SINGLE LOOP MCU BASED DIRECT DIGITAL CONTROLLERS

C-1813-E3

DIN SIZED 96×96mm **REX-C9**

DIN SIZED 96×48mm **REX-C4**

Under application for UL-approval

LEADING CONTROLLERS WITH HIGH TECHNOLOGY

RKC INSTRUMENT INC.

GENERAL DESCRIPTION

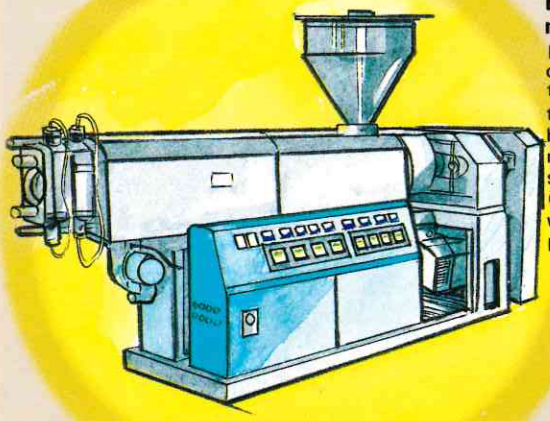
More accurate, more functions.

REX-C9 and REX-C4 series are MCU (Micro Computer Unit) based controllers. It is a great debut of a new era's pioneer with variety of functions such as PID constants auto-tuning, °C/°F selection and many others.

"Simpliness is an important factor on a high precision instrument" is our designing concept, and we proceeded the development based on this concept. As a result, we have eliminated all variable resistors from the hardware to increase reliability and incorporated heat/cool action in a short housing (100mm deep).

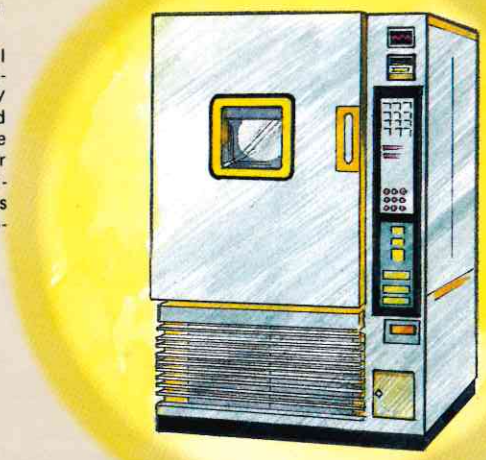
Furthermore, the use of a flat membrane panel eliminates effect by electrostatics, noise and dusts. The use of a hidden key and setting lock switch assures prevention of accidental changing of parameters.

APPLICATIONS



Extrusion and injection molding

In the temperature control of the extruder, temperature tends to go higher by the heat generation caused by friction between the resin and the screw. For such an application, REX-C9 with heat/cool outputs will certainly be appropriate.

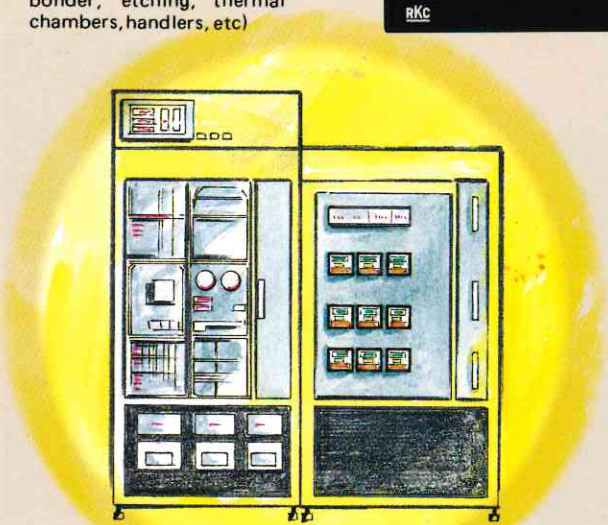


Scientific apparatus, biochemistry, and industrial furnaces

Can be used in constant temperature chamber and drying furnace applications. If miniaturization of the apparatus, operatability, and visual design are major factors of selection, models REX-C4 will be appropriate. If more sophisticated functions are required, model REX-C9 will be appropriate.

