1-channel Type Temperature Controller with Built-in SSR

SB1

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.

**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.
- Periodic maintenance is 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 is 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.

⚠️ **WARNING**

- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument must be used in accordance with the specifications to prevent 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.

⚠️ High temperature caution:
The back side and the heat radiating cover of the SB1 will be at a high temperature when the power is ON or right after the power is turned OFF. Do not touch the surfaces to avoid being burned.
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 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 should 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 power is turned on to prevent electric shock, instrument failure, or incorrect action. 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 or failure, protect the power line and the input/output lines from high currents with a protection device such as 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, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dispensation.
- 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 will 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.
- Do not connect modular connectors to telephone line.
- When high alarm with hold action/re-hold action is used for Event 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.

FOR PROPER DISPOSAL

- When disposing of each part used for this instrument, always follows the procedure for disposing of industrial wastes stipulated by the respective local community.
SYMBOLS

Safety Symbols:

⚠️ WARNING : This mark indicates precautions that must be taken if there is danger of electric shock, fire, etc., which could result in loss of life or injury.

⚠️ CAUTION : This mark indicates that if these precautions and operating procedures are not taken, damage to the instrument may result.

⚠️ NOTE : This mark indicates that all precautions should be taken for safe usage.

Character Symbols:

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>Minus</th>
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<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>-</td>
<td>.</td>
</tr>
</tbody>
</table>

A   B (b)  C   c  D (d)  E  F  G  H  I  J  K

A   b  C   c  D   d  E  F  G  H  I  J  K

L   M  N (n)  O (o)  P  Q (q)  R (r)  S  T  t  U  u

L   ñ  ñ  o  P  q  r  S  T  t  U  u

V   W  X  Y  Z  Degree  /  Dash

±  ü  ù  ý  ë  °  -  |
**DOCUMENT CONFIGURATION**

There are four manuals pertaining to this product. Please be sure to read all manuals specific to your application requirements. If you do not have a necessary manual, please contact RKC sales office, the agent, or download from the official RKC website.

The following manuals can be downloaded from the official RKC website: http://www.rkcinst.com/english/manual_load.htm.

<table>
<thead>
<tr>
<th>Manual</th>
<th>Manual Number</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>SB1 Installation Manual</td>
<td>IMR02M01-E</td>
<td>This manual is enclosed with instrument. This manual explains the mounting and wiring</td>
</tr>
<tr>
<td>SB1 Quick Operation Manual</td>
<td>IMR02M02-E</td>
<td>This manual is enclosed with instrument. This manual explains the basic key operation, mode menu, and data setting.</td>
</tr>
<tr>
<td>SB1 Parameter List</td>
<td>IMR02M03-E</td>
<td>This manual is enclosed with instrument. This list is a compilation of the parameter data of each mode.</td>
</tr>
<tr>
<td>SB1 Instruction Manual *</td>
<td>IMR02M04-E1</td>
<td>This Manual. This manual explains the method of the mounting and wiring, the operation of various functions, and troubleshooting.</td>
</tr>
</tbody>
</table>

* Sold separately

📖 Read this manual carefully before operating the instrument. Please place this manual in a convenient location for easy reference.
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1. OUTLINE

1.1 Features

SB1 is a 1 channel temperature controller designed for flexible heating solutions such as heat trace of pipelines (by controlling Jacket heater etc).

Features include:

- **Space-saving**: 103 × 57 × 44 (Height × Width × Depth) [Instrument only]

- **Built-in SSR (Solid state relay)**: Instrument can be wired directly to heaters.

- **Data can be viewed locally by using the display, operation keys or loader communication port.**

- **Various ways to mount the instrument based on the pipe**: Pipe wrapping type, Pipe hanging type, Panel mounting type, etc.

- **UP to 31 units can be connected to the Host computer.**

- **Easy parameter setup via USB loader port**
  Saving parameter settings to a PC and copying parameters to other controllers becomes easy with the USB port, a COM-K converter, and dedicated WinSCI software.
  Download the software from the official RKC website: http://www.rkcinst.com/
1.2 Input/Output and Function Blocks

This section describes the input/output and function blocks of the instrument.

- **Input processing**
  - PV digital filter
  - PV bias

- **PV monitor**
  - TC
  - RTD

- **DI function assignment**
  - SV selection
  - RUN/STOP transfer
  - AUTO/MAN transfer
  - Interlock release

- **DI ***: Digital input (Dry contact)

- **Communication function ***: Communication function is not available with DI.

- **RS-485**

- **Communication function**

- **Communication function**

- **Loader communication**
  - COM-K must be used to connect to a PC via the loader port.

- **SV selection (Front key, DI, communication)**
  - SV1
  - SV2

- **Setting change rate limiter**

- **Auto (AUTO)/Manual (MAN) transfer (Front key, DI, communication)**

- **Control processing**
  - PID control
  - ON/OFF control
  - Autotuning (AT)
  - Startup tuning (ST)
  - Fine tuning
  - Output limiter

- **MV monitor**

- **Control output**
  - Triac
  - OUT

- **Communication processing**
  - Temperature alarm
  - Control loop break alarm (LBA)
  - Monitor during RUN
  - Communication monitoring
  - FAIL

- **Event output**
  - Relay contact (DO)

- **Event 1 to 2 processing**
  - Fail event monitoring

- **Event output**
  - Relay contact (Contact open when error occurs)
1.3 Checking the Product

Before using this product, check each of the following:

- Model code
- Check that there are no scratches or breakage in external appearance (case, front panel, or terminal, etc.)
- Check that all of the items delivered are complete. (Refer to below)

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Q'TY</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Instrument</td>
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<tr>
<td>Installation Manual (IMR02M01-E)</td>
<td>1</td>
<td>Enclosed with instrument</td>
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<tr>
<td>Quick Operation Manual (IMR02M02-E)</td>
<td>1</td>
<td>Enclosed with instrument</td>
</tr>
<tr>
<td>Parameter List (IMR02M03-E)</td>
<td>1</td>
<td>Enclosed with instrument</td>
</tr>
<tr>
<td>Instruction Manual (IMR02M04-E1)</td>
<td>1</td>
<td>This manual (sold separately)</td>
</tr>
<tr>
<td>Measured input/Control output connector [plug] SB1P-C01</td>
<td>1</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Power supply/Event input/output/Communication connector [plug] SB1P-C02</td>
<td>1</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Fitting SB1P-M01: Fitting for pipe wrapping type SB1P-M02: Fitting for pipe hanging type (Heat radiating cover) SB1P-M03: Fitting for DIN rail mounting type</td>
<td>1</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Strapping for pipe wrapping type (Cross section: Extra heavy) Width: 12.7 mm Length: 594 mm SB1P-B01</td>
<td>Depending on the order quantity</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Strapping for pipe hanging type (Cross section: Heavy) Width: 7.9 mm Length: 1000 mm SB1P-B02</td>
<td>Depending on the order quantity</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Operating tool for Measured input/Control output connector SB1P-C11</td>
<td>Depending on the order quantity</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Push button (Connector operating lever) for Measured input/Control output connector SB1P-C12</td>
<td>Depending on the order quantity</td>
<td>Optional (sold separately)</td>
</tr>
<tr>
<td>Operating tool for Power supply/Event input/Event output/Communication connector SB1P-C13</td>
<td>Depending on the order quantity</td>
<td>Optional (sold separately)</td>
</tr>
</tbody>
</table>

*If any of the products are missing, damaged, or if your manual is incomplete, please contact RKC sales office or the agent.*
1.4 Model Code

Check that the product received is correctly specified by referring to the following model code list:
If the product is not identical to the specifications, please contact RKC sales office or the agent.

- **Suffix code**

```
SB1 □ □ □ □ □ □ □ □ □ □ □ □
```

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Suffix code</th>
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<td>Control Method</td>
<td>PID control with AT (Reverse action) F</td>
</tr>
<tr>
<td>Measured input and Range</td>
<td></td>
</tr>
<tr>
<td>Thermocouple K</td>
<td>K04</td>
</tr>
<tr>
<td>Thermocouple J</td>
<td>J04</td>
</tr>
<tr>
<td>RTD Pt100</td>
<td>D17</td>
</tr>
<tr>
<td>RTD Pt100</td>
<td>DB4</td>
</tr>
<tr>
<td>Control output</td>
<td>Triac output T</td>
</tr>
<tr>
<td>Power supply voltage</td>
<td>100 to 240 V AC 4</td>
</tr>
<tr>
<td>Digital output (DO)</td>
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</tr>
<tr>
<td>Digital input (DI)/</td>
<td>None N D</td>
</tr>
<tr>
<td>Communication function</td>
<td>Communication function RS-485 (RKC communication) 5</td>
</tr>
<tr>
<td>Mounting method</td>
<td>Without fitting (Panel mounting) N With fitting (Sold separately) 1</td>
</tr>
<tr>
<td>Quick start code</td>
<td>No quick start code N Specify quick start code 1</td>
</tr>
<tr>
<td>Event 1 type (Quick start code)</td>
<td>No code No specify quick start code N Refer to Event Type Code Table. □</td>
</tr>
<tr>
<td>Event 2 type (Quick start code)</td>
<td>No code No specify quick start code N Refer to Event Type Code Table. □</td>
</tr>
<tr>
<td>Digital output assignment (Quick start code)</td>
<td>No code No specify quick start code N Event 1 1 Event 2 2 Logical OR of Event 1 and Event 2 3 Logical AND of Event 1 and Event 2 4</td>
</tr>
</tbody>
</table>

**Event Type Code Table**

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
<th>Code</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>None</td>
<td>R</td>
<td>Deviation low with re-hold action</td>
</tr>
<tr>
<td>A</td>
<td>Deviation high</td>
<td>T</td>
<td>Deviation high/low with re-hold action</td>
</tr>
<tr>
<td>B</td>
<td>Deviation low</td>
<td>U</td>
<td>Band (High/Low individual setting)</td>
</tr>
<tr>
<td>C</td>
<td>Deviation high/low</td>
<td>V</td>
<td>3V high</td>
</tr>
<tr>
<td>D</td>
<td>Band</td>
<td>W</td>
<td>3V low</td>
</tr>
<tr>
<td>E</td>
<td>Deviation high with hold action</td>
<td>X</td>
<td>Deviation high/low (High/Low individual setting)</td>
</tr>
<tr>
<td>F</td>
<td>Deviation low with hold action</td>
<td>Y</td>
<td>Deviation high/low with hold action (High/Low individual setting)</td>
</tr>
<tr>
<td>G</td>
<td>Deviation high/low with hold action</td>
<td>Z</td>
<td>Deviation high/low with hold action (High/Low individual setting)</td>
</tr>
<tr>
<td>H</td>
<td>Process high</td>
<td>2</td>
<td>Control loop break alarm (LBA)</td>
</tr>
<tr>
<td>J</td>
<td>Process low</td>
<td>3</td>
<td>FAIL</td>
</tr>
<tr>
<td>K</td>
<td>Process high with hold action</td>
<td>4</td>
<td>Monitor during RUN</td>
</tr>
<tr>
<td>L</td>
<td>Process low with hold action</td>
<td>5</td>
<td>Output of the communication monitoring result</td>
</tr>
<tr>
<td>Q</td>
<td>Deviation high with re-hold action</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1.5 Parts Description

This section describes various display units and the key functions.

■ Front side

■ Upside

■ Underside

Power supply/Event input/Event output/Communication connector

Loader communication connector (Standard equipment)

Measured input/Control output connector

Protective earth (PE) terminal
1. OUTLINE

- **Display unit**

<table>
<thead>
<tr>
<th>Display</th>
<th>[Green]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displays Measured value (PV), Set value (SV), Manipulated output value (MV) or various parameter symbols.</td>
<td></td>
</tr>
</tbody>
</table>

- **Indication lamps**

<table>
<thead>
<tr>
<th>Lamp Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autotuning (AT) lamp</td>
<td>[Green]</td>
</tr>
</tbody>
</table>
| Flashes when Autotuning is activated. (After Autotuning is completed: AT lamp will go out)  
Light during Startup tuning (ST) execution. |
| Output (OUT) lamp | [Green] |
| Lights when Output is turned on. |
| Manual (MAN) mode lamp | [Green] |
| Lights when operated in Manual (MAN) mode. |
| STEP lamp | [Green] |
| Lights when SV2 is selected for the Set value (SV). |
| Measured value (PV) lamp | [Green] |
| Lights when the Measured value (PV) is displayed. |
| Digital output (DO) lamp | [Red] |
| Lights when the Event output is turned on. |

- **Operation keys**

<table>
<thead>
<tr>
<th>Key</th>
<th>Description</th>
</tr>
</thead>
</table>
| SET | Set (SET) key  
Used for parameter calling up and set value registration. |
| R/S | Shift (R/S) key  
Shift digits when settings are changed.  
Used to switch monitor items, RUN/STOP, and modes. |
| Down key | Decrease numerals.  
For switching to the Maintenance mode. |
| Up key | Increase numerals.  
For switching to the Maintenance mode. |

* Also used to switch items within Mode switching (AUTO/MAN, Set data lock, and Interlock release).

**NOTE**

To avoid damage to the instrument, never use a sharp object to press keys.

- **Connector/Terminal**

<table>
<thead>
<tr>
<th>Connector/Terminal Description</th>
<th>Description</th>
</tr>
</thead>
</table>
| Power supply/Event input/Event output/Communication connector | The following signals are assigned: Power supply, Digital output (DO) [Event output], Digital input (DI) [Event input] and Communication.  
(DI and Communication cannot be selected at the same time.) |
| Measured input/Control output connector | The following signals are assigned: Sensor input (Measured input) and Control output. |
| Loader communication connector (Standard equipment) | Setting and monitoring on a personal computer (PC) is possible if the controller is connected with our cable to a PC via our USB communication converter COM-K-1 (sold separately).  
Our communication software must be installed on the PC.  
1 For the COM-K, refer to COM-K Instruction Manual (IMR01Z01-E).  
2 Only available as a download from the official RKC website.  
| Protective earth (PE) terminal | Terminals for Protective earth |
How to connect the controller to a PC via loader communication port

Connect the controller, COM-K, and personal computer using a USB cable and a loader communication cable. Make sure the connectors are oriented correctly when connecting.

- Communication tool WinSCI
  - Software operation environment: Windows 95 or higher
- Communication port of host computer
  - USB port: Based on USB Ver. 2.0

Communication settings on the computer
(The following values are all fixed)
- Communication speed: 9600 bps
- Start bit: 1
- Data bit: 8
- Parity bit: Without
- Stop bit: 1

The device address for loader communication is fixed at “0.” The setting of the device address is disregarded.

NOTE

The Loader port is only for parameter setup.

Loader communication can be used on a controller even when the Communication function (optional) is not installed.

The loader communication corresponds to the RKC communication protocol “Based on ANSI X3.28-1976 subcategories 2.5 and A4.”
1.6 Handling Procedure to Operation

After installation and wiring, follow the procedure below to configure settings required for operation.

**Power ON**

Set operation conditions?
- Conditions specified at time of ordering are acceptable
- You wish to change conditions

**Change from RUN to STOP**
(Factory set value: RUN)

- Press the key for more than 2 seconds to change from RUN to STOP (display on the display unit).

**Initial Setting**
(Engineering mode)

- Check the parameter related to the input (P. 5-3)
- Check the parameter related to the event (P. 5-4)
- Check the parameter related to the control action (P. 5-5)

Refer to 8.5 Engineering Mode (P. 8-30).

**Operation Setting**

- Set the control set value (P. 5-6)
- Set the event set value (P. 5-7)

Refer to 8.2 SV Setting Mode (P. 8-6).

Refer to 8.4 Parameter Setting Mode (P. 8-12).

**Tuning Type?**

- Startup tuning (ST)

**Autotuning (AT)**

Refer to 5.3 Operation Start (P. 5-8).

**ST Setting**
(Parameter setting mode: STU)

(P. 6-12)

**Change from STOP to RUN**

Press and hold the key for more than 2 seconds to change from STOP mode to RUN mode (Measured value displays on the display unit). Operation starts as soon as the RUN/STOP mode is changed to RUN.

**AT lamp flashes**

- Refer to Tuning PID parameters (P. 5-10).

**AT End**

AT lamp turns off

When the AT is finished, the controller will automatically returns to PID control.

**During ST execution:**

AT lamp lights

**ST End**

ST lamp turns off

When the ST is finished, the controller will automatically returns to PID control.

**Operation**

*Adjust the PID constants manually when the optimum PID constants cannot be calculated by AT or ST for characteristic variations of the controlled system.*
This chapter describes installation environment, mounting cautions, dimensions and mounting procedures.

2.1 Mounting Cautions

2.2 Dimensions
- Panel mounting type
- DIN rail mounting type
- Pipe wrapping type
- Pipe hanging type

2.3 Procedures of Mounting
- Panel mounting
- DIN rail mounting
- Pipe wrapping
- Pipe hanging
2. Mounting

2.1 Mounting Cautions

⚠️ WARNING

To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.

(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:
  -10 to +60 °C (The allowable load current drops when the ambient temperature exceeds 40 °C.)

![](chart.png)

- Allowable ambient humidity:
  5 to 95 % RH (Absolute humidity: MAX.W.C 29 g/m³ dry air at 101.3 kPa)

- Installation environment conditions:
  Indoor use
  Altitude up to 2000 m
  Temperature of the Installation position (surface of a jacket heater): −10 to +100 °C

  Do not use the following items at 70 °C or more:
  - Fitting and banding for pipe wrapping type
  - Strapping for pipe hanging type
  - Fitting for DIN rail mounting.

  Diameter of the pipe (being covered with a jacket heater): φ 70 and φ 120 to 150

(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:

- Make sure to mount inside a control panel. (Indoor use)
- Ensure at least 200 mm space on top and bottom of the instrument for maintenance and environmental reasons.
- If the ambient temperature rises above 60 °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.
  - Power lines: Separate at least 200 mm.
  - Rotating machinery: Separate as far as possible.
- Space required between SB1
  Allow 30 mm or more between the instruments for proper heat radiation when mounting two or more SB1 controllers in parallel.
  When mounting the instruments vertically, allow 200 mm or more to have space for wiring to or from the connectors installed on the top and the bottom of the SB1.

- SB1 Mounting angle
  Mount SB1 within 10 degrees from front to back and from side to side. To avoid malfunction, do not exceed this angle.

(5) If this instrument is permanently connected to equipment, it is important to include a switch or circuit-breaker into the installation. This should be in close proximity to the equipment and within easy reach of the operator. It should be marked as the disconnecting device for the equipment.
2.2 Dimensions

- Panel mounting type

- DIN rail mounting type

- Pipe wrapping type
2. MOUNTING

- Pipe hanging type

(Unit: mm)

Heat radiating cover
2.3 Procedures of Mounting

- **Panel mounting**
  1. Refer to 2.2 Dimensions (P. 2-4) and the diagram (Fig. 2-3-1) at right to confirm the installation position.

  2. Fix the SB1 to its mounting position using M3 screws. Customer must provide the screws.

  Recommended screw size:
  - M3 size [Nominal length (L): 6 mm or more]
  - Recommended tightening torque:
    - 0.45 to 0.53 N-m (4.5 to 5.3 kgf·cm)

  **NOTE**
  As the temperature of back side of SB1 becomes high, mount the instrument on a non-inflammable material (metal plate, etc.).

- **DIN rail mounting**
  1. Install SB1 into the fitting by overlapping the 4 tabs of the fitting and the 4 slots of SB1 until the lock clicks. After installation, insert the supplied screw through the hole on SB1 into the fitting and tighten it firmly. (Fig. 2-3-2)

  2. Pull down the mounting bracket at the bottom of the instrument (A). Attach the hooks on the top of the instrument to the DIN rail and push the lower section into place on the DIN rail (B). (Fig. 2-3-3)

  3. Attach the hooks on the top of the instrument to the DIN rail and push the lower section into place on the DIN rail (B). (Fig. 2-3-4)
Pipe wrapping

1. Prepare a strapping for pipe wrapping type (not included) fitting the circumference of the pipe. Then attach a banding (head) to an edge of one side of the strapping. (Fig. 2-3-5)

⚠️ When cutting the strapping, take caution to avoid being injured by the cut end.

To attach a banding (head), refer to the catalog of the strapping maker.

Recommended banding and strapping [Model code: SB1P-B01]:
- Stainless steel banding and strapping (Manufactured by PANDUIT Corporation)
  - Cross section: Extra heavy  Width: 12.7 mm
  - Banding (stainless steel banding)
  - Holding power at wrapping: 30 N (3 kgf)
  - Maximum clamping capacity: 60 N (6 kgf)

2. Insert the strapping into the through holes of the fitting for pipe wrapping type. Insert the strapping into the through holes vertically or horizontally based on the direction of the pipe. (Fig. 2-3-6)

3. Wrap the pipe with the strapping and then insert the edge without a banding into the banding (head). (Fig. 2-3-7)

🌟 NOTE
Before inserting the strapping, confirm the installation position as the strapping cannot be released from the banding (head) once it has been inserted.

4. Hold the fitting at the installation position and carefully fasten the strapping. (Fig. 2-3-8)

🌟 NOTE
Take caution to avoid fastening the strapping too tight. The strapping cannot be loosened once it is tightened.
5. Install SB1 into the fitting by overlapping the 4 tabs of the fitting and the 4 slots of SB1 until the lock clicks. After installation, insert the supplied screw through the hole on SB1 into the fitting and tighten it firmly. (Fig. 2-3-9 and Fig. 2-3-10)

---

**Pipe hanging**

1. Prepare a strapping for Pipe hanging type with the length being matched to the pipe.

   **When cutting the strapping, take caution to avoid being injured by the cut end.**

   **NOTE**

   The pipe hanging type may experience resonance between the pipe and the SB1. To avoid resonance, adjust the lengths of the strapping.

   Recommended banding and strapping [Model code: SB1P-B02]:
   - Stainless steel banding and strapping (Manufactured by PANDUIT Corporation)
     - Cross section: Heavy
     - Width: 7.9 mm
   - Allowable tensile force at hanging: 30 N (3 kgf)

2. Fold the strapping for pipe hanging type at 20 to 30 mm from the edge. (Fig. 2-3-11)

   Press the folded part until the thickness becomes within 2 mm. Otherwise, the strapping cannot go into the through holes of the Heat radiating cover. (Fig. 2-3-12)
3. Secure the strapping by inserting an edge from inside of the Heat radiating cover. (Fig. 2-3-13)

![Fig. 2-3-13 Mounting method of strapping](image)

4. Hang the strapping on the piping and secure the other edge of the strapping as described at No. 3.

5. Mount the instrument to the Heat radiating cover.
   Install SB1 into the Heat radiating cover by overlapping the 4 tabs of the Heat radiating cover and the 4 slots of SB1 until the lock clicks. (Fig. 2-3-14)
● Mounting space of SB1
For pipe hanging type, allow sufficient space (200 mm or more) between the instruments for heat radiation.

⚠️ The back side and the heat radiating cover of the SB1 will be at a high temperature when the power is ON or right after the power is turned OFF. Do not touch the surfaces to avoid being burned.

![Diagram showing Mounting space of SB1](image-url)
3.1 Wiring Cautions .................................................................3-2
3.2 Protective Earth (PE) Terminal ..............................................3-4
3.3 Terminal Layout ..................................................................3-5
   • Connector configuration ......................................................3-5
   • Power supply/Event input/Event output/Communication connector (upper-side) ..........................................................3-5
   • Measured input/Control output connector (lower-side) ..........3-6
   • Isolation ............................................................................3-6
3.4 Wiring for Host Computer ..................................................3-7
   • Connection to the RS-485 port of the host computer ............3-7
   • Connection to the RS-232C port of the host computer ..........3-8
   • Connection to the USB of the host computer .....................3-9
3.5 Connections for Loader Communication ...............................3-10
3.1 Wiring Cautions

WARNING

To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

- 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.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
  - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
  - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- Allow approximately 5 seconds for contact output when the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not furnished with a power supply switch. When using a power supply switch, locate it near the instrument. To connect a fuse to the instrument externally, select the one matches to the wiring conditions (such as wiring and load).
  Recommended fuse rating: Rated voltage 250 V AC, Rated current 25 A
  Fuse type: Time-lag fuse
- Use the connector below (sold separately) for the input/output connector (plug side).

**Power supply/Event input/Event output/Communication connector (upper-side connector)**

Model code: SB1P-C02 (Manufactured by WAGO Corporation: 721-2107/037-000)

Compatible cable diameter:

12 AWG (2.5 mm²)

Stripping length: 9 to 10 mm

Wiring tool: SB1P-C13: Operating tool with partially isolated shaft type 2

(Manufactured by WAGO Corporation: 210-720)

Power supply/Event input/Event output/Communication connector

Model code: SB1P-C02

(Manufactured by WAGO Corporation: 721-2107/037-000)
3. WIRING

**Measured input/Control output connector (lower-side connector)**

- **Model code:** SB1P-C01 (Manufactured by WAGO Corporation: 734-108/037-000)
- **Compatible cable diameter:** 14 AWG (1.5 mm²)
- **Stripping length:** 6 to 7 mm
- **Wiring tool:**
  - SB1P-C11: Operating tool with partially isolated shaft type 1
    (Manufactured by WAGO Corporation: 210-719)
  - SB1P-C12: Push button (Connector operating lever)
    (Manufactured by WAGO Corporation: 734-230)

* A small screwdriver can be used for wiring.

* To wire the connector, refer to the catalog of WAGO Corporation.
3.2 Protective Earth (PE) Terminal

- Ground no other devices to the location where you ground this instrument.
- Avoid sharing earth lines with electric motors, motorized equipment, and other equipment that uses large amounts of electrify.
- In the earth system, be careful to earth each point and not to create an earth loop.
- Use wire of at least 2.0 mm² for earth lines.
3.3 Terminal Layout

**Connector configuration**

- Pin No. 1 ———— 7
- Pin No. 8 ———— 1

- The pins of the same number at line A and line B of the Plug are connected internally.
- Maximum allowable current of the Plug (power supply part) is 15 A.
- The pin No. 7 (N) of the Power supply terminal and the pin No. 7 and No. 8 of the Control output terminal are connected internally.
- Communication and Digital input (Event input) cannot be selected at the same time.

**NOTE**

Each connector should be connected or removed in parallel. Connecting or removing the connector forcibly in an inappropriate angle may cause damage or failure.

**Power supply/Event input/Event output/Communication connector (upper-side)**

- Socket (SB1 side)
  - 1 ———— 7
- Communication terminal [Optional]
- Digital output terminal (DO) (Event output) [Optional]
- Power supply terminal

- Plug (Model code: SB1P-C02)
  - Manufactured by WAGO Corporation:
  - 721-2107/037-000
  - A1 ———— A7
  - B1 ———— B7

- Digital input terminal (DI) (Event input) [Optional]
  - SG  T/R (A)  T/R (B)  RS-485
  - 1  2  3

- Dry contact input
  - 1  2

- Relay contact output
  - 4  5

- Dry contact input
  - 1  2

- Power supply/Event input/Event output/Communication connector

- Measured input/Control output connector
Measured input/Control output connector (lower-side)

- The pin No. 4: Unused
- Two pins are provided for the Neutral and the Line of the Control output terminal. Same function is assigned to the pin No. 5 and No. 6, and the pin No. 7 and No. 8.
- The pin No. 7 (N) of the Power supply terminal and the pin No. 7 and No. 8 of the Control output terminal are connected internally.
- Load can be connected in parallel. However, the allowable load current of the SB1 is 7 A maximum regardless of the number of the connected load.

Isolation

For isolated device input/output blocks, refer to the following:
3.4 Wiring for Host Computer

This section describes the wiring for setting or monitoring data of SB1 by the Host computer.

- **Connection to the RS-485 port of the host computer**

  - **Communication pin number and signal details**

    | Pin No. | Signal name       | Symbol |
    |---------|-------------------|--------|
    | 1       | Signal ground     | SG     |
    | 2       | Send/Receive data | T/R (A) |
    | 3       | Send/Receive data | T/R (B) |

  - **Wiring example**

    *R: Termination resistors (Example: 120 Ω 1/2 W)

    If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.

    Maximum connections: Up to 31

    The cable and termination resistor(s) must be provided by the customer.
3. WIRING

- **Connection to the RS-232C port of the host computer**
  Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.

- **Communication pin number and signal details**

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Signal ground</td>
<td>SG</td>
</tr>
<tr>
<td>2</td>
<td>Send/Receive data</td>
<td>T/R (A)</td>
</tr>
<tr>
<td>3</td>
<td>Send/Receive data</td>
<td>T/R (B)</td>
</tr>
</tbody>
</table>

- **Wiring example**

The cable and termination resistor(s) must be provided by the customer.
### Connection to the USB of the host computer

When the host computer (OS: Windows 98SE/2000/XP/Vista/7) is corresponding to the USB connector, our communication converter COM-K (sold separately) can be used.

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Signal name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Signal ground</td>
<td>SG</td>
</tr>
<tr>
<td>2</td>
<td>Send/Receive data</td>
<td>T/R (A)</td>
</tr>
<tr>
<td>3</td>
<td>Send/Receive data</td>
<td>T/R (B)</td>
</tr>
</tbody>
</table>

### Wiring example

* The termination resistor is built into the COM-K.

For the COM-K, refer to the **COM-K Instruction Manual (IMR01Z01-E)***.

The cable and termination resistor(s) must be provided by the customer.
3.5 Connections for Loader Communication

Connect a USB communication converter COM-K (sold separately) * between the host computer and the SB1.
Loader communication makes it possible to check and set data of the SB1. To monitor and set data via the WinSCI.

*A loader communication cable (optional) is required for the connection to the loader communication connector on the SB1.
USB communication converter COM-K-1 (with Loader communication cable [cable length: 1 m])

![Diagram of connections]

The termination resistor is built into the COM-K.
Communication settings on the computer (the following settings are all fixed)
- Communication speed: 38400 bps
- Start bit: 1
- Data bit: 8
- Parity bit: Without
- Stop bit: 1

**NOTE**
The Loader port is only for parameter setup.

- The WinSCI can be downloaded from the RKC official website: http://www.rkcinst.com/.
- Loader communication can be used on a controller even when the Communication function (optional) is not installed.
- The module address for loader communication is fixed at “0.”
- Loader communication corresponds to RKC communication (based on ANSI X3.28-1976 subcategories 2.5 and A4).

For the COM-K, refer to the COM-K Instruction Manual (IMR01Z01-E†).
This chapter explains the basic operations of switching modes and changing set values.

4.1 Operation Menu ................................................................. 4-2
4.2 Changing Set Value ........................................................... 4-4
4.1 Operation Menu

The controller has five different modes. All settable parameters belong to one of them. The following chart show how to access different setting modes.

For the details of changing set value, refer to 4.2 Changing Set Value (P. 4-4).

- **Power ON**

### Input type/Unit Display
- **Symbol**
  - L’
  - J
  - PT
  - TC
  - RTD

- **Unit symbol**
  - °C
  - °F
  - K
  - J
  - Pt100

### Parameter Setting Mode
Change parameters related to control such as PID values.
- Refer to P. 4-3 and P. 8-12.

### Engineering Mode
In this mode, it is possible to set operating conditions such as the Set lock level, Mode switching, the non-display selection of Parameter setting mode (F01 to F10), etc. specific to each customer.
- Refer to 8.5 Engineering Mode (P. 8-30).

### Monitor Display Mode
Monitor parameters such as PV, SV and MV.
- Refer to 8.1 Monitor Display Mode (P. 8-2).

### SV Setting Mode
In this mode, control Set value (SV) and Manipulated output value (MV) in Manual (MAN) mode can be set.
- Refer to 8.2 SV Setting Mode (P. 8-6).

### Mode Switching
In this mode, Auto/Manual transfer, Set data unlock/lock transfer, and Interlock release can be performed.
- Refer to 8.3 Mode Switching (P. 8-9).

Display returns to the PV monitor if no key operation is performed within 1 minute.

If any item not described in the specification or the relevant function is not selected, there may be parameters which are not displayed.
4. BASIC OPERATION

Monitor Display Mode

Parameter Setting Mode

F01 to F10 indicate group numbers used in Non-display block and Set lock level in Engineering mode. In the Factory set value, parameters at F01, F03 and F10 are not displayed (highlighted in grey: ). [To display the parameters, refer to the descriptions at P. 8-45, P. 8-47 and P. 8-65.]

* If any of the following Event functions are selected, this parameter will be Event set value (EV) [high]. (Event number at parameter setting shows up in .)
- Band (High/Low individual setting) [Event type code: U]
- Deviation high/low with hold action (High/Low individual setting) [Event type code: Y]
- Deviation high/low (High/Low individual setting) [Event type code: X]
- Deviation high/low with re-hold action (High/Low individual setting) [Event type code: Z]
4.2 Changing Set Value

- The high-lighted digit indicates which digit can be set. Press \( \text{R/S} \) key to go to a different digit. Every time the shift key is pressed, the high-lighted digit moves as follows.

- The following is also available when changing the set value.

**Increase SV from 199 °C to 200 °C:**
1. Press the \( \text{R/S} \) key to high-lighted the ones place (first digit from the right).
2. Press the \( \text{A} \) key to change to 0.
The display changes to 200.

**Decrease SV from 200 °C to 190 °C:**
1. Press the \( \text{R/S} \) key to high-lighted the tens place.
2. Press the \( \text{D} \) key to change to 9.
The display changes to 190.

**Decrease SV from 20 °C to –10 °C:**
1. Press the \( \text{R/S} \) key to high-lighted the tens place.
2. Press the \( \text{D} \) key (three times) to change to –1.
The display changes to –10.

- To store a new value for the parameter, always press the \( \text{SET} \) key. The display changes to the next parameter and the new value will be stored.

After a new value has been displayed by using the \( \text{A} \) and \( \text{D} \) keys, the \( \text{SET} \) key must be pressed within 1 minute, or the new value is not stored and the display will return to the Monitor display mode.
This chapter explains basic setup procedures prior to running the instrument.

5.1 Initial Setting ..................................................................................... 5-3
   - Check the parameter related to the input ........................................... 5-3
   - Check the parameter related to the event .......................................... 5-4
   - Check the parameter related to the control action ............................ 5-5

5.2 Operation Setting ............................................................................. 5-6
   - Set the control set value .................................................................... 5-6
   - Set the event set value ........................................................................ 5-7

5.3 Operation Start ................................................................................. 5-8
   - Change from STOP to RUN ................................................................. 5-9
   - Tunes up PID parameters ................................................................... 5-10
Setup the controller prior to operating the instrument. Refer to the following setup example.

**Setup example:**
- **Input specification:** Thermocouple (K) 0 to 800 °C
- **Control action:** PID action with AT (Reverse action)
- **Event specification (Event 1):** Deviation high/low with hold action (Uses Interlock function)
- **Control set value:** 200 °C
- **Event set value:** 20 °C
- **PID parameters:** Automatic setting by Autotuning (AT)

### Operation procedure

- **Power ON**

  - **Initial Setting**
    - Check the parameter related to the input
    - Check the parameter related to the event
    - Check the parameter related to the control action

  - **Operation Setting**
    - Set the control set value
    - Set the event set value

  - **Operation Start**
    - Change from STOP to RUN
    - Tune up PID parameters [Autotuning (AT) execution]

- **For operating of initial setting (Engineering mode), refer to** 5.1 Initial Setting (P. 5-3).

- **WARNING**
  Parameters in the Engineering mode should be set according to the application before setting any parameter related to operation. Once the parameters in the Engineering 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 Engineering mode.

- **For operation setting, refer to** 5.2 Operation Setting (P. 5-6).

- **For operation start, refer to** 5.3 Operation Start (P. 5-8).
5.1 Initial Setting

- **Check the parameter related to the input**

Parameter settings related to the control input specifications such as the input type, can be checked in Engineering mode. Parameters which are not specified when ordering must be set before use.

**Setup example:**
Input specification: Thermocouple (K) 0 to 800 °C [Input range code: K04]

- **Set value change and registration**
  - The high-lighted digit indicates which digit can be set. The high-lighted digit can be moved by pressing the \( \text{RS} \) key.
  - However, the changed data is not stored by the operation of the \( \text{A} \) and \( \text{V} \) keys alone. In order for the new parameter value to be stored, the \( \text{RS} \) key must be pressed within 1 minute after the new value is displayed. The new value will then be saved and the display will move to the next parameter.

---

For input types, refer to **Input type (P. 8-66)**.
Check the parameter related to the event

Parameter settings related to event action can be checked in Engineering mode. Parameters which are not specified when ordering must be set before use.

**Setup example:**
Event specification (Event 1):
- Deviation high/low with hold action
  - [Quick start code: G]
  - Uses Interlock function

**Set value change and registration**
- The high-lighted digit indicates which digit can be set. The high-lighted digit can be moved by pressing the key.
- However, the changed data is not stored by the operation of the and keys alone. In order for the new parameter value to be stored, the key must be pressed within 1 minute after the new value is displayed. The new value will then be saved and the display will move to the next parameter.

*For Event 1 parameter, refer to Function block 41 (F41) (P. 8-73 to 8-89).*
Check the parameter related to the control action

Parameter settings related to control action can be checked in Engineering mode. Parameters which are not specified when ordering must be set before use.

Setup example:
Control action: PID action with AT (Reverse action)
[Suffix code: F]

Set value change and registration
- The high-lighted digit indicates which digit can be set. The high-lighted digit can be moved by pressing the key.
- However, the changed data is not stored by the operation of the and keys alone. In order for the new parameter value to be stored, the key must be pressed within 1 minute after the new value is displayed. The new value will then be saved and the display will move to the next parameter.

For control action parameter, refer to Function block 51 (F51) (P. 8-94 to 8-96).

To hide Engineering mode screens:
After setting parameters in Engineering mode from Function block 21 (F21) to 51 (F51) must be hidden to prevent accidental parameter change from the front keys. To hide the Engineering mode screens from F21 to F51, go to the Mod screen of F00 and change from “128” to “000.”
5.2 Operation Setting

- **Set the control set value**
  After finishing the initial settings, set the control target value, SV.

  [Setting example: Set the control set value 1 (SV1) to 200 °C.]

  1. Press the SET key at the Measured value (PV) monitor to switch to the SV monitoring display. Then press the SET key again to go to the SV setting mode.

  ![Monitor display mode](image1)

  2. Press the key to switch to the settable mode. Then change the Set value (SV) to 200 °C by using the key and the ▲ key.

  ![Set value (SV)](image2)

  3. Press the SET key to store the data.

  ![SV setting mode](image3)

  **Set value change and registration**
  - The high-lighted digit indicates which digit can be set. The high-lighted digit can be moved by pressing the key.
  - However, the changed data is not stored by the operation of the ▲ and ▼ keys alone. In order for the new parameter value to be stored, the key must be pressed within 1 minute after the new value is displayed. The new value will then be saved and the display will move to the next parameter.

  ![Set value change and registration](image4)

  To operate by Set value 2 (SV2) or select Set value (SV) by using Digital input (DI), refer to 7.1 SV selection function (Step SV function) (P. 7-2).
5. SETUP PROCEDURES PRIOR TO RUNNING THE INSTRUMENT

**Set the event set value**

After finishing the initial settings, set the event set values if they are used.

[Setting example: Set the Event 1 set value (EV1) to 20 °C]

1. In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed by pressing and holding the SET key for more than 2 seconds at the Measured value (PV) monitor. When the parameters of F01 or F03 is set to display in the Parameter setting mode, Event 1 set value (EV1) displays after the parameters. Press the SET key until the character of Event 1 set value (EV1) displays.

   Monitor display mode
   
   PV monitor
   [STOP] --> Parameter setting mode
   Event 1 set value (EV1)

   Setting range:
   Deviation action: −199 to +Input span
   Input value or set value action: Input range low to Input range high
   [Factory set value: 50]

2. Press the SET key to switch to the settable mode. Then change the Set value (SV) to 20 °C by using the SET key and the key.

   Parameter setting mode
   Event 1 set value (EV1)

   Setting range:
   Deviation action: −199 to +Input span
   Input value or set value action: Input range low to Input range high
   [Factory set value: 50]

3. Press the SET key to store the data.

   Parameter setting mode
   Event 1 set value (EV1)

   To return the PV/SV monitor, press the SET key for 2 seconds or more.

**Set value change and registration**

- The high-lighted digit indicates which digit can be set. The high-lighted digit can be moved by pressing the SET key.
- However, the changed data is not stored by the operation of the SET and SET keys alone. In order for the new parameter value to be stored, the SET key must be pressed within 1 minute after the new value is displayed. The new value will then be saved and the display will move to the next parameter.

For details on other parameters related to Event functions, refer to **Check the parameter related to the event (P. 5-4).**
5.3 Operation Start

Check the following precautions before starting operation.

---

**CAUTION**

- **Power ON**
  There is no power switch on this instrument, so the instrument starts operation immediately following initial power ON. [Factory set value: RUN (Control start)]

- **Action at input error**
  If the input signal wiring is disconnected or short-circuited (RTD input only), the instrument determines that burnout has occurred.
  - **Burnout direction**
    - **Thermocouple input:** Upscale
    - **RTD input:** Upscale (at input break) or downscale (at short-circuited)
  - **Output at burnout**
    - **Control output:** According to the setting contents of Control output at burnout in the Engineering mode.
      - 0: Result of control computation
      - 1: Output limiter low (Output OFF)
      [Factory set value: Result of control computation]
    - **Event output:** According to the setting contents of Event output action at input burnout in the Engineering mode.
      - 0: Event output is not forcibly turned on when the Burnout function is activated.
      - 1: ON at over-scale; no action at underscale.
      - 2: ON at underscale; no action at over-scale.
      - 3: ON at over-scale or underscale.
      - 4: OFF at over-scale or underscale.
      [Factory set value: Event output is not forcibly turned on when the Burnout function is activated.]

- **Check each parameter**
  The settings for the SV and all parameters should be appropriate for the controlled system.
  There are parameters in Engineering mode which can not be changed when the controller is in RUN mode. Change the RUN/STOP mode from RUN to STOP when a change to parameters in Engineering mode is necessary.

- **Event hold action**
  - The event hold action is activated when the power is turned on or when transferred from STOP mode to RUN mode. (Event type with hold action)
  - The event re-hold action is activated when not only the SV is changed, but also when power is turned on or when transferred from STOP mode to RUN mode. (Event type with re-hold action)

- **Action at power failure**
  A power failure of 10 ms or less will not affect the control action. When a power failure of more than 10 ms occurs the instrument assumes that the power has been turned off.

- **Action at power fail recovery**
  The instrument will return to the same RUN/STOP state and the same operation mode which were used by the instrument before power failure.
  - **In case of AUTO mode**
    Output changes from the Output limiter low with control calculation results.
  - **In case of Manual (MAN) mode**
    Output status is defined as follows by the Bumpless mode setting in the Engineering mode.

<table>
<thead>
<tr>
<th>In case of “0: Without bumpless”</th>
<th>In case of “1: With bumpless” (Factory set value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preset manual value is output.</td>
<td>Output limiter low is output.</td>
</tr>
</tbody>
</table>
5. SETUP PROCEDURES PRIOR TO RUNNING THE INSTRUMENT

■ Change from STOP to RUN

To start control, change the RUN/STOP mode from STOP (stop control) to RUN (start control).

Press and hold the \( \text{RS} \) key for 2 seconds or more at the PV monitor screen and the instrument will switch from STOP to RUN.

![Monitor display mode](image)

---

To change from RUN mode to STOP mode, press and hold the \( \text{RS} \) key for 2 seconds or more.

---

State of this instrument when set to STOP mode

| STOP display | Displays \( s^P \) and Measured value (PV) in turn. |
| Control output | Output is OFF. |
| Event output | According to the setting contents of Output action at STOP mode in the Engineering mode. (Factory set value: Event output is OFF) |

---

The RUN/STOP transfer can be made by digital input (DI) [optional] or communication [optional] other than the key operation.

For details of the RUN/STOP transfer by digital input (DI), refer to the 6.1 RUN/STOP Transfer (P. 6-2).

For details of the RUN/STOP transfer by communication, refer to the 9. COMMUNICATION (P. 9-1).
5. SETUP PROCEDURES PRIOR TO RUNNING THE INSTRUMENT

Tuning PID parameters
Suitable PID values are automatically calculated by Autotuning (AT) function. The Autotuning (AT) function automatically measures, computes and sets the optimum PID values.

Before start Autotuning, make sure that all required conditions (refer to P. 6-7) to start AT are satisfied.

Start the Autotuning (AT)

1. Press and hold the key for 2 seconds or more at the PV monitor screen to go to the Parameter setting mode, and press the key to display the AT screen.
   (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

   2. Press the key to switch to the settable mode. Then press the key to set “1” to the high-lighted digit. Press the key and Autotuning will start. The AT lamp on the front panel will flash.

   • Autotuning (AT) finish
     When the Autotuning (AT) is finished, the control will automatically returns to PID control and the AT lamp turns off.

   • Autotuning (AT) cancellation
     When canceling the Autotuning function (AT), press the key to be set to “000” with the Autotuning (AT) screen.

   • Return to the PV monitor
     To return the PV monitor, press and hold the key for 2 seconds or more.

     After a new value is displayed on the display by using and keys, if no key operation is performed within 1 minute without pressing key, this instrument returns to the PV monitor screen and the set value will not be changed.
• **To manually adjust the PID parameters**
If the Autotuning (AT) function does not match the controlled object requirements, the optimum PID values may not be calculated by Autotuning (AT). In that case, adjust the PID parameters manually.

