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hardcopy.)

IMR02L03-E1

Ramp/Soak Controller

PF900
PF901

Instruction Manual

RKC INSTRUMENT INC.

NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for purpose of illustration.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
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- Windows is a trademark of Microsoft Corporation.
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- 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

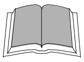
- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to instrument and equipment.
- This instrument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

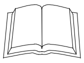
⚠ CAUTION

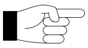
- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy.)
- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required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

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

This manual indicates 11-segment display characters as shown below.

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

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

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

U	u	V	W	X	Y	Z	Dash	/	*	Temperature units	
%	→	_									

	Dim lighting
	Bright lighting

	Flashing

■ Abbreviation Symbols

The names of some items are indicated by alphabetical abbreviations in this manual.

Abbreviation symbols	Name
PV	Measured value
SV	Set value
AT	Autotuning
ST	Self-tuning
OUT (1 to 3)	Output (1 to 3)
HBA (1 or 2)	Heater break alarm (1or 2)
CT (1 or 2)	Current transformer (1 or 2)
LBA	Control loop break alarm
LBD	LBA deadband

Abbreviation symbols	Name
DI (1 to 6)	Digital input (1 to 6)
DO (1 to 12)	Digital output (1 to 12)
FBR	Feedback resistance

Document Configuration

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

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

<table>
<tr><th>Manual</th><th>Manual Number</th><th>Description</th><th>Remarks</th></tr>
<tr><td>PF900/PF901
User’s Manual</td><td>IMR02L04-E□</td><td>This document describes installation, wiring and basic operation.</td><td>Provided with product</td></tr>
<tr><td>PF900/PF901
Instruction Manual</td><td>IMR02L03-E1</td><td>This Manual.
This manual explains the method of the mounting and wiring, the operation of various functions, and troubleshooting.</td><td rowspan="3">Provided with product
On CD-ROM
[Downloadable]</td></tr>
<tr><td>PF900/PF901 Pattern Record Sheet</td><td>IMR02L05-E□</td><td>This spreadsheet is to record patterns for Program control operation.</td></tr>
<tr><td>Communication Setup Tool for PF900/PF901 Program Controller (WinUCI-PF900) Instruction Manual</td><td>IMT01D09-E□</td><td>This document describes installation of communication setup tool, connection and setting of data.</td></tr>
</table>

Contents

Page

Page

The chapter 5 describes initial setting before operation, cautions for operation, parameter setting by Operation mode and setting procedure via loader communication.

Page

6. FUNCTION AND SETTING PROCEDURE 6-1

The chapter 6 describes function and parameter switching procedures.

Page

7. HOST COMMUNICATION [OPTIONAL] 7-1

The chapter 7 describes Host communication including connection, setting, protocol and communication data.

Page

8. TROUBLESHOOTING 8-1

The chapter 8 describes Error display when the Measured value (PV) exceeds the display range and the Self-diagnostic error.

9. SPECIFICATIONS 9-1

APPENDIX A-1

MEMO

OUTLINE

1

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

1.1 Features

The program controller has the following features:

Display

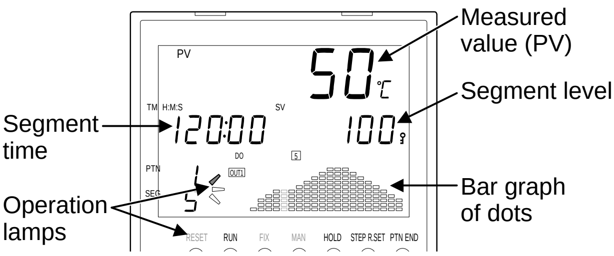
Selectable LCD color

Dominant color (s) of LCD is selectable when ordering.

- PF900: Green and Orange
- PF901: White

Easy-to-read display

Easily check the operation state in progress by the simultaneous display of segment level and segment time, the operation lamps, and the program pattern indicated with the bar graph of dots.



Function

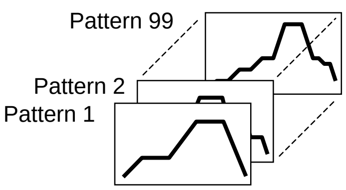
Selectable Sampling cycle

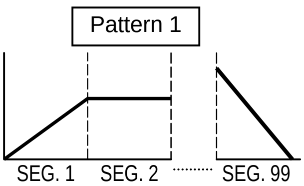
It is possible to switch Sampling cycle between 50 ms, 100 ms and 250 ms.

Large-capacity program setting

Up to 99 program patterns may be set. Each program pattern offers up to 99 segments.

(1024 segments maximum:
number of Pattern × number of segment)





Program pattern copy function

Easily create new program pattern by copying patterns or segments being programmed.

Set values management

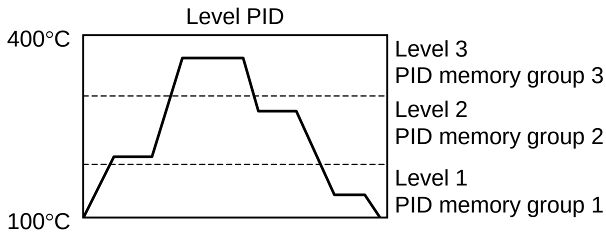
Setting the Memory group of each segment where set values such as PID values and Event are stored may allow specific control for each segment.

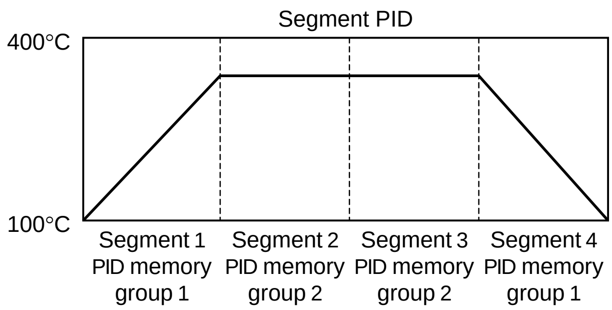
Parameter setting groups

- PID memory group: 8 groups
- Event memory group: 8 groups
- Wait memory group: 8 groups
- Time signal memory group: 16 groups
- Output program memory group:
  1 to (128/Maximum segment number)

Selectable PID zones

Level PID and Segment PID may be changed.



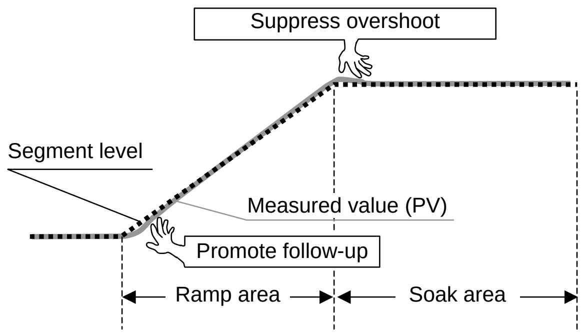


Autotuning (AT) with learning function

Search soak areas to conduct Autotuning (AT) to the segments in turn in the Reset mode (RESET).

Ramp/Soak stabilizer function

Suppress overshoot when the program shifts from ramp to soak.



Communication

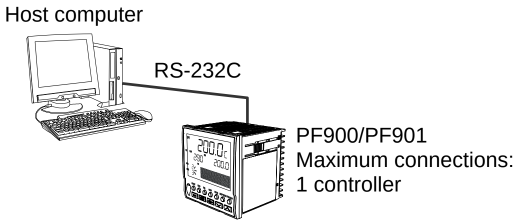
Two communication ports (optional)

PF900/901 has 2 communication ports: COM port 1 is for the Host communication and COM port 2 is for Intercontroller communication between controllers.

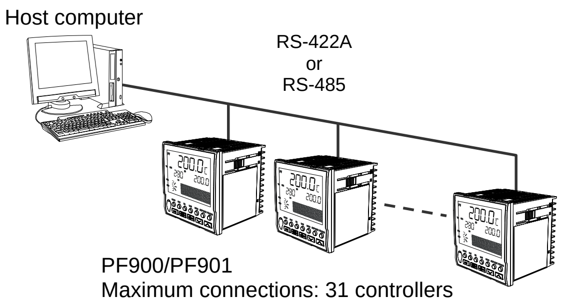
Host communication (communication 1)

Connect to the Host devices such as the Host computer and operation panel by using the Host communication.
Select communication interface from RS-232C, RS-422A or RS-485 (when ordering).

Connection by RS-232C



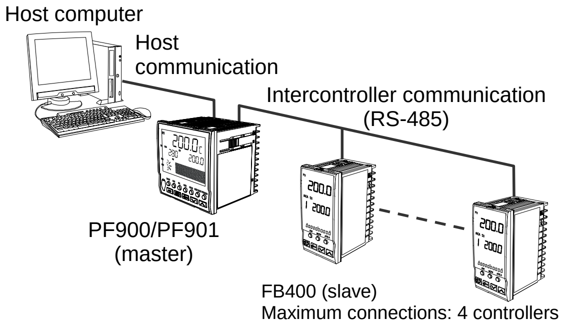
Multi-drop connection by RS-422 or RS-485



Link operation (communication 2)

Connect with single loop temperature controller or program controller via Intercontroller communication to operate master/slave link operation. No need to use remote setting input by analog signal or the Host communication.
(Communication interface: RS-485)

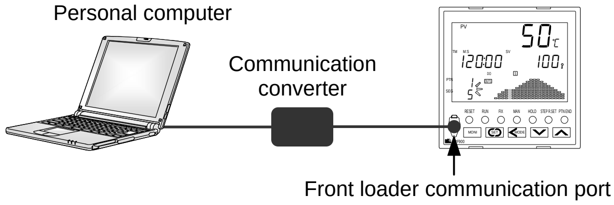
Link operation with program controller



Slave controller: PF900/PF901, FB series, RB series

Loader communication

Use the loader communication port to connect PF900/901 with the personal computer to set or monitor parameter set values.



Use with the communication converter, COM-K (RKC product).
WinUCI-PF900 (monitor and setting tool for PF900) is required to set or monitor this instrument by using a personal computer.
To use a personal computer to set or control this instrument, you must use WinUCI-PF900 software (monitor and setting tool for PF900).
Refer to the CD-ROM (accessory) or download from the official RKC website.

Operability

Simple setting by direct key

It is possible to switch operation mode among the Program control mode, the Fixed set point control mode, and the Manual control mode by using direct keys in the SV setting & monitor mode. No need to go to the specific setting display.
Also the type of key operation of the direct keys is selectable: Press once, Press twice, or Press and hold (2 seconds or more).
To prevent errors, the direct key operation can be prohibited.

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

Details	Q'TY	Remarks
☐ Instrument (PF900 or PF901)	1	————
☐ Mounting brackets (with screw)	4	————
☐ Seal (parts code: SAP-306)	1	————
☐ Waterproof/Dustproof rubber packing (parts code: KFB900-36<1>)	1	For waterproof/dustproof Placed on the case
☐ PF900/PF901 User's Manual (IMR02L04-E☐)	1	B6 size (hard copy)
☐ CD-ROM	1	Contents of CD-ROM • ReadMe • Communication Setup Tool for PF900/PF901 Program Controller (WinUCI-PF900)* • Communication Setup Tool for PF900/PF901 Program Controller (WinUCI-PF900) INSTRUCTION MANUAL (IMT01D09-☐☐)* • PF900/PF901 Instruction Manual (IMR02L03-☐☐)* • PF900/PF901 Pattern Record Sheet* • USB driver for COM-K communication converter* • Installation USB driver for COM-K communication converter [IMT01D07-E☐]* * This manual can be downloaded from the official RKC website: http://www.rkcinst.com/english/manual_load.htm.

Sold separately

Details	Q'TY	Remarks
☐ Terminal cover (parts code: KFB400-511)	2	Optional
☐ Front cover (parts code: KF9-35)	1	Optional
☐ Current transformer CTL-6-P-N [for 0 to 30 A] or CTL-12-S56-10L-N [for 0 to 100 A]	Depending on the order quantity	Optional

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

1.3 Model Code

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

■ Suffix code

Specifications		Suffix code										
		Hardware coding only								Quick start code1		
PF900 (PV display: Green, SV display: Orange) **PF901** (PV and SV displays: White)		(1) – □	(2) □	(3) □ –	(4) □ *	(5) □	(6) □	(7) □	(8) □ –	(9) □	(10) □□□	/Y
Output 1 (OUT1) [1]	Relay contact	M										
	Voltage pulse	V										
	Voltage/Current [Refer to Output Code Table (P. 1-7)]	□										
	Triac	T										
	Open collector	D										
Output 2 (OUT2) [1]	None		N									
	Relay contact		M									
	Voltage pulse		V									
	Voltage/Current [Refer to Output Code Table (P. 1-7)]		□									
	Triac		T									
	Open collector		D									
Output 3 (OUT3) [1]	None			N								
	Voltage pulse			V								
	Voltage/Current [Refer to Output Code Table (P. 1-7)]			□								
	Open collector			D								
Power supply voltage	24 V AC/DC				3							
	100 to 240 V AC				4							
Digital output (DO1 to DO12) [2]	4 points (DO1 to DO4) [Standard]					4						
	12 points (DO1 to DO12)					C						
CT input or Feedback resistance input	None						N					
	CT input (2 points)						T					
	Feedback resistance input [3]						F					
Communication function Digital input (DI1 to DI6) [4]	None							N				
	Communication 1 (RS-232C) and DI1 to DI6, No communication 2							1				
	Communication 1 (RS-422A) and DI1 to DI6, No communication 2							4				
	Communication 1 (RS-485) and DI1 to DI6, No communication 2							5				
	Communication 1 (RS-232C), Communication 2 (RS-485) [5] and DI1 to DI6							W				
	Communication 1 (RS-485), Communication 2 (RS-485) [5] and DI1 to DI6							X				
	Communication 1 (None), Communication 2 (RS-485) [5] and DI1 to DI6							Y				
	DI1 to DI6							D				
Quick start code	No quick start code (Configured at factory set value) [6]								N			
	Specify quick start code 1								1			
	Specify quick start code 1 and 2 (For Quick start code 2, refer to page 1-9)								2			
Control Method [Quick start code 1]	No specify quick start code									No code		
	PID control with AT (Reverse action)									F		
	PID control with AT (Direct action)									D		
	Heat/Cool PID control with AT (Cooling gain linear type)									G		
	Heat/Cool PID control with AT (for Extruder [air cooling])									A		
	Heat/Cool PID control with AT (for Extruder [water cooling])									W		
	Position proportioning PID control without FBR (Reverse action)									Z		
	Position proportioning PID control without FBR (Direct action)									C		
Measured input and Range [Quick start code 1]	No specify quick start code										No code	
	Refer to Range Code Table. (P.1-7, P. 1-8)										□□□	
Instrument specification	Version symbol											Y

[1] Some output types are not specifiable. Refer to the Output type availability on page 1-6.
[2] The output type for DO1 to DO4 is Relay: for DO5 to DO12 is Open collector.
[3] When Feedback resistance input is specified with other control method than Z or C, the factory set value is fixed to “Z: Position proportioning PID control without FBR (Reverse action).”
[4] Digital input 7 (DI7) to 11 (DI11) are standard.
[5] Communication 2 is for the Intercontroller communication.
[6] Set initial setting parameters in the Engineering mode. Refer to **4.5.5 Engineering mode (P.4-33)** for description of the parameters.

● Output type availability

PID control with AT

[×: Usable –: Not usable]

Output type		Manipulated output value 1 (MV1) [a]	Manipulated output value 2 (MV2) [a]	Transmission output: Other [b]	Transmission output: Output program	Event output
Output 1 (OUT1)	Relay contact	×	–	–	×	–
	Voltage pulse	×	–	–	×	–
	Voltage/Current	×	–	–	×	–
	Triac	×	–	–	×	–
	Open collector	×	–	–	×	–
Output 2 (OUT2)	Relay contact	×	–	–	×	×
	Voltage pulse	×	–	–	×	×
	Voltage/Current	×	–	×	×	–
	Triac	×	–	–	×	×
	Open collector	×	–	–	×	×
Output 3 (OUT3)	Voltage pulse	×	–	–	×	×
	Voltage/Current	×	–	×	×	–
	Open collector	×	–	–	×	×

[a] MV1 and MV2 can be used as Transmission output.
[b] Other: Transmission output of Measured value (PV), Deviation value (DEV), Set value (SV) monitor and Segment time (percentage)

Heat/Cool PID control with AT

[×: Usable –: Not usable]

Output type		Manipulated output value 1 (MV1) [heat-side] [a]	Manipulated output value 2 (MV2) [cool-side] [a]	Transmission output: Other [b]	Transmission output: Output program	Event output
Output 1 (OUT1)	Relay contact	×	–	–	×	–
	Voltage pulse	×	–	–	×	–
	Voltage/Current	×	–	–	×	–
	Triac	×	–	–	×	–
	Open collector	×	–	–	×	–
Output 2 (OUT2)	Relay contact	×	×	–	×	×
	Voltage pulse	×	×	–	×	×
	Voltage/Current	×	×	×	×	–
	Triac	×	×	–	×	×
	Open collector	×	×	–	×	×
Output 3 (OUT3)	Voltage pulse	×	×	–	×	×
	Voltage/Current	×	×	×	×	–
	Open collector	×	×	–	×	×

[a] MV1 and MV2 can be used as Transmission output.
[b] Other: Transmission output of Measured value (PV), Deviation value (DEV), Set value (SV) monitor and Segment time (percentage)

Position proportioning PID control without FBR

[×: Usable –: Not usable]

Output type		Manipulated output value 1 (MV1) [open-side] [a]	Manipulated output value 2 (MV2) [close-side] [a]	Transmission output: Other [b]	Transmission output: Output program	Event output
Output 1 (OUT1)	Relay contact	×	–	–	×	–
	Voltage pulse	×	–	–	×	–
	Voltage/Current	×	–	–	×	–
	Triac	×	–	–	×	–
	Open collector	×	–	–	×	–
Output 2 (OUT2)	Relay contact	–	×	–	×	×
	Voltage pulse	–	×	–	×	×
	Voltage/Current	–	×	× [c]	×	–
	Triac	–	×	–	×	×
	Open collector	–	×	–	×	×
Output 3 (OUT3)	Voltage pulse	–	–	–	×	×
	Voltage/Current	–	–	×	×	–
	Open collector	–	–	–	×	×

[a] MV1 and MV2 can be used as Transmission output.
[b] Other: Transmission output of Measured value (PV), Deviation value (DEV), Set value (SV) monitor and Segment time (percentage)
[c] When Position proportioning PID control is selected, it is still possible to assign PV, SV, SV monitor or Transmission output of Segment time (percentage) to OUT 2 while Manipulated output value 2 (MV2) [close-side] cannot be used.

● Output Code Table

Output type	Code	Output type	Code
Voltage (0 to 1 V DC) Available for OUT3 only	3	Voltage (1 to 5 V DC)	6
Voltage (0 to 5 V DC)	4	Current (0 to 20 mA DC)	7
Voltage (0 to 10 V DC)	5	Current (4 to 20 mA DC)	8

● Range Code Table

Thermocouple (TC) input [voltage (low) group]

Type	Code	Measured range	Code	Measured range
K	K02	0 to 400 °C	KA4	0.0 to 800.0 °F
	K06	0 to 1200 °C	KB4	0.0 to 2400.0 °F
	K09	0.0 to 400.0 °C	KC5	−328 to +2502 °F
	K23	0.0 to 1300.0 °C	KC9	−328.0 to +2502.0 °F
	K35	−200.0 to +400.0 °C		
	K41	−200 to +1372 °C		
	K42	−200.0 to +1372.0 °C		
J	J15	−200 to +1200 °C	JB5	0.0 to 2100.0 °F
	J16	0.0 to 1200.0 °C	JB6	0.0 to 800.0 °F
	J27	−200.0 to +400.0 °C	JB9	−328 to +2192 °F
	J29	−200.0 to +1200.0 °C	JC9	−328.0 to +2192.0°F
T	T06	0.0 to 400.0 °C	TA7	0.0 to 700.0 °F
	T13	−200.0 to +200.0 °C	TB7	−300.0 to +700.0 °F
	T16	−200 to +400 °C	TC2	−328.0 to +752.0 °F
	T19	−200.0 to +400.0 °C	TC9	−328 to +752 °F
E	E06	−200 to +1000 °C	EA6	0.0 to 1800.0 °F
	E08	0.0 to 1000.0 °C	EB1	−328 to +1832 °F
	E17	−200.0 to +200.0 °C	EB3	−328.0 to +1832.0 °F
	E20	−200.0 to +1000.0 °C		
L	L04	0.0 to 900.0 °C	LA3	0 to 1652 °F
	L05	0 to 900 °C	LA6	0.0 to 1600.0 °F
			LB1	0.0 to 1652.0 °F
U	U04	0.0 to 600.0 °C	UB1	0.0 to 1100.0 °F
	U08	0 to 600 °C	UB3	0.0 to 1112.0 °F
			UB4	0 to 1112 °F
N	N02	0 to 1300 °C	NA4	0.0 to 2300.0 °F
	N05	0.0 to 1300.0 °C	NA7	0 to 2372 °F
			NA8	0.0 to 2372.0 °F
R	R05	0.0 to 1700.0 °C	RA5	0.0 to 3200.0 °F
	R07	−50 to +1768 °C	RA7	−58 to +3214 °F
	R08	−50.0 to +1768.0°C	RA8	−58.0 to +3214.0 °F
S	S04	0.0 to 1700.0 °C	SA5	0.0 to 3200.0 °F
	S06	−50 to +1768 °C	SA7	−58 to +3214 °F
	S07	−50.0 to +1768.0 °C	SA8	−58.0 to +3214.0 °F
B	B03	0 to 1800 °C	BA9	0.0 to 3200.0 °F
	B04	0.0 to 1800.0 °C	BB2	0 to 3272 °F
			BB3	0.0 to 3272.0 °F
W5Re/W26Re	W03	0 to 2300 °C	WA2	0 to 4200 °F
	W04	0.0 to 2300.0 °C	WA6	0.0 to 2200.0 °F
	W06	0.0 to 1200.0 °C	WA8	0.0 to 4200.0 °F
PLII	A02	0 to 1390 °C	AA2	0 to 2534 °F
	A05	0.0 to 1300.0 °C	AA5	0.0 to 2300.0 °F
	A06	0.0 to 1390.0 °C	AA7	0.0 to 2534.0 °F
PR40-20	F01	0.0 to 1800.0 °C	FA1	0.0 to 3200.0 °F
	F02	0 to 1800 °C	FA2	0 to 3200 °F

Resistance temperature detector (RTD) input [voltage (low) group]

Type	Code	Measured range	Code	Measured range
Pt100	D21	−200.0 to +200.0 °C	DB8	−300.0 to +1200.0 °F
	D25	−200.0 to +600.0 °C	DC9	−328.0 to +1562.0 °F
	D34	−100.00 to +150.00 °C	DD2	−328 to +1562 °F
	D35	−200.0 to +850.0 °C		
	D36	−200 to +850 °C		
JPt100	P10	0.0 to 500.0 °C		
	P21	−200.00 to +200.00 °C		
	P26	−200.0 to +600.0 °C		
	P29	−100.00 to +150.00 °C		
	P30	−200.0 to +640.0 °C		
	P31	−200 to +640 °C		

Voltage input, Current input

Type	Code	Voltage input group	Measured range
Voltage 0 to 10 mV DC	101	Voltage (low) input group	Programmable range Setting range: −19999 to +32000 [The decimal point position is selectable] (Factory set value: 0.0 to 100.0)
Voltage 0 to 100 mV DC	201		
Voltage 0 to 1 V DC	301		
Voltage 0 to 5 V DC	401	Voltage (high) input group	
Voltage 0 to 10 V DC	501		
Voltage 1 to 5 V DC	601		
Current 0 to 20 mA DC	701	Current input group	
Current 4 to 20 mA DC	801		
Voltage −100 to +100 mV DC	901	Voltage (low) input group	
Voltage −1 to +1 V DC	902		
Voltage −10 to +10 mV DC	903		
Voltage −10 to +10 V DC	904	Voltage (high) input group	
Voltage −5 to +5 V DC	905		

■ Quick start code 2 (Initial setting code)

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

Specifications		Quick start code 2 (Initial setting code)						
		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		□ –	□	□	□	□ –	□	□
DI assignment	DI1 to DI6 (Refer to DI Assignment Code Table)	□						
Digital output 1 (DO1)	Event 1 [Deviation high]		N					
	Assign other DO type [Refer to DO Type Code Table (P. 1-10)]		□					
Digital output 2 (DO2)	Event 2 [Deviation low]			N				
	Assign other DO type [Refer to DO Type Code Table (P. 1-10)]			□				
Digital output 3 (DO3)	Time signal 1				N			
	Assign other DO type [Refer to DO Type Code Table (P. 1-11)]				□			
Digital output 4 (DO4)	Pattern end signal					N		
	Assign other DO type [Refer to DO Type Code Table (P. 1-11)]					□		
CT type	No CT1 and CT2						N	
	CT1: CTL-6-P-N CT2: No use						P	
	CT1: CTL-12-S56-10L-N CT2: No use						S	
	CT1: CTL-6-P-N CT2: CTL-6-P-N						T	
	CT1: CTL-12-S56-10L-N CT2: CTL-12-S56-10L-N						U	
Communication 1 protocol	None							N
	RKC communication (ANSI X3.28-1976)							1
	Modbus							2

Factory set value of DO5 through DO12 (optional) is Time signal.

● DI Assignment Code Table (DI1 to DI6: Optional DI7 to DI11: Standard function)

DI number	Code (0 to 5)					
	0	1	2	3	4	5
Digital input 1 (DI1)	PTN1	PTN1	WAIT release	WAIT release	WAIT release	WAIT release
Digital input 2 (DI2)	PTN2	PTN2	WAIT release	WAIT release	WAIT release	WAIT release
Digital input 3 (DI3)	PTN4	PTN4	WAIT release	WAIT release	WAIT release	WAIT release
Digital input 4 (DI4)	PTN8	PTN8	WAIT release	WAIT release	WAIT release	WAIT release
Digital input 5 (DI5)	PTN16	PTN16	WAIT release	WAIT release	WAIT release	WAIT release
Digital input 6 (DI6)	P. SET	P. SET	WAIT release	WAIT release	WAIT release	WAIT release
Digital input 7 (DI7)	RESET	RESET	PTN1	PTN1	RESET	RESET
Digital input 8 (DI8)	RUN	RUN	PTN2	PTN2	RUN	RUN
Digital input 9 (DI9)	STEP	STEP	PTN4	PTN4	STEP	STEP
Digital input 10 (DI10)	HOLD	PTN32	PTN8	PTN8	HOLD	HOLD
Digital input 11 (DI11)	PTN32	PTN64	P. SET	PTN16	Direct/Reverse	PTN_INC

PTN1, 2, 4, 8, 16, 32, 64: Pattern number switch
P. SET: Pattern set
WAIT release: Wait state release
RESET: Reset mode (RESET) setting
RUN: Program control mode (RUN) setting
STEP: Step (STEP) function
HOLD: Hold (HOLD) function
Direct/Reverse: Direct/Reverse action switching
PTN_INC: Pattern increment

● DO Type Code Table

Digital output 1 (DO1)

Code	Type	Code	Type	Code	Type
N	None	L	Event 1 process low with hold action	1	Event 1 manipulated output value (MV1) high [heat-side]
A	Event 1 deviation high	P	Heater break alarm 1 (HBA1)	2	Event 1 manipulated output value (MV1) low [heat-side]
B	Event 1 deviation low	Q	Heater break alarm 2 (HBA2)	3	Event 1 manipulated output value (MV2) high [cool-side]
C	Event 1 deviation high/low	R	Control loop break alarm (LBA)	4	Event 1 manipulated output value (MV2) low [cool-side]
D	Event 1 band	S	FAIL (de-energized fixed)	5	Time signal 1
E	Event 1 deviation high with hold action	T	Feedback resistance (FBR) input error	6	Time signal 2
F	Event 1 deviation low with hold action	U	Event 1 band (High/Low individual setting)	7	Time signal 3
G	Event 1 deviation high/low with hold action	V	Event 1 set value (SV) high	8	Time signal 4
H	Event 1 process high	W	Event 1 set value (SV) low	9	Pattern end signal
J	Event 1 process low	X	Event 1 deviation high/low (High/Low individual setting)		
K	Event 1 process high with hold action	Y	Event 1 deviation high/low with hold action (High/Low individual setting)		

Digital output 2 (DO2)

Code	Type	Code	Type	Code	Type
N	None	L	Event 2 process low with hold action	1	Event 2 manipulated output value (MV1) high [heat-side]
A	Event 2 deviation high	P	Heater break alarm 1 (HBA1)	2	Event 2 manipulated output value (MV1) low [heat-side]
B	Event 2 deviation low	Q	Heater break alarm 2 (HBA2)	3	Event 2 manipulated output value (MV2) high [cool-side]
C	Event 2 deviation high/low	R	Control loop break alarm (LBA)	4	Event 2 manipulated output value (MV2) low [cool-side]
D	Event 2 band	S	FAIL (de-energized fixed)	5	Time signal 1
E	Event 2 deviation high with hold action	T	Feedback resistance (FBR) input error	6	Time signal 2
F	Event 2 deviation low with hold action	U	Event 2 band (High/Low individual setting)	7	Time signal 3
G	Event 2 deviation high/low with hold action	V	Event 2 set value (SV) high	8	Time signal 4
H	Event 2 process high	W	Event 2 set value (SV) low	9	Pattern end signal
J	Event 2 process low	X	Event 2 deviation high/low (High/Low individual setting)		
K	Event 2 process high with hold action	Y	Event 2 deviation high/low with hold action (High/Low individual setting)		

Digital output 3 (DO3)

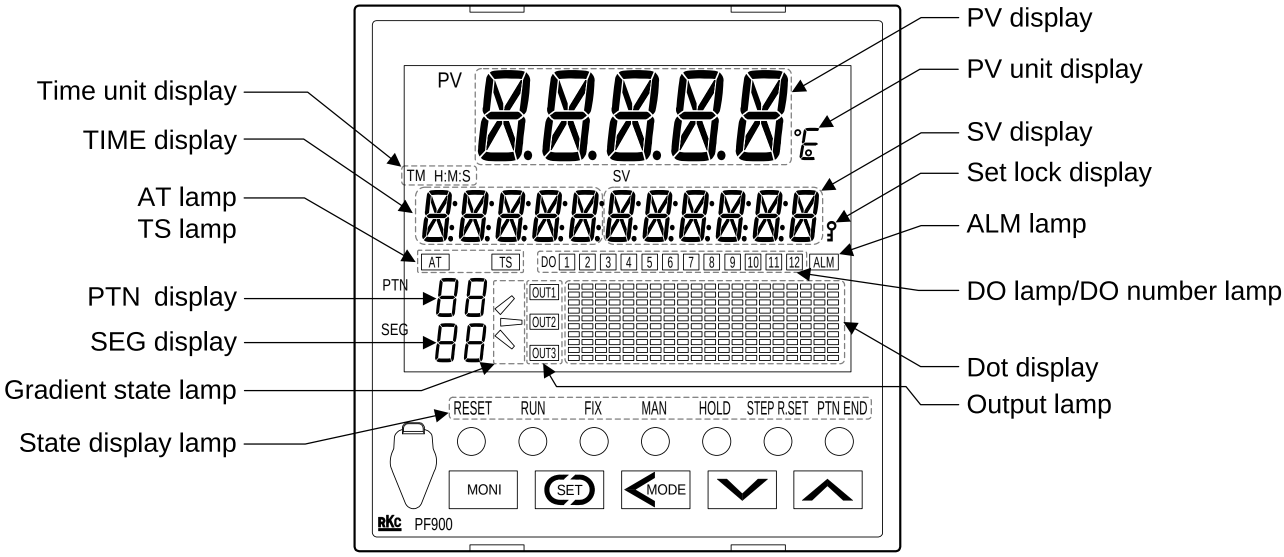
Code	Type	Code	Type	Code	Type
N	None	L	Event 3 process low with hold action	1	Event 3 manipulated output value (MV1) high [heat-side]
A	Event 3 deviation high	P	Heater break alarm 1 (HBA1)	2	Event 3 manipulated output value (MV1) low [heat-side]
B	Event 3 deviation low	Q	Heater break alarm 2 (HBA2)	3	Event 3 manipulated output value (MV2) high [cool-side]
C	Event 3 deviation high/low	R	Control loop break alarm (LBA)	4	Event 3 manipulated output value (MV2) low [cool-side]
D	Event 3 band	S	FAIL (de-energized fixed)	5	Time signal 1
E	Event 3 deviation high with hold action	T	Feedback resistance (FBR) input error	6	Time signal 2
F	Event 3 deviation low with hold action	U	Event 3 band (High/Low individual setting)	7	Time signal 3
G	Event 3 deviation high/low with hold action	V	Event 3 set value (SV) high	8	Time signal 4
H	Event 3 process high	W	Event 3 set value (SV) low	9	Pattern end signal
J	Event 3 process low	X	Event 3 deviation high/low (High/Low individual setting)		
K	Event 3 process high with hold action	Y	Event 3 deviation high/low with hold action (High/Low individual setting)		

Digital output 4 (DO4)

Code	Type	Code	Type	Code	Type
N	None	L	Event 4 process low with hold action	1	Event 4 manipulated output value (MV1) high [heat-side]
A	Event 4 deviation high	P	Heater break alarm 1 (HBA1)	2	Event 4 manipulated output value (MV1) low [heat-side]
B	Event 4 deviation low	Q	Heater break alarm 2 (HBA2)	3	Event 4 manipulated output value (MV2) high [cool-side]
C	Event 4 deviation high/low	R	Control loop break alarm (LBA)	4	Event 4 manipulated output value (MV2) low [cool-side]
D	Event 4 band	S	FAIL (de-energized fixed)	5	Time signal 1
E	Event 4 deviation high with hold action	T	Feedback resistance (FBR) input error	6	Time signal 2
F	Event 4 deviation low with hold action	U	Event 4 band (High/Low individual setting)	7	Time signal 3
G	Event 4 deviation high/low with hold action	V	Event 4 set value (SV) high	8	Time signal 4
H	Event 4 process high	W	Event 4 set value (SV) low	9	Pattern end signal
J	Event 4 process low	X	Event 4 deviation high/low (High/Low individual setting)		
K	Event 4 process high with hold action	Y	Event 4 deviation high/low with hold action (High/Low individual setting)		

1.4 Parts Description

■ Front Panel View



- **PV display [PF900: Green/PF901: White]**

  Displays Measured value (PV) or various parameter symbols.

- **PV unit display [PF900: Green/PF901: White]**

  Displays °C, °F or %. Displays % only for parameters on a percentage basis.

- **SV display [PF900: Orange/PF901: White]**

  Displays segment level, Set value (SV), Manipulated output value (MV) or various parameter set values.

- **Set lock display [PF900: Orange/PF901: White]**

  Displays key character "⚷" when the key operation is prohibited.

- **ALM lamp [Red]**

  Lights when Event occurs (Event 1 through 4, HBA1, HBA2, LBA, Self-diagnostic error, communication error or FAIL). Event type may be checked by Event state monitor (except Self-diagnostic error, communication error and FAIL).

- **DO lamp/DO number lamp [PF900: Green/PF901: White]**

  DO: Lights alphabet of the DO lamp at all times (when the power is on).
  DO number (1 to 12):
  Lights when the output corresponding to each lamp is ON.

- **Dot display [White] (20 dots for horizontal axis, 10 dots for vertical axis)**

  The bar graph displays the progress of program pattern, or increase and decrease of Manipulated output value (MV). Segments in process flash in the Program control mode.
  It is possible to change the color of dots into red for Event or Self-diagnostic error.

● Output lamp [PF900: Green/PF901: White]

OUT1: Lights when output 1 is turned on.*
OUT2: Lights when output 2 is turned on.*
OUT3: Lights when output 3 is turned on.*
* For voltage output or current output, the output lamp flashes when the output value goes below 0 % and lights when the value goes above 0 %.

● State display lamp [Green or Orange]

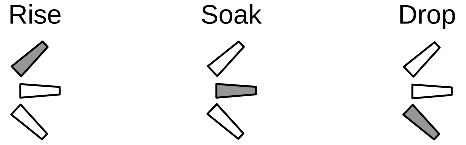
The control mode in progress and the operation function lamps will be lit.

Character	Lamp color	Details
RESET	Green or Orange	Reset mode (RESET) light will be orange. When other modes are selected the light will be green.
RUN	Green or Orange	Program control mode (RUN) light will be orange. When other modes are selected the light will be green.
FIX	Green or Orange	Fixed set point control mode (FIX) light will be orange. When other modes are selected the light will be green.
MAN	Green or Orange	Manual control mode (MAN) will be orange. When other modes are selected the light will be green.
HOLD	Green	Light is green when HOLD key is operative.
STEP R.SET	Green	Light is green when STEP R.SET key is operative.
STEP **R.SET**	Green	Light is green when STEP R.SET key is operative.
PTN END	Green	Light is green when PTN END key is operative.
PTN **END**	Green	Light is green when PTN END key is operative.

Flashing of State display lamp
When Direct key type is “Press twice,” State display lamp flashes when the Direct key is pressed once (except the PTN END key).

● Gradient state lamp [PF900: Green/PF901: White]

Lights the lamp of the gradient in process.



In the Program control mode (RUN):
Lights the lamp of the gradient of the segment in process.
Fixed set point control mode (FIX):
Lights soak lamp
In the Manual control mode (MAN) or the Reset mode (RESET):
Gradient state lamp does not light.

- **SEG display [PF900: Green/PF901: White]**

  Displays segment number (from 1 to 99).

  In the Reset mode (RESET):
  Displays the segment number before running the operation.
  In the Program control mode (RUN):
  Displays the segment number in process.
  In the Fixed set point control mode (FIX) or the Manual control mode (MAN):
  Displays the segment being displays in the previous mode.

- **PTN display [PF900: Green/PF901: White]**

  Displays program pattern number (from 1 to 99).

  In the Reset mode (RESET):
  Displays the Program pattern number being set.
  In the Program control mode (RUN):
  Displays the program pattern number in process.
  In the Fixed set point control mode (FIX) or the Manual control mode (MAN):
  Displays Program pattern number in the previous mode.

- **TS lamp [PF900: Green/PF901: White]**

  Lights when Time signal output is turned on.

- **AT lamp [PF900: Green/PF901: White]**

  Flashes during the Autotuning (including Autotuning with learning function).
  (AT end: AT lamp turns off)

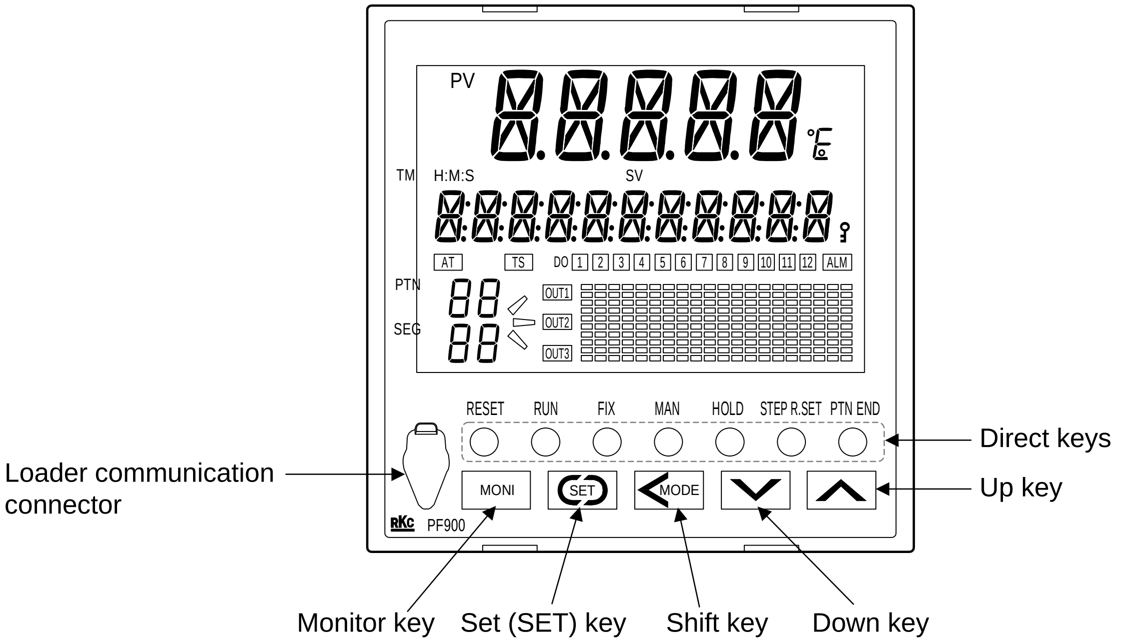
- **TIME display [PF900: Orange/PF901: White]**

  Displays segment time or character of parameter.

- **Time unit display [PF900: Green/PF901: White]**

  Displays time unit of Segment time. [hour (H): minute (M) or minute (M): second (S)]

■ Key operation



● Direct keys

It is possible to easily change the operation mode or switch the state of operation in process by using the direct keys. Use the RESET key, RUN key, FIX key or MAN key to change the operation mode. Use the HOLD key, STEP key, R.SET key, PTN key or END key to switch the state of operation.

Key name	Lamp to be lit	Details
RESET key	**RESET**	Press the RESET key to go to the Reset mode (RESET).
RUN key	**RUN**	Press the RUN key to go to the Program control mode (RUN).
FIX key	**FIX**	Press the FIX key to go to the Fixed set point control mode (FIX).
MAN key	**MAN**	Press the MAN key to go to the Manual control mode (MAN).
HOLD key	**HOLD**	Press the HOLD key to suspend the operation in process. Press again to release the Hold mode. [Hold (HOLD) function]
STEP R.SET key	**STEP** R.SET	It is possible to skip one segment of the program pattern in progress by pressing the STEP R.SET key. [Step (STEP) function]
	STEP **R.SET**	Press the SET key once to go back to the previous parameter when passing the parameter setting item to be changed.
PTN END key	**PTN** END	Switch display to the setting display of the Execution pattern number [PTN].
	PTN **END**	Switch display to the Program end screen [P. END].

- **Up key**
  - Increase numerals. *
  - Press the Up key to set segment time in the Program control mode (RUN).
    To scroll through numbers faster, press and hold the Up key. *

- **Down key**
  - Decrease numerals. *
  - Press the DOWN key to turn back to the previous value when passing the segment time to be set in the Program control mode. To scroll back through numbers faster, press and hold the DOWN key. *

- **Shift key** MODE
  - Shift digits when settings are changed.
  - Used to selection operation between modes.

- **Set (SET) key** SET

  Used for parameter calling up and set value registration.

- **Monitor key** MONI

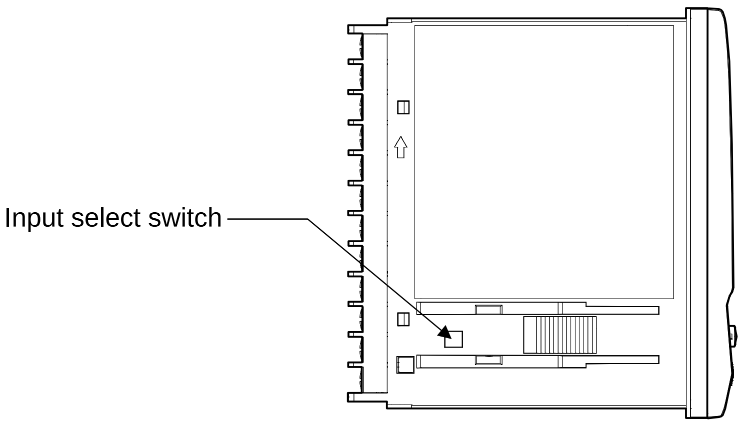
  Use to switch the monitor screen.
  Pressing the MONI key while any screen other than the Monitor mode screen is being displayed returns to the PV/SV monitor screen.

- **Loader communication connector**

  Designed to connect with W-BV-03 cable for loader communication (RKC product)

* Continuously pressing the and the keys will accelerate number change.
The following acceleration settings may be changed by using communication:
– Key accelerating speed setting [Communication identifier KV] (P. 7-80)
– Key acceleration speed Forward/Back-up [Communication identifier KW] (P. 7-80)

■ Side view

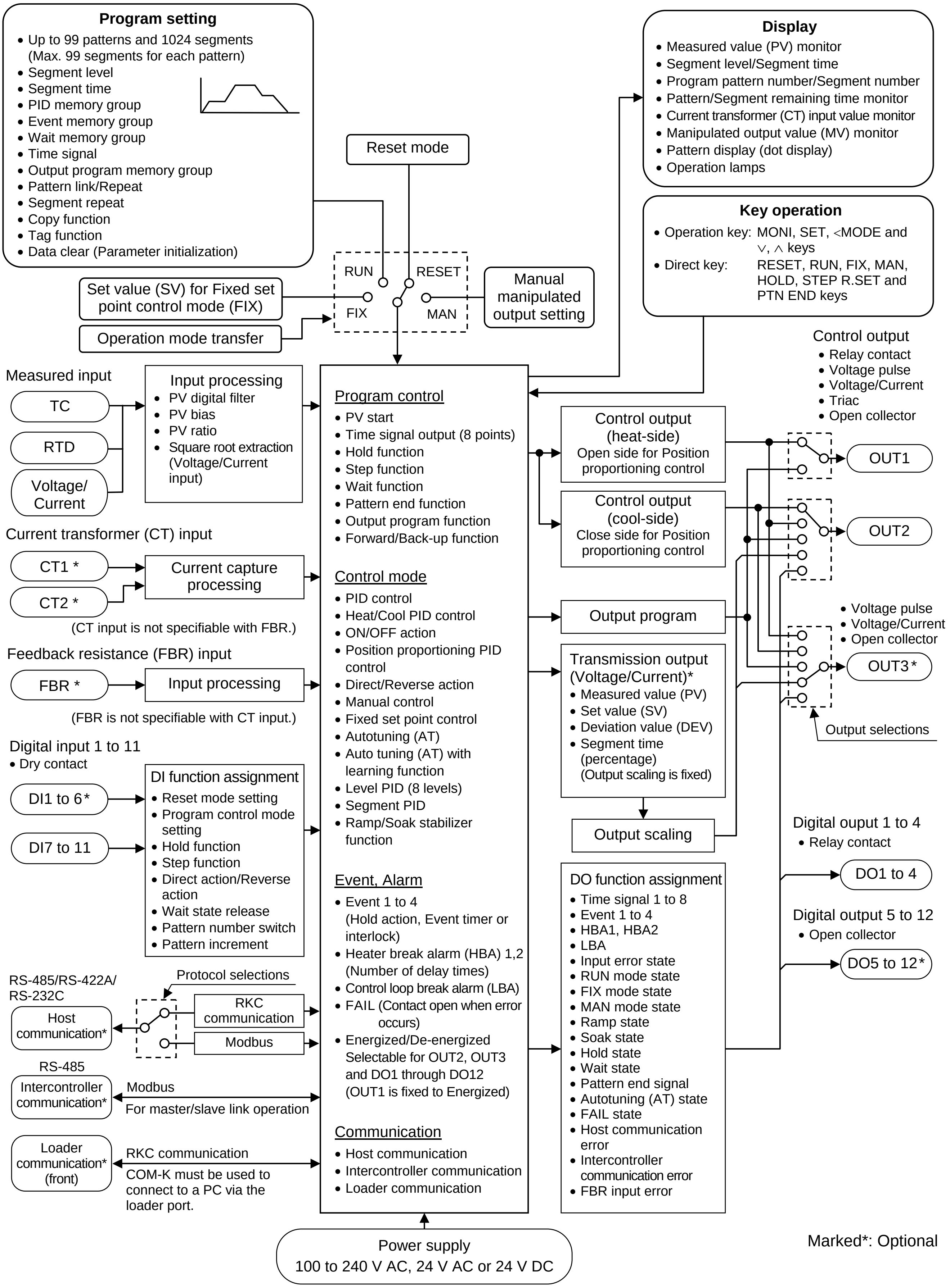


- **Input select switch**

  Use to switch Input groups of Measurement input. Set Voltage (low) input group, Voltage (high) input group or Current input group. (Refer to P. 3-9)

1.5 Input/Output and Function Blocks

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



1.6 Handling Procedure to Operation

Conduct necessary setting before operation according to the procedure described below.

Mounting and Wiring

☞ Refer to **2. MOUNTING (P. 2-1)** or **3. WIRING (P. 3-1)**.

Power ON

Switch mode from RUN to RESET.

Press the RESET key to go to the Reset mode (RESET) to stop the operation. (RESET lamp turns on.)

Set operation conditions?

No (No need to change the specification at ordering.)

Yes (To change the operating condition)

Initial Setting (Engineering mode)

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

☞ For details of Engineering mode parameters, refer to **4.5.5 Engineering mode (P. 4-33)**.

Program pattern setting

Record data of Program pattern in the spreadsheet before setting. (PF900/PF901 Pattern Record Sheet is included in the CD-ROM.)
Set Program pattern.

☞ Refer to **5.4.3 Set up program patterns (P. 5-13)**.

Start test run.

Switch mode from RESET to RUN.

Press the RUN key to go to the Program control mode (RUN) to start operation. (RUN lamp turns on.)

☞ Refer to **5.4.4 Start/End Program control (P.5-21)** for the procedure to switch operation modes.

Conduct Autotuning (AT)

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

☞ For details of Autotuning (AT), refer to **6.5.7 Autotuning (AT) (P. 6-119)**.

☞ For details of Autotuning (AT) with learning function, refer to **6.5.8 Autotuning (AT) with learning (P. 6-130)**.

Desired control result?

No

Conduct manual turning.

Yes

Start operation

MOUNTING 2

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

⚠ WARNING

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

2.1 Mounting Environment

(1) The PF900/PF901 is intended to be used under the following environmental conditions.
- IEC61010-1 OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2
  Indoor use, Altitude up to 2000 m

(2) Use this instrument within the following allowable range:
- Allowable ambient temperature: −10 to +55 °C
- Allowable ambient humidity: 5 to 95 % RH
  (Absolute humidity: MAX.W.C 29 g/m^3 dry air at 101.3 kPa)

(3) Do not use this instrument in the following environment:
- Sudden change in ambient temperature
- Condensation or icing
- Corrosive or inflammable gases.
- Strong vibration or impact
- 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.
- Direct radiant heat

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

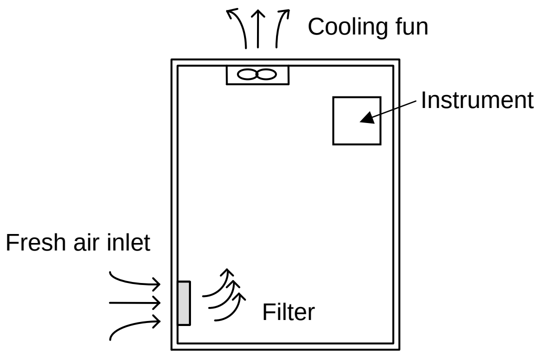
2.2 Mounting Cautions

To avoid problems, consider the following cautions when mounting the PF900/PF901:

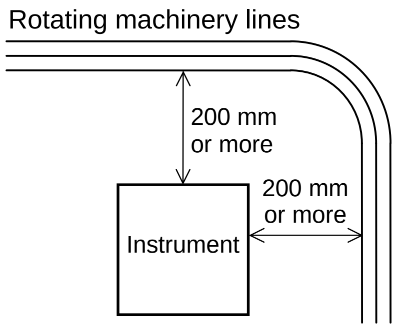
- Allow space for draft to release heat.
- Make sure to cool down the ambient temperature by using forced-air cooling system when the ambient temperature exceeds 55 °C. Do not expose this instrument directly to cool air from the forced-air cooling system.
- Do not mount this instrument directly above equipment that generates large amount of heat (heaters, transformers, semi-conductor functional devices, large-wattage resistors.)
- To improve noise immunity or safety, consider the following cautions:

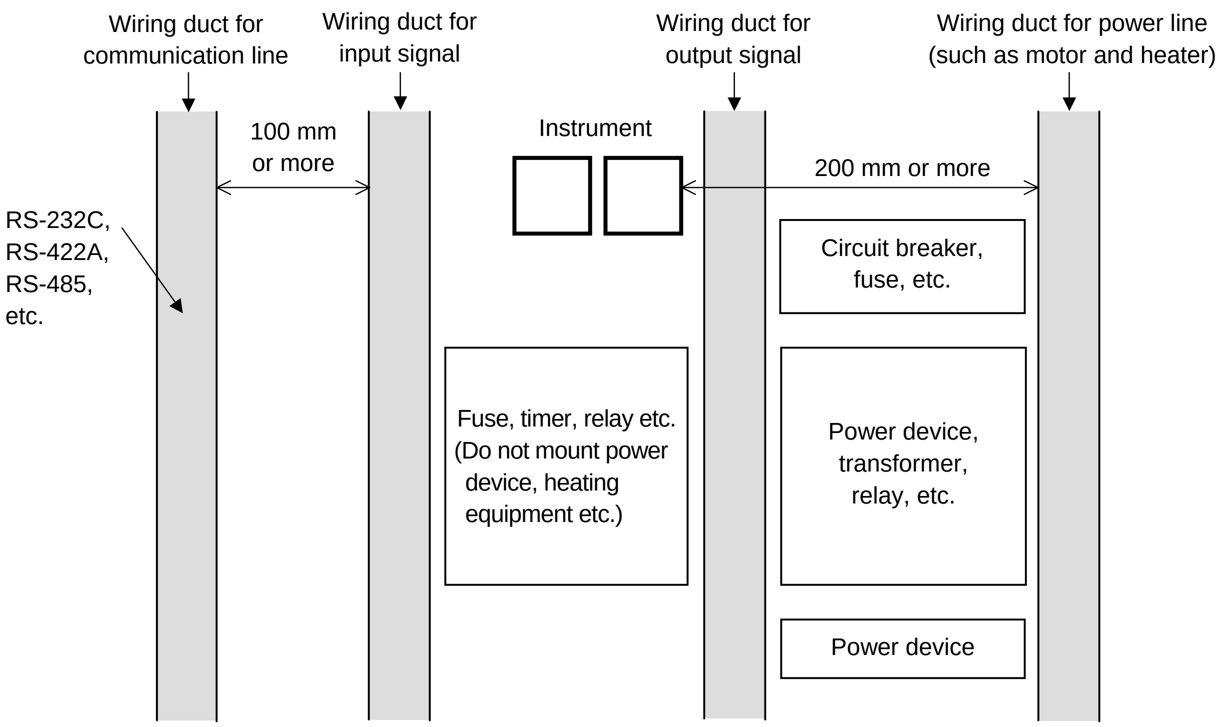
High voltage equipment:	Do not mount within the same panel.
Power lines:	Separate at least 200 mm.
Rotating machinery:	Separate as far as possible.

Example of cooling panel



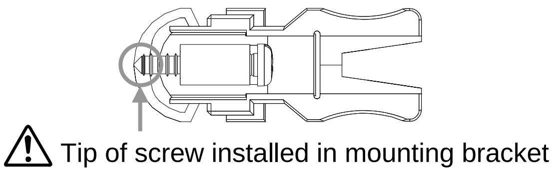
Distance from rotating machinery lines



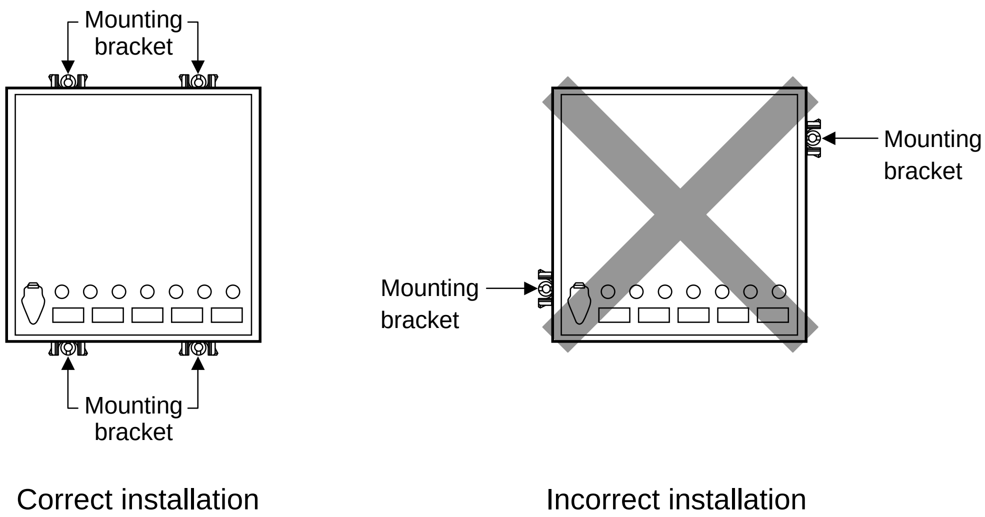


- Mount PF900/PF901 within the range of installation position (±90°).
- Concern the viewing angle of the display when mounting PF900/901.
  Viewing angle: Horizontal 90°/vertical 90° (contrast ratio 20:1)

- Take caution to avoid being hurt by the sharp-pointed tip of the screw installed in the mounting bracket.



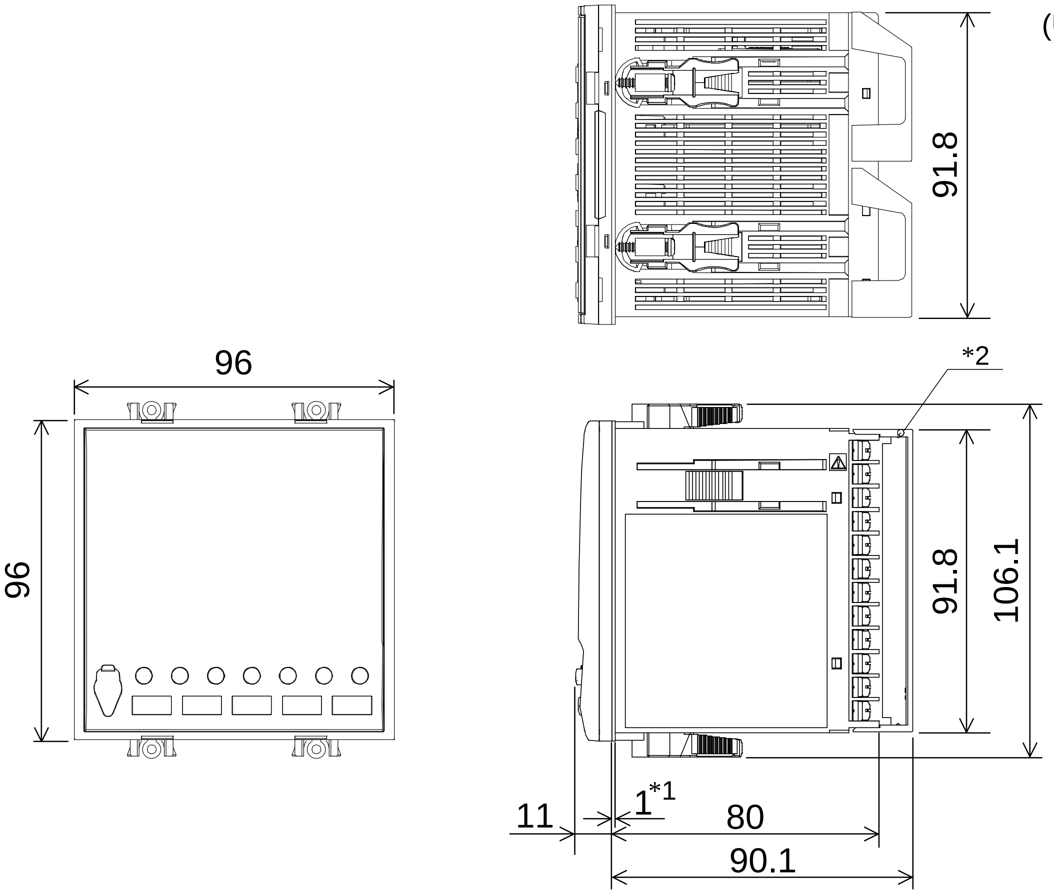
- Install two mounting brackets each on top and the bottom of the instrument. Do not install them in the grooves located on the side surfaces.



2.3 Dimensions

● Dimensions

(Unit: mm)

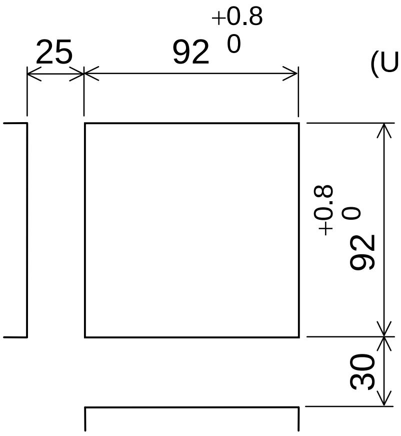


[Panel thickness: 1 to 10 mm]

*1 Waterproof/dustproof rubber packing (Model code: KFB900-36 <1>)
*2 Terminal cover [sold separately] (Model code: KFB 400-511)

● Panel cutout

To keep the instrument as waterproof as possible, make sure that the panel surface has no burr or distortion where the hole is to be cut out.



(Unit: mm)

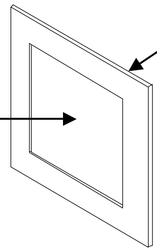
2.4 Procedures of Mounting and Removing

■ Mounting procedures

The front of the controller conforms to **IP55 (NEMA Type 3)** when mounted to the panel. For effective Waterproof/Dustproof, the waterproof/dustproof rubber packing must be securely placed between instrument and panel without any gap. If waterproof/dustproof rubber packing is damaged, please contact RKC sales office or the agent.

1. Prepare the panel cutout as specified in **2.3 Dimensions**. (Panel thickness: 1 to 10 mm)

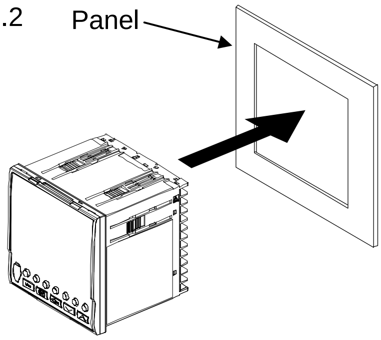
Fig. 2.1



2. Set the water/dustproof rubber packing on the case from the back side of the instrument shown in Fig. 2.2. Insert the instrument through the panel cutout.

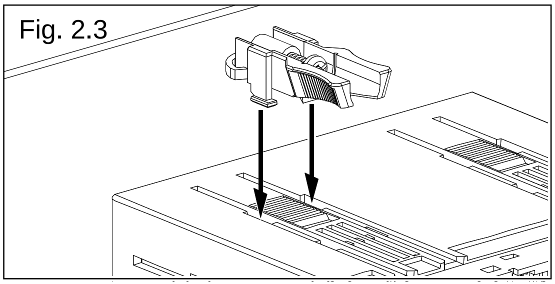
☞ For replacing of waterproof/dustproof rubber packing, refer to **APPENDIX A.3 Replacing the Waterproof/Dustproof Rubber Packing (P. A-16)**.

Fig. 2.2



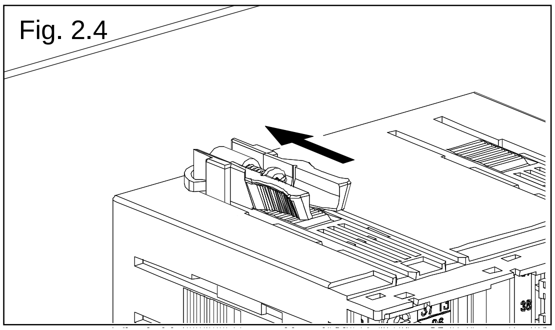
3. Insert the mounting bracket into the mounting groove of the instrument. (Fig. 2.3)

Fig. 2.3



4. Push the mounting bracket forward until the bracket is firmly secured to the panel. (Fig. 2.4)

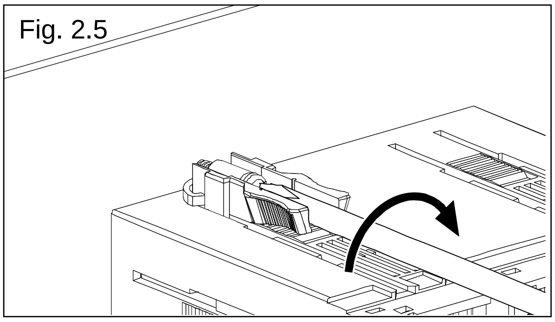
Fig. 2.4



5. Turn only one full revolution after the screw touches the panel. (Fig. 2.5)

If the screw has been rotated too tight, the screw may turn idle. In such a case, loosen the screw once and tighten it again until the instrument is firmly fixed.

Fig. 2.5



6. The other mounting bracket should be installed the same way described in ***3*** to ***5***.

■ Removal procedures

1. Turn the power OFF.

2. Remove the wiring.

3. Loosen the screw of the mounting bracket.

4. Remove the mounting bracket by pulling up (Fig. 2.7 [A]) and forward (Fig. 2.7 [B]) while holding the rear (Fig. 2.6).

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

6. Pull out the instrument from the mounting cutout while holding the front panel frame of this instrument. (Fig. 2.8)

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

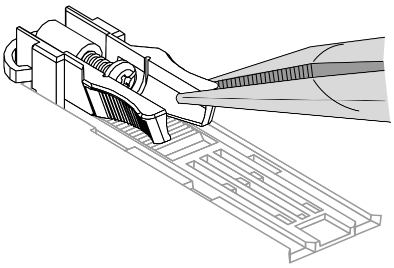


Fig. 2.6

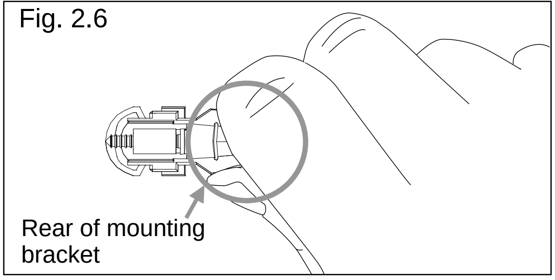


Fig. 2.7

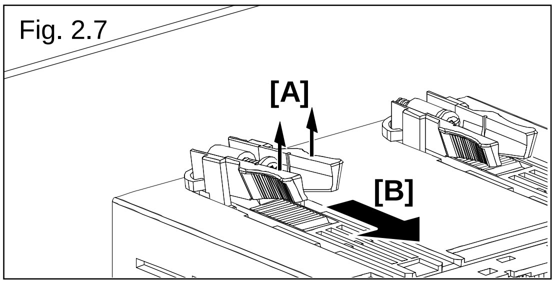
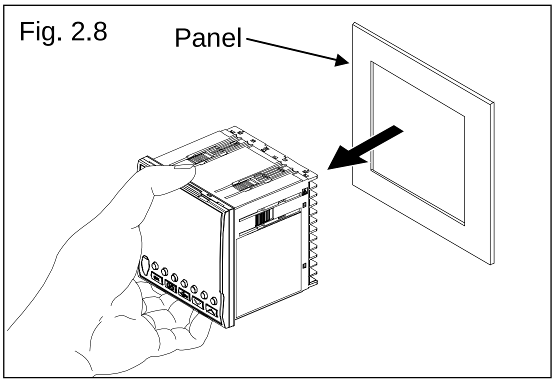


Fig. 2.8



■ Removal procedures by using slotted (standard) screwdriver

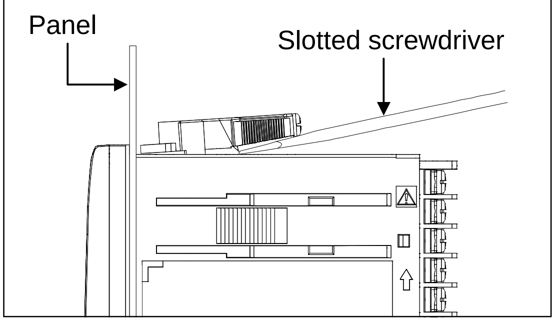
1. Turn the power OFF.

2. Remove the wiring.

3. Loosen the screw of the mounting bracket.

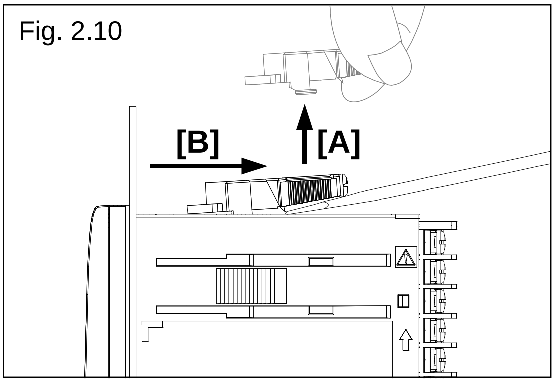
4. Lift the rear of the mounting bracket by inserting a slotted screwdriver between the mounting bracket and the instrument (Fig. 2.9).

Fig. 2.9



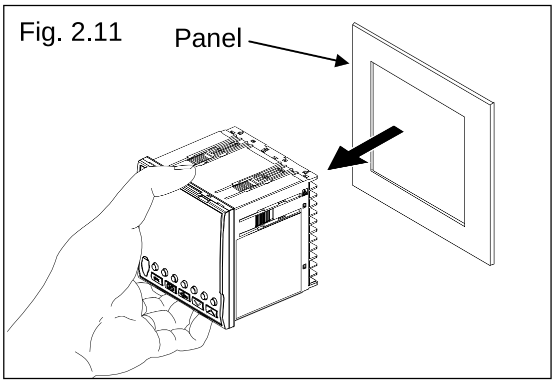
5. To remove the mounting bracket from the case [A] (fig. 2.10), pull up and forward [B]

Fig. 2.10



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

Fig. 2.11



WIRING 3

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

☞ For connection of loader communication, refer to **5.7 Parameter Setting via Loader Communication (P. 5-33)**.

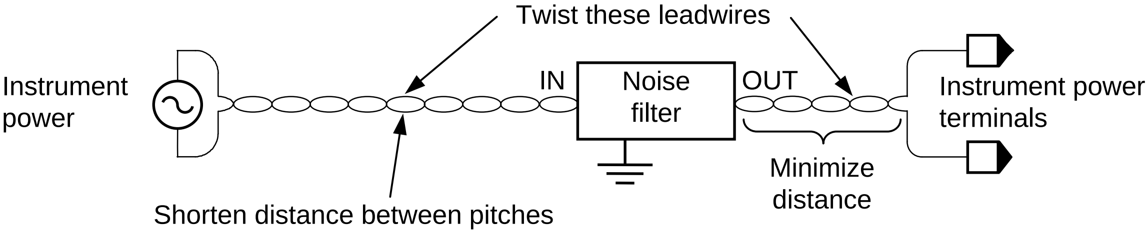
⚠ WARNING

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.

3.1 Wiring Cautions

■ Power supply wiring

- 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.

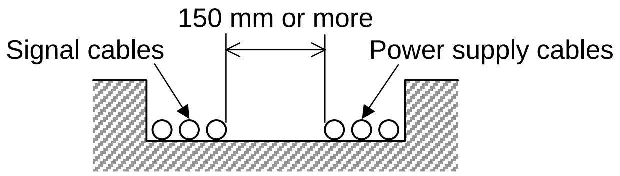


- About 5 seconds are required as preparation time for contact output every time the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.
- This instrument is not furnished with a power supply switch or fuse. Therefore, if a fuse or power supply switch is required, install close to the instrument.
  Recommended fuse rating: Rated voltage 250 V, Rated current 1 A
  Fuse type: Time-lag fuse
- For an instrument with 24 V power supply, supply power from a SELV circuit.
- 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).

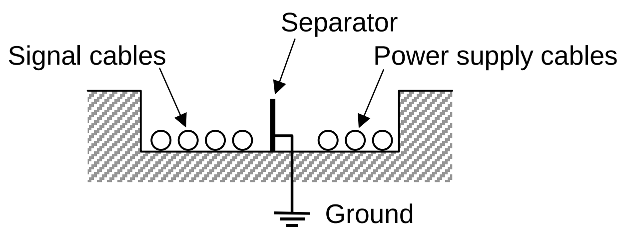
■ Input/Output wiring

- 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.

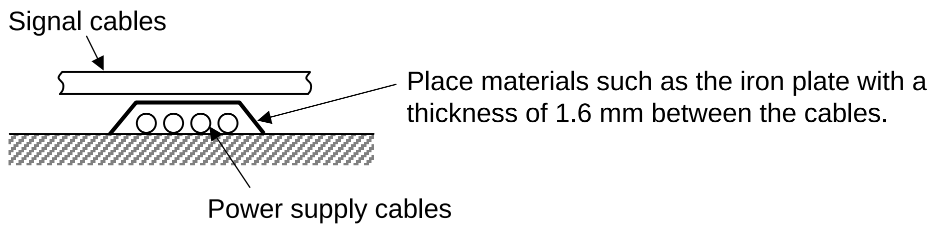
Example: Keep 150 mm or more between the cables.



Example: Locate separator.

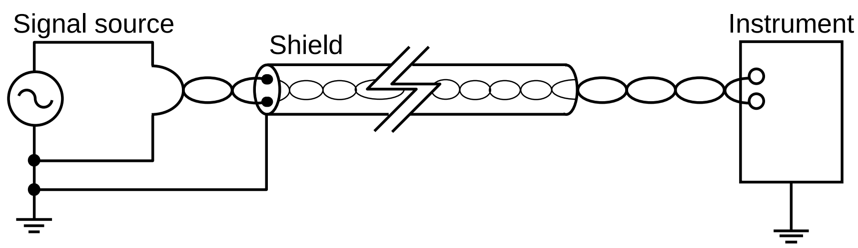


Example: Cross the cables at a right angle.

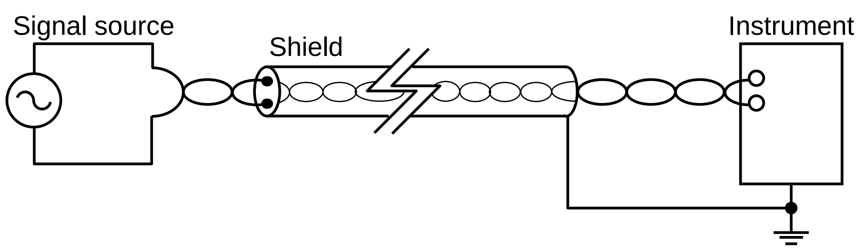


- Use independent ducts for the input/output wires and power circuits inside and outside the panel.
- If input/output wires have to be placed in the same duct as the power circuits, use shielded wires. Ground the shield to reject any noise generated by the floating capacitance between the cores and shield or by a grounding potential.

Example: When signal source is grounded, ground the shield to the signal source side.

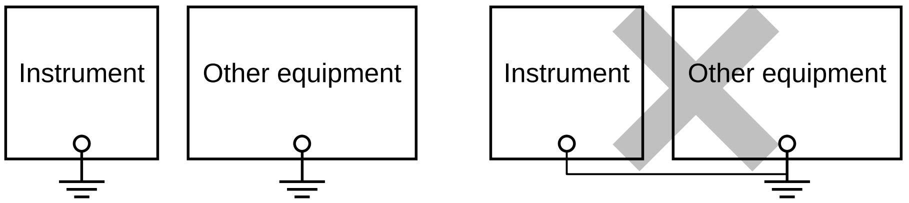


Example: When signal source is not grounded, ground the shield to the instrument side.



■ Ground wiring

- Ground the instrument separately from other equipment. The full grounding effect may not be produced depending on the grounding method.



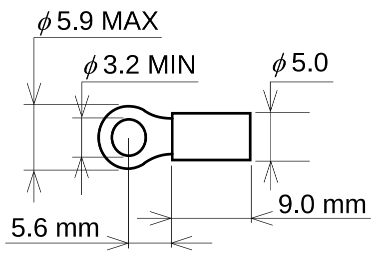
Dedicated grounding: Suitable　　Common grounding: Not suitable

- Do not mix this grounding wire with other grounding wires.
- Do not use the same grounding wire as that for high-voltage equipment such as motors, etc.
- Do not ground grounding wires so that they form a grounding loop. Ground each wire at one point.
- The grounding resistance should be 100 Ω or less.
- Use ground wires with a cross section of 2.0 mm^2 or more.

■ Wiring method

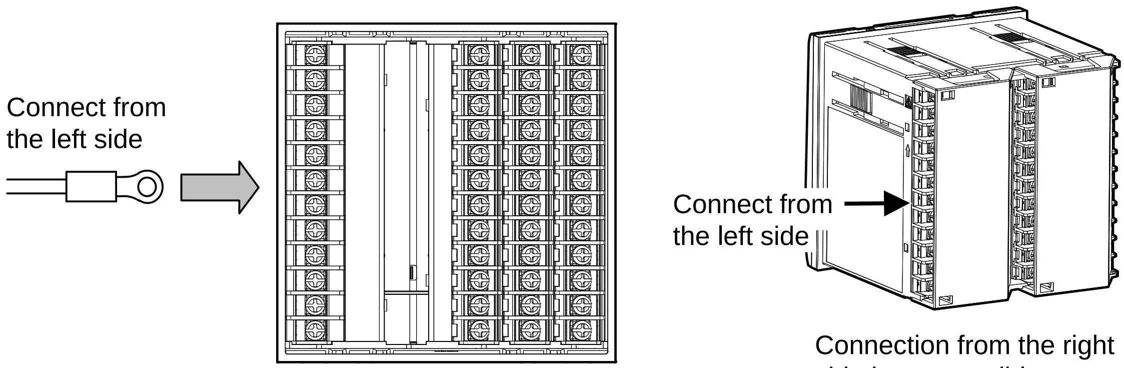
- Use the solderless terminal appropriate to the screw size.
  Screw size: M3 × 7 (With 5.8 × 5.8 square washer)
  Recommended tightening torque:
  0.4 N･m (4 kgf･cm)
  Applicable wire: Solid/Twisted wire of 0.25 to 1.65 mm^2
  Specified dimension: Refer to Fig. 3.1
  Specified solderless terminals:
  Manufactured by J.S.T MFG CO., LTD.
  Circular terminal with isolation
  V1.25-MS3
  (M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Fig 3.1



- Make sure that the any wiring such as solderless terminal is not in contact with the adjoining terminals.
- When making the connections, route from the left side toward the rear terminals as shown in Fig. 3.2. The central and right columns of terminals are slanted to facilitate connection from the left. If a terminal cover is used, connection from the right side is not possible.

Fig. 3.2 Wiring direction



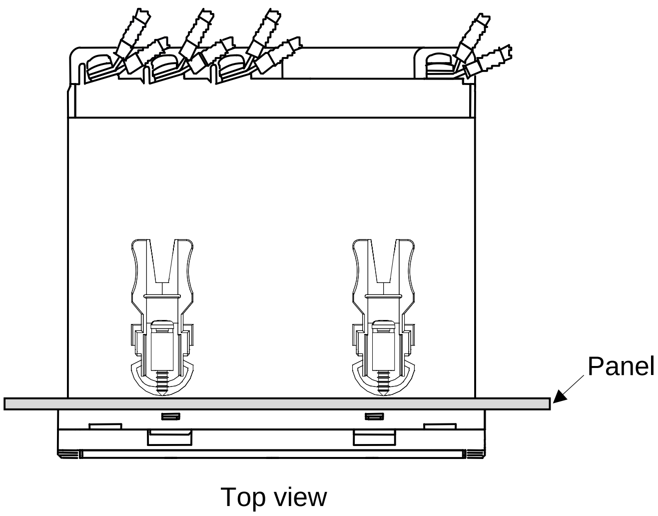
- Up to two solderless terminal lugs can be connected to one terminal screw.
  However, in this case, reinforced insulation cannot be used.

NOTE

Bend the solderless terminals for multi-drop wiring to avoid damage to the screws by securing forcibly. (Refer to Fig. 3.3)

If two solderless terminal lugs are connected to one terminal screw, a terminal cover cannot be used.

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



3.2 Terminal Layout

■ Terminal configuration

The PF900 and the PF901 offer the same terminal configuration.

Digital output (DO5 to 12) [optional]
Open collector
☞ Refer to **P. 3-15**.

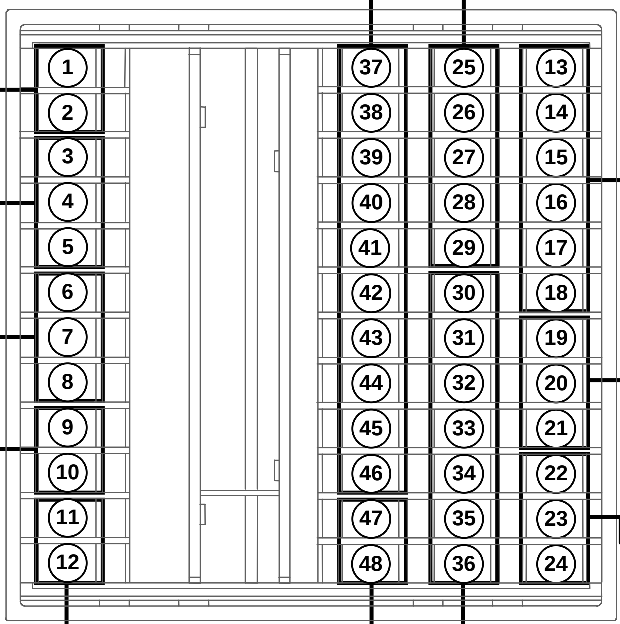
Power supply voltage
100 to 240 V AC
24 V AC
24 V DC
☞ Refer to **P. 3-8**.

Digital output 3 (DO3), Digital output 4 (DO4)
Relay contact
☞ Refer to **P. 3-14**.

Digital output 1 (DO1), Digital output 2 (DO2)
Relay contact
☞ Refer to **P. 3-14**.

Output 2 (OUT2)*
Relay contact
Voltage pulse
Voltage
Current
Triac
Open collector
☞ Refer to **P. 3-10**.

Output 1 (OUT1)
Relay contact
Voltage pulse
Voltage
Current
Triac
Open collector
☞ Refer to **P. 3-10**.



Communication 1 [optional]
RS-232C
RS-422A
RS-485
Communication 2 [optional]
RS-485
☞ Refer to **P. 3-17**.

Digital input (DI7 to DI11)
Dry contact
☞ Refer to **P. 3-13**.

Current transformer (CT) input [optional] or Feedback resistance (FBR) input [optional]
☞ Refer to **P. 3-16**.

Measured input [universal input]
Thermocouple (TC)
Resistance temperature detector (RTD)
Voltage
Current
☞ Refer to **P. 3-9**.

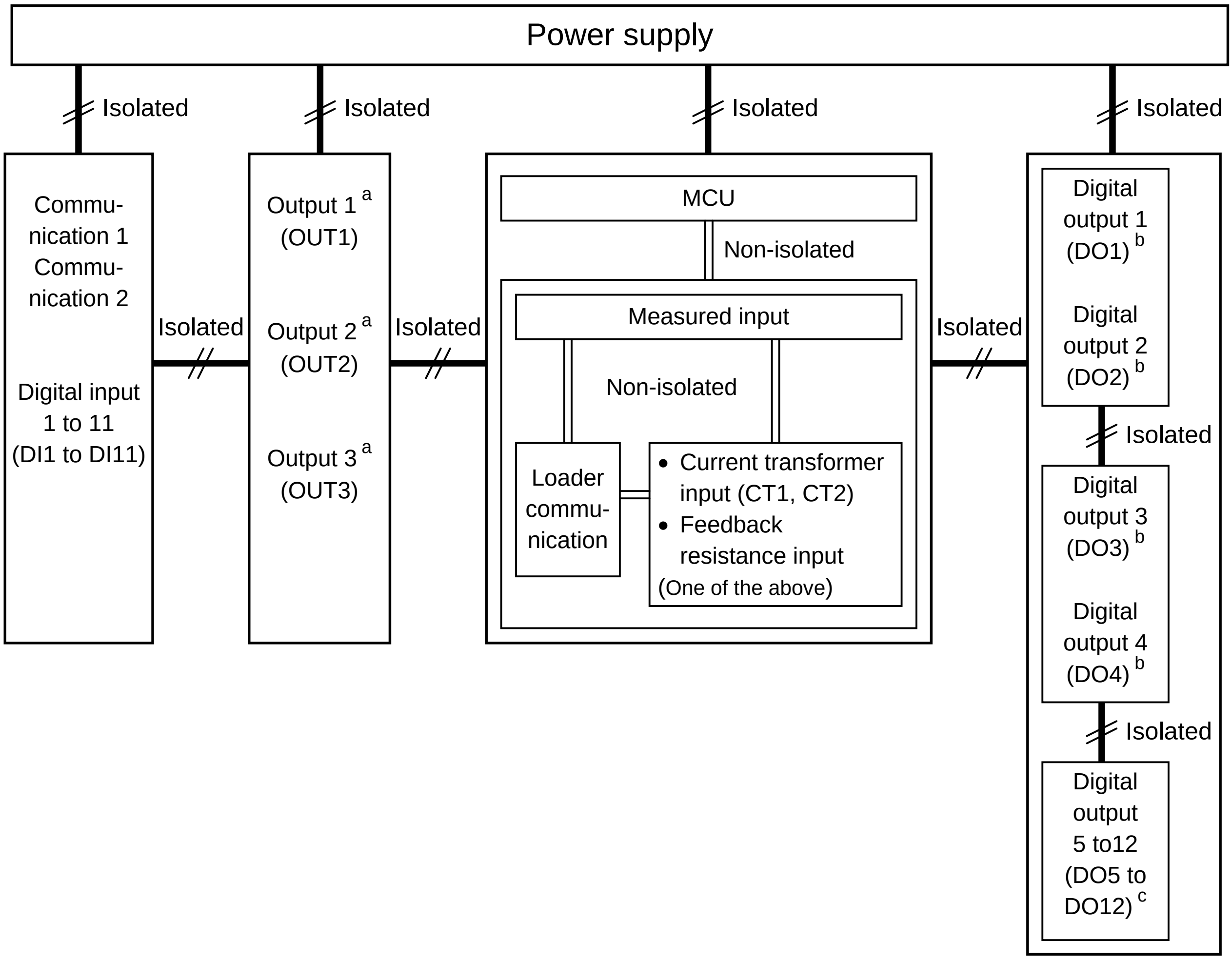
Digital input (DI1 to DI6) [optional]
Dry contact
☞ Refer to **P. 3-13**.

Output 3 (OUT3)*
Voltage pulse
Voltage
Current
Open collector
☞ Refer to **P. 3-12**.

***** Specify when ordering

■ Isolations of the instrument

For isolated device Input/Output blocks, refer to the following:



[a] OUT1, OUT2 and OUT3 are isolated when relay contact or triac is specified for OUT1 and OUT2.

[b] Not isolated between DO 1 and DO 2 or DO 3 and DO 4

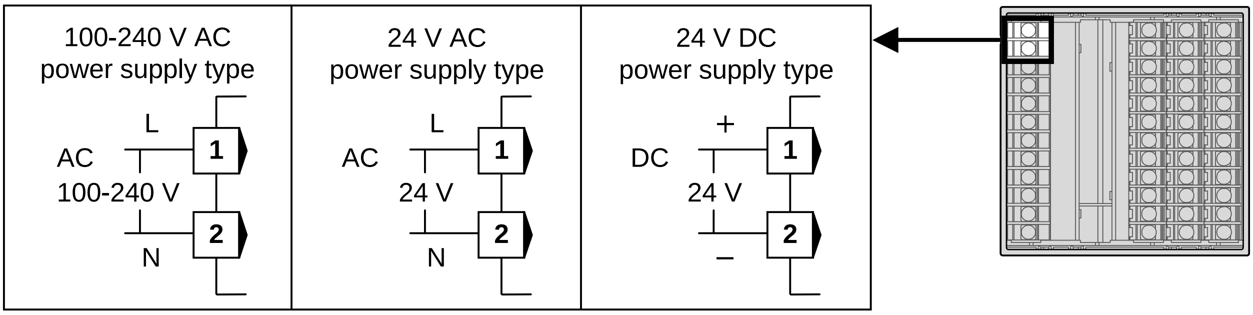
[c] Digital outputs from DO5 to DO12 are not isolated.

3.3 Wiring of Each Terminal

Prior to conducting wiring, always check the polarity of each terminal.

■ Power supply

- Connect the power to terminal numbers 1 and 2.



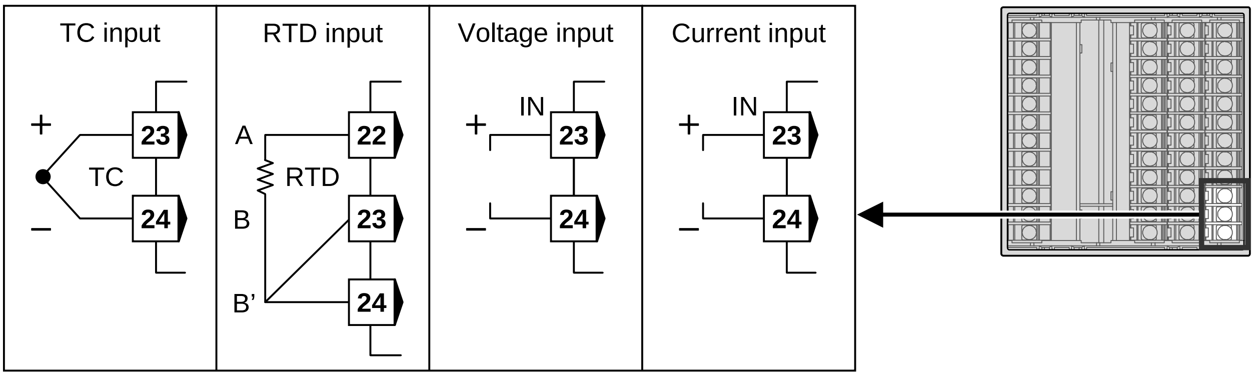
- The power supply types must be specified when ordering. Power supply voltage for the controller must be within the range shown below for the controller to satisfy the control accuracy in the specifications.

Specification code	Power supply type	Power consumption	Rush current
4	100-240 V AC power supply type: 85 to 264 V AC (Power supply voltage range) [Rating 100 to 240 V AC] Power supply frequency: 50/60 Hz	9.5 VA max. (at 100 V AC) 13.5 VA max. (at 240 V AC)	At 100 V AC: 7.5 A or less At 240 V AC: 17.5 A or less
3	24 V AC power supply type: 20.4 to 26.4 V AC (Power supply voltage range) [Rating 24 V AC] Power supply frequency: 50/60 Hz	8.5 VA max. (at 24 V AC)	8.5 A or less
	24 V DC power supply type: 20.4 to 26.4 V DC (Power supply voltage range) (Rating 24 V DC)	230 mA max. (at 24 V DC)	6.0 A or less

- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not furnished with a power supply switch or fuse. Therefore, if a fuse or power supply switch is required, install close to the instrument.
  Recommended fuse rating: Rated voltage 250 V, Rated current 1 A
  Fuse type: Time-lag fuse
- For an instrument with 24 V power supply, supply power from a SELV circuit.
- A suitable power supply should be considered in the end-use equipment. The power supply must be in compliance with a limited-energy circuits (maximum available current of 8 A).

■ Measured input (TC/RTD/Voltage/Current) [universal input]

- For the Measured input type, terminals 22 through 24 are allocated to the Measured input.



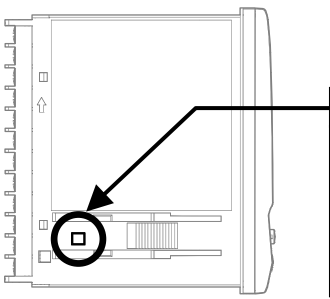
- Select the Voltage (low) input group, the Voltage (high) input group or the Current input group to conform to the input type to be set.

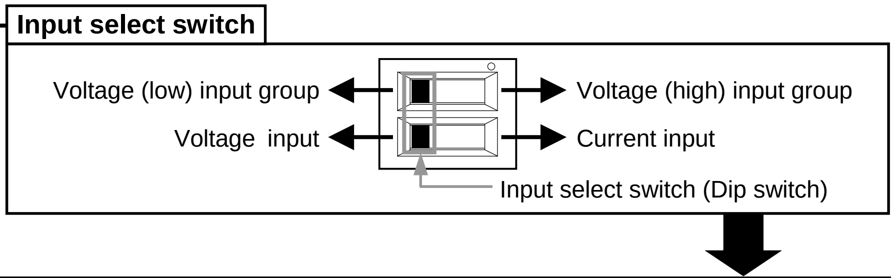
How to switch Input group

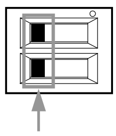
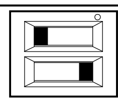
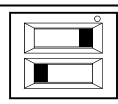
Switch the input group by using the upper Input select switch at the bottom left of the left side of this instrument. Select the voltage input or the current input by using the lower input select switch (refer to the description below).

NOTE

To avoid damage to the instrument, disconnect measurement input terminals before switching input groups.


Side view

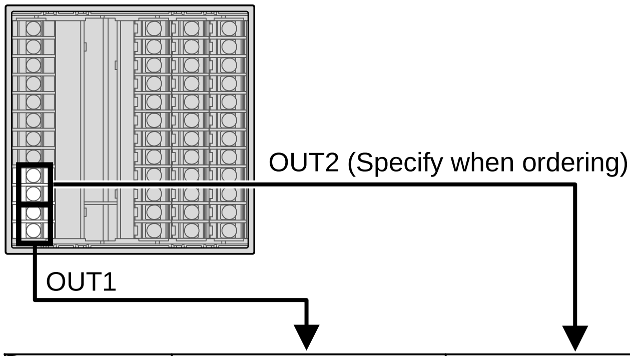


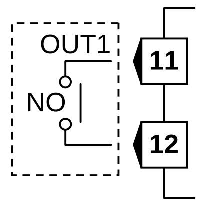
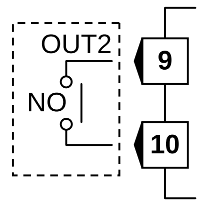
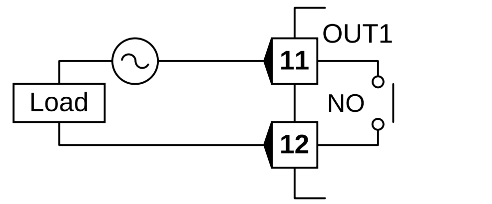
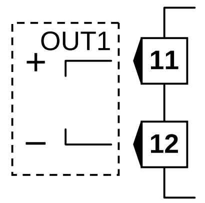
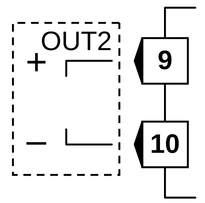
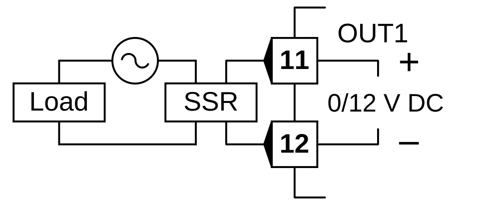
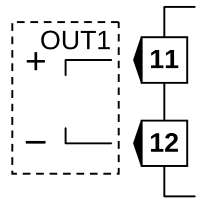
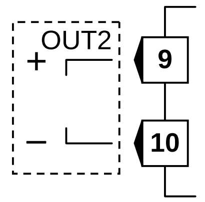
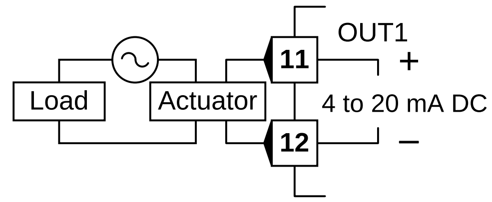
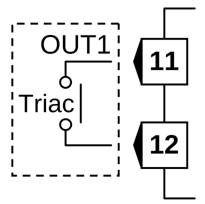
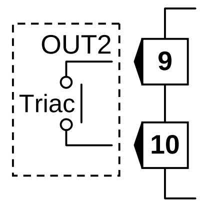
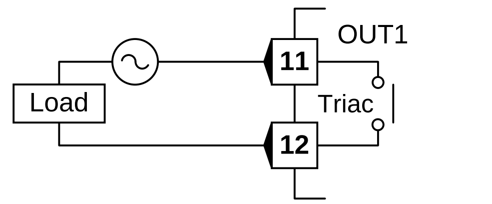
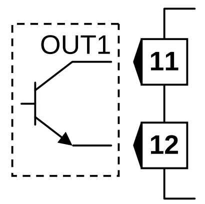
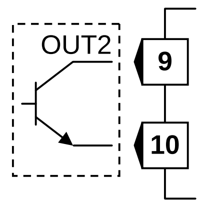
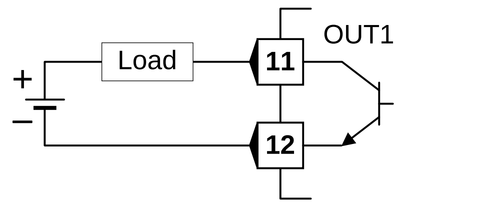
Input group		Input type	Input select switch
Voltage (low) input group	TC input	K, J, E, T, S, R, B, N (JIS-C1602-1995) PLII (NBS) W5Re/W26Re (ASTM-E988-96) U, L (DIN43710-1985) PR40-20 (ASTM-E1751-00)	 Input select switch (Dip switch)
	RTD input	Pt100 (JIS-C1604-1997) JPt100 (JIS-C1604-1981 Pt100)	
	Voltage (low) input	0 to 10 mV DC, 0 to 100 mV DC, 0 to 1 V DC, −10 to +10 mV DC, −100 to +100 mV DC, −1 to +1 V DC	
	Current input	0 to 20 mA DC, 4 to 20 mA DC	
Voltage (high) input group	Voltage (high) input	0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC −5 to +5 V DC, −10 to +10 V DC	

- For TC input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wires with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.

■ Output 1 (OUT1)/Output 2 (OUT2)

- Number of outputs must be specified when ordering.
- Terminal 11 and 12 are for output 1 (OUT1); Terminal 9 and 10 are for output 2 (OUT2).
- Connect an appropriate load according to the output type. (Specify when ordering)



	OUT1	OUT2	Wiring example
Relay contact			
Voltage pulse			
Voltage, Current			
Triac			
Open collector			

[ ] : The dotted box diagram describes the output state of the instrument.

- Number of outputs and output types must be specified when ordering. The specifications of each output are as follows.

Specification code	Output type	Specifications
N		None
M	Relay contact	250 V AC, 3 A (Resistive load)/30 V DC 1 A (Resistive load) 1a contact
V	Voltage pulse	0/12 V DC (Allowable load resistance: 600 Ω or more) Allowable load resistance is 300 Ω or more (within 40 mA) when using only OUT1.
4	Voltage	0 to 5 V DC (Allowable load resistance: 1 kΩ or more)
5		0 to 10 V DC (Allowable load resistance: 1 kΩ or more)
6		1 to 5 V DC (Allowable load resistance: 1 kΩ or more)
7	Current	0 to 20 mA DC (Allowable load resistance: 600 Ω or less)
8		4 to 20 mA DC (Allowable load resistance: 600 Ω or less)
T	Triac	Output method: Zero-cross output Allowable load current: 0.5 A (Ambient temperature 40 °C or less) [Derating: –0.02 A/°C when ambient is 40 °C or more.] Load voltage: 75 to 250 V AC Minimum load current: 30 mA ON voltage: 1.6 V or less (at maximum load current)
D	Open collector	Allowable load current: 100 mA Load voltage: 30 V DC or less ON voltage: 2 V or less (at maximum load current) Leakage current at OFF: 0.1 mA or less

- Assign Control output, Transmission output or Event output as described in the table below.

Output terminal	Details of output	Setting screen
OUT1	Control output, Transmission output *	Engineering mode F31.01: OUT1 assignment (LoGC1) [Refer to P. 4-37.]
OUT2	Control output, Transmission output or Event output	Engineering mode F32.01: OUT2 assignment (LoGC2) [Refer to P. 4-37, 38.]

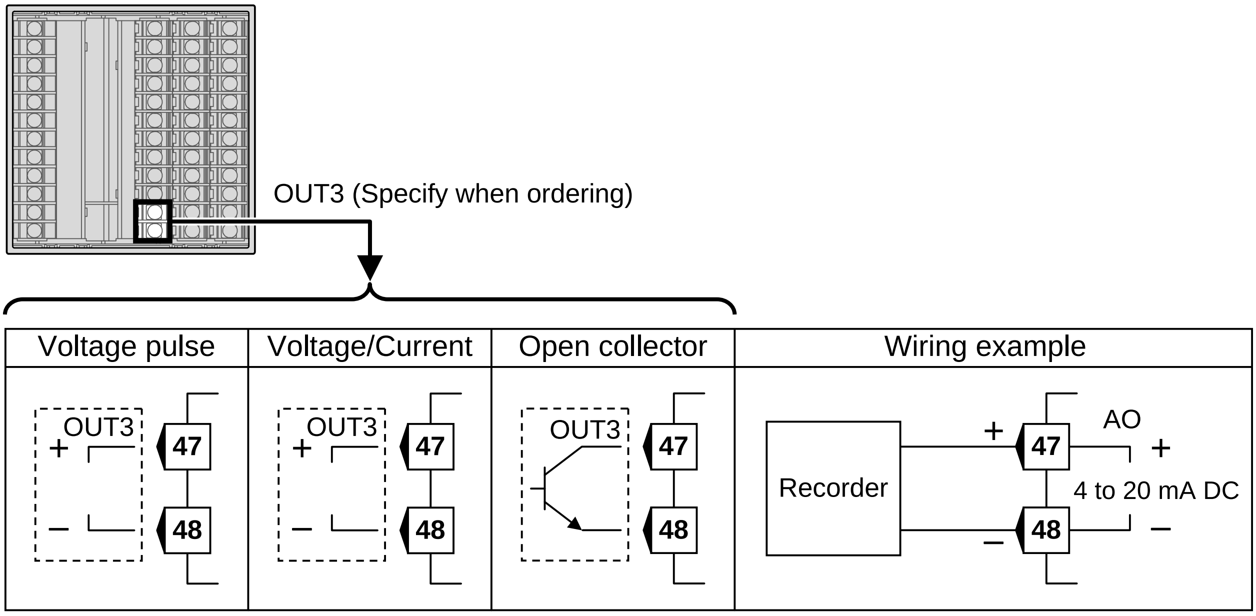
* Transmission output of OUT1 is only available for Output program.

Refer to the description below for general output assignment for each control action.

Control action	Details of assignment
PID control	OUT1: Control output: Manipulated output value 1 (MV1) (reverse action or direct action) OUT2: Transmission output or Event output
Heat/Cool PID control	OUT1: Control output: Manipulated output value 1 (MV1) [heat-side] OUT2: Control output: Manipulated output value 2 (MV2) [cool-side]
Position proportioning PID control without FBR	OUT1: Control output: Manipulated output value 1 (MV1) [open-side output] OUT2: Control output Manipulated output value 2 (MV2) [close-side output] Make sure to assign the output as described for the Position proportioning PID control.

■ Output 3 (OUT3)

- Number of outputs must be specified when ordering.
- Terminal 47 and 48 are for OUT3.
- Connect an appropriate load according to the output type. (Specify when ordering)



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

- Number of outputs and output types must be specified when ordering. The specifications of each output are as follows.

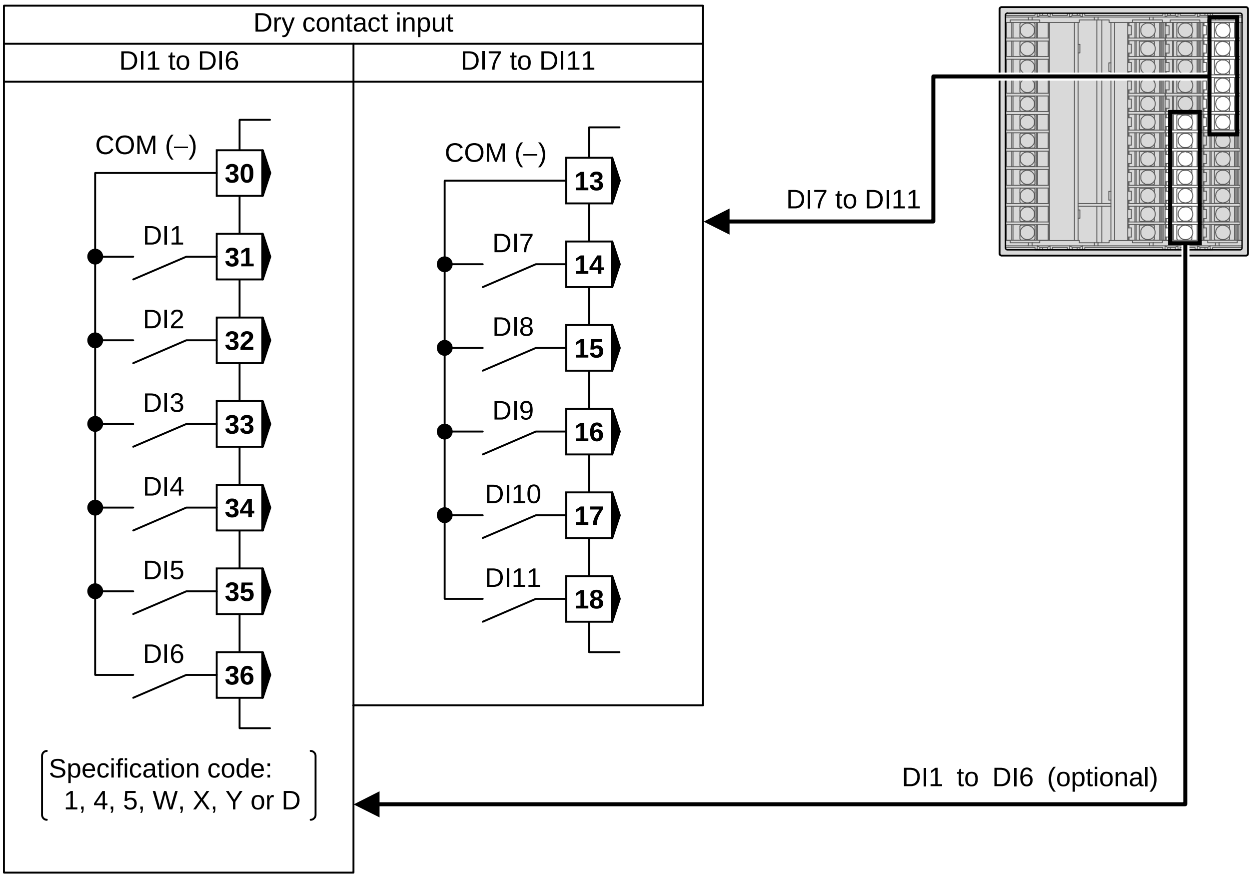
Specification code	Output type	Specifications
N		None
V	Voltage pulse	0/12 V DC (Allowable load resistance: 600 Ω or more)
3	Voltage	0 to 1 V DC (Allowable load resistance: 1 kΩ or more)
4		0 to 5 V DC (Allowable load resistance: 1 kΩ or more)
5		0 to 10 V DC (Allowable load resistance: 1 kΩ or more)
6		1 to 5 V DC (Allowable load resistance: 1 kΩ or more)
7	Current	0 to 20 mA DC (Allowable load resistance: 600 Ω or less)
8		4 to 20 mA DC (Allowable load resistance: 600 Ω or less)
D	Open collector	Allowable load current: 100 mA Load voltage: 30 V DC or less ON voltage: 2 V or less (at maximum load current) Leakage current at OFF: 0.1 mA or less

- Assign Control output, Transmission output or Event output at OUT3 assignment (LoGC3). *

* Refer to P. 4-38.

■ Digital input 1 to 11 (DI1 to DI6 [optional], DI7 to DI11 [standard])

- Terminals 30 through 36 for DI1 to DI6; and Terminals 13 through 18 for DI7 to DI11.



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

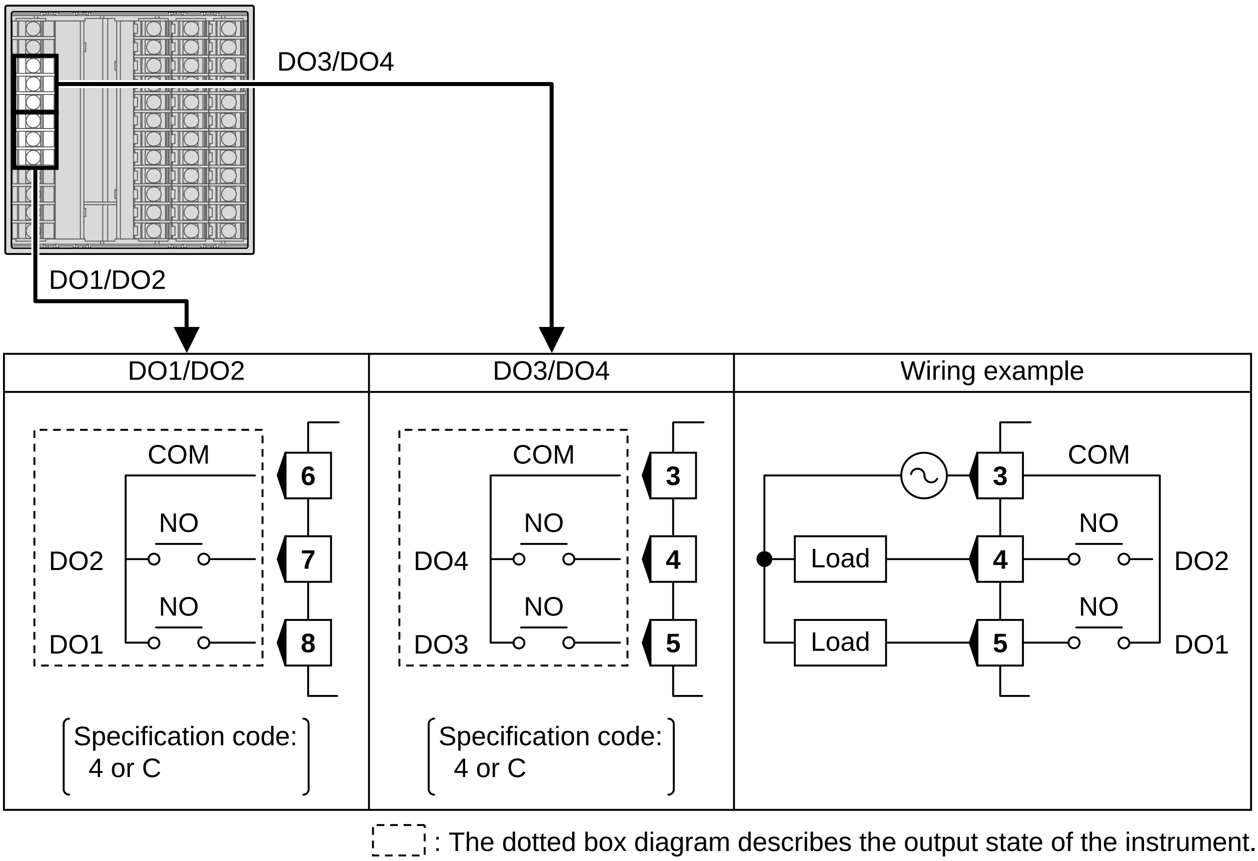
Contact specifications:	At OFF (contact open):	10 kΩ or more
	At ON (contact closed):	1 kΩ or less
	Contact current:	5 mA or less
	Capture judgment time:	Approx. 200 ms + 1 sampling cycle

- The following functions can be assigned to Digital inputs. (Can be specified when ordering.)
  - – Reset mode (RESET) setting
  - – Program control mode (RUN) setting
  - – Step function (STEP)
  - – Hold function (HOLD)
  - – Direct/Reverse action switching
  - – Wait state release
  - – Pattern number switch
  - – Pattern increment

☞ To assign functions to Digital inputs, refer to **6.1.9 Digital input (DI) (P. 6-14)**.

■ Digital output 1 to 4 (DO1 to DO4) [standard]

- With DO optional, terminals 3 through 5 (DO3, DO4) and 6 through 8 (DO1, DO2) are allocated to the DO.



- Output type is only relay contact output.

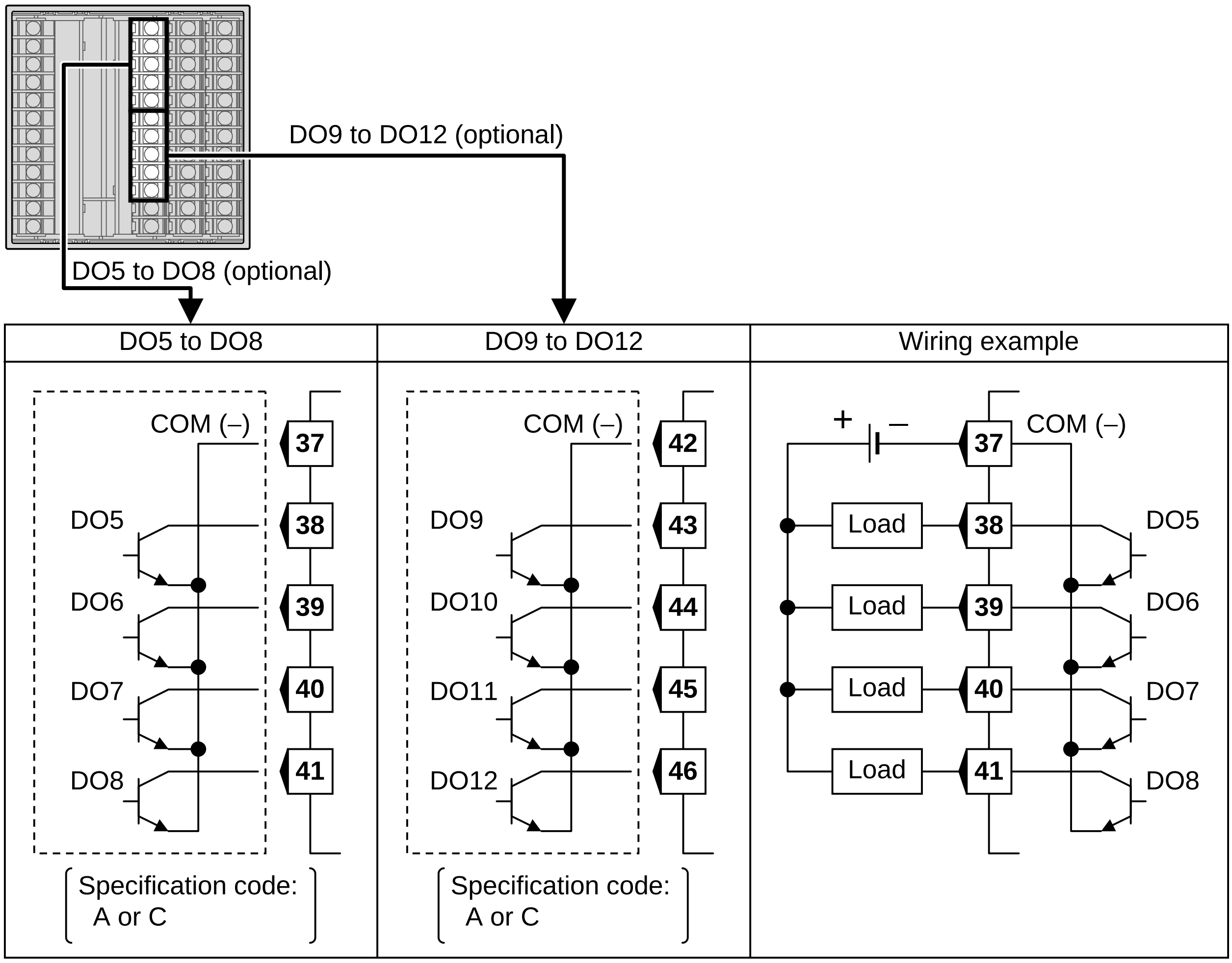
  Contact type: 1a contact
  Contact rating (Resistive load): 250 V AC 1 A, 30 V DC 1 A
  Electrical life: 300,000 times or more (Rated load)

- Assign Event type at the setting screen below.

Digital output terminal	Setting screen
DO1	Engineering mode F34.01: DO1 assignment (Ldo 1) [Refer to P. 4-39.]
DO2	Engineering mode F34.02: DO2 assignment (Ldo2) [Refer to P. 4-39.]
DO3	Engineering mode F34.03: DO3 assignment (Ldo3) [Refer to P. 4-39.]
DO4	Engineering mode F34.04: DO4 assignment (Ldo4) [Refer to P. 4-39.]

■ Digital output 5 to 12 (DO5 to DO12) [optional]

- With DO optional, terminals 37 through 41 (DO5 to DO8) and 42 through 46 (DO9 to DO12) are allocated to the DO.



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

- Output type is only open collector output.

Output method:	Sink type
Allowable load current:	100 mA
Load voltage:	30 V DC or less
ON voltage:	2 V or less (at maximum load current)
Leakage current at OFF:	0.1 mA or less

- Assign Event type at the setting screen below.

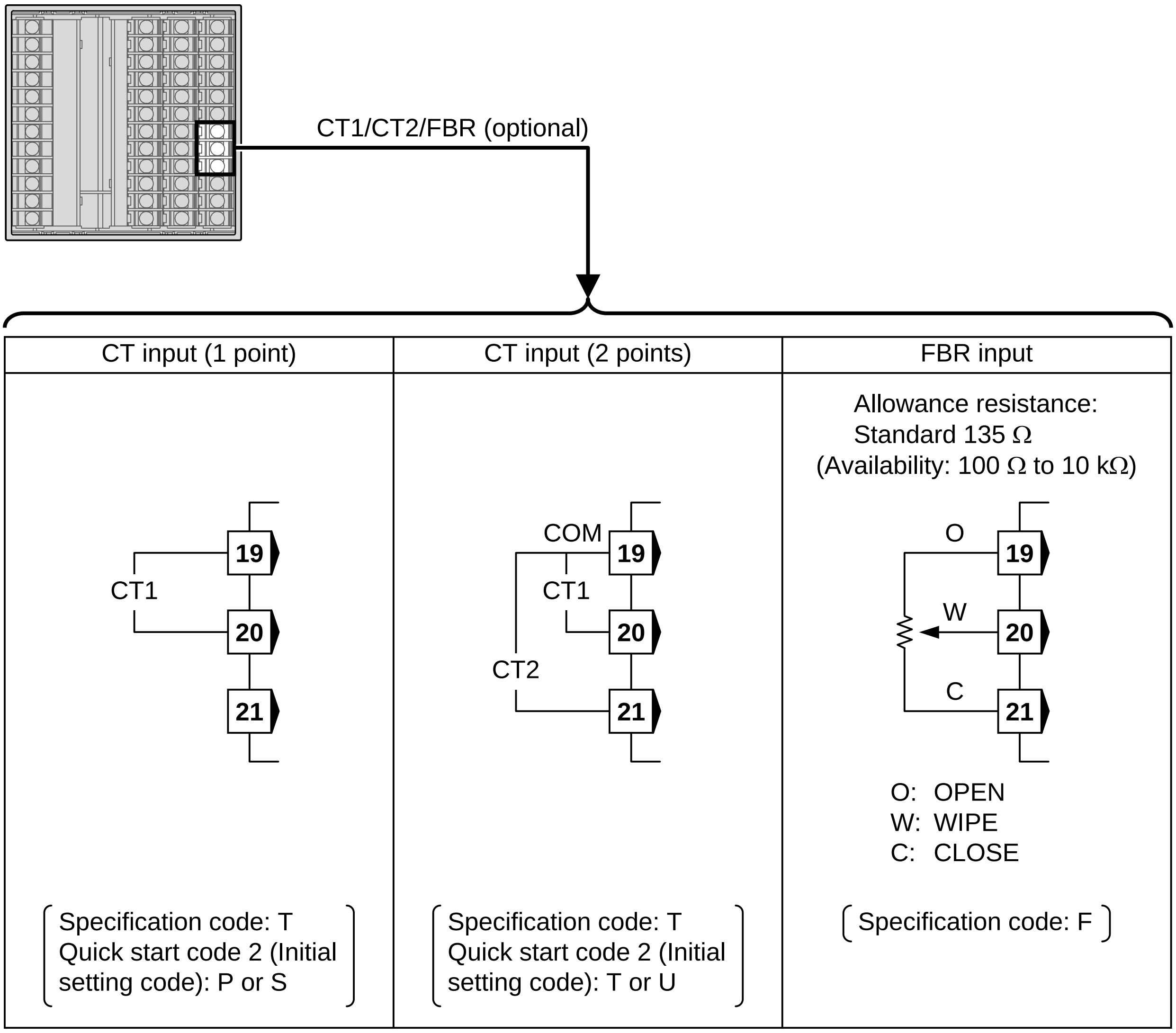
Digital output terminal	Setting screen
DO5	Engineering mode F34.05: DO5 assignment (Ldo5) [Refer to P. 4-39.]
DO6	Engineering mode F34.06: DO6 assignment (Ldo6) [Refer to P. 4-39.]
DO7	Engineering mode F34.07: DO7 assignment (Ldo7) [Refer to P. 4-39.]
DO8	Engineering mode F34.08: DO8 assignment (Ldo8) [Refer to P. 4-39.]
DO9	Engineering mode F34.09: DO9 assignment (Ldo9) [Refer to P. 4-39.]
DO10	Engineering mode F34.10: DO10 assignment (Ldo 10) [Refer to P. 4-39.]
DO11	Engineering mode F34.11: DO11 assignment (Ldo 11) [Refer to P. 4-39.]
DO12	Engineering mode F34.12: DO12 assignment (Ldo 12) [Refer to P. 4-39.]

■ Current transformer (CT) input/Feedback resistance (FBR) input [optional]

- With CT input or FBR input, terminals 19 through 21 are allocated to the specified input.
- When using CT input, connect CTs to the relevant terminals.
  CT: CTL-6-P-N [input range 0 to 30 A] (sold separately)
  CTL-12-S56-10L-N [input range 0 to 100 A] (sold separately)
  When CT type is not specified at ordering, the factory set value of the CT ratio is “800.” To use CTL-12-S56-10L-N, change the set value of CT ratio into “1000” at the setting screen described below.

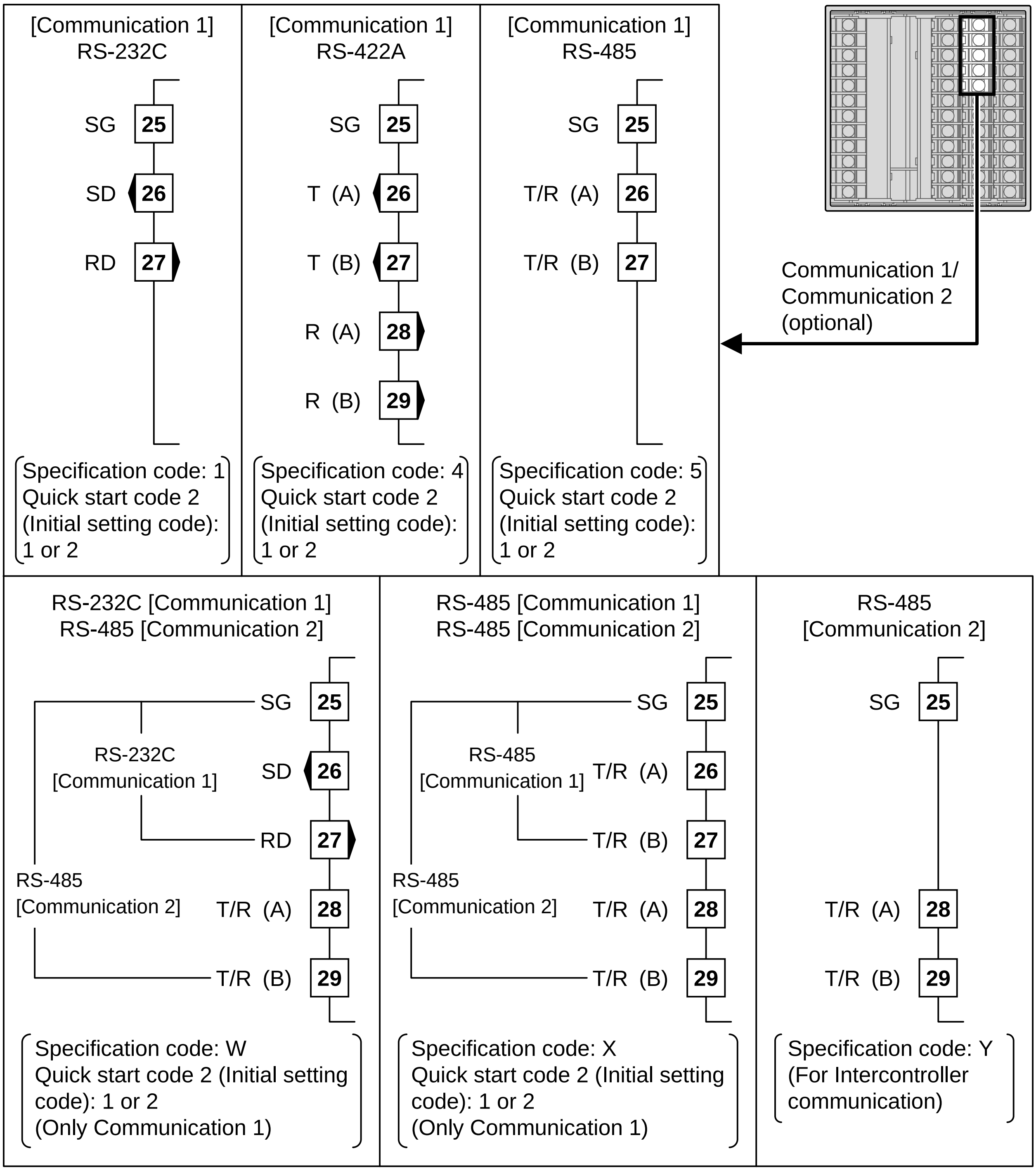
CT input terminal	Setting screen
CT1	Engineering mode F45.01: CT1 ratio (CTR1) [Refer to P. 4-41.]
CT2	Engineering mode F46.01: CT2 ratio (CTR2) [Refer to P. 4-41.]

- When using FBR input, connect a potentiometer to the relevant terminals.



■ Communication 1/Communication 2 [optional]

- With Communication function, terminals 25 through 29 are allocated to Communication.
- Before wiring, confirm the proper terminals to be used for the communication interface being specified. For wiring, refer to **7.1 Connections (P. 7-2)**.



- Communication 2 (RS-485) is for intercontroller communication.
- For the intercontroller communication, refer to **6.7 Intercontroller Communication Function (P. 6-193)**.

3.4 Handling of the Terminal Cover [optional]

When the mounting and removing of the terminal cover, take the following steps.

⚠ WARNING

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

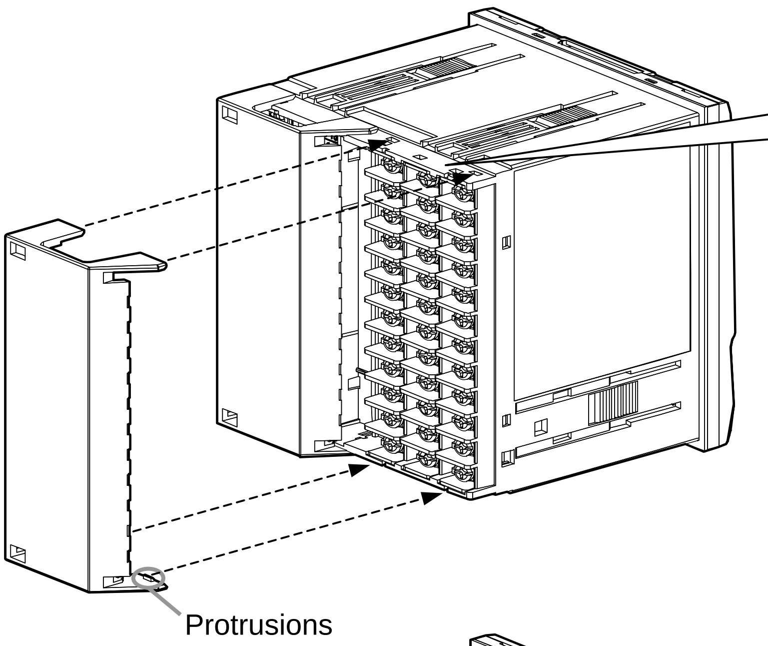
NOTE

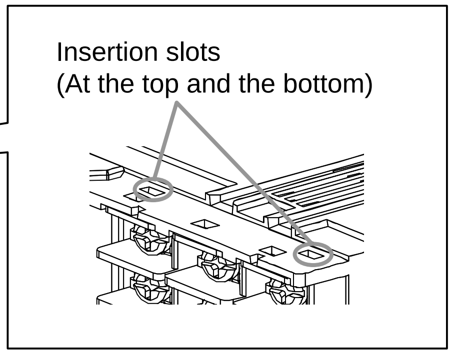
When mounting and removing the terminal cover, apply pressure very carefully for avoid damage to the terminal cover.

■ Mounting procedures

1. Check the mounting direction of the terminal cover.

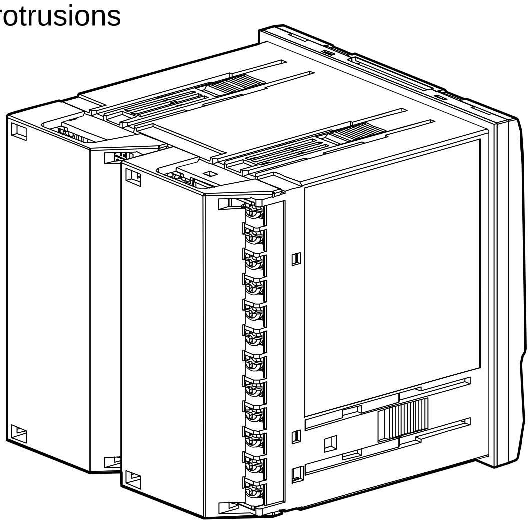
2. Push the protrusions of terminal cover into the insertion slots for mounting the terminal cover.





Terminal cover

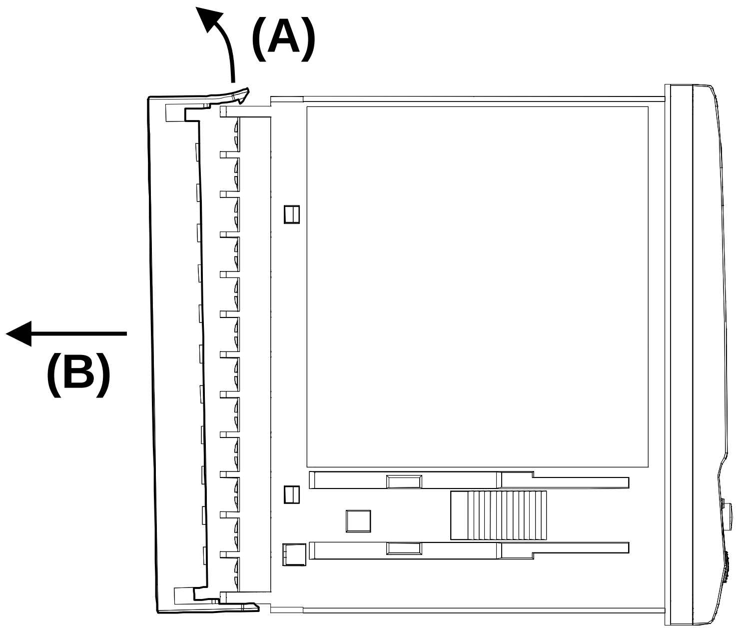
Parts code	KFB400-511



With the terminal cover fixed to instrument

■ Removing procedures

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



MEMO

BASIC OPERATION

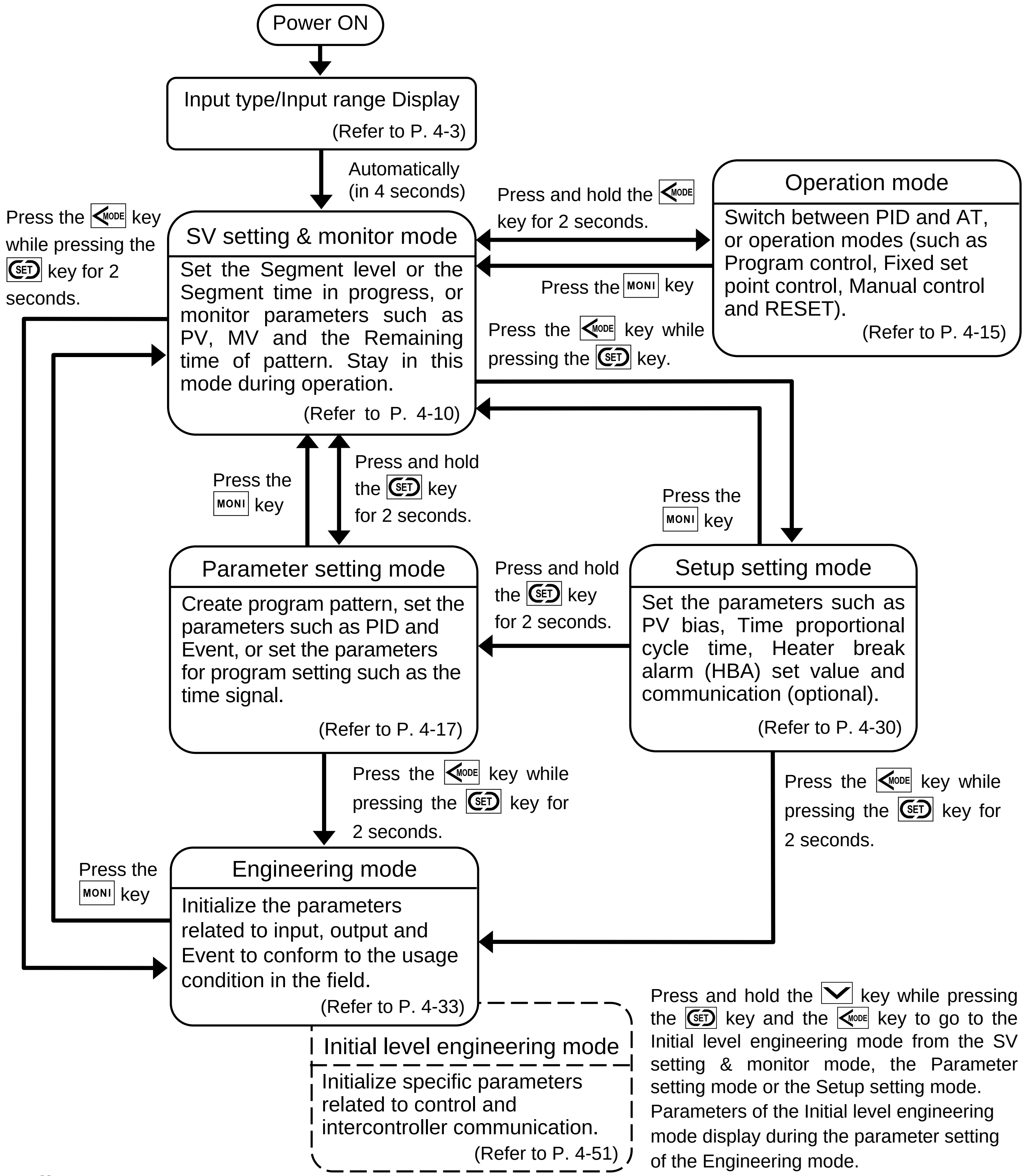
4

This chapter describes mode type, parameter, mode switching and set value change/setting.

4.1 Operation Menu

4.1.1 Mode switching

There are 5 setting modes. Switch mode by using the SET key, the MODE key or the MONI key.



NOTE

Make sure to be in the RESET mode before conducting parameter setting in the Engineering mode. It is possible to set parameters in the function block 10 (F10) and the function block 11 (F11) in the RUN mode, the FIX mode and the MAN mode.

It is also possible to go back to the SV setting & monitor mode by pressing the MODE key while pressing the SET key.

4.1.2 Input type and input range display

This instrument immediately confirms inputs type symbol and input range following power ON.

Example: When sensor type is K thermocouple

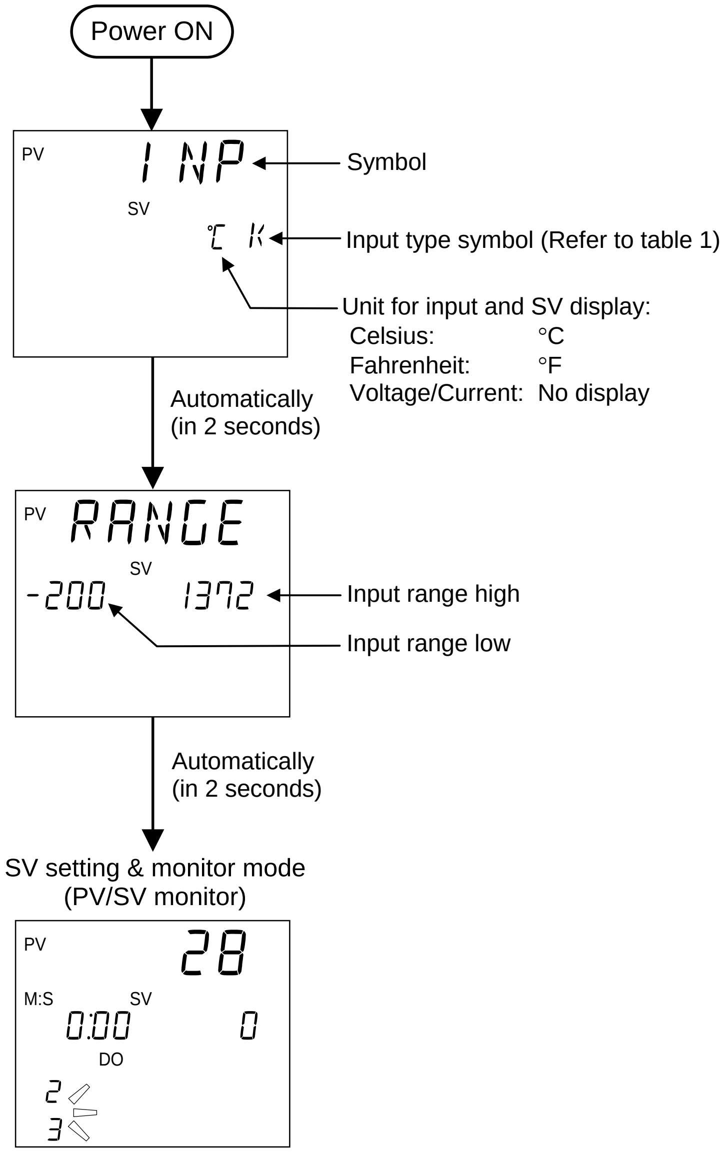


Table 1: Input type symbol table

Symbol	Input type
K	Thermocouple K
J	Thermocouple J
T	Thermocouple T
S	Thermocouple S
R	Thermocouple R
E	Thermocouple E
b	Thermocouple B
N	Thermocouple N
P	Thermocouple PLII
W	Thermocouple W5Re/W26Re
U	Thermocouple U
L	Thermocouple L
PR	Thermocouple PR40-20
PT	RTD Pt100
JP	RTD JPt100
V	Voltage (mV, V)
I	Current (mA)

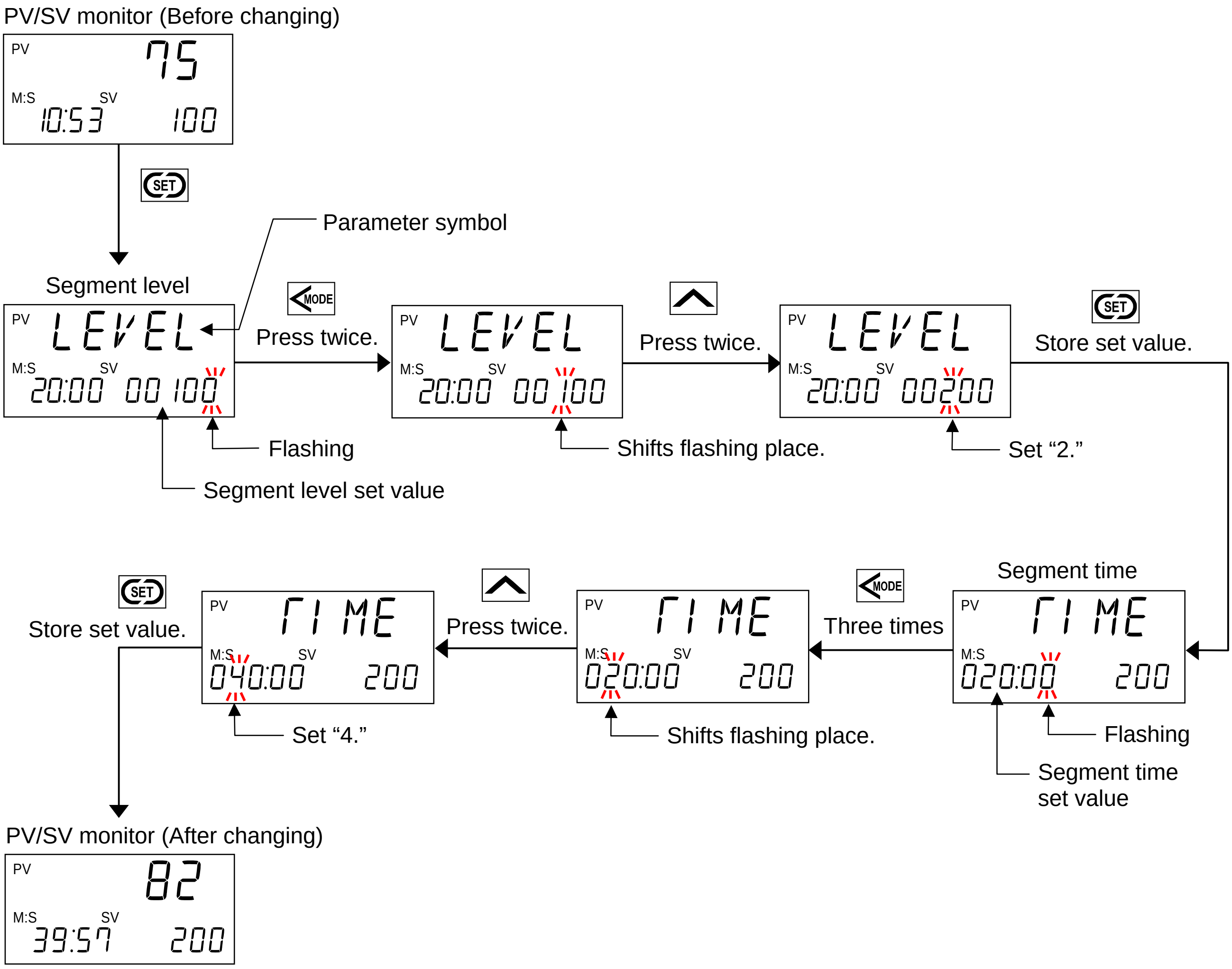
Once power is restored to the instrument the operation mode will return as it was before the power went OFF. The operation mode is displayed after the Input type and Input range.
[Factory set value: Reset mode (RESET)]
For the action at power ON, refer to **5.2 Operating Precautions (P. 5-8)**.

4.2 Changing Set Value

■ Numeric value setting

- The flashing digit indicates which digit can be set. Press MODE key to go to a different digit. Every time the shift key is pressed, the flashing digit moves.
- Set value (SV) may be changed by pressing the ∧ key or the ∨ key.
- 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.
- Press the STEP R.SET key to store the set value and return to the previous parameter setting display.

Example: Change the segment level (to 200 °C) and the segment time (to 40 minutes) in the Program control mode (RUN).



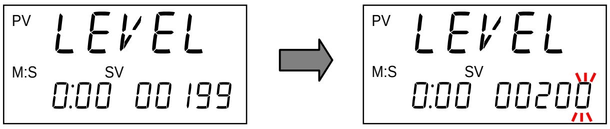
Display returns to the PV/SV monitor display without storing set value being changed if the SET key is not pressed within 1 minute. The new set values being set will not be stored when returning to the PV/SV monitor display if the MONI key is pressed before pressing the SET key.

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

Increase SV from 199 °C to 200 °C:

1. Press the <MODE key to flash the one place (first digit from the right).

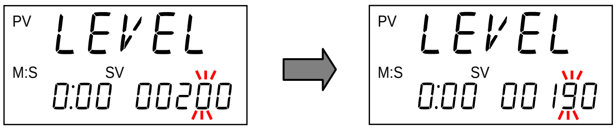
2. Press the ∧ key to change to 0.
The display changes to 200.



Decrease SV from 200 °C to 190 °C:

1. Press the <MODE key to flash the tens place.

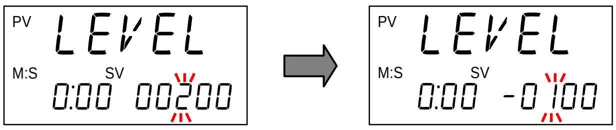
2. Press the ∧ key to change to 9.
The display changes to 190.



Decrease SV from 200 °C to –100 °C:

1. Press the <MODE key to flash the hundreds place.

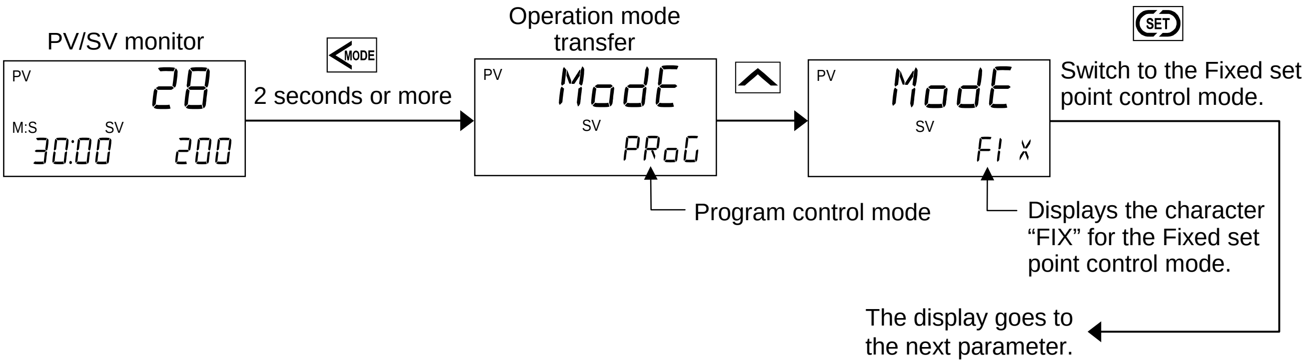
2. Press the ∧ key (three times) to change to –1.
The display changes to –100.



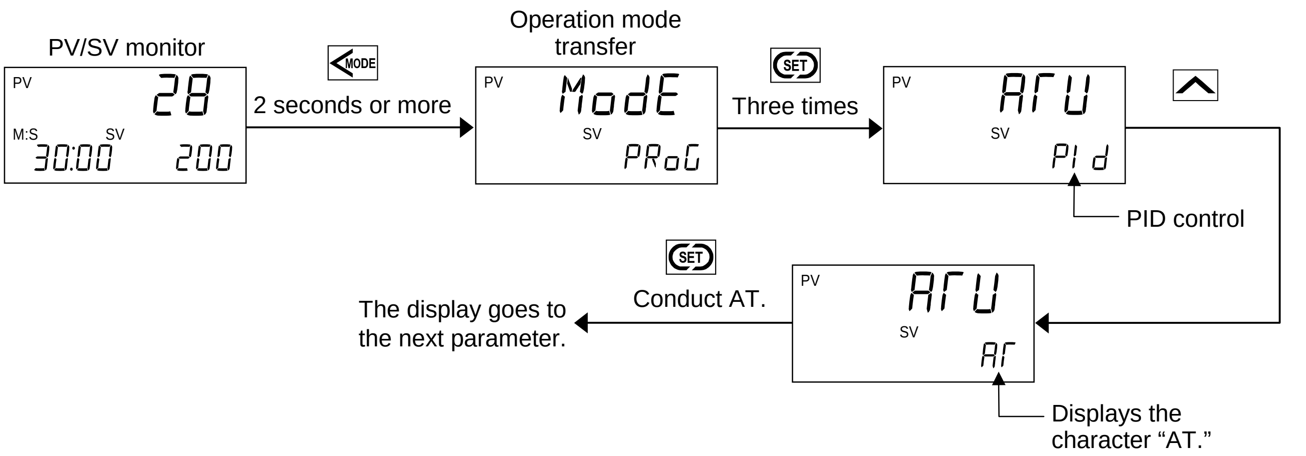
■ Setting item selection

- Press the ∧ key or the ∨ key to switch setting item.
- Press the SET key or the MODE key to store the set values being set and go to the next parameter setting display.

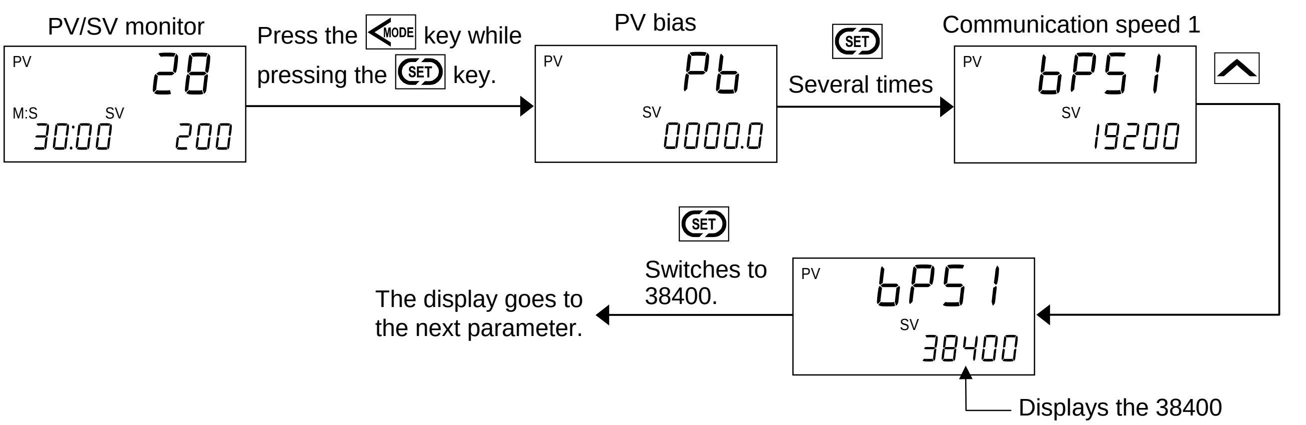
Example 1: Switch operation mode from the Program control mode to the Fixed set point control mode.



Example 2: Conduct Autotuning (AT).



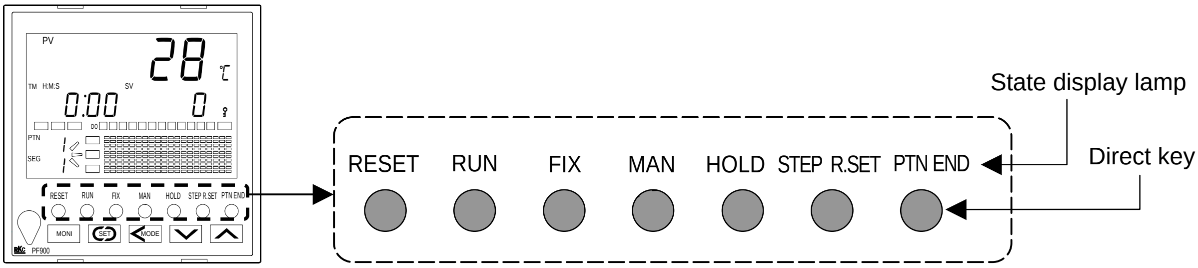
Example 3: Change communication speed 1 in the Setup setting mode.



4.3 Operation of the Direct Keys

■ Direct key menu

Use 7 direct keys to switch operation mode or to conduct simple key operation at program in progress.



● Operation mode switching

Switch operation mode by using the direct key and display the PV/SV screen of the operation mode in progress. State display lamp is orange when the operation mode is in progress. State display lamp turns off when Operation mode switching is not possible.

NOTE

The operation mode cannot be switched by using the direct keys when RESET or RUN of the Digital input (DI) is ON (contact closed).

Direct key	Operation mode	State display lamp	Display
RESET	Reset mode	RESET lamp lights [Orange]	PV/SV monitor of operation mode
RUN	Program control mode	RUN lamp lights [Orange]	
FIX	Fixed set point control mode	FIX lamp lights [Orange]	
MAN	Manual control mode	MAN lamp lights [Orange]	

● Key operation in the Program control mode (RUN)

HOLD key:

Press the HOLD key to stop progress of time in the Program control mode (RUN). To release the HOLD state, press the HOLD key again.

The HOLD key is not operative when conducting HOLD (contact closed) by using the Digital input (DI).

STEP R.SET key:

The STEP R.SET key offers 2 functions: the STEP function and the R.SET function. The STEP function is available for the PV/SV monitor state in the Program control mode. The R.SET function is validated in the Parameter setting mode.

- STEP function (STEP lamp lights):
  Forward the segment of the program pattern in process to the next.
- R.SET function (R.SET lamp lights):
  Go back to the previous parameter setting display (opposite action to the SET key). The set value of the parameter is stored when pressing the R.SET key.

PTN END key:

The PTN END key offers 2 functions: the PTN function and the END function. The END function is available for the program setting in the Parameter setting mode. The PTN function is available only in the Reset mode (RESET).

- END function (END lamp lights):
  Press the END key to display the program end screen when setting parameters related to segment at the Program setting block in the Parameter setting mode. Then press the SET key to go to the parameter setting display of pattern setting. Press the END key instead of the SET key to go back to the segment setting screen.
- PTN function (PTN lamp lights):
  Switch to the Execution pattern selection display.

■ Direct key type

To prevent error in key operation, select direct key type at the function block 11 in the Engineering mode.

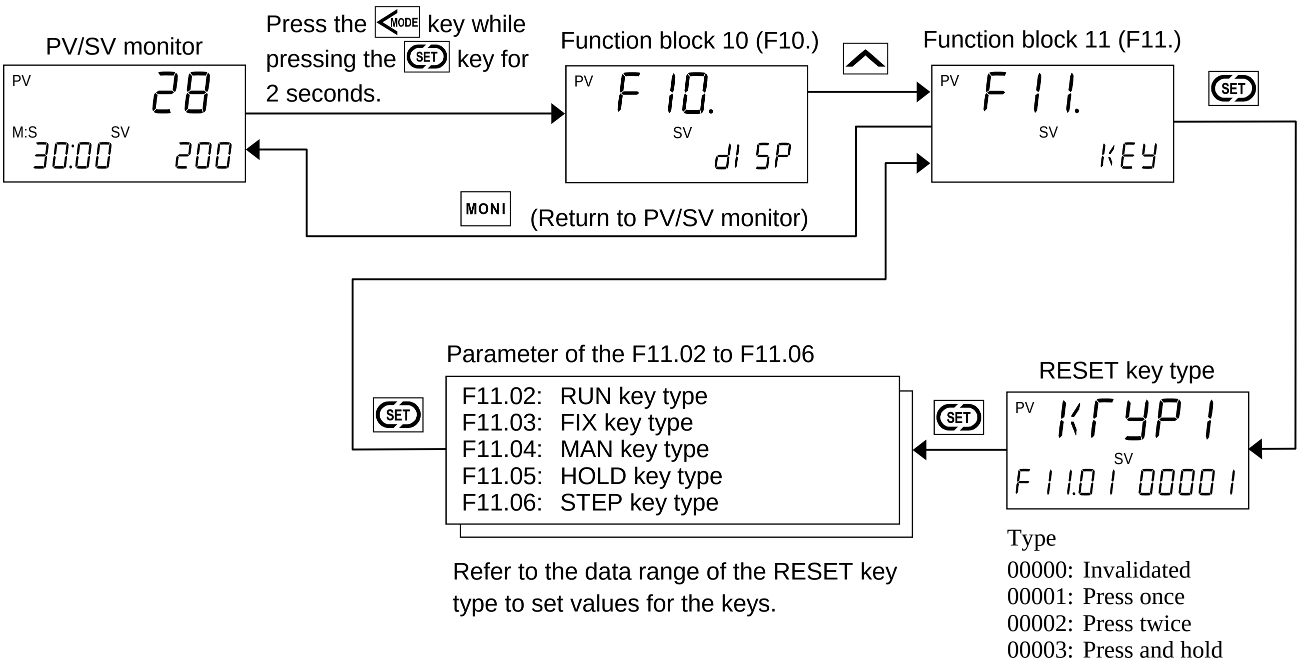
● Type:

- Invalidated: Direct key operation is invalidated
- Press once: Operate the direct key by pressing once.
- Press twice: Press the direct key once and confirm the state display lamp flashes in green. Then press again within 3 seconds to operate.
- Press and hold: Press and hold the direct key for 2 seconds to operate.

Direct key type is not available for the PTN END key (Press one type only).

The factory set value of the STEP R.SET key is "Press and hold" but the key type switches to "Press once" when the R.SET function is operative. The factory set value of the other direct keys is "Press once."

● Setting procedure



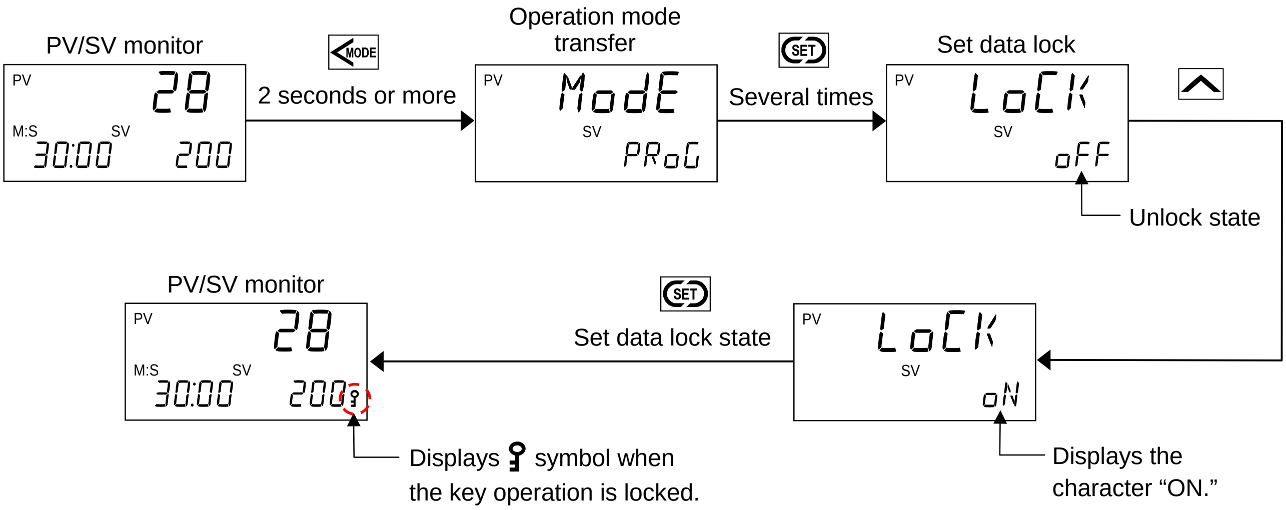
4.4 Protecting Setting Data

Prevent error in key operation by using the Set data lock function.

Parameter setting is prohibited when the Set data lock function is selected (except for the Operation mode transfer, the Set data lock and the Execution pattern selection).

● Setting procedure

Lock or unlock the key operation at the Set data lock setting display in the Operation mode.



It is possible to monitor set value of parameters.

Communication may be used to set parameters when the key operation is locked.

4.5 Parameter Description

Parameters are described by Mode type, Parameter list with Data range and Parameter switching diagram.

Reference page list

Mode type		Reference page: ■ Parameter list	Reference page: ■ Parameter switching
4.5.1 SV setting & monitor mode	SV setting mode	P. 4-10	P. 4-11, P. 4-12
	Monitor mode	P. 4-13	P. 4-14
4.5.2 Operation mode		P. 4-15	P. 4-16
4.5.3 Parameter setting mode	Partial setting type *	P. 4-18 to P. 4-22	P. 4-23 to P. 4-26
	Batch setting type *	P. 4-27	P. 4-28, P. 4-29
4.5.4 Setup setting mode		P. 4-30, P. 4-31	P. 4-32
4.5.5 Engineering mode		P. 4-33 to P. 4-44	P. 4-45 to P. 4-50
4.5.6 Initial level engineering mode		P. 4-51 to P. 4-53	P. 4-54 to P. 4-57

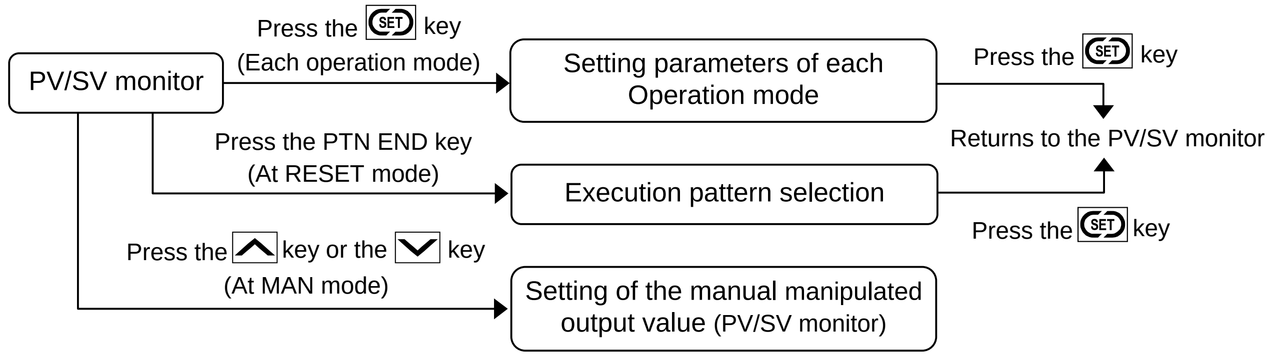
* For Partial setting type and Batch setting type, refer to ■ **Setting type for Program pattern (P. 4-17)**.

4.5.1 SV setting & monitor mode

Set the parameters such as the Segment level and Segment time in progress or switch the Execution pattern selection screen, monitor screen of the Pattern remaining time, Manipulated output value (MV) etc.

■ SV setting mode

Setting parameter varies with the operation mode (RESET, RUN, FIX, MAN) in the SV setting mode.



☞ Refer to P. 4-11 and P. 4-12 to switch parameter setting display.

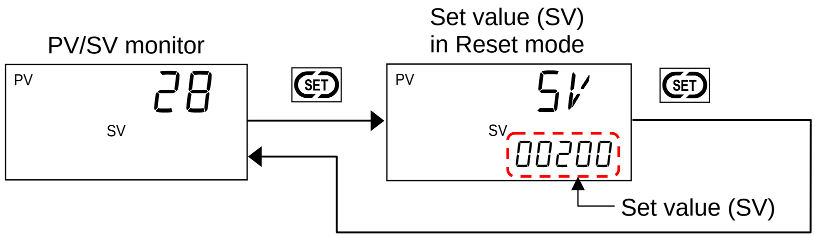
● Parameter list

Name	Symbol	Data range	Factory set value
Reset mode (RESET)			
Set value (SV) in Reset mode	SV	Setting limiter low to Setting limiter high	0
Execution pattern selection	PTN	1 to 99 (Within the maximum pattern number)	1
Program control mode (RUN)			
Segment level	LEVEL	Setting limiter low to Setting limiter high	0
Segment time	TIME	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute
Fixed set point control mode (FIX)			
Set value (SV) in Fixed set point control mode	SV	Setting limiter low to Setting limiter high	0
Manual control mode (MAN)			
Manual manipulated output value	MV	–5.0 to +105.0 %	–5.0
Set value (SV) in Manual control mode	SV	Setting limiter low to Setting limiter high	0

● Parameter switching

Reset mode (RESET)

Press the SET key to go to the Set value (SV) setting display in the Reset mode.



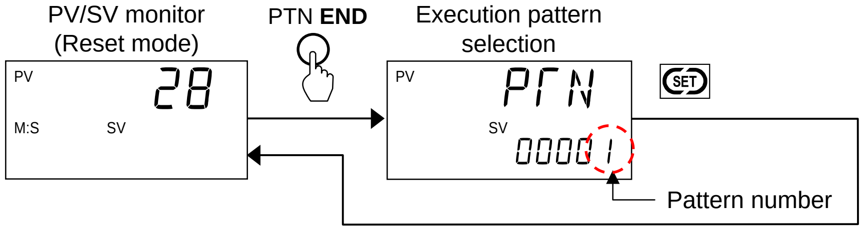
Execution pattern selection

Switch the PV/SV monitor display to the setting display of the Execution pattern selection by using the **PTN** END key (PTN lamp lights) in the Reset mode (RESET).

Select Execution pattern number by using the ▲ key or the ▼ key.

NOTE

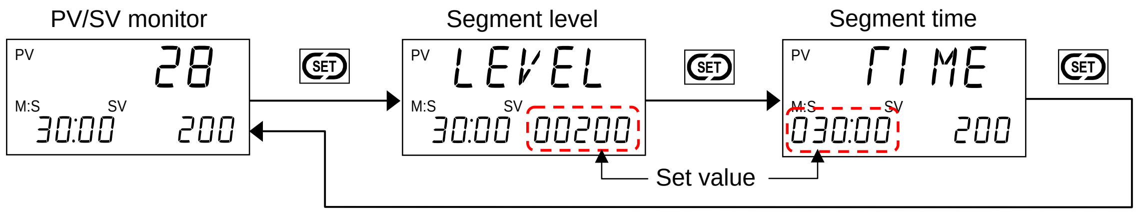
Execution pattern number can be selected only in the Reset mode (RESET).



Tag name setting will enable the display to show a tag name instead of the Pattern number.
Refer to **6.6.12 Tag function (P. 6-191)** for Tag name.

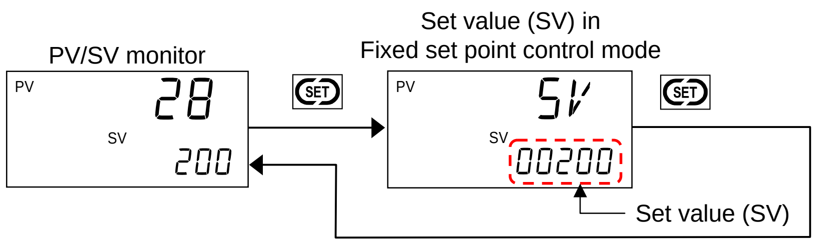
Program control mode (RUN)

Press the SET key in the Program control mode (RUN) to go to the setting display for the segment level and the segment time.



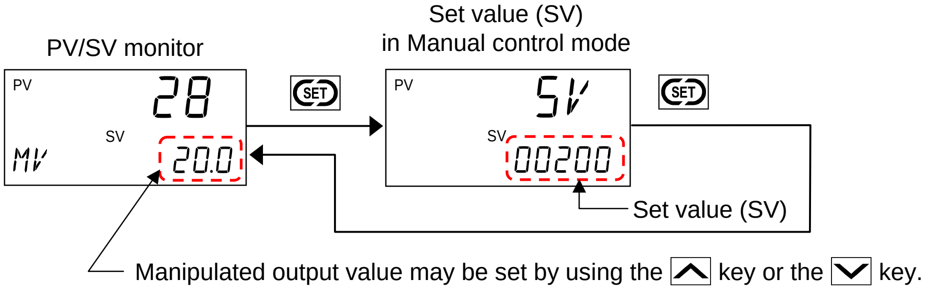
Fixed set point control mode (FIX)

Press the SET key in the Fixed set point control mode (FIX) to go to the Set value (SV) setting display.



Manual control mode (MAN)

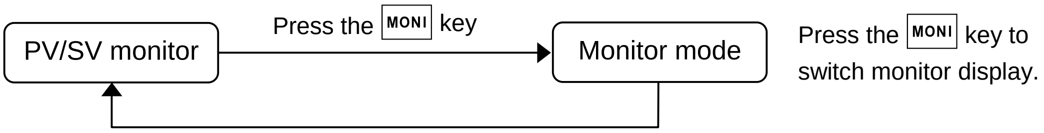
Set Manipulated output value by using the UP key or the DOWN key at the PV/SV monitor display in the Manual control mode (MAN). Press the SET key to go to the Set value (SV) setting display in the Manual control mode.



The Set value (SV) set in the previous mode is taken over when switching to the Manual control mode. However, the SV being changed in the Manual control mode is not affected when changing to the other modes.

■ Monitor mode

The contents of the monitor display are same in any operation mode (RESET, RUN, FIX, MAN).



Press the direct key (RUN, FIX, MAN or RESET) of the operation mode in progress to go back to the PV/SV monitor display from monitor screens.

☞ Refer to P. 4-14 to switch parameter setting display.

● Parameter list

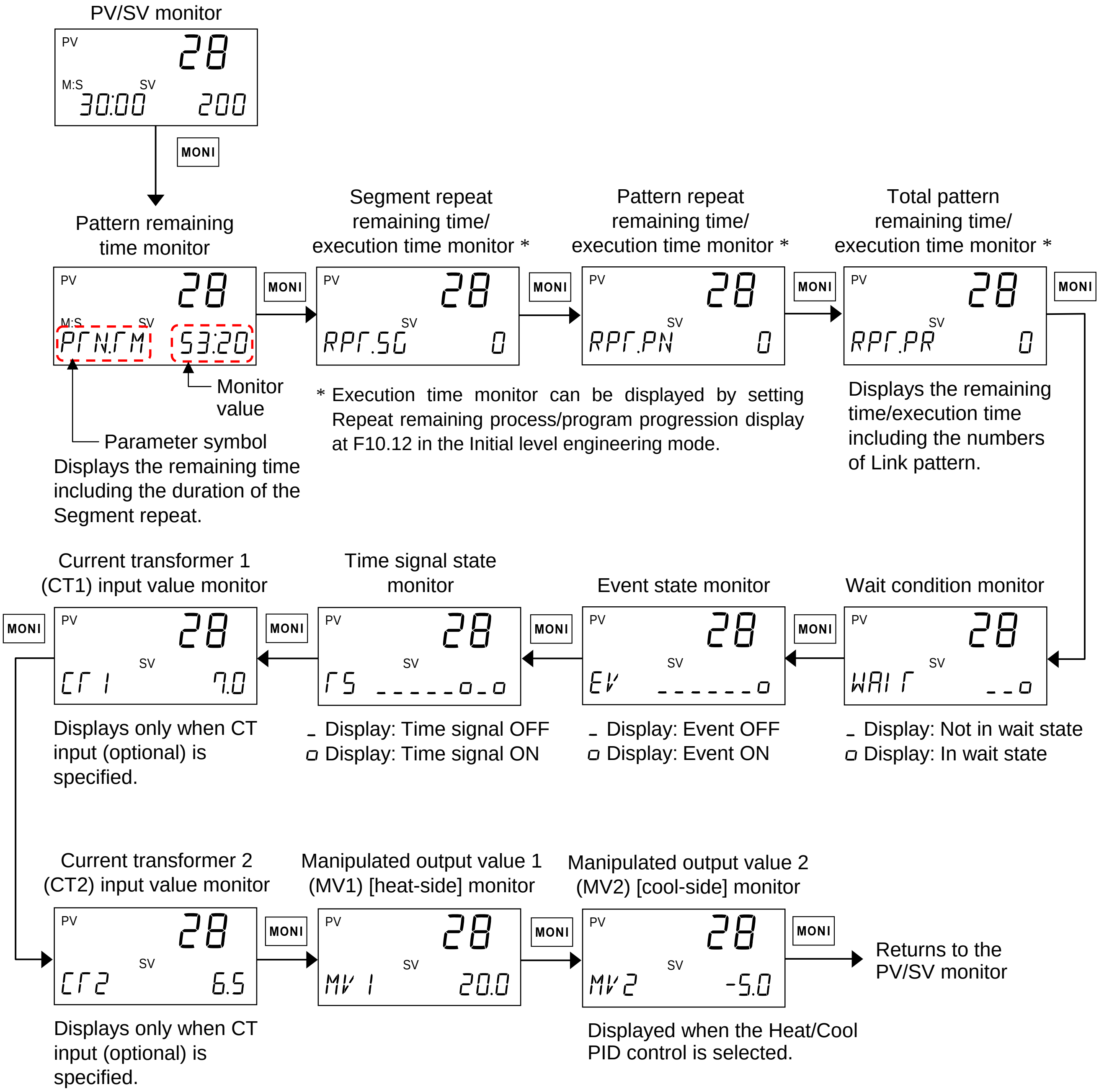
Name	Symbol	Data range	Factory set value
Pattern remaining time monitor	PTN.TM	From 0:00 to 999:59 (Hour: Minute), or from 0:00 to 999:59 (Minute: Second)	—
Segment repeat remaining time/ execution time monitor [1]	RPT.SG	0 to 9999 times	—
Pattern repeat remaining time/ execution time monitor [1]	RPT.PN	0 to 10000 times 10000: No limit	—
Total pattern remaining time/ execution time monitor [1]	RPT.PR	0 to 10000 times 10000: No limit	—
Wait condition monitor	WAIT	_ Display: Not in wait state □ Display: In wait state □□□ ← Value at SV display Zone wait of the controller Zone wait of the slave Zone wait of the DI	—
Event state monitor	EV	_ Display: OFF □ Display: ON □□□□□□□ ← Value at SV display Event 1 Event 2 Event 3 Event 4 HBA1 HBA2 LBA	—
Time signal state monitor	TS	_ Display: OFF □ Display: ON □□□□□□□□ ← Value at SV display Time signal 1 Time signal 2 Time signal 3 Time signal 4 Time signal 5 Time signal 6 Time signal 7 Time signal 8	—
Current transformer 1 (CT1) input value monitor [2]	CT1	0.0 to 100.0 A	—
Current transformer 2 (CT2) input value monitor [2]	CT2	0.0 to 100.0 A	—
Manipulated output value 1 (MV1) [heat-side] monitor	MV1	PID control, Heat/Cool PID control: −5.0 to +105.0 % Position proportioning PID control: 0.0 to 100.0 % (Displays the FBR input value)	—
Manipulated output value 2 (MV2) [cool-side] monitor [3]	MV2	−5.0 to +105.0 %	—

[1] Execution time monitor can be displayed by setting Repeat remaining process/program progression display at F10.12 in the Initial level engineering mode.
[2] Displays only when CT input (optional) is specified. CT input value monitor displays CT input value as 1.1 times the average current. CT input value is displayed for both time proportional output and current output. For current output, the error of measurement between actual current value and monitor display value becomes large when load factor is other than 0 % or 100 %.
[3] Displayed when the Heat/Cool PID control is selected.

