

SINGLE LOOP MCU BASED  
DIRECT DIGITAL CONTROLLERS  
**REX-C4** SERIES  
INSTRUCTION MANUAL

IMC403-E3

**RKC. RKC INSTRUMENT INC.**

IMC403-E3

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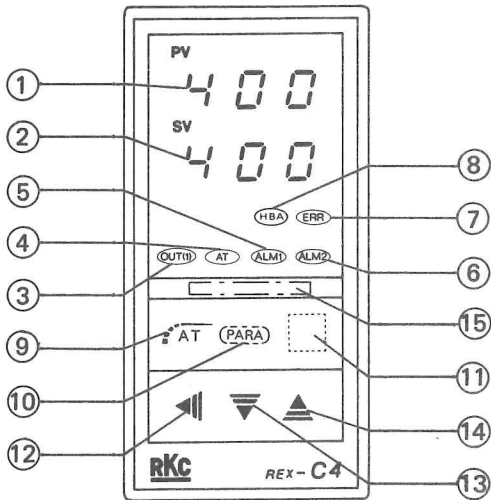
FEB, '89

**Note:**

Arrange that this manual will be handed to person in charge of the Controller.

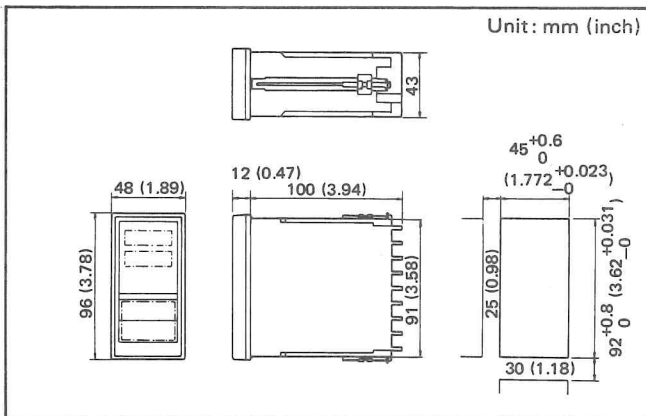
Specification subject to change without notices.

**1. Functional Description**



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

**2. Dimensions**



**3. Operation**

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

Measured-value (PV) display unit	Name	Description	Initial value prior to shipment
Measured-value		Displays measured-value. No setting is made.	
SV	Set-value (SV)	Desired value for control. Any value is settable within input range.	0°C [°F]
CT	Current transformer input (CT)	Displays input value from the current transformer. No setting is made.	
AL1	Alarm 1	Displays alarm set-value of Alarm 1.	50°C [°F]
AL2	Alarm 2	Displays alarm set-value of Alarm 2.	50°C [°F]
HBA	Heater break alarm (HBA)	Alarm value is set by referring to input value from the current transformer.	0.0 A
P	Proportional band (P)	Set when proportional control is performed. Control becomes ON/OFF action with P set to "0".	30°C [°F]
I	Integral time (I)	Eliminates offset occurring in proportional control. Integral action turns OFF with this action set to "0".	240 sec
D	Derivative time (D)	Prevents ripples by predicting output change there-by improving control stability. Derivative action turns OFF with this action set to "0".	60 sec
AR	Anti-reset wind-up (ARW)	Prevents overshoot and/or undershoot caused by integral action effect. Integral action is turned OFF with set to "0".	100%
f	Proportioning cycle	Displays manipulated output cycle (sec.)	Relay contact output: 20 sec. Voltage pulse output: 2 sec.

- \*1, \*4 : Does not display when no heater break alarm is provided, and/or 2 alarm outputs are provided.
- \*2, \*3 : [When no heater break alarm is provided.] Displayed even on the unit without alarm function.
- \*2 : [When heater break alarm is provided.] Does not display when no alarm is provided.
- \*3 : [When heater break alarm is provided.] Does not display when no alarm, one alarm output is provided and heater break alarm is provided.

### 3.2 Each parameter setting

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

	<p>① Press the (PARA) key to display the set-value (SV) parameter symbol (58) on the measured-value (PV) display unit.</p>
	<p>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.</p>
	<p>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.</p> <div style="text-align: center;"> </div>
	<p>④ Press the ▲ key to set "2". Pressing the ▲ key increments numerals, and pressing the ▼ key decrements numerals.</p> <ul style="list-style-type: none"> <li>Setting range: Within input range</li> <li>When minus (-) sign is set</li> </ul> <p>Example: When 200 is changed to -100, shift the digit 1 lit brightly to the hundreds digit, then press the ▼ key to decrement figures in due order of 1 → 0 → -1.</p>
	<p>⑤ After finishing the setting, press the (PARA) key. All of the set-value digits light brightly to indicate that the setting has ended. Pressing the (PARA) key again shifts to the next parameter. Repeat the procedures from ② to ⑤ to set each parameter in order.</p>

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

Each parameter symbol and setting range are shown in the following.

