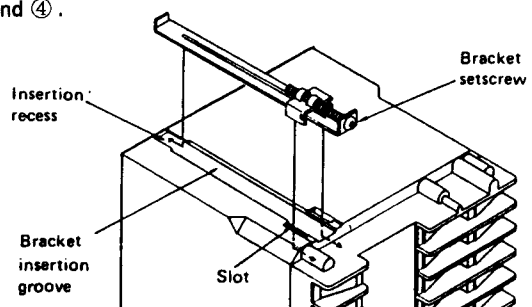
- Ambient temperature of less than 0 °C (32 °F) or more than 50 °C (122 °F).
- Ambient humidity of less than 45% or more than 85% RH.
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, 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



2.3 Mounting procedures

- ① Make a rectangular cutout corresponding to the number of controllers to be mounted on panel by referring to the panel cutout dimensions.
- ② Insert the controllers into the panel from the panel front.
- ③ Insert an upper mounting bracket along the bracket insertion groove from the back, and then engage a projection at the bracket end with a recess at the groove front and also insert metal fitting legs into slots.
- ④ Tighten a bracket setscrew from the rear of the bracket with Phillips screwdriver. Do not overtighten the bracket setscrew.
- ⑤ Set the other mounting bracket in the same way as in ③ and ④.



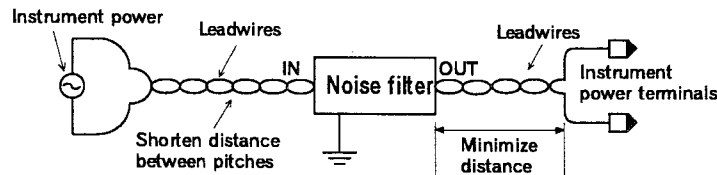
3. WIRING

⚠ WARNING

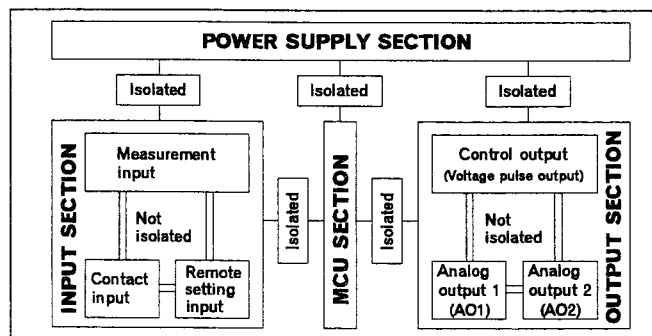
- In order to prevent electric shock or instrument failure, do not turn on the power supply until all of the wiring is completed.
- If failure or error of this instrument could result in a critical accident of the system, install an external protection circuit to prevent such an accident.
- In order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

3.1 Cautions for wiring ⚠

- (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.