● Scrolling through parameters

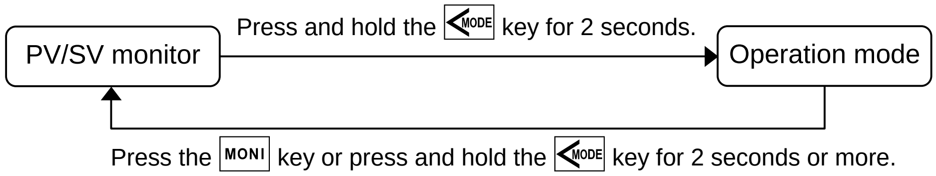
Press the MONI key to switch monitor screen.

- Press the SET key at the monitor screen to go to the SV setting mode of the operation mode in progress.
- The contents of the monitor display are same in any operation mode (RESET, RUN, FIX, MAN).
- Press the direct key (RUN, FIX, MAN or RESET) of the operation mode in progress to go back to the PV/SV monitor display from monitor screens.
- Parameters will not be displayed if the relevant function is not activated or no relevant specification is selected when ordering.



4.5.2 Operation mode

Set parameters such as PID/AT, and the operation mode (Program control, Fixed set point control, Manual control, or RESET).



- Press the SET key to switch operation screen.
- Press the STEP R.SET key to go back to the previous display.
- Press the STEP R.SET key while pressing the SET key to go back to the first parameter setting display (Operation mode transfer).

☞ Refer to P. 4-16 to switch parameter setting display.

■ Parameter list

Name	Symbol	Data range	Factory set value
Operation mode transfer	ModE	RESET (Reset mode) PROG (Program control mode) FIX (Fixed set point control mode) MAN (Manual control mode)	RESET
Step function	STEP	ON: Forward to the next segment in progress. Turns OFF automatically when the Step function is completed.	OFF
Search function	SARCH	ON: Search start OFF: Search stop Turns OFF automatically when the Search function is completed.	OFF
PID/AT transfer	ATU	PID: PID control AT: Autotuning (AT) start When the AT is finished, the control will automatically returns to "PID control."	PID
Autotuning (AT) with learning function	ATT	ON: Autotuning (AT) with learning start OFF: Autotuning (AT) with learning stop Turns OFF automatically when the AT with learning function is completed.	OFF
Interlock release	ILR	ON: Interlock OFF: Interlock release	OFF
Set data lock	LoCK	ON: Set data lock OFF: Set data unlock	OFF

[1] Operative only in the Program control mode (RUN) [Not available when the operation is in HOLD state or RUN of the Digital input (DI) is ON (contact closed).]

[2] Operative when the operation is in the Program control mode (RUN) and in the HOLD state [Not available during Autotuning (AT).]

[3] Operative when the operation is in the Program control mode (RUN) or in the Fixed set point control mode (FIX).

[4] Operative only in the Reset mode (RESET)

■ Parameter switching

- Press and hold the MODE key for 2 seconds at PV/SV monitor screen until Operation mode is displayed.
- Press the SET key to switch operation screen.

It is possible to switch displays by using the MODE key instead of the SET key.

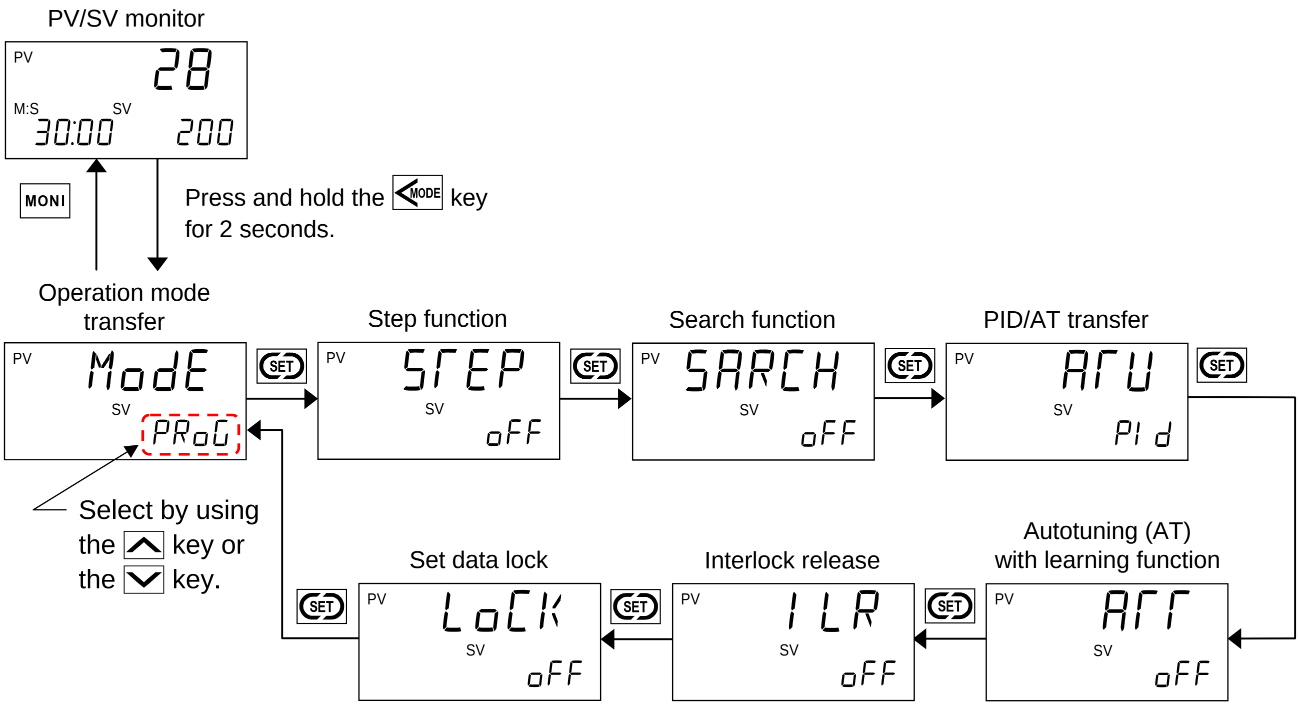
Press the MONI key to go back to the PV/SV monitor.

Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the Operation mode transfer display.

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

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



☞ Refer to **6. FUNCTION AND SETTING PROCEDURE (P. 6-1)** for the setting procedure of each function.

4.5.3 Parameter setting mode

Parameters are classified into 12 setting blocks such as Program setting block, PID memory group setting block and Event memory group setting block in the Parameter setting mode. Setting block may be switched by using the ∧ key or the ∨ key.

■ Setting type for Program pattern

Partial setting or Batch setting is selectable for setting type of Program pattern in the Parameter setting mode. To select the type, go to F80.03 in the Engineering mode.

☞ For parameter of the Engineering mode, refer to **4.5.5 Engineering mode (P. 4-33)**.

● Partial setting type (Factory set value)

Program setting block

Segment level
Segment time
Parameters for pattern

Program memory group setting block

PID memory group number
Event memory group number
Wait memory group number
Segment signal *

Partial setting type consists of Program setting block and Program memory group setting block. Setting block varies based on the parameters.

* Settable only when Segment signal is specified.
Validates when specifying Segment signal function.

● Batch setting type

Program setting block

Segment level
Segment time
Parameters for pattern
PID memory group number
Event memory group number
Wait memory group number
Segment signal *

Batch setting type consists of Program setting block where all parameters related to Program pattern can be set.

* Settable only when Segment signal is specified.
Validates when specifying Segment signal function.

☞ Refer to P. 4-18 to 4-22 for Parameter list of the Partial setting type and P. 4-23 to 4-26 for parameter switching.

☞ Refer to P. 4-27 for Parameter list of the Batch setting type and P. 4-28 to 4-29 for parameter switching.

■ Parameter list [Partial setting type]

PV/SV monitor → Press and hold the SET key for 2 seconds. → Parameter setting mode

Parameter setting mode → Press the MONI key or press and hold the MODE key for 2 seconds or more. → PV/SV monitor

- Press the SET key to switch setting screen.
- Setting block may be switched by using the UP key or the DOWN key.
- Press the STEP R.SET key to go back to the previous display.
- Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.

☞ For parameter switching, refer to P. 4-23 to 4-26.

Name	Symbol	Data range	Factory set value
Program setting block (PRoG)			
Setting pattern number	PTN.No	1 to 99 (Within the maximum pattern number)	1
Segment level	LEVEL	Setting limiter low to Setting limiter high	0
Segment time	TIME	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute
Segment repeat start/end number	ST→Ed	Start number: 1 to 99 End number: 1 to 99 Within the maximum segment number	1
Segment repeat execution time	RPT.SG	1 to 9999 times 1: No segment repeat	1
Pattern repeat execution time	RPT.PN	1 to 10000 times 1: No pattern repeat 10000: No limit	1
Link pattern number	LNK.PN	0 to 99 (Within the maximum pattern number) 0: No pattern link	0
Pattern end output duration	ENd.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second) Output remains ON at 0:00 (Hour: Minute or Minute: Second)	0 hour 00 minute
Time signal memory group number	TS.GR	0 to 16 0: No assignment	1
Output program memory group number	P.MV.GR	0 to [128/Maximum number of segments] Up to 99 0: No assignment	0
Program memory group setting block (PR.MEM)			
Setting pattern number	PTN.No	1 to 99 (Within the maximum pattern number)	1
PID memory group number	PId.GR	0 to 8 0: Level PID	0
Event memory group number	EV.GR	0 to 8 0: Event OFF	1
Wait memory group number	WT.GR	0 to 8 0: Wait OFF	1

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Name	Symbol	Data range	Factory set value
Segment signal [1]	SIGNL	0: OFF 1: ON 00000000 ← Value at SV display Segment signal 1 Segment signal 2 Segment signal 3 Segment signal 4 Segment signal 5 Segment signal 6 Segment signal 7 Segment signal 8	00000000
PID memory group setting block (PId)			
PID memory group number	PId.GR	1 to 8	1
Proportional band [heat-side]	P	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span 0 (0.0, 0.00): ON/OFF action	TC/RTD: 30 V/I: 3.0
Integral time [heat-side]	I	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	240
Derivative time [heat-side]	d	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60
Control response parameter	rPT	0: Slow 1: Medium 2: Fast P action and PD action, the control response is fixed at 2 (Fast).	2
Proportional band [cool-side] [2]	Pc	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span	TC/RTD: 30 V/I: 3.0
Integral time [cool-side] [2]	Ic	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action Varies with the setting of the Integral/Derivative time decimal point position selection.	240
Derivative time [cool-side] [2]	dc	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60
Overlap/Deadband [2]	db	TC/RTD inputs: –Input span to +Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: –100.0 to +100.0 % Minus (–) setting results in Overlap. However, the overlapping range is within the proportional range.	0
Open/Close output neutral zone [3]	Ydb	0.1 to 20.0 %	2.0
Manual reset [4]	MR	–100.0 to +100.0 %	0.0
Output limiter high (MV1)	oLH	Output limiter low (MV1) to 105.0 %	105.0
Output limiter low (MV1)	oLL	–5.0 % to Output limiter high (MV1)	–5.0

[1] Displayed when the Segment signal type is selected.
[2] Displayed when the Heat/Cool PID control is selected.
[3] Displayed when the Position proportioning PID control is selected.
[4] Displayed when the P (Proportional) action is selected.

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Name	Symbol	Data range	Factory set value
Output limiter high (MV2) [1]	oLH2	Output limiter low (MV2) to 105.0 %	105.0
Output limiter low (MV2) [1]	oLL2	−5.0 % to Output limiter high (MV2)	−5.0
ON/OFF action differential gap (upper) [2]	oHH	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of Input span	TC/RTD: 1 V/I: 0.1
ON/OFF action differential gap (lower) [2]	oHL		TC/RTD: 1 V/I: 0.1
Control loop break alarm (LBA) time [3]	LbA	0 to 7200 seconds 0: Unused	480
LBA deadband (LBD) [3]	Lbd	0 to Input span	0
Event memory group setting block (EVENT)			
Event memory group number	EV.GR	1 to 8	1
Event 1 set value (EV1)	EV 1	Deviation: −Input span to +Input span Process and set value: Input range low to Input range high Manipulated output value (MV1 or MV2): −5.0 to +105.0 %	50
Event 1 set value (EV1) [high] [4]		−Input span to +Input span	50
Event 1 set value (EV1') [low] [4]	EV 1'		−50
Event 2 set value (EV2)	EV 2	The data range is same as Event 1 set value (EV1).	50
Event 2 set value (EV2) [high] [4]		The data range is same as Event 1 set value (EV1) [high].	50
Event 2 set value (EV2') [low] [4]	EV 2'	The data range is same as Event 1 set value (EV1') [low].	−50
Event 3 set value (EV3)	EV 3	The data range is same as Event 1 set value (EV1).	50
Event 3 set value (EV3) [high] [4]		The data range is same as Event 1 set value (EV1) [high].	50
Event 3 set value (EV3') [low] [4]	EV 3'	The data range is same as Event 1 set value (EV1') [low].	−50
Event 4 set value (EV4)	EV 4	The data range is same as Event 1 set value (EV1).	50
Event 4 set value (EV4) [high] [4]		The data range is same as Event 1 set value (EV1) [high].	50
Event 4 set value (EV4') [low] [4]	EV 4'	The data range is same as Event 1 set value (EV1') [low].	−50
Wait memory group setting block (WAIT)			
Wait memory group number	WT.GR	1 to 8	1
Wait zone high	ZoNE.H	TC/RTD inputs: 0 (0.0, 0.00) to 200 (200.0, 200.00) (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 20.0 % of Input span 0 (0.0, 0.00): Wait zone high becomes OFF	0
Wait zone low	ZoNE.L	TC/RTD inputs: −200 (−200.0, −199.99) to 0 (0.0, 0.00) (Unit: °C [°F]) Voltage (V)/Current (I) inputs: −20.0 to 0.0 % of Input span 0 (0.0, 0.00): Wait zone low becomes OFF	0
Wait release trigger selection	RE.TRG	0: Invalidate 1: Validate 00000 ← Value at SV display Zone wait 1 (the controller) Zone wait 2 (all slave controllers) Wait release by digital input (DI) Unused	00001

[1] Displayed when the Heat/Cool PID control is selected.
[2] Displays when Proportional band [heat-side] is set to “0.”
[3] Displays when LBA is specified.
[4] This parameter displays when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).

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Name	Symbol	Data range	Factory set value
Wait time-out set value	TM.OUT	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second) 0:00 (Hour: Minute or Minute: Second): Unused	0 hour 00 minute
Time signal memory group setting block (TM.SIG)			
Time signal memory group number	TS.GR	1 to 16	1
Time signal output assignment	O1.OUT	1 to 8: Time signal 1 to 8 0: No assignment	0
Start segment of time signal	O1.S.SN	1 to 99 Within the maximum segment number.	1
Time signal start time	O1.S.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute
End segment of time signal	O1.E.SN	1 to 99 Within the maximum segment number.	1
Time signal end time	O1.E.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute
Output program memory group setting block (PRG.MV)			
Output program memory group number [a]	P.MV.GR	1 to [128/Maximum number of segments] Up to 99	1
Output program value 1 [a]	P.MV1	–5.0 to +105.0 %	–5.0
Output program value 2 [b]	P.MV2	–5.0 to +105.0 %	–5.0
Output program value 3 [c]	P.MV3	–5.0 to +105.0 %	–5.0
Level PID setting block (LV.PID)			
Level PID setting 1	LEVL.1	Input range low to Level PID setting 2	Input range high
Level PID setting 2	LEVL.2	Level PID setting 1 to Level PID setting 3	Input range high
Level PID setting 3	LEVL.3	Level PID setting 2 to Level PID setting 4	Input range high
Level PID setting 4	LEVL.4	Level PID setting 3 to Level PID setting 5	Input range high
Level PID setting 5	LEVL.5	Level PID setting 4 to Level PID setting 6	Input range high
Level PID setting 6	LEVL.6	Level PID setting 5 to Level PID setting 7	Input range high
Level PID setting 7	LEVL.7	Level PID setting 6 to Input range high	Input range high
Reset mode setting block (RESET)			
Set value (SV) in Reset mode	SV	Setting limiter low to Setting limiter high	0
Manipulated output value 1 (MV1) in Reset mode	MV1	–5.0 to +105.0 %	–5.0
Manipulated output value 2 (MV2) in Reset mode	MV2	–5.0 to +105.0 %	–5.0
Event memory group number in Reset mode	EV.GR	0 to 8 0: Event OFF	1
Fixed set point control mode setting block (FIX)			
Set value (SV) in Fixed set point control mode	SV	Setting limiter low to Setting limiter high	0
PID memory group number in Fixed set point control mode	PID.GR	0 to 8 0: Level PID	0
Event memory group number in Fixed set point control mode	EV.GR	0 to 8 0: Event OFF	1

[a] Displays when Output program value 1 is assigned to OUT1.
[b] Displays when Output program value 2 is assigned to OUT2.
[c] Displays when Output program value 3 is assigned to OUT3.

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Name	Symbol	Data range	Factory set value
Manual control mode setting block (MAN)			
PID memory group number in Manual control mode	PId.GR	0 to 8 0: Level PID	0
Event memory group number in Manual control mode	EV.GR	0 to 8 0: Event OFF	1
Editing block (EdIT)			
Pattern copy *	CoPY	Copy source number: 0 to 99 Copy destination number: 0 to 99 Within the maximum pattern number.	0
Data clear *	CLR	All set values in the Parameter setting mode will be initialized after setting 9999 and switching from NO to YES.	0

* Settable only in the Reset mode (RESET)

■ Parameter switching [Partial setting type]

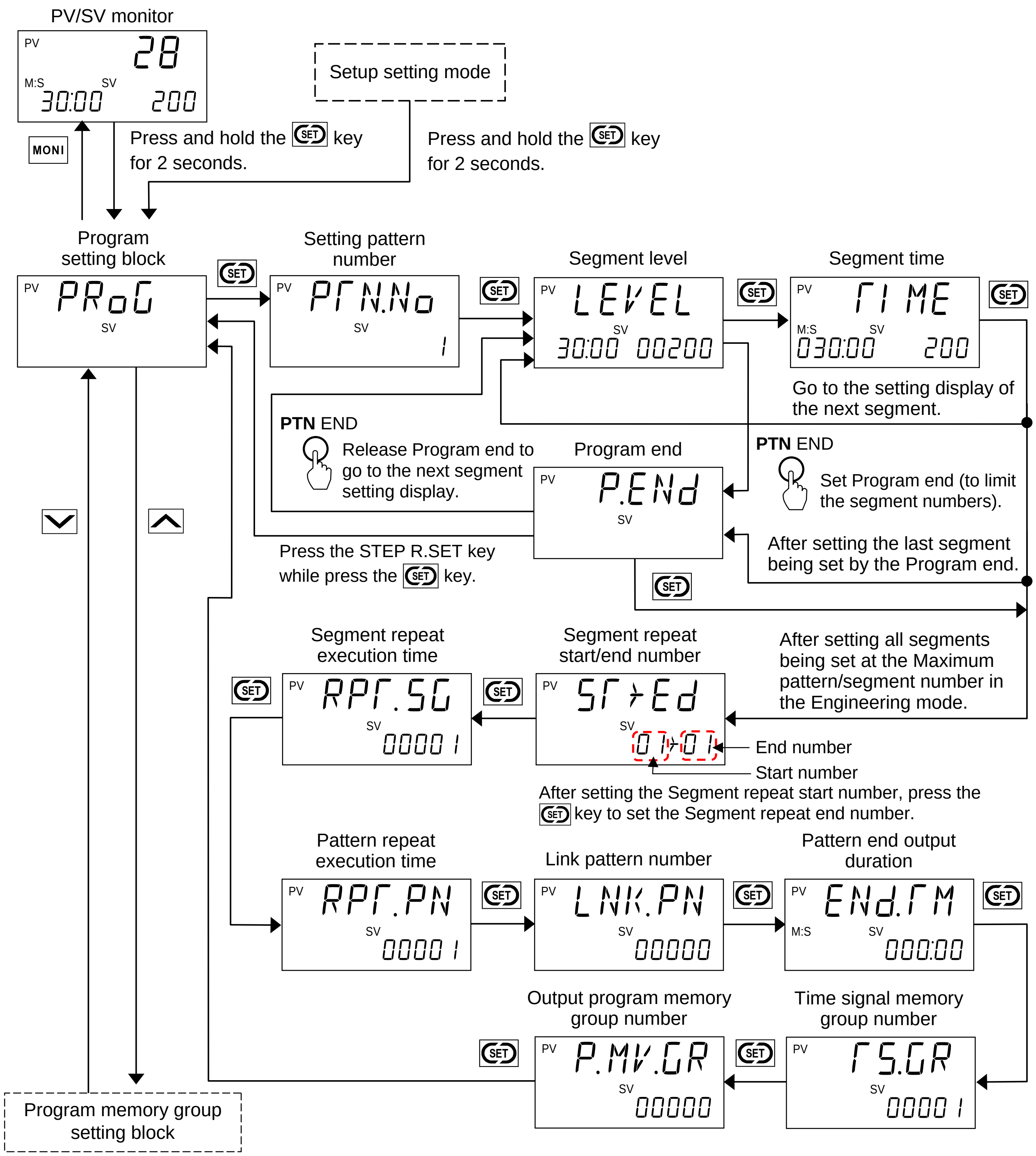
- Press and hold the SET key for 2 seconds at PV/SV monitor screen until Parameter setting mode is displayed.
- Press the SET key to switch operation screen.
- Switch setting block by using the UP key or the DOWN key.

Press the MONI key to go back to the PV/SV monitor.

Press the STEP R.SET key to go back to the previous display.

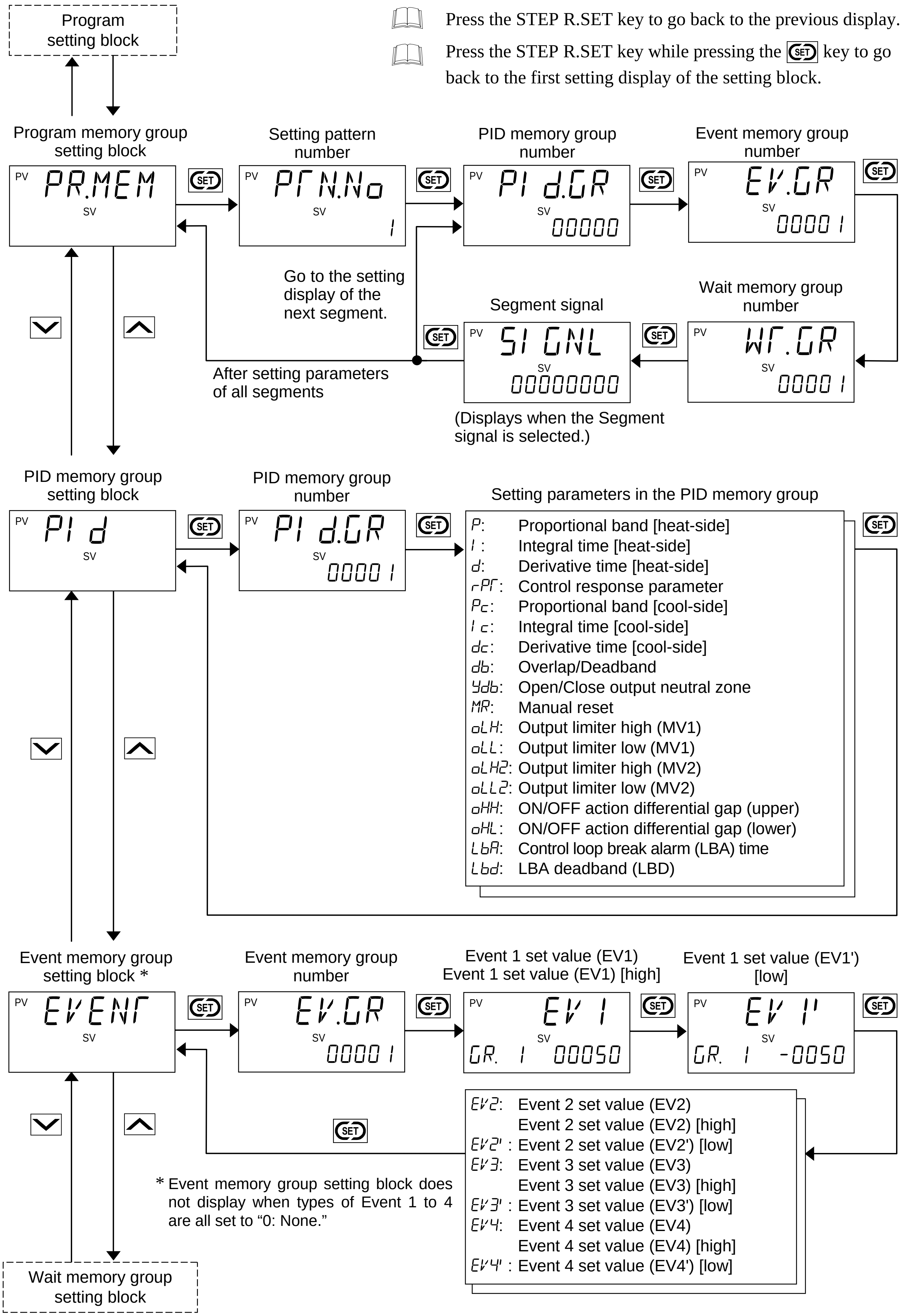
Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.

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



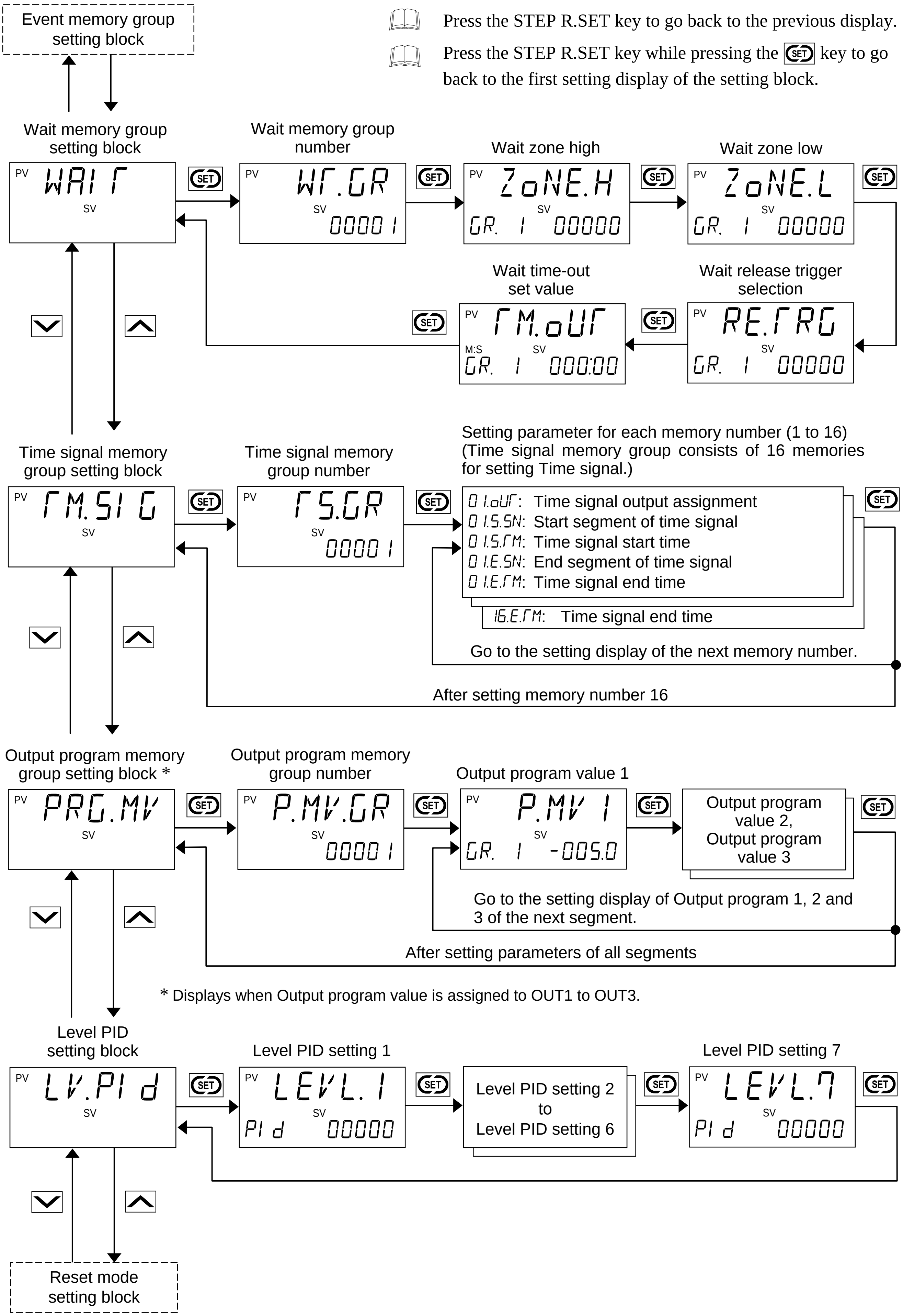
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.



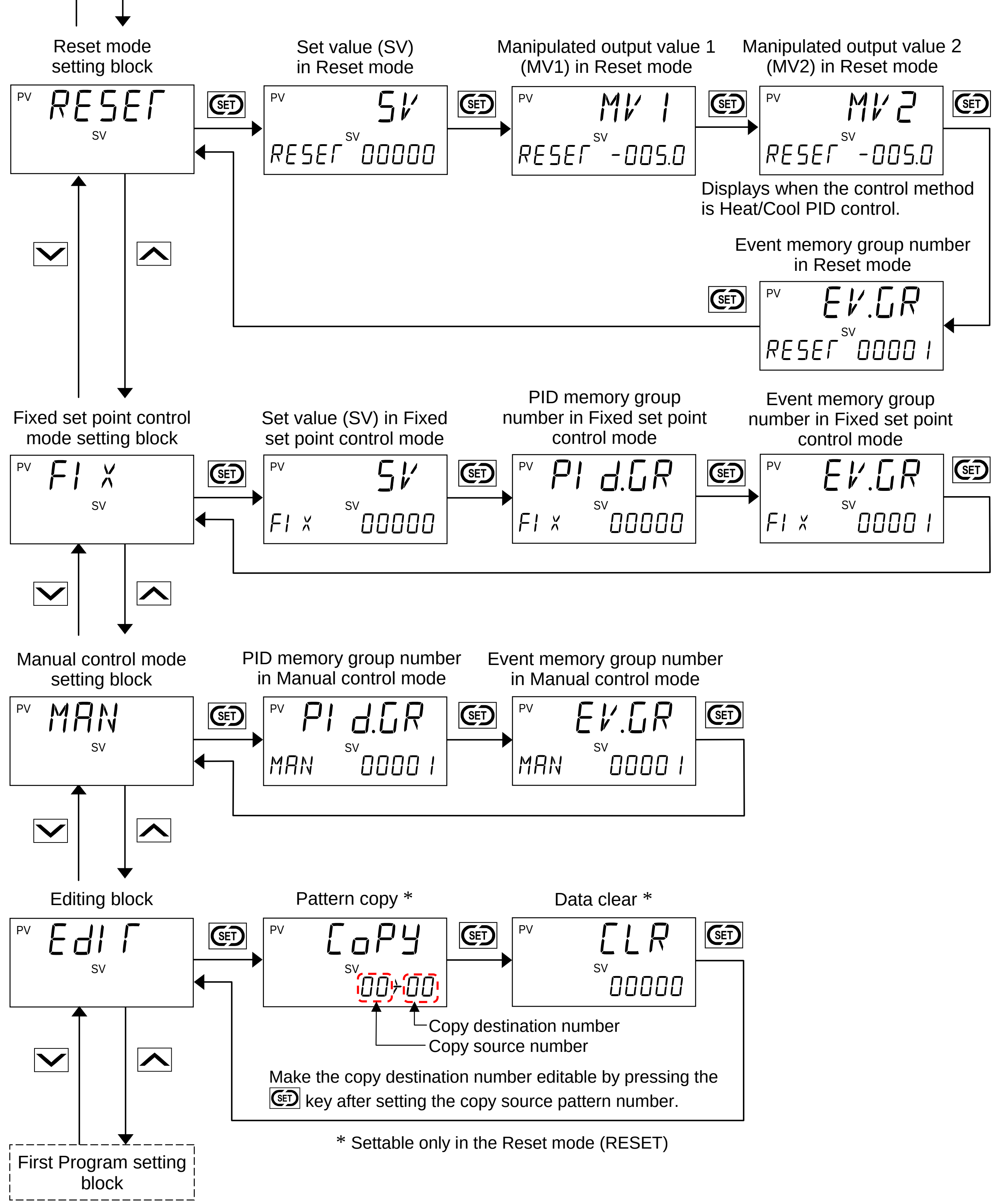
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.



Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.



Refer to **6. FUNCTION AND SETTING PROCEDURE (P. 6-1)** for the setting procedure of each function.

■ Parameter list [Batch setting type]

PV/SV monitor → Press and hold the SET key for 2 seconds. → Parameter setting mode

Parameter setting mode → Press the MONI key or press and hold the MODE key for 2 seconds or more. → PV/SV monitor

- Press the SET key to switch setting screen.
- Setting block may be switched by using the UP key or the DOWN key.
- Press the STEP R.SET key to go back to the previous display.
- Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.

☞ Refer to P. 4-28 and P. 4-29 to switch parameter setting display.

Name	Symbol	Data range	Factory set value
Program setting block (PRoG)			
Setting pattern number	PTN.No	1 to 99 (Within the maximum pattern number)	1
Segment level	LEVEL	Setting limiter low to Setting limiter high	0
Segment time	TIME	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute
PID memory group number	PId.GR	0 to 8 0: Level PID	0
Event memory group number	EV.GR	0 to 8 0: Event OFF	1
Wait memory group number	WT.GR	0 to 8 0: Wait OFF	1
Segment signal *	SIGNL	0: OFF 1: ON 00000000 ← Value at SV display Segment signal 1 Segment signal 2 Segment signal 3 Segment signal 4 Segment signal 5 Segment signal 6 Segment signal 7 Segment signal 8	00000000
Segment repeat start/end number	ST-Ed	Start number: 1 to 99 End number: 1 to 99 Within the maximum segment number.	1
Segment repeat execution time	RPT.SG	1 to 9999 times 1: No segment repeat	1
Pattern repeat execution time	RPT.PN	1 to 10000 times 1: No pattern repeat 10000: No limit	1
Link pattern number	LNK.PN	0 to 99 (Within the maximum pattern number) 0: No pattern link	0
Pattern end output duration	ENd.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second) Output remains ON at 0:00 (Hour: Minute or Minute: Second)	0 hour 00 minute
Time signal memory group number	TS.GR	0 to 16 0: No assignment	1
Output program memory group number	P.MV.GR	0 to [128/Maximum number of segments] Up to 99 0: No assignment	0
PID memory group setting block (PId)			
Refer to the parameter list of Partial setting type for the PID memory group setting block or the latter setting blocks of Batch setting type.			

* Displayed when the Segment signal type is selected.

■ Parameter switching [Batch setting type]

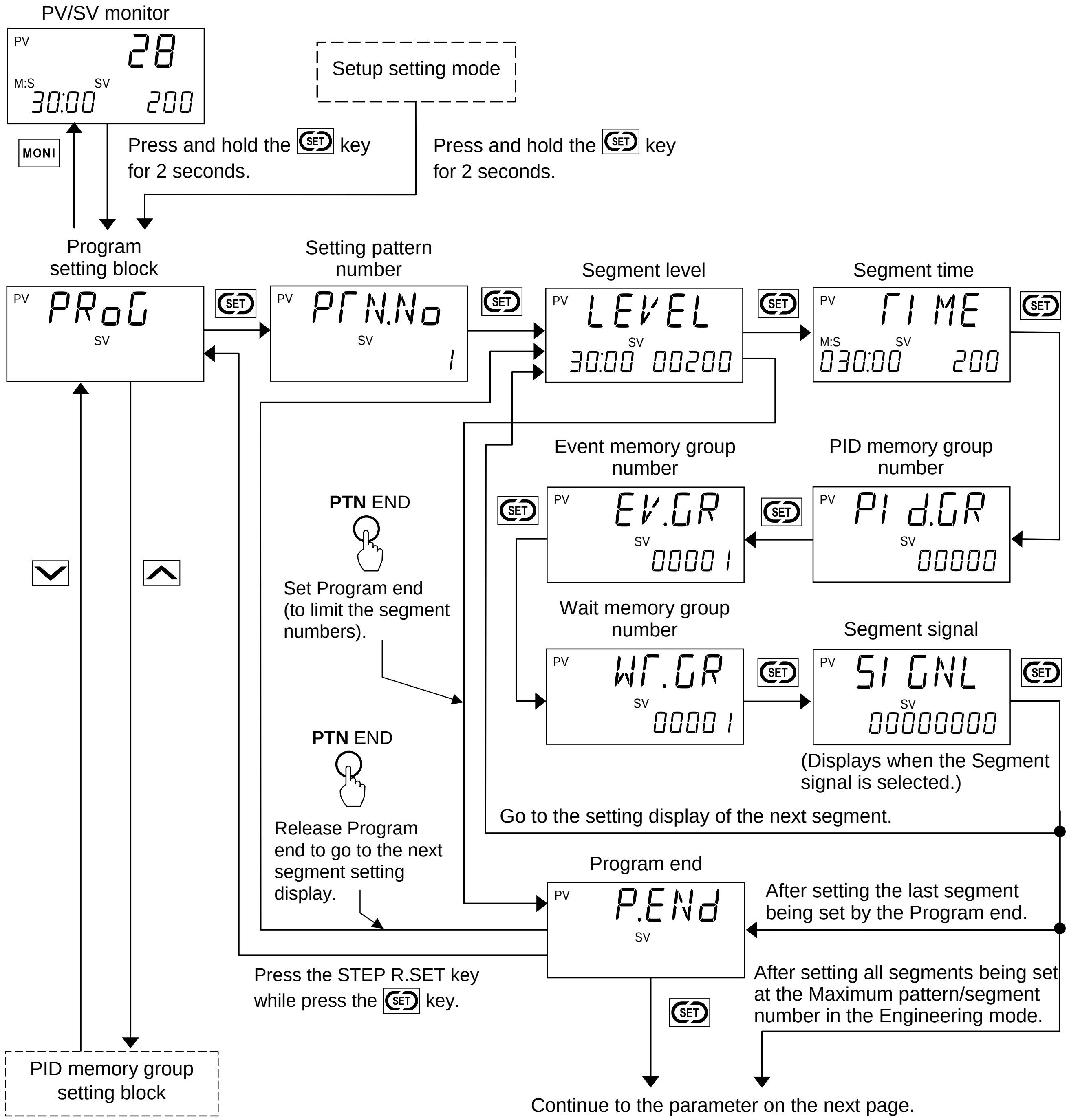
- To go to the Parameter setting mode, press and hold the SET key for 2 seconds at PV/SV monitor display.
- Press the SET key to switch operation screen.
- Switch setting block by using the UP key or the DOWN key.

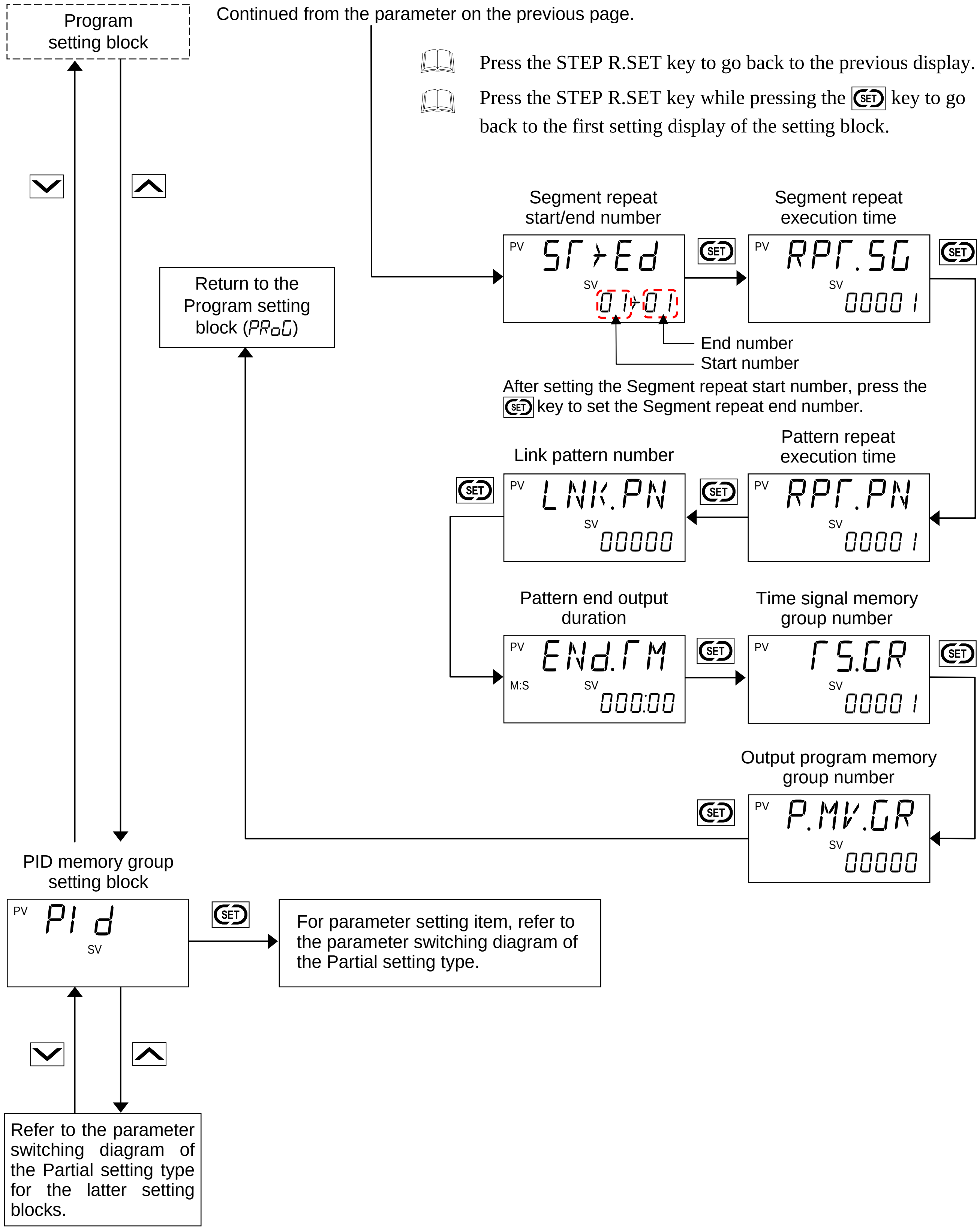
Press the MONI key to go back to the PV/SV monitor.

Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.

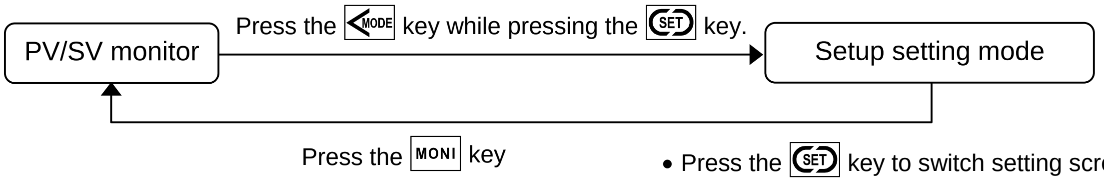
Display returns to the PV/SV monitor if no key operation is performed within 1 minute.




Program
setting block
Continued from the parameter on the previous page.
Press the STEP R.SET key to go back to the previous display.
Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the setting block.
Segment repeat
start/end number
SET
Segment repeat
execution time
SET
PV
SV
01↦01
RPT.SG
00001
End number
Start number
After setting the Segment repeat start number, press the SET key to set the Segment repeat end number.
Return to the
Program setting
block (PRoG)
Link pattern number
LNK.PN
00000
Pattern repeat
execution time
RPT.PN
00001
Pattern end output
duration
END.TM
M:S
000:00
Time signal memory
group number
TS.GR
00001
Output program memory
group number
P.MV.GR
00000
PID memory group
setting block
PId
For parameter setting item, refer to the parameter switching diagram of the Partial setting type.
Refer to the parameter switching diagram of the Partial setting type for the latter setting blocks.

4.5.4 Setup setting mode

Set parameters such as PV bias, Time proportional cycle time, Heater break alarm (HBA) set value and communication (optional).



- Press the SET key to switch setting screen.
- Press the STEP R.SET key to go back to the previous display.
- Press the STEP R.SET key while pressing the SET key to go back to the first parameter setting display (PV bias).

Refer to P. 4-32 to switch parameter setting display.

Some parameters in the Setup setting mode may be set in the Engineering mode.

■ Parameter list

Name	Symbol	Data range	Factory set value
PV bias	Pb	–Input span to +Input span	0
PV digital filter	dF	0.0 to 100.0 seconds 0.0: Unused	0.0
PV ratio	PR	1.000 to 9.999	1.000
PV low input cut-off [1]	L-CUT	0.00 to 25.00 % of Input span	0.00
OUT1 proportional cycle time [2]	T1	0.1 to 100.0 seconds M: Relay contact output T: Triac output V: Voltage pulse output D: Open collector output Relay contact output and Triac output cannot be selected for OUT3.	M: 20.0 V/T/D: 2.0
OUT2 proportional cycle time [2]	T2		M: 20.0 V/T/D: 2.0 Factory set value No output: 2.0
OUT3 proportional cycle time [2]	T3		V/D: 2.0 Factory set value No output: 2.0
Heater break alarm 1 (HBA1) set value [3]	HbA1	CTL-6-P-N: 0.0 to 30.0 A CTL-12-S56-10L-N: 0.0 to 100.0 A 0.0: Unused (Current value monitoring still available)	0.0
Heater break alarm 2 (HBA2) set value [3]	HbA2		0.0
SV selection at Program start	ST.SV	0: Start with the Set value (SV) in the Reset mode. 1: PV start 1 [Time fixed type] 2: PV start 2 [Time saving & ramp holding type] 3: PV start 3 [Time saving & level searching type/with HOLD function at start] 4: PV start 4 [Time saving & level searching type/without HOLD function at start]	2

[1] Displayed when the Square root extraction is selected.
[2] Displayed when the time-proportional control output (relay, voltage pulse, triac or open collector output) is selected.
[3] Displays only when CT input (optional) is specified.

Continued on the next page.

Continued from the previous page.

<table>
<tr><th>Name</th><th>Symbol</th><th>Data range</th><th>Factory set value</th></tr>
<tr><td>Control action at Pattern end</td><td>ENd.P</td><td>PID control, Heat/Cool PID control or
Position proportioning PID control (With FBR input):
0: Control continued 1: Control stop
Setting is still effective when using Output program function.
Position proportioning PID control (When there is no FBR input or the FBR input is break):
0: Control continued
1: Open-side output OFF, Close-side output OFF
2: Open-side output OFF, Close-side output ON
3: Open-side output ON, Close-side output OFF</td><td>0</td></tr>
<tr><td>Device address 1</td><td>Add 1</td><td>0 to 99</td><td>RKC communication: 0
Modbus: 1</td></tr>
<tr><td>Communication speed 1</td><td>bPS 1</td><td>2400: 2400 bps
4800: 4800 bps
9600: 9600 bps
19200: 19200 bps
38400: 38400 bps
57600: 57600 bps</td><td>19200</td></tr>
<tr><td>Data bit configuration 1</td><td>bIT 1</td><td><table>
<tr><th>Symbol</th><th>Data bit</th><th>Parity bit</th><th>Stop bit</th></tr>
<tr><td>8N1 *</td><td>8 bit</td><td>Without</td><td>1 bit</td></tr>
<tr><td>8N2 *</td><td>8 bit</td><td>Without</td><td>2 bit</td></tr>
<tr><td>8E1 *</td><td>8 bit</td><td>Even</td><td>1 bit</td></tr>
<tr><td>8E2 *</td><td>8 bit</td><td>Even</td><td>2 bit</td></tr>
<tr><td>8o1</td><td>8 bit</td><td>Odd</td><td>1 bit</td></tr>
<tr><td>8o2</td><td>8 bit</td><td>Odd</td><td>2 bit</td></tr>
<tr><td>7N1</td><td>7 bit</td><td>Without</td><td>1 bit</td></tr>
<tr><td>7N2</td><td>7 bit</td><td>Without</td><td>2 bit</td></tr>
<tr><td>7E1</td><td>7 bit</td><td>Even</td><td>1 bit</td></tr>
<tr><td>7E2</td><td>7 bit</td><td>Even</td><td>2 bit</td></tr>
<tr><td>7o1</td><td>7 bit</td><td>Odd</td><td>1 bit</td></tr>
<tr><td>7o2</td><td>7 bit</td><td>Odd</td><td>2 bit</td></tr>
</table>* Available for only Modbus</td><td>8N1</td></tr>
<tr><td>Interval time 1</td><td>INT 1</td><td>0 to 250 ms</td><td>10</td></tr>
<tr><td>Device address 2</td><td>Add2</td><td>0 to 99</td><td>0</td></tr>
<tr><td>Communication speed 2</td><td>bPS2</td><td>9600: 9600 bps
19200: 19200 bps
38400: 38400 bps</td><td>19200</td></tr>
</table>

[a] Displays only when Communication 1 (optional) is specified.
[b] Displays only when Communication 2 (optional) is specified.

■ Parameter switching

- Press the MODE key while pressing the SET key at PV/SV monitor screen until Setup setting mode is displayed.
- Press the SET key to switch operation screen.

Some parameters in the Setup setting mode may be set in the Engineering mode.

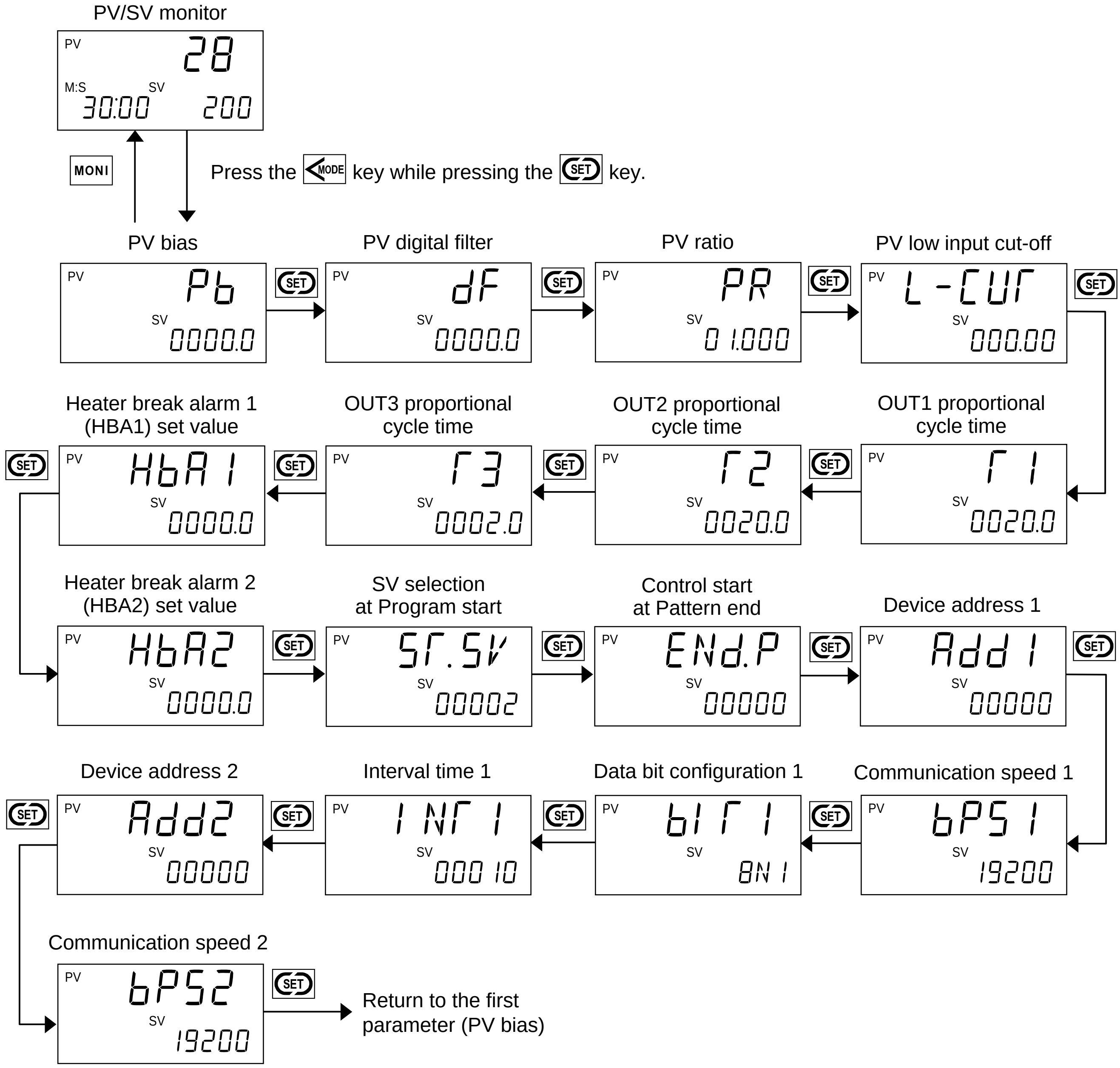
Press the MONI key to go back to the PV/SV monitor.

Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first parameter setting display (PV bias).

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

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



Refer to **6. FUNCTION AND SETTING PROCEDURE (P. 6-1)** for the setting procedure of each function.

4.5.5 Engineering mode

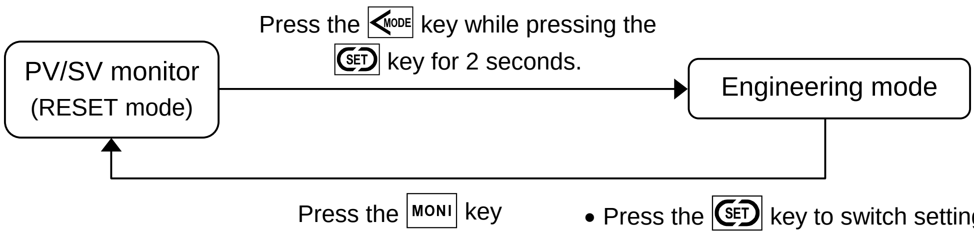
Parameters are classified into 23 function blocks. Initialize the parameters related to input, output, control, the Event type etc.

⚠ WARNING

Parameters in the Engineering mode (F10 to F80) 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 the Engineering mode are only available for monitoring in the RUN mode, the FIX mode and the MAN mode. Switch to the RESET mode to set the parameters. It is possible to set parameters in the function block 10 (F10) and the function block 11 (F11) in the RUN mode, the FIX mode and the MAN mode.



- Press the SET key to switch setting screen.
- Function blocks may be switched by using the UP key or the DOWN key.
- Press the STEP R.SET key to go back to the previous display.
- Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.

☞ For parameter switching, refer to P. 4-45 to 4-50.

■ Parameter list

Name	Symbol	Data range	Factory set value
Function block 10 (F10.01 to F10.11)			
PV flashing display at input error	dSoP	0: Flashing at input error 1: No flashing at input error	0
Dot monitor type	ddΓP	0: Program pattern type 1: Output bar graph type	0
Dot monitor scale high	dSCH	Dot monitor low to Maximum value of the selected input range Validate the Dot monitor type for the Program pattern type.	Input range high
Dot monitor scale low	dSCL	Minimum value of the selected input range to Dot monitor high Validate the Dot monitor type for the Program pattern type.	Input range low
ALM lamp light condition 1	ALC1	0: No lighting 1: Lighting 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 Unused	1111

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Name	Symbol	Data range	Factory set value
ALM lamp light condition 2	ALC2	0: No lighting 1: Lighting 00000 ← Value at SV display HBA1 HBA2 LBA Self-diagnostic error Unused	0011
ALM lamp light condition 3	ALC3	0: No lighting 1: Lighting 00000 ← Value at SV display FAIL Host communication error Intercontroller communication error Unused	000
Dot monitor at ALM lamp light	ddEV	0: Normal display 1: Red flashing display	0
TS lamp light condition 1	TSC1	0: No lighting 1: Lighting 00000 ← Value at SV display TS1 TS2 TS3 TS4 Unused	1111
TS lamp light condition 2	TSC2	0: No lighting 1: Lighting 00000 ← Value at SV display TS5 TS6 TS7 TS8 Unused	1111
Power saving mode duration	oFFTM	0 to 60 minutes (0: Lights at all times)	0
Function block 11 (F11.01 to F11.06)			
RESET key type	KTYP1	0: Invalid 1: Press once 2: Press twice 3: Press and hold Key type is not available for the PTN END key.	1
RUN key type	KTYP2		1
FIX key type	KTYP3		1
MAN key type	KTYP4		1
HOLD key type	KTYP5		1
STEP key type	KTYP6		3
Function block 21 (F21.01 to F21.15)			
Input type	INP	Voltage (low) input group 0: TC input K 1: TC input J 2: TC input R 3: TC input S 4: TC input B 5: TC input E 6: TC input N 7: TC input T 8: TC input W5Re/W26Re 9: TC input PL II 10: TC input U 11: TC input L 12: TC input PR40-20 13: RTD input Pt100 14: RTD input JPt100 22: Voltage (low) 0 to 10 mV DC 23: Voltage (low) 0 to 100 mV DC	Based on model code. When not specifying: 0

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Name	Symbol	Data range	Factory set value
Input type (A continuance)	INP	24: Voltage (low) 0 to 1 V DC 25: Voltage (low) −10 to +10 mV DC 26: Voltage (low) −100 to +100 mV DC 27: Voltage (low) −1 to +1 V DC Voltage (high) input group 17: Voltage (high) 0 to 10 V DC 18: Voltage (high) 0 to 5 V DC 19: Voltage (high) 1 to 5 V DC 20: Voltage (high) −5 to +5 V DC 21: Voltage (high) −10 to +10 V DC Current input group 15: Current 0 to 20 mA DC 16: Current 4 to 20 mA DC For the selecting proceduer, refer to the **6.1.1 Changing Measured value (PV) (P. 6-2)**.	Based on model code. When not specifying: 0
Display unit	UNIT	0: °C 1: °F	0
Decimal point position	PGdP	0: No decimal place 1: One decimal place 2: Two decimal place 3: Three decimal place 4: Four decimal place TC input: Only 0 or 1 can be set. RTD input: From 0 to 2 can be set. Voltage (V)/Current (I) input: From 0 to 4 can be set.	Based on model code. When not specifying: 1
Input range high	PGSH	TC/RTD inputs: Input range low to Maximum value of the selected input range Voltage (V)/Current (I) inputs: −19999 to +32000 Varies with the setting of the Decimal point position.	TC/RTD: Maximum value of the selected input range V/I: 100.0
Input range low	PGSL	TC/RTD inputs: Minimum value of the selected input range to Input range high Voltage (V)/Current (I) inputs: −19999 to +32000 Varies with the setting of the Decimal point position.	TC/RTD: Minimum value of the selected input range V/I: 0.0
Input error determination point (high)	PoV	Input range low − (5 % of Input span) to Input range high + (5 % of Input span) Maximum setting value of Input error determination point (high): 32767 (excluding decimal point) Minimum setting value of Input error determination point (low): −19999 (excluding decimal point)	Input range high + (5 % of Input span)
Input error determination point (low)	PUN		Input range low − (5 % of Input span)
Burnout direction	boS	0: Upscale 1: Downscale Valid only when the Voltage (low) input group selected.	0
Square root extraction	SQR	0: Unused 1: Used	0
Power supply frequency	PFRQ	0: 50 Hz 1: 60 Hz	0
Sampling cycle	SMP	0: 50 ms 1: 100 ms 2: 250 ms	1
PV bias *	Pb	−Input span to +Input span	0
PV digital filter *	dF	0.0 to 100.0 seconds 0.0: Unused	0.0
PV ratio *	PR	0.001 to 9.999	1.000
PV low input cut-off *	L-CUT	0.00 to 25.00 % of Input span	0.00

* It is not necessary to change the operation mode to the Reset mode (RESET) when setting the parameters. The parameters may also be set in the Setup setting mode.

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<table>
<tr><th>Name</th><th>Symbol</th><th>Data range</th><th>Factory set value</th></tr>
<tr><th colspan="4">Function block 23 (F23.01, F23.02)</th></tr>
<tr><td>Digital input (DI) assignment</td><td>dI SL</td><td>0 to 5
DI1 to DI6 (Optional)
<table>
<tr><th></th><th>DI1</th><th>DI2</th><th>DI3</th><th>DI4</th><th>DI5</th><th>DI6</th></tr>
<tr><td>0</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>PTN16</td><td>P.SET</td></tr>
<tr><td>1</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>PTN16</td><td>P.SET</td></tr>
<tr><td>2</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
<tr><td>3</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
<tr><td>4</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
<tr><td>5</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
</table>
DI7 to DI11 (Standard)
<table>
<tr><th></th><th>DI7</th><th>DI8</th><th>DI9</th><th>DI10</th><th>DI11</th></tr>
<tr><td>0</td><td>RESET</td><td>RUN</td><td>STEP</td><td>HOLD</td><td>PTN32</td></tr>
<tr><td>1</td><td>RESET</td><td>RUN</td><td>STEP</td><td>PTN32</td><td>PTN64</td></tr>
<tr><td>2</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>P.SET</td></tr>
<tr><td>3</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>PTN16</td></tr>
<tr><td>4</td><td>RESET</td><td>RUN</td><td>STEP</td><td>HOLD</td><td>D/R</td></tr>
<tr><td>5</td><td>RESET</td><td>RUN</td><td>STEP</td><td>HOLD</td><td>PTN_INC</td></tr>
</table>
PTN1 to PTN64: Pattern number switch
P.SET: Pattern set
WAIT: Wait state release
RESET, RUN: Switch Operation mode
HOLD, STEP: Conduct Hold action or Step action
D/R: Direct/Reverse action switching
PTN_INC: Pattern increment</td><td>Based on model code.

When not specifying: 0</td></tr>
<tr><td>Pattern input method of Digital input (DI)</td><td>dI PTN</td><td>0: Set Pattern number by using the Pattern set input.
Pattern number = Binary number of DI + 1
1: Set Pattern number by switching the contact input.
Pattern number = Binary number of DI + 1
2: Set Pattern number by using the Pattern set input.
Pattern number = Binary number of DI
3: Set Pattern number by switching the contact input.
Pattern number = Binary number of DI
For the switching method of Pattern number, refer to 6.1.9 Digital input (DI) (P. 6-14) and ■ Pattern number switch (P. 6-23).</td><td>0</td></tr>
<tr><th colspan="4">Function block 30 (F30.01 to F30.08)</th></tr>
<tr><td>OUT2, OUT3
Energized/De-energized</td><td>EXoUT</td><td>0: Energized 1: De-energized
00000 ← Value at SV display
OUT2
OUT3
Unused</td><td>00</td></tr>
<tr><td>DO1 to DO4
Energized/De-energized</td><td>EXdo1</td><td>0: Energized 1: De-energized
00000 ← Value at SV display
DO1
DO2
DO3
DO4
Unused</td><td>0000</td></tr>
<tr><td>DO5 to DO8
Energized/De-energized</td><td>EXdo2</td><td>0: Energized 1: De-energized
00000 ← Value at SV display
DO5
DO6
DO7
DO8
Unused</td><td>0000</td></tr>
</table>

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Name	Symbol	Data range	Factory set value
DO9 to DO12 Energized/De-energized	Exdo3	0: Energized 1: De-energized 00000 ← Value at SV display DO9 DO10 DO11 DO12 Unused	0000
Transmission output action in Reset mode	R.Ao	0: Action stop 1: Action continued 00000 ← Value at SV display OUT2 OUT3 Unused	00
Event action in Reset mode	R.EV	0: Action stop 1: Action continued 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 HBA1 or HBA2	00000
Transmission output action at Pattern end	P.Ed.Ao	0: Action stop 1: Action continued 00000 ← Value at SV display OUT2 OUT3 Unused Action of OUT1 stops or continues based on the setting of Control action selection at Pattern end.	00
Event action at Pattern end	P.Ed.EV	0: Action stop 1: Action continued 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 HBA1 or HBA2	00000
Function block 31 (F31.01)			
OUT1 assignment	LoGC1	0: Manipulated output value 1 (MV1) [For Control output] [PID control or Heat/Cool PID control: Heat-side output Position proportioning PID control: Open-side output] 1: Output program value 1 [For Control output or Transmission output (Voltage/Current output)]	0
Function block 32 (F32.01 to F32.03)			
OUT2 assignment	LoGC2	Voltage output or Current output Control output: 1, 2, 7 Transmission output: 3 to 7 0: None 1: Manipulated output value 1 (MV1) [Feedback resistance (FBR) input value when FBR input is specified with the Position proportioning PID control.] 2: Manipulated output value 2 (MV2) [Cool-side output at Heat/Cool PID control] 3: Measured value (PV) 4: Deviation value (DEV) 5: Set value (SV) monitor 6: Segment time (percentage basis) 7: Output program value 2 Manipulated output value (MV1 or MV2) may be used as a transmission output. Relay contact output, Voltage pulse output, Triac output or Open collector output Control output: 21, 22, 23 Event output: 24 to 53 20: None	Heat/Cool PID control: 22 or 2 (vary with output type) Position proportioning PID control: 22 Other control method: 0 or 20 (varies with output type) When the OUT2 is not provided: 0

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Name	Symbol	Data range	Factory set value
OUT2 assignment (A continuance)	LoGC2	21: Manipulated output value 1 (MV1) PID control or Heat/Cool PID control: Heat-side output [Feedback resistance (FBR) input value when FBR input is specified with the Position proportioning PID control.] 22: Manipulated output value 2 (MV2) Heat/Cool PID control: Cool-side output Position proportioning PID control: Close-side output 23: Output program value 2 24 to 31: Time signal 1 to Time signal 8 32 to 35: Event 1to Event 4 36: HBA1 37: HBA2 38: Logical *OR* of HBA1 and HBA2 39: LBA 40: Input error state 41: Program control mode (RUN) state 42: Fixed set point control mode (FIX) state 43: Manual control mode (MAN) state 44: Ramp state 45: Soak state 46: Hold state 47: Wait state 48: Pattern end signal 49: Autotuning (AT) state 50: FAIL state 51: Host communication error 52: Intercontroller communication error 53: Feedback resistance (FBR) input error	Heat/Cool PID control: 22 or 2 (vary with output type) Position proportioning PID control: 22 Other control method: 0 or 20 (varies with output type) When the OUT2 is not provided: 0
OUT2 transmission output scale high	AHS2	Varies with OUT2 assignment. Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): −Input span to +Input span (Within −19999 to +32000 [excluding decimal point]) Output program value 2: Fixed at 100.0 % (scaling is not available) Segment time (percentage basis): Fixed at 100.0 % (scaling is not available) When using Manipulated output value (MV1 or MV2) as a transmission output: Fixed at 100.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): + Input span Other: 100.0
OUT2 transmission output scale low	ALS2	Varies with OUT2 assignment. Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): −Input span to +Input span (Within −19999 to +32000 [excluding decimal point]) Output program value 2: Fixed at 0.0 % (scaling is not available) Segment time (percentage basis): Fixed at 0.0 % (scaling is not available) When using Manipulated output value (MV1 or MV2) as a transmission output: Fixed at 0.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): − Input span Other: 0.0
Function block 33 (F33.01 to F33.03)			
OUT3 assignment	LoGC3	The data range is same as OUT2 assignment. However, No. 7 or 23 becomes output program value 3. There are no relay contact output and triac output in OUT3 No control output when No. 21 or 22 is selected at Position proportioning PID control.	0 or 20 (vary with output type) When the OUT3 is not provided: 0
OUT3 transmission output scale high	AHS3	Varies with OUT3 assignment. The data range is the same as the OUT2 transmissionoutput scal high.	

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<table>
<tr><th>Name</th><th>Symbol</th><th>Data range</th><th>Factory set value</th></tr>
<tr><td>OUT3 transmission output scale low</td><td>ALS3</td><td colspan="2">Varies with OUT3 assignment.
The data range is the same as the OUT2 transmissionoutput scal low.</td></tr>
<tr><th colspan="4">Function block 34 (F34.01 to F34.12)</th></tr>
<tr><td>DO1 assignment</td><td>Ldo1</td><td rowspan="12">0: None
1 to 8: Time signal 1 to Time signal 8
9 to 12: Event 1 to Event 4
13: HBA1
14: HBA2
15: Logical OR of HBA1 and HBA2
16: LBA
17: Input error state
18: Program control mode (RUN) state
19: Fixed set point control mode (FIX) state
20: Manual control mode (MAN) state
21: Ramp state
22: Soak state
23: Hold state
24: Wait state
25: Pattern end signal
26: Autotuning (AT) state
27: FAIL state
28: Host communication error
29: Intercontroller communication error
30: Feedback resistance (FBR) input error</td><td rowspan="4">Based on model code.
When not specifying:
DO1: 9
DO2: 10
DO3: 1
DO4: 25</td></tr>
<tr><td>DO2 assignment</td><td>Ldo2</td></tr>
<tr><td>DO3 assignment</td><td>Ldo3</td></tr>
<tr><td>DO4 assignment</td><td>Ldo4</td></tr>
<tr><td>DO5 assignment</td><td>Ldo5</td><td rowspan="8">When specifying 12 points of DO at ordering:
DO5 to DO12: 1 to 8
When specifying 4 points of DO at ordering:
DO5 to DO12: 0</td></tr>
<tr><td>DO6 assignment</td><td>Ldo6</td></tr>
<tr><td>DO7 assignment</td><td>Ldo7</td></tr>
<tr><td>DO8 assignment</td><td>Ldo8</td></tr>
<tr><td>DO9 assignment</td><td>Ldo9</td></tr>
<tr><td>DO10 assignment</td><td>Ldo10</td></tr>
<tr><td>DO11 assignment</td><td>Ldo11</td></tr>
<tr><td>DO12 assignment</td><td>Ldo12</td></tr>
<tr><th colspan="4">Function block 41 (F41.01 to F41.08)</th></tr>
<tr><td>Event 1 type</td><td>ES1</td><td>0: None
1: Deviation high [1]
2: Deviation low [1]
3: Deviation high/low [1]
4: Deviation high/low (Individual high and low setting) [1]
5: Band [1]
6: Band (Individual high and low setting) [1]
7: Process high [1]
8: Process low [1]
9: SV high
10: SV low
11: MV1 high [heat-side] [1, 2]
12: MV1 low [heat-side] [1, 2]
13: MV2 high [cool-side] [1]
14: MV2 low [cool-side] [1]
[1] Event hold action is available.
[2] If there is Feedback resistance (FBR) input in Position proportioning PID control, set to the FBR input value.</td><td>Based on model code.
When not specifying: 1</td></tr>
<tr><td>Event 1 hold action</td><td>EHo1</td><td>0: OFF
1: Hold action ON
[when power turned on; when Event start (SV changed)]</td><td>Based on model code.
When not specifying: 0</td></tr>
<tr><td>Event 1 differential gap</td><td>EH1</td><td>Deviation, process or set value:
0 to Input span (Unit: °C [°F])
MV: 0.0 to 110.0 %</td><td>TC/RTD: 2
V/I: 0.2
MV: 0.2</td></tr>
<tr><td>Event 1 output action at input error</td><td>Ebo1</td><td>0 to 4<table>
<tr><th></th><th>When PV reaches Input error determination point (high) or higher temperature:</th><th>When PV reaches Input error determination point (low) or lower temperature:</th></tr>
<tr><td>0</td><td>Conforms to Event action</td><td>Conforms to Event action</td></tr>
<tr><td>1</td><td>ON</td><td>Conforms to Event action</td></tr>
<tr><td>2</td><td>Conforms to Event action</td><td>ON</td></tr>
<tr><td>3</td><td>ON</td><td>ON</td></tr>
<tr><td>4</td><td>OFF</td><td>OFF</td></tr>
</table></td><td>0</td></tr>
<tr><td>Event 1 timer</td><td>EVT1</td><td>0.0 to 600.0 seconds</td><td>0.0</td></tr>
</table>

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Name	Symbol	Data range	Factory set value
Event 1 interlock	EIL1	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0
Event 1 minimum ON time	E1oN	0.0 to 600.0 seconds	0.0
Event 1 minimum OFF time	E1oFF	0.0 to 600.0 seconds	0.0
Function block 42 (F42.01 to F42.08)			
Event 2 type	ES2	The data range is same as Event 1 type.	Based on model code. When not specifying: 2
Event 2 hold action	EHo2	The data range is same as Event 1 hold action.	Based on model code. When not specifying: 1
Event 2 differential gap	EH2	The data range is same as Event 1 differential gap.	
Event 2 output action at input error	Ebo2		
Event 2 timer	EVT2		
Event 2 interlock	EIL2		
Event 2 minimum ON time	E2oN		
Event 2 minimum OFF time	E2oFF		
Function block 43 (F43.01 to F43.08)			
Event 3 type	ES3	The data range is same as Event 1 type.	Based on model code. When not specifying: 0
Event 3 hold action	EHo3	The data range is same as Event 1 hold action.	Based on model code. When not specifying: 0
Event 3 differential gap	EH3	The data range is same as Event 1 differential gap.	
Event 3 output action at input error	Ebo3		
Event 3 timer	EVT3		
Event 3 interlock	EIL3		
Event 3 minimum ON time	E3oN		
Event 3 minimum OFF time	E3oFF		
Function block 44 (F44.01 to F44.08)			
Event 4 type	ES4	The data range is same as Event 1 type.	Based on model code. When not specifying: 0
Event 4 hold action	EHo4	The data range is same as Event 1 hold action.	Based on model code. When not specifying: 0
Event 4 differential gap	EH4	The data range is same as Event 1 differential gap.	
Event 4 output action at input error	Ebo4		
Event 4 timer	EVT4		
Event 4 interlock	EIL4		
Event 4 minimum ON time	E4oN		
Event 4 minimum OFF time	E4oFF		

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Name	Symbol	Data range	Factory set value
Function block 45 (F45.01 to F45.05)			
CT1 ratio	CTR1	0 to 9999	CTL-6-P-N: 800 CTL-12-S56: 1000 When not specifying: 800
CT1 assignment	CTA1	0: None 1: OUT1 2: OUT2 3: OUT3	When specifying CT at ordering: 1 When not specifying: 0
Number of heater break alarm 1 (HBA1) delay times	HbC1	0 to 255 times	5
Heater break alarm 1 (HBA1) set value *	HbA1	CTL-6-P-N: 0.0 to 30.0 A CTL-12-S56-10L-N: 0.0 to 100.0 A 0.0: Unused (Current value monitoring still available.)	0.0
Heater break alarm 1 (HBA1) interlock	HbIL1	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0
Function block 46 (F46.01 to F46.05)			
CT2 ratio	CTR2	The data range is same as Function block 45 (F45.)	CTL-6-P-N: 800 CTL-12-S56: 1000 When not specifying: 800
CT2 assignment	CTA2		When specifying CT at ordering: 2 When not specifying: 0
Number of heater break alarm 2 (HBA2) delay times	HbC2		5
Heater break alarm 2 (HBA2) set value *	HbA2		0.0
Heater break alarm 2 (HBA2) interlock	HbIL2		0
Function block 47 (F47.01, F47.02)			
Control loop break alarm (LBA) selection	LbASL	0: Without LBA 1: With LBA	0
Control loop break alarm (LBA) interlock	LbIL	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at input error.	0

* It is not necessary to change the operation mode to the Reset mode (RESET) when setting the parameters. The parameters may also be set in the Setup setting mode.

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Name	Symbol	Data range	Factory set value
Function block 50 (F50.01 to F50.14)			
Control action	oS	0: Brilliant II PID control (direct action) 1: Brilliant II PID control (reverse action) 2: Brilliant II Heat/Cool PID control (water cooling) 3: Brilliant II Heat/Cool PID control (air cooling) 4: Brilliant II Heat/Cool PID control (cooling gain linear type) 5: Brilliant II Position proportioning PID control (reverse action) 6: Brilliant II Position proportioning PID control (direct action)	Based on model code. When specifying FBR input at ordering: 5 When not specifying: 1
Hot/Cold start	Pd	0: Hot start 1 2: Cold start 1: Hot start 2 3: Reset start	0
Start determination point	PdA	0 to Input span (The unit is the same as input value.)	3 % of Input span
Action (high) at input error	AoVE	0: Normal control 1: Manipulated output value at input error	0
Action (low) at input error	AUNE		0
Manipulated output value at input error	PSM	PID contorl: −5.0 to +105.0 % Heat/Cool PID control: −105.0 to +105.0 % Actual output values become those restricted by the Output limiter.	0.0
Control action at Pattern end *	ENd.P	PID control or Heat/Cool PID control, Position proportioning PID control (with FBR input): 0: Control continued 1: Control stop Control action at Pattern end can be operative when using Output program function. Position proportioning PID control (When there is no FBR input or the FBR input is break): 0: Control continued 1: Open-side output OFF, Close-side output OFF 2: Open-side output OFF, Close-side output ON 3: Open-side output ON, Close-side output OFF	0
Intensity factor of Ramp/Soak stabilizer	RSS.AJ	0.0 to 1.0 0.0: Unused	0.5
OUT1 proportional cycle time *	T1	0.1 to 100.0 seconds M: Relay contact output T: Triac output V: Voltage pulse output D: Open collector output	M: 20.0 V/T/D: 2.0
OUT1 minimum ON/OFF time of proportioning cycle	o1.TM	0 to 1000 ms	0
OUT2 proportional cycle time *	T2	0.1 to 100.0 seconds M: Relay contact output T: Triac output V: Voltage pulse output D: Open collector output	M: 20.0 V/T/D: 2.0 When the OUT2 is not provided: 2.0
OUT2 minimum ON/OFF time of proportioning cycle	o2.TM	0 to 1000 ms	0
OUT3 proportional cycle time *	T3	0.1 to 100.0 seconds V: Voltage pulse output D: Open collector output	V/D: 2.0 When the OUT3 is not provided: 2.0
OUT3 minimum ON/OFF time of proportioning cycle	o3.TM	0 to 1000 ms	0
Function block 52 (F52.01 to F52.07)			
AT bias	ATb	–Input span to +Input span (The unit is the same as input value)	0
AT differential gap time	ATHS	0.0 to 100.0 seconds	10.0
AT time signal action	ATTS	0: Time signal OFF 1: Time signal ON	0

* It is not necessary to change the operation mode to the Reset mode (RESET) when setting the parameters. The parameters may also be set in the Setup setting mode.

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Name	Symbol	Data range	Factory set value
AT cycles	ATC	0: 1.5 cycles　2: 2.5 cycles 1: 2.0 cycles　3: 3.0 cycles	0
Output value with AT turned on	AToN	Output value with AT turned off to +105.0 % Actual output values become those restricted by the Output limiter. Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (high limit of Feedback resistance input at AT).	105.0
Output value with AT turned off	AToF	−105.0 % to Output value with AT turned on Actual output values become those restricted by the Output limiter. Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (low limit of Feedback resistance input at AT).	−105.0
AT with learning function at ramp segment	ATT.R	0: No AT with learning function at ramp segment 1: Conduct AT with learning function at ramp segment	0
Function block 53 (F53.01 to F53.05)			
Action at feedback resistance (FBR) input error	YbR	0: Action depending on the Valve action at Reset mode 1: Control action continued	0
Feedback adjustment	PoS	AdJ: Adjustment end oPEN: During adjustment on the open-side CLoSE: During adjustment on the close-side To start Feedback adjustment, press and hold the MODE key for 5 seconds or more at AdJ display. Err display: Adjustment error When FBR input is not specified, only AdJ displays.	AdJ
Control motor time	MoT	5 to 1000 seconds	10
Integrated output limiter	oLA	0.0 to 200.0 % of Control motor time 0.0: OFF Invalidate when Feedback resistance (FBR) input is selected.	150.0
Valve action in Reset mode	VAL	0: Open-side output OFF, Close-side output OFF 1: Open-side output OFF, Close-side output ON 2: Open-side output ON, Close-side output OFF Invalidate when Feedback resistance (FBR) input is selected.	0
Function block 60 (F60.01 to F60.05)			
Communication 1 protocol	CMP1	0: RKC communication 1: Modbus	Based on model code.
Device address 1 *	Add1	0 to 99 1 to 99 at Modbus	RKC communication: 0 Modbus: 1
Communication speed 1 *	bPS1	2400: 2400 bps　19200: 19200 bps 4800: 4800 bps　38400: 38400 bps 9600: 9600 bps　57600: 57600 bps	19200
Data bit configuration 1 *	bIT1	Symbol / Data bit / Parity bit / Stop bit 8N1 * / 8 bit / Without / 1 bit 8N2 * / 8 bit / Without / 2 bit 8E1 * / 8 bit / Even / 1 bit 8E2 * / 8 bit / Even / 2 bit 8o1 / 8 bit / Odd / 1 bit 8o2 / 8 bit / Odd / 2 bit 7N1 / 7 bit / Without / 1 bit 7N2 / 7 bit / Without / 2 bit 7E1 / 7 bit / Even / 1 bit 7E2 / 7 bit / Even / 2 bit 7o1 / 7 bit / Odd / 1 bit 7o2 / 7 bit / Odd / 2 bit [a] Available for only Modbus	8N1
Interval time 1 *	INT1	0 to 250 ms	10

* It is not necessary to change the operation mode to the Reset mode (RESET) when setting the parameters. The parameters may also be set in the Setup setting mode.

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Name	Symbol	Data range	Factory set value
Function block 61 (F61.01 to F61.06)			
Slave controller	SLV.SL	0: FB series 1: RB series 2: PF900/PF901	0
Number of slave unit	SLV.No	0 to 4	0
Device address 2 *	Add2	0 to 99	0
Communication speed 2 *	bPS2	9600: 9600 bps 19200: 19200 bps 38400: 38400 bps	19200
Host communication error judgment time	H.ER.TM	0 to 600 seconds 0: Unused	10
Intercontroller communication error judgment time	C.ER.TM	0 to 600 seconds 0: Real-time error	10
Function block 71 (F71.01, F71.02)			
Setting limiter high	SLH	Setting limiter low to Input range high (The unit is the same as input value)	Input range high
Setting limiter low	SLL	Input range low to Setting limiter high (The unit is the same as input value)	Input range low
Function block 80 (F80.01 to F80.07)			
SV selection at Program start *	ST.SV	0: Start with the Set value (SV) in the Reset mode. 1: PV start 1 [Time fixed type] 2: PV start 2 [Time saving & ramp holding type] 3: PV start 3 [Time saving & level searching type/ With HOLD function at start] 4: PV start 4 [Time saving & level searching type/ Without HOLD function at start]	2
Wait memory group number at Program start	ST.WT	0: Wait OFF 1 to 8: Wait memory 1 to Wait memory 8	0
Program setting type	PR.TYP	0: Batch setting type 1: Partial setting type	1
Signal type	TS.TYP	0: Time signal type 1: Segment signal type	0
Set time unit	TM.SL	0: Hour : Minute 1: Minute : Second	0
Maximum pattern/segment number	PN*SN	Maximum pattern number: 1 to 99 Maximum segment number: 1 to 99 Maximum pattern number × Maximum segment number = 1024 at maximum	Maximum pattern number: 32 Maximum segment number: 32

* It is not necessary to change the operation mode to the Reset mode (RESET) when setting the parameters. The parameters may also be set in the Setup setting mode.

■ Parameter switching

- To go to the Parameter setting mode, press the MODE key while pressing the SET key for 2 seconds at PV/SV monitor display.
- Press the SET key to switch operation screen.
- Function blocks may be switched by using the ∧ key or the ∨ key.

NOTE

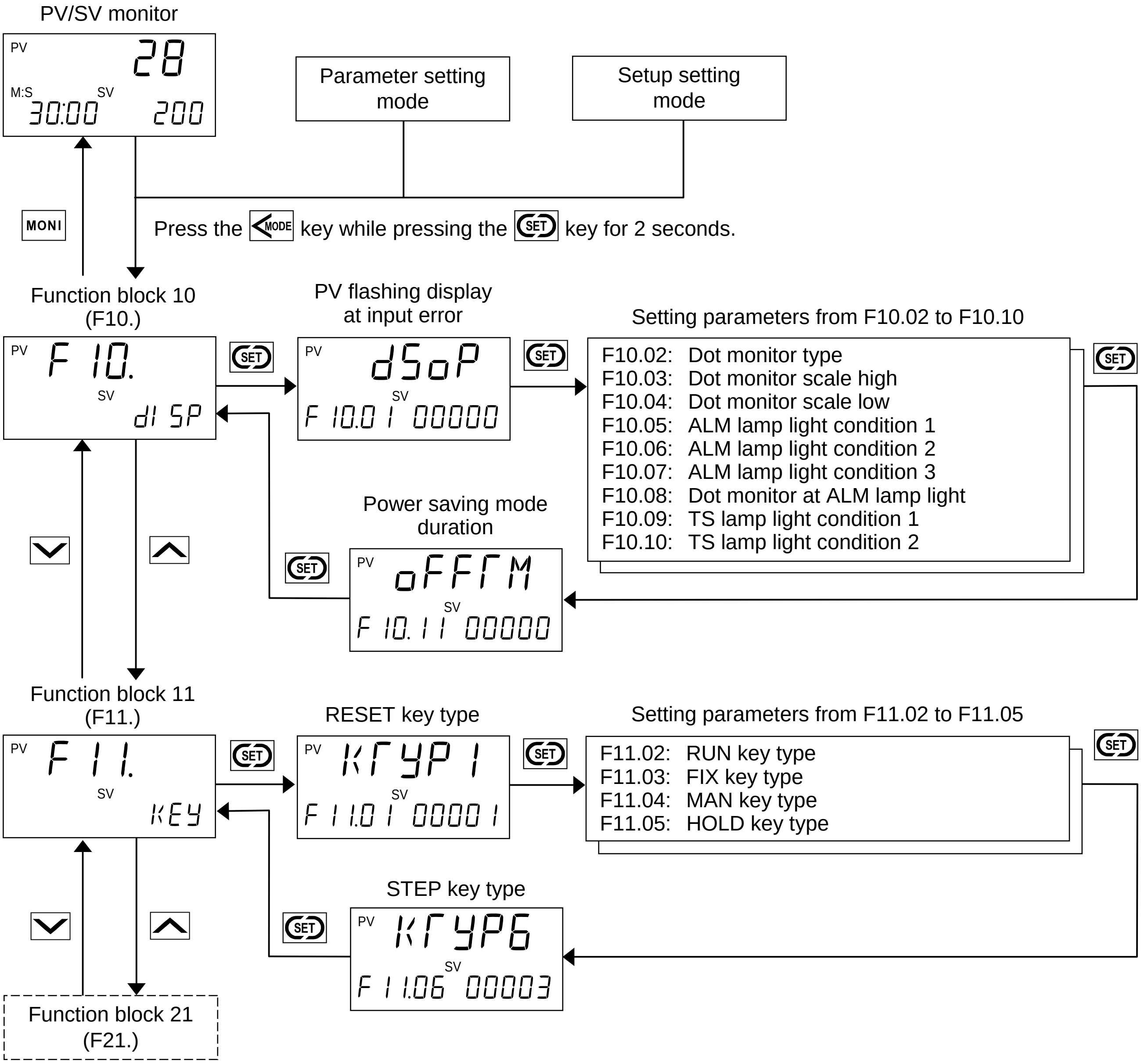
Parameters in the Engineering mode are only available for monitoring in the RUN mode, the FIX mode and the MAN mode. Switch to the RESET mode to set the parameters. It is possible to set parameters in the function block 10 (F10) and the function block 11 (F11) in the RUN mode, the FIX mode and the MAN mode.

Press the MONI key to go back to the PV/SV monitor.

Press the STEP R.SET key to go back to the previous display.

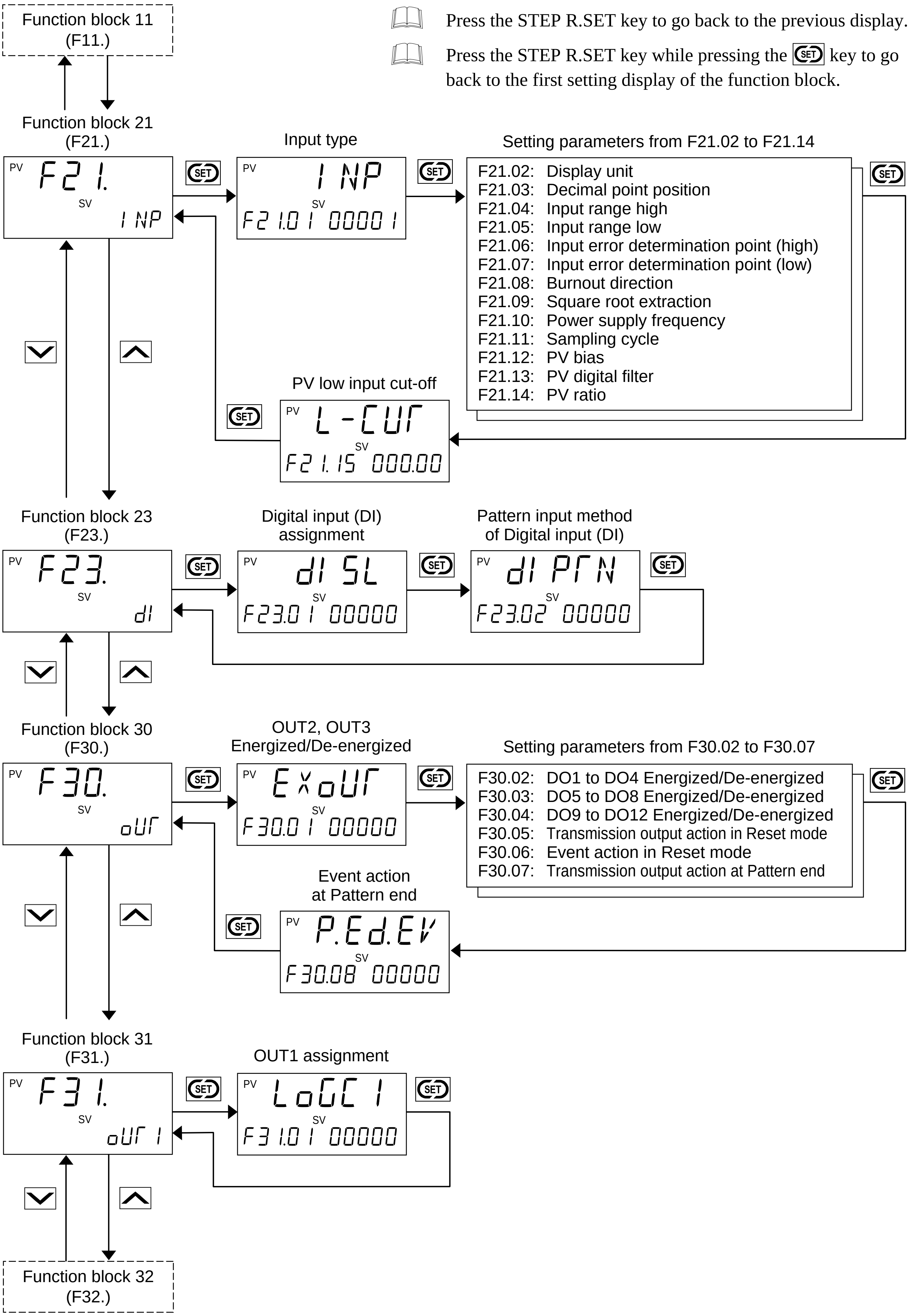
Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.

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



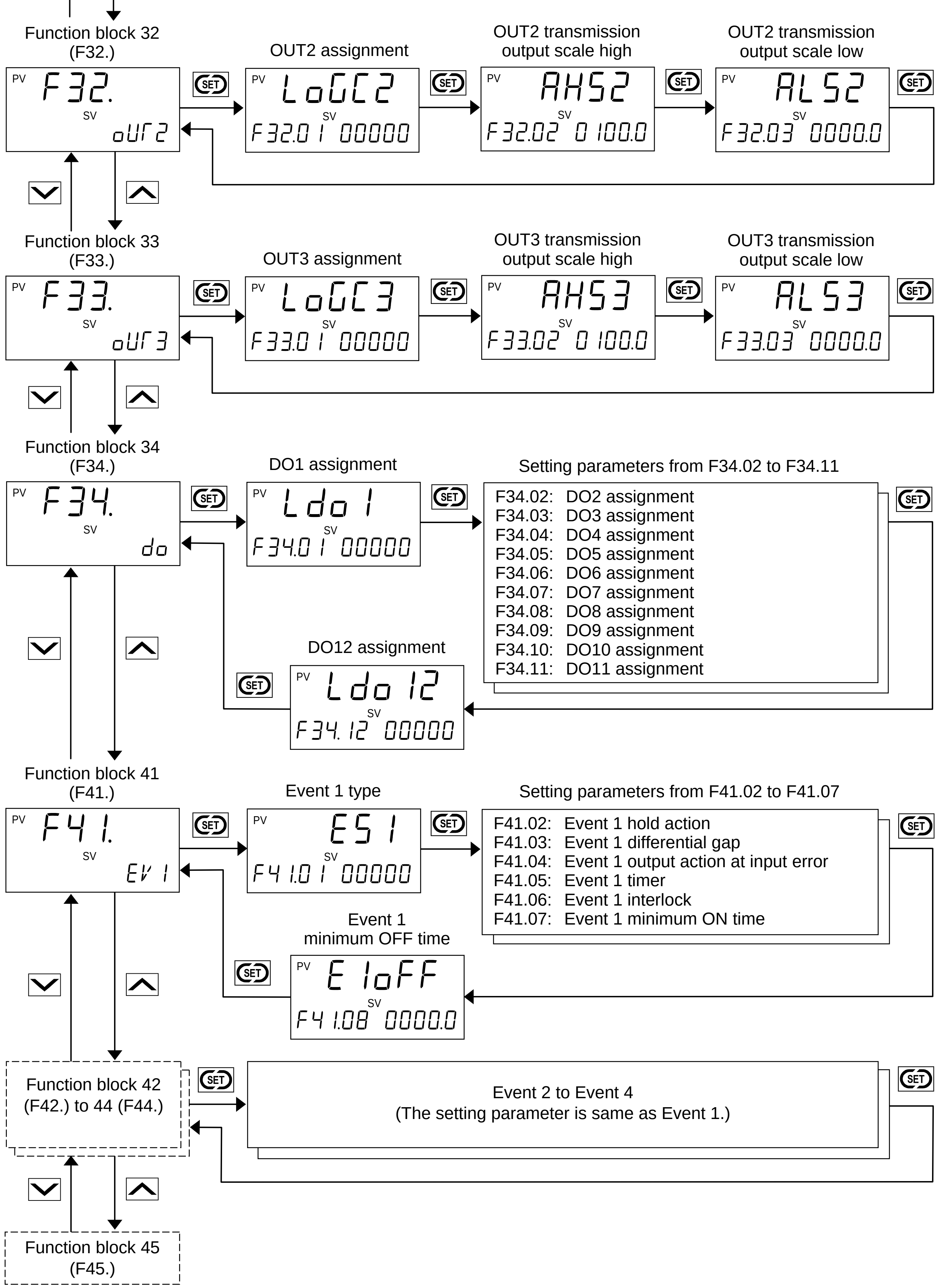
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



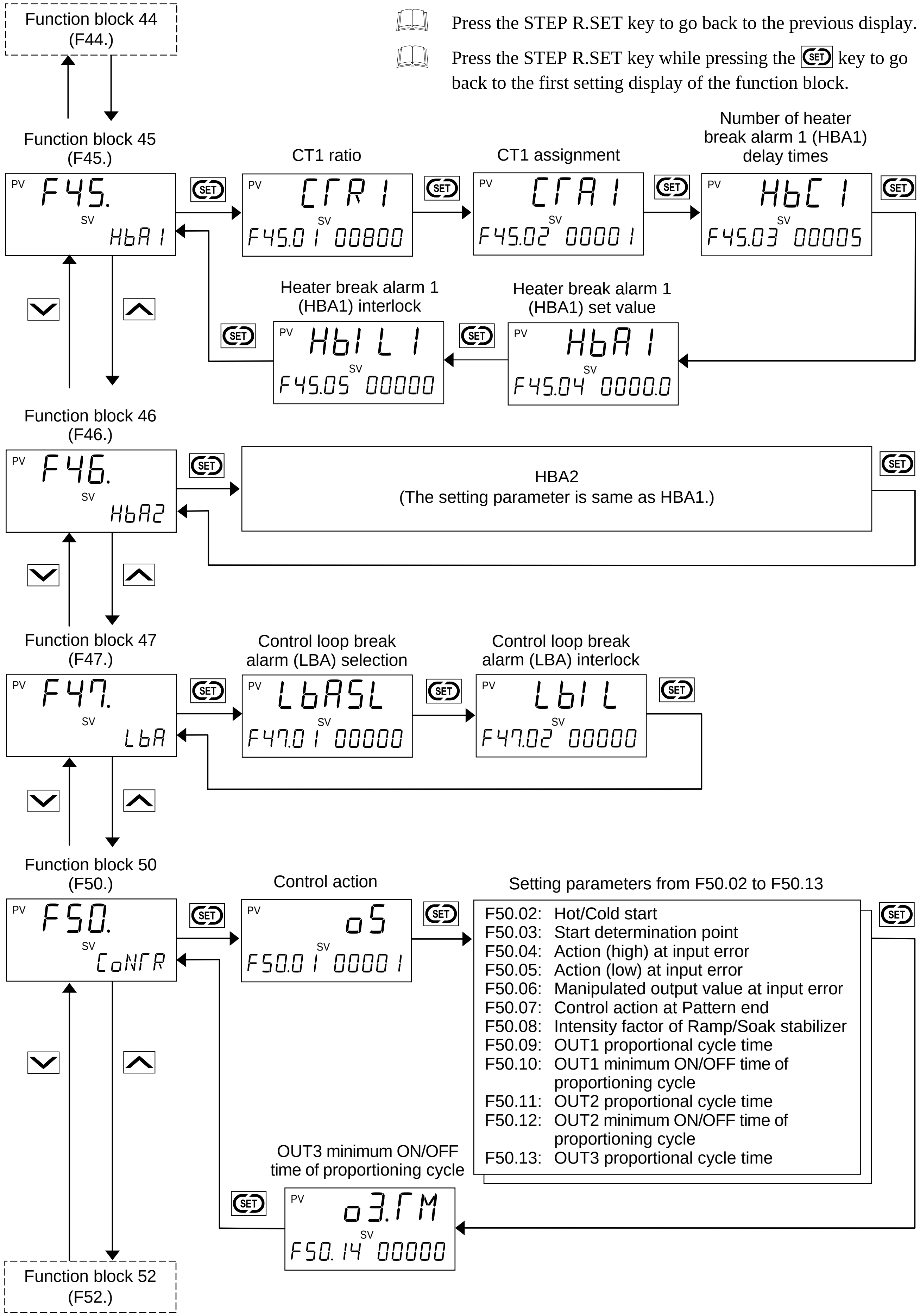
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



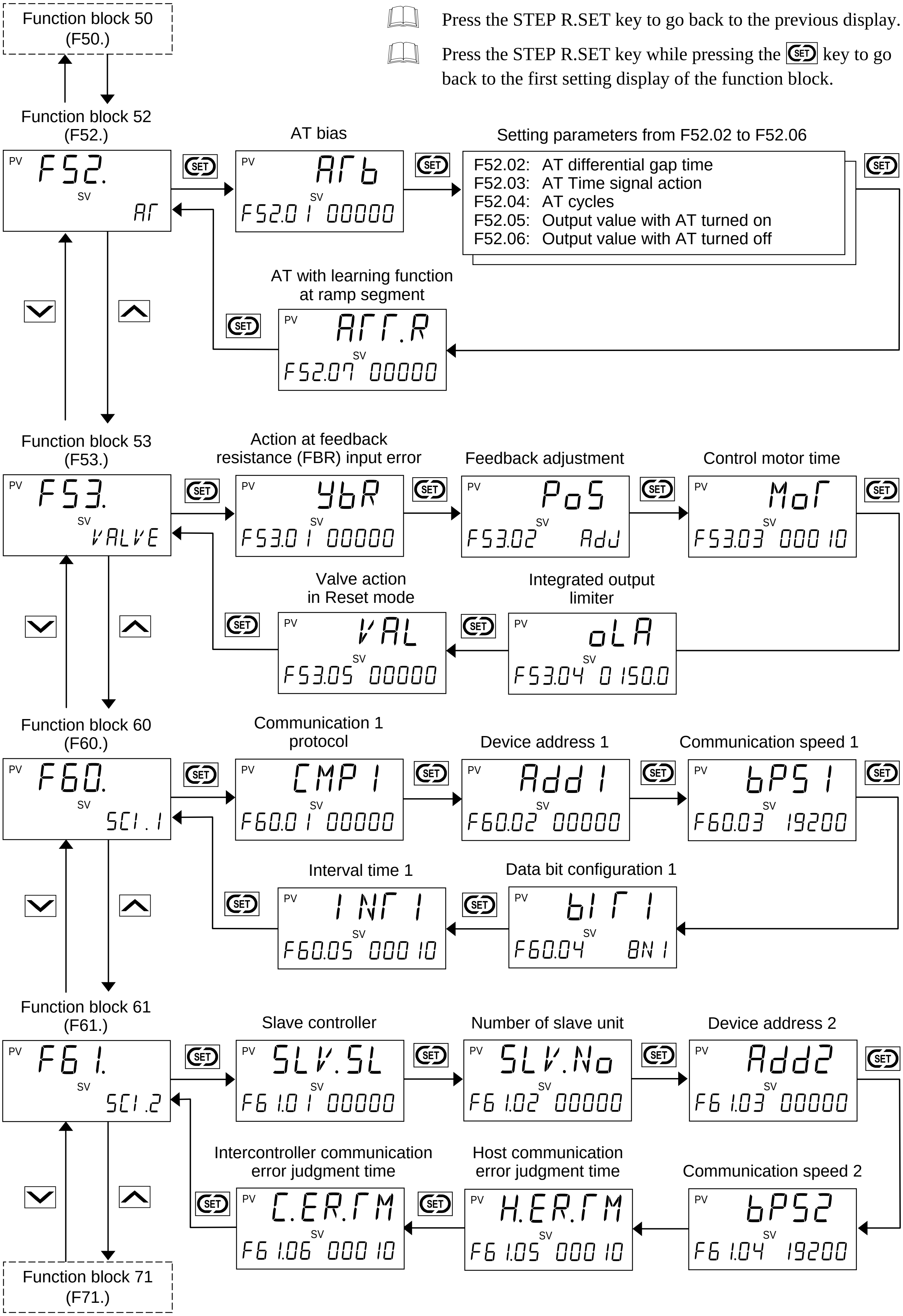
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



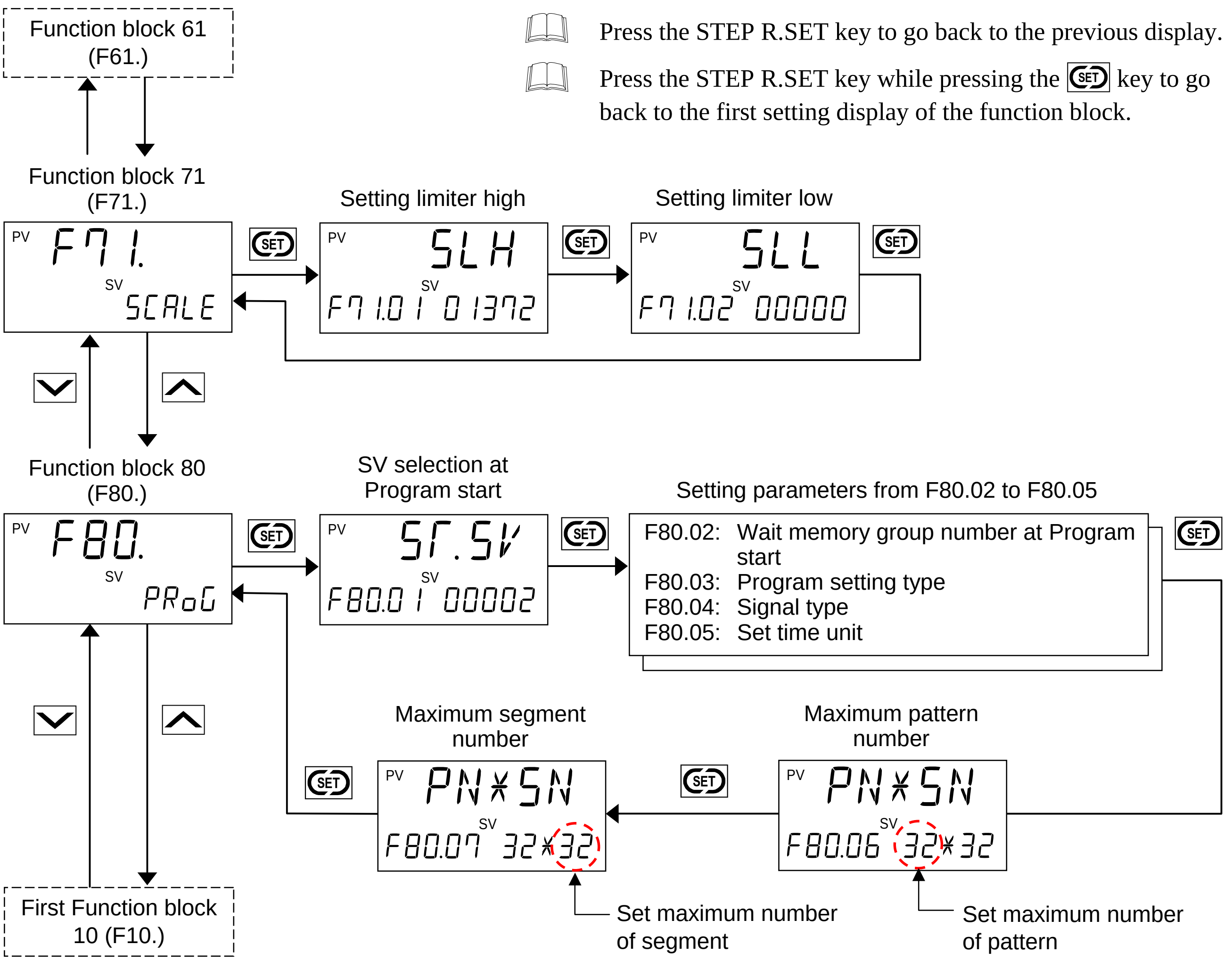
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



NOTE

When changing a Maximum pattern number or Maximum segment number, all parameters related to Program setting such as Segment level and Segment time will be initialized automatically.

Parameters to be initialized

Parameter setting mode:

- Parameters at the Program setting block
- Wait zone high and Wait zone low at the Wait memory group setting block
- Output program value from 1 to 3 at the Output program memory group setting block
- Parameters at the Time signal memory group setting block

SV setting mode:

- Execution pattern selection

Setting by RKC communication:

- Pattern tag name

It takes approximately 1 second to initialize the related parameters when a Maximum pattern number of Maximum segment number is changed.

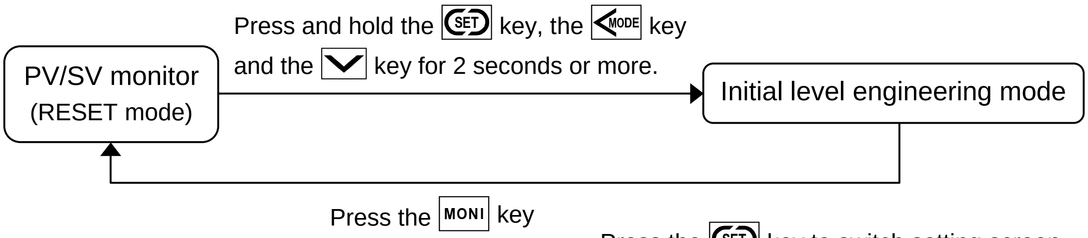
4.5.6 Initial level engineering mode

Initialize the specific parameters of initial setting level related to control, intercontroller communication etc.

> **⚠ WARNING**
>
> Parameters in the Engineering mode (F10 to F80) 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 the Engineering mode are only available for monitoring in the RUN mode, the FIX mode and the MAN mode. Switch to the RESET mode to set the parameters. It is possible to set parameters in the function block 10 (F10) and the function block 11 (F11) in the RUN mode, the FIX mode and the MAN mode.



- Press the SET key to switch setting screen.
- Function blocks may be switched by using the UP key or the DOWN key.
- Press the STEP R.SET key to go back to the previous display.
- Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.

☞ For parameter switching, refer to P. 4-54 to 4-57.

■ Parameter list

Parameters of the Initial level engineering mode are in the function blocks: F10, F50, F52, F53, F60, F61 and F80. Parameters of the Initial level engineering mode display in the Engineering mode.

Name	Symbol	Data range	Factory set value
Function block 10 (F10.12, F10.13)			
Repeat remaining process/program progression display selection	RPT.SL	0: Segment repeat remaining time 1: Segment repeat execution time	0
Unit display	UNT.SL	0: Conform to the input type TC/RTD inputs: °C or °F Voltage (V)/Current (I) inputs: No unit display 1: No unit display 2: % 3: °C 4: °F	0

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Name	Symbol	Data range	Factory set value
Function block 50 (F50.15 to F50.19)			
Integral/derivative time decimal point position	Id.dP	0: 1 second setting (No decimal place) 1: 0.1 seconds setting (One decimal place)	0
Derivative gain	d.GA	0.1 to 10.0	6.0
Derivative action	d.TP	0: Measured value derivative 1: Deviation derivative	0
Undershoot suppression factor	US	0.000 to 1.000	Water cooling: 0.100 Air cooling: 0.250 Cooling gain linear type: 1.000
Overlap/Deadband reference point	dbAA	0.0 to 1.0 0.0: Reference in the heat-side 1.0: Reference in the cool-side	0.0
Function block 52 (F52.08 to F52.25)			
Proportional band limiter (high) [heat-side]	PLH	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span	TC/RTD: Input span V/I: 1000.0
Proportional band limiter (low) [heat-side]	PLL		TC/RTD: 0 V/I: 0.0
Integral time limiter (high) [heat-side]	ILH	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
Integral time limiter (low) [heat-side]	ILL		PID control, Heat/Cool PID control: 0 Position proportioning PID control: 1
Derivative time limiter (high) [heat-side]	dLH	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
Derivative time limiter (low) [heat-side]	dLL		0
Proportional band limiter (high) [cool-side]	PcLH	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span	TC/RTD: Input span V/I: 1000.0
Proportional band limiter (low) [cool-side]	PcLL		TC/RTD: 1 V/I: 0.1
Integral time limiter (high) [cool-side]	IcLH	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
Integral time limiter (low) [cool-side]	IcLL		0
Derivative time limiter (high) [cool-side]	dcLH	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
Derivative time limiter (low) [cool-side]	dcLL		0
Proportional band adjusting factor [heat-side]	PAJ	0.01 to 10.00	1.00
Integral time adjusting factor [heat-side]	IAJ		1.00
Derivative time adjusting factor [heat-side]	dAJ		1.00
Proportional band adjusting factor [cool-side]	PcAJ		1.00
Integral time adjusting factor [cool-side]	IcAJ		1.00
Derivative time adjusting factor [cool-side]	dcAJ		1.00

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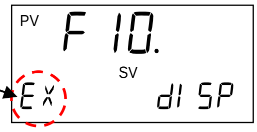
Name	Symbol	Data range	Factory set value
Function block 53 (F53.06)			
Action at saturated output	YASo	0: Invalid 1: Valid	0
Function block 60 (F60.06, F60.07)			
Communication 1 error (Monitor item)	CMRM1	0: Normal 1: Overrun error 2: Parity error 4: Framing error 8: Receive buffer overflow 16: Data not received When multiple errors occur, displays sum total of each error value.	0
Interval time-out 1	CMTo1	0 to 100 ms	0
Function block 61 (F61.07 to F61.22)			
Communication 2 error (Monitor item)	CMRM2	0: Normal 1: Overrun error 2: Parity error 4: Framing error 8: Receive buffer overflow 16: Data not received When multiple errors occur, displays sum total of each error value.	0
Action at Link error	L.ERR	0: Reset 1: Continue	0
Communication start time	S.SC1	2 to 100 seconds	3
Slave 1 ratio *	SLV.R1	0.001 to 9.999	1.000
Slave 2 ratio *	SLV.R2		1.000
Slave 3 ratio *	SLV.R3		1.000
Slave 4 ratio *	SLV.R4		1.000
Slave 1 bias *	SLV.b1	−1000.0 to +1000.0 Varies with the setting of the Decimal point position selection.	0.0
Slave 2 bias *	SLV.b2		0.0
Slave 3 bias *	SLV.b3		0.0
Slave 4 bias *	SLV.b4		0.0
Set memory area switching address	Add.SE	0000H to FFFFH	0500
Control memory area switching address	Add.RN		0024
SV address of set memory area	Add.SS		0507
EEPROM mode setting address	Add.EP		FFFF
RUN/STOP setting address	Add.RS		0023
Function block 80 (F80.08)			
Pattern end output action at Pattern repeat/Pattern link	PE.SL	0: OFF 1: ON (0.5 seconds) 000 ← Value at SV display Pattern end output is ON at Pattern repeat. Pattern end output is ON at Total pattern repeat. Pattern end output is ON at Pattern link.	000

* It is not necessary to change the operation mode to the Reset mode (RESET) when setting the parameters.

■ Parameter switching

- To go to the Initial level engineering mode, press and hold the SET key, the <MODE key and the ∨ key for 2 seconds or more at the PV/SV monitor display.
- Press the SET key to switch operation screen.
- Function blocks may be switched by using the ∧ key or the ∨ key.
- Parameters of the Initial level engineering mode display in the Engineering mode.

The character "EX" displays for parameter setting of the Initial level engineering mode.



NOTE

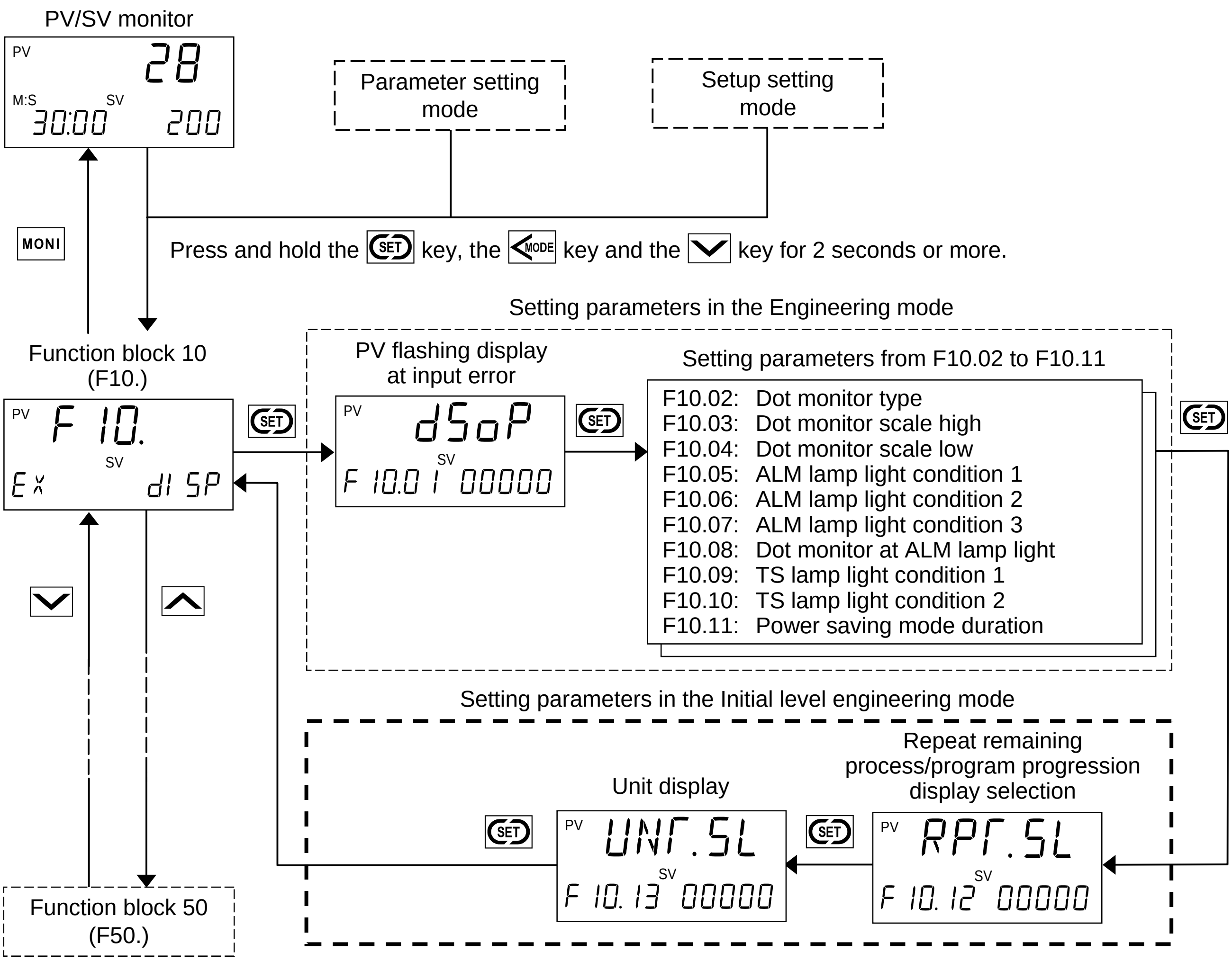
Parameters in the Engineering mode are only available for monitoring in the RUN mode, the FIX mode and the MAN mode. Switch to the RESET mode to set the parameters. It is possible to set parameters in the function block 10 (F10) and the function block 11 (F11) in the RUN mode, the FIX mode and the MAN mode.

Press the MONI key to go back to the PV/SV monitor.

Press the STEP R.SET key to go back to the previous display.

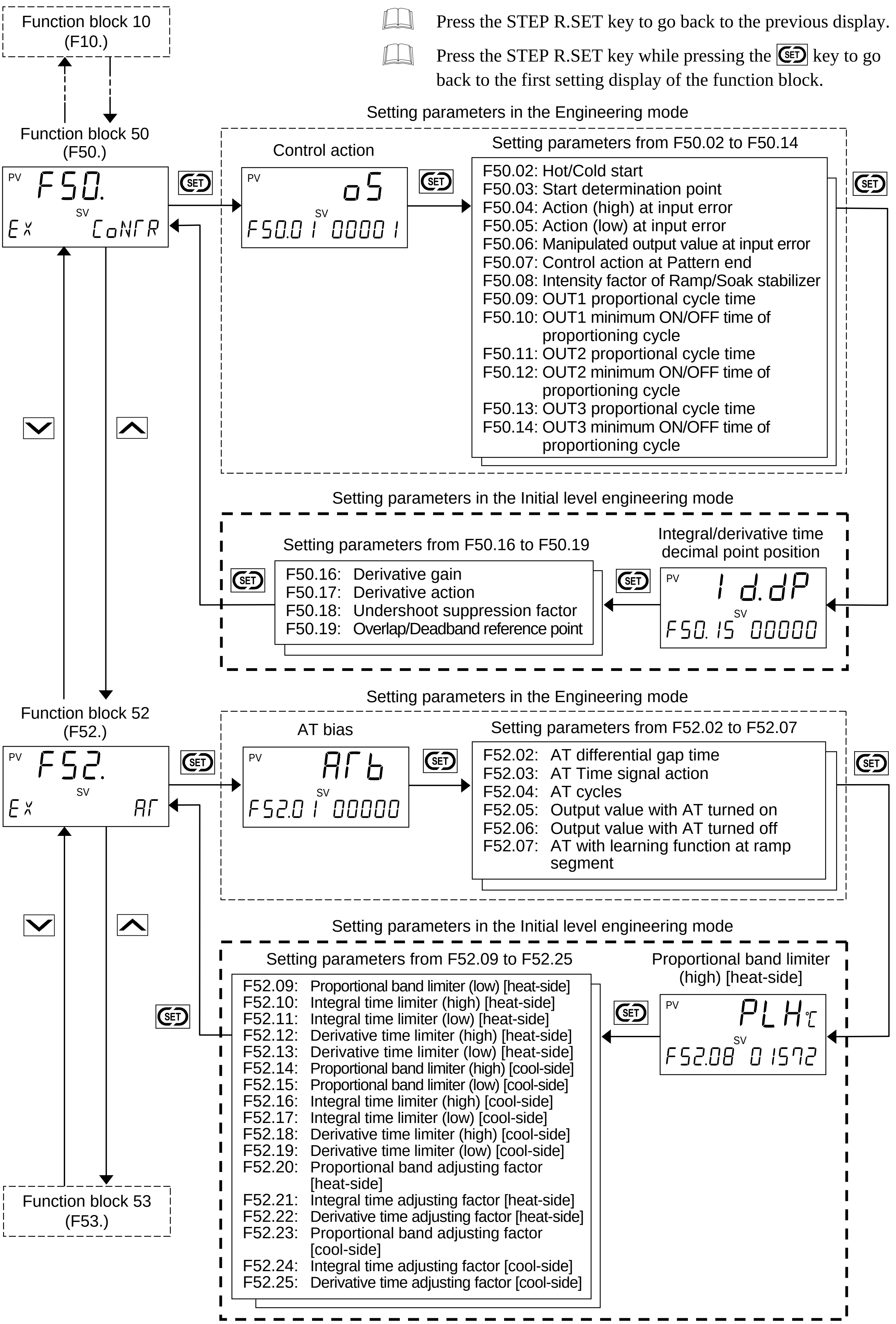
Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.

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



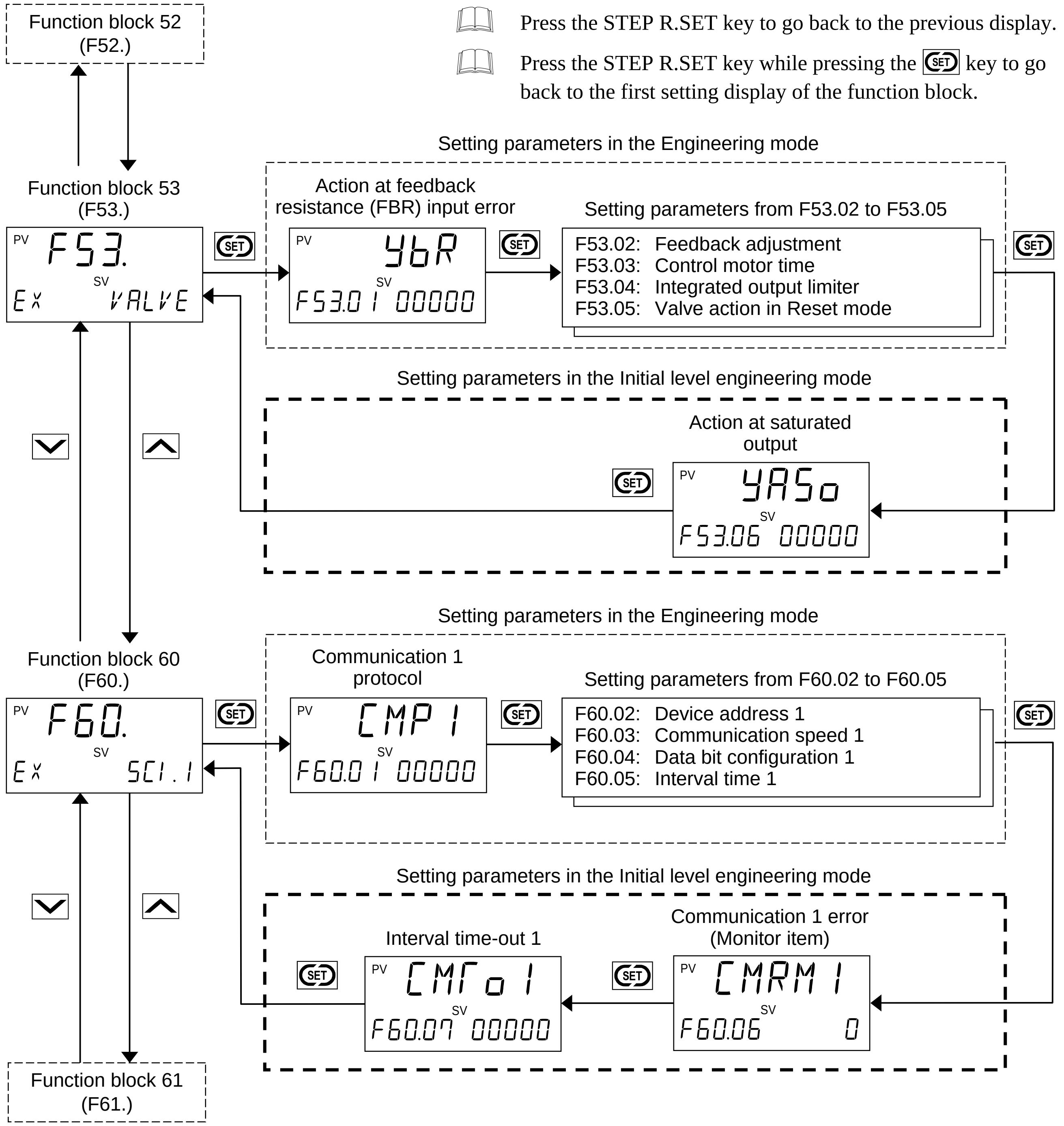
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



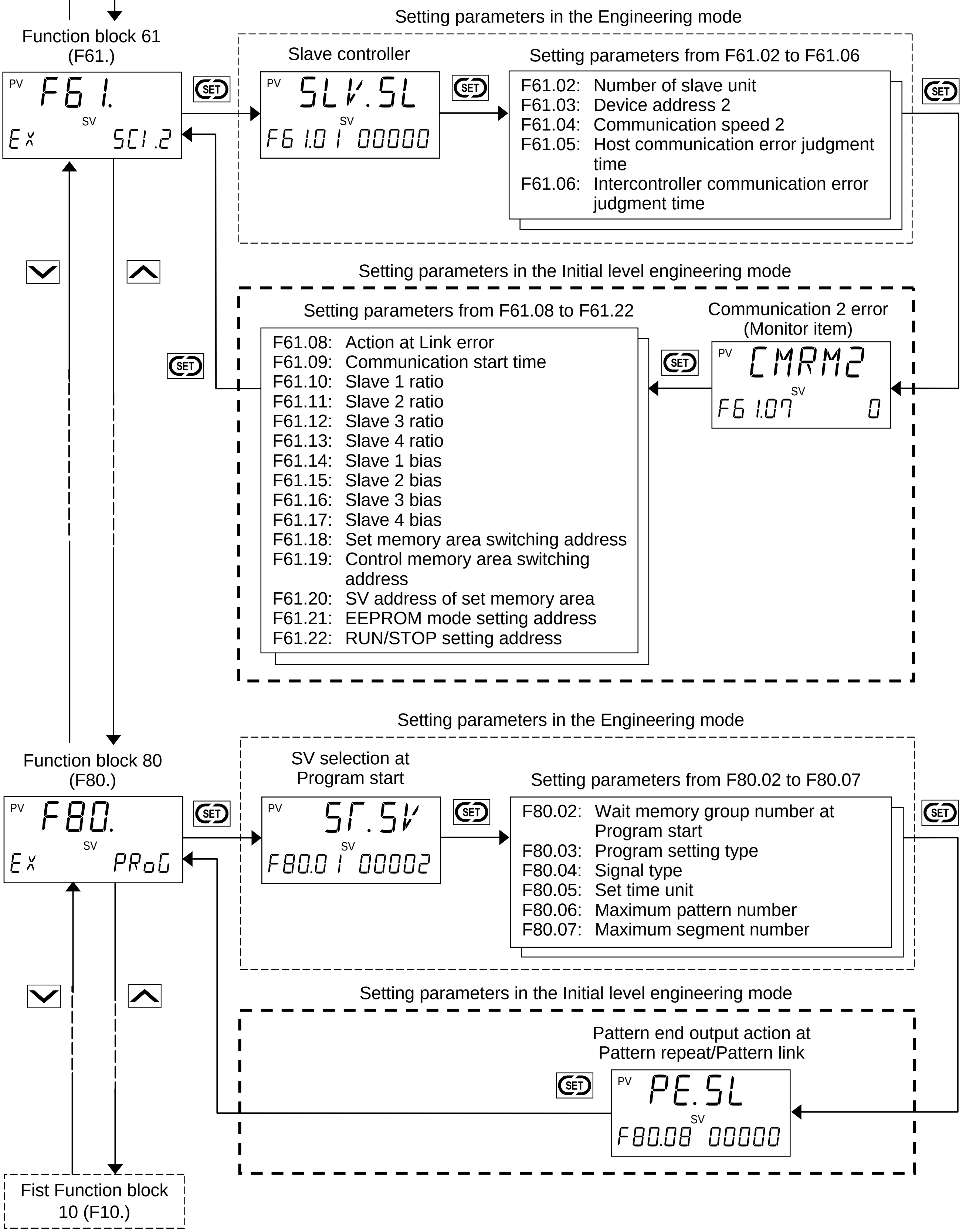
Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



Press the STEP R.SET key to go back to the previous display.

Press the STEP R.SET key while pressing the SET key to go back to the first setting display of the function block.



MEMO

OPERATION 5

This chapter describes initial setting before operation, cautions for operation, parameter setting by Operation mode and setting procedure via loader communication.

5.1 Initial Setting

Before starting operation, confirm that the set value of the parameter matches the model code as specified when ordered. Parameters which are not specified when ordering must be set before use.

⚠ WARNING

Parameters in the Engineering mode (F10 to F80) 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 Reset mode (RESET).

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

Setup example:

Input specification: Thermocouple K 0 to 400 °C
Control action: PID control (reverse action)
Control output: OUT1, Relay contact output,
Proportional cycle time: 20 seconds
Event specification (Event 1):
Deviation high/low with hold action
(Uses Interlock function)
Event output: Assigned to DO1
Program pattern/segment number:
Pattern/segment number: 32/32 (Factory set value)

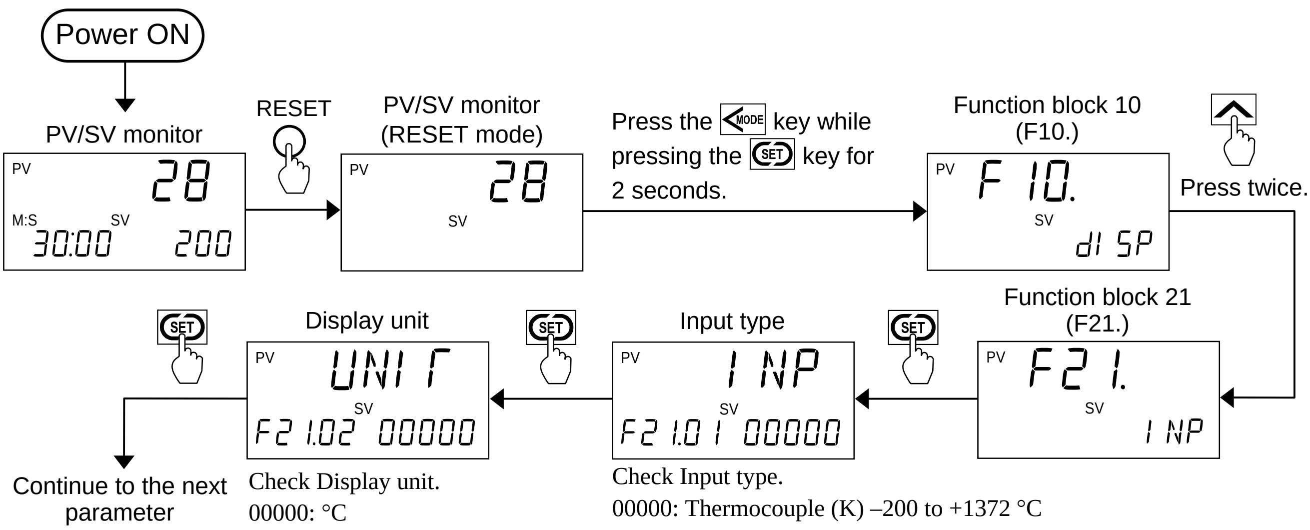
Set value change and registration

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

5.1.1 Check the parameter related to the input

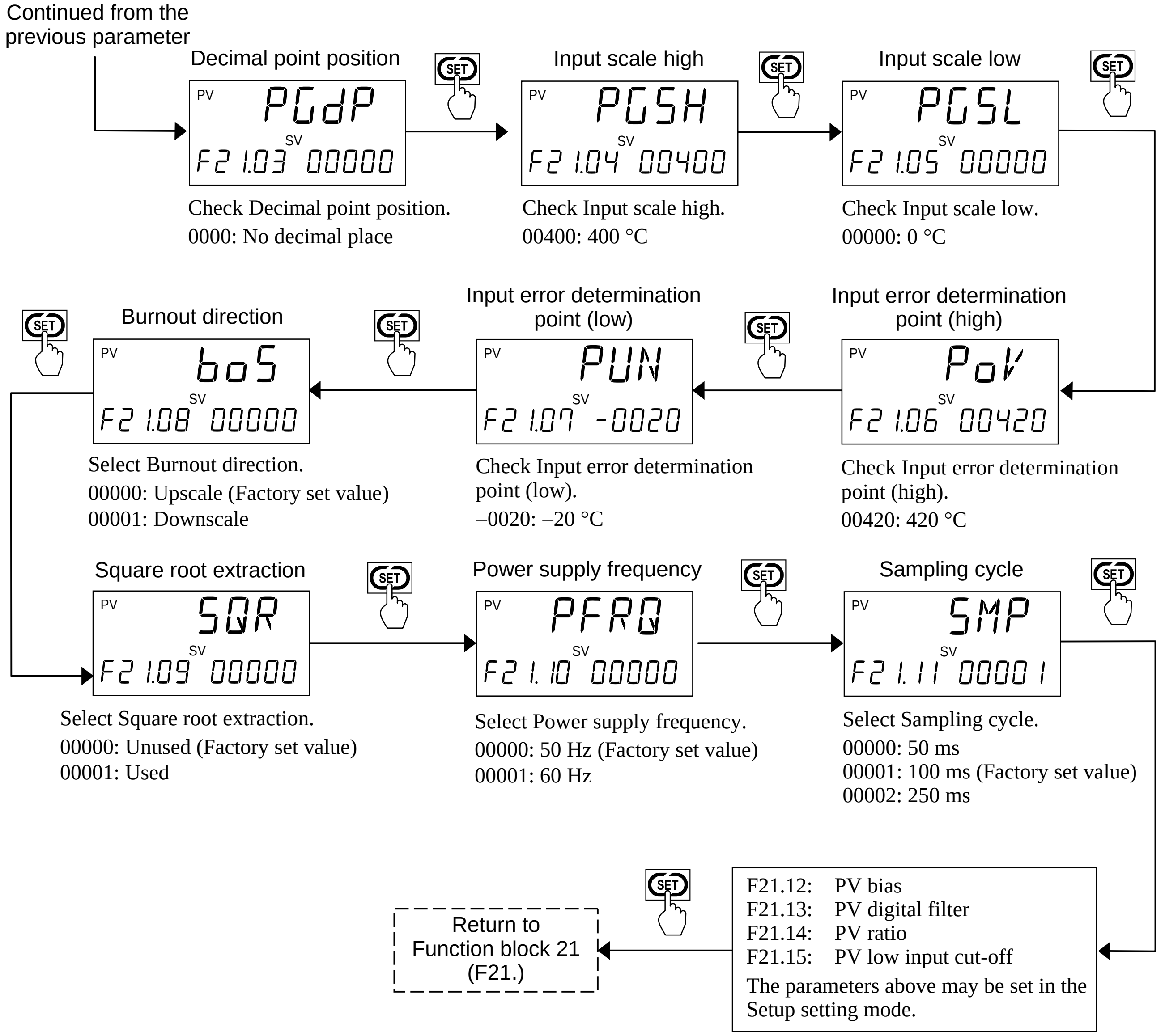
Check the set value of the parameter for input specification (such as the input type at F21 in the Engineering mode). Parameters which are not specified when ordering must be set before use.

Setup example:
Input specification: Thermocouple (K) 0 to 400 °C [Input range code: K02]

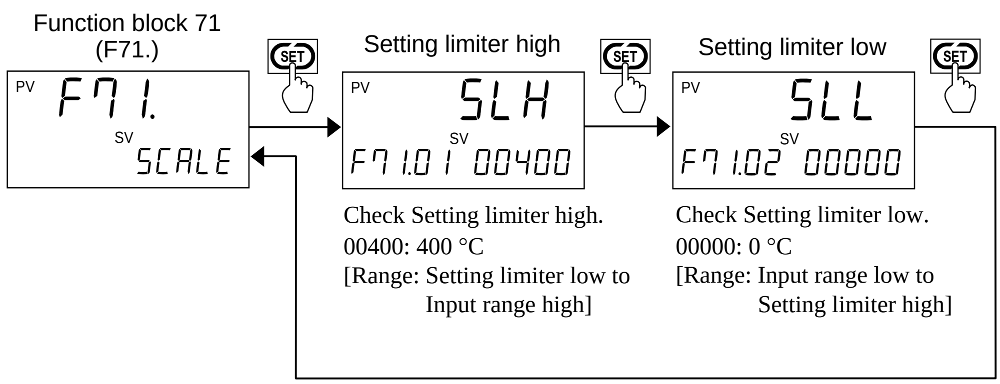


Check Display unit.
00000: °C

Check Input type.
00000: Thermocouple (K) –200 to +1372 °C



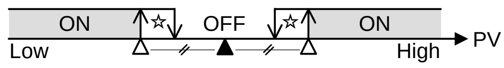
Check the set value of the Setting limiter at the function block 71 (F71.).



5.1.2 Check the parameter related to the event action

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

Setup example:
Event specification (Event 1):
Deviation high/low with hold action [Quick start code: G]
Uses Interlock function
Event output: Assigned to DO1



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

After setting input related parameters, check and set parameters related to event actions.

DO1 Energized/De-energized can be selected at function block 30 [F30.02 (EXDO1)]. (Factory set value: Energized)

Function block 21 (F21.)
PV: F21. SV: INP

Press the ⌃ key until F34 displays.

Function block 34 (F34.)
PV: F34. SV: do

SET

DO1 assignment
PV: Ldo1 SV: F34.01 00009

Set DO1 assignment to Event 1.
00009: Event 1

SET

The display goes to the next parameter (DO2 type)

STEP R.SET
Press twice.

Return to Function block 34 (F34.)

⌃

Function block 41 (F41.)
PV: F41. SV: EV1

SET

Event 1 type
PV: ES1 SV: F41.01 00003

Check Event 1 type.
00003: Deviation high/low

SET

Event 1 hold action
PV: EHo1 SV: F41.02 00001

Check Event 1 hold action.
00001: Hold action ON

SET

Event 1 differential gap
PV: EH1 SV: F41.03 00002

Set Event 1 differential gap.
00002: 2 °C (Factory set value)
[Range: 0 to Input span]

SET

Event 1 output action at input error
PV: Ebo1 SV: F41.04 00000

Select Event 1 output action at input error.

	When PV reaches Input error determination point (high) or higher temperature:	When PV reaches Input error determination point (low) or lower temperature:
00000	Conforms to Event action	Conforms to Event action
00001	ON	Conforms to Event action
00002	Conforms to Event action	ON
00003	ON	ON
00004	OFF	OFF

SET

Event 1 timer
PV: EVT1 SV: F41.05 0000.0

Set Event 1 timer.
0000.0: 0.0 second (Factory set value)
[Range: 0.0 to 600.0 seconds]

SET

Event 1 Interlock
PV: EIL1 SV: F41.06 00001

Set Event 1 Interlock to "Used."
00000: Unused
00001: Used

SET

Event 1 Minimum ON time
PV: E1oN SV: F41.07 0000.0

Set Event 1 Minimum ON time.
0000.0: 0.0 second (Factory set value)
[Range: 0.0 to 600.0 seconds]

SET

Event 1 Minimum OFF time
PV: E1oFF SV: F41.08 0000.0

Set Event 1 Minimum OFF time.
0000.0: 0.0 second (Factory set value)
[Range: 0.0 to 600.0 seconds]

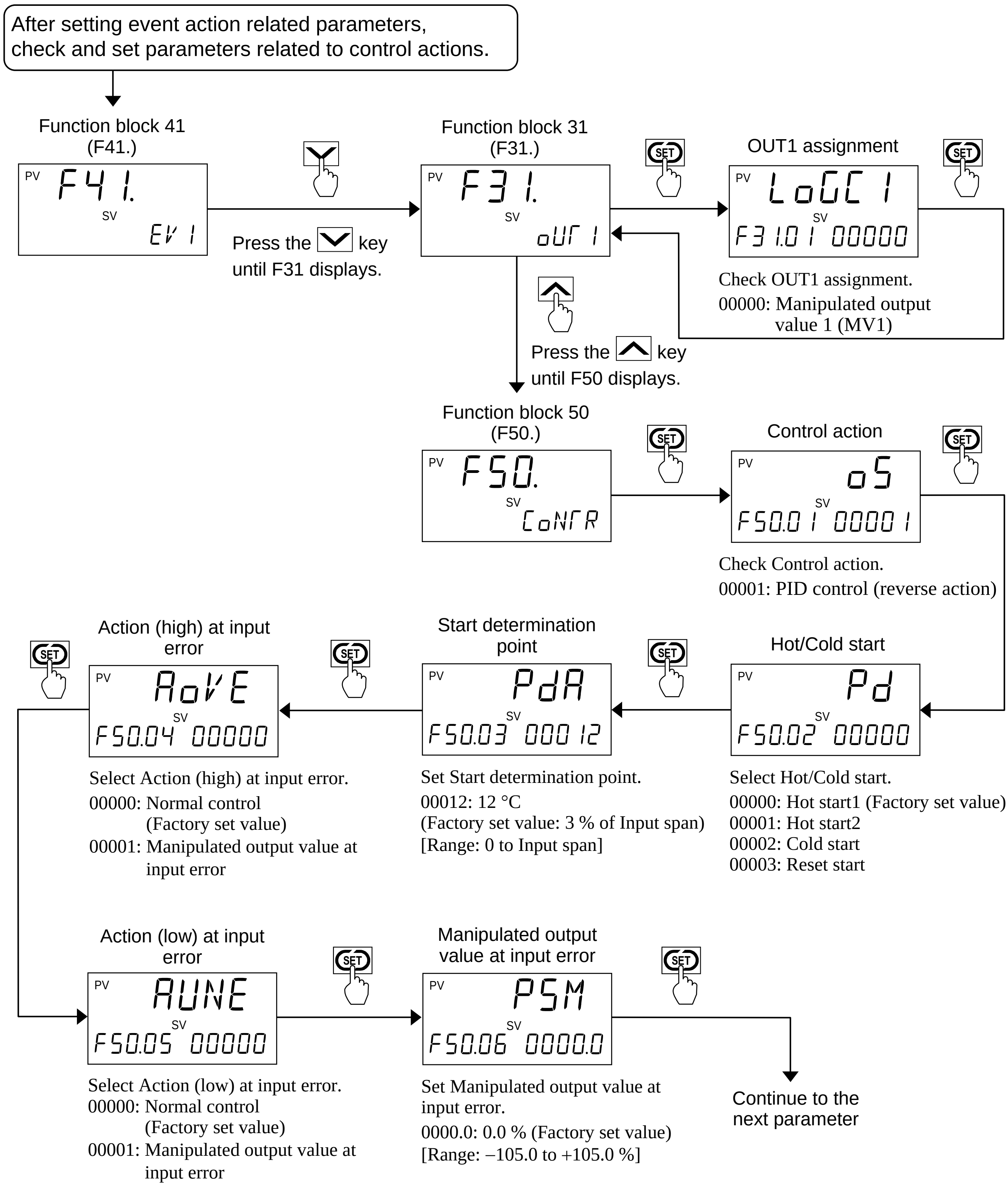
SET

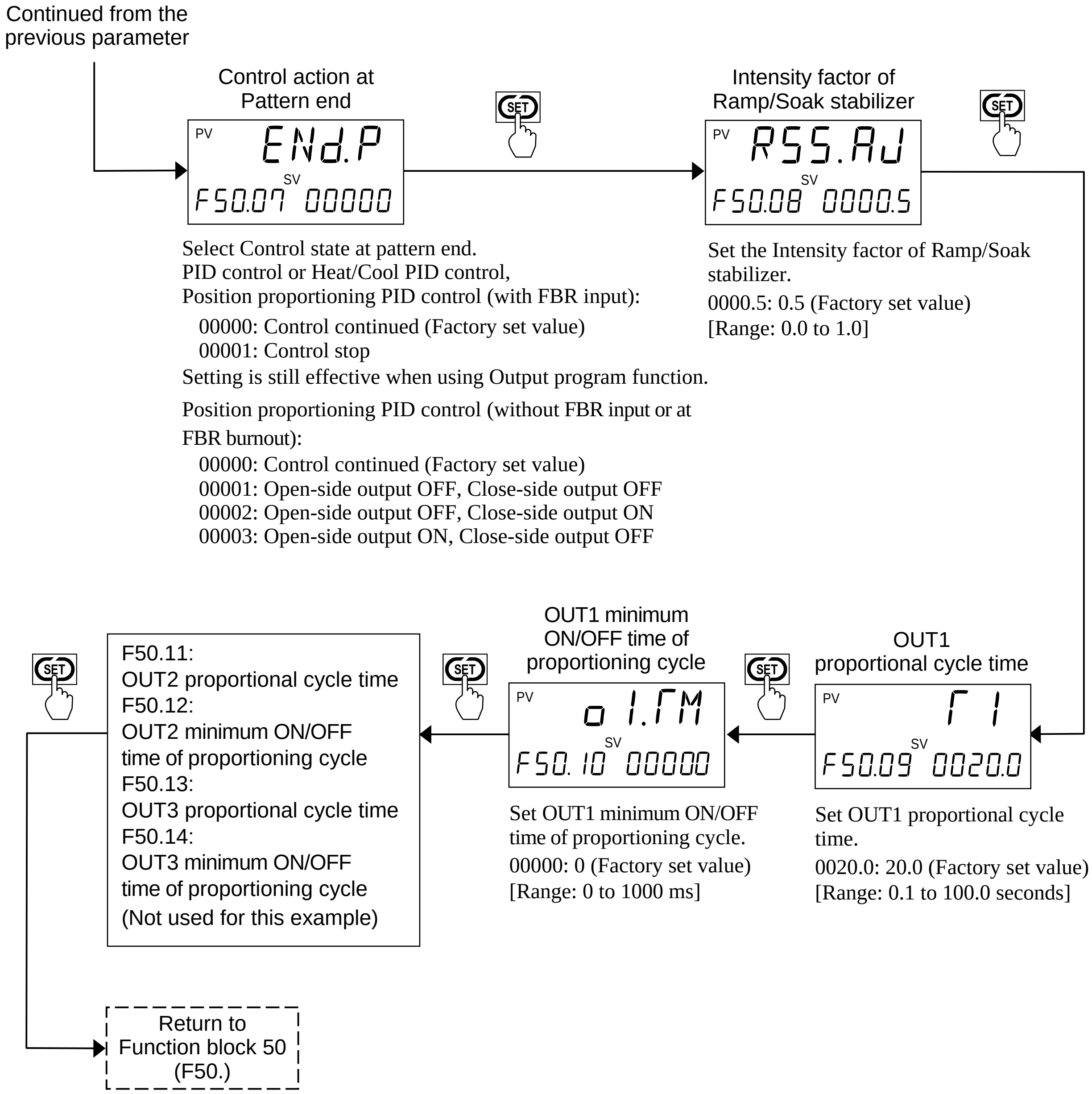
Return to Function block 41 (F41.)

5.1.3 Check the parameter related to the control

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

Setup example:
Control action: PID control (reverse action) [Suffix code: F]
Control output: OUT1, Relay contact output, Proportional cycle time: 20 seconds



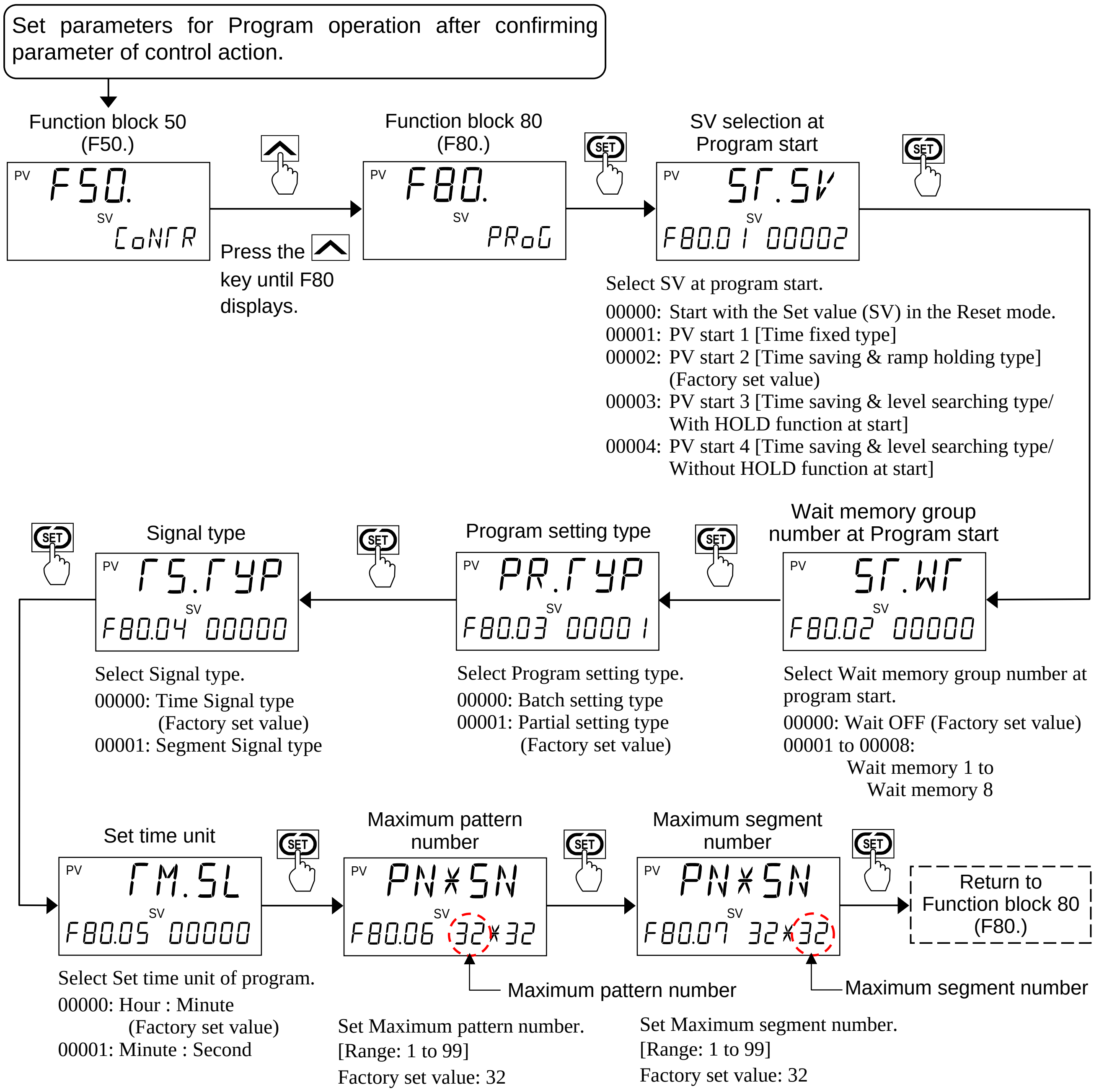


Control action at Pattern end and Proportional cycle time may be set in the Setup setting mode.

5.1.4 Check set value of parameter for program control operation

Parameter settings related to Program control operation can be checked at F80 in Engineering mode.

Setup example:
Number of program pattern: 32
Number of segment: 32



Maximum pattern number x Maximum segment number = 1024 maximum

NOTE

When changing a Maximum pattern number or Maximum segment number, all parameters related to Program setting such as Segment level and Segment time will be initialized automatically.

<u>Parameter to be initialized</u>

Parameter setting mode:
- Parameter at Program setting block
- Wait zone high and Wait zone low at the Wait memory group setting block
- Output program value from 1 to 3 at the Output program memory group setting block
- Parameter at the Time signal memory group setting block

SV setting mode:
- Execution pattern number

Setting by RKC communication:
- Pattern tag name

5.2 Operating Precautions

Check the following precautions before starting operation.

■ Power ON

Once power is restored to the instrument the operation mode will return as it was before the power went OFF. The operation mode is displayed after the Input type and Input range.
[Factory set value: Reset mode (RESET)]

Action at power ON can be selected at Hot/Cold start of F50.02 in the Engineering mode.

For Hot/Cold start, refer to **6.5.5 Start action at recovering power failure (P. 6-115)**.

■ Action at input error

If the input signal wiring is disconnected or short-circuited (RTD input only), the instrument determines that burnout has occurred.

● Burnout direction

Thermocouple input, RTD input, Voltage (low) input:
Conforms to the setting of Burnout direction in the Engineering mode F21.08.
0: Upscale (Factory set value) 1: Downscale
Voltage (high) input, Current input:
Downscale or indicate the value near 0

● Output at input error

Control output: Conforms to the setting of Action (high) at input error or Action (low) at input error in the Engineering mode F50.
0: Normal control (Factory set value) 1: Manipulated output value at input error

Event output: Conforms to the setting of Event output action at input error in the Engineering mode F41. to F44.

	When PV reaches Input error determination point (high) or higher temperature:	**When PV reaches Input error determination point (low) or lower temperature:**
0	Conforms to Event action	Conforms to Event action
1	ON	Conforms to Event action
2	Conforms to Event action	ON
3	ON	ON
4	OFF	OFF

Factory set value: 0 (Conforms to Event action)

■ Check each parameter

Control target value and parameters should be appropriate for the application when setting Segment level, Set value (SV) or parameters. There are parameters in Engineering mode which can not be changed when the controller is in the RUN mode, the FIX mode and the MAN mode. Switch to the RESET mode to set the parameters in Engineering mode.

For mode switching or parameters, refer to **4. BASIC OPERATION (P. 4-1)** and **6. FUNCTION AND SETTING PROCEDURE (P. 6-1)**.

■ Event hold action

Event hold action becomes active when turning on the instrument or starting Event (only for event with hold action).

■ Operation when power failure

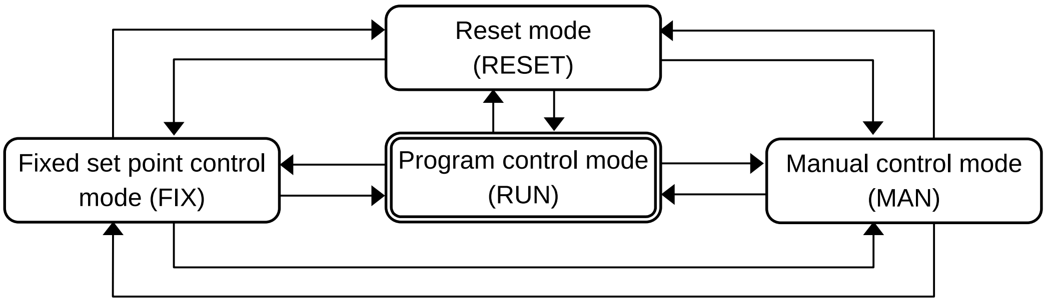
A power failure of 20 ms or less will not affect the control action. When a power failure of more than 20 ms occurs the instrument assumes that the power has been turned off. When restarting following a power failure, the instrument will restore to the Hot/Cold start setting.

For Hot/Cold start, refer to **6.5.5 Start action at recovering power failure (P. 6-115)**.

5.3 Type and Switching Procedures of Operation Mode

5.3.1 Type of Operation mode

PF900/PF901 offers 4 type of Operation mode. It is possible to switch any type within the Operation mode.



● Reset mode (RESET)

Initializes the program operation and produces the Manipulated output value set at the Reset mode.
Action stop or Action continued for Event or Transmission output may be selected at the Reset mode.

● Program control mode (RUN)

Controls based on the program pattern being set.

● Fixed set point control mode (FIX)

Controls with the Set value (SV) being set at the Fixed set point control mode.

● Manual control mode (MAN)

Set Manipulated output value manually.

5.3.2 Operation mode switching

■ Action at Operation mode switching

Refer to the table below for the action at Operation mode switching.

<table>
<tr><th></th><th colspan="4">Operation mode before switching</th></tr>
<tr><th>Operation mode after switching</th><th>Reset mode (RESET)</th><th>Program control mode (RUN) [1]</th><th>Fixed set point control mode (FIX)</th><th>Manual control mode (MAN)</th></tr>
<tr><td>Reset mode (RESET)</td><td></td><td colspan="3">Produces the Manipulated output value set at the Reset mode.</td></tr>
<tr><td>Program control mode (RUN)</td><td rowspan="2">Action starts based on the Control computation result.</td><td></td><td>Action continues with the SV in the Program control mode. [1]</td><td rowspan="2">Action continues with Manual manipulated output value. (Bumpless transfer [2])</td></tr>
<tr><td>Fixed set point control mode (FIX)</td><td>Action continues with the SV in the Fixed set point control mode.</td><td></td></tr>
<tr><td>Manual control mode (MAN)</td><td>Action starts with Manual manipulated output value (the output value in the Reset mode).</td><td>Action continues with Manual manipulated output value (the last output value in the Program control mode).</td><td>Action continues with Manual manipulated output value (the last output value in the Fixed set point control mode).</td><td></td></tr>
</table>

[1] Once Program control mode is restarted, the program state will return as it was before switched to the Fixed control mode (FIX) or the Manual control mode (MAN). If the Program control mode is switched to the RESET mode, program state will be reset and the operation restarts from the beginning of the program when switching to the Program control mode.

[2] When changing to the operation mode with the control action P, PD or ON/OFF, output may bump when using Bumpless switch (control output does not change rapidly).

■ Switching procedure of Operation mode

4 types of mode switching procedure:

- Parameter for Operation mode switching
- Direct key for Operation mode switching
- Digital input (DI) for Operation mode switching
- Host communication for Operation mode switching

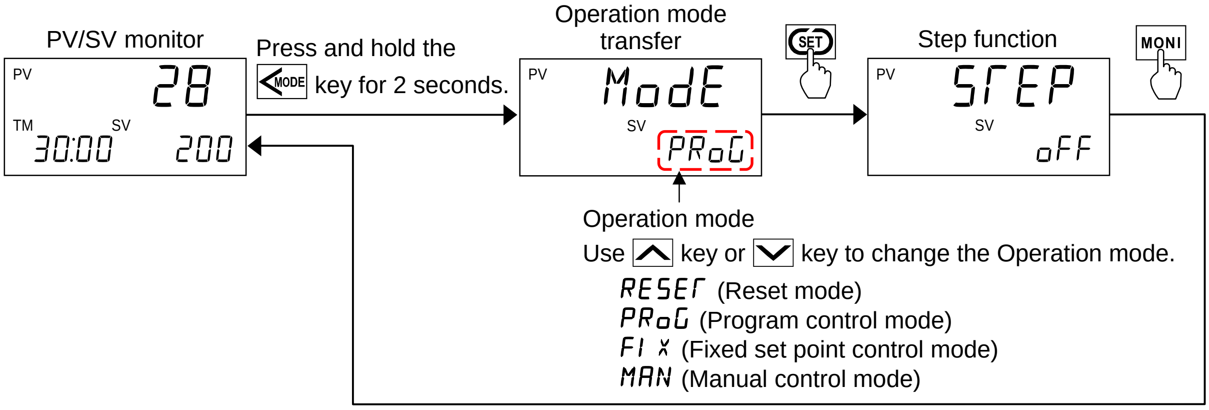
NOTE

Switching procedure does not affect the Operation mode. The Operation mode being selected last is validated. Operation mode cannot be changed by the Operation mode switching parameter, the Direct key or the Host communication when RESET or RUN of Digital input (DI) is ON (contact closed).

● When switching by the Operation mode switching parameter

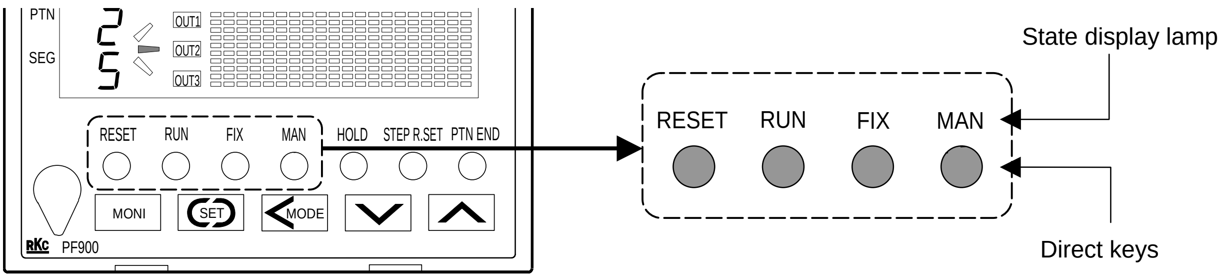
Switch the Operation mode by using [UP] key or [DOWN] key at the Operation mode transfer screen.

Release the Set data lock before changing the Operation mode.



● When switching by the Direct key

Use the front direct key.



Switch the Operation mode by using the direct key. The State display lamp turns from green to orange (State display lamp turns OFF when switching operation is not possible.) Displays the PV/SV monitor screen of the Operation mode last selected.

Direct key	Operation mode	State display lamp	Display
RESET	Reset	RESET lights [Orange]	PV/SV monitor screen of each Operation mode
RUN	Program control	RUN lights [Orange]	
FIX	Fixed set point control	FIX lights [Orange]	
MAN	Manual control	MAN lights [Orange]	

It is possible to invalidate the operation by using the direct keys. For direct key usage, refer to **■ Direct key type (P. 4-8)**.

● When switching by the Digital input (DI)

DI switching by using DI7 and DI8 is only available when switching to the Reset mode (RESET) or the Program control mode (RUN).

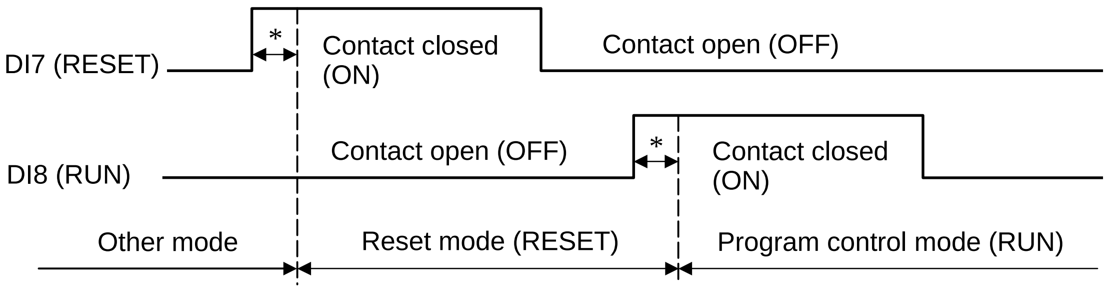
- Set 0, 1, 4 or 5 at the Digital input (DI) assignment of the Engineering mode F23.01 before switching mode by using DI.

DI assignment from DI7 to DI11 (DI7: RESET mode, DI8: RUN mode)

	DI7	DI8	DI9	DI10	DI11
0	RESET	RUN	STEP	HOLD	PTN32
1	RESET	RUN	STEP	PTN32	PTN64
2	PTN1	PTN2	PTN4	PTN8	P.SET
3	PTN1	PTN2	PTN4	PTN8	PTN16
4	RESET	RUN	STEP	HOLD	Direct/Reverse
5	RESET	RUN	STEP	HOLD	PTN_INC

☞ For Engineering mode parameters, refer to **4.5.5 Engineering mode (P. 4-33)**.

- Close (ON*) the contact of DI7 to switch to the Reset mode (RESET). To switch to the Program control mode (RUN), open (OFF) the contact of DI7 and close (ON*) the contact of DI8.



* Detects edge at start-up and judges that DI is validated when the contact is in ON state for at least 200 ms + 1 sampling cycle.

☞ Refer to **6.1.9 Digital input (DI) (P. 6-14)** for terminal configuration or procedure of DI switching.

● When switching by the Host communication

Refer to the communication data below when switching the Operation mode by the Host communication (RKC communication or Modbus).

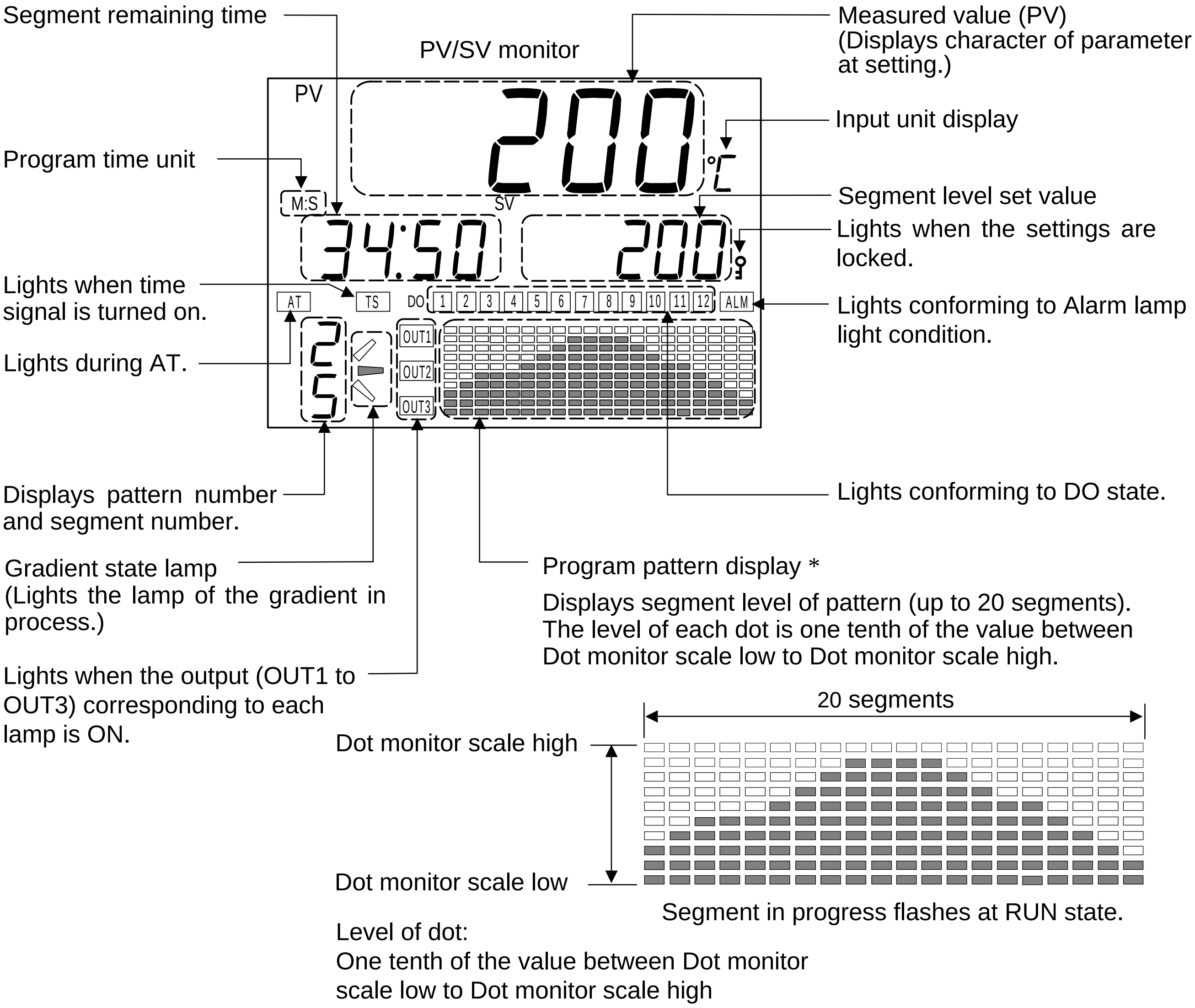
- Communication data

Name	RKC communication		Modbus		Attribute	Data range	Factory set value
	Identifier	Digits	Register address DEC	Register address HEX			
Operation mode transfer	XM	7	41	0029	R/W	0 to 3 0: Reset mode (RESET) 1: Program control mode (RUN) 2: Fixed set point value control mode (FIX) 3: Manual control mode (MAN)	0

☞ For details of the host communication, refer to **7. HOST COMMUNICATION [OPTIONAL] (P. 7-1)**.

5.4 Program Control Operation

5.4.1 Program control mode display



* To display Program pattern, select Program pattern type at Dot monitor type (ddrP) of F10.02 in the Engineering mode (Factory set value: Program pattern type).
(Factory set value: Program pattern type)

📖 Set Alarm lamp light condition at F10 in the Engineering mode.

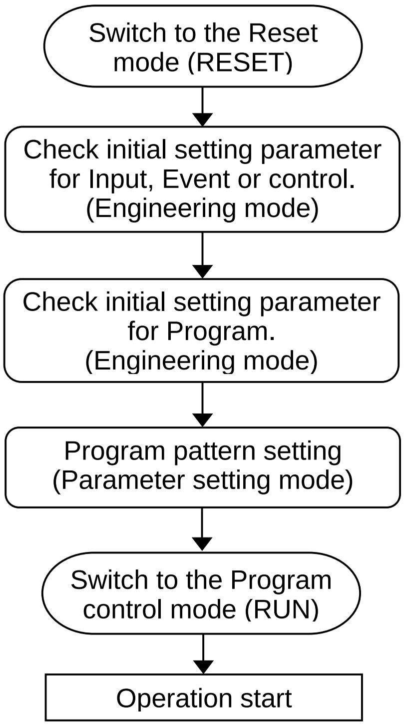
📖 Set DO type at F34 in the Engineering mode.

📖 Set parameter for Program pattern display at F10 in the Engineering mode.

☞ For Program pattern display, refer to **6.3.1 Graph display selection (P. 6-54)**.

☞ Refer to **6.6.8 Pattern end (P. 6-169)** for the display of Segment remaining time monitor at Pattern end.

5.4.2 Program control operation procedures



Go to the Reset mode (RESET) to set parameters in the Engineering mode.

☞ Refer to **5.3.2 Operation mode switching (P. 5-9)**.

Before starting operation, confirm that the setting of parameters for Input, Event or control matches the model code as specified when ordered.

Comply with the working conditions when setting other parameters.

☞ Refer to **5.1 Initial Setting (P. 5-2)**.

Set number of pattern or segment to be used, or unit for program time.

☞ Refer to **5.1.4 Check set value of parameter for program operation (P. 5-7)**.

Set parameter for pattern or segment of program.

☞ Refer to **5.4.3 Set up program patterns (P. 5-13)**.

Go to the Program control mode (RUN) to start program operation.