Semi-conductor manufacturing process

As an accurate PID controller, the instrument performs superb temperature control in CVD and other process applications. (burn-in aging, bonder, etching, thermal chambers, handlers, etc)



System instrumentation

Widely used in many systems in various industrial fields.

The units contribute to FA (Factory Automation) and LA (Laboratory Automation).

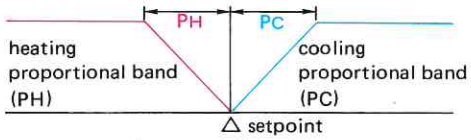
REX-C9 • REX-C4

■ PID Constants Auto-tuning

PID constants auto-tuning which already became as a function of common sense at present, is also available.
The optimum PID constants according to a control object are easily settable just at a touch of the AT Key, therefore the PID controller can be used by any people.

■ Heating/Cooling PID Action (for REX-C9 only)

In the control represented by the extrusion molding, temperature tends to go higher by the heat generation caused by friction etc. For such a case, independent heating and cooling controls not only provide good control result but also contribute to energy saving.



(when integral action is OFF)

■ Deviation Alarm (please refer to TYPE OF ALARM ACTION)

Any one action from several deviation alarm types can be selected (field selectable).

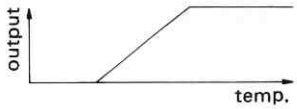
Deviation alarm: The alarm output is switched ON (or OFF) when the input value reaches the alarm set value which is set in degrees above or below the set value (SV).

■ Reconfigurable Thermocouple Input

REX-C9 . . . Field reconfigurable thermocouple input types (K, J, R, S, B, N) by software.
REX-C4 . . . Field reconfigurable thermocouple input types (K, J) by software plus internal jumper change.

■ °C/°F, Direct/Reverse Action Selection

°C/°F selector function may be a good feature for export and Direct/Reverse action may be good for research applications. The figure below shows the direct action which increases the output in accordance with the temperature rise. The cooling action is an example of this.



■ Heater Break Alarm

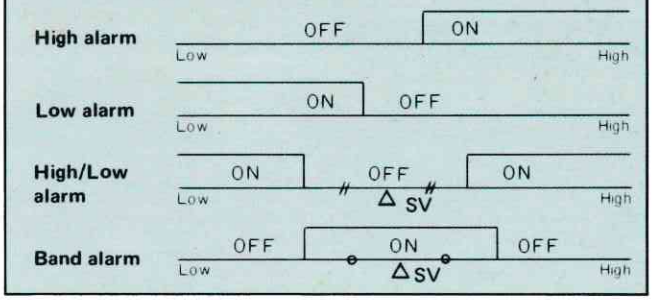
This alarm is essential in the production of high quality products as well as the input break alarm. The instrument shows the load current value when the current detector (CT) is connected. The heater state is constantly monitored only by setting 85% of the shown value as the alarm set value.

* This alarm can be used as an alarm for molten relay contact too.
* This alarm is available on instruments with relay output or SSR drive pulse voltage only (Responsible for ON time longer than 0.5 second)

* When heater break alarm is supplied, dual alarm is not available or when dual alarm is supplied, heater break alarm is not available.

TYPE OF ALARM ACTION

DEVIATION ALARM Alarm setpoint can be above or below the main set-point (except for high/low alarm and band alarm)



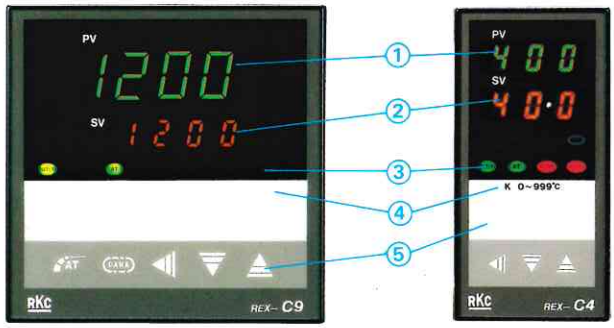
FRONT PLASTIC HARD COVER

The instrument uses membrane type flat keys on the front panel which are effective in protection from electrostatics, noise, and dust. The use of a dual security system (hidden key and internal setting lock switch) assures good protection from misoperation. If a further protection is required, such a plastic acrylic cover (hard cover) shown left is offered as option.
Optional terminal cover is available. Please specify REX-C4 or C9 when ordering.