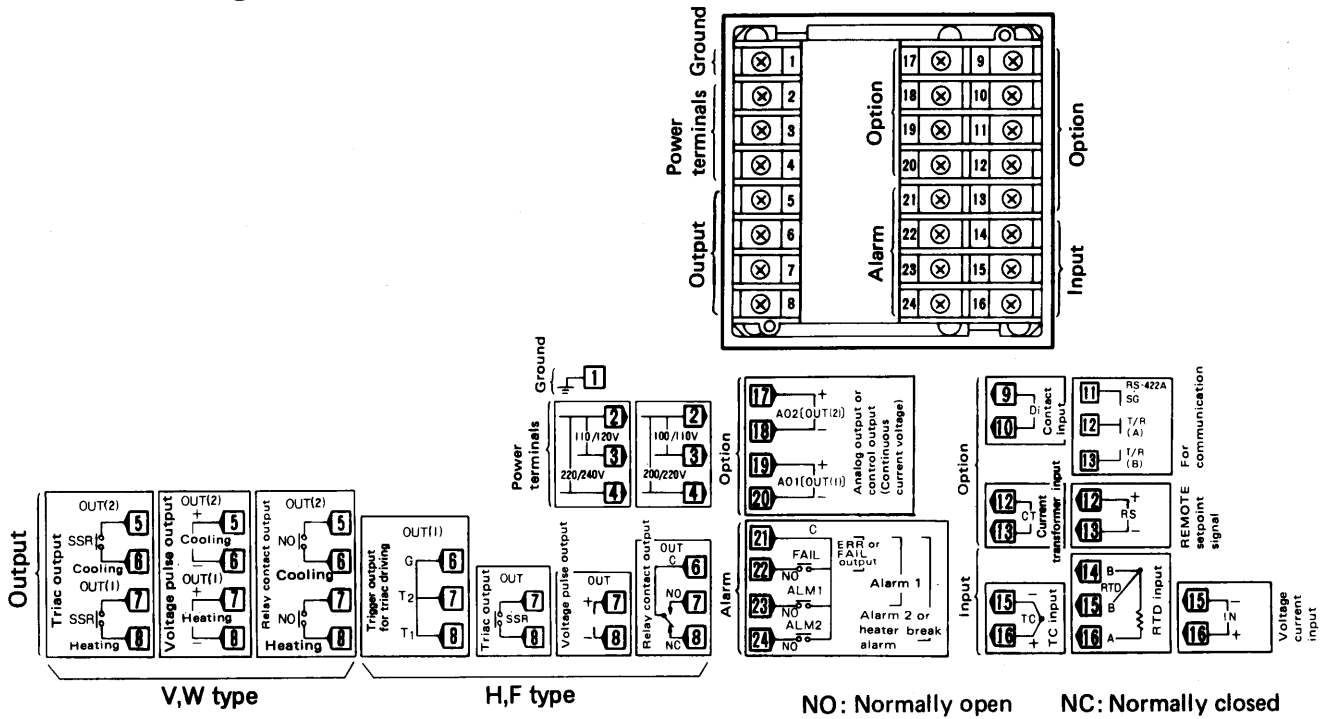


- (5) For wiring, use wires conforming to the domestic standard of each country.
 - Use vinyl covered power supply wires, use 600 V Polyvinyl chloride insulated wires (JIS C3307).
 - For instrument to the earth through the shortest route possible using an electric wire a nominal conductor cross section of 2.0 mm² or larger. [Grounding resistance : Less than 100 Ω]
- (6) 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.
- (7) The figures below show the REX-F9 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.

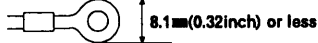


- (8) This instrument has no power supply switch nor fuses. Therefore, install them separately close to the instrument, if required. [Recommended fuse rating : Rated voltage;250V Rated current;1A Type;Time-lag fuse]
- (9) This instrument is intended to be used under the following environmental conditions. (IEC1010)
[OVERVOLTAGE CATEGORY II , POLLUTION DEGREE 2]

3.2 Terminal configuration



- Crimp-style terminal lug
Therefore, use the lug suitable for a screw of M3.



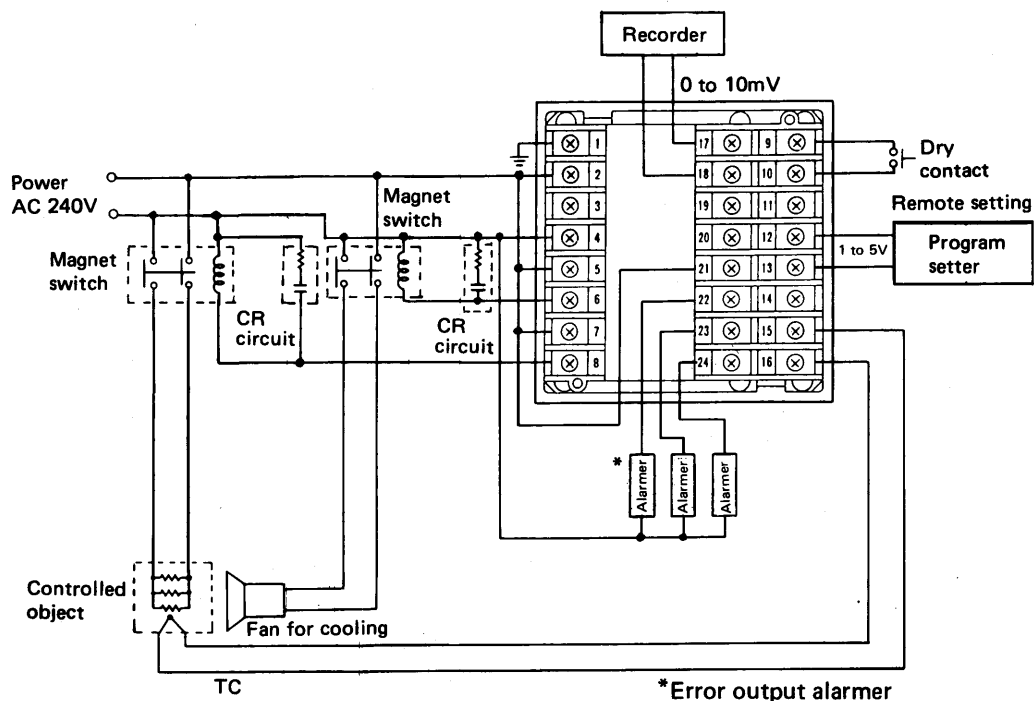
- Recommended tighten torque : 0.4N·m(4kgf·cm)
[Maximum allowance tighten torque : 1.0N·m(10kgf·cm)]

NOTES

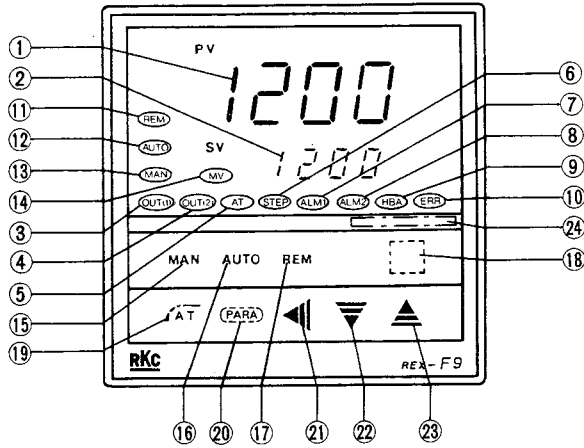
1. Terminals which are not used according to the controller type are all removed. (Excluding UL-approval type)
2. For thermocouple input, no metal piece is attached to terminal No.14. Instead, the temperature compensation element in the internal assembly is projected through a hole at terminal No.14. Do not damage the above temperature compensation element when the internal assembly is removed from the case.

