Temperature Controller

SA200/SA201

Instruction Manual

RKC® RKC INSTRUMENT INC.

IMR01D14-E1

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, and they have the following meaning.

  : Alternating current

  : Both direct and alternating current

  : Reinforced insulation

  : Safety precaution

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

- Windows is a trademark of Microsoft Corporation.
- Modbus is a registered trademark of Schneider Electric.
- Company names and product names used in this manual are the trademarks or registered trademarks of the respective companies.

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.
- All wiring must be completed before power is turned on to prevent electric shock, instrument failure, or incorrect action. The power must be turned off before repairing work for input break and output failure including replacement of sensor, contactor or SSR, and all wiring must be completed before power is turned on again.
- To prevent instrument damage 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

7-segment character

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

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

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

V	W	X	Y	Z	Degree	／	Prime	* (Asterisk)
V	W	X	Y	Z	o	／	'	*

■ Abbreviation symbols

These abbreviations are used in this manual:

Abbreviation symbols	Name	Abbreviation symbols	Name
PV	Measured value	I	Integral time
SV	Set value	D	Derivative time
SV1	Set value	ARW	Anti-reset windup
SV2	STEP set value	AHS	Analog output scale high
MV	Heat-side manipulated output value	ALS	Analog output scale low
MV2	Cool-side manipulated output value	SLH	Setting limiter [high limit]
LBA	Control loop break alarm	SLL	Setting limiter [low limit]
LBD	LBA deadband	TC (input)	Thermocouple (input)
ALM1	Alarm 1	RTD (input)	Resistance temperature detector (input)
ALM2	Alarm 2	V (input)	Voltage (input)
AT	Autotuning	I (input)	Current (input)
ST	Self-tuning	OUT (1, 2)	Output (1, 2)
P	Heat-side proportional band		

Document Configuration

There are four manuals pertaining to this product. Please be sure to read all manuals specific to your application requirements.

The following manuals can be downloaded from the official RKC website:
https://www.rkcinst.co.jp/english/download-center/

Manual	Manual Number	Remarks
SA200/SA201 Installation Manual	IMR01D12-X☐	This manual is enclosed with instrument. This manual explains the mounting and wiring.
SA200/SA201 Quick Operation Manual	IMR01D13-E☐	This manual is enclosed with instrument. This manual explains the basic key operation, mode menu, and data setting.
SA200/SA201 Instruction Manual	**IMR01D14-E1**	This manual you are reading now. This manual describes installation, wiring, operation of each function, and troubleshooting.
SA200/SA201 Communication Instruction Manual	IMR01D15-E☐	This manual explains RKC communication protocol (ANSI X3.28-1976) and Modbus relating to communication parameters setting.

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

Contents

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1 OUTLINE

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

1.1 Features

This temperature controller has the following features:

Contact input [optional]

The SA200/201 can switch the following items by contact input. The combination of items to be switched can be changed by the customer.

- RUN/STOP
- Temperature set value
  [Two set values (SV) can be registered]
- Alarm interlock release

Communication [optional]

The SA200/201 can be used at a required speed selected from the six communication speeds.

- 2400 bps
- 4800 bps
- 9600 bps
- 19200 bps
- 38400 bps
- 57600 bps

Transmission output (AO) [optional]

The SA200/201 can use an analog signal of 0 to 20 mA DC or 4 to 20 mA DC to output the changing state of the following values.

- Measured value (PV)
- Set value (SV)
- Deviation (DEV)
- Manipulated output value (MV)

Sampling cycle

The SA200/201 provides two types of sampling cycle to better suit the application requirements.

- 250 ms
- 500 ms

Self-tuning

The SA200/201 is equipped with a Self-tuning (ST) function as standard. The Self-tuning (ST) is a tuning function that is activated only when the control is disturbed. This tuning and the conventional Autotuning (AT) can be used individually according to the application requirements.

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	
☐ Mounting brackets	2	————	
☐ Mounting screws	2	————	
☐ SA200/SA201 Installation Manual (IMR01D12-X☐)	1	Enclosed with instrument	This manual can be downloaded from the official RKC website.
☐ SA200/SA201 Quick Operation Manual (IMR01D13-E☐)	1	Enclosed with instrument	

Sold separately	Q'TY	Remarks
☐ Shunt resistor for current input (external resistor) KD100-55	Depending on the order quantity	————
☐ Terminal cover KSA200-56A	Depending on the order quantity	————
☐ **SA200/SA201 Instruction Manual (IMR01D14-E1)**	Depending on the order quantity	This manual This manual can be downloaded from the official RKC website.
☐ SA200/SA201 Communication Instruction Manual (IMR01D15-E☐)	Depending on the order quantity	This manual can be downloaded from the official RKC website.

📖 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 you ordered, please contact RKC sales office or the agent.

■ Suffix code

SA200
SA201 □ □□□ − □ □ − □ ✱ □ □ − □ □ / □ / □□ /Y
(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12)

Specification		Suffix code											
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Control action	PID action with autotuning (Reverse action)	F											
	PID action with autotuning (Direct action)	D											
	Heat/Cool PID action with autotuning (Water cooling) *	W											
	Heat/Cool PID action with autotuning (Air cooling) *	A											
Input type/ Range type	Refer to Input Range Code Table (P. 1-6)		□□□										
Output 1 [OUT1] (Control output, Alarm output, or Transmission output)	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] (Control output or Alarm output)	No output				N								
	Relay contact output				M								
	Voltage pulse output (0/12 V DC)				V								
Power supply voltage	24 V AC/DC					3							
	100 to 240 V AC					4							
Alarm 1 [ALM1]	No alarm						N						
	Refer to Alarm Code Table (P. 1-4)						□						
Alarm 2 [ALM2]	No alarm							N					
	Refer to Alarm Code Table (P. 1-4)							□					
Optional function	No function								N				
	RS-485 (RKC communication)								5				
	RS-485 (Modbus)								6				
	Contact input								D				
Waterproof/ Dustproof	No Waterproof/Dustproof									N			
	Waterproof/Dustproof									1			
Case color	White										N		
	Black										A		
Output assignment code	Standard output Refer to Output Assignment Code Table (P. 1-5)											No symbol	
	Refer to Output Assignment Code Table (P. 1-5)											□□	
Version symbol	For Japanese domestic market												No code
	For International market												/Y

* When the control action type is W or A, the Self-tuning function cannot be used.

Alarm Code Table

Code	Alarm type	Code	Alarm type
A	Deviation high alarm	H	Process high alarm
B	Deviation low alarm	J	Process low alarm
C	Deviation high/low alarm	K	Process high alarm with hold action
D	Band alarm	L	Process low alarm with hold action
E	Deviation high alarm with hold action	R	Control loop break alarm (LBA) **
F	Deviation low alarm with hold action	V	SV high alarm
G	Deviation high/low alarm with hold action	W	SV low alarm

** LBA can be selected for only ALM1.
When the control action is Heat/Cool PID action with autotuning, the Control loop break alarm (LBA) cannot be used.

Output Assignment Code Table

Code	Output assignment	Code	Output assignment
No symbol	PID action OUT1: Control output OUT2: "No alarm," "Alarm 1 (Energized)" or "*OR* output of Alarm 1 and Alarm 2 (Energized)" Heat/Cool PID action OUT1: Heat-side control output OUT2: Cool-side control output	03	PID action + Alarm 1 OUT1: Control output OUT2: Alarm 1 output (De-energized)] (Alarm 2 can be checked via communication or by lamp lighting)
04	PID action + Alarm 1 and Alarm 2 OUT1: Control output OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized)	05	PID action + Alarm 1 and Alarm 2 OUT1: Control output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized)
06	PID action + Alarm 1 and Alarm 2 OUT1: Control output OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized)	07	PID action + "Alarm 1 and Alarm 2" or "Alarm 1 only" OUT1: Control output OUT2: No output (The alarm state can be checked via communication or by lamp lighting)
08	PID action + Alarm 1 and Alarm 2 OUT1: Control output OUT2: Alarm 1 output (Energized) (Alarm 2 can be checked via communication or by lamp lighting)	09	Alarm 1 + Alarm 2 OUT1: Alarm 1 output (Energized) OUT2: Alarm 2 output (Energized)
10	Alarm 1 + Alarm 2 OUT1: Alarm 1 output (Energized) OUT2: Alarm 2 output (De-energized)	11	Alarm 1 + Alarm 2 OUT1: Alarm 1 output (De-energized) OUT2: Alarm 2 output (De-energized)
12	Transmission output + PID action OUT1: Transmission output OUT2: Control output	13	Transmission output + Alarm 1 and Alarm 2 OUT1: Transmission output OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized)
14	Transmission output + Alarm 1 and Alarm 2 OUT1: Transmission output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized)	15	Transmission output + Alarm 1 and Alarm 2 OUT1: Transmission output OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized)
16	Transmission output + Alarm 1 and Alarm 2 OUT1: Transmission output OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized)	17	Transmission output + Alarm 1 OUT1: Transmission output OUT2: Alarm 1 output (Energized)
18	Transmission output + Alarm 1 OUT1: Transmission output OUT2: Alarm 1 output (De-energized)	19	Heat/Cool PID action OUT1: Cool-side control output OUT2: Heat-side control output

Input Range 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
	K08	−199.9 to +300.0 °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
	K29	0.0 to 200.0 °C
	K37	0.0 to 600.0 °C
	K38	−199.9 to +800.0 °C
	KA1	0 to 800 °F
	KA2	0 to 1600 °F
	KA3	0 to 2502 °F
	KA4	0.0 to 800.0 °F
	KA9	20 to 70 °F
	KB2	−199.9 to +999.9 °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
	J08	0.0 to 400.0 °C
	J09	0.0 to 800.0 °C
	J10	0 to 450 °C
	J22	0.0 to 200.0 °C
	J23	0.0 to 600.0 °C
	J30	−199.9 to +600.0 °C
	JA1	0 to 800 °F
	JA2	0 to 1600 °F
	JA3	0 to 2192 °F
	JA6	0 to 400 °F
	JA9	−199.9 to +999.9 °F
	JB6	0.0 to 800.0 °F
R	R01	0 to 1600 °C [1]
	R02	0 to 1769 °C [1]
	R04	0 to 1350 °C [1]
	RA1	0 to 3200 °F [1]

Input type	Code	Range
R	RA2	0 to 3216 °F [1]
S	S01	0 to 1600 °C [1]
	S02	0 to 1769 °C [1]
	SA1	0 to 3200 °F [1]
	SA2	0 to 3216 °F [1]
B	B01	400 to 1800 °C
	B02	0 to 1820 °C [1]
	BA1	800 to 3200 °F
	BA2	0 to 3308 °F [1]
E	E01	0 to 800 °C
	E02	0 to 1000 °C
	EA1	0 to 1600 °F
	EA2	0 to 1832 °F
N	N01	0 to 1200 °C
	N02	0 to 1300 °C
	N06	0.0 to 800.0 °C
	NA1	0 to 2300 °F
	NA2	0 to 2372 °F
	NA5	0.0 to 999.9 °F
T	T01	−199.9 to +400.0 °C [2]
	T02	−199.9 to +100.0 °C [2]
	T03	−100.0 to +200.0 °C
	T04	0.0 to 350.0 °C
	TA1	−199.9 to +752.0 °F [2]
	TA2	−100.0 to +200.0 °F
	TA3	−100.0 to +400.0 °F
	TA4	0.0 to 450.0 °F
	TA5	0.0 to 752.0 °F
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 [2]
	U02	−199.9 to +100.0 °C [2]
	U03	0.0 to 400.0 °C
	UA1	−199.9 to +999.9 °F [2]
	UA2	−100.0 to +200.0 °F
	UA3	0.0 to +999.9 °F
L	L01	0 to 400 °C
	L02	0 to 800 °C
	LA1	0 to 800 °F
	LA2	0 to 1600 °F

[1] Accuracy is not guaranteed below 399 °C (751 °F) or less for types R, S and B.
[2] Accuracy is not guaranteed below −100.0 °C (−148.0 °F) or less for types T and U.

● **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
	DA2	−199.9 to +400.0 °F
	DA3	−199.9 to +200.0 °F
	DA4	−100.0 to +100.0 °F
	DA5	−100.0 to +300.0°F
	DA6	0.0 to 100.0 °F
	DA7	0.0 to 200.0 °F
	DA8	0.0 to 400.0 °F
	DA9	0.0 to 500.0 °F

Input type	Code	Range
JPt100	P01	−199.9 to +649.0 °C
	P02	−199.9 to +200.0 °C
	P03	−100.0 to +50.0 °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

● **Voltage/Current inputs**

Input type	Code	Range
0 to 5 V DC	401	0. 0 to 100.0 %
0 to 10 V DC	501	0. 0 to 100.0 %
1 to 5 V DC	601	0. 0 to 100.0 %
0 to 20 mA DC *	701	0. 0 to 100.0 %
DC 4 to 20 mA DC *	801	0. 0 to 100.0 %

* For the current input specification, an external resistor of 250 Ω must be connected between the input terminals.

MEMO

2 MOUNTING

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 29.3 g/m^3 dry air at 101.3 kPa)
- Installation environment conditions: Indoor use
  Altitude up to 2000 m

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

(4) Mount this instrument in the panel considering the following conditions:
- Provide adequate ventilation space so that heat does not build up.
- Do not mount this instrument directly above the equipment that generates large amount of heat (heaters, transformers, semi-conductor functional devices, 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.

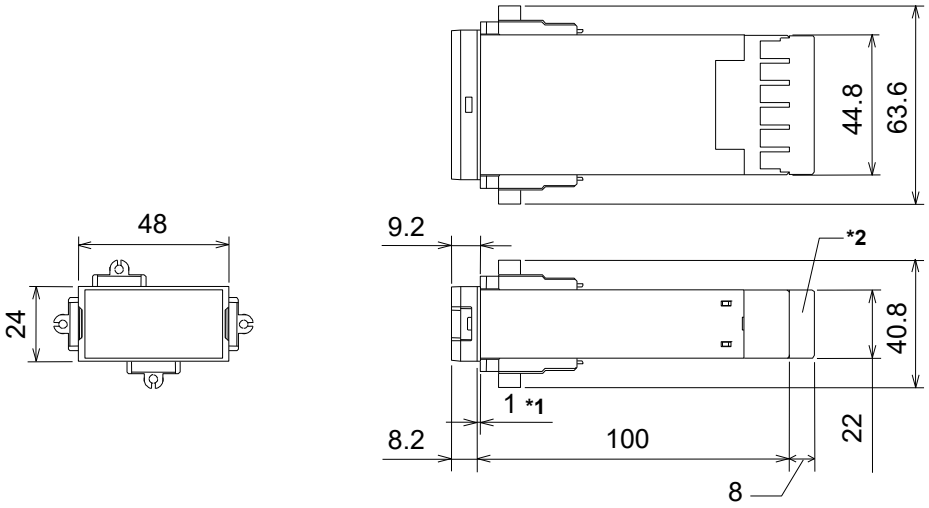
(5) In case this instrument is connected to a supply by means of a permanent connection, a switch or circuit-breaker shall be included in the installation. This shall be in close proximity to the equipment and within easy reach of the operator. It shall be marked as the disconnecting device for the equipment.

2.2 Dimensions

Panel thickness: 1 to 10 mm
(When mounting multiple SA200/201 controllers close together, the panel strength should be checked to ensure proper support.)

■ External dimensions

(Unit: mm)

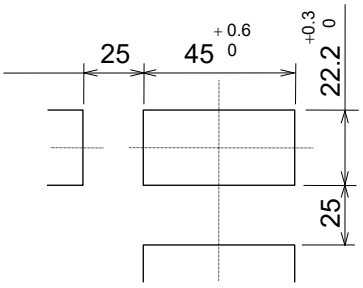


***1**: Rubber gasket (optional)
***2**: Terminal cover (optional)

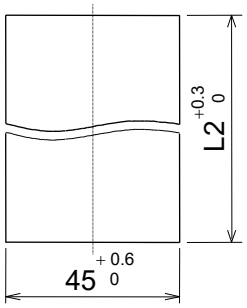
■ Panel cutout dimensions

(Unit: mm)

Individual mounting

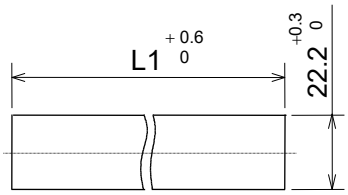


Close vertical mounting



L2 = 24 × *n* − 1.8
n: number of controllers (2 to 6)

Close horizontal mounting



L1 = 48 × *n* − 3
n: number of controllers (2 to 6)

Installation Conditions:
The display cannot be seen from the outside of the visual field range. The visual field range of SA200/201 is 40 degrees to the upper side, and 30 degrees to the lower side from the center of the display vertically.

2.3 Mounting Procedures

■ Individual mounting

When the instrument is individually mounted, always secure with two mounting brackets either top and bottom or right and left.

1. Prepare the panel cutout as specified in **2.2 Dimensions**.

2. Insert the instrument through the panel cutout.

3. Insert the mounting bracket into the mounting groove of the instrument. (Fig. 1)

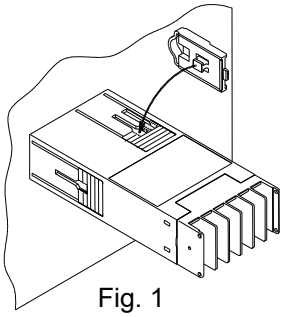


Fig. 1

4. Push the mounting bracket forward with a blade screwdriver until the bracket is firmly secured to the panel. (Fig. 2)

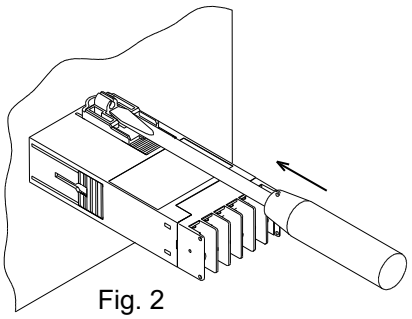


Fig. 2

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

In addition, the mounting assembly also includes two screws which can be used with the brackets to secure the instrument to the panel. Refer to Fig. 3.

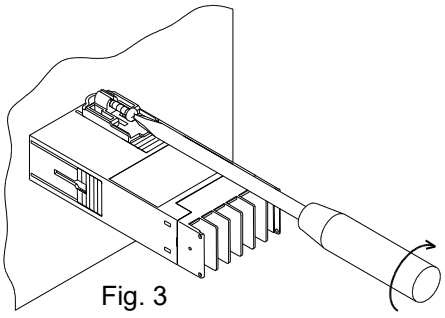


Fig. 3

When using the mounting screws, only turn one full revolution after the screw touches the panel.

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

■ Close mounting

Secure the mounting brackets in the positions as shown in Fig. 4 and Fig. 5.

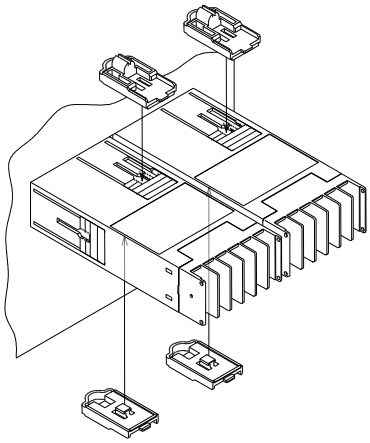


Fig. 4: Close horizontal mounting

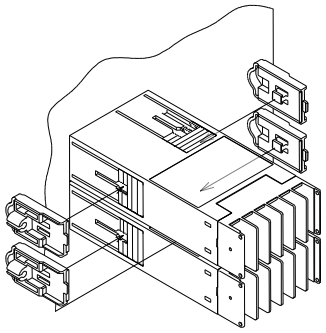


Fig. 5: Close vertical mounting

If the SA200/201 have waterproof/dustproof options, protection will be compromised and not meet **IP66** by close mounting.

Two SA200/201 cannot be inserted into a panel cutout of 48 × 48 mm.

MEMO

3 WIRING

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

- 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.
- Signal connected to Voltage input and Current input shall be low voltage defined as "SELV" circuit per IEC 60950-1.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - 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.

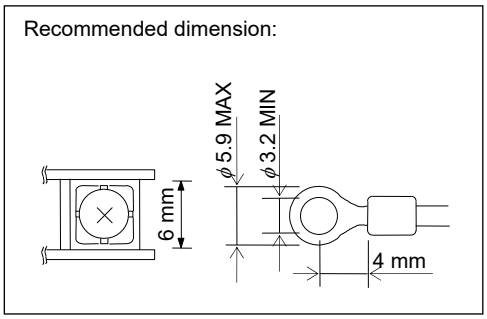
- **Preparation time for contact output**
  Allow approximately 4 seconds for contact output when the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.

- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not provided with an overcurrent protection device. For safety install an overcurrent protection device (such as a fuse) with adequate breaking capacity close to the instrument.
  Fuse type: Time-lag fuse (Approved fuse according IEC 60127-2 and/or UL 248-14)
  Recommended fuse rating: Rated current 0.4 A
- For the current input specification, an external resistor (250 Ω ±0.02 %, 0.25 W or more, ±10 ppm/°C) must be connected between the input terminals. For external resistor (shunt resistor), use the KD100-55 (RKC product). If this resistor is installed, close vertical mounting is not possible.
- For an instrument with 24 V power supply input, supply power from "SELV" circuit defined as IEC 60950-1.
- A suitable power supply should be considered in end-use equipment. The power supply must be in compliance with a limited-energy circuits (maximum available current of 8 A).
- When the control output is voltage pulse or current, always use an isolated type SSR. If the grounded type sensor is used, do not ground output wiring. Do not connect any output wires to the terminals with any other output wires.

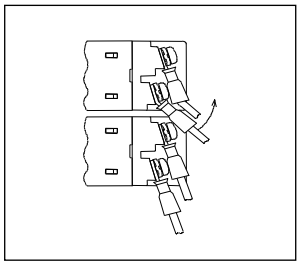
3.2 Restrictions on Wiring

- Always use recommended solderless terminal lugs or equivalent.

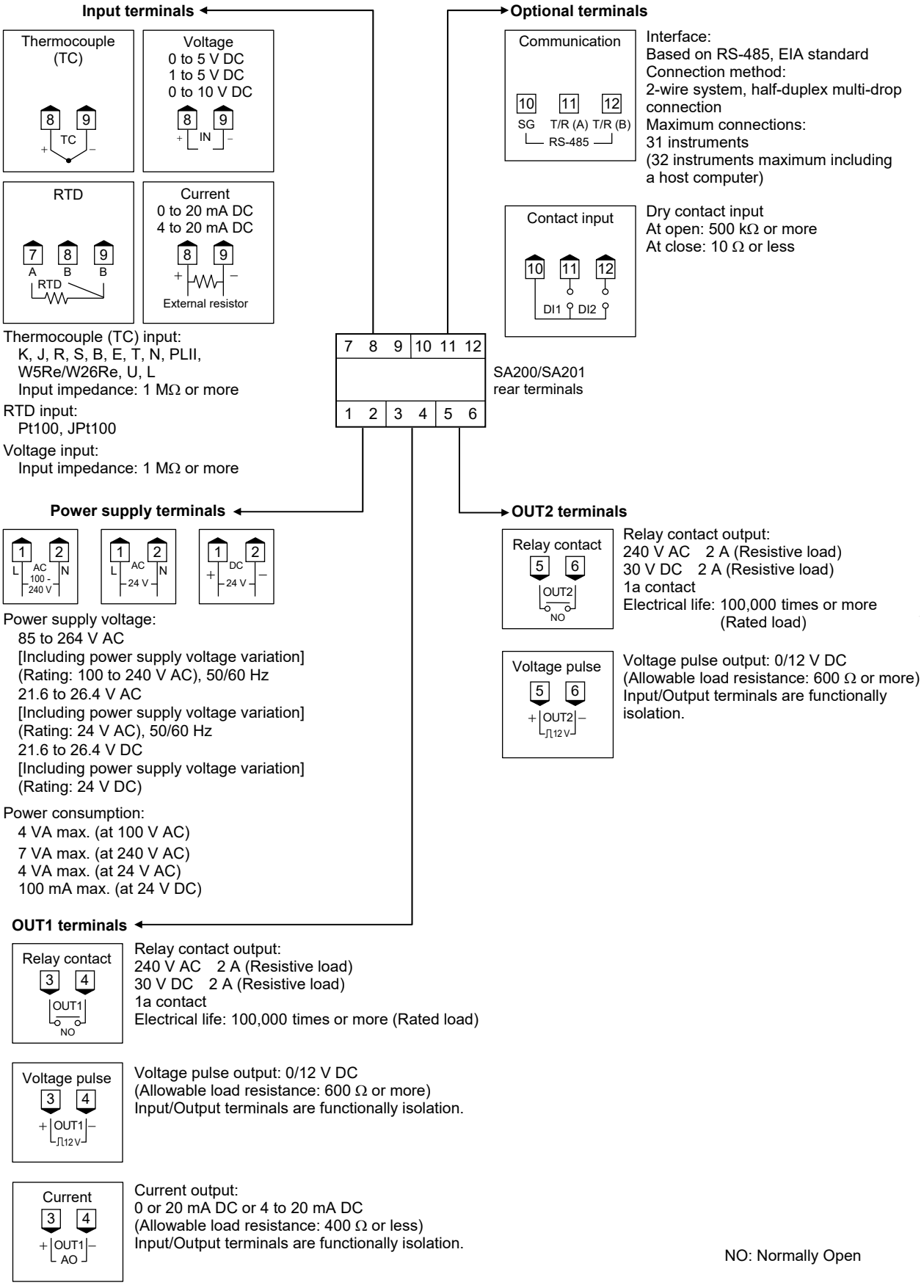
  Screw size: M3 × 6 (With 5.8 × 5.8 square washer)
  Recommended tightening torque: 0.4 N·m (4 kgf·cm)
  Applicable wire: Solid/twisted wire of 2 mm^2
  Recommended solderless terminals: Circular terminal with isolation
  (M3 screw, width 5.5 mm, hole diameter 3.2 mm)



- Make sure that during field wiring parts of conductors cannot come into contact with adjacent conductive parts.
- Always connect external wires starting from the lower terminals (No.1 to 6). Disconnect the wires starting from the upper terminals (No.7 to 12).
- When multiple instruments are vertically closely mounted, do not connect two or more solderless terminal lugs to one terminal.
- If multiple instruments are vertically closely mounted, it is necessary to bend the terminal lugs when they are connected to the lower terminals.



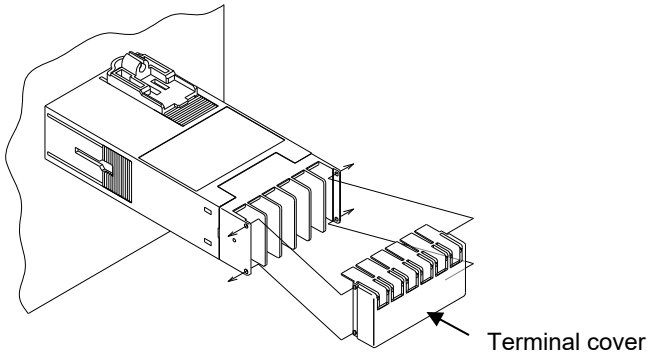
3.3 Terminal Configuration



3.4 Handling of the Terminal Cover

Mount each instrument by referring to the following Figures. If the terminal cover needs to be secured to each of the second and succeeding instruments with these instruments closely mounted including the first instrument, its post-treatment is required.

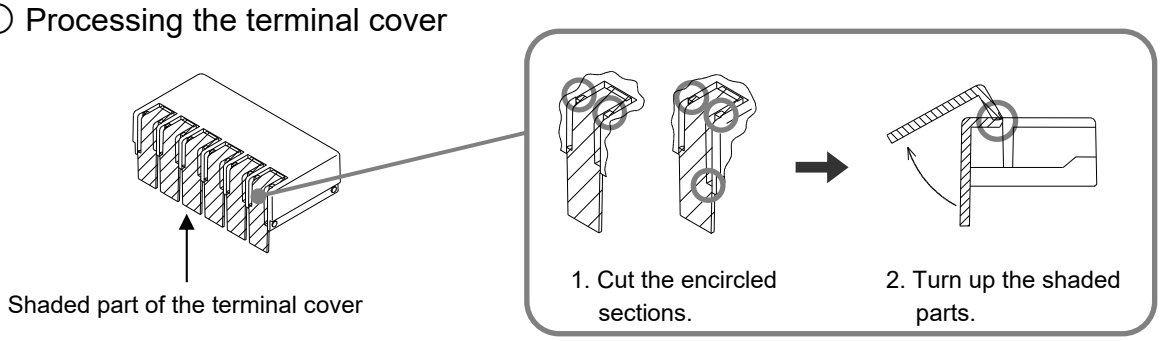
■ Individual mounting/Close horizontal mounting



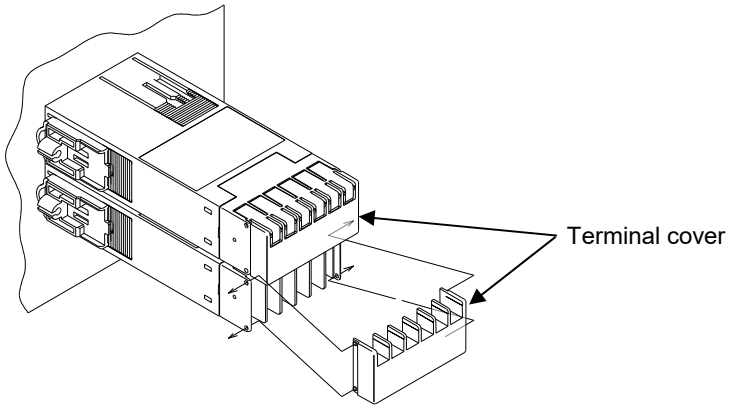
■ Close vertical mounting

Cut off the shaded parts in the following figure. For this post-processing, used a utility knife. The use of edged tools other than a utility knife may damage the terminal cover.

① Processing the terminal cover



② Mounting the terminal cover



MEMO

PARTS DESCRIPTION AND BASIC OPERATION

4

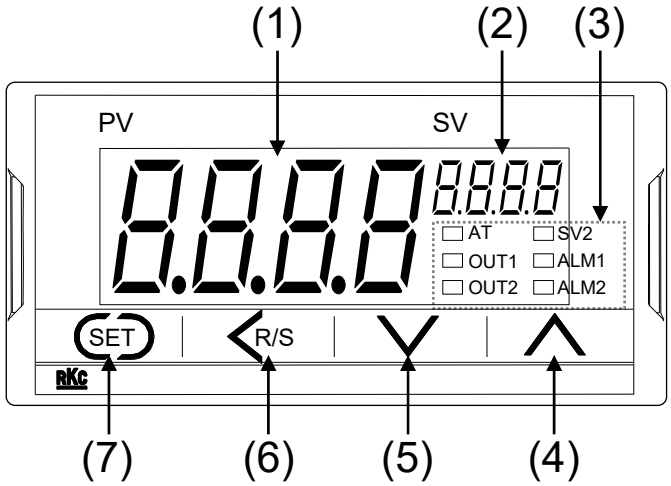
This chapter describes name of parts, setting and modifying values and other basic operations.

4.1 Parts Description

This section describes various display units and the key functions.

NOTE

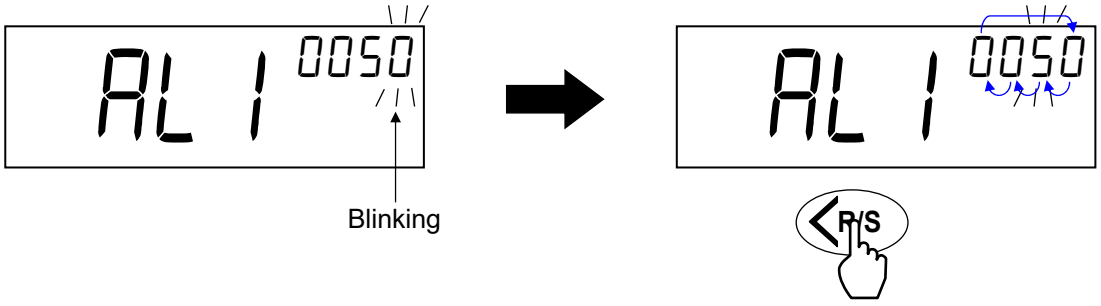
To avoid damage to the instrument, never use a sharp object to press keys.



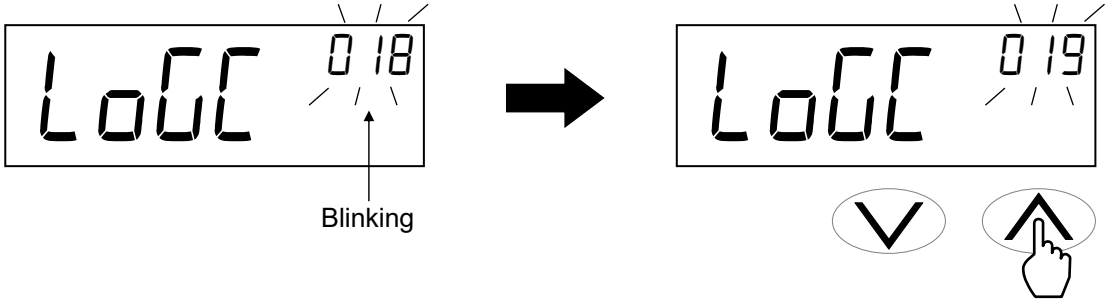
(1)	Measured value (PV) display [SA200: Green SA201: Red]		Displays PV or various parameter symbols.
(2)	Set value (SV) display [SA200: Orange SA201: Red]		Displays SV or STEP set value (SV1, SV2). Displays various parameter set values.
(3)	Indication lamps		**Autotuning (AT) lamp [SA200: Green SA201: Red]** Flashes during Autotuning activated. (After Autotuning is completed: AT lamp will become OFF) **Output lamps (OUT1, OUT2) [SA200: Green SA201: Red]** OUT1: Lights when Output 1 is turned on. OUT2: Lights when Output 2 is turned on. **STEP set value (SV2) lamp [SA200: Orange SA201: Red]** Lights when the SV2 of STEP function is selected. **Alarm lamps (ALM1, ALM2) [SA200: Orange SA201: Red]** ALM1: Lights when Alarm 1 is turned on. ALM2: Lights when Alarm 2 is turned on.
(4)	∧	UP key	Increases numerals.
(5)	∨	DOWN key	Decreases numerals.
(6)	<R/S	Shift & R/S key	Shifts digits when settings are changed. Selects the RUN/STOP function.
(7)	SET	Set key	Used for calling up parameters and set value registration.

4.2 Changing Set Value

- The blinking 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 blinking digit moves as follows.

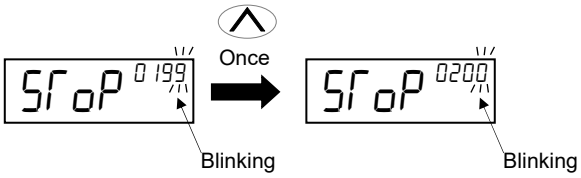


- For selective parameters, all digits will blink. Use the UP or DOWN key to set a number.

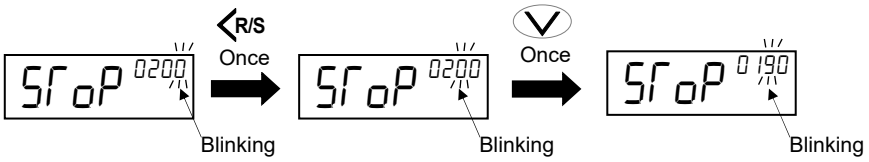


- The set value may be changed by pressing the UP or DOWN key.
  The following is also available when changing the set value

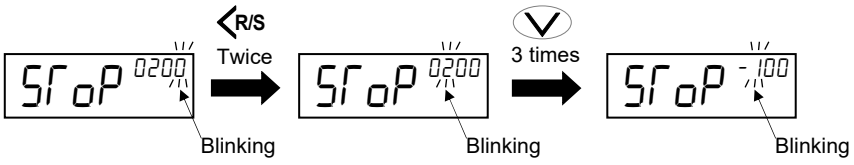
Increase SV from 199 °C to 200 °C:



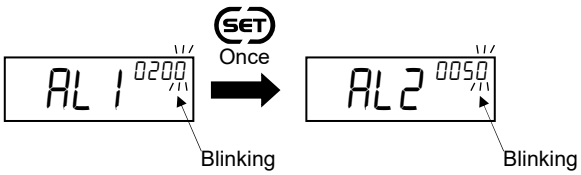
Decrease SV from 200 °C to 190 °C:



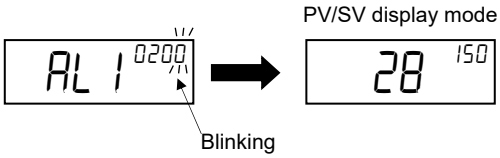
Decrease SV from 200 °C to –100 °C:



- **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. The modified data will not be stored only by operating the UP and DOWN keys.



- In case no operation is performed within one minute after the change of the setting, the mode will return to the PV/SV display mode. The modified data will not be registered in this case.

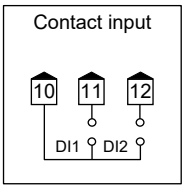


4.3 Switching Between Set Value (SV1) and STEP Set Value (SV2)

If the STEP function is provided, the set value (SV1) and the STEP set value (SV2) can be switched and used for control. The set value (SV1) and STEP set value (SV2) can be switched by the contact input DI1 (rear terminal numbers 10 and 11).

