1-channel Type
Temperature Controller
with Built-in SSR

SB1

Instruction Manual

RKC INSTRUMENT INC.

IMR02M04-E1

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.

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

NOTE : This mark indicates important information on installation, handling and operating procedures.

: This mark indicates supplemental information on installation, handling and operating procedures.

: This mark indicates where additional information may be located.

Character Symbols:

0	1	2	3	4	5	6	7	8	9	Minus	Period

A	B (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

V	W	X	Y	Z	Degree	/	Dash

	Dim lighting
	Bright lighting
	Flashing

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.

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

* 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

This chapter describes features, package contents and model code, etc.

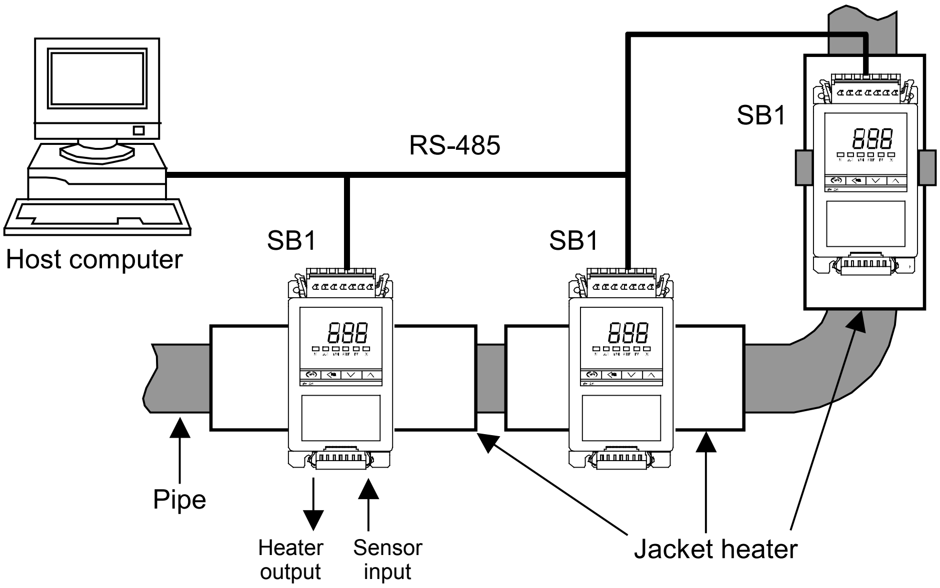
1.1 Features

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**

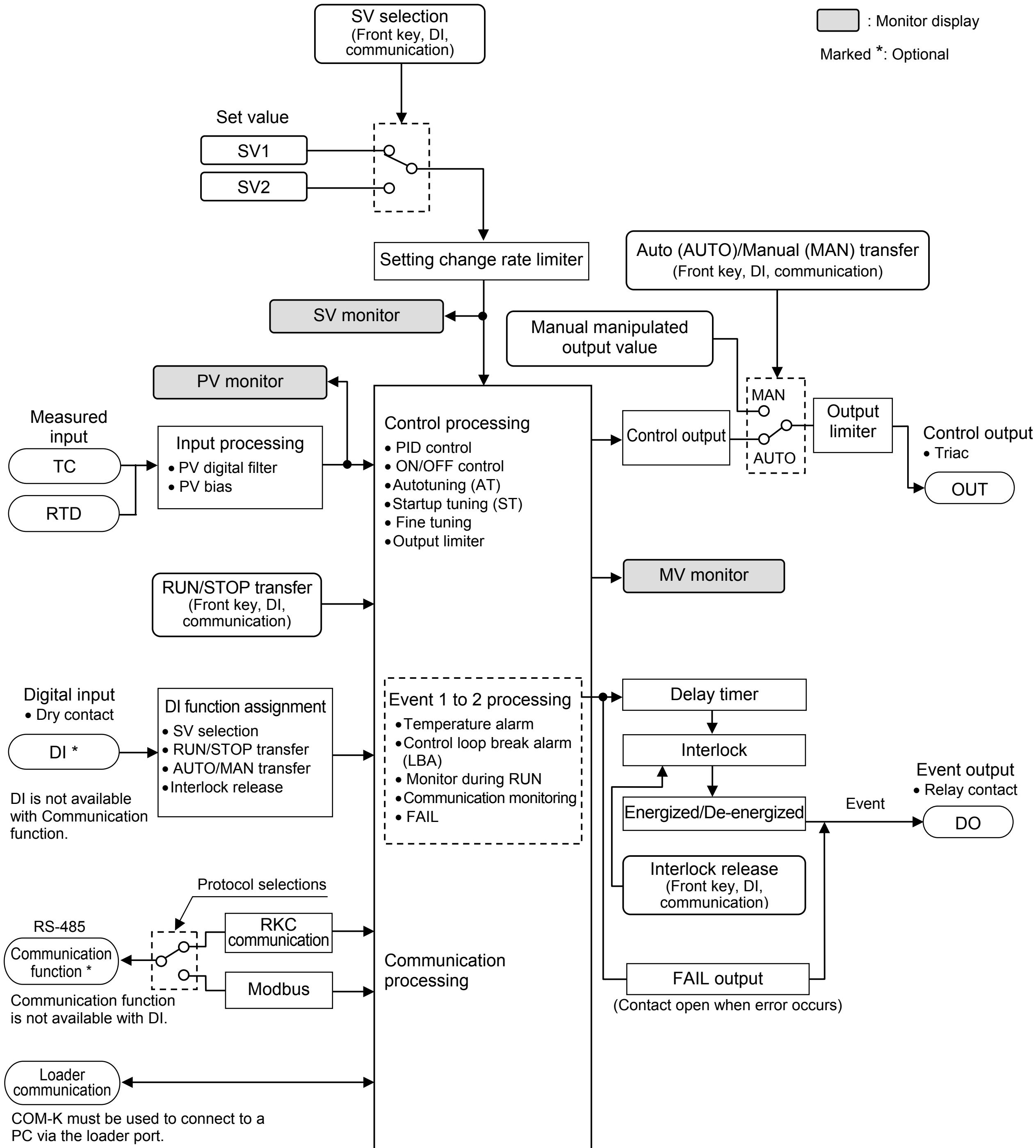
Saving parameter settings to a PC and copying parameters to other controllers becomes easy with the USB port, a COM-K converter, and dedicated WinSCI software.
Download the software from the official RKC website: http://www.rkcinst.com/



SB1 Installation example

1.2 Input/Output and Function Blocks

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



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>
<tr><th>Accessories</th><th>Q'TY</th><th colspan="2">Remarks</th></tr>
<tr><td>☐ Instrument</td><td>1</td><td colspan="2">————</td></tr>
<tr><td>☐ Installation Manual (IMR02M01-E☐)</td><td>1</td><td colspan="2">Enclosed with instrument</td></tr>
<tr><td>☐ Quick Operation Manual (IMR02M02-E☐)</td><td>1</td><td colspan="2">Enclosed with instrument</td></tr>
<tr><td>☐ Parameter List (IMR02M03-E☐)</td><td>1</td><td colspan="2">Enclosed with instrument</td></tr>
<tr><td>☐ Instruction Manual (IMR02M04-E1)</td><td>1</td><td>This manual
(sold separately)</td><td>This manual can be downloaded from the official RKC website:
http://www.rkcinst.com/english/manual_load.htm.</td></tr>
<tr><td>☐ Measured input/Control output connector [plug]
SB1P- C01</td><td>1</td><td colspan="2">Optional (sold separately)</td></tr>
<tr><td>☐ Power supply/Event input/output/Communication connector [plug]
SB1P-C02</td><td>1</td><td colspan="2">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 colspan="2">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 colspan="2">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 colspan="2">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 colspan="2">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 colspan="2">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 colspan="2">Optional (sold separately)</td></tr>
</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 □ □□□ − □ − □ ∗ □ □ □ □ − □ □ □

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

Specifications		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Control Method	PID control with AT (Reverse action)	F										
Measured input and Range	Thermocouple K 0 to 800 °C		K04									
	Thermocouple K 0 to 999 °F		KB1									
	Thermocouple J 0 to 800 °C		J04									
	Thermocouple J 0 to 999 °F		JA8									
	RTD Pt100 0 to 400 °C		D17									
	RTD Pt100 0 to 800 °F		DB4									
Control output	Triac output			T								
Power supply voltage	100 to 240 V AC				4							
Digital output (DO)	None					N						
	1 point					1						
Digital input (DI)/ Communication function	None						N					
	Digital input (1 point)						D					
	Communication function RS-485 (RKC communication)						5					
	Communication function RS-485 (Modbus)						6					
Mounting method	Without fitting (Panel mounting)							N				
	With fitting (Sold separately)							1				
Quick start code	No quick start code								N			
	Specify quick start code								1			
Event 1 type [Quick start code]	No code No specify quick start code									N		
	Refer to Event Type Code Table.									□		
Event 2 type [Quick start code]	No code No specify quick start code										N	
	Refer to Event Type Code Table.										□	
Digital output assignment [Quick start code]	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

● Event Type Code Table

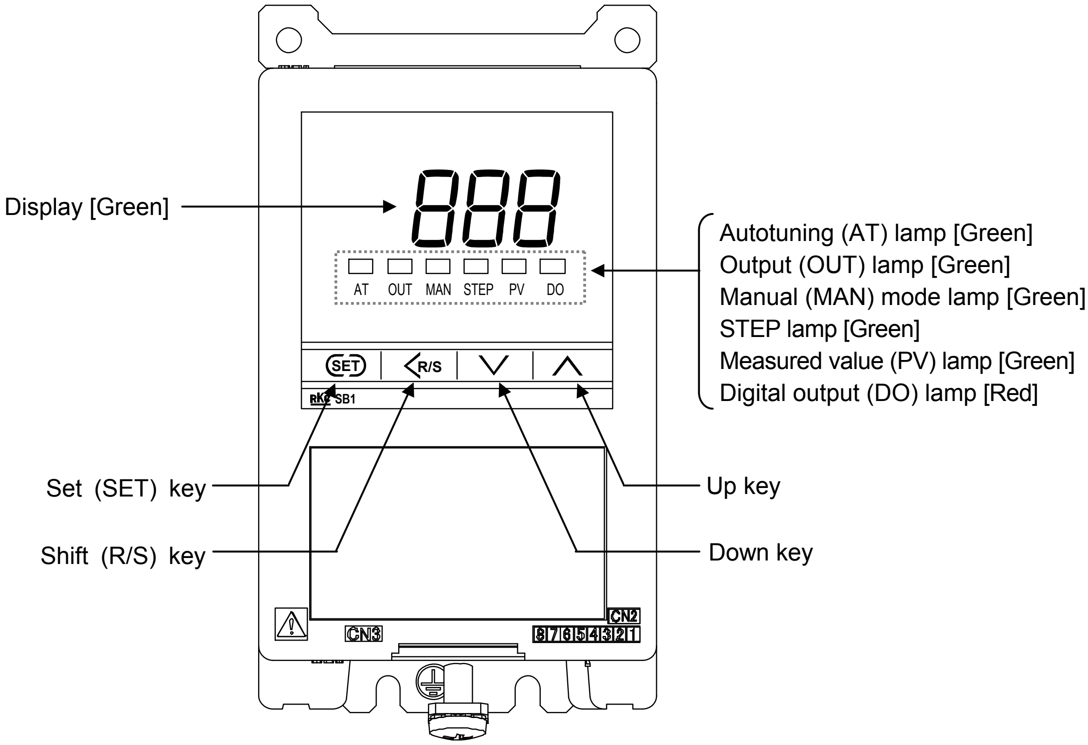
Code	Type
N	None
A	Deviation high
B	Deviation low
C	Deviation high/low
D	Band
E	Deviation high with hold action
F	Deviation low with hold action
G	Deviation high/low with hold action
H	Process high
J	Process low
K	Process high with hold action
L	Process low with hold action
Q	Deviation high with re-hold action

Code	Type
R	Deviation low with re-hold action
T	Deviation high/low with re-hold action
U	Band (High/Low individual setting)
V	SV high
W	SV low
X	Deviation high/low (High/Low individual setting)
Y	Deviation high/low with hold action (High/Low individual setting)
Z	Deviation high/low with re-hold action (High/Low individual setting)
2	Control loop break alarm (LBA)
3	FAIL
4	Monitor during RUN
5	Output of the communication monitoring result

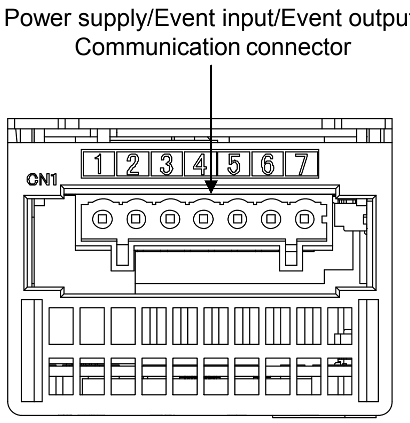
1.5 Parts Description

This section describes various display units and the key functions.

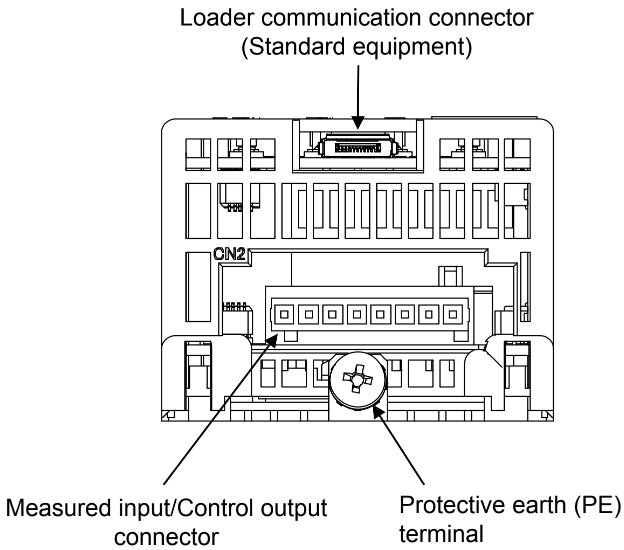
■ Front side



■ Upside



■ Underside



● Display unit

Display [Green]	Displays Measured value (PV), Set value (SV), Manipulated output value (MV) or various parameter symbols.

● Indication lamps

Autotuning (AT) lamp [Green]	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

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.
∧	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

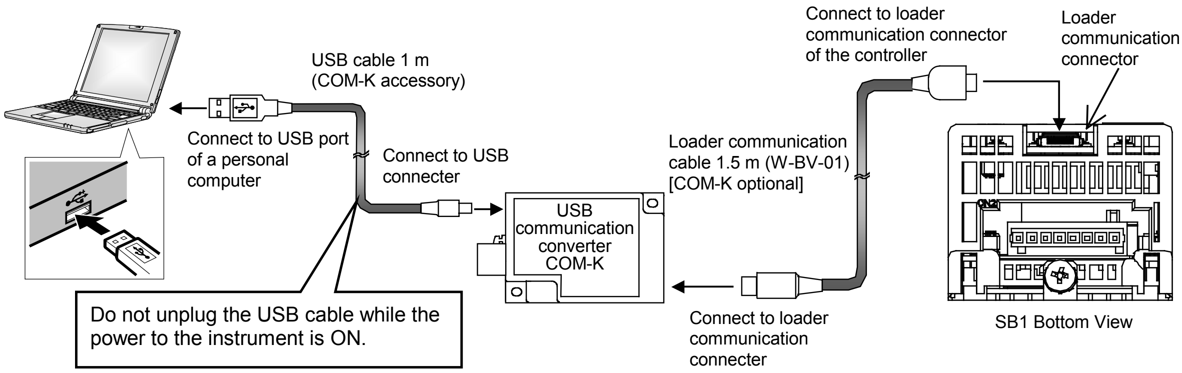
To avoid damage to the instrument, never use a sharp object to press keys.

● Connector/Terminal

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)[1]. Our communication software[2] 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. http://www.rkcinst.com.
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

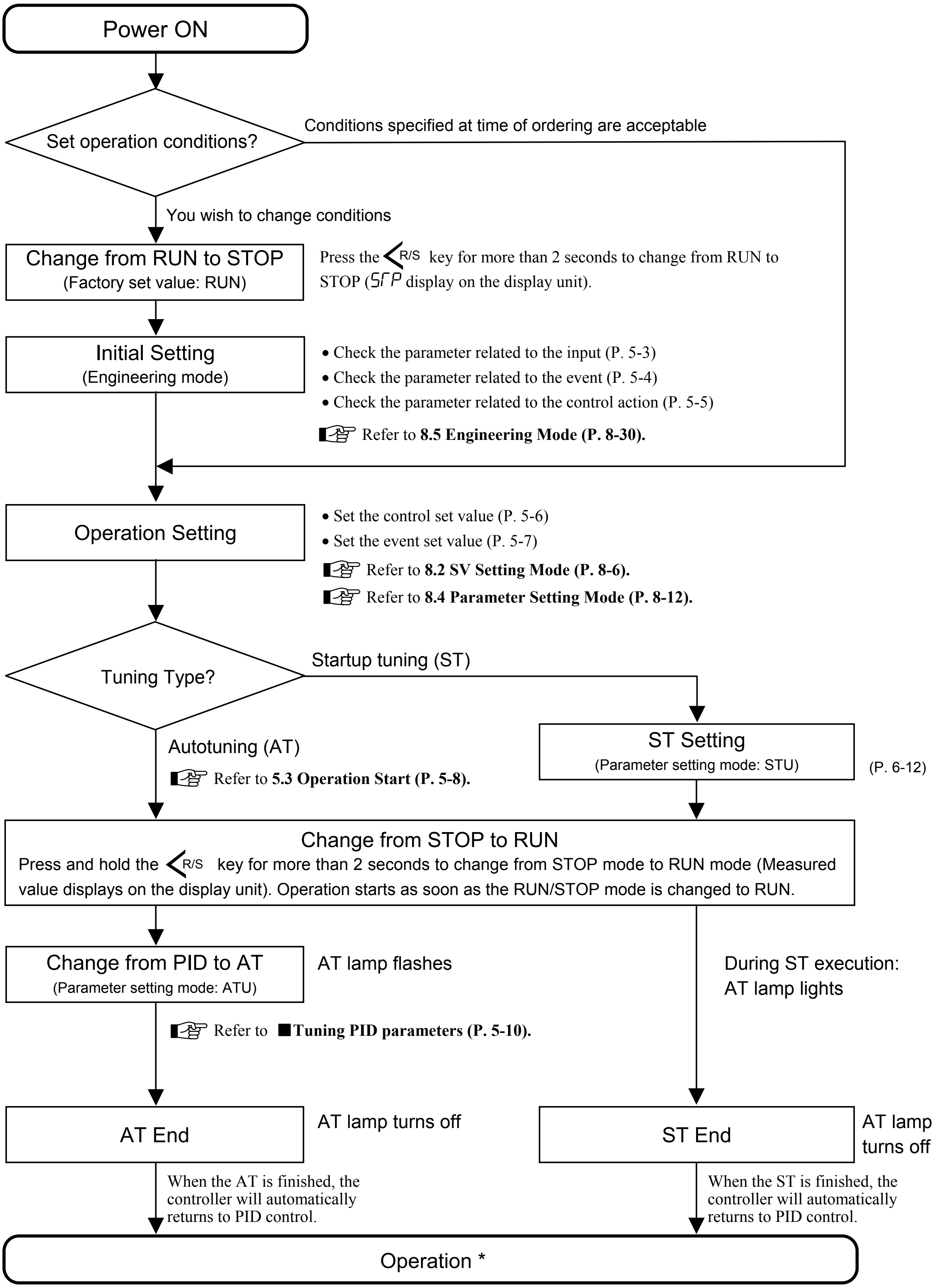
The Loader port is only for parameter setup.

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.



* Adjust the PID constants manually when the optimum PID constants cannot be calculated by AT or ST for characteristic variations of the controlled system.

MEMO

MOUNTING 2

This chapter describes installation environment, mounting cautions, dimensions and mounting procedures.

2.1 Mounting Cautions

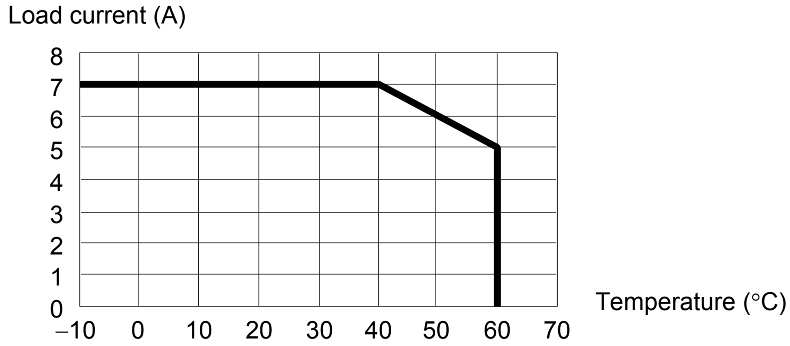
⚠ WARNING

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.)



Temperature characteristic

- Allowable ambient humidity:
  5 to 95 % RH (Absolute humidity: MAX.W.C 29 g/m^3 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): ϕ70 and ϕ120 to 150

(3) Avoid the following conditions when selecting the mounting location:

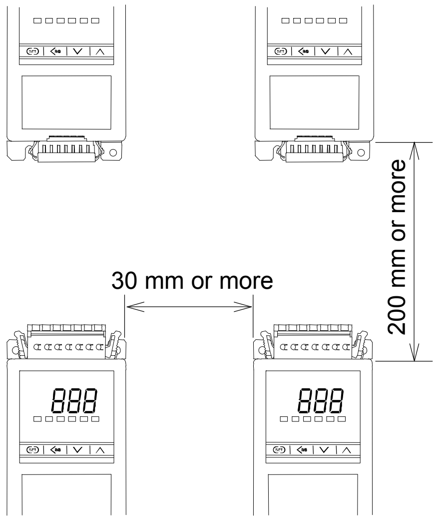
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields 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:

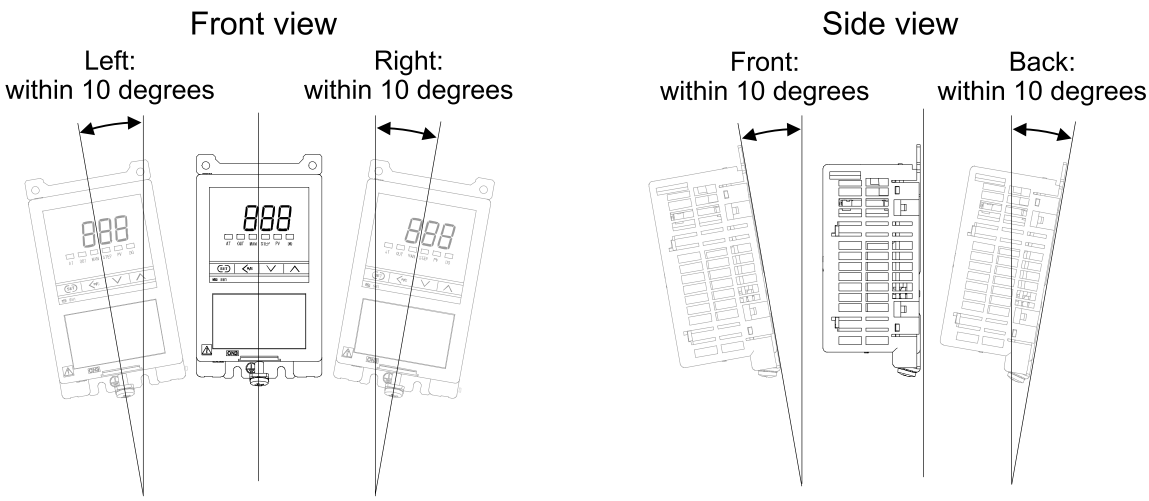
- Make sure to mount inside a control panel. (Indoor use)
- Ensure at least 200 mm space on top and bottom of the instrument for maintenance and environmental reasons.
- If the ambient temperature rises above 60 °C, cool this instrument with a forced air fan, cooler, etc. Cooled air should not blow directly 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.

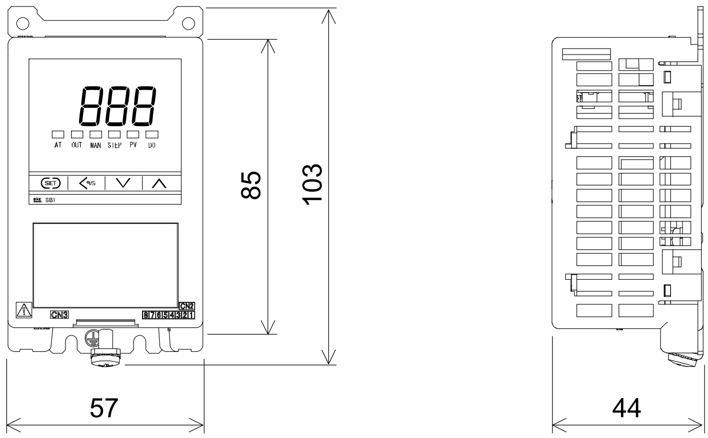


(5) If this instrument is permanently connected to equipment, it is important to include a switch or circuit-breaker into the installation. This should be in close proximity to the equipment and within easy reach of the operator. It should be marked as the disconnecting device for the equipment.

2.2 Dimensions

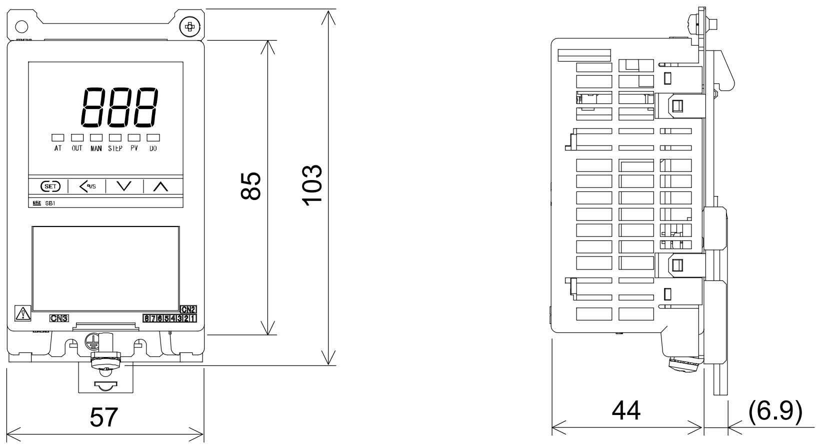
■ Panel mounting type

(Unit: mm)



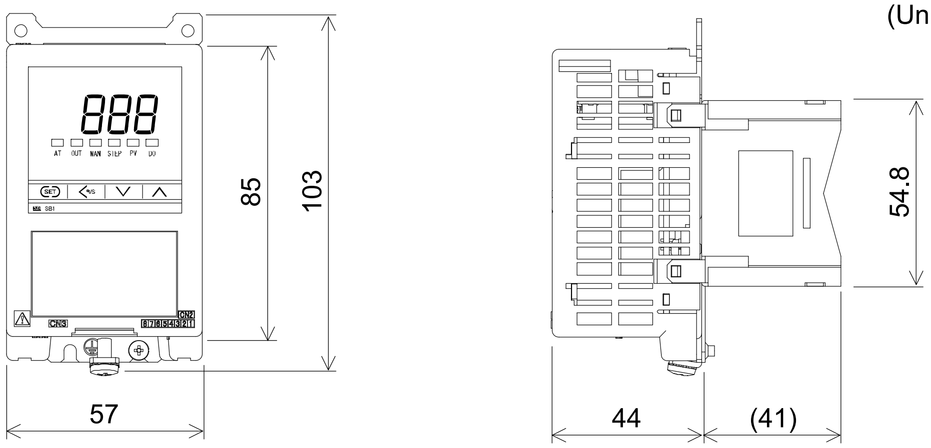
■ DIN rail mounting type

(Unit: mm)



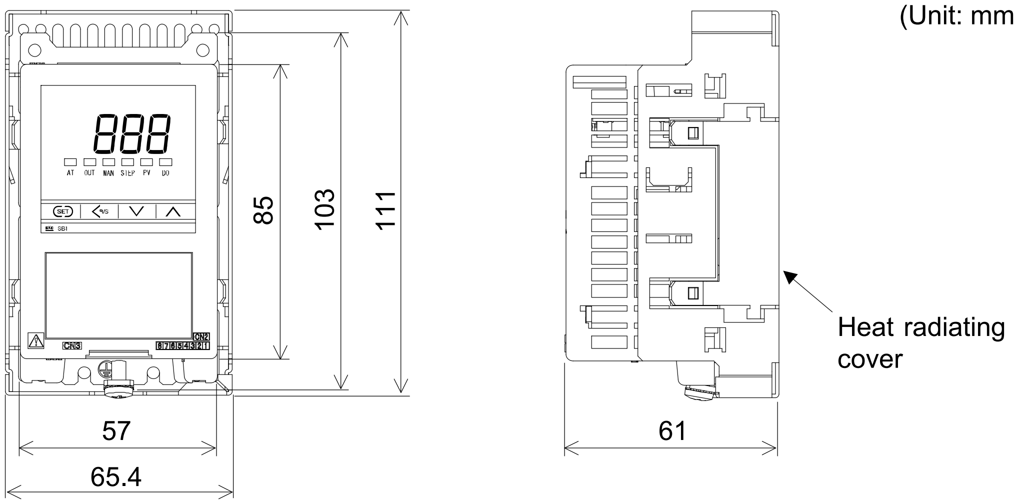
■ Pipe wrapping type

(Unit: mm)



■ Pipe hanging type

(Unit: mm)



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.).

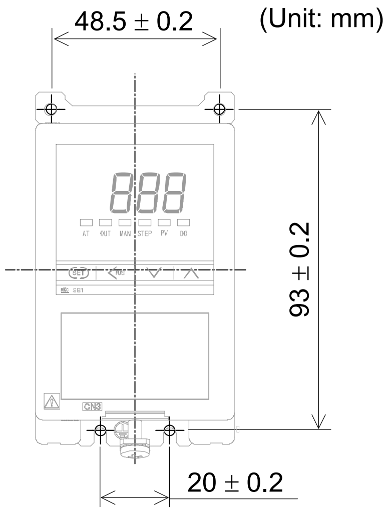


Fig. 2-3-1

■ 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)

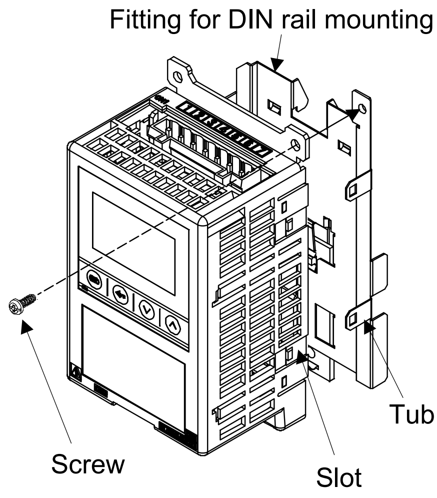


Fig. 2-3-2

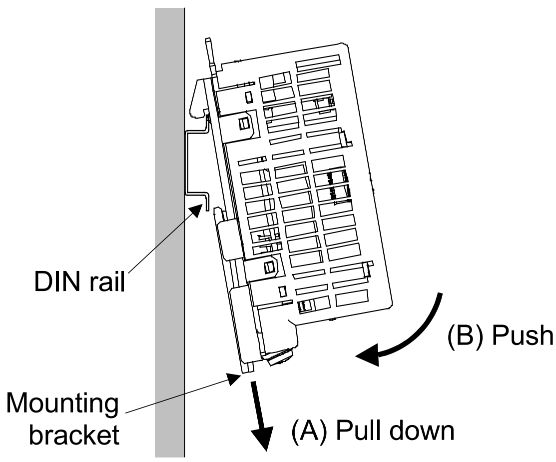


Fig. 2-3-3

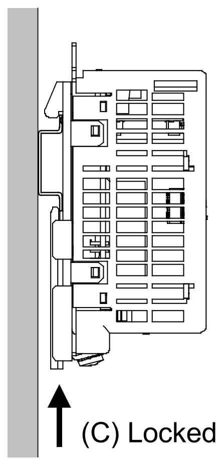


Fig. 2-3-4

■ 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)

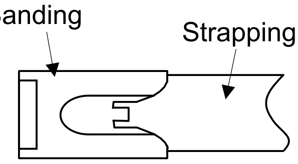


Fig. 2-3-5

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)

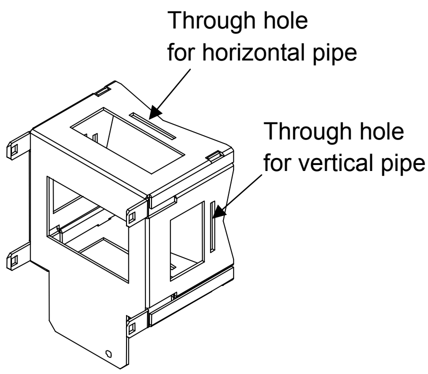


Fig 2-3-6 Fitting for pipe wrapping type

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.

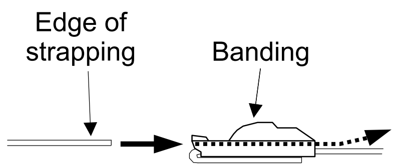


Fig. 2-3-7 Side view

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.

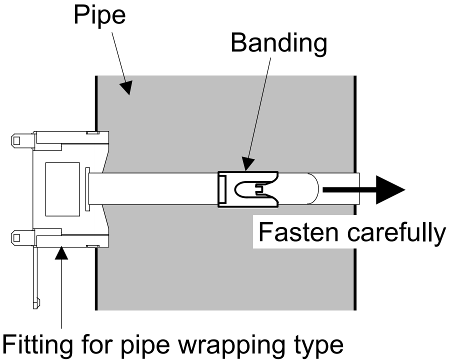


Fig. 2-3-8

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)

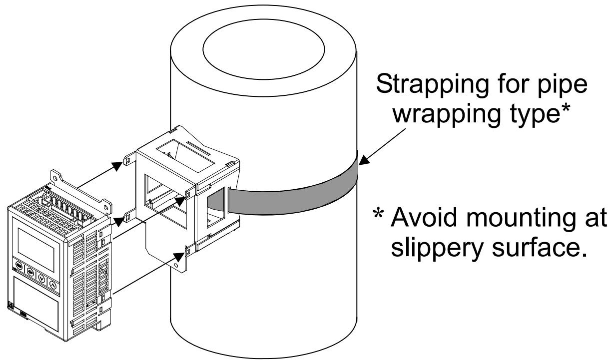


Fig. 2-3-9

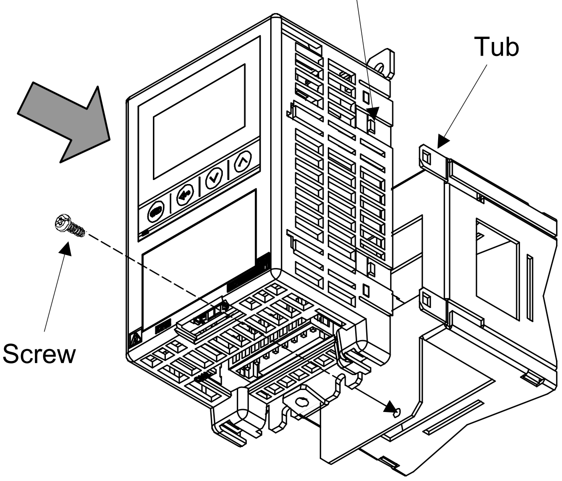


Fig. 2-3-10

■ 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)

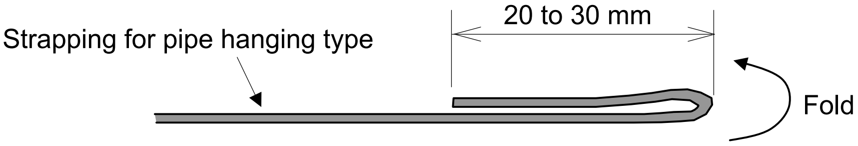


Fig. 2-3-11

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)

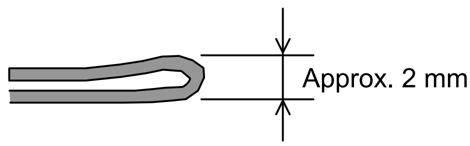


Fig. 2-3-12

3. Secure the strapping by inserting an edge from inside of the Heat radiating cover. (Fig. 2-3-13)

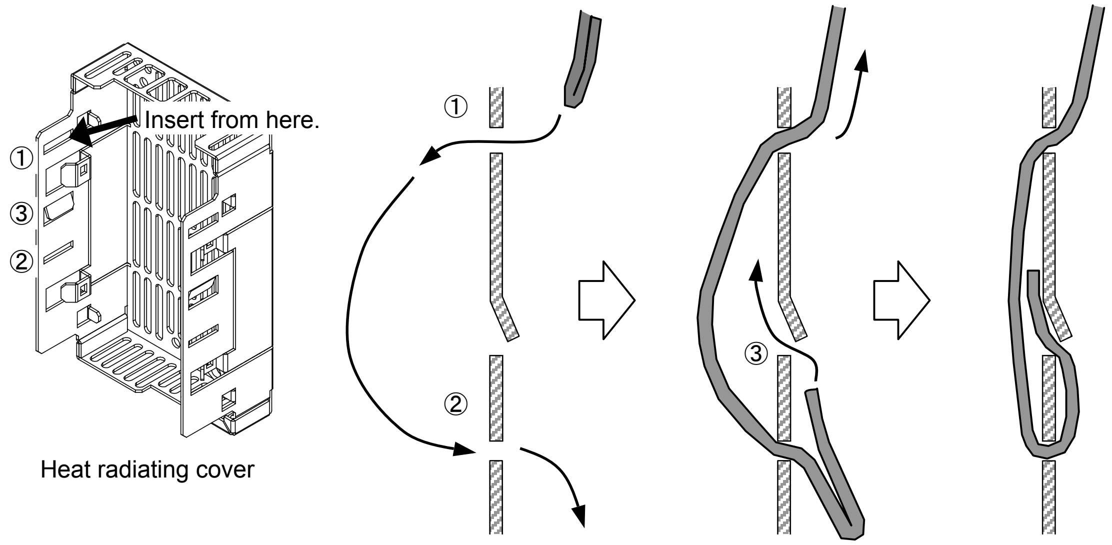


Fig.2-3-13 Mounting method of strapping

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)

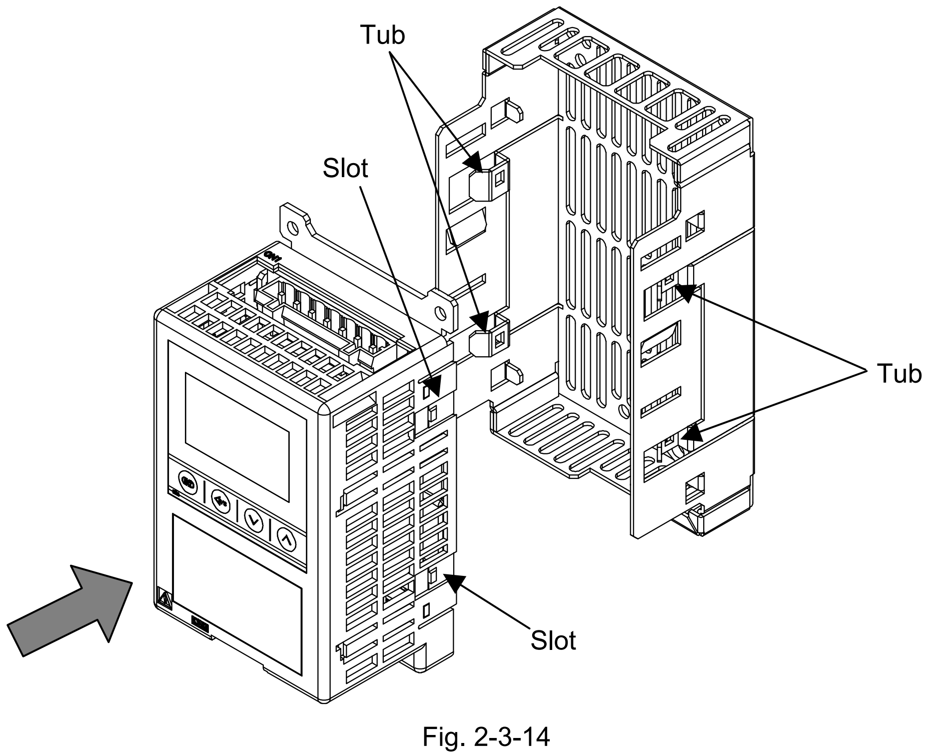


Fig. 2-3-14

- **Mounting space of SB1**

For pipe hanging type, allow sufficient space (200 mm or more) between the instruments for heat radiation.

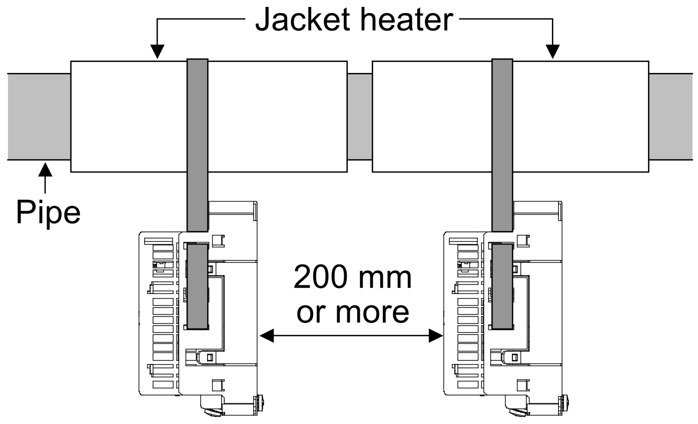


Fig. 2-3-15

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.

WIRING 3

This chapter describes wiring cautions, wiring layout and wiring of terminals.

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)

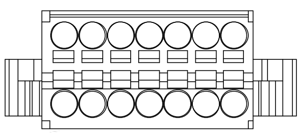
  Model code: SB1P-C02 (Manufactured by WAGO Corporation: 721-2107/037-000)

  Compatible cable diameter:

  12 AWG (2.5 mm^2)

  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)

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

Model code: SB1P-C01 (Manufactured by WAGO Corporation: 734-108/037-000)

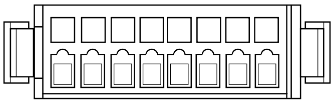
Compatible cable diameter:

14 AWG (1.5 mm^2)

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)

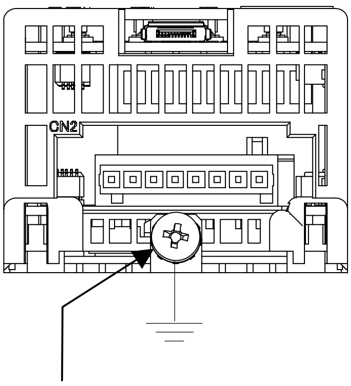


Measured input/Control output connector
Model code: SB1P-C01
(Manufactured by WAGO Corporation: 734-108/037-000)

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



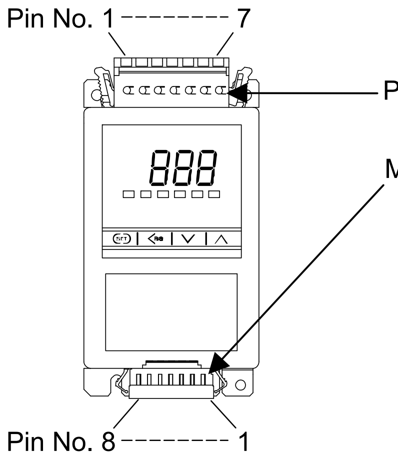
Protective Earth (PE) Terminal

SB1 bottom view

- 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 mm^2 for earth lines.

3.3 Terminal Layout

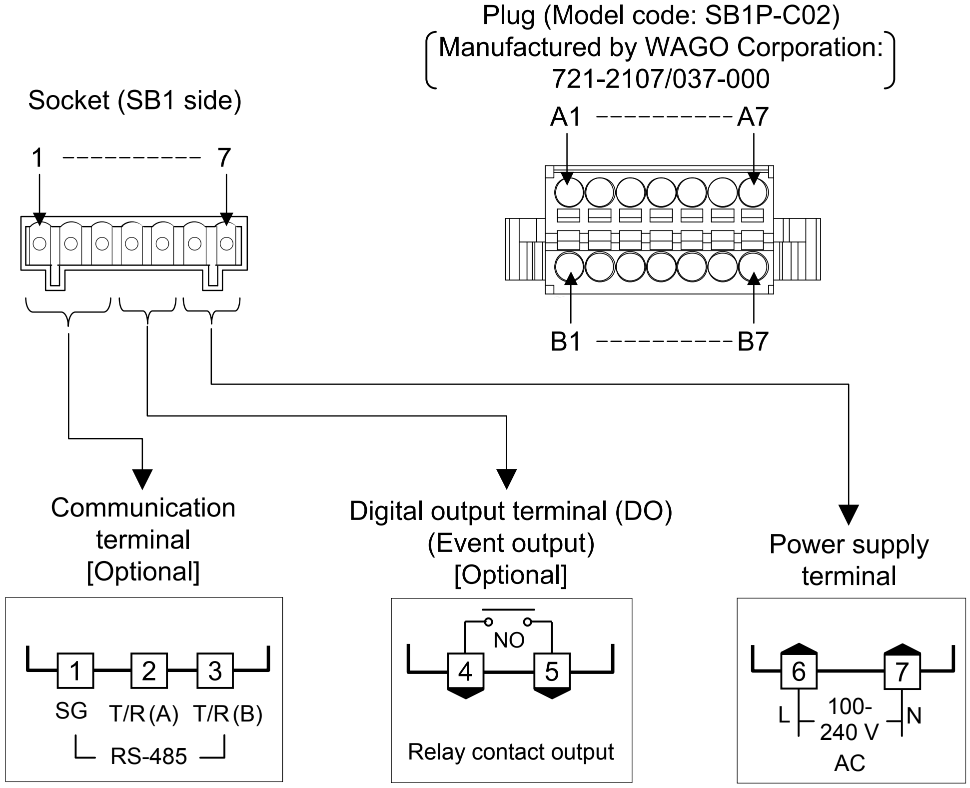
■ Connector configuration

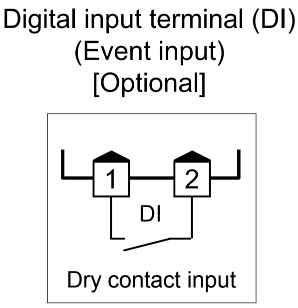


NOTE

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

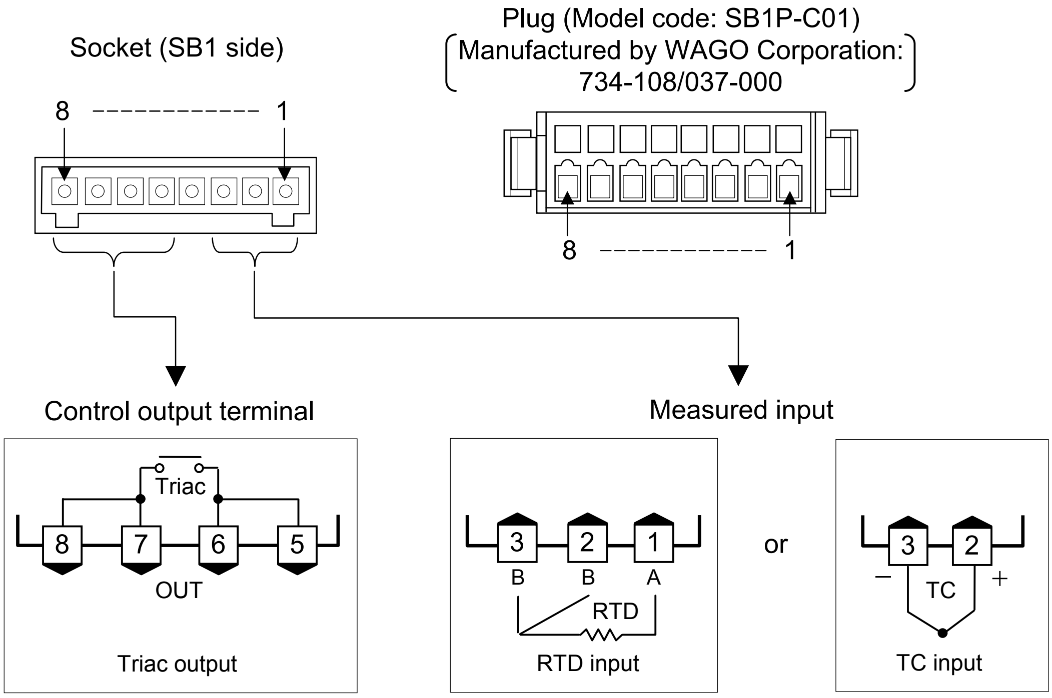
■ Power supply/Event input/Event output/Communication connector (upper-side)





- 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.

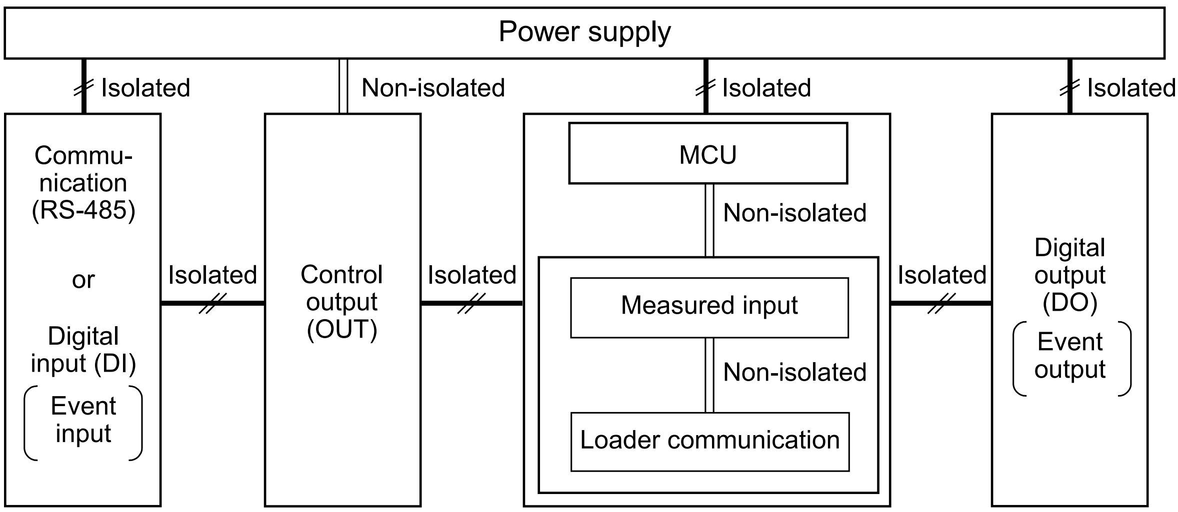
■ Measured input/Control output connector (lower-side)



- 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

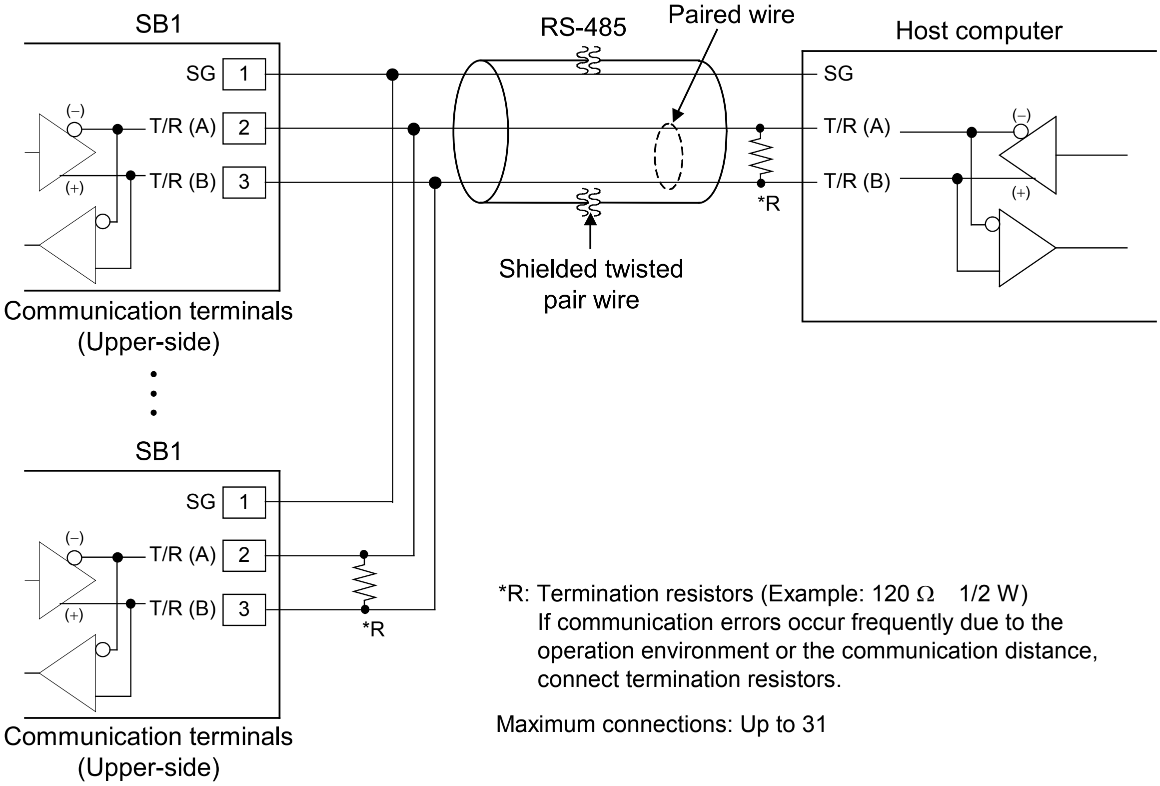
This section describes the wiring for setting or monitoring data of SB1 by the Host computer.

■ 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



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

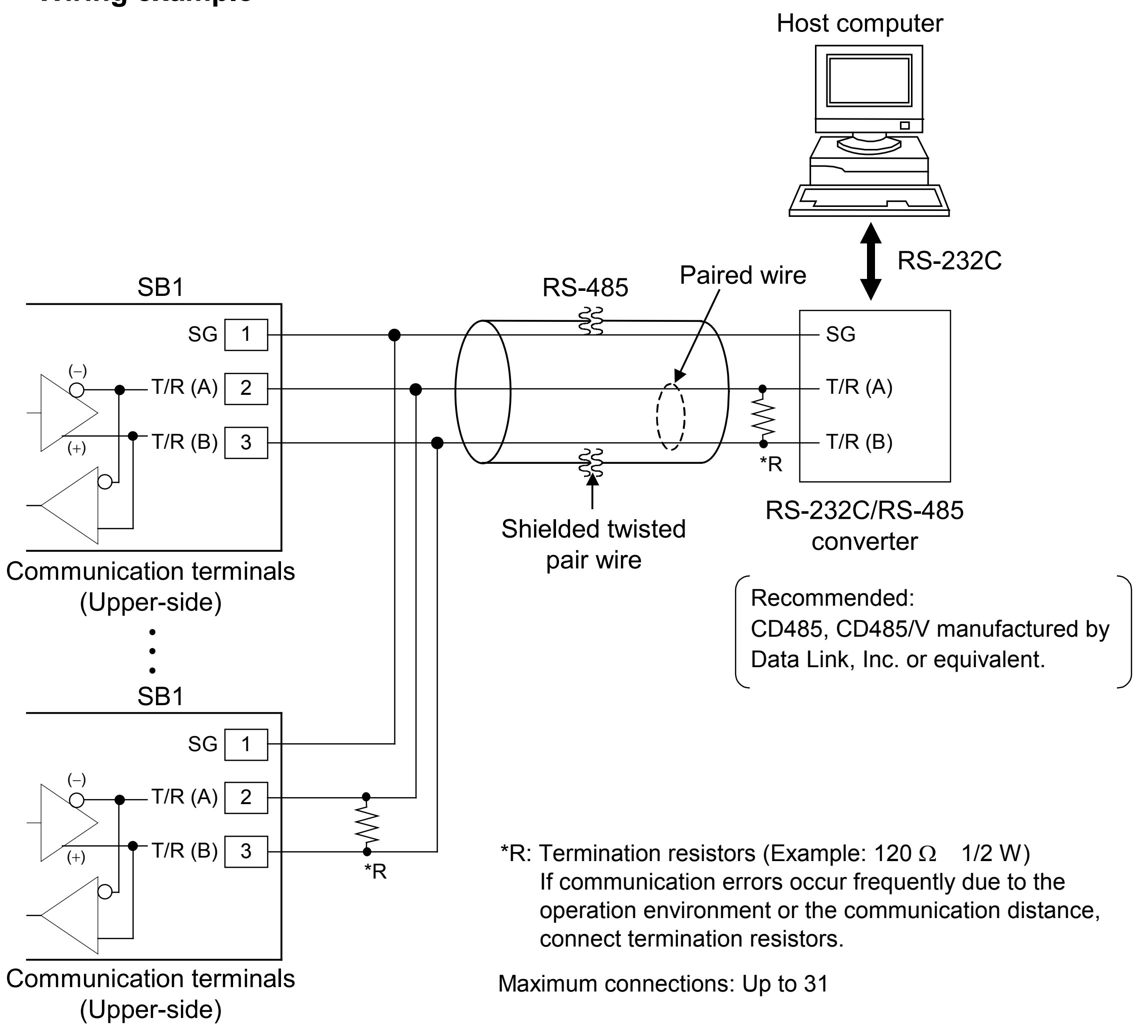
■ Connection to the RS-232C port of the host computer

Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.