• **Change the Proportional band (P)**

[Example: Change the Proportional band (P) to 20 °C]

1. Press and hold the SET key for 2 seconds or more at the PV monitor screen to go to the Parameter setting mode, and press the SET key to display the Proportional band screen.
   (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

   ![Diagram showing the change of Proportional band]

2. Press the key to switch to the settable mode. Then press the key and the ▼ key to change the value of the high-lighted digit. Press the SET key to store the new value.

   ![Diagram showing the change of Integral time and Derivative time]

• **Change the Integral time (I) and Derivative time (D)**
The setting procedure applies when the Integral time and the Derivative time are also set.

• **Return to the PV monitor**
To return the PV monitor, press and hold the SET key for 2 seconds or more.

⚠️ After a new value is displayed on the display by using ▲ and ▼ keys, if no key operation is performed within 1 minute without pressing the SET key, this instrument returns to the PV monitor screen and the set value will not be changed.
5. SETUP PROCEDURES PRIOR TO RUNNING THE INSTRUMENT

- **Changing control response with Fine tuning**
  After suitable PID values are calculated and stored by Autotuning or manual PID setting, the Fine tuning allows you to change the control response of the same PID constant control. The control response can be changed from fast to slow by simply changing the Fine tuning setting (6 levels: −3 to +3) in Parameter setting mode while the PID constant is unchanged.

  For details of the Fine tuning, refer to **6.4 Fine Tuning (P. 6-16)**.

- **Fine tuning setting**
  [Example: To slow the response (when “−1” is set)]

  1. Press and hold the **SET** key for 2 seconds or more at the PV/SV monitor screen to go to the Parameter setting mode, and press the **SET** key to display the Fine tuning setting screen.
     (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

        ![Diagram of monitor display mode: PV monitor (RUN) → Parameter setting mode: Event 1 set value (EV1) → Parameter setting mode: Fine tuning setting]

  2. Press the **R/S** key to switch to the settable mode. Then press the **V** key to change the value of the high-lighted digit. Press the **SET** key to store the new value.

     ![Diagram of Fine tuning setting: \( P \rightarrow 0 \rightarrow -1 \rightarrow \) Displays the next parameter: Proportional cycle time]

     Fine tuning setting range: −3 to +3
     [Factory set value: 0 (Unused)]

     When set to a positive value (+), the response becomes faster.
     When set to a negative value (−), the response becomes slower.

     If the set value of Fine tuning is returned to “0: Unused,” Fine tuning correction will be turned off.

- **Return to the PV monitor**
  To return the PV monitor, press and hold the **SET** key for 2 seconds or more.

     After a new value is displayed on the display by using **Δ** and **V** keys, if no key operation is performed within 1 minute without pressing **SET** key, this instrument returns to the PV monitor screen and the set value will not be changed.
5. SETUP PROCEDURES PRIOR TO RUNNING THE INSTRUMENT

To switch to ON/OFF control action
To switch to the ON/OFF control action, set “0” to the value of Proportional band.

- **Change the Proportional band (P)**

  [Example: Change the Proportional band (P) to 0]

  1. Press and hold the \( \text{SET} \) key for 2 seconds or more at the PV monitor screen to go to the Parameter setting mode, and press the \( \text{SET} \) key to display the Proportional band screen.

     (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

     Monitor display mode
     
     PV monitor
     
     Parameter setting mode
     
     Event 1 set value (EV1)
     
     Parameter setting mode
     
     Proportional band

     2 seconds or more

     Press the \( \text{SET} \) key to Proportional band screen (P)

  2. Press the \( \text{RS} \) key to switch to the settable mode. Then press the \( \text{RS} \) key and the \( \text{V} \) key to change the value of the high-lighted digit. Press the \( \text{SET} \) key to store the new value.

     Setting range of Proportional band:
     
     0 to Input span (Unit: °C [°F])
     
     (0: ON/OFF action)

- **Return to the PV monitor**

  To return the PV monitor, press and hold the \( \text{SET} \) key for 2 seconds or more.

  After a new value is displayed on the display by using \( \text{A} \) and \( \text{V} \) keys, if no key operation is performed within 1 minute without pressing \( \text{SET} \) key, this instrument returns to the PV monitor screen and the set value will not be changed.
This chapter describes the basic functions and the procedures for using basic functions.

6.1 RUN/STOP Transfer ........................................................................6-2
6.2 Autotuning (AT) .............................................................................6-7
6.3 Startup Tuning (ST) .......................................................................6-10
6.4 Fine Tuning ................................................................................6-16
6.5 Auto/Manual Transfer ....................................................................6-19
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6.7 Display/No display Setting of Mode Screens ..................................6-31
6.8 Interlock Release ...........................................................................6-38
6.1 RUN/STOP Transfer

It is possible to transfer between control start (RUN) and control stop (STOP). RUN/STOP transfer can be performed by key operation, by key operation using the RUN/STOP setting in Engineering mode, by digital input (DI) [optional] or communication [optional]. All methods of RUN/STOP operation are linked. For example, when the mode is changed from RUN to STOP via key operation, the setting of RUN/STOP setting in Engineering mode will also change to “STOP.”

**NOTE**
When the digital input RUN/STOP transfer function is used, it is impossible to transfer RUN/STOP through key operation if the contact is not closed. (When contact opens: STOP mode is maintained.)

For details of the RUN/STOP transfer by communication, refer to 9. COMMUNICATION (P. 9-1).

- **State of this instrument when set to STOP mode**

<table>
<thead>
<tr>
<th>STOP display</th>
<th>Displays the STOP symbol “STP” and Measured value (PV) in turn.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control output</td>
<td>Output is OFF.</td>
</tr>
<tr>
<td>Event output [optional]</td>
<td>The output content depends on the setting of Output action at STOP mode in the Engineering mode. Setting range: 0: Event output is OFF [Factory set value] 1: Event output remains unchanged</td>
</tr>
<tr>
<td>Autotuning (AT)</td>
<td>AT canceled (The PID constants are not updated)</td>
</tr>
</tbody>
</table>

For the settings of Output action at STOP mode, refer to 8.5 Engineering Mode (P. 8-72).

- **State of this instrument when set to RUN mode**

If the instrument is transferred to RUN mode from STOP mode, it performs the same operation (control RUN, event determination start-up) as the power-on.
RUN/STOP transfer by front key operation
Press and hold the \( \text{RUN/S} \) key for 2 seconds or more at the PV monitor screen and the instrument will switch from STOP to RUN.

To change from RUN mode to STOP mode, press and hold the \( \text{RUN/S} \) key for 2 seconds or more.

Performing RUN/STOP transfer in the “RUN/STOP setting” (Engineering mode)

1. Press the \( \text{RUN/S} \) key while pressing the \( \text{SET} \) key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Function block 00 screen is displayed first.

2. Press the \( \text{SET} \) key four times until RUN/STOP setting screen is displayed.
3. Press the \textls{6s} key to switch to the settable mode. Then press the \textls{A} key to set “1” (1: STOP) to the high-lighted digit. Press the \textls{SET} key to store the new value.

4. To return the PV monitor, press the \textls{6s} key while pressing the \textls{SET} key.

- To change from STOP mode to RUN mode
  1. Press the \textls{6s} key while pressing the \textls{SET} key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Function block 00 screen is displayed first.

2. Press the \textls{SET} key four times until RUN/STOP setting screen is displayed.

Continued on the next page.
3. Press the \(\uparrow^{\text{SET}}\) key to switch to the settable mode. Then press the \(\downarrow\) key to set “0” (0: RUN) to the high-lighted digit. Press the \(\uparrow^{\text{SET}}\) key to store the new value.

4. To return the PV monitor, press the \(\uparrow^{\text{SET}}\) key while pressing the \(\uparrow^{\text{SET}}\) key.

**RUN/STOP transfer by digital input (DI) [optional]**

RUN/STOP transfer by digital input (DI) is possible by assigning RUN/STOP transfer in DI assignment of Engineering mode.

**DI assignment**

<table>
<thead>
<tr>
<th>Set value</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unused (No DI assignment)</td>
</tr>
<tr>
<td>1</td>
<td>SV selection function (SV1/SV2)</td>
</tr>
<tr>
<td>2</td>
<td>RUN/STOP transfer</td>
</tr>
<tr>
<td>3</td>
<td>AUTO/MAN transfer</td>
</tr>
<tr>
<td>4</td>
<td>Interlock release</td>
</tr>
</tbody>
</table>

For the DI assignment, refer to 8.5 Engineering Mode (P. 8-71).

**Terminal configuration**

Digital input terminal (DI) (Event input) [Optional]

Contact closed: RUN
Contact open: STOP

Contact input from external devices or equipment should be dry contact input. If it is not dry contact input, the input should meet the specifications below:
Contact specifications: At OFF (contact open) 500 k\(\Omega\) or more
At ON (contact closed) 10 \(\Omega\) or less
• Transfer timing of RUN/STOP
When the contact is closed, RUN. When the contact is open, STOP.
RUN/STOP is switched based on the state of the contacts.

![Graph showing transfer timing of RUN/STOP]

**NOTE**
After the contact is transferred, it takes “250 ms + 1 sampling cycle**” until the action of this instrument is actually selected.
* Sampling cycle: 250 ms

• RUN/STOP transfer state
The table below shows the actual RUN/STOP modes and displays under different combinations of settings by key operation, communication, and STOP by the digital input (DI).

<table>
<thead>
<tr>
<th>RUN/STOP mode from key operation or communication</th>
<th>RUN/STOP mode by digital input (DI)</th>
<th>Actual RUN/STOP mode state</th>
<th>State of STOP (character)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN</td>
<td>Contact closed (RUN)</td>
<td>RUN</td>
<td>$dSF$</td>
</tr>
<tr>
<td></td>
<td>Contact open (STOP)</td>
<td>STOP</td>
<td>$kSF$</td>
</tr>
<tr>
<td>STOP</td>
<td>Contact closed (RUN)</td>
<td>STOP</td>
<td>$sFP$</td>
</tr>
<tr>
<td></td>
<td>Contact open (STOP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* When digital input (DI) is used for transfer, the new state is not backed up to EEPROM.

• STOP character display

Display when STOP mode is changed by key operation or communication [When there is no RUN/STOP transfer by the digital input (DI)]

Display when STOP mode is changed by key operation or communication [When there is RUN/STOP transfer by the digital input (DI)]

Display when STOP mode is selected by the digital input (DI)
6.2 Autotuning (AT)

The Autotuning (AT) function automatically measures, computes and sets the optimum PID values.

**Caution for using the Autotuning (AT)**
- When a temperature change (UP and/or Down) is 1 °C or less per minute during Autotuning (AT), Autotuning (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.
- If the manipulated output value may be limited by the Output limiter setting, the optimum PID values may not be calculated by Autotuning (AT).

**Requirements for Autotuning (AT) start**

Start the Autotuning (AT) when all following conditions are satisfied:

To start Autotuning (AT), go to Parameter setting mode.

<table>
<thead>
<tr>
<th>Operation state</th>
<th>PID control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter setting</td>
<td>Output limiter high ≥ 1 %, Output limiter low ≤ 99 %</td>
</tr>
<tr>
<td>Input value state</td>
<td>The Measured value (PV) is not underscale or over-scale.</td>
</tr>
</tbody>
</table>

**Requirements for Autotuning (AT) cancellation**

If the Autotuning (AT) is canceled according to any of the following conditions, the controller immediately changes to PID control. The PID values will be the same as before Autotuning (AT) was activated.

<table>
<thead>
<tr>
<th>Operation state</th>
<th>When the PID/AT transfer is changed to the PID control.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter changing</td>
<td>When the RUN/STOP mode is changed to the STOP mode.</td>
</tr>
<tr>
<td></td>
<td>When the Auto/Manual mode is changed to the Manual mode.</td>
</tr>
<tr>
<td>Input value state</td>
<td>When the Measured value (PV) goes to underscale or over-scale.</td>
</tr>
<tr>
<td>AT execution time</td>
<td>When the Autotuning (AT) does not end in 9 hours after Autotuning (AT) started.</td>
</tr>
<tr>
<td>Power failure</td>
<td>When the power failure of more than 10 ms occurs.</td>
</tr>
<tr>
<td>Instrument error</td>
<td>When the instrument is in the FAIL state.</td>
</tr>
</tbody>
</table>
Autotuning (AT) start/stop operation

The Autotuning function can start from any state after power on, during a rise in temperature or in stable control.

- **Start AT**

  1. Press and hold the \[\text{Set}\] key for 2 seconds or more at the PV monitor screen to go to the Parameter setting mode, and press the \[\text{Set}\] key to display the Autotuning (AT) screen. (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

  2. Press the \[\text{Set}\] key to switch to the settable mode. Then press the \[\uparrow\] key to set “1” to the high-lighted digit. Press the \[\text{Set}\] key and Autotuning will start. The AT lamp on the front panel will flash.

  3. When the Autotuning (AT) is finished, the control will automatically returns to PID control and the AT lamp turns off.

- If AT ends normally when LBA is set as the Event function, the LBA time is automatically set to twice the value of the Integral time.

- After a new value is displayed on the display by using \[\downarrow\] and \[\uparrow\] keys, if no key operation is performed within 1 minute without pressing \[\text{Set}\] key, this instrument returns to the PV monitor screen and the set value will not be changed.
• **Autotuning (AT) cancellation**
  When canceling the Autotuning function (AT), press the \( \sqrt{ } \) key to be set to “000” with the Autotuning (AT) screen. Then press the \( \text{SET} \) key to cancel AT.

![Autotuning (AT) cancellation diagram]

• **Return the PV monitor**
  To return the PV monitor, press and hold the \( \text{SET} \) key for 2 seconds or more.

  As the other parameters for Autotuning (AT) function, there are AT cycles, or AT differential gap time. For the each parameter, refer to 8.5 Engineering Mode (P. 8-97 to 8-98).
6.3 Startup Tuning (ST)

Startup tuning (ST) is a function which automatically computes and sets the PID values from the response characteristics of the controlled system at power ON, transfer from STOP to RUN, and Set value (SV) change.

- As simple autotuning, the PID values can be found in a short time without disturbing controllability for controlled systems with slow response at power ON.
- For controlled systems which require different PID values for each temperature setting, the PID values can be found for each Set value (SV) change.

![Graph](image)

- The setting items related to Startup tuning (ST) are shown below. Set them according to the application used.

<table>
<thead>
<tr>
<th>Setting item</th>
<th>Details</th>
<th>Setting mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start condition</td>
<td>When the power is turned on, operation is changed from STOP to RUN, or the Set value (SV) is changed.</td>
<td>Engineering mode</td>
</tr>
<tr>
<td>0 (Factory set value)</td>
<td>When the power is turned on or operation is changed from STOP to RUN.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>When the Set value (SV) is changed.</td>
<td></td>
</tr>
<tr>
<td>Execution method</td>
<td>ST unused</td>
<td>Parameter setting mode</td>
</tr>
<tr>
<td>0 (Factory set value)</td>
<td>Execute once</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Execute always</td>
<td></td>
</tr>
</tbody>
</table>

- **Caution for using the Startup tuning (ST)**
  - For Startup tuning (ST) at power ON or transfer from STOP to RUN, always set the heater power to ON simultaneously with the start of tuning or before the start of tuning.
  - Start Startup tuning (ST) in the state in which the temperature differential of the Measured value (PV) and Set value (SV) at the start of Startup tuning (ST) is twice the Proportional band, or greater.
  - When the manipulated output value may be limited by the Output limiter setting, the optimum PID values may not be calculated by Startup tuning (ST).
  - When setting the Setting change rate limiter, the optimum PID values are not obtained even when Startup tuning (ST) is executed at Set value (SV) change.
6. OPERATIONS OF THE BASIC FUNCTIONS

■ Requirements for Startup tuning (ST) start

Start the Startup tuning (ST) when all following conditions are satisfied:

<table>
<thead>
<tr>
<th>Operation state</th>
<th>PID control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RUN</td>
</tr>
<tr>
<td>Parameter setting</td>
<td>ST is set to ON. (Execute once, Execute always)</td>
</tr>
<tr>
<td></td>
<td>Output limiter high $\geq 1%$, Output limiter low $\leq 99%$</td>
</tr>
<tr>
<td>Input value state</td>
<td>The Measured value (PV) is not underscale or over-scale.</td>
</tr>
<tr>
<td></td>
<td>At ST at setting change, the Measured value (PV) shall be stabilized.</td>
</tr>
<tr>
<td>Output value state</td>
<td>At startup, output is changed and saturated at the Output limiter high or the Output limiter low.</td>
</tr>
</tbody>
</table>

■ Requirements for Startup tuning (ST) cancellation

If the Startup tuning (ST) is canceled according to any of the following conditions, the controller immediately changes to PID control. The PID values will be the same as before Startup tuning (ST) was activated:

<table>
<thead>
<tr>
<th>Operation state</th>
<th>When the Autotuning (AT) is activated.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>When the RUN/STOP mode is changed to the STOP mode.</td>
</tr>
<tr>
<td></td>
<td>When the Auto/Manual mode is changed to the Manual mode.</td>
</tr>
<tr>
<td>Parameter changing</td>
<td>When Startup tuning (ST) is set to “0 (ST unused).”</td>
</tr>
<tr>
<td></td>
<td>When the PV bias or the PV digital filter is changed.</td>
</tr>
<tr>
<td></td>
<td>When the Output limiter value is changed.</td>
</tr>
<tr>
<td>Input value state</td>
<td>When the Measured value (PV) goes to underscale or over-scale.</td>
</tr>
<tr>
<td>Startup tuning (ST) execution time</td>
<td>When the Startup tuning (ST) does not end in 100 minutes after Startup tuning (ST) started</td>
</tr>
<tr>
<td>Power failure</td>
<td>When the power failure of more than 10 ms occurs.</td>
</tr>
<tr>
<td>Instrument error</td>
<td>When the instrument is in the FAIL state.</td>
</tr>
</tbody>
</table>
6. OPERATIONS OF THE BASIC FUNCTIONS

**Start-up tuning (ST) setting**

The setting procedure when executing Start-up tuning (ST) only one time at power ON is shown below as a setting example.

- **Set the ST start condition**

First, set “When the power is turn on” to ST start condition by Engineering mode.

1. Change the operation mode from RUN mode to STOP mode.
   Press and hold the SET key for 2 seconds or more at the PV monitor screen, then instrument will go to RUN mode from STOP mode.

2. Press the SET key while pressing the R/S key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Function block 00 screen is displayed first.

3. Configure settings to display Function block 21 and following of Engineering mode.
   ➔ Press the SET key several times until Mode selection (no display) screen will be displayed.

Continued on the next page.
② Press the \textit{\textls{SET}} key to switch to the settable mode. Then set “128” and press the \textit{\textls{R/S}} key to register the value. (128: Displays parameters at F21 and the sequential function blocks).

Press the \textit{\textls{R/S}} key several times until the Function block 00 screen is displayed.

\begin{itemize}
  \item For the data setting, refer to \textbf{4.2 Changing Set Value (P. 4-4)}.
\end{itemize}

4. Press the \textit{\textls{SET}} key several times until Function block 52 screen is displayed.

\begin{itemize}
  \item Press the \textit{\textls{SET}} key to Function block 52 screen (F52).
\end{itemize}

5. Press the \textit{\textls{SET}} key several times until ST start condition screen will be displayed.

\begin{itemize}
  \item Press the \textit{\textls{SET}} key to ST start condition screen (STS).
\end{itemize}

6. Press the \textit{\textls{SET}} key to switch to the settable mode. Then press the \textit{\textls{SET}} key to set “1” (1: Activate the ST function when the power is turned on) to the high-lighted digit. Press the \textit{\textls{R/S}} key to store the new value.

\begin{itemize}
  \item Press the \textit{\textls{R/S}} key to display the next parameter (Function block 52).
\end{itemize}

Setting range:

0: Activate the ST function when the power is turned on; when transferred from STOP to RUN; or when the Set value (SV) is changed.

1: Activate the ST function when the power is turned on; or when transferred from STOP to RUN.

2: Activate the ST function when the Set value (SV) is changed.

Continued on the next page.
7. Press the $ key several times until Function block 00 screen is displayed.

8. Press the $ key several times until Mode selection (no display) screen is displayed.
   Change the value in the Mode selection (no display) screen to the original value and then press the $ key to store the set value.

9. To return the PV monitor, press the $ key while pressing the $ key.

   After a new value is displayed on the display by using $ and $ keys, if no key operation is performed within 1 minute without pressing $ key, this instrument returns to the PV monitor screen and the set value will not be changed.

**Set the execution method**

Set that the Startup tuning (ST) will be executed only once.

1. Change the operation mode from STOP mode to RUN mode.
   Press and hold the $ key for 2 seconds or more at the PV monitor screen, then instrument will go to RUN mode from STOP mode.

2. Press and hold the $ key for more than 2 seconds at the PV monitor screen to go to the Parameter setting mode. Then press the $ key to display Startup tuning (ST).
   (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

Continued on the next page.
3. Press the $\downarrow^{\circ}$ key to switch to the settable mode. Then press the $\wedge$ key to set “1” (1: Execute once) to the high-lighted digit. Press the $\Rightarrow$ key to store the new value.

4. Thus, the Startup tuning (ST) setting has been finished. To return the PV monitor, press and hold the $\Rightarrow$ key for 2 seconds or more.

   After a new value is displayed on the display by using $\wedge$ and $\vee$ keys, if no key operation is performed within 1 minute without pressing $\Rightarrow$ key, this instrument returns to the PV monitor screen and the set value will not be changed.

- Start the ST

   Turn off the power once and turn it on again. The Startup tuning (ST) will automatically start (During ST execution: AT lamp lights). When the calculation and setting of PID values is completed, setting of the Startup tuning (ST) screen will automatically change to “0” (0: ST unused).

   (ST is completed: AT lamp turns off)

   When Startup tuning (ST) was interrupted, the setting does not change to “0” (0: ST unused). Startup tuning (ST) starts when the restart conditions are satisfied.

   If Startup tuning (ST) ends normally when LBA is set as the Event function, the LBA time is automatically set to twice the value of the Integral time.
6.4 Fine Tuning

The Fine tuning function allows you to change the response of the set PID constant control.

■ To make control response faster

When the control response is set to the fast side, the Measured value (PV) will reach the Set value (SV) more quickly, however, overshoot will be unavoidable.

1. Press and hold the SET key for 2 seconds or more at PV monitor screen until Parameter setting mode is displayed.
   (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

   ![Diagram showing Fine tuning settings]

2. Press the SET key until Fine tuning setting screen is displayed.

3. Press the key to switch to the settable mode. Then press the key to make the control response faster. A value from +1 to +3 will give a faster control response. The larger the value, the faster the control response.

   ![Diagram showing Fine tuning settings]
4. Press the $\text{SET}$ key to store the new value. The display goes to the next parameter. Fine tuning begins when the $\text{SET}$ key is pressed.

To make the control response slower

When the control response is set to slow side, overshoot is suppressed. However, it takes more time for the Measured value (PV) to reach the Set value (SV).

1. Press and hold the $\text{SET}$ key for 2 seconds or more at PV monitor screen until Parameter setting mode is displayed.
   (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)

2. Press the $\text{SET}$ key until Fine tuning setting screen is displayed.

3. Press the $\text{DISP}$ key to switch to the settable mode. Then press the $\text{V}$ key to make the control response slower. A value from −1 to −3 will give a slower control response. The smaller the set value, the slower the control response.

Continued on the next page.
4. Press the SET key to store the new value. The display goes to the next parameter. Fine tuning begins when the SET key is pressed.

If the set value of Fine tuning is returned to “0: Unused,” fine tuning correction will be turned off.

After a new value is displayed on the display by using \( \Delta \) and \( \nabla \) keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the PV monitor screen and the set value will not be changed.
6.5 Auto/Manual Transfer

The Auto/Manual transfer can be made by digital input (DI) [optional] or communication [optional] other than the key operation.

For details of Auto/Manual transfer by communication, refer to the 9. COMMUNICATION (P. 9-1).

■ Bumpless function with Auto/Manual transfer

● **When the instrument is switched from Manual (MAN) mode to Auto (AUTO) mode**
  When the instrument is switched from Manual (MAN) mode to Auto (AUTO) mode, the instrument determines the state of the Measured value (PV) and performs the following processing:
  - If the Measured value (PV) is within the Proportional band, the Bumpless function will be activated.
  - If the Measured value (PV) is outside of the Proportional band, the Bumpless function will not be activated.

● **When the instrument is switched from Auto (AUTO) mode to Manual (MAN) mode**
  It can be set whether the Bumpless function is ON or OFF when the instrument is switched from Auto (AUTO) mode to Manual (MAN) mode. The following processing is performed depending on Bumpless function ON or OFF.
  - If the Bumpless function is set to OFF, the preset Manual manipulated output value (MV) will be output.
  - If the Bumpless function operates is set to ON, the Manipulated output value (MV) of Auto (AUTO) mode will be maintained as the output of Manual (MAN) mode.

■ Auto/Manual transfer by front key operation

This is performed in Auto/Manual transfer of Mode switching. Auto/Manual transfer can be done in the Mode switching. Every time the key or the key is pressed, the Auto (AUTO) mode is changed to the Manual (MAN) mode alternately. Press the key to store the mode.

1. In PV monitor, press the key while pressing the key.

   Continued on the next page.
2. Press the $\text{R/S}$ key to switch to the settable mode. Then press the $\wedge$ key to set “1” (1: Manual mode) to the high-lighted digit.

3. To make Manual mode (MAN) effective, press the $\text{SET}$ key to register the value.

After a new value is displayed on the display by using $\wedge$ and $\vee$ keys, if no key operation is performed within 1 minute without pressing $\text{R/S}$ key, this instrument returns to the Monitor display mode and the set value will not be changed.

Auto/Manual transfer by digital input (DI) [optional]

Auto/Manual transfer by the digital input (DI) is possible with the DI assignment of the Engineering mode.

For the DI assignment, refer to 8.5 Engineering Mode (P. 8-71).

Terminal configuration

Contact input from external devices or equipment should be dry contact input. If it is not dry contact input, the input should meet the specifications below:

Contact specifications:
- At OFF (contact open) 500 kΩ or more
- At ON (contact closed) 10 Ω or less
• Transfer timing of Auto/Manual
When the contact is closed, the mode will be AUTO, and when the contact is open, the mode will be MAN. Auto/Manual is switched based on the state of the contacts.

![Diagram showing Auto/Manual transition]

**NOTE**
After the contact is transferred, it takes “250 ms + 1 sampling cycle**” until the action of this instrument is actually selected.

* Sampling cycle: 250 ms

When the Auto/Manual state is changed by digital input (DI), the Auto/Manual state in EEPROM will not be overwritten.

• Auto/Manual transfer state
The table below shows the actual Auto/Manual modes and displays under different combinations of settings by key operation, communication, and digital input (DI).

<table>
<thead>
<tr>
<th>Auto/Manual select from key operation or communication</th>
<th>Auto/Manual select by digital input (DI) *</th>
<th>Actual Auto/Manual state</th>
<th>Indication lamp state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto (AUTO) mode</td>
<td>Contact closed [Auto (AUTO) mode]</td>
<td>Auto (AUTO) mode</td>
<td>MAN lamp turns off</td>
</tr>
<tr>
<td></td>
<td>Contact open [Manual (MAN) mode]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manual (MAN) mode</td>
<td>Contact closed [Auto (AUTO) mode]</td>
<td>Manual (MAN) mode</td>
<td>MAN lamp lights</td>
</tr>
<tr>
<td></td>
<td>Contact open [Manual (MAN) mode]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* When digital input (DI) is used for transfer, the new state is not backed up to EEPROM.

■ Procedure for setting the Manipulated output value (MV) in Manual mode
When the controller is in Manual mode, the Manipulated output value (MV) can be manually set.

1. Make sure the Manual (MAN) mode lamp is lit. Press the key to switch to the MV monitor.
2. Display the Manual manipulated output value (MV) setting display in the SV setting mode by pressing the \textless \textgreater key at the MV monitor display.

3. Press the \textless \textgreater key to switch to the settable mode. Press the \textless key or the \textgreater key to set the Manipulated output value (MV).

4. Press the \textless \textgreater key to store the new Manual manipulated output value (MV). The display goes to the PV monitor.

The Manual manipulated output value (MV) of SV setting mode is linked to the Manual manipulated output value (MV) of Parameter setting mode and Engineering mode. The Manual manipulated output value (MV) can also be changed by changing the Manual manipulated output value (MV) of Parameter setting mode and Engineering mode.

The Manual manipulated output value (MV) of Parameter setting mode is not displayed by factory default. To display it, set “0: Display” in F10 block selection (no display) (P. 8-65) of Engineering mode.
6.6 Protecting Setting Data (Data lock function)

To protect setting data in the instrument, the setting data can be locked so that no changes can be made (Data lock function). Parameters that can be locked are described below.

- Parameters of Parameter setting mode
- Parameters of Function block 01 (F01) to Function block 10 (F10) of Engineering mode
- Parameters of Function block 21 (F21) to Function block 91 (F91) of Engineering mode
  (Note that parameters of Function block 91 (F91) are for monitoring only)

Set lock level

- **Parameter setting mode:**
  Parameters can be locked by a block of parameters, using a set lock level. A parameter in Parameter setting mode also belongs to a Function block of Engineering mode between Function block 01 (F01) and 10 (F10). By locking a block to which the parameter belongs, the parameter can be locked and all parameters in the same block and parameters in all blocks included in the same lock level are locked at the same time (P. 6-24).

- **Function block 01 (F01) to Function block 10 (F10):**
  The data can be locked function block by Function block.

- **Function block 21 (F21) to Function block 91 (F91):**
  The data of F21 to F91 can be locked altogether at the same time. The data cannot be locked for each Function block. When the data of F21 to F91 is locked, the screens of F21 to F91 are not displayed.

Setting procedure flowchart

- **Step 1**
  Go to Engineering mode.

- **Step 2**
  Select the Set lock level.

- **Step 3**
  Go to Mode switching.

- **Step 4**
  Enable data lock function.

Screens of F21 to F91 are not displayed.

- For setting examples, refer to from P. 6-25 to P. 6-30.
### Set lock level of Parameter setting mode

The same parameters exist in Engineering mode, grouped by group number (F01 to F10) as shown below. In the Set lock level (LCK) screen, you can lock the group number that contains the parameter(s) that you wish to lock, and this will lock the same parameters in Parameter setting mode. After Set lock level is stored, data lock will be effective by setting Set data unlock/lock transfer in Mode switching to “lock.”

<table>
<thead>
<tr>
<th>No.*</th>
<th>Parameter setting mode</th>
<th>Engineering mode (Set lock level [LCK])</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>F01</td>
<td>Set value 1 (SV1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Set value 2 (SV2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SV selection</td>
<td></td>
</tr>
<tr>
<td>F03</td>
<td>Setting change rate limiter (up)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Setting change rate limiter (down)</td>
<td></td>
</tr>
<tr>
<td>F04</td>
<td>Event 1 set value (EV1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event 1 set value (EV1) [high]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event 1 set value (EV1') [low]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event 2 set value (EV2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event 2 set value (EV2) [high]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event 2 set value (EV2') [low]</td>
<td></td>
</tr>
<tr>
<td>F05</td>
<td>Autotuning (AT)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Startup tuning (ST)</td>
<td></td>
</tr>
<tr>
<td>F06</td>
<td>Proportional band</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integral time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Derivative time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anti-reset windup (ARW)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine tuning setting</td>
<td></td>
</tr>
<tr>
<td>F07</td>
<td>Control loop break alarm (LBA) time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LBA deadband (LBD)</td>
<td></td>
</tr>
<tr>
<td>F08</td>
<td>Proportional cycle time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Minimum ON/OFF time of proportioning cycle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output limiter high</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output limiter low</td>
<td></td>
</tr>
<tr>
<td>F09</td>
<td>PV bias</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PV digital filter</td>
<td></td>
</tr>
<tr>
<td>F10</td>
<td>Manual manipulated output value (MV)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power saving mode setting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance mode switching</td>
<td></td>
</tr>
</tbody>
</table>

* F01 to F10 indicate group numbers used in Set lock level in Engineering mode.
locking all data which can be locked
parameters that can be locked:
− parameters of parameter setting mode
− parameters of F01 to F91 of engineering mode

1. in pv monitor, press the \[SET\] key for 4 seconds or more while pressing the \[SET\] key. the display goes to the engineering mode.

2. press the \[SET\] key until set lock level screen is displayed.

3. press the \[SET\] key to switch to the settable mode. then press the \[\wedge\] key to set “1” to the high-lighted digit.

4. press the \[SET\] key to store the new value. the display goes to the next parameter.

after a new value is displayed on the display by using \[\wedge\] and \[\vee\] keys, if no key operation is performed within 1 minute without pressing \[SET\] key, this instrument returns to the monitor display mode and the set value will not be changed.
5. Press the \textsuperscript{\textregistered} key while pressing the SET key. The display goes to the PV monitor.

\[
\begin{array}{c}
\text{PV monitor [RUN]} \\
\text{AT OUT MAN STEP PV DO} \\
\text{non} \\
\text{While pressing the SET key} \\
\text{Press} \\
\end{array}
\]

6. In PV monitor, press the \textsuperscript{\textregistered} key while pressing the SET key. The display goes to the Mode switching.

\[
\begin{array}{c}
\text{Mode switching Auto/Manual transfer} \\
\text{AT OUT MAN STEP PV DO} \\
\text{28} \\
\text{While pressing the SET key} \\
\text{Press} \\
\end{array}
\]

7. Press the SET key until Set data unlock/lock transfer screen is displayed.

\[
\begin{array}{c}
\text{Set data unlock/lock transfer} \\
\text{AT OUT MAN STEP PV DO} \\
\text{A-n} \\
\text{Press} \\
\end{array}
\]

8. Press the \textsuperscript{\textregistered} key to switch to the settable mode. Then press the \textsuperscript{\textregistered} key to set “1” to the high-lighted digit.

\[
\begin{array}{c}
\text{Set data unlock/lock transfer} \\
\text{AT OUT MAN STEP PV DO} \\
\text{U-L} \\
\text{Press} \\
\end{array}
\]

When Set lock level is set to “0: All parameters can be changed,” setting “1” does not affect the unlock state.

9. Press the SET key to store the new value. The parameters of Parameter setting mode and F10 to F91 are locked, and the setting data cannot be changed.

\[
\begin{array}{c}
\text{Displays the next parameter} \\
\text{AT OUT MAN STEP PV DO} \\
\text{001} \\
\text{Press} \\
\end{array}
\]
Selecting the parameter to lock

Setting example: Locking the Proportional band and following parameters in Parameter setting mode

To lock Proportional band and following parameters, choose a suitable Set lock level by which Function block F06 is locked. Set lock level “6: F06 to F10” so that all parameters in F06 to F10 will lock.

1. In PV monitor, press the [SET] key for 4 seconds or more while pressing the [PV monitor] key. The display goes to the Engineering mode.

2. Press the [SET] key until Set lock level screen is displayed.

3. Press the [SET] key to switch to the settable mode. Then press the [key to set “6” to the high-lighted digit.

4. Press the [SET] key to store the new value. The display goes to the next parameter.

After a new value is displayed on the display by using [key and [key keys, if no key operation is performed within 1 minute without pressing [SET] key, this instrument returns to the Monitor display mode and the set value will not be changed.
5. Press the \( \leftarrow \) key while pressing the \( \text{SET} \) key. The display goes to the PV monitor.

\[
\text{non} \quad \text{PV monitor} \quad [\text{RUN}] \\
\text{AT OUT MAN STEP PV DO}
\]
While pressing the SET key

6. In PV monitor, press the \( \leftarrow \) key while pressing the \( \text{SET} \) key. The display goes to the Mode switching.

\[
28 \quad \text{Mode switching} \quad \text{Auto/Manual transfer} \\
\text{AT OUT MAN STEP PV DO}
\]
While pressing the SET key

7. Press the \( \text{SET} \) key until Set data unlock/lock transfer screen is displayed.

\[
A-n \quad \text{Set data unlock/lock transfer} \\
\text{AT OUT MAN STEP PV DO}
\]

8. Press the \( \leftarrow \) key to switch to the settable mode. Then press the \( \text{SET} \) key to set “1” to the high-lighted digit.

\[
\text{U-L} \quad \text{Set value and description} \\
0: \text{Unlock} \\
1: \text{Lock}
\]

When Set lock level is set to “0: All parameters can be changed,” setting “1” does not affect the unlock state.

9. Press the \( \text{SET} \) key to store the new value. The parameters of Parameter setting mode and F06 to F91 are locked, and the setting data cannot be changed.

\[
001 \quad \text{Displays the next parameter} \\
\text{AT OUT MAN STEP PV DO}
\]
6. OPERATIONS OF THE BASIC FUNCTIONS

Locking F21 to F91 data

To lock F21 to F91, set any value from “1” to “10” in the Set lock level, and enable the Data lock function in the Set data unlock/lock screen.

When locked, the screens of F21 to F91 will not be displayed even if “128” is set in the Mode selection (no display) screen of F00 in either RUN or STOP mode.

1. In PV monitor, press the \[\text{Set} \] key for 4 seconds or more while pressing the \[\text{Set} \] key.
   The display goes to the Engineering mode.

   ![PV monitor to Function block 00 (Engineering mode)]

   2. Press the \[\text{Set} \] key until Set lock level screen is displayed.

   ![Set lock level]

   3. Press the \[\text{Set} \] key to switch to the settable mode. Press the \[\text{Set} \] key to set any number from 1 to 10. (Here “1” is set as an example.)

   ![Set value and description]

   4. Press the \[\text{Set} \] key to store the new value. The display goes to the next parameter.

   ![Displays the next parameter]

   After a new value is displayed on the display by using \[\text{Set} \] and \[\text{Set} \] keys, if no key operation is performed within 1 minute without pressing \[\text{Set} \] key, this instrument returns to the Monitor display mode and the set value will not be changed.
5. Press the \( \downarrow \) key while pressing the SET key. The display goes to the PV monitor.

6. In PV monitor, press the \( \downarrow \) key while pressing the SET key. The display goes to the Mode switching.

7. Press the SET key until Set data unlock/lock transfer screen is displayed.

8. Press the \( \uparrow \) key to switch to the settable mode. Then press the key to set “1” to the high-lighted digit.

When Set lock level is set to “0: All parameters can be changed,” setting “1” does not affect the unlock state.

9. Press the SET key to store the new value. The parameters of Parameter setting mode and F21 to F91 are locked, and the setting data cannot be changed.
## 6.7 Display/No display Setting of Mode Screens

The instrument can be set not to display parameters that are not used (note that some parameters cannot be set to “no display”). Parameters that can be set to “no display” are shown below.

<table>
<thead>
<tr>
<th>Monitor display mode:</th>
<th>Engineering mode (F00):</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV monitor</td>
<td>Cannot be set to no display.</td>
</tr>
<tr>
<td>SV monitor</td>
<td>Display/No display can be set in Monitor selection (no display) (\text{MoN}) [factory set value: 0 (Display all)].</td>
</tr>
<tr>
<td>Manipulated output value (MV) monitor</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SV setting mode:</th>
<th>Engineering mode (F00):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set value (SV)</td>
<td>Cannot be set to no display.</td>
</tr>
<tr>
<td>Manual manipulated output value (MV)</td>
<td>Display/No display can be set in Monitor selection (no display) (\text{MoN}) [factory set value: 0 (Display all)].</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mode switching:</th>
<th>Engineering mode (F00):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto (AUTO)/Manual (MAN) transfer</td>
<td>Cannot be set to no display.</td>
</tr>
<tr>
<td>Set data unlock/lock transfer</td>
<td>Display/No display can be set in Monitor selection (no display) (\text{MoN}) [factory set value: 0 (Display all)].</td>
</tr>
<tr>
<td>Interlock release</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter setting mode:</th>
<th>Engineering mode (F00 to F10):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set value 1 (SV1)</td>
<td>Display/No display can be set in F01 block selection (no display) (\text{S01}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Set value 2 (SV2)</td>
<td>Display/No display can be set in F03 block selection (no display) (\text{S03}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>SV selection</td>
<td>Display/No display can be set in F04 block selection (no display) (\text{S04}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Setting change rate limiter (up)</td>
<td>Display/No display can be set in F05 block selection (no display) (\text{S05}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Setting change rate limiter (down)</td>
<td>Display/No display can be set in F06 block selection (no display) (\text{S06}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Event 1 set value (EV1) [high]</td>
<td>Display/No display can be set in F07 block selection (no display) (\text{S07}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Event 1 set value (EV1) [low]</td>
<td>Display/No display can be set in F08 block selection (no display) (\text{S08}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Event 2 set value (EV2) [high]</td>
<td>Display/No display can be set in F09 block selection (no display) (\text{S09}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Event 2 set value (EV2) [low]</td>
<td>Display/No display can be set in F10 block selection (no display) (\text{S10}) [factory set value: 1 (No display)].</td>
</tr>
<tr>
<td>Autotuning (AT)</td>
<td></td>
</tr>
<tr>
<td>Startup tuning (ST)</td>
<td></td>
</tr>
<tr>
<td>Proportional band</td>
<td></td>
</tr>
<tr>
<td>Integral time</td>
<td></td>
</tr>
<tr>
<td>Derivative time</td>
<td></td>
</tr>
<tr>
<td>Anti-reset windup (ARW)</td>
<td></td>
</tr>
<tr>
<td>Fine tuning setting</td>
<td></td>
</tr>
<tr>
<td>Control loop break alarm (LBA) time</td>
<td></td>
</tr>
<tr>
<td>LBA deadband (LBD)</td>
<td></td>
</tr>
<tr>
<td>Proportional cycle time</td>
<td></td>
</tr>
<tr>
<td>Minimum ON/OFF time of proportioning cycle</td>
<td></td>
</tr>
<tr>
<td>Output limiter high</td>
<td></td>
</tr>
<tr>
<td>Output limiter low</td>
<td></td>
</tr>
<tr>
<td>PV bias</td>
<td></td>
</tr>
<tr>
<td>PV digital filter</td>
<td></td>
</tr>
<tr>
<td>Manual manipulated output value (MV)</td>
<td></td>
</tr>
<tr>
<td>Power saving mode setting</td>
<td></td>
</tr>
<tr>
<td>Maintenance mode switching</td>
<td></td>
</tr>
</tbody>
</table>
**Engineering mode:**

<table>
<thead>
<tr>
<th>Function block</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>F00</td>
<td>Cannot be set to no display.</td>
</tr>
<tr>
<td>F01</td>
<td>Normally, these are set to no display. These can be displayed by setting “128” in Mode selection (no display) (Mod) of Function block 00 (F00) of Engineering mode. Note that display/no display selection by Function block (F††) is not possible.</td>
</tr>
<tr>
<td>F03</td>
<td></td>
</tr>
<tr>
<td>F04</td>
<td></td>
</tr>
<tr>
<td>F05</td>
<td></td>
</tr>
<tr>
<td>F06</td>
<td></td>
</tr>
<tr>
<td>F07</td>
<td></td>
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<tr>
<td>F08</td>
<td></td>
</tr>
<tr>
<td>F09</td>
<td></td>
</tr>
<tr>
<td>F10</td>
<td></td>
</tr>
<tr>
<td>F21</td>
<td></td>
</tr>
<tr>
<td>F23</td>
<td></td>
</tr>
<tr>
<td>F30</td>
<td></td>
</tr>
<tr>
<td>F33</td>
<td></td>
</tr>
<tr>
<td>F41</td>
<td></td>
</tr>
<tr>
<td>F42</td>
<td></td>
</tr>
<tr>
<td>F43</td>
<td></td>
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<tr>
<td>F44</td>
<td></td>
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<tr>
<td>F45</td>
<td></td>
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<tr>
<td>F51</td>
<td></td>
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<tr>
<td>F52</td>
<td></td>
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<tr>
<td>F60</td>
<td></td>
</tr>
<tr>
<td>F70</td>
<td></td>
</tr>
<tr>
<td>F80</td>
<td></td>
</tr>
<tr>
<td>F81</td>
<td></td>
</tr>
<tr>
<td>F91</td>
<td></td>
</tr>
</tbody>
</table>

Some parameters may not be displayed depending on product specifications.
Hiding the parameters of the Monitor display mode

Setting example: To hide the display for Manipulated output value (MV) monitor

1. In PV monitor, press the \textless{} key for 4 seconds or more while pressing the SET key. The display goes to the Engineering mode.

2. Press the SET key until Monitor selection (no display) screen is displayed.

3. Press the \textless{} key to switch to the settable mode. Then press the \textsuperscript{\wedge} key to set “2” to the high-lighted digit.

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

After a new value is displayed on the display by using \textsuperscript{\wedge} and \textsuperscript{\vee} keys, if no key operation is performed within 1 minute without pressing the SET key, this instrument returns to the Monitor display mode and the set value will not be changed.
Hiding the parameters of the Mode switching screen

Setting example: Set data unlock/lock transfer is set to no display.

1. In PV monitor, press the \[\text{SET}\] key for 4 seconds or more while pressing the \[\text{R/S}\] key. The display goes to the Engineering mode.

   ![Diagram](image1)

2. Press the \[\text{SET}\] key until Mode selection (no display) screen is displayed.

   ![Diagram](image2)

3. Press the \[\text{R/S}\] key to switch to the settable mode. Then press the \[\land\] key to set “2” to the high-lighted digit.

