1. PRODUCT CHECK

<table>
<thead>
<tr>
<th>Digital Controller</th>
<th>CB100/CB400/CB500/CB700/CB900</th>
</tr>
</thead>
</table>

**INSTRUCTION MANUAL**

Thank you for purchasing this RKC product. In order to achieve maximum performance and ensure proper operation of your new instrument, carefully read all the instructions in this manual. Please place the manual in a convenient location for easy reference.

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**WARNING**

- To prevent injury to persons, damage to instrument and equipment, a suitable external protection device shall be required.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction can occur and warranty is void under these conditions.

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**CAUTION**

- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy.)
- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless of the length.
- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock by operating personnel.
- All precautions described in this manual shall be taken to avoid damage to the instrument or equipment.
- All wiring must be in accordance with local codes and regulations.
- All wiring must be completed before specified power is turned on to prevent electric shock, instrument failure, or incorrect operation. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.
- To prevent instrument damage as a result of failure, protect the power line and the input/output connection terminal with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- Tighten each terminal screw to the specified torque found in the manual to avoid electric shock by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.
- When high alarm with hold action is used for Alarm function, alarm does not turn on while hold action is in operation. Take measures to prevent overheating which may occur if the control device fails.

**NOTICE**

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Personnel must be required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual shall be subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

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### 2. MOUNTING

#### 2.1 Mounting Cautions

1. This instrument is intended to be used under the following environmental conditions. (IEC61010-1)
   - **Overvoltage Category II**, **Pollution Degree 2**

2. Use this instrument within the following environment conditions:
   - Allowable ambient temperature: 0 to 50°C
   - Allowable ambient humidity: 5 to 95 % RH
     - (Absolute humidity: MAX. W. C 29.3 g/m³ dry air at 101.3 kPa)
   - Installation environment conditions: Indoor use, Altitude up to 2000 m

3. Avoid the following conditions when selecting the mounting location:
   - 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.
   - Exposure to direct sunlight.
   - Excessive heat accumulation.

4. Mount this instrument in the panel considering the following conditions:
   - Provide adequate ventilation space so that heat does not build up.
   - Do not mount this instrument directly above equipment that generates large amount of heat (heaters, transformers, semi-conductor functional devices, large- wattage resistors.)
   - If the ambient temperature rises above 50 °C, cool this instrument with a forced air fan, cooler, etc. Cooled air should not blow directly on this instrument.
   - In order to improve safety and the immunity to withstand noise, mount this instrument as far away as possible from high voltage equipment, power lines, and rotating machinery.
   - High voltage equipment: Do not mount within the same panel.

#### 2.2 Mounting IMCB34-E1

- **Mounting frame** (CB100): 1 (KCA100-526)
- **Mounting brackets** (CB400/500/700/900): 2 (KCA400-532)
- Instruction manual (IMCB34-E1): 1

* For CB900 waterproof/dustproof (optional): 4 pieces
2.2 Dimensions

2.3 Mounting Procedures

- CB100

<Mounting Procedures>
1. Prepare the panel cutout as specified in 2.2 Dimensions.
2. Insert the instrument through the panel cutout.
3. Insert the mounting frame into the mounting groove of the instrument.
4. Push the mounting frame forward until the frame is firmly secured to the panel. (Fig. 1)
5. Fix the instrument to the panel by using the two screws. (Fig. 2)

- CB400/500/700/900

<Mounting Procedures>
1. Prepare the panel cutout as specified in 2.2 Dimensions.
2. Insert the instrument through the panel cutout.
3. Insert the mounting bracket into the mounting groove of the instrument.
4. Do not push the mounting bracket forward. (Fig. 1)
5. Secure the bracket to the instrument by tightening the screw. Take care to refrain from moving the bracket forward.
6. Only turn about one full revolution after the screw touches the panel. (Fig. 2)

<Removal Procedures>
1. Turn the power OFF.
2. Remove the wiring.
3. Loosen the screw of the mounting frame.
4. Remove the mounting frame from the case. (Fig. 3)

The optional waterproof/dustproof on the front of the instrument conforms to IP66 when mounted on the panel. For effective waterproof/dustproof, the gasket must be securely placed between instrument and panel without any gap. If the gasket is damaged, please contact RKC sales office or the agent.

<Removal Procedures>
1. Turn the power OFF.
2. Remove the wiring.
3. Loosen the screw of the mounting bracket.
4. Hold the mounting bracket by the edge (①) and tilt it (②) to remove from the case. (Fig. 3)
5. The other mounting bracket should be removed in the same way as described in 3. to 5.
6. Pull out the instrument from the mounting cutout while holding the front panel frame of this instrument. (Fig. 4)
3. WIRING