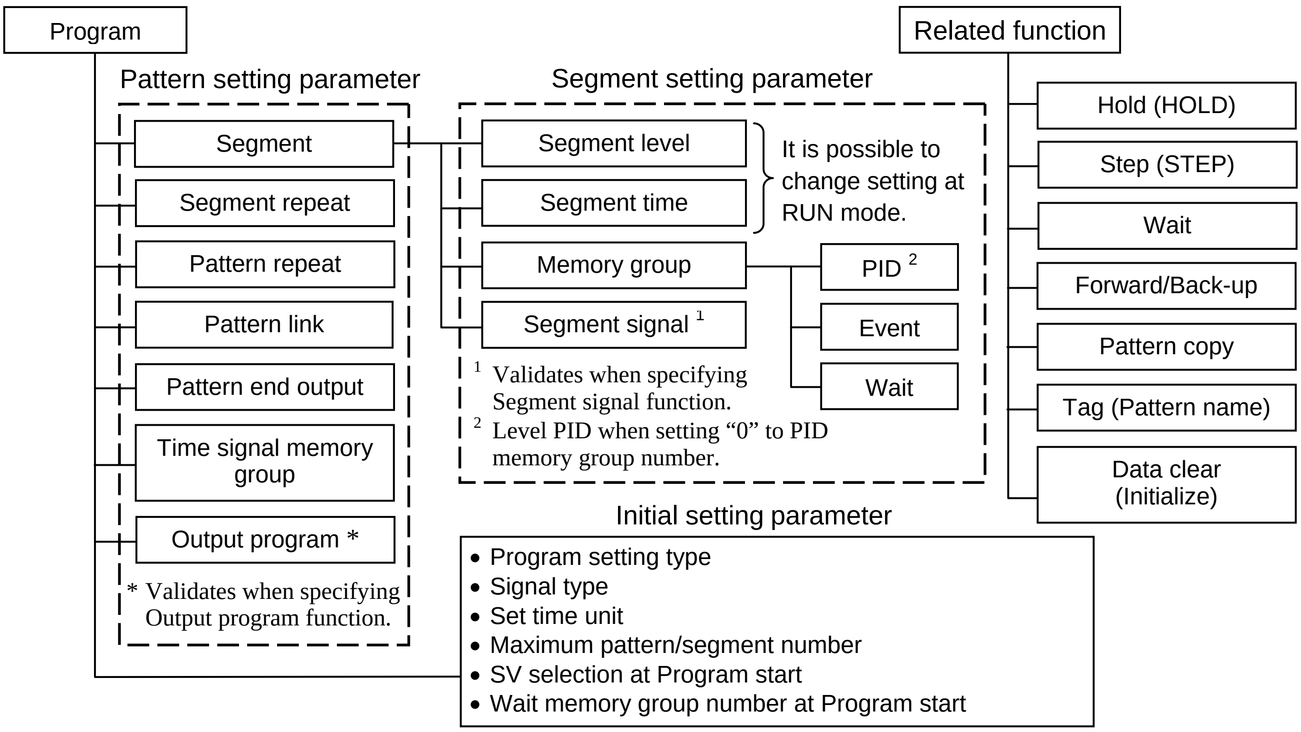
☞ Refer to **5.4.4 Start/End Program control (P. 5-21)**.

5.4.3 Set up program patterns

■ Configuration parameter for program

Program consists of parameters for pattern setting, segment setting, initial setting and function setting of program operation. It is possible to set 99 patterns and 1024 segments at the maximum. (Up to 99 segments for each pattern)

☞ Refer to **6.6 Program Control (P. 6-143)** for the parameters.



■ Setting example of program pattern

- Setting example of the program pattern is described by using the following data:

Pattern number	1				
Segment number	SEG1	SEG2	SEG3	SEG4	SEG5
Segment level	150 °C	150 °C	250 °C	250 °C	100 °C
Segment time	30 min.	45 min.	45 min.	70 min.	40 min.
PID memory group number	1	1	2	2	1
Event memory group number	1	1	1	1	1
Wait memory group number	1	1	1	1	1

SEG: Segment
TS: Time signal

Time signal memory group number	1	
Time signal memory number	1	2
Time signal output assignment	TS1	TS1
Start segment of time signal	2	4
Time signal start time	10 min.	15 min.
End segment of time signal	3	5
Time signal end time	20 min.	10 min.

Pattern repeat execution time	2
Link pattern number	1 (No pattern link)
Pattern end output duration	30 sec.
Wait zone high	10 °C
Wait zone low	–10 °C
Wait release trigger selection	Zone wait 1

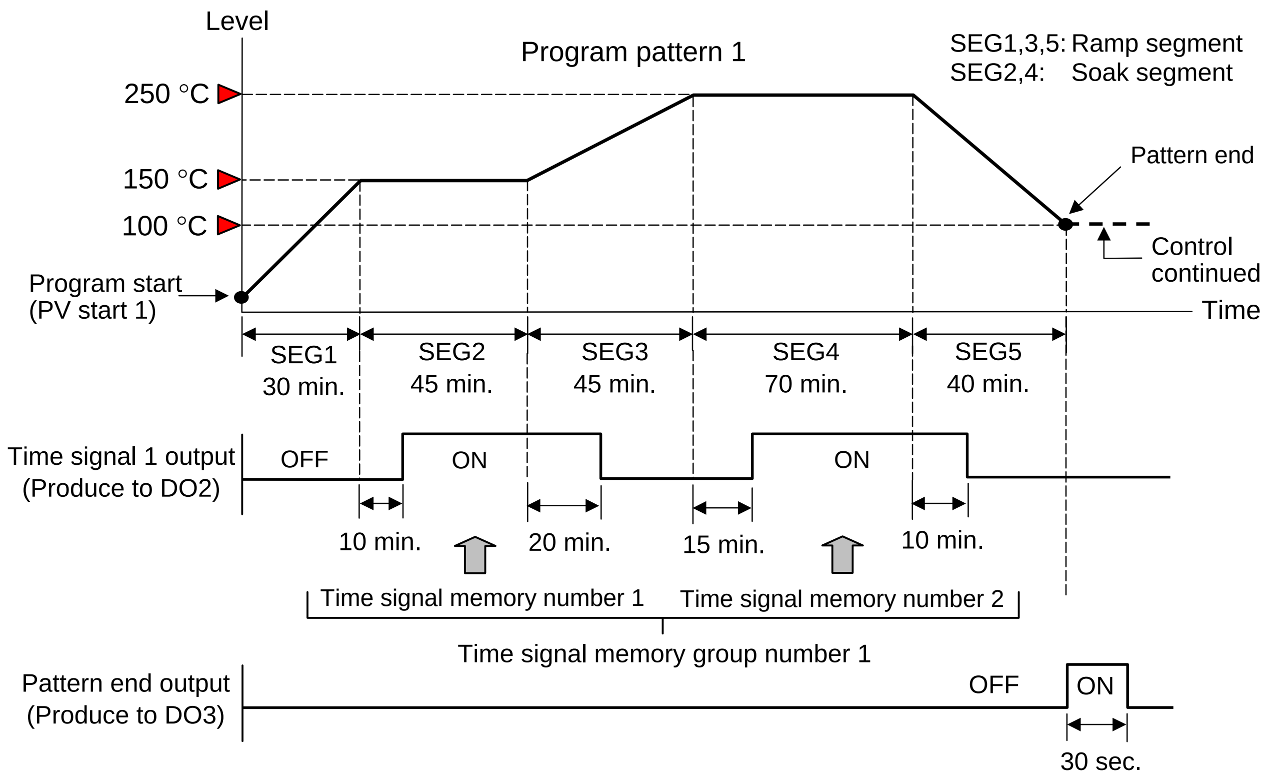
- Refer to the following values for the Initial setting parameters:

Function block 34 (F34.)	
DO2 assignment	1: Time signal 1
DO3 assignment	25: Pattern end signal

Function block 50 (F50.)	
Control action at Pattern end	0: Control continued

Function block 80 (F80.)	
SV selection at Program start	1: PV start 1 [Time fixed type]
Wait memory group number at Program start	0: Wait OFF
Program setting type	1: Partial setting type
Signal type	0: Time signal type
Set time unit	1: Minute : Second
Maximum pattern number	32: 32 pattern
Maximum segment number	32: 32 segment

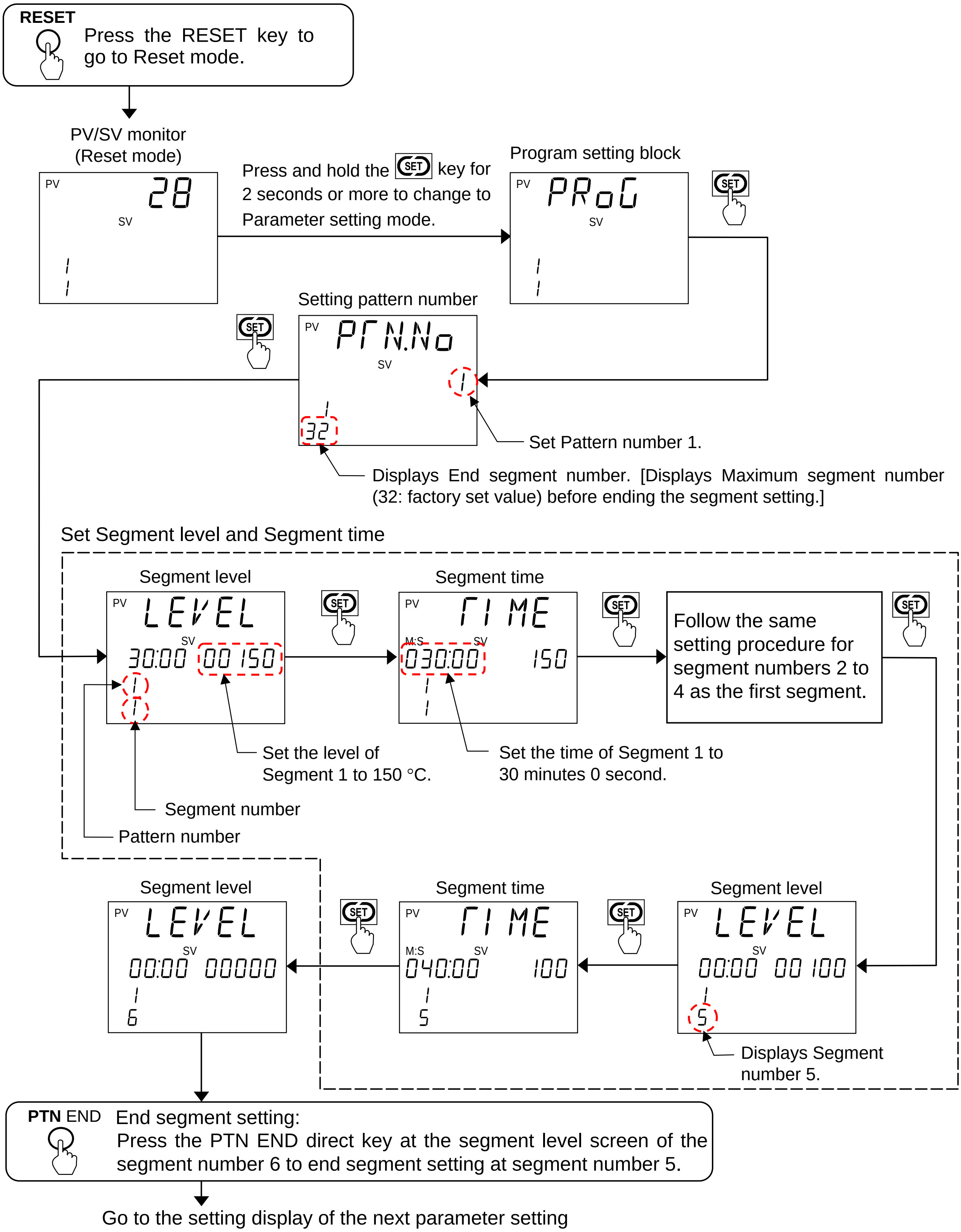
☞ For the initial setting parameter, refer to **4.5.5 Engineering mode (P. 4-33) and 5.1.4 Check set value of parameter for program control operation (P. 5-7)**.

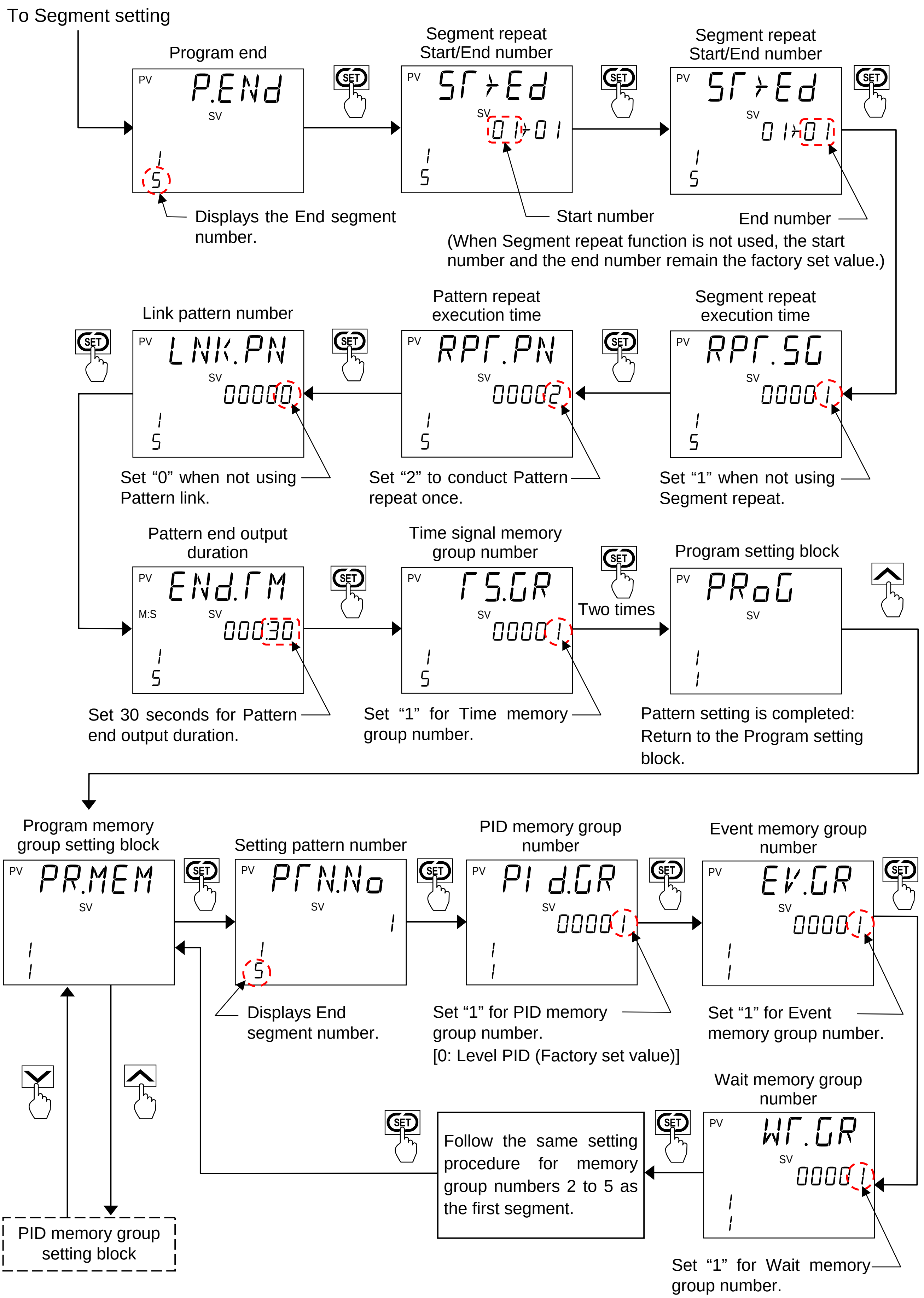


■ Setting procedure for program pattern

Setting procedure of the program pattern is described by using the parameters of the setting example and the Partial setting type (Factory set value).

☞ For Batch setting type, refer to ■ **Parameter switching [Batch setting type]** of **4.5.3 Parameter setting mode (P. 4-28)**.





☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

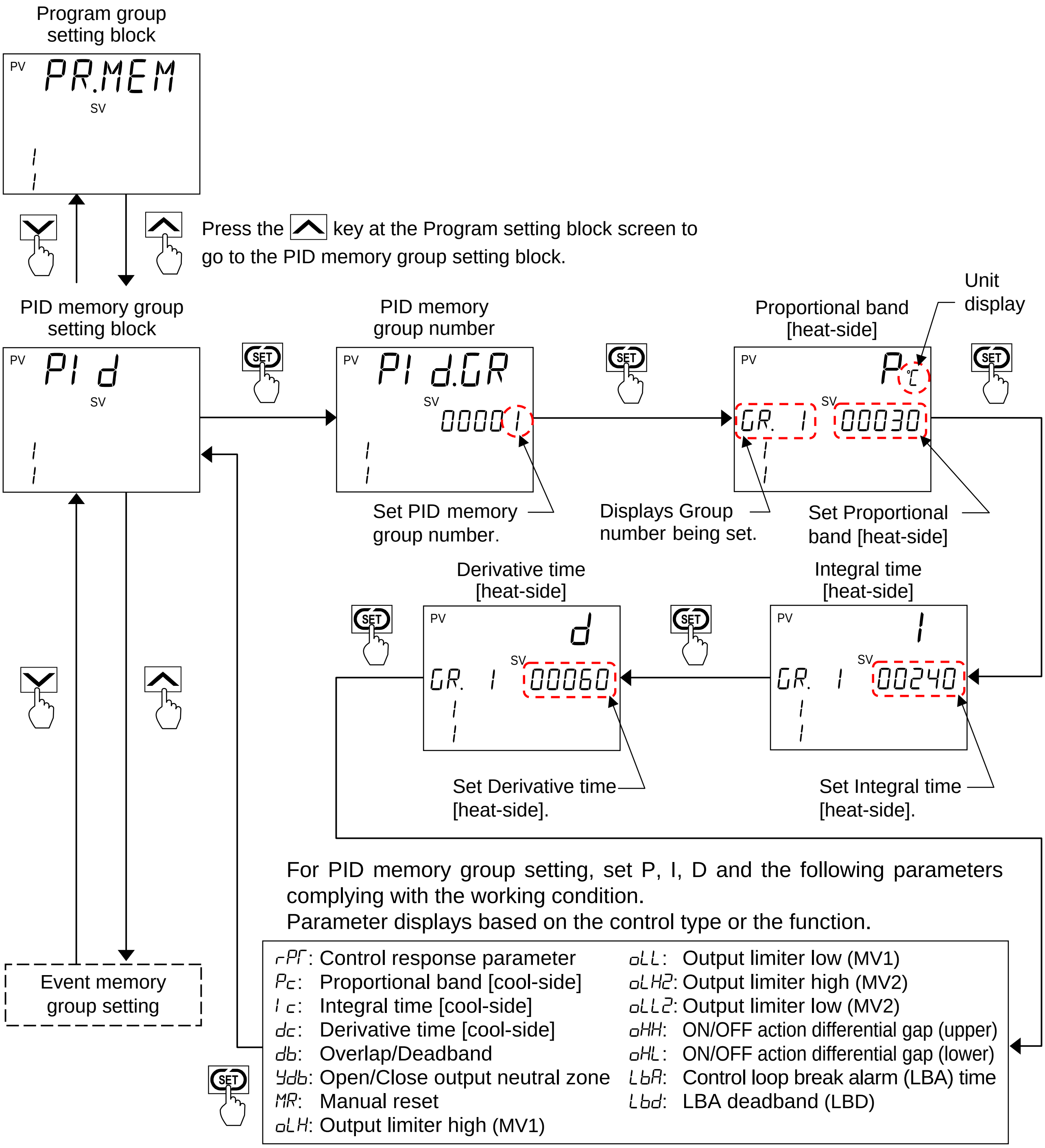
■ Parameter setting procedure for Memory group

Set the parameter of the following Memory groups after completing Program pattern setting.

- PID memory group
- Event memory group
- Wait memory group
- Time signal memory group

☞ For Memory group function, refer to **6.6.1 Memory group (P. 6-144)**.

● Parameter setting for PID memory group



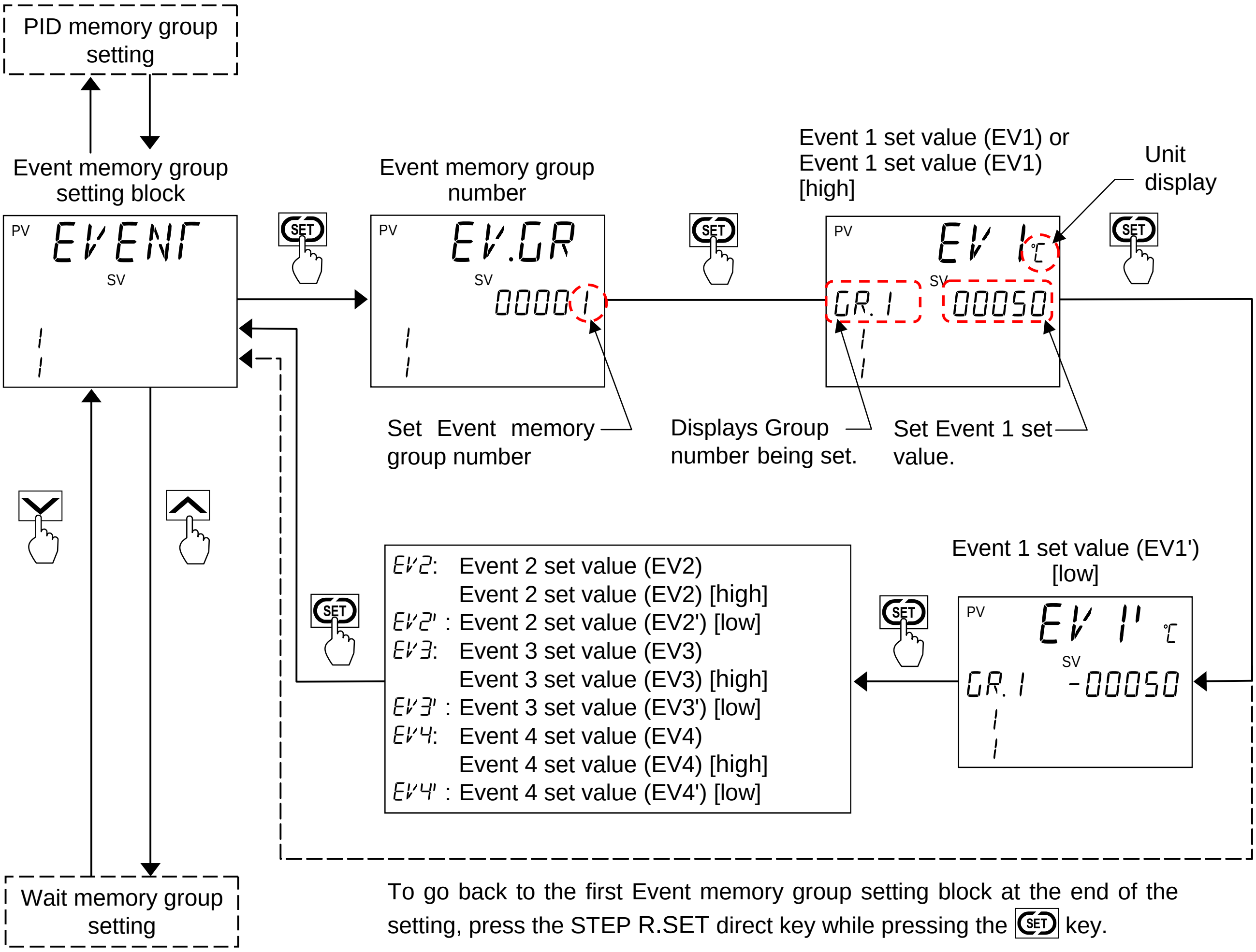
- Set the parameters for PID memory group number 2 in the same setting procedure as group number 1.

☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

☞ Refer to **6.5 Control (P. 6-88)** for the parameters related to control.

● Parameter setting for Event memory group

Set the Event memory group after PID memory group.



📖 Event set value from 1 to 4 (EV1 to 4) [high] and Event set value from 1 to 4 (EV1' to 4') [low] display when selecting Deviation high/low (High/Low individual setting) or Band (High/Low individual setting) at function blocks from 41 (F41.) to 44 (F44.) in the Engineering mode.

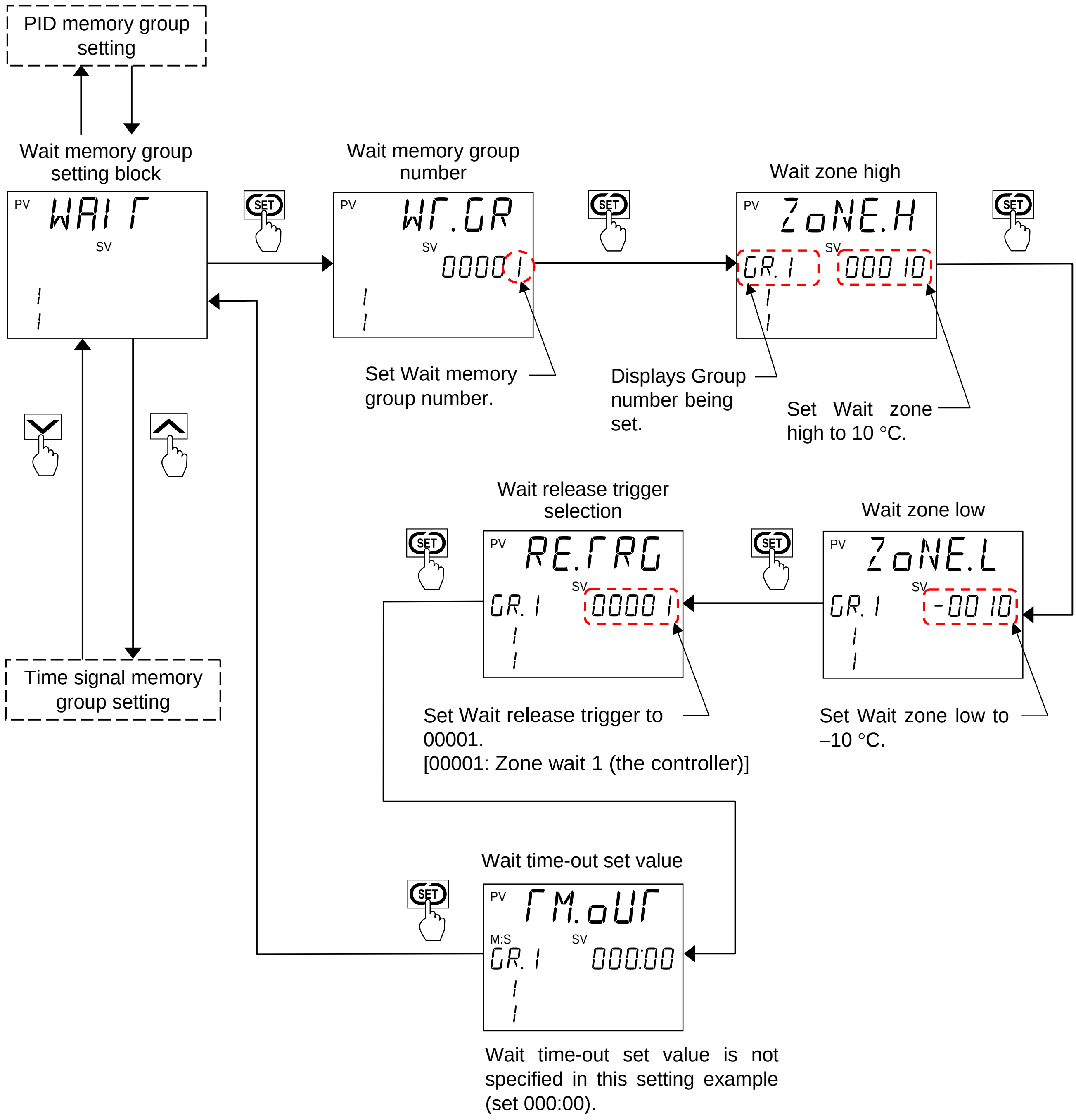
📖 When setting “0” to Event type at the function block 41 (F41.) to 44 (F44.) in the Engineering mode, the Event setting screens for relative parameters do not display. When setting “0” to all parameters of Event 1 to Event 4, all screens related to Event do not display, including the Event memory group setting block screen.

☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

☞ For Event function, refer to **6.4.1 Setting procedure of Event 1 to 4 (P. 6-61)**.

● Parameter setting for Wait memory group

Set the Wait memory group after Event memory group.

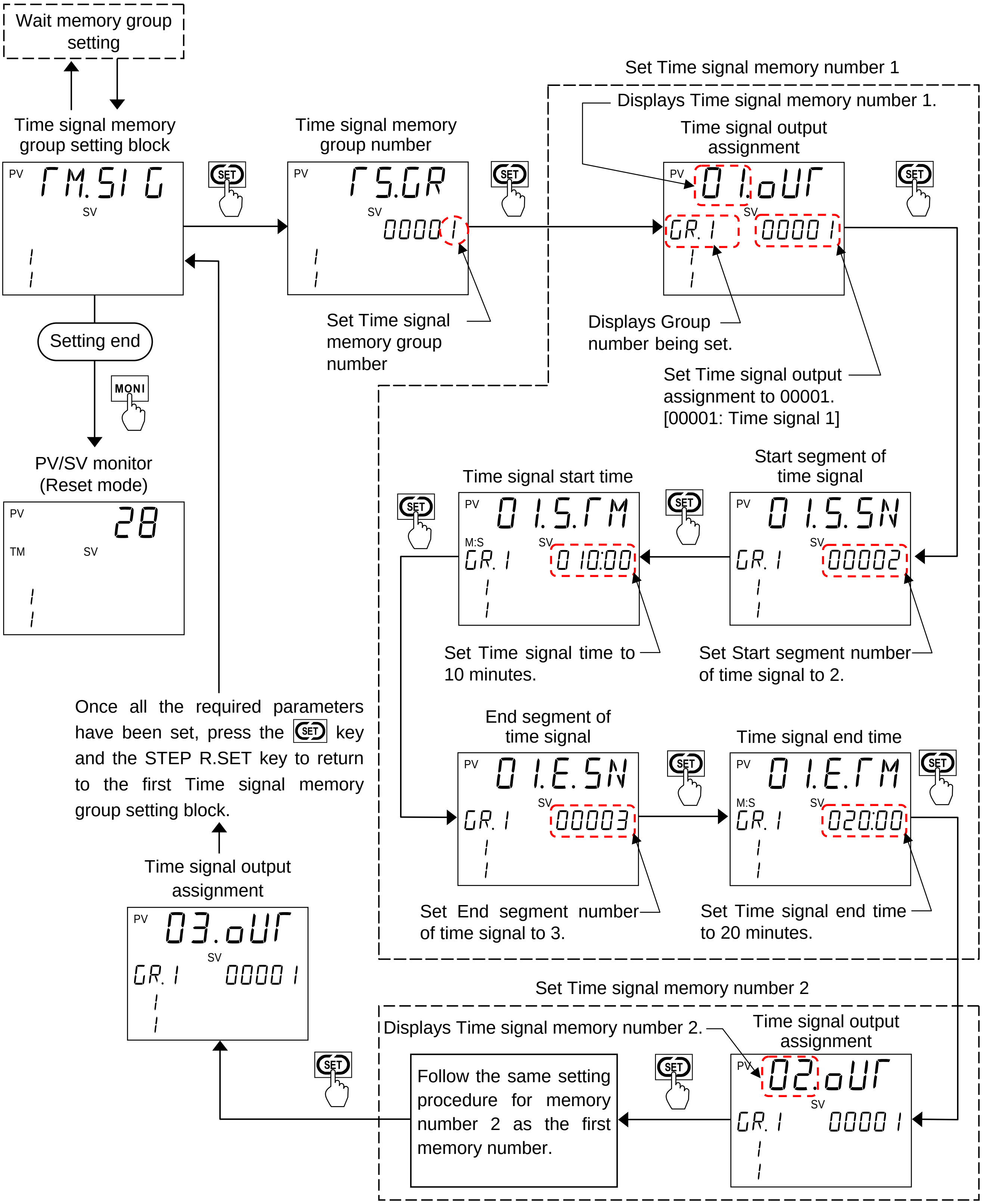


☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

☞ For Wait function, refer to **6.6.6 Wait (P. 6-158)**.

● Parameter setting for Time signal memory group

Set Time signal memory group after Wait memory group. Time signal memory group consists of time signal setting with 16 memory groups.



☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

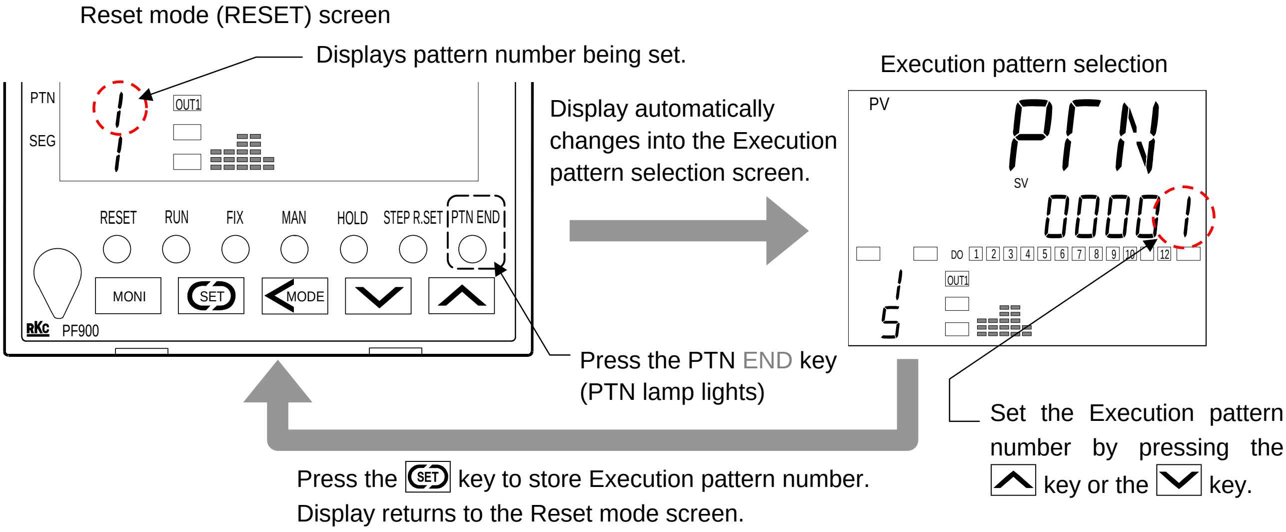
☞ For Time signal function, refer to **6.6.9 Time signal (Segment signal) (P. 6-174)**.

5.4.4 Start/End Program control

■ Start Program control

● Execution pattern selection

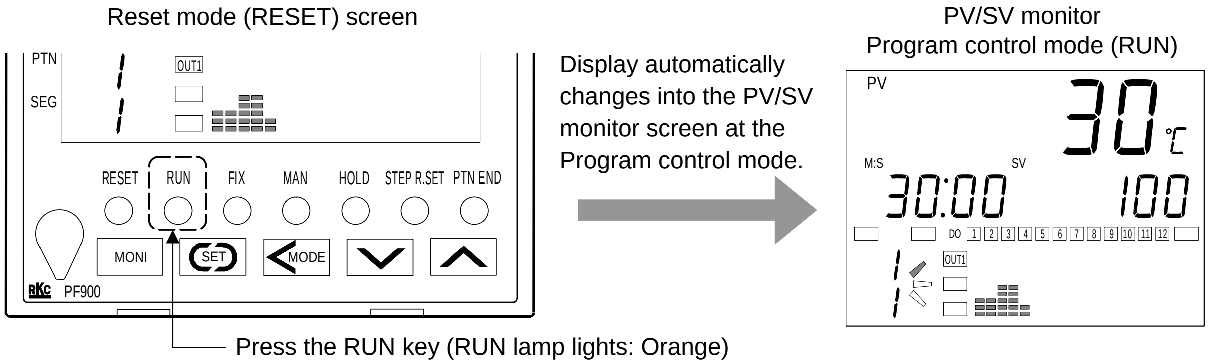
Press the PTN END key at the Reset mode (RESET) to go to the Execution pattern selection screen to set the Execution pattern number.



Tag name setting will enable the display to show a tag name instead of the Pattern number.
Refer to **6.6.12 Tag function (P. 6-191)** for Tag name.

● How to switch to the Program control mode

To switch to the Program control mode (RUN) and start operation, press the RUN key in the Reset mode (RESET).



● Action at switching to the Program control mode

Refer to the table below for action at switching to the Program control mode from the other operation modes.

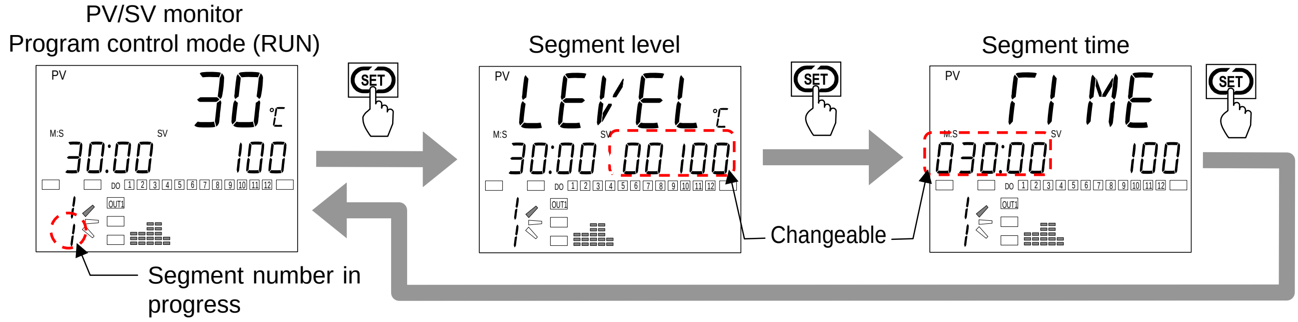
	Operation mode before switching			
Operation mode after switching	Reset mode (RESET)	Program control mode (RUN)	Fixed set point control (FIX)	Manual control mode (MAN)
Program control mode (RUN)	Action starts based on the Control computation result.		Action continues with the SV in the Program control mode. [1]	Manual manipulated output value. (Bumpless transfer [2])

[1] Once Program control mode is restarted, the program state will return as it was before switched to the Fixed control mode (FIX) or the Manual control mode (MAN). If the Program control mode is switched to the RESET mode, program state will be reset and the operation restarts from the beginning of the program when switching to the Program control mode.

[2] When changing to the operation mode with the control action P, PD or ON/OFF, output may bump when using Bumpless switch (control output does not change rapidly).

● Segment level/Segment time change in the Program control mode (RUN)

Segment level and Segment time in progress may be changed in the Program control mode (RUN).



☞ Refer to the following pages for the functions related to the Program control operation.

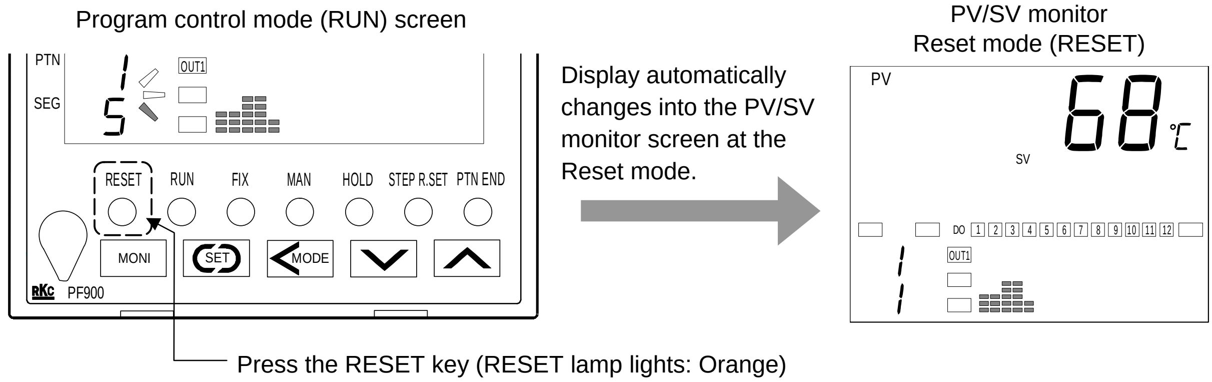
6.6.1 Memory group ....P. 6-144
6.6.2 Program control start selection ....P. 6-148
6.6.3 Search function ....P. 6-154
6.6.4 Hold (HOLD) ....P. 6-156
6.6.5 Step (STEP)..P. 6-157
6.6.6 Wait..P. 6-158
6.6.7 Repeat and Pattern link ....P. 6-164
6.6.8 Pattern end ....P. 6-169
6.6.9 Time signal (Segment signal) ....P. 6-174
6.6.10 Output program...P. 6-184
6.6.11 Edit function...P. 6-187
(Pattern copy/Segment copy/Data clear)
6.6.12 Tag function ....P. 6-191
6.6.13 Forward/Back-up function ....P. 6-192

☞ Refer to **6.5 Control (P. 6-88)** for the functions related to control such as Autotuning (AT), Autotuning with learning function and Level PID.

■ Stop Program control

Press the RESET key to switch to the Reset mode and stop the operation. When setting certain values to the following parameters, this instrument produces fixed Manipulated output value.

- Set value (SV) in Reset mode (SV) [Factory set value: 0]
- Manipulated output value 1 (MV1) in Reset mode [Factory set value: –5.0 %]
- Manipulated output value 2 (MV2) in Reset mode [Factory set value: –5.0 %]



☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

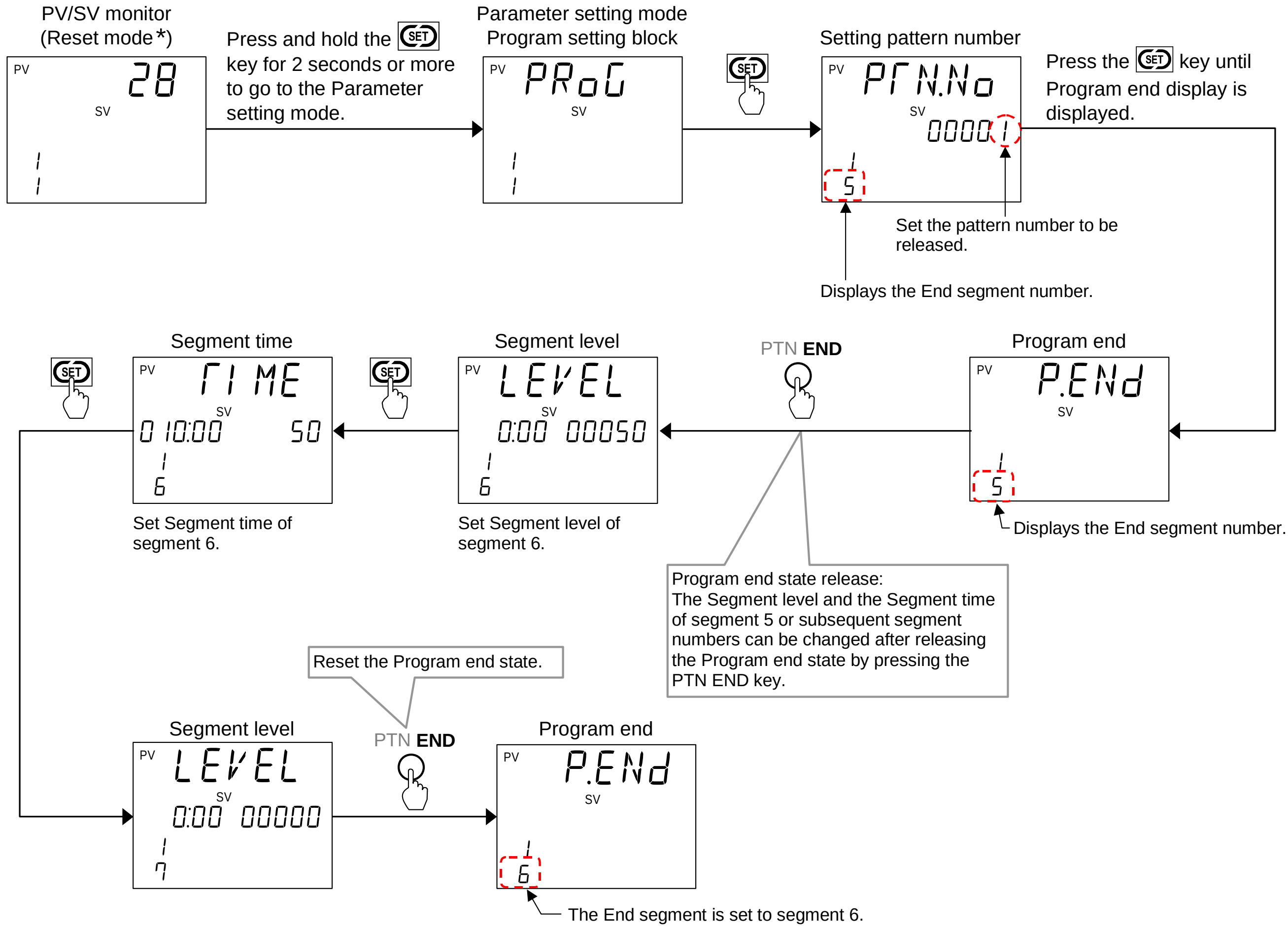
5.4.5 Changing procedure of End segment number in Program pattern

The End segment number in the composed Program pattern can be changed after releasing the Program end state.

■ Releasing procedure

Program end state will be released by switching to the Program end display and pressing the PTN END key.

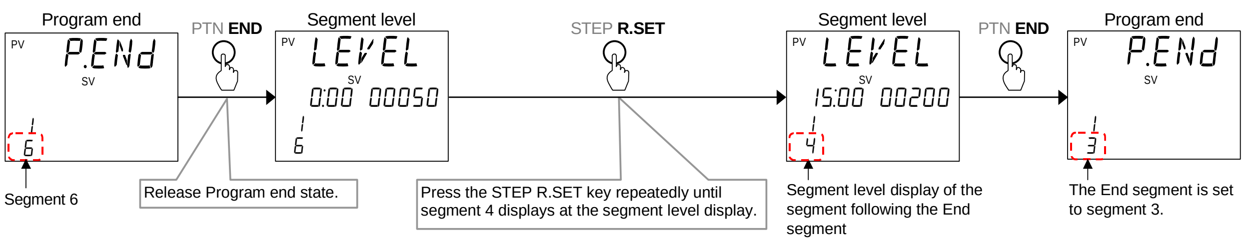
Example: When releasing the Program end state and changing the End segment number from 5 to 6
(Parameter setting in the Parameter setting mode [Partial setting type])



* To release the Program end state in the Program control mode (RUN), the Fixed set point mode (FIX), or the Manual mode (MAN), switch to the Parameter setting mode.

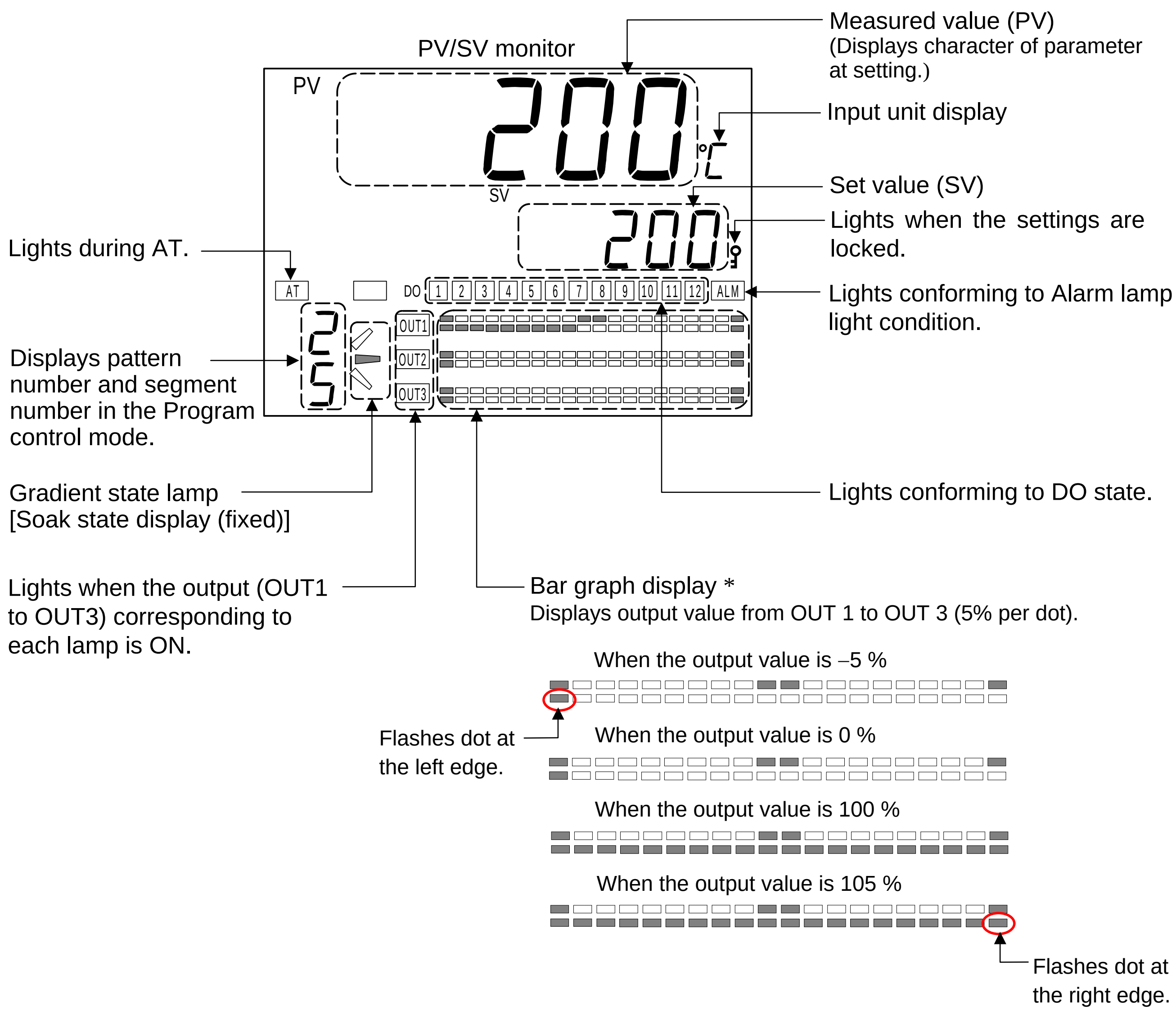
To shorten Program pattern:
Then switch to the segment level display of the segment following the End segment and press the PTN END key.

Example: To change the End segment number from 6 to 3:



5.5 Fixed Set Point Control Operation

5.5.1 Fixed set point control mode display



* To display bar graph, select Program pattern type at Dot monitor type (ddГP) of F10.02 in the Engineering mode (Factory set value: Program pattern type).
(Factory set value: Program pattern type)

Set Alarm lamp light condition at F10 in the Engineering mode.

Set DO type at F34 in the Engineering mode.

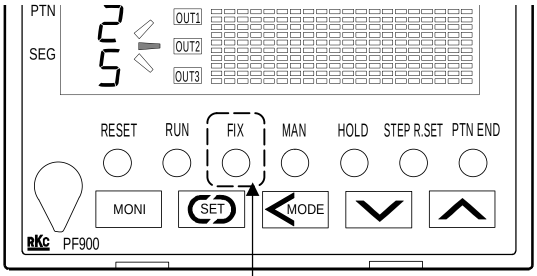
Set parameter for Bar graph display at F10 in the Engineering mode.

For Bar graph display, refer to **6.3.1 Graph display selection (P. 6-54)**.

5.5.2 Switch to Fixed set point control mode

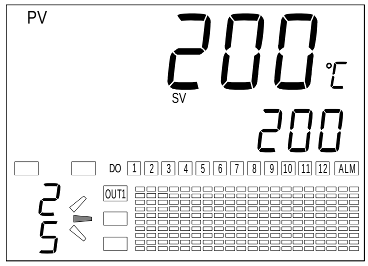
■ Start Fixed set point control

Press the FIX key to start control in the Fixed set point control mode.



Display automatically changes into the PV/SV monitor screen at the Fixed set point control mode.

PV/SV monitor
(Fixed set point control mode)



Press the FIX key (FIX lamp lights: Orange)

● Action at switching to the Fixed set point control mode

Refer to the table below for action at switching to the Fixed set point control mode from the other operation modes.

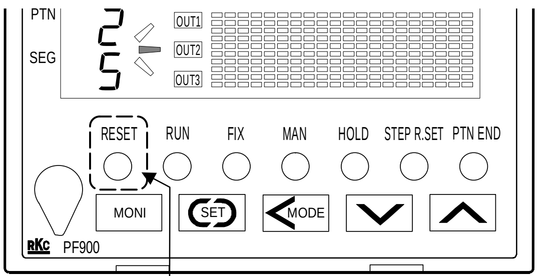
	Operation mode before switching			
Operation mode after switching	Reset mode (RESET)	Program control mode (RUN)	Fixed set point control mode (FIX)	Manual control mode (MAN)
Fixed set point control mode (FIX)	Action starts based on the Control computation result.	Action continues with the SV in the Fixed set point control mode.		Manual manipulated output value. (Bumpless transfer *)

* When changing to the operation mode with the control action P, PD or ON/OFF, output may bump when using Bumpless switch (control output does not change rapidly).

■ Stop Fixed set point control

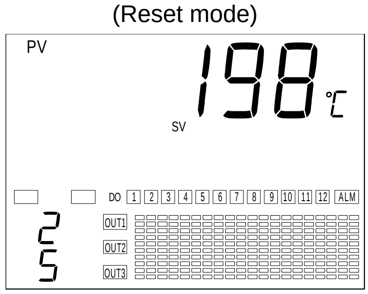
Press the RESET key to switch to the Reset mode and stop the operation. When setting certain values to the following parameters, this instrument produces fixed Manipulated output value.

- Set value (SV) in Reset mode (SV) [Factory set value: 0]
- Manipulated output value 1 (MV1) in Reset mode [Factory set value: –5.0 %]
- Manipulated output value 2 (MV2) in Reset mode [Factory set value: –5.0 %]



Display automatically changes into the PV/SV monitor screen at the Reset mode.

PV/SV monitor
(Reset mode)



Press the RESET key (RESET lamp lights: Orange)

☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

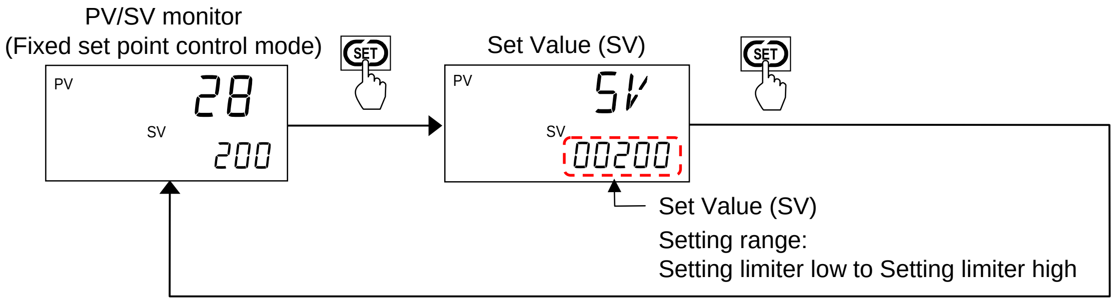
5.5.3 Parameter setting via Fixed set point control mode

Set the following parameters at the Fixed set point control mode:
- Set Value (SV)
- PID memory group
- Event memory group

☞ For details of setting method, refer to **4.2 Changing Set Value (P. 4-4)**.

■ Set value (SV)

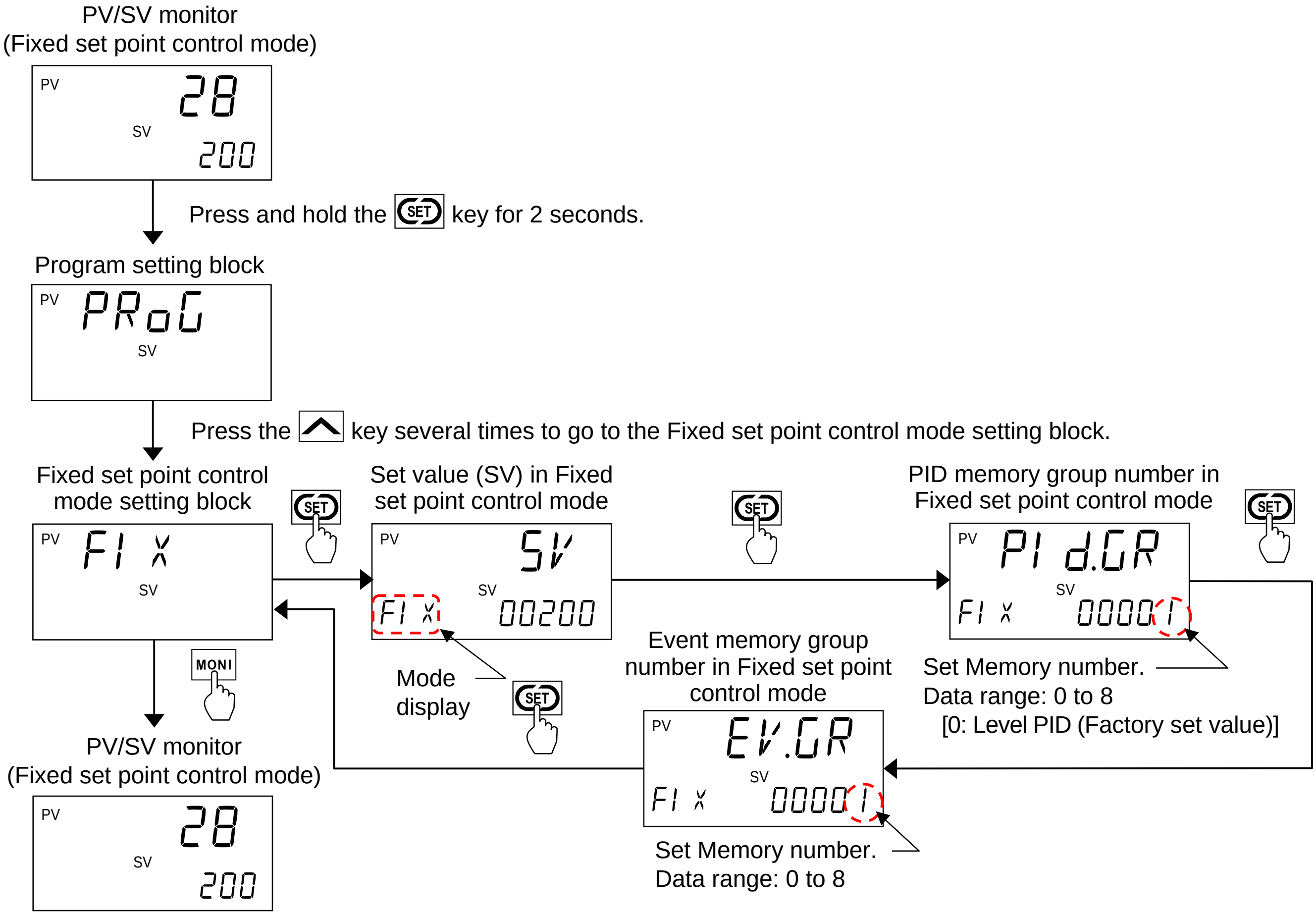
Go to the Set value (SV) setting screen by pressing the SET key at the PV/SV monitor screen in the Fixed set point control mode.



Set value (SV) can be set in the Fixed set point control mode setting block of the Parameter setting mode.

■ PID memory group number/Event memory group number

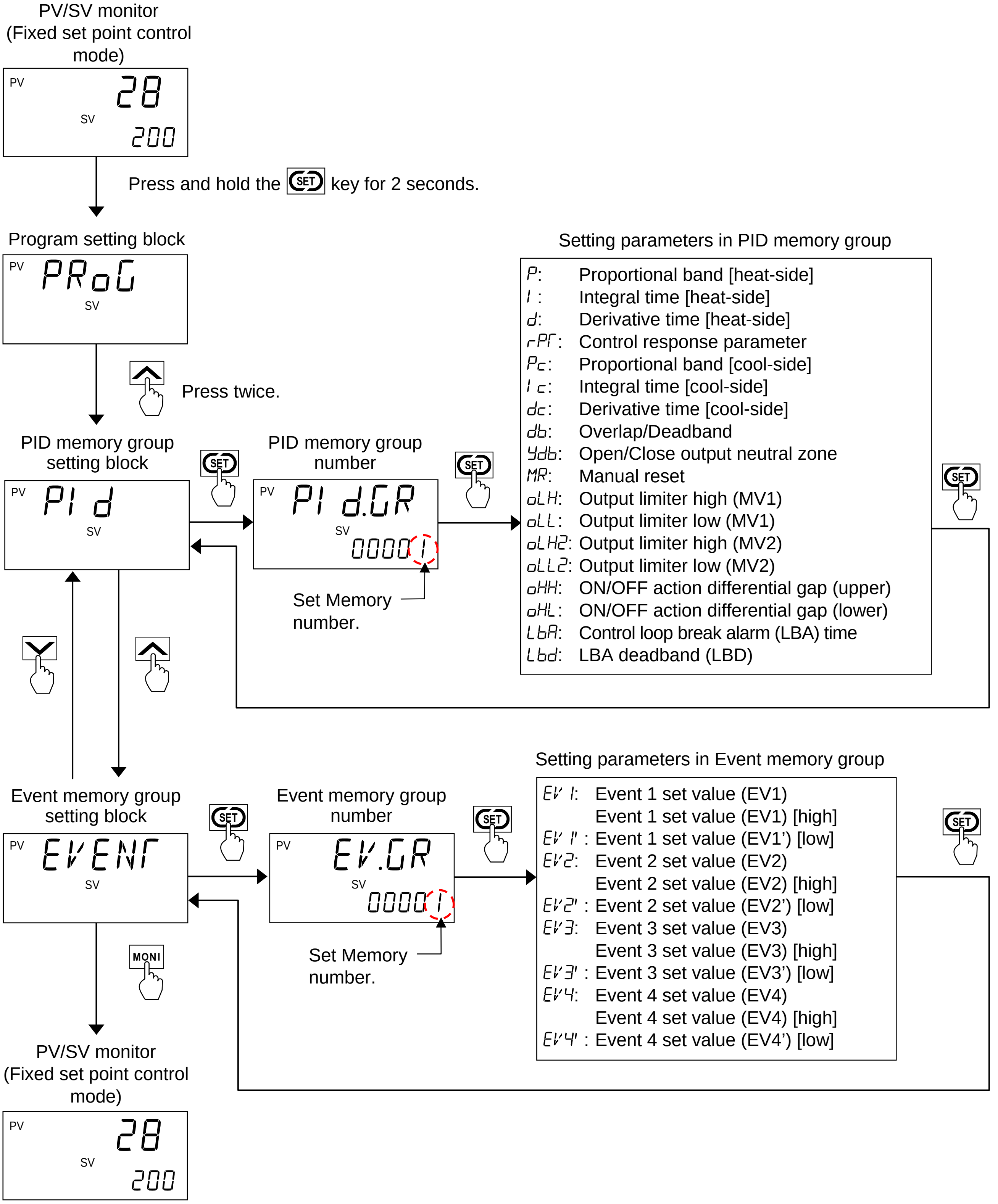
To set PID memory group number and Event memory group number to be used in the Fixed set point control mode, go to the Fixed Set point control mode setting block in the Parameter setting mode.



■ PID memory group/Event memory group

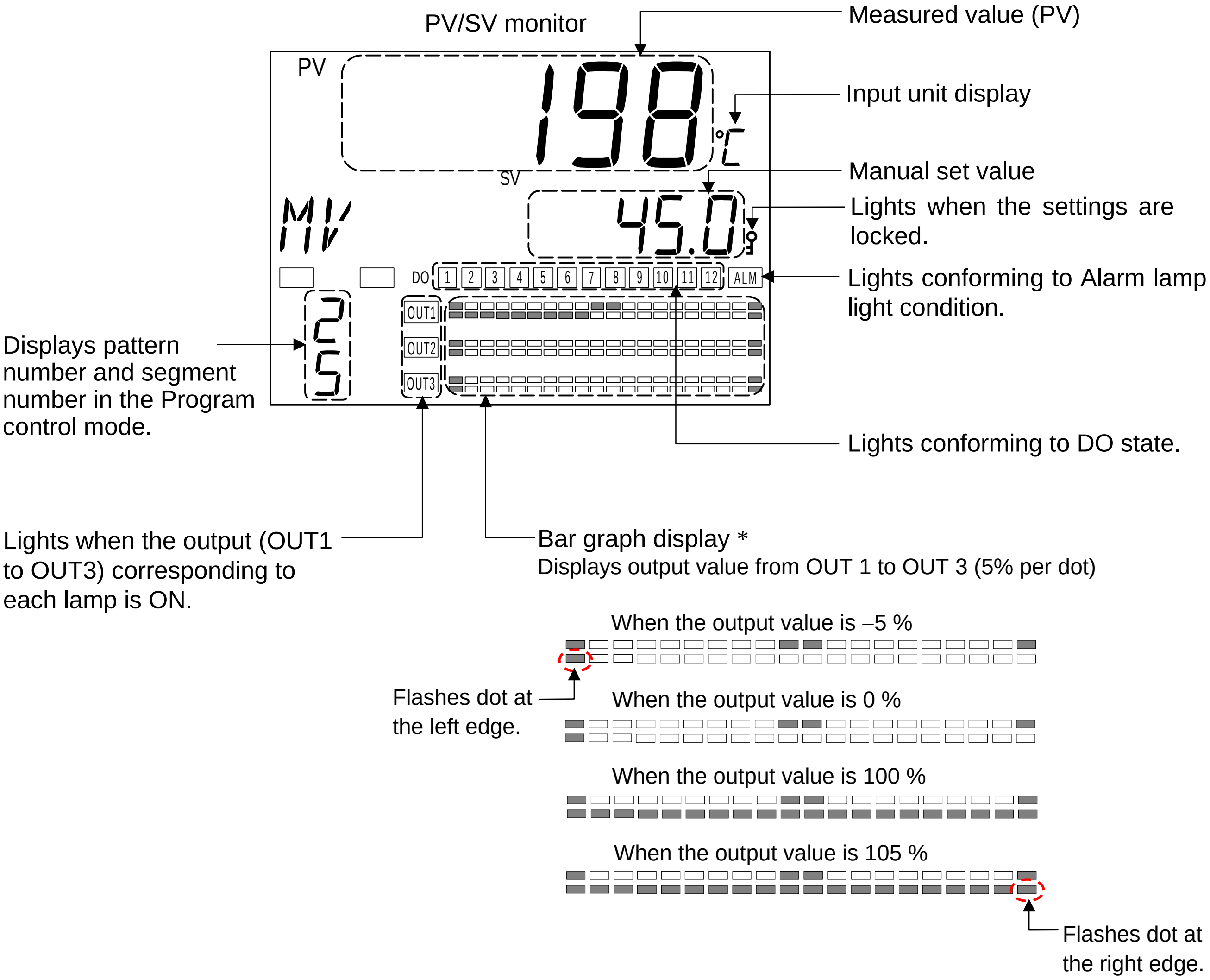
Set parameters of PID memory group at the PID memory group setting block and Event memory group at the Event memory group setting block in the Parameter setting mode. Set the parameters based on the application.

☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.



5.6 Manual Control Operation

5.6.1 Manual control mode display



* To display bar graph, select Program pattern type at Dot monitor type (ddΓP) of F10.02 in the Engineering mode (Factory set value: Program pattern type).

📖 Set Alarm lamp light condition at F10 in the Engineering mode.

📖 Set DO type at F34 in the Engineering mode.

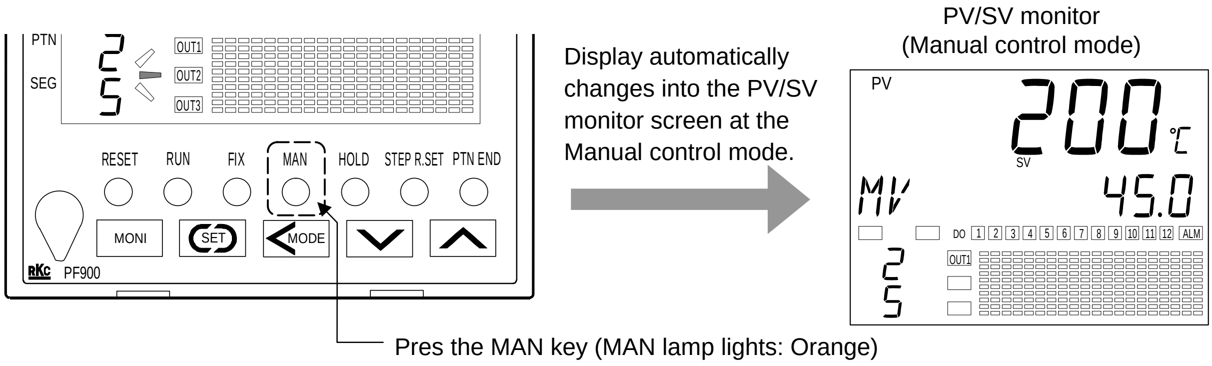
📖 Set parameter for Bar graph display at F10 in the Engineering mode.

☞ For Bar graph display, refer to **6.3.1 Graph display selection (P. 6-54)**.

5.6.2 Switch to Manual control mode

■ Start Manual control

Press the MAN key to start control in the Manual control mode. Set Manipulated output value by using the ∧ key or the ∨ key.



● Action at switching to the Manual control mode

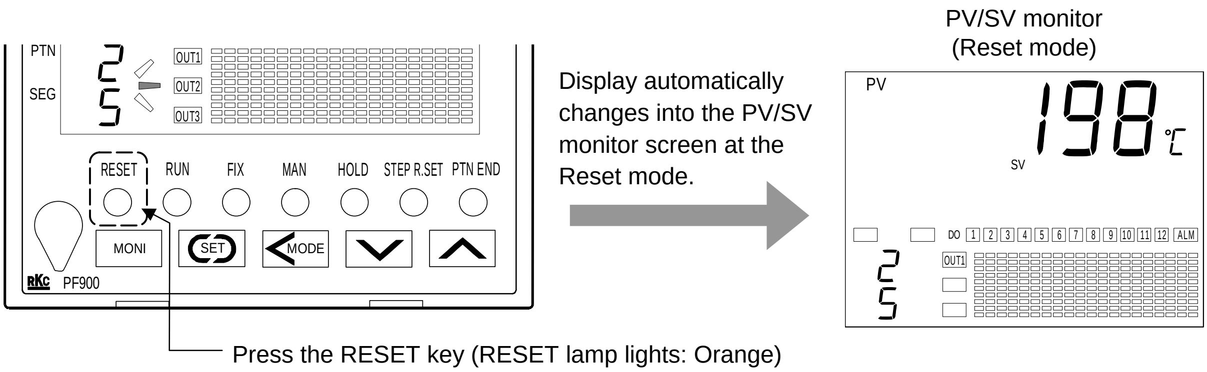
Refer to the table below for action at switching to the Manual control mode from the other operation modes.

	Operation mode before switching			
Operation mode after switching	Reset mode (RESET)	Program control mode (RUN)	Fixed set point control mode (FIX)	Manual control mode (MAN)
Manual control mode (MAN)	Action starts with Manual manipulated output value (the output value in the Reset mode).	Action continues with Manual manipulated output value (the last output value in the Program control mode).	Action continues with Manual manipulated output value (the last output value in the Fixed set point control mode).	

■ Stop Manual control

Press the RESET key to switch to the Reset mode and stop the operation. When setting certain values to the following parameters, this instrument produces fixed Manipulated output value.

- Set value (SV) in Reset mode (SV) [Factory set value: 0]
- Manipulated output value 1 (MV1) in Reset mode [Factory set value: –5.0 %]
- Manipulated output value 2 (MV2) in Reset mode [Factory set value: –5.0 %]



☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.

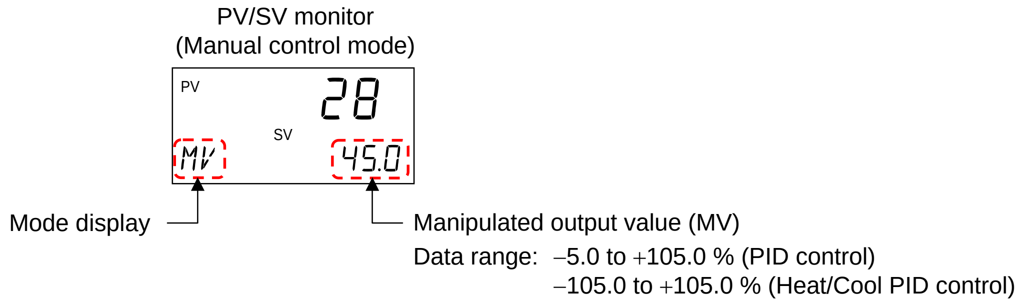
5.6.3 Parameter setting via Manual control mode

Set the following parameters at the Manual control mode:
- Manual manipulated output value (MV)
- Set value (SV) in Manual control mode
- PID memory group
- Event memory group

☞ For details of setting method, refer to **4.2 Changing Set Value (P. 4-4)**.

■ Manual manipulated output value (MV)

Set Manipulated output value (MV) by using the ∧ key or the ∨ key.



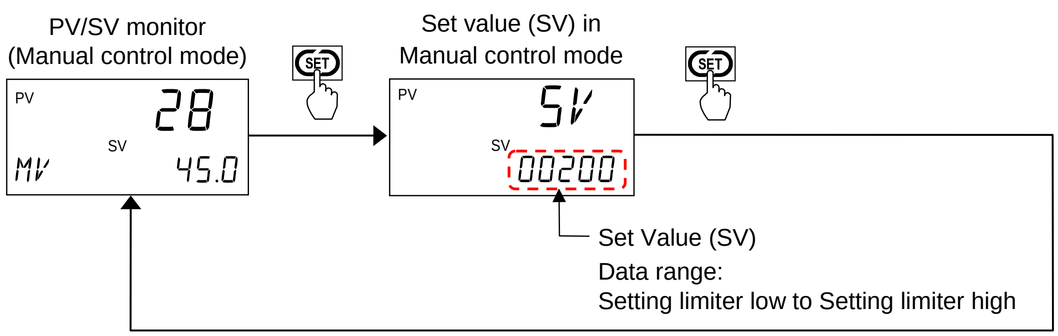
Press and hold the ∧ key or the ∨ key for 0.5 seconds to scroll numbers faster. To triple the speed, keep pressing and holding the key for more 3 seconds*. Press the MODE key while pressing the ∧ key or the ∨ key for 3 seconds to gain quintuple speed.

* The speed rate of scrolling numbers may be changed from 1 to 10 times by using RKC communication (RKC identifier: KV at No. 310 in **7.5.2 Communication data**).

Action when changing to the Manual control mode with Position proportioning PID control:
Set Control motor position by using the ∧ key or the ∨ key when specifying the Feedback resistance (FBR) input. Feedback resistance input value displays as the Manual manipulated output value (MV). When Feedback resistance (FBR) input is not specified, turn ON the output by pressing the ∧ key [open-side control output (OUT1)] or the ∨ key [close-side control output (OUT2)]. To turn OFF the output, release the ∧ key or the ∨ key. No display at Manual manipulated output value (MV). Lamp of OUT1 or OUT2 lights when the output is turned ON.

■ Set value (SV)

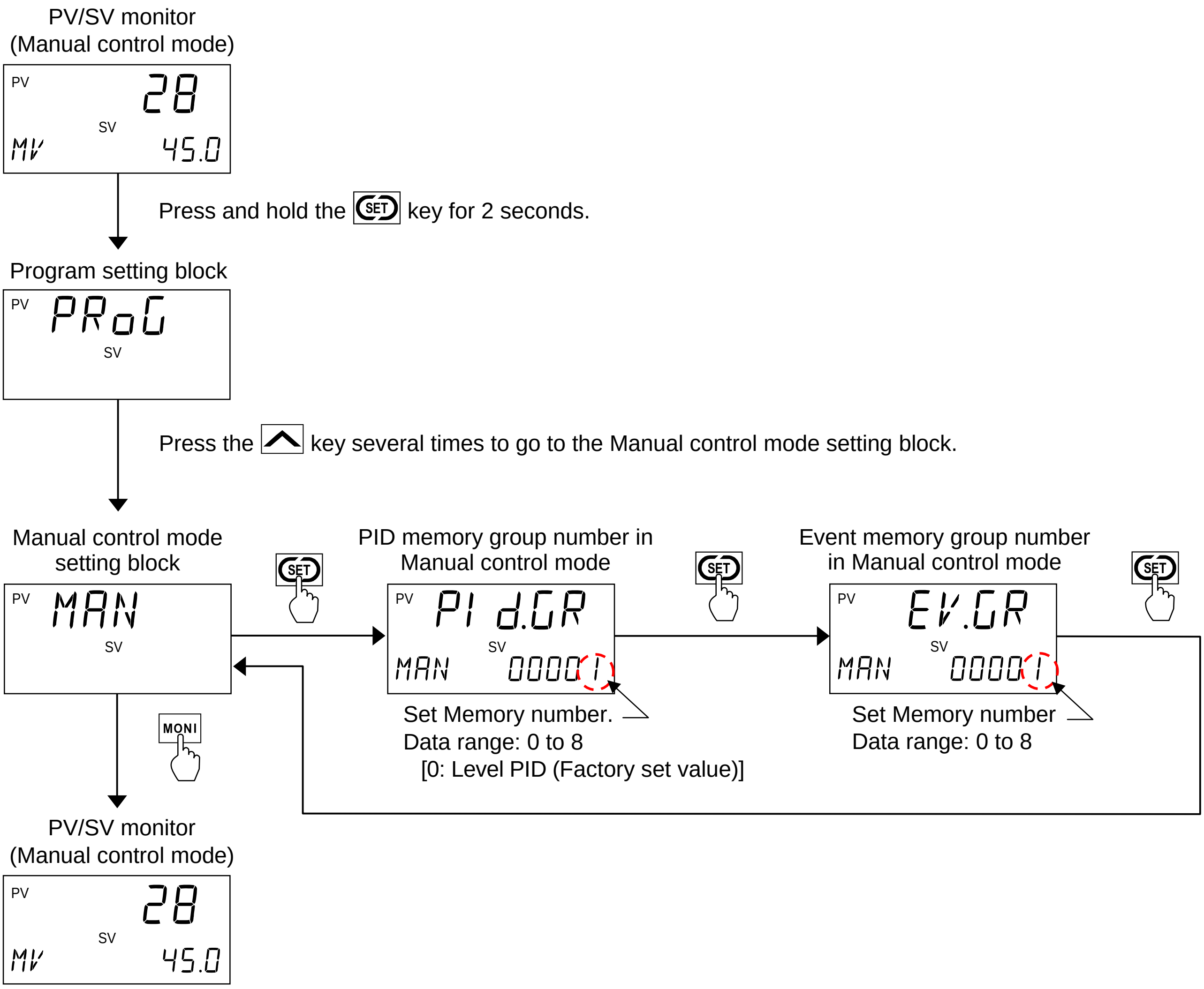
Go to the Set value (SV) setting screen by pressing the SET key at the PV/SV monitor screen in the Manual control mode.



The Set value (SV) set in a previous mode is taken over when switching to the Manual control mode. However, a SV change in the Manual control is not affected when changing to other modes.

■ PID memory group number/Event memory group number

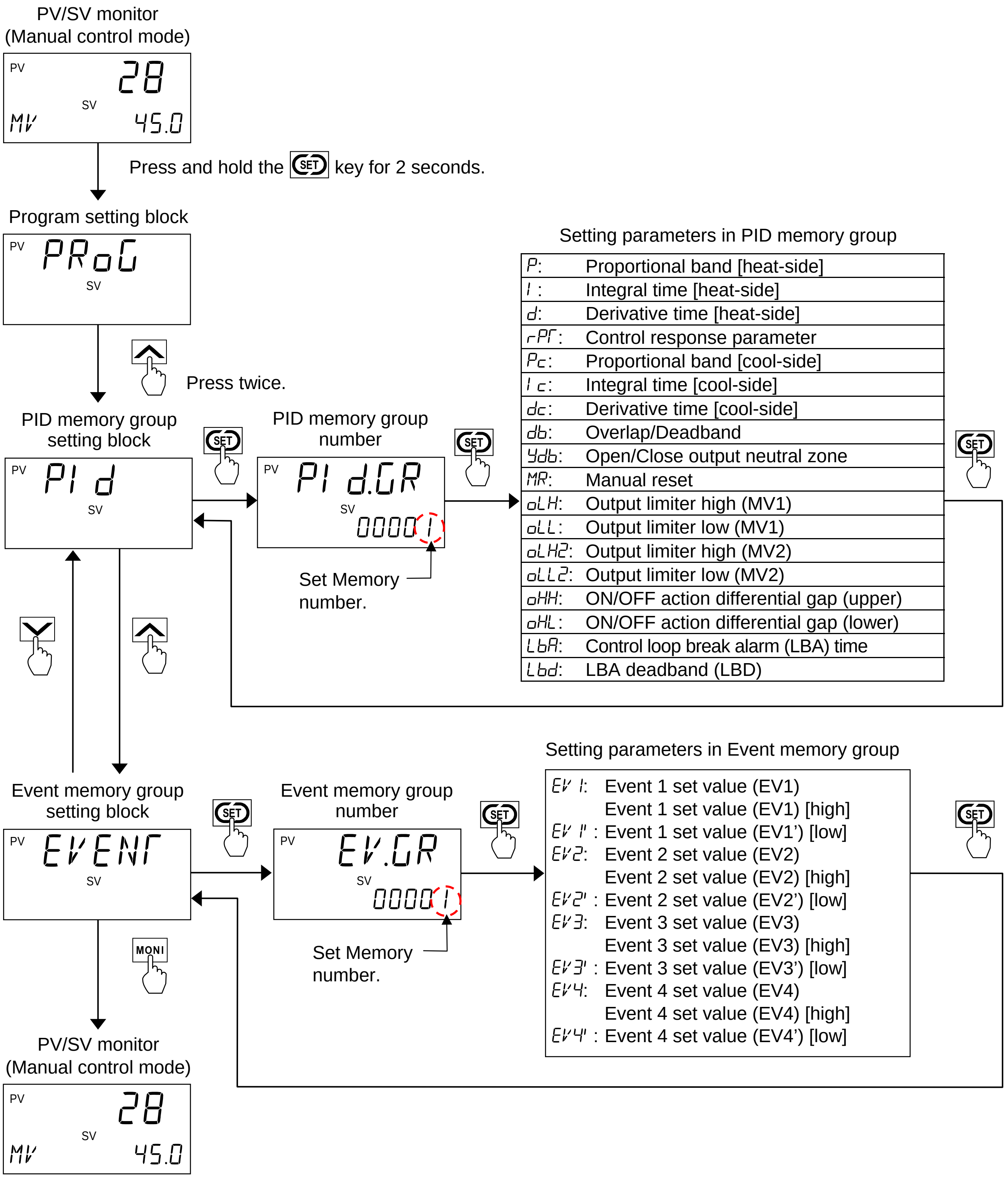
To set PID memory group number and Event memory group number to be used in the Manual control mode, go to the Manual control mode setting block in the Parameter setting mode.



■ PID memory group/Event memory group number

Set parameters of PID memory group at the PID memory group setting block and Event memory group at the Event memory group setting block in the Parameter setting mode. Set the parameters based on the application.

☞ For data range of parameter, refer to **4.5.3 Parameter setting mode (P. 4-17)**.



Setting parameters in PID memory group

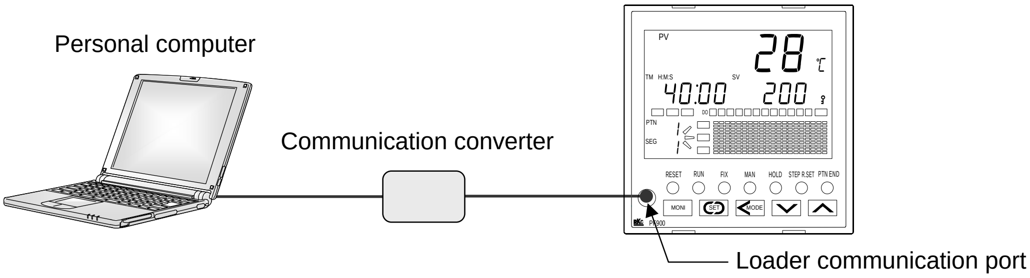
P:	Proportional band [heat-side]
I :	Integral time [heat-side]
d:	Derivative time [heat-side]
rPT:	Control response parameter
Pc:	Proportional band [cool-side]
Ic:	Integral time [cool-side]
dc:	Derivative time [cool-side]
db:	Overlap/Deadband
Ydb:	Open/Close output neutral zone
MR:	Manual reset
oLH:	Output limiter high (MV1)
oLL:	Output limiter low (MV1)
oLH2:	Output limiter high (MV2)
oLL2:	Output limiter low (MV2)
oHH:	ON/OFF action differential gap (upper)
oHL:	ON/OFF action differential gap (lower)
LbA:	Control loop break alarm (LBA) time
Lbd:	LBA deadband (LBD)

Setting parameters in Event memory group

EV1:	Event 1 set value (EV1)
	Event 1 set value (EV1) [high]
EV1' :	Event 1 set value (EV1') [low]
EV2:	Event 2 set value (EV2)
	Event 2 set value (EV2) [high]
EV2' :	Event 2 set value (EV2') [low]
EV3:	Event 3 set value (EV3)
	Event 3 set value (EV3) [high]
EV3' :	Event 3 set value (EV3') [low]
EV4:	Event 4 set value (EV4)
	Event 4 set value (EV4) [high]
EV4' :	Event 4 set value (EV4') [low]

5.7 Parameter Setting via Loader Communication

Use the PF900/PF901 setting tool (WinUCI-PF900) for parameter setting by loader communication. It is possible to use loader communication for the instrument without communication function (optional).



NOTE

Loader communication is for set up only. Do not use for data logging during operation.

Loader communication ports are located in the front and at the bottom of the instrument. Both ports cannot be used at the same time.

Use W-BV-03 loader communication cable to connect conventional COM-K to the loader communication port in front.

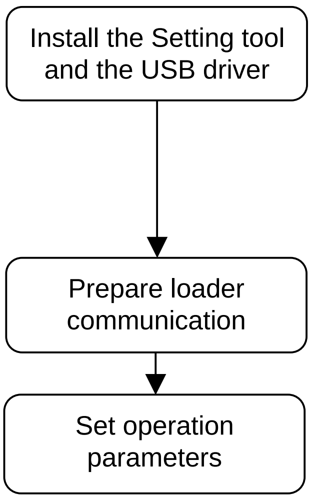
5.7.1 Preparation

Prepare the following items for parameter setting by loader communication:

- Personal computer (with USB port)
- USB communication converter (RKC product)
  COM-K-□
  3: W-BV-03 loader communication cable (for connecting to the loader communication port in front.)
  1: W-BV-01 loader communication cable (for connecting to the loader communication port at the bottom.)
- Loader communication cable
  W-BV-03: Connect to the loader communication port in front (Standard cable length: 1.5 m supplied with COM-K-3)
  W-BV-01: Connect to the loader communication port at the bottom (Standard cable length: 1.5 m supplied with COM-K-1)
- USB cable (Standard cable length: 1 m supplied with COM-K-□)
- Setting tool (WinUCI-PF900)
- USB driver for COM-K

5.7.2 Instructions for use

To set parameters by loader communication, follow the instructions below.



When using the loader communication, Communication Setup Tool and USB driver for COM-K must be installed on the personal computer. The Communication Setup Tool and the USB driver for COM-K and can be downloaded from the official RKC website: http://www.rkcinst.com/.

For the Setting tool, refer to **WinUCI-PF900 Instruction Manual (IMT01D09-E□)**.

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

Refer to **5.7.3 Connections for loader communication (P. 5-34)** for Connecting to loader communication.

To set parameters to be used for the operation, refer to **5.7.4. Parameter setting (P. 5-35)**.

5.7.3 Connections for loader communication

Connect PF900/PF901, COM-K and the personal computer by using the USB cable and loader communication cable. Confirm the orientation of the connector before connecting the cables.

NOTE

Both loader communication ports cannot be used at the same time.

- Communication port of host computer
  USB port: Based on USB Ver. 2.0
- Communication settings on the computer (Values other than the communication port are fixed.)

Communication speed:	38400 bps
Start bit:	1
Data bit:	8
Parity bit:	Without
Stop bit:	1

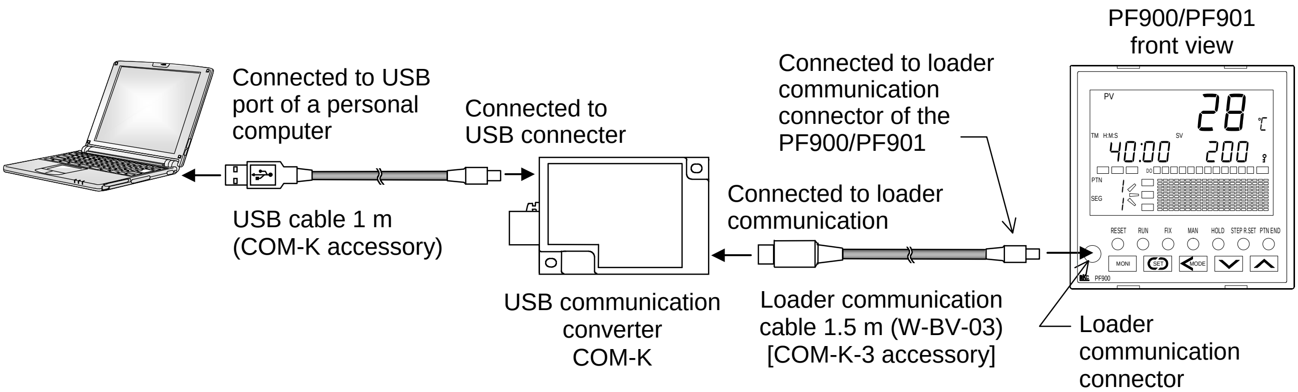
- The device address for Loader communication is fixed at "0."
  The setting of the device address is disregarded.

■ When using the loader communication port in front

Use COM-K communication converter and W-BV-03 loader communication cable.

NOTE

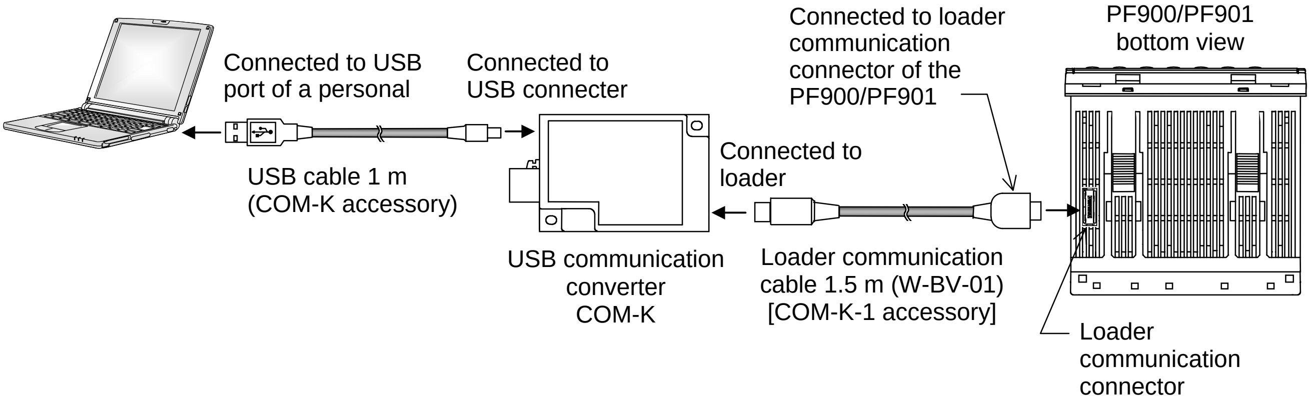
Turn ON the PF900/PF901 first when using the loader communication port in front.



■ When using the loader communication port at the bottom

Use COM-K communication converter and W-BV-01 loader communication cable.

PF900/PF901 may be OFF when using the loader communication port at the bottom.

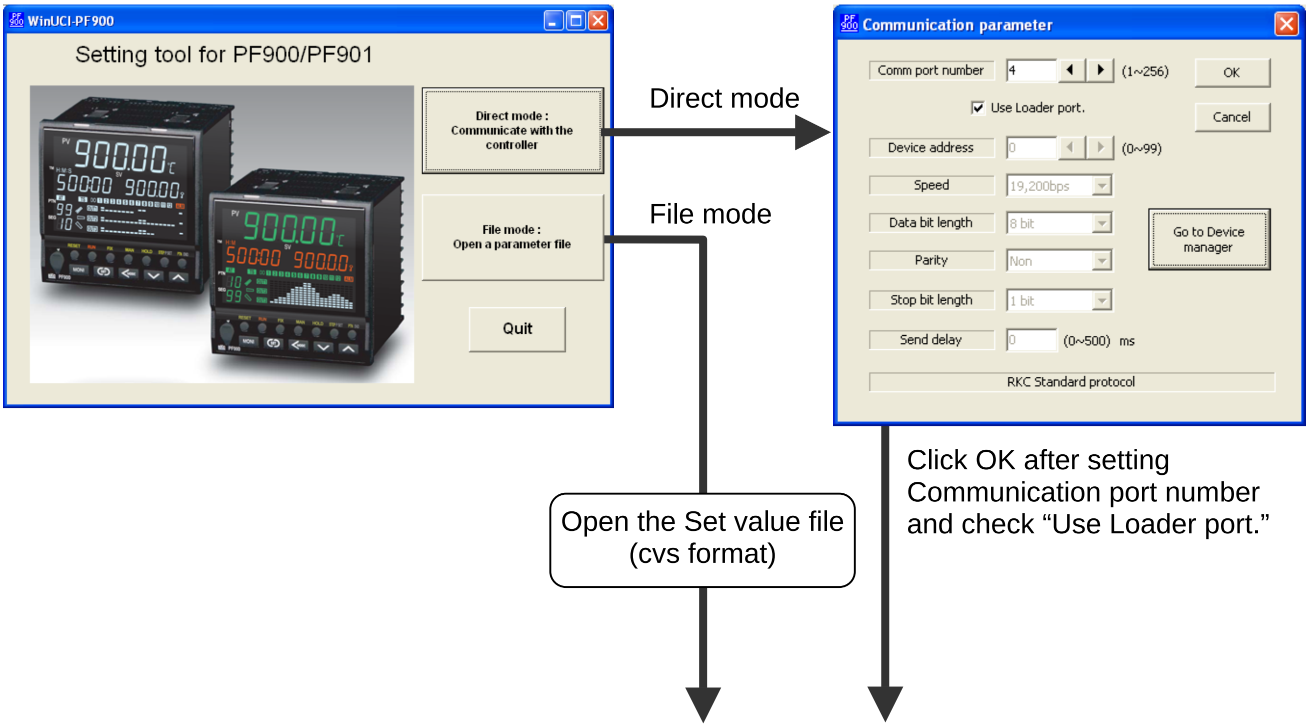


5.7.4 Parameter setting

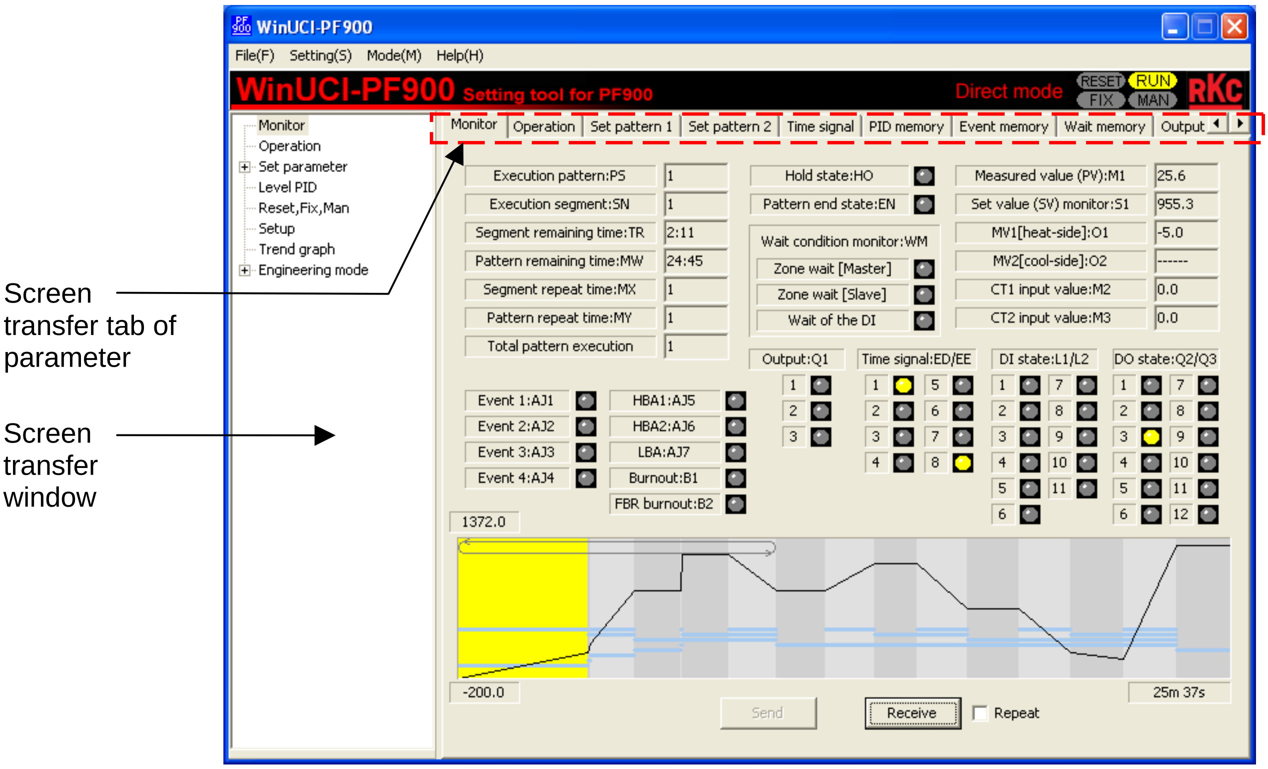
Start the WinUCI-PF900 (setting tool) and select the Direct mode or the File mode at the opening display.

To use the setting tool, refer to **WinUCI-PF900 Instruction Manual (IMT01D09-E☐)**.

Opening display



The monitor screen is first displayed where parameter is categorized into group. Select a group by using the screen transfer tab.



MEMO

6

FUNCTION AND SETTING PROCEDURE

This chapter describes function and parameter switching procedures.

6.1 Input

6.1.1 Changing Measured value (PV)

Measured input can be changed by setting the following parameters. Set the parameters based on the application or the sensor being used.

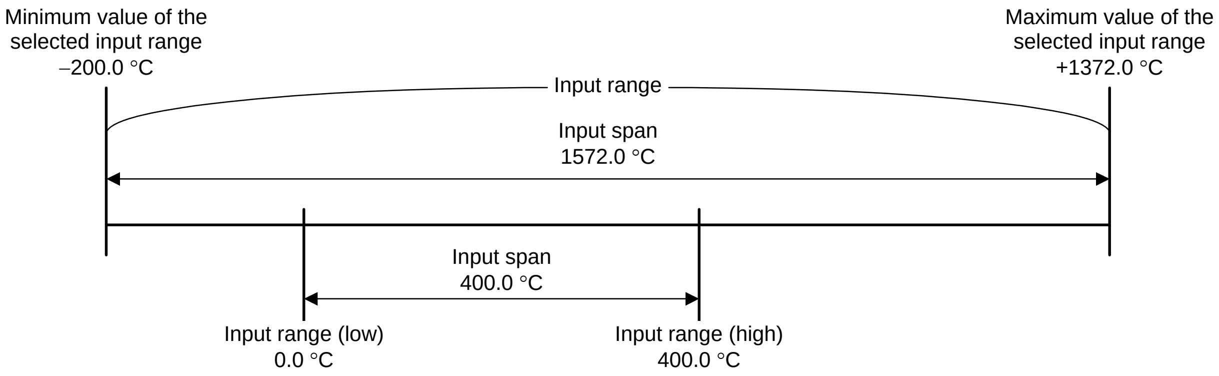
– Input type
– Display unit
– Decimal point position
– Input range (high)/Input range (low)

■ Description of function

Input range (high)/Input range (Low)

The input range can be changed for temperature input. Display can be scaled between –9999 to +32000 for Voltage (V) input and current (I) input.

Example (temperature input): When the range of –200.0 to +1372.0 °C for thermocouple Type K is changed to 0.0 to 400.0 °C

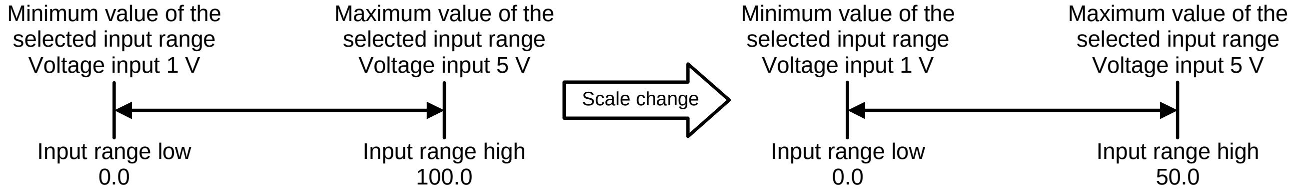


NOTE

When changing the range of temperature input, it is recommended to set the value within the range between the minimum value and the maximum value of the input range. If any value exceeding the input range is set, input resolution may vary.

When changing the Input range (high) and Input range (low), the value of "3 % of Input span" is automatically set to Start determination point (P. 6-115).

Example (Voltage (V)/Current (I) inputs):
When changing the display range from "0.0 to 100.0" to "0.0 to 50.0" for Voltage input (1 to 5 VDC).



When the voltage input is 1 V: Displays the "0.0" to the PV display.
When the voltage input is 5 V: Displays the "100.0" to the PV display.

When the voltage input is 1 V: Displays the "0.0" to the PV display.
When the voltage input is 5 V: Displays the "50.0" to the PV display.

■ Parameter setting

When changing Input type, Input range (high) or Input range (low), the Measured value (PV) will be recalculated. The PV displays "0" during the duration below:

When Sampling cycle is 250 ms: 4 seconds
When Sampling cycle is 100 ms: 2 seconds
When Sampling cycle is 50 ms: 1 second

● Input type

Parameter symbol	Data range	Factory set value
INP	Voltage (low) input group: 0: TC input K 1: TC input J 2: TC input R 3: TC input S 4: TC input B 5: TC input E 6: TC input N 7: TC input T 8: TC input W5Re/W26Re 9: TC input PL II 10: TC input U 11: TC input L 12: TC input PR40-20 13: RTD input Pt100 14: RTD input JPt100 22: Voltage (low) input 0 to 10 mV DC 23: Voltage (low) input 0 to 100 mV DC 24: Voltage (low) input 0 to 1 V DC 25: Voltage (low) input −10 to +10 mV DC 26: Voltage (low) input −100 to +100 mV DC 27: Voltage (low) input −1 to +1 V DC Voltage (high) input group: 17: Voltage (high) input 0 to 10 V DC 18: Voltage (high) input 0 to 5 V DC 19: Voltage (high) input 1 to 5 V DC 20: Voltage (high) input −5 to +5 V DC 21: Voltage (high) input −10 to +10 V DC Current input group: 15: Current input 0 to 20 mA DC 16: Current input 4 to 20 mA DC	If the input type is specified by the model and suffix code when ordering, that input type becomes the factory set value. When not specifying: 0

For the input range code, refer to ● **Range Code Table (P. 1-7)**.

● Display unit

Parameter symbol	Data range	Factory set value
UNIT	0: °C 1: °F	0

● Decimal point position

Parameter symbol	Data range	Factory set value
PGdP	0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places 4: Four decimal place TC input: Only 0 or 1 can be set. RTD input: From 0 to 2 can be set. Voltage (V)/Current (I) input: From 0 to 4 can be set.	If the Decimal point position is specified by the model and suffix code when ordering, that Decimal point position becomes the factory set value. When not specifying: 1

● Input range high

Parameter symbol	Data range	Factory set value
PGSH	TC/RTD inputs: Input range low to Maximum value of the selected input range Voltage (V)/Current (I) inputs: −19999 to +32000 Varies with the setting of the Decimal point position.	TC/RTD: Maximum value of the selected input range V/I: 100.0

● Input range low

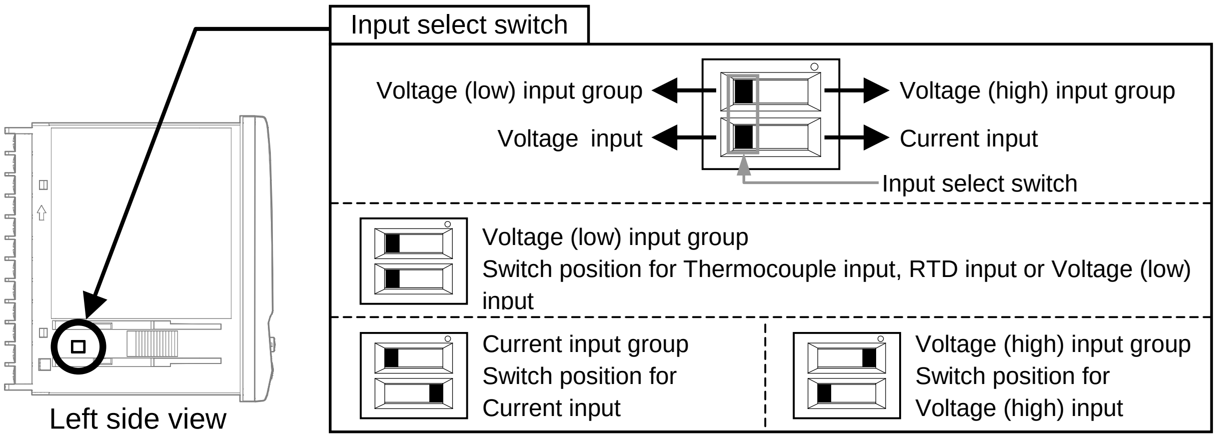
Parameter symbol	Data range	Factory set value
PGSL	TC/RTD inputs: Minimum value of the selected input range to Input range high Voltage (V)/Current (I) inputs: −19999 to +32000 Varies with the setting of the Decimal point position.	TC/RTD: Minimum value of the selected input range V/I: 0.0

■ Setting procedure

1. Input group can be switched by the Input select switch at the left side of this instrument.

NOTE

To avoid damage to the instrument, disconnect the measurement input terminals before switching the input group.

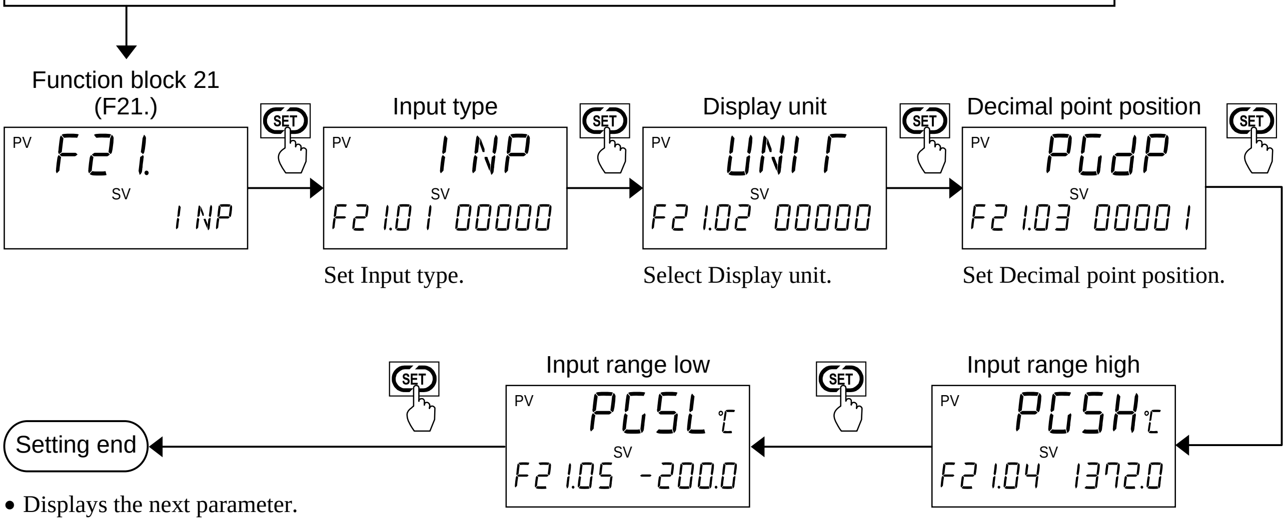


2. Set Input type, Decimal point position and Input range (high)/Input range (low) at F21 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).

2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.

3. Keep pressing the UP key until the F21 screen displays.



- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 21 (F21.).

NOTE

When changing the range of temperature input, it is recommended to set the value within the range between the minimum value and the maximum value of the input range. If any value exceeding the input range is set, input resolution may vary.

6.1.2 Changing Sampling cycle

Sampling cycle for checking the Measured value (PV) can be changed.

■ Parameter setting

When changing Sampling cycle, the Measured value (PV) will be recalculated. The PV displays “0” during the duration below:

When Sampling cycle is 250 ms: 4 seconds
When Sampling cycle is 100 ms: 2 seconds
When Sampling cycle is 50 ms: 1 second

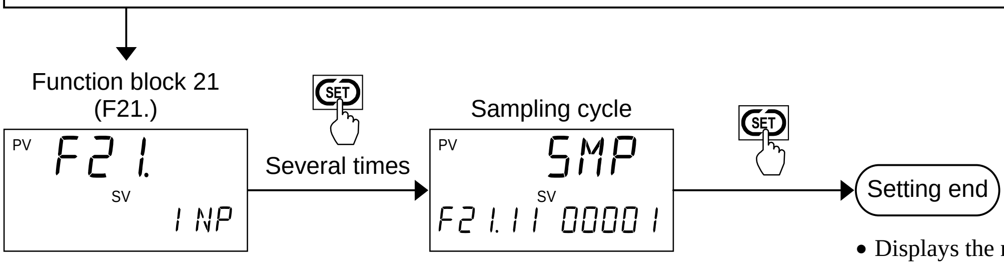
● Sampling cycle

Parameter symbol	Data range	Factory set value
SMP	0: 50 ms 1: 100 ms 2: 250 ms	1

■ Setting procedure

Sampling cycle can be set at F21.11 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F21 screen displays.

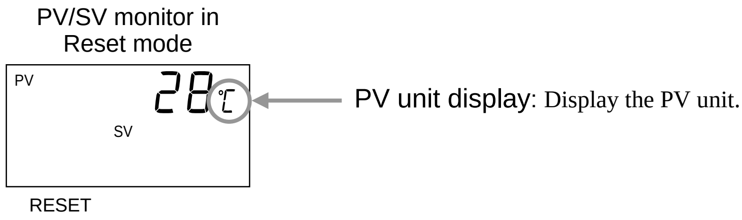


Set Sampling cycle.

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 21 (F21.).

6.1.3 Changing Measured value (PV) unit display

The unit for the Measured value (PV) is displayed in the SV setting & monitor mode. PV unit display can be changed at Unit display [UNT. SL] at F10.13 in the Initial level engineering mode.



■ Parameter setting

● Unit display

This parameter setting is only valid for the PV unit display in the SV setting & monitor mode.

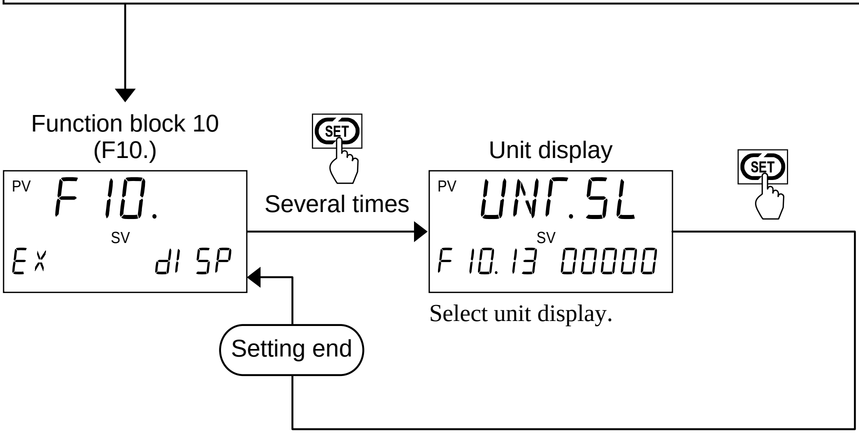
Parameter symbol	Data range	Factory set value
UNT.SL	0: Conform to the input type TC/RTD inputs: °C or °F Voltage (V)/Current (I) inputs: No unit display 1: No unit display 2: % 3: °C 4: °F	0

In the modes other than SV setting & monitor mode, the PV unit display is fixed and displayed based on parameter.

■ Setting procedure

To select Unit display, go to F10.13 in the Initial level engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press and hold the SET key, the MODE key and the ∨ key for 2 seconds or more to go to the Initial level engineering mode.



6.1.4 Changing Power supply frequency

Use to select the Power supply frequency of the controller suited to the application. If the display on the screen flickers, set the value to the same value as the power frequency used.
Power supply frequency cannot be changed when CT input is specified as the Power supply frequency is recognized automatically. The Power supply frequency being changed manually will be replaced with the power supply frequency to be recognized automatically.

■ Parameter setting

When changing Power supply frequency, the Measured value (PV) will be recalculated. The PV displays “0” during the duration below:

When Sampling cycle is 250 ms: 4 seconds
When Sampling cycle is 100 ms: 2 seconds
When Sampling cycle is 50 ms: 1 second

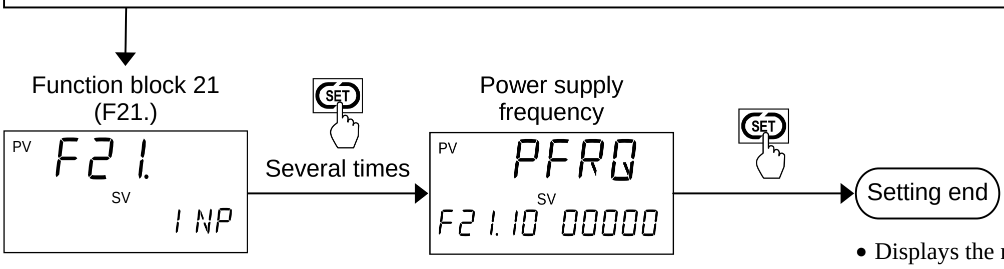
● Power supply frequency

Parameter symbol	Data range	Factory set value
PFRQ	0: 50 Hz 1: 60 Hz	0

■ Setting procedure

To select Power supply frequency, go to F21.10 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the UP key until the F21 screen displays.



Select Power supply frequency.

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 21 (F21.).

6.1.5 Input correction

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).

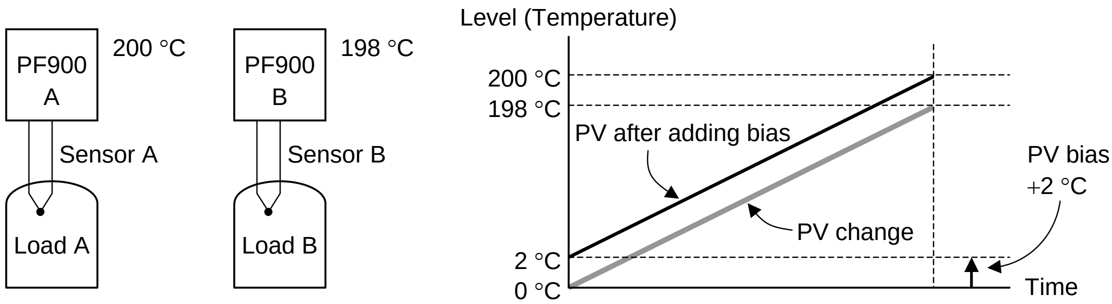
Setting example of PV bias:

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:

PF900 A: 200 °C PF900 B: 198 °C

To correct the Measure value (PV) of PF900B, add bias of +2 °C by PV bias:

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



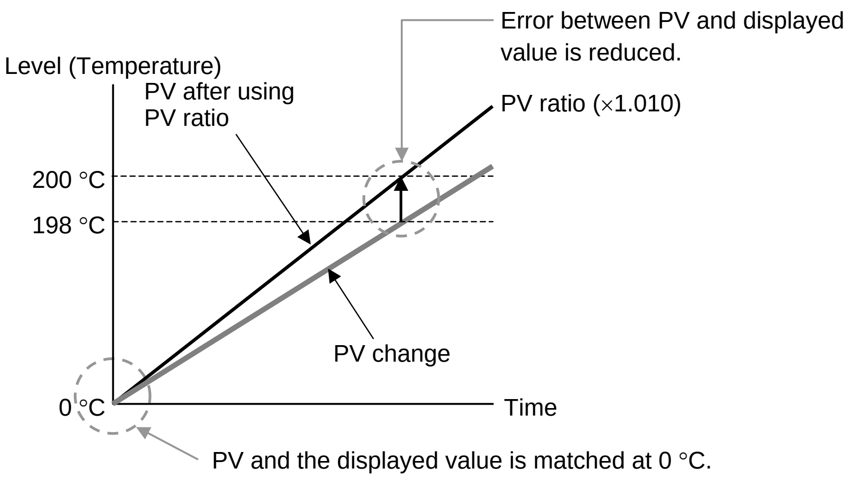
● PV ratio

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

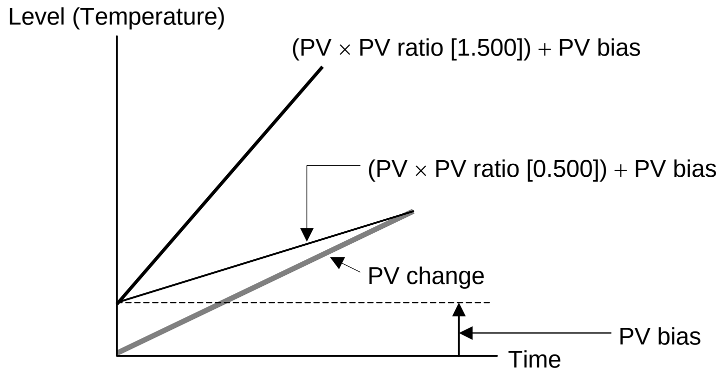
Setting example of PV ratio:

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



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



■ Parameter setting

● PV bias

Parameter symbol	Data range	Factory set value
Pb	−Input span to +Input span (Unit is based on PV.)	0

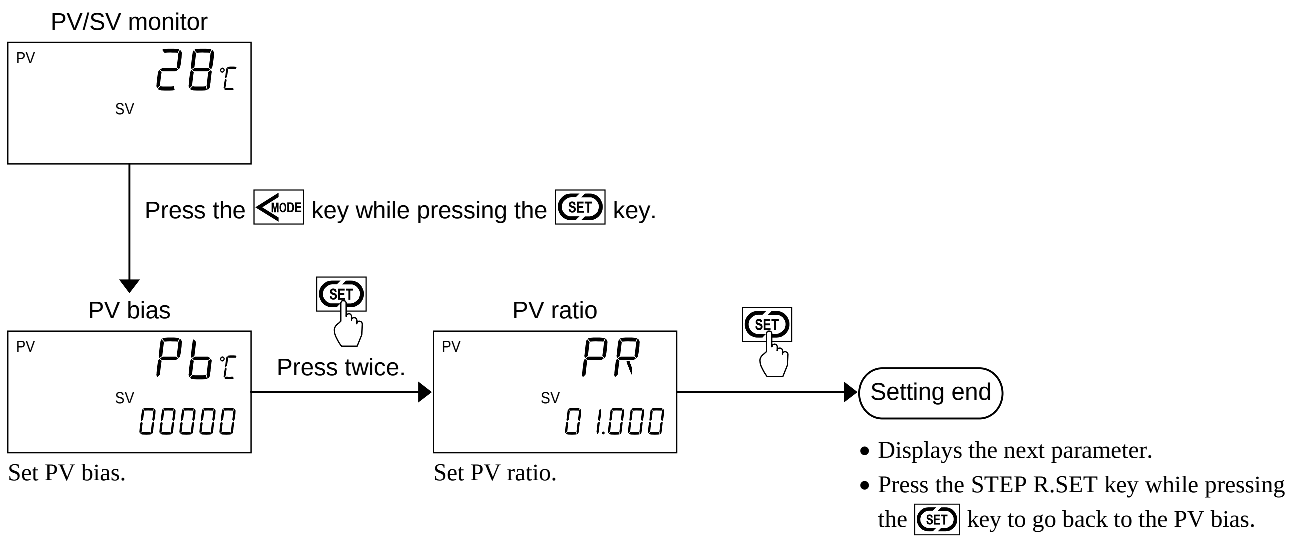
● PV ratio

Parameter symbol	Data range	Factory set value
PR	0.001 to 9.999	1.000

■ Setting procedure

To set PV bias and PV ratio, go to the Setup setting mode or F21 in the Engineering mode.

● When setting in the Setup setting mode



PV bias and PV ratio can be set in any operation mode (Reset mode, Program control mode, Fixed set point control mode or Manual control mode).

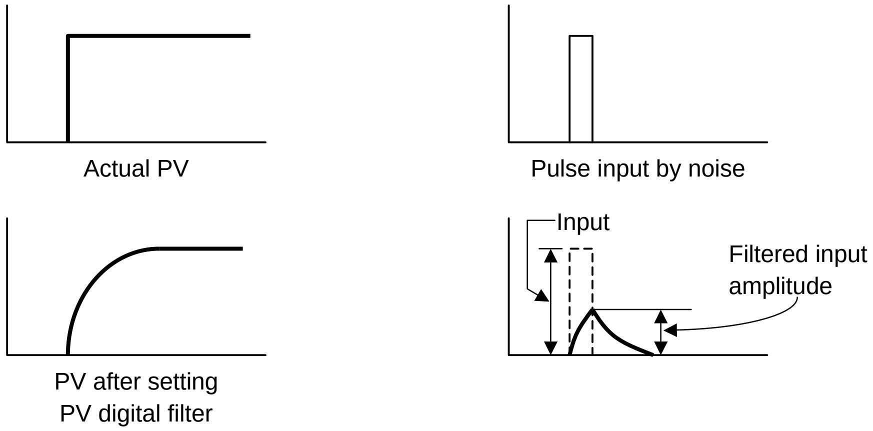
☞ To set in the Engineering mode, refer to **4.5.5. Engineering mode (P. 4-33)**.

6.1.6 Input filter

PV digital filter can be used for filter function of input by using First order lag.

■ Description of function

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



■ Parameter setting

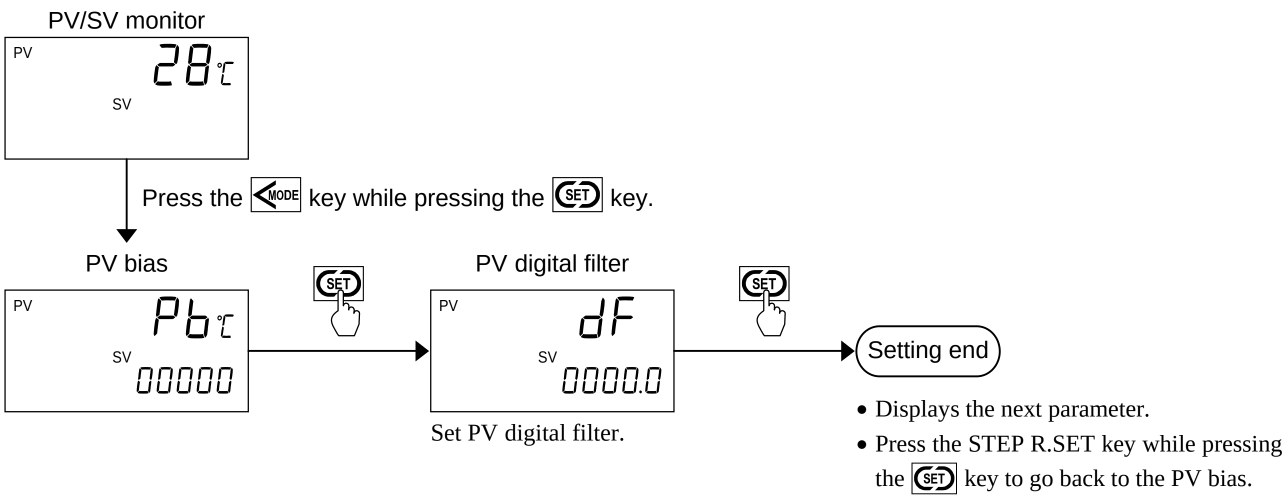
● PV digital filter

Parameter symbol	Data range	Factory set value
dF	0.0 to 100.0 seconds (0.0: Unused)	0.0

■ Setting procedure

PV digital filter can be set in the Setup setting mode or the Engineering mode F21.

● When setting in the Setup setting mode



📖 PV digital filter can be set in any operation mode (Reset mode, Program control mode, Fixed set point control mode or Manual control mode).

☞ To set in the Engineering mode, refer to **4.5.5. Engineering mode (P. 4-33)**.

6.1.7 Square root extraction

Square root extraction can control flow by sending the output signal directly from a differential pressure type flow transmitter to PF900/PF901. By setting PV low input cut-off, Square root extraction will not be performed for the Measured value below the set value of PV low input cut-off.

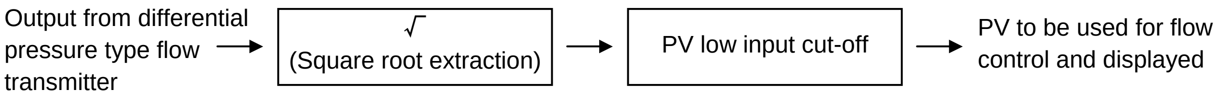
Square root extraction and PV low input cut-off can be used for Voltage (V) input and Current (I) input.

■ Description of function

● Square root extraction

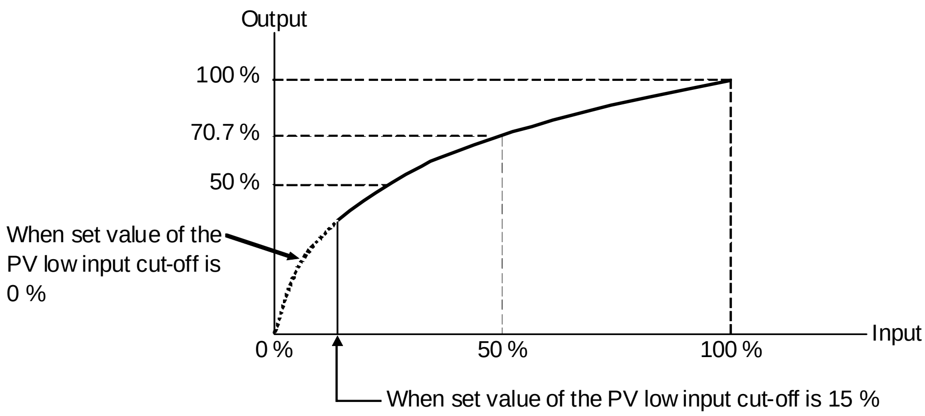
When using a differential pressure type flow transmitter, the Measured value (PV) is computed by Square root extraction.

Equation: Measured value (PV) = $\sqrt{\text{(Input value)}}$



● PV low input cut-off

The result of square root extraction become "0" when the Measured value (PV) drops below the set value of the PV low input cut-off. Output is not produced when the result of square root extraction is zero (0).
When input signal square root extraction is used for in flow control, etc., the Square root extraction result varies widely at the Low measured value range. The Measured value less than the PV low input cut-off is ignored to compute control output in order to prevent control disturbance caused by input variation at Low measured value range.



■ Parameter setting

● Square root extraction

Parameter symbol	Data range	Factory set value
SQR	0: Unused 1: Used	0

● PV low input cut-off

PV low input cut-off can be displayed in the Setup setting mode or at F21.15 in the Engineering mode. To monitor this parameter in the Setup setting mode, confirm that the input type is set to Voltage input or Current input, and Square root extraction is set to "1: Used." PV low input cut-off can be monitored without any setting in the Engineering mode.

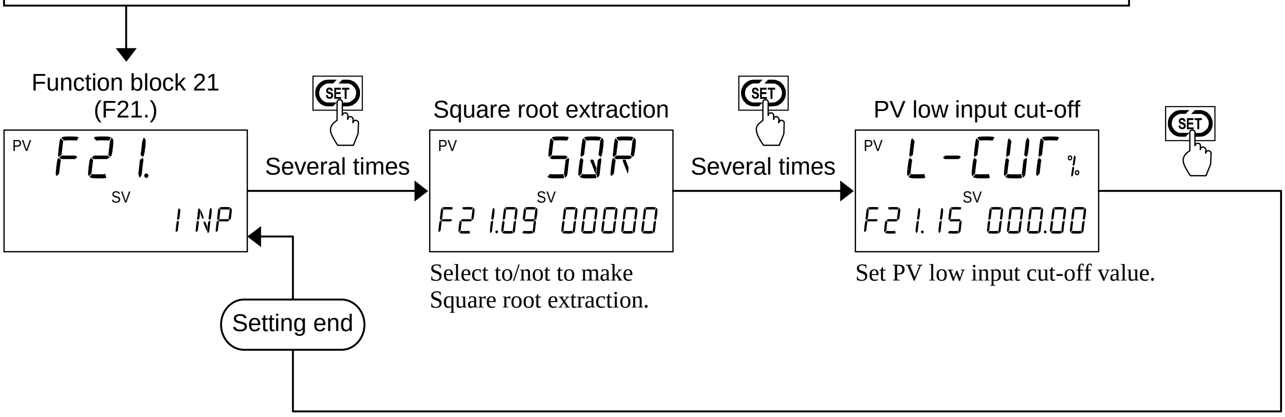
Parameter symbol	Data range	Factory set value
L-CUr	0.00 to 25.00 % of Input span	0.00

■ Setting procedure

- Set Square root extraction at F21.09 in the Engineering mode.
- Set PV low input cut-off in the Setup setting mode or at F21.15 in the Engineering mode.

● Parameter setting at F21 in the Engineering mode

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F21 screen displays.



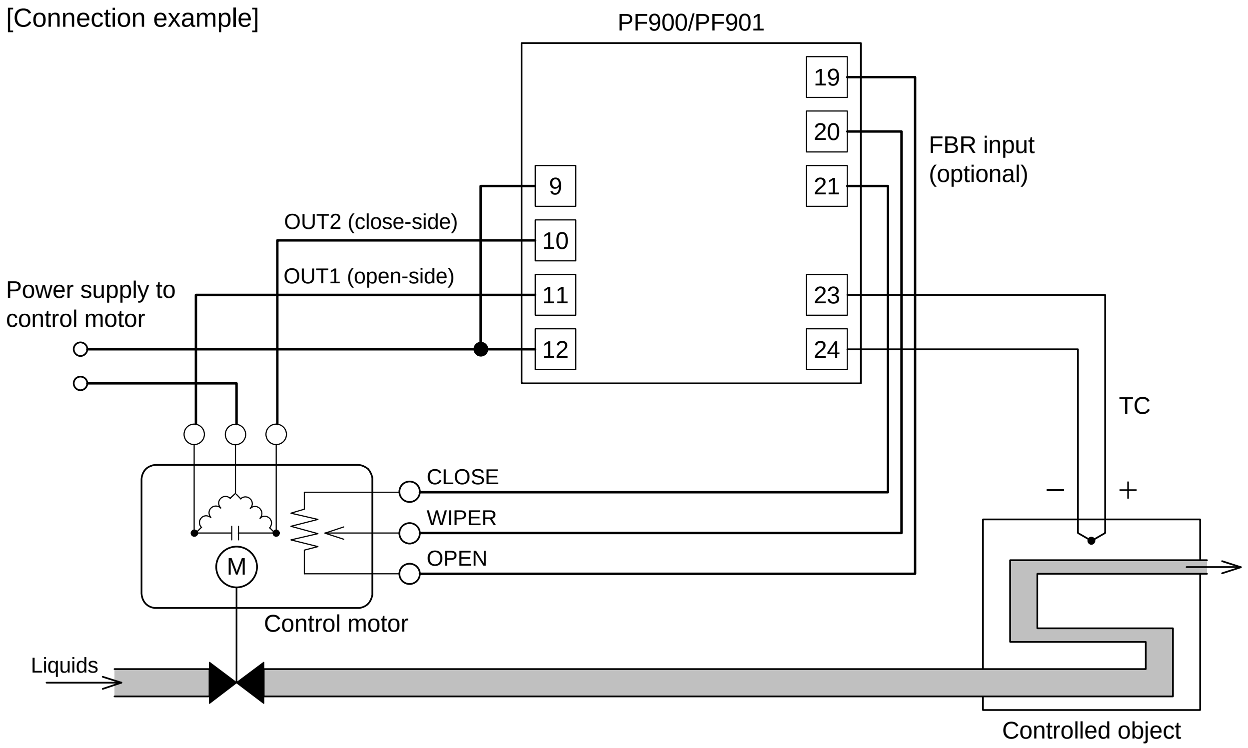
PV low input cut-off can be set in any operation mode (Reset mode, Program control mode, Fixed set point control mode or Manual control mode).

☞ To set PV low input cut-off in the Setup setting mode, refer to **4.5.4 Setup setting mode (P. 4-30)**. Before setting in the Setup setting mode, confirm that the input type is set to Voltage input or Current input, and Square root extraction is set to "1: Used."

6.1.8 Feedback resistance (FBR) input

FBR input (optional) is available to monitor the valve position of a control motor for Position proportional PID control. FBR input value can be monitored at Manipulated output value 1 (MV1) [heat-side] monitor.

[Connection example]



■ Display

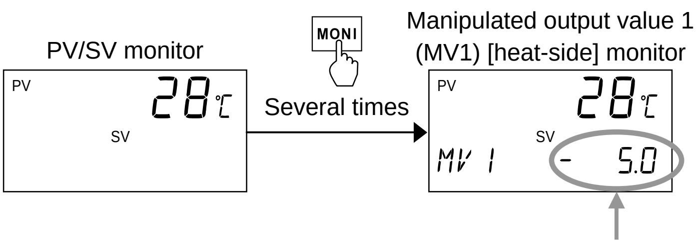
Display range	Factory set value
0.0 to 100.0 %	—

The character of over-scale “ooooo ” displays at SV display when
- FBR input is broken
- FBR input is specified but the FBR terminals are not connected with a potentiometer.

Manipulated output value 1 (MV1) [heat-side] monitor does not display when Position proportioning PID control for Control type (o5) is set but FBR input is not specified.

■ Key operation

Manipulated output value 1 (MV1) [heat-side] can be monitored in the Monitoring mode.



FBR input value displays at SV display when FBR input is specified with Position proportioning PID control.

6.1.9 Digital input (DI)

The operation mode, function or Program pattern number can be switched by an external switch or signal by external equipment via Digital input (DI).
Up to 11 points of DI (DI1 to DI11) are available including the optional points (DI1 to DI6). Assign DI before using.

☞ For DI assignment, refer to ■ **Parameter setting (P. 6-29)**.

For DI function, refer to the seven DI function types below in the table.

×: There is the priority order.
—: There is not the priority order.

DI function type	DI number	Detection method	Priority order
Reset mode (RESET) setting	DI7	State	×
Program control mode (RUN) setting	DI8	Rising edge	×
Step (STEP) function	DI9	Rising edge	×
Hold (HOLD) function	DI10	State (HOLD ON) Falling edge (HOLD OFF)	×
Direct/Reverse action switching	DI11	State	—
Wait state release	DI1 to DI6 (optional)	State	—
Pattern number switch	DI1 to DI6 (optional) DI7 to DI11 Based on the DI assignment setting.	Rising edge	—
Pattern increment	DI11	Rising edge	—

☞ To wire DI terminals, refer to ■ **Digital input 1 to 11 (P. 3-13)**.

■ Priority order of DI

Priority order is assigned to the four DI functions in the table below. Closing the contact of DI functions with lower priority will be ignored when the DI terminal assigned with the DI function with highest priority is ON.

NOTE

Do not switch DI functions being assigned priority order at the same time. Allow an interval of 200 ms + 1 sampling cycle before switching. If two or more DI functions are switched at the same time, only the DI function with highest priority affects the operation mode and the state of the DI functions with lower priority remains.

Priority order of DI

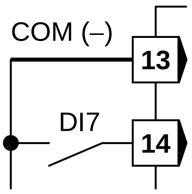
DI function	Priority order	
Reset mode (RESET) setting	Priority order 1	Higher
Program control mode (RUN) setting	Priority order 2	
Hold (HOLD) function	Priority order 3	
Step (STEP) function	Priority order 4	Lower

A priority order is not assigned to the following DI functions:
Direct/Reverse action switching, Wait state release, Pattern number switch and Pattern increment. These DI functions can be operative if a condition is satisfied regardless of whether the DI contact with priority order is closed.

■ Reset mode (RESET) setting

If terminal Nos. 13 and 14 are closed, Operation mode is set to Reset mode (RESET).

• Terminal configuration



DI7: Reset mode (RESET) setting

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

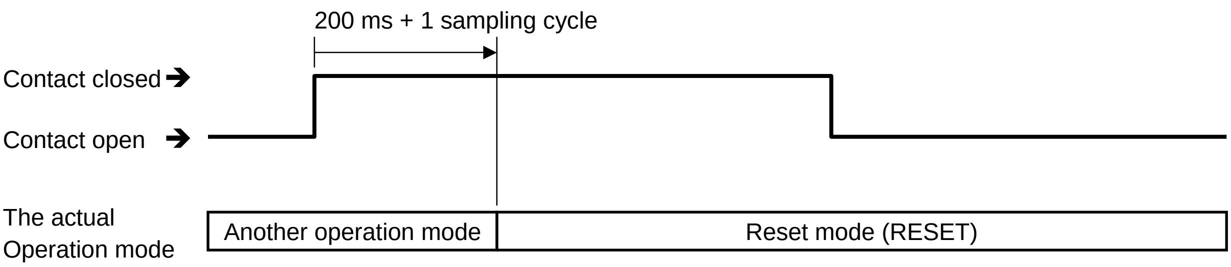
Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

• Transfer timing of Reset mode (RESET)

NOTE

After the contact is transferred, it takes “200 ms + 1 sampling cycle *” until the action of this instrument is actually selected.

*** Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)**



Operation mode cannot be switched by front key operation when the contact is closed.

Operation mode cannot be switched by communication when the contact is closed. The NAK message will be sent to the Host computer by PF900/901.

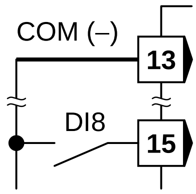
Once the contact is closed, Reset mode (RESET) remains regardless of whether the contact is opened.

Reset mode (RESET) setting can be used when setting 0, 1, 4 or 5 to the Digital input (DI) assignment [dI SL].

■ Program control mode (RUN) setting

If terminal Nos. 13 and 15 are closed, Operation mode is set to Program control mode (RUN).
Operation mode can be switched to the Program control mode (RUN) when the DI contacts of the Reset mode (RESET) are open.

- Terminal configuration



DI8: Program control mode (RUN) setting

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

Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

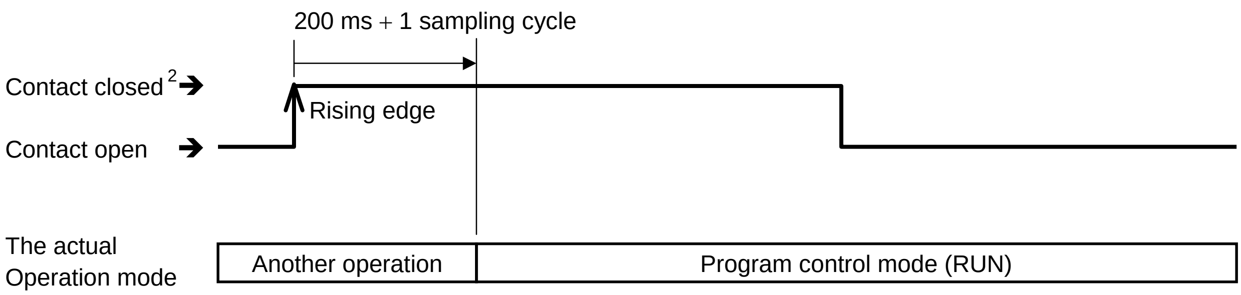
- Transfer timing of Program control mode (RUN)

Operation mode is switched to the Program control mode (RUN) when the opened DI contacts are closed (rising edge).

NOTE

After the contact is transferred, it takes "200 ms + 1 sampling cycle [1]" until the action of this instrument is actually selected.

[1] Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)



[2] To validate the action of contact, close the contact for 200 ms + 1 sampling cycle.

Operation mode cannot be switched by front key operation when the contact is closed.

Operation mode cannot be switched by communication when the contact is closed. The NAK message will be sent to the Host computer by PF900/901.

Once the contact is closed, Program control mode (RUN) remains regardless of whether the contact is opened.

When using Event interlock function
When setting "2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error" to Event interlock function, the operation mode will be switched to the Manual control mode if event occurs regardless of whether the contacts are closed.

Program control mode (RUN) setting can be used when setting 0, 1, 4 or 5 to the Digital input (DI) assignment [dI SL].

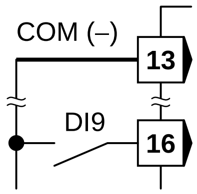
■ Step (STEP) function

Closing the contacts between the terminals No. 13 to 16 activates Step (STEP) function and the segment in progress will be skipped. To conduct Step (STEP) function again, open the contacts first and then close again.

Step (STEP) function is operative when
- – the contacts for Reset mode (RESET) setting are open.
- – operation mode is in the Program control mode (RUN).
- – the contacts for Program control mode (RUN) setting are open. *
- – Hold (HOLD) function is OFF.
- – the contacts for Hold (HOLD) function are open.

* Open the contacts for Program control mode (RUN) setting when Program control mode (RUN) is switched by DI. The state of Program control mode (RUN) remains regardless of whether the contacts are open.

• Terminal configuration



DI9: Step (STEP) function

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

Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

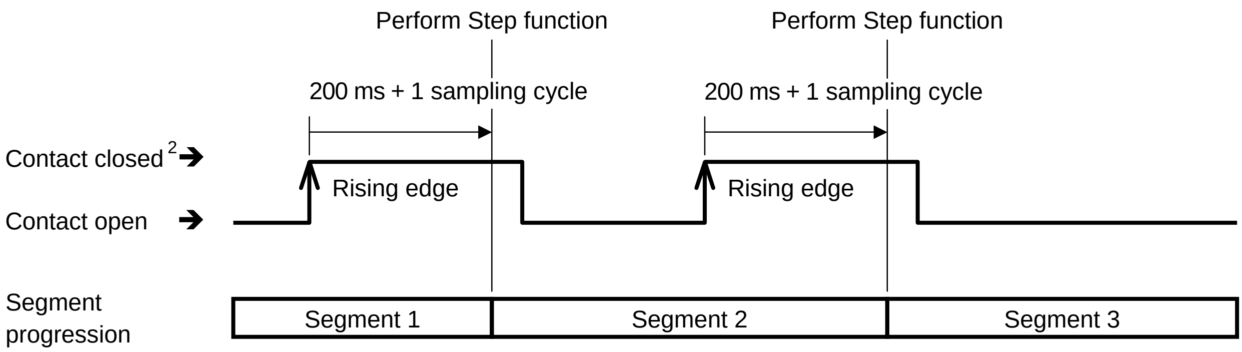
• Transfer timing of segment

Step function is performed when closing the DI contact (rising edge).

NOTE

After the contact is transferred, it takes "200 ms + 1 sampling cycle [1]" until the action of this instrument is actually selected.

[1] Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)



[2] To validate the action of contact, close the contact for 200 ms + 1 sampling cycle.

Step (STEP) function can be used when setting 0, 1, 4 or 5 to the Digital input (DI) assignment [dI SL].

■ Hold (HOLD) function

Closing the contacts between the terminals No. 13 to 17 activates Hold (HOLD) function and the progression of the program will be suspended. Hold (HOLD) function is only operative when the contacts are closed. Opening the contacts releases Hold state and Program control will be restarted from where the program was suspended.

To perform Hold (HOLD) function, refer to the following operating conditions:

Operating condition to perform Hold (HOLD) function:

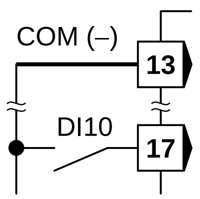
– The contacts for Reset mode (RESET) setting are open.
– Operation mode is in the Program control mode (RUN).
– The contacts for Program control mode (RUN) setting are open. *

Operating condition to release Hold (HOLD) function:

– The contacts for Reset mode (RESET) setting are open.
– The contacts for Program control mode (RUN) setting are open. *

* Open the contacts for Program control mode (RUN) setting when Program control mode (RUN) is switched by DI. The state of Program control mode (RUN) remains regardless of whether the contacts are open.

- Terminal configuration



DI10: Hold (HOLD) function

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

Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

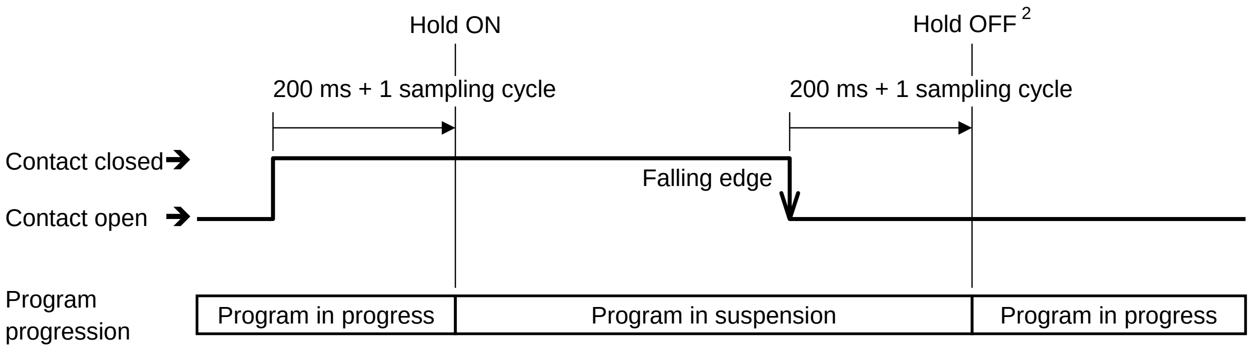
- Transfer timing of hold state

Hold (HOLD) function is released when opening the closed DI contacts (falling edge).

NOTE

After the contact is transferred, it takes “200 ms + 1 sampling cycle [1]” until the action of this instrument is actually selected.

[1] **Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)**



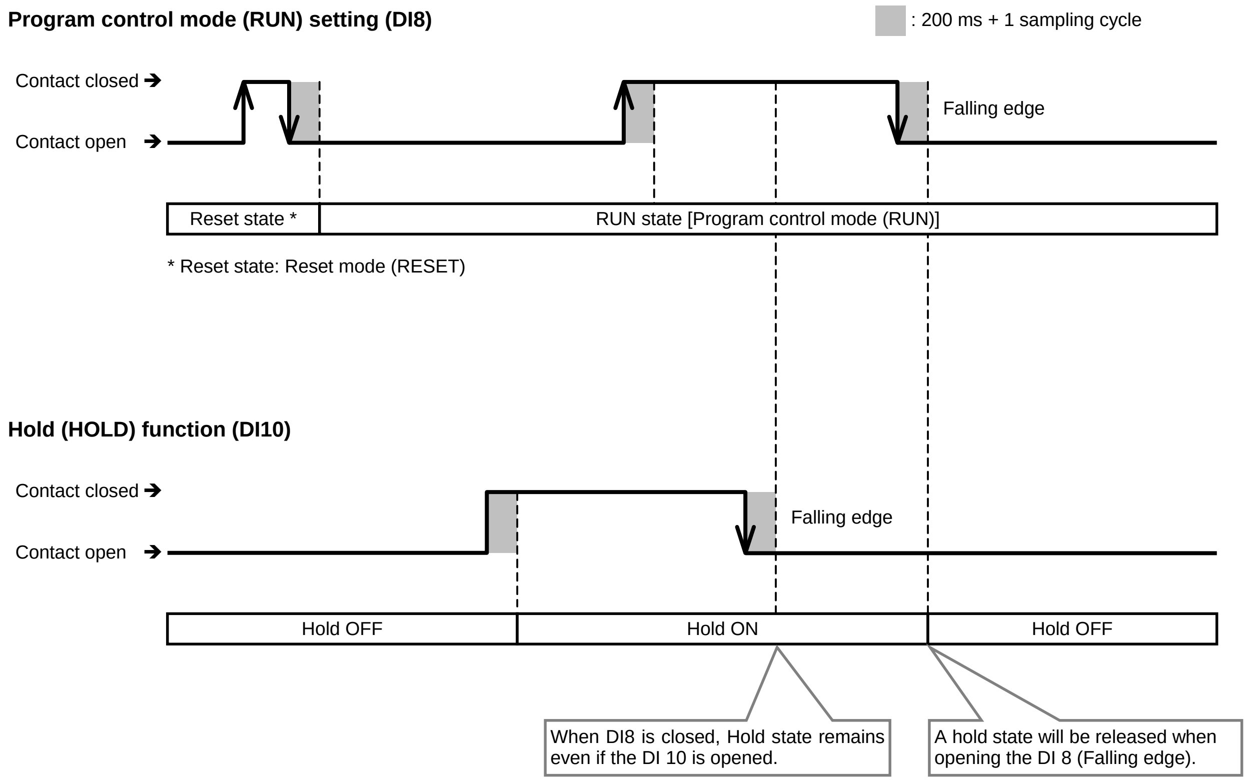
[2] To validate the action of contact, close the contact for 200 ms + 1 sampling cycle.

Hold function (HOLD) cannot be performed by the front key operation when the contacts are closed.

Hold function (HOLD) cannot be performed by communication when the contacts are closed. The NAK message will be sent to the Host computer by PF900/901.

Hold function (HOLD) can be used when setting 0, 4 or 5 to the Digital input (DI) assignment [dI SL].

When the contact (DI8) for Program control mode (RUN) is closed, a hold state cannot be released even if the contact (DI10) being assigned with Hold (HOLD) function is opened.
Refer to the description in the diagram below. To release the Hold state, open the contact (DI8) for the Program control mode (RUN) (Falling edge).



■ Direct/Reverse action switching

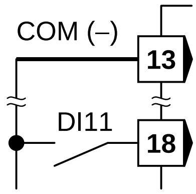
Direct action and Reverse action can be switched by opening or closing the contacts between the terminal No. 13 to 18.

Direct action and Reverse action can be switched when

- Operation mode is in the Reset mode (RESET)
- PID control or Position proportional PID control is specified

The set value of Control type [oS] at F50 in the Engineering mode will be changed automatically when switching Direct action and Reverse action by using DI. Direct action and Reverse action switching by DI does not affect Heat/Cool control operation.

• Terminal configuration



DI11: Direct/Reverse action switching

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

Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

• Transfer timing of Direct action/Reverse action

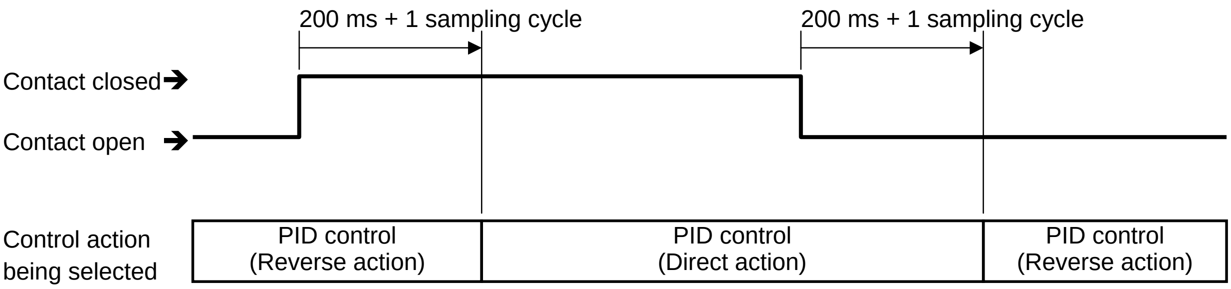
Reverse action is operative when the DI contacts are opened. When the contacts are closed, Direct action is operative.

NOTE

After the contact is transferred, it takes "200 ms + 1 sampling cycle *" until the action of this instrument is actually selected.

*** Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)**

Example: PID control



Direct action/Reverse action switching can be switched when the operation mode is in Reset mode (RESET) regardless of whether any DI contacts of the following functions are closed: Reset mode (RESET) setting, Program control mode (RUN), Hold (HOLD) function or Step function (STEP).

Direct action and Reverse action cannot be switched by front key operation or communication when using DI for Direct action/Reverse action switching. DI setting takes higher priority.

Direct action and Reverse action can be switched when setting 4 to the Digital input (DI) assignment [dI SL].

■ Wait state release

Wait state release can be performed by DI when the operation mode is in Program control mode (RUN).
Types of Wait state release function by DI

− Release by DI only [Logical *OR*]
− Release by Zone wait function and DI [Logical *AND*]

When releasing by DI only [Logical *OR*]

To release Wait state by DI, set “1: Validate” to the bit of Wait release by Digital input (DI) at Wait release trigger selection [RE. TRG] in the Parameter setting mode. Then close one of the contacts between the terminals No. 31 to 36 (DI1 to DI6).
When Wait release by Digital input (DI) is valid, Wait state by segment is available
When Wait state by segment is operative, Wait function will be performed regardless of whether Wait zone high [ZoNE. H] or Wait zone low [ZoNE. L] is set to “0: Wait OFF.”

Wait state by segment
Program is put on standby at Segment time end point. Wait state can be released by DI only.

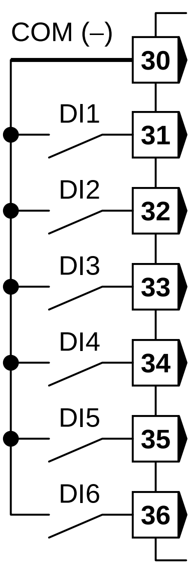
For details of Wait function, refer to **6.6.6 Wait (P. 6-158)**.

When releasing by Zone wait function and Digital input (DI) [Logical *AND*]

Validate Zone wait 1 and Wait release by Digital input (DI) at Wait trigger release selection [RE. TRG] in the Parameter setting mode. Wait state will be released when the following conditions are satisfied:
– Measured value (PV) reaches within the Wait zone (Zone wait function)
– Wait state has been released by DI

For details of Wait function, refer to **6.6.6 Wait (P. 6-158)**.

• Terminal configuration



DI1 to DI6: Wait state release

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

Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

To release Wait state, close any contact of DI1 to DI6.
Wait state can be released by external equipment being connected to the contacts from DI1 to DI6.

• Transfer timing of wait state

NOTE

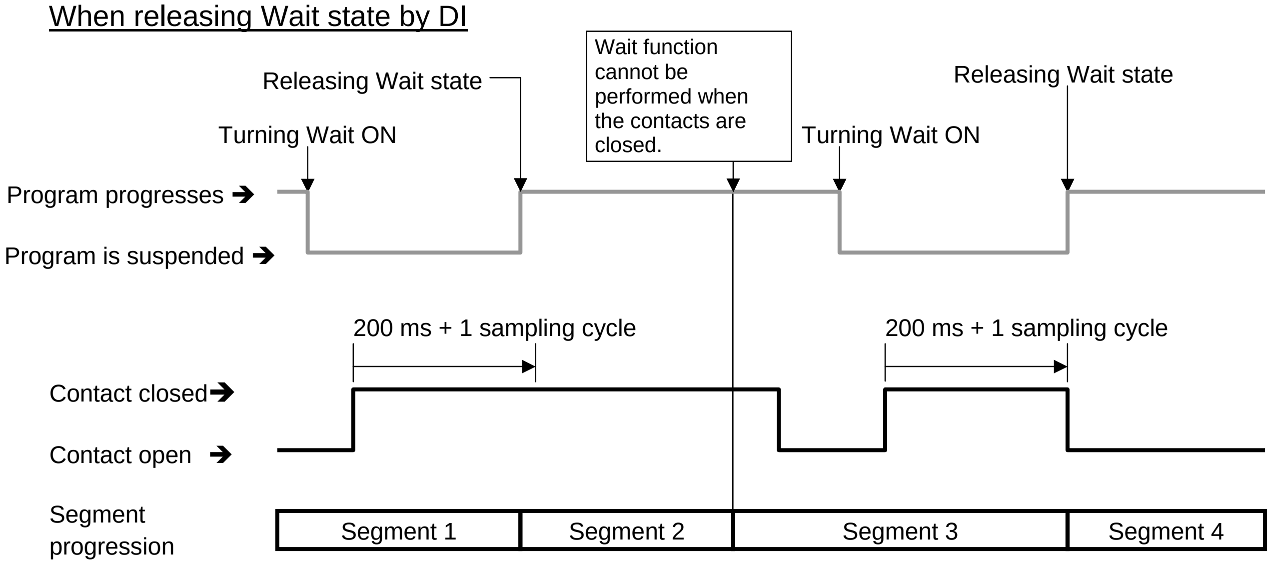
After the contact is transferred, it takes "200 ms + 1 sampling cycle *" until the action of this instrument is actually selected.

*** Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)**

Wait state release can be switched when the operation mode is in Program control mode (RUN) regardless of whether any DI contacts of the following functions are closed: Reset mode (RESET) setting, Program control mode (RUN), Hold (HOLD) function or Step (STEP) function.

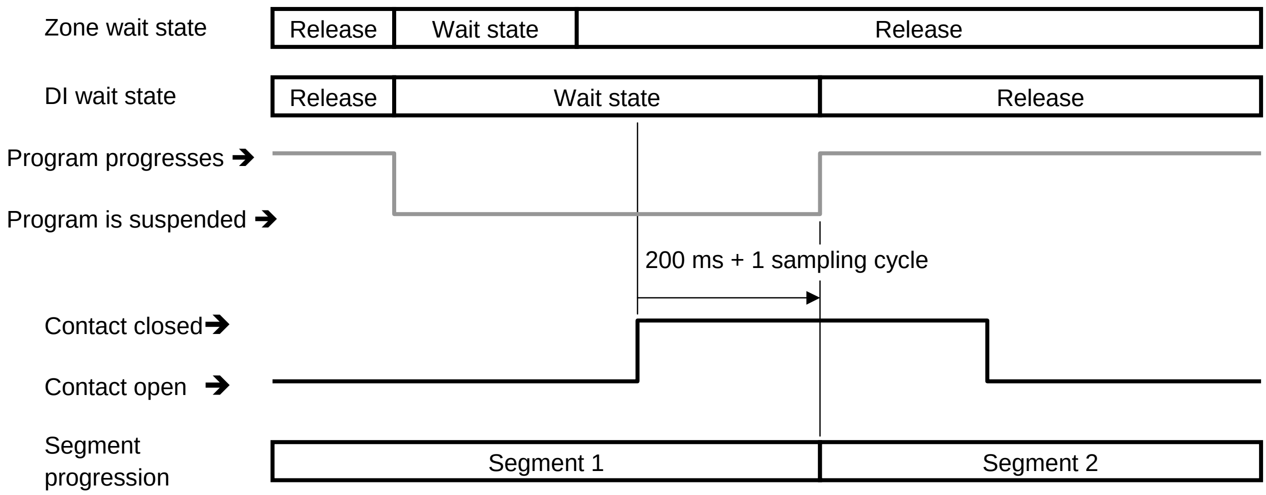
Wait function cannot be performed when Wait state release by DI is selected and the contacts are closed.

When releasing Wait state by DI



When using Zone wait function and Wait release by DI

Wait state will be released when the following conditions are satisfied:
- Measured value (PV) reaches within the Wait zone (Zone wait function).
- Wait state has been released by DI.



■ Pattern number switch

Program pattern number can be switched by Digital input (DI) when the operation mode is in the Reset mode (RESET).

Type of Pattern number determination

– Switch the pattern number by closing/opening DI contact.
– Determine the pattern number by Pattern set input (P.SET).

Type of Pattern number determination can be selected at Pattern input method of Digital input (DI) [dI PFN] of F23. Digital input (DI) in the Engineering mode.

When using a digital switch starting from 0 (zero), Pattern number and the number of Digital switch can be matched by setting Pattern input method of Digital input (DI) [dI PFN].

For type of Pattern number determination, refer to ● **Pattern input method of Digital input (DI) (P. 6-29)**.

- Limit of Maximum pattern number

Pattern number can be selected up to 127 by varying combinations of DI contacts. However, the actual Maximum pattern number is limited by the Maximum pattern/segment number [PN*SN] being set in the Engineering mode.

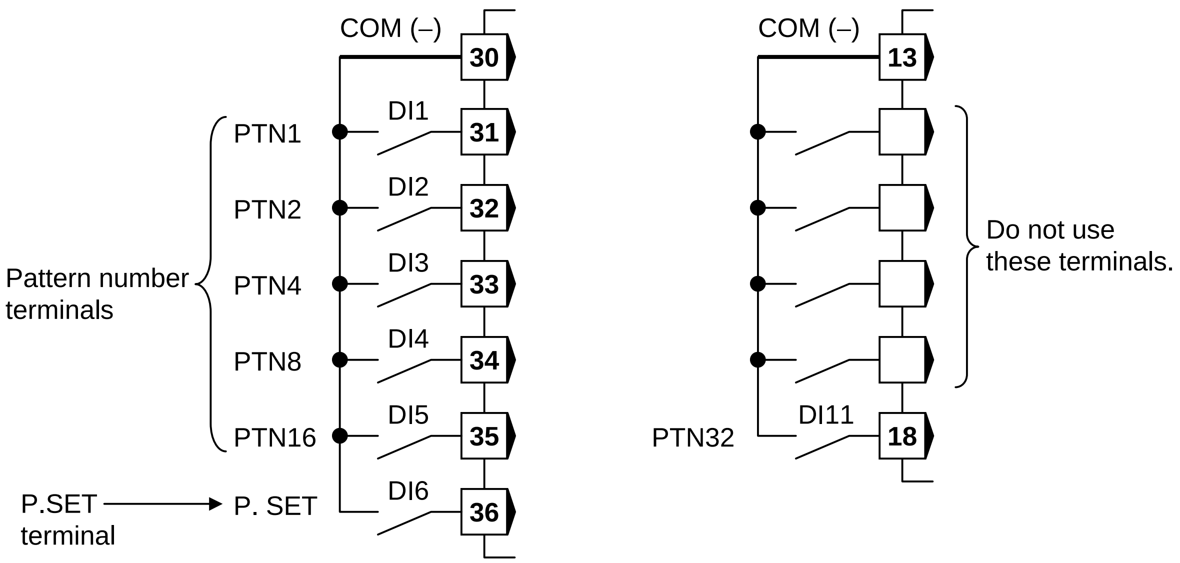
For example, when the Maximum pattern number is set to 99 at Maximum pattern/segment number [PN*SN] *, selecting 100 or more for the pattern number by the contacts will be ignored and the Pattern number remains 99.

* Maximum pattern number can be set up to 99.

- Terminal configuration

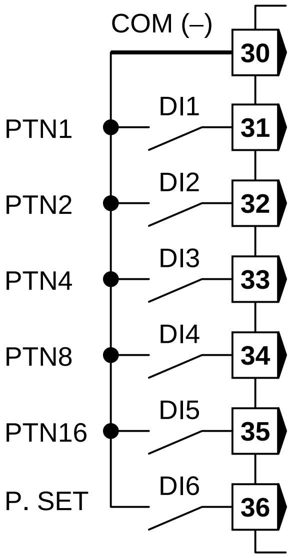
Positions of Pattern number being assigned to DI terminals are based on the set value of Digital input (DI) assignment [dI SL]. Refer to the positions of Pattern number for each set value of DI assignment below.

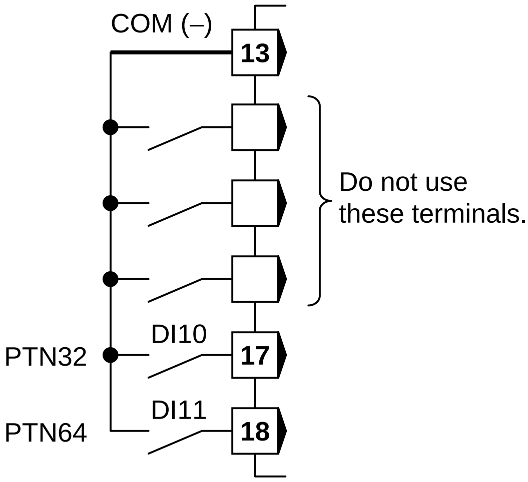
When setting 0 (zero) to Digital input (DI) assignment (Pattern number from 1 to 63 can be switched.)



DI1 to DI6 are optional.

When setting 1 to Digital input (DI) assignment (Pattern number from 1 to 99 * can be switched.)

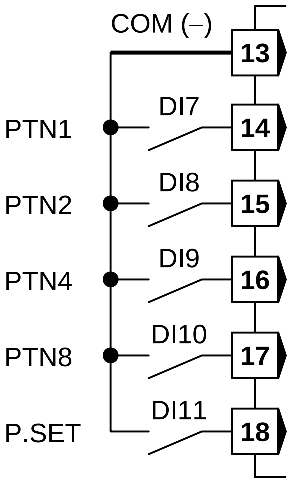




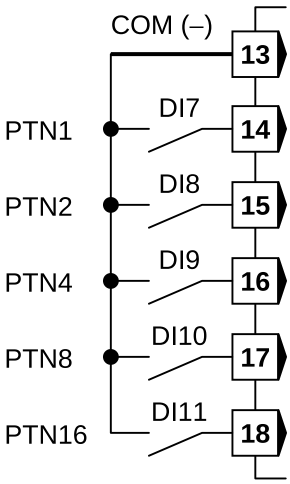
* Up to 127 patterns can be selected by varying combinations of DI contacts but up to 99 patterns are selectable for the actual Maximum pattern number.

DI1 to DI6 are optional.

When setting 2 to Digital input (DI) assignment (Pattern number from 1 to 15 can be switched.)



When setting 3 to Digital input (DI) assignment (Pattern number from 1 to 31 can be switched.)



Pattern set input (P.SET) is not assigned when the set value is “3.”

• Pattern number selection

Pattern number selection method is based on the set value at Pattern input method of [dI PFN] F23 Digital input (DI) in the Engineering mode. Refer to the selection method for each set value below.

When the set value is “0” or “1” for Pattern input method of Digital input (DI)

Pattern number is Binary number of DI +1. When setting 0 (zero), close the Pattern set input (P.SET) after closing/opening the DI contact for the specific pattern number.

When setting “1,” Pattern number will be determined by close/open the DI contact for the specific pattern number.

OFF: Contact open ON: Contact closed

Pattern number	Weighting						
	1 (PTN1)	2 (PTN2)	4 (PTN4)	8 (PTN8)	16 (PTN16)	32 (PTN32)	64 (PTN64)
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	ON	OFF	OFF	OFF	OFF	OFF	OFF
3	OFF	ON	OFF	OFF	OFF	OFF	OFF
4	ON	ON	OFF	OFF	OFF	OFF	OFF
5	OFF	OFF	ON	OFF	OFF	OFF	OFF
6	ON	OFF	ON	OFF	OFF	OFF	OFF
7	OFF	ON	ON	OFF	OFF	OFF	OFF
8	ON	ON	ON	OFF	OFF	OFF	OFF
9	OFF	OFF	OFF	ON	OFF	OFF	OFF
10	ON	OFF	OFF	ON	OFF	OFF	OFF
⋮							
20	ON	ON	OFF	OFF	ON	OFF	OFF
21	OFF	OFF	ON	OFF	ON	OFF	OFF
22	ON	OFF	ON	OFF	ON	OFF	OFF
23	OFF	ON	ON	OFF	ON	OFF	OFF
24	ON	ON	ON	OFF	ON	OFF	OFF
25	OFF	OFF	OFF	ON	ON	OFF	OFF
⋮							
32	ON	ON	ON	ON	ON	OFF	OFF
33	OFF	OFF	OFF	OFF	OFF	ON	OFF
34	ON	OFF	OFF	OFF	OFF	ON	OFF
35	OFF	ON	OFF	OFF	OFF	ON	OFF
36	ON	ON	OFF	OFF	OFF	ON	OFF
⋮							
41	OFF	OFF	OFF	ON	OFF	ON	OFF
⋮							
49	OFF	OFF	OFF	OFF	ON	ON	OFF
⋮							
64	ON	ON	ON	ON	ON	ON	OFF
65	OFF	OFF	OFF	OFF	OFF	OFF	ON
66	ON	OFF	OFF	OFF	OFF	OFF	ON
67	OFF	ON	OFF	OFF	OFF	OFF	ON
68	ON	ON	OFF	OFF	OFF	OFF	ON
⋮							
96	ON	ON	ON	ON	ON	OFF	ON
97	OFF	OFF	OFF	OFF	OFF	ON	ON
98	ON	OFF	OFF	OFF	OFF	ON	ON
99	OFF	ON	OFF	OFF	OFF	ON	ON
Setting 100 or more for Pattern number will be ignored and the number will be switched to 99.							

When the set value is “2” or “3” for Patten input method of Digital input (DI)

Pattern number is Binary number of DI.

When using a digital switch starting from 0 (zero), Pattern number and the number of Digital switch can be matched by setting “2” or “3” for Pattern input method of Digital input (DI) [dI PFN]. When setting “2,” close the Pattern set input (P.SET) after closing/opening the DI contact for the specific pattern number.

When setting “3,” Pattern number will be determined by close/open the DI contact for the specific pattern number.

OFF: Contact open ON: Contact closed

Pattern number	Weighting						
	1 (PTN1)	2 (PTN2)	4 (PTN4)	8 (PTN8)	16 (PTN16)	32 (PTN32)	64 (PTN64)
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF	OFF	OFF
5	ON	OFF	ON	OFF	OFF	OFF	OFF
6	OFF	ON	ON	OFF	OFF	OFF	OFF
7	ON	ON	ON	OFF	OFF	OFF	OFF
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	ON	OFF	OFF	ON	OFF	OFF	OFF
10	OFF	ON	OFF	ON	OFF	OFF	OFF
⋮							
15	ON	ON	ON	ON	OFF	OFF	OFF
16	OFF	OFF	OFF	OFF	ON	OFF	OFF
17	ON	OFF	OFF	OFF	ON		
18	OFF	ON	OFF	OFF	ON	OFF	OFF
19	ON	ON	OFF	OFF	ON	OFF	OFF
20	OFF	OFF	ON	OFF	ON	OFF	OFF
⋮							
31	ON	ON	ON	ON	ON	OFF	OFF
32	OFF	OFF	OFF	OFF	OFF	ON	OFF
33	ON	OFF	OFF	OFF	OFF	ON	OFF
34	OFF	ON	OFF	OFF	OFF	ON	OFF
35	ON	ON	OFF	OFF	OFF	ON	OFF
⋮							
40	OFF	OFF	OFF	ON	OFF	ON	OFF
⋮							
48	OFF	OFF	OFF	OFF	ON	ON	OFF
⋮							
63	ON	ON	ON	ON	ON	ON	OFF
64	OFF	OFF	OFF	OFF	OFF	OFF	ON
65	ON	OFF	OFF	OFF	OFF	OFF	ON
66	OFF	ON	OFF	OFF	OFF	OFF	ON
67	ON	ON	OFF	OFF	OFF	OFF	ON
⋮							
95	ON	ON	ON	ON	ON	OFF	ON
96	OFF	OFF	OFF	OFF	OFF	ON	ON
97	ON	OFF	OFF	OFF	OFF	ON	ON
98	OFF	ON	OFF	OFF	OFF	ON	ON
99	ON	ON	OFF	OFF	OFF	ON	ON
Setting 100 or more for Pattern number will be ignored and the number will be switched to 99.							

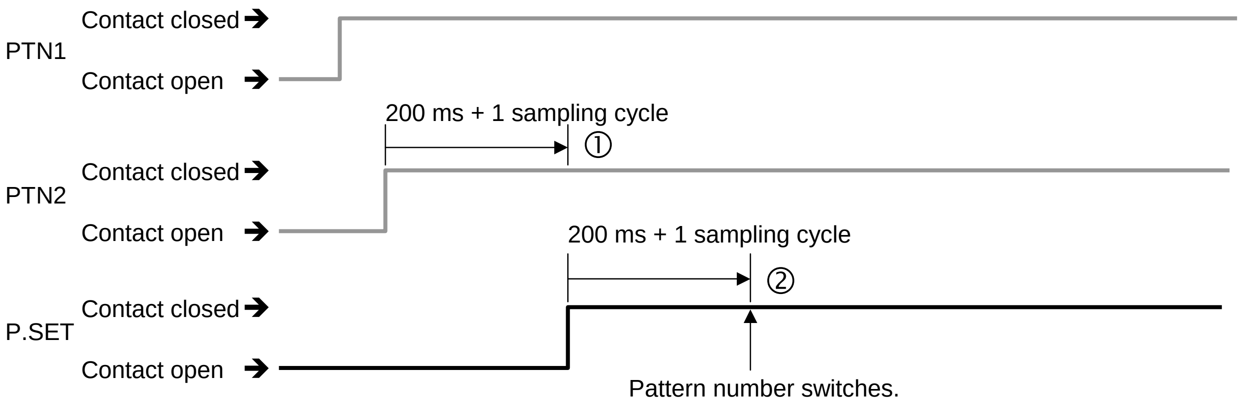
• Transfer timing of Pattern number

Pattern number can be switched by front key operation or communication regardless of whether setting the pattern number by DI.