   ![Diagram](image3)

   - If there are multiple parameters to be set to no display, set the sum of the set values of the parameters.

4. Press the \[\text{SET}\] key to store the new value. The display goes to the next parameter.

   ![Diagram](image4)

   - After a new value is displayed on the display by using \[\land\] and \[\lor\] keys, if no key operation is performed within 1 minute without pressing \[\text{SET}\] key, this instrument returns to the Monitor display mode and the set value will not be changed.
Parameters in the Engineering mode (F21 to F91) should be set according to the application before setting any parameter related to operation. Once the parameters in the Engineering 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 Engineering mode.

Display of F21 to F91 is set to “no display” as factory set value. To display F21 to F91, set mode selection (no display) screen to “128.” To display F21 to F91 while any mode transfer screens are hidden, set Mode selection (no display) screen parameter to the sum of the set value of the parameters.

Setting example:
Display F21 to F91 while Set data unlock/lock transfer is hidden
Set “130,” the sum of the set value “2” of Set data unlock/lock transfer and “128.”

“130,” the sum of set value “2” of Set data unlock/lock transfer and set value “128” that displays F21 and following
Hiding the parameters of the Parameter setting mode

Setting example: Setting the PV bias screen and PV digital filter screen to no display
The PV bias and PV digital filter screens are set by the F09 block selection (no display) of Engineering mode.

1. In PV monitor, press the \[SET\] key for 4 seconds or more while pressing the \[SET\] key.
The display goes to the Engineering mode.

![Diagram showing the change from PV monitor to function block 00](image)

2. Press the \[^{\downarrow}\] key until Function block 09 (F09) screen is displayed.

![Diagram showing the change from block 00 to block 09](image)

3. Press the \[SET\] key until F09 block selection (no display) screen is displayed.

![Diagram showing the change from block 09 to no display](image)

4. Press the \[SET\] key to switch to the settable mode. Then press the \[^{\downarrow}\] key to set “1” to the high-lighted digit.

![Diagram showing the change from no display to display](image)

5. Press the \[SET\] key to store the new value. The display goes to the next parameter.

![Diagram showing the change from settable mode to next parameter](image)

After a new value is displayed on the display by using \[^{\downarrow}\] and \[^{\uparrow}\] keys, if no key operation is performed within 1 minute without pressing \[SET\] key, this instrument returns to the Monitor display mode and the set value will not be changed.
Displaying Function block 21 (F21) to Function block 91 (F91) of the Engineering mode

**WARNING**

Parameters in the Engineering mode (F21 to F91) should be set according to the application before setting any parameter related to operation. Once the parameters in the Engineering 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 Engineering mode.

1. In PV monitor, press the \(<\downarrow/>\) key for 4 seconds or more while pressing the \(<\uparrow/>\) key.
   The display goes to the Engineering mode.

   ![Displaying Function block 21 (F21) to Function block 91 (F91) of the Engineering mode]

2. Press the \(<\uparrow/>\) key until Mode selection (no display) screen is displayed.

3. Press the \(<\downarrow/>\) key to switch to the settable mode. Then press the \(<\downarrow/>\) key or the \(<\uparrow/>\) key to set “128.”

4. Press the \(<\uparrow/>\) key to store the new value. The display goes to the next parameter.

   ![Displaying Function block 21 (F21) to Function block 91 (F91) of the Engineering mode]

After a new value is displayed on the display by using \(<\downarrow/>\) and \(<\uparrow/>\) keys, if no key operation is performed within 1 minute without pressing \(<\uparrow/>\) key, this instrument returns to the Monitor display mode and the set value will not be changed.
6.8 Interlock Release

The interlock action holds the event state even if the Measured value (PV) is out of the event zone after it enters the event zone once. The interlock release can be made by digital input (DI) [optional], or communication [optional] other than the key operation.

For the Interlock release by communication, refer to the 9. COMMUNICATION (P. 9-1).

NOTE
To validate the Interlock function, it is necessary to set Event interlock 1 and 2 (IL1 and IL2) to “1: Used” in 8.5 Engineering Mode (P. 8-88).

- The following example shows how the interlock is released.

![Diagram showing interlock release]
Interlock release by front key operation

1. In PV monitor, press the \( \text{\textless} \) key while pressing the \( \text{\textgreater} \) key.

   PV monitor [RUN]

   28

   While pressing
   the SET key

   Press

   Mode switching
   Auto/Manual transfer

2. Press the \( \text{\textgreater} \) key until Interlock release screen is displayed.

   \( \text{\textgreater} \)

   Interlock release

3. Press the \( \text{\textless} \) key to switch to the settable mode. Then press the \( \text{\textgreater} \) key to release Interlock state.

   \( \text{\textless} \)

   Interlock state

   ("001" is displayed when an event occurs)

   Interlock release state (000)

4. Press the \( \text{\textless} \) key to release the interlock. The display goes to the next parameter.

   \( \text{\textless} \)

   Displays the next parameter

   No event interlock can be released when in the event state. Release the event interlock after the cause of the event is cleared up.
Interlock release by digital input (DI) [optional]
Interlock release by the digital input (DI) is possible with the DI assignment of the Engineering mode.

For the DI assignment, refer to 8.5 Engineering Mode (P. 8-71).

Terminal configuration
Contact input from external devices or equipment should be dry contact input. If it is not dry contact input, the input should meet the specifications below:
Contact specifications: At OFF (contact open) 500 kΩ or more
At ON (contact closed) 10 Ω or less

Transfer timing of Interlock release
The interlock release operation is taken when DI contact is closed from the open condition (rising edge).

* To make contact activation valid, it is necessary to maintain the same contact state (contact closed) for more than 250 ms.

NOTE
After the contact is transferred, it takes “250 ms + 1 sampling cycle*” until the action of this instrument is actually selected.
* Sampling cycle: 250 ms

No event interlock can be released when in the event state. Release the event interlock after the cause of the event is cleared up.

If switched by digital input (DI), the interlock release state is not stored in EEPROM.
This chapter describes the setting procedure for additional functions.

7.1 SV Selection Function (Step SV function) ........................................ 7-2
7.2 Power Saving Mode Function ............................................................ 7-5
7.3 Maintenance Mode Function ............................................................. 7-7
7.4 Load Power Shutoff Function ............................................................. 7-9
7.5 Burnout Status Monitoring Delay Function ...................................... 7-13
7.6 SB Link/Peak Current Suppression Function .................................... 7-15
   7.6.1 SB link function ............................................................................. 7-15
   7.6.2 Peak current suppression function ................................................. 7-19
7.1 SV Selection Function (Step SV function)

The SV selection function enables control by switching to any one of the stored set values of up to two points (SV1 and SV2). The Set value (SV) selecting can be made by digital input (DI) [optional] or communication [optional] other than the key operation.

For SV selection by digital input (DI), refer to ■ SV selection by digital input (DI) (P. 7-4).

For SV selection by communication, refer to the 9. COMMUNICATION (P. 9-1).

Setting procedure

Before operation, set the Set values 1 (SV1) and 2 (SV2) that are used in SV selection and choose which SV (SV1 or SV2) will be used to start control.

Press and hold the SET key for 2 seconds or more at the PV monitor screen to go to the Parameter setting mode and set the control set value in the screen of SV1 or SV2.

- The high-lighted digit indicates which digit can be set. The high-lighted digit can be moved by pressing the R/S key.
- However, the changed data is not stored by the operation of the ▲ and ▼ keys alone. In order for the new parameter value to be stored, the SET key must be pressed within 1 minute after the new value is displayed. The new value will then be saved and the display will move to the next parameter.

- Return to the PV monitor

To return the PV monitor, press and hold the SET key for 2 seconds or more.

SV1 and SV2 setting range:
Setting limiter low to Setting limiter high
[Factory set value: 0]
SV selection by front key operation

To switch to SV1 and SV2 by front key operation, use the SV selection parameter of Parameter setting mode.

[Example: Switching from SV1 to SV2]

1. Press and hold the SET key for 2 seconds or more at the PV monitor screen to go to the Parameter setting mode, and press the SET key to display to the SV selection screen.

2. Press the key to switch to the settable mode. Then press the key to set “2” to the high-lighted digit. Press the SET key to store the new value.

- Return to the PV monitor

To return the PV monitor, press and hold the SET key for 2 seconds or more.

After a new value is displayed on the display by using and keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the Monitor display mode and the set value will not be changed.
7. OPERATING ADDITIONAL FUNCTIONS

■ SV selection by digital input (DI) [optional]

To switch SV1 and SV2 by using digital input (DI), assign SV selection function at DI assignment in the Engineering mode.

DI assignment

<table>
<thead>
<tr>
<th>Set value</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unused (No DI assignment)</td>
</tr>
<tr>
<td>1</td>
<td>SV selection function (SV1/SV2)</td>
</tr>
<tr>
<td>2</td>
<td>RUN/STOP transfer</td>
</tr>
<tr>
<td>3</td>
<td>AUTO/MAN transfer</td>
</tr>
<tr>
<td>4</td>
<td>Interlock release</td>
</tr>
</tbody>
</table>

For the DI assignment, refer to 8.5 Engineering Mode (P. 8-71).

● Terminal configuration

Contact input from external devices or equipment should be dry contact input. If it is not dry contact input, the input should meet the specifications below:

Contact specifications:
- At OFF (contact open) 500 kΩ or more
- At ON (contact closed) 10 Ω or less

● SV switchover timing

When the contact is open, SV1. When the contact is closed, SV2. SV1/SV2 is switched based on the state of the contacts.

NOTE
After the contact is transferred, it takes “250 ms + 1 sampling cycle*” until the action of this instrument is actually selected.

* Sampling cycle: 250 ms
7.2 Power Saving Mode Function

If no key operation is conducted for the duration being set at Power saving mode setting, the instrument will be in the Power saving mode by turning OFF the display (7 segments LED).

Power saving mode switching does not affect the state of the lamp displays.

To set Power saving mode by communication, refer to 9. COMMUNICATION (P. 9-1).

Setting procedure

The duration until the instrument switches to the Power saving mode can be set at Power saving mode setting in the Engineering mode.

[Example: To set Power saving mode setting to 5 minutes]

1. Press the \(<\) key while pressing the \(\uparrow\) key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the \(\downarrow\) key several times until the Function block 10 (F10) screen is displayed.

2. Press the \(\uparrow\) key to go to the Power saving mode setting display. Press the \(\downarrow\) key to switch to the settable mode.

3. Press the \(\downarrow\) key to set “5” and press the \(\uparrow\) key to register the set value. Display automatically switches to the next parameter.
• Return to the PV monitor
To return the PV monitor, press the \[\leftarrow\text{ws} \] key while pressing the \[\uparrow\text{down} \] key.

After a new value is displayed on the display by using \[\downarrow \text{and} \uparrow \] keys, if no key operation is performed within 1 minute without pressing \[\uparrow\text{down} \] key, this instrument returns to the Monitor display mode and the set value will not be changed.

When “0: Display” is set to F10 block selection (no display), the duration set for Power saving mode setting can be changed in the Parameter setting mode.
(Factory set value “1: No display”)

■ Action at Power saving mode
Display (7segments LED): OFF
Power saving mode switching does not affect the state of the lamp displays and the other actions.

■ To exit Power saving mode
Power saving mode is released when any key is pressed.

The key operation at Power saving mode releases this mode only. It does not affect display or settings.

■ Counting method at changing Power saving mode setting
When changing the Power saving mode setting in the course of counting process, refer to the following counting method (No key operation):

• Changing by key operation
Count restarts from the beginning.

• Changing by communication
Count continues as key operation is not conducted.
When a smaller value than the actual counted duration is set, the instrument will be in the power saving mode immediately.
Power saving mode setting: RKC communication identifier: DI
Modbus register address: 00ABH (171)

[Example]
Former Power saving mode setting: 10 minutes
Counted duration (Actual duration being elapsed): 7 minutes
Setting 5 minutes to Power saving mode setting by communication
Switches to Power saving mode immediately.
7.3 Maintenance Mode Function

For safety reasons, the instrument should be always turned OFF before exchanging sensors, etc. However, when the instrument cannot be OFF, switching to the Maintenance mode allows operator to exchange the sensors without turning the instrument OFF. When exchanging sensors in the Maintenance mode (by removing the connectors for sensor input and control output from the bottom side), the Host computer recognizes that the instrument is in the Maintenance mode instead of an instrument abnormality.

![Maintenance mode](image)

Maintenance mode can be switched or released by communication. For details, refer to 9. COMMUNICATION (P. 9-1).

To switch to the Maintenance mode

- **By the direct key operation**
  Press and hold the ▲ key for 2 seconds at the PV monitor display.

- **By parameter setting**
  1. Press the 조리개 key while pressing the 조리개 key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ▲ key several times until the Function block 10 (F10) screen is displayed.

  ![Diagram](image)

  2. Press the 조리개 key to go to the Maintenance mode switching display. Press the 조리개 key to switch to the settable mode.

  ![Diagram](image)

  3. Press the ▲ key to set “1” and press the 조리개 key to register the set value. Display automatically switches to the next parameter.

  ![Diagram](image)

  Setting range:
  0: Normal operation mode
  1: Maintenance mode
  [Factory set value: 0]
• Return to the PV monitor

To return the PV monitor, press the \( \Rightarrow \) key while pressing the (SET) key.

After a new value is displayed on the display by using \( \wedge \) and \( \vee \) keys, if no key operation is performed within 1 minute without pressing (SET) key, this instrument returns to the Monitor display mode and the set value will not be changed.

Maintenance mode is selectable in the Parameter setting mode when “0: Display” is set for F10 block selection (no display). [Factory set value “1: No display”]

• By communication

Set “1” for Maintenance mode switching.

0: Normal operation mode
1: Maintenance mode

Maintenance mode switching: RKC communication identifier: ZZ
Modbus register address: 00AAH (170)

Action at Maintenance mode

Display: Maintenance mode (Character: Mnt)
Input: Not measured (Input burnout detection is invalidated.)
     Measured value (PV) in communication: 0 °C [°F]
Output: Control output and Event is OFF.
     Output value in communication: -5 %
Communication:
     Maintenance mode displays at Operation mode state monitor.
     Operation mode state monitor: RKC communication identifier: L0 [Value at 6th digit: 1]
     Modbus resister address: 0037H (55) [Value at Bit 5: 1]

To release Maintenance mode

• By key operation

Maintenance mode can be released by pressing and holding the \( \wedge \) key for 2 seconds at Maintenance mode display (Mnt).

• By communication

Set “0” for Maintenance mode switching.
7.4 Load Power Shutoff Function

Overheating or other malfunctions can be avoided by shutting the load power OFF when an abnormality occurs.

To select Control action at Event or Load power shutoff function by communication, refer to 9. COMMUNICATION (P. 9-1).

**Diagram of function**

- Relay for Load power shutoff
- Control output
- Internal fuse
- SB1 internal
- Relay opens at FAIL or LBA.
- Control output turns OFF (−5 %) at Event.

**Control action at Event**

Control action turns OFF at Event by the combination use of Load power shutoff function and Event function.

**Selectable action**
- Action based on control computation
- Control output OFF (−5 %) at Event 1
- Control output OFF (−5 %) at Event 2
- Control output OFF (−5 %) at Event 1 or Event 2
- Control output OFF (−5 %) at Event 1 and Event 2

**Setting**

Select action at Control action at event in the Engineering mode.

1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the \[\text{R/S}\] key for 2 seconds at the PV monitor.

```
PV monitor [RUN] 28
\[\text{R/S}\]   \[\text{R/S}\]
2 seconds or more
PV monitor [STOP] SGP
Displays in turn
Measured value (PV) 28
```
2. Press the \textls{-10} key while pressing the \textls{-9} key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the \textls{-9} key several times until the Function block 46 (F46) screen is displayed.

3. Press the \textls{-9} key to go to the Control action at Event display. Press the \textls{-8} key to switch to the settable mode.

4. Press the \textls{-9} key to set the set value of desired action and press the \textls{-8} key to register the set value. Display automatically switches to the next parameter.

- **Return to the PV monitor**
  To return the PV monitor, press the \textls{-10} key while pressing the \textls{-9} key.
  To change from STOP mode to RUN mode, press and hold the \textls{-10} key for 2 seconds or more.

\text{After a new value is displayed on the display by using \textls{-9} and \textls{-8} keys, if no key operation is performed within 1 minute without pressing \textls{-9} key, this instrument returns to the Monitor display mode and the set value will not be changed.}
Load power shutoff function

The relay for Load power shutoff opens at the occurrence of instrument abnormality (FAIL) or Control loop break alarm (LBA). (Shut off the internal load power line. [L side of the power])

[Selectable action]
- Relay for Load power shutoff opens at FAIL (Restores when FAIL is resolved.)
- Relay for Load power shutoff opens at FAIL or LBA (FAIL state or LBA state remains *)
- Relay for Load power shutoff opens at FAIL or LBA (Returns to the normal state when FAIL state or LBA state recovers.)

* To return to the normal state, turn OFF then restart the instrument.

Instrument abnormality state (FAIL) or Control loop break alarm (LBA) can be selected at Event type in the Engineering mode. For details, refer to P. 8-73.

Setting

Select action at Load power shutoff function in the Engineering mode.

1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the $\text{\textasciitilde key}$ for 2 seconds at the PV monitor.

2. Press the $\text{\textasciitilde key}$ while pressing the $\text{STP}$ key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the $\text{UP}$ key several times until the Function block 46 (F46) screen is displayed.

3. Press the $\text{STP}$ key to go to the Load power shutoff function display. Press the $\text{\textasciitilde key}$ to switch to the settable mode.
4. Press the \( \wedge \) key to set the set value of desired action and press the \( \text{SET} \) key to register the set value. Display automatically switches to the next parameter.

![Diagram of setting process]

Setting range:
0: Relay for Load power shutoff opens at FAIL (Restores when FAIL is resolved.)
1: Relay for Load power shutoff opens at FAIL or LBA (FAIL state or LBA state remains)
2: Relay for Load power shutoff opens at FAIL or LBA
   (Returns to the normal state when FAIL state or LBA state recovers.)
[Factory set value: 0]

- **Return to the PV monitor**

To return the PV monitor, press the \( \text{R/S} \) key while pressing the \( \text{SET} \) key.
To change from STOP mode to RUN mode, press and hold the \( \text{R/S} \) key for 2 seconds or more.

📖 After a new value is displayed on the display by using \( \wedge \) and \( \vee \) keys, if no key operation is performed within 1 minute without pressing \( \text{SET} \) key, this instrument returns to the Monitor display mode and the set value will not be changed.
7.5 Burnout Status Monitoring Delay Function

When input burnout (Burnout) occurs, the timing of burnout occurrence for burnout status monitoring can be delayed.

When the system is programmed to stop the whole operation of the machine when a burnout is flagged, a false detection of burnout caused by noise disturbance may stop the entire operation. This function allows a delayed timing of burnout notification to avoid false detection of burnout. Burnout status monitoring can be confirmed only by communication.

**NOTE**
This function only delays the timing of flag for burnout at burnout status monitoring. Therefore, if burnout occurs, the actual control action of the instrument is switched to the action at burnout immediately.

To set Burnout status monitoring or Burn out status monitoring delay by communication, refer to 9. COMMUNICATION (P. 9-1).

**Setting procedure**
Set the number of input sampling cycle for Burnout status monitoring delay in the Engineering mode.

1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the \( \text{\textless} \text{\downarrow} \text{\textgreater} \) key for 2 seconds at the PV monitor.

2. Press the \( \text{\textless} \text{\downarrow} \text{\textgreater} \) key while pressing the \( \text{\textless} \text{\downarrow} \text{\textless} \text{\downarrow} \text{\textgreater} \) key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the \( \text{\uparrow} \) key several times until the Function block 80 (F80) screen is displayed.

3. Press the \( \text{\textless} \text{\downarrow} \text{\textless} \text{\downarrow} \text{\textless} \text{\downarrow} \text{\textgreater} \) key to go to the Burn out status monitoring delay display. Press the \( \text{\textless} \text{\downarrow} \text{\textless} \text{\downarrow} \text{\textless} \text{\downarrow} \text{\textgreater} \) key to switch to the settable mode.
4. Press the $\bigwedge$ key to set the number of input sampling cycle and register the value by pressing the $\bigotimes$ key. Display automatically switches to the next parameter.

![Setting range: 0 to 10 Setting example: 5][Factory set value: 0]

- **Return to the PV monitor**
  To return the PV monitor, press the $\leftarrow$ key while pressing the $\bigotimes$ key.
  To change from STOP mode to RUN mode, press and hold the $\leftarrow$ key for 2 seconds or more.

- **Function description**
  - **Process timing**
    Based on the input sampling cycle (At Burnout status monitoring judgment)
    Maximum delay time = Input sampling cycle × Maximum set value
    $= 0.25 \text{ seconds} \times 10 \text{ times} = 2.5 \text{ seconds}$

  - **Delay processing**
    The instrument is in burnout state at Burnout status monitoring if burnout continuously occurs more than the delay time being set.
    Otherwise the count of actual delayed time will be reset.

  - **Processing at set value change**
    When the set value of Burnout status monitoring delay is changed in the course of counting, the processing continues with the number of input sampling cycle being changed.
    If the value is smaller than the numbers counted before the change, burnout status occurs immediately.
7.6 SB Link/Peak Current Suppression Function

Using Peak current suppression function can suppress peak current value by delaying the start timing of Proportional cycle time to avoid all output from turning ON at the same time.
To use Peak current suppression function, controllers must be connected by SB link function.

7.6.1 SB link function

■ Communication specification

Maximum connections: Up to 4 controllers (Master controller: 1, Slave controller: 3)
Protocol: Modbus-RTU
Address: Intragroup address + 1
Communication speed: 19200 bps (fixed)
Data bit configuration: Start bit: 1
                     Data bit: 8
                     Parity bit: Without
                     Stop bit: 1
Interval times: 10 ms (fixed)
Error check method: CRC-16

Communication parameters such as Device address, Communication speed, Data bit configuration and Interval time will be set automatically to the specifications above by setting “1” to SB link selection, turning the instrument OFF then restoring the instrument.
Host communication cannot be used for SB link function.

■ Function description

In SB link function, one of the SB1 operates as the Host (Master side) and transmits Data with the connected SB1 controller(s) (slave side). Communication takes place only between the Master controller and the Slave controller(s).
Peak current suppression function can be applied for all SB1 controller connected by SB link.

Concept of SB link

![Concept of SB link diagram]

- Communication method

The communication method of SB link is based on the Broadcast function of Modbus communication.
Data transmission is carried between the Master controller and the Slave controller(s).

Broadcast communication:
Each connected Slave controller receives the sent data from the Master controller.
7. OPERATING ADDITIONAL FUNCTIONS

- **Action at Power ON**
  - When SB link selection is set to “1” at Power ON, the instrument operates in the SB link mode. The operation mode is automatically switched to STOP.

  **Display for Master controller:**
  
  Displays the character “MST” and the Measured value (PV) in turn.

  **Display for Slave controller:**
  
  Displays the character “STP” and the Measured value (PV) in turn.

  To start operation, switch the operation mode of each SB1 controller to RUN.

  - The SB1 set with Intragroup address “0” operates as a Master controller. The Slave controller(s) set with Intragroup address other than “0” can receive data from the Master controller.

  - The Master controller sends a Loopback test to recognize the number of connected Slave controllers based on the number of returned messages. It takes about 5 seconds to complete this process after the Power is turned ON.

- **Precaution for SB link**
  Turning on all connected controllers simultaneously (at least within 2 seconds).

  If a controller is connected after the elapse of 2 seconds, the Master controller recognizes it as a Slave controller at the time of connection.

- **SB link error (Err 16)**
  The character “Err” and “16” displays in turn at SB link error. SB link error can be caused by the following conditions:

  - **Master side**
    An SB link error occurs when the Master controller does not continuously receive a returned Loopback test message from the Slave controller(s) for the number of times selected at Control action at SB link error or if the content of the returned message is abnormal.

  - **Slave side**
    An SB link error occurs when the Slave controller does not continuously receive the Broadcast signal (synchronizing signal) from the Master controller for the number of times selected at Control action at SB link error.
    (Verifies a sent message from the Master controller every Output cycle time of the Slave controller.)

- **Setting range for Control action at SB link error**
  0: SB link error occurs by detecting an error. Operation continues.
  1 to 5: SB link error occurs when errors occur more than the number of times set. Operation is terminated.
Setting procedure

Set parameters related to SB link function such as SB link selection, Intragroup address and Control action at SB link error in the Engineering mode.

1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the  depressed key for 2 seconds at the PV monitor.

![Image](PV monitor [RUN] to PV monitor [STOP] transition)

2. Press the  depressed key while pressing the  depressed key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the  key several times until the Function block 81 (F81) screen is displayed.

![Image](Function block 81 transition)

3. Press the  depressed key to go to the SB link selection display. Press the  depressed key to switch to the settable mode.

![Image](SB link selection)

4. Press the  key to set “1” and press the  depressed key to register the set value. Display automatically switches to the Intragroup address.

![Image](Intragroup address)

Setting range:
0: Without SB link function
1: With SB link function
[Factory set value: 0]
5. Press the \textit{R/S} key to switch to the settable mode. Then press the \textit{\land} key and the \textit{\lor} key to set Intragroup address.

\begin{center}
\begin{tabular}{c|c|c}
Intragroup address & 000 & 001 \\
\hline
\textit{R/S} & \textit{\lor} & \textit{\lor}
\end{tabular}
\end{center}

Setting range:
0: Intragroup address 1 (Master)
1: Intragroup address 2
2: Intragroup address 3
3: Intragroup address 4
[Factory set value: 0]

6. Press the \textit{\lceil CE\rceil} key to register the set value. After confirming that the display automatically switched to the Control action at SB link error display, press the \textit{R/S} key to switch to the settable mode.

\begin{center}
\begin{tabular}{c|c|c}
Control action at SB link error & 001 & 000 \\
\hline
\textit{R/S} & \textit{\lor} & \textit{\lor}
\end{tabular}
\end{center}

Setting range:
0: SB link error occurs by detecting an error once. Action of Control output is based on control computation.
1: SB link error occurs by detecting an error once. Control output turns OFF ($-5\%$).
2: SB link error occurs by detecting an error twice consecutively. Control output turns OFF ($-5\%$).
3: SB link error occurs by detecting an error 3 times consecutively. Control output turns OFF ($-5\%$).
4: SB link error occurs by detecting an error 4 times consecutively. Control output turns OFF ($-5\%$).
5: SB link error occurs by detecting an error 5 times consecutively. Control output turns OFF ($-5\%$).
[Factory set value: 2]

7. Press the \textit{\land} key and the \textit{\lor} key to set Control action at SB link error. Then press the \textit{\lceil CE\rceil} key to register the set value. Display automatically switches to the next parameter.

\begin{center}
\begin{tabular}{c|c|c}
Displays the next parameter & 000 & 001 \\
\hline
\textit{\land} or \textit{\lor} & \textit{R/S} & \textit{\lceil CE\rceil}
\end{tabular}
\end{center}

- **Return to the PV monitor**

To return the PV monitor, press the \textit{R/S} key while pressing the \textit{\lceil CE\rceil} key.
To change from STOP mode to RUN mode, press and hold the \textit{R/S} key for 2 seconds or more.

After a new value is displayed on the display by using \textit{\land} and \textit{\lor} keys, if no key operation is performed within 1 minute without pressing \textit{\lceil CE\rceil} key, this instrument returns to the Monitor display mode and the set value will not be changed.
7.6.2 Peak current suppression function

Using Peak current suppression function can suppress peak current value by delaying the start timing of Proportional cycle time to avoid all output from turning ON at the same time.

To use Peak current suppression function, first connect controllers by SB link function then set Proportional cycle time and Output limiter according to the predescribed condition.

- **Peak current suppression action**
  - **Action at Power ON**
    - The Master controller recognizes the Slave controller(s) when powered ON. The operation mode of each connected controllers automatically switches to STOP.
    - **Display for Master controller:** Displays the character “$5f” and the Measured value (PV) in turn.
    - **Display for Slave controller:** Displays the character “$fP” and the Measured value (PV) in turn.
    
    To start operation, switch the operation mode of each SB1 controller to RUN.
    
    - After the recognizing process is completed, the Master controller sends a synchronizing signal by Broadcast communication to the Slave controller(s) being ready to receive the signal.
    - Peak current suppression function starts operating when the synchronizing signal is received by the Slave controller(s).
  
  - **Action at operation of Peak current suppression function**
    
    **Master side:** The Master controller sends a synchronizing signal regularly to the Slave controller(s) by Broadcast communication. To confirm that each controller is connected properly, the Master controller also sends the Loopback test to the Slave controller(s).
    
    Any Slave controller additionally connected during the operation of Peak current suppression function will be recognized as connected.

    **Slave side:** The control output action of the Slave controller is regularly updated by receiving the synchronizing signal sent by the Master controller. The Slave controller sends a reply message to each Loopback test.

- **To cancel Peak current suppression function**

To cancel the Peak current suppression function, change the setting of SB link selection to “0: Without SB link function” for both Master side and Slave side. An SB link error temporary occurs during the process by invalidating the SB link function. SB link error will be automatically released when SB link of the specific controller is invalidated.

The SB link error varies based on the order of invalidation on the SB link.

- When invalidating the SB link at the Master side first: an SB link error (Err 16) occurs at the Slave controller.
  - The Slave controller(s) cannot receive the synchronizing signal from the Master controller as SB link function was invalidated by the Master controller.

- When invalidating SB link at the Slave side first: an SB link error (Err 16) occurs at the Master controller.
  - When an SB link is invalidated with the Slave controller(s), no response signal is sent to the Loopback test from the Slave controller(s). Therefore the Master controller does not receive signals.

  For setting method of SB link selection, refer to **Setting Procedure (P. 7-17).**
### Proportional cycle time and Output limiter

With Peak current suppression function, the Proportional cycle time is equally divided into 4 cycles and the timing of output ON for each address within a group is delayed by 1/4 cycles. The Proportional cycle time is equally divided into 4 cycles no matter how many Slave controllers are connected. Therefore, the start timing of Proportional cycle time is fixed for each address.

- **Output limiter high:** 25 %
  - (Set to make the total value 100 % or less.)

<table>
<thead>
<tr>
<th>Address</th>
<th>Output limiter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address 1 (Master)</td>
<td>25 %</td>
</tr>
<tr>
<td>Address 2 (Slave)</td>
<td>25 %</td>
</tr>
<tr>
<td>Address 3 (Slave)</td>
<td>25 %</td>
</tr>
<tr>
<td>Address 4 (Slave)</td>
<td>25 %</td>
</tr>
</tbody>
</table>

#### Control output state for each address

<table>
<thead>
<tr>
<th>Address</th>
<th>Proportional cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address 1 (Master)</td>
<td></td>
</tr>
<tr>
<td>Address 2 (Slave)</td>
<td></td>
</tr>
<tr>
<td>Address 3 (Slave)</td>
<td></td>
</tr>
<tr>
<td>Address 4 (Slave)</td>
<td></td>
</tr>
</tbody>
</table>

#### Proportional cycle state for each address

- **Set the same value to Proportional cycle time of each controller connected by SB link. When the values vary, the following malfunctions may occur:**
  - Excessive suppression of Peak current value
  - Output cut-off
  - SB link error, etc.

- **Setting range of Proportional cycle time at SB link operation:** 2 to 100 seconds
  - (Any value smaller than 2 is counted as 2 seconds.)

- **Proportional cycle time and Output limiter can be set in the Parameter setting mode.**
  - For details, refer to **4. BASIC OPERATION (P. 4-1) and 8.4 Parameter Setting Mode (P. 8-25 and P. 8-27).**
### Setting example

#### When operating SB link by connecting 2 units of SB1 (Example A)
The start timing of Proportional cycle time is fixed as described at Proportional cycle time and Output limiter (P. 7-20).
When using SB link as follows, the Output limiter of Address 2 can be set up to 75%. In this case, do not set Output limiter for Address 1 (Master controller) more than 25%. Otherwise output of Address 1 and Address 2 partially overlap.

<table>
<thead>
<tr>
<th>Address 1 (Master)</th>
<th>Address 2 (Slave)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter</td>
<td>Output limiter</td>
</tr>
<tr>
<td>25%</td>
<td>75% max.</td>
</tr>
</tbody>
</table>

Control output state for each address

#### When operating SB link by connecting 2 units of SB1 (Example B)
As the start timing of Proportional cycle time is fixed for each Address, using Address 1 and Address 3 allows Output limiter to set up to 50% for each Address.

<table>
<thead>
<tr>
<th>Address 1 (Master)</th>
<th>Address 2 (Unused)</th>
<th>Address 3 (Slave)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter</td>
<td>Output limiter</td>
<td>Output limiter</td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td>50%</td>
</tr>
</tbody>
</table>

Control output state for each address

#### When operating SB link by connecting 3 units of SB1
Output limiter can be set as described in the diagram below when Address 3 is not used.

<table>
<thead>
<tr>
<th>Address 1 (Master)</th>
<th>Address 2 (Slave)</th>
<th>Address 3 (Unused)</th>
<th>Address 4 (Slave)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter</td>
<td>Output limiter</td>
<td>Output limiter</td>
<td>Output limiter</td>
</tr>
<tr>
<td>25%</td>
<td>50% max.</td>
<td></td>
<td>25%</td>
</tr>
</tbody>
</table>

Control output state for each address
This chapter describes each parameter and data range.

8.1 Monitor Display Mode ..............................................................8-2
8.2 SV Setting Mode ....................................................................8-6
8.3 Mode Switching ......................................................................8-9
8.4 Parameter Setting Mode .......................................................8-12
8.5 Engineering Mode ...............................................................8-30
8. PARAMETER DESCRIPTION

8.1 Monitor Display Mode

In Monitor display mode, the following monitors are possible.
- Measured value (PV) monitor
- Set value (SV) monitor
- Manipulated output value (MV) monitor

The Manipulated output value (MV) monitor can be hidden.

Set display/no display at the Monitor selection in the Function block F00 in the Engineering mode (P. 8-41).

8.1.1 Display sequence

■ At Auto (AUTO) mode

At Auto (AUTO) mode, the display sequence is as follows:

**RUN state**

- PV monitor

**STOP state**

- PV monitor

**SV monitor**

Displays in turn

■ At Manual (MAN) mode

At Manual (MAN) mode, the display sequence is as follows:

**RUN state**

- PV monitor

**STOP state**

- PV monitor

- SV monitor

Displays in turn

Key:
- [SV setting mode]

Notes:
- Auto/Manual transfer can be switched at 8.3 Mode Switching (P. 8-10).
8.1.2 Monitor item

Measured value (PV) monitor

Measured value (PV) is displayed at RUN mode. When the instrument is in STOP mode, the character “STP” and Measured value (PV) will display alternately.

### Display range

<table>
<thead>
<tr>
<th>Display range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 800 °C or 0 to 999 °F</td>
<td>—</td>
</tr>
</tbody>
</table>

When using communication, only a single digit of the Measured value (PV) can be displayed after the decimal point (the tenths place).

- 0.0 to 800.0 °C or 0.0 to 999.9 °F

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

**Related parameters**

**Engineering mode:**
- Decimal point position (P. 8-67)
Set value (SV) monitor

The target value for control [Set value (SV)] is displayed. With the setting change rate limiter when the set value is changed, the displayed set value changes according to the ramp-up/down rate.

<table>
<thead>
<tr>
<th>Display range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting limiter low to Setting limiter high</td>
<td>—</td>
</tr>
<tr>
<td>When using communication, only a single digit of the Set value (SV) can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

Set value 1 (SV1) is displayed when the STEP set value lamp is OFF. Set value 2 (SV2) is displayed when the STEP set value lamp lights. The display of SV1 and SV2 can be switched at SV selection in the Parameter setting mode (P. 8-14).

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Parameter setting mode:
• SV selection (P. 8-14)

Engineering mode:
• Decimal point position (P. 8-67)
Manipulated output value (MV) monitor

The Manipulated output value (MV) is displayed.

<table>
<thead>
<tr>
<th>Display range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter low to Output limiter high</td>
<td>—</td>
</tr>
<tr>
<td>When using communication, only a single digit of the Manipulated output value (MV) can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

To hide Manipulated output value (MV) monitor, set “No display” to Monitor selection (no display) in the Engineering mode (P. 8-41).

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters

Engineering mode:
- Monitor selection (no display) (P. 8-41)
- Decimal point position (P. 8-67)
8.2 SV Setting Mode

The SV setting mode is used to sets the Set value (SV) or Manipulated output value (MV).

- When the operation mode is the Auto (AUTO) mode, the Set value (SV) can be set.
- When the operation mode is the Manual (MAN) mode, the Manipulated output value (MV) can be set.

8.2.1 Display sequence

■ At Auto (AUTO) mode

[Monitor display mode]

[pv monitor] [set] [sv monitor] [set] [sv]
(P. 8-3) (P. 8-4)

Set value (SV)
(P. 8-7)

[SV setting mode]

■ At Manual (MAN) mode

[Monitor display mode]

[pv monitor] [set] [mv monitor] [set] [mv]
(P. 8-3) (P. 8-5)

Manual manipulated output value (MV)
(P. 8-8)

[SV setting mode]

The Set value (SV) and Manual manipulated output value (MV) can also be set in Parameter setting mode (P. 8-12).

Auto/Manual transfer can be switched at 8.3 Mode Switching (P. 8-10).
8.2.2 Setting item

Set value (SV)

The Set value (SV1 or SV2) for control can be set. The Set value 2 (SV2) can be set when STEP set value lamp lights.

---

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting limiter low to Setting limiter high When using communication, only a single digit of the Set value (SV) can be displayed after the decimal point (the tenths place).</td>
<td>0</td>
</tr>
</tbody>
</table>

The Set values showed on the SV display link to the Set values (SV1 and SV2) in the Parameter setting mode and Engineering mode. Set values in the Parameter setting mode and the Engineering mode are automatically changed to the same values in accordance with the change of Set values set on the SV display.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

For details on changing the Set value (SV), refer to 5.2 Operation Setting (P. 5-6).

Related parameters
Parameter setting mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)

Engineering mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-43)
- Decimal point position (P. 8-67)
Manual manipulated output value (MV)

The Manual manipulated output value (MV) can be set.

The Manual manipulated output value (MV) on the MV display link to the Manual manipulated output values (MV) in the Parameter setting mode and Engineering mode. Manual manipulated output value (MV) in the Parameter setting mode and the Engineering mode are automatically changed to the same values in accordance with the change of Manual manipulated output value (MV) set on the MV display. Manual manipulated output values (MV) is not displayed as the default value of the block selection at F10 (P. 8-65) when set to “1: No display” in the Engineering mode. To show the parameter, set the value to “0: Display.”

To hide Manual manipulated output value (MV) in SV setting mode, set “No display” to Monitor selection (no display) in the Engineering mode (P. 8-41).

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Parameter setting mode:
- Manual manipulated output value (P. 8-29)

Engineering mode:
- Manual manipulated output value (P. 8-63)
- Decimal point position (P. 8-67)

The Manual manipulated output value (MV) can be set.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter low to Output limiter high</td>
<td>0</td>
</tr>
<tr>
<td>When using communication, only a single digit of the Manipulated output value (MV) can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

For details on changing the Manipulated output value (MV), refer to 6.5 Auto/Manual Transfer (P. 6-19).
8.3 Mode Switching

In Mode switching, the following operations are possible.

- Auto (AUTO)/Manual (MAN) transfer
- Set data unlock/lock transfer
- Interlock release

To hide the parameters, set “No display” to Mode selection (no display) (P.8-41) at the Function block F00 in the Engineering mode.

8.3.1 Display sequence

Press the \( \text{R/S} \) key while pressing the \( \text{SET} \) key.

Press the \( \text{R/S} \) key while pressing the \( \text{SET} \) key.

Press the \( \text{R/S} \) key while pressing the \( \text{SET} \) key.
8.3.2 Setting item

Auto (AUTO)/Manual (MAN) transfer

Use to transfer the Auto (AUTO) mode or Manual (MAN) mode.

Auto (AUTO) mode: Automatic control is performed.
Manual (MAN) mode: The Manipulated output value (MV) can be manually changed.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Auto (AUTO) mode</td>
<td>0</td>
</tr>
<tr>
<td>1: Manual (MAN) mode</td>
<td></td>
</tr>
</tbody>
</table>

To hide the Auto (AUTO)/Manual (MAN) transfer, set “No display” to Mode selection (no display) (P. 8-41) in the Engineering mode.

For details of the Auto (AUTO)/Manual (MAN) transfer, refer to 6.5 Auto/Manual Transfer (P. 6-19).

Related parameters
Engineering mode:
• Mode selection (no display) (P. 8-41)

Set data unlock/lock transfer

Lock or unlock the setting data.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Unlock</td>
<td>0</td>
</tr>
<tr>
<td>1: Lock</td>
<td></td>
</tr>
</tbody>
</table>

To lock parameters, select the parameters at Set lock level (P. 8-40) in the Engineering mode.

To hide the parameter of Set data unlock/lock transfer, set “No display” to the Mode selection (no display) (P. 8-41) if the Engineering mode.

For details of the Set data unlock/lock transfer, refer to 6.6 Protecting Setting Data (P. 6-23).

Related parameters
Engineering mode:
• Set lock level (P. 8-40)
• Mode selection (no display) (P. 8-41)
### Interlock release

Release the interlock state of event.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Interlock release</td>
<td>0</td>
</tr>
<tr>
<td>1: Interlock state (only monitor)</td>
<td></td>
</tr>
</tbody>
</table>

Factory default setting: The screen is displayed.

In order to validate the event interlock function, it is necessary to set to “1: Used” in item Event 1 to 2 interlock.

No event interlock can be released when in the alarm state. Release the event interlock after the cause of the event is cleared up.

To hide Interlock release, set “No display” to the Mode selection (no display) (P. 8-41) in the Engineering mode.

For interlock release operation, refer to 6.8 Interlock Release (P. 6-38).

**Related parameters**

**Engineering mode:**
- Mode selection (no display) (P. 8-41)
- Event 1 interlock (P. 8-88)
- Event 2 interlock (P. 8-88)
8.4 Parameter Setting Mode

Set values (SV), Event set values and control parameters can be set in this mode.

8.4.1 Display sequence

Parameters will not be displayed if the relevant function is not activated or no relevant specification is selected when ordering.

This instrument returns to the Monitor display mode if no key operation is performed within 1 minute.
8.4.2 Parameter setting item

Set value 1 (SV1)  
Set value 2 (SV2)

Set value (SV) for control can be set.  
Up to two Set values (SV) can be stored. The SV selection function (SV step function) can be used to change individual values.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| Setting limiter low to Setting limiter high  
When using communication, only a single digit of the Set value (SV) can be displayed after the decimal point (the tenths place). | 0 |

- Set value (SV) is not displayed as the default when the block selection at F01 [50 /] (P. 8-45) is set to “1: No display” in the Engineering mode.  
To show the parameter, set the value to “0: Display.”  
Set value (SV) set at SV selection shows up in the SV setting mode.

- Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

- For the operating procedure of the SV selection function, refer to 7.1 SV Selection Function (SV Step Function) (P. 7-2).

Related parameters

Parameter setting mode:
- SV selection (P. 8-14)
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-14)

Engineering mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-43)
- Decimal point position (P. 8-67)
- Setting limiter high, Setting limiter low (P. 8-69)
### SV selection

Select Set value (SV) for control from SV1 to SV2.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Set value1 (SV1)</td>
<td>1</td>
</tr>
<tr>
<td>2: Set value 2 (SV2)</td>
<td></td>
</tr>
</tbody>
</table>

SV selection is not displayed as the default when the block selection at F01 [S01] (P. 8-45) is set to “1: No display” in the Engineering mode. To show the parameter (SV), set the value to “0: Display.”

#### Related parameters

**Parameter setting mode:**
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)

**Engineering mode:**
- SV selection (P. 8-44)

### Setting change rate limiter (up)

Set the values for Setting change rate limiter up and down.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to Input span (Unit °C [°F])/unit time</td>
<td>0</td>
</tr>
<tr>
<td>0: Unused [Factory set value of unit time: 0 (minute)]</td>
<td></td>
</tr>
</tbody>
</table>

Setting change rate limiter is not displayed as the default when the block selection at F03 [S03] (P. 8-47) is set to “1: No display” in the Engineering mode. To show the parameter, set the value to “0: Display.”

Set the unit time at Setting change rate limiter unit time (Sr) at F70 (P. 8-103) in the Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

#### Related parameters

**Engineering mode:**
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-46)
- Decimal point position (P. 8-67)
- Setting change rate limiter unit time (P. 8-103)
### Description of function

This function is to allow the Set value (SV) to be automatically changed at specific rates when a new Set value (SV). Setting change rate limiter (up) is used when the SV is changed to a higher SV. Setting change rate limiter (down) is used when the SV is changed to a lower SV.

**[Application examples of Setting change rate limiter]**

- **Increasing the SV to a higher value**

  ![Increase gradually at specific rate diagram](image)

- **Decreasing the SV to a lower value**

  ![Decrease gradually at specific rate diagram](image)

- When the Setting change rate limiter is used, the SV will also ramp up or ramp down by the function at power-on and operation mode change from STOP to RUN.