3.1 Wiring Cautions

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.
- For the current input specification, an external resistor (250 Ω ±0.02 %, 0.25 W or more, ±10 ppm/°C) must be connected between the input terminals. For external resistor (shunt resistor), use the KD-100-55; sold separately (RKC product). If this resistor is installed, close horizontal mounting is not possible.
- Signal connected to Voltage input and Current input shall be low voltage defined as “SELV” circuit per IEC 60950-1.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
- Use the solderless terminal appropriate to the screw size.
- For an instrument with 24 V power supply input, supply power from “SELV” circuit defined as IEC 60950-1.
- This instrument with 24 V power supply is not provided with an overcurrent protection device.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument with 24 V power supply input, supply power from "SELV" circuit defined as IEC 60950-1.
- A suitable power supply should be considered in end-use equipment. The power supply must be in compliance with a limited-energy circuits (maximum available current of 8 A).
- Use the solderless terminal appropriate to the screw size.
  - Screw size: M3 x 6
  - Recommended tightening torque: 0.4 N·m [4 kgf·cm]
  - Specified solderless terminals: With isolation
  - Applicable wire: Solid/twisted wire of 0.25 to 1.65 mm²
  - Fuse type: Time-lag fuse (Approved fuse according IEC60127-2 and/or UL248-14)
  - Fuse rating: Rated current: 0.5 A
  - Fuse size: M3 x 6
  - Recommended tightening torque: 0.4 N·m [4 kgf·cm]
  - Specified solderless terminals: With isolation
  - Applicable wire: Solid/twisted wire of 0.25 to 1.65 mm²

- Make sure that lugs or unshielded cables of the communication terminals are not touched to the screw heads, lugs, or unshielded wires of the power supply terminals to prevent electric shock or instrument failure. Use additional care when two lugs are screwed to one communication terminal.

3.2 Terminal Configuration

CB100

CB400

The terminal arrangement of CB500 is as shown in the following diagram, but the terminal configuration of CB500 is the same as that of CB400.

- Cautions for Communication terminal wiring

Make sure that lugs or unshielded cables of the communication terminals are not touched to the screw heads, lugs, or unshielded wires of the power supply terminals to prevent electric shock or instrument failure. Use additional care when two lugs are screwed to one communication terminal.
Specifications

Input:
- Type: K, J, R, S, B, E, T, N, PLII, W5Re/W26Re, U, L
- Impedance: Approx. 1 MΩ
- RTD: Pt100, JPt100
- Voltage: 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC (Z-T1010)
- Current: 0 to 20 mA DC, 4 to 20 mA DC
- Sampling cycle: 0.5 seconds
- Input range: Refer to Input range table

Control mode: PID control
- ON/OFF, P, PI, or PD actions are available
- Relay contact output:
  - 250 V AC, 3A (Resistive load)
  - Electrical life: 300,000 times or more (Rated load)
- Voltage pulse output:
  - 0/12 V DC (Load resistance 600 Ω or more)
- Current output: 4 to 20 mA DC (Load resistance 600 Ω or less)
- Trigger output for triac driving:
  - Zero cross method for medium capacity triac driving (100 A or less)
  - Load voltage used: 100 V AC line, 200 V AC line
  - Load used: Resistive load
- Triac output:
  - Output method: AC output (Zero-cross method)
  - Allowable load current: 0.5 A (Ambient temperature: 40 °C or less)
  - Load voltage: 75 to 250 V AC
  - Minimum load current: 20 mA
  - ON voltage: 1.6 V or less (at maximum load current)
- Alarm output:
  - Relay contact output:
    - 250 V AC, 1A (Resistive load)
    - Electrical life: 50,000 times or more (Rated load)

Performance:
- Display accuracy (at the ambient temperature 23 °C ± 2 °C):
  - Thermocouple: ± (0.3 % of display value + 1 digit) or ± 2 °C [4 °F]
  - Whatever is greater
  - R, S and B input: 0 to 399 °C [0 to 799 °F]
  - Accuracy is not guaranteed.
  - T and U input: −199.9 to −100.0 °C [−199.9 to −180.0 °F]
  - Accuracy is not guaranteed.
  - RTD: ± (0.3 % of display value + 1 digit) or ± 0.8 °C [1.6 °F]
  - Whatever is greater
- Voltage/Current: ± (0.3 % of Input span + 1 digit)

Memory backup:
- Backed up by Nonvolatile Memory
- Number of write times: Approx. 1,000,000 times
- Data storage period: Approx. 10 years

Power:
- Power supply voltage:
  - 85 to 264 V AC (Power supply voltage range), 50/60 Hz
  - Rating: 100 to 240 V AC
  - Rating: 24 V AC
  - Rating: 24 V DC
- Power consumption:
  - 7 VA max. (at 100 V AC)
  - 10 VA max. (at 240 V AC)
  - 5 VA max. (at 24 V AC)
  - 160 mA max. (at 24 V DC)

Weight:
- CB100: Approx. 170 g
- CB700: Approx. 290 g
- CB400/ CB500: Approx. 250 g
- CB900: Approx. 340 g
4. PARTS DESCRIPTION

**CB100**

(1) Measured value (PV) display [Green]
Displays PV or various parameter symbols.

(2) Set value (SV) display [Orange]
Displays SV or various parameter set values (or CT input value).

(3) Indication lamps
Alarm output lamps (ALM1, ALM2) [Red]
ALM1: Lights when alarm 1 output is turned on.
ALM2: Lights when alarm 2 output is turned on.