● Communication pin number and signal details

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



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

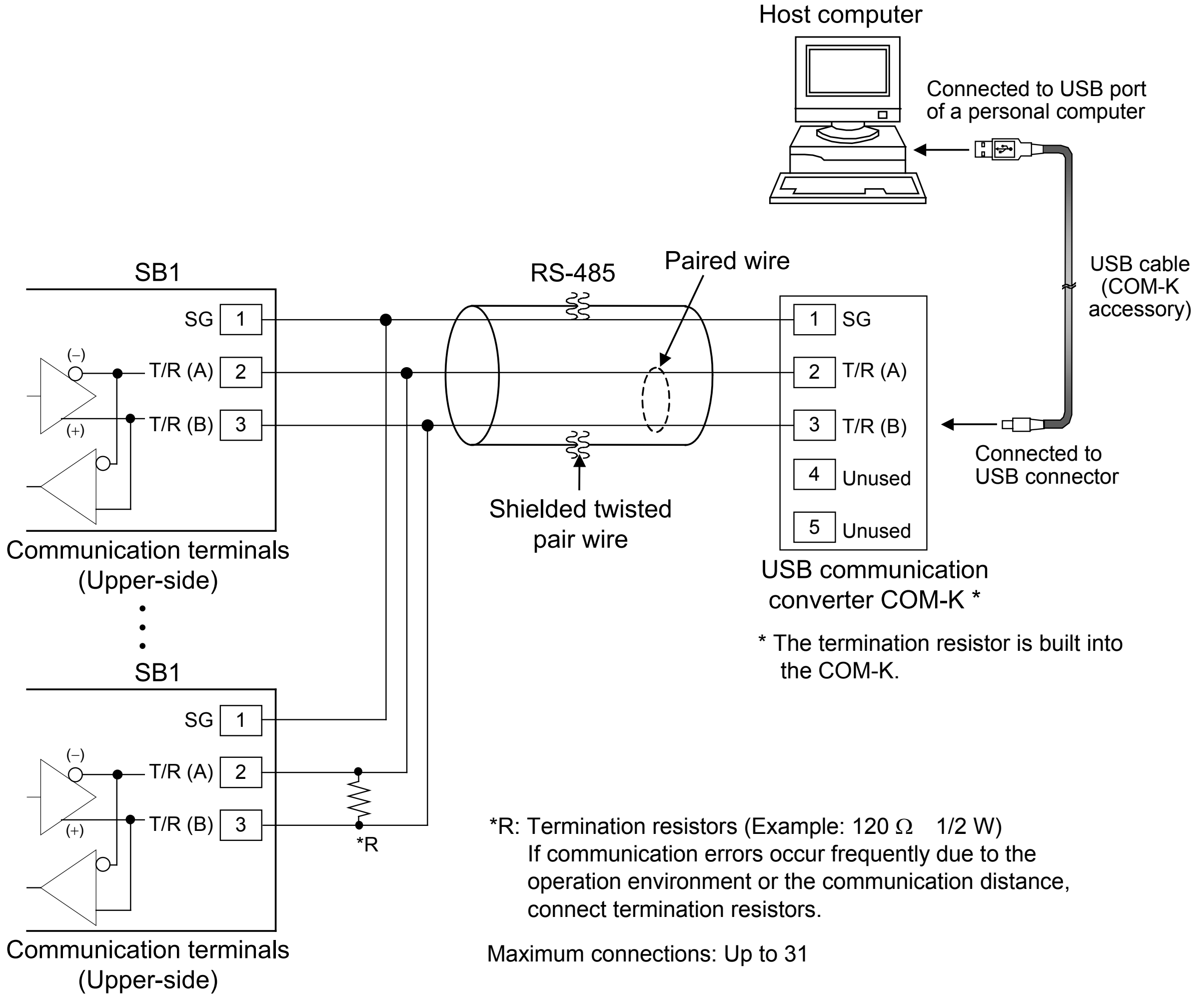
■ Connection to the USB of the host computer

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.

● 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



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.

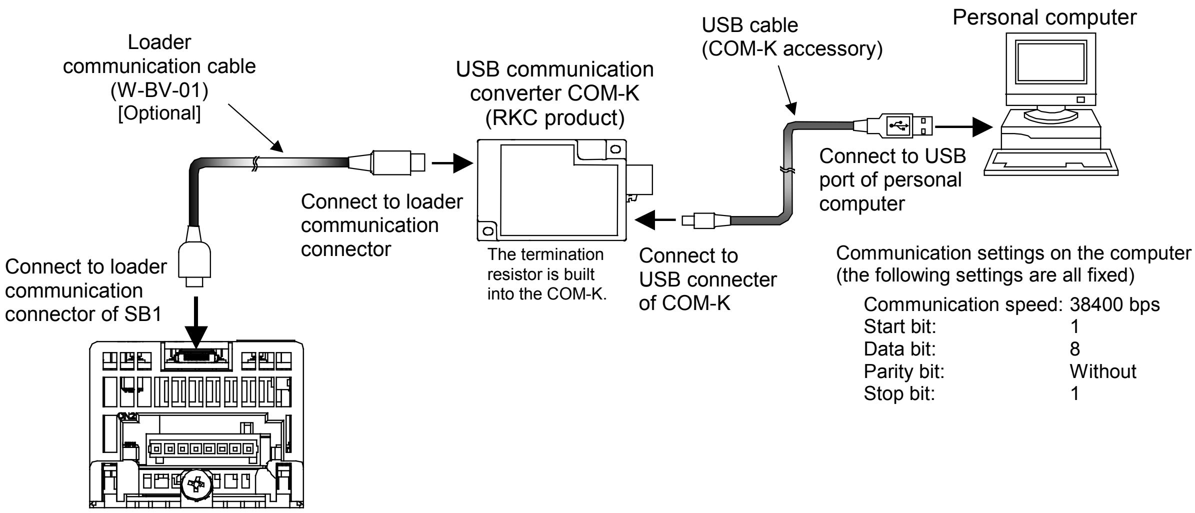
3.5 Connections for Loader Communication

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])



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□)**.

BASIC OPERATION

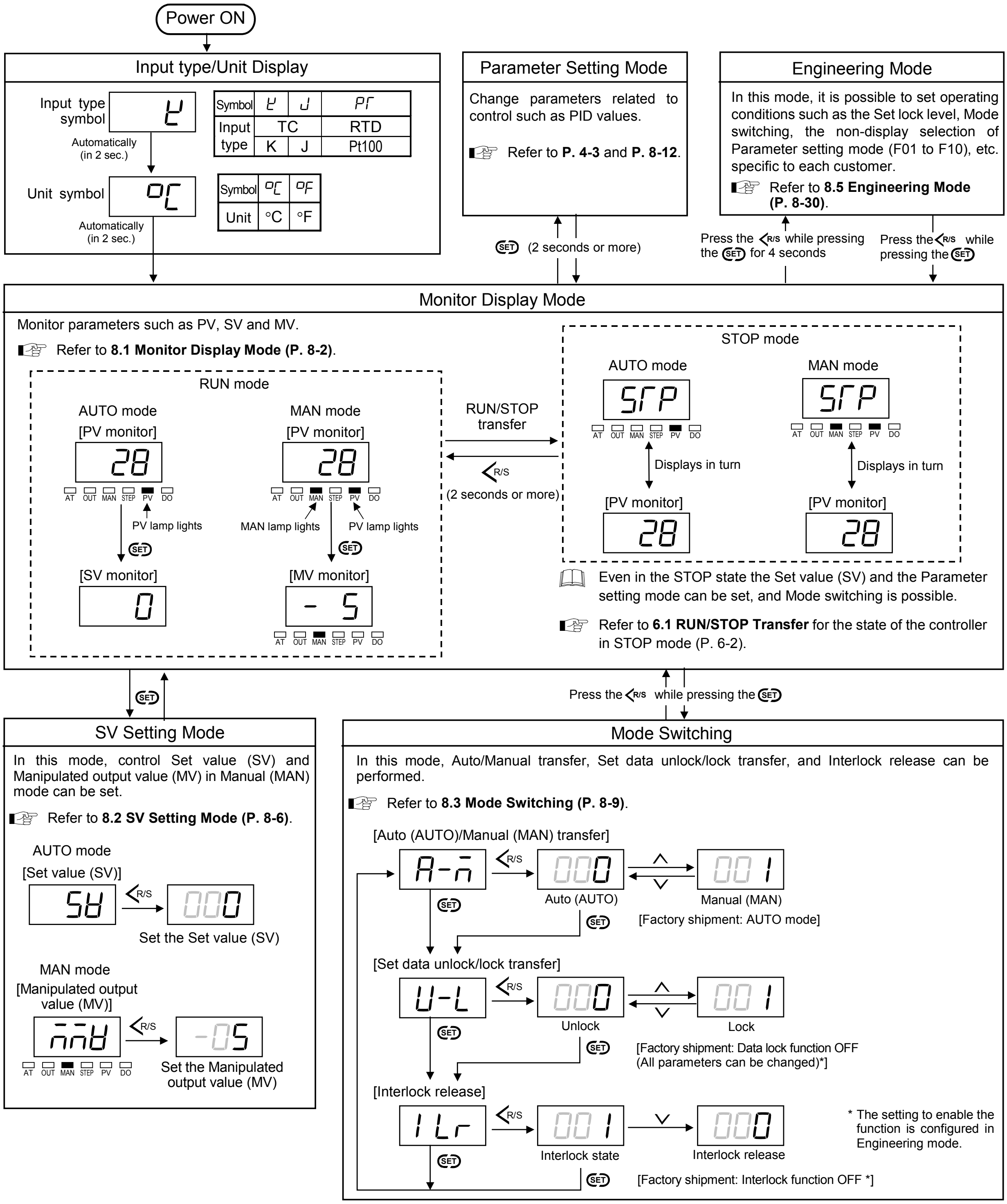
4

This chapter explains the basic operations of switching modes and changing set values.

4.1 Operation Menu

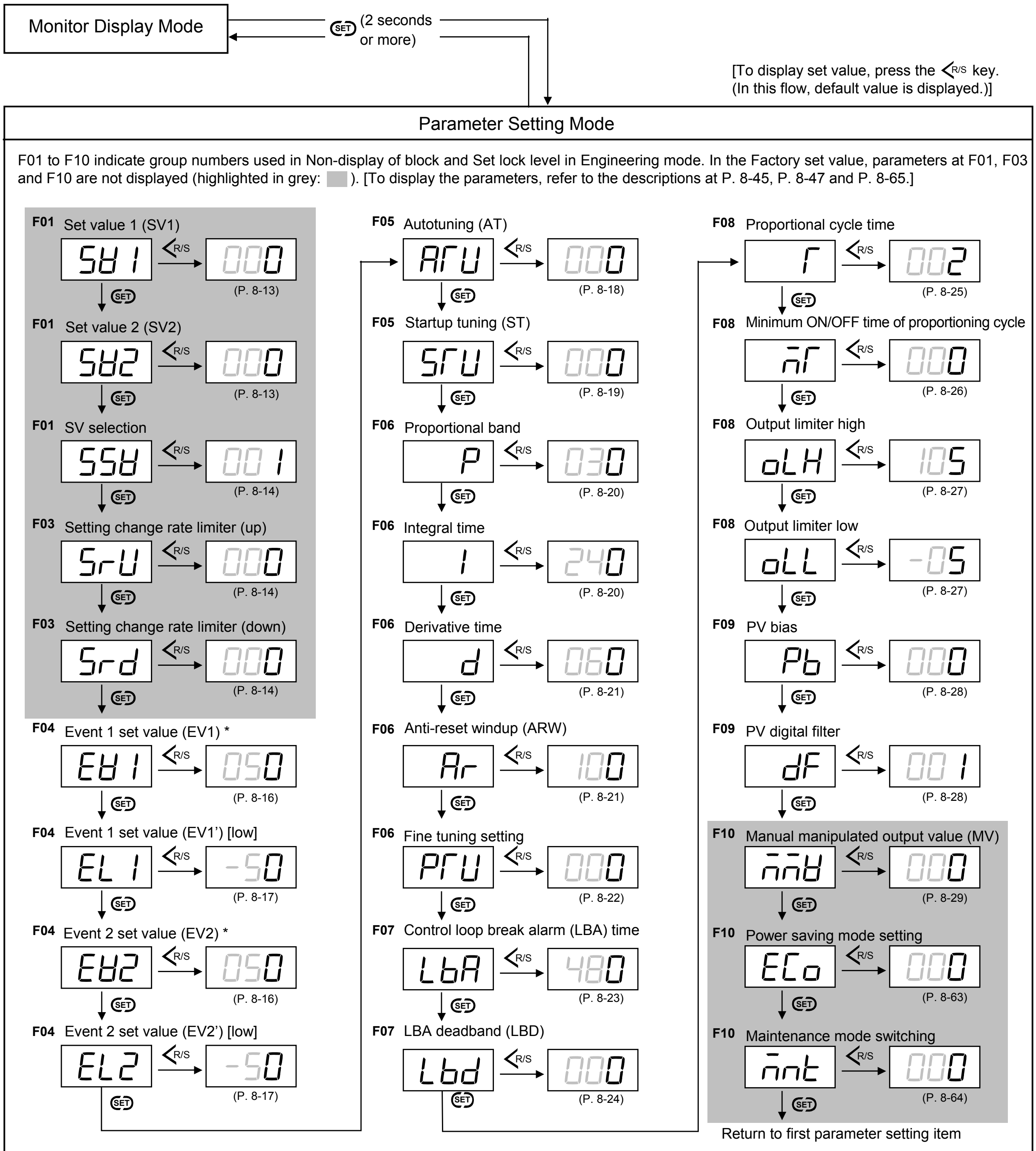
The controller has five different modes. All settable parameters belong to one of them.
The following chart show how to access different setting mode.

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



📖 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.

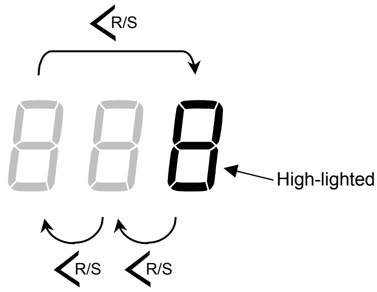


* If any of the following Event functions are selected, this parameter will be Event □ set value (EV□) [high].
(Event number at parameter setting shows up in □.)

- Band (High/Low individual setting) [Event type code: U]
- Deviation high/low (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]

4.2 Changing Set Value

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

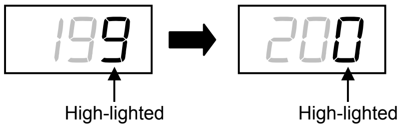


- The following is also available when changing the set value.

Increase SV from 199 °C to 200 °C:

1. Press the R/S key to high-lighted the ones place (first digit from the right).

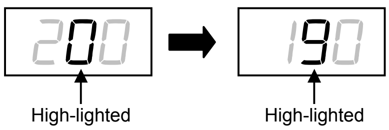
2. Press the ∧ key to change to 0.
The display changes to 200.



Decrease SV from 200 °C to 190 °C:

1. Press the R/S key to high-lighted the tens place.

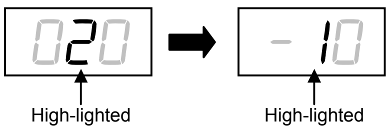
2. Press the ∨ key to change to 9.
The display changes to 190.



Decrease SV from 20 °C to –10 °C:

1. Press the R/S key to high-lighted the tens place.

2. Press the ∨ key (three times) to change to −1.
The display changes to −10.



- **To store a new value for the parameter, always press the 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 ∧ and ∨ keys, the 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.

SETUP PROCEDURES PRIOR TO RUNNING THE INSTRUMENT

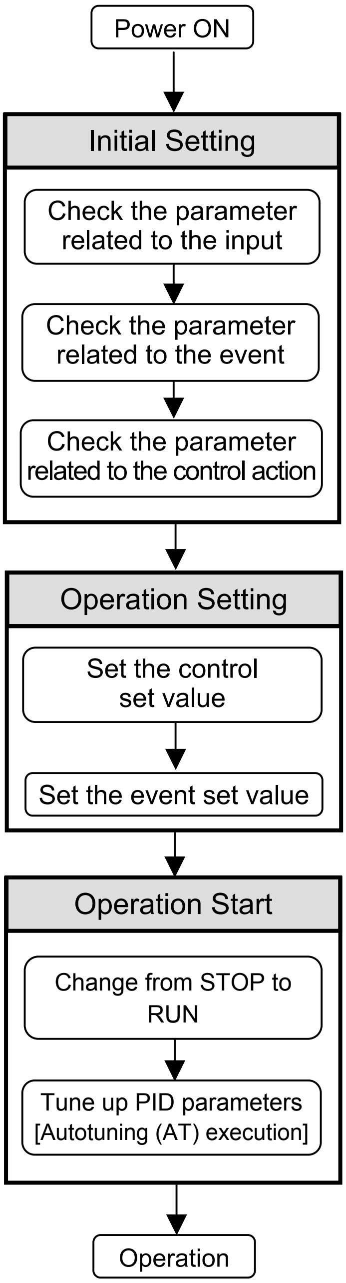
5

This chapter explains basic setup procedures prior to running the instrument.

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



☞ 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)**.

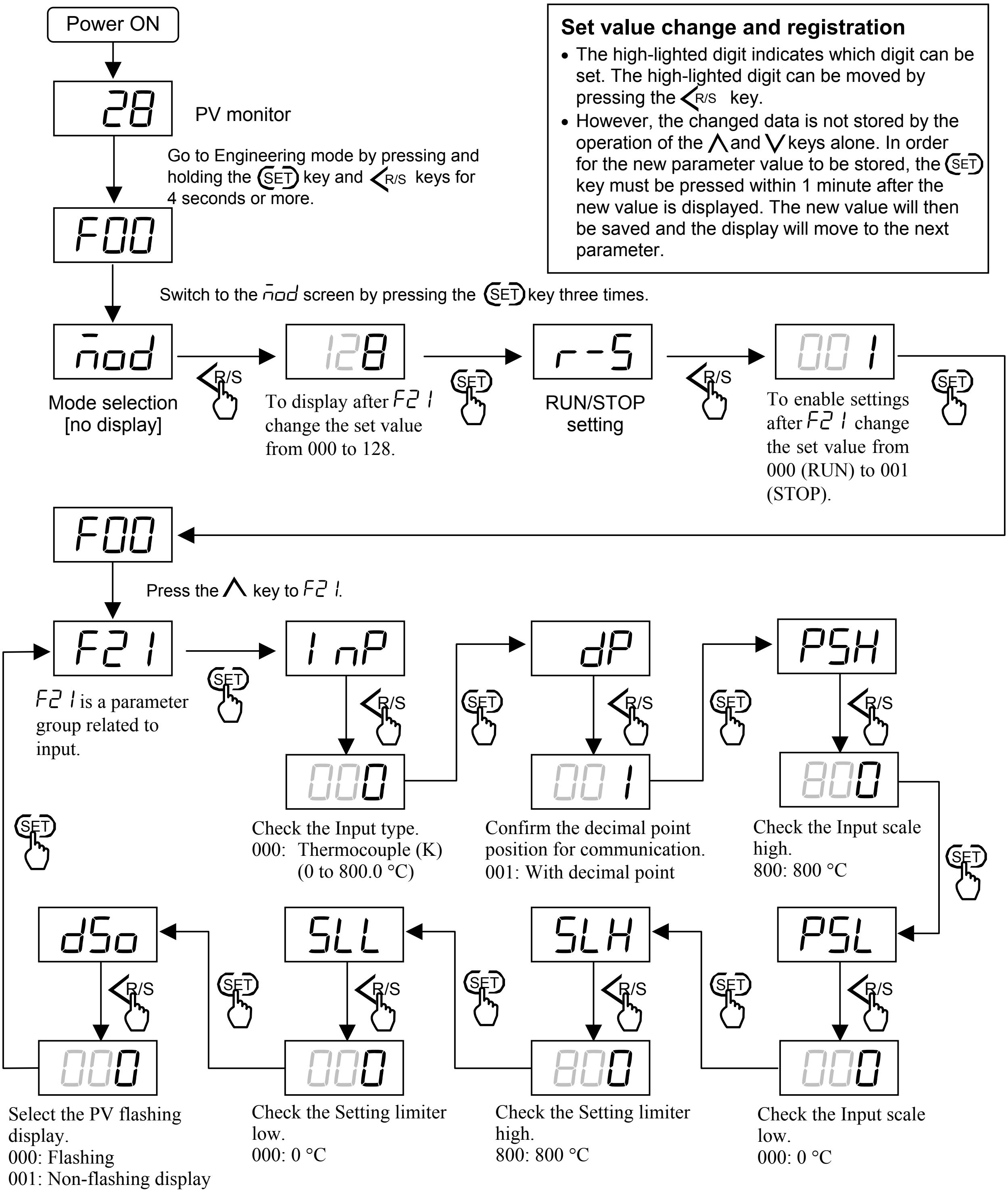
☞ For operation start, refer to **5.3 Operation Start (P. 5-8)**.

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]



☞ For input types, refer to **Input type (P. 8-66)**.

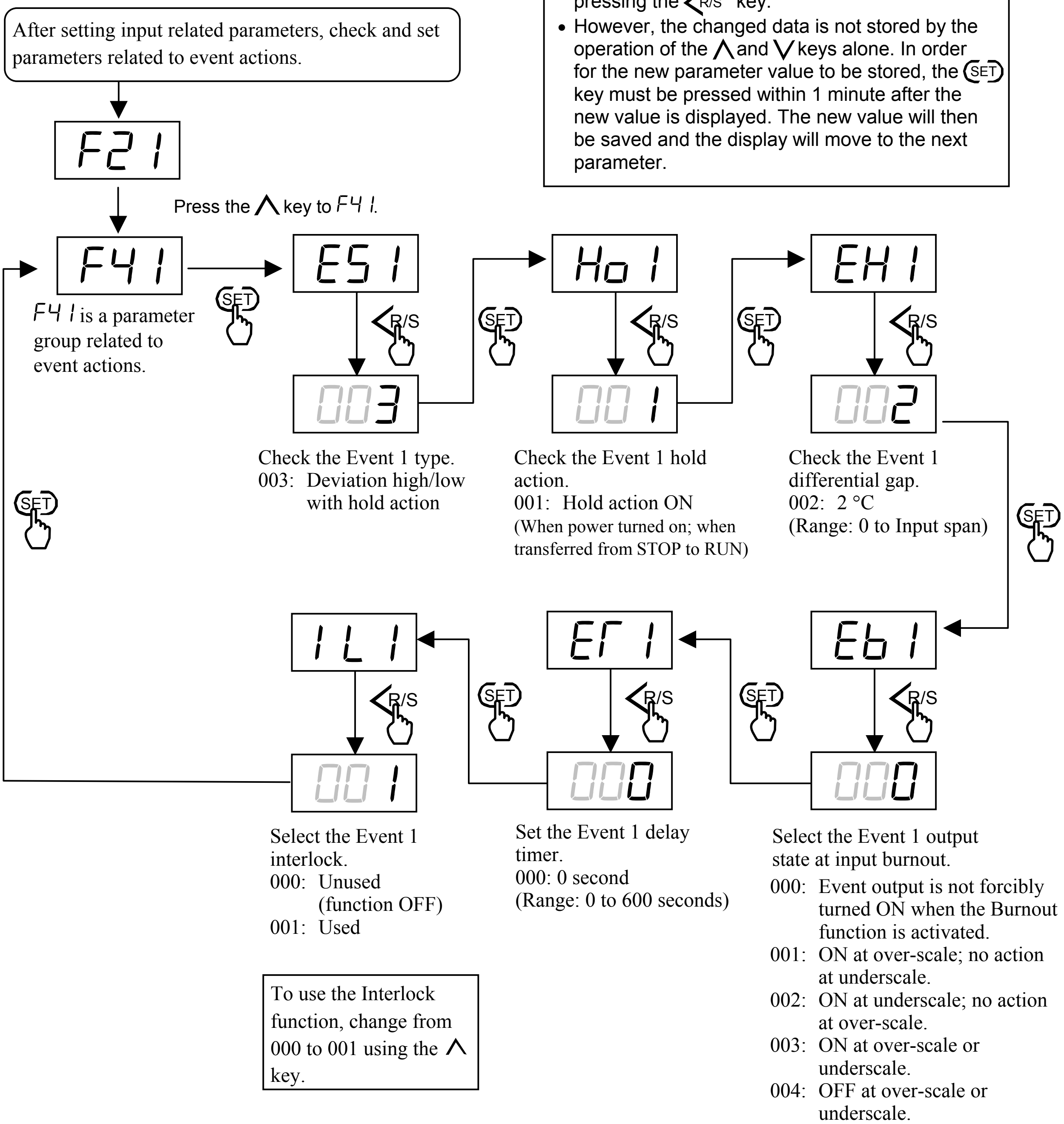
■ Check the parameter related to the event

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 <R/S key.
- However, the changed data is not stored by 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.



☞ For Event 1 parameter, refer to **Function block 41 (F41) (P. 8-73 to 8-89).**

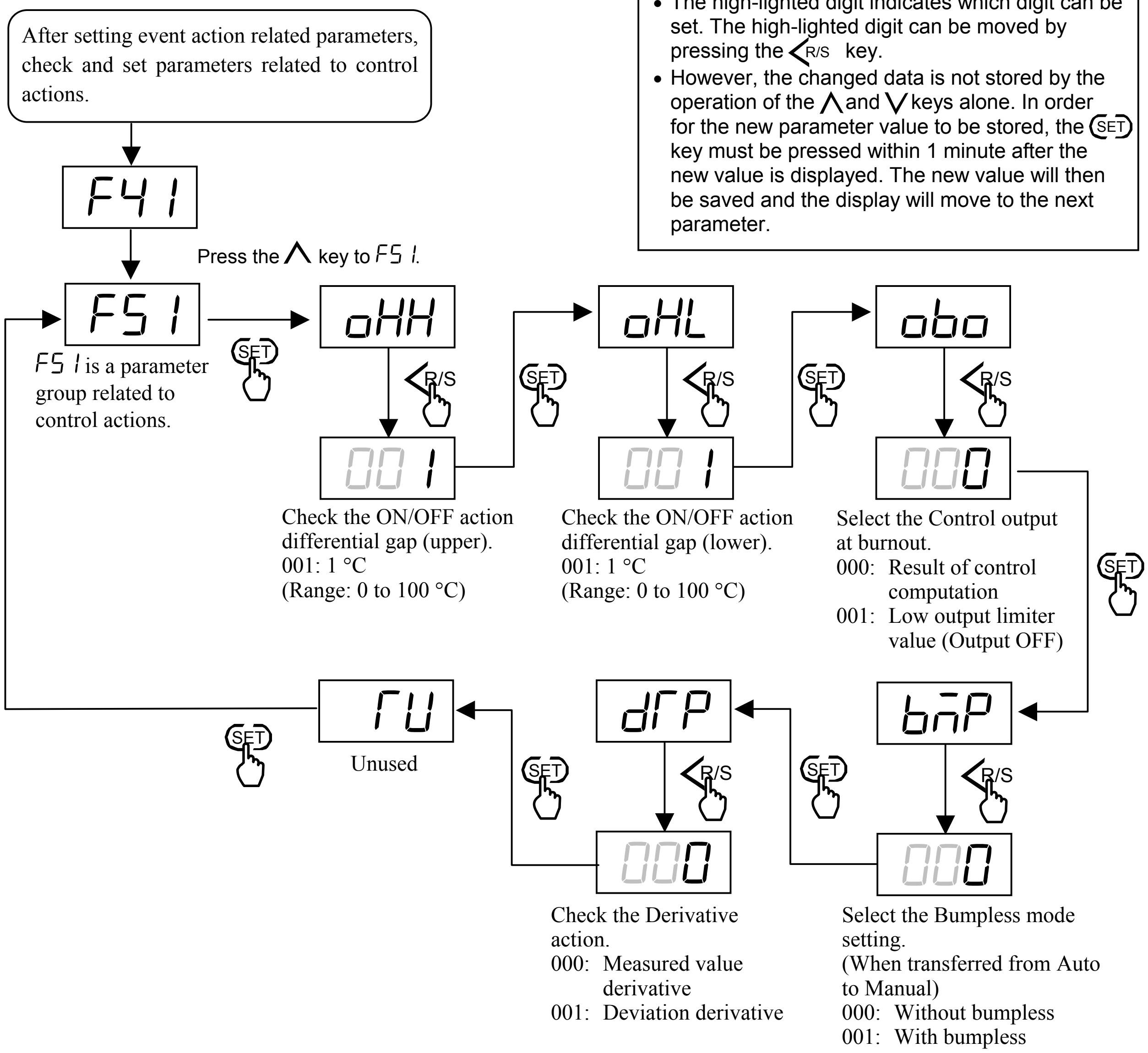
■ Check the parameter related to the control action

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 R/S key.
- However, the changed data is not stored by 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.



☞ 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 nod screen of F00 and change from “128” to “000.”

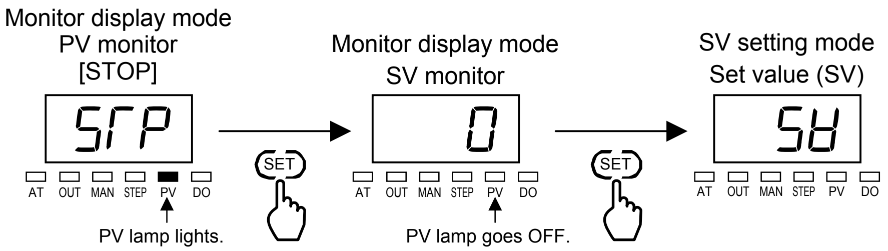
5.2 Operation Setting

■ Set the control set value

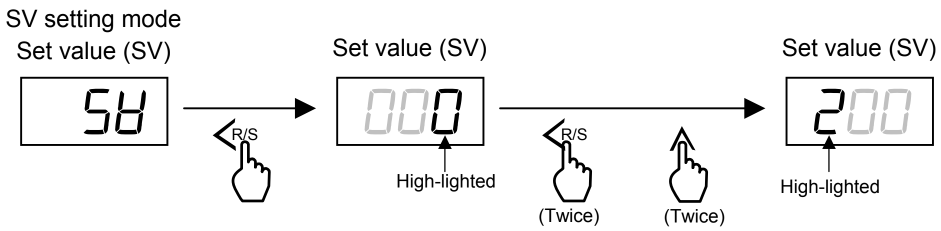
After finishing the initial settings, set the control target value, SV.

[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.

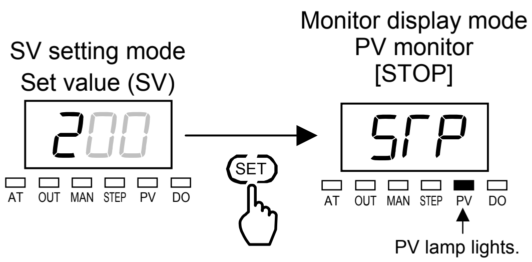


2. Press the R/S key to switch to the settable mode. Then change the Set value (SV) to 200 °C by using the R/S key and the ∧ key.



Setting range:
Setting limiter low to Setting limiter high
[Factory set value: 0 (0.0)]

3. Press the SET key to store the data.



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 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.

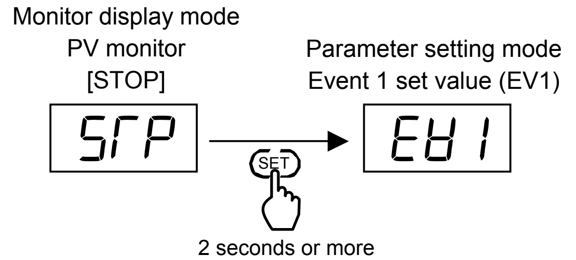
☞ To operate by Set value 2 (SV2) or select Set value (SV) by using Digital input (DI), refer to **7.1 SV selection function (Step SV function) (P. 7-2)**.

■ Set the event set value

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

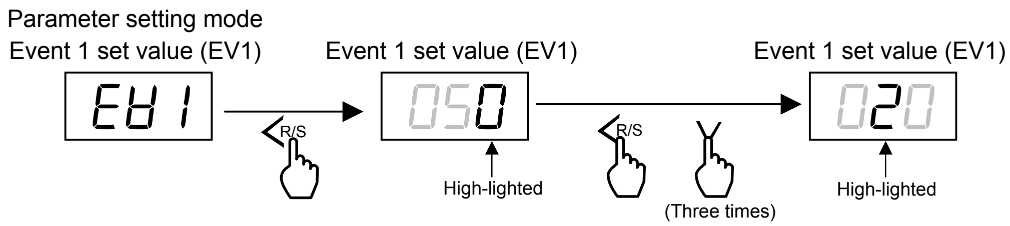
[Setting example: Set the Event 1 set value (EV1) to 20 °C]

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.



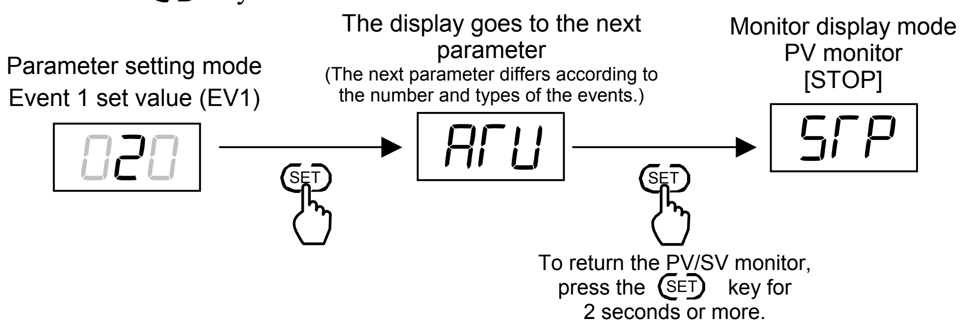
When "0: No event" is selected for the Event type in Engineering mode, the Event setting screen is not displayed.

2. Press the <R/S key to switch to the settable mode. Then change the Set value (SV) to 20 °C by using the <R/S key and the ∨ key.



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.



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 <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.

☞ 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.

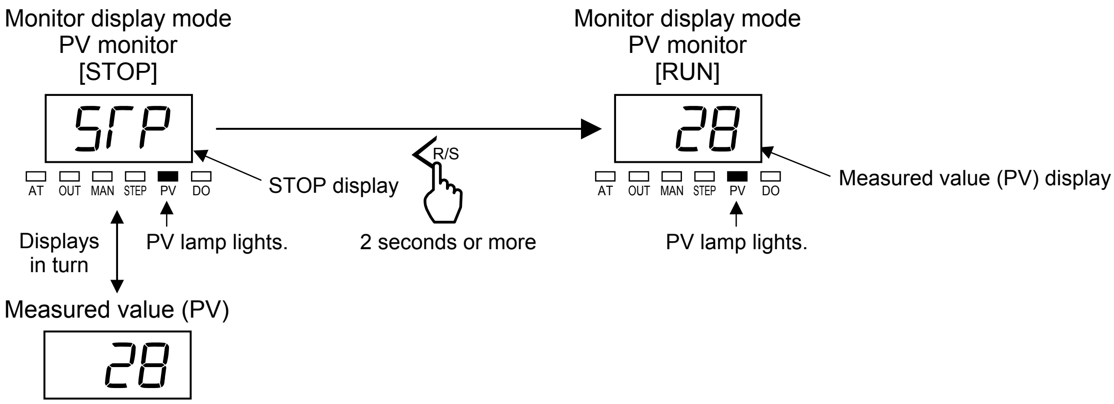
- **In case of AUTO mode**
  Output changes from the Output limiter low with control calculation results.
- **In case of Manual (MAN) mode**
  Output status is defined as follows by the Bumpless mode setting in the Engineering mode.

In case of "0: Without bumpless"	In case of "1: With bumpless" (Factory set value)
Preset manual value is output.	Output limiter low is output.

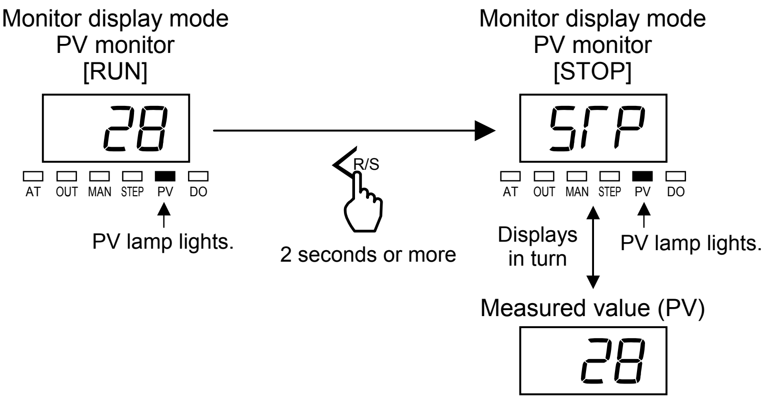
■ Change from STOP to RUN

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

Press and hold the <R/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 <R/S key for 2 seconds or more.



State of this instrument when set to STOP mode

STOP display	Displays STP 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)**.

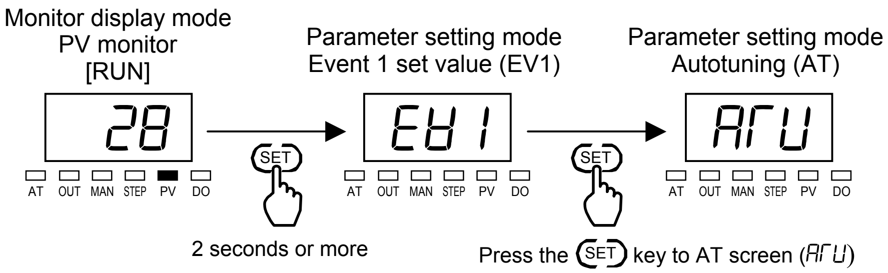
■ Tuning PID parameters

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

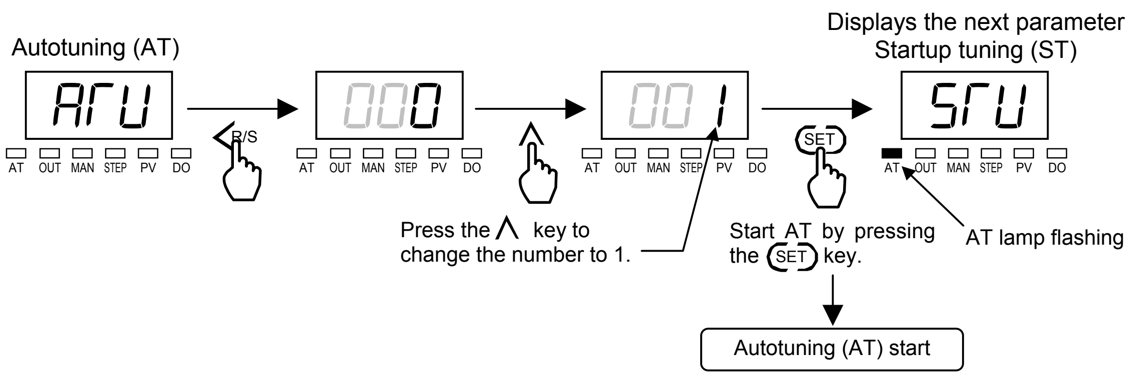
Before start Autotuning, make sure that all required conditions (refer to P. 6-7) to start AT are satisfied.

● Start the Autotuning (AT)

1. Press and hold the 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 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 R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit. Press the SET 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 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 PV monitor screen and the set value will not be changed.

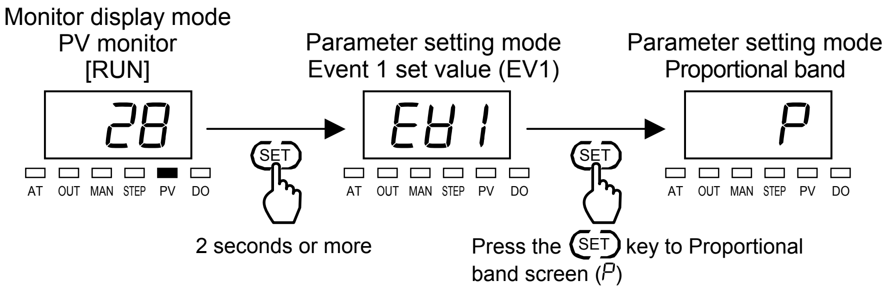
● To manually adjust the PID parameters

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.

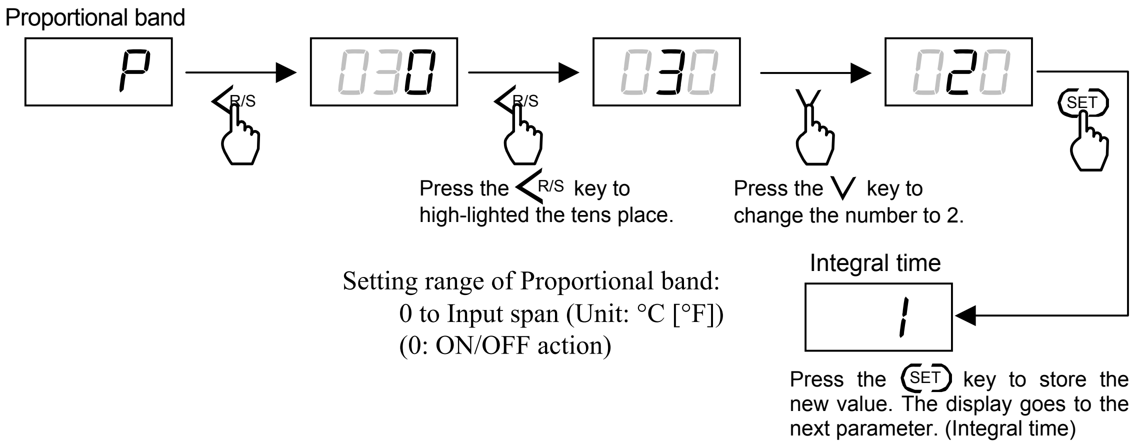
• **Change the Proportional band (P)**

[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.)



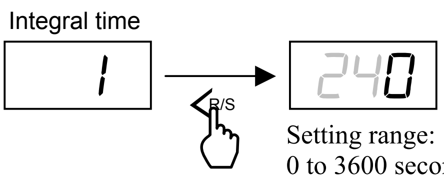
2. Press the R/S key to switch to the settable mode. Then press the R/S key and the ∨ key to change the value of the high-lighted digit. Press the SET key to store the new value.



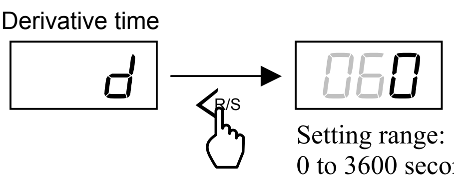
Setting range of Proportional band:
0 to Input span (Unit: °C [°F])
(0: ON/OFF action)

• **Change the Integral time (I) and Derivative time (D)**

The setting procedure applies when the Integral time and the Derivative time are also set.



Setting range:
0 to 3600 seconds
(0: PD action)



Setting range:
0 to 3600 seconds
(0: PI action)

• **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 PV monitor screen and the set value will not be changed.

● Changing control response with Fine tuning

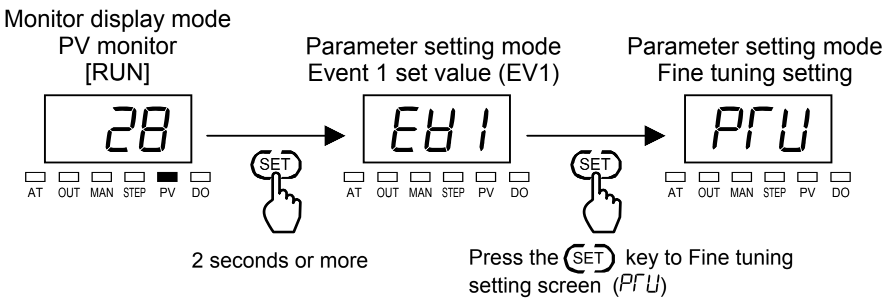
After suitable PID values are calculated and stored by Autotuning or manual PID setting, the Fine tuning allows you to change the control response of the same PID constant control. The control response can be changed from fast to slow by simply changing the Fine tuning setting (6 levels: –3 to +3) in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

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

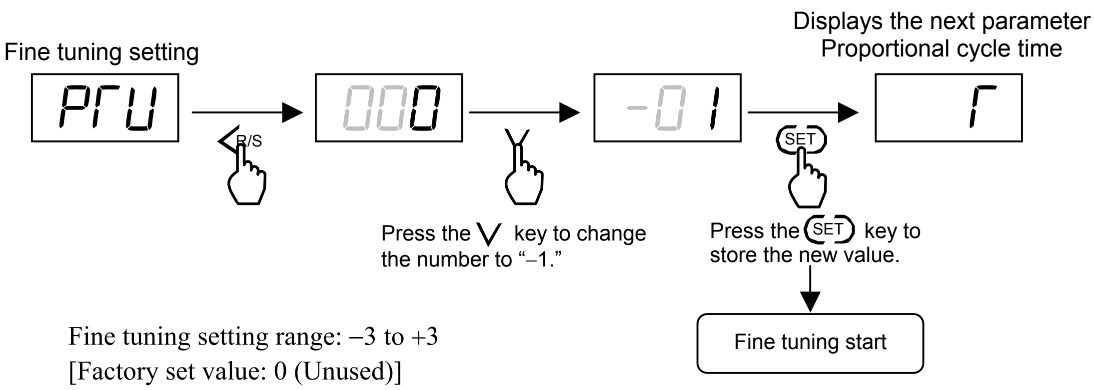
• Fine tuning setting

[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.)



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



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 ∧ and ∨ 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.

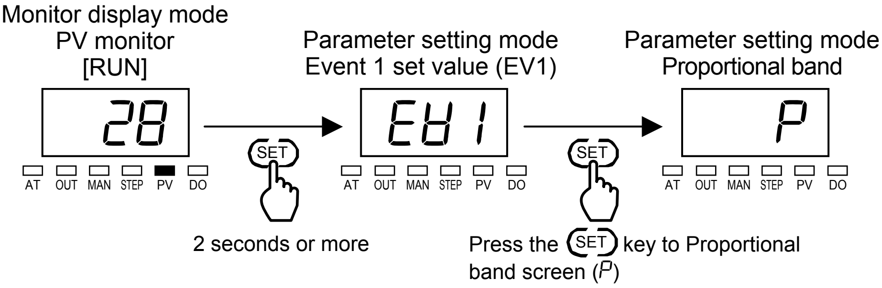
■ To switch to ON/OFF control action

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

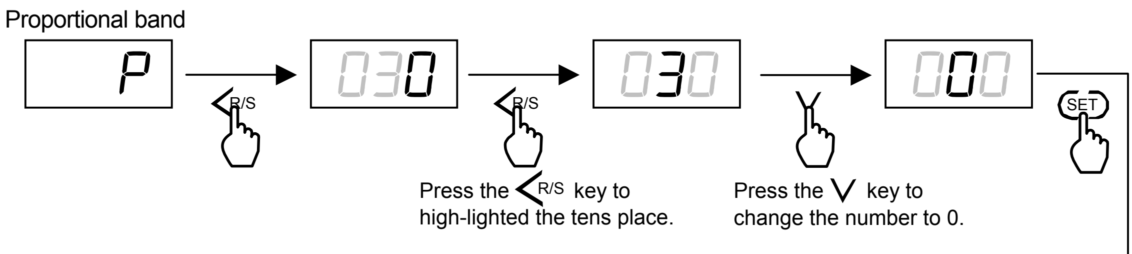
- **Change the Proportional band (P)**

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

1. Press and hold the 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.)



2. Press the <R/S key to switch to the settable mode. Then press the <R/S key and the ∨ key to change the value of the high-lighted digit. Press the 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 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 PV monitor screen and the set value will not be changed.

MEMO

OPERATIONS OF THE BASIC FUNCTIONS

6

This chapter describes the basic functions and the procedures for using basic functions.

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 <R/S 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 <R/S 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**

STOP display	Displays the STOP symbol "5ГP" and Measured value (PV) in turn.
Control output	Output is OFF.
Event output [optional]	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
Autotuning (AT)	AT canceled (The PID constants are not updated)

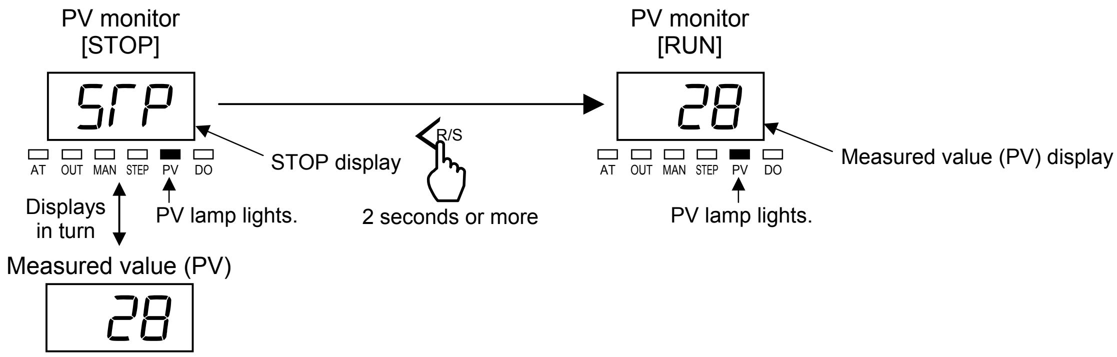
☞ For the settings of Output action at STOP mode, refer to **8.5 Engineering Mode (P. 8-72)**.

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

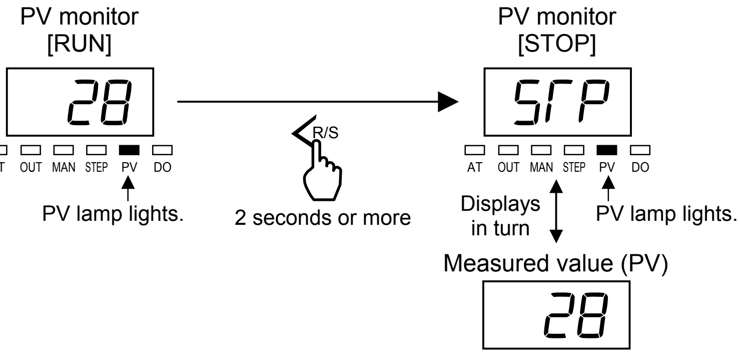
If the instrument is transferred to RUN mode from STOP mode, it performs the same operation (control RUN, event determination start-up) as the power-on.

■ RUN/STOP transfer by front key operation

Press and hold the R/S key for 2 seconds or more at the PV monitor screen and the instrument will switch from STOP to RUN.



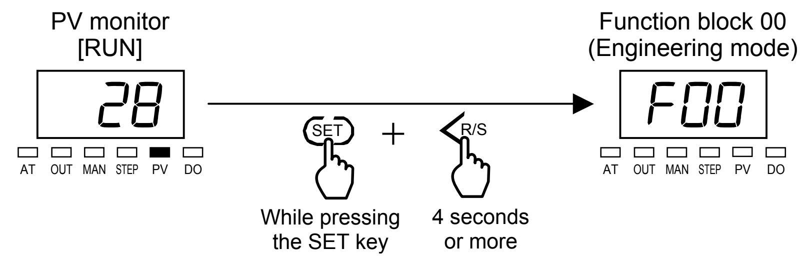
To change from RUN mode to STOP mode, press and hold the R/S key for 2 seconds or more.



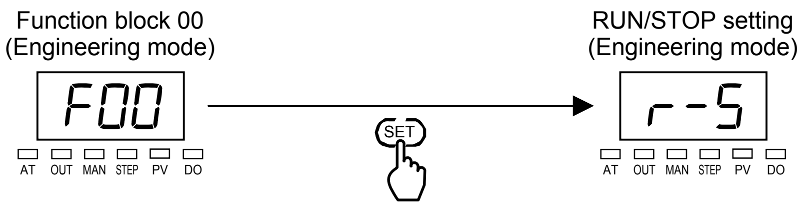
■ Performing RUN/STOP transfer in the "RUN/STOP setting" (Engineering mode)

● To change from RUN mode to STOP mode

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



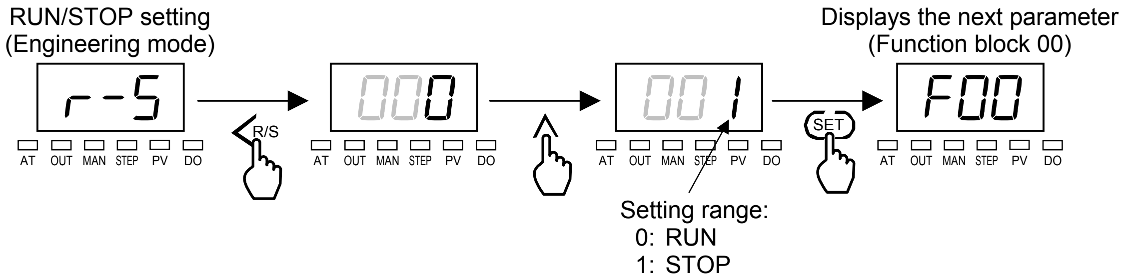
2. Press the SET key four times until RUN/STOP setting screen is displayed.



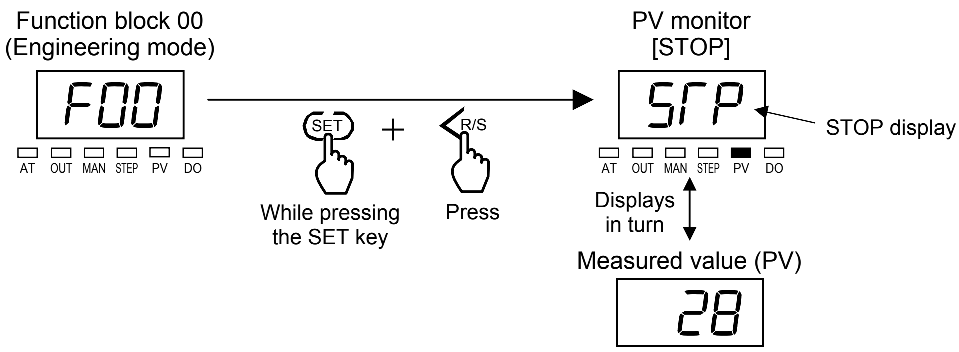
Press the SET key to RUN/STOP setting screen (r--S).

Continued on the next page.

3. Press the R/S key to switch to the settable mode. Then press the ∧ key to set "1" (1: STOP) to the high-lighted digit. Press the SET key to store the new value.