- If the Autotuning (AT) function is activated while the SV is ramping up or ramping down by the Setting change rate limiter, AT will start after the SV finishes ramp-up or ramp-down by the limiter, and the controller is in PID control mode until AT starts.

- When the value of Setting change rate limiter is changed during normal operation, the ramp-up or ramp-down rate will be changed unless the SV already has finished ramp-up or ramp-down by the function.

- If control is stopped during the Setting change rate limiter, the value at that point is considered the Set value (SV). Setting change rate limiter is canceled.

- If the Setting change rate limiter is set to any value other than “0 (Unused),” the event re-hold action to be taken by a Set value (SV) change becomes invalid.

- Setting change rate limiter is available during the Manual mode (MAN).
Set Event set value. When high/low individual setting is selected for the event type, the value is the Event set value [high].

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deviation action: −199 to +Input span</td>
<td>50</td>
</tr>
<tr>
<td>Input value or set value action:</td>
<td></td>
</tr>
<tr>
<td>Same as input range</td>
<td></td>
</tr>
<tr>
<td>When using communication, only a single digit of the Event set value can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

Event set value or Event set value [high] is not displayed when the block selection at F04 [504] (P. 8-50) is set to “1: No display” in the Engineering mode.

Event set value or Event set value [high] is not displayed when the Event 1 type (E51) to Event 2 type (E52) at the Function blocks from F41 to F42 (P. 8-73) are set to “0: No event” in the Engineering mode.

This parameter will not be displayed if Event 1 type (E51) to Event 2 type (E52) (P. 8-73) has been set to “11: Control loop break alarm (LBA), 13: FAIL, 12: Monitor during RUN or 23: Output of the communication monitoring result” in Function block 41 (F41) to 42 (F42) of Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

For the setting of the Event set value, refer to Set the event set value (P. 5-7).

Related parameters
Parameter setting mode:
- Event 1 set value (EV1’) [low], Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 set value (EV1), Event 2 set value (EV2) (P. 8-48)
- Event 1 set value (EV1) [high], Event 2 set value (EV2) [high] (P. 8-48)
- Decimal point position (P. 8-67)
- Event 1 type, Event 2 type (P. 8-73)
- Event 1 hold action, Event 2 hold action (P. 8-82)
- Event 1 differential gap, Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout, Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer, Event 2 delay timer (P. 8-86)
- Event 1 interlock, Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
Event 1 set value (EV1’) [low]  
Event 2 set value (EV2’) [low]

When high/low individual setting is selected for the Event type, the value is the Event set value [low]. Use with Event set value [high].

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>−199 to +Input span</td>
<td>−50</td>
</tr>
<tr>
<td>When using communication, only a single digit of the Event set value can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

Event set value [low] is not displayed when the block selection at F04 [S04] (P. 8-50) is set to “1: No display” in the Engineering mode.

Event set value [low] is not displayed when the Event 1 type (ES1) to Event 2 type (ES2) at the Function blocks from F41 to F42 (P. 8-73) are set to “0: No event” in the Engineering mode.

This parameter will not be displayed if Event 1 type (ES1) to Event 2 type (ES2) (P. 8-73) has been set to “11: Control loop break alarm (LBA), 13: FAIL, 12: Monitor during RUN or 23: Output of the communication monitoring result” in Function block 41 (F41) to 42 (F42) of Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P. 8-67).

For the setting of the Event set value, refer to ■ Set the event set value (P. 5-7).

Related parameters
Parameter setting mode:
- Event 1 set value (EV1) [high], Event 2 set value (EV2) [high] (P. 8-16)

Engineering mode:
- Event 1 set value (EV1’) [low], Event 2 set value (EV2’) [low] (P. 8-49)
- Decimal point position (P. 8-67)
- Event 1 type, Event 2 type (P. 8-73)
- Event 1 hold action, Event 2 hold action (P. 8-82)
- Event 1 differential gap, Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout, Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer, Event 2 delay timer (P. 8-86)
- Event 1 interlock, Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
Autotuning (AT)

To set Autotuning (AT), set the value to “1.” This allows automated calculating of proportional, integral and derivation.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: PID control</td>
<td>0</td>
</tr>
<tr>
<td>1: Autotuning (AT)</td>
<td></td>
</tr>
</tbody>
</table>

Autotuning (AT) is not displayed when the block selection at F05 [505] (P. 8-52) is set to “1: No display” in the Engineering mode.

For starting method and conditions for Autotuning (AT), refer to 6.2 Autotuning (AT) (P. 6-7).

Related parameters

Engineering mode:
- Autotuning (AT) (P. 8-51)
- AT cycles (P. 8-97)
- AT differential gap time (P. 8-98)
8. PARAMETER DESCRIPTION

Startup tuning (ST)

Use to set the number of execution times of Startup tuning (ST).

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: ST unused</td>
<td>0</td>
</tr>
<tr>
<td>1: Execute once</td>
<td></td>
</tr>
<tr>
<td>2: Execute always</td>
<td></td>
</tr>
</tbody>
</table>

Startup tuning (ST) is not displayed when the block selection at F05 [505] (P. 8-52) is set to “1: No display” in the Engineering mode.

If the optimum PID constants cannot be obtained by the Startup tuning (ST), please execute the Autotuning (AT).

For details of the Startup tuning (ST), refer to 6.3 Startup Tuning (ST) (P. 6-10).

Related parameters
Engineering mode:
- Startup tuning (ST) (P. 8-51)
- ST start condition (P. 8-99)

Description of function

The Startup tuning (ST) function is used to automatically calculate PID constants from the temperature rise characteristic (gradient: arrival time to SV) when power is turned on or the Set value (SV) is changed. Startup tuning (ST) eliminates the lag time in applications when conventional Autotuning (AT) requires a long time.

Timing of activating the Startup tuning (ST) can be selected from among the following three types.
- Activate the Startup tuning (ST) function when the power is turned on; when transferred from STOP to RUN, or when the Set value (SV) is changed.
- Activate the Startup tuning (ST) function when the power is turned on, or when transferred from STOP to RUN.
- Activate the Startup tuning (ST) function when the Set value (SV) is changed.

Set value (SV) is changed.

Power is turned on or control is changed to RUN from STOP.

Set value (SV) after being changed.
Proportional band

This is a Proportional band in P, PI, PD or PID control.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to Input span (Unit: °C [°F])</td>
<td>30</td>
</tr>
<tr>
<td>(0: ON/OFF action)</td>
<td></td>
</tr>
<tr>
<td>When using communication, only a single digit of the Proportional band can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

Proportional band is not displayed when the block selection at F06 [S06] (P. 8-55) is set to “1: No display” in the Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters

Parameter setting mode:
- Anti-reset windup (ARW) (P. 8-21)

Engineering mode:
- Proportional band (P. 8-53)
- Decimal point position (P. 8-67)
- ON/OFF action differential gap (upper), ON/OFF action differential gap (lower) (P. 8-94)
- Control output at burnout (P. 8-95)

Integral time

Integral action is to eliminate offset between SV and PV by proportional action.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 999 seconds</td>
<td>240</td>
</tr>
<tr>
<td>(0: PD action)</td>
<td></td>
</tr>
</tbody>
</table>

Integral time is not displayed when the block selection at F06 [S06] (P. 8-55) is set to “1: No display” in the Engineering mode.

Related parameter

Engineering mode:
- Integral time (P. 8-53)
### Derivative time

**Factory default setting:**

The screen is displayed.

Derivative time is to prevent rippling and make control stable by monitoring output change.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 999 seconds</td>
<td>60</td>
</tr>
<tr>
<td>(0: PI action)</td>
<td></td>
</tr>
</tbody>
</table>

Derivative time is not displayed when the block selection at F06 [S06] (P. 8-55) is set to “1: No display” in the Engineering mode.

**Related parameters**

- **Engineering mode:**
  - Derivative time (P. 8-54)
  - Derivative action (P. 8-96)

### Anti-reset windup (ARW)

**Factory default setting:**

The screen is displayed.

In order to prevent an overshoot caused by the integral effect, sets the value to restrict the effective range of integral action.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 100 % of Proportional band</td>
<td>100</td>
</tr>
<tr>
<td>(0: Integral action is always OFF)</td>
<td></td>
</tr>
</tbody>
</table>

Anti-reset windup (ARW) is not displayed when the block selection at F06 [S06] (P. 8-55) is set to “1: No display” in the Engineering mode.

**Related parameters**

- **Parameter setting mode:**
  - Proportional band (P. 8-20)
- **Engineering mode:**
  - Anti-reset windup (ARW) (P. 8-54)
Fine tuning function allows the operator to adjust the control response speed without changing PID values.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>−3 to +3</td>
<td>0</td>
</tr>
<tr>
<td>(0: Unused)</td>
<td></td>
</tr>
</tbody>
</table>

Positive values quicken the control response while negative values slow the control response.

Fine tuning setting is not displayed when the block selection at F06 [506] (P. 8-55) is set to “1: No display” in the Engineering mode.

For the Fine tuning function, refer to 6.4 Fine Tuning (P. 6-16).

Related parameter
Engineering mode:
- Fine tuning setting (P. 8-54)
8. PARAMETER DESCRIPTION

Control loop break alarm (LBA) time

The LBA time sets the time required for the LBA function to determine there is a loop failure. When the LBA is output (under alarm status), the LBA function still monitors the Measured value (PV) variation at an interval of the LBA time.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 999 seconds</td>
<td>480</td>
</tr>
</tbody>
</table>

LBA displays when PID control is specified and the value “11: Control loop break alarm (LBA)” is set to Event 1 type (E51) through Event 2 type (E52) (P. 8-73) at Function blocks from F41 to F42 in the Engineering mode.

LBA is not displayed when the block selection at F07 [S07] (P. 8-57) is set to “1: No display” in the Engineering mode.

Related parameters
Parameter setting mode:
- LBA deadband (P. 8-24)

Engineering mode:
- Control loop break alarm (LBA) time (P. 8-56)

Description of function

The Control loop break alarm (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 % (Output limiter low) or 100 % (Output limiter high). 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.

[Alarm action]
LBA determination range:
- Thermocouple/RTD input: 2 °C [°F] (fixed)
- Voltage/Current input: 0.2 % of input span (fixed)

- When the output reaches 0 % (Output limiter low)
  For direct action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.
  For reverse action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.

- When the output exceeds 100 % (Output limit high)
  For direct action: When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.
  For reverse action: When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.

If the Autotuning function is used, the LBA time is automatically set twice as large as the integral time. The LBA setting time will not change even if the integral time is changed.

If the LBA function detects an error occurring in the control loop, but cannot specify the location, the control loop should be checked. The LBA function does not detect the location which causes alarm status. If LBA alarm is ON, check each device or wiring in the control loop.
**LBA deadband (LBD)**

The LBA deadband gives a neutral zone to prevent the Control loop break alarm (LBA) from malfunction caused by disturbance.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to Input span</td>
<td>0</td>
</tr>
<tr>
<td>When using communication, only a single digit of the LBA deadband can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

LBD displays when PID control is specified and the value “11: Control loop break alarm (LBA)” is set to Event 1 type (ES1) through Event 2 type (ES2) (P. 8-73) at Function blocks from F41 to F42 in the Engineering mode.

LBD is not displayed when the block selection at F07 [S07] (P. 8-57) is set to “1: No display” in the Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

**Related parameters**

**Parameter setting mode:**
- Control loop break alarm (LBA) time (P. 8-23)

**Engineering mode:**
- LBA deadband (LBD) (P. 8-56)
- Decimal point position (P. 8-67)

**Description of function**

The LBA may malfunction due to external disturbances. To prevent malfunction 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.

* TC/RTD input: 0.8 °C [°F] (fixed) Voltage/Current input: 0.8 % of input span (fixed)

A: During temperature rise: Alarm area
B: During temperature rise: Non-alarm area

LBA function is not operative when:
- When AT function is activated.
- When the controller is in STOP mode.
- LBA time is set to “0.”
- LBA function is not assigned to Event 1 (ES1) and Event 2 (ES2).
If the LBA time is too short or does not match the controlled object requirements, LBA may turn ON or OFF at inappropriate time or remain OFF. Change the LBA time based on the malfunction.

While the LBA is ON (under alarm status), the following conditions will cancel the alarm status and LBA will be OFF:
- The Measured value (PV) rises beyond (or falls below) the LBA determination range within the LBA time.
- The Measured value (PV) enter within the LBA deadband (LBD).

**Proportional cycle time**

Proportional cycle time is to set control cycle time for time based control output.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 100 seconds</td>
<td>2</td>
</tr>
</tbody>
</table>

Proportional cycle time is not displayed when the block selection at F08 [S08] (P. 8-60) is set to “1: No display” in the Engineering mode.

**Related parameters**

Parameter setting mode:
- Minimum ON/OFF time of proportioning cycle (P. 8-26)

Engineering mode:
- Proportional cycle time (P. 8-58)
Minimum ON/OFF time of proportioning cycle

This is the Minimum ON/OFF time of the time proportioning cycle.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 999 ms</td>
<td>0</td>
</tr>
</tbody>
</table>

Minimum ON/OFF time of proportioning cycle is not displayed when the block selection at F08 [508] (P. 8-60) is set to “1: No display” in the Engineering mode.

Related parameters
Parameter setting mode:
- Proportional cycle time (P. 8-25)

Engineering mode:
- Minimum ON/OFF time of proportioning cycle (P. 8-58)

Description of function
The Minimum ON/OFF time of the proportioning cycle is used to prevent output ON or OFF when the output is greater than 0 % or less than 100 %. This is useful when you need to establish a minimum ON/OFF time to prolong the life of the relay.

Example 1: Setting of Minimum ON/OFF time of proportioning cycle > Computed output

More than 0 % (Around 0 %)
Setting of Minimum ON/OFF time
ON
OFF
Computed output
ON
OFF
Actual output
ON
OFF

Less than 100 % (Around 100 %)
Setting of Minimum ON/OFF time
ON
OFF
Computed output
ON
OFF
Actual output
ON
OFF

* When a long minimum ON/OFF time is required for the relay, set a time longer than that time.

Example 2: Setting of Minimum ON/OFF time of proportioning cycle ≤ Computed output

More than 0 % (Around 0 %)
Setting of Minimum ON/OFF time
ON
OFF
Computed output
ON
OFF
Actual output
ON
OFF

Less than 100 % (Around 100 %)
Setting of Minimum ON/OFF time
ON
OFF
Computed output
ON
OFF
Actual output
ON
OFF

* When a long minimum ON/OFF time is required for the relay, set a time longer than that time.

Operation will not take place if “Proportional cycle time < Minimum ON/OFF time of proportioning cycle.”
Output limiter high
Output limiter low

Output limiter high:
Use to set the high limit value of Manipulated output (MV).

Output limiter low:
Use to set the low limit value of Manipulated output (MV).

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter high: Output limiter low to 105 % When using communication, only a single digit of the Output limiter high can be displayed after the decimal point (the tenths place).</td>
<td>105</td>
</tr>
<tr>
<td>Output limiter low: −5 % to Output limiter high When using communication, only a single digit of the Output limiter low can be displayed after the decimal point (the tenths place).</td>
<td>−5</td>
</tr>
</tbody>
</table>

Output limiter high/low is not displayed when the block selection at F08 [S08] (P. 8-60) is set to “1: No display” in the Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Engineering mode:
• Output limiter high (P. 8-59)
• Output limiter low (P. 8-59)
• Decimal point position (P. 8-67)

Description of function
This function restricts the high and low limits of Manipulated output values (MV).

Output limiter is available for ON/OFF action.
PV bias

PV bias adds bias to the Measured value (PV). The PV bias is used to compensate the individual variations of the sensors or correct the difference between the Measured value (PV) of other instruments.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>−199 to +999 °C [°F]</td>
<td>0</td>
</tr>
<tr>
<td>When using communication, only a single digit of the PV bias can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

PV bias is not displayed when the block selection at F09 [509] (P. 8-62) is set to “1: No display” in the Engineering mode.

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Engineering mode:
- PV bias (P. 8-61)
- Decimal point position (P. 8-67)

PV digital filter

The PV filter is used to eliminate noise against the measured input.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 100 seconds</td>
<td>1</td>
</tr>
<tr>
<td>(0: Unused)</td>
<td></td>
</tr>
</tbody>
</table>

PV digital filter is not displayed when the block selection at F09 [509] (P. 8-62) is set to “1: No display” in the Engineering mode.

Related parameter
Engineering mode:
- PV digital filter (P. 8-61)
8. PARAMETER DESCRIPTION

Manual manipulated output value (MV)

Setting Manipulated output value (MV) in Manual (MAN) mode.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output limiter low to Output limiter high</td>
<td>0</td>
</tr>
</tbody>
</table>

- Manual manipulated output value (MV) is not displayed as the default value of the block selection at F10 [S] (P. 8-65) is set to “1: No display” in the Engineering mode. To show the parameter, set the value to “0: Display.”
- When the instrument is in the Manual (MAN) mode, manual setting of the Manipulated output value is available at SV setting mode (P. 8-8).
- Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Engineering mode:
- Manual manipulated output value (MV) (P. 8-63)
- Decimal point position (P. 8-67)

Power saving mode setting

The value set for this parameter is the amount of time before Power saving mode activates. Power saving mode setting in the Parameter setting mode is linked to the Power saving mode setting at Function block 10 (F10) in the Engineering mode.

For Power saving mode setting, refer to 8.5.3 Engineering setting item (P. 8-63).

Maintenance mode switching

Operation mode can be switched to the Maintenance mode. Maintenance mode switching in the Parameter setting mode is linked to the Maintenance mode switching at Function block 10 (F10) in the Engineering mode.

For Maintenance mode switching, refer to 8.5.3 Engineering setting item (P. 8-64).
8.5 Engineering Mode

The Engineering mode allows the control to be set according to application requirements. For parameter details, refer to the 8.5.3 Engineering item list (P. 8-40).

⚠️ WARNING

Parameters in the Engineering mode (F21 to F91) should be set according to the application before setting any parameter related to operation. Once the parameters in the Engineering 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 Engineering mode.

📖 NOTE

To configure settings in Engineering mode (F21 to F91), the following steps must be performed:
- Preset “0: Unlock” to the Set data unlock/lock transfer setting.
- Set STOP mode (control STOP) at the RUN/STOP transfer.*
* However, only checking can be made even in the RUN state.

To change the parameters in the Engineering mode from F21 to F91, preset “128” to the mode selection at F00.

8.5.1 Display sequence

continued on the next page.
Continued from the previous page.

*If any of the following Event functions are selected, this parameter will be Event \( \square \) set value (EV\( \square \)) [high].
(Event number at parameter setting shows up in \( \square \).
- Band (High/Low individual setting) [Event type code: U]
- Deviation high/low (High/Low individual setting) [Event type code: X]
- Deviation high/low with hold action (High/Low individual setting) [Event type code: Y]
- Deviation high/low with re-hold action (High/Low individual setting) [Event type code: Z]

Continued on the next page.
Continued from the previous page.

Prior to change in values of parameters in the blocks from F21 to F91, unlock and STOP (control stop) the instrument. To display parameters in the blocks from F21 to F91, set “128” to the mode selection at F00.
Continued from the previous page.

Function block 23 (F23)

Function block 30 (F30)

Function block 41 (F41)

Function block 42 (F42)

Function block 46 (F46)

Function block 51 (F51)

Function block 52 (F52)
Continued from the previous page.

Function block 51  
(F51)

Function block 52  
(F52)

Function block 60  
(F60)

Function block 70  
(F70)

Function block 80  
(F80)

Function block 81  
(F81)

Function block 91  
(F91)

Function block 00  
(F00)
Function block (F□□) structure in the Engineering mode

Setting items are classified into groups (Function block: F□□) within the Engineering mode.

- **Function block 00 (F00)**
  No display screen settings (Monitor display mode, Mode switching), set lock level settings for the Setting data lock function, and RUN/STOP switching in Engineering mode can be selected.

- **Function block 01 (F01) to Function block 10 (F10)**
  The parameter setting screen that is displayed in Parameter setting mode can be hidden. Some setting items in Parameter setting mode are the same as the items in F01 to F10. When the set value of one of these items is changed, the set value of the corresponding item in the other mode also changes.
  - If the setting data is locked, the data cannot be changed.

- **Function block 21 (F21) to Function block 91 (F91)**
  Settings related to the specifications of this product can be selected. Parameters from F21 to F91 are not displayed. To display these parameters, set “128” to the Mode selection (no display) [□□□] at F00.
  - If the setting data is locked, the data cannot be changed.
  - Display or setting of parameters in F21 to F91 is not available when the setting data is locked.
  - If the controller is RUN state, the data of F21 to F91 cannot be changed.

Restricting access to the Engineering mode

Access on display and setting is limited in the Engineering mode. When the setting data is locked by the Data lock function, the data is not displayed. Refer to the table below for access restrictions in the Engineering mode:

<table>
<thead>
<tr>
<th>Set data unlock/lock transfer</th>
<th>Engineering mode</th>
<th>RUN</th>
<th>STOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unlock</td>
<td>F00</td>
<td>◎</td>
<td>◎</td>
</tr>
<tr>
<td></td>
<td>F01 to F10</td>
<td>◎</td>
<td>◎</td>
</tr>
<tr>
<td></td>
<td>F21 to F91</td>
<td>◎</td>
<td>◎ (Excluding F91)</td>
</tr>
<tr>
<td>Lock</td>
<td>F00</td>
<td>◎</td>
<td>◎</td>
</tr>
<tr>
<td></td>
<td>F01 to F10 *</td>
<td>◎</td>
<td>◎</td>
</tr>
<tr>
<td></td>
<td>F21 to F91</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

* Settings can be changed within the parameters in the unlocked function blocks.
8.5.2 Precaution against parameter change

If any of the following parameters are changed, the set values of relevant parameters are initialized or automatically converted according to the new setting. It may result in malfunction or failure of the instrument.

- Input type (InP)
- Event 1 type (ES1)
- Event 2 type (ES2)
- Output limiter high (OLH)
- Output limiter low (OLL)
- Setting limiter high (SLH)
- Setting limiter low (SLL)
- Communication protocol (CMP)
- Decimal point position (dP)

NOTE

Before changing any parameter setting on the above list, always record all parameter settings in SV setting mode, Parameter setting mode and Engineering mode.

And after the change, always check all parameter settings in SV setting mode, Parameter setting mode and Engineering mode by comparing them with the record taken before the change.

When Input type (InP) is changed

The following parameter will be changed to factory default values according to the new setting.

<table>
<thead>
<tr>
<th>Item</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input high</td>
<td>Maximum value of the selected input range</td>
</tr>
<tr>
<td>Input low</td>
<td>Maximum value of the selected input range</td>
</tr>
<tr>
<td>Setting high</td>
<td>Input scale high</td>
</tr>
<tr>
<td>Setting low</td>
<td>Input scale low</td>
</tr>
<tr>
<td>Set value 1 (SV1)</td>
<td>0 °C [°F]</td>
</tr>
<tr>
<td>Set value 2 (SV2)</td>
<td></td>
</tr>
<tr>
<td>Setting change rate limiter (up)</td>
<td>0 °C [°F]</td>
</tr>
<tr>
<td>Setting change rate limiter (down)</td>
<td>0 °C [°F]</td>
</tr>
<tr>
<td>ON/OFF action differential gap (upper)</td>
<td>1 °C [°F]</td>
</tr>
<tr>
<td>ON/OFF action differential gap (lower)</td>
<td>1 °C [°F]</td>
</tr>
<tr>
<td>Proportional band</td>
<td>30 °C [°F]</td>
</tr>
<tr>
<td>Integral time</td>
<td>240 seconds</td>
</tr>
<tr>
<td>Derivative time</td>
<td>60 seconds</td>
</tr>
<tr>
<td>Anti-reset windup (ARW)</td>
<td>100 % of Proportional band</td>
</tr>
<tr>
<td>Fine tuning setting</td>
<td>0</td>
</tr>
</tbody>
</table>

When Event 1 type (ES1) is changed

The following parameter will be changed to factory default values according to the new setting.

<table>
<thead>
<tr>
<th>Item</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event 1 set value (EV1) or Event 1 set value (EV1) [high]</td>
<td>50 °C [°F]</td>
</tr>
<tr>
<td>Event 1 set value (EV1') [low]</td>
<td>−50 °C [°F]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event 1 differential gap</td>
<td>2 °C [°F]</td>
</tr>
<tr>
<td>Event 1 hold action</td>
<td>0</td>
</tr>
<tr>
<td>Event 1 delay timer</td>
<td>0 seconds</td>
</tr>
</tbody>
</table>
**8. PARAMETER DESCRIPTION**

- **When Event 2 type (ES2) is changed**
  The following parameter will be changed to factory default values according to the new setting.

<table>
<thead>
<tr>
<th>Item</th>
<th>Default value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event 2 set value (EV2) or</td>
<td>50 °C [°F]</td>
</tr>
<tr>
<td>Event 2 set value (EV2) [high]</td>
<td></td>
</tr>
<tr>
<td>Event 2 set value (EV2') [low]</td>
<td>−50 °C [°F]</td>
</tr>
</tbody>
</table>

- **When Output limiter high (oLH) is changed**
  The following parameter will be automatically converted.
  - Manual manipulated output value (MV)

- **When Output limiter low (oLL) is changed**
  The following parameter will be automatically converted.
  - Manual manipulated output value (MV)

- **When Decimal point position (dP) is changed**
  The following parameter (only communication data) will be automatically converted.
  - Measured value (PV)
  - Set value (SV) monitor
  - Manipulated output value (MV) monitor
  - Set value 1 (SV1)
  - Set value 2 (SV2)
  - Setting change rate limiter (up)
  - Setting change rate limiter (down)
  - Event 1 set value (EV1) or
    - Event 1 set value (EV1) [high]
  - Event 1 set value (EV1') [low]
  - Event 2 set value (EV2) or
    - Event 2 set value (EV2) [high]
  - Event 2 set value (EV2') [low]
  - Proportional band
  - LBA deadband (LBD)
  - Output limiter high
  - Output limiter low
  - PV bias
  - Manual manipulated output value (MV)
  - Input scale high
  - Input scale low
  - Setting limiter high
  - Setting limiter low
  - Event 1 differential gap
  - Event 2 differential gap
  - ON/OFF action differential gap (upper)
  - ON/OFF action differential gap (lower)

- **When Input scale high (PSH) is changed**
  The following parameter will be automatically converted.
  - Setting limiter high
  - Setting limiter low
  - Set value 1 (SV1)
  - Set value 2 (SV2)
  - Setting change rate limiter (up)
  - Setting change rate limiter (down)
  - Proportional band
  - LBA deadband (LBD)
  - Event 1 set value (EV1) or
    - Event 1 set value (EV1) [high]
  - Event 1 set value (EV1') [low]
  - Event 1 differential gap
  - Event 2 set value (EV2) or
    - Event 2 set value (EV2) [high]
  - Event 2 set value (EV2') [low]
  - Event 2 differential gap
8. PARAMETER DESCRIPTION

■ When Input scale low (PSL) is changed

When Input scale low (PSL) is changed, the following parameter will be automatically converted:

- Setting limiter high
- Setting limiter low
- Set value 1 (SV1)
- Set value 2 (SV2)
- Setting change rate limiter (up)
- Setting change rate limiter (down)
- Proportional band
- LBA deadband (LBD)  

- Event 1 set value (EV1) or
- Event 1 set value (EV1') [high]
- Event 1 differential gap
- Event 2 set value (EV2) or
- Event 2 set value (EV2') [high]
- Event 2 differential gap

■ When Setting limiter high (SLH) is changed

When Setting limiter high (SLH) is changed, the following parameter will be automatically converted:

- Set value 1 (SV1)
- Set value 2 (SV2)

■ When Setting limiter low (SLL) is changed

When Setting limiter low (SLL) is changed, the following parameter will be automatically converted:

- Set value 1 (SV1)
- Set value 2 (SV2)

■ When Communication protocol (CMP) is changed

When Communication protocol (CMP) is changed, the following parameter will be automatically converted:

- Device address
- Data bit configuration
### Example of automatic conversion

- Values of parameters related to Input scale high \((P_{SH})\) change automatically in accordance with the change in value of Input scale high \((P_{SH})\).

  Example: When Input scale high \((P_{SH})\) changes from 400 °C to 200 °C

  ![Setting limiter high](image)

  The value of the Setting limiter high automatically changes to 200 °C.

- Values of parameters related to Communication protocol \((C_{AP})\) automatically in accordance with the change from RKC communication to Modbus.

  Example 1: When Device address is “0”

  ![Device address](image)

  For Modbus, the Device address automatically sets to “1” as address number “0” is not available in Modbus.

  Example 2: When the Data bit configuration is “7 (data 7-bit, without parity, stop 2-bit)”

  ![Data bit configuration](image)

  For Modbus, the data bit configuration automatically changes to “0 (data 8-bit, without parity, stop 1 bit)” as the data bit 7 is not available in Modbus.
8. PARAMETER DESCRIPTION

8.5.3 Engineering setting item

Function block 00 (F00)

This is the first parameter symbol of Function block 00 (F00).

F00

Set lock level

Lock and protect set data of parameters in each parameter group.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: All parameters can be changed</td>
<td>0</td>
</tr>
<tr>
<td>1: Lock “Parameter Group” F01 through F10</td>
<td></td>
</tr>
<tr>
<td>2: Lock “Parameter Group” F02 through F10</td>
<td></td>
</tr>
<tr>
<td>3: Lock “Parameter Group” F03 through F10</td>
<td></td>
</tr>
<tr>
<td>4: Lock “Parameter Group” F04 through F10</td>
<td></td>
</tr>
<tr>
<td>5: Lock “Parameter Group” F05 through F10</td>
<td></td>
</tr>
<tr>
<td>6: Lock “Parameter Group” F06 through F10</td>
<td></td>
</tr>
<tr>
<td>7: Lock “Parameter Group” F07 through F10</td>
<td></td>
</tr>
<tr>
<td>8: Lock “Parameter Group” F08 through F10</td>
<td></td>
</tr>
<tr>
<td>9: Lock “Parameter Group” F09 and F10</td>
<td></td>
</tr>
<tr>
<td>10: Lock “Parameter Group” F10</td>
<td></td>
</tr>
</tbody>
</table>

Related parameter
Mode switching:
• Set data unlock/lock transfer (P. 8-10)

Description of function

The same parameters exist in Parameter setting mode and Engineering mode F01 to F10. Parameters are grouped into F01 to F10 blocks to lock set data per related parameters. Set data is locked by Setting data unlock/lock transfer in each Function blocks from F01 to F10. The same parameters will also be locked in Parameter setting mode.

For details of setting method, refer to 6.6 Protecting Setting Data (P. 6-23).
F00
Monitor selection (no display)

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display all</td>
<td>0</td>
</tr>
<tr>
<td>2: No display: Manipulated output value (MV) monitor and Manual manipulated output value (MV) at SV setting mode.</td>
<td></td>
</tr>
</tbody>
</table>

For details of setting method, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-33).

F00
Mode selection (no display)

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display Mode switching screen (Auto/Manual transfer, Set data unlock/lock transfer, Interlock release)</td>
<td>0</td>
</tr>
<tr>
<td>1: Auto (AUTO)/Manual (MAN) transfer [no display]</td>
<td></td>
</tr>
<tr>
<td>2: Set data unlock/lock transfer [no display]</td>
<td></td>
</tr>
<tr>
<td>4: Interlock release [no display]</td>
<td></td>
</tr>
<tr>
<td>8: Disable $&lt;^*$ key operation</td>
<td></td>
</tr>
<tr>
<td>128: Display F21 to F91 Engineering mode.</td>
<td></td>
</tr>
</tbody>
</table>

For details of setting method, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-34).
RUN/STOP transfer is can be set in the Engineering mode state. Select RUN or STOP and press the key.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: RUN</td>
<td>0</td>
</tr>
<tr>
<td>1: STOP</td>
<td></td>
</tr>
</tbody>
</table>

Set RUN mode “0: RUN” prior to transfer RUN/STOP mode by digital input (DI).

Relations between key operations/communication and DI status

<table>
<thead>
<tr>
<th>Mode select from key operation or communication</th>
<th>DI-switched *</th>
<th>Actual state</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN/STOP transfer or RUN/STOP setting</td>
<td>RUN</td>
<td>RUN (Contact closed)</td>
</tr>
<tr>
<td></td>
<td>STOP</td>
<td>STOP (Contact open)</td>
</tr>
<tr>
<td></td>
<td>RUN</td>
<td>RUN (Contact closed)</td>
</tr>
<tr>
<td></td>
<td>STOP</td>
<td>STOP (Contact open)</td>
</tr>
</tbody>
</table>

* When digital input (DI) is used for transfer, the new state is not backed up to EEPROM.

RUN/STOP setting links to the operation by key. When RUN/STOP mode is transferred by key, the set data of RUN/STOP setting is also transferred.
Function block 01 (F01)

This is the first parameter symbol of Function block 01 (F01).

F01

Set value 1 (SV1)
Set value 2 (SV2)

Link to the set values SV1 and SV2 of Parameter setting mode and the Set values (SV) of SV setting mode.

For details of Set value SV1 and SV2, refer to 8.4.2 Parameter setting item (P. 8-13).

Related parameter
SV setting mode:
- Set value (SV) (P. 8-7)
Parameter setting mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)
- SV selection (P. 8-14)
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-14)
Engineering mode:
- SV selection (P. 8-44)
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-46)
- Setting limiter high (P. 8-69)
- Setting limiter low (P. 8-69)
8.5.3 F01 SV selection

Link to the SV selection in Parameter setting mode.

For details of SV selection, refer to 8.4.2 Parameter setting item (P. 8-14).

Related parameter
SV setting mode:
- Set value (SV) (P. 8-7)
Parameter setting mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)
- SV selection (P. 8-14)
Engineering mode
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-43)
F01 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td></td>
</tr>
<tr>
<td>1: No display</td>
<td>1</td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F01 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)
- SV selection (P. 8-14)

Description of function

Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F01 block selection. Those parameters of the Parameter setting mode link to F01 block of the Engineering mode.
Function block 03 (F03)

This is the first parameter symbol of Function block 03 (F03).

F03

Setting change rate limiter (up)
Setting change rate limiter (down)

Link to the Setting change rate limiter in Parameter setting mode.

For details of Setting change rate limiter (up) and Setting change rate limiter (down), refer to 8.4.2 Parameter setting item (P. 8-14).

Related parameter
Parameter setting mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)
- SV selection (P. 8-14)
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-14)

Engineering mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-43)
- SV selection (P. 8-44)
F03 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>1</td>
</tr>
<tr>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F03 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-14)

■ Description of function

Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F03 block selection. Those parameters of the Parameter setting mode link to F03 block of the Engineering mode.
8. PARAMETER DESCRIPTION

Function block 04 (F04)

This is the first parameter symbol of Function block 04 (F04).

F04

Event 1 set value (EV1), Event 1 set value (EV1) [high]
Event 2 set value (EV2), Event 2 set value (EV2) [high]

Link to the Event 1 and Event 2 set value [high] in the Parameter setting mode.

For details of Event 1 set value (EV1) <Event 1 set value (EV1) [high]>
and Event 2 set value (EV2) <Event 2 set value (EV2) [high]>, refer to
8.4.2 Parameter setting item (P. 8-16).

Related parameter

Parameter setting mode:
- Event 1 set value (EV1) <Event 1 set value (EV1) [high]>
  and Event 2 set value (EV2) <Event 2 set value (EV2) [high]> (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-49)
- Event 1 type, Event 2 type (P. 8-73)
- Event 1 hold action, Event 2 hold action (P. 8-82)
- Event 1 differential gap, Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout,
  Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer, Event 2 delay timer (P. 8-86)
- Event 1 interlock, Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
8. PARAMETER DESCRIPTION

F04
Event 1 set value (EV1’) [low]  
Event 2 set value (EV2’) [low]

Link to the Event 1 and Event 2 set value [low] in the Parameter setting mode.

For details of Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low], refer to 8.4.2 Parameter setting item (P. 8-17).

Related parameter

Parameter setting mode:
- Event 1 set value (EV1) <Event 1 set value (EV1) [high]> and Event 2 set value (EV2) <Event 2 set value (EV2) [high]> (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 set value (EV1) <Event 1 set value (EV1) [high]> and Event 2 set value (EV2) <Event 2 set value (EV2) [high]> (P. 8-48)
- Event 1 type, Event 2 type (P. 8-73)
- Event 1 hold action, Event 2 hold action (P. 8-82)
- Event 1 differential gap, Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout, Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer, Event 2 delay timer (P. 8-86)
- Event 1 interlock, Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
F04

F04 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F04 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Event 1 set value (EV1) < Event 1 set value (EV1) [high] > and Event 2 set value (EV2) < Event 2 set value (EV2) [high] > (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 set value (EV1) < Event 1 set value (EV1) [high] > and Event 2 set value (EV2) < Event 2 set value (EV2) [high] > (P. 8-48)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-49)

Description of function
Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F04 block selection. Those parameters of the Parameter setting mode link to F04 block of the Engineering mode.
Function block 05 (F05)

This is the first parameter symbol of Function block 05 (F05).

F05

Autotuning (AT)

Link to the Autotuning (AT) in the Parameter setting mode.

For details of Autotuning (AT), refer to 8.4.2 Parameter setting item (P. 8-18).

Related parameter
Parameter setting mode:
- Autotuning (AT) (P. 8-18)

Engineering mode:
- AT cycles (P. 8-97)
- AT differential gap time (P. 8-98)

F05

Startup tuning (ST)

Link to the Startup tuning (ST) in the Parameter setting mode.

For details of Startup tuning (ST), refer to 8.4.2 Parameter setting item (P. 8-19).

Related parameter
Parameter setting mode:
- Startup tuning (ST) (P. 8-19)

Engineering mode:
- ST start condition (P. 8-99)
F05 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F05 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Autotuning (AT) (P. 8-18)
- Startup tuning (ST) (P. 8-19)

Description of function

Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F05 block selection. Those parameters of the Parameter setting mode link to F05 block of the Engineering mode.

Not displayed when set to “1: No display” in “F05 block selection (no display).”

Parameter of the F05 block linked to the Parameter setting mode.
Function block 06 (F06)

F06

This is the first parameter symbol of Function block 06 (F06).

F06
Proportional band

Link to the Proportional band in the Parameter setting mode.

For details of Proportional band, refer to 8.4.2 Parameter setting item (P. 8-20).

Related parameter
Parameter setting mode:
  • Proportional band (P. 8-20)

Engineering mode:
  • ON/OFF action differential gap (upper),
    ON/OFF action differential gap (lower) (P. 8-94)

F06
Integral time

Link to the Integral time in the Parameter setting mode.

For details of Integral time, refer to 8.4.2 Parameter setting item (P. 8-20).

Related parameter
Parameter setting mode:
  • Integral time (P. 8-20)
F06  
Derivative time

Link to the Derivative time in the Parameter setting mode.

For details of Derivative time, refer to 8.4.2 Parameter setting item (P. 8-21).

Related parameter
Parameter setting mode:
  • Derivative time (P. 8-21)
Engineering mode:
  • Derivative action (P. 8-96)

F06  
Anti-reset windup (ARW)

Link to the Anti-reset windup (ARW) in the Parameter setting mode.

For details of Anti-reset windup (ARW), refer to 8.4.2 Parameter setting item (P. 8-21).

Related parameter
Parameter setting mode:
  • Proportional band (P. 8-20)
  • Anti-reset windup (ARW) (P. 8-21)
Engineering mode:
  • Proportional band (P. 8-53)

F06  
Fine tuning setting

Link to the Fine tuning setting in the Parameter setting mode.

For details of Fine tuning setting, refer to 8.4.2 Parameter setting item (P. 8-22).

Related parameter
Parameter setting mode:
  • Fine tuning setting (P. 8-22)
F06
F06 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td></td>
</tr>
<tr>
<td>1: No display</td>
<td>0</td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F06 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Proportional band (P. 8-20)
- Integral time (P. 8-20)
- Derivative time (P. 8-21)
- Anti-reset windup (ARW) (P. 8-21)
- Fine tuning setting (P. 8-22)

Description of function
Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F06 block selection. Those parameters of the Parameter setting mode link to F06 block of the Engineering mode.

Parameter setting mode
- Proportional band
- Integral time
- Derivative time
- Anti-reset windup (ARW)
- Fine tuning setting

Not displayed when set to “1: No display” in F06 block selection (no display).

Engineering mode
Function block 06 (F06)
- Proportional band
- Integral time
- Derivative time
- Anti-reset windup (ARW)
- Fine tuning setting

Parameter of the F06 block linked to the Parameter setting mode.
Function block 07 (F07)

This is the first parameter symbol of Function block 07 (F07).

F07

Control loop break alarm (LBA) time

Link to the Control loop break alarm (LBA) time in the Parameter setting mode.

For details of Control loop break alarm (LBA) time, refer to 8.4.2 Parameter setting item (P. 8-23).

Related parameter
Parameter setting mode:
- Control loop break alarm (LBA) time (P. 8-23)
- LBA deadband (LBD) (P. 8-24)

Engineering mode:
- LBA deadband (LBD) (P. 8-56)
- Event 1 type and Event 2 type (P. 8-73)

F07

LBA deadband (LBD)

Link to the LBA deadband (LBD) in the Parameter setting mode.

For details of LBA deadband, refer to 8.4.2 Parameter setting item (P. 8-24).

Related parameter
Parameter setting mode:
- Control loop break alarm (LBA) time (P. 8-23)
- LBA deadband (LBD) (P. 8-24)

Engineering mode:
- Control loop break alarm (LBA) time (P. 8-56)
- Event 1 type and Event 2 type (P. 8-73)
8. PARAMETER DESCRIPTION

F07
F07 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F07 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Control loop break alarm (LBA) time (P. 8-23)
- LBA deadband (LBD) (P. 8-24)

■ Description of function

Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F07 block selection. Those parameters of the Parameter setting mode link to F07 block of the Engineering mode.
Function block 08 (F08)

This is the first parameter symbol of Function block 08 (F08).

F08
Proportional cycle time

Link to the Proportional cycle time in the Parameter setting mode.

For details of Proportional cycle time, refer to 8.4.2 Parameter setting item (P. 8-25).

Related parameter
Parameter setting mode:
- Proportional cycle time (P. 8-25)
- Minimum ON/OFF time of proportioning cycle (P. 8-26)

Engineering mode:
- Minimum ON/OFF time of proportioning cycle (P. 8-58)

F08
Minimum ON/OFF time of proportioning cycle

Link to the Minimum ON/OFF time of proportioning cycle in the Parameter setting mode.

For details of Minimum ON/OFF time of proportioning cycle, refer to 8.4.2 Parameter setting item (P. 8-26).

Related parameter
Parameter setting mode:
- Proportional cycle time (P. 8-25)
- Minimum ON/OFF time of proportioning cycle (P. 8-26)

Engineering mode:
- Proportional cycle time (P. 8-58)
F08
Output limiter high
Output limiter low

Link to the Output limiter high and Output limiter low in the Parameter setting mode.

For details of Output limiter high and Output limiter low, refer to 8.4.2 Parameter setting item (P. 8-27).

Related parameter
Parameter setting mode:
- Output limiter high (P. 8-27)
- Output limiter low (P. 8-27)
F08 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F08 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- Proportional cycle time (P. 8-25)
- Minimum ON/OFF time of proportioning cycle (P. 8-26)
- Output limiter high (P. 8-27)
- Output limiter low (P. 8-27)

Description of function
Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F08 block selection. Those parameters of the Parameter setting mode link to F08 block of the Engineering mode.
Function block 09 (F09)

This is the first parameter symbol of Function block 09 (F09).

F09

PV bias

Link to the PV bias in the Parameter setting mode.

For details of PV bias, refer to 8.4.2 Parameter setting item (P. 8-28).

Related parameter
Parameter setting mode:
• PV bias (P. 8-28)

F09

PV digital filter

Link to the PV digital filter in the Parameter setting mode.

For details of PV digital filter, refer to 8.4.2 Parameter setting item (P. 8-28).

Related parameter
Parameter setting mode:
• PV digital filter (P. 8-28)
F09

F09 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>1: No display</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F09 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36).

Related parameter
Parameter setting mode:
- PV bias (P. 8-28)
- PV digital filter (P. 8-28)

Description of function

Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F09 block selection. Those parameters of the Parameter setting mode link to F09 block of the Engineering mode.
**Function block 10 (F10)**

This is the first parameter symbol of Function block 10 (F10).

**F10**

**Manual manipulated output value (MV)**

Link to the Manual manipulated output value (MV) in the Parameter setting mode and the SV setting mode.

For details of Manual manipulated output value (MV), refer to 8.4.2 Parameter setting item (P. 8-29).

**Related parameter**

Parameter setting mode:
- Manual manipulated output value (MV) (P. 8-29)

**F10**

**Power saving mode setting**

The value set for this parameter is the amount of time before Power saving mode activates. Link to the Power saving mode setting in the Parameter setting mode.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 60 minutes (0: Always ON)</td>
<td>0</td>
</tr>
</tbody>
</table>

**Description of function**

When no key operation is performed within the time set for this parameter, the operation mode will switch to the Power saving mode and the display is turned OFF. This parameter is to set the amount of time before the Power saving mode activates.

- Power saving mode switching does not affect the state of the lamp displays.
- To release Power saving mode, press any front key. The key operation performed for releasing Power saving mode does not affect other functions (such as display switching).