	Parameter Symbol	Setting Range
Current transformer input	CT	No setting is done. Set heater break alarm value by referring to this value.
*1 Alarm 1	AL1	-199 to +999°C[°F] (Hysteresis band : 2°C[°F])
*2 Alarm 2	AL2	-199 to +999°C[°F] (Hysteresis band : 2°C[°F])
Heater break alarm	HbA	0.0 to 99.9 A
Proportional band	P	1 to span°C[°F] ON/OFF action with P set to "0". (Hysteresis band at ON/OFF action: 2°C[°F])
Integral time	I	1 to 999 sec. I action turns OFF with I set to "0".
Derivative time	D	1 to 999 sec. D action turns OFF with D set to "0".
Anti-reset windup	Ar	1 to 100% of P band I action turns OFF with this action set "0".
Proportioning cycle	f	1 to 100 sec.

\*1 : When heater break alarm is not attached : This parameter is displayed even on the unit without alarm function, but setting is disregarded.

\*2 : When heater break alarm is not attached : This parameter is displayed even on the unit without alarm function and/or one alarm signal is output, but setting is disregarded.

#### o Heater break alarm (HBA) setting

- Press the (PARA) key to set the parameter to "CT" (current transformer input). The measured heater current is displayed in A (amperes).
- Next, press the (PARA) 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 (CT). 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 CT value) so that the heater break alarm is turned ON even with on heater broke. 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 ON.  
For example, when current transformer input (CT) is 20A:  
HBA becomes 20(A) x 0.85 = 17(A).  
Therefore, the heater break alarm set-value can be set to about 17A.
- After the above setting is finished, press the (PARA) key. All the set-value digits then light up brightly to indicate that the setting is finished.

#### Caution

- 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. Therefore in this case, check that dip switch No. 2 inside the controller is turned OFF. (For set data lock, see 4 Main Functions.)
- This controller uses each parameter in any digit at the time is was changed.
- 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.
- If key operation is not performed for more than 10 sec. with any parameter displayed by the (PARA) key (including display other than measured value and that in the set mode), the display units show measured and set (SV) value.

### 3.3 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) Conduct auto tuning after set-value (SV), alarm, ARW and proportioning cycle settings have ended.
- (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 show each value on the set-value (SV) display unit.  
(The values before the auto tuning function is activated.)
- (4) When changing the constants automatically set by the auto tuning, change each constant in accordance with each parameter setting (See Item 3.2.)
- (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.
- (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.

### 3.4 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.)
- (4) The alarm hold action is activated when not only the power is turned ON, but the set-value (SV) is changed.

## 4. Main Functions

### (1) Self-diagnostic function

Self-diagnostic function	During abnormality	
	* Display	Output
① Non-volatile RAM check	"ERR" flashes on the measured value (PV) display unit	<ul style="list-style-type: none"> <li>• Control output (Relay contact, voltage pulse) } OFF</li> <li>• Alarm output</li> </ul>
② A/D converter check		
③ CPU power monitoring	The error (ERR) lamp (Red) lights.	

\* For error display release, turn OFF the power once.  
If the error display appears again after power-ON, constant us.

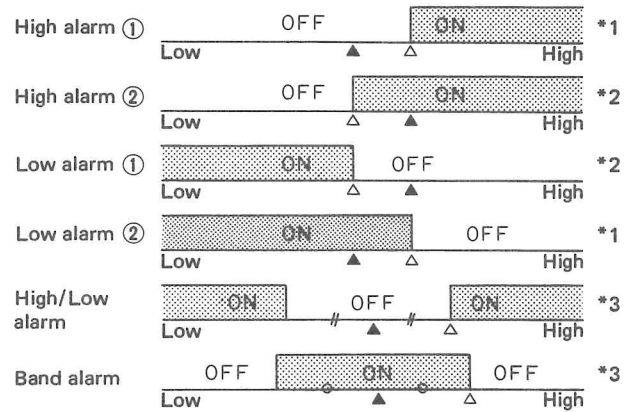
### (2) Overscale and underscale

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

Input	Type	Input display range	
TC	K	-30 to +999°C	-30 to +999°F
	J	-30 to +999°C	-30 to +999°F
	L(DIN)	-30 to +900°C	-30 to +999°F
RTD	Pt100Ω	-199 to +649°C	-199 to +999°F

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

### • Deviation alarm



- \*1 . . . Alarm set-value becomes a plus (+) setting.
- \*2 . . . Alarm set-value becomes a minus (-) setting.
- \*3 . . . Alarm set-value becomes the absolute deviation value setting.