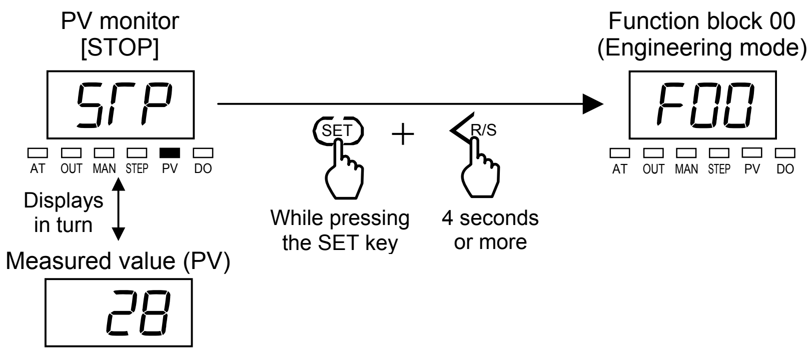


4. To return the PV monitor, press the R/S key while pressing the SET key.

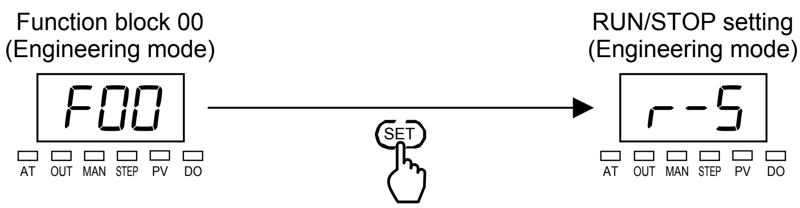


- **To change from STOP mode to RUN mode**

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



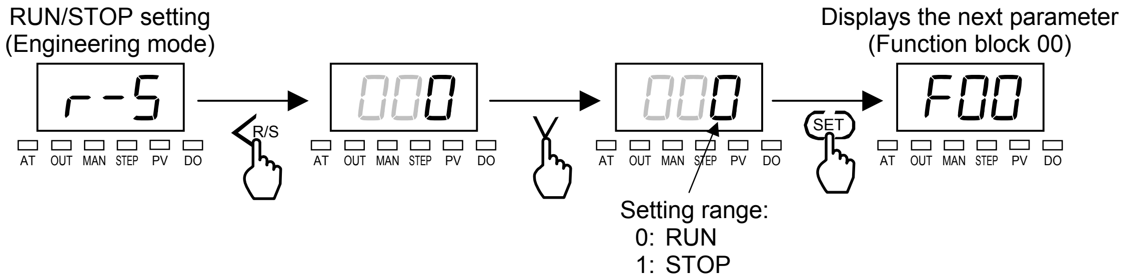
2. Press the SET key four times until RUN/STOP setting screen is displayed.



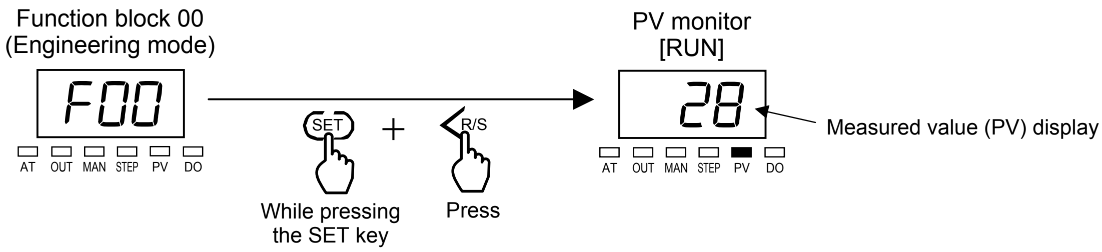
Press the SET key to RUN/STOP setting screen (r-S).

Continued on the next page.

3. Press the <R/S key to switch to the settable mode. Then press the ∨ key to set “0” (0: RUN) to the high-lighted digit. Press the SET key to store the new value.



4. To return the PV monitor, press the <R/S key while pressing the 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.

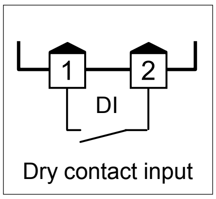
DI assignment

Set value	Contents
0	Unused (No DI assignment)
1	SV selection function (SV1/SV2)
2	RUN/STOP transfer ←
3	AUTO/MAN transfer
4	Interlock release

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

● Terminal configuration

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

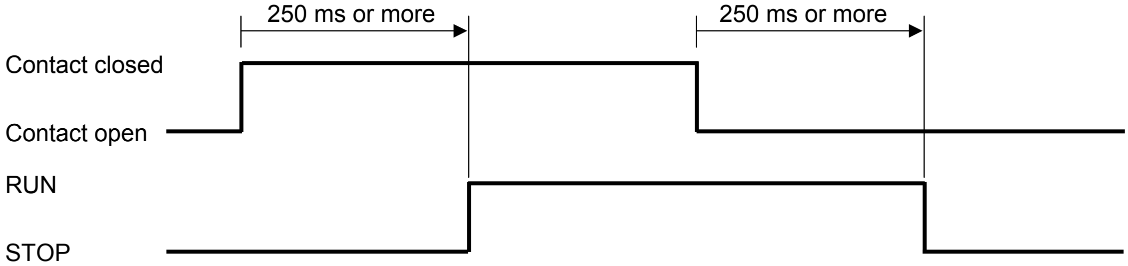


Contact closed: RUN
Contact open: STOP

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 kΩ or more
At ON (contact closed) 10 Ω 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.



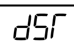
NOTE

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).

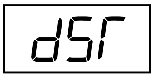
RUN/STOP mode from key operation or communication	RUN/STOP mode by digital input (DI) *	Actual RUN/STOP mode state	State of STOP (character)
RUN	Contact closed (RUN)	RUN	STOP is not displayed
	Contact open (STOP)	STOP	
STOP	Contact closed (RUN)		
	Contact open (STOP)		

* 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.

Operation state	PID control
	RUN
Parameter setting	Output limiter high ≥ 1 %, Output limiter low ≤ 99 %
Input value state	The Measured value (PV) is not underscale or over-scale.

■ 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.

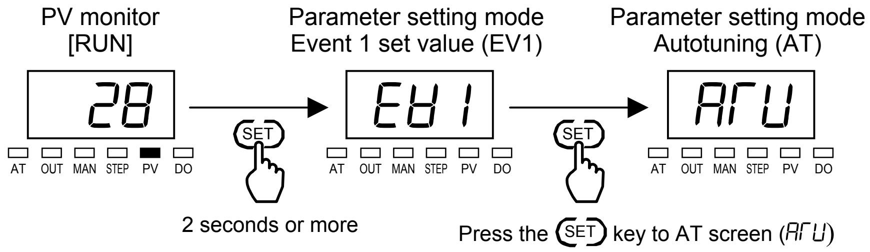
Operation state	When the PID/AT transfer is changed to the PID control.
	When the RUN/STOP mode is changed to the STOP mode.
	When the Auto/Manual mode is changed to the Manual mode.
Parameter changing	When the Set value (SV) is changed.
	When the PV bias or the PV digital filter is changed.
	When the Output limiter value is changed.
Input value state	When the Measured value (PV) goes to underscale or over-scale.
AT execution time	When the Autotuning (AT) does not end in 9 hours after Autotuning (AT) started.
Power failure	When the power failure of more than 10 ms occurs.
Instrument error	When the instrument is in the FAIL state.

■ Autotuning (AT) start/stop operation

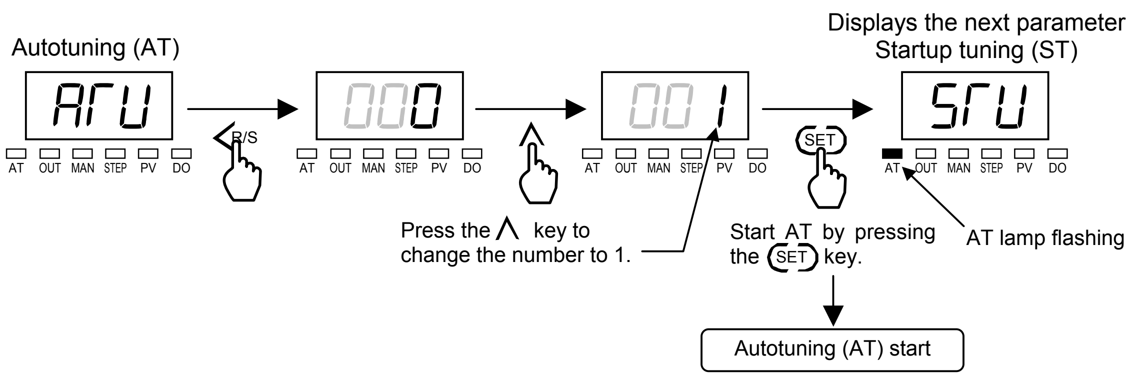
The Autotuning function can start from any state after power on, during a rise in temperature or in stable control.

● Start AT

1. Press and hold the 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 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 R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit. Press the SET key and Autotuning will start. The AT lamp on the front panel will flash.



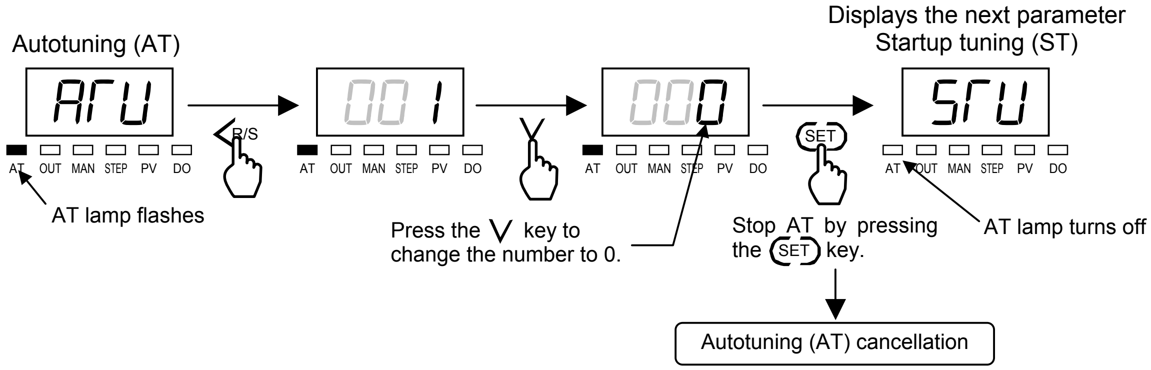
3. When the Autotuning (AT) is finished, the control will automatically returns to PID control and the AT lamp turns off.

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 ∧ and ∨ 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.

- **Autotuning (AT) cancellation**

When canceling the Autotuning function (AT), press the ∨ key to be set to "000" with the Autotuning (AT) screen. Then press the SET key to cancel AT.



- **Return the PV monitor**

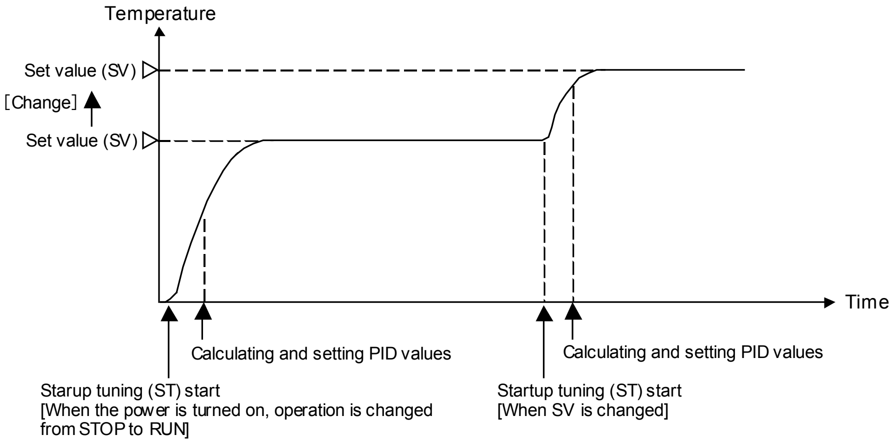
To return the PV monitor, press and hold the SET key for 2 seconds or more.

☞ 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.



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

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

■ 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.

■ Requirements for Startup tuning (ST) start

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

Operation state	PID control
	RUN
Parameter setting	ST is set to ON. (Execute once, Execute always)
	Output limiter high ≥ 1 %, Output limiter low ≤ 99 %
Input value state	The Measured value (PV) is not underscale or over-scale.
	At ST at setting change, the Measured value (PV) shall be stabilized.
Output value state	At startup, output is changed and saturated at the Output limiter high or the Output limiter low.

■ 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.

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

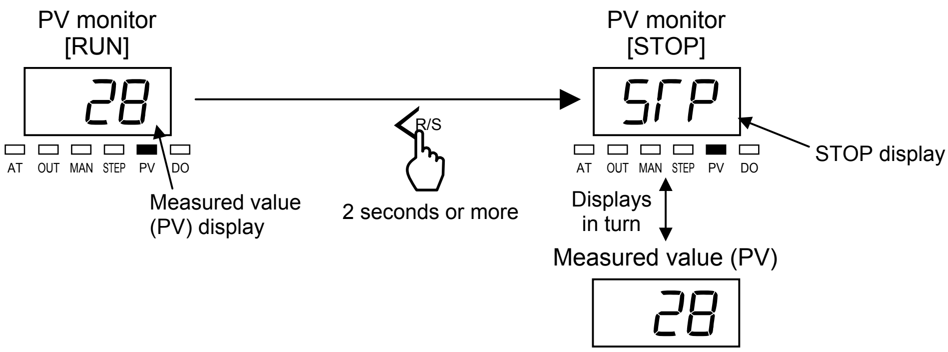
■ Startup tuning (ST) setting

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

● Set the ST start condition

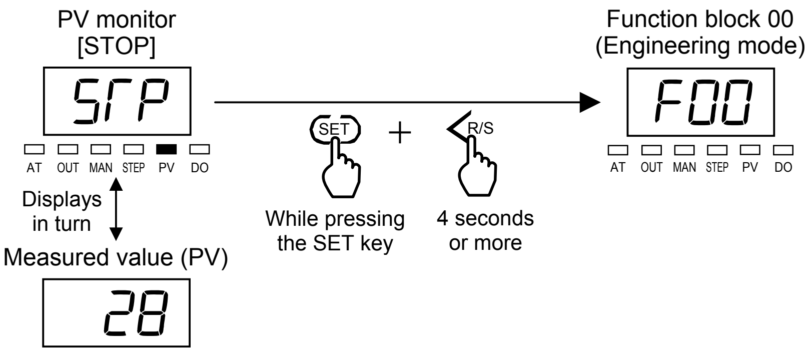
First, set "When the power is turn on" to ST start condition by Engineering mode.

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



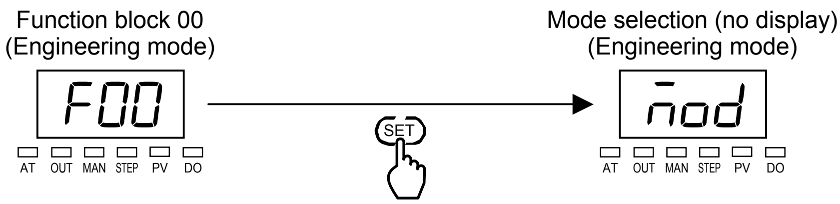
☞ To change from RUN mode to STOP mode, refer to **6.1 RUN/STOP Transfer (P. 6-3)**.

2. Press the R/S key while pressing the SET 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.

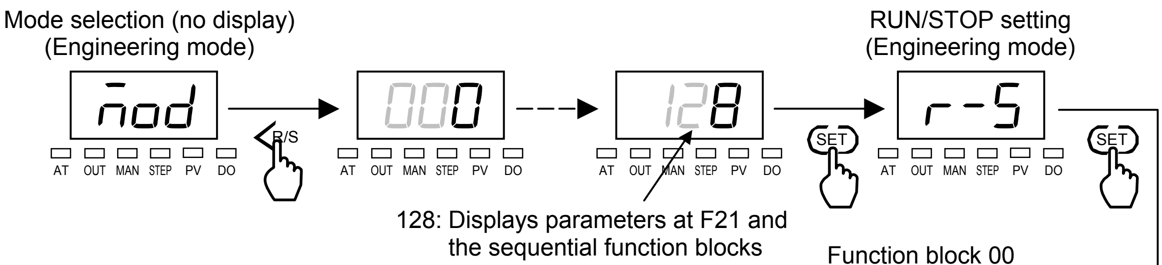
① Press the SET key several times until Mode selection (no display) screen will be displayed.



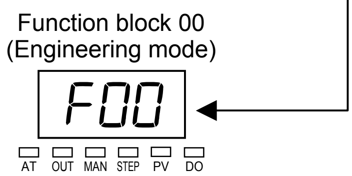
Press the SET key to Mode selection (no display) screen (mod).

Continued on the next page.

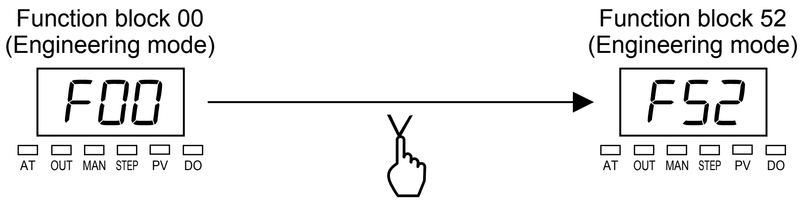
② Press the <R/S key to switch to the settable mode. Then set "128" and press the SET key to register the value. (128: Displays parameters at F21 and the sequential function blocks).
Press the SET key several times until the Function block 00 screen is displayed.



☞ For the data setting, refer to **4.2 Changing Set Value (P. 4-4)**.

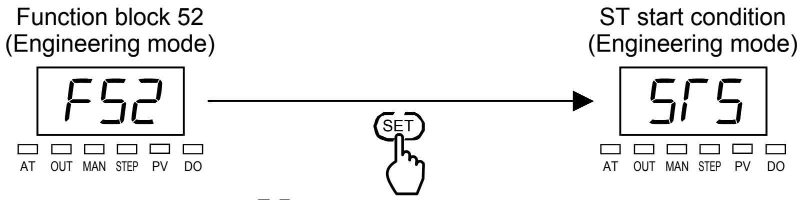


4. Press the ∨ key several times until Function block 52 screen is displayed.



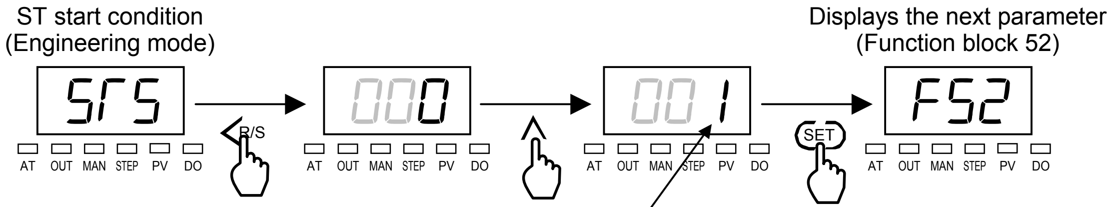
Press the ∨ key to Function block 52 screen (F52).

5. Press the SET key several times until ST start condition screen will be displayed.



Press the SET key to ST start condition screen (STS).

6. Press the <R/S key to switch to the settable mode. Then press the ∧ key to set "1" (1: Activate the ST function when the power is turned on) to the high-lighted digit. Press the SET key to store the new value.



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 SET 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 SET key to store the set value.

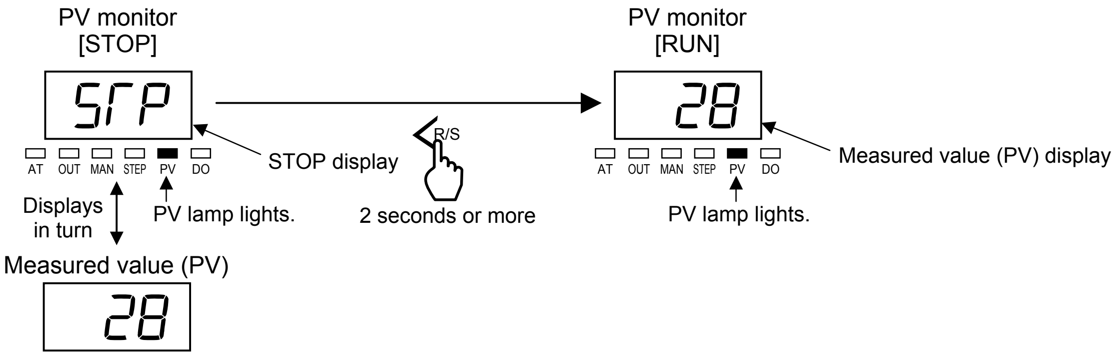
9. To return the PV monitor, press the <R/S key while pressing the SET key.

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

● Set the execution method

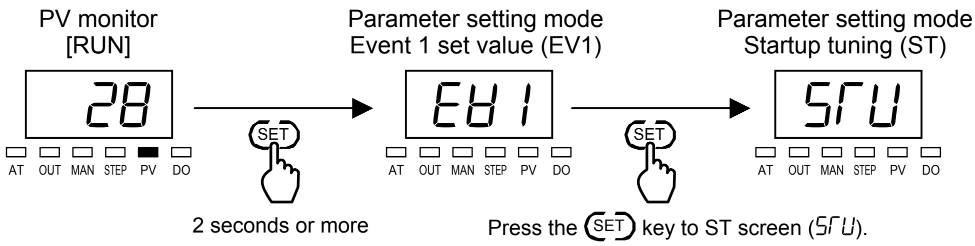
Set that the Startup tuning (ST) will be executed only once.

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



☞ To change from STOP mode to RUN mode, refer to **6.1 RUN/STOP Transfer (P. 6-3)**.

2. Press and hold the SET key for more than 2 seconds at the PV monitor screen to go to the Parameter setting mode. Then press the SET 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.)



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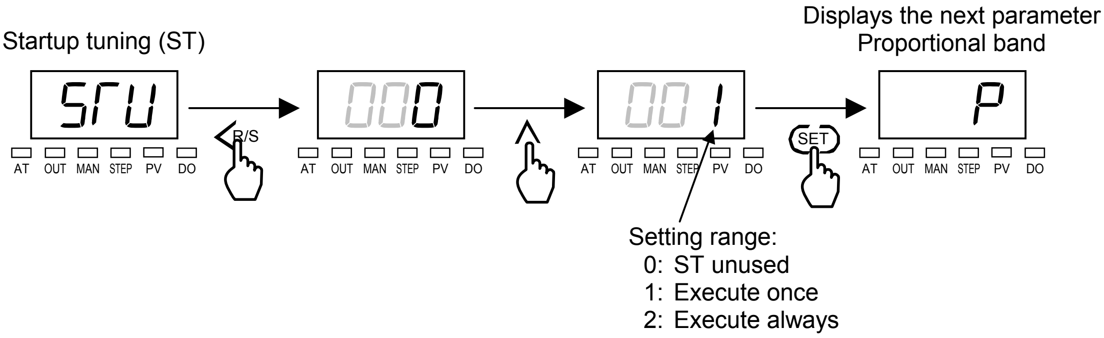
3. Press the <R/S key to switch to the settable mode. Then press the ∧ key to set “1” (1: Execute once) to the high-lighted digit. Press the SET key to store the new value.

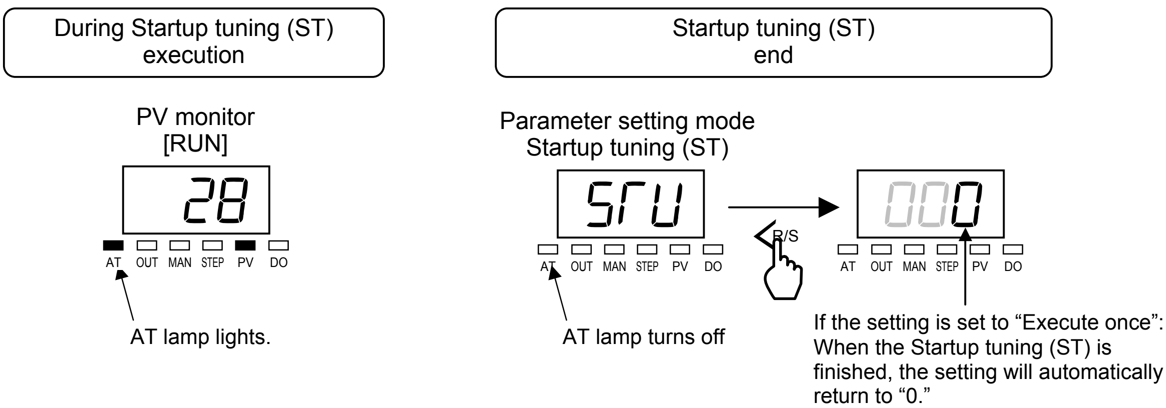


4. Thus, the Startup tuning (ST) setting has been finished.
To return the PV monitor, press and hold the SET key for 2 seconds or more.

📖 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 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)

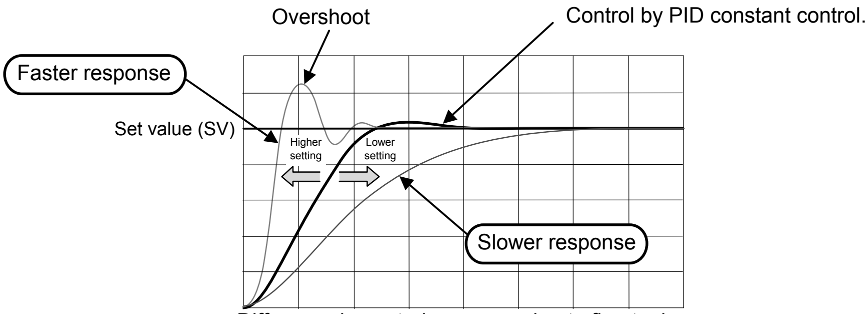


📖 When Startup tuning (ST) was interrupted, the setting does not change to “0” (0: ST unused). Startup tuning (ST) starts when the restart conditions are satisfied.

📖 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.

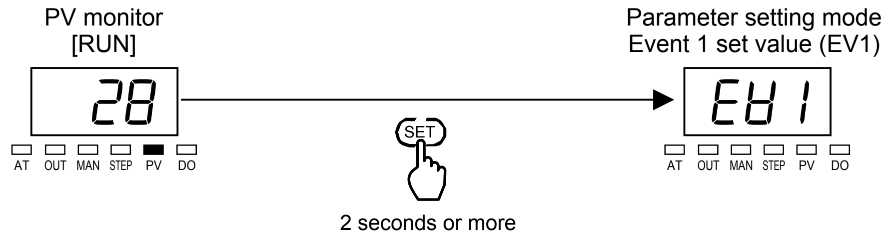


Difference in control response due to fine tuning

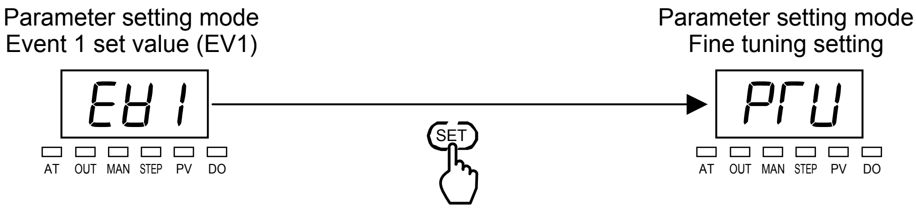
■ To make control response faster

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.)

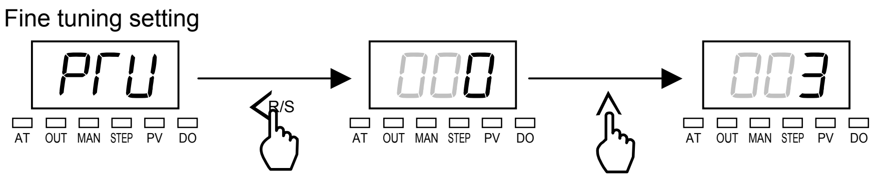


2. Press the SET key until Fine tuning setting screen is displayed.



Press the SET key to Fine tuning setting screen (PrU).

3. Press the <R/S 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.



Press the ∧ key to make the set value larger.

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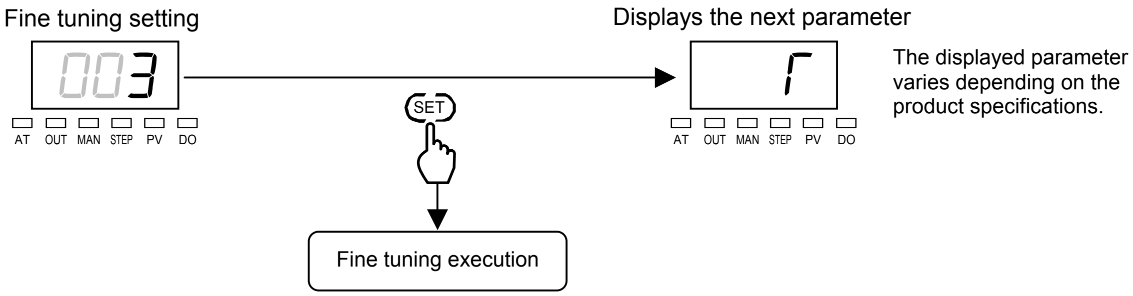
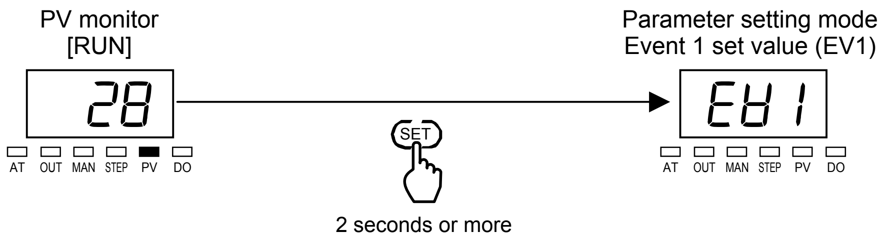
4. Press the SET key to store the new value. The display goes to the next parameter.
   Fine tuning begins when the SET key is pressed.



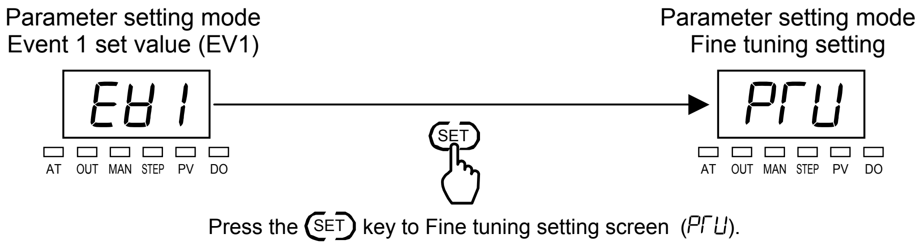
■ To make the control response slower

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).

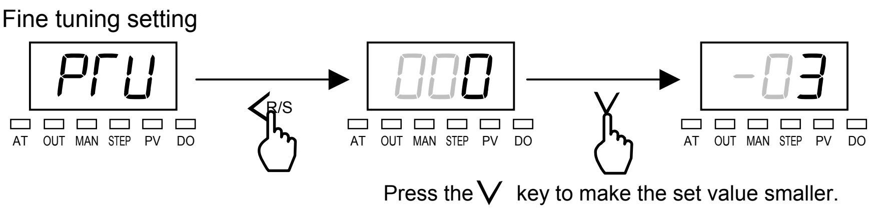
1. Press and hold the SET key for 2 seconds or more at PV monitor screen until Parameter setting mode is displayed.
   (In the factory set value, Event 1 set value (EV1) is displayed when the operation mode of the Parameter setting mode is changed.)



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



3. Press the <R/S key to switch to the settable mode. Then press the ∨ 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.



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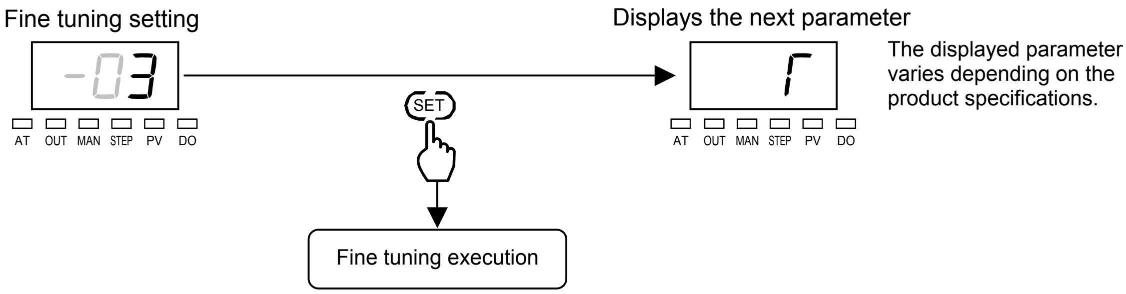
4. Press the SET key to store the new value. The display goes to the next parameter.
Fine tuning begins when the SET key is pressed.



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 ∧ and ∨ 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

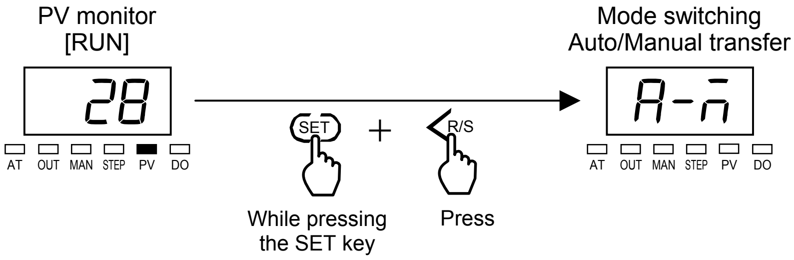
It can be set whether the Bumpless function is ON or OFF when the instrument is switched from Auto (AUTO) mode to Manual (MAN) mode. The following processing is performed depending on Bumpless function ON or OFF.

- 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 SET key to store the mode.

1. In PV monitor, press the <R/S key while pressing the SET key.



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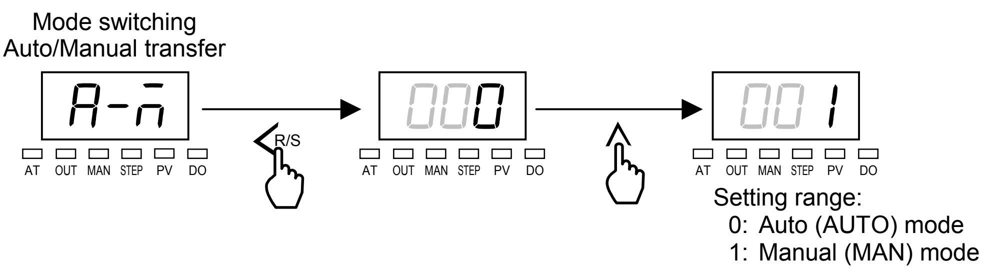
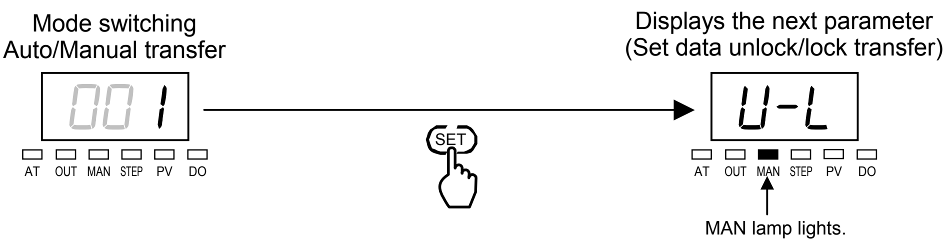
2. Press the <R/S key to switch to the settable mode. Then press the ∧ key to set "1" (1: Manual mode) to the high-lighted digit.



3. To make Manual mode (MAN) effective, press the SET key to register the value.



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.

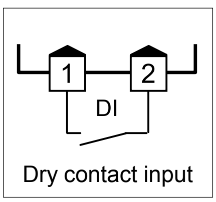
■ Auto/Manual transfer by digital input (DI) [optional]

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

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



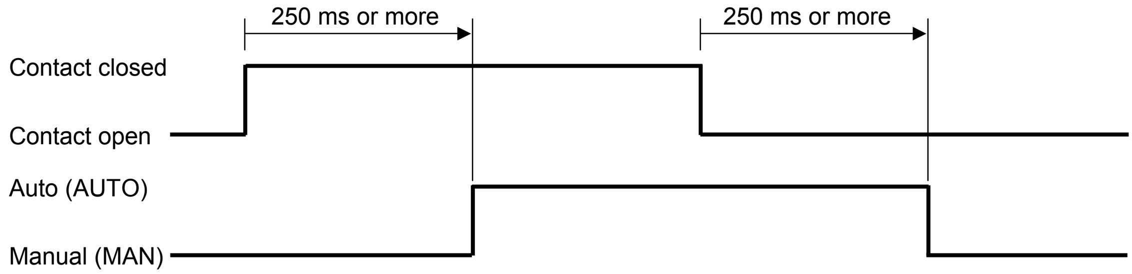
Contact closed: AUTO
Contact open: MAN

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.



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).

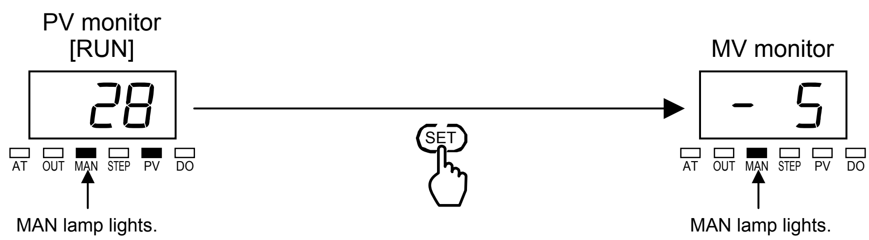
Auto/Manual select from key operation or communication	Auto/Manual select by digital input (DI) *	Actual Auto/Manual state	Indication lamp state
Auto (AUTO) mode	Contact closed [Auto (AUTO) mode]	Auto (AUTO) mode	MAN lamp turns off
	Contact open [Manual (MAN) mode]	Manual (MAN) mode	MAN lamp lights
Manual (MAN) mode	Contact closed [Auto (AUTO) mode]		
	Contact open [Manual (MAN) mode]		

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

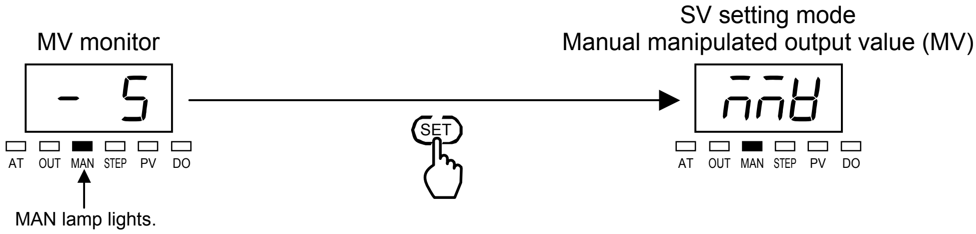
Procedure for setting the Manipulated output value (MV) in Manual mode

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

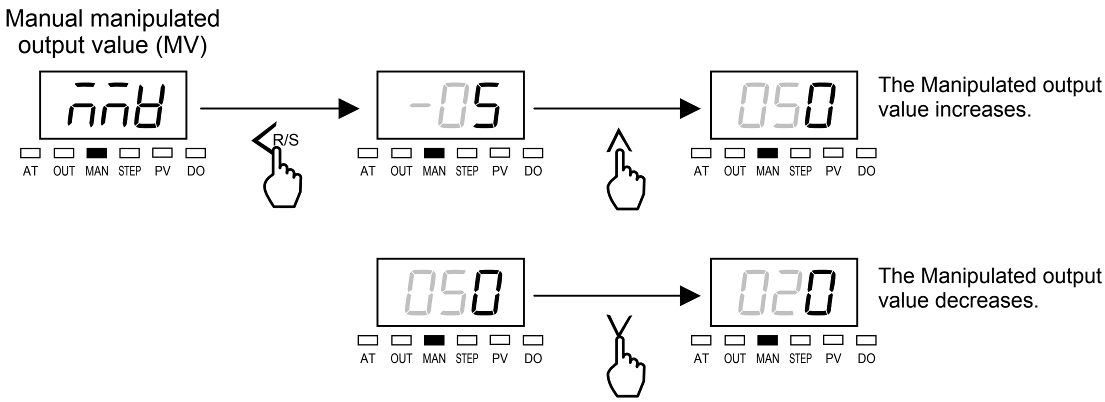
1. Make sure the Manual (MAN) mode lamp is lit. Press the SET key to switch to the MV monitor.



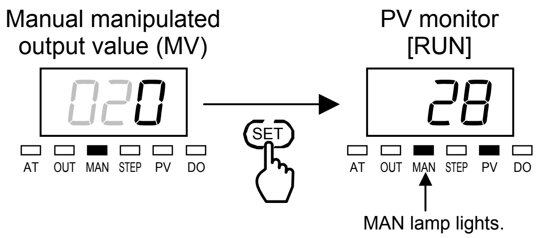
2. Display the Manual manipulated output value (MV) setting display in the SV setting mode by pressing the SET key at the MV monitor display.



3. Press the R/S key to switch to the settable mode. Press the ∧ key or the ∨ key to set the Manipulated output value (MV).



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



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.

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)

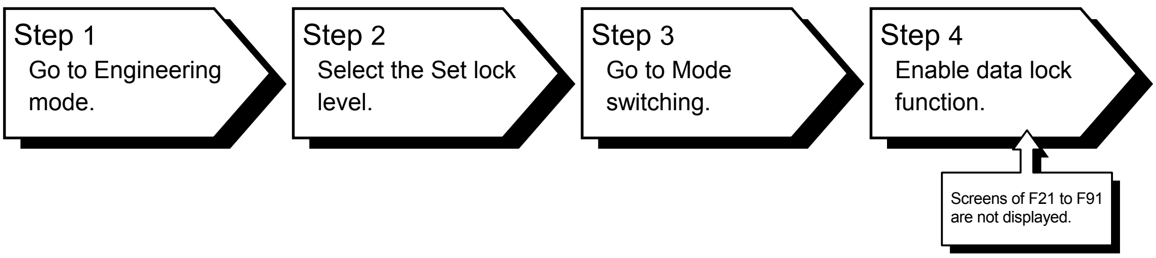
To protect setting data in the instrument, the setting data can be locked so that no changes can be made (Data lock function). Parameters that can be locked are described below.

- 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



☞ 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."

Set lock level (✓: Locked data)

No.*	Parameter setting mode	Engineering mode (Set lock level [LCk])										
		0	1	2	3	4	5	6	7	8	9	10
F01	Set value 1 (SV1) Set value 2 (SV2) SV selection	All settings unlocked (Factory set value)	✓									
F03	Setting change rate limiter (up) Setting change rate limiter (down)		✓	✓	✓							
F04	Event 1 set value (EV1) Event 1 set value (EV1) [high] Event 1 set value (EV1′) [low] Event 2 set value (EV2) Event 2 set value (EV2) [high] Event 2 set value (EV2′) [low]		✓	✓	✓	✓						
F05	Autotuning (AT) Startup tuning (ST)		✓	✓	✓	✓	✓					
F06	Proportional band Integral time Derivative time Anti-reset windup (ARW) Fine tuning setting		✓	✓	✓	✓	✓	✓				
F07	Control loop break alarm (LBA) time LBA deadband (LBD)		✓	✓	✓	✓	✓	✓	✓			
F08	Proportional cycle time Minimum ON/OFF time of proportioning cycle Output limiter high Output limiter low		✓	✓	✓	✓	✓	✓	✓	✓		
F09	PV bias PV digital filter		✓	✓	✓	✓	✓	✓	✓	✓	✓	
F10	Manual manipulated output value (MV) Power saving mode setting Maintenance mode switching		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

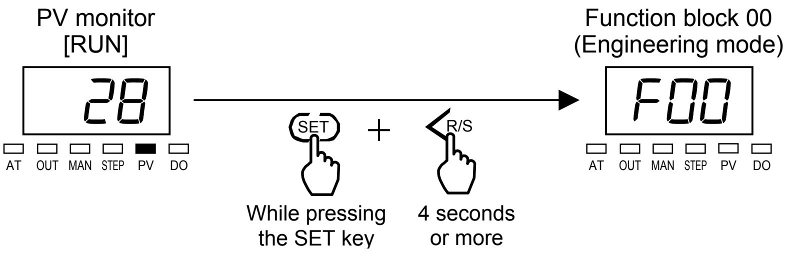
* F01 to F10 indicate group numbers used in Set lock level in Engineering mode.

■ Locking all data which can be locked

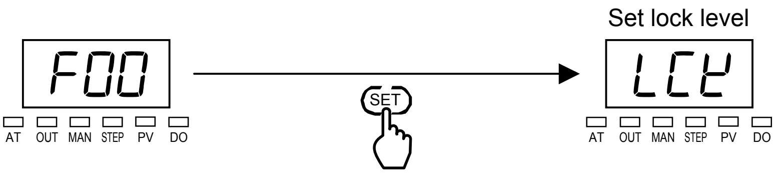
Parameters that can be locked:

– Parameters of Parameter setting mode
– Parameters of F01 to F91 of Engineering mode

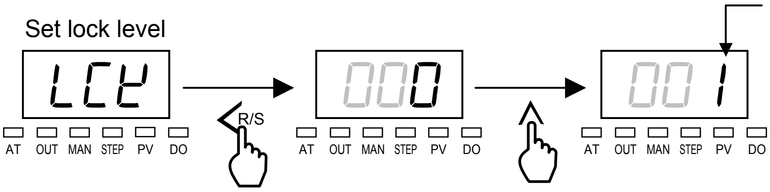
1. In PV monitor, press the <R/S key for 4 seconds or more while pressing the SET key.
The display goes to the Engineering mode.



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

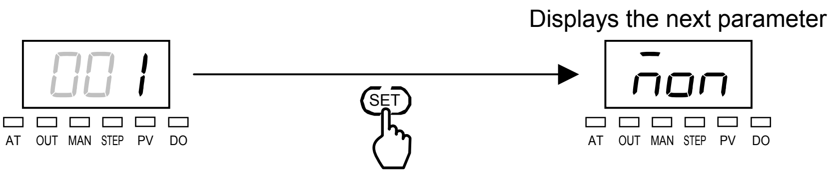


3. Press the <R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit.



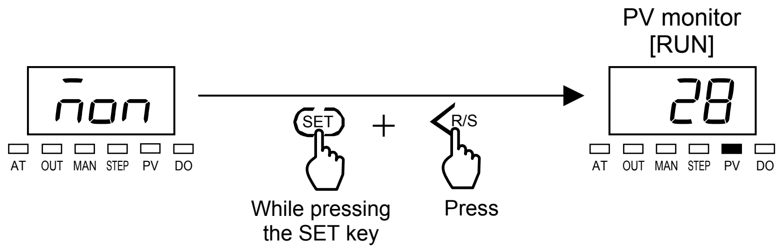
Set value and description
0: All parameter can be changed
1: Lock "Parameter Group" F01 through F10
2: Lock "Parameter Group" F02 through F10
3: Lock "Parameter Group" F03 through F10
4: Lock "Parameter Group" F04 through F10
5: Lock "Parameter Group" F05 through F10
6: Lock "Parameter Group" F06 through F10
7: Lock "Parameter Group" F07 through F10
8: Lock "Parameter Group" F08 through F10
9: Lock "Parameter Group" F09 and F10
10: Lock "Parameter Group" F10

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

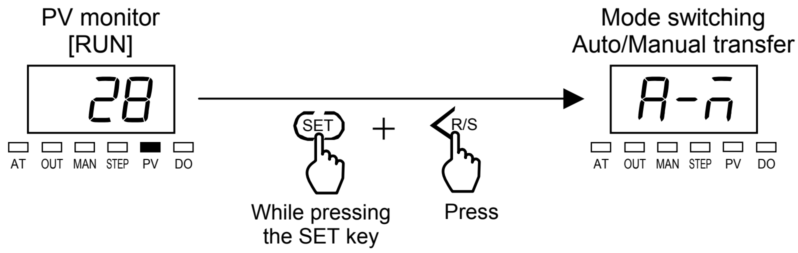


After a new value is displayed on the display by using ∧ and ∨ keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the Monitor display mode and the set value will not be changed.

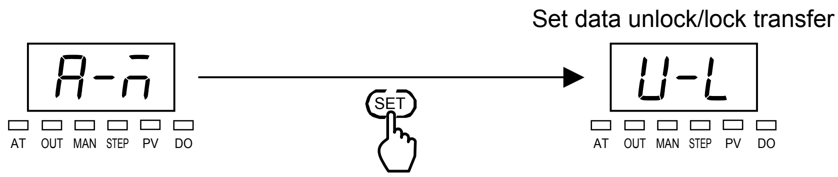
5. Press the R/S key while pressing the SET key. The display goes to the PV monitor.



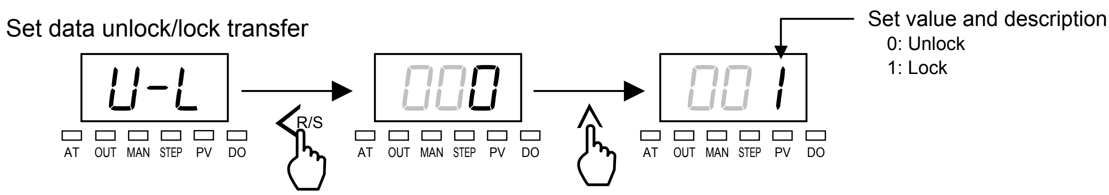
6. In PV monitor, press the R/S key while pressing the SET key.
The display goes to the Mode switching.



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

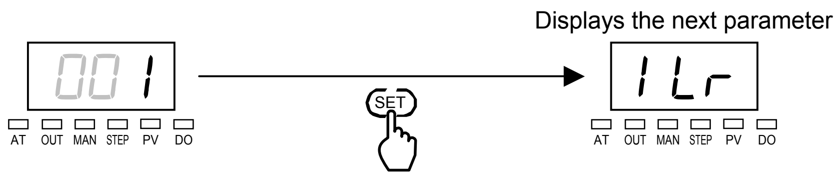


8. Press the R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit.



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

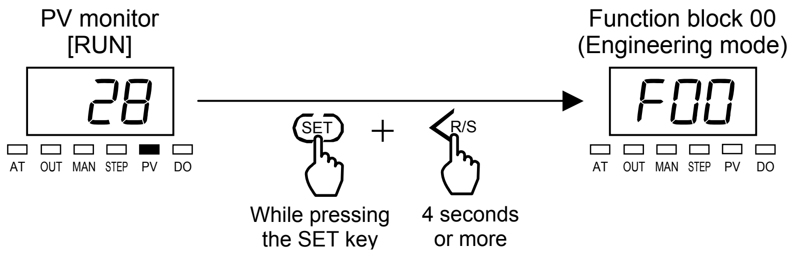
9. Press the SET key to store the new value. The parameters of Parameter setting mode and F10 to F91 are locked, and the setting data cannot be changed.



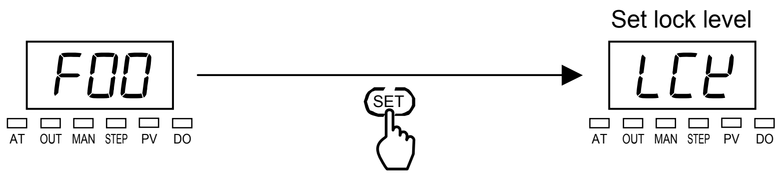
■ Selecting the parameter to lock

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.

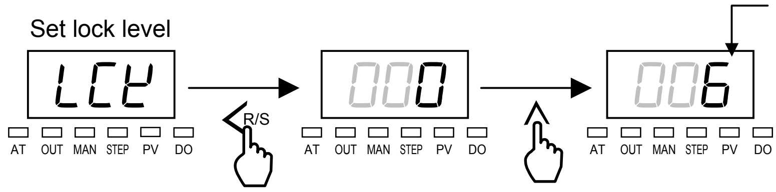
1. In PV monitor, press the <R/S key for 4 seconds or more while pressing the SET key.
The display goes to the Engineering mode.



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

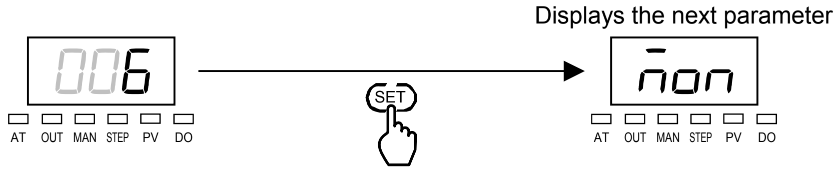


3. Press the <R/S key to switch to the settable mode. Then press the ∧ key to set “6” to the high-lighted digit.



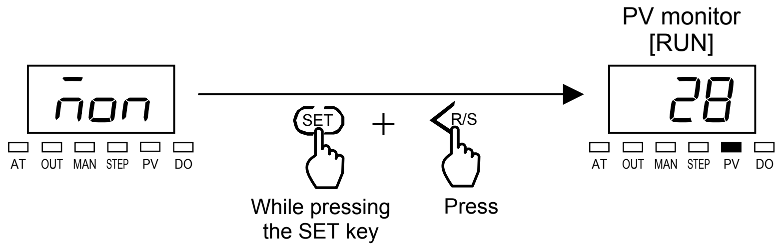
Set value and description
0: All parameter can be changed
1: Lock “Parameter Group” F01 through F10
2: Lock “Parameter Group” F02 through F10
3: Lock “Parameter Group” F03 through F10
4: Lock “Parameter Group” F04 through F10
5: Lock “Parameter Group” F05 through F10
6: Lock “Parameter Group” F06 through F10
7: Lock “Parameter Group” F07 through F10
8: Lock “Parameter Group” F08 through F10
9: Lock “Parameter Group” F09 and F10
10: Lock “Parameter Group” F10

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

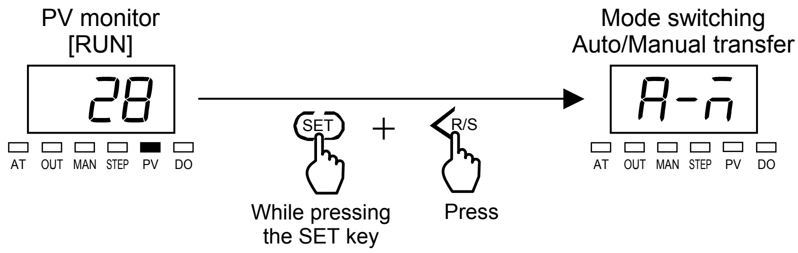


After a new value is displayed on the display by using ∧ and ∨ keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the Monitor display mode and the set value will not be changed.

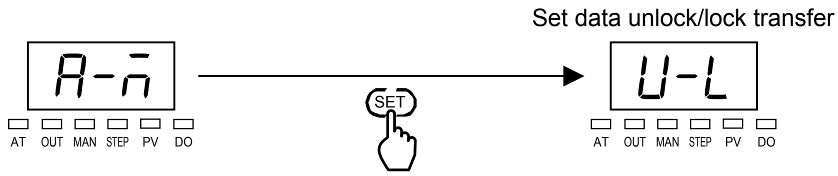
5. Press the R/S key while pressing the SET key. The display goes to the PV monitor.



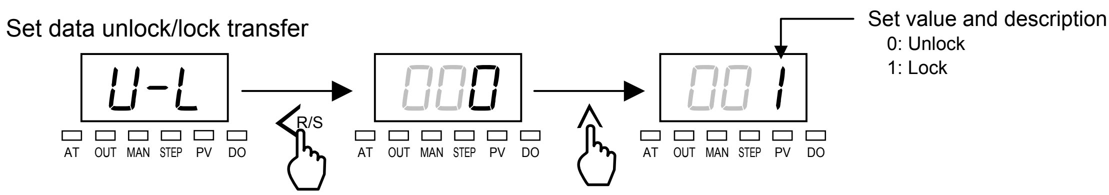
6. In PV monitor, press the R/S key while pressing the SET key.
The display goes to the Mode switching.



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

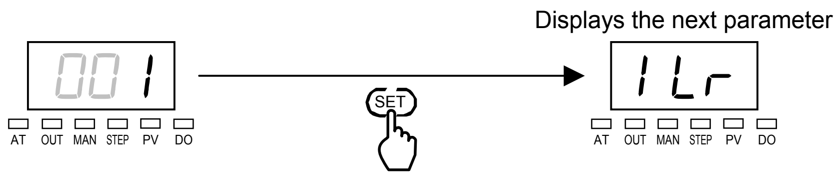


8. Press the R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit.



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

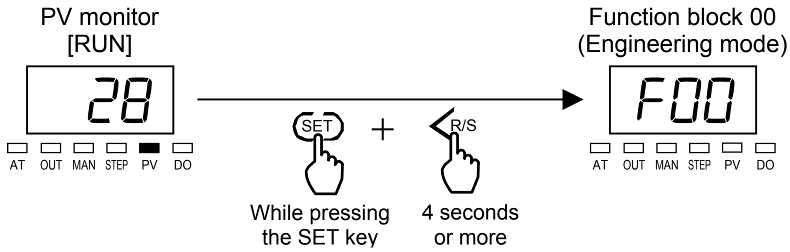
9. Press the SET key to store the new value. The parameters of Parameter setting mode and F06 to F91 are locked, and the setting data cannot be changed.



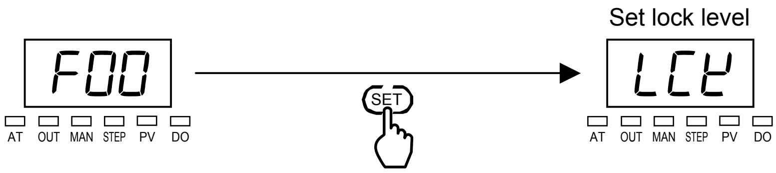
■ Locking F21 to F91 data

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.