For Power saving mode, refer to the 7.2 Power Saving Mode Function (P. 7-5).
8. PARAMETER DESCRIPTION

F10

Maintenance mode switching

Operation mode can be switched to the Maintenance mode.
Link to the Maintenance mode switching in the Parameter setting mode.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Normal operation mode</td>
<td>1: Maintenance mode</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Description of function

For safety reasons, the instrument should be always turned OFF before exchanging sensors, etc. However, when the instrument cannot be OFF, switching to the Maintenance mode allows operator to exchange the sensors without turning the instrument OFF. When exchanging sensors in the Maintenance mode (by removing the connectors for sensor input and control output from the bottom side), the Host computer recognizes that the instrument is in the Maintenance mode instead of an instrument abnormality.

- To switch to the Maintenance mode
  By parameter setting: Set “1” to the Maintenance mode switching at Function block 10 (F10) in the Engineering mode.
  By direct key operation: Press and hold the ▲ key for 2 seconds or more at the Measured value (PV) monitor.

- To release Maintenance mode
  Press and hold the ▲ key for 2 seconds or more.

- Action at Maintenance mode
  Display: Maintenance mode (Character: Mnt)
  Input: Not measured (Input burnout detection is invalidated.)
  Measured value (PV) in communication: 0 °C [°F]
  Output: Control output and Event is OFF.
  Output value in communication: −5 %
  Communication: Maintenance mode displays at Operation mode state monitor.
  RKC communication identifier: Value at 6th digit: 1
  Modbus resister address: Value at Bit 5: 1

The Maintenance mode can be switched or released by communication. For details, refer to 9. COMMUNICATION (P. 9-1).

For Maintenance mode, refer to the 7.3 Maintenance Mode Function (P. 7-7).
F10
F10 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Display</td>
<td>1</td>
</tr>
<tr>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F10 parameters are displayed.

For details of setting example, refer to 6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36)

Related parameter
Parameter setting mode:
• Manual manipulated output value (MV) (P. 8-29)

■ Description of function

Hide parameters of the Parameter setting mode from the display. Each parameter of Parameter setting mode link to the Engineering mode from F01 to F10. The parameters of the Parameter setting mode linked to the parameters of the Engineering mode is not displayed when “No display” is set to F10 block selection. Those parameters of the Parameter setting mode link to F10 block of the Engineering mode.
To display F21 and after, setting \( \text{Mode selection [no display]} \) in F00 to 128 is required. (Refer to P. 8-41)

**Function block 21 (F21)**

This is the first parameter symbol of Function block 21 (F21).

**F21**

**Input type**

Input type number is a number to indicate an input type. The Input type can be changed.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC input K</td>
<td>0 to 800 °C</td>
</tr>
<tr>
<td>TC input J</td>
<td>0 to 800 °C</td>
</tr>
<tr>
<td>RTD input Pt100</td>
<td>0 to 400 °C</td>
</tr>
<tr>
<td>TC input K</td>
<td>0 to 999 °F</td>
</tr>
<tr>
<td>TC input J</td>
<td>0 to 999 °F</td>
</tr>
<tr>
<td>RTD input Pt100</td>
<td>0 to 800 °F</td>
</tr>
</tbody>
</table>

**NOTE**

Do not set to any number which is not described in the input range table above. This may cause malfunction.

If the Input type is changed, the Decimal point position, the Input scale high and the Input scale low are initialized. It is required to reset the settings.

For the parameters which will be initialized if the Input type is changed, refer to **When input type (I \( I \)) is changed (P. 8-36)**.

**Related parameters**

Engineering mode:
- Decimal point position (P. 8-67)
- Input scale high (P. 8-68)
- Input scale low (P. 8-68)
F21

Decimal point position

A Decimal point can be specified for communication data.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Without decimal point for communication</td>
<td>1</td>
</tr>
<tr>
<td>1: With decimal point for communication</td>
<td></td>
</tr>
<tr>
<td>(the tenths place)</td>
<td></td>
</tr>
</tbody>
</table>

The value displayed at the instrument remains the same after specifying decimal point for communication data. Therefore, when decimal point is specified, the value displayed at the instrument and the actual communication data may be different.

Related parameters

Monitor display mode:
- Measured value (PV) (P. 8-3)
- Set value (SV) monitor (P. 8-4)
- Manipulated output value (MV) monitor (P. 8-5)

SV setting mode:
- Set value (SV) (P. 8-7)
- Manual manipulated output value (MV) (P. 8-8)

Parameter setting mode:
- Set value 1 (SV1) (P. 8-13)
- Set value 2 (SV2) (P. 8-13)
- Setting change rate limiter (up) (P. 8-14)
- Setting change rate limiter (down) (P. 8-14)
- Event 1 set value (EV1) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] (P. 8-17)
- Event 2 set value (EV2) [high] (P. 8-16)
- Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Set value 1 (SV1) (P. 8-43)
- Set value 2 (SV2) (P. 8-43)
- Setting change rate limiter (up) (P. 8-46)
- Setting change rate limiter (down) (P. 8-46)
- Event 1 set value (EV1) [high] (P. 8-48)
- Event 1 set value (EV1’) [low] (P. 8-49)
- Event 2 set value (EV2) [high] (P. 8-48)
- Event 2 set value (EV2’) [low] (P. 8-49)
- Proportional band (P. 8-53)
- LBA deadband (LBD) (P. 8-56)
- Output limiter high (P. 8-59)
- Output limiter low (P. 8-59)
- PV bias (P. 8-61)
- Manual manipulated output value (MV) (P. 8-63)
- Input scale high (P. 8-68)
- Input scale low (P. 8-68)
- Setting limiter high (P. 8-69)
- Setting limiter low (P. 8-69)
- Event 1 differential gap (P. 8-84)
- Event 2 differential gap (P. 8-84)
- ON/OFF action differential gap (upper) (P. 8-94)
- ON/OFF action differential gap (lower) (P. 8-94)
F21
Input scale high
Input scale low

Use to set the high limit and low limit of the input scale range.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| **Input scale high**  
Input scale low to Maximum value of the selected input range  
When using communication, only a single digit of the Input scale high can be displayed after the decimal point (the tenths place). | Maximum value of the selected input range |
| **Input scale low**  
Minimum value of the selected input range to Input scale high  
When using communication, only a single digit of the Input scale low can be displayed after the decimal point (the tenths place). | Minimum value of the selected input range |

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Engineering mode:
- Input type (P. 8-66)
- Decimal point position (P. 8-67)
- Setting limiter high, Setting limiter low (P. 8-69)

**Description of function**
The input range can be changed for temperature input (TC/RTD).

**Example [temperature input]:**
When the range of 0 to 800 °C for thermocouple type K is changed to 50 to 300 °C
8. PARAMETER DESCRIPTION

F21

Setting limiter high
Setting limiter low

Setting limiter high: Use to set a high limit of the set value.
Setting limiter low: Use to set a low limit of the set value.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting limiter high</td>
<td>Input scale high</td>
</tr>
<tr>
<td>Setting limiter low</td>
<td>Input scale low</td>
</tr>
</tbody>
</table>

Setting limiter low to Setting limiter high
When using communication, only a single digit of the Setting limiter high can be displayed after the decimal point (the tenths place).

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Engineering mode:
- Input type (P. 8-66)
- Decimal point position (P. 8-67)
- Input scale high, Input scale low (P. 8-68)

■ Description of function
Setting limiter is to set the range of the Set value (SV).

[Example]: Input scale range is from 0 to 400 °C, the Setting limiter high is 200 °C, and the Setting limiter low is 20 °C.
F21
**PV flashing display**

It can also be set so that the PV display does not flash “1: Non-flashing display.” When the Measured value (PV) goes beyond the Input scale high or Input scale low, the Measured value (PV) flashes until it reaches the limiting value.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Flashing</td>
<td>0</td>
</tr>
<tr>
<td>1: Non-flashing display</td>
<td></td>
</tr>
</tbody>
</table>

Example: PV flashing display range at the input scale range from 0 to 600 °C up to the out of the input range from 0 to 800 °C (maximum)
Function block 23 (F23)

This is the first parameter symbol of Function block 23 (F23).

F23
DI assignment

Use to assign the function (SV selection function, RUN/STOP transfer, Auto/Manual transfer, or interlock release) for the Digital input (DI) [optional].

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Unused (No DI assignment)</td>
<td>1</td>
</tr>
<tr>
<td>1: SV selection function (SV1/SV2)</td>
<td></td>
</tr>
<tr>
<td>2: RUN/STOP transfer</td>
<td></td>
</tr>
<tr>
<td>3: Auto/Manual transfer</td>
<td></td>
</tr>
<tr>
<td>4: Interlock release</td>
<td></td>
</tr>
</tbody>
</table>

1 SV selection function (SV1/SV2):
   Contact open state: SV1
   Contact closed state: SV2

2 RUN/STOP transfer:
   Contact open state: STOP
   Contact closed state: RUN

3 Auto/Manual transfer:
   Contact open state: Manual (MAN) mode
   Contact closed state: Auto (AUTO) mode

4 Interlock release:
   Interlock is released at the time of contact status change (from open to close).

For digital input transfer, refer to following pages.
- SV selection function: Refer to 7.1 SV Selection Function (Step SV function) (P. 7-2).
- RUN/STOP transfer: Refer to 6.1 RUN/STOP Transfer (P. 6-2).
- Auto/Manual transfer: Refer to 6.5 Auto/Manual Transfer (P. 6-19).
- Interlock release: Refer to 6.8 Interlock Release (P. 6-38).
Function block 30 (F30)

This is the first parameter symbol of Function block 30 (F30).

F30
Output action at STOP mode

Use to select action of Event output when the controller is set to STOP (control STOP).

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Event output is OFF</td>
<td>0</td>
</tr>
<tr>
<td>1: Event output remains unchanged</td>
<td></td>
</tr>
</tbody>
</table>

When the Digital output (DO) is not provided, this parameter is invalid.

Related parameters

Engineering mode:
- Event 1 type (P. 8-73)
- Event 2 type (P. 8-73)
Function block 41 (F41)  
Function block 42 (F42)

This is the first parameter symbol of Function block 41 (F41).

This is the first parameter symbol of Function block 42 (F42).

F41
Event 1 type
F42
Event 2 type

Use to select a action type of the Event 1

Use to select a action type of the Event 2.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 23</td>
<td>0</td>
</tr>
<tr>
<td>Refer to Event type (P. 8-74)</td>
<td>If the Event type is specified by the event type code when ordering, that Event type will be the factory set value.</td>
</tr>
</tbody>
</table>
### Event type

<table>
<thead>
<tr>
<th>Set value</th>
<th>Event type</th>
<th>Event type code</th>
<th>Action type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>N</td>
<td>—</td>
</tr>
<tr>
<td>1</td>
<td>Deviation high (Using SV monitor value)(^1)</td>
<td>A (With hold action: E With re-hold action: Q)</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Deviation low (Using SV monitor value)(^1)</td>
<td>B (With hold action: F With re-hold action: R)</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Deviation high/low (Using SV monitor value)(^1)</td>
<td>C (With hold action: G With re-hold action: T)</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Band (Using SV monitor value)</td>
<td>D</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>Deviation high/low (SV Using SV monitor value) [High/Low individual setting](^1)</td>
<td>X (With hold action: Y With re-hold action: Z)</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Band (Using SV monitor value) [High/Low individual setting]</td>
<td>U</td>
<td>—</td>
</tr>
<tr>
<td>7</td>
<td>SV high (Using SV monitor value)</td>
<td>V</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>SV low (Using SV monitor value)</td>
<td>W</td>
<td>—</td>
</tr>
<tr>
<td>9</td>
<td>Process high(^2)</td>
<td>H (With hold action: K)</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>Process low(^2)</td>
<td>J (With hold action: L)</td>
<td>—</td>
</tr>
<tr>
<td>11</td>
<td>Control loop break alarm (LBA)</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>12</td>
<td>Monitor during RUN</td>
<td>4</td>
<td>—</td>
</tr>
<tr>
<td>13</td>
<td>FAIL</td>
<td>3</td>
<td>—</td>
</tr>
<tr>
<td>14</td>
<td>Deviation high (Using local SV)(^1)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>15</td>
<td>Deviation low (Using local SV)(^1)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>16</td>
<td>Deviation high/low (Using local SV)(^1)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>17</td>
<td>Band (Using local SV)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>18</td>
<td>Deviation high/low (Using local SV) [High/Low individual setting](^1)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>19</td>
<td>Band (Using local SV) [High/Low individual setting]</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>20</td>
<td>SV high (Using local SV)</td>
<td>—</td>
<td>Set value action</td>
</tr>
<tr>
<td>21</td>
<td>SV low (Using local SV)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>22</td>
<td>Unused</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>23</td>
<td>Output of the communication monitoring result</td>
<td>5</td>
<td>—</td>
</tr>
</tbody>
</table>

\(^1\)Event hold and re-hold action is available.

\(^2\)Event hold action is available.

### Related parameters

**Parameter setting mode:**
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

**Engineering mode:**
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
8. PARAMETER DESCRIPTION

- **Description of function**
  - **FAIL**
    Operation stops if FAIL occurs
    (FAIL output [fixed at de-energized]: contact open when error occurs)
    FAIL output is ON (contact open) when power is supplied to the instrument only through loader communication.

- **Monitor during RUN**
  Event ON at RUN (Event OFF at STOP)
  Useful for operations such as turning on an indicator lamp or a rotary beacon light.

- **Output of the communication monitoring result**
  Event signal is turned on when communication is not made for 10 seconds.

<table>
<thead>
<tr>
<th>Communication timing</th>
<th>When communication is not performed within 10 seconds</th>
<th>When normal communication is performed within 10 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event status</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>

- Settings on Event set value (Parameter setting mode), Event hold action, and Event differential gap are not available when the Event output is set for FAIL, Monitor during RUN or Output of the communication monitoring result.
**Deviation action (High, low, High/low, Band)**

When the deviation (PV – SV) reaches the Event set value, event ON occurs.

SV monitor value type and local SV type are available for Deviation action.

<table>
<thead>
<tr>
<th>SV monitor value type</th>
<th>The Event set value is set for the SV monitor value. Setting change rate limiter adjusts the Event set value to follow the same change rate of SV monitor value. SV monitor value: SV monitor value is displayed in the Set value (SV) monitor screen (Monitor display mode). When Setting change rate limiter is set, the Set value (SV) in the changing process is displayed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local SV type</td>
<td>The Event set value is set for the Set value (SV) [Local SV]. Local SV: Local SV is displayed in the Set value (SV) screen (SV setting mode).</td>
</tr>
</tbody>
</table>

**SV monitor value type**

[When setting change rate limiter is not set.]

When the Set value (SV) is changed, the Event set value is set for the Set value (SV) after the change.

**Local SV type**

When the Set value (SV) is changed, the Event set value is set for the Set value (SV) after the change.

For the Setting change rate limiter, refer to the Setting change rate limiter [up/down] (P. 8-14).
Some examples of Deviation high are described in the following:

Deviation high: When the deviation (PV – SV) is more than the Event set value, the event ON occurs.

**SV monitor value type**
(Example: When setting change rate limiter is set.)

- **[Event set value is greater than 0]**
  - Measured value (PV)
  - Set value (SV)
  - Event set value
  - SV monitor value
  - Changing the set value (SV)
  - Event status: OFF, ON, OFF

- **[Event set value is less than 0]**
  - Measured value (PV)
  - Set value (SV)
  - Event set value
  - SV monitor value
  - Changing the set value (SV)
  - Event status: ON, OFF, ON

**Local SV type**

- **[Event set value is greater than 0]**
  - Measured value (PV)
  - Set value (SV)
  - Event set value
  - SV monitor value
  - Changing the set value (SV)
  - Event status: OFF, ON, OFF

- **[Event set value is less than 0]**
  - Measured value (PV)
  - Set value (SV)
  - Event set value
  - SV monitor value
  - Changing the set value (SV)
  - Event status: ON, OFF, ON

Event turns ON or OFF in accordance with the Differential gap setting. Refer to **Event 1 Differential gap and Event 2 Differential gap (P. 8-84).**
Diagrams of the Deviation action type are shown in the following:

**ON:** Event action turned on

**OFF:** Event action turned off

(▲: Set value (SV)  △: Event set value  ☆: Event differential gap)

---

### Deviation high

When the deviation (PV – SV) is more than the Event set value, the event ON occurs.

- **(Event set value is greater than 0.)**
  - Low
  - OFF
  - ▲
  - △
  - ON
  - △
  - ▲
  - PV

- **(Event set value is less than 0.)**
  - Low
  - OFF
  - ▲
  - △
  - ON
  - △
  - ▲
  - PV

---

### Deviation low

When the deviation (PV – SV) is less than the Event set value, the event ON occurs.

- **(Event set value is greater than 0.)**
  - Low
  - ON
  - ▲
  - △
  - OFF
  - △
  - ▲
  - PV

- **(Event set value is less than 0.)**
  - Low
  - ON
  - ▲
  - △
  - OFF
  - △
  - ▲
  - PV

---

### Deviation high/low

Two types of Deviation high/low action are available.

**Without high/low individual setting:**

- When the absolute deviation | PV – SV | is more/less than the Event set values, the event ON occurs.

**With high/low individual setting:**

- **High action:** When the deviation (PV – SV) is more than the Event set value [high], the event ON occurs.
- **Low action:** When the deviation (PV – SV) is less than the Event set value [low], the event ON occurs.

---

### Band

Two types of Band action are available.

**Without high/low individual setting:**

- When the absolute deviation | PV – SV | is within the Event set values, the event ON occurs.

**With high/low individual setting:**

- **High action:** When the deviation (PV – SV) is less than the Event set value [high], the event ON occurs.
- **Low action:** When the deviation (PV – SV) is more than the Event set value [low], the event ON occurs.
8. PARAMETER DESCRIPTION

- **Set value action (High, Low)**
  When the Set value (SV) reaches the Event set value, event ON occurs.
  SV monitor value type and local SV type are available for Set value action.

| SV monitor value type | Event turns on when SV monitor value reaches Event set value. Setting change rate limiter turns on the event when the Set value (SV) in the changing process reaches Event set value. SV monitor value: SV monitor value is displayed in the Set value (SV) monitor screen (Monitor display mode). When Setting change rate limiter is set, the Set value (SV) in the changing process is displayed. |
| Local SV type | Event turns on when Set value (SV) [Local SV] reaches Event set value. Local SV: Local SV is displayed in the Set value (SV) screen (SV setting mode). |

Some examples of SV high are described in the following:
SV high: When the Set value (SV) is more than the Event set value, the event ON occurs.

**SV monitor value type**

[When setting change rate limiter is not set.]

```
Set value (SV)  Event turns on when the changed Set value (SV) reaches the Event set value.
Set value (SV)  Event set value
Set value (SV)  Set value (SV)
Changing the set value (SV)
Time
Event status OFF ON
```

[When setting change rate limiter is set.]

```
Set value (SV)  Event turns on when the Set value (SV) in the changing process reaches the Event set value.
Set value (SV)  Event set value
Set value (SV)  Set value (SV)
SV monitor value
Changing the set value (SV)
Time
Event status OFF ON
```

**Local SV type**

```
Set value (SV)  Event turns on when the changed Set value (SV) reaches the Event set value.
Set value (SV)  Event set value
Set value (SV)  Set value (SV)
Changing the set value (SV)
Time
Event status OFF ON
```

Local SV type has only one type of action on a change with or without the Setting change rate limiter.

- For the Setting change rate limiter, refer to the **Setting change rate limiter [up/down]** (P. 8-14).
Diagrams of the Set value action type are shown in the following:

**ON:** Event action turned on

**OFF:** Event action turned off  
(▲: Set value (SV)  △: Event set value  ☆: Event differential gap)

**SV high**
When the Set value (SV) is more than the Event set value, the event ON occurs.

```
ON OFF SVLow High
```

**SV low**
When the Set value (SV) is less than the Event set value, the event ON occurs.

```
ON OFF SVLow High
```

**Input value action (High, Low)**
When the Measured value (PV) reaches the Event set value, event ON occurs.

Diagrams of the input value action type are shown in the following.

**ON:** Event action turned on

**OFF:** Event action turned off  
(▲: Set value (SV)  △: Event set value  ☆: Event differential gap)

**Process high**
When the Measured value (PV) is more than the Event set value, the event ON occurs.

```
ON OFF PVLow High
```

**Process low**
When the Measured value (PV) is less than the Event set value, the event ON occurs.

```
ON OFF PVLow High
```
8. PARAMETER DESCRIPTION

- **Control loop break alarm (LBA)**

The Control loop break alarm (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.

**[Alarm action]**

LBA determination range: Thermocouple/RTD input: $2 \, ^\circ \text{C} \quad [\text{°F}]$ (fixed)

Voltage/Current input: 0.2 % of input span (fixed)

<table>
<thead>
<tr>
<th>For reverse action</th>
<th>When the output reaches 0 % (low limit with output limit function)</th>
<th>When the output exceeds 100 % (high limit with output limit function)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>When the LBA time has passed and the PV has not fallen below the alarm determination range, the alarm will be turned on.</td>
<td>When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.</td>
</tr>
<tr>
<td>For direct action</td>
<td>When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.</td>
<td>When the LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.</td>
</tr>
</tbody>
</table>

- If the Autotuning function is used, the LBA time is automatically set twice as large as the Integral time. The LBA setting time will not be changed even if the Integral time is changed.

- Normally the LBA time of Parameter setting mode should be set to approximately twice the Integral time.

- LBA function is not operative when:
  - When AT function is activated.
  - When the controller is in STOP mode.
  - LBA time is set to “0.”
  - LBA function is not assigned to Event 1 (ES1) and Event 2 (ES2).

- If the LBA time is too short or does not match the controlled object requirements, LBA may turn ON or OFF at inappropriate time or remain OFF. Change the LBA time based on the malfunction.

- If the LBA function detects an error occurring in the control loop, but cannot specify the location, the control loop should be checked. The LBA function does not detect the location which causes alarm status. If LBA alarm is ON, check each device or wiring in the control loop.

- While the LBA is ON (under alarm status), the following conditions will cancel the alarm status and LBA will be OFF:
  - The Measured value (PV) rises beyond (or falls below) the LBA determination range within the LBA time.
  - The Measured value (PV) enters within the LBA deadband.
F41
Event 1 hold action

F42
Event 2 hold action

Use to set an event hold action for the Event 1.

Use to set an event hold action for the Event 2.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: OFF</td>
<td>0</td>
</tr>
<tr>
<td>1: Hold action ON (Only hold action)</td>
<td></td>
</tr>
<tr>
<td>• Validate the hold action when the power is turned on.</td>
<td></td>
</tr>
<tr>
<td>• Validate the hold action when transferred from STOP (control STOP) to RUN (control RUN).</td>
<td></td>
</tr>
<tr>
<td>2: Re-hold action ON (hold and re-hold actions)</td>
<td></td>
</tr>
<tr>
<td>• Validate the hold action when the power is turned on.</td>
<td></td>
</tr>
<tr>
<td>• Validate the hold action when transferred from STOP (control STOP) to RUN (control RUN).</td>
<td></td>
</tr>
<tr>
<td>• Validate the re-hold action when the Set value (SV) is changed.</td>
<td></td>
</tr>
<tr>
<td>• However, if the Setting change rate limiter is set to any function other than “0” or in the remote mode, the re-hold action becomes invalid.</td>
<td></td>
</tr>
<tr>
<td>• Re-hold action is only available for deviation high, deviation low, and deviation high/low.</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
When high alarm with hold action/re-hold action is used for Event function, alarm does not turn on while hold action is in operation. Use in combination with a high alarm without hold action in order to prevent overheating which may occur by failure of control devices, such as welding of relays.

Related parameters
Parameter setting mode:
• Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
• Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
• Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
• Event 1 type and Event 2 type (P. 8-73)
• Event 1 differential gap and Event 2 differential gap (P. 8-84)
• Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
• Event 1 delay timer and Event 2 delay timer (P. 8-86)
• Event 1 interlock and Event 2 interlock (P. 8-88)
• Energized/De-energized of DO (P. 8-93)
## Description of function

### (1) Hold action

When hold action is ON, the event action is suppressed at start-up or STOP to RUN until the measured value (PV) has entered the non-event range.

- **With hold action**
- **Without hold action**

### (2) Re-hold action

When re-hold action is ON, the event action is also suppressed at the control set value change until the measured value has entered the non-event range.

<table>
<thead>
<tr>
<th>Action condition</th>
<th>1: Hold action ON (Only hold action)</th>
<th>2: Re-hold action ON (Hold and re-hold actions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the power is turned on</td>
<td>Hold action</td>
<td>Hold action</td>
</tr>
<tr>
<td>When transferred from STOP (control STOP) to RUN (control RUN)</td>
<td>Hold action</td>
<td>Hold action</td>
</tr>
<tr>
<td>When the Set value (SV) is changed</td>
<td>Without hold and re-hold actions</td>
<td>Re-hold action</td>
</tr>
</tbody>
</table>

**NOTE**

The re-hold action is invalid for any of the following. However, the hold action is valid.

When Setting change rate limiter other than “0” are set

**[Example]** When Event 1 type is the deviation low:

When re-hold action is OFF and event output type is deviation, the event output is produced due to the Set value (SV) change. The re-hold action suppresses the alarm output until the measured value (PV) has entered the non-event range again.
F41
Event 1 differential gap

F42
Event 2 differential gap

Use to set a differential gap of the Event 1.

Use to set a differential gap of the Event 2.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to Input span</td>
<td>2</td>
</tr>
<tr>
<td>When using communication, only a single digit</td>
<td></td>
</tr>
<tr>
<td>of the Event differential gap can be displayed</td>
<td></td>
</tr>
<tr>
<td>after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Parameter setting mode:

- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:

- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)

Description of function

It prevents chattering of event output due to the Measured value (PV) fluctuation around the Event set value.
F41
Event 1 output action at input burnout
F42
Event 2 output action at input burnout

Use to select the output action of the Event 1 at input burnout.

Use to select the output action of the Event 2 at input burnout.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Event output is not forcibly turned ON when the burnout function is activated. 1: ON at over-scale; no action at underscale 2: ON at underscale; no action at over-scale 3: ON at over-scale or underscale 4: OFF at over-scale or underscale</td>
<td>0</td>
</tr>
</tbody>
</table>

Related parameters
Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
8. PARAMETER DESCRIPTION

F41
Event 1 delay timer

F42
Event 2 delay timer

Event 1 delay timer is to set an output delay time for event outputs.

Event 2 delay timer is to set an output delay time for event outputs.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 600 seconds</td>
<td>0</td>
</tr>
</tbody>
</table>

Related parameters
Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1') [low] and Event 2 set value (EV2') [low] (P. 8-17)

Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)
**Description of function**

When an event condition becomes ON, the output is suppressed until the Event delay timer set time elapses. If the event output is still ON after time is up, the output will resume.

Example: When the setting of Event 1 delay timer is 50 seconds

- **Event state**
  - Event output ON
  - Event output OFF

- **Non-event state**
  - Event output ON
  - Event output OFF

- **Event output ON**
  - Event output OFF

- **Event delay timer (50 seconds)**

- **Set value (SV)**

- **Measured value (PV)**

- **DO lamp state**
  - OFF
  - ON

The Event delay timer is also activated for the following reasons:

- When set to the event state simultaneously with power turned on
- When set to the event state simultaneously with control changed to RUN (control start) from STOP (control stop).

In the event wait state, no event output is turned on even after the Event delay timer preset time has elapsed.

The Event delay timer is reset for the following reasons:

- When power failure occurs while the Event delay timer is being activated
- When control is changed to STOP (control stop) from RUN (control start) while the Event delay timer is being activated
F41
Event 1 interlock
F42
Event 2 interlock

Use to select the Interlock function for the Event 1.

Use to select the Interlock function for the Event 2.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Unused (OFF)</td>
<td>0</td>
</tr>
<tr>
<td>1: Used</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters
Mode switching:
- Interlock release (P. 8-11)
Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)
Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Energized/De-energized of DO (P. 8-93)
Description of function

The Event interlock function is used to hold the event state.

[Example] When the Event interlock function is used for deviation high

[Without Event hold action]
Function block 46 (F46)

This is the first parameter symbol of Function block 46 (F46).

F46

Control action at Event

Set Control action at Event.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Action based on control computation</td>
<td>0</td>
</tr>
<tr>
<td>1: Control output OFF (−5 %) at Event 1</td>
<td></td>
</tr>
<tr>
<td>2: Control output OFF (−5 %) at Event 2</td>
<td></td>
</tr>
<tr>
<td>3: Control output OFF (−5 %) at Event 1 or Event 2</td>
<td></td>
</tr>
<tr>
<td>4: Control output OFF (−5 %) at Event 1 and Event 2</td>
<td></td>
</tr>
</tbody>
</table>

For Control action at Event, refer to 7.4 Load Power Shutoff Function (P. 7-9).

Related parameters

Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Load power shutoff function (P. 8-91)
- Event output (P. 8-92)
- Energized/De-energized of DO (P. 8-93)
F46

Load power shutoff function

Set a start-up condition of Load power shutoff function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Relay for Load power shutoff opens at FAIL (Restores when FAIL is resolved.)</td>
<td>0</td>
</tr>
<tr>
<td>1: Relay for Load power shutoff opens at FAIL or LBA (FAIL state or LBA state remains)</td>
<td></td>
</tr>
<tr>
<td>2: Relay for Load power shutoff opens at FAIL or LBA (Returns to the normal state when FAIL state or LBA state recovers.)</td>
<td></td>
</tr>
</tbody>
</table>

If Load power shutoff function activates when the start-up condition is set to “1,” turn OFF first and restart the instrument to turn the load power shutoff relay to close.

To active the Load power shutoff function at LBA, set “11: Control loop break alarm (LBA)” to Event 1 type or Event 2 type in the Engineering mode (P. 8-73).

For Load power shutoff function, refer to 7.4 Load Power Shutoff Function (P. 7-9).

Related parameters

Parameter setting mode:
- Control loop break alarm (LBA) time (P. 8-23)
- LBA deadband (LBD) (P. 8-24)

Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Control action at Event (P. 8-90)

■ Description of function

The Load power shutoff function shuts off the load power immediately upon instrument error preventing undesired operations such as overheating.

Opening load power shutoff relay will shut off power supplied to the load.

Load power shutoff function activates at the following instrument errors:

1. FAIL
   - Adjusted data error (Error code 1)
   - Data back-up error (Error code 2)
   - A/D conversion error (Error code 4)
   - Temperature compensation error (Error code 4)
   - Power supply voltage is abnormal (All display is OFF)
   - Watchdog timer (All display is OFF)
2. Control loop break alarm (LBA)
F46
Event output

Set an action of Event output (Digital output) at Event.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Event output full-time OFF</td>
<td>3</td>
</tr>
<tr>
<td>1: Event output ON at Event 1</td>
<td></td>
</tr>
<tr>
<td>2: Event output ON at Event 2</td>
<td></td>
</tr>
<tr>
<td>3: Event output ON at Event 1 or Event 2</td>
<td></td>
</tr>
<tr>
<td>4: Event output ON at Event 1 and Event 2</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters

Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Control action at Event (P. 8-90)
- Energized/De-energized of DO (P. 8-93)
F46
\textbf{Energized/De-energized of DO}

Use to select the Energized or De-energized for the digital output (DO). However, the FAIL alarm is fixed to “De-energized.” (When at FAIL alarm occurrence: Contact opened)

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Energized</td>
<td>0</td>
</tr>
<tr>
<td>1: De-energized</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters

Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Control action at Event (P. 8-90)
- Event output (P. 8-92)

\textbf{Description of function}

\textbf{Energized:} Relay contact is closed during the event or alarm.
\textbf{De-energized:} Relay contact opens during the event or alarm.

Diagram for explaining operation (At power-ON)
Function block 51 (F51)

This is the first parameter symbol of Function block 51 (F51).

F51

ON/OFF action differential gap (upper)
ON/OFF action differential gap (lower)

ON/OFF action differential gap (upper):
Use to set the ON/OFF control differential gap (upper).

ON/OFF action differential gap (upper):
Use to set the ON/OFF control differential gap (upper).

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 100 °C [°F]</td>
<td>1</td>
</tr>
<tr>
<td>When using communication, only a single digit of the ON/OFF action differential gap can be displayed after the decimal point (the tenths place).</td>
<td></td>
</tr>
</tbody>
</table>

Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters
Parameter setting mode:
• Proportional band (P. 8-20)

■ Description of function

ON/OFF control is possible when the Proportional band is set to “0.” In ON/OFF control, when the Measured value (PV) is smaller than the Set value (SV), the Manipulated output (MV) is 100 % or ON. When the PV is higher than the SV, the MV is 0 % or OFF. Differential gap setting prevents control output from repeating ON and OFF too frequently.
F51  
**Control output at burnout**

This sets the action when burnout occurs.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Result of control computation</td>
<td>0</td>
</tr>
<tr>
<td>1: Output limiter low (Output OFF)</td>
<td></td>
</tr>
</tbody>
</table>

F51  
**Bumpless mode setting**

Setting this parameter turns ON or OFF the bumpless function when the operation mode is changed from Auto mode to Manual mode.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Without bumpless</td>
<td>1</td>
</tr>
<tr>
<td>1: With bumpless</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters

Mode switching:

- Auto (AUTO)/Manual (MAN) transfer (P. 8-10)

For details of balanceless/bumpless, refer to **6.5 Auto/Manual transfer (P. 6-19)**.
F51
Derivative action

Use to select the action of derivative term.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Measured value derivative</td>
<td>0</td>
</tr>
<tr>
<td>1: Deviation derivative</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters
Parameter setting mode:
- Autotuning (AT) (P. 8-18)

**Description of function**

Measured value derivative: PID control putting emphasis on response most adaptive to fixed set point control (mode)

![Diagram of Measured value derivative (PID control)](image)

Deviation derivative: PID control putting much emphasis on follow-up most adaptive to ramp control or cascade control using a ratio of setting change limiter, etc. It is effective to follow-up at powering up a load or restrict the amount of overshooting when changed to Soak from Ramp.

![Diagram of Deviation derivative (PID control)](image)
Function block 52 (F52)

This is the first parameter symbol of Function block 52 (F52).

F52

AT cycles

The number of ON/OFF cycles is selected when the Autotuning (AT) function is executed.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: 1.5 cycles</td>
<td>0</td>
</tr>
<tr>
<td>1: 2.5 cycles</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters

Parameter setting mode:
- Autotuning (AT) (P. 8-18)

Example

When the AT cycle is set to 1.5 cycle and the Autotuning (AT) function is executed just after the power is turned on.
F52
AT differential gap time

Use to set an ON/OFF action differential gap time for Autotuning (AT).
This function prevents the AT function from malfunctioning caused by noise.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 50 seconds</td>
<td>10</td>
</tr>
</tbody>
</table>

Related parameters
Parameter setting mode:
- Autotuning (AT) (P. 8-18)

Description of function
In order to prevent the output from chattering due to the fluctuation of a Measured value (PV) caused by noise during Autotuning (AT), the output on or off state is held until “AT differential gap time” has passed after the output on/off state is changed to the other. Set “AT differential gap time” to “1/100 × Time required for temperature rise.”

[Example]
A: AT cycle time when the AT differential gap time is set to 0 second
The output chatters due to the fluctuation of the Measured value (PV) caused by noise, and Autotuning function is not able to monitor appropriate cycles to calculate suitable PID values.
B: AT cycle time when the AT differential gap time is set to “Time corresponding to 0.25 cycles.”
The fluctuation of a Measured value (PV) caused by noise is ignored and the Autotuning function is able to monitor appropriate cycles to calculate suitable PID values.

![Diagram]

The factory set value of the AT cycle is 1.5 cycles.
F52
ST start condition

Timing (starting condition) to activate the Startup tuning (ST) function is selected.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Activate the ST function when the power is turned on; when transferred from STOP to RUN; or when the Set value (SV) is changed.</td>
<td>0</td>
</tr>
<tr>
<td>1: Activate the ST function when the power is turned on; or when transferred from STOP to RUN.</td>
<td></td>
</tr>
<tr>
<td>2: Activate the ST function when the Set value (SV) is changed.</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters
Parameter setting mode:
- Startup tuning (ST) (P. 8-19)

For details of Startup tuning (ST), refer to 6.3 Startup Tuning (ST) (P. 6-10).
Function block 60 (F60)

This is the first parameter symbol of Function block 60 (F60). The settings of parameters in this block require the Communication function (optional) to be specified.

F60

Communication protocol

Use to select the protocol for Communication function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: RKC communication</td>
<td>Based on model code</td>
</tr>
<tr>
<td>1: Modbus</td>
<td></td>
</tr>
</tbody>
</table>

For the Communication function, refer to 9. COMMUNICATION (P. 9-1).

Related parameters

Engineering mode:
- Device address (P. 8-100)
- Communication speed (P. 8-101)
- Data bit configuration (P. 8-101)
- Interval time (P. 8-102)
- Communication response monitor (P. 8-102)

F60

Device address

Device address is used to set the slave address of the controller for Communication function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 99 (Modbus: 1 to 99)</td>
<td>RKC communication: 0</td>
</tr>
<tr>
<td></td>
<td>Modbus: 1</td>
</tr>
</tbody>
</table>

**NOTE**
Do not use the same Device address for more than one controller in multi-drop connection. Each controller must have a unique address in multi-drop connection.

**NOTE**
If the protocol is Modbus, no “0” can be set.

For the Communication function, refer to 9. COMMUNICATION (P. 9-1).
8. PARAMETER DESCRIPTION

F60
Communication speed

Communication speed is to set Communication speed for Communication function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: 2400 bps</td>
<td>3</td>
</tr>
<tr>
<td>1: 4800 bps</td>
<td></td>
</tr>
<tr>
<td>2: 9600 bps</td>
<td></td>
</tr>
<tr>
<td>3: 19200 bps</td>
<td></td>
</tr>
</tbody>
</table>

For the Communication function, refer to 9. COMMUNICATION (P. 9-1).

F60
Data bit configuration

This item is Data bit configuration of Communication function.

<table>
<thead>
<tr>
<th>Set value</th>
<th>Data bit configuration</th>
<th>Modbus Communication</th>
<th>RKC Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Data</td>
<td>Parity</td>
<td>Stop</td>
</tr>
<tr>
<td>0</td>
<td>8</td>
<td>Without</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>Without</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Even</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Even</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Odd</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>Odd</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>Without</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Without</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>Even</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>Even</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
<td>Odd</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>Odd</td>
<td>2</td>
</tr>
</tbody>
</table>

Factory set value: 0 (Data bit: 8, Parity bit: Without, Stop bit: 1)

For the Communication function, refer to 9. COMMUNICATION (P. 9-1).
F60
Interval time

This item is Interval time of Communication function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 250 ms</td>
<td>10</td>
</tr>
</tbody>
</table>

For the Communication function, refer to 9. COMMUNICATION (P. 9-1).

F60
Communication response monitor

This is the communication error. If two or more errors happen, the sum of errors will be displayed.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Normal response</td>
<td>0</td>
</tr>
<tr>
<td>1: Overrun error</td>
<td></td>
</tr>
<tr>
<td>2: Parity error</td>
<td></td>
</tr>
<tr>
<td>4: Framing error</td>
<td></td>
</tr>
<tr>
<td>8: Receive buffer overflow</td>
<td></td>
</tr>
</tbody>
</table>

For the Communication function, refer to 9. COMMUNICATION (P. 9-1).
Function block 70 (F70)

F70

This is the first parameter symbol of Function block 70 (F70).

F70

Setting change rate limiter unit time

Set the time unit for Setting change rate limiter (up/down).

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Minute</td>
<td>0</td>
</tr>
<tr>
<td>1: Hours</td>
<td></td>
</tr>
</tbody>
</table>

Related parameters
Parameter setting mode:
  - Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-14)
Engineering mode:
  - Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-46)
Function block 80 (F80)

This is the first parameter symbol of Function block 80 (F80).

F80

Burnout status monitoring delay

When input burnout (Burnout) occurs, the timing of burnout occurrence for burnout status monitoring can be delayed.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 10 times (Number of input sampling cycle)</td>
<td>0</td>
</tr>
</tbody>
</table>

NOTE

This function only delays the timing of flag for burnout at burnout status monitoring. Therefore, if burnout occurs, the actual control action of the instrument is switched to the action at burnout immediately.

For the Burnout status monitoring, refer to 9. COMMUNICATION (P. 9-1).

Description of function

Setting of this parameter is only used for Burnout status monitoring display of communication data. The setting of this parameter does not affect an actual control action at burnout.

Set the number of input sampling cycle from 0 to 10.
If burnout lasts more than the number of input sampling cycles set at this parameter, Burnout status monitoring display turns ON.
On the other hand, Burnout status monitoring display remains OFF when burnout ceases before the instrument detects burnout for the number of input sampling cycles set at this parameter.

Maximum delay time  =  Input sampling cycle × Maximum set value
                      =  0.25 seconds × 10 times = 2.5 seconds
Function block 81 (F81)

This is the first parameter symbol of Function block 81 (F81).

F81
SB link selection

Validate or invalidate SB link function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Without SB link function</td>
<td>0</td>
</tr>
<tr>
<td>1: With SB link function</td>
<td></td>
</tr>
</tbody>
</table>

SB link function and communication cannot be used at the same time. To use communication, set “0: Without SB link function.”

For SB link function, refer to 7.6 SB Link/Peak Current Suppression Function (P. 7-15).

Related parameters
Parameter setting mode:
- Proportional cycle time (P. 8-25)
- Output limiter high, Output limiter low (P. 8-27)

Engineering mode:
- Intragroup address (P. 8-106)
- Control action at SB link error (P. 8-107)
F81
Intragroup address

Set an address for SB link function.

<table>
<thead>
<tr>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0: Intragroup address 1 (Master)</td>
<td>0</td>
</tr>
<tr>
<td>1: Intragroup address 2</td>
<td></td>
</tr>
<tr>
<td>2: Intragroup address 3</td>
<td></td>
</tr>
<tr>
<td>3: Intragroup address 4</td>
<td></td>
</tr>
</tbody>
</table>

The instrument set to “0” operates as a master controller. Controllers set to “1,” “2,” or “3” becomes slave controllers.

For SB link function, refer to **7.6 SB Link/Peak Current Suppression Function (P. 7-15)**.

Related parameters

Engineering mode:
- SB link selection (P. 8-105)
- Control action at SB link error (P. 8-107)
F81  
Control action at SB link error

Set the number of SB link error determination and control action at SB link error.

<table>
<thead>
<tr>
<th>Set value</th>
<th>Number of SB link error determination</th>
<th>Control action at SB link error</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>Action of control output is based on control computation.</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Control output OFF (−5 %)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The characters “Err” and “Œ” display in turn at SB link error.

For SB link function, refer to 7.6 SB Link/Peak Current Suppression Function (P. 7-15).

Related parameters
Engineering mode:
- SB link selection (P. 8-105)
- Intragroup address (P. 8-106)

**Description of function**

SB link error determination

Master side: An SB link error occurs when the Master controller does not continuously receive a returned Loopback test message from the Slave controller(s) for the number of times selected at Control action at SB link error or if the content of the returned message is abnormal.

Slave side: An SB link error occurs when the Slave controller does not continuously receive the Broadcast signal (synchronizing signal) from the Master controller for the number of times selected at Control action at SB link error.
8. PARAMETER DESCRIPTION

Function block 91 (F91)

This is the first parameter symbol of Function block 91 (F91).

F91

ROM version monitor (upper)
ROM version monitor (lower)

Displays the installed ROM version by dividing it into high order and low order.

<table>
<thead>
<tr>
<th>Display range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed ROM version</td>
<td>⎯</td>
</tr>
</tbody>
</table>

F91

Integrated operating time monitor (upper)
Integrated operating time monitor (lower)

Displays Integrated operating time by dividing it into high order and low order.

<table>
<thead>
<tr>
<th>Display range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 19999 hours</td>
<td>⎯</td>
</tr>
</tbody>
</table>

F91

Holding peak value ambient temperature monitor

Stores and displays the maximum ambient temperature of the connector at the lower side.

<table>
<thead>
<tr>
<th>Display range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>−10 to +100 °C (14 to 212 °F)</td>
<td>⎯</td>
</tr>
</tbody>
</table>
This chapter describes Host communication including connection, setting, protocol and communication data.

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  9.2.1 Wiring for host communication ........................................................................9-4
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9.1 Outline

The communication function makes it possible to monitor and set the data of the Temperature Controller SB1 (hereafter called controller) from a computer. To perform communication between the computer and controller, you must create a communication program.

The controller interfaces with the host computer via Modbus or RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4) protocols. The communication interface used for both protocols is RS-485. In addition, the controller is equipped standard with a loader communication connector. Therefore, loader communication is possible. For reference purposes, the Modbus protocol identifies the host computer as master, the controller as slave.

- **RKC communication and Modbus**
  
  One host computer (master) can communicate with up to 31 controllers.

- **Loader communication**
  
  Loader communication allows controller data to be set from a personal computer. By saving data that was set using our setting and monitoring tool WinSCI to a computer, the data can be transferred to other controllers, allowing setup to be accomplished much more quickly than when the data is set in each controller using the front panel keys. RKC USB communication converter COM-K (sold separately) is required for the loader communication.