### (4) Heater break alarm (Optional)

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 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 is larger than the set value. (Alarm will not function when the control output OFF time is shorter than 0.5 sec.)
- (5) Set data locking function  
Set-value change by the front key 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  $\overline{\text{PARA}}$  key. Use the 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.

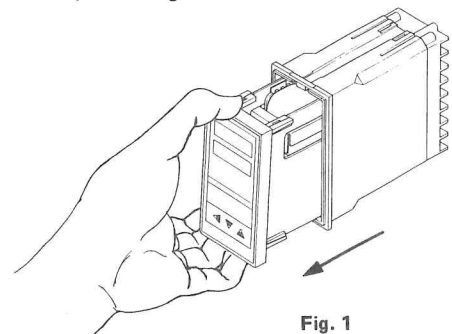


Fig. 1

Next, turn ON internal switch No. 2 at the lower part of the controller.

(Do not touch other switches.) (Fig. 2)

\* These switches are all turned OFF prior to shipment.

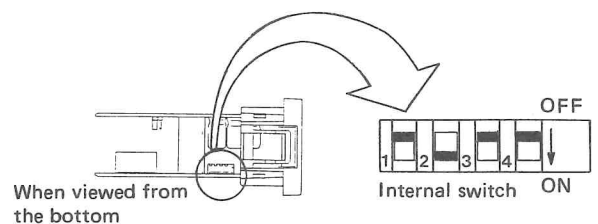


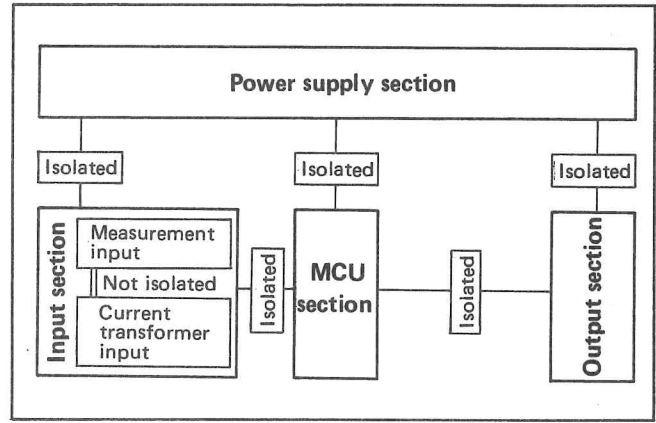
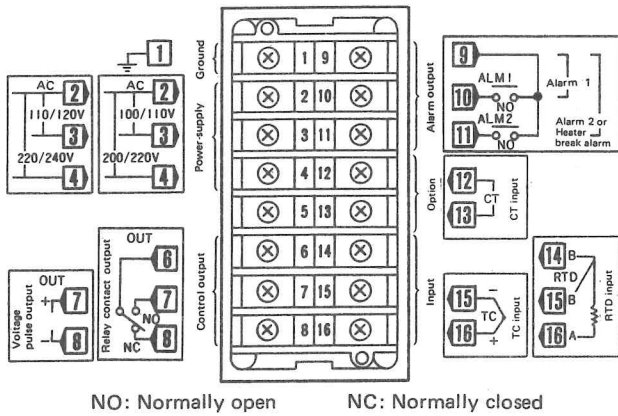
Fig. 2

Thus, the set data has been locked.

For set data locking release, turn OFF internal switch No. 2.

## 5. Wiring

### 5.1 Rear terminal connection



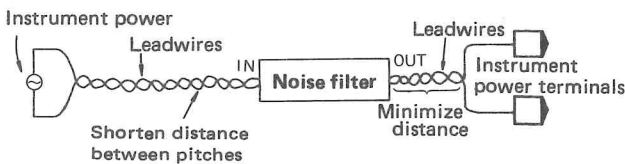
REX-C4 circuit configuration

#### Cautions

1. All of unused terminals are covered by blind patches.
2. For thermocouple input, a temperature compensation element is located at terminal No.14. Therefore, no terminal metal fitting and blind patch are mounted there.