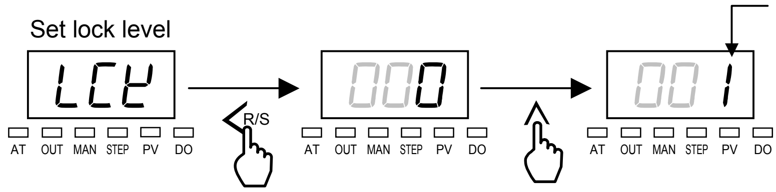
1. In PV monitor, press the <R/S key for 4 seconds or more while pressing the SET key.
The display goes to the Engineering mode.



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

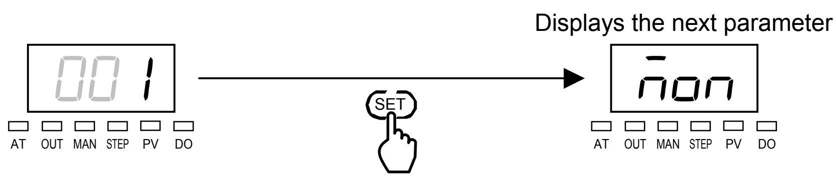


3. Press the <R/S key to switch to the settable mode. Press the ∧ key to set any number from 1 to 10. (Here “1” is set as an example.)



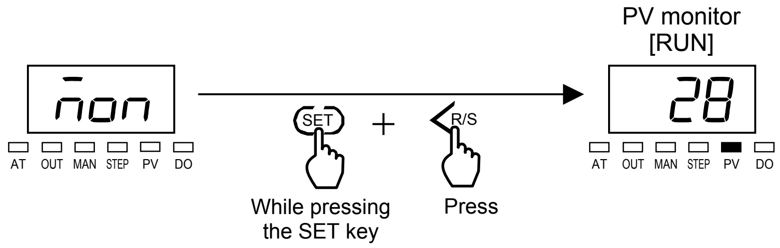
Set value and description
0: All parameter can be changed
1: Lock “Parameter Group” F01 through F10
2: Lock “Parameter Group” F02 through F10
3: Lock “Parameter Group” F03 through F10
4: Lock “Parameter Group” F04 through F10
5: Lock “Parameter Group” F05 through F10
6: Lock “Parameter Group” F06 through F10
7: Lock “Parameter Group” F07 through F10
8: Lock “Parameter Group” F08 through F10
9: Lock “Parameter Group” F09 and F10
10: Lock “Parameter Group” F10

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

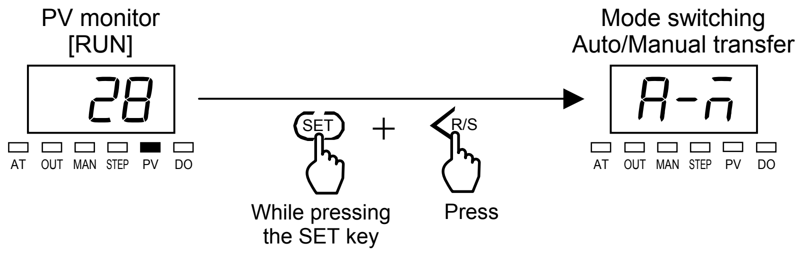


After a new value is displayed on the display by using ∧ and ∨ keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the Monitor display mode and the set value will not be changed.

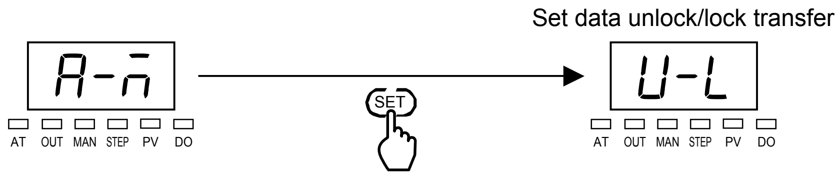
5. Press the R/S key while pressing the SET key. The display goes to the PV monitor.



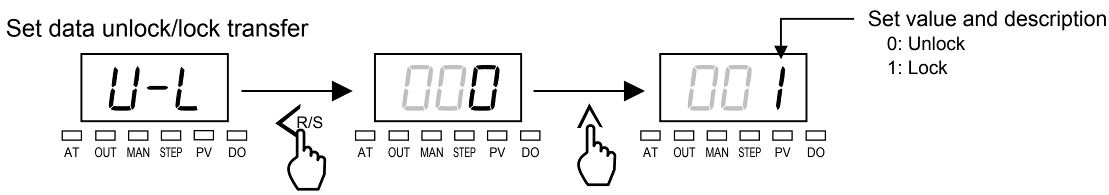
6. In PV monitor, press the R/S key while pressing the SET key.
The display goes to the Mode switching.



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

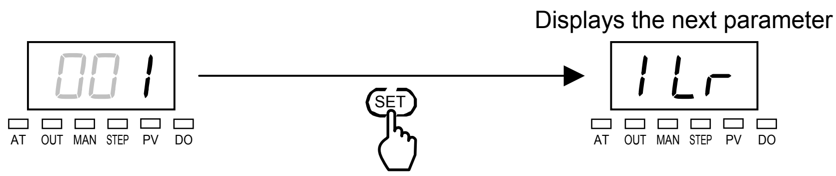


8. Press the R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit.



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.

Monitor display mode:		Engineering mode (F00):
PV monitor SV monitor	⇨	Cannot be set to no display.
Manipulated output value (MV) monitor	⇨	Display/No display can be set in Monitor selection (no display) (n̄on) [factory set value: 0 (Display all)].

SV setting mode:		Engineering mode (F00):
Set value (SV)	⇨	Cannot be set to no display.
Manual manipulated output value (MV)	⇨	Display/No display can be set in Monitor selection (no display) (n̄on) [factory set value: 0 (Display all)].

Mode switching:		Engineering mode (F00):
Auto (AUTO)/Manual (MAN) transfer Set data unlock/lock transfer Interlock release	⇨	Display/No display can be set in Monitor selection (no display) (n̄on) [factory set value: 0 (Display all)].

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

Engineering mode:

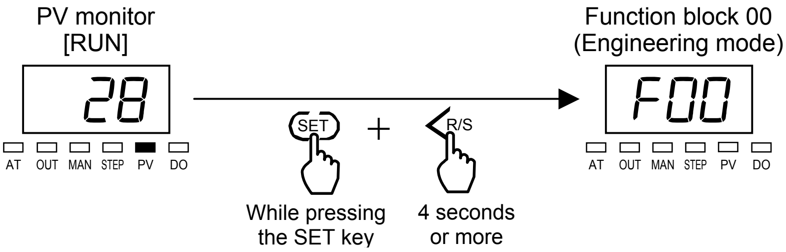
Function block 00 (F00) Function block 01 (F01) Function block 03 (F03) Function block 04 (F04) Function block 05 (F05) Function block 06 (F06) Function block 07 (F07) Function block 08 (F08) Function block 09 (F09) Function block 10 (F10)	⇨	Cannot be set to no display.
Function block 21 (F21) Function block 23 (F23) Function block 30 (F30) Function block 33 (F33) Function block 41 (F41) Function block 42 (F42) Function block 43 (F43) Function block 44 (F44) Function block 45 (F45) 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)	⇨	Normally, these are set to no display. These can be displayed by setting "128" in Mode selection (no display) (ᾱod) of Function block 00 (F00) of Engineering mode. Note that display/no display selection by Function block (F□□) is not possible. ⚠ **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.**

Some parameters may not be displayed depending on product specifications.

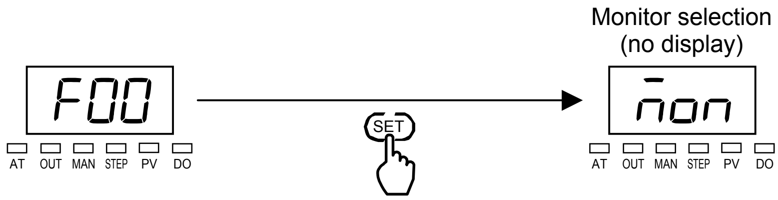
■ Hiding the parameters of the Monitor display mode

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

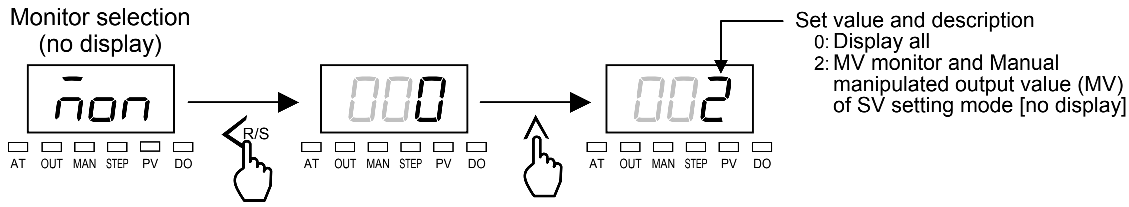
1. In PV monitor, press the <R/S key for 4 seconds or more while pressing the SET key.
The display goes to the Engineering mode.



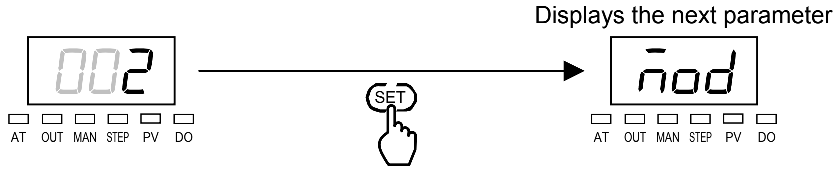
2. Press the SET key until Monitor selection (no display) screen is displayed.



3. Press the <R/S key to switch to the settable mode. Then press the ∧ 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.

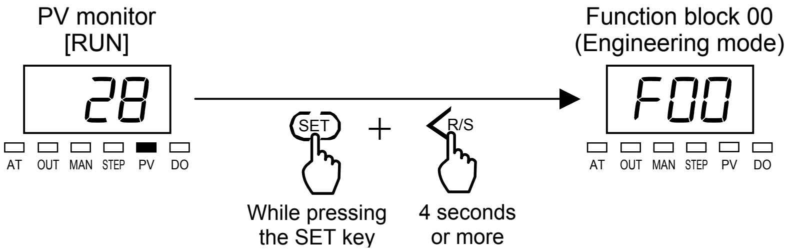


After a new value is displayed on the display by using ∧ and ∨ keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the Monitor display mode and the set value will not be changed.

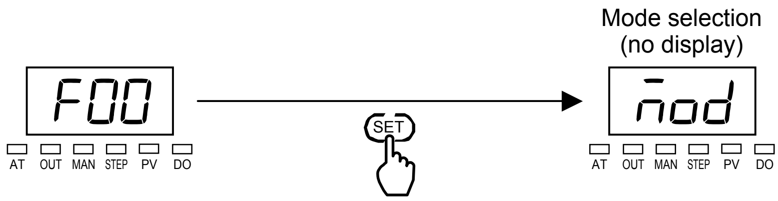
■ Hiding the parameters of the Mode switching screen

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

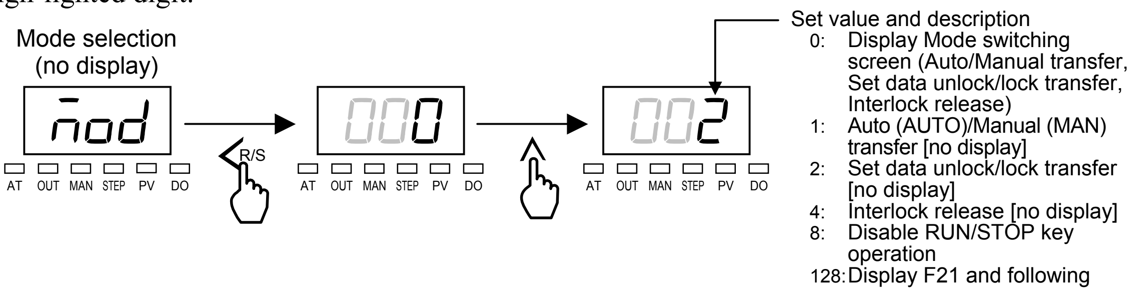
1. In PV monitor, press the R/S key for 4 seconds or more while pressing the SET key.
The display goes to the Engineering mode.



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

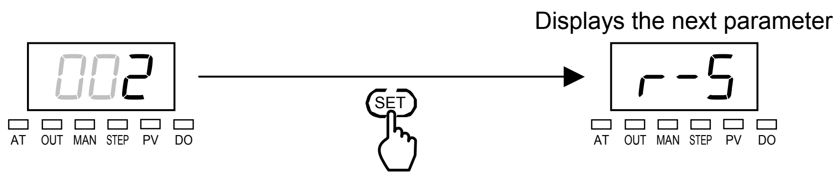


3. Press the R/S key to switch to the settable mode. Then press the ∧ key to set "2" to the high-lighted digit.



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

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 ∧ 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.

Screen displays of Function block 21 (F21) to Function block 91 (F91)

⚠ WARNING

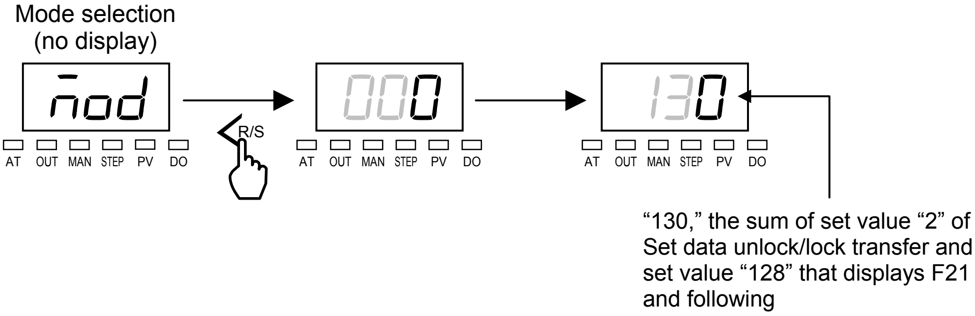
Parameters in the Engineering mode (F21 to F91) should be set according to the application before setting any parameter related to operation. Once the parameters in the Engineering mode are set correctly, no further changes need to be made to parameters for the same application under normal conditions. 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.

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

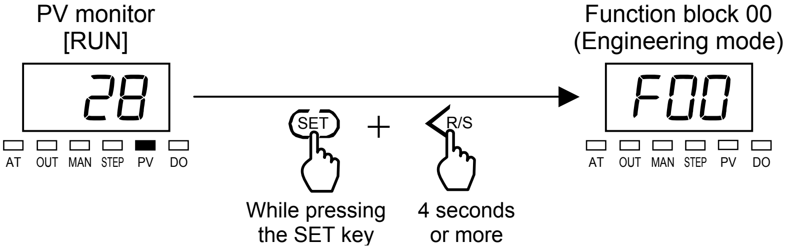
Set "130," the sum of the set value "2" of Set data unlock/lock transfer and "128."



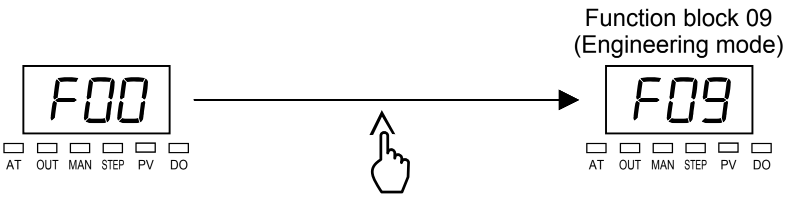
■ Hiding the parameters of the Parameter setting mode

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.

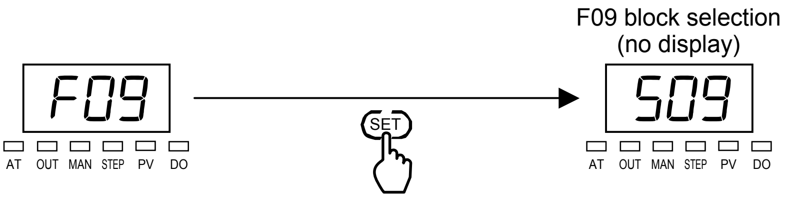
1. In PV monitor, press the <R/S key for 4 seconds or more while pressing the SET key.
The display goes to the Engineering mode.



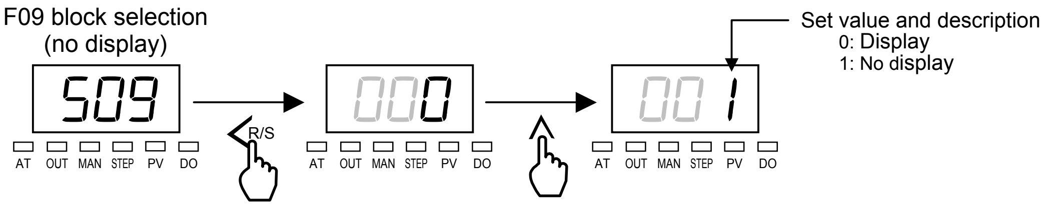
2. Press the ∧ key until Function block 09 (F09) screen is displayed.



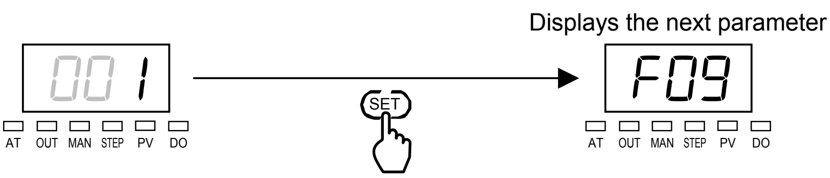
3. Press the SET key until F09 block selection (no display) screen is displayed.



4. Press the <R/S key to switch to the settable mode. Then press the ∧ key to set "1" to the high-lighted digit.



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



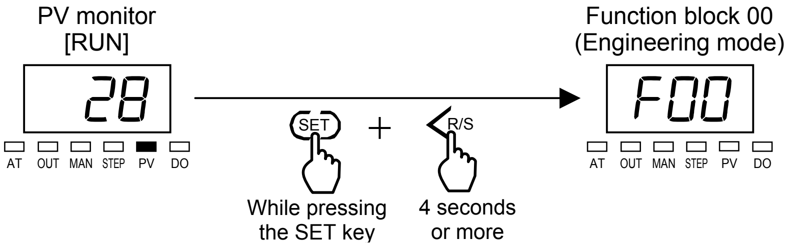
After a new value is displayed on the display by using ∧ and ∨ keys, if no key operation is performed within 1 minute without pressing SET key, this instrument returns to the Monitor display mode and the set value will not be changed.

■ Displaying Function block 21 (F21) to Function block 91 (F91) of the Engineering mode

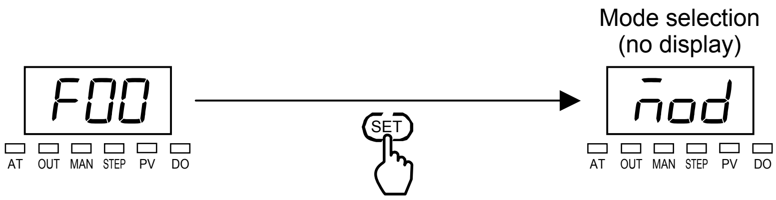
⚠ WARNING

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.

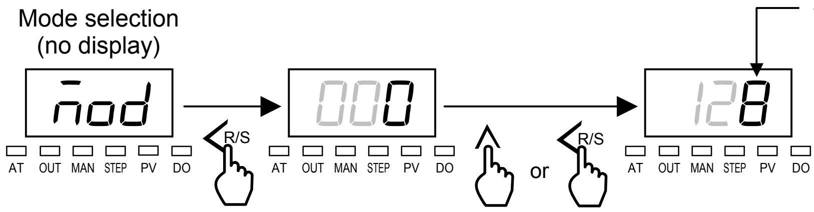
1. In PV monitor, press the <R/S key for 4 seconds or more while pressing the SET key. The display goes to the Engineering mode.



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

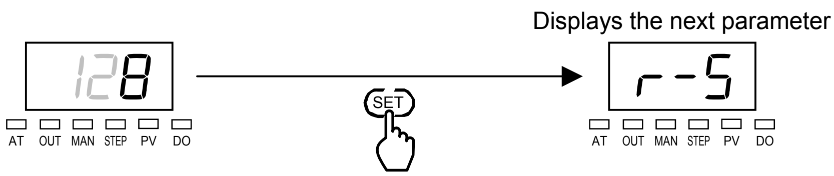


3. Press the <R/S key to switch to the settable mode. Then press the ∧ key or the <R/S key to set "128."



Set value and description
- 0: Display Mode switching screen (Auto/Manual transfer, Set data unlock/lock transfer, Interlock release)
- 1: Auto (AUTO)/Manual (MAN) transfer [no display]
- 2: Set data unlock/lock transfer [no display]
- 4: Interlock release [no display]
- 8: Disable RUN/STOP key operation
- 128: Display F21 and following

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 ∧ 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.

6.8 Interlock Release

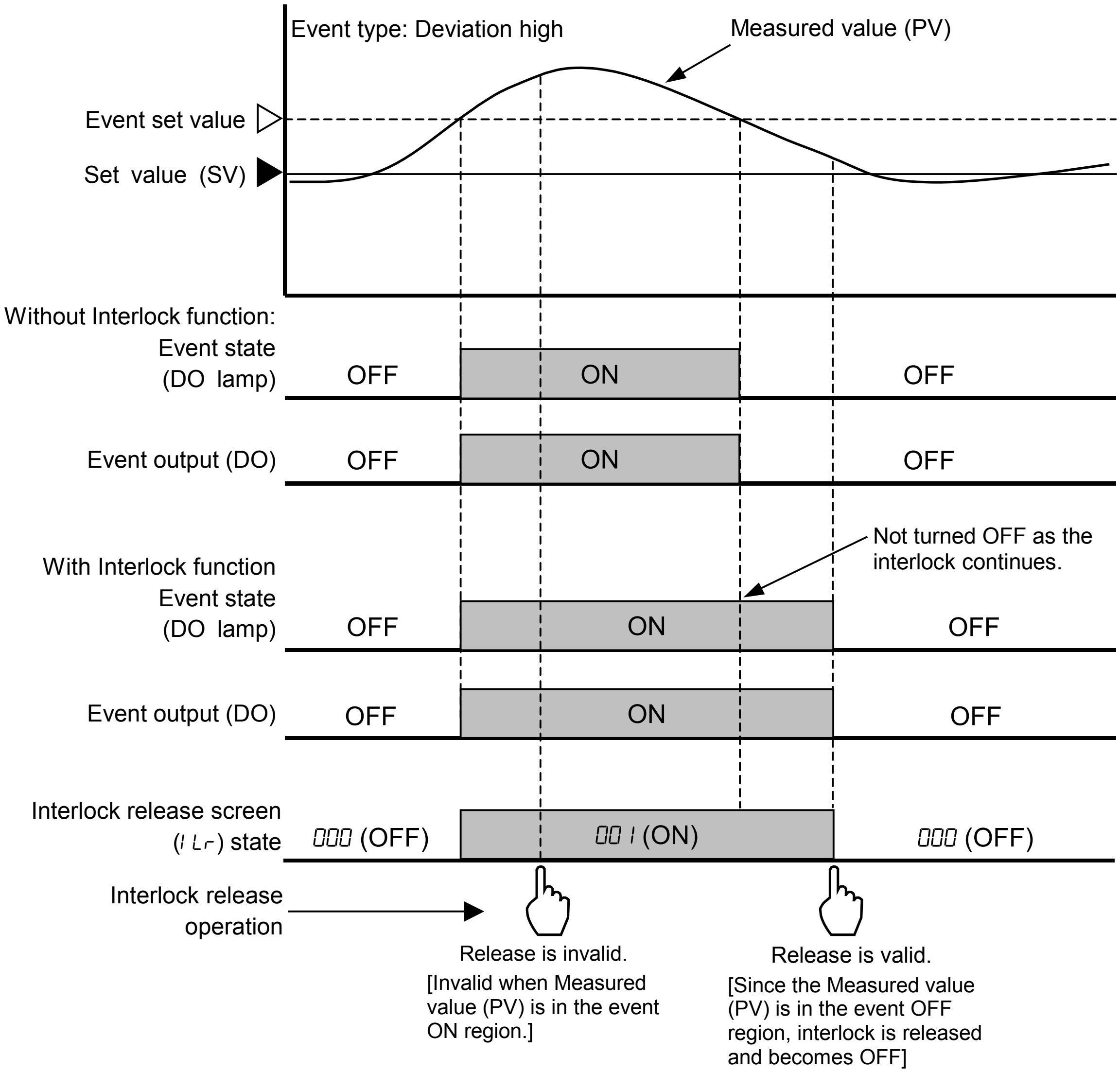
The interlock action holds the event state even if the Measured value (PV) is out of the event zone after it enters the event zone once. The interlock release can be made by digital input (DI) [optional], or communication [optional] other than the key operation.

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

NOTE

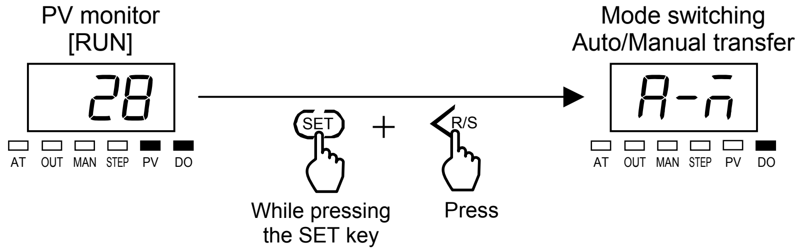
To validate the Interlock function, it is necessary to set Event interlock 1 and 2 (IL1 and IL2) to "1: Used" in 8.5 Engineering Mode (P. 8-88).

- The following example shows how the interlock is released.

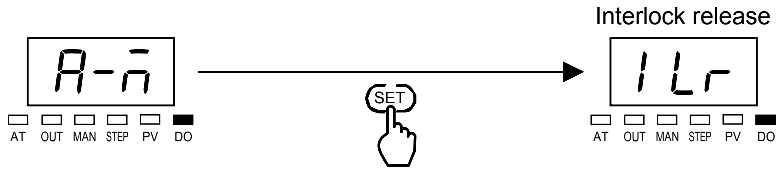


■ Interlock release by front key operation

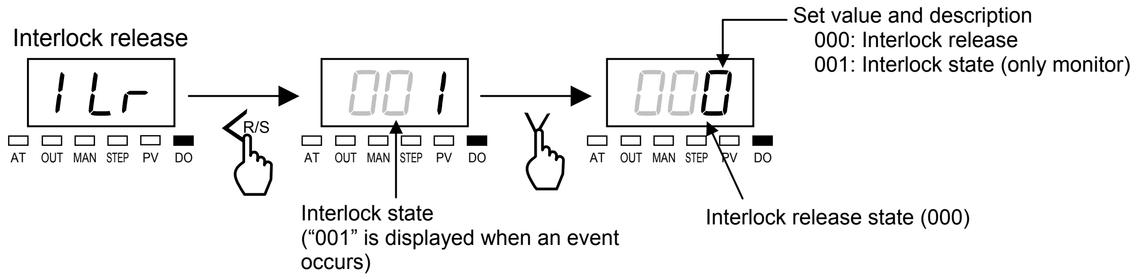
1. In PV monitor, press the <R/S key while pressing the SET key.



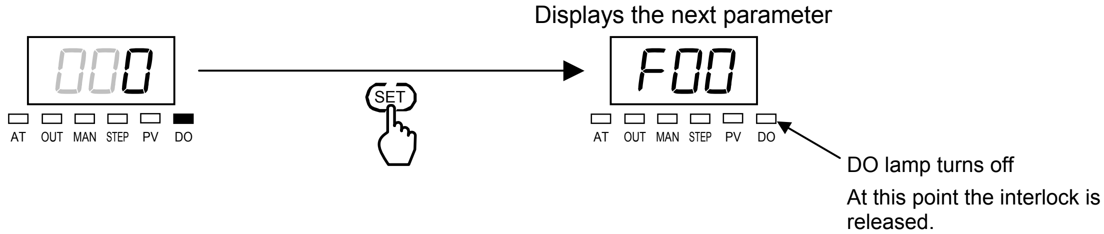
2. Press the SET key until Interlock release screen is displayed.



3. Press the <R/S key to switch to the settable mode. Then press the ∨ key to release Interlock state.



4. Press the SET key to release the interlock. The display goes to 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.

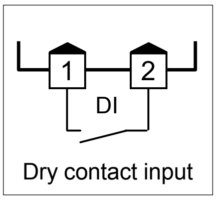
■ Interlock release by digital input (DI) [optional]

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

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

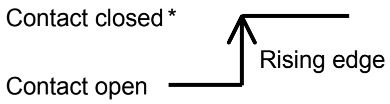


Contact closed: Interlock release

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.

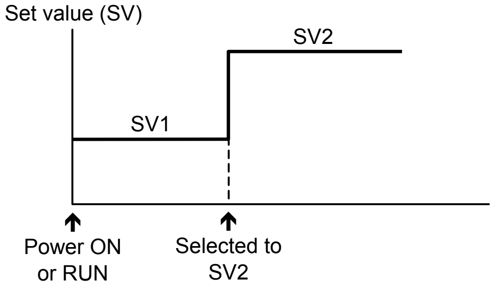
OPERATING ADDITIONAL FUNCTIONS

7

This chapter describes the setting procedure for additional functions.

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)**.

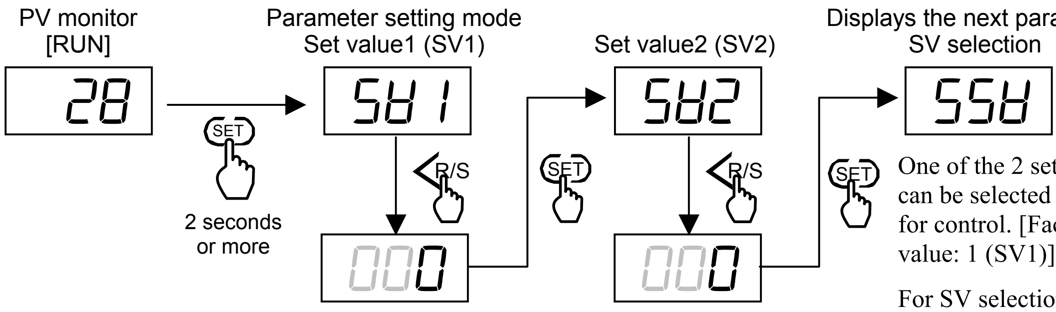
☞ For SV selection by communication, refer to the **9. COMMUNICATION (P. 9-1)**.

■ Setting procedure

The parameter for the SV selection function is not displayed in the factory default setting. Before enabling the function, set “0: Display” in the F01 block selection (no display) (SO 1) parameter of Function block 01 (F01) of Engineering mode. For the setting procedure, refer to ■ **Hiding the parameters of the Parameter setting mode (P. 6-36)**.

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.



One of the 2 set values can be selected and used for control. [Factory set value: 1 (SV1)]

For SV selection method, refer to ■ **SV selection by front key operation (P. 7-3)** or ■ **SV selection by digital input (DI) (P. 7-4)**.

SV1 and SV2 setting range:
Setting limiter low to Setting limiter high
[Factory set value: 0]

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 <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**

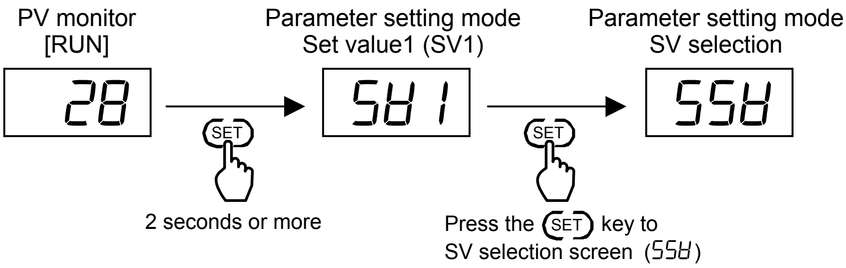
To return the PV monitor, press and hold the SET key for 2 seconds or more.

■ SV selection by front key operation

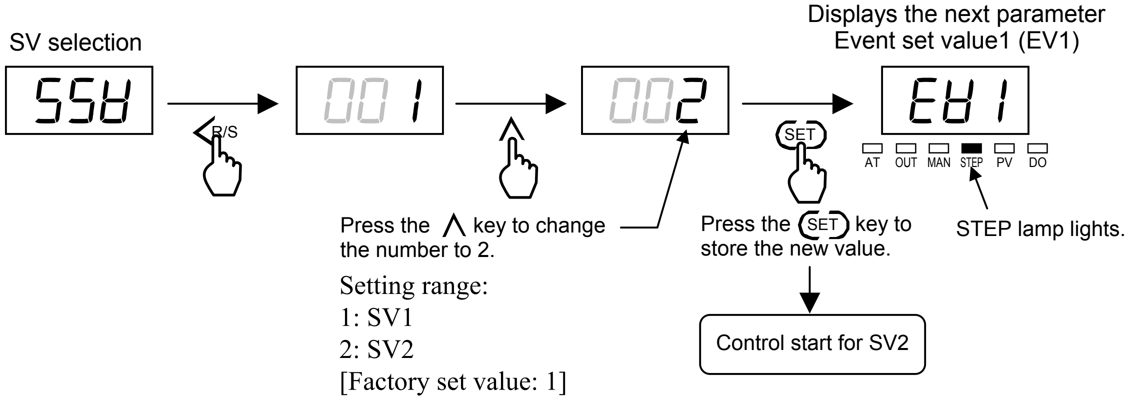
To switch to SV1 and SV2 by front key operation, use the SV selection parameter of Parameter setting mode.

[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 R/S 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.

■ 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.

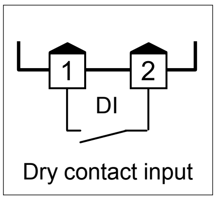
DI assignment

Set value	Contents
0	Unused (No DI assignment)
1	SV selection function (SV1/SV2)
2	RUN/STOP transfer
3	AUTO/MAN transfer
4	Interlock release

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

● Terminal configuration

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

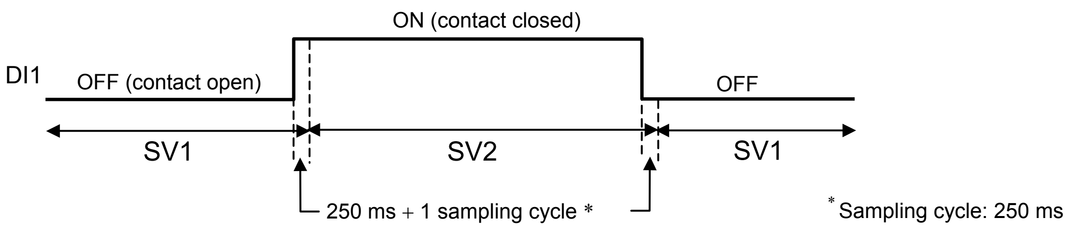


Contact open: SV1
Contact closed: SV2

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

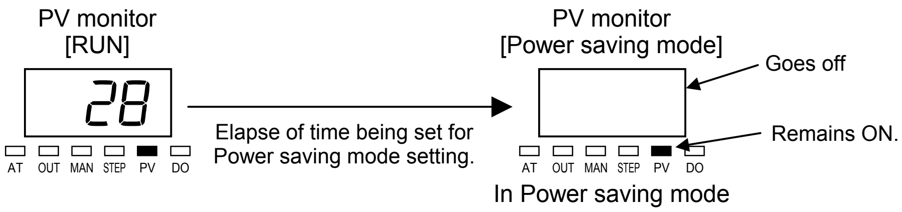
After the contact is transferred, it takes "250 ms + 1 sampling cycle*" until the action of this instrument is actually selected.

*** 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.



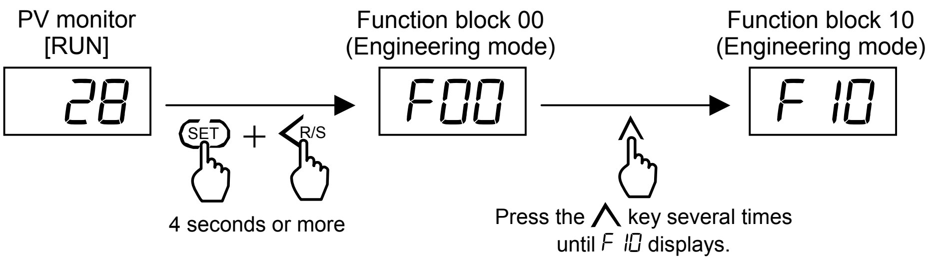
To set Power saving mode by communication, refer to **9. COMMUNICATION (P. 9-1)**.

■ Setting procedure

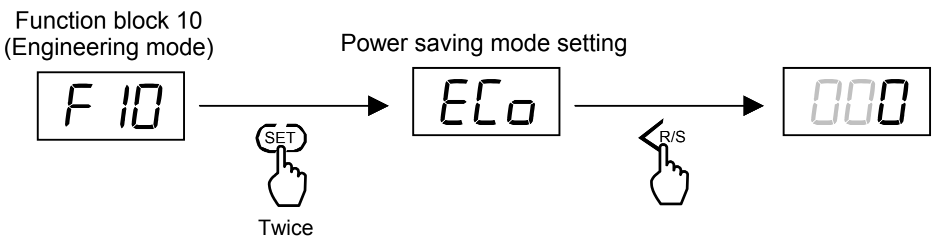
The duration until the instrument switches to the Power saving mode can be set at Power saving mode setting in the Engineering mode.

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

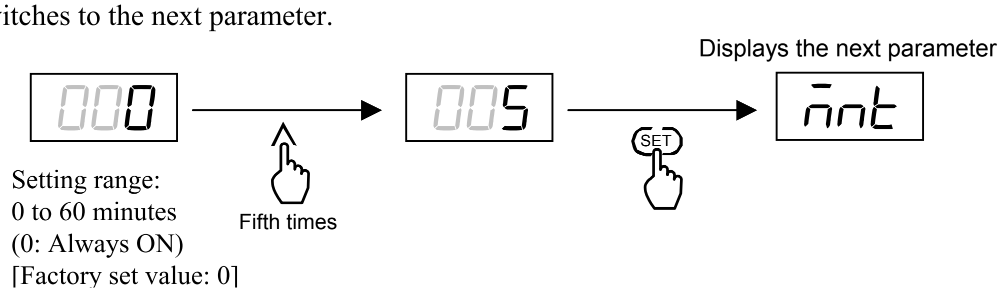
1. Press the R/S key while pressing the SET key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ∧ key several times until the Function block 10 (F10) screen is displayed.



2. Press the SET key to go to the Power saving mode setting display. Press the R/S key to switch to the settable mode.



3. Press the ∧ key to set "5" and press the SET 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 <R/S key while pressing the SET 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 SET 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 resister address:	00ABH (171)

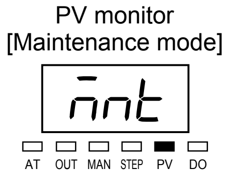
[Example]

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

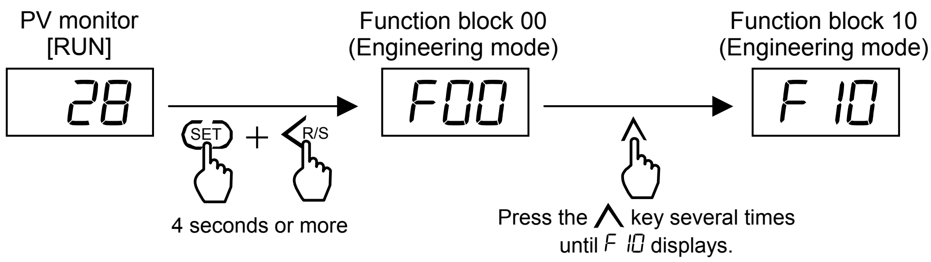
■ To switch to the Maintenance mode

● By the direct key operation

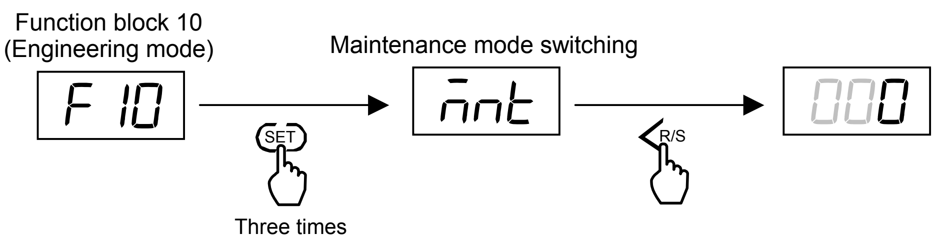
Press and hold the ∧ key for 2 seconds at the PV monitor display.

● By parameter setting

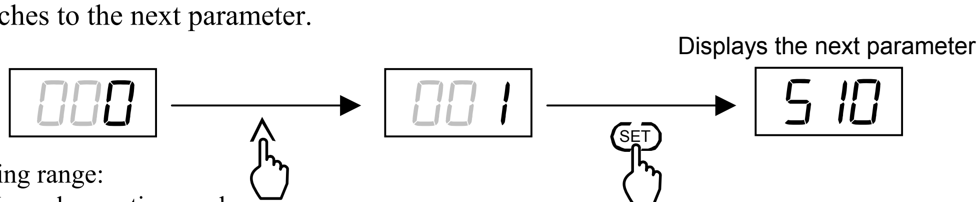
1. Press the <R/S key while pressing the SET key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ∧ key several times until the Function block 10 (F10) screen is displayed.



2. Press the SET key to go to the Maintenance mode switching display. Press the <R/S key to switch to the settable mode.



3. Press the ∧ key to set "1" and press the SET key to register the set value. Display automatically switches to the next parameter.



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 <R/S key while pressing the SET 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 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 resister 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 ∧ key for 2 seconds at Maintenance mode display (mnt).

● By communication

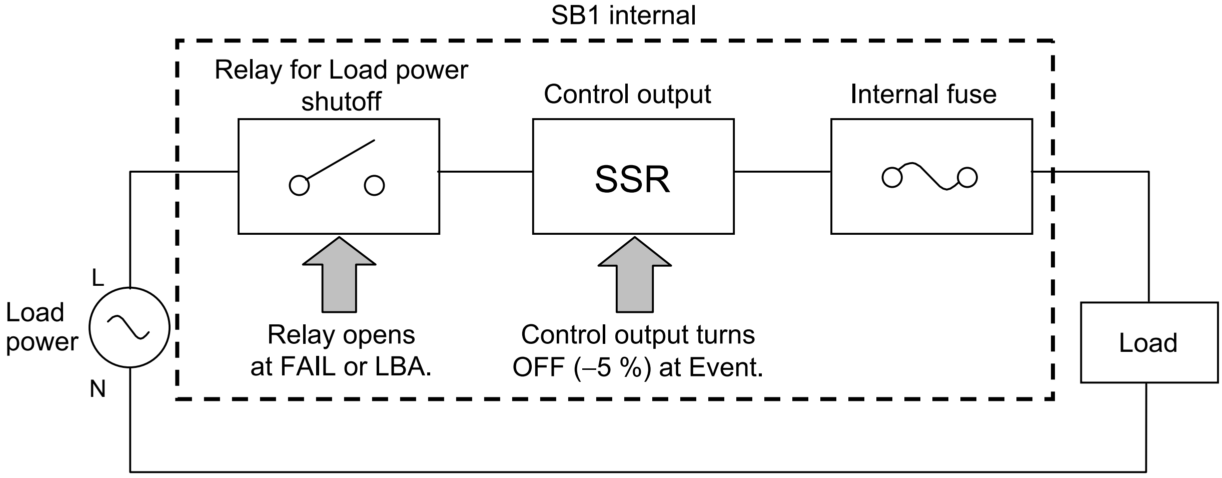
Set “0” for Maintenance mode switching.

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



■ Control action at Event

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

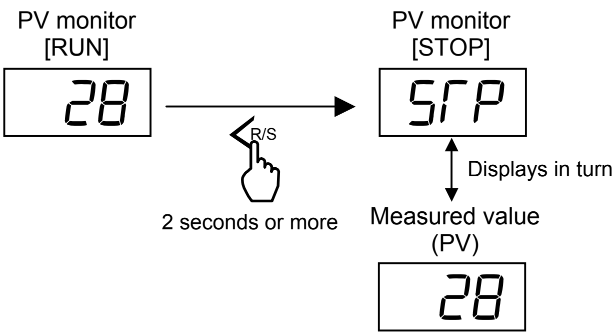
[Selectable action]

- 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

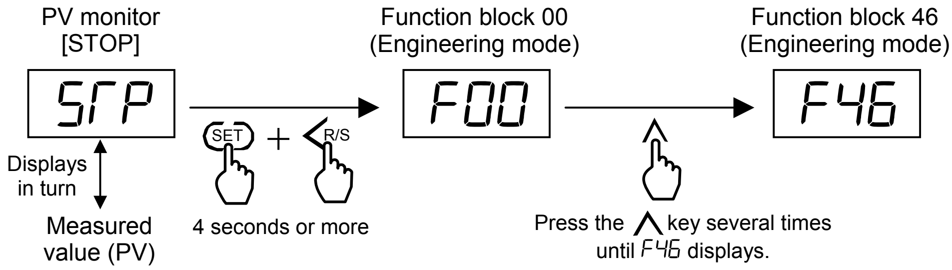
● Setting

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

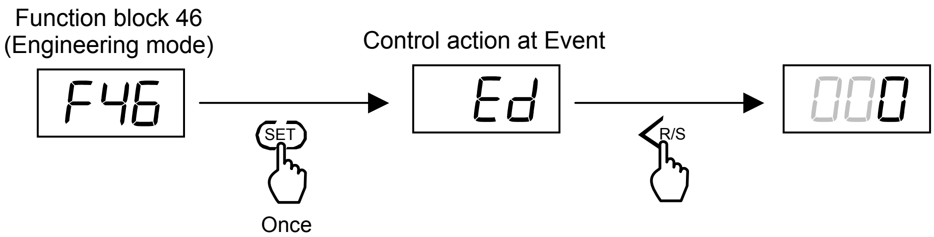
1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the R/S key for 2 seconds at the PV monitor.



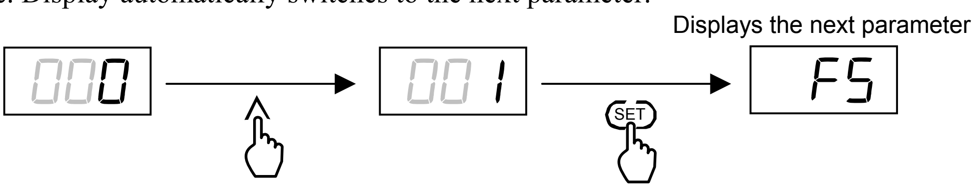
2. Press the R/S key while pressing the SET key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ∧ key several times until the Function block 46 (F46) screen is displayed.



3. Press the SET key to go to the Control action at Event display. Press the R/S key to switch to the settable mode.



4. Press the ∧ key to set the set value of desired action and press the SET key to register the set value. Display automatically switches to the next parameter.



Setting range:
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
[Factory set value: 0]

- **Return to the PV monitor**

To return the PV monitor, press the R/S key while pressing the SET key.
To change from STOP mode to RUN mode, press and hold the R/S 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.

■ 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.)

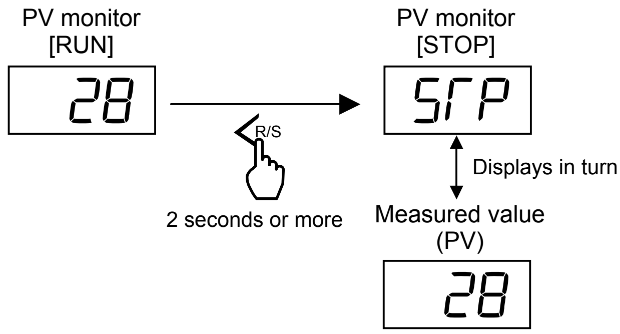
* To return to the normal state, turn OFF then restart the instrument.

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.

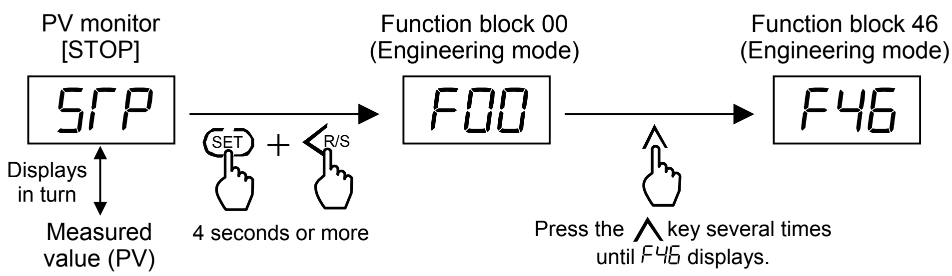
● Setting

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

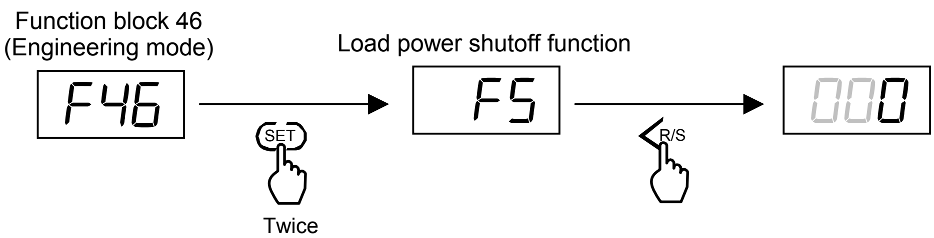
1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the <R/S key for 2 seconds at the PV monitor.



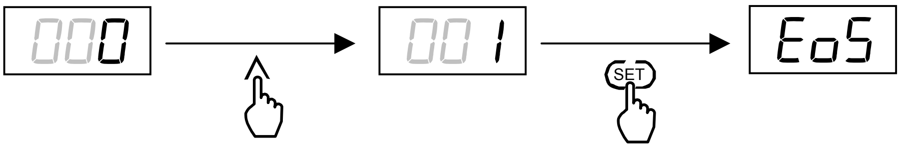
2. Press the <R/S key while pressing the SET key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ∧ key several times until the Function block 46 (F46) screen is displayed.



3. Press the SET key to go to the Load power shutoff function display. Press the <R/S key to switch to the settable mode.



4. Press the ∧ key to set the set value of desired action and press the SET key to register the set value. Display automatically switches to the next parameter.



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 <R/S key while pressing the SET key.
To change from STOP mode to RUN mode, press and hold the <R/S 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.

7.5 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

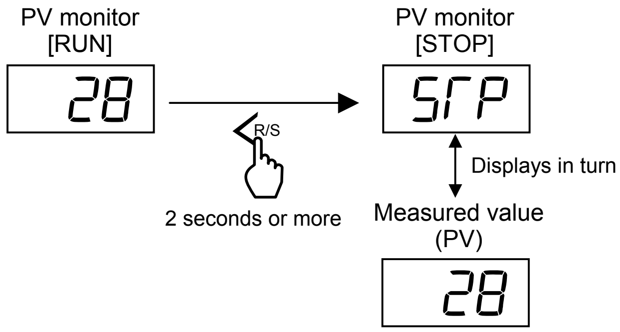
This function only delays the timing of flag for burnout at burnout status monitoring. Therefore, if burnout occurs, the actual control action of the instrument is switched to the action at burnout immediately.

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

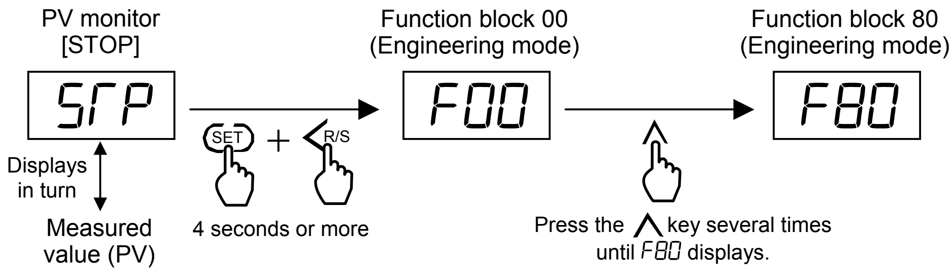
■ Setting procedure

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

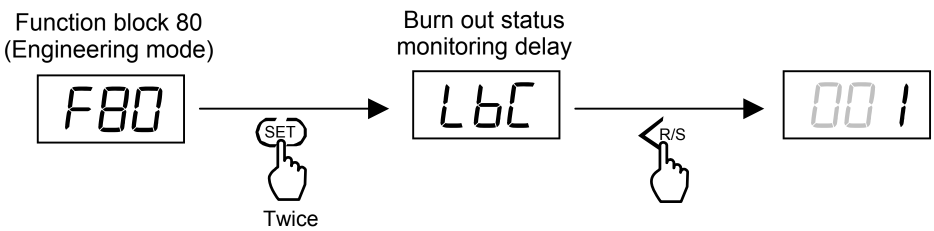
1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the R/S key for 2 seconds at the PV monitor.



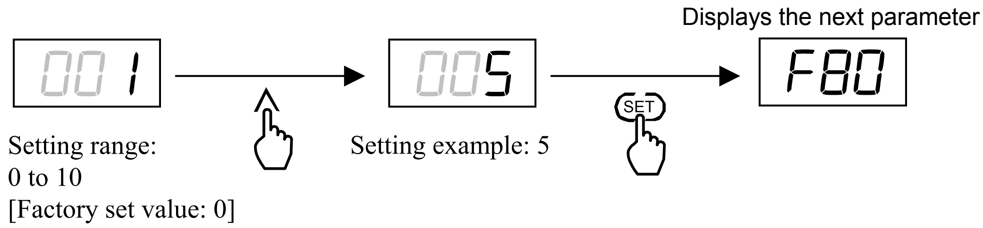
2. Press the R/S key while pressing the SET key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ∧ key several times until the Function block 80 (F80) screen is displayed.



3. Press the SET key to go to the Burn out status monitoring delay display. Press the R/S key to switch to the settable mode.



4. Press the ∧ key to set the number of input sampling cycle and register the value by pressing the SET key. Display automatically switches to the next parameter.



- **Return to the PV monitor**

To return the PV monitor, press the <R/S key while pressing the SET key.
To change from STOP mode to RUN mode, press and hold the <R/S 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.

■ 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 seconds × 10 times = 2.5 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

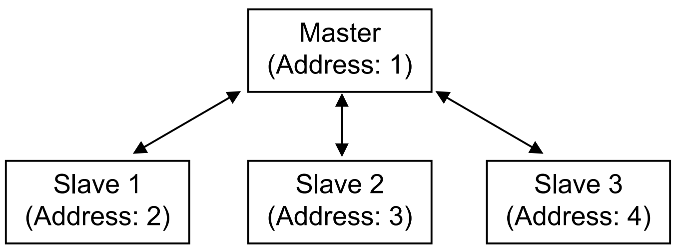
Maximum connections:	Up to 4 controllers (Master controller: 1, Slave controller: 3)
Protocol:	Modbus-RTU
Address:	Intragroup address + 1
Communication speed:	19200 bps (fixed)
Data bit configuration:	Start bit: 1
	Data bit: 8
	Parity bit: Without
	Stop bit: 1
Interval times:	10 ms (fixed)
Error check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

● Communication method

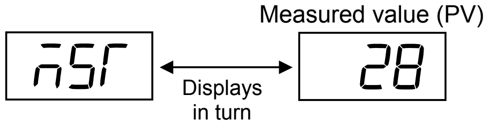
The communication method of SB link is based on the Broadcast function of Modbus communication.
Data transmission is carried between the Master controller and the Slave controller(s).

Broadcast communication:
Each connected Slave controller receives the sent data from the Master controller.

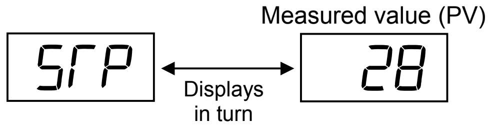
- **Action at Power ON**

–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 "mSr" and the Measured value (PV) in turn.



Display for Slave controller:
Displays the character "SrP" 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) sets 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.)

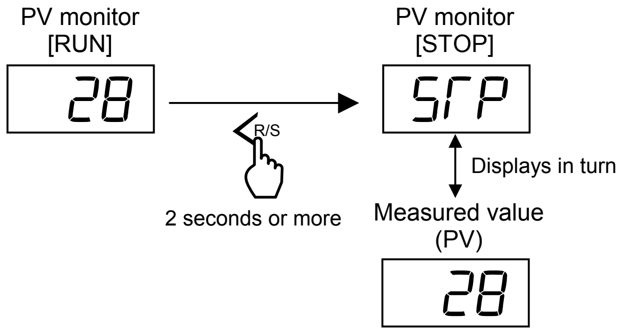
- **Setting range for Control action at SB link error**

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.