1. STANDARD TYPE (REX-C9, REX-C4)

FEATURES

- PID Auto-tuning Function
- Heater Break Alarm Function
- Deviation Alarm Function
- °C/°F, Direct/Reverse Action Selector Function
- Self-diagnosis Function
- Reconfigurable thermocouple input types and alarm actions.



NAMES OF PARTS

① **PV display (orange)**
Indicates a measured value.

② **SV display (orange)**
Indicates a set point value.

③ **Indicator lamps** (some lamps are not supplied or different according to the supplied specification.)

OUT(II) ... Lights when output (heating) is ON.

AT ... Lights during auto-tuning.

ALM1 ALM2 ... Lights when alarm output is ON.

HBA ... Lights when HBA output is ON.

ERR ... Lights when self-diagnosis function detects faults.

④ **Input · Range indication**

⑤ **Setting keys (flat keys)**

AT ... Pressed to initiate auto-tuning.

PARA ... Pressed to scroll parameters for setting and monitoring.

◀ ... Cursor shift key.

▼ ... Decrement key.

▲ ... Increment key.

For explanation purpose, all functions are supplied in this figure.

STANDARD RANGES

● REX-C9

( ): minimum resolution

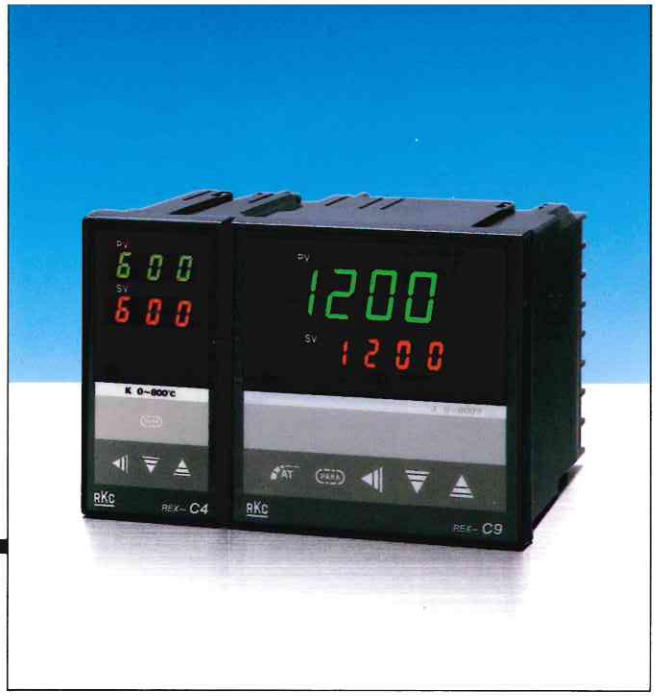
INPUT		STANDARD RANGES
THERMOCOUPLE	Type K (JIS/ANSI)	0~1200°C, 0~1372°C (1°C) 0~1600°F, 0~2502°F (1°F)
	Type J (JIS/ANSI)	0~1200°C (1°C) 0~1600°F, 0~2192°F (1°F)
	Type R, S (JIS/ANSI)	0~1600°C, 0~1769°C (1°C) 0~3200°F, 0~3216°F (1°F)
	Type B (JIS/ANSI)	400~1800°C, 0~1820°C (1°C) 800~3200°F, 0~3308°F (1°F)
	Type N (NBS)	0~1200°C, 0~1300°C (1°C) 0~2300°F, 0~2372°F (1°F)
RTD	Pt 100 (IEC/JIS) JPt 100 (JIS)	−199.9~649.0°C, −199.9~200.0°C, −100.0~50.0°C, −100.0~100.0°C, −100.0~200.0°C, 0.0~50.0°C, 0.0~100.0°C, 0.0~200.0°C, 0.0~300.0°C, 0.0~500.0°C (0.1°C)
	Pt 100 (IEC/JIS equivalent)	−199.9~999.9°F, −199.9~400.0°F, −199.9~200.0°F, −100.0~100.0°F, −100.0~300.0°F, 0.0~100.0°F, 0.0~200.0°F, 0.0~400.0°F, 0.0~500.0°F (0.1°F)

* The accuracy within 0~399°C (0~799°F) is out of guarantee.
* Input types K and J are supplied with maximum range, but they are field adjustable to desired scale ranges (e.g. 0~800°C) using SLH (Scale Limiter High) and SLL (Scale Limiter Low) functions.