3.3 Wiring example

REX-F9_W^V DC-MM*61-N1-N



4. 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 Step lamp (Green) (Option)
- ⑦ Alarm 1 (ALM1) lamp (Red)
- ⑧ Alarm 2 (ALM2) lamp (Red)
- ⑨ Heater break alarm (HBA) lamp (Red) (Option)
- ⑩ Error (ERR) lamp (Red)
- ⑪ Remote mode (REM) lamp (Green) (Option)
- ⑫ Auto mode (AUTO) lamp (Green)
- ⑬ Manual mode (MAN) lamp (Green)
- ⑭ Manipulated output (MV) lamp (Green)
- ⑮ Manual mode (MAN) key
- ⑯ Auto mode (AUTO) key
- ⑰ Remote mode (REM) key (Option)
- ⑱ Hidden key
- ⑲ Auto-tuning (AT) key (Option)
- ⑳ Parameter select key
- ㉑ Setting digit shift key
- ㉒ Set-value decrement key
- ㉓ Set-value increment key
- ㉔ Input range display

(Descriptions of the instrument with communication function are slightly different from those of instruments without communication.)

5. OPERATION

5.1 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 (PARA) key is pressed, parameters change as shown in the following table (When the last parameter is displayed, it returns to the first parameter). As 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.		
*1 581	SV1	Set-value	Desired value for control Any value is settable within input range.	Within input range	0 or 0.0
*2 582	SV2	Step set-value	Sets 2nd set point. It is selected by contact input.	Within input range	0 or 0.0
*3 58r	SVr	Remote set input value	Displays set-value (SV(R)) from external setting unit.	Setting is not possible.	
*4 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.	
*5 AL1	AL1	Alarm 1	Sets alarm set-value of Alarm 1.	-1999 to +9999 [Hysteresis band TC, RTD input: 2 or 2.0°C[°F] Voltage/current input: 0.2% of span] Decimal point position is the same as that of input range.	50 or 50.0 (Voltage/current input: 5.0)
*6 AL2	AL2	Alarm 2	Sets alarm set-value of Alarm 2.	-1999 to +9999 [Hysteresis band TC, RTD input: 2 or 2.0°C[°F] Voltage/current input: 0.2% of span] Decimal point position is the same as that of input range.	50 or 50.0 (Voltage/current input: 5.0)
*7 HbA	HbA	Heater break alarm	Alarm value is set by referring to input value from the current transformer (CT).	0.0 to 100.0A	0.0

to " rB " (MV)
from " oH " (oH)

from "HbR" (HbA)

Measured-value (PV) display unit	Symbol	Name	Description	Setting range	Initial value prior to shipment
*8	MV	Manipulated output	Sets manipulated output in the manual mode.	-5.0 to +105.0% (H, F type) -105.0 to +105.0% (V, W type)	0.0
	P	(Heating-side) proportional band	Set when proportional control is performed (on the heating-side).	1 to span or 0.1 to span (TC or RTD input) 0.1 to 100.0% for input range (voltage/current input) (ON/OFF action with P set to "0" or "0.0".)	30 or 30.0 (Voltage/current input 3.0)
	I	Integral time	Eliminates offset occurring in proportional control.	1 to 3600 sec. (I action turns OFF with I set to "0".)	240
	d	Derivative time	Prevents ripples by predicting output change, thereby improving control stability.	1 to 3600sec. (D action turns OFF with D set to "0".)	60
	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
*9	T	(Heating-side) proportional cycle	Sets control output cycle (on the heating-side).	1 to 100 sec.	Relay contact output : 20 Voltage pulse output, Trigger output for triac driving, Triac output : 2
*10	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] (For TC or RTD input) ● 0.0 to 10.0% of input range (For voltage or current input)	0 or 0.0
*11	t	(Cooling-side) proportional cycle	Sets control output cycle on the cooling-side.	1 to 100 sec.	Relay contact output : 20 Voltage pulse output Triac output : 2
	Pb	PV bias	Sensor is corrected by adding a bias value to measured-value (PV).	-1999 to +9999 (Decimal point position is the same as that of input range.)	0 or 0.0
*12	oH	ON/OFF action hysteresis band	Sets hysteresis band in ON/OFF action control.	For TC or RTD input 0 to 100°C [°F] or 0.0 to 100.0°C [°F] 0 to ±50°C [°F] or 0.0 to ±50.0°C [°F] for set-value (SV1) or step set-value (SV2). For voltage or current input 0.0 to 100.0% of span 0.0 to ±50.0% of span from set-value (SV1) or step set-value (SV2).	2 or 2.0 (Voltage/current input : 0.2)

