FP23 Series
Programmable Controller

Instruction Manual

Servo output

(Positioning proportional control)

Thank you for purchasing the Shimaden FP23 Series Programmable Controller. Check that the delivered product is the correct item you ordered. Do not begin operating this product until you have read and thoroughly understood the contents of this Instruction Manual.

SHIMADEN CO., LTD.

MFP023-E03-A

Mar, 2006

Request

Make sure that this instruction manual is given to the final user of the device.
Keep this manual at the work site during operation of the FP23 Series.

Preface

This Instruction Manual describes the basic functions and how to use "Servo output" FP23 Series Controllers.
For details on "2-input: 1-output/2-output" and "1-input: 1-output/2-output," refer to separate manuals.

This Instruction Manual is meant for those will be involved in the wiring, installation, operation and routine maintenance of the FP23 Series. This manual describes the handling, installation and wiring procedures for operation.

While using this device, you should always follow the instructions written in this manual.
For safety precautions and potential damage to equipment and/or facilities, additional instructions are indicated by the following headings.

Safety Precautions

⚠ **Warning**

The FP23 Series Digital Controller is designed for controlling temperature, humidity and other physical quantities in general industrial facilities. It must not be used in any way that may adversely affect the safety, health or working conditions of those who come into contact with the effects of its use. When used, adequate and effective safety countermeasures must be provided at all times by the user. No warranty, express or implied, is valid when this device is used without the proper safety countermeasures.

⚠ **Warning**

- Before you start to use this device, install it in a control panel or the like and avoid touching the terminals.
- Do not open this device's case, and touch the boards or inside of the case with your hands or a conductor. The user should never repair or modify this device. Doing so might cause an accident that may result in death or serious bodily injury from electric shock.
- This servo output product is a position proportional controller for a control motor with limit switches. Do not use it for a motor without limit switches, or a motor with misaligned limit switches, because a failure or damage might happen to the motor.

⚠ Caution

To avoid damage to connected peripheral devices, facilities or the product itself due to malfunction of this device, safety countermeasures such as proper installation of the fuse or installation of overheating protection must be taken before use. No warranty, express or implied, is valid in the case of use resulting in an accident without having taken the proper safety countermeasures.

- The warning mark on the plate affixed on the casing of this device warns you not to touch charged parts while this device is powered ON. Doing so might cause an electric shock.
- A means for turning the power OFF such as switch or a breaker must be installed on the external power circuit connected to the power terminal on this device. Fasten the switch or breaker at a position where it can be easily operated by the operator, and indicate that it is a means for powering this device OFF.
- This device does not have a built-in fuse. Install a fuse that conforms to the following rating in the power circuit connected to the power terminal.

  Fuse rating/characteristics: 250 VAC 1.0A/medium lagged or lagged type
- When wiring this device, tighten the terminal connections firmly.
- Use the device with the power voltage and frequency within their rated ranges.
- Do not apply a voltage or current outside of the input rating to the input terminal. Doing so might shorten the service life of this device or cause it to malfunction.
- The voltage and current of the load connected to the output terminal should be within the rated range. Exceeding this range may cause the temperature to rise which might shorten the service life of this device or cause it to malfunction.
- This device is provided with ventilation holes for heat to escape. Prevent metal objects or other foreign matter from entering these ventilation holes as this may cause this device to malfunction. Do not block these ventilation holes or allow dirt and dust to stick to these holes. Temperature buildup or insulation failure might shorten the service life of this device or cause it to malfunction.
- Repeated tolerance tests on voltage, noise, surge, etc. may cause this device to deteriorate.
- Never remodel this device or use it a prohibited manner.
- To ensure safe and proper use of this device, and to maintain its reliability, observe the precautions described in this manual.
- Do not operate the keys on the front panel of this device with a hard or sharp-tipped object. Be sure to operate the keys with your fingertips.
- When cleaning this device, do not use paint thinner or other solvents. Wipe gently with a soft, dry cloth.

Check before use

This device has been fully checked for quality assurance before shipment from the factory. However, you are requested to make sure that there are no errors, damages or shortages in the delivered items by confirming the model code, external appearance of the device and the number of accessories.

Confirmation of model codes

Referring to the table below check the model codes affixed to the case of the product to check if the respective codes indicate what was specified when you ordered the product.

Checking accessories

Make sure that your product package has all of the following items

Standard accessories

(1) Quick Reference
(2) Support CD
(3) Mounting fixture (w/ 2 screws)
(4) Terminal cover
(5) Unit decal

Optional accessories

(1) Terminal resistor (when the RS-485 communication option is selected)

Options (sold separately)

The following table shows the options available for this product.

Model Name	Model No.	Specification
Infrared Communication Adapter	S5004	USB 1.1
Shunt resistor	QCS002	250Ω±0.1%
Relay Unit	AP2MC	Converts open collector output to 2-point contact.

■ Servo-output specification

Item	Code							Specification
Series	FP23-	96 x 96 mm DIN size, high-performance digital controller						
Basic functions	MS	Universal-input, 1-input servo output, 3 event outputs						
Control Output *1		Y	Contact, rating: 240V AC 2A, CR absorber built-in					
		R	Contact, rating: 240V AC 2A without CR absorber					
		S	Combination of SSR and contact 240V AC 2A					
Control Output 2			N-	None				
Heater Break Alarm			00	None				
Analog Output 1				0	None			
				3	0 to 10mV DC, Output resistance: 10Ω			
				4	4 to 20mA DC, Load resistance: max.300Ω			
				6	0 to 10V DC, Load current: max. 2mA			
Analog Output 2/Sensor Power Supply					0	None		
					3	0 to 10 mV DC, Output resistance: 10Ω		
					4	4 to 20mA DC, Load resistance: max.300Ω		
					6	0 to 10V DC, Load current: max.2mA		
					8	Sensor power supply 24V DC 25mA		
External Input /Output control signal (DI/DO) *2			Standard			0	4 DI points , 5 DO points (start pattern No. switching not available)	
						1	10 DI points , 9 DO points (start pattern No. switching available)	
Communication function							0	None
							5	RS-485 / SHIMADEN protocol MODBUS (ASCII/RTU) protocol
							7	RS-232C
Remarks							0	Without
							9	With