● REX-C4

( ): minimum resolution

INPUT		STANDARD RANGES
TC	Type K, J (JIS/ANSI)	0~200°C, 0~400°C, 0~600°C, 0~800°C, 0~999°C (1°C) 0~800°F, 0~999°F (1°F)
RTD	Pt 100 (IEC/JIS) JPt 100 (JIS)	−199~649°C, −199~200°C, −100~100°C 0~50°C, 0~100°C, 0~200°C, 0~500°C (1°C)
	Pt 100 (IEC/JIS equivalent)	−199~999°F, −199~200°F, −100~100°F, −100~300°F, 0~500°F, 0~999°F (1°F)



SPECIFICATIONS

INPUT

- **Input** : Thermocouple (T/C)
  [input impedance more than 5M Ω]
  Resistance Temperature Detector (RTD)
  (refer to "Standard Ranges")
- **Effect of External Resistance** : Approx. 0.4μV/Ω (thermocouple input)
- **Effect of Input Wire Resistance** : Approx. 0.0075%/Ω of read value.
  Less than 10 Ω per 1 wire (RTD input)
- **Input Break Action** : Up-scale (as standard), control output OFF, alarm output ON
  [The down-scale also available as option in case of T/C input]
- **Sampling Cycle** : 0.5 sec.

SETTING

- **Setting Accuracy** : Set Value (SV)
  T/C ; Within ±(0.5% of SV + 1 digit) or ±3°C [6°F] (whichever is larger)
  R, S input 0 ~ 199°C [0 ~ 399°F]
  ... within ±5°C [10°F]
  B input 0 ~ 399°C [0 ~ 799°F]
  ... out of accuracy guarantee range.
  RTD ; Within ±(0.5% of SV + 1 digit) or ±2°C [3°F] (whichever is larger)
  The other SV;
  Within ±0.5% of Setting range

DISPLAY (the figures in [ ] are for REX-C4)

- **Input Display Range**: –1999 ~ 9999 (–199.9 ~ 999.9)
  [–199 ~ 999]°C [°F]
- **Input Display Accuracy** : Same as Setting Accuracy

CONTROL ACTION

- **PID Action (auto-tuning function also available as option)**
  ON/OFF · P · PI · PD action also available, Direct/Reverse action field selectable.

Proportional band (P) : 1 (0.1) to span of setting limiter
When P = 0 (0.0), ON/OFF action; hysteresis width : 2°C [°F]
Integral (I) : 1 ~ 3600 [1 ~ 999] sec.
Derivative (D) : 1 ~ 3600 [1 ~ 999] sec.
} the figures in [ ] are for 3 digit instrument
Anti-Reset Windup (ARW) : 1 ~ 100% of proportional band
Proportional cycle : 1 ~ 100 sec.

OUTPUT

- **Control Output** : Relay contact;
  Capacity 250V AC 3A (resistive load), 1c (NO/NC) contact
  SSR driving;
  0/12V DC (constant voltage pulse)
  [load resistance more than 800 Ω]
  Current;
  0 ~ 20mA or 4 ~ 20mA DC whichever is specified [load resistance less than 600 Ω]

ALARM

- **Alarm Action** : Deviation alarm
  [HOLD action can be specified]
  Refer to "Type of Alarm Action" (Field selectable)
  Relay contact output;
  capacity 250V AC 1A (resistive load), 1a (NO) contact
  (energizing alarm 2 points)
  [The action becomes poor, if used in inductive load]
  Alarm setting range;
  –1999 ~ 9999 (–199.9 ~ 999.9),
  [–199 ~ 999]°C [°F]
  The figures in [ ] are for REX-C4
  Hysteresis width;
  2°C [°F]