Pattern number can be switched when the operation mode is in Reset mode (RESET) regardless of whether any DI contacts of the following functions are closed: Reset mode (RESET) setting, Program control mode (RUN), Hold (HOLD) function or Step (STEP) function.

<u>When setting Pattern number by using the Pattern set input (P.SET) [Pattern number: Binary number of DI + 1]</u>

Example: Switch the pattern number to 4 (Close the contacts from PTN1, PTN2 and P.SET)

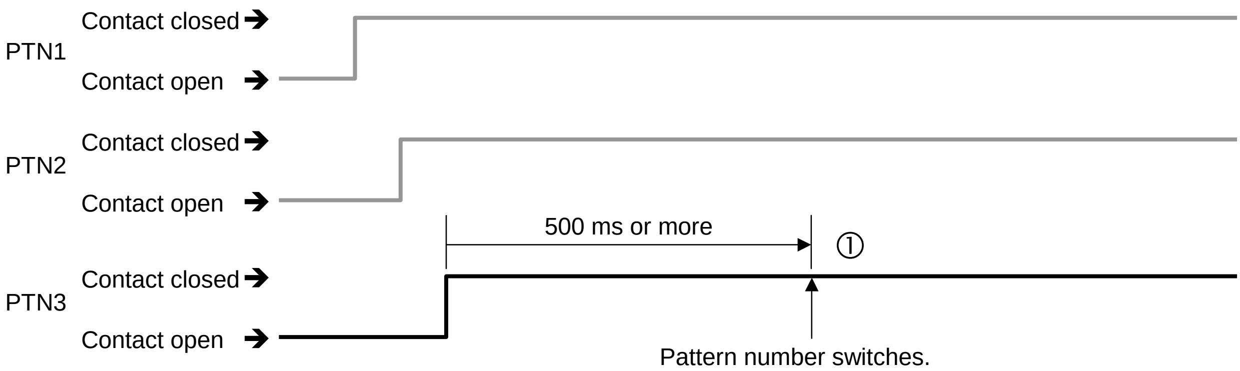


① Before closing the P.SET contacts, DI contacts of the Pattern number must be closed for 200 ms + 1 sampling cycle.

② To switch Pattern numbers, close the contacts of P.SET for 200ms + 1 sampling cycle. Switch from Reset mode (RESET) to Program control mode (RUN) after a Pattern number is determined.

<u>When setting Pattern number by switching DI [Pattern number: Binary number of DI]</u>

Example: Switch the pattern number to 7 (Close the contacts from PTN1, PTN2 and PTN3)

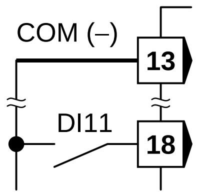


① To switch Pattern numbers, keep the state of the DI contacts of the Pattern number being closed last for 500 ms + 1 sampling cycle.
Switch from Reset mode (RESET) to Program control mode (RUN) after a Pattern number is determined.

■ Pattern increment

Program pattern number can be switched by DI when the operation mode is in the Reset mode (RESET).
Program pattern number can be increased by 1 when closing the opened DI contact for Pattern increment.
To increase the Program pattern number continuously, repeat sequence in opening and closing the DI.

- Terminal configuration



DI11: Pattern increment

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

Contact specifications: At OFF (contact open) 10 kΩ or more
At ON (contact closed) 1 kΩ or less

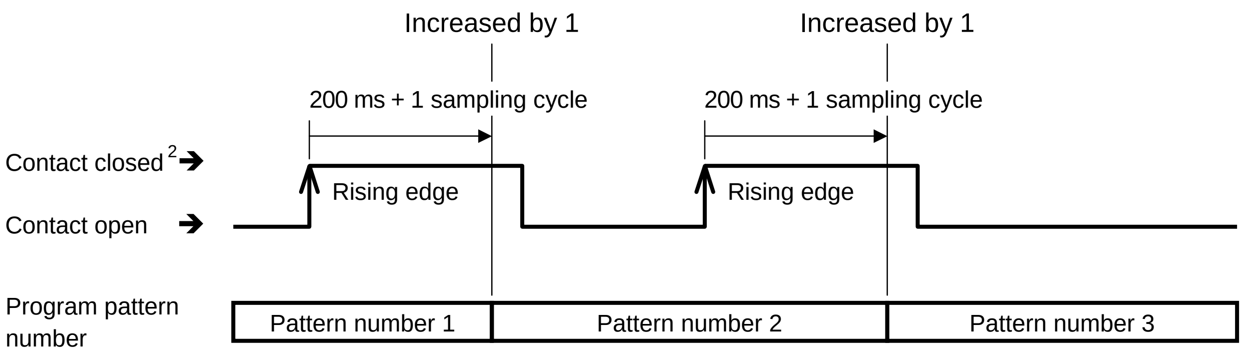
- Transfer timing of Pattern number

Program Pattern number can be increased by 1 when closing the opened DI contact for Pattern increment in the Reset mode (RESET) (Rising edge).

NOTE

After the contact is transferred, it takes "200 ms + 1 sampling cycle [1]" until the action of this instrument is actually selected.

[1] Sampling cycle: The value selected by the sampling cycle of the Engineering mode. (Factory set value: 100 ms)



[2] To validate the action of contact, close the contact for 200 ms + 1 sampling cycle.

Program pattern number returns to Pattern 1 when the contact is closed if the program is in the Maximum pattern number.

Pattern increment can be switched when the operation mode is in Reset mode (RESET) regardless of whether any DI contacts of the following functions are closed:
Reset mode (RESET) setting, Program control mode (RUN), Hold (HOLD) function or Step function (STEP).

Pattern number can be switched by front key operation or communication regardless of whether setting the pattern number by DI.

Pattern increment function can be used when setting 5 to the Digital input (DI) assignment [dI SL].

■ Parameter setting

● Digital input (DI) assignment

Parameter symbol	Data range	Factory set value
dI SL	0 to 4 (Refer to **DI Assignment Code Table**.)	Based on model code. When not specifying: 0

DI Assignment Code Table

DI number	Set value					
	0 [a]	1 [a]	2	3 [b]	4	5
DI1	PTN1	PTN1	WAIT	WAIT	WAIT	WAIT
DI2	PTN2	PTN2	WAIT	WAIT	WAIT	WAIT
DI3	PTN4	PTN4	WAIT	WAIT	WAIT	WAIT
DI4	PTN8	PTN8	WAIT	WAIT	WAIT	WAIT
DI5	PTN16	PTN16	WAIT	WAIT	WAIT	WAIT
DI6	P. SET	P. SET	WAIT	WAIT	WAIT	WAIT
DI7	RESET	RESET	PTN1	PTN1	RESET	RESET
DI8	RUN	RUN	PTN2	PTN2	RUN	RUN
DI9	STEP	STEP	PTN4	PTN4	STEP	STEP
DI10	HOLD	PTN32	PTN8	PTN8	HOLD	HOLD
DI11	PTN32	PTN64	P. SET	PTN16	Direct/Reverse	PTN_INC

[a] Setting zero (0) or “1” is suitable when DI1 to DI6 (optional) are specified at ordering.

[b] When selecting set value 3, the set value of the Pattern input method of Digital input (DI) should be changed to 1 or 3.

PTN1, 2, 4, 8, 16, 32, 64:	Pattern number switch
P. SET:	Pattern set
WAIT:	Wait state release
RESET:	Reset mode (RESET) setting
RUN:	Program control mode (RUN) setting
STEP:	Step (STEP) function
HOLD:	Hold (HOLD) function
Direct/Reverse:	Direct/Reverse action switching
PTN_INC:	Pattern increment

● Pattern input method of Digital input (DI)

Parameter symbol	Data range	Factory set value
dI PTN	0: Set Pattern number by using the Pattern set input. Pattern number = Binary number of DI + 1 1: Set Pattern number by switching the contact input. Pattern number = Binary number of DI + 1 2: Set Pattern number by using the Pattern set input. Pattern number = Binary number of DI 3: Set Pattern number by switching the contact input. Pattern number = Binary number of DI	0

Pattern input method of Digital input (DI) is invalid when Pattern increment function is selected for Digital input (DI).

● Wait release trigger selection

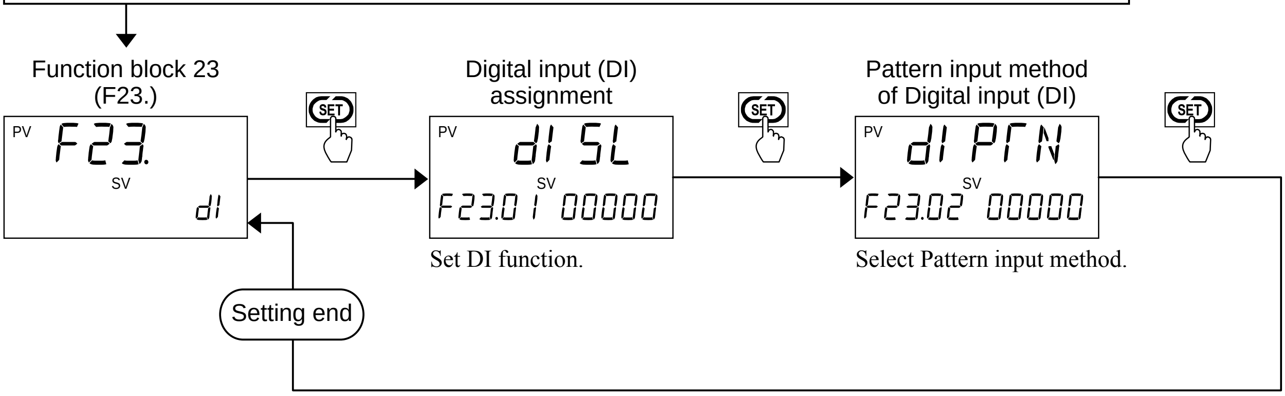
Parameter symbol	Data range	Factory set value
RE.TRG	0: Invalid 1: De-energized 00001 ← Value at SV display Zone wait 1 (the controller) Zone wait 2 (all slave controllers) Wait release by digital input (DI) Unused	00001

■ Setting procedure

- For Digital input (DI) assignment and Digital input (DI) pattern input method, go to F23 in the Engineering mode.
- For Wait trigger release selection, go to the Parameter setting mode (Wait memory group setting block).

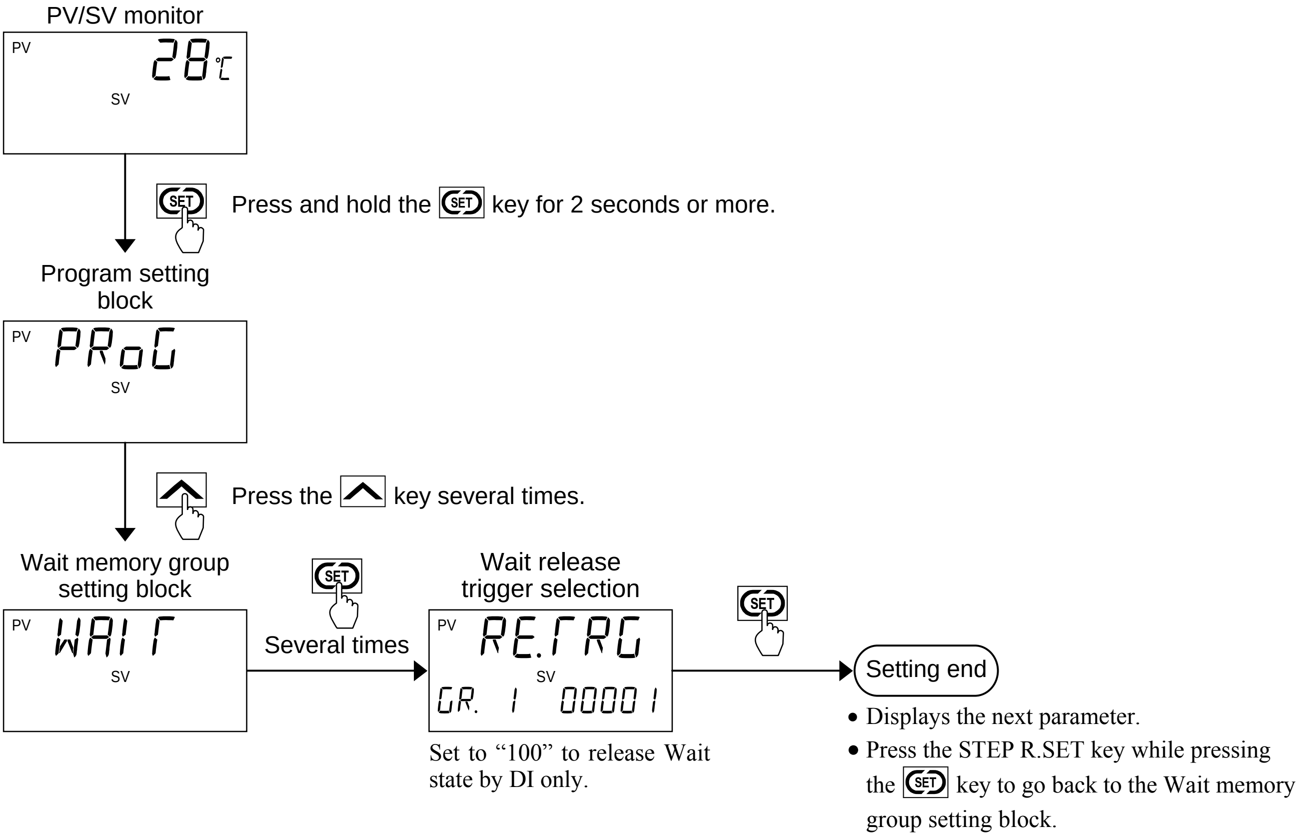
● Parameter setting at F23 in the Engineering mode

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F23 screen displays.



● Parameter setting in the Parameter setting mode (Partial setting type)

When releasing Wait state by DI.



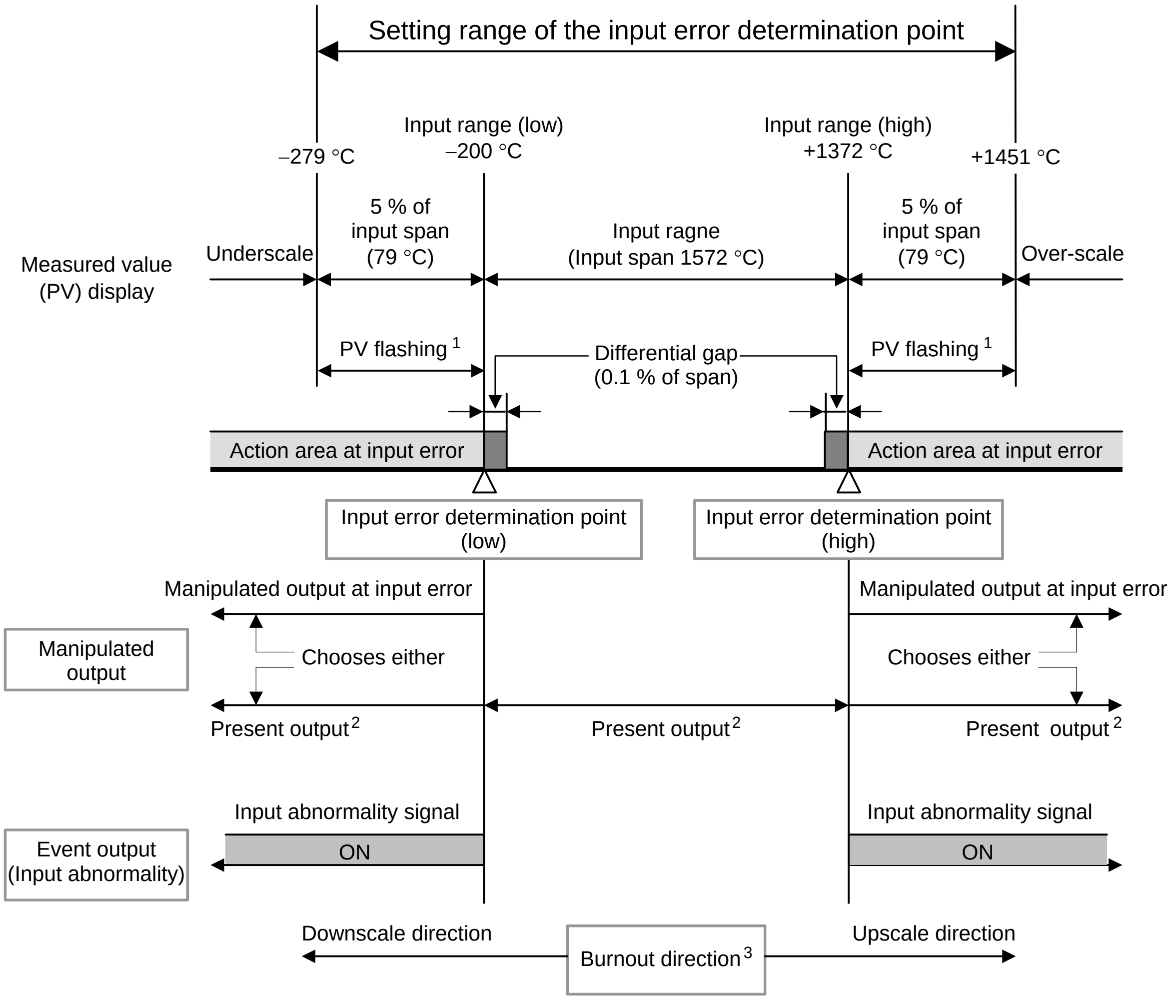
6.1.10 Action, Function and Settings for Input error

Input error determination point, Burnout direction (Thermocouple sensor only), Action at Input error and Manipulated output value (MV) at Input error can be set.
A signal of Input error state may be produced as Event output.

■ Description of function

If the Measured value (PV) is above the Input error determination point (high) or below the Input error determination point (low), Action (high) at input error or Action (low) at input error will be taken.
Event signal of the Input error state is produced from the output terminals of OUT2, OUT3 or DO to DO12.

Example: When the input range is –200 to +1372 °C
Input span: 1572
5 % of input span: 79 (78.6 was rounded off)
Setting range: –279 to +1451 °C



[1] "Flashing display" or "Non-flashing display" of PV can be selected for the PV flashing display at input error of the Engineering Mode (F10).

[2] Present output
- Program control mode (RUN): Manipulated output value (MV) of the segment in progress
- Fixed set point control mode (FIX): Manipulated output value (MV)
- Manual control mode (MAN): Manipulated output value (MV) at manual setting

[3] Burnout direction can be set for thermocouple sensor only. For other input types, Burnout direction is fixed as:
RTD input: Upscale
Voltage/Current input: Downscale (Indicates value near 0.)

■ Parameter setting

● PV flashing display at input error

Parameter symbol	Data range	Factory set value
dSoP	0: Flashing at input error 1: No flashing at input error	0

● Input error determination point (high)

Parameter symbol	Data range	Factory set value
PoV	Input range (low) – (5 % of Input span) to Input range (high) + (5 % of Input span)	Input range (high) + (5 % of Input span)

● Input error determination point (low)

Parameter symbol	Data range	Factory set value
PUN	Input range (low) – (5 % of Input span) to Input range (high) + (5 % of Input span)	Input range (low) – (5 % of Input span)

● Burnout direction

Parameter symbol	Data range	Factory set value
boS	0: Upscale 1: Downscale Valid only when the Voltage (low) input group selected.	0

● Action (high) at input error

Parameter symbol	Data range	Factory set value
AoVE	0: Normal control (present output) 1: Manipulated output value at input error	0

● Action (low) at input error

Parameter symbol	Data range	Factory set value
AUNE	0: Normal control (present output) 1: Manipulated output value at input error	0

● Manipulated output value at input error

Parameter symbol	Data range	Factory set value
PSM	−105.0 to +105.0 % Actual output values become those restricted by the Output limiter.	0.0

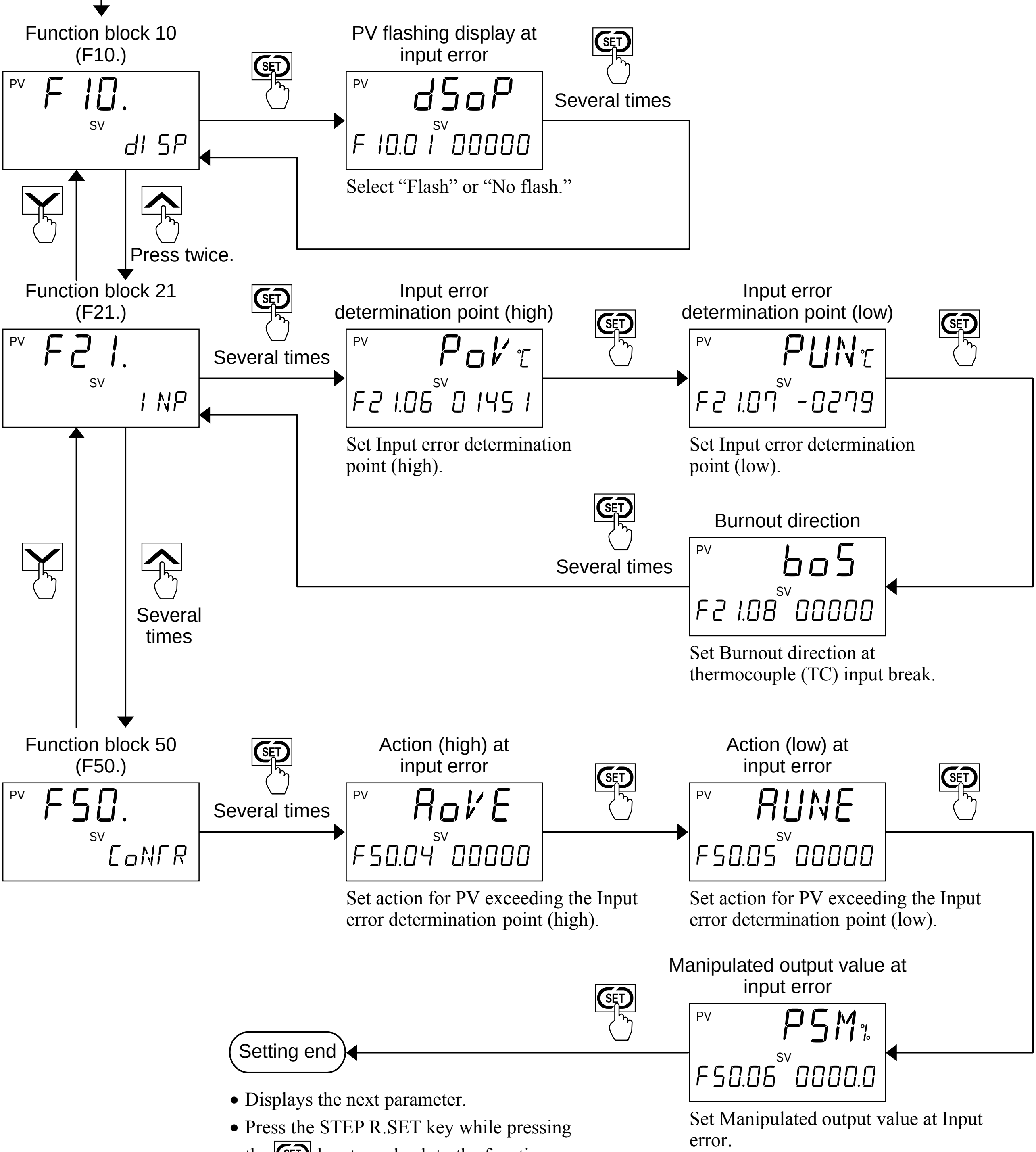
☞ **Event output setting at Input error**
To produce Event output at input error from the output terminals of OUT2, OUT3 or DO1 to DO12, refer to the descriptions of the sections below.

6.2.1 Output assignment (OUT1 to OUT3) ···················· **P. 6-37**
6.2.2 Digital output (DO) assignment (DO1 to DO12) ··········· **P. 6-41**

■ Setting procedure

- To set PV flashing display at input error, go to F10 in the Engineering mode.
- To set Input error determination point (high), Input error determination point (low) and Burnout direction, go to F21 in the Engineering mode.
- To set Action (high) at input error, Action (low) at input error and Manipulated output value at input error, go to F50 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.



- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 50 (F50.).

6.1.11 Current transformer (CT) input setting and assignment

To use Current transformer (CT) input, set CT ratio and assign CT. The CT input value is used to trigger the Heater break alarm (HBA). Set CT ratio and assign CT first then set Heater break alarm (HBA).

Setting of CT ratio

Set the number of turns (ratio) in the Current transformer.
The specific value of CT ratio will be preset when specifying a type of CT with the Initial setting code at ordering.

↓

Assignment of CT

Set the output to be assigned with CT1 and CT2. Detect the load current value of the assigned control output by CT.

↓

Setting related to Heater break alarm (HBA)

☞ For setting procedure of Heater break alarm (HBA), refer to **6.4.2 Setting procedure of Heater break alarm (HBA) setting (P. 6-77)**.

■ Parameter setting

● CT1 ratio

Set the number of turns (ratio) in the Current transformer 1 (CT1) for Heater break alarm 1 (HBA1).

Parameter symbol	Data range	Factory set value
CTR1	0 to 9999 Set the appropriate values below for each Current transformer type. CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000	CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000 When not specifying: 800

● CT1 assignment

Assign the objected output to control output for determining Heater break alarm 1 (HBA1).

Parameter symbol	Data range	Factory set value
CTA1	0: None 2: OUT2 1: OUT1 3: OUT3	When CT input is specified and Time proportioning output is set to OUT1: 1 For other settings: 0

● CT2 ratio

Set the number of turns (ratio) in the Current transformer 2 (CT2) for Heater break alarm 2 (HBA2).

Parameter symbol	Data range	Factory set value
CTR2	0 to 9999 Set the appropriate values below for each Current transformer type. CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000	CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000 When not specifying: 800

● CT2 assignment

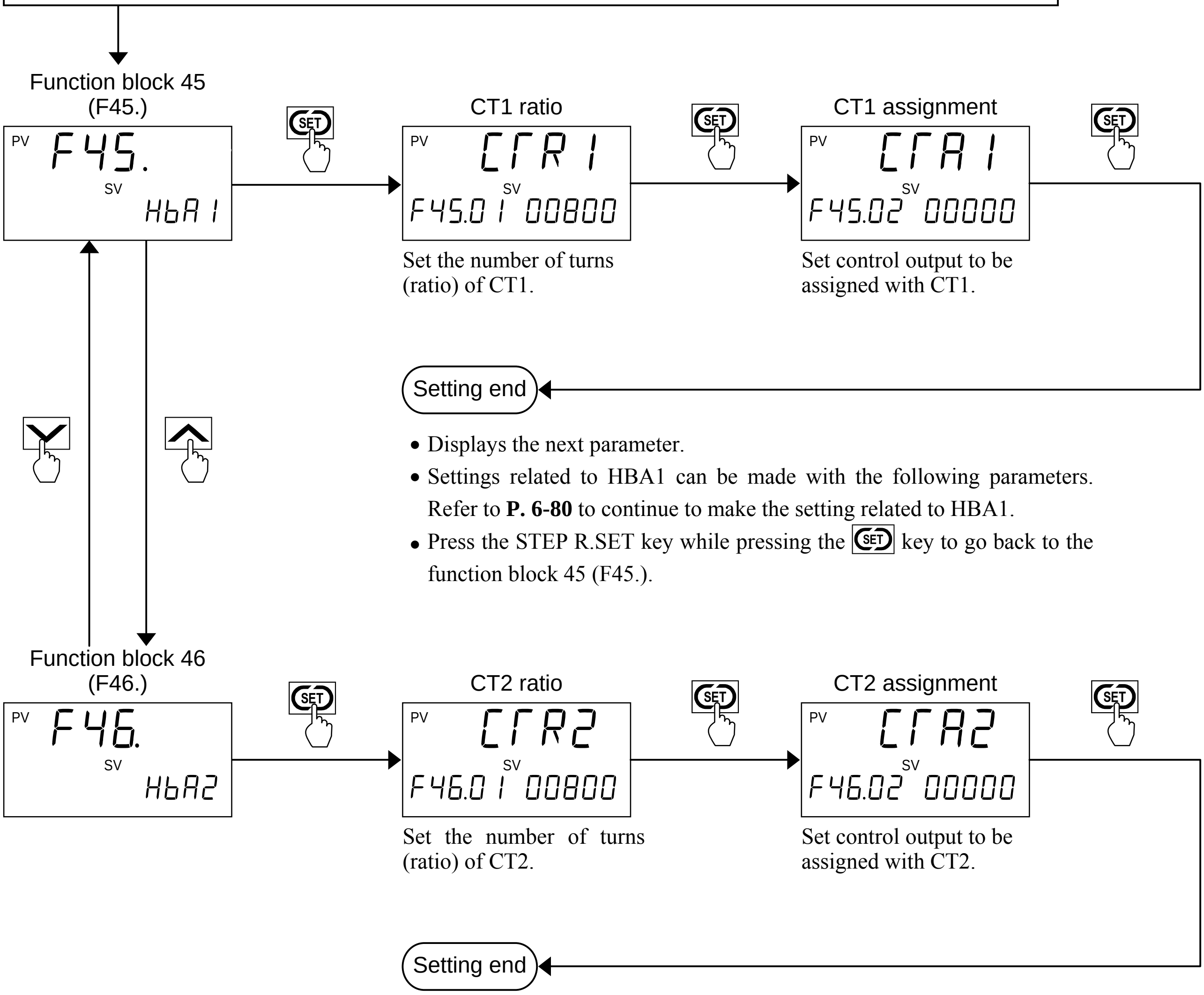
Assign the objected output to control output for determining Heater break alarm 2 (HBA2).

Parameter symbol	Data range	Factory set value
CTA2	0: None 2: OUT2 1: OUT1 3: OUT3	When CT input is specified and Time proportioning output is set to OUT2: 2 For other settings: 0

■ Setting procedure

- To set CT1 ratio and CT1 assignment, go to F45 in the Engineering mode.
- To set CT2 ratio and CT2 assignment, go to F46 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the <MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F45 screen displays.



Set the number of turns (ratio) of CT1.

Set control output to be assigned with CT1.

- Displays the next parameter.
- Settings related to HBA1 can be made with the following parameters. Refer to **P. 6-80** to continue to make the setting related to HBA1.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 45 (F45.).

Set the number of turns (ratio) of CT2.

Set control output to be assigned with CT2.

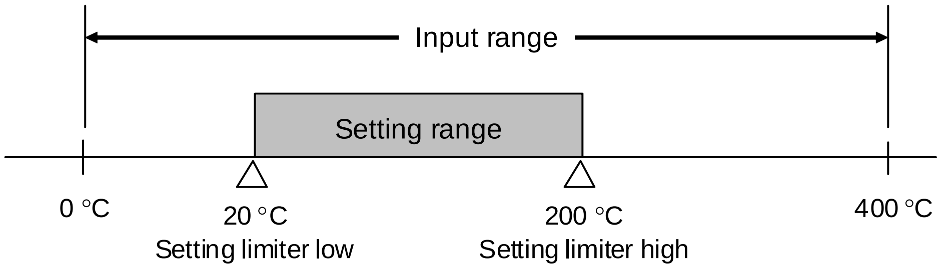
- Displays the next parameter.
- Settings related to HBA2 can be made with the following parameters. Refer to **P. 6-80** to continue to make the setting related to HBA2.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 46 (F46.).

Three-phase Heater break alarm assignment
To use HBA for a three-phase load, both CT inputs can be assigned to the same output.

6.1.12 Setting limiter

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

Example: The input range is from 0 to 400 °C, the Setting limiter high is 200 °C, and the Setting limiter low is 20 °C.



■ Parameter setting

● Setting limiter high

Parameter symbol	Data range	Factory set value
SLH	Setting limiter low to Input range high (The unit is the same as input value)	Input range high

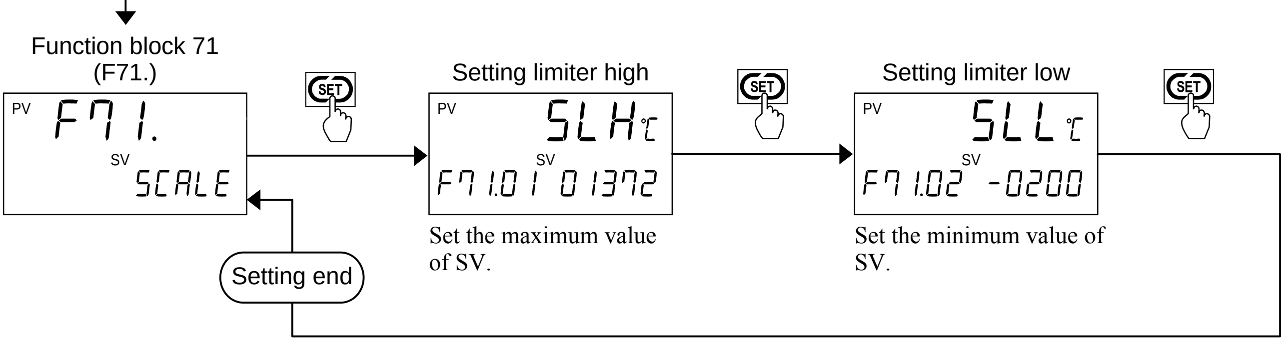
● Setting limiter low

Parameter symbol	Data range	Factory set value
SLL	Input range low to Setting limiter high (The unit is the same as input value)	Input range low

■ Setting procedure

To set Setting limiter high or Setting limiter low, go to F71 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F71 screen displays.



6.2 Output

6.2.1 Output assignment (OUT1 to OUT3)

To use OUT1 to OUT3, output function must be assigned to each output terminal.
Refer to the output function below.

Output function: Control output, Transmission output or Event output

- To assign Control output, refer to the recommended output allocation in the table below.

Recommended output allocation

Control action	Output terminals		
	OUT1	OUT2	OUT3
PID control	Manipulated output value 1 (MV1) (Direct action or Reverse action)		
Heat/Cool PID control	Manipulated output value 1 (MV1) [heat-side]	Manipulated output value 2 (MV2) [cool-side]	
Position proportioning PID control *	Manipulated output value 1 (MV1) [Open-side output]	Manipulated output value 2 (MV2) [Close-side output]	
Output program value	Output program value 1	Output program value 2	Output program value 3

* For Position proportioning PID control, assign output as described in the table to produce Control output.

- Output type availability is based on the output functions. For details, refer to the table below.

MV1: Manipulated output value 1 (MV1) MV2: Manipulated output value 2 (MV2)

Output type		Output function						
		Control output				Transmission output		Event output
		MV1 [a]		MV2 [a]		Others [b]	Output program	
		Heat-side output	Open-side output	Cool-side output	Close-side output			
Output 1 (OUT1)	Relay contact output	○	♦	×	×	×	■	×
	Voltage pulse output	○	♦	×	×	×	■	×
	Voltage/Current output	○	♦	×	×	×	■	×
	Triac output	○	♦	×	×	×	■	×
	Open collector output	○	♦	×	×	×	■	×
Output 2 (OUT2)	Relay contact output	○	×	●	♦	×	■	■
	Voltage pulse output	○	×	●	♦	×	■	■
	Voltage/Current output	○	×	●	♦	■ [c]	■	×
	Triac output	○	×	●	♦	×	■	■
	Open collector output	○	×	●	♦	×	■	■
Output 3 (OUT3)	Voltage pulse output	○	×	●	×	×	■	■
	Voltage/Current output	○	×	●	×	■	■	×
	Open collector output	○	×	●	×	×	■	■

[a] MV1 and MV2 can be used as Transmission output.
[b] Others: Transmission output of Measured value (PV), Deviation value (DEV), Set value (SV) monitor and Segment time (percentage)
[c] When Position proportioning PID control is selected, it is still possible to assign PV, SV, SV monitor or Transmission output of Segment time (percentage) to OUT 2 while Manipulated output value 2 (MV2) [close-side] cannot be used.

○: Specifiable at PID control or Heat/Cool PID control
♦: Specifiable at Position proportioning PID control
●: Specifiable at Heat/Cool PID control
■: Specifiable for any control method
×: Not specifiable

- Output assignment for Transmission output or Event output
  Do not assign Transmission output or Event output to the Control output terminals. Output terminals for OUT2 and OUT3 can be only used if specified at ordering.

• Details of Event output

Event output type: Time signal, Event 1 to 4, Heater break alarm (HBA), Control loop break alarm (LBA) and output signal may be selected for the state of PF900/PF901.
Refer to the status signal of the instrument in the table below.

Type	Details
Input error state	Input error signal is produced if • The Measured value (PV) exceeds the set value of the Input error determination point (high). • The Measured value (PV) goes below the set value of the Input error determination point (low).
Program control mode (RUN) state	The signal of Program control mode (RUN) state is produced when the operation mode is in the Program control mode (RUN).
Fixed set point control mode (FIX) state	The signal of Fixed set point control mode (FIX) state is produced when the operation mode is in the Fixed set point control mode (FIX).
Manual control mode (MAN) state	The signal of Manual control mode (MAN) state is produced when the operation mode is in the Manual control mode (MAN).
Ramp state	Ramp state signal is produced when the operation is at a ramp segment of the Program control mode (RUN).
Soak state	Soak state signal is produced when the operation is at a soak segment of the Program control mode (RUN).
Hold state	A Hold state signal is produced when the progress of the program in the Program control mode (RUN) is suspended by the HOLD function. The Hold state remains and the Hold state signal is continuous even if the operation mode in Hold state is changed from the Program control mode (RUN) to the Fixed set point control mode (FIX) or the Manual control mode (MAN).
Wait state	Wait state signal is produced when the progress of the Program pattern is in Wait state in the Program control mode (RUN). The Wait state remains and the Wait state signal is continuous even if the operation mode in Wait state is changed from the Program control mode (RUN) to the Fixed set point control mode (FIX) or the Manual control mode (MAN).
Pattern end signal	Pattern end signal is produced when the control of the program pattern is completed (at Pattern end) in the Program control mode (RUN).
Autotuning (AT) state	Autotuning (AT) state signal is produced when the operation is at a Autotuning (AT). Autotuning (AT) state signal is produced when the operation is at a Autotuning (AT) with learning.
FAIL state	FAIL state signal is produced if FAIL occurs. (FAIL output [fixed at de-energized])
Host communication error	Host communication error signal is produced if a Host communication error occurs.
Intercontroller communication error	Intercontroller communication error signal is produced if Link error occurs in the Intercontroller communication.
Feedback resistance (FBR) input error	FBR input error signal is produced if FBR input breaks and a burnout state occurs.

■ Parameter setting

● OUT1 assignment

Parameter symbol	Output function	Data range	Factory set value
LoGC1	Control output	0: Manipulated output value 1 (MV1) PID control, Heat/Cool PID control: Heat-side output Position proportioning PID control: Open-side output 1: Output program value 1	0
	Transmission output	1: Output program value 1	

● OUT2 assignment

Relay contact output/Voltage pulse output/Triac output/Open collector output

Parameter symbol	Output function	Data range	Factory set value
LoGC2		20: None	Heat/Cool PID control: 22 Position proportioning PID control: 22 For other settings: 20 When the OUT2 is not provided: 0
	Control output	21: Manipulated output value 1 (MV1) PID control, Heat/Cool PID control: Heat-side output Position proportioning PID control: Open-side output 22: Manipulated output value 2 (MV2) Heat/Cool PID control: Cool-side output Position proportioning PID control: Close-side output 23: Output program value 2	
	Event output	24: Time signal 1* 25: Time signal 2* 26: Time signal 3* 27: Time signal 4* 28: Time signal 5* 29: Time signal 6* 30: Time signal 7* 31: Time signal 8* 32: Event 1 33: Event 2 34: Event 3 35: Event 4 36: HBA1 37: HBA2 38: Logical *OR* of HBA1 and HBA2 39: LBA 40: Input error state 41: Program control mode (RUN) state 42: Fixed set point control mode (FIX) state 43: Manual control mode (MAN) state 44: Ramp state 45: Soak state 46: Hold state 47: Wait state 48: Pattern end signal 49: Autotuning (AT) state 50: FAIL state 51: Host communication error 52: Intercontroller communication error 53: Feedback resistance (FBR) input error	

* Segment signal 1 to Segment signal 8 is assigned to the Event output No. 24 to 31 when Segment signal type is selected for Signal type.

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Voltage/Current output

Parameter symbol	Output function	Data range	Factory set value
LoGC2		0: None	Heat/Cool PID control: 2 For other settings: 0
	Control output	1: Manipulated output value 1 (MV1) [Feedback resistance (FBR) input value when FBR input is specified with the Position proportioning PID control.] 2: Manipulated output value 2 (MV2) [Cool-side output at Heat/Cool PID control] 7: Output program value 2	
	Transmission output	3: Measured value (PV) 4: Deviation value (DEV) 5: Set value (SV) monitor 6: Segment time (percentage basis) 7: Output program value 2	

● OUT3 assignment [LoGC3]

For data range, refer to the table for OUT2 assignment. For OUT3 assignment, Output program value 3 is assigned to No. 7 and 23.

Control output is not produced from OUT3 when No. 21 or 22 is selected at Position proportioning PID control.

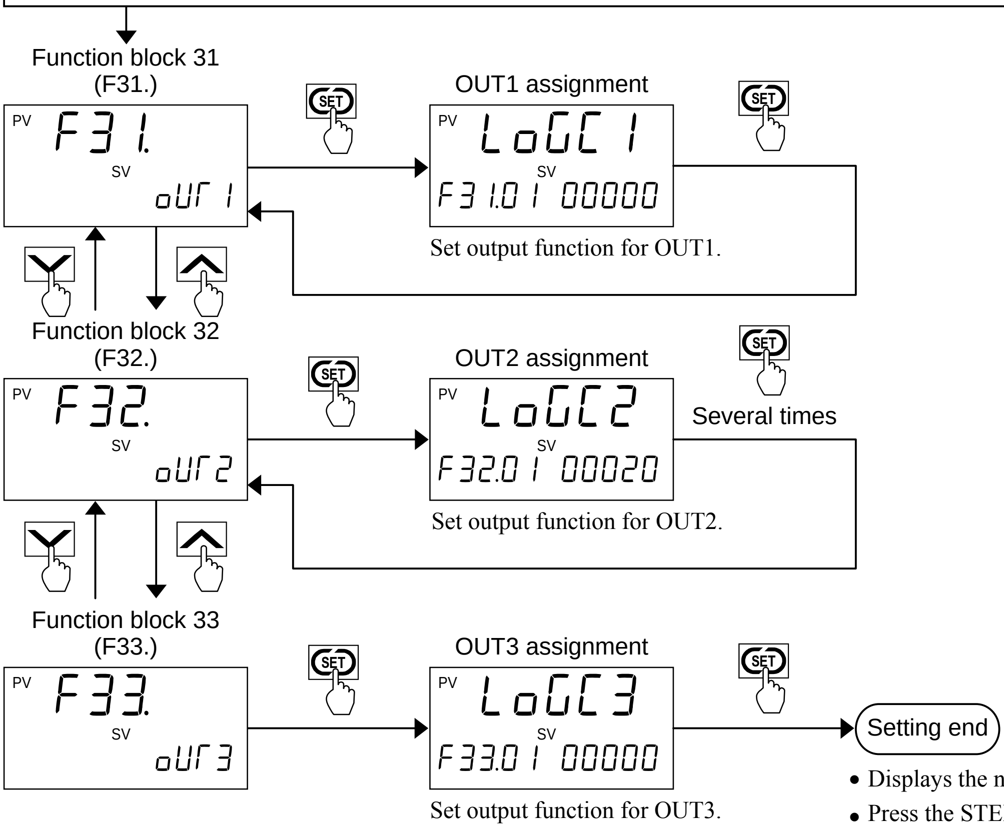
[Factory set value: 0 or 20]

Relay contact output and Triac output cannot be used for OUT3.

■ Setting procedure

To assign OUT1 to OUT3, go to F31 to F33 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F31 screen displays.



- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 33 (F33.).

6.2.2 Digital output (DO) assignment (DO1 to DO12)

Event output can be produced to the external equipment by Digital output (DO). To use DO1 to DO12, assign Event output type to the DO terminals from DO1 to DO12.

DO1 to DO4: Relay contact output
DO5 to DO12: Open collector output
DO terminals from DO5 to DO12 are available only when 12 points of Digital output are specified at ordering

■ Parameter setting

● DO1 assignment to DO12 assignment

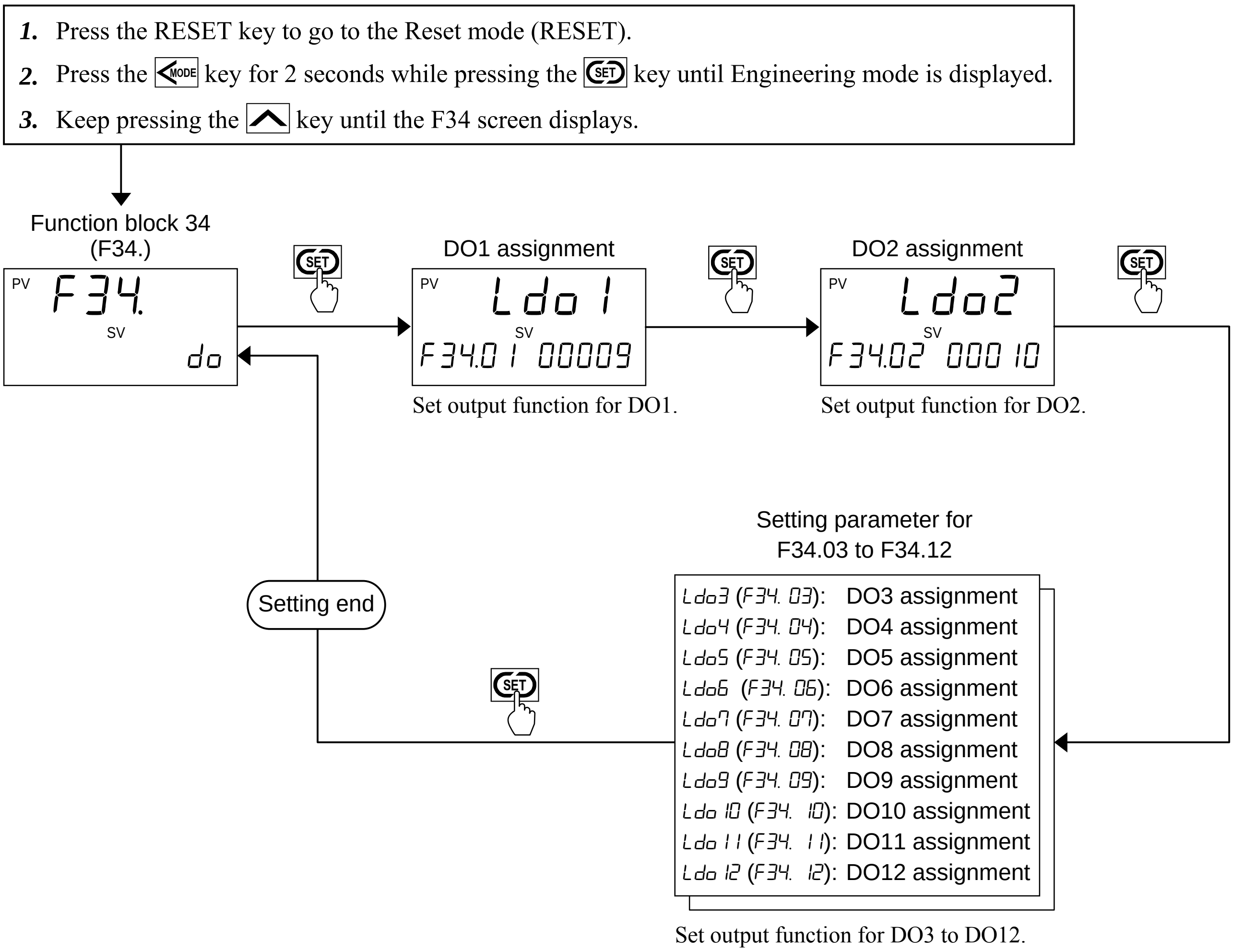
Parameter symbol	Data range	Factory set value
Ldo1 Ldo2 Ldo3 Ldo4 Ldo5 Ldo6 Ldo7 Ldo8 Ldo9 Ldo10 Ldo11 Ldo12	0: None 1: Time signal 1 [a] 2: Time signal 2 [a] 3: Time signal 3 [a] 4: Time signal 4 [a] 5: Time signal 5 [a] 6: Time signal 6 [a] 7: Time signal 7 [a] 8: Time signal 8 [a] 9: Event 1 10: Event 2 11: Event 3 12: Event 4 13: HBA1 14: HBA2 15: Logical *OR* of HBA1 and HBA2 16: LBA 17: Input error state [b] 18: Program control mode (RUN) state [b] 19: Fixed set point control mode (FIX) state [b] 20: Manual control mode (MAN) state [b] 21: Ramp state [b] 22: Soak state [b] 23: Hold state [b] 24: Wait state [b] 25: Pattern end signal [b] 26: Autotuning (AT) state [b] 27: FAIL state [b] 28: Host communication error [b] 29: Intercontroller communication error [b] 30: Feedback resistance (FBR) input error [b]	DO1 to DO4 When DO1 to DO4 are specified: Based on model code. When DO1 to DO4 are not specified: DO1 assignment [Ldo1]: 9 DO2 assignment [Ldo2]: 10 DO3 assignment [Ldo3]: 1 DO4 assignment [Ldo4]: 25 DO5 to DO12 [optional] When DO5 to DO12 are specified at ordering: DO5 assignment [Ldo5]: 1 DO6 assignment [Ldo6]: 2 DO7 assignment [Ldo7]: 3 DO8 assignment [Ldo8]: 4 DO9 assignment [Ldo9]: 5 DO10 assignment [Ldo10]: 6 DO11 assignment [Ldo11]: 7 DO12 assignment [Ldo12]: 8 When DO1 to DO4 are specified at ordering (without DO5 to DO12): DO5 assignment [Ldo5]: 0 DO6 assignment [Ldo6]: 0 DO7 assignment [Ldo7]: 0 DO8 assignment [Ldo8]: 0 DO9 assignment [Ldo9]: 0 DO10 assignment [Ldo10]: 0 DO11 assignment [Ldo11]: 0 DO12 assignment [Ldo12]: 0

[a] Segment signal 1 to Segment signal 8 is assigned to the No. 1 to 8 when Segment signal type is selected for Signal type.

[b] For the details of event, refer to **Details of Event output (P. 6-38)**.

■ Setting procedure

To assign DO1 to DO12, go to F34 in the Engineering mode.



6.2.3 Setting of Energized/De-energized (OUT2, OUT3 or DO1 to DO12)

Energized/De-energized can be selected when the Event outputs below are assigned to OUT2, OUT3 or DO1 to DO12. Energized/De-energized can be set for Relay contact output, Voltage pulse output, Triac output and Open collector output.

- Time signal 1 to Time signal 8
- Event 1 to Event 4
- HBA1, HBA2
- Logical *OR* of HBA1 and HBA2
- LBA
- Input error state
- Program control mode (RUN) state
- Fixed set point control mode (FIX) state
- Manual control mode (MAN) state
- Ramp state
- Soak state
- Hold state
- Wait state
- Pattern end signal
- Autotuning (AT) state
- Host communication error
- Intercontroller communication error
- Feedback resistance (FBR) input error

FAIL output
Energized cannot be selected for FAIL output. Action is based on De-energized even if Energized is selected.

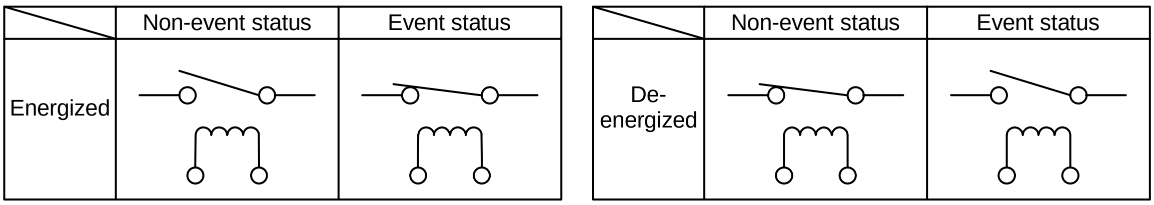
■ Description of function

Table for explaining operation (At power-ON)

Setting of Energized/De-energized	Output state of OUT2, OUT3 or DO1 to DO12	
	Non-event status	Event status
Energized	Event output OFF	Event output ON
De-energized	Event output ON	Event output OFF

Example: Relay contact output
Energized: Relay contact is closed under the event status.
De-energized: Relay contact opens under the event status.

Diagram for explaining operation (At power-ON)



■ Parameter setting

● OUT2, OUT3 Energized/De-energized

Parameter symbol	Data range	Factory set value
EXOUT	00000 ← Value at SV display OUT2 (0: Energized 1: De-energized) OUT3 (0: Energized 1: De-energized) Unused	00

● DO1 to DO4 Energized/De-energized

Parameter symbol	Data range	Factory set value
EXDO1	00000 ← Value at SV display DO1 (0: Energized 1: De-energized) DO2 (0: Energized 1: De-energized) DO3 (0: Energized 1: De-energized) DO4 (0: Energized 1: De-energized) Unused	0000

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● DO5 to DO8 Energized/De-energized

Parameter symbol	Data range	Factory set value
ExdO2	00000 ← Value at SV display DO5 (0: Energized 1: De-energized) DO6 (0: Energized 1: De-energized) DO7 (0: Energized 1: De-energized) DO8 (0: Energized 1: De-energized) Unused	0000

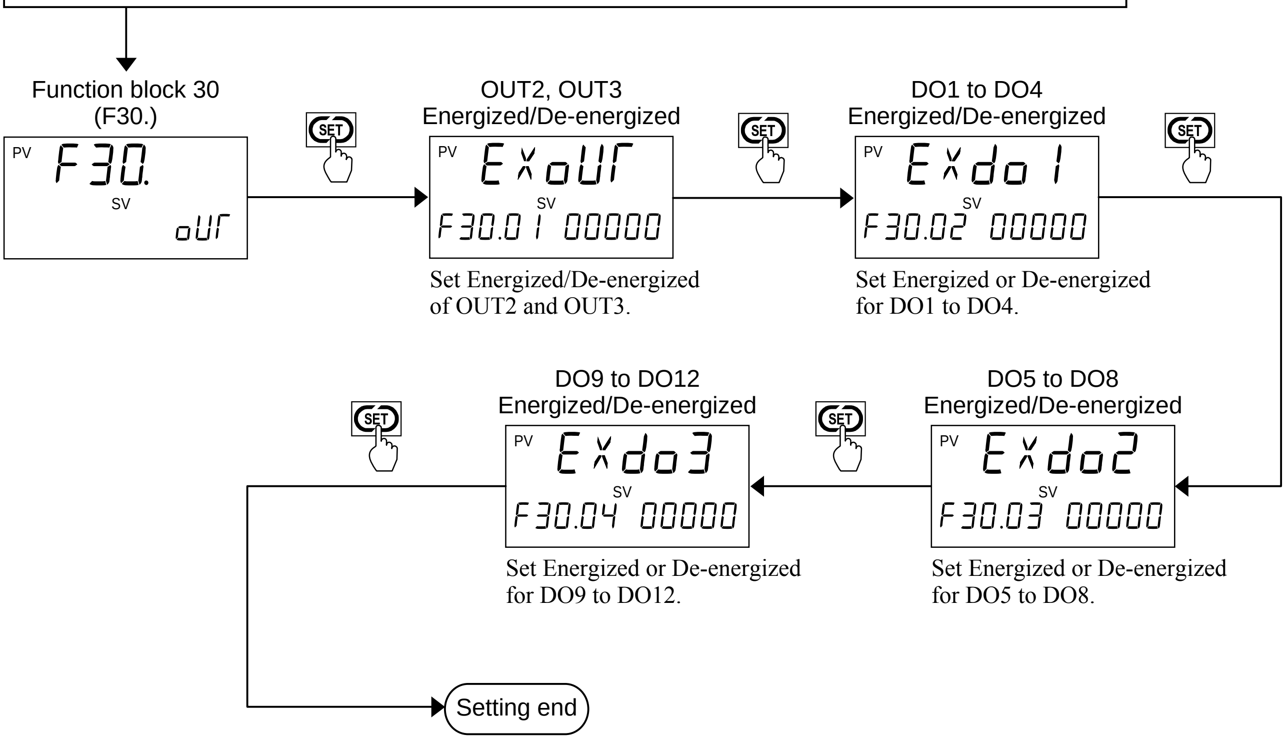
● DO9 to DO12 Energized/De-energized

Parameter symbol	Data range	Factory set value
ExdO3	00000 ← Value at SV display DO9 (0: Energized 1: De-energized) DO10 (0: Energized 1: De-energized) DO11 (0: Energized 1: De-energized) DO12 (0: Energized 1: De-energized) Unused	0000

■ Setting procedure

Energized/De-energized can be set at F30 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the <MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F30 screen displays.

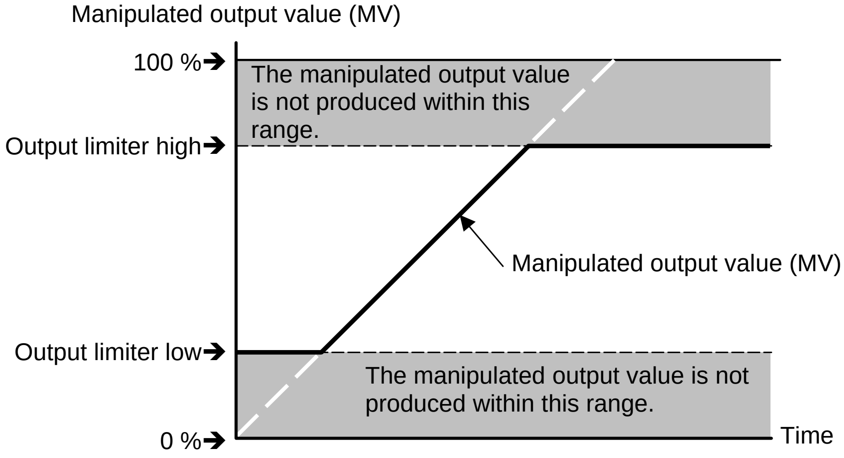


- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 30 (F30.).

6.2.4 Output limiter

■ Description of function

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



When the control action is the Position proportioning PID control:
Only when there is opening Feedback resistance (FBR) input and it does not break, the output limiter becomes valid.

Output limiter can be used whether or not Output program function is used.

■ Parameter setting

● Output limiter high (MV1) [heat-side]

Parameter symbol	Data range	Factory set value
oLH	Output limiter low (MV1) to 105.0 %	105.0

● Output limiter low (MV1) [heat-side]

Parameter symbol	Data range	Factory set value
oLL	−5.0 % to Output limiter high (MV1)	−5.0

● Output limiter high (MV2) [cool-side]

This parameter is displayed when in Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
oLH2	Output limiter low (MV2) to 105.0 %	105.0

● Output limiter low (MV2) [cool-side]

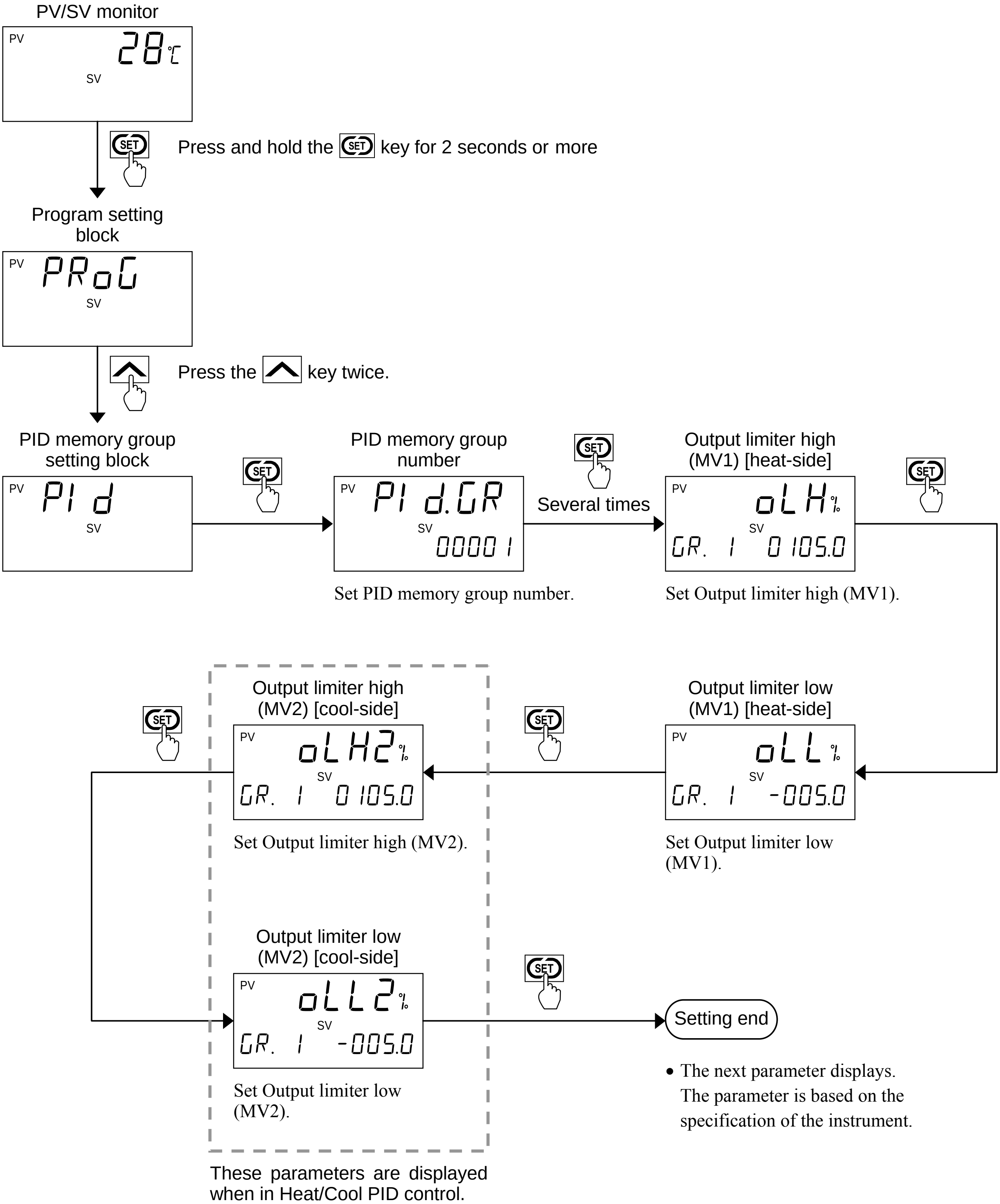
This parameter is displayed when in Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
oLL2	−5.0 % to Output limiter high (MV2)	−5.0

■ Setting procedure

To set Output limiter, go to the PID memory group setting block in the Parameter setting mode.

● Parameter setting in the Parameter setting mode (Partial setting type)



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

6.2.5 Proportional cycle time (OUT1 to OUT3)

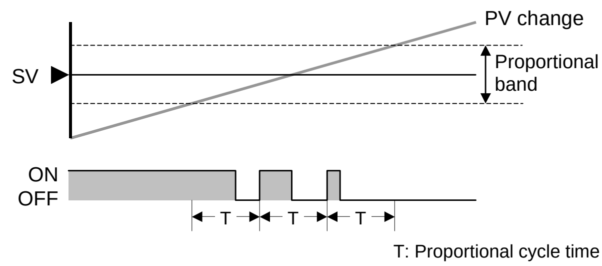
Proportional cycle time and Minimum ON/OFF time of proportioning cycle of OUT1 to OUT3 can be changed individually when Time proportioning output is specified at ordering: Relay contact output, Voltage pulse output, Triac output or Open collector output.
The output terminals for OUT2 and OUT3 can be used when output 2 and 3 are specified at ordering.

Settings of Proportional cycle time and Minimum ON/OFF time of proportioning cycle are valid whether or not Time proportioning output and Output program functions are used.

■ Description of function

● Proportional cycle time

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



● Minimum ON/OFF time of proportioning cycle

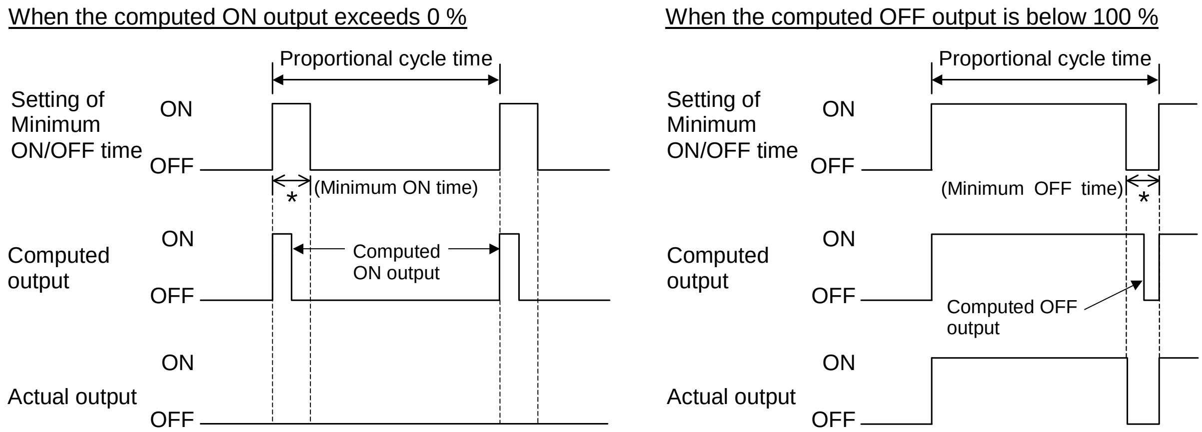
Minimum ON/OFF time of proportioning cycle can be used to compensate relay life by acquiring the minimum OF/OFF time.

Minimum ON time of proportioning cycle:

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

Minimum OFF time of proportioning cycle:

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



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

Minimum ON/OFF time of proportioning cycle is not operative if
- The Proportioning cycle is set shorter than the Minimum ON/OFF time of proportioning cycle (Proportioning cycle < Minimum ON/OFF proportioning time).
- Autotuning (AT) or Autotuning (AT) with learning function is performed.
- ON/OFF action is used.

When setting “Proportioning cycle < Minimum ON/OFF proportioning time × 2,” Manipulated output turns OFF when the computed output is below 100 %; Manipulated output turns ON when the computed output exceeds 100 %.

■ Parameter setting

● Proportional cycle time from OUT1 to OUT3

Parameter symbol	Data range	Factory set value
r 1 r2 r3	0.1 to 100.0 seconds M: Relay contact output T: Triac output V: Voltage pulse output D: Open collector output	OUT1 proportional cycle time [r 1], OUT2 proportional cycle time [r2] M: 20.0 V/T/D: 2.0 OUT3 proportional cycle time [r3] V/D: 2.0

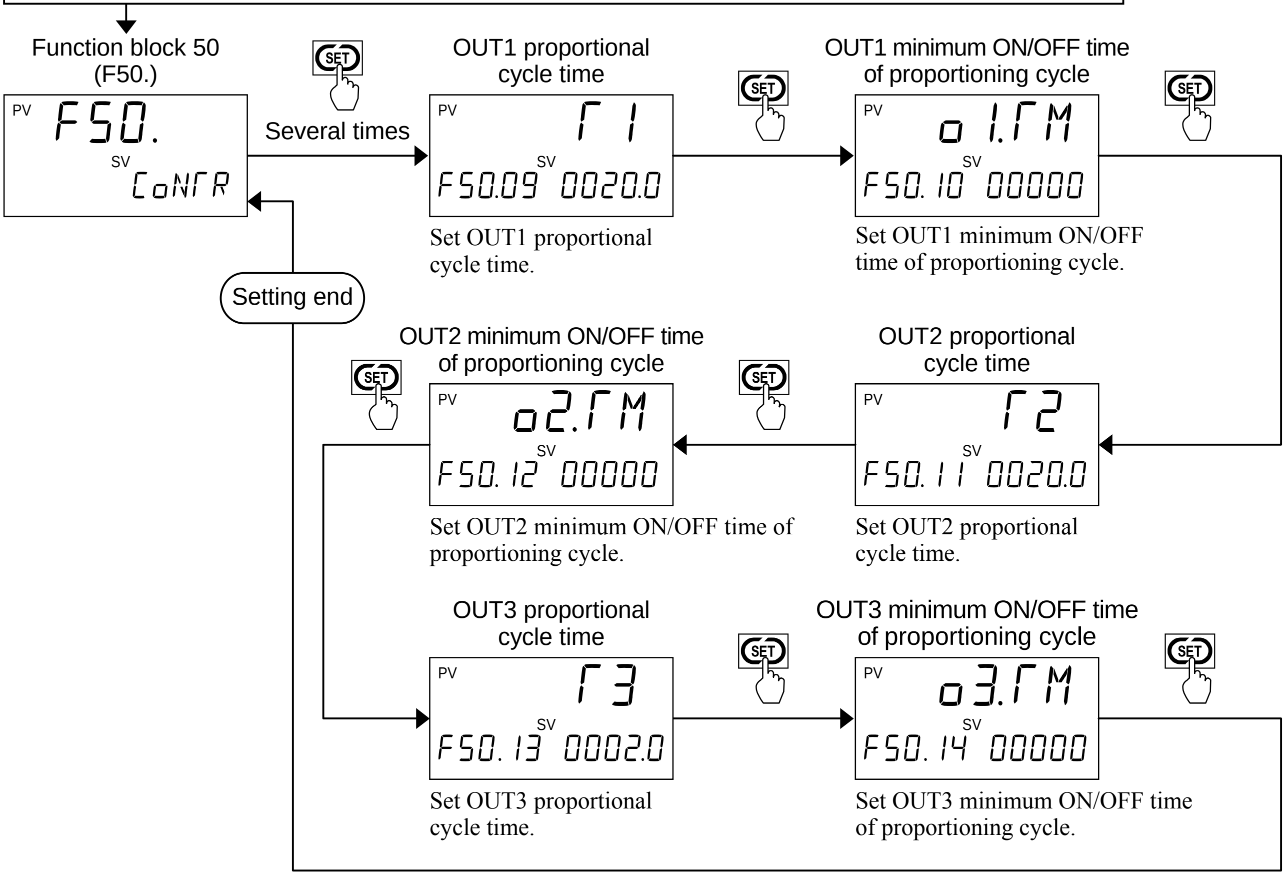
● Minimum ON/OFF time of proportioning cycle from OUT1 to OUT3

Parameter symbol	Data range	Factory set value
o 1.rM o2.rM o3.rM	0 to 1000 ms	0

■ Setting procedure

Proportional cycle time and Minimum ON/OFF time of proportioning cycle can be set at F50 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the <MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ^ key until the F50 screen displays.



Proportional cycle time from OUT1 to OUT3 can be changed in the Setup setting mode. A set value set in the Setup setting mode will automatically change when the set value is changed in the Engineering mode.

6.2.6 Transmission output

Transmission output can be used by assigning to the output terminals for OUT1 to OUT3 as long as the terminals are not used for Control output. Voltage output or Current output must be specified for OUT1, OUT2, or OUT3 to produce Transmission output at ordering.
Scaling of output range is available for the following transmission output type of OUT2 and OUT3:

- Measured value (PV)
- Deviation value (DEV)
- Set value (SV) monitor

■ Description of function

Voltage signal or Current signal of the following transmission output type can be produced as Transmission output: Measured value (PV), Deviation value (DEV), Set value (SV) monitor, Output program value and Segment time (percentage basis).

Output signal types of transmission output:

Voltage output	0 to 1 V DC (Only OUT3), 0 to 5 V DC, 1 to 5 V DC or 0 to 10 V DC
Current output	4 to 20 mA DC, 0 to 20 mA DC

● Transmission output type

Transmission output type	Description
Measured value (PV)	Voltage/Current signal of varying state of the Measured value (PV) is produced. Example: Use 0 to 20 mA DC Current output for input range from 0 to 400 °C. 0 mA is produced at 0 °C [Input range low] 20 mA is produced at 400 °C [Input range high]
Deviation value (DEV)	Voltage/Current signal of varying state of deviation value between the Measured value (PV) and the Set value (SV) is produced. Example: Use 0 to 20 mA DC Current output for input range from 0 to 400 °C 0 mA is produced at –400 °C [Input range low] 20 mA is produced at +400 °C [Input range high]
Set value (SV) monitor	Voltage/Current signal of varying state of the Set value (SV) is produced. Example: Use 0 to 20 mA DC Current output for input range from 0 to 400 °C 0 mA is produced at °C [Input range low] 20 mA is produced at °C [Input range high]
Output program value 1 to 3	Voltage/Current signal of Output program value being set for each segment is produced. Example 1: When the current output is 0 to 20 mA DC 0 mA is produced when Output program value is 0 %. 20 mA is produced when Output program value is 100 % Output program function is operative as Control output when using Time proportioning output: Relay contact output, Voltage pulse output, Triac output and Open collector output. Example 2: When using as Control output for Time proportioning output (Relay contact output, Proportional cycle time 20 seconds) ON time is 0 seconds when Output program value is 0 %. ON/OFF time is 10 seconds when Output program value is 50 %. ON time is 20 seconds when Output program value is 100 %.
Segment time (percentage basis)	Duration of the Start time to the End time of a segment in a Program pattern is produced as 0 to 100 %. Example: When current output is 0 to 20 mA DC and the segment time of segment 1 is set to 50 minutes. 0 mA is produced at 0 % [50 minutes] (Start time of segment) 20 mA is produced at 100 % [0 minute] (End time of segment)

● Transmission output for Operation mode

Transmission output type	Operation mode			
	Reset mode (RESET)	Program control mode (RUN)	Fixed set point control mode (FIX)	Manual control mode (MAN)
Measured value (PV)	Based on the set value of Transmission output action in the Reset mode (RESET). (Action stop or Action continued)	Produces Transmission output	Produces Transmission output	Produces Transmission output
Deviation value (DEV)		Produces Transmission output	Produces Transmission output	Produces Transmission output
Set value (SV) monitor		Produces Transmission output	Produces Transmission output	Produces Transmission output
Output program value 1 to 3	Output value: −5 %	Produces Transmission output	Based on the output produced in the previous operation mode. *	Based on the output produced in the previous operation mode. *
Segment time (percentage basis)	Output value: −5 %	Produces Transmission output		

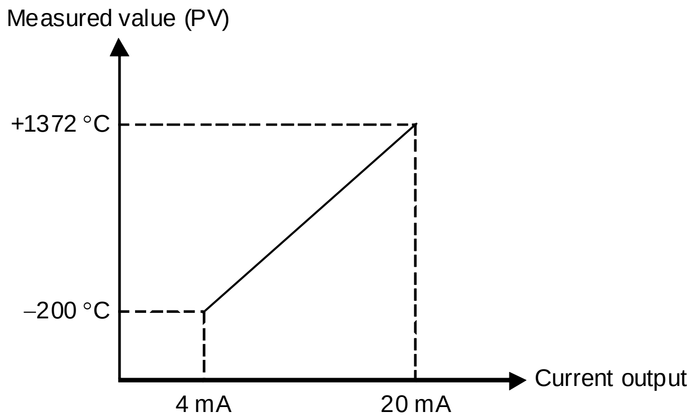
* When changing from the Reset mode (RESERT) to the Fixed set point control mode (FIX) or the Manual control mode (MAN):
−5 %
When changing from the Program control mode (RUN) to the Fixed set point control mode (FIX) or the Manual control mode (MAN):
Same output value produced in the Program control mode.

● Transmission output scale high/Transmission output scale low

Output range of Transmission output type can be scaled.

Example: If scaling is made under the following conditions

Output signal type:	Current output 4 to 20 mA DC
OUT2 assignment:	Measured value (PV)
Transmission output scale high (AHS):	+1372 °C
Transmission output scale low (ALS):	–200 °C



Scaling of output range is available for the following transmission output type of OUT2 and OUT3:

- Measured value (PV)
- Deviation value (DEV)
- Set value (SV) monitor

■ Parameter setting

Besides Transmission output, Control output and Event output can be assigned to OUT1 to OUT3; however, in this section only the setting range of Transmission output is described below.
Before changing the value of Transmission output scale, set Transmission output for OUT2 assignment or OUT3 assignment.
* For OUT1, only Control output can be assigned other than Transmission output.

● OUT1 assignment

Parameter symbol	Data range	Factory set value
LoGC1	1: Output program value 1	0

● OUT2 assignment

Parameter symbol	Data range	Factory set value
LoGC2	3: Measured value (PV) 4: Deviation value (DEV) 5: Set value (SV) monitor 6: Segment time (percentage basis) 7: Output program value 2	Refer to P. 4-37.

● OUT3 assignment

Parameter symbol	Data range	Factory set value
LoGC3	3: Measured value (PV) 4: Deviation value (DEV) 5: Set value (SV) monitor 6: Segment time (percentage basis) 7: Output program value 3	Refer to P. 4-38.

● OUT2 transmission output scale high

Parameter symbol	Data range	Factory set value
AHS2	Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): –Input span to +Input span (Within –19999 to +32000 [excluding decimal point]) Segment time (percentage basis): Fixed at 100.0 % (scaling is not available) Output program value 2: Fixed at 100.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): + Input span Other: 100

● OUT2 transmission output scale low

Parameter symbol	Data range	Factory set value
ALS2	Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): –Input span to +Input span (Within –19999 to +32000 [excluding decimal point]) Segment time (percentage basis): Fixed at 0.0 % (scaling is not available) Output program value 2: Fixed at 0.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): –Input span Other: 0

● OUT3 transmission output scale high

Parameter symbol	Data range	Factory set value
AHS3	Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): –Input span to +Input span (Within –19999 to +32000 [excluding decimal point]) Segment time (percentage basis): Fixed at 100.0 % (scaling is not available) Output program value 3: Fixed at 100.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): +Input span Other: 100

● OUT3 transmission output scale low

Parameter symbol	Data range	Factory set value
AL S3	Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): −Input span to +Input span (Within −19999 to +32000 [excluding decimal point]) Segment time (percentage basis): Fixed at 0.0 % (scaling is not available) Output program value 3: Fixed at 0.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): −Input span Other: 0

● Transmission output action in Reset mode

In the Reset mode (REST), a Transmission output signal can be produced or suspended.

Parameter symbol	Data range	Factory set value
R.Ao	0: Action stop 1: Action continued 0 0 ← Value at SV display OUT2 (right digit) OUT3 (left digit)	00

● Transmission output action at Pattern end

A Pattern end signal can be produced or suspended when the control of the program pattern is done (at Pattern end) in the Program control mode (RUN).

Parameter symbol	Data range	Factory set value
P.Ed.Ao	0: Action stop 1: Action continued 0 0 ← Value at SV display OUT2 (right digit) OUT3 (left digit)	00

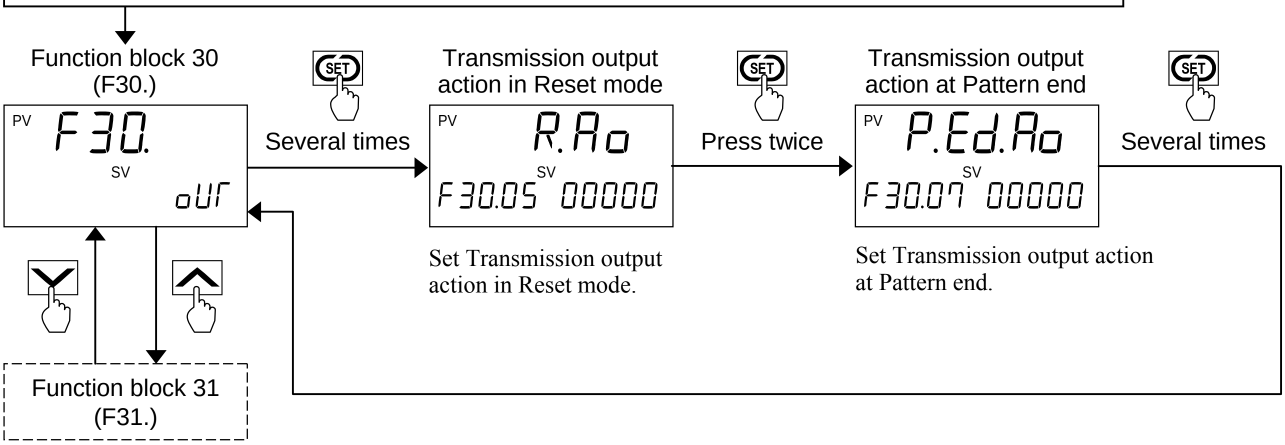
■ Setting procedure

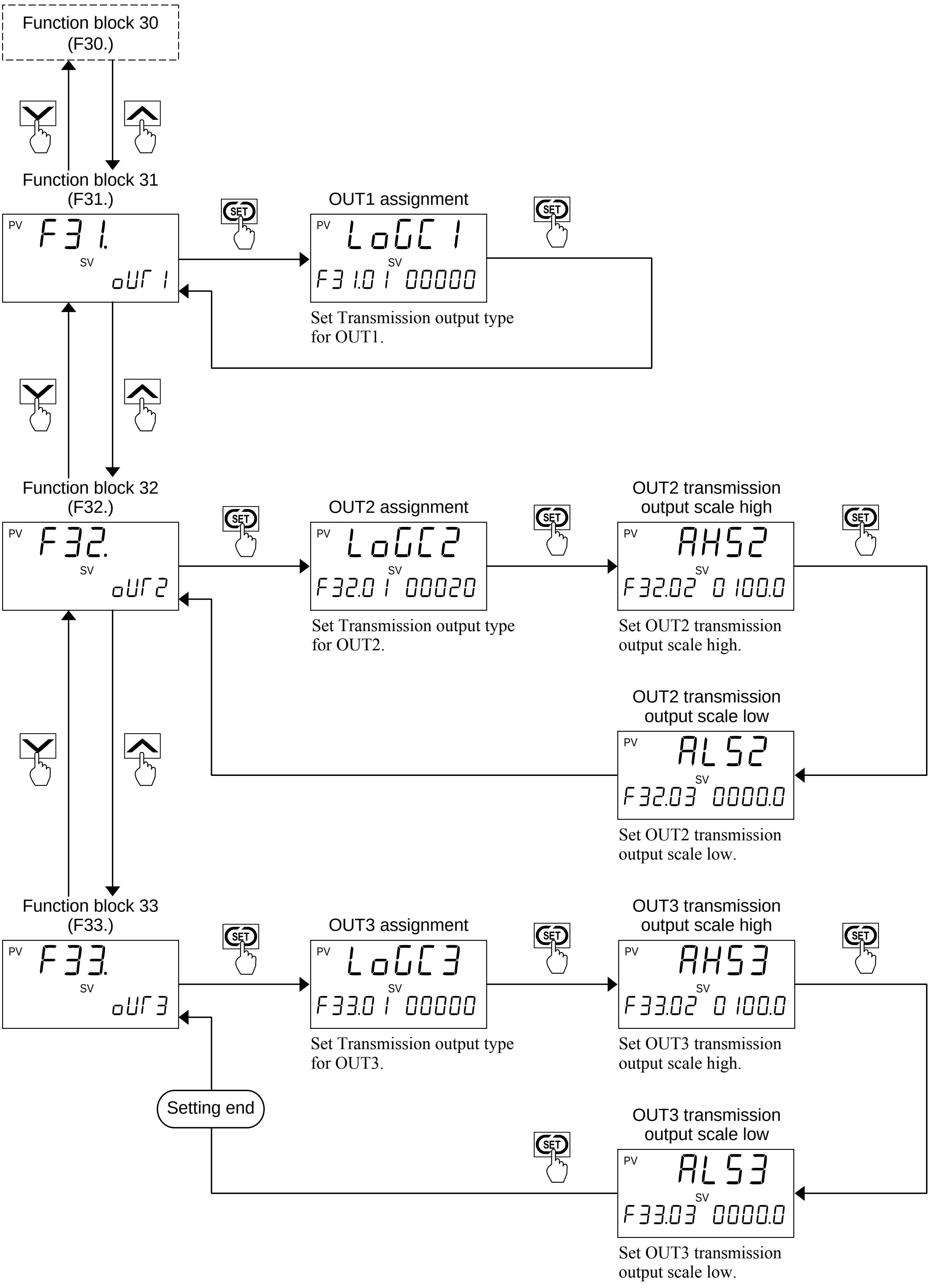
- To select Transmission output action in Reset mode or Transmission output action at Pattern end, go to F30 in the Engineering mode.
- To assign OUT1, go to F31 in the Engineering mode.
- To set OUT2 assignment, OUT2 transmission output scale high and OUT2 transmission output scale low, go to F32 in the Engineering mode.
- To set OUT3 assignment, OUT3 transmission output scale high and OUT3 transmission output scale low, go to F33 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).

2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.

3. Keep pressing the UP key until the F30 screen displays.




Function block 30
(F30.)
Function block 31
(F31.)
F31.
oUT1
OUT1 assignment
LoGC1
F31.01 00000
Set Transmission output type
for OUT1.
Function block 32
(F32.)
F32.
oUT2
OUT2 assignment
LoGC2
F32.01 00020
Set Transmission output type
for OUT2.
OUT2 transmission
output scale high
AHS2
F32.02 0100.0
Set OUT2 transmission
output scale high.
OUT2 transmission
output scale low
ALS2
F32.03 0000.0
Set OUT2 transmission
output scale low.
Function block 33
(F33.)
F33.
oUT3
OUT3 assignment
LoGC3
F33.01 00000
Set Transmission output type
for OUT3.
OUT3 transmission
output scale high
AHS3
F33.02 0100.0
Set OUT3 transmission
output scale high.
Setting end
OUT3 transmission
output scale low
ALS3
F33.03 0000.0
Set OUT3 transmission
output scale low.

6.3 Display

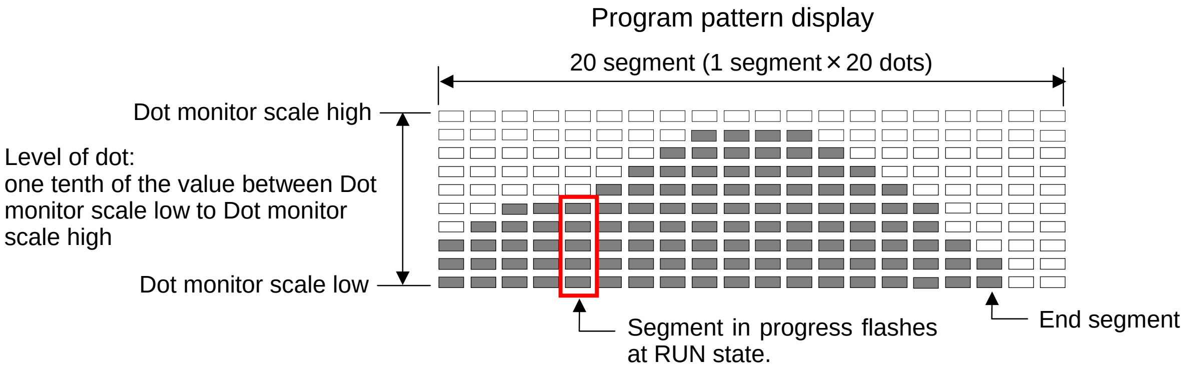
6.3.1 Graph display selection

The graph displays the progress of program pattern, or increase and decrease of Manipulated output value (MV).

☞ Setting procedure for Graph display selection, refer to ■ **Parameter setting (P. 6-57)** and ■ **Setting procedure (P. 6-58)**.

■ Program pattern display

Displays Segment level of the pattern being programmed by 10 × 20 dots (up to 20 segments). It is possible to set Display scale of Segment levels by setting Dot monitor scale high and low.

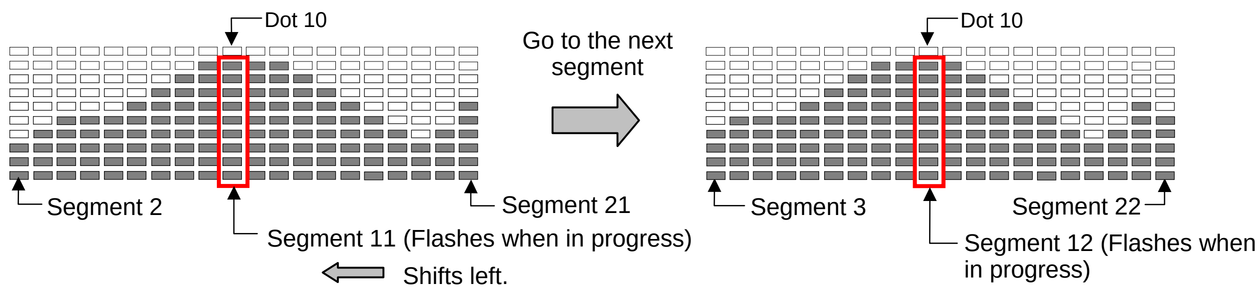


● Display at each operation mode

Program control mode (RUN):

Pattern in operation displays and dots of segment in progress flash.

When setting more than 20 segments, a vertical line of dots of the Program pattern display shifts to the left to follow progress of the segments.



Reset mode (RESET):

Resets pattern and segment in progress and displays the pattern of the number being set at Execution pattern selection (no flashing).

Switches to Execution pattern selection screen and displays program pattern of the pattern number being selected when pressing the PTN END key in the Reset mode.

Fixed set point control mode (FIX) or Manual control mode (MAN):

Displays the pattern of the number being set at Execution pattern selection (no flashing).

● Display in program setting

In the Parameter setting mode, displays the program pattern of the pattern number being set at each screen of the Program setting block.

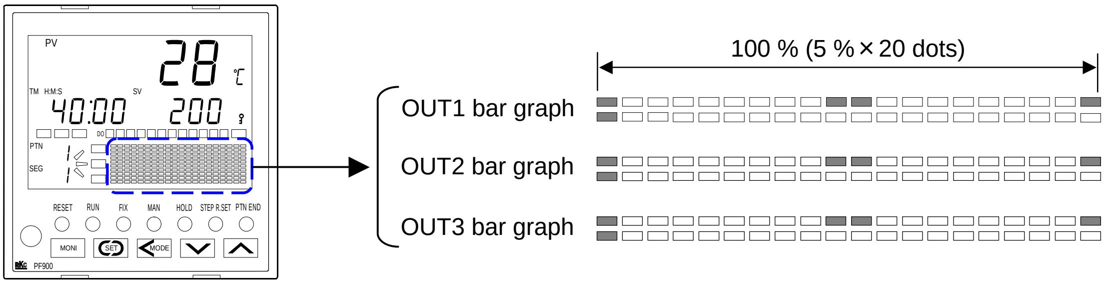
The dot of segment being set flashes at each screen of segment setting parameter.

In other setting modes, displays Program pattern or Output bar graph by conforming to the setting of Dot monitor type in the Engineering mode.

■ Output bar graph display

Displays output state of OUT1 to OUT3.

Displays bar graph only when Manipulated output value (MV1 or MV2) or Transmission output (Voltage output or Current output) is assigned to OUT1 to OUT3.

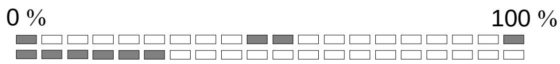


● Manipulated output value (MV1, MV2)

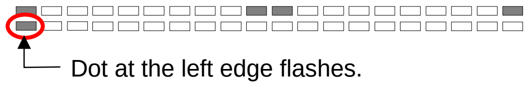
One dot displays 5 % of the Manipulated output value. The dot at the left edge of the bar graph flashes when the Manipulated output value is 0 % or less. When the value exceed 100 %, the dot at the right edge flashes.

Example:

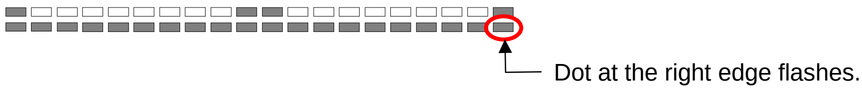
Manipulated output value: from 26 to 30 %



Manipulated output value: 0 % or less



Manipulated output value: 100 % or more



[Position proportioning PID control]

With FBR input: Displays FBR input value (0 to 100 %)
If the FBR input burnout, reading will be upscale and the dot at the right edge flashes.

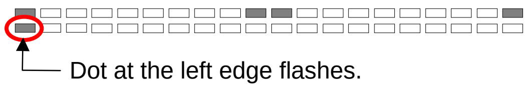
Without FBR input: Displays 0 % (fixed)

● Transmission output

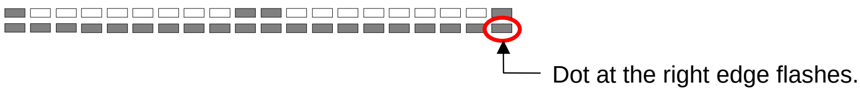
It is possible to scale display range of the bar graph for Transmission output by setting Transmission output scale high and low.

The dot at the left edge of the bar graph flashes when the output value goes below Transmission output scale low. When the value exceeds the Transmission output scale high, the dot at the right edge will flash.

- Output value: less than Transmission output scale low



- Output value: exceeding Transmission output scale high



Scaling of Transmission output is not available for Segment time (percentage basis), Output program value or Manipulated output value (MV1 or MV2).
(Transmission output scale low: 0 % fixed, Transmission output scale high: 100 % fixed)

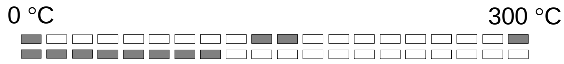
Measured value (PV):

Displays Measured value (PV).

Example:

When scaling Transmission output scale low at 0 °C and Transmission output scale high at 300 °C (15 °C per dot):

Measured value (PV): from 106 to 120 °C



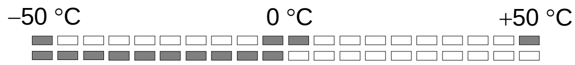
Deviation value (DEV):

Displays deviation value between control target value and Measured value (PV).

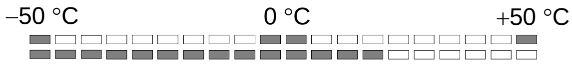
Example:

When scaling Transmission output scale low at -50 °C and Transmission output scale high at 50 °C (Deviation value per dot: 5 °C):

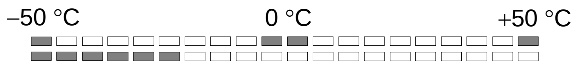
Deviation value: from −5 to 0 °C



Deviation value: from 16 to 20 °C



Deviation value: from −20 to −16 °C

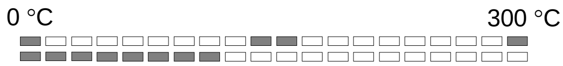


Set value (SV) monitor:

Displays Segment level of Program control mode or Set value (SV) of Fixed set point control mode.

Example:

When scaling Transmission output scale low at 0 °C and Transmission output scale high at 300 °C (15 °C per dot):
Set value (SV): from 106 to 120 °C



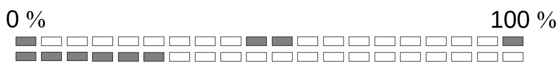
Displays the previous control target value when switching to the Manual control mode.

Segment time (percentage basis):

Displays Segment time in progress by 0 to 100 %.

Example:

Segment time: from 26 to 30 %

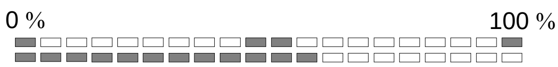


Output program value:

Displays Output program value by 0 to 100 %.

Example:

Output program value: from 56 to 60 %

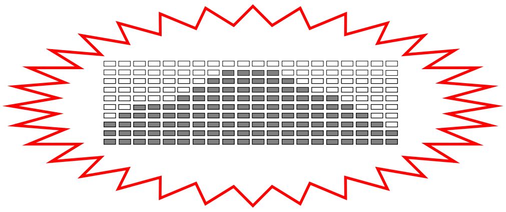


■ Red flashing display at ALM lamp lighting

It is possible to change the color of graph display into red when the ALM lamp lights. When ALM lamp goes off, the display returns to the normal mode.

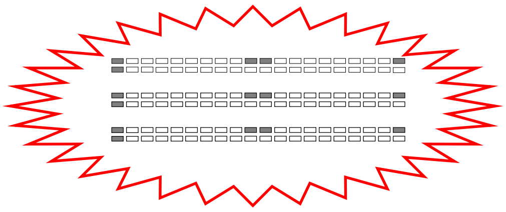
☞ Setting procedure for Red flashing display selection, refer to **■ Parameter setting (P. 6-57)** and **■ Setting procedure (P. 6-58)**.

Red flashing display: Program pattern



or

Red flashing display: Output bar graph



■ Parameter setting

Refer to the parameters below for graph display.

● Dot monitor type

Select type of graph display.

Symbol	Data range	Factory set value
ddrP	0: Program pattern type 1: Output bar graph type	0

● Dot monitor scale high

Set Display scale high for Program pattern display.

Symbol	Data range	Factory set value
dSCH	Dot monitor low to Maximum value of the selected input range	Input range high

● Dot monitor scale low

Set Display scale low for Program pattern display.

Symbol	Data range	Factory set value
dSCL	Minimum value of the selected input range to Dot monitor high	Input range low

● Dot monitor at ALM lamp light

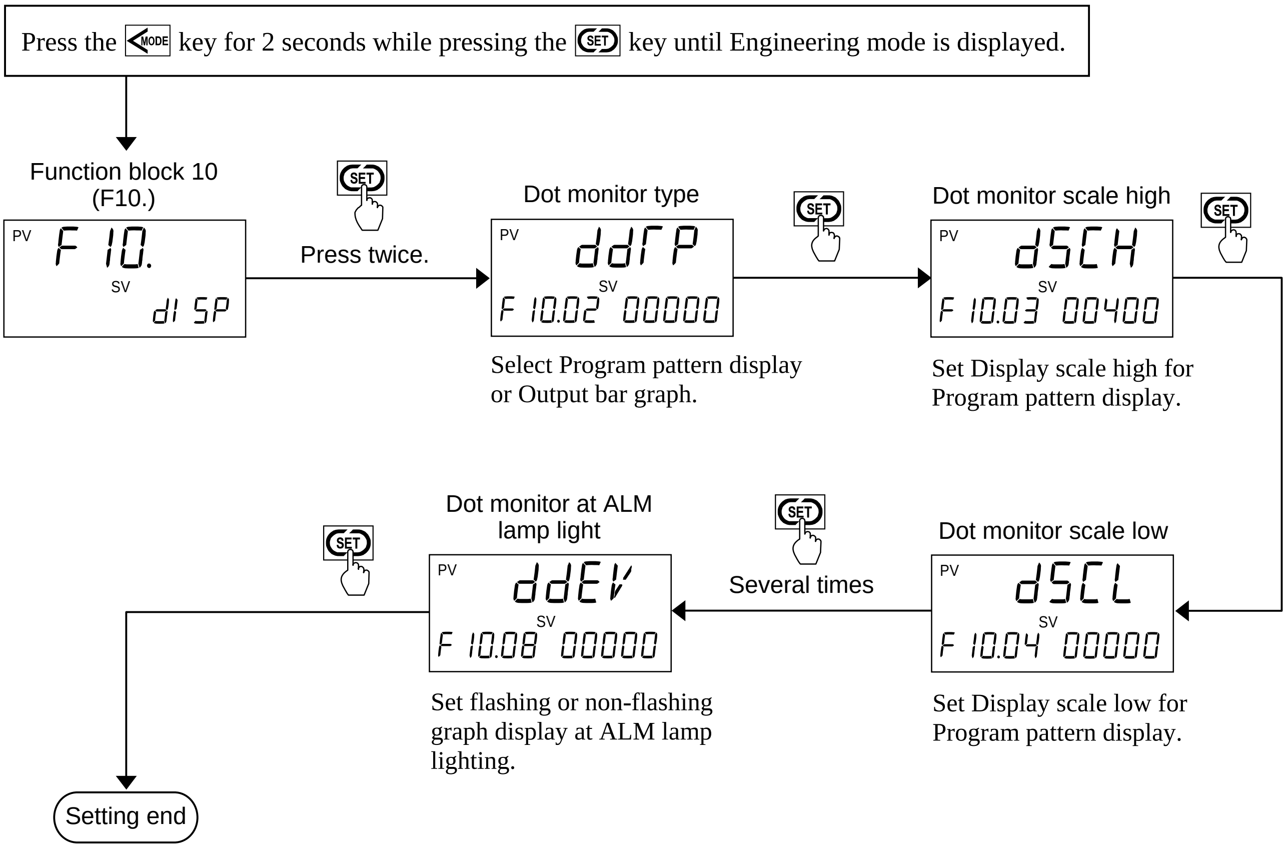
Select color of the graph display at ALM lamp lighting.

Symbol	Data range	Factory set value
ddEV	0: Normal display 1: Red flashing display	0

■ Setting procedure

Set parameters for graph display at F10 in the Engineering mode.

It is possible to set parameters at F10 in the Engineering mode in any operation mode (RESET, RUN, FIX or MAN).

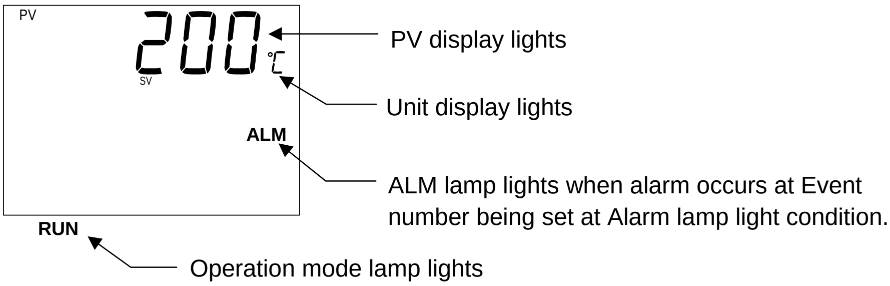


- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 10 (F10.).

6.3.2 Setting of Power saving mode

The back light goes OFF automatically if no key operation is performed at PV/SV monitor screen within the time being set (except the PV display). When alarm occurs at Event number being set at Alarm lamp light condition, the back light of the ALM lamp will light. The state lamp of the direct key lights in operation (RESET, RUN, FIX or MAN).

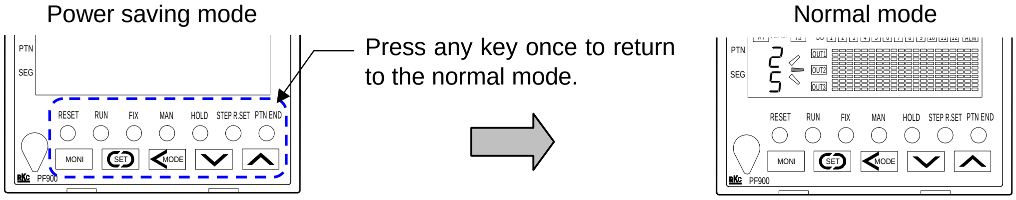
Display in Power saving mode



Release Power saving mode:

Press any key once to return to the normal mode. The function of the key being pressed will not affect.

Power saving mode Normal mode

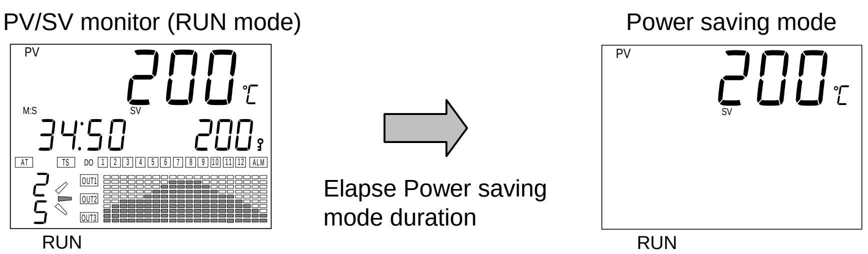


When pressing a key twice, the function becomes active. Select Direct key type to avoid incorrect key operation. For key type, refer to ■ **Direct key type (P. 4-8)**.

■ Action at Power saving mode

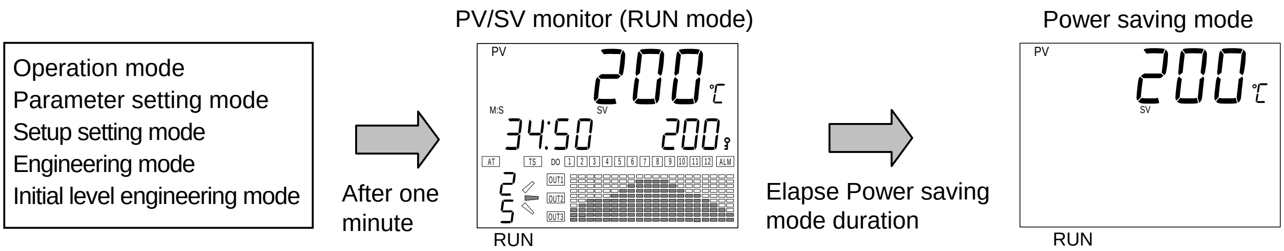
● PV/SV monitor display

Switches to the Power saving mode automatically after elapsing Power saving mode duration.



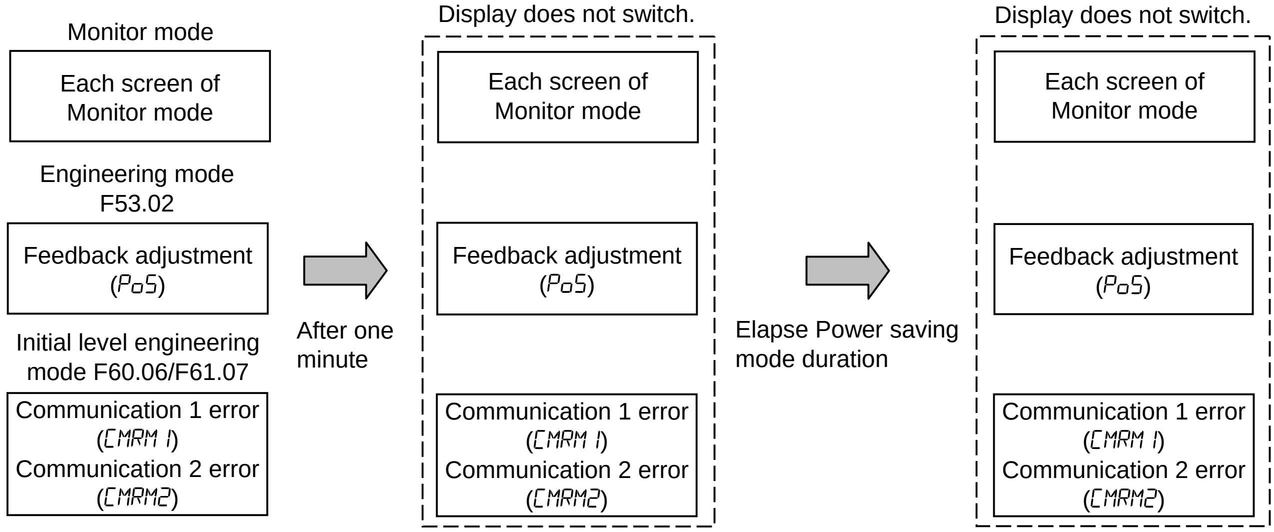
● Display switch to PV/SV monitor display

Returns to PV/SV monitor display automatically if no key operation is performed within one minute. Switches to the Power saving mode automatically after elapsing Power saving mode duration.



● Display not switch to PV/SV monitor display

Display does not switch to Power saving mode from Monitor mode screen, Feedback adjustment screen, Com. 1 error screen or Com. 2 error screen even if no key operation performed within one minute.



● When the self-diagnostic error

Display does not switch to Power saving mode after elapsing the Power saving mode duration when the instrument is in Self-diagnostic error. When Self-diagnostic error occurs during Power saving mode, it displays “Err” at the PV displays and error message number at SV display. Display conforms to the action at Self-diagnostic error when Self-diagnostic error without error display occurs.

■ Parameter setting

Refer to the following parameter for Power saving mode.

● Power saving mode duration

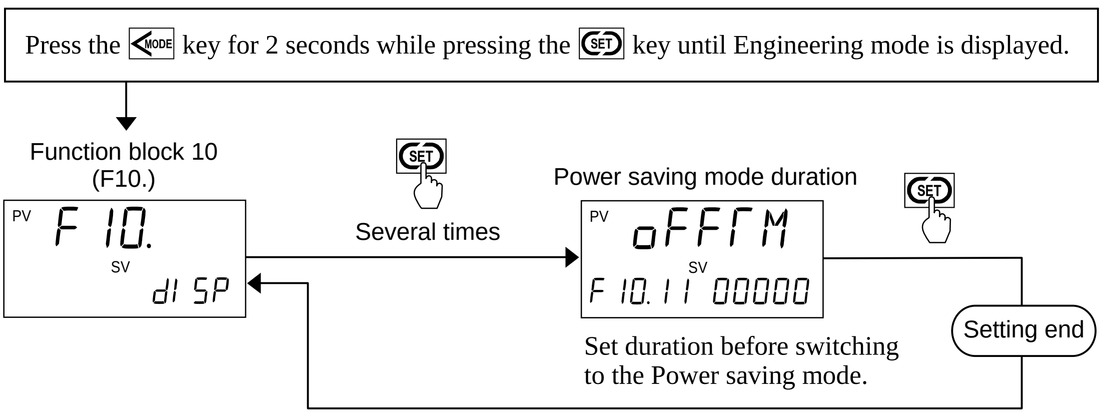
Set duration before switching to the Power saving mode.

Symbol	Data range	Factory set value
oFFTM	0 to 60 minutes 0: Lights at all times	0

■ Setting procedure

Set parameters for Power saving mode duration at F10 in the Engineering mode.

📖 It is possible to set parameters at F10 in the Engineering mode in any operation mode (RESET, RUN, FIX or MAN).



6.4 Event 1 to 4, Heater Break Alarm (HBA) and Control Loop Break Alarm (LBA)

6.4.1 Setting procedure of Event 1 to 4

For parameter setting of Event 1 to 4, follow the procedure below.

Assign Event output

Output signal of Event 1 to 4 can be produced from OUT2, OUT3 or DO1 to DO12 by assigning output allocation.

☞ To assign with OUT2 or OUT3, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)**.

☞ To assign with DO1 to DO12, refer to **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**.

↓

Select Energized or De-energized

Output Energized/De-energized may be changed.

☞ For the details of Energized/De-energized, refer to **6.2.3 Setting of Energized/De-energized (OUT2, OUT3 or DO1 to DO12) (P. 6-43)**.

↓

Set Event parameter

Set the following parameters:

- ALM lamp light condition 1
- Event action in Reset mode
- Event action at Pattern end
- Event type
- Event hold action
- Event differential gap
- Event output action at input error
- Event timer
- Event interlock
- Event minimum ON time
- Event minimum OFF time

☞ For the parameter description, refer to ■ **Description of function (P. 6-62).**

☞ For the data range of parameter, refer to ■ **Parameter setting (P. 6-69)**.

☞ For the operation of parameter, refer to ■ **Setting procedure (P. 6-73)**.

↓

Set Event set value

Select Event memory group and set the Event set value.

☞ Refer to "**<u>Set Event 1 set value.</u> (P. 6-75)**."

↓

Assign Event memory group

Assign Event memory group to the segment of the program pattern.
Also set the Event memory group for each operation mode.

☞ Refer to "**<u>Assign Event memory group.</u> (P. 6-76)**."

■ Description of function

Diagrams of the Deviation action type are shown in the following:

ON: Event action turned on

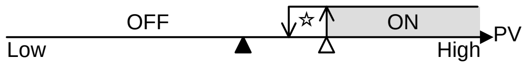
OFF: Event action turned off (▲ : Set value (SV) △: Event set value ☆: Event differential gap)

● Deviation action

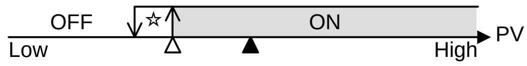
Deviation high

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

(Event set value is greater than 0.)



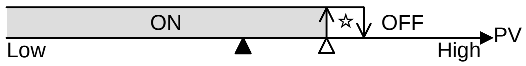
(Event set value is less than 0.)



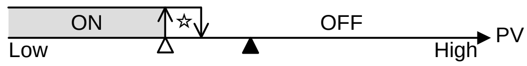
Deviation low

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

(Event set value is greater than 0.)



(Event set value is less than 0.)



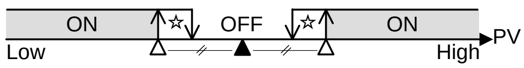
Deviation high/low

Tow types of Deviation high/low action are available.

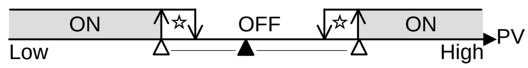
Without high/low individual setting:
When the absolute deviation | PV – SV | is more/less than the Event set values, the event ON occurs.

With high/low individual setting:
High action: When the deviation (PV – SV) is more than the Event set value [high], the event ON occurs.
Low action: When the deviation (PV – SV) is less than the Event set value [low], the event ON occurs.

(Without High/Low individual setting)



(With High/Low individual setting)



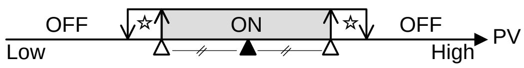
Band

Tow types of Band action are available.

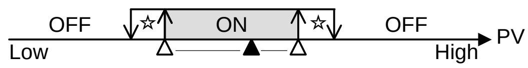
Without high/low individual setting:
When the absolute deviation | PV – SV | is within the Event set values, the event ON occurs.

With high/low individual setting:
High action: When the deviation (PV – SV) is less than the Event set value [high], the event ON occurs.
Low action: When the deviation (PV – SV) is more than the Event set value [low], the event ON occurs.

(Without high/low individual setting)



(With high/low individual setting)

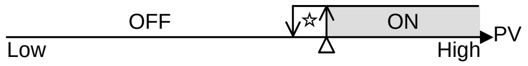


ON: Event action turned on
OFF: Event action turned off (▲: Set value (SV) △: Event set value ☆: Event differential gap)

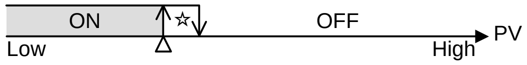
● Input value action

When the Measured value (PV) reaches the Event set value, event ON occurs.

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



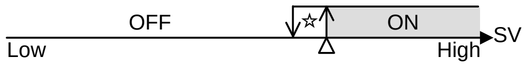
Process low
When the Measured value (PV) is less than the Event set value, the event ON occurs.



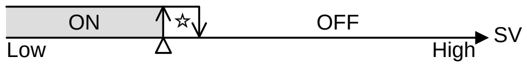
● Set value action

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

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



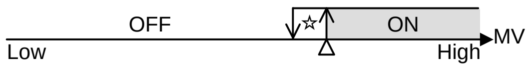
SV low
When the Set value (SV) is less than the Event set value, the event ON occurs.



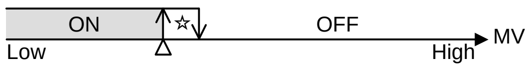
● Manipulated output value action

When the Manipulated output value 1 (MV1) or Manipulated output value 2 (MV2) reaches the Event set value, Event ON occurs.

MV1 high [heat-side]
MV2 high [cool-side]
When the Manipulated output value (MV) is more than the Event set value, the event ON occurs.



MV1 low [heat-side]
MV2 low [cool-side]
When the Manipulated output value (MV) is less than the Event set value, the event ON occurs.



● Hold action

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

- At power ON
- At Event ON

"At Event ON" refers to the following circumstances:

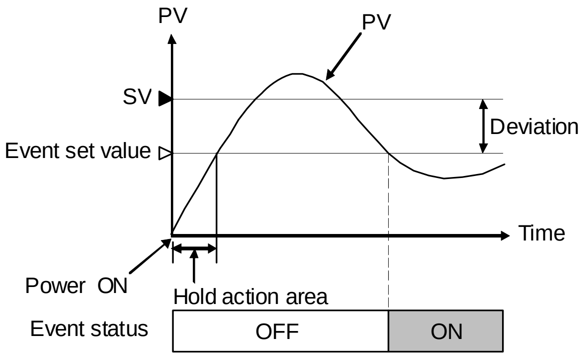
– Event occurrence condition is satisfied after changing the Event memory number from "0" to other number when Event is OFF.
– Event occurrence condition is satisfied after changing the Operation mode when Event is OFF.
– Event action in Reset mode is changed from "0: Action stop" to "1: Action continued" when Event occurrence condition in Reset mode is satisfied.
– Event action at Pattern end is changed from "0: Action stop" to "1: Action continued" when Event occurrence condition at Pattern end is satisfied.

NOTE

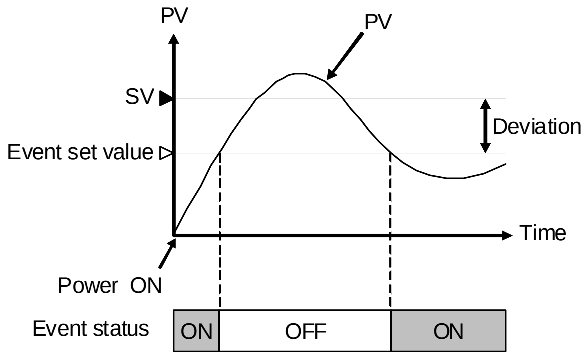
When high alarm with hold action is used for Event function, alarm does not turn on while hold action is in operation. Use in combination with a high alarm without hold action in order to prevent overheating which may occur by failure of control devices, such as welding of relays.

Example: When the power turned on

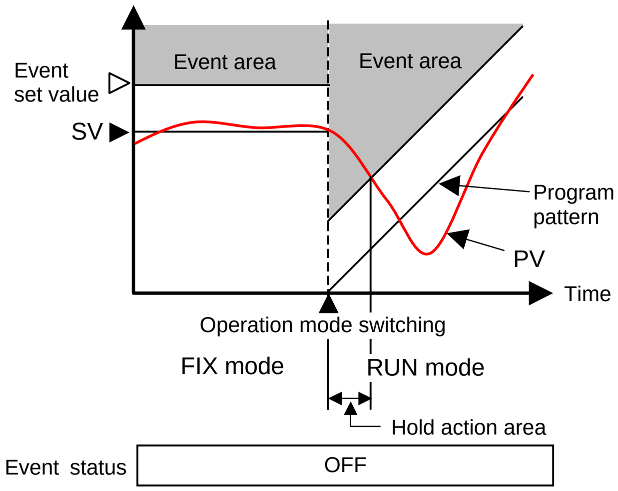
[With hold action]



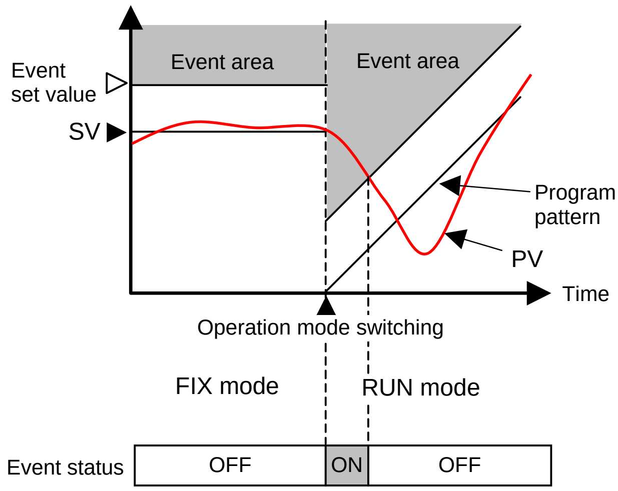
[Without hold action]



Example: When the Operation mode is switched from Fixed set point control mode (FIX) to Program control mode (RUN)



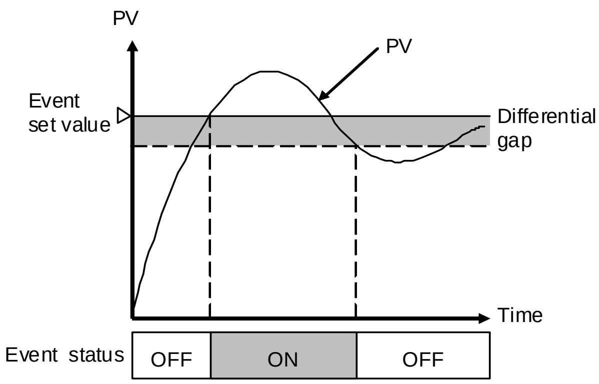
[With hold action]



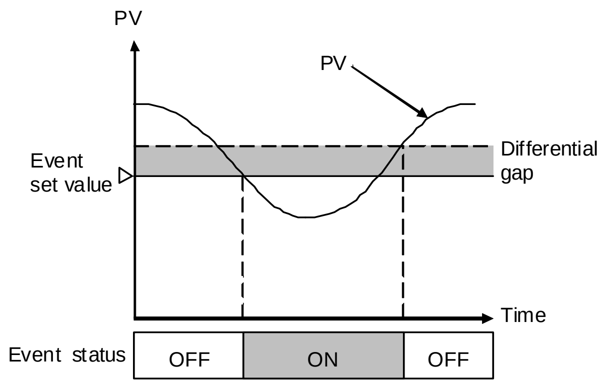
[Without hold action]

● Event 1 differential gap

It prevents chattering of Event output due to the Measured value fluctuation around the Event set value.



Process high



Process low

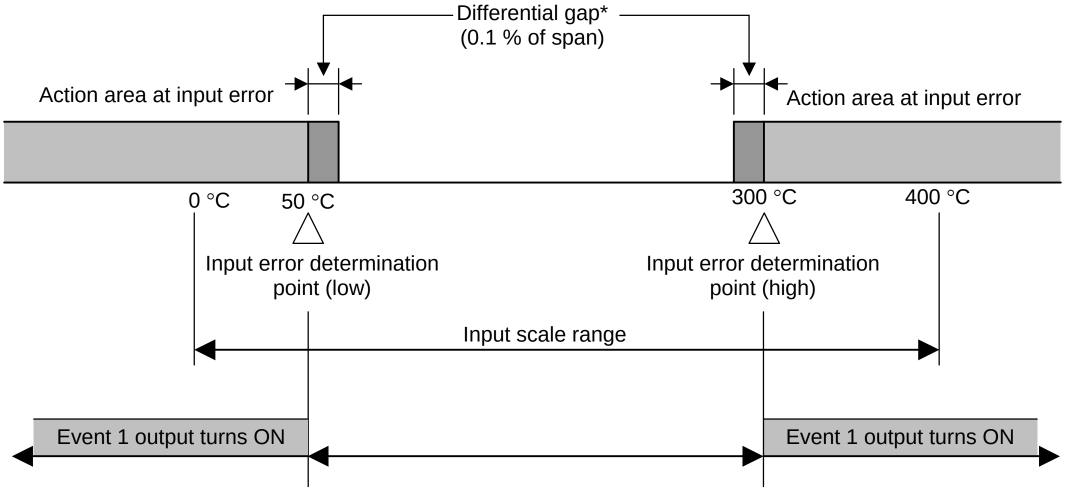
● Event output action at Input error

Event output action at Input error is selectable.

Action	Description
Conform to Event action	When Measured value (PV) exceeds the Input error determination point, Event output turns ON to conform to the Event action being selected at Event type.
ON	Event output turns ON when Measured value (PV) exceeds the Input error determination point.
OFF	Event output remains OFF when Measured value (PV) exceeds the Input error determination point.

Example: Turn ON Event 1 when Measured value (PV) exceeds the Input error determination point.

Input range: 0 to 400 °C
Input error determination point (high): 300 °C
Input error determination point (low): 50 °C



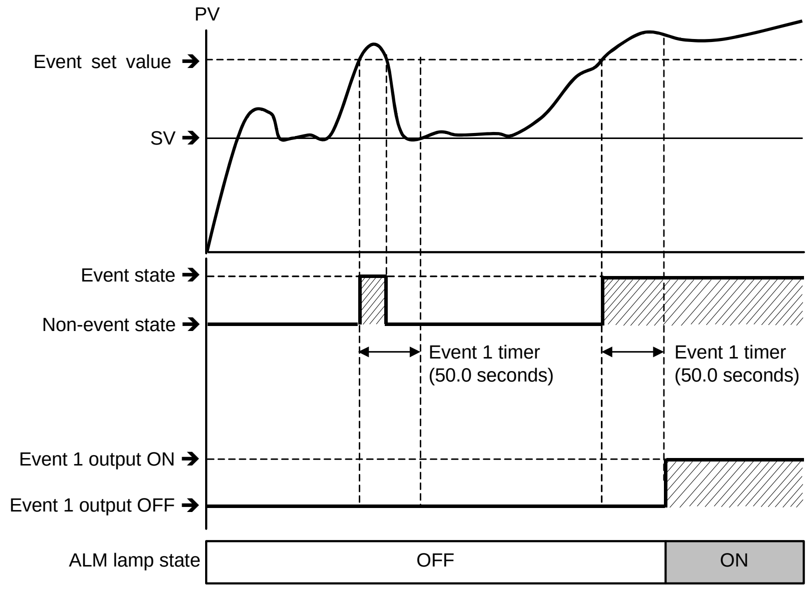
* Differential gap of PF900/901 (Value of Differential gap cannot be changed.)

When Input error state is selected at OUT2, OUT3 or DO1 to DO12 assignment, an output signal will be produced if the Measured value (PV) exceeds the Input error determination point.
For details, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)** and **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**.

● Event timer

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

Example: When the setting of Event 1 timer is 50.0 seconds



The Event timer is also activated for the following reasons:

- Event state occurs simultaneously when power turns ON.
- Event state occurs simultaneously when changing Event memory group number.
- Event state occurs simultaneously when changing Reset mode (RESET) to other operation mode. (“Action stop” should be selected at Event action in Reset mode.)
- Event state occurs simultaneously when changing “Action stop” to “Action continued” at Event action in Reset mode.
- Event state occurs simultaneously when changing “Action stop” to “Action continued” at Event action at Pattern end.
- Sampling cycle is changed when the Event action in Reset mode is “Action continued.”

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

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

- Power failure
- Change to the Reset mode (RESET)
- Change Event type
- Cancellation of Event state

● Event minimum ON time/Event minimum OFF time

Event minimum ON time or Event minimum OFF time can be set only in the Reset mode (RESET).

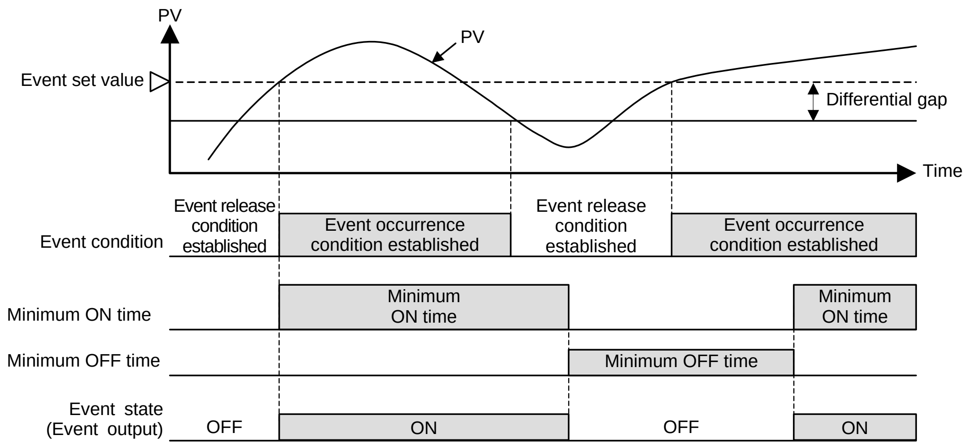
Event minimum ON time:

Event remains ON during the Event minimum ON time being set while the Measured value (PV) satisfies Event release condition.

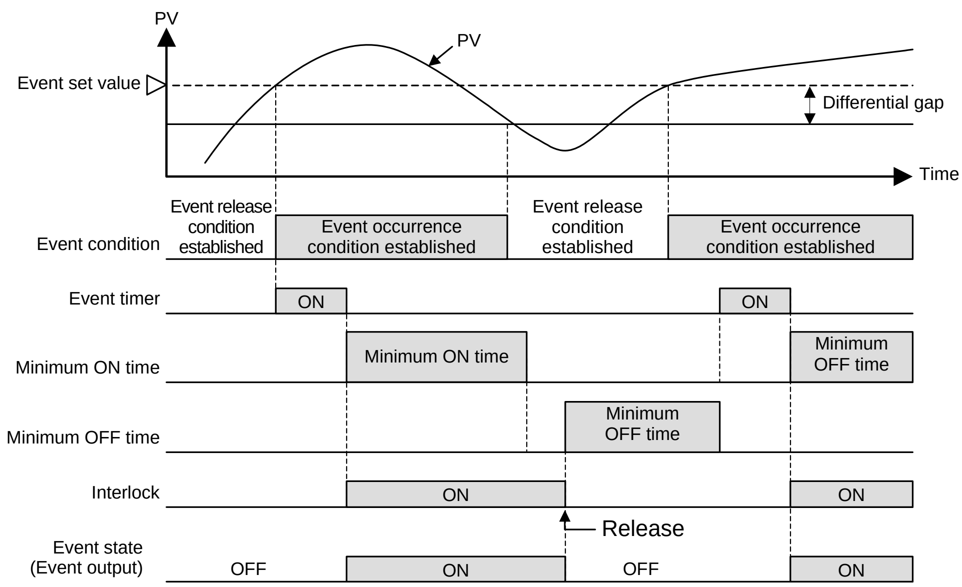
Event minimum OFF time:

Event remains OFF during the Event minimum OFF time being set while the Measured value (PV) satisfies Event occurrence condition.

Example 1: When the Process high is selected



Example 2: When setting Event timer and Interlock



Releasing Interlock during the Event minimum ON time does not affect the Event state until the Minimum ON time elapses.

Chattering of Event during the Minimum ON time or Minimum OFF time does not affect the Event state.

Set value change in Minimum ON time and Minimum OFF time

Minimum ON time can be changed only in the Reset mode (RESET). The Minimum ON time or the Minimum OFF time affects the event action soon after being changed when event memory group number of the Reset mode has been set and "Action continued" is selected for Event action in Reset mode.

Example: Minimum ON time

Condition: Minimum ON time: 60 seconds
Event has been ON for 30 seconds out of the Minimum ON time (60 seconds).

Example 1:

Setting: Change the Minimum ON time from 60 seconds to 120 seconds.
Result: Event remains ON for more 90 seconds from this point in time (as 30 seconds has elapsed).

Example 2:

Setting: Change the Minimum ON time from 60 seconds to 40 seconds.
Result: Event remains ON for more 10 seconds from this point in time (as 30 seconds has elapsed).

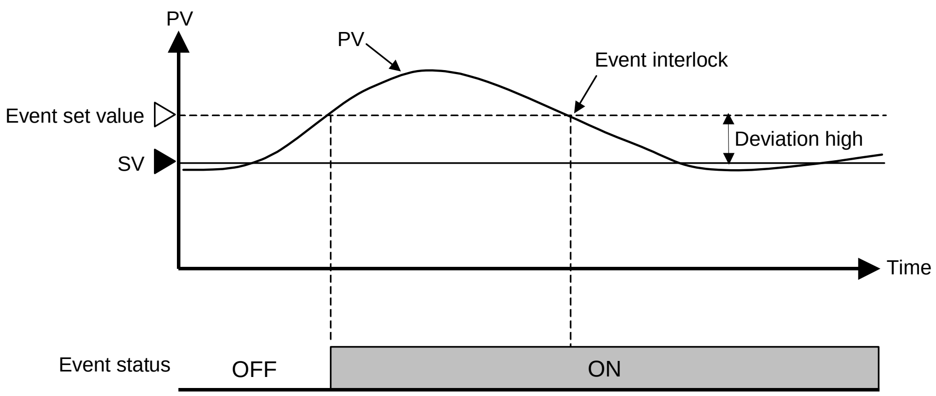
Example 3:

Setting: Change the Minimum ON time from 60 seconds to 20 seconds.
Result: Event turns OFF as 30 seconds has elapsed as of this point in time.

● Event interlock

The Event interlock function is used to hold the event state.

Example: When the Event interlock function is used for deviation high



[Without Event hold action]

📖 When setting "2" to Event Interlock at F41 through F44 in the Engineering mode, Interlock function is activated and operation mode is changed to Manual control mode to produce Manipulated output value at Input error.

☞ For the interlock release, refer to **6.4.4 Interlock release (P. 6-86)**.

■ Parameter setting

● ALM lamp light condition 1

ALM lamp can be set to “0: No lighting” or “1: Lighting” when each Event 1 to 4 turns ON.

Parameter symbol	Data range	Factory set value
ALC1	0: No lighting 1: Lighting 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 Unused	1111

● Event action in Reset mode

Each action of Event 1 to 4 may be continued or stopped in the Reset mode (RESET).

Parameter symbol	Data range	Factory set value
R.EV	0: Action stop 1: Action continued 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 HBA1 or HBA2	00000

If “Action continued” was selected for Event action in Reset mode, changing the event type may turn the Event ON since Parameters related to Event are automatically initialized when the Event type is changed. To avoid Event from turning ON at change of Event type in Reset mode, select “Action stop” for Event action in Reset mode before changing the Event type.

● Event action at Pattern end

Each action of Event 1 to 4 may be continued or stopped when the operation comes to the end of the Program pattern (Pattern end).

Parameter symbol	Data range	Factory set value
P.Ed.EV	0: Action stop 1: Action continued 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 HBA1 or HBA2	00000

● Event 1 to 4 type

Parameter symbol	Data range	Factory set value
ES1 ES2 ES3 ES4	0: None 1: Deviation high [1] 2: Deviation low [1] 3: Deviation high/low [1] 4: Deviation high/low (Individual high and low setting) [1] 5: Band [1] 6: Band (Individual high and low setting) [1] 7: Process high [1] 8: Process low [1] 9: SV high 10: SV low 11: MV1 high [heat-side] [1, 2] 12: MV1 low [heat-side] [1, 2] 13: MV2 high [cool-side] [1] 14: MV2 low [cool-side] [1] [1] Event hold action is available. [2] If there is Feedback resistance (FBR) input in Position proportioning PID control, set to the FBR input value.	Based on model code. When not specifying: Event 1 type: 1 Event 2 type: 2 Event 3 type: 0 Event 4 type: 0

● Event 1 to 4 hold action

Parameter symbol	Data range	Factory set value
EHo1 EHo2 EHo3 EHo4	0: OFF 1: Hold action ON [when power turned on; when Event start (SV changed)]	Based on model code. When not specifying: Event 1 hold action: 0 Event 2 hold action: 1 Event 3 hold action: 0 Event 4 hold action: 0

● Event 1 to 4 differential gap

Parameter symbol	Data range	Factory set value
EH1 EH2 EH3 EH4	Deviation, process or set value: 0 to Input span (Unit: °C [°F]) MV: 0.0 to 110.0 %	TC/RTD: 2 V/I: 0.2 MV: 0.2

● Event 1 to 4 output action at input error

Parameter symbol	Data range	Factory set value
Ebo1 Ebo2 Ebo3 Ebo4	0 to 4	0

	When PV reaches Input error determination point (high) or higher temperature:	When PV reaches Input error determination point (low) or lower temperature:
0	Conforms to Event action	Conforms to Event action
1	ON	Conforms to Event action
2	Conforms to Event action	ON
3	ON	ON
4	OFF	OFF

● Event 1 to 4 timer

Parameter symbol	Data range	Factory set value
EVT1 EVT2 EVT3 EVT4	0.0 to 600.0 seconds	0.0

● Event 1 to 4 interlock

Parameter symbol	Data range	Factory set value
EIL1 EIL2 EIL3 EIL4	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0

● Event 1 to 4 minimum ON time

Parameter symbol	Data range	Factory set value
E1oN E2oN E3oN E4oN	0.0 to 600.0 seconds 0.0: Function OFF	0.0

● Event 1 to 4 minimum OFF time

Parameter symbol	Data range	Factory set value
E1oFF E2oFF E3oFF E4oFF	0.0 to 600.0 seconds 0.0: Function OFF	0.0

● Event memory group number

Parameter symbol	Data range	Factory set value
EV.GR	1 to 8	1

● Event memory group number in Reset mode/ Event memory group number in Fixed set point control mode/ Event memory group number in Manual control mode

Parameter symbol	Data range	Factory set value
EV.GR	0 to 8 0: Event OFF	1

● Event 1 to 4 set value (EV1 to EV4) [high]

Parameter symbol	Data range	Factory set value
EV 1 EV 2 EV 3 EV 4	Deviation: –Input span to +Input span Process and set value: Input range low to Input range high Manipulated output value (MV1 or MV2): −5.0 to +105.0 % Deviation high/low (Individual high and low setting), Band (Individual high and low setting): –Input span to +Input span	50

● Event 1 to 4 set value (EV1' to EV4') [low]

Event set value from 1 to 4 (EV1' to EV4') [low] is displayed when Event type is Deviation high/low (Individual high and low settings) or Band (Individual high and low settings).

Parameter symbol	Data range	Factory set value
EV 1' EV 2' EV 3' EV 4'	Deviation: –Input span to +Input span	−50

■ Setting procedure

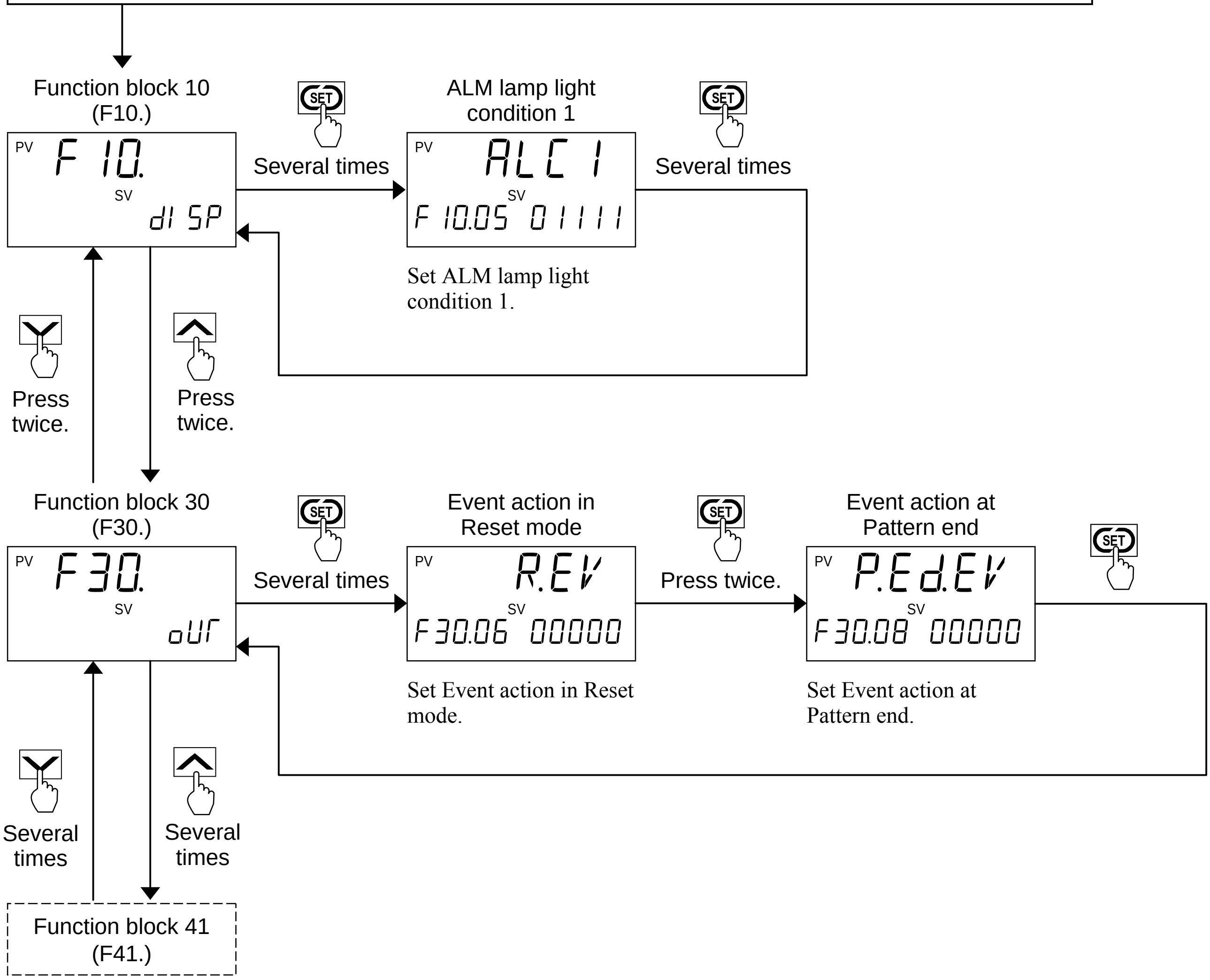
The following setting procedure refers to Event 1.

- ALM lamp light condition 1 can be set at F10.05 in the Engineering mode.
- Event action in Reset mode can be set at F30.06 in the Engineering mode.
- Event action at Pattern end can be set at F30.08 in the Engineering mode.
- Each setting item of Event 1 is at F41 in the Engineering mode.
- Event memory group number can be set in the Parameter setting mode (Program memory group setting block).
- Event memory group number and Event 1 to 4 set value can be set in the Parameter setting mode (Event memory group setting block).

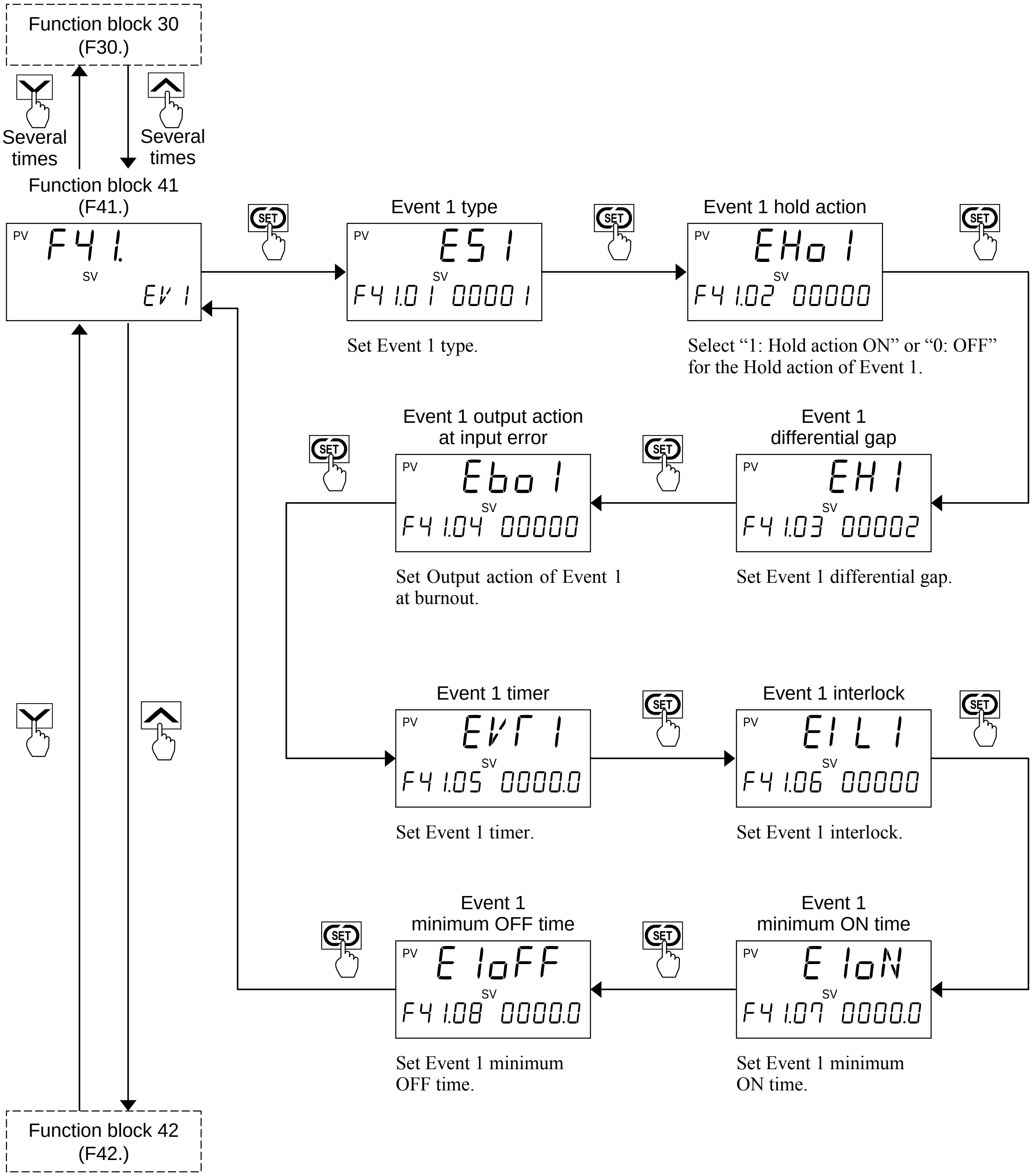
● Parameter setting in the Engineering mode

Set ALM lamp light condition 1, Event action in Reset mode and Event action at Pattern end.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the <MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.



Set Event 1 parameter.



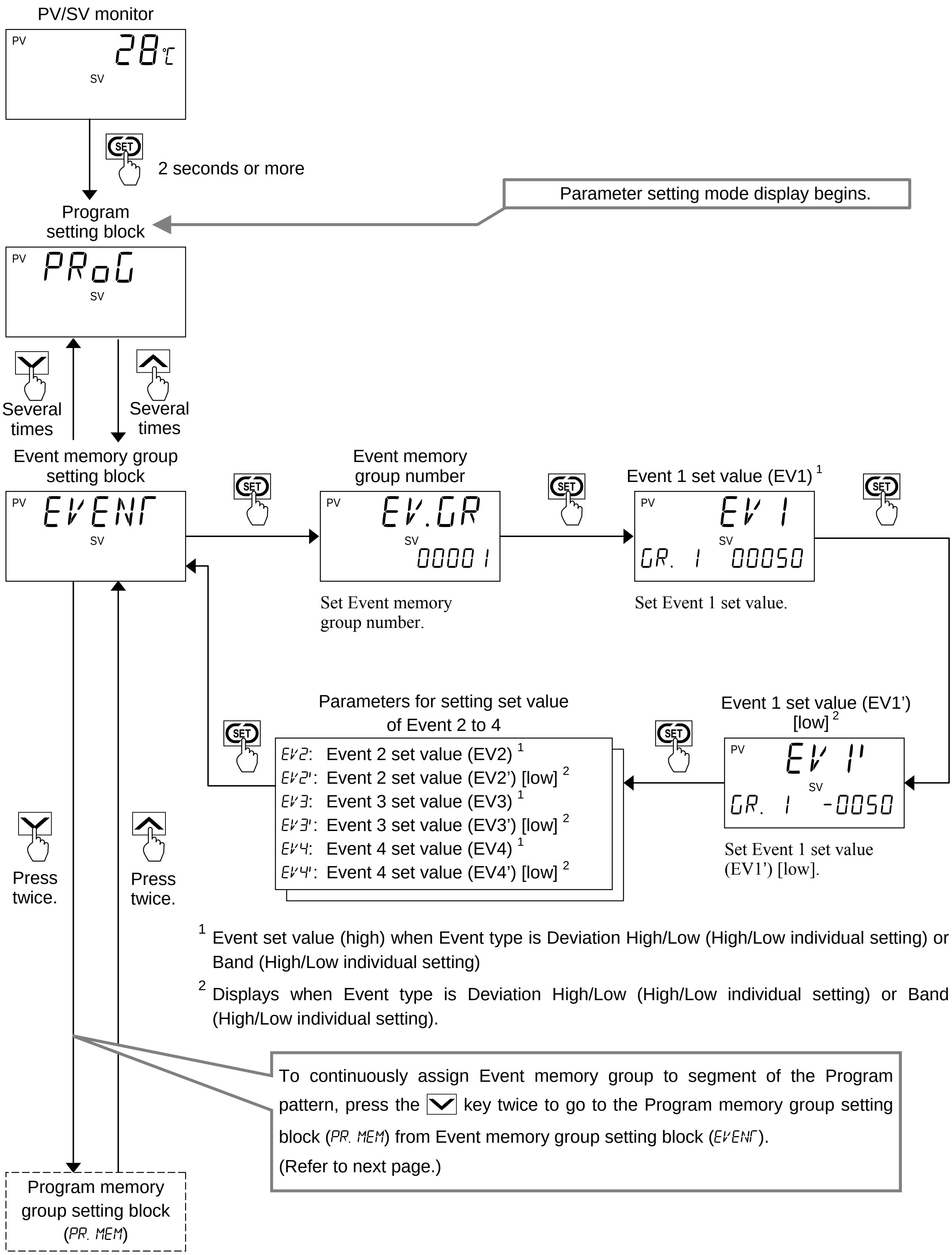
To set parameters for Event 2 to 4, follow the same setting procedure as Event 1 or go to the following function blocks:

Event 2: Function blocks 42 (F42.)
Event 3: Function blocks 43 (F43.)
Event 4: Function blocks 44 (F44.)

● Parameter setting in the Parameter setting mode (Partial setting type)

☞ For the Batch setting type, refer to ■ **Setting type for Program pattern** of **4.5.3 Parameter setting mode (P. 4-17).**

Set Event 1 set value.

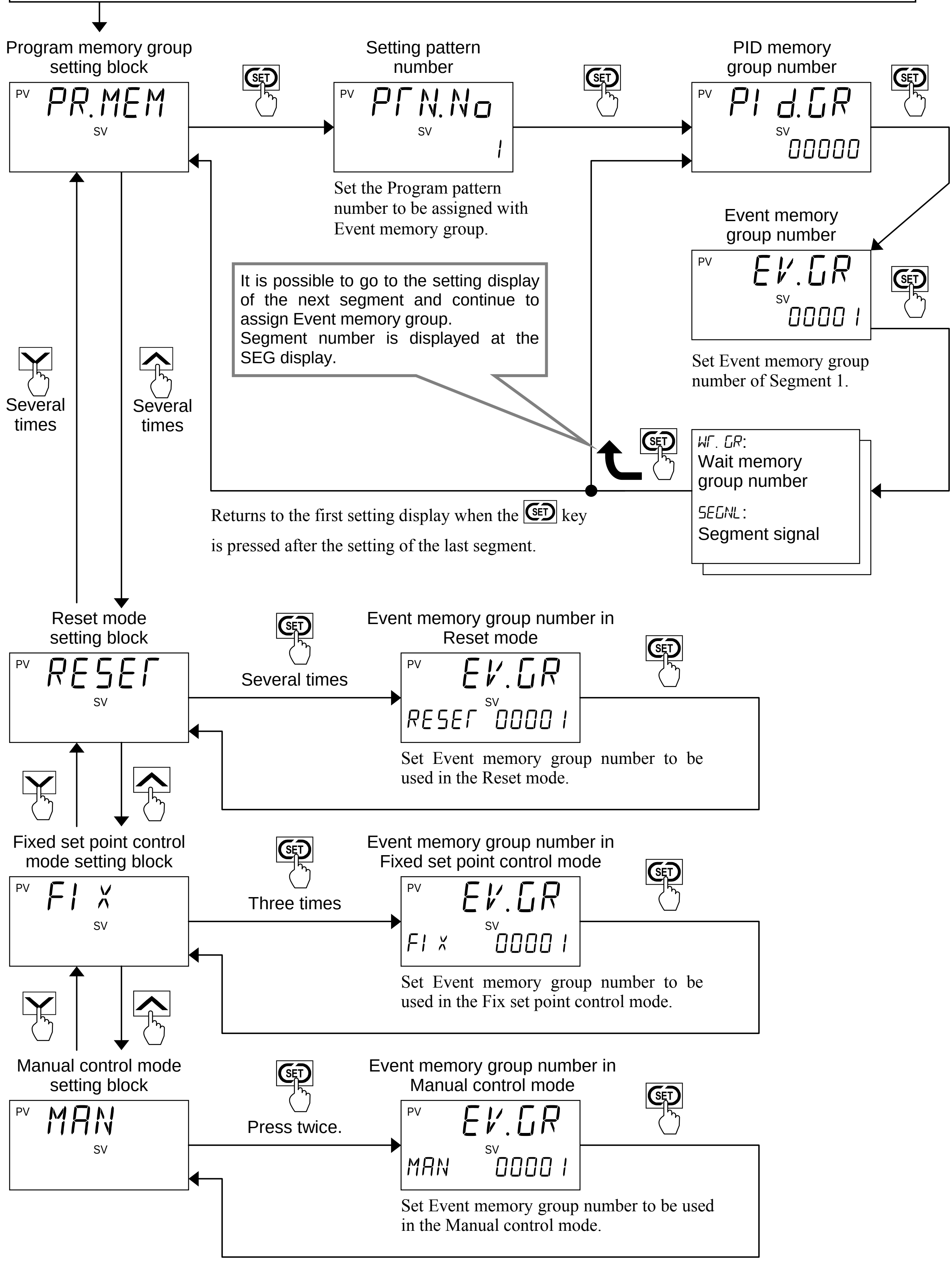


[1] Event set value (high) when Event type is Deviation High/Low (High/Low individual setting) or Band (High/Low individual setting)

[2] Displays when Event type is Deviation High/Low (High/Low individual setting) or Band (High/Low individual setting).

Assign Event memory group.

To go to the Program memory group setting block (PR. MEM), press the DOWN key twice at the Event memory group setting block (EVENT) as described on the previous page.



6.4.2 Setting procedure of Heater break alarm (HBA)

For parameter setting of Heater break alarm (HBA), follow the procedure below.

Assign Event output

Output signal of Heater break alarm (HBA) can be produced from OUT2, OUT3 or DO1 to DO12 by assigning output allocation.

☞ To assign with OUT2 or OUT3, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)**.

☞ To assign with DO1 to DO12, refer to **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**.

↓

Select Energized or De-energized

Output Energized/De-energized may be changed.

☞ For the details of Energized/De-energized, refer to **6.2.3 Setting of Energized/De-energized (OUT2, OUT3 or DO1 to DO12) (P. 6-43)**.

↓

Set CT ratio
Assign CT

☞ Refer to **6.1.11 Current transformer (CT) input setting and assignment (P. 6-34)**.

↓

Set HBA parameter and Heater break alarm set value

Set the following parameters:

- ALM lamp light condition 2
- Number of heater break alarm (HBA) delay times
- Heater break alarm (HBA) set value
- Heater break alarm (HBA) interlock

☞ For the parameter description, refer to ■ **Description of function (P. 6-78)**.

☞ For the data range of parameter, refer to ■ **Parameter setting (P. 6-79)**.

☞ For the operation of parameter, refer to ■ **Setting procedure (P. 6-80)**.

■ Description of function

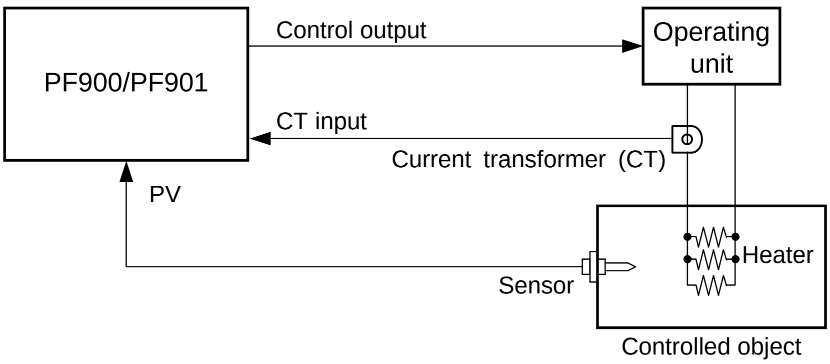
● Heater break alarm (HBA)

The Heater break alarm (HBA) function monitors the current flowing through the load by a dedicated current transformer (CT), then compares the measured value with the Heater break alarm (HBA) set values, and detects a fault in the heating circuit. Heater break alarm (HBA) can only be used with time-proportional control output (relay, voltage pulse, triac or open collector output).

The Heater break alarm (HBA) function is activated for the following cases:

① Low or No current flow (Heater break, malfunction of the control device, etc.):
When the control output is ON and the CT input value is equal to or less than the heater break determination point for the preset number of consecutive sampling cycles, an alarm is activated.

② Over current or short-circuit:
When the control output is OFF and the CT input value is equal to or greater than the heater break determination point for the preset number of consecutive sampling cycles, an alarm is activated.



● Number of heater break alarm (HBA) delay times

To prevent false alarming, the alarm function will wait to produce an alarm until the measured CT input value is in the alarm range for the preset number of consecutive sampling cycles.

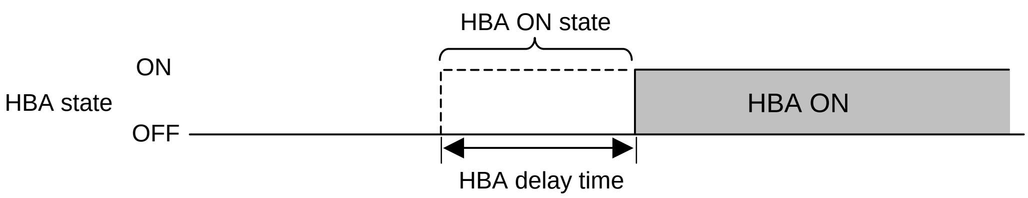
Heater break alarm (HBA) delay time = Number of heater break alarm (HBA) delay times × Sampling time*

*Twice of the measured input sampling cycle

Example:

Sampling time: 200 ms (Twice of the measured input sampling cycle [100 ms])
Number of heater break alarm (HBA) delay times: 5 times (Factory set value)

Heater break alarm (HBA) delay time = 5 times × 200 ms = 1000 ms = 1.0 seconds



● Heater break alarm (HBA) interlock

The interlock action holds the Heater break alarm state even if the CT input value is out of the Heater break alarm zone after it enters the Heater break alarm zone once.

☞ For the Interlock release, refer to **6.4.4 Interlock release (P. 6-86)**.

■ Parameter setting

● ALM lamp light condition 2

ALM lamp can be set to "0: Not lighting" or "1: Lighting" when Heater break alarm 1 (HBA1) or Heater break alarm 2 (HBA2) occurs.

Parameter symbol	Data range	Factory set value
ALC2	0: Not lighting 1: Lighting 0 0 0 0 0 ← Value at SV display (from right) HBA1, HBA2, LBA, Self-diagnostic error, Unused	0011

● Number of heater break alarm 1 (HBA1) delay times/ Number of heater break alarm 2 (HBA2) delay times

Parameter symbol	Data range	Factory set value
HbC1 HbC2	0 to 255 times	5

● Heater break alarm 1 (HBA1) set value/ Heater break alarm 2 (HBA2) set value

Set values of Heater break alarm 1(HBA1) and Heater break alarm 2 (HBA2) can be set in the Engineering mode and the Setup setting mode.

- Set the set value to approximately 85 % of the maximum reading of the CT input.
- Set the set value to a slightly smaller value to prevent a false alarm if the power supply becomes unstable.
- When more than one heater is connected in parallel, the HBA set value may need to be increased to detect a single heater failure.

Parameter symbol	Data range	Factory set value
HbA1 HbA2	CTL-6-P-N: 0.0 to 30.0 A CTL-12-S56-10L-N: 0.0 to 100.0 A 0.0: Unused (Current value monitoring still available.)	0.0

● Heater break alarm 1 (HBA1) interlock/Heater break alarm 2 (HBA2) interlock

Parameter symbol	Data range	Factory set value
HbIT1 HbIT2	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0

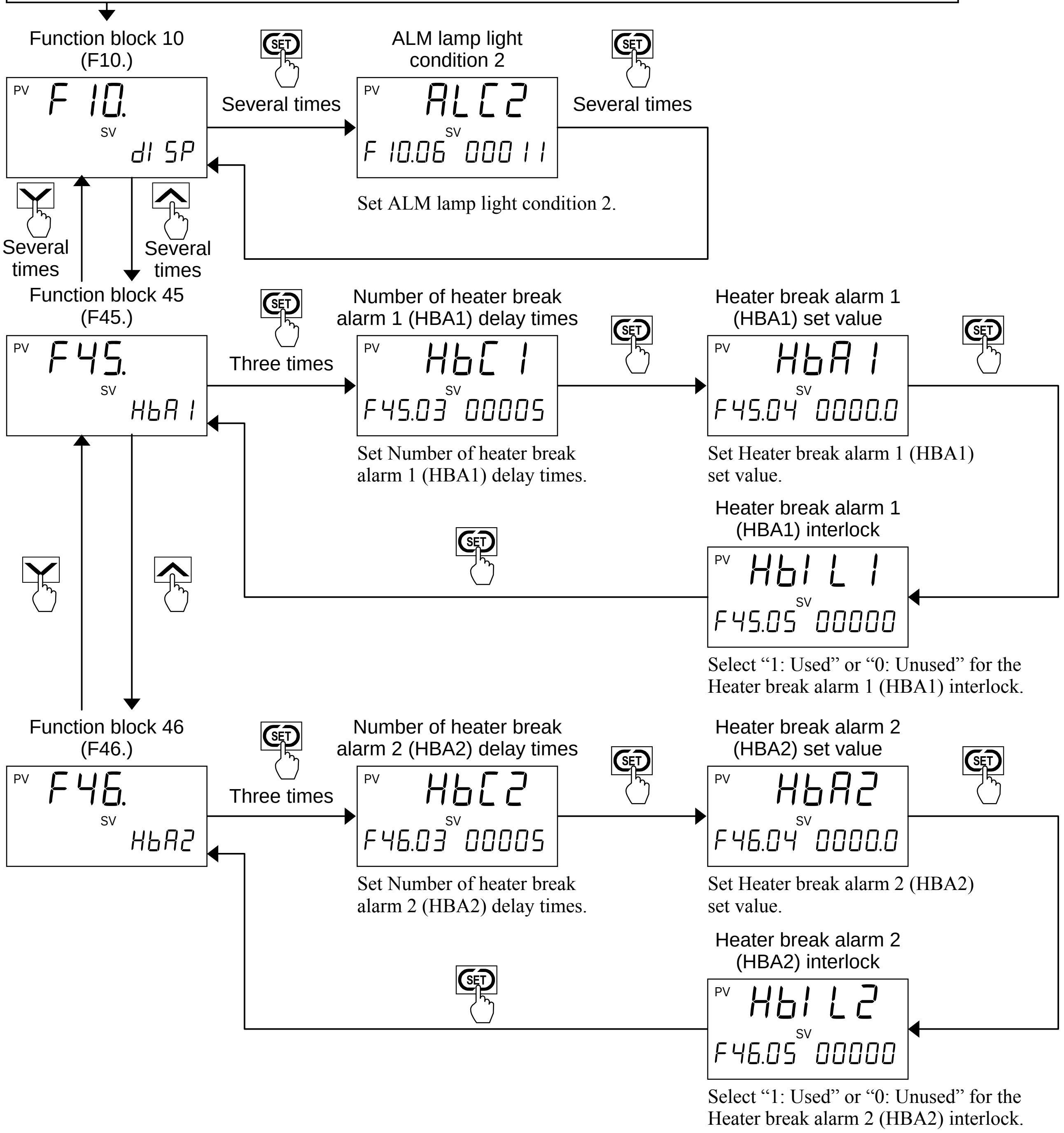
■ Setting procedure

- ALM lamp light condition 2 can be set at F10.06 in the Engineering mode.
- To set Number of heater break alarm 1 (HBA1) delay times, Heater break alarm 1 (HBA1) set value and Heater break alarm 1 (HBA1) interlock, go to F45 in the Engineering mode.
- To set Number of heater break alarm 2 (HBA2) delay times, Heater break alarm 2 (HBA2) set value and Heater break alarm 2 (HBA2) interlock, go to F45 in the Engineering mode.

● Parameter setting in the Engineering mode

1. Press the RESET key to go to the Reset mode (RESET).

2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.



Set values of Heater break alarm 1 (HBA1) and Heater break alarm 2 (HBA2) can be set in the Setup setting mode. Set values in the Setup setting mode will be changed automatically when changing set values in the Engineering mode. In the Setup setting mode, set values of Heater break alarm 1 (HBA1) and Heater break alarm 2 (HBA2) are not displayed when output allocation is not set by CT assignment.

6.4.3 Setting procedure of Control loop break alarm (LBA)

For parameter setting of Control loop break alarm (LBA), follow the procedure below.

Assign Event output

Output signal of Control loop break alarm (LBA) can be produced from OUT2, OUT3 or DO1 to DO12 by assigning output allocation.

☞ To assign with OUT2 or OUT3, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)**.

☞ To assign with DO1 to DO12, refer to **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**.

↓

Select Energized of De-energized

Output Energized/De-energized may be changed.

☞ For the details of Energized/De-energized, refer to **6.2.3 Setting of Energized/De-energized (OUT2, OUT3 or DO1 to DO12) (P. 6-43)**.

↓

Set LBA parameter and LBA time

Set the following parameters:

- ALM lamp light condition 2
- Control loop break alarm (LBA) selection
- Control loop break alarm (LBA) interlock
- Control loop break alarm (LBA) time
- LBA deadband (LBD)

☞ For the parameter description, refer to ■ **Description of function (P. 6-82)**.

☞ For the data range of parameter, refer to ■ **Parameter setting (P. 6-83)**.

☞ For the operation of parameter, refer to ■ **Setting procedure (P. 6-84)**.

■ 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: Temperature input: 2 °C [2 °F] (fixed)
Voltage/Current input: 0.2 % of span (fixed)

- **When the output reaches 0 % (low limit with output limit function)**

  For reverse action: When the Control loop break alarm (LBA) time has passed and the Measured value (PV) has not fallen below the alarm determination range, the alarm will be turned on.

  For direct action: When the Control loop break alarm (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 output exceeds 100 % (high limit with output limit function)**

  For reverse action: When the Control loop break alarm (LBA) has passed and the Measured value (PV) has not risen beyond the alarm determination range, the alarm will be turned on.

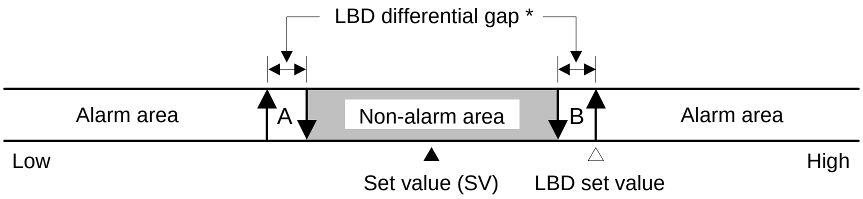
  For direct action: When the Control loop break alarm (LBA) has passed and the Measured value (PV) has not fallen below the alarm determination range, the alarm will be turned on.

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

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

● 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.



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

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

LBA function is not available:

- when displaying Input type and Input range after turning ON the power.
- during Autotuning (AT) or Autotuning (AT) with learning function.
- in the Reset mode (RESET).
- for Heat/Cool PID control.
- when “Without LBA” is selected at Control loop break alarm (LBA) selection.
- when setting “0” at Control loop break alarm (LBA) time.
- when the operation comes to the end of the Program pattern (Pattern end).

Continued on the next page.

Continued from the previous page.

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

While the Control loop break alarm (LBA) is ON (under alarm status), the following conditions will cancel the alarm status and Control loop break alarm (LBA) will be OFF:

- The Measured value (PV) rises beyond (or falls below) the Control loop break alarm (LBA) determination range within the Control loop break alarm (LBA) time.
- The Measured value (PV) enter within the Control loop break alarm (LBA) deadband.

● Control loop break alarm (LBA) interlock

When the Control loop break alarm (LBA) turns ON in the Interlock function, it remains ON regardless of whether output value returns to be within the Output limiter.

For interlock release operation, refer to **6.4.4 Interlock release (P. 6-86)**.

■ Parameter setting

● ALM lamp light condition 2

ALM lamp can be set to “0: No lighting” or “1: Lighting” when Control loop break alarm (LBA) occurs.

Parameter symbol	Data range	Factory set value
ALC2	0: No lighting 1: Lighting 0 0 0 0 0 ← Value at SV display HBA1 HBA2 LBA Self-diagnostic error Unused	0011

● Control loop break alarm (LBA) selection

Parameter symbol	Data range	Factory set value
LbASL	0: Without LBA 1: With LBA	0

● Control loop break alarm (LBA) interlock

Parameter symbol	Data range	Factory set value
LbIL	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0

● Control loop break alarm (LBA) time

Control loop break alarm (LBA) time is displayed when “1: With LBA” is selected.

Parameter symbol	Data range	Factory set value
LbA	0 to 7200 seconds 0: Unused	480

● LBA deadband (LBD)

LBA deadband (LBD) is displayed when “1: With LBA” is selected.

Parameter symbol	Data range	Factory set value
Lbd	0 to Input span	0

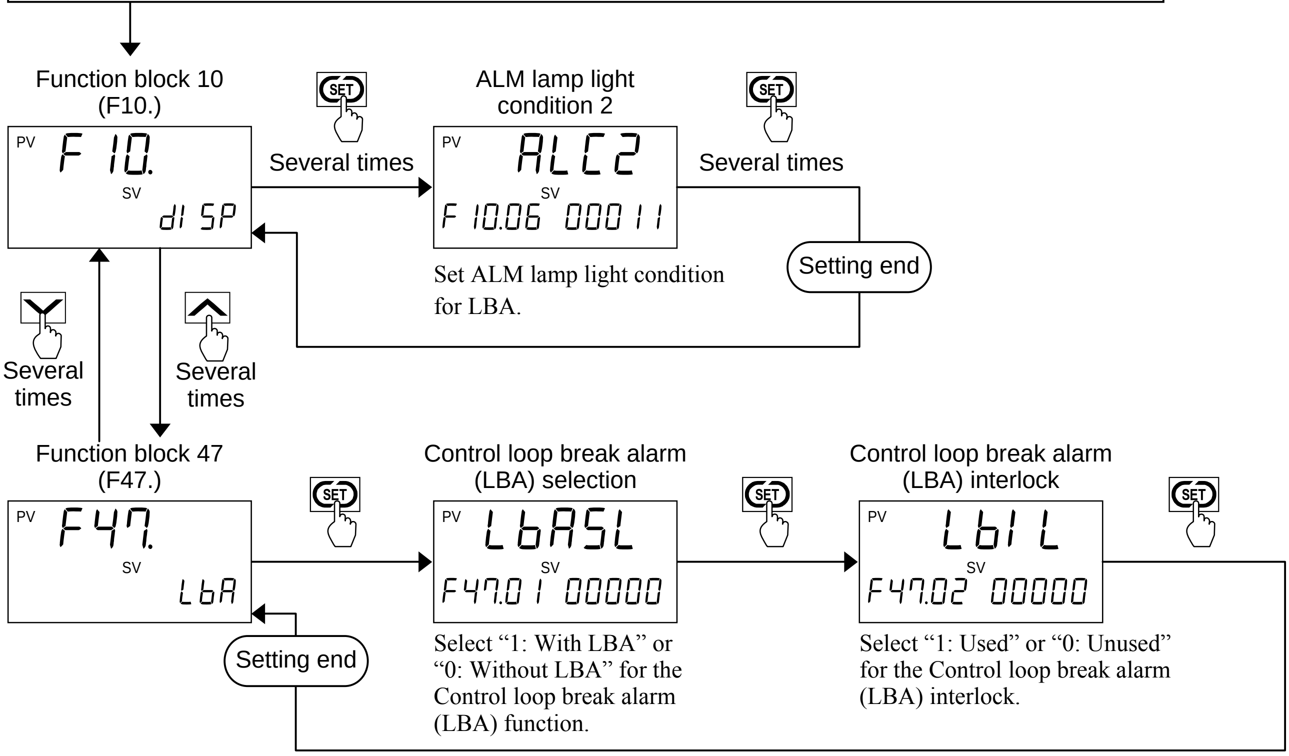
■ Setting procedure

- ALM lamp light condition 2 can be set at F10.06 in the Engineering mode.
- For Control loop break alarm (LBA) selection and Control loop break alarm (LBA) interlock, go to F47 in the Engineering mode.
- For Control loop break alarm (LBA) time and LBA deadband (LBD), go to the Parameter setting mode (PID memory group setting block).

● Parameter setting in the Engineering mode

Set ALM lamp light condition 2, Control loop break alarm (LBA) selection and Control loop break alarm (LBA) interlock.

