Temperature Controller

RZ100/RZ400

Instruction Manual

RKC® RKC INSTRUMENT INC.

IMR02Y05-E4

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 explanation purpose.
- 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.
- Various symbols are used on the equipment, they have the following meaning.

  ~ : Alternating current

  ⧈ : Reinforced insulation

  ⚠ : Safety precaution

  This symbol is used where the instruction manual needs to be consulted for the safety of operator and equipment. Carefully read the cautions in this manual before using the instrument.

Safety Precautions

■ Pictorial Symbols (safety symbols)

Various pictorial symbols are used in this manual to ensure safe use of the product, to protect you and other people from harm, and to prevent damage to property. The symbols are described below.
Be sure you thoroughly understand the meaning of the symbols before reading this manual.

⚠ 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.

⚠ WARNING

- To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the 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 may occur and warranty is void under these conditions.

⚠ 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 plant.)
- 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 to operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- All wiring must be in accordance with local codes and regulations.
- To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.
- A malfunction in this product may occasionally make control operations impossible or prevent alarm outputs, resulting in a possible hazard. Take appropriate measures in the end use to prevent hazards in the event of malfunction.
- 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 dissipation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to the instrument display, do not rub with an abrasive material or push the front panel with a hard object.

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

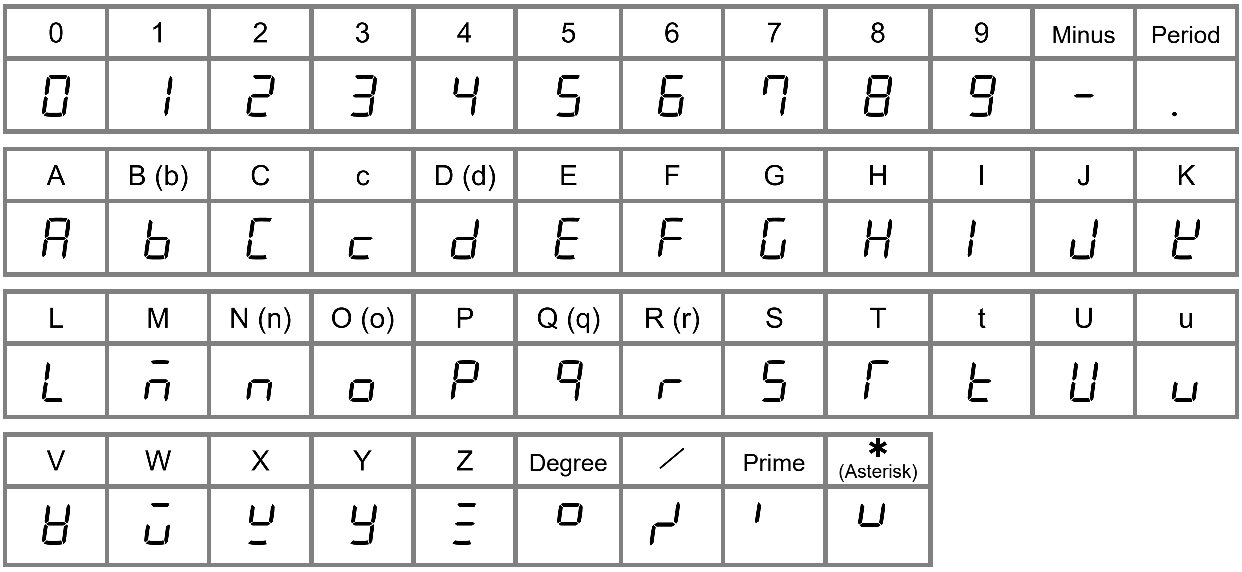
■ Pictorial Symbols (safety symbols)

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



8	Dimly lit
8	Highlighted

■ Other Symbols

EX : Parameters operatable during the “Expanded display mode”

OP : Parameters operatable when optional functions are supplied

☞ For the display mode, refer to **9. DISPLAY FUNCTION (P. 9-1)**.

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11. CONTROL FUNCTION 11-1

The chapter 11 describes control related functions, setting contents and setting procedure based on the key words related to controls.

12. COMMUNICATION FUNCTION (OPTION) 12-1

The chapter 12 describes Host communication including connection, setting, protocol and communication data.

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MEMO

1 OUTLINE

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

1.1 Features

This high performance digital controller has the following features:

- **Panel space saving: 60 mm depth (RZ400), 63 mm (RZ100)**

- **Sampling cycle 0.25 seconds**

- **Incorporates Autotuning (AT) for easy setting of PID values**

Automatically calculates the PID values to provide fast stabilization.

- **"Fine tuning" that changes responsiveness**

A new 6 level Fine tuning allows the operator to control response from fast to slow by changing the Fine tuning setting (−3 to +3) while the PID constant remains unchanged.

- **Startup tuning eliminates autotuning time**

Conventional autotuning time is eliminated by startup tuning which calculates optimum PID values immediately upon startup.

- **Freely assignable outputs**

This instrument can incorporate up to three outputs. Each output port can be freely configured for control outputs (heating and cooling outputs) and alarm outputs (including Heater break alarm outputs).

- **Easy parameter setup via USB loader port**

A user can easily save parameter settings to a PC and copy parameters to other controllers with the USB port, a COM-KG (or COM-K2) converter, and dedicated PROTEM2 software for the RZ100/400.
(Loader communication is available only while RZ100/400 are powered.)
Download the software from the official RKC website.

- **IP66 waterproof and dustproof protection for severe environments (option)**

Waterproof and dustproof construction (IP66) applies to the front part of the instrument when properly installed on the panel.

1.2 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)

Accessories	Q'TY	Remarks
☐ Instrument	1	————
☐ Mounting bracket (with screw)	2	————
☐ RZ100/RZ400 Instruction Manual (IMR02Y02-E☐)	1	Enclosed with RZ100/400 (for English)
☐ **RZ100/RZ400 Instruction Manual** **(IMR02Y05-E4)**	1	This manual (sold separately); This manual can be downloaded from the official RKC website.
☐ Gasket KRB100-39 (RZ100) KFB400-36 (RZ400)	1	Option (Waterproof/Dustproof type)
☐ Terminal cover KCA100-517 (RZ100) KFB400-58 (RZ400)	1	Option (sold separately)
☐ Front cover KRB100-315 (RZ100) [Soft cover] KRB100-36 (RZ100) [Hard cover] KRB400-36 (RZ400) [Hard cover]	1	Option (sold separately)
☐ CT (Current transformer for Heater break alarm) CTL-6-P-N [for 0 to 30 A] or CTL-12-S56-10L-N [for 0 to 100 A]	Depending on the order quantity	Option (sold separately)

If any of the above are missing, damaged, or if your manual is incomplete, please contact RKC sales office or the agent.

1.3 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

RZ100
RZ400 −□ □ □∗□ □ □ /□−□ □□□
(1) (2) (3) (4) (5) (6) (7) (8) (9)

Specification		Suffix code								
		Mandatory							Option	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Output 1 (OUT1)	None	N								
	Relay contact output	M								
	Voltage pulse output	V								
	Current output (0 to 20 mA DC)	7								
	Current output (4 to 20 mA DC)	8								
Output 2 (OUT2)	None		N							
	Relay contact output		M							
	Voltage pulse output		V							
	Current output (0 to 20 mA DC)		7							
	Current output (4 to 20 mA DC)		8							
Output 3 (OUT3)	None			N						
	Relay contact output			M						
Current transformer (CT) input (Option)	None				N					
	CTL-6-P-N (2 points)				T					
	CTL-12-S56-10L-N (2 points)				U					
Communication function (Option)	None					N				
	RS-485 (RKC communication)					5				
	RS-485 (Modbus)					6				
Waterproof/Dustproof (Option)	None						N			
	Waterproof/Dustproof (IP66)						1			
Quick start code	Quick start code not specified [1]							N		
	Specify quick start code 1 [2]							1		
	Specify quick start code 1 and 2							2		
Control method [Quick start code 1]	No specify quick start code								No code	
	PID control with AT (Reverse action)								F	
	PID control with AT (Direct action)								D	
	Heat/Cool PID control with AT								G	
	Heat/Cool PID control with AT (for Extruder [air cooling])								A	
	Heat/Cool PID control with AT (for Extruder [water cooling])								W	
Measured input and Range [Quick start code 1]	No specify quick start code									No code
	Refer to Input Range Code Table									□□□

[1] If Quick start code is not specified, control action, input range and outputs are factory configured as follows depending on with or without outputs.

	With/Without output(s)				Factory setting				
	Output 1 (OUT1)	Output 2 (OUT2)	Output 3 (OUT3)		Control method code	Range code	Output 1 (OUT1)	Output 2 (OUT2)	Output 3 (OUT3)
1	×	–	–	→	F	K02	Control output (heat-side)	–	–
2	×	×	–	→	A	K02	Control output (heat-side)	Control output (cool-side)	–
3	×	–	×	→	F	K02	Control output (heat-side)	–	Alarm 1 output (Deviation high)
4	×	×	×	→	A	K02	Control output (heat-side)	Control output (cool-side)	Alarm 1 output (Deviation high)
5	–	×	–	→	F	K02	–	Alarm 1 output (Deviation high)	–
6	–	×	×	→	F	K02	–	Alarm 1 output (Deviation high)	Alarm 2 output (Deviation high)
7	–	–	×	→	F	K02	–	–	Alarm 1 output (Deviation high)
8	–	–	–	→	F	K02	–	–	–

×: with output　　–: without output

[2] If Quick start code 1 is specified, output contents are configured as follows depending on with or without output(s). (Content of range code is not limited)

	With/Without output(s)			User specified setting			Factory setting		
	Output 1 (OUT1)	Output 2 (OUT2)	Output 3 (OUT3)	Control method code	Range code		Output 1 (OUT1)	Output 2 (OUT2)	Output 3 (OUT3)
1	×	–	–	F or D	Specified code	→	Control output (heat-side)	–	–
2	×	×	–	F or D	Specified code	→	Control output (heat-side)	Alarm 1 output (Deviation high)	–
3	×	–	×	F or D	Specified code	→	Control output (heat-side)	–	Alarm 1 output (Deviation high)
4	×	×	×	F or D	Specified code	→	Control output (heat-side)	Alarm 1 output (Deviation high)	Alarm 2 output (Deviation high)
5	–	×	–	F or D	Specified code	→	–	Alarm 1 output (Deviation high)	–
6	–	×	×	F or D	Specified code	→	–	Alarm 1 output (Deviation high)	Alarm 2 output (Deviation high)
7	–	–	×	F or D	Specified code	→	–	–	Alarm 1 output (Deviation high)
8	–	–	–	F or D	Specified code	→	–	–	–
9	×	×	–	G, A or W	Specified code	→	Control output (heat-side)	Control output (cool-side)	–
10	×	×	×	G, A or W	Specified code	→	Control output (heat-side)	Control output (cool-side)	Alarm 1 output (Deviation high)

×: with output　　–: without output

To use alarm output, relay contact output must be specified.

Input Range Code Table

● Thermocouple (TC) input

Input type	Code	Range
K	K01	0 to 200 °C
	K02	0 to 400 °C
	K03	0 to 600 °C
	K04	0 to 800 °C
	K05	0 to 1000 °C
	K06	0 to 1200 °C
	K07	0 to 1372 °C
	K09	0.0 to 400.0 °C
	K10	0.0 to 800.0 °C
	K13	0 to 100 °C
	K14	0 to 300 °C
	K17	0 to 450 °C
	K20	0 to 500 °C
	K41	−200 to +1372 °C
	K43	−199.9 to +400.0 °C
	KA1	0 to 800 °F
	KA2	0 to 1600 °F
	KA3	0 to 2502 °F
	KC8	−100.0 to +752.0 °F
J	J01	0 to 200 °C
	J02	0 to 400 °C
	J03	0 to 600 °C
	J04	0 to 800 °C
	J05	0 to 1000 °C
	J06	0 to 1200 °C
	J07	−199.9 to +300.0 °C
	J10	0 to 450 °C
	JA1	0 to 800 °F
	JA2	0 to 1600 °F
	JA3	0 to 2192 °F
	JA6	0 to 400 °F

Input type	Code	Range
J	JA7	0 to 300 °F
	JB9	−328 to +2192 °F
	JC8	−199.9 to +550.0 °F
T	T01	−199.9 to +400.0 °C
	T02	−199.9 to +100.0 °C
	T03	−100.0 to +200.0 °C
	T04	0.0 to 350.0 °C
	T05	−199.9 to +300.0 °C
	T06	0.0 to 400.0 °C
R	R01	0 to 1600 °C
	R02	0 to 1769 °C
	R04	0 to 1350 °C
	RA1	0 to 3200 °F
S	S01	0 to 1600 °C
	S02	0 to 1769 °C
B	B01	400 to 1800 °C
	B02	0 to 1820 °C
E	E01	0 to 800 °C
	E02	0 to 1000 °C
N	N01	0 to 1200 °C
W5Re/W26Re	W01	0 to 2000 °C
	W02	0 to 2320 °C
	WA1	0 to 4000 °F
PL II	A01	0 to 1300 °C
	A02	0 to 1390 °C
	A03	0 to 1200 °C
	AA1	0 to 2400 °F
	AA2	0 to 2534 °F
U	U01	−199.9 to +600.0 °C
L	L01	0 to 400 °C

● RTD input

Input type	Code	Range
Pt100	D01	−199.9 to +649.0 °C
	D02	−199.9 to +200.0 °C
	D03	−100.0 to +50.0 °C
	D04	−100.0 to +100.0 °C
	D05	−100.0 to +200.0 °C
	D06	0.0 to 50.0 °C
	D07	0.0 to 100.0 °C
	D08	0.0 to 200.0 °C
	D09	0.0 to 300.0 °C
	D10	0.0 to 500.0 °C
	DA1	−199.9 to +999.9 °F
	DA3	−199.9 to +200.0 °F
	DA4	−199.9 to +100.0 °F
	DA5	−199.9 to +300.0 °F
	DA6	0.0 to 100.0 °F
	DA8	0.0 to 400.0 °F
	DA9	0.0 to 500.0 °F
	DB2	−199.9 to +900.0 °F
JPt100	P01	−199.9 to +649.0 °C
	P02	−199.9 to +200.0 °C
	P04	−100.0 to +100.0 °C
	P05	−100.0 to +200.0 °C
	P06	0.0 to 50.0 °C
	P07	0.0 to 100.0 °C
	P08	0.0 to 200.0 °C
	P09	0.0 to 300.0 °C
	P10	0.0 to 500.0 °C

■ Quick start code 2 (Initial setting code)

Quick start code 2 tells the factory to ship with each parameter preset to the values detailed as specified by the customer. Quick start code 2 is not necessarily specified when ordering, unless the preset is requested. These parameters are software selectable items and can be re-programmed in the field following procedures found in the manual.

□ □ –□ –□ □ –□ □
(A) (B) (C) (D) (E) (F) (G)

Specifications		Quick start code 2 (Initial setting code)						
		(A)	(B)	(C)	(D)	(E)	(F)	(G)
Alarm 1 type	None	N						
	Deviation high	A						
	Deviation low	B						
	Deviation high/low	C						
	Band	D						
	Deviation high with hold action	E						
	Deviation low with hold action	F						
	Deviation high/low with hold action	G						
	Process high	H						
	Process low	J						
	Process high with hold action	K						
	Process low with hold action	L						
	Deviation high with re-hold action	Q						
	Deviation low with re-hold action	R						
	Deviation high/low with re-hold action	T						
	Band (High/Low individual setting)	U						
	SV high	V						
	SV low	W						
	Deviation high/low (High/Low individual setting)	X						
	Deviation high/low with hold action (High/Low individual setting)	Y						
	Deviation high/low with re-hold action (High/Low individual setting)	Z						
	Monitor during RUN	4						
Alarm 2 type	None		N					
	Alarm 2 (The code is same as Alarm 1 type)		□					
	Control loop break alarm (LBA) [1]		2					
Control output assignment	PID control: Output 1 (OUT1) Heat/Cool PID control: Heat-side control output: Output 1 (OUT1) Cool-side control output: Output 2 (OUT2)			1				
	PID control: Output 2 (OUT2) Heat/Cool PID control: Heat-side control output: Output 2 (OUT2) Cool-side control output: Output 1 (OUT1)			2				
Output assignment of Alarm 1 [2]	No assignment				N			
	Output 1 (OUT1)				1			
	Output 2 (OUT2)				2			
	Output 3 (OUT3)				3			
Output assignment of Alarm 2 [2]	No assignment					N		
	Output 1 (OUT1)					1		
	Output 2 (OUT2)					2		
	Output 3 (OUT3)					3		
Output assignment of Heater break alarm 1 [2]	No assignment						N	
	Output 1 (OUT1)						1	
	Output 2 (OUT2)						2	
	Output 3 (OUT3)						3	
Output assignment of Heater break alarm 2 [2]	No assignment							N
	Output 1 (OUT1)							1
	Output 2 (OUT2)							2
	Output 3 (OUT3)							3

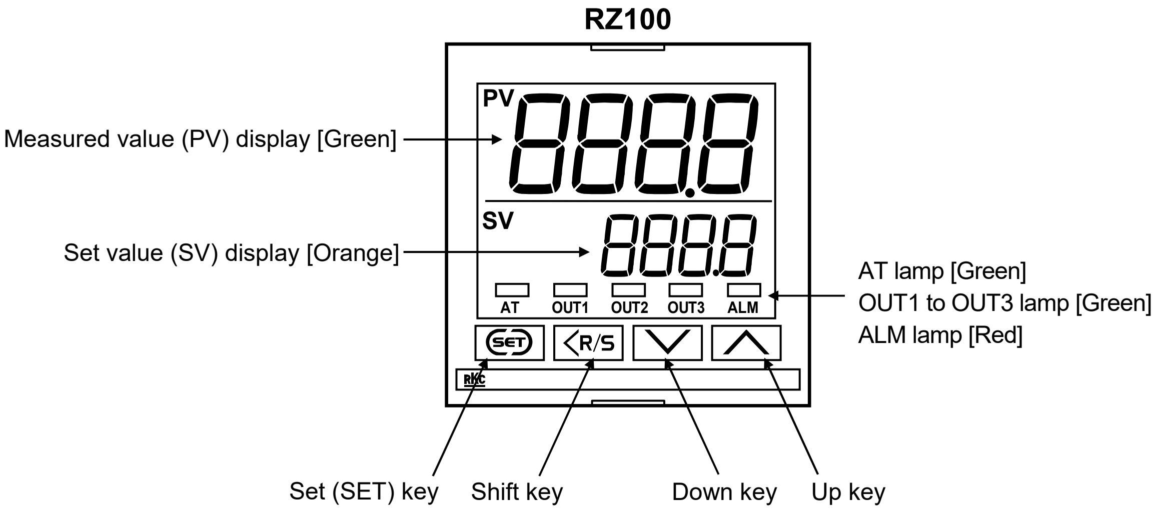
[1] Control loop break alarm (LBA) can be specified only for Alarm 2.

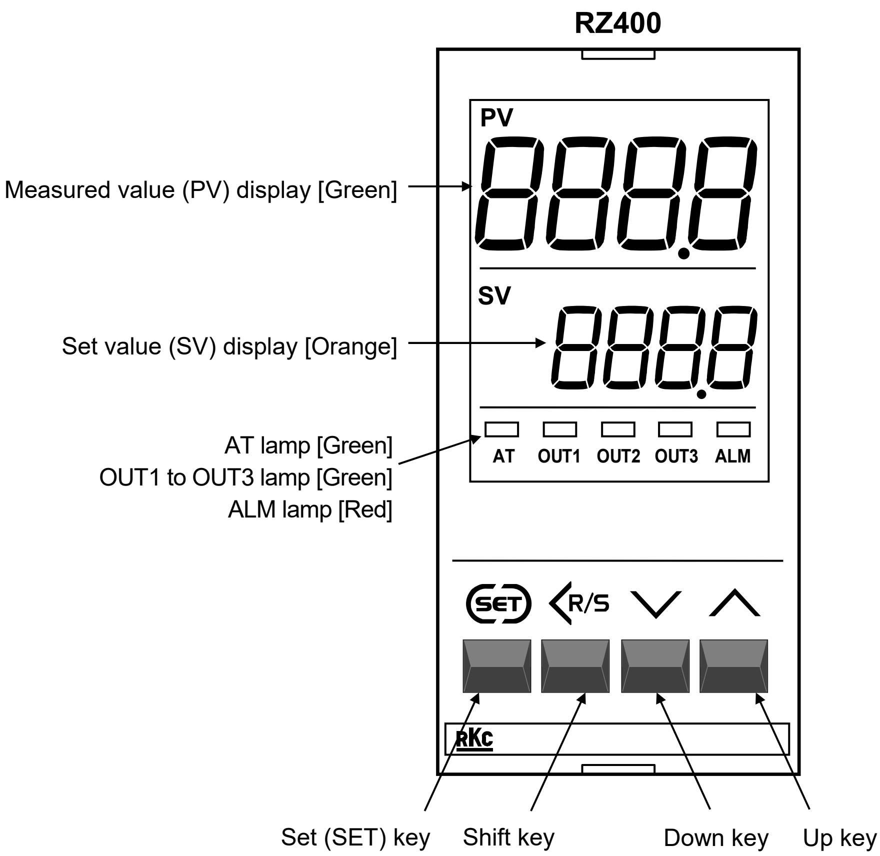
[2] Alarm output assignment cannot overlap the control output assignment.

1.4 Parts Description

This section describes various display units and the key functions.

■ Front Panel View





● Display units

Measured value (PV) display [Green]	Displays Measured value (PV) or various parameter symbols.
Set value (SV) display [Orange]	Displays Set value (SV) or various parameter set values.

● Indication lamps

AT lamp [Green]	• Flashes when Autotuning (AT) is activated. (After AT is completed: AT lamp will go out) • Lights during Startup tuning (ST) execution. (After ST is completed: AT lamp will go out)
OUT1 lamp [Green]	Lights when Output 1 (OUT1) is turned on.*
OUT2 lamp [Green]	Lights when Output 2 (OUT2) is turned on.*
OUT3 lamp [Green]	Lights when Output 3 (OUT3) is turned on.*
ALM lamp [Red]	Lights when Alarm 1, Alarm 2, Heater break alarm 1 or Heater break alarm 2 is turned on.

* Lamp indication becomes as follows for current output: For an output of less than 0 %: Extinguished
For an output of more than 100 %: Lit
For an output of more than 0 % but less than 100 %: Dimly lit.

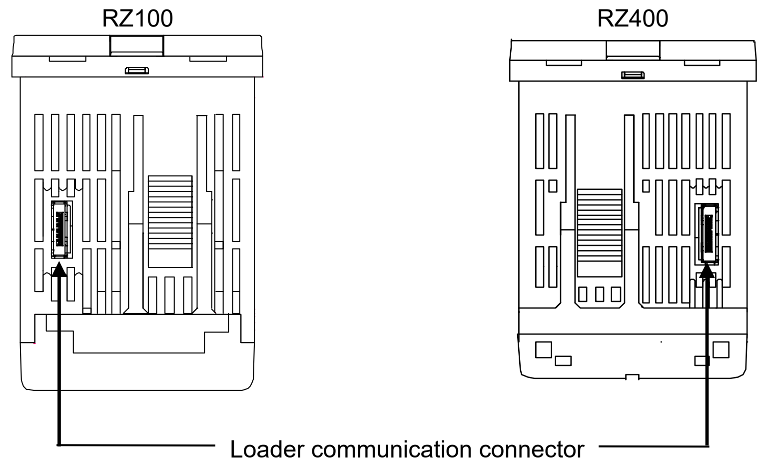
● Operation keys

SET	Set (SET) key	Used for calling up parameters and set value registration.
<R/S	Shift key	Shifts digits when settings are changed. Used to switch monitor items, RUN/STOP, and modes.
∨	Down key	Decreases numerals.
∧	Up key	Increases numerals.

NOTE

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

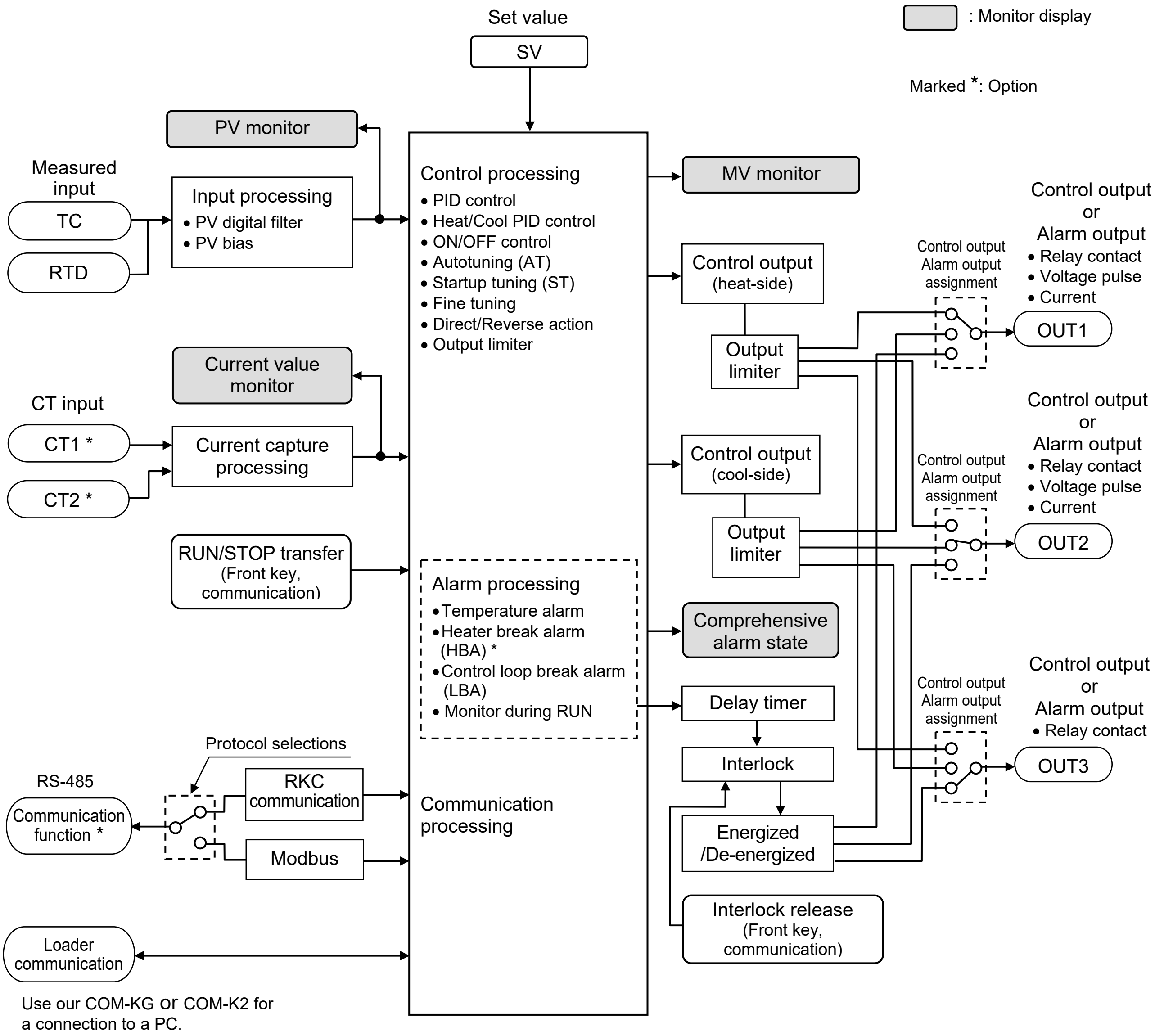
■ Bottom View



Loader communication connector	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-KG or COM-K2 (sold separately) [1]. Our communication software [2] must be installed on the PC. (Loader communication is available only while RZ100/400 are powered.) [1] For the COM-KG or COM-K2, refer to the official RKC website. [2] Only available as a download from the official RKC website.

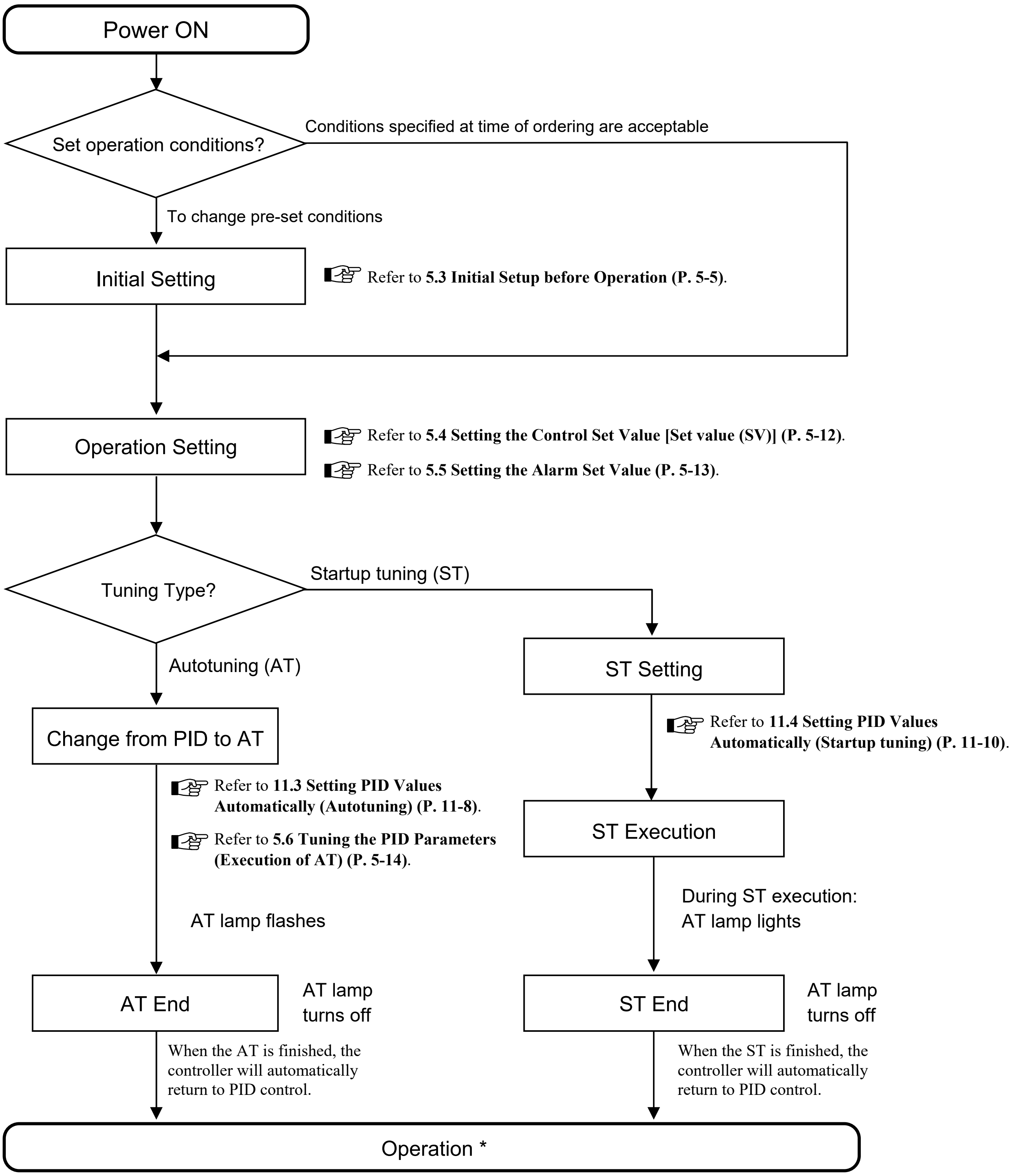
1.5 Input/Output and Function Blocks

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



1.6 Handling Procedure to Operation

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



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

MEMO

MOUNTING 2

This chapter describes 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. **(IEC 61010-1)**
[OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2]

(2) Use this instrument within the following environment conditions:
- Allowable ambient temperature: −10 to +55 °C
- 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
  Short-term temporary overvoltage: 1440 V
  Long-term temporary overvoltage: 490 V

(3) Avoid the following conditions when selecting the mounting location:
- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

(4) Mount this instrument in the panel considering the following conditions:
- Provide adequate ventilation space so that heat does not build up.
- Ensure at least 50 mm space on top and bottom of the instrument for maintenance and environmental reasons.
- Do not mount this instrument directly above the equipment that generates large amount of heat (heaters, transformers, thyristor units, large-wattage resistors.)
- If the ambient temperature rises above 55 °C, cool this instrument with a forced air cooling fan, cooling unit, 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.
- For correct functioning mount this instrument in a horizontal position.

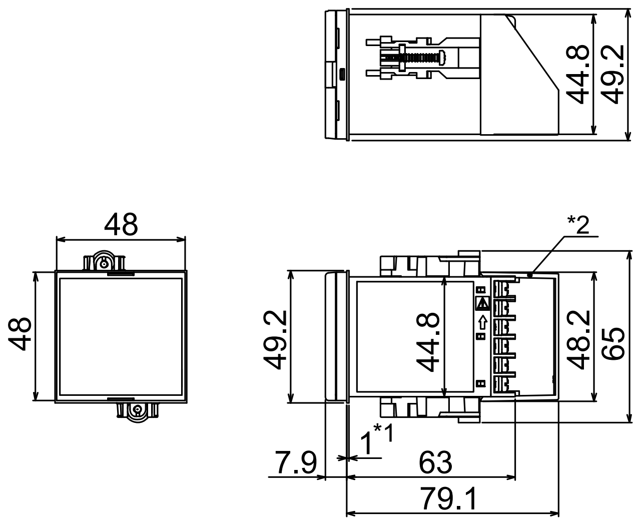
(5) In case this instrument is connected to a supply by means of a permanent connection, a switch or circuit-breaker shall be included in the installation. This shall be in close proximity to the equipment and within easy reach of the operator. It shall be marked as the disconnecting device for the equipment.

2.2 Dimensions

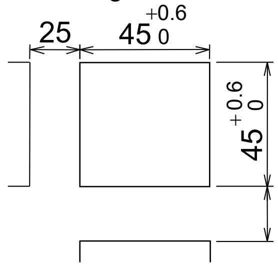
Panel thickness: 1 to 10 mm
(When mounting multiple instruments close together, the panel strength should be checked to ensure proper support.)

■ RZ100

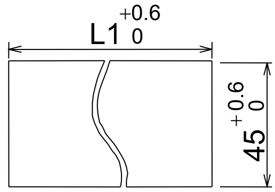
(Unit: mm)



Individual mounting *3



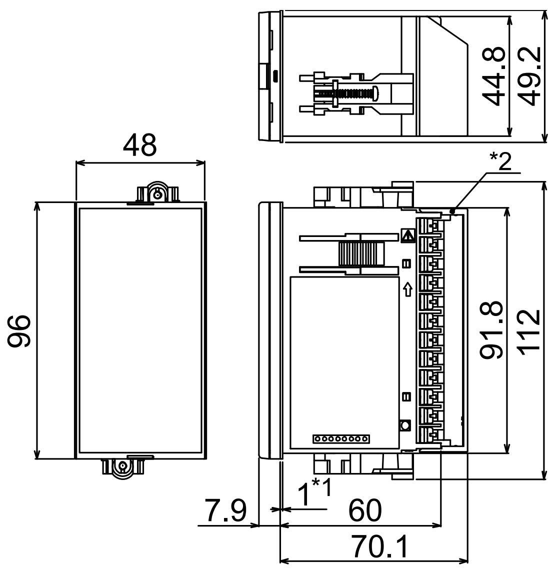
Close horizontal mounting *4



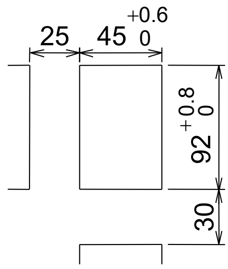
L1 = 48 × n – 3
n = Number of controllers (2 to 6)

■ RZ400

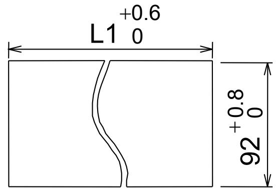
(Unit: mm)



Individual mounting *3



Close horizontal mounting *4



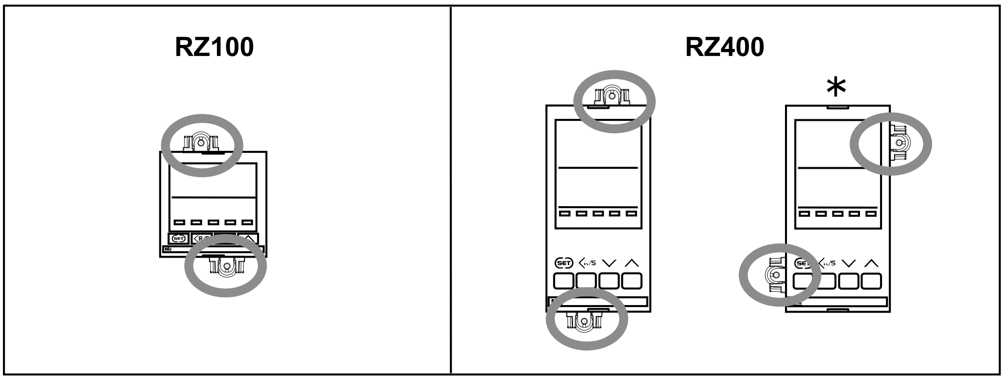
L1 = 48 × n – 3
n = Number of controllers (2 to 6)

*1 Gasket (option) [Waterproof/Dustproof]
*2 Terminal cover (option) [sold separately]
*3 To keep the instrument as waterproof as possible, make sure that the panel surface has no burr or distortion where the hole is to be cut out.
*4 Remove the gasket. When multiple RZ100/400 are mounted close to one another IP66 water-proof protection will no longer assured.

2.3 Procedures of Mounting and Removing

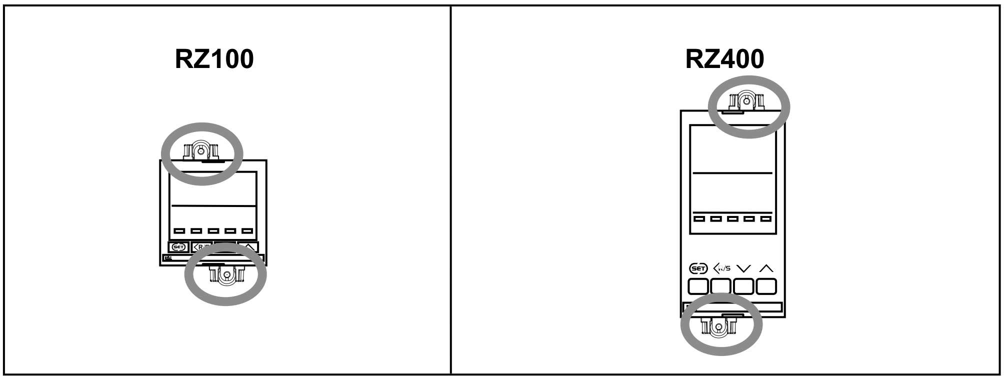
■ The mounting position of the mounting brackets

● Mounting positions for a single controller



* If mounting brackets are installed on the sides of the Waterproof/Dustproof type controller as shown in the figure (marked with ∗), sufficient Waterproof/Dustproof performance cannot be obtained.

● Mounting positions for close mounting

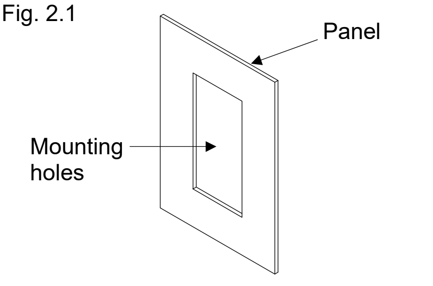


When two or more controllers are mounted closely, the optional waterproof/dustproof feature is no longer assured.

■ Mounting procedures (Standard type)

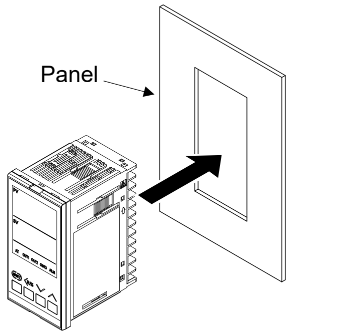
1. Prepare the panel cutout as specified in Fig. 2.1.
(Panel thickness: 1 to 10 mm)
Refer to **2.2 Dimensions (P. 2-3)**.

Fig. 2.1



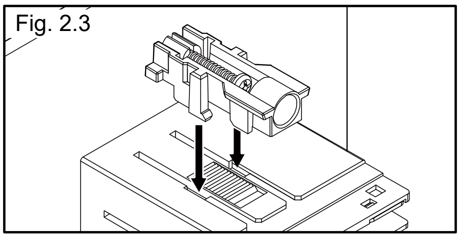
2. Insert the instrument through the panel cutout. (Fig. 2.2)

Fig. 2.2



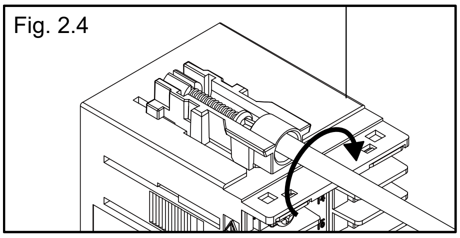
3. Insert the mounting bracket into the mounting groove of the instrument. (Fig. 2.3)
Do not push the bracket forcibly forward.

Fig. 2.3



4. Tighten up the screw for the mounting bracket with a Phillips screwdriver so that the mounting bracket is firmly secured in place. (Fig. 2.4)
Give the screw another turn when the tip of the screw touches the panel.

Fig. 2.4



Do not overtighten the screw. It may turn idle.
In case the screw has been overtightened to turn idle, loosen the screw, then tighten the screw again until the instrument is firmly fixed.

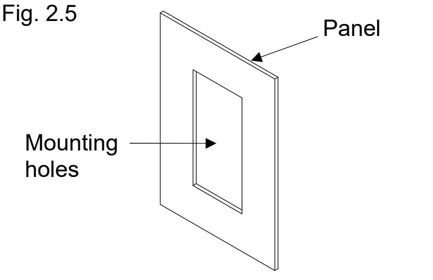
5. The other mounting bracket should be installed in the same way as described in ***3*** and ***4.***

■ Mounting procedures (Waterproof/Dustproof type)

The front of the instrument conforms to **IP66** [Specify when ordering] when mounted on the panel. For effective Waterproof/Dustproof, the gasket must be securely placed between the instrument and the panel without any gap. If gasket is damaged, please contact RKC sales office or the agent.

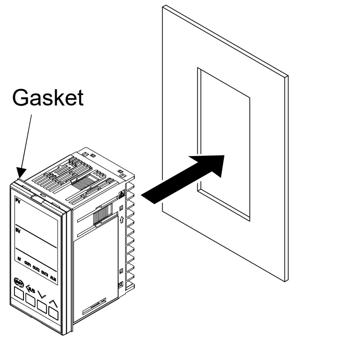
1. Prepare the panel cutout as specified in Fig. 2.5.
(Panel thickness: 1 to 10 mm)
Refer to **2.2 Dimensions (P. 2-3)**.

Fig. 2.5



2. Set the waterproof/dustproof gasket (option) on the case from the back side of the instrument as shown in Fig. 2.6.
Insert the instrument through the panel cutout.

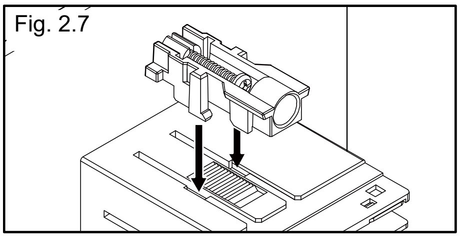
Fig. 2.6



3. Insert the mounting bracket into the mounting groove of the instrument. (Fig. 2.7)
Do not push the bracket forcibly forward.

NOTE
For waterproof and dustproof protection, two mounting brackets must be placed on the top and the bottom side of the instrument. If the mounting brackets are placed on the sides of the controller, waterproof and dustproof protection will not be guaranteed.

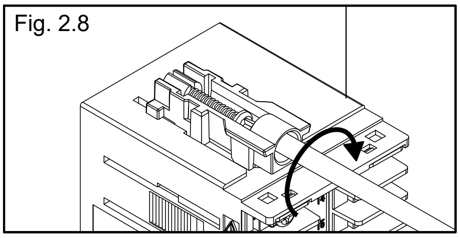
Fig. 2.7



4. Tighten up the screw for the mounting bracket with a Phillips screwdriver so that the mounting bracket is firmly secured in place. (Fig. 2.8)
Give the screw another turn when the tip of the screw touches the panel.

Do not overtighten the screw. It may turn idle.
In case the screw has been overtightened to turn idle, loosen the screw, then tighten the screw again until the instrument is firmly fixed.

Fig. 2.8



5. The other mounting bracket should be installed in the same way as described in ***3*** and ***4.***

☞ For replacing of the gasket, refer to **APPENDIX A.2 Replacing the Waterproof/Dustproof Gasket (Option) (P. A-7)**.

■ Removal procedures

1. Turn the power OFF.

2. Remove the wiring.

3. Loosen the screw of the mounting bracket.

4. Hold the rear of the mounting bracket (Fig.2.9), and lift up one side to remove it from the case. (Fig. 2.10)

5. The other mounting bracket(s) should be removed in the same way as described in ***3*** and ***4***.

Fig. 2.9

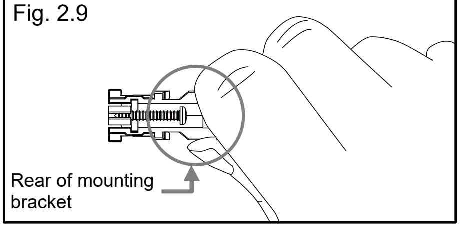
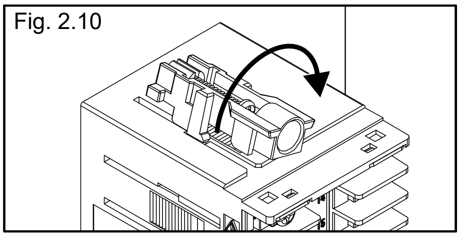
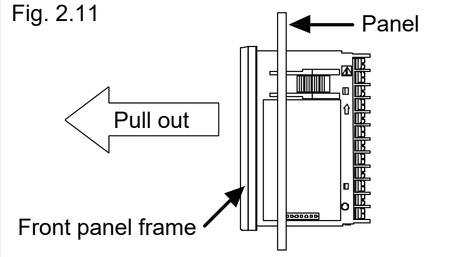


Fig. 2.10

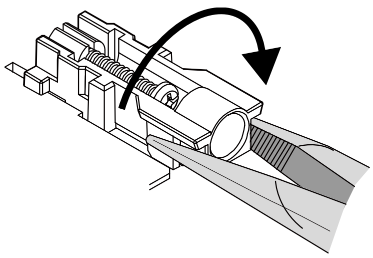


6. Pull out the instrument from the mounting cutout while holding the front panel frame of this instrument. (Fig. 2.11)

Fig. 2.11



Use long-nose pliers to remove mounting brackets from the instrument that is installed in a narrow place or installed tightly in a vertical position.



MEMO

WIRING

3

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

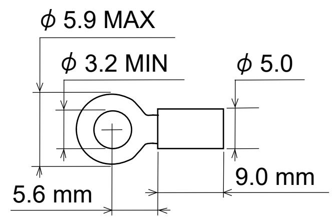
3.1 Wiring Cautions

⚠ 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 after 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 provided with an overcurrent protection device (fuse). If a fuse is required for safety, install a fuse close to the instrument.
  Fuse type: Time-lag fuse
  Fuse rating: Rated voltage 250 V, Rated current 1 A
- Use the solderless terminal appropriate to the screw size.
  Screw size: M3 × 7 (With 5.8 × 5.8 square washer)
  Recommended tightening torque:
  0.4 N・m (4 kgf・cm)
  Applicable wire: Solid/twisted wire of 0.25 to 1.65 mm^2
  Specified dimension: Refer to Fig. 3.1
  Specified solderless terminals:
  Circular terminal with isolation V1.25-MS3
  (M3 screw, width 5.6 mm, hole diameter 3.2 mm)

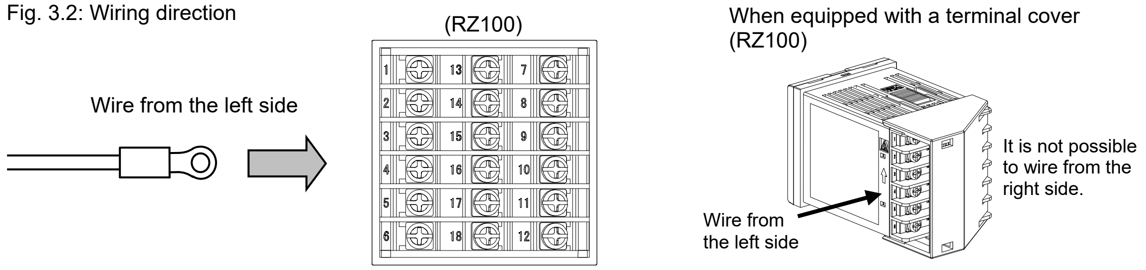
Fig. 3.1



- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.

- When wiring RZ100/RZ400, wire from the left direction toward the backside terminals as shown in Fig. 3.2.
  For RZ100, the wiring surfaces of the central and the right side lines of terminals are inclined to make it easier to wire from the left side.
  When using the terminal cover (Figs. 3.2, 3.4), it is not possible to wire from the right side.
  When wiring from the left and right with a close mounting, there are cases where adjacent instruments cannot be wired.

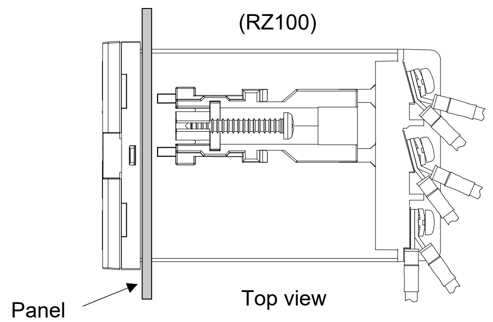
Fig. 3.2: Wiring direction



(RZ100 is used in the example shown, but the wiring directions are the same for RZ400.)

- Up to two solderless terminal lugs can be connected to one terminal screw.
  However, **reinforced insulation cannot be assured in this case.**

Fig. 3.3: Image of how to bend each solderless terminal lug

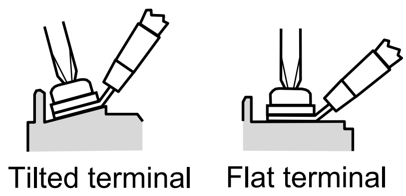


(RZ100 is used in the example shown, but restrictions for crossover wiring are the same for RZ400.)

📖 If solderless terminal lugs other than the recommended dimensions are used, terminal screws may not tighten. In that case, bend each solderless terminal lug before wiring.
If the terminal screw is forcibly tightened, it may be damaged.

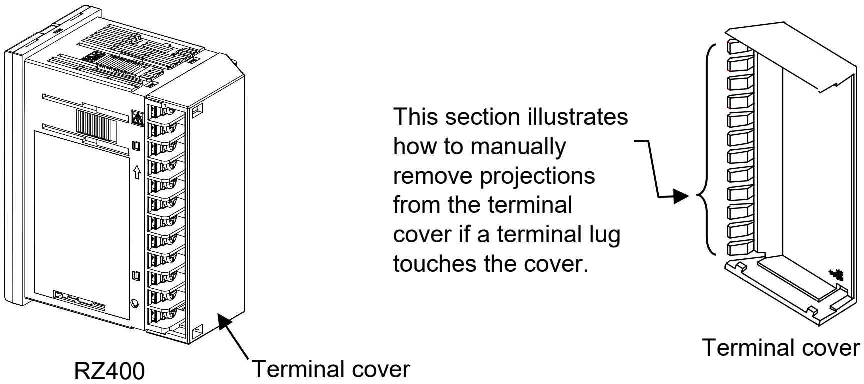
📖 In case of RZ100, if two solderless terminal lugs are connected to one terminal screw, a terminal cover cannot be used.

📖 When tightening a screw of the instrument, make sure to fit the screwdriver properly into the screw head mounted tilted or flat as shown in the right figure. Tightening the screw with excessive torque may damage the screw thread.



- Caution for using the terminal cover:
  - To prevent electric shock or instrument failure, always turn off the power before mounting or removing the terminal cover.
  - When mounting and removing the terminal cover, apply pressure very carefully to avoid damage to the terminal cover.
  - If a solderless terminal lug touches the RZ400 terminal cover, remove the projection from the terminal cover by manually bending it back and forth until it breaks off.
    (Fig. 3.4)

Fig. 3.4: Image of how to close the terminal board with the terminal cover and to remove projections.
(Only RZ400)



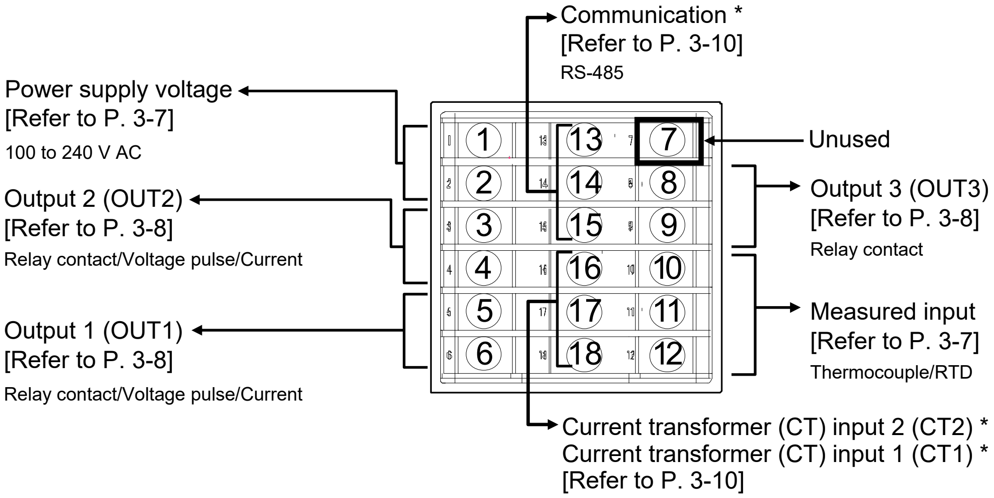
☞ For the mounting and removing of the terminal cover, refer to **3.4 Handling of the Terminal Cover (Option) (P. 3-11)**.

3.2 Terminal Layout

The terminal layout is as follows.

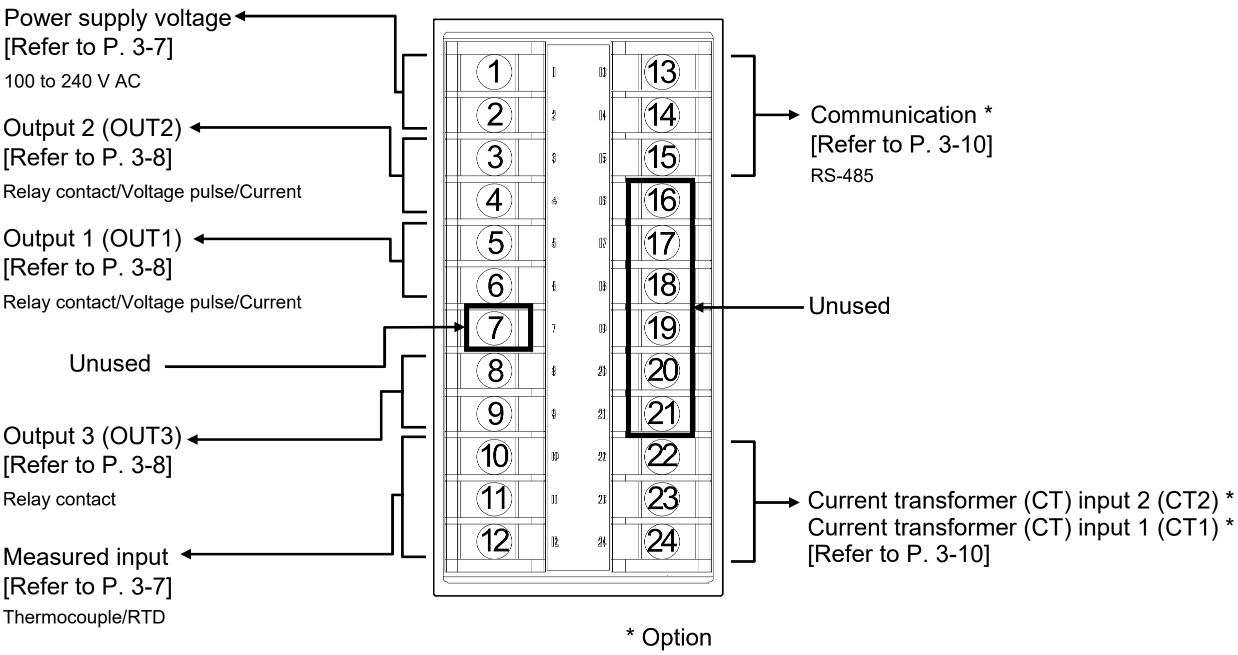
To prevent malfunctioning, do not connect wires to unused terminals.

■ RZ100



* Option

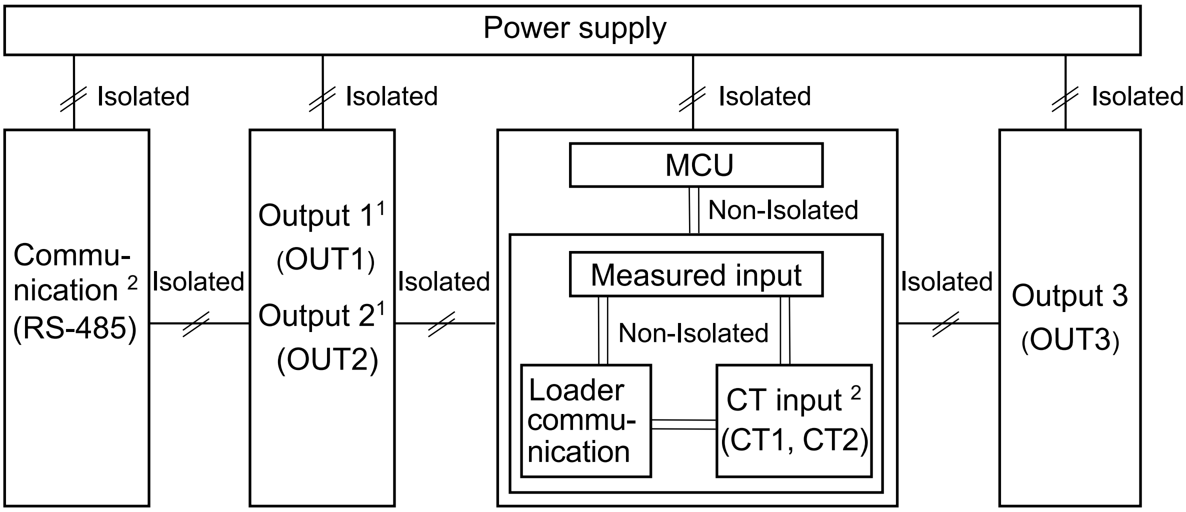
■ RZ400



* Option

■ Isolations of input and output

For the Input/Output isolation block of this instrument, refer to the following:



[1] Outputs are isolated if OUT1 or OUT2 is “relay contact output.” If both outputs are not “relay contact output,” outputs are not isolated.

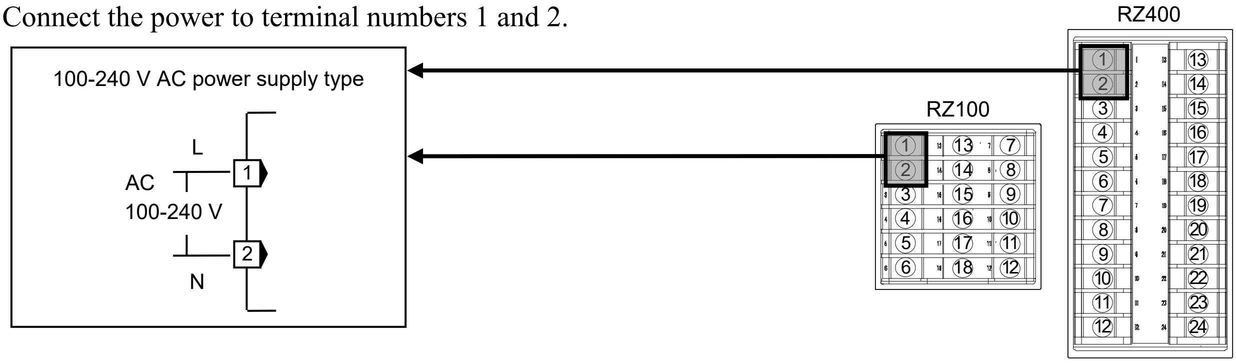
[2] Current transformer input and communication are optional functions.

3.3 Wiring of Each Terminal

Always check the polarity of each terminal prior to wiring.

■ Power supply

- Connect the power to terminal numbers 1 and 2.



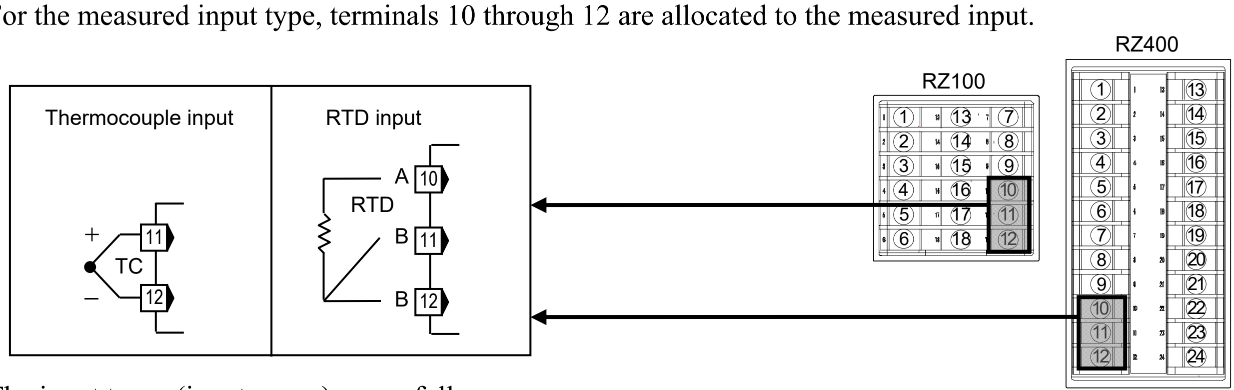
- Power supply voltage for the controller must be within the range shown below.

Power supply type	Power consumption
85 to 264 V AC (including voltage variation) [Rating: 100 to 240 V AC] Power supply frequency: 50/60 Hz	RZ100: 5.1 VA max. (at 100 V AC) 7.6 VA max. (at 240 V AC) RZ400: 5.9 VA max. (at 100 V AC) 8.4 VA max. (at 240 V AC)

- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not provided with an overcurrent protection device (fuse). If a fuse is required for safety, install a fuse close to the instrument.
  Fuse type: Time-lag fuse
  Fuse rating: Rated voltage 250 V, Rated current 1 A

■ Measured input (Thermocouple/RTD)

- For the measured input type, terminals 10 through 12 are allocated to the measured input.



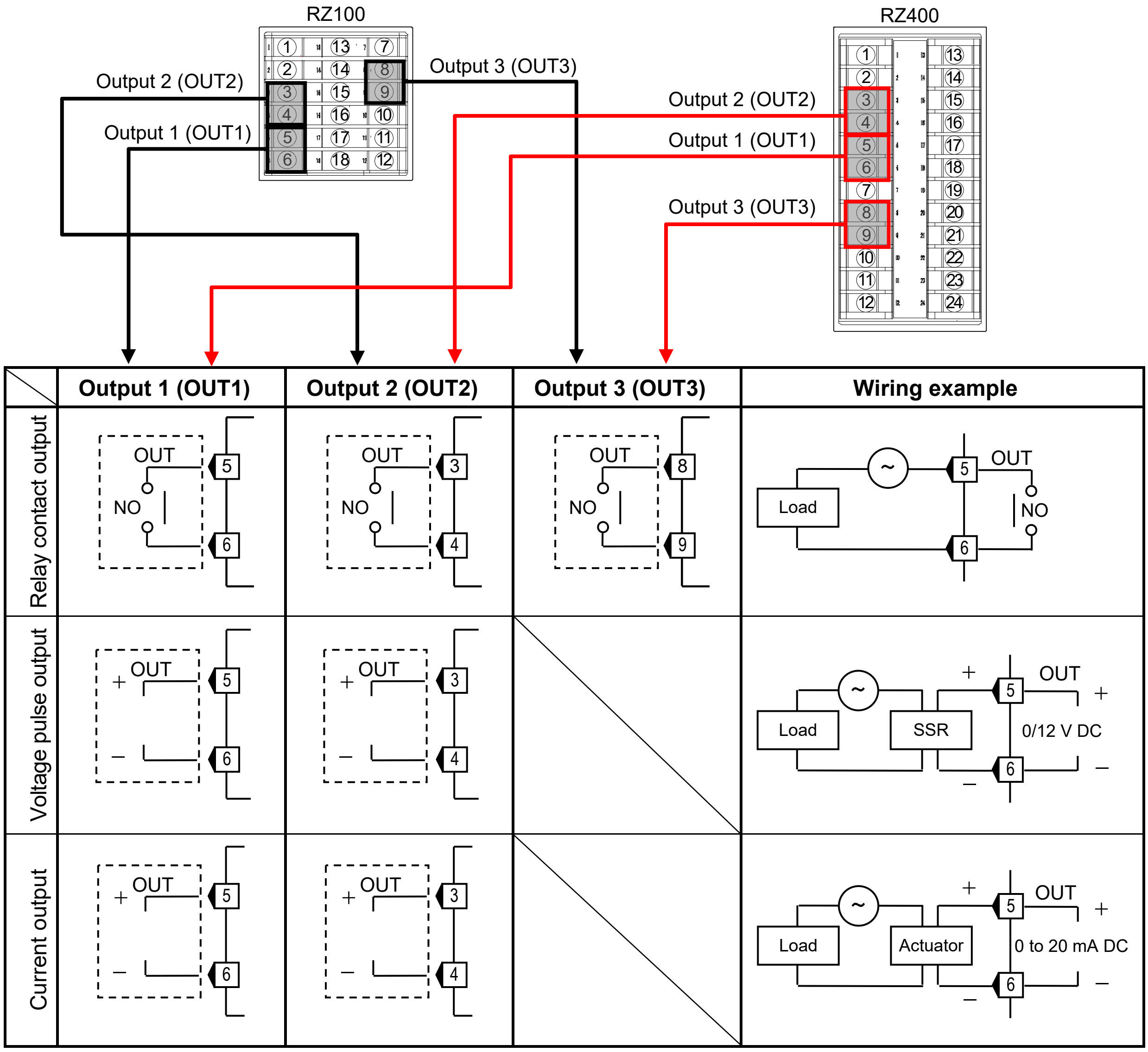
- The input types (input group) are as follows.

Input group	Input type
Thermocouple (TC) input	K, J, T, S, R, E, B, N (JIS C1602-1995), PLII (NBS), W5Re/W26Re (ASTM-E988-96), U, L (DIN43710-1985)
RTD input	Pt100 (JIS C1604-1997), JPt100 (JIS C1604-1997, JIS C1604-1981 of Pt100)

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wires 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.

■ Output 1 (OUT1)/Output 2 (OUT2)/Output 3 (OUT3)

- Terminals 5 and 6 are for output 1 (OUT1); Terminals 3 and 4 are for output 2 (OUT2); Terminals 8 and 9 are for output 3 (OUT3).
- Connect an appropriate load according to the output type. (Specify when ordering)



: The dotted box diagram describes the output state inside the instrument.

- Outputs are isolated if output 1 (OUT1) or output 2 (OUT2) is “relay contact output.” If both outputs are “relay contact output,” outputs are not isolated.
- Number of outputs and output types must be specified when ordering. The specifications of each output are as follows.

Specification code			Output type	Specifications
OUT1	OUT2	OUT3		
N	N	N	None	
M	M	M	Relay contact output	Refer to the table on the next page.
V	V	—	Voltage pulse output	0/12 V DC (Allowable load resistance: 500 Ω or more)
7	7	—	Current output	0 to 20 mA DC (Allowable load resistance: 500 Ω or less)
8	8	—		4 to 20 mA DC (Allowable load resistance: 500 Ω or less)

When output type is a relay contact, specification may be different depending on the assigned output type.

<table>
<tr><th>Type</th><th>Output terminal</th><th>Output type</th><th>Specification of relay contact output</th></tr>
<tr><td>RZ100</td><td>Output 1 (OUT1)
Output 2 (OUT2)
Output 3 (OUT3)</td><td rowspan="2">Control output</td><td rowspan="2">Contact type: 1a contact
Contact rating (Resistive load): 250 V AC 3 A, 30 V DC 1 A
Electrical life: 100,000 times or more (Rated load)
Mechanical life: 20 million times or more (Switching: 300 times/min)</td></tr>
<tr><td>RZ400</td><td>Output 3 (OUT3)</td></tr>
<tr><td>RZ400</td><td>Output 1 (OUT1)
Output 2 (OUT2)</td><td>Control output</td><td>Contact type: 1a contact
Contact rating (Resistive load): 250 V AC 3 A, 30 V DC 1 A
Electrical life: 300,000 times or more (Rated load)
Mechanical life: 50 million times or more (Switching: 180 times/min)</td></tr>
<tr><td>RZ100</td><td rowspan="2">Output 1 (OUT1)
Output 2 (OUT2)
Output 3 (OUT3)</td><td rowspan="2">Alarm output, Heater break alarm output</td><td rowspan="2">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: 300 times/min)</td></tr>
<tr><td>RZ400</td></tr>
</table>

- It is possible to specify the following uses for output when ordering. (Output reassignment is possible after the receipt of the delivery.)

Output assignment list [for PID control]

<table>
<tr><th>Control output</th><th>Alarm 1 output</th><th>Alarm 2 output</th><th>Heater break alarm 1 (HBA1) output</th><th>Heater break alarm 2 (HBA2) output</th></tr>
<tr><td>No assignment</td><td colspan="2">Any one of outputs 1,2, and 3 (OUT1, 2, 3) *</td><td colspan="2">Not available</td></tr>
<tr><td>Output 1 (OUT1)</td><td colspan="4">Output 2 (OUT2) or Output 3 (OUT3) *</td></tr>
<tr><td>Output 2 (OUT2)</td><td colspan="4">Output 1 (OUT1) or Output 3 (OUT3) *</td></tr>
</table>

* Output assignment can be overlapped. Overlapped outputs are produced as *OR* output.

Output assignment list [for Heat/Cool PID control]

<table>
<tr><th colspan="2">Control output</th><th rowspan="2">Alarm 1 output</th><th rowspan="2">Alarm 2 output</th><th rowspan="2">Heater break alarm 1 (HBA1) output</th><th rowspan="2">Heater break alarm 2 (HBA2) output</th></tr>
<tr><th>Heat-side output</th><th>Cool-side output</th></tr>
<tr><td>No assignment</td><td>No assignment</td><td colspan="2">Any one of outputs 1,2, and 3 (OUT1, 2, 3) [1]</td><td colspan="2">Not available</td></tr>
<tr><td>Output 1 (OUT1)</td><td>Output 2 (OUT2)</td><td colspan="4">Output 3 (OUT3) [1]</td></tr>
<tr><td>Output 2 (OUT2)</td><td>Output 1 (OUT1)</td><td colspan="4">Output 3 (OUT3) [1]</td></tr>
<tr><td>Output 1 (OUT1)</td><td>Output 3 (OUT3) [2]</td><td colspan="4">Output 2 (OUT2) [1]</td></tr>
<tr><td>Output 2 (OUT2)</td><td>Output 3 (OUT3) [2]</td><td colspan="4">Output 1 (OUT1) [1]</td></tr>
</table>

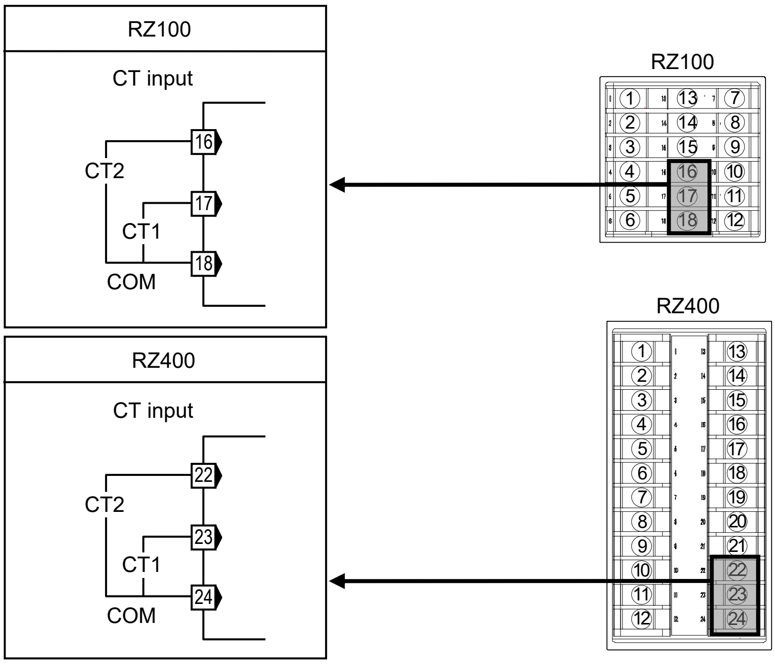
[1] Output assignment can be overlapped. Overlapped outputs are produced as *OR* output.

[2] When Output 3 (OUT3) is used on the RZ400 as a cool-side output, the operating life of the relay is shorter than that of Output 1 (OUT1) and Output 2 (OUT2).
(Refer to the **Specification of relay contact output** shown above.)

Heater break alarm (HBA) output is an optional function.

■ Current transformer (CT) input (option)

- Models that were specified with a current transformer (CT) when ordering can use the following terminal numbers.
  RZ100: Terminal No. 16 to 18 (CT1, CT2)
  RZ400: Terminal No. 22 to 24 (CT1, CT2)

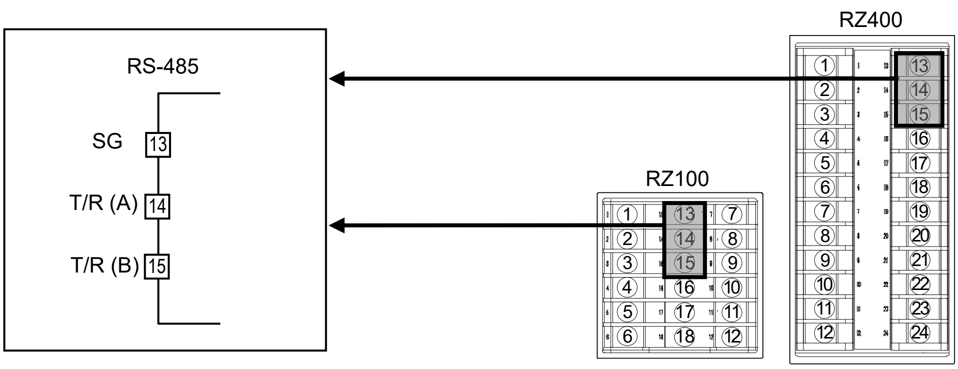


- When using CT input, connect CTs to the relevant terminals.
  Current transformer model code: CTL-6-P-N [Input range: 0 to 30 A] (sold separately)
  CTL-12-S56-10L-N [Input range: 0 to 100 A] (sold separately)
- Current transformer (CT) input is not isolated from the measured input.

If the current transformer (CT) was replaced, adjust the CT ratio. (Refer to P. 10-40)

■ Communication (option)

- With Communication function, terminals 13 through 15 are allocated to Communication.



For the wiring, refer to **12. COMMUNICATION FUNCTION (P. 12-1)**.

3.4 Handling of the Terminal Cover (Option)

When mounting and removing the terminal cover, take the following steps:

> **⚠ WARNING**
>
> To prevent electric shock or instrument failure, always turn off the power before mounting or removing the terminal cover.

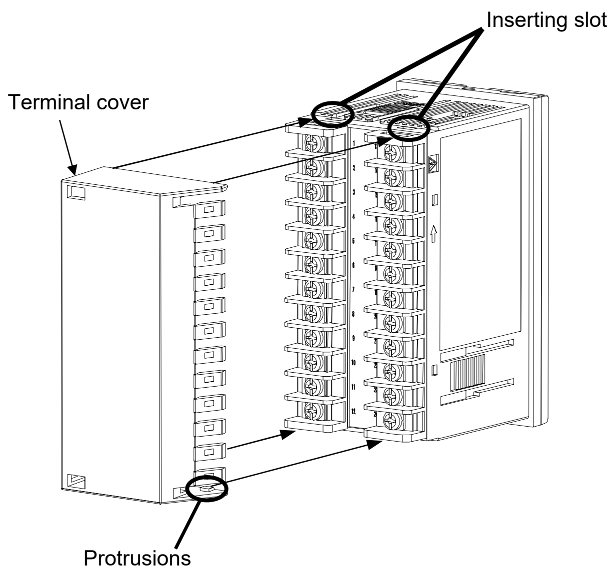
NOTE

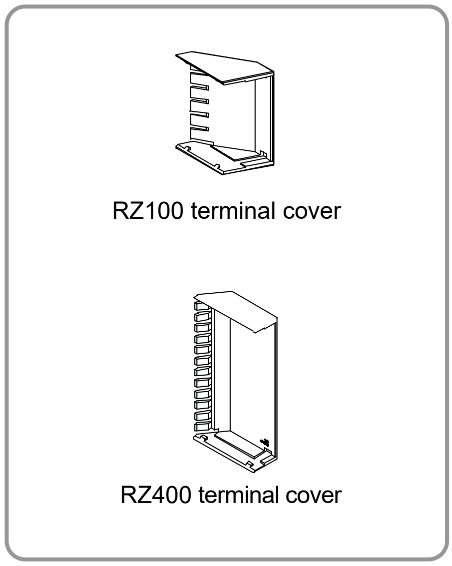
When mounting and removing the terminal cover, apply pressure very carefully to avoid damage to the terminal cover.

■ Mounting procedures

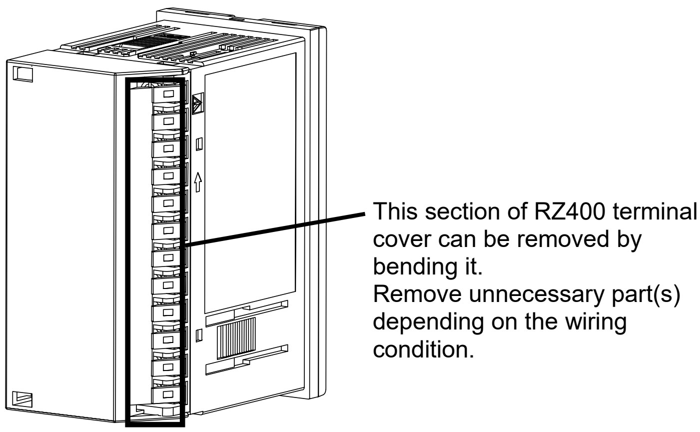
1. Check the mounting direction of the terminal cover.

2. Push the protrusions of terminal cover into the insertion slots for mounting the terminal cover.

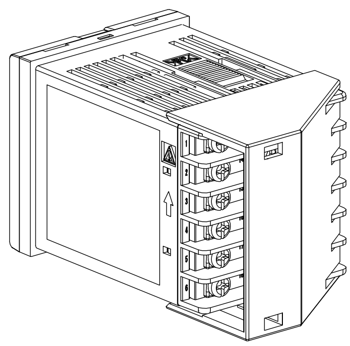




Drawing of RZ400 with terminal caver

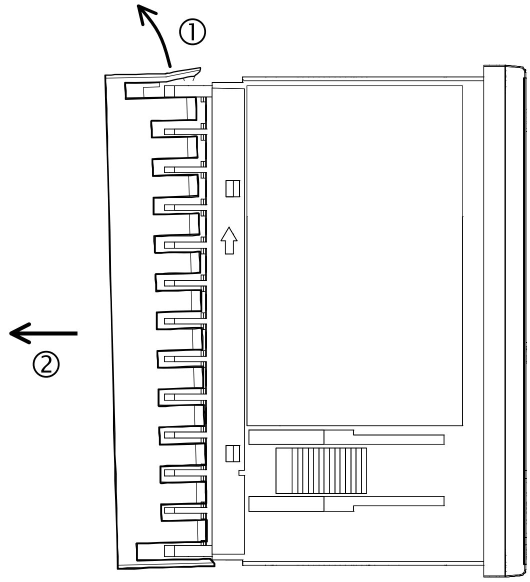


Drawing of RZ100 with terminal caver



■ Removing procedures

Release the protrusions of terminal cover from the insertion slots (①) shown in the following figure, and then pull the terminal cover (②) to remove it from the case.