Autotuning (AT) lamp [Green]
Flashes when autotuning is activated. (After autotuning is completed: AT lamp will go out)

5.1 Operation Menu

**Power ON**

Input type and Input range Display

PV/SV Display Mode
The controller will display the Measured value (PV) and the Set value (SV). The controller can be switched to RUN or STOP mode (Factory set value: RUN).

PV/SV monitor (RUN mode)
Press and hold the <R/S key for 1 second.

STOP character display
This is the mode used to set the SV.

PV setting
Factory set value: °C [°F] or 0.0 °C [°F]

SV Setting Mode
This is the mode used to set the SV.

Display returns to the PV/SV display mode if no key operation is performed within 1 minute.

### 5. SETTING

#### 5.1 Operation Menu

- **Input type and input range display**
  This instrument immediately confirms the input type and input range following power ON.
  Example: When sensor type of input is K thermocouple.

- **Temperature selection**
  Symbols

- **Input type symbol**
  (Celsius: °C, Fahrenheit: °F, Voltage/Current input: no character shown)

5.2 Parameter Setting Mode

This mode is used to set the parameters such as alarms, PID constants, etc. (Refer to page 6.)

- **Parameter Setting Mode**
  The following parameter symbols are displayed as the SET key is pressed.

- **Communication Setting Mode**
  This mode is used to set the communication parameters when specified. For details on protocol, identifiers and communication setting mode, refer to the Communication Instruction Manual (IMCB03-E3).

- **Input Type Symbol Table**

- **Input type**
  Symbol: °C, °F, Voltage/Current input: no character shown

- **Communication**
  Symbol: °C, °F, Voltage/Current input: no character shown

To avoid damage to the instrument, never use a sharp object to press keys.
### 5.2 Parameter List

Parameter symbols which are not related to existing functions on the controller are not displayed.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Setting range</th>
<th>Description</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Symbol" alt="CT" /></td>
<td>Current transformer (CT) input value 1 monitor</td>
<td>0.0 to 100.0 A [Display only]</td>
<td>Display input value from the current transformer. [Displayed only when the instrument has the Heater break alarm (HBA)]</td>
<td></td>
</tr>
<tr>
<td><img src="Symbol" alt="AL" /></td>
<td>Alarm 1 set value (ALM1)</td>
<td>TC/RTD inputs: Deviation alarm, Process alarm, SV alarm: -1999 to +9999 °C [°F] or -199.9 to +999.9 °C [°F] Voltage/Current inputs: -0.1 to 100.0 % of input span (Within 9999) Process alarm, SV alarm: Same as input range</td>
<td>Set the alarm 1 set value and alarm 2 set value.</td>
<td>TC/RTD inputs: 50 (50.0) Voltage/Current inputs: 5.0</td>
</tr>
<tr>
<td><img src="Symbol" alt="AL" /></td>
<td>Alarm 2 set value (ALM2)</td>
<td>TC/RTD inputs: Deviation alarm: -Input span to +Input span (Within 9999) Voltage/Current inputs: -0.1 to 100.0 % of input span</td>
<td>Alarm differential gap: TC/RTD inputs: 2 or 2.0 °C [°F] Voltage/Current inputs: 0.2% of Input span</td>
<td></td>
</tr>
<tr>
<td><img src="Symbol" alt="Ha" /></td>
<td>Heater break alarm (HBA) 1 set value</td>
<td>0.0 to 100.0 A</td>
<td>Alarm value is set by referring to input value from the Current transformer (CT). Used only for single-phase.</td>
<td>0.0</td>
</tr>
<tr>
<td><img src="Symbol" alt="Lb" /></td>
<td>Control loop break alarm (LBA) time</td>
<td>0.1 to 200.0 minutes</td>
<td>Set control loop break alarm (LBA) set value.</td>
<td>8.0</td>
</tr>
<tr>
<td><img src="Symbol" alt="Lb" /></td>
<td>LBA deadband</td>
<td>TC/RTD inputs: 0 to 9999 °C [°F] Voltage/Current inputs: 0 to 100 % of input span</td>
<td>Set the area of not outputting LBA.</td>
<td>0</td>
</tr>
<tr>
<td><img src="Symbol" alt="Au" /></td>
<td>Autotuning (AT)</td>
<td>0: AT end or cancel 1: AT start or execution</td>
<td>Turns the Autotuning ON/OFF.</td>
<td>0</td>
</tr>
<tr>
<td><img src="Symbol" alt="Su" /></td>
<td>Self-tuning (ST)</td>
<td>0: Self-tuning OFF 1: Self-tuning ON</td>
<td>Turns the Self-tuning ON/OFF.</td>
<td>0</td>
</tr>
<tr>
<td><img src="Symbol" alt="P" /></td>
<td>Proportional band</td>
<td>TC/RTD inputs: 1 (0.1) to Input span or 9999 (999.9) °C [°F] Voltage/Current inputs: 0.1 to 100.0 % of input span 0 (0.0): ON/OFF action</td>
<td>Set when PI, PD or PID control is performed. Heat/Cool PID action: Proportional band setting on the heat-side. ON/OFF action differential gap: TC/RTD inputs: 2 (0.2) °C [°F] Voltage/Current inputs: 0.2 % of input span</td>
<td>TC/RTD inputs: 30 (30.0) Voltage/Current inputs: 3.0</td>
</tr>
<tr>
<td><img src="Symbol" alt="I" /></td>
<td>Integral time</td>
<td>1 to 3600 seconds (6 second: PD action)</td>
<td>Set the time of integral action to eliminate the offset occurring in proportional control.</td>
<td>240</td>
</tr>
<tr>
<td><img src="Symbol" alt="d" /></td>
<td>Derivative time</td>
<td>1 to 3600 seconds (6 second: PI action)</td>
<td>Set the time of derivative action to improve control stability by preparing for output changes.</td>
<td>60</td>
</tr>
<tr>
<td><img src="Symbol" alt="Ar" /></td>
<td>Anti-reset windup (ARW)</td>
<td>1 to 100 % of heat-side proportional band (0 %: Integral action OFF)</td>
<td>Overshooting and undershooting are restricted by the integral effect.</td>
<td>100</td>
</tr>
<tr>
<td><img src="Symbol" alt="r" /></td>
<td>Heat-side proportioning cycle</td>
<td>1 to 100 seconds (Not displayed if the control output is current output.)</td>
<td>Set control output cycle. Heat/Cool PID action: Heat-side proportioning cycle</td>
<td>Relay contact output: 20 Voltage pulse output/Trigger output for triac driving/Triac output: 2</td>
</tr>
<tr>
<td><img src="Symbol" alt="Pc" /></td>
<td>Cool-side proportioning band</td>
<td>1 to 1000 % of heat-side proportional band.</td>
<td>Set cool-side proportional band when Heat/Cool PID action.</td>
<td>100</td>
</tr>
<tr>
<td><img src="Symbol" alt="d" /></td>
<td>Deadband</td>
<td>TC/RTD inputs: -10.0 to +10.0 °C [°F] Voltage/Current inputs: -10.0 to +10.0 % of input span</td>
<td>Set control action deadband between heat-side and cool-side proportional bands. Minus (−) setting results in overlap.</td>
<td>0 or 0.0</td>
</tr>
<tr>
<td><img src="Symbol" alt="e" /></td>
<td>Cool-side proportioning band</td>
<td>1 to 100 seconds (Not displayed if the control output is current output.)</td>
<td>Set control cool-side output cycle for Heat/Cool PID action.</td>
<td>Relay contact output: 20 Voltage pulse output/Triac output: 2</td>
</tr>
<tr>
<td><img src="Symbol" alt="Pb" /></td>
<td>PV bias</td>
<td>TC/RTD inputs: -1999 to +9999 °C [°F] Voltage/Current inputs: -Input span to +Input span</td>
<td>Sensor correction is made by adding bias value to Measured value (PV).</td>
<td>0 or 0.0</td>
</tr>
<tr>
<td><img src="Symbol" alt="Lc" /></td>
<td>Set data lock (LCK)</td>
<td>Performs set data change enable/disable.</td>
<td>0000</td>
<td>0000</td>
</tr>
</tbody>
</table>
1 Heater break alarm (HBA) function
The HBA function monitors the current flowing through the load by a dedicated Current transformer (CT), compares the measured value with the HBA set value, and detects a fault in the heating circuit.