to Measured-value

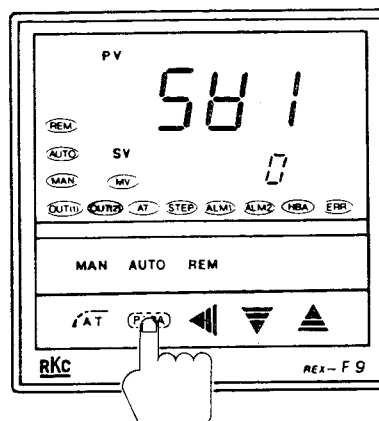
- *1 : [When no step function is provided.]
Does not display when the balanceless/bumpless function (during remote/auto transfer) is provided and during remote setting operation.
- *1, *2 : [When the step function is provided.]
Does not display the set-value selected by the step function when the balanceless/bumpless function (during remote/auto transfer) is provided and during remote setting operation.
- *2 : Does not display when no step function is provided, remote auto mode/manual mode transfer is provided and remote mode/auto mode transfer by contact input is provided.
- *3 : Does not display when no external setting function is provided and the heater break alarm function is provided.
- *3, *4 : Neither of them is displayed simultaneously.
- *4, *7 : Does not display when no heater break alarm function is provided, the external setting function is provided and 2 alarm outputs are provided.
- *5 : Does not display when no alarm is provided.
- *6 : Does not display when no alarm is provided, one alarm output is provided and heater break alarm function is provided.
- *6, *7 : Neither of them is displayed simultaneously.
- *7 : Heater break alarm function is not available on a current output or a continuous voltage output type.
- *8 : Does not display when the balanceless/bumpless function is selected during remote auto/manual transfer.
- *9, *11 : Does not display when current output or continuous voltage output is provided.
- *10 : Control actions become ON/OFF actions for both the heating and cooling side with heating-side proportional band set to "0" or "0.0".
- *12 : This setting becomes invalid if ON/OFF action control (proportional band is other than "0" or "0.0") is not performed.
- : This is displayed only in the heating/cooling control (V or W) type.

5.2 Each parameter setting

Following is an example of setting the set-value (SV1) to 200°C.

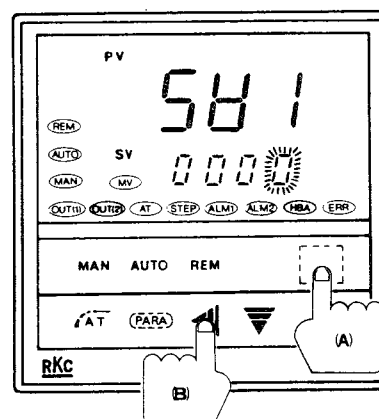
①

Press the **(PARA)** key to display the set-value (SV1) parameter symbol (**SV1**) on the measured-value (PV) display unit.



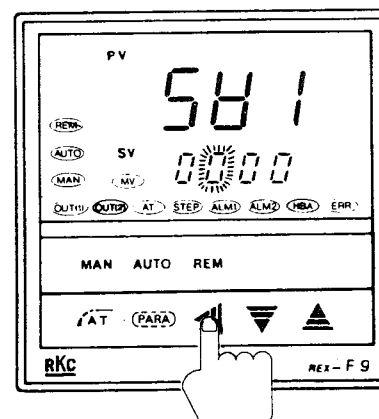
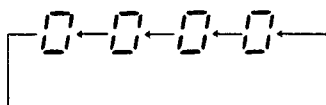
②

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

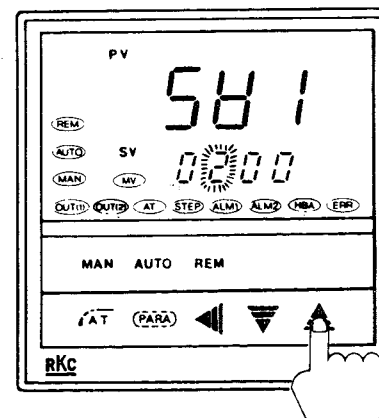
Press the **▲** key to set "2". Pressing the **▲** key increments numerals, and pressing the **▼** key decrements numerals.

●Setting range: Within input range

When minus (-) sign is set.

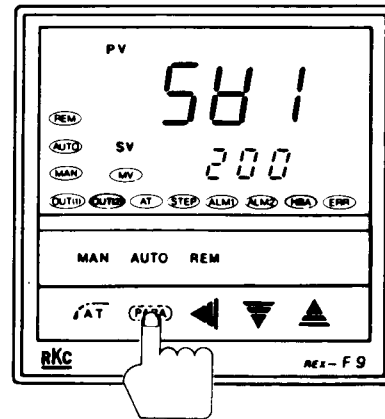
Example:

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.



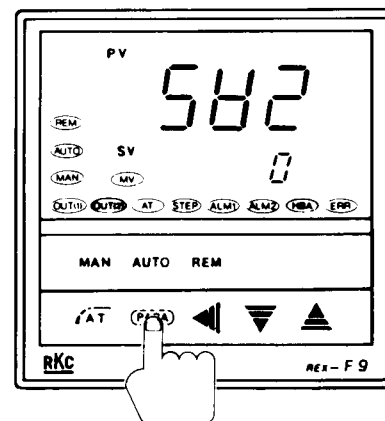
⑤

After finishing the setting, press the (P̄ARA) key. All of the set-value digits light brightly to indicate that the setting has ended.



⑥

Pressing the (P̄ARA) key again, then 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 (SV1), 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 "6. 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 displayed by the (P̄ARA) key (including display other than measured-value and that in the set mode), when the operation mode is changed, and the step function is actuated, the measured-value (PV) display unit displays a measured-value, and the set-value (SV) display unit displays any of set-value (SV1), step set-value (SV2), remote set-value (SV (R)) and manipulated output (MV).

5.3 Operation mode transfer

Operation mode transfer is performed by the instrument front key or contact input.