BASIC OPERATION AND PARAMETER LIST

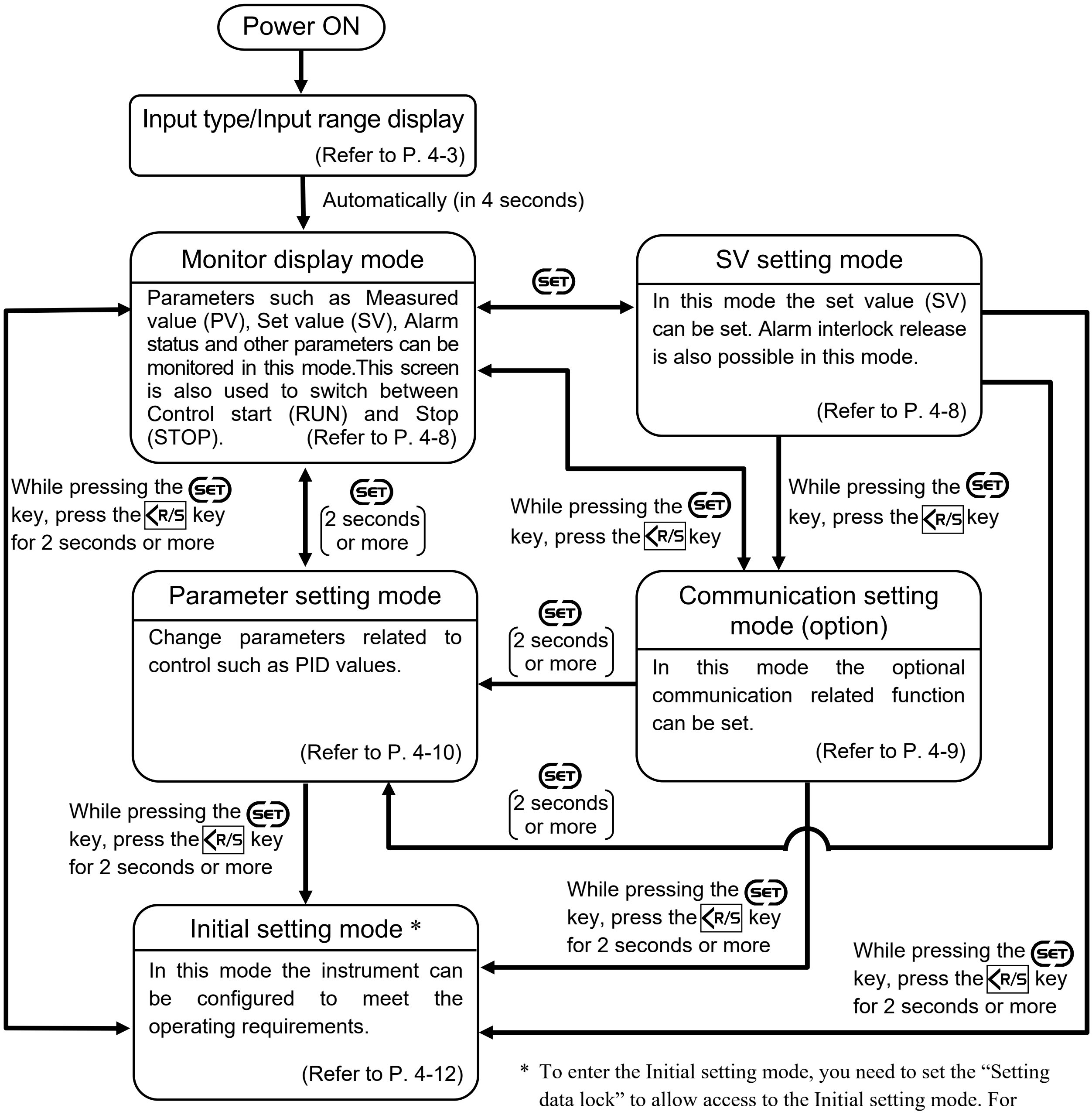
4

This chapter describes basic operations, different types of modes, switching between modes, and changing/storing the set values.

4.1 Mode Types and Switching

4.1.1 Switching between modes

The instrument has five different modes. Modes can be switched through key operations of SET and R/S keys.



* To enter the Initial setting mode, you need to set the "Setting data lock" to allow access to the Initial setting mode. For details, refer to **8.3 Restricting Key Operation (P. 8-7)**.

If no key operation is performed within 1 minute in the mode other than Initial setting, the Display returns to the PV/SV monitor. If no key operation is performed within 1 minute in the Initial setting mode, the Display returns to the Initial setting code number screen to which it belongs.

Parameters not included in the specification will not be displayed.

4.1.2 Input type and input range display

As soon as this instrument is powered on, input type and input range will be displayed.

Example: When sensor type is K thermocouple (0 to 400 °C)

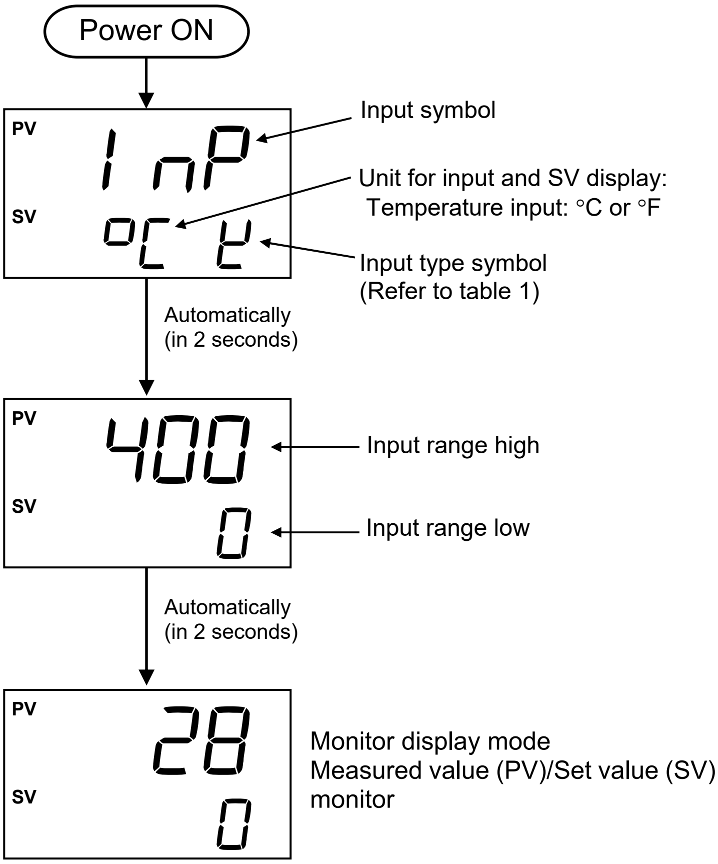


Table 1: Input type symbol

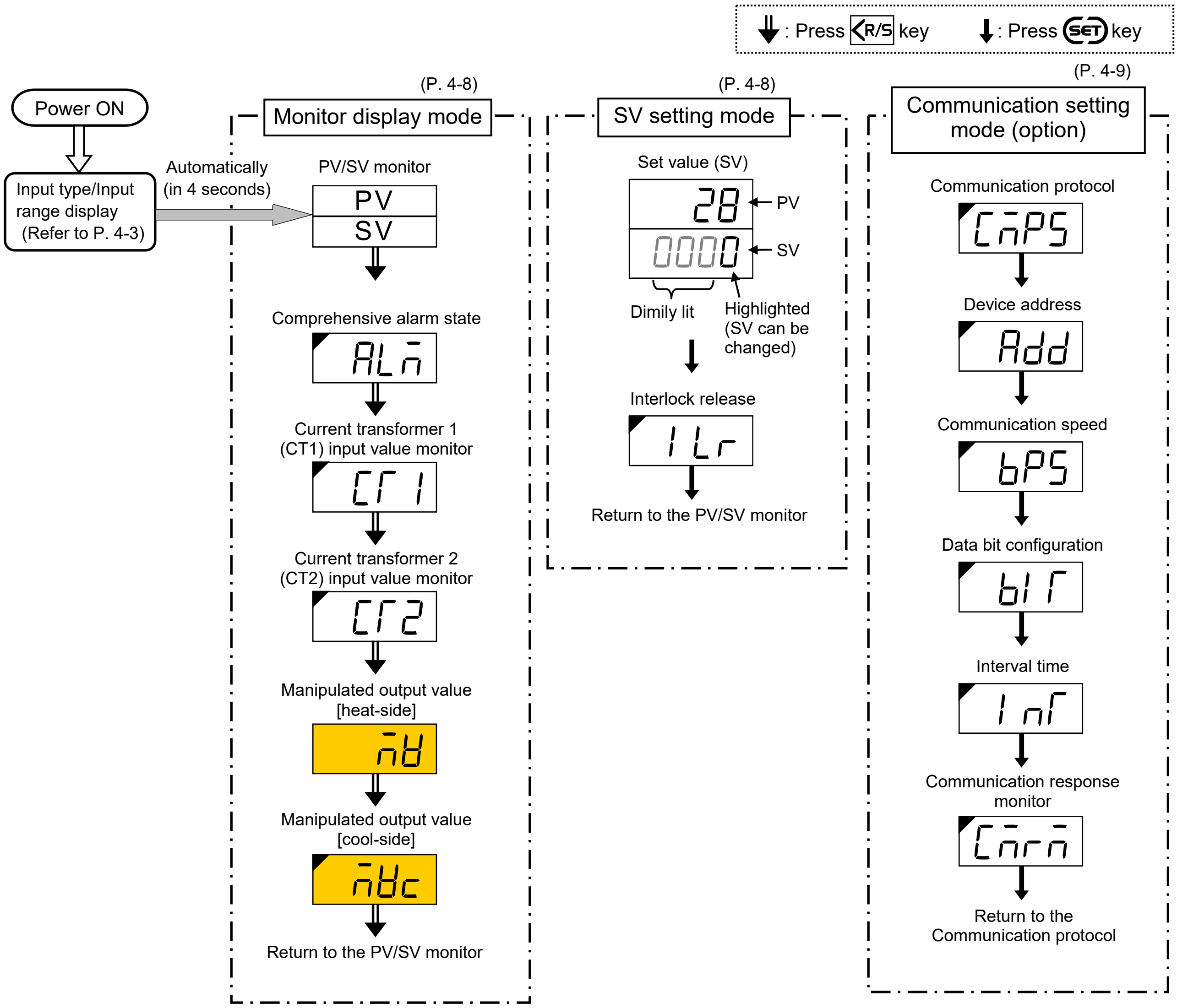
Symbol	Input type
K	Thermocouple K
J	Thermocouple J
T	Thermocouple T
S	Thermocouple S
r	Thermocouple R
E	Thermocouple E
b	Thermocouple B
n	Thermocouple N
P	Thermocouple PLII
w	Thermocouple W5Re/W26Re
U	Thermocouple U
L	Thermocouple L
PT	RTD Pt100
JP	RTD JPt100

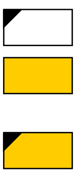
4.2 Parameter Types and Switching

4.2.1 Scrolling through parameters

The diagram below shows operating navigation.

Parameters not included in the specification will not be displayed.



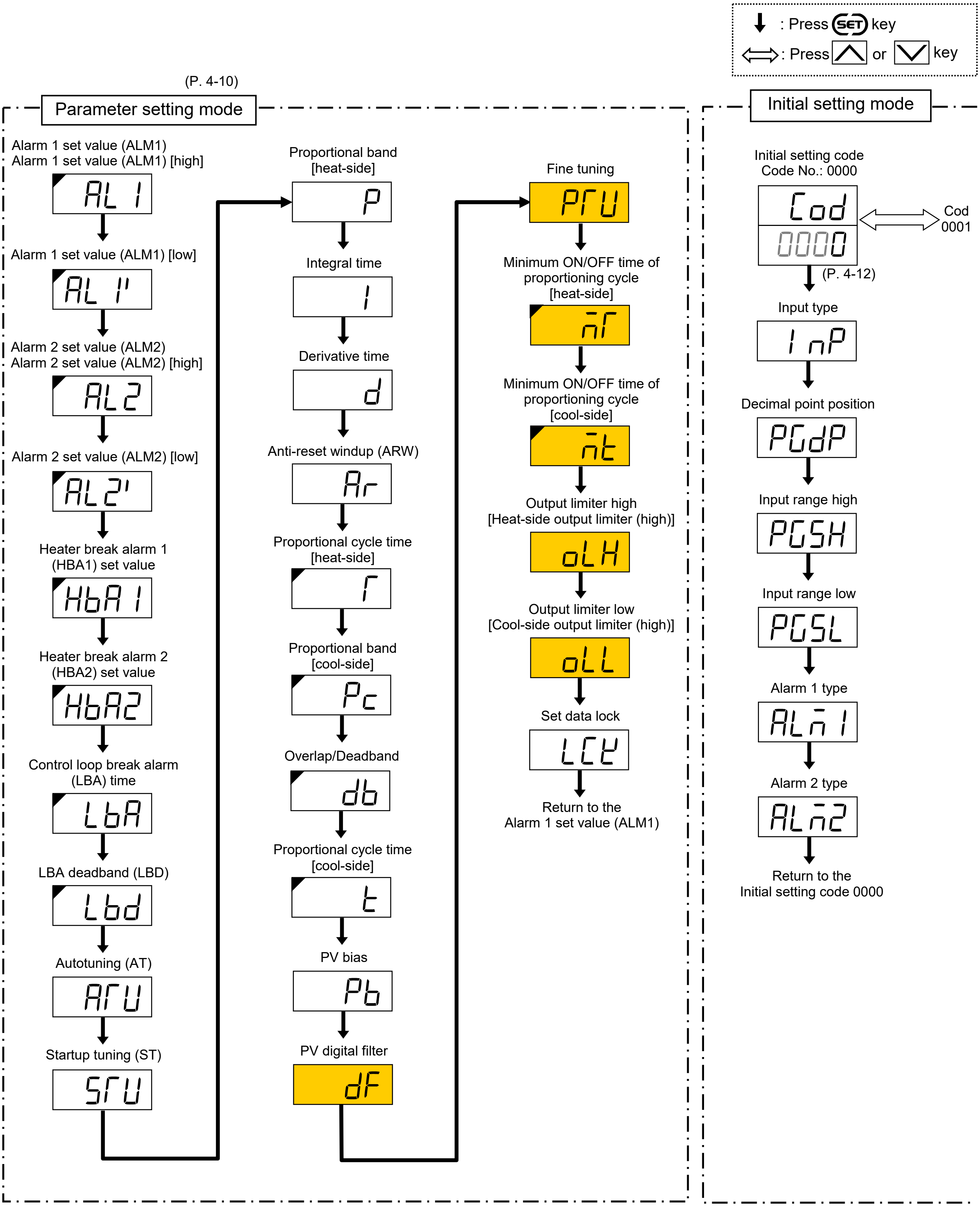


: Parameters that can be displayed if display requirements are satisfied.

: Parameters displayed in the Expanded display mode.
(The Expanded display mode can be set in the “Display mode selection” in the Initial setting mode.)

: Parameters displayed in the Expanded display mode. (If display requirements are satisfied)

For mode switching, refer to **4.1.1 Switching between modes (P. 4-2)**.

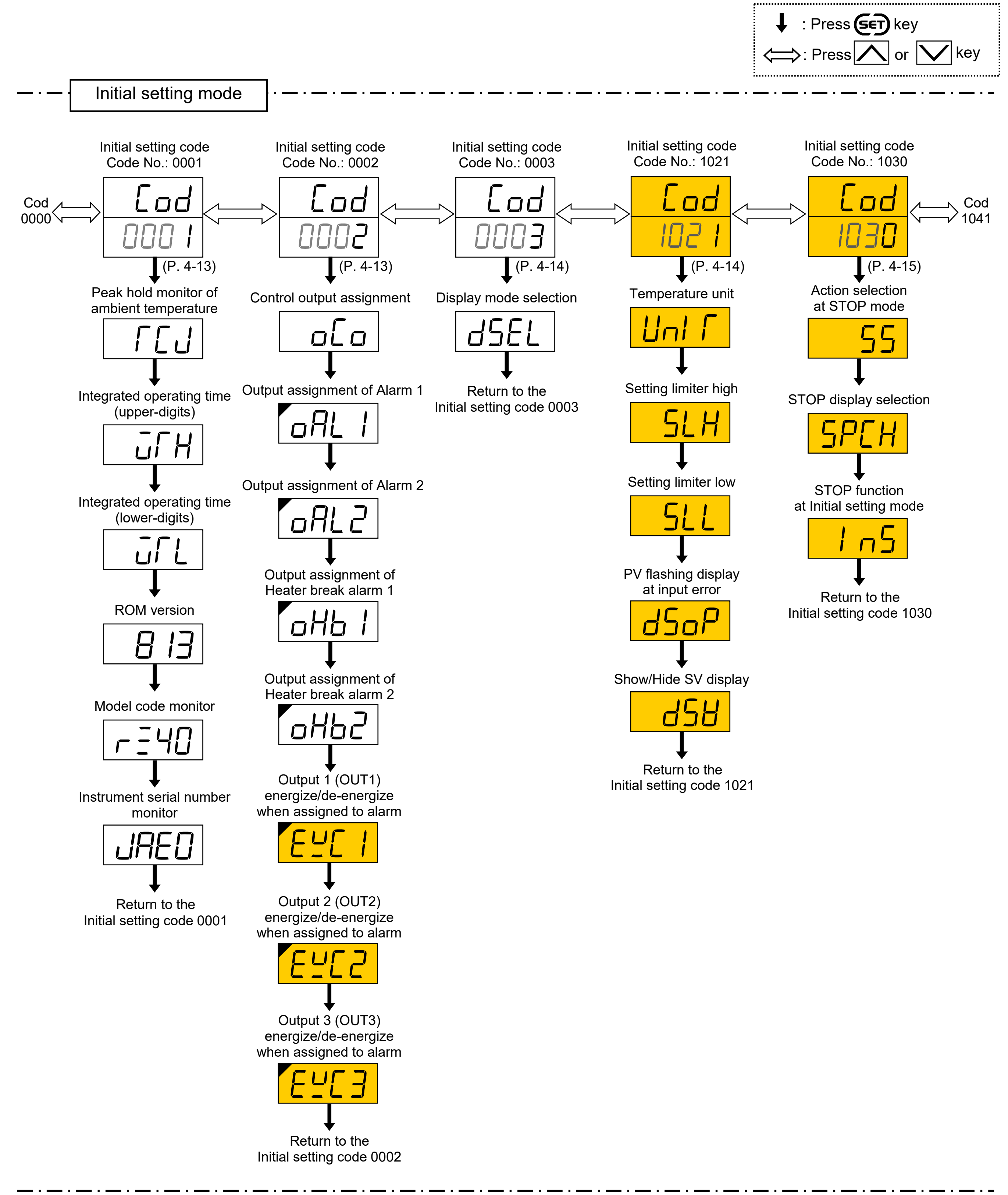


: Parameters that can be displayed if display requirements are satisfied.

: Parameters displayed in the Expanded display mode.
(The Expanded display mode can be set in the “Display mode selection” in the Initial setting mode.)

: Parameters displayed in the Expanded display mode. (If display requirements are satisfied)

☞ For mode switching, refer to **4.1.1 Switching between modes (P. 4-2)**.

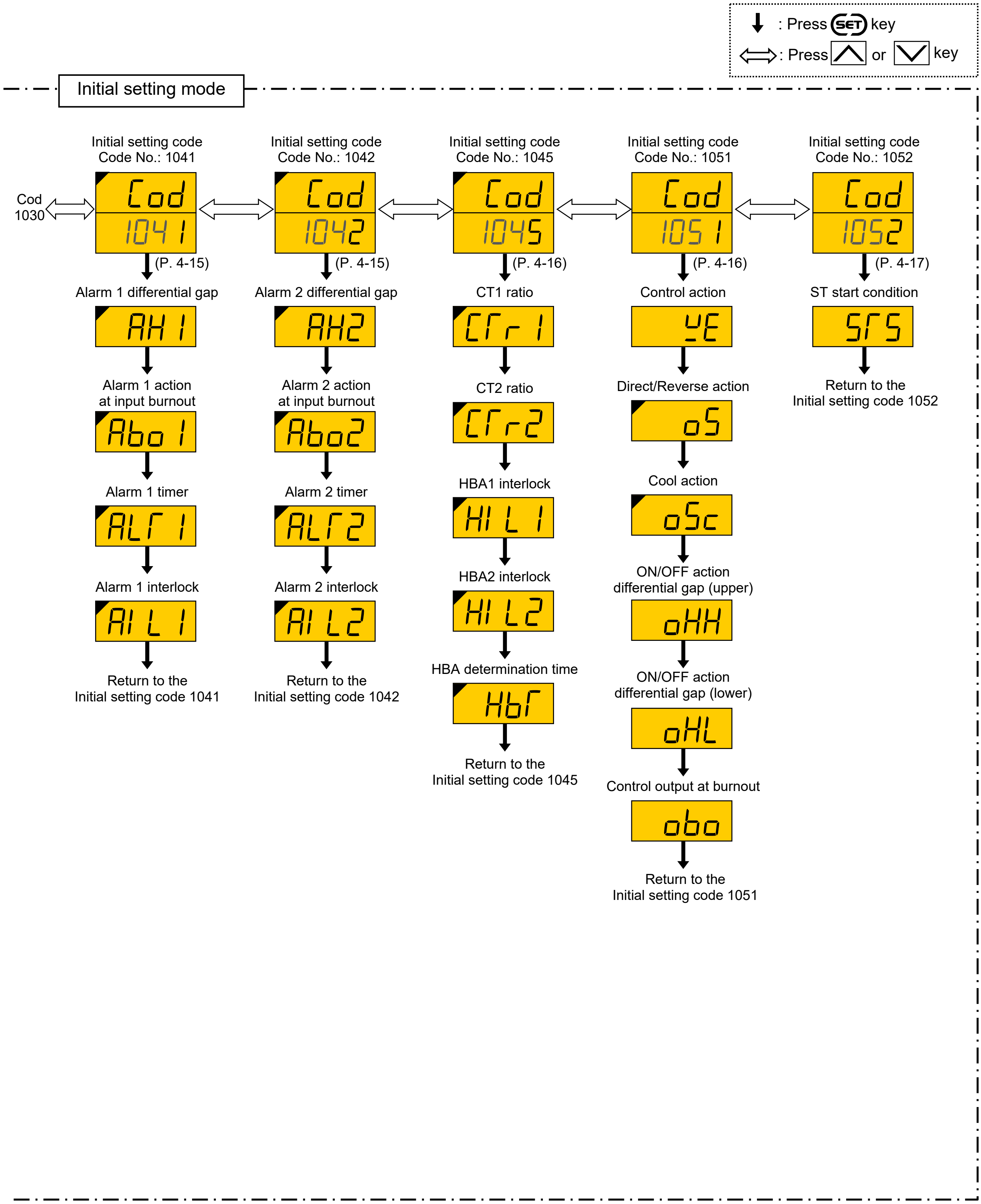


: Parameters that can be displayed if display requirements are satisfied.

: Parameters displayed in the Expanded display mode.
(The Expanded display mode can be set in the "Display mode selection" in the Initial setting mode.)

: Parameters displayed in the Expanded display mode. (If display requirements are satisfied)

☞ For mode switching, refer to **4.1.1 Switching between modes (P. 4-2)**.



: Parameters displayed in the Expanded display mode.
(The Expanded display mode can be set in the “Display mode selection” in the Initial setting mode.)

: Parameters displayed in the Expanded display mode. (If display requirements are satisfied)

☞ For mode switching, refer to **4.1.1 Switching between modes (P. 4-2)**.

4.2.2 Parameter list

■ Monitor display mode

Symbol	Name	Display range	Factory set value	Page
—	PV/SV monitor	PV display unit: Measured range low − (5 % of Measured range) to Measured range high + (5 % of Measured range) For a range with a decimal point, the maximum display range is −199.9 to +999.9. SV display unit [1]: Setting limiter low to Setting limiter high Varies with the setting of the Decimal point position.	—	—
ALM	Comprehensive alarm state [2, 3]	0: Alarm OFF or No alarm 1: Alarm ON 0000 ← SV display unit Alarm 1 Alarm 2 Heater break alarm 1 (HBA1) Heater break alarm 2 (HBA2)	—	10-48
CT1	Current transformer 1 (CT1) input value monitor [4]	0.0 to 100.0 A	—	10-38
CT2	Current transformer 2 (CT2) input value monitor [4]	0.0 to 100.0 A	—	10-38
MV	Manipulated output value [heat-side]	PID control: Output limiter low to Output limiter high Heat/Cool PID control: −5.0 to Heat-side output limiter (high)	—	7-15
MVc	Manipulated output value [cool-side] [5]	−5.0 to Cool-side output limiter (high)	—	7-15

(Shaded) Displayed when "Expanded display mode" is selected in the Display mode selection.

[1] Set value (SV) is not displayed in the following cases.
- "STOP" display during STOP is configured to the SV display. (Refer to P. 8-8)
- Set value (SV) is configured to "hide" in setting show/hide SV. (Refer to P. 8-8)
- While error exists.

[2] Displayed when any selection other than "None" is selected for Alarm 1 type and Alarm 2 type.

[3] Displayed when optional "Current transformer (CT) input" is specified at the time of ordering and the Heater break alarm (HBA) set value is other than "0.0."

[4] Displayed when optional "Current transformer (CT) input" is specified at the time of ordering.

[5] Displayed when "Heat/Cool PID control" is specified at the time ordering or when the instrument is configured to "Heat/Cool PID control" in the selection of the Control action.

■ SV setting mode

Symbol	Name	Data range	Factory set value	Page
—	Set value (SV) [1]	Setting limiter low to Setting limiter high Varies with the setting of the Decimal point position.	0 or 0.0	5-12
ILr	Interlock release [2]	oFF: Interlock release on: Interlock state	oFF	10-21 10-45

[1] Not displayed if "Set value (SV): Lock" is selected in the Set data lock. Displays in the following cases.
- "STOP" display during STOP is configured to the SV display. (Refer to P. 8-8)
- Set value (SV) is configured to "hide" in setting show/hide SV. (Refer to P. 8-8)
- While error exists.

[2] Displayed when Interlock is used in Alarm 1, 2, or HBA1 or 2.

■ Communication setting mode

<table>
<tr><th>Symbol</th><th>Name</th><th>Data range</th><th>Factory set value</th><th>Page</th></tr>
<tr><td>CMPS</td><td>Communication protocol [1]</td><td>0: RKC communication
1: Modbus</td><td>Communication Protocol specified at the time of ordering.</td><td>12-8</td></tr>
<tr><td>Add</td><td>Device address [1]</td><td>RKC communication: 0 to 99
Modbus [2]: 1 to 99</td><td>RKC communication: 0
Modbus: 1</td><td>12-8</td></tr>
<tr><td>bPS</td><td>Communication speed [1]</td><td>0: 2400 bps
1: 4800 bps
2: 9600 bps
3: 19200 bps
4: 38400 bps</td><td>2</td><td>12-8</td></tr>
<tr><td>bIT</td><td>Data bit configuration [1]</td><td>
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Data bit configuration</th></tr>
<tr><th>Data bit</th><th>Parity bit</th><th>Stop bit</th></tr>
<tr><td>0</td><td>8</td><td>None</td><td>1</td></tr>
<tr><td>1</td><td>8</td><td>None</td><td>2</td></tr>
<tr><td>2</td><td>7</td><td>Even</td><td>1</td></tr>
<tr><td>3</td><td>7</td><td>Even</td><td>2</td></tr>
<tr><td>4</td><td>7</td><td>Odd</td><td>1</td></tr>
<tr><td>5</td><td>7</td><td>Odd</td><td>2</td></tr>
<tr><td>6</td><td>8</td><td>Even</td><td>1</td></tr>
<tr><td>7</td><td>8</td><td>Odd</td><td>1</td></tr>
<tr><td>8</td><td>8</td><td>Even</td><td>2</td></tr>
<tr><td>9</td><td>8</td><td>Odd</td><td>2</td></tr>
<tr><td>10</td><td>7</td><td>None</td><td>1</td></tr>
<tr><td>11</td><td>7</td><td>None</td><td>2</td></tr>
</table>
Setting range of RKC communication: 0 to 11
Setting range of Modbus [3]: 0, 1, 6, 7, 8, 9</td><td>0</td><td>12-8</td></tr>
<tr><td>InT</td><td>Interval time [1]</td><td>0 to 150 (× 1.666 ms)

Actual interval time is set value (0 to 150) multiplied by 1.666 (unit: ms).</td><td>5</td><td>12-8</td></tr>
<tr><td>CMRM</td><td>Communication response monitor [1]</td><td>0000 ← SV display unit
Communication response monitor [4]
0: Normal response
1: Overrun error
2: Parity error
4: Framing error
8: Receive buffer overflow
Errors are displayed in the hexadecimal format (0 to F).
Unused
Reception status monitor *
Transmission status monitor *
* Each time signal is sent or received, 0 and 1 are displayed in turns.</td><td>—</td><td>—</td></tr>
</table>

[1] Displayed when optional “Communication function” is specified at the time of ordering.

[2] In Modbus communication, communication is not possible when the address is 0.

[3] In Modbus communication, setting 2, 3, 4, 5, 10, or 11 will not establish communication.

[4] When two or more errors occur at the same time, the sum of the error numbers are displayed in the hexadecimal format. (Example: In case all of four errors occur, a character “F” is displayed)

■ Parameter setting mode

Symbol	Name	Data range	Factory set value	Page
AL1	Alarm 1 set value (ALM1) Alarm 1 set value (ALM1) [high] [1]	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	10 or 10.0	5-13 10-2
AL1'	Alarm 1 set value (ALM1) [low] [2]		−10 or −10.0	
AL2	Alarm 2 set value (ALM2) Alarm 2 set value (ALM2) [high] [3]		10 or 10.0	
AL2'	Alarm 2 set value (ALM2) [low] [4]		−10 or −10.0	
HbA1	Heater break alarm 1 (HBA1) set value [5]	0.0 to 100.0 A (0.0: HBA function OFF)	0.0	10-32 10-38
HbA2	Heater break alarm 2 (HBA2) set value [5]		0.0	
LbA	Control loop break alarm (LBA) time [6]	0.1 to 200.0 minutes	8.0	10-23
Lbd	LBA deadband (LBD) [6]	0 to 9999 (Unit: °C [°F])	0	10-29
ATU	Autotuning (AT)	0: PID control 1: Start Autotuning (AT) When the Autotuning (AT) is finished, the control will automatically return to “0: PID control.”	0	5-14 11-8
STU	Startup tuning (ST)	0: ST unused 1: Execute once * 2: Execute always * When the Startup tuning (ST) is finished, the control will automatically return to “0: ST unused.”	0	11-10
P	Proportional band [heat-side]	0 (0.0) to Input span (Unit: °C [°F]) For a scale range with a decimal point, when the input span exceeds the display limit, the maximum value is 999.9. Varies with the setting of the Decimal point position. 0 (0.0): ON/OFF action	30 or 30.0	11-14
I	Integral time	0 to 3600 seconds (0: PD action)	240	11-14
d	Derivative time	0 to 3600 seconds (0: PI action)	60	11-14
Ar	Anti-reset windup (ARW)	0 to 100 % of Proportional band [heat-side] (0: Integral action is always OFF)	100	11-14
T	Proportional cycle time [heat-side] [7]	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2	7-8

[1] Displayed when Alarm 1 type is set to the type other than “None” and “Monitor during RUN.”
When “High/Low individual setting type” (setting: 16, 17, 18, 22) is set for Alarm 1 type, “AL1” becomes Alarm 1 set value (ALM1) [high].

[2] Displayed when Alarm 1 type is set to “High/Low individual setting type” (setting: 16, 17, 18, 22).

[3] Displayed when Alarm 2 type is set to the type other than “None,” “Monitor during RUN” and “Control loop break alarm (LBA).”
When “High/Low individual setting type” (setting: 16, 17, 18, 22) is set for Alarm 2 type, “AL2” becomes Alarm 2 set value (ALM2) [high].

[4] Displayed when Alarm 2 type is set to “High/Low individual setting type” (setting: 16, 17, 18, 22).

[5] Displayed when optional “Current transformer (CT) input” is specified at the time of ordering.

[6] Displayed when “Control loop break alarm (LBA)” is selected for Alarm 2 type.

[7] Displayed when output type (which was configured in control output assignment) is “Relay contact output” or “Voltage pulse output.”

Continued on the next page.

Symbol	Name	Data range	Factory set value	Page
Pc	Proportional band [cool-side] [1]	1 to 1000 % of Proportional band [heat-side] (ON/OFF action of cool-side only is not possible.)	100	11-24
db	Overlap/Deadband	−10 to +10 or −10.0 to +10.0 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	0 or 0.0	11-24
t	Proportional cycle time [cool-side] [1, 2]	1 to 100 seconds	For “Cooling linear type” configured to have “Voltage pulse output”: 2 Otherwise: 20	7-8
Pb	PV bias	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	0 or 0.0	6-7
dF	PV digital filter	0 to 100 seconds (0: Digital filter function OFF)	1	6-8
PrU	Fine tuning	−3 to +3 (0: Function OFF)	0	11-29
mr	Minimum ON/OFF time of proportioning cycle [heat-side] [2]	0 to 1000 ms	0	7-8
mt	Minimum ON/OFF time of proportioning cycle [cool-side] [1, 2]	0 to 1000 ms	0	7-8
oLH	Output limiter high [Heat-side output limiter (high)]	PID control: Output limiter low to 105.0 % (Output limiter high > Output limiter low) Heat/Cool PID control: 0.0 to 105.0 %	105.0	7-6
oLL	Output limiter low [Cool-side output limiter (high)]	PID control: −5.0 % to Output limiter high (Output limiter high > Output limiter low) Heat/Cool PID control: 0.0 to 105.0 %	PID control: −5.0 Heat/Cool PID control: 105.0	7-6
LCK	Set data lock	0000 ← SV display unit Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV) and Alarm set values (ALM1, ALM2) 0: Unlock 1: Lock Alarm set value (ALM1, ALM2) 0: Unlock 1: Lock Set value (SV) 0: Unlock 1: Lock Initial setting mode 0: Lock 1: Unlock	0000	4-19 8-7

(Yellow box) Displayed when “Expanded display mode” is selected in the Display mode selection.

[1] Displayed when “Heat/Cool PID control” is specified at the time ordering or when the instrument is configured to “Heat/Cool PID control” in the selection of the Control action.

[2] Displayed when output type (which was configured in control output assignment) is “Relay contact output” or “Voltage pulse output.”

■ Initial setting mode

Symbol	Name	Data range	Factory set value	Page
Cod	Initial setting code 0000	This is the first parameter symbol of Initial setting code 0000		
InP	Input type	0000: TC input K 0001: TC input J 0010: TC input L 0011: TC input E 0100: TC input N 0101: TC input T 0110: TC input U 0111: TC input R 1000: TC input S 1001: TC input B 1010: TC input W5Re/W26Re 1011: TC input PLII 1100: RTD input Pt100 1101: RTD input JPt100	When input range code is specified at the time of ordering, the input type in the input range code is the factory setting. If input range code is not specified: 0000	6-2
PGdP	Decimal point position	0: No decimal place 1: One decimal place Setting below zero (first decimal place) is possible if the selected input type has a measured range with a decimal place.	When input range code is specified at the time of ordering, the decimal point position in the input range code is the factory setting. If input range code is not specified: 0	6-2
PGSH	Input range high	(Input range low + 1digit) to Measured range high Varies with the setting of the Decimal point position.	When input range code is specified at the time of ordering, the input range high in the input range code is the factory setting. If input range code is not specified: 400	6-2
PGSL	Input range low	Measured range low to (Input range high − 1digit) Varies with the setting of the Decimal point position.	When input range code is specified at the time of ordering, the input range low in the input range code is the factory setting. If input range code is not specified: 0	6-2
ALM1	Alarm 1 type	0: None 1: Deviation high 2: Deviation high/low 3: Process high 5: Deviation low 6: Band 7: Process low 9: Deviation high with re-hold action 10: Deviation high/low with re-hold action 11: Process high with hold action 13: Deviation low with re-hold action 15: Process low with hold action 16: Deviation high/low (High/Low individual setting) 17: Band (High/Low individual setting) 18: Deviation high/low with re-hold action (High/Low individual setting) 19: Deviation high with hold action 20: Deviation high/low with hold action 21: Deviation low with hold action 22: Deviation high/low with hold action (High/Low individual setting) 23: SV high 24: SV low 25: Monitor during RUN Do not set 4, 8, 12, and 14.	When alarm code is specified at the time of ordering, the Alarm type in the alarm code is the factory setting. If Alarm type is not specified, factory setting depends on the specification (with or without outputs). If alarm output is assigned, Alarm type is "Deviation high." If not assigned, Alarm type is "None." For details, refer to **1.3 Model Code (P. 1-4)**.	10-8

Continued on the next page.

Symbol	Name	Data range	Factory set value	Page
ALM2	Alarm 2 type	0: None 1: Deviation high 2: Deviation high/low 3: Process high 5: Deviation low 6: Band 7: Process low 9: Deviation high with re-hold action 10: Deviation high/low with re-hold action 11: Process high with hold action 13: Deviation low with re-hold action 15: Process low with hold action 16: Deviation high/low (High/Low individual setting) 17: Band (High/Low individual setting) 18: Deviation high/low with re-hold action (High/Low individual setting) 19: Deviation high with hold action 20: Deviation high/low with hold action 21: Deviation low with hold action 22: Deviation high/low with hold action (High/Low individual setting) 23: SV high 24: SV low 25: Monitor during RUN 26: Control loop break alarm (LBA) Do not set 4, 8, 12, and 14.	When alarm code is specified at the time of ordering, the Alarm type in the alarm code is the factory setting. If Alarm type is not specified, factory setting depends on the specification (with or without outputs). If alarm output is assigned, Alarm type is "Deviation high." If not assigned, Alarm type is "None." For details, refer to **1.3 Model Code (P. 1-4)**.	10-8
Cod	Initial setting code 0001	This is the first parameter symbol of Initial setting code 0001		
rCJ	Peak hold monitor of ambient temperature	−120 to +120 °C	—	—
WTH	Integrated operating time (upper-digits)	0 to 9999 (×10000) hours	—	—
WTL	Integrated operating time (lower-digits)	0 to 9999 hours	—	—
—	ROM version	PV display: Version number SV display: Running number	—	13-12
—	Model code monitor	Model code is displayed. Display can be scrolled left and right with the Up/Down keys.	—	13-12
—	Instrument serial number monitor	Instrument serial number is displayed. Display can be scrolled left and right with the Up/Down keys.	—	13-12
Cod	Initial setting code 0002	This is the first parameter symbol of Initial setting code 0002		
oCo	Control output assignment	0: No assignment * 1: PID control: Output 1 (OUT1) Heat/Cool PID control: Heat-side output: Output 1 (OUT1) Cool-side output: Output 2 (OUT2) 2: PID control: Output 2 (OUT2) Heat/Cool PID control: Heat-side output: Output 2 (OUT2) Cool-side output: Output 1 (OUT1) 3: Heat-side output: Output 1 (OUT1) Cool-side output: Output 3 (OUT3) 4: Heat-side output: Output 2 (OUT2) Cool-side output: Output 3 (OUT3) Data range for PID control: 0 to 2 * If "No assignment" is specified, Heater break alarm (HBA) will be disabled.	When Control output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Control output assignment is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.	7-2

Continued on the next page.

Symbol	Name	Data range	Factory set value	Page
oAL1	Output assignment of Alarm 1 [1]	0: No assignment 1: Output 1 (OUT1) * 2: Output 2 (OUT2) * 3: Output 3 (OUT3) * If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assignment of Alarm output is ignored.	When Alarm output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Alarm output assignment is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.	7-2
oAL2	Output assignment of Alarm 2 [2]			7-2
oHb1	Output assignment of Heater break alarm 1 [3, 4]	0: No assignment 1: Output 1 (OUT1) * 2: Output 2 (OUT2) * 3: Output 3 (OUT3) * If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assignment of Heater break alarm (HBA) output is ignored.	When Heater break alarm output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Heater break alarm output assignment is not specified: 0	7-2
oHb2	Output assignment of Heater break alarm 2 [3, 5]			7-2
EVC1	Output 1 (OUT1) energize/de-energize when assigned to alarm [1, 2, 3, 4, 5]	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0	7-12
EVC2	Output 2 (OUT2) energize/de-energize when assigned to alarm [1, 2, 3, 4, 5]		0	7-12
EVC3	Output 3 (OUT3) energize/de-energize when assigned to alarm [1, 2, 3, 4, 5]		0	7-12
Cod	Initial setting code 0003	This is the first parameter symbol of Initial setting code 0003		
dSEL	Display mode selection	0: Standard display mode 1: Expanded display mode	0	9-2
Cod	Initial setting code 1021	This is the first parameter symbol of Initial setting code 1021		
UnIT	Temperature unit	0: °C 1: °F	When input range code is specified at the time of ordering, the temperature unit in the input range code is the factory setting. If input range code is not specified: 0	6-2
SLH	Setting limiter high	Setting limiter low to Input range high Varies with the setting of the Decimal point position.	Input range high	8-2

(Shaded box) Displayed when "Expanded display mode" is selected in the Display mode selection.

[1] Displayed when Alarm 1 type is set to the type other than "None."
[2] Displayed when Alarm 2 type is set to the type other than "None."
[3] Displayed when optional "Current transformer (CT) input" is specified at the time of ordering.
[4] Displayed when Heater break alarm 1 (HBA1) set value is set to any value other than "0.0."
[5] Displayed when Heater break alarm 2 (HBA2) set value is set to any value other than "0.0."

Continued on the next page.

Symbol	Name	Data range	Factory set value	Page
SLL	Setting limiter low	Input range low to Setting limiter high Varies with the setting of the Decimal point position.	Input range low	8-2
dSoP	PV flashing display at input error	0: Flashing display 1: Non-flashing display	0	6-10
dSV	Show/Hide SV display	0: Show SV 1: Hide SV	0	9-6
Cod	Initial setting code 1030	This is the first parameter symbol of Initial setting code 1030		
SS	Action selection at STOP mode	0: Alarm is cleared at STOP 1: Alarm remains on at STOP 0000 ← SV display unit Alarm action Heater break alarm (HBA) action 0 (fixed) [Do not change this one]	0000	10-46
SPCH	STOP display selection	0: STOP on PV display 1: STOP on SV display	1	9-4
InS	STOP function at Initial setting mode	0: STOP in the Initial setting mode 1: RUN/STOP continues in the Initial setting mode	0	8-5
Cod	Initial setting code 1041 [1]	This is the first parameter symbol of Initial setting code 1041		
AH1	Alarm 1 differential gap [2]	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	2 or 2.0	10-14
Abo1	Alarm 1 action at input burnout [1]	0: Alarm 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	3	6-10
ALT1	Alarm 1 timer [1]	0 to 600 seconds	0	10-16
AIL1	Alarm 1 interlock [1]	oFF: Unused on: Used	oFF	10-21
Cod	Initial setting code 1042 [3]	This is the first parameter symbol of Initial setting code 1042		
AH2	Alarm 2 differential gap [4]	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	2 or 2.0	10-14
Abo2	Alarm 2 action at input burnout [3]	0: Alarm 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	3	6-10
ALT2	Alarm 2 timer [3]	0 to 600 seconds	0	10-16
AIL2	Alarm 2 interlock [3]	oFF: Unused on: Used	oFF	10-21

Displayed when "Expanded display mode" is selected in the Display mode selection.

[1] Displayed when Alarm 1 type is set to the type other than "None."
[2] Displayed when Alarm 1 type is set to the type other than "None" and "Monitor during RUN."
[3] Displayed when Alarm 2 type is set to the type other than "None."
[4] Displayed when Alarm 2 type is set to the type other than "None," "Monitor during RUN" and "Control loop break alarm (LBA)."

Continued on the next page.

Symbol	Name	Data range	Factory set value	Page
Cod	Initial setting code 1045 [1]	This is the first parameter symbol of Initial setting code 1045		
CTr1	CT1 ratio [1]	1 to 1000 Set the following value depending on the CT type. CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000	When CTL-6-P-N is specified at the time or ordering: 800 When CTL-12-S56-10L-N is specified at the time or ordering: 1000	10-40
CTr2	CT2 ratio [1]			10-40
HIL1	HBA1 interlock [1]	oFF: Unused on: Used	oFF	10-44
HIL2	HBA2 interlock [1]			10-44
HbT	HBA determination time [1]	0 to 255 seconds	3	10-42
Cod	Initial setting code 1051	This is the first parameter symbol of Initial setting code 1051		
XE	Control action	0: PID control 1: Heat/Cool PID control	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If control action is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.	11-4
oS	Direct/Reverse action [2]	0: PID control: Direct action 1: PID control: Reverse action	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If Control action is not specified: 1	11-4
oSc	Cool action [3]	0: Heat/Cool PID control: Air cooling (for Extruder) 1: Heat/Cool PID control: Water cooling (for Extruder) 2: Heat/Cool PID control: Cooling linear type	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If Control action is not specified: 0	11-4 11-24
oHH	ON/OFF action differential gap (upper)	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	1 or 1.0	11-19
oHL	ON/OFF action differential gap (lower)			11-19

Displayed when “Expanded display mode” is selected in the Display mode selection.

[1] Displayed when optional “Current transformer (CT) input” is specified at the time of ordering.
[2] Displayed when “PID control” is specified for Control action.
[3] Displayed when “Heat/Cool PID control” is specified for Control action.

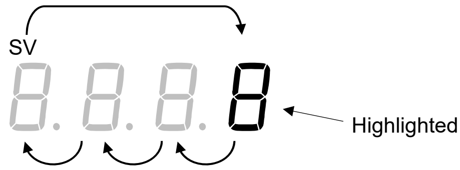
Continued on the next page.

Symbol	Name	Data range	Factory set value	Page
obo	Control output at burnout	0: Result of control computation 1: PID control: Output limiter low (output OFF) Heat/Cool PID control: −5.0 % (output OFF) * * Both heating and cooling outputs are forced OFF.	PID control: 0 Heat/Cool PID control: 1	6-10
Cod	Initial setting code 1052	This is the first parameter symbol of Initial setting code 1052		
STS	ST start condition	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	11-10

Displayed when “Expanded display mode” is selected in the Display mode selection.

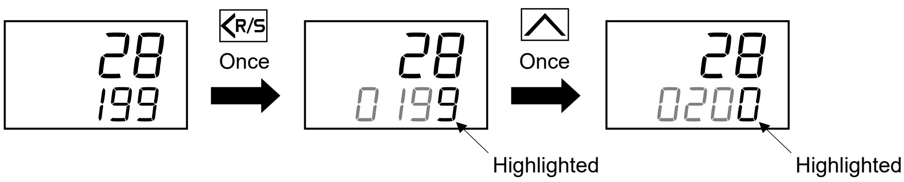
4.3 Changing Set Value

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

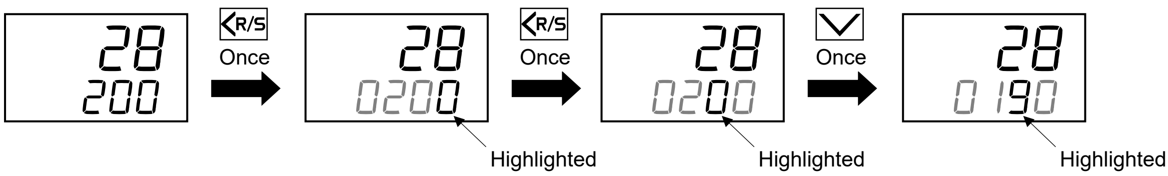


- The following is also available when changing the set value.

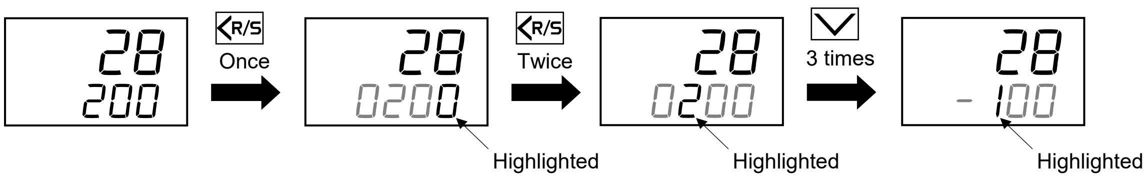
Increase SV from 199 °C to 200 °C:



Decrease SV from 200 °C to 190 °C:



Decrease SV from 200 °C to –100 °C:



- **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.

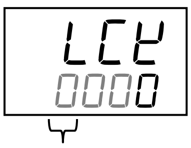
A new value will not be stored without pressing SET key after the new value is displayed on the display.

If no key operation is performed within 1 minute without pressing the SET key after the new value has been set by using UP and DOWN keys, this instrument returns to the PV/SV monitor display mode if the instrument is in the mode other than Initial setting mode.
In case the instrument is in the Initial setting mode, the display goes to the initial setting code number screen to which the displayed screen belongs (For example, in case of Control output assignment, the display goes to the initial setting Cod 0002 screen). In each case the modified value is not stored.

4.4 Protecting Setting Data

To protect setting data in the instrument, the setting data can be locked so that no changes can be made (Set data lock function). The Set data lock function uses the lower three digits of the set value to restrict the setting in the SV setting mode, the Parameter setting mode, and the Communication setting mode.
The highest digit is used to show/hide the Initial setting mode.

Perform setting in the Parameter setting mode.

	Set value	Description of Set Lock
 Restricting the operations in the SV setting mode, the Parameter setting mode, and the Communication setting mode	□000	All parameters [Factory set value]
	□001	Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV) and Alarm set values (ALM1, ALM2) *
	□010	All parameters except for Alarm 1 set value (ALM1) and Alarm 2 set value (ALM2) *
	□011	Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV)
	□100	All parameters except for Set value (SV)
	□101	Parameters in the Parameter setting mode and the Communication setting mode excluding Alarm set values (ALM1, ALM2) *
	□110	All parameters except for Set value (SV), Alarm 1 set value (ALM1) and Alarm 2 set value (ALM2) *
	□111	No parameter (All Locked)
 Restricting access to Initial setting mode	0□□□	Hide Initial setting mode [Factory set value]
	1□□□	Show Initial setting mode (Show all parameters)

* Values for Control loop break alarm (LBA) time and LBA deadband (LBD) are not included.

The following parameters cannot be locked:
- Interlock release (SV setting mode)
- Set data lock (Parameter setting mode)

The contents of lock mode can be switched anytime regardless of RUN/STOP mode.

As the parameters can be viewed even in the lock state, the set data can be verified.
However, when the set value (SV) is locked, the SV screen in the SV setting mode will not be displayed. (Refer to P.8-8)

Setting through the Communication (option) is possible even when setting is locked. However, to change parameters in the Initial setting mode, the controller must be set to STOP mode.

For details, refer to **8.3 Restricting Key Operation (P. 8-7)**.

MEMO

OPERATION 5

This chapter describes Operating precautions, Setup procedures and Parameter setting that are required before operation.

5.1 Operating Precautions

Before starting the operation, check the following items.

■ Power ON

As soon as the instrument is powered up, operation is started after the display of the input type and the input range.

■ Action at input error

In case of input failure this instrument provides the following behaviors and output.

● Action at input break

Thermocouple input: Upscale
RTD input: Upscale

● Action at input short-circuit

RTD input: Downscale

● Action at input burnout

Control output at burnout (Initial setting mode) [Refer to P. 6-11]:

- Result of control computation
- PID control: Output limiter low (output OFF)
  Heat/Cool PID control: −5.0 % (output OFF) *
  * On the Heat/Cool PID control type, both heating and cooling outputs are off.

Alarm action at input burnout (Initial setting mode) [Refer to P. 6-11]:

- Alarm output is not forcibly turned ON when the burnout function is activated.
- ON at over-scale; no action at underscale
- ON at underscale; no action at over-scale
- ON at over-scale or underscale
- OFF at over-scale or underscale

■ Checking each parameter

- The settings for the Set value (SV) and all parameters should be appropriate for the controlled system.
- With the factory setting, all parameters cannot be verified. Switch the mode to "Expanded display mode," then the parameters not displayed can be seen. Some parameters may not be displayed if display requirements are not met.
- With the factory setting, control is stopped if the mode is switched to the Initial setting mode. It is possible to verify the parameters in the Initial setting mode without stopping the control. However, to change the parameters in the Initial setting mode, the control needs to be stopped, because the parameters in the Initial setting mode cannot be changed while the control is running.

☞ Refer to **4. BASIC OPERATION AND PARAMETER LIST (P. 4-1)** and **chapters 6 to 11** for switching between each mode and details of parameters.

☞ For switching to the Expanded display mode, refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)**.

☞ For continuing the control in the Initial setting mode, refer to **8.2 Continuing the Control when Entering the Initial Setting Mode (P. 8-5)**.

■ Alarm hold action

- The Alarm hold action is activated when the power is turned on or when transferred from STOP mode to RUN mode. (in case of “with hold action”)
- The Alarm re-hold action is activated when not only the Set value (SV) is changed, but also the power is turned on or when transferred from STOP mode to RUN mode. (in case of “with re-hold action”)

■ Operation at power failure

A power failure of 20 ms or less will not affect the control action (at 100 V AC). When a power failure of more than 20 ms occurs the instrument assumes that the power has been turned off. The instrument restarts from the mode operated prior to the power failure.

5.2 Setup Procedures

Setup the controller prior to operating the instrument. Refer to the following setup example.

Setup example 1

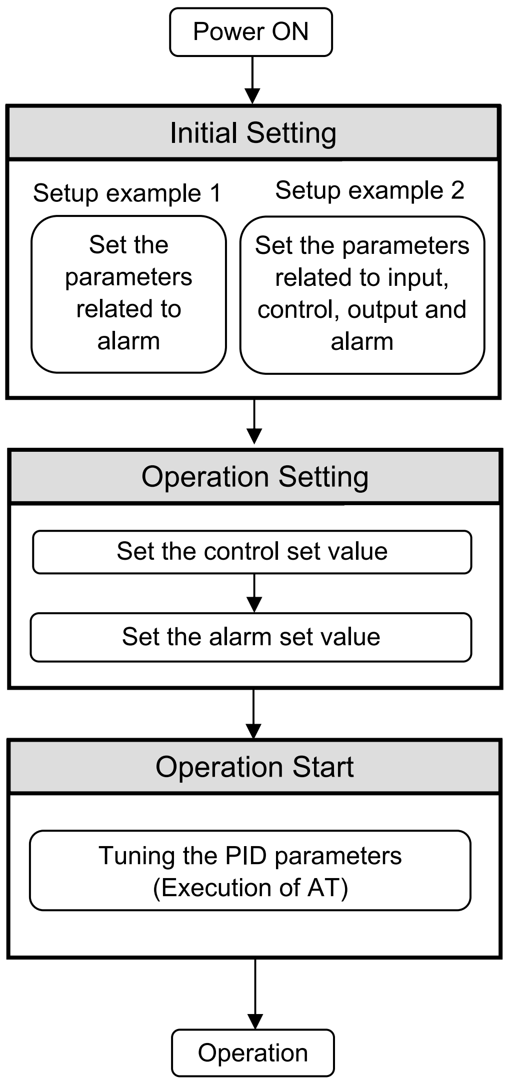
Input: Thermocouple (K), 0 to 400 °C
Control: PID control with AT (reverse action)
Output: Control output: Uses Output 1 (OUT1)
Alarm output: Uses Output 3 (OUT3)
Alarm: Number of alarm points: 1 point (Uses Alarm 1)
Deviation high/low with hold action
Without interlock function
Control set value: 200.0 °C
Alarm set value: 10.0 °C
PID constants: Automatic setting by Autotuning (AT)

: Values to be set in the Initial setting

Setup example 2

Input: RTD (Pt100), 0.0 to 300.0 °C
Control: Heat/Cool PID control with AT (air cooling)
Output: Control output: Heat-side: Uses Output 1 (OUT1)
Cool-side: Uses Output 2 (OUT2)
Alarm output: Uses Output 3 (OUT3) (Shared between Alarm 1 and Alarm 2)
Alarm: Number of alarm points: 2 points (Uses Alarm 1 and Alarm 2)
Alarm 1 type: Deviation high
Alarm 2 type: Deviation low
Uses interlock function
Control set value: 100.0 °C
Alarm set value: Alarm 1: 10.0 °C, Alarm 2: –10.0 °C
PID constants: Automatic setting by Autotuning (AT)

: Values to be set in the Initial setting



☞ For operation in initial setting (Initial setting mode), refer to **5.3 Initial Setup before Operation (P. 5-5)**.

☞ For operation setting, refer to the following:
- **5.4 Setting the Control Set Value [Set value (SV)] (P. 5-12)**
- **5.5 Setting the Alarm Set Value (P. 5-13)**

☞ For starting the operation, refer to **5.6 Tuning the PID Parameters (Execution of AT) (P. 5-14)**.

5.3 Initial Setup before Operation

Before starting the operation, confirm that the set value of the parameter matches the model code as specified when ordered. Parameters which were not specified when ordered must be set before use.
Some functions may need to be set in the Initial setting mode. Read the following part before attempting the setting.

⚠ WARNING

Parameters in the Initial setting mode should be set according to the application before setting any parameters related to operation. Once the parameters in the Initial setting mode are set correctly, no further changes need to be made to the 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 Initial setting mode.

NOTE

To make setting in the Initial setting mode, control needs to be stopped (STOP). With the factory setting, control is stopped when the mode is switched to the Initial setting mode. When the mode is switched back to the Monitor display mode from the Initial setting mode, control is started (RUN) again.

Control can be set to continue after switching to the Initial setting mode. For details, refer to **8.2 Continuing the Control when Entering the Initial Setting Mode (P. 8-5)**. Even if the control is set to continue in the Initial setting mode, the Initial setting mode still requires the control to be stopped (STOP). Switching between RUN and STOP can be made only in the Monitor display mode.

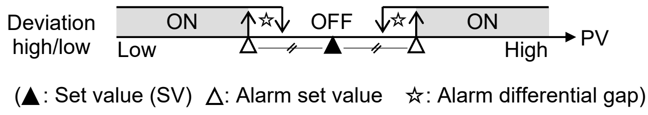
Set value change and registration

- The highlighted digit indicates which digit can be set. The highlighted digit can be shifted by pressing the <R/S key.
- However, the changed data is not stored by the operation of the UP and DOWN keys alone. In order to store the new parameter value, 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.
- In any mode other than the Initial setting mode, if no registration is made within 1 minute after the change, the display returns to the PV/SV monitor. In such a case the changed data is not stored.
- In the Initial setting mode, if no registration operation is made within 1 minute after the change, the display returns to the Initial setting code number screen to which the displayed parameter belongs (For example, in case of the Control output assignment screen, the display returns to the initial setting code 0002 screen). The changed data will not be stored in this case either.

5.3.1 Initial setting of setup example 1 (Setting parameters related to the alarm)

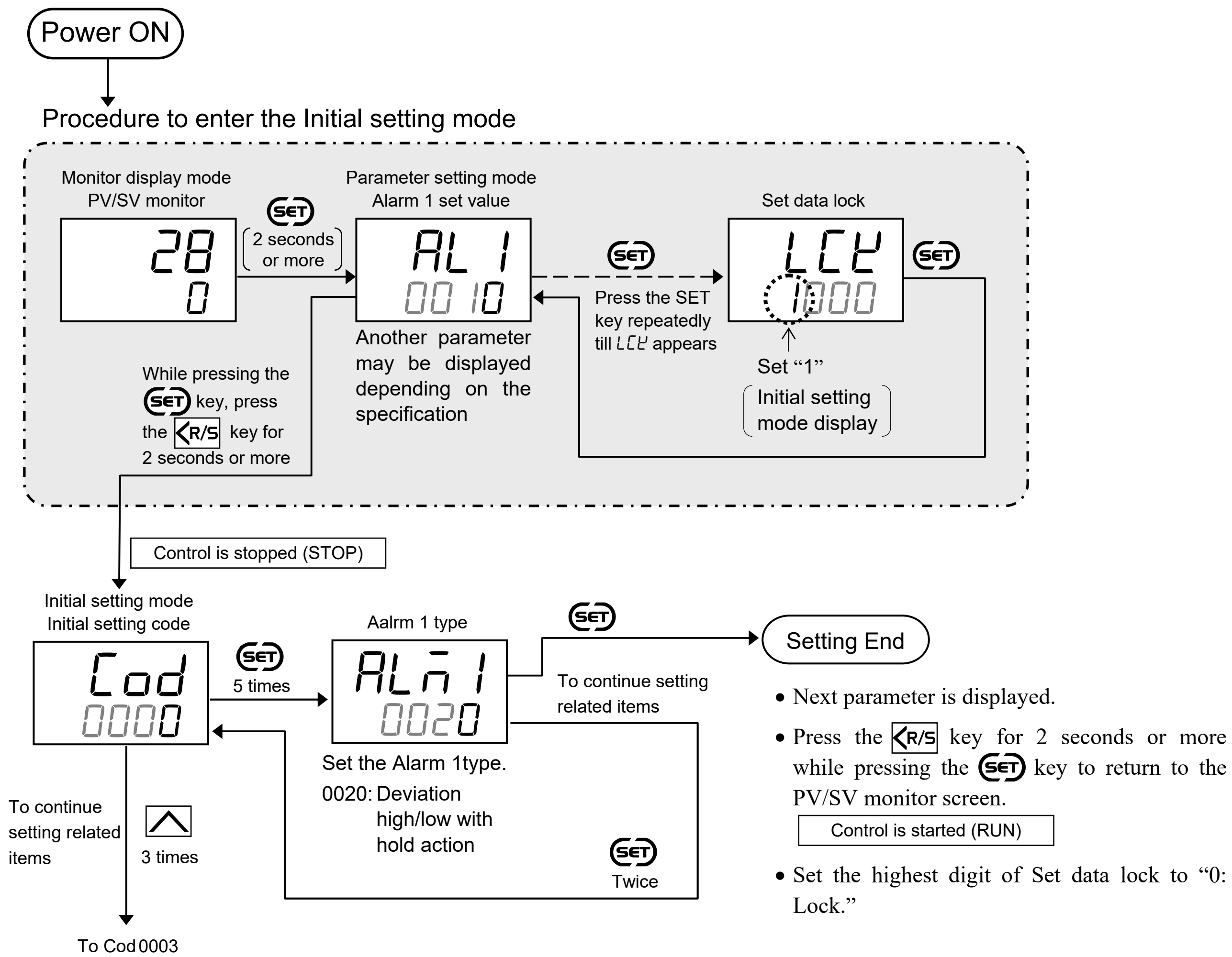
In the Setup example 1 (refer to P. 5-4), all default factory set values except alarm related parameters can be used in actual applications without any changes.
This section describes the Initial setting of the alarm related operation used in the Setup example 1.

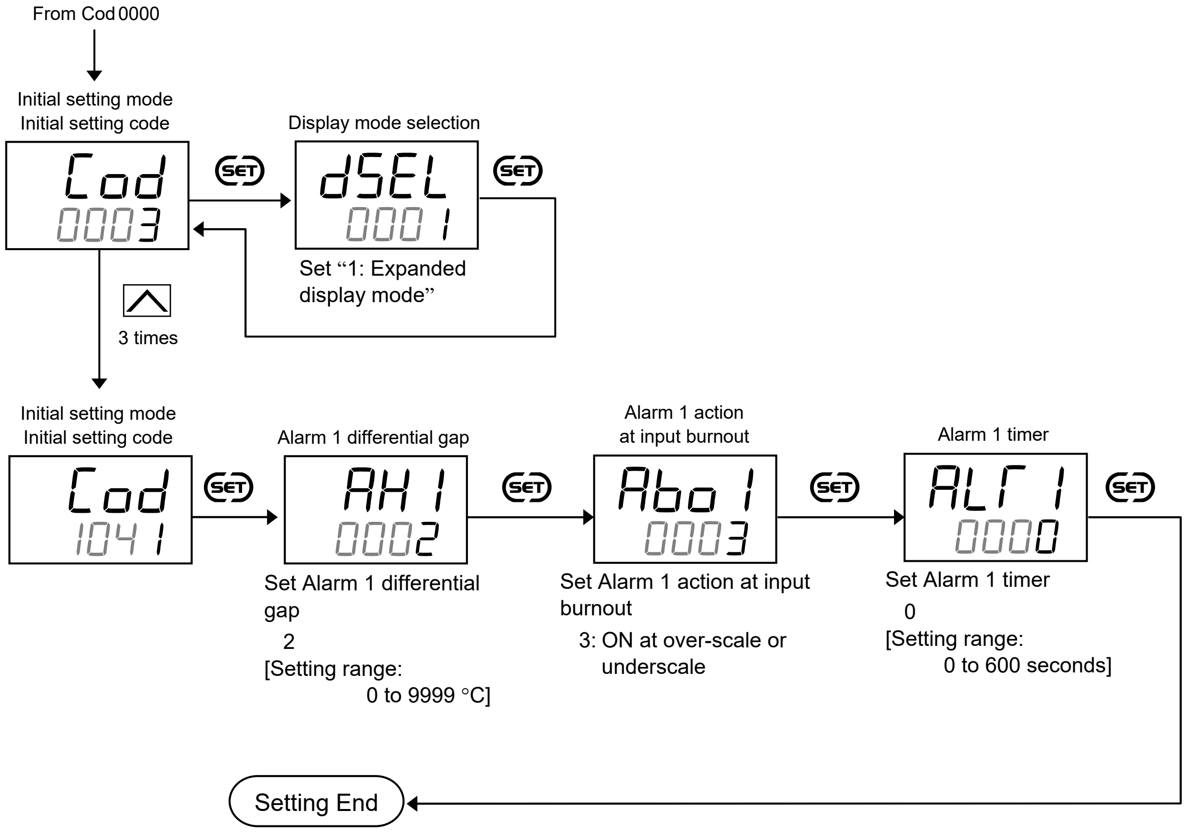
Setup example 1:
Alarm: Number of alarm points: 1 point (Uses Alarm 1)
Deviation high/low with hold action
Without interlock function



Parameters to be set (Initial setting mode):

- Mandatory setting items:
  Cod 0000: Alarm 1 type
- Related setting items (Set only when necessary):
  Cod 1041: Alarm 1 differential gap, Alarm 1 action at input burnout, Alarm 1 timer
- Items unnecessary to set (Used with factory setting):
  Cod 0002: Output assignment of Alarm 1
  [Alarm 1 is assigned to Output 3 (OUT3)]
  Output 3 (OUT3) energize/de-energize when assigned to alarm
  [Output 3 (OUT3) to which Alarm 1 is assigned is energizing]
  Cod 1041: Alarm 1 interlock
  [Alarm 1 interlock is disabled]





- Next parameter is displayed.
- Set the “Display mode selection” at Cod 0003 in the Initial setting mode to “0: Standard display mode.”
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.

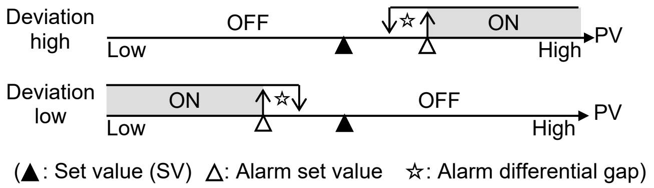
  Control is started (RUN)

- Set the highest digit of Set data lock to “0: Lock.”

5.3.2 Initial setting of setup example 2 (Setting parameters related to the input, control, output and alarm)

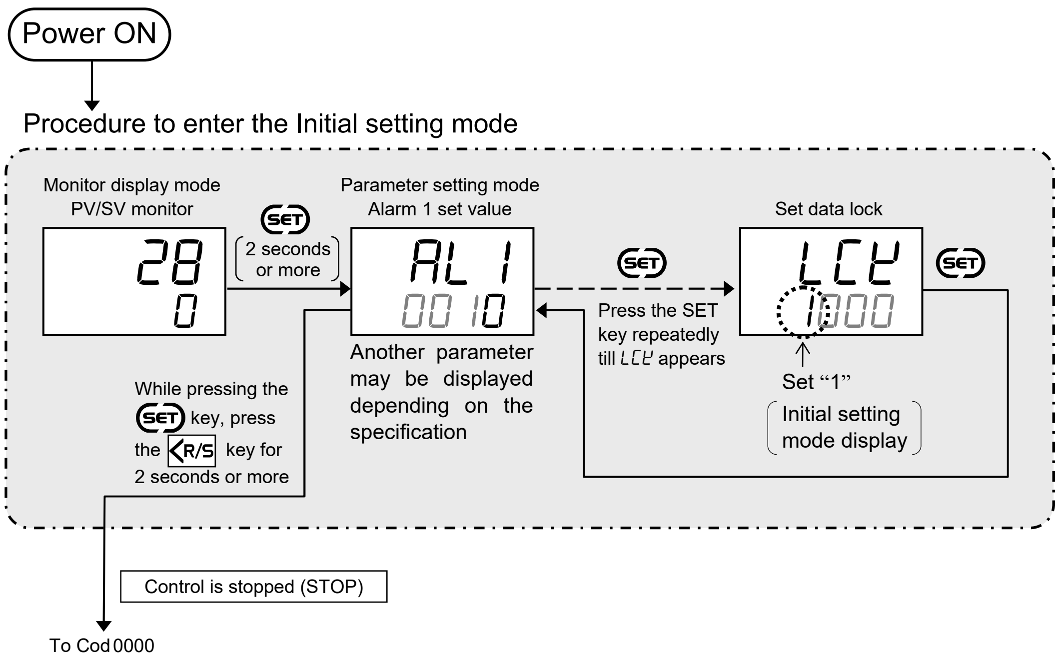
The setup example 2 (refer to P. 5-4) describes the initial setting of input, control, output and alarm action.

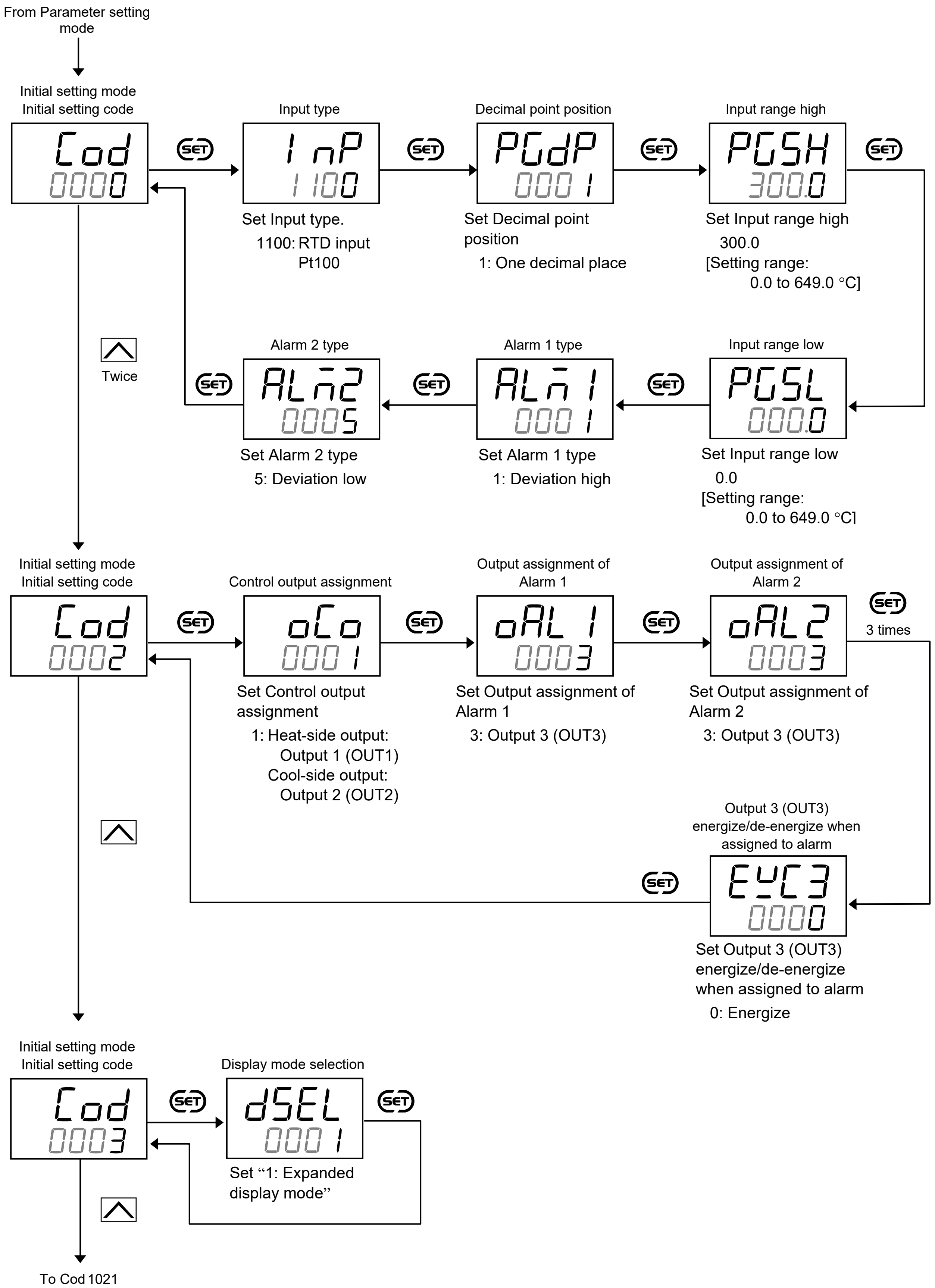
Setup example 2:
Input: RTD (Pt100), 0.0 to 300.0 °C
Control: Heat/Cool PID control with AT (air cooling)
Output: Control output:
  Heat-side: Uses Output 1 (OUT1)
  Cool-side: Uses Output 2 (OUT2)
 Alarm output: Uses Output 3 (OUT3)
  (Shared between Alarm 1 and Alarm 2)
Alarm: Number of alarm points: 2 points
  (Uses Alarm 1 and Alarm 2)
 Alarm 1 type: Deviation high
 Alarm 2 type: Deviation low
 Uses interlock function

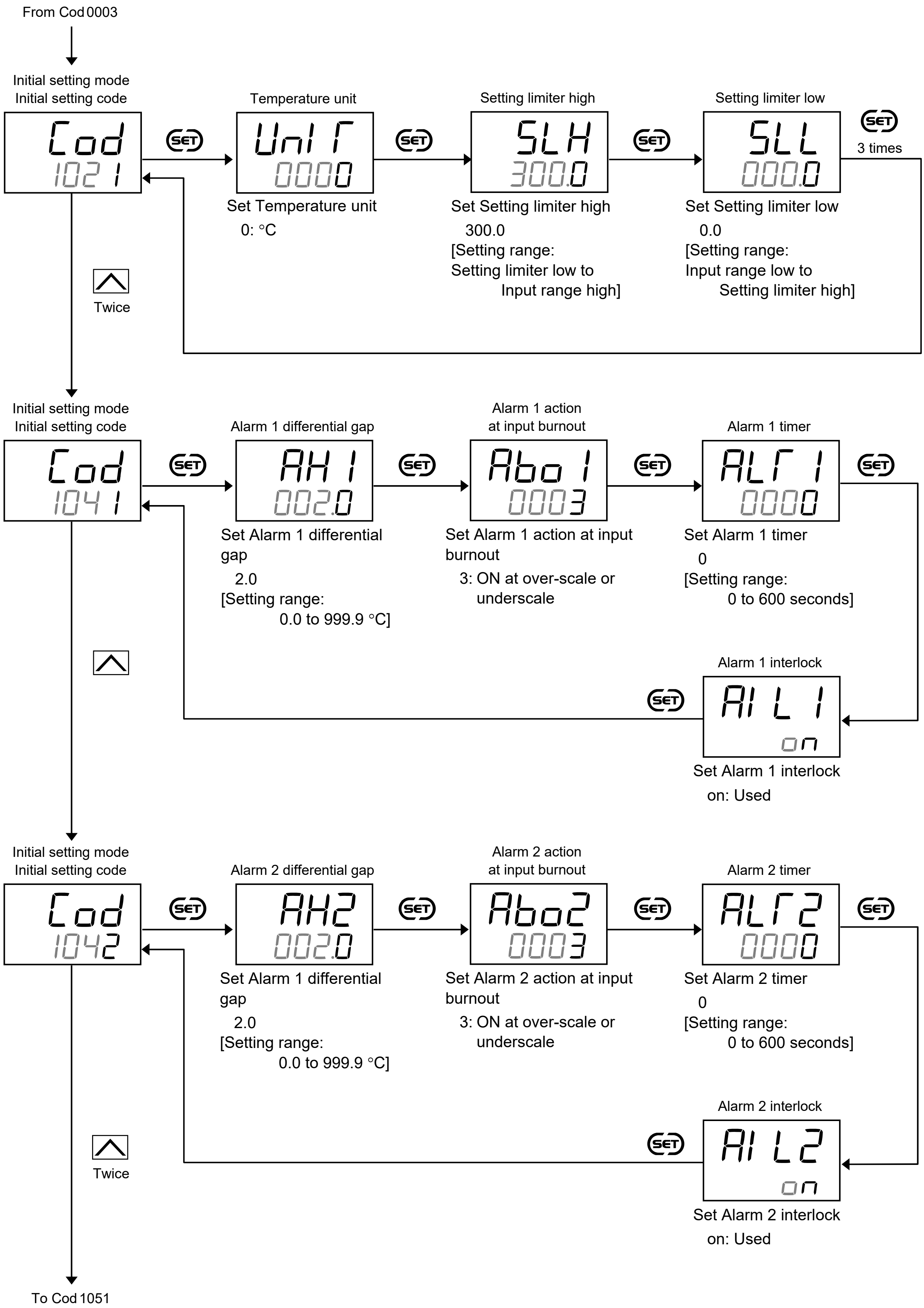


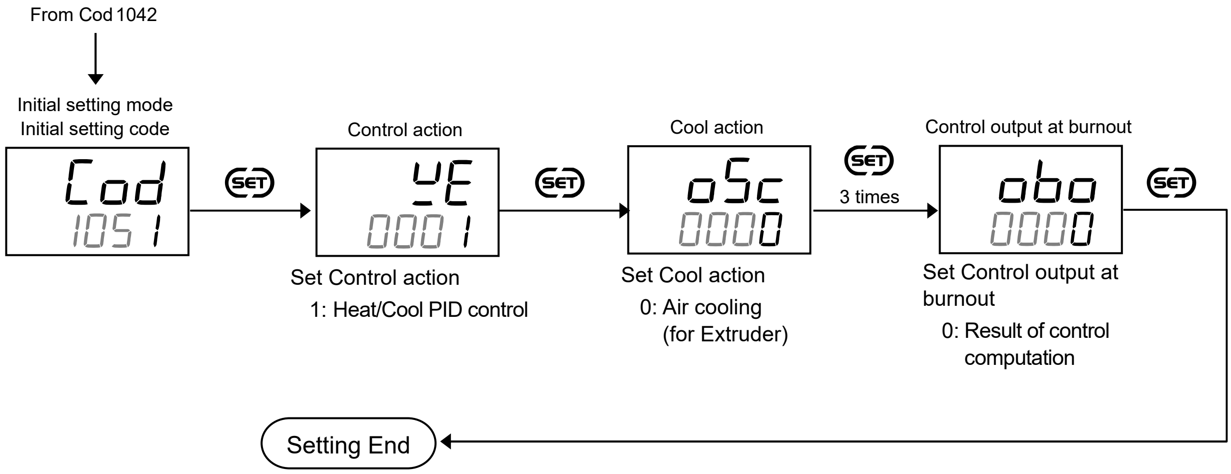
Parameters to be set (Initial setting mode):

- Mandatory setting items:
  Cod 0000: Input type, Decimal point position, Input range high, Input range low, Alarm 1 type, Alarm 2 type
  Cod 0002: Control output assignment, Output assignment of Alarm 1, Output assignment of Alarm 2
  Cod 1021: Temperature unit
  Cod 1041: Alarm 1 interlock
  Cod 1042: Alarm 2 interlock
  Cod 1051: Control action, Cool action
- Related setting items (Set only when necessary):
  Cod 0002: Output 3 (OUT3) energize/de-energize when assigned to alarm
  Cod 1021: Setting limiter high, Setting limiter low, PV flashing display at input error
  Cod 1041: Alarm 1 differential gap, Alarm 1 action at input burnout, Alarm 1 timer
  Cod 1042: Alarm 2 differential gap, Alarm 2 action at input burnout, Alarm 2 timer
  Cod 1051: Control output at burnout




From Parameter setting mode
Initial setting mode
Initial setting code
Cod
0000
Input type
InP
1100
Set Input type.
1100: RTD input Pt100
Decimal point position
PGdP
0001
Set Decimal point position
1: One decimal place
Input range high
PGSH
300.0
Set Input range high
300.0
[Setting range:
0.0 to 649.0 °C]
Input range low
PGSL
000.0
Set Input range low
0.0
[Setting range:
0.0 to 649.0 °C]
Alarm 1 type
0001
Set Alarm 1 type
1: Deviation high
Alarm 2 type
0005
Set Alarm 2 type
5: Deviation low
Twice
Initial setting mode
Initial setting code
Cod
0002
Control output assignment
oCo
0001
Set Control output assignment
1: Heat-side output:
Output 1 (OUT1)
Cool-side output:
Output 2 (OUT2)
Output assignment of Alarm 1
oAL1
0003
Set Output assignment of Alarm 1
3: Output 3 (OUT3)
Output assignment of Alarm 2
oAL2
0003
Set Output assignment of Alarm 2
3: Output 3 (OUT3)
3 times
Output 3 (OUT3) energize/de-energize when assigned to alarm
0000
Set Output 3 (OUT3) energize/de-energize when assigned to alarm
0: Energize
Initial setting mode
Initial setting code
Cod
0003
Display mode selection
dSEL
0001
Set “1: Expanded display mode”
To Cod 1021


From Cod 0003
Initial setting mode
Initial setting code
Cod
1021
SET
Temperature unit
UnIT
0000
Set Temperature unit
0: °C
Setting limiter high
SLH
300.0
Set Setting limiter high
300.0
[Setting range:
Setting limiter low to
Input range high]
Setting limiter low
SLL
000.0
Set Setting limiter low
0.0
[Setting range:
Input range low to
Setting limiter high]
3 times
Twice
Initial setting mode
Initial setting code
Cod
1041
Alarm 1 differential gap
AH1
002.0
Set Alarm 1 differential
gap
2.0
[Setting range:
0.0 to 999.9 °C]
Alarm 1 action
at input burnout
Abo1
0003
Set Alarm 1 action at input
burnout
3: ON at over-scale or
underscale
Alarm 1 timer
ALT1
0000
Set Alarm 1 timer
0
[Setting range:
0 to 600 seconds]
Alarm 1 interlock
AIL1
on
Set Alarm 1 interlock
on: Used
Initial setting mode
Initial setting code
Cod
1042
Alarm 2 differential gap
AH2
002.0
Set Alarm 1 differential
gap
2.0
[Setting range:
0.0 to 999.9 °C]
Alarm 2 action
at input burnout
Abo2
0003
Set Alarm 2 action at input
burnout
3: ON at over-scale or
underscale
Alarm 2 timer
ALT2
0000
Set Alarm 2 timer
0
[Setting range:
0 to 600 seconds]
Alarm 2 interlock
AIL2
on
Set Alarm 2 interlock
on: Used
Twice
To Cod 1051



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.