2 Low or No current flow (Heater break, malfunction of the control device, etc.):
When the control output is ON and the current transformer input value is equal to or less than the heater break determination point for the preset number of consecutive sampling cycle, an alarm is activated.

Over current or short-circuit:
When the control output is OFF and the current transformer input value is equal to or greater than the heater break determination point for the preset number of consecutive sampling cycle, an alarm is activated.

Precaution for LBA setting:
- Displayed only for when HBA is selected as Alarm 2.
- HBA is not available on a current output.
- Set the set value to approximately 85 % of the maximum reading of the CT input.
- Set the set value to a slightly smaller value to prevent a false alarm if the power supply may become unstable.
- When more than one heater is connected in parallel, it may be necessary to increase the HBA set value to detect a single heater failure.
- When the current transformer is not connected, the HBA is turned on.

Control loop break alarm (LBA) function
The LBA function is used to detect a load (heater) break or a failure in the external actuator (power controller, magnet relay, etc.), or a failure in the control loop caused by an input (sensor) break. The LBA function is activated when control output reaches 0 % (low limit with output limit function) or 100 % (high limit with output limit function). LBA monitors variation of the measured value (PV) for the length of LBA time. When the LBA time has elapsed and the PV is still within the alarm determination range, the LBA will be ON.

Precaution for LBA setting:
- Displayed only for when LBA is selected as Alarm 1 or Alarm 2.
- No LBA function can be used at Heat/Cool PID control action.
- The LBA function cannot be activated when AT function is turned on.
- The LBA function is activated when control output reaches 0 % or 100 %. The time required for the LBA output to turn on includes both the time from the initial occurrence of loop failure and the LBA setting time. Recommended setting for LBA is for the set value of the LBA to be twice the value of the Integral time (I).
- If LBA setting time does not match the controlled object requirements, the LBA setting time should be lengthened. If setting time is not correct, the LBA will malfunction by turning on or off at inappropriate times or not turning on at all.