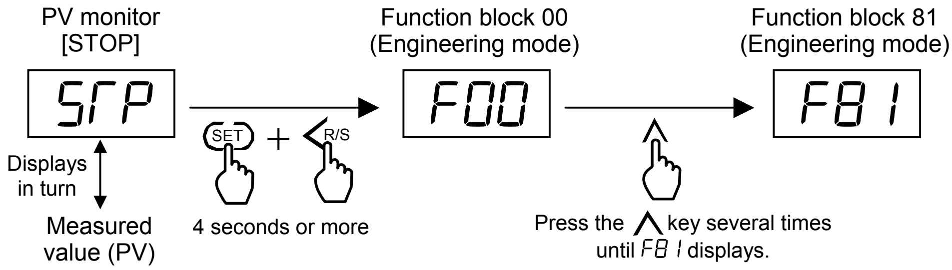
■ Setting procedure

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.

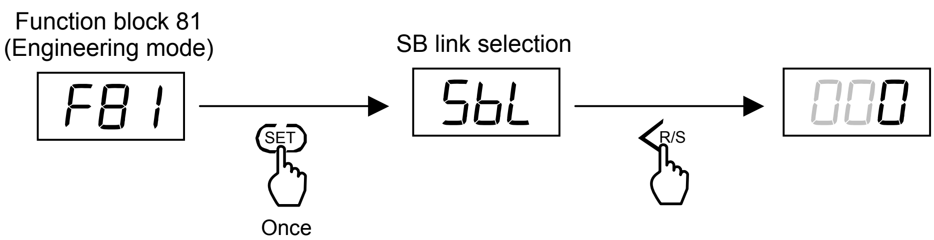
1. When the operation is in RUN mode, switch to STOP mode by pressing and holding the R/S key for 2 seconds at the PV monitor.



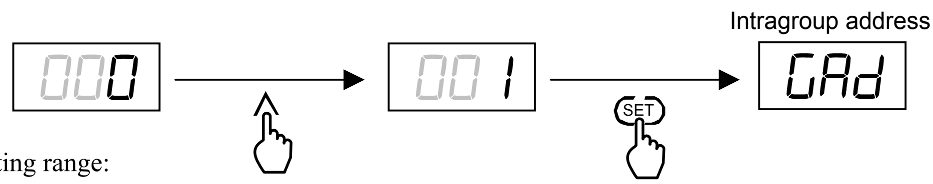
2. Press the R/S key while pressing the SET key for 4 seconds or more at PV monitor screen until Engineering mode is displayed. Then press the ∧ key several times until the Function block 81 (F81) screen is displayed.



3. Press the SET key to go to the SB link selection display. Press the R/S key to switch to the settable mode.

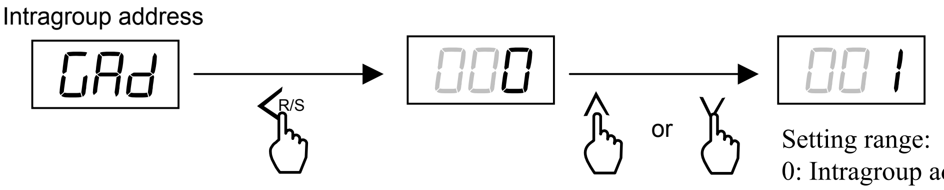


4. Press the ∧ key to set "1" and press the SET key to register the set value. Display automatically switches to the Intragroup address.



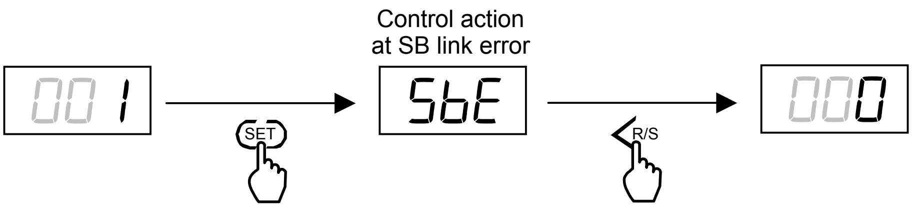
Setting range:
0: Without SB link function
1: With SB link function
[Factory set value: 0]

5. Press the R/S key to switch to the settable mode. Then press the ∧ key and the ∨ key to set Intragroup address.

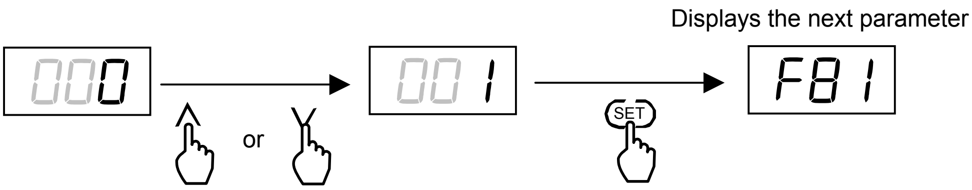


Setting range:
0: Intragroup address 1 (Master)
1: Intragroup address 2
2: Intragroup address 3
3: Intragroup address 4
[Factory set value: 0]

6. Press the SET key to register the set value. After confirming that the display automatically switched to the Control action at SB link error display, press the R/S key to switch to the settable mode.



7. Press the ∧ key and the ∨ key to set Control action at SB link error. Then press the SET key to register the set value. Display automatically switches to the next parameter.



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]

- **Return to the PV monitor**

To return the PV monitor, press the R/S key while pressing the SET key.
To change from STOP mode to RUN mode, press and hold the R/S 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.

7.6.2 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 Salve controller(s) when powered ON. The operation mode of each connected controllers automatically switches 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.

− 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.

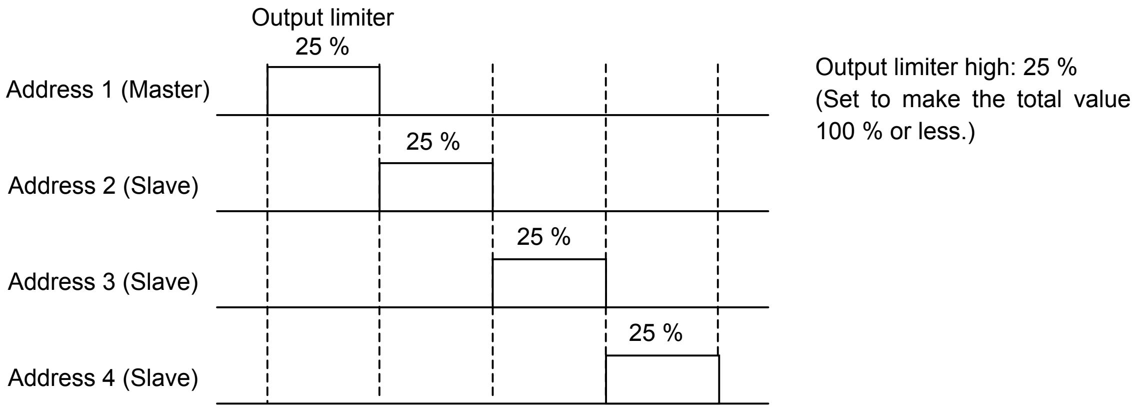
- When invalidating the SB link at the Master side first: an SB link error (Err 16) occurs at the Slave controller.
  → The Slave controller(s) cannot receive the synchronizing signal from the Master controller as SB link function was invalidated by the Master controller.

- 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.

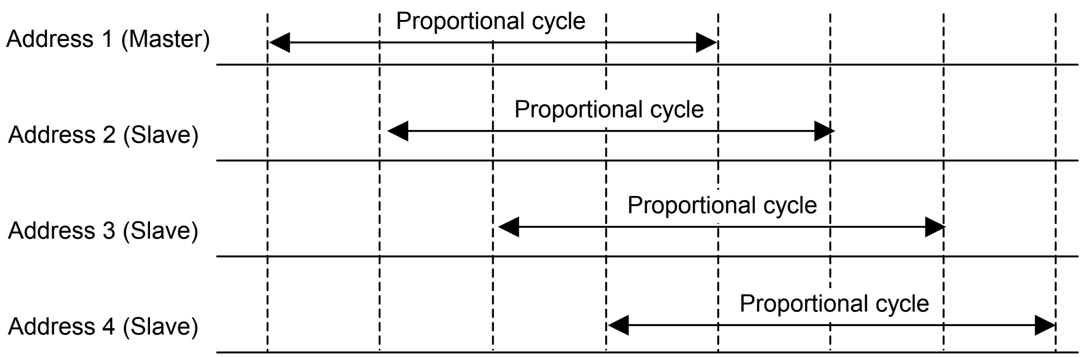
☞ For setting method of SB link selection, refer to ■ **Setting Procedure (P. 7-17)**.

■ 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 Salve controllers are connected. Therefore, the start timing of Proportional cycle time is fixed for each address.



Control output state for each address



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.)

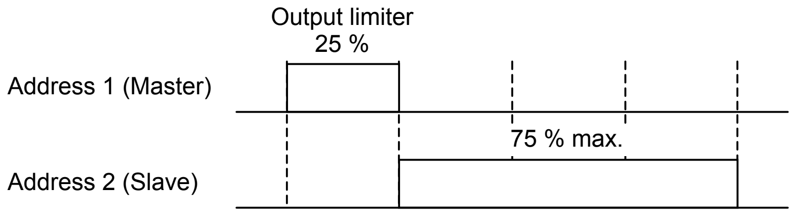
Proportional cycle time and Output limiter can be set in the Parameter setting mode.
For details, refer to **4. BASIC OPERATION (P. 4-1)** and **8.4 Parameter Setting Mode (P. 8-25** and **P. 8-27)**.

■ 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.

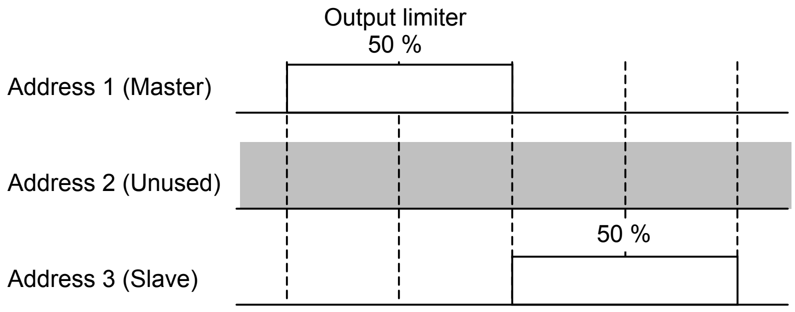


Output limiter for Address 2 can be set up to 75 %.
(Set to make the total value 100 % or less.)

Control output state for each address

● When operating SB link by connecting 2 units of SB1 (Example B)

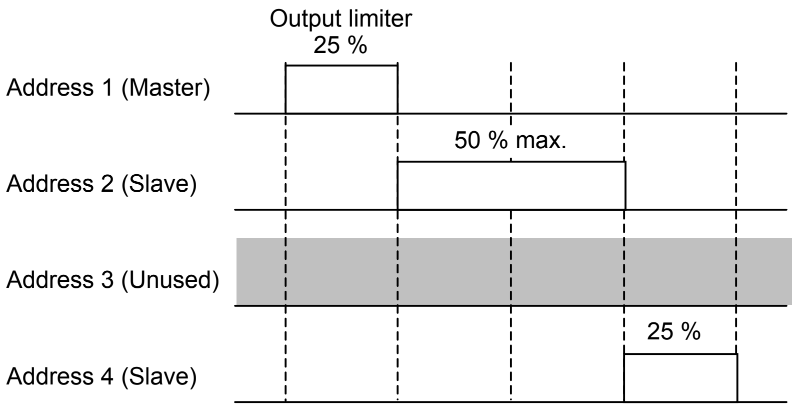
As the start timing of Proportional cycle time is fixed for each Address, using Address 1 and Address 3 allows Output limiter to set up to 50 % for each Address.



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.



Control output state for each address

MEMO

PARAMETER DESCRIPTION

8

This chapter describes of each parameters and data range.

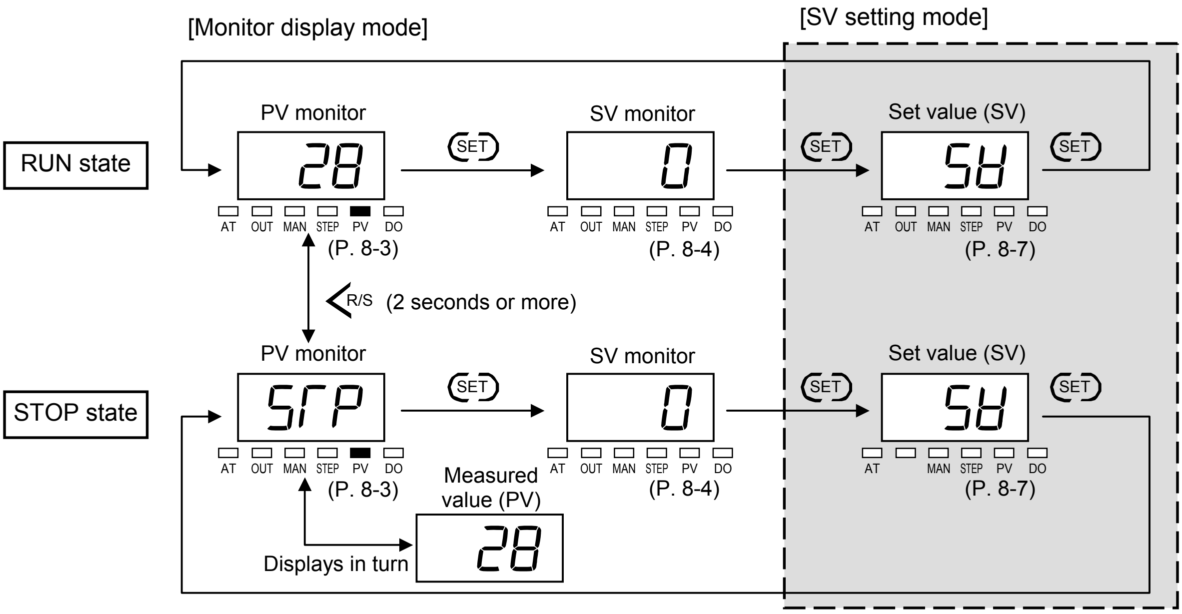
8.1 Monitor Display Mode

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

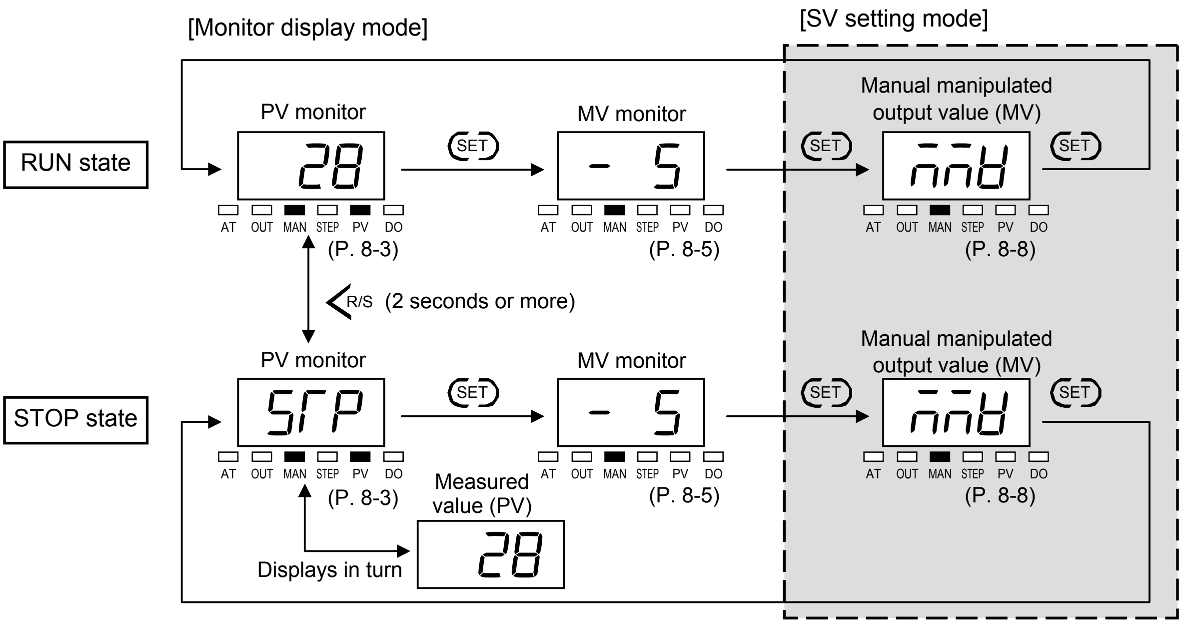
The Manipulated output value (MV) monitor can be hidden.
Set display/no display at the Monitor selection in the Function block F00 in the Engineering mode (P. 8-41).

8.1.1 Display sequence

■ At Auto (AUTO) mode



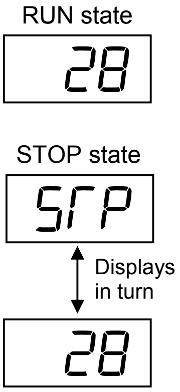
■ At Manual (MAN) mode



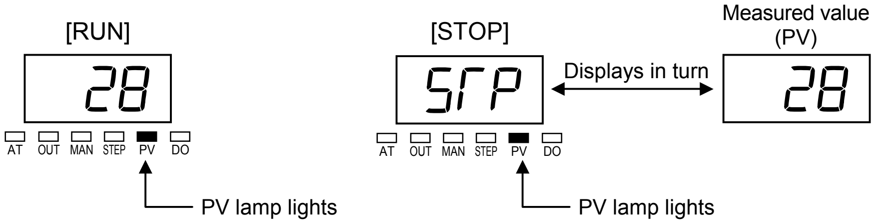
Auto/Manual transfer can be switched at **8.3 Mode Switching (P. 8-10)**.

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 “SrP” and Measured value (PV) will display alternately.



Display range	Factory set value
0 to 800 °C or 0 to 999 °F 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	—

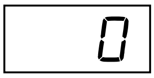
Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

Related parameters

Engineering mode:

- Decimal point position (P. 8-67)

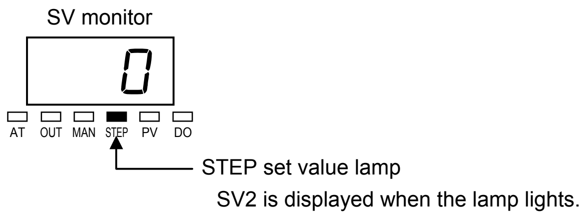
Set value (SV) monitor



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.

Display range	Factory set value
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).	—

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).



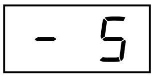
Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

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.

Display range	Factory set value
Output limiter low to Output limiter high When using communication, only a single digit of the Manipulated output value (MV) can be displayed after the decimal point (the tenths place).	—

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)

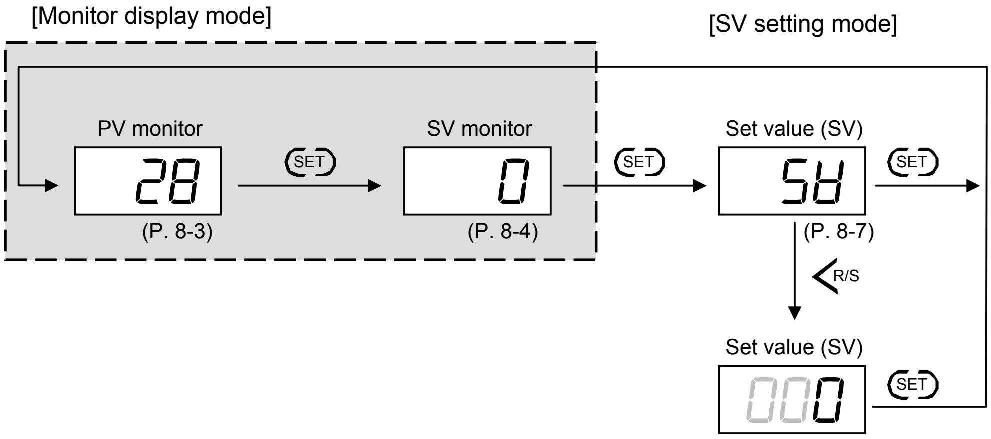
8.2 SV Setting Mode

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

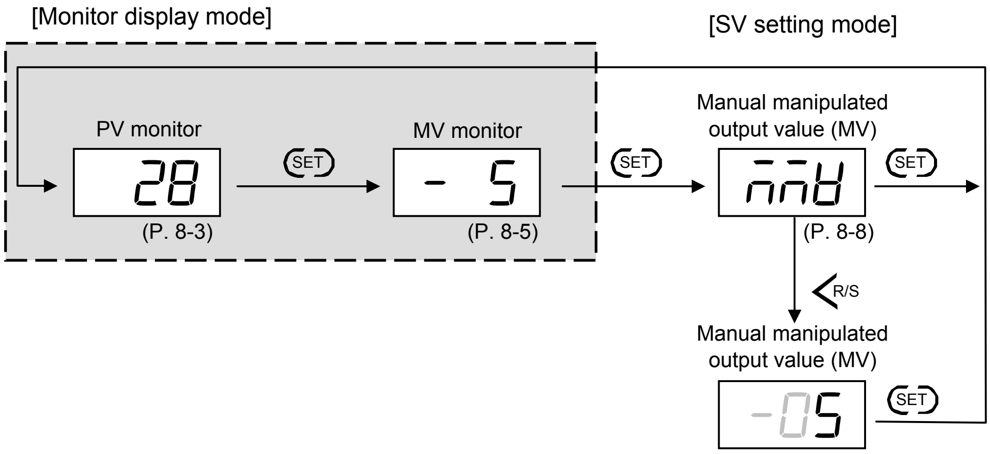
- When the operation mode is the Auto (AUTO) mode, the Set value (SV) can be set.
- When the operation mode is the Manual (MAN) mode, the Manipulated output value (MV) can be set.

8.2.1 Display sequence

■ At Auto (AUTO) mode



■ At Manual (MAN) mode

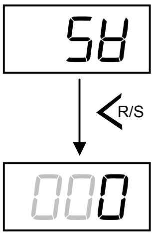


The Set value (SV) and Manual manipulated output value (MV) can also be set in Parameter setting mode (P. 8-12).

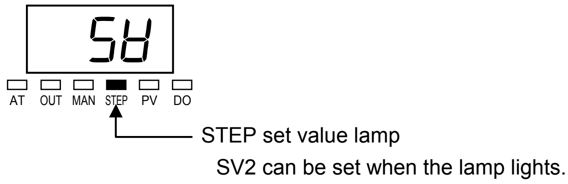
Auto/Manual transfer can be switched at **8.3 Mode Switching (P. 8-10)**.

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.



Data range	Factory set value
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

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).

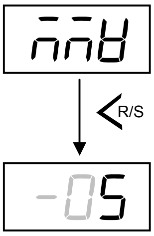
☞ For details on changing the Set value (SV), refer to **5.2 Operation Setting (P. 5-6)**.

Related parameters

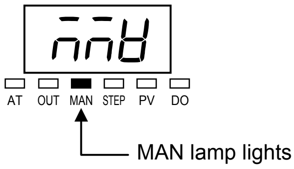
Parameter setting mode:
- Set value 1 (SV1), Set value 2 (SV2) (P. 8-13)

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.



Data range	Factory set value
Output limiter low to Output limiter high When using communication, only a single digit of the Manipulated output value (MV) can be displayed after the decimal point (the tenths place).	0

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).

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

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)

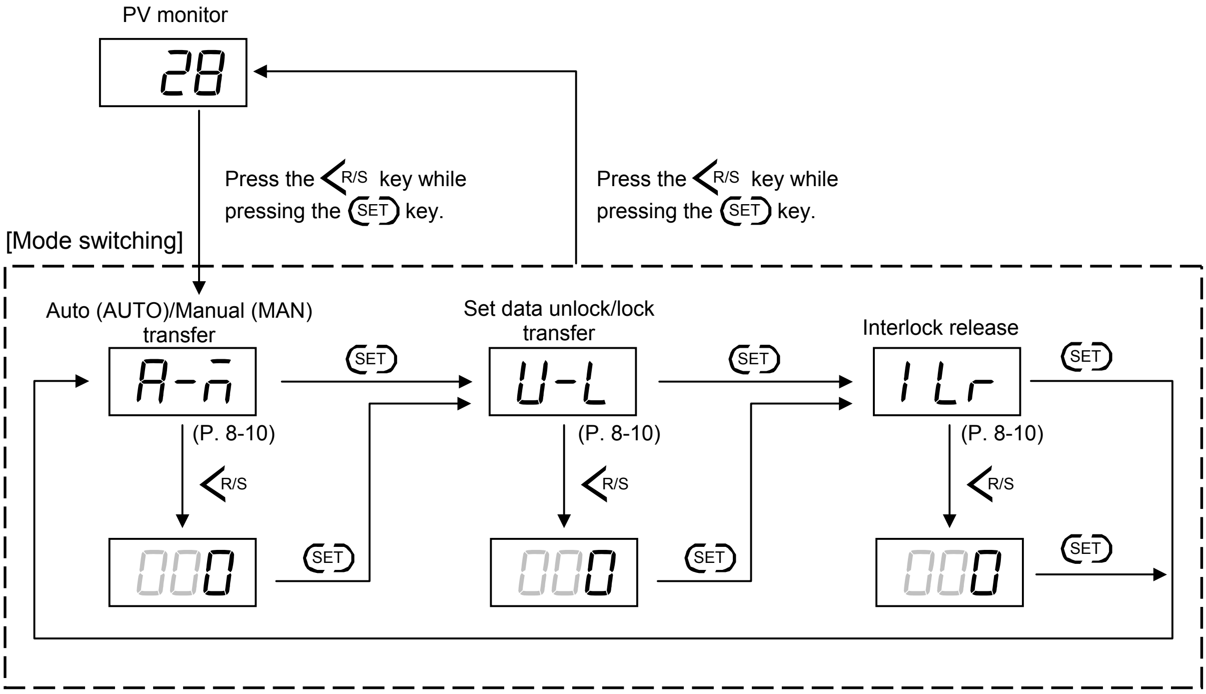
8.3 Mode Switching

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.

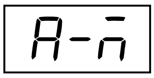
8.3.1 Display sequence



8.3.2 Setting item

Auto (AUTO)/Manual (MAN) transfer

Factory default setting:
The screen is displayed.



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.

Data range	Factory set value
0: Auto (AUTO) mode 1: Manual (MAN) mode	0

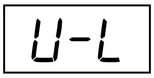
To hide the Auto (AUTO)/Manual (MAN) transfer, set "No display" to Mode selection (no display) (P. 8-41) in the Engineering mode.

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

Factory default setting:
The screen is displayed.



Lock or unlock the setting data.

Data range	Factory set value
0: Unlock 1: Lock	0

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

Factory default setting:
The screen is displayed.

ILr

Release the interlock state of event.

Data range	Factory set value
0: Interlock release 1: Interlock state (only monitor)	0

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

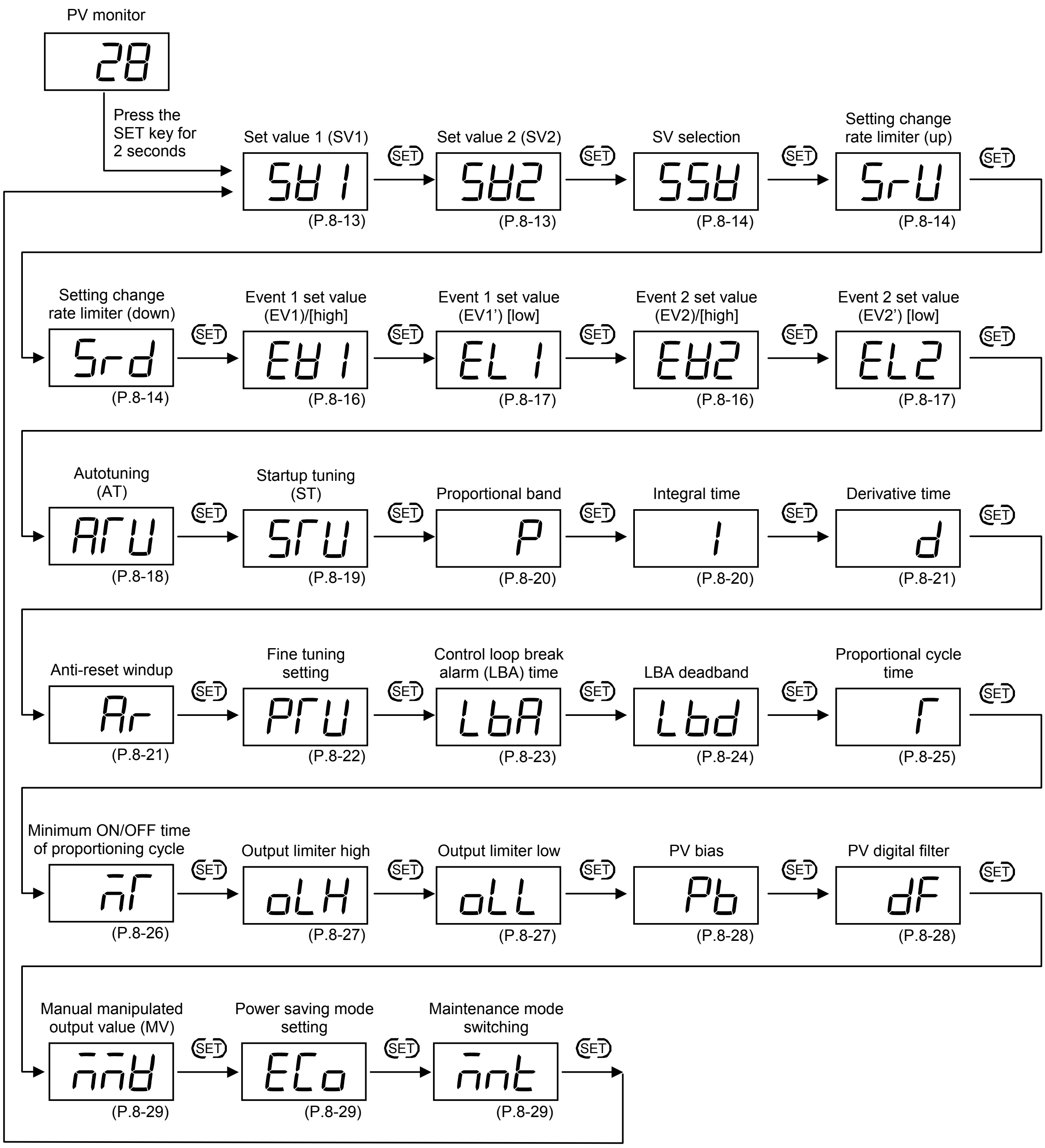
Engineering mode:

- 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)

Factory default setting:
The screen is not displayed.

SV1

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.

Data range	Factory set value
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 [S01] (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

Factory default setting:
The screen is not displayed.

SSV

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

Data range	Factory set value
1: Set value1 (SV1) 2: Set value 2 (SV2)	1

SV selection is not displayed as the default when the block selection at F01 [SO1] (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)
Setting change rate limiter (down)

Factory default setting:
The screen is not displayed.

SrU

Srd

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

Data range	Factory set value
0 to Input span (Unit °C [°F])/unit time 0: Unused [Factory set value of unit time: 0 (minute)] When using communication, only a single digit of the Setting change rate limiter can be displayed after the decimal point (the tenths place).	0

Setting change rate limiter is not displayed as the default when the block selection at F03 [SO3] (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 (SrT) 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).

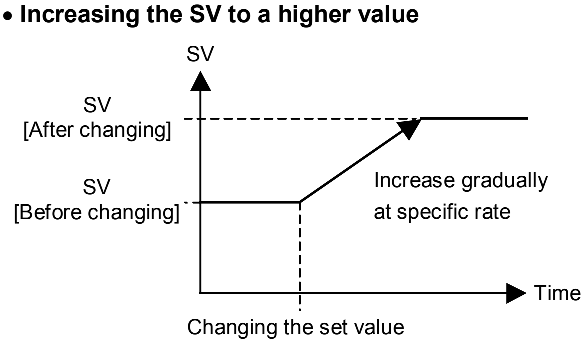
Related parameters

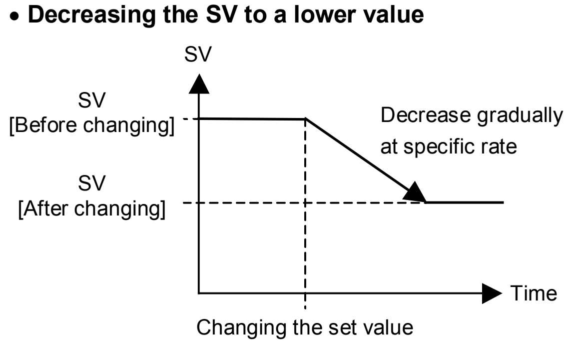
Engineering mode:
- Setting change rate limiter (up), Setting change rate limiter (down) (P. 8-46)
- Decimal point position (P. 8-67)
- Setting change rate limiter unit time (P. 8-103)

■ 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]





📖 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 starts 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.

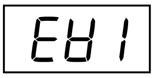
📖 If control is stopped during the Setting change rate limiter, the value at that point is considered the Set value (SV). Setting change rate limiter is canceled.

📖 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).

Event 1 set value (EV1), Event 1 set value (EV1) [high] Event 2 set value (EV2), Event 2 set value (EV2) [high]

Factory default setting: The screen is displayed.



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

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

📖 Event set value or Event set value [high] is not displayed when the block selection at F04 [SO4] (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 (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') [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]

Factory default setting: The screen is displayed.

EL1

EL2

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].

Data range	Factory set value
−199 to +Input span When using communication, only a single digit of the Event set value can be displayed after the decimal point (the tenths place).	−50

Event set value [low] is not displayed when the block selection at F04 [SO4] (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)

Factory default setting:
The screen is displayed.

ATU

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

Data range	Factory set value
0: PID control 1: Autotuning (AT)	0

Autotuning (AT) is not displayed when the block selection at F05 [SOS] (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)

Startup tuning (ST)

Factory default setting: The screen is displayed.

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

Data range	Factory set value
0: ST unused 1: Execute once 2: Execute always	0

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.

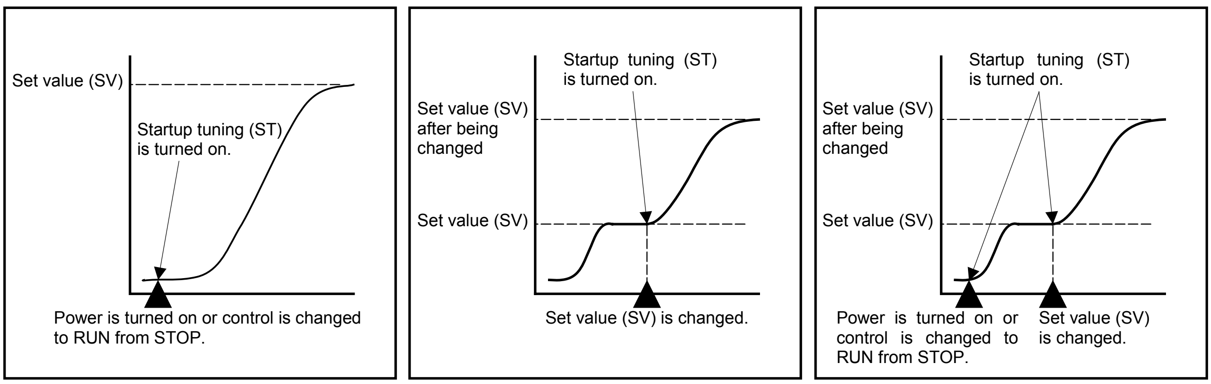
Timing of activating the Startup tuning (ST) can be selected from among the following three types.

- 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.

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.

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.



Proportional band

Factory default setting:
The screen is displayed.

P

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

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

Proportional band is not displayed when the block selection at F06 [506] (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

Factory default setting:
The screen is displayed.

I

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

Data range	Factory set value
0 to 999 seconds (0: PD action)	240

Integral time is not displayed when the block selection at F06 [506] (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.

d

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

Data range	Factory set value
0 to 999 seconds (0: PI action)	60

Derivative time is not displayed when the block selection at F06 [5O6] (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.

Ar

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

Data range	Factory set value
0 to 100 % of Proportional band (0: Integral action is always OFF)	100

Anti-reset windup (ARW) is not displayed when the block selection at F06 [5O6] (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 setting

(Factory default setting: The screen is displayed.)

PrU

Fine tuning function allows the operator to adjust the control response speed without changing PID values.

Data range	Factory set value
−3 to +3 (0: Unused)	0

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 [5O6] (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)

Control loop break alarm (LBA) time

Factory default setting:
The screen is displayed.

LbA

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.

Data range	Factory set value
0 to 999 seconds (0: Unused)	480

LBA 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.

LBA is not displayed when the block selection at F07 [SO7] (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)

Factory default setting:
The screen is displayed.

Lbd

The LBA deadband gives a neutral zone to prevent the Control loop break alarm (LBA) from malfunction caused by disturbance.

Data range	Factory set value
0 to Input span When using communication, only a single digit of the LBA deadband can be displayed after the decimal point (the tenths place).	0

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.

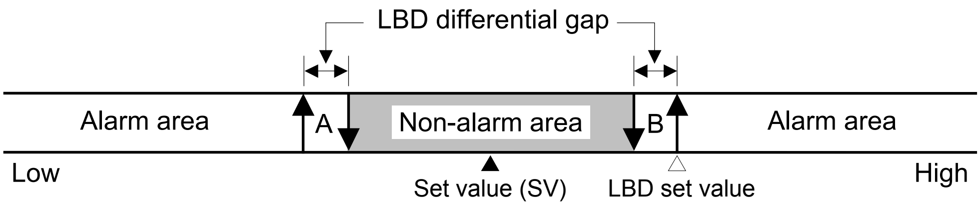
Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

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 During temperature fall: Non-alarm area
B: During temperature rise: Non-alarm area During temperature fall: 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

Factory default setting: The screen is displayed.

r

Proportional cycle time is to set control cycle time for time based control output.

Data range	Factory set value
1 to 100 seconds	2

Proportional cycle time is not displayed when the block selection at F08 [508] (P. 8-60) is set to “1: No display” in the Engineering mode.

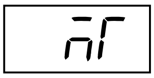
Related parameters

Parameter setting mode:
- 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

Factory default setting: The screen is displayed.



This is the Minimum ON/OFF time of the time proportioning cycle.

Data range	Factory set value
0 to 999 ms	0

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)

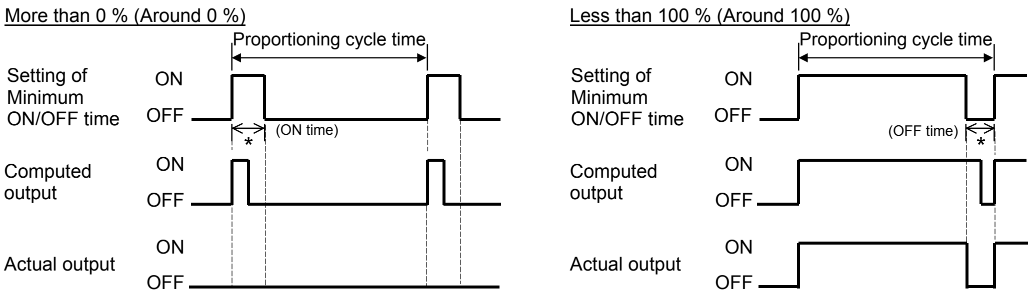
Engineering mode:

- Minimum ON/OFF time of proportioning cycle (P. 8-58)

■ Description of function

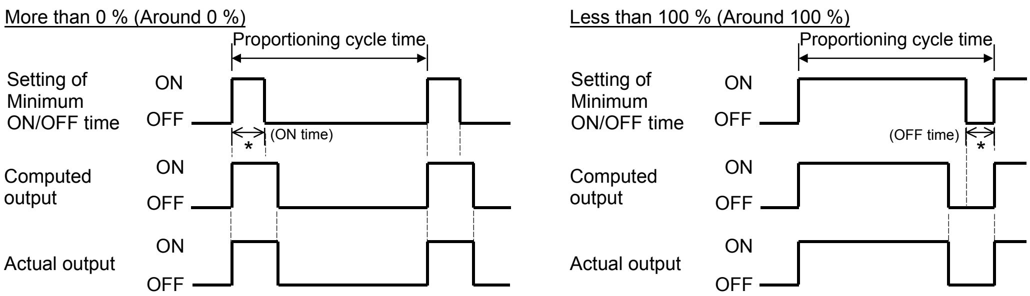
The Minimum ON/OFF time of the proportioning cycle is used to prevent output ON or OFF when the output is greater than 0 % or less than 100 %. This is useful when you need to establish a minimum ON/OFF time to prolong the life of the relay.

Example 1: Setting of Minimum ON/OFF time of proportioning cycle > Computed output



* 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



* 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

Factory default setting:
The screen is displayed.

oLH

oLL

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).

Data range	Factory set value
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).	105
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).	–5

Output limiter high/low is not displayed when the block selection at F08 [508] (P. 8-60) is set to "1: No display" in the Engineering mode.

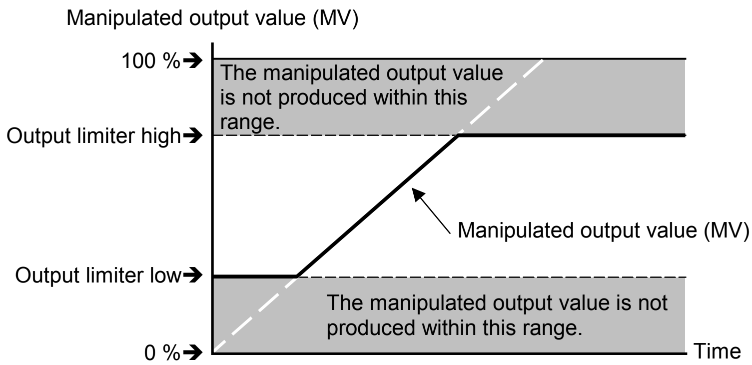
Decimal point for communication data can be set at Decimal point position in the Engineering mode (P.8-67).

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

Factory default setting:
The screen is displayed.

Pb

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.

Data range	Factory set value
−199 to +999 °C [°F] When using communication, only a single digit of the PV bias can be displayed after the decimal point (the tenths place).	0

PV bias is not displayed when the block selection at F09 [S09] (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

Factory default setting:
The screen is displayed.

dF

The PV filter is used to eliminate noise against the measured input.

Data range	Factory set value
0 to 100 seconds (0: Unused)	1

PV digital filter is not displayed when the block selection at F09 [S09] (P. 8-62) is set to "1: No display" in the Engineering mode.

Related parameter

Engineering mode:
- PV digital filter (P. 8-61)

Manual manipulated output value (MV)

Factory default setting:
The screen is not displayed.

mnV

Setting Manipulated output value (MV) in Manual (MAN) mode.

Data range	Factory set value
Output limiter low to Output limiter high When using communication, only a single digit of the Manual manipulated output value (MV) can be displayed after the decimal point (the tenths place).	0

Manual manipulated output value (MV) is not displayed as the default value of the block selection at F10 [S10] (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

Factory default setting:
The screen is not displayed.

ECo

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

Factory default setting:
The screen is not displayed.

mnt

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

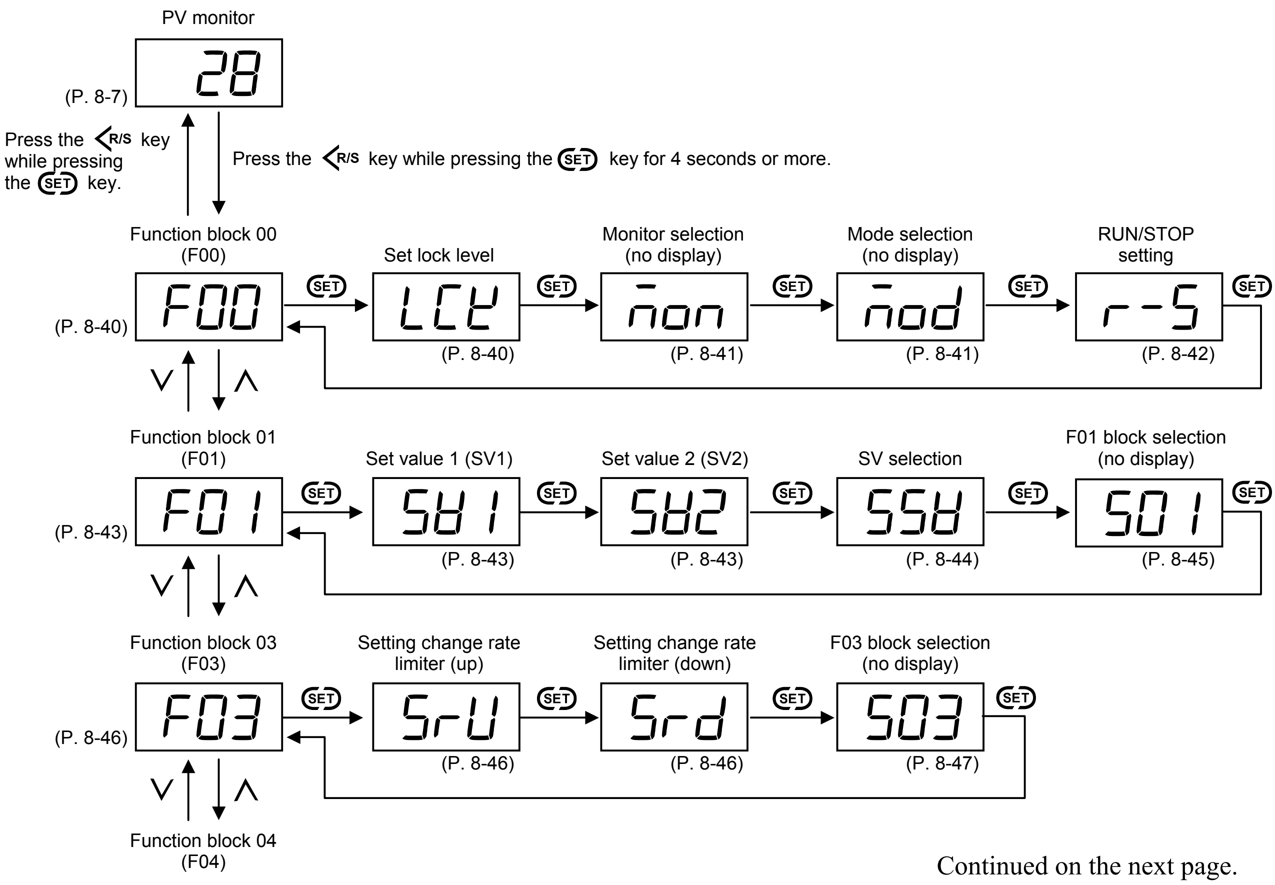
To configure settings in Engineering mode (F21 to F91), the following steps must be performed:

- **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



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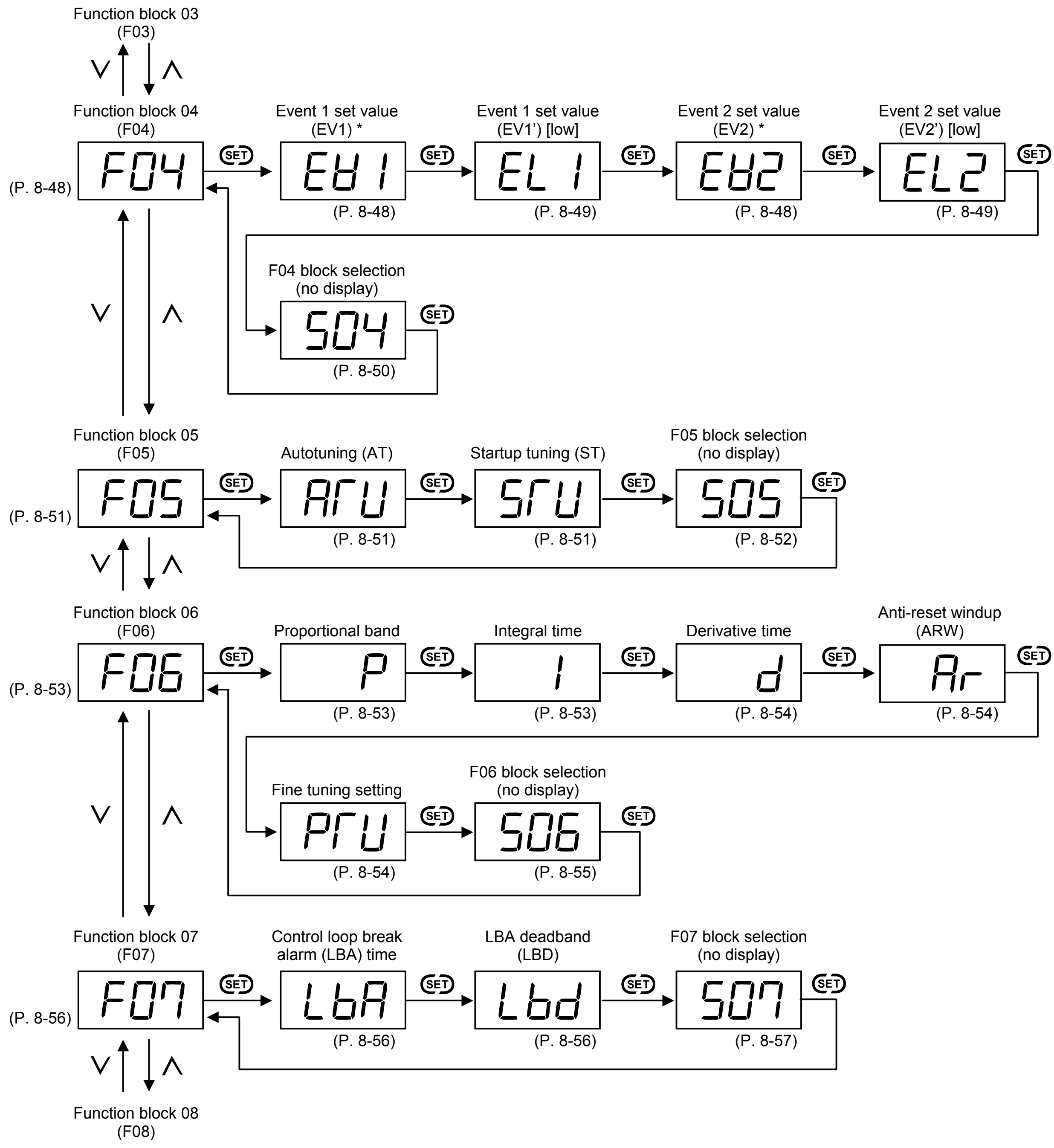

* If any of the following Event functions are selected, this parameter will be Event □ set value (EV□) [high].
(Event number at parameter setting shows up in □.)