  Control is started (RUN)

- Set the highest digit of Set data lock to "0: Lock."

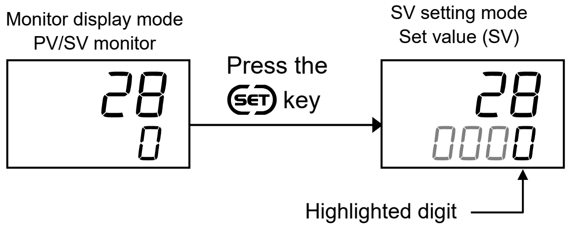
5.4 Setting the Control Set Value [Set value (SV)]

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

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

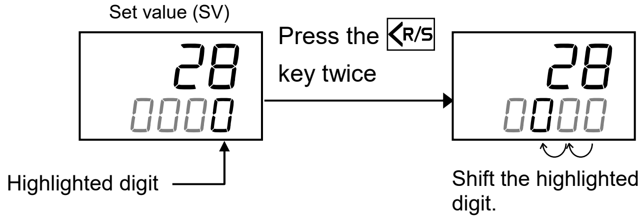
1. Switch the display to the Set value (SV) setting mode

Press the SET key to switch the display to the SV setting screen from the PV/SV monitor.



2. Shift the highlighted digit to the hundreds digit

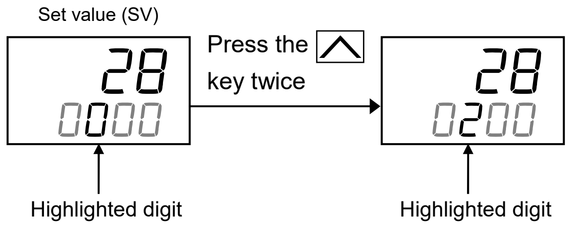
Press R/S key to shift the highlighted digit to the hundreds digit.
The highlighted digit indicates which digit can be set.



3. Change the numerical value from "0" to "2"

Press the UP key twice to change the numerical value from "0" to "2."

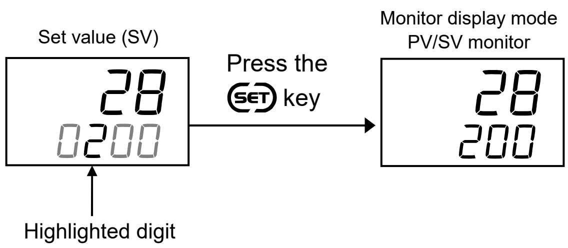
Setting range:
Setting limiter low to Setting limiter high
Varies with the setting of the Decimal point position.
Factory set value: 0



4. Store the set value (SV)

Press the SET key to store the set value.
The display changes to the next parameter.

The parameter displayed after the set value (SV) varies depends on the product specifications.



Set value change and registration

- The highlighted digit indicates which digit can be set. The highlighted digit can be shifted by pressing the R/S key.
- However, the changed data is not stored by the operation of the UP and DOWN keys alone. In order to store the new parameter value, 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.
- In any mode other than the Initial setting mode, if no registration is made within 1 minute after the change, the display returns to the PV/SV monitor. In such a case the changed data is not stored.

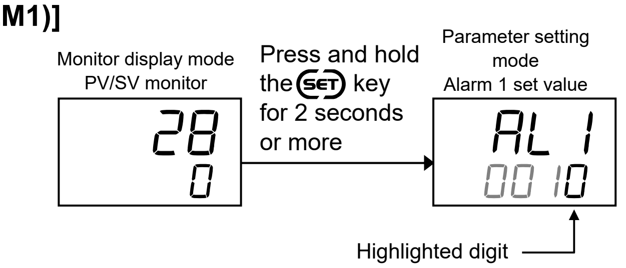
5.5 Setting the Alarm Set Value

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

[Setting example: Set the Alarm 1 set value (ALM1) to 20 °C.]

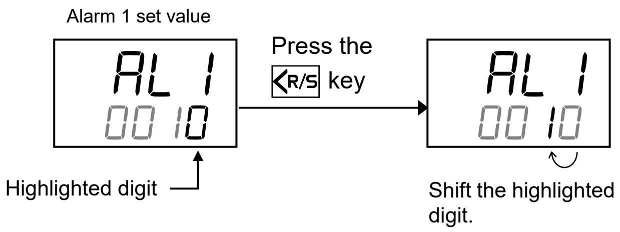
1. Switch the mode to the Parameter setting mode [Switch the screen to Alarm 1 set value (ALM1)]

Press and hold the SET key for 2 seconds or more on the PV/SV monitor screen until Parameter setting mode is displayed.
The first screen in the Parameter setting mode is Alarm 1 set value (ALM1).



2. Shift the highlighted digit to the tens digit

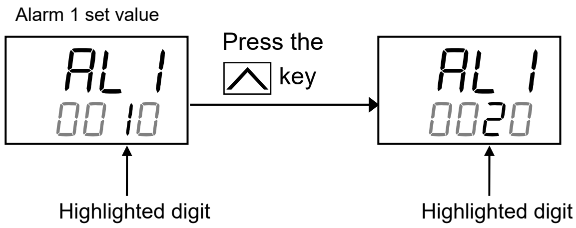
Press the R/S key to shift the highlighted digit to the tens digit. The highlighted digit indicates which digit can be set.



3. Change the numerical value from “1” to “2”

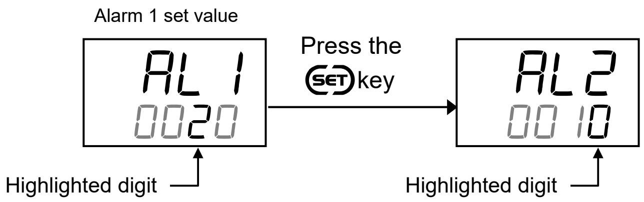
Press the △ key once to change the numerical value from “1” to “2.”

Setting range:
–1999 to +9999 or –199.9 to +999.9
(Unit: °C [°F])
Varies with the setting of the Decimal point position.
Factory set value: 10



4. Store the Alarm 1 set value

Press the SET key to store the set value. The display changes to the next parameter.



Set value change and registration

- The highlighted digit indicates which digit can be set. The highlighted digit can be shifted by pressing the R/S key.
- However, the changed data is not stored by the operation of the △ and ▽ keys alone. In order to store the new parameter value, 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.
- In any mode other than the Initial setting mode, if no registration is made within 1 minute after the change, the display returns to the PV/SV monitor. In such a case the changed data is not stored.

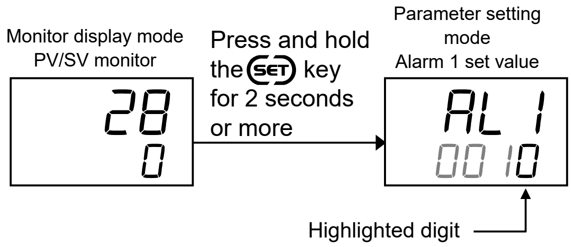
5.6 Tuning the PID Parameters (Execution of AT)

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

Before starting the Autotuning, make sure that all required conditions to start the AT are satisfied. (Refer to **11.3 Setting PID Values Automatically (Autotuning) [P. 11-8]**)

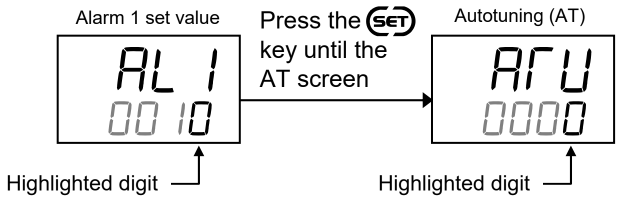
1. Switch the mode to the Parameter setting mode

Press and hold the SET key for 2 seconds or more on the PV/SV monitor screen until Parameter setting mode is displayed.
The first screen in the Parameter setting mode is Alarm 1 set value (ALM1).
(If alarm is supplied)



2. Switch the display to the Autotuning (AT)

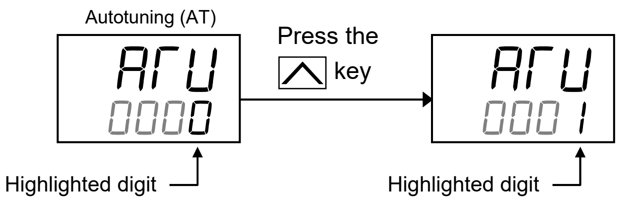
Press the SET key until the Autotuning (AT) is displayed.
The number of available displays depends on the specification.



3. Change the numerical value from "0" to "1"

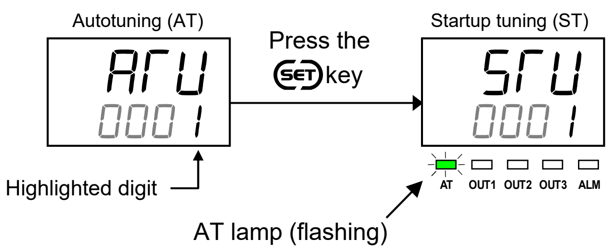
Press the UP key to change the numerical value from "0" to "1."

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



4. Start the Autotuning (AT)

Press the SET key to store the set value. The display shows the next parameter and the autotuning (AT) is started.
The Autotuning (AT) lamp starts flashing.



5. Finish the Autotuning (AT)

When the Autotuning (AT) is finished, the control will automatically return to "0: PID control" and the AT lamp turns off.

- When canceling the Autotuning (AT) function, press the DOWN key to be set to “0: PID control” with the Autotuning (AT) screen.

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

- If no key operation is performed within 1 minute, the display returns to the PV/SV monitor screen. If the Autotuning (AT) is not completed yet at this moment, the Autotuning (AT) continues even after the display has returned to the PV/SV monitor.

MEMO

INPUT FUNCTION

6

This chapter describes input related functions, setting contents and setting procedure based on the key words related to inputs.

6.1 Changing Input

Measured input can be changed at following parameters. Set the input according to the sensor and the application.

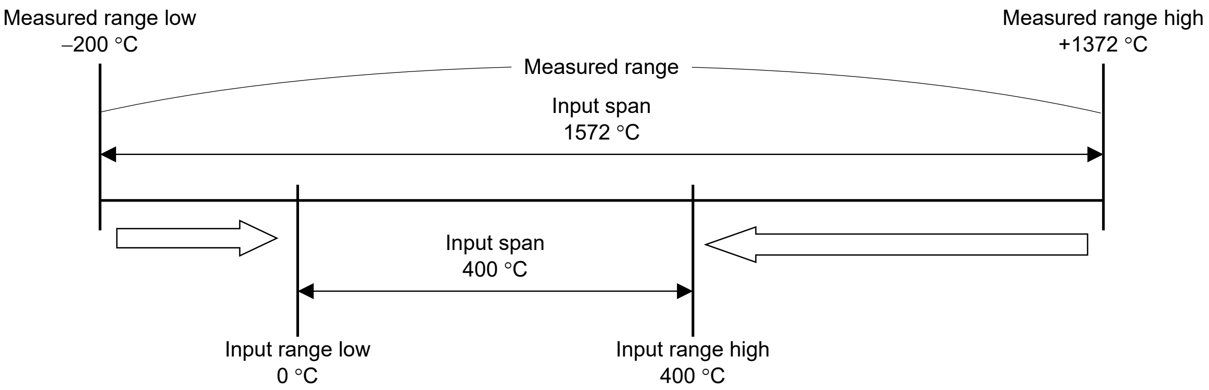
- Input type
- Decimal point position
- Input range high/Input range low
- Temperature unit

■ Description of function

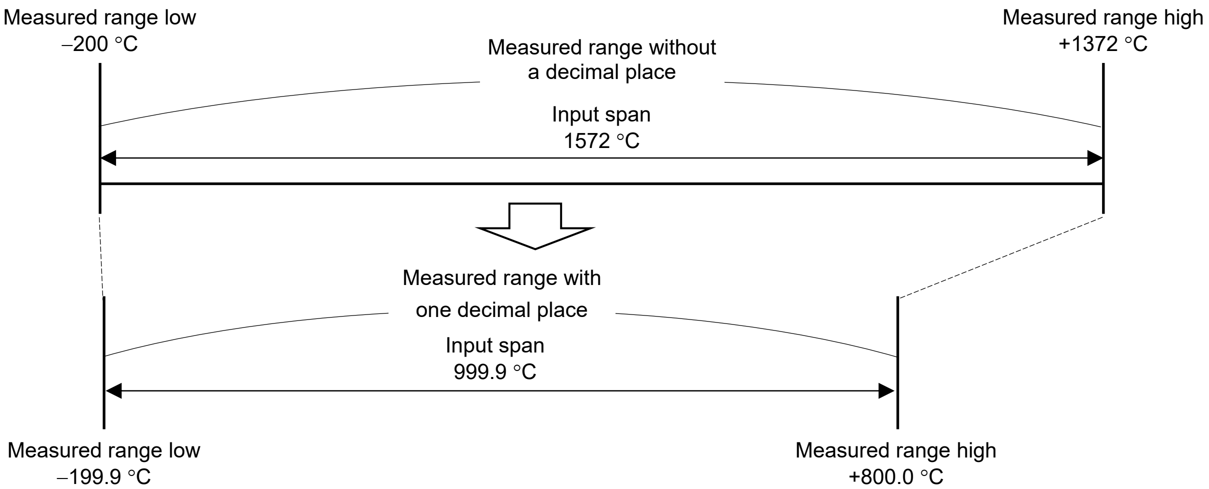
Input range high/low

High and low limits of the input range can be changed within the measured range.
(The input range specified when ordered can be changed by setting the input range high and low.)

Example of input change 1:
Changing thermocouple K “−200 to +1372 °C” to “0 to 400 °C”



Example of input change 2:
When a range of −200 to +1372 °C with a type K thermocouple input is changed from “No decimal place” to “One decimal place,” the measured range is changed to −199.9 to +800.0 °C. For a thermocouple input K with a range with one decimal place, the maximum measured range is limited to −199.9 to +800.0 °C.



NOTE

Changing a Decimal point position changes the input resolution.

■ Parameter setting

☞ Refer to the **Measured range table (P. 6-5)** for the measured range of each input type.

☞ For the input range code, refer to **Input range code table (P. 6-5)**.

● Input type [Initial setting mode: Cod 0000]

Parameter symbol	Data range		Factory set value
InP	0000: TC input K 0001: TC input J 0010: TC input L 0011: TC input E 0100: TC input N 0101: TC input T 0110: TC input U	0111: TC input R 1000: TC input S 1001: TC input B 1010: TC input W5Re/W26Re 1011: TC input PL II 1100: RTD input Pt100 1101: RTD input JPt100	When input range code is specified at the time of ordering, the input type in the input range code is the factory setting. If input range code is not specified: 0000

☞ Some parameters are initialized when Input type is changed. Refer to appendix **A.1 Parameters to be Initialized/Changed at the time of changing set values (P. A-2)**.

● Decimal point position [Initial setting mode: Cod 0000]

Parameter symbol	Data range	Factory set value
PGdP	0: No decimal place 1: One decimal place Setting below zero (first decimal place) is possible if the selected input type has a measured range with a decimal place.	When input range code is specified at the time of ordering, the decimal point position in the input range code is the factory setting. If input range code is not specified: 0

NOTE

Changing a Decimal point position changes the input resolution.

☞ Range of some parameters are limited when a Decimal point position is changed. Refer to appendix **A.1 Parameters to be Initialized/Changed at the time of changing set values (P. A-2)**.

● Input range high [Initial setting mode: Cod 0000]

Parameter symbol	Data range	Factory set value
PGSH	(Input range low + 1 digit) to Measured range high Varies with the setting of the Decimal point position.	When input range code is specified at the time of ordering, the input range high in the input range code is the factory setting. If input range code is not specified: 400

NOTE

When the input range is changed, it is recommended to set a value within the specified range shown in the measured range table. Setting a value outside the described range may change the input resolution.

☞ Some parameters are limited when Input range high limit or low limit is changed. Refer to appendix **A.1 Parameters to be Initialized/Changed at the time of changing set values (P. A-2)**.

- **Input range low**
  [Initial setting mode: Cod 0000]

Parameter symbol	Data range	Factory set value
PGSL	Measured range low to (Input range high – 1 digit) Varies with the setting of the Decimal point position.	When input range code is specified at the time of ordering, the input range low in the input range code is the factory setting. If input range code is not specified: 0

NOTE

When the input range is changed, it is recommended to set a value within the specified range shown in the measured range table. Setting a value outside the described range may change the input resolution.

☞ Some parameters are limited when Input range high limit or low limit is changed. Refer to appendix **A.1 Parameters to be Initialized/Changed at the time of changing set values (P. A-2)**.

- **Temperature unit**
  [Initial setting mode: Cod 1021] EX

Parameter symbol	Data range	Factory set value
UnIT	0: °C 1: °F	When input range code is specified at the time of ordering, the temperature unit in the input range code is the factory setting. If input range code is not specified: 0

NOTE

Changing a temperature unit changes the input resolution.

To show the "Temperature unit," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

☞ Some parameters are limited when Temperature unit is changed. Refer to appendix **A.1 Parameters to be Initialized/Changed at the time of changing set values (P. A-2)**.

Measured range table

● TC input

Input type	Measured range	
K	−200 to +1372 °C	−328 to +2502 °F
	−199.9 to +400.0 °C	−100.0 to +752.0 °F
	−199.9 to +800.0 °C	
J	−200 to +1200 °C	−328 to +2192 °F
	−199.9 to +300.0 °C	−199.9 to +550.0 °F
T	−200 to +400 °C	−328 to +752 °F
	−199.9 to +300.0 °C	−199.9 to +300.0 °F
	−199.9 to +400.0 °C	−199.9 to +600.0 °F
		−199.9 to +752.0 °F
S	0 to 1769 °C	0 to 3216 °F
R	0 to 1769 °C	0 to 3216 °F
E	0 to 1000 °C	0 to 1832 °F
B	0 to 1820 °C	0 to 3308 °F
N	0 to 1300 °C	0 to 2372 °F
PL II	0 to 1390 °C	0 to 2534 °F
W5Re/W26Re	0 to 2320 °C	0 to 4208 °F
U	−200 to +600 °C	−328 to +1112 °F
	−199.9 to +600.0 °C	−199.9 to +999.9 °F
L	0 to 900 °C	0 to 1652 °F

● RTD input

Input type	Measured range	
Pt100	−200 to +649 °C	−328 to +1200 °F
	−199.9 to +649.0 °C	−199.9 to +999.9 °F
JPt100	−200 to +649 °C	−328 to +1200 °F
	−199.9 to +649.0 °C	−199.9 to +999.9 °F

Measured range table and Input range code table

The measured range table shows the measured range of each input by the temperature unit and a decimal point position. Input resolution depends on the range.

The range code table is a list of input range codes so that a user can specify the input range at the time of ordering.

Even if the input range has been specified when ordered, the input range can be changed later within the measured range.

Input range code table (Input ranges specifiable at ordering)

● TC input

Input type	Code	Range
K	K01	0 to 200 °C
	K02	0 to 400 °C
	K03	0 to 600 °C
	K04	0 to 800 °C
	K05	0 to 1000 °C
	K06	0 to 1200 °C
	K07	0 to 1372 °C
	K09	0.0 to 400.0 °C
	K10	0.0 to 800.0 °C
	K13	0 to 100 °C
	K14	0 to 300 °C
	K17	0 to 450 °C
	K20	0 to 500 °C
	K41	−200 to +1372 °C
	K43	−199.9 to +400.0 °C
	KA1	0 to 800 °F
	KA2	0 to 1600 °F
	KA3	0 to 2502 °F
	KC8	−100.0 to +752.0 °F
J	J01	0 to 200 °C
	J02	0 to 400 °C
	J03	0 to 600 °C
	J04	0 to 800 °C
	J05	0 to 1000 °C
	J06	0 to 1200 °C
	J07	−199.9 to +300.0 °C
	J10	0 to 450 °C
	JA1	0 to 800 °F
	JA2	0 to 1600 °F
	JA3	0 to 2192 °F
	JA6	0 to 400 °F

Input type	Code	Range
J	JA7	0 to 300 °F
	JB9	−328 to +2192 °F
	JC8	−199.9 to +550.0 °F
T	T01	−199.9 to +400.0 °C
	T02	−199.9 to +100.0 °C
	T03	−100.0 to +200.0 °C
	T04	0.0 to 350.0 °C
	T05	−199.9 to +300.0 °C
	T06	0.0 to 400.0 °C
R	R01	0 to 1600 °C
	R02	0 to 1769 °C
	R04	0 to 1350 °C
	RA1	0 to 3200 °F
S	S01	0 to 1600 °C
	S02	0 to 1769 °C
B	B01	400 to 1800 °C
	B02	0 to 1820 °C
E	E01	0 to 800 °C
	E02	0 to 1000 °C
N	N01	0 to 1200 °C
W5Re/W26Re	W01	0 to 2000 °C
	W02	0 to 2320 °C
	WA1	0 to 4000 °F
PL II	A01	0 to 1300 °C
	A02	0 to 1390 °C
	A03	0 to 1200 °C
	AA1	0 to 2400 °F
	AA2	0 to 2534 °F
U	U01	−199.9 to +600.0 °C
L	L01	0 to 400 °C

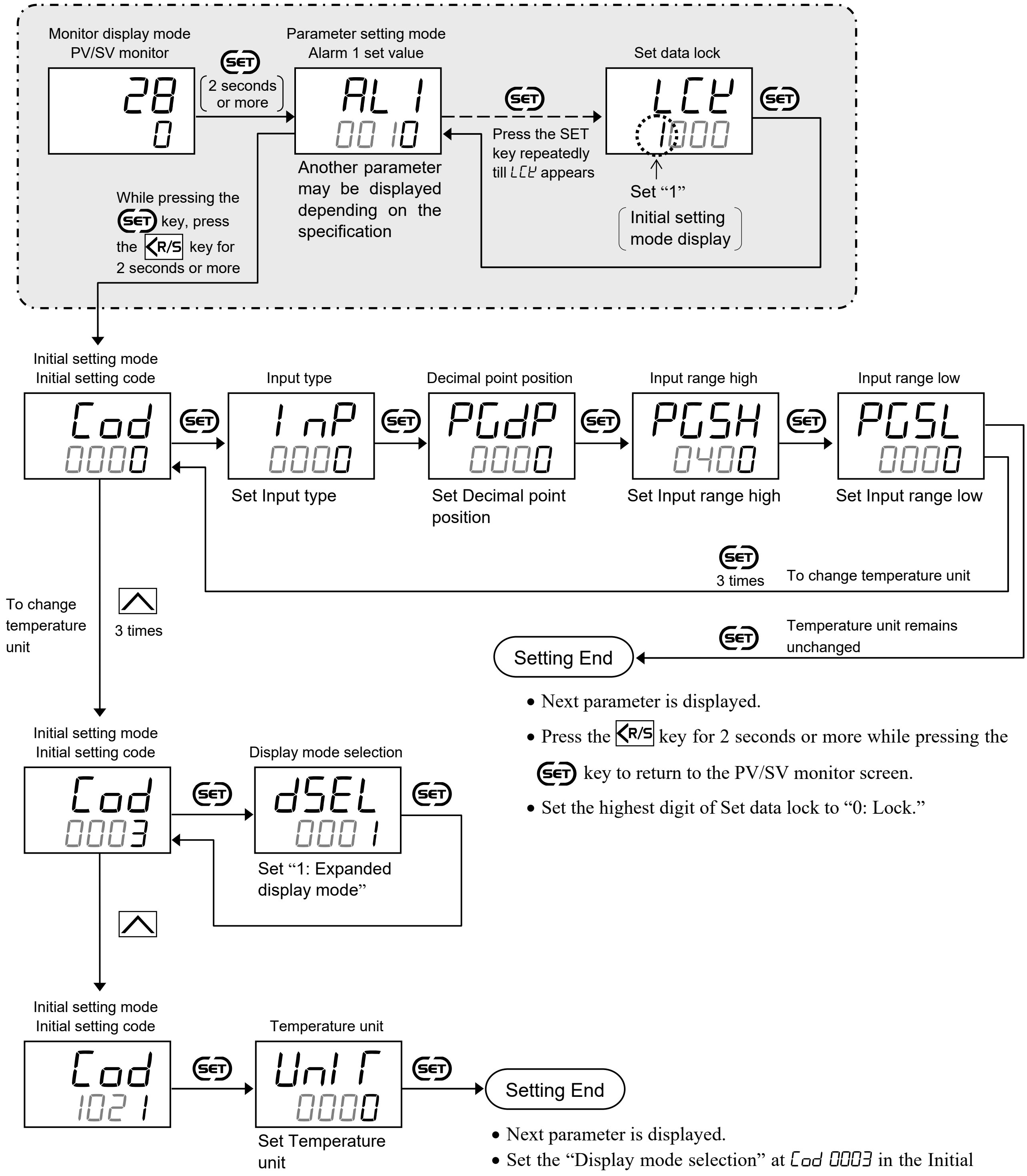
● RTD input

Input type	Code	Range
Pt100	D01	−199.9 to +649.0 °C
	D02	−199.9 to +200.0 °C
	D03	−100.0 to +50.0 °C
	D04	−100.0 to +100.0 °C
	D05	−100.0 to +200.0 °C
	D06	0.0 to 50.0 °C
	D07	0.0 to 100.0 °C
	D08	0.0 to 200.0 °C
	D09	0.0 to 300.0 °C
	D10	0.0 to 500.0 °C
	DA1	−199.9 to +999.9 °F
	DA3	−199.9 to +200.0 °F
	DA4	−199.9 to +100.0 °F
	DA5	−199.9 to +300.0 °F
	DA6	0.0 to 100.0 °F
	DA8	0.0 to 400.0 °F
	DA9	0.0 to 500.0 °F
	DB2	−199.9 to +900.0 °F
JPt100	P01	−199.9 to +649.0 °C
	P02	−199.9 to +200.0 °C
	P04	−100.0 to +100.0 °C
	P05	−100.0 to +200.0 °C
	P06	0.0 to 50.0 °C
	P07	0.0 to 100.0 °C
	P08	0.0 to 200.0 °C
	P09	0.0 to 300.0 °C
	P10	0.0 to 500.0 °C

■ Setting procedure

- Input type, Decimal point position and Input range high/low can be set at Cod 0000 in the Initial setting mode.
- Temperature unit can be set at Cod 1021 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

6.2 Correcting Input

PV bias can be used for Input correction. 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.

■ Description of function

● PV bias

PV bias adds bias to the Measured value (PV).

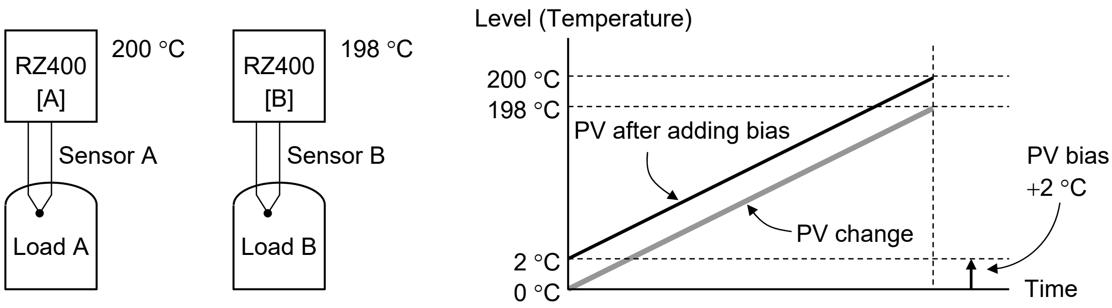
Setting example of PV bias:

When measuring the same type of load by using different sensors, the Measured value (PV) will be displayed differently based on the features of sensors:

RZ400 [A]: 200 °C   RZ400 [B]: 198 °C

To correct the Measure value (PV) of RZ400 [B], add bias of +2 °C by PV bias:

Displayed value = Measured value (PV) + PV bias = 198 °C + 2 °C = 200 °C



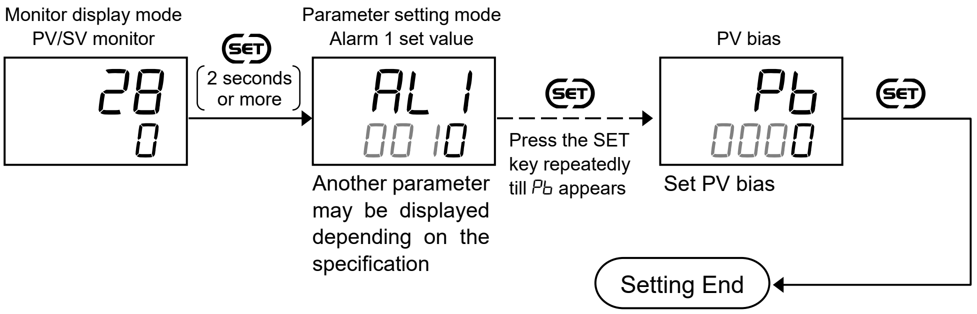
■ Parameter setting

● PV bias
[Parameter setting mode]

Parameter symbol	Data range	Factory set value
Pb	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	0 or 0.0

■ Setting procedure

PV bias can be set in Parameter setting mode.



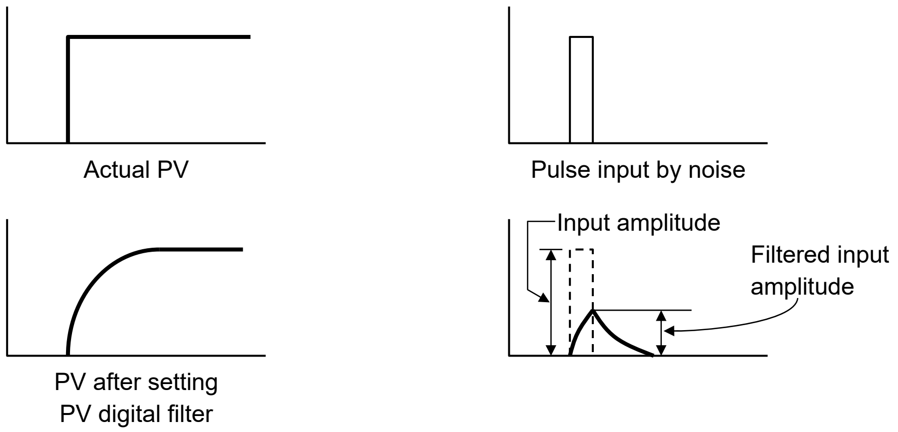
- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

6.3 Preventing the Input Flicker

To prevent the input flicker, PV digital filter with the first-order lag calculation is provided.

■ Description of function

PV digital filter is software designed to reduce variance of PV caused by noise. Effect of Input noise can be reduced by setting time constant of PV digital filter based on the controlled object requirement and its level of noise. Setting a value too small leads to a poor result of PV digital filter; just as an input response will be poor when setting a value too large.



■ Parameter setting

● PV digital filter [Parameter setting mode] EX

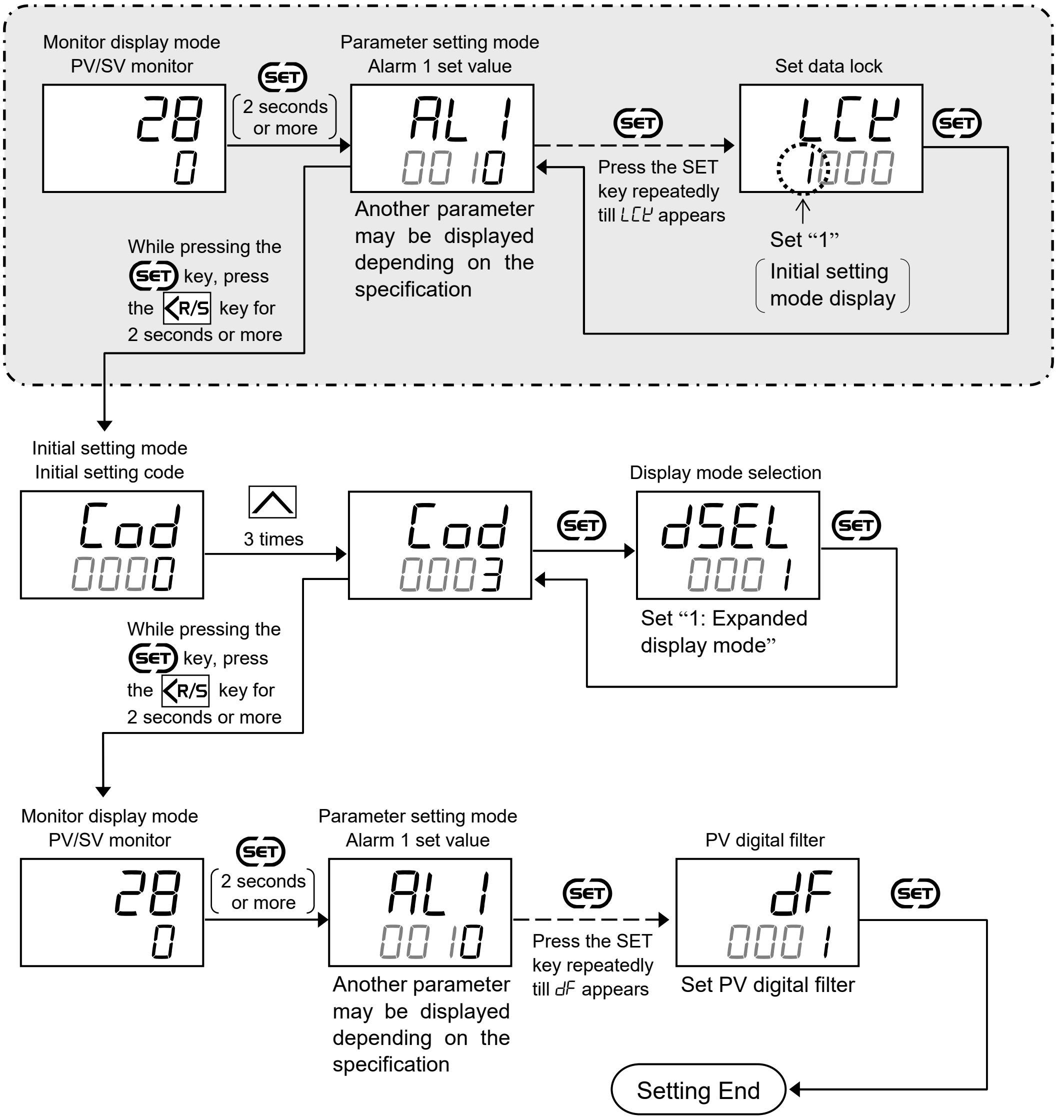
Parameter symbol	Data range	Factory set value
dF	0 to 100 seconds (0: Digital filter function OFF)	1

To show the "PV digital filter," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

PV digital filter can be set in the Parameter setting mode.
To show the PV digital filter, enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

Procedure to enter the Initial setting mode



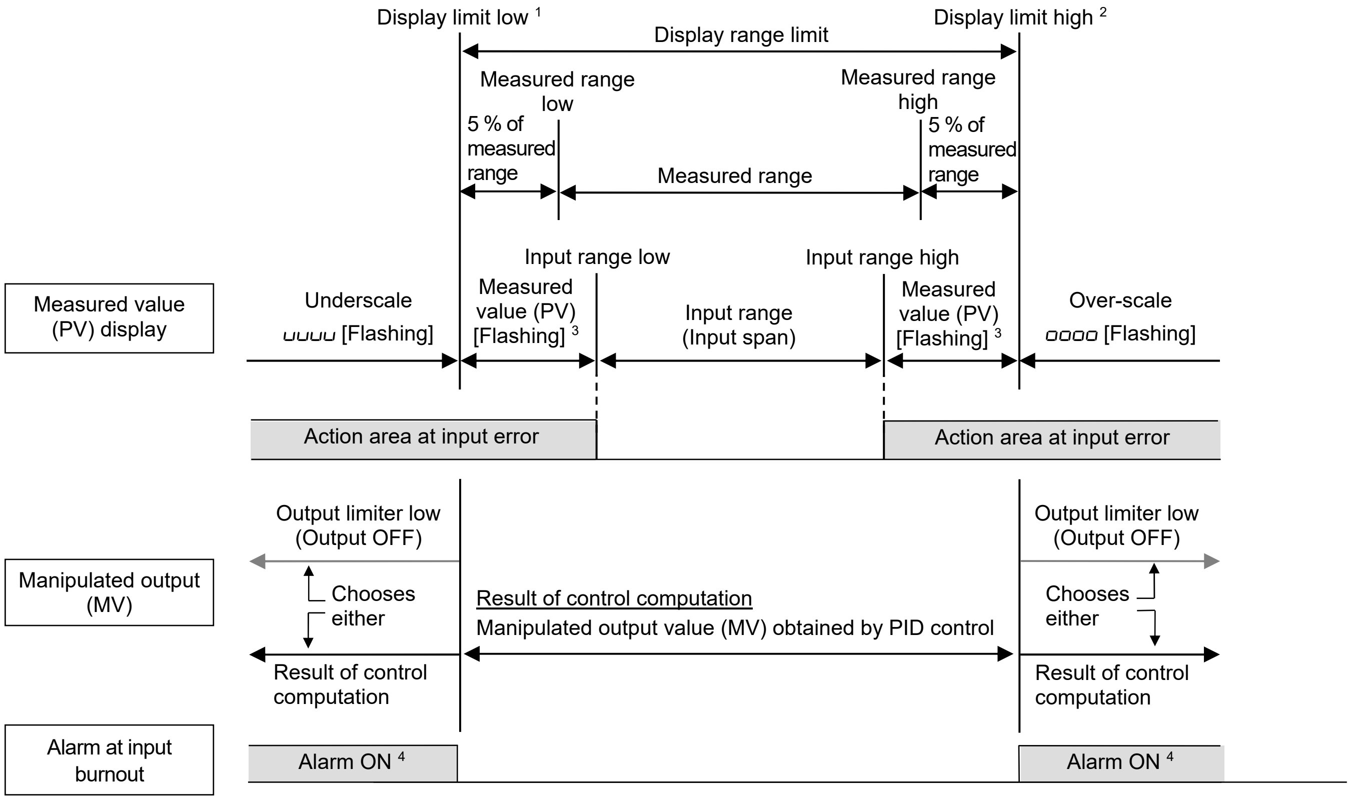
- Next parameter is displayed.
- Set the “Display mode selection” at Cod 0003 in the Initial setting mode to “0: Standard display mode.”
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to “0: Lock.”

6.4 Changing Error Handling at Input Error

PV flashing display at input error, Control output at burnout and Alarm action at input burnout can be set.

■ Description of function

When the Measured value (PV) exceeds the input range high limit or goes below the input range low limit, action is switched to the one specified in the Selection of control output at input burnout. Alarm functions according to the setting of the Selection of alarm action at input burnout.



[1] Minimum display limit is −1999 or −199.9

[2] Maximum display limit is 9999 or 999.9

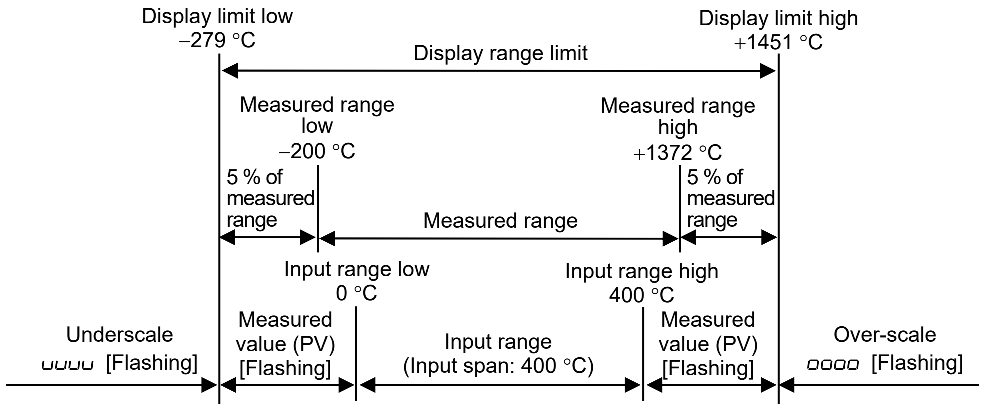
[3] "Flashing display" or "Non-flashing display" of PV can be selected for the "PV flashing display at input error."

[4] Selection of "Alarm NOT forced to ON" at input burnout is possible at Selection of Alarm action at input burnout.

☞ Refer to the **Measured range table (P. 6-5)** for the measured range of each input type.

[Example of display range at the time of abnormal input]

Input type: thermocouple K, Measured range: −200 to +1372 °C, Input range: 0 to 400 °C



■ Parameter setting

● PV flashing display at input error [Initial setting mode: Cod 1021] EX

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

To show the "PV flashing display at input error," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

● Alarm 1 and 2 action at input burnout [Initial setting mode: Cod 1041, Cod 1042] EX

Parameter symbol	Data range	Factory set value
Abo1 Abo2	0: Alarm output is not forcibly turned ON when the burnout function is activated. 1: ON at over-scale; no action at underscale [1] 2: ON at underscale; no action at over-scale [1] 3: ON at over-scale or underscale 4: OFF at over-scale or underscale [2]	3

[1] "No action" means alarm action is not forced to ON when burnout occurs. For example, if the alarm is ON when burnout occurs, the alarm remains ON.

[2] Regardless of the alarm state, alarms are forced to turn off when overrange (going over-scale or underscale) happens.

To show the "Alarm 1 action at input burnout" and "Alarm 2 action at input burnout," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

To show the "Alarm 1 action at input burnout," set a value other than "None" at Cod 0000 (Alarm 1 type) in the Initial setting mode.

To show the "Alarm 2 action at input burnout," set a value other than "None" at Cod 0000 (Alarm 2 type) in the Initial setting mode.

For alarm output, refer to **7.1 Changing Output Assignment (P. 7-2)**.

For alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**.

● Control output at burnout [Initial setting mode: Cod 1051] EX

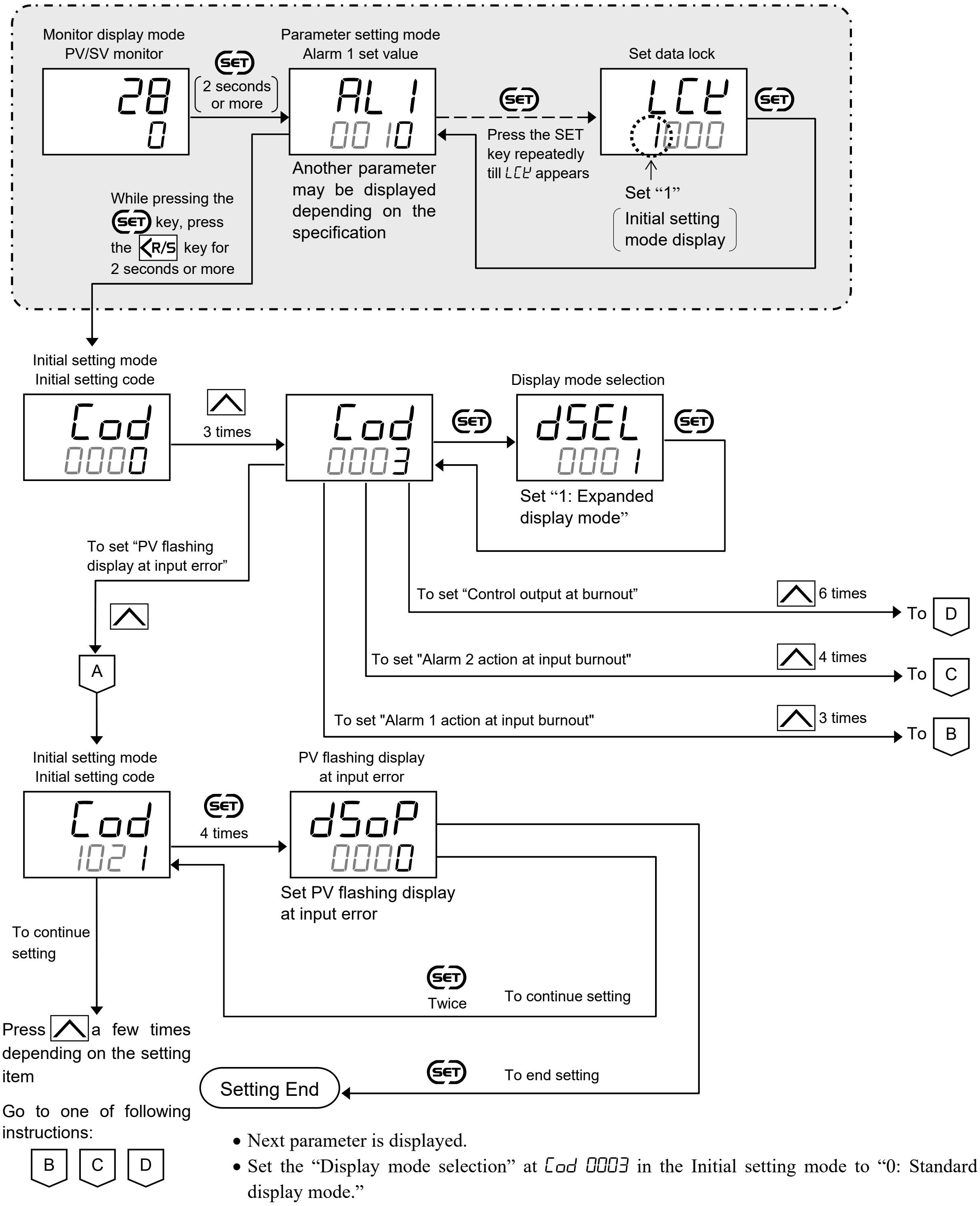
Parameter symbol	Data range	Factory set value
obo	0: Result of control computation 1: PID control: Output limiter low (output OFF) Heat/Cool PID control: −5.0 % (output OFF) * * Both heating and cooling outputs are forced OFF.	PID control: 0 Heat/Cool PID control: 1

To show the "Control output at burnout," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

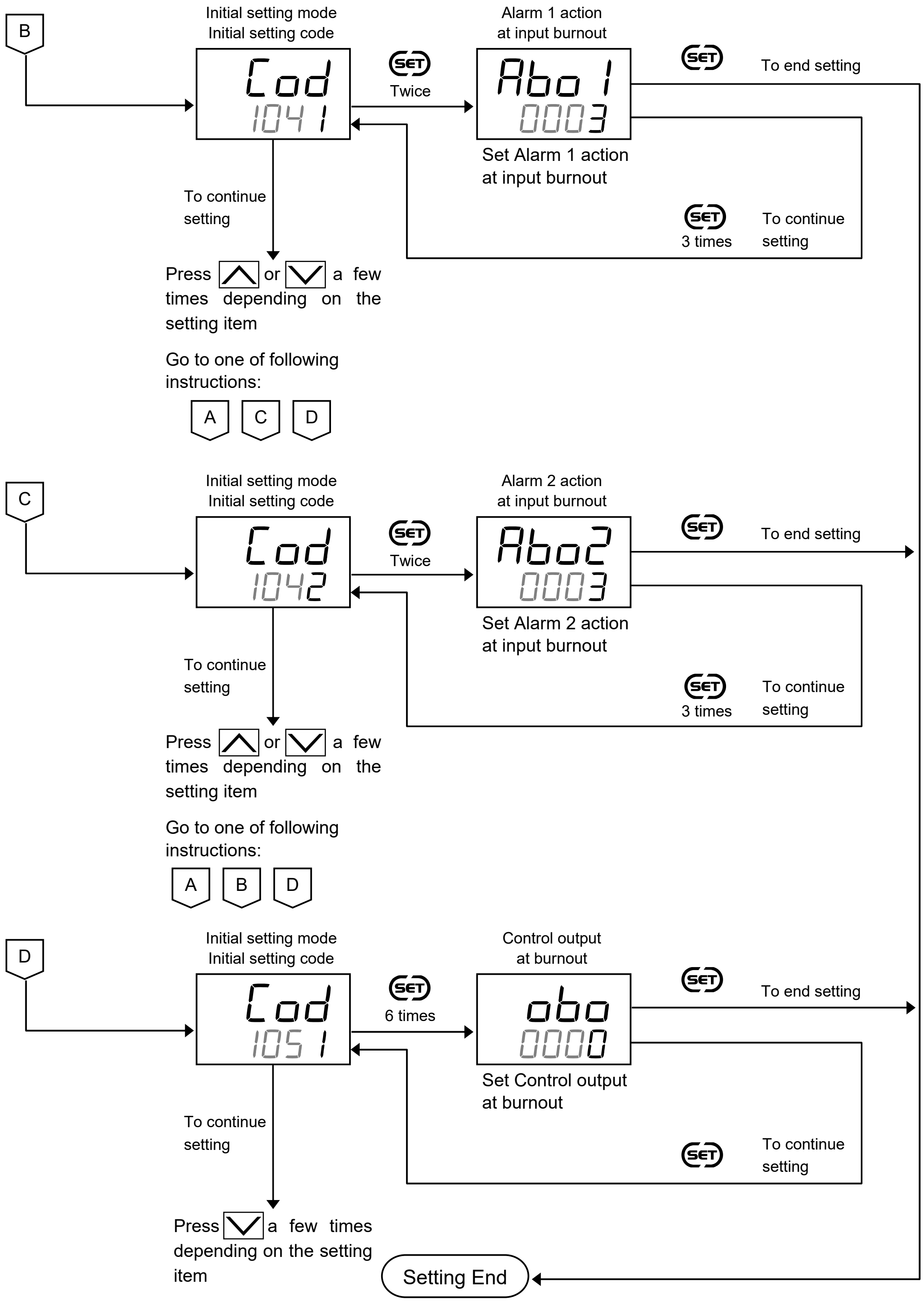
- PV flashing display at input error can be set at Cod 1021 in the Initial setting mode.
- Alarm 1 output action at input burnout can be set at Cod 1041 in the Initial setting mode.
- Alarm 2 output action at input burnout can be set at Cod 1042 in the Initial setting mode.
- Control output at burnout can be set at Cod 1051 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Set the “Display mode selection” at Cod 0003 in the Initial setting mode to “0: Standard display mode.”
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to “0: Lock.”

Continued on the next page.



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

MEMO

OUTPUT FUNCTION

7

This chapter describes output related functions, setting contents and setting procedure based on the key words related to outputs.

7.1 Changing Output Assignment

This instrument has up to three hardware outputs. The following output signals can be assigned to each output.

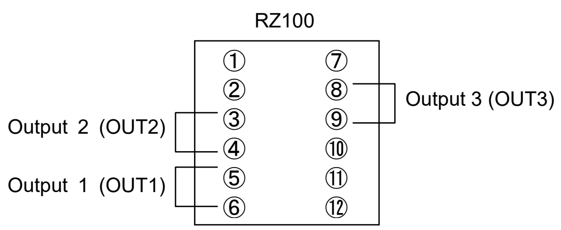
- Control output
- Alarm output
- Heater break alarm (HBA) output (option)

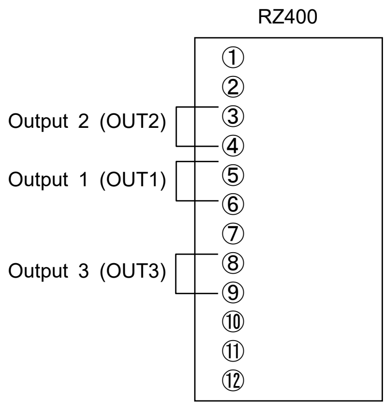
Configuration of alarm type, Heater break alarm setup and selection of energized/de-energized will be required to provide alarm and Heater break alarm (HBA) output in addition to the output assignment.

■ Description of function

Assign outputs [control output, alarm output, Heater break alarm (HBA) output] to the output terminals. When assigning outputs, assign Control output(s) first. Then, assign Alarm output and Heater break alarm (HBA) output. Refer to the following table for available assignments.

● Output terminals





● Output assignment [for PID control]

Control output	Alarm 1 output	Alarm 2 output	Heater break alarm 1 (HBA1) output	Heater break alarm 2 (HBA2) output
No assignment	Any one of Output 1, 2, and 3 (OUT1, 2, 3) *		Not settable	
Output 1 (OUT1)	Output 2 (OUT2) or Output 3 (OUT3) *			
Output 2 (OUT2)	Output 1 (OUT1) or Output 3 (OUT3) *			

* Output assignment can be overlapped. Overlapped outputs are produced as *OR* output.

● Output assignment [for Heat/Cool PID control]

Control output		Alarm 1 output	Alarm 2 output	Heater break alarm 1 (HBA1) output	Heater break alarm 2 (HBA2) output
Heat-side output	Cool-side output				
No assignment	No assignment	Any one of Output 1, 2, and 3 (OUT1, 2, 3) [1]		Not settable	
Output 1 (OUT1)	Output 2 (OUT2)	Output 3 (OUT3) [1]			
Output 2 (OUT2)	Output 1 (OUT1)	Output 3 (OUT3) [1]			
Output 1 (OUT1)	Output 3 (OUT3) [2]	Output 2 (OUT2) [1]			
Output 2 (OUT2)	Output 3 (OUT3) [2]	Output 1 (OUT1) [1]			

[1] Output assignment can be overlapped. Overlapped outputs are produced as *OR* output.

[2] When Output 3 (OUT3) is used on the RZ400 as a cool-side output, the operating life of the relay is shorter than that of Output 1 (OUT1) and Output 2 (OUT2). (Refer to the **Specification of relay contact output** on the next page.)

Specification of relay contact varies with the assigned output (relay type).

Type	Output terminal	Output type	Specification of relay contact output
RZ100	Output 1 (OUT1) Output 2 (OUT2) Output 3 (OUT3)	Control output	Contact type: 1a contact Contact rating (Resistive load): 250 V AC **3 A**, 30 V DC **1 A** Electrical life: **100,000** times or more (Rated load) Mechanical life: **20 million** times or more (Switching: 300 times/min)
RZ400	Output 3 (OUT3)		
RZ400	Output 1 (OUT1) Output 2 (OUT2)	Control output	Contact type: 1a contact Contact rating (Resistive load): 250 V AC **3 A**, 30 V DC **1 A** Electrical life: **300,000** times or more (Rated load) Mechanical life: **50 million** times or more (Switching: 180 times/min)
RZ100	Output 1 (OUT1) Output 2 (OUT2) Output 3 (OUT3)	Alarm output (including Heater break alarm output)	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: 300 times/min)
RZ400			

If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assigning Alarm output or Heater break alarm (HBA) output will be ignored.

■ Parameter setting

● Control output assignment [Initial setting mode: Cod 0002]

Parameter symbol	Data range	Factory set value
oCo	0: No assignment 1: PID control: Output 1 (OUT1) Heat/Cool PID control: Heat-side output: Output 1 (OUT1) Cool-side output: Output 2 (OUT2) 2: PID control: Output 2 (OUT2) Heat/Cool PID control: Heat-side output: Output 2 (OUT2) Cool-side output: Output 1 (OUT1) 3: Heat-side output: Output 1 (OUT1) Cool-side output: Output 3 (OUT3) * 4: Heat-side output: Output 2 (OUT2) Cool-side output: Output 3 (OUT3) * Data range for PID control: 0 to 2	When Control output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Control output assignment is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.

* When Output 3 (OUT3) is used on the RZ400 as a cool-side output, the operating life of the relay is shorter than that of Output 1 (OUT1) and Output 2 (OUT2). (Refer to the **Specification of relay contact output** shown above.)

When Control output assignment is set to "No assignment," then Heater break alarm (HBA) function is disabled.

● Output assignment of Alarm 1, 2 [Initial setting mode: Cod 0002]

Parameter symbol	Data range	Factory set value
oAL1 oAL2	0: No assignment 1: Output 1 (OUT1) 2: Output 2 (OUT2) 3: Output 3 (OUT3)	When Alarm output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Alarm output assignment is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.

To show the “Output assignment of Alarm 1,” set a value other than “None” at Cod 0000 (Alarm 1 type) in the Initial setting mode.

To show the “Output assignment of Alarm 2,” set a value other than “None” at Cod 0000 (Alarm 2 type) in the Initial setting mode.

If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assignment of Alarm output is ignored.

To provide alarm output, both alarm output assignment and alarm type selection are required. Implement setting of Energized/De-energized according to the necessity. For the alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**. For the Energized/De-energized, refer to **7.4 Changing Alarm Output (Energize/De-energize) (P. 7-12)**.

Refer to the list of **Output assignment (P. 7-2)** for assignable alarm output.

● Output assignment of Heater break alarm 1, 2 [Initial setting mode: Cod 0002] OP

Parameter symbol	Data range	Factory set value
oHb1 oHb2	0: No assignment 1: Output 1 (OUT1) 2: Output 2 (OUT2) 3: Output 3 (OUT3)	When Heater break alarm output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Heater break alarm output assignment is not specified: 0

To show the “Output assignment of Heater break alarm 1” and “Output assignment of Heater break alarm 2,” specify “with current transformer (CT),” which is an optional function. You also need to set a value other than “0.0” for “Heater break alarm 1 (HBA1) set value” and “Heater break alarm 2 (HBA2) set value.”

If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assignment of Heater break alarm (HBA) output is ignored.

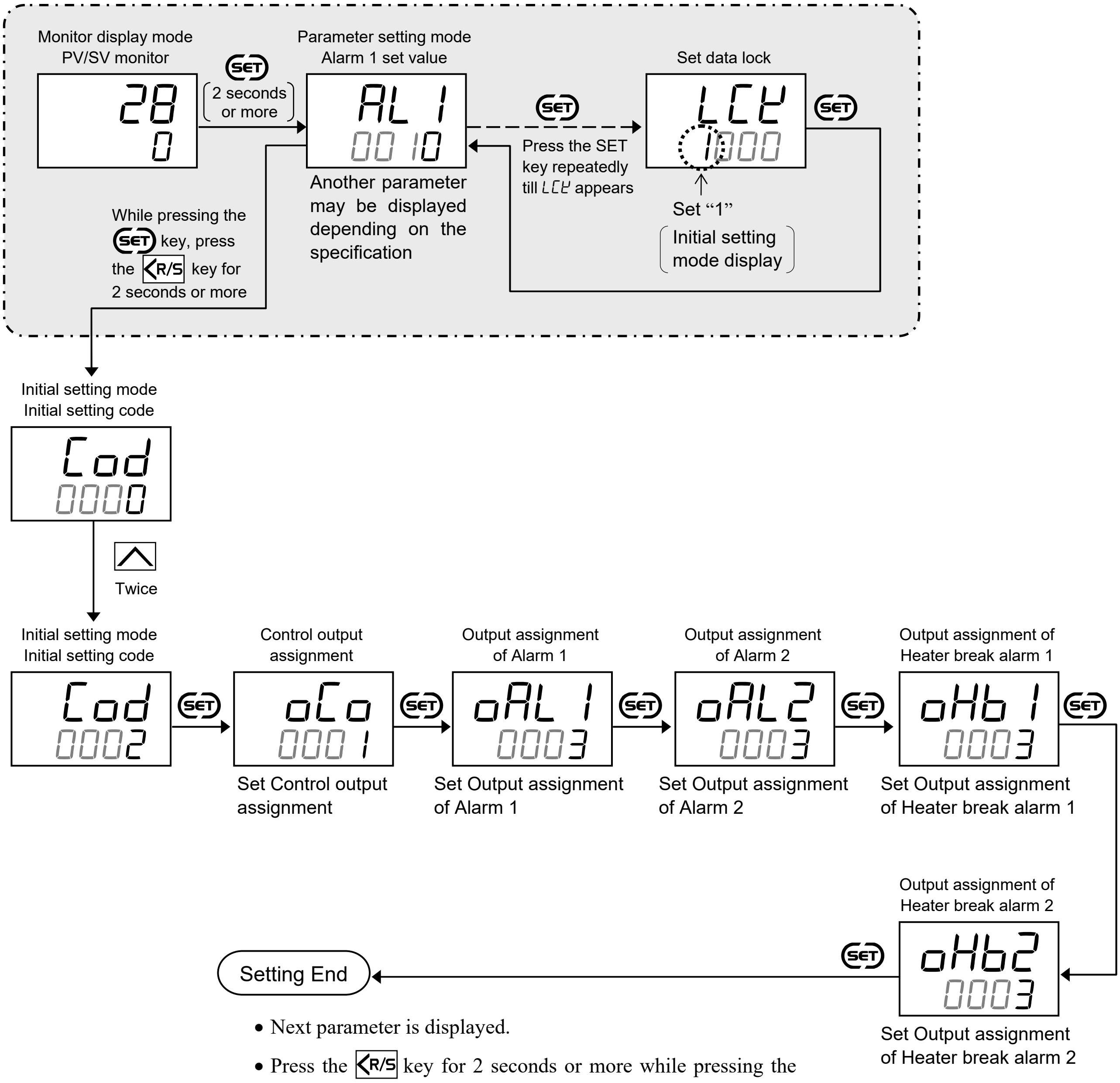
To provide Heater break alarm, both of Heater break alarm output assignment and setup of the Heater break alarm function will be required. Implement setting of Energized/De-energized according to the necessity. For setting up a Heater break alarm, refer to **10.3.2 Setting the Heater break alarm (HBA) set value (P. 10-38)**. For the Energized/De-energized, refer to **7.4 Changing Alarm Output (Energize/De-energize) (P.7-12)**.

Refer to the list of **Output assignment (P. 7-2)** for assignable Heater break alarm (HBA) output.

■ Setting procedure

Control output assignment, Output assignment of Alarm and Output assignment of Heater break alarm can be set at Cod 0002 in the Initial setting mode.

Procedure to enter the Initial setting mode



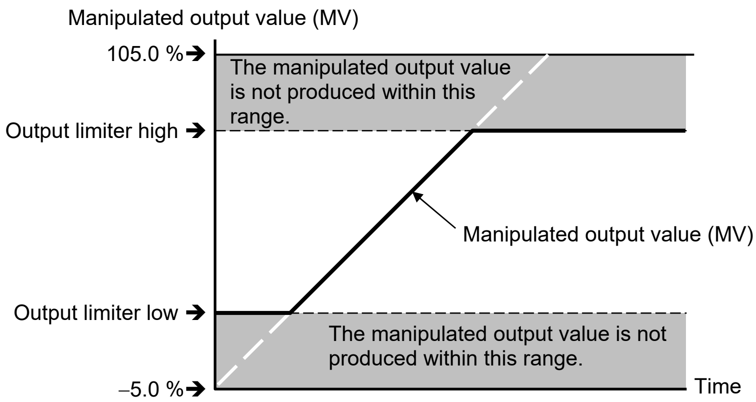
- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

7.2 Limiting Output

Use output limiter to limit the output.

■ Description of function

This is the function which restricts the high and low limits of Manipulated output values (MV).



Output limiter is also effective in ON/OFF control.

■ Parameter setting

● Output limiter high [Heat-side output limiter (high)] [Parameter setting mode] EX

Parameter symbol	Data range	Factory set value
oLH	PID control: Output limiter low to 105.0 % (Output limiter high > Output limiter low) Heat/Cool PID control: 0.0 to 105.0 %	105.0

To show the "Output limiter high [Heat-side output limiter (high)]," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

● Output limiter low [Cool-side output limiter (high)] [Parameter setting mode] EX

Parameter symbol	Data range	Factory set value
oLL	PID control: –5.0 % to Output limiter high (Output limiter high > Output limiter low) Heat/Cool PID control: 0.0 to 105.0 % For Heat/Cool PID control, this is a Cool-side output limiter (high).	PID control: –5.0 Heat/Cool PID control: 105.0

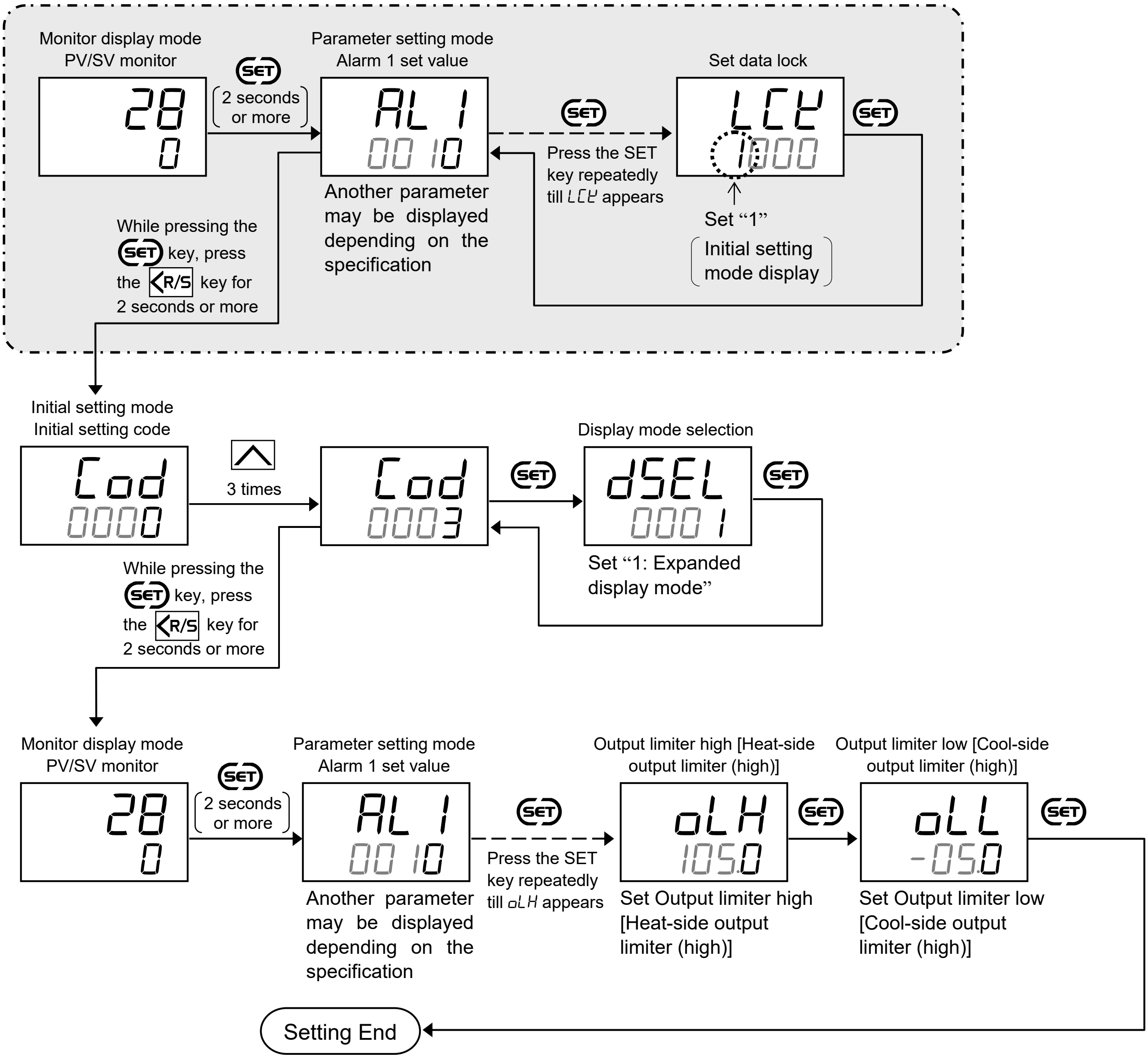
To show the "Output limiter low [Cool-side output limiter (high)]," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

Output limiter high/low can be set in the Parameter setting mode.

To show the "Output limiter high/low," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

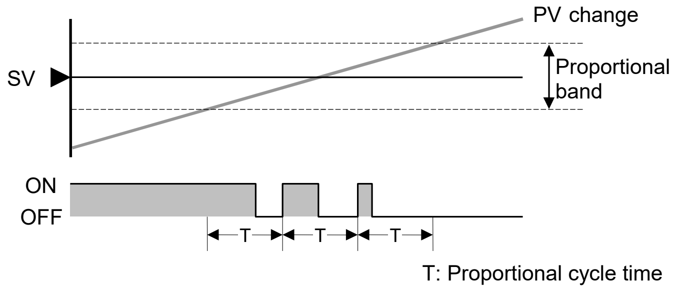
7.3 Changing Proportional Cycle Time

When time proportioning output (relay output or voltage pulse output) is specified at the time of ordering, proportional cycle and Minimum ON/OFF time can be changed.

■ Description of function

● Proportional cycle time

Manipulated output value turns ON and OFF in a certain cycle (Proportional cycle time) when the Measured value (PV) reaches within the Proportional band at Time proportioning action. More precise control can be achieved by shortening Proportional cycle time, however, the life of operating unit (Relay etc.) can be shortened based on the feature of the specific controlled object.



● Minimum ON/OFF time of proportioning cycle

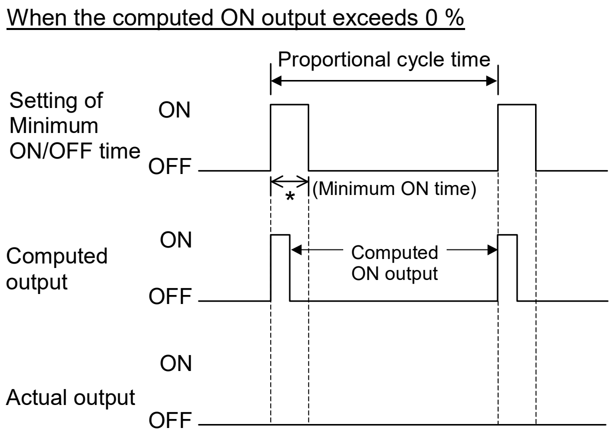
Minimum ON/OFF time of proportioning cycle can be used to compensate relay life by acquiring the minimum OF/OFF time.

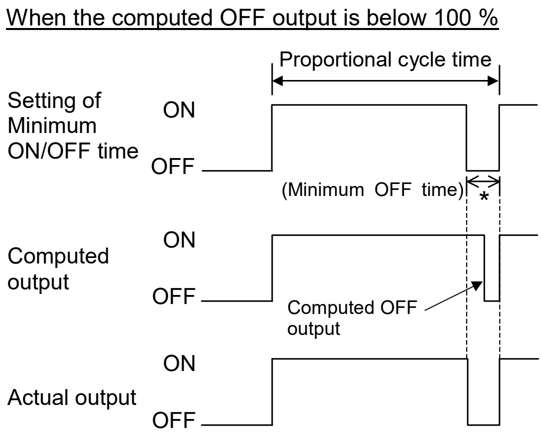
Minimum ON time of proportioning cycle:

Manipulated output does not turn ON when the duration of the computed ON output is shorter than the Minimum ON time of proportioning cycle being set.
Manipulated output remains ON the same amount of time as the computed ON output when the computed ON output is longer than the Minimum ON time of proportioning cycle being set.
(Minimum ON time of proportioning cycle is valid when the computed ON output exceeds 0 %.)

Minimum OFF time of proportioning cycle:

Manipulated output remains OFF the same amount of time as the Minimum OFF time set when the computed OFF output is shorter than the Minimum OFF time being set.
Manipulated output remains OFF the same amount of time as the computed OFF output when the computed OFF output is longer than the Minimum OFF time being set.
(Minimum OFF time of proportioning cycle is valid when the computed OFF output is below 100 %.)





* When a long minimum ON/OFF time is required for the relay, set a time longer than that time.

Minimum ON/OFF time of proportioning cycle is not operative if the Proportioning cycle is set shorter than the Minimum ON/OFF time of proportioning cycle (Proportioning cycle < Minimum ON/OFF proportioning time).

■ Parameter setting

● Proportional cycle time [heat-side] [Parameter setting mode]

Parameter symbol	Data range	Factory set value
T	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2

To show the “Proportional cycle time [heat-side],” specify time proportioning output (relay contact output or voltage pulse output) on the heat-side control output.

● Proportional cycle time [cool-side] [Parameter setting mode]

Parameter symbol	Data range	Factory set value
t	1 to 100 seconds	For “Cooling linear type” configured to have “Voltage pulse output”: 2 Otherwise: 20

To show the “Proportional cycle time [cool-side],” specify time proportioning output (relay contact output or voltage pulse output) on the cool-side control output.

To show the “Proportional cycle time [cool-side],” specify “Heat/Cool PID control” at the time of ordering or configure the instrument to “Heat/Cool PID control” at Cod 1051 in the Initial setting mode to “Control action.”

For the selection of Control action, refer to **11.2 Changing Control Action (P. 11-4)**.

● Minimum ON/OFF time of proportioning cycle [heat-side] [Parameter setting mode] EX

Parameter symbol	Data range	Factory set value
MT	0 to 1000 ms	0

To show the “Minimum ON/OFF time of proportioning cycle [heat-side],” specify time proportioning output (relay contact output or voltage pulse output) on the heat-side control output.

To show the “Minimum ON/OFF time of proportioning cycle [heat-side],” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

- **Minimum ON/OFF time of proportioning cycle [cool-side] [Parameter setting mode]** EX

Parameter symbol	Data range	Factory set value
nt	0 to 1000 ms	0

📖 To show the “Minimum ON/OFF time of proportioning cycle [cool-side],” specify time proportioning output (relay contact output or voltage pulse output) on the cool-side control output.

📖 To show the “Minimum ON/OFF time of proportioning cycle [cool-side],” specify “Heat/Cool PID control” at the time of ordering or configure the instrument to “Heat/Cool PID control” at Cod 1051 in the Initial setting mode to “Control action.”

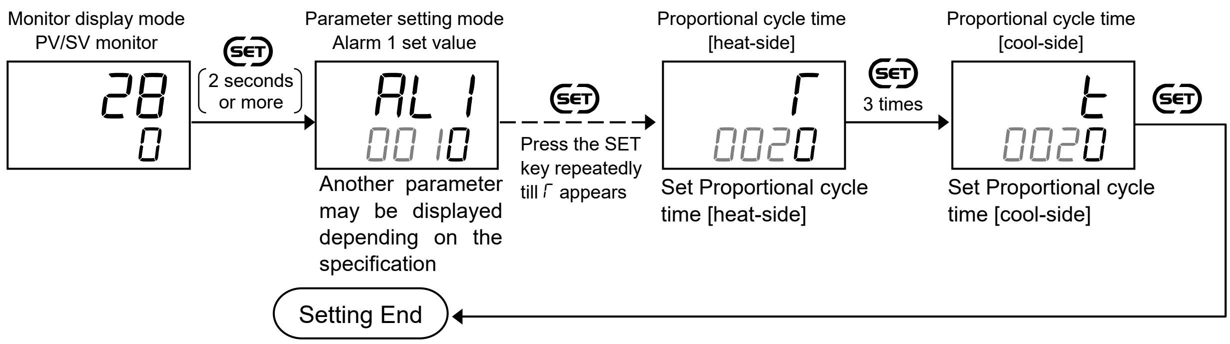
📖 To show the “Minimum ON/OFF time of proportioning cycle [cool-side],” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

☞ For the selection of Control action, refer to **11.2 Changing Control Action (P. 11-4)**.

Parameter setting

Proportional cycle time

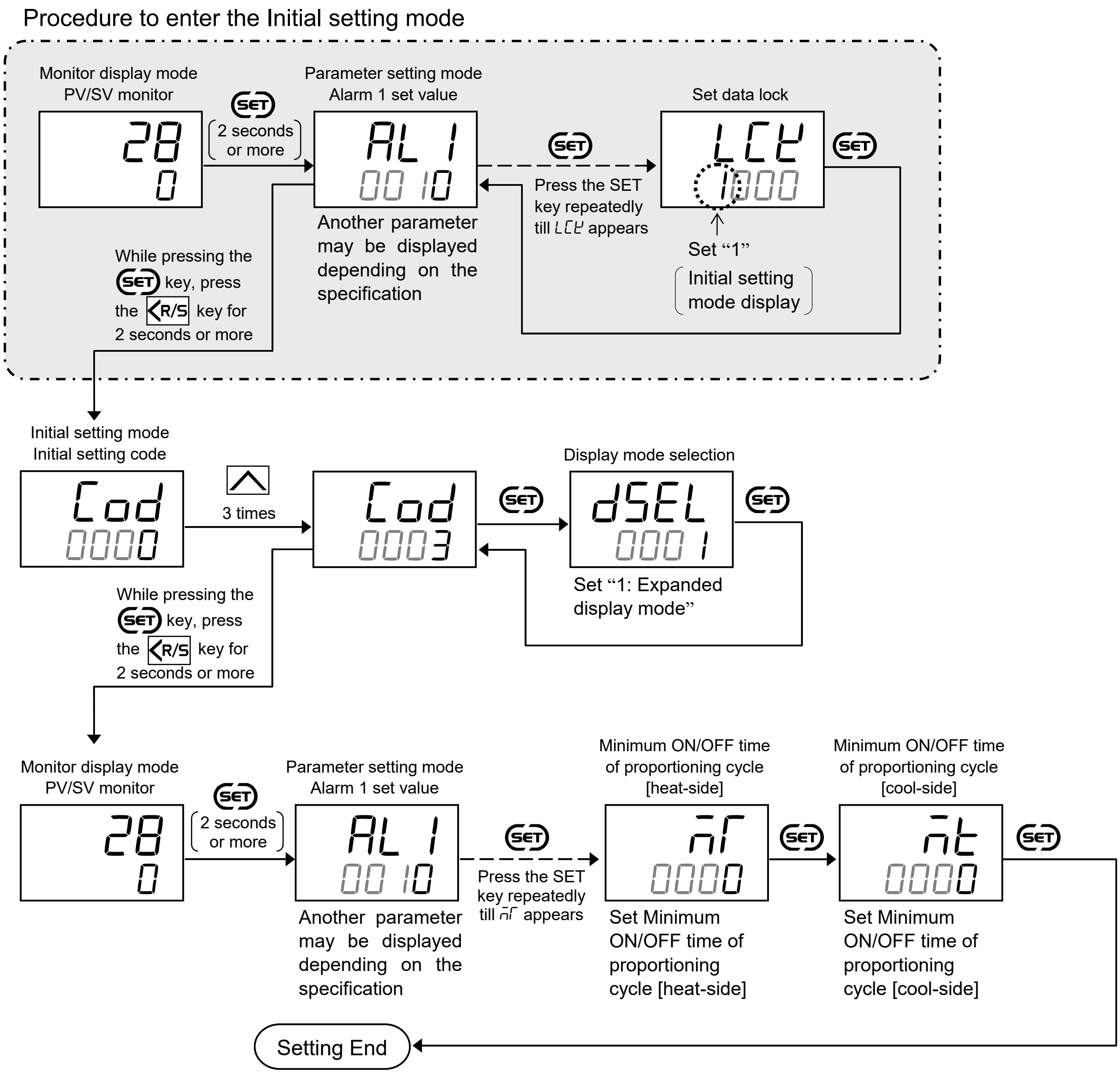
Proportional cycle time can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

● Minimum ON/OFF time of proportioning cycle

Minimum ON/OFF time of proportioning cycle can be set in the Parameter setting mode.
To show the "Minimum ON/OFF time of proportioning cycle," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.



- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

7.4 Changing Alarm Output (Energize/De-energize)

Energize or De-energize can be selected for Alarm outputs and Heater break alarm (HBA) outputs (option).

📖 Energize or De-energize can be set on the output terminals (OUT1 to OUT3) which were configured at Cod 0002 in the Initial setting mode for “Output assignment of Alarm 1 and 2” and “Output assignment of Heater break alarm 1 and 2.” Setting this function on the output terminals to which control output is assigned is ignored.

■ Description of function

Explanation of Energize/De-energize action

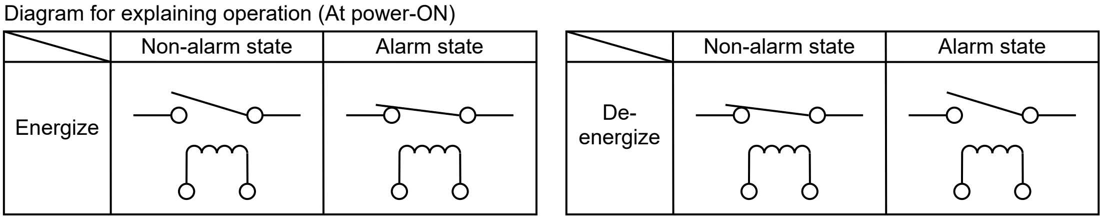
Setting Energize/De-energize	Output state of alarm	
	Non-alarm state	Alarm state
When set to Energize	Alarm output OFF	Alarm output ON
When set to De-energize	Alarm output ON	Alarm output OFF

Example: For relay contact output

Energize: Relay contact is closed in alarm condition.

De-energize: Relay contact is open in alarm condition.

Diagram for explaining operation (At power-ON)



■ Parameter setting

● Output 1 (OUT1) energize/de-energize when assigned to alarm [Initial setting mode: Cod 0002]

EX

Parameter symbol	Data range	Factory set value
EVC1	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0

📖 To show the “Output 1 (OUT1) energize/de-energize when assigned to alarm,” set a value other than “None” at Cod 0000 in the Initial setting mode for “Alarm 1 type” or “Alarm 2 type.” Alternatively “with current transformer (CT)” needs to be specified as an option at the time of ordering. You also need to set a value other than “0.0” for “Heater break alarm 1 (HBA1) set value” or “Heater break alarm 2 (HBA2) set value” in the Parameter setting mode.

📖 To show the “Output 1 (OUT1) energize/de-energize when assigned to alarm,” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

📖 If the output terminal set at Cod 0002 in the Initial setting mode for “Output assignment of Alarm 1 and 2” and “Output assignment of Heater break alarm 1 and 2” is not Output 1 (OUT1), the setting is ignored.

☞ For output assignment of Alarm and Heater break alarm, refer to **7.1 Changing Output Assignment (P. 7-2)**.

● Output 2 (OUT2) energize/de-energize when assigned to alarm [Initial setting mode: Cod 0002] EX

Parameter symbol	Data range	Factory set value
EUC2	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0

To show the "Output 2 (OUT2) energize/de-energize when assigned to alarm," set a value other than "None" at Cod 0000 in the Initial setting mode for "Alarm 1 type" or "Alarm 2 type." Alternatively "with current transformer (CT)" needs to be specified as an option at the time of ordering. You also need to set a value other than "0.0" for "Heater break alarm 1 (HBA1) set value" or "Heater break alarm 2 (HBA2) set value" in the Parameter setting mode.

To show the "Output 2 (OUT2) energize/de-energize when assigned to alarm," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

If the output terminal set at Cod 0002 in the Initial setting mode for "Output assignment of Alarm 1 and 2" and "Output assignment of Heater break alarm 1 and 2" is not Output 2 (OUT2), the setting is ignored.

For output assignment of Alarm and Heater break alarm, refer to **7.1 Changing Output Assignment (P. 7-2)**.

● Output 3 (OUT3) energize/de-energize when assigned to alarm [Initial setting mode: Cod 0002] EX

Parameter symbol	Data range	Factory set value
EUC3	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0

To show the "Output 3 (OUT3) energize/de-energize when assigned to alarm," set a value other than "None" at Cod 0000 in the Initial setting mode for "Alarm 1 type" or "Alarm 2 type." Alternatively "with current transformer (CT)" needs to be specified as an option at the time of ordering. You also need to set a value other than "0.0" for "Heater break alarm 1 (HBA1) set value" or "Heater break alarm 2 (HBA2) set value" in the Parameter setting mode.

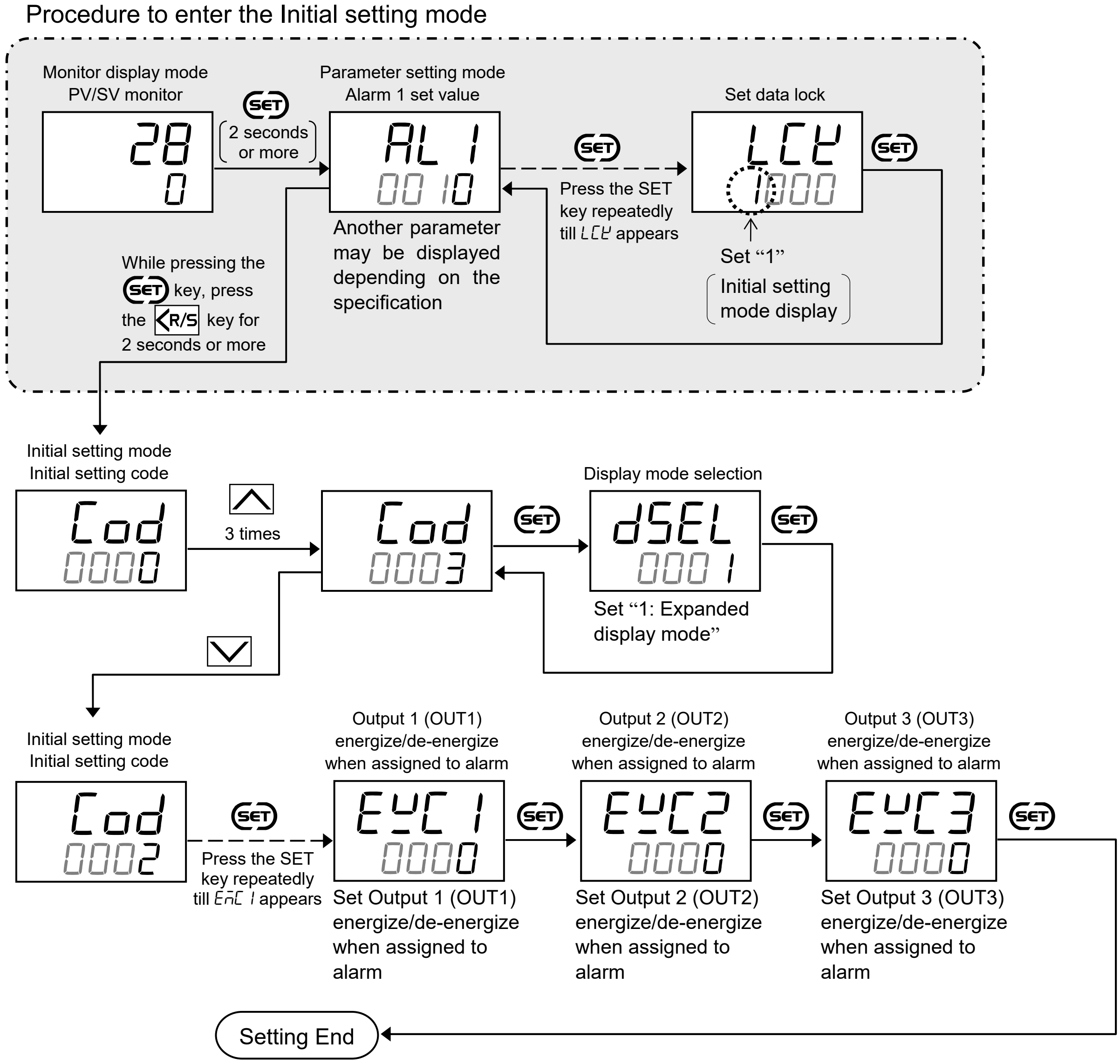
To show the "Output 3 (OUT3) energize/de-energize when assigned to alarm," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

If the output terminal set at Cod 0002 in the Initial setting mode for "Output assignment of Alarm 1 and 2" and "Output assignment of Heater break alarm 1 and 2" is not Output 3 (OUT3), the setting is ignored.

For output assignment of Alarm and Heater break alarm, refer to **7.1 Changing Output Assignment (P. 7-2)**.

■ Setting procedure

Output energize/de-energize when assigned to alarm can be set at Cod 0002 in the Initial setting mode.



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

7.5 Monitoring Manipulated Output Value

Manipulated output value can be monitored on this instrument.

■ Display contents

● Manipulated output value [heat-side] [Monitor display mode] EX

Parameter symbol	Data range	Factory set value
MV	PID control: Output limiter low to Output limiter high Heat/Cool PID control: −5.0 % to Heat-side output limiter (high)	

To show the “Manipulated output value [heat-side],” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

● Manipulated output value [cool-side] [Monitor display mode] EX

Parameter symbol	Data range	Factory set value
MVc	−5.0 % to Cool-side output limiter (high)	

To show the “Manipulated output value [cool-side],” specify “Heat/Cool PID control” at the time of ordering or configure the instrument to “Heat/Cool PID control” at Cod 1051 in the Initial setting mode to “Control action.”

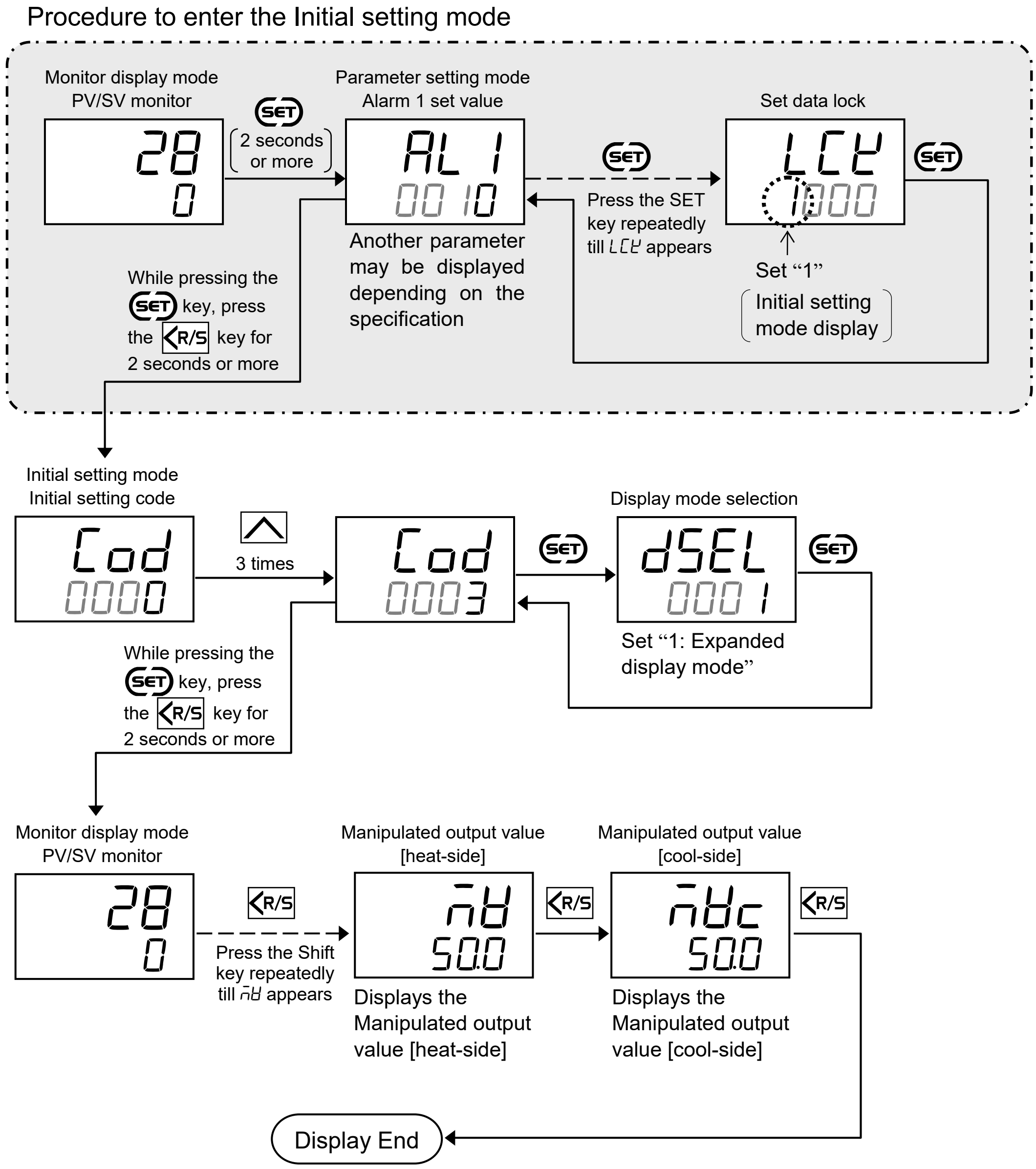
To show the “Manipulated output value [cool-side],” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

For the selection of Control action, refer to **11.2 Changing Control Action (P. 11-4)**.

■ Display operation

Manipulated output value can be found in the Monitor display mode.

To show the "Manipulated output value," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.



- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

SETTING AND KEY OPERATION

8

This chapter describes display related functions, setting contents and setting procedure based on the keywords related to setting and key operation.

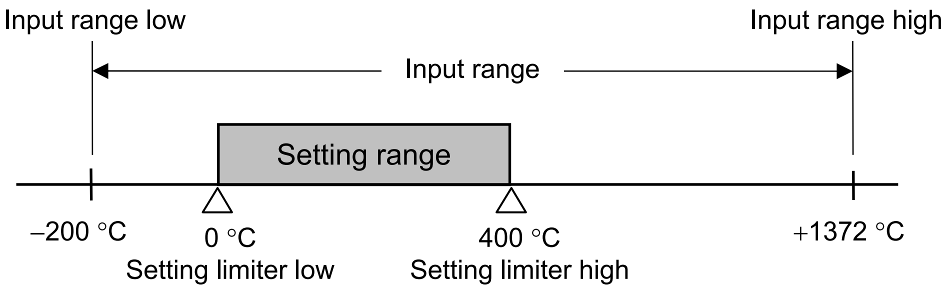
8.1 Limiting the Setting Range of Set Value (SV)

To limit the setting range of the Set value (SV), Setting limiter is used.

■ Description of function

Setting limiter is a function to limit the setting range of the Set value (SV) within the input range.

Example: The input range is from –200 to +1372 °C, the Setting limiter high is 400 °C, and the Setting limiter low is 0 °C.



■ Parameter setting

● Setting limiter high
[Initial setting mode: Cod 1021] EX

Parameter symbol	Data range	Factory set value
SLH	Setting limiter low to Input range high Varies with the setting of the Decimal point position.	Input range high

To show the "Setting limiter high," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

● Setting limiter low
[Initial setting mode: Cod 1021] EX

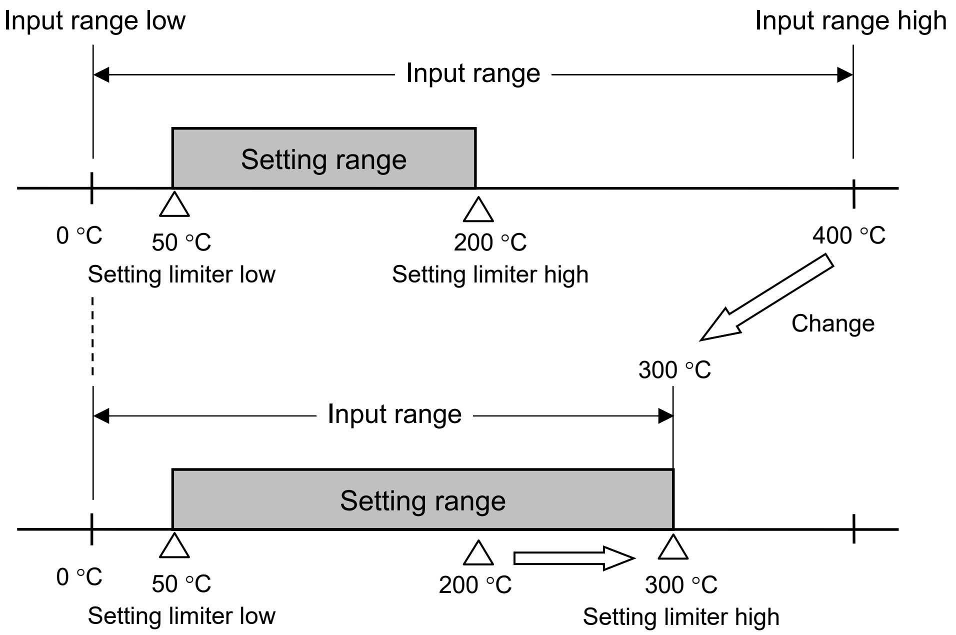
Parameter symbol	Data range	Factory set value
SLL	Input range low to Setting limiter high Varies with the setting of the Decimal point position.	Input range low

To show the "Setting limiter low," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

Setting limitter high is initialized to the input range high value when the input range is changed. Similarly when setting limiter low is changed, it is initialized to the value of Input range low.

[Example]

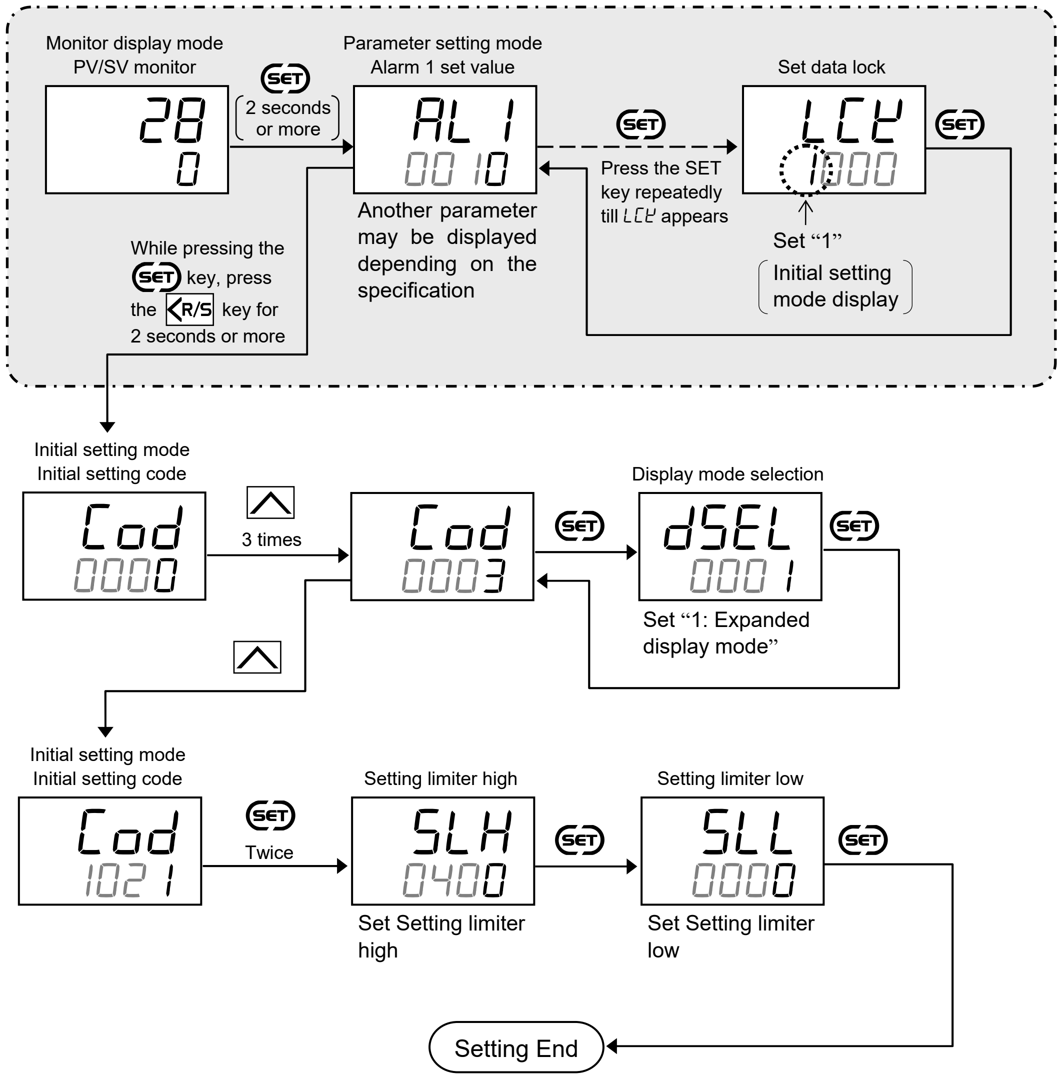
Assuming that the setting limiter high is set to 200 ºC and the setting limiter low is set to 50 ºC on the instrument with a range of 0 to 400 ºC, changing the input range high to 300 ºC will initialize the setting limiter high to the value same as the input range high (300 ºC).



■ Setting procedure

Setting limiter high/low can be set at Cod 1021 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

8.2 Continuing the Control when Entering the Initial Setting Mode

With the factory setting, the instrument is configured to automatically stop the control (STOP) when the instrument is switched to the Initial setting mode. With another setting, the instrument can continue the control (RUN) even if the instrument is switched to the Initial setting mode.

■ Description of function

With the use of "STOP function at Initial setting mode" (at Cod 1030 in the Initial setting mode) the instrument can continue the control (RUN) even if the mode is switched to the Initial setting mode. This feature may be useful to view parameters in the Initial setting mode without stopping the control.
It should be noted, however, that the parameters in the Initial setting mode cannot be changed during the control (RUN) state. To change the parameters in the Initial setting mode, the control must be stopped (STOP).

Control state at the time of mode switching

Setting contents of "STOP function at Initial setting mode"	Control state of Monitor display mode/ SV setting mode/ Parameter setting mode	Mode switching	Control state of Initial setting mode	Mode switching	Control state of Monitor display mode
0: STOP	RUN	⇨	STOP	⇨	RUN
	STOP				STOP
1: RUN/STOP continue	RUN	⇨	RUN	⇨	RUN
	STOP	⇨	STOP	⇨	STOP

● Procedures to change parameters for the Initial setting mode when "RUN/STOP continue" is selected

It is assumed here that the control state is RUN before the change in the Initial setting mode.

1. Press and hold the R/S key for 1 second to STOP the control.
2. Press the R/S key for 2 seconds or more while pressing the SET key to enter the Initial setting mode. (Control state is STOP)
3. Change set value(s) of desired parameter(s).
4. Press the R/S key for 2 seconds or more while pressing the SET key to return the PV/SV monitor screen (Monitor display mode).
5. Press and hold the R/S key for 1 second to RUN the control.

■ Parameter setting

● STOP function at Initial setting mode [Initial setting mode: Cod 1030] EX

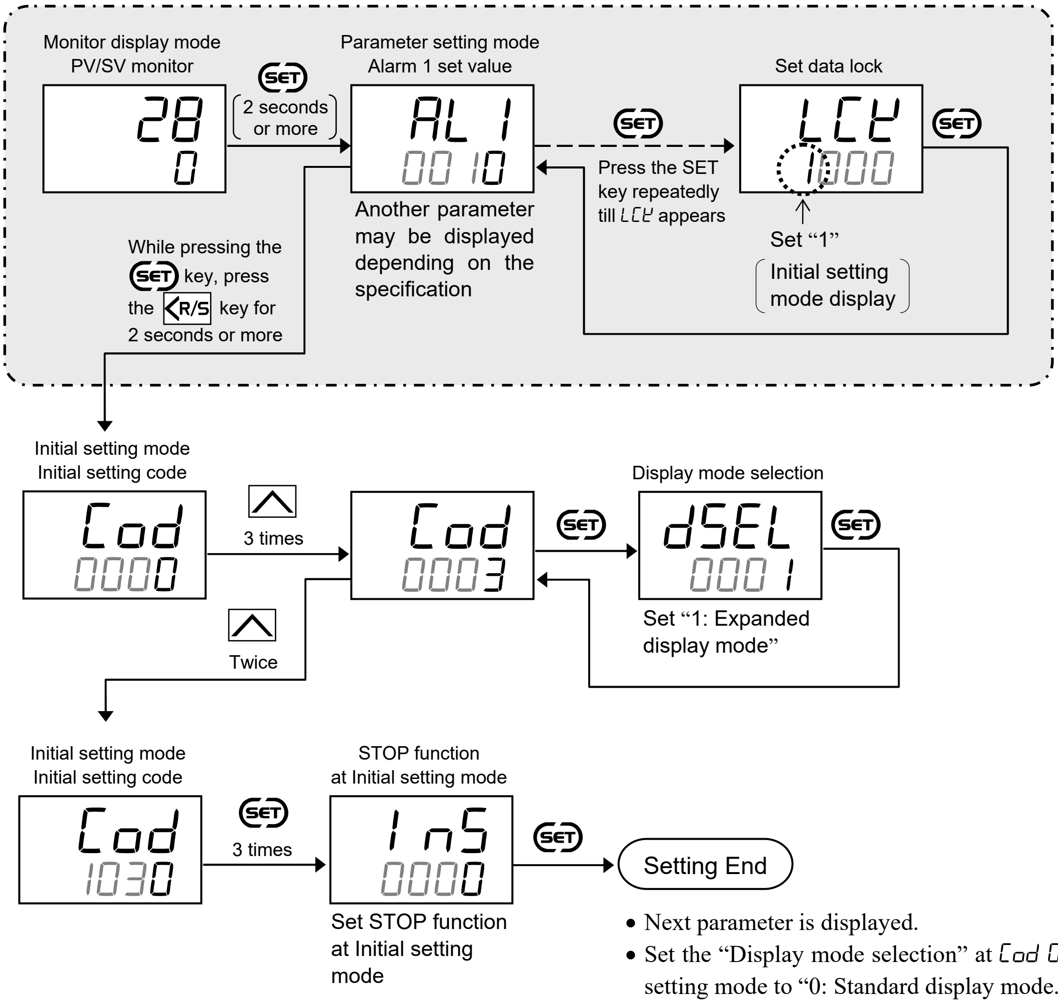
Parameter symbol	Data range	Factory set value
InS	0: STOP in the Initial setting mode 1: RUN/STOP continues in the Initial setting mode	0

📖 To show the “STOP function at Initial setting mode,” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

■ Setting procedure

STOP function at Initial setting mode can be set at Cod 1030 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Set the “Display mode selection” at Cod 0003 in the Initial setting mode to “0: Standard display mode.”
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to “0: Lock.”

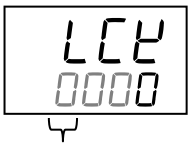
8.3 Restricting Key Operation

The set data lock function limits access of unauthorized personnel to the parameters and prevents parameter change by mistake.

■ Description of function

The Set data lock function uses the lower three digits of the set value to restrict the setting in the SV setting mode, the Parameter setting mode, and the Communication setting mode. The highest digit is used to show/hide the Initial setting mode.

<table>
<tr><th></th><th>Set value</th><th>Description of Set Lock</th></tr>
<tr><td rowspan="8">

Restricting the operations in the SV setting mode, the Parameter setting mode, and the Communication setting mode</td><td>□000</td><td>All parameters
[Factory set value]</td></tr>
<tr><td>□001</td><td>Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV) and Alarm set values (ALM1, ALM2) *</td></tr>
<tr><td>□010</td><td>All parameters except for Alarm 1 set value (ALM1) and Alarm 2 set value (ALM2) *</td></tr>
<tr><td>□011</td><td>Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV)</td></tr>
<tr><td>□100</td><td>All parameters except for Set value (SV)</td></tr>
<tr><td>□101</td><td>Parameters in the Parameter setting mode and the Communication setting mode excluding Alarm set values (ALM1, ALM2) *</td></tr>
<tr><td>□110</td><td>All parameters except for Set value (SV), Alarm 1 set value (ALM1) and Alarm 2 set value (ALM2) *</td></tr>
<tr><td>□111</td><td>No parameter (All Locked)</td></tr>
<tr><td rowspan="2">

Restricting access to Initial setting mode</td><td>0□□□</td><td>Hide Initial setting mode
[Factory set value]</td></tr>
<tr><td>1□□□</td><td>Show Initial setting mode (Show all parameters)</td></tr>
</table>

* Values for Control loop break alarm (LBA) time and LBA deadband (LBD) are not included.

📖 The following parameters cannot be locked:
- Interlock release (SV setting mode)
- Set data lock (Parameter setting mode)

📖 The contents of lock mode can be switched anytime regardless of RUN/STOP mode.

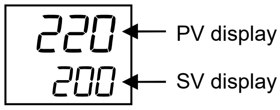
📖 As the parameters can be viewed even in the lock state, the set data can be verified.
However, when the Set value (SV) is locked, the SV screen in the SV setting mode will not be displayed. (Refer to P. 8-8)

📖 Setting through the Communication (option) is possible even when setting is locked. However, to change parameters in the Initial setting mode, the controller must be set to STOP mode.

The display status of the Set value (SV) depends on the following items;
- Lock/Unlock of the Set value (SV),
- Show SV/Hide SV" setting at Cod 1021 in the Initial setting mode,
- Selection of STOP display at Cod 1030 in the Initial setting, and
- RUN/STOP status.

Refer to the following table for details.

The table below shows PV and SV under the following conditions.
- Measured value (PV): 220 °C
- Set value (SV): 200 °C
- Alarm interlock: Use



STOP display selection		STOP is displayed on the SV display				STOP is displayed on the PV display			
Show/Hide SV display		Show SV		Hide SV		Show SV		Hide SV	
RUN/STOP status		RUN	STOP	RUN	STOP	RUN	STOP	RUN	STOP
Set data locked Set value (SV) adjustable	Monitor display mode	220 200	220 StoP	220	220 StoP	220 200	StoP 200	220	StoP
	SV setting mode *	220 0200	220 0200	220 0200	220 0200	220 0200	StoP 0200	220 0200	StoP 0200
Set data locked Set value (SV) locked (unsettable)	Monitor display mode	220 200	220 StoP	220	220 StoP	220 200	StoP 200	220	StoP
	SV setting mode *	A ILr oFF	220 B 200	220 B 200	220 B 200	A ILr oFF	A ILr oFF	220 B 200	StoP B 200

* Display when the SET key is pressed once in the Monitor display mode.

A: As the Set value (SV) is locked, a screen after the Set value (Interlock release) is displayed.

B: As the Set value (SV) cannot be verified in the Monitor display mode, only the Set value (SV) can be viewed in the SV setting mode.

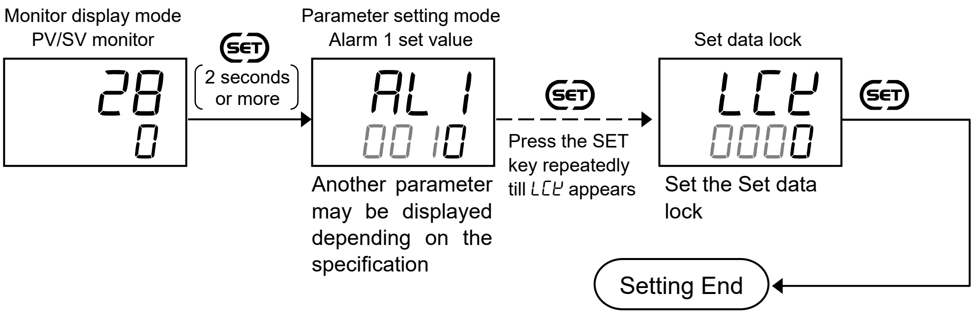
■ Parameter setting

● Set data lock
[Parameter setting mode]

Parameter symbol	Data range	Factory set value
LCK	0 or 1 is settable at each digit. 0000 ← SV display unit Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV) and Alarm set values (ALM1, ALM2) 0: Unlock 1: Lock Alarm set value (ALM1, ALM2) 0: Unlock 1: Lock Set value (SV) 0: Unlock 1: Lock Initial setting mode 0: Lock 1: Unlock	0000

■ Setting procedure

Set data lock can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

MEMO

DISPLAY FUNCTION

9

This chapter describes display related functions, setting contents and setting procedure based on the key words related to Display.

9.1 Releasing the Display Restriction of the Parameters

This instrument has two display modes; "Standard display mode" and "Expanded display mode." The instrument is shipped from the factory with the factory setting of "Standard display mode." Switch the mode to "Expanded display mode" according to the necessity.

■ Description of function

Below is the display structure of parameters.
The display mode can be switched at Cod 0003 "Display mode selection" in the Initial setting mode.

● Monitor display mode

PV/SV monitor	
Comprehensive alarm state	★
Current transformer 1 (CT1) input value monitor	○
Current transformer 2 (CT2) input value monitor	○
Manipulated output value [heat-side]	
Manipulated output value [cool-side]	

● SV setting mode

Set value (SV)	
Interlock release	★

● Communication setting mode

Communication protocol	○
Device address	○
Communication speed	○
Data bit configuration	○
Interval time	○
Communication response monitor	○

● Parameter setting mode

Alarm 1 set value (ALM1) [high]	★
Alarm 1 set value (ALM1) [low]	★
Alarm 2 set value (ALM2) [high]	★
Alarm 2 set value (ALM2) [low]	★
Heater break alarm 1 (HBA1) set value	○
Heater break alarm 2 (HBA2) set value	○
Control loop break alarm (LBA) time	★
LBA deadband (LBD)	★
Autotuning (AT)	
Startup tuning (ST)	
Proportional band [heat-side]	
Integral time	
Derivative time	
Anti-reset windup (ARW)	
Proportional cycle time [heat-side]	★
Proportional band [cool-side]	★
Overlap/Deadband	★
Proportional cycle time [cool-side]	★
PV bias	
PV digital filter	
Fine tuning	
Minimum ON/OFF time of proportioning cycle [heat-side]	★
Minimum ON/OFF time of proportioning cycle [cool-side]	★
Output limiter high [Heat-side output limiter (high)]	
Output limiter low [Cool-side output limiter (high)]	
Set data lock	

● Initial setting mode

Cod:0000	
Input type	
Decimal point position	
Input range high	
Input range low	
Alarm 1 type	
Alarm 2 type	
Cod:0001	
Peak hold monitor of ambient temperature	
Integrated operating time (upper-digits)	
Integrated operating time (lower-digits)	
ROM version	
Model code monitor	
Instrument serial number monitor	
Cod:0002	
Control output assignment	
Output assignment of Alarm 1	★
Output assignment of Alarm 2	★
Output assignment of Heater break alarm 1	○
Output assignment of Heater break alarm 2	○
Output 1 (OUT1) energize/de-energize when assigned to alarm	★
Output 2 (OUT2) energize/de-energize when assigned to alarm	★
Output 3 (OUT3) energize/de-energize when assigned to alarm	★
Cod:0003	
Display mode selection	← Switch the display mode here.
Cod:1021	
Tempreature unit	
Setting limiter high	
Setting limiter low	
PV flashing display at input error	
Show/Hide SV display	
Cod:1030	
Action selection at STOP mode	
STOP display selection	
STOP function at Initial setting mode	
Cod:1041	
Alarm 1 differential gap	★
Alarm 1 action at input burnout	★
Alarm 1 timer	★
Alarm 1 interlock	★
Cod:1042	
Alarm 2 differential gap	★
Alarm 2 action at input burnout	★
Alarm 2 timer	★
Alarm 2 interlock	★
Cod:1045	
CT1 ratio	○
CT2 ratio	○
HBA1 interlock	○
HBA2 interlock	○
HBA determination time	○
Cod:1051	
Control action	
Direct/Reverse action	★
Cool action	★
ON/OFF action differential gap (upper)	
ON/OFF action differential gap (lower)	
Control output at burnout	
Cod:1052	
ST start condition	

☐ Displayed

■ Displayed in Expanded display mode (Hidden in Standard display mode)

○: Displayed only when relevant option is supplied

★: Displayed if display condition is satisfied

■ Parameter setting

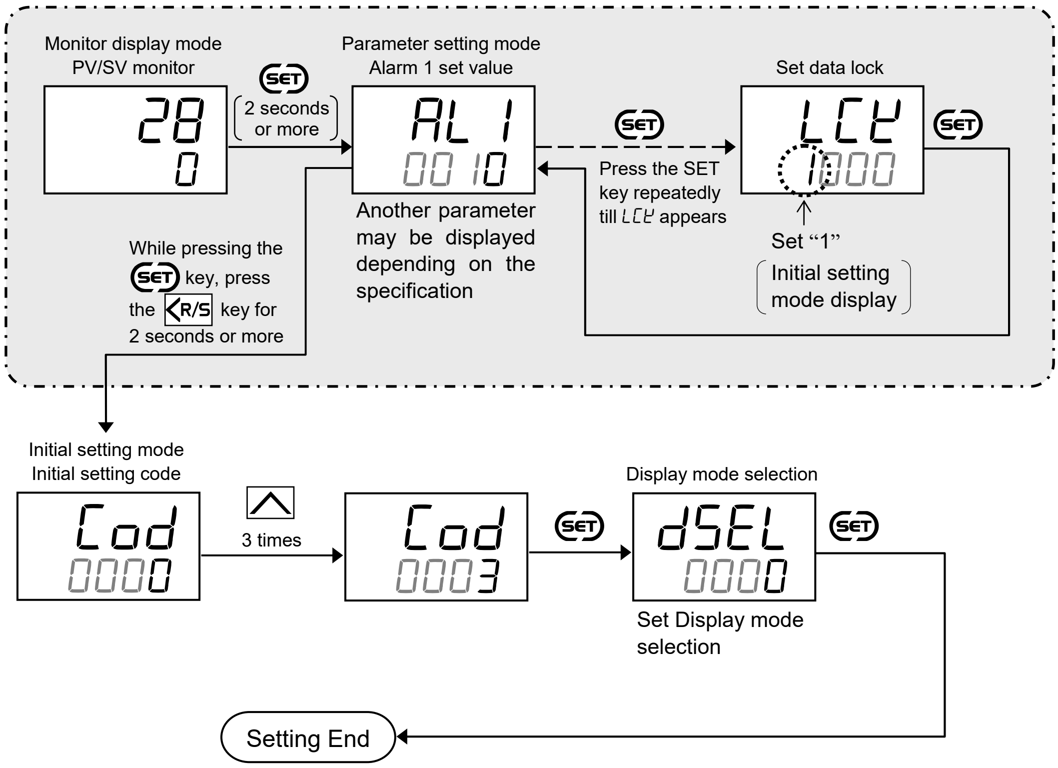
● Display mode selection
[Initial setting mode: Cod 0003]

Parameter symbol	Data range	Factory set value
dSEL	0: Standard display mode 1: Expanded display mode	0

■ Setting procedure

Display mode selection can be set at Cod 0003 in the Initial setting mode.

Procedure to enter the Initial setting mode



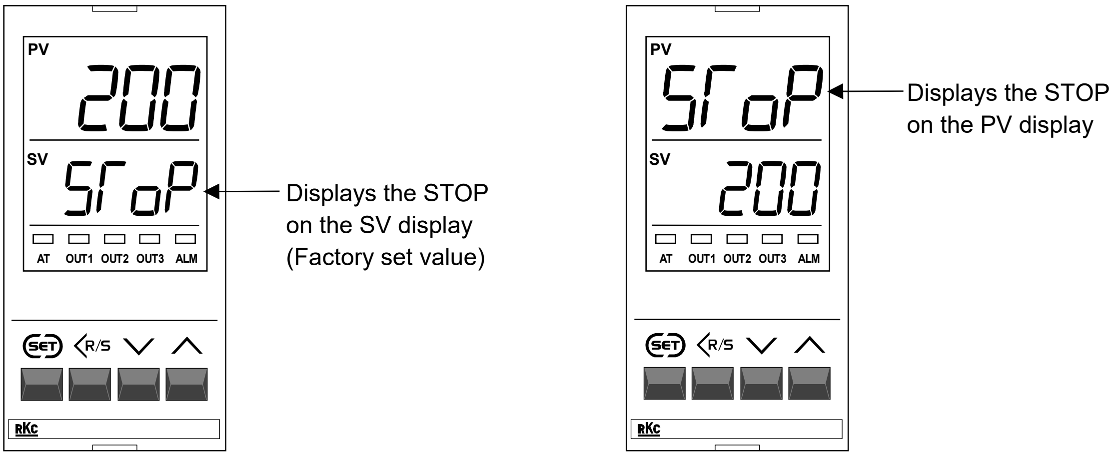
- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

9.2 Changing the Display Position of STOP during the Control Stop

The display position of "SToP" showing the control stop state can be changed.

■ Description of function

The STOP position of the STOP character can be selected; on the SV display or on the PV display.



In the above figure RZ400 is used for explanation, but the operation is the same for RZ100.

■ Parameter setting

● STOP display selection [Initial setting mode: Cod 1030] EX

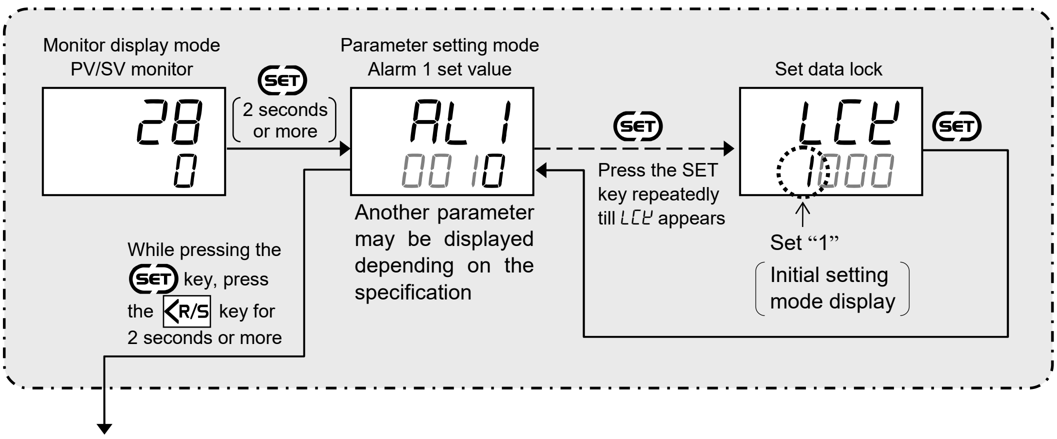
Parameter symbol	Data range	Factory set value
SPCH	0: STOP on PV display 1: STOP on SV display	1

To show the "STOP display selection," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

STOP display selection can be set at Cod 1030 in the Initial setting mode.

Procedure to enter the Initial setting mode



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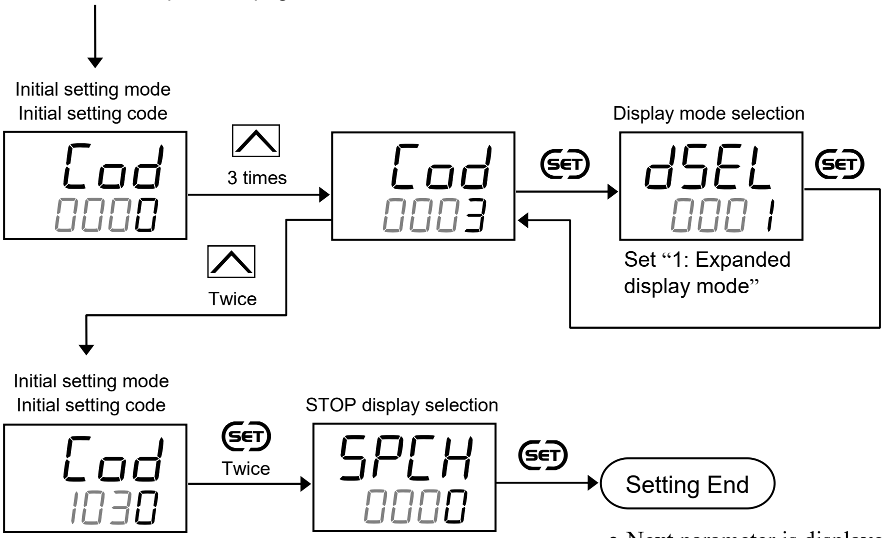


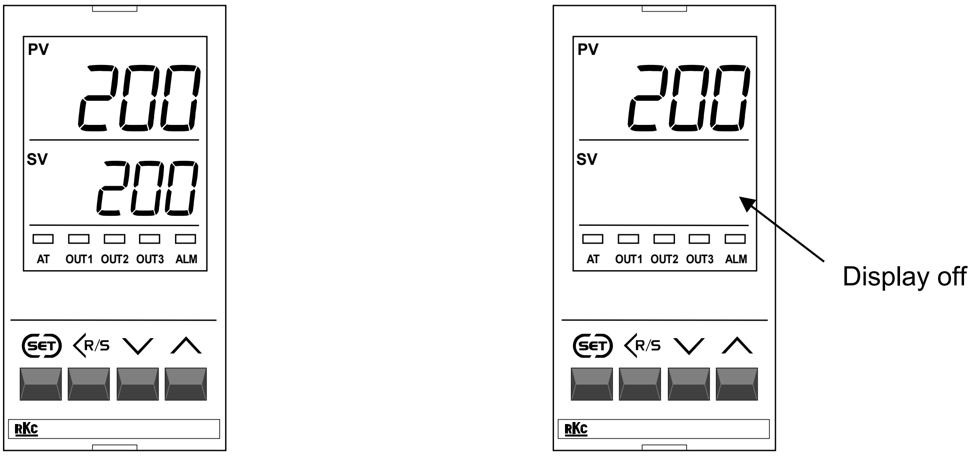
- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

9.3 Hiding the Display of the Set Value (SV)

On the normal PV/SV monitor screen, the Set value (SV) is displayed on the set value (SV) display unit. This display can be turned OFF.

■ Description of function

With set value (SV) display | Without set value (SV) display



In the above figure RZ400 is used for explanation, but the operation is the same for RZ100.

■ Parameter setting

● Show/Hide SV display [Initial setting mode: Cod 1021] EX

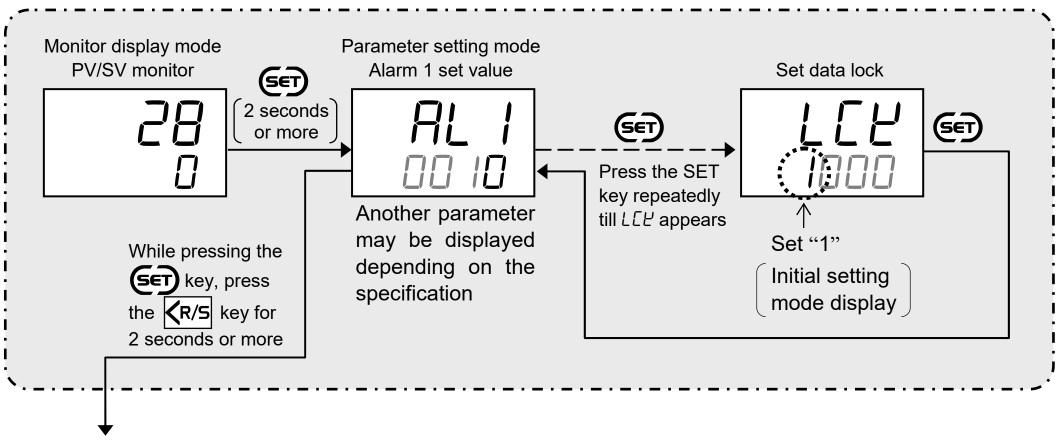
Parameter symbol	Data range	Factory set value
dSV	0: Show SV 1: Hide SV	0

To show the "Show/Hide SV display," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

Show/Hide SV display can be set at Cod 1021 in the Initial setting mode.

Procedure to enter the Initial setting mode



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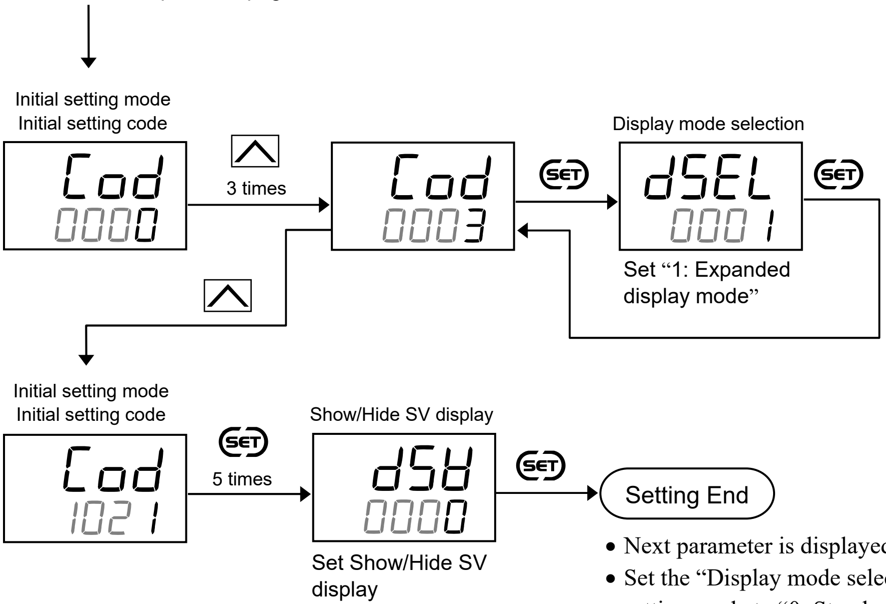


- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

MEMO

10 ALARM FUNCTION

This chapter describes alarm related functions, setting contents and setting procedure based on the key words related to alarms.

10.1 Using Alarm Function

10.1.1 Setting procedure for alarm function

Set alarm as follows:

Set the Alarm type

Set the Alarm type.

☞ For alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**.

↓

Set the parameter related to alarm output

Set the parameter related to Alarm output.

- Output assignment of Alarm
- Output energize/de-energize when assigned to alarm

☞ For output assignment of Alarm, refer to **7.1 Changing Output Assignment (P. 7-2)**.

☞ For output energize/de-energize when assigned to alarm, refer to **7.4 Changing Alarm Output (Energize/De-energize) (P. 7-12)**.

↓

Setting alarm action at control stop

Set the Action selection at STOP mode.

☞ For alarm selection at STOP mode, refer to **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**.

↓

Set the Alarm parameter

Set the following parameters:

- Alarm differential gap
- Alarm action at input burnout
- Alarm timer
- Alarm interlock

☞ For alarm differential gap, refer to **10.1.3 Setting a differential gap in alarm action (P. 10-14)**.

☞ For alarm action at input burnout, refer to **6.4 Changing Error Handling at Input Error (P. 6-10)**.

☞ For alarm timer, refer to **10.1.4 Preventing alarm from turning on due to a transient abnormal input (P. 10-16)**.

☞ For alarm interlock, refer to **10.1.5 Keeping the alarm state (Interlock function) (P. 10-19)** and **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

↓

Set the Alarm set value

Set the Alarm set value.

☞ For alarm set value, refer to **5.5 Setting the Alarm Set Value (P. 5-13).**

■ Setting example: Set the Alarm 1 (Model code: RZ100-MNM ∗ NNN/N)

- **Alarm 1 type**

  [Initial setting mode: Cod 0000]

  Alarm 1 type (ALn 1): **Deviation high/low with hold action** [Set value: 20] (Factory set value: 1 *)

- **Alarm output condition**

  [Initial setting mode: Cod 0002]

  Output assignment of Alarm 1 (oAL 1): **Output 3 (OUT3)** [Set value: 3] (Factory set value: 3 *)

  Output 3 (OUT3) energize/de-energize when assigned to alarm (EYC3):

  Energize [Set value: 0] (Factory set value: 0) EX

- **Alarm action at control stop**

  [Initial setting mode: Cod 1030]

  Action selection at STOP mode (SS): **Stop alarm at control stop**

  [Set value: 0000] (Factory set value: 0000) EX

- **Setup parameters for Alarm 1**

  [Initial setting mode: Cod 1041]

  Alarm 1 differential gap (AH 1): **Supplied** [Set value: 2] (Factory set value: 2) EX

  Alarm 1 action at input burnout (Abo 1): **ON at over-scale or underscale**

  [Set value: 3] (Factory set value: 3) EX

  Alarm 1 timer (ALT 1): **2 seconds** [Set value: 2] (Factory set value: 0) EX

  Alarm 1 interlock (AIL 1): **Used** [Set value: on] (Factory set value: oFF) EX

- **Set value of Alarm 1**

  [Parameter setting mode]

  Alarm 1 set value (AL 1): **100** [Set value: 100] (Factory set value: 10)

* Model code: RZ100-MNM∗NNN/N

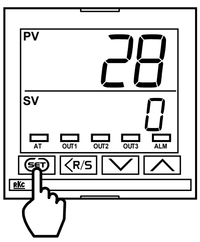
If parameters in the Initial setting mode cannot be changed, exit the Initial setting mode once and press the Shift key for 1 second or longer to stop the control. Reenter the Initial setting mode for adjustment.
To stop the control when switching the Initial setting mode, refer to **8.2 Continuing the Control when Entering the Initial Setting Mode (P. 8-5)**.

In the following procedure RZ100 is used for explanation, but the operation is the same for RZ400.

[Setting procedure]

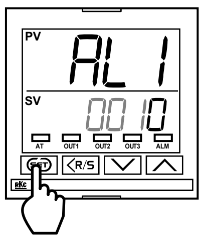
● Enabling parameter to be set

1
Monitor display mode
(PV/SV monitor screen)



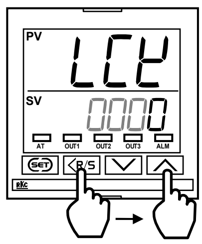
Press and hold the SET key for 2 seconds to go to the Parameter setting mode.

2
Parameter setting mode
(Alarm 1 set value screen)



Press the SET key several times to show the Set data lock screen. Another parameter may be displayed depending on the specification.

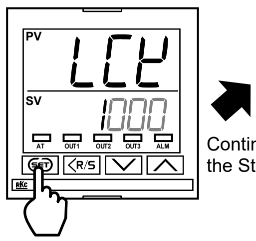
3
Parameter setting mode
(Set data lock screen)



To enter the Initial setting mode, use Shift and Up keys to set "**1**" at **the highest digit**.

For details, refer to **8.3 Restricting Key Operation (P. 8-7)**.

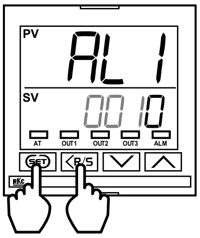
4



Continued on the Step 5

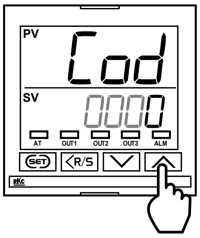
Press the SET key to store the new value.
The display goes to the Alarm 1 set value screen.
Another parameter may be displayed depending on the specification.

5
Parameter setting mode
(Alarm 1 set value screen)



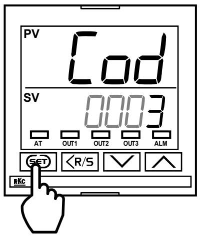
Press the Shift key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.

6
Initial setting mode
(Initial setting code screen)



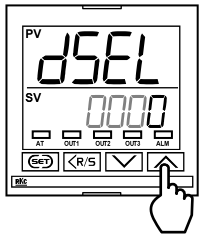
Press the Up key three times to change the Initial setting code to "**0003**."

7



Press the SET key to go to the Display mode selection screen.

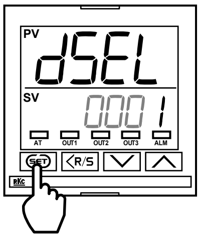
8
Initial setting mode
(Display mode selection screen)



Enter "**1**" at the **Display mode selection** using the Up key to change the display mode to "**Expanded display mode**."

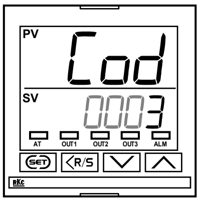
☞ For details, refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)**.

9
Initial setting mode
(Display mode selection screen)



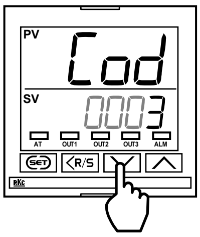
Press the SET key to store the new value.
The display goes to the Initial setting code screen.

10
Initial setting mode
(Initial setting code screen)



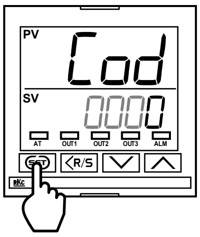
● Setting up Alarm 1 type

1
Initial setting mode
(Initial setting code screen)



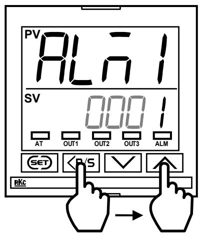
Press the Down key three times to change the Initial setting code to "**0000**."

2



Press the SET key five times to go to the Alarm 1 type screen.

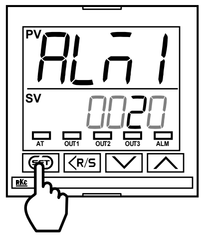
3
Initial setting mode
(Alarm 1 type screen)



The alarm code of the desired alarm is "**20**." Use Shift and Up keys to enter "**20**."

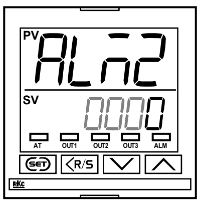
☞ For details, refer to **10.1.2 Changing alarm type (P. 10-8)**.

4



Press the SET key to store the new value.
The display goes to the Alarm 2 type screen.

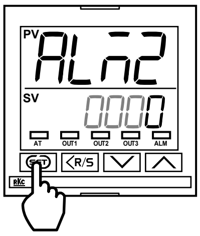
5
Initial setting mode
(Alarm 2 type screen)



Setting up alarm output

1

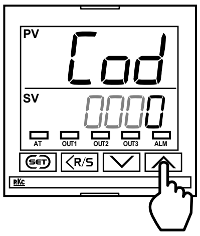
Initial setting mode
(Alarm 2 type screen)



Press the SET key to go to the Initial setting code screen.

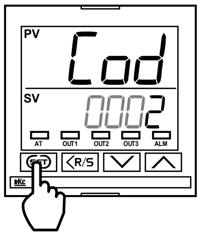
2

Initial setting mode
(Initial setting code screen)



Press the Up key twice to change the Initial setting code to "**0002**."

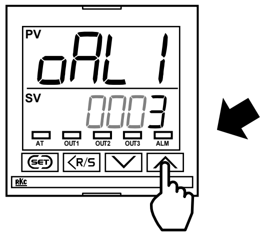
3



Press the SET key twice to go to the Output assignment of Alarm 1 screen.

4

Initial setting mode
(Output assignment of Alarm 1)

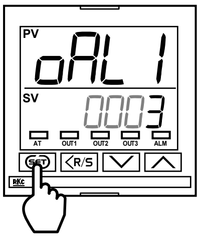


Output assignment of Alarm 1 is set to "**3**" as factory set value. There's no need to change the value.

For details, refer to **7.1 Changing Output Assignment (P. 7-2)**.

5

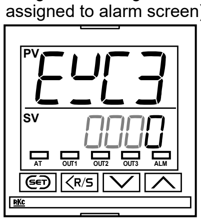
Initial setting mode
(Output assignment of Alarm 1)



Press the SET key to store the new value.
After the value has been stored, press the SET key a few times until EVC3 is displayed.
The number of times of pressing the SET key depends on the specification.

6

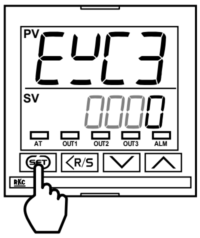
Initial setting mode
(Output 3 (OUT3) energize/de-energize when assigned to alarm screen)



Output 3 energize/de-energize when assigned to alarm is set to "**0**" as factory set value. There's no need to change the value.

For details, refer to **7.4 Changing Alarm Output (Energize/ De-energize) (P. 7-12)**.

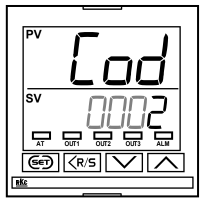
7



Press the SET key to store the new value.
The display goes to the Initial setting code screen.

8

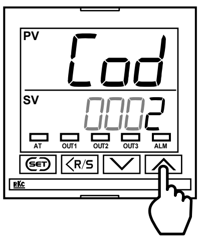
Initial setting mode
(Initial setting code screen)



Setting up alarm action at control stop

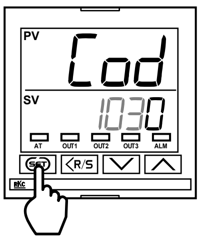
1

Initial setting mode
(Initial setting code screen)



Press the Up key three times to change the Initial setting code to "**1030**."

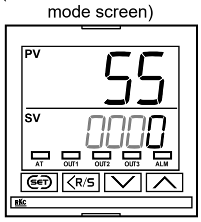
2



Press the SET key to go to the Action selection at STOP mode screen.

3

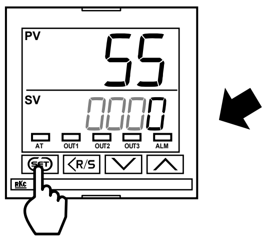
Initial setting mode
(Action selection at STOP mode screen)



Action selection at STOP mode is "**0000**." There's no need to change the value.

For details, refer to **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**.

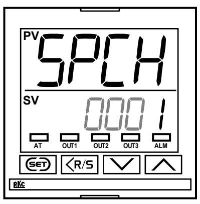
4



Press the SET key to store the new value.
The display goes to the STOP display selection screen.

5

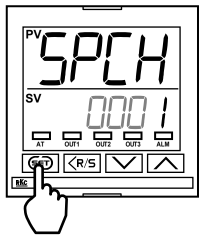
Initial setting mode
(STOP display selection screen)



● Setting up Alarm 1

1

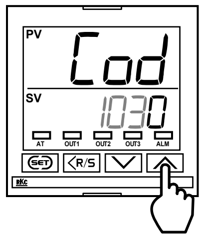
Initial setting mode
(STOP display selection screen)



Press the SET key twice to go to the Initial setting code screen.

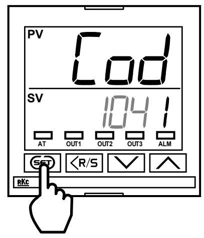
2

Initial setting mode
(Initial setting code screen)



Press the Up key to change the Initial setting code to "**1041**."

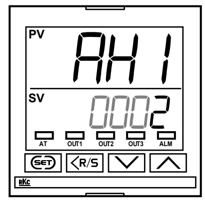
3



Press the SET key to go to the Alarm 1 differential gap screen.

4

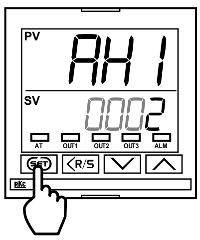
Initial setting mode
(Alarm 1 differential gap screen)



Alarm 1 differential gap is set to “**2**” as factory set value. There’s no need to change the value.

☞ For details, refer to **10.1.3 Setting a differential gap in alarm action (P. 10-14)**.

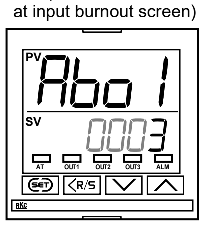
5



Press the SET key to store the new value.
The display goes to the Alarm 1 action at input burnout screen.

6

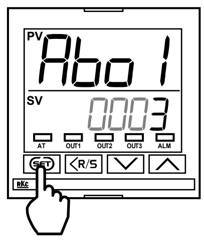
Initial setting mode
(Alarm 1 action
at input burnout screen)



Alarm 1 action at input burnout is set to “**3**” as factory set value. There’s no need to change the value.

☞ For details, refer to **6.4 Changing Error Handling at Input Error (P. 6-10)**.

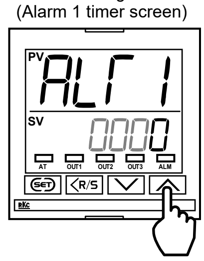
7



Press the SET key to store the new value.
The display goes to the Alarm 1 timer screen.

8

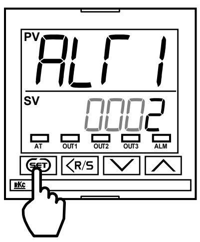
Initial setting mode
(Alarm 1 timer screen)



Alarm 1 timer is currently set to “**0**.” Use the Up key to adjust it to “**2**.”

☞ For details, refer to **10.1.4 Preventing alarm from turning on due to a transient abnormal input (P. 10-16)**.

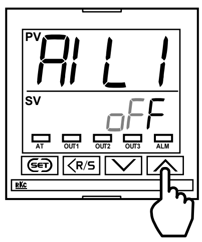
9



Press the SET key to store the new value.
The display goes to the Alarm 1 interlock screen.

10

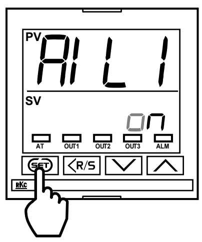
Initial setting mode
(Alarm 1 interlock screen)



Alarm 1 interlock is currently set to “**oFF**.” Use the Up key to adjust it to “**on**.”

☞ For details, refer to **10.1.5 Keeping the alarm state (Interlock function) (P. 10-19)** and **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

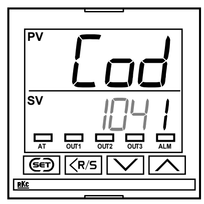
11



Press the SET key to store the new value.
The display goes to the Initial setting code screen.

12

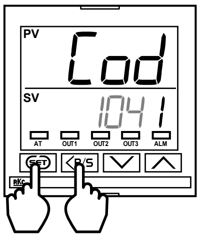
Initial setting mode
(Initial setting code screen)



● Setting up Alarm 1 set value

1

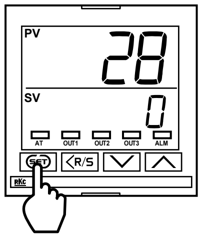
Initial setting mode
(Initial setting code screen)



Press the Shift key for 2 seconds or more while pressing the SET key to go to the PV/SV monitor screen.

2

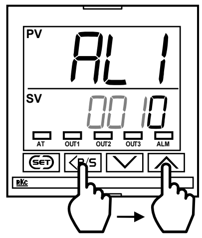
Monitor display mode
(PV/SV monitor screen)



Press the SET key for 2 seconds or more to enter the Alarm 1 set value screen in the Parameter setting mode.

3

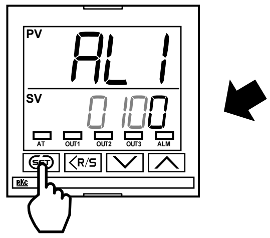
Parameter setting mode
(Alarm 1 set value screen)



Alarm 1 set value is currently set to “**10**.” Use Shift and Up keys to enter “**100**.”

☞ For details, refer to **5.5 Setting the Alarm Set Value (P. 5-13)**.

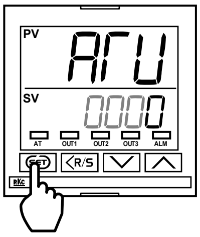
4



Press the SET key to store the new value.
The display goes to the Autotuning (AT) screen.

5

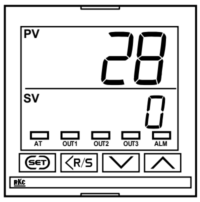
Parameter setting mode
(Autotuning screen)



Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

6

Monitor display mode
(PV/SV monitor screen)



Change the display mode to “Standard display mode” and/or hide the Initial setting mode using the Set data lock function depending on the necessity.

☞ Refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)** for how to change the display mode. For Set data lock, refer to **8.3 Restricting Key Operation (P. 8-7)**.

10.1.2 Changing alarm type

There are 21 types of alarm in total.

Deviation action:
- Deviation high
- Deviation high with hold action
- Deviation high with re-hold action
- Deviation low
- Deviation low with hold action
- Deviation low with re-hold action
- Deviation high/low
- Deviation high/low with hold action
- Deviation high/low with re-hold action
- 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)
- Band
- Band (High/Low individual setting)

Input value action:
- Process high
- Process high with hold action
- Process low
- Process low with hold action

Set value action:
- SV high
- SV low

- Monitor during RUN

Control loop break alarm (LBA) is also selectable. For more details, refer to **10.2 Using Control Loop Break Alarm (LBA) (P. 10-23)**.

■ Description of function

● Deviation action

When the deviation (PV – SV) reaches the Alarm set value, alarm ON occurs.

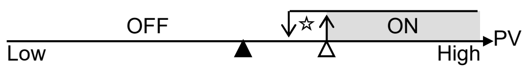
ON: Alarm action turned on
OFF: Alarm action turned off

(▲: Set value (SV) △ : Alarm set value ☆: Alarm differential gap)

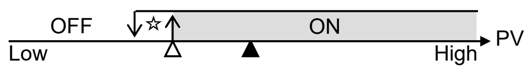
Deviation high

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

(Alarm set value is greater than 0.)



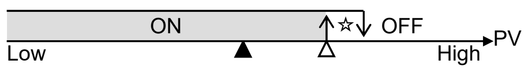
(Alarm set value is less than 0.)



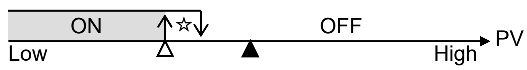
Deviation low

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

(Alarm set value is greater than 0.)



(Alarm set value is less than 0.)



Deviation high/low

Two types of Deviation high/low action are available.

Without high/low individual setting:

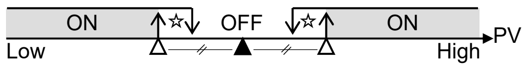
When the absolute deviation |PV – SV| is more/less than the Alarm set value, the alarm ON occurs.

With high/low individual setting:

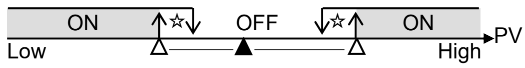
High action: When the deviation (PV – SV) is more than the Alarm set value [high], the alarm ON occurs.

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

(Without High/Low individual setting)



(With High/Low individual setting)



Band

Two types of Band action are available.

Without high/low individual setting:

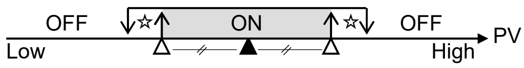
When the absolute deviation |PV – SV| is within the Alarm set value, the alarm ON occurs.

With high/low individual setting:

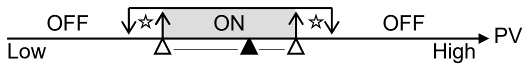
High action: When the deviation (PV – SV) is less than the Alarm set value [high], the alarm ON occurs.

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

(Without High/Low individual setting)



(With High/Low individual setting)



● Input value action

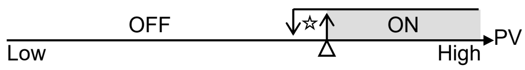
When the Measured value (PV) reaches the Alarm set value, the alarm ON occurs.

ON: Alarm action turned on
OFF: Alarm action turned off

(△: Alarm set value ☆: Alarm differential gap)

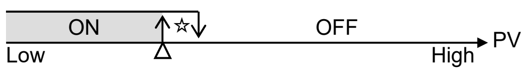
Process high

When the measured value (PV) is more than the Alarm set value, the alarm ON occurs.



Process low

When the measured value (PV) is less than the Alarm set value, the alarm ON occurs.



● Set value action

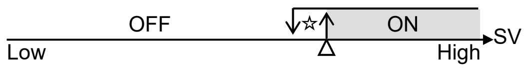
When the Set value (SV) reaches the Alarm set value, alarm ON occurs.

ON: Alarm action turned on
OFF: Alarm action turned off

(△: Alarm set value ☆: Alarm differential gap)

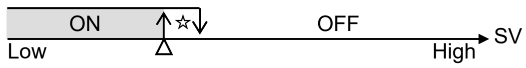
SV high

When the Set value (SV) is more than the Alarm set value, the alarm ON occurs.



SV low

When the Set value (SV) is less than the Alarm set value, the alarm ON occurs.



● Monitor during RUN

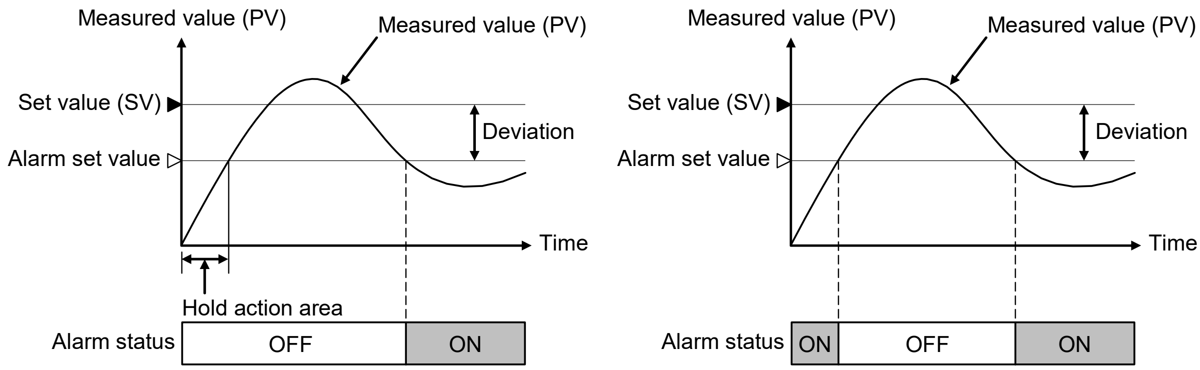
Alarm ON at RUN (Alarm OFF at STOP)
Useful for operations such as turning on an indicator lamp or a rotary beacon light.

If "Monitor during RUN" is selected, setting of Alarm set values (Parameter setting mode) and Alarm action differential gap (Initial setting mode) will be disabled.

● Hold action

When Hold action is ON, the alarm action is suppressed at start-up or STOP to RUN until the Measured value (PV) has entered the non-alarm range.

Example:



[With hold action] **[Without hold action]**

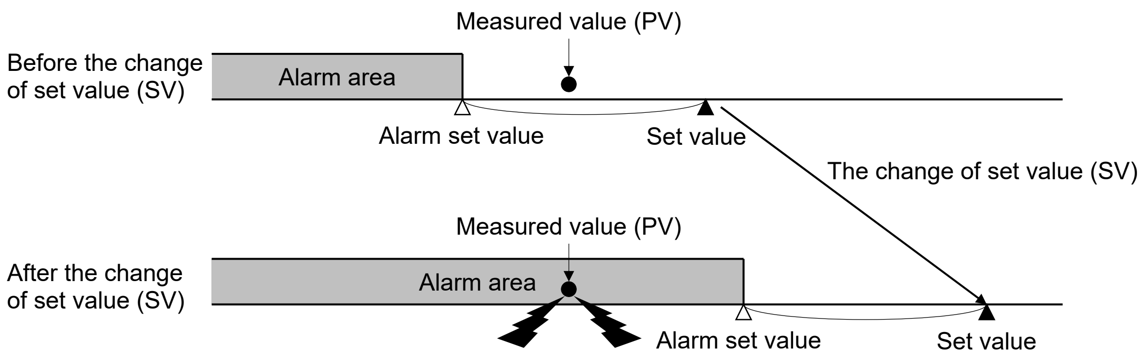
● Re-hold action

When Re-hold action is ON, the alarm action is also suppressed at the control set value (SV) change until the Measured value (PV) has entered the non-alarm range.

Action condition	Hold action	Re-hold action
When the power is turned on	With function	With function
When transferred from STOP (control STOP) to RUN (control RUN)	With function	With function
When the set value (SV) is changed	Without function	With function

Example: When Alarm 1 type is the deviation low

When Re-hold action is OFF and alarm output type is deviation, the alarm 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-alarm range again.



■ Parameter setting

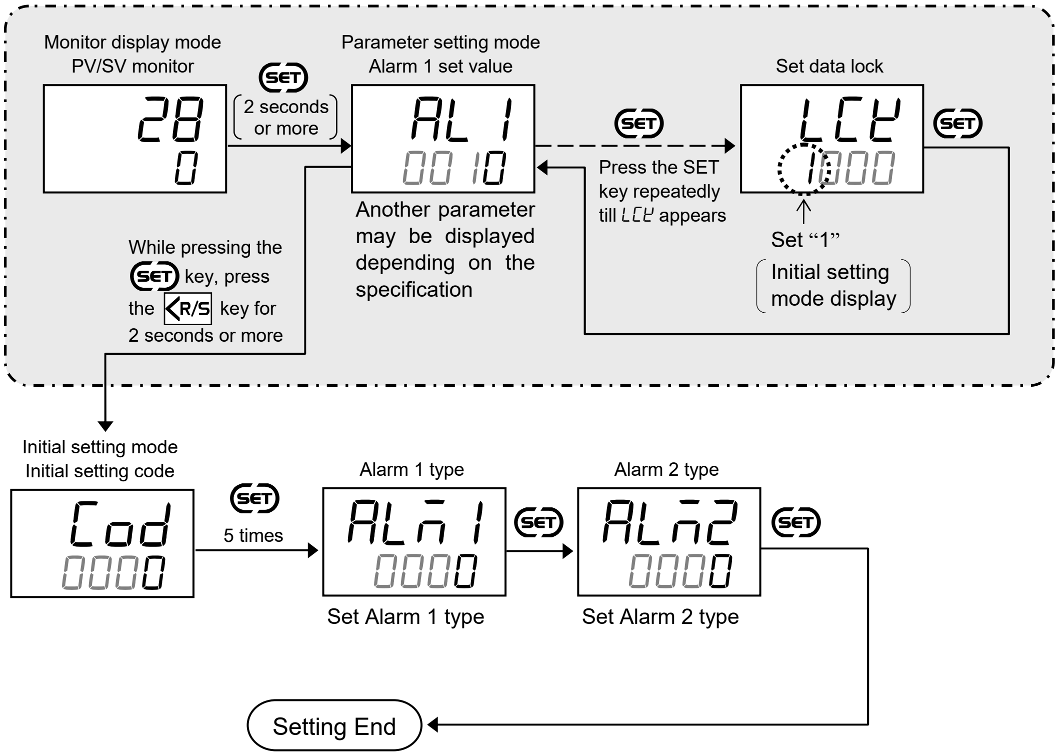
● Alarm 1 and 2 type [Initial setting mode: Cod 0000]

Parameter symbol	Data range	Factory set value
ALM1 ALM2	0: None 1: Deviation high 2: Deviation high/low 3: Process high 5: Deviation low 6: Band 7: Process low 9: Deviation high with re-hold action 10: Deviation high/low with re-hold action 11: Process high with hold action 13: Deviation low with re-hold action 15: Process low with hold action 16: Deviation high/low (High/Low individual setting) 17: Band (High/Low individual setting) 18: Deviation high/low with re-hold action (High/Low individual setting) 19: Deviation high with hold action 20: Deviation high/low with hold action 21: Deviation low with hold action 22: Deviation high/low with hold action (High/Low individual setting) 23: SV high 24: SV low 25: Monitor during RUN 26: Control loop break alarm (LBA) * * Settable only for Alarm 2 type Do not set 4, 8, 12, and 14.	When alarm code is specified at the time of ordering, the Alarm type in the alarm code is the factory setting. If Alarm type is not specified, factory setting depends on the specification (with or without outputs). If alarm output is assigned, Alarm type is “Deviation high.” If not assigned, Alarm type is “None.” For details, refer to **1.3 Model Code (P. 1-4)**.

■ Setting procedure

Alarm type can be set at Cod 0000 in the Initial setting mode.