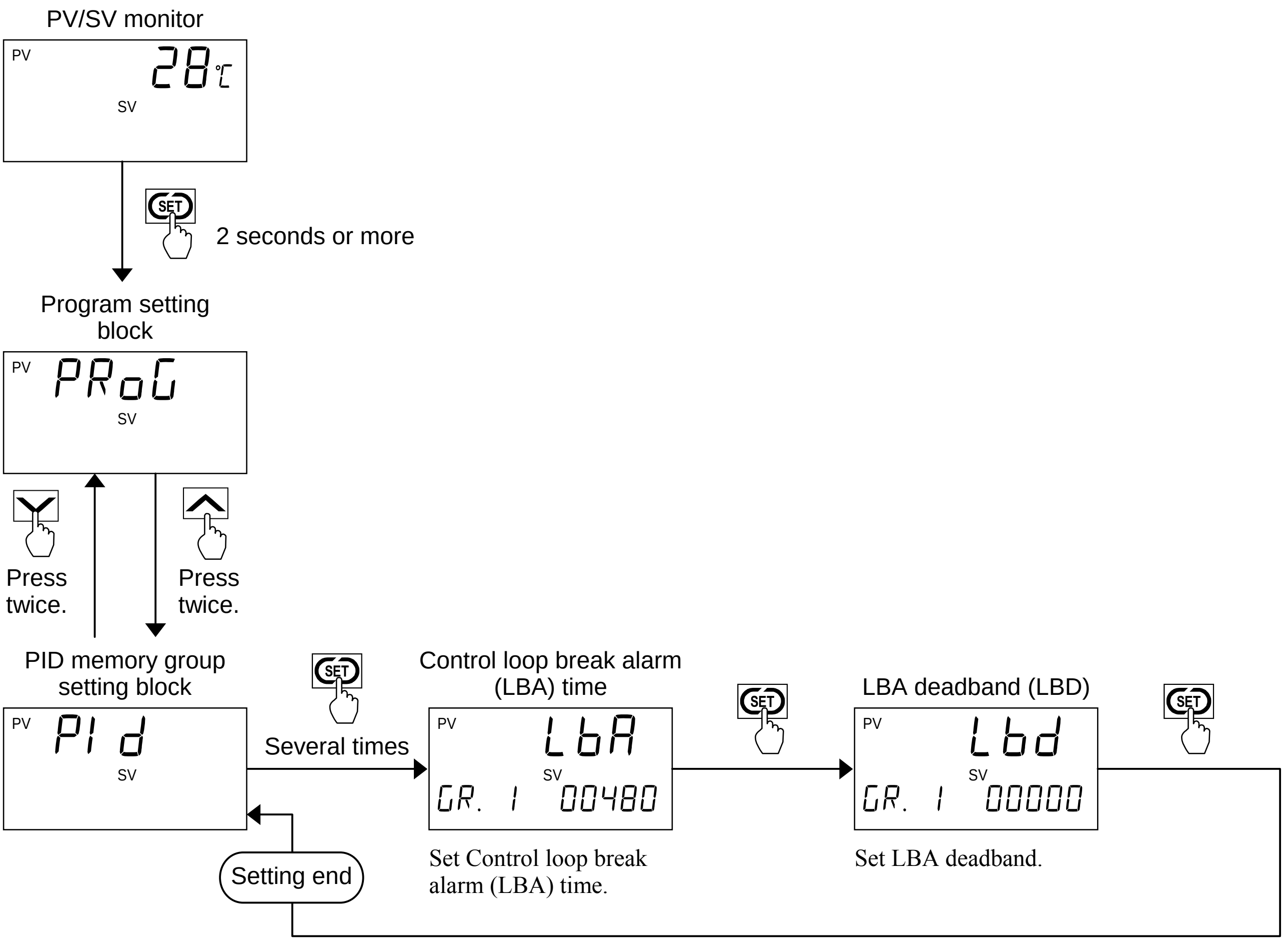
1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.



● Parameter setting in the Parameter setting mode (Partial setting type)

☞ For the Batch setting type, refer to ■ **Setting type for Program pattern** of **4.5.3 Parameter setting mode (P. 4-17)**.

Set Control loop break alarm (LBA) time and LBA deadband (LBD).



6.4.4 Interlock release

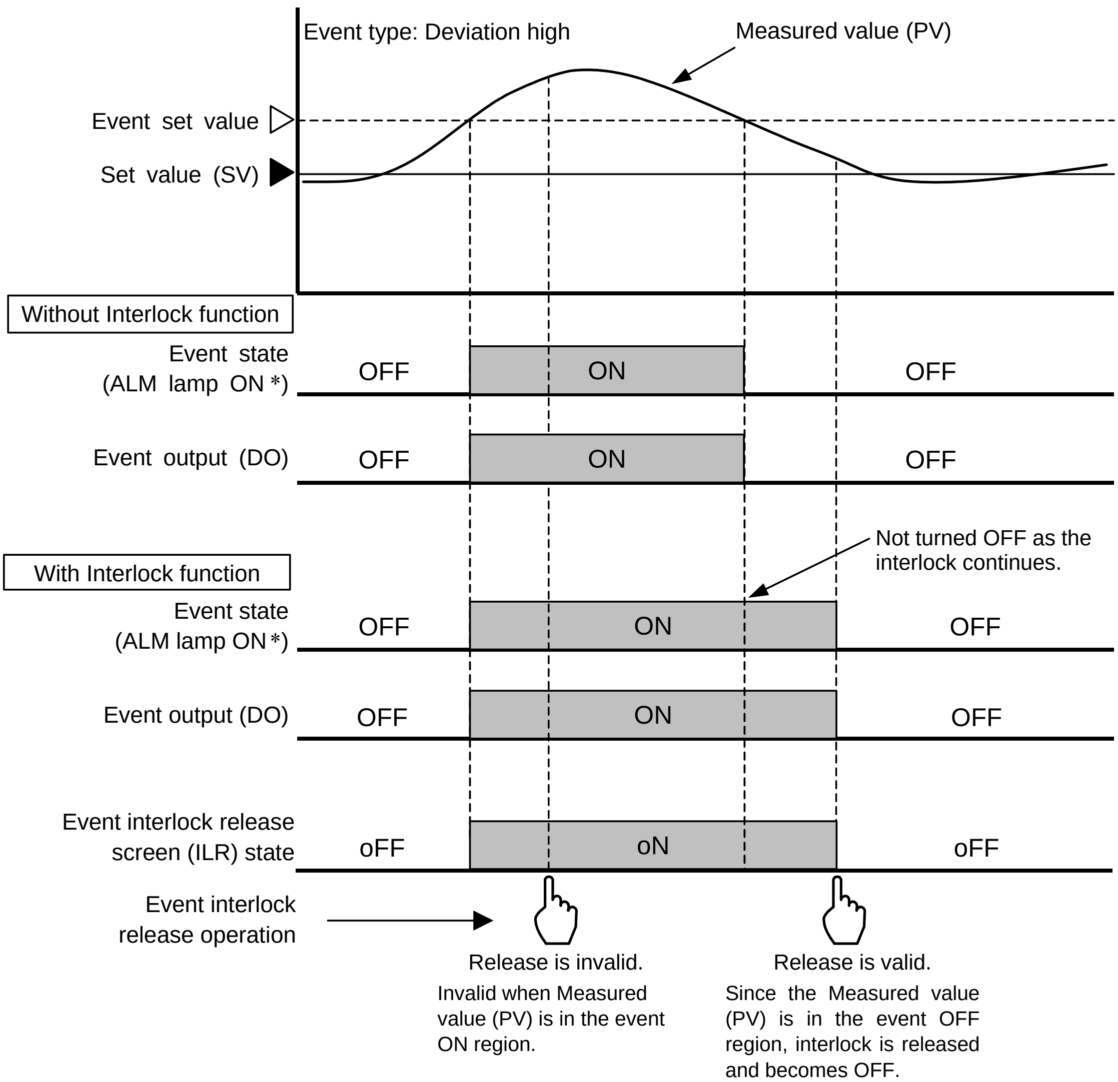
Types of Interlock:
Event interlock, Heater break alarm (HBA) interlock and Control loop break alarm (LBA) interlock

- **Event interlock function:**
  The Interlock action holds the Event state even if the Measured value (PV) is out of the Event zone after it enters the Event zone once.
- **Heater break alarm (HBA) interlock:**
  The interlock action holds the Heater break alarm state even if the CT input value is out of the Heater break alarm zone after it enters the Heater break alarm zone once.
- **Control loop break alarm (LBA) interlock:**
  When the Control loop break alarm (LBA) turns ON in the Interlock function, it remains ON regardless of whether output value returns to be within the Output limiter.

Interlock can be released by using Key operation or Communication (optional).

☞ For the Interlock release by communication, refer to the **7. HOST COMMUNICATION [OPTIONAL] (P. 7-1)** and **7.5 Communication Data List (P. 7-39)**.

The following example shows how the interlock is released.

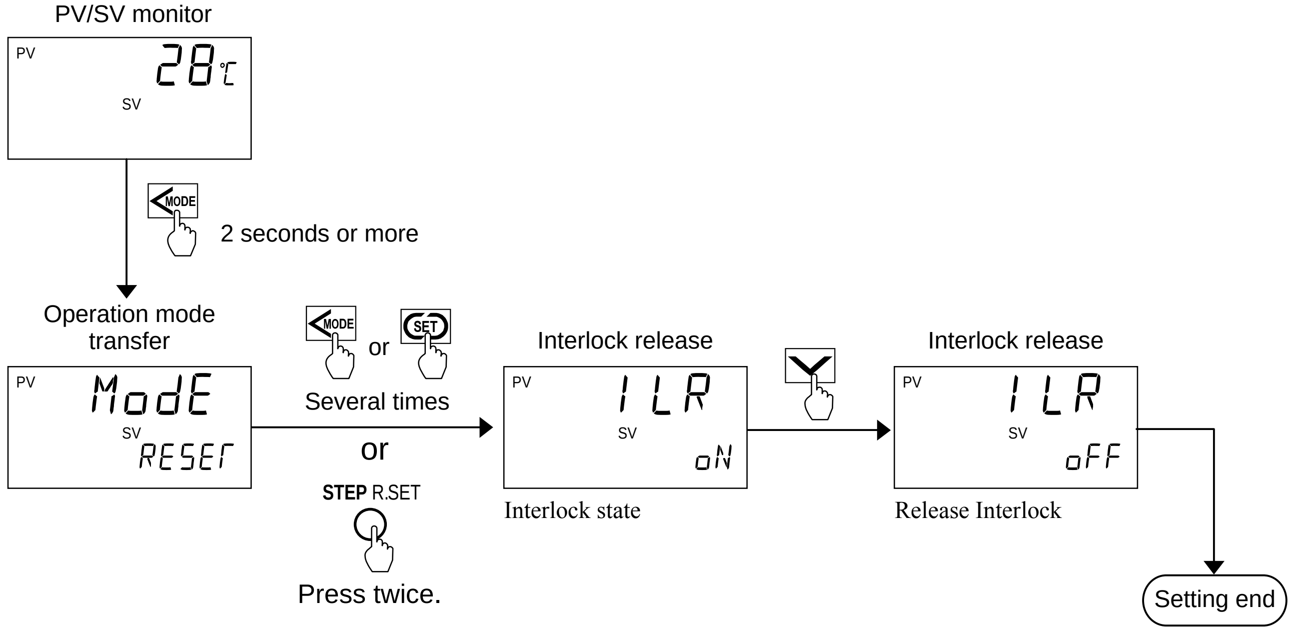


* ALM lamp lights when setting "1: Lighting" for Alarm lamp light condition 1 at F10.05 in the Engineering mode. (Factory set value: Lighting)

- Set Event interlock at F41.06, F42.06, F43.06 and F44.06 in the Engineering mode.
- Set Heater break alarm (HBA) interlock at F45.05 and F46.05 in the Engineering mode.
- Set Control loop break alarm (LBA) interlock at F47.02 in the Engineering mode.
- When using Event to set “No lighting” or “Lighting” for Alarm lamp light condition, go to F10.05 in the Engineering mode.
- When using Heater break alarm (HBA) or Control loop break alarm (LBA) to set “No lighting” or “Lighting” for Alarm lamp light condition, go to F10.06 in the Engineering mode.

■ Setting procedure

To release Interlock, go to the Operation mode.



6.5 Control

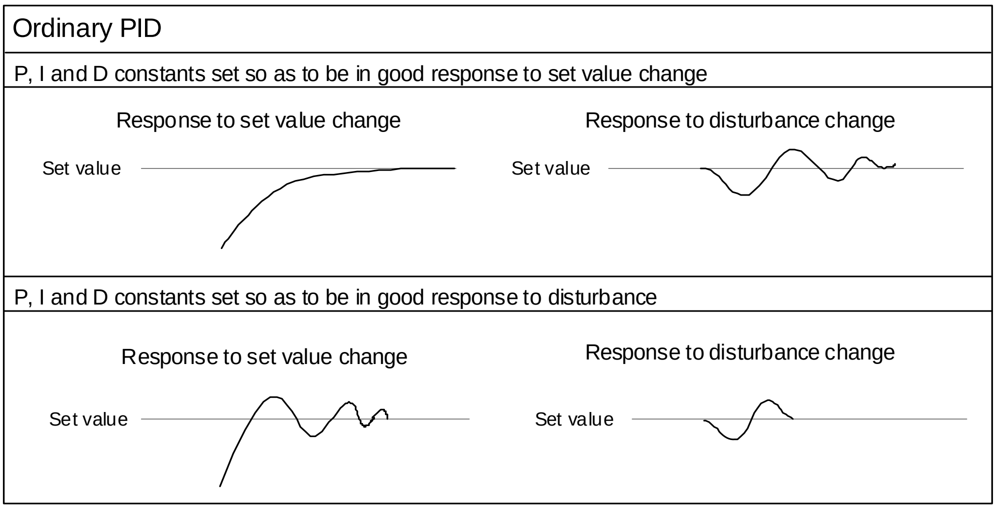
6.5.1 Change Control Action

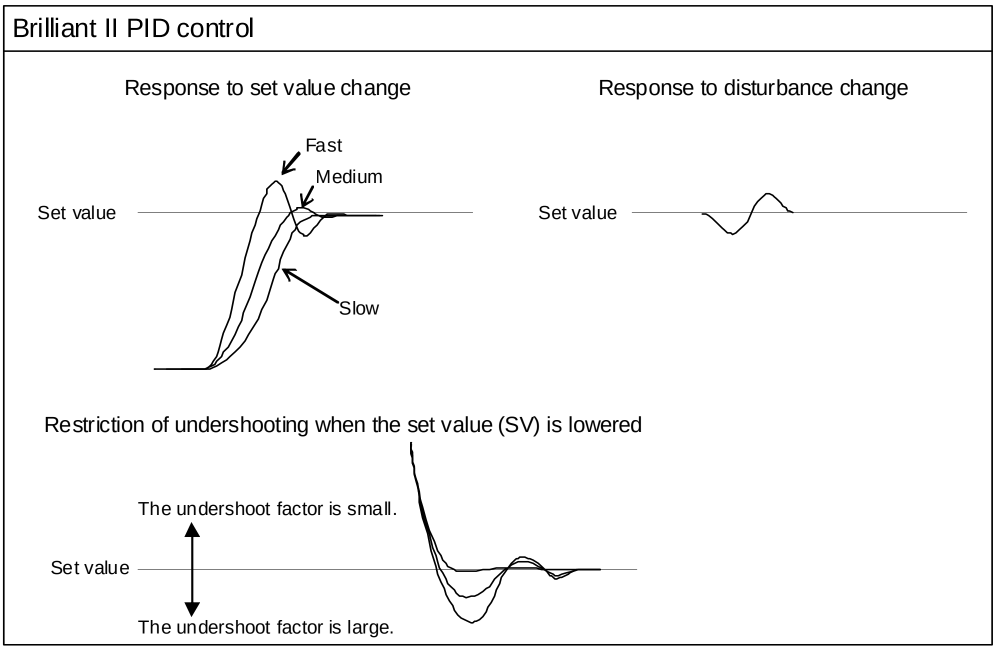
The control algorithm of the instrument is Brilliant II PID control. Refer to the following 8 types of control action:

- PID control (direct action)
- PID control (reverse action)
- ON/OFF action
- Heat/Cool PID control [water cooling]
- Heat/Cool PID control [air cooling]
- Heat/Cool PID control [Cooling gain linear type]
- Position proportioning PID control (reverse action)
- Position proportioning PID control (direct action)

■ Brilliant II PID control

PID control is a control method of achieving stabilized control result by setting P (Proportional band), I (Integral time) and D (Derivative time) constants, and is widely used. However, with this PID control, if P, I and D values are set to focus on “better response to control set value change,” “response to external disturbance” deteriorates. In contrast, if PID values are set to focus on “better response to external disturbance,” “response to control set value change” deteriorates. In brilliant II PID control a form of “Response to setting” can be selected from among **Fast**, **Medium** and **Slow** with PID constants remaining unchanged so as to be in good “Response to disturbances.” In addition, the controller is provided with the function which restricts the amount of undershooting caused by the cooling nonlinear characteristic possessed by plastic molding machines when the Set value (SV) is lowered in Heat/Cool PID control.





■ PID control (direct action/reverse action)

Reverse action is used for heat control, and Direct action for cool control.
In PID control, P, I, and D values must be set.
PID values can be set by Autotuning (AT), Autotuning (AT) with learning function, or manual.

– Proportional band (P)
– Integral time (I)
– Derivative time (D)

The following can be also set:

– Integral/derivative time decimal point
– Derivative gain
– Derivative action

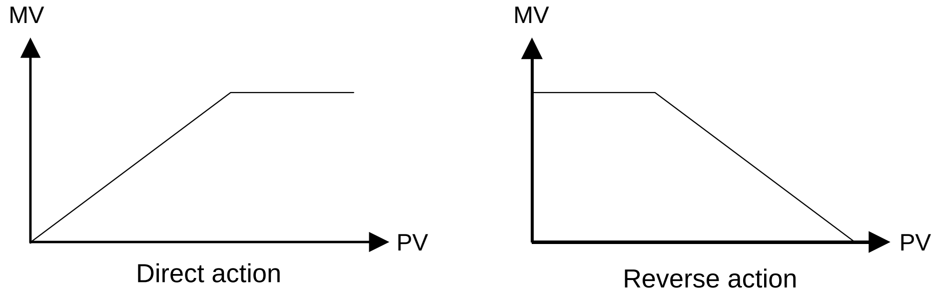
Parameters to be used with the factory set values
Do not change the set values of the parameters related to PID control from F50.15 to F52.25 in the Initial level engineering mode. To avoid poor control or undesired action, use the factory set values.

● PID control (direct action)

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

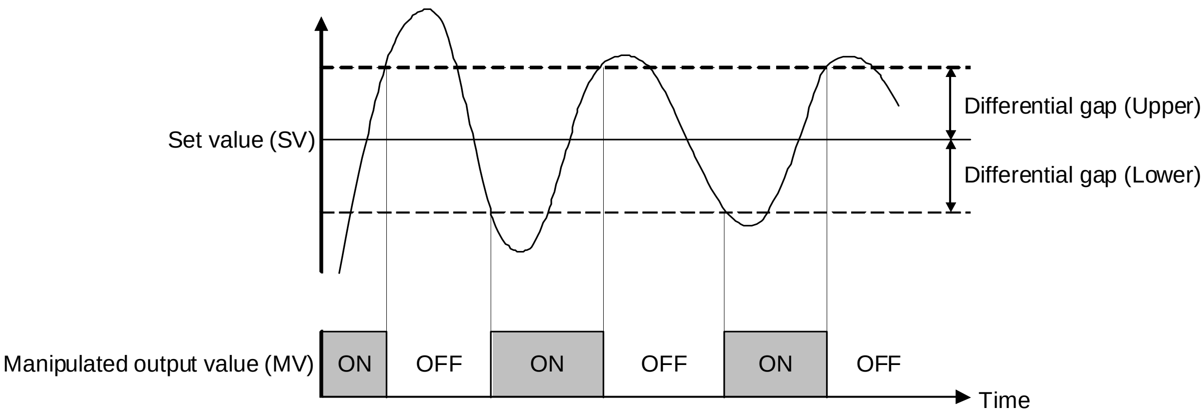
● PID control (reverse action)

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



● ON/OFF control

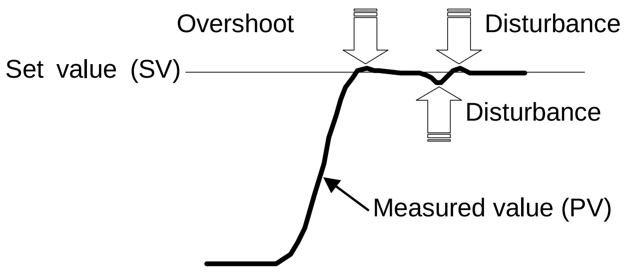
ON/OFF control is possible when the Proportional band is set to 0 (0.0, 0.00). In ON/OFF control with Reverse action, when the Measured value (PV) is smaller than the Set value (SV), the Manipulated output (MV) is 100 % or ON. When the PV is higher than the SV, the MV is 0 % or OFF. Differential gap setting prevents control output from repeating ON and OFF too frequently.



● Derivative action

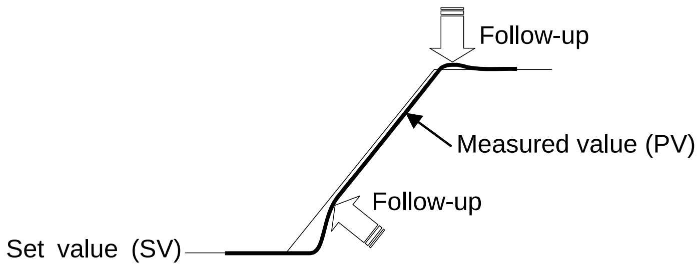
Measured value derivative: PID control putting much emphasis on response most adaptive to fixed set point control (mode)

Measured value derivative (PID control)



Deviation derivative: Deviation derivative (PID control) is designed for PID control requiring enhanced follow-up at powering up a load or reducing the amount of overshoot when switching from ramp to soak.

Deviation derivative (PID control)



■ Heat/Cool PID control (Water cooling type/Air cooling type/Cooling gain linear type)

In Heat/Cool control, only one controller enables heat and cool control.
In Heat/Cool PID control, P, I, and D values must be set. PID values can be set by Autotuning (AT), Autotuning (AT) with learning function, or manual.

– Proportional band [heat-side]
– Integral time [heat-side]
– Derivative time [heat-side]
– Proportional band [cool-side]
– Integral time [cool-side]
– Derivative time [cool-side]

The following can be also set:

– Integral/derivative time decimal point
– Derivative gain
– Derivative action
– Undershoot suppression factor
– Overlap/Deadband

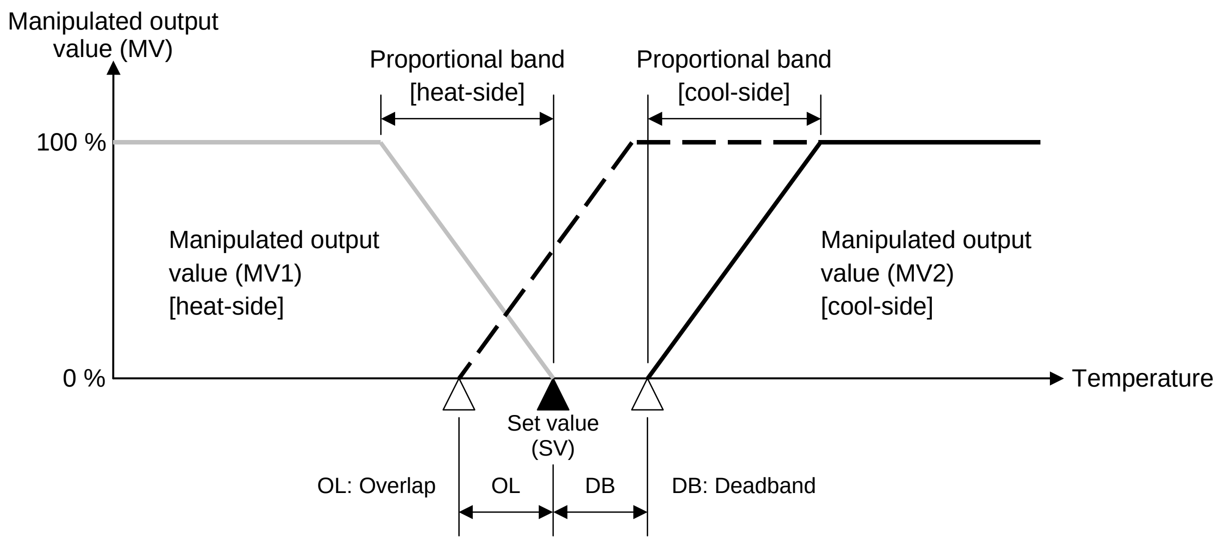
Parameters to be used with the factory set values

Do not change the set values of the parameters related to Heat/Cool PID control from F50.15 to F52.25 in the Initial level engineering mode. To avoid poor control or undesired action, use the factory set values.

- Proportional band adjusting factor [heat-side]
- Integral time adjusting factor [heat-side]
- Derivative time adjusting factor [heat-side]
- Proportional band adjusting factor [cool-side]
- Integral time adjusting factor [cool-side]
- Derivative time adjusting factor [cool-side]

Water cooling/Air cooling: The algorithm assuming plastic molding machine Heat/Cool control is employed. Even in equipment provided with a cooling mechanism having nonlinear characteristics, it responds quickly to attain the characteristic responding to the set value with small overshooting.

Cooling gain linear type: The algorithm assuming applications without nonlinear cooling capability is employed.



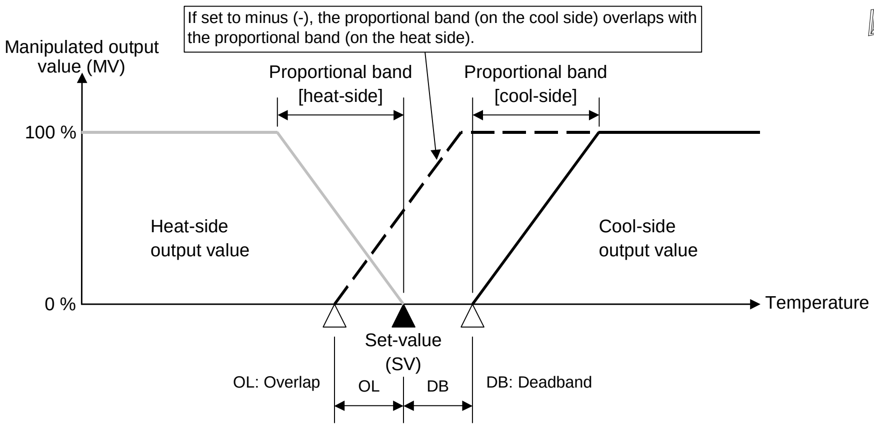
● Overlap/Deadband

Overlap (OL):

Range in which the Proportional band [heat-side] and the Proportional band [cool-side] are overlapped.
If a Measured value (PV) is within the overlapped range, Manipulated output values (MV1 and MV2) may be simultaneously output.

Deadband (DB):

This is a control dead zone existing between the Proportional band [heat-side] and the Proportional band [cool-side]. If a Measured value (PV) is within the deadband range, neither the Manipulated output value (MV1) nor the Manipulated output value (MV2) is output.



The diagram is an example when setting 0.0 to the Overlap/Deadband reference point.

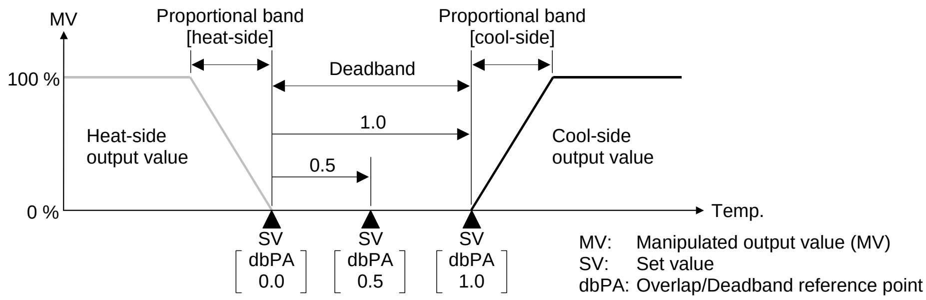
● Overlap/Deadband reference point

Each Set value (SV) for the Heat/Cool PID control becomes the Overlap/Deadband reference point.

① When setting 0.0, Overlap/Deadband reference point is at 0 % of the output at Proportional band [heat-side].

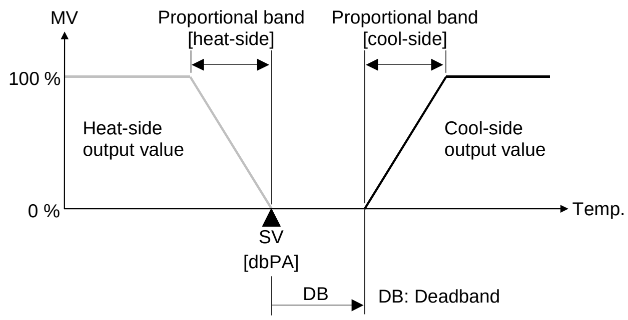
② When setting 0.5, Overlap/Deadband reference point is at the midpoint of the Overlap/Deadband.

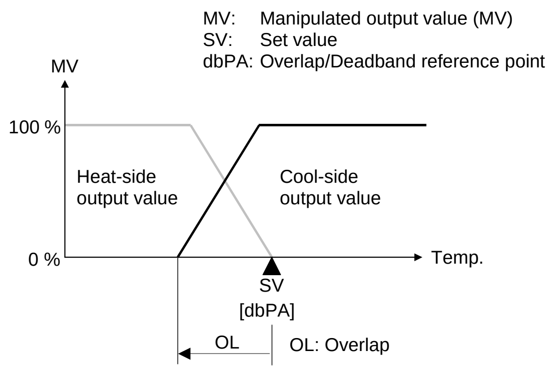
③ When setting 1.0, Overlap/Deadband reference point is at 0 % of the output at Proportional band [cool-side].



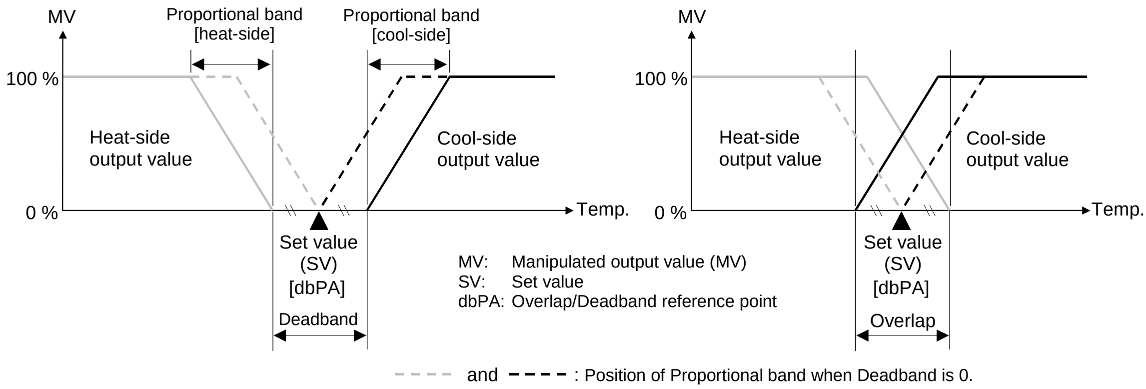
Example: Difference in Overlap/Deadband reference point

[Overlap/Deadband reference point: 0.0]

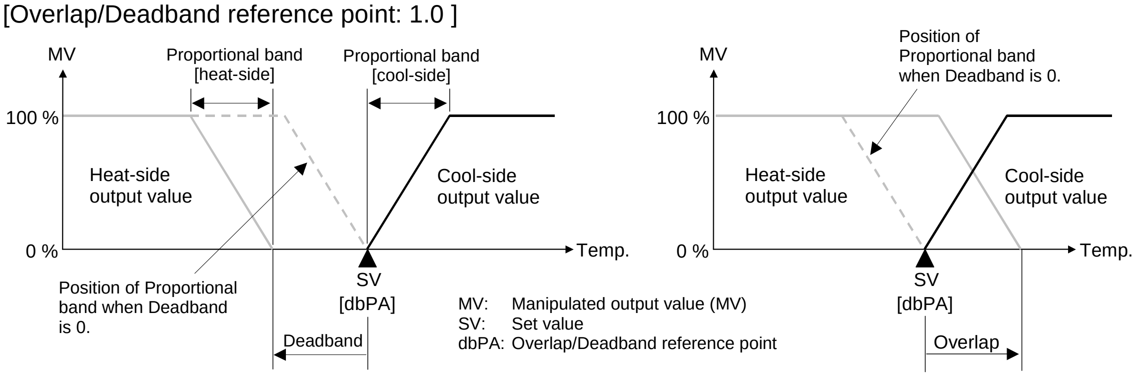




[Overlap/Deadband reference point: 0.5]



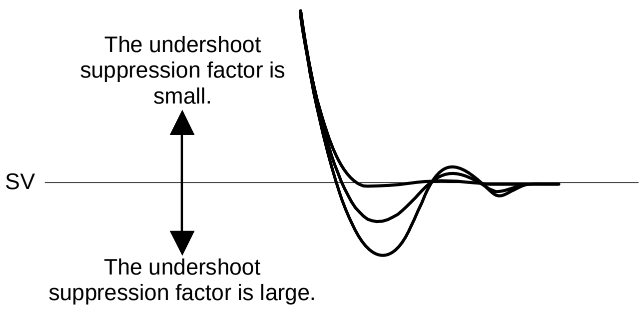
[Overlap/Deadband reference point: 1.0]



To change Deadband when the Overlap/Deadband reference point is 0.5, the Proportional band on heat-side and cool-side shift equidistantly to the midpoint of the Overlap/Deadband.

● Undershoot suppression factor

The Undershoot suppression function suppresses the undershoot that occurs when the Set value (SV) is lowered due to the special cooling characteristic (cooling nonlinear characteristic) of plastic molding machines. The undershoot suppression effect increases as a smaller value is set for the Undershoot suppression factor.



NOTE

If the Undershoot suppression factor is set too small, the undershoot suppression function acts excessively and prevents the Measured value (PV) from reaching the Set value (SV).
As a result, the PV stabilizes at an offset or approaches the set value very slowly, preventing normal control. In this event, change the setting for the Undershoot suppression factor to a slightly higher value.

■ Position proportioning PID control (direct action/reverse action)

Position proportioning PID control converts the control output value of the controller into the corresponding signal to control a motor driven valve (control motor) and then performs temperature control of a controlled object by regulating fluid flow. In Position proportioning PID control of this controller, it is possible to select the presence or absence of Feedback resistance (FBR) input which monitors the degree of valve opening (necessary to be selected when ordering). In addition, the direct action or reverse action can be selected.
In Position proportioning PID control, P, I, and D values must be set. PID values can be set by Autotuning (AT), Autotuning (AT) with learning function, or manual.

– Proportional band
– Integral time
– Derivative time

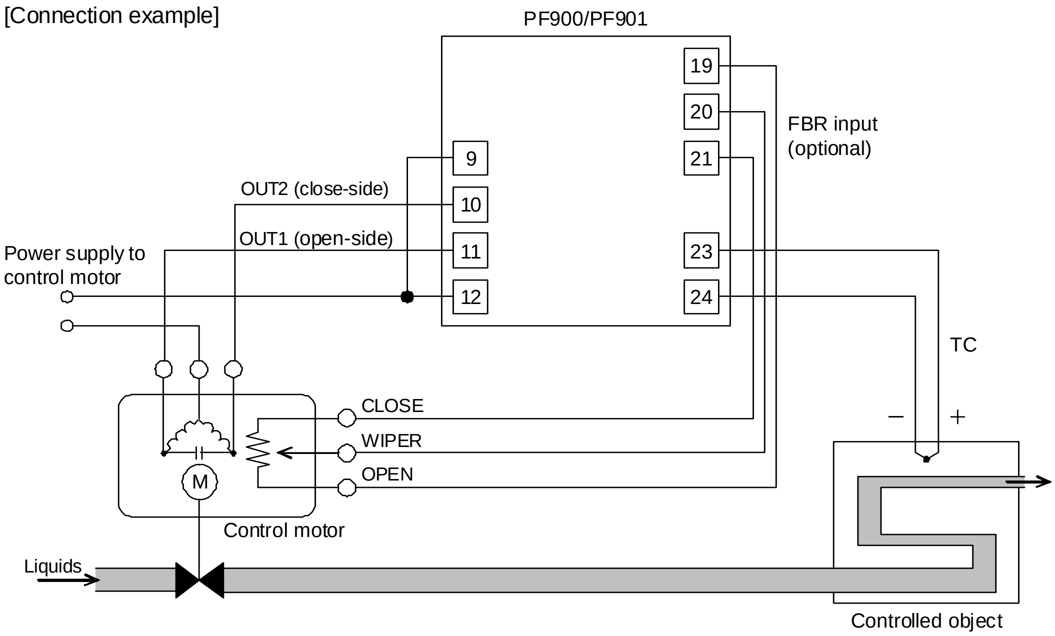
In addition to PID values, the following parameters should be set based on the application:

– Manipulated output value 1 (MV1) in Reset mode
– Open/Close output neutral zone
– Output limiter high or low
– Control action at Pattern end
– Output value with AT turned on/Output value with AT turned off
– Action at feedback resistance (FBR) input error
– Feedback adjustment
– Control motor time
– Integrated output limiter
– Valve action in Reset mode
– Action at saturated output

Parameters to be used with the factory set values

Do not change the set values of the parameters related to Heat/Cool PID control from F50.15 to F52.25 in the Initial level engineering mode. To avoid poor control or undesired action, use the factory set values.

[Connection example]



☞ For the setting method of Position proportioning PID control, refer to **6.5.3 Position proportioning PID control setting (P. 6-102)**.

■ Parameter setting

● Control action

Parameter symbol	Data range	Factory set value
oS	0: Brilliant II PID control (direct action) 1: Brilliant II PID control (reverse action) 2: Brilliant II Heat/Cool PID control (water cooling) 3: Brilliant II Heat/Cool PID control (air cooling) 4: Brilliant II Heat/Cool PID control (cooling gain linear type) 5: Brilliant II Position proportioning PID control (reverse action) 6: Brilliant II Position proportioning PID control (direct action)	Based on model code. When not specifying: 1 When FBR input is specified and a control action other than Position proportioning PID control is selected in the Initial set code at ordering, "5: Brilliant II Position proportional PID control (reverse action)" will be preset as factory set value.

● Proportional band [heat-side]

This is a Proportional band in P, PI, PD or PID control. When in Heat/Cool PID control, it becomes the Proportional band on the heat side.

Parameter symbol	Data range	Factory set value
P	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span 0 (0.0, 0.00): ON/OFF action	TC/RTD: 30 V/I: 3.0

● Integral time [heat-side]

Integral action is to eliminate offset between Set value (SV) and Measured value (PV) by proportional action.
The degree of Integral action is set by time in seconds.
When in Heat/Cool PID control, it becomes the Integral time on the heat side.

Parameter symbol	Data range	Factory set value
I	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	240

● Derivative time [heat-side]

Derivative action is to prevent rippling and make control stable by monitoring output change.
The degree of Derivative action is set by time in seconds.
When in Heat/Cool PID control, it becomes the Derivative time on the heat side.

Parameter symbol	Data range	Factory set value
d	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60

● Proportional band [cool-side]

This is a Proportional band for the cool side in Heat/Cool P, PI, PD or PID control.
This screen is displayed when in Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
Pc	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span	TC/RTD: 30 V/I: 3.0

● Integral time [cool-side]

Integral action [cool-side] is to eliminate offset between Set value (SV) and Measured value (PV) by proportional action of cool-side. The degree of Integral action [cool-side] is set by time in seconds. This screen is displayed when in Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
Ic	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action Varies with the setting of the Integral/Derivative time decimal point position selection.	240

● Derivative time [cool-side]

Derivative action of cool-side is to prevent rippling and make control stable by monitoring output change.
The degree of Derivative action [cool-side] is set by time in seconds.
This screen is displayed when in Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
dc	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60

● Overlap/Deadband

This is the overlapped range of Proportional bands (on the heat and cool sides) or the deadband range when Heat/Cool PID control is performed. This screen is displayed when in Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
db	TC/RTD inputs: −Input span to +Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: −100.0 to +100.0 % Minus (−) setting results in Overlap. However, the overlapping range is within the proportional range.	0

● ON/OFF action differential gap (upper)

Parameter symbol	Data range	Factory set value
oHH	TC input: 0 (0.0) to Input span (Unit: °C [°F]) RTD input: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of Input span	TC/RTD: 1 V/I: 0.1

● ON/OFF action differential gap (lower)

Parameter symbol	Data range	Factory set value
oHL	TC input: 0 (0.0) to Input span (Unit: °C [°F]) RTD input: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of Input span	TC/RTD: 1 V/I: 0.1

● Integral/derivative time decimal point position

Use to select a Decimal point position of Integral time and Derivative time.

Parameter symbol	Data range	Factory set value
I d.dP	0: 1 second setting (No decimal place) 1: 0.1 seconds setting (One decimal place)	0

When changing a decimal point position of Integral/Derivative time, the decimal point positions of following parameters will automatically change to the new decimal point position.

Parameter setting mode:
Integral time [heat-side]
Derivative time [heat-side]
Integral time [cool-side]
Derivative time [cool-side]

Initial level engineering mode:
Integral time limiter (high) [heat-side] *
Integral time limiter (low) [heat-side] *
Derivative time limiter (high) [heat-side] *
Derivative time limiter (low) [heat-side] *
Integral time limiter (high) [cool-side] *
Integral time limiter (low) [cool-side] *
Derivative time limiter (high) [cool-side] *
Derivative time limiter (low) [cool-side] *

* To avoid poor control or undesired action, do not change the factory set value.

● Derivative gain

Use to set a gain used for the derivative action in PID control. Derivative gain should not be changed under ordinary operation. Under ordinary operation, it is not necessary to change the factory set value.

Parameter symbol	Data range	Factory set value
d.GA	0.1 to 10.0	6.0

● Derivative action

Select Derivative action at PID control.

Parameter symbol	Data range	Factory set value
d.rP	0: Measured value derivative 1: Deviation derivative	0

In Position proportioning PID control, action becomes Measured value derivative regardless of the setting.

Derivative action selection is invalid when Ramp/Soak stabilizer (RSS) is ON in the Program control mode.

● Undershoot suppression factor

This is a factor to suppress undershoot on the cool side.

Parameter symbol	Data range	Factory set value
US	0.000 to 1.000	Water cooling: 0.100 Air cooling: 0.250 Cooling gain linear type: 1.000

The Undershoot suppression factor is invalid even if set when control is not in Heat/Cool PID control.

● Overlap/Deadband reference point

Overlap/Deadband reference point at Heat/Cool PID control

Parameter symbol	Data range	Factory set value
dbAA	0.0 to 1.0 0.0: Reference in the heat-side 1.0: Reference in the cool-side	0.0

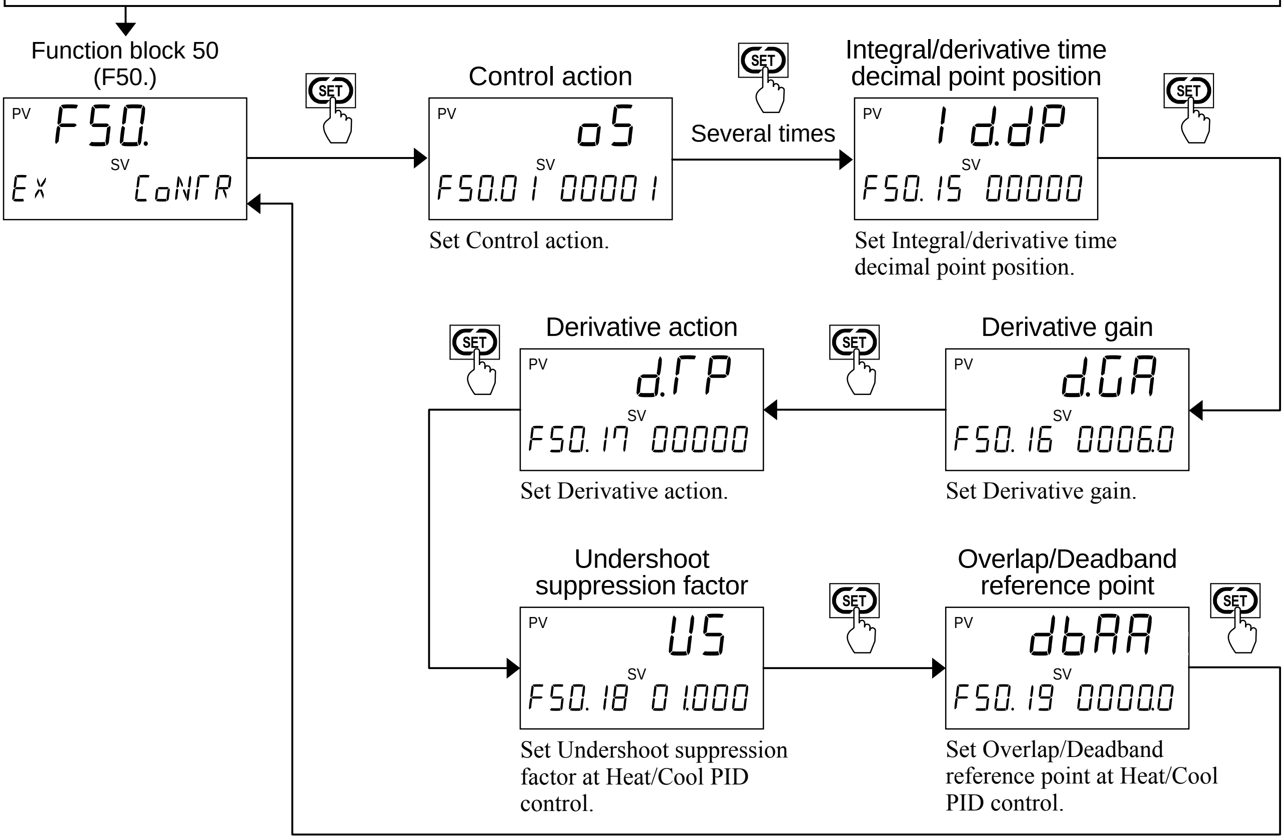
■ Setting procedure

Settings related to control

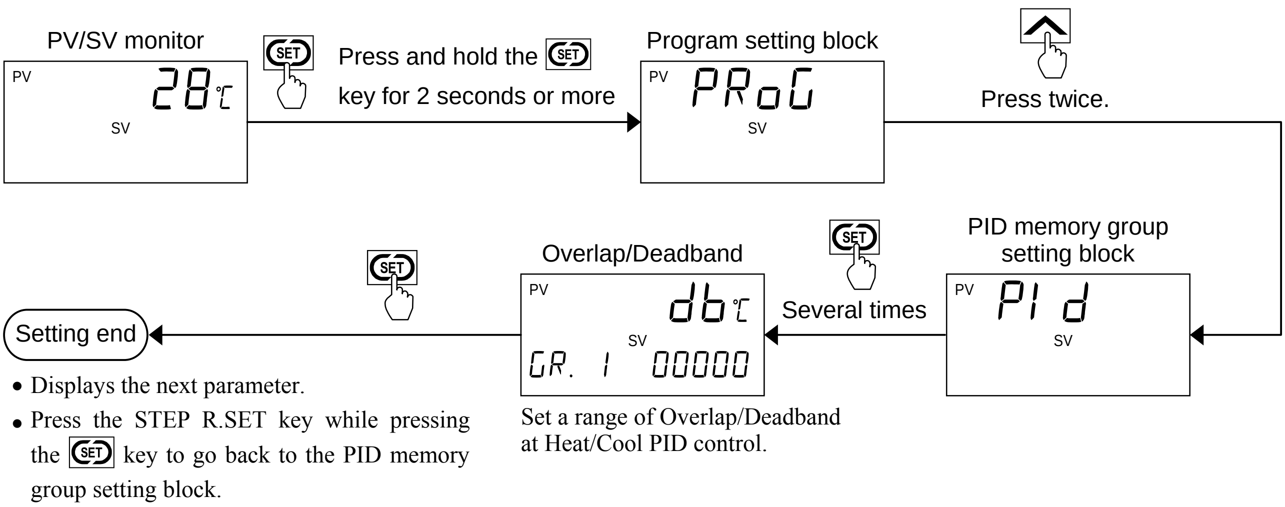
- To set Control action, go to F50.01 in the Engineering mode.
- To set Integral/derivative time decimal point position, Derivative gain, Derivative action, Undershoot suppression factor and Overlap/Deadband reference point, go to F50 in the Initial level engineering mode.
- To set Overlap/Deadband reference point, go to the PID memory group setting block in the Parameter setting mode.

● Parameter setting in the Initial level engineering mode

1. Press the RESET key to go to the Reset mode (RESET).
2. Press and hold the SET key, the MODE key and the ∨ key for 2 seconds or more to go to the Initial level engineering mode.
3. Keep pressing the ∧ key until the F50 screen displays.



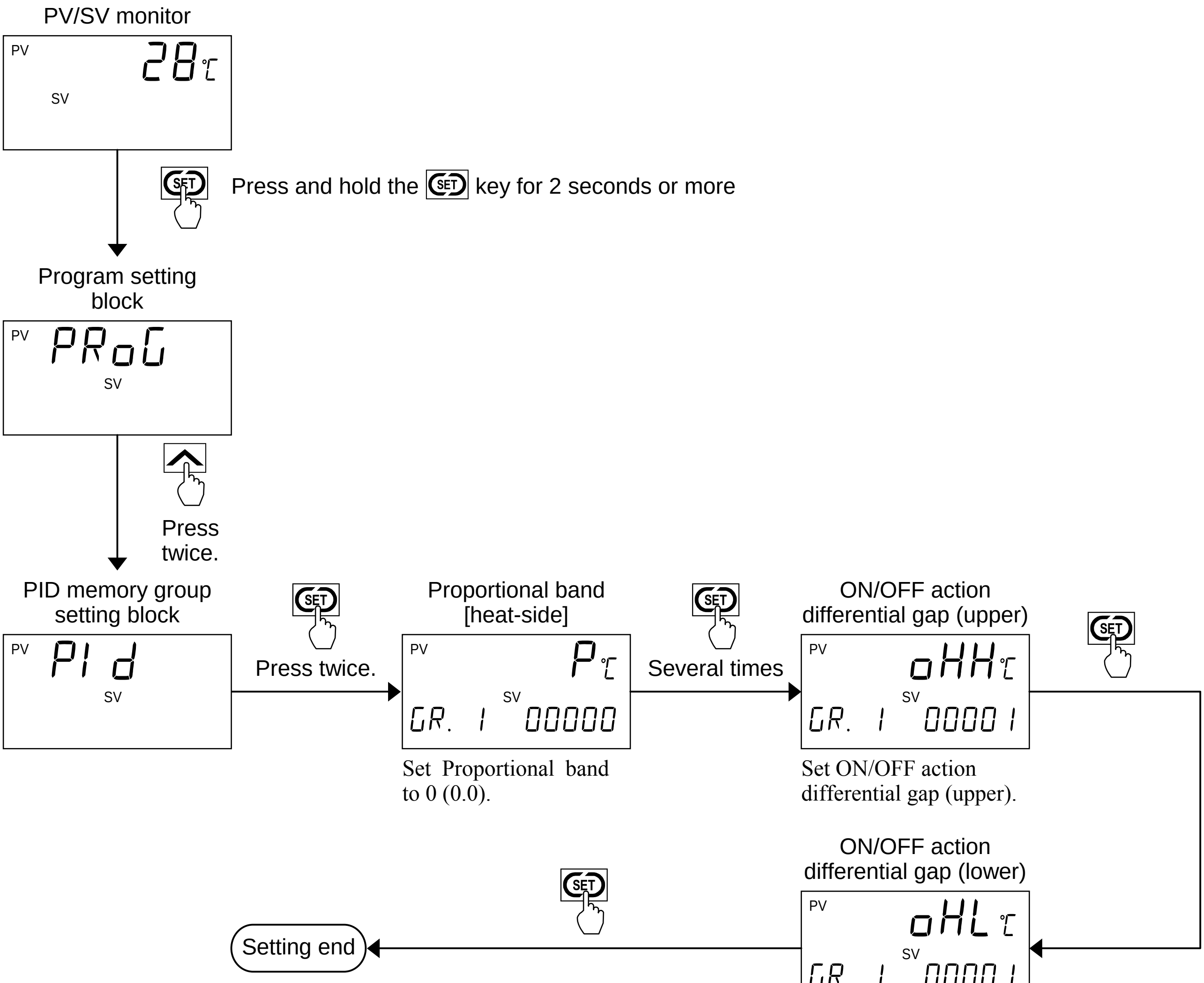
● Parameter setting in the Parameter setting mode (Partial setting type)



Settings for ON/OFF action

ON/OFF control is possible when the Proportional band [heat-side] is set to 0 (0.0, 0.00).
For Proportional band [heat-side], ON/OFF action differential gap (upper) and ON/OFF action differential gap (lower), go to the Parameter setting mode (PID memory group setting block).

● Parameter setting in the Parameter setting mode (Partial setting type)

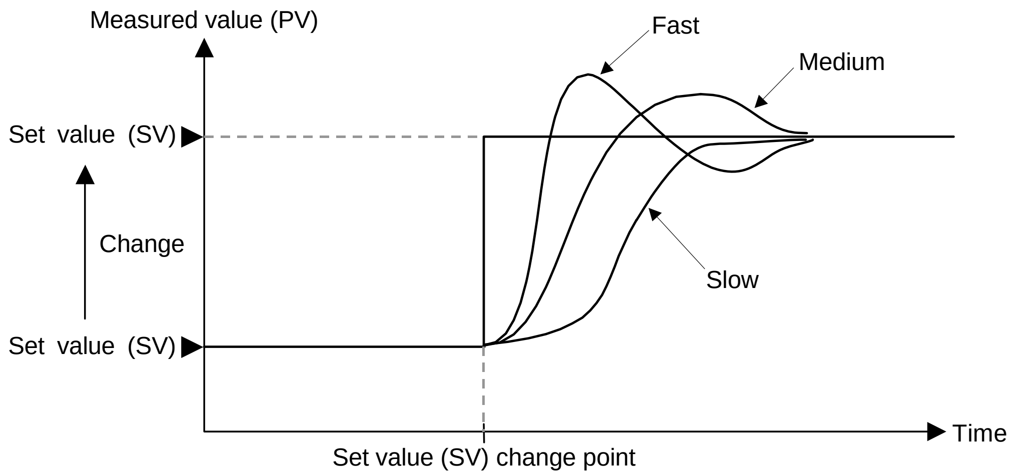


- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the PID memory group setting block.

6.5.2 Control response parameter

A response speed level at changing Set value (SV) at PID control can be selected from three levels (Slow, Medium and Fast) in the Control response parameter. Select "Fast" to quicken the response of the controlled object to the change in segment level and Set value (SV). When the response speed level is "Fast," overshoot will occur. To avoid overshoot, select "Slow."

Fast	Selected when rise time needs to be shortened (operation needs to started fast). However in this case, slight overshooting may not be avoided.
Medium	Middle between "Fast" and "Slow." Overshooting when set to "Medium" becomes less than that when set to "Fast."
Slow	Selected when no overshooting is allowed. Used when material may be deteriorated if the temperature becomes higher that the set value.



■ Parameter setting

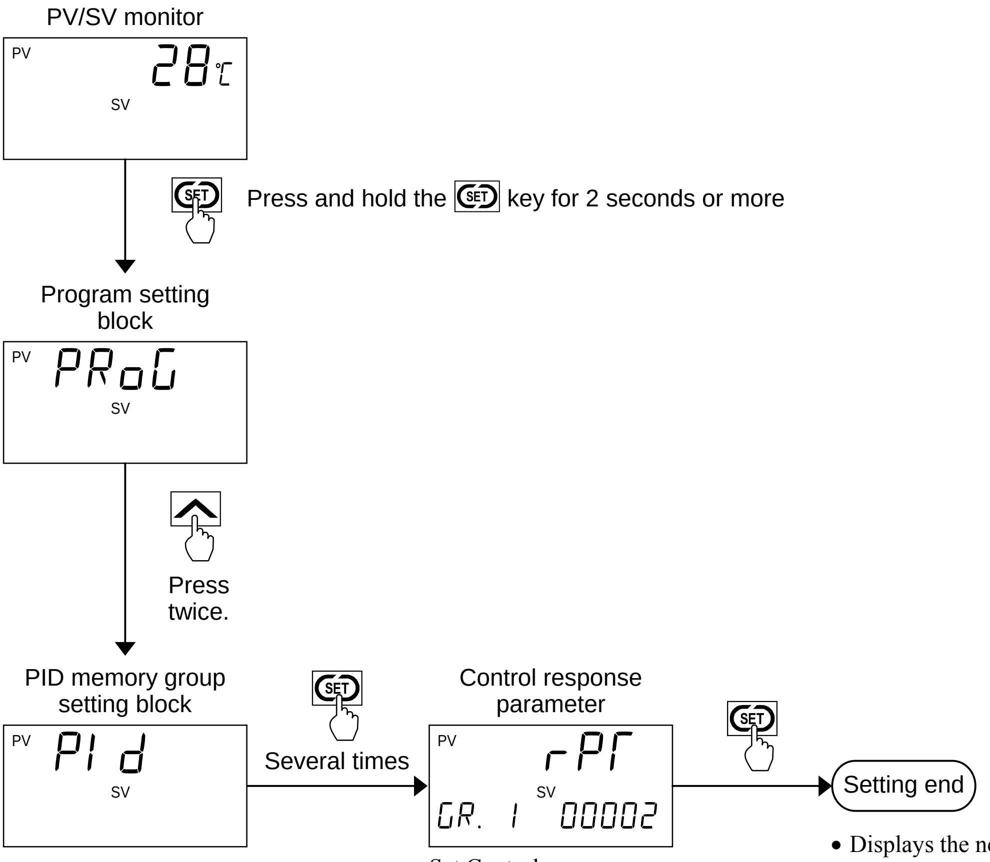
● Control response parameter

Parameter symbol	Data range	Factory set value
rPr	0: Slow 1: Medium 2: Fast P action and PD action, the control response is fixed at 2 (Fast).	2

■ Setting procedure

For Control response parameter, go to the Parameter setting mode (PID memory group setting block).

● Parameter setting in the Parameter setting mode (Partial setting type)



Set Control response parameter.

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the PID memory group setting block.

6.5.3 Position proportioning PID control setting

Parameters are different when Position proportioning PID control is specified with or without Feedback resistance (FBR).

● When the Feedback resistance (FRB) is provided:

- High/Low limit of valve position (limit value of FBR input) can be set.
  [Output limiter high, Output limiter low]
- The valve position can be manually changed.
  [Manipulated output value 1 (MV1) setting in Manual control mode]
- The feedback adjustment is necessary. [Feedback adjustment preparation]
- Action taken when Feedback resistance (FBR) input breaks can be selected.
  [Action at feedback resistance (FBR) input error]
- Output value (FBR input) with the output turned on or off when the Autotuning (AT) function is executed can be restricted. [Output value with AT turned on, Output value with AT turned off]
- The close-side (or open-side) output remains ON when the valve position is fully closed (or opened). [Action at saturated output]

● When the Feedback resistance (FRB) is not provided:

- Control motor operation can be restricted by the Integrated output limiter. [Integrated output limiter]
- The UP/DOWN key is used to output opening or closing signal in Manual control mode.

UP (⋀) key (open-side):

While the ⋀ key is being pressed, open-side output (OUT1) is output continuously. Releasing the ⋀ key turns off the output on the open-side to hold the opened state at that time.

DOWN (⋁) key (close-side):

While the ⋁ key is being pressed, close-side output (OUT2) is output continuously. Releasing the ⋁ key turns off the output on the closed-side to hold the opened state at that time.

☞ For Manual operation in Position proportioning PID control, refer to **5.6.3 Parameter setting via Manual control mode (P. 5-30)**.

Parameter validate/invalidate depending on the presence or absence of Feedback resistance (FBR) input (×: Validate −: Invalidate)

Parameter	With FBR input	Without FBR input	Mode
Open/Close output neutral zone *	×	×	Parameter setting mode
Output limiter high (MV1)	×	−	
Output limiter low (MV1)	×	−	
Manipulated output value 1 (MV1) in Reset mode	×	−	
Control action at Pattern end	×	×	Engineering mode F50.07
Output value with AT turned on	×	−	Engineering mode F52.05
Output value with AT turned off	×	−	Engineering mode F52.06
Action at feedback resistance (FBR) input error	×	−	Engineering mode F53.01
Feedback adjustment	×	−	Engineering mode F53.02
Control motor time *	×	×	Engineering mode F53.03
Integrated output limiter	−	×	Engineering mode F53.04
Valve action in Reset mode *	×	×	Engineering mode F53.05
Action at saturated output *	×	−	Initial level engineering mode F53.06

* These parameters are necessary to set regardless of the presence or absence of Feedback resistance (FBR) input.

■ Setting flowchart

This section describes the Position proportioning PID control dedicated setting items and the setting items which are effective when there is or is not a Feedback resistance (FBR) input.

Position proportioning PID control common setting	Effective when there is a Feedback resistance (FBR) input	Effective when there is not a Feedback resistance (FBR) input

Select the Control action

Select the Position proportioning PID control (direct/reverse action).
[Position proportioning PID control common setting]

Control action can be specified by Quick start code at ordering.

To select control action, refer to ■ **Parameter setting (P. 6-95)** and ■ **Setting procedure (P.6-98)**.

↓

Set the Open/Close output neutral zone

Set the output OFF zone between open-side and close-side outputs.
[Position proportioning PID control common setting]

Differential gap of the open/close output
Differential gap of the open/close output cannot be changed for PF900/PF901. Differential gap of the open/close output is fixed to one-second of the neutral zone.

↓

Set the Output limiter

Set the high-limit/low-limit value of the valve position.
[Effective when there is a Feedback resistance (FBR) input]

↓

Set the Manipulated output value 1 (MV1) in Reset mode

Set valve position at Reset mode (RESET).
[Effective when there is a Feedback resistance (FBR) input]

↓

Set the Control action at Pattern end

"Control continued" or "Control stop" at Program pattern end can be set.
[Position proportioning PID control common setting]

↓

Set the output value with AT turned on/off

Set the upper limit and lower limit values of the valve position which is opened and closed by output ON/OFF at Autotuning (AT) execution.
[Effective when there is a Feedback resistance (FBR) input]

Set when you want to limit the position of the valve which is opened and closed by output ON/OFF at AT execution.

↓

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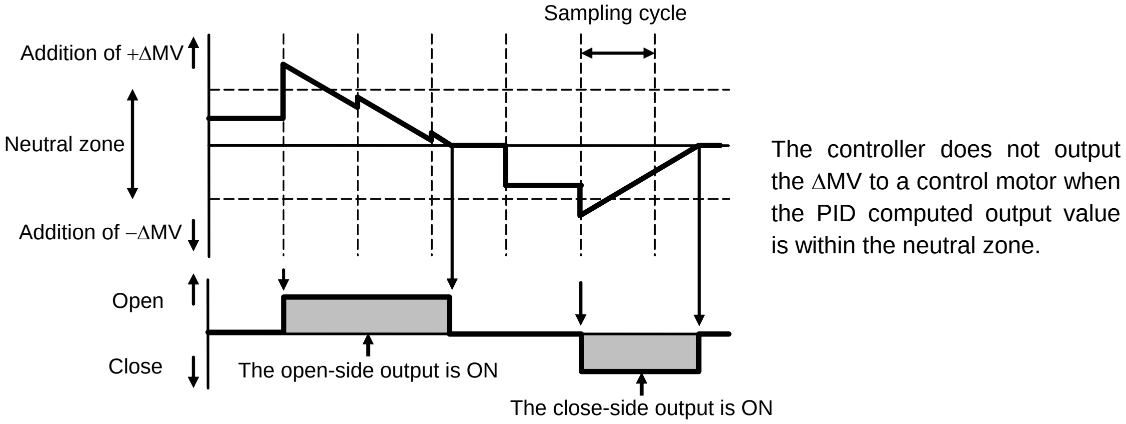
Step	Description
Set the Action at feedback resistance (FBR) input error	Set the Action at feedback resistance (FBR) input error. [Effective when there is a Feedback resistance (FBR) input]
Feedback adjustment	Adjust the Feedback resistance (FBR) input. [Effective when there is a Feedback resistance (FBR) input]
Set the Control motor time	Set the Control motor time required for rotation from the fully closed position to the fully opened position. [Position proportioning PID control common setting]
Set the Integrated output limiter	Set the Integrated output limiter which integrates the output and sets the output to OFF when the result reached the set value when an open-side (or close-side) output is outputted continuously. [Effective when there is not a Feedback resistance (FBR) input]
Set the valve action in Reset mode	Set the action of open-side and close-side outputs at Reset mode. [Position proportioning PID control common setting]
Action at saturated output	Set to maintain ON state for the close-side (or open-side) output when the valve position is fully closed (or opened). [Effective when there is a Feedback resistance (FBR) input]

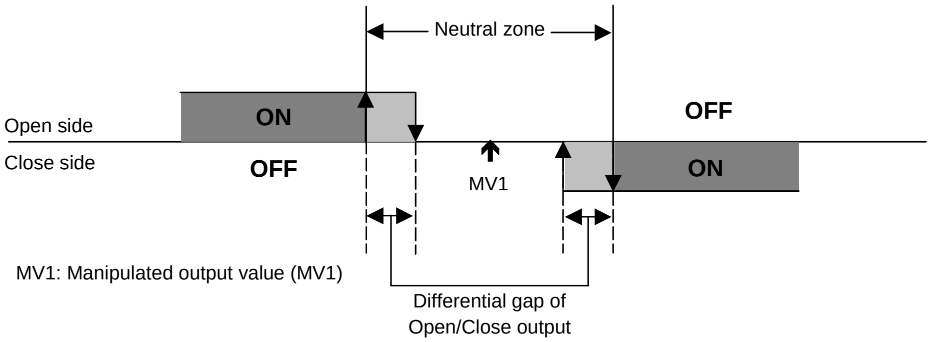
■ Description of function

● Open/Close output neutral zone

The neutral zone is used to prevent a control motor from repeating ON/OFF too frequently. When the PID computed output value is within the neutral zone, the controller will not output the MV to a control motor.



📖 Differential gap of open/close output
Differential gap is used to prevent chattering of the Open-side output and the Close-side output due to unsteady Feedback resistance (FBR) input. Differential gap of the open/close output is fixed to one-second of the neutral zone.



● Action at saturated output

Close-side (Open-side) output can remain ON when the valve is fully closed (opened).

[When the Action at saturated output is invalid]
The close-side output turns OFF when the valve position is fully closed (FBR input value ≤ 0 %). *
The open-side output turns OFF when the valve position is fully opened (FBR input value ≥ 100 %). *

[When the Action at saturated output is valid]
The close-side output remains ON when the valve position is fully closed (FBR input value ≤ 0 %). *
The open-side output remains ON when the valve position is fully opened (FBR input value ≥ 100 %). *

* When controlling the valve position by Output limiter, the output limiter value becomes the close-side (or the open-side) output value.

NOTE

To validate the Action at saturated output, make sure to use valve with limit switch.

📖 Refer to the Action at Feedback resistance (FBR) input error for the valve action when the FBR input is broken.

■ Parameter setting

● Open/Close output neutral zone

This screen is displayed when in Position proportioning PID control.

Parameter symbol	Data range	Factory set value
ydb	0.1 to 20.0 %	2.0

● Output limiter high (MV1)

Parameter symbol	Data range	Factory set value
oLH	Output limiter low (MV1) to 105.0 %	105.0

● Output limiter low (MV1)

Parameter symbol	Data range	Factory set value
oLL	−5.0 % to Output limiter high (MV1)	−5.0

● Manipulated output value 1 (MV1) in Reset mode

Parameter symbol	Data range	Factory set value
MV 1	−5.0 to +105.0 %	−5.0

● Control action at Pattern end

Parameter symbol	Data range	Factory set value
ENd.P	PID control or Heat/Cool PID control, Position proportioning PID control (With FBR input): 0: Control continued 1: Control stop Setting is still effective when using Output program function. Position proportioning PID control (When there is no FBR input or the FBR input is break): 0: Control continued 1: Open-side output OFF, Close-side output OFF 2: Open-side output OFF, Close-side output ON 3: Open-side output ON, Close-side output OFF	0

● Output value with AT turned on

Parameter symbol	Data range	Factory set value
AT oN	Output value with AT turned off to +105.0 % Actual output values become those restricted by the Output limiter. Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (high limit of Feedback resistance input at AT).	105.0

● Output value with AT turned off

Parameter symbol	Data range	Factory set value
AT oF	−105.0 % to Output value with AT turned on Actual output values become those restricted by the Output limiter. Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (low limit of Feedback resistance input at AT).	−105.0

● Action at feedback resistance (FBR) input error

Parameter symbol	Data range	Factory set value
YbR	0: Action depending on the Valve action at Reset mode 1: Control action continued	0

● Feedback adjustment

Feedback adjustment function is to adjust controller's output value to match the Feedback resistance (FBR) of the control motor. The adjustment have to be completed before starting operation. Always make sure that the wiring is correct and the control motor operates normally before the adjustment. In addition, if opening adjustment is performed, the control motor time is automatically computed.
If the computed time is shorter than 5 seconds, the set value will be automatically set to 5 seconds.

Parameter symbol	Data range	Factory set value
PoS	AdJ: Adjustment end oPEN: During adjustment on the open-side CLoSE: During adjustment on the close-side	AdJ

● Control motor time

Parameter symbol	Data range	Factory set value
MoT	5 to 1000 seconds	10

● Integrated output limiter

This is a restricted value when the output on the open or closed side is integrated.
If the output on the open (or closed) side is output in succession, it is integrated and if the result reaches the Integrated output limiter value, the output on the open (or closed) side is turned off.
In addition, if the output on the open (or closed) side is reversed, the integrated value is reset.

Parameter symbol	Data range	Factory set value
oLA	0.0 to 200.0 % of Control motor time 0.0: OFF Invalidate when Feedback resistance (FBR) input is selected.	150.0

● Valve action in Reset mode

Select the valve action when Feedback resistance (FBR) input is disabled or "0 (Action depending on the Valve action at Reset mode)" is set for the action when a Feedback resistance (FBR) input break occurs.

Parameter symbol	Data range	Factory set value
VAL	0: Open-side output OFF, Close-side output OFF 1: Open-side output OFF, Close-side output ON 2: Open-side output ON, Close-side output OFF Invalidate when Feedback resistance (FBR) input is selected.	0

● Action at saturated output

Set to maintain ON state for the close-side (or open-side) output when the valve position is fully closed (or opened).

Parameter symbol	Data range	Factory set value
YASo	0: Invalidate (The close-side [or open-side] output turns to OFF when the valve position is fully closed [or opened]). 1: Validate (The close-side [or open-side] output remains ON state when the valve position is fully closed [or opened]).	0

NOTE

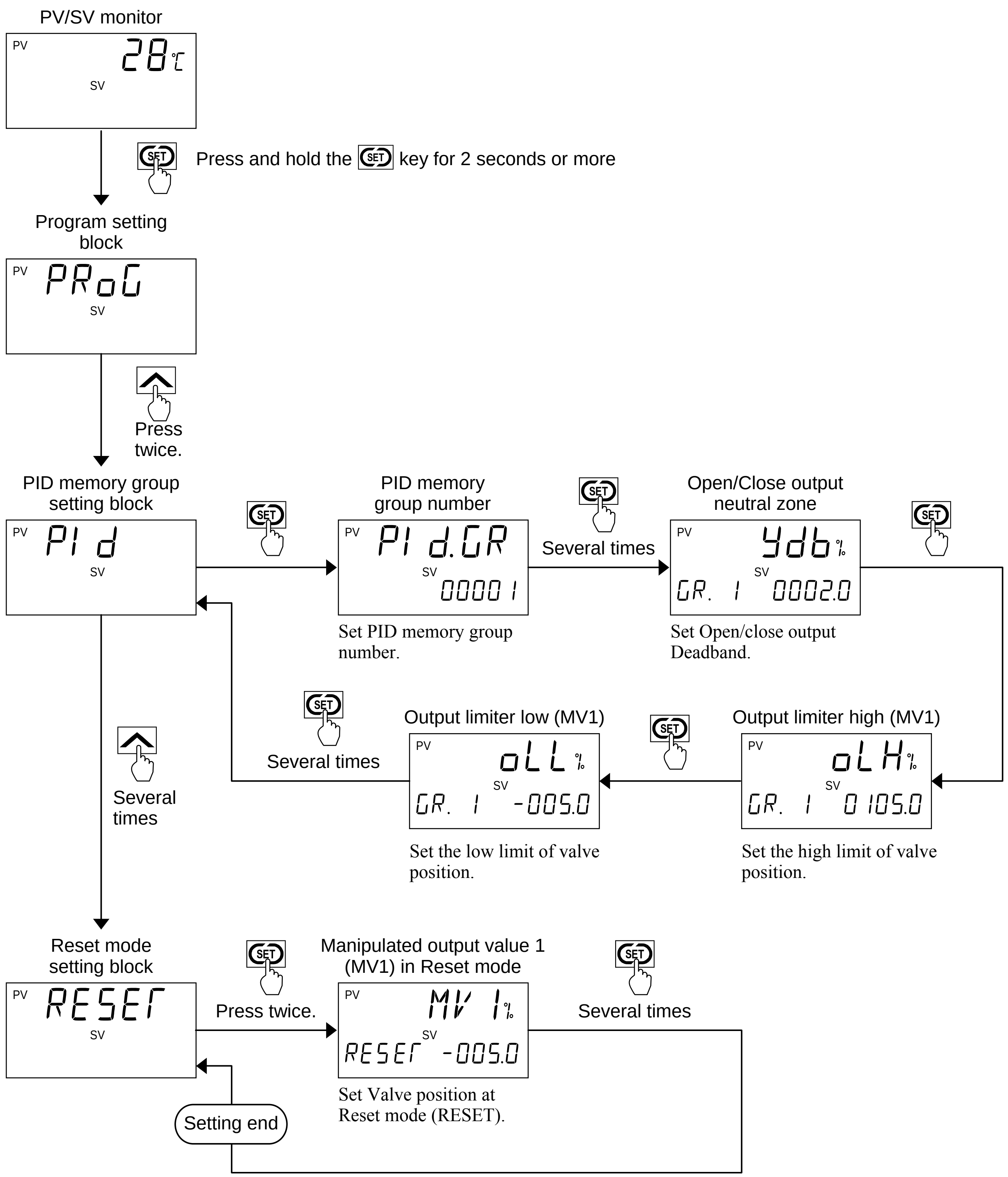
To validate the Action at saturated output, make sure to use valve with limit switch.

Refer to the Action at Feedback resistance (FBR) input error for the valve action when the FBR input is broken.

■ Setting procedure

When there is a Feedback resistance (FBR) input

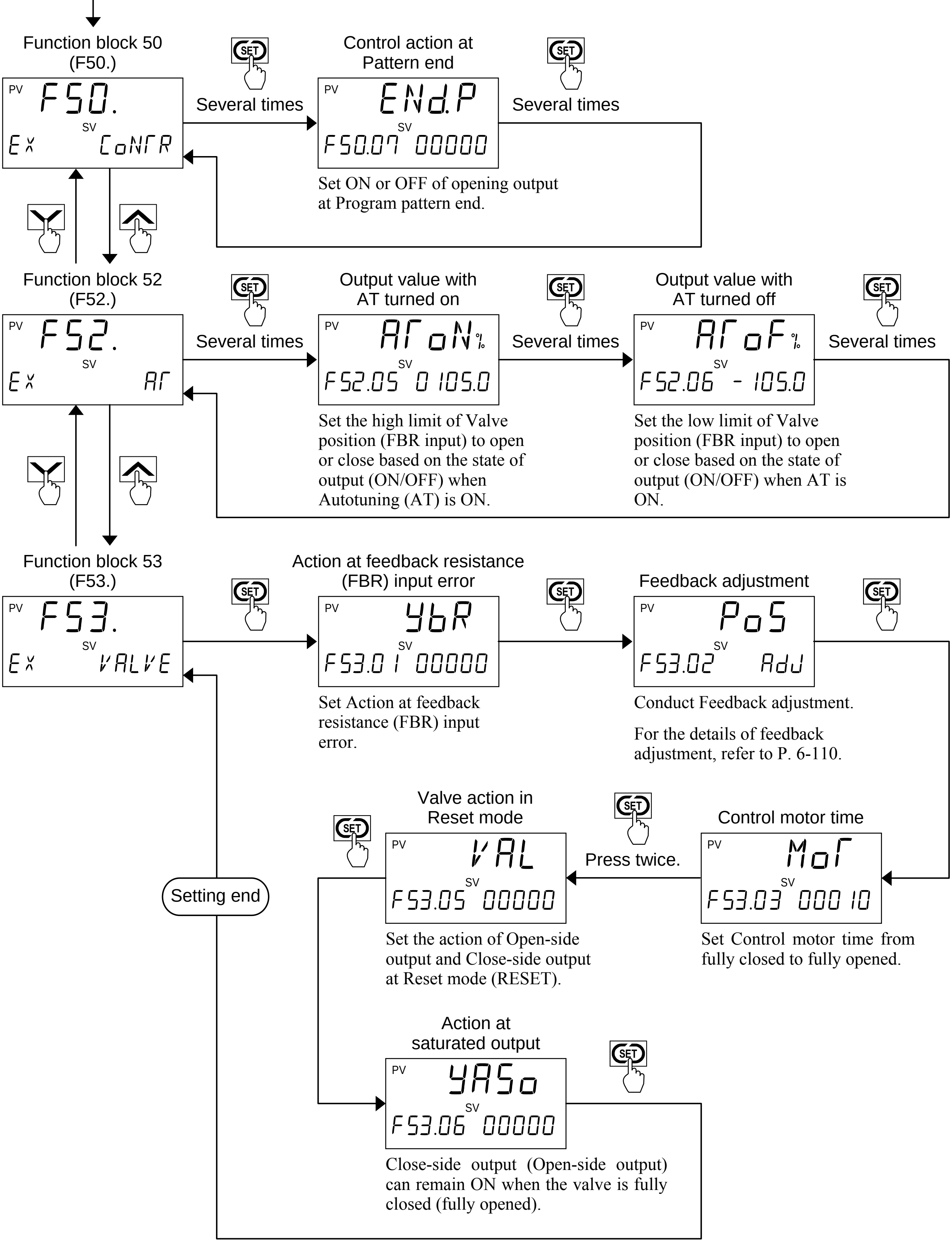
● Parameter setting in the Parameter setting mode (Partial setting type)



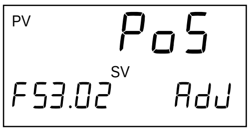
Go to the next page and set parameters in the Initial level engineering mode.

● Parameter setting in the Initial level engineering mode

1. Press the RESET key to go to the Reset mode (RESET).
2. Press and hold the SET key, the MODE key and the DOWN key for 2 seconds or more to go to the Initial level engineering mode.
3. Keep pressing the UP key until the F50 screen displays.



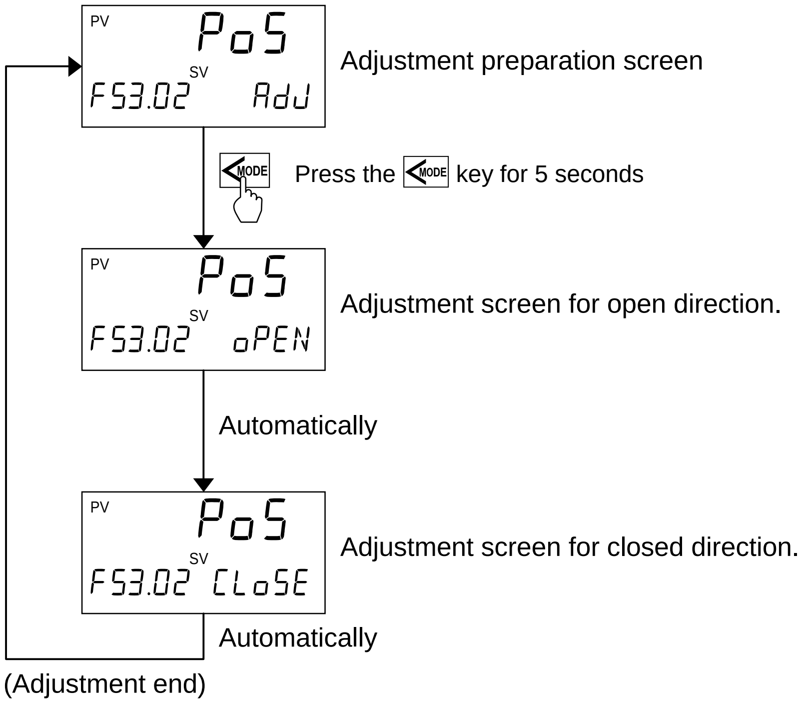
Feedback adjustment



Adjust the Feedback resistance (FBR) input.

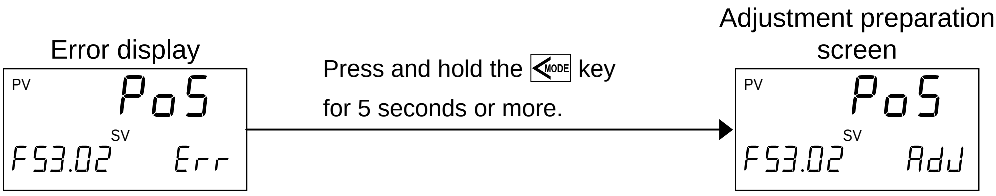
After the adjustment, the Manipulated output value from 0 to 100 % obtained after PID computation matches the valve position signal of the fully closed position to the fully opened position [Feedback resistance (FBR) input] sent from the control motor.

At the adjustment preparation screen, press and hold the MODE key for 5 seconds to start the adjustment. The display automatically return to the adjustment preparation screen after the adjustment is completed.



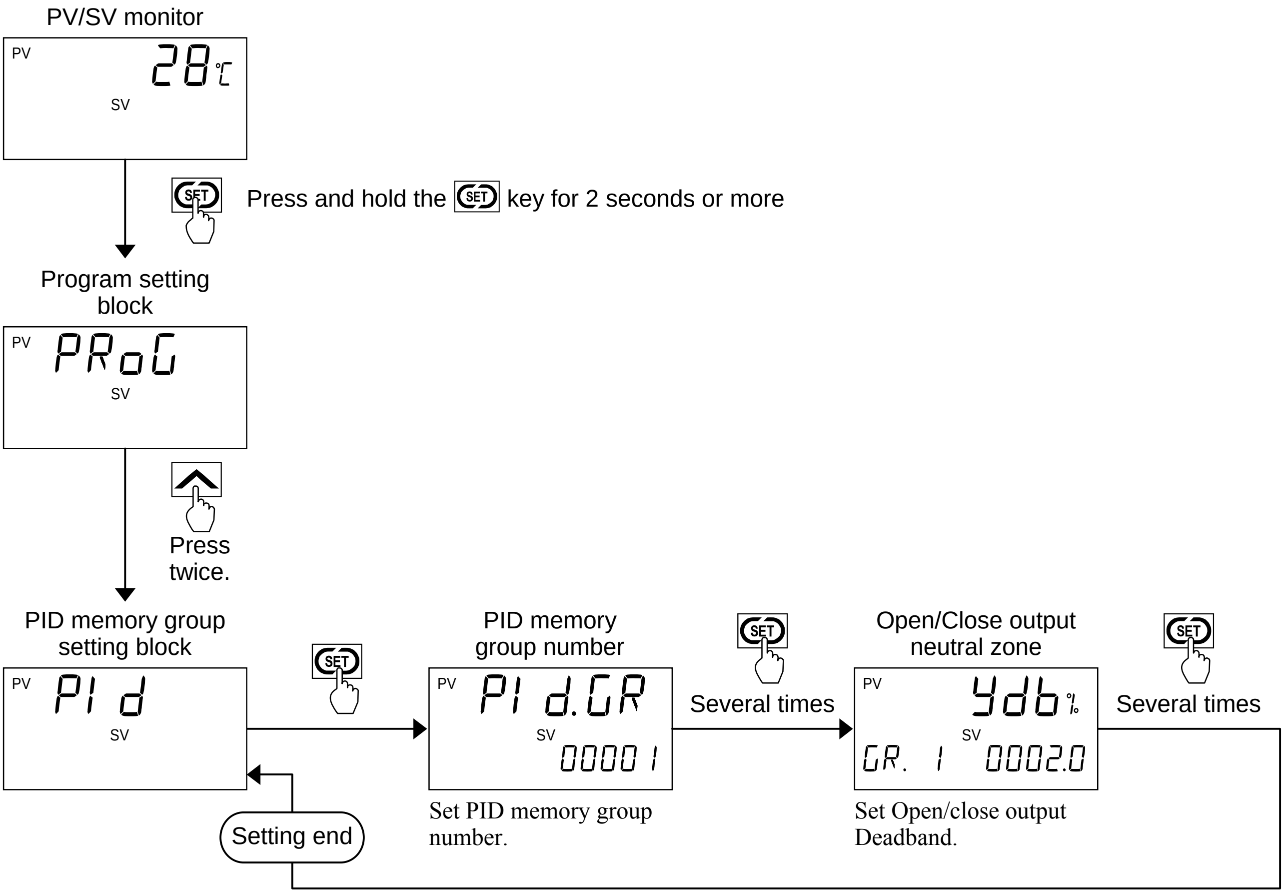
- During Feedback adjustment, the display does not return to PV/SV monitor.
- Feedback adjustment can be started by pressing the MODE key for 5 seconds in the Engineering mode when the operation mode is in the Reset mode (RESET).
- An error occurs in Feedback adjustment if
  - Feedback resistance (FBR) input is not connected.
  - Wiring of Feedback resistance (FBR) input is incorrect.
  - Wiring of Feedback resistance (FBR) input breaks.
  - The valve movement from fully closed to fully opened is completed less than 50%.
  - Feedback adjustment time exceeds 1000 seconds.

  When an error occurs, "Err" will be displayed on the SV display. To return to adjustment preparation display, press and hold MODE key for 5 seconds or more.



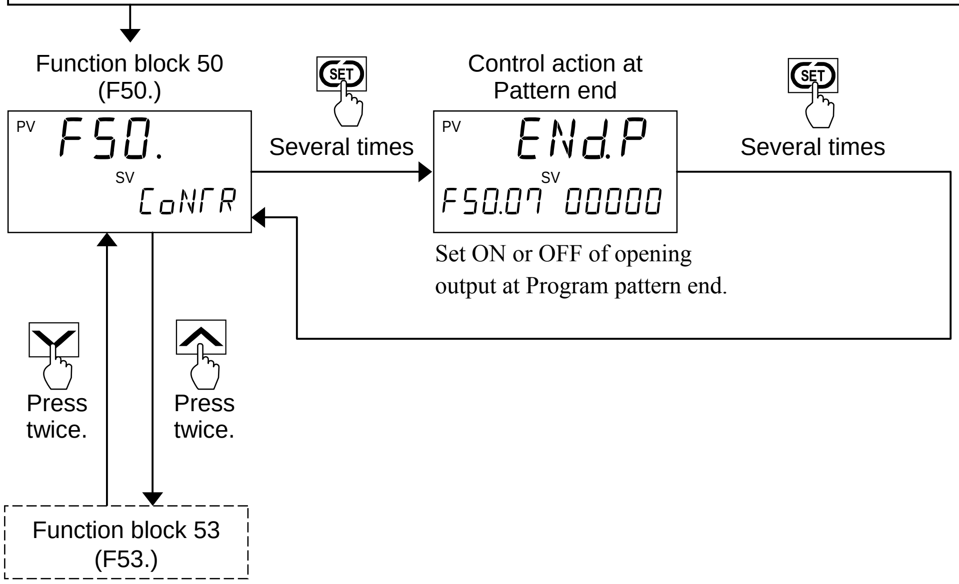
When there is no Feedback resistance (FBR) input

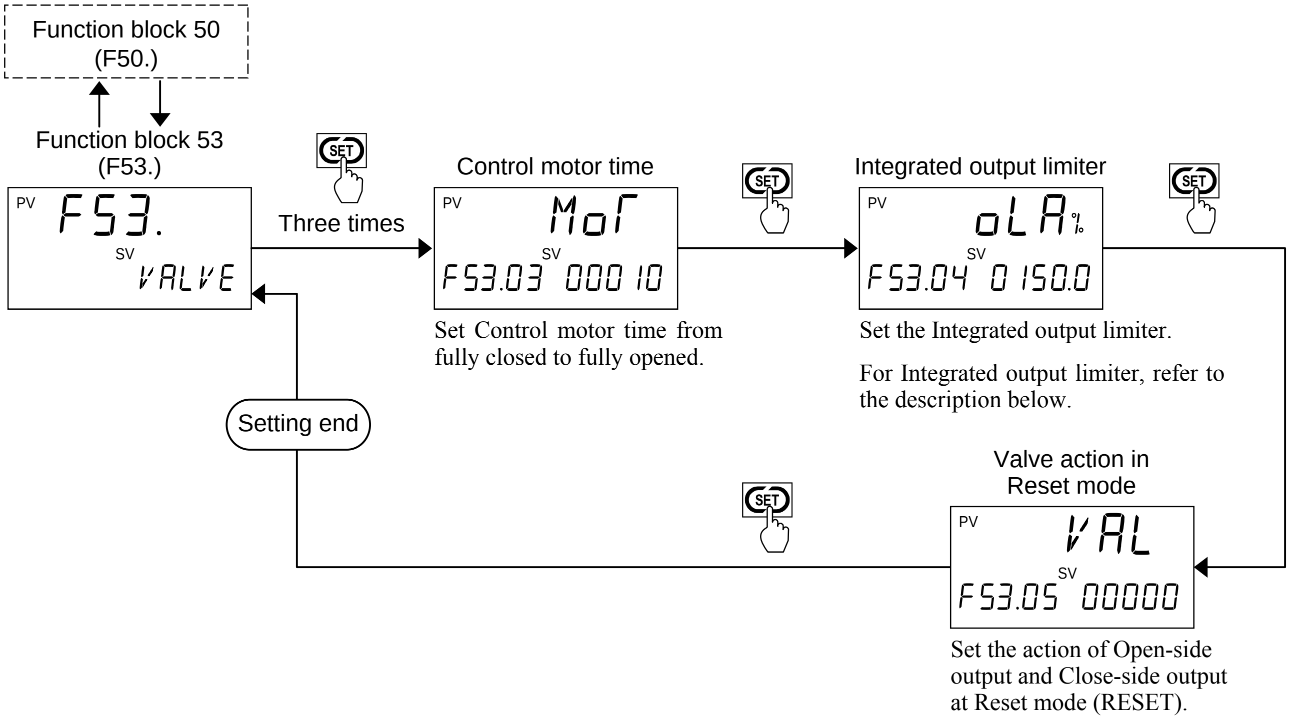
● Parameter setting in the Parameter setting mode (Partial setting type)



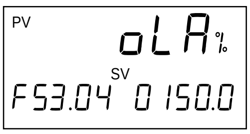
● Parameter setting in the Engineering mode

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ▲ key until the F50 screen displays.





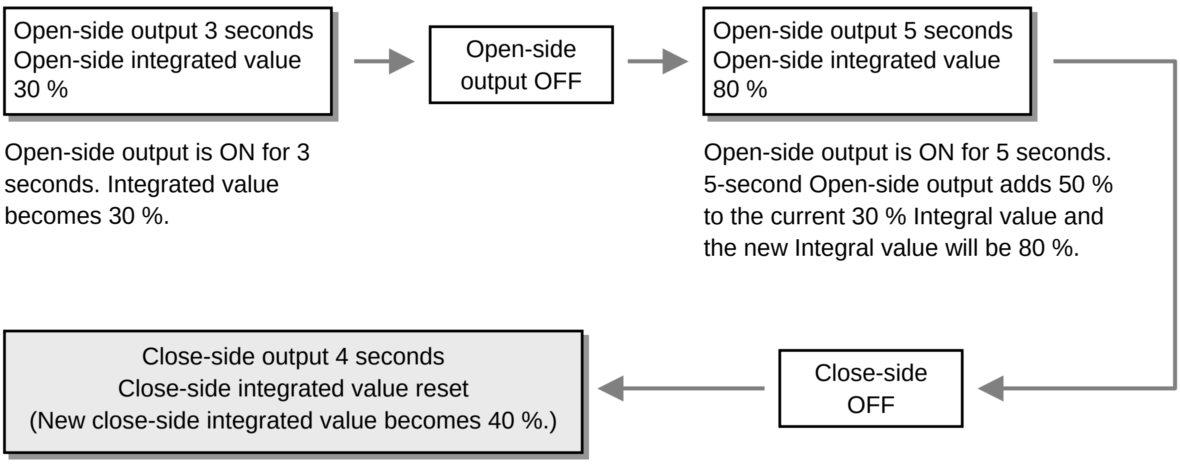
Integrated output limiter



Set the Integrated output limiter which integrates the output and sets the output to OFF when the result reached the set value when an open-side (or close-side) output is outputted continuously.

Since the output is integrated when the open-side (or close-side) output is outputted continuously, once the inverted output is outputted, the integrated value is reset.

Example: If control is started at the fully closed state when the Control motor time is set at 10 seconds and the Integrated output limiter value is set at 100 %, the following results.

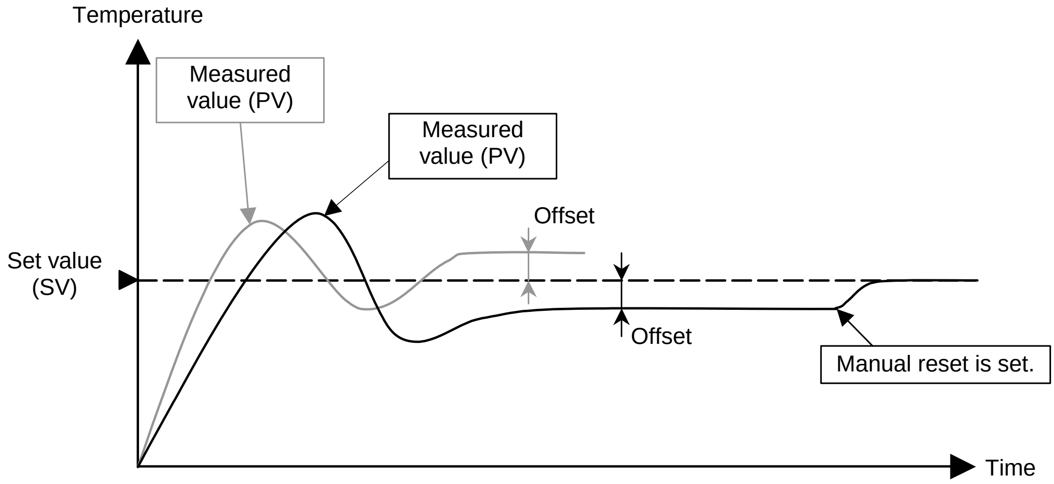


When turning ON the Close-side output for 4 seconds, Open-side Integral value is reset to 0 % and Close-side Integral value becomes 40 %.

6.5.4 Manual reset

This is the function used to manually correct the offset when in Proportional (P) control or PD control.
Offset means the deviation of the actual when the Manipulated output value becomes stabilized (stable state).
If the Manual reset value varies, the Manipulated output value also changes.

Fixed set point control mode:



■ Parameter setting

● Manual reset

In order to eliminate the offset occurring in Proportional (P) control, the Manipulated output value is manually corrected.
Set Manual reset value to cancel the difference between PV and SV by checking PV and SV at the PV/SV monitor. Manipulated output value can be checked at Manipulated output value 1 (MV1) [Heat-side] monitor or Manipulated output value 2 (MV2) [Cool-side] monitor.

Manual reset is displayed when Integral time [Heat-side] or Integral time [Cool-side] is set to 0 (0.0).

When the Manual reset is set to the plus (+) side:

The Manipulated output value* under the stable condition increases by the Manual reset value.

When the Manual reset is set to the minus (–) side:

The Manipulated output value* under the stable condition decreases by the Manual reset value.

* Manipulated output value at soak segment in the Program control mode

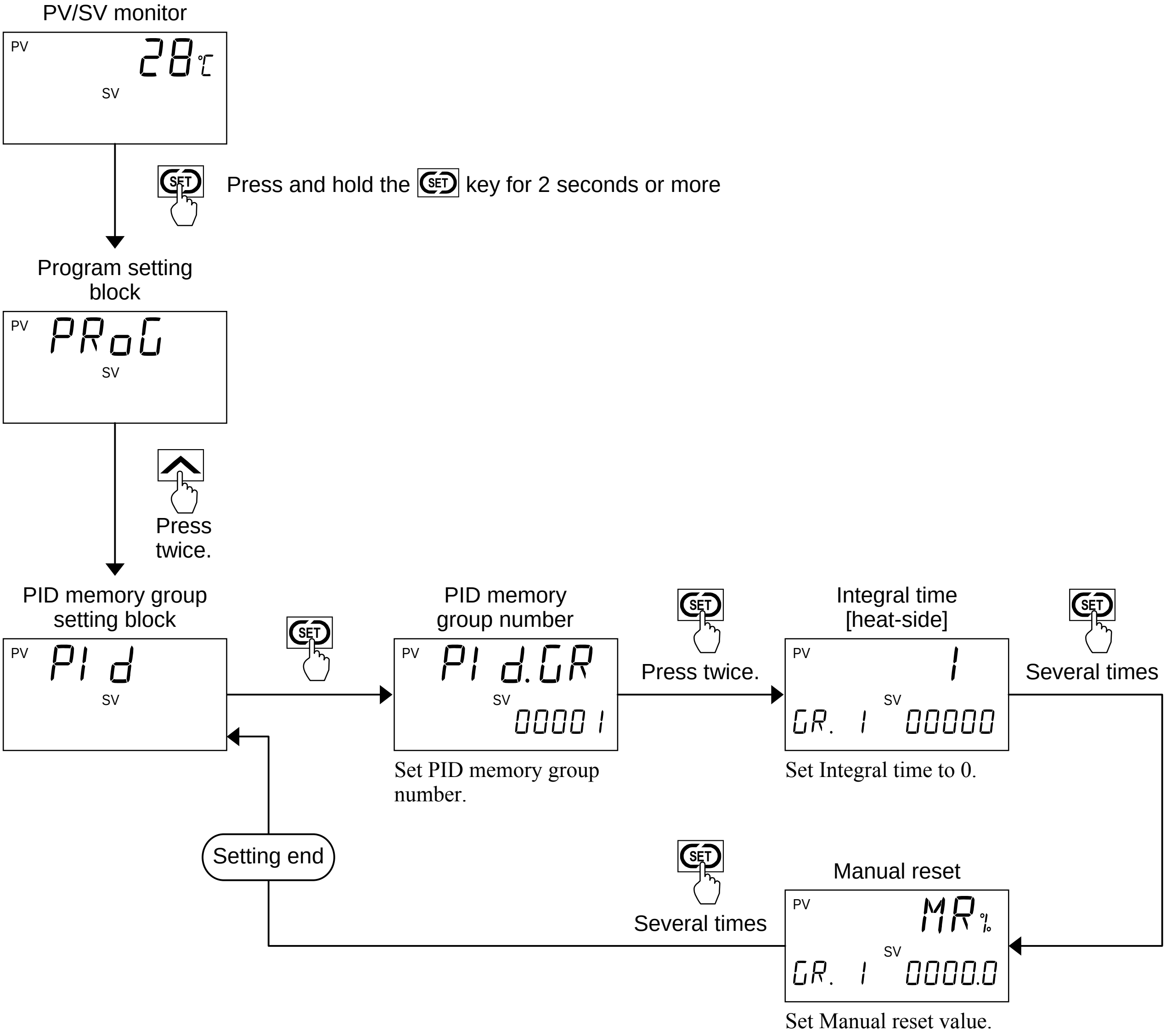
Parameter symbol	Data range	Factory set value
MR	−100.0 to +100.0 %	0.0

■ Setting procedure

For Manual reset, go to the Parameter setting mode (PID memory group setting block).

● Parameter setting in the Parameter setting mode (Partial setting type)

Example: When the control action is the PID control



6.5.5 Start action at recovering power failure

When restarting following a power failure (power OFF from ON), the start action can be selected by the following parameters:

– Hot/Cold start
– Start determination point

■ Description of function

● Hot/Cold start

The operation of this instrument is not affected by a power failure of 20 ms or less. The control start mode at power recovery after more than 20 ms power failure can be selected as follows.

Action when power failure recovers	Operation mode when power failure recovers	Output value when power failure recovers	
Hot start 1	Same as that before power failure	Near the output value before power failure occurs	
Hot start 2	Same as that before power failure	Reset mode	Computed control output value [1]
		Program control mode	
		Fixed set point control mode	
		Manual control mode	Output limiter low [2]
Cold start	Manual control mode	Output limiter low [2]	
Reset start	Started in the Reset mode regardless of the Operation mode before power failure.	Manipulated output value (MV) in Reset mode [2]	

Factory set value: Hot start 1

[1] The result of control computation varies with the Control response parameter.

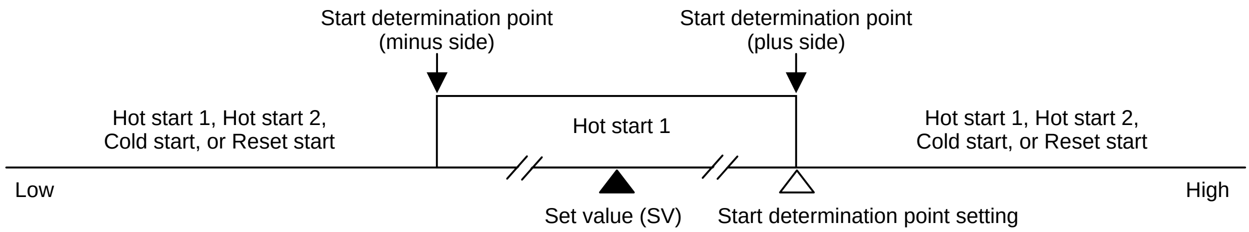
[2] If there is no Feedback resistance (FBR) input in Position proportioning PID control, the following results.

- Hot start 2 (Manual control mode): No output (no control motor is driven)
- Cold start: No output (no control motor is driven)
- Reset start: In accordance with the setting of Valve action in Reset mode.

● Start determination point

In addition to Hot/Cold start, set the determination point of Hot start 1.
The Start determination point becomes the deviation setting from the Set value (SV).

The start state is determined according to the Measured value (PV) level [deviation from set value] at power recovery.
When a Measured value (PV) is between the determination points on the + (plus) and − (minus) sides, always started from Hot start 1 when recovered.
When a Measured value (PV) is out of the determination points or the Start determination point is set at “0,” operation starts from any start state selected by Hot/Cold start.



■ Parameter setting

● Hot/Cold start

Parameter symbol	Data range	Factory set value
Pd	0: Hot start 1 1: Hot start 2 2: Cold start 3: Reset start	0

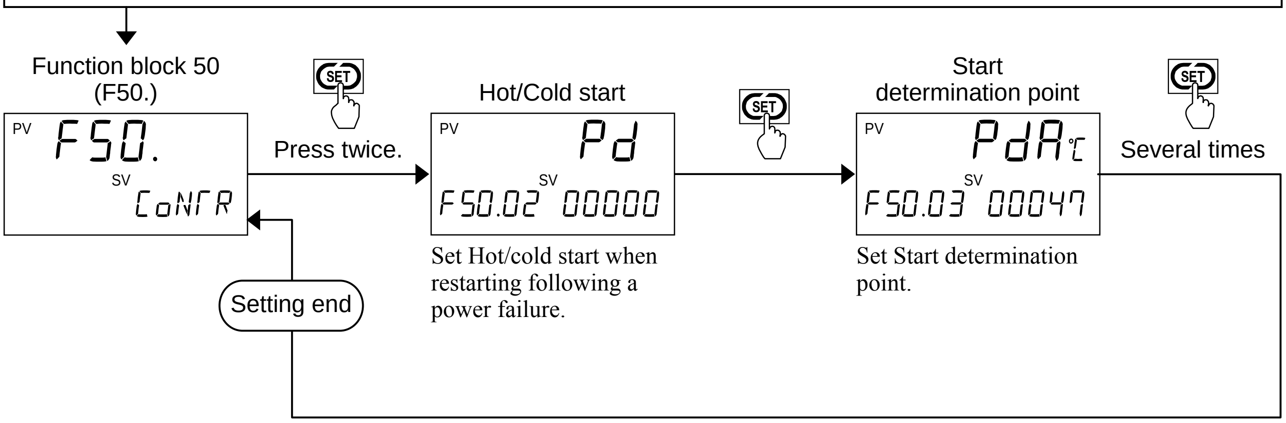
● Start determination point

Parameter symbol	Data range	Factory set value
PdA	0 to Input span (The unit is the same as input value.)	3 % of Input span

■ Setting procedure

Hot/cold start and Start determination point can be set at F50 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key until the F50 screen displays.

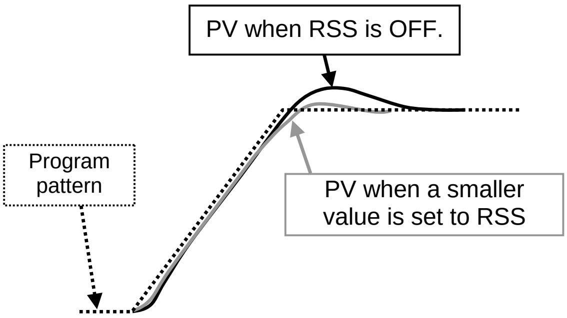


Set the following parameters if necessary:
- Output limiter low
- Manipulated output value 1 (MV1) in Reset mode
- Valve action in Reset mode (Only Position proportioning PID control)

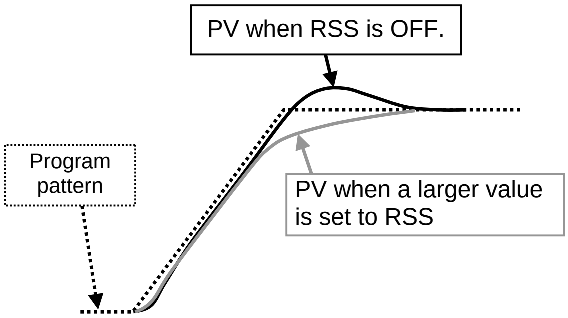
6.5.6 Ramp/Soak stabilizer function

Overshoot occurring during the transition from ramp segment to soak segment in the Program control mode can be suppressed by Ramp/Soak stabilizer function.

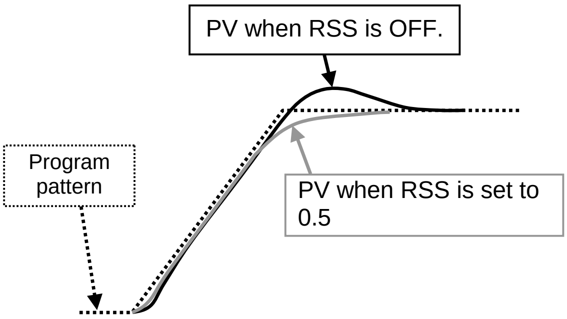
When setting a smaller value to Ramp/Soak stabilizer (RSS)



When setting a larger value to Ramp/Soak stabilizer (RSS)



When setting 0.5 to Ramp/Soak stabilizer (RSS)



When Ramp/Soak stabilizer (RSS) is ON, setting of Deviation action (d.TP) will be ignored and the Measured value derivative action will be used.

● Condition of action

– PI or PID control is used.
– The operation is at ramp segment in the Program control mode (RUN).

■ Parameter setting

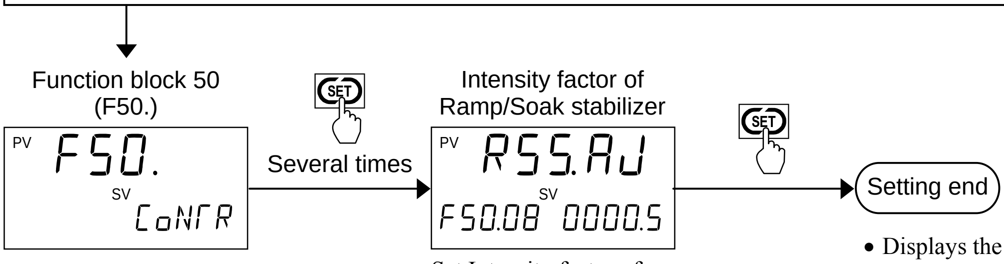
● Intensity factor of Ramp/Soak stabilizer

Parameter symbol	Data range	Factory set value
RSS.AJ	0.0 to 1.0 0.0: Unused	0.5

■ Setting procedure

Intensity factor of Ramp/Soak stabilizer can be set at F50.08 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the UP key until the F50 screen displays.



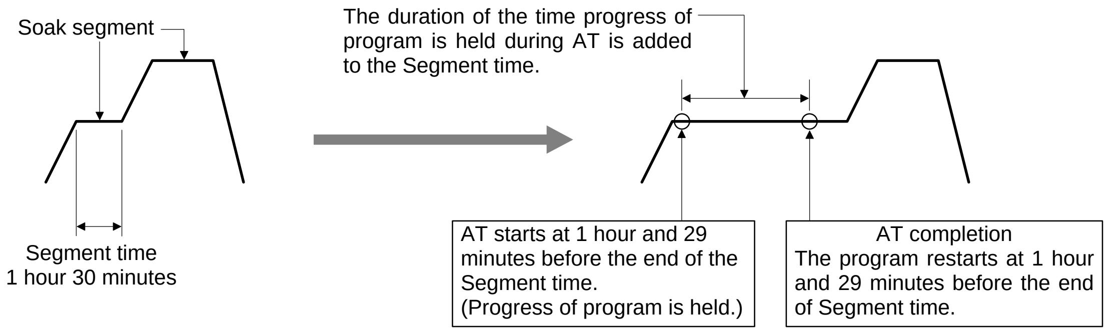
Set Intensity factor of Ramp/Soak stabilizer.

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the Function block 50 (F50).

6.5.7 Autotuning (AT)

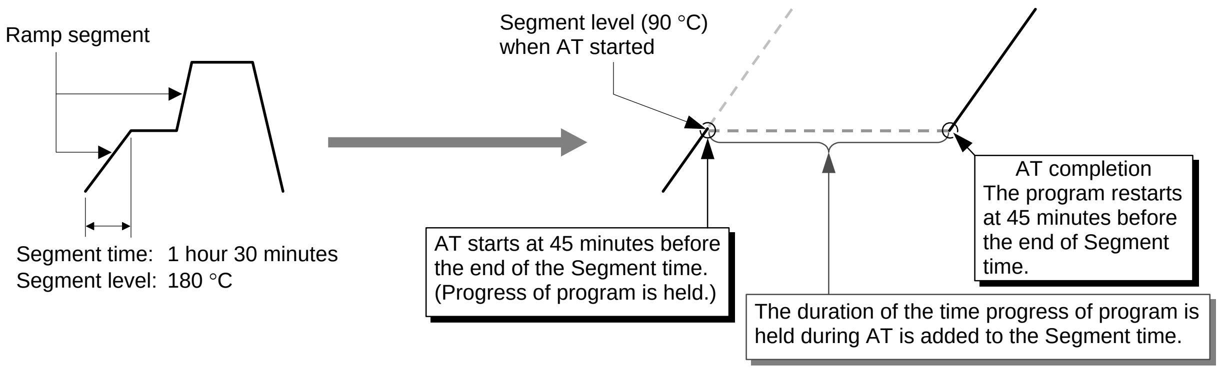
The Autotuning (AT) function automatically measures, computes and sets the optimum PID values.
The AT can be used for PID control (Direct/Reverse action), Heat/Cool PID control, and Position proportioning PID control (Direct/Reverse action).
AT can be activated when the operation is in the Program control mode (RUN) or the Fixed set point control mode. During AT, progress of the program is held automatically. When AT is finished, the program will restart automatically.

- **When conduct AT at a soak segment**



- **When conduct AT at a ramp segment**

AT activates at the Segment level where AT starts when conducting AT at a ramp segment.
During AT, progress of the program is held automatically.
When AT is finished, the program will restart automatically.



■ Segment PID and Level PID

PID values of Level PID and Segment PID can be calculated by AT.
(Factory set value: Level PID)

- **Level PID**

PID values to be used for Control are set based on the divided ranges of input range by Level PID.

☞ For details of Level PID, refer to the **6.5.9 Level PID (P. 6-135)**.

- **Segment PID**

PID values to be used for Control are set based on segments of the Program pattern by Segment PID. Up to 8 sets of PID values can be set for segments. PID memory group from 1 to 8 must be set for the segments before conducting AT.

■ Operation procedure [When conducting regular Autotuning (AT) by Segment PID]

Step	Description
Switch to the Reset mode (RESET).	Press the RESET key to go to the Reset mode (RESET).
Set Segment PID.	Set PID memory group to each segment in the program pattern. Refer to ■ **Setting example of program pattern (P. 5-14)**.
Set parameters related to AT.	Refer to ■ **Parameter setting (P. 6-125)**. Refer to ■ **Setting procedure (P. 6-127)**.
Confirm AT start condition.	Refer to ■ **Requirements for AT start (P. 6-121)**.
Select Program pattern.	Select Program pattern to conduct AT. Refer to ● **Execution pattern selection (P. 5-21)**.
Start control.	Switch to the operation mode to conduct AT. In Program control mode (RUN): Press the RUN key. In Fixed set point control mode (FIX): Press the FIX key.
Wait until the Measured value (PV) reaches the temperature of the segment to conduct AT.	In Program control mode (RUN): Wait until the Measured value (PV) reaches the temperature of the segment to conduct AT. In Fixed set point control mode (FIX): Wait until the Measured value (PV) reaches the temperature to conduct AT.
Start Autotuning.	To start Autotuning (AT), refer to ■ **Setting procedure (P. 6-127)**.
AT end	
Confirm PID values.	Confirm the PID values computed by Autotuning. If PID values are not correct for the application, adjust the values manually.

■ Caution for using the Autotuning (AT)

- The factory default of the PID memory group number of each segment is set to 0 (Level PID). To use Segment PID, change PID memory group number of each segment to 1 to 8 before 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 start

Start the AT when all following conditions are satisfied:
To start AT, go to PID/AT transfer [ATU] in Operation mode.

Operation mode state	Operation mode transfer	Program control mode or Fixed set point control mode
	PID/AT transfer	PID control (State before starting AT)
Parameter setting		**PID control, Position proportioning PID control:** ・Output limiter high (MV1) ≥ 0.1 %, Output limiter low (MV1) ≤ 99.9 % ・Output value with AT turned on ≥ 0.1 %, Output value with AT turned off ≤ 99.9 %
		Heat/Cool PID control: ・Output limiter high (MV1) ≥ 0.1 %, Output limiter low (MV1) ≤ 99.9 % ・Output limiter high (MV2) ≥ 0.1 %, Output limiter low (MV2) ≤ 99.9 % ・Output value with AT turned on ≥ +0.1 %, Output value with AT turned off ≤ −0.1 %
Input value state		The Measured value (PV) is not underscale or over-scale.
		Input error determination point (high) ≥ Measured value (PV) ≥ Input error determination point (low)

■ Requirements for AT cancellation

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

When the Operation mode is transferred	When the operation mode is changed to the Reset mode (RESET).
	When AT is conducted in the Program control mode (RUN): When switching to the Fixed set point control mode (FIX) or the Manual control mode (MAN) When AT is conducted in the Fixed set point control mode (FIX): When switching to the Program control mode (RUN) or the Manual control mode (MAN)
	When the PID/AT transfer is changed to the PID control.
When the parameter is changed	When changing Segment level or Set value (SV)
	When the PV bias, the PV digital filter, or the PV ratio is changed.
	When changing Output limiter high or low
	When performing Step function
When the input value becomes abnormal	When the Measured value (PV) goes to underscale or over-scale.
	When the Measured value (PV) goes to input error range. (Measured value (PV) ≥ Input error determination point (high) or Input error determination point (low) ≥ Measured value (PV))
When the AT exceeded the execution time	When the AT does not end in nine hours after AT started
Power failure	When the power failure of more than 20 ms occurs.
Instrument error	When the instrument is in the FAIL state.

■ Where to store computed PID value by regular Autotuning (AT) (For Segment PID)

For Program control mode (RUN):

AT-computed PID values are stored in PID memory group being set for each segment.

For Fixed set point control mode (FIX):

AT-computed PID values are stored in PID memory group being set by PID memory group number [PId. GR] in the Fixed set point control mode (FIX).

■ Parameters related to AT

Parameters for AT are provided to compute the PID values suitable for various controlled systems and control actions. Set them, as required. Parameters related to AT can be set in the Engineering mode or the Initial level engineering mode.

Example 1: When you want to find each constant suited for P control, PI control, or PD control by AT.

For P control:
Set “0” to Integral time limiter (high) [heat-side] and Derivative time limiter (high) [heat-side].

For PI control:
Set “0” to Derivative time limiter (high) [heat-side].

For PD control:
Set “0” to Integral time limiter (high) [heat-side].

When AT is executed by making the settings above, the control constants suited for P, PI, or PD control are found.

Also corresponds to Heat/Cool PID control cool-side and Position proportioning control.

Example 2: When you want to limit on/off output only at AT

AT that limits the ON/OFF output values only at AT can be executed by setting the output value with AT turned on and the output value with AT turned off.

Only when the Feedback resistance (FBR) input is connected in the Position proportioning control, the “Output value with AT turned on” and “Output value with AT turned off” setting becomes valid.

Parameters to be used with the factory set values

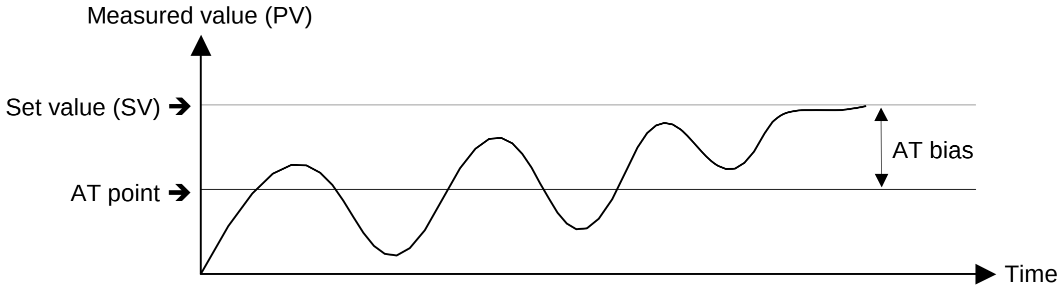
Do not change the set values of the following parameters at F50.15 to F52.25 in the Initial level engineering mode. To avoid poor control or undesired action, use the factory set values.

- Proportional band adjusting factor [heat-side]
- Integral time adjusting factor [heat-side]
- Derivative time adjusting factor [heat-side]
- Proportional band adjusting factor [cool-side]
- Integral time adjusting factor [cool-side]
- Derivative time adjusting factor [cool-side]

● AT bias

The AT bias is used to prevent overshoot during Autotuning (AT) in the application which does not allow overshoot even during AT. RKC AT method uses ON/OFF control at the set value to compute the PID values. However, if overshoot is a concern during AT, the desired AT bias should be set to lower the set point during AT so that overshoot is prevented.

Example: When AT bias is set to the minus (–) side.



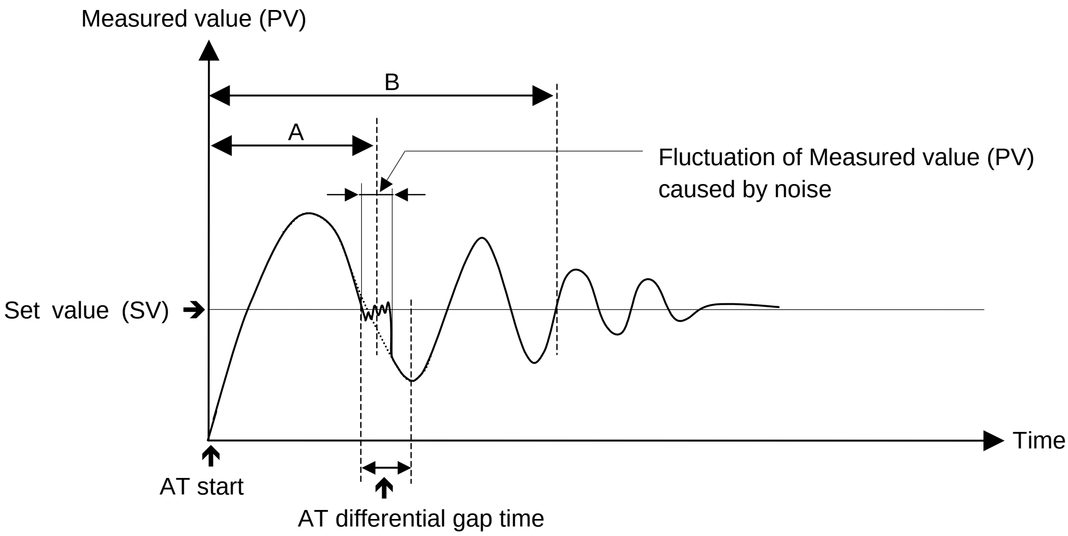
● AT differential gap time

In order to prevent the output from chattering due to the fluctuation of a Measured value (PV) caused by noise during AT, the output on or off state is held until “AT differential gap time” has passed after the output on/off state is changed to the other.
Set “AT differential gap time” to “1/100 × Time required for temperature rise.”

Example:

A: AT cycle time when the AT differential gap time is set to 0.0 second
The output chatters due to the fluctuation of the Measured value (PV) caused by noise, and AT function is not able to monitor appropriate cycles to compute suitable PID values.

B: AT cycle time when the AT differential gap time is set to “Time corresponding to 0.25 cycles.”
The fluctuation of a Measured value (PV) caused by noise is ignored and as a result AT function is able to monitor appropriate cycles to compute suitable PID values.



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

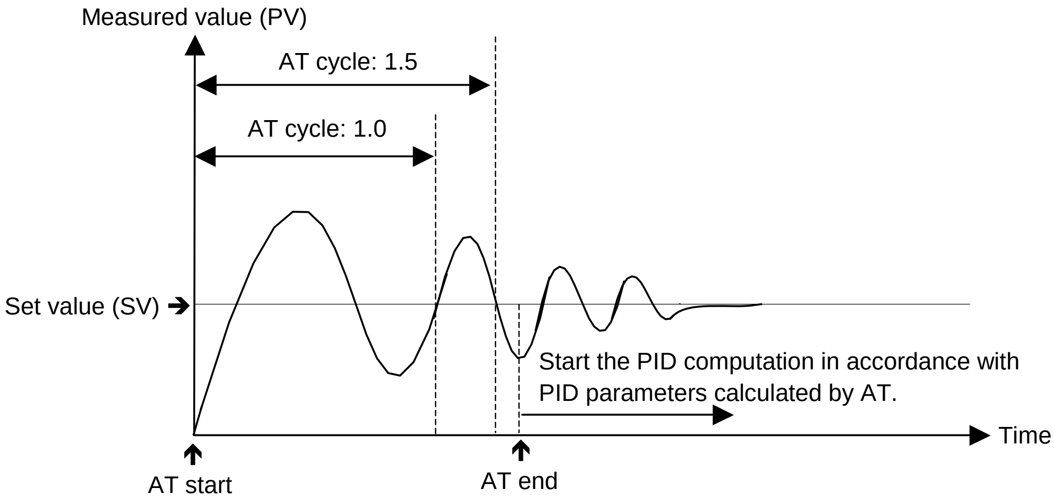
● AT time signal action

For the AT time signal action, refer to the ● **Time signal (Segment signal) during AT (P. 6-175)**.

● AT cycles

AT cycle is the number of cycle in ON/OFF at conducting Autotuning (AT).

Example: When the AT cycle is set to 1.5 cycle and the AT function is executed just after the power is turned on.



● Output value with AT turned on/Output value with AT turned off

Output value with AT turned on:

Manipulated output value when output is ON during AT or AT with learning function.

Output value with AT turned off:

Manipulated output value when output is OFF during AT or AT with learning function.

The actual output value becomes the value restricted by the output limiter.

Plus (+)/minus (–) setting when in Heat/Cool PID control

- When Output value with AT turned on is set to a plus side (+), Manipulated output value 1 (MV1) [heat-side] at ON and OFF will be as described below.

  Output value of Manipulated output value 1(MV1) [heat-side] at ON = Output value with AT turned on
  Output value of Manipulated output value 1(MV1) [heat-side] at OFF = Output limiter low (MV1)

- When Output value with AT turned off is set to a minus side (-), Manipulated output value 2 (MV2) [cool-side] at ON and OFF will be as described below.

  Output value of Manipulated output value 2 (MV2) [cool-side] at ON = Output value with AT turned off
  Output value of Manipulated output value 2 (MV2) [cool-side] at OFF = Output limiter low (MV2)

In Position proportioning PID control, Output value with AT turned on and Output value with AT turned off is valid when Feedback resistance (FBR) input is specified and FBR input break does not occur.

Output value with AT turned on:

High limit of Feedback resistance (FBR) input at AT or AT with learning function

Output value with AT turned off:

Low limit of Feedback resistance (FBR) input at AT or AT with learning function

■ Parameter setting

● AT bias

Parameter symbol	Data range	Factory set value
ATb	–Input span to +Input span (The unit is the same as input value)	0

● AT differential gap time

Parameter symbol	Data range	Factory set value
ATHS	0.0 to 100.0 seconds	10.0

● AT time signal action

Parameter symbol	Data range	Factory set value
ATTS	0: Time signal OFF 1: Time signal ON	0

● AT cycles

Parameter symbol	Data range	Factory set value
ATC	0: 1.5 cycles 2: 2.5 cycles 1: 2.0 cycles 3: 3.0 cycles	0

● Output value with AT turned on

Parameter symbol	Data range	Factory set value
AToN	Output value with AT turned off to +105.0 % (Actual output values become those restricted by the Output limiter.) Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (high limit of Feedback resistance input at AT).	105.0

● Output value with AT turned off

Parameter symbol	Data range	Factory set value
AToF	–105.0 % to Output value with AT turned on (Actual output values become those restricted by the Output limiter.) Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (low limit of Feedback resistance input at AT).	–105.0

● Proportional band limiter (high) [heat-side]/Proportional band limiter (low) [heat-side]

The Proportional band [heat-side] range is restricted while the AT and AT with learning functions are being executed.

<table>
<tr><th>Parameter symbol</th><th>Data range</th><th>Factory set value</th></tr>
<tr><td>PLH</td><td rowspan="2">TC/RTD inputs:
0 (0.0, 0.00) to Input span (Unit: °C [°F])
Varies with the setting of the Decimal point position selection.
Voltage (V)/Current (I) inputs:
0.0 to 1000.0 % of Input span</td><td>TC/RTD: Input span
V/I: 1000.0</td></tr>
<tr><td>PLL</td><td>TC/RTD: 0
V/I: 0.0</td></tr>
</table>

● Integral time limiter (high) [heat-side]/Integral time limiter (low) [heat-side]

The Integral time limiter [heat-side] range is restricted while the Autotuning (AT) and AT with learning functions are being executed.

<table>
<tr><th>Parameter symbol</th><th>Data range</th><th>Factory set value</th></tr>
<tr><td>ILH</td><td rowspan="2">PID control or Heat/Cool PID control:
0 to 3600 seconds or 0.0 to 3600.0 seconds
Position proportioning PID control:
1 to 3600 seconds or 0.1 to 3600.0 seconds
Varies with the setting of the Integral/Derivative time decimal point position selection.</td><td>3600</td></tr>
<tr><td>ILL</td><td>PID control, Heat/Cool PID control: 0
Position proportioning PID control: 1</td></tr>
</table>

If the AT function is executed when the Integral time limiter (high) [heat-side] is set at “0” or “0.0,” P and D values suitable to PD control (heat-side) are computed (excluding the Position proportioning control).

● Derivative time limiter (high) [heat-side]/Derivative time limiter (low) [heat-side]

The Derivative time limiter [heat-side] range is restricted while the AT and AT with learning functions are being executed.

Parameter symbol	Data range	Factory set value
dLH	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
dLL		0

📖 If the AT function is executed when the Derivative time limiter (high) [heat-side] is set at “0” or “0.0,” P and I values suitable to PI control (heat-side) are computed.

● Proportional band limiter (high) [cool-side]/Proportional band limiter (low) [cool-side]

The Proportional band [cool-side] range is restricted while the AT and AT with learning functions are being executed. The Proportional band limiter (high) [cool-side] and Proportional band limiter (low) [cool-side] are valid only during Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
PcLH	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span	TC/RTD: Input span V/I: 1000.0
PcLL		TC/RTD: 1 V/I: 0.1

● Integral time limiter (high) [cool-side]/Integral time limiter (low) [cool-side]

The Integral time limiter [cool-side] range is restricted while the AT and AT with learning functions are being executed. The Integral time limiter (high) [cool-side] and Integral time limiter (low) [cool-side] are valid only during Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
IcLH	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
IcLL		0

📖 If the AT function is executed when the Integral time limiter (high) [cool-side] is set at “0” or “0.0,” P and D values suitable to PD control (cool-side) are computed.

● Derivative time limiter (high) [cool-side]/Derivative time limiter (low) [cool-side]

The Derivative time limiter [cool-side] range is restricted while the Autotuning (AT) and AT with learning functions are being executed. The Derivative time limiter (high) [cool-side] and Derivative time limiter (low) [cool-side] are valid only during Heat/Cool PID control.

Parameter symbol	Data range	Factory set value
dcLH	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
dcLL		0

📖 If the AT function is executed when the Derivative time limiter (high) [cool-side] is set at “0” or “0.0,” P and I values suitable to PI control (cool-side) are computed.

● PID/AT transfer

To set AT, set to “PID.” This allows automated calculating of proportional, integral and derivation.

Parameter symbol	Data range	Factory set value
ATU	PID: PID control AT: Autotuning (AT) start When the AT is finished, the control will automatically returns to “PID control.”	PID

■ Setting procedure

Setting parameters related to AT

- To set the following parameters, go to F52 in the Engineering mode.

AT bias	AT time signal action	Output value with AT turned on
AT differential gap time	AT cycles	Output value with AT turned off

- To set the following parameters, go to F52 in the Initial level engineering mode.

Proportional band limiter (high) [heat-side]	Proportional band limiter (high) [cool-side]
Proportional band limiter (low) [heat-side]	Proportional band limiter (low) [cool-side]
Integral time limiter (high) [heat-side]	Integral time limiter (high) [cool-side]
Integral time limiter (low) [heat-side]	Integral time limiter (low) [cool-side]
Derivative time limiter (high) [heat-side]	Derivative time limiter (high) [cool-side]
Derivative time limiter (low) [heat-side]	Derivative time limiter (low) [cool-side]

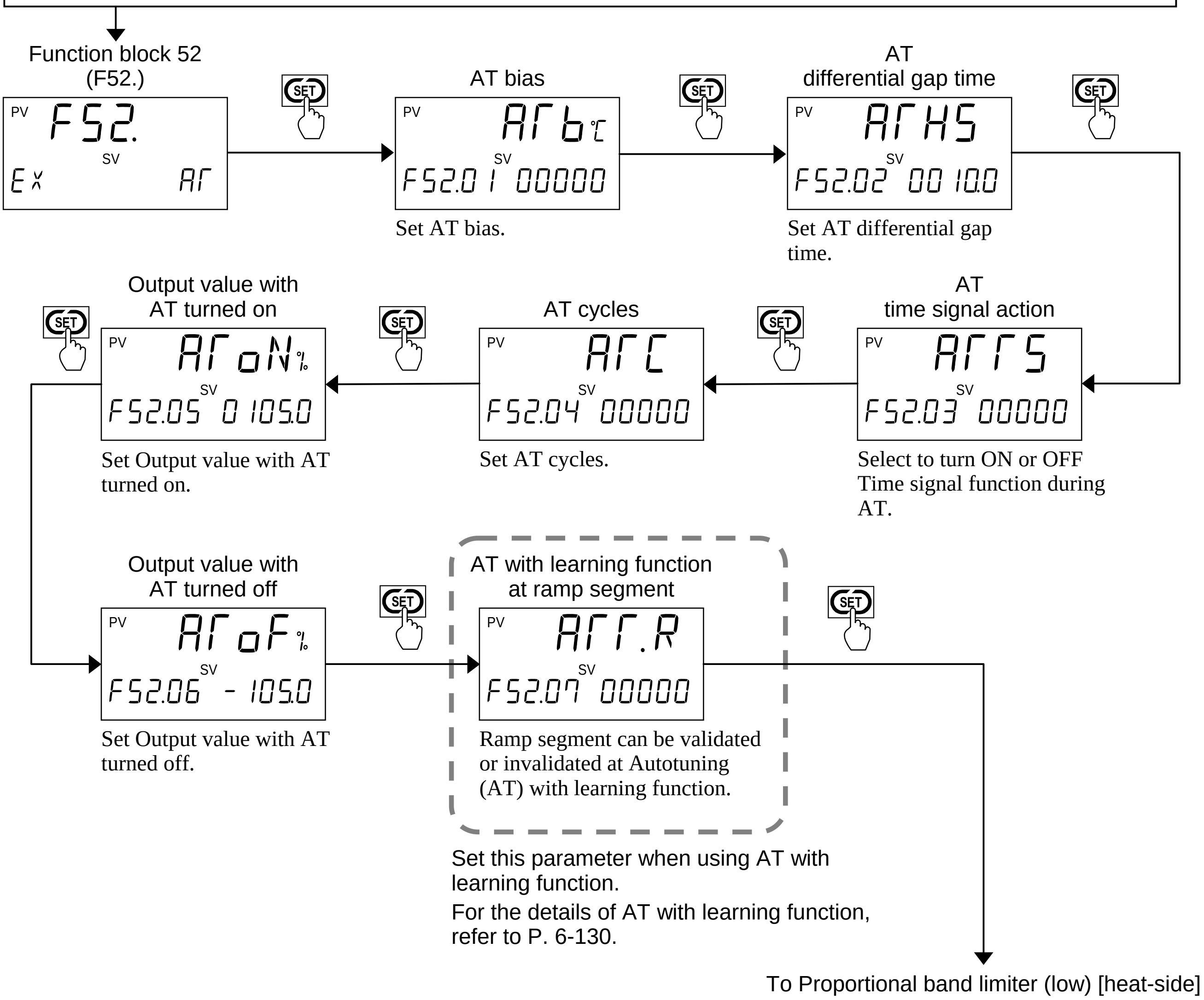
● Parameter setting in the Initial level engineering mode F52

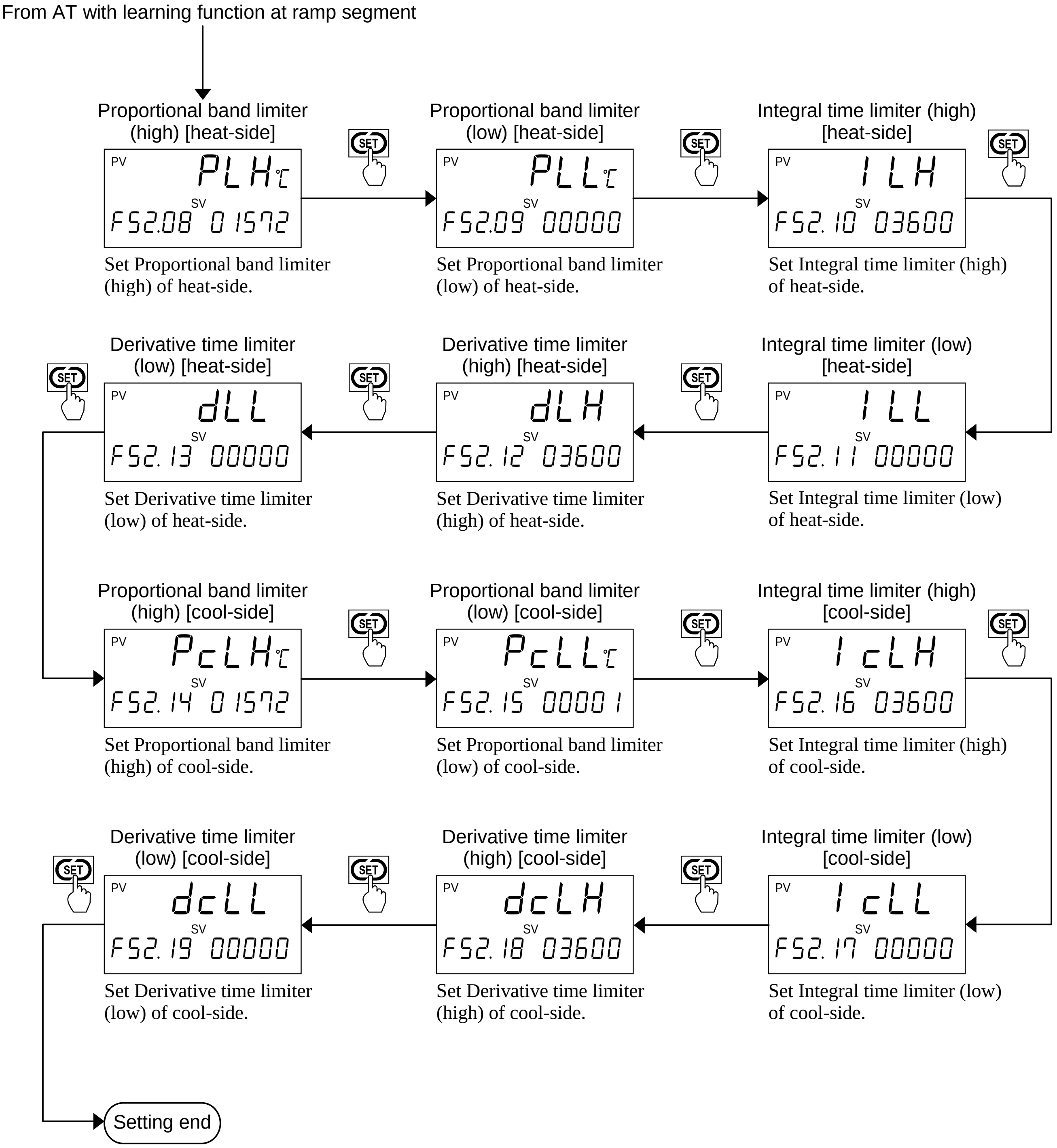
The following setting procedure is based on F52 in the Initial level engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).

2. Press and hold the SET key, the MODE key and the ∨ key for 2 seconds or more to go to the Initial level engineering mode.

3. Keep pressing the ∧ key until the F52 screen displays.





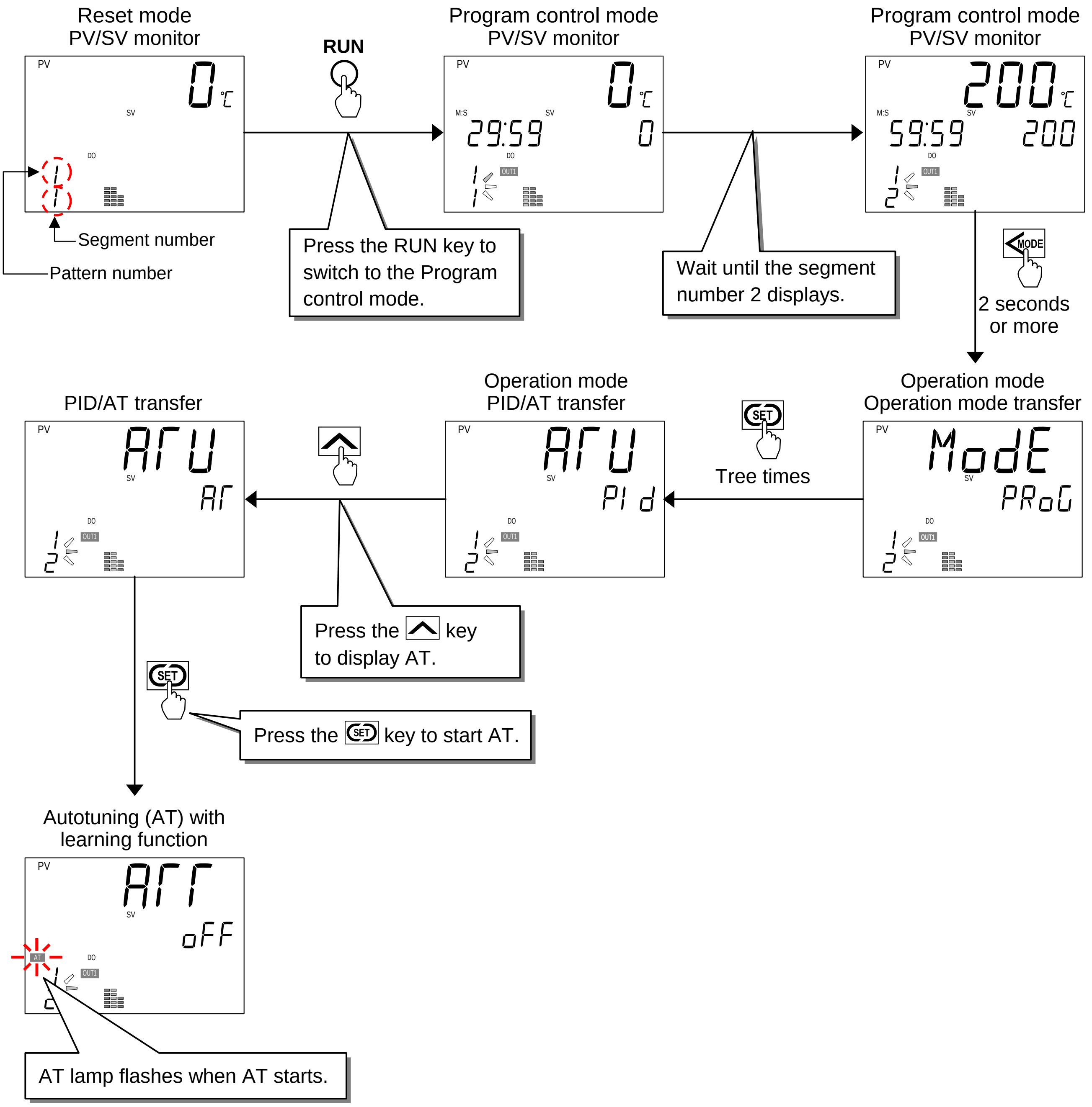
- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the Function block 52 (F52).

● Parameter setting in Operation mode

Starting Autotuning (AT)

“AT ON” or “AT OFF” can be set by Operation mode PID/AT transfer.

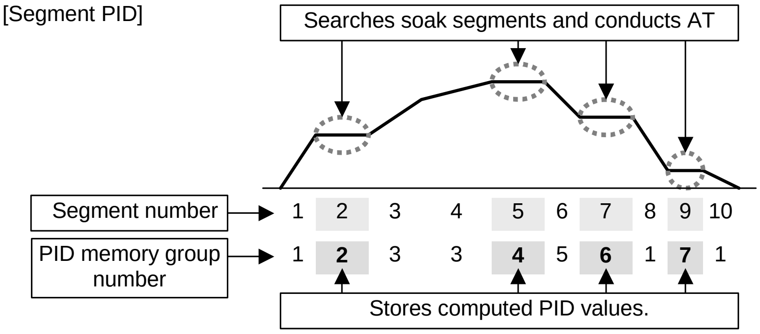
Example: When computing PID values of segment 2 (soak segment) of Program pattern 1



To conduct AT in the Fixed set control mode (FIX), press the FIX key at the PV/SV monitor screen in the Reset mode. Follow the setting procedure described above to conduct AT in the Fixed set point control mode (FIX).

6.5.8 Autotuning (AT) with learning

Autotuning (AT) is conducted to the soak segments of the Program pattern searched automatically by AT with learning function. AT with learning function can be operative when the operation is in the Reset mode (RESET) and the control method is PID control (Direct/Reverse), Heat/Cool PID control or Position proportioning PID control (Direct/Reverse).



For Ramp segment
Ramp segment can be validated or invalidated at AT with learning function.

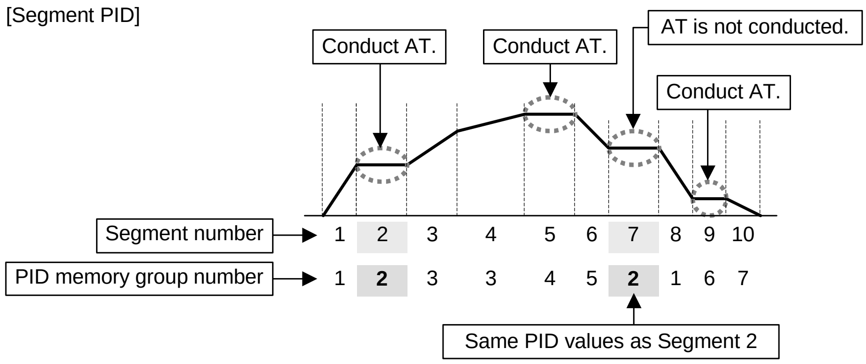
☞ Refer to ■ **Parameters related to Autotuning (AT) with learning function (P. 6-133)**.

AT with learning function can be used with both Segment PID and Level PID.

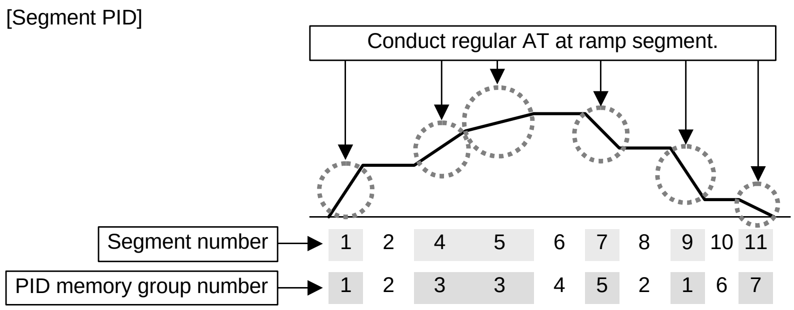
☞ For the Level PID, refer to **6.5.9 Level PID (P. 6-135)**.

■ Caution for using the AT with learning function

- When performing AT with learning function, AT will not be conducted to the PID memory group where PID values are written. If the PID values are incorrect, set proper PID value by conducting AT with learning function after changing the PID memory group number or by conducting regular AT on each segment individually.



- AT with learning function is not operative at ramp segment. To conduct AT to ramp segment, activate regular AT on each ramp segment individually.



■ Operation procedure [When conducting Autotuning (AT) with learning function by Segment PID]

Step	Description
Switch to the Reset mode (RESET).	Press the RESET key to go to the Reset mode (RESET).
↓	
Set Segment PID.	Set PID memory group to each segment in the program pattern. ☞ Refer to ■ **Setting example of program pattern (P. 5-14)**.
↓	
Set parameters related to AT.	☞ Refer to ■ **Parameter setting (P. 6-125)**. ☞ Refer to ■ **Setting procedure (P. 6-127)**.
↓	
Confirm AT start condition.	☞ Refer to ■ **Requirements for Autotuning (AT) with learning function start (P. 6-132)**.
↓	
Select Program pattern.	Select Program pattern to conduct AT with learning start. ☞ Refer to ● **Execution pattern selection (P. 5-21)**.
↓	
Start AT with learning function.	☞ Refer to ■ **Setting procedure (P. 6-134)**.
↓	
AT with learning function ends.	
↓	
Confirm PID values.	Confirm the PID values computed by AT. If PID values are are not correct for the application, adjust the values manually.
↓	
Conduct AT at ramp segment.	To compute PID values for ramp segment, conduct regular AT on each ramp segment individually. ☞ For regular AT, refer to **6.5.7 Autotuning (AT) (P. 6-119)**.

■ Requirements for Autotuning (AT) with learning function start

Start the Autotuning (AT) with learning function when all following conditions are satisfied:
To start AT with learning function, go to AT with learning function [ATT] in Operation mode.

Operation mode state	Operation mode transfer	Reset mode (RESET)
	PID/AT transfer	PID control (State before starting AT)
Parameter setting		**PID control, Position proportioning PID control:** ・Output limiter high (MV1) ≥ 0.1 %, Output limiter low (MV1) ≤ 99.9 % ・Output value with AT turned on ≥ 0.1 %, Output value with AT turned off ≤ 99.9 %
		Heat/Cool PID control: ・Output limiter high (MV1) ≥ 0.1 %, Output limiter low (MV1) ≤ 99.9 % ・Output limiter high (MV2) ≥ 0.1 %, Output limiter low (MV2) ≤ 99.9 % ・Output value with AT turned on ≥ +0.1 %, Output value with AT turned off ≤ −0.1 %
Input value state		The Measured value (PV) is not underscale or over-scale.
		Input error determination point (high) ≥ Measured value (PV) ≥ Input error determination point (low)

■ Requirements for AT with learning function cancellation

AT with learning function is canceled and the operation mode will be switched to the Reset mode (RESET) when the following conditions occur. The PID values before conducting AT with learning function remains.

When the Operation mode is transferred	When the operation mode is changed to the Program control mode, Fixed set point control mode or Manual control mode.
	When pressing the RESET key during AT with learning function
	When the PID/AT transfer is changed to the PID control.
When the parameter is changed	When changing Segment level or Set value (SV)
	When the PV bias, the PV digital filter, or the PV ratio is changed.
	When changing value of AT bias or AT cycle
	When changing Output limiter High or Low
	When the Input type, the Input range high or the Input range low is changed.
	When the Control action is changed.
When the input value becomes abnormal	When the Measured value (PV) goes to underscale or over-scale.
	When the Measured value (PV) goes to input error range. (Measured value (PV) ≥ Input error determination point (high) or Input error determination point (low) ≥ Measured value (PV))
When the AT exceeded the execution time	When the AT does not end in nine hours after AT started
Power failure	When the power failure of more than 20 ms occurs.
Instrument error	When the instrument is in the FAIL state.

■ Where to store computed PID value by AT with learning function (For Segment PID)

The PID value being computed by AT with learning function are stored in PID memory group being set for each segment of the program pattern.

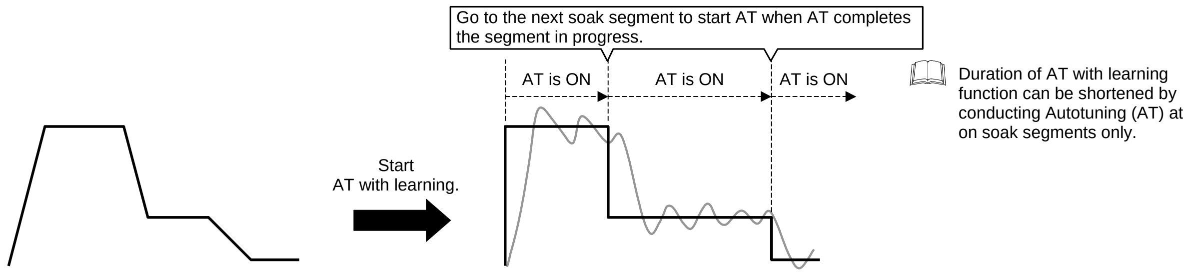
■ Parameters related to Autotuning (AT) with learning function

● AT with learning function at ramp segment

Ramp segment can be validated or invalidated at Autotuning (AT) with learning function.

When setting to “No AT with learning function at ramp segment”

AT with learning function can be conducted only on soak segments along the Set value (SV) by ignoring ramp segments of the program pattern.



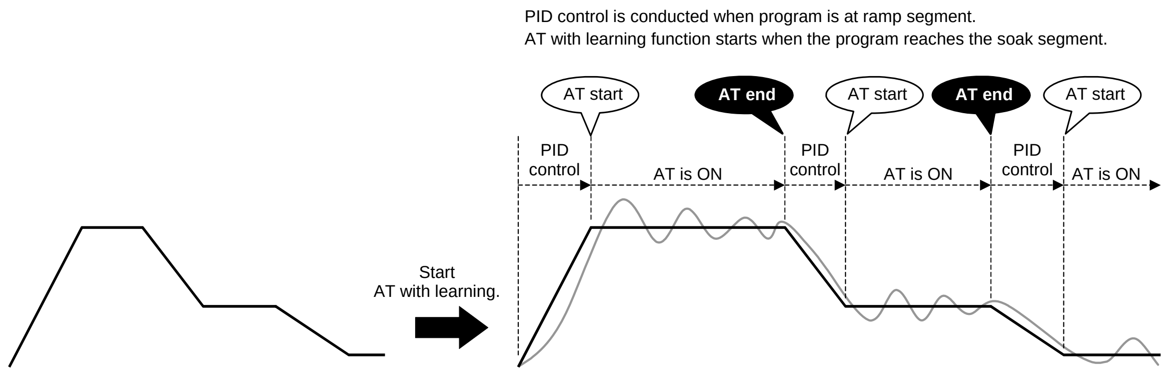
The original program pattern

Program pattern during AT with learning function

When setting to “Conduct AT with learning function at ramp segment”

Ramp segment can be validated when conducting AT with learning function. For ramp segments, PID values are not computed as PID control is performed instead of AT with learning function.

Setting “Conduct AT with learning function at ramp segment” is effective to avoid sudden change in value of Control output.

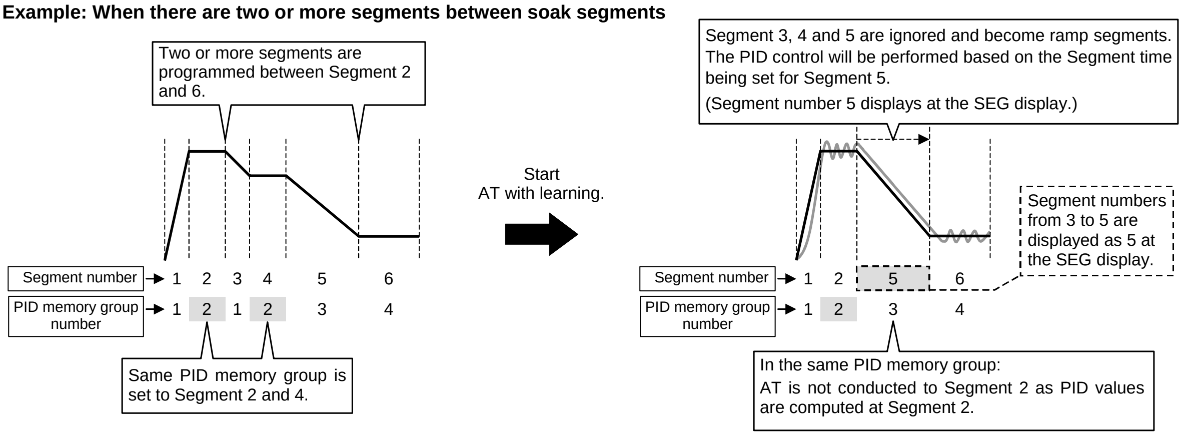


The original program pattern

Program pattern during AT with learning function

When performing AT with learning function, AT will not be conducted to the PID memory group where PID values are written. The following description explains when a segment of the written PID memory group is recognized during the AT with learning function when ramp segment is validated.

Example: When there are two or more segments between soak segments



The original program pattern

Program pattern during AT with learning function

■ Parameter setting

● AT with learning function at ramp segment

Parameter symbol	Data range	Factory set value
ArT.R	0: No AT with learning function at ramp segment 1: Conduct AT with learning function at ramp segment	0

● Autotuning (AT) with learning function

Autotuning (AT) with learning function can be started or stopped.

Parameter symbol	Data range	Factory set value
ArT	ON: Autotuning (AT) with learning start OFF: Autotuning (AT) with learning stop Turns OFF automatically when the AT with learning function is completed.	OFF

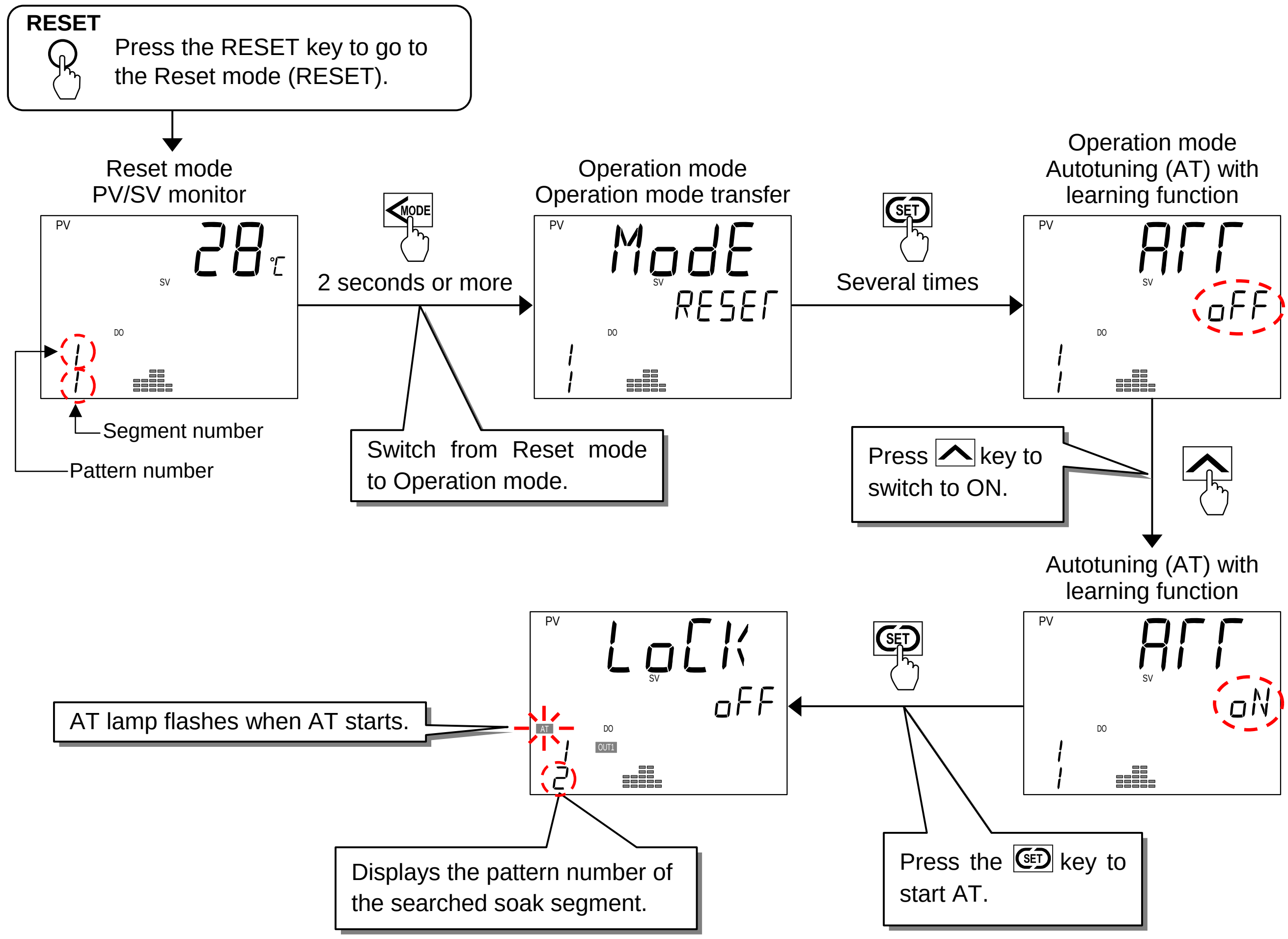
Other parameters related to AT
Other parameters related to AT must be set as regular Autotuning at F52 in the Engineering mode.
For the details of Engineering mode F52, refer to P. 6-125.

■ Setting procedure

To set parameters related to AT, refer to **Setting parameters related to AT (P. 6-127)**.

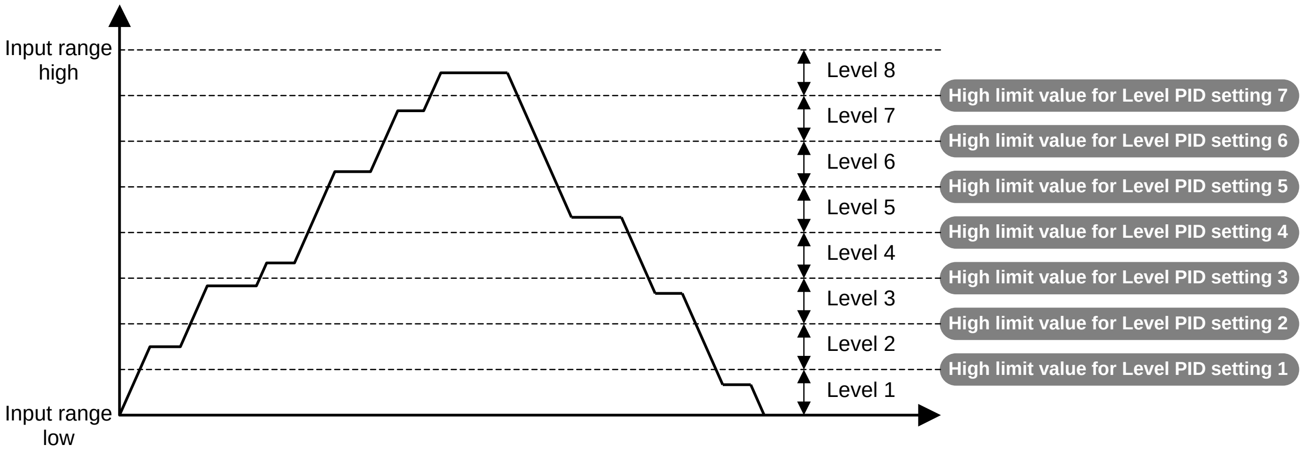
Starting AT with learning function

AT can be started or stopped by Operation mode Autotuning (AT) with learning function.



6.5.9 Level PID

PID values to be used for control are set based on the divided ranges of input range (up to 8 ranges) by Level PID.
Each level range is set automatically based on the set values of Level PID setting 1 [LEVL.1] to Level PID setting 7 [LEVL.7].



■ PID memory group to be used for level range

Refer to the following PID memory group used for the divided level range. The PID values being computed by Autotuning (AT) with learning function or regular Autotuning (AT) are stored in the same PID memory group where Level number belongs.

Level	PID memory group
8	PID memory group 8
7	PID memory group 7
6	PID memory group 6
5	PID memory group 5
4	PID memory group 4
3	PID memory group 3
2	PID memory group 2
1	PID memory group 1

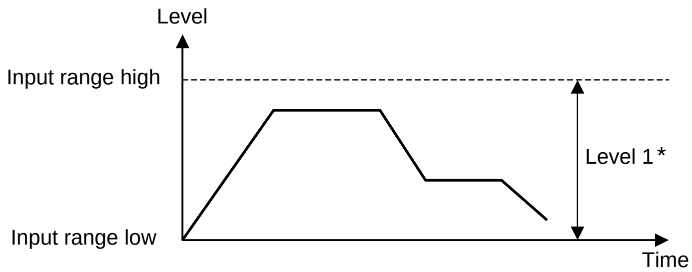
Where to store the PID values computed by AT with learning function or regular AT:

- PID values of Level 8 ⇒ Stored in PID memory group 8
- PID values of Level 7 ⇒ Stored in PID memory group 7
- PID values of Level 6 ⇒ Stored in PID memory group 6
- PID values of Level 5 ⇒ Stored in PID memory group 5
- PID values of Level 4 ⇒ Stored in PID memory group 4
- PID values of Level 3 ⇒ Stored in PID memory group 3
- PID values of Level 2 ⇒ Stored in PID memory group 2
- PID values of Level 1 ⇒ Stored in PID memory group 1

The level with lower level number validates when setting the same value to each Level PID setting. For example, when setting the same value to the high limit value of Level 1 and Level 2, the level range of Level 1 validates.

■ Precaution for use of Level PID

- The factory set values for all Level PID settings (Level PID setting 1 [LEVL.1] to Level PID setting 7 [LEVL.7]) are preset to Input range high. If regular AT or AT with learning function is conducted before dividing the input range, only the PID values for Level 1 will be computed and stored. In this case, the PID values of Level 1 (in PID memory group 1) are used to control at all input levels of one program pattern.



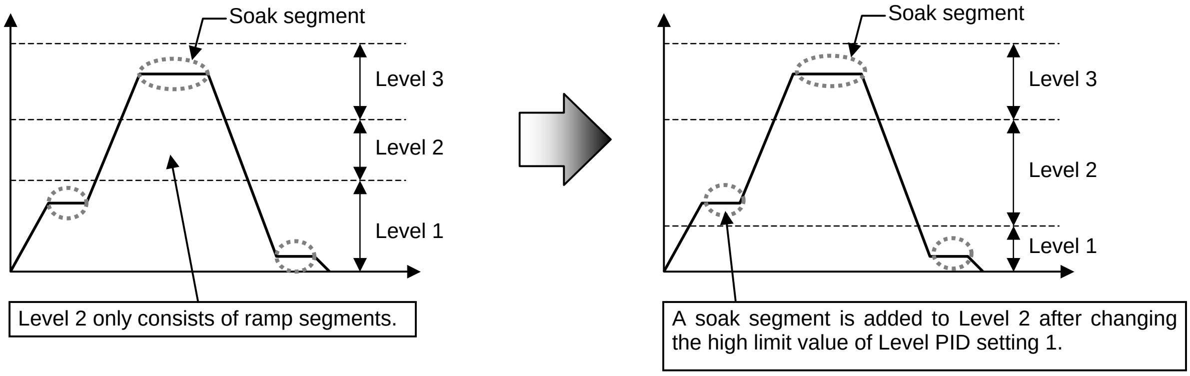
High limit value for all Level PID settings:
Input range high [Factory set value]

To use Level PID, set "0" to the PID memory group number [PId.GR] at the Program memory group setting block [PR.MEM].

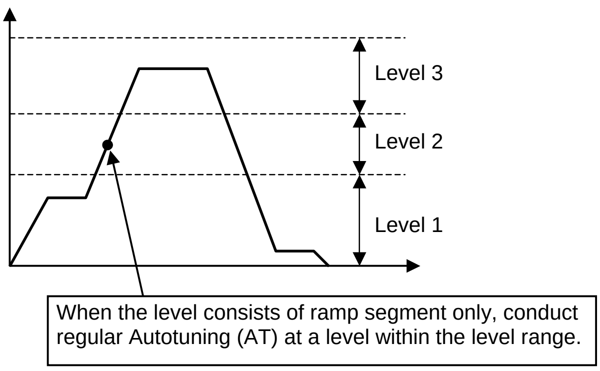
*The range of Level 1 validates as high limit value for all Level PID settings is set to the same value [Factory set value: Input range high].

- At Level PID, conducting Autotuning (AT) with learning function is ignored within the range of the level consisting of ramp segment only. Refer to the descriptions below to compute PID values when the level consists of ramp segment only.

① Conduct AT with learning function after changing the range of the level to make a soak segment.



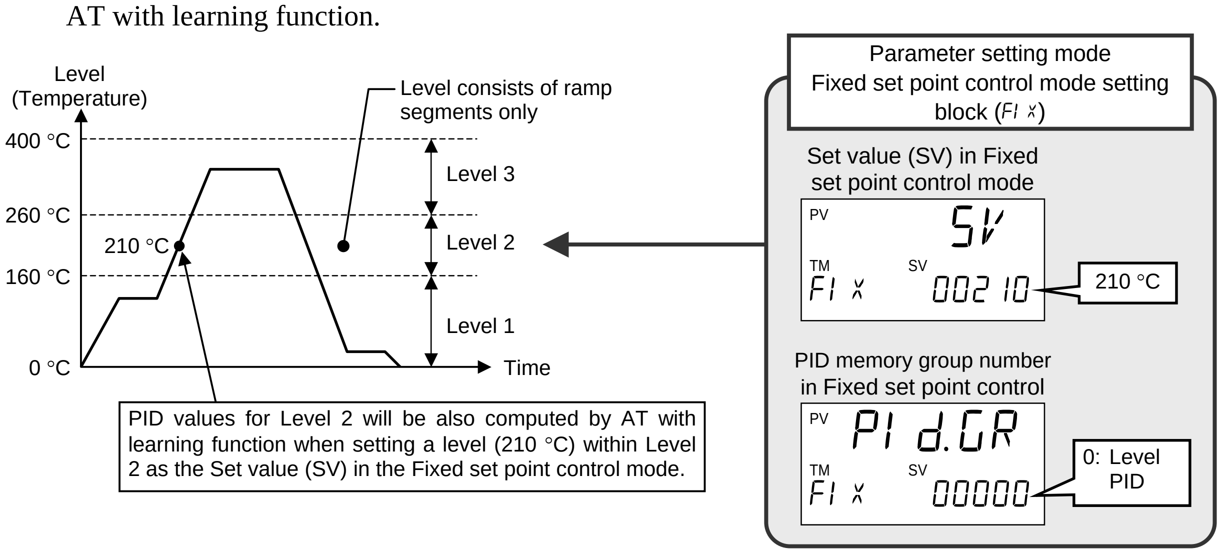
② Activate regular AT on the level consisting of ramp segment only after conducting AT with learning function.



③ Compute PID values based on the Set value (SV) in the Fixed set point control mode. °C

Example: When the input range is 0 to 400 °C

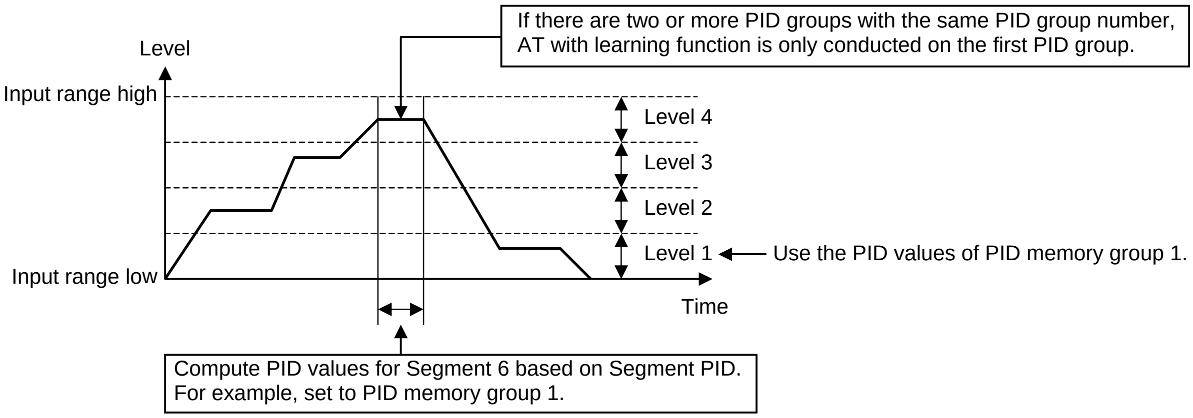
Prior to conducting AT with learning function, set the Level PID for the Fixed set point control mode. To conduct AT with learning function on Level 2, set a level within Level 2 (210 °C in the diagram below) as the Set value (SV) for the Fixed set point control mode and then activate AT with learning function.



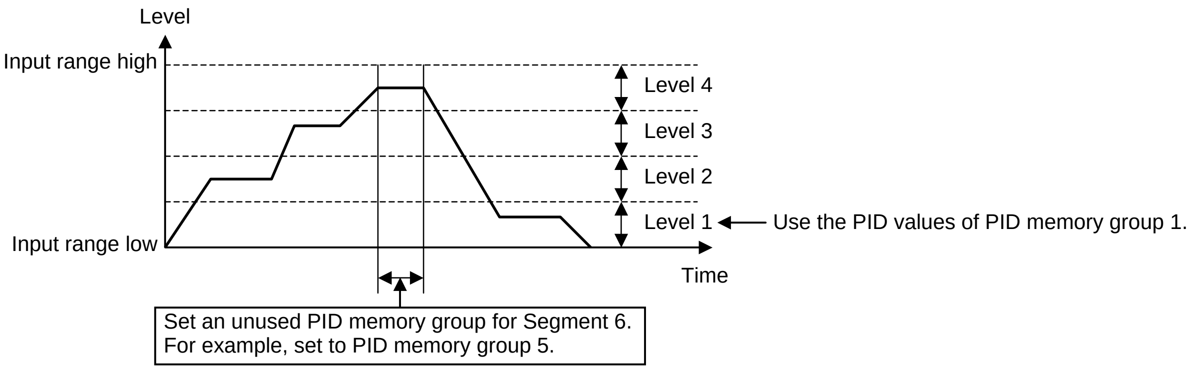
If there are two or more levels consisting of ramp segment only, this method is only operative for the first level.

- Precaution for combined use of Segment PID and Level PID

  As described in the diagram below, the control in Level 1 is based on the PID values computed at Segment 6 when setting the same PID memory group number for Segment PID and Level PID and conducting Autotuning (AT) with learning function. That is, the control in Level 1 is based on the PID values to be used in the Level 4 (different temperature range from Level 1).



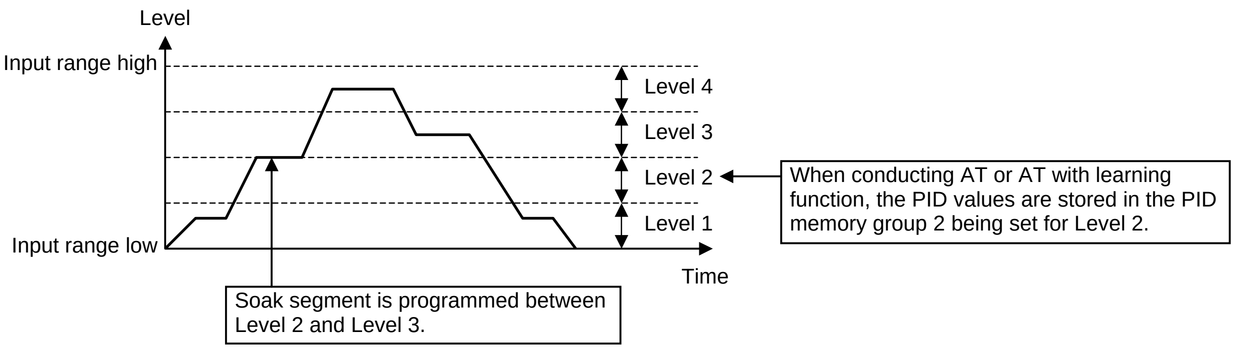
To avoid the above situation, use the unused PID memory group in Level PID as the PID memory group of the Segment PID. As described in the diagram below, Level 5 to Level 8 are not set for Level PID. The PID memory group numbers from 5 to 8 can then be used as the PID memory group of Segment PID. To avoid malfunction due to the combined use of Segment PID and Level PID, set one of the unused PID memory groups to Segment 6.