**NOTE**

The Loader port is only for parameter setup.
Setting and monitoring tool WinSCI

The setting and monitoring tool WinSCI has the following features:

- Communication data such as measured values and set values can be monitored on a personal computer screen.
- The communication data of controller can be set by the personal computer.
- Communication data can save to a personal computer.
- Communication data saved to a personal computer can be transferred to (set in) other controllers.

The WinSCI corresponds to the RKC communication protocol.
In addition, WinSCI can be used for both loader communication and host communication.

The WinSCI can be downloaded from the RKC official website:
9.2 Wiring

9.2.1 Wiring for host communication

The cable is provided by the customer.

Communication terminal number and signal details

<table>
<thead>
<tr>
<th>Terminal No.</th>
<th>Signal name</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Signal ground</td>
<td>SG</td>
</tr>
<tr>
<td>2</td>
<td>Send data</td>
<td>T/R (A)</td>
</tr>
<tr>
<td>3</td>
<td>Receive data</td>
<td>T/R (B)</td>
</tr>
</tbody>
</table>

Wiring method

- Connection to the RS-485 port of host computer (master)

To prevent electric shock or instrument failure, turn off the power before connecting or disconnecting the instrument and peripheral equipment.

*R: Termination resistors (Example: 120 Ω 1/2 W)
If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.
- **Connection to the RS-232C port of host computer (master)**

Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.

![Diagram of RS-232C/RS-485 connection](image)

- **RS-485 Paired wire**
- **Shielded twisted pair wire**
- **Maximum connections: Up to 31 controllers**

**RS-232C/RS-485 converter**

Host computer (master)

**Recommended converter:** CD485, CD485/V manufactured by Data Link, Inc. or equivalent.

**R:** Termination resistors (Example: 120 Ω 1/2 W)

If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.
**Connection to the USB of the host computer (master)**

Connect the USB communication converter between the host computer and the controller.

For the COM-K, refer to the **COM-K Instruction Manual (IMR01Z01-E)**.
9.2.2 Connections for loader communication

RKC USB communication converter COM-K, loader communication cable and USB cable are required for connecting this controller to the personal computer.

For the COM-K, refer to the COM-K Instruction Manual (IMR01Z01-E†).

■ Position of loader communication connector

![Diagram of loader communication connector](image)

■ Wiring method

Connect the controller, COM-K, and personal computer using a USB cable and a loader communication cable. Make sure the connectors are oriented correctly when connecting.

Do not unplug the USB cable while the power to the instrument is ON.

Communication settings on the computer
(The following values are all fixed)
Communication speed: 9600 bps
Start bit: 1
Data bit: 8
Parity bit: Without
Stop bit: 1

When using the loader communication, USB driver for COM-K must be installed on the personal computer.
The USB driver for COM-K can be downloaded from the RKC official website:
9.3 Setting

9.3.1 Description of each parameters

To establish communication parameters between host computer (master) and controller (slave), it is necessary to set the device address (Modbus: Slave address), communication speed, data bit configuration and interval time on each controller (slave) in the Function block 60 (F60.) of Engineering mode.

<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>F60</td>
<td>Function block 60</td>
<td>—</td>
<td>This is the first parameter symbol of Function block 60.</td>
<td>—</td>
</tr>
<tr>
<td>CMP</td>
<td>Communication protocol</td>
<td>0: RKC communication 1: Modbus</td>
<td>Use to select a protocol of communication function.</td>
<td>RKC communication: 0 * Modbus: 1 *</td>
</tr>
<tr>
<td>Add</td>
<td>Device address</td>
<td>RKC communication: 0 to 99 Modbus: 1 to 99</td>
<td>Do not use the same device address for more than one controller in multi-drop connection. Each controller must have a unique address in multi-drop connection. In Modbus communication, communication is not possible when the address is 0.</td>
<td>RKC communication: 0 Modbus: 1</td>
</tr>
<tr>
<td>bPS</td>
<td>Communication speed</td>
<td>0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps</td>
<td>Set the same communication speed for both the controller (slave) and the host computer (master).</td>
<td>3</td>
</tr>
<tr>
<td>blF</td>
<td>Data bit configuration</td>
<td>RKC communication: 0 to 11 Modbus: 0 to 5 Refer to Data bit configuration table.</td>
<td>Set the same data bit configuration for both the controller (slave) and the host computer (master).</td>
<td>0</td>
</tr>
<tr>
<td>Intf</td>
<td>Interval time</td>
<td>0 to 250 ms</td>
<td>The interval time for the controller should be set to provide a time for the host computer to finish sending all data including stop bit and to switch the line to receive status for the host.</td>
<td>10</td>
</tr>
<tr>
<td>Cn</td>
<td>Communication response monitor</td>
<td>0: Normal response 1: Overrun error 2: Parity error 4: Framing error 8: Receive buffer overflow</td>
<td>When a communication error occurs, a number is displayed to indicate the error type. If two or more errors happen, the sum of errors will be displayed.</td>
<td>—</td>
</tr>
</tbody>
</table>

* The communication protocol that was selected by means of the model code when the order was placed is set as the factory set value.

Data bit configuration table

<table>
<thead>
<tr>
<th>Set value</th>
<th>Data bit</th>
<th>Parity bit</th>
<th>Stop bit</th>
<th>Settable communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>8</td>
<td>Without</td>
<td>1</td>
<td>RKC communication and Modbus</td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>Without</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Even</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Even</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Odd</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>Odd</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set value</th>
<th>Data bit</th>
<th>Parity bit</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7</td>
<td>Without</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Without</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>Even</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>7</td>
<td>Even</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>7</td>
<td>Odd</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>Odd</td>
<td>2</td>
</tr>
</tbody>
</table>
Interval time:
The interval time for the controller should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for the host. If the interval time between the two is too short, the controller may send data before the host computer is ready to receive it. In this case, communication transmission cannot be conducted correctly.

For communication data, Decimal points (the tenths place) can be selected at Decimal point position of Function block 21 (F21). Setting of this parameter can be changed by communication [RKC communication identifier: XU, or Modbus resistor address: 00AFH (175)]. For communication data affected by setting a Decimal point position, refer to the notes at 9.4.3 RKC communication identifier list (P.9-25) and 9.5.8 Modbus communication data list (P. 9-46).

The device address (slave address), communication speed, data bit configuration, and interval time can also be set by loader communication using WinSCI.

9.3.2 Setting procedure example
This setting example shows the setting procedure when the controller settings are set to the factory set values (the state when the controller power is initially turned on).

![WARNING]
Parameters in the Engineering mode (F21 to F81) should be set according to the application before setting any parameter related to operation. Once the parameters in the Engineering 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 Engineering mode.

NOTE
After all the communications parameters are set, perform one of the following steps to make settings valid:
- The power is turned on again after turning it off once.
- The RUN/STOP mode is changed to RUN from STOP again after changing it to STOP once.

If you have locked the controller setting data so that it cannot be changed, the lock must be released before configuring the communication settings.
- To release the lock, refer to 6.6 Protecting Setting Data (Data lock function) (P. 6-23) or SB1 Quick Operation Manual (IMR02M02-E).

Press the SET key to store the new value. If the SET key is not pressed within 1 minute, the display returns to the measured value (PV) monitor screen and the set value returns the previous setting.
- For details on changing the numeric value, refer to 4.2 Changing Set Value (P. 4-4) or SB1 Quick Operation Manual (IMR02M02-E).
1. Turn on the power of the controller.

2. Go to the Engineering mode.
   Press the <R/S key for 4 seconds while pressing the SET key at PV monitor until Engineering mode is displayed.

3. Enable display of function blocks 21 (F21) to 91 (F91).
   Press the SET key three times at Function block 00 (F00) until Mode selection (no display) is displayed.

4. Set the controller to the STOP state (control stop).
   Set the RUN/STOP setting to “1: STOP.”

Press the SET key to store the new set value. The display goes to the RUN/STOP setting.

When “128” is set, display of the parameters from function block 21 (F21) to function block 91 (F91) is enabled.

Press the SET key to store the new set value. The display goes to the function block 00 (F00).

Set the mode selection (no display) to “128.”
5. Go to the Function block 60 (F60).
Press the DOWN key five times at Function block 00 (F00) until Function block 60 (F60) is displayed.

6. Set the communication parameter.
Press the SET key twice at Function block 60 (F60) until device address is displayed.

Set the device address (slave address).
Example: Setting the device address (slave address) to 1.
Setting range: 0 to 99 (RKC communication)
1 to 99 (Modbus)

Press the SET key to store the new set value.
The display goes to the communication speed.

Press the SET key to store the new set value.
The display goes to the data bit configuration.

For details of setting range, refer to Data bit configuration table (P. 9-8).
9. COMMUNICATION

Press the SET key.
The display goes to the interval time.

Set the interval time.
As an example, factory set value “10” is set.
Setting range: 0 to 250 ms

Press the SET key.
The display goes to the communication response monitor.

---

7. Enable communication parameter

After all the communications parameters are set, perform one of the following steps to make settings valid:
- The power is turned on again after turning it off once.
- The RUN/STOP mode is changed to RUN from STOP again after changing it to STOP once.

---

**NOTE**

If you changed the communication parameters, be sure to turn the power OFF and then ON or switch from STOP to RUN.
If this is not done, the higher level device will not be able to recognize the changed values and communication may not be possible.
9.3.3 Communication requirement

■ Processing times during data send/receive

When the host computer is using either the polling or selecting procedure for communication, the following processing times are required for controller to send data:
- Response wait time after controller sends BCC in polling procedure
- Response wait time after controller sends ACK or NAK in selecting procedure

Response send time is time when interval time is set at 0 ms.

### RKC communication (Polling procedure) processing times

<table>
<thead>
<tr>
<th>Procedure details</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response send time after controller receives ENQ</td>
<td>60 ms max.</td>
</tr>
<tr>
<td>Response send time after controller receives ACK</td>
<td>60 ms max.</td>
</tr>
<tr>
<td>Response send time after controller receives NAK</td>
<td>60 ms max.</td>
</tr>
<tr>
<td>Response send time after controller sends BCC</td>
<td>52 ms max.</td>
</tr>
</tbody>
</table>

### RKC communication (Selecting procedure) processing times

<table>
<thead>
<tr>
<th>Procedure details</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Response send time after controller receives BCC</td>
<td>65 ms max.</td>
</tr>
<tr>
<td>Response wait time after controller sends ACK</td>
<td>52 ms max.</td>
</tr>
<tr>
<td>Response wait time after controller sends NAK</td>
<td>52 ms max.</td>
</tr>
</tbody>
</table>

### Modbus processing times

<table>
<thead>
<tr>
<th>Procedure details</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Read holding registers [03H]</td>
<td>60 ms max.</td>
</tr>
<tr>
<td>Preset single register [06H]</td>
<td>65 ms max.</td>
</tr>
<tr>
<td>Diagnostics (loopback test) [08H]</td>
<td>60 ms max.</td>
</tr>
</tbody>
</table>
RS-485 (2-wire system) send/receive timing (RKC communication)

RS-485 communication is conducted through two wires, therefore, the transmission and reception of data requires precise timing.

- **Polling procedure**

<table>
<thead>
<tr>
<th>Host computer</th>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending status</td>
<td>![Diagram]</td>
<td>![Diagram]</td>
<td>![Diagram]</td>
</tr>
</tbody>
</table>

- **Controller**

<table>
<thead>
<tr>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending status</td>
<td>![Diagram]</td>
<td>![Diagram]</td>
</tr>
</tbody>
</table>

- **Selecting procedure**

<table>
<thead>
<tr>
<th>Host computer</th>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending status</td>
<td>![Diagram]</td>
<td>![Diagram]</td>
<td>![Diagram]</td>
</tr>
</tbody>
</table>

- **Controller**

<table>
<thead>
<tr>
<th>Send data (Possible/Impossible)</th>
<th>Possible</th>
<th>Impossible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sending status</td>
<td>![Diagram]</td>
<td>![Diagram]</td>
</tr>
</tbody>
</table>

- **To switch the host computer from transmission to reception, send data must be on line.**
- **The following processing times are required for the controller to process data:**
  - In polling procedure, Response wait time after the controller sends BCC
  - In selecting procedure, Response wait time after the controller sends ACK or NAK

- **Fail-safe**

A transmission error may occur if the transmission line is disconnected, shorted or set to the high-impedance state. In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer. The fail-safe function can prevent a framing error from its occurrence by making the receiver output stable to the MARK (1) when the transmission line is in the high-impedance state.

- **Data backup**

The nonvolatile memory (EEPROM) for data backup has limitations on the number of memory rewrite times (approx. 1,000,000 times). If set values are frequently changed through communication, please select “Buffer mode” in the EEPROM mode (Identifier: EB or Register address: 001B).
9.4 RKC Communication Protocol

The controller uses the polling/selecting method to establish a data link. The basic procedure is followed ANSI X3.28-1976 subcategories 2.5 and A4 basic mode data transmission control procedure (Fast selecting is the selecting method used in this controller).

- The polling/selecting procedures are a centralized control method where the host computer controls the entire process. The host computer initiates all communication so the controller responds according to queries and commands from the host.

- The code use in communication is 7-bit ASCII code including transmission control characters. The transmission control characters are EOT (04H), ENQ (05H), ACK (06H), NAK (15H), STX (02H) and ETX (03H). The figures in the parenthesis indicate the corresponding hexadecimal number.

The RKC communication data transmission/reception status can be checked by using the setting and monitoring tool “WinSCI.” The WinSCI can be downloaded from the official RKC website: http://www.rkcinst.com/.

9.4.1 Polling

Polling is the action where the host computer requests one of the connected controllers to transmit data. An example of the polling procedure is shown below:

**ID:** Identifier

---

IMR02M04-E1
Polling procedures

(1) Data link initialization
Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence
The host computer sends the polling sequence in the following formats:

1. Address (2 digits)
The device address specifies the controller to be polled and each controller must have its own unique device address. This data is a device address of the controller to be selected and must be the same as the device address set value in item 9.3 Setting (P. 9-8).

2. Identifier (2 digits)
The identifier specifies the type of data that is requested from the controller. Always attach the ENQ code to the end of the identifier.

3. ENQ
The ENQ is the transmission control character that indicates the end of the polling sequence. The ENQ must be attached to the end of the identifier.

(3) Data sent from the controller
If the polling sequence is received correctly, the controller sends data in the following format:

1. STX
STX is the transmission control character which indicates the start of the text transmission (identifier and data).

2. Identifier (2 digits)
The identifier indicates the type of data (measured value, status and set value) sent to the host computer.

For details, refer to 9.5.3 RKC Communication identifier list (P. 9-25).
3. Data (6 digits)
Data indicated by the identifier belonging to the controller. It is expressed in decimal ASCII code including a minus sign (-) and a decimal point. Data is not zero-suppressed.

- The data of “Model codes: ID” has 32 digits.
- The data of “ROM version monitor: VR” has 8 digits.

4. ETX
ETX is a transmission control character used to indicate the end of text transmission.

5. BCC
BCC (Block Check Character) detects error by using horizontal parity (even number).

Calculation method of BCC: Exclusive OR all data and characters from STX through ETX, not including STX.

Example:

<table>
<thead>
<tr>
<th>STX</th>
<th>M</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>.</th>
<th>0</th>
<th>ETX</th>
<th>BCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>4DH</td>
<td>31H</td>
<td>30H</td>
<td>31H</td>
<td>30H</td>
<td>30H</td>
<td>2EH</td>
<td>30H</td>
<td>03H</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H = 60H
(⊕: Exclusive OR)
Value of BCC becomes 60H.

4) **EOT sent from the controller** (Ending data transmission from the controller)

In the following cases, the controller makes a timeout judgment after about 3 seconds, sends EOT, and ends the data link:

- When the specified identifier is invalidated
- When there is an error in the data type
- When all the data has been sent

5) **No response from the controller**

The controller will not respond if the polling address is not received correctly. It may be necessary for the host computer to take corrective action such as a time-out.

6) **ACK (Acknowledgment)**

An acknowledgment ACK is sent by the host computer when data received is correct. When the controller receives ACK from the host computer, the controller will send any remaining data of the next identifier without additional action from the host computer.

For the identifier, refer to **9.5.3 RKC Communication identifier list (P. 9-25)**.

When host computer determines to terminate the data link, EOT is sent from the host computer.
(7) **NAK (Negative acknowledge)**

If the host computer does not receive correct data from the controller, it sends a negative acknowledgment NAK to the controller. The controller will re-send the same data when NAK is received. This cycle will go on continuously until either recovery is achieved or the data link is corrected at the host computer.

(8) **No response from host computer**

When the host computer does not respond within approximately three seconds after the controller sends data, the controller sends EOT to terminate the data link. (Time out: 3 seconds)

(9) **Indefinite response from host computer**

The controller sends EOT to terminate the data link when the host computer response is indefinite.

(10) **EOT (Data link termination)**

The host computer sends EOT message when it is necessary to suspend communication with the controller or to terminate the data link due lack of response from the controller.
Polling procedure example (When the host computer requests data)

Normal transmission

(1) When the measured value (PV) monitor (identifier: M1) is polled

```
Host computer send
```

```
Address Identifier
```

```
Identifier Data
```

```
Controller send
```

```
To *1
```

```
```

(2) Polling the next identifier with ACK (acknowledgment) after polling ends

```
Host computer send
```

```
Address Identifier
```

```
Identifier Data
```

```
Controller send
```

```
To *1
```

```
```

*1
9. COMMUNICATION

- **Error transmission**

```
<table>
<thead>
<tr>
<th>Host computer send</th>
<th>Host computer send</th>
</tr>
</thead>
<tbody>
<tr>
<td>EOT 00 M1 E1 Q05H</td>
<td>NAK 15H</td>
</tr>
<tr>
<td>Address Identifier</td>
<td>Error data</td>
</tr>
<tr>
<td>STX 02H M1 0100 .0 ETX 03H</td>
<td></td>
</tr>
<tr>
<td>Identifier</td>
<td>Data</td>
</tr>
<tr>
<td>Controller send</td>
<td></td>
</tr>
<tr>
<td>To *1</td>
<td></td>
</tr>
</tbody>
</table>

```

```
<table>
<thead>
<tr>
<th>Controller re-send</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX 02H M1 0100 .0 ETX 03H</td>
</tr>
<tr>
<td>Identifier</td>
</tr>
<tr>
<td>Controller re-send</td>
</tr>
</tbody>
</table>

```

*1
9.4.2 Selecting

Selecting is the action where the host computer requests one of the connected controllers to receive data. An example of the selecting procedure is shown below:

### Selecting procedures

1. **Data link initialization**
   
   Host computer sends EOT to the controllers to initiate data link before selecting sequence.

2. **Sending selecting address from the host computer**
   
   Host computer sends selecting address for the selecting sequence.
   
   - **Address (2 digits)**
     
     This data is a device address of the controller to be selected and must be the same as the device address set value in item 9.3 Setting (P. 9-8).

     As long as the data link is not initialized by sending or receiving EOT, the selecting address once sent becomes validate.
(3) Data sent from the host computer

<table>
<thead>
<tr>
<th></th>
<th>1. Identifier</th>
<th>2. Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>STX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ETX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BCC</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the STX, ETX and BCC, refer to 9.4.1 Polling (P. 9-15).

1. Identifier (2 digits)
   The identifier specifies the type of data that is requested from the controller, such as set value.
   For the identifier, refer to 9.5.3 RKC Communication identifier list (P. 9-25).

2. Data
   Data which is indicated by an identifier of the controller is expressed in decimal ASCII code including a minus sign (-) and a decimal point. The channel number can be zero-suppressed.
   The number of digits varies depending on the type of identifier. (Within 6 digits)
   About numerical data

   Numerical data which the controller can receive
   • Data with numbers below the decimal point omitted or zero-suppressed data can be received.
     (Number of digits: Within 6 digits)
     <Example> When data send with −001.5, −01.5, −1.5, −1.50, −1.500 at the time of −1.5, controller can receive data.
   • When the host computer sends data containing a decimal point to an item without a decimal point, the controller receives a message rounded down to the nearest whole number.
     <Example> When setting range is 0 to 200, the controller will receive as follows:

     | Send data | 0.5 | 100.5 |
     | Receive data | 0 | 100 |

   • The controller receives the value based on the decided number of places after decimal point. Any number beyond the established number of decimal points will be cut off.
     <Example> When setting range is −10.0 to +10.0, the controller will receives as follows:

     | Send data | −.5 | −.05 | .5 | −0 | 0.0 |
     | Receive data | −0.5 | 0.0 | 0.5 | 0.0 | 0.0 |

   Numerical data which the controller can not receive
   When the host computer sends abnormal character data, the controller returns NAK as a response.
     <Example> Only minus sign (there is no figure)
     Only decimal point (period)
(4) **ACK (Acknowledgment)**
An acknowledgment ACK is sent by the controller when data received is correct. When the host computer receives ACK from the controller, the host computer will send any remaining data. If there is no more data to be sent to the controller, the host computer sends EOT to terminate the data link.

(5) **NAK (Negative acknowledge)**
If the controller does not receive correct data from the host computer, it sends a negative acknowledgment NAK to the host computer. Corrections, such as re-send, must be made at the host computer. The controller will send NAK in the following cases:
- When an error occurs on communication the line (parity, framing error, etc.)
- When a BCC check error occurs
- When the specified identifier is invalidated
- When receive data exceeds the setting range
- When receive data is the identifier of RO (read only)

(6) **No response from controller**
The controller does not respond when it cannot receive the selecting address, STX, ETX or BCC.

(7) **EOT (Data link termination)**
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the controller.
### Selecting procedure example (When the host computer sends the set values)

#### Normal transmission

- **Normal transmission**

  - **Host computer send**
    
    ![Normal Transmission Diagram](image)

  - **Controller send**

- **Error transmission**

  - **Error transmission**

  - **Host computer send**

    ![Error Transmission Diagram](image)

  - **Controller send**

  - **Error data**

  - **Host computer re-send**

    ![Error Re-send Diagram](image)

  - **Controller send**

  - **To *1**
### 9.4.3 RKC communication identifier list

#### Reference to RKC communication identifier list

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value (PV) monitor 1</td>
<td>M1</td>
<td>6</td>
<td>RO</td>
<td>0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Event 1 state monitor 2</td>
<td>AA</td>
<td>6</td>
<td>RO</td>
<td>0: Event 1 OFF 1: Event 1 ON</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Event 2 state monitor 3</td>
<td>AB</td>
<td>6</td>
<td>RO</td>
<td>0: Event 2 OFF 1: Event 2 ON</td>
<td>—</td>
</tr>
</tbody>
</table>

1. **Name:** Communication data name
2. **Identifier:** Communication identifier of RKC communication
3. **Digits:** The number of maximum digits
4. **Attribute:** A method of how communication data items are read or written when viewed from the host computer is described
   - RO: Read only data
   - R/W: Read and Write data
5. **Data range:** Read or write range of communication data
   - ASCII code data of 6 digits
     - Most significant digit
     - Least significant digit
6. **Factory set value:** Factory set value of communication data

---

**NOTE**
For details of data, refer to 8. PARAMETER DESCRIPTION (P. 8-1).

For data corresponding to No. 61 to 98, its attribute becomes RO (Only reading data is possible) during RUN (control). When setting data corresponding to No. 61 to 98, write the data after STOP (control stop) is selected.
## RKC communication identifier list

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value (PV)</td>
<td>M1</td>
<td>6</td>
<td>RO</td>
<td>0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Event 1 state monitor</td>
<td>AA</td>
<td>6</td>
<td>RO</td>
<td>0: Event 1 OFF 1: Event 1 ON</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Event 2 state monitor</td>
<td>AB</td>
<td>6</td>
<td>RO</td>
<td>0: Event 2 OFF 1: Event 2 ON</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Burnout state monitor</td>
<td>B1</td>
<td>6</td>
<td>RO</td>
<td>0: OFF 1: ON (burnout)</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>Error code</td>
<td>ER</td>
<td>6</td>
<td>RO</td>
<td>1: Adjustment data error 2: Data back-up error 4: A/D conversion error (Including temperature compensation error)</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>RUN/STOP transfer</td>
<td>SR</td>
<td>6</td>
<td>R/W</td>
<td>0: RUN 1: STOP</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Set value 1 (SV1)</td>
<td>S1</td>
<td>6</td>
<td>R/W</td>
<td>Setting limiter low to Setting limiter high</td>
<td>0.0</td>
</tr>
<tr>
<td>8</td>
<td>Event 1 set value (EV1)</td>
<td>A1</td>
<td>6</td>
<td>R/W</td>
<td>Deviation action: 199 (−199.9) to +Input span Input value or set value action: Input range low to Input range high</td>
<td>50.0</td>
</tr>
<tr>
<td>9</td>
<td>Event 2 set value (EV2)</td>
<td>A2</td>
<td>6</td>
<td>R/W</td>
<td>Deviation action: 199 (−199.9) to +Input span Input value or set value action: Input range low to Input range high</td>
<td>50.0</td>
</tr>
<tr>
<td>10</td>
<td>Control loop break alarm (LBA)</td>
<td>A5</td>
<td>6</td>
<td>R/W</td>
<td>0 to 999 seconds (0: Unused)</td>
<td>480</td>
</tr>
<tr>
<td>11</td>
<td>LBA deadband (LBD)</td>
<td>A6</td>
<td>6</td>
<td>R/W</td>
<td>0 (0.0) to Input span</td>
<td>0.0</td>
</tr>
</tbody>
</table>

1 Decimal point: Based on the setting of Decimal point position (Identifier: XU)
2 When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 1 type (identifier: XA).
3 When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 2 type (identifier: XB).
4 Data is invalidated if any of the following Event functions are selected:
   • Control loop break alarm (LBA)
   • FAIL
   • Monitor during RUN
   • Output of the communication monitoring result
   If any of the following Event functions are selected, this data will be Event□ set value (EV□) [high]. (□: 1 or 2)
   • Band (High/Low individual setting)
   • Deviation high/low (High/Low individual setting)
   • Deviation high/low with hold action (High/Low individual setting)
   • Deviation high/low with re-hold action (High/Low individual setting)
5 For the deviation action, input value action and set value action, refer to Event type (P. 8-74).
6 Control loop break alarm (LBA) must be selected as an Event function.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Autotuning (AT)</td>
<td>G1</td>
<td>6</td>
<td>R/W</td>
<td>0: PID control 1: AT start</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>Proportional band *</td>
<td>P1</td>
<td>6</td>
<td>R/W</td>
<td>1 (0.1) to Input span 0 (0.0): ON/OFF action</td>
<td>30.0</td>
</tr>
<tr>
<td>14</td>
<td>Integral time</td>
<td>I1</td>
<td>6</td>
<td>R/W</td>
<td>1 to 999 seconds (0: PD action)</td>
<td>240</td>
</tr>
<tr>
<td>15</td>
<td>Derivative time</td>
<td>D1</td>
<td>6</td>
<td>R/W</td>
<td>1 to 999 seconds (0: PI action)</td>
<td>60</td>
</tr>
<tr>
<td>16</td>
<td>Anti-reset windup (ARW)</td>
<td>W1</td>
<td>6</td>
<td>R/W</td>
<td>1 to 100 % of proportional band (0: Integral action is always OFF)</td>
<td>100</td>
</tr>
<tr>
<td>17</td>
<td>Proportional cycle time</td>
<td>T0</td>
<td>6</td>
<td>R/W</td>
<td>1 to 100 seconds</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>PV bias *</td>
<td>PB</td>
<td>6</td>
<td>R/W</td>
<td>−199 (−199.9) to +999 (+999.9) °C [°F]</td>
<td>0.0</td>
</tr>
<tr>
<td>19</td>
<td>Set lock level</td>
<td>LK</td>
<td>6</td>
<td>R/W</td>
<td>0: All parameter can be changed 1: Lock “Parameter Group” F01 through F10 2: Lock “Parameter Group” F02 through F10 3: Lock “Parameter Group” F03 through F10 4: Lock “Parameter Group” F04 through F10 5: Lock “Parameter Group” F05 through F10 6: Lock “Parameter Group” F06 through F10 7: Lock “Parameter Group” F07 through F10 8: Lock “Parameter Group” F08 through F10 9: Lock “Parameter Group” F09 through F10 10: Lock “Parameter Group” F10</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>EEPROM mode</td>
<td>EB</td>
<td>6</td>
<td>R/W</td>
<td>0: Backup mode 1: Buffer mode  Set values stored to the EEPROM when set values are changed.  No set values stored to the EEPROM when set values are changed.</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>EEPROM state</td>
<td>EM</td>
<td>6</td>
<td>RO</td>
<td>0: The content of the EEPROM does not coincide with that of the RAM. 1: The content of the EEPROM coincides with that of the RAM.</td>
<td>—</td>
</tr>
<tr>
<td>22</td>
<td>Interlock release</td>
<td>IR</td>
<td>6</td>
<td>R/W</td>
<td>To release the interlock, write “0 (zero).”</td>
<td>0</td>
</tr>
</tbody>
</table>

* Decimal point: Based on the setting of Decimal point position (Identifier: XU)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>Event 1 delay timer¹</td>
<td>TD</td>
<td>6</td>
<td>R/W</td>
<td>0 to 600 seconds Data can be written only in STOP mode.</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>Event 2 delay timer²</td>
<td>TG</td>
<td>6</td>
<td>R/W</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>Manipulated output value (MV) monitor³</td>
<td>QI</td>
<td>6</td>
<td>RO</td>
<td>−5 (−5.0) to +105 (+105.0) %</td>
<td>—</td>
</tr>
<tr>
<td>26</td>
<td>Manipulated output ON/OFF state monitor</td>
<td>QI</td>
<td>6</td>
<td>RO</td>
<td>0: Output OFF 1: Output ON</td>
<td>—</td>
</tr>
<tr>
<td>27</td>
<td>Model code</td>
<td>ID</td>
<td>32</td>
<td>RO</td>
<td>Model code (character)</td>
<td>—</td>
</tr>
<tr>
<td>28</td>
<td>ROM version monitor</td>
<td>VR</td>
<td>8</td>
<td>RO</td>
<td>ROM version</td>
<td>—</td>
</tr>
<tr>
<td>29</td>
<td>Comprehensive event state</td>
<td>AJ</td>
<td>6</td>
<td>RO</td>
<td>Least significant digit: Event 1 (EV1) 2nd digit: Event 2 (EV2) 3rd digit:</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Burnout 4th digit: Most significant digit: Unused Data 0: OFF 1: ON</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Output state monitor</td>
<td>Q3</td>
<td>6</td>
<td>RO</td>
<td>Least significant digit: Control output (OUT) 2nd digit: Digital output</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DO 3rd digit: Relay for Load power shut off 4th digit: Most significant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>digit: Unused Data 0: OFF 1: ON</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Set value (SV) display while the setting</td>
<td>MS</td>
<td>6</td>
<td>RO</td>
<td>Setting limiter low to Setting limiter high</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>change rate limiter is working³</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Operation mode state monitor</td>
<td>L0</td>
<td>6</td>
<td>RO</td>
<td>Least significant digit: STOP 2nd digit: RUN 3rd digit: Manual mode (During</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RUN 4th digit: SB link 5th digit: Unused Most significant digit: Maintenance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>mode Data 0: OFF 1: ON</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Actual SV selection number</td>
<td>LZ</td>
<td>6</td>
<td>RO</td>
<td>1 to 2</td>
<td>—</td>
</tr>
<tr>
<td>34</td>
<td>Auto (AUTO)/ Manual (MAN) transfer</td>
<td>J1</td>
<td>6</td>
<td>R/W</td>
<td>0: Auto (AUTO) mode 1: Manual (MAN) mode</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 1 type (identifier: XA).
² When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 2 type (identifier: XB).
³ Decimal point: Based on the setting of Decimal point position (Identifier: XU)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| 35  | Monitor selection (no display) | LP | 6 | R/W | 0 to 15 (Decimal) | Bit 0: Unused
Bit 1: Manipulated output value (MV) monitor and Manual manipulated output value (MV) at SV setting mode
Bit 2 to Bit 7: Unused
Data 0: Display 1: No display | 0 |
| 36  | Mode selection (no display) | LM | 6 | R/W | 0 to 255 (Decimal) | Bit 0: Auto (AUTO)/Manual (MAN) transfer
Bit 1: Set data unlock/lock transfer
Bit 2: Interlock release
Bit 3: Disable <R/S key operation
Bit 4 to Bit 6: Unused
Bit 7: Displays F21 and after
Data 0: OFF (Display)
1: ON (No display) | 0 |
| 37  | Set value 2 (SV2) | S2 | 6 | R/W | Setting limiter low to Setting limiter high | 0 |
| 38  | SV selection | ZB | 6 | R/W | 1 to 2 | 1 |
| 39  | F01 block selection (no display) | DA | 6 | R/W | 0: Display
1: No display | 1 |
| 40  | Setting change rate limiter (up) | HH | 6 | R/W | 0 (0.0) to Input span (Unit: °C [°F])/unit time | 0.0 |
| 41  | Setting change rate limiter (down) | HL | 6 | R/W | 0 (0.0) to Input span (Unit: °C [°F])/unit time | 0.0 |
| 42  | F03 block selection (no display) | DL | 6 | R/W | 0: Display
1: No display | 1 |
| 43  | Event 1 set value (EV1) [low] | BT | 6 | R/W | Deviation action:
−199 (−199.9) to +Input span | −50.0 |
| 44  | Event 2 set value (EV2) [low] | BU | 6 | R/W | Input value or set value action:
Input range low to Input range high | −50.0 |

1 Set the bit data after converting it to decimal.
2 Decimal point: Based on the setting of Decimal point position (Identifier: XU)
3 When the Digital output (DO) is not provided, this data is invalidated.
The data is also invalidated when “0: None” is set for Event 1 type (identifier: XB).
4 Data is validated if any of the following Event functions are selected:
   • Band (High/Low individual setting)
   • Deviation high/low (High/Low individual setting)
   • Deviation high/low with hold action (High/Low individual setting)
   • Deviation high/low with re-hold action (High/Low individual setting)
5 When the Digital output (DO) is not provided, this data is invalidated.
The data is also invalidated when “0: None” is set for Event 2 type (identifier: XB).
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>F04 block selection (no display) 1</td>
<td>DM</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>0</td>
</tr>
<tr>
<td>46</td>
<td>Startup tuning (ST)</td>
<td>ST</td>
<td>6</td>
<td>R/W</td>
<td>0: ST unused 1: Execute once * * When the Startup tuning (ST) is finished, the setting will automatically returns to “0: ST unused.” 2: Execute always</td>
<td>0</td>
</tr>
<tr>
<td>47</td>
<td>F05 block selection (no display)</td>
<td>DN</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>0</td>
</tr>
<tr>
<td>48</td>
<td>Fine tuning setting</td>
<td>CB</td>
<td>6</td>
<td>R/W</td>
<td>−3 to +3 (0: Unused)</td>
<td>0</td>
</tr>
<tr>
<td>49</td>
<td>F06 block selection (no display)</td>
<td>DO</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>F07 block selection (no display) 2</td>
<td>DQ</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>0</td>
</tr>
<tr>
<td>51</td>
<td>Minimum ON/OFF time of proportioning cycle</td>
<td>VI</td>
<td>6</td>
<td>R/W</td>
<td>0 to 999 ms</td>
<td>0</td>
</tr>
<tr>
<td>52</td>
<td>Output limiter high 3</td>
<td>OH</td>
<td>6</td>
<td>R/W</td>
<td>Output limiter low to 105 (105.0) %</td>
<td>105.0</td>
</tr>
<tr>
<td>53</td>
<td>Output limiter low 3</td>
<td>OL</td>
<td>6</td>
<td>R/W</td>
<td>−5 to −5.0 % to Output limiter high (Output limiter high &gt; Output limiter low)</td>
<td>−5.0</td>
</tr>
<tr>
<td>54</td>
<td>F08 block selection (no display)</td>
<td>DR</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>0</td>
</tr>
<tr>
<td>55</td>
<td>PV digital filter</td>
<td>F1</td>
<td>6</td>
<td>R/W</td>
<td>0 to 100 seconds (0: Unused)</td>
<td>1</td>
</tr>
<tr>
<td>56</td>
<td>F09 block selection (no display)</td>
<td>DS</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>0</td>
</tr>
<tr>
<td>57</td>
<td>Manual manipulated output value (MV) 3</td>
<td>ON</td>
<td>6</td>
<td>R/W</td>
<td>Output limiter low to Output limiter high</td>
<td>0.0</td>
</tr>
<tr>
<td>58</td>
<td>F10 block selection (no display)</td>
<td>DT</td>
<td>6</td>
<td>R/W</td>
<td>0: Display 1: No display</td>
<td>1</td>
</tr>
<tr>
<td>59</td>
<td>Holding peak value ambient temperature monitor</td>
<td>HP</td>
<td>6</td>
<td>RO</td>
<td>−10 to +100 °C [14 to 212 °F]</td>
<td>—</td>
</tr>
<tr>
<td>60</td>
<td>Integrated operating time monitor</td>
<td>UT</td>
<td>6</td>
<td>RO</td>
<td>0 to 9999 hours</td>
<td>—</td>
</tr>
</tbody>
</table>

1 When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 2 type (identifier: XB).

2 Data is invalidated in the following cases:
- When Event 1 type (identifier: XA) and Event 2 type (identifier: XB) are all set to “0: None.”
- When any of Event 1 type (identifier: XA) or Event 2 type (identifier: XB) is not set to “Control loop break alarm (LBA).”

3 Decimal point: Based on the setting of Decimal point position (Identifier: XU)
### NOTE

Write the following data after you have switched to STOP (control stop).

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>Input type</td>
<td>XI</td>
<td>6</td>
<td>R/W</td>
<td>0: K (0 to 800 °C)</td>
<td>Based on model code</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3: J (0 to 800 °C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15: Pt100 (0 to 400 °C)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17: K (0 to 999 °F)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19: J (0 to 999 °F)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31: Pt100 (0 to 800 °F)</td>
<td></td>
</tr>
<tr>
<td>62</td>
<td>Decimal point position</td>
<td>XU</td>
<td>6</td>
<td>R/W</td>
<td>0: Without decimal point for communication</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: With decimal point for communication (the tenths place)</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Input scale high ¹</td>
<td>XV</td>
<td>6</td>
<td>R/W</td>
<td>Input scale low to Maximum value of the selected input range</td>
<td>Maximum value of the selected input range</td>
</tr>
<tr>
<td>64</td>
<td>Input scale low ¹</td>
<td>XW</td>
<td>6</td>
<td>R/W</td>
<td>Minimum value of the selected input range to Input scale high</td>
<td>Minimum value of the selected input range</td>
</tr>
<tr>
<td>65</td>
<td>Setting limiter high ¹</td>
<td>SH</td>
<td>6</td>
<td>R/W</td>
<td>Setting limiter low to Input scale high</td>
<td>Input scale high</td>
</tr>
<tr>
<td>66</td>
<td>Setting limiter low ¹</td>
<td>SL</td>
<td>6</td>
<td>R/W</td>
<td>Input scale low to Setting limiter high</td>
<td>Input scale low</td>
</tr>
<tr>
<td>67</td>
<td>PV flashing display</td>
<td>DU</td>
<td>6</td>
<td>R/W</td>
<td>0: Flashing</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: Non-flashing display</td>
<td></td>
</tr>
<tr>
<td>68</td>
<td>DI assignment ²</td>
<td>H2</td>
<td>6</td>
<td>R/W</td>
<td>0: Unused (No DI assignment)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: SV selection function (SV1/SV2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact open: SV1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact closed: SV2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2: RUN/STOP transfer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact open: STOP</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact closed: RUN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3: Auto/Manual transfer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact open: Manual (MAN) mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Contact closed: Auto (AUTO) mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4: Interlock release</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Interlock is released at the time of contact status change (from open to close) by edge monitoring.</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>Output action at STOP mode ³</td>
<td>SS</td>
<td>6</td>
<td>R/W</td>
<td>0: Event output is OFF</td>
<td>0</td>
</tr>
</tbody>
</table>

¹ Decimal point: Based on the setting of Decimal point position (Identifier: XU)
² Communication and Digital input (DI) cannot be used at the same time. When Digital input (DI) is used, only read/write is available by loader communication.
³ This parameter is invalidated when a Digital output (DO) or Event function is unused.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>Event 1 type</td>
<td>XA</td>
<td>6</td>
<td>R/W</td>
<td>0 to 23 Refer to Event type table (P. 9-35).</td>
<td>Based on model code</td>
</tr>
</tbody>
</table>
| 71  | Event 1 hold action         | WA         | 6      | R/W       | 0: OFF  
1: Hold action ON (When power turned on; when transferred from STOP to RUN)  
2: Re-hold action ON (When power turned on; when transferred from STOP to RUN; SV changed) | Based on model code |
| 72  | Event 1 differential gap    | HA         | 6      | R/W       | 0 to Input span | 2 |
| 73  | Event 1 output action at input burnout | OA | 6 | R/W | 0: Event output is not forcibly turned ON when the burnout function is activated.  
1: ON at over-scale; no action at underscale  
2: ON at underscale; no action at over-scale  
3: ON at over-scale or underscale  
4: OFF at over-scale or underscale | 0 |
| 74  | Energized/De-energized of DO | ZI         | 6      | R/W       | 0: Energized  
1: De-energized | 0 |
| 75  | Event 1 interlock           | LF         | 6      | R/W       | 0: Unused (OFF)  
1: Used | 0 |
| 76  | Event 2 type                | XB         | 6      | R/W       | 0 to 23 Refer to Event type table (P. 9-35). | Based on model code |
| 77  | Event 2 hold action         | WB         | 6      | R/W       | 0: OFF  
1: Hold action ON (When power turned on; when transferred from STOP to RUN)  
2: Re-hold action ON (When power turned on; when transferred from STOP to RUN; SV changed) | Based on model code |
| 78  | Event 2 differential gap    | HB         | 6      | R/W       | 0 to Input span | 2 |

1 When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 1 type (identifier: XA).

2 Decimal point: Based on the setting of Decimal point position (Identifier: XU)

3 This parameter is invalidated when a Digital output (DO) or Event function is unused.

4 When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 2 type (identifier: XB).
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
</table>
| 79  | Event 2 output action at input burnout ¹                              | OB         | 6      | R/W       | 0: Event output is not forcibly turned ON when the burnout function is activated.  
1: ON at over-scale; no action at underscale  
2: ON at underscale; no action at over-scale  
3: ON at over-scale or underscale  
4: OFF at over-scale or underscale | 0        |
| 80  | Event 2 interlock ¹                                                   | LG         | 6      | R/W       | 0: Unused (OFF)  
1: Used | 0        |
| 81  | ON/OFF action differential gap (upper) ²                             | IV         | 6      | R/W       | 0 (0.0) to 100 (100.0) °C [°F] | 1.0    |
| 82  | ON/OFF action differential gap (lower) ²                             | IW         | 6      | R/W       | 0 to 100 (0.0) to 100 (100.0) °C [°F] | 1.0    |
| 83  | Control output at burnout                                            | WH         | 6      | R/W       | 0: Result of control computation  
1: Output limiter low (Output OFF) | 0        |
| 84  | Bumpless mode setting                                                | OT         | 6      | R/W       | 0: Without bumpless  
1: With bumpless | 1        |
| 85  | Derivative action                                                    | KA         | 6      | R/W       | 0: Measured value derivative  
1: Deviation derivative | 0        |
| 86  | AT cycles                                                            | G3         | 6      | R/W       | 0: 1.5 cycles  
1: 2.5 cycles | 0        |
| 87  | AT differential gap time                                             | GH         | 6      | R/W       | 0 to 50 seconds | 10     |
| 88  | ST start condition                                                   | SU         | 6      | R/W       | 0: Activate the ST function when the power is turned on; when transferred from STOP to RUN; or when the Set value (SV) is changed.  
1: Activate the ST function when the power is turned on; or when transferred from STOP to RUN.  
2: Activate the ST function when the Set value (SV) is changed. | 0        |
| 89  | Setting change rate limiter unit time                                | HU         | 6      | R/W       | 0: Minute  
1: Hours | 0        |
| 90  | Control action at Event ³                                             | LU         | 6      | R/W       | 0: Action based on control computation  
1: Control output OFF (−5 %) at Event 1  
2: Control output OFF (−5 %) at Event 2  
3: Control output OFF (−5 %) at Event 1 or Event 2  
4: Control output OFF (−5 %) at Event 1 and Event 2 | 0        |

¹ When the Digital output (DO) is not provided, this data is invalidated.  
The data is also invalidated when “0: None” is set for Event 2 type (identifier: XB).  
² Decimal point: Based on the setting of Decimal point position (Identifier: XU)  
³ This parameter is invalidated when a Digital output (DO) or Event function is unused.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Identifier</th>
<th>Digits</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>91</td>
<td>Load power shutoff function</td>
<td>HZ</td>
<td>6</td>
<td>R/W</td>
<td>0: Relay for Load power shutoff opens at FAIL (Restores when FAIL is resolved.) 1: Relay for Load power shutoff opens at FAIL or LBA (FAIL state or LBA state remains) 2: Relay for Load power shutoff opens at FAIL or LBA (Returns to the normal state when FAIL state or LBA state recovers.)</td>
<td>0</td>
</tr>
<tr>
<td>92</td>
<td>Event output ¹</td>
<td>E1</td>
<td>6</td>
<td>R/W</td>
<td>0: Event output full-time OFF 1: Event output ON at Event 1 2: Event output ON at Event 2 3: Event output ON at Event 1 or Event 2 4: Event output ON at Event 1 and Event 2</td>
<td>3</td>
</tr>
<tr>
<td>93</td>
<td>Maintenance mode switching</td>
<td>ZZ</td>
<td>6</td>
<td>R/W</td>
<td>0: Normal operation mode 1: Maintenance mode</td>
<td>0</td>
</tr>
<tr>
<td>94</td>
<td>Power saving mode setting</td>
<td>DI</td>
<td>6</td>
<td>R/W</td>
<td>0 to 60 minutes (0: Always ON)</td>
<td>0</td>
</tr>
<tr>
<td>95</td>
<td>Burnout status monitoring delay</td>
<td>IB</td>
<td>6</td>
<td>R/W</td>
<td>0 to 10 times (Number of input sampling cycle)</td>
<td>0</td>
</tr>
<tr>
<td>96</td>
<td>SB link selection ²</td>
<td>C0</td>
<td>6</td>
<td>R/W</td>
<td>0: Without SB link function 1: With SB link function</td>
<td>0</td>
</tr>
<tr>
<td>97</td>
<td>Intragroup address ²</td>
<td>G0</td>
<td>6</td>
<td>R/W</td>
<td>0: Intragroup address 1 (Master) 1: Intragroup address 2 2: Intragroup address 3 3: Intragroup address 4</td>
<td>0</td>
</tr>
<tr>
<td>98</td>
<td>Control action at SB link error ²</td>
<td>QM</td>
<td>6</td>
<td>R/W</td>
<td>0: Continues output by control computation 1: Turns off output (−5 %) when an error is detected once. 2: Turns off output (−5 %) when an error is detected twice. 3: Turns off output (−5 %) when an error is detected three times. 4: Turns off output (−5 %) when an error is detected four times. 5: Turns off output (−5 %) when an error is detected five times.</td>
<td>2</td>
</tr>
</tbody>
</table>

¹ This parameter is invalidated when a Digital output (DO) or Event function is unused.
² Communication is invalidated when using the SB link function. Parameters related to SB link can only be read/write on the loader communication.
### Event type table

<table>
<thead>
<tr>
<th>Set value</th>
<th>Event type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>1</td>
<td>Deviation high (Using SV monitor value)</td>
</tr>
<tr>
<td>2</td>
<td>Deviation low (Using SV monitor value)</td>
</tr>
<tr>
<td>3</td>
<td>Deviation high/low (Using SV monitor value)</td>
</tr>
<tr>
<td>4</td>
<td>Band (Using SV monitor value)</td>
</tr>
<tr>
<td>5</td>
<td>Deviation high/low (Using SV monitor value) [High/Low individual setting]</td>
</tr>
<tr>
<td>6</td>
<td>Band (Using SV monitor value) [High/Low individual setting]</td>
</tr>
<tr>
<td>7</td>
<td>SV high (Using SV monitor value)</td>
</tr>
<tr>
<td>8</td>
<td>SV low (Using SV monitor value)</td>
</tr>
<tr>
<td>9</td>
<td>SV high</td>
</tr>
<tr>
<td>10</td>
<td>SV low</td>
</tr>
<tr>
<td>11</td>
<td>Control loop break alarm (LBA)</td>
</tr>
<tr>
<td>12</td>
<td>Monitor during RUN</td>
</tr>
<tr>
<td>13</td>
<td>FAIL (Fixed at de-energized; Contact open when error occurs)</td>
</tr>
<tr>
<td>14</td>
<td>Deviation high (Using local SV)</td>
</tr>
<tr>
<td>15</td>
<td>Deviation low (Using local SV)</td>
</tr>
<tr>
<td>16</td>
<td>Deviation high/low (Using local SV)</td>
</tr>
<tr>
<td>17</td>
<td>Band (Using local SV)</td>
</tr>
<tr>
<td>18</td>
<td>Deviation high/low (Using local SV) [High/Low individual setting]</td>
</tr>
<tr>
<td>19</td>
<td>Band (Using local SV) [High/Low individual setting]</td>
</tr>
<tr>
<td>20</td>
<td>SV high (Using local SV)</td>
</tr>
<tr>
<td>21</td>
<td>SV low (Using local SV)</td>
</tr>
<tr>
<td>22</td>
<td>Unused</td>
</tr>
<tr>
<td>23</td>
<td>Output of the communication monitoring result</td>
</tr>
<tr>
<td></td>
<td>(Event signal is turned on when communication is not properly made for 10 seconds.)</td>
</tr>
</tbody>
</table>

1 This alarm function can add the hold action or re-hold action.
2 This alarm function can add a hold action.
3 Precautions for Control loop break alarm (LBA) setting:
   - The control loop break alarm (LBA) function cannot be activated when AT function is turned on.
   - Normally the control loop break alarm (LBA) time of parameter setting mode should be set to approximately twice the integral time.
   - If the LBA time is too short or does not match the controlled object requirements, LBA may turn ON or OFF at inappropriate time or remain OFF. Change the LBA time based on the malfunction.
9. COMMUNICATION

9.5 Modbus Communication Protocol

The master controls communication between master and slave. A typical message consists of a request (query message) sent from the master followed by an answer (response message) from the slave. When master begins data transmission, a set of data is sent to the slave in a fixed sequence. When it is received, the slave decodes it, takes the necessary action, and returns data to the master.