Contact input status:
Contact open: Set value (SV1)
Contact closed: STEP set value (SV2)

Contact input rear terminals:



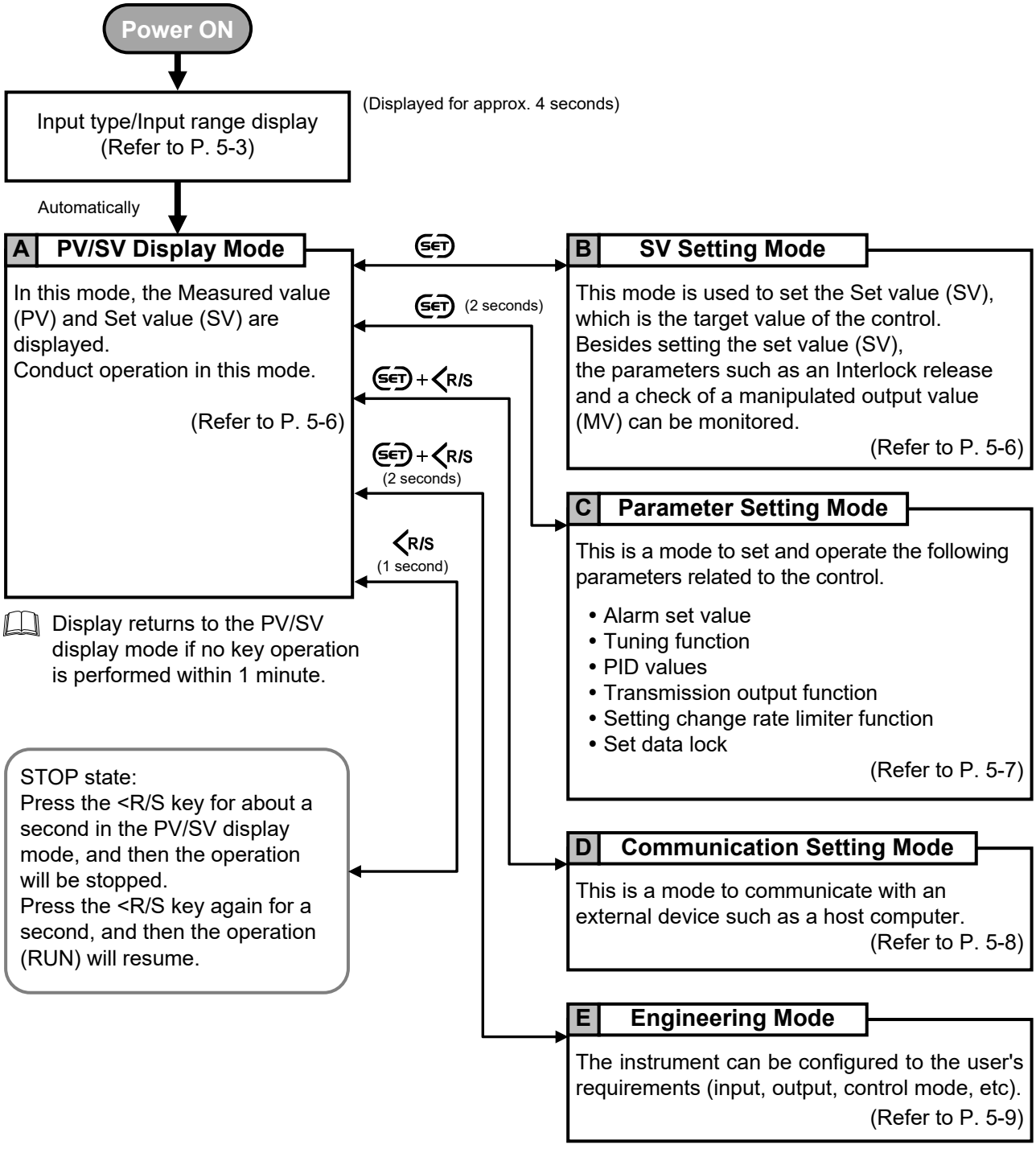
Dry contact input
At open: 500 kΩ or more
At close: 10 Ω or less

5 MODE SWITCHING

This chapter describes various modes and how to switch between them.

5.1 Switching Between Modes

The instrument has five different modes for operation and setting. Modes can be switched through the key operation of SET and Shift keys.



NOTE

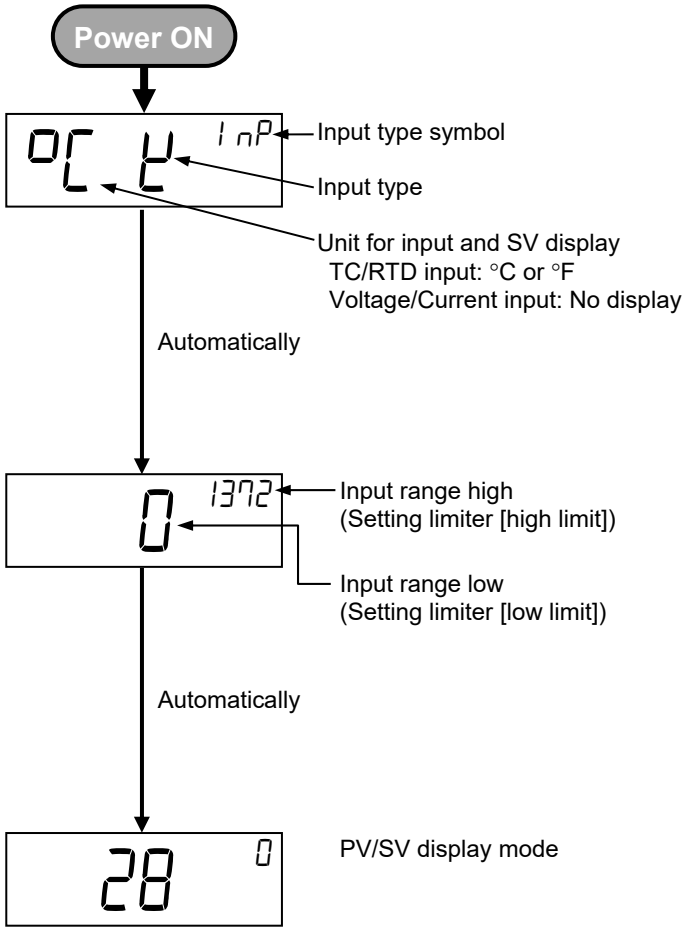
Engineering mode parameters can be changed in the STOP state.

The Engineering mode is initially locked. To switch to the Engineering mode, unlock it at “Set data lock (LCK).”

■ Input type, Units, and Input range

Immediately after the instrument is powered, the input type, the unit symbol and the input range will be displayed (in 4 seconds).

Example: When a range of 0 to 1372 °C with a thermocouple input (type K)



Input type symbol

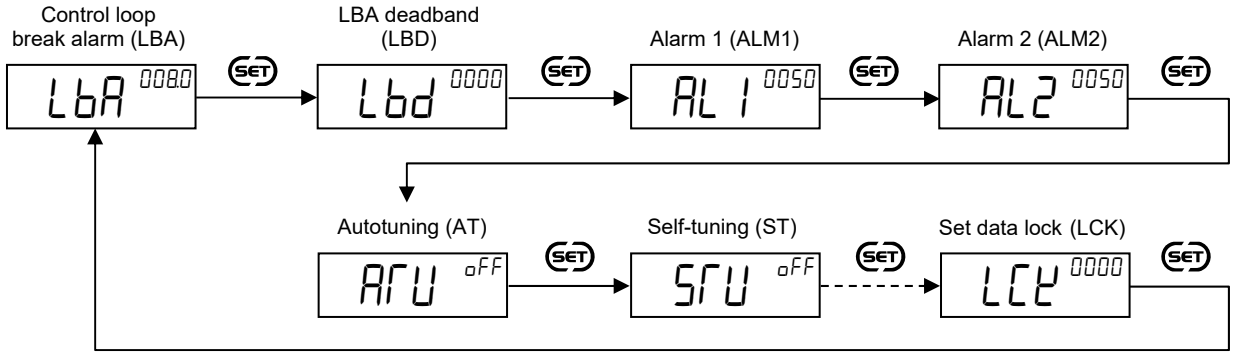
Symbol	Input type
K	Thermocouple K
J	Thermocouple J
r	Thermocouple R
S	Thermocouple S
b	Thermocouple B
E	Thermocouple E
T	Thermocouple T
n	Thermocouple N
P	Thermocouple PLII
C	Thermocouple W5Re/W26Re
U	Thermocouple U
L	Thermocouple L
JP	RTD JPt100
Pt	RTD Pt100
V	Voltage/Current

5.2 Switching Parameters within the Same Mode

■ SV setting mode, Parameter setting mode, and Communication setting mode

Every time the SET key is pressed, the screen goes to the next parameter.

Example: Parameter setting mode



📖 The displayed parameter varies depending on the product specifications.

■ Engineering mode

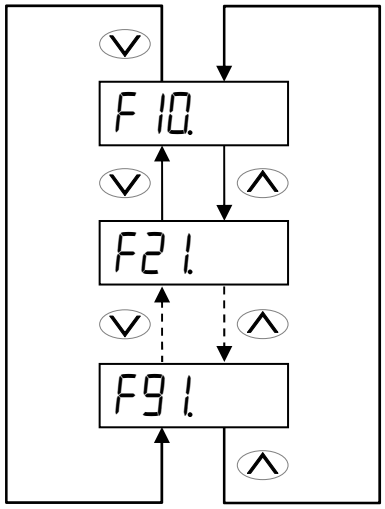
📖 **NOTE**

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

📖 When switching to the Engineering mode, it is necessary to release the Engineering mode lock.

● Switching between function blocks

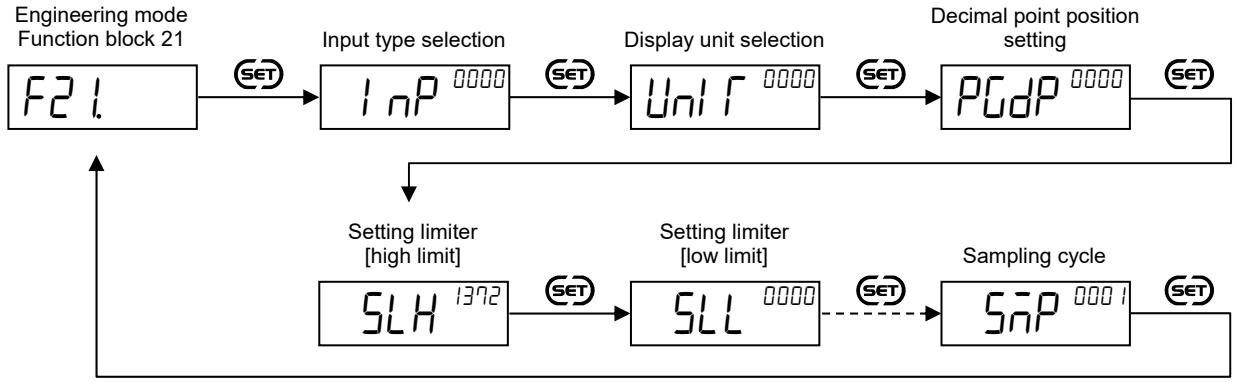
The parameters in the Engineering mode are grouped into function blocks. Each press of the UP key moves the function block one block forward. Each press of the DOWN key moves the function block one block backward.



● Scrolling through parameters

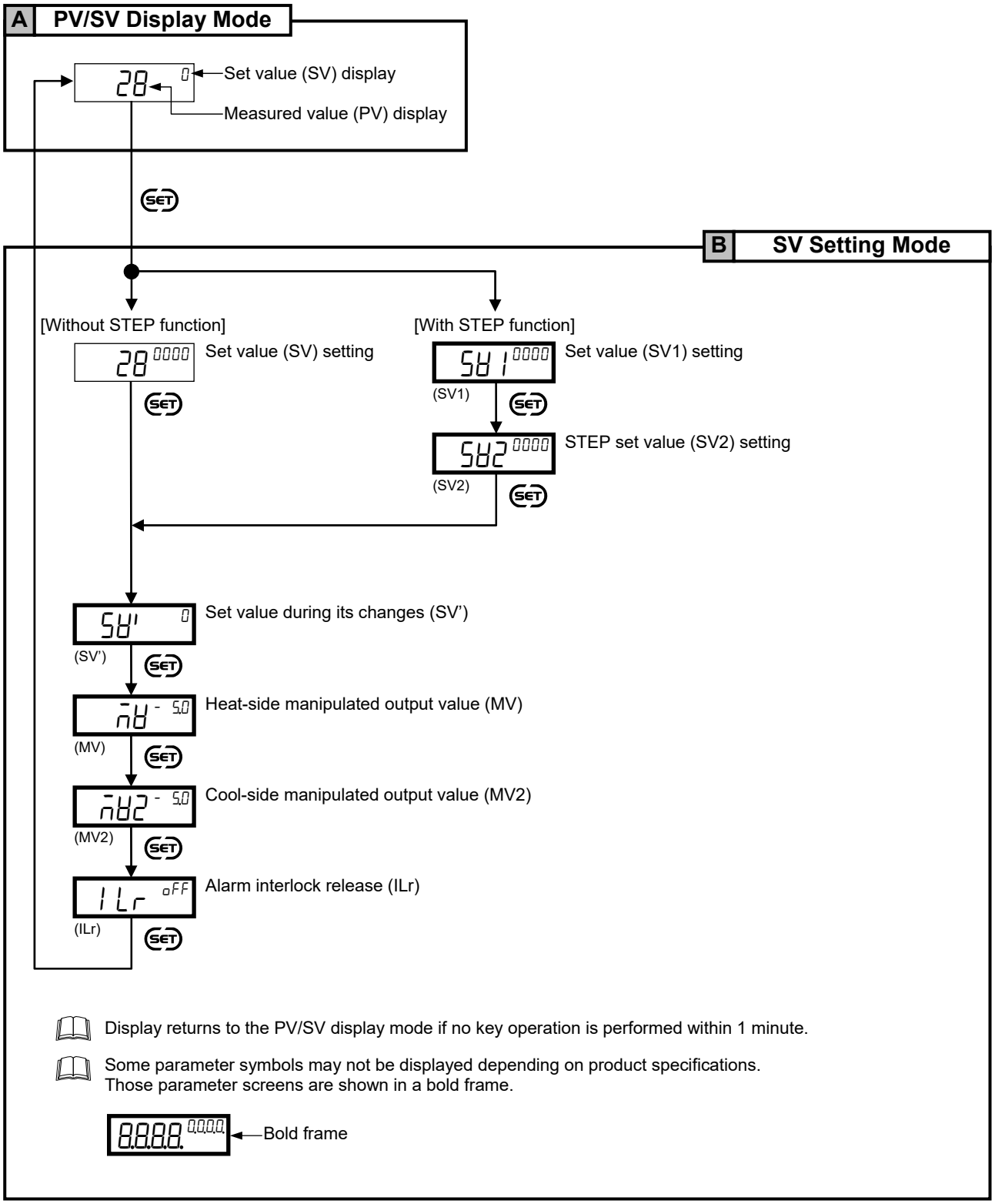
Each press of the SET key advances the parameter to the next within the same function block.

Example: Function block No. 21

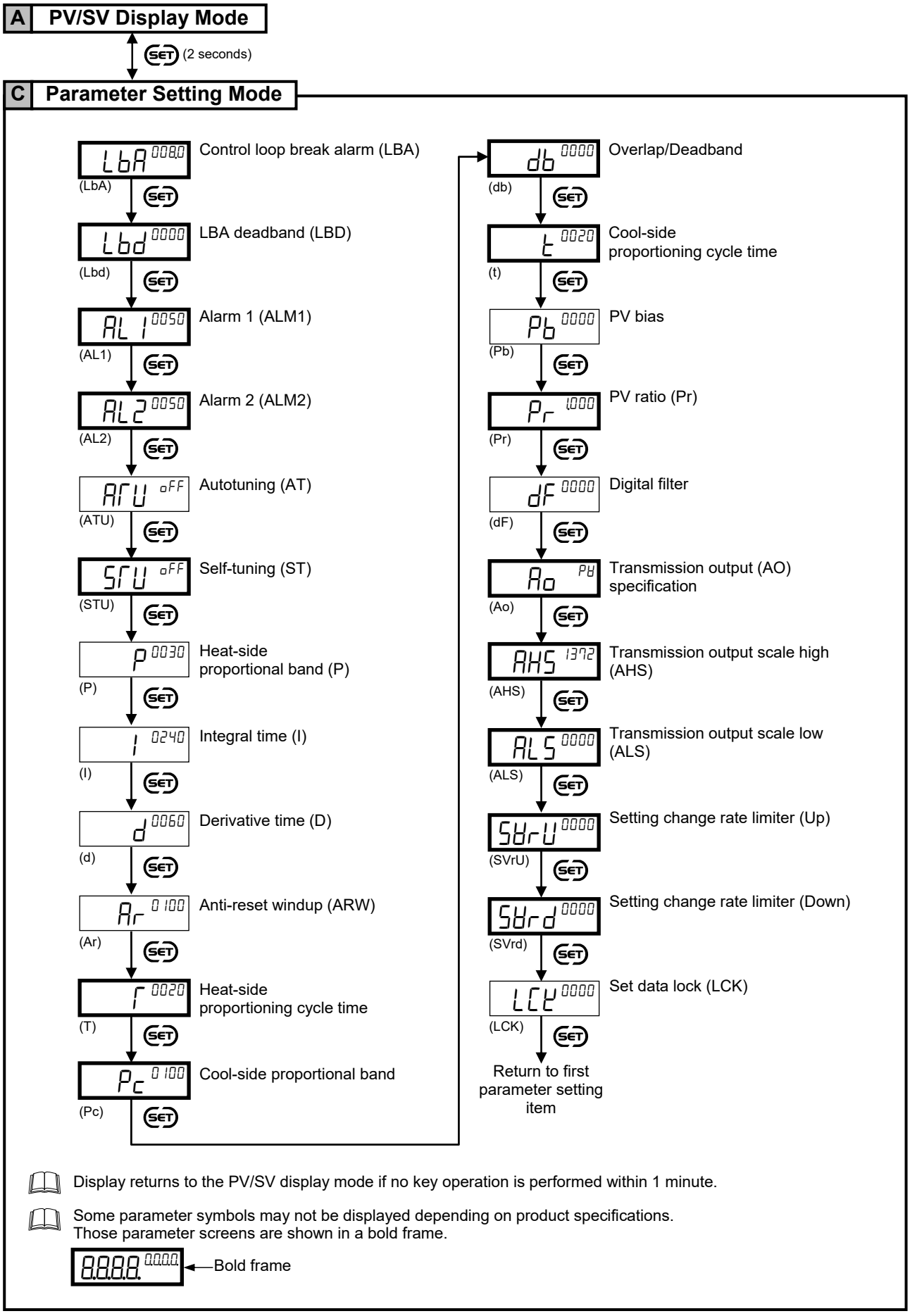


5.3 List of Parameter Operations

5.3.1 PV/SV display mode and SV setting mode

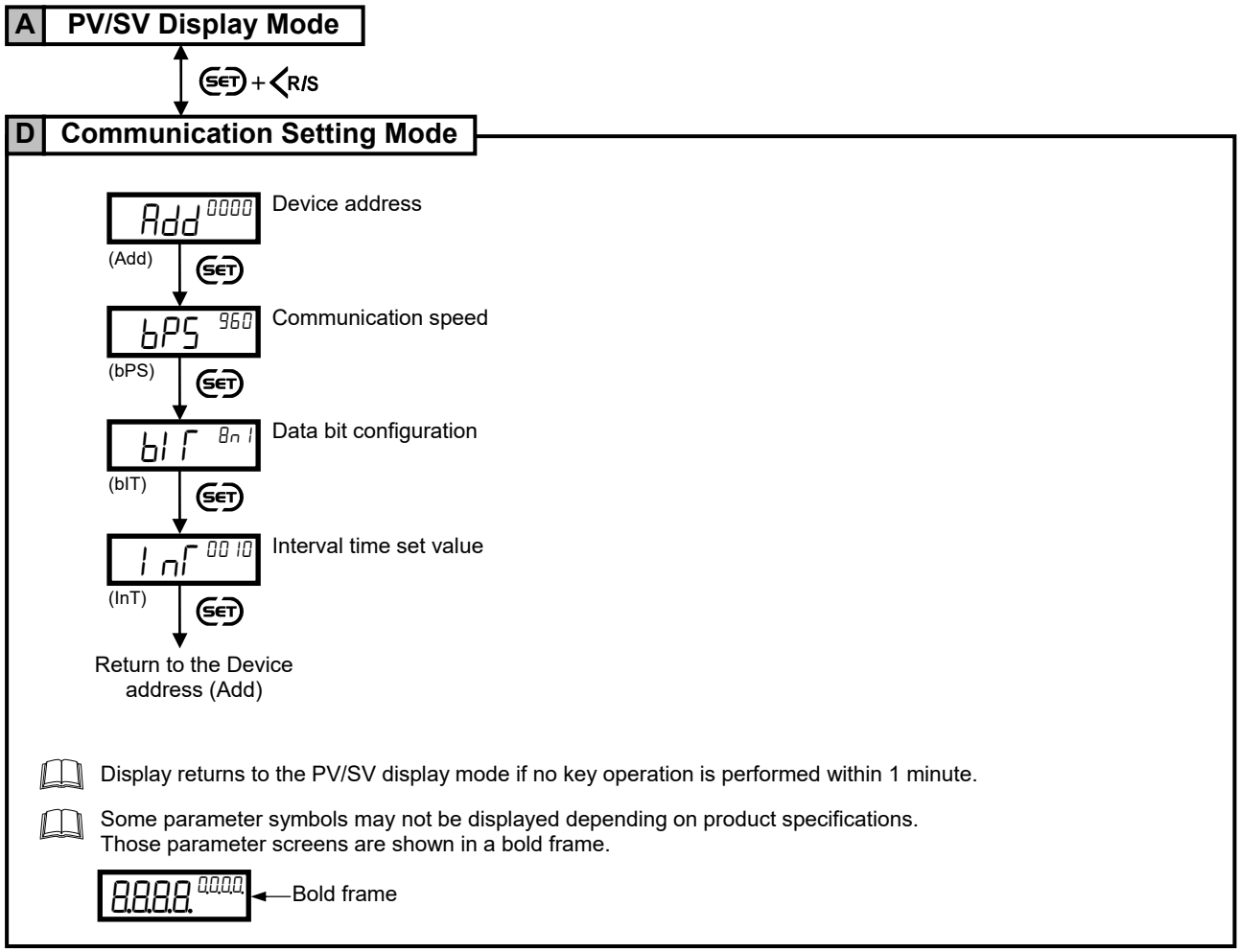


5.3.2 Parameter setting mode

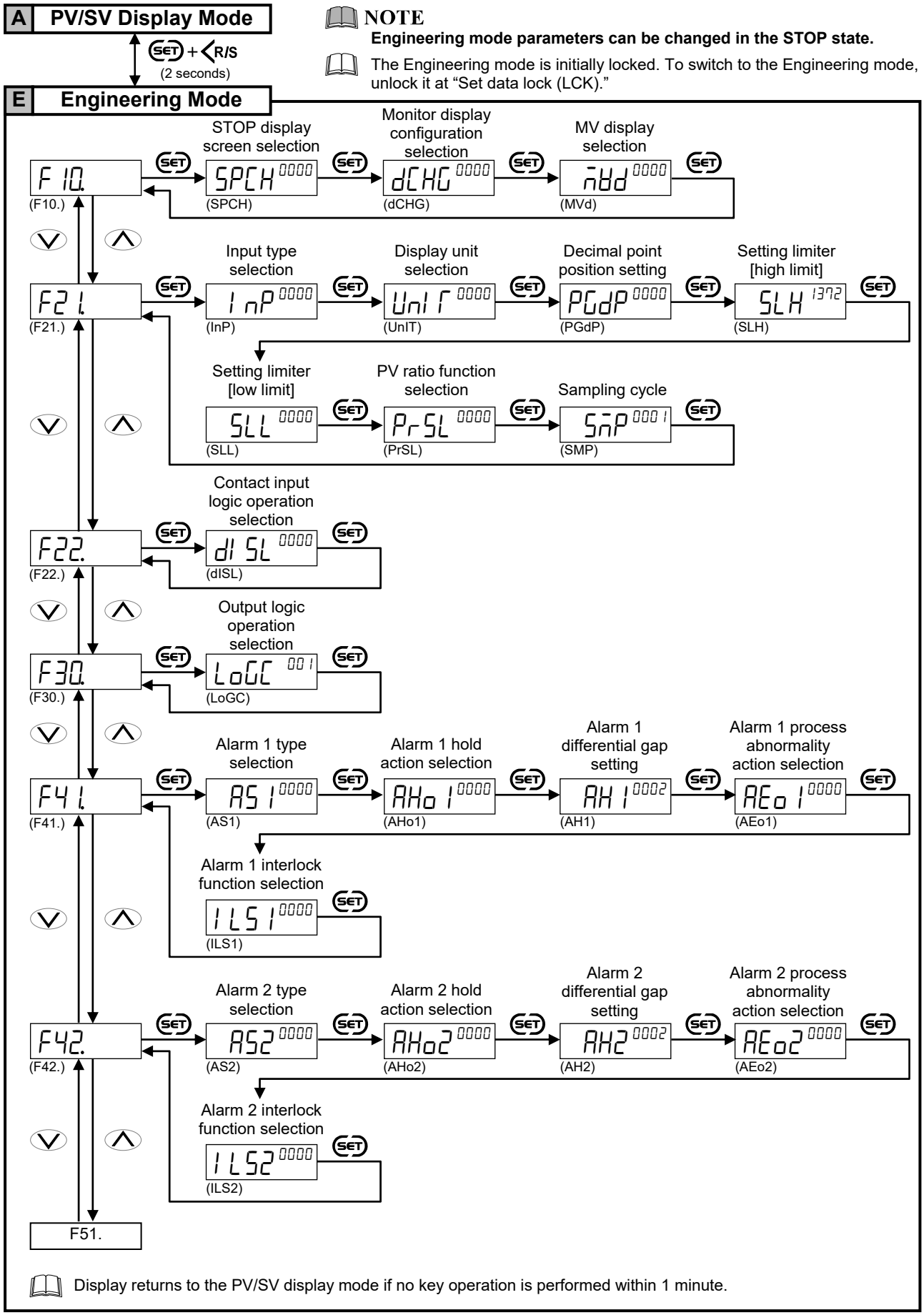


5.3.3 Communication setting mode

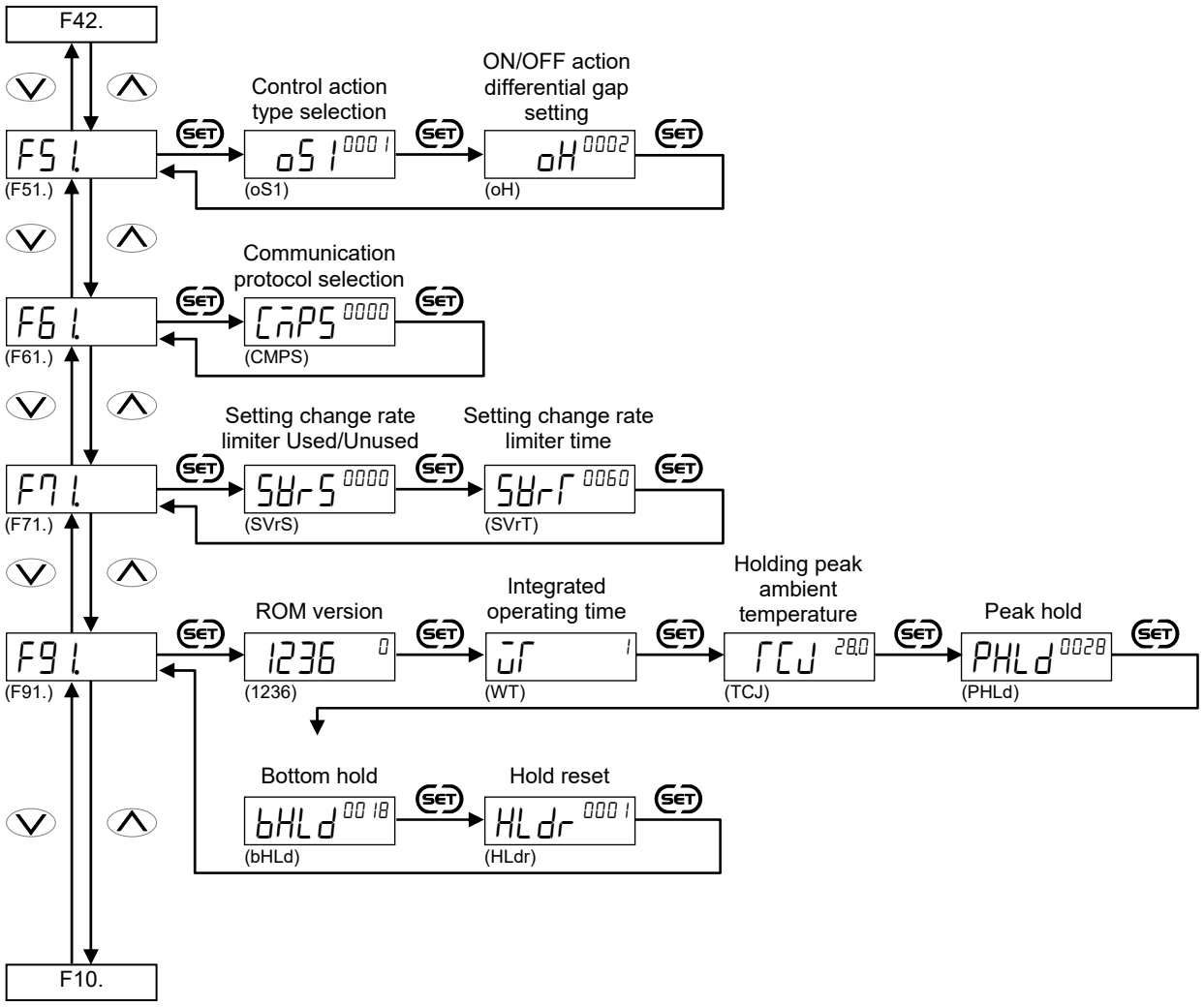
The communication setting mode is displayed when the communication function is specified as an option.



5.3.4 Engineering mode



E Engineering Mode



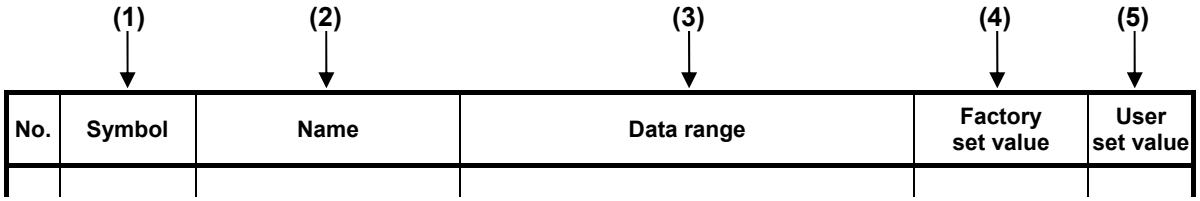
Display returns to the PV/SV display mode if no key operation is performed within 1 minute.

6

PARAMETER LIST

This chapter describes displays, names and data ranges of each parameter.

6.1 How to Read the Table



(1) Symbol: 7-segment parameter symbols shown on the Measured value (PV) display.

(2) Name: Name of parameter

(3) Data range: Data range of parameter

(4) Factory set value: Factory set value of parameters

(5) User set value: Stores parameter values set by the user.
This may be useful when the data is initialized.

6.2 PV/SV Display Mode [A]

No.	Symbol	Name	Data range	Factory set value	User set value
1	—	Measured value (PV) display	Within input range [Setting limiter [low limit] − (5 % of span) to Setting limiter [high limit] + (5 % of span)] Varies with the setting of the Decimal point position.	—	
2	—	Set value (SV) display	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—	

6.3 SV Setting Mode [B]

No.	Symbol	Name	Data range	Factory set value	User set value
3	—	Set value (SV) setting	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0	
	SV1 (SV1)	Set value (SV1) setting [1]			
4	SV2 (SV2)	STEP set value (SV2) setting [1]			
5	SV' (SV')	Set value during its changes (SV') [2]	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—	
6	oV (MV)	Heat-side manipulated output value (MV) [3]	−5.0 to +105.0 %	—	
7	oV2 (MV2)	Cool-side manipulated output value (MV2) [4]	−5.0 to +105.0 %	—	
8	ILr (ILr)	Alarm interlock release [5]	on: Alarm interlock state oFF: Alarm interlock release For Alarm interlock release, refer to P.10-11.	—	

[1] This parameter is displayed in the following cases.
- When contact input is specified at the time of ordering.
- When "STEP function" is set in “Contact input logic operation selection”

[2] This parameter is displayed when the “Setting change rate limiter Used/Unused" is set to "Used.”

[3] This parameter is displayed when the “MV display selection” is set to the “MV display provided.”

[4] This parameter is displayed in the following cases.
- When the “MV display provided” is set in the “MV display selection”
- When the Heat/Cool PID control with autotuning is specified

[5] This parameter is displayed when the alarm interlock function is enabled in the “Alarm 1 interlock function selection” or the “Alarm 2 interlock function selection.”

6.4 Parameter Setting Mode [C]

No.	Symbol	Name	Data range	Factory set value	User set value
9	LbA (LbA)	Control loop break alarm (LBA) [1]	0.0 to 200.0 minutes (0.0: OFF)	8.0	
10	Lbd (Lbd)	LBA deadband (LBD) [1]	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0	
11	AL1 (AL1)	Alarm 1 (ALM1) [2]	Process alarm, SV alarm: Same as input range. (Setting limiter [low limit] to Setting limiter [high limit]) Deviation alarm: −Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 50 (50.0) Voltage/ Current inputs: 5.0	
12	AL2 (AL2)	Alarm 2 (ALM2) [3]		TC/RTD inputs: 50 (50.0) Voltage/ Current inputs: 5.0	
13	ATU (ATU)	Autotuning (AT)	on: AT start or execution oFF: AT end or cancel When the Autotuning is finished, the control will automatically return to “oFF.”	oFF	
14	STU (STU)	Self-tuning (ST) [4]	on: Self-tuning ON oFF: Self-tuning OFF	oFF	
15	P (P)	Heat-side proportional band (P)	0 (0.0) to Span (However, 9999 digits or less) 0 (0.0): ON/OFF action Varies with the setting of the Decimal point position.	TC/RTD inputs: 30 (30.0) Voltage/ Current inputs: 3.0	
16	I (I)	Integral time (I)	0 to 3600 seconds (0: PD action)	240	
17	d (d)	Derivative time (D)	0 to 3600 seconds (0: PI action)	60	
18	Ar (Ar)	Anti-reset windup (ARW)	0 to 100 % of heat-side proportional band (0: Integral action OFF)	100	
19	T (T)	Heat-side proportioning cycle time [5]	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2	
20	Pc (Pc)	Cool-side proportional band [6]	1 to 1000 % of heat-side proportional band	100	
21	db (db)	Overlap/Deadband [6]	−Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0	

[1] This parameter is displayed when the “Alarm 1 type selection” is set to the “Control loop break alarm (LBA).”

[2] This parameter is displayed when the alarm type is set in the “Alarm 1 type selection.”

[3] This parameter is displayed when the alarm type is set in the “Alarm 2 type selection.”

[4] This parameter is displayed when the “Control action type selection” is set to 0 or 1.

[5] This parameter is displayed when the output type is the relay contact output or voltage pulse output.
This parameter is displayed when the “Output logic operation selection” is set to “Control output” or “Heat-side control output.”

[6] This parameter is displayed when the Heat/Cool PID control with autotuning is selected.

Parameter Setting Mode [C]

No.	Symbol	Name	Data range	Factory set value	User set value
22	t (t)	Cool-side proportioning cycle time [1]	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2	
23	Pb (Pb)	PV bias	−Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0	
24	Pr (Pr)	PV ratio (Pr) [2]	0.500 to 1.500 times	1.000	
25	dF (dF)	Digital filter	0 to 100 seconds (0: Digital filter OFF)	0	
26	Ao (Ao)	Transmission output (AO) specification [3]	PV: Measured value (PV) SV: Set value (SV) dEV: Deviation (DEV) MV: Manipulated output value (MV)	PV	
27	AHS (AHS)	Transmission output scale high (AHS) [3]	Measured value (PV): Same as input range. * (Transmission output scale low to Setting limiter [high limit]) Set value (SV): Same as input range. * (Transmission output scale low to Setting limiter [high limit]) Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) (Transmission output scale low to +Span) Manipulated output value (MV): 0.0 to 100.0 % (Transmission output scale low to 100.0 %) * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range high Voltage/ Current inputs: 100.0	
28	ALS (ALS)	Transmission output scale low (ALS) [3]	Measured value (PV): Same as input range. * (Setting limiter [low limit] to Transmission output scale high) Set value (SV): Same as input range. * (Setting limiter [low limit] to Transmission output scale high) Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) (−Span to Transmission output scale high) Manipulated output value (MV): 0.0 to 100.0 % (0.0 to Transmission output scale high) * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range low Voltage/ Current inputs: 0.0	

[1] This parameter is displayed in the following cases.
- When the output type for output 2 [OUT2] is specified when ordering. (Relay contact output or Voltage pulse output)
- When the Cool-side control output is set in the “Output logic operation selection”
- When the "Heat/Cool PID action with autotuning" is set in the "Control action type selection"

[2] This parameter is displayed when the PV ratio function is enabled in the "PV ratio function selection."

[3] This parameter is displayed in the following cases.
- When the current output is specified at the time of ordering.
- When a code that includes transmission output is selected from the output assignment codes when ordering.

Parameter Setting Mode [C]

No.	Symbol	Name	Data range	Factory set value	User set value
29	SHrU (SVrU)	Setting change rate limiter (Up) [1]	TC/RTD inputs: 0 (0.0) to Span °C [°F]/unit time [2] (However, 9999 digits or less) Voltage/ Current inputs: 0 (0.0) to Span/unit time [2] (However, 9999 digits or less) 0 (0.0): Limiter OFF Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0	
30	SHrd (SVrd)	Setting change rate limiter (Down) [1]		TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0	
31	LCK (LCK)	Set data lock (LCK)	0000 to 1111 Refer to Table 1 for description of the Set data lock.	0000	

[1] This parameter is displayed when the “Setting change rate limiter Used/Unused” is set to “Used.”