- When a soak segment is programmed between two levels

  When conducting regular AT or AT with learning function, the computed PID values will be stored in the PID memory group with lowest group number.

Example: When a soak segment is programmed between Level 2 and Level 3



■ Operation procedure

Switch to the Reset mode (RESET).	Press the RESET key to go to the Reset mode (RESET).
↓	
Select Level PID.	Confirm that the Level PID is set for the instrument. ☞ Refer to ■ **Setting procedure (P. 6-140)**.
↓	
Set ranges of Level PID.	Set ranges of Level PID by setting Level PID setting 1 to 7. ☞ Refer to **Set ranges of Level PID (P. 6-142)**.
↓	
Set parameter related to AT.	☞ Refer to ■ **Parameter setting (P. 6-125)**. ☞ Refer to ■ **Setting procedure (P. 6-127)**.
↓	
Confirm AT start condition	☞ Refer to ■ **Requirements for AT start (P. 6-121)**. ☞ Refer to ■ **Requirements for AT with learning function start (P. 6-132)**.
↓	
Select Program pattern.	Select a Program pattern to conduct Autotuning (AT) or AT with learning function. ☞ Refer to ● **Execution pattern selection (P. 5-21)**.
↓	
Conduct AT or AT with learning function.	To conduct AT or AT with learning function, refer to the pages below. Each title refers to Segment PID, however, the operation procedures for "Select Program pattern" and following process are the same for Level PID. ☞ For the AT, refer to ■ **Operation procedure [When conducting regular Autotuning (AT) by Segment PID] (P. 6-120)**. ☞ For operation procedure of AT with learning function, refer to ■ **Operation procedure [When conducting Autotuning (AT) with learning function by Segment PID] (P. 6-131)**.

■ Parameter setting

● Level PID setting 1

Set the value to divide the Level into Level 1 and Level 2.

Parameter symbol	Data range	Factory set value
LEVL.1	Input range low to Level PID setting 2	Input range high

● Level PID setting 2

Set the value to divide the Level into Level 2 and Level 3.

Parameter symbol	Data range	Factory set value
LEVL.2	Level PID setting 1 to Level PID setting 3	Input range high

● Level PID setting 3

Set the value to divide the Level into Level 3 and Level 4.

Parameter symbol	Data range	Factory set value
LEVL.3	Level PID setting 2 to Level PID setting 4	Input range high

● Level PID setting 4

Set the value to divide the Level into Level 4 and Level 5.

Parameter symbol	Data range	Factory set value
LEVL.4	Level PID setting 3 to Level PID setting 5	Input range high

● Level PID setting 5

Set the value to divide the Level into Level 5 and Level 6.

Parameter symbol	Data range	Factory set value
LEVL.5	Level PID setting 4 to Level PID setting 6	Input range high

● Level PID setting 6

Set the value to divide the Level into Level 6 and Level 7.

Parameter symbol	Data range	Factory set value
LEVL.6	Level PID setting 5 to Level PID setting 7	Input range high

● Level PID setting 7

Set the value to divide the Level into Level 7 and Level 8.

Parameter symbol	Data range	Factory set value
LEVL.7	Level PID setting 6 to Input range high	Input range high

■ Setting procedure

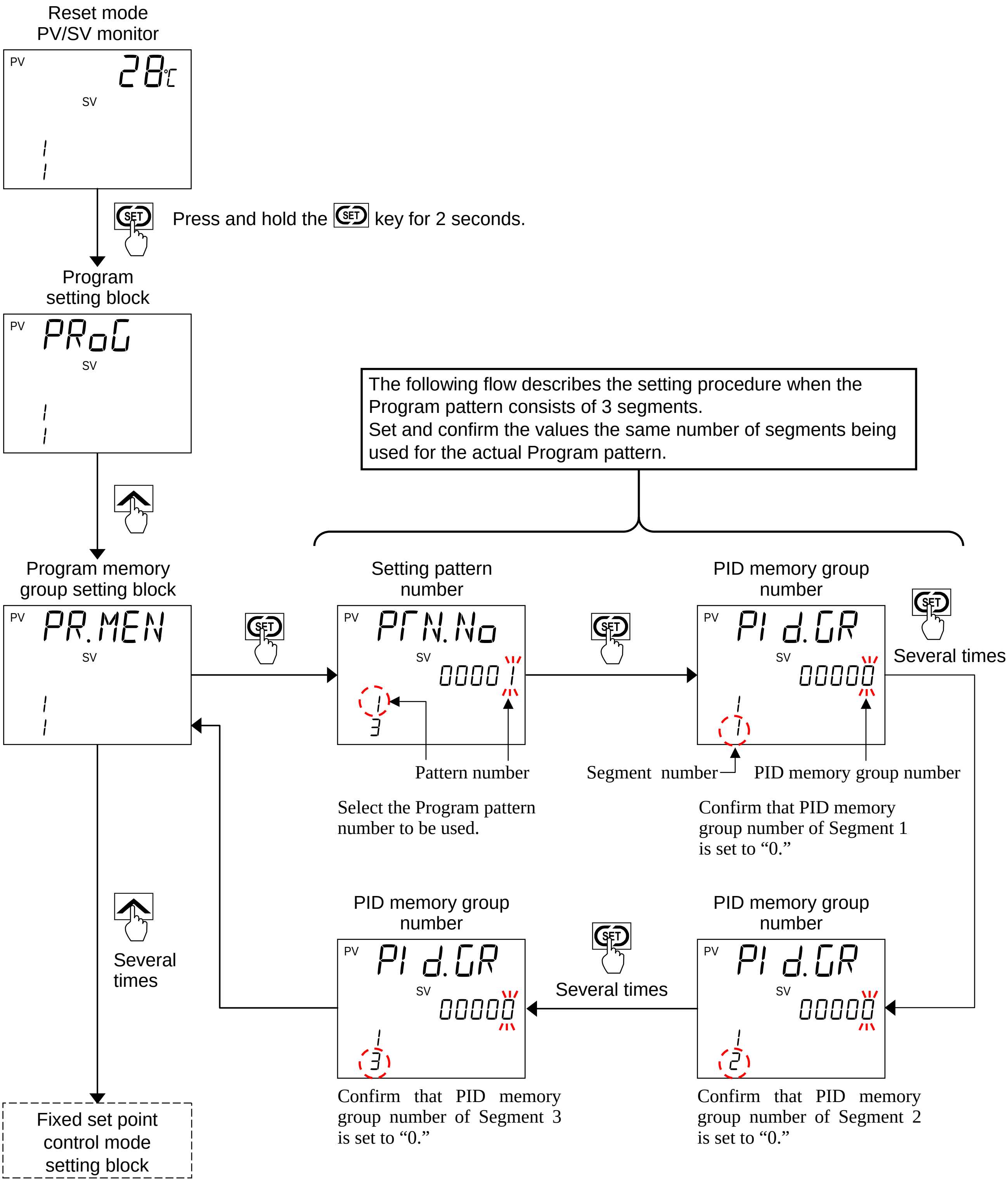
This section describes the setting procedure for Level PID.

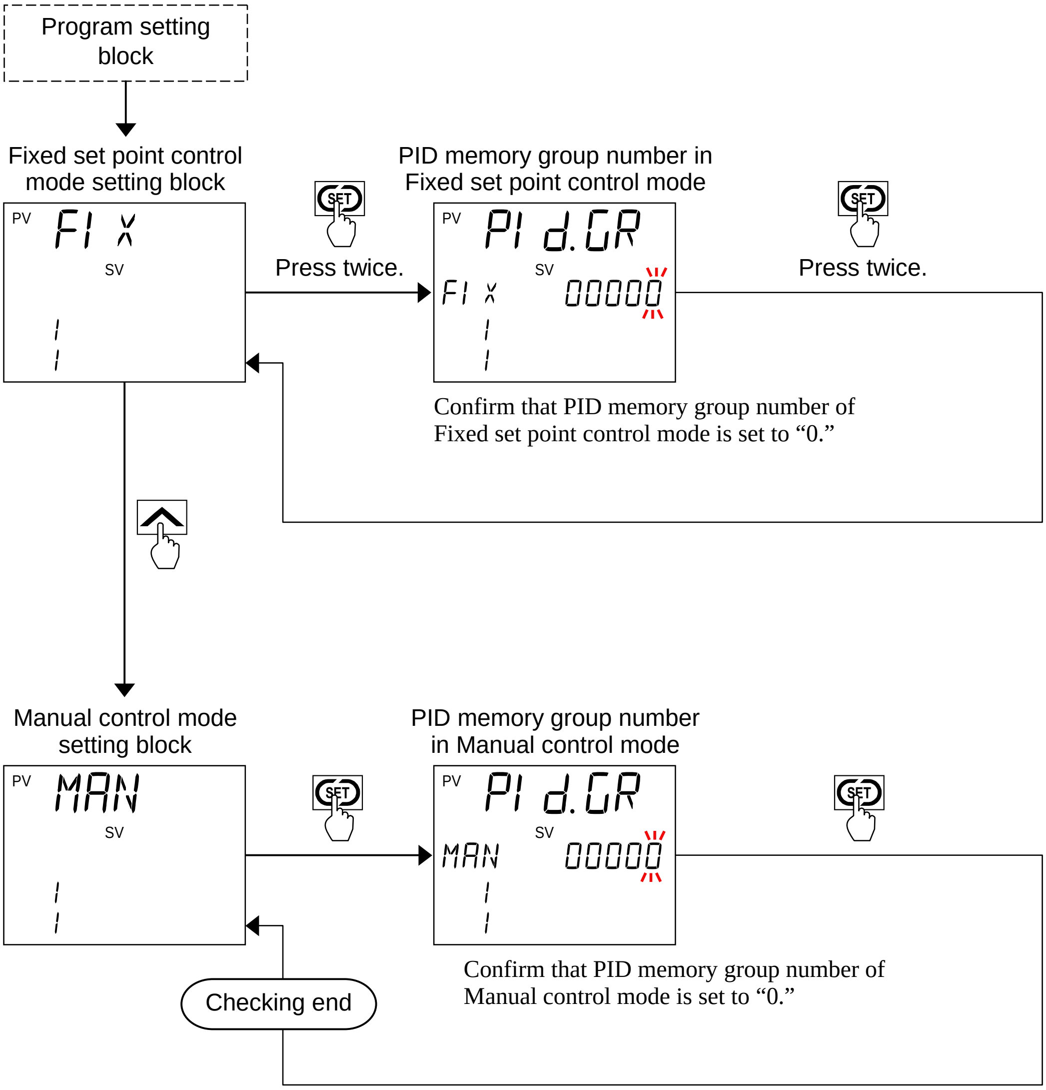
Select Level PID

Confirm that the PID memory group numbers of the setting block below are set to “0: Level PID.”
(Factory set value: Level PID)

- Program memory group setting block
- Fixed set point control mode setting block
- Manual control mode setting block

● Parameter setting in the Parameter setting mode (Partial setting type)





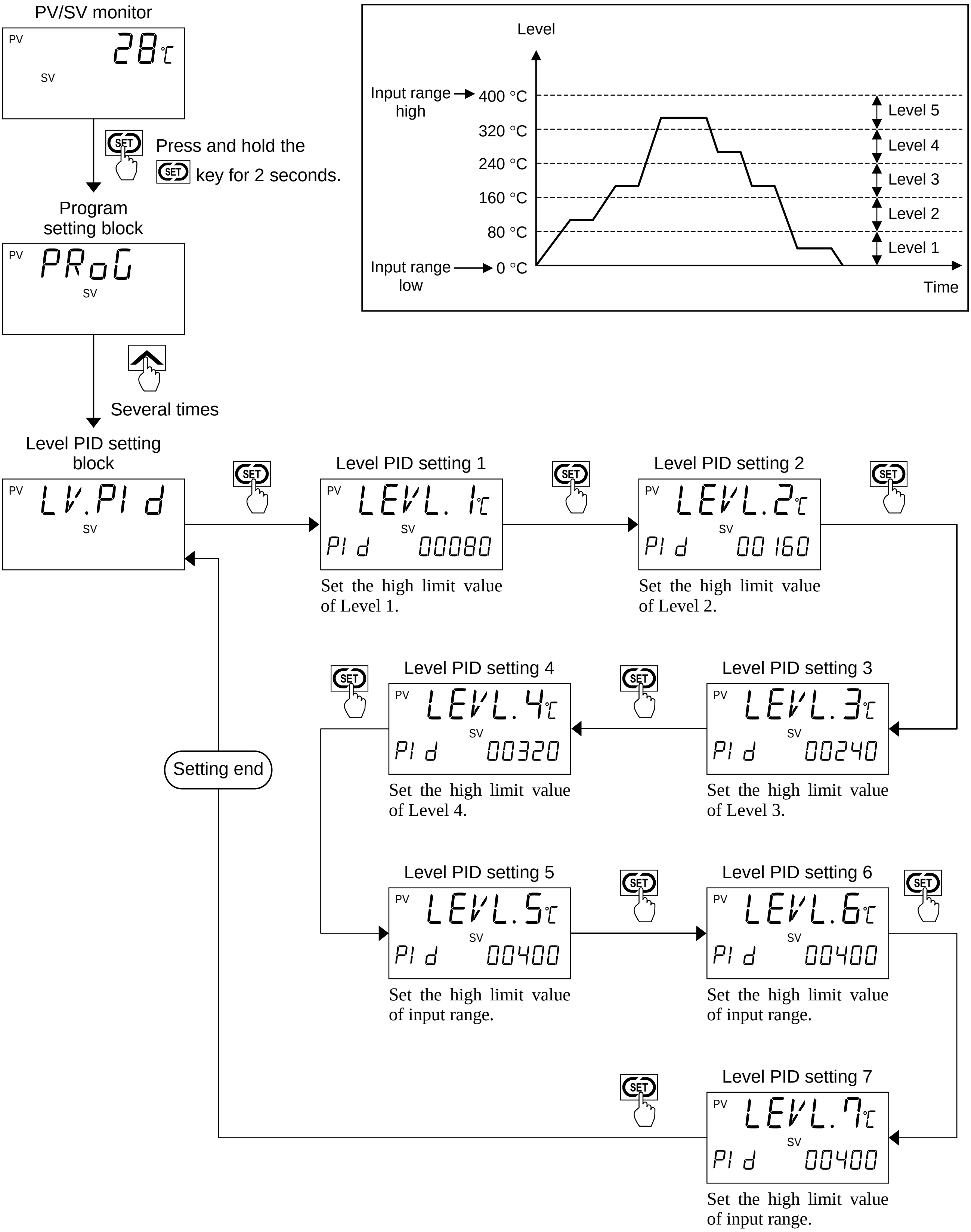
Program setting block
Fixed set point control mode setting block
PV
FIX
SV
Press twice.
PID memory group number in Fixed set point control mode
PV
PId.GR
SV
FIX
00000
Press twice.
Confirm that PID memory group number of Fixed set point control mode is set to "0."
Manual control mode setting block
PV
MAN
SV
PID memory group number in Manual control mode
PV
PId.GR
SV
MAN
00000
Checking end
Confirm that PID memory group number of Manual control mode is set to "0."

Set ranges of Level PID

Set ranges to divide the Level.

● Parameter setting in the Parameter setting mode (Partial setting type)

Example: When dividing the input range from 0 to 400 °C into 5 levels



6.6 Program Control

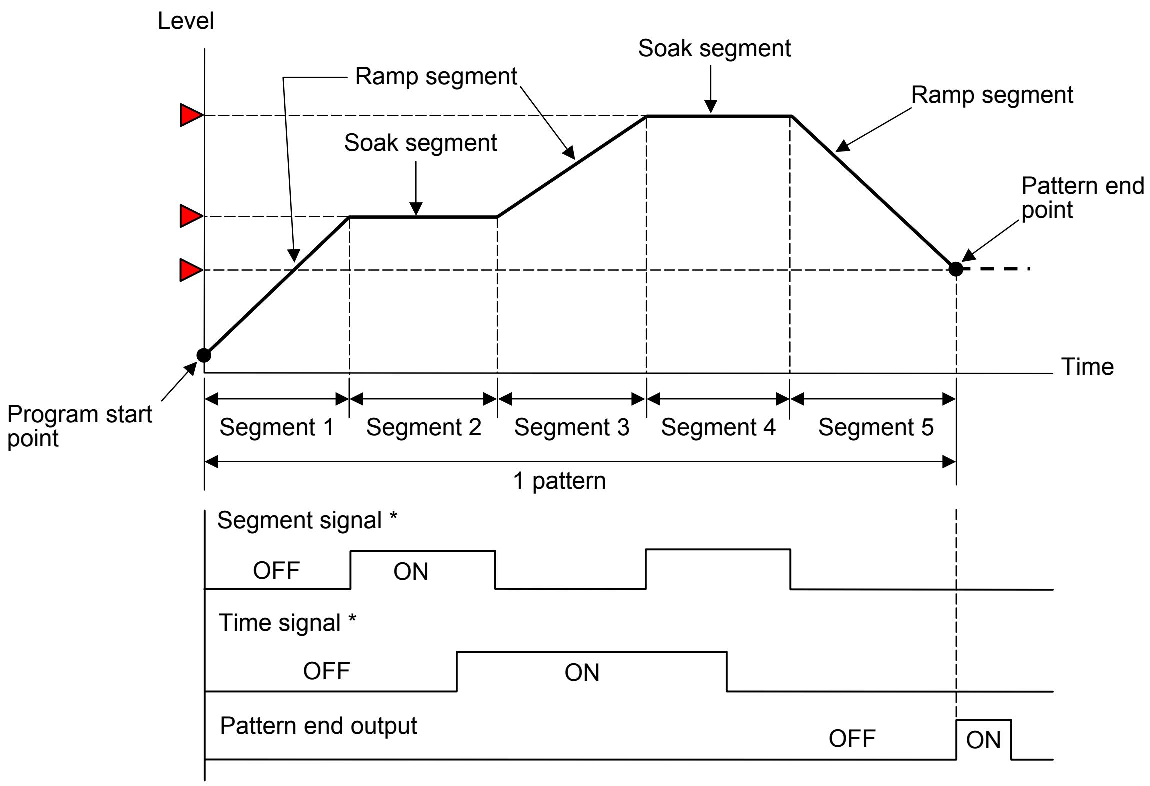
Program control operation allows specific operation of the controlled object by programming Segment levels (Set value of segment) and tracking the program progress.

☞ For the program control operation, refer to **5.4 Program Control Operation (P. 5-12)**.

■ Program configuration

- The change in Segment level from the beginning to the end of the program is defined as “Pattern.” It is possible to store up to 99 patterns.
- A pattern consists of section called “Segment.” Pattern is composed by setting Segment level (Set value of the segment) and Segment time (duration of the segment).
  It is possible to set 1024 segments maximum (up to 99 segments for one pattern).
- PID setting, Event function and Wait function can be set in each segment by using the PID memory group, Event memory group and Wait memory group. Time signal and Output program are activated by setting the Memory group of each pattern.
- Functions of Program control operation: Program control start selection, Search function, Hold, Step, Wait, Repeat, Pattern link, Pattern end, Time signal, Segment signal, Output program, Forward/Back-up function, Pattern remaining time monitor, Pattern copy/data clear and Tag function.

Example of Program pattern configuration



* The Segment signal and Time signal cannot be used at the same time.

6.6.1 Memory group

PID values, Event, Wait, Time signal and Output program can be stored in a memory group.
A Memory group is set by segment or pattern.

■ Memory group to be set by segment

PID memory group:

Number of group: Up to 8 groups

Setting items:

PID memory group number	Output limiter high (MV1)
Proportional band [heat-side]	Output limiter low (MV1)
Integral time [heat-side]	Output limiter high (MV2)
Derivative time [heat-side]	Output limiter low (MV2)
Control response parameter	ON/OFF action differential gap (upper)
Proportional band [cool-side]	ON/OFF action differential gap (lower)
Integral time [cool-side]	Control loop break alarm (LBA) time
Derivative time [cool-side]	LBA deadband (LBD)
Overlap/Deadband	
Open/Close output neutral zone	
Manual reset	

Event memory group:

Number of group: Up to 8 groups

Setting items:
Event memory group number
Event 1 set value (EV1)/Event 1 set value (EV1) [high]
Event 1 set value (EV1') [low]
Event 2 set value (EV2)/Event 2 set value (EV2) [high]
Event 2 set value (EV2') [low]
Event 3 set value (EV3)/Event 3 set value (EV3) [high]
Event 3 set value (EV3') [low]
Event 4 set value (EV4)/Event 4 set value (EV4) [high]
Event 4 set value (EV4') [low]

Wait memory group:

Number of group: Up to 8 groups

Setting items:

Wait memory group number	Wait release trigger selection
Wait zone high	Wait time-out set value
Wait zone low	

■ Memory group to be set by pattern

Time signal memory group:

Number of group: Up to 16 groups (Up to 16 memories for each group)

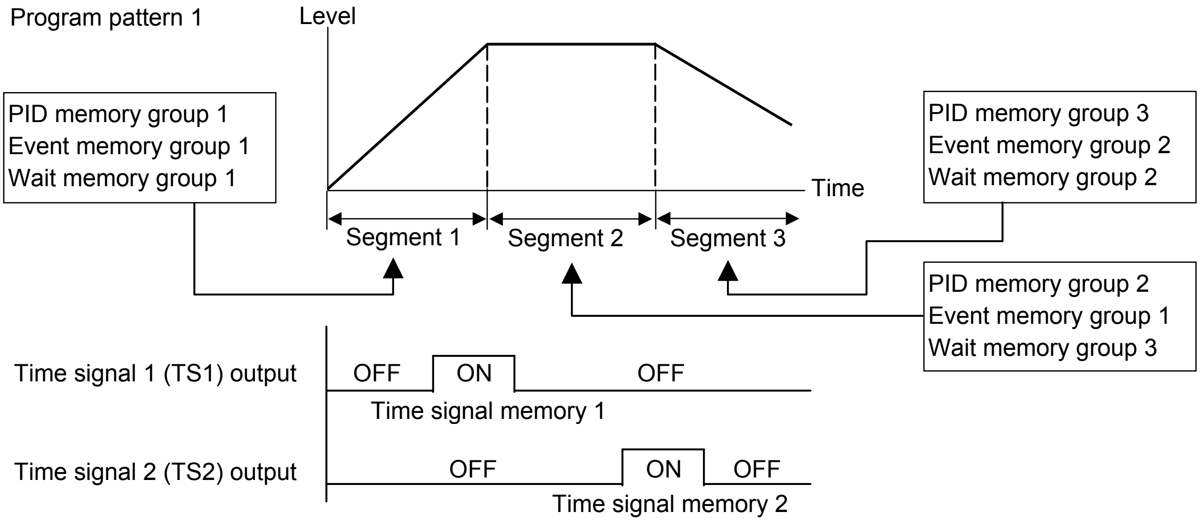
Setting items:
Time signal memory group number
Time signal output assignment
Start segment of time signal
Time signal start time
End segment of time signal
Time signal end time

Output program memory group:

Number of group: 128/Maximum number of segments (Up to 99)
Maximum number of segments:
Number of pattern × Number of segments

Setting items:
Output program memory group number
Output program value 1
Output program value 2
Output program value 3

■ Setting example of Memory group



Pattern number	1		
Segment number	1	2	3
PID memory group number	1	2	3
Event memory group number	1	1	2
Wait memory group number	1	3	2

Time signal memory group number	1	
Time signal memory number	1	2
Time signal output assignment	1	2

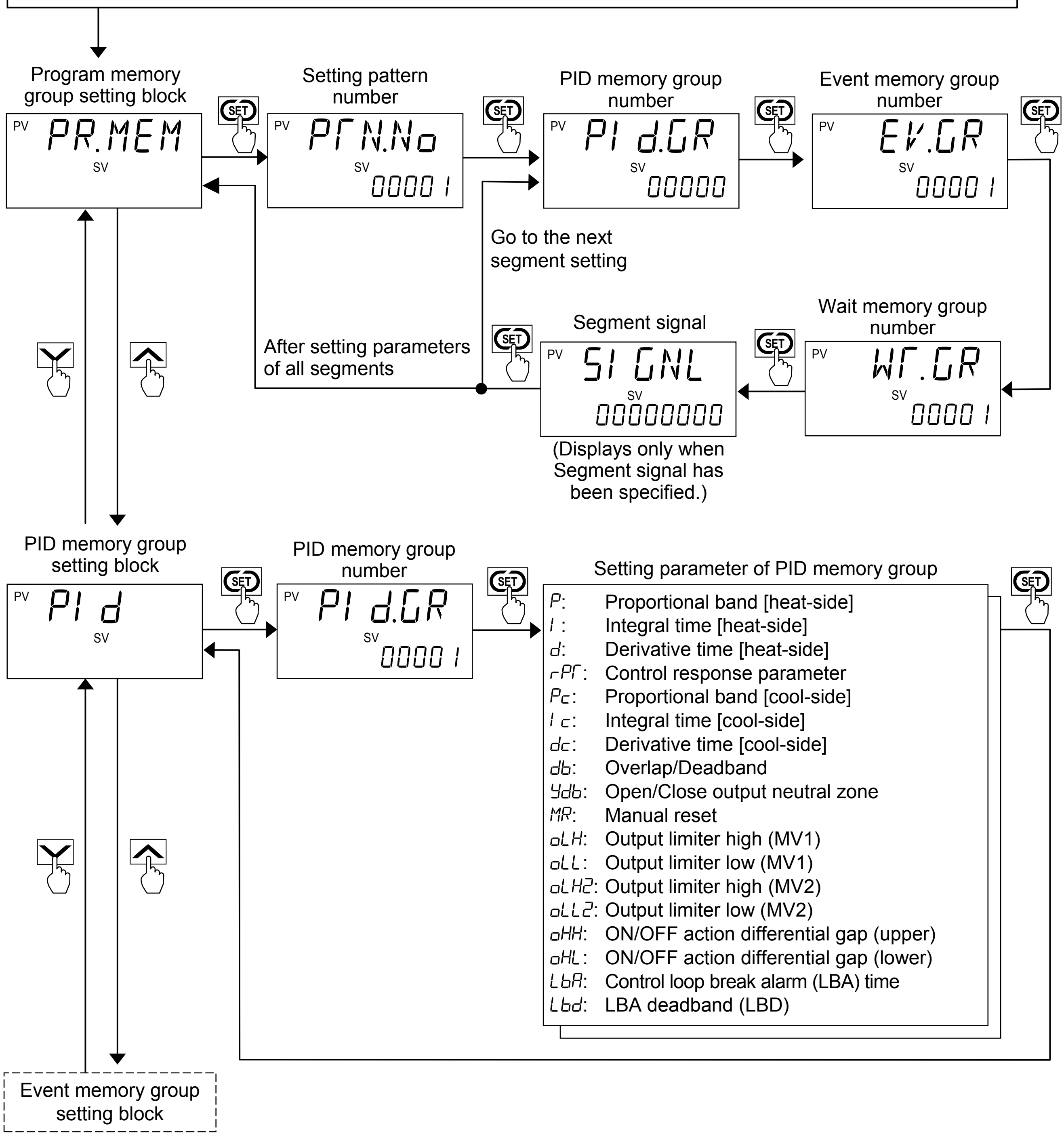
■ Setting procedure

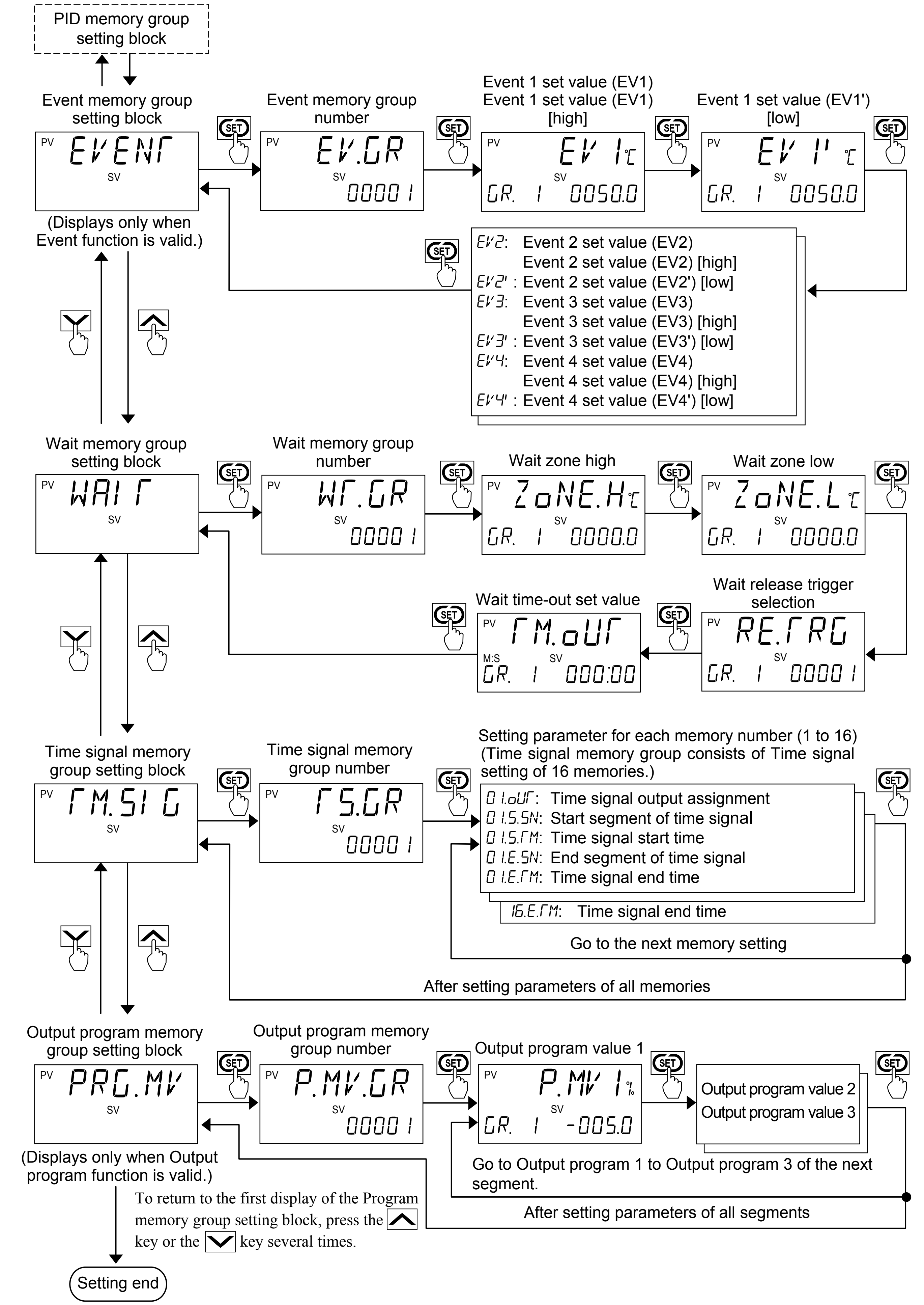
Set memory group in the Parameter setting mode.

The following setting procedure describes the key operation of Partial setting type (factory set value) of Program setting time being set at F80 in the Engineering mode. For description of the Program setting type, refer to ■ **Setting type for Program pattern** of **4.5.3 Parameter setting mode (P. 4-17)**.

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

2. Press the UP key until the Program memory group setting block screen displays.




PID memory group setting block
Event memory group setting block
PV EVENT
SV
(Displays only when Event function is valid.)
Event memory group number
PV EV.GR
SV 00001
Event 1 set value (EV1)
Event 1 set value (EV1) [high]
PV EV1 ℃
GR. 1 SV 0050.0
Event 1 set value (EV1') [low]
PV EV1' ℃
GR. 1 SV 0050.0
SET
EV2: Event 2 set value (EV2)
Event 2 set value (EV2) [high]
EV2' : Event 2 set value (EV2') [low]
EV3: Event 3 set value (EV3)
Event 3 set value (EV3) [high]
EV3' : Event 3 set value (EV3') [low]
EV4: Event 4 set value (EV4)
Event 4 set value (EV4) [high]
EV4' : Event 4 set value (EV4') [low]
Wait memory group setting block
PV WAIT
SV
Wait memory group number
PV WT.GR
SV 00001
Wait zone high
PV ZoNE.H℃
GR. 1 SV 0000.0
Wait zone low
PV ZoNE.L℃
GR. 1 SV 0000.0
Wait time-out set value
PV TM.oUT
M:S
GR. 1 SV 000:00
Wait release trigger selection
PV RE.TRG
GR. 1 SV 00001
Time signal memory group setting block
PV TM.SIG
SV
Time signal memory group number
PV TS.GR
SV 00001
Setting parameter for each memory number (1 to 16) (Time signal memory group consists of Time signal setting of 16 memories.)
01.oUT: Time signal output assignment
01.S.SN: Start segment of time signal
01.S.TM: Time signal start time
01.E.SN: End segment of time signal
01.E.TM: Time signal end time
16.E.TM: Time signal end time
Go to the next memory setting
After setting parameters of all memories
Output program memory group setting block
PV PRG.MV
SV
(Displays only when Output program function is valid.)
Output program memory group number
PV P.MV.GR
SV 00001
Output program value 1
PV P.MV1%
GR. 1 SV -005.0
Output program value 2
Output program value 3
Go to Output program 1 to Output program 3 of the next segment.
After setting parameters of all segments
To return to the first display of the Program memory group setting block, press the key or the key several times.
Setting end

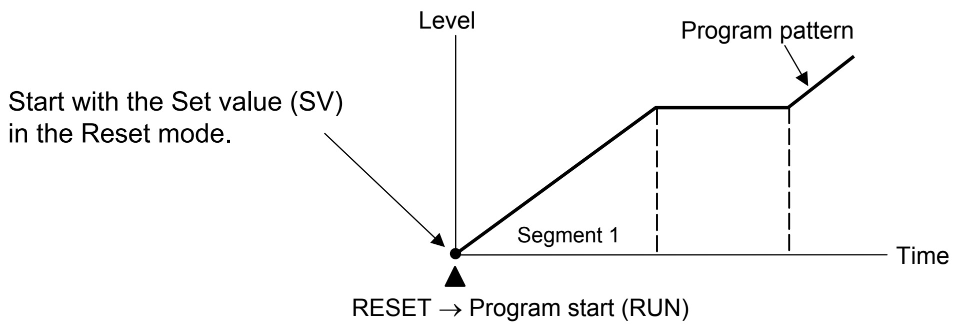
6.6.2 Program control start selection

Segment level and action at Program control start are selectable from the following 5 types of SV at Program start in the Setup setting mode.

- Start with the Set value (SV) in the Reset mode.
- PV start 1 [Time fixed type]
- PV start 2 [Time saving & ramp holding type] (Factory set value)
- PV start 3 [Time saving & level searching type/with HOLD function at start]
- PV start 4 [Time saving & level searching type/without HOLD function at start]

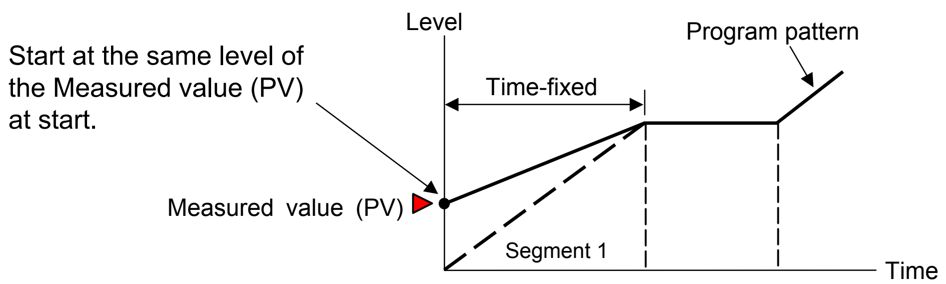
Wait function is available at Program control start. To set Wait function condition at Program control start, select Wait memory group number at F80 in the Engineering mode.

■ Start with the Set value (SV) in the Reset mode



- Set value (SV) in the Reset mode
  Data range: Setting limiter low to Setting limiter high [Factory set value: 0 (0.0)]

■ PV start 1 [Time fixed type]



Actions when the Measured value (PV) at start exceeds the input range:

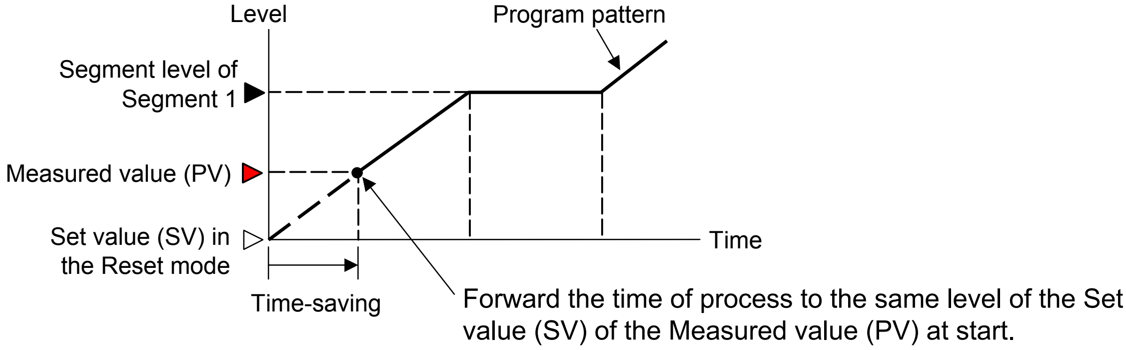
- Measured value (PV) > Input range (high): Starts from the Input range (high).
- Measured value (PV) < Input range (low): Starts from the Input range (low).

■ PV start 2 [Time saving & ramp holding type] (Factory set value)

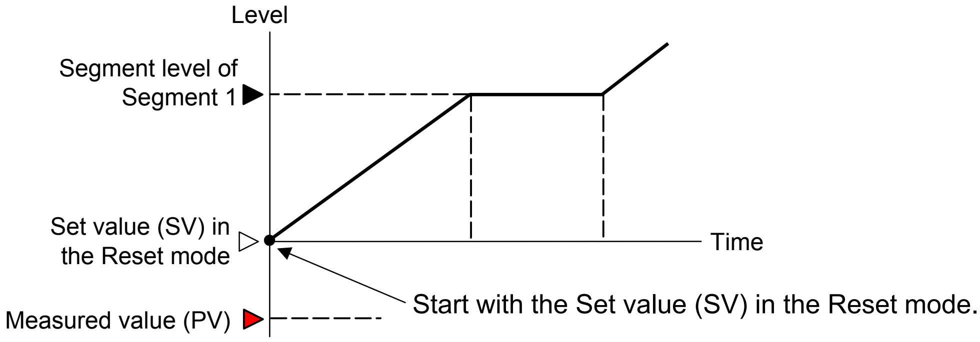
Start point varies by Measured value (PV) at start, Segment level of Segment 1 and Set value (SV) in the Reset mode.

● When Set value (SV) in the Reset mode is smaller than the Segment level of the Segment 1

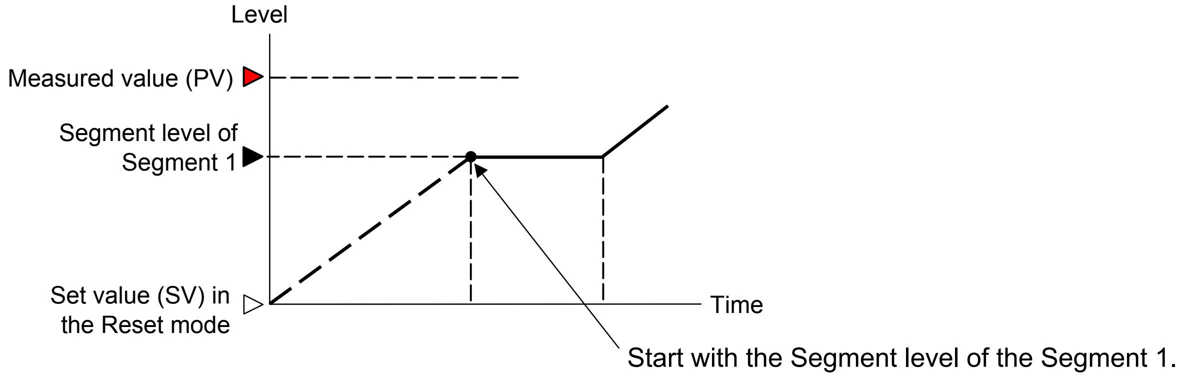
• Set value (SV) in the Reset mode < Measured value (PV) < Segment level of Segment 1



• Set value (SV) in the Reset mode ≥ Measured value (PV)

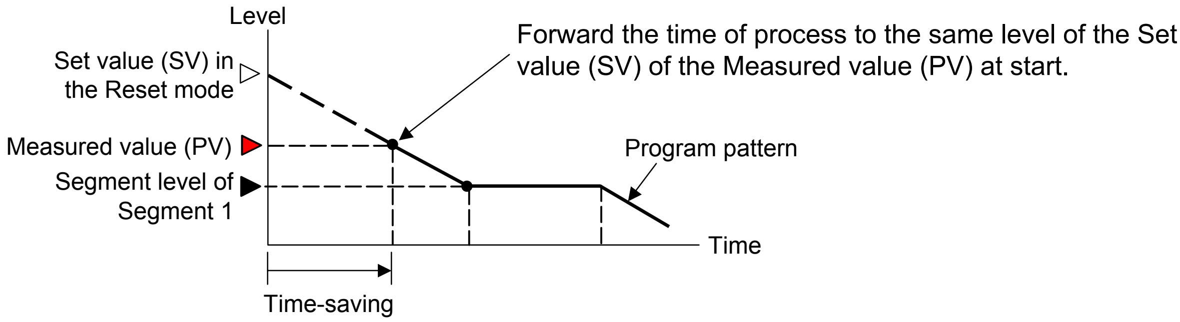


• Segment level of Segment 1 ≤ Measured value (PV)

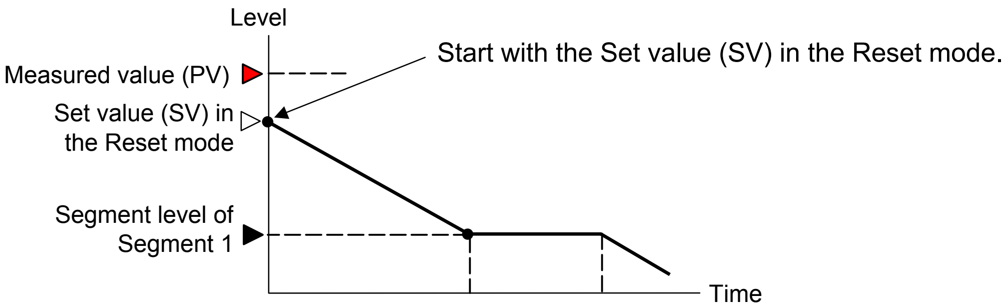


● When Set value (SV) in the Reset mode is larger than the Segment level of the Segment 1

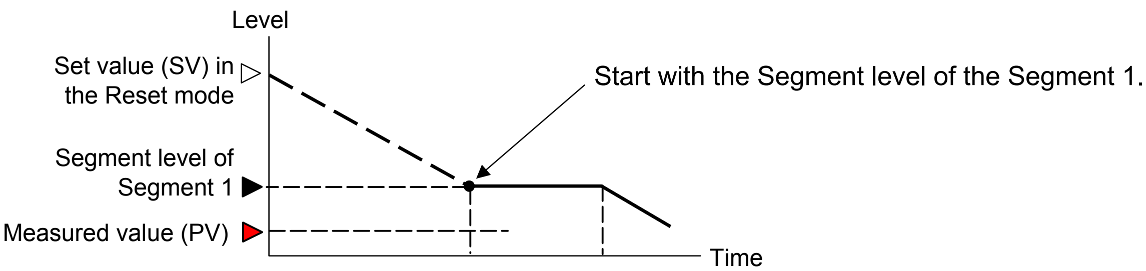
• Set value (SV) in the Reset mode ≥ Measured value (PV) ≥ Segment level of Segment 1



• Set value (SV) in the Reset mode ≤ Measured value (PV)



• Segment level of Segment 1 > Measured value (PV)



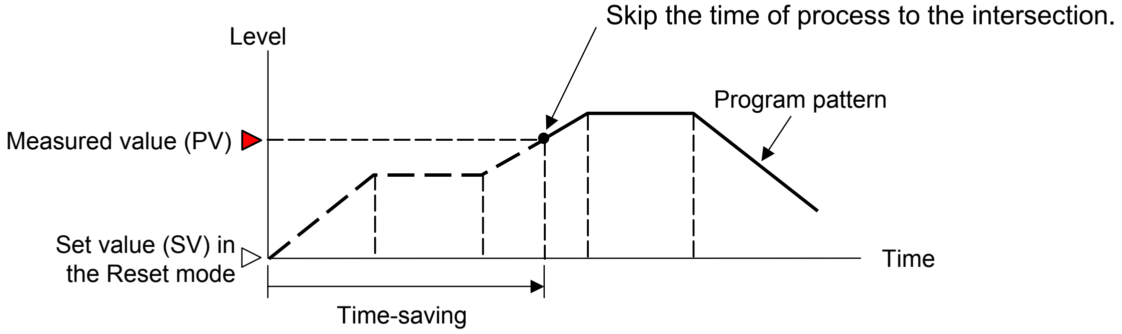
■ PV start 3/PV start 4 [Time saving & level searching type]

Search locates the intersection of the Measured value (PV) at start and Set value (SV) in the program pattern to skip time of process until the PV and the SV intersect.

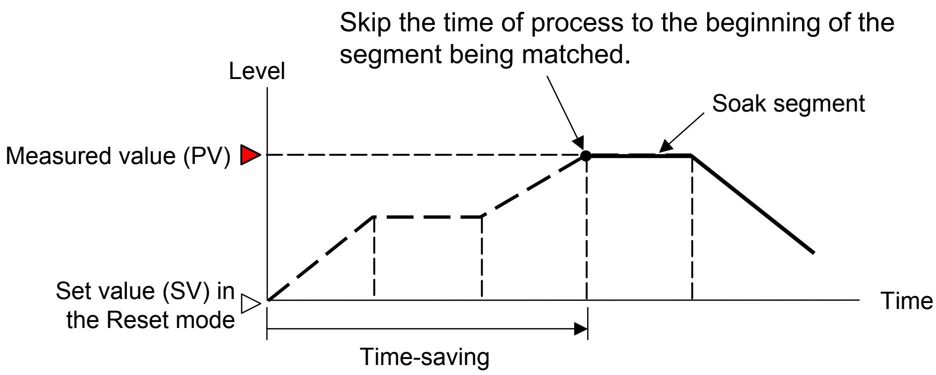
Search function is not performed in the Program pattern being linked.

Differences between PV start 3 and PV start 4:
- PV start 3: Starts in Hold state
- PV start 4: Starts in RUN state (without Hold)

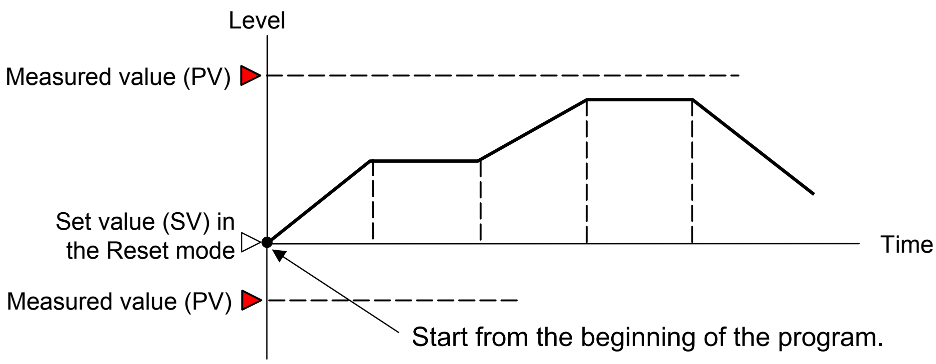
● When the intersection is found:



● When the Measured value (PV) matches soak segment:



● When no intersection was found:



■ Parameter setting

● SV selection at Program start

Select Segment level at Program control start.

Parameter symbol	Data range	Factory set value
ST.SV	0: Start with the Set value (SV) in the Reset mode. 1: PV start 1 [Time fixed type] 2: PV start 2 [Time saving & ramp holding type] 3: PV start 3 [Time saving & level searching type/with HOLD function at start] 4: PV start 4 [Time saving & level searching type/without HOLD function at start]	2

● Set value (SV) in Reset mode

Set SV in the Reset mode.

Parameter symbol	Data range	Factory set value
SV	Setting limiter low to Setting limiter high	0 (0.0)

● Wait memory group number at Program start

Select Wait memory group number as Wait function condition at Program control start.

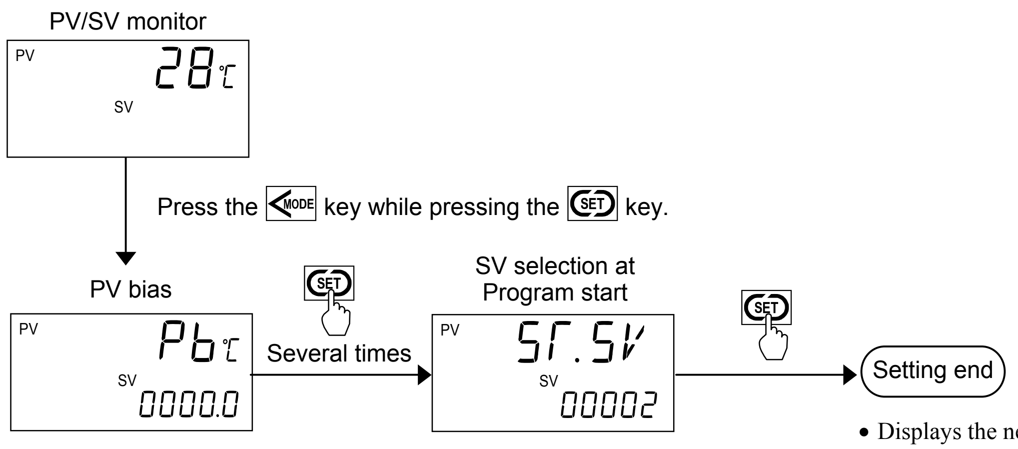
Parameter symbol	Data range	Factory set value
ST.WT	0: Wait OFF 1: Wait memory 1 2: Wait memory 2 3: Wait memory 3 4: Wait memory 4 5: Wait memory 5 6: Wait memory 6 7: Wait memory 7 8: Wait memory 8	0

■ Setting procedure

● SV selection at Program start

SV selection at Program start can be set in the Setup setting mode.

SV selection at Program start can be set at F80.01 in the Engineering mode.



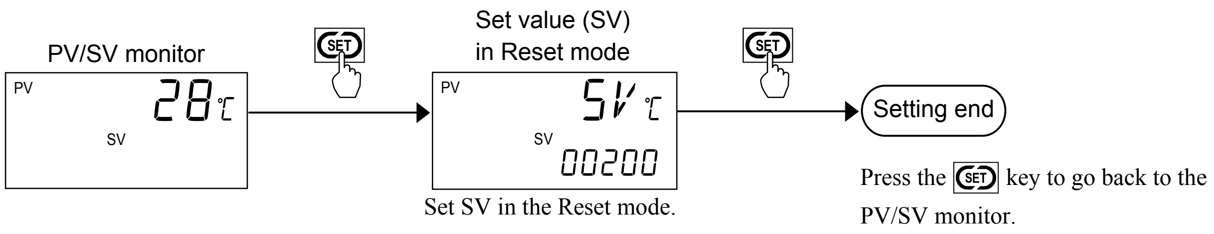
Set SV selection at Program start.

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the PV bias.

● Set value (SV) in Reset mode

Press the SET key at the Reset mode (RESET) to display the Set value (SV) setting screen.

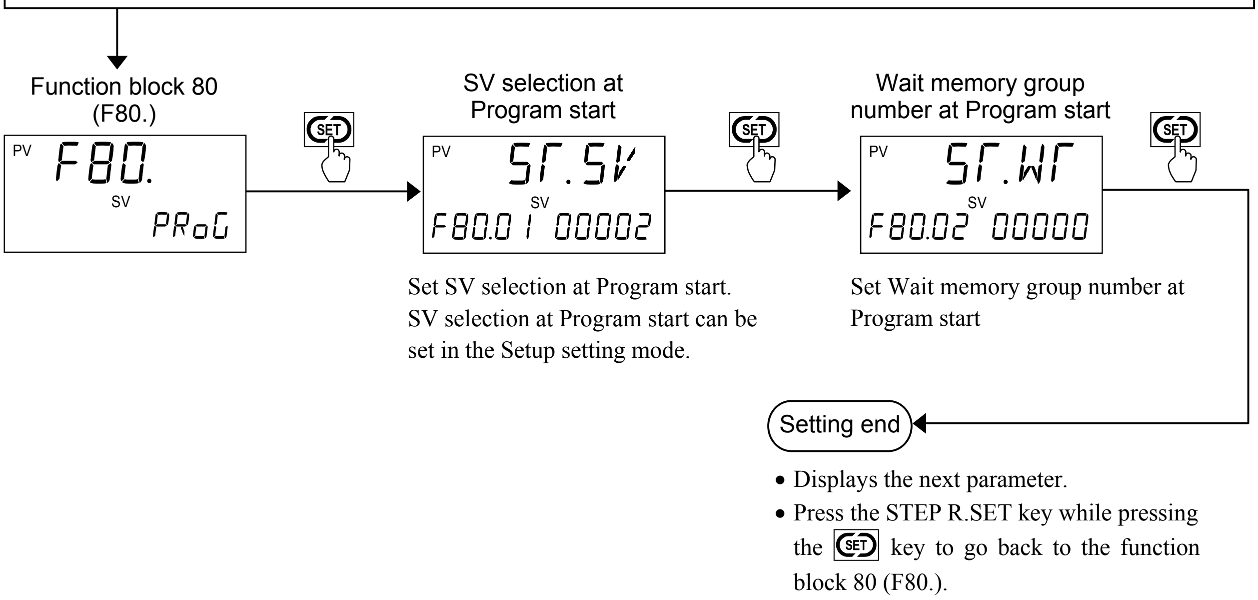
SV at the Reset mode can be set in the Reset mode setting block of the Parameter setting mode.



● Wait memory group number at Program start

Wait memory group number at Program start can be set at F80.02 in the Engineering mode.

1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Keep pressing the ∧ key or the ∧ key until the F80 screen displays.



6.6.3 Search function

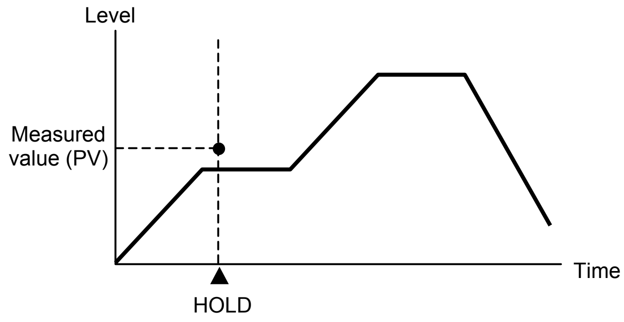
Use the Search function to skip the time of process to the intersection of the Measured value (PV) and the pattern of the program.

■ Description of function

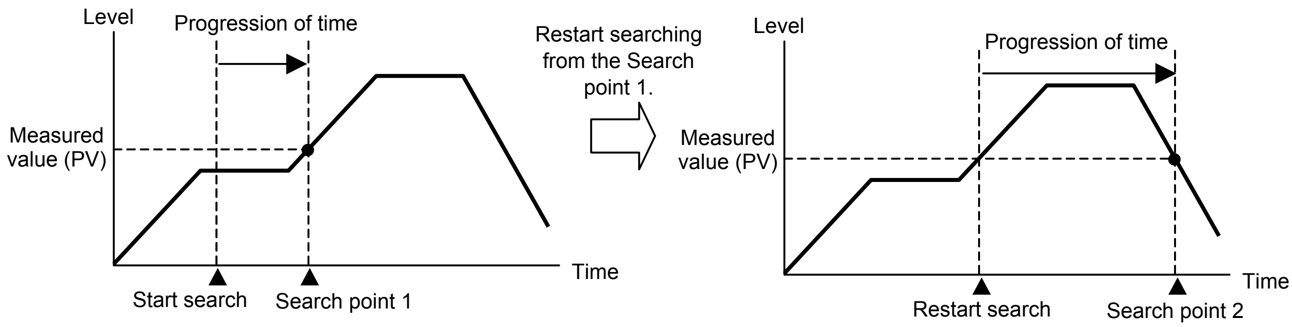
Searches the intersection of the pattern and the Measured value (PV) when the pattern, position of Hold state and PV are as described in the right diagram.

NOTE

The program must be in HOLD state to conduct Search function.



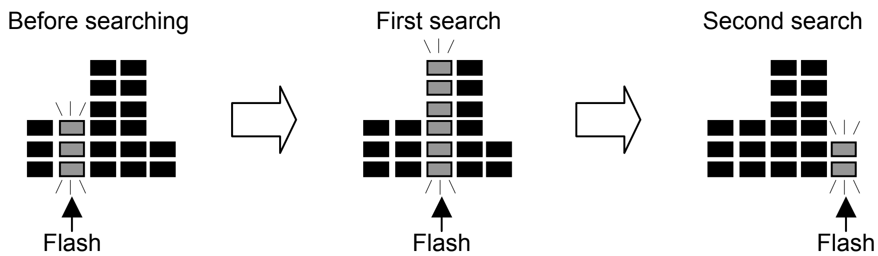
Before searching: in HOLD state



First search

Second search

When finding an intersection: skip the time of process of the program to the intersection.
For Dot display, segments in progress flash. Next the segments of the intersection will flash.



When no intersection was found: no change in operation occurs.

Search function is available in any time during Program control if in HOLD state.

Scope of search function is within a pattern. It is not possible to search a pattern repeated or linked by Pattern repeat or Pattern link.

Skip the time of process to the beginning of the soak segment being matched with the Measured value (PV).

For Hold function, refer to **6.6.4 Hold (HOLD) (P. 6-156)**.

■ Parameter setting

● Search function

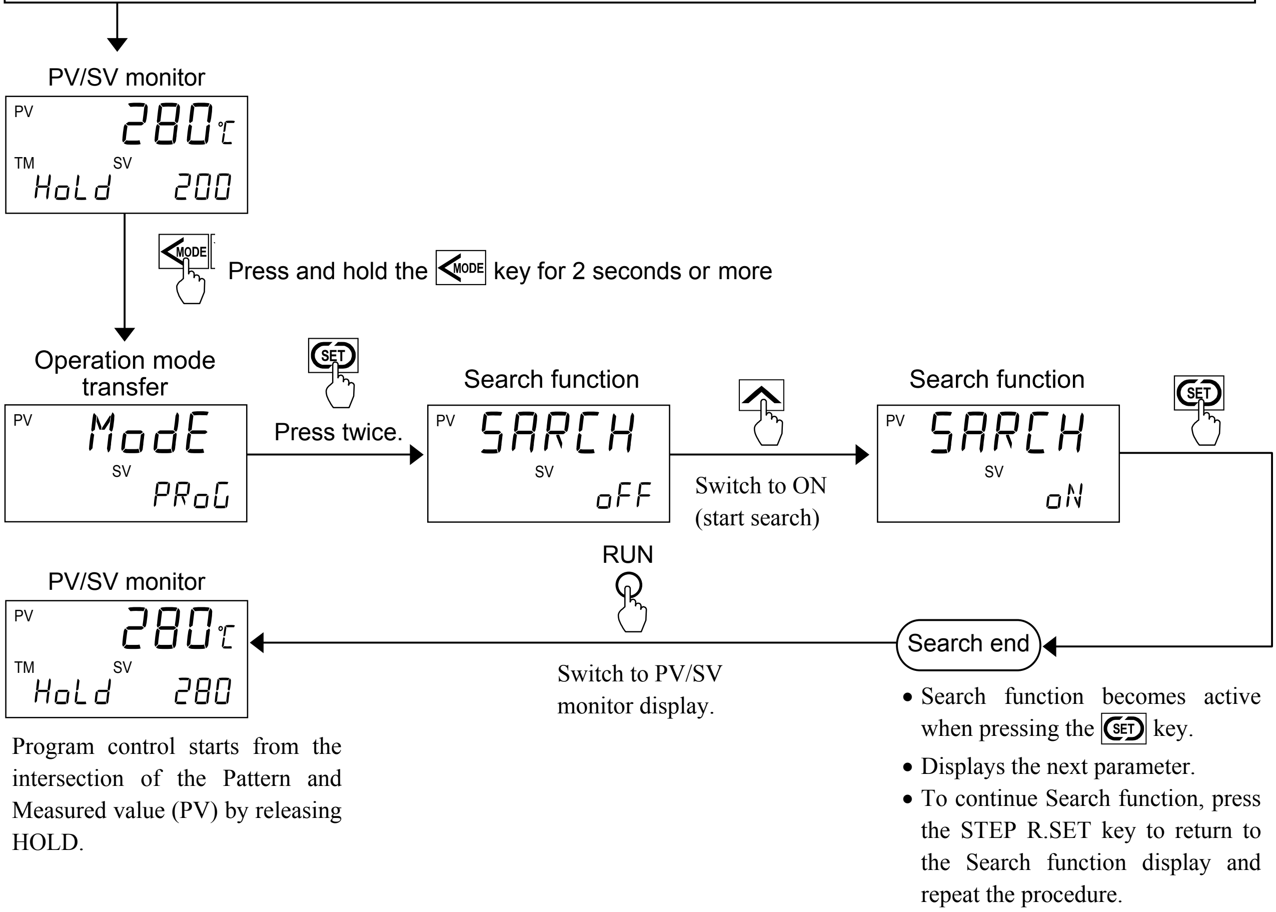
Conduct Search function.

Parameter symbol	Data range	Factory set value
SARCH	ON: Search start OFF: Search stop Turns OFF automatically when the Search function is completed.	OFF

■ Setting procedure

Conduct Search function at the Operation mode.

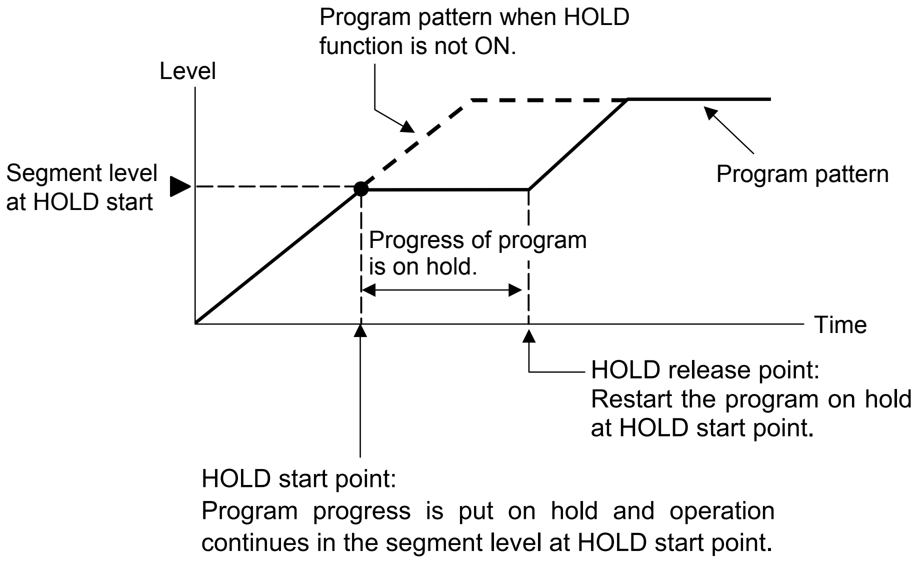
1. Start Program control operation.
2. Press the HOLD key to switch to HOLD state.



It is also possible to conduct Search function by communication.

6.6.4 Hold (HOLD)

Progress of the program is suspended during the Program control operation.
Start or release HOLD function by using the key operation, Digital input (DI) or communication.

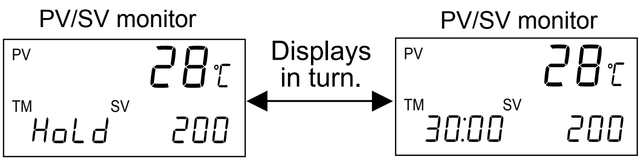


HOLD start condition
- Operation is in Program control mode (RUN).
- DI being assigned with Reset mode (RESET) is open.
- DI being assigned with Program control mode (RUN) is open.

HOLD release condition
- DI being assigned with Reset mode (RESET) is open.
- DI being assigned with Program control mode (RUN) is open.

■ HOLD display

In HOLD state, "HoLd" and the Segment remaining time will alternate on TIME monitor display.



■ Key operation

To switch to HOLD state, press the HOLD key during Program control operation.
To continue Program control operation, release HOLD by pressing the HOLD key.

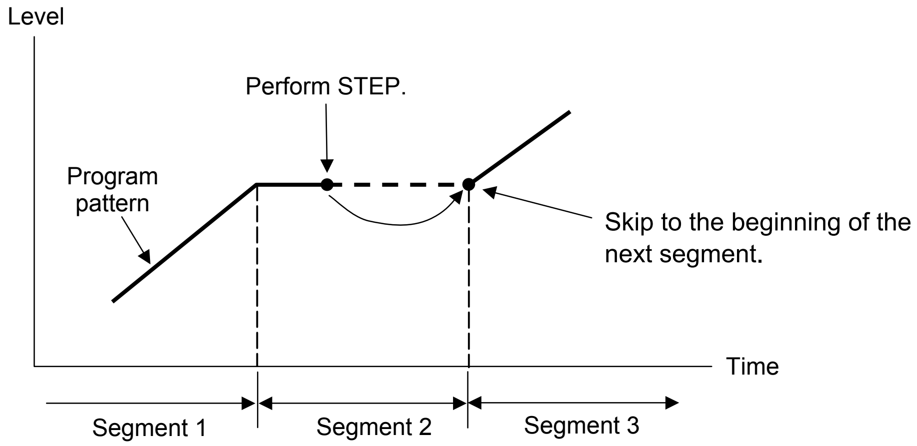
- It is possible to produce the HOLD signal from OUT2, OUT3 or DO. (DO5 to DO12: optional)
- HOLD state remains in effect when changing to the Fixed set point control mode (FIX) or the Manual control mode (MAN). To release HOLD state, switch the operation mode to the Program control mode (RUN).
- Key operation or communication is not available for releasing the HOLD state conducted by using Digital input (DI).
- The program is in HOLD state when performing Autotuning (AT) during Program control operation. "HoLd" is not displayed at TIME monitor display. Restart Program control operation after completing AT.
- HOLD function is operative when the remaining time of the Pattern end output is displayed. When the operation is in HOLD state, time counting of the remaining time is suspended but Pattern end output remains ON. HOLD function is invalidated when the remaining time of the Pattern end output is zero (0).

☞ To set HOLD function by using Digital input (DI), refer to **■ Hold (HOLD) function (P. 6-18)** of **6.1.9 Digital input (DI)**.

☞ To set Digital output (DO) in HOLD state, refer to **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-39)**.

6.6.5 Step (STEP)

During the Program control operation, a segment of the program may be skipped by STEP function.
Key operation, Digital input (DI) or communication is available to perform STEP function.



■ Key operation

To perform STEP function, press and hold the STEP R.SET key for 2 seconds (factory set value) during the Program control operation.

📖 STEP function is not operative when the program is in HOLD state or the operation mode is in the Reset mode (RESET), the Fixed set point mode (FIX) or the Manual mode (MAN).

📖 If STEP function is performed while the program is in Wait state, Wait state will be released and the segment in progress skips to the next segment.

📖 Direct key type can be set individually (Press once, Press twice or Press and hold) for direct keys such as the STEP R.SET key at F11 in the Engineering mode.

☞ To set STEP function by using Digital input (DI), refer to ■ **Step (STEP) function (P. 6-17)** of **6.1.9 Digital input (DI)**.

6.6.6 Wait

In the Program control operation, the Wait function switches the progress of segment into a standby state.
Types of Wait state:

- By Wait zone (Zone wait function)
- By segment

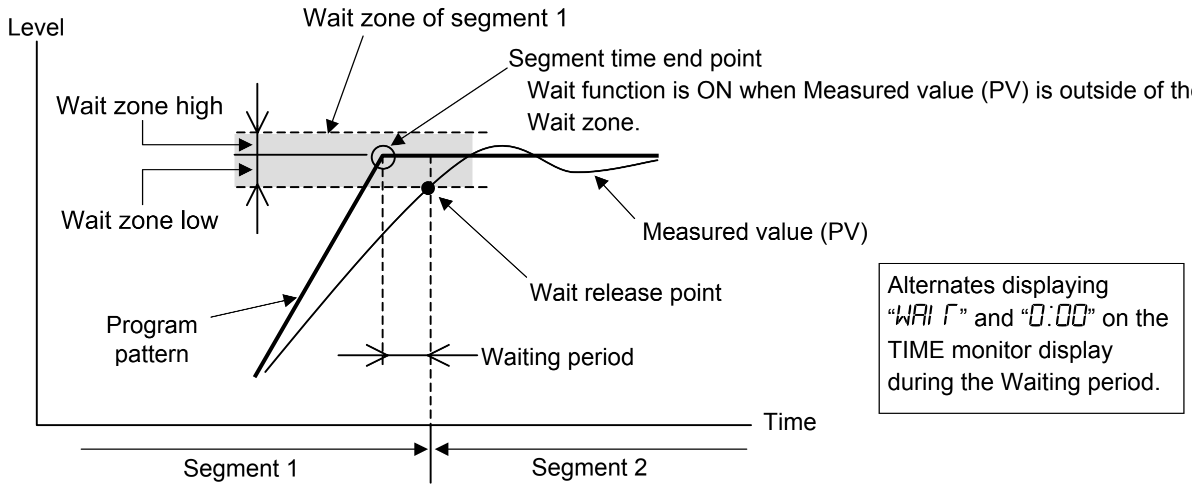
■ Description of function

● Wait state by Wait zone (Zone wait function)

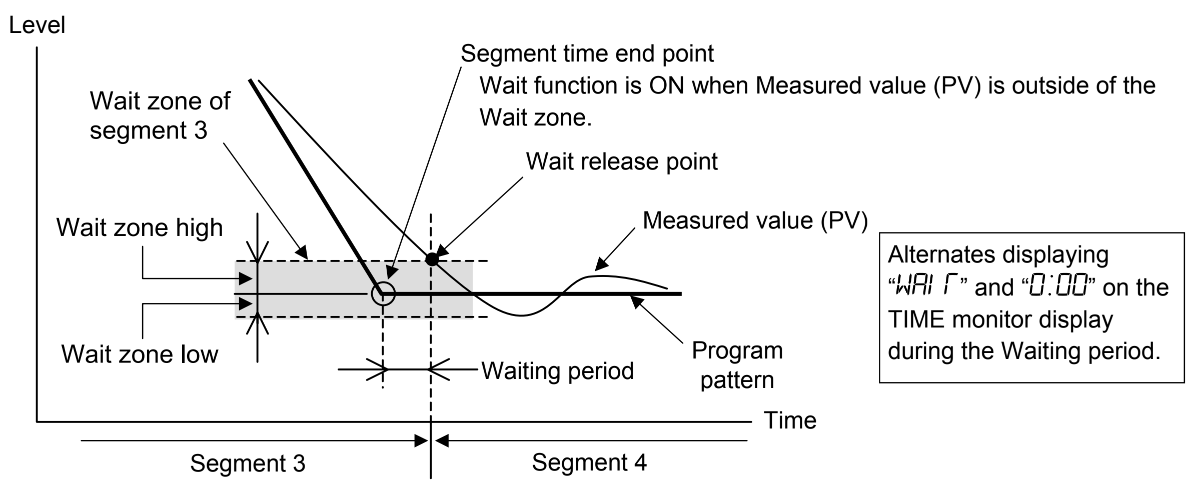
When Measured value (PV) does not follow the progress of the program (when difference between PV and SV remains) during the Program control operation, the program will be on standby state at Segment time end point until the Measured value (PV) reaches the Wait zone.

Wait releasing condition: Wait function is released when the Measured value (PV) reaches the Wait zone.

[Example: At Level rising]



[Example: At Level dropping]



☞ Wait function is available for Link operation by Intercontroller communication. For details, refer to **■ Wait function in intercontroller communication (P. 6-208)**.

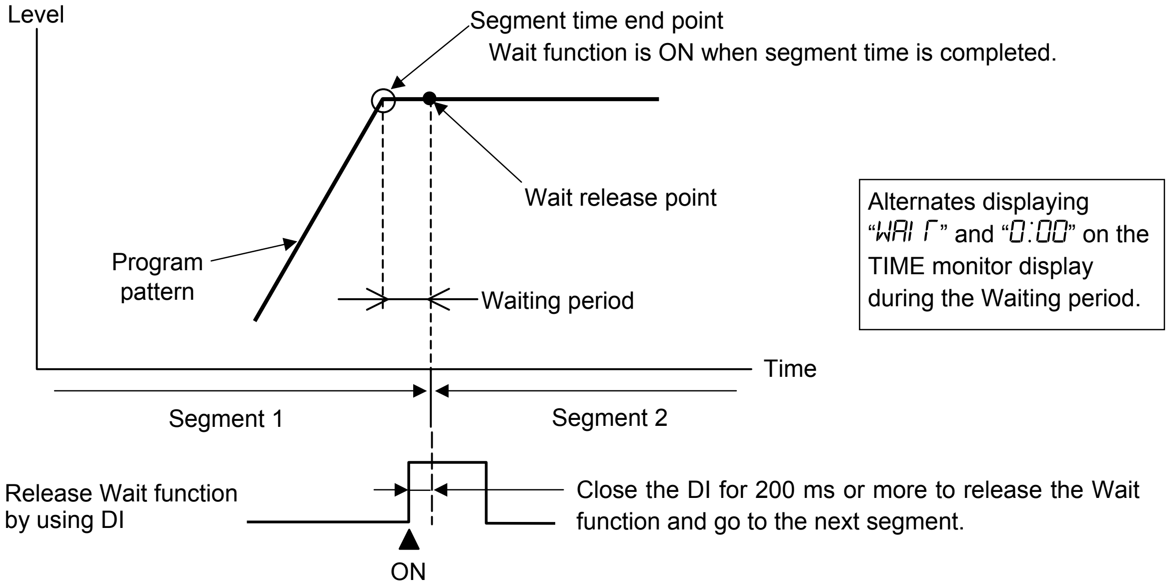
● Wait state by segment

Program is put on standby at Segment time end point and will not go to the next segment until the Digital input (DI) assigning Wait release is received.

Wait releasing condition: Close the DI assigning Wait release.

☞ For Wait releasing by using DI, refer to ■ **Wait state release (P. 6-21)** of **6.1.9 Digital input (DI)**.

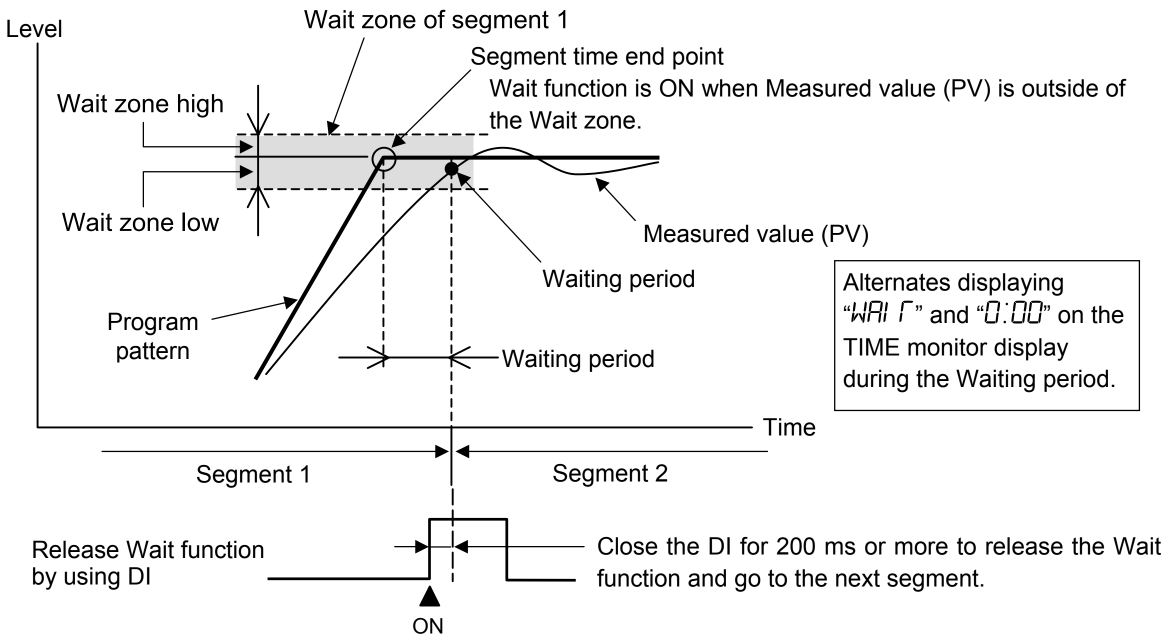
[Example]



Wait function is not possible when the DI (assigning Wait release) is closed.

Wait function can be released by using the Zone wait function and DI at the same time. Wait action is same as Zone wait function. Wait function is released when the Measured value (PV) reaches the Wait zone and the DI (assigning Wait release) is closed.

[Example: At Level rising]



● Wait releasing

How to release Wait function:

- By Wait zone judgment
- By Digital input (DI)
- By Wait time-out

☞ For Wait releasing by the Wait zone judgment, refer to **● Wait state by Wait zone (Zone wait function) (P. 6-158)**.

☞ For Wait releasing by using DI, refer to **● Wait state by segment (P. 6-159)** and **■ Wait state release (P. 6-21)** of **6.1.9 Digital input (DI)**.

- Wait release by Wait time-out

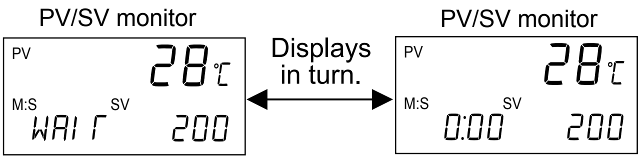
Wait state is released after the elapse of time being set.
Wait releasing by Wait time-out is available for both "Wait state by Wait zone" and "Wait state by segment."

Wait state will be released by performing STEP function or Forward/Back-up function when the program is in Wait state.

Wait state remains in effect when changing to the Fixed set point control mode (FIX) or the Manual control mode (MAN).

● Wait display

Alternates displaying "WAIT" and Segment remaining time (0:00) when the program is in Wait state.



■ Parameter setting

The setting related to Wait function is stored in Wait memory group. Group number can be set for each segment.

☞ For Wait memory group, refer to **6.6.1 Memory group (P. 6-144)**.

(1) Parameter setting to set Wait function by Wait zone

● Wait zone high/low

Set deviation setting against segment level by setting Wait zone high (ZoNE.H) and Wait zone low (ZoNE.L) individually.

Parameter symbol	Data range	Factory set value
ZoNE.H	TC/RTD inputs: 0 (0.0, 0.00) to 200 (200.0, 200.00) (Unit: °C [°F]) Voltage (V)/Current (I) inputs: 0.0 to 20.0 % of Input span 0 (0.0, 0.00): Wait zone high becomes OFF	0
ZoNE.L	TC/RTD inputs: −200 (−200.0, −199.99) to 0 (0.0, 0.00) (Unit: °C [°F]) Voltage (V)/Current (I) inputs: −20.0 to 0.0 % of Input span 0 (0.0, 0.00): Wait zone low becomes OFF	0

● Wait release trigger selection

Select Wait release method.
Set “1” at the one place to conduct Zone wait function (Wait releasing by Wait zone judgment).
When using Digital input (DI) in combination with Zone wait function, also set “1” at hundred places.

Parameter symbol	Data range	Factory set value
RE.TRG	00000 Zone wait 1 (the controller) [0: Invalidate, 1: Validate] Zone wait 2 (all slave controllers) [0: Invalidate, 1: Validate] Wait release by digital input (DI) [0: Invalidate, 1: Validate] Unused	00001

The ten places is for slave controller of the Intercontroller communication.

● Wait time-out set value

Set duration of Time-out for wait release by Time-out.

Parameter symbol	Data range	Factory set value
TM.oUT	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second) 0:00 (Hour: Minute or Minute: Second): Unused	0 hour 00 minute

☞ Set time unit at F80.05 in the Engineering mode. Refer to **4.5.5 Engineering mode (P. 4-44)**.

(2) Parameter setting to set Wait function by segment

● Digital input (DI) assignment

Assign Digital input (DI).
Set 2, 3 or 4 to set wait function for each segment.

Parameter symbol	Data range	Factory set value
dI SL	0 to 5 (For details, refer to DI Assignment Code Table)	0

DI Assignment Code Table

DI number	Set value					
	0 [a]	1 [a]	2	3 [b]	4	5
DI1	PTN1	PTN1	WAIT	WAIT	WAIT	WAIT
DI2	PTN2	PTN2	WAIT	WAIT	WAIT	WAIT
DI3	PTN4	PTN4	WAIT	WAIT	WAIT	WAIT
DI4	PTN8	PTN8	WAIT	WAIT	WAIT	WAIT
DI5	PTN16	PTN16	WAIT	WAIT	WAIT	WAIT
DI6	P. SET	P. SET	WAIT	WAIT	WAIT	WAIT
DI7	RESET	RESET	PTN1	PTN1	RESET	RESET
DI8	RUN	RUN	PTN2	PTN2	RUN	RUN
DI9	STEP	STEP	PTN4	PTN4	STEP	STEP
DI10	HOLD	PTN32	PTN8	PTN8	HOLD	HOLD
DI11	PTN32	PTN64	P. SET	PTN16	Direct/ Reverse	PNT_INC

- PTN1, 2, 4, 8, 16, 32, 64: Pattern number switch
- P. SET: Pattern set
- WAIT: Wait state release
- RESET: Reset mode (RESET) setting
- RUN: Program control mode (RUN) setting
- STEP: Step (STEP) function
- HOLD: Hold (HOLD) function
- Direct/Reverse: Direct/Reverse action switching
- PNT_INC: Pattern increment

[a] Setting zero (0) or "1" is suitable when DI1 to DI6 (optional) are specified at ordering.
[b] When selecting set value 3, the set value of the Pattern input method of Digital input (DI) should be changed to 1 or 3. (For details, refer to **P. 6-29**.)

● Wait release trigger selection

Select Wait release method.
Set "0" at the one place and "1" at hundred places set Wait function for each segment.

Parameter symbol	Data range	Factory set value
RE.TRG	00000 One place: Zone wait 1 (the controller) [0: Invalidate, 1: Validate] Ten places: Zone wait 2 (all slave controllers) [0: Invalidate, 1: Validate] Hundred places: Wait release by digital input (DI) [0: Invalidate, 1: Validate] Thousand and ten-thousand places: Unused	00001

The ten places is for slave controller of the Intercontroller communication.

● Wait time-out set value

Set duration of Time-out for wait release by Time-out.

Parameter symbol	Data range	Factory set value
TM.OUT	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second) 0:00 (Hour: Minute or Minute: Second): Unused	0 hour 00 minute

☞ Set time unit at F80.05 in the Engineering mode. Refer to **4.5.5 Engineering mode (P. 4-44)**.

■ Setting procedure

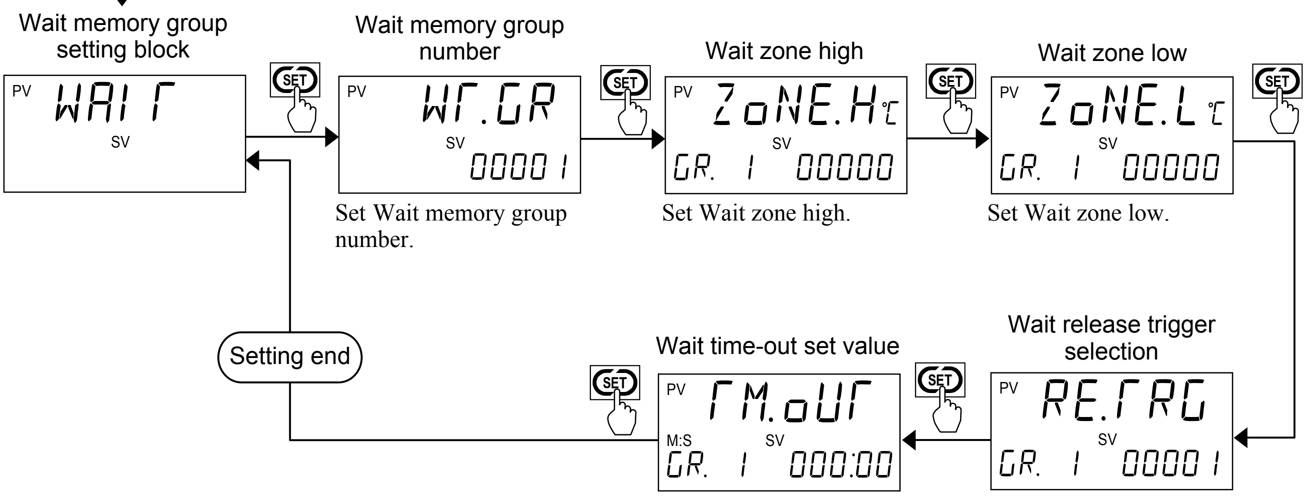
- Wait zone high/low, Wait release trigger selection and Wait time-out set value can be set in the Parameter setting mode (Wait memory group setting block).
- Digital input (DI) assignment can be set at F23 in the Engineering mode.

● Parameter setting for the Parameter setting mode (Partial setting type)

☞ For the Batch setting type, refer to ■ **Setting type for Program pattern (P. 4-17)** of **4.5.3 Parameter setting mode**.

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

2. Press the ⋀ key until the Wait memory group setting block screen displays



Set Wait memory group number.

Set Wait zone high.

Set Wait zone low.

Set Wait time-out set value.

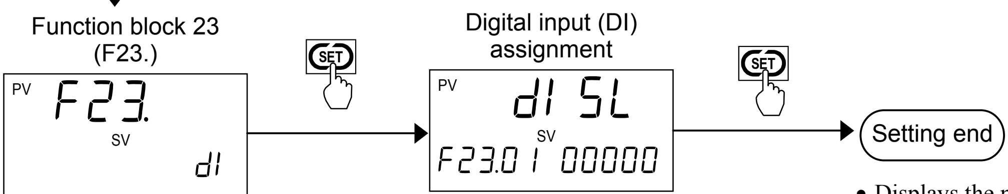
Set Wait release method.

● Parameter setting at F23 in the Engineering mode

1. Press the RESET key to go to the Reset mode (RESET).

2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.

3. Keep pressing the ⋀ key until the F23 screen displays.



Set the DI function.

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 23 (F23.).

6.6.7 Repeat and Pattern link

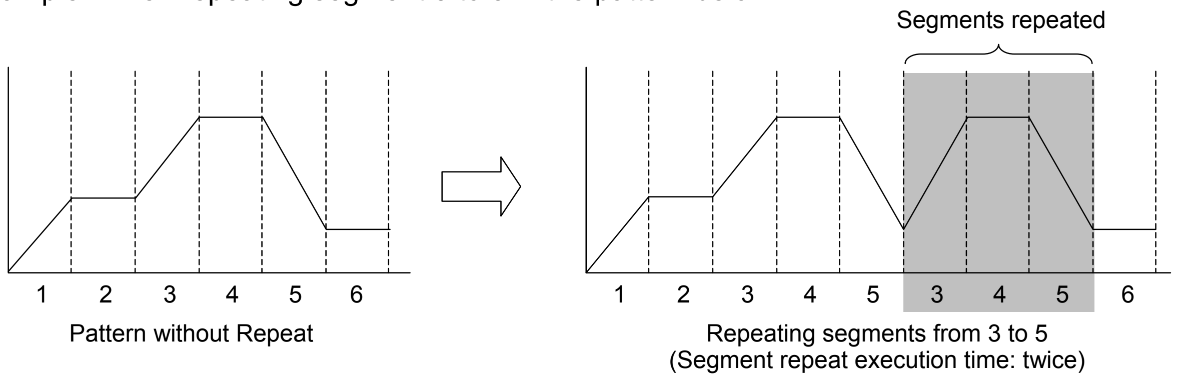
Repeat function: Repeat the program entirely or partially for the number of Repeat times. Segment repeat and Pattern repeat are available.
Pattern link: Link the program patterns.

■ Description of function

● Segment repeat

Repeat segments being selected in the Program pattern for the number of Segment repeat time.
Set Start segment, End segment and Segment repeat time for each pattern.

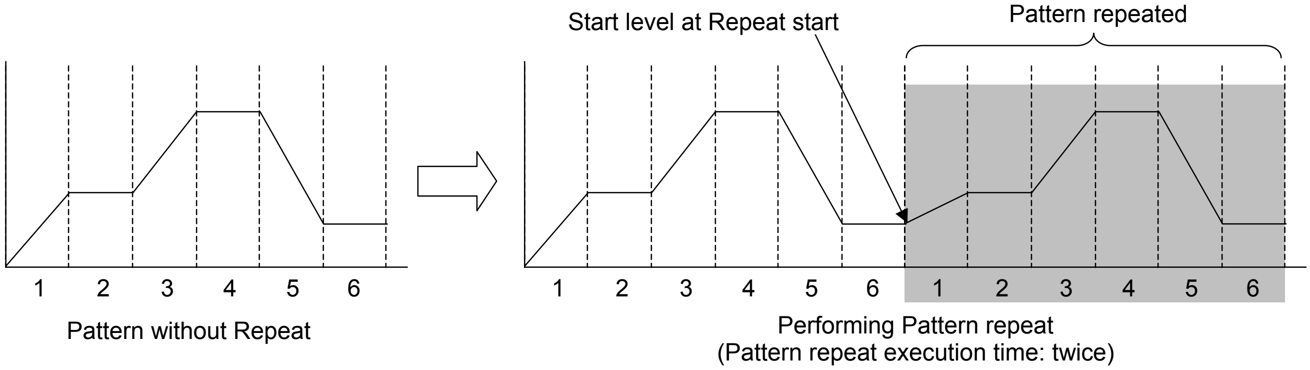
Example: When repeating segment 3 to 5 in the pattern below



● Pattern repeat

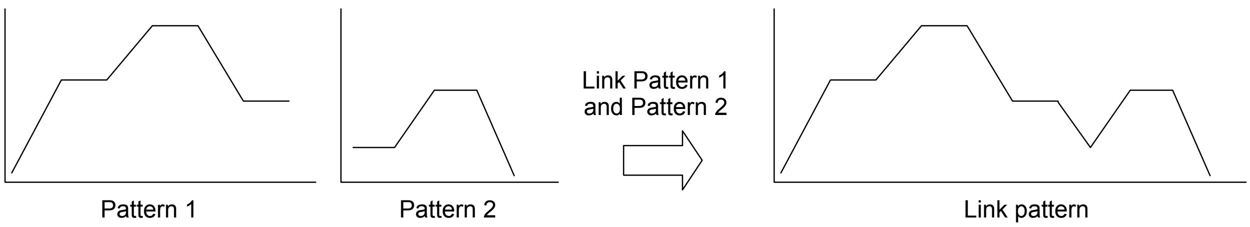
Repeat the program pattern for the number of Pattern repeat time. The level at pattern end becomes the start level of the repeated pattern.
Set Repeat time for each pattern.

Example: When repeating the pattern below



● Pattern link

Link program patterns by setting pattern numbers.



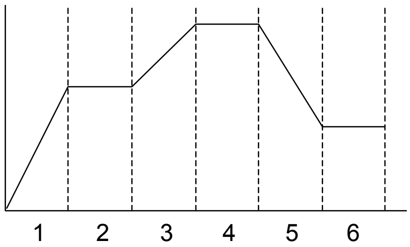
● Combination of Repeat function and Pattern link

Segment repeat, Pattern repeat and Pattern link may be used at the same time.

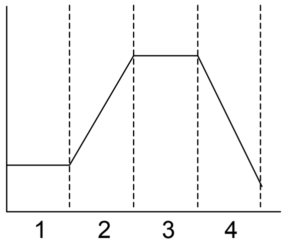
Order of action: Segment repeat > Pattern repeat > Pattern link

Example: Perform following Repeat function and Pattern link:

- Repeat Segments from 3 to 6 of the Pattern 1.
- Repeat Pattern 1.
- Link Pattern 1 and Pattern 2.
- Repeat Total pattern (linked patterns of Pattern 1 and Pattern 2)

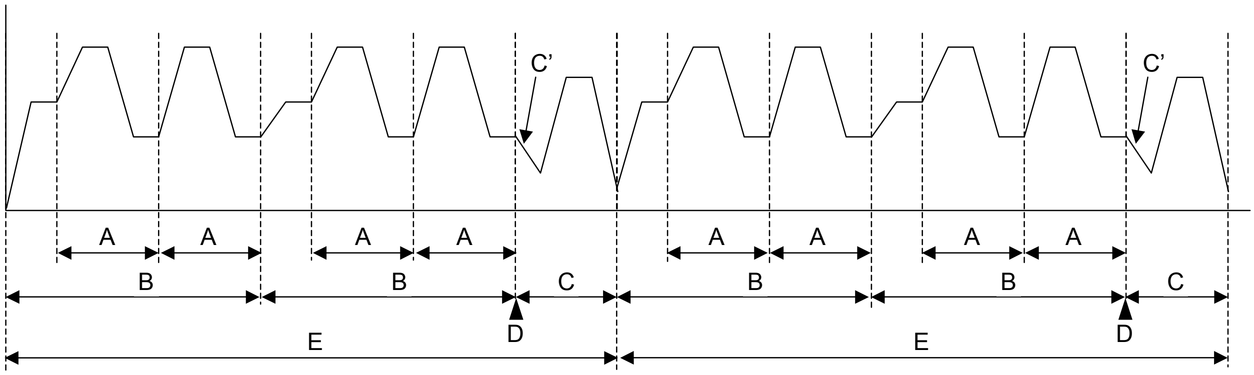


Pattern 1



Pattern 2

Program pattern composed by Repeat function and Pattern link



A: Repeating Segments from 3 to 6
B: Repeating Pattern 1
C: Pattern 2
D: Linking Pattern 1 and Patten 2
E: Repeating Total pattern *
* Repeat Total pattern (linked patterns)

C': The segment between Pattern 1 and Pattern 2 becomes ramp segment as there is a difference between the last segment level of Pattern 1 and the first segment level of Pattern 2.

[Parameter setting]

Pattern 1:	Segment repeat start/end number:	Start number: 3	
		End number: 6	
	Segment repeat execution time:	2 (A in the above diagram)	
	Pattern repeat execution time:	2 (B in the above diagram)	
	Link pattern number:	2 (D in the above diagram)	
Pattern 2:	Segment repeat start/end number:	Start number: 1 (factory set value)	
		End number: 1 (factory set value)	
	Segment repeat execution time:	1 (No segment repeat)	
	Pattern repeat execution time:	2 (E in the above diagram)	← Repeat setting of Total pattern
	Link pattern number:	0 (No pattern link)	

☞ It is possible to produce Pattern end signal at Pattern repeat and Pattern link. For details, refer to **6.6.8 Pattern end (P. 6-169)**.

■ Parameter setting

● Segment repeat start/end number

Set Start segment number and End segment number of Segment repeat.

Parameter symbol	Data range	Factory set value
STEd	Start number (ST): 1 to 99 End number (Ed): 1 to 99 Within the maximum segment number	1

● Segment repeat execution time

Set Segment repeat execution time.

Parameter symbol	Data range	Factory set value
RPT.SG	1 to 9999 times 1: No segment repeat	1

● Pattern repeat execution time

Set Pattern repeat execution time.

Parameter symbol	Data range	Factory set value
RPT.PN	1 to 10000 times 1: No pattern repeat 10000: No limit	1

● Link pattern number

Set Pattern number to be linked next.

Parameter symbol	Data range	Factory set value
LNK.PN	0 to 99 (Within the maximum pattern number) 0: No pattern link	0

● Repeat remaining process/program progression display selection

Select type of monitoring display between “Segment repeat remaining time” and “Segment repeat execution time.”

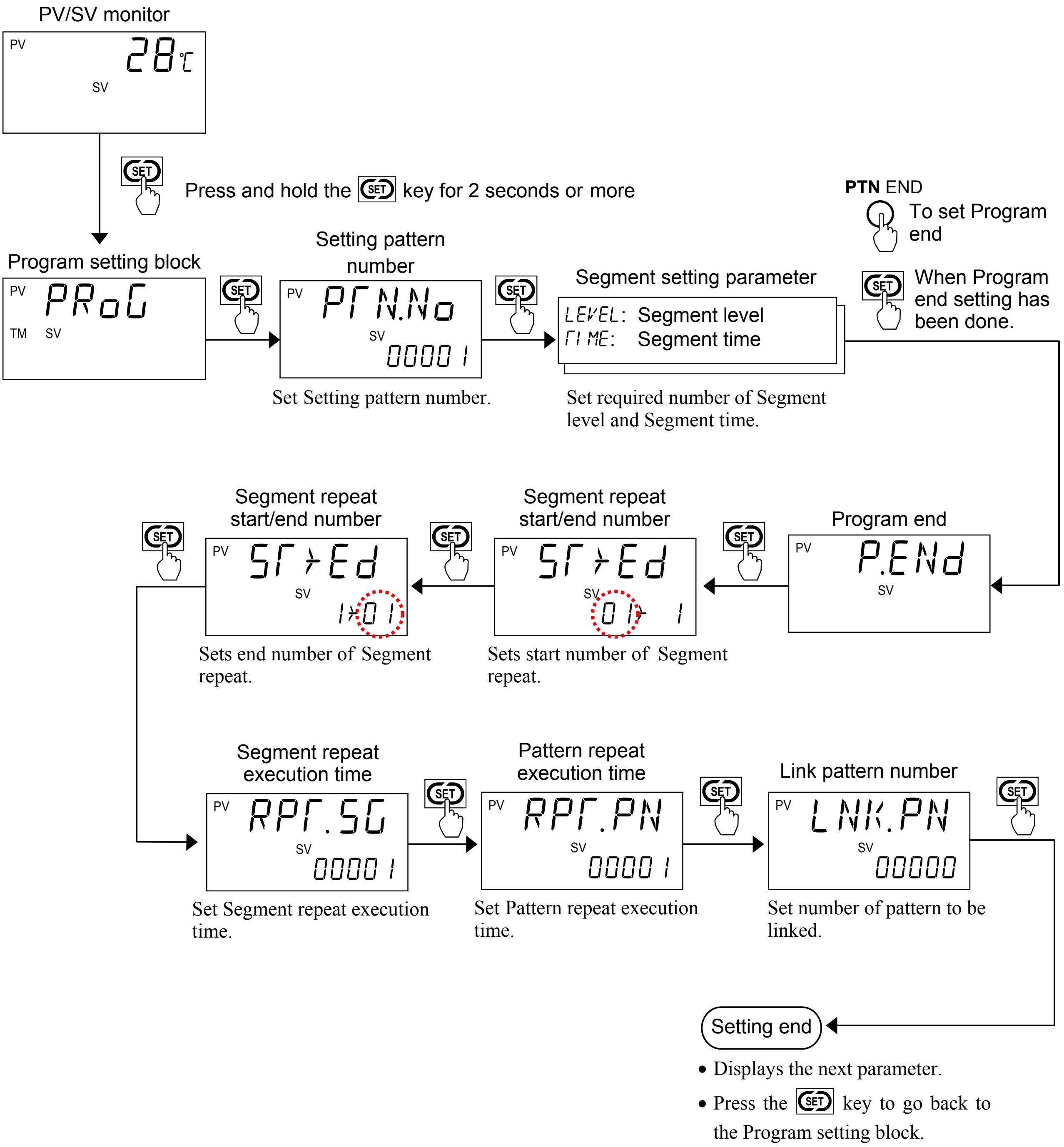
Parameter symbol	Data range	Factory set value
RPT.SL	0: Segment repeat remaining time 1: Segment repeat execution time	0

■ Setting procedure

Set parameter setting related to Repeat function at Program setting block in the Parameter setting mode.
For Repeat remaining process/program progression display selection, go to F10.12 in the Initial level engineering mode.

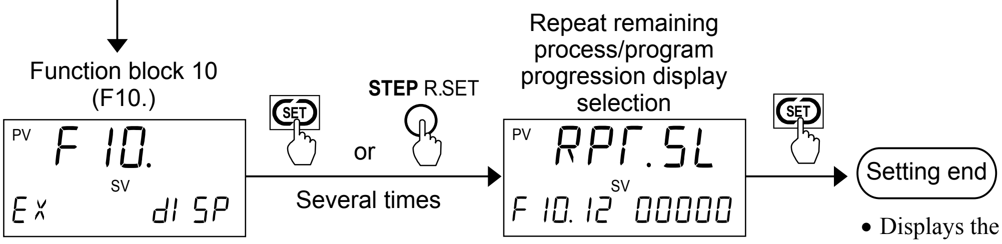
● Parameter setting for the Parameter setting mode (Partial setting type)

☞ For the Batch setting type, refer to ■ **Setting type for Program pattern (P. 4-17)** of **4.5.3 Parameter setting mode**.



● Parameter setting for Engineering mode (including Initial level engineering mode)

1. Press the RESET key to go to the Reset mode (RESET).
2. Go to the Initial level engineering mode by pressing and holding the SET key, the <MODE key and the ∨ key for 2 seconds or more.

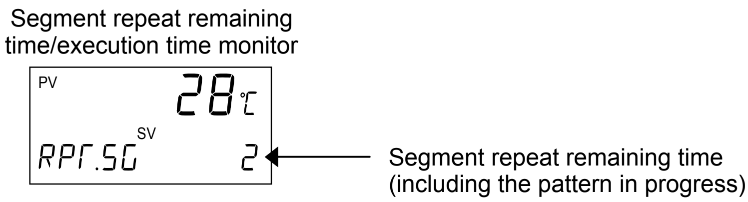


Select type of monitoring display between "Segment repeat remaining time" and "Segment repeat execution time."

- Displays the next parameter.
- Press the STEP R.SET key while pressing the SET key to go back to the function block 10 (F10.).

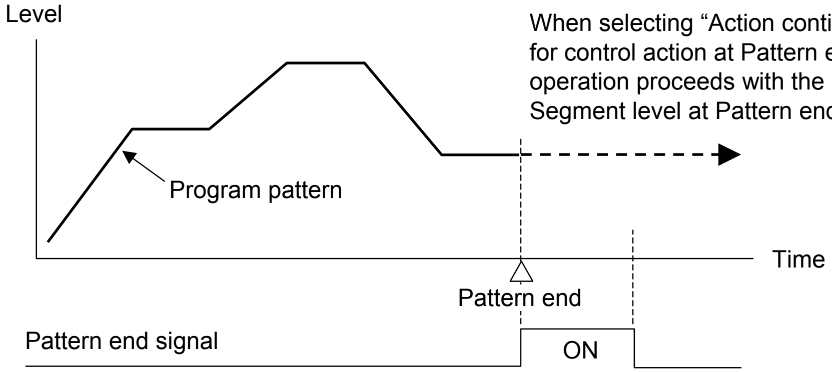
When "0" is set at Repeat remaining process/program progression display selection, the remaining time of Segment repeat (including the repeat in progress) will display at the Segment repeat remaining time/execution time monitor when the MONI key is pressed during the Program control operation.
When setting "1" at Repeat remaining process/program progression display selection, the Segment repeat execution time displays.
The displays of Pattern repeat remaining time/execution time monitor and Total pattern remaining time/execution time monitor is the same as above.

Display example:



6.6.8 Pattern end

Pattern end signal is produced when program is done. Control action at Pattern end may also be selected.



■ Description of function

● Action at Pattern end

Pattern end signal: A Pattern end signal may be created from OUT2, OUT3 or Digital output (DO) as an Event output. When setting "0:00" to the duration, output is continuously produced until the operation mode switches to the Reset mode.

Control action selection:

PID control, Heat/Cool PID control or Position proportioning PID control (With FBR input):
Control continued or Control stop

Position proportioning PID control (When there is no FBR input or the FBR input is break):
- Control continued
- Open-side output OFF, Close-side output OFF
- Open-side output OFF, Close-side output ON
- Open-side output ON, Close-side output OFF

Event state: Action OFF or Action continued (selectable for each Event)

Transmission output state:
Action OFF or Action continued (selectable for each output)

Pattern end output at Pattern repeat or Pattern link:
OFF or ON (0.5 seconds)

It is not possible to invalidate the Pattern end output by setting the Pattern end output duration. When Pattern end output is not required, do not assign Pattern end output at Output function selection.

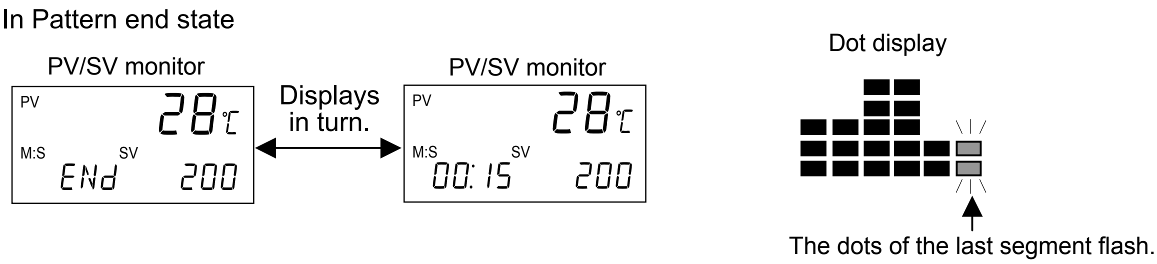
"Control stop" or "Control continued" can be set for Control action selection at Pattern end of F50.07 in the Engineering mode when Output program value is assigned to OUT1.

Pattern end signal goes OFF when switching to the Fixed set point control mode (FIX), the Manual control mode (MAN) or the Reset mode (RESET). Pattern end signal turns ON when returning to the Program control mode (RUN).

☞ For Pattern end output assignment, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)** and **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**.

● Pattern end display

Alternately displays "ENd" and the remaining time of the Pattern end output duration when the operation is in the Pattern end state. After the elapse of Pattern end output duration only "ENd" flashes.
At the Dot display, the dots of the last segment of the Program pattern flash.

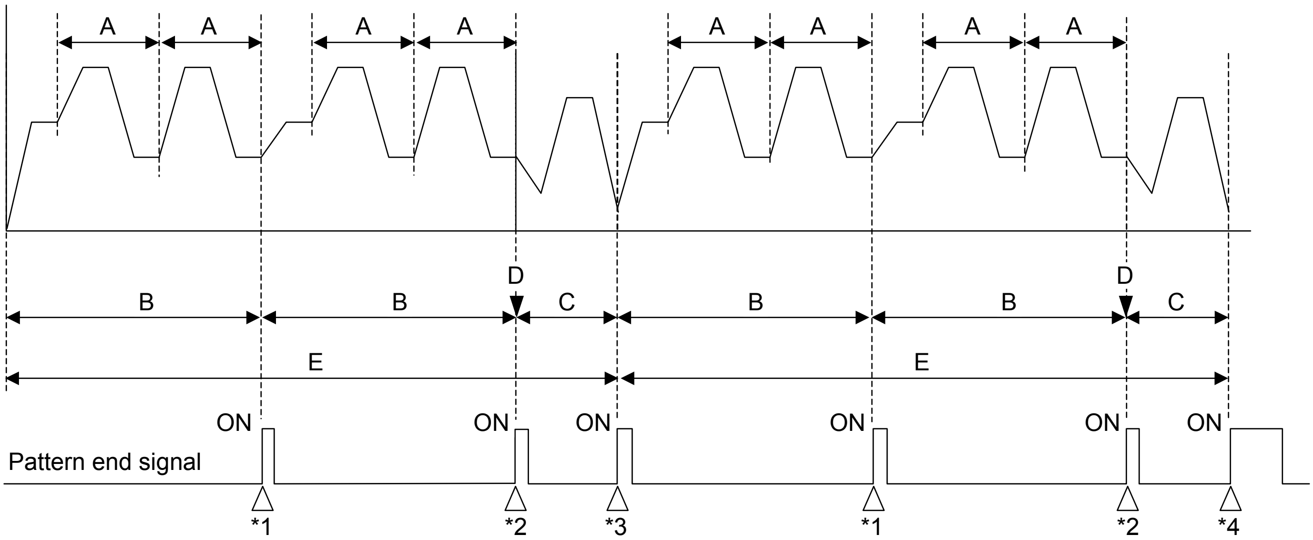


HOLD function is operative when the remaining time of the Pattern end output is displayed. When the operation is in HOLD state, time counting of the remaining time is suspended but Pattern end output remains ON. HOLD function is invalidated when the remaining time of the Pattern end output is zero (0).

● Pattern end output action at Repeat or Link

It is possible to produce Pattern end signal for 0.5 seconds (fixed) when shifting to the segment of Pattern repeat, Total Pattern repeat or Pattern link.

Example: Program pattern composed by Repeat function and Pattern link



A: Repeating Segments from 3 to 6
B: Repeating Pattern 1
C: Pattern 2
D: Linking Pattern 1 and Patten 2
E: Repeating Total pattern *
* Repeat Total pattern (linked patterns)

*1: Pattern end signal for Pattern repeat (ON for 0.5 seconds) *2: Pattern end signal for Pattern link (ON for 0.5 seconds) *3: Pattern end signal for Total Pattern repeat (ON for 0.5 seconds) *4: Pattern end signal for Pattern 2 (ON within the Pattern end output duration being set.)

For the pattern diagram above, also refer to ● **Combination of Repeat function and Pattern link (P. 6-165)**.

■ Parameter setting

● Pattern end output duration

Set the duration of the Pattern end signal.

Parameter symbol	Data range	Factory set value
ENd.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second) Output remains ON at 0:00 (Hour: Minute or Minute: Second)	0 hour 00 minute

☞ Set time unit at F80.05 in the Engineering mode. Refer to **4.5.5 Engineering mode (P. 4-44)**.

● Control action at Pattern end

Set control action at Pattern end.

Parameter symbol	Data range	Factory set value
ENd.P	PID control, Heat/Cool PID control or Position proportioning PID control (With FBR input): 0: Control continued 1: Control stop Position proportioning PID control (When there is no FBR input or the FBR input is break): 0: Control continued 1: Open-side output OFF, Close-side output OFF 2: Open-side output OFF, Close-side output ON 3: Open-side output ON, Close-side output OFF	0

● Transmission output action at Pattern end

Set action of Transmission output at Pattern end.

Parameter symbol	Data range	Factory set value
P.Ed.Ao	0: Action stop 1: Action continued 00000 ← Value at SV display OUT2 OUT3 Unused	00000

● Event action at Pattern end

Set event action at Pattern end.

Parameter symbol	Data range	Factory set value
P.Ed.EV	0: Action stop 1: Action continued 00000 ← Value at SV display Event 1 Event 2 Event 3 Event 4 HBA1, HBA2	00000

● Pattern end output action at Pattern repeat/Pattern link

Set Pattern end output action at Pattern repeat/Pattern link.

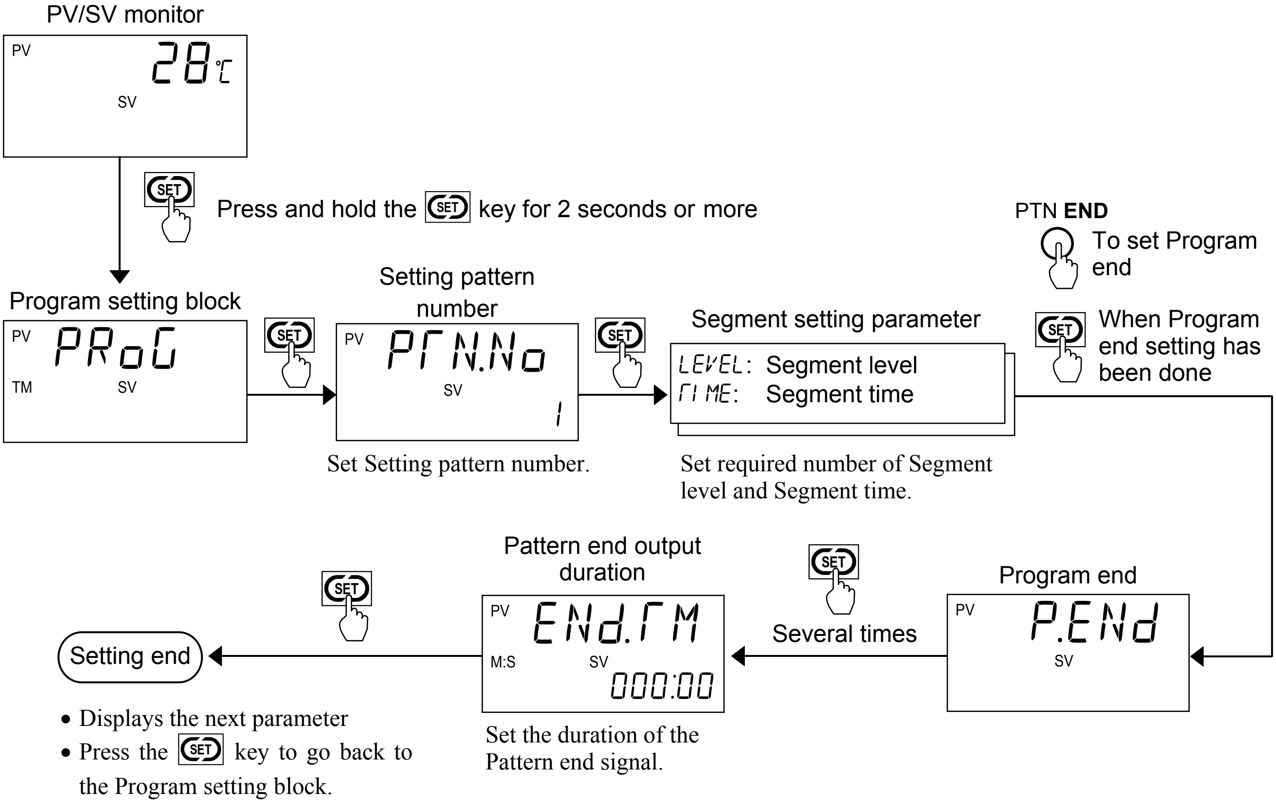
Parameter symbol	Data range	Factory set value
PE.SL	0: OFF 1: ON (0.5 seconds) 00000 ← Value at SV display Pattern end output is ON at Pattern repeat. Pattern end output is ON at Total pattern repeat. Pattern end output is ON at Pattern link. Unused	00000

■ Setting procedure

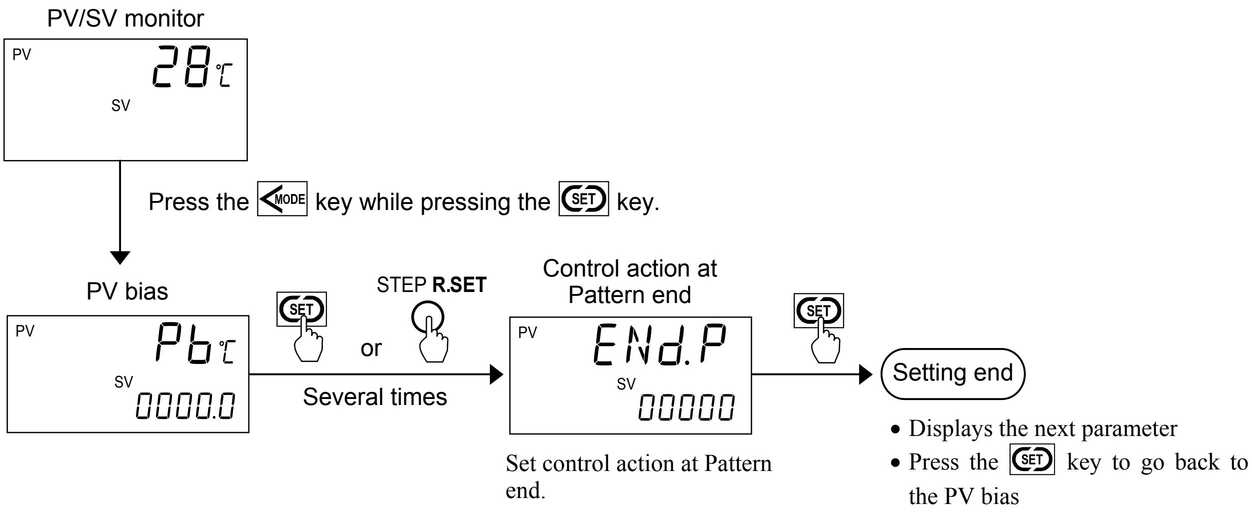
- Pattern end output duration can be set in the Parameter setting mode (Program setting block).
- Control action at pattern end can be set in the Setup setting mode.
- Transmission output action at Pattern end and Event action at Pattern end can be set at F30 in the Engineering mode.
- Pattern end output action at Pattern repeat/Pattern link can be set at F80 in the Initial level engineering mode.

● Parameter setting for the Parameter setting mode (Partial setting type)

☞ For the Batch setting type, refer to ■ **Setting type for Program pattern (P. 4-17)** of **4.5.3 Parameter setting mode**.

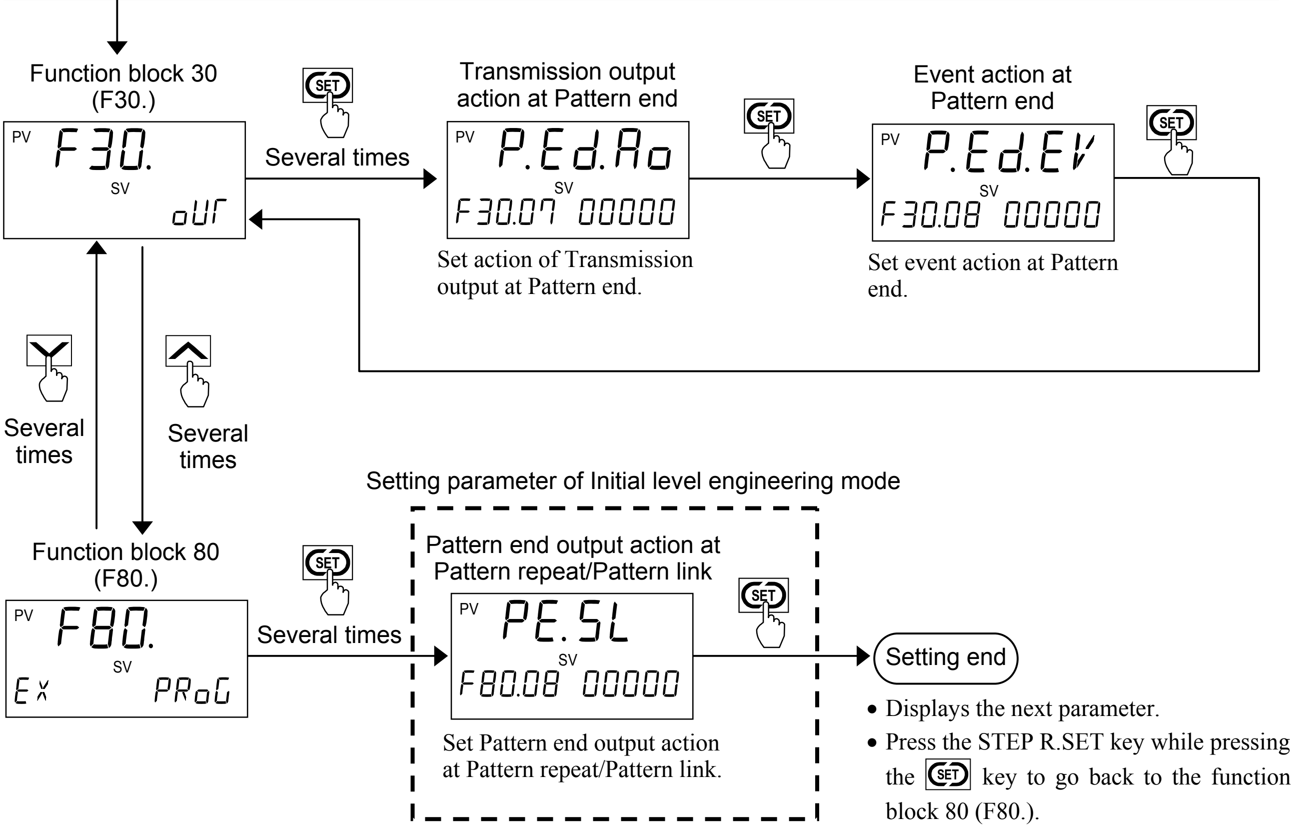


● Parameter setting for the Setup setting mode



● Parameter setting for Engineering mode (including Initial level engineering mode)

1. Press the RESET key to go to the Reset mode (RESET).
2. Go to the Initial level engineering mode by pressing and holding the SET key, the <MODE key and the ∨ key for 2 seconds or more.
3. Keep pressing the ∧ key until the F30 screen displays.



6.6.9 Time signal (Segment signal)

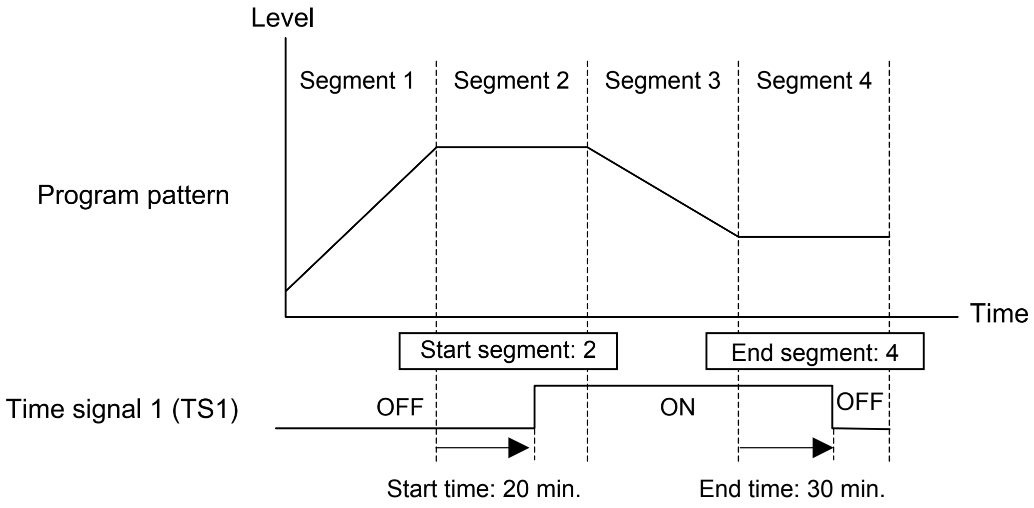
Time signal (Segment signal) is a function to produce ON/OFF signals along the state of progress of the program to the external devices such as Sequencer and Alarm unit. Only Time signal or Segment signal is selectable.

■ Description of function

Time signal:

It is possible to produce a signal over two or more segments by setting Start/End segment number and Start/End time.

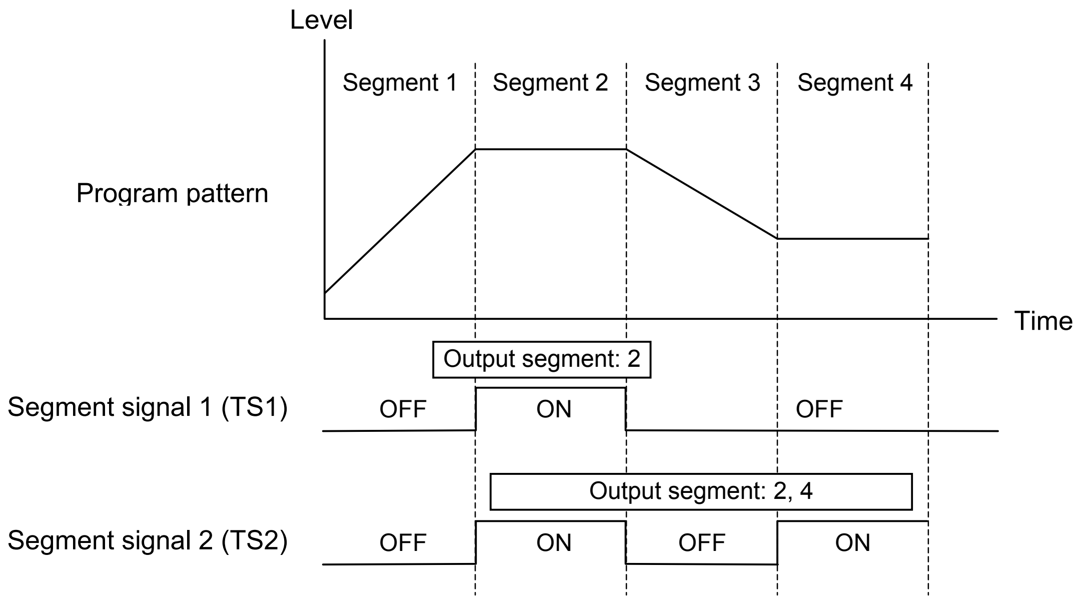
[Image of Time signal]



Segment signal:

The signal is produced on a segment basis. Set ON or OFF to each segment of the Segment signal 1 through 8 (TS1 to TS8).

[Image of Segment signal]



● Time signal (Segment signal) output

Number of Time signal (Segment signal): 8 points (TS1 to TS8)
Time signal (Segment signal) output assignment: Up to 14 points (OUT2, OUT3, DO1 to DO12)

☞ For Time signal (Segment signal) output assignment, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)** and **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**.

● Time signal (Segment signal) during AT

It is possible to set Time signal (Segment signal) action during Autotuning (AT).

Time signal OFF: Time signal (Segment signal) action stops during Autotuning (AT). When completing AT, Time signal (Segment signal) action restarts as set.

Time signal ON: Time signal (Segment signal) action continues during Autotuning (AT).

📖 When setting "Time signal ON," Time signal (Segment signal) action continues while the operation is on HOLD by Autotuning (AT) in the Program control mode.

📖 Time signal is not produced during AT with learning function.

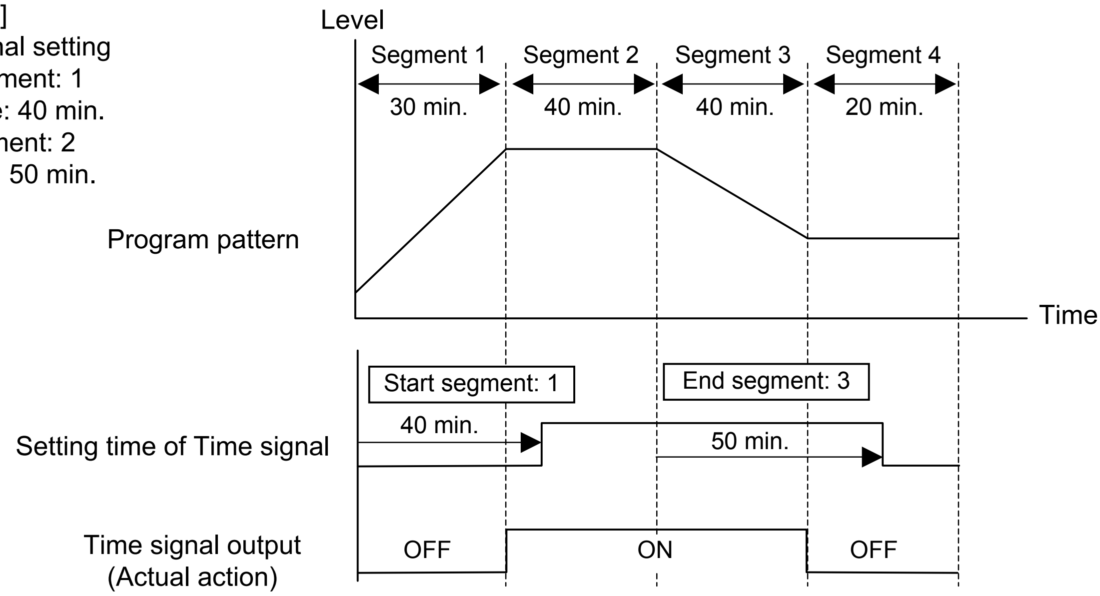
● Precaution for Time signal setting

• For Time signal, set smaller numbers to Start segment rather than End segment. Time signal output is not produced if the number of Start segment is larger than the End segment.

Start segment < End segment

• When the duration of the Start segment is larger than Segment time in progress, Time signal turns ON in the next segment. When the duration of the End segment is larger than Segment time in progress, Time signal turns OFF in the next segment.

[Example]
Time signal setting
Start segment: 1
Start time: 40 min.
End segment: 2
End time: 50 min.



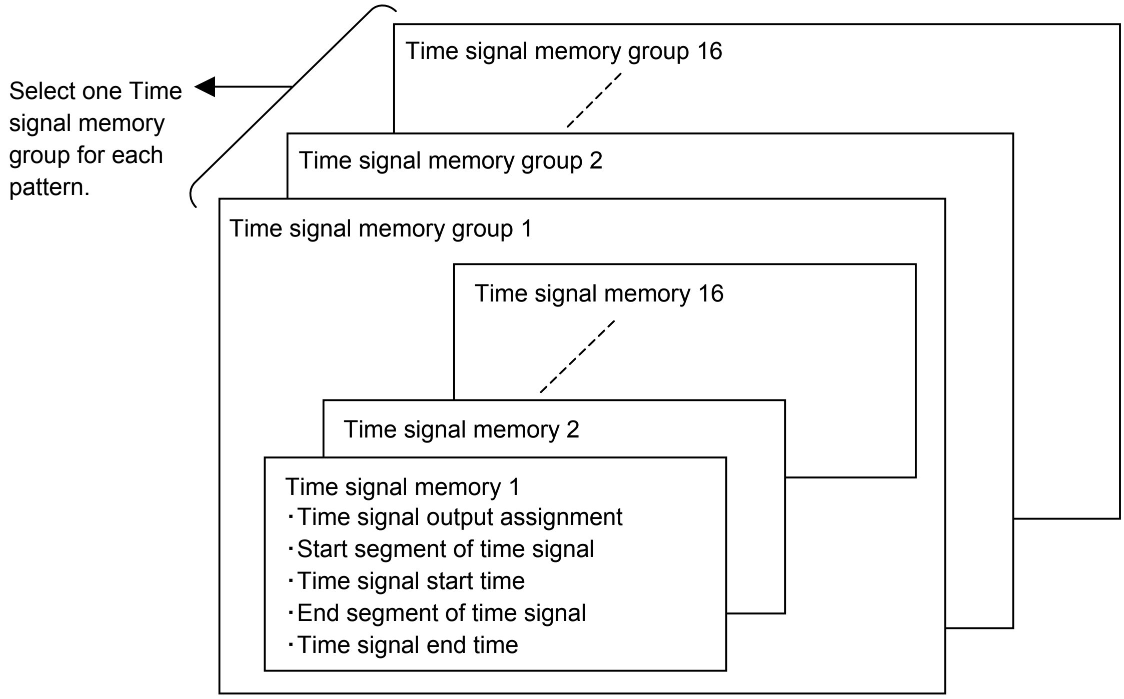
If the End segment is the final segment of the pattern and duration of the End segment is longer than the final segment, Time signal will go OFF in Pattern end state. When the program is linked (Pattern link) or repeated (Pattern repeat), Time signal action continues by following the program.

If the duration of End time of Time signal and the Segment time in progress is equal, Time signal goes off when Wait function is performed. (The extended time by Wait function is not considered.) If the duration of End time of Time signal is longer than the Segment time in progress, Time signal remains ON when Wait function is performed. (The extended time by Wait function is considered to be a part of the duration of Time signal since the segment in progress is the final segment of the program.)

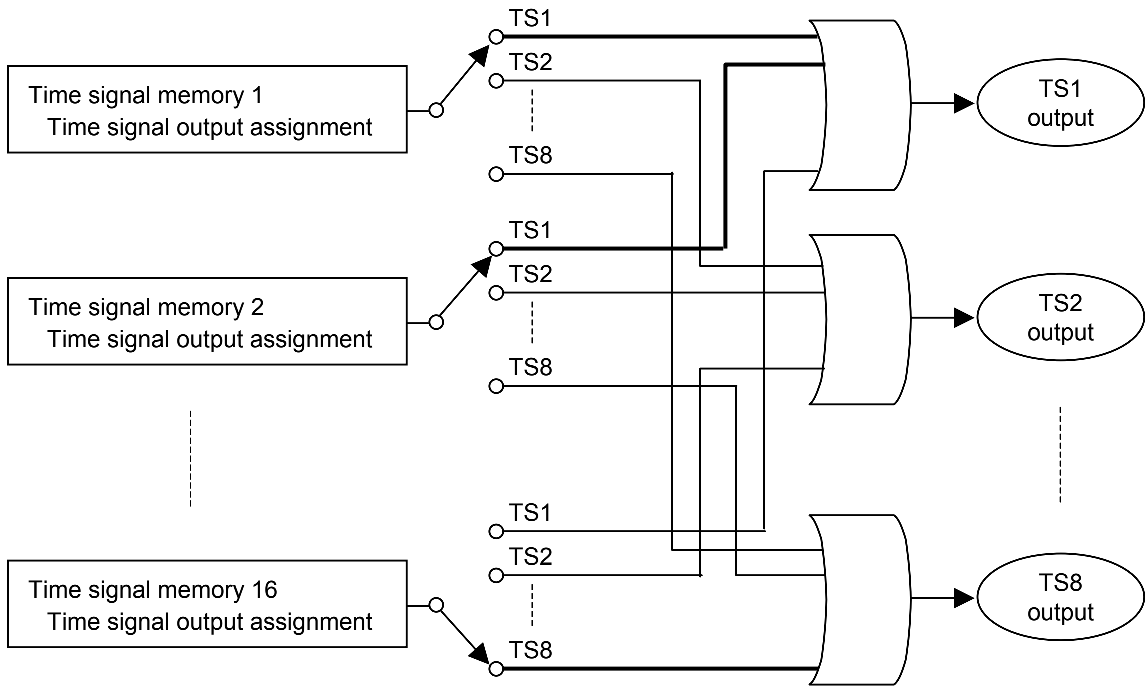
When the Time signal is ON, switching the operation mode to the Fixed set point control mode (FIX) or the Manual mode (MAN) turns OFF the Time signal. Time signal turns ON when switching to the Program control mode (RUN).

● Time signal memory group

Select one Time signal memory group for each pattern (up to 16 memory groups are available). Memory group consists of 16 memories and each one of the memories is used for setting each Time signal.
When several Time signals are assigned to one Time signal output, signal will be produced by logical *OR*.

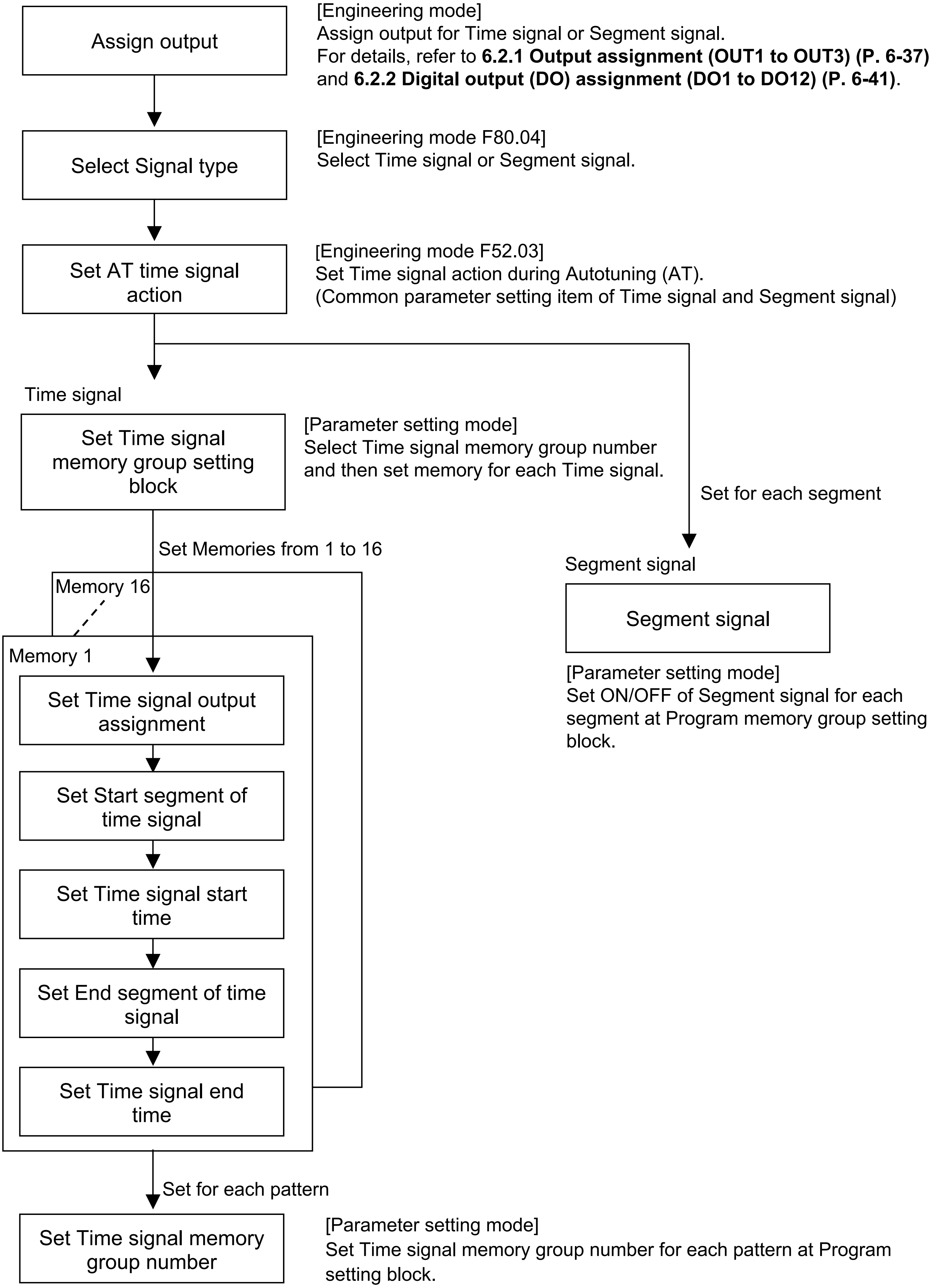


[Outline of Time signal output]



Time signal 1 (TS1) turns ON when either Time signal memory 1 or 2 turns ON as Time signal 1 (TS1) output is selected to be the output assignment of Time signal memory 1 and 2 in the above diagram.

■ Setting procedure flowchart



■ Parameter setting

(1) Time signal type or Segment signal type

● Signal type

Select Time signal or Segment signal.

Parameter symbol	Data range	Factory set value
TS.TYP	0: Time signal type 1: Segment signal type	0

(2) Common parameter setting item of Time signal and Segment signal

● AT Time signal action

Set Time signal action during Autotuning (AT).

Parameter symbol	Data range	Factory set value
ATTS	0: Time signal OFF 1: Time signal ON	0

(3) Parameter setting item of Time signal

Settings related to Time signal are stored as Time signal memory group in the Parameter setting mode.

● Time signal memory group number

Set Time signal memory group number for each pattern.

Parameter symbol	Data range	Factory set value
TS.GR	0 to 16 0: No assignment	1

● Time signal output assignment

Set output assignment of Time signal for each memory.

Parameter symbol	Data range	Factory set value
01.oUT	1 to 8: Time signal 1 to 8 0: No assignment	0

● Start segment of time signal

Set Start segment number of Time signal.

Parameter symbol	Data range	Factory set value
01.S.SN	1 to 99 Within the maximum segment number.	1

● Time signal start time

Set duration of Start time of Time signal start segment.

Parameter symbol	Data range	Factory set value
01.S.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute

☞ Set time unit at F80.05 in the Engineering mode. Refer to **4.5.5 Engineering mode (P. 4-44)**.

● End segment of time signal

Set End segment number of Time signal.

Parameter symbol	Data range	Factory set value
01.E.SN	1 to 99 Within the maximum segment number.	1

● Time signal end time

Set duration of End time of Time signal end segment.

Parameter symbol	Data range	Factory set value
01.E.TM	From 0:00 to 500:00 (Hour: Minute), or from 0:00 to 500:00 (Minute: Second)	0 hour 00 minute

☞ Set time unit at F80.05 in the Engineering mode. Refer to **4.5.5 Engineering mode (P. 4-44)**.

(4) Parameter setting item of Segment signal

● Segment signal

Set ON/OFF to Segment signal for each segment.

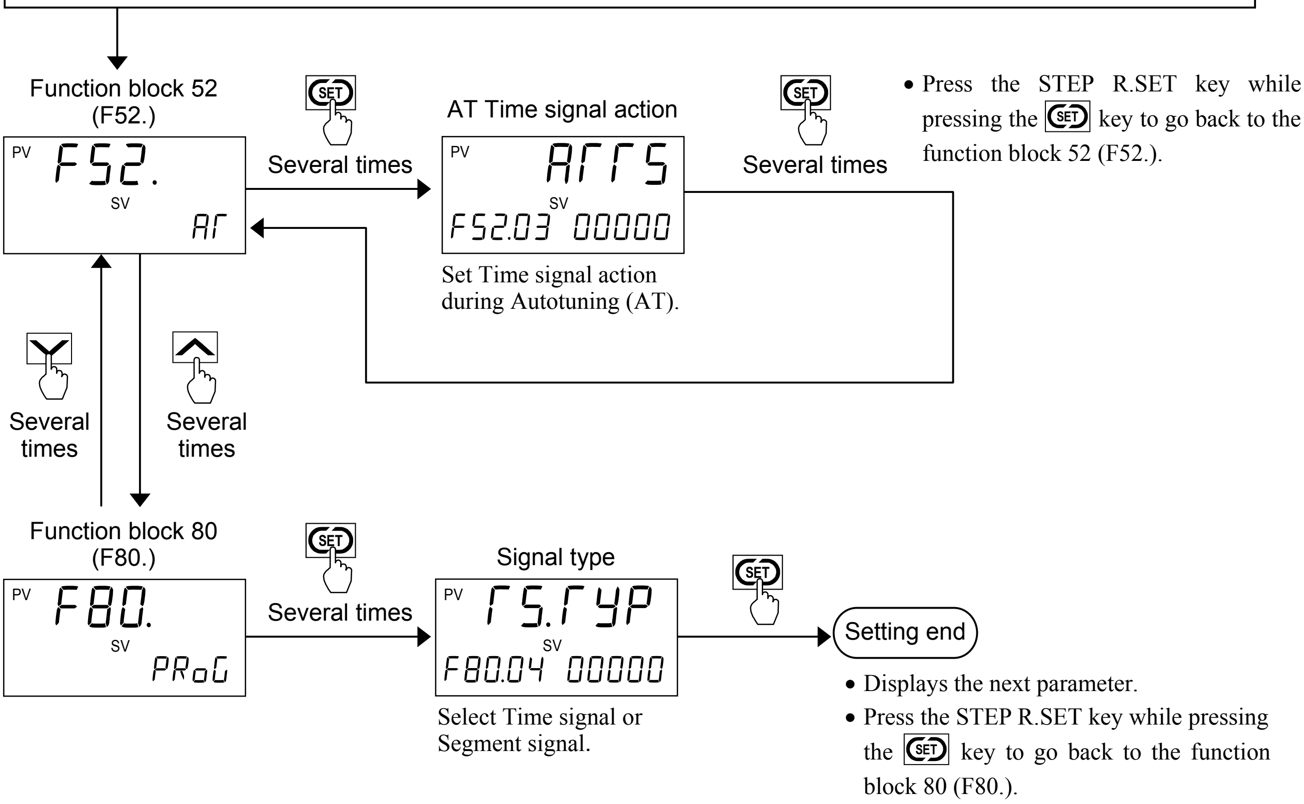
Parameter symbol	Data range	Factory set value
SIGNL	0: OFF 1: ON 00000000 ← Value at SV display Segment signal 1 Segment signal 2 Segment signal 3 Segment signal 4 Segment signal 5 Segment signal 6 Segment signal 7 Segment signal 8	00000000

■ Setting procedure

- Signal type can be set at F80.04 in the Engineering mode.
- AT time signal action can be set at F52.03 in the Engineering mode.
- Time signal memory group number can be set in the Parameter setting mode (Program setting block).
- Time signal memory group number, Time signal output assignment, Start segment of time signal, Time signal start time, End segment of time signal and Time signal end time can be set in the Parameter setting mode (Time signal memory group setting block).
- Segment signal can be set in the Parameter setting mode (Program memory group setting block).

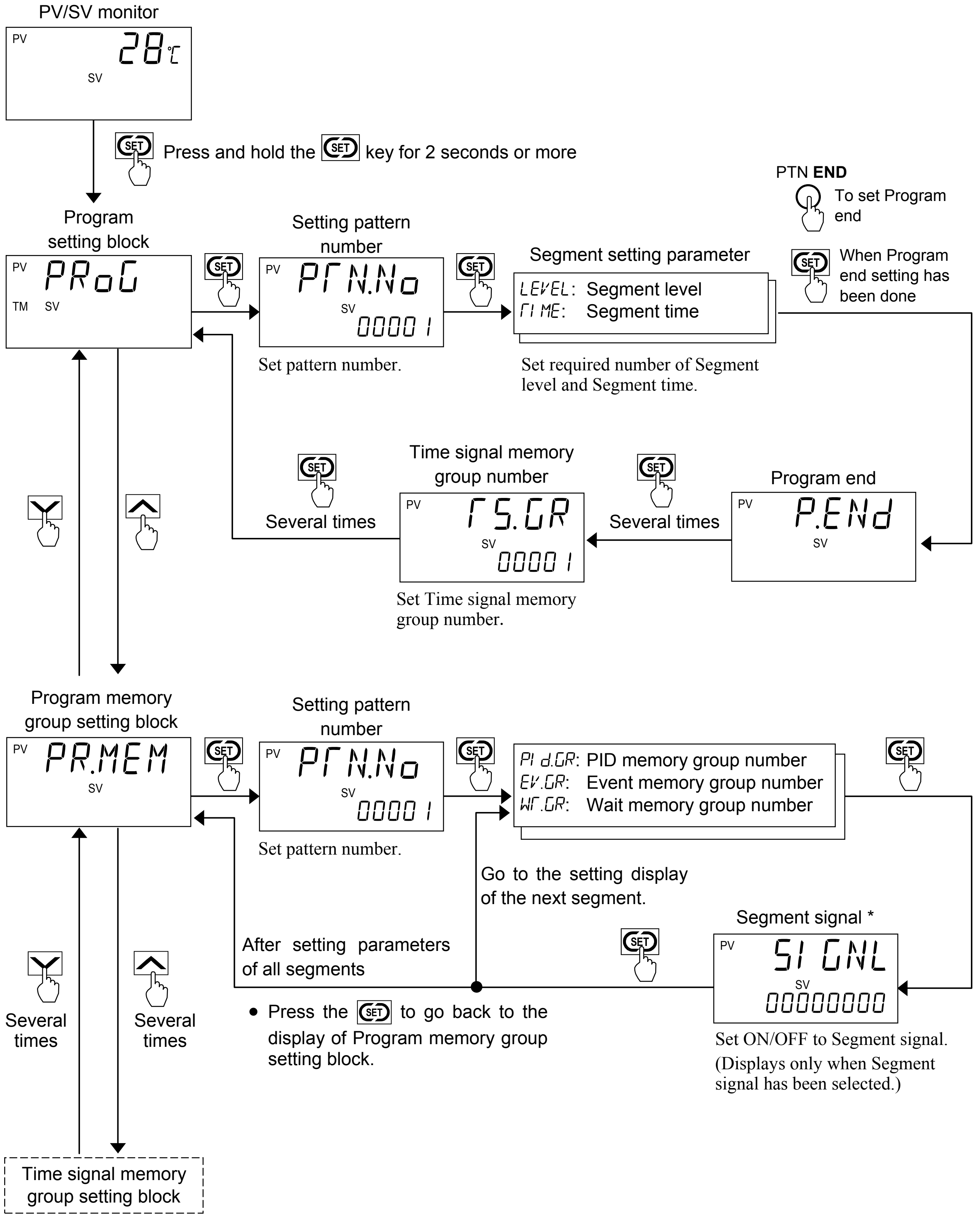
● Parameter setting for Engineering mode

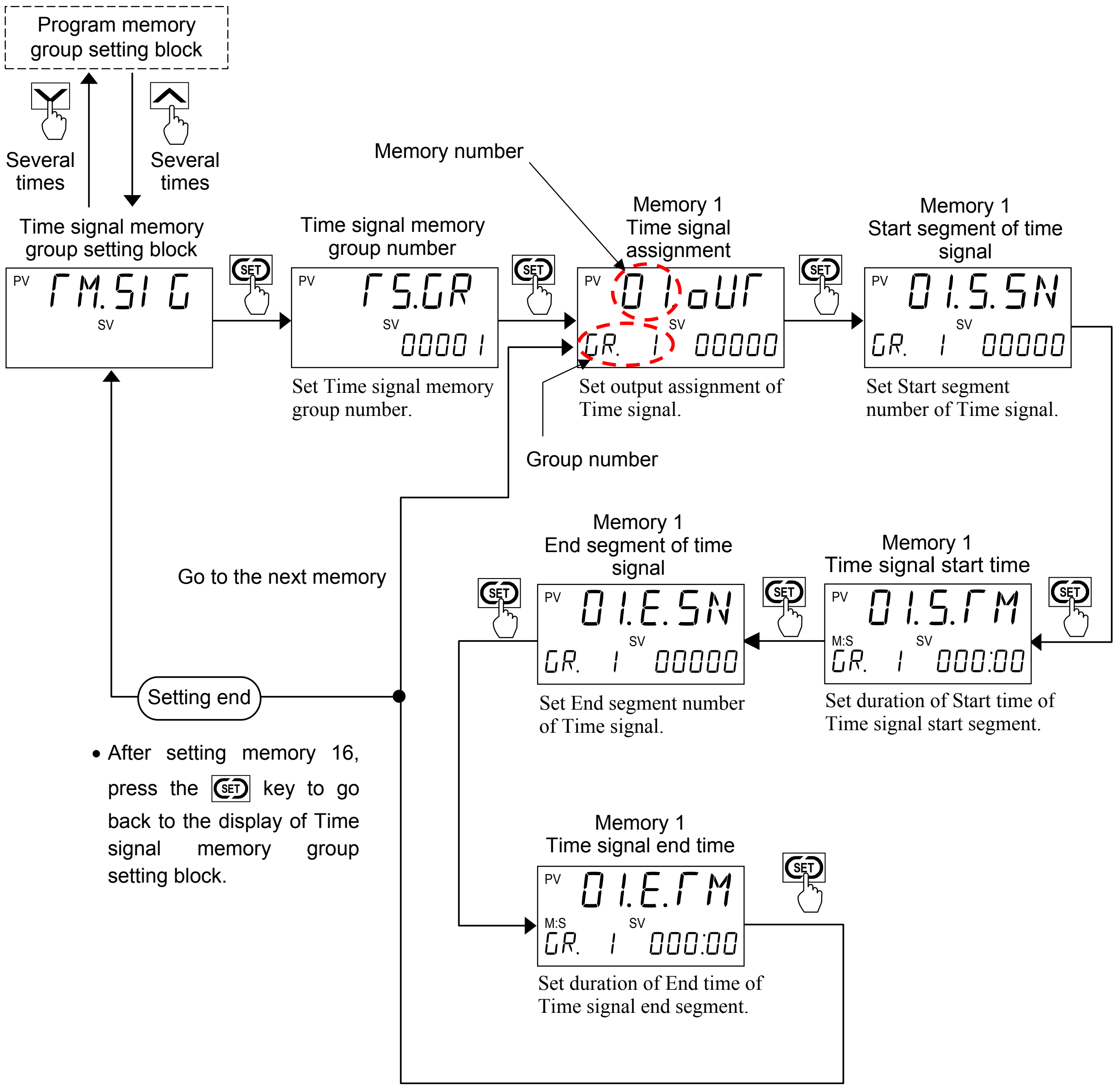
1. Press the RESET key to go to the Reset mode (RESET).
2. Press the MODE key for 2 seconds while pressing the SET key until Engineering mode is displayed.
3. Press the ∧ key until F52 screen displays.



● Parameter setting for Parameter setting mode (Partial setting type)

☞ For Batch setting type, refer to ■ **Setting type for Program pattern** of **4.5.3 Parameter setting mode (P. 4-17)**.



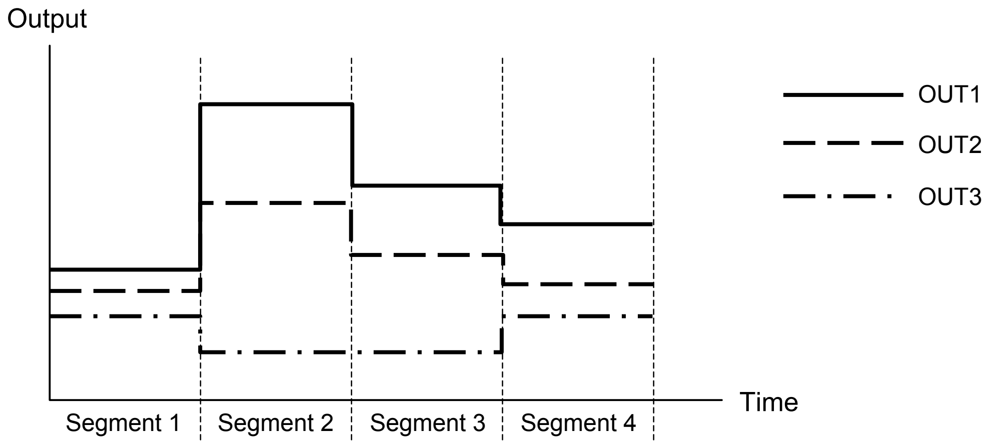


- After setting memory 16, press the SET key to go back to the display of Time signal memory group setting block.

6.6.10 Output program

Output values being set arbitrarily is produced in order of segment.
Number of output: Up to 3 points (It is possible to assign to OUT1 through OUT3)

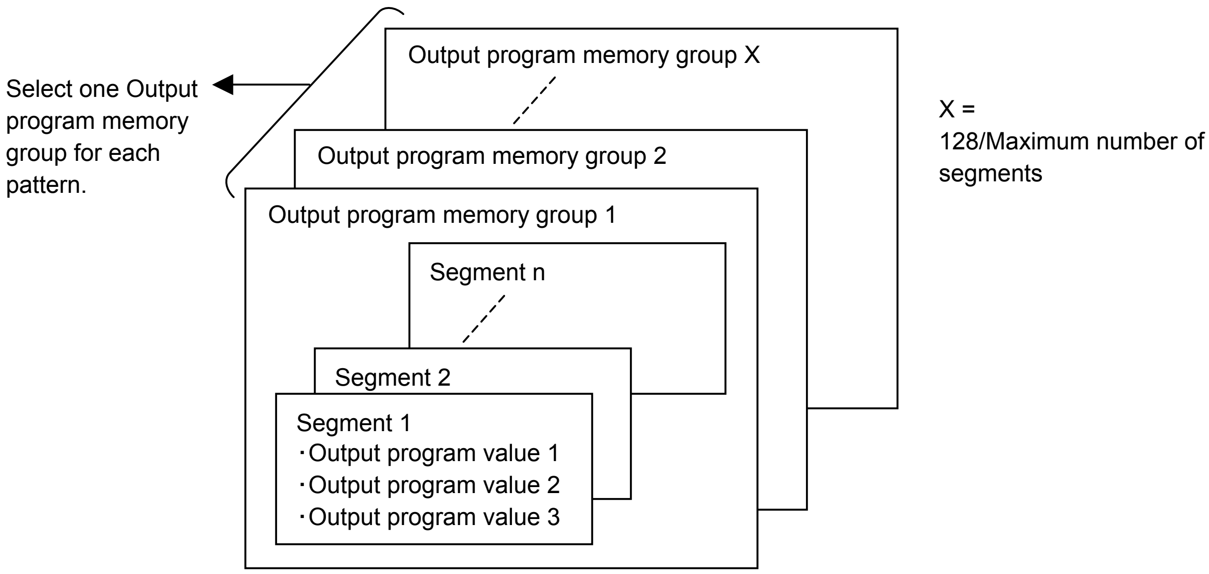
[Example of Output program]



● Output program memory group

Select one Memory group for each pattern to set Output program value of segments stored in the Memory group.

Output program memory group number: 0 to (128/Maximum number of segments)
Up to 99



"Control stop" or "Control continued" can be set for Control action selection at Pattern end of F50.07 in the Engineering mode when Output program value is assigned to OUT1.
"Control stop" or "Control continued" can be set for Transmission output action at Pattern end of F30.07 in the Engineering mode when Output program value is assigned to OUT2 or OUT3.

For Output program assignment, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)**.

■ Parameter setting

Settings related to Output program are stored as Output program memory group in the Parameter setting mode.

Assign Output program value at Output function before performing Output program function.

For Output program assignment, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P. 6-37)**.

● Output program memory group number

Set Output program memory group number for each pattern.

Parameter symbol	Data range	Factory set value
P.MV.GR	0 to [128/Maximum number of segments] Up to 99 0: No assignment	0

● Output program value

Set Output program value for each segment.

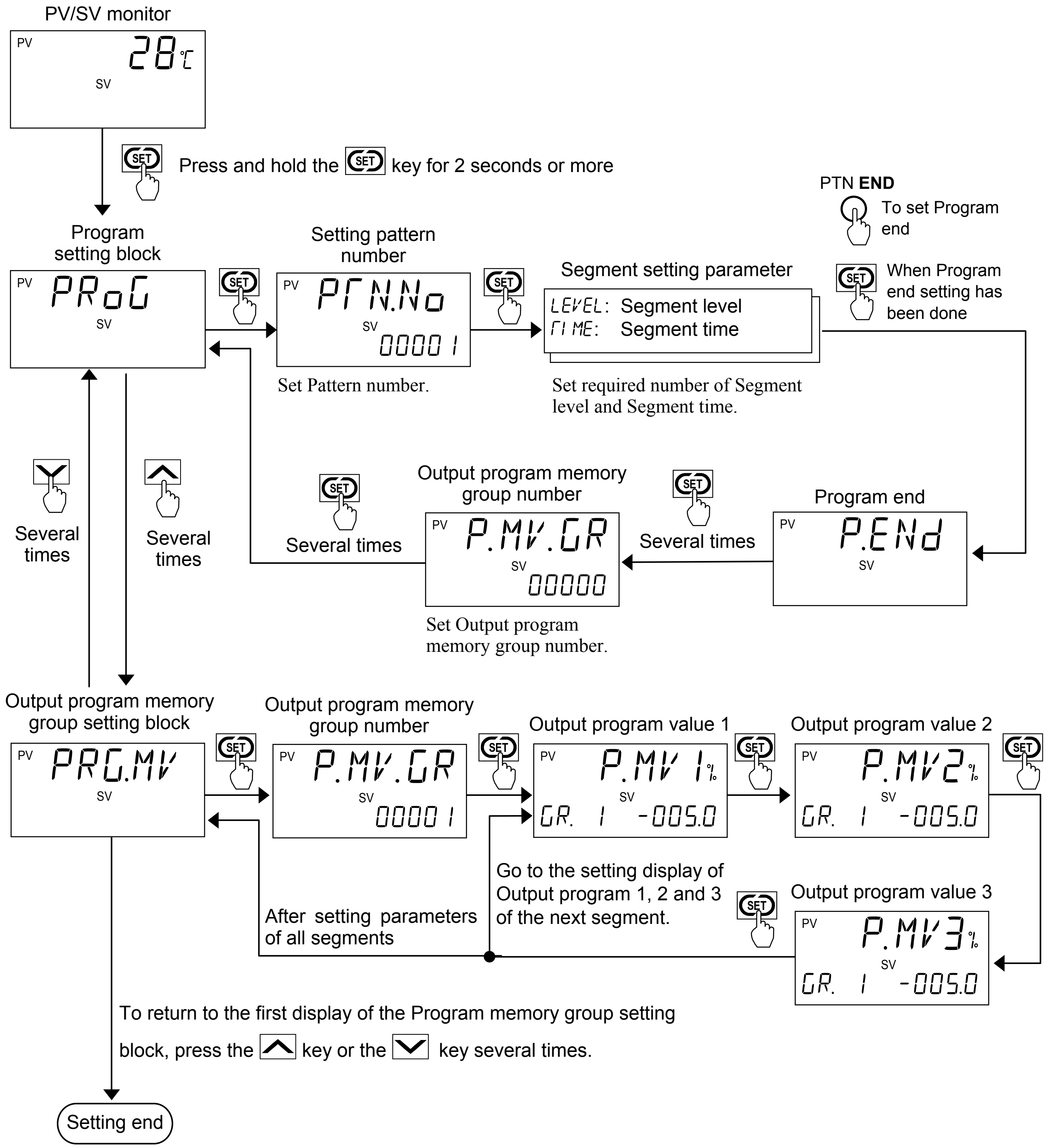
Parameter symbol	Data range	Factory set value
P.MV 1	Output program value 1: −5.0 to +105.0 %	−5.0
P.MV 2	Output program value 2: −5.0 to +105.0 %	−5.0
P.MV 3	Output program value 3: −5.0 to +105.0 %	−5.0

■ Setting procedure

- Output program memory group number can be set in the Parameter setting mode (Program setting block).
- Output program can be set in the Parameter setting mode (Output program memory group setting block).

● Parameter setting for Parameter setting mode (Partial setting type)

☞ For Batch setting type, refer to **■ Setting type for Program pattern** of **4.5.3 Parameter setting mode (P. 4-17)**.



6.6.11 Edit function

Copy and Data clear are available for edit function.

Pattern copy or Data clear is only available at the Reset mode (RESET).

■ Pattern copy

All set values of a pattern may be copied to another pattern.

■ Segment copy

Within a pattern, settings of the previous segment may be copied to the next segment.

To copy the setting data of the previous segment, press the ∧ key and the ∨ key at the same time at parameter setting display of the next segment.

Items to be copied: Segment level, Segment time, PID memory group number, Event memory group number, Wait memory group number, Segment signal

■ Data clear

Set values at the Parameter setting mode and Tag name may be initialized based on the set values such as Input types, and Decimal point position being set in the Engineering mode.

■ Parameter setting

● Pattern copy

Set copy source pattern number and copy destination pattern number.

Parameter symbol	Data range	Factory set value
CoPY	Copy source number: 0 to 99 Copy destination number: 0 to 99 Within the maximum pattern number.	0

● Data clear

Parameter symbol	Data range	Factory set value
CLR	All set values in the Parameter setting mode will be initialized after setting 9999 and switching from NO to YES.	0

■ Setting procedure

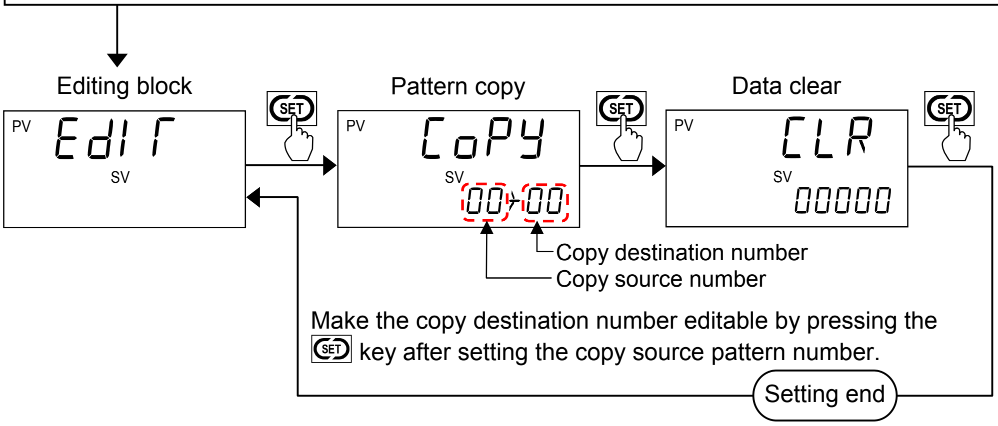
Conduct Pattern copy and Data clear at editing block in the Parameter setting mode.

● Parameter setting for Parameter setting mode (Partial setting type)

☞ For Batch setting type, refer to ■ **Setting type for Program pattern** of **4.5.3 Parameter setting mode (P. 4-17)**.

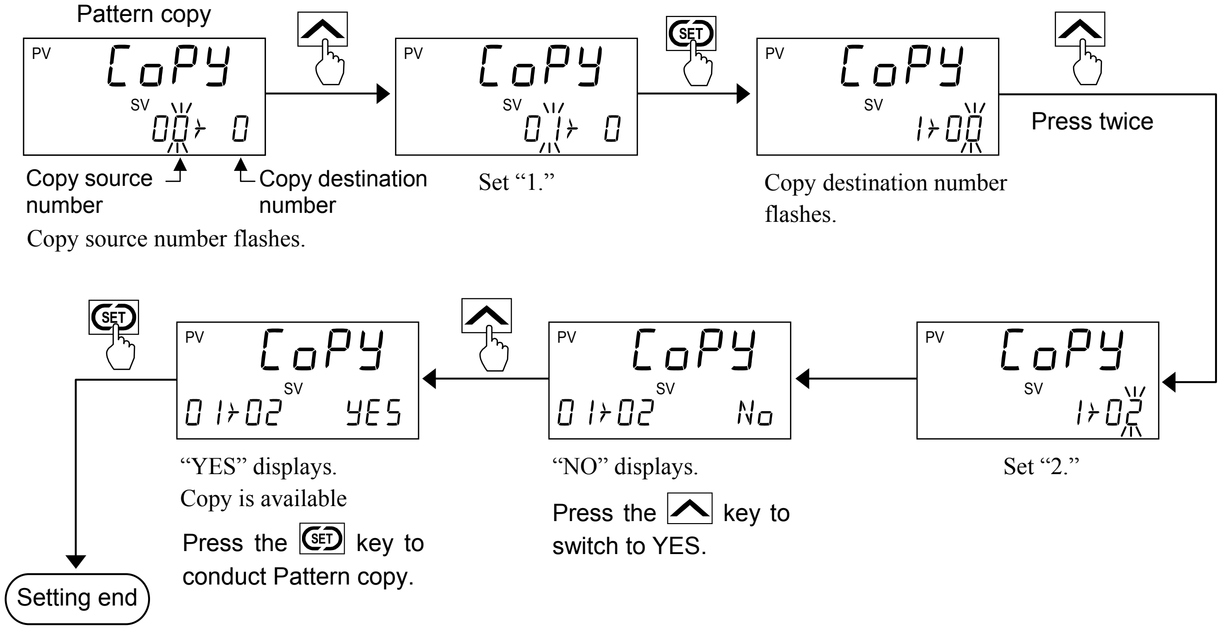
1. Press and hold the SET key for 2 seconds until parameter setting mode is displayed.

2. Press the ∧ key until Editing block screen displays.



● How to conduct Pattern copy

[Example: Copy the data of Pattern 1 to Pattern 2.]

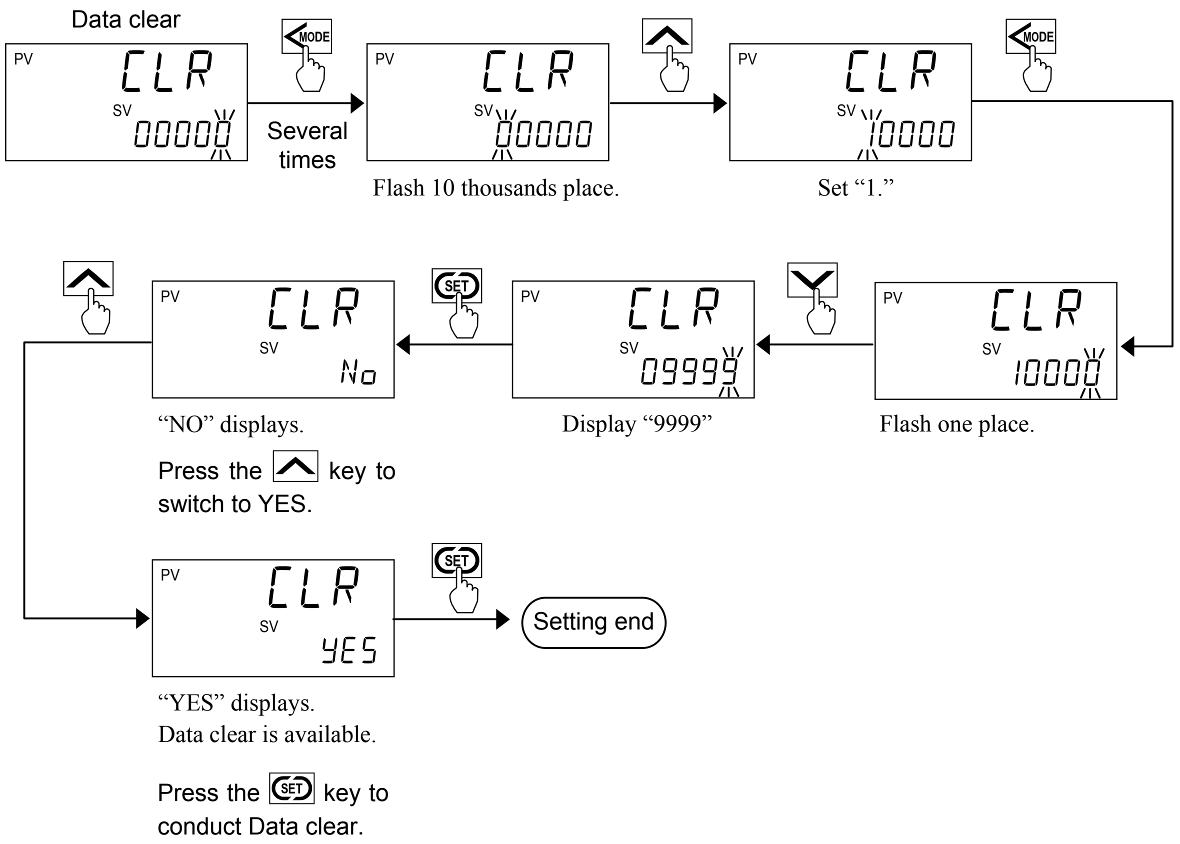


The next parameter displays instead of YES/NO display when the same value or "0" is set to the numbers of Copy source and Copy destination.

● How to conduct Data clear

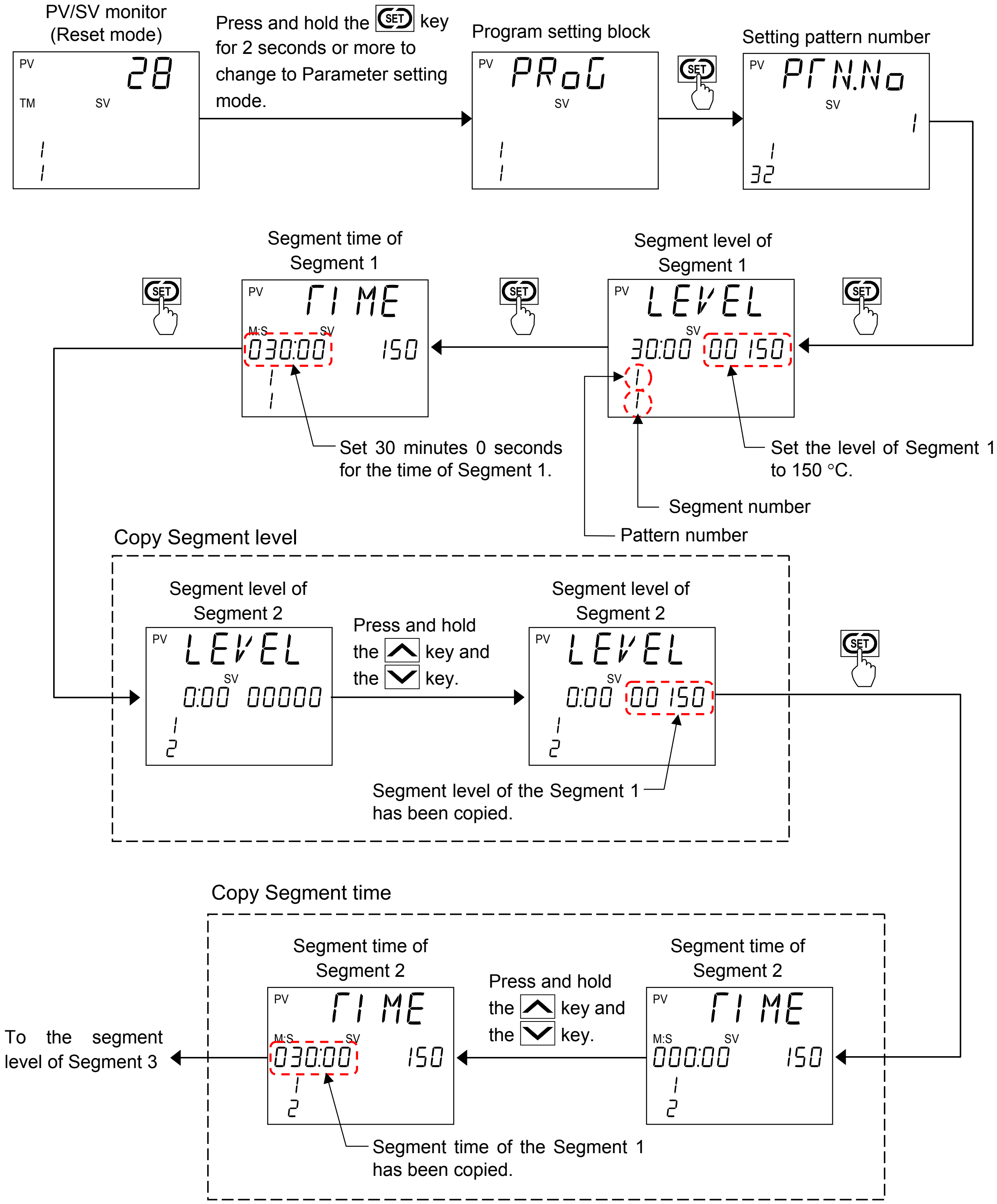
To conduct Data clear, set “9999.”