LBA deadband function
The LBA may malfunction due to external disturbances. To prevent malfunctioning due to external disturbance, LBA deadband (LBD) sets a neutral zone in which LBA is not activated. When the Measured value (PV) is within the LBD area, LBA will not be activated. If the LBD setting is not correct, the LBA will not work correctly.

Precaution for HBA setting:
- Displayed only for when HBA is selected as Alarm 2.
- HBA is not available on a current output.
- Set the set value to approximately 85 % of the maximum reading of the CT input.
- Set the set value to a slightly smaller value to prevent a false alarm if the power supply may become unstable.
- When more than one heater is connected in parallel, it may be necessary to increase the HBA set value to detect a single heater failure.
- When the current transformer is not connected, the HBA is turned on.

5.3 Changing Parameter Settings
Procedures to change parameter settings are shown below.

- Change the Set value (SV)
Change the Set value (SV) from 0 °C to 200 °C
1. Select the SV setting mode
Press the SET key at PV/SV monitor screen until SV setting screen is displayed.

2. Shift the high-lighted digit
Press the <R/S key to high-light the hundreds digit. The high-lighted digit indicates which digit can be set.

3. Change the set value
Press the UP key to change the number to 2.

4. Store the set value
Press the SET key to store the new set value. The display returns to the PV/SV monitor screen.

Change parameters other than the Set value (SV)
The changing procedures are the same as those of example 2 to 4 in the above * Change the Set value (SV).* Pressing the SET key after the setting end shifts to the next parameter. When no parameter setting is required, return the instrument to the PV/SV display mode.
6. OPERATIONS

CAUTIONS

- All mounting and wiring must be completed before the power is turned on. If the input signal wiring is disconnected or short-circuited (RTD input only), the instrument determines that burnout has occurred.
  - Displays:
    - Upscale: Thermocouple input, RTD input (when input break)
    - Downsacle: Thermocouple input (specify when ordering), RTD input (when short-circuited), Voltage input (1 to 5 V DC), Current input (4 to 20 mA DC)
  - Outputs:
    - Control output: OFF (Heat/Cool control: the control output on both heat-side and cool-side is turned off)
    - Alarm output: Both of the Alarm 1 and Alarm 2 outputs of this instrument are turned on when burnout occurs regardless of any of the following actions taken (High alarm, low alarm, etc.). In addition, when used for any purposes other than these alarms (event, etc.), specify the Z-124 specification (not to be forcibly turned on).
- A power failure of 20 ms or less will not affect the control action. When a power failure of more than 20 ms occurs, the instrument assumes that the power has been turned off. When power returns, the controller will retain the conditions that existed prior to shut down.
- The alarm hold action is activated when not only the power is turned on, but also the SV is changed.

6.1 Operation Procedures

1. Prior to starting operation, check that the mounting and wiring have been finished, and that the SV and various parameters have been set.
2. A power supply switch is not furnished with this instrument. It is ready to operate as soon as the power is turned on. (Factory set value: RUN).
   - This instrument holds the conditions that exist just before the power is turned on. For example, if the power is turned off in STOP mode, the instrument starts in STOP mode when the power is turned on again.

RUN/STOP

Each time the <R/S key is pressed for 1 second, RUN/STOP mode changes from RUN to STOP or STOP to RUN. If the instrument is switched to STOP mode, its display, output, etc. become as follows.
- Display: The PV display shows \( \text{STOP} \).
- Output: Control output OFF, Alarm output OFF
- Autotuning: AT canceled (The PID constants are not updated.)

RUN/STOP display (Z-1018 specification)

When operation is changed to the STOP mode by RUN/STOP selection, a parameter symbol to indicate the STOP mode is displayed on the SV display. Pressing the SET key with the STOP mode displayed can also check and change the Set value (SV).

6.2 Set Data Lock (LCK) Function

The set data lock restricts parameter setting changes by key operation. This function prevents the operator from making errors during operation. There are 8 set data lock levels. (refer to below)

<table>
<thead>
<tr>
<th>Set value</th>
<th>Parameters which can be changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>All parameters (Factory set value)</td>
</tr>
<tr>
<td>0001</td>
<td>SV, Alarms (ALM1, ALM2)</td>
</tr>
<tr>
<td>0010</td>
<td>All parameters except for Alarms (ALM1, ALM2)</td>
</tr>
<tr>
<td>0011</td>
<td>SV</td>
</tr>
<tr>
<td>0100</td>
<td>All parameters except for SV</td>
</tr>
<tr>
<td>0101</td>
<td>Alarms (ALM1, ALM2)</td>
</tr>
<tr>
<td>0110</td>
<td>All parameters except for SV and Alarms (ALM1, ALM2)</td>
</tr>
<tr>
<td>0111</td>
<td>No parameters (All Locked)</td>
</tr>
</tbody>
</table>

HBA, LBA and LBD can be locked when any of 0001, 0011, 0101 and 0111 is set.
- Set data lock can be changed in both RUN and STOP mode.
- Parameters protected by Set data lock function are still displayed for monitoring.