[2] The unit time can be set by the “Setting change rate limiter time.” (Factory set value: 60 seconds)

Table 1 ×: Settable-Data unlocked —: Unsettable-Data locked

Set data	Setting items of Engineering mode	Set value (SV)	Alarm set value (Alarm 1, Alarm 2)	Other setting items
0000	—	×	×	×
0001	—	×	×	—
0010	—	×	—	×
0011	—	×	—	—
0100	—	—	×	×
0101	—	—	×	—
0110	—	—	—	×
0111	—	—	—	—
1000	×	×	×	×
1001	×	×	×	—
1010	×	×	—	×
1011	×	×	—	—
1100	×	—	×	×
1101	×	—	×	—
1110	×	—	—	×
1111	×	—	—	—

The data lock function only prevents setting changes being made from the front keys.
Setting changes can still be made through communication transmission.

6.5 Communication Setting Mode [D]

The Communication setting mode is displayed when RKC communication or Modbus is specified as an optional function at the time of ordering.

No.	Symbol	Name	Data range	Factory set value	User set value
32	Add (Add)	Device address	0 to 99	0	
33	bPS (bPS)	Communication speed	240: 2400 bps 480: 4800 bps 960: 9600 bps 1920: 19200 bps 3840: 38400 bps 5760: 57600 bps	960	
34	bIT (bIT)	Data bit configuration	Refer to Table 2 for Data bit configurations.	8n1	
35	InT (InT)	Interval time set value	0 to 250 ms	10	

Table 2

Set value	Data bit	Parity bit	Stop bit
7n1 (7n1)	7	None	1
7n2 (7n2)	7	None	2
7E1 (7E1)	7	Even	1
7E2 (7E2)	7	Even	2
7o1 (7o1)	7	Odd	1
7o2 (7o2)	7	Odd	2
8n1 (8n1)	8	None	1
8n2 (8n2)	8	None	2
8E1 (8E1)	8	Even	1
8E2 (8E2)	8	Even	2
8o1 (8o1)	8	Odd	1
8o2 (8o2)	8	Odd	2

: Not settable for Modbus

6.6 Engineering Mode [E]

⚠ WARNING

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

NOTE

Parameters in Engineering mode are settable only when the controller is in STOP mode. However, only checking can be made even in the RUN state.

■ Function block 10

No.	Symbol	Name	Data range	Factory set value	User set value
36	F 10. (F10.)	Function block 10	This is the first parameter symbol of Function block 10	—	
37	SPCH (SPCH)	STOP display screen selection	0: STOP is displayed on the PV display unit. (TYPE 1) 1: STOP is displayed on the SV display unit. (TYPE 2) 2: No selection from RUN to STOP by the front key can be made.	0	
38	dCHG (dCHG)	Monitor display configuration selection	0: PV/SV display 2: Only SV display 1: Only PV display	0	
39	nUd (MVd)	MV display selection	0: MV display not provided 1: MV display provided	0	

■ Function block 21

No.	Symbol	Name	Data range	Factory set value	User set value
40	F2 1. (F21.)	Function block 21	This is the first parameter symbol of Function block 21	—	
41	I nP (InP)	Input type selection	0: Thermocouple K [1] 1: Thermocouple J [1] 2: Thermocouple R [1] 3: Thermocouple S [1] 4: Thermocouple B [1] 5: Thermocouple E [1] 6: Thermocouple N [1] 7: Thermocouple T [1] 8: Thermocouple W5Re/W26Re [1] 9: Thermocouple PL II [1] 10: Thermocouple U [1] 11: Thermocouple L [1] 12: RTD Pt100 [1] 13: RTD JPt100 [1] 14: 0 to 5 V DC or 0 to 20 mA DC [1, 2] 15: 1 to 5 V DC or 4 to 20 mA DC [1, 2] 16: 0 to 10 V DC [1]	Factory set value varies depending on the instrument specification.	

[1] Input type (TC/RTD to voltage/current inputs or voltage/current inputs to TC/RTD) cannot be changed because the hardware is different.

[2] For the current input specification, an external resistor of 250 Ω must be connected between the input terminals.

Function block 21

No.	Symbol	Name	Data range	Factory set value	User set value
42	UnIT (UnIT)	Display unit selection	0: °C 1: °F	0	
43	PGdP (PGdP)	Decimal point position setting	0: No digit below decimal point 1: 1 digit below decimal point 2: 2 digits below decimal point 3: 3 digits below decimal point	Factory set value varies depending on the instrument specification.	
44	SLH (SLH)	Setting limiter [high limit]	−1999 to +9999 • Refer to the Table 3 for the setting range of the Setting limiter [high limit]/Setting limiter [low limit] for each input type. • For the input range, refer to "**Input Range Table**" (P. 1-6). • This instrument sets the input range with the Setting limiter. Please note that changing the Setting limiter will also change the input range.	Factory set value varies depending on the instrument specification.	
45	SLL (SLL)	Setting limiter [low limit]		Factory set value varies depending on the instrument specification.	
46	PrSL (PrSL)	PV ratio function selection	0: Disable PV ratio function 1: Enable PV ratio function	0	
47	SMP (SMP)	Sampling cycle	0: 250 ms (0.25 seconds) 1: 500 ms (0.5 seconds)	1	

Table 3

Input type		Setting range
Thermocouple (TC)	K	−199 to +1372 °C (−326 to +2502 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	J	−199 to +1200 °C (−326 to +2192 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	R	0 to 1769 °C (0 to 3216 °F)
	S	0 to 1769 °C (0 to 3216 °F)
	B	0 to 1820 °C (0 to 3308 °F)
	E	0 to 1000 °C (0 to 1832 °F)
	N	0 to 1300 °C (0 to 2372 °F)
		0.0 to 999.9°C (0.0 to 999.9 °F)
	T	−199 to +400 °C (−326 to +752 °F)
		−199.9 to +400.0 °C (−199.9 to +752.0 °F)
	W5Re/W26Re	0 to 2320 °C (0 to 4208 °F)
	PL II	0 to 1390 °C (0 to 2534 °F)
	U	−199 to +600 °C (−326 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	Pt100 (JIS/IEC) [1]	−199.9 to +649.0 °C (−199.9 to +999.9 °F)
	JPt100 (JIS)	
Voltage [2]	0 to 5 V DC	−1999 to +9999 (programmable scale)
	1 to 5 V DC	
	0 to 10 V DC	
Current [2, 3]	0 to 20 mA DC	−1999 to +9999 (programmable scale)
	4 to 20 mA DC	

[1] **IEC** (International Electrotechnical Commission) is equivalent to **JIS**, **DIN** and **ANSI**.
[2] In case of voltage/current inputs, SLH can be set below SLL.
[3] For the current input specification, an external resistor of 250 Ω must be connected between the input terminals.

☞ Refer to **14.1.1 When "Input type selection (InP)" is changed (P. 14-2)**.

■ Function block 22

No.	Symbol	Name	Data range	Factory set value	User set value
48	F22. (F22.)	Function block 22	This is the first parameter symbol of Function block 22	—	
49	dI SL (dISL)	Contact input logic operation selection	0: DI1: STEP function DI2: RUN/STOP transfer 1: DI1: STEP function DI2: Alarm interlock release 2: DI1: Alarm interlock release DI2: RUN/STOP transfer	0	

■ Function block 30

No.	Symbol	Name	Data range	Factory set value	User set value
50	F30. (F30.)	Function block 30	This is the first parameter symbol of Function block 30	—	
51	LoGC (LoGC)	Output logic operation selection	001: OUT1: Control output OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 002: OUT1: Heat-side control output OUT2: Cool-side control output (In case of direct action or reverse action, it is OFF) 003: OUT1: Control output OUT2: Alarm 1 output (De-energized) (Alarm 2 can be checked via communication or by lamp lighting) 004: OUT1: Control output OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 005: OUT1: Control output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 006: OUT1: Control output OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 007: OUT1: Control output OUT2: Not output (The Alarm state can be checked via communication or by lamp lighting) 008: OUT1: Control output OUT2: Alarm 1 output only (Energized) (Alarm 2 can be checked via communication or by lamp lighting) 009: OUT1: Alarm 1 output (Energized) OUT2: Alarm 2 output (Energized) 010: OUT1: Alarm 1 output (Energized) OUT2: Alarm 2 output (De-energized) 011: OUT1: Alarm 1 output (De-energized) OUT2: Alarm 2 output (De-energized) 012: OUT1: Transmission output OUT2: Control output 013: OUT1: Transmission output OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 014: OUT1: Transmission output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 015: OUT1: Transmission output OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 016: OUT1: Transmission output OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 017: OUT1: Transmission output OUT2: Alarm 1 output (Energized) 018: OUT1: Transmission output OUT2: Alarm 1 output (De-energized) 019: OUT1: Cool-side control output (In case of direct action or reverse action, it is OFF) OUT2: Heat-side control output	Factory set value varies depending on the instrument specification. *	

* Factory set value when no output assignment code is specified when ordering:
Depending on the control action specified at the time of order, the factory set value of the output assignment code is set to one of the following.
- PID action with autotuning: 001
- Heat/Cool PID action with autotuning: 002

■ Function block 41

No.	Symbol	Name	Data range	Factory set value	User set value
52	F41. (F41.)	Function block 41	This is the first parameter symbol of Function block 41	—	
53	AS1 (AS1)	Alarm 1 type selection	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm 9: Control loop break alarm (LBA)	Factory set value varies depending on the instrument specification.	
54	AHo1 (AHo1)	Alarm 1 hold action selection	0: Without alarm hold action 1: Effective when the power is turned on, or operation is changed from STOP to RUN. 2: Effective when the power is turned on, or operation is changed from STOP to RUN or the SV is changed.	Factory set value varies depending on the instrument specification.	
55	AH1 (AH1)	Alarm 1 differential gap setting	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/ Current inputs: 0.2	
56	AEo1 (AEo1)	Alarm 1 process abnormality action selection	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 1 not provided or LBA: 0 Alarm 1 provided: 1	
57	ILS1 (ILS1)	Alarm 1 interlock function selection	0: Disable Alarm 1 interlock function 1: Enable Alarm 1 interlock function	0	

■ Function block 42

No.	Symbol	Name	Data range	Factory set value	User set value
58	F42. (F42.)	Function block 42	This is the first parameter symbol of Function block 42	—	
59	AS2 (AS2)	Alarm 2 type selection	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm	Factory set value varies depending on the instrument specification.	
60	AHo2 (AHo2)	Alarm 2 hold action selection	0: Without alarm hold action 1: Effective when the power is turned on, or operation is changed from STOP to RUN. 2: Effective when the power is turned on, or operation is changed from STOP to RUN or the SV is changed.	Factory set value varies depending on the instrument specification.	
61	AH2 (AH2)	Alarm 2 differential gap setting	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/ Current inputs: 0.2	
62	AEo2 (AEo2)	Alarm 2 process abnormality action selection	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 2 not provided: 0 Alarm 2 provided: 1	
63	ILS2 (ILS2)	Alarm 2 interlock function selection	0: Disable Alarm 2 interlock function 1: Enable Alarm 2 interlock function	0	

■ Function block 51

No.	Symbol	Name	Data range	Factory set value	User set value
64	F51. (F51.)	Function block 51	This is the first parameter symbol of Function block 51	—	
65	oS1 (oS1)	Control action type selection	0: PID action with autotuning (Direct action) [D type] 1: PID action with autotuning (Reverse action) [F type] 2: Heat/Cool PID action with autotuning (Water cooling) [W type] 3: Heat/Cool PID action with autotuning (Air cooling) [A type]	Factory set value varies depending on the instrument specification.	
66	oH (oH)	ON/OFF action differential gap setting	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/ Current inputs: 0.2	

■ Function block 61

No.	Symbol	Name	Data range	Factory set value	User set value
67	F61. (F61.)	Function block 61	This is the first parameter symbol of Function block 61	—	
68	CMPS (CMPS)	Communication protocol selection	0: RKC standard protocol 1: Modbus protocol	Factory set value varies depending on the instrument specification.	

■ Function block 71

No.	Symbol	Name	Data range	Factory set value	User set value
69	F71. (F71.)	Function block 71	This is the first parameter symbol of Function block 71	—	
70	SVrS (SVrS)	Setting change rate limiter Used/Unused	0: Unused 1: Used	0	
71	SVrT (SVrT)	Setting change rate limiter time	1 to 3600 seconds	60	

■ Function block 91

No.	Symbol	Name	Data range	Factory set value	User set value
72	F91. (F91.)	Function block 91	This is the first parameter symbol of Function block 91	—	
73	1236 (1236)	ROM version	Display the version of loading software.	—	
74	WT (WT)	Integrated operating time	0 to 99999 hours	—	
75	TCJ (TCJ)	Holding peak ambient temperature	0.0 to 999.9 °C	—	
76	PHLd (PHLd)	Peak hold	Within input range (Setting limiter [low limit] to Setting limiter [high limit]) Varies with the setting of the Decimal point position.	—	
77	bHLd (bHLd)	Bottom hold		—	
78	HLdr (HLdr)	Hold reset	0: Hold reset execution After executing the hold reset, the value automatically returns to “1.”	1	

MEMO

7 OPERATION

This chapter describes the operating precautions and operating examples when the instrument is used for the first time.

7.1 Operating Precautions

Before starting the operation, check the following items.

■ Check before turning on the power

NOTE

- **All mounting and wiring must be completed before the power is turned on.**
- **Before turning on the power, check that the power supply voltage applied to the instrument is correct.**
- **Connect the input signal wiring and turn the power on. If the input signal wiring is not complete prior to turning the power on, the instrument determines that burnout has occurred.**

■ Power ON

As soon as the instrument is powered up, operation is started after the display of the input type and the input range. [Factory set value: RUN]

■ Action at input error

This instrument can be configured to provide an alarm output for handling input failures when the input exceeds (or falls below) the flashing Measured value (PV). At an input error state of this instrument, actions or outputs will be provided according to the setting.

☞ For the action at input error, refer to **8.5 Changing Error Handling at Input Error (P. 8-13)**.

■ Checking each parameter

The settings for the Set value (SV) and all parameters should be appropriate for the controlled system.
There are parameters in Engineering mode which cannot be changed when the controller is in RUN mode. Change the RUN/STOP mode from RUN to STOP when a change for the parameters in Engineering mode is necessary.

☞ For parameters in the Engineering mode, refer to **6. PARAMETER LIST (P. 6-1)**.

■ Operation at power failure

A power failure of 20 ms or less will not affect the control action. When a power failure of more than 20 ms occurs the instrument assumes that the power has been turned off.

■ Alarm hold action

- The alarm hold action is activated in the following cases.
  - When the power is turned on
  - When transferred from STOP (control STOP) to RUN (control RUN)
  - When the Set value (SV) is changed

☞ For details on the alarm hold action, refer to **10.1.2 Adding hold action to the alarm action (P. 10-7)**.

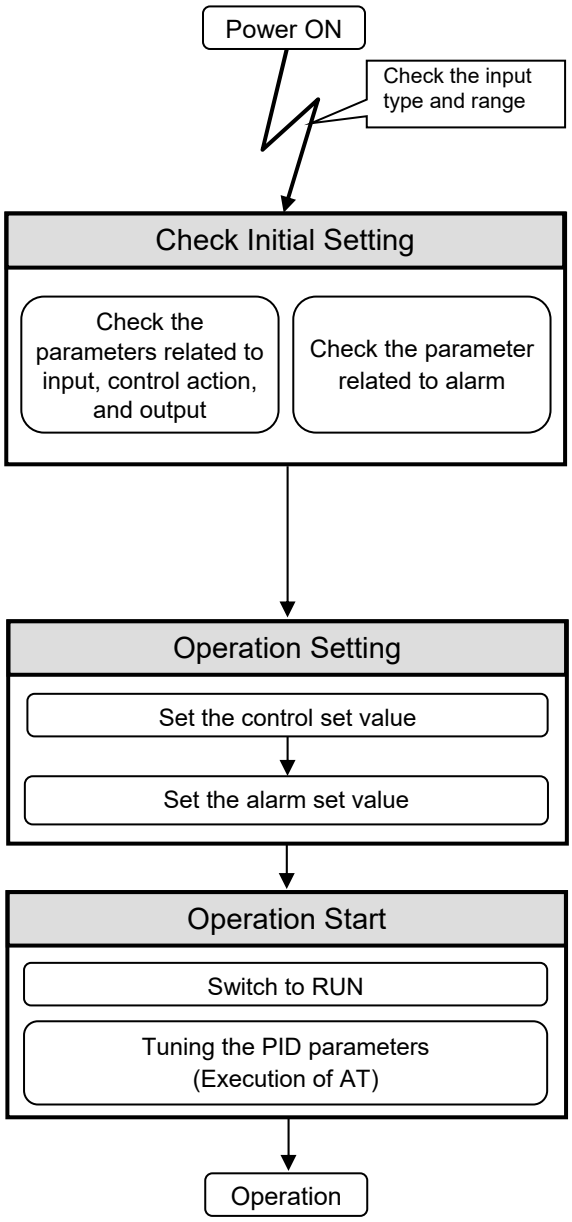
7.2 Setup Procedures

Set up the instrument prior to operating it referring to the following operating procedure.
Refer to the following setup example.

Setup example

Model code: SA200 F K02—M M—3 ∗ AB—N N / N / 05 /Y

Control action:	PID action with autotuning (Reverse action)
Input type/Range:	Thermocouple K, 0 to 400 °C
Alarm 1 [ALM1]:	Deviation high alarm
Alarm 2 [ALM2]:	Deviation low alarm
Output assignment code:	PID action + Alarm 1, Alarm 2 [OUT1: Control output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized)]
Control set value:	200 °C
Alarm 1 set value (ALM1):	+10 °C
Alarm 2 set value (ALM2):	−10 °C
PID constants:	Automatic setting by Autotuning (AT)



☞ Input type and input range can be checked when the power is turned on. To see the information on items, refer to ■ **Input type, Units, and Input range (P. 5-3)**.

The Input type and alarm type are set as specified at the time of ordering. If necessary, the factory set value can be changed.

☞ To check the initial settings, refer to **7.3 Initial Settings Before Operation (P. 7-4)**.

☞ To change input type, refer to **8.1 Changing Input (P. 8-2)**.

☞ To change alarm type, refer to **10.1 Using Alarm Function (P. 10-2)**.

☞ For operation setting, refer to the following:

- **7.4 Setting the Control Set Value [Set value (SV)] (P. 7-8)**
- **7.5 Setting the Alarm Set Value (P. 7-9)**

☞ For starting the operation, refer to the following:

- **7.6 RUN/STOP Transfer (P. 7-11)**
- **7.6 Tuning the PID Parameters (Execution AT) (P. 7-12)**

7.3 Initial Setup Before Operation

7.3.1 Engineering mode precautions

If necessary, check the parameters before operation to ensure if they are as specified at the time of ordering. Parameters which were not specified when ordered must be set before use.
Some functions may need to be set in the Engineering mode. Read the following part before attempting the setting.

⚠ WARNING

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

NOTE
Parameters in Engineering mode are settable only when the controller is in STOP mode. However, only checking can be made even in the RUN state.

■ Set value change and registration

- The blinking digit indicates which digit can be set. Every time the <R/S key is pressed, the blinking digit moves.
- If all the digits of the set value are blinking, the <R/S key is not available.
- **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.
  The modified data will not be stored only by operating the UP and DOWN keys.
- In case no operation is performed within 1 minute after the change of the setting, the mode will return to the PV/SV display mode. The modified data will not be registered in this case.

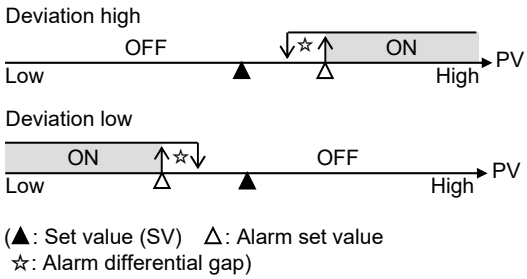
7.3.2 Checking the initial settings of the setup example (Checking parameters related to the input, control action, output and alarm)

To check the initial settings of the setup example, check the following parameters.

Setup example

Model code: SA200 F K02−M M−3＊AB−N N / N / 05 / Y

Control action: PID action with autotuning (Reverse action)
Input type/Range: Thermocouple K, 0 to 400 °C
Alarm 1 [ALM1]: Deviation high alarm
Alarm 2 [ALM2]: Deviation low alarm
Output assignment code:
PID action + Alarm 1, Alarm 2
OUT1: Control output
OUT2: *OR* output of Alarm 1 and Alarm 2
(De-energized)



Parameters to be checked (Engineering mode)

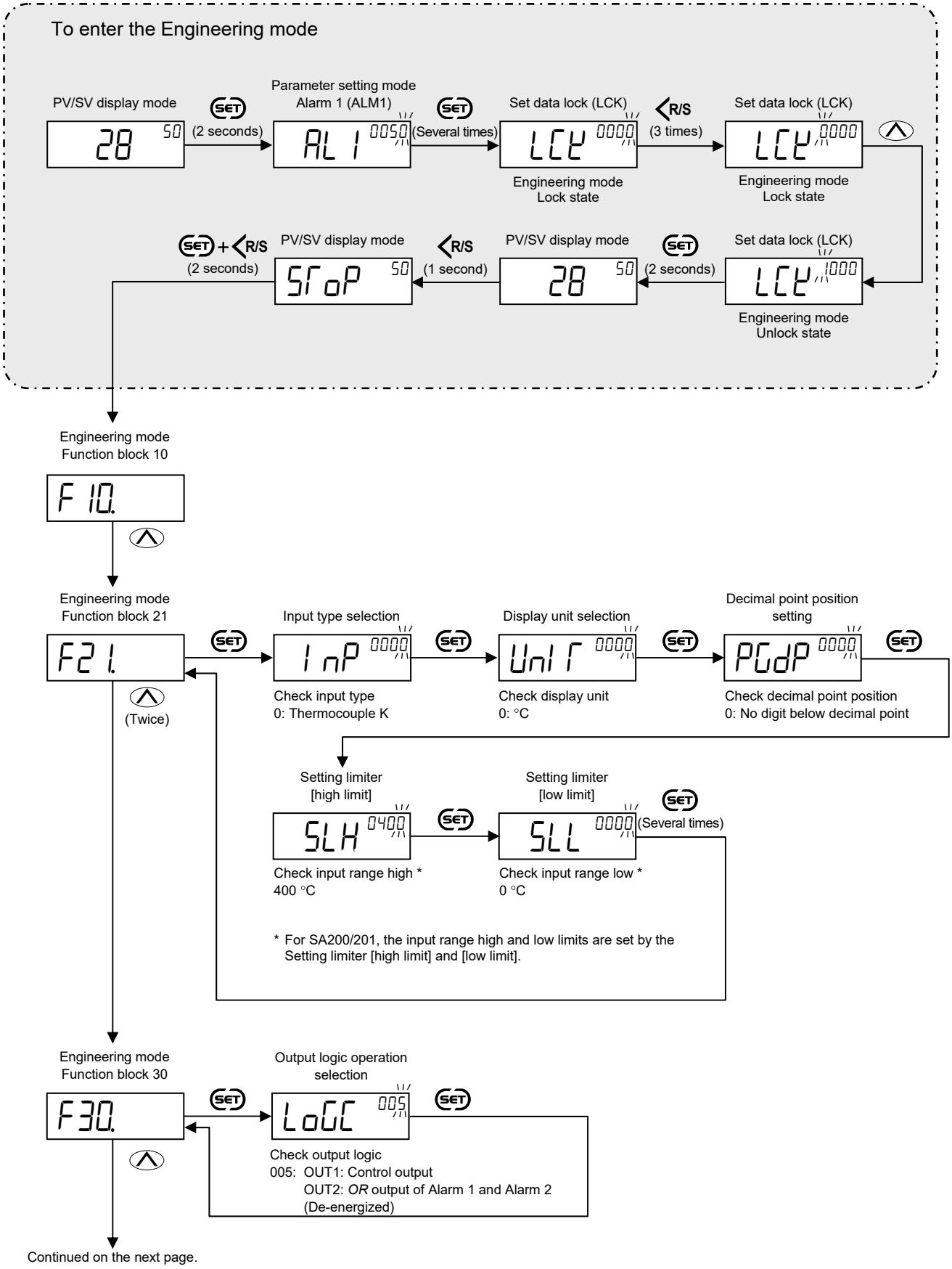
- Checking items

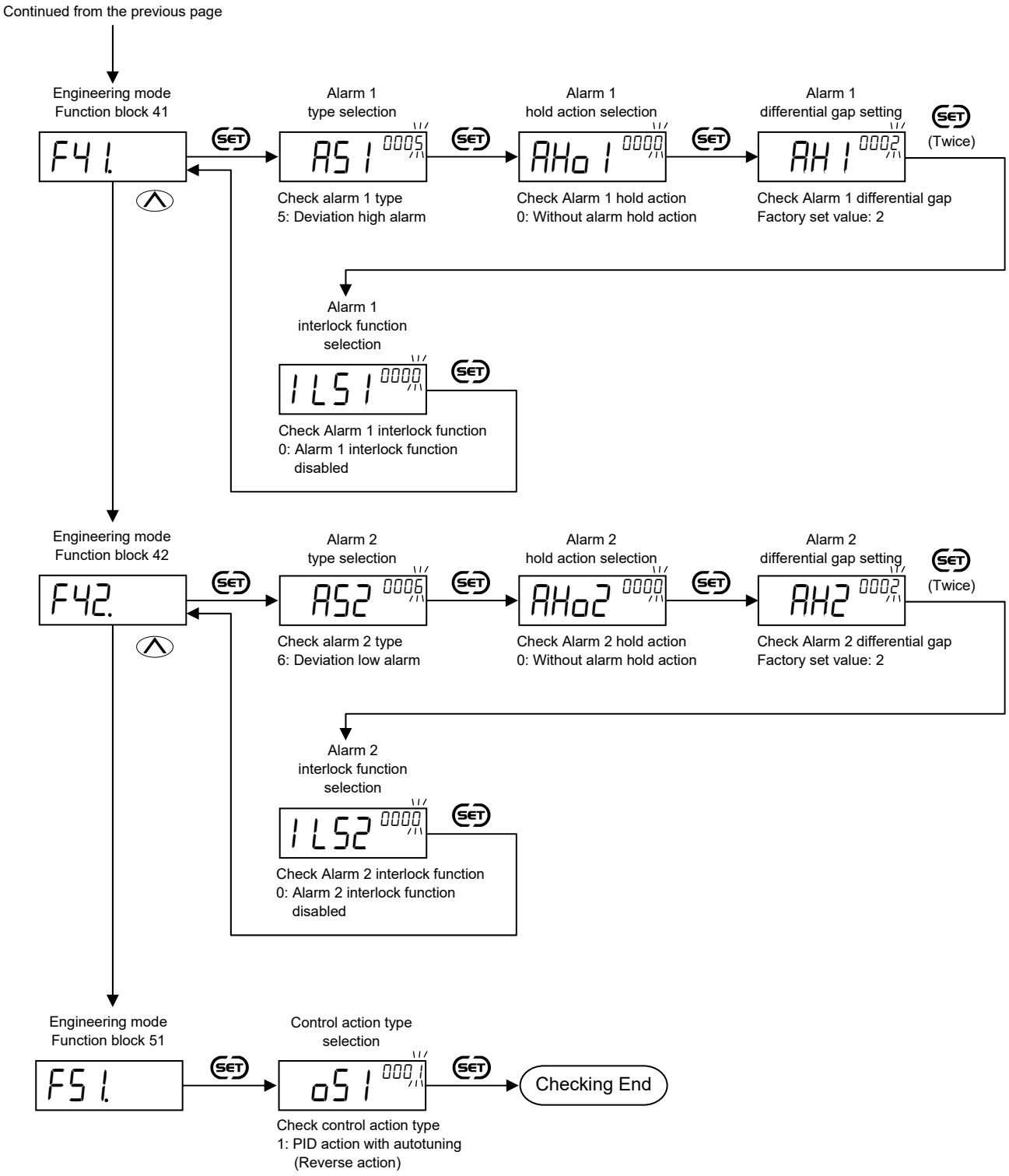
Function block 21 (F2 1.): Input type selection (In P)
Display unit selection (Unit)
Decimal point position setting (PGdP)
Setting limiter [high limit] (SLH)
Setting limiter [low limit] (SLL)
Function block 30 (F30.): Output logic operation selection (LoGC)
Function block 41 (F4 1.): Alarm 1 type selection (AS 1)
Alarm 1 hold action selection (AHo 1)
Function block 42 (F42.): Alarm 2 type selection (AS2)
Alarm 2 hold action selection (AHo2)
Function block 51 (F5 1.): Control action type selection (oS 1)

- Related setting items (Set only when necessary)

Function block 41 (F4 1.): Alarm 1 differential gap setting (AH 1)
Alarm 1 interlock function selection (ILS 1)
Function block 42 (F42.): Alarm 2 differential gap setting (AH2)
Alarm 2 interlock function selection (ILS2)

■ Setting procedure




Continued from the previous page
Engineering mode
Function block 41
F41.
Alarm 1
type selection
AS1 0005
Check alarm 1 type
5: Deviation high alarm
Alarm 1
hold action selection
AHo1 0000
Check Alarm 1 hold action
0: Without alarm hold action
Alarm 1
differential gap setting
AH1 0002
(Twice)
Check Alarm 1 differential gap
Factory set value: 2
Alarm 1
interlock function
selection
ILS1 0000
Check Alarm 1 interlock function
0: Alarm 1 interlock function
disabled
Engineering mode
Function block 42
F42.
Alarm 2
type selection
AS2 0006
Check alarm 2 type
6: Deviation low alarm
Alarm 2
hold action selection
AHo2 0000
Check Alarm 2 hold action
0: Without alarm hold action
Alarm 2
differential gap setting
AH2 0002
(Twice)
Check Alarm 2 differential gap
Factory set value: 2
Alarm 2
interlock function
selection
ILS2 0000
Check Alarm 2 interlock function
0: Alarm 2 interlock function
disabled
Engineering mode
Function block 51
F51.
Control action type
selection
oS1 0001
Check control action type
1: PID action with autotuning
(Reverse action)
Checking End

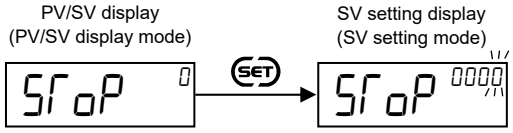
7.4 Setting the Control Set Value [Set value (SV)]

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

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

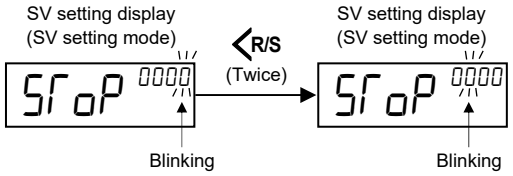
1. Select the SV setting mode

Press the SET key at PV/SV display mode until the SV display mode is displayed.



2. Shift the blinking digit to the hundreds digit

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

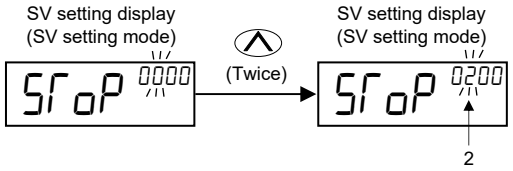


3. Change the numerical value from “0” to “2”

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

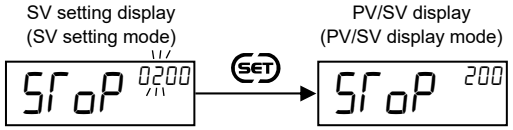
Setting range: Within input range
(Setting limiter [low limit] to Setting limiter [high limit])

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 SV setting display varies depends on the product specifications.

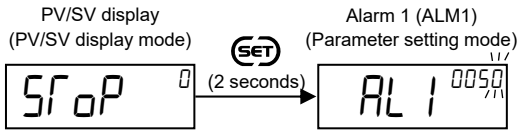
7.5 Setting the Alarm Set Value

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

[Setting example: Set the Alarm 1 (ALM1) to +10 °C and the Alarm 2 (ALM2) to −10 °C]

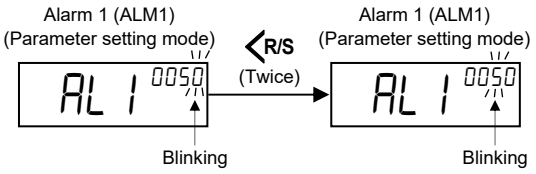
1. Switch the mode to the Parameter setting mode

Press and hold SET key for 2 seconds at PV/SV display mode until the Parameter setting mode is displayed.



2. Shift the blinking digit to the tens digit

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

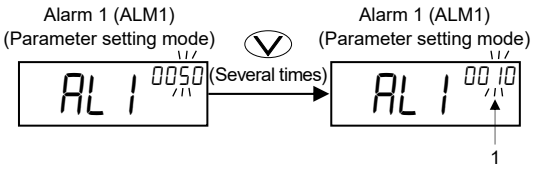


3. Change the numerical value from “5” to “1”

Press the DOWN key to change the the numerical value from “5” to “1.”

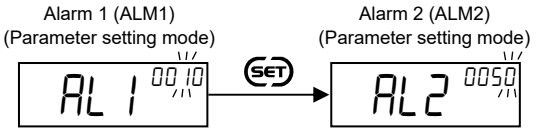
Setting range: Deviation alarm
−Span to +Span
(However, within −1999 to +9999 digits)

Factory set value: 50



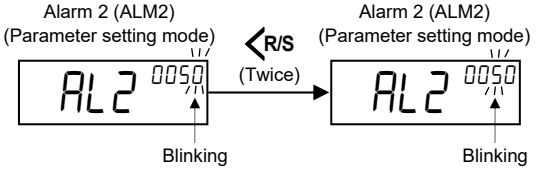
4. Store the alarm set value

Press the SET key to store the set value. The display changes to the next parameter “Alarm 2 (ALM2).”



5. Shift the blinking digit to the tens digit

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

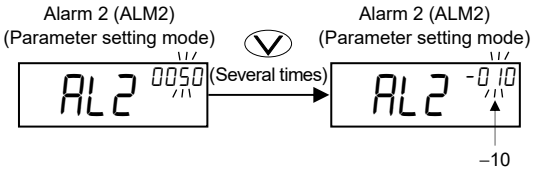


6. Change the alarm set value from "+50" to "–10"

Press the DOWN key to change the the alarm set value from "+50" to "–10."

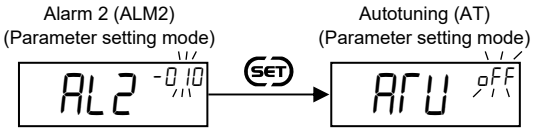
Setting range: Deviation alarm
–Span to +Span
(However, within –1999 to +9999 digits)

Factory set value: 50



7. Store the alarm set value

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



7.6 RUN/STOP Transfer

RUN/STOP can be selected by contact input (optional) other than the key operation. In addition, at STOP the key operation and contact state are displayed on the PV display. Relationships between key operation, RUN/STOP and the characters to indicate the STOP state are shown in the following.

		RUN/STOP with Contact Input [1]	
		RUN (Contact closed)	STOP (Contact open)
RUN/STOP with Key Operation	RUN	RUN	STOP
		STOP is not displayed	dSTP (dSTP) [2]
	STOP	STOP	STOP
		KSTP (KSTP) [2]	STOP (STOP) [2]

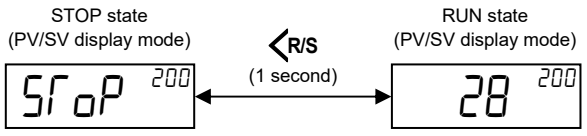
[1] Terminal No.10, No.12: STOP state when contact is open, RUN state when contact is closed

[2] Characters in parentheses are those shown on the PV display:
dSTP: Only contact input is in the STOP mode
KSTP: Only key operation is in the STOP mode
STOP: Both key operation and contact input are in the STOP mode

Conditions when changed to STOP mode:
- Control, Alarm: Control OFF, Alarm OFF
- Output: OUT1 output OFF (OPEN), OUT2 output OFF (OPEN)
- Autotuning (AT): AT canceled (PID constants are not updated)

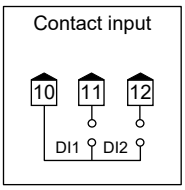
■ RUN/STOP transfer by key operation

Each press of the <R/S key for one second in the PV/SV display mode will allow switching between RUN and STOP.



■ RUN/STOP transfer by contact input

RUN/STOP can be selected according to the open or closed state of the terminal numbers 10 and 12 (DI2).



Dry contact input
At open: 500 kΩ or more
At close: 10 Ω or less

Terminal No.	RUN	STOP
10 - 12	Contact closed	Contact open

7.7 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.

NOTE

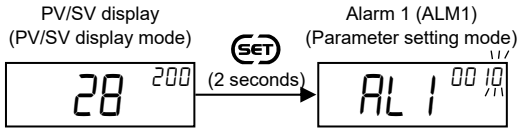
Caution for using the Autotuning (AT):
When a temperature change (UP and/or Down) is 1 °C or less per minute during AT, AT may not be finished normally. In that case, adjust the PID values manually. Manual setting of PID values may also be necessary if the set value is around the ambient temperature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

■ Requirements for Autotuning (AT) start

- Prior to starting the AT function, end all the parameter settings other than PID and LBA.
- Confirm the Set data lock (LCK) function has not been engaged. (LCK must be 0000)

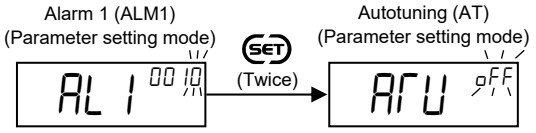
1. Select the Parameter setting mode

Press and hold the SET key for 2 seconds in the PV/SV display mode state to transfer to Parameter setting mode.