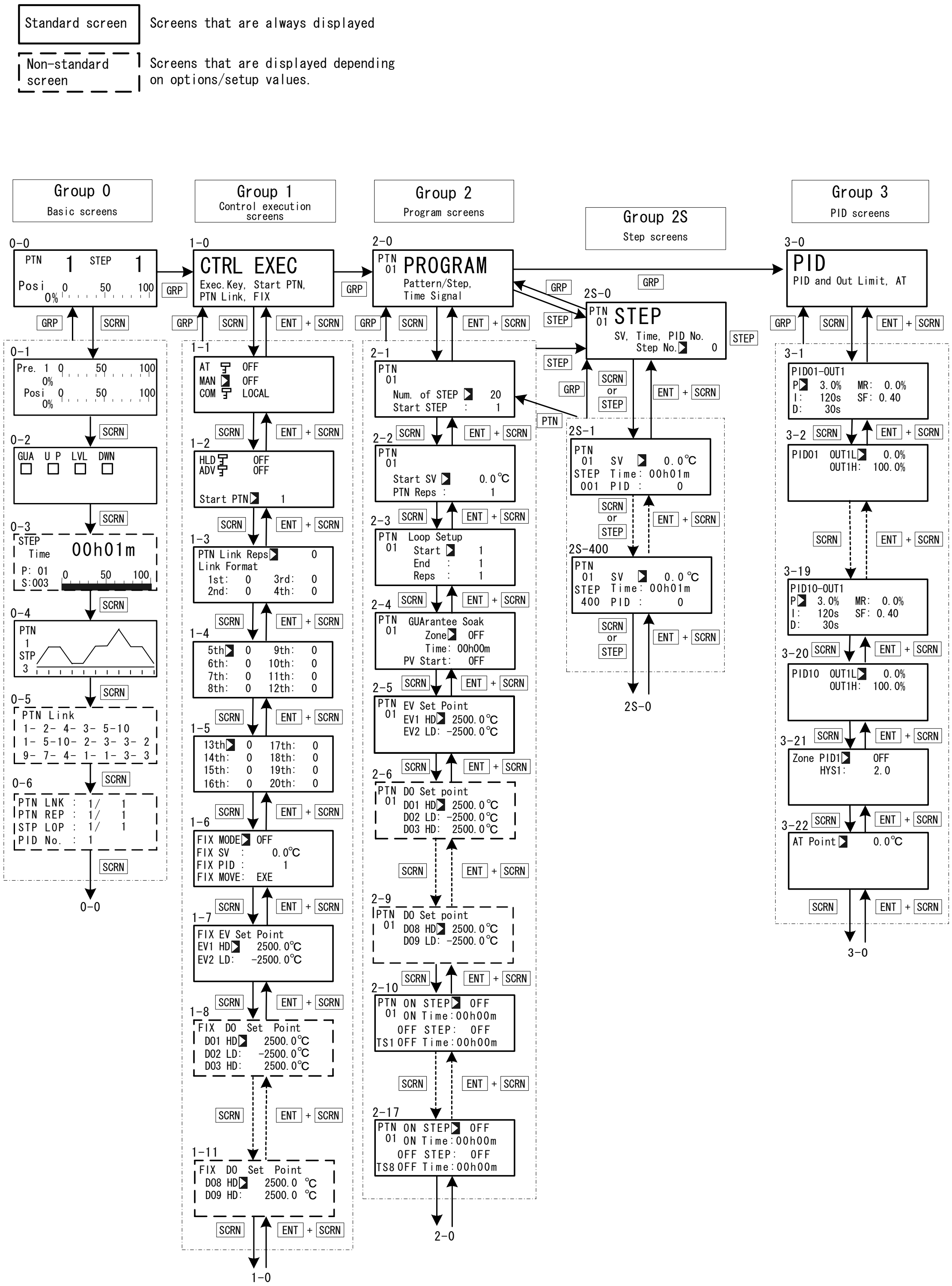
*1 Y: This must be selected when directly controlling the motor.
R: This must be selected when controlling the motor through auxiliary relay, PLC or the like.
S: This must be selected when directly controlling AC motor. A longer life will result.

*2 When switching start pattern No. by DI, 10 points of DI (CODE 1) are required.

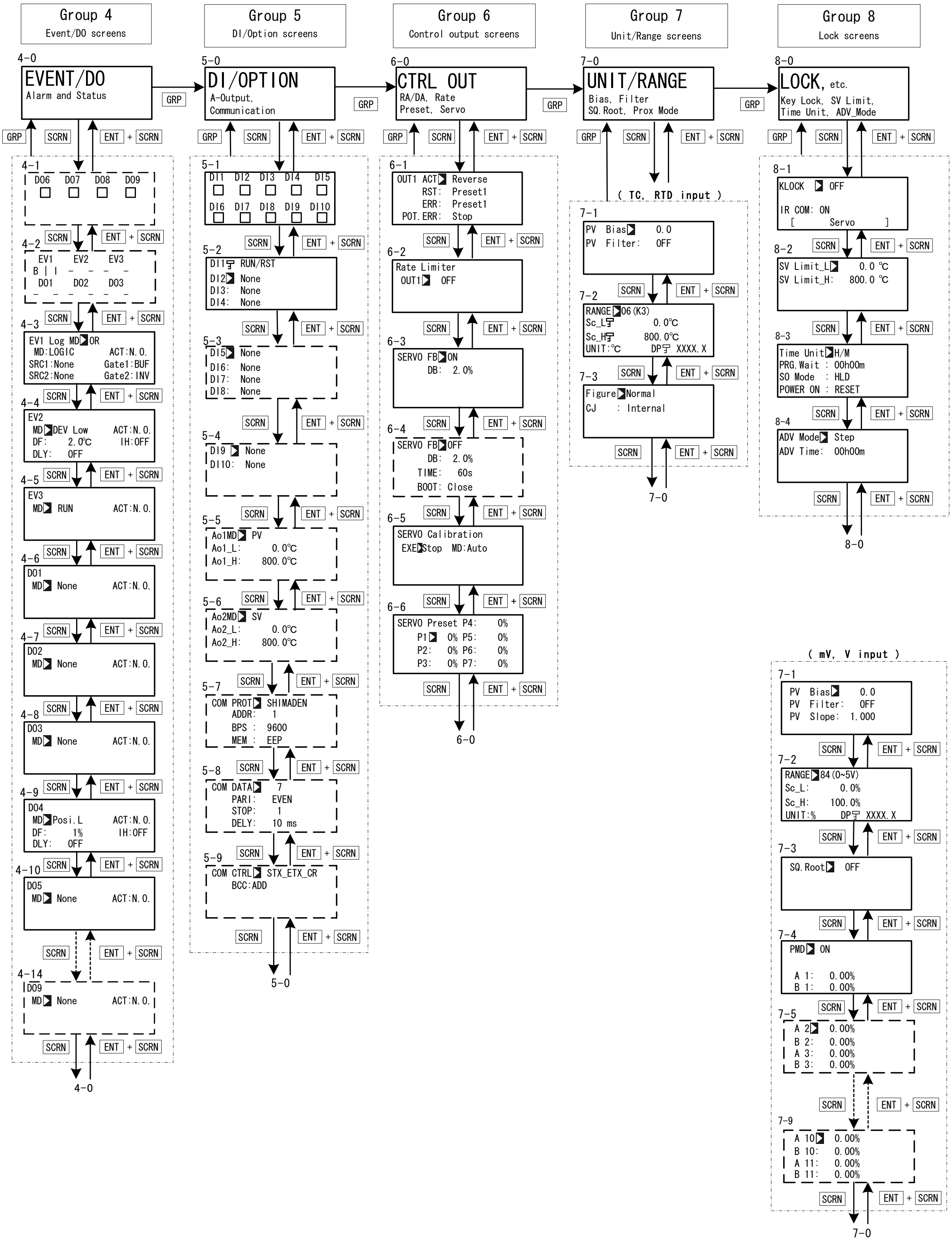
Contents

LCD Flow Chart

The following shows how to move between the LCD display screens of this device.