6.3 Autotuning (AT) Function

Autotuning (AT) automatically measures, computes and sets the optimum PID and LBA constants. The following conditions are necessary to carry out Autotuning and the conditions which will cause the Autotuning to stop.

Requirements for AT start

Start the Autotuning when all following conditions are satisfied:
- Prior to starting the AT function, end all the parameter settings other than PID and LBA.
- Confirm the LCK function has not been engaged.
- When the AT function is activated, the controller immediately changes to PID control. The PID values will be the same as before AT was activated.
- When AT is canceled, the controller immediately changes to PID control. If the control system does not allow the AT cycling process, set each PID constant manually to meet the needs of the application.

Requirements for AT cancellation

The Autotuning is canceled if any of the following conditions exist.
- When the Set value (SV) is changed.
- When the PV bias value is changed.
- When the RUN/STOP mode is changed to the STOP mode.
- When the PV becomes abnormal due to burnout.
- When the power is turned off.
- When power failure longer than 20 ms occurs.
- When the AT does not end in 9 hours after autotuning started.

Caution for using the Autotuning (AT)

- When a temperature change (UP and/or Down) is 1 °C or less per minute during AT, AT may not be finished normally. In that case, adjust the PID values manually.
- Manual setting of PID values may also be necessary if the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.

6.4 Self-tuning (ST) Function

The ST function is used to automatically calculate and set adaptive PID constants anytime the power is turned on, the SV is changed or the controller detects unstable control conditions.
- The ST function should be turned off when the controlled system is affected by rippling that occurs due to periodic external disturbances.
- The power to the controlled system must be turned on before the power to the instrument is turned on or SV is changed. This is required when ST function is on.
- To activate the ST function, the following parameters must not be set to zero: Pa0, Iw, Da0, ARWx=0.
- When Heat/Cool PID action is selected, the ST function can not be activated.
- When the AT function is activated, the ST function can not be turned on.
- When the ST function is activated, the PID and ARW settings can be monitored, but not changed.
7. INITIAL SETTING

Parameters in the Initialization mode should be set according to the application before setting any parameter related to operation. Once the Parameters in the Initialization mode are set correctly, no further changes need to be made to parameters for the same application under normal conditions. If they are changed unnecessarily, it may result in malfunction or failure of the instrument. RKC will not bear any responsibility for malfunction or failure as a result of improper changes in the Initialization mode.

7.1 Go to Initialization Mode

1. Turn on the power to this controller. The instrument goes to the PV/SV display after confirming input type symbol and input range.
2. Press and hold the SET key for 2 seconds to go to the Parameter Setting Mode from the PV/SV display.
3. Press the SET key until “LCK” (Set data lock display) will be displayed.
4. The high-lighted digit indicates which digit can be set. Press <R/S key to high-light the thousands digit. (The section in each image of the controller shows the digits which are not high-lighted.)
5. Press the UP key to change 0 to 1.
6. Press the SET key to store the new set value. The display goes to the next parameter, and the Initialization mode is unlocked.
7. Press the <R/S key for two seconds while pressing the SET key to go to the Initialization mode. When the controller goes to the Initialization mode, “Cod” will be displayed.

7.2 Exit Initialization Mode

When any parameter setting is changed in the Initialization mode, check all parameter set values in SV setting mode and Parameter setting mode.

1. Press the <R/S key for 2 seconds while pressing the SET key from any display in the Initialization mode. The controller goes back to the operation mode and the PV/SV display will be displayed.
2. Press and hold the SET key for 2 seconds in the PV/SV display.
3. Press the SET key until “LCK” (Set data lock display) will be displayed.
4. The high-lighted digit indicates which digit can be set. Press <R/S key to high-light the thousands digit. (The section in each image of the controller shows the digits which are not high-lighted.)
5. Press the DOWN key to change 1 to 0.
7.4 Input Type Selection (SL1)

When any parameter setting is changed in the Initialization mode, check all parameter set values in SV setting mode and Parameter setting mode.

Factory set value varies depending on the input type.

<table>
<thead>
<tr>
<th>Set value</th>
<th>Input type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>K</td>
<td>Thermocouple 1 (TC)</td>
</tr>
<tr>
<td>0001</td>
<td>J</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>0010</td>
<td>L</td>
<td>Current 1.3</td>
</tr>
<tr>
<td>0011</td>
<td>E</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>0100</td>
<td>N</td>
<td>Current 1.3</td>
</tr>
<tr>
<td>0110</td>
<td>R</td>
<td>Current 1.3</td>
</tr>
<tr>
<td>1000</td>
<td>S</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1001</td>
<td>T</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1010</td>
<td>W5Re/W26Re</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1011</td>
<td>PL II</td>
<td>Current 1.3</td>
</tr>
<tr>
<td>0101</td>
<td>U</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1100</td>
<td>Pt100 (JIS/JEC)</td>
<td>Current 1.3</td>
</tr>
<tr>
<td>1101</td>
<td>JPt100 (JIS)</td>
<td>Current 1.3</td>
</tr>
<tr>
<td>1110</td>
<td>0 to 5 V DC</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1111</td>
<td>0 to 10 V DC</td>
<td>Voltage 1</td>
</tr>
<tr>
<td></td>
<td>1 to 5 V DC</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1110</td>
<td>0 to 20 mA DC</td>
<td>Voltage 1</td>
</tr>
<tr>
<td>1111</td>
<td>4 to 20 mA DC</td>
<td>Voltage 1</td>
</tr>
</tbody>
</table>