GENERAL SPECIFICATIONS

- **Self-diagnosis** : Error display
  Check of non-volatile RAM, A/D converter and CPU power supply.
  Display;
  "E r r" shown on PV display or ERR lamp lights
- **Supply Voltage** : 100/110V, 200/220V or 110/120V, 220/240V AC, (50/60 Hz) whichever is specified.
- **Supply Voltage Variation** : Within ±10% of rated supply voltage.
- **Power Consumption**: Less than 6 VA [REX-C9],
  Less than 5 VA [REX-C4]
- **Ambient Temperature** : 0 ~ 50°C (32 ~ 122°F)
- **Ambient Humidity** : 45 ~ 85% RH
- **Net Weight** : Approx. 550g (1.2 lbs) [REX-C9],
  450g (1.0 lbs) [REX-C4]
- **External Dimensions**: Refer to the drawings of external dimensions.
- **Option** : Heater Break Alarm (HBA)
  Input;
  the output from current detector (CTL-6-P-N)
  Allowable Range of Heater Current; 0 ~ 30A
  Setting Range; 0.0 ~ 30.0A (0.1A)
  Setting Accuracy;
  ±5% of set value or ±2A
  (whichever is larger)
  Output;
  Relay contact capacity 250V AC 1A (resistive load) 1a contact.

LIST OF MODEL CODE

● REX-C9

MODEL	SUFFIX CODE	DESCRIPTION
REX-C9	□ □ □–□ *□	Direct Digital Controller
Control Action	H	PID action
	F	PID action with auto-tuning
Alarm Action *A	N	Not supplied
	S	1 point alarm action
	D	2 points alarm action
		} Refer to the table of Alarm Action (P. 3)
Input	C	Thermocouple input
	R	RTD input
Control Output	M	Relay contact output
	V	For SSR driving output
	R	Current output
Option *A	N	Not supplied
	2	With Heater Break Alarm

* Only either of the functions is available if marked with the same alphabet.

● REX-C4

MODEL	SUFFIX CODE	DESCRIPTION
REX-C4	□ □ □–□ *2 □	Direct Digital Controller
Control Action	H	PID action
	F	PID action with auto-tuning
Alarm Action *A	N	Not supplied
	S	1 point alarm action
	D	2 points alarm action
		} Refer to the table of Alarm Action (P. 3)
Input	C	Thermocouple input
	R	RTD input
Control Output	M	Relay contact output
	V	For SSR driving output
Housing Type	2	Vertical 96(H) x 48(W)mm/3.8"(H) x 1.9"(W)
Option *A	N	No option
	2	With Heater Break Alarm

* Only either of the functions is available if marked with the same alphabet.

2. HEATING/COOLING TYPE (REX-C9)

FEATURES

- PID Auto-tuning Function
- Heating/Cooling PID Action (contributes to energy saving)
- Heater Break Alarm Function
- Deviation Alarm Function
- °C/°F, Direct/Reverse Action Selector Function
- Self-diagnosis Function
- Recondigurable Thermocouple Input Types and Alarm Actions

LIST OF MODEL CODE

● REX-C9

MODEL	SUFFIX CODE	DESCRIPTION
REX-C9	□ □ □–□ □*□	Direct Digital Controller
Control Action	V: Heating/cooling PID action W: Heating/cooling PID action with auto-tuning	
Alarm Action *A	N: Not supplied S: 1 point alarm action D: 2 points alarm action (Refer to the table of Alarm Action (P.3))	
Input	C: Thermocouple input R: RTD input	
Heating Control Output	M: Relay contact output V: For SSR driving output R: Current output	
Cooling Control Output	M: Relay contact output V: For SSR driving output R: Current output	
Option *A	N: Not supplied 2: With Heater Break Alarm	

* Only either of the functions is available if marked with the same alphabet.

NAMES OF PARTS

① **PV display (orange)**
Indicates a measured value.

② **SV display (orange)**
Indicates a set point value.

③ **Indicator lamps** (some lamps are not supplied or different according to the supplied specification.)
OUT(1) ... Lights when output (heating) is ON.
OUT(2) ... Lights when output (cooling) is ON.
AT ... Lights during auto-tuning.
ALM1 ALM2 ... Lights when alarm output is ON.
HBA ... Lights when HBA output is ON.
ERR ... Lights when self-diagnosis function detects faults.