When the mode is transferred by the front key, press the key corresponding to the mode desired to be changed while pressing the hidden key. At this time, the lamp corresponding to the mode changed lights up.

However, for the instrument whose mode can be changed by contact input, the lamp may sometimes flash (For operation mode transfer by contact input, and the priority of transfer by the front key and the contact input, see "6. MAIN FUNCTIONS").

5.4 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, the AT lamp stops flashing. 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 5.2).
- (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 (SV1) or step set-value (SV2) during progress in the auto-tuning function, or changing the PV bias value, suspend the auto-tuning to perform PID control using the values before auto-tuning start.

5.5 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 or downscale of measured-value display.
 - Upscale For TC or RTD input
 - Downscale For TC (To be specified when ordering), Voltage or current input
- (3) No influence is exerted upon the controller for power failure of less than 30ms. For power failure of more than 30ms, 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).

6. MAIN FUNCTIONS

6.1 Self-diagnostic function

① Without communication function

Self-diagnostic function	During abnormality	
	*Display	Output
Non-volatile RAM check	"ERR" flashes on the measured-value (PV) display unit.	<ul style="list-style-type: none"> • Error output . . . Contact open
A/D converter check		
CPU power monitoring	The error (ERR) lamp (red) lights.	<ul style="list-style-type: none"> • Control output [Relay contact, voltage pulse, trigger (for triac driving), triac] } OFF • Alarm output • Control output (Current, continuous voltage) } Output low-limit • Analog output

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

② With communication function

Self-diagnostic function	During abnormality	
	*Display	Output
Non-volatile RAM check	FAIL lamp (red) lights and all other lamps on REX-F9 will light out.	<ul style="list-style-type: none"> • FAIL output . . . Contact open
A/D converter check		
CPU power monitoring		
Watch-dog timer		

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

6.2 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 "oooo".
- 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 "uuuu".

Input	Type	Input display Range
TC	K	-30 to +1372°C, -30 to +2502°F
	J	-30 to +1200°C, -30 to +2192°F
	R	-30 to +1769°C, -30 to +3216°F
	S	-30 to +1820°C, -30 to +3308°F
	B	-30 to +1000°C, -30 to +1832°F
	E	-30 to +1300°C, -30 to +2372°F
	N	-30 to +400°C, -30 to +752°F
	T	-199.9 to +400.0°C, -199.9 to +752.0°F
	L	-30 to +900°C, -30 to +1652°F
RTD	Pt100 (JIS/IEC)	-199.9 to +649.0°C
	JPt100 (JIS)	
	Pt100 *1	-199.9 to +999.9°F
	JPt100 *2	
Voltage/current		(Low limit of setting range)-(3% of span) to (High limit of setting range)+(3% of span)

*1 Conforming to JIS/IEC

*2 Conforming to JIS

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

6.3 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 (PARA) 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.

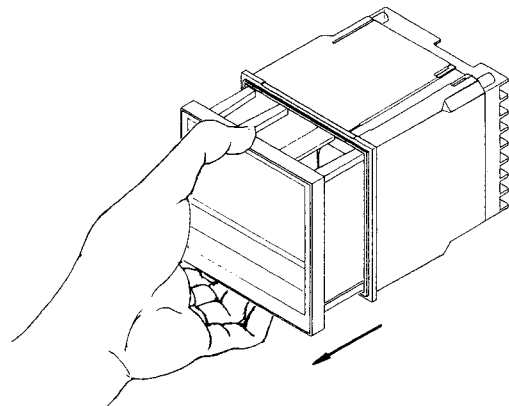


Fig. 1

Next, turn ON internal switch No. 2 at the upper part of the controller (Do not touch other switches). (Fig. 2, 3)