- Band (High/Low individual setting) [Event type code: U]
- Deviation high/low (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]

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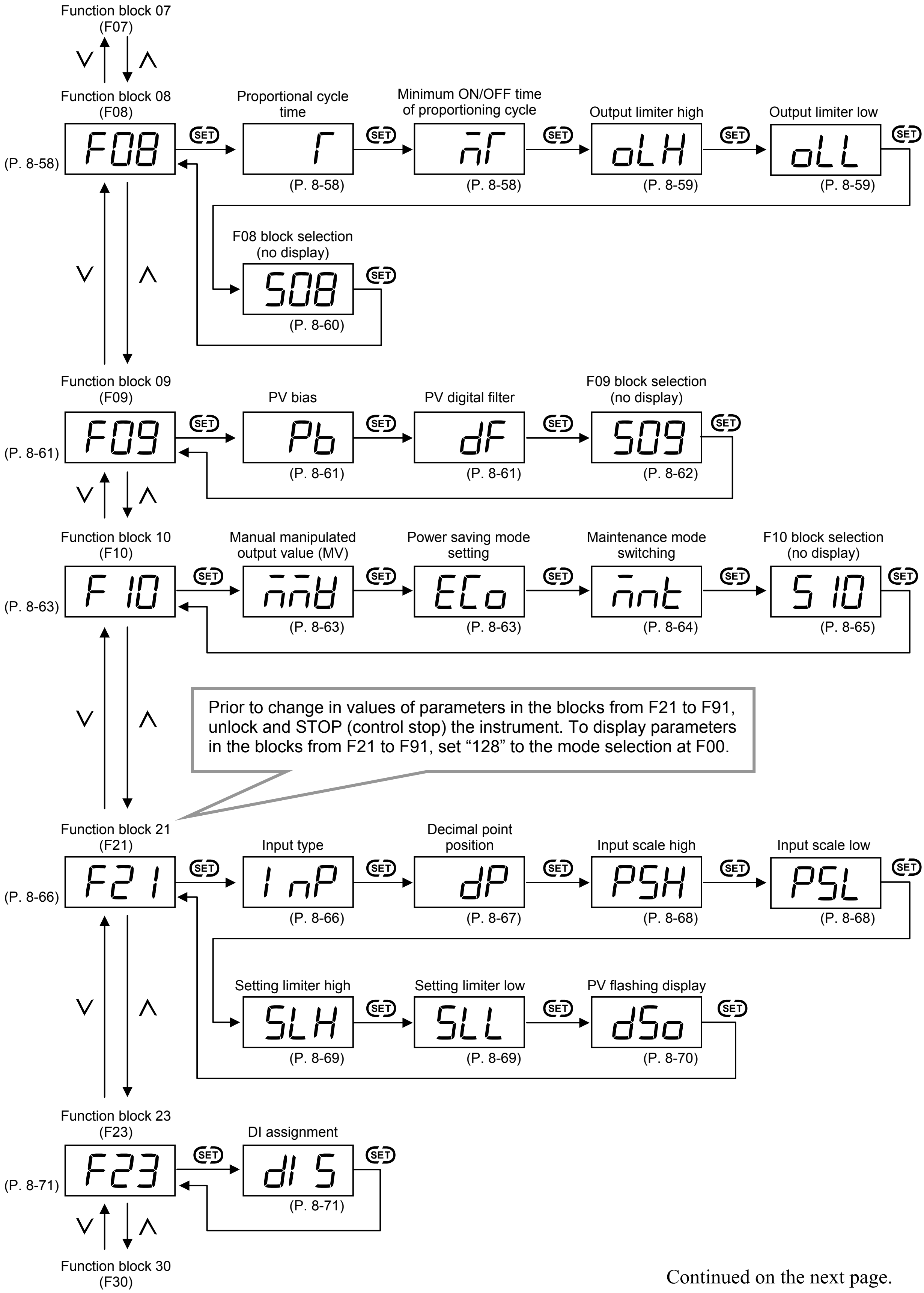

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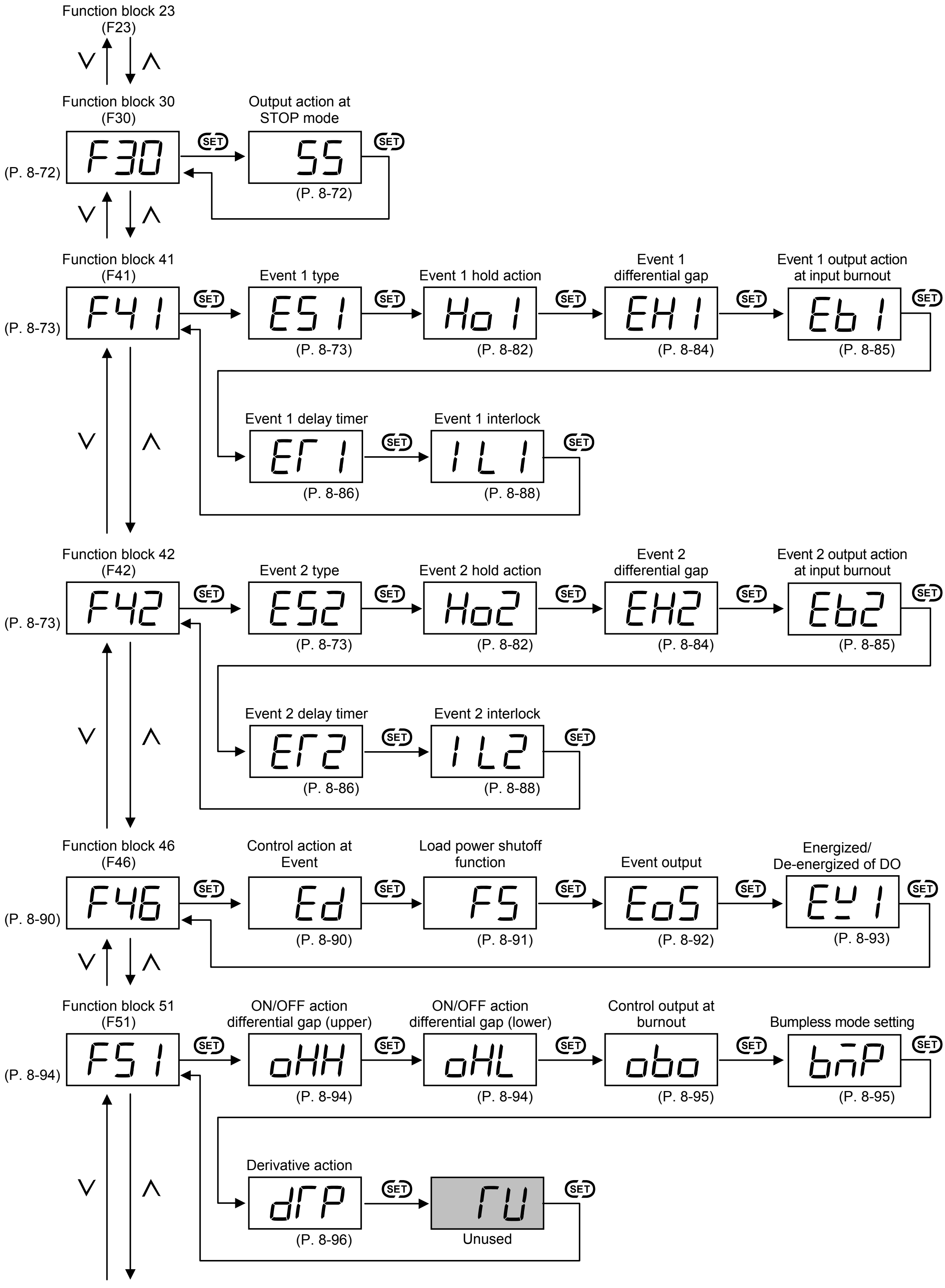

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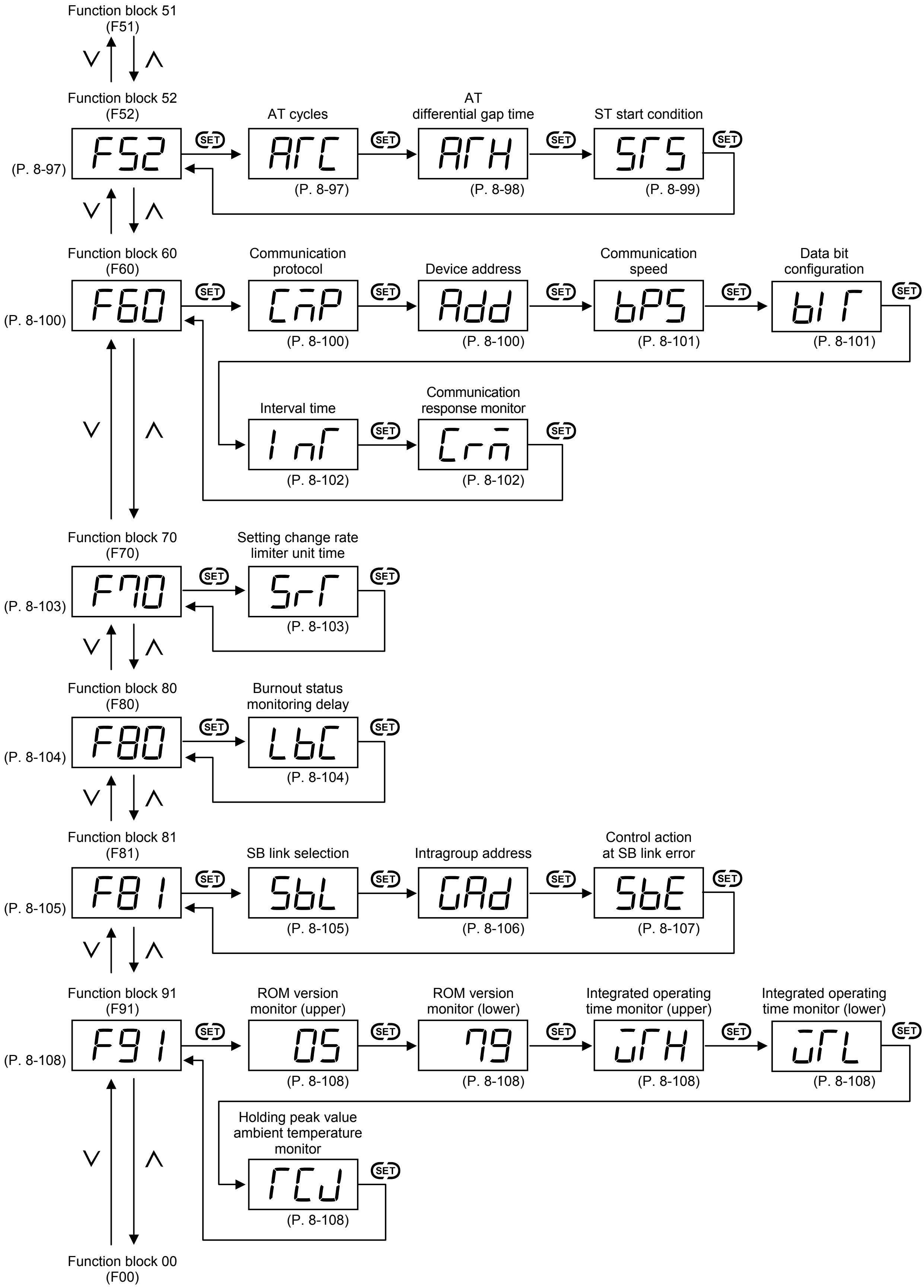


■ Function block (F□□) structure in the Engineering mode

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) [nod] 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:

◎: Can be displayed and change ○: Can be displayed ●: Cannot be displayed or change

Set data unlock/ lock transfer	Engineering mode	RUN/STOP	
		RUN	STOP
Unlock	F00	◎	◎
	F01 to F10	◎	◎
	F21 to F91	○	◎ (Excluding F91)
Lock	F00	◎	◎
	F01 to F10 *	◎	◎
	F21 to F91	●	●

* 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 (I nP)**
- **Event 1 type (ES 1)**
- **Event 2 type (ES2)**
- **Output limiter high (oLH)**
- **Output limiter low (oLL)**
- **Decimal point position (dP)**
- **Input scale high (PSH)**
- **Input scale low (PSL)**
- **Setting limiter high (SLH)**
- **Setting limiter low (SLL)**
- **Communication protocol (CMP)**

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 (I nP) is changed

The following parameter will be changed to factory default values according to the new setting.

Item	Default value
Input scale high	Maximum value of the selected input range
Input scale low	Maximum value of the selected input range
Setting limiter high	Input scale high
Setting limiter low	Input scale low
Set value 1 (SV1)	0 °C [°F]
Set value 2 (SV2)	
Setting change rate limiter (up)	0 °C [°F]
Setting change rate limiter (down)	0 °C [°F]
ON/OFF action differential gap (upper)	1 °C [°F]
ON/OFF action differential gap (lower)	1 °C [°F]
Proportional band	30 °C [°F]
Integral time	240 seconds
Derivative time	60 seconds
Anti-reset windup (ARW)	100 % of Proportional band
Fine tuning setting	0

Item	Default value
PV bias	0 °C [°F]
PV digital filter	1
Control loop break alarm (LBA) time	480 seconds
LBA deadband (LBD)	0 °C [°F]
Event 1 set value (EV1) or Event 1 set value (EV1) [high]	50 °C [°F]
Event 2 set value (EV2) or Event 2 set value (EV2) [high]	
Event 1 set value (EV1') [low]	–50 °C [°F]
Event 2 set value (EV2') [low]	
Event 1 differential gap	2 °C [°F]
Event 2 differential gap	
Event 1 hold action	0
Event 2 hold action	
Event 1 delay timer	0 seconds
Event 2 delay timer	

■ When Event 1 type (ES 1) is changed

The following parameter will be changed to factory default values according to the new setting.

Item	Default value
Event 1 set value (EV1) or Event 1 set value (EV1) [high]	50 °C [°F]
Event 1 set value (EV1') [low]	–50 °C [°F]

Item	Default value
Event 1 differential gap	2 °C [°F]
Event 1 hold action	0
Event 1 delay timer	0 seconds

■ When Event 2 type (ES2) is changed

The following parameter will be changed to factory default values according to the new setting.

Item	Default value
Event 2 set value (EV2) or Event 2 set value (EV2) [high]	50 °C [°F]
Event 2 set value (EV2') [low]	−50 °C [°F]

Item	Default value
Event 2 differential gap	2 °C [°F]
Event 2 hold action	0
Event 2 delay timer	0 seconds

■ 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

■ 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 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

■ 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

The following parameter will be automatically converted.

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

■ When Communication protocol (CMP) is changed

The following parameter will be automatically converted.

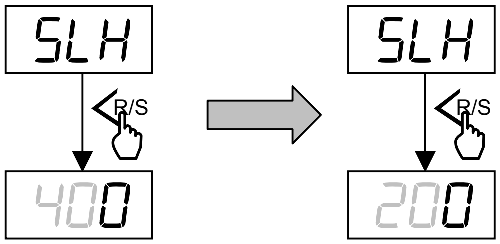
- Device address
- Data bit configuration

■ Example of automatic conversion

- Values of parameters related to Input scale high (PSH) change automatically in accordance with the change in value of Input scale high (PSH).

Example: When Input scale high (PSH) changes from 400 °C to 200 °C

Setting limiter high

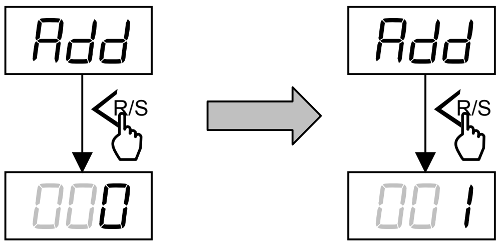


The value of the Setting limiter high automatically changes to 200 °C.

- Values of parameters related to Communication protocol (CMP) automatically in accordance with the change from RKC communication to Modbus.

Example 1: When Device address is “0”

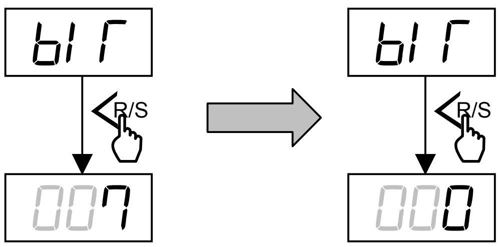
Device address



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



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.

8.5.3 Engineering setting item

Function block 00 (F00)

F00

This is the first parameter symbol of Function block 00 (F00).

F00

Set lock level

LCK

Lock and protect set data of parameters in each parameter group.

Data range	Factory set value
0: All parameters 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 and F10 10: Lock "Parameter Group" F10	0

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)

mon

Setting this parameter can hide the Manipulated output value (MV) monitor at the Monitor display mode and the Manual manipulated output value (MV) at the SV setting mode.

Data range	Factory set value
0: Display all 2: No display: Manipulated output value (MV) monitor and Manual manipulated output value (MV) at SV setting mode.	0

☞ 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)

mod

Hide Mode switching screens at the Mode switching. To select more than one Mode switching screens, set the total value of the Mode switching screens.
This parameter can also be used to prohibit RUN/STOP transfer with the <R/S key and display F21 to F91 of Engineering mode.

Data range	Factory set value
0: Display Mode switching screen (Auto/Manual transfer, Set data unlock/lock transfer, Interlock release) 1: Auto (AUTO)/Manual (MAN) transfer [no display] 2: Set data unlock/lock transfer [no display] 4: Interlock release [no display] 8: Disable <R/S key operation 128: Display F21 to F91 Engineering mode.	0

☞ For details of setting method, refer to **6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-34)**.

F00

RUN/STOP setting

r-S

RUN/STOP transfer is can be set in the Engineering mode state. Select RUN or STOP and press the SET key.

Data range	Factory set value
0: RUN 1: STOP	0

Set RUN mode “0: RUN” prior to transfer RUN/STOP mode by digital input (DI).

Relations between key operations/communication and DI status

<table>
<tr><th colspan="2">Mode select from key operation or communication</th><th>DI-switched *</th><th>Actual state</th></tr>
<tr><td rowspan="4">RUN/STOP transfer
or
RUN/STOP setting</td><td rowspan="2">RUN</td><td>RUN (Contact closed)</td><td>RUN</td></tr>
<tr><td>STOP (Contact open)</td><td rowspan="3">STOP</td></tr>
<tr><td rowspan="2">STOP</td><td>RUN (Contact closed)</td></tr>
<tr><td>STOP (Contact open)</td></tr>
</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 R/S key. When RUN/STOP mode is transferred by R/S key, the set data of RUN/STOP setting is also transferred.

Function block 01 (F01)

F01

This is the first parameter symbol of Function block 01 (F01).

F01

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

SV1

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)

F01
SV selection

SSV

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

F01 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	1

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)**.

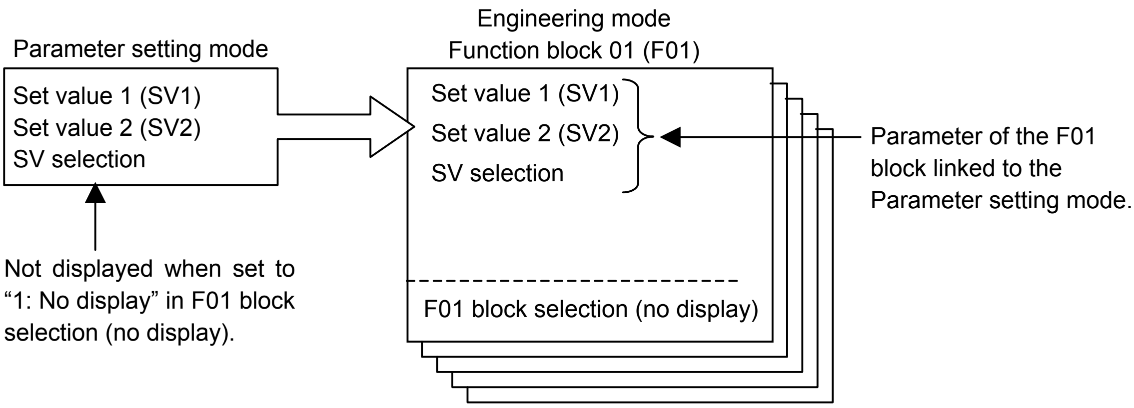
Related parameter

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)

F03

This is the first parameter symbol of Function block 03 (F03).

F03

Setting change rate limiter (up)
Setting change rate limiter (down)

SrU

Srd

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

F03 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	1

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)**.

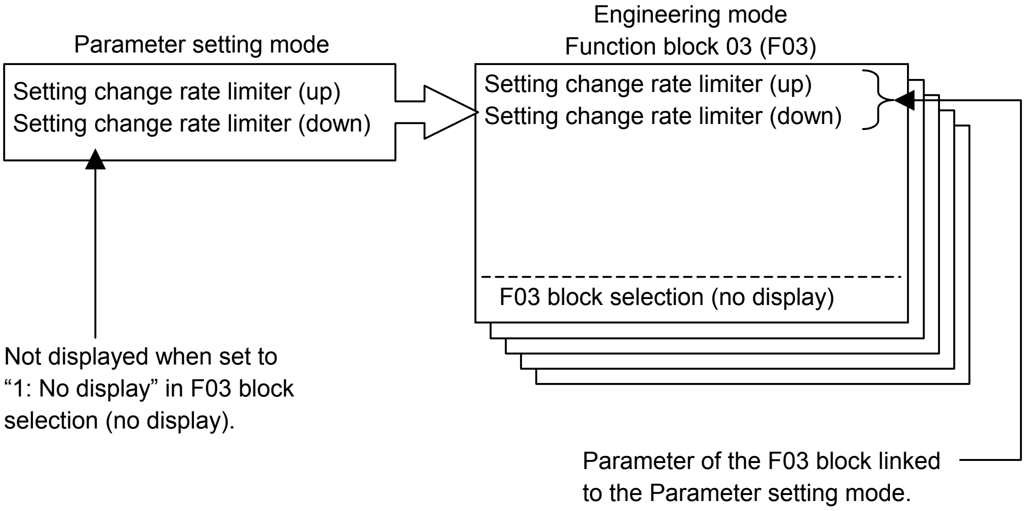
Related parameter

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.

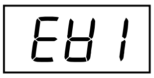


Function block 04 (F04)

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)

F04

Event 1 set value (EV1’) [low]
Event 2 set value (EV2’) [low]

EL1

EL2

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.

Data range	Factory set value
0: Display 1: No display	0

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:

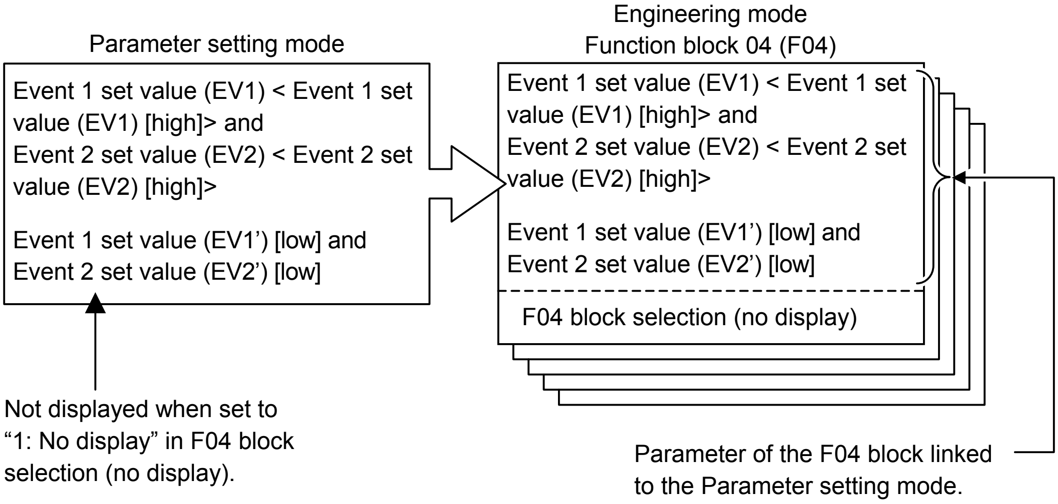
- Event 1 set value (EV1) <Event 1 set value (EV1) [high]> and
  Event 2 set value (EV2) <Event 2 set value (EV2) [high]> (P. 8-16)
- Event 1 set value (EV1') [low] and Event 2 set value (EV2') [low] (P. 8-17)

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)

F05

This is the first parameter symbol of Function block 05 (F05).

F05

Autotuning (AT)

ATU

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)

STU

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

F05 block selection (no display)

505

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	0

When “No display” is selected, the parameters of Parameter setting mode are not displayed; however, F05 parameters are displayed.

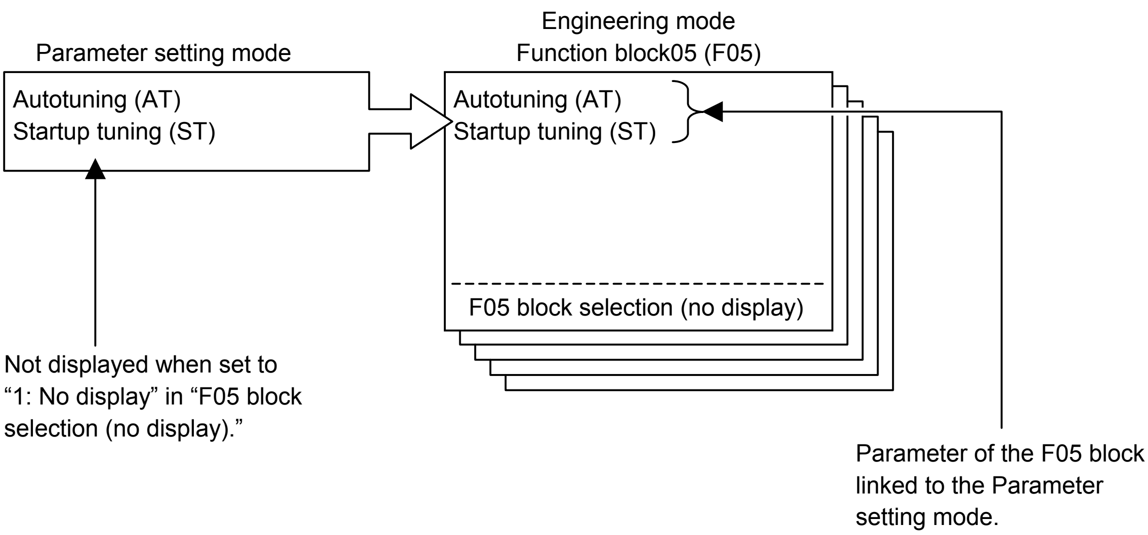
For details of setting example, refer to **6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36)**.

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.



Function block 06 (F06)

F06

This is the first parameter symbol of Function block 06 (F06).

F06

Proportional band

P

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

I

Link to the Integral time in the Parameter setting mode.

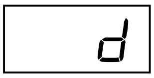
☞ For details of Integral time, refer to **8.4.2 Parameter setting item (P. 8-20)**.

Related parameter

Parameter setting mode:

- Integral time (P. 8-20)

F06
Derivative time



Link to the Derivative time in the Parameter setting mode.

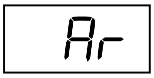
☞ For details of Derivative time, refer to **8.4.2 Parameter setting item (P. 8-21)**.

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)

S06

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	0

When "No display" is selected, the parameters of Parameter setting mode are not displayed; however, F06 parameters are displayed.

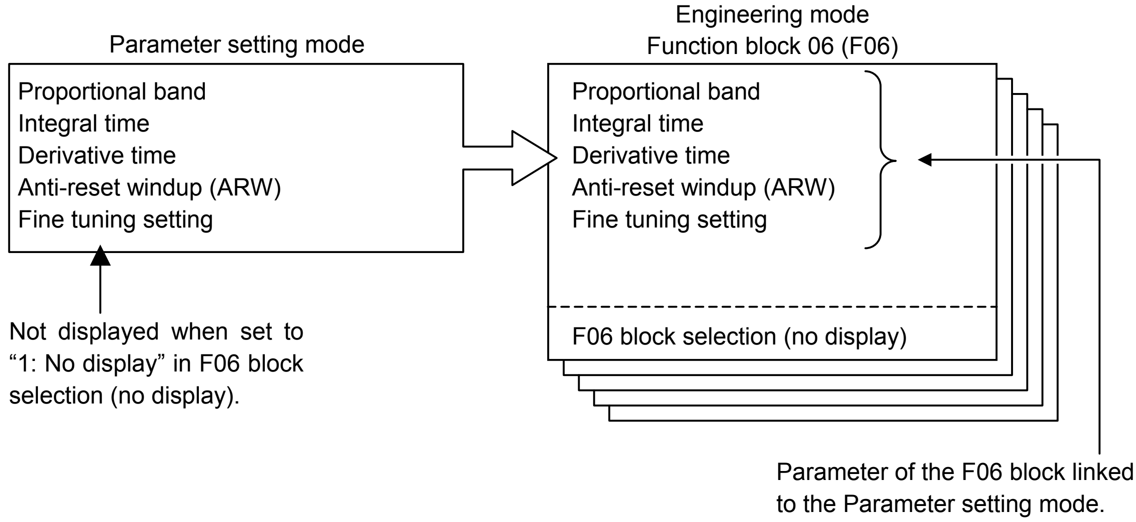
For details of setting example, refer to **6.7 Display/No display Setting of Mode Screens (P. 6-31, P. 6-36)**.

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.



Function block 07 (F07)

F07

This is the first parameter symbol of Function block 07 (F07).

F07

Control loop break alarm (LBA) time

LbA

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)

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)

F07

F07 block selection (no display)

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	0

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)**.

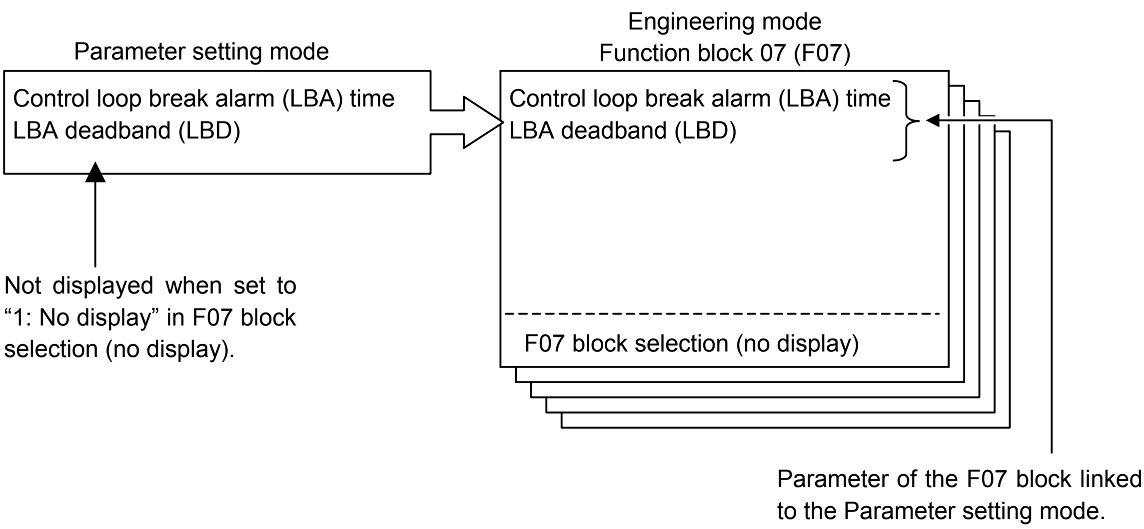
Related parameter

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.

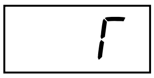


Function block 08 (F08)

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:

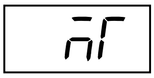
- Proportional cycle time (P. 8-25)
- Minimum ON/OFF time of proportioning cycle (P. 8-26)

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

oLH

oLL

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

F08 block selection (no display)

S08

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	0

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)**.

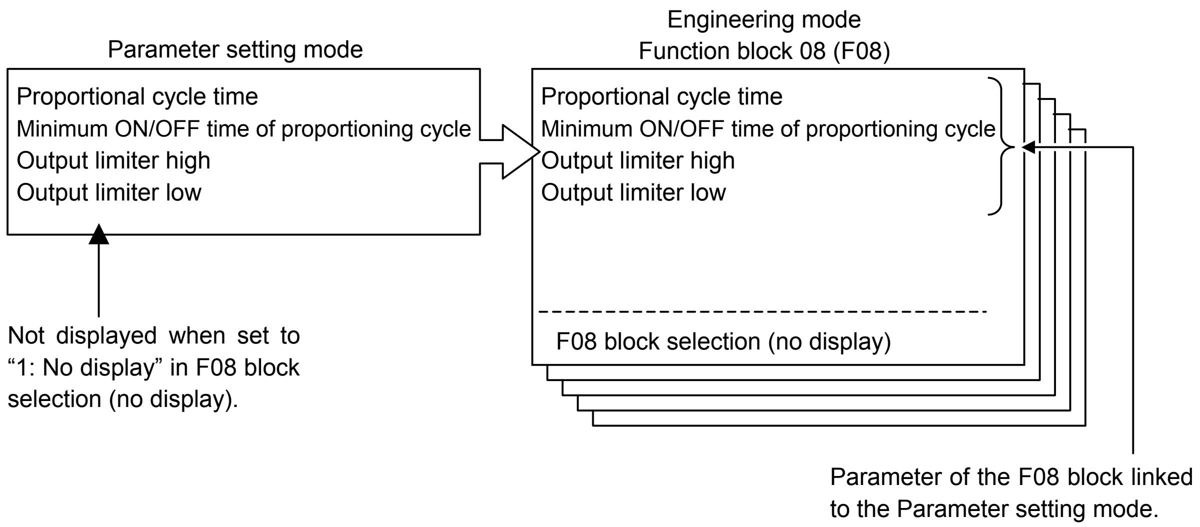
Related parameter

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)

F09

This is the first parameter symbol of Function block 09 (F09).

F09

PV bias

Pb

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

dF

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)

S09

Hide parameter symbols in the Parameter setting mode from the display.

Data range	Factory set value
0: Display 1: No display	0

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)**.

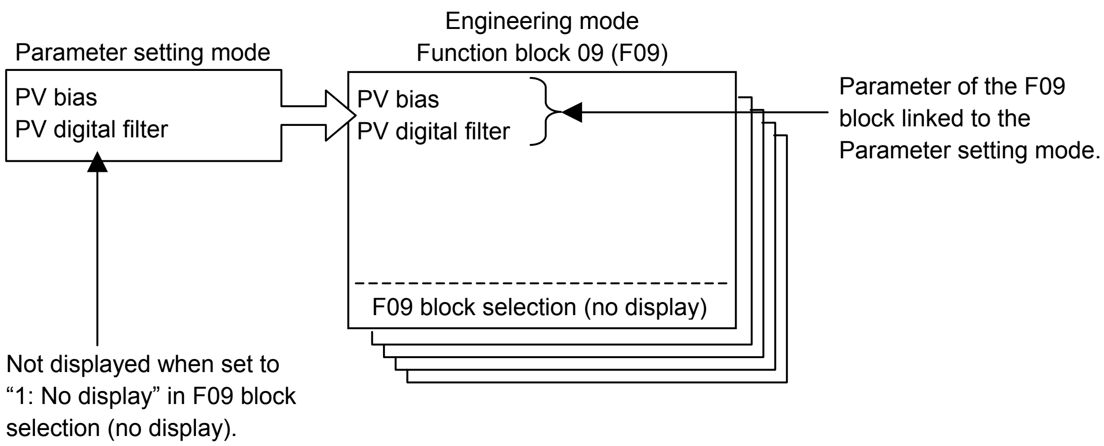
Related parameter

Parameter setting mode:

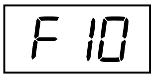
- PV bias (P. 8-28)
- PV digital filter (P. 8-28)

■ 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.



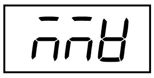
Function block 10 (F10)



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

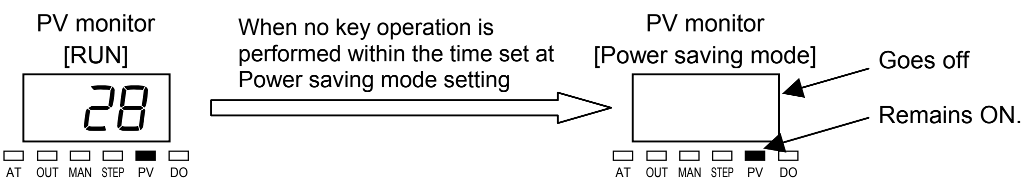
Power saving mode setting

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.

Data range	Factory set value
0 to 60 minutes (0: Always ON)	0

■ 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)**.

F10

Maintenance mode switching

mnt

Operation mode can be switched to the Maintenance mode.
Link to the Maintenance mode switching in the Parameter setting mode.

Data range	Factory set value
0: Normal operation mode 1: Maintenance mode	0

■ 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

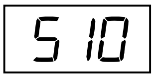
Display: Maintenance mode (Character: mnt)
Input: Not measured (Input burnout detection is invalidated.)
Measured value (PV) in communication: 0 °C [°F]
Output: Control output and Event is OFF.
Output value in communication: –5 %
Communication: Maintenance mode displays at Operation mode state monitor.
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.

Data range	Factory set value
0: Display 1: No display	1

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)**

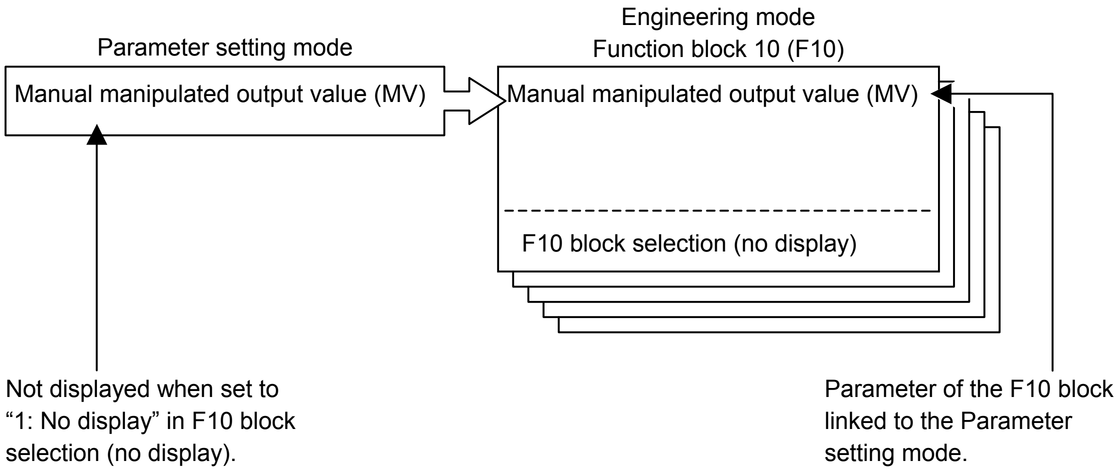
Related parameter

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 Mod (Mode selection [no display]) in F00 to 128 is required. (Refer to P. 8-41)

Function block 21 (F21)

F21

This is the first parameter symbol of Function block 21 (F21).

F21
Input type

InP

Input type number is a number to indicate an input type. The Input type can be changed.

Data range		Factory set value
0: TC input K	0 to 800 °C	Based on model code
3: TC input J	0 to 800 °C	
15: RTD input Pt100	0 to 400 °C	
17: TC input K	0 to 999 °F	
19: TC input J	0 to 999 °F	
31: RTD input Pt100	0 to 800 °F	

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 (InP) 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

dP

A Decimal point can be specified for communication data.

Data range	Factory set value
0: Without decimal point for communication 1: With decimal point for communication (the tenths place)	1

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)
- Proportional band (P. 8-20)
- LBA deadband (LBD) (P. 8-24)
- Output limiter high (P. 8-27)
- Output limiter low (P. 8-27)
- PV bias (P. 8-28)
- Manual manipulated output value (MV) (P. 8-29)

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.

Data range	Factory set value
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

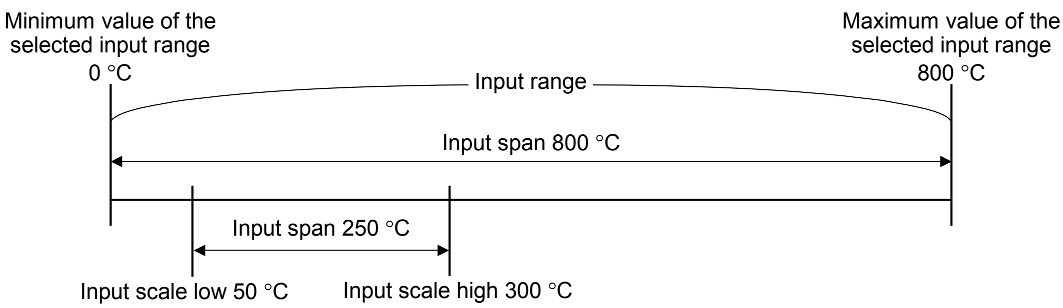
Engineering mode:
- Input type (P. 8-66)
- Decimal point position (P. 8-67)
- Setting limiter high, Setting limiter low (P. 8-69)

■ 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



F21

Setting limiter high
Setting limiter low

SLH

SLL

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.

Data range	Factory set value
Setting limiter high Setting limiter low to Input scale high When using communication, only a single digit of the Setting limiter high can be displayed after the decimal point (the tenths place).	Input scale high
Setting limiter low Input scale low to Setting limiter high When using communication, only a single digit of the Setting limiter low can be displayed after the decimal point (the tenths place).	Input scale low

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

Related parameters

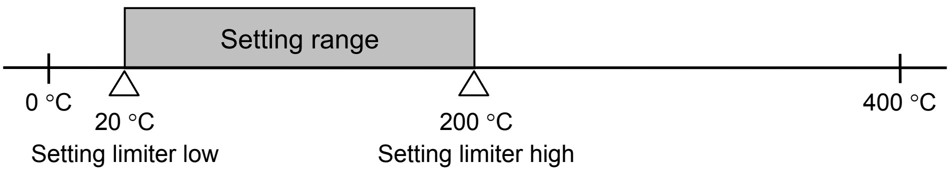
Engineering mode:

- Input type (P. 8-66)
- Decimal point position (P. 8-67)
- Input scale high, Input scale low (P. 8-68)

■ Description of function

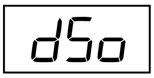
Setting limiter is to set the range of the Set value (SV).

[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

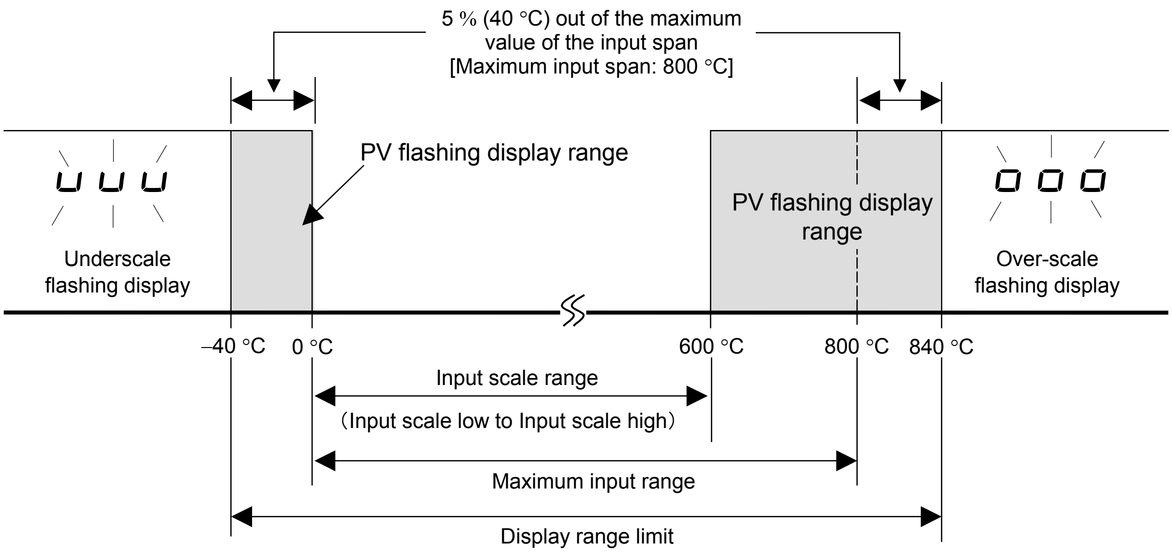
PV flashing display



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.

Data range	Factory set value
0: Flashing 1: Non-flashing display	0

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)

F23

This is the first parameter symbol of Function block 23 (F23).

F23

DI assignment

dI S

Use to assign the function (SV selection function, RUN/STOP transfer, Auto/Manual transfer, or interlock release) for the Digital input (DI) [optional].

Data range	Factory set value
0: Unused (No DI assignment) 1: SV selection function (SV1/SV2) [1] 2: RUN/STOP transfer [2] 3: Auto/Manual transfer [3] 4: Interlock release [4]	1

[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)

F30

This is the first parameter symbol of Function block 30 (F30).

F30

Output action at STOP mode

SS

Use to select action of Event output when the controller is set to STOP (control STOP).

Data range	Factory set value
0: Event output is OFF 1: Event output remains unchanged	0

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)

F41 — This is the first parameter symbol of Function block 41 (F41).

F42 — This is the first parameter symbol of Function block 42 (F42).

F41
Event 1 type
F42
Event 2 type

ES1 — Use to select a action type of the Event 1

ES2 — Use to select a action type of the Event 2.

Data range	Factory set value
0 to 23 Refer to **Event type (P. 8-74)**.	0 If the Event type is specified by the event type code when ordering, that Event type will be the factory set value.

Event type

Set value	Event type	Event type code	Action type
0	None	N	—
1	Deviation high (Using SV monitor value) [1]	A (With hold action: E With re-hold action: Q)	Deviation action
2	Deviation low (Using SV monitor value) [1]	B (With hold action: F With re-hold action: R)	
3	Deviation high/low (Using SV monitor value) [1]	C (With hold action: G With re-hold action: T)	
4	Band (Using SV monitor value)	D	
5	Deviation high/low (SV Using SV monitor value) [High/Low individual setting] [1]	X (With hold action: Y With re-hold action: Z)	
6	Band (Using SV monitor value) [High/Low individual setting]	U	
7	SV high (Using SV monitor value)	V	Set value action
8	SV low (Using SV monitor value)	W	
9	Process high [2]	H (With hold action: K)	Input value action
10	Process low [2]	J (With hold action: L)	
11	Control loop break alarm (LBA)	2	—
12	Monitor during RUN	4	—
13	FAIL	3	—
14	Deviation high (Using local SV) [1]	—	Deviation action
15	Deviation low (Using local SV) [1]	—	
16	Deviation high/low (Using local SV) [1]	—	
17	Band (Using local SV)	—	
18	Deviation high/low (Using local SV) [High/Low individual setting] [1]	—	
19	Band (Using local SV) [High/Low individual setting]	—	
20	SV high (Using local SV)	—	Set value action
21	SV low (Using local SV)	—	
22	Unused	—	—
23	Output of the communication monitoring result	5	—

[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)

■ Description of function

● FAIL

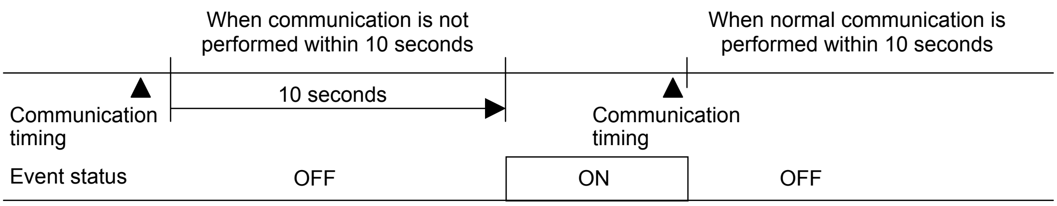
Operation stops if FAIL occurs
(FAIL output [fixed at de-energized]: contact open when error occurs)
FAIL output is ON (contact open) when power is supplied to the instrument only through loader communication.

● 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.



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)

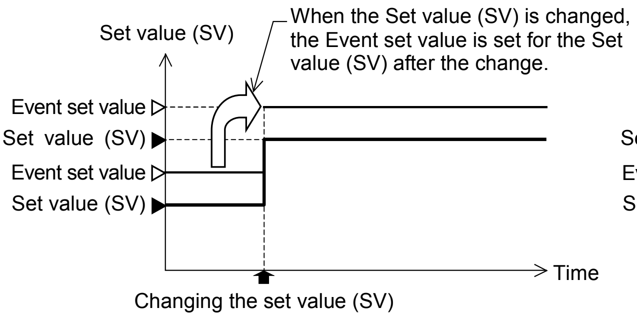
When the deviation (PV – SV) reaches the Event set value, event ON occurs.

SV monitor value type and local SV type are available for Deviation action.

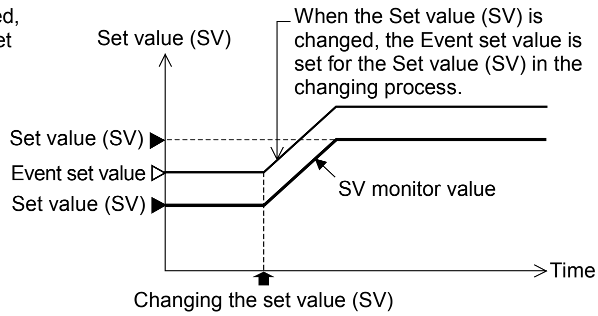
SV monitor value type	The Event set value is set for the SV monitor value. Setting change rate limiter adjusts the Event set value to follow the same change rate of SV monitor value. SV monitor value: SV monitor value is displayed in the Set value (SV) monitor screen (Monitor display mode). When Setting change rate limiter is set, the Set value (SV) in the changing process is displayed.
Local SV type	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).

SV monitor value type

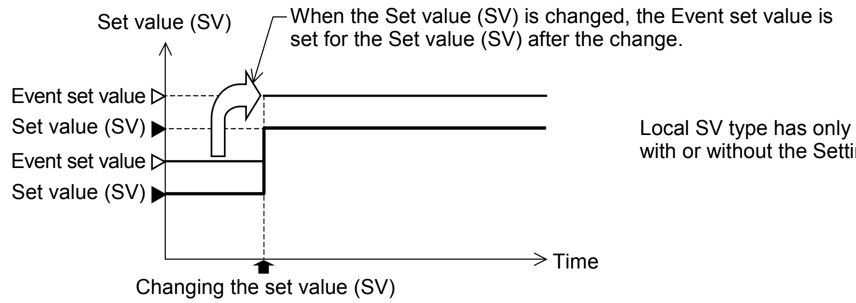
[When setting change rate limiter is not set.]



[When setting change rate limiter is set.]



Local SV type



Local SV type has only one type of action on change with or without the Setting change rate limiter.

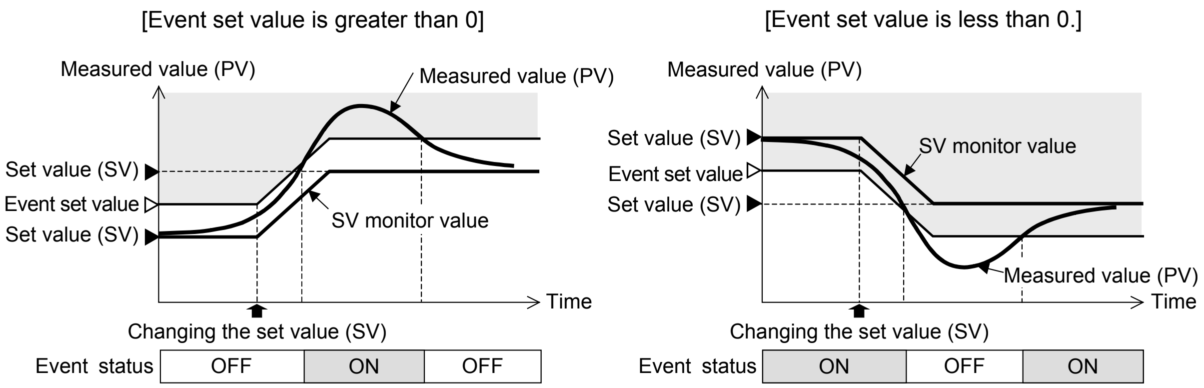
☞ For the Setting change rate limiter, refer to the **Setting change rate limiter [up/down] (P. 8-14)**.

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.

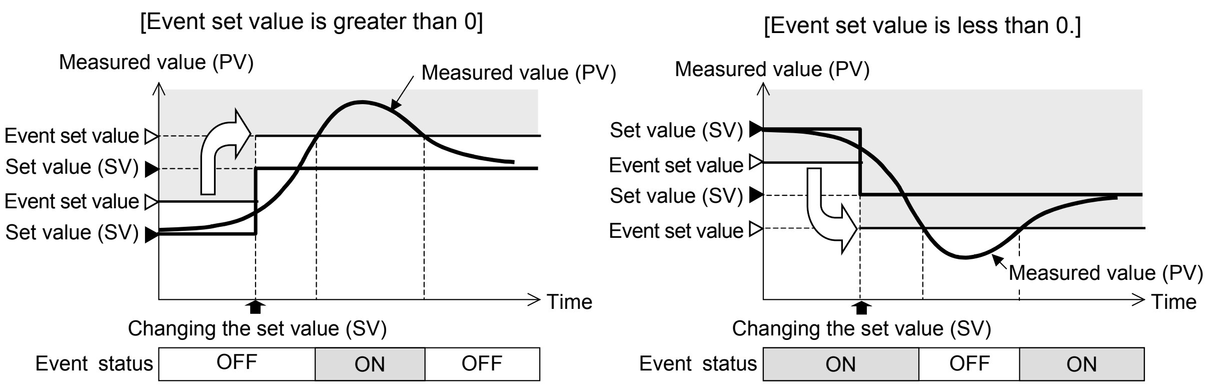
SV monitor value type
(Example: When setting change rate limiter is set.)

: Event ON zone



Local SV type

: Event ON zone



☞ 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:

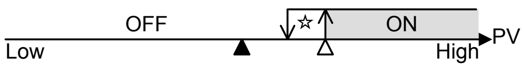
ON: Event action turned on

OFF: Event action turned off (▲: Set value (SV) △: Event set value ☆: Event differential gap)

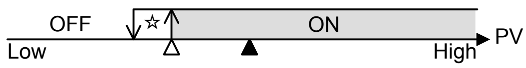
Deviation high

When the deviation (PV – SV) is more than the Event set value, the event ON occurs.

(Event set value is greater than 0.)



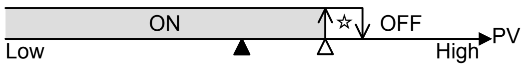
(Event set value is less than 0.)



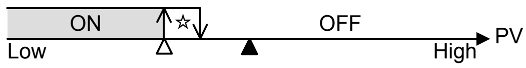
Deviation low

When the deviation (PV – SV) is less than the Event set value, the event ON occurs.

(Event set value is greater than 0.)



(Event set value is less than 0.)



Deviation high/low

Tow types of Deviation high/low action are available.

Without high/low individual setting:

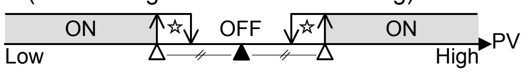
When the absolute deviation | PV – SV | is more/less than the Event set values, the event ON occurs.

With high/low individual setting:

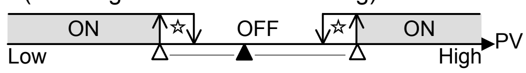
High action: When the deviation (PV – SV) is more than the Event set value [high], the event ON occurs.

Low action: When the deviation (PV – SV) is less than the Event set value [low], the event ON occurs.

(Without High/Low individual setting)



(With High/Low individual setting)



Band

Tow types of Band action are available.

Without high/low individual setting:

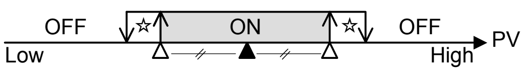
When the absolute deviation | PV – SV | is within the Event set values, the event ON occurs.

With high/low individual setting:

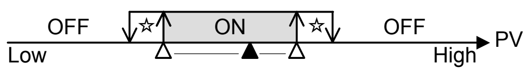
High action: When the deviation (PV – SV) is less than the Event set value [high], the event ON occurs.

Low action: When the deviation (PV – SV) is more than the Event set value [low], the event ON occurs.

(Without high/low individual setting)



(With high/low individual setting)



● 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).

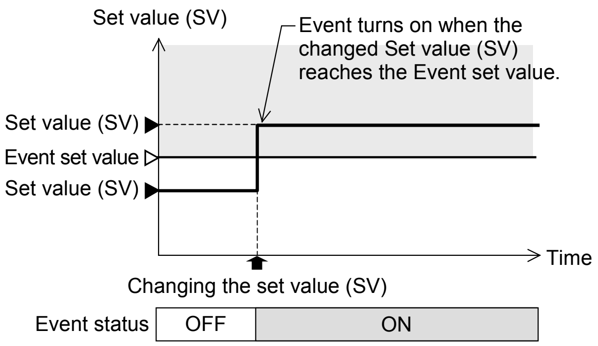
Some examples of SV high are described in the following:

SV high: When the Set value (SV) is more than the Event set value, the event ON occurs.

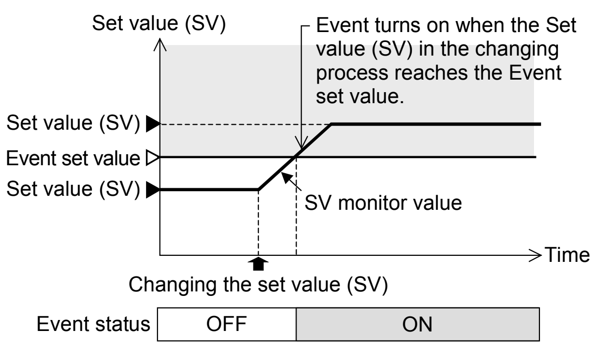
SV monitor value type

: Event ON zone

[When setting change rate limiter is not set.]

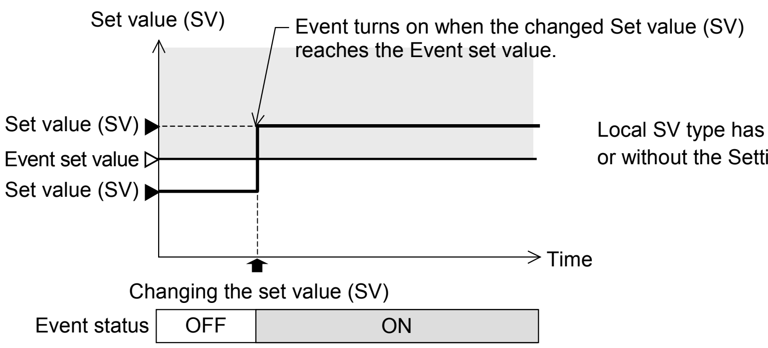


[When setting change rate limiter is set.]



Local SV type

: Event ON zone



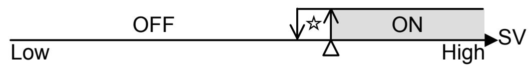
Local SV type has only one type of action on a change with or without the Setting change rate limiter.

☞ 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)

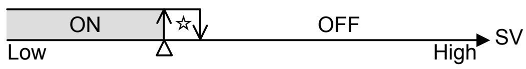
SV high

When the Set value (SV) is more than the Event set value, the event ON occurs.



SV low

When the Set value (SV) is less than the Event set value, the event ON occurs.

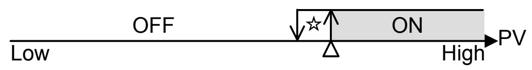


- **Input value action (High, Low)**

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)

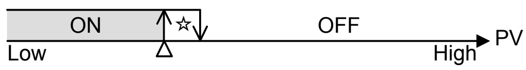
Process high

When the Measured value (PV) is more than the Event set value, the event ON occurs.



Process low

When the Measured value (PV) is less than the Event set value, the event ON occurs.



● 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 °C [°F] (fixed)
Voltage/Current input: 0.2 % of input span (fixed)

	When the output reaches 0 % (low limit with output limit function)	**When the output exceeds 100 % (high limit with output limit function)**
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 LBA time has passed and the PV has not risen beyond the alarm determination range, the alarm will be turned on.
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.	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 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

Ho1

Use to set an event hold action for the Event 1.

Ho2

Use to set an event hold action for the Event 2.

Data range	Factory set value
0: OFF 1: Hold action ON (Only hold action) • Validate the hold action when the power is turned on. • Validate the hold action when transferred from STOP (control STOP) to RUN (control RUN). 2: Re-hold action ON (hold and re-hold actions) • Validate the hold action when the power is turned on. • Validate the hold action when transferred from STOP (control STOP) to RUN (control RUN). • Validate the re-hold action when the Set value (SV) is changed. 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. Re-hold action is only available for deviation high, deviation low, and deviation high/low.	0 If the Event type is specified by the event type code when ordering, the factory set value of Event 1 to 2 hold action differs depending on the Event type.

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)

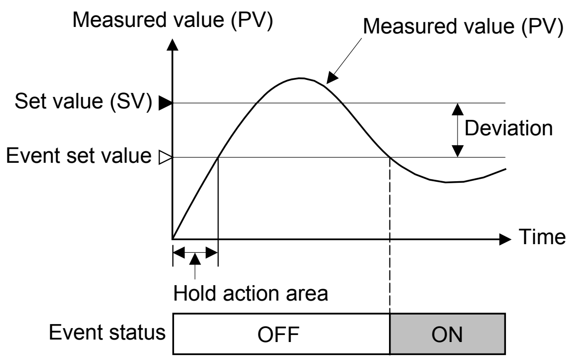
Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)

■ Description of function

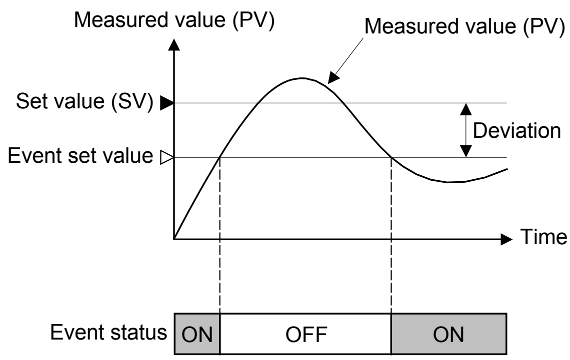
(1) Hold action

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.