When the DISP key is pressed at a screen other than the 0-0 basic screen, the 0-0 basic screen is returned to.



Group 4
Event/DO screens
Group 5
DI/Option screens
Group 6
Control output screens
Group 7
Unit/Range screens
Group 8
Lock screens
4-0
EVENT/DO
Alarm and Status
5-0
DI/OPTION
A-Output,
Communication
6-0
CTRL OUT
RA/DA, Rate
Preset, Servo
7-0
UNIT/RANGE
Bias, Filter
SQ.Root, Prox Mode
8-0
LOCK, etc.
Key Lock, SV Limit,
Time Unit, ADV_Mode
GRP
SCRN
ENT + SCRN
4-1
DO6 DO7 DO8 DO9
4-2
EV1 EV2 EV3
DO1 DO2 DO3
4-3
EV1 Log MD OR
MD:LOGIC ACT:N.O.
SRC1:None Gate1:BUF
SRC2:None Gate2:INV
4-4
EV2
MD DEV Low ACT:N.O.
DF: 2.0℃ IH:OFF
DLY: OFF
4-5
EV3
MD RUN ACT:N.O.
4-6
DO1
MD None ACT:N.O.
4-7
DO2
MD None ACT:N.O.
4-8
DO3
MD None ACT:N.O.
4-9
DO4
MD Posi.L ACT:N.O.
DF: 1% IH:OFF
DLY: OFF
4-10
DO5
MD None ACT:N.O.
4-14
DO9
MD None ACT:N.O.
4-0
5-1
DI1 DI2 DI3 DI4 DI5
DI6 DI7 DI8 DI9 DI10
5-2
DI1 RUN/RST
DI2 None
DI3: None
DI4: None
5-3
DI5 None
DI6: None
DI7: None
DI8: None
5-4
DI9 None
DI10: None
5-5
Ao1MD PV
Ao1_L: 0.0℃
Ao1_H: 800.0℃
5-6
Ao2MD SV
Ao2_L: 0.0℃
Ao2_H: 800.0℃
5-7
COM PROT SHIMADEN
ADDR: 1
BPS : 9600
MEM : EEP
5-8
COM DATA 7
PARI: EVEN
STOP: 1
DELY: 10 ms
5-9
COM CTRL STX_ETX_CR
BCC:ADD
5-0
6-1
OUT1 ACT Reverse
RST: Preset1
ERR: Preset1
POT.ERR: Stop
6-2
Rate Limiter
OUT1 OFF
6-3
SERVO FB ON
DB: 2.0%
6-4
SERVO FB OFF
DB: 2.0%
TIME: 60s
BOOT: Close
6-5
SERVO Calibration
EXE Stop MD:Auto
6-6
SERVO Preset P4: 0%
P1 0% P5: 0%
P2: 0% P6: 0%
P3: 0% P7: 0%
6-0
(TC, RTD input)
7-1
PV Bias 0.0
PV Filter: OFF
7-2
RANGE 06(K3)
Sc_L 0.0℃
Sc_H 800.0℃
UNIT:℃ DP XXXX.X
7-3
Figure Normal
CJ : Internal
7-0
8-1
KLOCK OFF
IR COM: ON
[Servo]
8-2
SV Limit_L 0.0 ℃
SV Limit_H: 800.0 ℃
8-3
Time Unit H/M
PRG.Wait : 00h00m
SO Mode : HLD
POWER ON : RESET
8-4
ADV Mode Step
ADV Time: 00h00m
8-0
(mV, V input)
7-1
PV Bias 0.0
PV Filter: OFF
PV Slope: 1.000
7-2
RANGE 84(0~5V)
Sc_L: 0.0%
Sc_H: 100.0%
UNIT:% DP XXXX.X
7-3
SQ.Root OFF
7-4
PMD ON
A 1: 0.00%
B 1: 0.00%
7-5
A 2 0.00%
B 2: 0.00%
A 3: 0.00%
B 3: 0.00%
7-9
A 10 0.00%
B 10: 0.00%
A 11: 0.00%
B 11: 0.00%
7-0

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1 INSTALLATION & WIRING

1-1 Installation Site

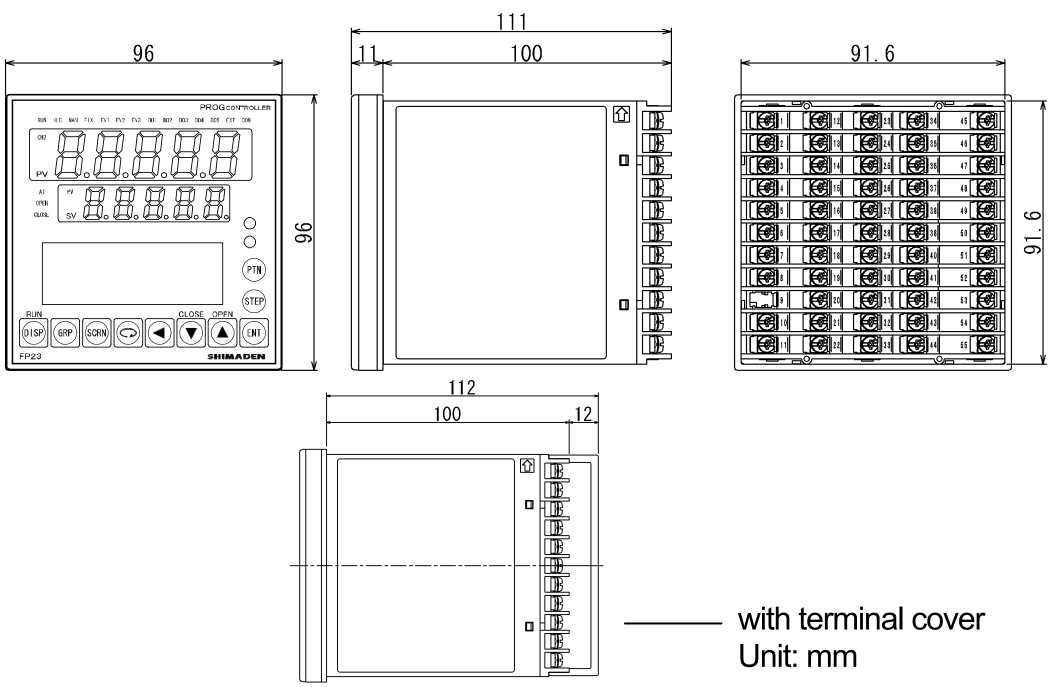
Caution

Do not use this device in the following sites. Doing so might result in malfunction or damage to this device and in some cases cause fire and/or dangerous situations.