Tip: It is easier to set “10000” first and press the [DOWN] key to reduce the number by 1 rather than setting “9” to each place.



● How to conduct Segment copy

[Example: Copy Segment level and Segment time]



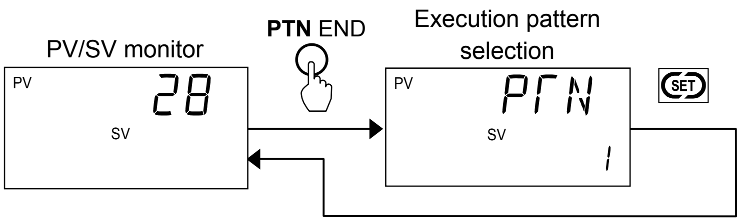
6.6.12 Tag function

Alphanumeric Tag name (up to 11 letters) displays instead of pattern number when setting Execution pattern. Use communication (Protocol: RKC communication) to set Tag name.

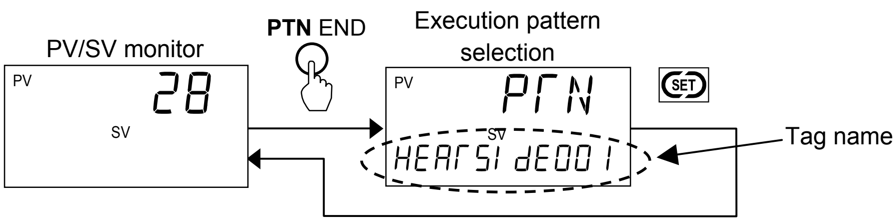
● Tag name display

Press the PTN END key (PTN lamp lights) to go to the Execution pattern selecting display.

[Example of display without Tag name]



[Example of display with Tag name]



📖 Use the WinUCI-PF900 setting tool to input a Tag name.

📖 Alphanumeric character of JIS/ACSII code is only available for setting Tag name.

☞ For Tag name setting, refer to **7.3 RKC Communication Protocol (P. 7-13)** and **7.5 Communication Data List (P. 7-80)**.

6.6.13 Forward/Back-up function

It is possible to speed up the progress of time process program by pressing and holding the [UP] key during the Program control. To back-up the progress of time process, press and hold the [DOWN] key.

NOTE

Forward/Back-up function is not available in the Factory set value.
Set Key accelerating speed Forward/Back-up function to 1 or more by using communication (Protocol: RKC communication [Identifier: KW]) before conducting Forward/Back-up function. Key operation is not available.

☞ For Key accelerating speed Forward/Back-up function, refer to **7.3 RKC Communication Protocol (P. 7-13)** and **7.5 Communication Data List (P. 7-80)**.

● Forward function

Time process of program may be speeded up by pressing and holding the [UP] key. For the condition of time progression, refer to the Key accelerating speed below. Operation progresses by following settings including Pattern link and Repeat until reaching to the Program end.

● Back-up function

Time process of program may be back-up by pressing and holding the [DOWN] key. For the condition of time progression, refer to the Key accelerating speed below. The progress of the program returns to the Program start of the pattern by conducting Back-up function. It is not possible to go beyond the linked patterns when conducting back-up function. For example, when conducting a Back-up function to the program linked by Pattern A and Pattern B, the program returns to the beginning of Pattern B.
It is possible to back-up segment or pattern for up to the numbers of Segment repeat or Pattern repeat being set (10000 times maximum). When setting "No limit" at Pattern repeat execution time, Back-up function is available up to 10000 times.

● Key accelerating speed

Time progression of Program when pressing and holding the [UP] key or the [DOWN] key.

[UP] [DOWN] keys operation state	Time progression
Press	Progress for one second
Press and hold the key for 3 seconds	Progress at double speed
Press and hold the key for 3 seconds or more	Progress at the rate being set at Key accelerating speed Forward/Back-up function (Factory set value: 0). When setting "1," the program progresses at double speed. Forward/Back-up function turns OFF when setting "0."

Forward/Back-up function does not affect operation of Program control operation or Time signal action.

Forward/Back-up function is not available when the operation is in HOLD state or Pattern end state.

Wait function is not available when conducting Forward/Back-up function.

6.7 Intercontroller Communication Function

To create a Master/Slave link, connect PF900/PF901 (master) to FB controller, RB controller or PF900/PF901 (slave) via Intercontroller communication by using the terminals for Communication 2.
It is possible to operate slave controller by replicating the program pattern of master controller.

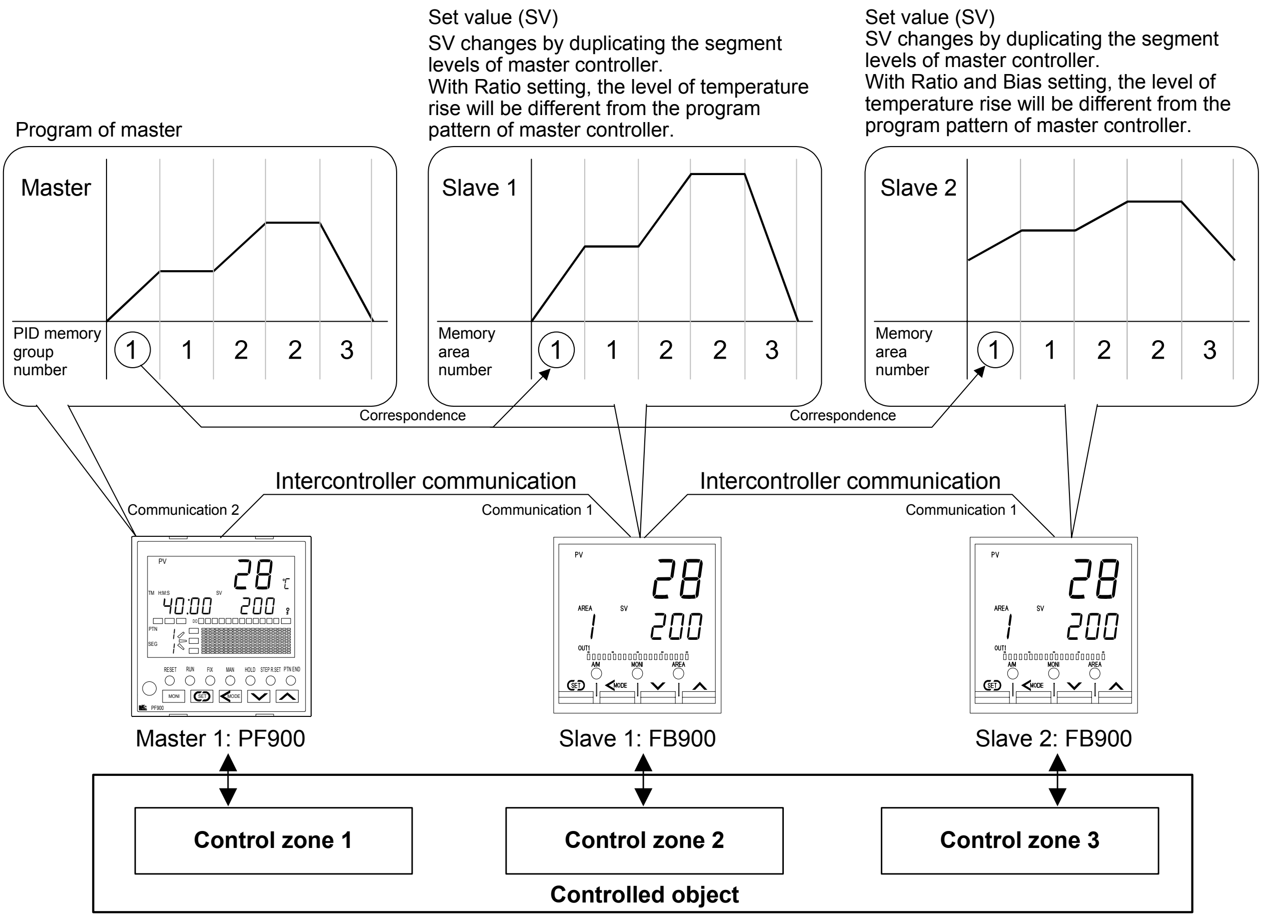
CAUTION

- Time lag occurs during intercontroller communication when two or more controllers are connected. (Time lag per date: 100 ms maximum x number of connected controllers)
  This time lag delay should be taken into consideration as intercontroller communication is not always suitable for applications requiring fast control.
- Turn ON master controller and slave controller at the same time. The master controller sends a message to the slave controller to establish communication when the power turns ON.

PF900/901 operates in the Fixed set point control mode when connected as a slave controller.

Example: Link operation between a PF900 (master) and 2 units of FB900 (slave)
Preset ratio for slave controller 1: ratio and bias for slave controller 2 with master controller.

- Segment levels of master controller follow the program pattern. Set value (SV) of slave controller changes by duplicating the Segment levels of master controller.
- When setting ratio or bias to the SV of slave controller, the level of temperature rise will be different from the program pattern of master controller.
- Memory area number of slave controller automatically changes into the same number of the PID memory group number being changed for each segment of master controller.



■ Settable parameter in link operation

The following parameters change automatically by following the program pattern of master controller.

Parameter for master controller (PF900/901)	Parameter for slave controller		Descriptions
• Segment level in Program control mode • Set value (SV) in Fixed set point control mode	Set value (SV) [1]	FB series	• **When master controller is in the Program control mode** SV changes by duplicating the Segment level of program pattern of master controller. • **When the master controller is in the Fixed set point control mode** SV replicates segment levels of master controller. When setting ratio or bias to the SV, level of temperature rise will be different from the program pattern of master controller.
	EEPROM mode	RB series	When the EEPROM mode of slave controller is in the backup mode, SV is overwritten every time the value changes and the life expectancy of EEPROM will shorten. To avoid overwriting SV, preset the EEPROM mode setting address via intercontroller communication to make the mode change automatically into the buffer mode during the operation.
	Set value (SV) in Fixed set point control mode	PF900/901	PF900/901 operates in the Fixed set point control mode when connected as a slave controller. Refer to the descriptions of Set value (SV) for FB series (within the table).
PID memory group number	Memory area number	FB series	• **When the master controller is in the Program control mode** Memory area number automatically changes into the same number of PID memory group number being changed by duplicating the program pattern. • **When the master controller is in the Fixed set point control mode** Memory area number automatically changes into the same number of PID memory group number being changed in the Fixed set point control mode.
	PID memory group number in Fixed set point control mode	PF900/901	PID memory group number of the slave controller in the Fixed set point control mode changes automatically to conform to the PID memory group number of the master controller.
Operation mode transfer [2]	RUN/STOP transfer	FB series RB series	RUN/STOP switches by following the change in operation mode of master controller. Switching RUN/STOP does not affect operation mode of master controller. Master controller: RESET↔ RUN, FIX, MAN Slave controller: STOP ↔ RUN Auto/Manual mode and Remote/Local mode of the slave controller do not change.
	Operation mode transfer	PF900/901	Operation mode of the slave controller (Reset mode or Fixed set point mode) switches automatically when the operation mode of the master controller is changed. However, the operation mode of the master controller does not change when the operation mode of the slave controller is changed. Master controller: RESET↔ RUN, FIX, MAN Slave controller: RESET↔ FIX

RESET: Reset mode　　RUN: Program control mode
FIX: Fixed set point mode　　MAN: Manual control mode

[1] Master controller sends SV rewriting message to the slave controller when the segment level changes.
Using intercontroller communication during operation, the master controller automatically changes the Set value (SV) of the slave controller being changed by key operation or communication.

[2] When the slave controller is FB series or RB series:
Switching Auto/Manual mode of the slave controller does not affect the operation mode of the master controller. Switching Remote/Local mode of the FB controller does not affect the operation mode of the master controller.

6.7.1 Operation procedure

Wiring	**6.7.2 Wiring procedure for Intercontroller communication** (Refer to **P. 6-196**)
↓	
Parameter setting for master controller	**6.7.3 Parameter setting for master controller** (Refer to **P. 6-199**)
↓	
Parameter setting for slave controller	**6.7.4 Parameter setting for slave controller** (Refer to **P. 6-204**)
↓	
Power supply OFF → ON	Turn ON the master controller and the slave controller at the same time. The master controller sends a message to the slave controller to establish communication when the power turns ON.
↓	
Communication established	**6.7.5 Action at power ON** (Refer to **P. 6-206**)
↓	
Change to Program control mode (RUN)	Changes to Program control mode (RUN) before starting operation when the operation mode is in another mode.
↓	
Start Program control	**6.7.6 Link operation via intercontroller communication** (Refer to **P. 6-207**)

6.7.2 Wiring procedure for Intercontroller communication

■ Connectable controller

● Master controller

- PF900/901
  Availability: Communication code W, X or Y

● Slave controller

- FB100/400/900 (FB series)
  Availability: FB100: Optional function code E, F, H or J
  FB400/900: Communication code 5 or X
- RB100/400/500/700/900 (RB series)
  Availability: Communication code 5, 6, B or C
  (Modbus should be specified for communication protocol when the communication code is 5 or B.)
- PF900/901
  Availability: Communication code 5 or X

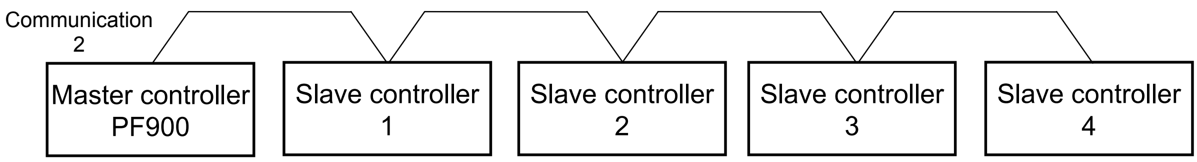
NOTE

Up to 4 slave controllers can be connected to one master controller.

Use RS-485 for communication interface and Modbus-RTU for communication protocol

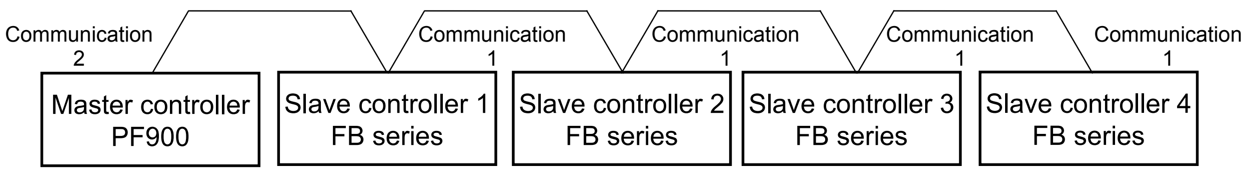
The combined use of PF900/901, FB series and RB series is not possible for the slave controller.

Communication port for the Intercontroller communication:
Master controller: Use Communication 2.
Slave controller: FB series: Use Communication 1.
RB series: Use the communication port.
PF900/901: Use Communication 1.



(Maximum connections: Up to 4 slave controllers)

Example: When connecting FB series as slave controllers



■ Communication terminal number and signal details

• PF900/901 (Master controller): Communication 2
(Communication code: W, X and Y)

Terminal No.	Signal name	Symbol
25	Signal ground	SG
28	Send data/Receive data	T/R (A)
29	Send data/Receive data	T/R (B)

• FB100 (Slave controller): Communication 1
(Optional function: E, F, H and J)

Terminal No.	Signal name	Symbol
13	Signal ground	SG
14	Send data/Receive data	T/R (A)
15	Send data/Receive data	T/R (B)

• FB400/900 (Slave controller): Communication 1
(Communication code: 5, X)

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data/Receive data	T/R (A)
27	Send data/Receive data	T/R (B)

• RB100/400/500/900 (Slave controller)
(Communication code: 5, 6, B and C)

Terminal No.	Signal name	Symbol
13	Signal ground	SG
14	Send data/Receive data	T/R (A)
15	Send data/Receive data	T/R (B)

• RB700 (Slave controller)
(Communication code: 5 and 6)

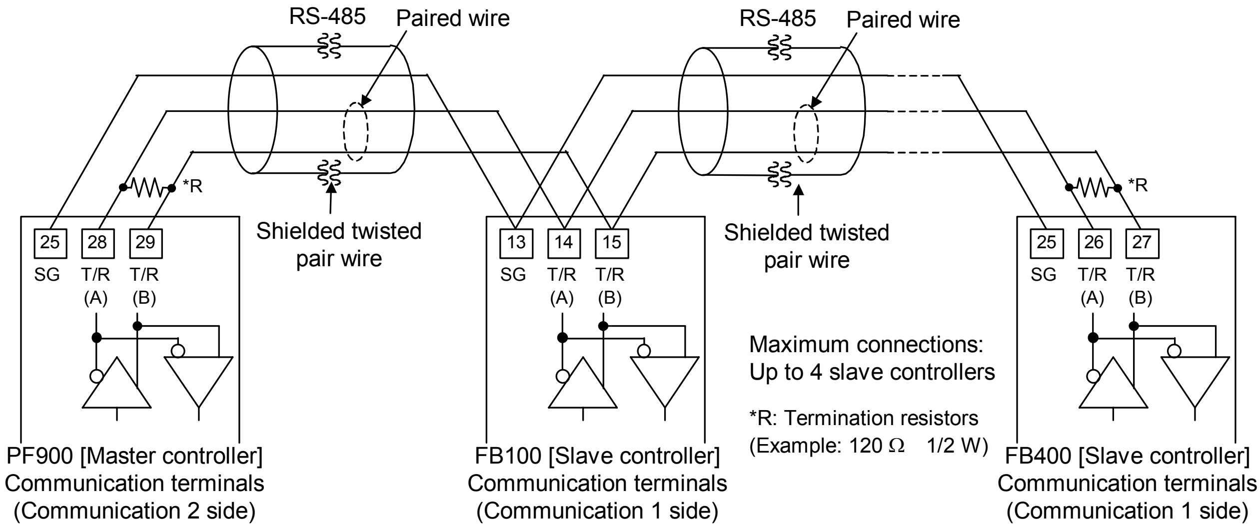
Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data/Receive data	T/R (A)
27	Send data/Receive data	T/R (B)

• PF900/901 (Slave controller): Communication 1
(Communication code: 5 and X)

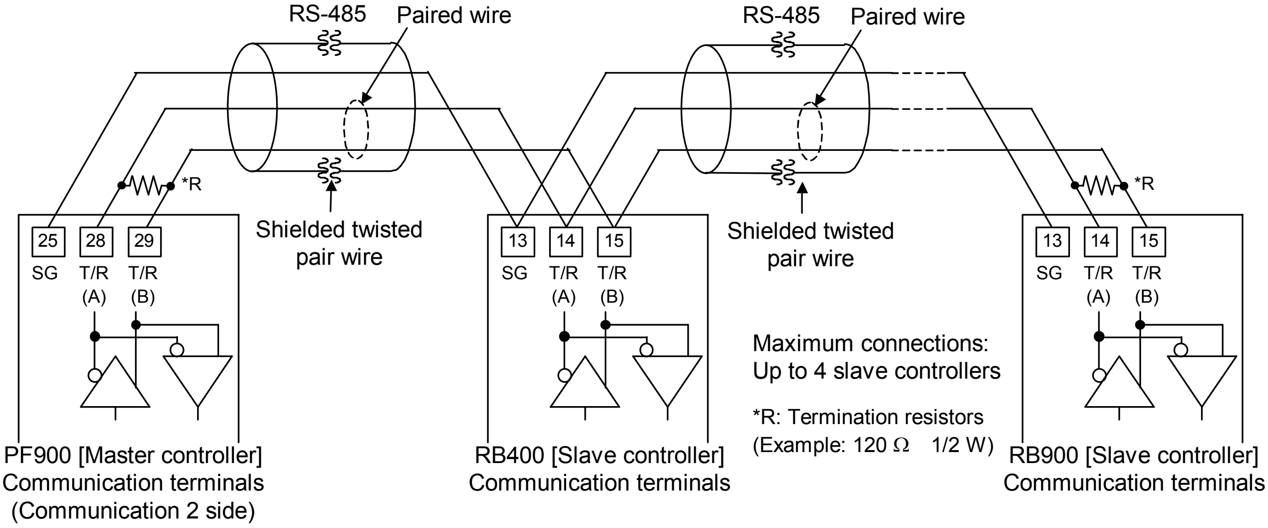
Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data/Receive data	T/R (A)
27	Send data/Receive data	T/R (B)

■ Wiring example

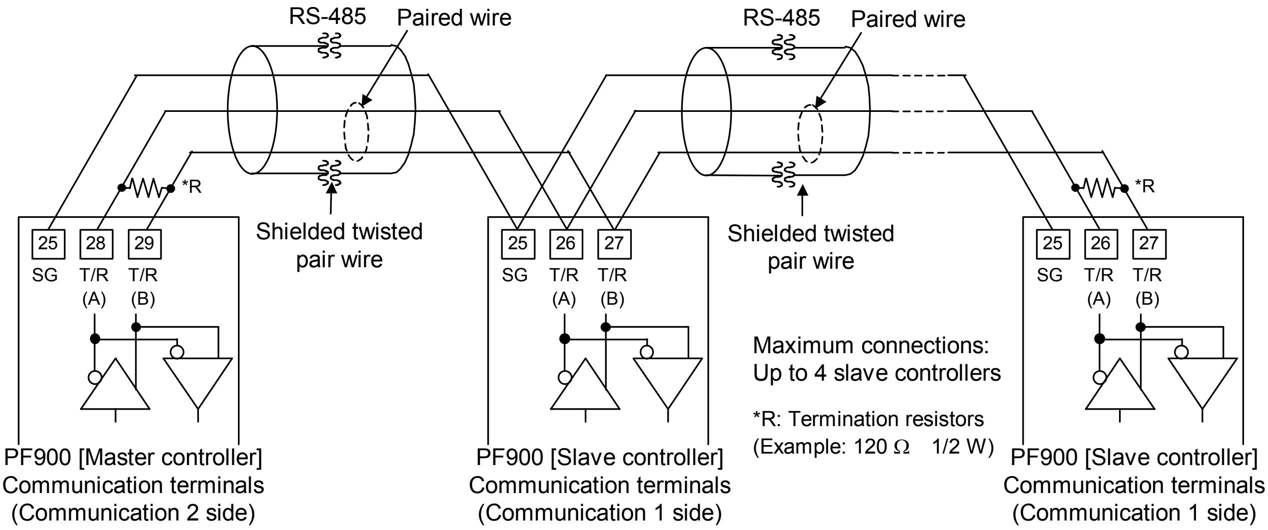
[Connecting to FB series]



[Connecting to RB series]



[Connecting to PF900/901 series]



6.7.3 Parameter setting for master controller

■ Parameter setting at F61 in the Engineering mode

● Slave controller

Slave controller is selectable.
The combined use of PF900/901, FB series and RB series is not possible for the slave controller.

Parameter symbol	Data range	Factory set value
SLV.SL	0: FB series: FB100/FB400/FB900 1: RB series: RB100/RB400/RB500/RB700/RB900 2: PF900/PF901	0

When switching the model of slave controller, the set values of the following parameters will automatically change to conform to the switched slave controller.

- Set memory area switching address
- Control memory area switching address
- SV address of set memory area
- EEPROM mode setting address
- Set RUN/STOP switching address

● Number of slave unit

Set the number of slave controllers to be connected.
Up to 4 slave controllers can be connected to one master controller.

Parameter symbol	Data range	Factory set value
SLV.No	0 to 4 0: No Intercontroller communication function	0

● Device address 2

Set device address for Communication 2.
Set to "0 (factory set value)" for intercontroller communication.

Parameter symbol	Data range	Factory set value
Add2	0 to 99	0

It is possible to set Device address 2 in the Setup setting mode.

● Communication speed 2

Set communication speed for Communication 2.
Set the same value as communication speed of slave controller.

Parameter symbol	Data range	Factory set value
bPS2	9600: 9600 bps 19200: 19200 bps 38400: 38400 bps *	19200

* Communication speed "38400 bps" is not selectable when connecting RB controller.

It is possible to set Communication speed 2 in the Setup setting mode.

● Intercontroller communication error judgment time

Link error occurs when communication was not established during Intercontroller communication error judgment time.

Parameter symbol	Data range	Factory set value
C.ER.TM	0 to 600 seconds 0: Real-time error	10

■ Parameter setting at F61 in the Initial level engineering mode

● Action at Link error

Select action when Intercontroller communication error (Link error) occurs during intercontroller communication.

Parameter symbol	Data range	Factory set value
L.ERR	0: Reset: Go to the Reset mode when Link error occurs. 1: Continue: Continue operation when Link error occurs.	0

● Communication start time

Set Communication start time for duration starting after the PF900/901 turns ON and ending before Intercontroller communication starts.

Parameter symbol	Data range	Factory set value
S.SCI	2 to 100 seconds	3

Intercontroller communication starts at the establishment of communication when the duration of the process for establishing communication is shorter than Communication start time.

● Slave ratio

Determine Set value (SV) of slave controller by setting ratio to Segment levels of master controller.

Slave ratio can be set for each slave controller.

Parameter symbol	Data range	Factory set value
SVL.R1	Slave 1 ratio: 0.001 to 9.999	1.000
SVL.R2	Slave 2 ratio: 0.001 to 9.999	1.000
SVL.R3	Slave 3 ratio: 0.001 to 9.999	1.000
SVL.R4	Slave 4 ratio: 0.001 to 9.999	1.000

● Slave bias

Determine Set value (SV) of slave controller by setting bias to Segment levels of master controller.

Slave bias can be set for each slave controller.

Parameter symbol	Data range	Factory set value
SVL.b1	Slave 1 bias: −1000.0 to +1000.0	0.0
SVL.b2	Slave 2 bias: −1000.0 to +1000.0	0.0
SVL.b3	Slave 3 bias: −1000.0 to +1000.0	0.0
SVL.b4	Slave 4 bias: −1000.0 to +1000.0	0.0

● Set memory area switching address

This parameter is only required for connecting FB controller. Set the address of Setting memory area number of the FB series.

To set the address automatically, select the model of slave controller first.

Parameter symbol	Data range	Factory set value
Add.SE	0000H toFFFFH FFFF: Unused (FB series: 0500H RB series: FFFFH PF900/901: FFFFH)	0500 (FB series)

● Control memory area switching address

This parameter is required for connecting FB controller and PF900/901. Set the address of Control memory area number of the FB series.
To set the address automatically, select the model of slave controller first.

Parameter symbol	Data range		Factory set value
Add.RN	0000H to FFFFH FFFF: Unused	FB series: 0240H RB series: FFFFH PF900/901: 0073H	0024 (FB series)

● SV address of set memory area

When connecting FB controller, set “0507H” to the address of the Set value (SV) of memory area to be called by Setting memory area number.
For RB controller, set “0006H” to the address of Set value 1 (SV1).
For PF900/901, set the address of Set value (SV) in the Fixed set point mode.
To set the address automatically, select the model of slave controller first.

Parameter symbol	Data range		Factory set value
Add.SS	0000H to FFFFH FFFF: Unused	FB series: 0507H RB series: 0006H PF900/901: 0072H	0507 (FB series)

By setting Set memory area switching address, Control memory area switching address and SV address of set memory area, it is possible to match the memory area number of slave controllers (FB series only) automatically to the PID memory group number of each segment of the master controller.
When using PF900/901 as a slave controller, it is possible to have the PID memory group number of the slave controller in the Fixed set point control mode automatically conform to the PID memory group number of each segment programmed with the master controller by setting Control memory area switching address and SV address of set memory area.

● EEPROM mode setting address

This parameter is only required for connecting RB controller. Set the address of EEPROM mode of the RB series.
To set the address automatically, select the model of slave controller first.

Parameter symbol	Data range		Factory set value
Add.RN	0000H to FFFFH FFFF: Unused	FB series: FFFFH RB series: 001BH PF900/901: FFFFH	001B (RB series)

● RUN/STOP setting address

Set the address of RUN/STOP transfer (FB series and RB series) or Operation mode transfer (PF900/901).
To set the address automatically, select the model of slave controller first.

Parameter symbol	Data range		Factory set value
Add.RS	0000H to FFFFH FFFF: Unused	FB series: 0023H RB series: 0019H PF900/901: 002BH	0023 (FB series)

The RUN/RESET of the master controller can be linked with the RUN/STOP of the FB series or RB series or FIX/RESET of PF900/901 by setting this parameter.

■ Parameter setting at Wait memory group setting block in the Parameter setting mode

● Wait release trigger selection

Set “1” to the value at a ten place (Zone wait 2) to validate Wait function of slave controller during operation via intercontroller communication

Parameter symbol	Data range	Factory set value
RE.TRG	00000 Zone wait 1 (the controller) [0: Invalidate, 1: Validate] Zone wait 2 (all slave controllers) [0: Invalidate, 1: Validate] Wait release by digital input (DI) [0: Invalidate, 1: Validate] Unused	00001

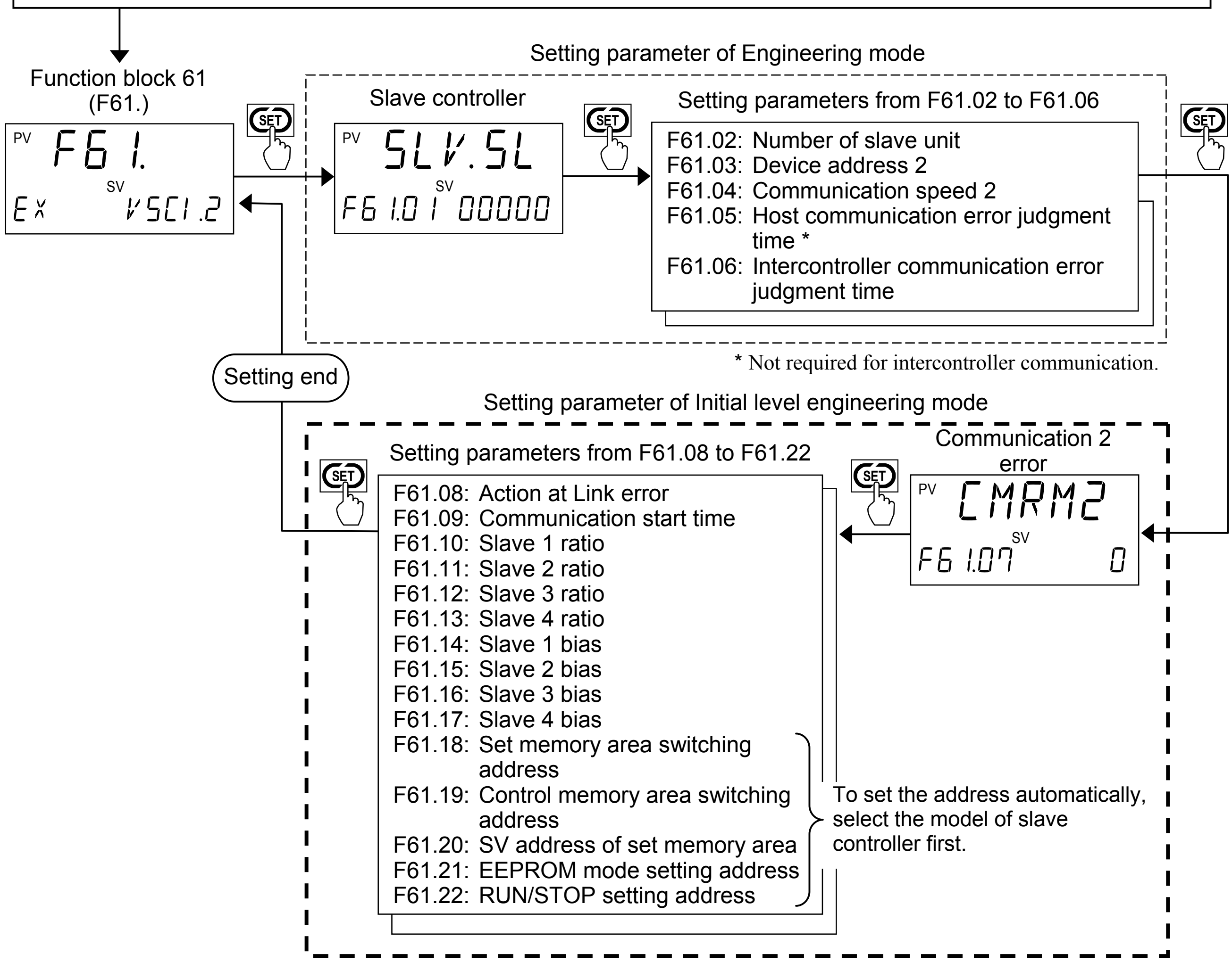
■ Setting procedure

● Parameter setting for Engineering mode (including Initial level engineering mode)

NOTE

Set parameter of the Engineering mode or the Initial level engineering mode in the Reset mode (RESET).

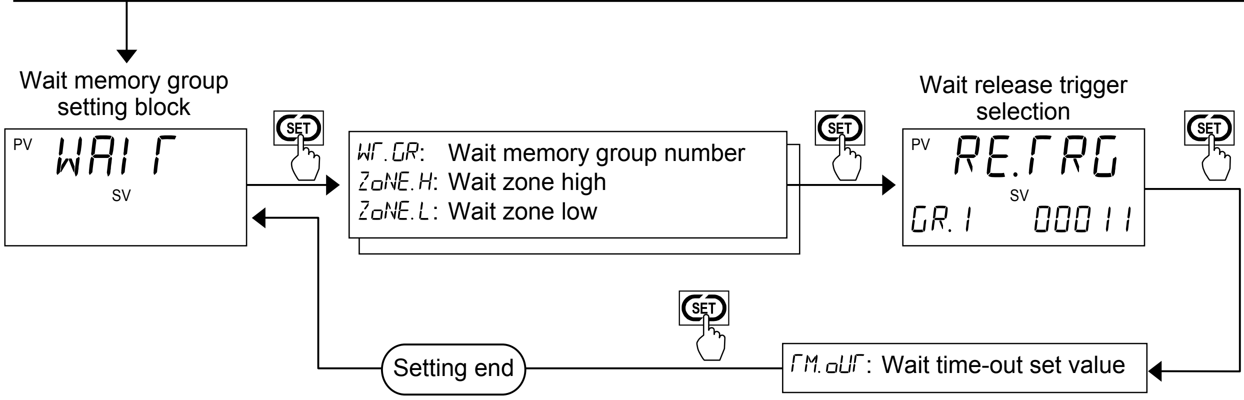
1. Press the RESET key to go to the Reset mode (RESET).
2. Go to the Initial level engineering mode by pressing and holding the SET key, the MODE key and the ∨ key for 2 seconds or more.
3. Keep pressing the ∧ key until the F61 screen displays.



● Parameter setting in the Parameter setting mode

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

2. Keep pressing the ∧ key until the Wait memory group setting block displays.



6.7.4 Parameter setting for slave controller

Refer to the following descriptions to set parameters for slave controller:

NOTE

Scale range (Input range) and the location of decimal point of the slave controller should conform to the master controller.

☞ For setting details refer to the following descriptions.
FB series: **FB100 Instruction Manual (IMR01W16-E☐)**,
FB400/FB900 Instruction Manual (IMR01W03-E☐)
RB series: **RB series Communication Instruction Manual (IMR02C16-E☐)**
PF900/901: **4.5.5 Engineering mode (P. 4-33)**, **7.2 Setting (P. 7-9)**

● FB series

Set the following parameters with FB controller.

Setting mode: Communication 1 protocol: Function block 60 in the Engineering mode
Device address 1, Communication speed 1, Data bit configuration 1, Interval time 1: Setup setting mode

Name	Symbol	Setting range of slave controller	Description
Communication 1 protocol	CMP1	1: Modbus	Select Modbus.
Device address 1	Add1	1 to 4	Set Devise address consecutively from 1 for the slave controller.
Communication speed 1	bPS1	9.6: 9600 bps 19.2: 19200 bps 38.4: 38400 bps	Set the same value as the communication speed of PF900/901 controller. FB series does not offer 2400 bps and 4800 bps.
Data bit configuration 1	bIT1	8n1: Data bit: 8 Parity bit: Without Stop bit: 1	Select Data bit: 8, Parity bit: Without and Stop bit: 1.
Interval time 1	InT1	0 to 250 ms	There is no need to change the value from the factory set value (10 ms). Change the value as required.

● RB series

Set the following parameters with RB controller.

Setting mode: Function block 60 in the Engineering mode

Name	Symbol	Setting range of slave controller	Description
Communication protocol	CMPS	1: Modbus	Select Modbus.
Device address	Add	1 to 4	Set Devise address consecutively from 1 for the slave controller.
Communication speed	bPS	2: 9600 bps 3: 19200 bps	Set the same value as the communication speed of PF900/901 controller. FB series does not offer 2400 bps and 4800 bps.
Data bit configuration	bIT	8n1: Data bit: 8 Parity bit: Without Stop bit: 1	Select Data bit: 8, Parity bit: Without and Stop bit: 1.
Interval time	INT	0 to 250 ms	There is no need to change the value from the factory set value (10 ms). Change the value as required.

● PF900/901

Set the following parameters with PF900/901.

Setting mode: Communication 1 protocol: Function block 60 in the Engineering mode
Device address 1, Communication speed 1, Data bit configuration 1, Interval time 1:
Setup setting mode or Function block 60 in Engineering mode

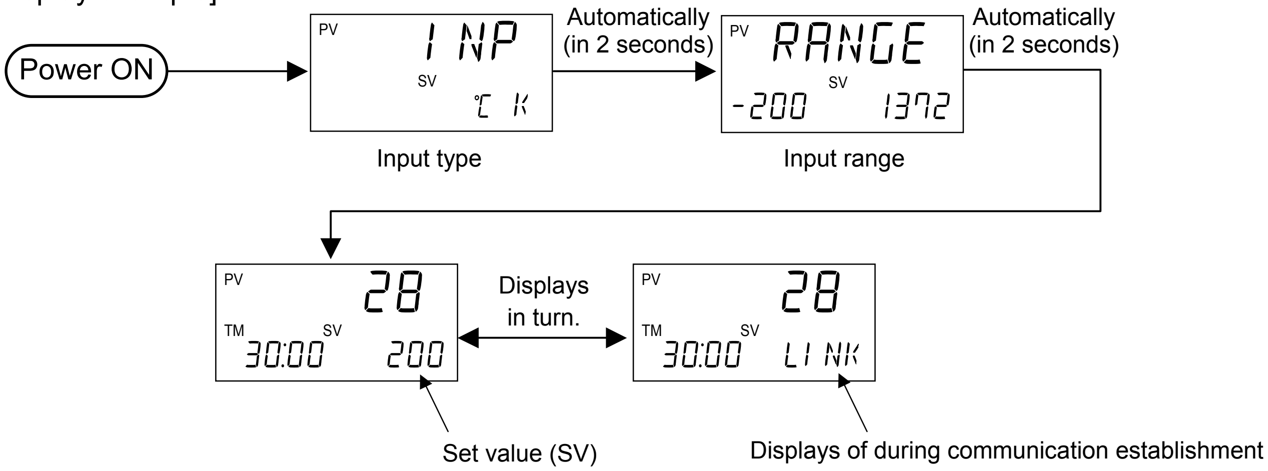
Name	Symbol	Setting range of slave controller	Description
Communication 1 protocol	CMP1	1: Modbus	Select Modbus.
Device address 1	Add1	1 to 4	Set Devise address consecutively from 1 for the slave controller.
Communication speed 1	bPS1	9.6: 9600 bps 19.2: 19200 bps 38.4: 38400 bps	Set the same value as the communication speed of PF900/901 controller. FB series does not offer 2400 bps and 4800 bps.
Data bit configuration 1	bIT1	8n1: Data bit: 8 Parity bit: Without Stop bit: 1	Select Data bit: 8, Parity bit: Without and Stop bit: 1.
Interval time 1	InT1	0 to 250 ms	There is no need to change the value from the factory set value (10 ms). Change the value as required.

PF900/901 operates in the Fixed set point control mode when connected as a slave controller.

6.7.5 Action at power ON

This instrument displays Input type followed by input range when power is turned ON. Next the Set value (SV) and LINK will display in turn at the SV monitor while the master controller checks the slave controller to establish communication. LINK display goes OFF once communication is established and intercontroller communication starts.

[Display example]



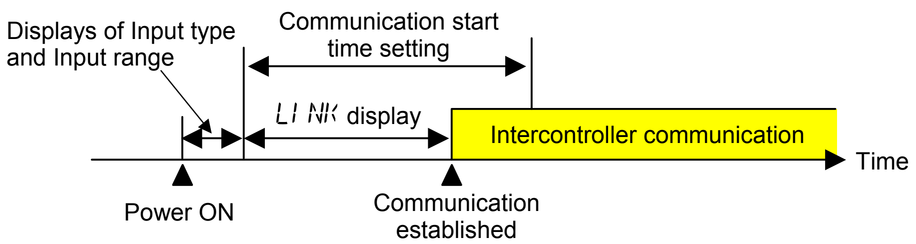
Controller will be in the Reset mode and displays error messages* when failing to establish communication (Link error), even "Action at Link error" is set to "continue."

* Displays "ERR" at PV display. Displays error code "16" for Link error at SV display.

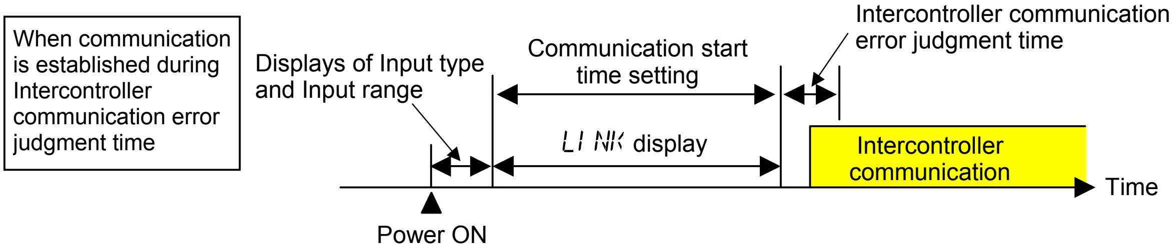
● Communication start time

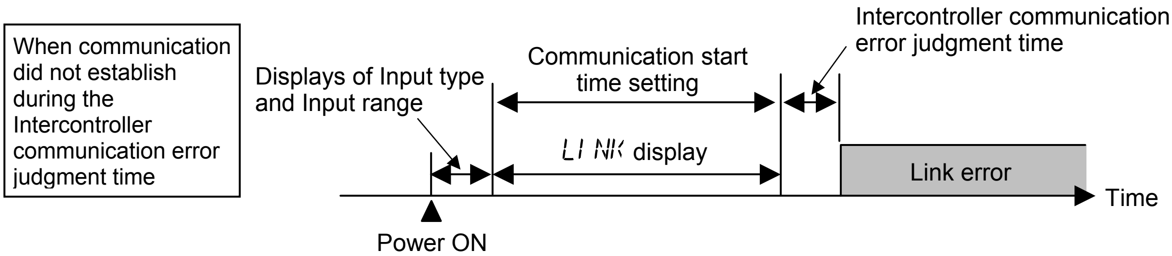
Refer to the figures below for Communication start time setting and establishment of communication.

[When communication is established during Communication start time]



[When communication did not establish during the Communication start time]





6.7.6 Link operation via intercontroller communication

■ When intercontroller communication is in error state

Intercontroller communication error (Link error) occurs when
- The master controller does not receive response from the slave controller.
- The slave controller sends error message (for setting data outside of the setting range, specifying incorrect address etc.)

● Action at error

When the Link error occurs, operation conforms to the action ("Reset" or "Program continue") being set at Action at Link error with the master controller.

• Reset
When Link error occurs, operation mode automatically changes to the Reset mode.

Slave controller will be in STOP mode when receiving message from master controller being in the Reset mode (RESET). When communication is disconnected, the slave controller operates by following the last message received.

• Program continue
Link error does not affect program control of master controller

Even Link error occurs, the master controller keeps sending message to the slave controller. When communication recovers, Link operation restarts and error display will be released. The Set value (SV) of the slave controller automatically changes by following the program of the master controller. When communication is disconnected, the slave controller operates by following the last message received.

● Output at error

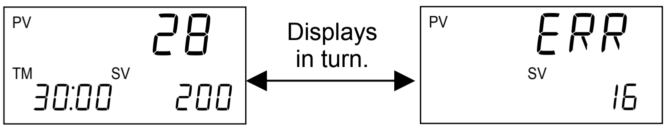
It is possible to produce output signal of OUT2, OUT3 or DO when Link error occurs.

[Parameter setting]
Select "52 (Intercontroller communication error)" for OUT 2 assignment at F32.01 in the Engineering mode.
Select "52 (Intercontroller communication error)" for OUT 3 assignment at F33.01 in the Engineering mode.
Select "29 (Intercontroller communication error)" for DO1 to DO12 assignment at F34 in the Engineering mode.

For output assignment, refer to **6.2 Output (P. 6-37)**.

● Error display

• Displays PV/SV monitor and error message in turn when Link error occurs.



Normal display   Error display

Displays "ERR" at PV display.
Displays error code "16" for Link error at SV display.

• It is possible to light ALM lamp when Link error occurs.

[Parameter setting]
Set "1 (Light)" at a hundred place at F10.07 Alarm lamp light condition in the Engineering mode.

• To release the error message, press the MODE key while pressing the MONI key. To recover the error state, take the appropriate action.

If the error message is released without correcting the error, an error will reoccur when attempting to change the operation mode.

■ Autotuning (AT) in intercontroller communication

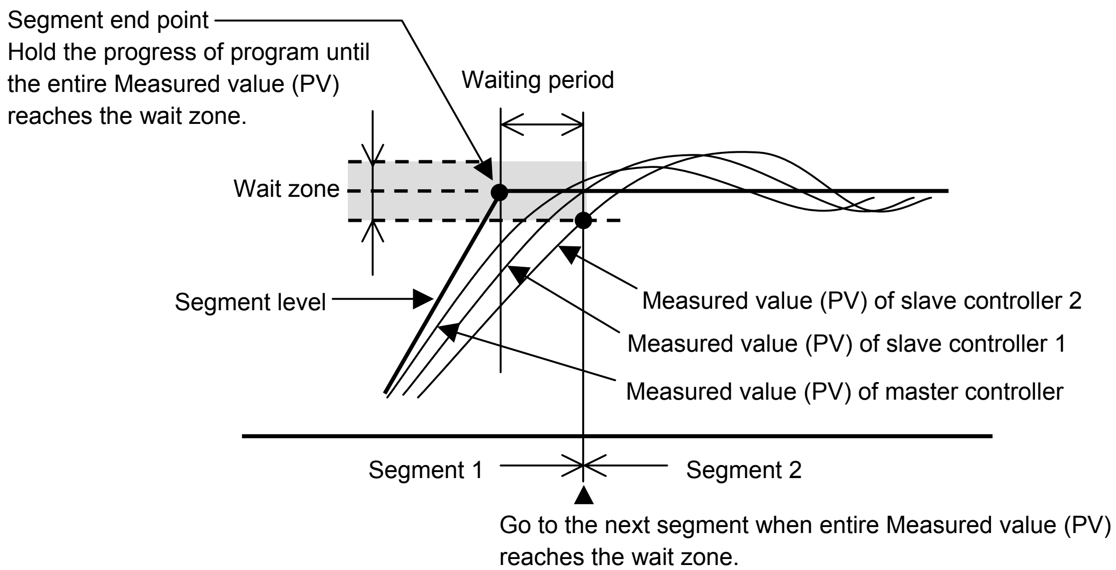
Autotuning (AT) is not available for Link operation. No message will be sent to the slave controller when conducting Autotuning (AT) with the master controller.

Conduct Autotuning (AT) with learning function in the Reset mode. Go to the Reset mode to conduct Autotuning (AT) with learning function with the master controller. The slave controller is in STOP state when the master controller is in the Reset mode.

■ Wait function in intercontroller communication

Wait function is available for Link operation. Hold the progress of program until every Measured value (PV) of the master controller and the slave controller reach the wait zone.

[Example]

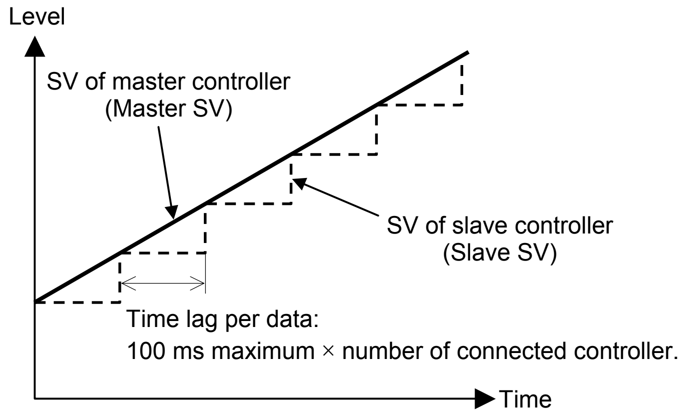


Validate Zone wait 2 at Wait trigger release selection in the Parameter setting mode.
Refer to ■ **Parameter setting (P. 6-161)**.

For the Wait function, refer to **6.6.6 Wait (P. 6-158)**.

■ Remarks

- Error occurring with the slave controller does not affect operation of the master controller.
- Set value (SV) of the slave controller changes in a stepped way for time lag occurred in intercontroller communication. Segment level of the master controller changes successively.



Master SV change and Slave SV change

MEMO

HOST COMMUNICATION [OPTIONAL]

7

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

7.1 Connections

Host communication uses terminals for Communication 1.

⚠ WARNING

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

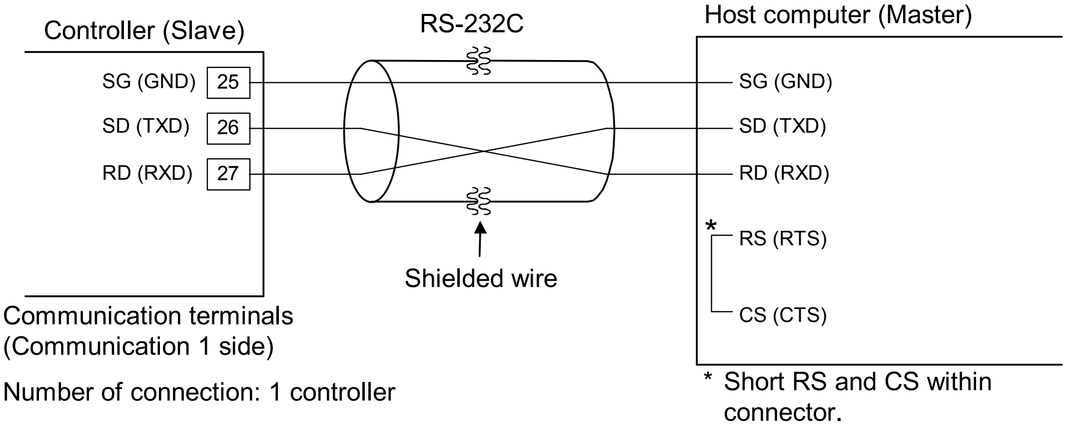
7.1.1 RS-232C connection

■ Connection to the RS-232C port of the controller

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG (GND)
26	Send data	SD (TXD)
27	Receive data	RD (RXD)

● Wiring example



Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N·m (4 kgf·cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

The cable is provided by the customer.

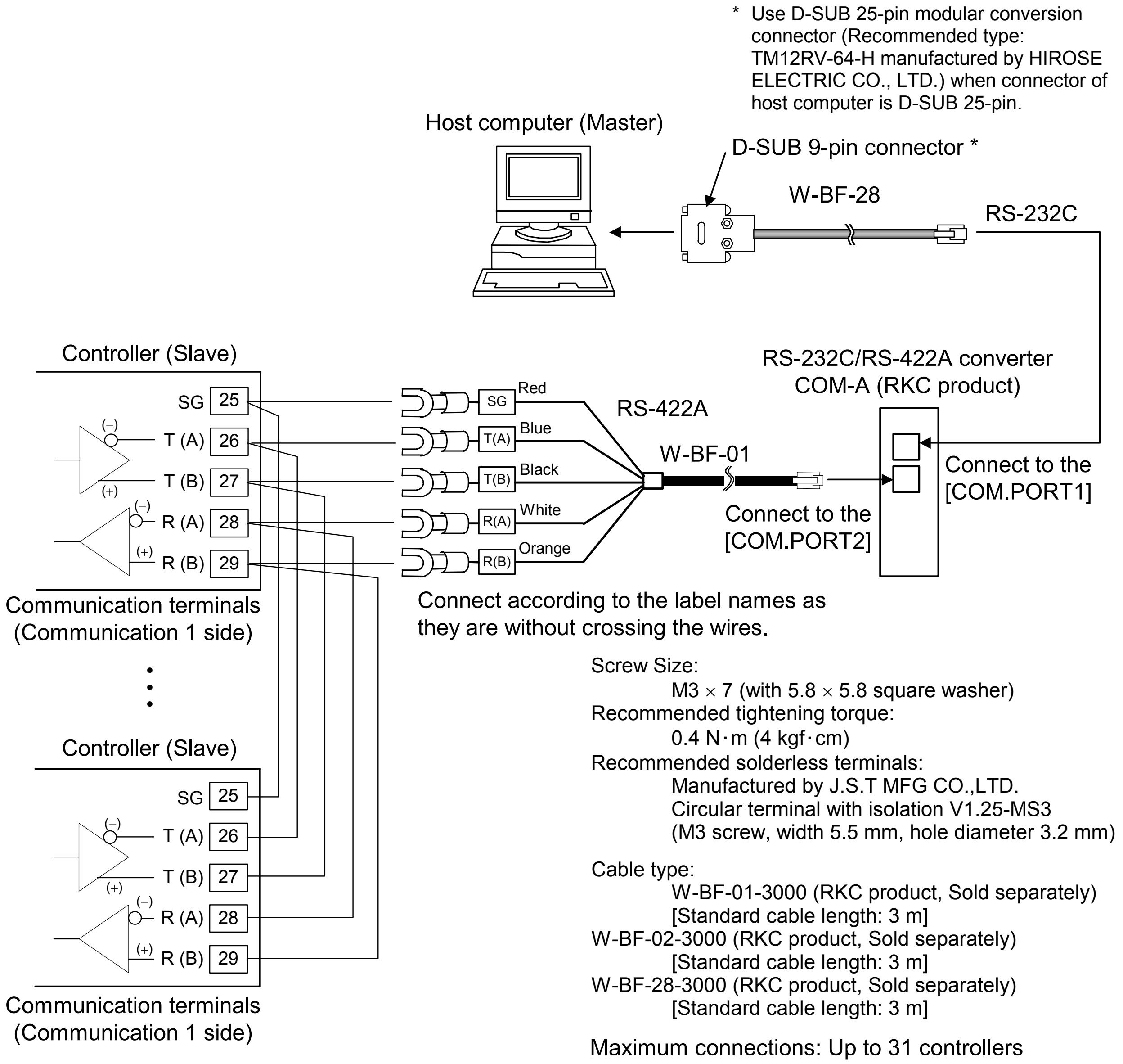
■ Connection to the RS-422A port of the controller

A RS-232C/RS-422A converter is required.

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data	T (A)
27	Send data	T (B)
28	Receive data	R (A)
29	Receive data	R (B)

● Wiring example



Screw Size:
M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Cable type:
W-BF-01-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]
W-BF-02-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]
W-BF-28-3000 (RKC product, Sold separately)
[Standard cable length: 3 m]

Maximum connections: Up to 31 controllers

Recommended RS-232C/RS-422A converter: **COM-A** (RKC product)
For the COM-A, refer to the **COM-A/COM-B Instruction Manual (IMSRM33-E□)**.

The cable is provided by the customer.

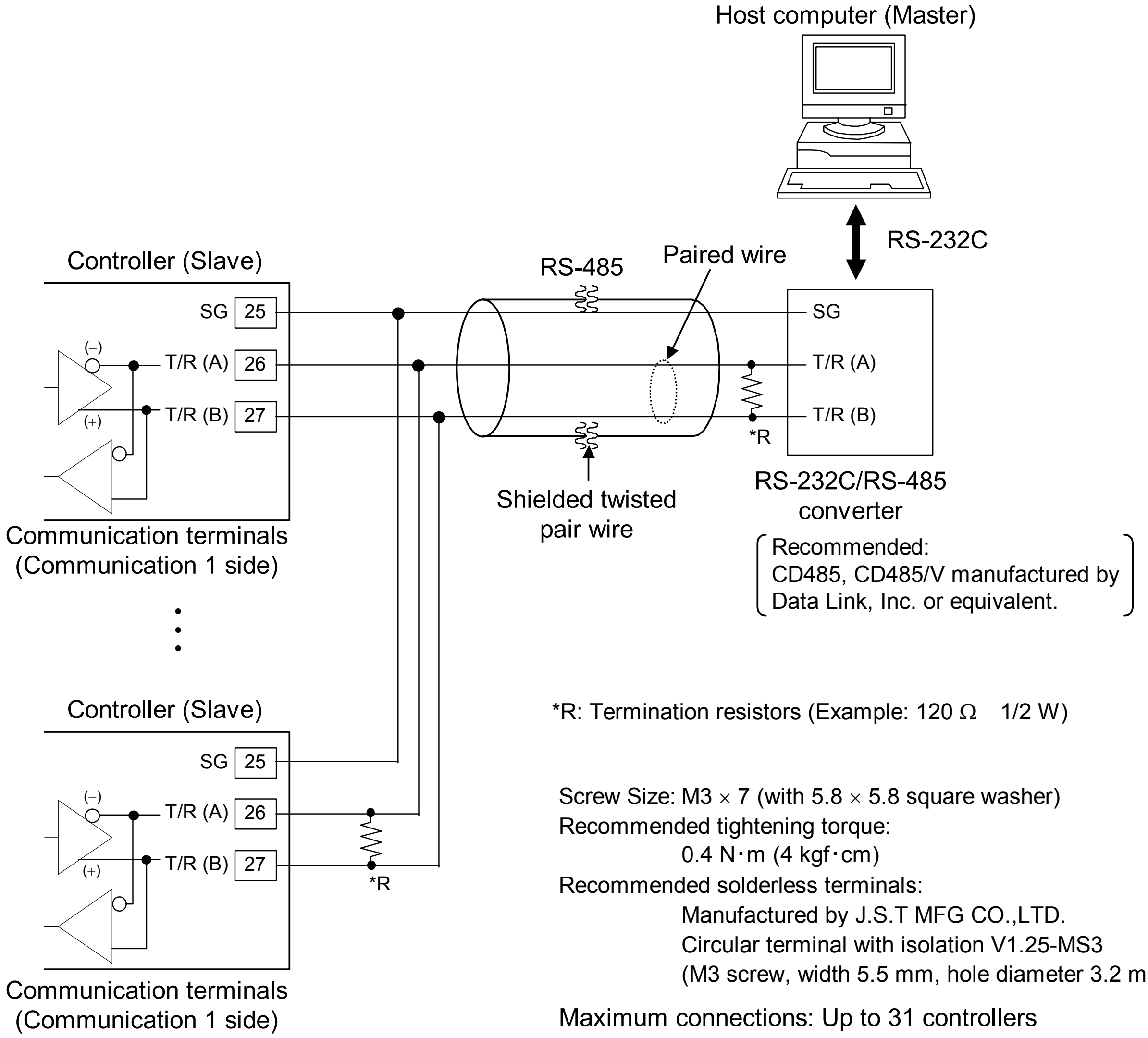
■ Connection to the RS-485 port of the controller

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

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send/Receive data	T/R (A)
27	Send/Receive data	T/R (B)

● Wiring example



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

Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Maximum connections: Up to 31 controllers

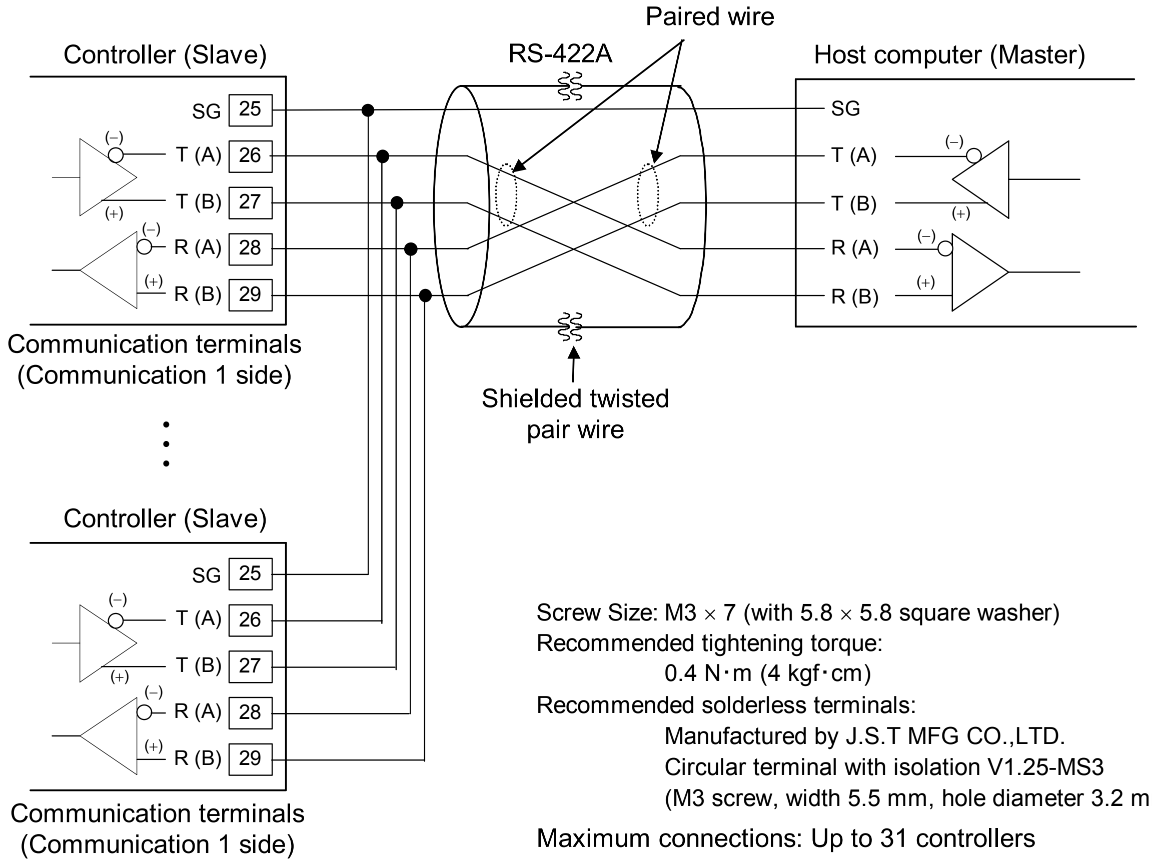
The cable is provided by the customer.

7.1.2 RS-422A connection

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data	T (A)
27	Send data	T (B)
28	Receive data	R (A)
29	Receive data	R (B)

● Wiring example



Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N·m (4 kgf·cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)
Maximum connections: Up to 31 controllers

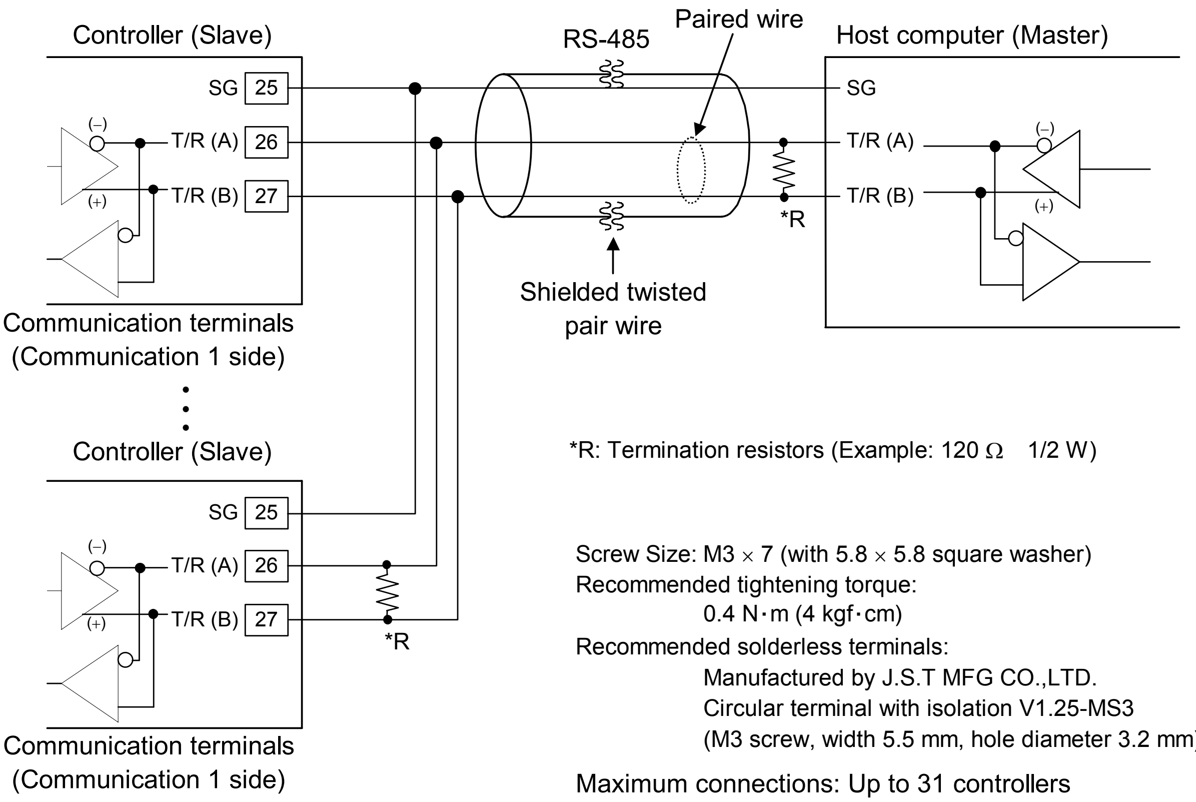
The cable is provided by the customer.

7.1.3 RS-485 connection

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send/Receive data	T/R (A)
27	Send/Receive data	T/R (B)

● Wiring example



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

Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Maximum connections: Up to 31 controllers

The cable is provided by the customer.

7.1.4 USB connection

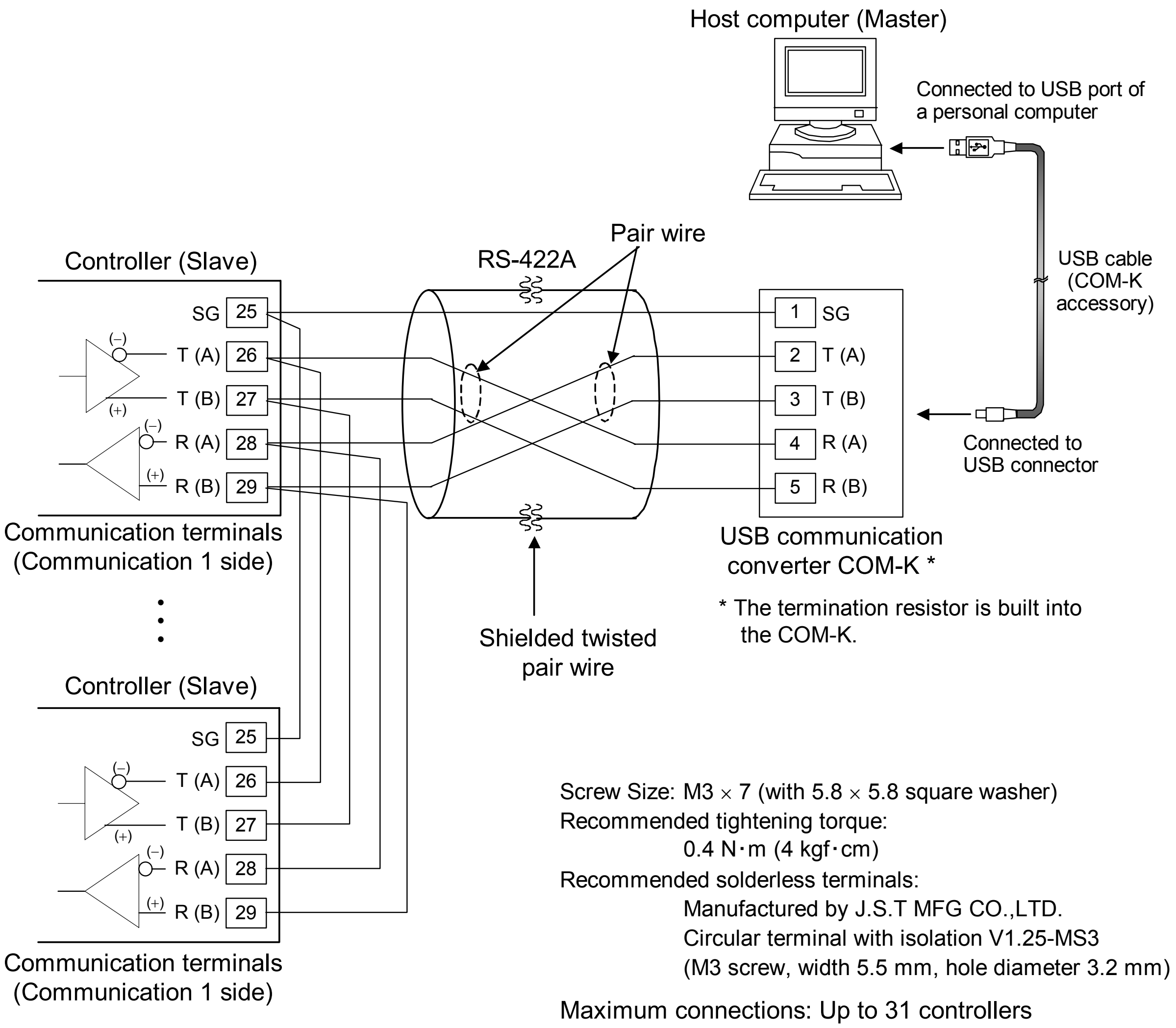
When the host computer (OS: Windows 98SE/2000/XP/Vista) is corresponding to the USB connector, our communication converter COM-K (sold separately) can be used.

■ Connection to the RS-422A port of the controller

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send data	T (A)
27	Send data	T (B)
28	Receive data	R (A)
29	Receive data	R (B)

● Wiring example



Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N･m (4 kgf･cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Maximum connections: Up to 31 controllers

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

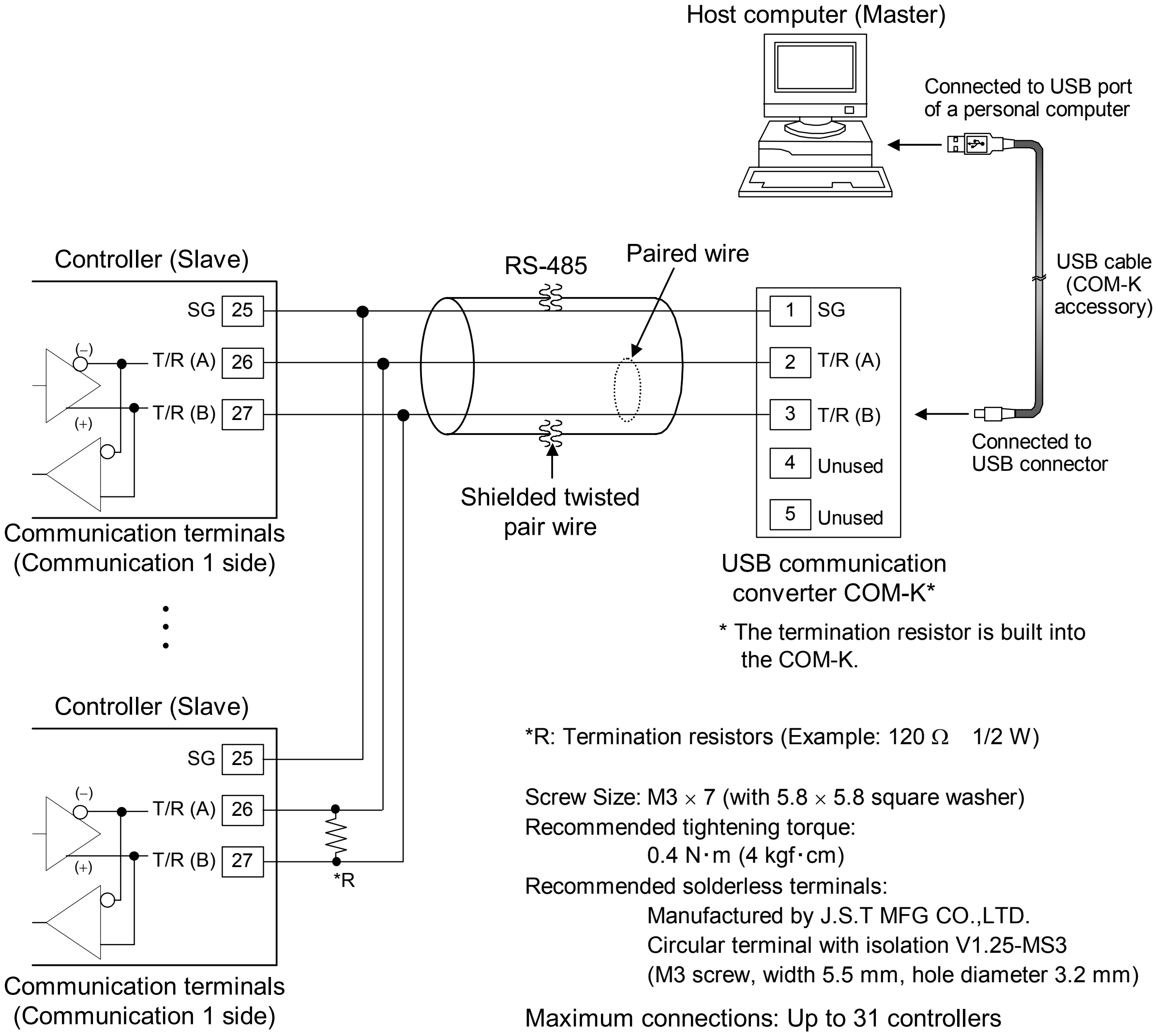
The cable is provided by the customer.

■ Connection to the RS-485 port of the controller

● Communication terminal number and signal details

Terminal No.	Signal name	Symbol
25	Signal ground	SG
26	Send/Receive data	T/R (A)
27	Send/Receive data	T/R (B)

● Wiring example



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

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

Screw Size: M3 × 7 (with 5.8 × 5.8 square washer)
Recommended tightening torque:
0.4 N·m (4 kgf·cm)
Recommended solderless terminals:
Manufactured by J.S.T MFG CO.,LTD.
Circular terminal with isolation V1.25-MS3
(M3 screw, width 5.5 mm, hole diameter 3.2 mm)

Maximum connections: Up to 31 controllers

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

The cable is provided by the customer.

7.2 Setting

7.2.1 Description of each parameter

To communicate between the controller (slave) and the Host computer (master), set the following parameters of Com.1: protocol, communication device address (slave address), communication speed, data bit configuration and interval time.

■ Parameter list

Parameters for communication are at Function block 60 (F60) in the Engineering mode.

Symbol	Name	Data range	Description	Factory set value
Function block 60 (F60.)				
CMP1 (CMP1)	Communication protocol 1	0: RKC communication 1: Modbus	Use to select a protocol of Communication function.	RKC communication: 0 * Modbus: 1 *
Add1 (Add1)	Device address 1 (Slave address)	RKC communication: 0 to 99 Modbus: 1 to 99	Do not use the same Device address for more than one controller in multi-drop connection. Each controller must have a unique address in multi-drop connection. In Modbus communication, communication is not possible when the address is 0.	RKC communication: 0 Modbus: 1
bPS1 (bPS1)	Communication speed 1	2400: 2400 bps 4800: 4800 bps 9600: 9600 bps 19200: 19200 bps 38400: 38400 bps 57600: 57600 bps	Set the same Communication speed for both the controller (slave) and the host computer (master).	19200
bIT1 (bIT1)	Data bit configuration 1	RKC communication: 8N1 to 7o2 Modbus: 8N1 to 8E2 Refer to **Data bit configuration table**	Set the same Data bit configuration for both the controller (slave) and the host computer (master).	8N1
INT1 (INT1)	Interval time 1	0 to 250 ms	The Interval time for the controller should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for the host.	10

* The communication protocol that was selected by means of the model code when the order was placed is set as the factory set value.

Data bit configuration table

Set value	Data bit	Parity bit	Stop bit	Settable communication
8N1	8	Without	1	RKC communication Modbus
8N2	8	Without	2	
8E1	8	Even	1	
8E2	8	Even	2	
8o1	8	Odd	1	RKC communication
8o2	8	Odd	2	

Set value	Data bit	Parity bit	Stop bit	Settable communication
7N1	7	Without	1	RKC communication
7N2	7	Without	2	
7E1	7	Even	1	
7E2	7	Even	2	
7o1	7	Odd	1	
7o2	7	Odd	2	

All parameters except Communication protocol 1 can be set in the Setup setting mode.

Interval time:
The Interval time for the controller should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for the host. If the Interval time between the two is too short, the controller may send data before the host computer is ready to receive it. In this case, communication transmission cannot be conducted correctly.

7.2.2 Setting procedure

Parameters for communication are at Function block 60 (F60) in the Engineering mode.

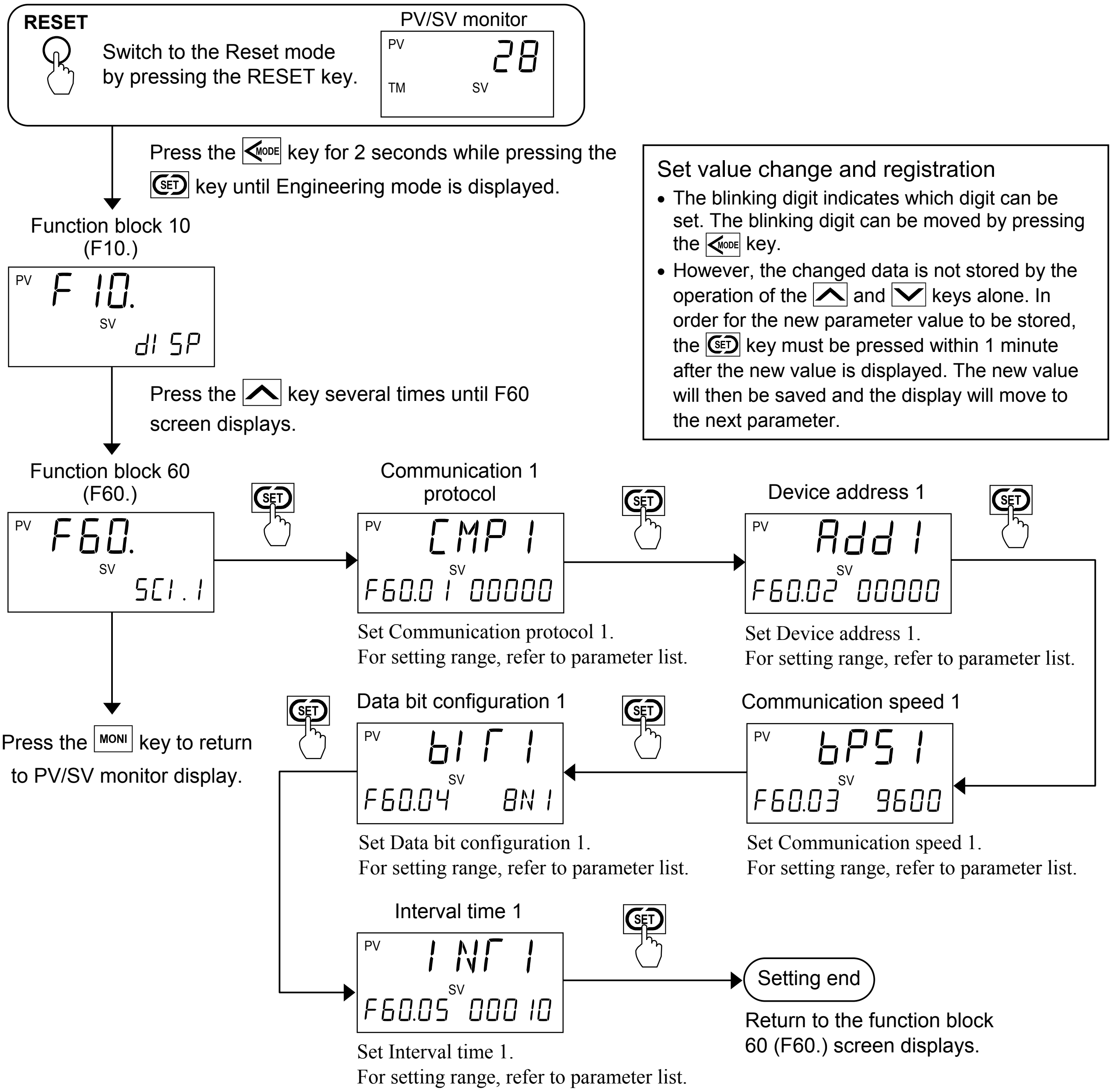
NOTE

Make sure to be in the RESET mode before conducting parameter setting in the Engineering mode.

When Data lock function is ON, parameters in the Engineering mode can not be changed. Data lock function can be released in the Operation mode.

Press the STEP R.SET key to go back to the previous display.

■ Setting sequence



■ To activate the parameter change

To validate the set value being changed, change all communication parameters, then turn the power OFF and then ON. If this is not done, the higher level device will not be able to recognize the changed values and communication may not be possible.

7.2.3 Communication requirements

■ Processing times during data send/receive

When the host computer is using either the polling or selecting procedure for communication, the following processing times are required for controller to send data:

– Response wait time after controller sends BCC in polling procedure
– Response wait time after controller sends ACK or NAK in selecting procedure

Response send time is time when Interval time is set at 0 ms.

● RKC communication (Polling procedure) processing times

[Unit: ms]

Procedure details	MIN [1]	TYP	MAX [2]
Response send time after controller receives ENQ	0.4	2.4	12
Response send time after controller receives ACK or Response send time after controller receives NAC	0.08	—	12
Response send time after controller sends BCC	—	—	1

● RKC communication (Selecting procedure) processing times

[Unit: ms]

Procedure details	MIN [1]	TYP	MAX [2]
Response send time after controller receives BCC	0.4	3	38
Response wait time after controller sends ACK	—	—	1
Response wait time after controller sends NAK	—	—	1

[1] Min of response send time is time at having set Input sampling cycle in 250 ms.
[2] Max of response send time is time at having set Input sampling cycle in 50 ms.

● Modbus processing times (Maximum)

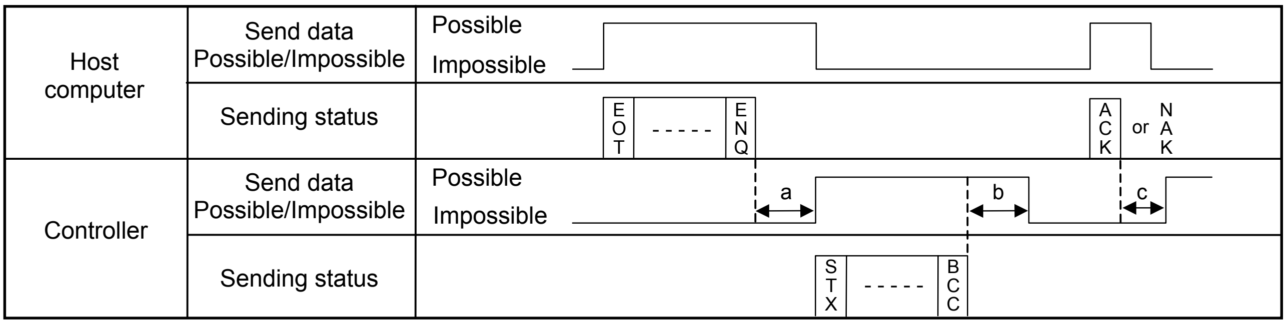
[Unit: ms]

Procedure details Input sampling cycle (ms)	250	100	50
Read holding registers [03H] Response transmission time after the slave receives the query message (When 125 registers are collectively read)	110	470	2100
Preset single register [06H] Response transmission time after the slave receives the query message	30		
Diagnostics (loopback test) [08H] Response transmission time after the slave receives the query message	22		
Preset multiple registers [10H] Response transmission time after the slave receives the query message (When 123 registers are collectively write)	210	460	2100

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

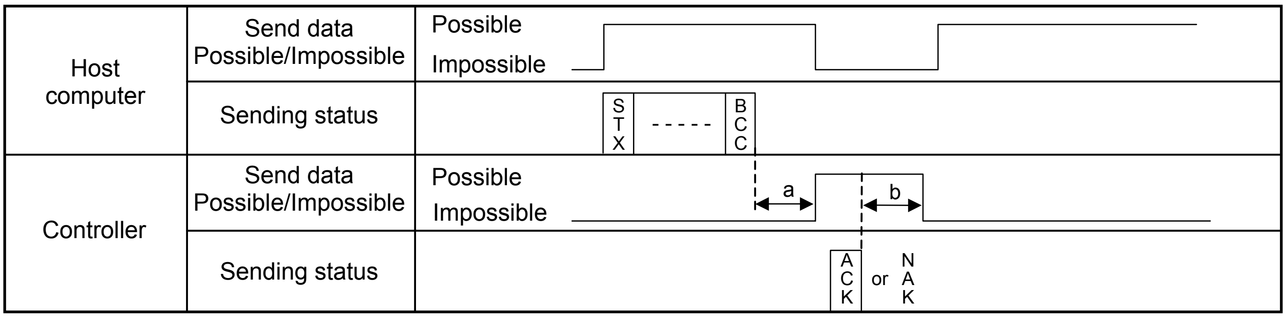
RS-485 communication is conducted through two wires, therefore, the transmission and reception of data requires precise timing.

● Polling procedure



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

● Selecting procedure



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

📖 To switch the host computer from transmission to reception, send data must be on line.

📖 The following processing times are required for the controller to process data:
– In polling procedure, Response wait time after the controller sends BCC
– In selecting procedure, Response wait time after the controller sends ACK or NAK

■ RS-422A/RS-485 Fail-safe

A transmission error may occur if the transmission line is disconnected, shorted or set to the high-impedance state. In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer. The fail-safe function can prevent a framing error from its occurrence by making the receiver output stable to the MARK (1) when the transmission line is in the high-impedance state.

7.3 RKC Communication Protocol

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

- The Polling/Selecting procedures are a centralized control method where the host computer controls the entire process. The host computer initiates all communication so the controller responds according to queries and commands from the host.

- The code use in communication is 7-bit ASCII code including transmission control characters.
  The transmission control characters are EOT (04H), ENQ (05H), ACK (06H), NAK (15H), STX (02H) and ETX (03H). The figures in the parenthesis indicate the corresponding hexadecimal number.

Data send/receive state (communication data setting) of RKC communication can be checked by using the following software:

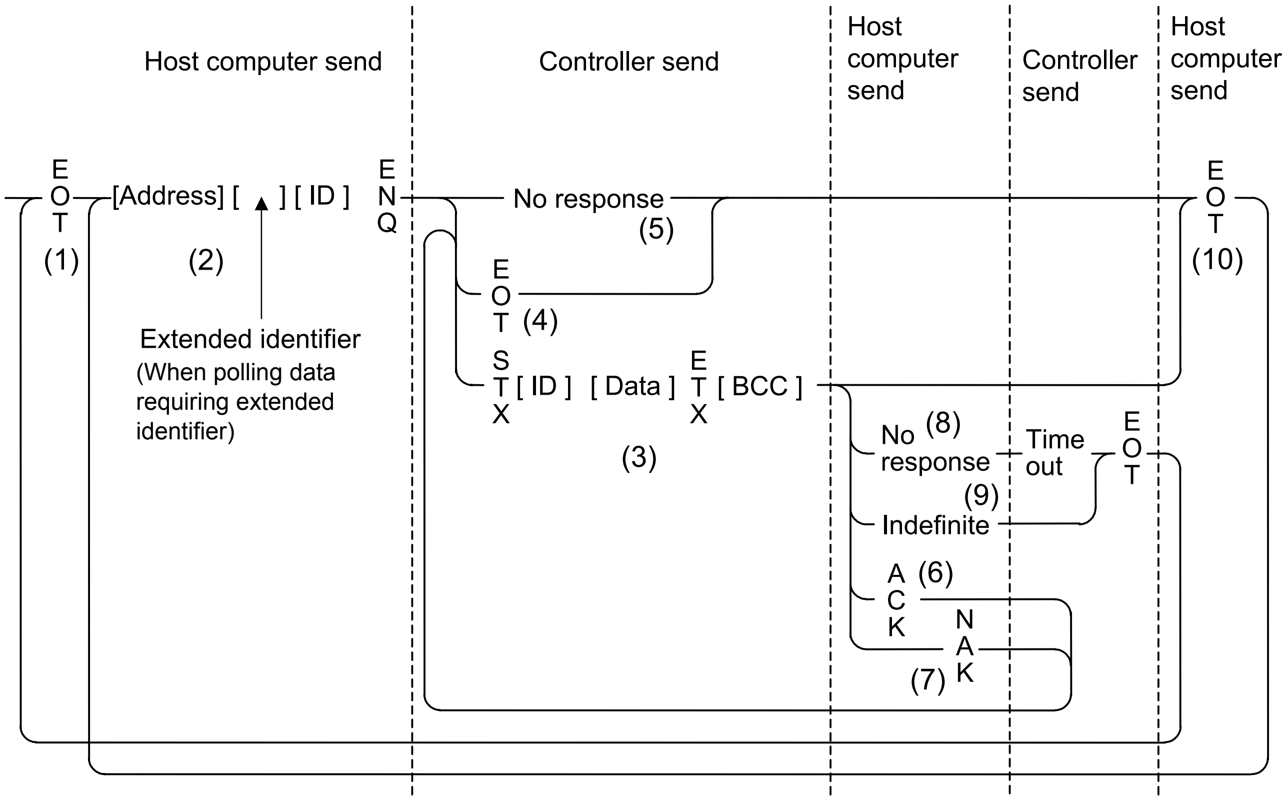
- Setup tool "WinUCI-PF900"

The software can be downloaded from the RKC official website or the CD-R supplied with the instrument.

URL: http://www.rkcinst.com

7.3.1 Polling

Polling is the action where the host computer requests one of the connected controllers to transmit data. An example of the polling procedure is shown below:



ID: Identifier

■ Polling procedures

(1) Data link initialization

Host computer sends EOT to the controllers to initiate data link before polling sequence.

(2) Data sent from host computer - Polling sequence

The host computer sends the polling sequence in the following two types of formats:

- Format when Extended identifier is not required, and
- Format when Extended identifier is not required.

Extended identifiers are used when a parameter requires Pattern number, Segment number or Memory group number.

● When Extended identifier is not required

1.	*3.*	*4.*
Address	Identifier	ENQ

Example: Measured value (PV)

0	1	M	1	ENQ

Identifier: M1

● When Extended identifier is required

1.	*2.*	*3.*	*4.*
Address	Extended identifier	Identifier	ENQ

Example: Proportional band in the PID memory group 1

0	1	P	O	1	P	1	ENQ

Identifier: P1

Extended identifier: PO1

1. Address (2 digits)

The device address specifies the controller to be polled and each controller must have its own unique device address.
This data is a device address of the controller to be selected and must be the same as the device address set value in item **7.2 Setting (P. 7-9)**.

NOTE

Always specify the device address in RS-232C specification.

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

2. Extended identifier

Extended identifiers are used when a parameter requires Pattern number, Segment number or Memory group number. There are 7 types of Extended identifiers.

• To specify data with Pattern number and Segment number (8 digits)

P	N	□	□	S	N	□	□

Specify Segment number from 01 to 99.

Specify Pattern number from 01 to 99.

• To specify data with Pattern number (4 digits)

P	N	□	□

Specify Pattern number from 01 to 99.

• To specify data with Time signal memory group (8 digits)

P	N	□	□	T	N	□	□

Specify Time signal memory number from 01 to 16.

Specify Time signal memory group number from 01 to 16

• To specify data with Output program memory group (8 digits)

N	K	□	□	S	N	□	□

Specify Segment number from 01 to 99.

Specify Output program memory group number from 01 to (128/Maximum number of segment).

• To specify data with PID memory group (3 digits)

P	O	□

Specify PID memory group number from 0* to 8.

• To specify data with Event memory group (3 digits)

A	N	□

Specify Event memory group number from 0* to 8.

• To specify data with Wait memory group (3 digits)

P	N	□

Specify Wait memory group number from 0* to 8.

* The data of the Memory group number being used is specified upon when setting “0” for Memory group number.

When specifying a parameter which does not have Extended identifier, the specified Extended identifier is ignored.

3. Identifier (2 digits)
The identifier specifies the type of data that is requested from the controller. Always attach the ENQ code to the end of the identifier.

☞ For the identifier, refer to **7.5 Communication Data List (P. 7-39)**.

4. ENQ
The ENQ is the transmission control character that indicates the end of the polling sequence.
The ENQ must be attached to the end of the identifier.
The host computer then must wait for a response from the controller.

(3) Data sent from the controller

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

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

1. STX
STX is the transmission control character which indicates the start of the text transmission (identifier and data).

2. Identifier (2 digits)
The identifier indicates the type of data (measured value, status and set value) sent to the host computer.

☞ For the identifier, refer to **7.5 Communication Data List (P. 7-39)**.

3. Data (7 digits)
Data which is indicated by an identifier of the controller. It is expressed in decimal ASCII code including a minus sign (–) and a decimal point. Data is not zero-suppressed.

"Model Code: ID" has 32 digits. "Pattern tag name: GN" has 11 digits.

The time data is described as shown below:

- Segment remaining time, Segment time, Pattern end output duration, Wait time-out set value and Time signal start/end: from 0 hours 00 minutes to 500 hours 00 minutes
- Pattern remaining time: from 0 hours 00 minutes to 999 hours 59 minutes

Use "(2EH)" to separate hours and minutes, for example, 10 hours 30 minutes is written as "0010.30".

4. ETX
ETX is a transmission control character used to indicate the end of text transmission.

5. BCC
BCC (Block Check Character) detects error by using horizontal parity (even number).

Calculation method of BCC: *Exclusive OR* all data and characters from STX through ETX, not including STX.

Example:

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

BCC = 4DH ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 31H ⊕ 30H ⊕ 30H ⊕ 2EH ⊕ 30H ⊕ 03H = 50H (⊕: Exclusive *OR*)
Value of BCC becomes 50H.

(4) EOT sent from the controller (Ending data transmission from the controller)

In the following cases, the controller sends EOT to terminate the data link:

- When the specified identifier is invalid
- When the Extended identifier is not specified for the data required Extended identifier.
- When there is an error in the data type
- When data is not sent from the host computer even if the data link is initialized
- When all the data has been sent

(5) No response from the controller

The controller will not respond if the polling address is not received correctly. It may be necessary for the host computer to take corrective action such as a time-out.

(6) ACK (Acknowledgment)

An acknowledgment ACK is sent by the host computer when data received is correct. When the controller receives ACK from the host computer, the controller will send any remaining data of the next identifier without additional action from the host computer.

☞ For the identifier, refer to **7.5.2 Communication data [RKC Communication/Modbus] (P. 7-40)**

When host computer determines to terminate the data link, EOT is sent from the host computer.

(7) NAK (Negative acknowledge)

If the host computer does not receive correct data from the controller, it sends a negative acknowledgment NAK to the controller. The controller will re-send the same data when NAK is received. This cycle will go on continuously until either recovery is achieved or the data link is corrected at the host computer.

(8) No response from host computer

When the host computer does not respond within approximately three seconds after the controller sends data, the controller sends EOT to terminate the data link. (Time out: 3 seconds)

(9) Indefinite response from host computer

The controller sends EOT to terminate the data link when the host computer response is indefinite.

(10) EOT (Data link termination)

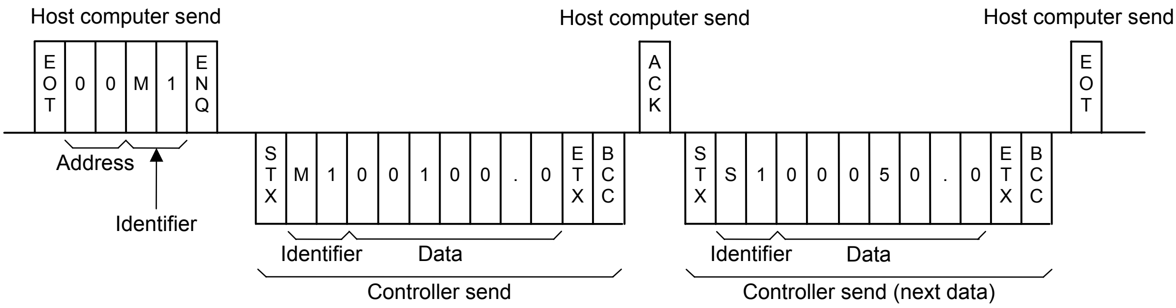
The host computer sends EOT message when it is necessary to suspend communication with the controller or to terminate the data link due lack of response from the controller.

■ Polling procedure example

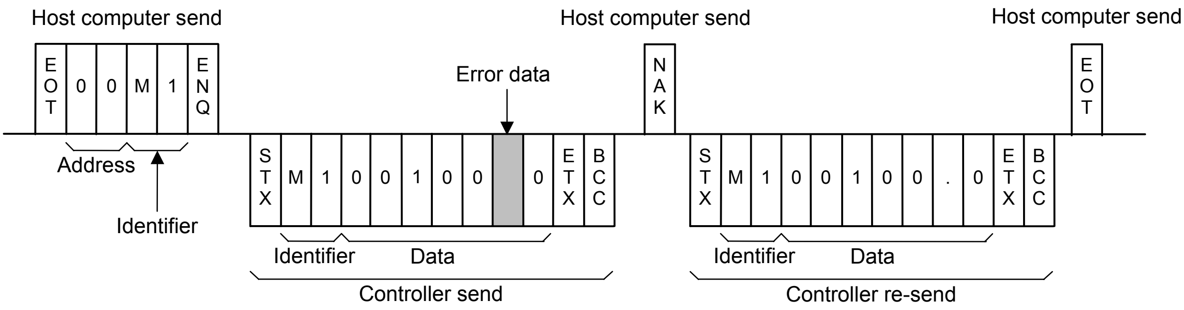
(1) When polling items which does not have Extended identifier.

Example: Read Measured value (PV) from the controller.

● Normal transmission



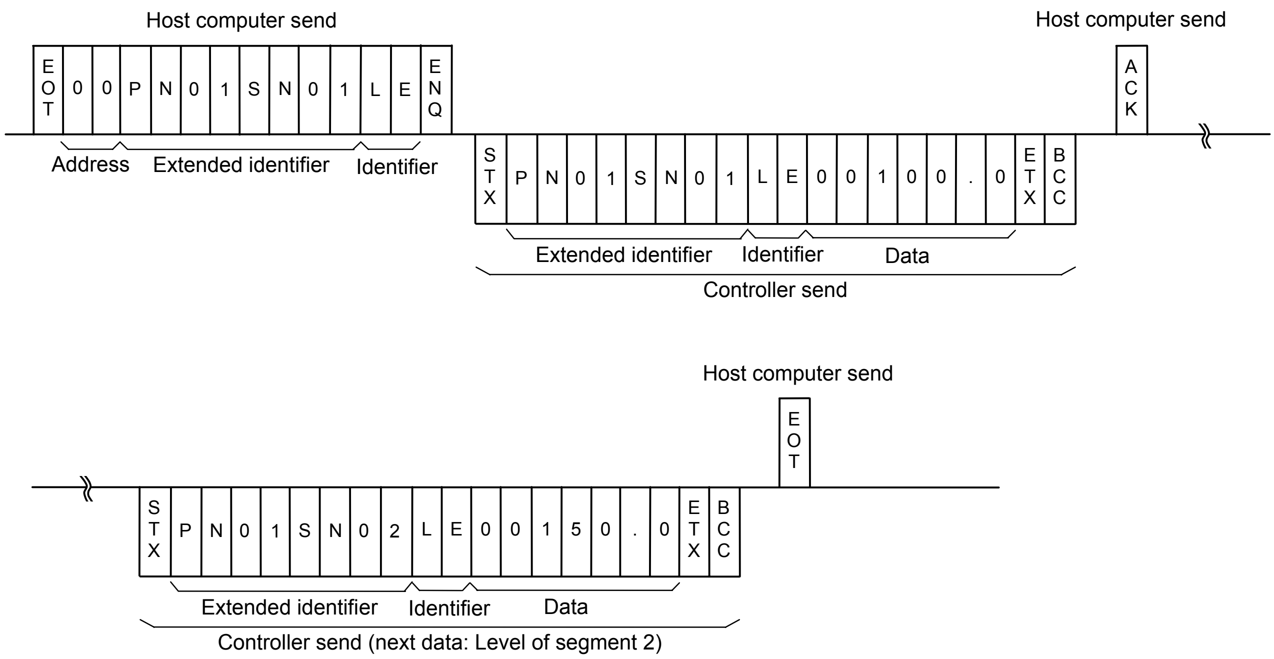
● Error transmission



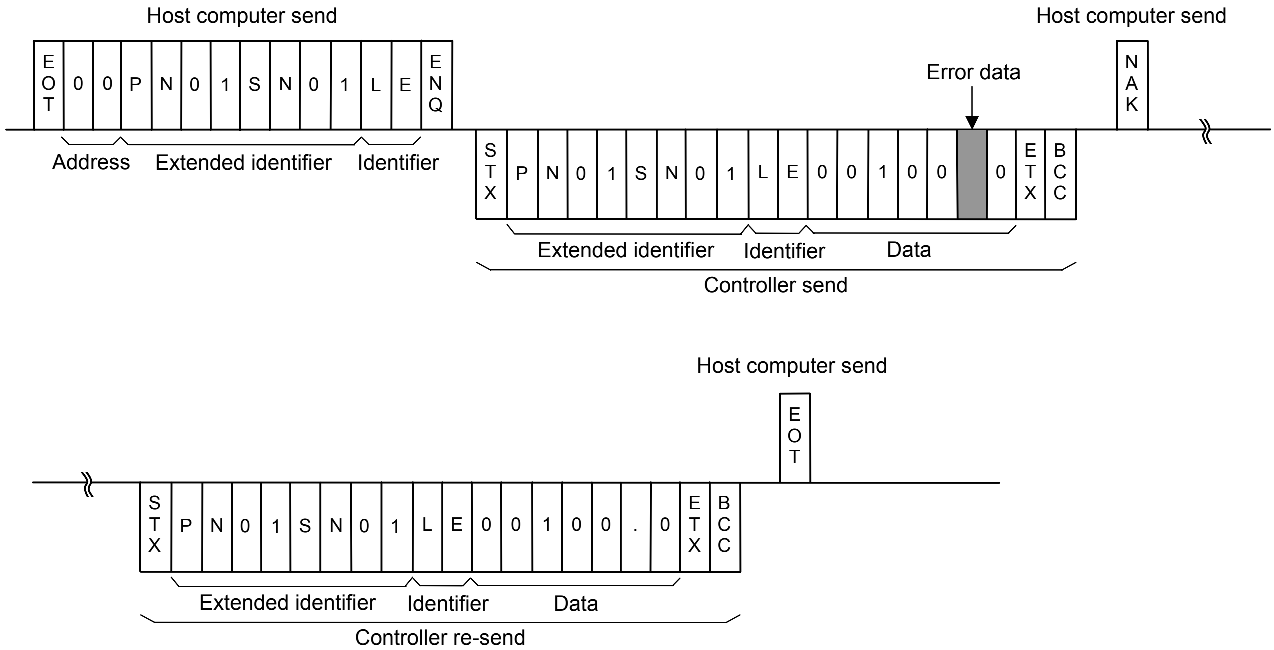
(2) When polling items which requires Extended identifier.

Example: Read data of Segment level 1 of Pattern 1 from controller.

● Normal transmission

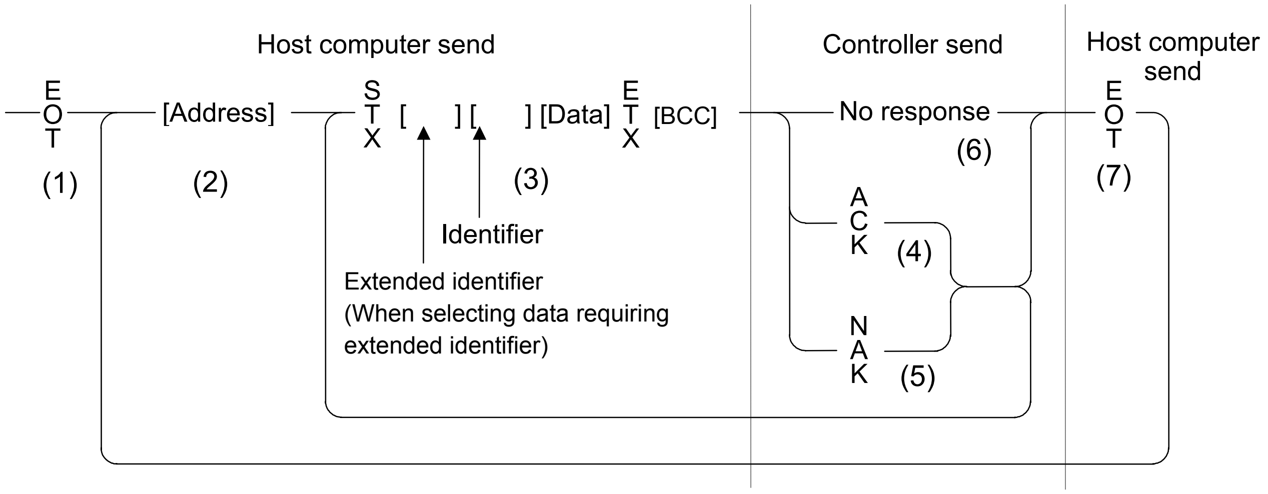


● Error transmission



7.3.2 Selecting

Selecting is the action where the host computer requests one of the connected controllers to receive data. An example of the selecting procedure is shown below:



■ Selecting procedures

(1) Data link initialization

Host computer sends EOT to the controllers to initiate data link before selecting sequence.

(2) Sending selecting address from the host computer

Host computer sends selecting address for the selecting sequence.

• Address (2 digits)

This data is a device address of the controller to be selected and must be the same as the device address set value in item **7.2 Setting (P. 7-9)**.

NOTE

Always specify the device address in RS-232C specification.

As long as the data link is not initialized by sending or receiving EOT, the selecting address once sent becomes valid.

(3) Data sent from the host computer

The host computer sends data for the selecting sequence with the following format:

● When Extended identifier is not required

	2.	3.		
STX	Identifier	Data	ETX	BCC

● When Extended identifier is required

	1.	2.	3.		
STX	Extended identifier	Identifier	Data	ETX	BCC

☞ For the STX, ETX and BCC, refer to **7.3.1 Polling (P. 7-13)**.

1. Extended identifier
Extended identifiers are used when a parameter requires Pattern number, Segment number or Memory group number.

☞ For details, refer to **(2) Data sent from host computer - Polling sequence, *2.* Extended identifier (P. 7-15)**.

📖 When specifying a parameter which does not have Extended identifier, the specified Extended identifier is ignored.

2. Identifier (2 digits)
The identifier specifies the type of data that is requested from the controller, such as set value.

☞ For the identifier, refer to **7.5 Communication Data List (P. 7-39)**.

3. Data
Data which is indicated by an identifier of the controller is expressed in decimal ASCII code including a minus sign (−) and a decimal point. The data are zero-suppression possibility.
The number of digits varies depending on the type of identifier.
Number of digits: Within 7 digits except for Pattern tag name (11 digits fixed)

📖 The time data is described as shown below:

- Segment remaining time, Segment time, Pattern end out duration, Wait time-out set value and Time signal start/end: from 0 hours 00 minutes to 500 hours 00 minutes
- Pattern remaining time: from 0 hours 00 minutes to 999 hours 59 minutes

Use “(2EH)” to separate hours and minutes, for example, 10 hours 30 minutes is written as “0010.30”.

In addition to above, when minute and second data are set in more than 60, become as the following:

Example: 1.65 (1 hour 65 minutes) → 2.05 (2 hours 05 minutes)
0.65 (0 minute 65 seconds) → 1.05 (1 minute 05 seconds)

● About numerical data

Numerical data which the controller can receive

- Data with numbers below the decimal point omitted or zero-suppressed data can be received.
  The number of digits is based on the identifier (up to 7 digits). (The Pattern tag name fixed to 11 digits.)

  Example: When data send with –001.5, –01.5, –1.5, –1.50, –1.500 at the time of –1.5, controller can receive data.

- When the host computer sends data containing a decimal point to an item without a decimal point, the controller receives a message rounded down to the nearest whole number.

  Example: When setting range is 0 to 200, the controller will receive as follows:

Send data	0.5	100.5
Receive data	0	100

- The controller receives the value based on the decided number of places after decimal point.
  Any number beyond the established number of decimal points will be cut off.

  Example: When setting range is –10.00 to +10.00, the controller will receives as follows:

Send data	–.5	–.058	.05	–0
Receive data	–0.50	–0.05	0.05	0.00

Numerical data which the controller can not receive

The controller sends NAK when received a following data.

+	Plus sign and the data that gained plus sing
–	Only minus sign (there is no figure)
.	Only decimal point (period)
–.	Only minus sign and decimal point (period)

● Processing of Pattern tag name data

An 11 digit alphanumeric Tag name can be set for each pattern by communication.

- The space where non 11-segment display character of the ASCII is input becomes blank.
- Execution pattern number displays if the 11-digit space becomes blank by setting non 11-segment display character.

ASCII character/Display character table

Number, Symbol:

ASCII character	0	1	2	3	4	5	6	7	8	9	-	/	*	_	Space
Display character	0	1	2	3	4	5	6	7	8	9	-	/		_	Space

Alphabetical characters (Letter "C," "R," "T," and "U" are upper/lower case sensitive in display.)

ASCII character	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Display character	A	b	C	d	E	F	G	H	I	J	K	L	M	N	o	P	Q	R	S	T	U	V	W	X	Y	Z

ASCII character	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
Display character	A	b	c	d	E	F	G	H	I	J	K	L	M	N	o	P	Q	r	S	t	u	V	W	X	Y	Z

(4) ACK (Acknowledgment)

An acknowledgment ACK is sent by the controller when data received is correct. When the host computer receives ACK from the controller, the host computer will send any remaining data. If there is no more data to be sent to the controller, the host computer sends EOT to terminate the data link.

(5) NAK (Negative acknowledge)

If the controller does not receive correct data from the host computer, it sends a negative acknowledgment NAK to the host computer. Corrections, such as re-send, must be made at the host computer. The controller will send NAK in the following cases:

- When an error occurs on communication the line (parity, framing error, etc.)
- When a BCC check error occurs
- When the specified identifier is invalid
- When the Extended identifier is not specified for the data required Extended identifier.
- When receive data exceeds the setting range
- When receive data is the identifier of RO (read only)

(6) No response from controller

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

(7) EOT (Data link termination)

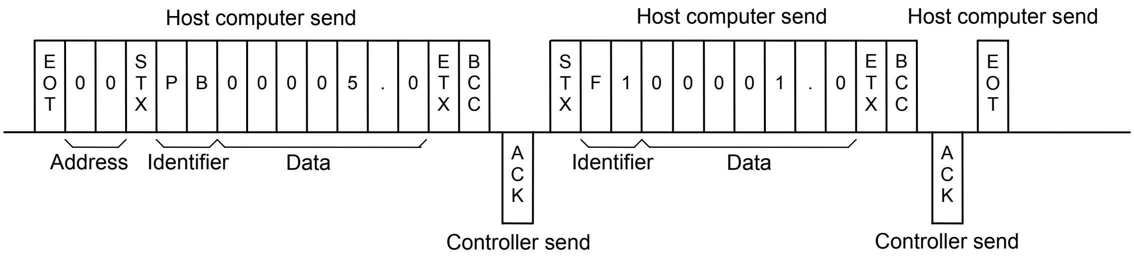
The host computer sends EOT when there is no more data to be sent from the host computer or there is no response from the controller.

■ Selecting procedure example

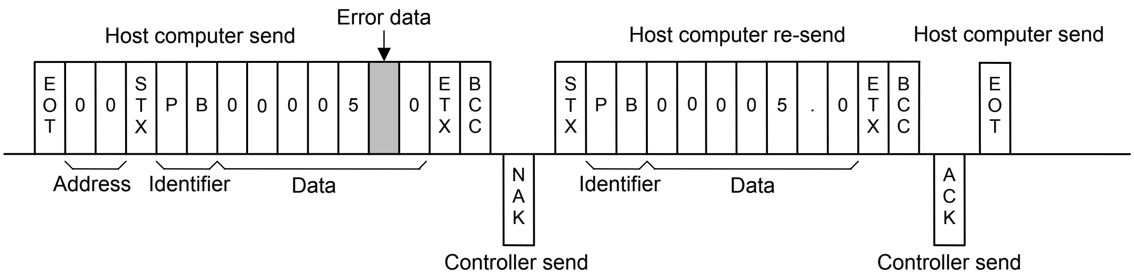
(1) When selecting items which does not have Extended identifier.

Example: Write PV bias to the controller.

● Normal transmission



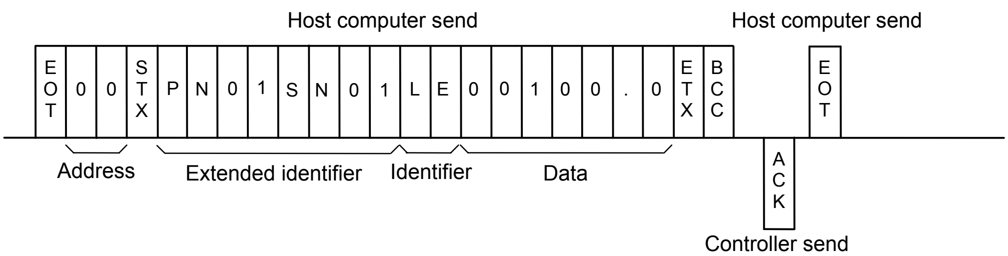
● Error transmission



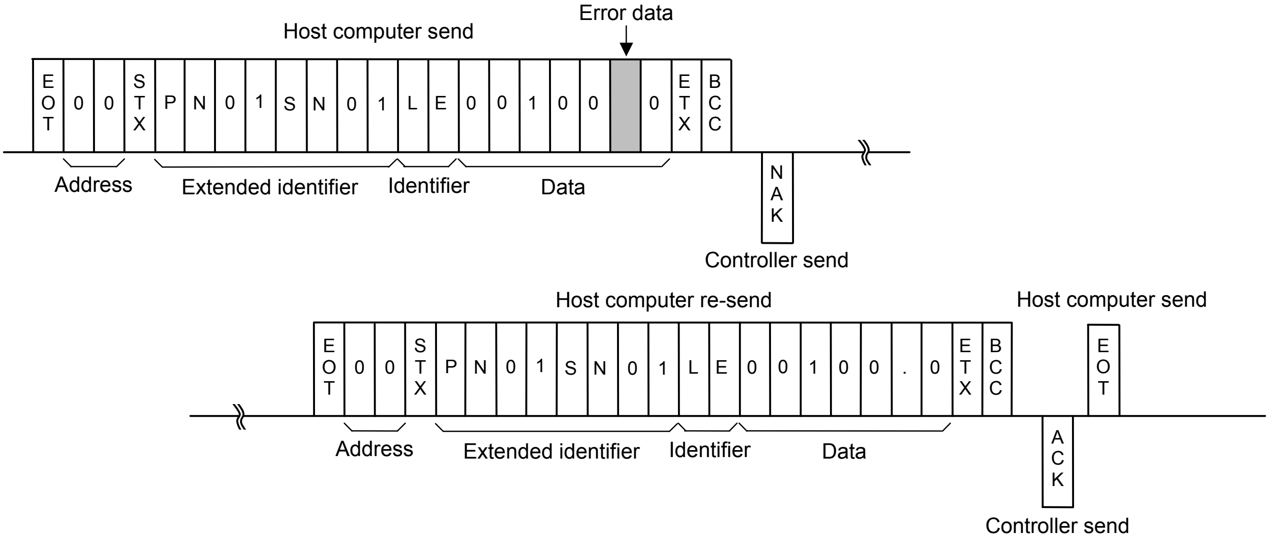
(2) When selecting items which requires Extended identifier.

Example: Write data of Segment level 1 of Pattern 1 to controller.

● Normal transmission



● Error transmission



7.4 Modbus Protocol

The master controls communication between master and slave. A typical message consists of a request (query message) sent from the master followed by an answer (response message) from the slave. When master begins data transmission, a set of data is sent to the slave in a fixed sequence. When it is received, the slave decodes it, takes the necessary action, and returns data to the master.

7.4.1 Message format

The message consists of four parts: slave address, function code, data, and error check code which are always transmitted in the same sequence.

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

Message format

■ Slave address

The slave address is a number from 1 to 99 manually set at the front key panel of the controller.

Master does not communicate with the slave when the address is set to “0.”

For details, refer to **7.2 Setting (P. 7-9)**.

Although all connected slave units receive the query message sent from the master, only the slave with the slave address coinciding with the query message will accept the message.

■ Function code

The function codes are the instructions set at the master and sent to the slave describing the action to be executed. The function codes are included when the slave responds to the master.

For details, refer to **7.4.2 Function code (P. 7-26)**.

■ Data

The data to execute the function specified by the function code is sent to the slave and corresponding data returned to the master from the slave.

For details, refer to **7.4.6 Register read and write (P. 7-30)** and **7.5 Communication Data List (P. 7-39)**.

■ Error check

An error checking code (CRC-16: Cyclic Redundancy Check) is used to detect an error in the signal transmission.

For details, refer to **7.4.5 Calculating CRC-16 (P. 7-28)**.

7.4.2 Function code

Function code contents

Function code (Hexadecimal)	Function	Contents
03H	Read holding registers	Measured value, control output value, Event status, etc.
06H	Preset single register	Program set vale, Event set value, PID constants, PV bias, etc. (Write single data)
08H	Diagnostics (loopback test)	loopback test
10H	Preset multiple registers	Program set vale, Event set value, PID constants, PV bias, etc. (Write multiple consecutive data)

Message length of each function (Unit: byte)

Function code (Hexadecimal)	Function	Query message		Response message	
		Min	Max	Min	Max
03H	Read holding registers	8	8	7	255
06H	Preset single register	8	8	8	8
08H	Diagnostics (loopback test)	8	8	8	8
10H	Preset multiple registers	11	255	8	8

7.4.3 Communication Mode

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

Items	Contents
Data bit length	8-bit (Binary)
Start mark of message	Unused
End mark of message	Unused
Message length	Refer to **7.4.2 Function code**
Data time interval	Less than 24-bit time *
Error check	CRC-16 (Cyclic Redundancy Check)

* When sending a command message from the master, set intervals of data configuring one message to time shorter than the 24-bit time. If time intervals become time longer than the 24-bit time the relevant slave assumes that message sending from the master is terminated and there is no response.
If the Data time interval cannot be set less than 24 bit time, duration of time-out should be extended by setting “Interval time-out 1” (P. 4-53) at F60.07 in the Initial level engineering mode.

7.4.4 Slave Responses

(1) Normal response

- In the response message of the Read Holding Registers, the slave returns the read out data and the number of data items with the same slave address and function code as the query message.
- In the response message of the Preset Single Register, the slave returns the same message as the query message.
- In the response message of the Diagnostics (Loopback test), the slave returns the same message as the query message.
- In the response message of the Preset Multiple Registers, the slave returns the slave address, the function code, starting number, and number of holding registers in the multi-query message.

(2) Defective message response

- If the query message from the master is defective, except for transmission error, the slave returns the error response message without any action.

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

Error response message

- If the self-diagnostic function of the slave detects an error, the slave will return an error response message to all query messages.
- The function code of each error response message is obtained by adding 80H to the function code of the query message.

Error code	Contents
1	Function code error (An unsupported function code was specified)
2	When the mismatched address is specified.
3	When the specified number of data items in the query message exceeds the maximum number of data items available.
4	Self-diagnostic error response

(3) No response

The slave ignores the query message and does not respond when:
- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity and etc., is found in the query message.
- Data time interval in the query message from the master exceeds 24-bit time.

7.4.5 Calculating CRC-16

The Cyclic Redundancy Check (CRC) is a 2 byte (16-bit) error check code. After constructing the data message, not including start, stop, or parity bit, the master calculates a CRC code and appends this to the end of the message. The slave will calculate a CRC code from the received message, and compare it with the CRC code from the master. If they do not coincide, a communication error has occurred and the slave does not respond.

The CRC code is formed in the following sequence:

1. Load FFFFH to a 16-bit CRC register.

2. *Exclusive OR* (⊕) the first byte (8 bits) of the message with the CRC register. Return the result to the CRC register.

3. Shift the CRC register 1 bit to the right.

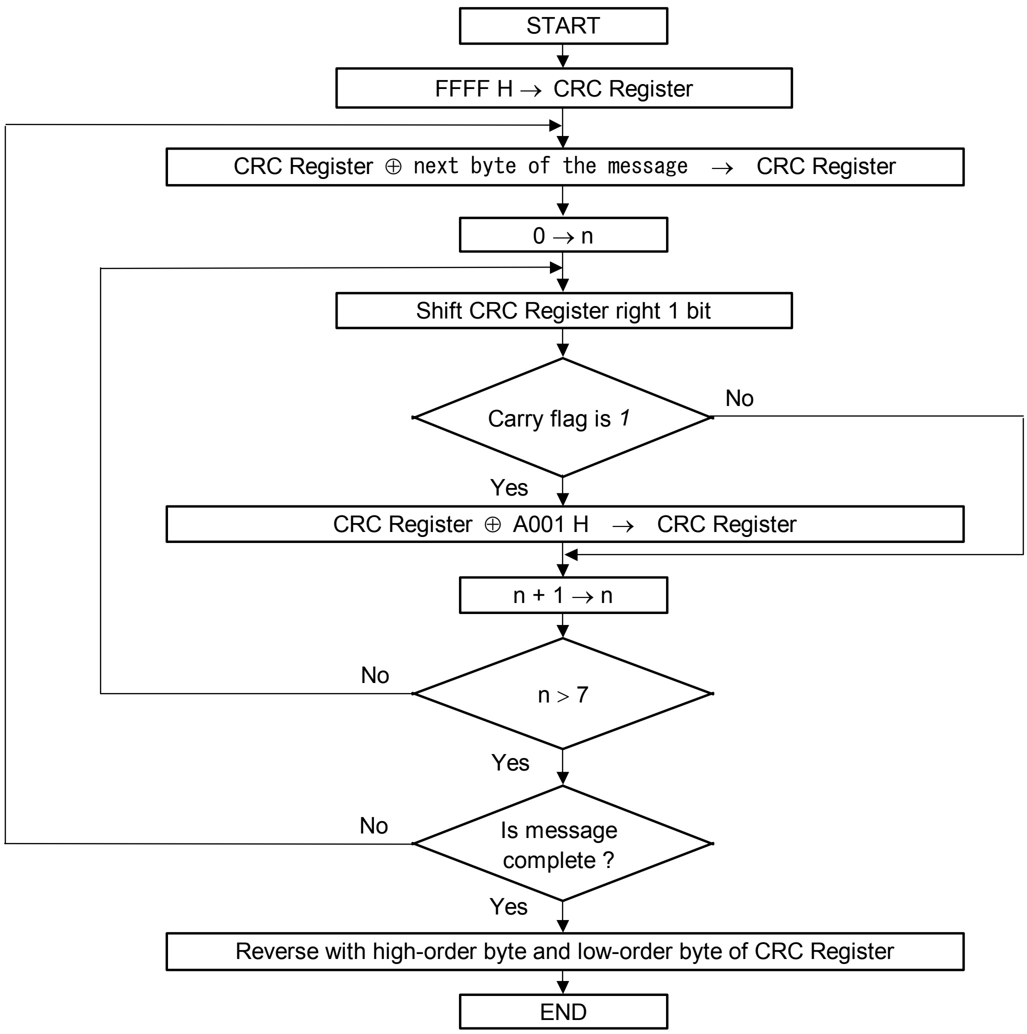
4. If the carry flag is 1, *exclusive OR* the CRC register with A001 hexadecimal and return the result to the CRC register. If the carry flag is 0, repeat step ***3***.

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

6. *Exclusive OR* the next byte (8 bits) of the message with the CRC register.

7. Repeat step ***3*** through ***6*** for all bytes of the message (except the CRC).

8. The CRC register contains the 2 byte CRC error code. When they are appended to the message, the low-order byte is appended first, followed by the high-order byte.



The ⊕ symbol indicates an *exclusive OR* operation. The symbol for the number of data bits is *n*.

■ Example of a CRC calculation in the 'C' language

This routine assumes that the data types 'uint16' and 'uint8' exists. Theses are unsigned 16-bit integer (usually an 'unsigned short int' for most compiler types) and unsigned 8-bit integer (unsigned char). 'z_p' is a pointer to a Modbus message, and 'z_messaage_length' is its length, excluding the CRC. Note that the Modbus message will probably contain NULL characters and so normal C string handling techniques will not work.