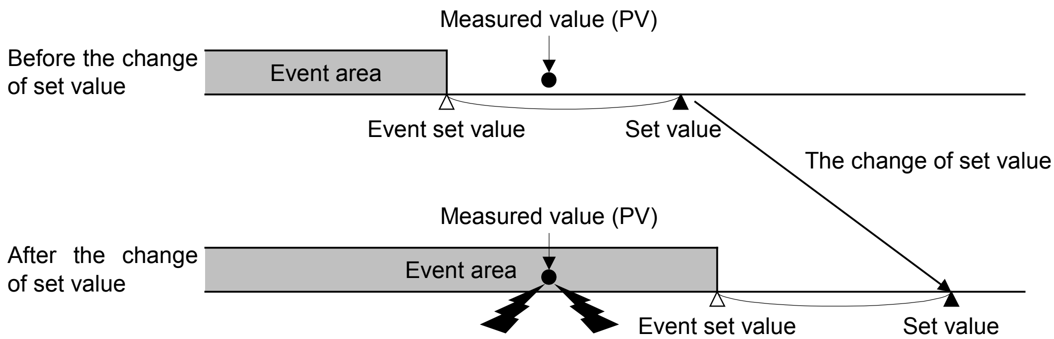
Action condition	1: Hold action ON (Only hold action)	2: Re-hold action ON (Hold and re-hold actions)
When the power is turned on	Hold action	Hold action
When transferred from STOP (control STOP) to RUN (control RUN)	Hold action	Hold action
When the Set value (SV) is changed	Without hold and re-hold actions	Re-hold action

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.

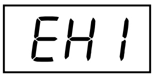


F41

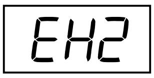
Event 1 differential gap

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.

Data range	Factory set value
0 to Input span When using communication, only a single digit of the Event differential gap can be displayed after the decimal point (the tenths place).	2

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

Related parameters

Parameter setting mode:

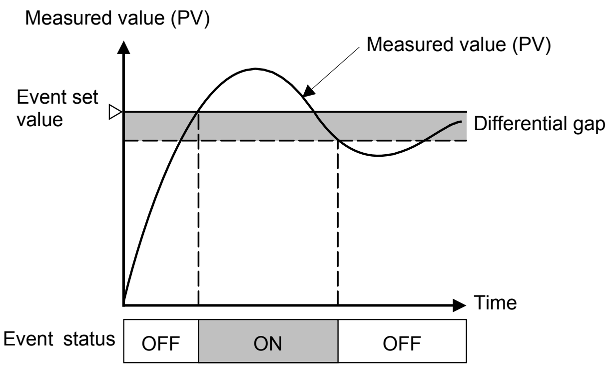
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1') [low] and Event 2 set value (EV2') [low] (P. 8-17)

Engineering mode:

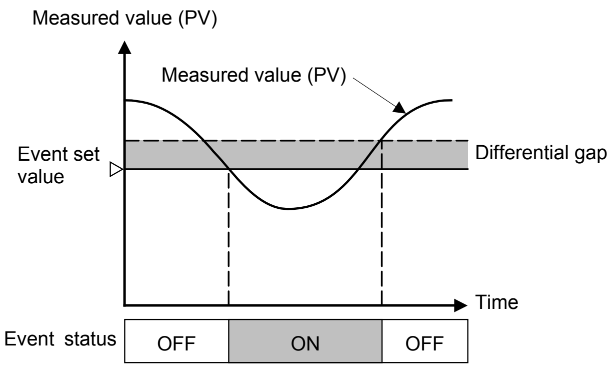
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 output action at input burnout and Event 2 output action at input burnout (P. 8-85)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- 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.

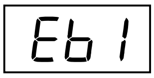


Process high

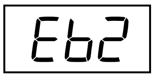


Process low

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.

Data range	Factory set value
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

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)

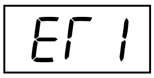
Engineering mode:
- Event 1 type and Event 2 type (P. 8-73)
- Event 1 hold action and Event 2 hold action (P. 8-82)
- Event 1 differential gap and Event 2 differential gap (P. 8-84)
- Event 1 delay timer and Event 2 delay timer (P. 8-86)
- Event 1 interlock and Event 2 interlock (P. 8-88)
- Energized/De-energized of DO (P. 8-93)

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.

Data range	Factory set value
0 to 600 seconds	0

Related parameters

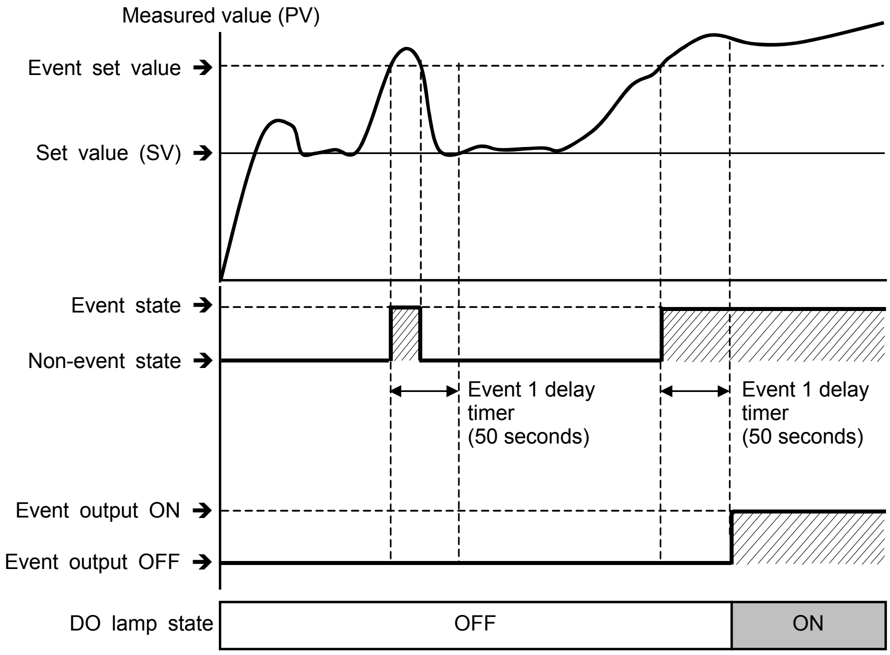
Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

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



- 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

IL1

Use to select the Interlock function for the Event 1.

IL2

Use to select the Interlock function for the Event 2.

Data range	Factory set value
0: Unused (OFF) 1: Used	0

Related parameters

Mode switching:
- Interlock release (P. 8-11)

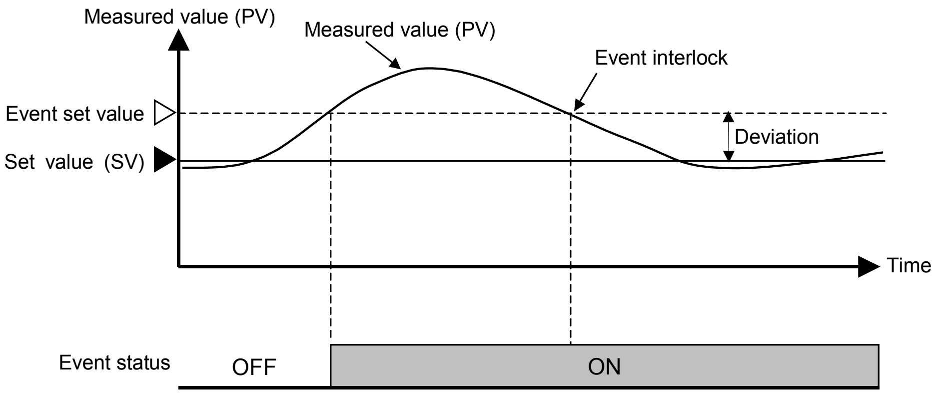
Parameter setting mode:
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1’) [low] and Event 2 set value (EV2’) [low] (P. 8-17)

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)

F46

This is the first parameter symbol of Function block 46 (F46).

F46

Control action at Event

Ed

Set Control action at Event.

Data range	Factory set value
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

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

F5

Set a start-up condition of Load power shutoff function.

Data range	Factory set value
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.)	0

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

EoS

Set an action of Event output (Digital output) at Event.

Data range	Factory set value
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	3

Related parameters

Parameter setting mode:

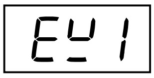
- Event 1 set value (EV1) and Event 2 set value (EV2) (P. 8-16)
- Event 1 set value (EV1) [high] and Event 2 set value (EV2) [high] (P. 8-16)
- Event 1 set value (EV1') [low] and Event 2 set value (EV2') [low] (P. 8-17)

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

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)

Data range	Factory set value
0: Energized 1: De-energized	0

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)

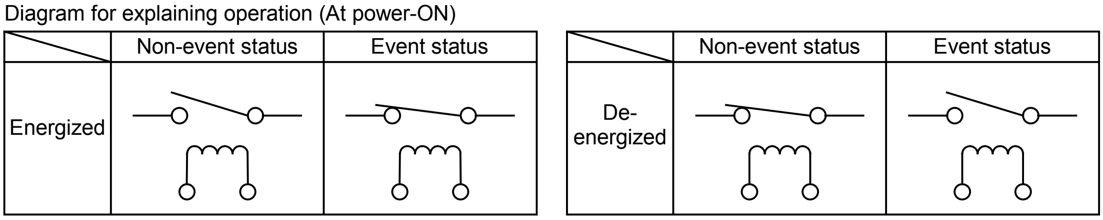
Engineering mode:

- 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)

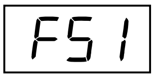
■ Description of function

Energized: Relay contact is closed during the event or alarm.
De-energized: Relay contact opens during the event or alarm.

Diagram for explaining operation (At power-ON)



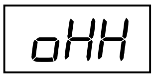
Function block 51 (F51)



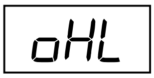
This is the first parameter symbol of Function block 51 (F51).

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).

Data range	Factory set value
0 to 100 °C [°F] When using communication, only a single digit of the ON/OFF action differential gap can be displayed after the decimal point (the tenths place).	1

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

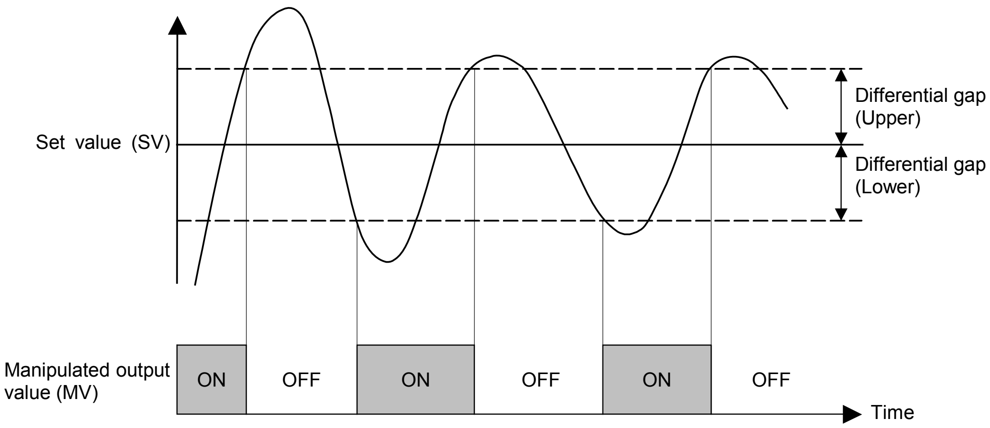
Related parameters

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

obo

This sets the action when burnout occurs.

Data range	Factory set value
0: Result of control computation 1: Output limiter low (Output OFF)	0

F51

Bumpless mode setting

bnP

Setting this parameter turns ON or OFF the bumpless function when the operation mode is changed from Auto mode to Manual mode.

Data range	Factory set value
0: Without bumpless 1: With bumpless	1

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

drP

Use to select the action of derivative term.

Data range	Factory set value
0: Measured value derivative 1: Deviation derivative	0

Related parameters

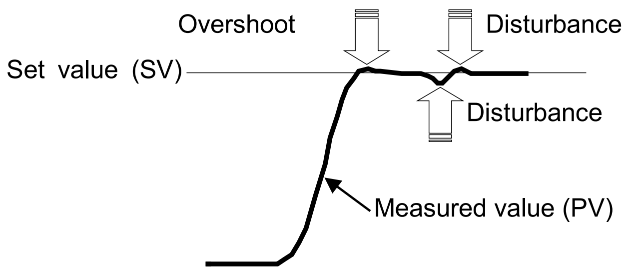
Parameter setting mode:

- Autotuning (AT) (P. 8-18)

■ Description of function

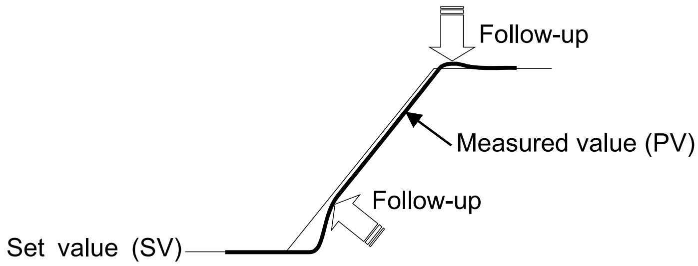
Measured value derivative: PID control putting emphasis on response most adaptive to fixed set point control (mode)

Measured value derivative (PID control)

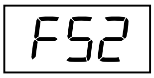


Deviation derivative: PID control putting much emphasis on follow-up most adaptive to ramp control or cascade control using a ratio of setting change limiter, etc. It is effective to follow-up at powering up a load or restrict the amount of overshooting when changed to Soak from Ramp.

Deviation derivative (PID control)



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.

Data range	Factory set value
0: 1.5 cycles 1: 2.5 cycles	0

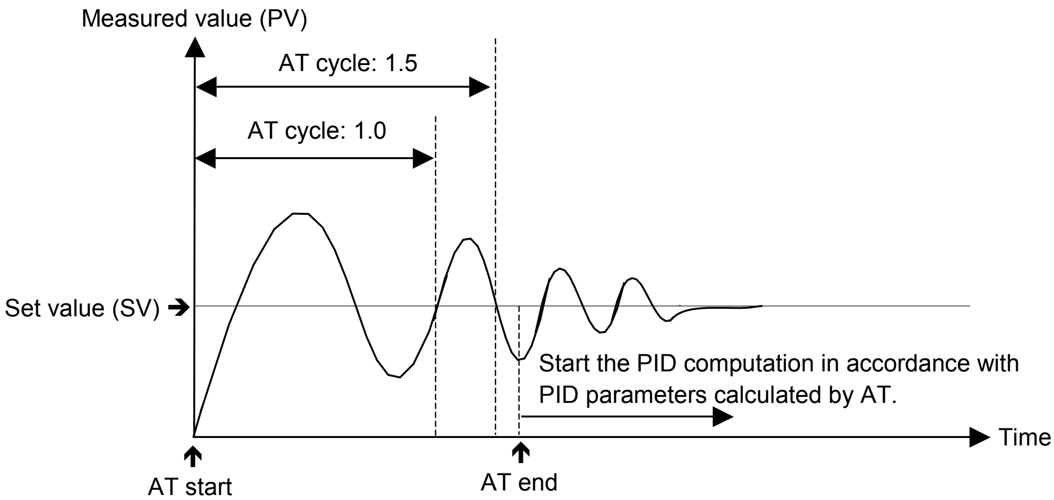
Related parameters

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.

Data range	Factory set value
0 to 50 seconds	10

Related parameters

Parameter setting mode:

- Autotuning (AT) (P. 8-18)

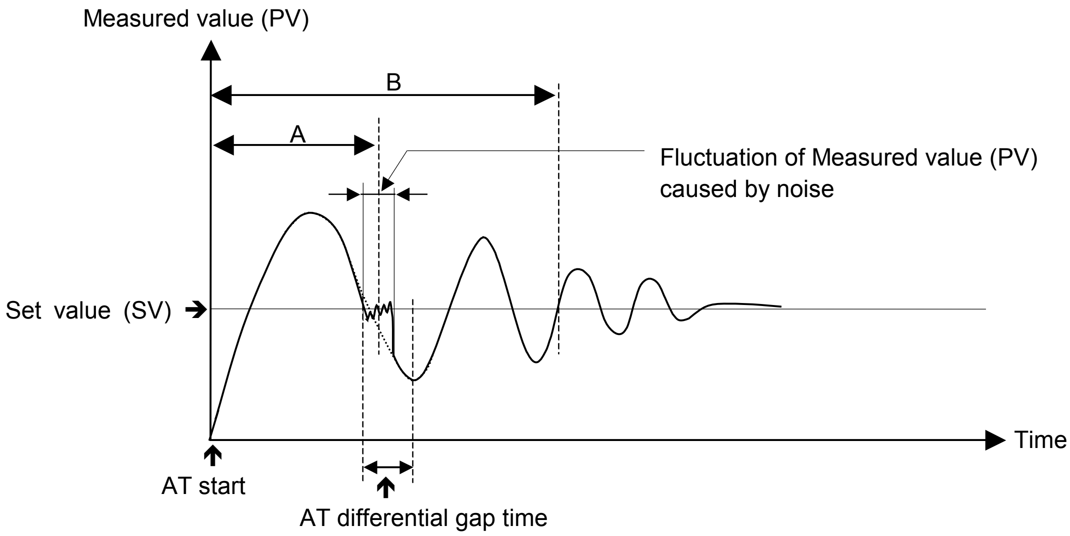
■ Description of function

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.



The factory set value of the AT cycle is 1.5 cycles.

F52

ST start condition

SrS

Timing (starting condition) to activate the Startup tuning (ST) function is selected.

Data range	Factory set value
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

Related parameters

Parameter setting mode:

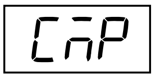
- Startup tuning (ST) (P. 8-19)

☞ 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.

Data range	Factory set value
0: RKC communication 1: Modbus	Based on model code

☞ 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.

Data range	Factory set value
0 to 99 (Modbus: 1 to 99)	RKC communication: 0 Modbus: 1

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)**.

F60
Communication speed

bPS

Communication speed is to set Communication speed for Communication function.

Data range	Factory set value
0:2400 bps 1:4800 bps 2:9600 bps 3:19200 bps	3

☞ For the Communication function, refer to **9. COMMUNICATION (P. 9-1)**.

F60
Data bit configuration

bIT

This item is Data bit configuration of Communication function.

<table>
<tr><th rowspan="2">Set value</th><th colspan="3">Data bit configuration</th><th rowspan="2">Modbus Communi-cation</th><th rowspan="2">RKC Communi-cation</th></tr>
<tr><th>Data</th><th>Parity</th><th>Stop</th></tr>
<tr><td>0</td><td>8</td><td>Without</td><td>1</td><td rowspan="6">Selectable</td><td rowspan="12">Selectable</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><td rowspan="6">Not selectable</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>
</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

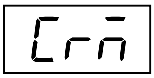
This item is Interval time of Communication function.

Data range	Factory set value
0 to 250 ms	10

☞ 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.

Data range	Factory set value
0: Normal response 1: Overrun error 2: Parity error 4: Framing error 8: Receive buffer overflow	0

☞ 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

SrT

Set the time unit for Setting change rate limiter (up/down).

Data range	Factory set value
0: Minute 1: Hours	0

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)

F80

This is the first parameter symbol of Function block 80 (F80).

F80

Burnout status monitoring delay

LbC

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

Data range	Factory set value
0 to 10 times (Number of input sampling cycle)	0

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)

F81

This is the first parameter symbol of Function block 81 (F81).

F81

SB link selection

SbL

Validate or invalidate SB link function.

Data range	Factory set value
0: Without SB link function 1: With SB link function	0

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

GAd

Set an address for SB link function.

Data range	Factory set value
0: Intragroup address 1 (Master) 1: Intragroup address 2 2: Intragroup address 3 3: Intragroup address 4	0

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

SbE

Set the number of SB link error determination and control action at SB link error.

Set value	Number of SB link error determination	Control action at SB link error	Factory set value
0	1	Action of control output is based on control computation.	2
1	1	Control output OFF (−5 %)	
2	2		
3	3		
4	4		
5	5		

The characters "Err" and " 16" 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.

Function block 91 (F91)

F91

This is the first parameter symbol of Function block 91 (F91).

F91

ROM version monitor (upper)
ROM version monitor (lower)

05

79

Displays the installed ROM version by dividing it into high order and low order.

Display range	Factory set value
Installed ROM version	—

F91

Integrated operating time monitor (upper)
Integrated operating time monitor (lower)

WTH

WTL

Displays Integrated operating time by dividing it into high order and low order.

Display range	Factory set value
0 to 19999 hours	—

F91

Holding peak value ambient temperature monitor

TCJ

Stores and displays the maximum ambient temperature of the connector at the lower side.

Display range	Factory set value
−10 to +100 °C (14 to 212 °F)	—

COMMUNICATION 9

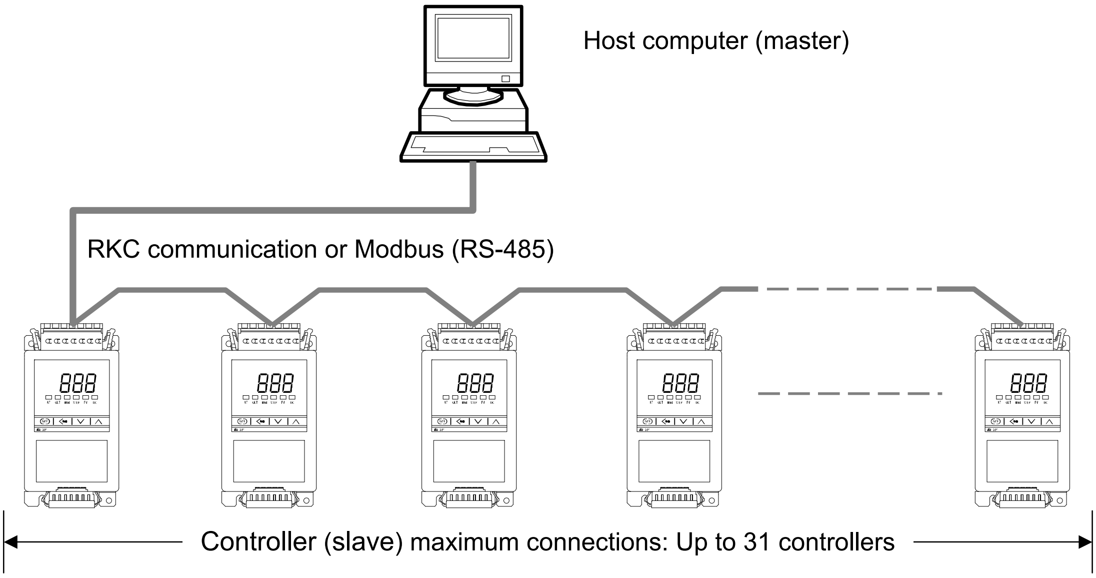
This chapter describes Host communication including connection, setting, protocol and communication data.

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.

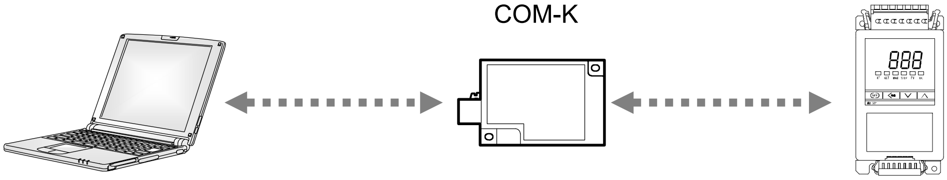
■ RKC communication and Modbus

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:
http://www.rkcinst.com/.

9.2 Wiring

⚠ WARNING

To prevent electric shock or instrument failure, turn off the power before connecting or disconnecting the instrument and peripheral equipment.

9.2.1 Wiring for host communication

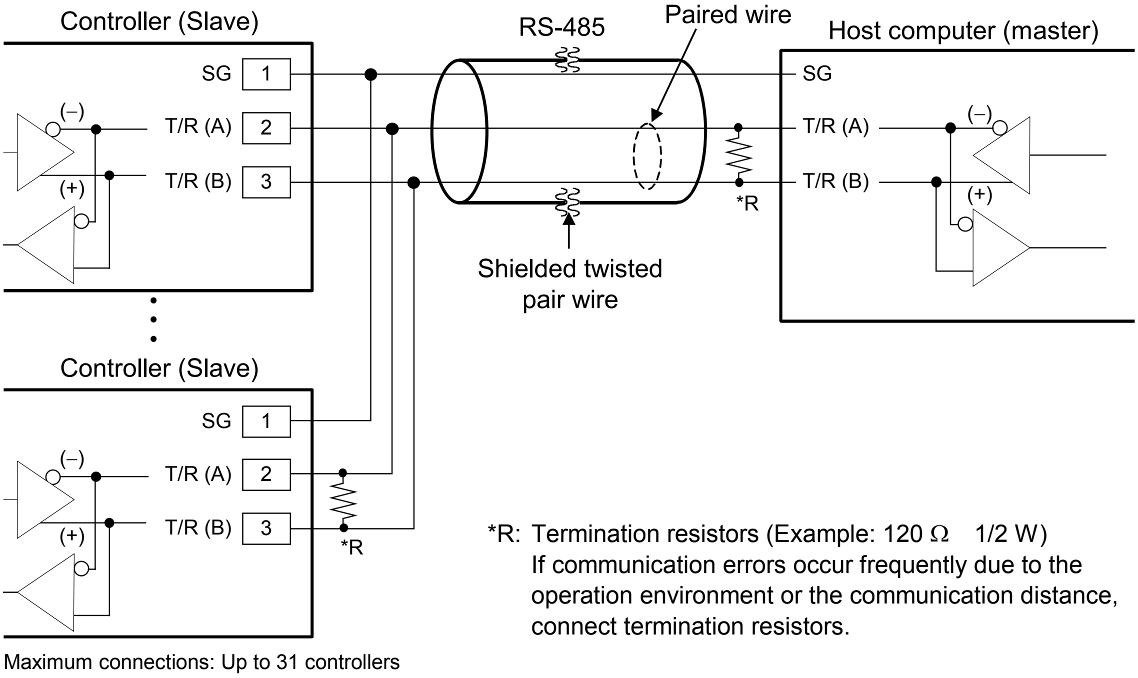
The cable is provided by the customer.

■ Communication terminal number and signal details

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

■ Wiring method

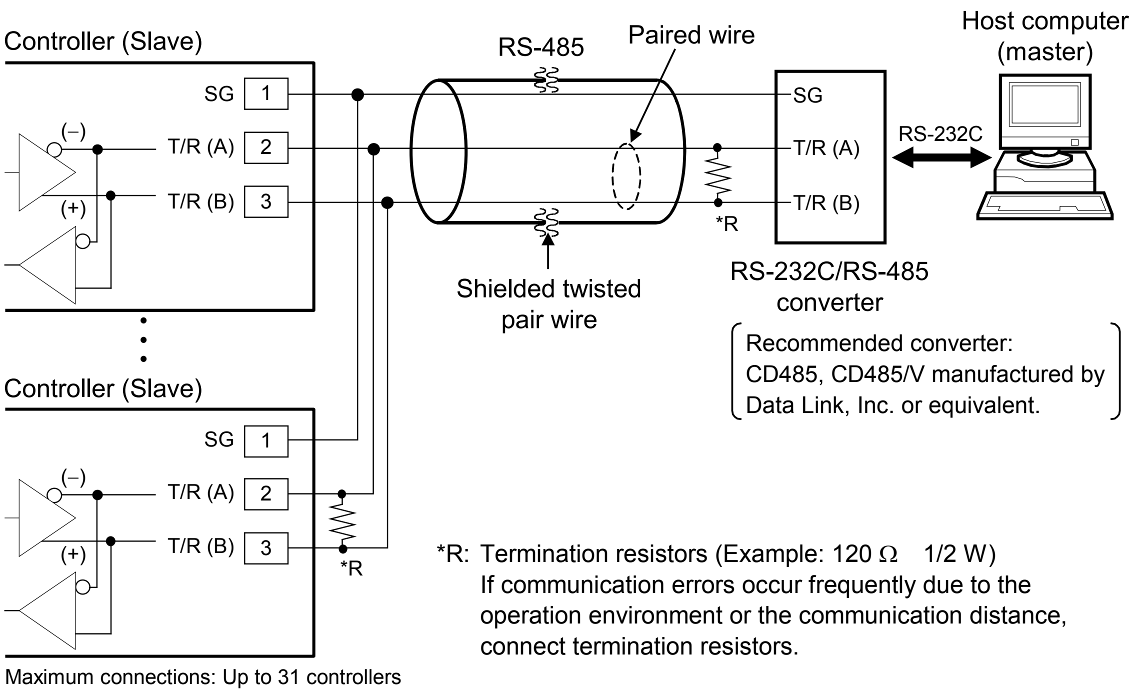
● Connection to the RS-485 port of host computer (master)



*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.

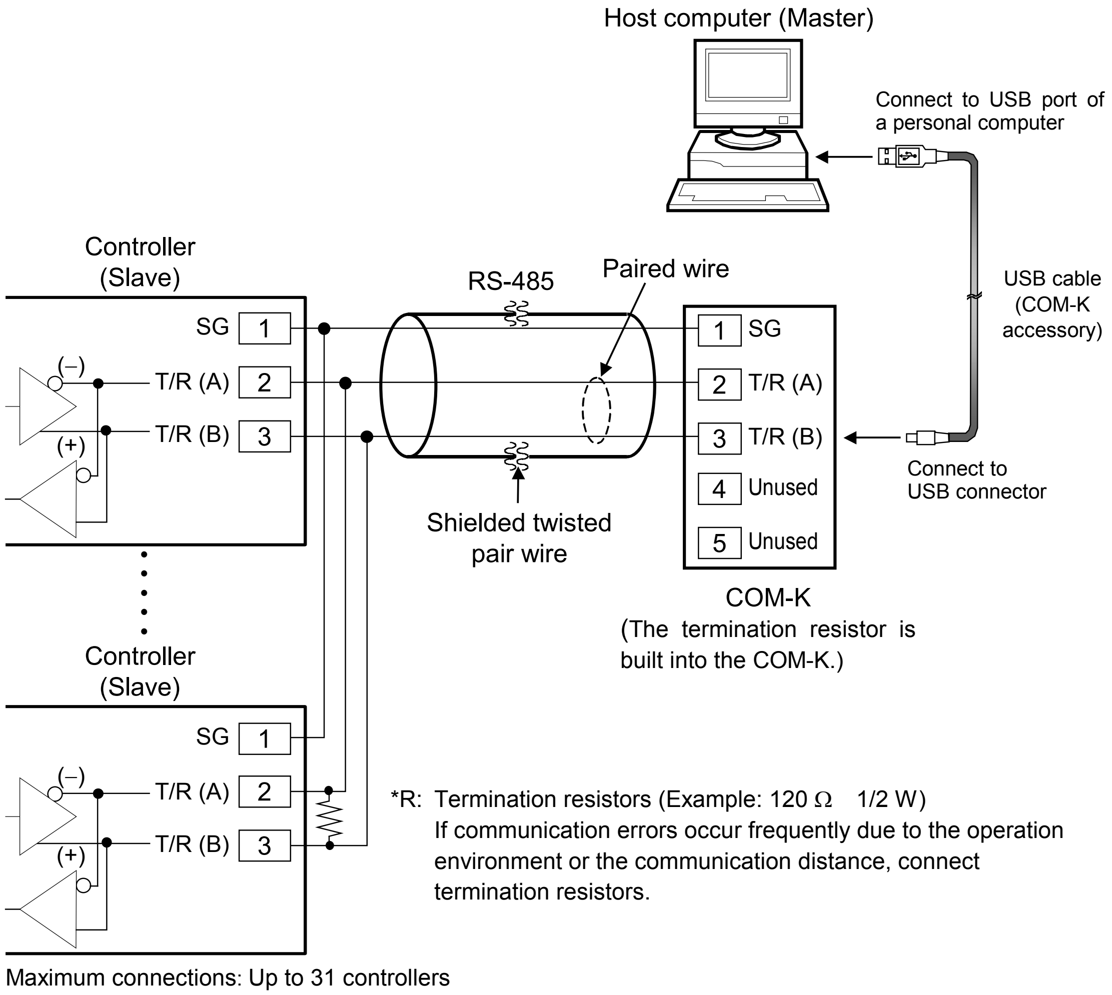
- **Connection to the RS-232C port of host computer (master)**

Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.



- **Connection to the USB of the host computer (master)**

Connect the USB communication converter between the host computer and the controller.



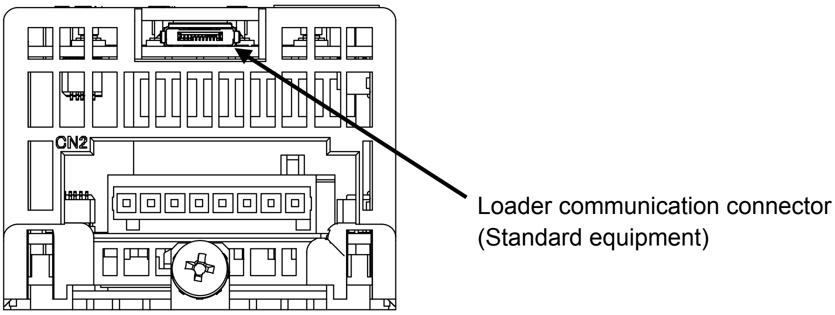
☞ For the COM-K, refer to the **COM-K Instruction Manual (IMR01Z01-E☐)**.

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.

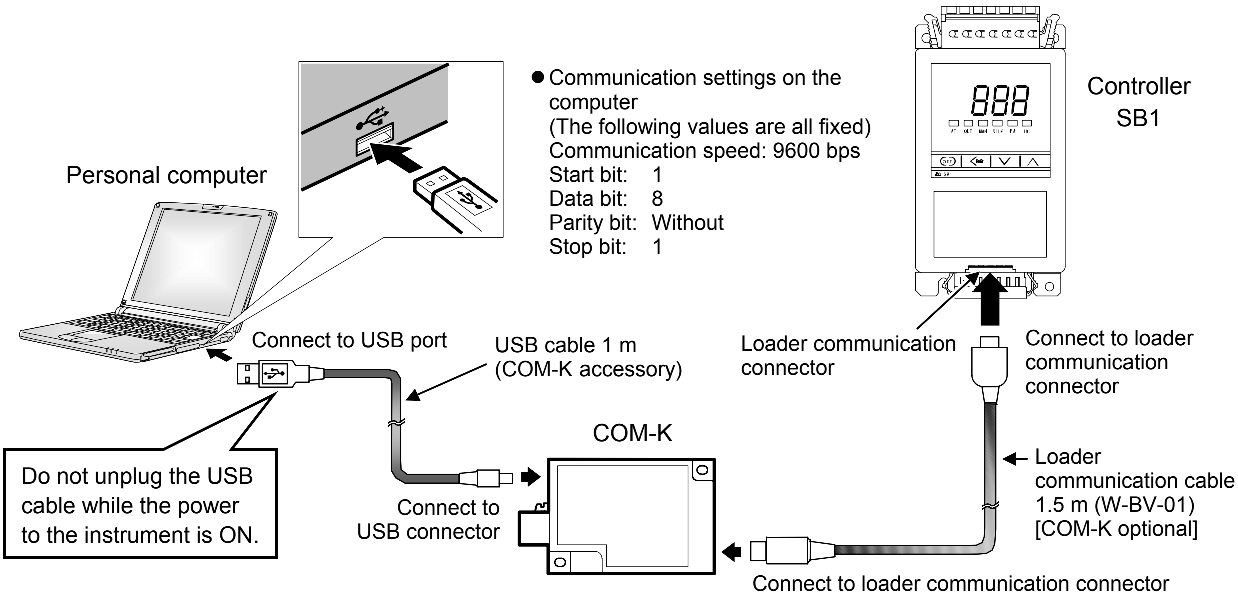
☞ For the COM-K, refer to the **COM-K Instruction Manual (IMR01Z01-E☐)**.

■ Position of loader communication connector



■ 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.



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 the RKC official website:
http://www.rkcinst.com/.

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.

Symbol	Name	Setting range	Description	Factory set value
F60	Function block 60	—	This is the first parameter symbol of Function block 60.	—
CMP	Communication protocol	0: RKC communication 1: Modbus	Use to select a protocol of communication function.	RKC communication: 0 * Modbus: 1 *
Add	Device address	RKC communication: 0 to 99 Modbus: 1 to 99	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.	RKC communication: 0 Modbus: 1
bPS	Communication speed	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps	Set the same communication speed for both the controller (slave) and the host computer (master).	3
bIT	Data bit configuration	RKC communication: 0 to 11 Modbus: 0 to 5 Refer to **Data bit configuration table**.	Set the same data bit configuration for both the controller (slave) and the host computer (master).	0
INT	Interval time	0 to 250 ms	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.	10
CRM	Communication response monitor	0: Normal response 1: Overrun error 2: Parity error 4: Framing error 8: Receive buffer overflow	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.	—

* 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

Set value	Data bit	Parity bit	Stop bit	Settable communication
0	8	Without	1	RKC communication and Modbus
1	8	Without	2	
2	8	Even	1	
3	8	Even	2	
4	8	Odd	1	
5	8	Odd	2	

Set value	Data bit	Parity bit	Stop bit	Settable communication
6	7	Without	1	RKC communication
7	7	Without	2	
8	7	Even	1	
9	7	Even	2	
10	7	Odd	1	
11	7	Odd	2	

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□).**

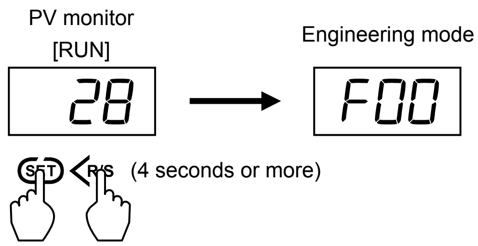
Press the SET key to store the new value. If the SET key is not pressed within 1 minute, the display returns to the measured value (PV) monitor screen and the set value returns the previous setting.

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.

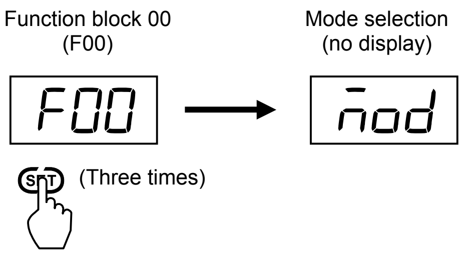
2. Go to the Engineering mode.

Press the <R/S key for 4 seconds while pressing the SET key at PV monitor until Engineering mode is displayed.

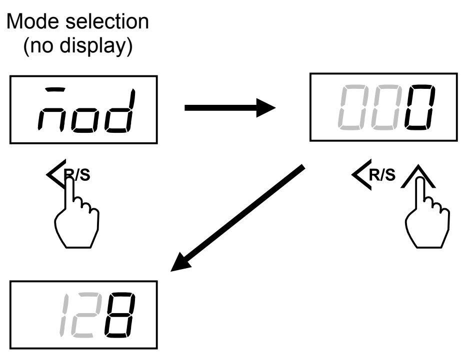


3. Enable display of function blocks 21 (F21) to 91 (F91).

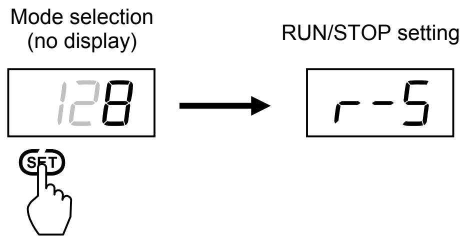
Press the SET key three times at Function block 00 (F00) until Mode selection (no display) is displayed.



Set the mode selection (no display) to "128."



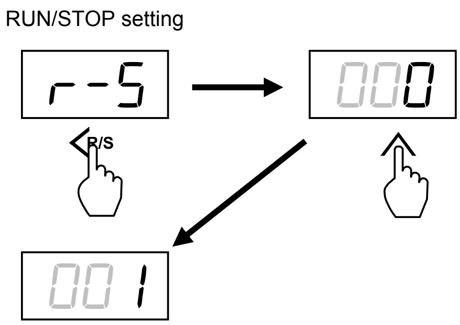
Press the SET key to store the new set value.
The display goes to the RUN/STOP setting.



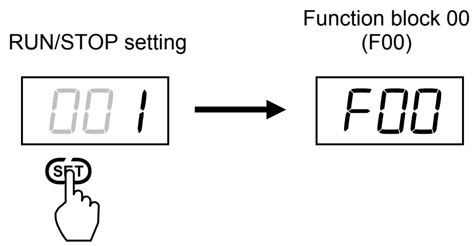
When "128" is set, display of the parameters from function block 21 (F21) to function block 91 (F91) is enabled.

4. Set the controller to the STOP state (control stop).

Set the RUN/STOP setting to "1: STOP."

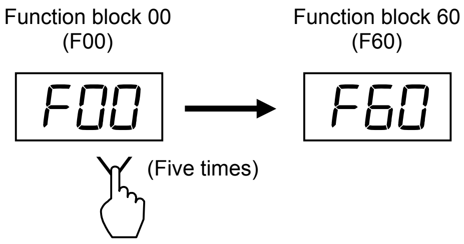


Press the SET key to store the new set value.
The display goes to the function block 00 (F00).



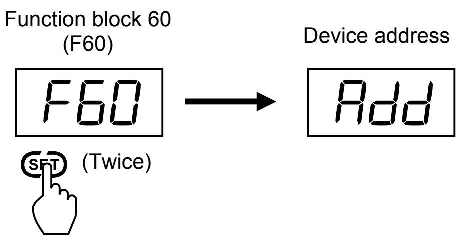
5. Go to the Function block 60 (F60).

Press the DOWN key five times at Function block 00 (F00) until Function block 60 (F60) is displayed.



6. Set the communication parameter.

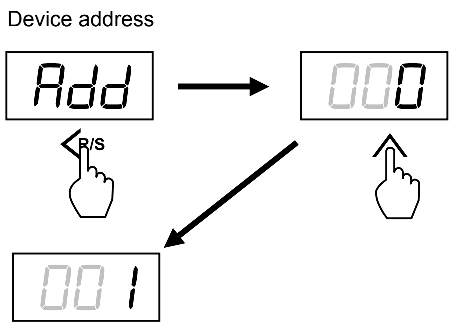
Press the SET key twice at Function block 60 (F60) until device address is displayed.



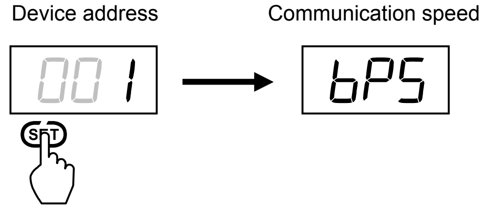
Set the device address (slave address).

Example: Setting the device address (slave address) to 1.

Setting range: 0 to 99 (RKC communication)
1 to 99 (Modbus)



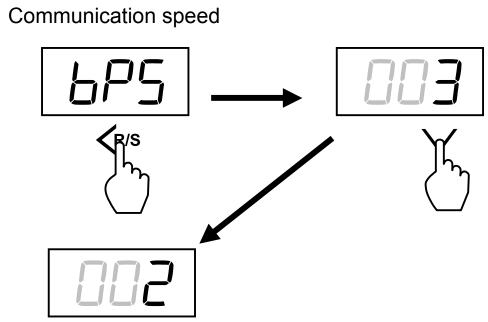
Press the SET key to store the new set value.
The display goes to the communication speed.



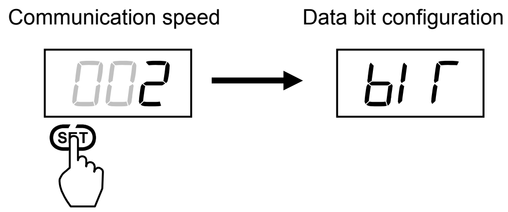
Set the communication speed.

Example: Setting the communication speed to “2 (9600 bps).”

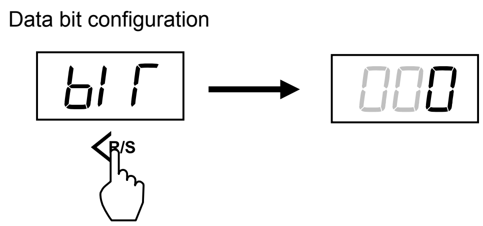
Setting range: 0: 2400 bps
1: 4800 bps
2: 9600 bps
3: 19200 bps



Press the SET key to store the new set value.
The display goes to the data bit configuration.

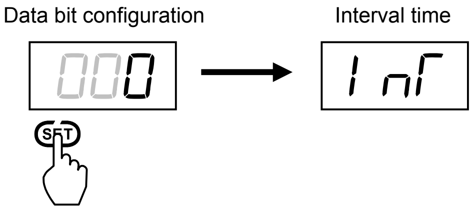


Set the data bit configuration. As an example, factory set value “0 (data bit 8, without parity bit, stop bit 1)” is set.



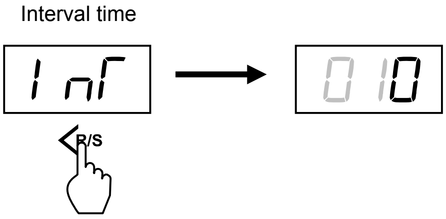
☞ For details of setting range, refer to **Data bit configuration table (P. 9-8).**

Press the SET key.
The display goes to the interval time.

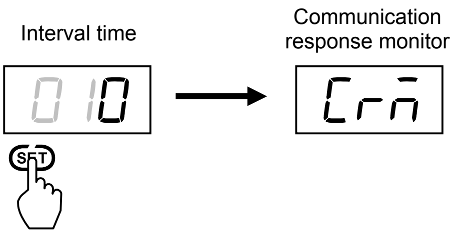


Set the interval time.
As an example, factory set value “10” is set.

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

Procedure details	Time
Response send time after controller receives ENQ	60 ms max.
Response send time after controller receives ACK	60 ms max.
Response send time after controller receives NAK	60 ms max.
Response send time after controller sends BCC	52 ms max.

RKC communication (Selecting procedure) processing times

Procedure details	Time
Response send time after controller receives BCC	65 ms max.
Response wait time after controller sends ACK	52 ms max.
Response wait time after controller sends NAK	52 ms max.

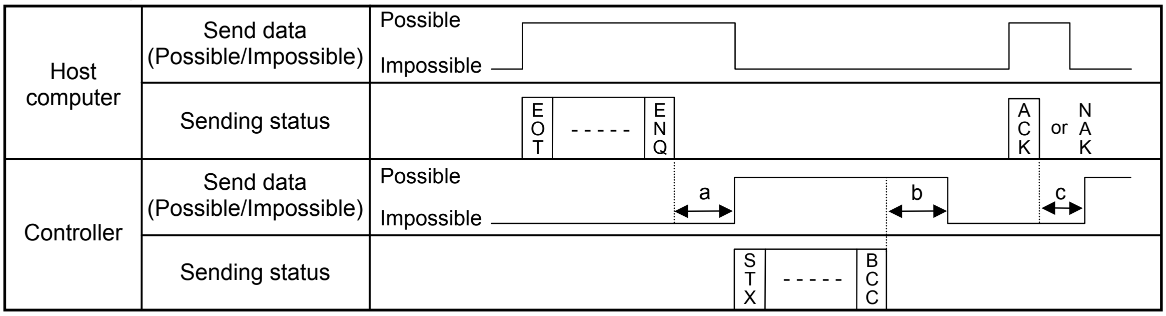
Modbus processing times

Procedure details	Time
Read holding registers [03H] Response send time after the slave receives the query message	60 ms max.
Preset single register [06H] Response send time after the slave receives the query message	65 ms max.
Diagnostics (loopback test) [08H] Response send time after the slave receives the query message	60 ms max.

■ RS-485 (2-wire system) send/receive timing (RKC communication)

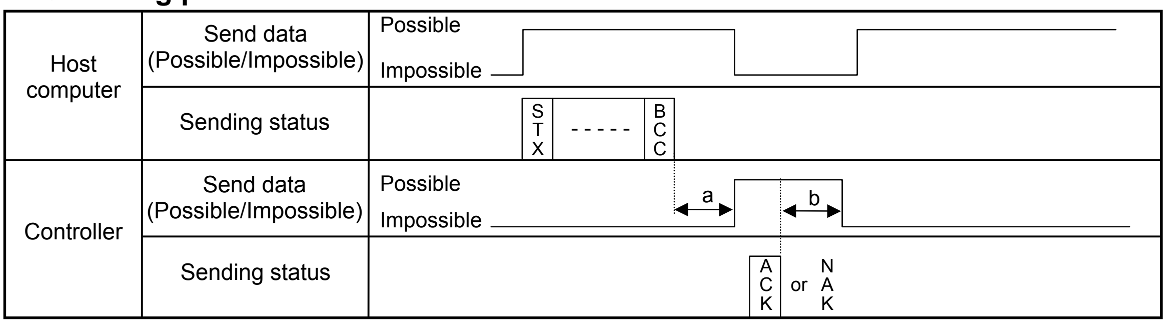
RS-485 communication is conducted through two wires, therefore, the transmission and reception of data requires precise timing.

● Polling procedure



a: Response send time after the controller receives [ENQ] + Interval time
b: Response send time after the controller sends BCC
c: Response send time after the controller receives [ACK] + Interval time or
Response send time after the controller receives [NAK] + Interval time

● Selecting procedure



a: Response send time after the controller receives BCC + Interval time
b: Response wait time after the controller sends ACK or Response wait time after the controller sends NAK

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

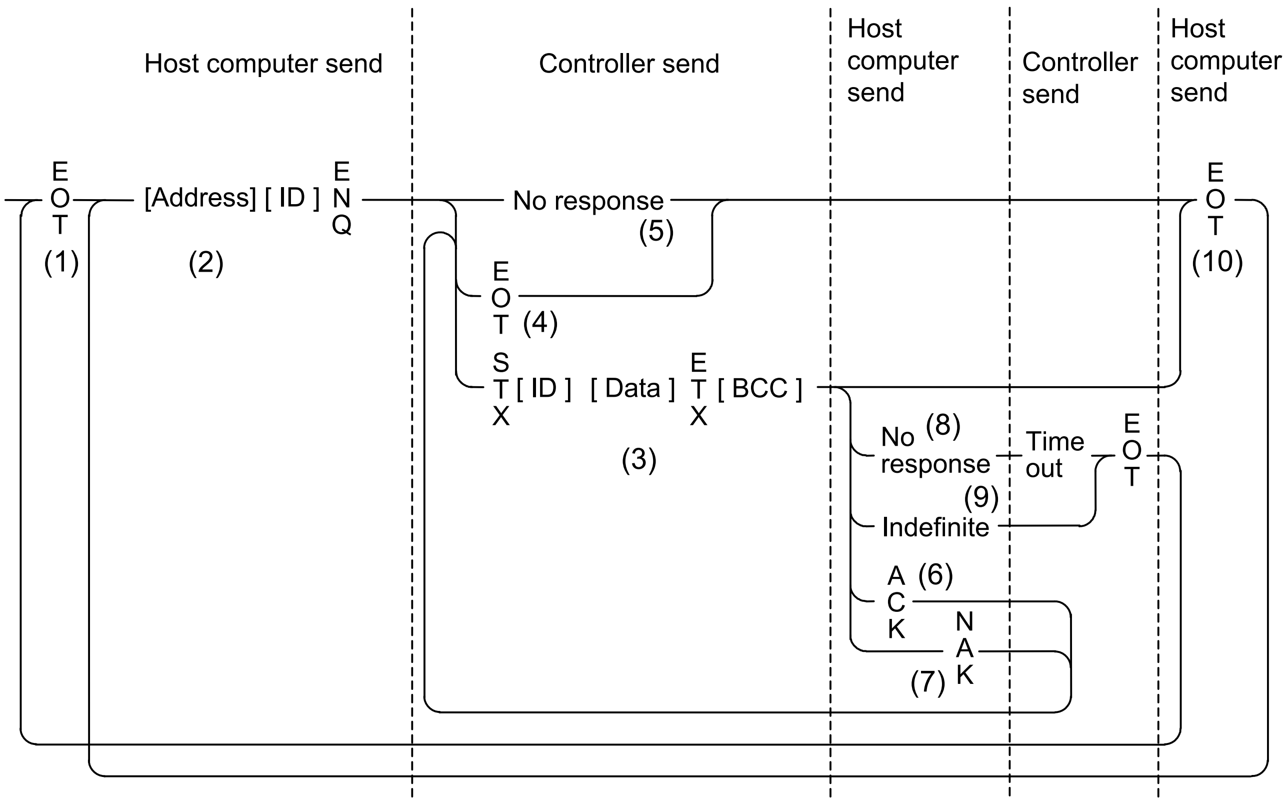
The controller uses the polling/selecting method to establish a data link.
The basic procedure is followed ANSI X3.28-1976 subcategories 2.5 and A4 basic mode data transmission control procedure (Fast selecting is the selecting method used in this controller).

- 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

■ 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.	*3.*	*4.*
		ENQ
Address	Identifier	

Example:

0	2	M	1	ENQ

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)**.

The polling address which transmitted a message once becomes effective so long as data link is not initialized by transmit and receive of EOT.

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.

For details, refer to **9.5.3 RKC Communication identifier list (P. 9-25)**.

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.
The host computer then must wait for a response from the controller.

(3) Data sent from the controller

If the polling sequence is received correctly, the controller sends data in the following format:

1.	*2.*	*3.*	*4.*	*5.*
STX	Identifier	Data	ETX	BCC

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:

STX	M	1	0	1	0	0	.	0	ETX	BCC
	4DH	31H	30H	31H	30H	30H	2EH	30H	03H	← Hexadecimal numbers

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.

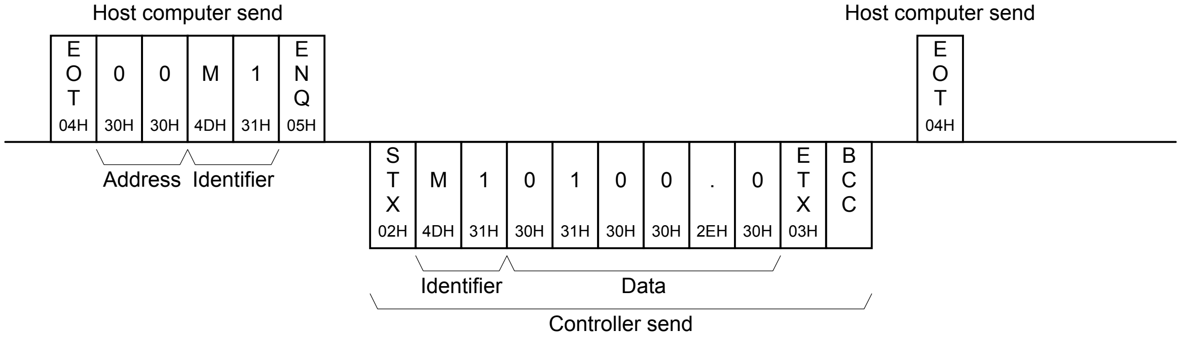
(10) EOT (Data link termination)

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.