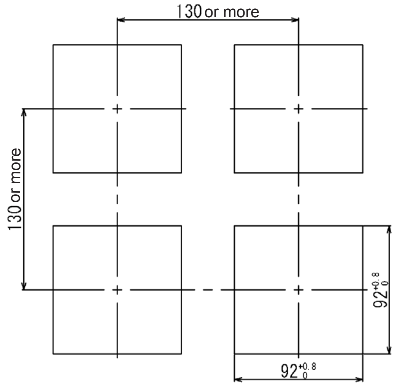
- Locations that are filled with or generate inflammable gas, corrosive gas, dirt and dust, smoke, etc.
- Locations that are subject to water droplets, direct sunlight or strong radiated heat from other equipment
- Locations where the ambient temperature falls below -10°C or rises above 50°C
- Locations where dew condensation forms and the humidity reaches 90% or more
- Near equipment that generates high-frequency noise
- Near heavy current circuits or locations likely to be subject to inductive interference
- Locations subject to strong vibration and impact
- Locations exceeding an elevation of 2000 m

1-2 External Dimensions and Panel Cutout

■ External dimensions



■ Panel cutout dimensions and space for gang mounting



Unit: mm

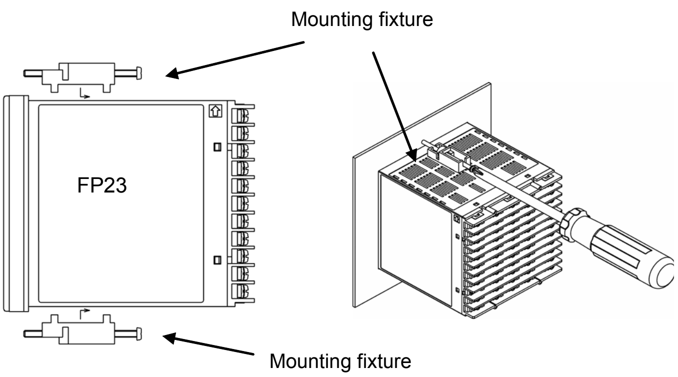
1-3 Mounting

⚠ Caution

To ensure safety and maintain the functions of this device, do not disassemble this device.
If this device must be disassembled for replacement or repair, contact your dealer.

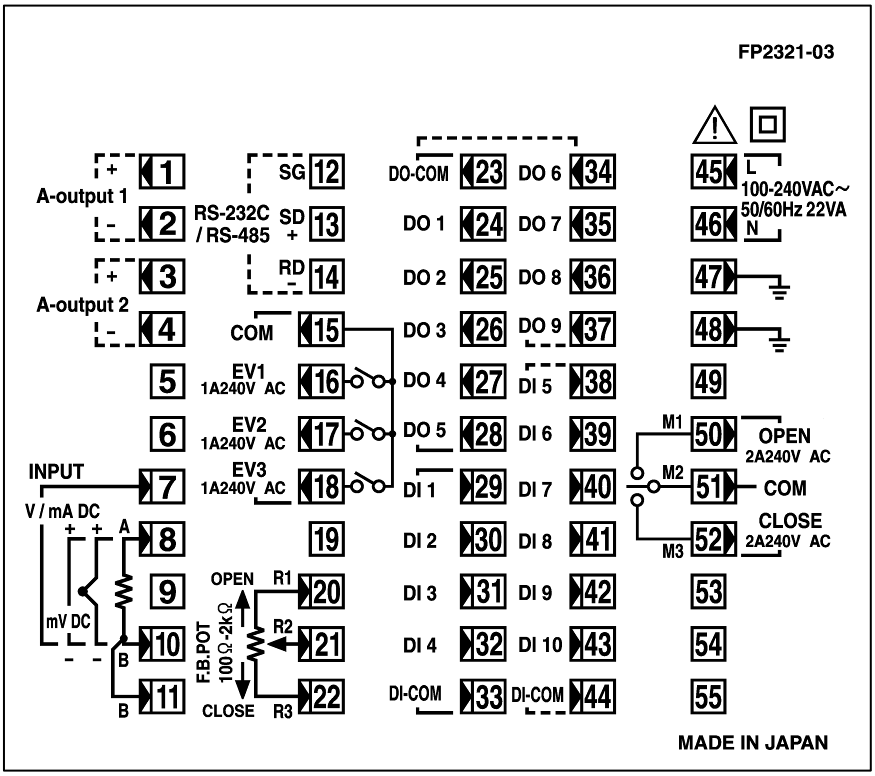
Follow the procedure below to mount this device on a panel.

1. Drill mounting holes referring to the panel cutout dimensions described in the previous section.
   The applicable thickness of the mounting panel is 1.0 to 8.0 mm.
2. Press this device into the panel from the front of the panel.
3. Insert the mounting fixtures at the top and bottom of this device, and tighten the screws from behind to fasten the device in place.
4. Over-tightening the screws may deform or damage the device housing.
   Take care not to tighten the screws too tight.
5. After completing wiring after installation, attach the terminal cover.