1 Any input change in TC/RTD group is possible. Any input change in Voltage & Current group except for 0 to 10 V DC input is possible. No input change between TC/RTD group and Voltage & Current group is possible.
2 The input type of Z-1010 specification is fixed to 0 to 10 V DC due to the hardware difference.
3 For the current input specification, a resistor of 250 Ω must be connected between the input terminals.
4 W5Re/W26Re and B are not available with Z-1021 specification (Modbus communication).

Change Settings

Example: Change the input type from “K” to “J”

1. Set “Cod” to 0000, and press the SET key. The display will go to SL1.

![Cod](image)

2. Press the UP key to change the number to 1.

![SL 1](image)

3. Press the SET key to store the new set value. The display goes to the next parameter.

7.5 Temperature Unit and Cooling Type Selection (SL2)

Inappropriate settings may result in malfunction. Control type between Heat Only and Heat/Cool cannot be changed by this parameter. Factory set value varies depending on the instrument specification.

<table>
<thead>
<tr>
<th>Set value</th>
<th>Temperature unit</th>
<th>Cooling type selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>°C</td>
<td>Air cooling (A type) or Heat only type (F, D type)</td>
</tr>
<tr>
<td>0001</td>
<td>°F</td>
<td>Air cooling (A type) or Heat only type (F, D type)</td>
</tr>
<tr>
<td>0010</td>
<td>°C</td>
<td>Water cooling (W type)</td>
</tr>
<tr>
<td>0011</td>
<td>°F</td>
<td>Water cooling (W type)</td>
</tr>
</tbody>
</table>

Change Settings

Example: Change the temperature unit of the Heat only type from “°C (0000)” to “°F (0001)”

1. Press the SET key until SL2 is displayed.
2. Press the UP key to change the number to 1.

![SL 2](image)

3. Press the SET key to store the new set value. The display goes to the next parameter.

7.6 Alarm 1 [ALM1] Type Selection (SL4) Alarm 2 [ALM2] Type Selection (SL5)

If the alarm function is not provided with the instrument when shipped from the factory, no alarm output is available by changing SL4 and/or SL5.

SL4 is set to 0000 in the following cases.
- When the instrument does not have ALM1 output
- When Control loop break alarm (LBA) is provided and assigned to ALM1
- When the SV alarm is provided and assigned to ALM1

SL5 is set to 0000 in the following cases.
- When the instrument does not have ALM2 output
- When Control loop break alarm (LBA) is provided and assigned to ALM2
- When the SV alarm is provided and assigned to ALM2
- When the Heater break alarm (HBA) is provided
- When the instrument has Z-168 specification

Factory set value varies depending on the instrument specification.

<table>
<thead>
<tr>
<th>Set value</th>
<th>Details of setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td>No alarm</td>
</tr>
<tr>
<td>0001</td>
<td>Deviation high alarm</td>
</tr>
<tr>
<td>0101</td>
<td>Deviation low alarm</td>
</tr>
<tr>
<td>0010</td>
<td>Deviation high/low alarm</td>
</tr>
<tr>
<td>0110</td>
<td>Band alarm</td>
</tr>
<tr>
<td>0011</td>
<td>Process high alarm</td>
</tr>
<tr>
<td>0111</td>
<td>Process low alarm</td>
</tr>
<tr>
<td>1001</td>
<td>Deviation high alarm with hold action *</td>
</tr>
<tr>
<td>1101</td>
<td>Deviation low alarm with hold action *</td>
</tr>
<tr>
<td>1010</td>
<td>Deviation high/low alarm with hold action *</td>
</tr>
<tr>
<td>1111</td>
<td>Process low alarm with hold action *</td>
</tr>
</tbody>
</table>

* Hold action: When Hold action is ON, the alarm action is suppressed at start-up or the control set value change until the measured value enters the non-alarm range.

Alarm action type

Both of the Alarm 1 and Alarm 2 outputs of this instrument are turned on when burnout occurs regardless of any of the following actions taken (high alarm, low alarm, etc.). In addition, when used for any purposes other than these alarms (event, etc.), specify the Z-124 specification (not to be forcibly turned on).

Alarm action type

- Deviation high alarm (Alarm set value is greater than 0.)
- Deviation low alarm (Alarm set value is less than 0.)
- Deviation high/low alarm (Alarm set value is greater than 0. and Alarm set value is less than 0.)
- Band alarm
- Process high alarm
- Process low alarm

Change Settings

Example: Change the ALM1 type from “Deviation high alarm (0001)” to “Deviation low alarm (0101)”

1. Press the SET key three times at SL1 until SL4 is displayed.
2. Press the <R/S key to highlight the hundreds digit.
3. Press the SET key until SL4 is displayed.