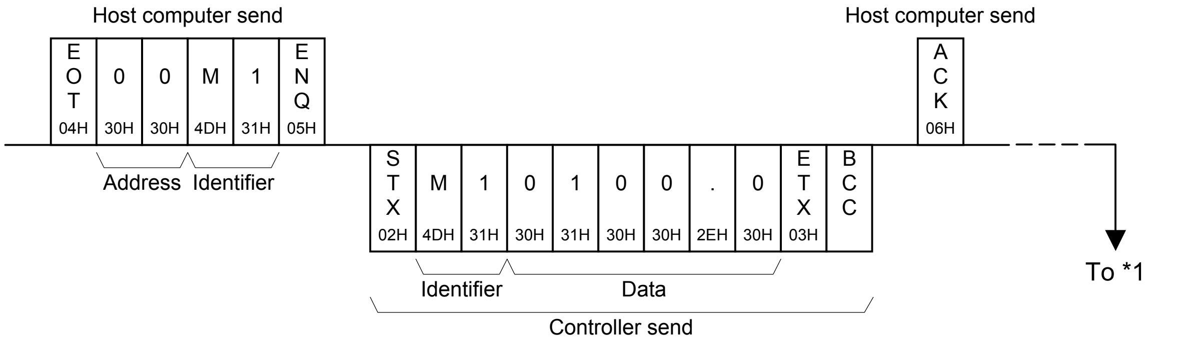
■ Polling procedure example (When the host computer requests data)

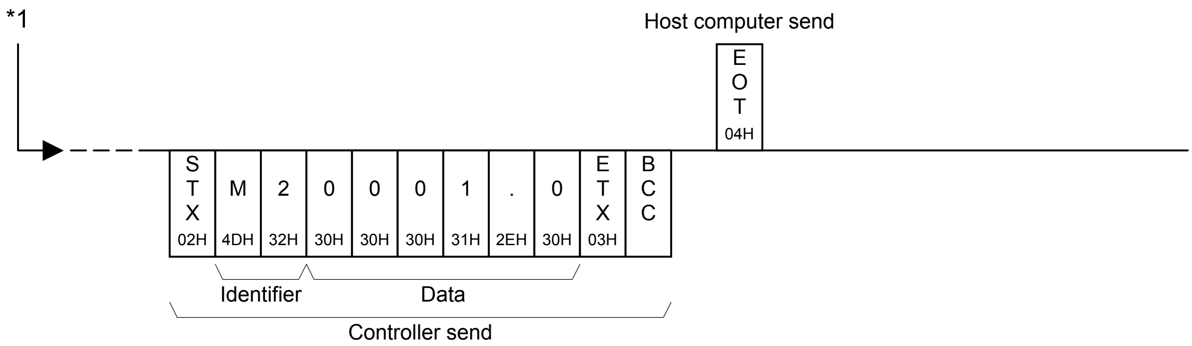
● Normal transmission

(1) When the measured value (PV) monitor (identifier: M1) is polled

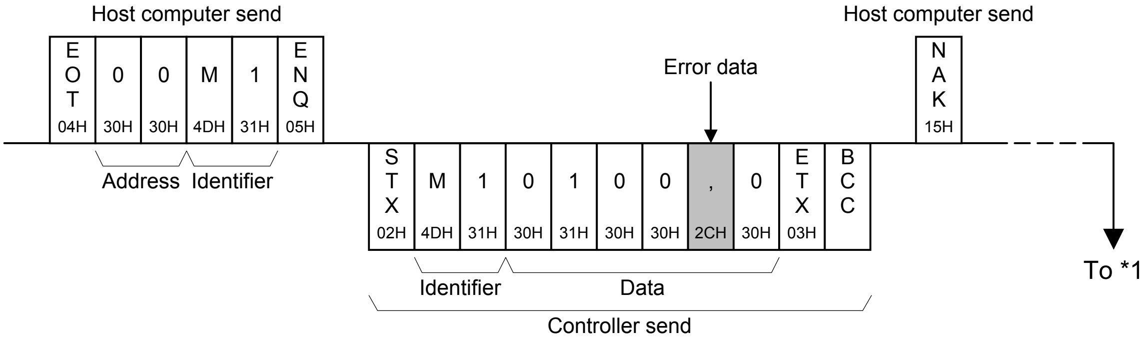


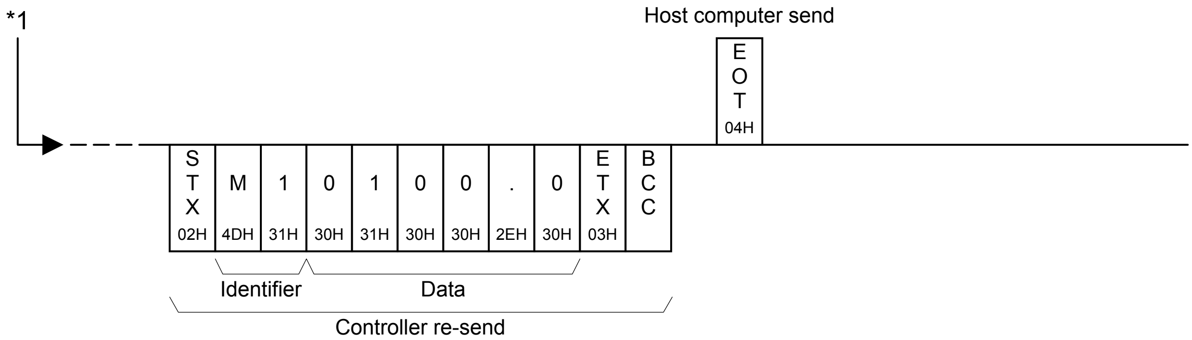
(2) Polling the next identifier with ACK (acknowledgment) after polling ends





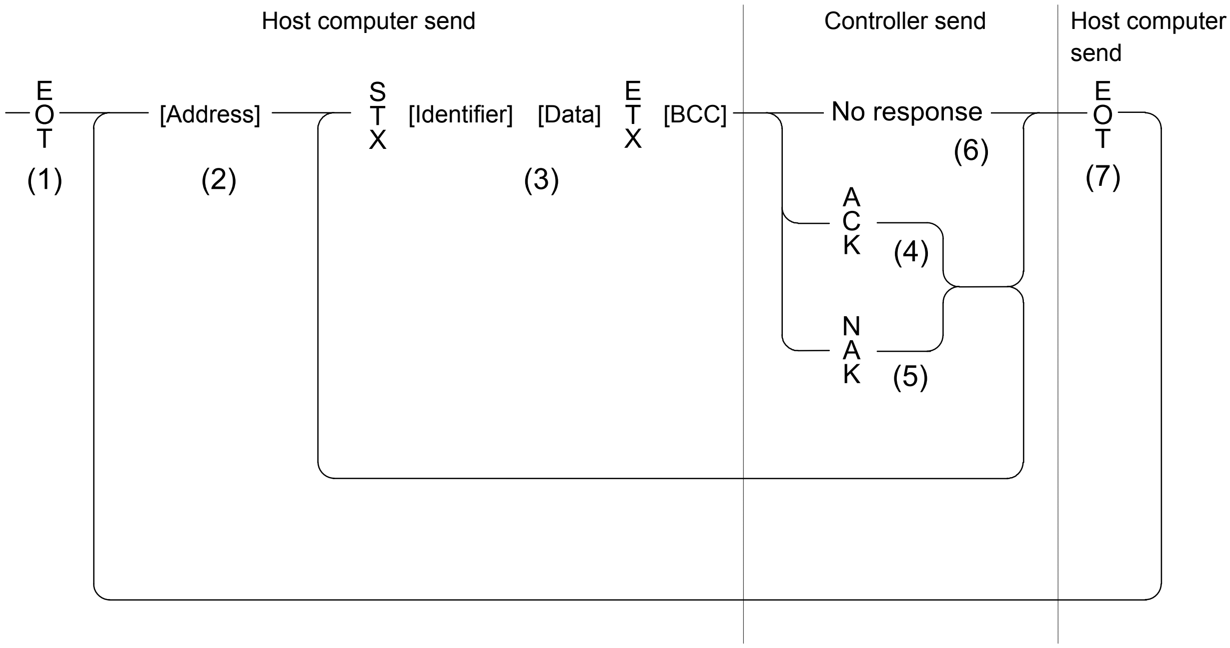
● Error transmission





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

	1.	*2.*		
STX	Identifier	Data	ETX	BCC

☞ 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.
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**

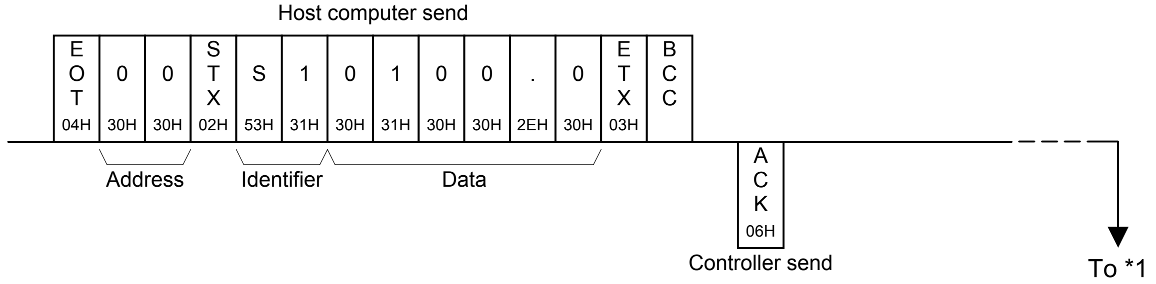
The controller does not respond when it cannot receive the selecting address, STX, ETX or BCC.

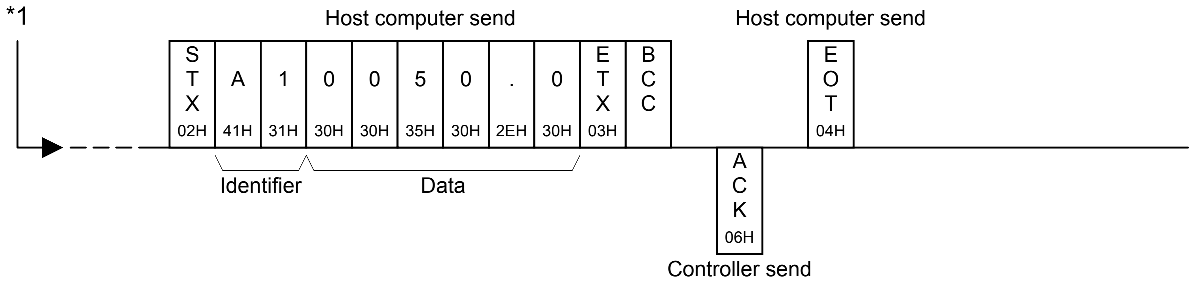
(7) **EOT (Data link termination)**

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.

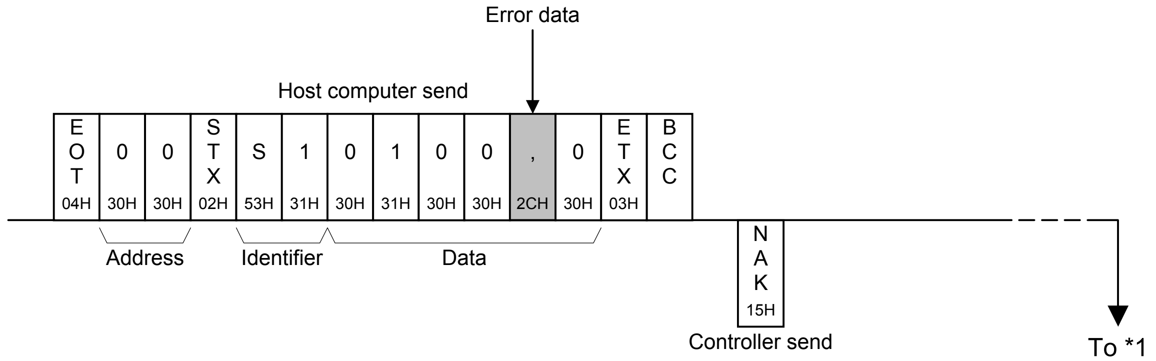
■ Selecting procedure example (When the host computer sends the set values)

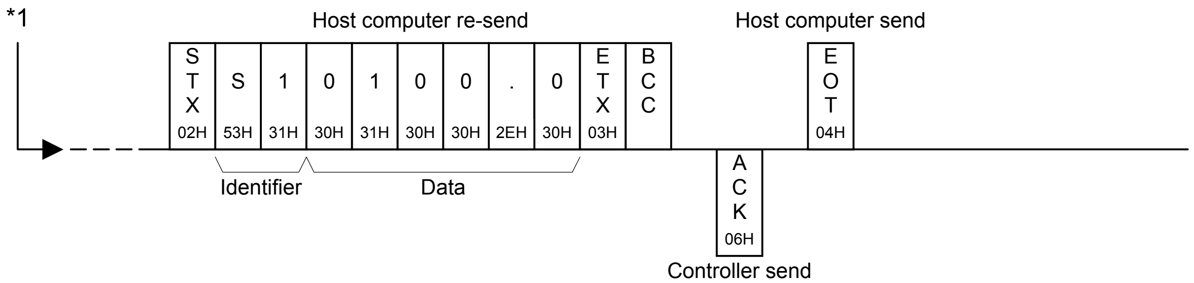
● Normal transmission





● Error transmission





9.4.3 RKC communication identifier list

■ Reference to RKC communication identifier list

(1) (2) (3) (4) (5) (6)

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
1	Measured value (PV) monitor [1]	**M1**	6	RO	0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F	—
2	Event 1 state monitor [2]	**AA**	6	RO	0: Event 1 OFF 1: Event 1 ON	—
3	Event 2 state monitor [3]	**AB**	6	RO	0: Event 2 OFF 1: Event 2 ON	—

(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

Data direction

Host computer ← Controller

R/W: Read and Write data

Data direction

Host computer ↔ Controller

(5) Data range: Read or write range of communication data

RKC communication

ASCII code data of 6 digits

Most significant digit ········· Least significant digit

(6) 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. 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

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
1	Measured value (PV) monitor [1]	**M1**	6	RO	0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F	—
2	Event 1 state monitor [2]	**AA**	6	RO	0: Event 1 OFF 1: Event 1 ON	—
3	Event 2 state monitor [3]	**AB**	6	RO	0: Event 2 OFF 1: Event 2 ON	—
4	Burnout state monitor	**B1**	6	RO	0: OFF 1: ON (burnout)	—
5	Error code	**ER**	6	RO	1: Adjustment data error 2: Data back-up error 4: A/D conversion error (Including temperature compensation error)	—
6	RUN/STOP transfer	**SR**	6	R/W	0: RUN 1: STOP	0
7	Set value 1 (SV1) [1]	**S1**	6	R/W	Setting limiter low to Setting limiter high	0.0
8	Event 1 set value (EV1) [1, 2, 4, 5, 6] (Event 1 set value (EV1) [high])	**A1**	6	R/W	Deviation action: −199 (−199.9) to +Input span Input value or set value action: Input range low to Input range high	50.0
9	Event 2 set value (EV2) [1, 3, 4, 5, 6] (Event 2 set value (EV2) [high])	**A2**	6	R/W	Deviation action: −199 (−199.9) to +Input span Input value or set value action: Input range low to Input range high	50.0
10	Control loop break alarm (LBA) time [2, 3, 7]	**A5**	6	R/W	0 to 999 seconds (0: Unused)	480
11	LBA deadband (LBD) [1, 2, 3, 7]	**A6**	6	R/W	0 (0.0) to Input span	0.0

[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

[5] 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)

[6] For the deviation action, input value action and set value action, refer to **Event type (P. 8-74).**

[7] Control loop break alarm (LBA) must be selected as an Event function.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
12	Autotuning (AT)	**G1**	6	R/W	0: PID control 1: AT start	0
13	Proportional band *	**P1**	6	R/W	1 (0.1) to Input span 0 (0.0): ON/OFF action	30.0
14	Integral time	**I1**	6	R/W	1 to 999 seconds (0: PD action)	240
15	Derivative time	**D1**	6	R/W	1 to 999 seconds (0: PI action)	60
16	Anti-reset windup (ARW)	**W1**	6	R/W	1 to 100 % of proportional band (0: Integral action is always OFF)	100
17	Proportional cycle time	**T0**	6	R/W	1 to 100 seconds	2
18	PV bias *	**PB**	6	R/W	−199 (−199.9) to +999 (+999.9) °C [°F]	0.0
19	Set lock level	**LK**	6	R/W	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	0
20	EEPROM mode	**EB**	6	R/W	0: Backup mode Set values stored to the EEPROM when set values are changed. 1: Buffer mode No set values stored to the EEPROM when set values are changed.	0
21	EEPROM state	**EM**	6	RO	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.	—
22	Interlock release	**IR**	6	R/W	To release the interlock, write "0 (zero)."	0

* Decimal point: Based on the setting of Decimal point position (Identifier: XU)

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
23	Event 1 delay timer [1]	**TD**	6	R/W	0 to 600 seconds Data can be written only in STOP mode.	0
24	Event 2 delay timer [2]	**TG**	6	R/W		0
25	Manipulated output value (MV) monitor [3]	**O1**	6	RO	−5 (−5.0) to +105 (+105.0) %	—
26	Manipulated output ON/OFF state monitor	**Q1**	6	RO	0: Output OFF 1: Output ON	—
27	Model code	**ID**	32	RO	Model code (character)	—
28	ROM version monitor	**VR**	8	RO	ROM version	—
29	Comprehensive event state	**AJ**	6	RO	Least significant digit: Event 1 (EV1) 2nd digit: Event 2 (EV2) 3rd digit: Burnout 4th digit to Most significant digit: Unused Data 0: OFF 1: ON	—
30	Output state monitor	**Q3**	6	RO	Least significant digit: Control output (OUT) 2nd digit: Digital output (DO) 3rd digit: Relay for Load power shutoff 4th digit to Most significant digit: Unused Data 0: OFF 1: ON	—
31	Set value (SV) display while the setting change rate limiter is working [3]	**MS**	6	RO	Setting limiter low to Setting limiter high	—
32	Operation mode state monitor	**L0**	6	RO	Least significant digit: STOP 2nd digit: RUN 3rd digit: Manual mode (During RUN) 4th digit: SB link 5th digit: Unused Most significant digit: Maintenance mode Data 0: OFF 1: ON	—
33	Actual SV selection number	**LZ**	6	RO	1 to 2	—
34	Auto (AUTO)/ Manual (MAN) transfer	**J1**	6	R/W	0: Auto (AUTO) mode 1: Manual (MAN) mode	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 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)

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
35	Monitor selection (no display) [1]	**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) [1]	**LM**	6	R/W	0 to 255 (Decimal) Bit 0: Auto (AUTO)/Manual (MAN) transfer [a] Bit 1: Set data unlock/lock transfer [a] Bit 2: Interlock release [a] Bit 3: Disable <R/S key operation [b] Bit 4 to Bit 6: Unused Bit 7: Displays F21 and after [c] [a] Data 0: OFF (Display) 1: ON (No display) [b] Data 0: Enable <R/S key operation 1: Disable <R/S key operation [c] Data 0: No display F21 through F91. 1: Display F21 through F91.	0
37	Set value 2 (SV2) [2]	**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) [2]	**HH**	6	R/W	0 (0.0) to Input span (Unit: °C [°F])/unit time	0.0
41	Setting change rate limiter (down) [2]	**HL**	6	R/W		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] [2, 3, 4]	**BT**	6	R/W	Deviation action: −199 (−199.9) to +Input span	−50.0
44	Event 2 set value (EV2') [low] [2, 3, 5]	**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: XA).

[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).

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
45	F04 block selection (no display) [1]	**DM**	6	R/W	0: Display 1: No display	0
46	Startup tuning (ST)	**ST**	6	R/W	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	0
47	F05 block selection (no display)	**DN**	6	R/W	0: Display 1: No display	0
48	Fine tuning setting	**CB**	6	R/W	−3 to +3 (0: Unused)	0
49	F06 block selection (no display)	**DO**	6	R/W	0: Display 1: No display	0
50	F07 block selection (no display) [2]	**DQ**	6	R/W	0: Display 1: No display	0
51	Minimum ON/OFF time of proportioning cycle	**VI**	6	R/W	0 to 999 ms	0
52	Output limiter high [3]	**OH**	6	R/W	Output limiter low to 105 (105.0) %	105.0
53	Output limiter low [3]	**OL**	6	R/W	−5 (−5.0) % to Output limiter high (Output limiter high > Output limiter low)	−5.0
54	F08 block selection (no display)	**DR**	6	R/W	0: Display 1: No display	0
55	PV digital filter	**F1**	6	R/W	0 to 100 seconds (0: Unused)	1
56	F09 block selection (no display)	**DS**	6	R/W	0: Display 1: No display	0
57	Manual manipulated output value (MV) [3]	**ON**	6	R/W	Output limiter low to Output limiter high	0.0
58	F10 block selection (no display)	**DT**	6	R/W	0: Display 1: No display	1
59	Holding peak value ambient temperature monitor	**HP**	6	RO	−10 to +100 °C [14 to 212 °F]	—
60	Integrated operating time monitor	**UT**	6	RO	0 to 9999 hours	—

[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).

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
61	Input type	**XI**	6	R/W	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)	Based on model code
62	Decimal point position	**XU**	6	R/W	0: Without decimal point for communication 1: With decimal point for communication (the tenths place)	1
63	Input scale high [1]	**XV**	6	R/W	Input scale low to Maximum value of the selected input range	Maximum value of the selected input range
64	Input scale low [1]	**XW**	6	R/W	Minimum value of the selected input range to Input scale high	Minimum value of the selected input range
65	Setting limiter high [1]	**SH**	6	R/W	Setting limiter low to Input scale high	Input scale high
66	Setting limiter low [1]	**SL**	6	R/W	Input scale low to Setting limiter high	Input scale low
67	PV flashing display	**DU**	6	R/W	0: Flashing 1: Non-flashing display	0
68	DI assignment [2]	**H2**	6	R/W	0: Unused (No DI assignment) 1: SV selection function (SV1/SV2) Contact open: SV1 Contact closed: SV2 2: RUN/STOP transfer Contact open: STOP Contact closed: RUN 3: Auto/Manual transfer Contact open: Manual (MAN) mode Contact closed: Auto (AUTO) mode 4: Interlock release Interlock is released at the time of contact status change (from open to close) by edge monitoring.	1
69	Output action at STOP mode [3]	**SS**	6	R/W	0: Event output is OFF 1: Event output remains unchanged	0

[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.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
70	Event 1 type [1]	**XA**	6	R/W	0 to 23 Refer to ■ **Event type table (P. 9-35)**.	Based on model code
71	Event 1 hold action [1]	**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 [1, 2]	**HA**	6	R/W	0 to Input span	2
73	Event 1 output action at input burnout [3]	**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 [3]	**Z1**	6	R/W	0: Energized 1: De-energized	0
75	Event 1 interlock [1]	**LF**	6	R/W	0: Unused (OFF) 1: Used	0
76	Event 2 type [4]	**XB**	6	R/W	0 to 23 Refer to ■ **Event type table (P. 9-35)**.	Based on model code
77	Event 2 hold action [4]	**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 [2, 4]	**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).

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
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		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.

No.	Name	Iden-tifier	Digits	Attri-bute	Data range	Factory set value
91	Load power shutoff function	**HZ**	6	R/W	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.)	0
92	Event output [1]	**E1**	6	R/W	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	3
93	Maintenance mode switching	**ZZ**	6	R/W	0: Normal operation mode 1: Maintenance mode	0
94	Power saving mode setting	**DI**	6	R/W	0 to 60 minutes (0: Always ON)	0
95	Burnout status monitoring delay	**IB**	6	R/W	0 to 10 times (Number of input sampling cycle)	0
96	SB link selection [2]	**C0**	6	R/W	0: Without SB link function 1: With SB link function	0
97	Intragroup address [2]	**G0**	6	R/W	0: Intragroup address 1 (Master) 1: Intragroup address 2 2: Intragroup address 3 3: Intragroup address 4	0
98	Control action at SB link error [2]	**QM**	6	R/W	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.	2

[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

Set value	Event type
0	None
1	Deviation high (Using SV monitor value) [1]
2	Deviation low (Using SV monitor value) [1]
3	Deviation high/low (Using SV monitor value) [1]
4	Band (Using SV monitor value)
5	Deviation high/low (Using SV monitor value) [High/Low individual setting] [1]
6	Band (Using SV monitor value) [High/Low individual setting]
7	SV high (Using SV monitor value)
8	SV low (Using SV monitor value)
9	SV high [2]
10	SV low [2]
11	Control loop break alarm (LBA) [3]
12	Monitor during RUN
13	FAIL (Fixed at de-energized: Contact open when error occurs)
14	Deviation high (Using local SV) [1]
15	Deviation low (Using local SV) [1]
16	Deviation high/low (Using local SV) [1]
17	Band (Using local SV)
18	Deviation high/low (Using local SV) [High/Low individual setting] [1]
19	Band (Using local SV) [High/Low individual setting]
20	SV high (Using local SV)
21	SV low (Using local SV)
22	Unused
23	Output of the communication monitoring result (Event signal is turned on when communication is not properly made for 10 seconds.)

[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.

9.5 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.

Slave address
Function code
Data
Error check CRC-16

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

Function code (Hexadecimal)	Function	Contents
03H	Read holding registers	Measured value (PV), Event status and Monitor, etc.
06H	Preset single register	Set value (SV), Event set value, PID constants and PV bias, etc.
08H	Diagnostics (loopback test)	Loopback test

Message length of each function (Unit: byte)

Function code (Hexadecimal)	Function	Query message		Response message	
		Min	Max	Min	Max
03H	Read holding registers	8	8	7	255
06H	Preset single register	8	8	8	8
08H	Diagnostics (loopback test)	8	8	8	8

9.5.3 Communication mode

Signal transmission between the master and slaves is conducted in Remote Terminal Unit (RTU) mode.

Items	Contents
Data bit length	8-bit (Binary)
Start mark of message	Unused
End mark of message	Unused
Message length	Refer to **9.5.2 Function code**.
Data time interval	Less than 24-bit time *
Error check	CRC-16 (Cyclic Redundancy Check)

* 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.

Slave address
Function code
Error code
Error check (CRC-16)

Error response message

- 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.

Error code	Contents
1	Function code error (An unsupported function code was specified)
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 • 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***.

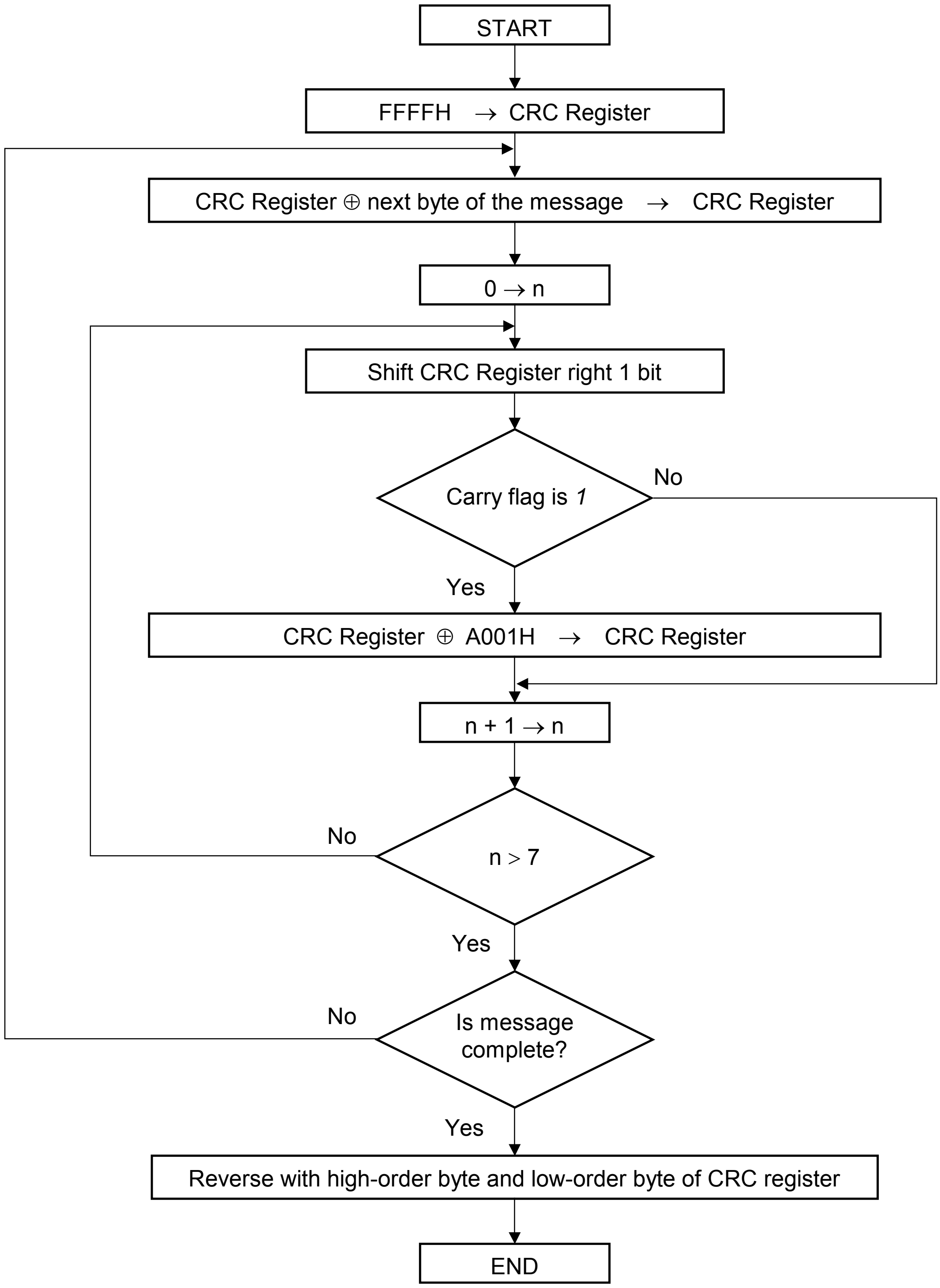
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

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



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_messaage_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.

```
uint16 calculate_crc（byte *z_p, unit16 z_message_length）

/* CRC runs cyclic Redundancy Check Algorithm on input z_p          */
/* Returns value of 16 bit CRC after completion and                 */
/* always adds 2 crc bytes to message                               */
/* returns 0 if incoming message has correct CRC                    */

{
    uint16 CRC= 0xffff;
    uint16 next;
    uint16 carry;
    uint16 n;
    uint8 crch, crcl;

    while (z_messaage_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_messaage_length++] = crcl;
    z_p [z_messaage_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 the read out from slave address 2.

Query message

Slave address		02H	
Function code		03H	
Starting No.	High	00H	First holding register address
	Low	00H	
Quantity	High	00H	The setting must be between 1 (0001H) and 125 (007DH).
	Low	04H	
CRC-16	High	44H	
	Low	3AH	

Normal response message

Slave address		02H	
Function code		03H	
Number of data		08H	→ Number of holding registers × 2
First holding register contents	High	00H	
	Low	19H	
Next holding register contents	High	00H	
	Low	00H	
Next holding register contents	High	00H	
	Low	00H	
Next holding register contents	High	00H	
	Low	00H	
CRC-16	High	12H	
	Low	52H	

Error response message

Slave address		02H
80H + Function code		83H
Error code		03H
CRC-16	High	F1H
	Low	31H

■ 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

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	06H
Write data	High	00H
	Low	32H
CRC-16	High	E8H
	Low	1EH

Any data within the range

Normal response message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	06H
Write data	High	00H
	Low	32H
CRC-16	High	E8H
	Low	1EH

Contents will be the same as query message data.

Error response message

Slave address		01H
80H + Function code		86H
Error code		02H
CRC-16	High	C3H
	Low	A1H

■ 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

Slave address		01H
Function code		08H
Test code	High	00H
	Low	00H
Data	High	1FH
	Low	34H
CRC-16	High	E9H
	Low	ECH

Test code must be set to 00.

Any pertinent data

Normal response message

Slave address		01H
Function code		08H
Test code	High	00H
	Low	00H
Data	High	1FH
	Low	34H
CRC-16	High	E9H
	Low	ECH

Contents will be the same as query message data.

Error response message

Slave address		01H
80H + Function code		88H
Error code		03H
CRC-16	High	06H
	Low	01H

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 is processed as 50,
  50 = 0032H

Manipulated output value (MV) monitor	High	00H
	Low	32H

- 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.

9.5.8 Modbus communication data list

■ Reference to Modbus communication identifier list

(1) (2) (3) (4) (5)

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
1	Measured value (PV) monitor	0000	0	RO	0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F	—
2	Unused	0001	1	RO		—
3	Unused	0002	2	RO		—
4	Event 1 state monitor [2]	0003	3	RO	0: Event 1 OFF 1: Event 1 ON	—

(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.

Data direction
Host computer ←——— Controller

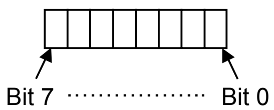
R/W: Reading and writing data is possible.

Data direction
Host computer ←——→ 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

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
1	Measured value (PV) monitor [1]	0000	0	RO	0 (0.0) to 800 (800.0) °C or 0 (0.0) to 999 (999.9) °F	—
2	Unused	0001	1	RO	Read: 0 Write: Not allowed	—
3	Unused	0002	2	RO		—
4	Event 1 state monitor [2]	0003	3	RO	0: Event 1 OFF 1: Event 1 ON	—
5	Event 2 state monitor [3]	0004	4	RO	0: Event 2 OFF 1: Event 2 ON	—
6	Burnout state monitor	0005	5	RO	0: OFF 1: ON (burnout)	—
7	Set value 1 (SV1) [1]	0006	6	R/W	Setting limiter low to Setting limiter high	0
8	Event 1 set value (EV1) [1, 2, 4, 5, 6] (Event 1 set value (EV1) [high])	0007	7	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] (Event 2 set value (EV2) [high])	0008	8	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	9	R/W	Read/Write: 0	—
11	Unused	000A	10	R/W		—
12	Control loop break alarm (LBA) time [7, 8]	000B	11	R/W	0 to 999 seconds (0: Unused)	480
13	LBA deadband (LBD) [1, 7, 8]	000C	12	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 invalidated 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 invalidated 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☐ 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)

[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.

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
14	Autotuning (AT)	000D	13	R/W	0: PID control 1: AT start	0
15	Unused	000E	14	R/W	Read/Write: 0	—
16	Proportional band *	000F	15	R/W	1 (0.1) to Input span 0 (0.0): ON/OFF action	30.0
17	Integral time	0010	16	R/W	1 to 999 seconds (0: PD action)	240
18	Derivative time	0011	17	R/W	1 to 999 seconds (0: PI action)	60
19	Anti-reset windup (ARW)	0012	18	R/W	1 to 100 % of proportional band (0: Integral action is always OFF)	100
20	Proportional cycle time	0013	19	R/W	1 to 100 seconds	2
21	Unused	0014	20	R/W	Read/Write: 0	—
22	Unused	0015	21	R/W		—
23	Unused	0016	22	R/W		—
24	PV bias *	0017	23	R/W	−199 (−199.9) to +999 (+999.9) °C [°F]	0.0
25	Set lock level	0018	24	R/W	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	0
26	RUN/STOP transfer	0019	25	R/W	0: RUN 1: STOP	0
27	Unused	001A	26	R/W	Read/Write: 0	—

* Decimal point: Based on the setting of Decimal point position (Register address: 0062H)

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
28	EEPROM mode	001B	27	R/W	0: Backup mode Set values stored to the EEPROM when set values are changed. 1: Buffer mode No set values stored to the EEPROM when set values are changed.	0
29	EEPROM state	001C	28	RO	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.	—
30	Manipulated output value (MV) monitor	001D	29	RO	−5 (−5.0) to +105 (+105.0) %	—
31	Unused	001E	30	RO	Read: 0 Write: Not allowed	—
32	Unused	001F : 002C	31 : 44	R/W	Read/Write: 0	—
33	Manipulated output ON/OFF state monitor	002D	45	RO	0: Output OFF 1: Output ON	—
34	Unused	002E	46	RO	Read: 0 Write: Not allowed	—
35	Comprehensive event state	002F	47	RO	Bit data Bit 0: Event 1 (EV1) Bit 1: Event 2 (EV2) Bit 2: Burnout Bit 3 to Bit 7: Unused Data 0: OFF 1: ON [Decimal number: 0 to 7]	—
36	Unused	0030	48	RO	Read: 0 Write: Not allowed	—
37	Output state monitor	0031	49	RO	Bit data Bit 0: Control output (OUT) Bit 1: Digital output (DO) Bit 2: Relay for Load power shutoff Bit 3 to Bit 7: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	—
38	Set value (SV) display while the setting change rate limiter is working *	0032	50	RO	Setting limiter low to Setting limiter high	—
39	Unused	0033	51	RO	Read: 0 Write: Not allowed	—
40	Unused	0034	52	RO		—
41	Unused	0035	53	RO		—

* Decimal point: Based on the setting of Decimal point position (Register address: 0062H)

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
42	Error code	0036	54	RO	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]	—
43	Operation mode state monitor	0037	55	RO	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]	—
44	Actual SV selection number	0038	56	RO	1 to 2	—
45	Auto (AUTO)/ Manual (MAN) transfer	0039	57	R/W	0: Auto (AUTO) mode 1: Manual (MAN) mode	0
46	Interlock release	003A	58	R/W	To release the interlock, write “0 (zero).”	0
47	Monitor selection (no display)	003B	59	R/W	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]	0
48	Mode selection (no display)	003C	60	R/W	Bit data Bit 0: Auto (AUTO)/Manual (MAN) transfer [a] Bit 1: Set data unlock/lock transfer [a] Bit 2: Interlock release [a] Bit 3: Disable <R/S key operation [b] Bit 4 to Bit 6: Unused Bit 7: Displays F21 and after [c] [a] Data 0: OFF (Display) 1: ON (No display) [b] Data 0: Enable <R/S key operation 1: Disable <R/S key operation [c] Data 0: No display F21 through F91. 1: Display F21 through F91. [Decimal number: 0 to 143]	0

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
49	Set value 2 (SV2) [1]	003D	61	R/W	Setting limiter low to Setting limiter high	0
50	Unused	003E	62	R/W	Read/Write: 0	—
51	Unused	003F	63	R/W		—
52	SV selection	0040	64	R/W	1 to 2	1
53	F01 block selection (no display)	0041	65	R/W	0: Display 1: No display	1
54	Unused	0042 ⋮ 0048	66 ⋮ 72	R/W	Read/Write: 0	—
55	Setting change rate limiter (up)	0049	73	R/W	0 (0.0) to Input span (Unit: °C [°F])/unit time	0.0
56	Setting change rate limiter (down)	004A	74	R/W		0.0
57	F03 block selection (no display)	004B	75	R/W	0: Display 1: No display	1
58	Event 1 set value (EV1') [low] [1, 2, 3]	004C	76	R/W	Deviation action: −199 (−199.9) to +Input span	−50.0
59	Event 2 set value (EV2') [low] [1, 3, 4]	004D	77	R/W	Input value or set value action: Input range low to Input range high	−50.0
60	Unused	004E	78	R/W	Read/Write: 0	—
61	Unused	004F	79	R/W		—
62	Unused	0050	80	R/W		—
63	Unused	0051	81	R/W		—
64	F04 block selection (no display) [5]	0052	82	R/W	0: Display 1: No display	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] 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)

[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).

[5] 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.”

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
65	Startup tuning (ST)	0053	83	R/W	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	0
66	F05 block selection (no display)	0054	84	R/W	0: Display 1: No display	0
67	Fine tuning setting	0055	85	R/W	−3 to +3 (0: Unused)	0
68	F06 block selection (no display)	0056	86	R/W	0: Display 1: No display	0
69	F07 block selection (no display) [1]	0057	87	R/W	0: Display 1: No display	0
70	Minimum ON/OFF time of proportioning cycle	0058	88	R/W	0 to 999 ms	0
71	Output limiter high [2]	0059	89	R/W	Output limiter low to 105 (105.0) %	105.0
72	Output limiter low [2]	005A	90	R/W	−5 (−5.0) % to Output limiter high (Output limiter high > Output limiter low)	−5.0
73	Unused	005B	91	R/W	Read/Write: 0	—
74	F08 block selection (no display)	005C	92	R/W	0: Display 1: No display	0
75	PV digital filter	005D	93	R/W	0 to 100 seconds (0: Unused)	1
76	F09 block selection (no display)	005E	94	R/W	0: Display 1: No display	0
77	Manual manipulated output value (MV) [2]	005F	95	R/W	Output limiter low to Output limiter high	0.0
78	F10 block selection (no display)	0060	96	R/W	0: Display 1: No display	1

[1] 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)."

[2] 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).

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
79	Input type	0061	97	R/W	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)	Based on model code
80	Decimal point position	0062	98	R/W	0: Without decimal point for communication 1: With decimal point for communication (the tenths place)	1
81	Unused	0063	99	R/W	Read/Write: 0	—
82	Input scale high [1]	0064	100	R/W	Input scale low to Maximum value of the selected input range	Maximum value of the selected input range
83	Input scale low [1]	0065	101	R/W	Minimum value of the selected input range to Input scale high	Minimum value of the selected input range
84	Setting limiter high [1]	0066	102	R/W	Setting limiter low to Input scale high	Input scale high
85	Setting limiter low [1]	0067	103	R/W	Input scale low to Setting limiter high	Input scale low
86	PV flashing display	0068	104	R/W	0: Flashing 1: Non-flashing display	0
87	Unused	0069	105	R/W	Read/Write: 0	—
88	Output action at STOP mode [2]	006A	106	R/W	0: Event output is OFF 1: Event output remains unchanged	0
89	Unused	006B ⋮ 006F	107 ⋮ 111	R/W	Read/Write: 0	—
90	Event 1 type [3]	0070	112	R/W	0 to 23 Refer to ■ **Event type table (P. 9-35)**.	Based on model code
91	Event 1 hold action [3]	0071	113	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

[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).

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
92	Event 1 differential gap [1, 2]	0072	114	R/W	0 to Input span	2
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 [4]	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 [4]	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).

No.	Name	Register address HEX	Register address DEC	Attri-bute	Data range	Factory set value
103	Event 2 interlock [1]	007D	125	R/W	0: Unused (OFF) 1: Used	0
104	Unused	007E : 008F	126 : 143	R/W	Read/Write: 0	—
105	ON/OFF action differential gap (upper) [2]	0090	144	R/W	0 (0.0) to 100 (100.0) °C [°F]	1.0
106	ON/OFF action differential gap (lower) [2]	0091	145	R/W		1.0
107	Control output at burnout	0092	146	R/W	0: Result of control computation 1: Output limiter low (Output OFF)	0
108	Bumpless mode setting	0093	147	R/W	0: Without bumpless 1: With bumpless	1
109	Derivative action	0094	148	R/W	0: Measured value derivative 1: Deviation derivative	0
110	AT cycles	0095	149	R/W	0: 1.5 cycles 1: 2.5 cycles	0
111	AT differential gap time	0096	150	R/W	0 to 50 seconds	10
112	ST start condition	0097	151	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
113	Setting change rate limiter unit time	0098	152	R/W	0: Minute 1: Hours	0
114	Unused	0099 : 00A1	153 : 161	R/W	Read/Write: 0	—
115	Control action at Event [3]	00A2	162	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 (Register address: 0077H).

[2] Decimal point: Based on the setting of Decimal point position (Register address: 0062H)

[3] This parameter is invalidated when a Digital output (DO) or Event function is unused.

No.	Name	Register address		Attri-bute	Data range	Factory set value
		HEX	DEC			
116	Load power shutoff function	00A3	163	R/W	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.)	0
117	Event output *	00A4	164	R/W	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	3
118	Unused	00A5	165	R/W	Read/Write: 0	—
119	Unused	00A6	166	R/W		—
120	Unused	00A7	167	R/W		—
121	Unused	00A8	168	R/W		—
122	Unused	00A9	169	R/W		—
123	Maintenance mode switching	00AA	170	R/W	0: Normal operation mode 1: Maintenance mode	0
124	Power saving mode setting	00AB	171	R/W	0 to 60 minutes (0: Always ON)	0
125	Burnout status monitoring delay	00AC	172	R/W	0 to 10 times (Number of input sampling cycle)	0
126	Unused	00AD	173	R/W	Read/Write: 0	—
127	Unused	00AE	174	R/W		—
128	Unused	00AF	175	R/W		—
129	Unused	00B0	176	R/W		—
130	Unused	00B1	177	R/W		—

* 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.

					b7	0	0	0	0	1	1	1	1
					b6	0	0	1	1	0	0	1	1
					b5	0	1	0	1	0	1	0	1
b5 to b7	b4	b3	b2	b1		0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	@	P	‘	p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	”	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1	0	6	ACK	SYM	&	6	F	V	f	v
	0	1	1	1	7	BEL	ETB	’	7	G	W	g	w
	1	0	0	0	8	BS	CAN	(	8	H	X	h	x
	1	0	0	1	9	HT	EM	)	9	I	Y	i	y
	1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
	1	0	1	1	B	VT	ESC	+	;	K	[	k	{
	1	1	0	0	C	FF	FS	,	<	L	¥	l	|
	1	1	0	1	D	CR	GS	-	=	M	]	m	}
	1	1	1	0	E	SO	RS	.	>	N	^	n	˜
	1	1	1	1	F	SI	US	/	?	O	_	o	DEL

MEMO

10 TROUBLE SHOOTING

This chapter describes error displays and procedures to follow when problems occur.

10.1 Error Display

This Section describes error display when the Measured value (PV) exceeds the display range and the self-diagnostic error.

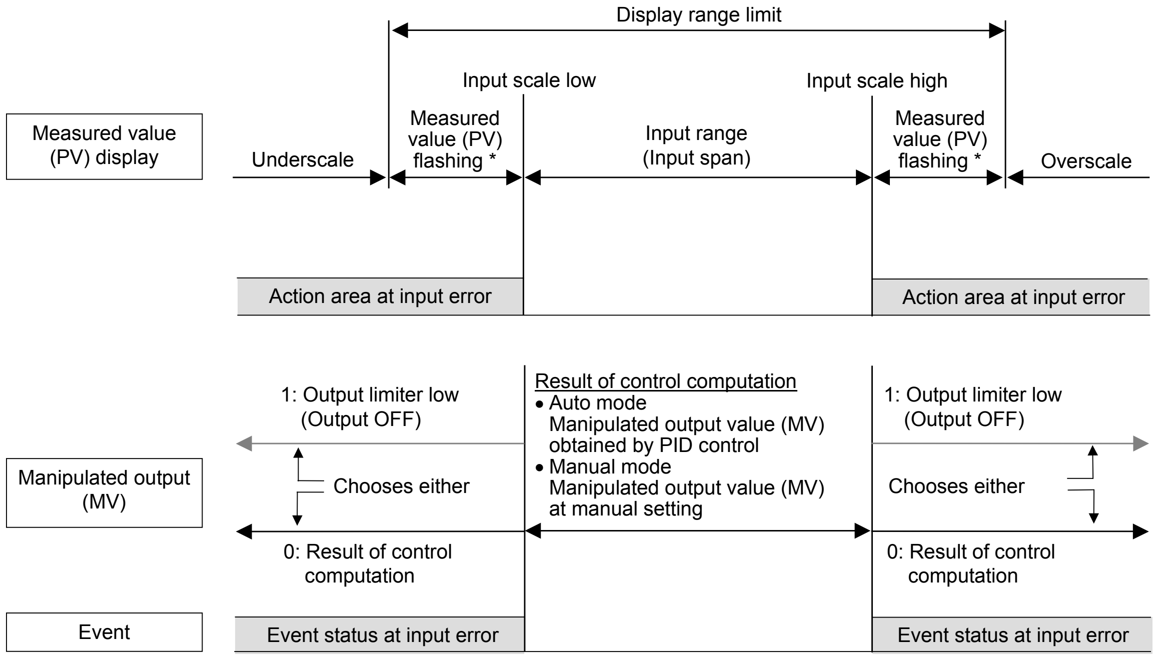
■ Display when input error occurs

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.

Display	Description	Action (Output)	Solution
Measured value (PV) [Flashing]	Measured value (PV) exceeds the input range. Display does not flash when "Non-flashing display" is set.	• Control output: Output depending on the "Control output at burnout" (Refer to P. 8-95) • Event output: Output depending on the "Event output state at input burnout" (Refer to P. 8-85)	Check Input type, Input range and connecting state of sensor. Confirm that the sensor or wire is not broken.
ooo [Flashing]	Over-scale Measured value (PV) is above the display range limit high.		
uuu [Flashing]	Underscale Measured value (PV) is below the display range limit low.		



* "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 displays in turn. If two or more errors occur simultaneously, the total summation of these error codes is displayed.

<table>
<tr><th>Error number</th><th>Description</th><th>Action</th><th>Solution</th></tr>
<tr><td>1</td><td>Adjusted data error
• Adjusted data range is abnormal.</td><td rowspan="3">Display:
Displays “Err” and error number alternately.
Control output:
Output of −5%
Relay for Load power shutoff:
Contact open
FAIL output:
Contact open
[When FAIL is selected for the Event (EV)] [1]
Communication:
Displays error number relevant to the readout value of the error code(s).</td><td rowspan="3">Turn off the power at once.
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
• Error occurs to backup data.</td></tr>
<tr><td>4</td><td>A/D conversion error
• Response signal from A/D converter is abnormal.
Temperature compensation error
• Temperature measuring range (+100 °C or more, −20 °C or less) is abnormal.</td></tr>
<tr><td>16</td><td>SB link error
• Error occurs in communication between controllers. (At SB link)
[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 [2]
[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 [2]</td><td>Display:
Displays “Err” and error number alternately.
Control output:
Continue control/Stop control is selectable. [2]
Relay for Load power shutoff:
Start-up condition is selectable. [3]
FAIL output:
Contact open
[When FAIL is selected for the Event (EV)] [1]
Communication:
Readout value of the error code: 16</td><td>Error state recovers by solving causes (such as breaking of communication line).</td></tr>
</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>
<tr><th>Description</th><th>Action</th><th>Solution</th></tr>
<tr><td>Power supply voltage is abnormal (power supply voltage monitoring)</td><td rowspan="2">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)] [1]
Communication:
No response</td><td rowspan="2">The SB1 must be repaired or replaced.
Please contact RKC sales office or the agent.</td></tr>
<tr><td>Watchdog timer
• The part of an internal program stops the action.</td></tr>
</table>

[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.

■ Display

Problem	Possible cause	Solution
No display appears	Power supply terminal connection not correct.	Connect the terminals correctly by referring to **3.3 Terminal Layout (P. 3-5)**.
	Power supply terminal contact defect.	Reconnect the connectors properly.
	Proper power supply voltage is not being supplied.	Apply the normal power supply by referring to **11. SPECIFICATIONS (P. 11-1)**.
Display is abnormal	Noise source is present near the instrument.	Separate the noise source from the instrument.
		Set the appropriate digital filter according to the responding control systems.
	The terminal board on the instrument using the thermocouple is directly exposed to the air from an air conditioner.	Do not directly expose the terminal board to the air from the air conditioner.
Measured value (PV) display differs from the actual value	Proper sensor is not being used.	Use the specified sensor.
	The PV bias is set.	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.

How to check if the input function of the controller is working correctly.

- When the controller is configured as Thermocouple input:
  Short the input terminals No. 2 and No. 3 for Measured input/Control output connector. If the controller shows a Measured value around the ambient temperature of the input terminals, the input function of the controller is working correctly.
- When the controller is configured as RTD input:
  Connect a 100 Ω resister between the input terminals No. 1 and No. 2 for Measured input/Control output connector, and short the input terminals No. 2 and No. 3 for Measured input/Control output connector. If the controller shows Measured value around 0 °C (32 °F), the input function of the controller is working correctly.

■ Control

Problem	Possible cause	Solution
Control is abnormal	Proper power supply voltage is not being supplied.	Apply the normal power supply by referring to **11. SPECIFICATIONS (P. 11-1)**.
	Sensor or input lead wires break.	Turn off the power or STOP the operation by “RUN/STOP transfer” and repair the sensor or replace it.
	The sensor is not wired correctly.	Conduct sensor wiring correctly by referring to **3.3 Terminal Layout (P. 3-5)**.
	Proper sensor is not being used.	Use the specified sensor.
	Sensor insertion depth is insufficient.	Check whether sensor is inserted too loosely. If so, fully insert the sensor.
	Sensor insertion position is not appropriate.	Insert the sensor at the specified location.
	Input signal wires are not separated from instrument power and/or load wires.	Separate each wire.
	Noise source is present near the wiring.	Separate the noise source from the wiring.
	Inappropriate PID constants	Set the appropriate PID constants.
Startup tuning (ST) function cannot be activated	Startup tuning (ST) mode is “0 (ST unused).” (Factory set value: 0)	Refer to **6.3 Startup Tuning (ST) (P. 6-10)**.
	Requirements for performing the Startup tuning (ST) function are not satisfied.	Satisfy the requirements for performing the Startup tuning (ST) function by referring to **6.3 Startup Tuning (ST) (P. 6-10)**.

Continued on the next page.

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Problem	Possible cause	Solution
Autotuning (AT) function not activated	Requirements for performing the Autotuning (AT) function are not satisfied.	Satisfy the requirements for performing the Autotuning (AT) function by referring to **6.2 Autotuning (AT) (P. 6-7)**.
Autotuning (AT) suspended	Requirements for suspending the Autotuning (AT) function are established.	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.
Acceptable PID values cannot be calculated by Autotuning (AT)	The Autotuning (AT) function does not appropriately meet the characteristics of the controlled object.	Set PID constants manually.
Autotuning (AT) cannot be finished normally	A temperature change (UP and/or Down) is 1 °C or less per minute during Autotuning.	Set PID constants manually.
	Autotuning (AT) is activated when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.	
Output does not change.	The Output limiter is set.	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.

■ Operation

Problem	Possible cause	Solution
No control RUN can be made by key operation.	RUN/STOP transfer of the digital input (DI) is set to the contact opened.	Check the contact state of RUN/STOP transfer by referring to **6.1 RUN/STOP Transfer (P. 6-2)**.
No Manual mode can be made by key operation.	Auto/Manual transfer of the digital input (DI) is set to the contact opened.	Check the contact state of Auto/Manual transfer by referring to **6.5 Auto/Manual Transfer (P. 6-19)**.
No setting change can be made by key operation.	Set data is locked.	Release the set data lock by referring **to 6.6 Protecting Setting Data (P. 6-23)**.
Set value does not change.	The Setting limiter is set.	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.
Set value (SV) does not change immediately when the Set value (SV) is changed	The Setting change rate limiter is set.	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.

■ Event function

Problem	Possible cause	Solution
Event function is abnormal	Event function is different from the specification.	Change the Event action type by referring to **Event type (P. 8-73)** after the instrument specification is confirmed.
	Digital output (DO) relay contact Energized/De-energized is reversed. When FAIL is selected for digital output: De-energized fixed: Contact opens under FAIL	Check the setting details by referring to **Energized/De-energized of DO (P. 8-93)**.
	Setting of Event differential gap is not appropriate.	Set the appropriate Event differential gap by referring to **Event differential gap (P. 8-84)**.
Event hold action is not activated.	The Setting change rate limiter is set.	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.

■ RKC communication

Problem	Possible cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	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

Problem	Possible cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	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

11

■ Measured input

Number of input: 1 point

Input type:

Input type		Measured range	Standard
TC input	K	0 to 800 °C 0 to 999 °F	JIS-C1602-1995
	J		
RTD input	Pt100	0 to 400 °C 0 to 800 °F	JIS-C1604-1997

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:

Measured input: [For Fahrenheit: Converted value of Celsius]

Input type	Input range	Accuracy
K, J	0 °C or more, Less than 500 °C	±(1.5 °C + 1 digit)
	500 °C or more	±(0.3 % of Reading + 1 digit)
Pt100, JPt100	0 °C or more, Less than 200 °C	±(0.6 °C + 1 digit)
	200 °C or more	±(0.3 % of Reading + 1 digit)

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

■ 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)
Deviation high/low with hold action (Using SV monitor value)
Deviation high/low with re-hold action (Using SV monitor value)
Deviation high/low (Using local SV)
Deviation high/low with hold action (Using local SV)
Deviation high/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
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 +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 +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 shutoff 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 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.)

■ 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: RS-485

Signal voltage	Logic
V (A) – V (B) ≥ 2 V	0 (SPACE)
V (A) – V (B) ≤ –2 V	1 (MARK)

Voltage between V (A) and V (B) is the voltage of (A) terminal for the (B) terminal.

- **Modbus**

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: 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

■ 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:

Test voltage: 500 V DC	①	②	③	④
① Grounding terminal (PE terminal)				
② Power, output terminals (SSR)	20 MΩ or more			
③ Measured input terminal	20 MΩ or more	20 MΩ or more		
④ Digital output (DO) terminal	20 MΩ or more	20 MΩ or more	20 MΩ or more	
⑥ Communication, digital input (DI) terminals	20 MΩ or more	20 MΩ or more	20 MΩ or more	20 MΩ or more

Withstand voltage:

Time: 1 min.	①	②	③	④
① Grounding terminal (PE terminal)				
② Power, output terminals (SSR)	1500 V AC			
③ Measured input terminal	1000 V AC	2300 V AC		
④ Digital output (DO) terminal	1500 V AC	2300 V AC	2300 V AC	
⑥ Communication, digital input (DI) terminals	1000 V AC	2300 V AC	750 V AC	2300 V AC

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/m^3 dry air at 101.3kPa)

Installation environment conditions:

Indoor use
Altitude up to 2000 m

Transportation and Storage environment conditions:

Vibration:

Number of vibration Hz	Level		Attenuation slope dB/oct
	$(m/s^2)^2/Hz$	$[g^2/Hz]$ *	
3	0.048	(0.0005)	—
3 to 6	—	—	+13.75
6 to 18	1.15	(0.012)	
18 to 40	—	—	−9.34
40	0.096	(0.001)	
40 to 200	—	—	−1.29
200	0.048	(0.0005)	—

The effective value of the acceleration is 5.8 m/s^2 [0.59 g*] within the number of vibration.

* g = 9.806658 m/s^2

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/m^3 dry air at 101.3kPa

Mounting and Structure: Mounting method:

- 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

MEMO

Alphabetical order

Character Order

* Mode

SV:	SV setting mode	MODE:	Mode switching
PARA:	Parameter setting mode	ENG:	Engineering mode

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