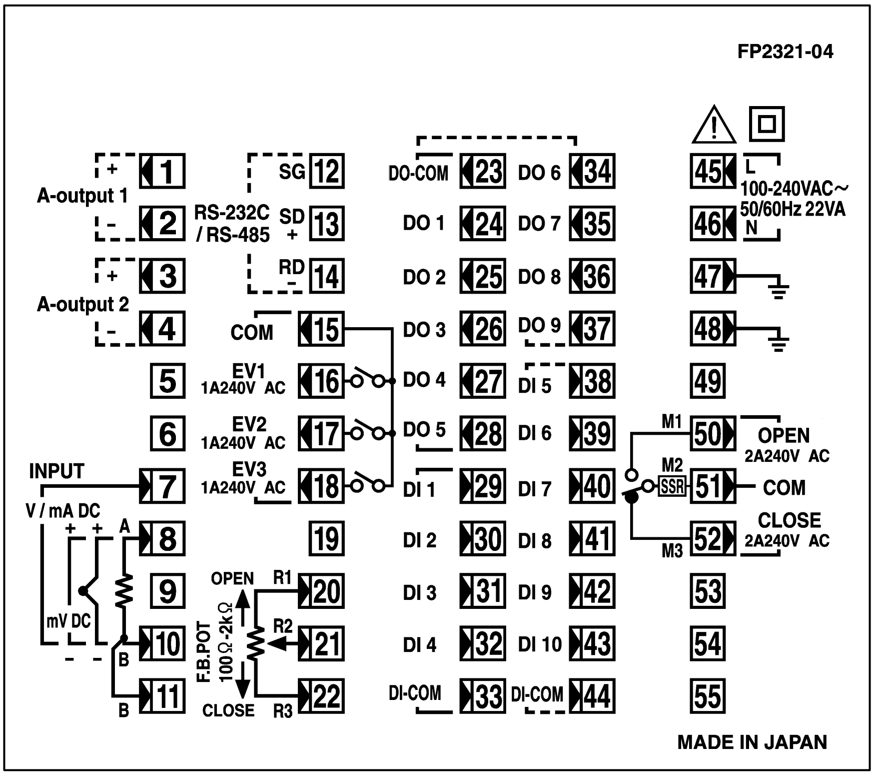


1-4 Rear Terminal Arrangement Diagram

■ Contact output model



■ Combination of SSR output and contact output model



<table>
<tr><th>Terminal No.</th><th>Symbol</th><th colspan="2">Description</th></tr>
<tr><td>1
2</td><td>+
-</td><td colspan="2">Analog output 1 (option)</td></tr>
<tr><td>3
4</td><td>+
-</td><td colspan="2">Analog output 2 or Sensor power supply (option)</td></tr>
<tr><td>5
6</td><td>+
-</td><td colspan="2">NC</td></tr>
<tr><td>8
10</td><td>+
-</td><td>mV, Thermocouple input</td><td rowspan="3">PV Input</td></tr>
<tr><td>8
10
11</td><td>A
B
B</td><td>RTD input</td></tr>
<tr><td>7
10</td><td>+
-</td><td>V, mA input</td></tr>
<tr><td>45
46</td><td>L
N</td><td colspan="2">Power supply</td></tr>
<tr><td>47
48</td><td></td><td colspan="2">Grounding (internal shorting across terminals)</td></tr>
<tr><td>49</td><td></td><td colspan="2">NC</td></tr>
<tr><td>50
51
52</td><td>M1
M2
M3</td><td colspan="2">OPEN
COM Control Output
CLOSE</td></tr>
<tr><td>53
54
55</td><td></td><td colspan="2">NC</td></tr>
<tr><td>23</td><td>COM</td><td rowspan="3">External control output DO (standard feature)</td><td></td></tr>
<tr><td>24
25
26</td><td>DO1
DO2
DO3</td><td>Darlington output</td></tr>
<tr><td>27
28</td><td>DO4
DO5</td><td>Open collector output</td></tr>
<tr><td>29
30
31
32
33</td><td>DI1
DI2
DI3
DI4
COM</td><td colspan="2">External control output D1 (standard)</td></tr>
<tr><td>34
35
36
37</td><td>DO6
DO7
DO8
DO9</td><td colspan="2">External control output DO
Open collector output (option)</td></tr>
</table>

Terminal No.	Symbol	Description
38 39 40 41 42 43 44	DI5 DI6 DI7 DI8 DI9 DI10 COM	External input DI5 to DI10 (option)
12 13 14	SG SD + RD -	Communication function (option)
15 16 17 18	COM EV1 EV2 EV3	Event output
19		NC
20 21 22	R1 R2 R3	Feedback potentiometer input

A receiving resistor of 1/2W 250Ω 0.1% is attached across input terminals (7-10) for use for the 0 to 20mA, and 4 to 20mA inputs.

1-5 Wiring

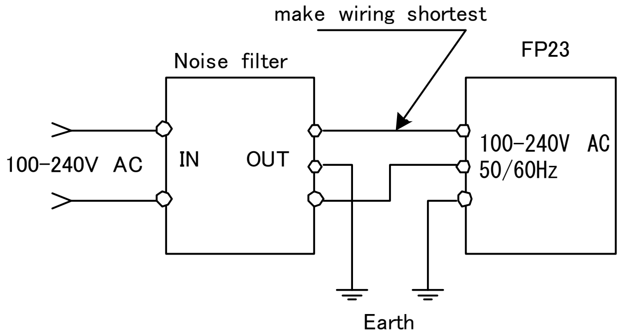
(1) Precautions for wiring

Caution

- To prevent electric shock, always turn off and disconnect this device from the power supply before starting wiring.
- Do not touch wired terminals or charged parts with your hands while the power is supplied.

Pay attention to the following points when performing wiring:

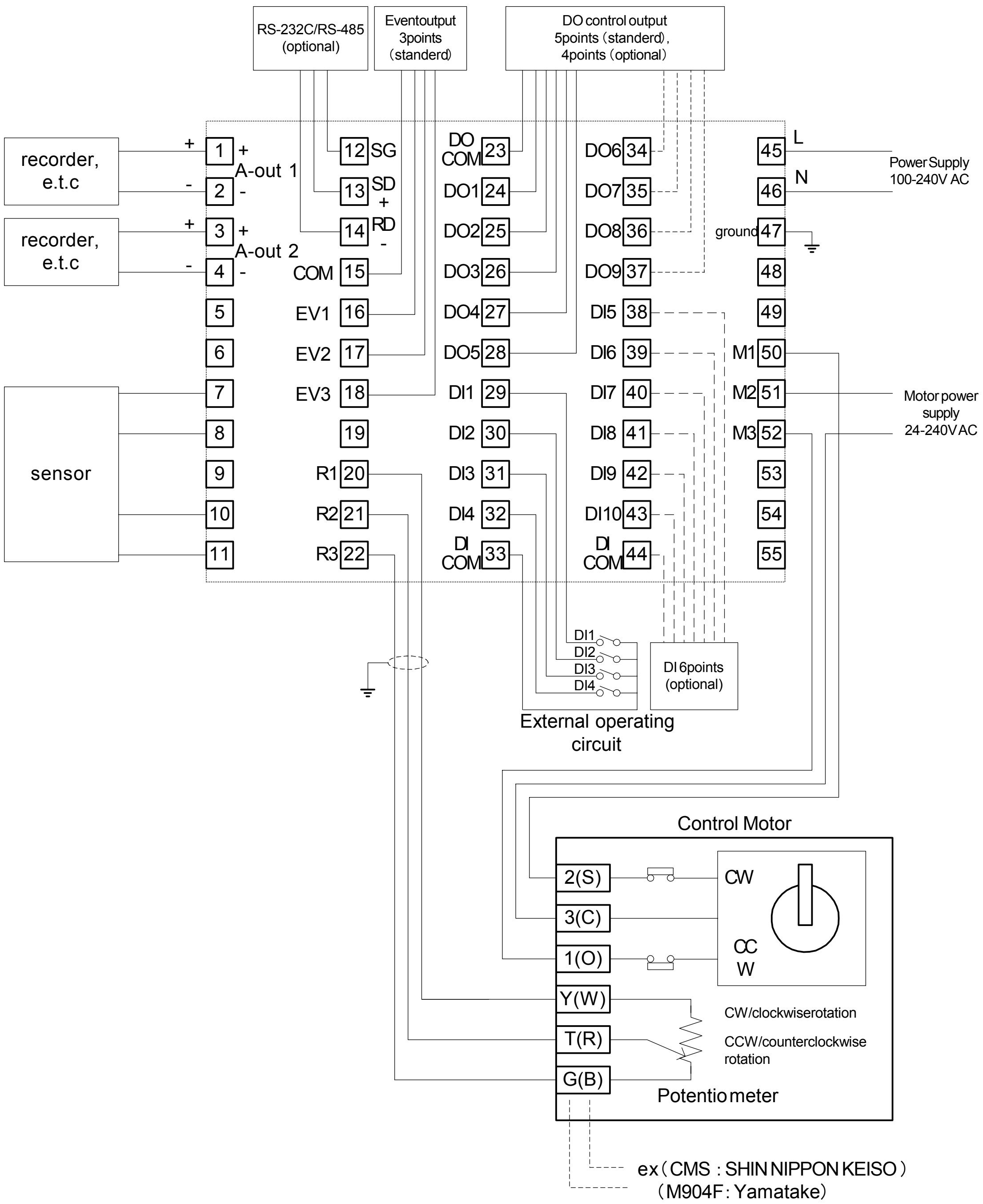
- Check that the wiring is free from mistakes according to "1-4 Rear Terminal Arrangement Diagrams."
- Use crimped terminals that accommodate an M3 screw and that have a width of 6.2 mm or less.
- For thermocouple input, use a compensation wire compatible with the type of thermocouple.
- For RTD input, the resistance of a single lead wire must be 10Ω or less and the three wires must have the same resistance.
- The input signal lead must not be passed along the same conduit or duct as that for high-voltage power lines.
- Shield wiring (single point grounding) is effective against static induction noise.
- Short interval twisted pair wiring is effective against electromagnetic induction noise.
- When wiring, use wire or cable (minimum 1 mm^2 cross-sectional area) of 600 V grade PVC insulated wire or equivalent wire having the same rating.
- For wiring the ground, ground the ground terminal with the earth resistance at less than 100Ω and with wire 2 mm^2 or thicker.
- Two earth terminals are provided, each connected internally. One is for the ground connection, and the other is for connecting the shield of the signal lead. Do not use the earth terminals for crossover wiring of the power system ground lead.
- If this device is considered as being susceptible to noise caused by the power supply, attach a noise filter to prevent abnormal functioning.
  Install a noise filter onto a grounded panel, and make the wire connecting the noise filter output and the power supply terminal on this controller as short as possible.



Recommended filter: ZMB2203-13 from TDK

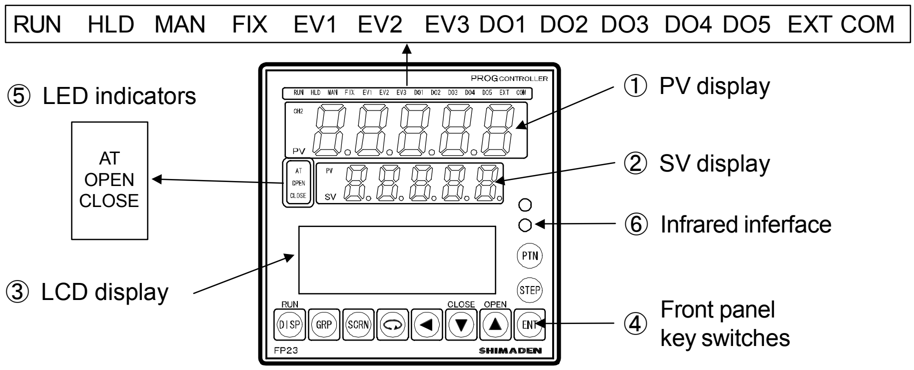
(2) Connection example

This instrument is designed to connect a control motor directly via the terminal M1, M2, and M3.
AC relay may have built-in CR absorber to protect its contact. DC relay use is recommended, because if AC relay is used as auxiliary relay, it cannot recover from magnetic excitation.
The terminal 47 and 48 are ground terminals.
One of these terminals should be connected to ground. Use another terminal in case the shield of the signal lead is running short.
Do not use the ground terminals for the power system ground lead.



As for how to connect motor, refer to the manuals/documents of motors.

2 NAMES & FUNCTIONS OF PARTS ON FRONT PANEL



①PV display

Displays the measured value (PV).
Displays an error message when an error (e.g. scale over) occurs.

②SV display

Displays the target set value (SV).

③LCD display (21 characters x 4 lines, max.)

- **Pattern/step No. display**
  Displays the pattern/step No. in the Program mode.
  In the "F" mode, "F" indicating the FIX mode is displayed at the PTN field and "- - -" is displayed at the STEP field.
  "- - - " at the STEP field goes out during control execution (RUN) in the FIX mode.
- **Output (OUT) display**
  The control output value (OUT1 or Posi) is displayed by a numerical value and a bar graph as a percentage (%).
- **Program monitor display**
  Displays the program status monitor.
- **Remaining step time display**
  Displays the remaining step time during program operation.
- **Pattern graph display**
  Displays the pattern (step) graph during program operation.
- **Screen title display**
  Displays the screen group title in the respective screen group top screen.
- **Setup parameter display**
  Parameters can be selected and displayed by front key operation.

④Key switches

RUN DISP	(Display key)	Displays the basic screen.
GRP	(Group key)	Changes the screen group. Or, returns to the screen group top screen.
SCRN	(Screen key)	Switches the parameter display screen in a screen group.
⮌	(Parameter key)	Selects the parameter to set up or change. The parameter to be changed is indicated by the cursor (►).
◄	(Shift key)	Moves the digit in set numerical values.
CLOSE ▼	(Down/CLOSE key)	Decrements parameters and numerical values during setup. When it is under the Manual mode, close output is set to on.
OPEN ▲	(Up/OPEN key)	Increments parameters and numerical values during setup. When it is under the Manual mode, open output is set to on.
ENT	(Entry key)	Resisters data or parameter numerical values.
STEP	(Step key)	At a reset, increments the start step No. in the basic screen. (ENT must be pressed to resister.)
PTN	(Pattern key)	At a reset, increments the start pattern No. in the basic screen. (ENT must be pressed to resister.)