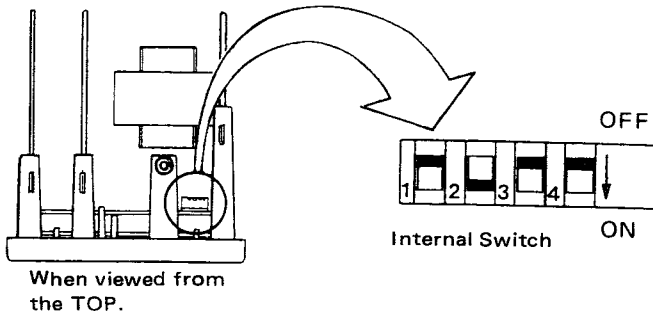


Fig. 2 Without communication function

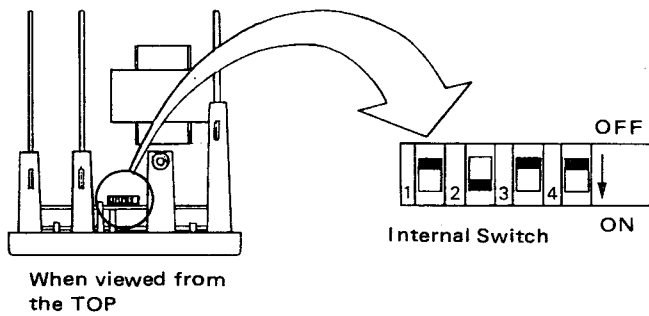


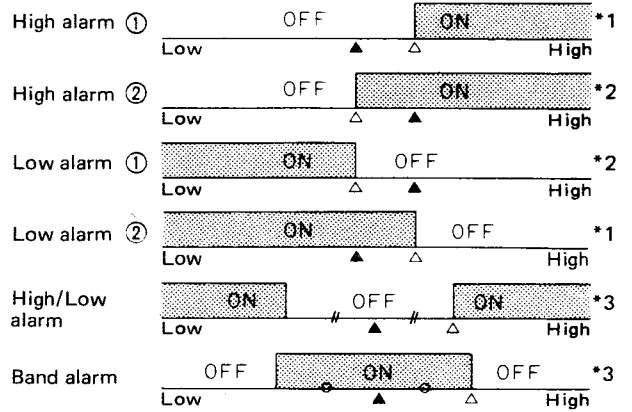
Fig. 3 With communication function

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

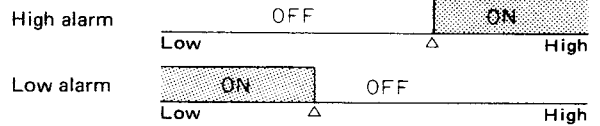
6.4 Alarm (ALM) function

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

● Deviation alarm



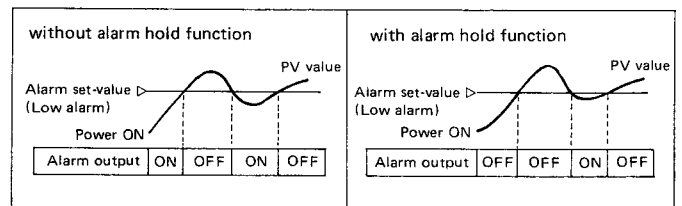
● Process alarm



- *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 for the following cases.

- ① When the set-value (SV1) (or step set-value (SV2)) is changed.
- ② The set-value is changed by the step function.
- ③ When the PV bias value is changed.

6.5 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 (\bar{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 weld of the relay contacts when control output is off and when the input value from the current transformer input (\bar{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 ($\overline{\text{PARA}}$) key to set the parameter to " \bar{I} " (current transformer input). The measured heater current is displayed in A (amperes).
- ② Next, press the ($\overline{\text{PARA}}$) key to display "HBR" (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 (\bar{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 \bar{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 $20(\text{A}) \times 0.85 = 17(\text{A})$.

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

- ③ After the above setting is finished, press the ($\overline{\text{PARA}}$) key. All the set-value digits then light up brightly to indicate that the setting is finished.

6.6 Step function

The controller has 2 set-values (SV).

This step function selects these 2 set-values (SV) by contact input (Rear terminal Nos. 9 and 10).

Contact open Set-value (SV1)

Contact closed Step set-value (SV2)

6.7 Analog output

As analog output, any one of manipulated output (MV), measured-value (PV), set-value (SV1) (or step set-value (SV2)) and remote set-value (SV(R)) can be selected. The maximum number of output points is 2, but when control output is current or continuous voltage, the number of analog output points lessens by the number of control output points due to the use of those analog output terminals.

For the number of analog output points, see "6. SPECIFICATION. (7) Model No."

6.8 Functions of operation mode transfer

The remote/auto and remote auto/manual mode can be transferred through instrument front key operation and also by contact input.

(Rear terminals Nos. 9 and 10)

- ① For remote/auto transfer

Mode selected by front key	Contact status	Set-value used for computation (SV)	Computation	Lamp status		
				REM	AUTO	MAN
Remote mode (REM)	Open	Set-value (SV1)	PID	Δ	\circ	—
	Closed	Remote set-value (SV (R))		\circ	—	—
Auto mode (AUTO)	Open *	Set-value (SV1)		—	\circ	—
	Closed *			—	\circ	—
Manual mode (MAN)	Open *		Manual	—	—	\circ
	Closed *			—	—	\circ

\circ : Light up Δ : Flashing — : Light out

* No influence is exerted on contact status.

- ② For remote auto/manual transfer

Mode selected by front key	Contact status	Set-value used for computation (SV)	Computation	Lamp status		
				REM	AUTO	MAN
Remote mode (REM)	Open		Manual	Δ	—	\circ
	Closed	Remote set-value (SV (R))	PID	\circ	—	—
Auto mode (AUTO)	Open		Manual	—	Δ	\circ
	Closed	Set-value (SV1)	PID	—	\circ	—
Manual mode (MAN)	Open *		Manual	—	—	\circ
	Closed *			—	—	\circ

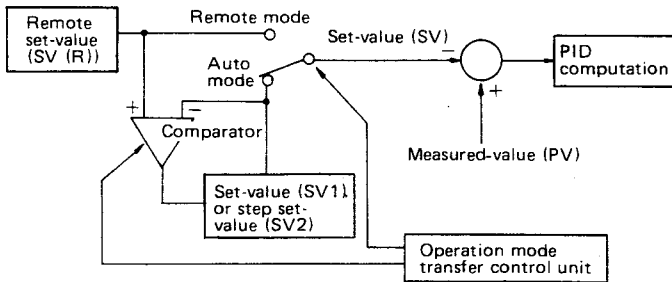
\circ : Light up Δ : Flashing — : Light out

* No influence is exerted on contact status.

6.9 Balanceless/bumpless transfer

(1) Balanceless/bumpless remote/auto transfer

In a controlled object which does not desire rapid output change with changes in set-value (SV), this function restricts rapid change in set-value (SV) during transfer from the remote mode to the auto mode and vice versa.