![SL 4](image)

4. Press the SET key to store the new set value. The display goes to the next parameter.
For voltage or current input, set scaling within the input range.

For ALM2 setting, the third digit from the right is set to “0” in the following cases:
- When the instrument does not have ALM2 output.
- When the ALM1 output is used for Process/Deviation/Band alarm or Control loop break alarm (LBA).

To make SV alarm setting effective, set SL4 to “0000” when using ALM1 for SV alarm, or set SL5 to “0000” when using ALM2 for SV alarm. SL4 and SL5 have priority to SL11 setting.

### 7.8 Setting Limiter Low (SLL)

#### SV alarm action type

<table>
<thead>
<tr>
<th>SV high alarm</th>
<th>SV low alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

### Change Settings

Example: Change the SV alarm type of the ALM1 from “SV high alarm (0001)” to “SV low alarm (0011)”
1. Press the SET key ten times at SL1 until SL11 is displayed.
2. Press the <R/S key to highlight the tens digit. Next, press the UP key to change the number to 1.
3. Press the SET key to store the new set value. The display goes to the initialize code parameter.

#### 7.9 Decimal Point Position (PGdP)

Use to select a Decimal point position of the input range (voltage input and current input). PGdP is displayed only for voltage or current input.

### Change Settings

Example: Change the Decimal point position from “One decimal place (0001)” to “No decimal place (0000)”
1. Press the SET key two times at SLH until PGdP is displayed.
2. Press the DOWN key to change the number to 0.
3. Press the SET key to store the new set value. The display goes to the next parameter.
8. ERROR DISPLAYS

- Error display
  - RAM failure (Incorrect set data write, etc.)
  - Turn off the power at once. If an error occurs after the power is turned on again, please contact RKC sales office or the agent.

- Over-scale and Underscale
  - Measured value (PV) [Flashing]
    - PV is outside of input range.
  - Underscale: PV is below the low input display range limit.

![ERROR DISPLAYS](image)

9. INPUT RANGE TABLE

<table>
<thead>
<tr>
<th>Input type</th>
<th>Model</th>
<th>Input type</th>
<th>Model</th>
<th>Input type</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 100 C</td>
<td>K F 01</td>
<td>0 to 800 C</td>
<td>K F 02</td>
<td>0 to 1200 C</td>
<td>U L 02</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 03</td>
<td>0 to 1600 C</td>
<td>K F 04</td>
<td>0 to 1200 C</td>
<td>U L 03</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 05</td>
<td>0 to 2000 C</td>
<td>K F 06</td>
<td>0 to 3000 C</td>
<td>U L 04</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 07</td>
<td>0 to 2500 C</td>
<td>K F 08</td>
<td>0 to 4000 C</td>
<td>U L 05</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 09</td>
<td>0 to 3000 C</td>
<td>K F 10</td>
<td>0 to 5000 C</td>
<td>U L 06</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 11</td>
<td>0 to 3500 C</td>
<td>K F 12</td>
<td>0 to 6000 C</td>
<td>U L 07</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 13</td>
<td>0 to 4000 C</td>
<td>K F 14</td>
<td>0 to 7000 C</td>
<td>U L 08</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 15</td>
<td>0 to 4500 C</td>
<td>K F 16</td>
<td>0 to 8000 C</td>
<td>U L 09</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 17</td>
<td>0 to 5000 C</td>
<td>K F 18</td>
<td>0 to 9000 C</td>
<td>U L 10</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 19</td>
<td>0 to 5500 C</td>
<td>K F 20</td>
<td>0 to 10000 C</td>
<td>U L 11</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 21</td>
<td>0 to 6000 C</td>
<td>K F 22</td>
<td>0 to 11000 C</td>
<td>U L 12</td>
</tr>
<tr>
<td>0 to 100 C</td>
<td>K F 23</td>
<td>0 to 6500 C</td>
<td>K F 24</td>
<td>0 to 12000 C</td>
<td>U L 13</td>
</tr>
</tbody>
</table>

*0 to 399 / 0 to 799 : Accuracy is not guaranteed.
*1 0 to 399 / 0 to 799 : Accuracy is not guaranteed.
*2 0 to 399 / 0 to 799 : Accuracy is not guaranteed.
*3 0 to 399 / 0 to 799 : Accuracy is not guaranteed.

10. REMOVING THE INTERNAL ASSEMBLY

Usually, this instrument is not necessary to remove the internal assembly from the case. When removing the internal assembly without disconnecting the external wiring, take the following steps.

**WARNING**

- To prevent electric shock or instrument failure, only qualified personnel should be allowed to pull out the internal assembly.
- To prevent electric shock or instrument failure, always turn off the power before pulling out the internal assembly.
- To prevent injury or instrument failure, do not touch the internal printed wiring board.

Apply pressure very carefully when removing internal assembly to avoid damage to the frame.

To conform to IEC61010-1 requirements for protection from electric shock, the internal assembly of this instrument can only be removed with an appropriate tool.

Unlocking points (marked with “O”) depend on the model as follows:

- CB400
- CB500
- CB700
- CB900

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