The following key combination operations are available in screens from 0-1 to 0-6.

ENT + PTN : Hold (HLD) operation

ENT + STEP : Advance (ADV) operation

⑤LED indicators

■ Status lamps

RUN	green	Lights during control is being executed. Blinks during program start delay time (PRG.Wait).
HLD	green	Lights when the program is paused in Program mode. Blinks when the pause has caused by an input error in the Program mode or in the Fix mode.
MAN	green	Blinks when control output is set to manual operation (MAN).
FIX	green	Lights in the FIX mode.
EV1	orange	Lights during EV1 action.
EV2	orange	Lights during EV2 action.
EV3	orange	Lights during EV3 action.
DO1	orange	Lights during DO1 action.
DO2	orange	Lights during DO2 action.
DO3	orange	Lights during DO3 action.
DO4	orange	Lights during DO4 action.
DO5	orange	Lights during DO5 action.
EXT	green	Lights when start pattern No. selection (PTN2bit, PTN3bit, PTN4bit, PTN5bit) are set to DI5 to DI8.
COM	green	Lights during communication (COM) mode.
AT	green	Lights during auto tuning standby. Blinks during auto tuning execution.
OPEN	green	Lights when open output is on, and goes out when it is OFF.
CLOSE	green	Lights when close output is on, and goes out when it is OFF.

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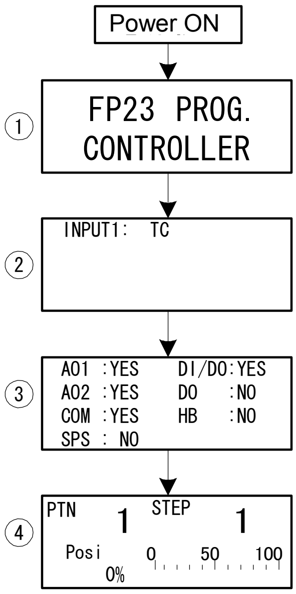
3 BASIC OPERATIONS

3-1 Power ON

When the power is turned ON, the basic screen is displayed after the initial screens are displayed on the LCD for about three seconds.
When the FP23 is powered ON for the first time, check on screen to make sure that this device is the one you ordered.



① **The series name is displayed.**

② **The I/O type is displayed.**
The figure shows a thermocouple (TC) set for Input 1.

③ **The installation status of option functions is displayed.**
The figure shows that Analog Output 1, Analog Output 2 and the communication function are installed (YES), SPS (sensor power supply) is not available (NO), DI (10 points) and DO (9 points) are installed (YES), and DO 13 points and the heater break alarm are not installed (NO).

④ **Basic screen (Monitor Group top screen)**
The figure shows that PTN.1 STEP1 position value is 0%.

The details displayed on screen vary according to specifications, or according to preset function specifications.

Note

- The actually installed numbers for external DI or DO can be confirmed with the above ③ screen.

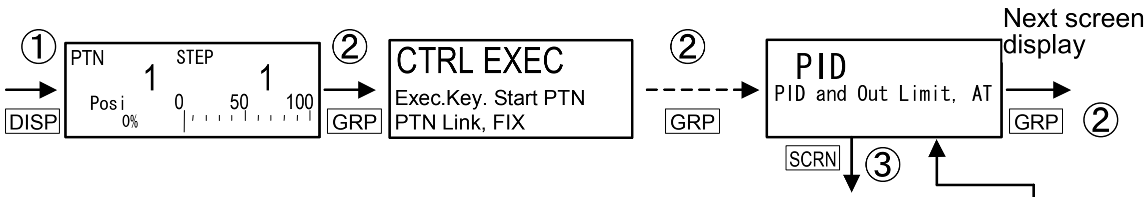
LCD Display		Actual numbers	
DI/DO	DO	DI	DO
NO	NO	4	5
YES	NO	10	9

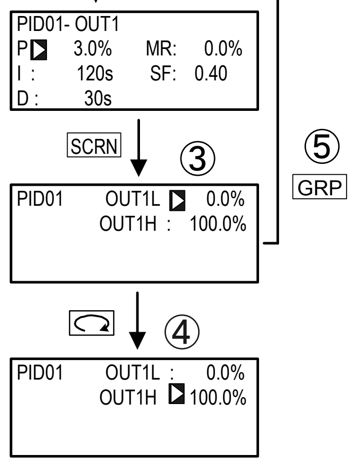
3-2 Switching LCD Screen Display and Moving the Cursor

(1) Switching the screen display

For details on moving between screens, see "LCD Flow Chart" in the preface.

The operation screens of this device are configured so that screens are displayed in order from the most frequently used screen in regular use.





① **To display the basic screen**
Press the DISP key.

② **To switch the display between screen groups**
Press the GRP key to successively switch screen group top screens.

③ **To switch setup screens within groups**
Press the SCRN key to successively switch screens.

④ **To move the cursor in a screen**
Press the ⟲ key to move the cursor (▶: blinking) when there are two or more parameters in the same screen.

⑤ **To display the top screen**
Press the GRP key in a respective parameter setup screen other than the basic screen group to switch to the top screen of a screen group.

3-3 Changing and Registering Data

Basically, set up and change parameters while confirming the LCD screen display.

(1) Entering numerical values

1. When there are two or more parameters, press the [↻] key to move the cursor (▶) to the parameter to be changed.
2. Press the [◄] or [▼], [▲] keys. The smallest digit of the numerical value blinks.
3. Press the [◄] key again. Move the blinking section in the numerical value to the digit to be changed, and change the value using the [▼] or [▲] key.
4. Press the [ENT] key. The numerical value is fixed and registered, and stops blinking.

■ Changing a numerical value setting (example)

The following shows the procedure for changing the value of PID parameter I to 100 s.

①
```
PID01-OUT1
P▶  3.0%    MR:  0.0%
I:  120s    SF: 0.40
D:   30s
```
↓ [↻]

②
```
PID01-OUT1
P:  3.0%    MR:  0.0%
I▶  120s    SF: 0.40
D:   30s
```
↓ [◄]

③
```
PID01-OUT1
P:  3.0%    MR:  0.0%
I▶  120s    SF: 0.40
D:   30s
```
↓ [▼]

④
```
PID01-OUT1
P:  3.0%    MR:  0.0%
I▶  100s    SF: 0.40
D:   30s
```
↓ [ENT]

⑤
```
PID01-OUT1
P:  3.0%    MR:  0.0%
I▶  100s    SF: 0.40
D:   30s
```

① **To move between screens**
Press the [GRP] key three times in the initial screen to display the top screen of the PID screen (group 3).
Next, press the [SCRN] key once.