④ **Input · Range indication**

⑤ **Setting keys (flat keys)**
AT ... Pressed to initiate auto-tuning.
PARA ... Pressed to scroll parameters for setting and monitoring.
◀ ... Cursor shift key.
▼ ... Decrement key.
▲ ... Increment key.

For explanation purpose, all functions are supplied in this figure.

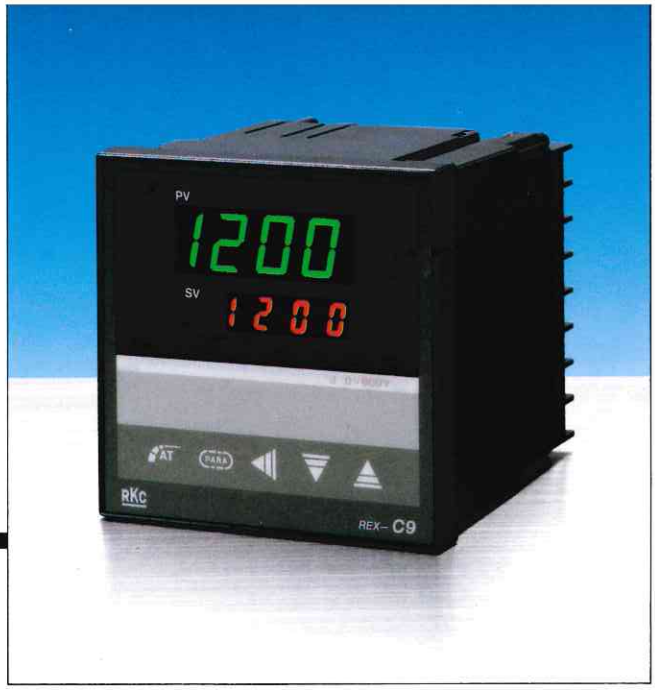
STANDARD RANGES

● REX-C9

( ): minimum resolution

	INPUT	STANDARD RANGES
THERMOCOUPLE	Type K (JIS/ANSI)	0~1200°C, 0~1372°C (1°C) 0~1600°F, 0~2502°F (1°F)
	Type J (JIS/ANSI)	0~1200°C (1°C) 0~1600°F, 0~2192°F (1°F)
	Type R, S (JIS/ANSI)	0~1600°C, 0~1769°C (1°C) 0~3200°F, 0~3216°F (1°F)
	Type B * (JIS/ANSI)	400~1800°C, 0~1820°C (1°C) 800~3200°F, 0~3308°F (1°F)
	Type N (NBS)	0~1200°C, 0~1300°C (1°C) 0~2300°F, 0~2372°F (1°F)
RTD	Pt 100 (IEC/JIS) JPt 100 (JIS)	−199.9~649.0°C, −199.9~200.0°C, −100.0~50.0°C, −100.0~100.0°C, −100.0~200.0°C, 0.0~50.0°C, 0.0~100.0°C, 0.0~200.0°C, 0.0~300.0°C, 0.0~500.0°C (0.1°C)
	Pt 100 (IEC/JIS equivalent)	−199.9~999.9°F, −199.9~400.0°F, −199.9~200.0°F, −100.0~100.0°F, −100.0~300.0°F, 0.0~100.0°F, 0.0~200.0°F, 0.0~400.0°F, 0.0~500.0°F (0.1°F)

* The accuracy within 0~399°C (0~799°F) is out of guarantee.
* Input types K and J are supplied with maximum range, but they are field adjustable to desired scale ranges (e.g. 0~800°C) using SLH (Scale Limiter High) and SLL (Scale Limiter Low) functions.



SPECIFICATIONS

INPUT

- **Input** : Thermocouple (T/C)
  [input impedance more than 5M Ω]
  Resistance Temperature Detector (RTD)
  (refer to "Standard Ranges")
- **Effect of External Resistance** : Approx. 0.4μV/Ω (thermocouple input)
- **Effect of Input Wire Resistance** : Approx. 0.0075%/Ω of read value
  Less than 10 Ω per 1 wire (RTD input)
- **Input Break Action** : Up-scale (as standard), control output OFF, alarm output ON
  [The down-scale is also available as option in case of T/C input]
- **Sampling Cycle** : 0.5 sec.