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

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

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

    while (z_messaage_length--) {
        next = (uint16) *z_p;
        CRC ^= next;
        for (n = 0; n < 8; n++) {
            carry = CRC & 1;
            CRC >>= 1;
            if (carry) {
              CRC ^= 0xA001;
            }
        }
        z_p++;
    }
    crch = CRC / 256;
    crcl = CRC % 256
    z_p [z_messaage_length++] = crcl;
    z_p [z_messaage_length] = crch;
    return CRC;
}
```

7.4.6 Register read and write

■ Read holding registers [03H]

The query message specifies the starting register address and quantity of registers to be read.
The contents of the holding registers are entered in the response message as data, divided into two parts: the high-order 8-bit and the low-order 8-bit, arranged in the order of the register numbers.

Example: The contents of the four holding registers from 0000H to 0003H are the read out from slave address 2.

Query message

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

Normal response message

Slave address		02H	
Function code		03H	
Number of data		08H	→ Number of holding registers × 2
First holding register contents	High	00H	
	Low	19H	
Next holding register contents	High	00H	
	Low	00H	
Next holding register contents	High	00H	
	Low	19H	
Next holding register contents	High	00H	
	Low	00H	
CRC-16	High	C3H	
	Low	95H	

Error response message

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

■ Preset single register [06H]

The query message specifies data to be written into the designated holding register. The write data is arranged in the query message with high-order 8-bit first and low-order 8-bit next. Only R/W holding registers can be specified.

Example: Data is written into the holding register 0026H of slave address 1.

Query message

Slave address		01H	
Function code		06H	
Holding register number	High	00H	
	Low	26H	
Write data	High	00H	Any data within the range
	Low	64H	
CRC-16	High	69H	
	Low	EAH	

Normal response message

Slave address		01H	Contents will be the same as query message data.
Function code		06H	
Holding register number	High	00H	
	Low	26H	
Write data	High	00H	
	Low	64H	
CRC-16	High	69H	
	Low	EAH	

Error response message

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

■ Diagnostics (Loopback test) [08H]

The master's query message will be returned as the response message from the slave.
This function checks the communication system between the master and slave (the controller).

Example: Loopback test for slave address 1

Query message

Slave address		01H	
Function code		08H	
Test code	High	00H	Test code must be set to 00.
	Low	00H	
Data	High	1FH	Any pertinent data
	Low	34H	
CRC-16	High	E9H	
	Low	ECH	

Normal response message

Slave address		01H	Contents will be the same as query message data.
Function code		08H	
Test code	High	00H	
	Low	00H	
Data	High	1FH	
	Low	34H	
CRC-16	High	E9H	
	Low	ECH	

Error response message

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

■ Preset multiple registers [10H]

The query message specifies the starting register address and quantity of registers to be written.
The write data is arranged in the query message with high-order 8-bit first and low-order 8-bit next. Only R/W holding registers can be specified.

Example: Data is written into the two holding registers from 0065H to 0066H of slave address 1.

Query message

Slave address		01H	
Function code		10H	
Starting number	High	00H	First holding register address
	Low	65H	
Quantity	High	00H	The setting must be between 1 (0001H) and 123 (007BH).
	Low	02H	
Number of data		04H	Number of holding registers × 2
Data to first register	High	00H	Any pertinent data
	Low	32H	
Data to next register	High	00H	
	Low	64H	
CRC-16	High	95H	
	Low	9CH	

Normal response message

Slave address		01H
Function code		10H
Starting number	High	00H
	Low	65H
Quantity	High	00H
	Low	02H
CRC-16	High	51H
	Low	D7H

Error response message

Slave address		01H
80H + Function code		90H
Error code		02H
CRC-16	High	CDH
	Low	C1H

7.4.7 Caution for handling communication data

- Write/Read data in each Memory group by using register addresses from 0500H to 053DH.

  ☞ For the memory group data, refer to **7.5.3 Memory group data [Modbus] (P. 7-81)**.

- The numeric range of data used in Modbus protocol is 0000H to FFFFH. Only the set value within the setting range is effective.

  FFFFH represents −1.

  The following data does not handle +/- sign:

  Integral time [heat-side]
  Integral time [cool-side]
  Derivative time [heat-side]
  Derivative time [cool-side]
  Integral time limiter (high) [heat-side]
  Integral time limiter (low) [heat-side]
  Derivative time limiter (high) [heat-side]
  Derivative time limiter (low) [heat-side]
  Integral time limiter (high) [cool-side]
  Integral time limiter (low) [cool-side]
  Derivative time limiter (high) [cool-side]
  Derivative time limiter (low) [cool-side]

- The Modbus protocol does not recognize data with decimal points during communication.

  Example: When Manipulated output value (MV1) monitor [heat-side] is 5.0 %, 5.0 is processed as 50, 50 = 0032H

Manipulated output value (MV1) monitor [heat-side]	High	00H
	Low	32H

- If data (holding register) exceeding the accessible address range is accessed, an error response message is returned.

- If data range or address error occurs during data writing (Write Action), it is not processed as an error. Normal data is written in data register but data with error is not written; therefore, it is recommended to confirm data of changed items after the data setting.

- An attribute of the item for functions which are not in the controller is RO (read only). If read action to this item is performed, the read data will be “0.” If write action to this item is performed, no error message is indicated and no data is written.

- Commands should be sent at time intervals of 24 bits after the master receives the response message.

7.4.8 How to use memory group data

There are 2 ways to access data in Memory group:

• Access method via Group number

Specify group number and then access data in the Memory group by using the resister addresses from 0500H to 053DH.

• Direct data access method

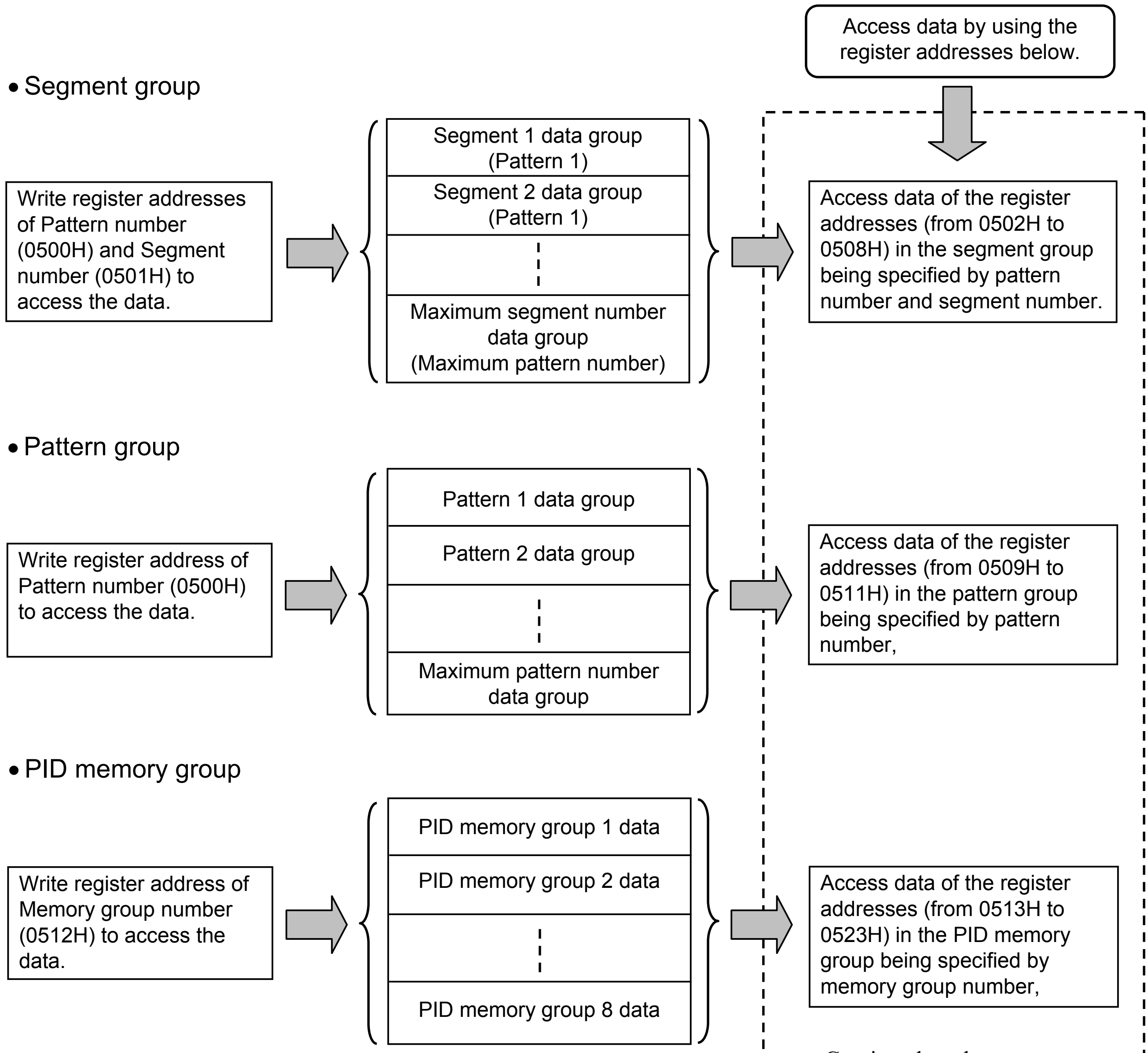
Access data in Memory group by using the register address from 2000H to 99A7H.

The Memory group can be changed at Program control mode (RUN), Fix set point control mode (FIX), Manual control mode (MAN) or Reset mode (RESET).

■ Access method via Group number

Specify Pattern number, Segment number or Memory group number first, then access data in the Memory group by writing the register addresses.

For the memory group data, refer to **7.5.3 Memory group data [Modbus], ■ Data list [Access method via Group number] (P. 7-81)**.



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• Event memory group

Write register address of Memory group number (0524H) to access the data.

- Event memory group 1 data
- Event memory group 2 data
- ⋮
- Event memory group 8 data

Access data of the register addresses (from 0525H to 052CH) in the event memory group being specified by memory group number,

• Wait memory group

Write register address of Memory group number (052DH) to access the data.

- Wait memory group 1 data
- Wait memory group 2 data
- ⋮
- Wait memory group 8 data

Access data of the register addresses (from 052EH to 0531H) in the wait memory group being specified by memory group number,

• Time signal memory group

Write register address of Memory group number (0532H) and Memory number (0533H) to access the data.

- Memory number 1 data (Time signal memory group 1)
- Memory number 2 data (Time signal memory group 1)
- ⋮
- Memory number 16 data (Time signal memory group 16)

Access data of the register addresses (from 0534H to 0538H) in the time signal memory group being specified by memory group number and memory number,

• Output program memory group

Write register address of Memory group number (0539H) and Memory number (053AH) to access the data.

- Memory number 1 data (Output program memory group 1)
- Memory number 2 data (Output program memory group 1)
- ⋮
- Maximum segment number data (Last output program memory group = 128/Maximum number of segments [Up to 99])

Access data of the register addresses (from 053BH to 053DH) in the output program memory group being specified by memory group number and memory number,

■ Direct data access method

Access data in Memory group by using the register address from 2000H to 99A7H.

📖 Data belonging to different groups can not read/write sequently.

☞ For the memory group data, refer to **7.5.3 Memory group data [Modbus], ■ Data list [Direct data access method] (P. 7-88)**.

Group	Data	Address
Segment group	Segment level of Segment 1 (Pattern 1)	2000H
	Segment level of Segment 2 (Pattern 1)	2001H
	⋮	⋮
	Segment signal 2 of Segment 64 (Pattern 64)	8FFFH
Pattern group	Program end number (Pattern 1)	9000H
	Program end number (Pattern 2)	9001H
	⋮	⋮
	Program end number (Pattern 64)	923FH
PID memory group	Proportional band [heat-side] (Memory group number 1)	9240H
	Proportional band [heat-side] (Memory group number 2)	9241H
	⋮	⋮
	Control loop break alarm deadband (LBD) (Memory group number 8)	92C7H
Event memory group	Event 1 set value (EV1) (Memory group number 1)	92C8H
	Event 1 set value (EV1) (Memory group number 2)	92C9H
	⋮	⋮
	Event 4 set value (EV4) [low] (Memory group number 8)	9307H
Wait memory group	Wait zone high (Memory group number 1)	9308H
	Wait zone high (Memory group number 2)	9309H
	⋮	⋮
	Wait time-out set value (Memory group number 8)	9327H
Time signal memory group	Time signal output assignment of memory number 1 (Memory group number 1)	9328H
	Time signal output assignment of memory number 2 (Memory group number 1)	9329H
	⋮	⋮
	Time signal end time of memory number 16 (Memory group number 16)	9827H
Output program memory group	Output program value 1 of memory number 1 (Memory group number 1)	9828H
	Output program value 1 of memory number 2 (Memory group number 1)	9829H
	⋮	⋮
	Output program value 3 of memory number □ (Memory group number □)	99A7H

Segment group:
- It is possible to access 4096 data maximum (64 segments × 64 patterns) of each parameter.
- Reading data will be “0” and writing data will be ignored by the controller when the Host computer reads or writes data of segment numbers or pattern numbers exceeding the setting of Maximum segment number or Maximum pattern number.
- It is possible to access data of more than 64 segments or 64 patterns by Access method via Group number.

Pattern group:
- It is possible to access data of up to 64 patterns for each parameter.
- Reading data will be “0” and writing data will be ignored by the controller when the Host computer reads or writes data of pattern numbers exceeding the setting of Maximum pattern number.
- It is possible to access data of more than 64 patterns by Access method via Group number.

PID memory group, Event memory group, Wait memory group:
It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.

Time signal memory group:
It is possible to access 256 data (16 groups × 16 memories) for each parameter.

Output program memory group:
It is possible to access 128 data for each parameter.

7.4.9 How to use data mapping

Data mapping makes the speed of Read/Write faster by specifying up to 16 data and reading or writing data of consecutive register addresses.

- Register address to specify mapping data: 1000H to 100FH
- Register address to actually read/write data: 1500H to 150FH
- Register address of data which can be mapped: Refer to **7.5.2 Communication data [RKC communication/ Modbus] (P. 7-40)**.

☞ For the data mapping address list, refer to **7.5.4 Data mapping address [Modbus] (P. 7-95)**.

Example: Map and Read the following data:
- Measured value (PV) monitor of slave address 2,
- Comprehensive event state,
- Manipulated value (MV1) [heat-side] monitor,
- Pattern remaining time monitor

1. Write register addresses of mapping data (0000H, 0004H, 0002H and 000EH) to register address setting from 1 (1000H) to 4 (1003H).

Mapping data

Name	Register address	
	HEX	DEC
Measured value (PV) monitor	0000	0
Comprehensive event state	0004	4
Manipulated value (MV1) [heat-side] monitor	0002	2
Pattern remaining time monitor	000E	14

For data mapping

Name	Register address		Setting data
	HEX	DEC	
Register address setting 1 [Read/write address: 1500H]	1000	4096	0000H
Register address setting 2 [Read/write address: 1501H]	1001	4097	0004H
Register address setting 3 [Read/write address: 1502H]	1002	4098	0002H
Register address setting 4 [Read/write address: 1503H]	1003	4099	000EH

Write

The table below shows the assignment of read/write register addresses 1500H – 1503H by the above mapping.

Register address		Name
HEX	DEC	
1500	5376	Measured value (PV) monitor
1501	5377	Comprehensive event state
1502	5378	Manipulated value (MV1) [heat-side] monitor
1503	5379	Pattern remaining time monitor

2. Reads out the mapping data by following order message.

Slave address		02H	
Function code		03H	
Starting No.	High	15H	First holding register address (1500H)
	Low	00H	
Quantity	High	00H	Number of data (4)
	Low	04H	
CRC-16	High	40H	
	Low	36H	

7.5 Communication Data List

7.5.1 Reference to communication data list

(1) (2) (3) (4) (5) (6) (7)

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
1	Model code	ID	32	—	—	RO	Model code(character)	—
2	Measured value (PV)	M1	7	0000	0	RO	Input range low to Input range high	—
3	Set value (SV) monitor	S1	7	0001	1	RO	Setting limiter low to Setting limiter high	—

(1) Name: Communication data name

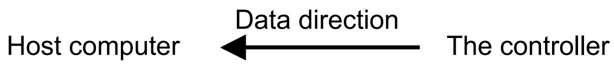
(2) RKC communication identifier:
Communication identifier of RKC communication

(3) Digits: The number of digits of RKC communication

(4) Modbus register address:
Register address of Modbus
HEX: Hexadecimal
DEC: Decimal

(5) Attribute: A method of how communication data items are read or written when viewed from the host computer is described

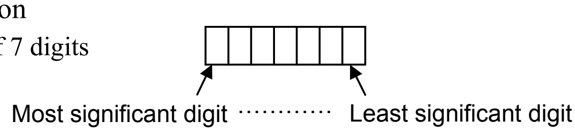
RO: Read only data



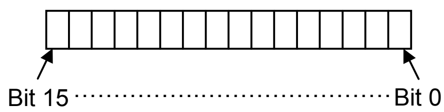
R/W: Read and Write data

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

- RKC communication
  ASCII code data of 7 digits



- Modbus
  16-bit data



(7) Factory set value: Factory set value of communication data

☞ For the Memory group data, refer to **7.5.3 Memory group data [Modbus] (P. 7-81)**.
☞ For the Data mapping address, refer to **7.5.4 Data mapping address [Modbus] (P. 7-95)**.

7.5.2 Communication data [RKC communication/Modbus]

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
1	Model code	ID	32	—	—	RO	Model code (character)	—
2	Measured value (PV)	M1	7	0000	0	RO	Input range low to Input range high	—
3	Set value (SV) monitor	S1	7	0001	1	RO	Setting limiter low to Setting limiter high Segment level in operation at Program control mode Set value (SV) based on the operation mode: Reset mode, Fixed set point control mode or Manual control mode	—
4	Manipulated output value 1 (MV1) [heat-side] monitor	O1	7	0002	2	RO	PID control or Heat/Cool PID control: −0.5 to +105.0 % Position proportioning PID control [With Feedback resistance (FBR) input]: 0.0 to 100.0 % (Displays the FBR input value)	—
5	Manipulated output value 2 (MV2) [cool-side] monitor	O2	7	0003	3	RO	−5.0 to +105.0 %	—
6	Comprehensive event state	AJ	7	0004	4	RO	RKC communication Least significant digit: Event 1 2nd digit: Event 2 3rd digit: Event 3 4th digit: Event 4 5th digit: HBA1 6th digit: HBA2 Most significant digit: LBA Data 0: OFF 1: ON	—
							Modbus (Bit data) Bit 0: Event 1 Bit 1: Event 2 Bit 2: Event 3 Bit 3: Event 4 Bit 4: HBA1 Bit 5: HBA2 Bit 6: LBA Bit 7 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 127]	—
7	Burnout state monitor	B1	7	0005	5	RO	0: Normal 1: Burnout	—

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
8	Burnout state monitor of feedback resistance input	B2	7	0006	6	RO	0: Normal 1: Burnout	—
9	Error code	ER	7	0007	7	RO	RKC communication 1: Adjustment data error 2: Data back-up error 4: A/D conversion error or Temperature compensation error 8: Setting item range error 16: Intercontroller communication error If two or more errors occur simultaneously, the total summation of these error codes is displayed.	—
							Modbus (Bit data) Bit 0: Adjustment data error Bit 1: Data back-up error Bit 2: A/D conversion error or Temperature compensation error Bit 3: Setting item range error Bit 4: Intercontroller communication error Bit 5 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 31]	—
10	Execution pattern selection	PS	7	0008	8	R/W	1 to 99 (Within the maximum pattern number) For RKC communication: Selectable in the Reset mode [RO (Read only) during RUN, FIX or MAN mode.] For Modbus: Selectable in the Reset mode [WO (Write only data)]	1
11	Pattern number	—	7	0009	9	RO	1 to 99 (Within the maximum pattern number) Reading out the Pattern number in operation	—
12	Segment number	SN	7	000A	10	RO	1 to 99 (Within the maximum segment number) Reading out the Segment number in operation	1
13	Time signal/Segment signal state monitor 1	ED	7	000B	11	RO	RKC communication Least significant digit: Time signal 1/Segment signal 1 2nd digit: Time signal 2/Segment signal 2 3rd digit: Time signal 3/Segment signal 3 4th digit: Time signal 4/Segment signal 4 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	—

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
13	Time signal/Segment signal state monitor 1 (A continuance)	ED	7	000B	11	RO	Modbus (Bit data) Bit 0: Time signal 1/Segment signal 1 Bit 1: Time signal 2/Segment signal 2 Bit 2: Time signal 3/Segment signal 3 Bit 3: Time signal 4/Segment signal 4 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	—
14	Time signal/Segment signal state monitor 2	EE	7	000C	12	RO	RKC communication Least significant digit: Time signal 5/Segment signal 5 2nd digit: Time signal 6/Segment signal 6 3rd digit: Time signal 7/Segment signal 7 4th digit: Time signal 8/Segment signal 8 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	—
							Modbus (Bit data) Bit 0: Time signal 5/Segment signal 5 Bit 1: Time signal 6/Segment signal 6 Bit 2: Time signal 7/Segment signal 7 Bit 3: Time signal 8/Segment signal 8 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	—
15	Pattern end state	EN	7	000D	13	RO	0: Not in end state 1: In end state	—
16	Segment remaining time monitor	TR	7	000E	14	RO	RKC communication 0.00 to 500.00 (Hour.Minute or Minute.Second) Hour and minute, or minute and second is separated by [.(2EH)]. Modbus 0 to 30000 (Minute or Second) The remaining time of Pattern end output time is displayed at Pattern end.	—

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
17	Pattern remaining time monitor	MW	7	000F	15	RO	RKC communication 0.00 to 999.59 (Hour.Minute or Minute.Second) Hour and minute, or minute and second is separated by [.(2EH)]. Modbus 0 to 59999 (Minute or Second)	—
18	Segment repeat remaining time/execution time monitor [1]	MX	7	0010	16	RO	0 to 9999 times	—
19	Pattern repeat remaining time/execution time monitor [1]	MY	7	0011	17	RO	0 to 10000 times 10000: No limit	—
20	Total pattern repeat remaining time/execution time monitor [1]	RT	7	0012	18	RO	0 to 10000 times 10000: No limit Including Repeat execution times of Link pattern	—
21	Wait condition monitor	WM	7	0013	19	RO	RKC communication Least significant digit: Zone wait of the controller 2nd digit: Zone wait of the slave 3rd digit: Zone wait of the DI 4th digit to Most significant digit: Unused Data 0: Not in wait state 1: In wait state	—
							Modbus (Bit data) Bit 0: Zone wait of the controller Bit 1: Zone wait of the slave Bit 2: Zone wait of the DI Bit 3 to Bit 15: Unused Data 0: Not in wait state 1: In wait state [Decimal number: 0 to 7]	—
22	Current transformer 1 (CT1) input value monitor [2]	M2	7	0014	20	RO	0.0 to 100.0 A	—
23	Current transformer 2 (CT2) input value monitor [2]	M3	7	0015	21	RO		—

[1] Execution time monitor can be read by setting at No. 144 "Repeat remaining process/program progression display selection" (Engineering mode).

[2] CT input value monitor displays CT input value as 1.1 times the average current. CT input value is displayed for both time proportional output and current output. For current output, the error of measurement between actual current value and monitor display value becomes large when load factor is other than 0 % or 100 %.

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
24	DO1 state monitor	AA	7	0016	22	RO	0: OFF 1: ON	—
25	DO2 state monitor	AB	7	0017	23	RO		—
26	DO3 state monitor	AC	7	0018	24	RO		—
27	DO4 state monitor	AD	7	0019	25	RO		—
28	DO5 state monitor	T1	7	001A	26	RO		—
29	DO6 state monitor	T2	7	001B	27	RO		—
30	DO7 state monitor	T3	7	001C	28	RO		—
31	DO8 state monitor	T4	7	001D	29	RO		—
32	DO9 state monitor	T5	7	001E	30	RO		—
33	DO10 state monitor	T6	7	001F	31	RO		—
34	DO11 state monitor	T7	7	0020	32	RO		—
35	DO12 state monitor	T8	7	0021	33	RO		—
36	Digital input (DI) state 1 monitor	L1	7	0022	34	RO	RKC communication Least significant digit: DI 1 2nd digit: DI 2 3rd digit: DI 3 4th digit: DI 4 5th digit: DI 5 6th digit: DI 6 Most significant digit: Unused Data 0: Open 1: Closed	—
							Modbus (Bit data) Bit 0: DI 1 Bit 1: DI 2 Bit 2: DI 3 Bit 3: DI 4 Bit 4: DI 5 Bit 5: DI 6 Bit 6 to Bit 15: Unused Data 0: Open 1: Closed [Decimal number: 0 to 63]	—

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
37	Digital input (DI) state 2 monitor	L2	7	0023	35	RO	RKC communication Least significant digit: DI 7 2nd digit: DI 8 3rd digit: DI 9 4th digit: DI 10 5th digit: DI 11 6th digit and Most significant digit: Unused Data 0: Open 1: Closed	—
							Modbus (Bit data) Bit 0: DI 7 Bit 1: DI 8 Bit 2: DI 9 Bit 3: DI 10 Bit 4: DI 11 Bit 5 to Bit 15: Unused Data 0: Open 1: Closed [Decimal number: 0 to 31]	—
38	Output state 1 monitor	Q1	7	0024	36	RO	RKC communication Least significant digit: OUT1 2nd digit: OUT2 3rd digit: OUT3 4th digit to Most significant digit: Unused Data 0: OFF 1: ON	—
							Modbus (Bit data) Bit 0: OUT1 Bit 1: OUT2 Bit 2: OUT3 Bit 3 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 7]	—

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
39	Output state 2 monitor	Q2	7	0025	37	RO	RKC communication Least significant digit: DO1 2nd digit: DO2 3rd digit: DO3 4th digit: DO4 5th digit: DO5 6th digit: DO6 Most significant digit: Unused Data 0: OFF 1: ON	—
							Modbus (Bit data) Bit 0: DO1 Bit 1: DO2 Bit 2: DO3 Bit 3: DO4 Bit 4: DO5 Bit 5: DO6 Bit 6 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 63]	—
40	Output state 3 monitor	Q3	7	0026	38	RO	RKC communication Least significant digit: DO7 2nd digit: DO8 3rd digit: DO9 4th digit: DO10 5th digit: DO11 6th digit: DO12 Most significant digit: Unused Data 0: OFF 1: ON	—

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
40	Output state 3 monitor (A continuance)	Q3	7	0026	38	RO	Modbus (Bit data) Bit 0: DO7 Bit 1: DO8 Bit 2: DO9 Bit 3: DO10 Bit 4: DO11 Bit 5: DO12 Bit 6 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 63]	—
41	For system use	—	7	0027	39	RO	—	—
42	Manual manipulated output value	ON	7	0028	40	R/W	PID control or Position proportioning PID control (With FBR input): −5.0 to +105.0 % (Within the Output limiter) Heat/Cool PID control: −105.0 to +105.0 % (Within the Output limiter)	−0.5
43	PID/AT transfer	G1	7	0029	41	R/W	0: PID control 1: Autotuning (AT) start When the Autotuning (AT) is finished, the control will automatically returns to “0: PID control.”	0
44	Autotuning (AT) with learning function	TT	7	002A	42	R/W	0: OFF 1: Autotuning (AT) with learning start When the Autotuning (AT) with learning is finished, the data will automatically returns to “0: OFF.”	0
45	Operation mode transfer *	XM	7	002B	43	R/W	0: Reset mode (RESET) 1: Program control mode (PROG) 2: Fixed set point control mode (FIX) 3: Manual control mode (MAN)	0
46	Wait state monitor	WT	7	002C	44	RO	0: Not in wait state 1: In wait state	—
47	Hold state	HO	7	002D	45	R/W	0: Not in hold state 1: In hold state	0
48	Step function	SK	7	002E	46	R/W	1: Step After Step function is set to “1” to activate, the setting will go back to “0” automatically.	0

* Operation mode cannot be switched when DI for RESET or RUN is ON (contact closed).

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
49	Search function	SM	7	002F	47	R/W	0: Search stop 1: Search start After Searching function is set to “1” to activate, the setting will go back to “0” automatically.	0
50	Interlock release	IL	7	0030	48	R/W	0: Interlock release (execution/state) 1: Interlock An event whose Event interlock is set to “1: Used” is set to the event ON state results in “1: Interlocked state.” “1” is for monitoring the interlocked state. Under this condition, do not write “1.”	0
51	Set data lock	LK	7	0031	49	R/W	0: Unlock 1: Lock	0
No. 52- 58 are specific to Segment setting. For RKC communication, Extended identifiers (PN and SN) are necessary.								
52	Segment level	LE	7	0032	50	R/W	Setting limiter low to Setting limiter high	0
53	Segment time	TM	7	0033	51	R/W	RKC communication 0.00 to 500.00 (Hour.Minute or Minute.Second) Hour and minute, or minute and second is separated by [.(2EH)]. Modbus 0 to 30000 (Minute or Second)	RKC communication: 0.00 Modbus: 0
54	PID memory group number	PO	7	0034	52	R/W	0: Level PID 1 to 8: PID memory group 1 to 8	0
55	Event memory group number	AN	7	0035	53	R/W	0: Event OFF 1 to 8: Event memory group 1 to 8	1
56	Wait memory group number	WG	7	0036	54	R/W	0: Wait OFF 1 to 8: Wait memory group 1 to 8	1
57	Segment signal 1	WE	7	0037	55	R/W	RKC communication Least significant digit: Segment signal 1 2nd digit: Segment signal 2 3rd digit: Segment signal 3 4th digit: Segment signal 4 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	0000

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
57	Segment signal 1 (A continuance)	WE	7	0037	55	R/W	Modbus (Bit data) Bit 0: Segment signal 1 Bit 1: Segment signal 2 Bit 2: Segment signal 3 Bit 3: Segment signal 4 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0000 (Bit image)
58	Segment signal 2	WF	7	0038	56	R/W	RKC communication Least significant digit: Segment signal 5 2nd digit: Segment signal 6 3rd digit: Segment signal 7 4th digit: Segment signal 8 5th digit to Most significant digit: Unused Data 0: OFF 1: ON	0000
							Modbus (Bit data) Bit 0: Segment signal 5 Bit 1: Segment signal 6 Bit 2: Segment signal 7 Bit 3: Segment signal 8 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0000 (Bit image)
No. 59- 67 are specific to Pattern setting. For RKC communication, Extended identifier (PN) is necessary.								
59	Program end number	PE	7	0039	57	R/W	1 to 99 (Within the maximum segment number)	32
60	Segment repeat execution time	RF	7	003A	58	R/W	1 to 9999 times	1
61	Segment repeat start number	RG	7	003B	59	R/W	1 to 99 (Within the maximum segment number)	1
62	Segment repeat end number	RH	7	003C	60	R/W	1 to 99 (Within the maximum segment number)	1
63	Pattern repeat execution time	RR	7	003D	61	R/W	1 to 10000 times 10000: No limit	1

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
64	Link pattern number	LP	7	003E	62	R/W	0 to 99 (Within the maximum pattern number) 0: No pattern link	0
65	Pattern end output duration	ET	7	003F	63	R/W	RKC communication 0.00 to 500.00 (Hour.Minute or Minute.Second) Hour and minute, or minute and second is separated by [.(2EH)]. Modbus 0 to 30000 (Minute or Second)	RKC communication: 0.00 Modbus: 0
66	Time signal memory group number	TQ	7	0040	64	R/W	0: Time signal OFF 1 to 16: Time signal memory group 1 to 16	Pattern 1 to 16: 1 to 16 Pattern 17 or more: 0
67	Output program memory group number	NK	7	0041	65	R/W	0 to [128/Maximum number of segment] (Up to 99) 0: No assignment	0
No. 68- 84 are specific to PID memory group. For RKC communication, Extended identifier (PO) is necessary.								
68	Proportional band [heat-side]	P1	7	0042	66	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span 0 (0.0, 0.00): ON/OFF action	TC/RTD: 30 V/I: 30.0
69	Integral time [heat-side]	I1	7	0043	67	R/W	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action [both heat-side and cool-side] Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	240
70	Derivative time [heat-side]	D1	7	0044	68	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60
71	Control response parameter	CA	7	0045	69	R/W	0: Slow 1: Medium 2: Fast P action and PD action, the control response is fixed at 2 (Fast).	2

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
72	Proportional band [cool-side]	P2	7	0046	70	R/W	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span Read/write is available only for Heat/Cool PID control.	TC/RTD: 30 V/I: 30.0
73	Integral time [cool-side]	IA	7	0047	71	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action [both heat-side and cool-side] Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	240
74	Derivative time [cool-side]	DA	7	0048	72	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	60
75	Overlap/Deadband or Open/Close output neutral zone	V1	7	0049	73	R/W	Heat/Cool PID control (Overlap/Deadband) TC/RTD inputs: –Input span to +Input span (Unit: °C [°F]) Within the range from –19999 to +32000 (Ignoring the decimal point) Voltage (V)/Current (I) inputs: –100.0 to +100.0 % of Input span Minus (–) setting results in Overlap. However, the overlapping range is within the proportional range. Read/write is available only for Heat/Cool PID control. Position proportioning PID control (Open/Close output neutral zone): 0.1 to 20.0 %	Overlap/Deadband TC/RTD: 0 V/I: 0.0 Open/Close output neutral zone: 2.0
76	Manual reset	MR	7	004A	74	R/W	–100.0 to +100.0 % The offset can be manually eliminated. Unable to Read/write when Integral function is active.	0.0
77	Output limiter high (MV1)	OH	7	004B	75	R/W	Output limiter low (MV1) to 105.0 % Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break.	105.0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
78	Output limiter low (MV1)	OL	7	004C	76	R/W	−5.0 % to Output limiter high (MV1) Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break.	−5.0
79	Output limiter high (MV2)	OX	7	004D	77	R/W	Output limiter low (MV2) to 105.0 % Read/write is available only for Heat/Cool PID control.	105.0
80	Output limiter low (MV2)	OY	7	004E	78	R/W	−5.0 % to Output limiter high (MV2) Read/write is available only for Heat/Cool PID control.	−5.0
81	ON/OFF action differential gap (upper)	IV	7	004F	79	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of Input span Unable to Read/write unless Proportional band [heat-side] is set to 0 (ON/OFF action).	TC/RTD: 1 V/I: 0.1
82	ON/OFF action differential gap (lower)	IW	7	0050	80	R/W		TC/RTD: 1 V/I: 0.1
83	Control loop break alarm (LBA) time	A5	7	0051	81	R/W	0 to 7200 seconds (0: Unused) Read/write is only available when LBA is specified.	480
84	LBA deadband (LBD)	N1	7	0052	82	R/W	0 to Input span Read/write is only available when LBA is specified.	0
No. 85- 92 are specific to Event memory group. For RKC communication, Extended identifier (AN) is necessary.								
85	Event 1 set value (EV1)	A1	7	0053	83	R/W	Deviation: −Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) Process and set value: Input range low to Input range high Manipulated output value (MV1 or MV2): −5.0 to +105.0 % Unable to Read/write when Event type is set to “0: None.”	50
	Event 1 set value (EV1) [high]						−Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) This data valid when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).	50
86	Event 1 set value (EV1’) [low]	BT	7	0054	84	R/W	−Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) This data valid when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).	−50

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
87	Event 2 set value (EV2)	A2	7	0055	85	R/W	The data range is same as Event 1 set value (EV1).	50
	Event 2 set value (EV2) [high]						The data range is same as Event 1 set value (EV1) [high].	50
88	Event 2 set value (EV2’) [low]	BU	7	0056	86	R/W	The data range is same as Event 1 set value (EV1’) [low].	–50
89	Event 3 set value (EV3)	A3	7	0057	87	R/W	The data range is same as Event 1 set value (EV1).	50
	Event 3 set value (EV3) [high]						The data range is same as Event 1 set value (EV1) [high].	50
90	Event 3 set value (EV3’) [low]	BV	7	0058	88	R/W	The data range is same as Event 1 set value (EV1’) [low].	–50
91	Event 4 set value (EV4)	A4	7	0059	89	R/W	The data range is same as Event 1 set value (EV1).	50
	Event 4 set value (EV4) [high]						The data range is same as Event 1 set value (EV1) [high].	50
92	Event 4 set value (EV4’) [low]	BW	7	005A	90	R/W	The data range is same as Event 1 set value (EV1’) [low].	–50
No. 93- 96 are specific to Wait memory group. For RKC communication, Extended identifier (PN) is necessary.								
93	Wait zone high	ZW	7	005B	91	R/W	TC/RTD inputs: 0 (0.0, 0.00) to 200 (200.0, 200.00) (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 20.0 % of Input span 0 (0.0, 0.00): Wait zone high becomes OFF	0
94	Wait zone low	ZX	7	005C	92	R/W	TC/RTD inputs: –200 (–200.0, –199.99) to 0 (0.0, 0.00) (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: –20.0 to 0.0 % of Input span 0 (0.0, 0.00): Wait zone low becomes OFF	0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
95	Wait release trigger selection	WU	7	005D	93	R/W	RKC communication Least significant digit: Zone wait 1 (the controller) 2nd digit: Zone wait 2 (all slave controllers) 3rd digit: Wait release by digital input (DI) 4th digit to Most significant digit: Unused Data 0: Invalid 1: Valid	001
							Modbus (Bit data) Bit 0: Zone wait 1 (the controller) Bit 1: Zone wait 2 (all slave controllers) Bit 2: Wait release by digital input (DI) Bit 3 to Bit 15: Unused Data 0: Invalid 1: Valid [Decimal number: 0 to 7]	001 (Bit image)
96	Wait time-out set value	WV	7	005E	94	R/W	RKC communication 0.00 to 500.00 (Hour.Minute or Minute.Second) Modbus 0 to 30000 (Minute or Second) 0.00 (0): Wait OFF	RKC communication: 0.00 Modbus: 0
No. 97- 101 are specific to Time signal memory group. For RKC communication, Extended identifiers (PN and TN) are necessary.								
97	Time signal output assignment	RE	7	005F	95	R/W	1: Time signal 1 2: Time signal 2 3: Time signal 3 4: Time signal 4 5: Time signal 5 6: Time signal 6 7: Time signal 7 8: Time signal 8 0: No assignment	0
98	Start segment of time signal	SO	7	0060	96	R/W	1 to 99 (Within the maximum segment number)	1
99	Time signal start time	TO	7	0061	97	R/W	RKC communication 0.00 to 500.00 (Hour.Minute or Minute.Second) Hour and minute, or minute and second is separated by [.(2EH)]. Modbus 0 to 30000 (Minute or Second)	RKC communication: 0.00 Modbus: 0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
100	End segment of time signal	SF	7	0062	98	R/W	1 to 99 (Within the maximum segment number)	1
101	Time signal end time	TF	7	0063	99	R/W	RKC communication 0.00 to 500.00 (Hour.Minute or Minute.Second) Hour and minute, or minute and second is separated by [.(2EH)]. Modbus 0 to 30000 (Minute or Second)	RKC communication: 0.00 Modbus: 0
No. 102- 104 are specific to Output program memory group. For RKC communication, Extended identifiers (NK and SN) are necessary.								
102	Output program value 1	NL	7	0064	100	R/W	−5.0 to +105.0 % Read/write is only available when OUT1 assignment is set to Output program value 1.	−5.0
103	Output program value 2	NM	7	0065	101	R/W	−5.0 to +105.0 % Read/write is only available when OUT2 assignment is set to Output program value 2.	−5.0
104	Output program value 3	NN	7	0066	102	R/W	−5.0 to +105.0 % Read/write is only available when OUT3 assignment is set to Output program value 3.	−5.0
105	Level PID setting 1	PW	7	0067	103	R/W	Input range low to Level PID setting 2	Input range high
106	Level PID setting 2	PX	7	0068	104	R/W	Level PID setting 1 to Level PID setting 3	Input range high
107	Level PID setting 3	PY	7	0069	105	R/W	Level PID setting 2 to Level PID setting 4	Input range high
108	Level PID setting 4	PF	7	006A	106	R/W	Level PID setting 3 to Level PID setting 5	Input range high
109	Level PID setting 5	PG	7	006B	107	R/W	Level PID setting 4 to Level PID setting 6	Input range high
110	Level PID setting 6	PH	7	006C	108	R/W	Level PID setting 5 to Level PID setting 7	Input range high
111	Level PID setting 7	PI	7	006D	109	R/W	Level PID setting 6 to Input range high	Input range high
112	Set value (SV) in Reset mode	RJ	7	006E	110	R/W	Setting limiter low to Setting limiter high	0
113	Manipulated output value 1 (MV1) in Reset mode	XN	7	006F	111	R/W	−5.0 to +105.0 % Position proportioning PID control: Only when there is Feedback resistance (FBR) input and no FBR input is disconnected, the Manipulated output value (MV1) during Reset mode is output.	−5.0
114	Manipulated output value 2 (MV2) in Reset mode	OG	7	0070	112	R/W	−5.0 to +105.0 % Read/write is available only for Heat/Cool PID control.	−5.0
115	Event memory group number in Reset mode	AO	7	0071	113	R/W	0 to 8 0: Event OFF	1

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
116	Set value (SV) in Fixed set point control mode	S2	7	0072	114	R/W	Setting limiter low to Setting limiter high	0
117	PID memory group number in Fixed set point control mode	PP	7	0073	115	R/W	0 to 8 0: Level PID	0
118	Event memory group number in Fixed set point control mode	AP	7	0074	116	R/W	0 to 8 0: Event OFF	1
119	Set value (SV) in Manual control mode	S3	7	0075	117	R/W	Setting limiter low to Setting limiter high SV in the previous mode remains when switching to the Manual control mode.	0
120	PID memory group number in Manual control mode	PQ	7	0076	118	R/W	0 to 8 0: Level PID	0
121	Event memory group number in Manual control mode	AQ	7	0077	119	R/W	0 to 8 0: Event OFF	1
122	PV bias	PB	7	0078	120	R/W	−Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point)	0
123	PV digital filter	F1	7	0079	121	R/W	0.0 to 100.0 seconds (0.0: Unused)	0.0
124	PV ratio	PR	7	007A	122	R/W	0.001 to 9.999	1.000
125	PV low input cut-off	DP	7	007B	123	R/W	0.00 to 25.00 % of Input span Unable to Read/write when Input square root extraction is set to “0: Unused.”	0.00
126	OUT1 proportional cycle time	TC	7	007C	124	R/W	0.1 to 100.0 seconds M: Relay contact output V: Voltage pulse output T: Triac output D: Open collector output Unable to Read/write when output type of OUT1 is voltage/current output.	M: 20.0 V/T/D: 2.0
127	OUT2 proportional cycle time	T0	7	007D	125	R/W	0.1 to 100.0 seconds Unable to Read/write when output type of OUT2 is voltage/current output.	M: 20.0 V/T/D: 2.0
128	OUT3 proportional cycle time	TV	7	007E	126	R/W	0.1 to 100.0 seconds V: Voltage pulse output D: Open collector output Unable to Read/write when output type of OUT3 is voltage/current output.	V/D: 2.0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
129	Heater break alarm 1 (HBA1) set value	A7	7	007F	127	R/W	CTL-6-P-N: 0.0 to 30.0 A (0.0: Unused) CTL-12-S56-10L-N: 0.0 to 100.0 A (0.0: Unused) Unable to Read/write when Current transformer 1 (CT1) is not specified or CT1 is assigned to “0: None.”	0.0
130	Heater break alarm 2 (HBA2) set value	A8	7	0080	128	R/W	CTL-6-P-N: 0.0 to 30.0 A (0.0: Unused) CTL-12-S56-10L-N: 0.0 to 100.0 A (0.0: Unused) Unable to Read/write when Current transformer 2 (CT2) is not specified or CT2 is assigned to “0: None.”	0.0
131	SV selection at Program start	SS	7	0081	129	R/W	0: Start with the Set value (SV) in the Reset mode. 1: PV start 1 [Time fixed type] 2: PV start 2 [Time saving & ramp holding type] 3: PV start 3 [Time saving & level searching type/with HOLD function at start] 4: PV start 4 [Time saving & level searching type/without HOLD function at start]	2
132	Control action at Pattern end	X1	7	0082	130	R/W	PID control, Heat/Cool PID control or Position proportioning PID control (with FBR input): 0: Control continued 1: Control stop Control action at Pattern end can be operative when using Output program function. Position proportioning PID control (When there is no FBR input or the FBR input is break): 0: Control continued 1: Open-side output OFF, Close-side output OFF 2: Open-side output OFF, Close-side output ON 3: Open-side output ON, Close-side output OFF	0
The attributes of parameters from No.133 to 307 (Engineering mode) are RO (Read only) in the Program control mode (RUN), the Fixed set point control mode (FIX) or the Manual control mode (MAN). To set and change No. 133 to 307, switch to the Reset mode (RESET).								
133	PV flashing display at input error	DU	7	0083	131	R/W	0: Flashing at input error 1: No flashing at input error	0
134	Dot monitor type	DY	7	0084	132	R/W	0: Program pattern type 1: Output bar graph type	0
135	Dot monitor scale high	DV	7	0085	133	R/W	Dot monitor scale low to Maximum value of the selected input range Validate the Dot monitor type for the Program pattern type.	Input range high

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
136	Dot monitor scale low	DW	7	0086	134	R/W	Minimum value of the selected input range to Dot monitor high Validate the Dot monitor type for the Program pattern type.	Input range low
137	ALM lamp light condition 1	LY	7	0087	135	R/W	RKC communication Least significant digit: Event 1 2nd digit: Event 2 3rd digit: Event 3 4th digit: Event 4 5th digit to Most significant digit: Unused Data 0: No lighting 1: Lighting	1111
							Modbus (Bit data) Bit 0: Event 1 Bit 1: Event 2 Bit 2: Event 3 Bit 3: Event 4 Bit 4 to Bit 15: Unused Data 0: No lighting 1: Lighting [Decimal number: 0 to 15]	1111 (Bit image)
138	ALM lamp light condition 2	LZ	7	0088	136	R/W	RKC communication Least significant digit: HBA1 2nd digit: HBA2 3rd digit: LBA 4th digit: Self-diagnostic error 5th digit to Most significant digit: Unused Data 0: No lighting 1: Lighting	0011
							Modbus (Bit data) Bit 0: HBA1 Bit 1: HBA2 Bit 2: LBA Bit 3: Self-diagnostic error Bit 4 to Bit 15: Unused Data 0: No lighting 1: Lighting [Decimal number: 0 to 15]	0011 (Bit image)

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
139	ALM lamp light condition 3	LV	7	0089	137	R/W	RKC communication Least significant digit: FAIL 2nd digit: Host communication error 3rd digit: Intercontroller communication error 4th digit to Most significant digit: Unused Data 0: No lighting 1: Lighting	000
							Modbus (Bit data) Bit 0: FAIL Bit 1: Host communication error Bit 2: Intercontroller communication error Bit 3 to Bit 15: Unused Data 0: No lighting 1: Lighting [Decimal number: 0 to 7]	000 (Bit image)
140	Dot monitor at ALM lamp light	DZ	7	008A	138	R/W	0: Normal display 1: Red flashing display	0
141	TS lamp light condition 1	LW	7	008B	139	R/W	RKC communication Least significant digit: TS1 2nd digit: TS2 3rd digit: TS3 4th digit: TS4 5th digit to Most significant digit: Unused Data 0: No lighting 1: Lighting	1111
							Modbus (Bit data) Bit 0: TS1 Bit 1: TS2 Bit 2: TS3 Bit 3: TS4 Bit 4 to Bit 15: Unused Data 0: No lighting 1: Lighting [Decimal number: 0 to 15]	1111 (Bit image)

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
142	TS lamp light condition 2	LX	7	008C	140	R/W	RKC communication Least significant digit: TS5 2nd digit: TS6 3rd digit: TS7 4th digit: TS8 5th digit to Most significant digit: Unused Data 0: No lighting 1: Lighting	1111
							Modbus (Bit data) Bit 0: TS5 Bit 1: TS6 Bit 2: TS7 Bit 3: TS8 Bit 4 to Bit 15: Unused Data 0: No lighting 1: Lighting [Decimal number: 0 to 15]	1111 (Bit image)
143	Power saving mode duration	DI	7	008D	141	R/W	0 to 60 minutes 0: Lights at all times	0
144	Repeat remaining process/ program progression display selection	DD	7	008E	142	R/W	0: Segment repeat remaining time 1: Segment repeat execution time	0
145	Unit display	BX	7	008F	143	R/W	0: Conform to the input type 1: No unit display 2: % 3: °C 4: °F	0
146	RESET key type	DJ	7	0090	144	R/W	0: Invalid 1: Press once 2: Press twice 3: Press and hold	1
147	RUN key type	DK	7	0091	145	R/W		1
148	FIX key type	DL	7	0092	146	R/W		1
149	MAN key type	DM	7	0093	147	R/W		1
150	HOLD key type	DN	7	0094	148	R/W		1
151	STEP key type	DO	7	0095	149	R/W		3

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
152	Input type	XI	7	0096	150	R/W	Voltage (low) input group: 0: TC input K 1: TC input J 2: TC input R 3: TC input S 4: TC input B 5: TC input E 6: TC input N 7: TC input T 8: TC input W5Re/W26Re 9: TC input PLII 10: TC input U 11: TC input L 12: TC input PR40-20 13: RTD input Pt100 14: RTD input JPt100 22: Voltage (low) 0 to 10 mV DC 23: Voltage (low) 0 to 100 mV DC 24: Voltage (low) 0 to 1 V DC 25: Voltage (low) −10 to +10 mV DC 26: Voltage (low) −100 to +100 mV DC 27: Voltage (low) −1 to +1 V DC Voltage (high) input group: 17: Voltage (high) 0 to 10 V DC 18: Voltage (high) 0 to 5 V DC 19: Voltage (high) 1 to 5 V DC 20: Voltage (high) −5 to +5 V DC 21: Voltage (high) −10 to +10 V DC Current input group 15: Current 0 to 20 mA DC 16: Current 4 to 20 mA DC For the selecting proceduer, refer to the **6.1.1. Changing Measured value (PV) (P. 6-2)**.	Factory set value is based on the Input range code specified at ordering. When not specifying: 0
153	Display unit	PT	7	0097	151	R/W	0: °C 1: °F	0
154	Decimal point position	XU	7	0098	152	R/W	0: No decimal place 1: One decimal place 2: Two decimal place 3: Three decimal place 4: Four decimal place TC input: Only 0 or 1 can be set. RTD input: From 0 to 2 can be set. Voltage (V)/Current (I) input: From 0 to 4 can be set.	Factory set value is based on the Input range code specified at ordering. When not specifying: 1

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
155	Input range high	XV	7	0099	153	R/W	TC/RTD inputs: Input range low to Maximum value of the selected input range Voltage (V)/Current (I) inputs: −19999 to +32000 Varies with the setting of the Decimal point position.	TC/RTD: Maximum value of the selected input range V/I: 100.0
156	Input range low	XW	7	009A	154	R/W	TC/RTD inputs: Minimum value of the selected input range to Input range high Voltage (V)/Current (I) inputs: −19999 to +32000 Varies with the setting of the Decimal point position.	TC/RTD: Minimum value of the selected input range V/I: 0.0
157	Input error determination point (high)	AV	7	009B	155	R/W	Input range low − (5 % of Input span) to Input range high + (5 % of Input span) Maximum setting value of Input error determination point (high): 32767 (excluding decimal point)	TC/RTD: Input range high + (5 % of Input span) V/I: 105.0
158	Input error determination point (low)	AW	7	009C	156	R/W	Minimum setting value of Input error determination point (low): −19999 (excluding decimal point)	TC/RTD: Input range low − (5 % of Input span) V/I: −5.0
159	Burnout direction	B3	7	009D	157	R/W	0: Upscale 1: Downscale Valid only when the Voltage (low) input group selected.	0
160	Square root extraction	XH	7	009E	158	R/W	0: Unused 1: Used	0
161	Power supply frequency	JT	7	009F	159	R/W	0: 50 Hz 1: 60 Hz	0
162	Sampling cycle	TZ	7	00A0	160	R/W	0: 50 ms 1: 100 ms 2: 250 ms	1

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Name</th><th rowspan="2">Identifier</th><th rowspan="2">Digits</th><th colspan="2">Register address</th><th rowspan="2">Attribute</th><th rowspan="2">Data range</th><th rowspan="2">Factory set value</th></tr>
<tr><th>HEX</th><th>DEC</th></tr>
<tr><td>163</td><td>Digital input (DI) assignment</td><td>EX</td><td>7</td><td>00A1</td><td>161</td><td>R/W</td><td>0 to 5
DI1 to DI6 (Optional)
<table>
<tr><th></th><th>DI1</th><th>DI2</th><th>DI3</th><th>DI4</th><th>DI5</th><th>DI6</th></tr>
<tr><td>0</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>PTN16</td><td>P.SET</td></tr>
<tr><td>1</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>PTN16</td><td>P.SET</td></tr>
<tr><td>2</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
<tr><td>3</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
<tr><td>4</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
<tr><td>5</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td><td>WAIT</td></tr>
</table>
DI7 to DI11 (Standard)
<table>
<tr><th></th><th>DI7</th><th>DI8</th><th>DI9</th><th>DI10</th><th>DI11</th></tr>
<tr><td>0</td><td>RESET</td><td>RUN</td><td>STEP</td><td>HOLD</td><td>PTN32</td></tr>
<tr><td>1</td><td>RESET</td><td>RUN</td><td>STEP</td><td>PTN32</td><td>PTN64</td></tr>
<tr><td>2</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>P.SET</td></tr>
<tr><td>3</td><td>PTN1</td><td>PTN2</td><td>PTN4</td><td>PTN8</td><td>PTN16</td></tr>
<tr><td>4</td><td>RESET</td><td>RUN</td><td>STEP</td><td>HOLD</td><td>D/R</td></tr>
<tr><td>5</td><td>RESET</td><td>RUN</td><td>STEP</td><td>HOLD</td><td>PTN_INC</td></tr>
</table>
PTN1 to PTN64: Pattern number switch
P.SET: Pattern set
WAIT: Wait state release
RESET, RUN: Switch Operation mode
HOLD, STEP: Conduct Hold action or Step action
D/R: Direct/Reverse action switching
PTN_INC Pattern increment
Direct action/Reverse action can be only switched in the Reset mode (RESET).</td><td>0</td></tr>
<tr><td>164</td><td>Pattern input method of Digital input (DI)</td><td>XK</td><td>7</td><td>00A2</td><td>162</td><td>R/W</td><td>0: Set Pattern number by using the Pattern set input.
Pattern number = Binary number of DI + 1
1: Set Pattern number by switching the contact input.
Pattern number = Binary number of DI + 1
2: Set Pattern number by using the Pattern set input.
Pattern number = Binary number of DI
3: Set Pattern number by switching the contact input.
Pattern number = Binary number of DI
For the switching method of Pattern number, refer to 6.1.9 Digital input (DI) (P. 6-14) and ■ Pattern number switch (P. 6-23).</td><td>0</td></tr>
</table>

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
165	OUT2, OUT3 Energized/De-energized	NC	7	00A3	163	R/W	RKC communication Least significant digit: OUT2 2nd digit: OUT3 3rd digit to Most significant digit: Unused Data 0: Energized 1: De-energized	00
							Modbus (Bit data) Bit 0: OUT2 Bit 1: OUT3 Bit 2 to Bit 15: Unused Data 0: Energized 1: De-energized [Decimal number: 0 to 3]	00 (Bit image)
166	DO1 to DO4 Energized/De-energized	ND	7	00A4	164	R/W	RKC communication Least significant digit: DO1 2nd digit: DO2 3rd digit: DO3 4th digit: DO4 5th digit to Most significant digit: Unused Data 0: Energized 1: De-energized	0000
							Modbus (Bit data) Bit 0: DO1 Bit 1: DO2 Bit 2: DO3 Bit 3: DO4 Bit 4 to Bit 15: Unused Data 0: Energized 1: De-energized [Decimal number: 0 to 15]	0000 (Bit image)

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
167	DO5 to DO8 Energized/De-energized	NE	7	00A5	165	R/W	RKC communication Least significant digit: DO5 2nd digit: DO6 3rd digit: DO7 4th digit: DO8 5th digit to Most significant digit: Unused Data 0: Energized 1: De-energized	0000
							Modbus (Bit data) Bit 0: DO5 Bit 1: DO6 Bit 2: DO7 Bit 3: DO8 Bit 4 to Bit 15: Unused Data 0: Energized 1: De-energized [Decimal number: 0 to 15]	0000 (Bit image)
168	DO9 to DO12 Energized/De-energized	NF	7	00A6	166	R/W	RKC communication Least significant digit: DO9 2nd digit: DO10 3rd digit: DO11 4th digit: DO12 5th digit to Most significant digit: Unused Data 0: Energized 1: De-energized	0000
							Modbus (Bit data) Bit 0: DO9 Bit 1: DO10 Bit 2: DO11 Bit 3: DO12 Bit 4 to Bit 15: Unused Data 0: Energized 1: De-energized [Decimal number: 0 to 15]	0000 (Bit image)

No.	Name	Identifier	Digits	Register address HEX	DEC	Attribute	Data range	Factory set value
169	Transmission output action in Reset mode	Q6	7	00A7	167	R/W	RKC communication Least significant digit: OUT2 2nd digit: OUT3 3rd digit to Most significant digit: Unused Data 0: Action stop 1: Action continued	00
							Modbus (Bit data) Bit 0: OUT2 Bit 1: OUT3 Bit 2 to Bit 15: Unused Data 0: Action stop 1: Action continued [Decimal number: 0 to 3]	00 (Bit image)
170	Event action in Reset mode	Q7	7	00A8	168	R/W	RKC communication Least significant digit: Event 1 2nd digit: Event 2 3rd digit: Event 3 4th digit: Event 4 5th digit: HBA1 or HBA2 6th digit and 7th digit: Unused Data 0: Action stop 1: Action continued	00000
							Modbus (Bit data) Bit 0: Event 1 Bit 1: Event 2 Bit 2: Event 3 Bit 3: Event 4 Bit 4: HBA1 or HBA2 Bit 5 to Bit 15: Unused Data 0: Action stop 1: Action continued [Decimal number: 0 to 31]	00000 (Bit image)

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
171	Transmission output action at Pattern end	Q8	7	00A9	169	R/W	RKC communication Least significant digit: OUT2 2nd digit: OUT3 3rd digit to Most significant digit: Unused Data 0: Action stop 1: Action continued	00
							Modbus (Bit data) Bit 0: OUT2 Bit 1: OUT3 Bit 2 to Bit 15: Unused Data 0: Action stop 1: Action continued [Decimal number: 0 to 3]	00 (Bit image)
172	Event action at Pattern end	Q9	7	00AA	170	R/W	RKC communication Least significant digit: Event 1 2nd digit: Event 2 3rd digit: Event 3 4th digit: Event 4 5th digit: HBA1 or HBA2 6th digit and 7th digit: Unused Data 0: Action stop 1: Action continued	00000
							Modbus (Bit data) Bit 0: Event 1 Bit 1: Event 2 Bit 2: Event 3 Bit 3: Event 4 Bit 4: HBA1 or HBA2 Bit 5 to Bit 15: Unused Data 0: Action stop 1: Action continued [Decimal number: 0 to 31]	00000 (Bit image)
173	OUT1 assignment	E5	7	00AB	171	R/W	0: Manipulated output value 1 (MV1) [For control output] PID control or Heat/Cool PID control: Heat-side output Position proportioning PID control: Open-side output 1: Output program value 1 [For Control output or Transmission output (Voltage/Current output)]	0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
174	OUT2 assignment	E0	7	00AC	172	R/W	Voltage output or Current output (Control output: 1, 2 or 7 Transmission output: 3 to 7): 0: None 1: Manipulated output value 1 (MV1) [Feedback resistance (FBR) input value when FBR input is specified with the Position proportioning PID control.] 2: Manipulated output value 2 (MV2) [Cool-side output at Heat/Cool PID control] 3: Measured value (PV) 4: Deviation value (DEV) 5: Set value (SV) monitor 6: Segment time (percentage basis) 7: Output program value 2 Manipulated output value (MV1 or MV2) may be used as a transmission output. Relay contact output, Voltage pulse output, Triac output or Open collector output (Control output: 21, 22 or 23 Event output: 24 to 53): 20: None 21: Manipulated output value 1 (MV1) PID control or Heat/Cool PID control: Heat-sid output [Feedback resistance (FBR) input value when FBR input is specified with the Position proportioning PID control.] 22: Manipulated output value 2 (MV2) Heat/Cool PID control: Cool-side output Position proportioning PID control: Close-side output 23: Output program value 2 24 to 31: Time signal 1 to Time signal 8 32 to 35: Event 1 to Event 4 36: HBA1 37: HBA2 38: Logical *OR* of HBA1 and HBA2 39: LBA 40: Input error state 41: Program control mode (RUN) state 42: Fixed set point control mode (FIX) state 43: Manual control mode (MAN) state 44: Ramp state 45: Soak state 46: Hold state 47: Wait state 48: Pattern end signal 49: Autotuning (AT) state 50: FAIL state 51: Host communication error 52: Intercontroller communication error 53: Feedback resistance (FBR) input error	Heat/Cool PID control: 22 or 2 (vary with output type) Position proportioning PID control: 22 Other control method: 0 or 20 (varies with output type) When the OUT2 is not provided: 0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
175	OUT2 transmission output scale high	EV	7	00AD	173	R/W	Varies with OUT2 assignment. Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): −Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) Output program value 2: Fixed at 100.0 % (scaling is not available) Segment time (percentage basis): Fixed at 100.0 % (scaling is not available) When using Manipulated output value (MV1 or MV2) as a Transmission output: Fixed at 100.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): +Input span Other: 100.0
176	OUT2 transmission output scale low	EW	7	00AE	174	R/W	Varies with OUT2 assignment. Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): −Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) Output program value 2: Fixed at 0.0 % (scaling is not available) Segment time (percentage basis): Fixed at 0.0 % (scaling is not available) When using Manipulated output value (MV1 or MV2) as a Transmission output: Fixed at 100.0 % (scaling is not available)	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): −Input span Other: 0.0
177	OUT3 assignment	LA	7	00AF	175	R/W	The data range is same as OUT2 assignment. However, No. 7 or 23 becomes Output program value 3. There are no relay contact output and triac output in OUT3 No control output when No. 21 or 22 is selected at Position proportioning PID control.	0 or 20 (vary with output type) When the OUT3 is not provided: 0
178	OUT3 transmission output scale high	HV	7	00B0	176	R/W	Varies with OUT3 assignment. The data range is the same as the OUT2 transmissionoutput scal high.	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): +Input span Other: 100.0
179	OUT3 transmission output scale low	HW	7	00B1	177	R/W	Varies with OUT3 assignment. The data range is the same as the OUT2 transmissionoutput scal low.	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): −Input span Other: 0.0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
180	DO1 assignment	QC	7	00B2	178	R/W	0: None 1: Time signal 1 2: Time signal 2 3: Time signal 3 4: Time signal 4 5: Time signal 5 6: Time signal 6 7: Time signal 7 8: Time signal 8 9: Event 1 10: Event 2 11: Event 3 12: Event 4 13: HBA1 14: HBA2 15: Logical *OR* of HBA1 and HBA2 16: LBA 17: Input error state 18: Program control mode (RUN) state 19: Fixed set point control mode (FIX) state 20: Manual control mode (MAN) state 21: Ramp state 22: Soak state 23: Hold state 24: Wait state 25: Pattern end signal 26: Autotuning (AT) state 27: FAIL state 28: Host communication error 29: Intercontroller communication error 30: Feedback resistance (FBR) input error	Based on model code. When not specifying: 9
181	DO2 assignment	KB	7	00B3	179	R/W	The data range is the same as the DO1 assignment.	Based on model code. When not specifying: 10
182	DO3 assignment	XC	7	00B4	180	R/W	The data range is the same as the DO1 assignment.	Based on model code. When not specifying: 1
183	DO4 assignment	XD	7	00B5	181	R/W	The data range is the same as the DO1 assignment.	Based on model code. When not specifying: 25

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
184	DO5 assignment	QG	7	00B6	182	R/W	The data range is the same as the DO1 assignment.	When specifying 12 points of DO at ordering: DO5 to DO12: 1 to 8 When specifying 4 points of DO at ordering: DO5 to DO12: 0
185	DO6 assignment	QH	7	00B7	183	R/W	The data range is the same as the DO1 assignment.	
186	DO7 assignment	QI	7	00B8	184	R/W	The data range is the same as the DO1 assignment.	
187	DO8 assignment	QJ	7	00B9	185	R/W	The data range is the same as the DO1 assignment.	
188	DO9 assignment	QK	7	00BA	186	R/W	The data range is the same as the DO1 assignment.	
189	DO10 assignment	QL	7	00BB	187	R/W	The data range is the same as the DO1 assignment.	
190	DO11 assignment	QM	7	00BC	188	R/W	The data range is the same as the DO1 assignment.	
191	DO12 assignment	QN	7	00BD	189	R/W	The data range is the same as the DO1 assignment.	
192	Event 1 type	XA	7	00BE	190	R/W	0: None 1: Deviation high [1] 2: Deviation low [1] 3: Deviation high/low [1] 4: Deviation high/low (Individual high and low setting) [1] 5: Band [1] 6: Band (Individual high and low setting) [1] 7: Process high [1] 8: Process low [1] 9: SV high 10: SV low 11: MV1 high [heat-side] [1, 2] 12: MV1 low [heat-side] [1, 2] 13: MV2 high [cool-side] [1] 14: MV2 low [cool-side] [1] [1] Event hold action is available. [2] If there is Feedback resistance (FBR) input in Position proportioning PID control, set to the FBR input value.	Based on model code. When not specifying: 1
193	Event 1 hold action	WA	7	00BF	191	R/W	0: OFF 1: Hold action ON [when power turned on; when Event start (SV changed)]	Based on model code. When not specifying: 0
194	Event 1 differential gap	HA	7	00C0	192	R/W	Deviation, process or set value: 0 to Input span (Unit: °C [°F]) MV: 0.0 to 110.0 %	TC/RTD: 2 V/I: 0.2 MV: 0.2

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
195	Event 1 output action at input error	OA	7	00C1	193	R/W	0 to 4 (—) / When PV reaches Input error determination point (high) or higher temperature: / When PV reaches Input error determination point (low) or lower temperature: 0 / Conform to Event action / Conform to Event action 1 / ON / Conform to Event action 2 / Conform to Event action / ON 3 / ON / ON 4 / OFF / OFF	0
196	Event 1 timer	TD	7	00C2	194	R/W	0.0 to 600.0 seconds	0.0
197	Event 1 interlock	LF	7	00C3	195	R/W	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0
198	Event 1 minimum ON time	BA	7	00C4	196	R/W	0.0 to 600.0 seconds	0.0
199	Event 1 minimum OFF time	BB	7	00C5	197	R/W	0.0 to 600.0 seconds	0.0
200	Event 2 type	XB	7	00C6	198	R/W	The data range is same as Event 1 type.	Based on model code. When not specifying: 2
201	Event 2 hold action	WB	7	00C7	199	R/W	The data range is same as Event 1 hold action.	Based on model code. When not specifying: 1
202	Event 2 differential gap	HB	7	00C8	200	R/W	The data range is same as Event 1 differential gap.	TC/RTD: 2 V/I: 0.2 MV: 0.2
203	Event 2 output action at input error	OB	7	00C9	201	R/W	The data range is same as Event 1 output action at input error.	0
204	Event 2 timer	TG	7	00CA	202	R/W	The data range is same as Event 1 timer.	0.0
205	Event 2 interlock	LG	7	00CB	203	R/W	The data range is same as Event 1 interlock.	0
206	Event 2 minimum ON time	BC	7	00CC	204	R/W	The data range is same as Event 1 minimum ON time.	0.0
207	Event 2 minimum OFF time	BD	7	00CD	205	R/W	The data range is same as Event 1 minimum OFF time.	0.0
208	Event 3 type	ZC	7	00CE	206	R/W	The data range is same as Event 1 type.	Based on model code. When not specifying: 0
209	Event 3 hold action	WC	7	00CF	207	R/W	The data range is same as Event 1 hold action.	Based on model code. When not specifying: 0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
210	Event 3 differential gap	HC	7	00D0	208	R/W	The data range is same as Event 1 differential gap.	TC/RTD: 2 V/I: 0.2 MV: 0.2
211	Event 3 output action at input error	OC	7	00D1	209	R/W	The data range is same as Event 1 output action at input error.	0
212	Event 3 timer	TE	7	00D2	210	R/W	The data range is same as Event 1 timer.	0.0
213	Event 3 interlock	LH	7	00D3	211	R/W	The data range is same as Event 1 interlock.	0
214	Event 3 minimum ON time	BE	7	00D4	212	R/W	The data range is same as Event 1 minimum ON time.	0.0
215	Event 3 minimum OFF time	BF	7	00D5	213	R/W	The data range is same as Event 1 minimum OFF time.	0.0
216	Event 4 type	ZD	7	00D6	214	R/W	The data range is same as Event 1 type.	Based on model code. When not specifying: 0
217	Event 4 hold action	WD	7	00D7	215	R/W	The data range is same as Event 1 hold action.	Based on model code. When not specifying: 0
218	Event 4 differential gap	HD	7	00D8	216	R/W	The data range is same as Event 1 differential gap.	TC/RTD: 2 V/I: 0.2 MV: 0.2
219	Event 4 output action at input error	OD	7	00D9	217	R/W	The data range is same as Event 1 output action at input error.	0
220	Event 4 timer	TH	7	00DA	218	R/W	The data range is same as Event 1 timer.	0.0
221	Event 4 interlock	LI	7	00DB	219	R/W	The data range is same as Event 1 interlock.	0
222	Event 4 minimum ON time	BG	7	00DC	220	R/W	The data range is same as Event 1 minimum ON time.	0.0
223	Event 4 minimum OFF time	BH	7	00DD	221	R/W	The data range is same as Event 1 minimum OFF time.	0.0
224	CT1 ratio	XS	7	00DE	222	R/W	0 to 9999	CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000 When not specifying: 800
225	CT1 assignment	ZF	7	00DF	223	R/W	0: None 1: OUT1 2: OUT2 3: OUT3	When specifying CT at ordering: 1 When not specifying: 0
226	Number of heater break alarm 1 (HBA1) delay times	DH	7	00E0	224	R/W	0 to 255 times	5
227	Heater break alarm 1 (HBA1) interlock	LL	7	00E1	225	R/W	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
228	CT2 ratio	XT	7	00E2	226	R/W	The data range is same as CT1 ratio.	CTL-6-P-N: 800 CTL-12-S56-10L-N: 1000 When not specifying: 800
229	CT2 assignment	ZG	7	00E3	227	R/W	The data range is same as CT1 assignment.	When specifying CT at ordering: 2 When not specifying: 0
230	Number of heater break alarm 2 (HBA2) delay times	DF	7	00E4	228	R/W	The data range is same as Number of heater break alarm 1 (HBA1) delay times.	5
231	Heater break alarm 2 (HBA2) interlock	LM	7	00E5	229	R/W	The data range is same as Heater break alarm 1 (HBA1) interlock.	0
232	Control loop break alarm (LBA) selection	XF	7	00E6	230	R/W	0: Without LBA 1: With LBA	0
233	Control loop break alarm (LBA) interlock	LN	7	00E7	231	R/W	0: Unused 1: Used 2: Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.	0
234	Control action	XE	7	00E8	232	R/W	0: Brilliant II PID control (direct action) 1: Brilliant II PID control (reverse action) 2: Brilliant II Heat/Cool PID control (water cooling) 3: Brilliant II Heat/Cool PID control (air cooling) 4: Brilliant II Heat/Cool PID control (cooling gain linear type) 5: Brilliant II Position proportioning PID control (reverse action) 6: Brilliant II Position proportioning PID control (direct action)	Based on model code. When specifying FBR input at ordering: 5 When not specifying: 1
235	Hot/Cold start	PD	7	00E9	233	R/W	0: Hot start 1 1: Hot start 2 2: Cold start 3: Rset start	0
236	Start determination point	SX	7	00 EA	234	R/W	0 to Input span (The unit is the same as input value.) (0: Action depending on the Hot/Cold start selection)	3 % of Input span
237	Action (high) at input error	WH	7	00EB	235	R/W	0: Normal control 1: Manipulated output value at input error	0
238	Action (low) at input error	WL	7	00EC	236	R/W		0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
239	Manipulated output value at input error	OE	7	00ED	237	R/W	PID control: −5.0 to +105.0 % Heat/Cool PID control: −105.0 to +105.0 % Actual output values become those restricted by the Output limiter. Position proportioning PID control: If there is no Feedback resistance (FBR) input or the FBR input is disconnected, an action taken when abnormal is in accordance with the "Value action in Reset mode."	0.0
240	Intensity factor of Ramp/Soak stabilizer	CC	7	00EE	238	R/W	0.0 to 1.0 0.0: Unused	0.5
241	OUT1 minimum ON/OFF time of proportioning cycle	VI	7	00EF	239	R/W	0 to 1000 ms	0
242	OUT2 minimum ON/OFF time of proportioning cycle	VJ	7	00F0	240	R/W	0 to 1000 ms	0
243	OUT3 minimum ON/OFF time of proportioning cycle	VK	7	00F1	241	R/W	0 to 1000 ms	0
244	Integral/derivative time decimal point position	PK	7	00F2	242	R/W	0: 1 second setting (No decimal place) 1: 0.1 seconds setting (One decimal place)	0
245	Derivative gain	DG	7	00F3	243	R/W	0.1 to 10.0	6.0
246	Derivative action	KA	7	00F4	244	R/W	0: Measured value derivative 1: Deviation derivative	0
247	Undershoot suppression factor	K9	7	00F5	245	R/W	0.000 to 1.000	Water cooling: 0.100 Air cooling: 0.250 Cooling gain linear type: 1.000
248	Overlap/Deadband reference point	UY	7	00F6	246	R/W	0.0 to 1.0	0.0
249	AT bias	GB	7	00F7	247	R/W	−Input span to +Input span (The unit is the same as input value) Within the range from −19999 to +32000 (Ignoring the decimal point)	0
250	AT differential gap time	GH	7	00F8	248	R/W	0.0 to 100.0 seconds	10.0
251	AT time signal action	GS	7	00F9	249	R/W	0: Time signal OFF 1: Time signal ON	0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
252	AT cycles	G3	7	00FA	250	R/W	0: 1.5 cycles 1: 2.0 cycles 2: 2.5 cycles 3: 3.0 cycles	0
253	Output value with AT turned on	OP	7	00FB	251	R/W	Output value with AT turned off to +105.0 % Actual output values become those restricted by the Output limiter. Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (high limit of Feedback resistance input at AT).	105.0
254	Output value with AT turned off	OQ	7	00FC	252	R/W	−105.0 % to Output value with AT turned on Actual output values become those restricted by the Output limiter. Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break (low limit of Feedback resistance input at AT).	−105.0
255	AT with learning function at ramp segment	G4	7	00FD	253	R/W	0: No AT with learning function at ramp segment 1: Conduct AT with learning function at ramp segment	0
256	Proportional band limiter (high) [heat-side]	O6	7	00FE	254	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span	TC/RTD: Input span V/I: 1000.0
257	Proportional band limiter (low) [heat-side]	O7	7	00FF	255	R/W		TC/RTD: 0 V/I: 0.0
258	Integral time limiter (high) [heat-side]	I6	7	0100	256	R/W	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
259	Integral time limiter (low) [heat-side]	I7	7	0101	257	R/W		PID control or Heat/Cool PID control: 0 Position proportioning PID control: 1
260	Derivative time limiter (high) [heat-side]	D6	7	0102	258	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	3600
261	Derivative time limiter (low) [heat-side]	D7	7	0103	259	R/W		0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
262	Proportional band limiter (high) [cool-side]	O8	7	0104	260	R/W	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position selection. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span Read/write is available only for Heat/Cool PID control.	TC/RTD: Input span V/I: 1000.0
263	Proportional band limiter (low) [cool-side]	O9	7	0105	261	R/W		TC/RTD: 1 V/I: 0.1
264	Integral time limiter (high) [cool-side]	I8	7	0106	262	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	3600
265	Integral time limiter (low) [cool-side]	I9	7	0107	263	R/W		0
266	Derivative time limiter (high) [cool-side]	D8	7	0108	264	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	3600
267	Derivative time limiter (low) [cool-side]	D9	7	0109	265	R/W		0
268	Proportional band adjusting factor [heat-side]	KC	7	010A	266	R/W	0.01 to 10.00	1.00
269	Integral time adjusting factor [heat-side]	KD	7	010B	267	R/W		1.00
270	Derivative time adjusting factor [heat-side]	KE	7	010C	268	R/W		1.00
271	Proportional band adjusting factor [cool-side]	KF	7	010D	269	R/W	0.01 to 10.00 Read/write is available only for Heat/Cool PID control.	1.00
272	Integral time adjusting factor [cool-side]	KG	7	010E	270	R/W		1.00
273	Derivative time adjusting factor [cool-side]	KH	7	010F	271	R/W		1.00
274	Action at feedback resistance (FBR) input error	SY	7	0110	272	R/W	0: Action depending on the Valve action at Reset mode 1: Control action continued	0
275	Feedback adjustment	FV	7	0111	273	R/W	0: Adjustment end 1: During adjustment on the open-side 2: During adjustment on the close-side 3: Adjustment error	0
276	Control motor time	TJ	7	0112	274	R/W	5 to 1000 seconds	10

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
277	Integrated output limiter	OI	7	0113	275	R/W	0.0 to 200.0 % of control motor time 0.0: OFF Invalidate when Feedback resistance input (FBR) is selected.	150.0
278	Valve action in Reset mode	VS	7	0114	276	R/W	0: Open-sid output OFF, Close-side output OFF 1: Open-sid output OFF, Close-side output ON 2: Open-sid output ON, Close-side output OFF Valid when there is no Feedback resistance (FBR) input or the FBR input is disconnected.	0
279	Action at saturated output	UZ	7	0115	277	R/W	0: Invalid 1: Valid	0
280	Host communication error judgment time	FU	7	0116	278	R/W	0 to 600 seconds 0: Unused	10
No. 281 – 298 are parameters for Intercontroller communication in the Engineering mode.								
281	Intercontroller communication error judgment time	FW	7	0117	279	R/W	0 to 600 seconds 0: Real-time error	10
282	Slave controller	FD	7	0118	280	R/W	0: FB series 1: RB series 2: PF900/PF901	0
283	Number of slave unit	FE	7	0119	281	R/W	0 to 4	0
284	Action at Link error	FF	7	011A	282	R/W	0: Reset 1: Continue	0
285	Communication start time	FG	7	011B	283	R/W	2 to 100 seconds	3
286	Slave 1 ratio	FH	7	011C	284	R/W	0.001 to 9.999	1.000
287	Slave 2 ratio	FI	7	011D	285	R/W		1.000
288	Slave 3 ratio	FJ	7	011E	286	R/W		1.000
289	Slave 4 ratio	FK	7	011F	287	R/W		1.000
290	Slave 1 bias	FL	7	0120	288	R/W	−1000.0 to +1000.0 Varies with the setting of the Decimal point position selection.	0.0
291	Slave 2 bias	FM	7	0121	289	R/W		0.0
292	Slave 3 bias	FN	7	0122	290	R/W		0.0
293	Slave 4 bias	FO	7	0123	291	R/W		0.0

No.	Name	Identifier	Digits	Register address		Attribute	Data range	Factory set value
				HEX	DEC			
294	Set memory area switching address	FP	7	0124	292	R/W	RKC communication: 0000H to FFFFH Modbus: 0 to 65535	RKC communication: 0500H Modbus: 1280
295	Control memory area switching address	FQ	7	0125	293	R/W	RKC communication: 0000H to FFFFH Modbus: 0 to 65535	RKC communication: 0024H Modbus: 36
296	SV address of set memory area	FR	7	0126	294	R/W	RKC communication: 0000H to FFFFH Modbus: 0 to 65535	RKC communication: 0507H Modbus: 1287
297	EEPROM mode setting address	FS	7	0127	295	R/W	RKC communication: 0000H to FFFFH Modbus: 0 to 65535	RKC communication: FFFFH Modbus: 65535
298	RUN/STOP setting address	FT	7	0128	296	R/W	RKC communication: 0000H to FFFFH Modbus: 0 to 65535	RKC communication: 0023H Modbus: 35
299	Setting limiter high	SH	7	0129	297	R/W	Setting limiter low to Input range high	Input range high
300	Setting limiter low	SL	7	012A	298	R/W	Input range low to Setting limiter high	Input range low
301	Wait memory group number at Program start	RK	7	012B	299	R/W	0: Wait OFF 1: Wait memory group 1 2: Wait memory group 2 3: Wait memory group 3 4: Wait memory group 4 5: Wait memory group 5 6: Wait memory group 6 7: Wait memory group 7 8: Wait memory group 8	0
302	Program setting type	KP	7	012C	300	R/W	0: Batch setting type 1: Partial setting type	1
303	Signal type	KQ	7	012D	301	R/W	0: Time signal type 1: Segment signal type	0

No.	Name	Identifier	Digits	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
304	Set time unit	PU	7	012E	302	R/W	RKC communication: 0: Hour : Minute 1: Minute : Second Modbus: 0: Minute 1: Second	0
305	Pattern end output action at Pattern repeat/Pattern link	KU	7	012F	303	R/W	RKC communication: Least significant digit: Pattern end output is ON at Pattern repeat. 2nd digit: Pattern end output is ON at Total pattern repeat. 3rd digit: Pattern end output is ON at Pattern link. 4th digit to Most significant digit: Unused Data 0: OFF 1: ON (0.5 seconds)	000
							Modbus (Bit data): Bit 1: Pattern end output is ON at Pattern repeat. Bit 2: Pattern end output is ON at Total pattern repeat. Bit 3: Pattern end output is ON at Pattern link. Bit 4 to Bit 15: Unused Data 0: OFF 1: ON (0.5 seconds) [Decimal number: 0 to 7]	000 (Bit image)
306	Maximum pattern number	KS	7	0130	304	R/W	1 to 99 Maximum pattern number × Maximum segment number = 1024 at maximum	32
307	Maximum segment number	KT	7	0131	305	R/W	1 to 99 Maximum pattern number × Maximum segment number = 1024 at maximum	32
308	Pattern tag name (Extended identifier (PN) is necessary.)	GN	11	—	—	R/W	RKC communication: Within 11 characters of combination of letters and numbers in ASCII code. Modbus: None	—
309	Data clear	CL	7	0132	306	R/W	Data clear execution with 9999. Data in the Parameter setting mode and tag name will be only cleared.	0
310	Key accelerating speed setting	KV	7	—	—	R/W	0 to 10 digit/50 ms 0: OFF Refer to the description at ■ **Manual manipulated output value (MV) (P. 5-30)**.	3
311	Key accelerating speed Forward/Back-up function	KW	7	—	—	R/W	0 to 120 times 0: OFF Acceleration rate of time at each sampling after pressing and holding the key for 3 seconds. (2 times until 3 seconds)	0

7.5.3 Memory group data [Modbus]

■ Data list [Access method via Group number]

Specify group number and then access data in the Memory group by using the resister addresses from 0500H to 053DH.

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
					Segment group		
1	Pattern number	0500	1280	R/W	1 to Maximum pattern number	1	—
2	Segment number	0501	1281	R/W	1 to Maximum segment number	1	
3	Segment level	0502	1282	R/W	Setting limiter low to Setting limiter high	0	Specify Pattern number (0500H) and Segment number (0501H) first, then access data in the Segment group by writing the register addresses.
4	Segment time	0503	1283	R/W	0 to 30000 (Minute or Second)	0	
5	PID memory group number	0504	1284	R/W	0: Level PID 1 to 8: PID memory group 1 to 8	0	
6	Event memory group number	0505	1285	R/W	0: Event OFF 1 to 8: Event memory group 1 to 8	1	
7	Wait memory group number	0506	1286	R/W	0: Wait OFF 1 to 8: Wait memory group 1 to 8	1	
8	Segment signal 1	0507	1287	R/W	Bit data Bit 0: Segment signal 1 Bit 1: Segment signal 2 Bit 2: Segment signal 3 Bit 3: Segment signal 4 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0000 (Bit image)	
9	Segment signal 2	0508	1288	R/W	Bit data Bit 0: Segment signal 5 Bit 1: Segment signal 6 Bit 2: Segment signal 7 Bit 3: Segment signal 8 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0000 (Bit image)	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
Pattern group							
10	Program end number	0509	1289	R/W	1 to 99 (Within the maximum segment number)	32	Specify Pattern number (0500H) first, then access data in the Pattern group by writing the register addresses.
11	Segment repeat execution time	050A	1290	R/W	1 to 9999 times	1	
12	Segment repeat start number	050B	1291	R/W	1 to 99 (Within the maximum segment number)	1	
13	Segment repeat end number	050C	1292	R/W	1 to 99 (Within the maximum segment number)	1	
14	Pattern repeat execution time	050D	1293	R/W	1 to 10000 times 10000: No limit	1	
15	Link pattern number	050E	1294	R/W	0 to 99 (Within the maximum pattern number) 0: No link pattern	0	
16	Pattern end output duration	050F	1295	R/W	0 to 30000 (Minute or Second)	0	
17	Time signal memory group number	0510	1296	R/W	0: Time signal OFF 1 to 16: Time signal memory group 1 to 16	Pattern 1 to 16: 1 Pattern 17 or more: 0	
18	Output program memory group number	0511	1297	R/W	0 to [128/Maximum number of segment] (Up to 99) 0: No assignment	0	
PID memory group							
19	PID memory group number	0512	1298	R/W	1 to 8	1	—
20	Proportional band [heat-side]	0513	1299	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span 0 (0.0, 0.00): ON/OFF action	TC/RTD: 30 V/I: 30.0	Specify PID memory group number (0512H) first, then access data in the PID memory group by writing the register addresses.
21	Integral time [heat-side]	0514	1300	R/W	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action [both heat-side and cool-side] Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	240	
22	Derivative time [heat-side]	0515	1301	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
23	Control response parameter	0516	1302	R/W	0: Slow 1: Medium 2: Fast P action and PD action, the control response is fixed at 2 (Fast).	2	Specify PID memory group number (0512H) first, then access data in the PID memory group by writing the register addresses.
24	Proportional band [cool-side]	0517	1303	R/W	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span Read/write is available only for Heat/Cool PID control.	TC/RTD: 30 V/I: 30.0	
25	Integral time [cool-side]	0518	1304	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action [both heat-side and cool-side] Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	240	
26	Derivative time [cool-side]	0519	1305	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	60	
27	Overlap/Deadband or Open/Close output neutral zone	051A	1306	R/W	Heat/Cool PID control (Overlap/Deadband) TC/RTD inputs: −Input span to +Input span (Unit: °C [°F]) Voltage (V)/Current (I) inputs: −100.0 to +100.0 % of Input span Minus (−) setting results in Overlap. However, the overlapping range is within the proportional range. Read/write is available only for Heat/Cool PID control. Position proportioning PID control (Open/Close output neutral zone): 0.1 to 20.0 %	Overlap/Deadband TC/RTD: 0 V/I: 0.0 Open/Close output neutral zone: 2.0	
28	Manual reset	051B	1307	R/W	−100.0 to +100.0 % The offset can be manually eliminated. Unable to Read/write when Integral function is active.	0.0	

No.	Name	Register address		Attribute	Data range	Factory set value	Note
		HEX	DEC				
29	Output limiter high (MV1)	051C	1308	R/W	Output limiter low (MV1) to 105.0 % Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break.	105.0	Specify PID memory group number (0512H) first, then access data in the PID memory group by writing the register addresses.
30	Output limiter low (MV1)	051D	1309	R/W	−5.0 % to Output limiter high (MV1) Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break.	−5.0	
31	Output limiter high (MV2)	051E	1310	R/W	Output limiter low (MV2) to 105.0 % Read/write is available only for Heat/Cool PID control.	105.0	
32	Output limiter low (MV2)	051F	1311	R/W	−5.0 % to Output limiter high (MV2) Read/write is available only for Heat/Cool PID control.	−5.0	
33	ON/OFF action differential gap (upper)	0520	1312	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of Input span Unable to Read/write unless Proportional band [heat-side] is set to 0 (ON/OFF action).	TC/RTD: 1 V/I: 0.1	
34	ON/OFF action differential gap (lower)	0521	1313	R/W		TC/RTD: 1 V/I: 0.1	
35	Control loop break alarm (LBA) time	0522	1314	R/W	0 to 7200 seconds (0: Unused) Read/write is only available when LBA is specified.	480	
36	LBA deadband (LBD)	0523	1315	R/W	0 to Input span Read/write is only available when LBA is specified.	0	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
					Event memory group		
37	Event memory group number	0524	1316	R/W	1 to 8	1	—
38	Event 1 set value (EV1)	0525	1317	R/W	Deviation: –Input span to +Input span Within the range from –19999 to +32000 (Ignoring the decimal point) Process and set value: Input range low to Input range high Manipulated output value (MV1 or MV2): –5.0 to +105.0 % Unable to Read/write when Event type is set to “0: None.”	50	Specify Event memory group number (0524H) first, then access data in the Event memory group by writing the register addresses.
	Event 1 set value (EV1) [high]				–Input span to +Input span Within the range from –19999 to +32000 (Ignoring the decimal point) This data valid when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).	50	
39	Event 1 set value (EV1’) [low]	0526	1318	R/W	–Input span to +Input span Within the range from –19999 to +32000 (Ignoring the decimal point) This data valid when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).	–50	
40	Event 2 set value (EV2)	0527	1319	R/W	The data range is same as Event 1 set value (EV1).	50	
	Event 2 set value (EV2) [high]				The data range is same as Event 1 set value (EV1) [high].	50	
41	Event 2 set value (EV2’) [low]	0528	1320	R/W	The data range is same as Event 1 set value (EV1’) [low].	–50	
42	Event 3 set value (EV3)	0529	1321	R/W	The data range is same as Event 1 set value (EV1).	50	
	Event 3 set value (EV3) [high]				The data range is same as Event 1 set value (EV1) [high].	50	
43	Event 3 set value (EV3’) [low]	052A	1322	R/W	The data range is same as Event 1 set value (EV1’) [low].	–50	

No.	Name	Register address		Attribute	Data range	Factory set value	Note
		HEX	DEC				
44	Event 4 set value (EV4)	052B	1323	R/W	The data range is same as Event 1 set value (EV1).	50	Specify Event memory group number (0524H) first, then access data in the Event memory group by writing the register addresses.
	Event 4 set value (EV4) [high]				The data range is same as Event 1 set value (EV1) [high].	50	
45	Event 4 set value (EV4') [low]	052C	1324	R/W	The data range is same as Event 1 set value (EV1') [low].	−50	
Wait memory group							
46	Wait memory group number	052D	1325	R/W	1 to 8	1	—
47	Wait zone high	052E	1326	R/W	TC/RTD inputs: 0 (0.0, 0.00) to 200 (200.0, 200.00) (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 20.0 % of Input span 0 (0.0, 0.00): Wait zone high becomes OFF	0	Specify Wait memory group number (052DH) first, then access data in the Wait memory group by writing the register addresses.
48	Wait zone low	052F	1327	R/W	TC/RTD inputs: −200 (−200.0, −199.99) to 0 (0.0, 0.00) (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: −20.0 to 0.0 % of Input span 0 (0.0, 0.00): Wait zone low becomes OFF	0	
49	Wait release trigger selection	0530	1328	R/W	Bit data Bit 0: Zone wait 1 (the controller) Bit 1: Zone wait 2 (all slave controllers) Bit 2: Wait release by digital input (DI) Bit 3 to Bit 15: Unused Data 0: Invalid 1: Valid [Decimal number: 0 to 7]	001 (Bit image)	
50	Wait time-out set value	0531	1329	R/W	0 to 30000 (Minute or Second) 0: Wait OFF	0	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
					Time signal memory group		
51	Time signal memory group number	0532	1330	R/W	1 to 16	1	—
52	Time signal memory number	0533	1331	R/W	1 to 16	1	
53	Time signal output assignment	0534	1332	R/W	1: Time signal 1 2: Time signal 2 3: Time signal 3 4: Time signal 4 5: Time signal 5 6: Time signal 6 7: Time signal 7 8: Time signal 8 0: No assignment	0	Specify Time signal memory group number (0532H) and Time signal memory number (0533H) first, then access data in the Time signal memory group by writing the register addresses.
54	Start segment of time signal	0535	1333	R/W	1 to 99 (Within the maximum segment number)	1	
55	Time signal start time	0536	1334	R/W	0 to 30000 (Minute or Second)	0	
56	End segment of time signal	0537	1335	R/W	1 to 99 (Within the maximum segment number)	1	
57	Time signal end time	0538	1336	R/W	0 to 30000 (Minute or Second)	0	
					Output program memory group		
58	Output program memory group number	0539	1337	R/W	1 to [128/Maximum number of segments] (Up to 99)	1	—
59	Output program memory number	053A	1338	R/W	1 to Maximum segment number	1	
60	Output program value 1	053B	1339	R/W	−5.0 to +105.0 %	−5.0	Specify Output program memory group number (0539H) and Output program memory number (053AH) first, then access data in the Output program memory group by writing the register addresses.
61	Output program value 2	053C	1340	R/W	−5.0 to +105.0 %	−5.0	
62	Output program value 3	053D	1341	R/W	−5.0 to +105.0 %	−5.0	

■ Data list [Direct data access method]

Access data in Memory group by using the resister address from 2000H to 99A7H.

Data belonging to different groups cannot read/write sequently.

No.	Name	Register address		Attribute	Data range	Factory set value	Note
		HEX	DEC				
Segment group							
1	Segment level	2000	8192	R/W	Setting limiter low to Setting limiter high	0	• It is possible to access 4096 data maximum (64 segments × 64 patterns) of each parameter. • Reading data will be "0" and writing data will be ignored by the controller when the Host computer reads or writes data of segment numbers or pattern numbers exceeding the setting of Maximum segment number or Maximum pattern number. • It is possible to access data of more than 64 segments or 64 patterns by Access method via Group number.
2	Segment time	3000	12288	R/W	0 to 30000 (Minute or Second)	0	
3	PID memory group number	4000	16384	R/W	0: Level PID 1 to 8: PID memory group 1 to 8	0	
4	Event memory group number	5000	20480	R/W	0: Event OFF 1 to 8: Event memory group 1 to 8	1	
5	Wait memory group number	6000	24576	R/W	0: Wait OFF 1 to 8: Wait memory group 1 to 8	1	
6	Segment signal 1	7000	28672	R/W	Bit data Bit 0: Segment signal 1 Bit 1: Segment signal 2 Bit 2: Segment signal 3 Bit 3: Segment signal 4 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0000 (Bit image)	
7	Segment signal 2	8000	32768	R/W	Bit data Bit 0: Segment signal 5 Bit 1: Segment signal 6 Bit 2: Segment signal 7 Bit 3: Segment signal 8 Bit 4 to Bit 15: Unused Data 0: OFF 1: ON [Decimal number: 0 to 15]	0000 (Bit image)	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
Pattern group							
8	Program end number	9000	36864	R/W	1 to 99 (Within the maximum segment number)	32	• It is possible to access data of up to 64 patterns for each parameter. • Reading data will be "0" and writing data will be ignored by the controller when the Host computer reads or writes data of pattern numbers exceeding the setting of Maximum pattern number. • It is possible to access data of more than 64 patterns by Access method via Group number.
9	Segment repeat execution time	9040	36928	R/W	1 to 9999 times	1	
10	Segment repeat start number	9080	36992	R/W	1 to 99 (Within the maximum segment number)	1	
11	Segment repeat end number	90C0	37056	R/W	1 to 99 (Within the maximum segment number)	1	
12	Pattern repeat execution time	9100	37120	R/W	1 to 10000 times 10000: No limit	1	
13	Link pattern number	9140	37184	R/W	0 to 99 (Within the maximum pattern number) 0: No link pattern	0	
14	Pattern end output duration	9180	37248	R/W	0 to 30000 (Minute or Second)	0	
15	Time signal memory group number	91C0	37312	R/W	0: Time signal OFF 1 to 16: Time signal memory group 1 to 16	Pattern 1 to 16: 1 Pattern 17 or more: 0	
16	Output program memory group number	9200	37376	R/W	0 to [128/Maximum number of segments] (Up to 99) 0: No assignment	0	
PID memory group							
17	Proportional band [heat-side]	9240	37440	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 1000.0 % of Input span 0 (0.0, 0.00): ON/OFF action	TC/RTD: 30 V/I: 30.0	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
18	Integral time [heat-side]	9248	37448	R/W	PID control or Heat/Cool PID control: 0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action [both heat-side and cool-side] Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds Varies with the setting of the Integral/Derivative time decimal point position selection.	240	
19	Derivative time [heat-side]	9250	37456	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection.	60	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
20	Control response parameter	9258	37464	R/W	0: Slow 1: Medium 2: Fast P action and PD action, the control response is fixed at 2 (Fast).	2	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
21	Proportional band [cool-side]	9260	37472	R/W	TC/RTD inputs: 1 (0.1, 0.01) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.1 to 1000.0 % of Input span Read/write is available only for Heat/Cool PID control.	TC/RTD: 30 V/I: 30.0	
22	Integral time [cool-side]	9268	37480	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PD action [both heat-side and cool-side] Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	240	
23	Derivative time [cool-side]	9270	37488	R/W	0 to 3600 seconds or 0.0 to 3600.0 seconds 0 (0.0): PI action Varies with the setting of the Integral/Derivative time decimal point position selection. Read/write is available only for Heat/Cool PID control.	60	
24	Overlap/Deadband or Open/Close output neutral zone	9278	37496	R/W	Heat/Cool PID control (Overlap/Deadband) TC/RTD inputs: −Input span to +Input span (Unit: °C [°F]) Within the range from −19999 to +32000 (Ignoring the decimal point) Voltage (V)/Current (I) inputs: −100.0 to +100.0 % of Input span Minus (−) setting results in Overlap. However, the overlapping range is within the proportional range. Read/write is available only for Heat/Cool PID control. Position proportioning PID control (Open/Close output neutral zone): 0.1 to 20.0 %	Overlap/Deadband TC/RTD: 0 V/I: 0.0 Open/Close output neutral zone: 2.0	
25	Manual reset	9280	37504	R/W	−100.0 to +100.0 % The offset can be manually eliminated. Unable to Read/write when Integral function is active.	0.0	

No.	Name	Register address		Attribute	Data range	Factory set value	Note
		HEX	DEC				
26	Output limiter high (MV1)	9288	37512	R/W	Output limiter low (MV1) to 105.0 % Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break.	105.0	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
27	Output limiter low (MV1)	9290	37520	R/W	–5.0 % to Output limiter high (MV1) Position proportioning PID control: Becomes valid only when there is Feedback resistance (FBR) input and it does not break.	–5.0	
28	Output limiter high (MV2)	9298	37528	R/W	Output limiter low (MV2) to 105.0 % Read/write is available only for Heat/Cool PID control.	105.0	
29	Output limiter low (MV2)	92A0	37536	R/W	–5.0 % to Output limiter high (MV2) Read/write is available only for Heat/Cool PID control.	–5.0	
30	ON/OFF action differential gap (upper)	92A8	37544	R/W	TC/RTD inputs: 0 (0.0, 0.00) to Input span (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 100.0 % of Input span Unable to Read/write unless Proportional band [heat-side] is set to 0 (ON/OFF action).	TC/RTD: 1 V/I: 0.1	
31	ON/OFF action differential gap (lower)	92B0	37552	R/W		TC/RTD: 1 V/I: 0.1	
32	Control loop break alarm (LBA) time	92B8	37560	R/W	0 to 7200 seconds (0: Unused) Read/write is only available when LBA is specified.	480	
33	LBA deadband (LBD)	92C0	37568	R/W	0 to Input span Read/write is only available when LBA is specified.	0	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
	Event memory group						
34	Event 1 set value (EV1)	92C8	37576	R/W	Deviation: −Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) Process and set value: Input range low to Input range high Manipulated output value (MV1 or MV2): −5.0 to +105.0 % Unable to Read/write when Event type is set to "0: None."	50	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
	Event 1 set value (EV1) [high]				−Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) This data valid when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).	50	
35	Event 1 set value (EV1') [low]	92D0	37584	R/W	−Input span to +Input span Within the range from −19999 to +32000 (Ignoring the decimal point) This data valid when the event type is the Deviation High/Low (Individual high and low setting) or the Band (Individual high and low setting).	−50	
36	Event 2 set value (EV2)	92D8	37592	R/W	The data range is same as Event 1 set value (EV1).	50	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
	Event 2 set value (EV2) [high]				The data range is same as Event 1 set value (EV1) [high].	50	
37	Event 2 set value (EV2') [low]	92E0	37600	R/W	The data range is same as Event 1 set value (EV1') [low].	−50	
38	Event 3 set value (EV3)	92E8	37608	R/W	The data range is same as Event 1 set value (EV1).	50	
	Event 3 set value (EV3) [high]				The data range is same as Event 1 set value (EV1) [high].	50	
39	Event 3 set value (EV3') [low]	92F0	37616	R/W	The data range is same as Event 1 set value (EV1') [low].	−50	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
40	Event 4 set value (EV4)	92F8	37624	R/W	The data range is same as Event 1 set value (EV1).	50	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
	Event 4 set value (EV4) [high]				The data range is same as Event 1 set value (EV1) [high].	50	
41	Event 4 set value (EV4’) [low]	9300	37632	R/W	The data range is same as Event 1 set value (EV1’) [low].	–50	
Wait memory group							
42	Wait zone high	9308	37640	R/W	TC/RTD inputs: 0 (0.0, 0.00) to 200 (200.0, 200.00) (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: 0.0 to 20.0 % of Input span 0 (0.0, 0.00): Wait zone high becomes OFF	0	It is possible to access data in group numbers from 1 to 8 (8 data) for each parameter.
43	Wait zone low	9310	37648	R/W	TC/RTD inputs: –200 (–200.0, –199.99) to 0 (0.0, 0.00) (Unit: °C [°F]) Varies with the setting of the Decimal point position. Voltage (V)/Current (I) inputs: –20.0 to 0.0 % of Input span 0 (0.0, 0.00): Wait zone low becomes OFF	0	
44	Wait release trigger selection	9318	37656	R/W	Bit data Bit 0: Zone wait 1 (the controller) Bit 1: Zone wait 2 (all slave controllers) Bit 2: Wait release by digital input (DI) Bit 3 to Bit 15: Unused Data 0: Invalid 1: Valid [Decimal number: 0 to 7]	001 (Bit image)	
45	Wait time-out set value	9320	37664	R/W	0 to 30000 (Minute or Second) 0: Wait OFF	0	

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value	Note
Time signal memory group							
46	Time signal output assignment	9328	37672	R/W	1: Time signal 1 2: Time signal 2 3: Time signal 3 4: Time signal 4 5: Time signal 5 6: Time signal 6 7: Time signal 7 8: Time signal 8 0: No assignment	0	It is possible to access 256 data (16 groups × 16 memories) for each parameter.
47	Start segment of time signal	9428	37928	R/W	1 to 99 (Within the maximum segment number)	1	
48	Time signal start time	9528	38184	R/W	0 to 30000 (Minute or Second)	0	
49	End segment of time signal	9628	38440	R/W	1 to 99 (Within the maximum segment number)	1	
50	Time signal end time	9728	38696	R/W	0 to 30000 (Minute or Second)	0	
Output program memory group							
51	Output program value 1	9828	38952	R/W	−5.0 to +105.0 %	−5.0	It is possible to access 128 data for each parameter.
52	Output program value 2	98A8	39080	R/W	−5.0 to +105.0 %	−5.0	
53	Output program value 3	9928	39208	R/W	−5.0 to +105.0 %	−5.0	

7.5.4 Data mapping address [Modbus]

It is possible to Read/Write data in batch by assigning selected data consecutively (16 maximum).

■ Register address for data mapping

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
1	Register address setting 1 [Read/write address: 1500H]	1000	4096	R/W	Set the register address of data to be assigned to 1500H to 150FH. Decimal: −1 to 4095 (−1: No mapping) Hexadecimal: FFFFH to 0FFFH (FFFFH: No mapping)	−1
2	Register address setting 2 [Read/write address: 1501H]	1001	4097	R/W		−1
3	Register address setting 3 [Read/write address: 1502H]	1002	4098	R/W		−1
4	Register address setting 4 [Read/write address: 1503H]	1003	4099	R/W		−1
5	Register address setting 5 [Read/write address: 1504H]	1004	4100	R/W		−1
6	Register address setting 6 [Read/write address: 1505H]	1005	4101	R/W		−1
7	Register address setting 7 [Read/write address: 1506H]	1006	4102	R/W		−1
8	Register address setting 8 [Read/write address: 1507H]	1007	4103	R/W		−1
9	Register address setting 9 [Read/write address: 1508H]	1008	4104	R/W		−1
10	Register address setting 10 [Read/write address: 1509H]	1009	4105	R/W		−1
11	Register address setting 11 [Read/write address: 150AH]	100A	4106	R/W		−1
12	Register address setting 12 [Read/write address: 150BH]	100B	4107	R/W		−1
13	Register address setting 13 [Read/write address: 150CH]	100C	4108	R/W		−1
14	Register address setting 14 [Read/write address: 150DH]	100D	4109	R/W		−1
15	Register address setting 15 [Read/write address: 150EH]	100E	4110	R/W		−1
16	Register address setting 16 [Read/write address: 150FH]	100F	4111	R/W		−1

■ Register address for data read/writes

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
1	Data specified by register address setting 1 (1000H)	1500	5376	Based on the data specified at 1000H to 100FH.		
2	Data specified by register address setting 2 (1001H)	1501	5377			
3	Data specified by register address setting 3 (1002H)	1502	5378			
4	Data specified by register address setting 4 (1003H)	1503	5379			
5	Data specified by register address setting 5 (1004H)	1504	5380			
6	Data specified by register address setting 6 (1005H)	1505	5381			
7	Data specified by register address setting 7 (1006H)	1506	5382			
8	Data specified by register address setting 8 (1007H)	1507	5383			
9	Data specified by register address setting 9 (1008H)	1508	5384			
10	Data specified by register address setting 10 (1009H)	1509	5385			
11	Data specified by register address setting 11 (100AH)	150A	5386			
12	Data specified by register address setting 12 (100BH)	150B	5387			
13	Data specified by register address setting 13 (100CH)	150C	5388			
14	Data specified by register address setting 14 (100DH)	150D	5389			
15	Data specified by register address setting 15 (100EH)	150E	5390			
16	Data specified by register address setting 16 (100FH)	150F	5391			

TROUBLE SHOOTING

8

8.1 Error Display

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

■ Display when input error occurs

The table below shows displays, description, control actions and solutions when the Measured value (PV) exceeds the display range.

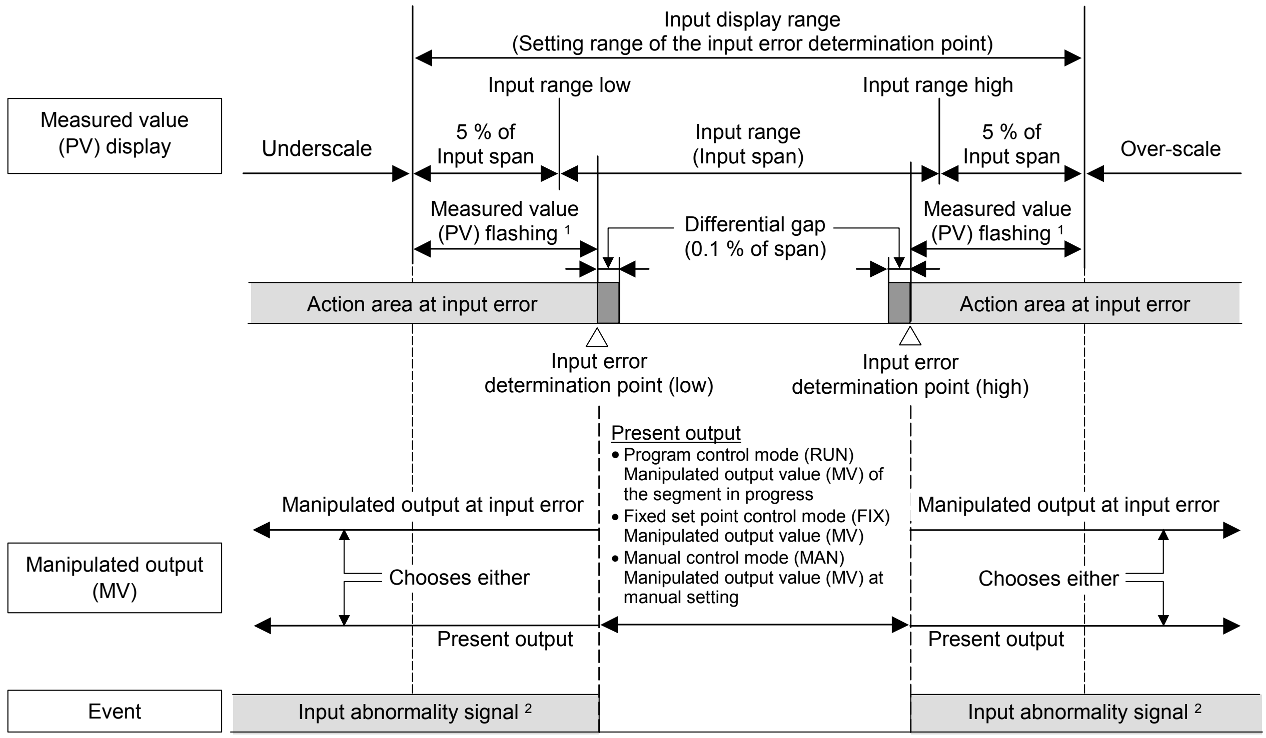
NOTE

Prior to replacing the sensor, always turn OFF the power.

Display	Description	Action (Output)	Solution
Measured value (PV) [Flashing]	• Measured value (PV) exceeds the Input scale high/low. • Measured value (PV) exceeds the Input error determination point (high/low limit).	Action at input error: Output depending on the Action (high or low) at input error (Refer to page **6-31**) Event output: Output depending on the Event output action at input error	Check Input type, Input range and connecting state of sensor. Confirm that the sensor or wire is not broken.
ooooo [Flashing]	Over-scale Measured value (PV) is above the input display range high (or +99999).		
uuuuu [Flashing]	Underscale Measured value (PV) is below the input display range low (or −19999).		

● Setting Input error determination point within input range

Measured value (PV) display starts flashing when Input error occurs within the input range. PV flashes when PV is within 5 % of input span. When PV goes over or under 5 % of input span, "oooo" or "uuuu" flashes.

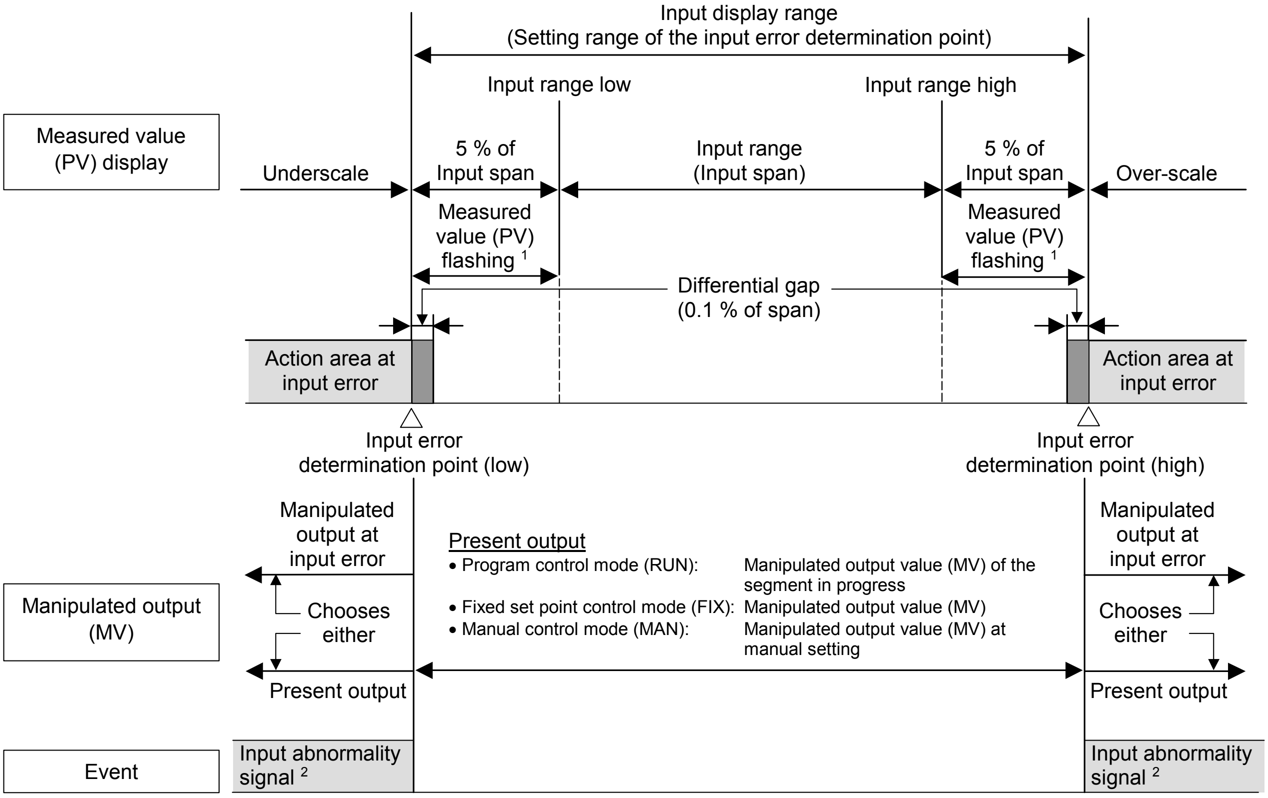


[1] "Flashing display" or "Non-flashing display" of PV can be selected for the PV flashing display at input error of the Engineering Mode (F10.01).

[2] For details on Event output at input error, refer to ● **Event output action at Input error (P.6-65)**.
For details on Input abnormality signal, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P.6-37)** or **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P.6-41)**.

● Setting Input error determination point when out of input range

Measured value (PV) display starts flashing when Input error occurs out of the input range. PV flashes while PV is within 5 % of input span. When PV goes over or under 5 % of input span, “oooo” or “uuuu” flashes.



[1] “Flashing display” or “Non-flashing display” of PV can be selected for the PV flashing display at input error of the Engineering Mode (F10.01).

[2] For details on Event output at input error, refer to ● **Event output action at Input error (P.6-65)**.
For details on Input abnormality signal, refer to **6.2.1 Output assignment (OUT1 to OUT3) (P.6-37)** or **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P.6-41)**.

■ Self-diagnostic error

In 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 is displayed.

Error code	Description	Action	Solution
1	Adjusted data error	Display: Error code display Output: All the output is OFF Produces Fail output when the Fail output is allocated to output terminals. Communication: Send Error code. Communication is available.	Turn off the power at once. If the PF900/PF901 is restored to normal after the power is turned on again, then probable cause may be external noise source affecting the control system. Check for the external noise source. If an error occurs after the power is turned on again, the PF900/PF901 must be repaired or replaced. Please contact RKC sales office or the agent.
2	Data back-up error • Back-up action is abnormal • Data write failure		
4	A/D conversion error • Response signal from A/D converter is abnormal.		
	Temperature compensation error • The temperature compensation data is out of range.		
8	Segment level error • Segment level of the segment in progress is outside of the input range.	Display: Error number and PV/SV display alternatively. Output: Control is continued. Communication: Send Error code. Communication is available.	Set the segment level within the input range.[1]
16	Intercontroller communication error (Link error) • No response from the slave • Error message received from the slave, Example: Sending data out of the setting range or sending data to a non-existing address	Display: Error number and PV/SV display alternatively. Output: Continues based on the operation mode in progress. Communication: Send Error code. Communication is available.	Check connection between the slave, data to be sent to the slave, and other settings such as controller communication address. [2]
No error display	Watchdog timer error • The part of an internal program stops the action.	Display: ALM lamp ON, other lamps are all OFF. Output: All output is OFF Communication: Stop	Turn off the power at once. If an error occurs after the power is turned again, the PF900/PF901 must be repaired or replaced. Please contact RKC sales office or the agent.
	Power supply voltage is abnormal (power supply voltage monitoring) • Reduction in Power supply voltage	Display: All display is OFF Output: All output is OFF Communication: Stop	

[1] Error display can be released by switching to the Reset mode by front key operation.

[2] Error display can be released by pressing the MONI key and the MODE key.

8.2 Solutions for Problems

This section explains probable causes and solutions if any abnormality occurs in the instrument. For any inquiries or to confirm the specifications of the product, please contact RKC sales office or the agent.

If it is necessary to replace a device, always strictly observe the warnings below.

⚠ WARNING

- To prevent electric shock or instrument failure, always turn off the system power before replacing the instrument.
- To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.
- To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.
- To prevent electric shock or instrument failure, do not touch the inside of the instrument.
- All wiring must be performed by authorized personnel with electrical experience in this type of work.

CAUTION

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

■ Display

Problem	Probable 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 not correct	Connect the terminals correctly by referring to **3.3 Wiring of Each Terminal (P. 3-8).**
	Power supply terminal contact defect	Retighten the terminals
	Proper power supply voltage is not being supplied.	Apply the normal power supply by referring to **9. SPECIFICATIONS (P. 9-1).**
Display is abnormal	Noise source is present near the instrument.	Separate the noise source from the instrument.
		Set the appropriate digital filter according to the responding control systems
	The terminal board on the instrument using the thermocouple is directly exposed to the air from an air conditioner.	Do not directly expose the terminal board to the air from the air conditioner.
Measured value (PV) display differs from the actual value	Proper sensor is not being used.	Use the specified sensor
	The Input type is not set correctly.	Correct setting of the Input type. Refer to **6.1.1 Changing Measured value (P. 6-2)**.
	Suitable compensation wires were not used to connect thermocouple and the controller.	Use suitable compensation wires for the thermocouple to extend thermocouple wires.
	For RTD input, three lead wires between the controller and the RTD do not have the same resistance value.	Use lead wires with the same resistance value.
	The input select switch is not set correctly.	Correct setting of the input select switch. Refer to **3.3 Wiring of Each Terminal (P. 3-8)**.
	The PV bias is set	Set the PV bias to “0” by referring to PV bias of **6.1.5 Input correction (P. 6-8)**. However, this is limited only to when the PV bias setting can be changed.
	The PV ratio is set.	Change the PV ratio setting by referring to PV ratio of **6.1.5 Input correction (P. 6-8)**. However, this is limited only to when the PV ratio setting can be changed.
Display value fluctuates	Setting of measured input sampling cycle is not appropriate. (Factory set value: 100 ms)	Set the appropriate sampling cycle by referring to **6.1.2 Changing Sampling cycle (P. 6-5)**. However, this is limited only to when the Sampling cycle setting can be changed.

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Problem	Probable cause	Solution
Display value fluctuates	Setting of power supply frequency is not appropriate. (Factory set value: 50 Hz)	Set the appropriate power supply frequency by referring to **6.1.4 Changing Power supply frequency (P. 6-7)**. However, this is limited only to when the power supply frequency can be changed.
All displays, except for Measured value and Alarm, go off.	Power saving mode function is activated. Power saving mode: After the preset time has elapsed, the back lights will go off (except Measured input value screen and lamps for ALM).	Press any key to light all displays.

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

- When the controller is configured as Thermocouple input:
  Short the input terminal No. 23 and 24.
  If the controller shows a Measured value (PV) around the ambient temperature of the input terminals, the input function of the controller is working correctly.
- When the controller is configured as RTD input:
  Connect a 100 Ω resister between the input terminal No. 22 and 23, and short the input terminal No. 23 and 24.
  If the controller shows Measured value (PV) around 0 °C (32 °F), the input function of the controller is working correctly.
- When the controller 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.

■ Control

Problem	Probable cause	Solution
Control is abnormal	The power supply is not correct.	Apply the normal power supply by referring to **9. SPECIFICATIONS (P. 9-1)**.
	Sensor or input lead wires break.	Turn off the power and repair the sensor or replace it.
	The sensor is not wired correctly.	Conduct sensor wiring correctly by referring to **3.3 Wiring of Each Terminal (P. 3-8)**.
	Proper sensor is not being used.	Use the specified sensor.
	The Input type is not set correctly.	Correct setting of the Input type. Refer to **6.1.1 Changing Measured value (P. 6-2)**.
	Sensor insertion depth is insufficient.	Check whether sensor is inserted too loosely. If so, fully insert the sensor.
	Sensor insertion position is not appropriate.	Insert the sensor at the specified location.
	Input signal wires are not separated from instrument power and/or load wires.	Separate each wire.
	Noise source is present near the wiring.	Separate the noise source from the wiring.
	Inappropriate PID constants.	Set the appropriate PID constants.
Autotuning (AT) function not activated	Requirements for performing the Autotuning (AT) function are not satisfied.	Satisfy the requirements for performing the Autotuning (AT) function by referring to **6.5.7 Autotuning (AT) (P. 6-119)**.
Autotuning (AT) suspended	Requirements for suspending the Autotuning (AT) function are established.	Identify causes for Autotuning (AT) suspension by referring to **6.5.7 Autotuning (AT) (P. 6-119)** and then remove them. Then, execute the Autotuning (AT) function again.
Acceptable PID values can not be calculated by Autotuning (AT)	The Autotuning (AT) function does not appropriately meet the characteristics of the controlled object.	Set PID constants manually.
Autotuning (AT) cannot be finished normally	A temperature change (UP and/or Down) is 1 °C or less per minute during Autotuning.	Set PID constants manually.
	Autotuning (AT) is activated when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.	

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Problem	Probable cause	Solution
Autotuning (AT) cannot be finished normally	Chattering output caused the AT cycle to finish too soon, due to PV fluctuation by noise.	Refer to **6.5.7 Autotuning (AT) (P. 6-119)**, and set a suitable AT differential gap time.
Autotuning (AT) with learning function is performed on ramp segment *.	In the Engineering mode, parameter "AT with learning function at ramp segment" is set to "1: Conduct AT with learning function at ramp segment."	Set to "0: No AT with learning function at ramp segment." Refer to **6.5.8 Autotuning (AT) with learning (P. 6-130)**. When the function is OFF, AT with learning function will be performed only on soak segment.
Measured value (PV) is overshoot or undershoot.	Proportional band is too narrow Proportional band set value is too small.	Increase Proportional band (P) set value to fall within the range of an acceptable response delay.
	Integral time is too short Integral time set value is too small.	Increase Integral time (I) set value to fall within the range of an acceptable response delay.
	Derivative time is too short Derivative time set value is too small.	Increase Derivative time (D) set value to fall within the range of an acceptable response delay.
	Proportional band set value is set to 0, and the control type is in ON/OFF control.	Set Proportional band set value to a value other than 0 to use P, PI or PID control.
In the Program control mode, when a segment in program pattern changes from ramp to soak, the overshoot/undershoot of the measured value (PV) is too large.	The cause varies from controlled object.	Change the Ramp/Soak stabilizer (RSS) setting. Refer to **6.5.6 Ramp/Soak stabilizer function (P.6-117)**.
Output does not change.	The Output limiter is set.	Change the Output limiter setting by referring to **6.2.4 Output limiter (P. 6-45)**. However, this is limited only to when the Output limiter setting can be changed.

■ Operation

Problem	Probable cause	Solution
Operation mode can not be switched via key operation.	DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting are closed.	Refer to **6.1.9 Digital input (DI) (P.6-15 and P.6-16)**, and open DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting.
Program control can not be started via key operation.	DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting are closed.	Refer to **6.1.9 Digital input (DI) (P.6-15 and P.6-16)**, and open DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting.
Hold state can not be released via key operation.	DI terminals for Program control mode (RUN) setting or Hold (HOLD) function are closed.	Refer to **6.1.9 Digital input (DI) (P.6-16 and P.6-18)**, and open DI terminals for Program control mode (RUN) setting or Hold (HOLD) function.
Step action is not performed by pressing the STEP R.SET key.	Factory setting for the STEP R.SET key is set to 3: Press and hold for 2 seconds.	Press and hold the STEP R.SET key for 2 seconds. Change the STEP R.SET key type. Refer to **■ Direct key type (P. 4-8)**
	DI terminals for Hold (HOLD) function or Program control mode (RUN) setting are closed.	Refer to **6.1.9 Digital input (DI) (P.6-16 and P.6-18)**, and open DI terminals for Hold (HOLD) function or Program control mode (RUN) setting.
Program control can not be started via Digital input (DI).	DI terminal for Reset mode (RESET) setting is closed.	Refer to **6.1.9 Digital input (DI) (P.6-15)**, and open DI terminal for Reset mode (RESET) setting.
Hold (HOLD) function can not be performed via Digital input (DI).	DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting are closed.	Refer to **6.1.9 Digital input (DI) (P.6-15 and P.6-16)**, and open DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting.
Step (STEP) function can not be performed via Digital input (DI).	Hold state (HOLD) is ON via key or communication.	Release Hold state (HOLD) via key or communication. Refer to **6.1.9 Digital input (DI) (P. 6-18)** and **7.5.2 Communication data [RKC communication/Modbus] (P. 7-40)**.
	DI terminals for Program control mode (RUN) setting or Hold (HOLD) function are closed.	Refer to **6.1.9 Digital input (DI) (P.6-16 and P.6-18)**, and open DI terminals for Program control mode (RUN) setting or Hold (HOLD) function.
No setting change can be made by key operation.	Set data is locked.	Release the set data lock by referring to **4.4 Protecting Setting Data (P. 4-9)**.
Set value (SV) does not change.	The Setting limiter is set.	Change the Setting limiter setting by referring to **Setting limiter (high/low) (P. 5-3)**. However, this is limited only to when the Setting limiter setting can be changed.

■ Event function

Problem	Probable cause	Solution
Event function is abnormal.	Event function is different from the specification.	Change the Event action type by referring to **6.4.1 Setting procedure of Event 1 to 4 (P. 6-61)** after the instrument specification is confirmed.
	Event output relay contact Energized/De-energized is reversed. When FAIL is selected for digital output: De-energized fixed: Contact opens under FAIL	Check the setting details by referring to **6.2.3 Setting of Energized/ De-energized (OUT2, OUT3 or DO1 to DO12) (P. 6-43)**.
	Event hold action is ON.	Refer to **6.4.1 Setting procedure of Event 1 to 4 (P.6-63)**, and set a suitable Event hold action.
	Setting of Event differential gap is not appropriate.	Set the appropriate Event differential gap by referring to **6.4.1 Setting procedure of Event 1 to 4 (P. 6-64)**.
	Event timer function is set and used.	Change Event timer setting. Refer to **6.4.1 Setting procedure of Event 1 to 4 (P. 6-66)**.
	Event minimum ON/OFF time function is set and used.	Change Event minimum ON/OFF time setting. Refer to **6.4.1 Setting procedure of Event 1 to 4 (P. 6-67)**.
	Event memory group setting is incorrect.	Refer to **5.4.3 Set up Program pattern (P. 5-13)** or **6.6.1 Memory group (P.6-144)**, and set a correct memory group.
When Event occurs, Operation mode switches to Manual control mode (MAN).	Event interlock setting is set to 2: Switch to Produces Manipulated output value at input error when Interlock becomes active in the Manual mode.	Change Event interlock setting. Refer to **6.4.1 Setting procedure of Event 1 to 4 (P.6-68)**.
No output of the Event function is turned on	Event type is not assigned to the Digital output (DO).	Check the contents of Output assignment by referring to **6.2.1 Output assignment (OUT1 to OUT3) (P.6-37)** or **6.2.2 Digital output (DO) assignment (DO1 to DO12) (P. 6-41)**. (Not applied to OUT1.)

■ Heater break alarm (HBA)

Problem	Probable cause	Solution
No heater break can be detected	Setting of Heater break alarm is not appropriate.	Set the appropriate Heater break alarm value.
	The CT is not connected.	Connect the CT by referring to **3.3 Wiring of Each Terminal (P. 3-16).**
When Heater break alarm occurs, Operation mode switches to Manual control mode (MAN).	Heater break alarm interlock setting is set to 2: Produces Manipulated output value at input error when Interlock becomes active in the Manual mode.	Change Heater break alarm interlock setting. Refer to **6.4.2 Setting procedure of Heater break alarm (P.6-77)**.
CT input value is abnormal	Proper CT is not used.	Use the specified CT.
	The heater is broken.	Check the heater.
	CT wiring improperly.	Conduct CT wiring correctly by referring to **3.3 Wiring of Each Terminal (P. 3-16)**.
	Input terminal contact defect.	Retighten the terminals.

■ Control loop break alarm (LBA)

Problem	Probable cause	Solution
Control loop break alarm (LBA) is not generated under alarm-ON condition.	Control loop break alarm (LBA) time setting is not suitable.	Refer to **6.4.3 Setting procedure of Control loop break alarm (LBA) (P. 6-81)**, and set a suitable value.
	LBA deadband setting is not suitable.	
	The control mode is Reset mode.	Switch to a different Operation mode only when operation is not affected.
	Autotuning (AT) or Autotuning (AT) with learning function is activated.	Wait until Autotuning (AT) finishes, or cancel Autotuning (AT).
	Control action is set to Heat/Cool PID control.	Change the control action only when operation is not affected.
	The controller is under Pattern end state.	Start Program control mode (RUN), or switch to other Operation modes (except for Reset mode).
	LBA is not suitable for the controlled object.	Use other alarm types or method to detect Control loop break.
Control loop break alarm (LBA) is generated under alarm-OFF condition.	Control loop break alarm (LBA) time setting is not suitable.	Refer to **6.4.3 Setting procedure of Control loop break alarm (LBA) (P. 6-81)**, and set a suitable value.
	LBA deadband setting is not suitable.	
	LBA is not suitable for the controlled object.	Use other alarm types or method to detect Control loop break.

■ Ramp/Soak control

Problem	Probable cause	Solution
When program control is started, Segment 1 is skipped and the program starts from Segment 2.	The SV selection at Program start is set to 2: PV start 2 [Time saving & lamp holding type]. [Operation starts from segment 2 when the Measured value (PV) is larger than the level of segment 1.]	Change the SV selection at program start. Refer to **6.6.2 Program control start selection (P. 6-148)**.
When program control is started, one or more than one segments are skipped.	The parameter of SV at program start is set to “3: PV start 3 (Time saving & searching type)” or “4: PV start 4 (Time saving & searching type).” [Program starts from a segment in which the Segment level equals Measured value (PV).]	
	Segment time set value of the skipped segment is set to “0 (zero).”	Refer to **5.4.3 Set up program patterns (P.5-13)**, and set Segment time.
The program does not start from Measured value (PV).	SV selection at program start is set to “0: Start with the Set value (SV) in the Reset mode.”	Change the SV selection at program start. Refer to **6.6.2 Program control start selection (P. 6-148)**.
	An intersection of the PV level and Program pattern was not found by search at program start when SV selection at program start is set to “PV start 3” or “PV start 4.”	
Segment level does not ramp up/down following the program.	The program is in Hold state.	Refer to **6.6.4 Hold (HOLD) (P.6-156)**, and release Hold state.
	Wait function for Program control mode is ON.	Refer to ● **Wait releasing (P. 6-158)**, and release Wait state.
		Refer to **6.6.6 Wait (P. 6-156)**, and set a suitable Wait zone. However, this is limited only to when the Wait zone setting can be changed.
Ramp/Soak program does not proceed.	The program is in Hold state.	Refer to **6.6.4 Hold (HOLD) (P.6-154)**, and release Hold state.
	Wait function for Program control mode is ON.	Refer to ● **Wait releasing (P. 6-160)**, and release Wait state.
		Refer to **6.6.6 Wait (P. 6-158)**, and set a suitable Wait zone. However, this is limited only to when the Wait zone setting can be changed.
Ramp/Soak program does not start.	End state continues after Ramp/Soak program ended.	Go to Reset mode (RESET), and restart Ramp/Soak program.
	DI terminals for Reset mode (RESET) setting or Program control mode (RUN) setting are closed.	Open DI terminals for both Reset mode (RESET) setting and Program control mode (RUN) setting. Refer to **6.1.9 Digital input (DI) (P. 6-15 and P. 6-16)**.

Continued on the next page.

Continued from the previous page

Problem	Probable cause	Solution
Time signal is incorrect.	Time signal start time or Time signal end time are not set correctly.	Set Time signal start time or Time signal end time correctly. Refer to **6.6.9 Time signal (Segment signal) (P. 6-174)**.
Segment level does not change.	The operation mode is in Fixed set point control mode (FIX) or Manual control mode (MAN).	Go to Reset mode (RESET), and restart Ramp/Soak program.
Control is not stable.	PID values in the PID memory group are not suitable for the segment.	Set suitable PID memory group for the segment. (Referring to **6.6.1 Memory group P. 6-144**) Autotune PID values of the PID memory group. (Refer to **6.5.7 Autotuning (AT) P. 6-119** or **6.5.8 Autotuning (AT) with learning P. 6-130**)
Program does not proceed as planned.	Any one of the parameters below is set incorrectly. • Segment repeat execution time • Pattern repeat execution time • Link pattern number • Segment repeat start/end number	Correct by setting the proper priority order among Segment repeat execution time, Pattern repeat execution time and Link pattern number. Set Segment repeat start/end number to allow suitable repeat interval for the application. Refer to **6.6.7 Repeat and Pattern link (P. 6-164).**
	The program pattern selected is incorrect for the application.	Change Program pattern number at Execution pattern selection (PTN). Refer to **5.4.3 Set up program patterns (P. 5-13)**.
	The segment number at Program pattern end is set incorrectly.	Release Program end state and re-set the correct end segment number. Refer to **5.4.5 Changing procedure of End segment number in Program pattern (P. 5-23)**.

■ Communication function

● RKC communication

Problem	Probable cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	Error in the data format	Re-examine the communication program
	Transmission line is not set to the receive state after data send (for RS-485)	
	Communication protocol setting is not correct.	Refer to **7.2 Setting (P. 7-9)**, and set Communication protocol to “0: RKC communication.”
EOT return	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it
	Error in the data format	Reexamine the communication program
NAK return	Error occurs on the line (parity bit error, framing error, etc.)	Confirm the cause of error, and solve the problem appropriately. (Confirm the transmitting data, and resend data)
	BCC error	
	The data exceeds the setting range	Confirm the setting range and transmit correct data
	The specified identifier is invalid	Confirm the identifier is correct or that with the correct function is specified. Otherwise correct it

● Modbus

Problem	Probable cause	Solution
No response	Wrong connection, no connection or disconnection of the communication cable	Confirm the connection method or condition and connect correctly
	Breakage, wrong wiring, or imperfect contact of the communication cable	Confirm the wiring or connector and repair or replace the wrong one
	Mismatch of the setting data of communication speed and data bit configuration with those of the host computer	Confirm the settings and set them correctly
	Wrong address setting	
	A transmission error (overrun error, framing error, parity error or CRC-16 error) is found in the query message	Re-transmit after time-out occurs or verify communication program

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Problem	Probable cause	Solution
No response	The time interval between adjacent data in the query message is too long, exceeding 24-bit time	Re-transmit after time-out occurs or verify communication program
	Communication protocol setting is not correct.	Refer to **7.2 Setting (P. 7-9)**, and set Communication protocol to "1: Modbus."
Error code: 1	Function cod error (Specifying nonexistent function code)	Confirm the function code
Error code: 2	When any address other than 0000H to 0132H, 0500H to 053DH, 1000H to 100FH, 1500H to 150FH and 2000H to 99A7H are specified	Confirm the address of holding register
Error code: 3	When the specified number of data items in the query message exceeds the maximum number of data items available	Confirm the setting data
Error code: 4	Self-diagnostic error	Turn off the power to the instrument. If the same error occurs when the power is turned back on, please contact RKC sales office or the agent.

SPECIFICATIONS

9

■ Measured input

Number of input: 1 point

Input type:

- **Low voltage group ***

  Thermocouple (TC):
  K, J, T, S, R, E, B, N (JIS-C1602-1995)
  PL II (NBS), W5Re/W26Re (ASTM-E988-96)
  U, L (DIN43710-1985),
  PR40-20 (ASTM-E17551-00)

  RTD: Pt100 (JIS-C1604-1997), JPt100 (JIS-C1604-1981 of Pt100)
  3-wire system

  Voltage: 0 to 10 mV DC, −10 to +10 mV DC, 0 to 100 mV DC,
  −100 to +100 mV DC, 0 to 1 V DC, −1 to +1 V DC

- **High voltage group ***

  Voltage: 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC, −5 to +5 V DC,
  −10 to +10 V DC

- **Current group ***

  Current: 4 to 20 mA DC, 0 to 20 mA DC

* Universal input (Use the input select switch to change input group.)

Input range:

TC input

Input type	Measured range	
K	−200 to +1372 °C, −200.0 to +1372.0 °C	−328 to +2502 °F, −328.0 to +2502.0 °F
J	−200 to +1200 °C, −200.0 to +1200.0 °C	−328 to +2192 °F, −328.0 to +2192.0 °F
T	−200 to +400 °C, −200.0 to +400.0 °C	−328 to +752 °F, −328.0 to +752.0 °F
S	−50 to +1768 °C, −50.0 to +1768.0 °C	−58 to +3214 °F, −58.0 to +3214.0 °F
R	−50 to +1768 °C, −50.0 to +1768.0 °C	−58 to +3214 °F, −58.0 to +3214.0 °F
E	−200 to +1000 °C, −200.0 to +1000.0 °C	−328 to +1832 °F, −328.0 to +1832.0 °F
B	0 to 1800 °C, 0.0 to 1800.0 °C	0 to 3272 °F, 0.0 to 3272.0 °F
N	0 to 1300 °C, 0.0 to 1300.0 °C	0 to 2372 °F, 0.0 to 2372.0 °F
PLII	0 to 1390 °C, 0.0 to 1390.0 °C	0 to 2534 °F, 0.0 to 2534.0 °F
W5Re/W26Re	0 to 2300 °C, 0.0 to 2300.0 °C	0 to 4200 °F, 0.0 to 4200.0 °F
U	0 to 600 °C, 0.0 to 600.0 °C	0 to 1112 °F, 0.0 to 1112.0 °F
L	0 to 900 °C, 0.0 to 900.0 °C	0 to 1652 °F, 0.0 to 1652.0 °F
PR40-20	0 to 1800 °C, 0.0 to 1800.0 °C	0 to 3200 °F, 0.0 to 3200.0 °F

RTD input

Input type	Measured range	
Pt100	−200 to +850 °C, −200.0 to +850.0 °C, −100.00 to +150.00 °C	−328 to +1562 °F, −328.0 to +1562.0 °F, −148.00 to +302.00 °F
JPt100	−200 to +640 °C, −200.0 to +640.0 °C, −100.00 to +150.00 °C	−328 to +1184 °F, −328.0 to +1184.0 °F, −148.00 to +302.00 °F

Voltage/Current input

Input type		Measured range
Voltage (low)	0 to 10 mV DC, −10 to +10 mV DC, 0 to 100 mV DC, −100 to +100 mV DC 0 to 1 V DC, −1 to +1 V DC	Programmable range Setting range: −19999 to +32000
Voltage (high)	0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC, −5 to +5 V DC, −10 to +10 V DC	
Current	0 to 20 mA DC, 4 to 20 mA DC	

Sampling cycle: 100 ms (50 ms or 250 ms is selectable)

Influence of external resistance:

Approx. 0.2 μV/Ω (Converted depending on TC types)

Influence of input lead: Approx. 0.01 % of span (Only RTD input)
10 Ω or less per wire
(When the value is 10 Ω or more, measuring range may be limited.)

Input impedance:
Voltage (low) input: Approx.1 MΩ or more
Voltage (high) input: Approx.1 MΩ or more
Current input: Approx. 50 Ω

Measured current: Approx. 0.25 mA (Only RTD input)

Action at input beak:
TC input: Upscale or downscale (Selectable)
RTD input: Upscale
Voltage (low) input: Upscale or downscale (Selectable)
Voltage (high) input: Downscale (Indicates value near 0 V)
Current input: Downscale (Indicates value near 0 mA)

Action at input short circuit:
Downscale (Only RTD input)

Input error determination:
Setting range of Input error determination point (high/low):
Input range low − (5 % of Input span) to Input range high + (5 % of Input span)

Measured input correction:
PV bias: −Input span to +Input span
Within the range: −19999 to +32000 (Except decimal point)
PV ratio: 0.001 to 9.999

Input filter: PV digital filter (First order lag digital filter):
0.0 to 100.0 seconds (0.0: OFF)

Allowable input voltage: Within ±5 V
(High voltage group: Within ±12 V)

Square root extraction (Voltage/Current inputs):
Calculation method: Measured value = $\sqrt{\text{(Input value)}}$ × PV ratio + PV bias
PV low input cut-off: 0.00 to 25.00 % of Input span

■ Current transformer (CT) input [optional]

Number of inputs: 2 points

CT type: CTL-6-P-N or CTL-12-S56-10-N (Sold separately)

Input range:
CTL-6-P-N: 0.0 to 30.0 A
CTL-12-S56-10L-N: 0.0 to 100.0 A

Sampling cycle:
200 ms (twice of the measured input sampling cycle)
100 ms (twice of the measured input sampling cycle)
500 ms (twice of the measured input sampling cycle)

CT ratio (Number of turns):
0 to 9999
CTL-6-P-N: 800
CTL-12-S56-10L-N: 1000

■ Feedback resistance (FBR) input [optional]

Number of input: 1 point

Permissible resistance range:
100 Ω to 10 kΩ (Standard: 135 Ω)

Input range: 0.0 to 100.0 % (for adjustment span of open and close)

Sampling cycle: 200 ms (twice of the measured input sampling cycle)
100 ms (twice of the measured input sampling cycle)
500 ms (twice of the measured input sampling cycle)

Action at FBR break: Upscale

■ Digital input (DI)

Number of inputs: Up to 11 points
(6 points: DI1 to DI6 [optional], 5 points: DI7 to DI11 [standard])

Input method: Dry contact input

Open state:	10 kΩ or more
Close state:	1 kΩ or less
Contact current:	5 mA or less
Voltage at open:	Approx. 5 V DC

Capture judgment time: 200 ms max. + 1 sampling cycle

■ Output

Number of outputs: Up to 15 points (OUT1 to 3, DO1 to 12)
OUT3 and DO5 to 12 is optional

Output type:

- **Relay contact output (OUT1 and 2)**
  Contact type: 1a contact
  Contact rating (Resistive load): 250 V AC 3 A, 30 V DC 1 A
  Electrical life: 300,000 times or more (Rated load)
  Mechanical life: 50 million times or more (Switching: 180 times/min)
  Proportional cycle time: 0.1 to 100.0 seconds (When control output is selected)
  Minimum ON/OFF time of proportioning cycle: 0 to 1000 ms (Valid only for time proportional output)
- **Relay contact output (DO1 to 4)**
  Contact type: 1a contact
  Contact rating (Resistive load): 250 V AC 1 A, 30 V DC 1 A
  Electrical life: 300,000 times or more (Rated load)
  Mechanical life: 20 million times or more (Switching: 300 times/min)
- **Voltage pulse output (OUT1 to 3)**
  Output voltage: 0/12 V DC (Rating)
  ON voltage: 11 V or more, 13 V or less
  OFF voltage: 0.2 V or less
  Allowable load resistance: 600 Ω or more (20 mA or less)
  OUT1: 300 Ω or more when not using OUT2. (40 mA or less)
  Time proportional cycle: 0.1 to 100.0 seconds (When control output is selected)
  Minimum ON/OFF time of proportioning cycle: 0 to 1000 ms (Valid only for time proportional output)
- **Current output (OUT1 to 3)**
  Output current (Rating): 4 to 20 mA DC, 0 to 20 mA DC (Specify when ordering)
  Output range: 3 to 21 mA DC, 0 to 21 mA DC
  Allowable load resistance: 600 Ω or less
- **Voltage output (OUT1 to 3)**
  Output voltage (Rating): 0 to 1 V DC *, 0 to 5 V DC, 1 to 5 V DC, 0 to 10 V DC (Specify when ordering)
  * Available for OUT3
  Output range: –0.05 to +1.05 V DC, –0.25 to +5.25 V DC, 0.8 to 5.2 V DC, –0.5 to +10.5 V DC
  Allowable load resistance: 1 kΩ or more

- **Triac output (OUT1 and 2)**
  Output method: AC output (Zero-cross method)
  Allowable load current: 0.5 A (Ambient temperature 40 °C or less)
  (Derating: −0.02A/°C when ambient is 40 °C or more.)
  Load voltage: 75 to 250 V AC
  Minimum load current: 30 mA
  ON voltage: 1.6 V or less (at maximum load current)
  Time proportional cycle: 0.1 to 100.0 seconds
  (When control output is selected)
  Minimum ON/OFF time of proportioning cycle:
  0 to 1000 ms
  (Valid only for time proportional output)
- **Open collector output (OUT1 to 3)**
  Allowable load current: 100 mA
  Load voltage: 30 V DC or less
  ON voltage: 2 V or less (at maximum load current)
  Leakage current at OFF: 0.1 mA or less
  Time proportional cycle: 0.1 to 100.0 seconds
  (When control output is selected)
  Minimum ON/OFF time of proportioning cycle:
  0 to 1000 ms
  (Valid only for time proportional output)
- **Open collector output (DO5 to 12)**
  Output method: Sink type
  Use same common terminal for DO5 to 8 and DO9 to 12.
  Allowable load current: 100 mA
  Load voltage: 30 V DC or less
  ON voltage: 2 V or less (at maximum load current)
  Leakage current at OFF: 0.1 mA or less

Energized/De-energized: OUT1: Energized (FIX)
OUT2, OUT3 or DO: Selectable (Validate for Event output)

■ Performance (at the ambient temperature 23 ±2 °C):

Input accuracy:

- **Measured input:**

Input type	Input range	Accuracy
K, J, T, PLII, E, U, L (Accuracy is not guaranteed for less than −100 °C)	Less than −100 °C	±1.0 °C
	−100 °C or more, less than +500 °C	±0.5 °C
	500 °C or more	±(0.1 % of Reading)
S, R, N, W5Re/W26Re (Accuracy is not guaranteed for less than 400 °C for Input type S, R, and W5Re/W26Re.)	Less than 0 °C	±2.0 °C
	0 °C or more, less than 1000 °C	±1.0 °C
	1000 °C or more	±(0.1 % of Reading)
B (Accuracy is not guaranteed for less than 400 °C)	Less than 400 °C	±70 °C
	400 °C or more, less than 1000 °C	±1.4 °C
	1000 °C or more	±(0.1 % of Reading)
PR40-20	Less than 400 °C	±20 °C
	400 °C or more, less than 1000 °C	±10 °C
	1000 °C or more	±(0.1 % of Reading)
Pt100、JPt100	Less than 200 °C	±0.2 °C
	200 °C or more	±(0.1 % of Reading)
Voltage	±0.1 % of Input span	
Current		

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

Cold-junction temperature compensation error:
Within ±1.0 °C
Within ±1.5 °C (Between −10 to +55 °C)

- **Current transformer (CT) input:**
  ±5 % of Reading or ±2 A (whichever is larger)
- **Feedback resistance (FBR) input:**
  ±0.5 % ±1 digit of Input span (for adjustment span of open and close)

Output accuracy:

Current output: ±0.1 % of Output span
Output resolution: Approx. 1/10000

Voltage output: ±0.1 % of Output span
Output resolution: Approx. 1/10000

Operation influence:

- **Effect of ambient temperature**
  Input: ±0.006 %/°C of Input span
  Output: ±0.015 %/°C of Output span
- **Influence of physical orientation**
  Input: TC input: ±0.3 % of Input span or ±3.0 °C or less
  RTD input: ±0.5 °C or less
  Voltage/Current inputs:
  ±0.1 % or less of Input span
  Output: ±0.3 % or less of Output span

■ Display

Display contents:

- **Measured input display**
  5-digits 11-segmants LCD (Green or White)   Character height 15.5 mm
- **Setting/Time display**
  11-digits 11-segmants LCD (Orange or White)   Character height 9.1 mm
- **Pattern display and Segment display**
  2-digits 7-segmants LCD (Green or White)   Character height 6.5 mm
- **Indication lamps**
  Point light emission LCD (Green, Orange, White or Red)
- **Dots display**
  20×10 dots LCD (White/Red)
  Display area graph for pattern or vertical bar graph for Manipulated output value (MV).
  (It is possible to change the color of dots into red when alarm occurs.)

Power saving mode: Turn off the back light if no key operation is performed within the time being set (except the Measured input value screen and lamps for ALM).
(Press any key to turn on the back light.)
Setting range: 0 to 60 minutes (0: always ON)

■ Control

Control method: a) Brilliant II PID control
b) Brilliant II Heat/Cool PID control
c) Brilliant II Position proportioning PID control
d) Manual control
Selectable from a) to d)

● PID control, Heat/Cool PID control, Position proportioning PID control

Overshoot suppression function:

- Reset feedback (RFB) method
- Ramp/Soak stabilizer (RSS)

Proportional band (P) [Proportional band [heat-side] for Heat/Cool PID control]:

- TC/RTD inputs 0 [0.0, 0.00] to Input span (unit: °C [°F])
- Voltage/Current inputs: 0.0 to 1000.0 % of Input span

0 [0.0, 0.00]: ON/OFF action
ON/OFF action differential gap:
TC/RTD inputs: 0 [0.0, 0.00] to Input span (unit: °C [°F])
Voltage/Current inputs: 0.0 to 100.0 % of Input span
High/Low individual setting

Integral time (I) [Integral time: Same at Heat side and Cool side for Heat/Cool PID control]:
0 to 3600 seconds or 0.0 to 3600.0 seconds
(0 [0.0]: Integral action OFF)
[Position proportioning PID control: 1 to 3600 seconds or 0.1 to 3600.0 seconds]

Derivative time (D) [Integral time: Same at Heat side and Cool side for Heat/Cool PID control]:
0 to 3600 seconds or 0.0 to 3600.0 seconds
(0 [0.0]: Derivative action OFF)

Proportional band [cool-side] (Only Heat/Cool PID control):

- TC/RTD inputs: 1 [0.1 or 0.01] to Input span (unit: °C [°F])
- Voltage/Current inputs: 0.1 to 1000.0 % of Input span

Overlap/Deadband (Only Heat/Cool PID control):

- TC/RTD inputs: −Input span to +Input span (unit: °C [°F])
  Within the range: −19999 to +32000
  (Except decimal point)
- Voltage/Current inputs: −100.0 to +100.0 % of Input span
  Minus (−) setting results in overlap. (However, the overlapping range is within the proportional range.)

Control response parameter:
Slow, Medium and Fast (3-step selection)
Invalidate at P action or PD action.

Open/Close output neutral zone (Only Position proportioning PID control):
0.1 to 20.0 %
Differential gap of the open/close output is fixed to one-second of the neutral zone.

Manual reset: −100.0 to +100.0 %
Validates when Integral time is set to 0 [0.0].

Proportional cycle time: 0.1 to 100.0 seconds

Output limiter high/low (High/Low individual setting):
–5.0 to +105.0 %
Output limiter low ≤ Output limiter high

Control output at Reset mode:
–5.0 to +105.0 %

Overlap/Deadband reference point (Only Heat/Cool PID control):
0.0 to 1.0
(0.0: Proportional band on heat-side, 1.0: Proportional band on cool-side)

Control motor time (Only Position proportioning PID control):
5 to 1000 seconds

Integrated output limiter (Only Position proportioning PID control):
0.0 to 200.0 % of control motor time
(0.0: Integrated output limiter OFF)
Invalid when feedback resistance (FBR) input is used.

Valve action in Reset mode (Only Position proportioning PID control):
a) Open-side output OFF, Close-side output OFF
b) Open-side output OFF, Close-side output ON
c) Open-side output ON, Close-side output OFF
Selectable from a) to c)
Action when either Feedback resistance (FBR) input is burned out or FBR input is not selected.

Action at saturated output (Only Position proportioning PID control):
0 (Invalidate), 1 (Validate)
When the Action at saturated output is valid:
・The close-side output remains ON when the valve position is fully closed
・The open-side output remains ON when the valve position is fully opened
To validate the Action at saturated output, make sure to use valve with limit switch.

Additional function:
・Direct/Reverse action is selectable.
[PID control, Position proportioning PID control]
・Air cooling, Water cooling or Cooling gain linear type is selectable.
[Heat/Cool PID control]
・Manipulated output value of input error:
–105.0 to +105.0 %
Actual output value is limited by Output limiter.

● Manual control

Manual manipulated output value (MV1, MV2):
a) PID control: Output limiter low to Output limiter high

b) Heat/Cool PID control:
–Output limiter high [cool-side] to
+Output limiter high [heat-side]

c) Position proportioning PID control:
With FBR input
Output limiter low to Output limiter high
Without FBR input
It is possible to turn ON/OFF output by using the UP key or the DOWN key.

■ Autotuning

Autotuning (AT) type is automatically selected to conform to control action.

- For Brilliant II PID control and Brilliant II Position proportioning PID control
- For Brilliant II Heat/Cool PID control (air cooling/water cooling/cooling gain linear type)

■ Autotuning (AT) with learning function

Search soak areas of the program at the Reset mode to conduct Autotuning (AT) in turn.
The PID parameter being calculated is stored in the PID memory group assigned to the segment.

■ Level PID

Up to 8 PID groups are automatically selected by setting level PID.

Number of levels: 8 levels (PID group 1 to 8)

Level setting range: Set 7 level PID settings to divide the level into 8 levels.

Level PID setting 1: Input range low to Level PID setting 2
Level PID setting 2: Level PID setting 1 to Level PID setting 3
Level PID setting 3: Level PID setting 2 to Level PID setting 4
Level PID setting 4: Level PID setting 3 to Level PID setting 5
Level PID setting 5: Level PID setting 4 to Level PID setting 6
Level PID setting 6: Level PID setting 5 to Level PID setting 7
Level PID setting 7: Level PID setting 6 to Input range high

PID group: PID group is automatically selected by setting the Set value (SV) *.

PID group 1: Set value (SV) * ≤ Level PID setting 1
PID group 2: Level PID setting 1 < Set value (SV) * ≤ Level PID setting 2
PID group 3: Level PID setting 2 < Set value (SV) * ≤ Level PID setting 3
PID group 4: Level PID setting 3 < Set value (SV) * ≤ Level PID setting 4
PID group 5: Level PID setting 4 < Set value (SV) * ≤ Level PID setting 5
PID group 6: Level PID setting 5 < Set value (SV) * ≤ Level PID setting 6
PID group 7: Level PID setting 6 < Set value (SV) * ≤ Level PID setting 7
PID group 8: Level PID setting 7 < Set value (SV) *

* Set value (SV)
Program control mode: Segment level set value of the segment in progress
Fixed set point control mode: Set value (SV) of the Fixed set point control mode

■ Ramp/Soak stabilizer (RSS)

Suppress overshoot when the program shifts from ramp to soak.

Setting range: Intensity factor of RSS: 0.0 to 1.0
(0.0: RSS OFF)

Validate RSS at PI control or PID control.

■ Event function

Number of events: Up to 4 points (Event 1 to 4)

Event action:
Deviation high, Deviation low,
Deviation high/low (High/Low common setting),
Deviation high/low (High/Low individual setting),
Band (High/Low common setting), Band (High/Low individual setting),
Process high, Process low, SV high, SV low,
MV1 high [heat-side] *, MV1 low [heat-side] *,
MV2 high [cool-side], MV2 low [cool-side]

* Position proportioning PID control: Feedback resistance (FBR) input value

Setting range:

Deviation:

- Event setting:
  - High/Low common setting:
    - −Input span to +Input span
    - Within the range: −19999 to +32000 (Except decimal point)
    - Event performs with an absolute value when setting minus value for Deviation high/low or Band.
  - High/Low individual setting:
    - −Input span to +Input span
    - Within the range: −19999 to +32000 (Except decimal point)
- Differential gap: 0 to span

Process and SV:

- Event setting: Same as input range
- Differential gap: 0 to Input span

MV:

- Event setting: − 5.0 to +105.0 %
- Differential gap: 0 to 110 %

Additional function:

Hold action:
a) Without Hold action
b) With Hold action
(When power turned on; At Event start)
Selectable from a) and b)
Valid only when the event action (Process, Deviation or MV) is selected.

Event timer: 0.0 to 600.0 seconds

Event action in Reset mode:
Stop or Continue

Interlock:
a) Without Interlock
b) With Interlock
c) Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.
Selectable from a) to c)

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Event output action at input error:
a) Conform to Event action
b) PV value exceeds Input error determination point (high): ON
PV value is below Input error determination point (low): Conform to Event action
c) PV value exceeds Input error determination point (high): Conform to Event action
PV value is below Input error determination point (low): ON
d) PV value exceeds Input error determination point (high): ON
PV value is below Input error determination point (low): ON
e) PV value exceeds Input error determination point (high): OFF
PV value is below Input error determination point (low): OFF
Selectable from a) to e)

Event minimum ON time:
0.0 to 600.0 seconds (0.0: Function OFF)

Event minimum OFF time:
0.0 to 600.0 seconds (0.0: Function OFF)

■ Control loop break alarm (LBA)

LBA function is not available when Heat/Cool control or Autotuning (AT) is in progress.

Setting range: Control loop break alarm (LBA) time:
0 to 7200 seconds (0: LBA function OFF)

LBA deadband (LBD): 0 to Input span

LBA interlock:
a) Without interlock
b) With interlock
c) Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.
Selectable from a) to c)

■ Heater break alarm (HBA) [for time proportional-control output] (optional)

Number of HBA: Up to 2 points (1 point for three-phase)

Setting range: 0.0 to 100.0 A (0.0: HBA function OFF)
Current value monitor is available regardless of whether HBA is OFF.
It is not possible to detect the value if the ON time or OFF time of control output is within:
160 ms (with CT sampling cycle of 200 ms).
140 ms (with CT sampling cycle of 100 ms).
220 ms (with CT sampling cycle of 500 ms).

Additional function: Number of HBA delay times:
0 to 255 times

HBA Interlock:
a) Without Interlock
b) With Interlock
c) Activate Interlock and switch to the Manual control mode to produce Manipulated output at Input error.
Selectable from a) to c)

■ Transmission output [optional]

Number of output: 1 point (Use the OUT1 to 3)

Output contents: Measured value (PV), Set value (SV) monitor, Deviation value, Output program value *, Segment time (percentage basis)
* For OUT1, only Output program value 1 is available.

Output scaling: It is possible to set the high/low limit setting (High limit > Low limit)

Measured value (PV):	Same as measured range Up to 32767 (except decimal point)
Set value (SV):	Same as measured range Up to 32767 (except decimal point)
Deviation value:	–Input span to +Input span Within the range: –19999 to +32000 (Except decimal point)
Output program value 1 to3:	Scaling is not available (Fixed value: Low: 0 %, High: 100 %)
Segment time (percentage basis):	Scaling is not available (Fixed value: Start: 0 %, End: 100 %)

Additional function: Transmission output action in Reset mode:
Stop or Continue
For Output program value: Output is –5 %

■ Communication function [optional]

● Communication 1 (For the host communication)

Interface: Based on RS-422A, EIA standard
Based on RS-485, EIA standard
Based on RS-232C, EIA standard
Multi-drop connection of RS-485 and RS-422A is available.

Connection method:
RS-422A: 4-wire system, half-duplex multi-drop connection
RS-485: 2-wire system, half-duplex multi-drop connection
RS-232C: 3-wire system, point-to-point connection

Synchronous method: Start/Stop synchronous type

Communication speed: 2400 bps, 4800 bps, 9600 bps, 19200 bps, 38400 bps, 57600 bps

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

Data bit configuration:
Start bit: 1
Data bit: 7 or 8 (Modbus: 8-bit only)
Parity bit: Without, Odd or Even (Modbus cannot be select the Odd)
Stop bit: 1 or 2

Maximum connections:
RS-422A: Up to 31 controllers
RS-485: Up to 31 controllers
RS-232C: 1 controller

● Communication 2 (For the intercontroller communication)

Function:	Send the Set value (SV) to the slave controllers being connected to link operation. It is possible to link PID memory area.
Interface:	Based on RS-485, EIA standard
Connection method:	RS-485: 2-wire system, half-duplex multi-drop connection
Synchronous method:	Start/Stop synchronous type
Communication speed:	9600 bps, 19200 bps, 38400 bps
Protocol:	Modbus-RTU
Data bit configuration:	Start bit: 1 Data bit: 8 Parity bit: Without Stop bit: 1
Slave connections:	Up to 4 controllers 0 to 4 (0: Link OFF)
Slave controllers:	FB series, RB series or PF900/901

■ Loader communication

Loader ports:	1 point (Front or bottom) The front loader port only works when instrument is ON. It is not possible to use the loader port at the front and the one at the bottom at the same time.
Loader communication:	For RKC communication protocol only
Synchronous method:	Start/Stop synchronous type
Communication speed:	38400 bps
Protocol:	ANSI X3.28-1976 subcategories 2.5 and A4
Data bit configuration:	Start bit: 1 Data bit: 8 Parity bit: Without Stop bit: 1

Maximum number of connection points:
1 point (Only COM-K)

Connection method:	COM-K special cable Front port: W-BV-03 Bottom port: W-BV-01

■ Program control

Time accuracy: ±0.01 % of Reading or Input sampling cycle (whichever is larger)
Delay for input sampling cycle at every shift of segment of "segment time = 0."

Number of program memories:

Number of program patterns: Up to 99 patterns
Number of segments: Up to 1024 segments
Up to 99 segments for each pattern

Segment setting items: It is possible to change the set value at the RUN mode.
The new set value takes effect immediately.

Segment level: Range of Setting limiter
Segment time: 0 hours 0 minutes to 500 hours 00 minutes or
0 minutes 0 seconds to 500 minutes 00 seconds
PID memory group number: 0 to 8 (0: Used to the level PID)
Event memory group number: 0 to 8 (0: Event OFF)
Wait memory group number: 0 to 8 (0: Wait OFF)
Segment signal: OFF or ON (Setting of each digit)
Segment signal assignment is listed in reverse from TS8 (on left) to TS1 (far right).
Validate when specifying Segment signal.

Pattern setting items: Segment repeat execution time:
1 to 9999 times
Number of times to repeat the set of segments from the Segment repeat start segment to the Segment repeat end segment.
Segment repeat start number: 1 to 99 (within Maximum segment number being set)
Segment repeat start number ≤ Segment repeat end number
Segment repeat end number: 1 to 99 (within Maximum segment number being set)
Segment repeat start number ≤ Segment repeat end number
Pattern repeat execution time: 1 to 10000 times (10000: No limit)
Execution time of the total pattern at Link operation
Link pattern number: 0 to 99 (0: No pattern link)
(within Maximum pattern number being set)
Priority: Link < Repeat
Pattern end output duration: 0 hours 0 minutes to 500 hours 00 minutes or
0 minutes 0 seconds to 500 minutes 00 seconds
(0: Remain ON)
Time signal memory group number:
0 to 16 (0: No assignment)
Output program memory group number:
0 to (128/Maximum number of segments *)
(0: No assignment)
Up to 99
* Maximum number of segments:
Number of pattern × Number of segments

Program start action:

a) Program start action selection
- Start from the Set value (SV at the Reset mode).
- Start from the Measured input value (PV) (Time fixed type).
- Start from the Measured input value (PV) (Time saving).
- Find the intersection of Measured input value (PV) and the pattern to start operation from the position. (HOLD state at start)
- Find the intersection of Measured input value (PV) and the pattern to start operation from the position. (RUN state at start)

b) Wait condition setting at Program start.
Wait memory group number at program start: 0 to 8 (0: Wait OFF)

Hold function:

Suspend the operation of the program in progress.
Release of the hold state made by Digital input (DI), key operation or communication is not available. HOLD state remains when changing to the Fixed set point control mode or the Manual control mode.

Step function:

Forward the segment of the program pattern in progress to the next.
Not available in the HOLD state.

Forward/back-up function:

Scroll up or down the numbers faster.
Not available in the HOLD state.

Wait function:

Program remains stopped until all conditions are satisfied after the elapsed Segment time.
Select Wait release condition: Wait zone judgment, Contact input (DI), or Time-out.

a) Wait release trigger selection:
- The one place: Zone wait 1 (the controller)
- The tens place: Zone wait 2 (all slave controller)
- The hundreds place: Wait release by digital input (DI)

0: Invalidate, 1: Validate

b) Wait zone high:
- TC/RTD inputs: 0 to 200 °C, 0.0 to 200.0 °C or 0.00 to 200.00 °C
- Voltage/Current inputs: 0.0 to 20.0 % of Input span

0 (0.0, 0.00): Wait zone high becomes OFF

c) Wait zone low:
- TC/RTD inputs: −200 to 0 °C, −200.0 to 0.0 °C or −199.99 to 0.00 °C
- Voltage/Current inputs: −20.0 to 0.0 % of Input span

0 (0.0, 0.00): Wait zone low becomes OFF

d) Wait time-out:
Restart the program without conditions after the expiration of the time set.
0 hours 00 minutes to 500 hours 00 minutes or 0 minutes 00 seconds to 500 minutes 00 seconds
(0: Unused)

Release Wait function to go to the next segments when the STEP function or the Forward/Back-up function turns on when this instrument is in the wait state.

Pattern end function:

a) Pattern end signal: Produce signal at pattern end.
It is possible to select Pattern end output at OUT2, OUT3 or DO type.
Remains ON for approximately 0.5 seconds at Pattern repeat, Program link, or repeat time of the total pattern.

b) Pattern end output action selection at repeat or link:
The one place: Pattern end output is ON at Pattern repeat.
The ten place: Pattern end output is ON at Total pattern repeat.
The hundred place: Pattern end output is ON at Pattern link.
0: Turn OFF the Pattern end output.
1: Turn ON the Pattern end output for 0.5 seconds.

c) Control action at Pattern end:
PID control, Heat/Cool PID control, Position proportioning PID control (With FBR input): Control stop or Control continued
Position proportioning PID control (No FBR input):
a) Control continued
b) Open-side output OFF, Close-side output OFF
c) Open-side output OFF, Close-side output ON
d) Open-side output ON, Close-side output OFF
Selectable from a) to d)
"Control continued" or "Control stop" may be selected at Control state at pattern end when Output program value is assigned at OUT1.

d) Event action at Pattern end:
Action stop or Action continued
From Event 1 to 4 individual setting

e) Transmission output action at Pattern end
Action stop or Action continued
This parameter is available when the Transmission output is assigned to OUT2 or OUT3.

Time signal output:

Select Time signal or Segment signal.
Time signal: Set the start segment and the end segment, and time.
Segment signal: Conduct ON/OFF action for each segment.
a) Number of outputs: 8 points
b) Output assignment: Up to 14 points (The relay outputs are 4 points.)
Select by OUT2, OUT3 or DO assignments.
c) Time signal:
Time signal memory group:
16 groups
Select Time signal memory group by pattern.
Number of memories: 16 group × 16 memories
Time signal output assignment:
0 to 8 (0: No assigment)
Start segment: 1 to Number of segments (Up to 99 segments)
Start time: 0 hours 00 minutes to 500 hours 00 minutes or
0 minutes 00 seconds to 500 minutes 00 seconds
End segment: 1 to Number of segments (Up to 99 segments)
However, Start segment ≤ End segment
End time: 0 hours 00 minutes to 500 hours 00 minutes or
0 minutes 00 seconds to 500 minutes 00 seconds

d) Segment signal: It is possible to set ON/OFF action of TS1 to TS8 by segment.

e) Time signal action during Autotuning (AT)
Time signal OFF or Time signal ON

Output program function: Produce fixed value by segment.
Validate Output program function by assigning output 1 to 3 (OUT1 to OUT3) to the Output program.

a) Output program memory group number:
128/Maximum number of segments *
* Maximum number of segments:
Number of pattern × Number of segments
Up to 99

b) Setting items:
Output program value 1: −5.0 to +105.0 %
Output program value 2: −5.0 to +105.0 %
Output program value 3: −5.0 to +105.0 %

Copy function: a) Pattern copy: Copy all data of pattern.

b) Segment copy: Copy the data of the previous segment.

Tag function: Display 11 digits of alphanumeric characters instead of pattern numbers at Execution pattern selection.

Data clear: Initialize the set values at the Parameter setting mode and Tag name.

Segment remaining time monitor:

a) Segment remaining time:
0 hours 00 minutes to 500 hours 00 minutes or
0 minutes 00 seconds to 500 minutes 00 seconds
Display remaining segment time in progress.

b) Pattern remaining time:
0 hours 00 minutes to 999 hours 59 minutes or
0 minutes 00 seconds to 999 minutes 59 seconds
Display remaining pattern time in progress.
Display remaining time of the Segment repeat.

Search function: Conduct search function in hold state to skip time of process until the PV and pattern intersect.
0: Normal mode 1: Start searching
Setting data returns to 0 (Normal Mode) when searching process is completed.

■ Memory group

PID memory group:	Group number:	0 to 8 (0: Level PID function)
	Setting item:	Proportional band (P), Integral time (I), Derivative time (D), Control response parameter, Proportional band [cool-side], Integral time [cool-side], Derivative time [cool-side], Overlap/Deadband, Open/Close output neutral zone, Manual reset, Output limiter high (MV1), Output limiter low (MV1), Output limiter high (MV2), Output limiter low (MV2), ON/OFF action differential gap (upper), ON/OFF action differential gap (lower), Control loop break alarm (LBA) time or LBA deadband (LBD)
Event memory group:	Group number:	0 to 8 (0: Event OFF)
	Setting item:	Event 1 set value (EV1), Event 1 set value (EV1) [high], Event 1 set value (EV1) [low], Event 2 set value (EV2), Event 2 set value (EV2) [high], Event 2 set value (EV2) [low], Event 3 set value (EV3), Event 3 set value (EV3) [high], Event 3 set value (EV3) [low], Event 4 set value (EV4), Event 4 set value (EV4) [high] or Event 4 set value (EV4) [low]
Wait memory group:	Group number:	0 to 8 (0: Wait OFF)
	Setting item:	Wait zone high Wait zone low Wait release trigger selection Wait time-out set value
Time signal memory group:	Group number:	0 to 16 (0: Time signal OFF)
	Memory number:	1 to 16 Up to 16 memory settings are available for each Time signal memory group.
	Setting item:	Time signal output assignment, Start segment of time signal, Time signal start time, End segment of time signal or Time signal end time
Output program memory group:	Output program memory group number:	1 to (128/Maximum segment number) Up to 99
	Segment number:	1 to Maximum segment value
	Setting item:	Output program value 1, Output program value 2, Output program value 3

■ Self-diagnostic function

Contents of Self-diagnostic:	Adjustment data error Data back-up error A/D conversion error Temperature compensation error Segment level error Intercontroller communication error Watchdog timer Power supply voltage is abnormal	
Error display:	Error code display:	Adjustment data error Data back-up error A/D conversion error Temperature compensation error
	PV/SV display and Error code alternatively:	Segment level error Intercontroller communication error
	ALM lamp ON, other displays are all OFF:	Watchdog timer
	Display is OFF:	Power supply voltage is abnormal
Communication at error:	Error code to be sent:	Adjustment data error, Data back-up error A/D conversion error Temperature compensation error Segment level error Intercontroller communication error
	Communication stop:	Watchdog timer Power supply voltage is abnormal
Output at error:	Output OFF:	Adjustment data error Data back-up error A/D conversion error Temperature compensation error Watchdog timer Power supply voltage is abnormal
	Control continued:	Segment level error
	Continue operation conforming to Operation mode:	Intercontroller communication error

■ General specifications

Power supply voltage:

100 to 240 V AC type:
85 to 264 V AC [Including power supply voltage variation], 50/60 Hz,
(Rating 100 to 240 V AC)
Frequency variation: 50 Hz (−10 to +5 %), 60 Hz (−10 to +5 %)

24 V AC type:
20.4 to 26.4 V AC [Including power supply voltage variation], 50/60 Hz,
(Rating 24 V AC)
Frequency variation: 50 Hz (−10 to +5 %), 60 Hz (−10 to +5 %)

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

Power consumption/Current (at maximum load):

100 to 240 V AC type:
9.5 VA max. (at 100 V AC), 13.5 VA max. (at 240 V AC)
Rush current: 7.5 A or less (at 100 V AC), 17.5 A or less (at 240 V AC)
Power saving mode: 7.1 VA [Approximately 15 % OFF] (at 100 V AC)
10.9 VA [Approximately 16 % OFF] (at 240 V AC)
Varies from condition.

24 V AC type:
8.5 VA max. (at 24 V AC)
Rush current: 8.5 A or less
Power saving mode: 6.2 VA (Approximately 16 % OFF) (Varies from condition.)

24 V DC type:
230 mA max. (at 24 V DC)
Rush current: 6.0 A or less
Power saving mode: 173 mA (Approximately 19 % OFF) (Varies from condition.)

Insulation resistance:

Between measuring terminal and grounding: 20 MΩ or more at 500 V DC
Between power supply terminal and grounding: 20 MΩ or more at 500 V DC
Between power supply and measuring terminals: 20 MΩ or more at 500 V DC
When grounding is not provided: Between panels

Withstand voltage:

Time: 1 min.	①	②	③	④	⑤
① Grounding terminal					
② Power terminal	1500 V AC				
③ Measured input terminal	1500 V AC	2300 V AC			
④ Output terminal (Relay contact, Triac)	1500 V AC	2300 V AC	2300 V AC		
⑤ Output terminal (Other than ④)	1500 V AC	2300 V AC	1500 V AC		
⑥ Communication, digital input (DI) terminals	1500 V AC	2300 V AC	510V AC	2300 V AC	1000 V AC

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: Approximately ten billion times (FRAM)
(Depending on storage and operating conditions.)
Data storage period: Approximately 10 years (FRAM)

Power failure recovery: Hot/Cold start:
a) Hot start 1
b) Hot start 2
c) Cold start
d) Reset start
Selectable from a) to d)
Restart at the Reset mode (RESET) when power failure occurs at the Reset mode.

Start determination point: 0 to Input span
(0: Action conforms to the Hot/Cold start)
Unit: same as the reading

Allowable ambient temperature:
−10 to +55 °C

Allowable ambient humidity:
5 to 95 % RH (Absolute humidity: MAX.W.C 29 g/m^3 dry air at 101.3kPa)

Vibration • Shock:
Vibration: Frequency range: 10 to 150 Hz
Maximum amplitude: 0.075 mm
Maximum acceleration: 9.8 m/s^2
Each direction of XYZ axes
Shock: Free fall from 50mm in height
Each direction of XYZ axes (In non-energization)

Installation environment conditions:
Indoor use
Altitude up to 2000 m

Transportation and Storage environment conditions:
Vibration: Random vibration (Based on JIS Z-0232 7.3.1)
Shock: Height 600 mm or less
Packed state
Temperature: −40 to +70 °C
Humidity: 5 to 95 % RH (Non condensing)
Absolute humidity: MAX.W.C 35 g/m^3 dry air at 101.3kPa

Mounting and Structure:
Mounting method: Panel-mounted
Mounting orientation: Datum plane ± 90°
Front panel material: Polycarbonate
Case material: Polycarbonate
Filter material: Acrylic
Terminal cover material: Polycarbonate

Weight: Approx. 470 g

Dimensions: 96 × 96 × 80 mm (W × H × D)

Mounting size: 25mm (Wide), 30mm (High)

■ Standard

Safety standards:	UL:	UL61010-1
	cUL:	CAN/CSA-C22.2 No.61010-1
CE marking:	LVD:	EN61010-1 OVERVOLTAGE CATEGORYII, POLLUTION DEGREE 2, Class II (Reinforced insulation)
	EMC:	EN61326
C-Tick:	AS/NZS CISPR 11 (equivalent to EN55011)	
Panel sealing:	Based on IP55 (IEC60529: 2001) [When mounting to the Front panel of a control board]	

APPENDIX

A.1 The parameters which will be initialized or changed, if the parameters are changed

NOTE

Before changing any parameter setting on the above list, always record all parameter settings in SV setting mode, Parameter setting mode, Setup setting mode and Engineering mode. And after the change, always check all parameter settings in SV setting mode, Parameter setting mode, Setup setting mode and Engineering mode by comparing them with the record taken before the change.

■ The parameters which will be initialized, if the parameters are changed

● When Input type or Display unit are changed

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

Name	Symbol	Default value
SV setting mode		
Execution pattern selection	PTN	1
Segment level	LEVEL	0
Segment time	TIME	0 hour 00 minute
Parameter setting mode		
PID memory group number	PID.GR	0
Event memory group number	EV.GR	1
Wait memory group number	WT.GR	1
Segment signal	SIGNL	00000000
Program end number	P.END	Maximum segment number
Segment repeat execution time	RPT.SG	1
Segment repeat start/end number	ST-Ed	1
Pattern repeat execution time	RPT.PN	1
Link pattern number	LNK.PN	0
Pattern end output duration	END.TM	0 hour 00 minute
Time signal memory group number	TS.GR	Pattern 1 to 16: 1 to 16, Pattern 17 or more: 0
Output program memory group number	P.MV.GR	0
Proportional band [heat-side]	P	30
Integral time [heat-side]	I	240
Derivative time [heat-side]	d	60
Control response parameter	rPT	2
Proportional band [cool-side]	Pc	30
Integral time [cool-side]	Ic	240
Derivative time [cool-side]	dc	60
Overlap/Deadband	db	0
Open/Close output neutral zone	Ydb	2.0
Manual reset	MR	0
Output limiter high (MV1)	oLH	105.0
Output limiter low (MV1)	oLL	–5.0
Output limiter high (MV2)	oLH2	105.0
Output limiter low (MV2)	oLL2	–5.0
ON/OFF action differential gap (upper)	oHH	TC/RTD inputs: 1, V/I inputs: 0.1
ON/OFF action differential gap (lower)	oHL	TC/RTD inputs: 1, V/I inputs: 0.1
Control loop break alarm (LBA) time	LbA	480
LBA deadband (LBD)	Lbd	0

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Name	Symbol	Default value
Event 1 set value (EV1)	EV1	50
Event 1 set value (EV1) [high]		50
Event 1 set value (EV1') [low]	EV1'	–50
Event 2 set value (EV2)	EV2	50
Event 2 set value (EV2) [high]		50
Event 2 set value (EV2') [low]	EV2'	–50
Event 3 set value (EV3)	EV3	50
Event 3 set value (EV3) [high]		50
Event 3 set value (EV3') [low]	EV3'	–50
Event 4 set value (EV4)	EV4	50
Event 4 set value (EV4) [high]		50
Event 4 set value (EV4') [low]	EV4'	–50
Wait zone high	ZoNE.H	0
Wait zone low	ZoNE.L	0
Wait release trigger selection	RE.TRG	00001
Wait time-out set value	TM.oUT	0 hour 00 minute
Time signal output assignment	O1.oUT	0
Start segment of time signal	O1.S.SN	1
Time signal start time	O1.S.TM	0 hour 00 minute
End segment of time signal	O1.E.SN	1
Time signal end time	O1.E.TM	0 hour 00 minute
Output program value 1	P.MV1	–5.0
Output program value 2	P.MV2	–5.0
Output program value 3	P.MV3	–5.0
Level PID setting 1	LEVL.1	Input range high
Level PID setting 2	LEVL.2	Input range high
Level PID setting 3	LEVL.3	Input range high
Level PID setting 4	LEVL.4	Input range high
Level PID setting 5	LEVL.5	Input range high
Level PID setting 6	LEVL.6	Input range high
Level PID setting 7	LEVL.7	Input range high
Set value (SV) in Reset mode	SV	0
Manipulated output value 1 (MV1) in Reset mode	MV1	–5.0
Manipulated output value 2 (MV2) in Reset mode	MV2	–5.0
Event memory group number in Reset mode	EV.GR	1
Set value (SV) in Fixed set point control mode	SV	0
PID memory group number in Fixed set point control mode	PId.GR	0
Event memory group number in Fixed set point control mode	EV.GR	1
PID memory group number in Manual control mode	PId.GR	0
Event memory group number in Manual control mode	EV.GR	1
Setup setting mode		
PV bias	Pb	0
PV digital filter	dF	0.0
PV ratio	PR	1.000
PV low input cut-off	L-CUT	0.00
Engineering mode		
Dot monitor scale high	dSCH	Input range high
Dot monitor scale low	dSCL	Input range low
Display unit	UNIT	0
Decimal point position	PGdP	TC/RTD inputs: 0, V/I inputs: 1
Input range high	PGSH	Refer to Input range table
Input range low	PGSL	

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Name	Symbol	Default value
Input error determination point (high)	PoV	Input range high + (5 % of Input span)
Input error determination point (low)	PUN	Input range low – (5 % of Input span) [0 (When input range is W5Re/W26Re and the Measured input value (PV) unit is °F.)]
OUT2 transmission output scale high	AHS2	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): + Input span Other: 100.0
OUT2 transmission output scale low	ALS2	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): – Input span Other: 0.0
OUT3 transmission output scale high	AHS3	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): + Input span Other: 100.0
OUT3 transmission output scale low	ALS3	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): – Input span Other: 0.0
Event 1 hold action	EHo1	0
Event 1 differential gap	EH1	TC/RTD inputs: 2, V/I inputs: 0.2, MV: 0.2
Event 1 output action at input error	Ebo1	0
Event 1 timer	EVT1	0.0
Event 1 interlock	EIL1	0
Event 1 minimum ON time	E1oN	0.0
Event 1 minimum OFF time	E1oFF	0.0
Event 2 hold action	ES2	0
Event 2 differential gap	EHo2	TC/RTD inputs: 2, V/I inputs: 0.2, MV: 0.2
Event 2 output action at input error	EH2	0
Event 2 timer	Ebo2	0.0
Event 2 interlock	EVT2	0
Event 2 minimum ON time	EIL2	0.0
Event 2 minimum OFF time	E2oN	0.0
Event 3 hold action	ES3	0
Event 3 differential gap	EHo3	TC/RTD inputs: 2, V/I inputs: 0.2, MV: 0.2
Event 3 output action at input error	EH3	0
Event 3 timer	Ebo3	0.0
Event 3 interlock	EVT3	0
Event 3 minimum ON time	EIL3	0.0
Event 3 minimum OFF time	E3oN	0.0
Event 4 hold action	ES4	0
Event 4 differential gap	EHo4	TC/RTD inputs: 2, V/I inputs: 0.2, MV: 0.2
Event 4 output action at input error	EH4	0
Event 4 timer	Ebo4	0.0
Event 4 interlock	EVT4	0
Event 4 minimum ON time	EIL4	0.0
Event 4 minimum OFF time	E4oN	0.0
Start determination point	PdA	3 % of Input span (Initialized when input range is changed.)
AT bias	ATb	0
Setting limiter high	SLH	Input range high
Setting limiter low	SLL	Input range low
Initial level engineering mode		
Proportional band limiter (high) [heat-side]	PLH	TC/RTD inputs: Input span, V/I inputs: 1000.0

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Name	Symbol	Default value
Proportional band limiter (low) [heat-side]	PLL	TC/RTD inputs: 0, V/I inputs: 0.0
Integral time limiter (high) [heat-side]	ILH	3600
Integral time limiter (low) [heat-side]	ILL	PID control or Heat/Cool PID control: 0 Position proportioning PID control: 1
Derivative time limiter (high) [heat-side]	dLH	3600
Derivative time limiter (low) [heat-side]	dLL	0
Proportional band limiter (high) [cool-side]	PcLH	TC/RTD input: Input span, V/I inputs: 1000.0
Proportional band limiter (low) [cool-side]	PcLL	TC/RTD inputs: 1, V/I inputs: 0.1
Integral time limiter (high) [cool-side]	IcLH	3600
Integral time limiter (low) [cool-side]	IcLL	0
Derivative time limiter (high) [cool-side]	dcLH	3600
Derivative time limiter (low) [cool-side]	dcLL	0
Set only by communication		
Pattern tag name	—	Space (11 digits)

Input range table

Input type	Input range high	Input range low	Input type	Input range high	Input range low	Input type	Input range high	Input range low
K	1372 °C	–200 °C	K	2502 °F	–328 °F	0 to 20 mA	100.0	0.0
J	1200 °C	–200 °C	J	2192 °F	–328 °F	4 to 20 mA	100.0	0.0
R	1768 °C	–50 °C	R	3214 °F	–58 °F	0 to 10 V	100.0	0.0
S	1768 °C	–50 °C	S	3214 °F	–58 °F	0 to 5 V	100.0	0.0
B	1800 °C	0 °C	B	3272 °F	0 °F	1 to 5 V	100.0	0.0
E	1000 °C	–200 °C	E	1832 °F	–328 °F	–5 to +5 V	100.0	0.0
N	1300 °C	0 °C	N	2372 °F	0 °F	–10 to +10 V	100.0	0.0
T	400 °C	–200 °C	T	752 °F	–328 °F	0 to 10 mV	100.0	0.0
W5e/W26Re	2300 °C	0 °C	W5e/W26Re	4200 °F	0 °F	0 to 100 mV	100.0	0.0
PL II	1390 °C	0 °C	PL II	2534 °F	0 °F	0 to 1 V	100.0	0.0
U	600 °C	0 °C	U	1112 °F	0 °F	–10 to +10m V	100.0	0.0
L	900 °C	0 °C	L	1652 °F	0 °F	–100 to +100 mV	100.0	0.0
PR40-20	1800 °C	0 °C	PR40-20	3200 °F	0 °F	–1 to +1 V	100.0	0.0
Pt100	850 °C	–200 °C	Pt100	1562 °F	–328 °F	—	—	—
JPt100	640 °C	–200 °C	JPt100	1184 °F	–328 °F	—	—	—

● When Control action is changed

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

Name	Symbol	Default value
SV setting mode		
Manual manipulated out put value	MV	–5.0
Parameter setting mode		
Proportional band [heat-side]	P	30 *
Integral time [heat-side]	I	240
Derivative time [heat-side]	d	60
Control response parameter	rPT	2
Proportional band [cool-side]	Pc	30 *
Integral time [cool-side]	Ic	240
Derivative time [cool-side]	dc	60
Overlap/Deadband	db	0
Open/Close output neutral zone	Ydb	2.0
Manual reset	MR	0
Output limiter high (MV1)	oLH	105.0
Output limiter low (MV1)	oLL	–5.0
Output limiter high (MV2)	oLH2	105.0

* The input span is automatically set when the default value exceeds the input span.

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Name	Symbol	Default value
Output limiter low (MV2)	oLL2	–5.0
ON/OFF action differential gap (upper)	oHH	TC/RTD inputs: 1 *, V/I inputs: 0.1
ON/OFF action differential gap (lower)	oHL	TC/RTD inputs: 1 *, V/I inputs: 0.1
Control loop break alarm (LBA) time	LbA	480
LBA deadband (LBD)	Lbd	0
Setup setting mode		
Control action at pattern end	ENd.P	0
Engineering mode		
Manipulated output value at input error	PSM	0.0
Initial level engineering mode		
Undershoot suppression factor	US	Water cooling: 0.100, Air cooling: 0.250, Cooling gain linear type: 1.000
Proportional band limiter (high) [heat-side]	PLH	TC/RTD inputs: Input span, V/I inputs: 1000.0
Proportional band limiter (low) [heat-side]	PLL	TC/RTD inputs: 0, V/I inputs: 0.0
Integral time limiter (high) [heat-side]	ILH	3600
Integral time limiter (low) [heat-side]	ILL	PID control or Heat/Cool PID control: 0 Position proportioning PID control: 1
Derivative time limiter (high) [heat-side]	dLH	3600
Derivative time limiter (low) [heat-side]	dLL	0
Proportional band limiter (high) [cool-side]	PcLH	TC/RTD input: Input span, V/I inputs: 1000.0
Proportional band limiter (low) [cool-side]	PcLL	TC/RTD inputs: 1, V/I inputs: 0.1
Integral time limiter (high) [cool-side]	IcLH	3600
Integral time limiter (low) [cool-side]	IcLL	0
Derivative time limiter (high) [cool-side]	dcLH	3600
Derivative time limiter (low) [cool-side]	dcLL	0

* The input span is automatically set when the default value exceeds the input span.

● When OUT2 assignment is changed

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

Name	Symbol	Default value
Engineering mode		
OUT2 transmission output scale high	AHS2	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): + Input span * Other: 100.0
OUT2 transmission output scale low	ALS2	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): – Input span * Other: 0.0

* The input span is automatically set when the default value exceeds the input span.

● When OUT3 assignment is changed

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

Name	Symbol	Default value
Engineering mode		
OUT3 transmission output scale high	AHS3	Measured value (PV), Set value (SV) monitor: Input range high Deviation value (DEV): + Input span * Other: 100.0
OUT3 transmission output scale low	ALS3	Measured value (PV), Set value (SV) monitor: Input range low Deviation value (DEV): – Input span * Other: 0.0

* The input span is automatically set when the default value exceeds the input span.

● When Maximum pattern number or Maximum segment number are changed

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

Name	Symbol	Default value
SV setting mode		
Execution pattern selection	PTN	1
Segment level	LEVEL	0 *
Segment time	TIME	0 hour 00 minute
Parameter setting mode		
PID memory group number	PId.GR	0
Event memory group number	EV.GR	1
Wait memory group number	WT.GR	1
Segment signal	SIGNL	00000000
Program end number	P. ENd	Maximum segment number
Segment repeat execution time	RPT.SG	1
Segment repeat start/end number	STtEd	1
Pattern repeat execution time	RPT.PN	1
Link pattern number	LNK.PN	0
Pattern end output duration	ENd.TM	0 hour 00 minute
Time signal memory group number	TS.GR	Pattern 1 to 16: 1 to 16, Pattern 17 or more: 0
Output program memory group number	P.MV.GR	0
Wait zone high	ZoNE.H	0
Wait zone low	ZoNE.L	0
Wait release trigger selection	RE.TRG	00001
Wait time-out set value	TM.oUT	0 hour 00 minute
Time signal output assignment	01.oUT	0
Start segment of time signal	01.S.SN	1
Time signal start time	01.S.TM	0 hour 00 minute
End segment of time signal	01.E.SN	1
Time signal end time	01.E.TM	0 hour 00 minute
Output program value 1	P.MV1	–5.0
Output program value 2	P.MV2	–5.0
Output program value 3	P.MV3	–5.0
Set only by communication		
Pattern tag name	—	Space (11 digits)

* Setting limiter value (low) is automatically set when the default value (0) is outside of the range of the Setting limiter.

● When Event 1 type is changed

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

Name	Symbol	Default value
Parameter setting mode		
Event 1 set value (EV1)	EV1	50 [a]
Event 1 set value (EV1) [high]		50 [a]
Event 1 set value (EV1’) [low]	EV1'	–50 [a]
Engineering mode		
Event 1 hold action	EHo1	0
Event 1 differential gap	EH1	TC/RTD inputs: 2 [b], V/I inputs: 0.2 [b], MV: 0.2

[a] When deviation type is selected for Event: The input span is automatically set when the default value exceeds the input span.
When Process type or Set value type is selected for Event: Input range high or low is automatically set when the default value exceeds the input range.

[b] The input span is automatically set when the default value exceeds the input span.

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Name	Symbol	Default value
Event 1 output action at input error	Ebo1	0
Event 1 timer	EVT1	0.0
Event 1 interlock	EIL1	0
Event 1 minimum ON time	E1oN	0.0
Event 1 minimum OFF time	E1oFF	0.0

● When Event 2 type is changed

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

Name	Symbol	Default value
Parameter setting mode		
Event 2 set value (EV2)	EV2	50 [a]
Event 2 set value (EV2) [high]		50 [a]
Event 2 set value (EV2') [low]	EV2'	–50 [a]
Engineering mode		
Event 2 hold action	EHo2	0
Event 2 differential gap	EH2	TC/RTD inputs: 2 [b], V/I inputs: 0.2 [b], MV: 0.2
Event 2 output action at input error	Ebo2	0
Event 2 timer	EVT2	0.0
Event 2 interlock	EIL2	0
Event 2 minimum ON time	E2oN	0.0
Event 2 minimum OFF time	E2oFF	0.0

[a] When deviation type is selected for Event: The input span is automatically set when the default value exceeds the input span.
When Process type or Set value type is selected for Event: Input range high or low is automatically set when the default value exceeds the input range.
[b] The input span is automatically set when the default value exceeds the input span.

● When Event 3 type is changed

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

Name	Symbol	Default value
Parameter setting mode		
Event 3 set value (EV3)	EV3	50 [a]
Event 3 set value (EV3) [high]		50 [a]
Event 3 set value (EV3') [low]	EV3'	–50 [a]
Engineering mode		
Event 3 hold action	EHo3	0
Event 3 differential gap	EH3	TC/RTD inputs: 2 [b], V/I inputs: 0.2 [b], MV: 0.2
Event 3 output action at input error	Ebo3	0
Event 3 timer	EVT3	0.0
Event 3 interlock	EIL3	0
Event 3 minimum ON time	E3oN	0.0
Event 3 minimum OFF time	E3oFF	0.0

[a] When deviation type is selected for Event: The input span is automatically set when the default value exceeds the input span.
When Process type or Set value type is selected for Event: Input range high or low is automatically set when the default value exceeds the input range.
[b] The input span is automatically set when the default value exceeds the input span.

● When Event 4 type is changed

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

Name	Symbol	Default value
Parameter setting mode		
Event 4 set value (EV4)	EV4	50 [a]
Event 4 set value (EV4) [high]		50 [a]
Event 4 set value (EV4') [low]	EV4'	–50 [a]
Engineering mode		
Event 4 hold action	EHo4	0
Event 4 differential gap	EH4	TC/RTD inputs: 2 [b], V/I inputs: 0.2 [b], MV: 0.2
Event 4 output action at input error	Ebo4	0
Event 4 timer	EVT4	0.0
Event 4 interlock	EIL4	0
Event 4 minimum ON time	E4oN	0.0
Event 4 minimum OFF time	E4oFF	0.0

[a] When deviation type is selected for Event: The input span is automatically set when the default value exceeds the input span. When Process type or Set value type is selected for Event: Input range high or low is automatically set when the default value exceeds the input range.

[b] The input span is automatically set when the default value exceeds the input span.

● When Communication 1 protocol is changed

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

Name	Symbol	Default value
Engineering mode		
Data bit configuration 1	bIT1	8N1

● When Slave controller is changed

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

Name	Symbol	Default value
Initial level engineering mode		
Set memory area switching address	Add.SE	FB series: 0500 RB series: FFFF PF900/PF901: FFFF
Control memory area switching address	Add.RN	FB series: 0024 RB series: FFFF PF900/PF901: 0073
SV address of set memory area	Add.SS	FB series: 0507 RB series: 0006 PF900/PF901: 0072
EEPROM mode setting address	Add.EP	FB series: FFFF RB series: 001B PF900/PF901: FFFF
RUN/STOP setting address	Add.RS	FB series: 0023 RB series: 0019 PF900/PF901: 002B

■ Parameters with limited data range at setting change

● When Decimal point position is changed

All parameter settings shown in the table below will be automatically converted into the a values to match the new decimal point position as long as the converted values are in the acceptable range of each parameter.

When Decimal point position is added: the added digit displays 0.
Example: 400 → 400.0
When Decimal point position is deleted: the set value is rounded off to the closest whole number.
Example: 155.5 → 156

Name	Symbol	Limiter range
Parameter setting mode		
Segment level	LEVEL	Setting limiter low to Setting limiter high
Proportional band [heat-side]	P	Input span [1]
Proportional band [cool-side]	Pc	
Overlap/Deadband	db	–Input span to +Input span [2]
Open/Close output neutral zone	Ydb	
ON/OFF action differential gap (upper)	oHH	Input span [1]
ON/OFF action differential gap (lower)	oHL	
LBA deadband (LBD)	Lbd	Input span
Event 1 set value (EV1)	EV1	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [2]
Event 1 set value (EV1) [high]		
Event 1 set value (EV1') [low]	EV1'	–Input span to +Input span [2]
Event 2 set value (EV2)	EV2	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [2]
Event 2 set value (EV2) [high]		
Event 2 set value (EV2') [low]	EV2'	–Input span to +Input span [2]
Event 3 set value (EV3)	EV3	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [2]
Event 3 set value (EV3) [high]		
Event 3 set value (EV3') [low]	EV3'	–Input span to +Input span [2]
Event 4 set value (EV4)	EV4	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [2]
Event 4 set value (EV4) [high]		
Event 4 set value (EV4') [low]	EV4'	–Input span to +Input span [2]
Wait zone low	ZoNE.L	–200 to 0 (For low limit, up to–19999 can be set without decimal point position) [1]
Level PID setting 1	LEVL.1	Input range low to Input range high
Level PID setting 2	LEVL.2	
Level PID setting 3	LEVL.3	
Level PID setting 4	LEVL.4	
Level PID setting 5	LEVL.5	
Level PID setting 6	LEVL.6	
Level PID setting 7	LEVL.7	
Set value (SV) in Reset mode	SV	Setting limiter low to Setting limiter high
Set value (SV) in Fixed set point control mode	SV	
Setup setting mode		
PV bias	Pb	–Input span to +Input span [2]

[1] Only for TC or RTD inputs
[2] Maximum range: –19999 to +32000

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Name	Symbol	Limiter range
Engineering mode		
Dot monitor scale high	dSCH	Input range low to Input range high
Dot monitor scale low	dSCL	
Input range high	PGSH	RTD inputs [1], V/I inputs [2]
Input range low	PGSL	
Input error determination point (high)	PoV	Input range low – (5 % of Input span) to Input range high + (5 % of Input span) [3]
Input error determination point (low)	PUN	
OUT2 transmission output scale high	AHS2	Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): – Input span to + Input span [2]
OUT2 transmission output scale low	ALS2	
OUT3 transmission output scale high	AHS3	
OUT3 transmission output scale low	ALS3	
Event 1 differential gap	EH1	Input span [4]
Event 2 differential gap	EH2	
Event 3 differential gap	EH3	
Event 4 differential gap	EH4	
Start determination point	PdA	Input span
AT bias	ATb	– Input span to + Input span [2]
Setting limiter high	SLH	Input range low to Input range high
Setting limiter low	SLL	
Initial level engineering mode		
Proportional band limiter (high) [heat-side]	PLH	Input span [5]
Proportional band limiter (low) [heat-side]	PLL	
Proportional band limiter (high) [cool-side]	PcLH	
Proportional band limiter (low) [cool-side]	PcLL	

[1] Data range is from–100.00 to +150.00 °C (–148.00 to +302.00 °F) when setting two places of decimal point position for RTD input.
[2] Maximum range: –19999 to +32000
[3] Maximum range: –19999 to +32767
[4] Except for MV type
[5] Only for TC or RTD inputs

● When Input range low or Input range high is changed

The setting range of the parameters below may be limited based on the Input range low or Input range high to be set.

Name	Symbol	Limiter range
Parameter setting mode		
Segment level	LEVEL	Setting limiter low to Setting limiter high
Proportional band [heat-side]	P	Input span [1]
Proportional band [cool-side]	Pc	
Overlap/Deadband	db	–Input span to +Input span [2]
Open/Close output neutral zone	Ydb	
ON/OFF action differential gap (upper)	oHH	Input span [1]
ON/OFF action differential gap (lower)	oHL	
LBA deadband (LBD)	Lbd	Input span
Event 1 set value (EV1)	EV1	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [2]
Event 1 set value (EV1) [high]		
Event 1 set value (EV1') [low]	EV1'	–Input span to +Input span [2]

[1] Only for TC or RTD inputs
[2] Maximum range: –19999 to +32000

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Name	Symbol	Limiter range
Event 2 set value (EV2)	EV2	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [1]
Event 2 set value (EV2) [high]		
Event 2 set value (EV2’) [low]	EV2'	–Input span to +Input span [1]
Event 3 set value (EV3)	EV3	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [1]
Event 3 set value (EV3) [high]		
Event 3 set value (EV3’) [low]	EV3'	–Input span to +Input span [1]
Event 4 set value (EV4)	EV4	Process, SV: Input range low to Input range high Deviation: – Input span to + Input span [1]
Event 4 set value (EV4) [high]		
Event 4 set value (EV4’) [low]	EV4'	–Input span to +Input span [1]
Level PID setting 1	LEVL.1	Input range low to Input range high
Level PID setting 2	LEVL.2	
Level PID setting 3	LEVL.3	
Level PID setting 4	LEVL.4	
Level PID setting 5	LEVL.5	
Level PID setting 6	LEVL.6	
Level PID setting 7	LEVL.7	
Set value (SV) in Reset mode	SV	Setting limiter low to Setting limiter high
Set value (SV) in Fixed set point control mode	SV	
Setup setting mode		
PV bias	Pb	–Input span to +Input span [1]
Engineering mode		
Dot monitor scale high	dSCH	Input range low to Input range high
Dot monitor scale low	dSCL	
Input error determination point (high)	PoV	Input range low – (5 % of Input span) to Input range high + (5 % of Input span) [2]
Input error determination point (low)	PUN	
OUT2 transmission output scale high	AHS2	Measured value (PV), Set value (SV) monitor: Input range low to Input range high Deviation value (DEV): – Input span to + Input span [3]
OUT2 transmission output scale low	ALS2	
OUT3 transmission output scale high	AHS3	
OUT3 transmission output scale low	ALS3	
Event 1 differential gap	EH1	Input span [3]
Event 2 differential gap	EH2	
Event 3 differential gap	EH3	
Event 4 differential gap	EH4	
AT bias	ATb	–Input span to +Input span [1]
Setting limiter high	SLH	Input range low to Input range high
Setting limiter low	SLL	
Initial level engineering mode		
Proportional band limiter (high) [heat-side]	PLH	Input span [4]
Proportional band limiter (low) [heat-side]	PLL	
Proportional band limiter (high) [cool-side]	PcLH	
Proportional band limiter (low) [cool-side]	PcLL	

[1] Maximum range: −19999 to +32000
[2] Maximum range: −19999 to +32767
[3] Except for MV type.
[4] Only for TC or RTD inputs

● When Integral/derivative time decimal point position is changed

All parameter settings shown in the table below will be automatically converted into the a values to match the new decimal point position as long as the converted values are in the acceptable range of each parameter.

Name	Symbol	Limiter range
Parameter setting mode		
Integral time [heat-side]	I	PID control or Heat/Cool PID control: 0 to 3600 Position proportioning PID control: 1 to 3600
Initial level engineering mode		
Integral time limiter (high) [heat-side]	ILH	PID control or Heat/Cool PID control: 0 to 3600 Position proportioning PID control: 1 to 3600
Integral time limiter (low) [heat-side]	ILL	

● When Setting limiter low or Setting limiter high is changed

The setting range of the parameters below may be limited based on the Input range low or Input range high to be set.

Name	Symbol	Limiter range
Parameter setting mode		
Segment level	LEVEL	Setting limiter low to Setting limiter high
Set value (SV) in Reset mode	SV	
Set value (SV) in Fixed set point control mode	SV	

A.2 Removing the Internal Assembly

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

⚠ WARNING

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

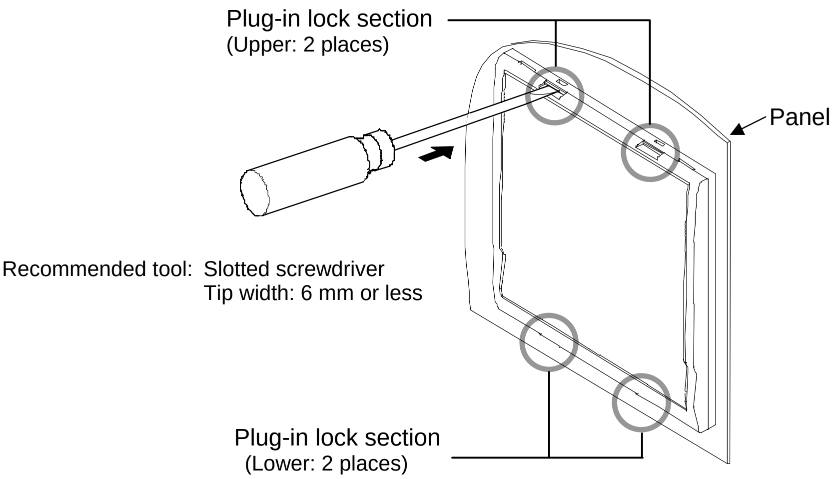
NOTE

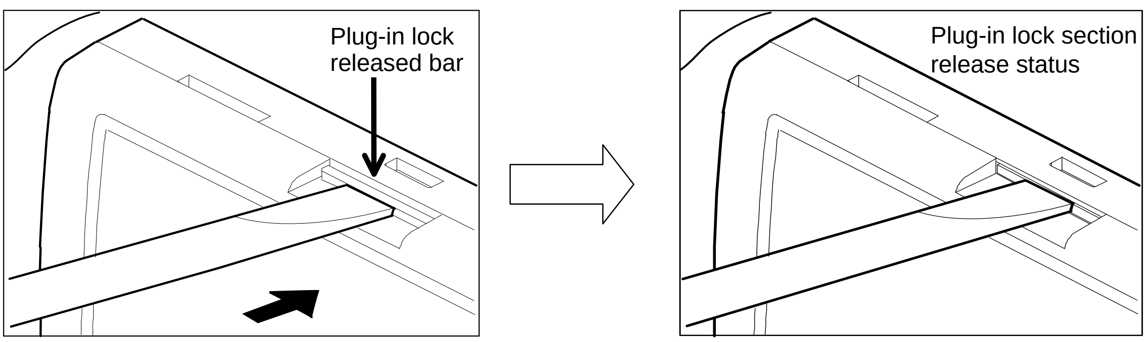
Apply pressure very carefully when removing internal assembly to avoid damage to the frame.

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

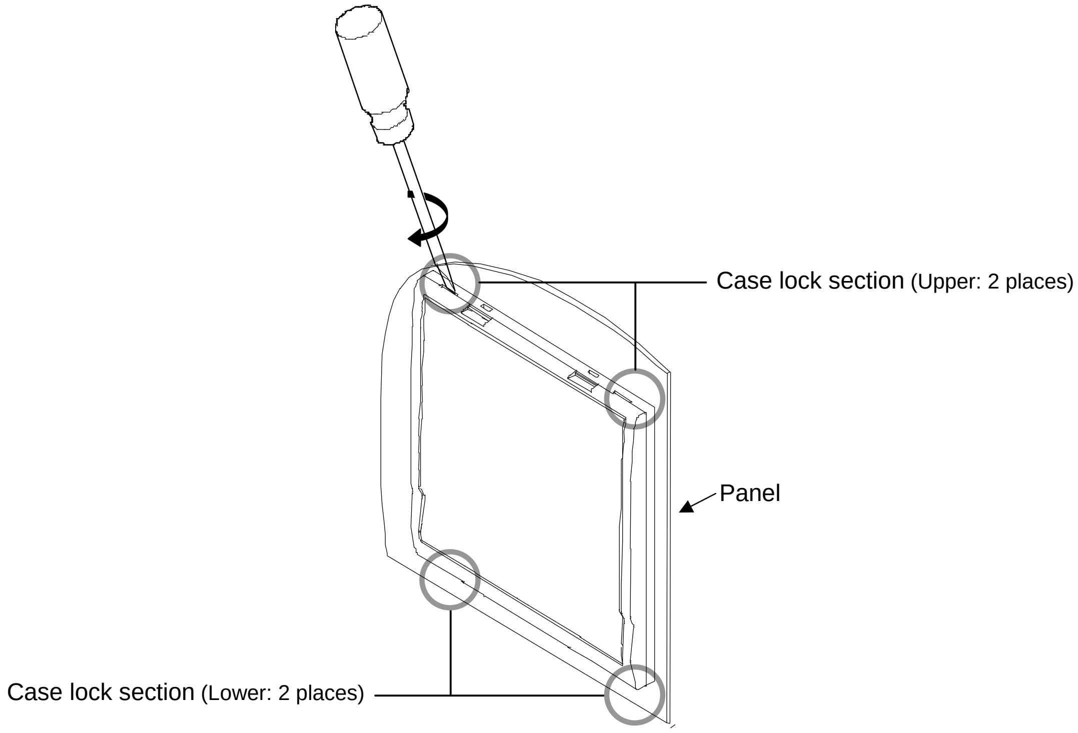
■ Procedures

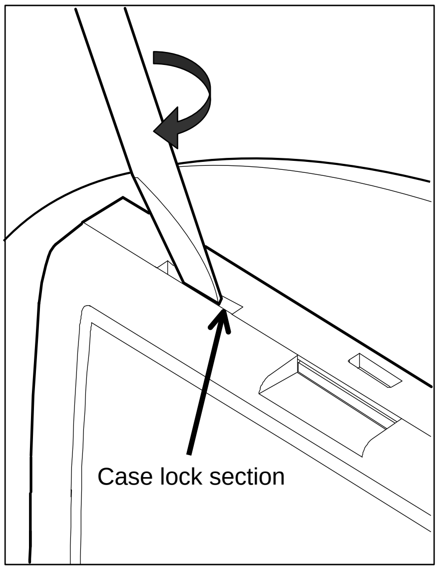
1. Insert the screwdriver in the plug-in lock section as shown in the following figure, and then lightly push the screwdriver in the horizontal direction to release the plug-in lock released bar.
The plug-in lock section is released.

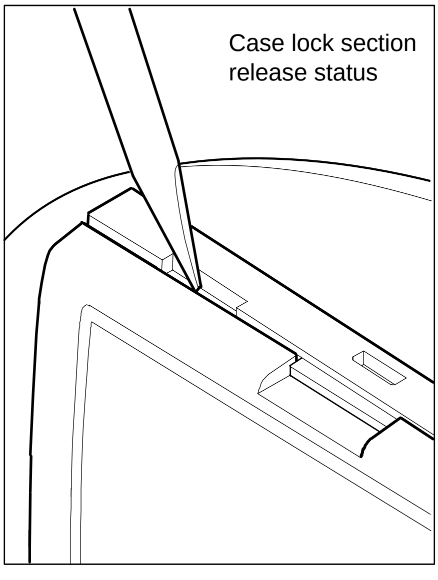




2. Insert the screwdriver in the case lock section as shown in the following figure, and then lightly turn the screwdriver to release the case lock section. The case lock section is released.







3. The other case lock section should be released the same way described in steps ***1*** and ***2.***

4. Remove the internal assembly from the case.

A.3 Replacing the Waterproof/Dustproof Rubber Packing

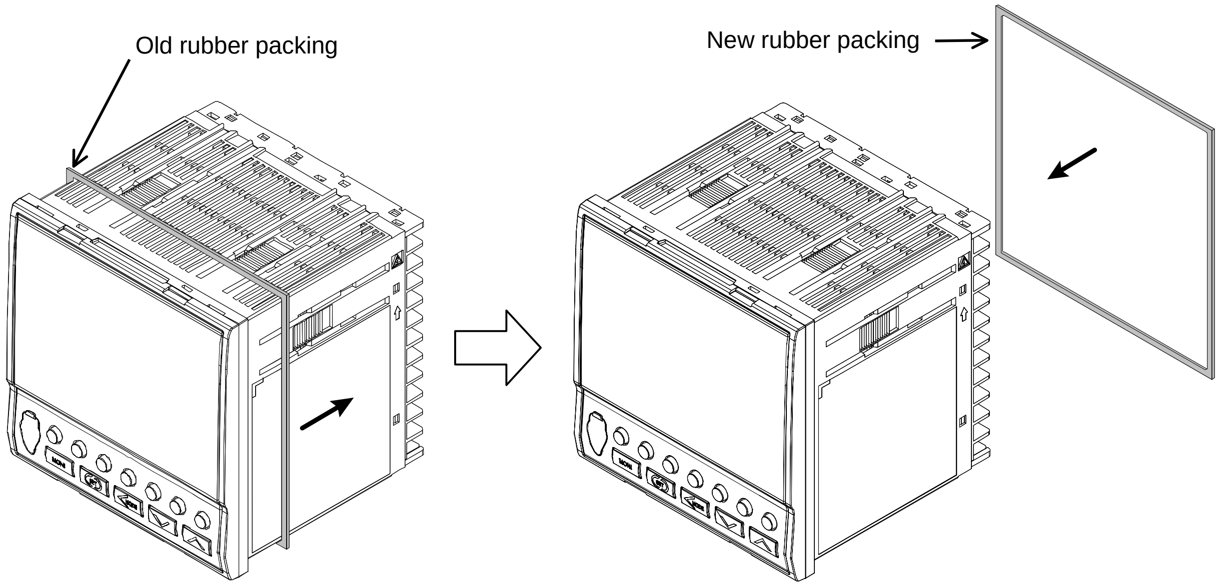
If the waterproof and dustproof rubber packing deteriorates, please contact RKC sales office or the agent. When the replacement of the rubber packing, take the following steps.

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

■ Replacement of the case rubber packing

1. Turn the power OFF.
2. Remove the wiring.
3. Remove the mounting bracket, and then remove the instrument from the control panel.

   ☞ Refer to **2.4 Procedures of Mounting and Removing (P. 2-6).**
4. Remove the old rubber packing, and then replace the old rubber packing with a new one.



Parts list

	PF900/PF901
Parts code	KFB900-36 <1>
Ordering code	00421248

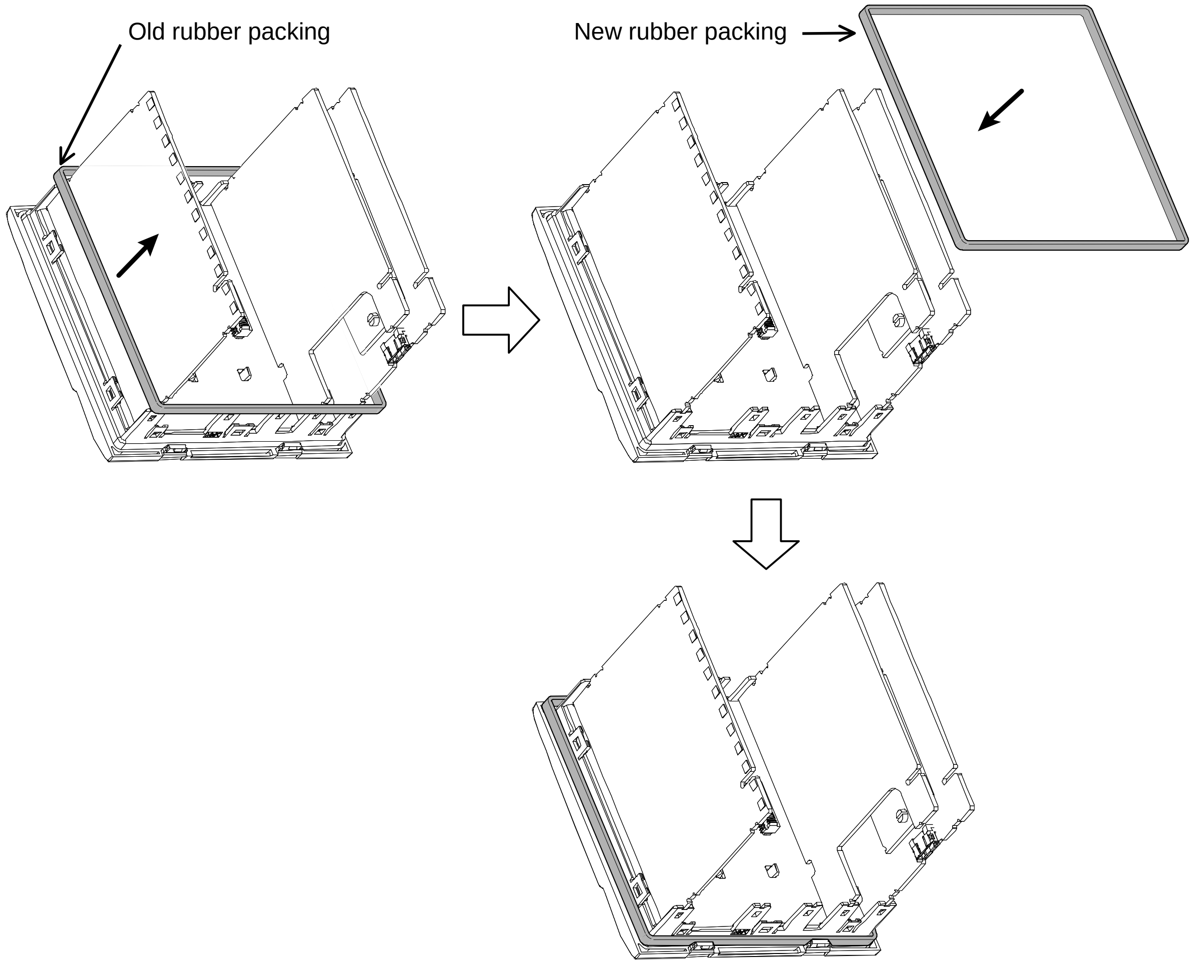
■ Replacement of the board rubber packing

1. Turn the power OFF.

2. Remove the internal assembly from the case.

☞ Refer to **APPENDIX A.2 Removing the Internal Assembly (P. A-14)**.

3. Remove the old rubber packing, and then replace the old rubber packing with a new one.



Rubber packing mounting status

Parts list

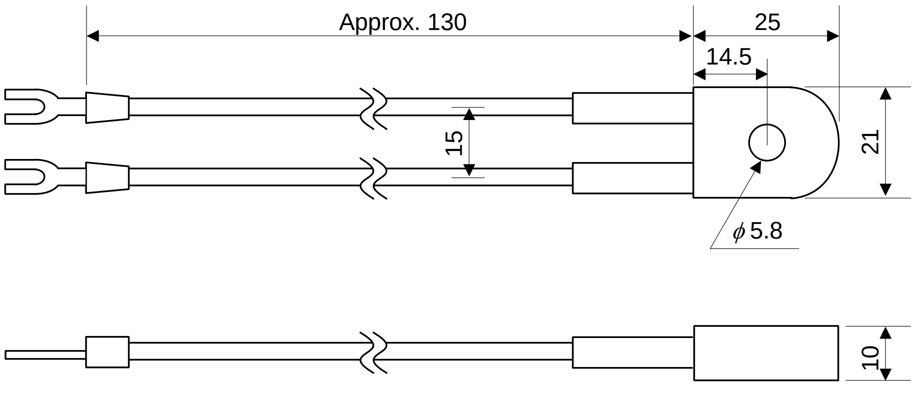
	PF900/PF901
Parts code	KFB900-35 <2>
Ordering code	00478546

4. Insert the internal assembly in the case.

A.4 Current Transformer (CT) Dimensions

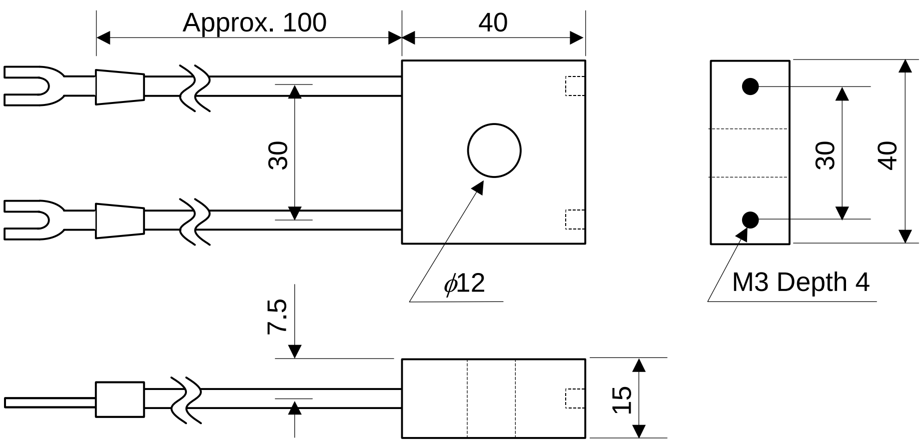
■ CTL-6-P-N (For 0 to 30 A)

(Unit: mm)



■ CTL-12-S56-10L-N (For 0 to 100 A)

(Unit: mm)



INDEX

E

F

H

I

L

S

T

U

V

W

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