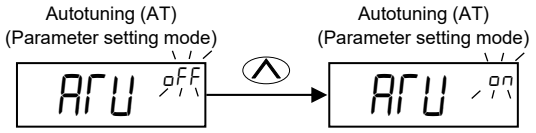
2. Select the Autotuning (AT) display

Press the SET key twice to change the display from “Alarm 1 (ALM1)” to “Autotuning (AT).”



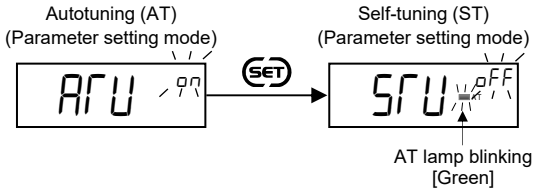
3. Set Autotuning (AT) to "on"

Press the UP key to set “on.”



4. Start the Autotuning (AT)

Press the SET key and Autotuning (AT) will start. The display changes to the next setting item.



5. Finish the Autotuning (AT)

When the Autotuning (AT) is finished, the control will automatically return to “oFF” and AT lamp turns off.

8 INPUT FUNCTION

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

8.1 Changing Input

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

- **Input type selection**
- **Display unit selection**
- **Decimal point position setting**
- **Setting limiter [high limit]/Setting limiter [low limit]**
- **Sampling cycle**

■ Description of function

Input type

The input type of this instrument can be changed within the same input type group.

TC input type: K, J, R, S, B, E, N, T, W5Re/W26Re, PL II, U, L

RTD input type: Pt100, JPt100

Voltage/Current input type: 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC, 0 to 20 mA DC, 4 to 20 mA DC

For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

Decimal point position

The decimal point position of the Measured value (PV) can be programmed. The decimal point position depends on the input type.

TC input:

For input types K, J, N, T, and U: Selectable from no decimal place (0) or one decimal place (0.0).
For input types R, S, B, E, W5Re/W26Re, PL II, and L: Fixed to no decimal place.

RTD input: Selectable from "No decimal place (0)" or "One decimal place (0.0)".

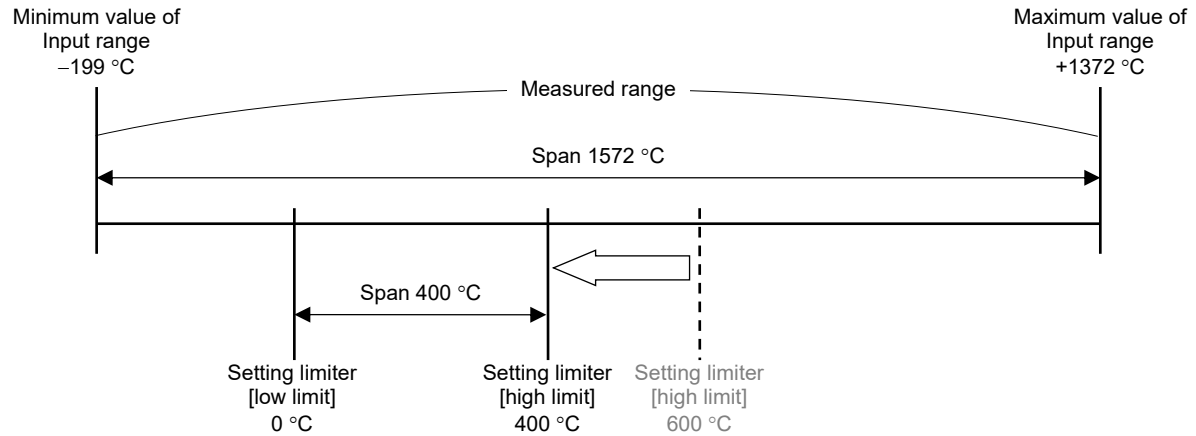
Voltage/Current input:

Selectable from "No decimal place (0)" and up to "Three decimal places (0.000)".

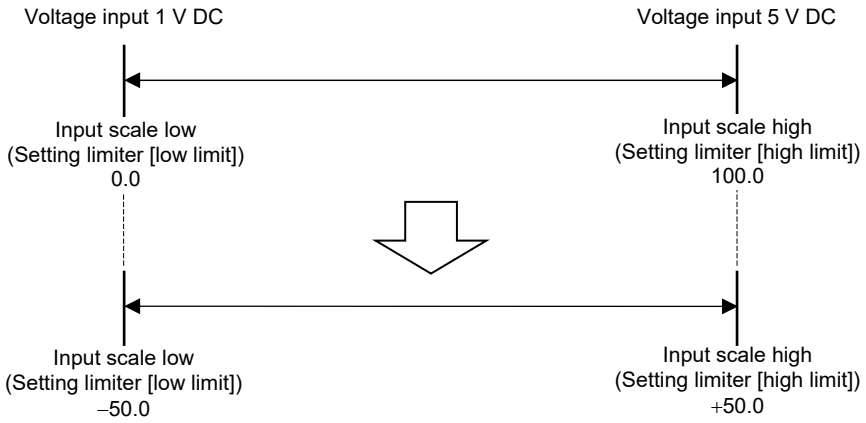
Setting limiter [high limit]/Setting limiter [low limit]

The input range of this instrument can be changed by "Setting limiter [high limit]" and "Setting limiter [low limit]." In the case of temperature input (TC and RTD), input ranges can be changed. In the case of voltage (V) and current (I) inputs, the display range is programmable within −1999 and +9999.

Example of input change 1:
Changing thermocouple K "0 to 600 °C" to "0 to 400 °C" (No digit below decimal point)



Example of input change 2:
In the case of Voltage input (1 to 5 V DC), the input range has been reduced from “0.0 to 100.0” to “–50.0 to +50.0”



Sampling cycle

The sampling time of the Measured input can be selected from 0.5 seconds and 0.25 seconds.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F21. (F21.)	InP (InP)	Input type selection	0: Thermocouple K [1] 1: Thermocouple J [1] 2: Thermocouple R [1] 3: Thermocouple S [1] 4: Thermocouple B [1] 5: Thermocouple E [1] 6: Thermocouple N [1] 7: Thermocouple T [1] 8: Thermocouple W5Re/W26Re [1] 9: Thermocouple PL II [1] 10: Thermocouple U [1] 11: Thermocouple L [1] 12: RTD Pt100 [1] 13: RTD JPt100 [1] 14: Voltage 0 to 5 V DC or Current 0 to 20 mA DC [1, 2] 15: Voltage 1 to 5 V DC or Current 4 to 20 mA DC [1, 2] 16: Voltage 0 to 10 V DC [1]	Factory set value varies depending on the instrument specification.
	UnIT (UnIT)	Display unit selection	0: °C 1: °F	0
	PGdP (PGdP)	Decimal point position setting	0: No digit below decimal point 1: 1 digit below decimal point [3] 2: 2 digits below decimal point [4] 3: 3 digits below decimal point [4]	Factory set value varies depending on the instrument specification.

[1] Input type (TC/RTD to Voltage/Current inputs or Voltage/Current inputs to TC/RTD) cannot be changed because the hardware is different.

[2] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

[3] This option is selectable when the input type is Thermocouple (K, J, N, T, U), RTD, voltage or current.

[4] This option is selectable when the input type is voltage or current.

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F21. (F21.)	SLH (SLH)	Setting limiter [high limit]	−1999 to +9999 • Refer to Table 1 below for the setting range of the low and high limits of the Setting limiter for each input type. • Refer to "Input range table" (P. 1-6) for the Input range. • This instrument sets the input range with the Setting limiter. Please note that changing the Setting limiter will also change the input range.	Factory set value varies depending on the instrument specification.
	SLL (SLL)	Setting limiter [low limit]		Factory set value varies depending on the instrument specification.
	SMP (SMP)	Sampling cycle	0: 250 ms (0.25 seconds) 1: 500 ms (0.5 seconds)	1

Table 1

Input type		Setting range
Thermocouple (TC)	K	−199 to +1372 °C (−326 to +2502 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	J	−199 to +1200 °C (−326 to +2192 °F)
		−199.9 to +999.9 °C (−199.9 to +999.9 °F)
	R	0 to 1769 °C (0 to 3216 °F)
	S	0 to 1769 °C (0 to 3216 °F)
	B	0 to 1820 °C (0 to 3308 °F)
	E	0 to 1000 °C (0 to 1832 °F)
	N	0 to 1300 °C (0 to 2372 °F)
		0.0 to 999.9°C (0.0 to 999.9 °F)
	T	−199 to +400 °C (−326 to +752 °F)
		−199.9 to +400.0 °C (−199.9 to +752.0 °F)
	W5Re/W26Re	0 to 2320 °C (0 to 4208 °F)
	PL II	0 to 1390 °C (0 to 2534 °F)
	U	−199 to +600 °C (−326 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	Pt100 (JIS/IEC) [1]	−199.9 to +649.0 °C (−199.9 to +999.9 °F)
	JPt100 (JIS)	
Voltage [2]	0 to 5 V DC	−1999 to +9999 (programmable scale)
	1 to 5 V DC	
	0 to 10 V DC	
Current [2, 3]	0 to 20 mA DC	−1999 to +9999 (programmable scale)
	4 to 20 mA DC	

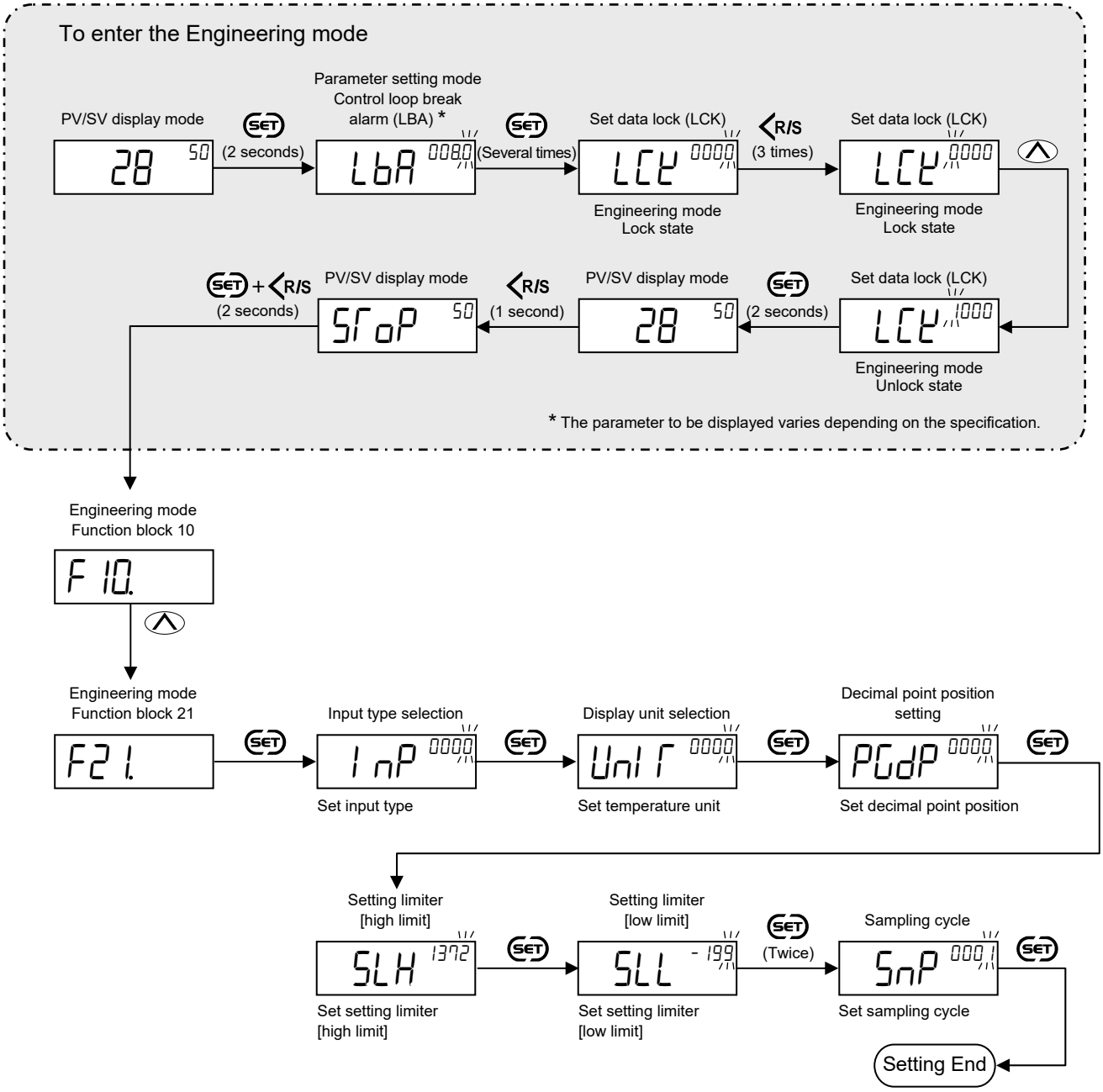
[1] **IEC** (International Electrotechnical Commission) is equivalent to **JIS**, **DIN** and **ANSI**.

[2] In case of voltage/current inputs, SLH can be set below SLL.

[3] For the current input specification, a resistor of 250 Ω must be connected between the input terminals.

☞ Some parameters may be initialized or the range may be changed when the input type or the scale limiter has been changed. Refer to **14. PARAMETERS THAT ARE INITIALIZED/ MODIFIED WHEN SETTING IS CHANGED (P. 14-1)** for details.

■ Setting procedure

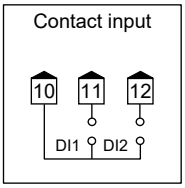


8.2 Switching Functions Using Contact Inputs

The Set value (SV) and the status can be switched using the contact input (optional). The following three functions can be switched by assigning one function to each of the rear terminals DI1 and DI2.

- STEP function
- RUN/STOP transfer
- Alarm interlock release

Contact input rear terminals:

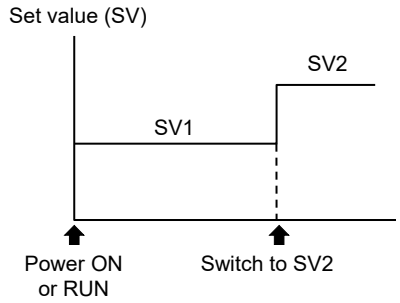


Dry contact input
At open: 500 kΩ or more
At close: 10 Ω or less

■ Description of function

● STEP function

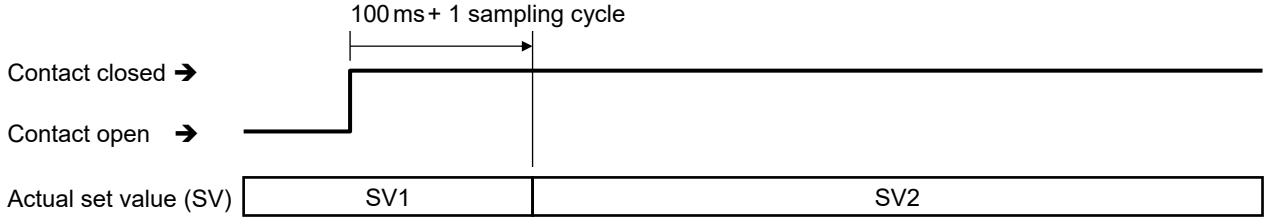
The instrument has two Set values (SV). This STEP function selects these two Set values (SV) by contact input.



Open/Close action of Contact:

Contact open: Set value (SV1)
Contact closed: STEP set value (SV2)

Transfer timing of Set value (SV):



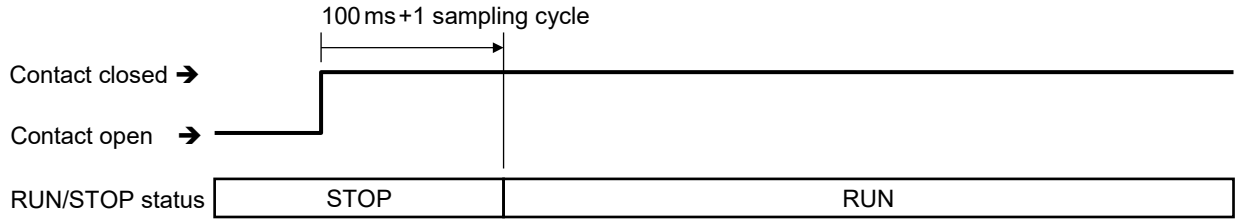
● RUN/STOP transfer

This is a function to switch the mode between RUN (Start operation) and STOP (Stop operation) by the Contact input.

Open/Close action of Contact:

Contact open: STOP
Contact closed: RUN

Transfer timing of RUN/STOP:



Relation between front key and contact input for RUN/STOP selection

Setting via front keys	Setting via Contact input	Instrument status	Screen display
RUN	RUN	RUN	Measured value (PV) is displayed.
	STOP	STOP	"dSTP" is displayed.
STOP	RUN		"USTP" is displayed.
	STOP		"STop" is displayed.

● Alarm interlock release

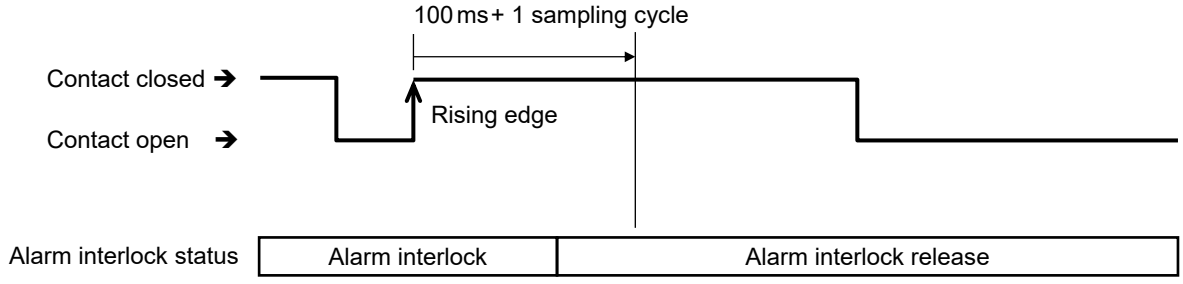
This is a function to release the alarm interlock state by the contact input.

Open/Close action of Contact:

Contact closed: Alarm interlock release

The timing to release the alarm interlock:

The alarm interlock is released when the contact is closed (rising edge).



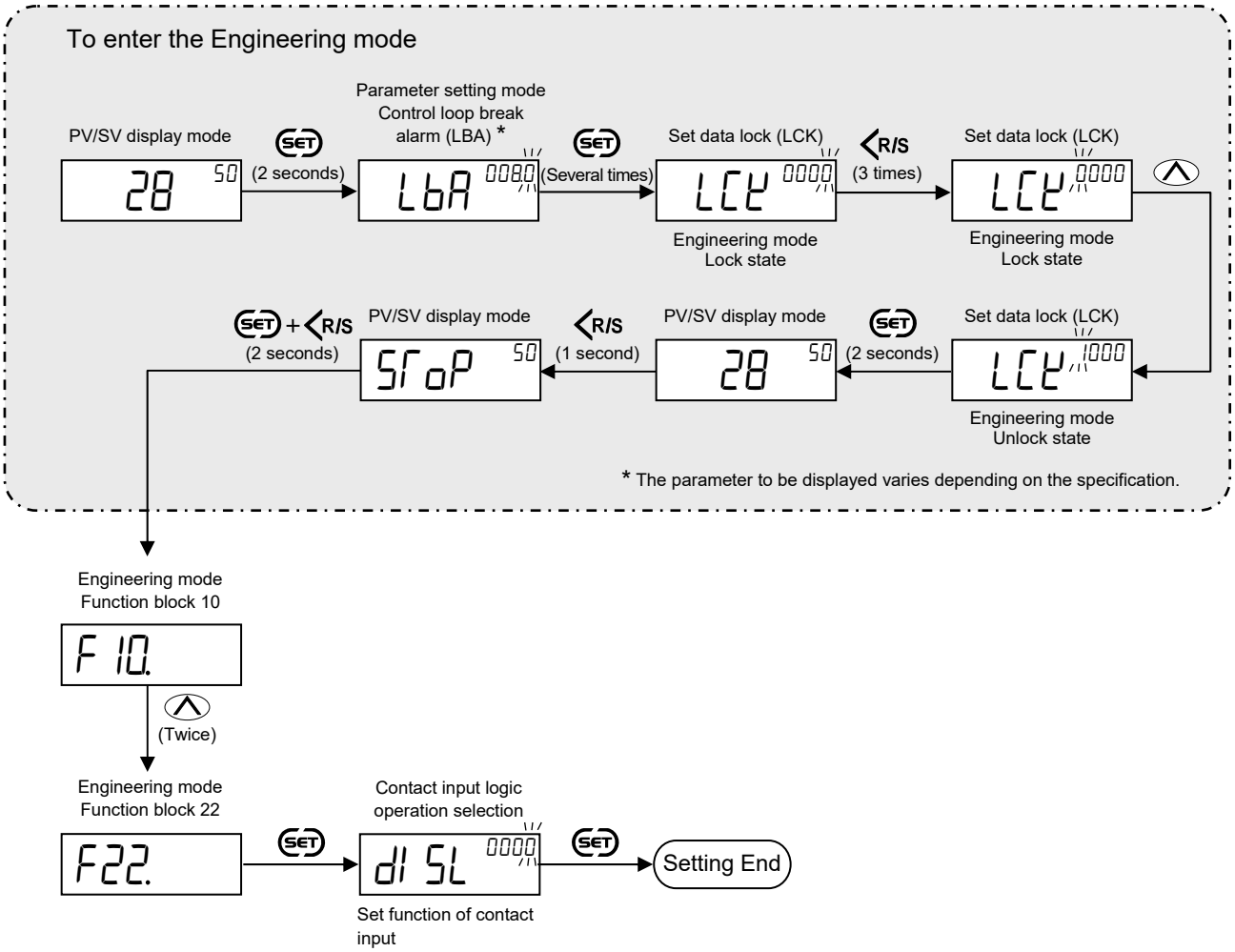
When the instrument is in the alarm status, the Alarm interlock cannot be released.
The alarm interlock state is kept even if alarm interlock release is attempted by the contact input.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F22. (F22.)	dI SL (dISL)	Contact input logic operation selection	0: DI1: STEP function DI2: RUN/STOP transfer 1: DI1: STEP function DI2: Alarm interlock release 2: DI1: Alarm interlock release DI2: RUN/STOP transfer	0

■ Setting procedure



8.3 Correcting Input

PV bias and PV ratio 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).

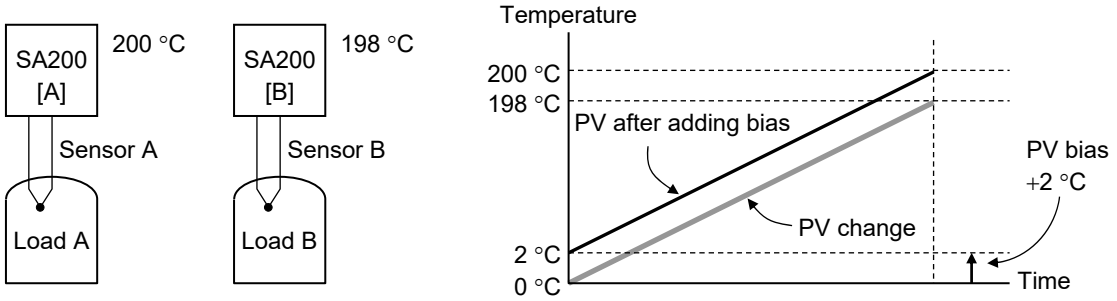
Setting example of PV bias:

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:

SA200 [A]: 200 °C SA200 [B]: 198 °C

To correct the Measured value (PV) of SA200 [B], add bias of +2 °C by PV bias:

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



● PV ratio

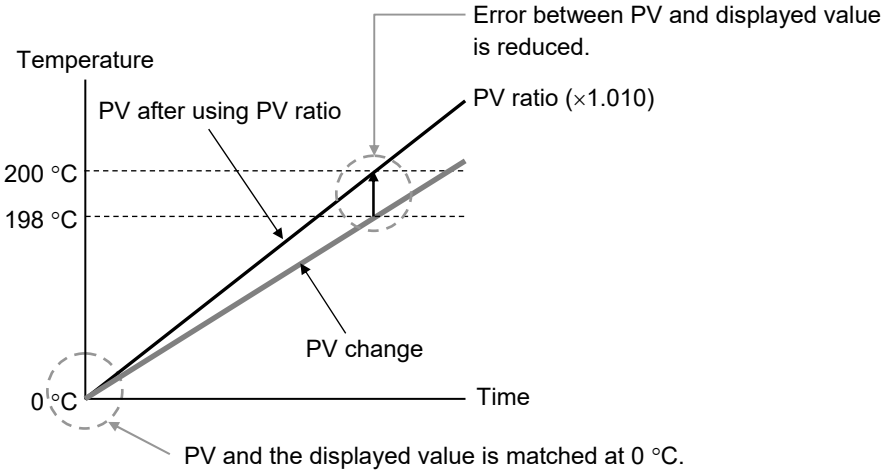
PV ratio is a multiplier to be applied to the Measured value (PV).

Setting example of PV ratio:

PV ratio can be used to display 200 °C by adding 2 °C when the actual Measured value (PV) is 198 °C but the displayed value remains 0 °C when the actual PV is 0 °C. (The displayed value changes from 0 °C to 2 °C by PV bias setting.)

Displayed value = Measured value (PV) × PV ratio = 198 °C × 1.010 = 199.98 °C

(The display shows 200)

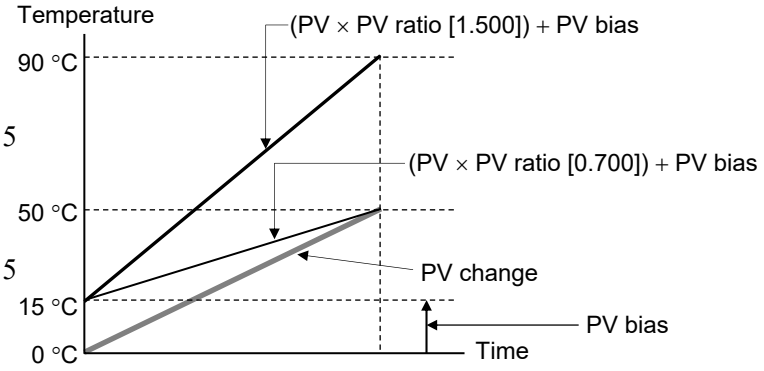


The PV ratio function is disabled at the time of shipment. To use the PV ratio, the function must be enabled. When the function is enabled, the PV ratio parameters are displayed in the Parameter setting mode.

● When setting PV bias and PV ratio at the same time

[Example]
When PV bias = 15 °C
Measured value (PV) = 50 °C
If PV ratio = 0.700
Displayed value = 50 × 0.700 + 15
= 50 °C

PV ratio = 1.500
Displayed value = 50 × 1.500 + 15
= 90 °C



■ Parameter setting

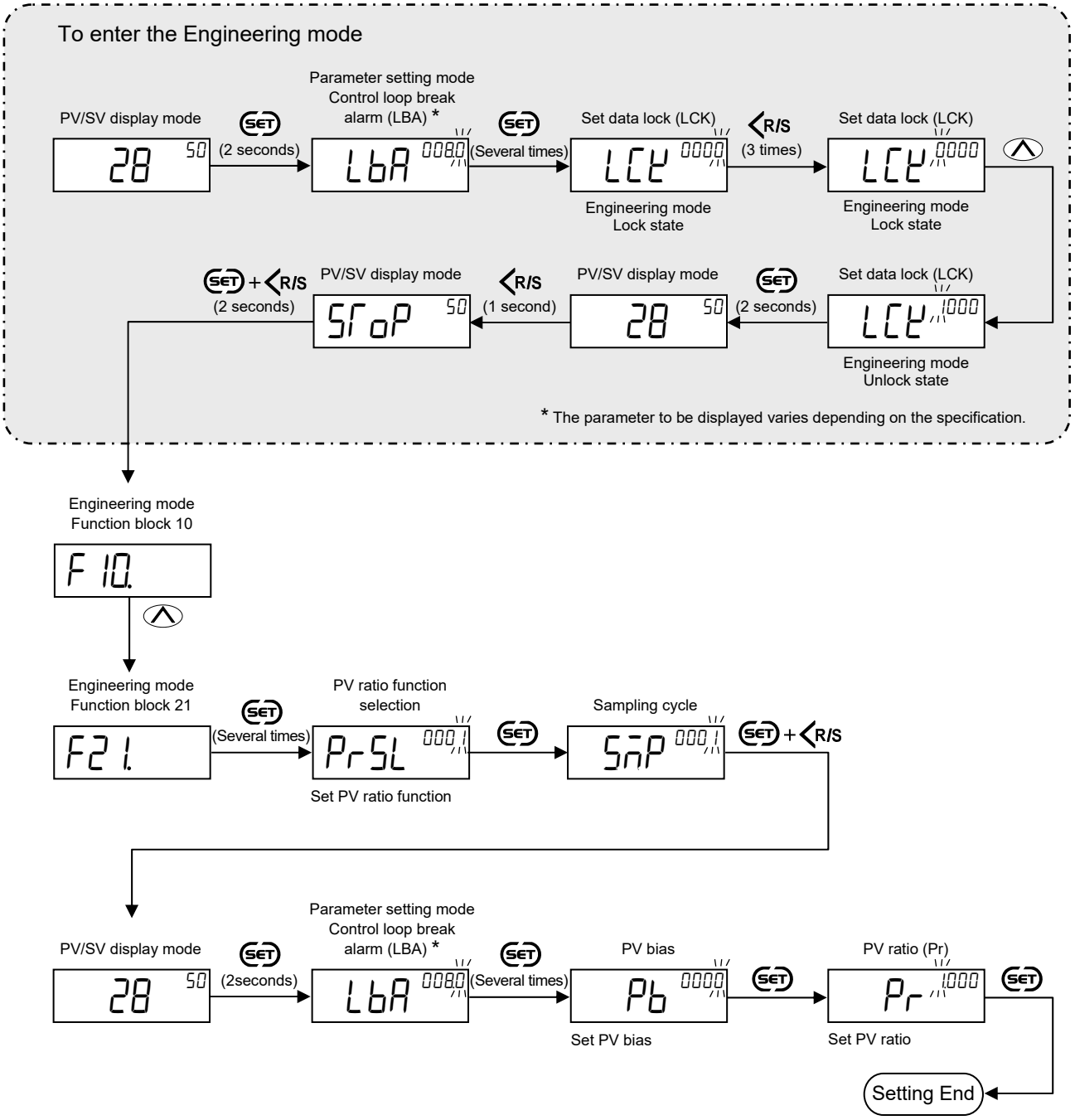
● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F21. (F21.)	PrSL (PrSL)	PV ratio function selection	0: Disable PV ratio function 1: Enable PV ratio function	0

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
Pb (Pb)	PV bias	−Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0
Pr (Pr)	PV ratio (Pr)	0.500 to 1.500 times	1.000

■ Setting procedure

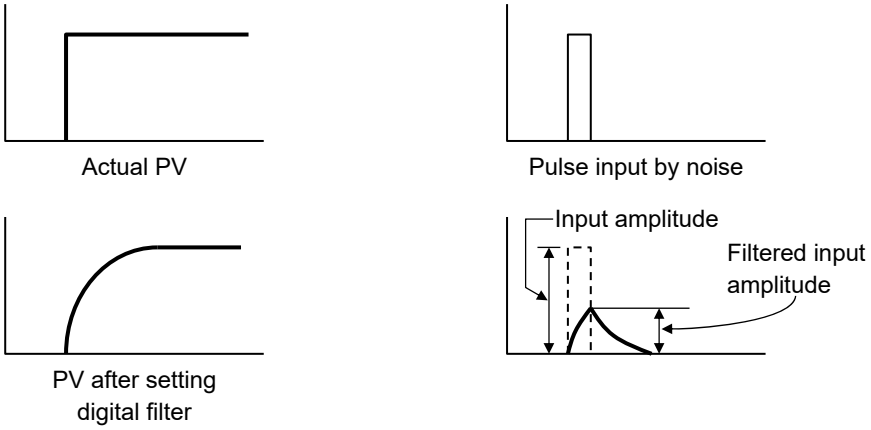


8.4 Preventing the Input Flicker

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

■ Description of function

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 digital filter based on the controlled object requirement and its level of noise. Setting a value too small leads to a poor result of digital filter; just as an input response will be poor when setting a value too large.

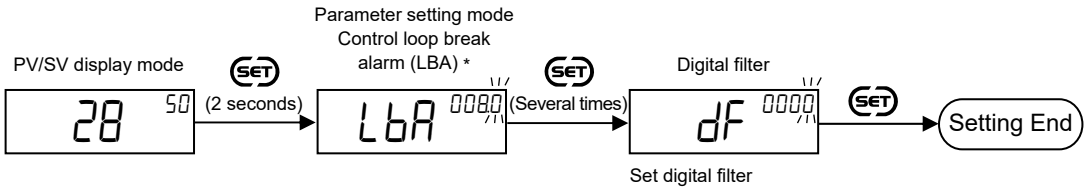


■ Parameter setting

● Parameter setting mode: C

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

■ Setting procedure



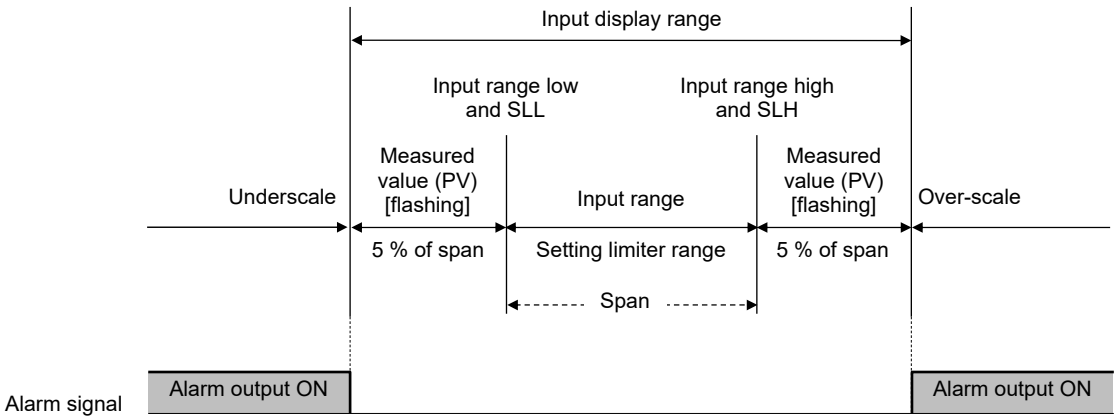
* The parameter to be displayed varies depending on the specification.

8.5 Changing Error Handling at Input Error

This chapter guides you to configure the alarm output when an input error such as underscale and over-scale occurred.

■ Description of function

In addition to the normal alarm operation, this function outputs an alarm signal even if an input error (underscale/over-scale) occurs. When set to "1: Forcibly turned on when abnormal," the alarm output is turned ON in the event of underscale or over- scale.



■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F41. (F41.)	AEo1 (AEo1)	Alarm 1 process abnormality action selection	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 1 not provided or LBA: 0 Alarm 1 provided: 1
F42. (F42.)	AEo2 (AEo2)	Alarm 2 process abnormality action selection	0: Normal processing 1: Forcibly turned on when abnormal	Alarm 2 not provided: 0 Alarm 2 provided: 1

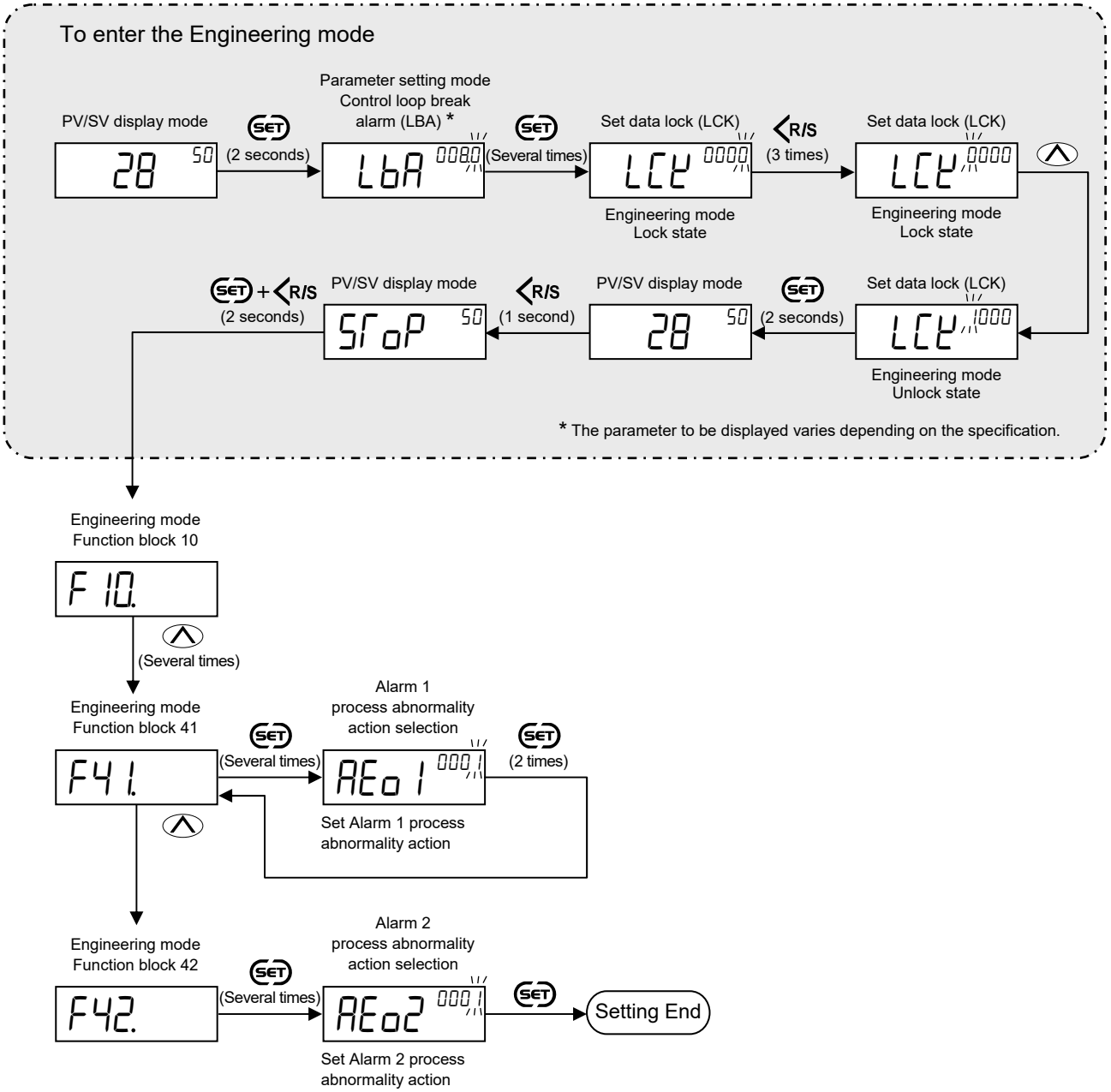
Normal processing:

Only the alarm action set in the Alarm 1 type selection (AS1) and the Alarm 2 type selection (AS2) is enabled.