### 5.2 Cautions for wiring

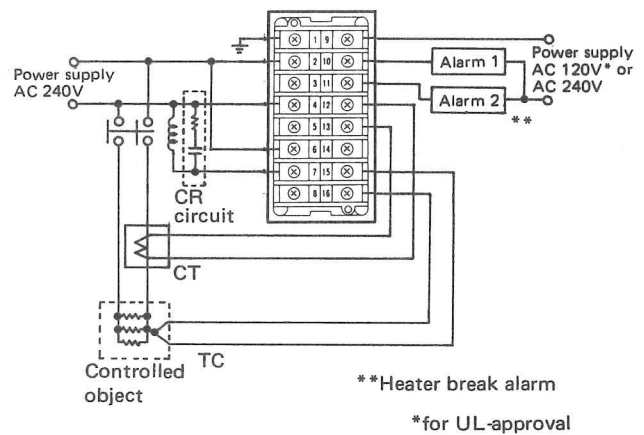
- (1) Conduct input signal wiring away from instrument, electric equipment power and load lines as such as possible to avoid noise induction.
- (2) Conduct instrument power wiring so as not to be influenced from the electric equipment power.  
If it is assumed that a noise generation source is located 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 expected depending on the filter. Therefore, select the filter by referring to its frequency characteristic, etc.
- (3) 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.)
- (4) 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 filter may lessen its effect.
- (5) 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 mm<sup>2</sup>, 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 internal interlock circuit.
- (5) The following Fig. shows the REX-C4 circuit configuration. The power supply, input, MCU and output sections are isolated each other.  
However, pay attention to controller wiring, since each subsection in the input section is not isolated.

### 5.3 Wiring example

REX-C4□DC-MX2



## 6. Specification

### (1) Input

Influence of external resistance	Approx. 0.01°C/Ω (0.02°F/Ω) (For TC input)
Influence of input lead	Approx. 0.0075%/Ω of reading (For RTD input)
Display accuracy	<ul style="list-style-type: none"> <li>• Within ±(0.5% of displayed value +1 digit)</li> <li>or {±3°C [±6°F] (For TC input)</li> <li>or {±2°C [±3°F] (For RTD input)</li> </ul> *Whichever is greater.

### • Input scale range

Input	Type	Scale range
TC	K	0 to 999°C, 0 to 999°F
	J	0 to 999°C, 0 to 999°F
	L(DIN)	0 to 900°C, 0 to 999°F
RTD	Pt100Ω	-199 to +649°C, -199 to +999°F

## (2) Setting

	Range	Resolution	Accuracy
Set-value (SV)	Same as input range.	1°C[°F]	<ul style="list-style-type: none"> <li>• Within ±(0.5% of set value (SV) +1 digit)               <ul style="list-style-type: none"> <li>±3°C[6°F] (For TC input)</li> <li>±2°C[3°F] (For RTD input)</li> </ul> </li> <li>or</li> <li>*Whichever is greater.</li> </ul>
Proportional band(P)	1 to span	1°C[°F]	Within ±0.5% of setting range
Integral time(D)			
Derivative time(D)	1 to 999 sec.	1 sec.	
Anti-reset windup	1 to 100% of P	1%	
Proportioning cycle	1 to 100 sec.	1 sec.	

## (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 one of them.
Allowable voltage variation	Within ±10% of rating
Power consumption	5VA or less (with heater break alarm: 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: 20MΩ or more at 500V DC Between power and grounding terminals: 20MΩ 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. 450g (0.99lb)

## (3) Output

Control output	Relay contact output	250V AC 3A (resistive load) 1 "c" contact Life: 300,000 times or more (rated load)
	Voltage pulse output	0/12V DC (load resistance 800Ω or more)

## (4) Alarm

Type	Deviation alarm	
Action	High alarm, Low alarm, High/Low alarm, Band alarm	
Setting range	-199 to +999	
Setting resolution	Same as set-value (SV)	
Setting accuracy		
Hysteresis	2°C[°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 Life: 50,000 times or more (rated load)
Additional function	Hold action	

\*for UL-approval

## (5) Options

Heater break alarm	Input	CT output
	Setting accuracy	Within ±5% of set value or ±2A (Whichever is greater.)
	Output	Relay contact: 125V AC 0.6A* 250V AC 1A (resistive load) 1 "a" contact Life: 50,000 times or more (Rated load)

\*for UL-approval