Procedure to enter the Initial setting mode

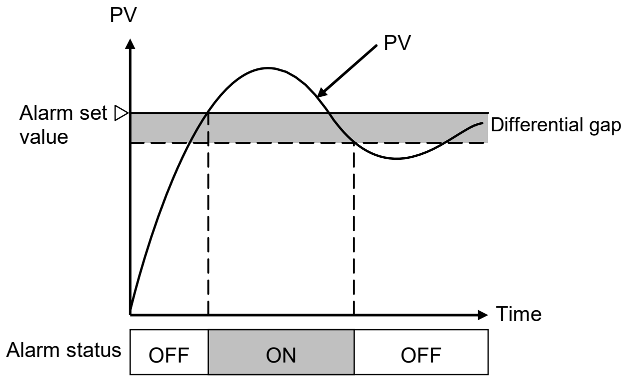


- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

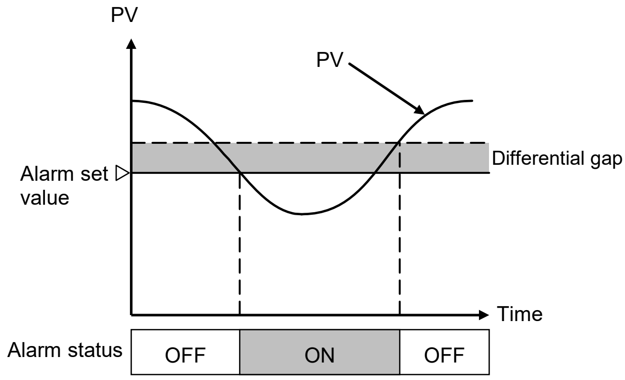
10.1.3 Setting a differential gap in alarm action

■ Description of function

It prevents chattering of alarm output due to the Measured value (PV) fluctuation around the Alarm set value.



Process high



Process low

■ Parameter setting

● **Alarm 1 and 2 differential gap**
[Initial setting mode: Cod 1041, Cod 1042] EX

Parameter symbol	Data range	Factory set value
AH1 AH2	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	2 or 2.0

📖 To show the "Alarm 1 differential gap" and "Alarm 2 differential gap," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

📖 To show the "Alarm 1 differential gap," set a value other than "None" and "Monitor during RUN" at Cod 0000 (Alarm 1 type) in the Initial setting mode.

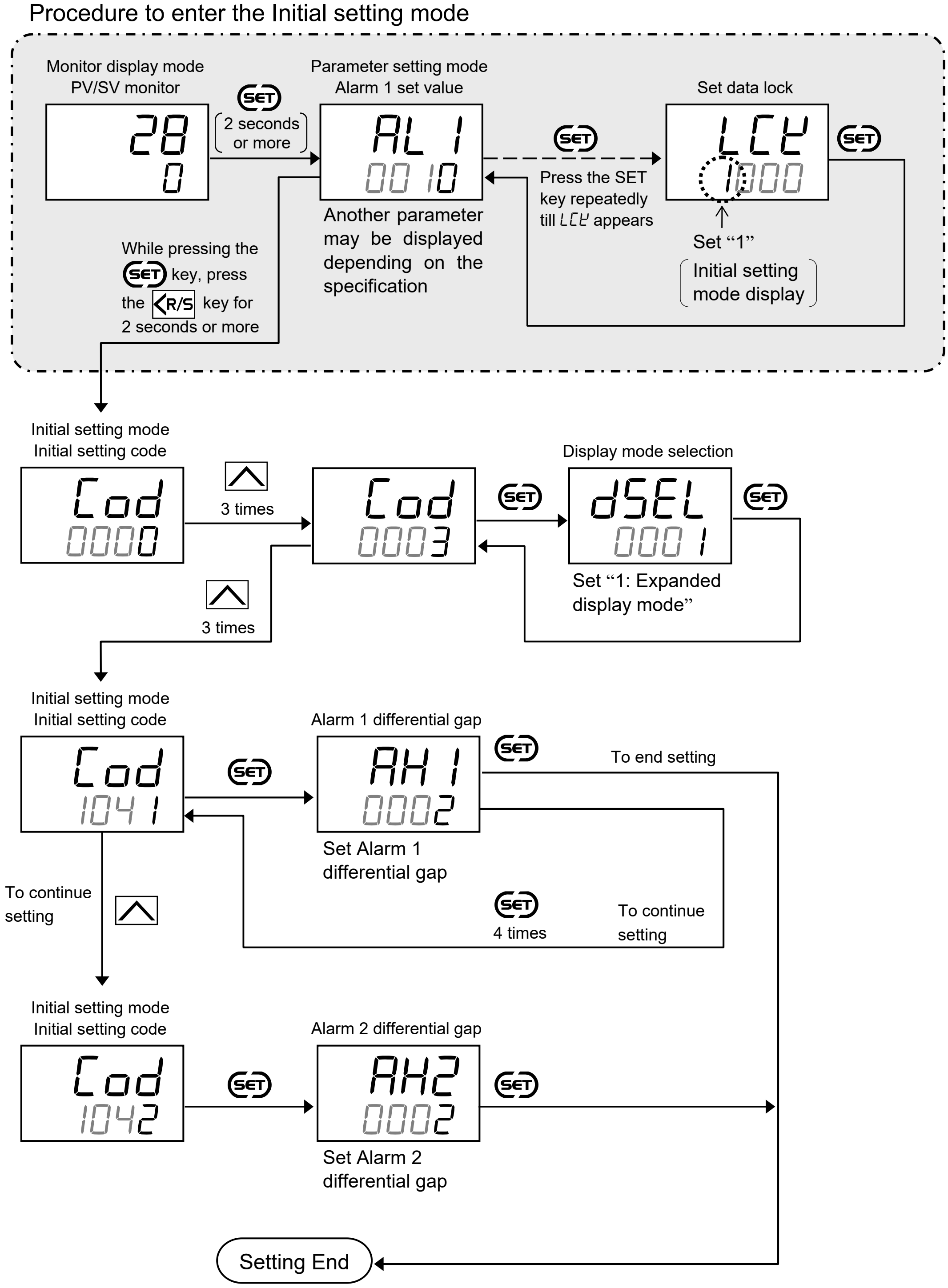
📖 To show the "Alarm 2 differential gap," set a value other than "None," "Monitor during RUN," and "Control loop break alarm (LBA)" at Cod 0000 (Alarm 2 type) in the Initial setting mode.

☞ For alarm output, refer to **7.1 Changing Output Assignment (P. 7-2)**.

☞ For alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**.

■ Setting procedure

- Alarm 1 differential gap can be set at Cod 1041 in the Initial setting mode.
- Alarm 2 differential gap can be set at Cod 1042 in the Initial setting mode.



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

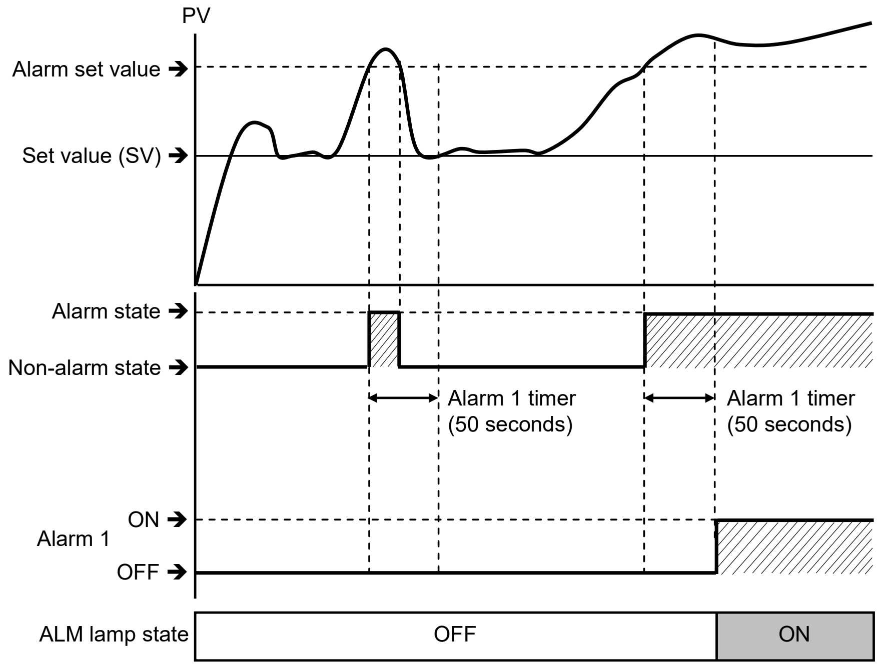
10.1.4 Preventing alarm from turning on due to a transient abnormal input

Alarm timer can be used to prevent alarm from turning on for the alarm state shorter than the set time.

■ Description of function

When an alarm condition becomes ON, the output is suppressed until the Alarm timer set time elapses. If the alarm output is still ON after the time is up, the output will resume.

Example: When the setting of Alarm 1 timer is 50 seconds



The Alarm timer is also activated for the following reasons:

- When set to the alarm state simultaneously with power turned on
- When set to the alarm state simultaneously with control changed to RUN (control start) from STOP (control stop)

In the alarm wait state, no alarm output is turned on even after the Alarm timer preset time has elapsed.

Alarm timer will be reset if the following circumstances occur when the Alarm timer is activated:

- Power failure
- Change to STOP (control stop) from RUN (control start) *
- Cancellation of Alarm state

* Alarm timer will not be reset by switching to the STOP (control stop) when “Alarm action: Alarm remains on at STOP” is set for the Action selection at STOP mode.

■ Parameter setting

● Alarm 1 and 2 timer
[Initial setting mode: Cod 1041, Cod 1042] EX

Parameter symbol	Data range	Factory set value
ALT1 ALT2	0 to 600 seconds	0

To show the "Alarm 1 timer" and "Alarm 2 timer," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

To show the "Alarm 1 timer," set a value other than "None" at Cod 0000 (Alarm 1 type) in the Initial setting mode.

To show the "Alarm 2 timer," set a value other than "None" at Cod 0000 (Alarm 2 type) in the Initial setting mode.

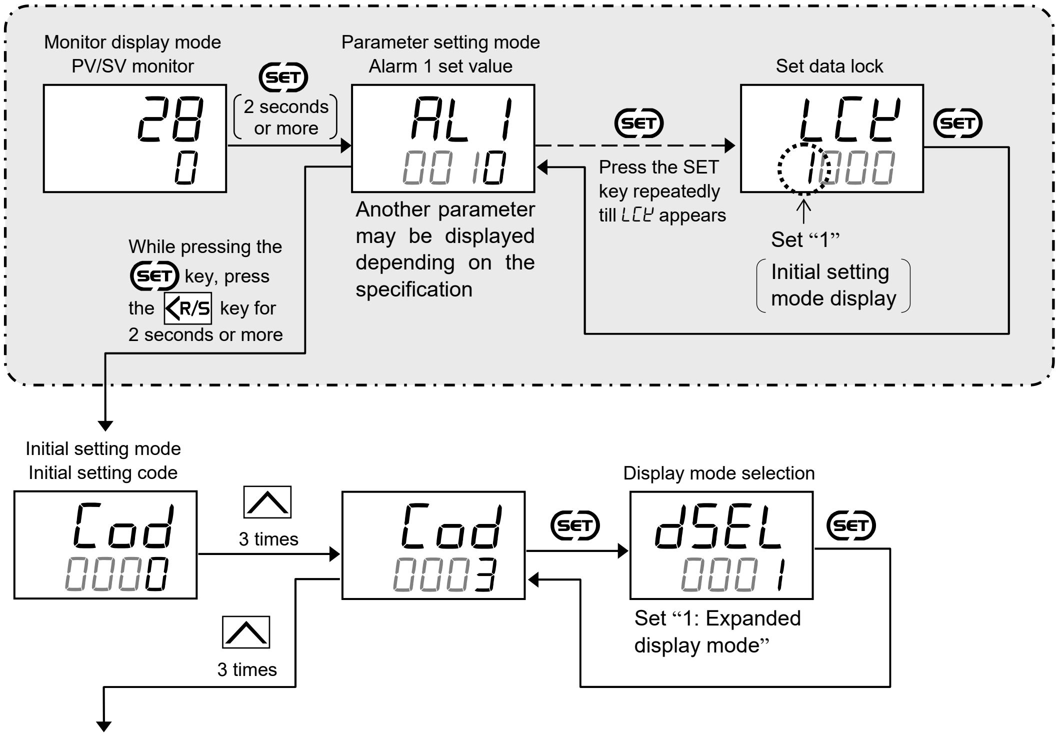
For alarm output, refer to **7.1 Changing Output Assignment (P. 7-2)**.

For alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**.

■ Setting procedure

- Alarm 1 timer can be set at Cod 1041 in the Initial setting mode.
- Alarm 2 timer can be set at Cod 1042 in the Initial setting mode.

Procedure to enter the Initial setting mode



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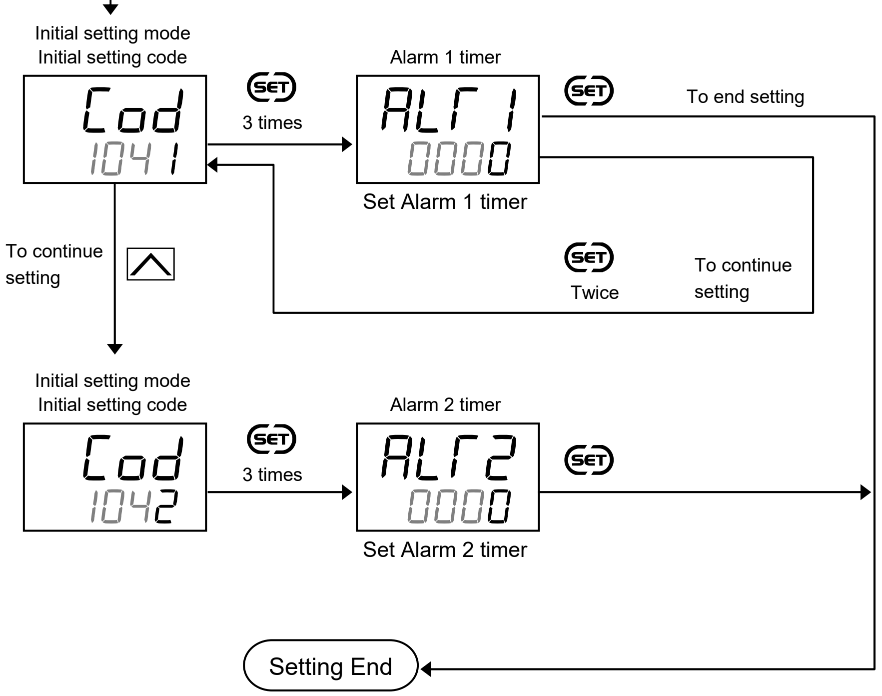


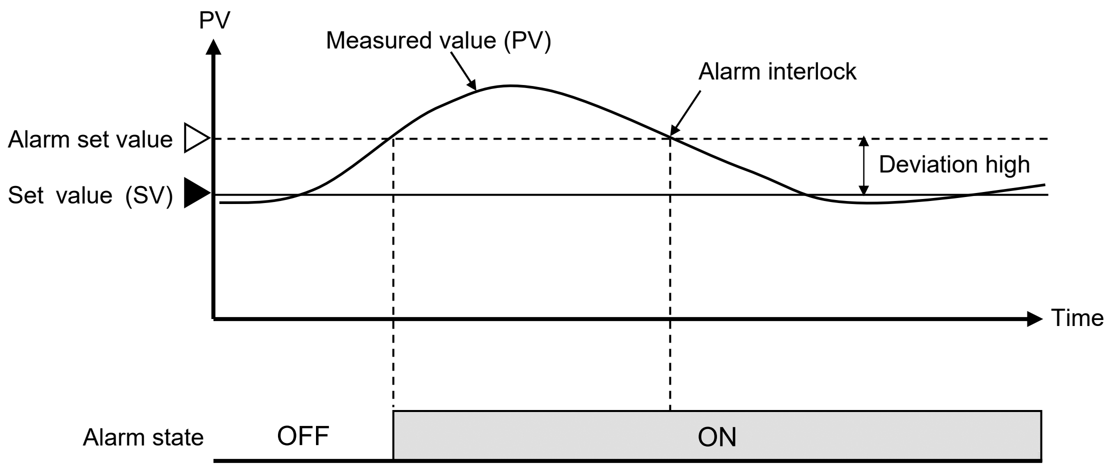
- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

10.1.5 Keeping the alarm state (Interlock function)

■ Description of function

The Alarm interlock function holds the alarm state even if the Measured value (PV) is out of the alarm zone after it enters the alarm zone once.

Example: When the Alarm interlock function is used for Deviation high



[Without Alarm hold action]

☞ For the interlock release, refer to **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

■ Parameter setting

● Alarm 1 and 2 interlock
[Initial setting mode: Cod 1041, Cod 1042] EX

Parameter symbol	Data range	Factory set value
A1L1 A1L2	oFF: Unused on: Used	oFF

📖 To show the “Alarm 1 interlock” and “Alarm 2 interlock,” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

📖 To show the “Alarm 1 interlock,” set a value other than “None” at Cod 0000 (Alarm 1 type) in the Initial setting mode.

📖 To show the “Alarm 2 interlock,” set a value other than “None” at Cod 0000 (Alarm 2 type) in the Initial setting mode.

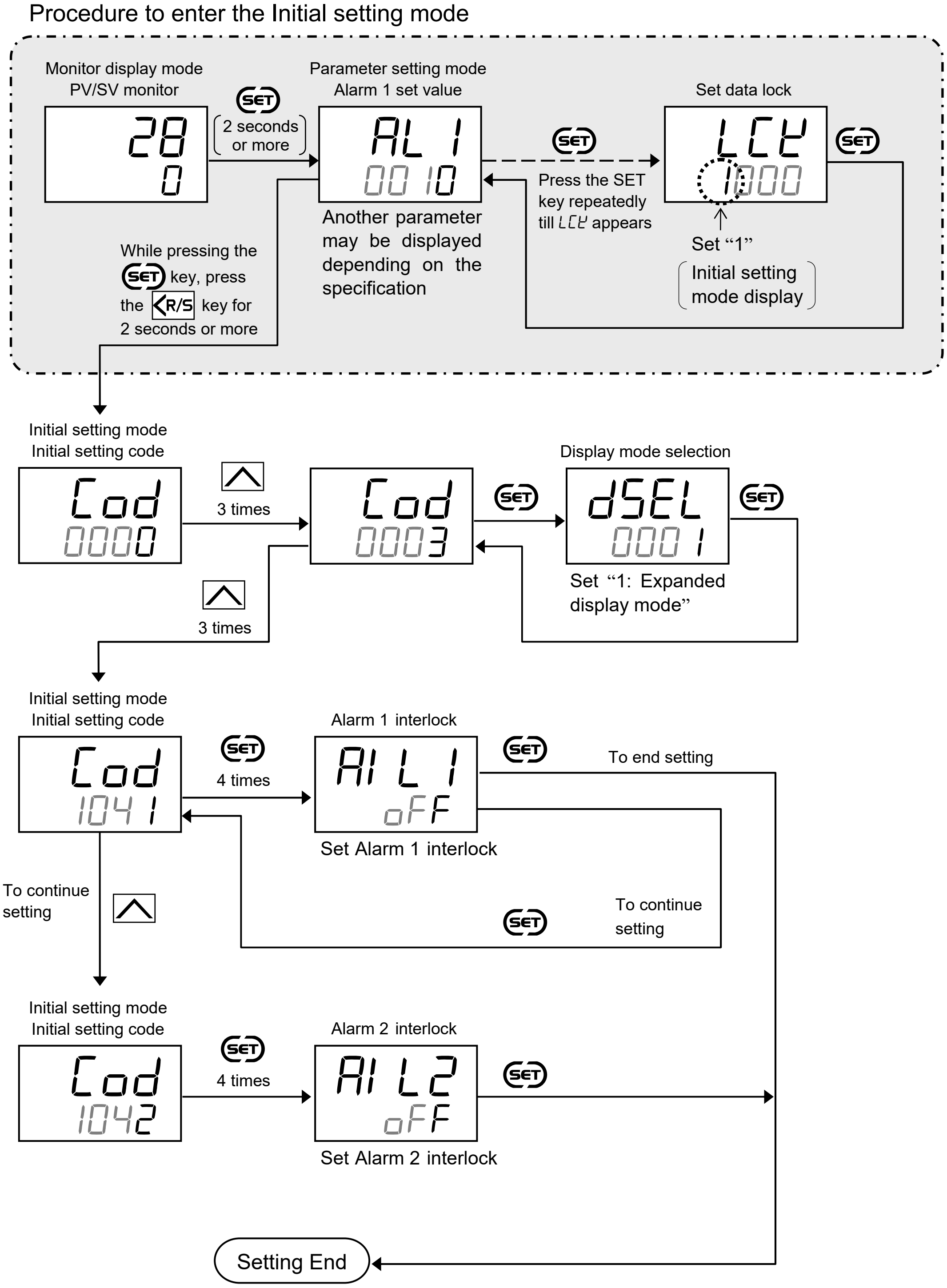
📖 Interlock function can be used even when “Control loop break alarm (LBA)” is specified for Alarm 2 type. Once the LBA has turned on, the LBA interlock maintains the alarm ON state even if LBA OFF conditions are met. For the interlock release, refer to **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

☞ For alarm output, refer to **7.1 Changing Output Assignment (P. 7-2)**.

☞ For alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**.

■ Setting procedure

- Alarm 1 interlock can be set at Cod 1041 in the Initial setting mode.
- Alarm 2 interlock can be set at Cod 1042 in the Initial setting mode.



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

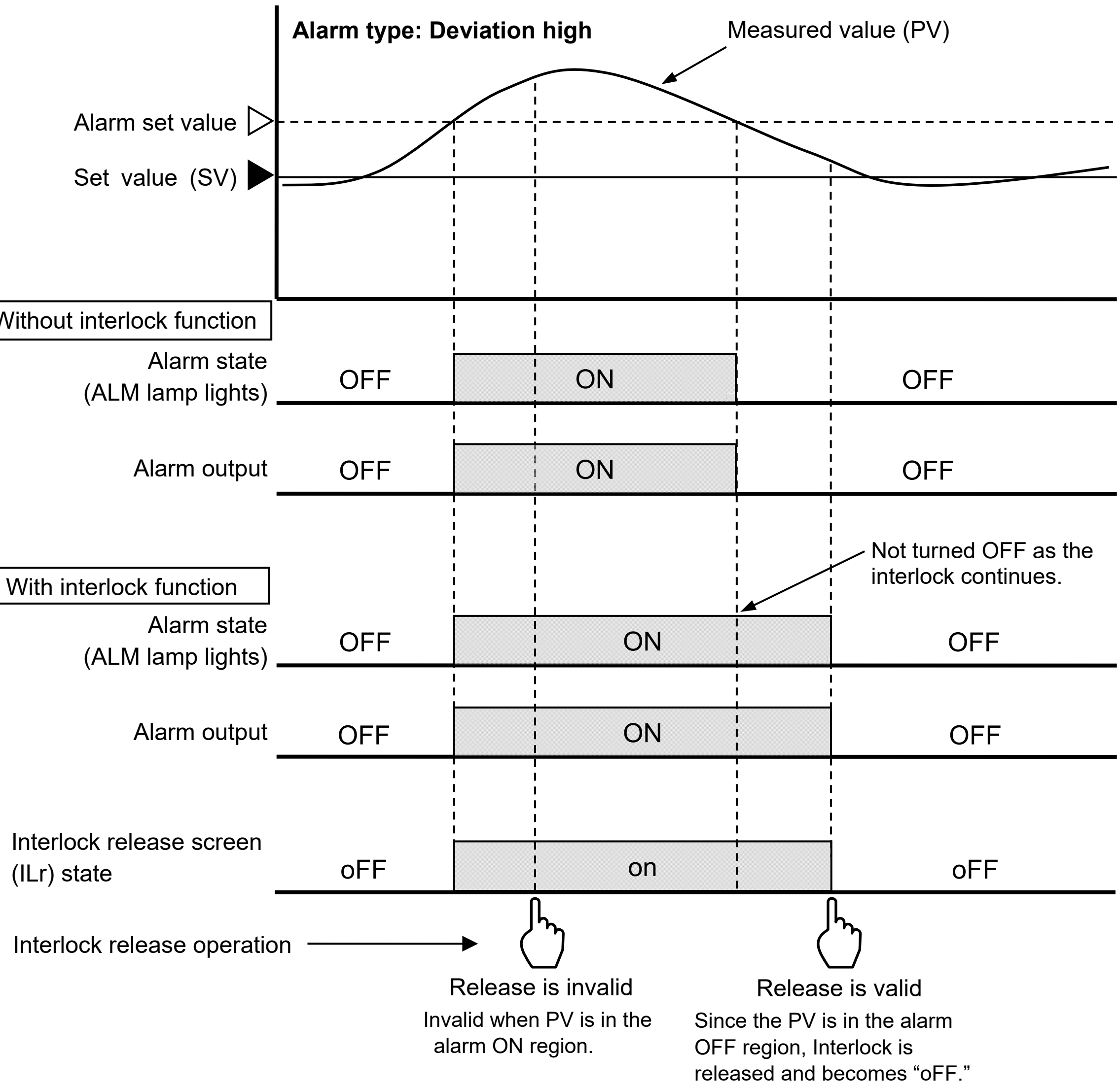
10.1.6 Releasing the alarm state (Interlock release)

■ Description of function

The Alarm interlock function holds the alarm state even if the Measured value (PV) is out of the alarm zone after it enters the alarm zone once.

In case of Control loop break alarm (LBA), once the LBA has turned ON, the LBA ON state is kept even if LBA OFF conditions are met. Alarm interlock can be released by key operation or communication (optional function).

The following picture shows how to release the interlock.



📖 The Interlock release has an influence to all alarms, Control loop break alarm (LBA) and Heater break alarm (HBA)* that are in the interlock state and releases such alarms at one time whose interlock release conditions are met.

☞ Refer to **12. COMMUNICATION FUNCTION (P. 12-1)** for Interlock release through communication.

* Optional function

■ Parameter setting

● Interlock release [SV setting mode]

Parameter symbol	Data range	Factory set value
ILr	oFF: Interlock release on: Interlock state	oFF

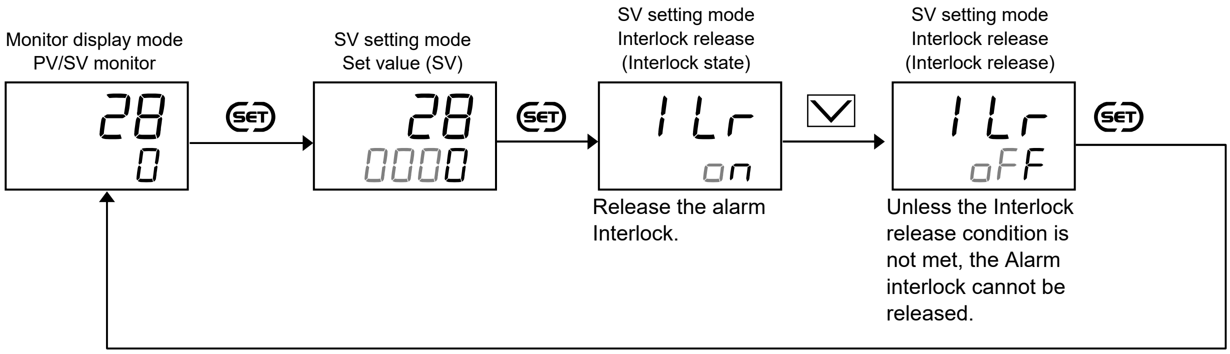
To show the "Interlock release (ILr)," "Interlock" parameter must be set to "on: Used" at any one of "Alarm 1 interlock" (Cod 1041 in the Initial setting mode), "Alarm 2 interlock" (Cod 1042 in the Initial setting mode), or "HBA1 interlock" or "HBA2 interlock" in Cod 1045 in the Initial setting mode. Without this setting, the Interlock release parameter is not displayed.

■ Setting procedure

The Interlock release can be found in the SV setting mode.

[Releasing the Interlock]

In the interlock state, the display in the Interlock release automatically turns on (on).



10.2 Using Control Loop Break Alarm (LBA)

■ Setting procedure for control loop break alarm (LBA)

Control loop break alarm (LBA) is one of alarm functions. Because of this reason, many of the setting items for Control loop break alarm (LBA) are common to the alarm function. However, it should be noted that Control loop break alarm (LBA) can be assigned to Alarm 2 only.

Set Control loop break alarm (LBA) as follows:

Set the Alarm type

Set the Alarm type.

☞ For alarm type, refer to **10.1.2 Changing alarm type (P. 10-8)**.

↓

Set the parameter related to alarm output

Set the parameter related to Alarm output.

- Output assignment of Alarm
- Output energize/de-energize when assigned to alarm

☞ For output assignment of Alarm, refer to **7.1 Changing Output Assignment (P. 7-2)**.

☞ For output energize/de-energize when assigned to alarm, refer to **7.4 Changing Alarm Output (Energize/De-energize) (P. 7-12)**.

↓

Setting alarm action at control stop

Set the Action selection at STOP mode.

☞ For alarm selection at STOP mode, refer to **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**.

↓

Set the Alarm parameter

Set the following parameters:

- Alarm action at input burnout
- Alarm timer
- Alarm interlock

☞ For alarm action at input burnout, refer to **6.4 Changing Error Handling at Input Error (P. 6-10)**.

☞ For alarm timer, refer to **10.1.4 Preventing alarm from turning on due to a transient abnormal input (P. 10-16)**.

☞ For alarm interlock, refer to **10.1.5 Keeping the alarm state (Interlock function) (P. 10-19)** and **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

↓

Set LBA time and LBD

Set the following parameters:

- Control loop break alarm (LBA) time
- LBA deadband (LBD)

☞ For the parameter description, refer to **■ Description of function (P. 10-29).**

☞ For the data range of parameter, refer to **■ Parameter setting (P. 10-30).**

☞ For the operation of parameter, refer to **■ Setting procedure (P. 10-31).**

■ Setting example: Setting Control loop break alarm (LBA) on Alarm 2 (Model code: RZ100-MNM ∗ NNN/N)

[Alarm 1 is not used]

- **Alarm 2 type**

  [Initial setting mode: Cod 0000]

  Alarm 2 type (ALm2): **Control loop break alarm (LBA)** [Set value: 26] (Factory set value: 0 *)

- **Alarm output condition**

  [Initial setting mode: Cod 0002]

  Output assignment of Alarm 1 (oAL1): **No assignment** [Set value: 0] (Factory set value: 3 *)

  Output assignment of Alarm 2 (oAL2): **Output 3 (OUT3)** [Set value: 3] (Factory set value: 0 *)

  Output 3 (OUT3) energize/de-energize when assigned to alarm (EXC3): **Energize** [Set value: 0] (Factory set value: 0) EX

- **Setup parameters for Alarm 2**

  [Initial setting mode: Cod 1042]

  Alarm 2 action at input burnout (Abo2): **ON at over-scale or underscale** [Set value: 3] (Factory set value: 3) EX

  Alarm 2 timer (ALT2): **2 seconds** [Set value: 2] (Factory set value: 0) EX

  Alarm 2 interlock (AIL2): **Used** [Set value: on] (Factory set value: oFF) EX

- **Set value of Control loop break alarm (LBA)**

  [Parameter setting mode]

  Control loop break alarm (LBA) time (LbA): **8.0** [Set value: 8.0] (Factory set value: 8.0)

  LBA deadband (Lbd): **10** [Set value: 10] (Factory set value: 0)

* Model code: RZ100-MNM∗NNN/N

If parameters in the Initial setting mode cannot be changed, exit the Initial setting mode once and press the Shift key for 1 second or longer to stop the control. Reenter the Initial setting mode for adjustment.
To stop the control when switching the mode to the Initial setting, refer to **8.2 Continuing the Control when Entering the Initial Setting Mode (P. 8-5)**.

In the following procedure RZ100 is used for explanation, but the operation is the same for RZ400.

[Setting procedure]

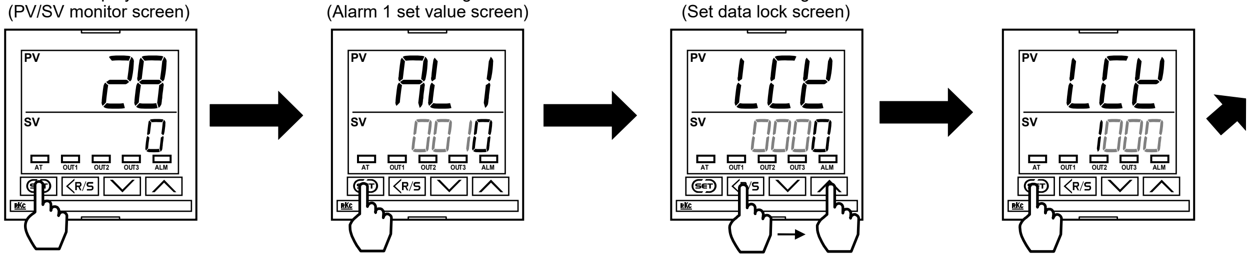
● Enabling parameter to be set

1 Monitor display mode (PV/SV monitor screen)

2 Parameter setting mode (Alarm 1 set value screen)

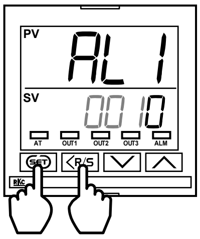
3 Parameter setting mode (Set data lock screen)

4



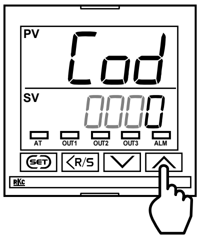
1. Press and hold the SET key for 2 seconds to go to the Parameter setting mode.
2. Press the SET key several times to show the Set data lock screen. Another parameter may be displayed depending on the specification.
3. To enter the Initial setting mode, use Shift and Up keys to set "**1**" at **the highest digit**.
   For details, refer to **8.3 Restricting Key Operation (P. 8-7).**
4. Press the SET key to store the new value. The display goes to the Alarm 1 set value screen. Another parameter may be displayed depending on the specification.

5
Parameter setting mode
(Alarm 1 set value screen)



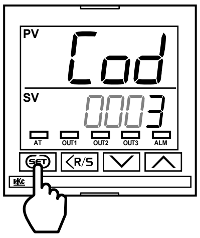
Press the Shift key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.

6
Initial setting mode
(Initial setting code screen)



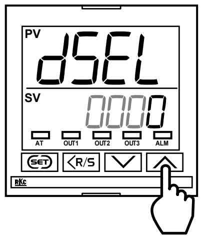
Press the Up key three times to change the Initial setting code to "**0003**."

7



Press the SET key to go to the Display mode selection screen.

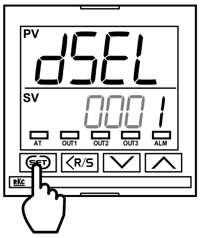
8
Initial setting mode
(Display mode selection screen)



Enter “**1**” at the **Display mode selection** using the Up key to change the display mode to “**Expanded display mode**.”

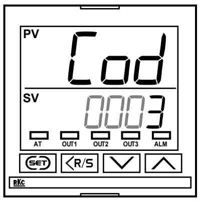
For details, refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)**.

9
Initial setting mode
(Display mode selection screen)



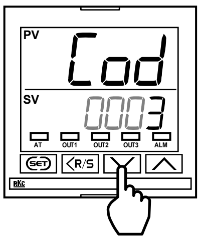
Press the SET key to store the new value.
The display goes to the Initial setting code screen.

10
Initial setting mode
(Initial setting code screen)



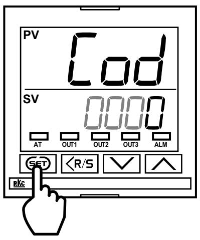
● Setting up Alarm 2 type

1
Initial setting mode
(Initial setting code screen)



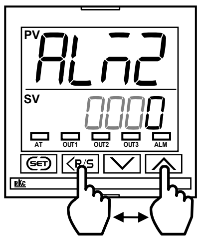
Press the Down key three times to change the Initial setting code to "**0000**."

2



Press the SET key six times to go to the Alarm 2 type screen.

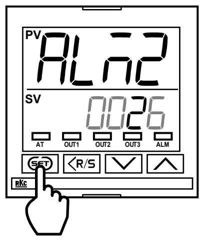
3
Initial setting mode
(Alarm 2 type screen)



The alarm code of the desired alarm is “**26**.” Use Shift and Up keys to enter “**26**.”

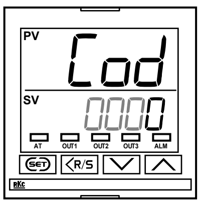
For details, refer to **10.1.2 Changing alarm type (P. 10-8)**.

4



Press the SET key to store the new value.
The display goes to the Initial setting code screen.

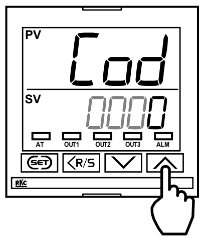
5
Initial setting mode
(Initial setting code screen)



● Setting up alarm output

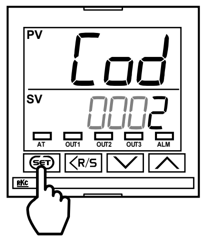
1

Initial setting mode
(Initial setting code screen)



Press the Up key twice to change the Initial setting code to "**0002**."

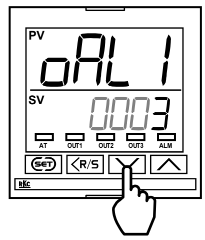
2



Press the SET key twice to go to the Output assignment of Alarm 1 screen.

3

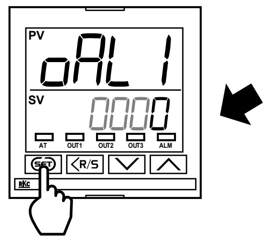
Initial setting mode
(Output assignment of Alarm 1)



Output assignment of Alarm 1 is currently set to "**3**." Use the Down key to adjust it to "**0**."

If the set value remains "3," Alarm 1 and Alarm 2 are output as a logical sum (*OR*). Change the **Output assignment of Alarm 1** to "**No assignment**."

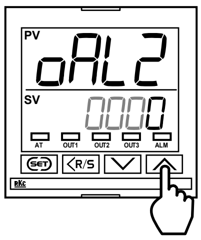
4



Press the SET key to store the new value.
The display goes to the Output assignment of Alarm 2 screen.

5

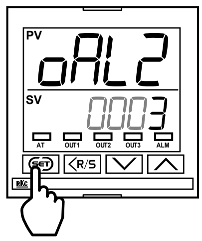
Initial setting mode
(Output assignment of Alarm 2)



Output assignment of Alarm 2 is currently set to "**0**." Use the Up key to adjust it to "**3**."

For details, refer to **7.1 Changing Output Assignment (P. 7-2)**.

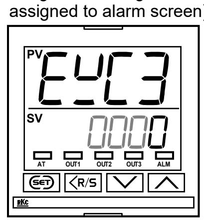
6



Press the SET key to store the new value.
After the value has been stored, press the SET key a few times until EYC3 is displayed.
The number of times of pressing the SET key depends on the specification.

7

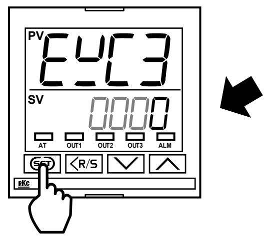
Initial setting mode
(Output 3 (OUT3) energize/de-energize when assigned to alarm screen)



Output 3 energize/de-energize when assigned to alarm is set to "**0**" as factory set value. There's no need to change the value.

For details, refer to **7.4 Changing Alarm Output (Energize/ De-energize) (P. 7-12)**.

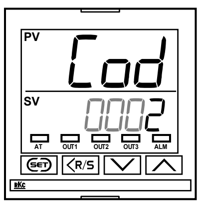
8



Press the SET key to store the new value.
The display goes to the Initial setting code screen.

9

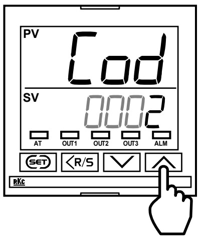
Initial setting mode
(Initial setting code screen)



● Setting up Alarm 2

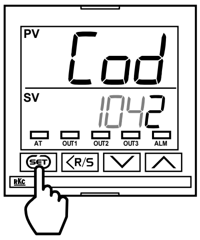
1

Initial setting mode
(Initial setting code screen)



Press the Up key five times to change the Initial setting code to "**1042**."

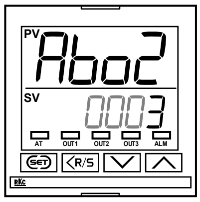
2



Press the SET key twice to go to the Alarm 2 action at input burnout screen.

3

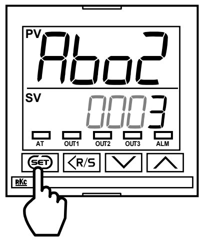
Initial setting mode
(Alarm 2 action
at input burnout screen)



Alarm 2 action at input burnout is set to "**3**" as factory set value. There's no need to change the value.

☞ For details, refer to **6.4 Changing Error Handling at Input Error (P. 6-10)**.

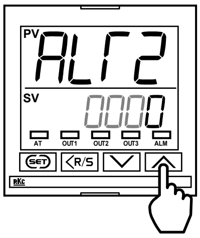
4



Press the SET key to store the new value.
The display goes to the Alarm 2 timer screen.

5

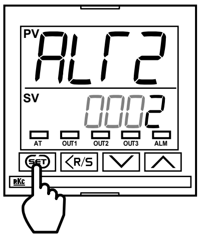
Initial setting mode
(Alarm 2 timer screen)



Alarm 2 timer is currently set to "**0**." Use the Up key to adjust it to "**2**."

☞ For details, refer to **10.1.4 Preventing alarm from turning on due to a transient abnormal input (P. 10-16)**.

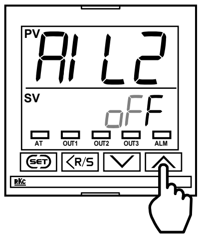
6



Press the SET key to store the new value.
The display goes to the Alarm 2 interlock screen.

7

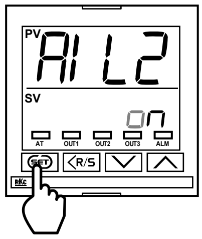
Initial setting mode
(Alarm 2 interlock screen)



Alarm 2 interlock is currently set to "**oFF**." Use the Up key to adjust it to "**on**."

☞ For details, refer to **10.1.5 Keeping the alarm state (Interlock function) (P. 10-19)** and **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

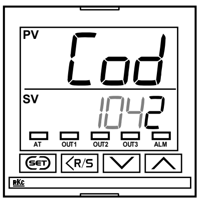
8



Press the SET key to store the new value.
The display goes to the Initial setting code screen.

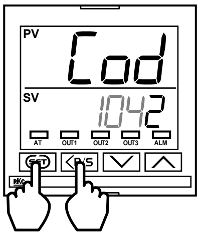
9

Initial setting mode
(Initial setting code screen)



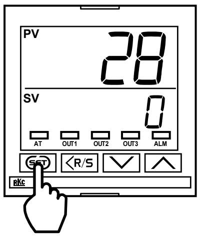
● Setting up Control loop break alarm (LBA) set value

1
Initial setting mode
(Initial setting code screen)



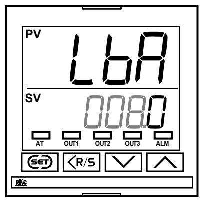
Press the Shift key for 2 seconds or more while pressing the SET key to go to the PV/SV monitor screen.

2
Monitor display mode
(PV/SV monitor screen)



Press and hold the SET key for 2 seconds to go to the Parameter setting mode.
Press the SET key several times to show the Control loop break alarm (LBA) time screen.
Another parameter may be displayed depending on the specification.

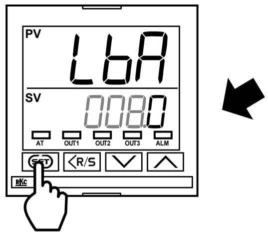
3
Parameter setting mode
(Control loop break alarm time screen)



Control loop break alarm (LBA) time is set to "**8.0**" as factory set value. There's no need to change the value.

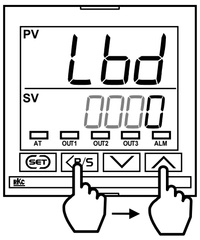
☞ For details, see from **P. 10-29** to **P. 10-31**.

4



Press the SET key to store the new value.
The display goes to the LBA deadband (LBD) screen.

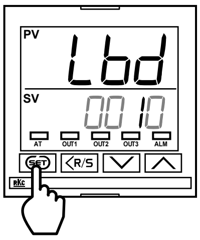
5
Parameter setting mode
(LBA deadband screen)



LBA deadband (LBD) is currently set to **"0."** Use Shift and Up keys to enter "**10**."

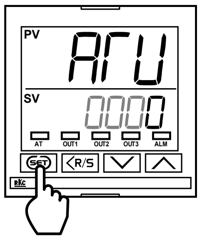
☞ For details, see from **P. 10-29** to **P. 10-31**.

6



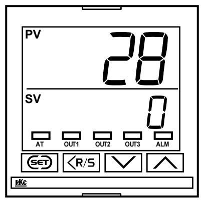
Press the SET key to store the new value.
The display goes to the Autotuning (AT) screen.

7
Parameter setting mode
(Autotuning screen)



Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

8
Monitor display mode
(PV/SV monitor screen)



📖 Change the display mode to "Standard display mode" and/or hide the Initial setting mode using the Set data lock function depending on the necessity.

☞ Refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)** for how to change the display mode. For Set data lock, refer to **8.3 Restricting Key Operation (P. 8-7)**.

■ 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 % (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: 2 °C [°F] (fixed)

Heating control

		When the output reaches 0 % (low limit with output limit function)	**When the output exceeds 100 % (high limit with output limit function)**
LBA occurring condition	For reverse action	When the LBA time has passed and the Measured value (PV) has not fallen below the alarm determination range, the alarm will be turned on.	When the LBA time has passed and the Measured value (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 Measured value (PV) has not risen beyond the alarm determination range, the alarm will be turned on.	When the LBA time has passed and the Measured value (PV) has not fallen below the alarm determination range, the alarm will be turned on.

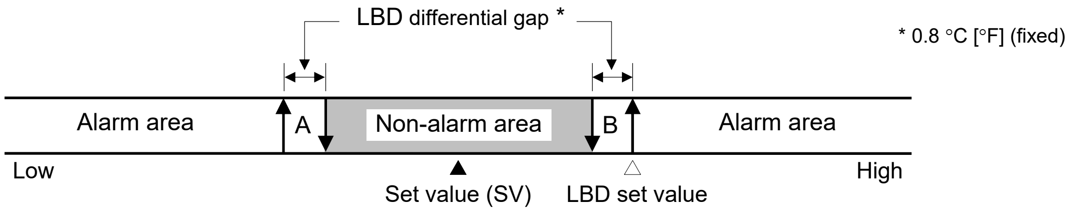
Heat/Cool control

	When the heat-side output exceeds 100 % (high limit with heat-side output limit function) and the cool-side output reaches 0 % (A) *	**When the heat-side output reaches 0 % and the cool-side output exceeds 100 % (high limit with cool-side output limit function) (B) ***
LBA occurring condition	When the LBA time has passed and the Measured value (PV) has not risen beyond the alarm determination range, the alarm will be turned on.	When the LBA time has passed and the Measured value (PV) has not fallen below the alarm determination range, the alarm will be turned on.

* If conditions of (A) and (B) are both met, priority is given to (A).

● LBA deadband (LBD)

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



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 available:

- when displaying Input type and Input range after turning ON the power.
- during Autotuning (AT).
- in the STOP mode.
- when the LBA function is not assigned to Alarm 2 type.

If the Control loop break alarm (LBA) setting time does not match the controlled object requirements, the Control loop break alarm (LBA) setting time should be lengthened. If setting time is not correct, the Control loop break alarm (LBA) will malfunction by turning on or off at inappropriate times or not turning on at all.

While the LBA is ON (under alarm status), the following conditions 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 (LBD).

If the Autotuning (AT) is used, the Control loop break alarm (LBA) time is automatically set twice as large as the integral time. The Control loop break alarm (LBA) time will not change even if the integral time is changed.

If the Control loop break alarm (LBA) function detects an error occurring in the control loop, but cannot specify the location, the control loop should be checked. The Control loop break alarm (LBA) function does not detect the location which causes alarm status. If Control loop break alarm (LBA) is ON, check each device or wiring in the control loop.

■ Parameter setting

● Control loop break alarm (LBA) time [Parameter setting mode]

Parameter symbol	Data range	Factory set value
LbA	0.1 to 200.0 minutes	8.0

To show the "Control loop break alarm (LBA) time," set a value "Control loop break alarm (LBA)" at Cod 0000 (Alarm 2 type) in the Initial setting mode.

● LBA deadband (LBD) [Parameter setting mode]

Parameter symbol	Data range	Factory set value
1.Lbd	0 to 9999 (Unit: °C [°F])	0

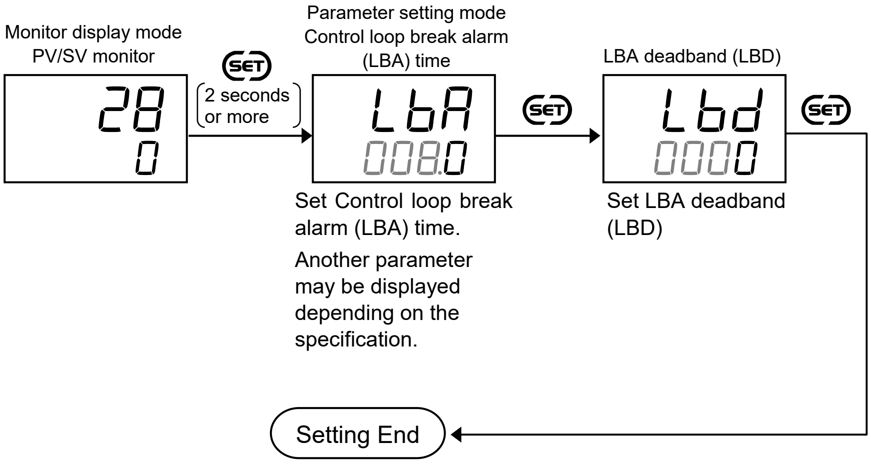
To show the "LBA deadband (LBD)," set a value "Control loop break alarm (LBA)" at Cod 0000 (Alarm 2 type) in the Initial setting mode.

For Control loop break alarm (LBA) related items except the above, refer to the following sections.

- Alarm type: **10.1.2 Changing alarm type (P. 10-8)**
- Output assignment of Alarm: **7.1 Changing Output Assignment (P. 7-2)**
- Output energize/de-energize when assigned to alarm: **7.4 Changing Alarm Output (Energize/De-energize) (P. 7-12)**
- Action selection at STOP mode: **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**
- Alarm action at input burnout: **6.4 Changing Error Handling at Input Error (P. 6-10)**
- Alarm timer: **10.1.4 Preventing alarm from turning on due to a transient abnormal input (P. 10-16)**
- Alarm interlock: **10.1.5 Keeping the alarm state (Interlock function) (P. 10-19)** and **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**

■ Setting procedure

Control loop break alarm (LBA) time and LBA deadband (LBD) can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

10.3 Using Heater Break Alarm (HBA) (Option)

10.3.1 Setting procedure for Heater break alarm (HBA)

Set Heater break alarm (HBA) as follows:

Set the parameter related to HBA output	Set the parameter related to Heater break alarm (HBA) output. • Output assignment of Heater break alarm • Output energize/de-energize when assigned to alarm ☞ For output assignment of Heater break alarm **7.1 Changing Output Assignment (P. 7-2)**. ☞ For output energize/de-energize when assigned to alarm, refer to **7.4 Changing Alarm Output (Energize/De-energize) (P. 7-12)**.
↓	
Setting alarm action at control stop	Set the Action selection at STOP mode. ☞ For alarm selection at STOP mode, refer to **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**.
↓	
Set the HBA parameter	Set the following parameters: • CT ratio • HBA determination time • HBA interlock ☞ For CT ratio, refer to **10.3.3 Changing the current transformer (CT) type (P. 10-40)**. ☞ For HBA determination time, refer to **10.3.4 Preventing Heater break alarm (HBA) from turning on due to a transient abnormal input (P. 10-42)**. ☞ For HBA interlock, refer to **10.3.5 Keeping the Heater break alarm (HBA) state (Interlock function) (P. 10-44)** and **10.3.6 Releasing Heater break alarm (HBA) state (Interlock release) (P. 10-45)**.
↓	
Set the HBA set value	Set the Heater break alarm (HBA) set value. ☞ For Heater break alarm (HBA) set value, refer to **10.3.2 Setting the Heater break alarm (HBA) set value (P. 10-38).**

■ Setting example: Set the Heater break alarm 1 (HBA1) (Model code: RZ100-MNM ∗ TNN/N)

[Alarm 1 is not used]

• Heater break alarm (HBA) output condition

[Initial setting mode: Cod 0002]

Output assignment of Heater break alarm 1 (oHb1):

Output 3 (OUT3) [Set value: 3] (Factory set value: 0 *) OP

Output 3 (OUT3) energize/de-energize when assigned to alarm (EXC3):

Energize [Set value: 0] (Factory set value: 0) EX

• Alarm action at control stop

[Initial setting mode: Cod 1030]

Action selection at STOP mode (SS): **Stop alarm at control stop**

[Set value: 0000] (Factory set value: 0000) EX

• Setup parameters for Heater break alarm 1 (HBA1)

[Initial setting mode: Cod 1045]

CT1 ratio (CTr1):	**CTL-6-P-N**	[Set value: 800]	(Factory set value: 800 *)	EX OP
HBA1 interlock (HIL1):	**Used**	[Set value: on]	(Factory set value: oFF)	EX OP
HBA determination time (HbT):	**3 seconds**	[Set value: 3]	(Factory set value: 3)	EX OP

• Set value of Heater break alarm 1 (HBA1)

[Parameter setting mode]

Heater break alarm 1 (HBA1) set value (HbA1): **5.0** [Set value: 5.0] (Factory set value: 0.0) OP

* Model code: RZ100-MNM∗TNN/N

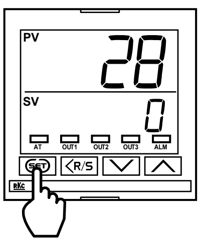
If parameters in the Initial setting mode cannot be changed, exit the Initial setting mode once and press the Shift key for 1 second or longer to stop the control. Reenter the Initial setting mode for adjustment.
To stop the control when switching the Initial setting mode, refer to **8.2 Continuing the Control when Entering the Initial Setting Mode (P. 8-5)**.

In the following procedure RZ100 is used for explanation, but the operation is the same for RZ400.

[Setting procedure]

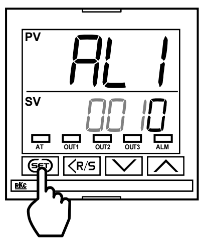
● Enabling parameter to be set

1 Monitor display mode (PV/SV monitor screen)



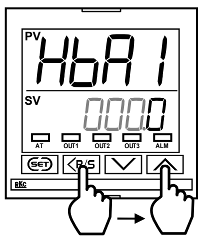
Press and hold the SET key for 2 seconds to go to the Parameter setting mode.

2 Parameter setting mode (Alarm 1 set value screen)



Press the SET key to go to the Heater break alarm 1 (HBA1) set value screen.
Another parameter may be displayed depending on the specification.

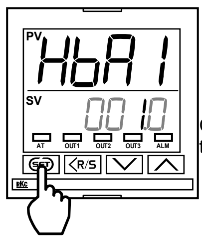
3 Parameter setting mode (Heater break alarm 1 set value screen)



Set **the Heater break alarm 1 (HBA1) set value** to other than "**0.0**".

Setting the **Heater break alarm 1 (HBA1) set value** to any value **other than 0.0** will enable the "Output assignment of Heater break alarm 1" screen to be displayed.

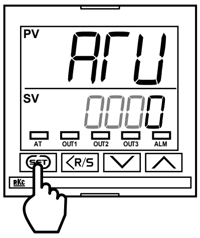
4



Continued on the Step 5

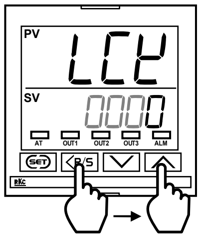
Press the SET key to store the new value.
The display goes to the Autotuning (AT) screen.
Another parameter may be displayed depending on the specification.

5
Parameter setting mode
(Autotuning screen)



Press the SET key several times to show the Set data lock screen. Another parameter may be displayed depending on the specification.

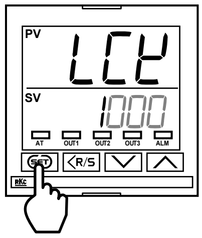
6
Parameter setting mode
(Set data lock screen)



To enter the Initial setting mode, use Shift and Up keys to set "**1**" at **the highest digit**.

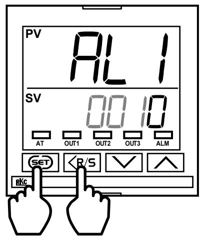
☞ For details, refer to **8.3 Restricting Key Operation (P. 8-7)**.

7



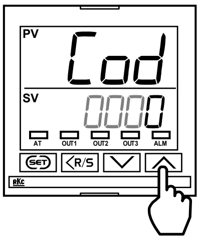
Press the SET key to store the new value.
The display goes to the Alarm 1 set value screen.
Another parameter may be displayed depending on the specification.

8
Parameter setting mode
(Alarm 1 set value screen)



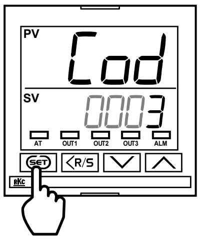
Press the Shift key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.

9
Initial setting mode
(Initial setting code screen)



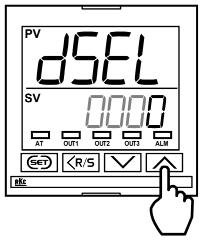
Press the Up key three times to change the Initial setting code to "**0003**."

10



Press the SET key to go to the Display mode selection screen.

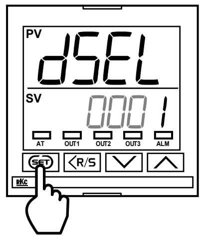
11
Initial setting mode
(Display mode selection screen)



Enter "**1**" at the **Display mode selection** using the Up key to change the display mode to "**Expanded display mode**."

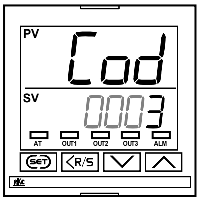
☞ For details, refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)**.

12
Initial setting mode
(Display mode selection screen)



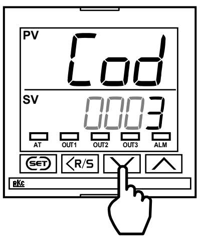
Press the SET key to store the new value.
The display goes to the Initial setting code screen.

13
Initial setting mode
(Initial setting code screen)



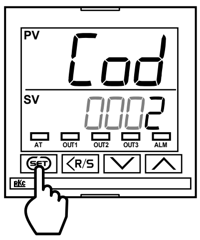
● Setting up Heater break alarm (HBA) output

1
Initial setting mode
(Initial setting code screen)



Press the Down key three times to change the Initial setting code to "**0002**."

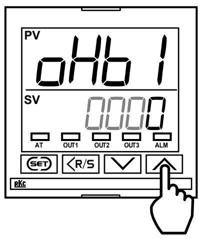
2



Press the SET key several times to show the Output assignment of Heater break alarm 1 screen.

The number of times of pressing the SET key depends on the specification.

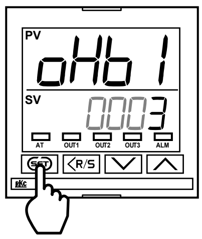
3
Initial setting mode
(Output assignment of Heater break alarm 1 screen)



Output assignment of Heater break alarm 1 is currently set to "**0**." Use the Up key to adjust it to "**3**."

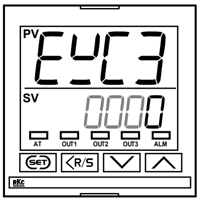
☞ For details, refer to **7.1 Changing Output Assignment (P. 7-2)**.

4



Press the SET key to store the new value.
After the value has been stored, press the SET key a few times until EYC3 is displayed.
The number of times of pressing the SET key depends on the specification.

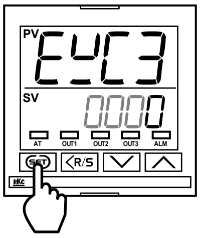
5 Initial setting mode (Output 3 (OUT3) energize/de-energize when assigned to alarm screen)



Output 3 energize/de-energize when assigned to alarm is set to “**0**” as factory set value. There’s no need to change the value.

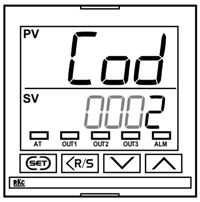
For details, refer to **7.4 Changing Alarm Output (Energize/ De-energize) (P. 7-12)**.

6



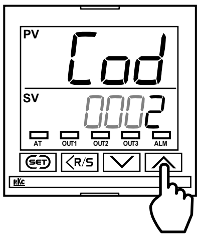
Press the SET key to store the new value.
The display goes to the Initial setting code screen.

7 Initial setting mode (Initial setting code screen)



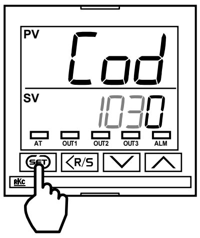
● Setting up alarm action at control stop

1 Initial setting mode (Initial setting code screen)



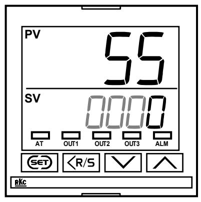
Press the Up key three times to change the Initial setting code to "**1030**."

2



Press the SET key to go to the Action selection at STOP mode screen.

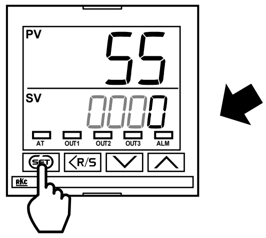
3 Initial setting mode (Action selection at STOP mode screen)



Action selection at STOP mode is “**0000**.” There’s no need to change the value.

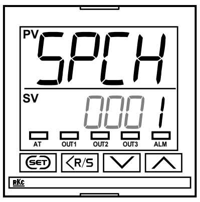
For details, refer to **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**.

4



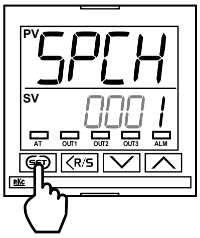
Press the SET key to store the new value.
The display goes to the STOP display selection screen.

5 Initial setting mode (STOP display selection screen)



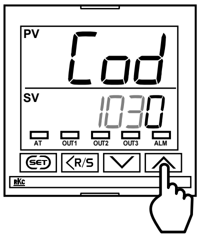
● Setting up Heater break alarm 1 (HBA1)

1
Initial setting mode
(STOP display selection screen)



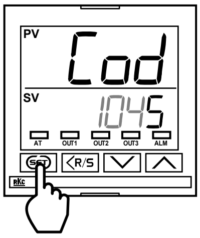
Press the SET key twice to go to the Initial setting code screen.

2
Initial setting mode
(Initial setting code screen)



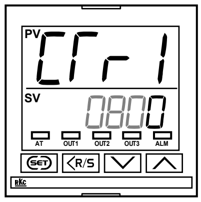
Press the Up key three times to change the Initial setting code to "**1045**."

3



Press the SET key to go to the CT1 ratio screen.

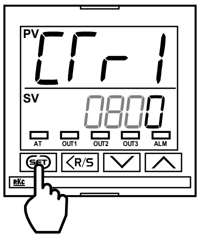
4
Initial setting mode
(CT1 ratio screen)



CT1 ratio is set to "**800**" as factory set value. There's no need to change the value.

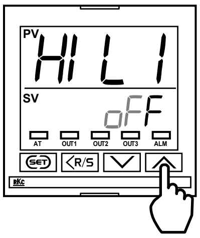
☞ For details, refer to **10.3.3 Changing the current transformer (CT) type (P. 10-40)**.

5



Press the SET key to store the new value.
The display goes to the HBA1 interlock screen.
(Depending on the specification, another pressing the SET key may be necessary.)

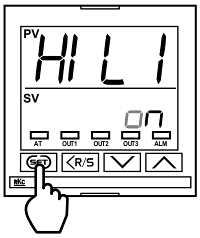
6
Initial setting mode
(HBA1 interlock screen)



HBA1 interlock is currently set to "**oFF**." Use the Up key to adjust it to "**on**."

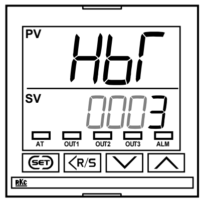
☞ For details, refer to **10.3.5 Keeping the Heater break alarm (HBA) state (Interlock function) (P. 10-44)**.

7



Press the SET key to store the new value.
The display goes to the HBA determination time screen.
(Depending on the specification, another pressing the SET key may be necessary.)

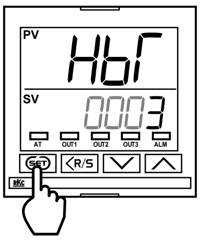
8
Initial setting mode
(HBA determination time screen)



HBA determination time is set to "**3**" as factory set value. There's no need to change the value.

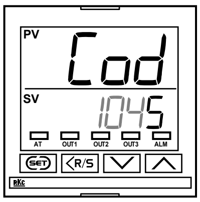
☞ For details, refer to **10.3.4 Preventing Heater break alarm (HBA) from turning on due to a transient abnormal input (P. 10-42)**.

9



Press the SET key to store the new value.
The display goes to the Initial setting code screen.

10
Initial setting mode
(Initial setting code screen)



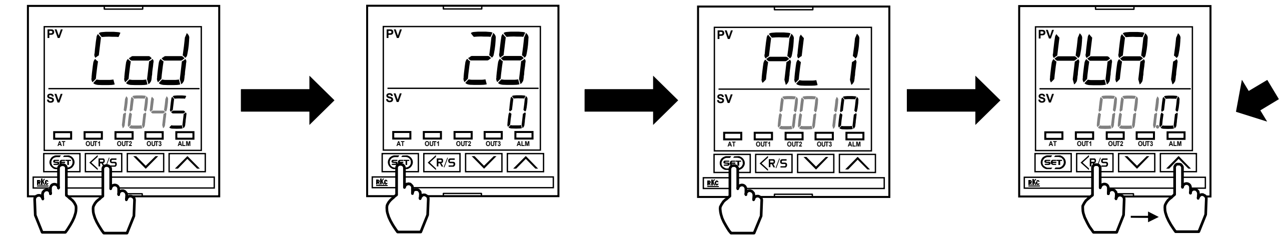
● Setting up Heater break alarm 1 (HBA1) set value

1 Initial setting mode (Initial setting code screen)

2 Monitor display mode (PV/SV monitor screen)

3 Parameter setting mode (Alarm 1 set value screen)

4 Parameter setting mode (Heater break alarm 1 set value screen)



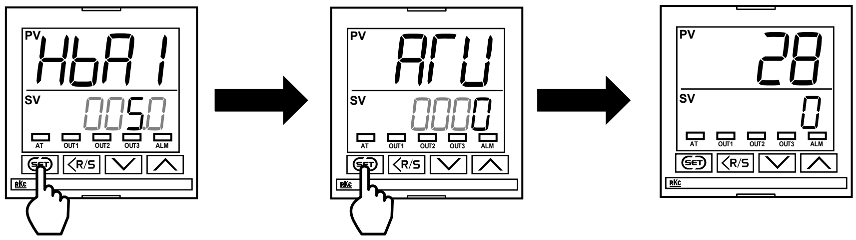
1. Press the Shift key for 2 seconds or more while pressing the SET key to go to the PV/SV monitor screen.
2. Press and hold the SET key for 2 seconds to go to the Parameter setting mode.
3. Press the SET key to go to the Heater break alarm 1 (HBA1) set value screen. Another parameter may be displayed depending on the specification.
4. **Heater break alarm 1 (HBA1) set value** is currently set to "**0.0**." Use Shift and Up keys to enter "**5.0**."

   ☞ For details, refer to **10.3.2 Setting the Heater break alarm (HBA) set value (P. 10-38)**.

5

6 Parameter setting mode (Autotuning screen)

7 Monitor display mode (PV/SV monitor screen)



5. Press the SET key to store the new value. The display goes to the Autotuning (AT) screen. Another parameter may be displayed depending on the specification.
6. Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

📖 Change the display mode to "Standard display mode" and/or hide the Initial setting mode using the Set data lock function depending on the necessity.

☞ Refer to **9.1 Releasing the Display Restriction of the Parameters (P. 9-2)** for how to change the display mode. For Set data lock, refer to **8.3 Restricting Key Operation (P. 8-7)**.

10.3.2 Setting the Heater break alarm (HBA) set value

■ Description of function

● Heater break alarm (HBA)

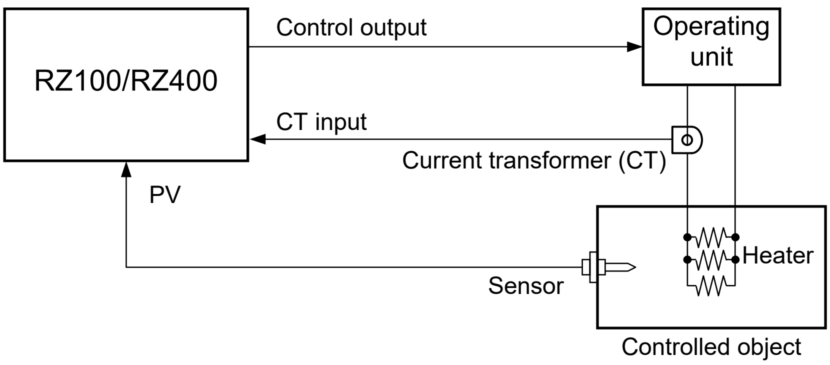
Heater break alarm (HBA) can only be used with time-proportional control output (relay or voltage pulse output).

The Heater break alarm (HBA) function monitors the current flowing through the load by a dedicated current transformer (CT), then compares the measured value with the Heater break alarm (HBA) set values, and detects a fault in the heating circuit.

The Heater break alarm (HBA) function is activated for the following cases:

① Low or No current flow (Heater break, malfunction of the control device, etc.):
When the control output is ON and the CT input value is equal to or less than the heater break determination point for the preset number of consecutive sampling cycles, an alarm is activated.

② Over current or short-circuit:
When the control output is OFF and the CT input value is equal to or greater than the heater break determination point for the preset number of consecutive sampling cycles, an alarm is activated.



In case of Heat/Cool PID control, Heater break alarm (HBA) monitors the output terminals to which heating control output is assigned. Install a Current transformer (CT) on the output from the load connected to the heating control output.
In case the output assignment of the heating control output has been changed according to the Control output assignment (see P.7-3), the output terminals to be monitored will be also changed.

■ Parameter setting

● Heater break alarm 1 (HBA1) and 2 (HBA2) set value [Parameter setting mode]

OP

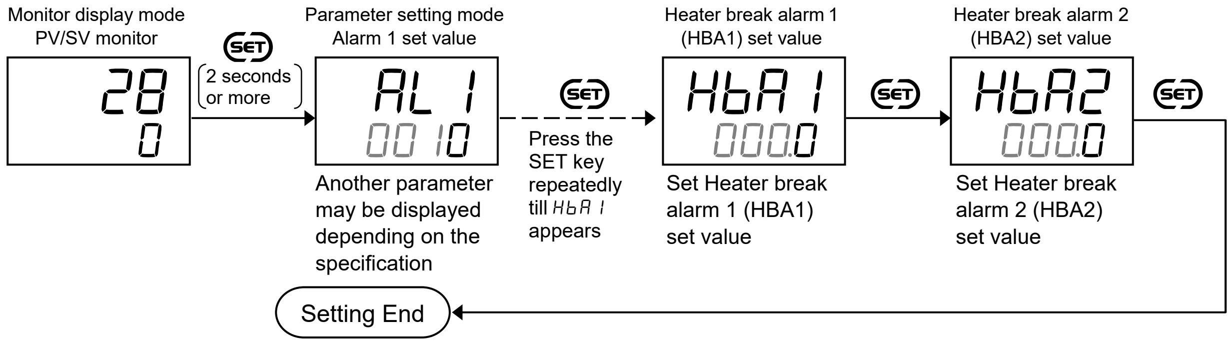
Parameter symbol	Data range	Factory set value
HbA1 HbA2	0.0 to 100.0 A (0.0: HBA function OFF)	0.0

- Set the HBA set value to approximately 85 % of the maximum reading of the CT input.
- Set the HBA set value to a slightly smaller value to prevent a false alarm if the power supply becomes unstable.
- When more than one heater is connected in parallel, the HBA set value may need to be increased to detect a single heater failure.

To show the “Heater break alarm 1 (HBA1) set value” and “Heater break alarm 2 (HBA2) set value,” specify “with current transformer (CT),” which is an optional function.

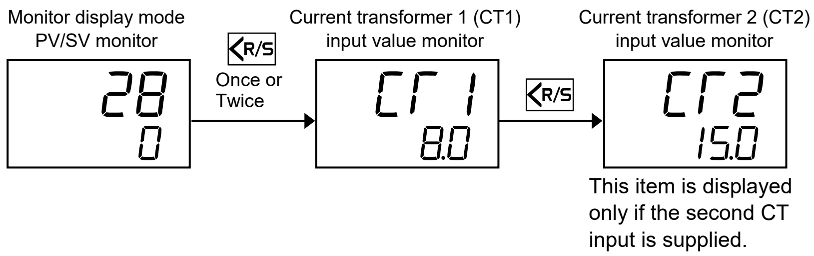
■ Setting procedure

Heater break alarm (HBA) set value can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

To verify the monitor value of the current transformer (CT), go to the Monitor display mode.



10.3.3 Changing the current transformer (CT) type

Set the number of turns (ratio) in the Current transformer (CT) for Heater break alarm (HBA).

■ Parameter setting

● CT1 and 2 ratio
[Initial setting mode: Cod 1045] EX OP

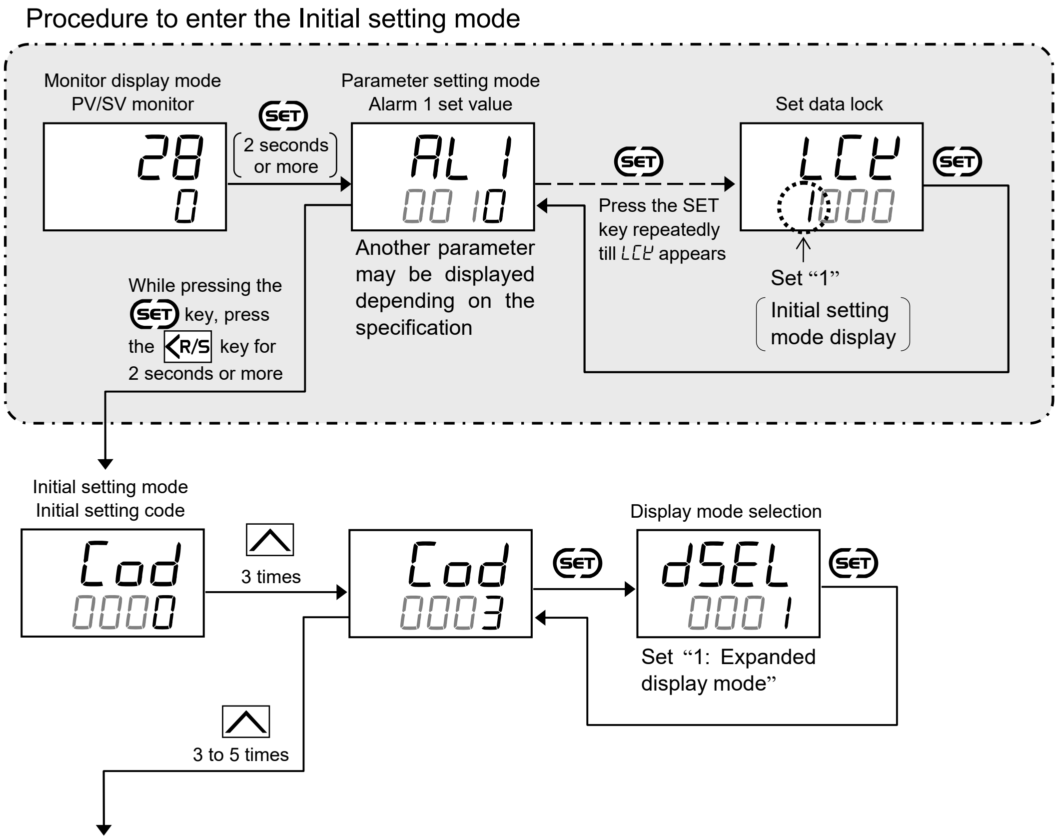
Parameter symbol	Data range	Factory set value
CTr1 CTr2	1 to 1000 Set the following value depending on the CT type. CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000	• When CTL-6-P-N is specified at the time or ordering: 800 • When CTL-12-S56-10L-N is specified at the time or ordering: 1000

To show the "CT1 ratio" and "CT2 ratio," specify "with current transformer (CT)," which is an optional function.

To show the "CT1 ratio" and "CT2 ratio," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

CT ratio can be set at Cod 1045 in the Initial setting mode.



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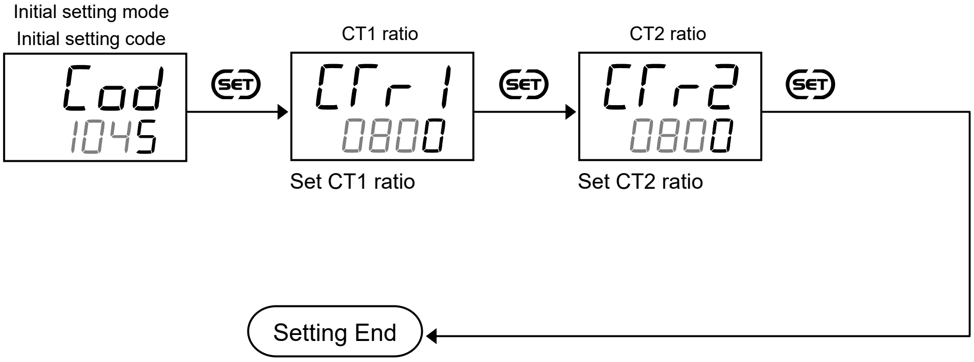


- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

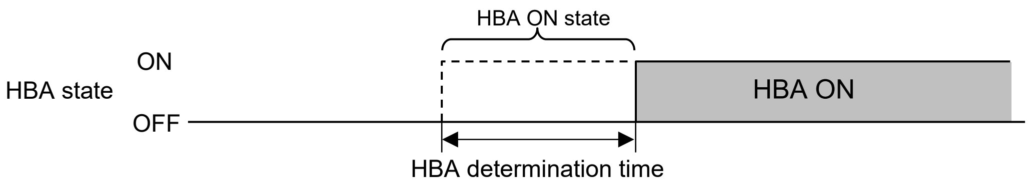
10.3.4 Preventing Heater break alarm (HBA) from turning on due to a transient abnormal input

If alarm should not be generated in case the Heater break alarm (HBA) condition is shorter than the set time, HBA determination time is used.

■ Description of function

● HBA determination time

This is a function to allow the Heater break alarm (HBA) to turn on if the Heater break alarm (HBA) ON condition continues beyond the set time.