SETTING

- **Setting Accuracy** : Set Value (SV)
  T/C ; Within ±(0.5% of SV + 1 digit) or ±3°C [6°F] (whichever is larger)
  R, S input 0 ~ 199°C [0 ~ 399°F]
  ... within ±5°C [10°F]
  B input 0 ~ 399°C [0 ~ 799°F]
  ... out of accuracy guarantee range.
  RTD ; Within ±(0.5% of SV + 1 digit) or ±2°C [3°F] (whichever is larger)
  The other SV;
  Within ±0.5% of Setting range

DISPLAY (the figures in [ ] are for 3 digit instrument)

- **Input Display Range**: −1999 ~ 9999 (−199.9 ~ 999.9) °C [°F]
- **Input Display Accuracy** : Same as Setting Accuracy

CONTROL ACTION

- **Heating/Cooling PID Action**
  (auto-tuning function also available as option)
  ON/OFF · P · PI · PD action also available. Air cooling/water cooling field selectable.

Heating proportional band (PH)	: 1 (0.1) to span of setting limiter When PH = 0 (0.1), ON/OFF action for both heating and cooling Hysteresis width; 2°C [°F]
Cooling proportional band (PC)	: 1 ~ 1000 (1 ~ 999)% of heating proportional band (PH)
Integral (I)	: 1 ~ 3600 sec.
Derivative (D)	: 1 ~ 3600 sec.
Anti-Reset Windup (ARW)	: 1 ~ 100% of proportional band
Proportional cycle	: 1 ~ 100 sec.
Dead band (DB)	: 0 ~ 10 (0.0 ~ 10.0)°C [°F]

OUTPUT

- **Control Output** : (Specify heating and cooling outputs respectively)
  Relay contact;
  Capacity 250V AC 3A (resistive load),
  1 form "C" (NO/NC) contact
  SSR driving;
  0/12V DC (constant voltage pulse)
  [load resistance more than 800 Ω]
  Current;
  0 ~ 20mA or 4 ~ 20mA DC whichever is specified [load resistance less than 600 Ω]

ALARM

- **Alarm Action** : Deviation alarm
  [HOLD action can be specified]
  Refer to "Type of Alarm Action" (Field selectable)
  Relay contact output;
  capacity 250V AC 1A (resistive load),
  1a (NO) contact
  (energizing alarm 2 points)
  [The action becomes poor, if used in inductive load]
  Alarm setting range;
  −1999 ~ 9999 (−199.9 ~ 999.9) °C [°F]
  Hysteresis band;
  2°C [°F]