Forcibly turned on when abnormal:

Alarms set in Alarm 1 type selection (AS1) and Alarm 2 type selection (AS2) as well as the alarm action when the input is abnormal (underscale/over-scale) will be activated.

■ Setting procedure



9 OUTPUT FUNCTION

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

9.1 Changing Output Assignment

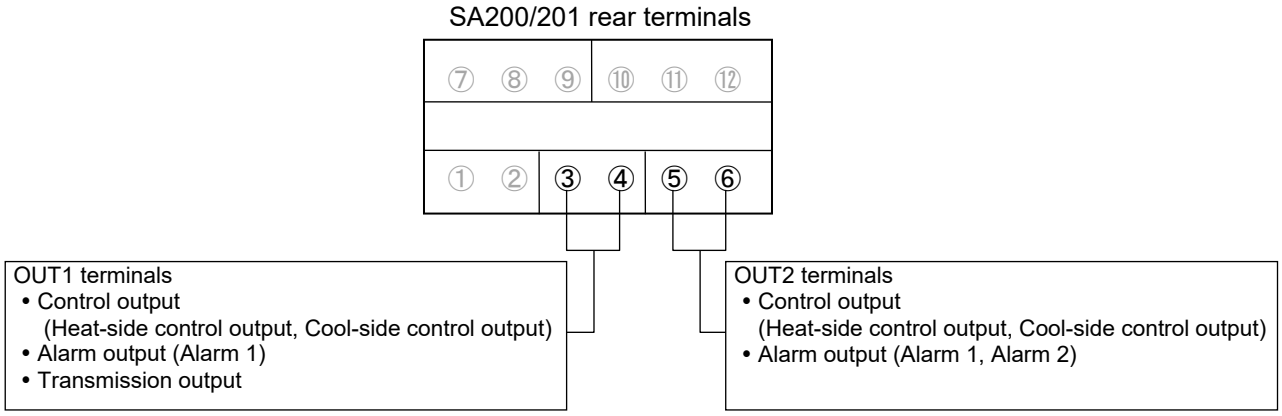
The output types of OUT1 and OUT2 on the SA200/201 are configurable.

■ Description of function

The following output signals can be assigned to the OUT1 and OUT2 of the SA200/SA201.

- Control output (Heat-side control output, Cool-side control output)
- Alarm output (Alarm 1, Alarm 2)
- Transmission output

● Position of output terminals



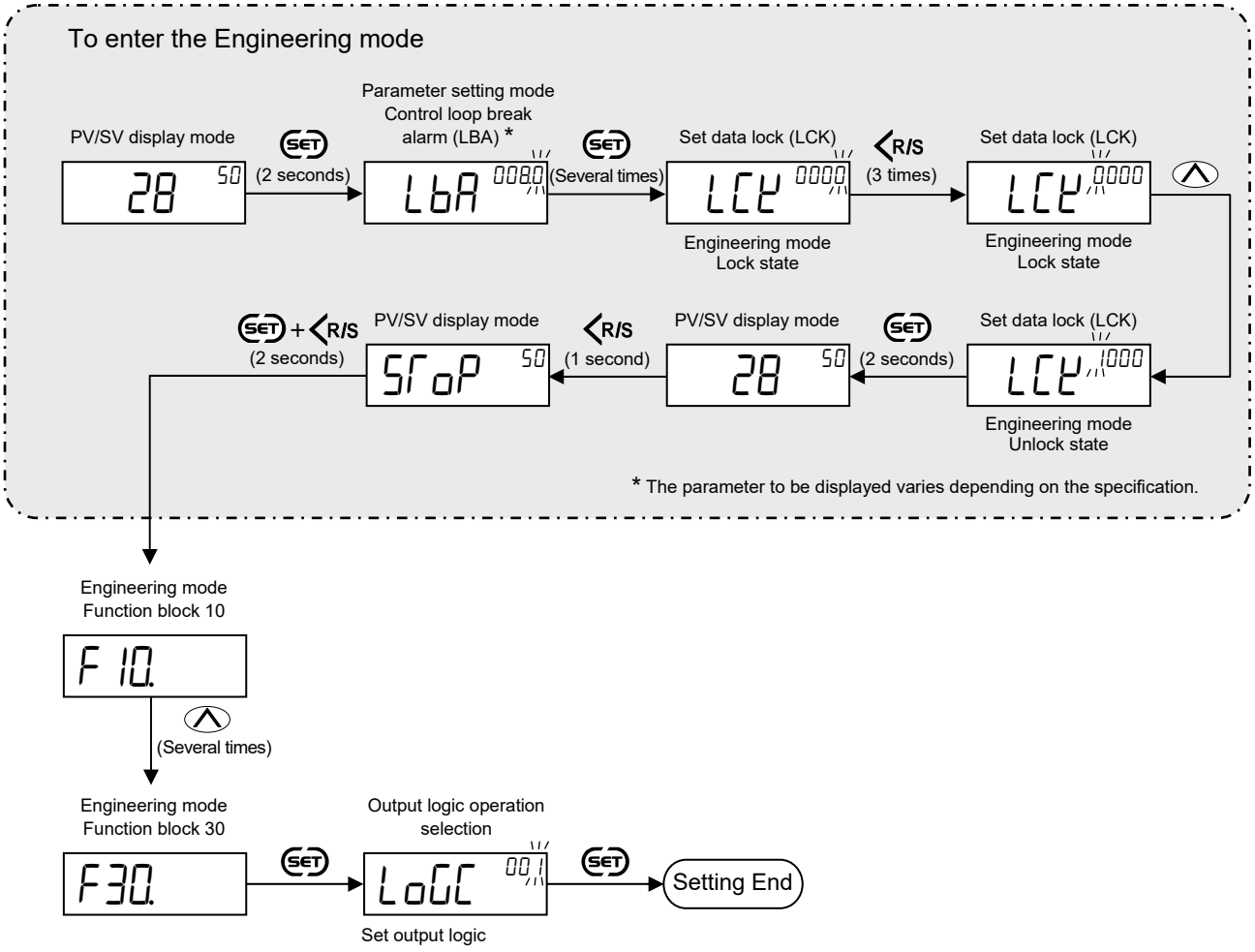
Transmission output is optional. If the transmission output is not specified at the time of ordering, no output will be produced from the output terminals even if it is assigned.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F30. (F30.)	LoGC (LoGC)	Output logic operation selection	001: OUT1: Control output OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 002: OUT1: Heat-side control output OUT2: Cool-side control output (In case of direct action or reverse action, it is OFF) 003: OUT1: Control output OUT2: Alarm 1 output (De-energized) (Alarm 2 can be checked via communication or by lamp lighting) 004: OUT1: Control output OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 005: OUT1: Control output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 006: OUT1: Control output OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 007: OUT1: Control output OUT2: No output (The Alarm state can be checked via communication or by lamp lighting) 008: OUT1: Control output OUT2: Alarm 1 output only (Energized) (Alarm 2 can be checked via communication or by lamp lighting) 009: OUT1: Alarm 1 output (Energized) OUT2: Alarm 2 output (Energized) 010: OUT1: Alarm 1 output (Energized) OUT2: Alarm 2 output (De-energized) 011: OUT1: Alarm 1 output (De-energized) OUT2: Alarm 2 output (De-energized) 012: OUT1: Transmission output OUT2: Control output 013: OUT1: Transmission output OUT2: *OR* output of Alarm 1 and Alarm 2 (Energized) 014: OUT1: Transmission output OUT2: *OR* output of Alarm 1 and Alarm 2 (De-energized) 015: OUT1: Transmission output OUT2: *AND* output of Alarm 1 and Alarm 2 (Energized) 016: OUT1: Transmission output OUT2: *AND* output of Alarm 1 and Alarm 2 (De-energized) 017: OUT1: Transmission output OUT2: Alarm 1 output (Energized) 018: OUT1: Transmission output OUT2: Alarm 1 output (De-energized) 019: OUT1: Cool-side control output (In case of direct action or reverse action, it is OFF) OUT2: Heat-side control output	Factory set value varies depending on the instrument specification.

■ Setting procedure



9.2 Using Transmission Output

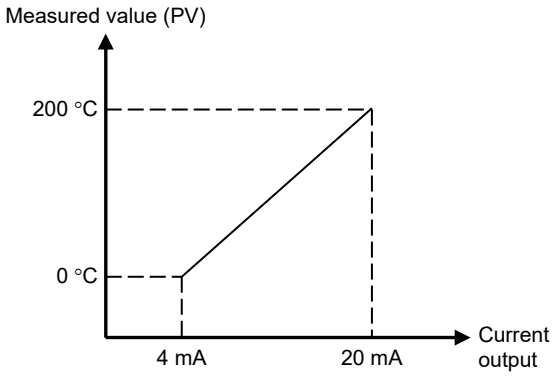
Transmission output can be provided from OUT1.

■ Description of function

The transmission output (analog output) is the function of outputting the state of Measured value (PV), Set value (SV), Deviation value (DEV), or Manipulated output value (MV) as a current signal. It is possible to record the state of Measured value (PV) or Set value (SV) when connected to a recorder.

Example 1: Measured value (PV)
Condition:

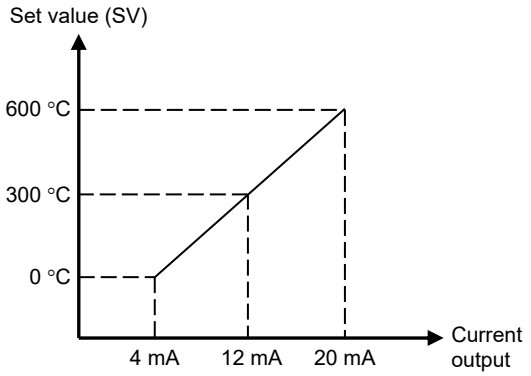
- Current output type: 4 to 20 mA DC
- Input range: Thermocouple K, 0 to 200 °C
- Transmission output (AO) type: Measured value (PV)
- Transmission output scale high (AHS): 200 °C
- Transmission output scale low (ALS): 0 °C



Example 2: Set value (SV)
The state of change in the Set value (SV) due to the Setting change rate limiter function is output.

Condition:

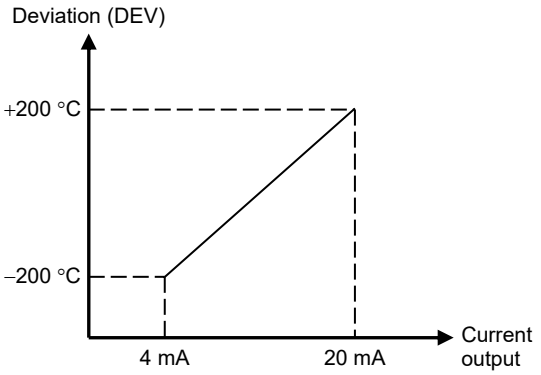
- Current output type: 4 to 20 mA DC
- Input range: Thermocouple K, 0 to 600 °C
- Transmission output (AO) type: Set value (SV)
- Transmission output scale high (AHS): 600 °C
- Transmission output scale low (ALS): 0 °C
- Set value (SV): 300 °C
- Setting change rate limiter (Up): 10 °C/minute
- Setting change rate limiter (Down): 10 °C/minute
- Setting change rate limiter setting: Used
- Setting change rate limiter time: 60 seconds



Example 3: Deviation (DEV)
The deviation of [Measured value (PV) − Set value (SV)] is output.

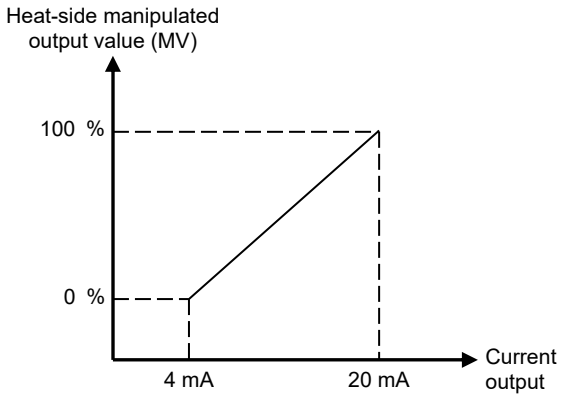
Condition:

- Current output type: 4 to 20 mA DC
- Input range: Thermocouple K, 0 to 200 °C
- Transmission output (AO) type: Deviation (DEV)
- Transmission output scale high (AHS): +200 °C
- Transmission output scale low (ALS): −200 °C



Example 4: Manipulated output value (MV)
The Heat-side manipulated output value (MV) internally calculated is output.

Condition:
Current output type: 4 to 20 mA DC
Transmission output (AO) type:
Manipulated output value (MV)
Transmission output scale high (AHS): 100 %
Transmission output scale low (ALS): 0 %



When the instrument is configured to have a "PID action with autotuning (Direct action)," the manipulated output value of direct action is output.

■ Parameter setting

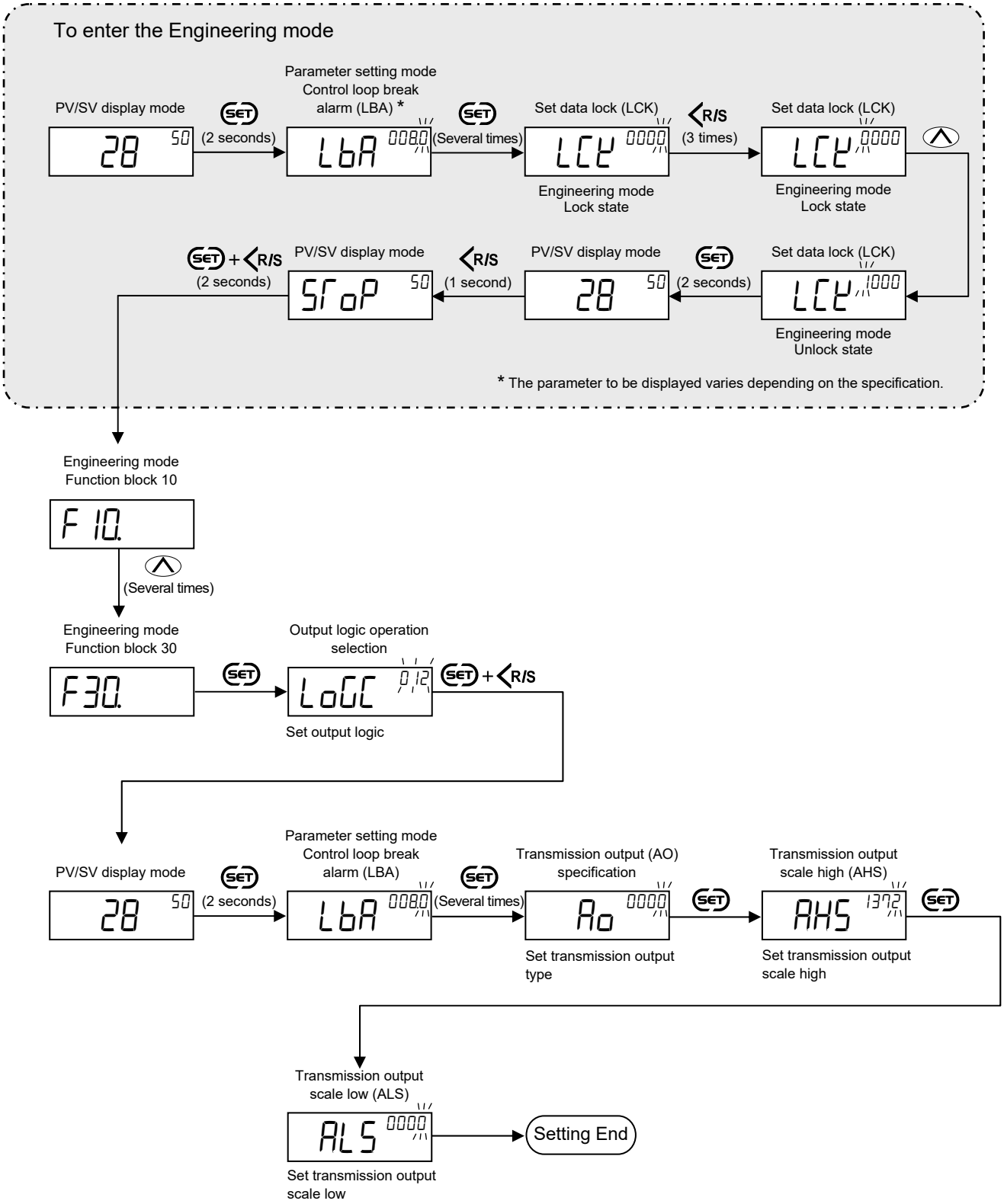
● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F30. (F30.)	LoGC (LoGC)	Output logic operation selection	The output assignment codes for transmission output are 012 to 018. For details of the output assignment code, refer to **P. 6-3**.	Factory set value varies depending on the instrument specification.

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
Ao (Ao)	Transmission output (AO) specification	PV: Measured value (PV) SV: Set value (SV) dEV: Deviation (DEV) MV: Manipulated output value (MV)	PV
AHS (AHS)	Transmission output scale high (AHS)	Measured value (PV): Same as input range * (Transmission output scale low to Setting limiter [high limit]) Set value (SV): Same as input range * (Transmission output scale low to Setting limiter [high limit]) Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) (Transmission output scale low to +Span) Manipulated output value (MV): 0.0 to 100.0 % (Transmission output scale low to 100.0 %) * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range high Voltage/ Current inputs: 100.0
ALS (ALS)	Transmission output scale low (ALS)	Measured value (PV): Same as input range * (Setting limiter [low limit] to Transmission output scale high) Set value (SV): Same as input range * (Setting limiter [low limit] to Transmission output scale high) Deviation (DEV): −Span to +Span * (However, within −1999 to +9999 digits) (−Span to Transmission output scale high) Manipulated output value (MV): 0.0 to 100.0 % [0.0 to Transmission output scale high] * Varies with the setting of the Decimal point position.	TC/RTD inputs: Input range low Voltage/ Current inputs: 0.0

■ Setting procedure



9.3 Monitoring Manipulated Output Value

To check the Manipulated output value (MV), the Heat-side manipulated output value (MV) and the Cool-side manipulated output value (MV2) can be displayed in the SV setting mode.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F 10. (F10.)	nUd (MVd)	MV display selection	0: MV display not provided 1: MV display provided	0

■ Display contents

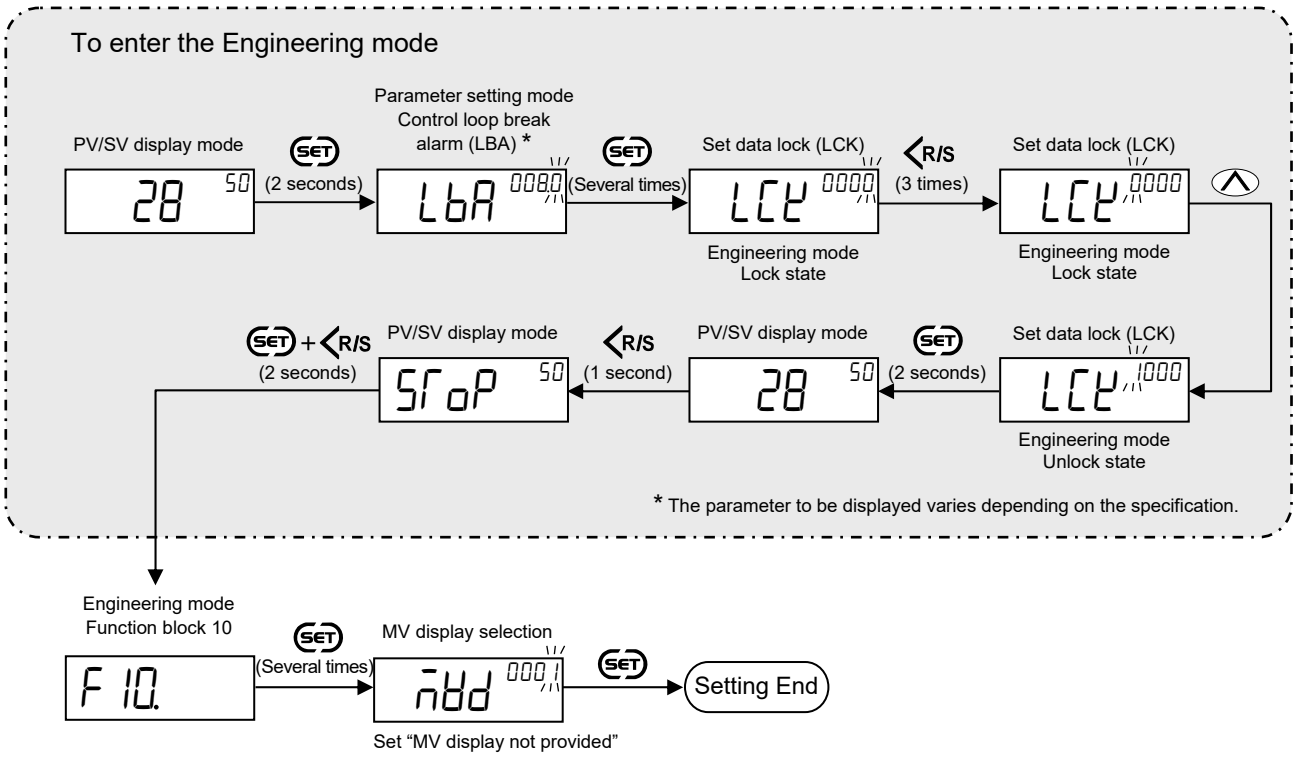
● SV setting mode: B

Parameter symbol	Name	Data range	Factory set value
nU (MV)	Heat-side manipulated output value (MV) [1]	–5.0 to +105.0 %	—
nU2 (MV2)	Cool-side manipulated output value (MV2) [2]	–5.0 to +105.0 %	—

[1] This parameter is displayed when the “MV display selection" is set to the "MV display provided.”

[2] This parameter is displayed in the following cases.
- When the “MV display provided” is set in the “MV display selection”
- When the Heat/Cool PID control with autotuning is specified

■ Setting procedure

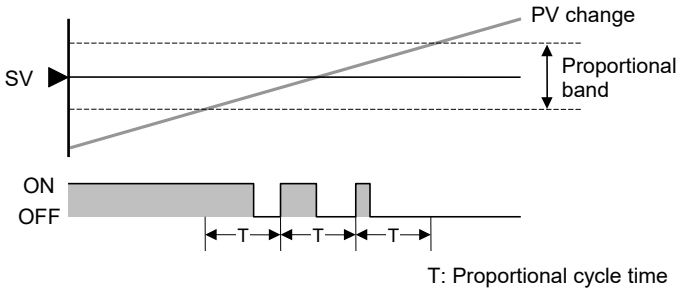


9.4 Changing Proportional Cycle Time

When time proportioning output (relay output or voltage pulse output) is specified at the time of ordering, Proportional cycle time can be changed.

■ Description of function

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.

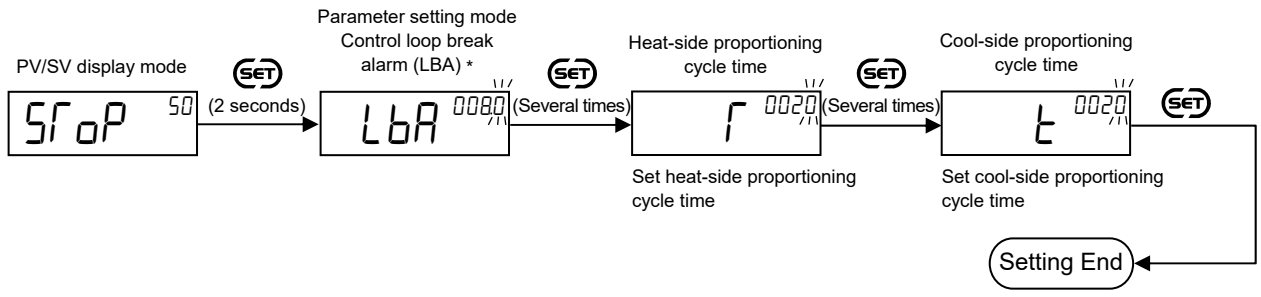


■ Parameter setting

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
r (T)	Heat-side proportioning cycle time	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2
t (t)	Cool-side proportioning cycle time	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2

■ Setting procedure



* The parameter to be displayed varies depending on the specification.

MEMO

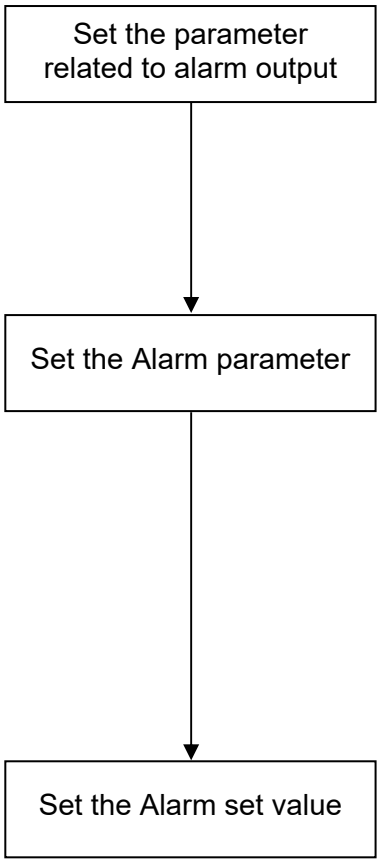
10 ALARM FUNCTION

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

10.1 Using Alarm Function

■ Setting procedure for alarm function

Set alarm function as follows:



Set the parameter related to Alarm output.

- Output logic operation selection
- Alarm interlock function selection

☞ For setting procedure of output logic operation selection, refer to **9.1 Changing Output Assignment (P. 9-2)**.

☞ For alarm interlock, refer to **10.1.4 Keeping the alarm state (P. 10-10)**.

Set the following parameters:

- Alarm type
- Alarm hold action
- Alarm differential gap

☞ For alarm type, refer to **10.1.1 Changing alarm type (P. 10-3)**.

☞ For alarm hold action, refer to **10.1.2 Adding hold action to the alarm action (P. 10-7)**.

☞ For alarm differential gap, refer to **10.1.3 Setting a differential gap in alarm action (P. 10-9)**.

Set the Alarm set value.

☞ For alarm set value, refer to **7.5 Setting the Alarm Set Value (P. 7-9)**.

10.1.1 Changing alarm type

There are 9 types of alarm in total.

- **Alarm type**
  - SV high alarm
  - SV low alarm
  - Process high alarm (The alarm hold action can be added.)
  - Process low alarm (The alarm hold action can be added.)
  - Deviation high alarm (The alarm hold action can be added.)
  - Deviation low alarm (The alarm hold action can be added.)
  - Deviation high/low alarm (The alarm hold action can be added.)
  - Band alarm
  - Control loop break alarm (LBA) [LBA can be selected for only Alarm 1.]

■ Description of function

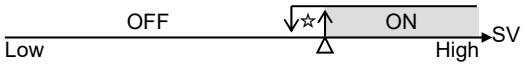
● Set value action

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)

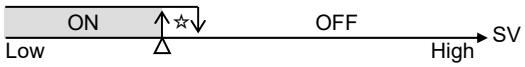
SV high

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.



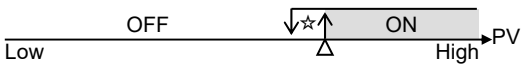
● Input value action

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

ON: Alarm action turned on
OFF: Alarm action turned off (△: Alarm set value ☆: Alarm differential gap)

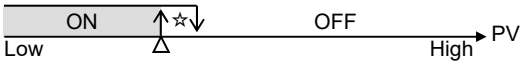
Process high

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.



● Deviation action

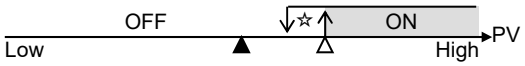
When the deviation (PV – SV) reaches the Alarm set value, alarm ON occurs.

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.)



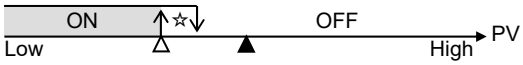
(Alarm set value is less than 0.)

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

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

Band

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

Control loop break alarm (LBA)

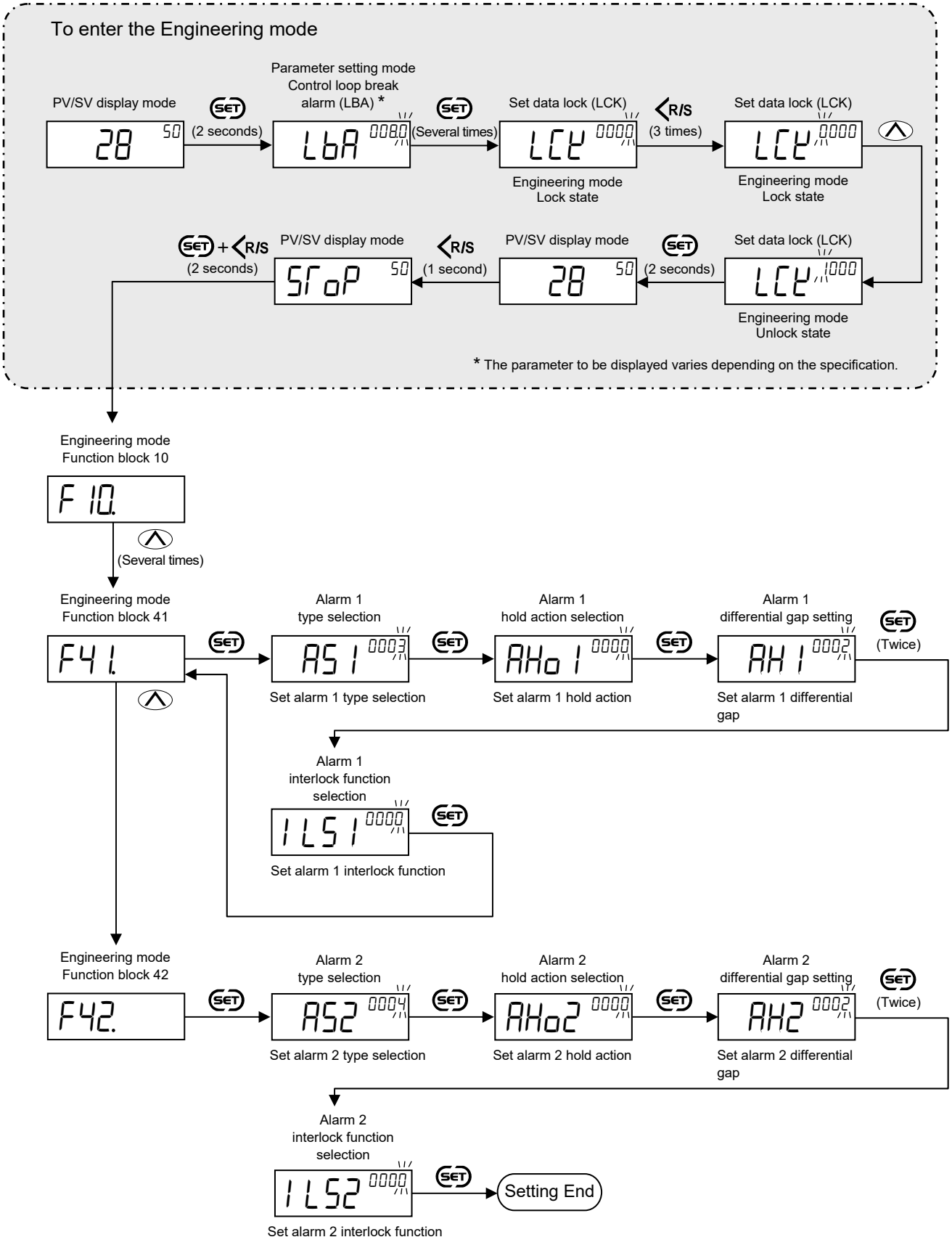
☞ For the Control loop break alarm (LBA), refer to **10.2 Using Control Loop Break Alarm (LBA) (P. 10-12)**.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F41. (F41.)	AS1 (AS1)	Alarm 1 type selection	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm 9: Control loop break alarm (LBA)	Factory set value varies depending on the instrument specification.
F42. (F42.)	AS2 (AS2)	Alarm 2 type selection	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm	Factory set value varies depending on the instrument specification.

■ Setting procedure



☞ For the setting procedure of output logic operation selection, refer to **9.1 Changing Output Assignment (P. 9-2)**.

10.1.2 Adding hold action to the alarm action

On this instrument hold action can be added to the Alarm action.

Some alarm actions may not be available with hold action. Setting hold action on the alarm that is not available with hold action will just be ignored.

Refer to **Setting of Alarm types (P. 10-3)** for those alarms that are available with hold action.

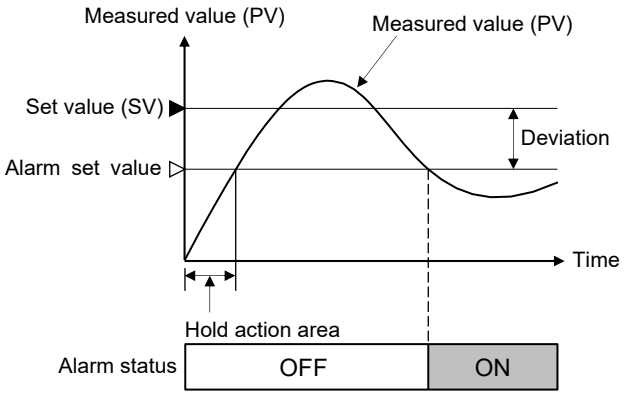
■ Description of function

● Hold action

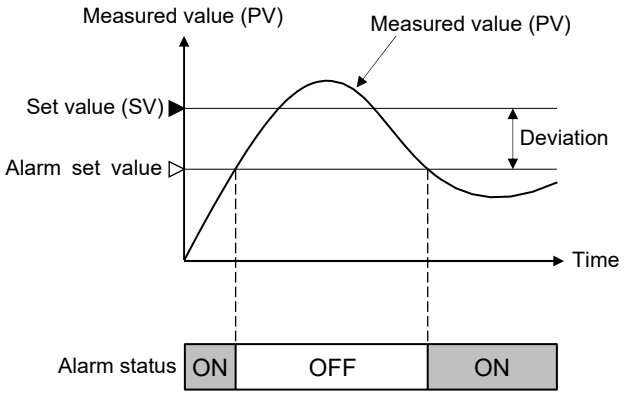
When hold action is ON, the alarm action is suppressed at start-up or STOP to RUN until the measured value has entered the non-alarm range.

- When the power is turned on
- When transferred from STOP (control STOP) to RUN (control RUN)
- When the Set value (SV) is changed

[With hold action]



[Without hold action]



NOTE

When high alarm with hold action is used for Alarm function, alarm does not turn on while hold action is in operation. Take measures to prevent overheating which may occur if the control device fails.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F41. (F41.)	AHo1 (AHo1)	Alarm 1 hold action selection	0: Without alarm hold action 1: Effective when the power is turned on, or operation is changed from STOP to RUN. 2: Effective when the power is turned on, or operation is changed from STOP to RUN or the SV is changed.	Factory set value varies depending on the instrument specification.
F42. (F42.)	AHo2 (AHo2)	Alarm 2 hold action selection	0: Without alarm hold action 1: Effective when the power is turned on, or operation is changed from STOP to RUN. 2: Effective when the power is turned on, or operation is changed from STOP to RUN or the SV is changed.	Factory set value varies depending on the instrument specification.

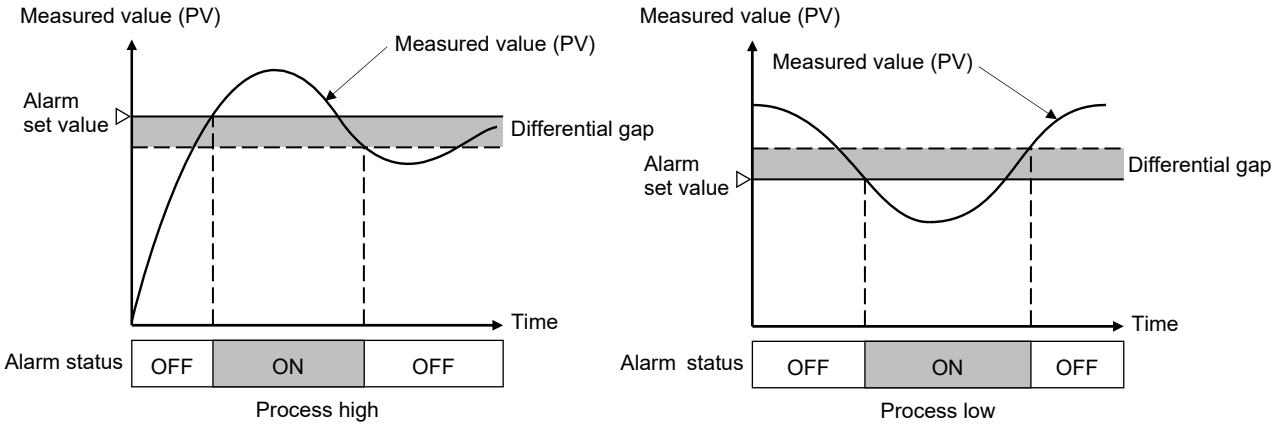
■ Setting procedure

Refer to the operation on P. 10-6.