9.5.1 Message format

The message consists of four parts: slave address, function code, data, and error check code which are always transmitted in the same sequence.

<table>
<thead>
<tr>
<th>Slave address</th>
<th>Function code</th>
<th>Data</th>
<th>Error check CRC-16</th>
</tr>
</thead>
</table>

Message format

- **Slave address**
  
The slave address is a number from 1 to 99 manually set at the front key panel of the controller.
  
  For details, refer to 9.3. Setting (P. 9-8).
  
  Although all connected slave units receive the query message sent from the master, only the slave with the slave address coinciding with the query message will accept the message.

- **Function code**
  
The function codes are the instructions set at the master and sent to the slave describing the action to be executed. The function codes are included when the slave responds to the master.
  
  For details, refer to 9.5.2 Function code (P. 9-37).

- **Data**
  
The data to execute the function specified by the function code is sent to the slave and corresponding data returned to the master from the slave.
  
  For details, refer to 9.5.6 Register read and write (P. 9-42), 9.6.7 Caution for handling communication data (P. 9-45) and 9.5.8 Modbus communication data list (P. 9-46).

- **Error check**
  
  An error checking code (CRC-16: Cyclic Redundancy Check) is used to detect an error in the signal transmission.
  
  For details, refer to 9.5.5 Calculating CRC-16 (P. 9-39).
9.5.2 Function code

Function code contents

<table>
<thead>
<tr>
<th>Function code (Hexadecimal)</th>
<th>Function</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>03H</td>
<td>Read holding registers</td>
<td>Measured value (PV), Event status and Monitor, etc.</td>
</tr>
<tr>
<td>06H</td>
<td>Preset single register</td>
<td>Set value (SV), Event set value, PID constants and PV bias, etc.</td>
</tr>
<tr>
<td>08H</td>
<td>Diagnostics (loopback test)</td>
<td>Loopback test</td>
</tr>
</tbody>
</table>

Message length of each function (Unit: byte)

<table>
<thead>
<tr>
<th>Function code (Hexadecimal)</th>
<th>Function</th>
<th>Query message</th>
<th>Response message</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>03H</td>
<td>Read holding registers</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>06H</td>
<td>Preset single register</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>08H</td>
<td>Diagnostics (loopback test)</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

9.5.3 Communication mode

Signal transmission between the master and slaves is conducted in Remote Terminal Unit (RTU) mode.

<table>
<thead>
<tr>
<th>Items</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data bit length</td>
<td>8-bit (Binary)</td>
</tr>
<tr>
<td>Start mark of message</td>
<td>Unused</td>
</tr>
<tr>
<td>End mark of message</td>
<td>Unused</td>
</tr>
<tr>
<td>Message length</td>
<td>Refer to 9.5.2 Function code.</td>
</tr>
<tr>
<td>Data time interval</td>
<td>Less than 24-bit time *</td>
</tr>
<tr>
<td>Error check</td>
<td>CRC-16 (Cyclic Redundancy Check)</td>
</tr>
</tbody>
</table>

* When sending a command message from the master, set intervals of data configuring one message to time shorter than the 24-bit time. If time intervals become time longer than the 24-bit time the relevant slave assumes that message sending from the master is terminated and there is no response.
9.5.4 Slave responses

(1) Normal response

- In the response message of the Read Holding Registers, the slave returns the read out data and the number of data items with the same slave address and function code as the query message.
- In the response message of the Preset Single Register, the slave returns the same message as the query message.
- In the response message of the Diagnostics (Loopback test), the slave returns the same message as the query message.

(2) Defective message response

- If the query message from the master is defective, except for transmission error, the slave returns the error response message without any action.

<table>
<thead>
<tr>
<th>Slave address</th>
<th>Function code</th>
<th>Error code</th>
<th>Error check (CRC-16)</th>
</tr>
</thead>
</table>

- If the self-diagnostic function of the slave detects an error, the slave will return an error response message to all query messages.
- The function code of each error response message is obtained by adding 80H to the function code of the query message.

<table>
<thead>
<tr>
<th>Error code</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Function code error (An unsupported function code was specified)</td>
</tr>
<tr>
<td>2</td>
<td>When the mismatched address is specified.</td>
</tr>
</tbody>
</table>
| 3          | • When the specified number of data items in the query message exceeds the maximum number of data items available  
          | • When the data written exceeds the setting range |

(3) No response

The slave ignores the query message and does not respond when:

- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity and etc., is found in the query message.
- Data time interval in the query message from the master exceeds 24-bit time.
9.5.5 Calculating CRC-16

The Cyclic Redundancy Check (CRC) is a 2 byte (16-bit) error check code. After constructing the data message, not including start, stop, or parity bit, the master calculates a CRC code and appends this to the end of the message. The slave will calculate a CRC code from the received message, and compare it with the CRC code from the master. If they do not coincide, a communication error has occurred and the slave does not respond.

The CRC code is formed in the following sequence:

1. Load FFFFH to a 16-bit CRC register.
2. Exclusive OR (⊕) the first byte (8 bits) of the message with the CRC register. Return the result to the CRC register.
3. Shift the CRC register 1 bit to the right.
4. If the carry flag is 1, exclusive OR the CRC register with A001 hexadecimal and return the result to the CRC register. If the carry flag is 0, repeat step 3.
5. Repeat step 3 and 4 until there have been 8 shifts.
6. Exclusive OR the next byte (8 bits) of the message with the CRC register.
7. Repeat step 3 through 6 for all bytes of the message (except the CRC).
8. The CRC register contains the 2 byte CRC error code. When they are appended to the message, the low-order byte is appended first, followed by the high-order byte.
The flow chart of CRC-16

- **START**
  - FFFFH → CRC Register
  - CRC Register ⊕ next byte of the message → CRC Register
  - 0 → n
  - Shift CRC Register right 1 bit
  - Carry flag is 1
    - Yes
      - CRC Register ⊕ A001H → CRC Register
      - n + 1 → n
    - No
      - n > 7
        - Yes
          - Is message complete?
            - No
              - Reverse with high-order byte and low-order byte of CRC register
            - Yes
              - END
        - No
          - Carry flag is 1

Note: The ⊕ symbol indicates an *exclusive OR* operation. The symbol for the number of data bits is *n*. 
Example of a CRC calculation in the ‘C’ language

This routine assumes that the data types ‘uint16’ and ‘uint8’ exists. Theses are unsigned 16-bit integer (usually an ‘unsigned short int’ for most compiler types) and unsigned 8-bit integer (unsigned char). ‘z_p’ is a pointer to a Modbus message, and ‘z_message_length’ is its length, excluding the CRC. Note that the Modbus message will probably contain NULL characters and so normal C string handling techniques will not work.

```c
uint16 calculate_crc (byte *z_p, unit16 z_message_length)
{
    uint16 CRC= 0xffff;
    uint16 next;
    uint16 carry;
    uint16 n;
    uint8 crch, crcl;

    while (z_message_length--) {
        next = (uint16) *z_p;
        CRC ^= next;
        for (n = 0; n < 8; n++) {
            carry = CRC & 1;
            CRC >>= 1;
            if (carry) {
                CRC ^= 0xA001;
            }
        }
        z_p++;
    }
    crch = CRC / 256;
    crcl = CRC % 256
    z_p[z_message_length++] = crcl;
    z_p[z_message_length] = crch;
    return CRC;
}
```

9.5.6 Register read and write

**Read holding registers [03H]**

The query message specifies the starting register address and quantity of registers to be read. The contents of the holding registers are entered in the response message as data, divided into two parts: the high-order 8-bit and the low-order 8-bit, arranged in the order of the register numbers.

Example: The contents of the four holding registers from 0000H [Measured value (PV) monitor] to 0003H [Event 1 state monitor] are read out from slave address 2.

**Query message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Starting No.</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>00H</td>
</tr>
<tr>
<td>Quantity</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>04H</td>
</tr>
<tr>
<td>CRC-16</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>44H</td>
</tr>
<tr>
<td>Low</td>
<td>3AH</td>
</tr>
</tbody>
</table>

**Normal response message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>03H</td>
</tr>
<tr>
<td>Number of data</td>
<td>08H</td>
</tr>
<tr>
<td>First holding register contents</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>19H</td>
</tr>
<tr>
<td>Next holding register contents</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>00H</td>
</tr>
<tr>
<td>Next holding register contents</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>00H</td>
</tr>
<tr>
<td>Next holding register contents</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>00H</td>
</tr>
<tr>
<td>Low</td>
<td>00H</td>
</tr>
<tr>
<td>CRC-16</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>12H</td>
</tr>
<tr>
<td>Low</td>
<td>52H</td>
</tr>
</tbody>
</table>

**Error response message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>02H</th>
</tr>
</thead>
<tbody>
<tr>
<td>80H + Function code</td>
<td>83H</td>
</tr>
<tr>
<td>Error code</td>
<td>03H</td>
</tr>
<tr>
<td>CRC-16</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>F1H</td>
</tr>
<tr>
<td>Low</td>
<td>31H</td>
</tr>
</tbody>
</table>
Preset single register [06H]

The query message specifies data to be written into the designated holding register. The write data is arranged in the query message with high-order 8-bit first and low-order 8-bit next. Only R/W holding registers can be specified.

Example: Data is written into the holding register 0006H [Set value 1 (SV1)] of slave address 1

**Query message**

<table>
<thead>
<tr>
<th><em>slave address</em></th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Function code</em></td>
<td>06H</td>
</tr>
<tr>
<td><em>Holding register number</em></td>
<td>High 00H, Low 06H</td>
</tr>
<tr>
<td><em>Write data</em></td>
<td>High 00H, Low 32H</td>
</tr>
<tr>
<td><em>CRC-16</em></td>
<td>High E8H, Low 1EH</td>
</tr>
</tbody>
</table>

**Normal response message**

<table>
<thead>
<tr>
<th><em>slave address</em></th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Function code</em></td>
<td>06H</td>
</tr>
<tr>
<td><em>Holding register number</em></td>
<td>High 00H, Low 06H</td>
</tr>
<tr>
<td><em>Write data</em></td>
<td>High 00H, Low 32H</td>
</tr>
<tr>
<td><em>CRC-16</em></td>
<td>High E8H, Low 1EH</td>
</tr>
</tbody>
</table>

**Error response message**

<table>
<thead>
<tr>
<th><em>slave address</em></th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>80H + Function code</em></td>
<td>86H</td>
</tr>
<tr>
<td><em>Error code</em></td>
<td>02H</td>
</tr>
<tr>
<td><em>CRC-16</em></td>
<td>High C3H, Low A1H</td>
</tr>
</tbody>
</table>

Any data within the range

Contents will be the same as query message data.
Diagnostics (Loopback test) [08H]

The master’s query message will be returned as the response message from the slave. This function checks the communication system between the master and slave (the controller).

Example: Loopback test for slave address 1

**Query message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>08H</td>
</tr>
<tr>
<td>Test code</td>
<td>High 00H</td>
</tr>
<tr>
<td></td>
<td>Low 00H</td>
</tr>
<tr>
<td>Data</td>
<td>High 1FH</td>
</tr>
<tr>
<td></td>
<td>Low 34H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High E9H</td>
</tr>
<tr>
<td></td>
<td>Low ECH</td>
</tr>
</tbody>
</table>

Test code must be set to 00. Any pertinent data

**Normal response message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function code</td>
<td>08H</td>
</tr>
<tr>
<td>Test code</td>
<td>High 00H</td>
</tr>
<tr>
<td></td>
<td>Low 00H</td>
</tr>
<tr>
<td>Data</td>
<td>High 1FH</td>
</tr>
<tr>
<td></td>
<td>Low 34H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High E9H</td>
</tr>
<tr>
<td></td>
<td>Low ECH</td>
</tr>
</tbody>
</table>

Contents will be the same as query message data.

**Error response message**

<table>
<thead>
<tr>
<th>Slave address</th>
<th>01H</th>
</tr>
</thead>
<tbody>
<tr>
<td>80H + Function code</td>
<td>88H</td>
</tr>
<tr>
<td>Error code</td>
<td>03H</td>
</tr>
<tr>
<td>CRC-16</td>
<td>High 06H</td>
</tr>
<tr>
<td></td>
<td>Low 01H</td>
</tr>
</tbody>
</table>
9.5.7 Caution for handling communication data

- The numeric range of data used in Modbus protocol is 0000H to FFFFH. Only the set value within the setting range is effective.
  - FFFFH represents -1.

- The Modbus protocol does not recognize data with decimal points during communication.

  Example: When Manipulated output value (MV) monitor is 5.0 %,
  
  \[
  5.0 \text{ is processed as } 50, \\
  50 = 0032H
  \]

- If data (holding register) exceeding the accessible address range is accessed, an error response message is returned.

- Read data of unused item is a default value.

- Any attempt to write to an unused item is not processed as an error. Data cannot be written into an unused item.

- An attribute of the item for functions which are not in the controller is RO (read only). If read action to this item is performed, the read data will be “0.” If write action to this item is performed, no error message is indicated and no data is written.

- Commands should be sent at time intervals of 24 bits after the master receives the response message.
9. COMMUNICATION

9.5.8 Modbus communication data list

- Reference to Modbus communication identifier list

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value (PV) monitor</td>
<td>0000 0</td>
<td>RO</td>
<td>0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Unused</td>
<td>0001 1</td>
<td>RO</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Unused</td>
<td>0002 2</td>
<td>RO</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Event 1 state monitor</td>
<td>0003 3</td>
<td>RO</td>
<td>0: Event 1 OFF 1: Event 1 ON</td>
<td>—</td>
</tr>
</tbody>
</table>

(1) Name: Communication data name

(2) Register address: Modbus communication data register addresses
HEX: Hexadecimal
DEC: Decimal

(3) Attribute: A method of how communication data items are read or written when viewed from the host computer is described.
RO: Only reading data is possible.

Host computer  Data direction  Controller
R/W: Reading and writing data is possible.

Host computer  Data direction  Controller

(4) Data range: Read or write range of communication data

- Bit data

- 8-bit data

(5) Factory set value: Factory set value of communication data

For details of data, refer to 8. PARAMETER DESCRIPTION (P. 8-1).

NOTE
For data corresponding to No. 79 to 130, its attribute becomes RO (Only reading data is possible) during RUN (control). When setting data corresponding to No. 79 to 130, write the data after STOP (control stop) is selected.
### Modbus communication data list

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Measured value (PV) monitor(^1)</td>
<td>0000</td>
<td>RO</td>
<td>0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Unused</td>
<td>0001</td>
<td>RO</td>
<td>Read: 0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Unused</td>
<td>0002</td>
<td>RO</td>
<td>Write: Not allowed</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Event 1 state monitor(^2)</td>
<td>0003</td>
<td>RO</td>
<td>0: Event 1 OFF 1: Event 1 ON</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Event 2 state monitor(^3)</td>
<td>0004</td>
<td>RO</td>
<td>0: Event 2 OFF 1: Event 2 ON</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Burnout state monitor</td>
<td>0005</td>
<td>RO</td>
<td>0: OFF 1: ON (burnout)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Set value 1 (SV1)(^1)</td>
<td>0006</td>
<td>R/W</td>
<td>Setting limiter low to Setting limiter high</td>
<td>0</td>
</tr>
</tbody>
</table>
| 8   | Event 1 set value (EV1)\(^1, 2, 4, 5, 6\) | 0007             | R/W       | Deviation action: −199 (−199.9) to +Input span  
Input value or set value action: Same as input range | 50.0              |
| 9   | Event 2 set value (EV2)\(^1, 3, 4, 5, 6\) | 0008             | R/W       | Deviation action: −199 (−199.9) to +Input span  
Input value or set value action: Same as input range | 50.0              |
| 10  | Unused                                    | 0009             | R/W       | Read/Write: 0                                                               |                   |
| 11  | Unused                                    | 000A             | R/W       |                                                                       |                   |
| 12  | Control loop break alarm (LBA)\(^7, 8\)   | 000B             | R/W       | 0 to 999 seconds (0: Unused)                                              | 480               |
| 13  | LBA deadband (LBD)\(^1, 7, 8\)            | 000C             | R/W       | 0 to Input span                                                            | 0                 |

\(^1\) Decimal point: Based on the setting of Decimal point position (Register address: 0062H)

\(^2\) When the Digital output (DO) is not provided, this data is invalidated.  
The data is also invalid when “0: None” is set for Event 1 type (Register address: 0070H).

\(^3\) When the Digital output (DO) is not provided, this data is invalidated.  
The data is also invalid when “0: None” is set for Event 2 type (Register address: 0077H).

\(^4\) Data is invalidated if any of the following Event functions are selected:  
- Control loop break alarm (LBA)
- FAIL
- Monitor during RUN
- Output of the communication monitoring result

\(^5\) If any of the following Event functions are selected, this data will be Event\(^\bullet\) set value (EV\(^\bullet\)) [high].  
(\(\bullet\): 1 or 2)  
- Band (High/Low individual setting)
- Deviation high/low (High/Low individual setting)
- Deviation high/low with hold action (High/Low individual setting)
- Deviation high/low with re-hold action (High/Low individual setting)

\(^6\) For the deviation action, input value action and set value action, refer to Event type (P. 8-74).

\(^7\) When the Digital output (DO) is not provided, this data is invalidated.

\(^8\) Control loop break alarm (LBA) must be selected as an Event function.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Autotuning (AT)</td>
<td>000D</td>
<td>R/W</td>
<td>0: PID control 1: AT start</td>
</tr>
<tr>
<td>15</td>
<td>Unused</td>
<td>000E</td>
<td>R/W Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>16</td>
<td>Proportional band *</td>
<td>000F</td>
<td>R/W</td>
<td>1 (0.1) to Input span 0 (0.0): ON/OFF action</td>
</tr>
<tr>
<td>17</td>
<td>Integral time</td>
<td>0010</td>
<td>R/W</td>
<td>1 to 999 seconds (0: PD action)</td>
</tr>
<tr>
<td>18</td>
<td>Derivative time</td>
<td>0011</td>
<td>R/W</td>
<td>1 to 999 seconds (0: PI action)</td>
</tr>
<tr>
<td>19</td>
<td>Anti-reset windup (ARW)</td>
<td>0012</td>
<td>R/W</td>
<td>1 to 100 % of proportional band (0: Integral action is always OFF)</td>
</tr>
<tr>
<td>20</td>
<td>Proportional cycle time</td>
<td>0013</td>
<td>R/W</td>
<td>1 to 100 seconds</td>
</tr>
<tr>
<td>21</td>
<td>Unused</td>
<td>0014</td>
<td>R/W Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>22</td>
<td>Unused</td>
<td>0015</td>
<td>R/W</td>
<td>—</td>
</tr>
<tr>
<td>23</td>
<td>Unused</td>
<td>0016</td>
<td>R/W</td>
<td>—</td>
</tr>
<tr>
<td>24</td>
<td>PV bias *</td>
<td>0017</td>
<td>R/W</td>
<td>−199 (−199.9) to +999 (+999.9) °C [°F]</td>
</tr>
<tr>
<td>25</td>
<td>Set lock level</td>
<td>0018</td>
<td>R/W</td>
<td>0: All parameter can be changed 1: Lock “Parameter Group” F01 through F10 2: Lock “Parameter Group” F02 through F10 3: Lock “Parameter Group” F03 through F10 4: Lock “Parameter Group” F04 through F10 5: Lock “Parameter Group” F05 through F10 6: Lock “Parameter Group” F06 through F10 7: Lock “Parameter Group” F07 through F10 8: Lock “Parameter Group” F08 through F10 9: Lock “Parameter Group” F09 through F10 10: Lock “Parameter Group” F10</td>
</tr>
<tr>
<td>26</td>
<td>RUN/STOP transfer</td>
<td>0019</td>
<td>R/W</td>
<td>0: RUN 1: STOP</td>
</tr>
<tr>
<td>27</td>
<td>Unused</td>
<td>001A</td>
<td>R/W Read/Write: 0</td>
<td>—</td>
</tr>
</tbody>
</table>

* Decimal point: Based on the setting of Decimal point position (Register address: 0062H)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>EEPROM mode</td>
<td>001B 27</td>
<td>R/W</td>
<td>0: Backup mode&lt;br&gt;Set values stored to the EEPROM when set values are changed.&lt;br&gt;1: Buffer mode&lt;br&gt;No set values stored to the EEPROM when set values are changed.</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>EEPROM state</td>
<td>001C 28</td>
<td>RO</td>
<td>0: The content of the EEPROM does not coincide with that of the RAM.&lt;br&gt;1: The content of the EEPROM coincides with that of the RAM.</td>
<td>—</td>
</tr>
<tr>
<td>30</td>
<td>Manipulated output value (MV) monitor</td>
<td>001D 29</td>
<td>RO</td>
<td>~5 (~5.0) to +105 (+105.0) %</td>
<td>—</td>
</tr>
<tr>
<td>31</td>
<td>Unused</td>
<td>001E 30</td>
<td>RO</td>
<td>0: The content of the EEPROM does not coincide with that of the RAM.&lt;br&gt;1: The content of the EEPROM coincides with that of the RAM.</td>
<td>—</td>
</tr>
<tr>
<td>32</td>
<td>Unused</td>
<td>001F 31</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>33</td>
<td>Manipulated output ON/OFF state monitor</td>
<td>002D 45</td>
<td>RO</td>
<td>0: Output OFF&lt;br&gt;1: Output ON</td>
<td>—</td>
</tr>
<tr>
<td>34</td>
<td>Unused</td>
<td>002E 46</td>
<td>RO</td>
<td>Read: 0&lt;br&gt;Write: Not allowed</td>
<td>—</td>
</tr>
<tr>
<td>35</td>
<td>Comprehensive event state</td>
<td>002F 47</td>
<td>RO</td>
<td>Bit data&lt;br&gt;Bit 0: Event 1 (EV1)&lt;br&gt;Bit 1: Event 2 (EV2)&lt;br&gt;Bit 2: Burnout&lt;br&gt;Bit 3 to Bit 7: Unused&lt;br&gt;Data 0: OFF 1: ON&lt;br&gt;[Decimal number: 0 to 7]</td>
<td>—</td>
</tr>
<tr>
<td>36</td>
<td>Unused</td>
<td>0030 48</td>
<td>RO</td>
<td>Read: 0&lt;br&gt;Write: Not allowed</td>
<td>—</td>
</tr>
<tr>
<td>37</td>
<td>Output state monitor</td>
<td>0031 49</td>
<td>RO</td>
<td>Bit data&lt;br&gt;Bit 0: Control output (OUT)&lt;br&gt;Bit 1: Digital output (DO)&lt;br&gt;Bit 2: Relay for Load power shutoff&lt;br&gt;Bit 3 to Bit 7: Unused&lt;br&gt;Data 0: OFF 1: ON&lt;br&gt;[Decimal number: 0 to 15]</td>
<td>—</td>
</tr>
<tr>
<td>38</td>
<td>Set value (SV) display while the setting change rate limiter is working *</td>
<td>0032 50</td>
<td>RO</td>
<td>Setting limiter low to Setting limiter high</td>
<td>—</td>
</tr>
<tr>
<td>39</td>
<td>Unused</td>
<td>0033 51</td>
<td>RO</td>
<td>Read: 0</td>
<td>—</td>
</tr>
<tr>
<td>40</td>
<td>Unused</td>
<td>0034 52</td>
<td>RO</td>
<td>Write: Not allowed</td>
<td>—</td>
</tr>
<tr>
<td>41</td>
<td>Unused</td>
<td>0035 53</td>
<td>RO</td>
<td></td>
<td>—</td>
</tr>
</tbody>
</table>

* Decimal point: Based on the setting of Decimal point position (Register address: 0062H)
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>Error code</td>
<td>0036</td>
<td>RO</td>
<td>Bit data Bit 0: Adjustment data error Bit 1: Data back-up error Bit 2: A/D conversion error (Including temperature compensation error) Bit 3 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 7]</td>
<td>—</td>
</tr>
<tr>
<td>43</td>
<td>Operation mode state monitor</td>
<td>0037</td>
<td>RO</td>
<td>Bit data Bit 0: STOP Bit 1: RUN Bit 2: Manual mode (During RUN) Bit 3: SB link Bit 4: Unused Bit 5: Maintenance mode Bit 6 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 47]</td>
<td>—</td>
</tr>
<tr>
<td>44</td>
<td>Actual SV selection number</td>
<td>0038</td>
<td>RO</td>
<td>1 to 2</td>
<td>—</td>
</tr>
<tr>
<td>45</td>
<td>Auto (AUTO)/Manual (MAN) transfer</td>
<td>0039</td>
<td>R/W</td>
<td>0: Auto (AUTO) mode 1: Manual (MAN) mode</td>
<td>0</td>
</tr>
<tr>
<td>46</td>
<td>Interlock release</td>
<td>003A</td>
<td>R/W</td>
<td>To release the interlock, write “0 (zero).”</td>
<td>0</td>
</tr>
<tr>
<td>47</td>
<td>Monitor selection (no display)</td>
<td>003B</td>
<td>R/W</td>
<td>Bit data Bit 0: Unused Bit 1: Manipulated output value (MV) monitor and Manual manipulated output value (MV) at SV setting mode Bit 2 to Bit 7: Unused Data 0: OFF (Display) 1: ON (No display) [Decimal number: 0 to 15]</td>
<td>0</td>
</tr>
<tr>
<td>48</td>
<td>Mode selection (no display)</td>
<td>003C</td>
<td>R/W</td>
<td>Bit data Bit 0: Auto (AUTO)/Manual (MAN) transfer Bit 1: Set data unlock/lock transfer Bit 2: Interlock release Bit 3: Disable &lt;R/S key operation Bit 4 to Bit 6: Unused Bit 7: Displays F21 and after Data 0: OFF (Display) 1: ON (No display) [Decimal number: 0 to 143]</td>
<td>0</td>
</tr>
</tbody>
</table>
### 9. COMMUNICATION

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>49</td>
<td>Set value 2 (SV2) &lt;sup&gt;1&lt;/sup&gt;</td>
<td>003D</td>
<td>R/W</td>
<td>Setting limiter low to Setting limiter high</td>
<td>0</td>
</tr>
<tr>
<td>50</td>
<td>Unused</td>
<td>003E</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>51</td>
<td>Unused</td>
<td>003F</td>
<td>R/W</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>52</td>
<td>SV selection</td>
<td>0040</td>
<td>R/W</td>
<td>1 to 2</td>
<td>1</td>
</tr>
<tr>
<td>53</td>
<td>F01 block selection (no display)</td>
<td>0041</td>
<td>R/W</td>
<td>0: Display</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Unused</td>
<td>0042</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>55</td>
<td>Setting change rate limiter (up)</td>
<td>0049</td>
<td>R/W</td>
<td>0 (0.0) to Input span (Unit: °C [°F])/unit time</td>
<td>0.0</td>
</tr>
<tr>
<td>56</td>
<td>Setting change rate limiter (down)</td>
<td>004A</td>
<td>R/W</td>
<td></td>
<td>0.0</td>
</tr>
<tr>
<td>57</td>
<td>F03 block selection (no display)</td>
<td>004B</td>
<td>R/W</td>
<td>0: Display</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
<tr>
<td>58</td>
<td>Event 1 set value (EV1’) [low] &lt;sup&gt;1,2,3&lt;/sup&gt;</td>
<td>004C</td>
<td>R/W</td>
<td>Deviation action: -199 (~199.9) to +Input span</td>
<td>-50.0</td>
</tr>
<tr>
<td>59</td>
<td>Event 2 set value (EV2’) [low] &lt;sup&gt;1,3,4&lt;/sup&gt;</td>
<td>004D</td>
<td>R/W</td>
<td>Input value or set value action: Input range low to Input range high</td>
<td>-50.0</td>
</tr>
<tr>
<td>60</td>
<td>Unused</td>
<td>004E</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>61</td>
<td>Unused</td>
<td>004F</td>
<td>R/W</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>62</td>
<td>Unused</td>
<td>0050</td>
<td>R/W</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>63</td>
<td>Unused</td>
<td>0051</td>
<td>R/W</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>64</td>
<td>F04 block selection (no display) &lt;sup&gt;5&lt;/sup&gt;</td>
<td>0052</td>
<td>R/W</td>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> Decimal point: Based on the setting of Decimal point position (Register address: 0062H)

<sup>2</sup> When the Digital output (DO) is not provided, this data is invalidated.

The data is also invalidated when “0: None” is set for Event 1 type (Register address: 0070H).

<sup>3</sup> Data is validated if any of the following Event functions are selected:

- Band (High/Low individual setting)
- Deviation high/low (High/Low individual setting)
- Deviation high/low with hold action (High/Low individual setting)
- Deviation high/low with re-hold action (High/Low individual setting)

<sup>4</sup> When the Digital output (DO) is not provided, this data is invalidated.

The data is also invalidated when “0: None” is set for Event 2 type (Register address: 0077H).

<sup>5</sup> Data is invalidated in the following cases:

- When the Digital output (DO) is not provided
- When Event 1 type (Register address: 0070H) and Event 2 type (Register address: 0077H) are all set to “0: None.”
- When Event 1 type (Register address: 0070H) and Event 2 type (Register address: 0077H) are set to the Event functions “Control loop break alarm (LBA),” “FAIL,” “Monitor during RUN,” and “Output of the communication monitoring result.”
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>Startup tuning (ST)</td>
<td>0053</td>
<td>R/W</td>
<td>0: ST unused</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: Execute once *</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>* When the Startup tuning (ST) is finished, the setting will automatically returns to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>“0: ST unused.”</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2: Execute always</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>F05 block selection (no display)</td>
<td>0054</td>
<td>R/W</td>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
<tr>
<td>67</td>
<td>Fine tuning setting</td>
<td>0055</td>
<td>R/W</td>
<td>−3 to +3 (0: Unused)</td>
<td>0</td>
</tr>
<tr>
<td>68</td>
<td>F06 block selection (no display)</td>
<td>0056</td>
<td>R/W</td>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
<tr>
<td>69</td>
<td>F07 block selection (no display)</td>
<td>0057</td>
<td>R/W</td>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>Minimum ON/OFF time of proportioning cycle</td>
<td>0058</td>
<td>R/W</td>
<td>0 to 999 ms</td>
<td>0</td>
</tr>
<tr>
<td>71</td>
<td>Output limiter high^2</td>
<td>0059</td>
<td>R/W</td>
<td>Output limiter low to 105 (105.0) %</td>
<td>105.0</td>
</tr>
<tr>
<td>72</td>
<td>Output limiter low^2</td>
<td>005A</td>
<td>R/W</td>
<td>−5 (−5.0) % to Output limiter high (Output limiter high &gt; Output limiter low)</td>
<td>−5.0</td>
</tr>
<tr>
<td>73</td>
<td>Unused</td>
<td>005B</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>74</td>
<td>F08 block selection (no display)</td>
<td>005C</td>
<td>R/W</td>
<td>0: Display</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>PV digital filter</td>
<td>005D</td>
<td>R/W</td>
<td>0 to 100 seconds (0: Unused)</td>
<td>1</td>
</tr>
<tr>
<td>76</td>
<td>F09 block selection (no display)</td>
<td>005E</td>
<td>R/W</td>
<td>0: Display</td>
<td>0</td>
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<td>1: No display</td>
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</tr>
<tr>
<td>77</td>
<td>Manual manipulated output value (MV)^2</td>
<td>005F</td>
<td>R/W</td>
<td>Output limiter low to Output limiter high</td>
<td>0.0</td>
</tr>
<tr>
<td>78</td>
<td>F10 block selection (no display)</td>
<td>0060</td>
<td>R/W</td>
<td>0: Display</td>
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<td></td>
<td></td>
<td></td>
<td>1: No display</td>
<td></td>
</tr>
</tbody>
</table>

Data is invalidated in the following cases:
- When Event 1 type (Register address: 0070H) and Event 2 type (Register address: 0077H) are all set to “0: None.”
- When any of Event 1 type (Register address: 0070H) or Event 2 type (Register address: 0077H) is not set to “Control loop break alarm (LBA).”

Decimal point: Based on the setting of Decimal point position (Register address: 0062H)
NOTE

Write the following data after you have switched to STOP (control stop).

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>79</td>
<td>Input type</td>
<td>0061 Preset</td>
<td>R/W</td>
<td>0: K (0 to 800 °C) 3: J (0 to 800 °C) 15: Pt100 (0 to 400 °C) 17: K (0 to 999 °F) 19: J (0 to 999 °F) 31: Pt100 (0 to 800 °F)</td>
<td>Based on model code</td>
</tr>
<tr>
<td>80</td>
<td>Decimal point position</td>
<td>0062 Preset</td>
<td>R/W</td>
<td>0: Without decimal point for communication 1: With decimal point for communication (the tenths place)</td>
<td>1</td>
</tr>
<tr>
<td>81</td>
<td>Unused</td>
<td>0063 Preset</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>82</td>
<td>Input scale high¹</td>
<td>0064 Preset</td>
<td>R/W</td>
<td>Input scale low to Maximum value of the selected input range</td>
<td>Maximum value of the selected input range</td>
</tr>
<tr>
<td>83</td>
<td>Input scale low¹</td>
<td>0065 Preset</td>
<td>R/W</td>
<td>Minimum value of the selected input range to Input scale high</td>
<td>Minimum value of the selected input range</td>
</tr>
<tr>
<td>84</td>
<td>Setting limiter high¹</td>
<td>0066 Preset</td>
<td>R/W</td>
<td>Setting limiter low to Input scale high</td>
<td>Input scale high</td>
</tr>
<tr>
<td>85</td>
<td>Setting limiter low¹</td>
<td>0067 Preset</td>
<td>R/W</td>
<td>Input scale low to Setting limiter high</td>
<td>Input scale low</td>
</tr>
<tr>
<td>86</td>
<td>PV flashing display</td>
<td>0068 Preset</td>
<td>R/W</td>
<td>0: Flashing 1: Non-flashing display</td>
<td>0</td>
</tr>
<tr>
<td>87</td>
<td>Unused</td>
<td>0069 Preset</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>88</td>
<td>Output action at STOP mode²</td>
<td>006APreset</td>
<td>R/W</td>
<td>0: Event output is OFF 1: Event output remains unchanged</td>
<td>0</td>
</tr>
<tr>
<td>89</td>
<td>Unused</td>
<td>006BPreset</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>90</td>
<td>Event 1 type¹</td>
<td>0070 Preset</td>
<td>R/W</td>
<td>0 to 23 Refer to Event type table (P. 9-35)</td>
<td>Based on model code</td>
</tr>
<tr>
<td>91</td>
<td>Event 1 hold action¹</td>
<td>0071 Preset</td>
<td>R/W</td>
<td>0: OFF 1: Hold action ON (When power turned on; when transferred from STOP to RUN) 2: Re-hold action ON (When power turned on; when transferred from STOP to RUN; SV changed)</td>
<td>Based on model code</td>
</tr>
</tbody>
</table>

¹ Decimal point: Based on the setting of Decimal point position (Register address: 0062H)
² This parameter is invalidated when a Digital output (DO) or Event function is unused.
³ When the Digital output (DO) is not provided, this data is invalidated.
The data is also invalidated when “0: None” is set for Event 1 type (Register address: 0070H).
### 9. COMMUNICATION

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>92</td>
<td>Event 1 differential gap ¹,²</td>
<td>0072</td>
<td>114</td>
<td>R/W 0 to Input span</td>
<td>2</td>
</tr>
</tbody>
</table>
| 93  | Event 1 output action at input burnout ³   | 0073             | 115       | R/W 0: Event output is not forcibly turned ON when the burnout function is activated.  
1: ON at over-scale; no action at underscale  
2: ON at underscale; no action at over-scale  
3: ON at over-scale or underscale  
4: OFF at over-scale or underscale | 0                 |
| 94  | Energized/De-energized of DO ³            | 0074             | 116       | R/W 0: Energized  
1: De-energized | 0                 |
| 95  | Event 1 delay timer ²                      | 0075             | 117       | R/W 0 to 600 seconds                                                      | 0                 |
| 96  | Event 1 interlock ²                        | 0076             | 118       | R/W 0: Unused (OFF)  
1: Used | 0                 |
| 97  | Event 2 type ⁴                             | 0077             | 119       | R/W 0 to 23  
Refer to Event type table (P. 9-35) | Based on model code |
| 98  | Event 2 hold action ²                      | 0078             | 120       | R/W 0: OFF  
1: Hold action ON  
(When power turned on; when transferred from STOP to RUN)  
2: Re-hold action ON  
(When power turned on; when transferred from STOP to RUN; SV changed) | Based on model code |
| 99  | Event 2 differential gap ¹,⁴               | 0079             | 121       | R/W 0 to Input span                                                       | 2                 |
| 100 | Event 2 output action at input burnout ⁴   | 007A             | 122       | R/W 0: Event output is not forcibly turned ON when the burnout function is activated.  
1: ON at over-scale; no action at underscale  
2: ON at underscale; no action at over-scale  
3: ON at over-scale or underscale  
4: OFF at over-scale or underscale | 0                 |
| 101 | Unused                                    | 007B             | 123       | R/W Read/Write: 0                                                         | —                 |
| 102 | Event 2 delay timer ²                      | 007C             | 124       | R/W 0 to 600 seconds                                                      | 0                 |

¹ Decimal point: Based on the setting of Decimal point position (Register address: 0062H)
² When the Digital output (DO) is not provided, this data is invalidated.
   The data is also invalidated when “0: None” is set for Event 1 type (Register address: 0070H).
³ This parameter is invalidated when a Digital output (DO) or Event function is unused.
⁴ When the Digital output (DO) is not provided, this data is invalidated.
   The data is also invalidated when “0: None” is set for Event 2 type (Register address: 0077H).
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>103</td>
<td>Event 2 interlock&lt;sup&gt;1&lt;/sup&gt;</td>
<td>007D 125</td>
<td>R/W</td>
<td>0: Unused (OFF) 1: Used</td>
<td>0</td>
</tr>
<tr>
<td>104</td>
<td>Unused</td>
<td>007E 126</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>105</td>
<td>ON/OFF action differential gap (upper)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0090 144</td>
<td>R/W</td>
<td>0 (0.0) to 100 (100.0) °C [°F]</td>
<td>1.0</td>
</tr>
<tr>
<td>106</td>
<td>ON/OFF action differential gap (lower)&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0091 145</td>
<td>R/W</td>
<td>0 (0.0) to 100 (100.0) °C [°F]</td>
<td>1.0</td>
</tr>
<tr>
<td>107</td>
<td>Control output at burnout</td>
<td>0092 146</td>
<td>R/W</td>
<td>0: Result of control computation 1: Output limiter low (Output OFF)</td>
<td>0</td>
</tr>
<tr>
<td>108</td>
<td>Bumpless mode setting</td>
<td>0093 147</td>
<td>R/W</td>
<td>0: Without bumpless 1: With bumpless</td>
<td>1</td>
</tr>
<tr>
<td>109</td>
<td>Derivative action</td>
<td>0094 148</td>
<td>R/W</td>
<td>0: Measured value derivative 1: Deviation derivative</td>
<td>0</td>
</tr>
<tr>
<td>110</td>
<td>AT cycles</td>
<td>0095 149</td>
<td>R/W</td>
<td>0: 1.5 cycles 1: 2.5 cycles</td>
<td>0</td>
</tr>
<tr>
<td>111</td>
<td>AT differential gap time</td>
<td>0096 150</td>
<td>R/W</td>
<td>0 to 50 seconds</td>
<td>10</td>
</tr>
<tr>
<td>112</td>
<td>ST start condition</td>
<td>0097 151</td>
<td>R/W</td>
<td>0: Activate the ST function when the power is turned on; when transferred from STOP to RUN; or when the Set value (SV) is changed. 1: Activate the ST function when the power is turned on; or when transferred from STOP to RUN. 2: Activate the ST function when the Set value (SV) is changed.</td>
<td>0</td>
</tr>
<tr>
<td>113</td>
<td>Setting change rate limiter unit time</td>
<td>0098 152</td>
<td>R/W</td>
<td>0: Minute 1: Hours</td>
<td>0</td>
</tr>
<tr>
<td>114</td>
<td>Unused</td>
<td>0099 153</td>
<td>R/W</td>
<td>Read/Write: 0</td>
<td>—</td>
</tr>
<tr>
<td>115</td>
<td>Control action at Event&lt;sup&gt;3&lt;/sup&gt;</td>
<td>00A2 162</td>
<td>R/W</td>
<td>0: Action based on control computation 1: Control output OFF (−5 %) at Event 1 2: Control output OFF (−5 %) at Event 2 3: Control output OFF (−5 %) at Event 1 or Event 2 4: Control output OFF (−5 %) at Event 1 and Event 2</td>
<td>0</td>
</tr>
</tbody>
</table>

<sup>1</sup> When the Digital output (DO) is not provided, this data is invalidated. The data is also invalidated when “0: None” is set for Event 2 type (Register address: 0077H).