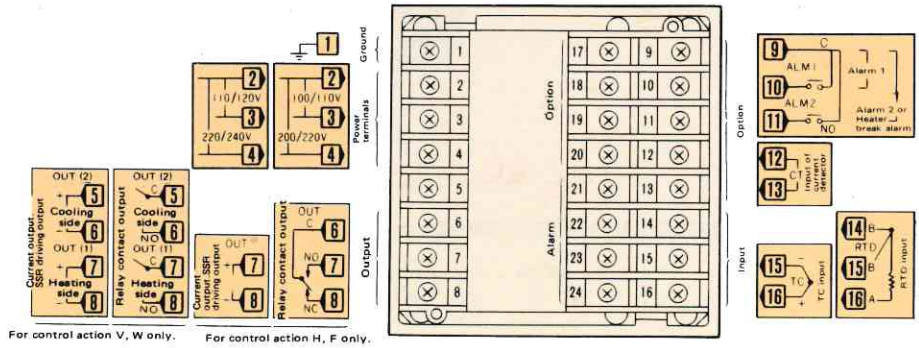
GENERAL SPECIFICATIONS

- **Self-diagnosis** : Error display
  Check of non-volatile RAM, A/D converter and CPU power supply.
  Display;
  "E r r" shown on PV display or ERR lamp lights
- **Supply Voltage** : 100/110V, 200/220V or 110/120V, 220/240V AC, (50/60 Hz) whichever is specified.
- **Supply Voltage Variation** : Within ±10% of rated supply voltage.
- **Power Consumption**: Less than 6 VA
- **Ambient Temperature** : 0 ~ 50°C (32 ~ 122°F)
- **Ambient Humidity** : 45 ~ 85% RH
- **Net Weight** : Approx. 550g (1.2 lbs)
- **External Dimensions**: Refer to the drawing of external dimensions.
- **Option** : Heater Break Alarm (HBA)
  Input;
  the output from current detector (CTL-6-P-N)
  Allowable Range of Heater Current; 0 ~ 30A
  Setting Range; 0.0 ~ 30.0A (0.1A)
  Setting Accuracy;
  ±5% of set value or ±2A
  (whichever is larger)
  Output;
  Relay contact capacity 250V AC 1A
  (resistive load) 1a contact.

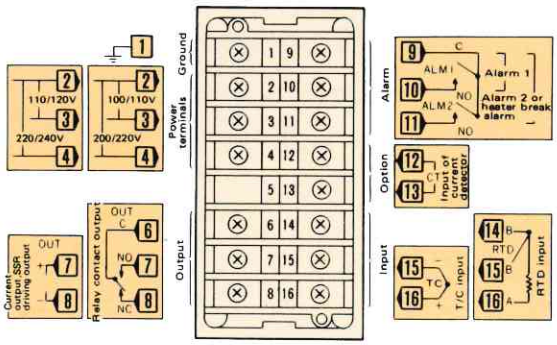
REAR TERMINALS • EXTERNAL DIMENSIONS

REAR TERMINALS

REX-C9



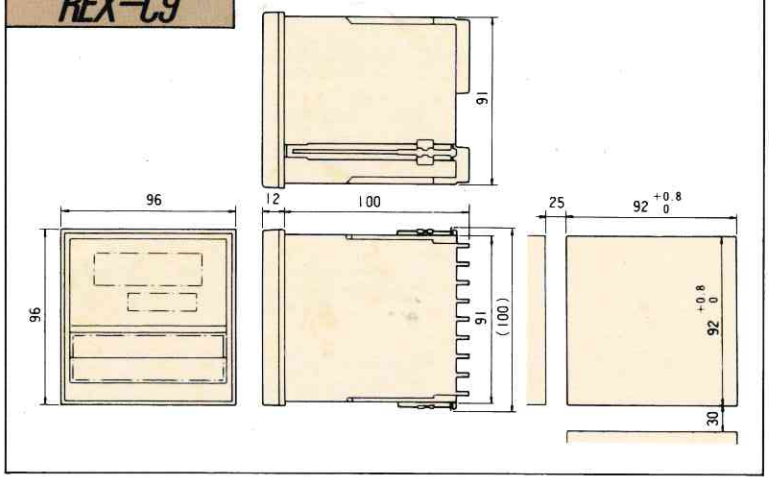
REX-C4



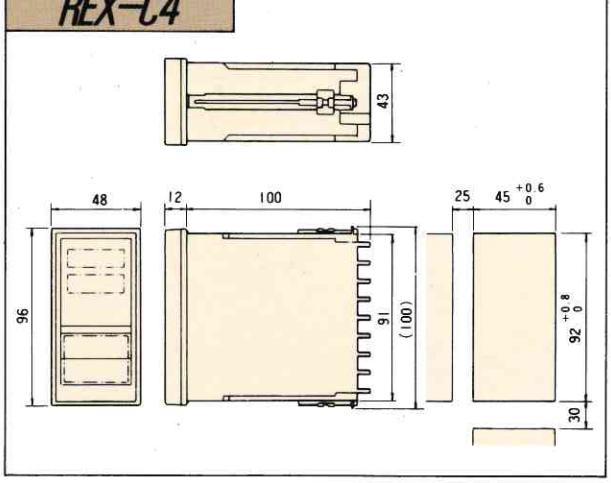
EXTERNAL DIMENSIONS

Unit: mm

REX-C9



REX-C4



Subject to change without notice due to design changes.

RKC INSTRUMENT INC.

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