10.1.3 Setting a differential gap in alarm action

■ Description of function

It prevents chattering of alarm output due to the measured value fluctuation around the Alarm set value.



■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F41. (F41.)	AH1 (AH1)	Alarm 1 differential gap setting	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/ Current inputs: 0.2
F42. (F42.)	AH2 (AH2)	Alarm 2 differential gap setting		TC/RTD inputs: 2 (2.0) Voltage/ Current inputs: 0.2

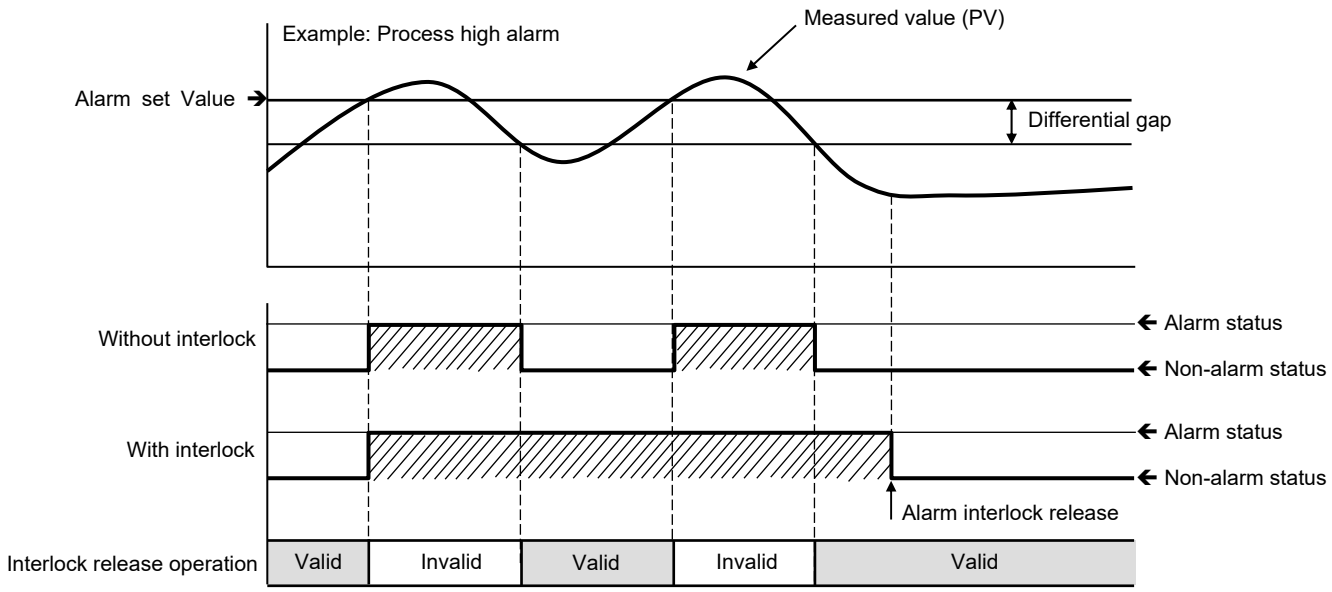
■ Setting procedure

Refer to the operation on P. 10-6.

10.1.4 Keeping the alarm state (alarm interlock function)

■ Description of function

This is the action of holding the alarm ON state even if the measured value is out of the alarm zone after entering the alarm zone once to be set to the alarm ON state. This interlock is released by key operation, contact input, or via communication.



The Alarm interlock function is OFF in the following cases.

- When the power is turned on (However, Alarm interlock function becomes ON when alarm became ON with control start simultaneously.)
- When the STOP state (When changed from STOP to RUN, the instrument performs the same operation as that at the time of power is turned on.)
- When the alarm hold state

The interlock is not released in the following cases.

- When the monitored value such as a Measured value (PV) or a Set value (SV) is in the alarm zone
- When the monitored value such as a Measured value (PV) or a Set value (SV) is in the Alarm differential gap

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F41. (F41.)	ILS1 (ILS1)	Alarm 1 interlock function selection	0: Disable Alarm 1 interlock function 1: Enable Alarm 1 interlock function	0
F42. (F42.)	ILS2 (ILS2)	Alarm 2 interlock function selection	0: Disable Alarm 2 interlock function 1: Enable Alarm 2 interlock function	0

■ Setting procedure

For the setting procedure of Alarm interlock function disabled/enabled, refer to the operation on P. 10-6.

■ Alarm interlock release operation

There are three ways to release the alarm interlock as shown below.

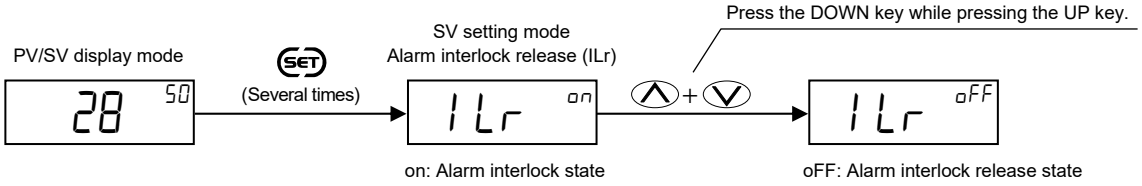
- By key operation
- By contact input (optional)
- By communication (optional)

NOTE

Release the alarm interlock in the alarm OFF state.

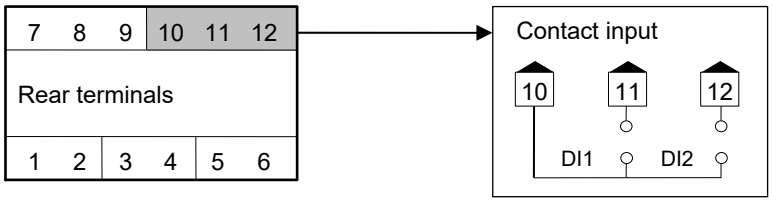
● By key operation

The alarm interlock can be released by the "Alarm Interlock release (ILr)" in the SV setting mode.



● By contact input

The interlock state can be released by closing the DI1 or DI2 contact. The contact to release the interlock differs depending on the setting of "Contact input logic operation selection" in Engineering mode F22.



When the set value is "1" for Contact input logic operation selection:

DI1: STEP function

DI2: Alarm interlock release (Contact closed: Interlock release)

When the set value is "2" for Contact input logic operation selection:

DI1: Alarm interlock release (Contact closed: Interlock release)

DI2: RUN/STOP transfer

● By communication

The following communication data can be used to release the interlock.

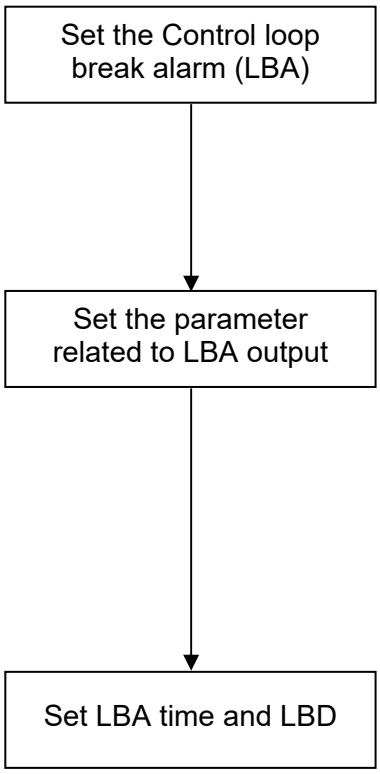
Communication type	Name	Communication data	Data range	Factory set value	Attribute
RKC communication	Alarm interlock release	Identifier: **IR**	0: Alarm interlock release *	—	R/W
Modbus		Address: **2AH**			

* The interlock is released by setting the "0." In the read state, becomes "1."

10.2 Using Control Loop Break Alarm (LBA)

■ Setting procedure for control loop break alarm (LBA)

Set control loop break alarm (LBA) function as follows:



Select the control loop break alarm (LBA) with the following parameter:

- Alarm 1 type selection

☞ For Alarm 1 type selection, refer to ■ **Description of function (P.10-14)**.

Set the parameter related to LBA output.

- Output logic operation selection
- Alarm interlock function selection

☞ For setting procedure of output logic operation selection, refer to **9.1 Changing Output Assignment (P. 9-2)**.

☞ For alarm interlock, refer to **10.1.4 Keeping the alarm state (P. 10-10)**.

Set the following parameters:

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

☞ For the parameter description, refer to ■ **Description of function (P. 10-14)**.

☞ For the data range of parameter, refer to ■ **Parameter setting (P. 10-15)**.

■ 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: TC/RTD inputs: 2 °C [°F] (fixed)
Voltage /Current inputs: 0.2 % of Span (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.

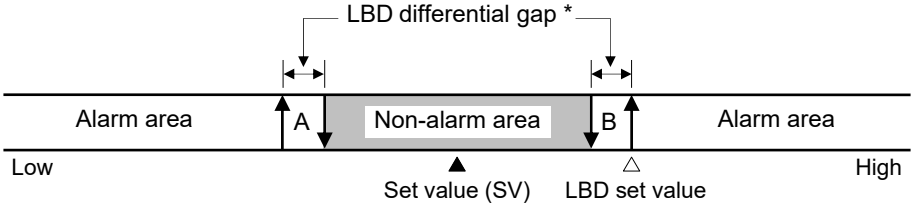
Precaution for LBA setting:

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

The Control loop break alarm (LBA) turns off when it enters the non-alarm state area.

● 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.

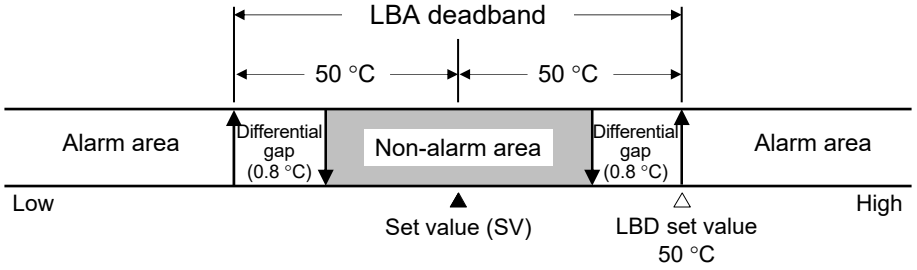


A: During temperature rise: Alarm area
During temperature fall: Non-alarm area

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

* TC/RTD inputs: 0.8 °C [°F] (fixed)
Voltage/Current inputs: 0.8 % of Span (fixed)

Example: When the LBA deadband is set to 50 °C



■ Parameter setting

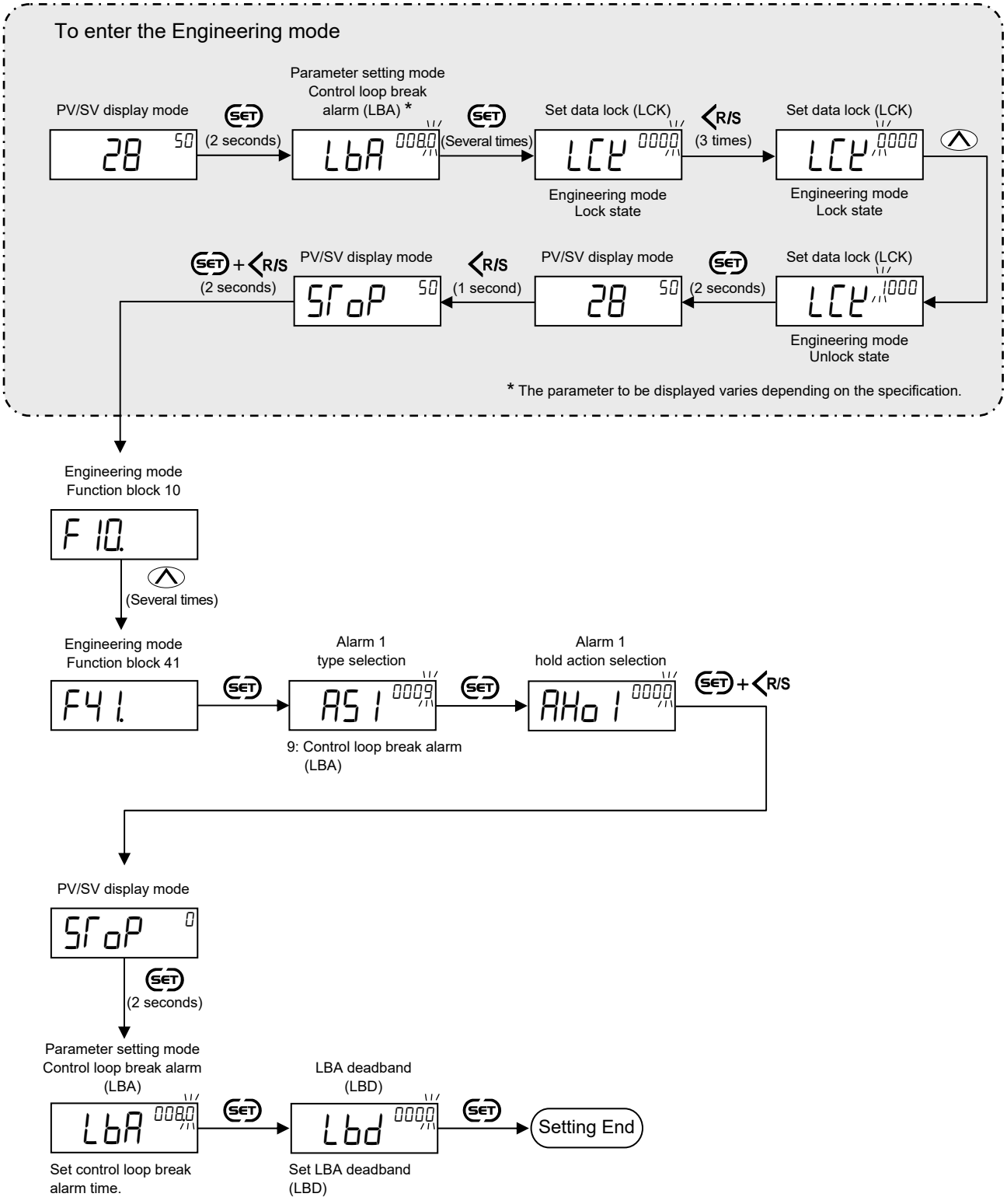
● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F41. (F41.)	AS1 (AS1)	Alarm 1 type selection	0: Alarm not provided 1: SV high alarm 2: SV low alarm 3: Process high alarm 4: Process low alarm 5: Deviation high alarm 6: Deviation low alarm 7: Deviation high/low alarm 8: Band alarm 9: Control loop break alarm (LBA)	Factory set value varies depending on the instrument specification.

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
LbA (LbA)	Control loop break alarm (LBA)	0.0 to 200.0 minutes (0.0: OFF)	8.0
Lbd (Lbd)	LBA deadband (LBD)	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0

■ Setting procedure



MEMO

CONTROL FUNCTION

11

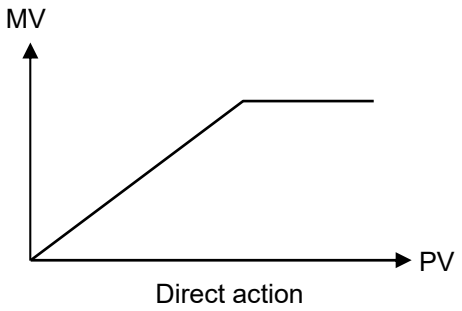
This chapter describes control related functions, setting contents and setting procedure based on the key words related to controls.

11.1 Changing Control Action

Refer to the following 5 types of control action:
- PID action with autotuning (direct action)
- PID action with autotuning (reverse action)
- ON/OFF action
- Heat/Cool PID action with autotuning (water cooling)
- Heat/Cool PID action with autotuning (air cooling)

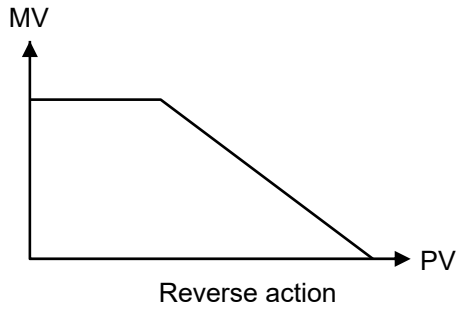
■ PID action with autotuning (direct action)

The Manipulated output value (MV) increases as the Measured value (PV) increases. This action is used generally for cooling control.



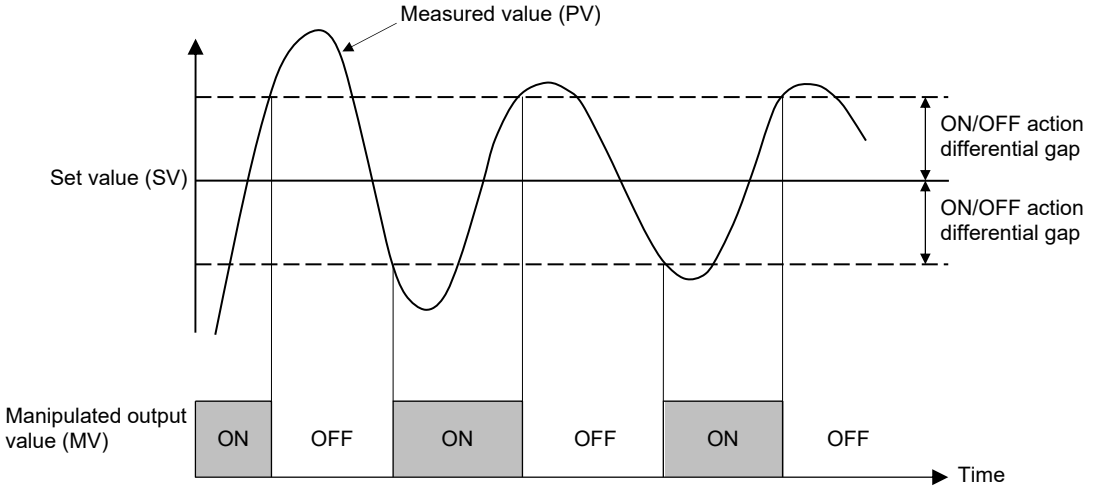
■ PID action with autotuning (reverse action)

The Manipulated output value (MV) decreases as the Measured value (PV) increases. This action is used generally for heating control.



■ ON/OFF action

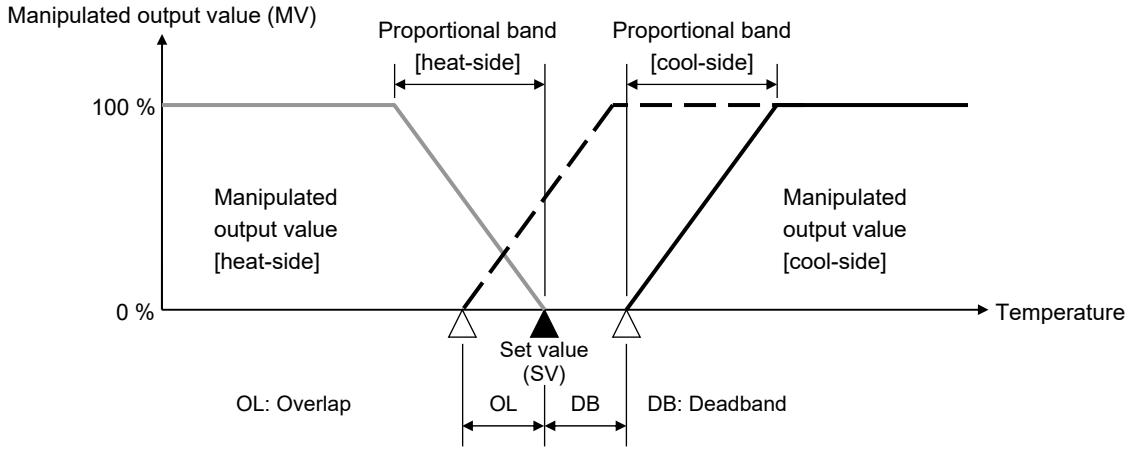
ON/OFF control is possible when the Proportional band [heat-side] is set to 0. In ON/OFF control with Reverse action, when the Measured value (PV) is smaller than the Set value (SV), the Manipulated output (MV) is 100 % or ON. When the PV is higher than the SV, the MV is 0 % or OFF. Differential gap setting prevents control output from repeating ON and OFF too frequently.



☞ For the ON/OFF action, refer to **11.3 Controlling with ON/OFF Action (P. 11-8)**.

■ Heat/Cool PID action with autotuning (Water cooling/Air cooling)

In Heat/Cool control PID action with autotuning, heating and cooling control can be achieved with a single controller.



☞ For Heat/Cool PID control, refer to **11.4 Controlling with Heat/Cool Control (P. 11-12)**.

■ Anti-reset windup (ARW)

This function limits the effective range of the integral action with respect to the range of the Heat-side proportional band (P). By limiting the effective range of the Integral action, overshoot and undershoot due to the integral action are prevented.

■ Parameter setting

● Engineering mode: E

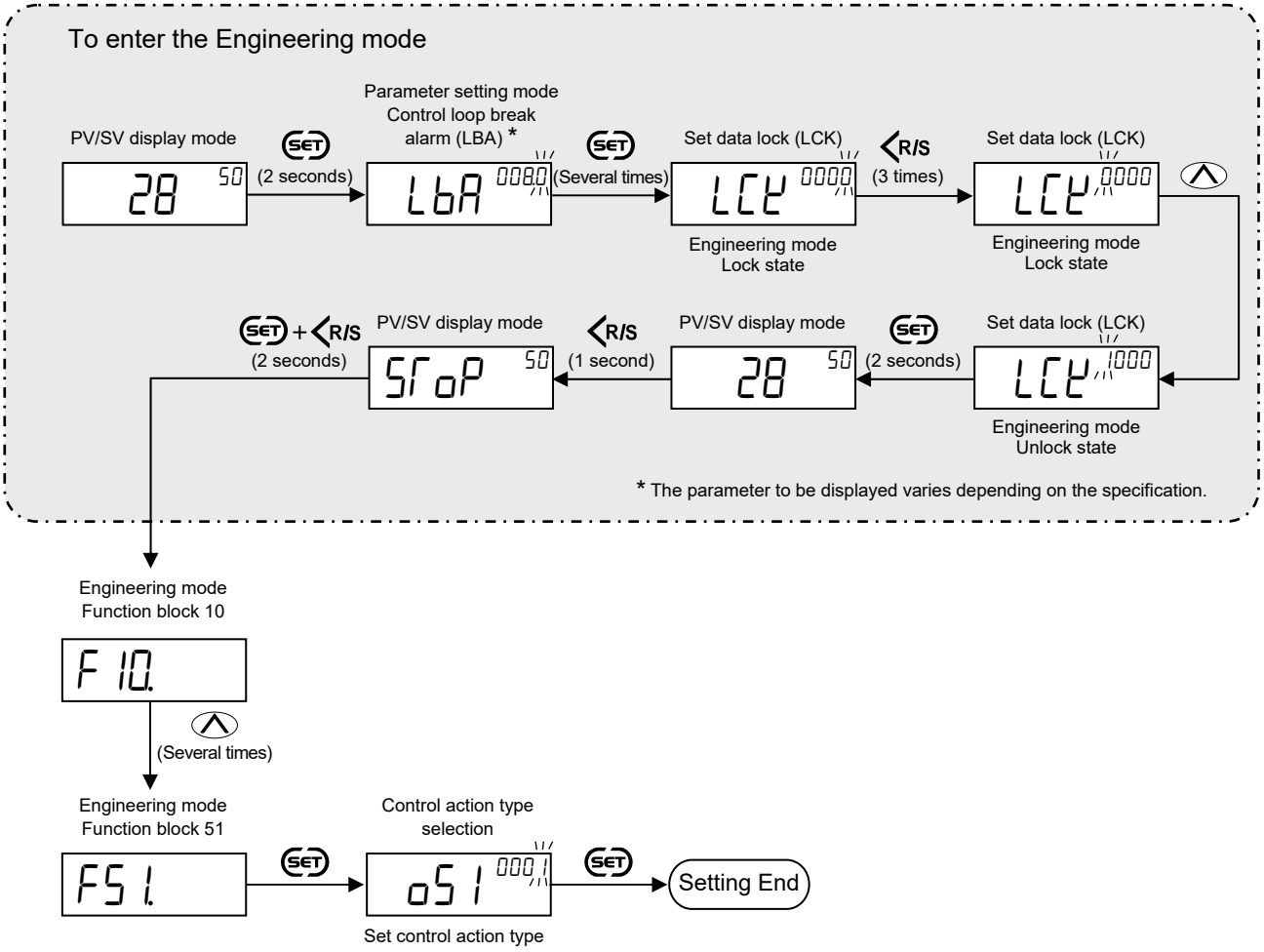
Function block	Parameter symbol	Name	Data range	Factory set value
F51. (F51.)	oS1 (oS1)	Control action type selection	0: PID action with autotuning (Direct action) [D type] 1: PID action with autotuning (Reverse action) [F type] 2: Heat/cool PID action with autotuning (Water cooling) [W type] 3: Heat/cool PID action with autotuning (Air cooling) [A type]	Factory set value varies depending on the instrument specification.

● Parameter setting mode: C

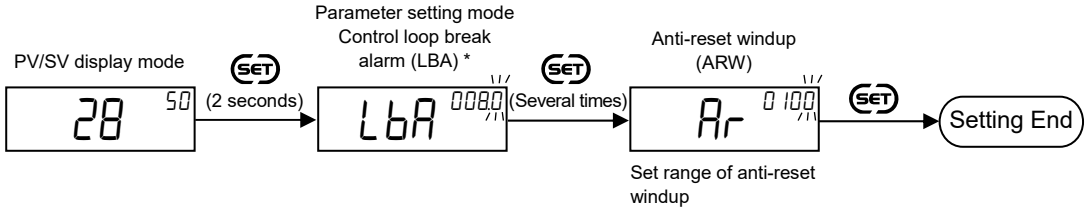
Parameter symbol	Name	Data range	Factory set value
Ar (Ar)	Anti-reset windup (ARW)	0 to 100 % of heat-side proportional band (0: Integral action OFF)	100

■ Setting procedure

● Control action



● Anti-reset windup (ARW)



* The parameter to be displayed varies depending on the specification.

11.2 Setting PID Values Automatically

There are the following two methods to automatically calculate and set the PID values.

– Autotuning (AT)
– Self-tuning (ST)

11.2.1 Autotuning (AT)

■ Description of function

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

Parameters computed by Autotuning (AT):

– Heat-side proportional band (P)
– Integral time (I)
– Derivative time (D)
– Cool-side proportional band (Only for Heat/Cool PID control with autotuning)
– Control loop break alarm (LBA) time * (The LBA time is automatically set to twice the value of the Integral time)

* When the Control break alarm (LBA) time is set to 0, the time will not be automatically obtained through the AT.

NOTE

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

● Requirements for AT cancellation

The AT is canceled if any of the following conditions exist.

– When the Set value (SV1, SV2) is changed.
– When the power is turned off.
– When the PV bias value is changed.
– When the RUN/STOP mode is changed to the STOP mode.
– When the PV becomes abnormal due to burnout.
– When the AT does not end in 9 hours after autotuning started.
– When power failure longer than 20 ms occurs.

If the AT is canceled, the controller immediately changes to PID control. The PID values will be the same as before the AT was activated.

When the AT is completed, the controller immediately changes to PID control. If the control system does not allow the AT cycling process, set each PID constant manually to meet the needs of the application.

● Requirements for AT start

Start the AT when all following conditions are satisfied:

- Prior to starting the AT function, end all the parameter settings other than PID and LBA.
- Confirm the LCK function has not been engaged. (LCK must be 0000)

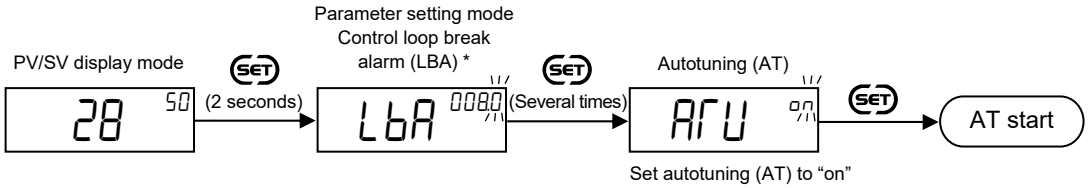
When the AT is finished, the controller will automatically returns to PID control.

■ Parameter setting

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
AT U (ATU)	Autotuning (AT)	on: AT start or execution oFF: AT end or cancel When the Autotuning is finished, the control will automatically return to "oFF."	oFF

■ Setting procedure

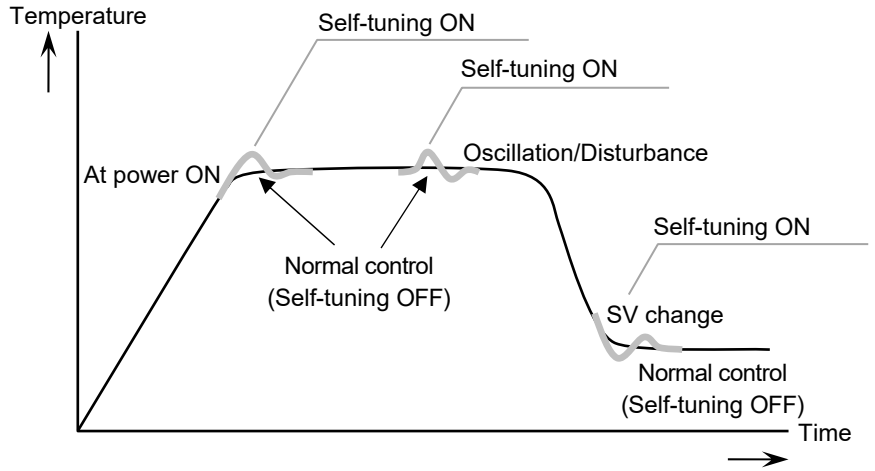


* The parameter to be displayed varies depending on the specification.

11.2.2 Self-tuning (ST)

■ Description of function

The ST function is used to automatically calculate and set adaptive PID constants anytime the power is turned on, the SV is changed or the controller detects unstable control conditions.



NOTE

- **The ST function should be turned off when the controlled system is affected by rippling that occurs due to periodic external disturbances.**
- **The power to the controlled system must be turned on before the power to the instrument is turned on or SV is changed. This is required when the ST function is on.**
- **To activate the ST function, the following parameters must not be set to zero: P≠0, I≠0, D≠0, ARW≠0**

When the AT function is activated, the ST function cannot be turned on.

When the Heat/Cool PID action is selected, the ST function cannot be activated.

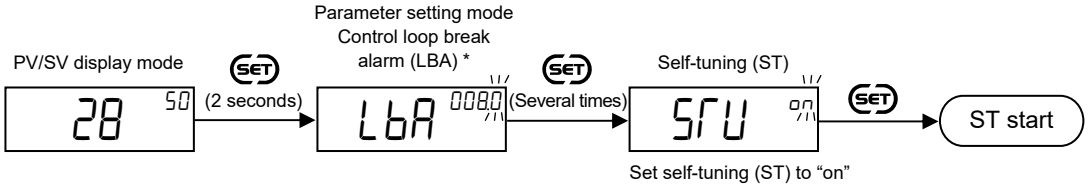
When the ST function is activated, the PID and the ARW settings can be monitored, but not changed.

■ Parameter setting

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
STU (STU)	Self-tuning (ST)	on: Self-tuning ON oFF: Self-tuning OFF	oFF

■ Setting procedure



* The parameter to be displayed varies depending on the specification.

11.3 Controlling with ON/OFF Action

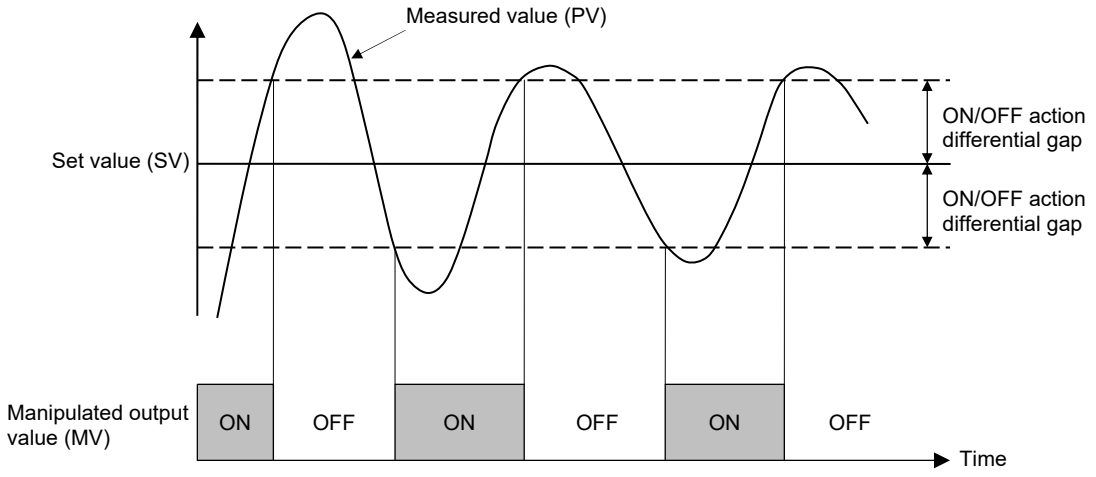
In ON/OFF control, the Manipulated output value (MV) is turned on or off depending on the Measured value (PV) whether it is above or below the Set value (SV).

■ 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 Heat-side 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).
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 of 5 °C, the Manipulated output value (MV) turns off at 105 °C and turns on when the temperature drops below 95 °C.

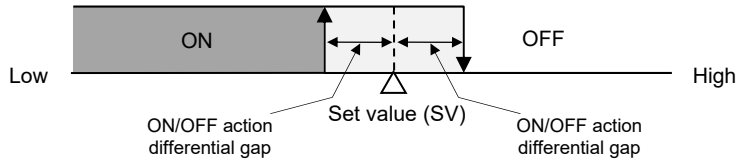
● Cooling control with ON/OFF action

After selecting "0: PID control with Autotuning (Direct action)" in "Control action type selection" in the Engineering mode (function block 51), set the "Heat-side proportional band (P)" to zero. Then, the Cooling control (direct action) of ON/OFF action can be executed.
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

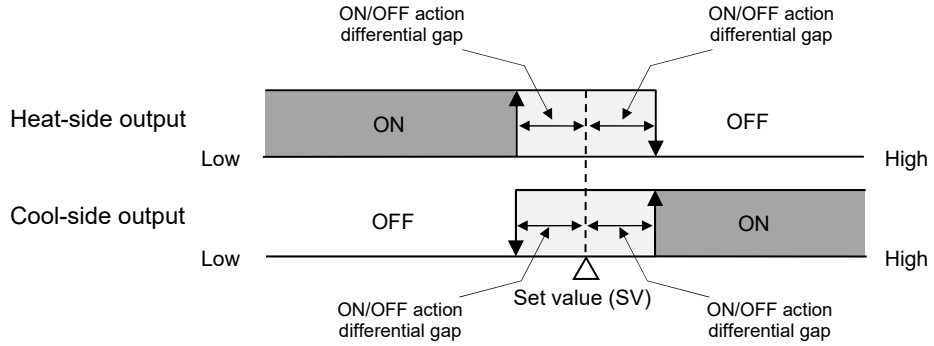
After selecting “2: Heat/Cool PID action with autotuning (Water cooling)” or "3: Heat/Cool PID action with autotuning (Air cooling)”in “Control action type selection” in the Engineering mode (function block 51), set the “Heat-side proportional band (P)” to zero. Then, the Heat/Cool control of ON/OFF action can be executed.

Manipulated output for ON/OFF action [at Heating control]

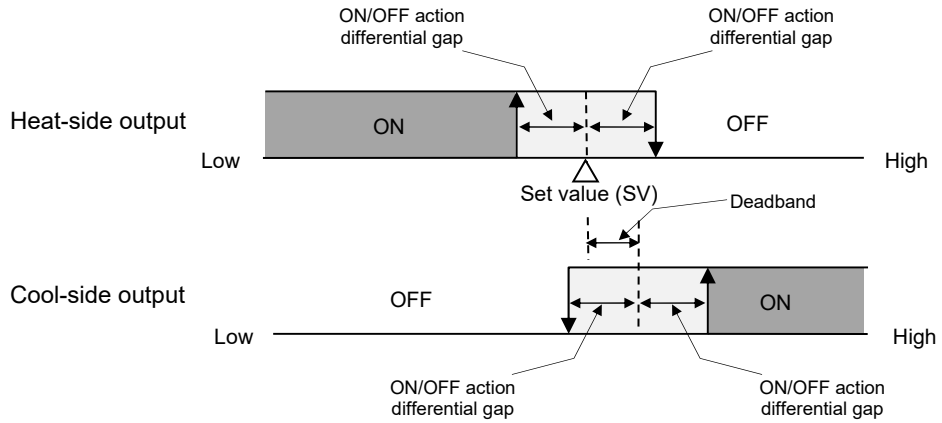


Manipulated output for ON/OFF action [at Heat/Cool control]

● Overlap/Deadband= 0



● Overlap/Deadband > 0



☞ Refer to **P. 11-12** for the Overlap/Deadband.