Conceptual diagram of balanceless/bumpless remote/auto transfer

① Operation during transfer from the remote mode to the auto mode

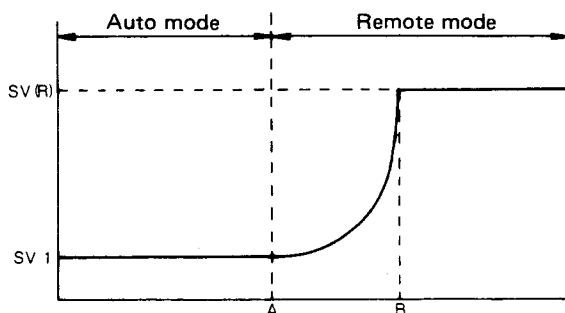
The set-value (SV1) (or step set-value (SV2)) matches to the remote set-value (SV (R)) by the comparator.

② Operation during transfer from the auto mode to the remote mode

When the auto mode is transferred to the remote mode, the display shows a value in the remote mode.

However, the set-value (SV) does not immediately change to the remote set-value (SV (R)), but the comparator gradually changes the set-value (SV1) (or step set-value (SV2)) to match it to the remote set-value (SV (R)).

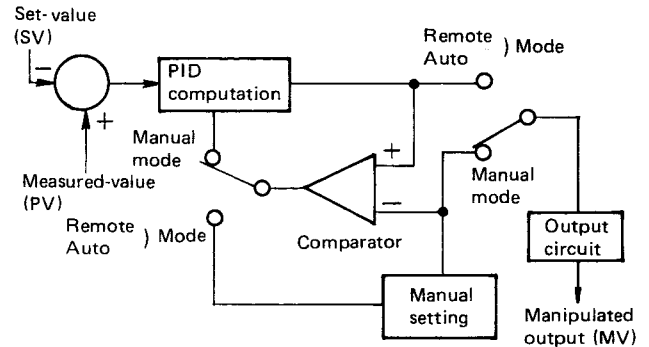
— Example —



When the auto mode is transferred to the remote mode at time A, the set-value changes exponentially from SV1 to SV (R) and reaches SV (R) at time B. For control from time A to time B, the set-value now changing is used.

(2) Balanceless/bumpless remote auto/manual transfer

In a controlled object which does not desire rapid output change, the operation mode is transferred after the manipulated output (MV) on the side transferred to the present manipulated output (MV) is automatically matched.



Conceptual diagram of balanceless/bumpless remote auto/manual transfer

① Operation during transfer from the manual mode to the remote mode (or auto mode)

The comparator compares the output value in the remote mode (or auto mode) with that in the manual mode and a signal is fed back to the integral term (I) so that these values become equal.

For the above reason, the following relationship is maintained. $[\text{PID computed value}] + [\text{Feedback value from comparator}] = [\text{Output value in manual mode}]$ Therefore, no balanceless/bumpless transfer from the manual mode to the remote mode (or auto mode) is made with the I action turned OFF.

Also, when a measured-value (PV) is out of the proportional band, no balanceless/bumpless transfer is made.

② Operation during transfer from the auto mode (or remote mode) to the manual mode

When the switch in the above Fig. is turned to the remote-auto mode, a comparator output is fed back to the manual setting to always match the output value in the remote (or auto mode) to that in the manual mode.

7. SPECIFICATIONS

(1) Input

Influence of external resistance	Approx. $0.35\mu\text{V}/\Omega$ (For TC input)	
Influence of input lead	Approx. $0.0075\%/ \Omega$ of reading (For RTD input)	
Display accuracy	<ul style="list-style-type: none"> • Within $\pm(0.3\%$ of displayed value +1 digit) or $\pm 2^\circ\text{C}[\pm 4^\circ\text{F}]$ (For TC input) $\pm 0.8^\circ\text{C}[\pm 1.6^\circ\text{F}]$ (For RTD input) * Whichever is greater. • Within $\pm(0.2\%$ of span +1 digit) (For voltage/current input) 	
External setting input signal	Input impedance	<ul style="list-style-type: none"> • Voltage input: $250\text{K}\Omega$ or more • Current input: Approx. 250Ω
	Operation during input disconnection	Downscale