■ Parameter setting

● HBA determination time [Initial setting mode: Cod 1045] EX OP

Parameter symbol	Data range	Factory set value
HbT	0 to 255 seconds	3

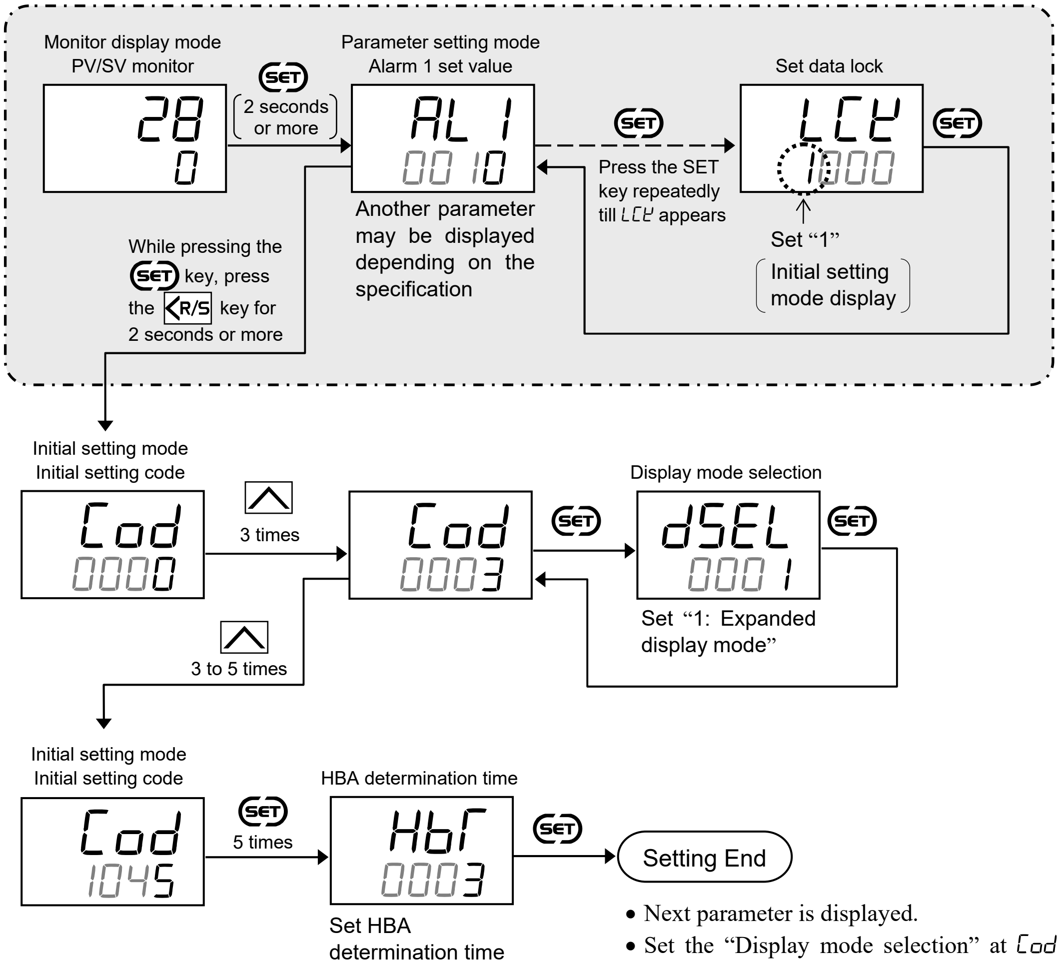
To show the "HBA determination time," specify "with current transformer (CT)," which is an optional function.

To show the "HBA determination time," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

HBA determination time can be set at Cod 1045 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

10.3.5 Keeping the Heater break alarm (HBA) state (Interlock function)

HBA interlock function is used to maintain the Heater break alarm (HBA) state. Once the Heater break alarm (HBA) condition is reached, the Heater break alarm (HBA) condition is held even if the alarm ON condition is lost.

■ Parameter setting

● HBA1 and 2 interlock
[Initial setting mode: Cod 1045] EX OP

Parameter symbol	Data range	Factory set value
HIL1 HIL2	oFF: Unused on: Used	oFF

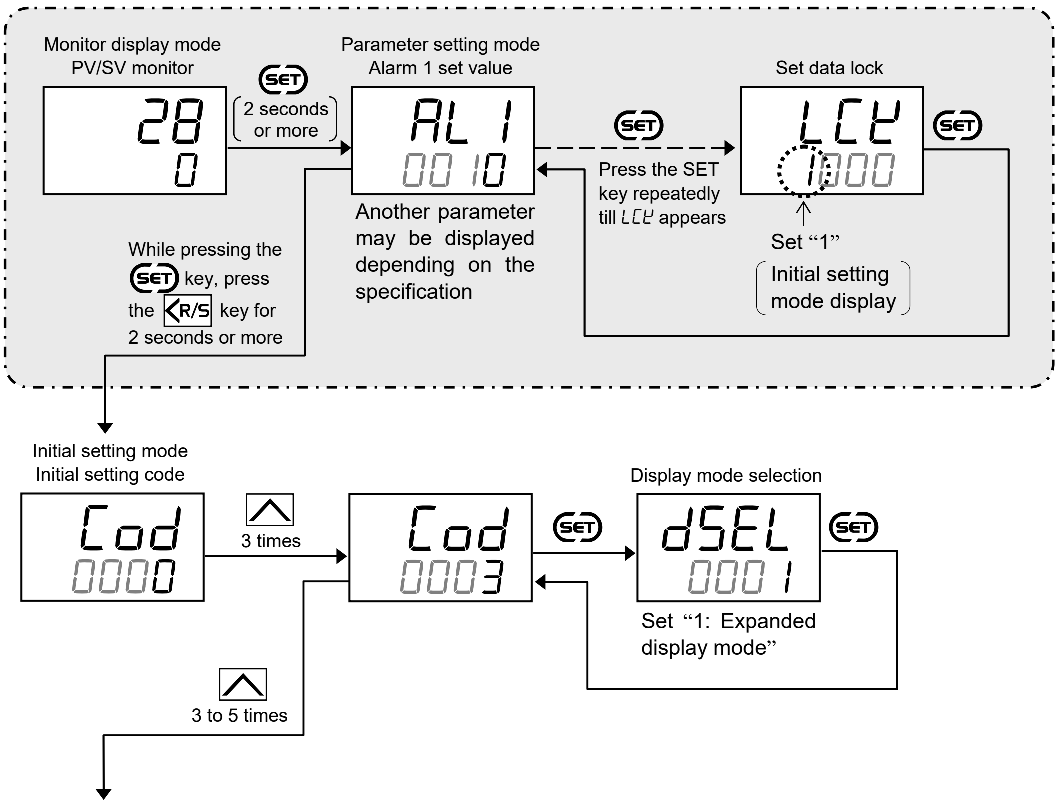
📖 To show the "HBA1 interlock" and "HBA2 interlock," specify "with current transformer (CT)," which is an optional function.

📖 To show the "HBA1 interlock" and "HBA2 interlock," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

HBA interlock can be set at Cod 1045 in the Initial setting mode.

Procedure to enter the Initial setting mode



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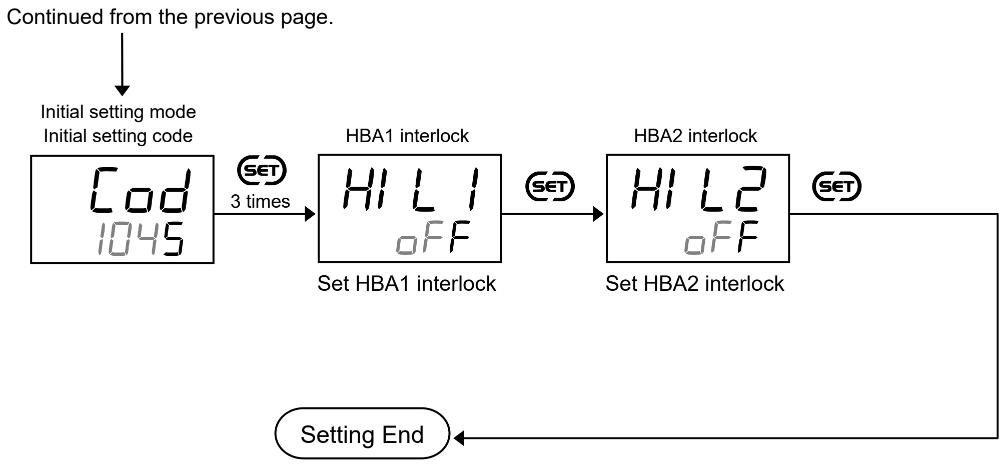


- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

10.3.6 Releasing Heater break alarm (HBA) state (Interlock release)

Procedure to release the Heater break alarm (HBA) interlock state is the same as the Alarm interlock release. Heater break alarm (HBA) state cannot be released by interlock release operation as long as the Heater break alarm (HBA) ON condition remains.

☞ For the procedure to release the interlock, refer to **10.1.6 Releasing the alarm state (Interlock release) (P. 10-21)**.

10.4 Keeping the Alarm State in STOP Mode

Both Alarm action and Heater break alarm (HBA) action can continue the action in control stop (STOP) state. Setting can be made at “Action selection at STOP mode.”

Heater break alarm (HBA) is an optional function.

■ Parameter setting

● Action selection at STOP mode [Initial setting mode: Cod 1030] EX OP

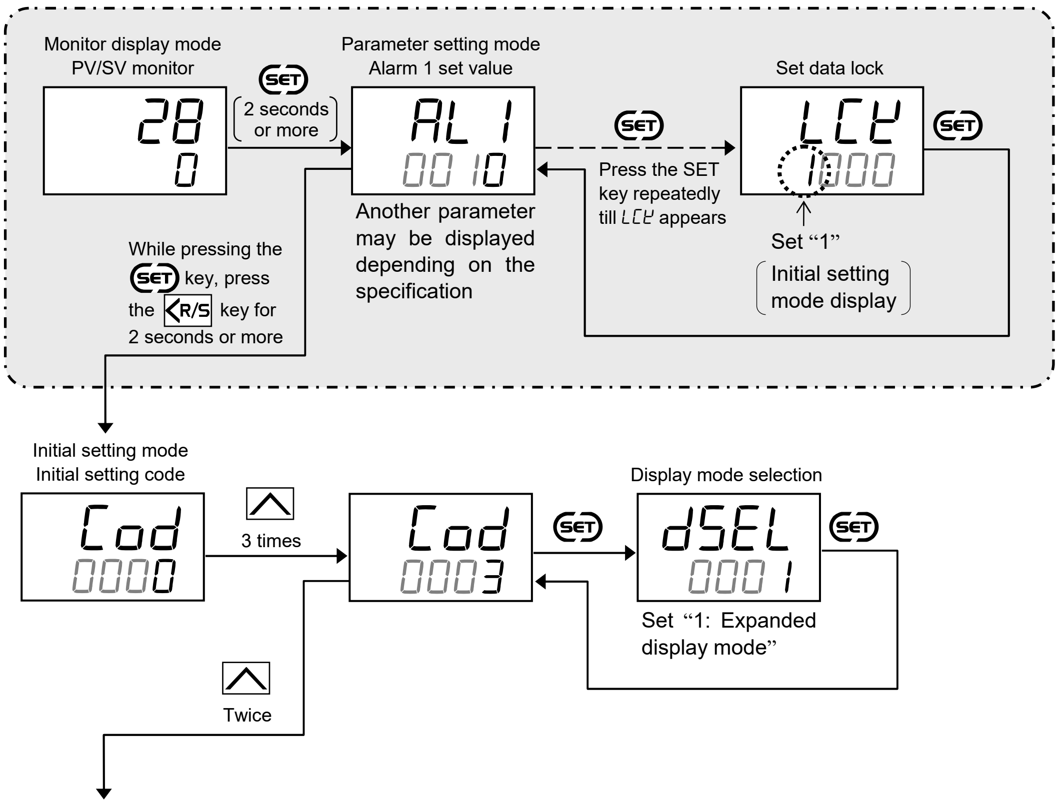
Parameter symbol	Data range	Factory set value
SS	0: Alarm is cleared at STOP 1: Alarm remains on at STOP 0000 ← SV display unit Alarm action Heater break alarm (HBA) action 0 (fixed) [Do not change this one]	0000

To show the “Action selection at STOP mode,” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

■ Setting procedure

Action selection at STOP mode can be set at Cod 1030 in the Initial setting mode.

Procedure to enter the Initial setting mode



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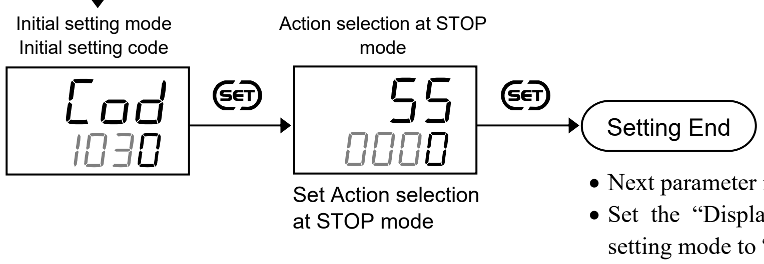


- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

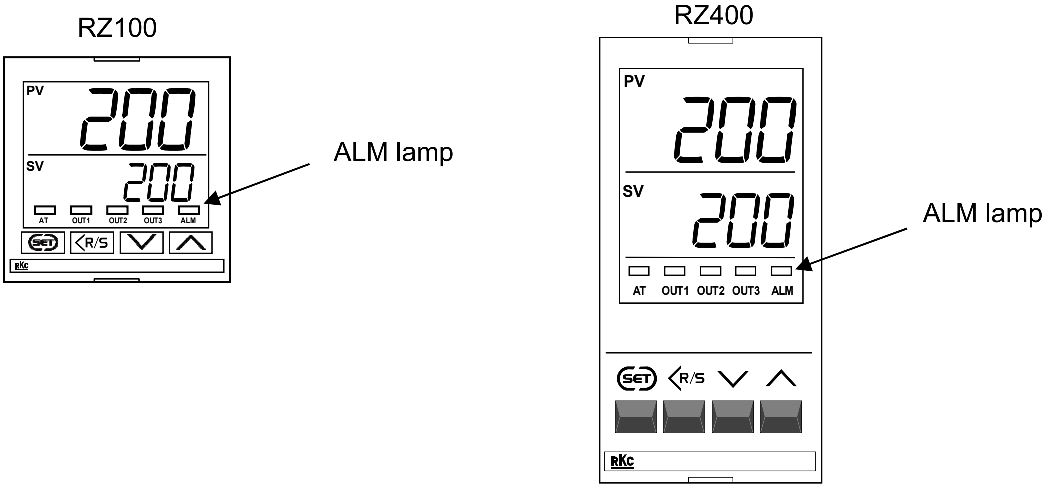
10.5 Checking Alarm ON State

The alarm ON state can be checked with the ALM lamp or on the Comprehensive alarm state screen in the Monitor display mode.

■ Display contents

● ALM lamp

When in Alarm ON condition, the ALM lamp lights. However, because the controller has only one lamp, the lamp is lit as an *OR* of Alarm 1, Alarm 2, Heater break alarm 1, and Heater break alarm 2.



● Comprehensive alarm state [Monitor display mode]

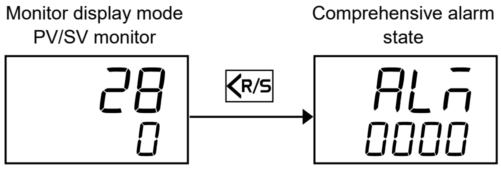
Parameter symbol	Data range	Factory set value
ALm	0: Alarm OFF or No alarm 1: Alarm ON 0000 ← SV display unit Alarm 1 Alarm 2 Heater break alarm 1 (HBA1) Heater break alarm 2 (HBA2)	

📖 To show the "Comprehensive alarm state," set a value other than "None" at Cod 0000 in the Initial setting mode for "Alarm 1 type" or "Alarm 2 type." You also need to set a value other than "0.0" for "Heater break alarm 1 (HBA1) set value" or "Heater break alarm 2 (HBA2) set value" in the Parameter setting mode.

📖 Heater break alarm (HBA) is an optional function.

■ Display operation

Comprehensive alarm state can be found in the Monitor display mode.



MEMO

CONTROL FUNCTION

11

This chapter describes control related functions, setting contents and setting procedure based on the key words related to controls.

11.1 Running/Stopping control (RUN/STOP transfer)

In the Monitor display mode, control start (RUN) and stop (STOP) can be switched between each other.
The factory set value is RUN. As soon as the controller is powered on, control is started.
The RUN/STOP transfer can be made by the key operation or communication (optional function).

● State of this instrument when set to STOP mode

STOP display	● PV/SV monitor screen Displays the STOP symbol "5ΓoP" on the SV display or on the PV display. According to the setting contents of "STOP display selection" in the Initial setting code. Setting range: 0: STOP on PV display 1: STOP on SV display [Factory set value] ● Other than the PV/SV monitor screen The switching screen is displayed for 1 second when the mode is switched by key operations.
Control output	Relay contact output, Voltage pulse output: Output OFF Current output: Output of −5 %
Alarm action	According to the setting contents of "Action selection at STOP mode" in the Initial setting code. Setting range: 0000: Both Alarm action and Heater break alarm (HBA) action are stopped. [Factory set value] 0001: Alarm action is continued and Heater break alarm (HBA) action is stopped. 0010: Alarm action is stopped and Heater break alarm (HBA) action is continued. 0011: Both Alarm action and Heater break alarm (HBA) action are continued. * Heater break alarm (HBA) is an optional function.
Autotuning, Startup tuning	AT canceled (PID constants are not updated.)

☞ For STOP display selection, refer to **9.2 Changing the Display Position of STOP during the Control Stop (P. 9-4)**.

☞ For Action selection at STOP mode, refer to **10.4 Keeping the Alarm State in STOP Mode (P. 10-46)**.

● State of this instrument when set to RUN mode

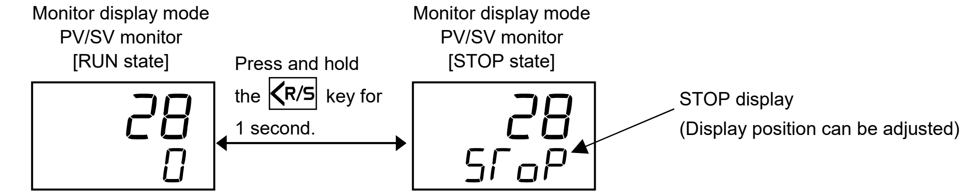
If the instrument is transferred to RUN mode from STOP mode, it performs the same operation (control RUN, Alarm determination start-up) as the power-on.

☞ For RUN/STOP transfer by Communication (optional function), refer to **12. COMMUNICATION FUNCTION (P. 12-1)**.

■ Setting procedure

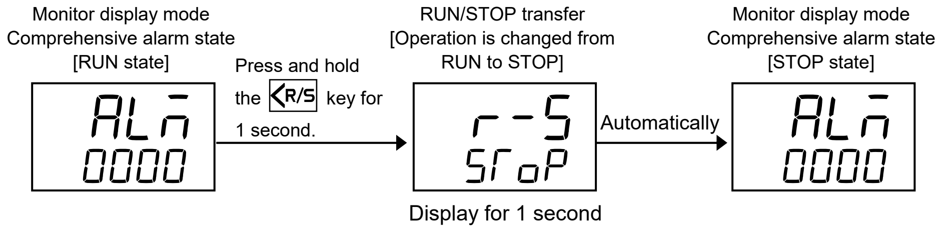
Pressing the R/S key for one second in the Monitor display mode switches the mode from RUN to STOP or from STOP to RUN.

● PV/SV monitor screen

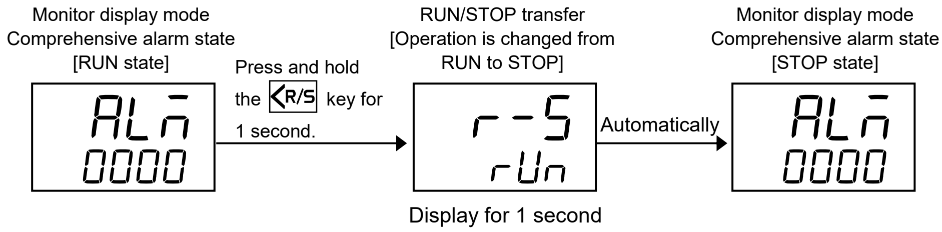


● Other than the PV/SV monitor screen

[Example] Switching from RUN to STOP in the Comprehensive alarm state screen



[Example] Switching from STOP to RUN in the Comprehensive alarm state screen



📖 Operation and screens are similar for other monitor mode displays (Current transformer input value monitor, Manipulated output value).

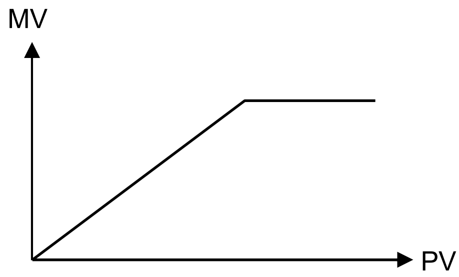
11.2 Changing Control Action

Refer to the following 6 types of control action:

- PID control (direct action)
- PID control (reverse action)
- ON/OFF action
- Heat/Cool PID control (water cooling)
- Heat/Cool PID control (air cooling)
- Heat/Cool PID control (cooling linear type)

■ PID control (direct action)

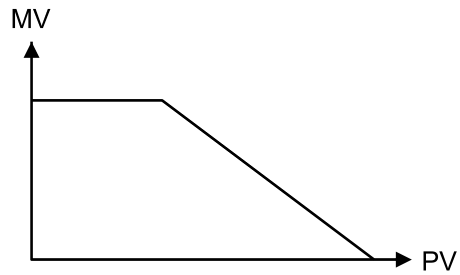
The Manipulated output value (MV) increases as the Measured value (PV) increases.
This action is used generally for cooling control.



Direct action

■ PID control (reverse action)

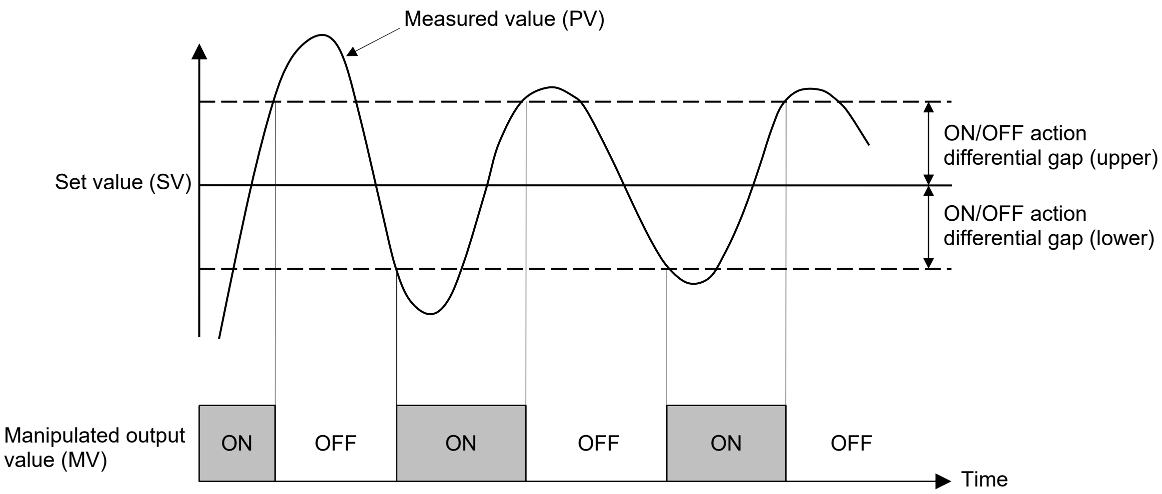
The Manipulated output value (MV) decreases as the Measured value (PV) increases.
This action is used generally for heating control.



Reverse action

■ ON/OFF action

ON/OFF control is possible when the Proportional band [heat-side] is set to 0. In ON/OFF control with Reverse action, 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.



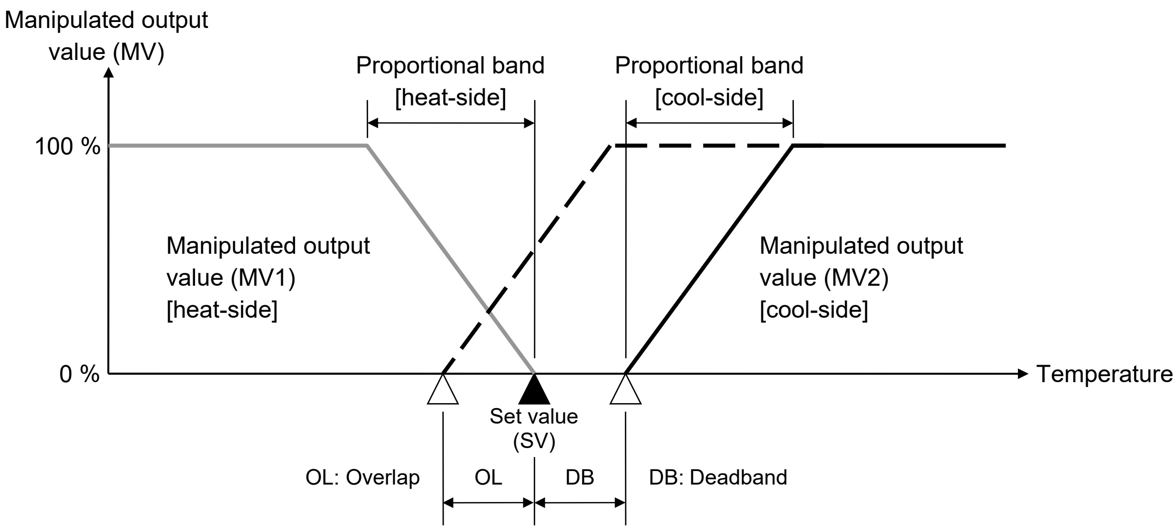
☞ For ON/OFF action, refer to **11.6 Controlling with ON/OFF Action (P. 11-19)**.

■ Heat/Cool PID control

In Heat/Cool control, heating and cooling control can be achieved with a single controller.

Water cooling/Air cooling: The algorithm intended for Heat/Cool control on the plastic extruders is employed. Even in equipment provided with a cooling mechanism having nonlinear characteristics, it responds quickly to attain the characteristic responding to the set value with small overshooting.

Cooling linear type: The algorithm intended for applications without nonlinear cooling capability is employed.



☞ For Heat/Cool PID control, refer to **11.7 Controlling with Heat/Cool Action (P. 11-24)**.

■ Parameter setting

● Control action
[Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
XE	0: PID control 1: Heat/Cool PID control	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If control action is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.

To show the "Control action," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

● Direct/Reverse action
[Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
oS	0: PID control: Direct action 1: PID control: Reverse action	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If Control action is not specified: 1

To show the "Direct/Reverse action," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

To show the "Direct/Reverse action," configure the instrument to "PID control" at Cod 1051 in the Initial setting mode to "Control action."

● Cool action
[Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
oSc	0: Heat/Cool PID control: Air cooling (for Extruder) 1: Heat/Cool PID control: Water cooling (for Extruder) 2: Heat/Cool PID control: Cooling linear type	When control action is specified at the time of ordering, the ordered code for control action is the factory setting.* If Control action is not specified: 0

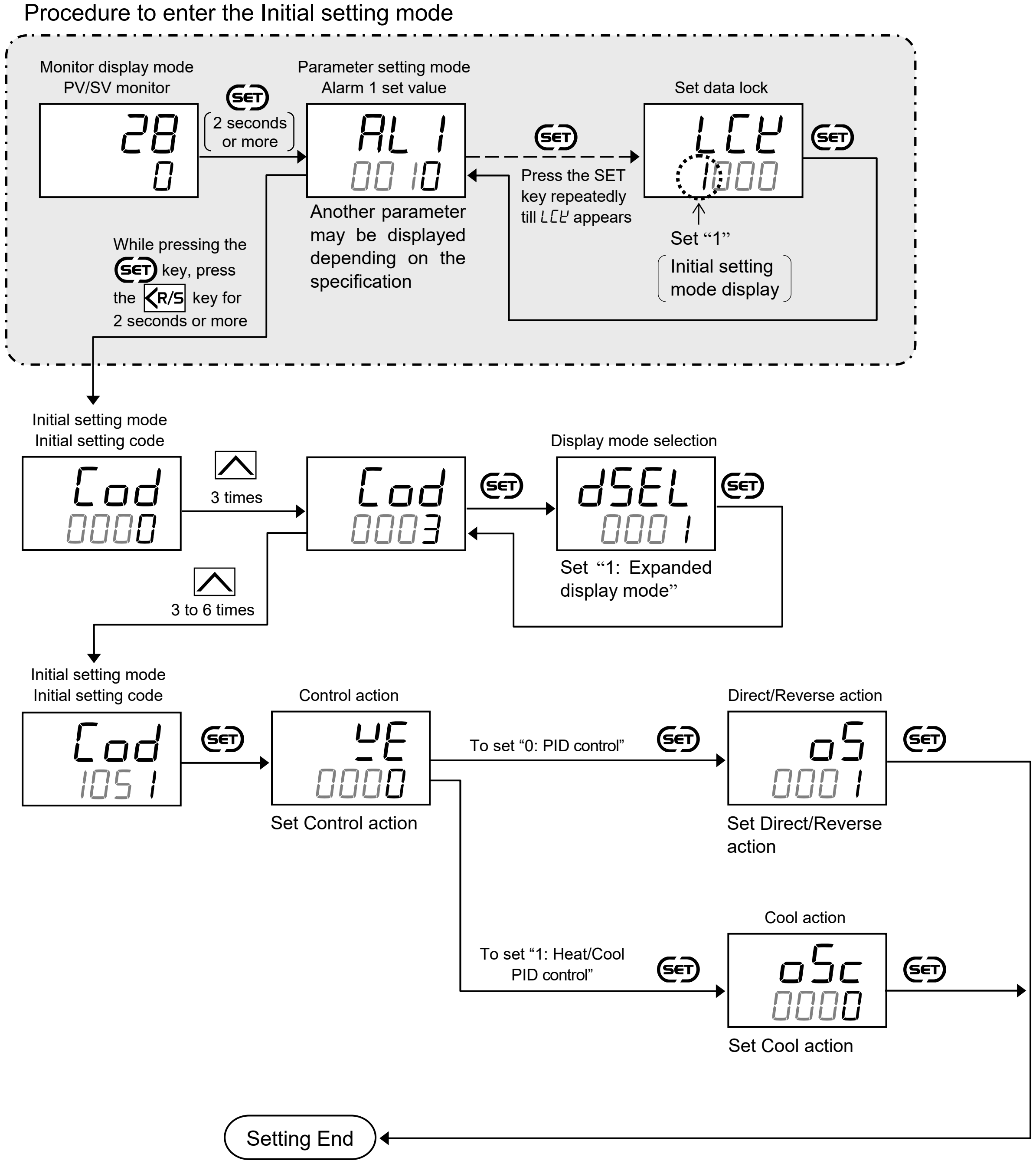
* If control action code is "G," this parameter is "2."
If control action code is "A," this parameter is "0."
If control action code is "W," this parameter is "1."

To show the "Cool action," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

To show the "Cool action," configure the instrument to "Heat/Cool PID control" at Cod 1051 in the Initial setting mode to "Control action."

■ Setting procedure

Control action, Direct/Reverse action and Cool action can be set at Cod 0051 in the Initial setting mode.



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

11.3 Setting PID Values Automatically (Autotuning)

The Autotuning (AT) automatically measures, computes and sets the optimum PID values. The Autotuning (AT) can be used for PID control (Direct action/Reverse action) and Heat/Cool PID control.

■ Description of function

● Parameters computed by Autotuning (AT)

- Proportional band (P)
- Integral time (I)
- Derivative time (D)
- Proportional band [cool-side] (Only for Heat/Cool PID control)
- Control loop break alarm (LBA) time (The LBA time is automatically set to twice the value of the Integral time)

● 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).

☞ For the manual setting of PID values, refer to **11.5 Setting PID Values Manually (P. 11-14)**.

● 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	RUN
	PID control
Parameter setting	Output limiter high ≥ 0.1 % Output limiter low ≤ 99.9 %
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 RUN/STOP mode is changed to the STOP mode.
	When the PID/AT transfer is changed to the PID control.
Parameter changing	When the temperature Set value (SV) is changed.
	When the PV bias or the PV digital filter is changed.
	When the Output limiter high or Output limiter low 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 20 ms occurs.
Instrument error	When the instrument is in the FAIL state.

■ Parameter setting

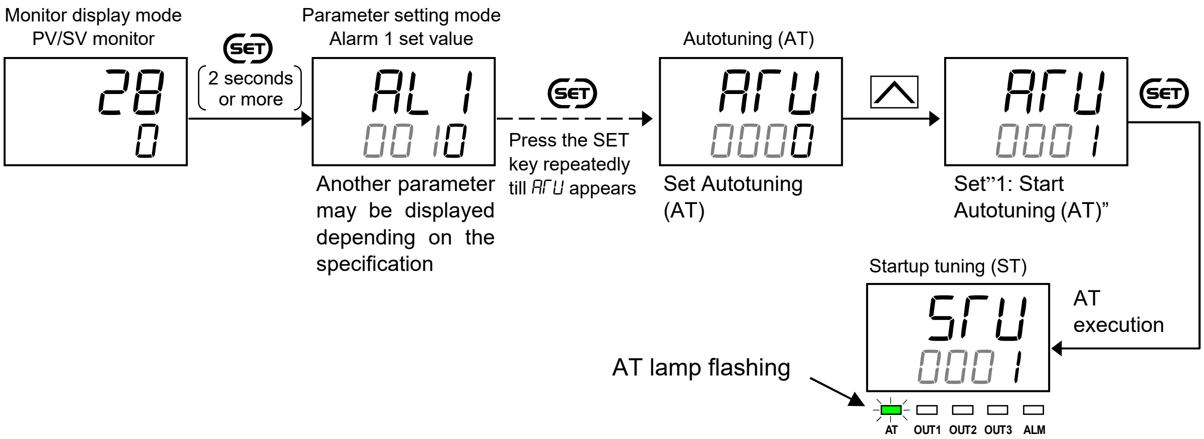
● Autotuning (AT) [Parameter setting mode]

Parameter symbol	Data range	Factory set value
ATU	0: PID control 1: Start Autotuning (AT)	0

■ Setting procedure

● Start the Autotuning (AT)

PID/AT transfer can be set in the Parameter setting mode.
Before starting the AT, refer to **"● Requirements for Autotuning (AT) start (P. 11-8)."** Make sure that all required conditions to start the AT are satisfied.



During the Autotuning (AT), the AT lamp blinks.

When the Autotuning (AT) is finished, the control will automatically return to "0: PID control" and the AT lamp turns off.

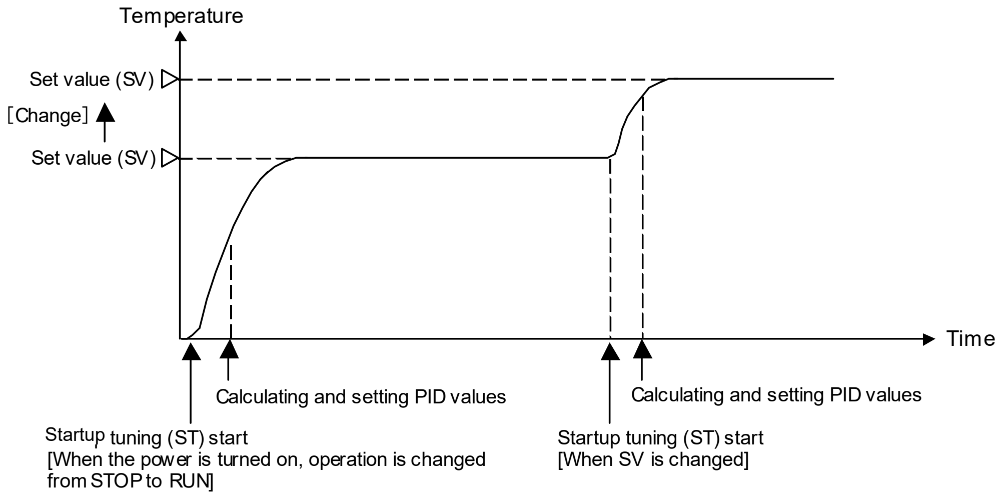
For execution of Autotuning (AT), refer to **5.6 Tuning the PID Parameters (Execution of AT) (P. 5-14)**.

11.4 Setting PID Values Automatically (Startup tuning)

Startup tuning (ST) is a function which automatically computes and sets the PID values (Proportional band: heat-side only) and Control loop break alarm (LBA) time from the response characteristics of the controlled system at power ON, transfer from STOP to RUN, and Set value (SV) change.

■ Description of function

- 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. At the same time, Control loop break alarm (LBA) time is calculated (about twice of the Integral time).
- 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.	Initial setting 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	

When the Startup tuning (ST) function is activated in Heat/Cool PID control, only heat-side PID values are calculated and changed (the Proportional band [cool-side] is not calculated).

● 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.
- If in Heat/Cool PID control, start activating the Startup tuning (ST) function under the condition of "Set value (SV) > Measured value (PV)." Only the PID values on the heat-side are automatically calculated but no PID values on the cool-side are changed. Execute the Autotuning (AT) function to the PID valued on the cool-side.
- 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).

● Requirements for Startup tuning (ST) start

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

Operation state	PID control
	RUN
Parameter setting	Startup tuning (ST) is set to ON (Execute once, Execute always)
	Output limiter high ≥ 0.1 %, Output limiter low ≤ 99.9 % [Heat/Cool PID control type: Output limiter high (heat-side) ≥ 0.1 %]
Input value state	The Measured value (PV) is not underscale or over-scale.
	At ST at Set value (SV) change, the Measured value (PV) shall be stabilized.
	Set value (SV) > Measured value (PV) [Heat/Cool PID control]
Output value state	At startup, output is changed and saturated at the Output limiter high or the Output limiter low [Heat/Cool PID control type: Output limiter high (heat-side)].

● 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.
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 hundred minutes after Startup tuning (ST) started.
Power failure	When the power failure of more than 20 ms occurs.
Instrument error	When the instrument is in the FAIL state.

■ Parameter setting

● Startup tuning (ST) [Parameter setting mode]

Parameter symbol	Data range	Factory set value
SrU	0: ST unused 1: Execute once * 2 Execute always * When the Startup tuning (ST) is finished, the control will automatically return to "0: ST unused."	0

● ST start condition [Initial setting mode: Cod 1052] EX

Parameter symbol	Data range	Factory set value
SrS	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

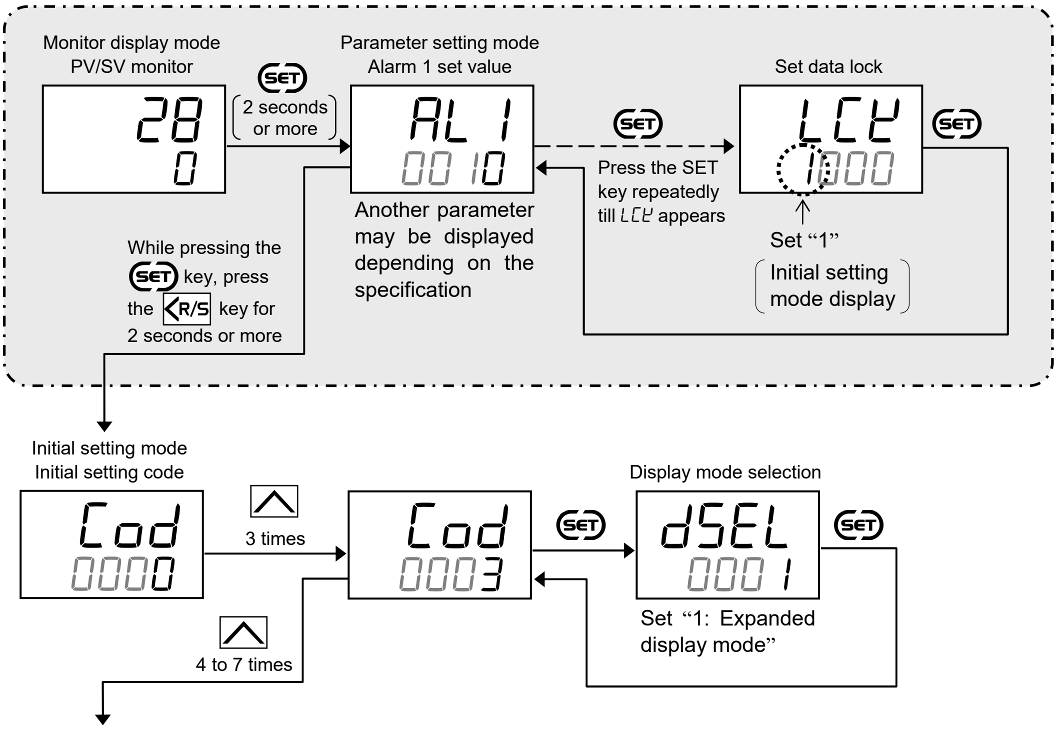
To show "ST start condition," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

● Set the ST start condition

ST start condition can be set at Cod 1052 in the Initial setting mode.

Procedure to enter the Initial setting mode



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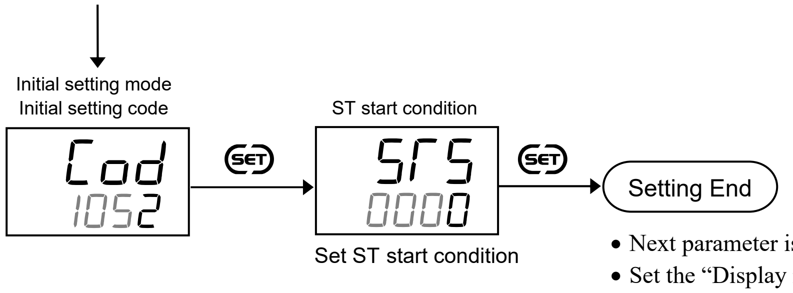
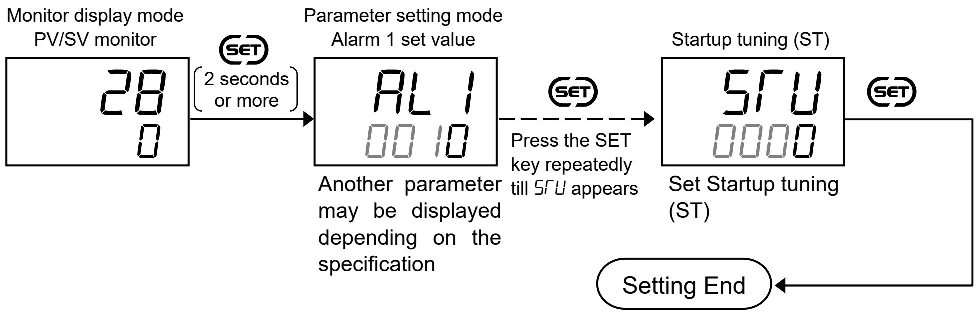


- Next parameter is displayed.
- Set the “Display mode selection” at Cod 0003 in the Initial setting mode to “0: Standard display mode.”
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to “0: Lock.”

● Set the Startup tuning (ST)

Startup tuning (ST) can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

● Start the Startup tuning (ST)

Before starting the ST, refer to **“● Requirements for Startup tuning (AT) start (P. 11-11).”** Make sure that all required conditions to start the ST are satisfied.
Startup tuning can be started in the following manner. (started in the manner that satisfies the starting condition)

- Power off the controller once and power on again.
- Stop the control once (STOP) and start the control again (RUN).
- Change the Set value (SV).

The AT lamp lights during the Startup tuning (ST).

After completion of the Startup tuning (ST), the AT lamp goes off.
When the Startup tuning setting is “1: Execute once,” the setting will go back to “0: ST unused” automatically.

11.5 Setting PID Values Manually

To perform PID control, PID parameters shown below need to be set up. These PID parameters can be automatically set using Autotuning (AT) or Startup tuning (ST). Manual adjustment is also available.

- Proportional band (P)
- Integral time (I)
- Derivative time (D)

Also set Anti-reset windup (ARW), if necessary.

☞ For Autotuning (AT) function, refer to **11.3 Setting PID Values Automatically (Autotuning) (P. 11-8)**. For Startup tuning (ST) function, refer to **11.4 Setting PID Values Automatically (Startup tuning) (P. 11-10)**.

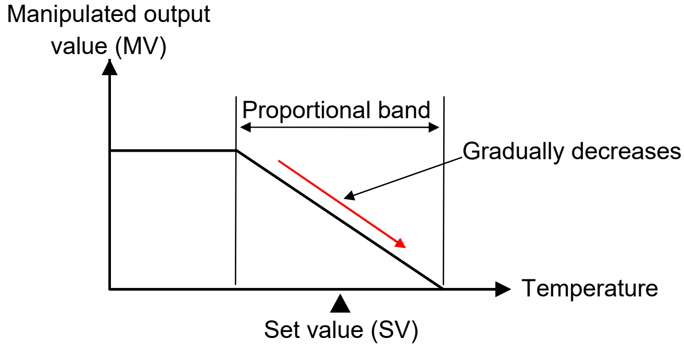
■ Description of function

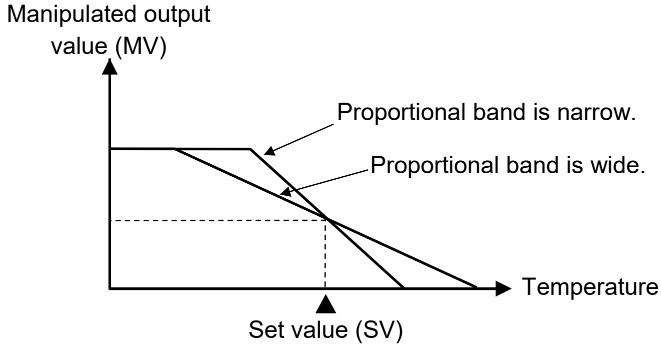
Critical parameters of PID control such as Proportional action (Proportional band: P), Integral action (Integral time: I), and Derivative action (Derivative time: D) are explained below.
Note that this explanation is based on the reverse action (heating control). With the direct action (cooling control), the output increases as the measured value increases.

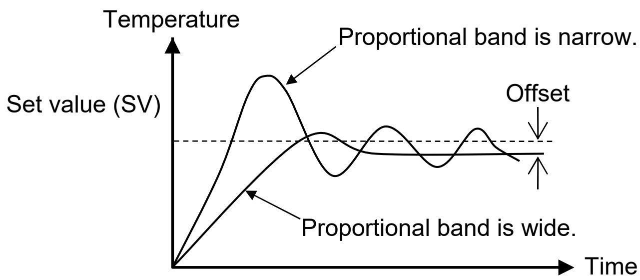
● Proportional action

In the ON/OFF control action, the manipulated output is turned on and off repeatedly, resulting in oscillatory control.
To eliminate this oscillation, control is performed by producing Manipulated output value (MV) proportional to the deviation between the Set value (SV) and the Measured value (PV).
Technically a zone called "Proportional band" is established around the Set value (SV) and when the Measured value (PV) enters the proportional band, the Manipulated output value (MV) is gradually reduced.
The measured value (PV) stabilizes within the Proportional band at the equilibrium point, but in many cases the stabilized temperature does not match the Set value (SV).
This deviation between the Set value (SV) and the stabilized temperature is called "Offset."
With a narrower proportional band the control result becomes closer to that of the ON/OFF control (oscillatory).
With a wider proportional band the output is gradually reduced to stabilize quicker, however, often with a larger offset.

☞ For ON/OFF action, refer to **11.6 Controlling with ON/OFF Action (P. 11-19)**.

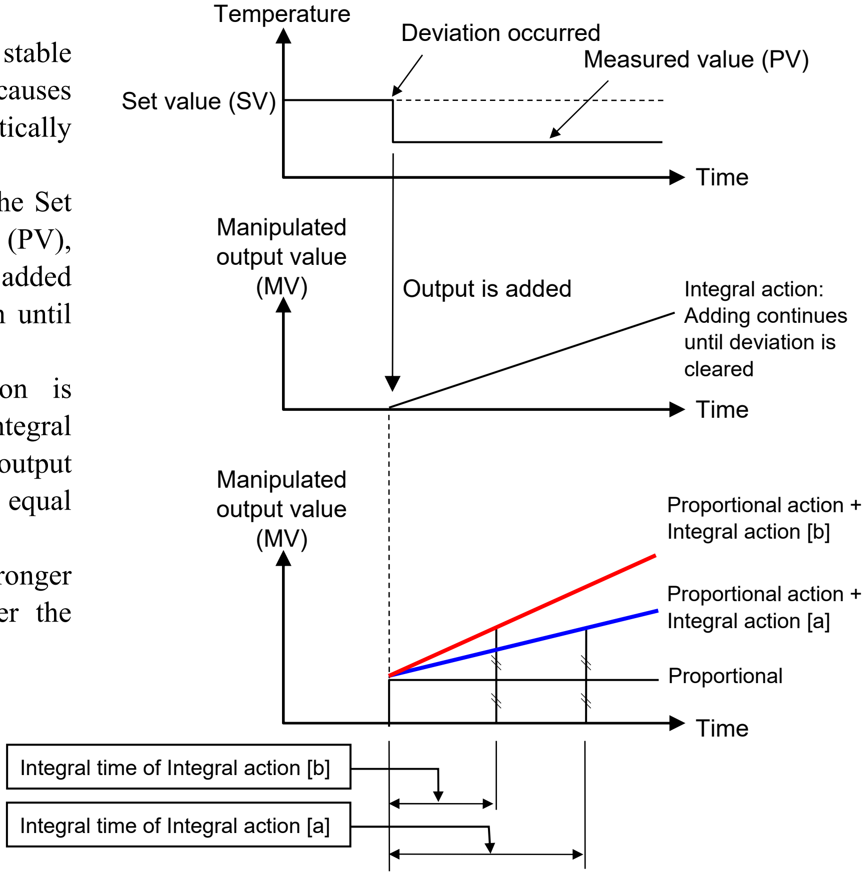






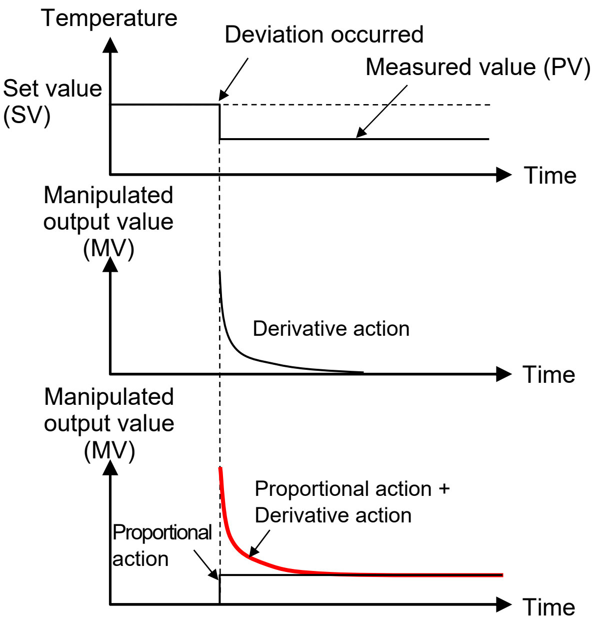
● Integral action

Proportional action provides more stable control than ON/OFF control, but causes offset. This offset can be automatically corrected by Integral action.
As long as deviation exists between the Set value (SV) and the Measured value (PV), the Manipulated output value (MV) is added according to the size of the deviation until no deviation exists.
The strength of the Integral action is expressed by the Integral time. The Integral time is the time till the Manipulated output value (MV) by the Integral action gets equal to that by the Proportional action.
The shorter the Integral time, the stronger the integral effect is, and the longer the weaker.

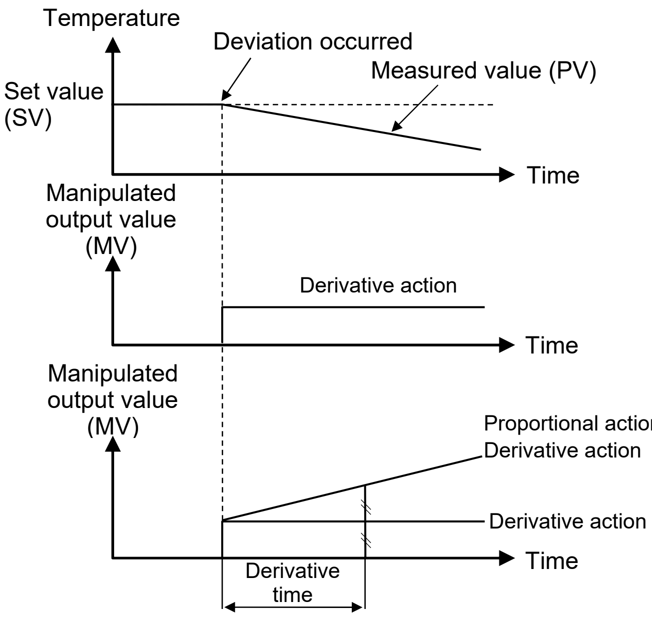


● Derivative action

This action produces Manipulated output value (MV) proportional to the changing rate of the deviation between the Set value (SV) and the Measured value (PV) to prevent the deviation from becoming larger.
The strength of the Derivative action is expressed by the derivative time, which is the time till the Manipulated output (MV) by the Proportional action becomes the same as that by the Derivative action.
The longer the Derivative time is, the stronger the Derivative effect is, and the shorter the weaker.
The Derivative effect, if set too strong, produces large Manipulated output (MV) against a small change of the Measured value (PV), thus causing hunting and resulting in unstable control.



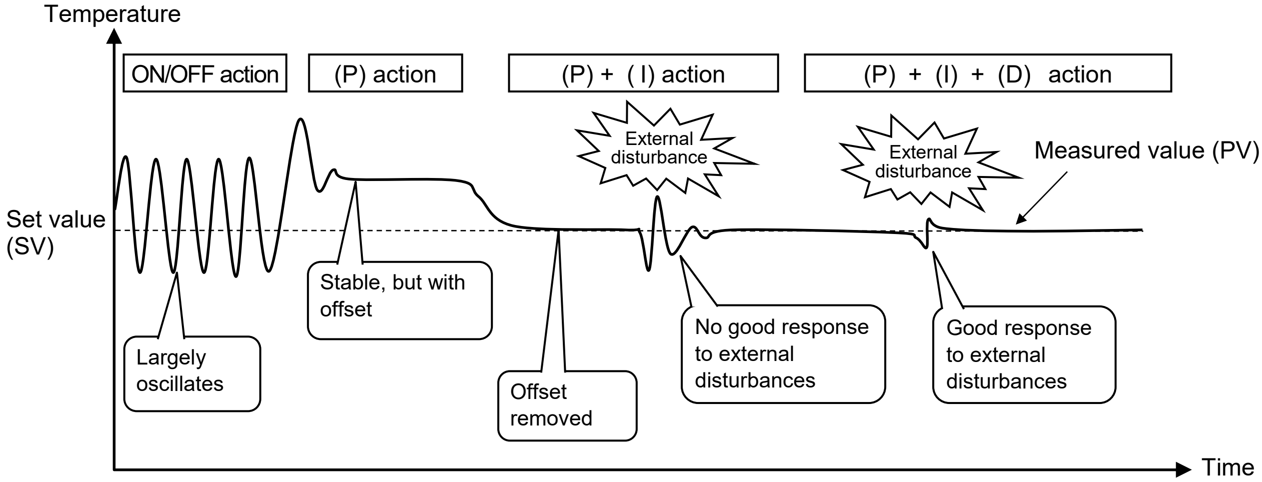
Deviation changes stepwise



Deviation gradually changes (Deviation changes at a constant rate)

● Outline of effect of PID

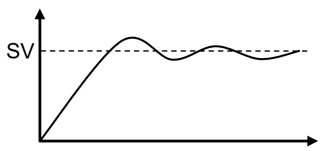
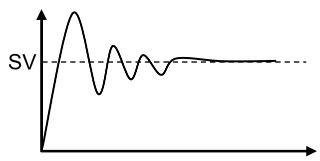
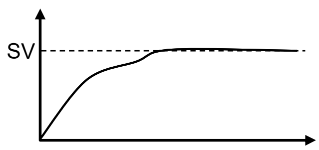
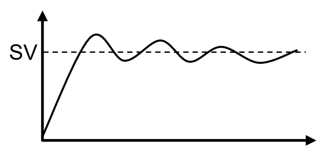
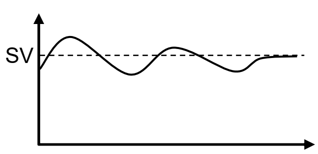
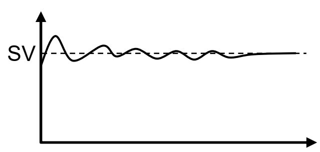
The following figure shows control behaviors under various control actions; ON/OFF control, proportional control (P), Proportional + Integral action (PI action), and Proportional + Integral + Derivative actions (PID control).



● Adjusting PID parameters (Applications controlled with PID control)

In some applications PID values calculated and obtained through Autotuning (AT) and Startup tuning (ST) may not be appropriate. In such a case the PID values need to be adjusted manually.
Attempt this adjustment referring to the following.

The sample here shows a general tendency. Control results depend on the controlled object and combinations of control constants.

	Made larger (wider, longer)	Made smaller (narrower, shorter)
Proportional band (P) adjusted	Overshoot is suppressed, but it takes time until the temperature stabilizes. 	Overshoot may occur, but temperature reaches the Set value (SV) faster. Setting the value too small may result in hunting (oscillation of Manipulated output (MV)). 
Integral time (I) adjusted	Overshoot, undershoot and hunting are suppressed. Setting the value too long may need longer time till the Set value (SV) is reached. 	Starts up quickly. Setting the value too short may cause overshoot, undershoot or hunting. 
Derivative time (D) adjusted	Suppresses hunting (oscillation). Setting the value too long may cause large overshoot and take time till the Set value is reached. 	Makes overshoot and undershoot smaller. Setting the value too short causes hunting (oscillation). 

■ Parameter setting

● Proportional band [heat-side] [Parameter setting mode]

Parameter symbol	Data range	Factory set value
P	0 (0.0) to Input span (Unit: °C [°F]) For a scale range with a decimal point, when the input span exceeds the display limit, the maximum value is 999.9. Varies with the setting of the Decimal point position. 0 (0.0): ON/OFF action	30 or 30.0

● Integral time [Parameter setting mode]

Parameter symbol	Data range	Factory set value
I	0 to 3600 seconds (0: PD action)	240

● Derivative time [Parameter setting mode]

Parameter symbol	Data range	Factory set value
d	0 to 3600 seconds (0: PI action)	60

● Anti-reset windup (ARW) [Parameter setting mode]

Parameter symbol	Data range	Factory set value
Ar	0 to 100 % of Proportional band [heat-side] (0: Integral action is always OFF)	100

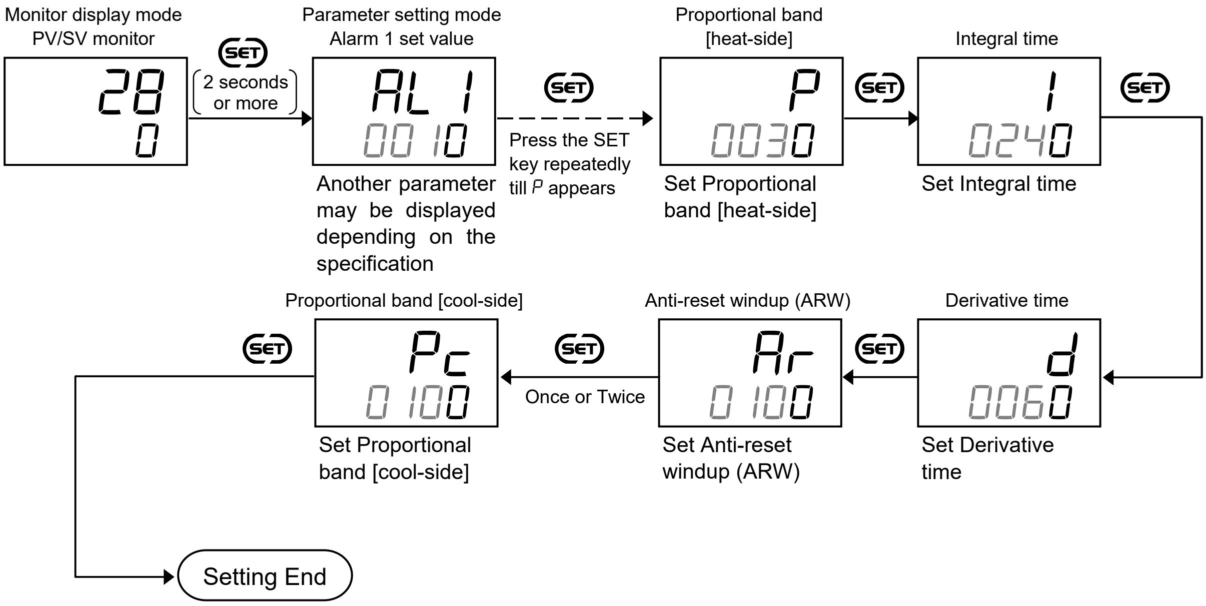
● Proportional band [cool-side] [Parameter setting mode]

Parameter symbol	Data range	Factory set value
Pc	1 to 1000 % of Proportional band [heat-side] (ON/OFF action of cool-side only is not possible.)	100

To show the "Proportional band [cool-side]," specify "Heat/Cool PID control" at the time of ordering or configure the instrument to "Heat/Cool PID control" at Cod 1051 in the Initial setting mode to "Control action."

■ Setting procedure

Proportional band [heat-side], Integral time, Derivative time, Anti-reset windup (ARW), and Proportional band [cool-side] can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

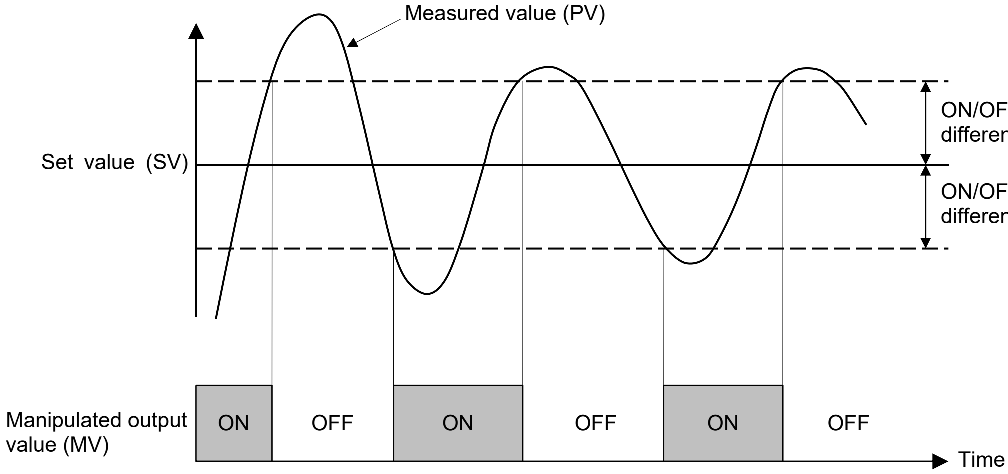
11.6 Controlling with ON/OFF Action

In ON/OFF control, the Manipulated output value (MV) is turned on or off depending on the Measured value (PV) whether it is above or below the Set value (SV).

■ Description of function

When the Measured value (PV) is above the Set value (SV), the Manipulated output value (MV) is turned OFF, and when the Measured value (PV) is below the Set value (SV), the Manipulated output value (MV) is turned ON. **To use the ON/OFF control, set the Proportional band [heat-side] to "0."**

In the ON/OFF control the output is turned on and off around the Set value (SV) and the output may be turned on and off too frequently for a small change of temperature. This is called "chattering" and may reduce the life of the output relay. To prevent this, ON/OFF differential gap should be properly set.



This explanation applies to "Reverse action" (heating control).

The value of the ON/OFF action differential gap is a deviation from the Set value (SV). This gap can be set individually above and below the Set value (SV). For example, in case of a Reverse action (heating control), assuming that the Set value (SV) is 100 °C with a ON/OFF action differential gap (upper) of 5 °C, the Manipulated output value (MV) turns off at 105 °C.

● Cooling control with ON/OFF action

Cooling control (direct action) can be conducted as follows.

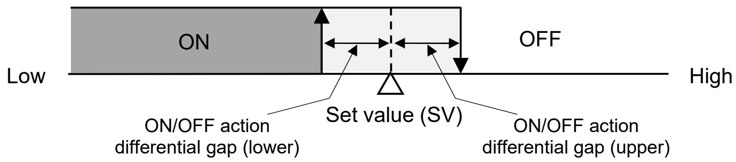
- Select "0: PID control" in the selection of Control action in the Initial setting mode "Cod 1051."
- Select "0: PID control: Direct action" in the "Direct/Reverse action".
- Set "0" at Proportional band [heat-side] to change the control action to the ON/OFF action for cooling control (direct action).

The action is the same as above, but the ON/OFF position of the Manipulated output value (MV) becomes opposite. The ON/OFF action differential gap can be set similarly.

● Heat/Cool control with ON/OFF action

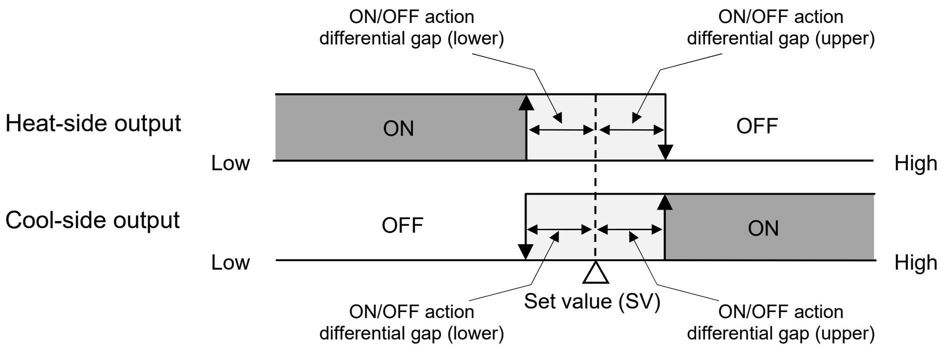
Select “1: Heat/Cool PID control” at the “Cod 1051 (Control action)” in the Initial setting mode. Then, select one from “0: Heat/Cool PID control: Water cooling (for Extruder),” “1: Heat/Cool PID control: Air cooling (for Extruder)” or “2: Heat/Cool PID control: Cooling linear type” for setting the Cool action.
After the control action has been set up, set zero to the Proportional band [heat-side] to start.

Manipulated output for ON/OFF action [at Heating control]

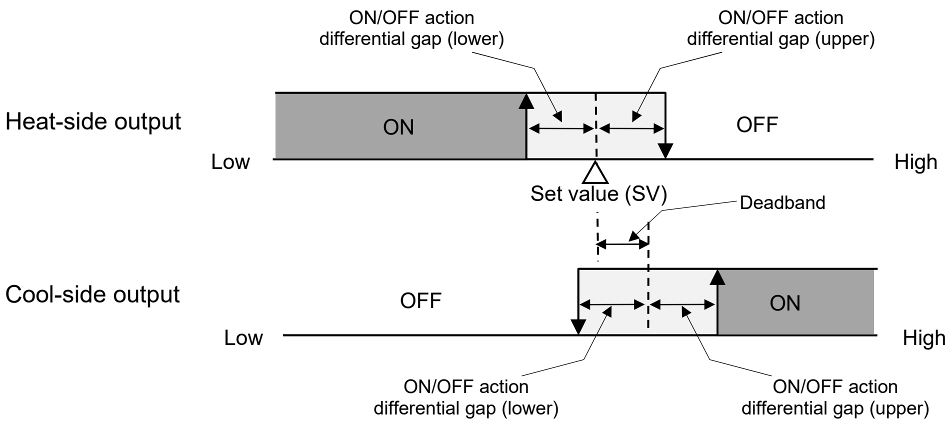


Manipulated output for ON/OFF action [at Heat/Cool control]

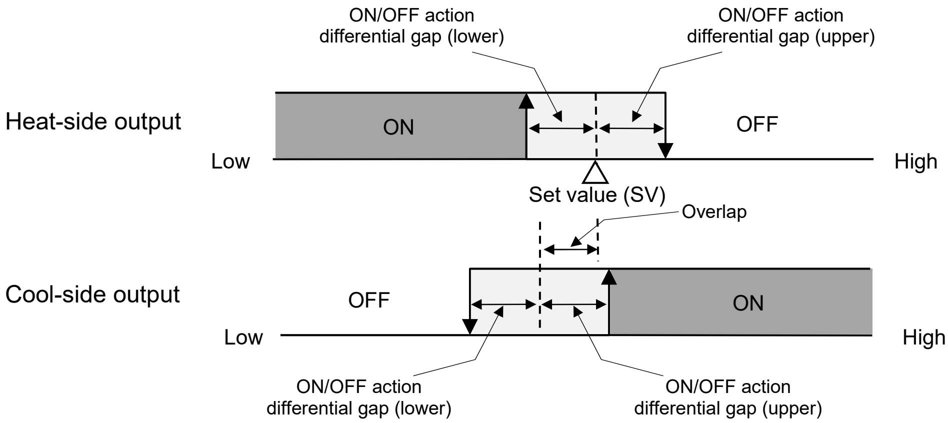
● Overlap/Deadband = 0



● Overlap/Deadband > 0



● Overlap/Deadband < 0



■ Parameter setting

● Proportional band [heat-side] [Parameter setting mode]

Parameter symbol	Data range	Factory set value
P	0 (0.0) to Input span (Unit: °C [°F]) For a scale range with a decimal point, when the input span exceeds the display limit, the maximum value is 999.9. Varies with the setting of the Decimal point position. 0 (0.0): ON/OFF action	30 or 30.0

● ON/OFF action differential gap (upper) [Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
oHH	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	1 or 1.0

To show the "ON/OFF action differential gap (upper)," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

● ON/OFF action differential gap (lower) [Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
oHL	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	1 or 1.0

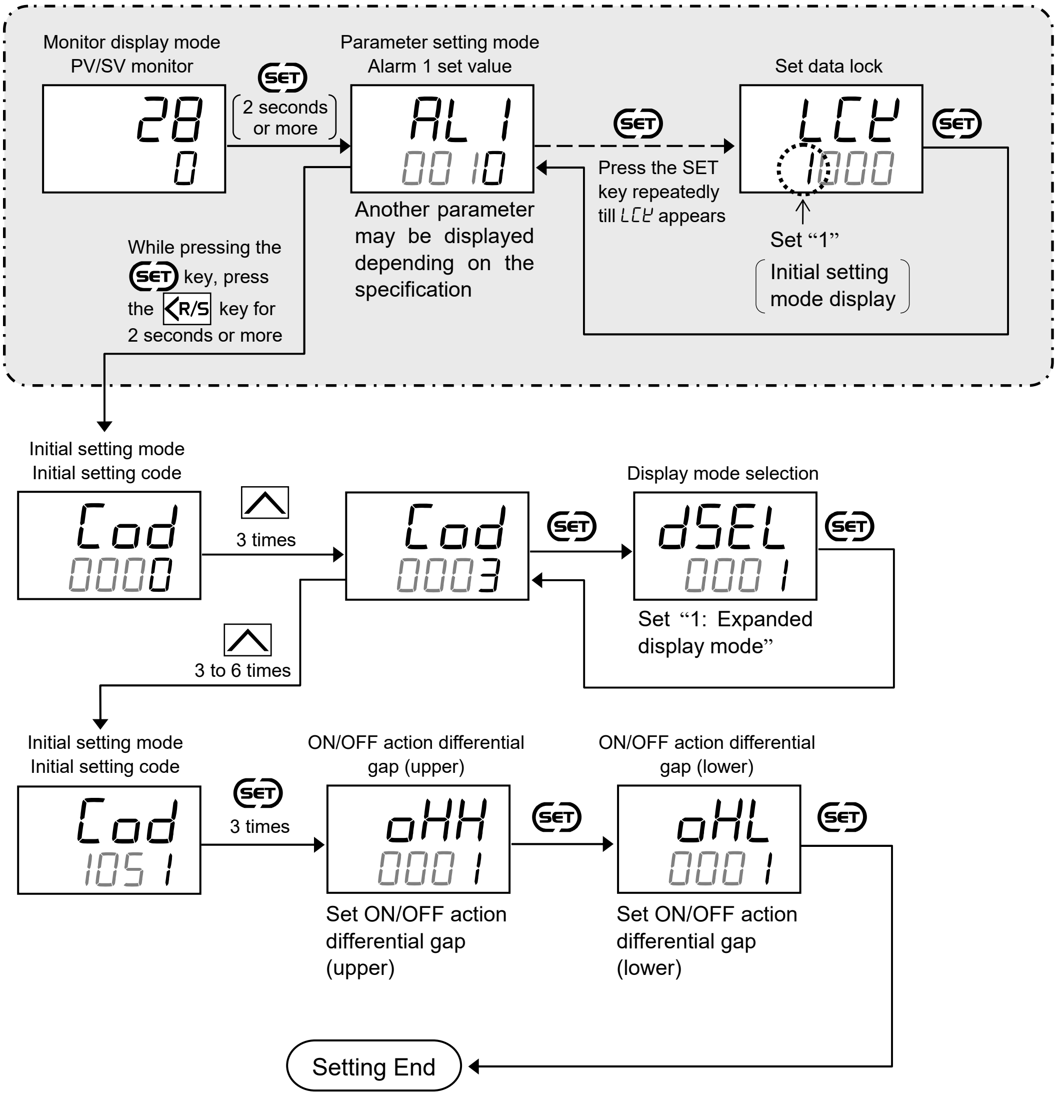
To show the "ON/OFF action differential gap (lower)," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

■ Setting procedure

● Set the ON/OFF action differential gap

ON/OFF action differential gap can be set at Cod 1051 in the Initial setting mode.

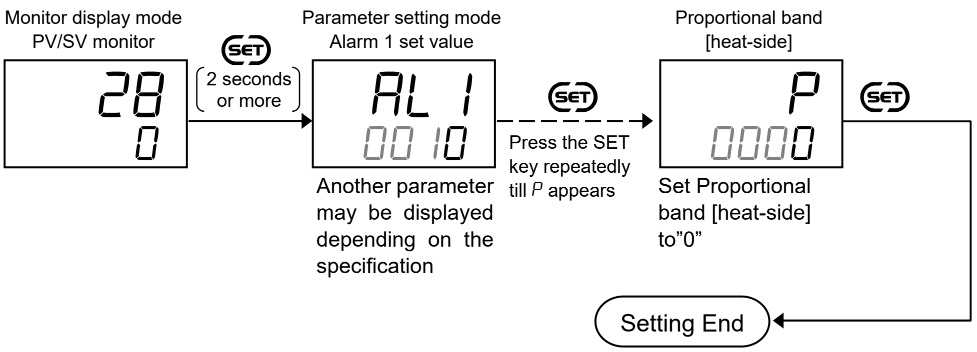
Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

● Set the ON/OFF action

To select an ON/OFF control, go to the Parameter setting mode and set the Proportional band [heat-side] to "0."



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

11.7 Controlling with Heat/Cool Action

With Heat/Cool PID control method, heat-side and cool-side can be controlled by a controller. For example, this is effective when cooling control is required in extruder cylinder temperature control.

■ Description of function

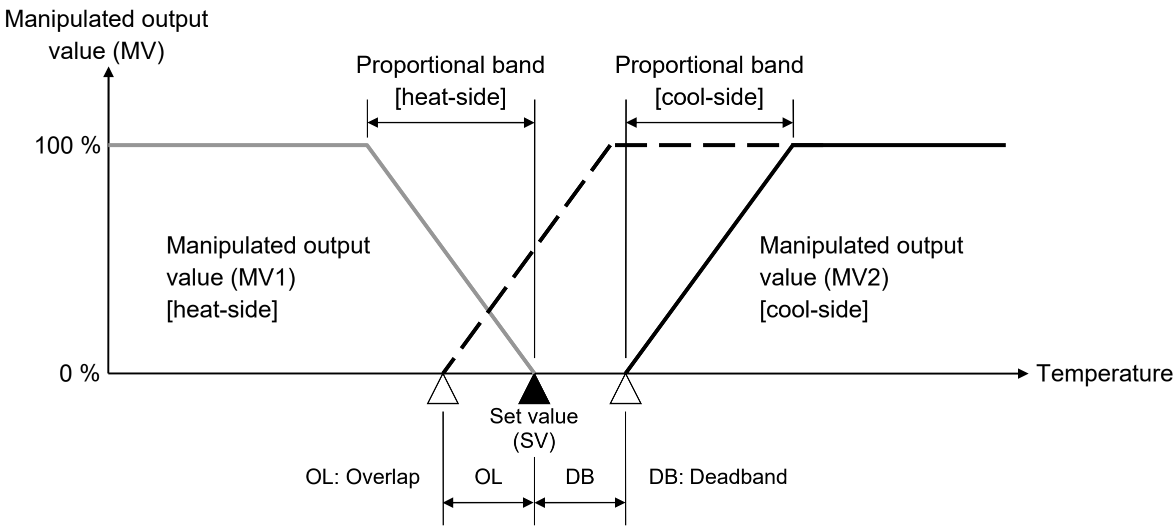
● Cool control type

The control on the heat-side is the same as the standard PID control. The control on the cool-side can be selected from a few types according to the controlled object.

- Water cooling/Air cooling: The algorithm assuming plastic molding machine Heat/Cool control is employed. Even in equipment provided with a cooling mechanism having nonlinear characteristics, it responds quickly to attain the characteristic responding to the set value with small overshooting.
- Cooling linear type: The algorithm assuming applications without nonlinear cooling capability is employed.

● Overlap/Deadband

Heat/Cool PID control has a proportional band individually on each side of the heating and the cooling. With the Set value (SV) as a reference point, setting the Overlap/Deadband below the Set value (SV) [setting on the negative side] generates an overlap of the heating and the cooling proportional bands. Setting this parameter above the Set value (SV) [setting on the positive side] generates a deadband.



■ Parameter setting

● Proportional band [heat-side] [Parameter setting mode]

Parameter symbol	Data range	Factory set value
P	0 (0.0) to Input span (Unit: °C [°F]) For a scale range with a decimal point, when the input span exceeds the display limit, the maximum value is 999.9. Varies with the setting of the Decimal point position. 0 (0.0): ON/OFF action	30 or 30.0

- **Integral time**
  [Parameter setting mode]

Parameter symbol	Data range	Factory set value
I	0 to 3600 seconds (0: PD action)	240

- **Derivative time**
  [Parameter setting mode]

Parameter symbol	Data range	Factory set value
d	0 to 3600 seconds (0: PI action)	60

- **Anti-reset windup (ARW)**
  [Parameter setting mode]

Parameter symbol	Data range	Factory set value
Ar	0 to 100 % of Proportional band [heat-side] (0: Integral action is always OFF)	100

- **Proportional band [cool-side]**
  [Parameter setting mode]

Parameter symbol	Data range	Factory set value
Pc	1 to 1000 % of Proportional band [heat-side] (ON/OFF action of cool-side only is not possible.)	100

To show the "Proportional band [cool-side]," specify "Heat/Cool PID control" at the time of ordering or configure the instrument to "Heat/Cool PID control" at Cod 1051 in the Initial setting mode to "Control action."

- **Overlap/Deadband**
  [Parameter setting mode]

Parameter symbol	Data range	Factory set value
db	−10 to +10 or −10.0 to +10.0 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	0 or 0.0

To show the "Overlap/Deadband," specify "Heat/Cool PID control" at the time of ordering or configure the instrument to "Heat/Cool PID control" at Cod 1051 in the Initial setting mode to "Control action."

● Control action
[Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
YE	0: PID control 1: Heat/Cool PID control	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If control action is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.

To show the "Control action," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

● Cool action
[Initial setting mode: Cod 1051] EX

Parameter symbol	Data range	Factory set value
oSC	0: Heat/Cool PID control: Air cooling (for Extruder) 1: Heat/Cool PID control: Water cooling (for Extruder) 2: Heat/Cool PID control: Cooling linear type	When control action is specified at the time of ordering, the ordered code for control action is the factory setting.* If Control action is not specified: 0

* If control action code is "G," this parameter is "2."
If control action code is "A," this parameter is "0."
If control action code is "W," this parameter is "1."