<sup>2</sup> Decimal point: Based on the setting of Decimal point position (Register address: 0062H)

<sup>3</sup> This parameter is invalidated when a Digital output (DO) or Event function is unused.
<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Register address</th>
<th>Attribute</th>
<th>Data range</th>
<th>Factory set value</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>Load power shutoff function</td>
<td>00A3</td>
<td>R/W</td>
<td>0: Relay for Load power shutoff opens at FAIL (Restores when FAIL is resolved.)&lt;br&gt;1: Relay for Load power shutoff opens at FAIL or LBA (FAIL state or LBA state remains)&lt;br&gt;2: Relay for Load power shutoff opens at FAIL or LBA (Returns to the normal state when FAIL state or LBA state recovers.)</td>
<td>0</td>
</tr>
<tr>
<td>117</td>
<td>Event output *</td>
<td>00A4</td>
<td>R/W</td>
<td>0: Event output full-time OFF&lt;br&gt;1: Event output ON at Event 1&lt;br&gt;2: Event output ON at Event 2&lt;br&gt;3: Event output ON at Event 1 or Event 2&lt;br&gt;4: Event output ON at Event 1 and Event 2</td>
<td>3</td>
</tr>
<tr>
<td>118</td>
<td>Unused</td>
<td>00A5</td>
<td>R/W</td>
<td>Read/Write: 0</td>
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</tr>
<tr>
<td>119</td>
<td>Unused</td>
<td>00A6</td>
<td>R/W</td>
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</tr>
<tr>
<td>120</td>
<td>Unused</td>
<td>00A7</td>
<td>R/W</td>
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<tr>
<td>121</td>
<td>Unused</td>
<td>00A8</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>122</td>
<td>Unused</td>
<td>00A9</td>
<td>R/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>Maintenance mode switching</td>
<td>00AA</td>
<td>R/W</td>
<td>0: Normal operation mode&lt;br&gt;1: Maintenance mode</td>
<td>0</td>
</tr>
<tr>
<td>124</td>
<td>Power saving mode setting</td>
<td>00AB</td>
<td>R/W</td>
<td>0 to 60 minutes&lt;br&gt;(0: Always ON)</td>
<td>0</td>
</tr>
<tr>
<td>125</td>
<td>Burnout status monitoring delay</td>
<td>00AC</td>
<td>R/W</td>
<td>0 to 10 times&lt;br&gt;(Number of input sampling cycle)</td>
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<tr>
<td>126</td>
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<td>00AD</td>
<td>R/W</td>
<td>Read/Write: 0</td>
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<tr>
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<td>R/W</td>
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<tr>
<td>128</td>
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<td>00AF</td>
<td>R/W</td>
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<td>Unused</td>
<td>00B1</td>
<td>R/W</td>
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</tr>
</tbody>
</table>

* This parameter is invalidated when a Digital output (DO) or Event function is unused.
### 9.6 ASCII 7-Bit Code Table

This table is only for use with RKC communication.

<table>
<thead>
<tr>
<th>b7</th>
<th>b6</th>
<th>b5</th>
<th>b4</th>
<th>b3</th>
<th>b2</th>
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</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>9</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>A</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>B</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>C</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>D</td>
<td>14</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>E</td>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASCII 7-Bit Code Table</th>
<th>Character</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NUL</td>
</tr>
<tr>
<td>1</td>
<td>DLE</td>
</tr>
<tr>
<td>2</td>
<td>SP</td>
</tr>
<tr>
<td>3</td>
<td>@</td>
</tr>
<tr>
<td>4</td>
<td>P</td>
</tr>
<tr>
<td>5</td>
<td>SOH</td>
</tr>
<tr>
<td>6</td>
<td>DC1</td>
</tr>
<tr>
<td>7</td>
<td>STX</td>
</tr>
<tr>
<td>8</td>
<td>ETX</td>
</tr>
<tr>
<td>9</td>
<td>EOT</td>
</tr>
<tr>
<td>10</td>
<td>ENQ</td>
</tr>
<tr>
<td>11</td>
<td>ACK</td>
</tr>
<tr>
<td>12</td>
<td>BEL</td>
</tr>
<tr>
<td>13</td>
<td>BS</td>
</tr>
<tr>
<td>14</td>
<td>CAN</td>
</tr>
<tr>
<td>15</td>
<td>LF</td>
</tr>
<tr>
<td>16</td>
<td>VT</td>
</tr>
<tr>
<td>17</td>
<td>FF</td>
</tr>
<tr>
<td>18</td>
<td>CR</td>
</tr>
<tr>
<td>19</td>
<td>SI</td>
</tr>
</tbody>
</table>
This chapter describes error displays and procedures to follow when problems occur.

10.1 Error Display ........................................................................................................ 10-2
10.2 Solutions for Problems ....................................................................................... 10-5
This Section describes error display when the Measured value (PV) exceeds the display range and the self-diagnostic error.

### Display when input error occurs

The table below shows displays, description, control actions and solutions when the Measured value (PV) exceeds the display range.

**NOTE**

Prior to replacing the sensor, always turn the power OFF or change to STOP with RUN/STOP transfer.

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Action (Output)</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured value (PV) [Flashing]</td>
<td>Measured value (PV) exceeds the input range. Display does not flash when “Non-flashing display” is set.</td>
<td>Control output: Output depending on the “Control output at burnout” (Refer to P. 8-95)</td>
<td>Check Input type, Input range and connecting state of sensor. Confirm that the sensor or wire is not broken.</td>
</tr>
<tr>
<td>OOO [Flashing]</td>
<td>Over-scale Measured value (PV) is above the display range limit high.</td>
<td>Event output: Output depending on the “Event output state at input burnout” (Refer to P. 8-85)</td>
<td></td>
</tr>
<tr>
<td>UUU [Flashing]</td>
<td>Underscale Measured value (PV) is below the display range limit low.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* “PV flashing display” (P. 8-70) of PV can be selected for the PV flashing display at input error of the Engineering mode (F21).
## Self-diagnostic error

When the instrument is in Self-diagnostic error, the character “Err” and error number will display in turn. If two or more errors occur simultaneously, the total summation of these error codes is displayed.

<table>
<thead>
<tr>
<th>Error number</th>
<th>Description</th>
<th>Action</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Adjusted data error&lt;br&gt;- Adjusted data range is abnormal.</td>
<td>Display: Displays “Err” and error number alternately.&lt;br&gt;Control output: Output of −5%</td>
<td>Turn off the power at once.&lt;br&gt;If the SB1 is restored to normal after the power is turned on again, then probable cause may be external noise source affecting the control system. Check for the external noise source. If an error occurs after the power is turned on again, the SB1 must be repaired or replaced. Please contact RKC sales office or the agent.</td>
</tr>
<tr>
<td>2</td>
<td>Data backup error&lt;br&gt;- Error occurs to backup data.</td>
<td>Control output: Output of −5%&lt;br&gt;Relay for Load power shutoff: Contact open&lt;br&gt;FAIL output: Contact open&lt;br&gt;[When FAIL is selected for the Event (EV)] Communication: Displays error number relevant to the readout value of the error code(s).</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>A/D conversion error&lt;br&gt;- Response signal from A/D converter is abnormal.&lt;br&gt;Temperature compensation error&lt;br&gt;- Temperature measuring range (+100 °C or more, −20 °C or less) is abnormal.</td>
<td>Control output: Output of −5%&lt;br&gt;Relay for Load power shutoff: Contact open&lt;br&gt;FAIL output: Contact open&lt;br&gt;[When FAIL is selected for the Event (EV)] Communication: Displays error number relevant to the readout value of the error code(s).</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>SB link error&lt;br&gt;- Error occurs in communication between controllers. (At SB link)&lt;br&gt;[Master side] When the Master controller does not continuously receive a returned Loopback test message from the Slave controller(s) for the number of times selected at Control action at SB link error or if the content of the returned message is abnormal&lt;br&gt;[Slave side] When the Slave controller does not continuously receive the Broadcast signal (synchronizing signal) from the Master controller for the number of times selected at Control action at SB link error.</td>
<td>Display: Displays “Err” and error number alternately.&lt;br&gt;Control output: Continue control/Stop control is selectable.&lt;br&gt;Relay for Load power shutoff: Start-up condition is selectable.&lt;br&gt;FAIL output: Contact open&lt;br&gt;[When FAIL is selected for the Event (EV)] Communication: Readout value of the error code: 16</td>
<td>Error state recovers by solving causes (such as breaking of communication line).</td>
</tr>
</tbody>
</table>

---

1 Event type can be specified at Event type 1 at F41 or Event type 2 at F42 in the Engineering mode.
2 Control action at SB link error can be specified at Control action at SB link error at F81 in the Engineering mode.
3 Load power shutoff function can be specified at Load power shutoff function at F46 in the Engineering mode.
If any of the following errors occur, all action of the SB1 is stopped.
In this case the error number is not displayed.

<table>
<thead>
<tr>
<th>Description</th>
<th>Action</th>
<th>Solution</th>
</tr>
</thead>
</table>
| Power supply voltage is abnormal (power supply voltage monitoring) | Display: All display is OFF  
Control output: Output of −5%  
Relay for Load power shutoff: Contact open  
FAIL output: Contact open  
[When FAIL is selected for the Event (EV)]  
Communication: No response | The SB1 must be repaired or replaced. Please contact RKC sales office or the agent. |
| Watchdog timer                                   |                                                                       |                                                                          |
| • The part of an internal program stops the action. |                                                                       |                                                                          |

1 Event type can be specified at Event type 1 at F41 or Event type 2 at F42 in the Engineering mode.
10.2 Solutions for Problems

This section explains probable causes and solutions if any abnormality occurs in the instrument. For any inquiries or to confirm the specifications of the product, please contact RKC sales office or the agent.

If it is necessary to replace a device, always strictly observe the warnings below.

⚠️ WARNING

- To prevent electric shock or instrument failure, always turn off the system power before replacing the instrument.
- To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.
- To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.
- To prevent electric shock or instrument failure, do not touch the inside of the instrument.
- All wiring must be performed by authorized personnel with electrical experience in this type of work.

⚠️ CAUTION

All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. 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.
10. TROUBLESHOOTING

## Display

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No display appears</td>
<td>Power supply terminal connection not correct.</td>
<td>Connect the terminals correctly by referring to 3.3 Terminal Layout (P. 3-5).</td>
</tr>
<tr>
<td></td>
<td>Power supply terminal contact defect.</td>
<td>Reconnect the connectors properly.</td>
</tr>
<tr>
<td></td>
<td>Proper power supply voltage is not being supplied.</td>
<td>Apply the normal power supply by referring to 11. SPECIFICATIONS (P. 11-1).</td>
</tr>
<tr>
<td>Display is abnormal</td>
<td>Noise source is present near the instrument.</td>
<td>Separate the noise source from the instrument.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Set the appropriate digital filter according to the responding control systems.</td>
</tr>
<tr>
<td></td>
<td>The terminal board on the instrument using the thermocouple is directly exposed to the air from an air conditioner.</td>
<td>Do not directly expose the terminal board to the air from the air conditioner.</td>
</tr>
<tr>
<td>Measured value (PV) display differs from the actual value</td>
<td>Proper sensor is not being used.</td>
<td>Use the specified sensor.</td>
</tr>
<tr>
<td></td>
<td>The PV bias is set.</td>
<td>Set the PV bias to “0 (0.0)” by referring to PV bias (P. 8-28). However, this is limited only to when the PV bias setting can be changed.</td>
</tr>
</tbody>
</table>

如何检查输入功能是否正常工作。

- 当控制器配置为热电偶输入时：
  短接输入端子 No. 2 和 No. 3 以测得输入/控制输出连接器。如果控制器测得的值在输入端子周围的环境温度范围内，输入功能正常。
- 当控制器配置为RTD输入时：
  连接一个100 Ω电阻器在输入端子 No. 1 和 No. 2 之间，然后短接输入端子 No. 2 和 No. 3 以测得输入/控制输出连接器。如果控制器测得的值在0 °C（32 °F）范围内，输入功能正常。
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control is abnormal</td>
<td>Proper power supply voltage is not being supplied.</td>
<td>Apply the normal power supply by referring to <strong>11. SPECIFICATIONS</strong> (<em>P. 11-1</em>).</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>Sensor or input lead wires break.</td>
<td>Turn off the power or STOP the operation by “RUN/STOP transfer” and repair the sensor or replace it.</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>The sensor is not wired correctly.</td>
<td>Conduct sensor wiring correctly by referring to <strong>3.3 Terminal Layout (P. 3-5)</strong>.</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>Proper sensor is not being used.</td>
<td>Use the specified sensor.</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>Sensor insertion depth is insufficient.</td>
<td>Check whether sensor is inserted too loosely. If so, fully insert the sensor.</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>Sensor insertion position is not appropriate.</td>
<td>Insert the sensor at the specified location.</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>Input signal wires are not separated from instrument power and/or load wires.</td>
<td>Separate each wire.</td>
</tr>
<tr>
<td>Control is abnormal</td>
<td>Noise source is present near the wiring.</td>
<td>Separate the noise source from the wiring.</td>
</tr>
<tr>
<td>Inappropriate PID constants</td>
<td></td>
<td>Set the appropriate PID constants.</td>
</tr>
<tr>
<td>Startup tuning (ST) function cannot be activated</td>
<td>Startup tuning (ST) mode is “0 (ST unused).”   (Factory set value: 0)</td>
<td>Refer to <strong>6.3 Startup Tuning (ST)</strong> (<em>P. 6-10</em>).</td>
</tr>
<tr>
<td>Startup tuning (ST) function cannot be activated</td>
<td>Requirements for performing the Startup tuning (ST) function are not satisfied.</td>
<td>Satisfy the requirements for performing the Startup tuning (ST) function by referring to <strong>6.3 Startup Tuning (ST)</strong> (<em>P. 6-10</em>).</td>
</tr>
</tbody>
</table>

Continued on the next page.
Continued from the previous page.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autotuning (AT) function not activated</td>
<td>Requirements for performing the Autotuning (AT) function are not satisfied.</td>
<td>Satisfy the requirements for performing the Autotuning (AT) function by referring to 6.2 Autotuning (AT) (P. 6-7).</td>
</tr>
<tr>
<td>Autotuning (AT) suspended</td>
<td>Requirements for suspending the Autotuning (AT) function are established.</td>
<td>Identify causes for Autotuning (AT) suspension by referring to 6.2 Autotuning (AT) (P. 6-7) and then remove them. Then, execute the Autotuning (AT) function again.</td>
</tr>
<tr>
<td>Acceptable PID values cannot be calculated by Autotuning (AT)</td>
<td>The Autotuning (AT) function does not appropriately meet the characteristics of the controlled object.</td>
<td>Set PID constants manually.</td>
</tr>
<tr>
<td>Autotuning (AT) cannot be finished normally</td>
<td>A temperature change (UP and/or Down) is 1 °C or less per minute during Autotuning.</td>
<td>Set PID constants manually.</td>
</tr>
<tr>
<td></td>
<td>Autotuning (AT) is activated when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.</td>
<td></td>
</tr>
<tr>
<td>Output does not change.</td>
<td>The Output limiter is set.</td>
<td>Change the Output limiter setting by referring to Output limiter (high/low) (P. 8-27). However, this is limited only to when the Output limiter setting can be changed.</td>
</tr>
</tbody>
</table>
### Operation

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No control RUN can be made by key operation.</td>
<td>RUN/STOP transfer of the digital input (DI) is set to the contact opened.</td>
<td>Check the contact state of RUN/STOP transfer by referring to 6.1 RUN/STOP Transfer (P. 6-2).</td>
</tr>
<tr>
<td>No Manual mode can be made by key operation.</td>
<td>Auto/Manual transfer of the digital input (DI) is set to the contact opened.</td>
<td>Check the contact state of Auto/Manual transfer by referring to 6.5 Auto/Manual Transfer (P. 6-19).</td>
</tr>
<tr>
<td>No setting change can be made by key operation.</td>
<td>Set data is locked.</td>
<td>Release the set data lock by referring to 6.6 Protecting Setting Data (P. 6-23).</td>
</tr>
<tr>
<td>Set value does not change.</td>
<td>The Setting limiter is set.</td>
<td>Change the Setting limiter setting by referring to Setting limiter (high/low) (P. 8-69). However, this is limited only to when the Setting limiter setting can be changed.</td>
</tr>
<tr>
<td>Set value (SV) does not change immediately when the Set value (SV) is changed</td>
<td>The Setting change rate limiter is set.</td>
<td>Set the Setting change rate limiter to “0 (0.0)” by referring to Setting change rate limiter (up/down) (P. 8-14). However, this is limited only to when the Setting limiter setting can be changed.</td>
</tr>
</tbody>
</table>
## Event function

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event function is abnormal</td>
<td>Event function is different from the specification.</td>
<td>Change the Event action type by referring to <strong>Event type (P. 8-73)</strong> after the instrument specification is confirmed.</td>
</tr>
<tr>
<td></td>
<td>Digital output (DO) relay contact Energized/De-energized is reversed. When FAIL is selected for digital output: De-energized fixed: Contact opens under FAIL</td>
<td>Check the setting details by referring to <strong>Energized/De-energized of DO (P. 8-93)</strong>.</td>
</tr>
<tr>
<td>Setting of Event differential gap is not appropriate.</td>
<td></td>
<td>Set the appropriate Event differential gap by referring to <strong>Event differential gap (P. 8-84)</strong>.</td>
</tr>
<tr>
<td>Event hold action is not activated.</td>
<td>The Setting change rate limiter is set.</td>
<td>Set the Setting change rate limiter to “0 (0.0)” by referring to Setting change rate limiter (up/down) (P. 8-14). However, this is limited only to when the Setting limiter setting can be changed.</td>
</tr>
</tbody>
</table>
## RKC communication

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No response</td>
<td>Wrong connection, no connection or disconnection of the communication cable</td>
<td>Confirm the connection method or condition and connect correctly</td>
</tr>
<tr>
<td></td>
<td>Breakage, wrong wiring, or imperfect contact of the communication cable</td>
<td>Confirm the wiring or connector and repair or replace the wrong one</td>
</tr>
<tr>
<td></td>
<td>Mismatch of the setting data of communication speed and data bit configuration with those of the host computer</td>
<td>Confirm the settings and set them correctly</td>
</tr>
<tr>
<td>Wrong address setting</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| | The communication settings (device address, communication speed, data bit configuration, etc.) were not enabled after being changed. | After all communication parameters are set, perform one of the following operations.  
- The power is turned on again after turning it off once  
- The RUN/STOP mode is changed in RUN from STOP again after changing it in STOP |
| Error in the data format | | Re-examine the communication program |
| Transmission line is not set to the receive state after data send (for RS-485) | | |
| EOT return | The specified identifier is invalidated | Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it |
| | Error in the data format | Re-examine the communication program |
| NAK return | Error occurs on the line (parity bit error, framing error, etc.) | Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data) |
| | BCC error | |
| | The data exceeds the setting range | Confirm the setting range and transmit correct data |
| | The specified identifier is invalidated | Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it |
### Modbus

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>No response</td>
<td>Wrong connection, no connection or disconnection of the communication cable</td>
<td>Confirm the connection method or condition and connect correctly</td>
</tr>
<tr>
<td></td>
<td>Breakage, wrong wiring, or imperfect contact of the communication cable</td>
<td>Confirm the wiring or connector and repair or replace the wrong one</td>
</tr>
<tr>
<td></td>
<td>Mismatch of the setting data of communication speed and data bit configuration with those of the host computer</td>
<td>Confirm the settings and set them correctly</td>
</tr>
<tr>
<td></td>
<td>Wrong address setting</td>
<td></td>
</tr>
</tbody>
</table>
|                          | The communication settings (device address, communication speed, data bit configuration, etc.) were not enabled after being changed. | After all communication parameters are set, perform one of the following operations.  
  • The power is turned on again after turning it off once  
  • The RUN/STOP mode is changed in RUN from STOP again after changing it in STOP |
|                          | A transmission error (overrun error, framing error, parity error or CRC-16 error) is found in the query message | Re-transmit after time-out occurs or verify communication program         |
|                          | The time interval between adjacent data in the query message is too long, exceeding 24-bit time |                                                                          |
| Error code 1             | Function cod error (Specifying nonexistent function code)                      | Confirm the function code                                                 |
| Error code 2             | When any address other than 0000H to 00B1H are specified                      | Confirm the address of holding register                                   |
| Error code 3             | When the specified number of data items in the query message exceeds the maximum number of data items available | Confirm the setting data                                                  |
SPECIFICATIONS
### Measured input

**Number of input:** 1 point  

**Input type:**

<table>
<thead>
<tr>
<th>Input type</th>
<th>Measured range</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC input K</td>
<td>0 to 800 °C</td>
<td>JIS-C1602-1995</td>
</tr>
<tr>
<td></td>
<td>0 to 999 °F</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTD input Pt100</td>
<td>0 to 400 °C</td>
<td>JIS-C1604-1997</td>
</tr>
<tr>
<td></td>
<td>0 to 800 °F</td>
<td></td>
</tr>
</tbody>
</table>

**Sampling cycle:** 0.25 seconds

**Influence of external resistance:**
Approx. 0.25 μV/Ω (Converted depending on TC types)

**Influence of input lead:**
Approx. 0.02 %/Ω of span (Only RTD)  
10 Ω or less per wire

**Input impedance:** 1 MΩ or more (Only TC)  

**Sensor current:** Approx. 200 μA (Only RTD)

**Action at input break:**
TC input: Upscale  
RTD input: Upscale

**Action at input short circuit:**
Downscale (Only RTD)

**Input correction:**
PV bias: −199 to +999 °C [°F]  
PV digital filter (First order lag digital filter):
0 to 100 seconds (0: Filter OFF)

**Burnout status monitoring delay:**
0 to 10 times

- When burnout occurs, control action will be in the state of burnout.
- This parameter only affects delay time of Burnout status monitoring.
- Burnout status monitoring can be monitored by communication only.  
  (Delay time cannot be monitored at the display.)
## Digital input (DI) [optional]

**Number of input:** 1 point (Isolated input)

**Input method:** Dry contact input:
- **Open state:** 500 kΩ or more
- **Close state:** 10 Ω or less
- **Contact current:** 3.3 mA or less
- **Voltage at open:** Approx. 5 V DC

**Capture judgment time:** Approx. 0.25 seconds

**Function:** One of the following functions is selectable:
- Set value 1 (SV1) and Set value 2 (SV2) select
- RUN/STOP transfer
- AUTO/MAN transfer
- Interlock release

> When the Set value (SV) is set by digital input (DI), settings by front keys are not available.

> Prior to the RUN/STOP transfer and AUTO/MAN transfer by digital input (DI), the instrument must first be set to RUN mode and AUTO mode by front keys.

> Changes of state and mode by digital input (DI) are not stored in EEPROM.

> Digital input (DI) and Communication cannot be used at the same time. (Specify when ordering)
## Output

### Number of output:
- Up to 2 points
- Control output: Triac output
- Digital output (DO): Relay contact output [optional]

### Output type: Triac output (control output)
- Output method: AC output (Zero-cross method)
- Allowable load current: 7 A (Ambient temperature 40 °C or less)
  - Set the surface temperature to the following degree if the allowable load current exceeds 3A:
    - Front side: 80 °C or less
    - Metal at the back side: 100 °C or less
- Load voltage: 100 to 240 V AC
  (Same as the power supply voltage)
- Minimum load current: 50 mA
- ON voltage: 1.5 V or less (at maximum load current)
- Proportional cycle time: 1 to 100 seconds
  - When Peak current suppression function is ON: 2 to 100 seconds
  - (The actual cycle is 2 seconds when 1 second is set.)
- Minimum ON/OFF time of proportioning cycle: 0 to 999 ms
- Fuse: Rated current 12.5 A (Not replaceable.)

### Relay contact output (digital output) [optional]
- Contact type: 1a contact
- Contact rating (Resistive load):
  - 250 V AC: 1 A, 30 V DC: 0.5 A
- Electrical life: 150,000 times or more (Rated load)
- Mechanical life: 20 million times or more
  (Switching: 360 times/min [no-load])

### Additional function: Peak current suppression function
When a group of controllers (up to 4 units) is connected by SB link, use the Peak current suppression function by setting Output limiter high to prevent all outputs from turning ON at the same time.
Peak current suppression function operates when the controllers are in RUN state and a synchronizing signal is sent/received.

- Response may vary based on the number of connected controllers.
- The connected controllers within the group are regularly synchronized.
### Performance (at the ambient temperature 23 ±2 °C)

#### Input accuracy:

<table>
<thead>
<tr>
<th>Input type</th>
<th>Input range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>K, J</td>
<td>0 °C or more, Less than 500 °C</td>
<td>±(1.5 °C + 1 digit)</td>
</tr>
<tr>
<td></td>
<td>500 °C or more</td>
<td>±(0.3 % of Reading + 1 digit)</td>
</tr>
<tr>
<td>Pt100, JPt100</td>
<td>0 °C or more, Less than 200 °C</td>
<td>±(0.6 °C + 1 digit)</td>
</tr>
<tr>
<td></td>
<td>200 °C or more</td>
<td>±(0.3 % of Reading + 1 digit)</td>
</tr>
</tbody>
</table>

- **Measured input:**
  - [For Fahrenheit: Converted value of Celsius]

#### Noise rejection:
- Series mode: 60 dB or more (50/60 Hz)
- Common mode: 120 dB or more (50/60 Hz)

#### Resolution:
- Approx. 1/65535 (Performance of A/D converter)

#### Cold-junction temperature compensation error:
- ±1 °C
- ±2 °C (−10 to +60°C)

#### Operating influence:

- **Influence ambient temperature:**
  - TC/RTD inputs: ±0.06 °C/°C

- **Influence of power supply voltage:**
  - Same as input accuracy

- **Influence of physical orientation:**
  - TC input: ±2 °C or less
  - RTD input: ±0.5 °C or less
11. SPECIFICATIONS

■ Control

Control method: PID control
P, PI, PD, or ON/OFF action is available

Additional function: Autotuning, Startup tuning, Fine tuning

■ PID control

Overshoot suppression function: Anti-reset windup (ARW)

Setting range:

a) Proportional band (P):
   0 to Input span (unit: °C [°F])
   0: ON/OFF action
   ON/OFF action differential gap:
   0 to 100 °C [°F]

b) Integral time (I):
   0 to 999 seconds (0: PD action)

c) Derivative time (D):
   0 to 999 seconds (0: PI action)

d) Anti-reset windup (ARW):
   0 to 100 % of Proportional band
   (0: Integral action OFF)

e) Derivative action:
   Measured value derivative,
   Deviation derivative

f) Proportional cycle time:
   1 to 100 seconds

g) Output limiter (high/low):
   −5.0 to +105.0 %
   (High/Low individual setting) *

   * Output limiter low < Output limiter high

h) Manual output:
   Output limiter low to Output limiter high
**Event function**

**Number of events:** Up to 2 points

**Event output:**
- Digital output (DO) [optional]
- Number of outputs: 1 point
- Output action:
  - 0: Event output full-time OFF
  - 1: Event output ON at Event 1
  - 2: Event output ON at Event 2
  - 3: Event output ON at Event 1 or Event 2
  - 4: Event output ON at Event 1 and Event 2

**Energized/De-energized (Selectable):**
- Energized/De-energized cannot be selected for FAIL.
  - [Fixed to De-energized]

**Event action:**
- Deviation high (Using SV monitor value)
- Deviation high with hold action (Using SV monitor value)
- Deviation high with re-hold action (Using SV monitor value)
- Deviation high (Using local SV)
- Deviation high with hold action (Using local SV)
- Deviation high with re-hold action (Using local SV)
- Deviation low (Using SV monitor value)
- Deviation low with hold action (Using SV monitor value)
- Deviation low with re-hold action (Using SV monitor value)
- Deviation low (Using local SV)
- Deviation low with hold action (Using local SV)
- Deviation low with re-hold action (Using local SV)
- Deviation high/low (Using SV monitor value) [High/Low individual setting]
- Deviation high/low with hold action (Using SV monitor value) [High/Low individual setting]
- Deviation high/low with re-hold action (Using SV monitor value) [High/Low individual setting]
- Deviation high/low (Using local SV) [High/Low individual setting]
- Deviation high/low with hold action (Using local SV) [High/Low individual setting]
- Deviation high/low with re-hold action (Using local SV) [High/Low individual setting]
- Band (Using SV monitor value)
- Band (Using local SV)
- Band (Using SV monitor value) [High/Low individual setting]
- Band (Using local SV) [High/Low individual setting]
- Process high
- Process high with hold action
Process low with hold action
SV high (Using SV monitor value)
SV high (Using local SV)
SV low (Using SV monitor value)
SV low (Using local SV)
Control loop break alarm (LBA)
FAIL
Monitor during RUN
Output of the communication monitoring result

**Setting range:**

**Deviation action:**
- Event setting:
  - High/Low common setting: $-199$ to $+\text{Input span}$
    Setting a minus (-) value for event types C, G, T (deviation high/low alarm) and D (band alarm) is taken as an absolute value.
  - High/Low individual setting: $-199$ to $+\text{Input span}$
  - Differential gap: 0 to Input span

**Process:**
- Event setting: Same as input range
- Differential gap: 0 to Input span

**SV:**
- Event setting: Same as input range
- Differential gap: 0 to Input span

**Control loop break alarm (LBA) time:**
- LBA time: 0 to 999 seconds
- LBA deadband (LBD): 0 to Input span

**Output of the communication monitoring result:**
Event signal is turned on when communication is not properly made for 10 seconds.

- Event setting and Event differential gap are not available for the following actions:
  - Control loop break alarm (LBA), FAIL, Monitor during RUN,
  - Output of the communication monitoring result

**Additional function:**
- Hold action: OFF
  - Hold action ON
    (When power turned on; when transferred from STOP to RUN)
  - Re-hold action ON
    (When power turned on; when transferred from STOP to RUN; SV changed)

- During the operation of the Setting change rate limiter, Hold action and Re-hold action are not available.
- Hold action is effective for Input value action or Deviation action.
- Re-hold action is effective for Deviation action.
Event delay timer: 0 to 600 seconds
Interlock function: Use/Unuse is selectable
Event output action at input burnout:
   0: Event output is not forcibly turned ON when the burnout function is activated.
   1: ON at over-scale; no action at underscale
   2: ON at underscale; no action at over-scale
   3: ON at over-scale or underscale
   4: OFF at over-scale or underscale
Load power shutdown function:
   Internal load power (L side of the power) is turned off by the internal relay at instrument error (FAIL).
   0: Relay for Load power shutdown opens at FAIL (Restores when FAIL is resolved.)
   1: Relay for Load power shutdown opens at FAIL or LBA (FAIL state or LBA state remains)
   2: Relay for Load power shutdown opens at FAIL or LBA (Returns to the normal state when FAIL state or LBA state recovers.)

## SV selection function

**Number of SV:** 2 points
**Setting method:** Front keys
   Digital input (DI) *
   Communication *
* Digital input (DI) and Communication cannot be used at the same time.
(Specify when ordering)
Attention must be paid to the number of EEPROM writes. (P. 11-15)

**Setting range:** 1 to 2

## Operation mode

**Auto mode:** Optimum PID values are automatically measured, computed and set.

**Manual mode:** Optimum PID values are tuned manually by front keys.

**Control stop (STOP mode):**
   Control output (continuous): Low limit or less
   Event output: OFF (Contact open) *
* Output still functions during in the Stop state

**Output action at STOP mode:**
   Event output is OFF
   Event output remains unchanged
Action at mode transfer

Transfer AUTO/MAN mode from Manual to Auto:
Automatically activates the Bumpless function when Measured value (PV) is within the Proportional band.
Bumpless function does not activate when Measured value (PV) is out of the Proportional band.

Transfer AUTO/MAN mode from Auto to Manual:
Set ON or OFF to Bumpless function
In case of “0: without bumpless” Output the Manual manipulated value (MV)
In case of “1: with bumpless” Output the Manual manipulated value (MV) set before the AUTO/MAN transfer.

Transfer RUN/STOP mode from Stop to Run:
Same action as when the power is turned on.

Loader communication

Loader communication: For RKC communication protocol only
Synchronous method: Start/Stop synchronous type
Communication speed: 9600 bps
Data format: Start bit: 1
Data bit: 8
Parity bit: Without
Stop bit: 1
Protocol: ANSI X3.28-1976 subcategories 2.5 and A4
Maximum connections: 1 point (Only COM-K)
Address is fixed at 0.
Connection method: COM-K loader cable (equivalent to W-BV-01-1500)
Interval time: 10 ms
Other: ① Power supply from COM-K is available for only internal setting change. Control and host communication are suspended. For this reason, display indicate “---.”
② The instrument operates normally when it is restored.
③ Host communication is available when the instrument is restored.
- **Communication [optional]**
  - **RKC communication**
    - **Interface:** Based on RS-485, EIA standard
    - **Connection method:** 2-wire system, half-duplex multi-drop connection
    - **Synchronous method:** Start/Stop synchronous type
    - **Communication speed:** 2400 bps, 4800 bps, 9600 bps, 19200 bps
    - **Data bit configuration:**
      - Start bit: 1
      - Data bit: 7 or 8
      - Parity bit: Without, Odd or Even
      - Stop bit: 1 or 2
    - **Protocol:** ANSI X3.28-1976 subcategories 2.5 and A4
      - RKC communication protocol
      - Polling/Selecting type
    - **Error control:** Vertical parity (With parity bit selected)
      - Horizontal parity (BCC check)
    - **Communication code:** JIS/ASCII 7-bit code
    - **Termination resistor:** Externally terminal connected (Example: 120 Ω, 1/2 W)
    - **Xon/Xoff control:** None
    - **Maximum connections:** 31 controllers (Address setting range: 0 to 99)
    - **Interval time:** 0 to 250 ms
    - **Signal logic:**

<table>
<thead>
<tr>
<th>Signal voltage</th>
<th>Logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>V (A) − V (B) ≥ 2 V</td>
<td>0 (SPACE)</td>
</tr>
<tr>
<td>V (A) − V (B) ≤ −2 V</td>
<td>1 (MARK)</td>
</tr>
</tbody>
</table>

Voltage between V (A) and V (B) is the voltage of (A) terminal for the (B) terminal.
<table>
<thead>
<tr>
<th><strong>Modbus</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interface:</strong></td>
<td>Based on RS-485, EIA standard</td>
</tr>
<tr>
<td><strong>Connection method:</strong></td>
<td>2-wire system, half-duplex multi-drop connection</td>
</tr>
<tr>
<td><strong>Synchronous method:</strong></td>
<td>Start/Stop synchronous type</td>
</tr>
<tr>
<td><strong>Communication speed:</strong></td>
<td>2400 bps, 4800 bps, 9600 bps, 19200 bps</td>
</tr>
</tbody>
</table>
| **Data bit configuration:** | Start bit: 1  
Data bit: 8  
Parity bit: Without, Odd or Even  
Stop bit: 1 or 2 |
| **Protocol:** | Modbus |
| **Signal transmission mode:** | Remote Terminal Unit (RTU) mode |
| **Function code:** | 03H (Read holding registers)  
06H (Preset single register)  
08H (Diagnostics: loopback test) |
| **Error check method:** | CRC-16 |
| **Error code:** | 1: Function code error  
2: When the mismatched address is specified  
3: When the specified number of data items in the query message exceeds the maximum number of data items available |
| **Termination resistor:** | Externally terminal connected (Example: 120 Ω, 1/2 W) |
| **Maximum connections:** | 31 controllers (Address setting range: 1 to 99) |
| **Interval time:** | 0 to 250 ms |
### SB link

**Function:** Synchronizing signal for Peak current suppression function

**Interface:** Based on RS-485, EIA standard

**Connection method:** 2-wire system, half-duplex multi-drop connection

**Synchronous method:** Start/Stop synchronous type

**Communication speed:** 19200 bps

**Data bit configuration:**
- Start bit: 1
- Data bit: 8
- Parity bit: Without
- Stop bit: 1

**Interval time:** 10 ms

**Protocol:** Modbus

**Signal transmission mode:** Remote Terminal Unit (RTU) mode

**Termination resistor:** Externally terminal connected (Example: 120 Ω, 1/2 W)

**Maximum connections:** 4 controllers (Address setting range: 0 to 3 *)
- * Address No. 0 is for Master controller.

**Setting items:**
- Function selection: 0: Without SB link function
- 1: With SB link function
- Intragroup address: 0: Intragroup address 1 (Master)
- 1: Intragroup address 2
- 2: Intragroup address 3
- 3: Intragroup address 4

When SB link is in operation, Host communication (RKC communication or Modbus) cannot be used.

Set value for the following communication parameters are automatically changed to the fixed values:
- Communication speed
- Data bit configuration
- Interval time
11. SPECIFICATIONS

■ Self-diagnostic function

Control stop (Error number is displayed [Operation: Possible]):
- Adjustment data error (Err 1)
- Data back-up error (Err 2)
- A/D conversion error (Err 4)
- Temperature compensation error (Err 4)
- SB link error (Err 16)

Action stop (Error number is not displayed [Operation: Impossible]):
- Power supply voltage is abnormal
- Watchdog timer

■ Power

Power supply voltage:
- 90 to 264 V AC [Including power supply voltage variation], 50/60 Hz, (Rating 100 to 240 V AC)
- Frequency variation: ±50 Hz±10 %, 60 Hz±10 %

Power consumption (When a load is disconnected):
- 4.0 VA max. (at 100 V AC)
  - Rush current: 5.6 A or less
- 6.7 VA max. (at 240 V AC)
  - Rush current: 13.3 A or less

Power consumption (When a load is disconnected in power saving mode):
- 3.0 VA max. (at 100 V AC)
  - Approximately 25% off from the power consumption (when disconnected to load)
- 5.2 VA max. (at 240 V AC)
  - Approximately 22% off from the power consumption (when disconnected to load)

Power consumption (When a load is connected) [Ambient temperature: 40 °C]:
- 705 VA max. (When connecting a load equivalent to 7A at 100 V AC)
  - Rush current: 5.6 A or less
- 1690 VA max. (When connecting a load equivalent to 7A at 240 V AC)
  - Rush current: 13.3 A or less
General specifications

Insulation resistance:

<table>
<thead>
<tr>
<th>Test voltage: 500 V DC</th>
<th>①</th>
<th>②</th>
<th>③</th>
<th>④</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Grounding terminal (PE terminal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>② Power, output terminals (SSR)</td>
<td>20 MΩ or more</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ Measured input terminal</td>
<td>20 MΩ or more</td>
<td>20 MΩ or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>④ Digital output (DO) terminal</td>
<td>20 MΩ or more</td>
<td>20 MΩ or more</td>
<td>20 MΩ or more</td>
<td></td>
</tr>
<tr>
<td>⑥ Communication, digital input (DI) terminals</td>
<td>20 MΩ or more</td>
<td>20 MΩ or more</td>
<td>20 MΩ or more</td>
<td>20 MΩ or more</td>
</tr>
</tbody>
</table>

Withstand voltage:

<table>
<thead>
<tr>
<th>Time: 1 min.</th>
<th>①</th>
<th>②</th>
<th>③</th>
<th>④</th>
</tr>
</thead>
<tbody>
<tr>
<td>① Grounding terminal (PE terminal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>② Power, output terminals (SSR)</td>
<td>1500 V AC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>③ Measured input terminal</td>
<td>1000 V AC</td>
<td>2300 V AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>④ Digital output (DO) terminal</td>
<td>1500 V AC</td>
<td>2300 V AC</td>
<td>2300 V AC</td>
<td></td>
</tr>
<tr>
<td>⑥ Communication, digital input (DI) terminals</td>
<td>1000 V AC</td>
<td>2300 V AC</td>
<td>750 V AC</td>
<td>2300 V AC</td>
</tr>
</tbody>
</table>

Cutoff current value: 0.5 mA or less

Power failure: A power failure of 10 ms or less will not affect the control action.

Memory backup: Backed up by non-volatile memory

Number of writing: Approx. 1,000,000 times

(Depending on storage and operating conditions.)

Data storage period: Approx. 10 years

Power failure recovery: Restart the mode operated prior to the power failure.

- In case of AUTO mode:
  Output changes from the Output limiter low with control calculation results.
- In case of a Manual (MAN) mode:
  Output status is defined as follows by the “Bumpless mode setting” in the Engineering mode.
  - In case of “0: Without bumpless”
    Preset manual value is output.
  - In case of “1: With bumpless”
    PID control: Output limiter low is output.

Allowable ambient temperature: −10 to +60 °C

Allowable ambient humidity: 5 to 95 % RH (Absolute humidity: MAX.W.C 29 g/m³ dry air at 101.3kPa)

Installation environment conditions:

Indoor use

Altitude up to 2000 m
Transportation and Storage environment conditions:

**Vibration:**

<table>
<thead>
<tr>
<th>Number of vibration Hz</th>
<th>Level (m/s²)/Hz</th>
<th>[g²/Hz] *</th>
<th>Attenuation slope dB/oct</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0.048</td>
<td>(0.0005)</td>
<td>—</td>
</tr>
<tr>
<td>3 to 6</td>
<td>—</td>
<td>—</td>
<td>+13.75</td>
</tr>
<tr>
<td>6 to 18</td>
<td>1.15</td>
<td>(0.012)</td>
<td>—</td>
</tr>
<tr>
<td>18 to 40</td>
<td>—</td>
<td>—</td>
<td>−9.34</td>
</tr>
<tr>
<td>40</td>
<td>0.096</td>
<td>(0.001)</td>
<td>—</td>
</tr>
<tr>
<td>40 to 200</td>
<td>—</td>
<td>—</td>
<td>−1.29</td>
</tr>
<tr>
<td>200</td>
<td>0.048</td>
<td>(0.0005)</td>
<td>—</td>
</tr>
</tbody>
</table>

The effective value of the acceleration is 5.8 m/s² [0.59 g*] within the number of vibration.

* g = 9.806658 m/s²

**Shock:** Height 600 mm or less

**Temperature:** −10 to +60 °C

**Humidity:** 50 to 95 % RH (Non condensing)

Absolute humidity: MAX.W.C 35 g/m³ dry air at 101.3kPa

**Mounting and Structure:**

- **Panel mounting**
  - Screw: Size: M3 [Nominal length (L): 6 mm or more]
  - Recommended tightening torque: 0.45 to 0.53 N·m

- **Pipe wrapping**
  - Fitting: Model code: SB1P-M01
  - Holding power at wrapping: 30 N (300 kgf·cm)
  - Maximum clamping capacity: 60 N (600 kgf·cm)
  - Recommended strapping: Stainless steel strapping
    (Manufactured by PANDUIT Corporation)
    Cross section: Extra heavy
    Width: 12.7 mm
    Length: 594 mm
    Model code: SB1P-B01

- **Pipe hanging**
  - Fitting: Model code: SB1P-M02
  - Allowable tensile force at hanging: 30 N (300 kgf·cm)
  - Recommended strapping: Stainless steel strapping
    (Manufactured by PANDUIT Corporation)
    Cross section: Heavy
    Width: 7.9 mm
    Length: 1000 mm
    Model code: SB1P-B02

- **DIN rail mounting**
  - Fitting: Model code: SB1P-M03
  - Holding power at DIN rail mounting: 30 N (300 kgf·cm)
Temperature of the Installation position (surface of a jacket heater):
−10 to +100 °C
Do not use the following items at 70 °C or more:
- Fitting and banding for pipe wrapping type
- Strapping for pipe hanging type
- Fitting for DIN rail mounting.
Diameter of the pipe (being covered with a jacket heater):
φ 70 and φ 120 to 150
Mounting orientation:
±10°
Case material: PC [Flame retardancy: UL94 V-1]
Connector material: Polyamide 6.6 [Flame retardancy: UL94 V-0]
Panel sheet material: Polyester
Connector:
- Power supply/Event input/Event output/
  Communication connector
  Socket side: Manufactured by WAGO Corporation
  721-467/001-000
  Plug side: Manufactured by WAGO Corporation
  721-2107/037-000
  (Model code: SB1P-C02)
  Allowable current at crossover wiring: 15 A
- Measured input/Control output connector
  Socket side: Manufactured by WAGO Corporation
  734-168
  Plug side: Manufactured by WAGO Corporation
  734-108/037-000
  (Model code: SB1P-C01)
Weight:  
Approx. 130 g (Instrument only)
Dimensions:  
57 × 85 × 44 mm (W × H × D) Not including protruding parts

■ Standard
Safety standards:  
UL: UL61010-1
cUL: CAN/CSA-C22.2 No. 61010-1
CE marking:  
LVD: EN61010-1
OVERVOLTAGE CATEGORYII, POLLUTION DEGREE 2
EMC: EN61326-1
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### Note
- *Mode* stands for parameter setting mode.
- **SV:** SV setting mode
- **PARA:** Parameter setting mode
- **ENG:** Engineering mode

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**IMR02M04-E1**

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