(2) Setting

	Range	Resolution	Accuracy
Set-value (SV1) (Step set-value (SV2))	Same as input range.	<ul style="list-style-type: none"> • $1^\circ\text{C}[^{\circ}\text{F}]$ or $0.1^\circ\text{C}[^{\circ}\text{F}]$ (For TC or RTD input) • 0.001 to 1 Depending on decimalpoint position (For voltage/current input) 	<ul style="list-style-type: none"> • Within $\pm(0.3\%$ of set-value (SV) +1 digit) $\pm 2^\circ\text{C}[\pm 4^\circ\text{F}]$ (For TC input) $\pm 0.8^\circ\text{C} \pm 1.6^\circ\text{F}$ (For RTD input) * Whichever is greater. • Within $\pm(0.2\%$ of span +1 digit) (For voltage/current input)
(Heating-side) proportional band (P)	<ul style="list-style-type: none"> • 1 to span or 0.1 to span (For TC or RTD input) • For input range 0.1 to 100.0% (For voltage/current input) 	<ul style="list-style-type: none"> • $1^\circ\text{C}[^{\circ}\text{F}]$ or $0.1^\circ\text{C}[^{\circ}\text{F}]$ (For TC or RTD input) • 0.1% (For voltage/current input) 	<ul style="list-style-type: none"> • Within $\pm 0.5\%$ of setting range
(Cooling-side) proportional band (Pc)	1 to 1000% of heating-side P band	1%	
Integral time (I)	1 to 3600 sec.	1 sec.	
Derivative time (D)			
Anti-reset windup	1 to 100% of P	1%	
Dead band	<ul style="list-style-type: none"> • 0 to $10^\circ\text{C}[^{\circ}\text{F}]$ or 0.0 to $10.0^\circ\text{C}[^{\circ}\text{F}]$ (For TC or RTD input) • 0.0 to 10.0% of input range (For voltage/current input.) 	<ul style="list-style-type: none"> • $1^\circ\text{C}[^{\circ}\text{F}]$ or $0.1^\circ\text{C}[^{\circ}\text{F}]$ (For TC or RTD input) • 0.1% (For voltage/current input) 	
(Heating-side) proportional cycle	1 to 100 sec.	1 sec.	
(Cooling-side) proportional cycle	1 to 100 sec.	1 sec.	

(3) Output

Control output	Relay contact 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 800Ω or more)
	Current output	4 to 20mA DC, 0 to 20mA DC (load resistance 600Ω or less)
	Continuous voltage output	0 to 5V DC, 0 to 10V DC, 1 to 5V DC (load resistance $1\text{K}\Omega$ or more)
	Trigger output for triac driving	Zero-cross method for medium capacity triac driving.
	Triac output	Capacity 0.5A (at ambient temperature $40^\circ\text{C} [104^\circ\text{F}]$), zero-cross method.

(4) Alarm

Type	Process alarm, Deviation alarm	
Action	High alarm, Low alarm, High/Low alarm, Band alarm (High/Low,Band; for Deviation alarm only)	
Setting range	-1999 to +9999	
Setting resolution	Same as set-value (SV1)	
Setting accuracy		
Hysteresis	2 or $2.0^\circ\text{C}[^{\circ}\text{F}]$ (For TC or RTD input) 0.2% of span (For voltage/current input)	
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	Current transformer input		
	Setting accuracy	Within $\pm 5\%$ of set-value or $\pm 2\text{A}$ (Whichever is greater.)		
Contact input	Output	Relay contact output: 125V AC, 0.6A * 250V AC, 1A (Resistive load) 1 "a" contact Electrical life: 50,000 times or more (Rated load)		
	Input type	Dry contact input $500\text{K}\Omega$ or more Open 10Ω or less Closed		
Analog output	Contact current	4mA or less (Current flowing when each external contact terminal is shorted.)		
	Voltage when opened	17VDC or less (With built-in power)		
	Wiring distance	10m or less (Differs with installation environment (noise, etc.))		
	No. of output points	2 points, max.		
Analog output	Output type	Continuous voltage/current		
	Resolution	10 bits or more		
	Output signal	0 to 10mV	0 to 1V	0 to 20mA
		0 to 100mV	0 to 5V	4 to 20mA
	Output impedance	Approx. 10Ω	0.1 Ω or less	5M Ω or more
Allowable load resistance		20K Ω or more	1K Ω or more	600 Ω or less

* For UL-approval

(6) Other specifications

Error or Fail output	No. of points	1 point
	Type	Relay contact output (Open during abnormality)
	Rating	Load 125V AC*, 250V AC 0.1A or less (Resistive load)
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	8VA or less	
Allowable ambient temperature	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	Without communication function: Approx. 800 g (1.76 lb) With communication function: Approx. 850 g (1.87 lb)	

* For UL-approval

* Input scale range

Input	Type	Scale Range
TC	K	0 to 1372°C, 0 to 2502°F
	J	0 to 1200°C, 0 to 2192°F
	R	0 to 1769°C, 0 to 3216°F
	S	
	B	0 to 1820°C, 0 to 3308°F
	E	0 to 1000°C, 0 to 1832°F
	N	0 to 1300°C, 0 to 2372°F
	T	0 to 400°C, 0 to 752°F -199.9 to +400.0°C, -199.9 to +752.0°F
	L	0 to 900°C, 0 to 1652°F
PL-II	0 to 1390°C, 0 to 2534°F	
RTD	Pt100 (JIS/IEC)	-199.9 to +649.0°C
	JPt100 (JIS)	
	Pt100 *1	-199.9 to +999.9°F
	JPt100 *2	
Voltage/ current		Can be programmed in the range of -1999 to +9999

☆ For thermocouple inputs, R, S and B, display accuracy and setting accuracy differ from those of other thermocouple inputs.
R, S Within $\pm 4^\circ\text{C}$ (8°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).

*1 Conforming to JIS/IEC

*2 Conforming to JIS

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

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RKc. RKC INSTRUMENT INC.

I IMF917-E3

HEAD OFFICE: 16-6, KUGAHARA 5-CHOME, OHTA-KU TOKYO JAPAN
 PHONE: 03-3751-9799 (+81 3 3751 9799)
 TELEX : 0246-8818 RKCTOK J
 CABLE : RKCRIKAROL
 FAX : 03-3751-8585 (+81 3 3751 8585)

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