■ Parameter setting

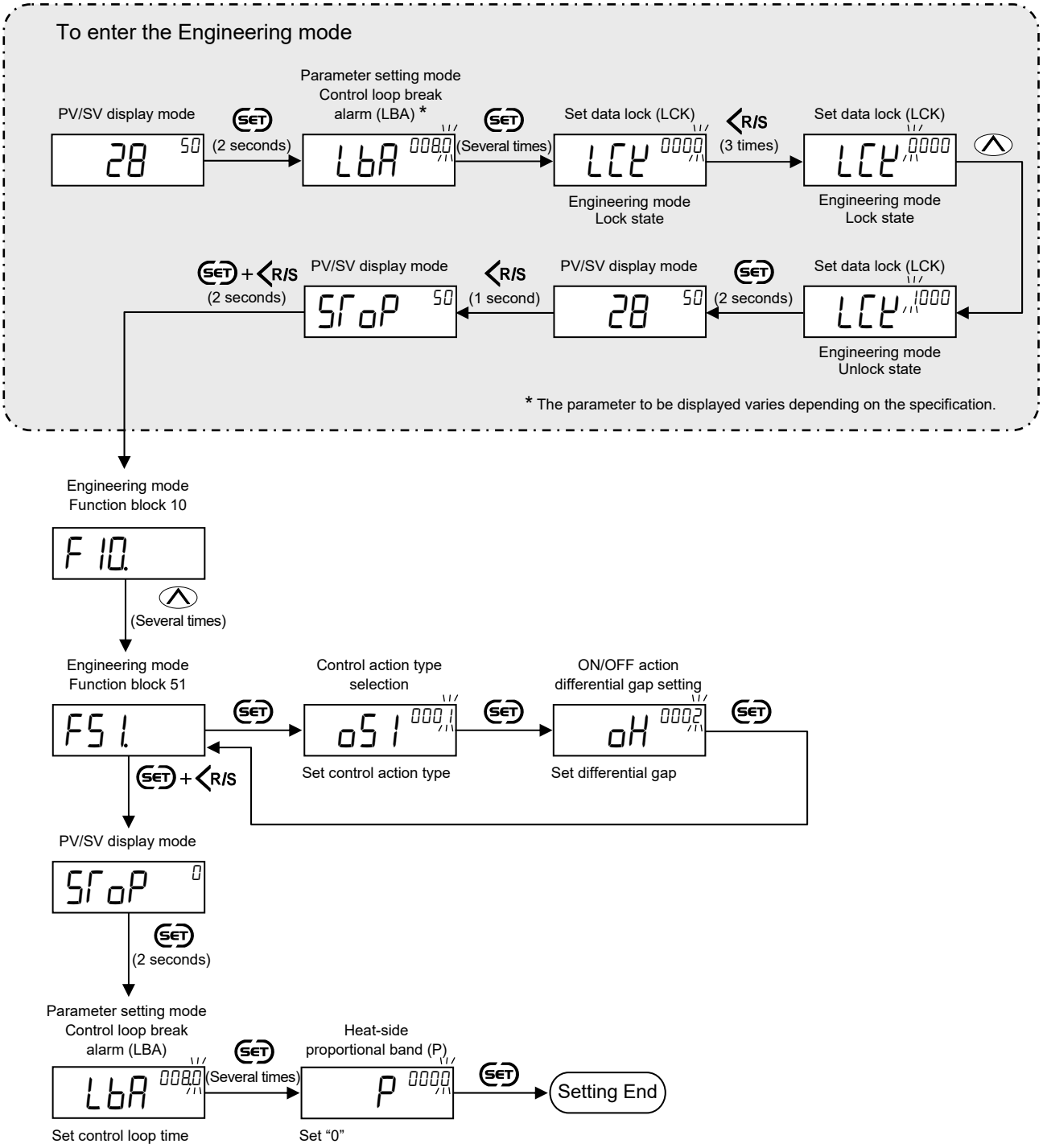
● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F51. (F51.)	oS1 (oS1)	Control action type selection	0: PID action with autotuning (Direct action) [D type] 1: PID action with autotuning (Reverse action) [F type] 2: Heat/cool PID action with autotuning (Water cooling) [W type] 3: Heat/cool PID action with autotuning (Air cooling) [A type]	Factory set value varies depending on the instrument specification.
	oH (oH)	ON/OFF action differential gap setting	0 (0.0) to Span (However, 9999 digits or less) Varies with the setting of the Decimal point position.	TC/RTD inputs: 2 (2.0) Voltage/ Current inputs: 0.2

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
P (P)	Heat-side proportional band (P)	0 (0.0) to Span (However, 9999 digits or less) 0 (0.0): ON/OFF action Varies with the setting of the Decimal point position.	TC/RTD inputs: 30 (30.0) Voltage/ Current inputs: 3.0

■ Setting procedure



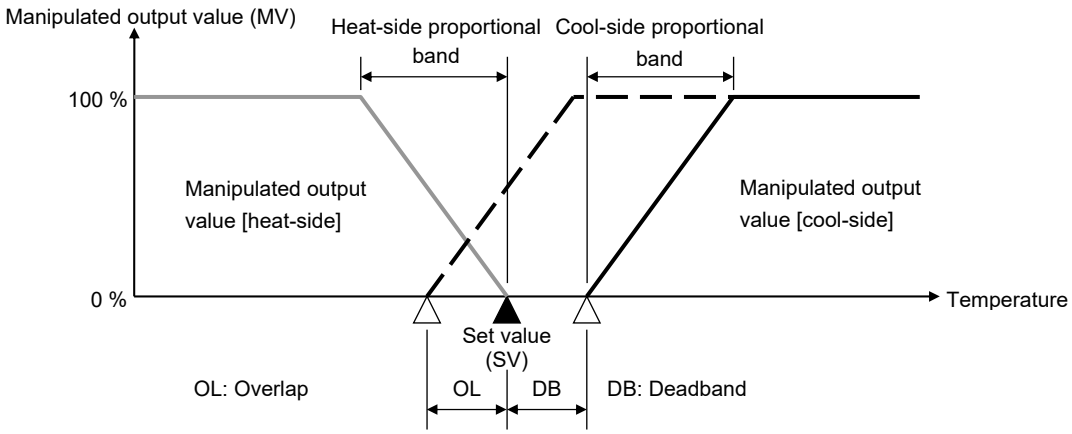
11.4 Controlling with Heat/Cool Control

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

● 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.
The Overlap/Deadband setting works on the cool-side.



OL: Overlap (OL)
Range in which the Heat-side proportional band and the Cool-side proportional band are overlapped.

DB: Deadband
This is a control dead zone existing between the Heat-side proportional band and the Cool-side proportional band.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F30. (F30.)	LoGC (LoGC)	Output logic operation selection	002: OUT1: Heat-side control output OUT2: Cool-side control output (In case of direct action or reverse action, it is OFF) 019: OUT1: Cool-side control output (In case of direct action or reverse action, it is OFF) OUT2: Heat-side control output For other output assignment codes not described above, refer to **P. 9-3**.	Factory set value varies depending on the instrument specification.
F51. (F51.)	oS1 (oS1)	Control action type selection	0: PID action with autotuning (Direct action) [D type] 1: PID action with autotuning (Reverse action) [F type] 2: Heat/cool PID action with autotuning (Water cooling) [W type] 3: Heat/cool PID action with autotuning (Air cooling) [A type]	Factory set value varies depending on the instrument specification.

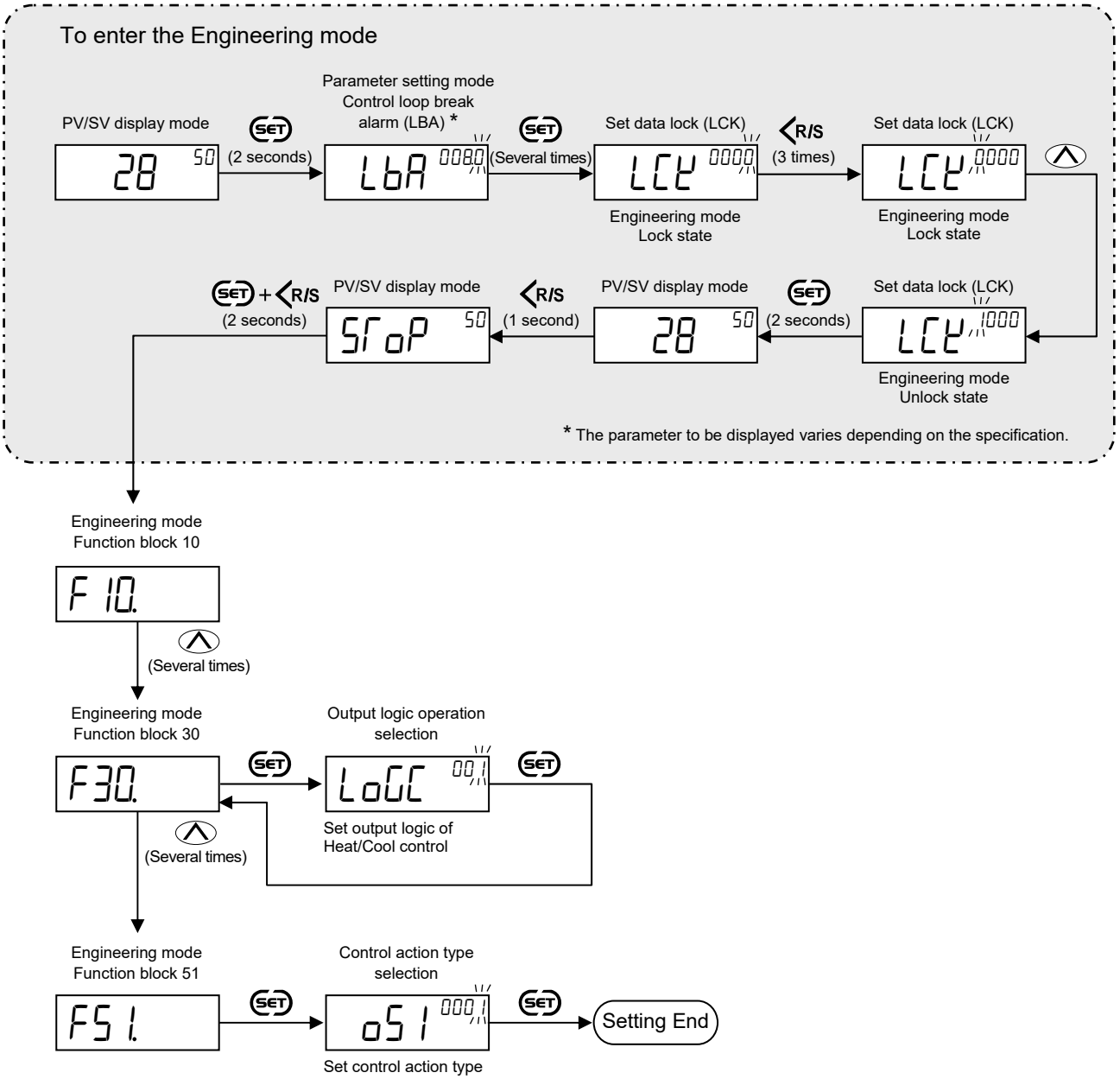
● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
P (P)	Heat-side proportional band (P)	0 (0.0) to Span (However, 9999 digits or less) 0 (0.0): ON/OFF action Varies with the setting of the Decimal point position.	TC/RTD inputs: 30 (30.0) Voltage/ Current inputs: 3.0
I (I)	Integral time (I)	0to 3600 seconds (0: PD action)	240
d (d)	Derivative time (D)	0to 3600 seconds (0: PI action)	60
Ar (Ar)	Anti-reset windup (ARW)	0 to 100 % of heat-side proportional band (0: Integral action OFF)	100
T (T)	Heat-side proportioning cycle time *	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2
Pc (Pc)	Cool-side proportional band	1 to 1000 % of heat-side proportional band	100
db (db)	Overlap/Deadband	−Span to +Span (However, within −1999 to +9999 digits) Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0
t (t)	Cool-side proportioning cycle time *	1 to 100 seconds	Relay contact output: 20 Voltage pulse output: 2

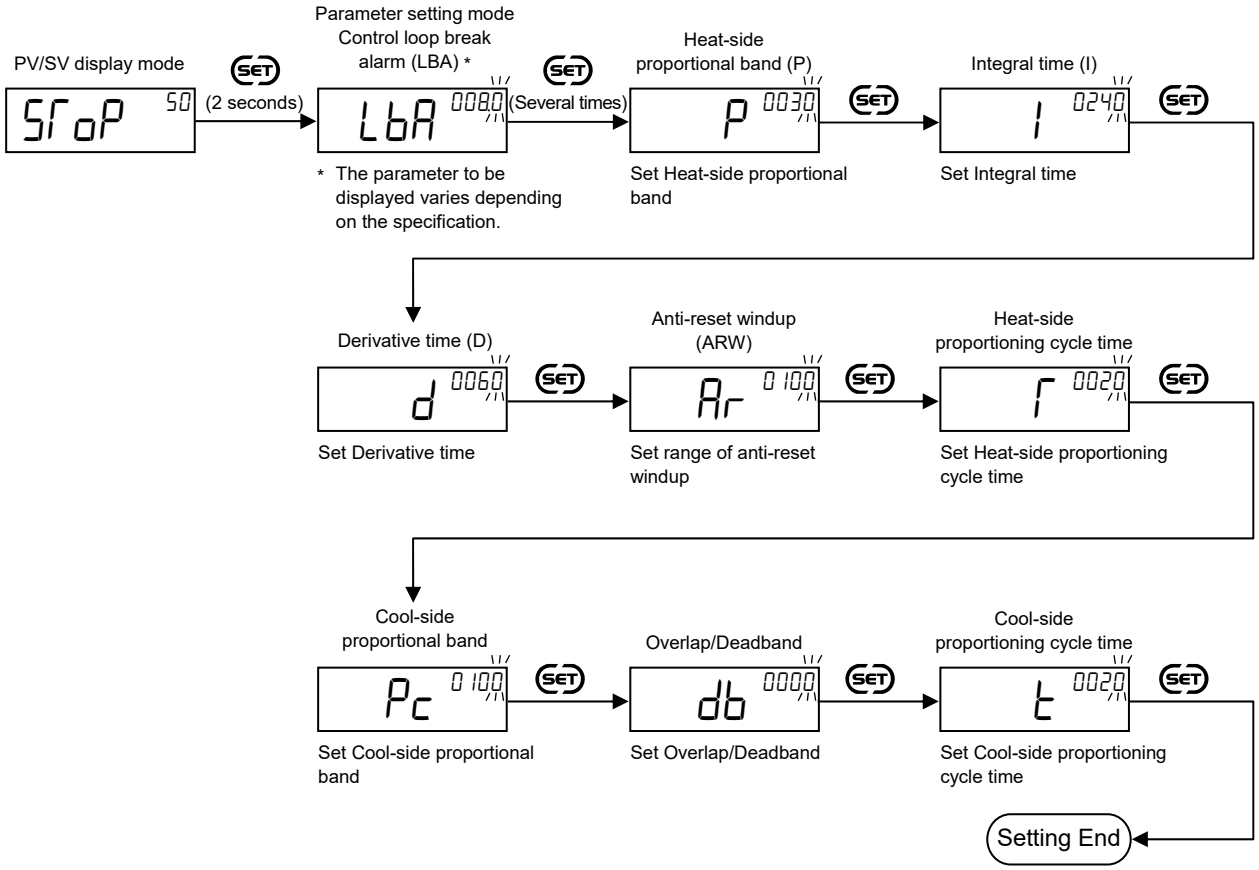
* For the Proportional cycle time, refer to **9.4 Changing Proportional Cycle Time (P. 9-9)**.

■ Setting procedure

● Selecting Heat/Cool PID control



● Setting parameters for Heat/Cool PID control



MEMO

DISPLAY RELATED FUNCTIONS

12

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

12.1 Changing the Display Position of STOP during the Control Stop

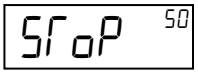
The display position of "SToP" showing the control stop state can be changed.

■ Description of function

This function selects whether the STOP is displayed on the Measured value (PV) display or the Set value (SV) display.

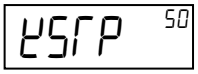
When "STOP" is displayed on the PV display unit (TYPE 1)

PV/SV display mode



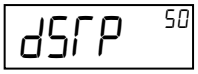
(STOP)

PV/SV display mode



(KSTP)

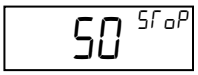
PV/SV display mode



(dSTP)

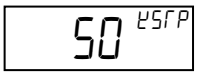
When "STOP" is displayed on the SV display unit (TYPE 2)

PV/SV display mode



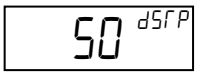
(STOP)

PV/SV display mode



(KSTP)

PV/SV display mode



(dSTP)

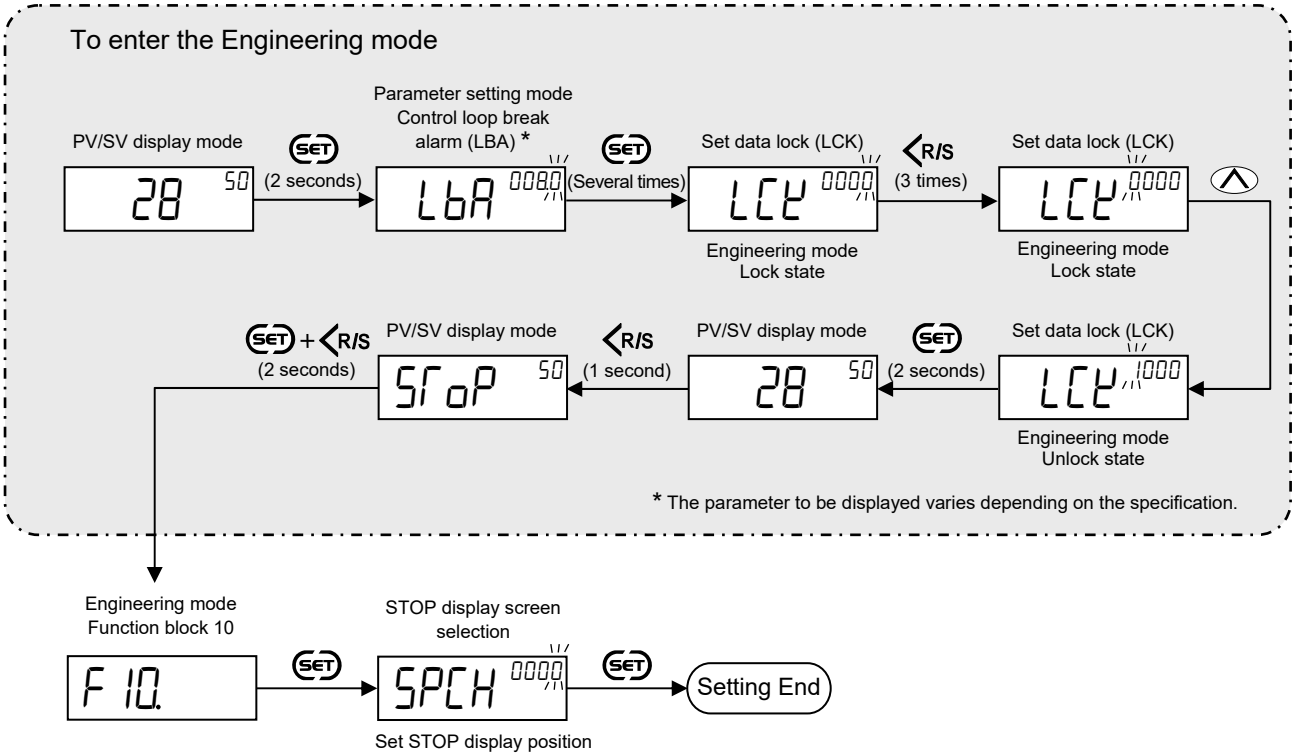
KSTP:	This parameter symbol indicates that this instrument is set to STOP by the front keys when the contact input is used. (Contact input: RUN state)
dSTP:	This parameter symbol indicates that this instrument is set to STOP by the contact input. (Key operation: RUN state)

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F10. (F10.)	SPCH (SPCH)	STOP display screen selection	0: STOP is displayed on the PV display unit. (TYPE 1) 1: STOP is displayed on the SV display unit. (TYPE 2) 2: No selection from RUN to STOP by the front key can be made.	0

■ Setting procedure



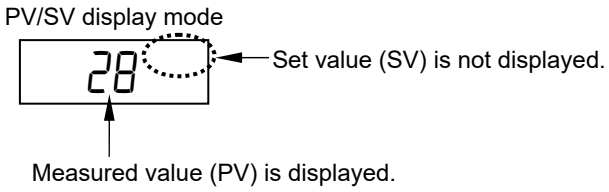
12.2 Hiding the Display of the Measured Value (PV) or Set Value (SV)

The Measured value (PV) or Set value (SV) can be hidden.

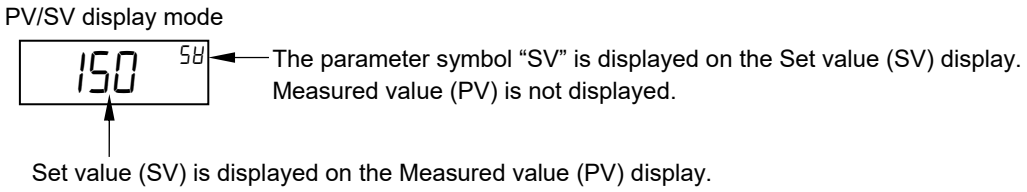
■ Description of function

This function is to prevent the Measured value (PV) or Set value (SV) displayed in the PV/SV display mode from being displayed.

Display example: Only PV display



Display example: Only SV display

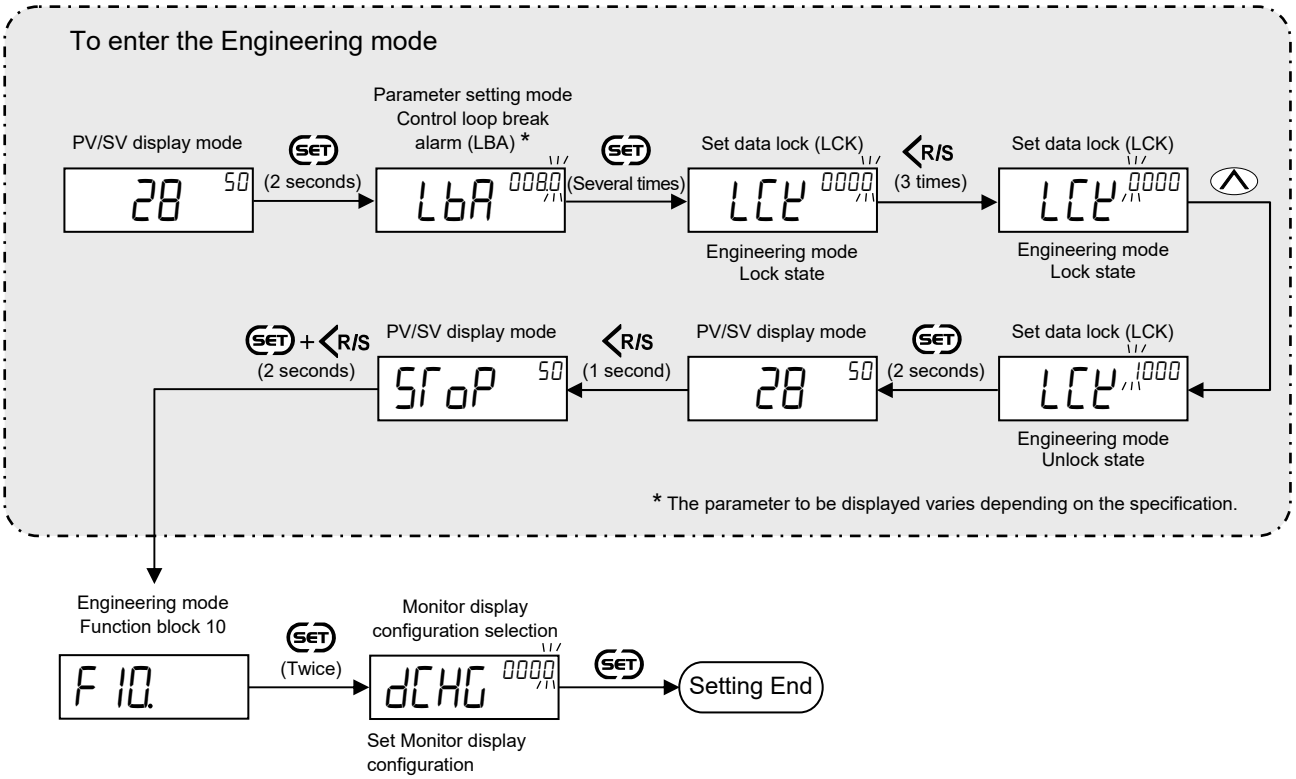


■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F10. (F10.)	dCHG (dCHG)	Monitor display configuration selection	0: PV/SV display 1: Only PV display 2: Only SV display	0

■ Setting procedure



12.3 Checking Input Peak Value/Bottom Value

This instrument incorporates as standard the Peak/Bottom hold function which allows storing the peak (max) and the bottom (min) Measured values (PV).

■ Description of function

● Peak hold, Bottom hold

The peak hold/bottom hold function is used to store (hold) the peak (max) and the bottom (min) Measured values (PV). The peak hold and bottom hold values are updated regardless of the STOP or RUN state if the power to this instrument is turned on. Each of these values is updated when the Measured value (PV) becomes more (or less) than the value now being held. However, if the following operation is performed, the value now being held is reset and as a result the Measured value (PV) just when reset becomes the peak hold or bottom hold value.

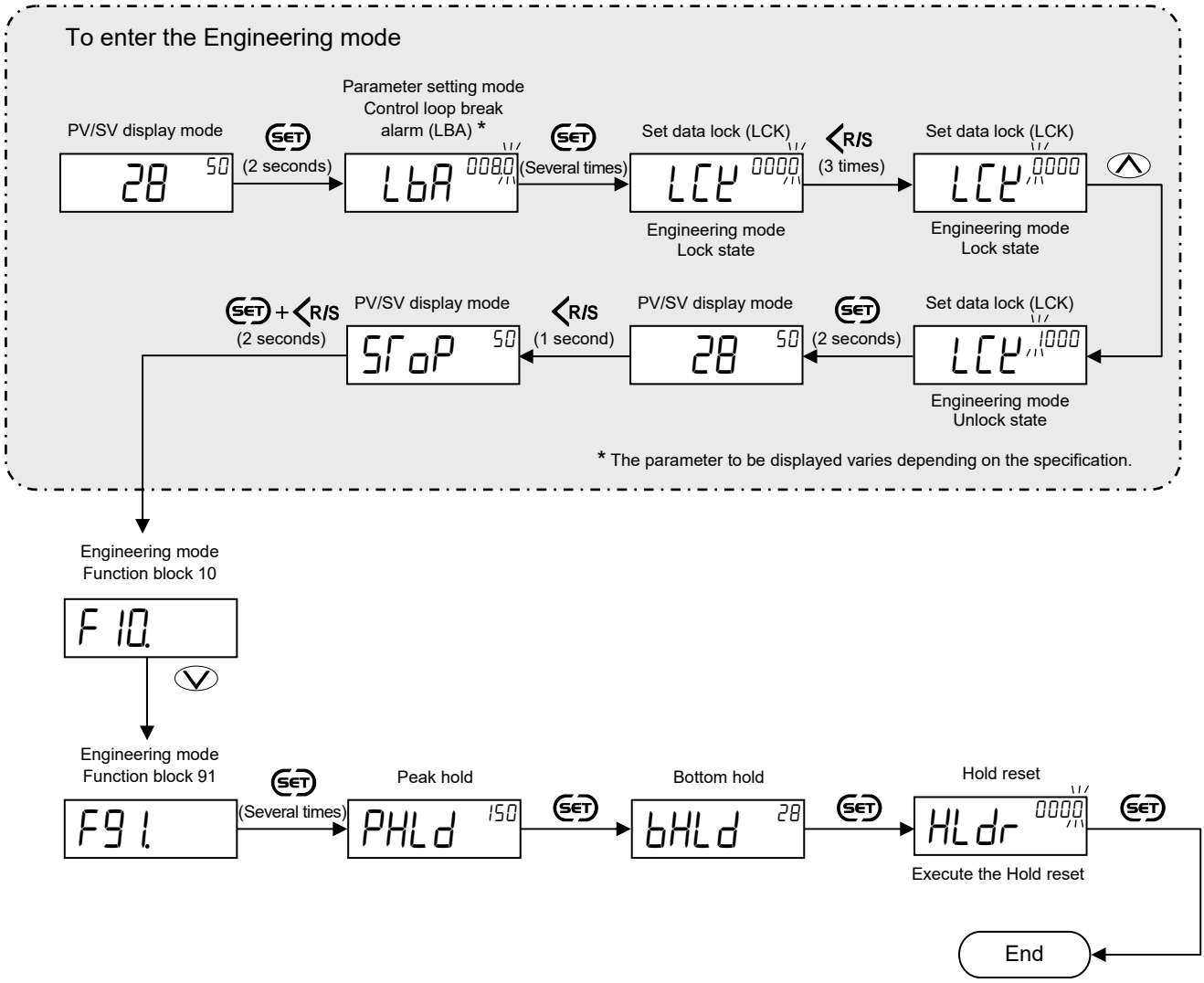
- When the power of this instrument is turned off/on
- When the instrument is switched from STOP to RUN
- When the Hold reset is executed

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F91. (F91.)	PHLd (PHLd)	Peak hold	Within input range (Setting limiter [low limit] to Setting limiter [high limit])	—
	bHLd (bHLd)	Bottom hold	Varies with the setting of the Decimal point position.	—
	HLdr (HLdr)	Hold reset	0: Hold reset execution After executing the hold reset, the value automatically returns to "1."	1

■ Setting procedure



12.4 Checking the 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 on the instrument display. The Integrated operating time and the maximum ambient temperature (Holding peak ambient temperature).

■ Description of function

● ROM version

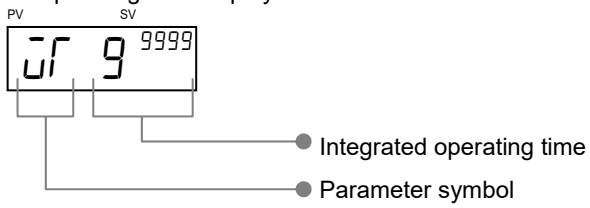
Display the version of loading software.

● Integrated operating time

Display product calculation operating time. However, as the integral time is increments by “1” when the power is turned on or off. The Integrated operating time cannot be reset.

Display range: 0 to 99999 hours
Display resolution: 1 hour

Integrated operating time display



● Holding peak ambient temperature

The maximum ambient temperature on the rear terminal board of the instrument is stored and displayed on the set value (SV) display. The Holding peak ambient temperature cannot be reset.

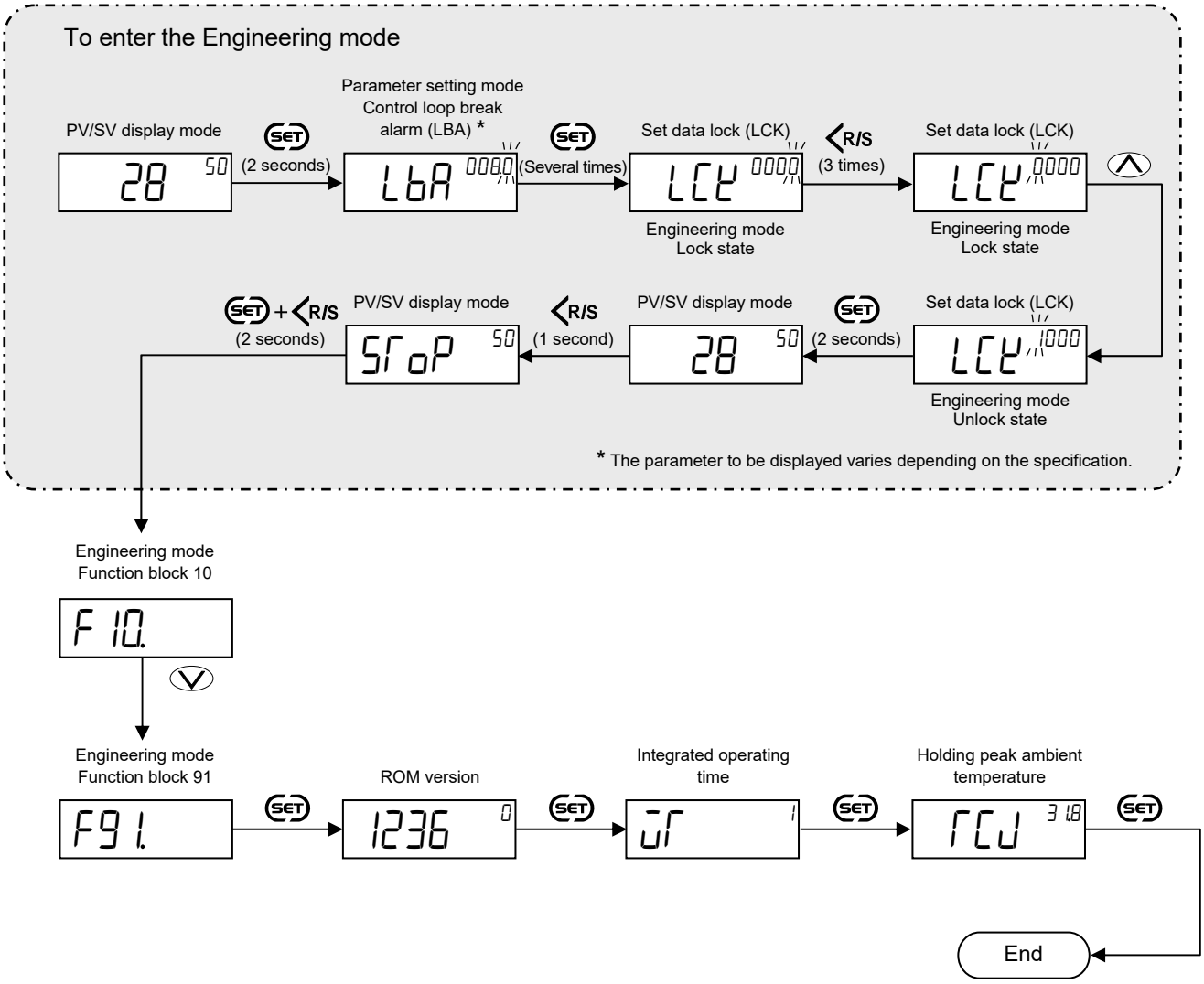
Display range: 0.0 to 999.9 °C
Display resolution: 0.1 °C

■ Display contents

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F91. (F91.)	—	ROM version	Display the version of loading software.	—
	WT (WT)	Integrated operating time	0 to 99999 hours	—
	TCJ (TCJ)	Holding peak ambient temperature	0.0 to 999.9 °C	—

■ Confirmation procedure



MEMO

SETTING AND KEY OPERATION

13

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

13.1 Eliminating a Sudden Set Value Change (Setting Change Rate Limiter)

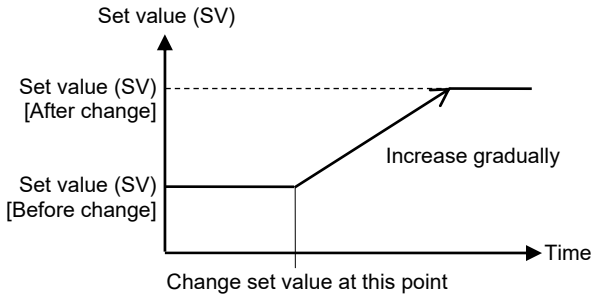
This function allows the Set value (SV) to change gradually, not rapidly or not at a time, when the Set value (SV) is changed.

■ Description of function

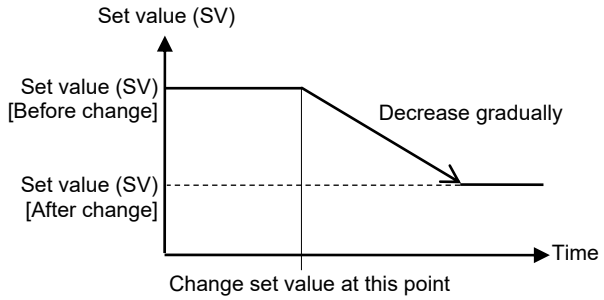
This function is to allow the Set value (SV) to be automatically changed at specific rates when a new Set value (SV). Setting the Setting change rate limiter unit time parameter and the Setting change rate limiter (up and down) will enable setting the changing rate (setting change rate limiter/unit time) of the Setting change rate limiter (up or down).

[Application examples of Setting change rate limiter]

- Example of increasing set value to higher value



- Example of decreasing set value to lower value



NOTE

- **When the power is turned on, the setting change rate limiter functions toward the set value (SV) from the measured value (PV) when started, but it may not start to function from the measured value (PV) in the following cases.**
  - **– Started from the set value (SV) if the display shows "oooo" or "uuuu" when the power is turned on.**
  - **– If out of the input range (flashing display),**
    If more than the input range (high limit): Started from the input range (high limit)
    If less than the input range (low limit): Started from the input range (low limit)
- **If the autotuning (AT) function is activated while the setting change rate limiter functions, PID control continues until the limiter completes its functioning, and the autotuning (AT) function is activated after the limiter completes its functioning.**
- **When the limiter is set as follows, no alarm hold action is taken even if the set value is changed.**
  - **– If the set value (SV) is changed in the upward direction when the set value on the upward side is other than 0.**
  - **– If the set value (SV) is changed in the downward direction when the set value on the downward side is other than 0.**

When the instrument is set to RUN from STOP, the Setting change rate limiter operation is performed from the measured value (PV) at that time to the set value (SV).