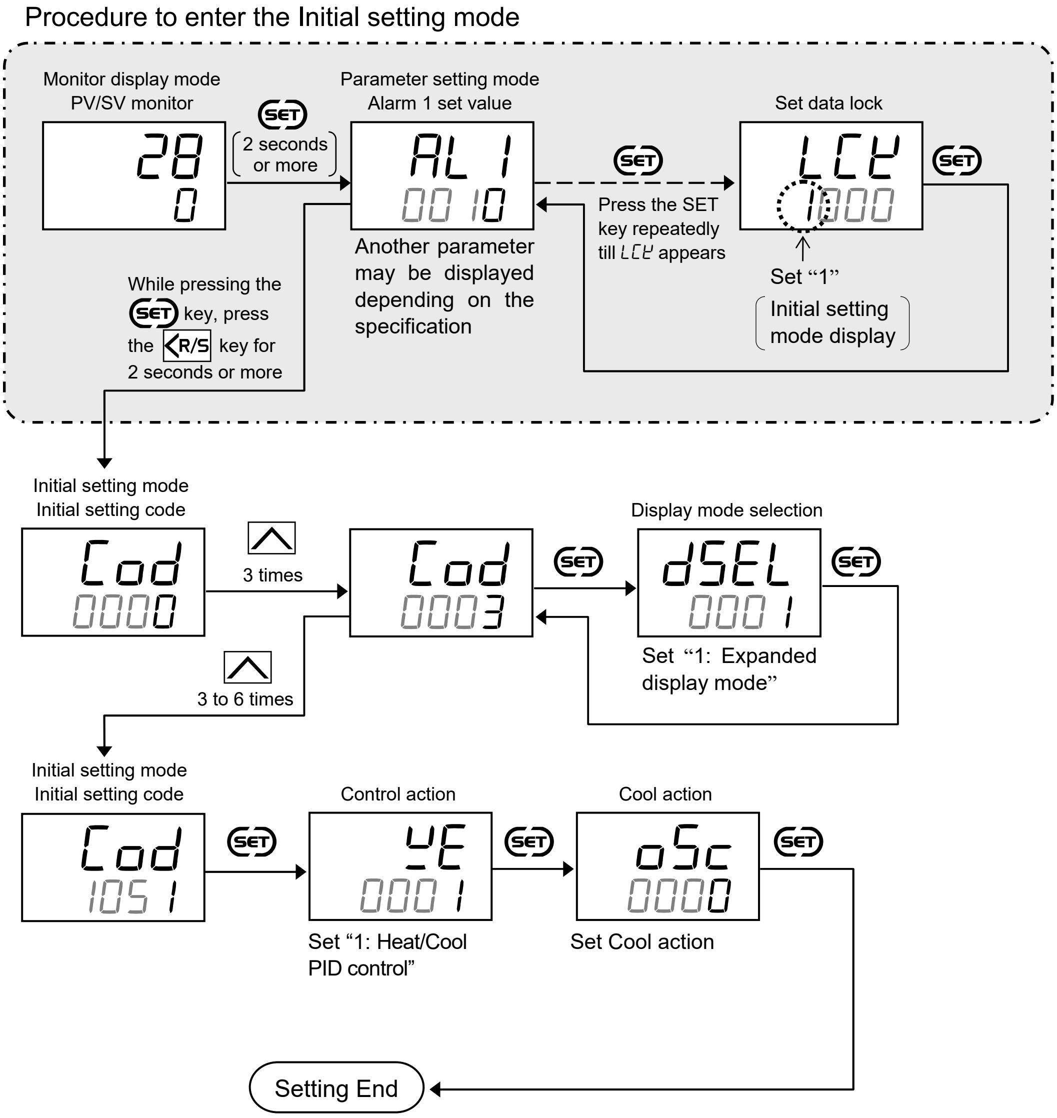
To show the "Cool action," enter the Expanded display mode by setting the "Display mode selection" at Cod 0003 in the Initial setting mode.

To show the "Cool action," configure the instrument to "Heat/Cool PID control" at Cod 1051 in the Initial setting mode to "Control action."

■ Setting procedure

● Set the Control action to "Heat/Cool PID control"

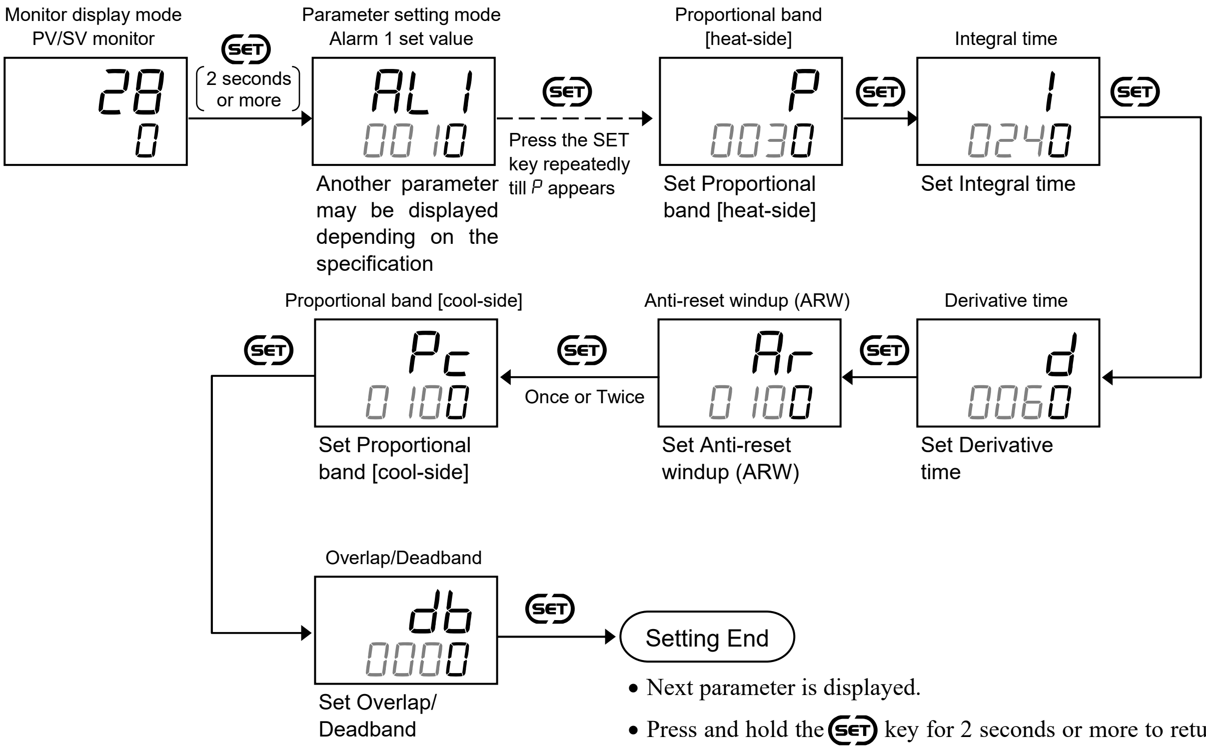
Control action and Cool action can be set at Cod 1051 in the Initial setting mode.



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

● Set the parameters related to Heat/Cool PID control

Proportional band [heat-side], Integral time, Derivative time, Anti-reset windup (ARW), Proportional band [cool-side], and Overlap/Deadband can be set in the Parameter setting mode.



- Next parameter is displayed.
- Press and hold the SET key for 2 seconds or more to return to the PV/SV monitor screen.

The parameters for Heat/Cool PID control can be calculated with Autotuning (AT) (however, Anti-reset windup and the Overlap/Deadband are excluded). For the autotuning (AT), refer to **11.3 Setting PID Values Automatically (Autotuning) (P. 11-8)**.

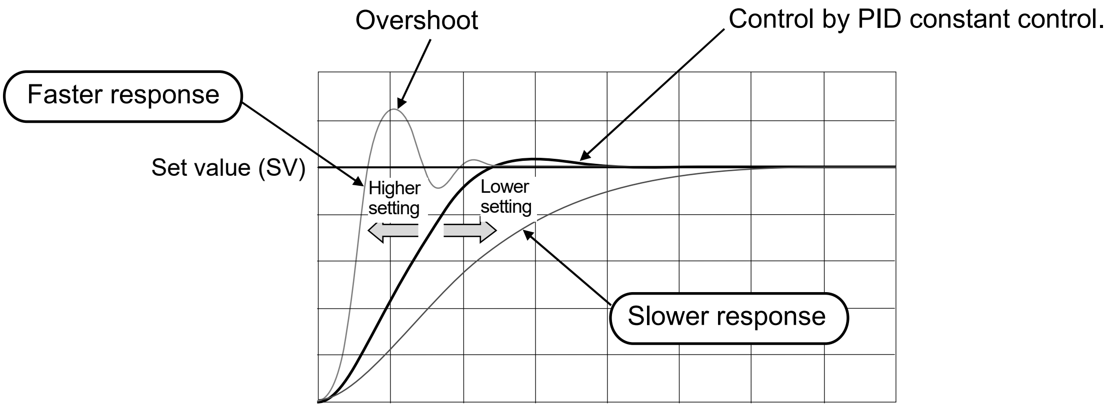
11.8 Increasing Control Response/Suppressing Overshoot (Fine tuning)

Fine tuning is a function to adjust the control response time or the amount of overshoot without changing the PID parameters when a Set value (SV) is changed or when external disturbance occurs.
Fine tuning fine-tunes the PID values according to the Fine tuning setting to improve the control response.
Once Fine tuning is done, the control action will be different from that performed with the currently set PID values.

■ Description of function

Depending on the Fine tuning setting (–3 to +3), the resultant actions may be as follows.

- Setting a “0” value: Control is not influenced by Fine tuning.
- Setting a positive value (fast response):
  Time to the Set value (SV) is faster, but small overshoot is unavoidable.
- Setting a negative value (slow response):
  Overshoot can be reduced, but time to the Set value (SV) may take longer.



Difference in control response due to fine tuning

■ Parameter setting

● Fine tuning [Parameter setting mode] EX

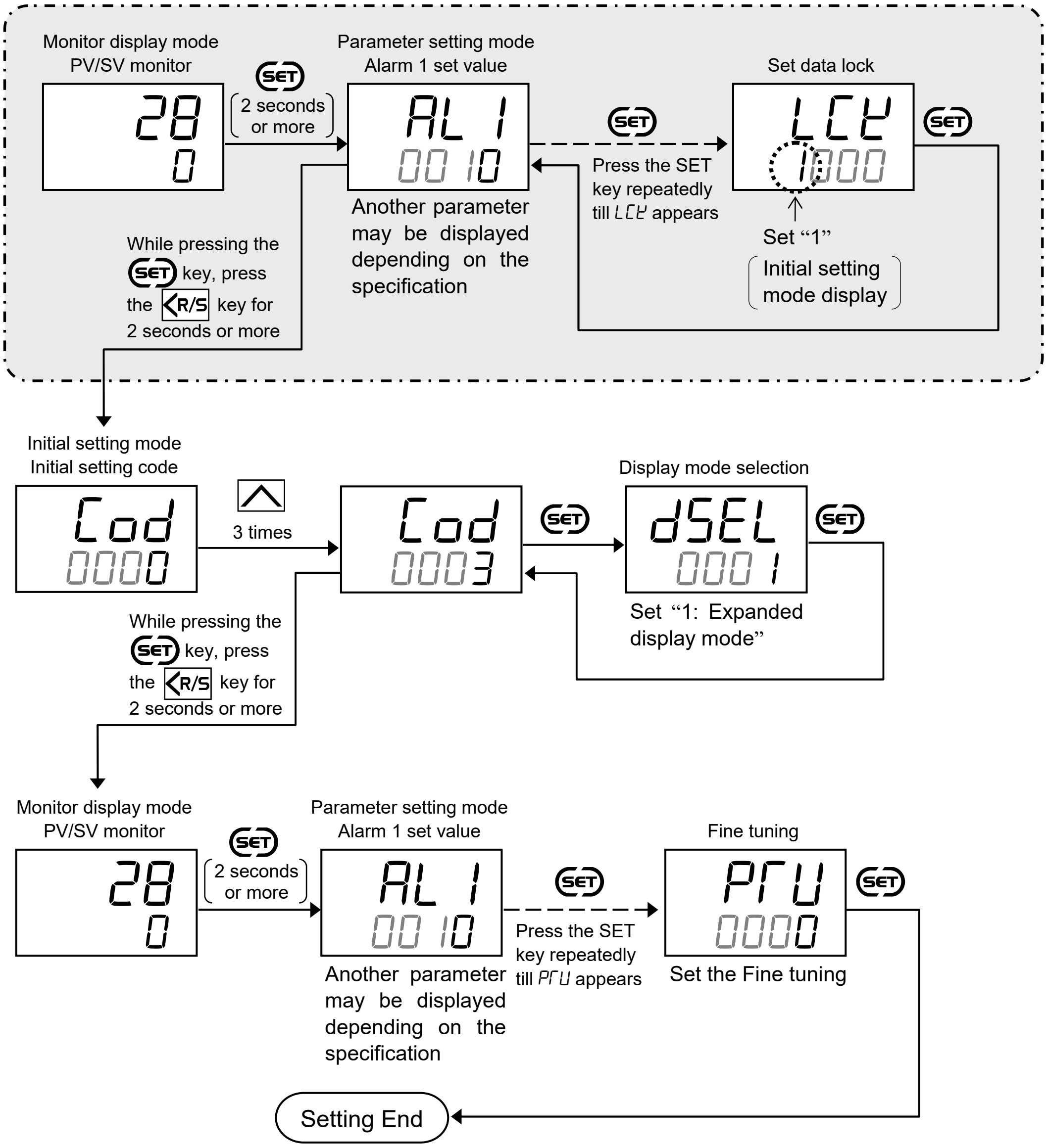
Parameter symbol	Data range	Factory set value
PrU	–3 to +3 (0: Function OFF)	0

To show the “Fine tuning,” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

■ Setting procedure

Fine tuning can be set in Parameter setting mode.
To show the “Fine tuning,” enter the Expanded display mode by setting the “Display mode selection” at Cod 0003 in the Initial setting mode.

Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Press the R/S key for 2 seconds or more while pressing the SET key to go to the Initial setting mode.
- Set the “Display mode selection” at Cod 0003 in the Initial setting mode to “0: Standard display mode.”
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to “0: Lock.”

COMMUNICATION FUNCTION (OPTION)

12

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

12.1 Outline

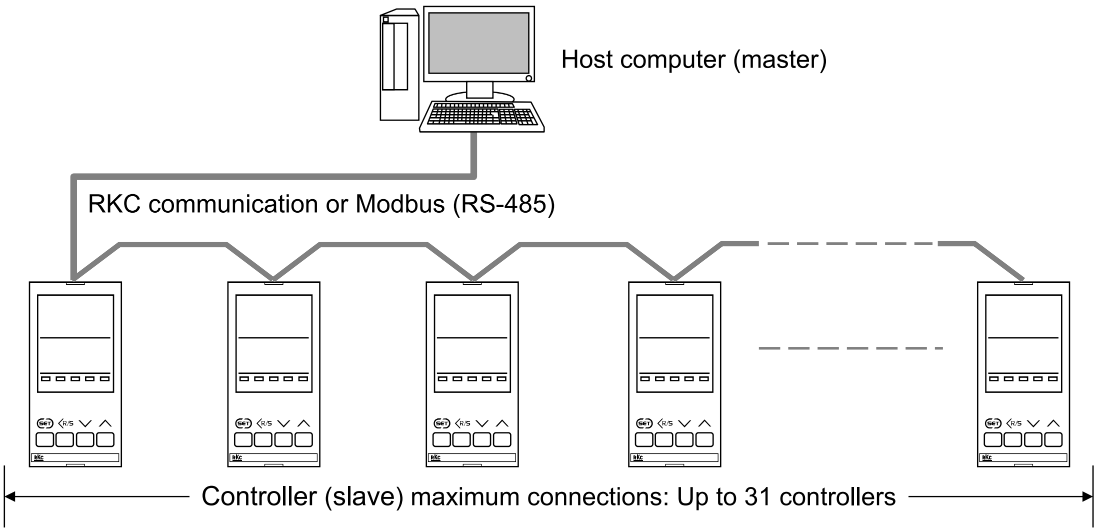
The communication function makes it possible to monitor and set the data of the Temperature Controller RZ100/RZ400 (hereafter called controller) from a host computer. The controller interfaces with the host computer via Modbus or RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4) protocols. Communication function is available only when optional communication function has been specified at the time of ordering.
In addition, the controller RZ100/400 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.

■ Host communication (RKC communication, Modbus) [Option]

Communication interface: RS-485

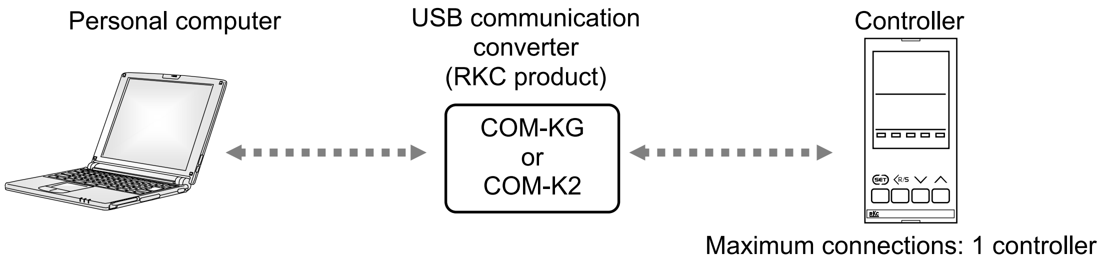
● Multi-drop connection (Communication interface: RS-485)

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 the data that was set using our Communication Tool PROTEM2 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-KG or COM-K2 (sold separately) is required for the loader communication.



NOTE

The Loader port is only for parameter setup. Not used for data logging during operation.

Loader communication can be used on a RZ100/400 even when the Communication function (option) is not installed.

■ Communication Tool PROTEM2

PROTEM2 is an integrated configuration support software to manage parameter setting and measured values of our controllers (including RZ100/400).
The PROTEM2 can be downloaded from the official RKC website.

Check our website for more details and operating environment of the PROTEM2.

📖 PROTEM2 requires Microsoft.NET Framework 4.5 or later to be installed on the computer.

📖 PROTEM2 can be used with RKC communication protocol and Modbus protocol.
PROTEM2 can also be used for loader communication and a host communication.

12.2 Connections

WARNING

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

12.2.1 Wiring for host communication

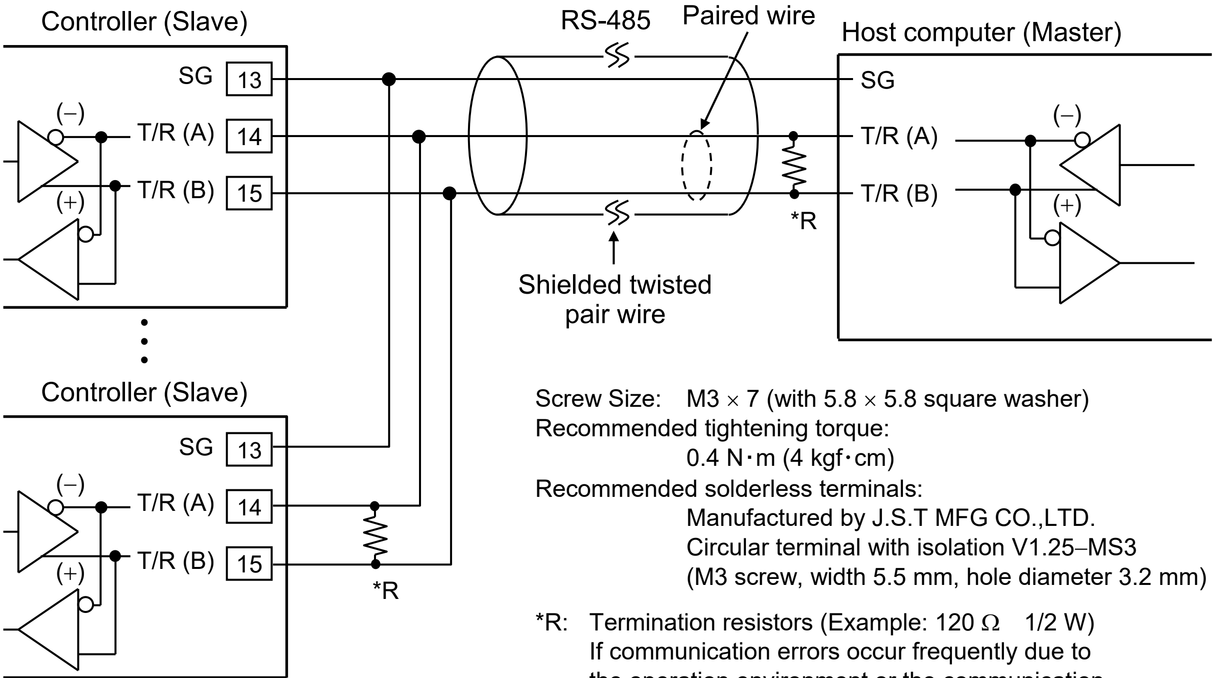
Host communication is used for a connection to a host computer via RS-485.

■ Communication terminal number and signal details

Terminal No.	Signal name	Symbol
13	Signal ground	SG
14	Send data/Receive data	T/R (A)
15	Send data/Receive data	T/R (B)

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

● Wiring example



Maximum connections: Up to 31 controllers

Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25–MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

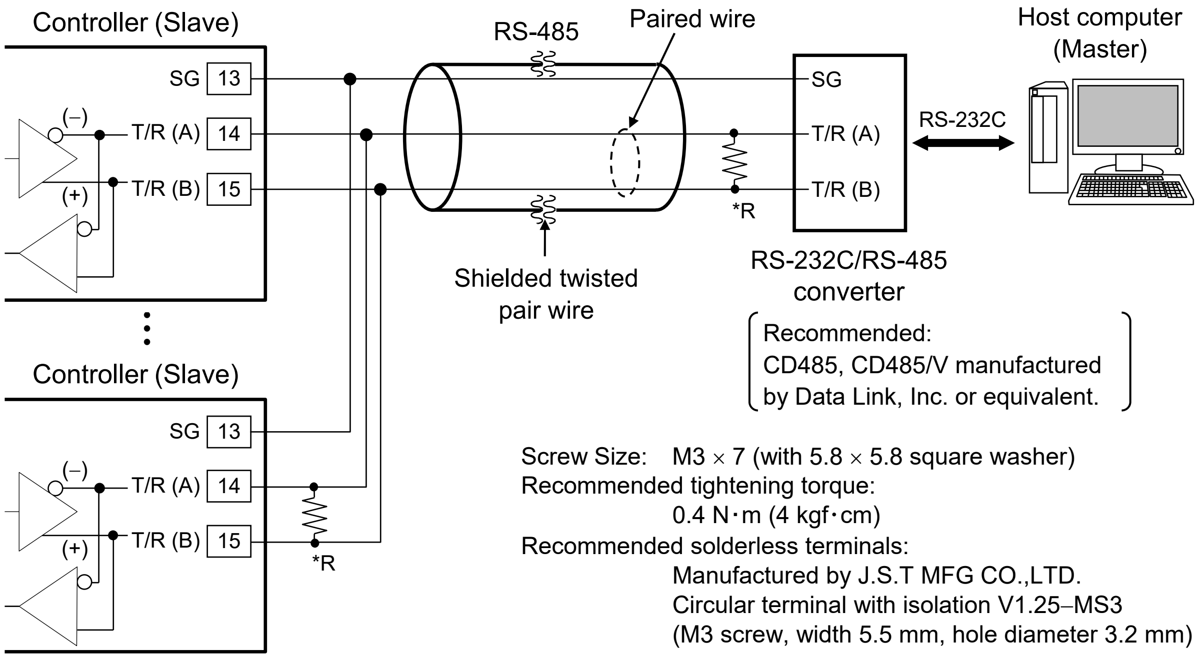
*R: Termination resistors (Example: 120 Ω 1/2 W)
If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.

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

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

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

● Wiring example



Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25–MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Maximum connections: Up to 31 controllers

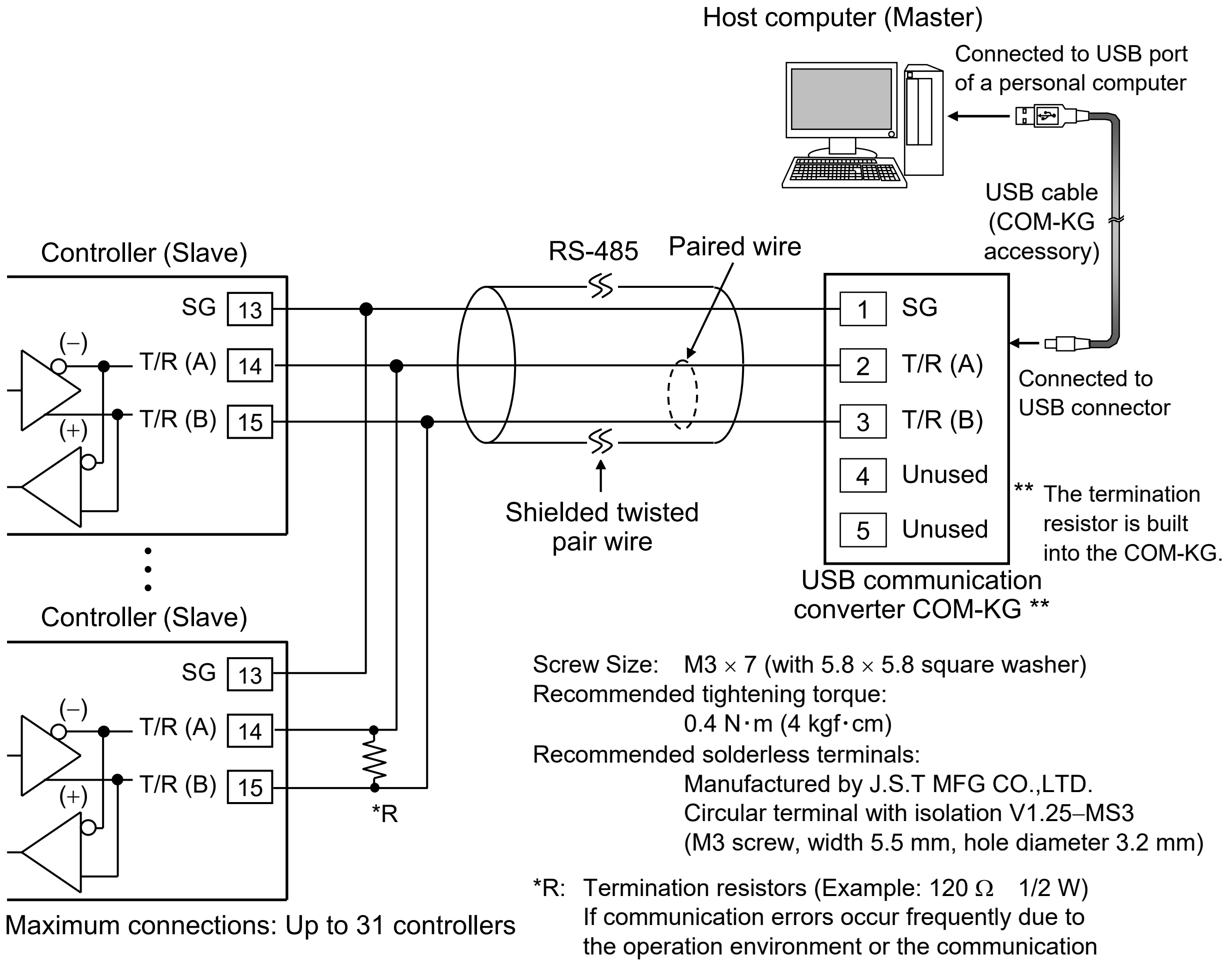
*R: Termination resistors (Example: 120 Ω 1/2 W)
If communication errors occur frequently due to the operation environment or the communication distance, connect termination resistors.

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

■ Connection to the USB of the host computer (master)

Connect the USB communication converter between the host computer and the controller.
When the host computer has a standard USB connector, our communication converter COM-KG or COM-K2 (sold separately) can be used.

● Wiring example



Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25–MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

*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.

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

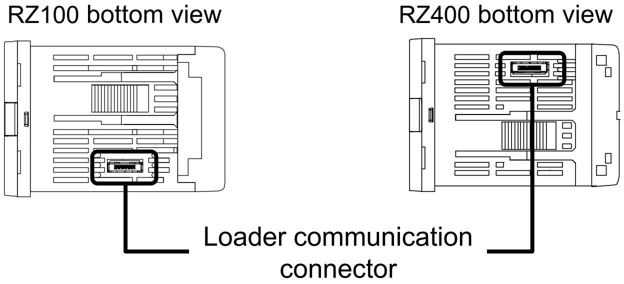
For the COM-KG, refer to the **COM-KG Instruction Manual**.
You can also use our USB communication converter COM-K2.

12.2.2 Connections for loader communication

RKC USB communication converter COM-KG (or COM-K2), loader communication cable and USB cable are required for connecting this controller to the personal computer.

☞ For the COM-KG or COM-K2, refer to the official RKC website.

■ Position of loader communication connector

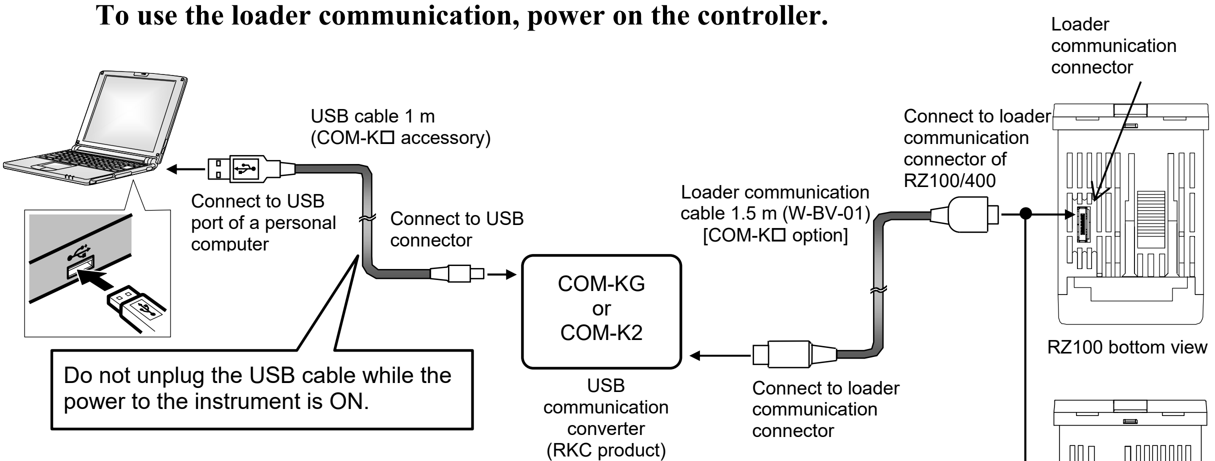


■ Wiring method

Connect the controller, COM-KG (or COM-K2), and personal computer using a USB cable and a loader communication cable. Make sure the connectors are oriented correctly when connecting.

NOTE

To use the loader communication, power on the controller.



Connection example of loader communication

- Communication Tool
  PROTEM2

  Software operation environment:
  Consult the manual that you downloaded

- 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:	38400 bps
Start bit:	1
Data bit:	8
Parity bit:	None
Stop bit:	1

- The device address for loader communication is fixed at “0.”
- The setting of the RZ100/400 device address is disregarded.
- The loader communication corresponds to the RKC communication protocol “Based on ANSI X3.28-1976 subcategories 2.5 and A4.”

When using the loader communication, USB driver for COM-KG (for Windows7) and COM-K2 must be installed on the personal computer. The USB driver can be downloaded the official RKC website. Installation of the USB driver is not necessary when the COM-KG is used on Windows 10.

12.3 Setting

12.3.1 Description of each parameter

To establish communication between host computer (master) and controller (slave), it is necessary to set the following parameters. The communication related parameters can be found in the Communication setting mode.

■ Communication setting mode

Symbol	Name	Data range	Description	Factory set value
CMPS	Communication protocol	0: RKC communication 1: Modbus	Select the communication protocol type.	Communication Protocol specified at the time of ordering.
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 4: 38400 bps	Set the same communication speed for both the controller (slave) and the host computer (master).	2
bIT	Data bit configuration	RKC communication: 0 to 11 Modbus: 0, 1, 6, 7, 8, 9 Refer to **Data bit configuration table**.	Set the same data bit configuration for both the controller (slave) and the host computer (master). In Modbus (host communication), setting 2, 3, 4, 5, 10, or 11 will not establish communication.	0
InT	Interval time	0 to 150 (× 1.666 ms) Actual interval time is set value (0 to 150) multiplied by 1.666 (unit: 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.	5

*** Data bit configuration table**

Setting	Data bit configuration		
	Data bit	Parity bit	Stop bit
0	8	None	1
1	8	None	2
2	7	Even	1
3	7	Even	2
4	7	Odd	1
5	7	Odd	2

Setting	Data bit configuration		
	Data bit	Parity bit	Stop bit
6	8	Even	1
7	8	Odd	1
8	8	Even	2
9	8	Odd	2
10	7	None	1
11	7	None	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.

The communication protocol, device address (slave address), communication speed, data bit configuration, and interval time can also be set by loader communication using PROTEM2. It can also be set by host communication.

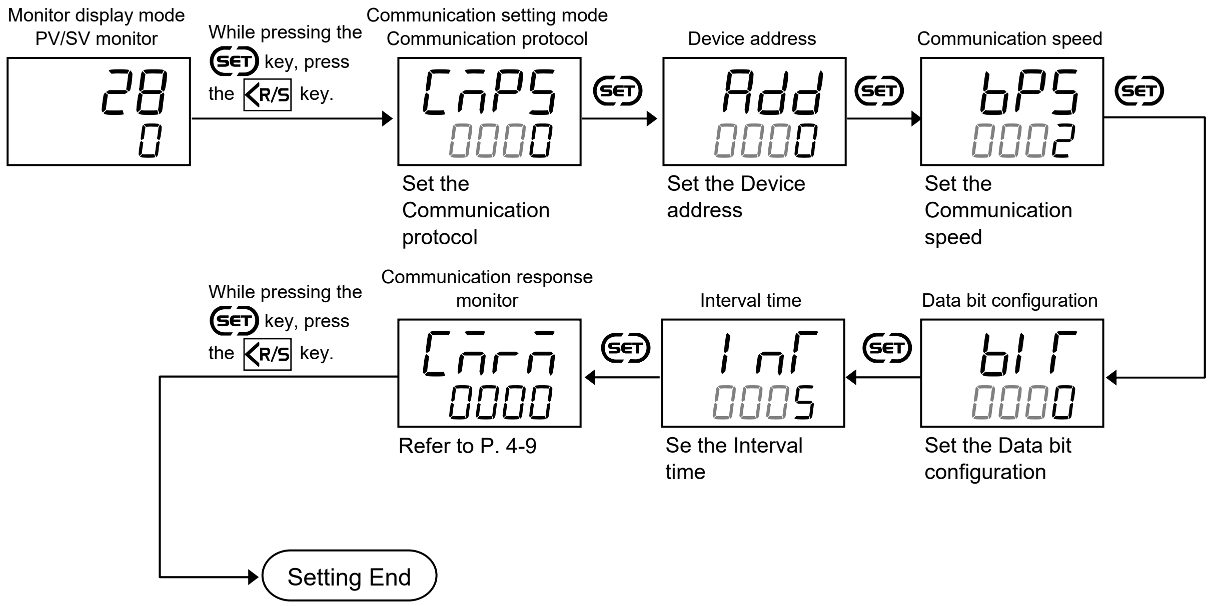
12.3.2 Setting procedure

The communication related parameters can be found in the Communication setting mode.

Set value change and registration

- The highlighted digit indicates which digit can be set. The highlighted digit can be shifted by pressing the R/S key.
- However, the changed data is not stored by the operation of the UP and DOWN keys alone. In order to store the new parameter value, 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.
- In any mode other than the Initial setting mode, if no registration is made within 1 minute after the change, the display returns to the PV/SV monitor. In such a case the changed data is not stored.

■ Setting sequence



Return to the PV/SV monitor screen displays.

12.3.3 Communication requirements

■ 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	6.0 ms max.
Response send time after controller receives ACK	2.6 ms max.
Response send time after controller receives NAK	2.6 ms max.
Response send time after controller sends BCC	63 μs max.

RKC communication (Selecting procedure) processing times

Procedure details	Time
Response send time after controller receives BCC	4.4 ms max.
Response wait time after controller sends ACK	7.4 ms max.
Response wait time after controller sends NAK	43 μs max.

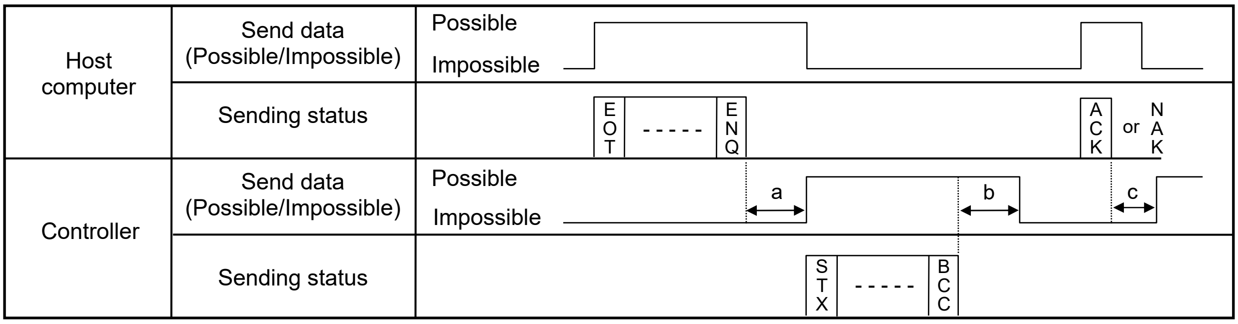
Modbus processing times

Procedure details	Time
Read holding registers [03H] Response send time after the slave receives the query message	38 ms max.
Preset single register [06H] Response send time after the slave receives the query message	17.4 ms max.
Diagnostics (loopback test) [08H] Response send time after the slave receives the query message	16.8 ms max.
Preset multiple registers (Write multiple registers) [10H] Response send time after the slave receives the query message	108 ms max.

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

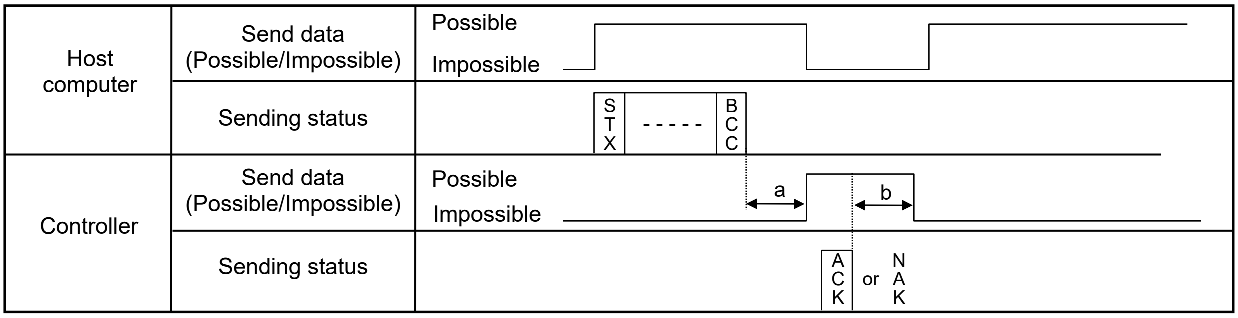
RS-485 communication is conducted through two wires, therefore, the transmission and reception of data requires precise timing.

● 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: 001BH).

12.4 RKC Communication Protocol

The RKC communication uses the Polling/Selecting method to establish a data link. The basic procedure follows 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 used 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 parentheses indicate the corresponding hexadecimal number.

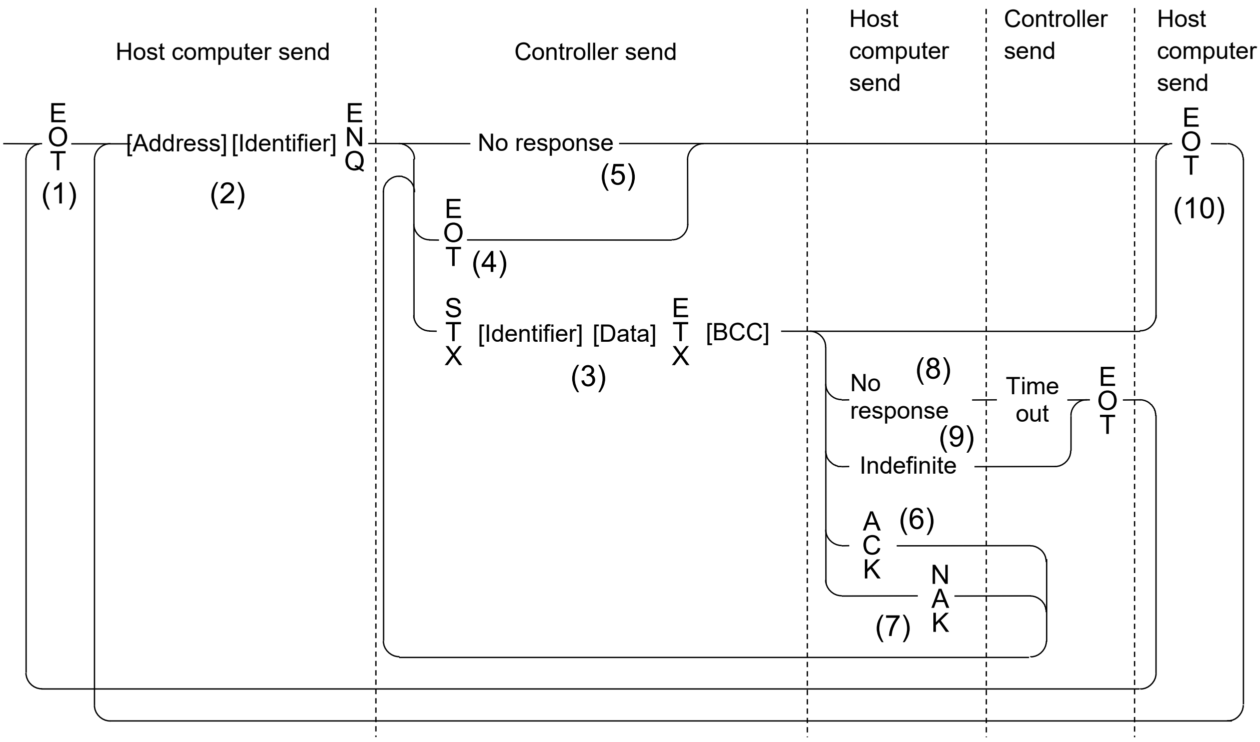
Data send/receive state (communication data monitoring and setting) of RKC communication can be checked by using the following software:

Communication Tool "PROTEM2"

The software can be downloaded from the official RKC website.

12.4.1 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:



■ 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 type of format:

1.		*2.*		*4.*
				ENQ
Address		Identifier		

Example:

0	1	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 **12.3 Setting (P. 12-8)**.

📖 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 the identifier, refer to **12.6 Communication Data List (P. 12-33)**.

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 the identifier, refer to **12.6 Communication Data List (P. 12-33)**.

3. Data (6 digits)
Data which is indicated by an identifier of the controller. It is expressed in decimal ASCII code including a minus sign (−) and a decimal point. Data is not zero-suppressed.

The number of the digit of the following item is other than 6 digits.
・Instrument serial number monitor (identifier RX): 10 digits
・Model code monitor (identifier ID): 32 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 sends EOT to terminate the data link:

- When the specified identifier is invalid
- When there is an error in the data type
- When data is not sent from the host computer even if the data link is initialized
- 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 **12.6.2 Communication data [RKC communication/Modbus] (P. 12-34)**.

When the 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.

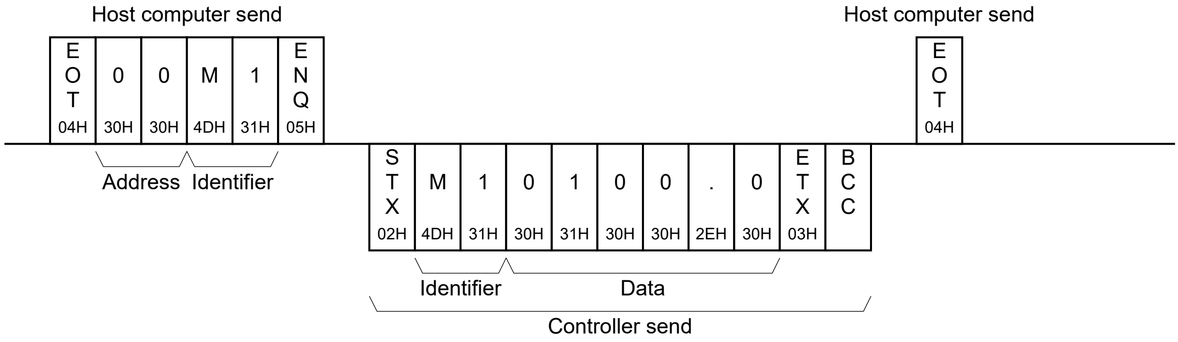
(10) EOT (Data link termination)

The host computer sends EOT message when it is necessary to suspend communication with the controller or to terminate the data link due to lack of response from the controller.

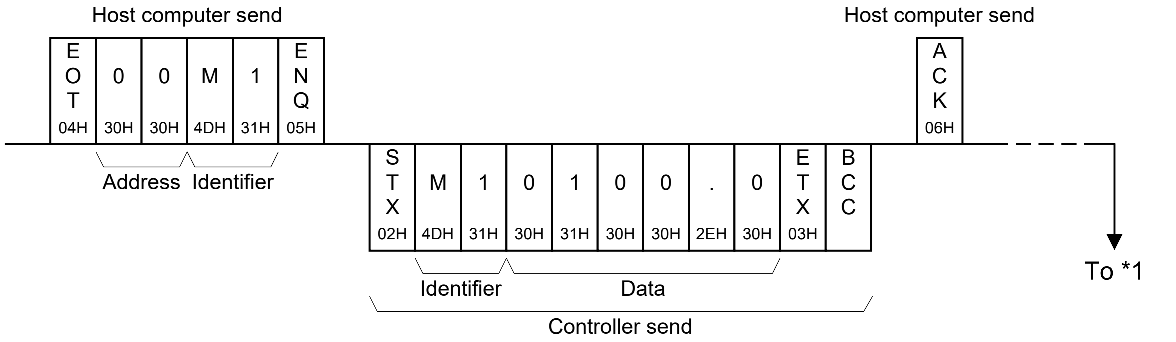
■ Polling procedure example (When the host computer requests data)

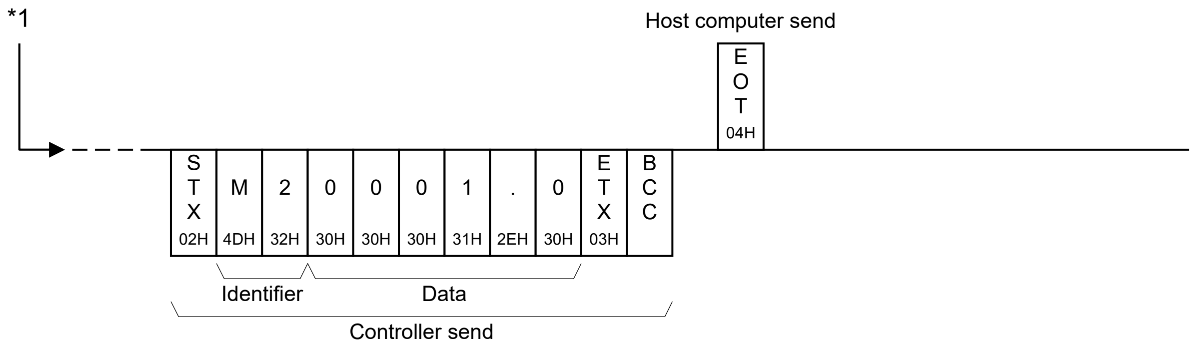
● Normal transmission

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

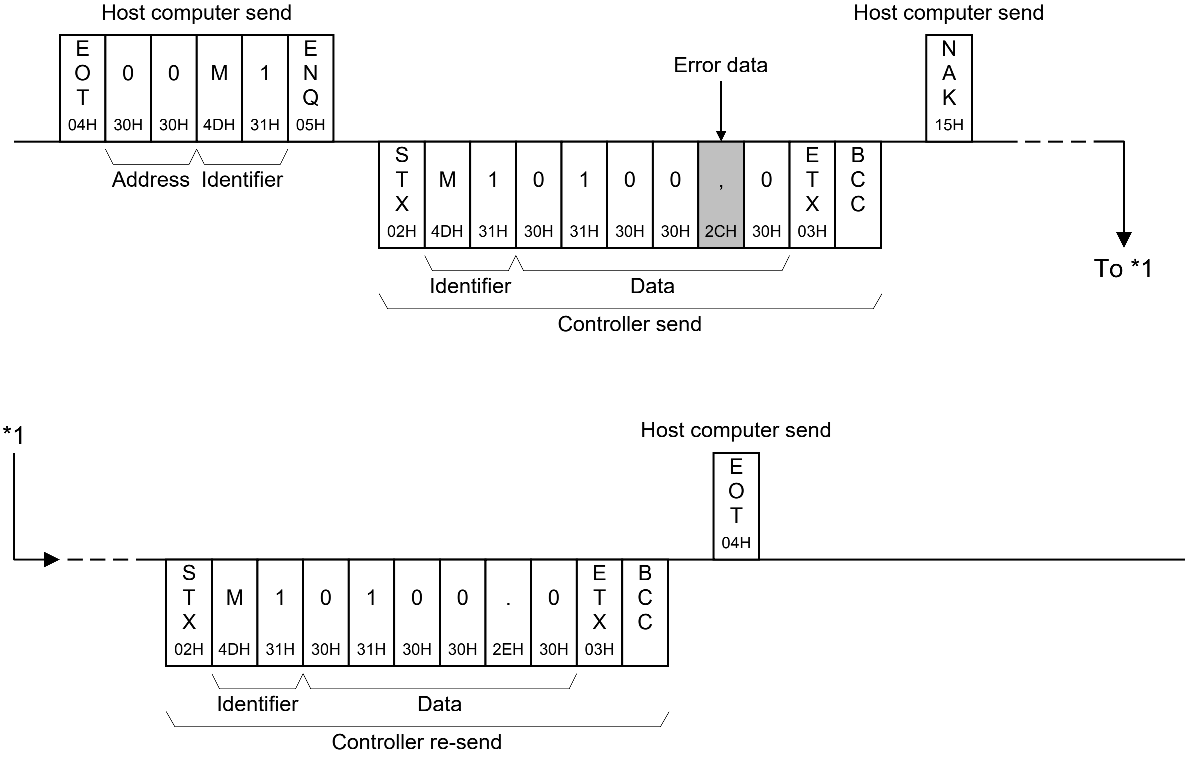


(2) Polling the next identifier with ACK (acknowledgment) after polling ends



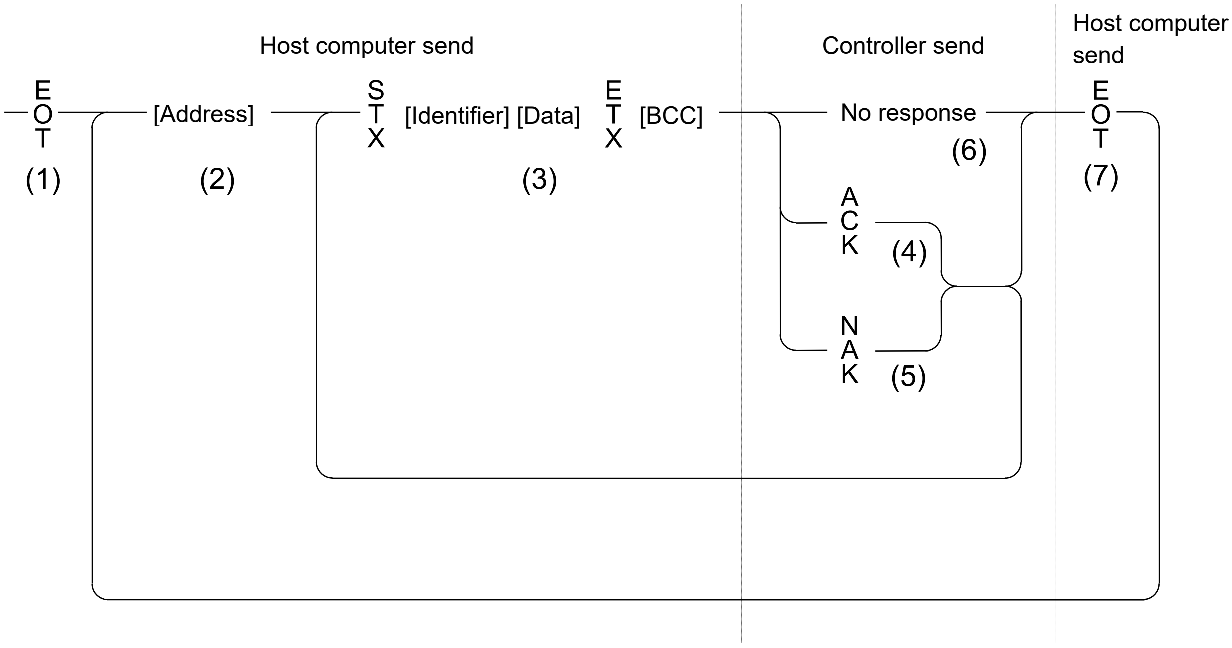


● Error transmission



12.4.2 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 **12.3 Setting (P. 12-8)**.

As long as the data link is not initialized by sending or receiving EOT, the selecting address once sent becomes valid.

(3) Data sent from the host computer

The host computer sends data for the selecting sequence with the following format:

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

☞ For the STX, ETX and BCC, refer to **12.4.1 Polling (P. 12-12)**.

1. Identifier (2 digits)
The identifier specifies the type of data that is requested from the controller, such as set value.

☞ For details, refer to **12.6 Communication Data List (P. 12-33)**.

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 data can be zero-suppressed.
The number of digits varies depending on the type of identifier. (Within 6 digits)

● About numerical data

Receivable data

- The controller can receive zero-suppressed data and whole number data (data without decimal fraction)..

Example: For example, even if the data –1.5 is sent by the host as –001.5, –01.5, –1.5, –1.50, –1.500, the controller receives the data as –1.5.

- When the host computer sends data containing a decimal point to the item without a decimal point, the controller receives a message with the value that is cut off below the decimal point.

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 a value truncated to a specified number of decimal places. The digits smaller than that will be cut off.

Example: When setting range is –10.00 to +10.00, the controller will receive as follows:

Send data	–.5	–.058	.05	–0
Receive data	–0.50	–0.05	0.05	0.00

Unreceivable data

The controller sends NAK when received a following data.

+	Plus sign and data with a plus sign
–	Only minus sign (without a number)
.	Only decimal point (period)
–.	Only minus sign and a decimal point

(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 error, framing error, etc.)
- When a BCC check error occurs
- When the specified identifier is invalid
- When receive data exceeds the setting range
- When receive data is the identifier of RO (read only)

(6) No response from controller

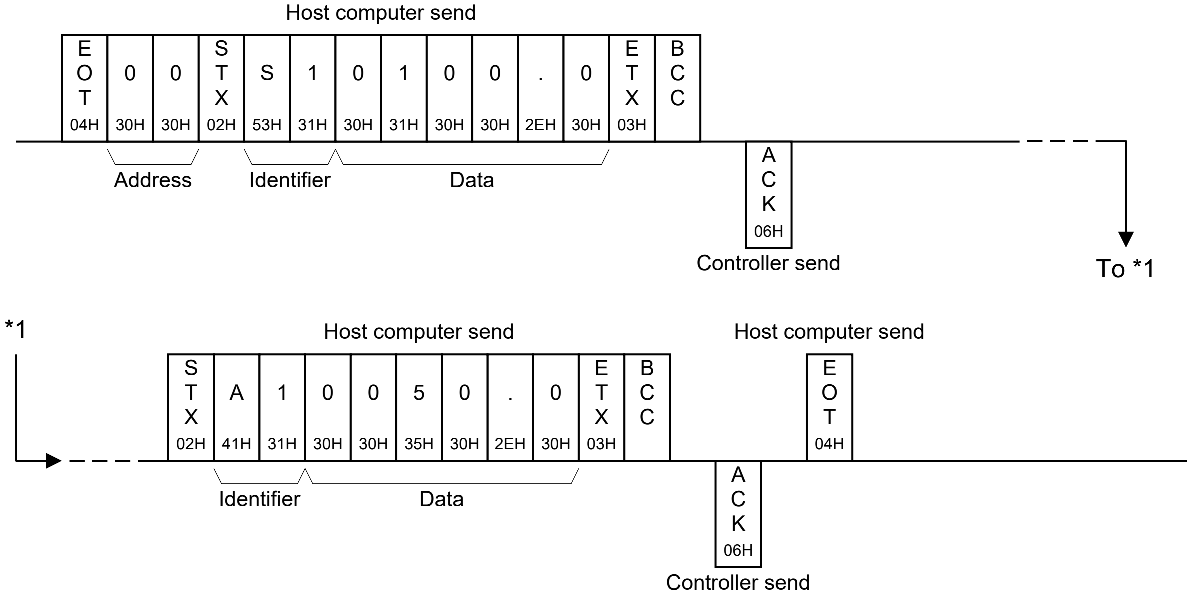
The controller does not respond when it cannot receive the selecting address, STX, ETX or BCC.

(7) EOT (Data link termination)

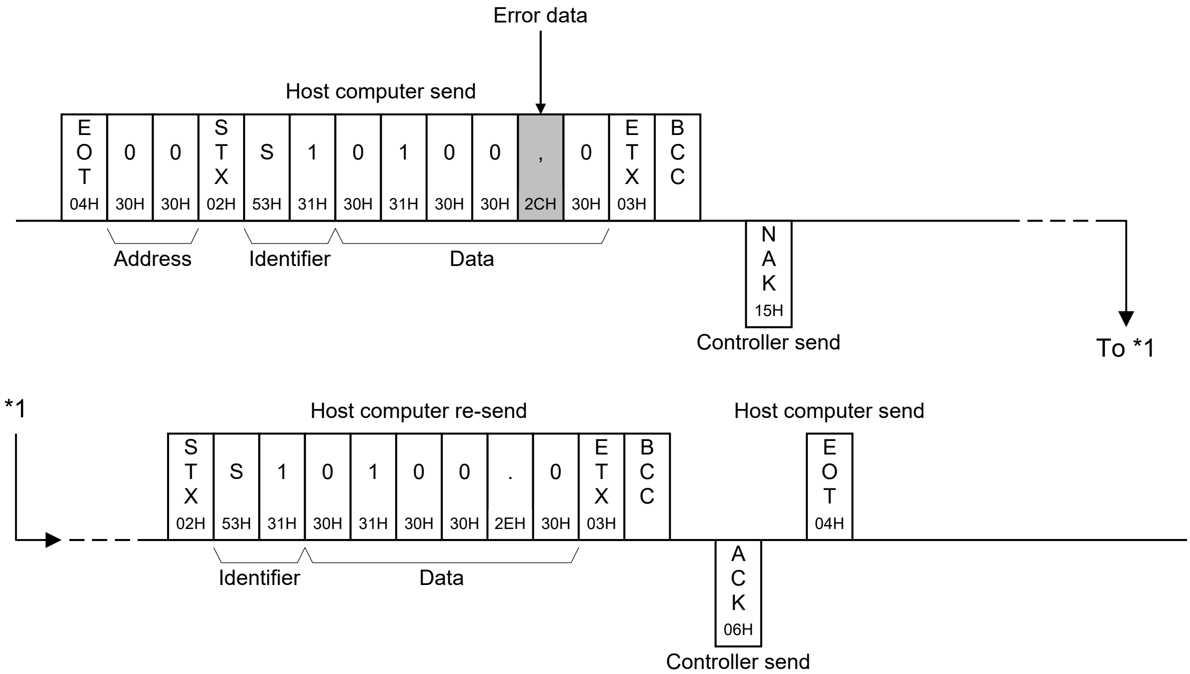
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the controller.

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

● Normal transmission



● Error transmission



12.5 Modbus 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.

Data send/receive state (communication data setting) of Modbus can be checked by using the following software:

Communication Tool "PROTEM2"

The software can be downloaded from the official RKC website.

12.5.1 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.

Master does not communicate with the slave when the address is set to "0."

For details, refer to **12.3 Setting (P. 12-8)**.

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 **12.5.2 Function code (P. 12-23)**.

■ 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 **12.5.6 Register read and write (P. 12-28)** and **12.6 Communication Data List (P. 12-33)**.

■ 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 **12.5.5 Calculating CRC-16 (P. 12-25)**.

12.5.2 Function code

Function code contents

Function code (Hexadecimal)	Function	Contents
03H	Read holding registers	Measured (PV) value monitor, Alarm state monitor, etc.
06H	Preset single register	Set value (SV), Alarm set value, PID constants, PV bias, etc. (Write single data)
08H	Diagnostics (loopback test)	loopback test
10H	Preset multiple registers (Write multiple registers)	Set value (SV), Alarm set value, PID constants, PV bias, etc. (Write multiple consecutive data)

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	5	255
06H	Preset single register	8	8	5	8
08H	Diagnostics (loopback test)	8	8	5	8
10H	Preset multiple registers (Write multiple registers)	11	255	5	8

12.5.3 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 **12.5.2 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.

12.5.4 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.
- In the response message of the Preset Multiple Registers (Write Multiple Registers), the slave returns the slave address, the function code, starting number, and number of holding registers in the multi-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. • Address other than 0000H to 00AFH is specified as the starting number.
3	• The maximum number (Read from a read holding resister or write to Preset multiple resisters [Write multiple registers]) has been exceeded. • The setting of the number of data (the number of requested byte) is not set to a double of the requested number of data at the time of "Preset multiple registers (Write multiple registers)"
4	Self-diagnostic error response

(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 etc., is found in the query message.
- Data time interval in the query message from the master exceeds 24-bit time.

12.5.5 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***.

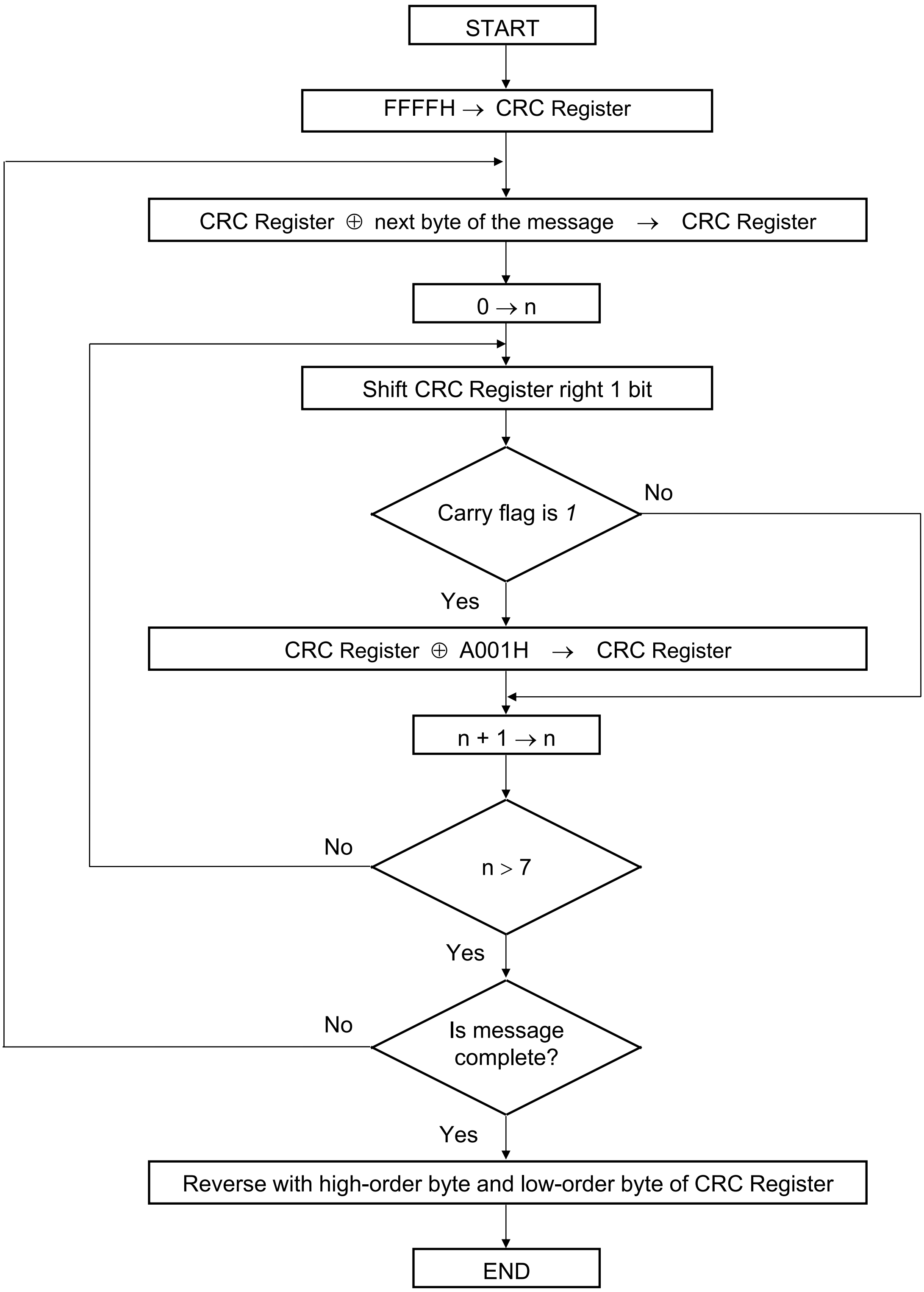
5. Repeat step ***3*** and ***4*** until there have been 8 shifts.