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F71. (F71.)	SVrS (SVrS)	Setting change rate limiter Used/Unused	0: Unused 1: Used	0
	SVrT (SVrT)	Setting change rate limiter time	1 to 3600 seconds	60

● Parameter setting mode: C

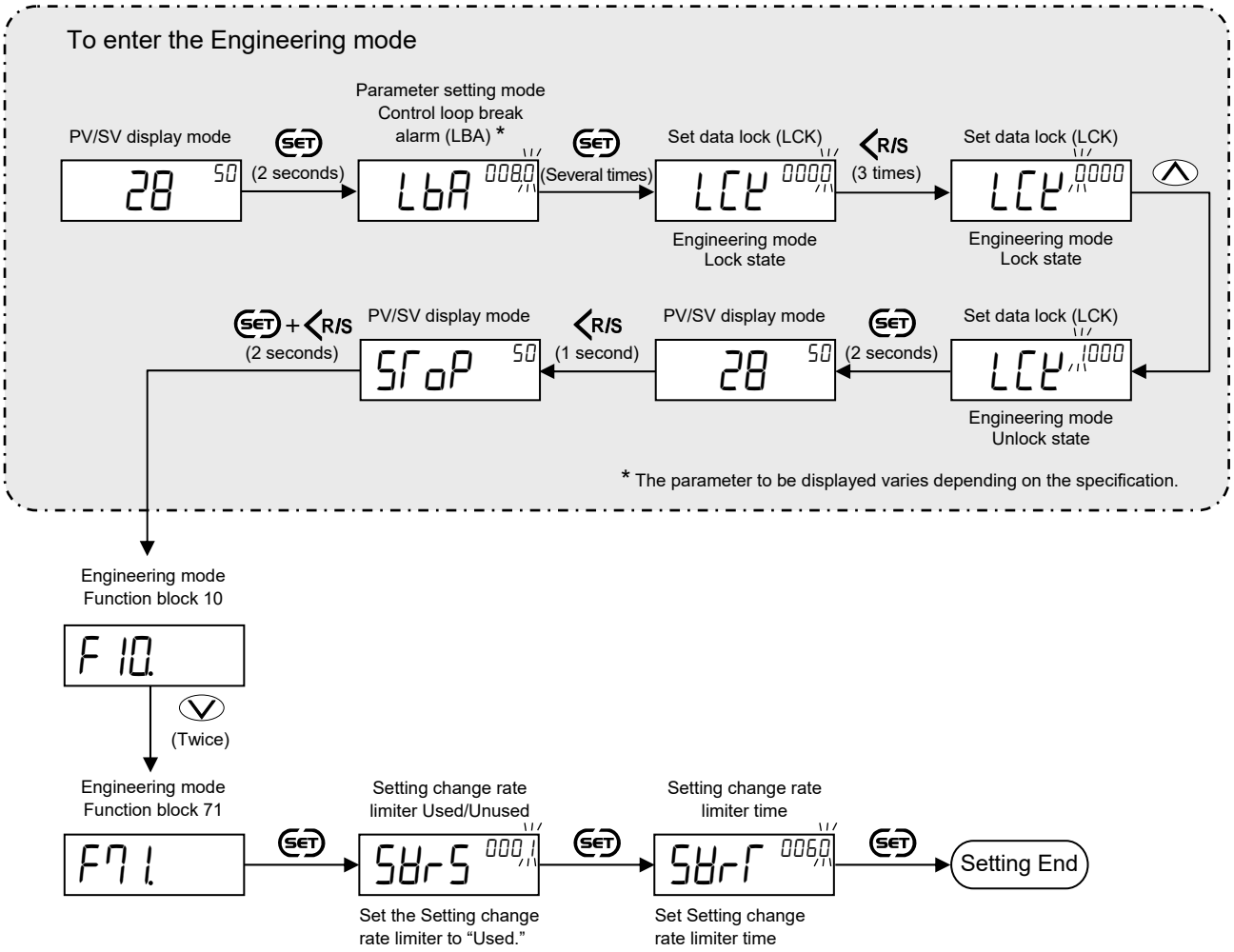
Parameter symbol	Name	Data range	Factory set value
SVrU (SVrU)	Setting change rate limiter (Up) [1]	TC/RTD inputs: 0 (0.0) to Span °C [°F]/unit time [2] (However, 9999 digits or less) Voltage/ Current inputs: 0 (0.0) to Span °C [°F]/unit time [2] (However, 9999 digits or less) 0 (0.0): Limiter OFF Varies with the setting of the Decimal point position.	TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0
SVrd (SVrd)	Setting change rate limiter (Down) [1]		TC/RTD inputs: 0 (0.0) Voltage/ Current inputs: 0.0

[1] This parameter is displayed when the “Setting change rate limiter Used/Unused” is set to the “Used.”

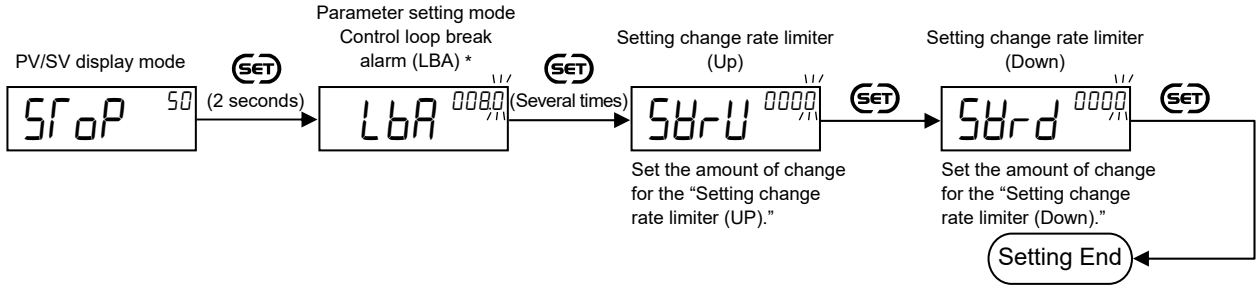
[2] The unit time can be set in the “Setting change rate limiter time.” (Factory set value: 60 seconds)

■ Setting procedure

● Enable Setting change rate limiter



● Set the amount of change for the Setting change rate limiter



* The parameter to be displayed varies depending on the specification.

13.2 Restricting Key Operation (Set Data Lock)

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

■ Parameter setting

● Parameter setting mode: C

Parameter symbol	Name	Data range	Factory set value
LCK (LCK)	Set data lock (LCK)	0000 to 1111 *	0000

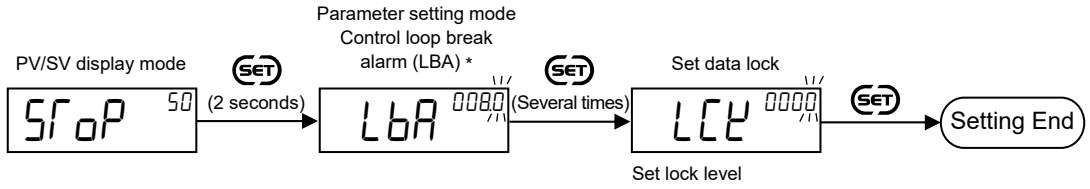
* Details of set data lock function

×: Settable-Data unlocked —: Unsettable-Data locked

Set data	Setting items of Engineering mode	Set value (SV)	Alarm set value (Alarm 1, Alarm 2)	Other setting items
0000	—	×	×	×
0001	—	×	×	—
0010	—	×	—	×
0011	—	×	—	—
0100	—	—	×	×
0101	—	—	×	—
0110	—	—	—	×
0111	—	—	—	—
1000	×	×	×	×
1001	×	×	×	—
1010	×	×	—	×
1011	×	×	—	—
1100	×	—	×	×
1101	×	—	×	—
1110	×	—	—	×
1111	×	—	—	—

The data lock function only prevents setting changes being made from the front keys.
Setting changes can still be made through communication transmission.

■ Setting procedure



* The parameter to be displayed varies depending on the specification.

13.3 Prohibition of STOP Operation by the Front Key

The method of switching from RUN to STOP can be restricted.

■ Description of function

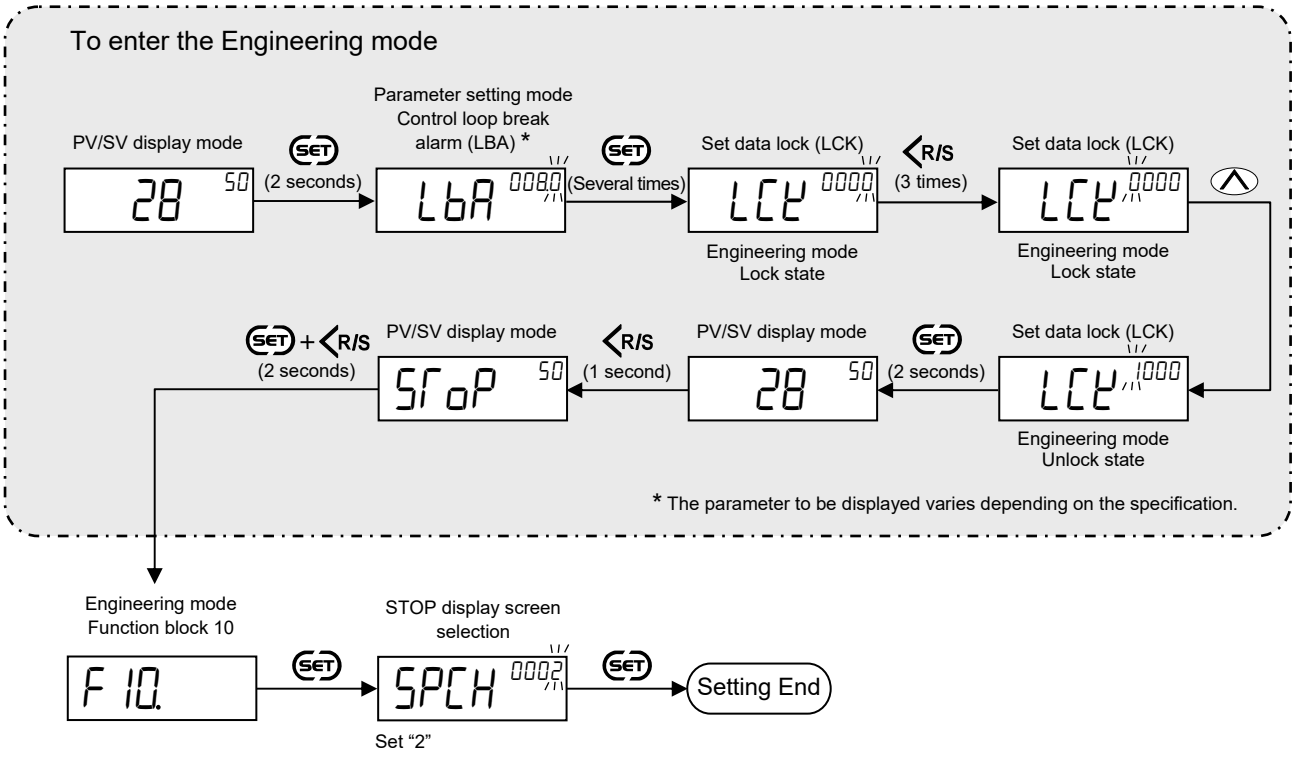
This function limits the switching operation from RUN to STOP with the front key of the instrument. However, it is possible to switch from STOP to RUN. In addition, there are no restrictions on switching via communication or contact input.

■ Parameter setting

● Engineering mode: E

Function block	Parameter symbol	Name	Data range	Factory set value
F 10. (F10.)	SPCH (SPCH)	STOP display screen selection	0: STOP is displayed on the PV display unit. (TYPE 1) 1: STOP is displayed on the SV display unit. (TYPE 2) **2: No selection from RUN to STOP by the front key can be made.**	0

■ Setting procedure



PARAMETERS THAT ARE INITIALIZED/MODIFIED WHEN SETTING IS CHANGED

14

This chapter describes the parameters that are initialized/modified when setting is changed.

14.1 Parameters to Be Initialized

Changing any of the following parameters will require initialization of the related settings.

NOTE

Make sure all settings are recorded before changing the set values.

NOTE

Check all set values after having changed the settings.

14.1.1 When "Input type selection (I nP)" is changed

The following parameters will be initialized.

Mode		Items		Symbol	Default value	
					TC/RTD inputs	Voltage/Current inputs
Engineering mode	Function block 21.	Decimal point position setting		PGdP	0 (No decimal place)	1 (One decimal place)
		Setting limiter [high limit]		SLH	Maximum settable value	100.0
		Setting limiter [low limit]		SLL	Minimum settable value	0.0
	Function block 41.	Alarm 1 hold action selection		AHo1	0 (Without alarm hold action)	
		Alarm 1 differential gap setting		AH1	2	0.2
		Alarm 1 process abnormality action selection		AEo1	Alarm 1 not provided or LBA: 0 (Normal) Alarm 1 provided: 1 (Forcibly turned on)	
	Function block 42.	Alarm 2 hold action selection		AHo2	0 (Without alarm hold action)	
		Alarm 2 differential gap setting		AH2	2	0.2
		Alarm 2 process abnormality action selection		AEo2	Alarm 2 not provided: 0 (Normal) Alarm 2 provided: 1 (Forcibly turned on)	
	Function block 51.	ON/OFF action differential gap setting		oH	2	0.2
Parameter setting mode		Control loop break alarm (LBA)		LbA	8.0	
		LBA deadband (LBD)		Lbd	0	0.0
		Alarm 1 (ALM1)		AL1	50	5.0
		Alarm 2 (ALM2)		AL2		
		Heat-side proportional band (P)		P	30	3.0
		Integral time (I)		I	240	
		Derivative time (D)		d	60	
		Anti-reset windup (ARW)		Ar	100	
		Cool-side proportional band		Pc	100	
		Overlap/Deadband		db	0	0.0
		PV bias		Pb	0	0.0
		PV ratio (Pr)		Pr	1.000	
		Digital filter		dF	0 (off)	
		Transmission output scale high (AHS)		AHS	Input range high	100.0
		Transmission output scale low (ALS)		ALS	Input range low	0.0
		Setting change rate limiter (Up)		SHrU	0	0.0
		Setting change rate limiter (Down)		SHrd	0	0.0
SV setting mode		Set value (SV) setting	Without STEP function	—	0	0.0
		Set value (SV1) setting	With STEP function	SH1		
		STEP set value (SV2) setting		SH2		

14.1.2 When “Alarm 1 type selection (AS 1)” is changed

The following parameters will be initialized.

Mode		Items	Symbol	Default value	
				TC/RTD inputs	Voltage/Current inputs
Engineering mode	Function block 41.	Alarm 1 hold action selection	AHo 1	0 (Without alarm hold action)	
		Alarm 1 differential gap setting	AH 1	2 (2.0)	0.2
		Alarm 1 process abnormality action selection	AEo 1	Alarm 1 not provided or LBA: 0 (Normal) Alarm 1 provided: 1 (Forcibly turned on)	
Parameter setting mode		Alarm 1 (ALM1)	AL 1	50 (50.0)	5.0
		Control loop break alarm (LBA)	LbA	8.0	
		LBA deadband (LBD)	Lbd	0 (0.0)	0.0

14.1.3 When “Alarm 2 type selection (AS2)” is changed

The following parameters will be initialized.

Mode		Items	Symbol	Default value	
				TC/RTD inputs	Voltage/Current inputs
Engineering mode	Function block 42.	Alarm 2 hold action selection	AHo2	0 (Without alarm hold action)	
		Alarm 2 differential gap setting	AH2	2 (2.0)	0.2
		Alarm 2 process abnormality action selection	AEo2	Alarm 2 not provided: 0 (Normal) Alarm 2 provided: 1 (Forcibly turned on)	
Parameter setting mode		Alarm 2 (ALM2)	AL2	50 (50.0)	5.0

14.1.4 When “Transmission output (AO) specification (Ao)” is changed

The following parameters will be initialized.

Mode	Items	Symbol	Default value	
			TC/RTD inputs	Voltage/Current inputs
Parameter setting mode	Transmission output scale high (AHS)	AHS	Input range high	100.0
	Transmission output scale low (ALS)	ALS	Input range low	0.0

14.2 Parameters to Be Automatically Converted

14.2.1 When “Setting limiter [low limit] (SLL)” or “Setting limiter [high limit] (SLH)” is changed

If the setting limiter [high limit] or setting limiter [low limit] is changed as follows, the related set values are changed. (Refer to the table below)

Only for TC/RTD inputs:

- If SLH is set to SLH<SLL, it is changed to SLH=SLL.
  Example: If SLH is set to 100 with SLL set to 200, SLL is changed to 100.
- If SLL is set to SLH<SLL, it is changed to SLH=SLL.
  Example: If SLL is set to 200 with SLH set to 100, SLH is changed to 200.

TC/RTD inputs, voltage/current inputs:

If the setting is made so that the span becomes narrower, there may be a case where the related set value becomes smaller or 0.

Mode		Items		Symbol
Engineering mode	Function block 41.	Alarm 1 differential gap setting		AH1
	Function block 42.	Alarm 2 differential gap setting		AH2
	Function block 51.	ON/OFF action differential gap setting		oH
Parameter setting mode		LBA deadband (LBD)		Lbd
		Alarm 1 (ALM1)		AL1
		Alarm 2 (ALM2)		AL2
		Heat-side proportional band (P)		P
		Overlap/Deadband		db
		PV bias		Pb
		Transmission output scale high (AHS)		AHS
		Transmission output scale low (ALS)		ALS
		Setting change rate limiter (Up)		SHrU
		Setting change rate limiter (Down)		SHrd
SV setting mode		Set value (SV) setting	Without STEP function	—
		Set value (SV1) setting	With STEP function	SH1
		STEP set value (SV2) setting		SH2

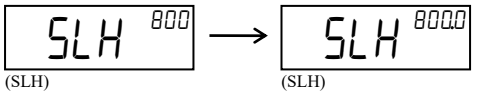
14.2.2 When “Decimal point position setting” is changed

The set value is automatically converted.

- After the position of the decimal point is changed, conduct automatic conversion so that the following values may not be changed.

Mode		Items		Symbol
Engineering mode	Function block 21.	Setting limiter [high limit]		SLH
		Setting limiter [low limit]		SLL
	Function block 41.	Alarm 1 differential gap setting		AH1
	Function block 42.	Alarm 2 differential gap setting		AH2
	Function block 51.	ON/OFF action differential gap setting		oH
Parameter setting mode		LBA deadband (LBD)		Lbd
		Alarm 1 (ALM1)		AL1
		Alarm 2 (ALM2)		AL2
		Heat-side proportional band (P)		P
		Overlap/Deadband		db
		PV bias		Pb
		Transmission output scale high (AHS)		AHS
		Transmission output scale low (ALS)		ALS
		Setting change rate limiter (Up)		SHrU
		Setting change rate limiter (Down)		SHrd
SV setting mode		Set value (SV) setting	Without STEP function	—
		Set value (SV1) setting	With STEP function	SV1
		STEP set value (SV2) setting		SV2

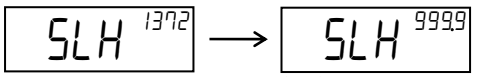
Example: When the position of the decimal point changed from 0 to 1 with SLH set to 800 °C.



(SLH) (SLH) (Changed from 800 to 800.0.)

- If the setting range is not between −1999 and +9999 regardless of the position of the decimal point, it is limited by the range from −1999 to +9999.

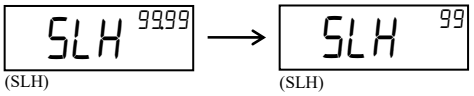
Example: When SLH is 1372 °C with no decimal position, and the decimal position is changed from 0 to 1 (one decimal position), SLH will become 999.9.



(SLH) (SLH)

- If the number of digits below the decimal point is changed in the decreasing direction, the decreased number of digits is omitted.

Example: When SLH is 99.99 with two decimal positions, and the decimal position is changed from 2 to 0, SLH will become 99 by discarding the digits below the decimal point.



(SLH) (SLH)

MEMO

TROUBLE SHOOTING

15

This chapter describes error displays and countermeasures for errors.

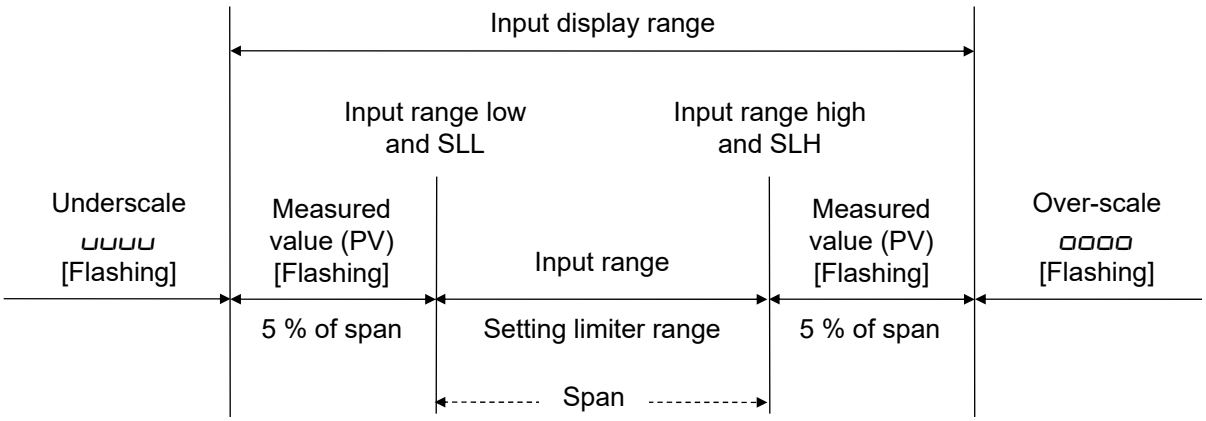
15.1 Error Displays

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.

Display	Description	Solution
Measured value (PV) [Flashing]	Measured value (PV) is outside of input range.	**⚠ WARNING** To prevent electric shock, always turn off the power before replacing the sensor. Check Input type, Input range and connecting state of sensor. Confirm that the sensor or wire is not broken.
200 OOOO [Flashing]	Over-scale: Measured value (PV) is above the high input display range limit.	
200 UUUU [Flashing]	Underscale: Measured value (PV) is below the low input display range limit.	



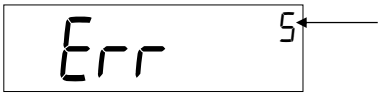
SLH: Setting limiter [high limit]
SLL: Setting limiter [low limit]

■ 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	Adjustment data error	Display: Error display (Err) Control output: All outputs are OFF Alarm output: All outputs are OFF	Turn off the power once. If an error occurs after the power is turned on again, please contact RKC sales office or the agent.
2	EEPROM error		
4	A/D conversion error		
8	RAM check error		
128	Watchdog timer error		

Example: When the adjustment data error (1) and A/D conversion error (4) occurs simultaneously



The error codes are shown in the SV display.
When two or more errors occur simultaneously, the total summation of these error codes is displayed.

15.2 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 Terminal Configuration (P. 3-4)**.
	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. 7-22)**.
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 **8.1 Changing Input (P. 8-2)**.
	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 **8.3 Correcting Input (P. 8-9)**. However, this is limited only to when the PV bias setting can be changed.
	PV ratio is set.	Change the PV ratio setting by referring to **8.3 Correcting Input (P. 8-9)**. However, this is limited only to when the PV ratio setting can be changed.

How to check the input

• When the input is configured as Thermocouple input:
Short the input terminals*, and if a temperature around the ambient temperature of the input terminals is displayed, the controller is working properly.

* Input terminals 8-9

• When the input is configured as RTD input:
Insert a 100 Ω resistor across Input terminals A-B.[1] Short terminals between B-B.[2]
If temperature around 0 °C is displayed, the instrument is working fine.

[1] Input terminals 7-8 [2] Input terminals 8-9

• When the input is configured as Voltage/Current input:
Input* a certain voltage or current from a voltage/current generator to the controller. If the controller shows the equivalent input value, the input setting and function of the controller is working correctly.

* Input terminals 8-9

■ 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. 7-22)**.
	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 Terminal Configuration (P. 3-4)**.
	Wrong sensor is used.	Check the instrument specification and use a proper sensor.
	Input type setting is wrong.	Make proper setting by referring to **8.1 Changing Input (P. 8-2)**.
	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.
Self-tuning (ST) does not activate	Self-tuning (ST) mode is "oFF." (Factory set value: oFF)	Make proper setting by referring to **11.2.2 Self-tuning (ST) (P. 11-7)**.
	The control action type is set to the "Heat/Cool PID action with autotuning."	Self-tuning (ST) does not activate when the "Heat/ Cool PID action with autotuning" is not selected. The control action type must be changed. However, only when the control action type is allowed to be changed.
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 **11.2.1 Autotuning (AT) (P. 11-5)**.
Autotuning (AT) aborted	Requirements for aborting the Autotuning (AT) are established.	Identify causes for Autotuning (AT) abort by referring to **11.2.1 Autotuning (AT) (P. 11-5)** and then remove them. Then, execute Autotuning (AT) again.
Optimum PID values cannot be obtained by Autotuning (AT)	Autotuning (AT) does not match the characteristics of the controlled object.	Set PID constants manually.

Continued on the next page.

Continued from the previous page.

Problem	Possible cause	Solution
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.
	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.

■ 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 **13.2 Restricting Key Operation (Set Data Lock) (P. 13-5)**. However, only when it is allowed to release it.
Cannot switch to STOP with the front key	STOP operation by the front key is prohibited.	Release it by referring to **13.3 Prohibition of STOP Operation by the Front Key (P. 13-6)**. However, only when it is allowed to release it.
Set value (SV) does not change immediately when the Set value (SV) is changed	Setting change rate limiter is set.	Set the Setting change rate limiter to "0 (0.0): Limiter OFF" by referring to **13.1 Eliminating a Sudden Set Value Change (Setting Change Rate Limiter) (P. 13-2)**.
		Set the Setting change rate limiter function to "0: Unused" by referring to **13.1 Eliminating a Sudden Set Value Change (Setting Change Rate Limiter) (P. 13-2)**.
Unable to switch to the RUN mode from the STOP mode.	The terminal to which the RUN/STOP transfer of the Digital input (DI) function is assigned may be open. *	Close the contact input terminal (DI2).

* When Digital input is specified at the time of ordering, functions like "STEP function" or "RUN/STOP transfer" will be assigned to the Digital input terminal. (Factory set value: 0 [DI1: STEP function, DI2: RUN/STOP transfer])

■ 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 Using Alarm Function (P. 10-2)** after the instrument specification is confirmed.
	Alarm output relay contact action Energized/De-energized is reversed.	Check the setting details of Energized/De-energized by referring to **9.1 Changing Output Assignment (P. 9-2)**. However, only when the output assignment is allowed to be changed.
	Setting of Alarm differential gap is not appropriate.	Set the appropriate Alarm differential gap by referring to **10.1.3 Setting a differential gap in alarm action (P. 10-9)**.
No output of the Alarm function is turned on	Alarm is not assigned to the output.	Check the contents of Output assignment by referring to **9.1 Changing Output Assignment (P. 9-2)**.

■ 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. 10-12)**.
	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. Attempt this only when the mode is allowed to be transferred to RUN.
	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.	Set an appropriate value by referring to **10.2 Using Control Loop Break Alarm (LBA) (P. 10-12)**.
	LBA deadband (LBD) setting is not appropriate.	
	LBA does not match the characteristics of the process (controlled object).	Try another type of alarm.

MEMO

16

SPECIFICATIONS

This chapter describes Specifications.

■ Measured input

Number of input: 1 point

Input type: Thermocouple (TC) input:
K, J, T, S, R, E, B, N (JIS-C1602-2015)
PLII (NBS)
W5Re/W26Re (ASTM-E988-96 [Reapproved 2002])
U, L (DIN43710-1985)
RTD input: Pt100 (JIS-C1604-2013)
JPt100 (Pt100 of JIS-C1604-1981)
3-wire system
Voltage input (high voltage):
0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC
Current input: 0 to 20 mA DC, 4 to 20 mA DC
For the current input specification, an external resistor of 250 Ω must be connected between the input terminals.

Input range: Thermocouple (TC) input

Input type	Measured range
K	−199 to +1372 °C (−326 to +2502 °F) −199.9 to +999.9 °C (−199.9 to +999.9 °F)
J	−199 to +1200 °C (−326 to +2192 °F) −199.9 to +999.9 °C (−199.9 to +999.9 °F)
T	−199 to +400 °C (−326 to +752 °F) [1] −199.9 to +400.0 °C (−199.9 to +752.0 °F) [1]
S	0 to 1769 °C (0 to 3216 °F) [2]
R	0 to 1769 °C (0 to 3216 °F) [2]
E	0 to 1000 °C (0 to 1832 °F)
B	0 to 1820 °C (0 to 3308 °F) [2]
N	0 to 1300 °C (0 to 2372 °F) 0.0 to 999.9°C (0.0 to 999.9 °F)
PLII	0 to 1390 °C (0 to 2534 °F)
W5Re/W26Re	0 to 2320 °C (0 to 4208 °F)
U	−199 to +600 °C (−326 to +1112 °F) [1] −199.9 to +600.0 °C (−199.9 to +999.9 °F) [1]
L	0 to 900 °C (0 to 1652 °F)

[1] Accuracy is not guaranteed below −100.0 °C (−148.0 °F) or less for types T and U.
[2] Accuracy is not guaranteed below 399 °C (751 °F) or less for types R, S and B.

RTD input

Input type	Measured range
Pt100	−199.9 to +649.0 °C (−199.9 to +999.9 °F)
JPt100	−199.9 to +649.0 °C (−199.9 to +999.9 °F)

Voltage (high voltage)/Current input

Input type	Measured range
High voltage	0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC
Current	0 to 20 mA DC, 4 to 20 mA DC

For the current input specification, an external resistor of 250 Ω must be connected between the input terminals.

Sampling cycle: 0.25 seconds, 0.5 seconds (Selectable)

Influence of signal source resistance (TC input):
Approx. 0.2 μV/Ω (Converted depending on TC types)

Influence of input lead (RTD input):
Approx. 0.01 %/Ω of span (10 Ω or less per wire)

Input impedance:
Low voltage input (TC, RTD): 1 MΩ or more
High voltage input: 1 MΩ or more

Action at input break:

TC input:	Upscale or Downscale (Specify when ordering)
RTD input:	Upscale
Voltage input (high voltage):	Downscale [1, 2]
Current input:	Downscale [1, 2]

[1] Setting limiter [high limit] (SLH) < Setting limiter [low limit] (SLL): Upscale

[2] For the voltage input (high voltage) "0 to 5 V DC," "0 to 10 V DC," and the current input "0 to 20 mA DC," the displayed value is around zero.

Action at input short circuit (RTD input):
Downscale

■ Contact input

Number of input: 2 points (DI1, DI2)

Input method: Dry contact input

OFF (Open state):	500 kΩ or more
ON (Close state):	10 Ω or less

■ Output

Assign output:

Number of output:
Output (OUT): 2 points [Output 1 (OUT1), Output 2 (OUT2)]
Output type:

Output 1 (OUT1)	Relay contact output
	Voltage pulse output
	Current output
Output 2 (OUT2)	No output
	Relay contact output
	Voltage pulse output

The output type is specified at the time of ordering.
It cannot be changed by the customer after purchase.

Output type:

• Relay contact output (OUT1, OUT2)

Contact type: 1a contact
Contact rating: 240 V AC 2 A (Resistive load)
30 V DC 2 A (Resistive load)
Electrical life: 100,000 times or more (Rated load)

• Voltage pulse output (OUT1, OUT2)

Output voltage: 0/12 V DC (Rated)
Allowable load resistance: 600 Ω or more

• Current output (OUT1)

Output current: 0 to 20 mA DC
4 to 20 mA DC
Output resolution: 10 bits or more
Allowable load resistance: 400 Ω or less

■ Performance

Reference performance (Performance under the standard performance condition)

• Measured input (PV): Accuracy

Input type	Accuracy
K	±0.3 % of displayed value + 1 digit or ±2 °C (whichever is larger)
J	
T [1]	
E	
U [1]	
L	
N	
S [2]	
R [2]	
PLII	
W5Re/W26Re	
B [2]	
Pt100	±0.3 % of displayed value + 1 digit or ±8 °C (whichever is larger)
JPt100	
Voltage/Current input	±0.3 % of span + 1 digit

[1] Accuracy is not guaranteed below –100.0 °C (–148.0 °F) or less for types T and U.
[2] Accuracy is not guaranteed below 399 °C (751 °F) or less for types R, S and B.

Noise elimination ratio:
Series mode: 60 dB or more (50/60 Hz)
Common mode: 120 dB or more (50/60 Hz)

• Current output: Accuracy: ±0.3 % of span

■ Display

Measured input display (PV):
4-digit 7-segment LED (Green) [SA200]
4-digit 7-segment LED (Red) [SA201]

Setting display (SV): 4-digit 7-segment LED (Orange) [SA200]
4-digit 7-segment LED (Red) [SA201]

Output display (OUT1, OUT2):
Point light emission LED (Green) × 2 points [SA200]
Point light emission LED (Red) × 2 points [SA201]

Autotuning display (AT):
Point light emission LED (Green) [SA200]
Point light emission LED (Red) [SA201]

Alarm display (ALM1, ALM2):
Point light emission LED (Orange) [SA200]
Point light emission LED (Red) [SA201]

STEP set value (SV2) selection display:
Point light emission LED (Orange) [SA200]
Point light emission LED (Red) [SA201]

■ Operation keys

Select items/Set parameters:
4 keys (SET , R/S , ▽ , △)

RUN/STOP switching: key (R/S [1 second])

■ Host communication

Interface: Based on RS-485, EIA standard

Protocol: RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4)
Modbus –RTU

Connection method: 2-wire system, half-duplex multi-drop connection

Maximum connections: 31 instruments (32 instruments maximum including a host computer)

■ Self-diagnostic function

Self-diagnosis items	Error display	Communication at error
Adjustment data error	Error code 1 (Err 1)	Error code 1 (Err 1)
EEPROM error	Error code 2 (Err 2)	Error code 2 (Err 2)
A/D conversion error	Error code 4 (Err 4)	Error code 4 (Err 4)
RAM check error	Error code 8 (Err 8)	Error code 8 (Err 8)
Power supply voltage is abnormal	Display is OFF	Communication stop
Watchdog timer error	Error code 128 (Err 128)	Communication stop

■ General specifications

Power supply voltage: 100 to 240 V AC type:
85 to 264 V AC [Including power supply voltage variation], 50/60 Hz
(Rated: 100 to 240 V AC)

24 V AC type:
21.6 to 26.4 V AC [Including power supply voltage variation], 50/60 Hz
(Rated: 24 V AC)

24 V DC type:
21.6 to 26.4 V DC [Including power supply voltage variation]
(Rated: 24 V DC)

Power consumption (at maximum load):

100 to 240 V AC type:
4 VA max. (at 100 V AC)
7 VA max. (at 240 V AC)

24 V AC type:
4 VA max. (at 24 V AC)

24 V DC type:
100 mA max. (at 24 V DC)

Insulation resistance:

	①	②	③	④
①Grounding terminal				
②Power supply terminal	20 MΩ or more at 500 V DC			
③Input terminal, Voltage pulse output, Current output	20 MΩ or more at 500 V DC	20 MΩ or more at 500 V DC		
④Relay output terminal	20 MΩ or more at 500 V DC	20 MΩ or more at 500 V DC	20 MΩ or more at 500 V DC	

If there is no ground terminal, grounding is done on the control panel.

Functional isolation is provided between input and voltage pulse output, and between input and current output.

Withstand voltage:

Time: 1 min.	①	②	③	④
①Grounding terminal				
②Power supply terminal	1500 V AC			
③Input terminal, Voltage pulse output, Current output	1500 V AC	2300 V AC		
④Relay output terminal	1500 V AC	2300 V AC		

If there is no ground terminal, grounding is done on the control panel.

Functional isolation is provided between input and voltage pulse output, and between input and current output.

Power failure handling: **Power failure:** A power failure of 20 ms or less will not affect the control action

Memory backup:

Backed up by non-volatile memory
Number of writing: Approx. 100,000 times
Data storage period: Approx. 10 years

■ Environment Condition

● Operating environmental conditions (normal operating conditions)

Ambient temperature: −10 to +55 °C

Ambient humidity: 5 to 95 %RH (Non condensing)
Absolute humidity: MAX.W.C 29.3 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: The instrument is tilted along one bottom edge so that the distance between the opposite edge is 50 mm, or so that the angle made by the bottom and the instrument is 30°, whichever is less severe (X and Y axes)

● Reference operating conditions

Reference temperature: 23 °C ± 2 °C
Temperature variation: ±2 °C/h

Reference humidity: 50 %RH ± 10 %RH

Magnetic field: Geomagnetism

Power supply voltage: Alternating current, Direct current: Reference 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 60 cm or less

Temperature: −10 to +55 °C

Humidity: Less than 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
Close horizontal mounting or Close vertical mounting

Case color: White or Black (Specify when ordering)

Case material: Polycarbonate (Flame retardancy: UL94 V-0)

Panel sheet material: Polyester

Front panel material: Polycarbonate (Flame retardancy: UL94 V-0)

Terminal block material: Modified polyphenylene ether

Mounting bracket material:
Polyacetal

Panel sealing: Based on IP66 (IEC 60529) [optional]

Weight: Approx. 110 g

Dimensions: 48 mm × 24 mm × 100 mm (W × H × Depth behind the panel)
Panel thickness: 8.2 mm (No Waterproof/Dustproof)
9.2 mm (Waterproof/Dustproof)

■ Standard

● Safety standards

UL: UL 61010-1

cUL: CAN/CSA-C22.2 No.61010-1

● Other approved standards

CE marking: LVD: EN61010-1
EMC: EN61326-1
RoHS: EN IEC 63000

RCM: EN55011

UKCA marking: Electrical Safety: EN61010-1
EMC: EN61326-1
RoHS: EN IEC 63000

● Environment Condition

Protection against electric shock:
Class II (Reinforced insulation)

Overvoltage category: CATEGORY II

Pollution degree: POLLUTION DEGREE 2

Altitude: Altitude up to 2000 m (Indoor use)

Recommended fuse: Fuse type: Time-lag fuse
(Approved fuse according IEC 60127-2 and/or UL 248-14)
Fuse rating: Rated current 0.4 A

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INDEX [Character Order]

* Mode
B: SV setting mode
C: Parameter setting mode
D: Communication setting mode
E: Engineering mode

MEMO

The first edition: JUL. 2022 [IMQ00]

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