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’ exist. These 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;
}
```

12.5.6 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 to 0003H are the read out from slave address 2.

Query message

Slave address		02H	
Function code		03H	
Starting number	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	62H	
Next holding register contents	High	00H	
	Low	14H	
Next holding register contents	High	00H	
	Low	00H	
Next holding register contents	High	00H	
	Low	00H	
CRC-16	High	E9H	
	Low	56H	

Error response message

Slave address		02H
80H + Function code (+ denotes a logical add)		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 of slave address 1.

Query message

Slave address		01H
Function code		06H
Holding register number	High	00H
	Low	06H
Write data	High	00H
	Low	C8H
CRC-16	High	68H
	Low	5DH

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	C8H
CRC-16	High	68H
	Low	5DH

Contents will be the same as query message data.

Error response message

Slave address		01H
80H + Function code (+ denotes a logical add)		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	Test code must be set to "00."
	Low	00H	
Data	High	1FH	Any pertinent data
	Low	34H	
CRC-16	High	E9H	
	Low	ECH	

Normal response message

Slave address		01H	Contents will be the same as query message data.
Function code		08H	
Test code	High	00H	
	Low	00H	
Data	High	1FH	
	Low	34H	
CRC-16	High	E9H	
	Low	ECH	

Error response message

Slave address		01H
80H + Function code (+ denotes a logical add)		88H
Error code		03H
CRC-16	High	06H
	Low	01H

■ Preset multiple registers (Write multiple registers) [10H]

The query message specifies the starting register address and quantity of registers to be written. 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 two holding registers from 0066H to 0067H of slave address 1.

Query message

Slave address		01H	
Function code		10H	
Starting number	High	00H	First holding register address
	Low	66H	
Quantity	High	00H	The setting must be between 1 (0001H) and 123 (007BH).
	Low	02H	
Number of data		04H	→ Number of holding registers × 2
Data to first register	High	01H	Any pertinent data
	Low	90H	
Data to next register	High	00H	
	Low	00H	
CRC-16	High	74H	
	Low	7CH	

Normal response message

Slave address		01H
Function code		10H
Starting number	High	00H
	Low	66H
Quantity	High	00H
	Low	02H
CRC-16	High	A1H
	Low	D7H

Error response message

Slave address		01H
80H + Function code (+ denotes a logical add)		90H
Error code		02H
CRC-16	High	CDH
	Low	C1H

12.5.7 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 1: When Manipulated output value monitor [heat-side] is 5.0 %, 5.0 is processed as 50,
50 = 0032H.

Manipulated output value monitor [heat-side]	High	00H
	Low	32H

Example 2: When Set value (SV) is –20.0 °C, –20.0 is processed as –200,
–200 = 0000H – 00C8H = FF38H.

Set value (SV)	High	FFH
	Low	38H

- If data (holding register) exceeding the accessible address range is accessed, an error response message is returned.
- Read data of unused item is “0.”
- Any attempt to write to an unused item is not processed as an error. Data cannot be written into an unused item.
- If data range or address error occurs during data writing (Write Action), it is not processed as an error. Normal data is written in data register but data with error is not written; therefore, it is recommended to confirm data of changed items after the data setting.
- Communication items not existing in the product because of the specifications are handled as “0” when the data is read in. 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.

12.6 Communication Data List

12.6.1 Reference to communication data list

(1) (2) (3) (4) (5) (6) (7)

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
1	Measured value (PV) monitor	M1	6	0000	0	RO	Measured range low – (5 % of Measured range) to Measured range high + (5 % of Measured range) For a range with a decimal point, the maximum display range is −199.9 to +999.9. Varies with the setting of the Decimal point position. Refer to **Measured range table (P. 14-2)**	—
2	Current transformer 1 (CT1) input value monitor	M2	6	0001	1	RO	0.0 to 100.0 A	—
3	Current transformer 2 (CT2) input value monitor	M3	6	0002	2	RO	0.0 to 100.0 A	—

(1) Name: Communication data name

(2) Identifier: Identifier for RKC communication

(3) Digits: Number of digits for RKC communication

(4) Register address: Register address for Modbus communication
HEX: Hexadecimal
DEC: Decimal

(5) Attribute: A method of how communication data items are read or written when viewed from the host computer is described.

RO: Read only data

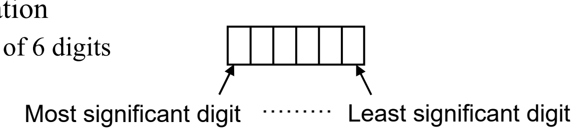
Data direction
Host computer ← Controller

R/W: Read and Write data

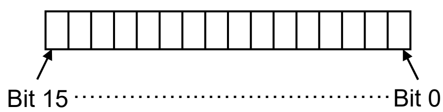
Data direction
Host computer ↔ Controller

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

- RKC communication
  ASCII code data of 6 digits



- Modbus
  16-bit data



(7) Factory set value: Factory set value of communication data

12.6.2 Communication data [RKC communication/Modbus]

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
1	Measured value (PV) monitor	**M1**	6	0000	0	RO	Measured range low – (5 % of Measured range) to Measured range high + (5 % of Measured range) For a range with a decimal point, the maximum display range is −199.9 to +999.9. Varies with the setting of the Decimal point position. Refer to **Measured range table (P. 14-2)**	—
2	Current transformer 1 (CT1) input value monitor	**M2**	6	0001	1	RO	0.0 to 100.0 A	—
3	Current transformer 2 (CT2) input value monitor	**M3**	6	0002	2	RO	0.0 to 100.0 A	—
4	Alarm 1 state monitor	**AA**	6	0003	3	RO	0: Alarm 1 OFF 1: Alarm 1 ON	—
5	Alarm 2 state monitor	**AB**	6	0004	4	RO	0: Alarm 2 OFF 1: Alarm 2 ON	—
6	Burnout state monitor	**B1**	6	0005	5	RO	0: OFF 1: ON (Burnout state)	—
7	Error code	**ER**	6	0036	54	RO	RKC communication 1: Adjustment data error 2: Data back-up error 4: A/D conversion error (Incuding temperature compensation error)	—
							Modbus (Bit data) Bit 0: Adjustment data error Bit 1: Data back-up error Bit 2: A/D conversion error (Incuding temperature compensation error) Bit 3 to 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 7]	—
8	RUN/STOP transfer	**SR**	6	0019	25	R/W	0: RUN 1: STOP	0
9	Set value (SV)	**S1**	6	0006	6	R/W	Setting limiter low to Setting limiter high Varies with the setting of the Decimal point position.	0 or 0.0
10	Alarm 1 set value (ALM1) (Alarm 1 set value (ALM1) [high])	**A1**	6	0007	7	R/W	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	10 or 10.0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
11	Alarm 2 set value (ALM2) (Alarm 2 set value (ALM2) [high])	**A2**	6	0008	8	R/W	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	10 or 10.0
12	Heater break alarm 1 (HBA1) set value	**A3**	6	0009	9	R/W	0.0 to 100.0 A (0.0: HBA function OFF)	0.0
13	Heater break alarm 2 (HBA2) set value	**A4**	6	000A	10	R/W	0.0 to 100.0 A (0.0: HBA function OFF)	0.0
14	Control loop break alarm (LBA) time	**A5**	6	000B	11	R/W	0.1 to 200.0 minutes	8.0
15	LBA deadband (LBD)	**A6**	6	000C	12	R/W	0 to 9999 (Unit: °C [°F])	0
16	Autotuning (AT)	**G1**	6	000D	13	R/W	0: PID control 1: Start Autotuning (AT) When the Autotuning (AT) is finished, the control will automatically return to “0: PID control.”	0
17	Unused	**G2**	6	000E	14	R/W	Must be always “0”	—
18	Proportional band [heat-side]	**P1**	6	000F	15	R/W	0 (0.0) to Input span (Unit: °C [°F]) For a scale range with a decimal point, when the input span exceeds the display limit, the maximum value is 999.9. Varies with the setting of the Decimal point position. 0 (0.0): ON/OFF action	30 or 30.0
19	Integral time	**I1**	6	0010	16	R/W	0 to 3600 seconds (0: PD action)	240
20	Derivative time	**D1**	6	0011	17	R/W	0 to 3600 seconds (0: PI action)	60
21	Anti-reset windup (ARW)	**W1**	6	0012	18	R/W	0 to 100 % of Proportional band [heat-side] (0: Integral action is always OFF)	100
22	Proportional cycle time [heat-side]	**T0**	6	0013	19	R/W	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2
23	Proportional band [cool-side]	**P2**	6	0014	20	R/W	1 to 1000 % of Proportional band [heat-side] (ON/OFF action of cool-side only is not possible.)	100
24	Overlap/Deadband	**V1**	6	0015	21	R/W	−10 to +10 or −10.0 to +10.0 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	0 or 0.0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
25	Proportional cycle time [cool-side]	**T1**	6	0016	22	R/W	1 to 100 seconds	For "Cooling linear type" configured to have "Voltage pulse output": 2 Otherwise: 20
26	PV bias	**PB**	6	0017	23	R/W	−1999 or +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	0 or 0.0
27	Set data lock	**LK**	6	0018	24	R/W	RKC communication 0 to 15 (Decimal number) The following binary number is converted into a decimal number. Bit 0: Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV) and Alarm set values (ALM1, ALM2) Bit 1: Alarm set value (ALM1, ALM2) Bit 2: Set value (SV) 0: Unlock 1: Lock Bit 3: Initial setting mode 0: Hide Initial setting mode 1: Show Initial setting mode (Show all parameters)	0
							Modbus (Bit data) Bit 0: Parameters in the Parameter setting mode and the Communication setting mode excluding the Set value (SV) and Alarm set values (ALM1, ALM2) Bit 1: Alarm set value (ALM1, ALM2) Bit 2: Set value (SV) 0: Unlock 1: Lock Bit 3: Initial setting mode 0: Hide Initial setting mode 1: Show Initial setting mode (Show all parameters) Bit 4 to 15: Unused [Decimal number: 0 to 15]	0000
28	EEPROM mode	**EB**	6	001B	27	R/W	0: Backup mode Set values are stored to the EEPROM when set values are changed. 1: Buffer mode No set values are stored to the EEPROM when set values are changed. PID values and LBA time obtained by AT or ST will be stored.	0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
29	EEPROM state	**EM**	6	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	Interlock release	**IR**	6	003A	58	R/W	To release the interlock, write "0 (zero)." Value read during interlock state: 1	0
31	Alarm 1 timer	**TD**	6	0075	117	R/W	0 to 600 seconds Data can be written only in STOP mode.	0
32	Alarm 2 timer	**TG**	6	007C	124	R/W		0
33	Manipulated output value [heat-side]	**O1**	6	001D	29	RO	PID control: Output limiter low to Output limiter high Heat/Cool PID control: –5.0 to Heat-side output limiter (high)	—
34	Manipulated output value [cool-side]	**O2**	6	001E	30	RO	–5.0 to Cool-side output limiter (high)	—
35	Manipulated output ON/OFF state monitor [heat-side]	**Q1**	6	002D	45	RO	0: Output OFF 1: Output ON	—
36	Manipulated output ON/OFF state monitor [cool-side]	**Q2**	6	002E	46	RO		—
37	Instrument serial number monitor	**RX**	10	—	—	RO	Instrument serial number	—
38	Model code monitor	**ID**	32	—	—	RO	Model code (character)	—
39	ROM version monitor	**Vr**	6	—	—	RO	ROM version number	—
40	Peak hold monitor of ambient temperature	**HP**	6	—	—	RO	–120 to +120 °C	—
41	Integrated operating time (upper-digits)	**UT**	6	—	—	RO	0 to 9999 (×10000) hours	—
42	Integrated operating time (lower-digits)	**UU**	6	—	—	RO	0 to 9999 hours	—
43	Comprehensive alarm state	**AJ**	6	002F	47	RO	RKC communication Least significant digit: Alarm 1 2nd digit: Alarm 2 3rd digit: Heater break alarm 1 (HBA1) 4th digit: Heater break alarm 2 (HBA2) 5th digit to Most significant digit: Unused Data 0: OFF or No alarm 1: ON	—

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
43	Comprehensive alarm state	**AJ**	6	002F	47	RO	Modbus (Bit data) Bit 0: Alarm 1 Bit 1: Alarm 2 Bit 2: Heater break alarm 1 (HBA1) Bit 3: Heater break alarm 2 (HBA2) Bit 4 to 15: Unused Data 0: OFF or No alarm 1: ON [Decimal number: 0 to 15]	—
44	Output state monitor	**Q3**	6	0031	49	RO	RKC communication Least significant digit: Output 1 (OUT1) 2nd digit: Output 2 (OUT2) 3rd digit: Output 3 (OUT3) 4th digit to Most significant digit: Unused Data 0: OFF 1: ON	—
							Modbus (Bit data) Bit 0: Output 1 (OUT1) Bit 1: Output 2 (OUT2) Bit 2: Output 3 (OUT3) Bit 3 to 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 7]	—
45	Operation mode state monitor	**L0**	6	0037	55	RO	RKC communication Least significant digit: STOP 2nd digit: RUN 3rd digit to Most significant digit: Unused Data 0: OFF 1: ON	—
							Modbus (Bit data) Bit 0: STOP Bit 1: RUN Bit 2 to 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 3]	—

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
46	Alarm 1 set value (ALM1) [low]	**BT**	6	004C	76	R/W	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	−10 or −10.0
47	Alarm 2 set value (ALM2) [low]	**BU**	6	004D	77	R/W	−1999 to +9999 or −199.9 to +999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	−10 or −10.0
48	Startup tuning (ST)	**ST**	6	0053	83	R/W	0: ST unused 1: Execute once * 2: Execute always * When the Startup tuning (ST) is finished, the control will automatically return to "0: ST unused."	0
49	Fine tuning setting	**CB**	6	0055	85	R/W	−3 to +3 (0: Function OFF)	0
50	Minimum ON/OFF time of proportioning cycle [heat-side]	**VI**	6	0058	88	R/W	0 to 1000 ms	0
51	Output limiter high [Heat-side output limiter (high)]	**OH**	6	0059	89	R/W	PID control: Output limiter low to 105.0 % (Output limiter high > Output limiter low) Heat/Cool PID control: 0.0 to 105.0 %	105.0
52	Output limiter low [Cool-side output limiter (high)]	**OL**	6	005A	90	R/W	PID control: −5.0 % to Output limiter high (Output limiter high > Output limiter low) Heat/Cool PID control: 0.0 to 105.0 %	PID control: −5.0 Heat/Cool PID control: 105.0
53	Minimum ON/OFF time of proportioning cycle [cool-side]	**VJ**	6	005B	91	R/W	0 to 1000 ms	0
54	PV digital filter	**F1**	6	005D	93	R/W	0 to 100 seconds (0: Digital filter function OFF)	1

■ Data items for Initial setting mode

Data in the Initial setting mode becomes RO (Read only) during the RUN (control). To set the initial setting data, the controller must be set to STOP (control stop) using RUN/STOP transfer.

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
55	Input type	**XI**	6	0061	97	R/W	0: TC input K 1: TC input J 2: TC input L 3: TC input E 4: TC input N 5: TC input T 6: TC input U 7: TC input R 8: TC input S 9: TC input B 10: TC input W5Re/W26Re 11: TC input PLII 12: RTD input Pt100 13: RTD input JPt100	When input range code is specified at the time of ordering, the input type in the input range code is the factory setting. If input range code is not specified: 0
56	Decimal point position	**XU**	6	0062	98	R/W	0: No decimal place 1: One decimal place Setting below zero (first decimal place) is possible if the selected input type has a measured range with a decimal place.	When input range code is specified at the time of ordering, the decimal point position in the input range code is the factory setting. If input range code is not specified: 0
57	Input range high	**XV**	6	0064	100	R/W	(Input range low + 1 digit) to Measured range high Varies with the setting of the Decimal point position.	When input range code is specified at the time of ordering, the input range high in the input range code is the factory setting. If input range code is not specified: 400
58	Input range low	**XW**	6	0065	101	R/W	Measured range low to (Input range high − 1 digit) Varies with the setting of the Decimal point position.	When input range code is specified at the time of ordering, the input range low in the input range code is the factory setting. If input range code is not specified: 0
59	Setting limiter high	**SH**	6	0066	102	R/W	Setting limiter low to Input range high Varies with the setting of the Decimal point position.	Input range high
60	Setting limiter low	**SL**	6	0067	103	R/W	Input range low to Setting limiter high Varies with the setting of the Decimal point position.	Input range low
61	PV flashing display at input error	**DU**	6	0068	104	R/W	0: Flashing display 1: Non-flashing display	0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
62	Action selection at STOP mode	**SS**	6	006A	106	R/W	RKC communication Least significant digit: Alarm action 2nd digit: Heater break alarm (HBA) action 3rd digit to Most significant digit: Unused Data 0: Alarm is cleared at STOP 1: Alarm remains on at STOP	0
							Modbus (Bit data) Bit 0: Alarm action Bit 1: Heater break alarm (HBA) action Bit 2 to 15: Unused Data 0: Alarm is cleared at STOP 1: Alarm remains on at STOP [Decimal number: 0 to 3]	00
63	Alarm 1 type	**XA**	6	0070	112	R/W	0: None 1: Deviation high 2: Deviation high/low 3: Process high 5: Deviation low 6: Band 7: Process low 9: Deviation high with re-hold action 10: Deviation high/low with re-hold action 11: Process high with hold action 13: Deviation low with re-hold action 15: Process low with hold action 16: Deviation high/low (High/Low individual setting) 17: Band (High/Low individual setting) 18: Deviation high/low with re-hold action (High/Low individual setting) 19: Deviation high with hold action 20: Deviation high/low with hold action 21: Deviation low with hold action 22: Deviation high/low with hold action (High/Low individual setting) 23: SV high 24: SV low 25: Monitor during RUN Do not set 4, 8, 12, and 14.	When alarm code is specified at the time of ordering, the Alarm type in the alarm code is the factory setting. If Alarm type is not specified, factory setting depends on the specification (with or without outputs). If alarm output is assigned, Alarm type is “Deviation high.” If not assigned, Alarm type is “None.” For details, refer to **1.3 Model Code (P. 1-4)**.
64	Alarm 1 differential gap	**HA**	6	0072	114	R/W	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	2 or 2.0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
65	Alarm 1 action at input burnout	**OA**	6	0073	115	R/W	0: Alarm 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	3
66	Output 1 (OUT1) energize/de-energize when assigned to alarm	**Z1**	6	0074	116	R/W	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0
67	Alarm 1 interlock	**LF**	6	0076	118	R/W	0: Unused 1: Used	0
68	Alarm 2 type	**XB**	6	0077	119	R/W	0: None 1: Deviation high 2: Deviation high/low 3: Process high 5: Deviation low 6: Band 7: Process low 9: Deviation high with re-hold action 10: Deviation high/low with re-hold action 11: Process high with hold action 13: Deviation low with re-hold action 15: Process low with hold action 16: Deviation high/low (High/Low individual setting) 17: Band (High/Low individual setting) 18: Deviation high/low with re-hold action (High/Low individual setting) 19: Deviation high with hold action 20: Deviation high/low with hold action 21: Deviation low with hold action 22: Deviation high/low with hold action (High/Low individual setting) 23: SV high 24: SV low 25: Monitor during RUN 26: Control loop break alarm (LBA) Do not set 4, 8, 12, and 14.	When alarm code is specified at the time of ordering, the Alarm type in the alarm code is the factory setting. If Alarm type is not specified, factory setting depends on the specification (with or without outputs). If alarm output is assigned, Alarm type is "Deviation high." If not assigned, Alarm type is "None." For details, refer to **1.3 Model Code (P. 1-4)**.
69	Alarm 2 differential gap	**HB**	6	0079	121	R/W	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	2 or 2.0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
70	Alarm 2 action at input burnout	**OB**	6	007A	122	R/W	0: Alarm 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	3
71	Output 2 (OUT2) energize/de-energize when assigned to alarm	**NB**	6	007B	123	R/W	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0
72	Alarm 2 interlock	**LG**	6	007D	125	R/W	0: Unused 1: Used	0
73	CT1 ratio	**XR**	6	008C	140	R/W	1 to 1000 Set the following value depending on the CT type. CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000	When CTL-6-P-N is specified at the time or ordering: 800 When CTL-12-S56-10L-N is specified at the time or ordering: 1000
74	CT2 ratio	**XS**	6	009D	157	R/W	1 to 1000 Set the following value depending on the CT type. CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000	When CTL-6-P-N is specified at the time or ordering: 800 When CTL-12-S56-10L-N is specified at the time or ordering: 1000
75	HBA1 interlock	**LN**	6	009E	158	R/W	0: Unused 1: Used	0
76	HBA2 interlock	**LO**	6	009F	159	R/W		0
77	HBA determination time	**EH**	6	008D	141	R/W	0 to 255 seconds	3

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
78	Control action	**XE**	6	00A0	160	R/W	0: PID control 1: Heat/Cool PID control	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If control action is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.
79	Direct/Reverse action	**CA**	6	008E	142	R/W	0: PID control: Direct action 1: PID control: Reverse action	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If Control action is not specified: 1
80	Cool action	**XQ**	6	008F	143	R/W	0: Heat/Cool PID control: Air cooling (for Extruder) 1: Heat/Cool PID control: Water cooling (for Extruder) 2: Heat/Cool PID control: Cooling linear type	When control action is specified at the time of ordering, the ordered code for control action is the factory setting. If Control action is not specified: 0
81	ON/OFF action differential gap (upper)	**IV**	6	0090	144	R/W	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	1 or 1.0
82	ON/OFF action differential gap (lower)	**IW**	6	0091	145	R/W	0 to 9999 or 0.0 to 999.9 (Unit: °C [°F]) Varies with the setting of the Decimal point position.	1 or 1.0
83	Control output at burnout	**WH**	6	0092	146	R/W	0: Result of control computation 1: PID control: Output limiter low (output OFF) Heat/Cool PID control: −5.0 % (output OFF) * * Both heating and cooling outputs are forced OFF.	PID control: 0 Heat/Cool PID control: 1
84	ST start condition	**SU**	6	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

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
85	STOP display selection	**DX**	6	009A	154	R/W	0: STOP on PV display 1: STOP on SV display	1
86	Control output assignment	**E1**	6	00A1	161	R/W	0: No assignment * 1: PID control: Output 1 (OUT1) Heat/Cool PID control: Heat-side output: Output 1 (OUT1) Cool-side output: Output 2 (OUT2) 2: PID control: Output 2 (OUT2) Heat/Cool PID control: Heat-side output: Output 2 (OUT2) Cool-side output: Output 1 (OUT1) 3: Heat-side output: Output 1 (OUT1) Cool-side output: Output 3 (OUT3) 4: Heat-side output: Output 2 (OUT2) Cool-side output: Output 3 (OUT3) Data range for PID control: 0 to 2 * If "No assignment" is specified, Heater break alarm (HBA) will be disabled.	When Control output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Control output assignment is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.
87	Output assignment of Alarm 1	**E2**	6	00A2	162	R/W	0: No assignment 1: Output 1 (OUT1) * 2: Output 2 (OUT2) * 3: Output 3 (OUT3) * If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assignment of Alarm output is ignored.	When Alarm output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Alarm output assignment is not specified, factory setting depends on the specification (with or without outputs). For details, refer to **1.3 Model Code (P. 1-4)**.
88	Output assignment of Alarm 2	**E3**	6	00A3	163	R/W		
89	Output assignment of Heater break alarm 1	**E4**	6	00A4	164	R/W	0: No assignment 1: Output 1 (OUT1) * 2: Output 2 (OUT2) * 3: Output 3 (OUT3) * If Output 1 or 2 (OUT1 or 2) is voltage pulse output or current output, assignment of Heater break alarm (HBA) output is ignored.	When Heater break alarm output assignment is specified at the time of ordering, the ordered output assignment is the factory setting. If Heater break alarm output assignment is not specified: 0
90	Output assignment of Heater break alarm 2	**E5**	6	00A5	165	R/W		

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
91	STOP function at Initial setting mode	**DY**	6	00A6	166	R/W	0: STOP in the Initial setting mode 1: RUN/STOP continues in the Initial setting mode	0
92	Show/Hide SV display	**DZ**	6	00A7	167	R/W	0: Show SV 1: Hide SV	0
93	Display mode selection	**DW**	6	00A8	168	R/W	0: Standard display mode 1: Expanded display mode	0
94	Temperature unit	**PU**	6	00A9	169	R/W	0: °C 1: °F	When input range code is specified at the time of ordering, the temperature unit in the input range code is the factory setting. If input range code is not specified: 0
95	Output 3 (OUT3) energize/de-energize when assigned to alarm	**NC**	6	00AA	170	R/W	0: Energize 1: De-energize (Contact CLOSE or OPEN, at STOP) * 2: De-energize (Contact OPEN, at STOP) * If the controller is not in the alarm state at STOP, contact CLOSE. If the controller is in the alarm state at STOP, contact OPEN.	0
96	HBA1 state monitor	**AE**	6	0034	52	RO	0: OFF 1: ON	—
97	HBA2 state monitor	**AF**	6	0035	53	RO	0: OFF 1: ON	—
98	Device address	**JP**	6	00AB	171	R/W	RKC communication: 0 to 99 Modbus: 1 to 99	RKC communication: 0 Modbus: 1
99	Communication speed	**JR**	6	00AC	172	R/W	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps	2

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Name</th><th rowspan="2">Identifier</th><th rowspan="2">Digits</th><th colspan="2">Register address</th><th rowspan="2">Attribute</th><th rowspan="2">Data range</th><th rowspan="2">Factory set value</th></tr>
<tr><th>HEX</th><th>DEC</th></tr>
<tr><td>100</td><td>Data bit configuration</td><td>IQ</td><td>6</td><td>00AD</td><td>173</td><td>R/W</td><td>
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Data bit configuration</th></tr>
<tr><th>Data bit</th><th>Parity bit</th><th>Stop bit</th></tr>
<tr><td>0</td><td>8</td><td>None</td><td>1</td></tr>
<tr><td>1</td><td>8</td><td>None</td><td>2</td></tr>
<tr><td>2</td><td>7</td><td>Even</td><td>1</td></tr>
<tr><td>3</td><td>7</td><td>Even</td><td>2</td></tr>
<tr><td>4</td><td>7</td><td>Odd</td><td>1</td></tr>
<tr><td>5</td><td>7</td><td>Odd</td><td>2</td></tr>
<tr><td>6</td><td>8</td><td>Even</td><td>1</td></tr>
<tr><td>7</td><td>8</td><td>Odd</td><td>1</td></tr>
<tr><td>8</td><td>8</td><td>Even</td><td>2</td></tr>
<tr><td>9</td><td>8</td><td>Odd</td><td>2</td></tr>
<tr><td>10</td><td>7</td><td>None</td><td>1</td></tr>
<tr><td>11</td><td>7</td><td>None</td><td>2</td></tr>
</table>
Setting range of RKC communication: 0 to 11
Setting range of Modbus: 0, 1, 6, 7, 8, 9</td><td>0</td></tr>
<tr><td>101</td><td>Interval time</td><td>IT</td><td>6</td><td>00AE</td><td>174</td><td>R/W</td><td>0 to 150 (× 1.666 ms)
Actual interval time is set value (0 to 150) multiplied by 1.666 (unit: ms).</td><td>5</td></tr>
<tr><td>102</td><td>Communication protocol</td><td>IS</td><td>6</td><td>00AF</td><td>175</td><td>R/W</td><td>0: RKC communication
1: Modbus</td><td>Protocol specified at the time of ordering.</td></tr>
</table>

MEMO

TROUBLE SHOOTING

13

This chapter describes error displays and countermeasures for errors.

13.1 Error Displays

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

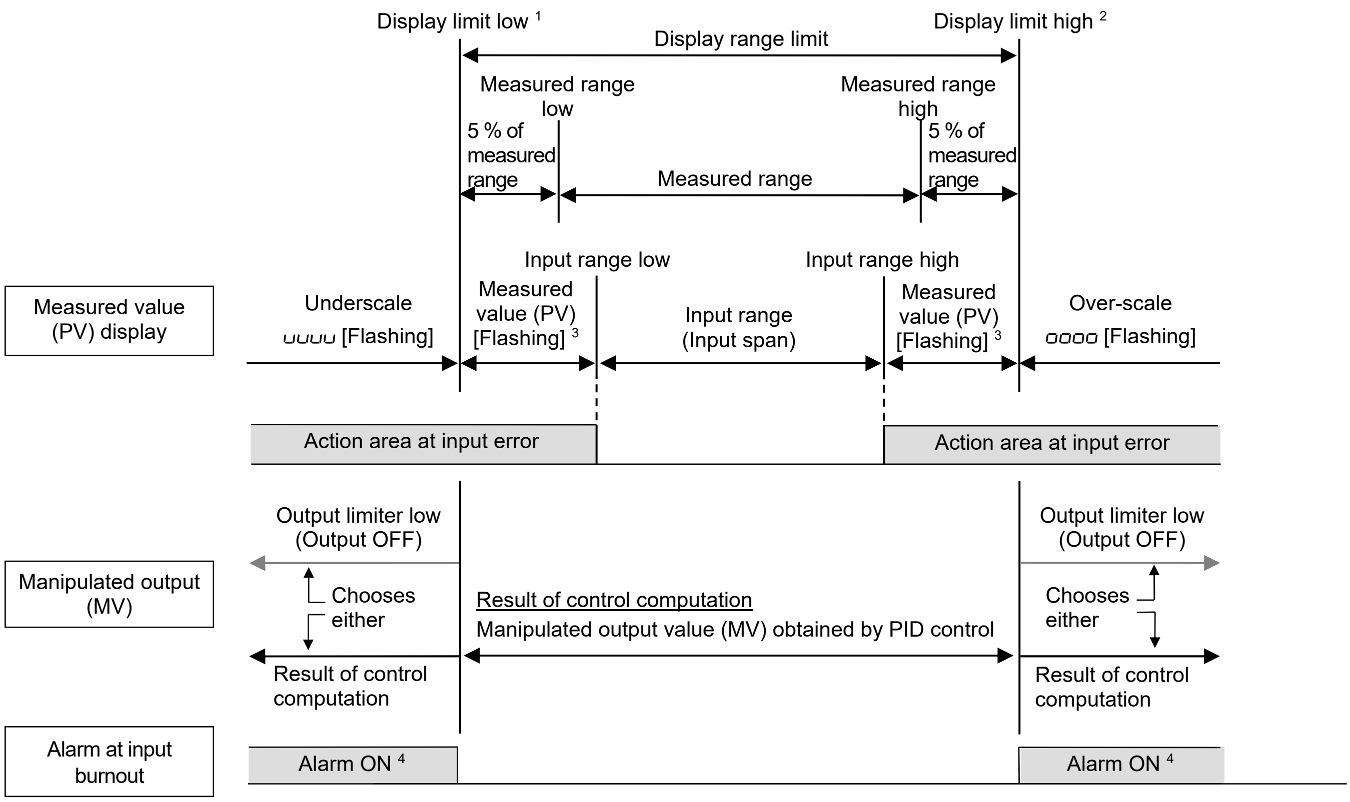
■ Input error displays

The table below shows displays, description, actions and solutions when the measured value (PV) exceeds the display range.

NOTE

Before replacing the sensor, always turn OFF the power of the RZ100/RZ400 or switch the mode 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 and Alarm output: Output is produced in the same way as under the normal state.	Check input type, input range, sensor connection and sensor break.
oooo [Flashing]	Over-scale Measured value (PV) is above the display range limit high.	• Control output: Output is produced according to the "Control output at burnout" (P. 4-17, P. 6-10) • Alarm output: Output is produced according to the "Alarm action at burnout" (P. 4-15, P. 6-10)	
uuuu [Flashing]	Underscale Measured value (PV) is below the display range limit low.		



[1] Minimum display limit is –1999 or –199.9

[2] Maximum display limit is 9999 or 999.9

[3] "Flashing display" or "Non-flashing display" of PV can be selected for the "PV flashing display at input error."

[4] Selection of "Alarm NOT forced to ON" at input burnout is possible at Selection of Alarm action at input burnout.

■ Self-diagnostic error

If an error is detected by the self-diagnostic function, the PV display shows "Err," and the SV display shows the error code. If two or more errors occur simultaneously, the total summation of these error codes are displayed.

Error code	Description	Action	Solution
1	Adjusted data error • Adjusted data range is abnormal.	Display: Error code display Output: All the outputs are OFF Communication: Possible [Example of error display] Err 4	Turn off the power once. If the RZ100/400 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 is repeated after the power is turned on again, the RZ100/400 may need to be repaired or replaced. Please contact RKC sales office or the agent.
2	Data back-up error • Back-up action is abnormal. • Data write failure		
4	A/D conversion error • Error in A/D conversion circuit is detected. Temperature compensation error • Temperature measuring range (+120 °C or more, −120 °C or less) is abnormal.		

If any of the following errors occur, all actions of the RZ100/400 are stopped.
In this case the error code is not displayed.

Error code	Description	Action	Solution
No error display	Watchdog timer error • Part of the internal program stops running.	Display: All displays are OFF Output: All outputs are OFF Communication: Stopped	Turn off the power once. If an error is repeated after the power is turned on again, the RZ100/400 may need to be repaired or replaced. Please contact RKC sales office or the agent.
	Power supply voltage is abnormal (power supply voltage monitoring) • Decrease of power supply voltage	Display: All displays are OFF Output: All outputs are OFF Communication: Stopped	

13.2 Solutions for Problems

This section explains possible causes and solutions of the errors. For any inquiries or to confirm the specifications of the product, please contact RKC sales office or the agent.

If the instrument needs to replaced, 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 related errors

Problem	Possible cause	Solution
No display appears	The internal assembly is not inserted into the case correctly.	Insert the internal assembly into the case correctly.
	Power supply terminal connection is not correct.	Connect power supply correctly by referring to **3.3 Wiring of Each Terminal (P. 3-7)**.
	Power supply terminal contact failure.	Retighten the terminal screws.
	Supply voltage is not correct.	Apply proper power supply voltage by referring to **■ General specifications (P. 14-13)**.
Display is unstable	Noise source is present near the instrument.	Separate the noise source from the instrument.
		Set the appropriate value at Digital filter according to the input response.
	The terminal block of the instrument (with thermocouple input) is directly exposed to the air flow from an air conditioner.	Do not directly expose the terminal block to the air from the air conditioner.
Measured value (PV) display differs from the actual value	Wrong sensor is used.	Check the instrument specification and use a proper sensor.
	Input type setting is wrong.	Make proper setting by referring to **6.1 Changing Input (P. 6-2)**.
	Connection between the sensor (thermocouple) and the instrument is made with a cable other than compensating wire.	Be sure to use a compensating wire.
	For RTD input, leadwire resistance in three wires between the sensor and the instrument is different from one another.	Use a leadwire with the same resistance among three leadwires.
	PV bias is set.	Set PV bias to "0" by referring to **6.2 Correcting Input (P. 6-7)**. Note: Attempt this only when the PV bias is allowed to turn off.

How to check the input

- When the input is configured as Thermocouple input:
  Short the input terminals (No.11 and 12), and if a temperature around the ambient temperature of the input terminals is displayed, the controller is working properly.
- When the input is configured as RTD input:
  Connect a 100 Ω resister between the input terminals No.10 and No.11, and short B-B (input terminals No.11 and 12). If the instrument shows a measured value around 0 °C (32 °F), the input function of the instrument is working correctly.

■ Control related errors

Problem	Possible cause	Solution
Control is abnormal	Supply voltage is not correct.	Apply proper power supply voltage by referring to ■ **General specifications (P. 14-13)**.
	Disconnection of sensor or sensor wire.	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 correct wiring of sensor by referring to **3.3 Wiring of Each Terminal (P. 3-7)**.
	Wrong sensor is used.	Check the instrument specification and use a proper sensor.
	Input type setting is wrong.	Make proper setting by referring to **6.1 Changing Input (P. 6-2)**.
	Sensor insertion depth is insufficient.	Check the sensor insertion. If insertion is loose, firmly insert the sensor.
	Sensor insertion position is wrong.	Insert the sensor at the specified location.
	Input signal wires are not separated from instrument power and/or load wires.	Separate input signal wires from instrument power and load wires
	Noise source is present near the instrument.	Separate the noise source from the instrument.
	Inappropriate PID constants.	Set appropriate PID constants.
Startup tuning (ST) cannot be activated	Startup tuning (ST) mode is "0 (ST unused)." (Factory set value: 0)	Refer to **11.4 Setting PID Values Automatically (Startup tuning) (P. 11-10)**.
	Requirements for performing the Startup tuning (ST) are not satisfied.	Satisfy the requirements for performing the Startup tuning (ST) by referring to **11.4 Setting PID Values Automatically (Startup tuning) (P. 11-10)**.
Autotuning (AT) cannot be activated	Requirements for performing the Autotuning (AT) are not satisfied.	Satisfy the requirements for performing the Autotuning (AT) by referring to **11.3 Setting PID Values Automatically (Autotuning) (P. 11-8)**.
Autotuning (AT) aborted	Requirements for aborting the Autotuning (AT) are established.	Identify causes for Autotuning (AT) abort by referring to **11.3 Setting PID Values Automatically (Autotuning) (P. 11-8)** and then remove them. Then, execute Autotuning (AT) again.

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Problem	Possible cause	Solution
Optimum PID values cannot be obtained by Autotuning (AT)	Autotuning (AT) does not match the characteristics of the controlled object.	Set PID constants manually by referring **11.5 Setting PID Values Manually (P. 11-14)**.
Autotuning (AT) cannot be finished normally	Temperature change of the process is too slow (1 °C or less per minute for temperature rise and fall).	Set PID constants manually by referring **11.5 Setting PID Values Manually (P. 11-14)**.
	Autotuning (AT) was executed around the ambient temperature or close to the maximum temperature achieved by the load.	
Measured value (PV) overshoots or undershoots	Proportional band is narrow. Proportional (P) constant is small.	Increase Proportional (P) value within the acceptable limit of response delay.
	Integral time is short. Integral (I) constant is small.	Increase Integral (I) value within the acceptable limit of response delay.
	Derivative time is short. Derivative (D) constant is small.	Increase Derivative (D) value within the acceptable limit of process stability.
	The instrument is configured for ON/OFF control.	Change the control mode to Proportional control or PID control.
Output does not rise over (or goes below) a certain value	Output limiter is set.	Change the Output limiter setting by referring to **7.2 Limiting Output (P. 7-6)**. However, this is limited only to when the Output limiter setting can be changed.

■ Operation related errors

Problem	Possible cause	Solution
No setting change can be made by key operation	Set data is locked.	Release the Set data lock by referring to **8.3 Restricting Key Operation (P. 8-7)**.
A set value (SV) above (or below) a certain limit cannot be set	Setting limiter is set.	Change the Setting limiter setting by referring to **8.1 Limiting the Setting Range of Set Value (SV) (P. 8-2)**. However, this is limited only to when the Setting limiter setting can be changed.

■ Alarm related errors

Problem	Possible cause	Solution
Alarm function is abnormal	Alarm function is different from the specification.	Change the Alarm action type by referring to **10.1.2 Changing alarm type (P. 10-8)** after the instrument specification is confirmed.
	Alarm output relay contact action Energized/De-energize is reversed.	Check the setting details by referring to **7.4 Changing Alarm Output (Energize/De-energize) (P. 7-12)**.
	Setting of Alarm differential gap is not appropriate.	Set an appropriate Alarm differential gap by referring to **10.1.3 Setting a differential gap in alarm action (P. 10-14)**.
Alarm output is not produced	Alarm function is not assigned.	Check the Output assignment by referring to **7.1 Changing Output Assignment (P. 7-2)**.

■ Control loop break alarm (LBA) related errors

Problem	Possible cause	Solution
Control loop break alarm (LBA) is not generated under the alarm condition.	LBA time setting is not appropriate.	Set an appropriate value by referring to **10.2 Using Control Loop Break Alarm (LBA) (P. 10-23)**.
	LBA deadband (LBD) setting is not appropriate.	
	Autotuning (AT) is in execution.	Wait for Autotuning (AT) to finish or abort Autotuning (AT).
	The instrument stays in control stop (STOP).	Switch the mode to RUN (control) by referring to **11.1 Running/Stopping control (RUN/STOP transfer) (P. 11-2)**. Attempt this only when the mode is allowed to be transferred to RUN (control start).
	LBA is not specified in Alarm type.	Set LBA by referring to **10.1.2 Changing alarm type (P. 10-8)**.
	LBA does not match the characteristics of the process (controlled object).	Try another type of alarm.
Control loop break alarm (LBA) is generated under the no alarm condition.	LBA time setting is not appropriate.	Refer to **10.2 Using Control Loop Break Alarm (LBA) (P. 10-23)**, and set a suitable value.
	LBA deadband (LBD) setting is not appropriate.	
	LBA does not match the characteristics of the process (controlled object).	Try another type of alarm.

■ Heater break alarm (HBA) related errors

Problem	Possible cause	Solution
No heater break can be detected	Setting of Heater break alarm (HBA) is not appropriate.	Set an appropriate Heater break alarm (HBA) set value by referring to **10.3.2 Setting the Heater break alarm (HBA) set value (P. 10-38)**.
	CT is not connected.	Connect CT by referring to **3.3 Wiring of Each Terminal (P. 3-7)**.
CT input value is abnormal	Wrong CT is used.	Check the instrument specification and use an appropriate CT.
	Heater is broken.	Check the disconnected heater.
	CT wiring is wrong.	Check CT wiring by referring to **3.3 Wiring of Each Terminal (P. 3-7)**.
	Input terminal contact failure.	Retighten the terminal screws.
Heater break alarm (HBA) is not produced.	Heater break alarm (HBA) output is not assigned.	Check Output assignment by referring to **7.1 Changing Output Assignment (P. 7-2)**.

■ Communication related errors

● RKC communication

<table>
<tr><th>Problem</th><th>Possible cause</th><th>Solution</th></tr>
<tr><td rowspan="7">No response</td><td>Wrong connection, no connection or disconnection of the communication cable</td><td>Check connection and connect cable properly.</td></tr>
<tr><td>Disconnection, contact failure, or wrong connection of communication cable</td><td>Check wiring and connector.
Repair or replace, if necessary.</td></tr>
<tr><td>Communication setting (communication speed, data bit configuration) is different from a host computer.</td><td rowspan="2">Check setting and make a proper setting.</td></tr>
<tr><td>Address setting is wrong.</td></tr>
<tr><td>Data format is wrong.</td><td rowspan="2">Review communication program.</td></tr>
<tr><td>Transmission line is not set to the receive state after data send.</td></tr>
<tr><td>Communication protocol setting is wrong.</td><td>Set Communication protocol to “0: RKC communication” by referring to 12.3 Setting (P. 12-8).</td></tr>
<tr><td rowspan="2">EOT return</td><td>Invalid communication identifiers.</td><td>Check if communication identifiers are correct and if there are any unsupported identifiers.</td></tr>
<tr><td>Data format is wrong.</td><td>Review communication program.</td></tr>
<tr><td rowspan="4">NAK return</td><td>Communication error occurred (parity error, framing error, etc.)</td><td rowspan="2">Identify the error and take necessary actions (e.g. check of transmitted data, retransmission)</td></tr>
<tr><td>BCC error occurred</td></tr>
<tr><td>Data is out of the setting range.</td><td>Check the setting range and correct the data.</td></tr>
<tr><td>Invalid communication identifiers.</td><td>Check if communication identifiers are correct and if there are any unsupported identifiers.</td></tr>
</table>

● Modbus

<table>
<tr><th>Problem</th><th>Possible cause</th><th>Solution</th></tr>
<tr><td rowspan="5">No response</td><td>Wrong connection, no connection or disconnection of the communication cable</td><td>Check connection and connect cable properly.</td></tr>
<tr><td>Disconnection, contact failure, or wrong connection of communication cable</td><td>Check wiring and connector.
Repair or replace, if necessary.</td></tr>
<tr><td>Communication setting (communication speed, data bit configuration) is different from a host computer.</td><td rowspan="2">Check setting and make a proper setting.</td></tr>
<tr><td>Address setting is wrong.</td></tr>
<tr><td>Transmission error detected. (Overrun error, framing error, parity error, or CRC-16 error)</td><td>Retransmit after time-out or
Review program on master side</td></tr>
</table>

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Problem	Possible cause	Solution
No response	Time interval between data that consist a message is more than 24-bit time.	Retransmit after time-out or Review program on master side
	Communication protocol setting is wrong.	Set Communication protocol to "1: Modbus" by referring to **12.3 Setting (P. 12-8)**.
Error code: 1	Function code error (unsupported function code specified)	Check function code.
Error code: 2	Unsupported address is specified.	Check holding register.
Error code: 3	Maximum number of reading data of holding register exceeded.	Check setting data.

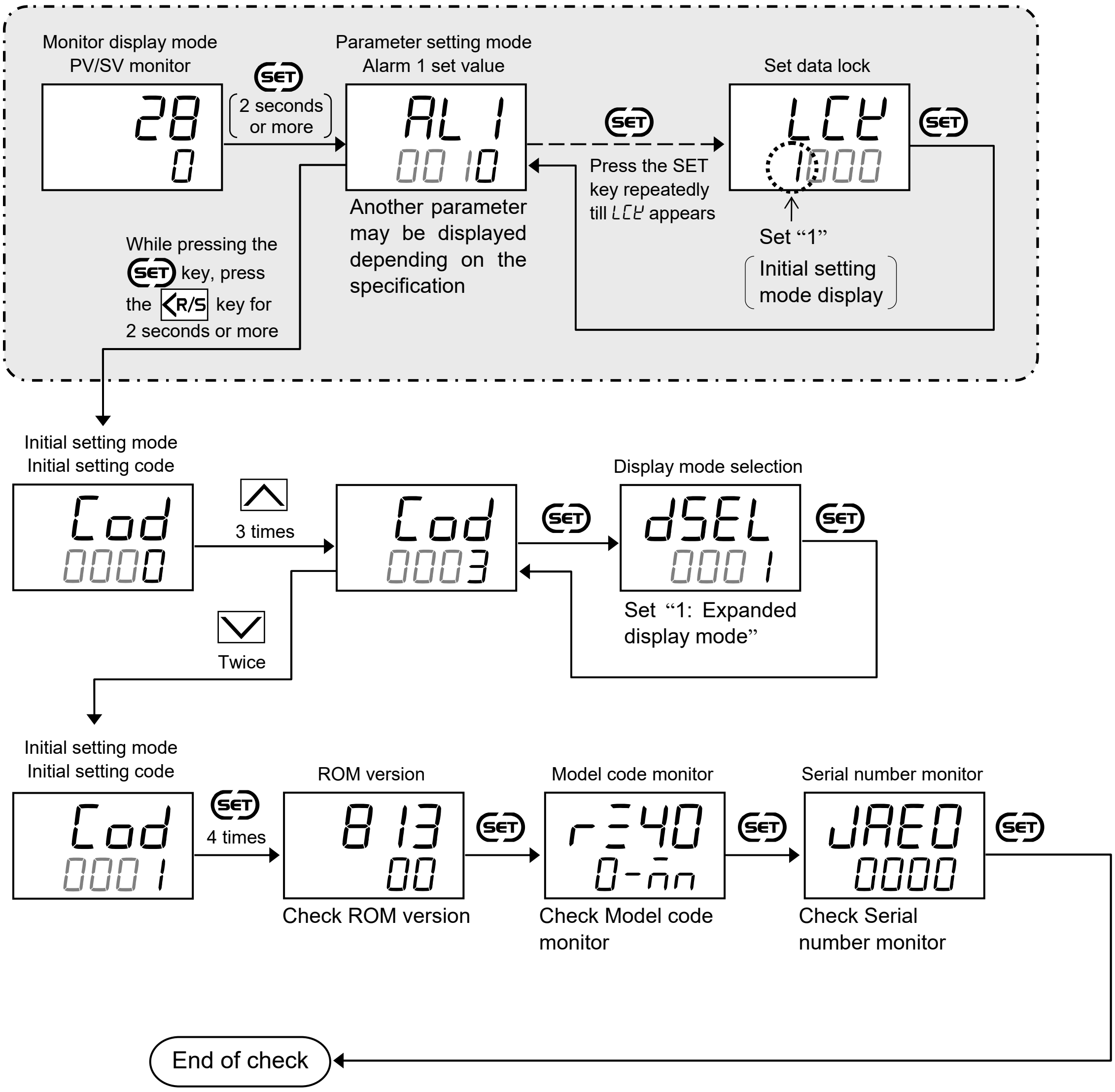
13.3 Verifying Instrument Information

When error occurs and when you contact us, you are requested to provide us with the information on the instrument model code and specification. You can check the ROM version, model code and serial number of the instrument on the instrument display.

■ How to display the information

ROM version, Model code monitor and Serial number monitor can be set at Cod 0001 in the Initial setting mode.

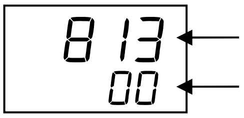
Procedure to enter the Initial setting mode



- Next parameter is displayed.
- Set the "Display mode selection" at Cod 0003 in the Initial setting mode to "0: Standard display mode."
- Press the R/S key for 2 seconds or more while pressing the SET key to return to the PV/SV monitor screen.
- Set the highest digit of Set data lock to "0: Lock."

■ How to check

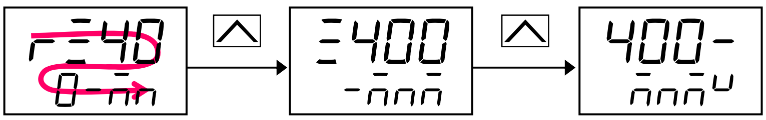
● ROM Version



● Model code monitor

Displays the model code of the instrument. As the Model code is too long to be displayed on a single screen, it can be scrolled left and right with ∧ and ∨ keys.

Example: Model code is RZ400-MNM∗N



● Serial number monitor

Displays the serial number of the instrument. As the Serial number is too long to be displayed on a single screen, it can be scrolled left and right with ∧ and ∨ keys.

To read the displayed characters, refer to "■ **Character Symbols**" **(P. i-3)**.

Alternatively, you can check the model code (MODEL), serial number (S/N) and suffix code (CODE) on the label on the side of the instrument if you are unable to check the information on the display.

MEMO

SPECIFICATIONS

14

This chapter describes Specifications.

■ Measured input

Number of input: 1 point

Input type: TC input: K, J, T, S, R, E, B, N (JIS-C1602-1995)
PLII (NBS), W5Re/W26Re (ASTM-E988-96)
U, L (DIN43710-1985)
RTD input: Pt100 (JIS-C1604-1997)
JPt100 (JIS-C1604-1997, Pt100 of JIS-C1604-1981)
3-wire system

Input range: TC input (Measured range table)

Input type	Measured range
K	−200 to +1372 °C, −199.9 to +400.0 °C, −199.9 to +800.0 °C −328 to +2502 °F, −100.0 to +752.0 °F
J	−200 to +1200 °C, −199.9 to +300.0 °C −328 to +2192 °F, −199.9 to +550.0 °F
T	−200 to +400 °C, −199.9 to +300.0 °C, −199.9 to +400.0 °C −328 to +752 °F, −199.9 to +300.0 °F, −199.9 to +600.0 °F, −199.9 to +752.0 °F
S	0 to 1769 °C, 0 to 3216 °F
R	0 to 1769 °C, 0 to 3216 °F
E	0 to 1000 °C, 0 to 1832 °F
B	0 to 1820 °C, 0 to 3308 °F
N	0 to 1300 °C, 0 to 2372 °F
PLII	0 to 1390 °C, 0 to 2534 °F
W5Re/W26Re	0 to 2320 °C, 0 to 4208 °F
U	−200 to +600 °C, −199.9 to +600.0 °C −328 to +1112 °F, −199.9 to +999.9 °F
L	0 to 900 °C, 0 to 1652 °F

RTD input (Measured range table)

Input type	Measured range
Pt100	−200 to +649 °C, −199.9 to +649.0 °C −328 to +1200 °F, −199.9 to +999.9 °F
JPt100	−200 to +649 °C, −199.9 to +649.0 °C −328 to +1200 °F, −199.9 to +999.9 °F

Sampling cycle: 0.25 seconds

Influence of signal source resistance:
Approx. 0.2 μV/Ω (Converted depending on TC types)

Influence of input lead: Approx. 0.02 %/Ω of span (Only RTD input)
10 Ω or less per wire
(When the value is 10 Ω or more, measuring range may be limited.)

Measured current: Approx. 800 μA (Only RTD input)

Action at input break: TC input: Upscale
RTD input: Upscale

Action at input short-circuit: Downscale (Only RTD input)

Action at burnout: Determination range of sensor burnout (high/low)
High limit value: Measured range high + (5 % of Measured range)
Low limit value: Measured range low − (5 % of Measured range)

Low and high limit values may be different from the above values depending on the input types.

Also used to determine the input break of alarm action.

Measured input correction: PV bias: −1999 to +9999 °C [°F] or −199.9 to +999.9 °C [°F]
PV digital filter (First order lag digital filter):
0 to 100 seconds (0: Filter OFF)

■ Current transformer (CT) input

Number of input: 2 points
CT type: CTL-6-P-N or CTL-12-S56-10-N (Sold separately)
Measurable current range: 0.0 to 30.0 A (CTL-6-P-N)
0.0 to 100.0 A (CTL-12-S56-10L-N)
Sampling cycle: 0.5 seconds
Voltage of through current: 300 V or less

■ Output

Assign output:

Number of outputs: 3 points (OUT1 to OUT3)

Output assignment: Output assignment function enables the assignment of control, alarm or HBA functions to each output port.

If alarm or HBA output is assigned to the output where control output is already assigned, the alarm or the HBA output, which is assigned later, will be disabled.

Output assignment table

Output specification	OUT1	OUT2	OUT3
Control output (heat-side)	×	×	
Control output (cool-side)	×	×	×
Alarm 1 output	×	×	×
Alarm 2 output	×	×	×
HBA1 output	×	×	×
HBA2 output	×	×	×

- OUT1
  This output port can be assigned with the following functions: Control output (heat-side), Control output (cool-side), Alarm 1 output, Alarm 2 output, HBA1 output and HBA2 output.
- OUT2
  This output port can be assigned with the following functions: Control output (heat-side), Control output (cool-side), Alarm 1 output, Alarm 2 output, HBA1 output and HBA2 output.
- OUT3
  This output port can be assigned with the following functions: Control output (cool-side), Alarm 1 output, Alarm 2 output, HBA1 output and HBA2 output.

Function assignment:

Function assignment table

Output type	Control output (heat-side)	Control output (cool-side)	Alarm 1 output Alarm 2 output HBA1 output HBA2 output
Relay contact output (1) ★ Relay contact output (2) ★	×	×	
Relay contact output (3)			×
Voltage pulse output	×	×	
Current output 4 to 20 mA 0 to 20 mA	×	×	

★ Relay contact output (1): OUT1, OUT2 and OUT3 of RZ100: Control output
OUT3 of RZ400: Control output

★ Relay contact output (2): OUT2 and OUT3 of RZ400: Control output

- OUT1, OUT2
  For control output (heat-side) and control output (cool-side), any one of Relay output (1) or (2), Voltage pulse output, or Current output can be assigned to this port respectively. For Alarm 1 output, Alarm 2 output, HBA1 output, HBA2 output, only Relay output (3) can be assigned.
- OUT3
  Control output (cool-side) is limited to relay output (1). For Alarm 1 output, Alarm 2 output, HBA1 output, or HBA2 output, only Relay output (3) is assignable.

Output type:

- **Relay contact output (1)**
  (OUT1 to OUT3 of RZ100: Control output,
  OUT3 of RZ400: Control output)

  Contact type: 1a contact
  Contact rating (Resistive load): AC 250 V 3 A, DC 30 V 1 A
  Electrical life: 100,000 times or more (Rated load)
  Mechanical life: 20 million times or more (Switching: 300 times/min)
  Time proportional cycle: 1 to 100 seconds (When control output is selected)

- **Relay contact output (2)**
  (OUT1 and OUT2 of RZ400: Control output)

  Contact type: 1a contact
  Contact rating (Resistive load): AC 250 V 3 A, DC 30 V 1 A
  Electrical life: 300,000 times or more (Rated load)
  Mechanical life: 50 million times or more (Switching: 180 times/min)
  Time proportional cycle: 1 to 100 seconds (When control output is selected)

- **Relay contact output (3)**
  (RZ100/RZ400: Alarm output [including HBA output])

  Contact type: 1a contact
  Contact rating (Resistive load): AC 250 V 1 A, DC 30 V 0.5 A
  Electrical life: 150,000 times or more (Rated load)
  Mechanical life: 20 million times or more (Switching: 300 times/min)

- **Voltage pulse output**

  Output voltage: 0/12 V DC (Rated)
  ON voltage: 10 to 13 V
  OFF voltage: 0.5 V or less
  Allowable load resistance: 500 Ω or more
  Time proportional cycle: 1 to 100 seconds (When control output is selected)

- **Current output**
  Output current (Rated): 4 to 20 mA DC, 0 to 20 mA DC
  Output range: 3.2 to 20.8 mA DC, 0 to 21 mA DC
  Allowable load resistance: 500 Ω or less

- **Control output at burnout**
  0: Result of control computation
  1: PID control: Output limiter low (output OFF)
  Heat/Cool PID control: –5.0 % (output OFF) *
  * Both heat-side and cool-side outputs are forced OFF

Related function:

- **Control output assignment**

  PID control specification:
  Control output (heat-side) can be assigned to either OUT1 or OUT2.
  Heat/Cool PID control specification:
  Control output (heat-side) can be assigned to either OUT1 or OUT2.
  Control output (cool-side) can be assigned to any one of OUT, OUT2 or OUT3.

  If Alarm output is assigned to the output where Control output is already assigned, the Alarm output, which is assigned later, will be disabled.

- **Alarm output assignment**
  Alarm output can be assigned to any one of OUT1, OUT2 or OUT3.

  If Control output is assigned to the output where Alarm output is already assigned, the Alarm output will be disabled.

- **HBAoutput assignment**
  Heater break alarm (HBA) can be assigned to any one of OUT1, OUT2 or OUT3.

  If HBA output is assigned to the output where Control output is already assigned, the HBA output will be disabled.

- **Output energize/de-energize when assigned to alarm**
  Energize/De-energize is selectable

■ Performance (at the ambient temperature 23 ±2 °C)

Reference performance (Performance under the standard performance condition)

• **Measured input:** Accuracy

Input type	Input range	Accuracy
K, J, T, PLII, E, U, L (Accuracy is not guaranteed for less than −100 °C)	Less than −100 °C	±(2.0 °C + 1digit)
	−100 °C or more, Less than +500 °C	±(1.0 °C + 1digit)
	500 °C or more	±(0.2 % of Reading+ 1digit)
N, S, R, W5Re/W26Re (Accuracy is not guaranteed for less than 400 °C for input type S, R and W5Re/W26Re)	Less than 0 °C	±(4 °C+ 1digit)
	0 °C or more, Less than 1000 °C	±(2 °C + 1digit)
	1000 °C or more	±(0.2 % of Reading + 1digit)
B (Accuracy is not guaranteed for less than 400 °C)	Less than 400 °C	±(70 °C + 1digit)
	400 °C or more	±(2 °C + 1digit)
Pt100, JPt100	Less than 200 °C	±(0.4 °C + 1digit)
	200 °C or more	±(0.2 % of Reading + 1digit)

Display accuracy:
Is equal to the above accuracy with the value below the minimum resolution rounded up.

Noise elimination ratio:
Series mode: 60 dB or more (50/60 Hz)
Common mode: 120 dB or more (50/60 Hz)

Resolution: 65535 counts (Performance of A/D converter)

Cold-junction temperature compensation error:
±0.5 °C (Between −10 to +55 °C)

Close horizontal mounting error:
±1.5 °C (within ±3.0 °C for input lower than −100 °C)

• **Current transformer (CT) input:**
Accuracy: ± (5 % of Reading) or ±2 A (whichever is larger)
Resolution: CTL-6-P-N: 1/5000
CTL-12-S56-10L-N: 1/10000

• **Current output:** Accuracy: ±5.0 % of Output span
Resolution: Approx. 1/15000

Operating influence (Variation under the operating condition)

• **Influence ambient temperature:**
Input: Measured input: ±0.06 °C/°C
Output: Current output: ±0.02 %/°C of Output span

• **Influence of physical orientation:**
Input: ±0.6 % of Input span or ±3.0 °C
These errors are added to the accuracy.
Output: Current output: Less than ±0.3 % of Output span
These errors are added to the accuracy.

■ Display

Measured input display: 4-digit 7-segment LED (Green)

Display range:

Measured range low − (5 % of Measured range) to
Measured range high + (5 % of Measured range)

The display starts flashing when the input exceeds the input range.

The display starts flashing "oooo" when the input exceeds the display range.

The display starts flashing "uuuu" when the input goes below the display range.

Setting display: 4-digit 7-segment LED (Orange)

Output display (OUT1 to OUT3):

Point light emission LED (Green): 3 points

Display action:

When ON/OFF output:

Output OFF:	Extinguished
Output ON:	Lit

When Current output:

0.0 % ≥ Manipulated output:	Extinguished
0.0 % < Manipulated output < 100.0 %:	Dimly lit.
100.0 % ≤ Manipulated output:	Lit

Autotuning state display (AT):

Point light emission LED (Green)

Display action:

Flashes when Autotuning (AT) is activated.
Lights during Startup tuning (ST) execution.

Alarm state display (ALM):

Point light emission LED (Red):

Display action:

Lights when Comprehensive alarm state occurs.

■ Operation keys

Select items/Set parameters:

4 keys (SET, R/S, ∨, ∧)

RUN/STOP transfer: Press and hold the R/S key (for one second)

■ Control

● PID control

Overshoot suppression function:
Anti-reset windup (ARW) method

Proportional band: TC/RTD inputs:
0 (0.0) to Input span (Unit: °C [°F])
If the input span exceeds 9999 (999.9) °C [°F], the maximum value is 9999 (999.9) °C [°F].
0 (0.0): ON/OFF action

Integral time: 0 to 3600 seconds (0: PD action)
Output is 50 % when the deviation is zero.

Derivative time: 0 to 3600 seconds (0: PI action)

Anti-reset windup (ARW):
0 to 100 % of Proportional band
(0: Integral action OFF)

ON/OFF action differential gap:
0 to 9999 or 0.0 to 999.9 (Unit: °C [°F])
High/Low individual setting

Proportional cycle time: 1 to 100 seconds
Valid at Relay contact output and Voltage pulse output

Output limiter high: Output limiter low to +105.0 % *

Output limiter low: –5.0 % to Output limiter high *

* Output limiter high > Output limiter low

Fine tuning: –3 to +3 (0: Function OFF)
Positive values quicken the control response while negative values slow the control response.

Direct/Reverse action: Selectable

● Heat/Cool PID control

Overshoot suppression function: Anti-reset windup (ARW) method

Proportional band [heat-side]:
TC/RTD inputs:
0 (0.0) to Input span (Unit: °C [°F])
If the input span exceeds 9999 (999.9) °C [°F], the maximum value is 9999 (999.9) °C [°F].
0 (0.0): Heat-side and cool-side are both ON/OFF action

Integral time: 0 to 3600 seconds (0: PD action)
Output is 0 % when the deviation is zero.

Derivative time: 0 to 3600 seconds (0: PI action)

Anti-reset windup (ARW):
0 to 100 % of Proportional band [heat-side]
(0: Integral action OFF)

Proportional band [cool-side]:
1 to 1000 % of Proportional band [heat-side]
This setting is disabled by setting the Proportional band to zero.
ON/OFF action of cool-side only is not possible.

Overlap/Deadband: TC/RTD inputs: −10.0 to +10.0 (Unit: °C [°F])
Minus (−) setting results in overlap.
(However, the overlapping range is within the proportional range.)
This setting is disabled for ON/OFF control action.

Proportional cycle time [heat-side]:
1 to 100 seconds
Valid at Relay contact output and Voltage pulse output

Proportional cycle time [cool-side]:
1 to 100 seconds
Valid at Relay contact output and Voltage pulse output

Heat-side output limiter (high): 0.0 to 105.0 %

Cool-side output limiter (high): 0.0 to 105.0 %

Fine tuning: −3 to +3 (0: Function OFF)
Positive values quicken the control response while negative values slow the control response.

● Mode switching

RUN/STOP transfer: Used to switch the mode between RUN and STOP.
When switching the mode from STOP to RUN, the action is the same as that at power on.
RUN: PID control is performed.
STOP: PID control and alarm function are disabled, and the output state will be as follows.
Relay contact output: Opened
Voltage pulse output: OFF
Current output: −5.0 %
Action at STOP can be selected (Alarm or HBA)

● Autotuning (AT)

Tuning method: Computed by Limit cycle system

AT cycle: 1.5

AT differential gap time: 10 seconds

● Startup tuning (ST)

Selection of ST execution:
0: ST OFF
1: Execute once
2: Execute always

ST start condition:
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.

■ Alarm function

Number of alarm: 2 points

Alarm type:
Deviation high
Deviation high with hold action
Deviation high with re-hold action
Deviation low
Deviation low with hold action
Deviation low with re-hold action
Deviation high/low
Deviation high/low with hold action
Deviation high/low with re-hold action
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)
Band
Band (High/Low individual setting)
Process high
Process high with hold action
Process low
Process low with hold action
SV high
SV low
Control loop break alarm (LBA)
Monitor during RUN

Setting range:
Alarm setting: −1999 to +9999 °C [°F] or −199.9 to +999.9 °C [°F]
Differential gap: 0 to 9999 °C [°F] or 0.0 to 999.9 °C [°F]

Additional function:
Hold action:
a) without Hold function
b) with Hold function (When power is turned on; when transferred from STOP to RUN)
c) with Re-hold action (When power is turned on; when transferred from STOP to RUN; when SV changed)

The hold function in b) is enabled for process alarm or deviation alarm.
The re-hold function in c) is enabled for deviation alarm.

Alarm action at input burnout:
0: Alarm 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

Alarm timer: 0 to 600 seconds

Alarm interlock: Used/Unused is selectable

Energize/De-energize: Selectable

■ Control loop break alarm (LBA)

This function is enabled if Control loop break alarm (LBA) is specified for Alarm 2.

Control loop break alarm (LBA) time: 0.1 to 200.0 minutes

LBA deadband (LBD): 0 to 9999 (Unit: °C [°F])

■ Heater break alarm (HBA)

Number of HBA: 2 points (1 point per CT input)

Setting range: 0.0 to 100.0 A
(0.0: HBA function OFF [Current value monitoring is still available])
CT does not detect current value when the control output ON time or control output OFF time is less than 250 ms.

HBA determination time: 0 to 255 seconds

HBA interlock: Used/Unused is selectable

■ Comprehensive alarm

When alarm and HBA are generated, corresponding bits of Comprehensive alarm turn “1.”

Alarm type and corresponding Bit:

Bit 0: When Alarm 1 is generated, “0” is lit (communication display: 1)
Bit 1: When Alarm 2 is generated, “0” is lit (communication display: 2)
Bit 2: When HBA 1 is generated, “0” is lit (communication display: 4)
Bit 3: When HBA 2 is generated, “0” is lit (communication display: 8)
If two or more alarms are generated simultaneously, the communication display shows the sum of the alarms.

■ Communication

● 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, 38400 bps

Protocol: ANSI X3.28-1976 subcategories 2.5 and A4
Polling/Selecting type

Data bit configuration:
Start bit: 1
Data bit: 7 or 8
Parity bit: None, Odd or Even
Stop bit: 1 or 2

Error control: Vertical parity (With parity bit selected)
Horizontal parity (BCC check)

Communication code: JIS/ASCII 7-bit code

Termination resistor: Externally terminal connected (120 Ω 1/2 W)

Xon/Xoff control: None

Maximum connections: Up to 31 controllers

Signal logic: RS-485

Signal logic	Logic
V (A) − V (B) ≥ 1.5 V	0 (SPACE)
V (A) − V (B) ≤ −1.5 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, 38400 bps
Data bit configuration:	Start bit: 1 Data bit: 8 Parity bit: None, 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) 10H (Preset multiple registers [Write multiple registers])
Error check method:	CRC-16
Error code:	1: Function code error 2: • When the mismatched address is specified. • Address other than 0000H to 00AFH is specified as the starting number. 3: • The maximum number (Read from a read holding resistor or write to Preset multiple resistors [Write multiple registers]) has been exceeded. • The setting of the number of data (the number of requested byte) is not set to a double of the requested number of data at the time of "Preset multiple registers (Write multiple registers)" 4: Self-diagnostic error response
Termination resistor:	Externally terminal connected (Example: 120 Ω 1/2 W)
Maximum connections:	Up to 31 controllers

■ Loader communication

Protocol:	For RKC communication protocol only (ANSI X3.28-1976 subcategories 2.5 and A4)
Synchronous method:	Start/Stop synchronous type
Communication speed:	38400 bps
Data bit configuration:	Start bit: 1 Data bit: 8 Parity bit: None Stop bit: 1
Maximum connections:	1 point
Connection method:	Exclusive cable (W-BV-01) Loader communication is enabled while the instrument is powered.
Interval time:	10 ms

■ Self-diagnostic function

Control stop (Error number is displayed [Operation: Possible]):

Adjusted data error (Err 1)
Data back-up error (Err 2)
A/D conversion error (Err 4)
Temperature compensation error (Err 4)

Action stop (Error number is not displayed [Operation: Impossible]):

Power supply voltage is abnormal
Watchdog timer error

■ General specifications

Power supply voltage: 85 to 264 V AC [Including power supply voltage variation], 50/60 Hz
(Rated: 100 to 240 V AC)
Frequency variation: 50 Hz (−10 to +5 %), 60 Hz (−10 to +5 %)

Power consumption (at maximum load):

RZ100: 5.1 VA max. (at 100 V AC)
7.6 VA max. (at 240 V AC)
RZ400: 5.9 VA max. (at 100 V AC)
8.4 VA max. (at 240 V AC)

Rush current: 5.6 A or less (at 100 V AC)
13.3 A or less (at 240 V AC)

Insulation resistance:

	①	②	③	④
① Grounding				
② Power supply terminal	20 MΩ or more at 500V DC			
③ Measured input terminal	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC	
④ Output terminal	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC	
⑤ Communication terminal	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC	20 MΩ or more at 500V DC

Grounding is done on the control panel.

Withstand voltage:

Time: 1 min.	①	②	③	④	⑤
① Grounding					
② Power supply terminal	1500 V AC				
③ Measured input terminal	1500 V AC	3000 V AC			
④ Output terminal (Relay contact)	1500 V AC	3000 V AC	3000 V AC		
⑤ Output terminal (Other than ④)	1500 V AC	3000 V AC	1000 V AC		
⑥ Communication terminal	1500 V AC	3000 V AC	1000 V AC	3000 V AC	1000 V AC

Grounding is done on the control panel.

Power failure handling: **Power failure:** A power failure of 20 ms or less will not affect the control action (at Rated voltage)

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.
Outputs the computed result of the initial control sampling.
(within the Output limiter range)

■ Environment Condition

● Operating environmental conditions

Ambient temperature: –10 to +55 °C

Ambient humidity: 5 to 95 %RH (Absolute humidity: MAX.W.C 29 g/m^3 dry air at 101.3 kPa)

Vibration: Frequency range: 10 to 150 Hz
Maximum amplitude: 0.075 mm
Maximum acceleration: 9.8 m/s^2
Each direction of XYZ axes

Shock: Free fall from 50 mm in height
Each direction of XYZ axes (In non-energization)

● Reference operating conditions

Reference temperature: 23 °C ± 2 °C
Temperature variation: ±5 °C/h

Reference humidity: 50 %RH ± 10 %RH

Magnetic field: Geomagnetism

Power supply voltage: AC power supply Rated value ± 1 %

● Transportation and Storage environment conditions

Vibration:

Number of vibration [Hz]	Level		Attenuation slope [dB/oct]
	$(m/s^2)^2/Hz$	$[g^2(1)/Hz]$	
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 (1)] within the number of vibration.

NOTE: (1) g = 9.806658 m/s^2

Shock: Height 400 mm or less

Temperature: –40 to +70 °C

Humidity: 5 to 95 %RH (Non condensing)
Absolute humidity: MAX.W.C 35 g/m^3 dry air at 101.3 kPa

■ Mounting and Structure

Mounting method: Panel-mounted

Mounting orientation: Datum plane ± 90°

Case material: PC (Flame retardancy: UL94 V-0)

Front panel material: PC (Flame retardancy: UL94 V-0)

Terminal block material: PPE (Flame retardancy: UL94 V-1)

Panel sheet material: Polyester

Panel sealing: without waterproof and dustproof structure:
Based on IP00 (IEC60529: 2001)
with waterproof and dustproof structure:
Based on IP66 (IEC60529: 2001) [when properly mounted on the control panel]
(Waterproof and dustproof structure is an optional function.)

Weight: RZ100: Approx. 115 g
RZ400: Approx. 165 g

Dimensions: RZ100: 48 mm × 48 mm × 63 mm (W × H × D)
RZ400: 48 mm × 96 mm × 60 mm (W × H × D)

■ Standard

● Safety standards

UL: UL61010-1
cUL: CAN/CSA-C22.2 No.61010-1

● Other approved standards

CE marking: LVD: EN61010-1
EMC: EN61326-1

RCM: EN55011

● Environment Condition

Protection against electric shock:
Class II (Reinforced insulation)

Overvoltage category: OVERVOLTAGE CATEGORY II

Pollution degree: POLLUTION DEGREE 2

Altitude: Altitude up to 2000 m (Indoor use)

MEMO

APPENDIX A

A.1 Parameters to be Initialized/Changed at the time of changing set values

If any of the following parameters are changed, the set values of relevant parameters are initialized or automatically converted according to the new setting. If not properly set, it may result in malfunction or failure of the instrument.

- **Input type (I nP) [Initial setting mode]**
- **Input range high (PGSH) [Initial setting mode]**
- **Input range low (PGSL) [Initial setting mode]**
- **Temperature unit (UnI T) [Initial setting mode]**
- **Alarm 1 type (ALM1) [Initial setting mode]**
- **Alarm 2 type (ALM2) [Initial setting mode]**
- **Control action (ΨE) [Initial setting mode]**
- **Communication protocol (CMPS) [Communication setting mode]**
- **Decimal point position (PGdP) [Initial setting mode]**
- **Input range high (PGSH) [Initial setting mode]**
- **Input range low (PGSL) [Initial setting mode]**
- **Setting limiter high (SLH) [Initial setting mode]**
- **Setting limiter low (SLL) [Initial setting mode]**

Before changing any parameter setting on the above list, always record all parameter settings in SV setting mode, Parameter setting mode, Communication setting mode and Initial setting mode. And after the change, always check all parameter settings in SV setting mode, Parameter setting mode, Communication setting mode and Initial setting mode by comparing them with the record taken before the change.

A.1.1 Data to be initialized

■ When Input type (I nP) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
SV setting mode	Set value (SV)		0 or 0.0
Parameter setting mode	Alarm 1 set value Alarm 1 set value [high]	AL 1	10 or 10.0
	Alarm 1 set value [low]	AL 1'	–10 or –10.0
	Alarm 2 set value Alarm 2 set value [high]	AL2	10 or 10.0
	Alarm 2 set value [low]	AL2'	–10 or –10.0
	Control loop break alarm (LBA) time	LbA	8.0
	LBA deadband (LBD)	Lbd	0
	Proportional band [heat-side]	P	30 or 30.0
	Integral time	I	240
	Derivative time	d	60
	Anti-reset windup (ARW)	Ar	100
	Proportional band [cool-side]	Pc	100
	Overlap/Deadband	db	0 or 0.0
	PV bias	Pb	0 or 0.0
	Fine tuning	PTU	0
	PV digital filter	dF	1
Initial setting mode Cod0000	Decimal point position	PGdP	For TC inputs (T and U) and RTD inputs (Pt100 and JPt100): 1 Otherwise: 0
	Input range high	PGSH	High-limit of measured range
	Input range low	PGSL	Low-limit of measured range
Initial setting mode Cod1021	Setting limiter high	SLH	Input range high
	Setting limiter low	SLL	Input range low
Initial setting mode Cod1041	Alarm 1 differential gap	AH 1	2 or 2.0
	Alarm 1 timer	ALT 1	0
Initial setting mode Cod1042	Alarm 2 differential gap	AH2	2 or 2.0
	Alarm 2 timer	ALT2	0
Initial setting mode Cod1051	ON/OFF action differential gap (upper)	oHH	1 or 1.0
	ON/OFF action differential gap (lower)	oHL	1 or 1.0

■ When Input range high (PGSH) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Initial setting mode Cod1021	Setting limiter high	SLH	Input range high

■ When Input range low (PGSL) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Initial setting mode Cod1021	Setting limiter low	SLL	Input range low

■ When Temperature unit (UnIT) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
SV setting mode	Set value (SV)		0 or 0.0
Parameter setting mode	Alarm 1 set value Alarm 1 set value [high]	AL1	10 or 10.0
	Alarm 1 set value [low]	AL1'	–10 or –10.0
	Alarm 2 set value Alarm 2 set value [high]	AL2	10 or 10.0
	Alarm 2 set value [low]	AL2'	–10 or –10.0
	Control loop break alarm (LBA) time	LbA	8.0
	LBA deadband (LBD)	Lbd	0
	Proportional band [heat-side]	P	30 or 30.0
	Integral time	I	240
	Derivative time	d	60
	Anti-reset windup (ARW)	Ar	100
	Proportional band [cool-side]	Pc	100
	Overlap/Deadband	db	0 or 0.0
	PV bias	Pb	0 or 0.0
	Fine tuning	PTU	0
	PV digital filter	dF	1
Initial setting mode Cod0000	Input range high	PGSH	High-limit of measured range
	Input range low	PGSL	Low-limit of measured range
Initial setting mode Cod1021	Setting limiter high	SLH	Input range high
	Setting limiter low	SLL	Input range low
Initial setting mode Cod1041	Alarm 1 differential gap	AH1	2 or 2.0
	Alarm 1 timer	ALT1	0
Initial setting mode Cod1042	Alarm 2 differential gap	AH2	2 or 2.0
	Alarm 2 timer	ALT2	0
Initial setting mode Cod1051	ON/OFF action differential gap (upper)	oHH	1 or 1.0
	ON/OFF action differential gap (lower)	oHL	1 or 1.0

■ When Alarm 1 type (ALn̄ 1) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Parameter setting mode	Alarm 1 set value Alarm 1 set value [high]	AL 1	10 or 10.0
	Alarm 1 set value [low]	AL 1'	–10 or –10.0
Initial setting mode Cod1041	Alarm 1 differential gap	AH 1	2 or 2.0
	Alarm 1 timer	ALT 1	0

■ When Alarm 2 type (ALn̄2) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Parameter setting mode	Alarm 2 set value Alarm 2 set value [high]	AL 2	10 or 10.0
	Alarm 2 set value [low]	AL 2'	–10 or –10.0
Initial setting mode Cod1042	Alarm 2 differential gap	AH2	2 or 2.0
	Alarm 2 timer	ALT 2	0

■ When Control action (ȳE) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Parameter setting mode	Control loop break alarm (LBA) time	LbA	8.0
	LBA deadband (LBD)	Lbd	0
	Proportional band [heat-side]	P	30 or 30.0
	Integral time	I	240
	Derivative time	d	60
	Anti-reset windup (ARW)	Ar	100
	Proportional band [cool-side]	Pc	100
	Overlap/Deadband	db	0 or 0.0
	Fine tuning	PTU	0
	Output limiter high [Heat-side output limiter (high)]	oLH	105.0
	Output limiter low [Cool-side output limiter (high)]	oLL	PID control: –5.0 Heat/Cool PID control: +105.0
Initial setting mode Cod0002	Control output assignment	oCo	When Heat/Cool PID control is changed to PID control: If the value before the change is 3: the new value is 1. If the value before the change is 4: the new value is 2. Other values remain unchanged.
Initial setting mode Cod1051	ON/OFF action differential gap (upper)	oHH	1 or 1.0
	ON/OFF action differential gap (lower)	oHL	1 or 1.0

■ When Control output assignment (oCo) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Parameter setting mode	Proportional cycle time [heat-side]	T	Relay contact output: 20 Voltage pulse output: 2
	Proportional cycle time [cool-side]	t	Relay contact output: 20 For "Air cooling/Water cooling" configured to have "Voltage pulse output": 20 For "Cooling linear type" configured to have "Voltage pulse output": 2

■ When Cool action (oSc) [Initial setting mode] is changed

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

Mode	Name	Symbol	Default value
Parameter setting mode	Proportional cycle time [cool-side]	t	For "Air cooling/Water cooling" configured to have "Voltage pulse output": 20 For "Cooling linear type" configured to have "Voltage pulse output": 2 Otherwise: Not initialized

A.1.2 Data to be automatically converted

■ When Decimal point position (PGdP) [Initial setting mode] is changed

The following parameter will be automatically converted.

- Set value (SV)
- Alarm 1 set value
- Alarm 1 set value [high]
- Alarm 1 set value [low]
- Alarm 2 set value
- Alarm 2 set value [high]
- Alarm 2 set value [low]
- Proportional band [heat-side]
- Overlap/Deadband
- PV bias
- Input range high
- Input range low
- Setting limiter high
- Setting limiter low
- Alarm 1 differential gap
- Alarm 2 differential gap
- ON/OFF action differential gap (upper)
- ON/OFF action differential gap (lower)

☞ For details of automatic conversion, refer to ■ **Example of automatic conversion (P. A-6)**.

■ When Input range high (PGSH) [Initial setting mode] are changed

The following parameter will be automatically converted.

- Set value (SV)
- Proportional band [heat-side]
- Setting limiter low

☞ For details of automatic conversion, refer to ■ **Example of automatic conversion (P. A-6)**.

■ When Input range low (PGSL) [Initial setting mode] are changed

The following parameter will be automatically converted.

- Set value (SV)
- Proportional band [heat-side]
- Setting limiter high

☞ For details of automatic conversion, refer to ■ **Example of automatic conversion (P. A-6)**.

■ When Setting limiter high (SLH) or Setting limiter low (SLL) [Initial setting mode] are changed

The following parameter will be automatically converted.

- Set value (SV)

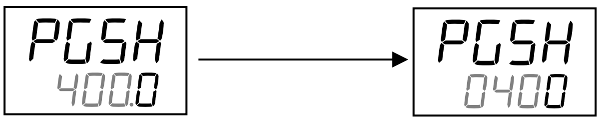
☞ For details of automatic conversion, refer to ■ **Example of automatic conversion (P. A-6)**.

■ Example of automatic conversion

- Decimal point position moves in accordance with the setting change.

Example 1: When the setting of the Decimal point position (PGdP) is changed from 1 (One decimal place) to 0 (no decimal place) with Input range high (PGSH) set to 400.0 °C:

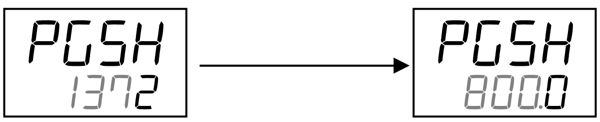
Input range high



Values are rounded off to the decimal place.

Example 2: When the setting of the Decimal point position (PGdP) is changed from 0 (no decimal place) to 1 (One decimal place) with Input range high (PGSH) set to 1372 °C (Input type: thermocouple K):

Input range high

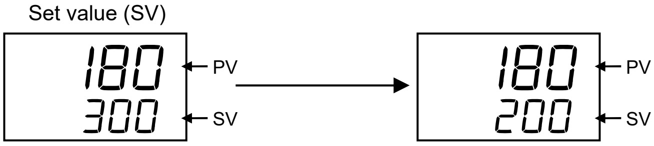


For thermocouple K, the maximum settable value with one decimal place is 800.0 and the value cannot be larger than this.

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

Example: When Input range high (PGSH) is changed from 400 °C to 200 °C

Set value (SV)



If 300 °C is entered as a set value (SV), it is automatically converted to 200 °C.

A.2 Replacing the Waterproof/Dustproof Gasket (Option)

RZ100/400 can be equipped with an optional water- and dust-proof structure, which has to be specified at the time of ordering. This waterproof and dustproof construction uses two types of rubber gaskets. If the waterproof and dustproof gasket deteriorates, please contact RKC sales office or the agent. To replace the gasket, take the following steps:

> ⚠ **WARNING**
>
> - In order to prevent electric shock and instrument failure, always turn off the power supply before replacing the gasket.
> - In order to prevent electric shock and instrument failure, always turn off the power supply before pulling out the internal chassis.
> - In order to prevent injury or instrument failure, do not touch the internal printed wiring board.

■ Replacement of the gasket for the case

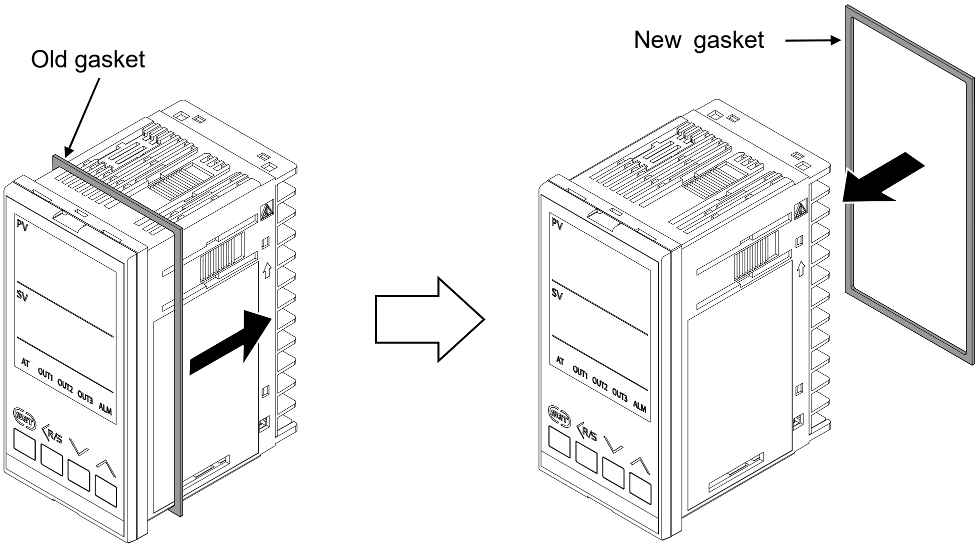
1. Turn the power OFF.

2. Remove the wiring.

3. Remove the mounting bracket, and then remove the instrument from the control panel.

☞ Refer to **2.3 Procedures of Mounting and Removing (P. 2-4)**.

4. Remove the old gasket, and then replace the old gasket with a new one.

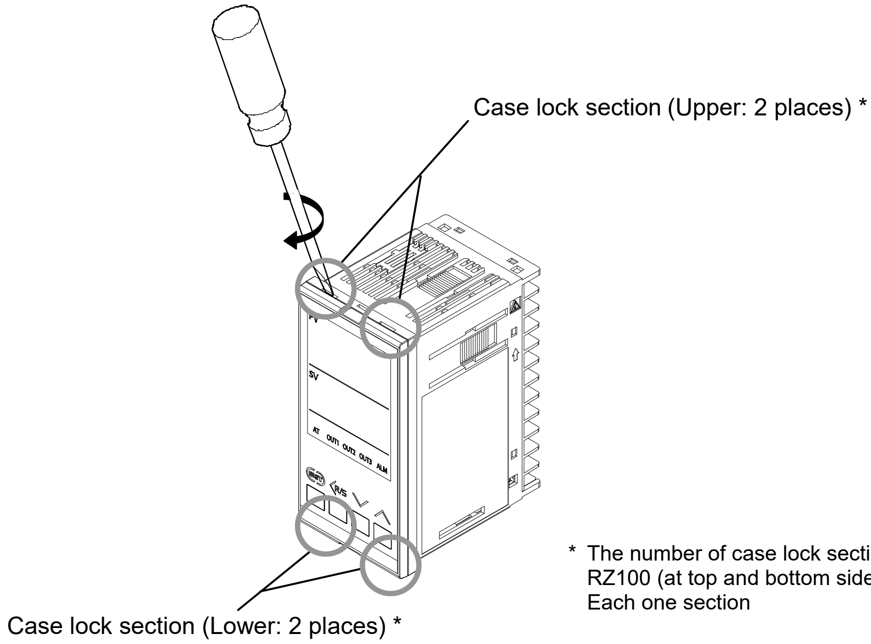


Gasket for the case:
RZ100: KRB100-39
RZ400: KFB400-36

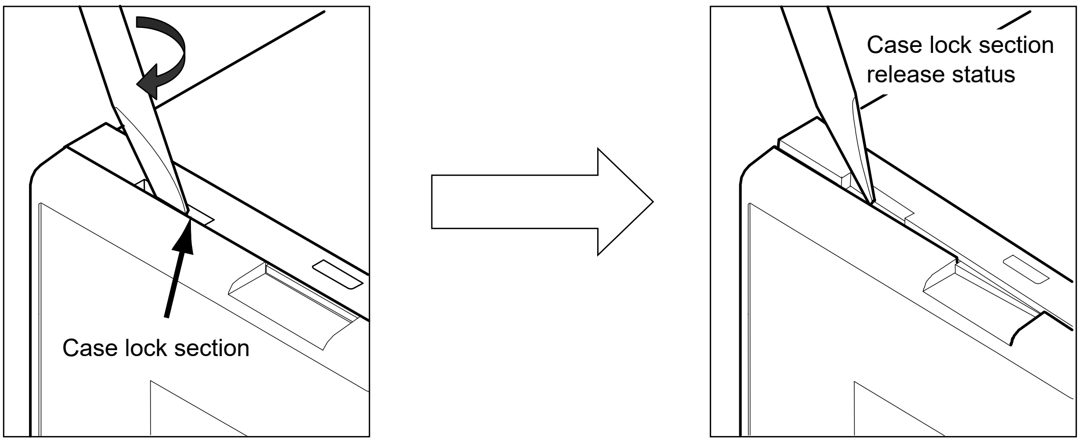
■ Replacing the gasket for the front frame

1. Turn the power OFF.

2. Insert the slotted screwdriver into the case lock section as shown in the following figure, and then lightly turn the slotted screwdriver to release the case lock section. The case lock section is released.



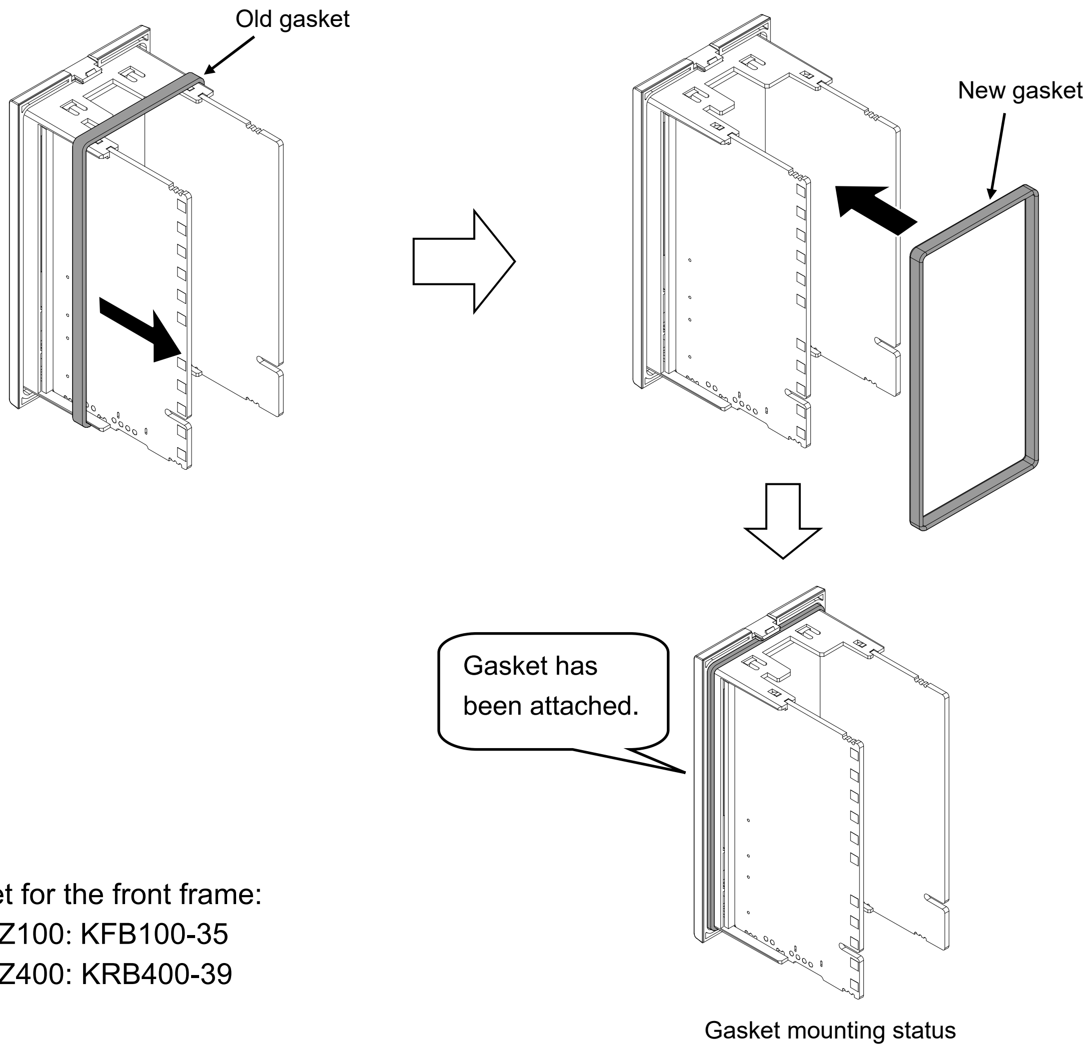
* The number of case lock sections of RZ100 (at top and bottom sides): Each one section



3. The other case lock section should be released in the same way as described in steps ***1*** and ***2.***

4. Remove the internal assembly from the case.

5. Remove the old gasket, and then replace the old gasket with a new one.



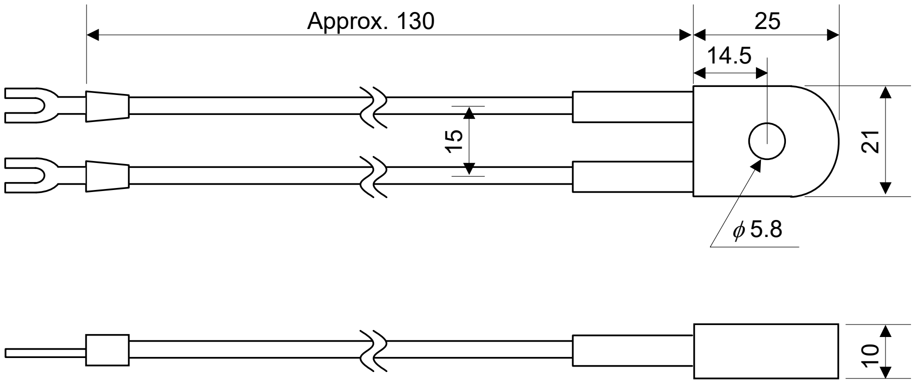
Gasket for the front frame:
RZ100: KFB100-35
RZ400: KRB400-39

6. Insert the internal assembly in the case.

A.3 Current Transformer (CT) Dimensions (Option)

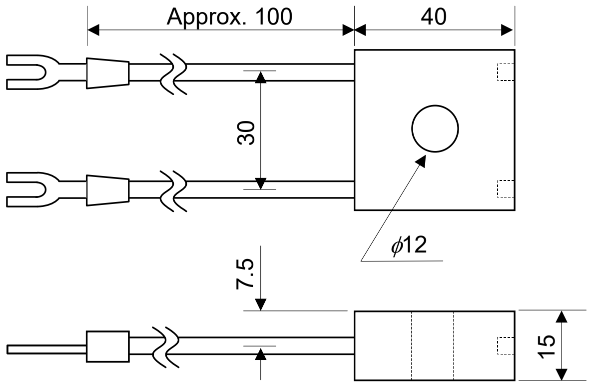
■ CTL-6-P-N (For 0 to 30 A)

(Unit: mm)



■ CTL-12-S56-10L-N (For 0 to 100 A)

(Unit: mm)



INDEX [Alphabetical order]

T

U

W

INDEX [Character order]

* Mode

MONI: Monitor display mode   SV: SV setting mode   COMM: Communication setting mode

PARA: Parameter setting mode   INI: Initial setting mode (Code number)

[ ]: Parameters displayed in the Expanded display mode (The Expanded display mode can be set in the “Display mode selection” in the Initial setting mode.)

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