② **To move the cursor from P to I**
Press the [↻] key once to move the blinking cursor (▶) to I.

③ **To make the I numerical value blink and move to the 10's digit**
Press the [◄] key twice to move the blinking cursor to the 10's digit.

④ **To change the numerical value of the 10's digit to 0**
Press the [▼] key to change the display from "2" to "0".

⑤ **To fix and register the setting**
Press the [ENT] key to fix the new setting.

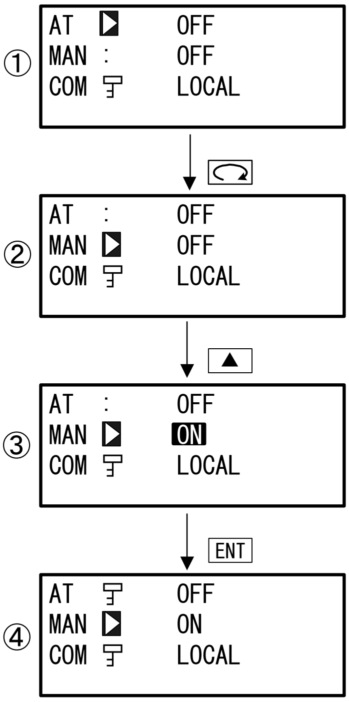
(2) Selecting setup items

The settings of parameters marked by a ⚿ key mark cannot be changed.

1. When there are two or more parameters, press the [↩] key to move the cursor (▶) to the parameter to be changed.
2. Change the parameter settings by the [▼] or [▲] key, check the setting, and press the [ENT] key to fix and register settings. The character stops blinking.

■ Selecting a parameter (example)

The following shows the procedure for changing control output to manual in the RUN mode.



① **To move between screens**
Press the [GRP] key once in the initial screen to display the top screen of the execution screen (group 1).
Next, press the [SCRN] key once.

② **To move the cursor from AT to MAN**
Press the [↩] key once to move the blinking cursor (▶) to MAN.

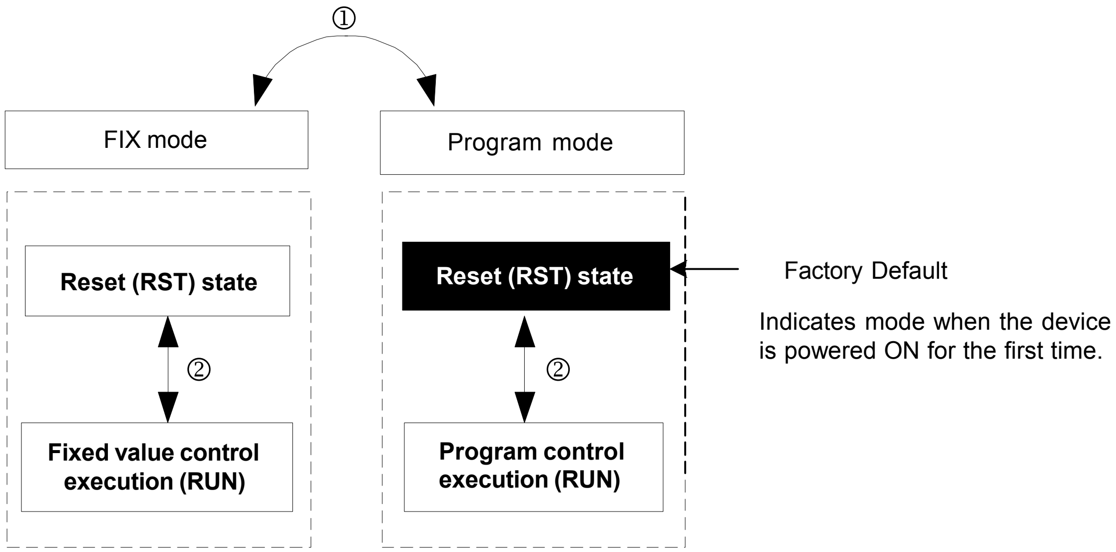
③ **To change the MAN setting from OFF to ON**
Press the [▲] key to change the display from OFF to ON.

④ **To fix and register the setting**
Press the [ENT] key to fix the new setting.
In this case, Auto Tuning can no longer be executed, and the key mark is displayed.

4 CONTROL MODES & FUNCTION BLOCKS

4-1 Control Modes

The FP23 has two control modes.
They are the "Program mode" for performing program operation, and the "FIX mode" for performing fixed value control.
The following illustrates how to move between the two modes.



The control mode is switched by the FIX mode ON/OFF settings in the FIX MODE screen (No.1 to 6). The Mode switches to the FIX (fixed value) mode when ON is set, and to the Program mode when OFF is set.

Switch RST/RUN by the ENT + DISP keys.

4-2 Reset State

The FP23 does not execute control when it is in a Reset State in both the Program mode and the FIX mode.
Note, however, that output at reset can be set in advance.
For details, see "14-2 (2) Output at reset."
Also, when the operation modes shown in the next page are assigned to EVENT/DO, EVENT/DO are not output in a reset state.

■ EVENT/DO operation modes that are not output in a reset state

Type	Action
DEV Hi	Higher limit deviation
DEV Low	Lower limit deviation
DEV Out	Outside higher/lower limit deviation
Posi.H	Position higher limit absolute value

Type	Action
DEV In	Inside higher/lower limit deviation
PV Hi	PV higher limit absolute value
PV Low	PV lower limit absolute value
Posi.L	Position lower limit absolute value

4-3 Program Functions

Up to 20 steps x 20 patterns can be stored to memory on this device.
Steps can be freely assigned as long as the total number of steps to assign to each pattern is within 400 steps.

For example, when you have completely used up the steps, set the number of steps allocated to pattern 20 to 0 (20 to 0), and change the number of steps in pattern 1 to 40 (20 to 40) as shown in the following example.

```
PTN                 CH
 20                  1
    Num. of STEP▶    0
    Start STEP   :   1
```

```
PTN                 CH
 01                  1
    Num. of STEP▶   40
    Start STEP   :   1
```

In this case, pattern 20 cannot be used in the program.

The FP23 is also installed with various program setup functions such as the pattern link function, pattern execution function, and step loop function.
The following briefly introduces these functions.

■ Pattern link function

Each of the patterns can be linked.
The pattern link can be set in any order.
Linking is not performed when the pattern link is set to 0.

```
1-3
PTN Link Reps:      1
Link Format
   1st▶  3    3rd:  4
   2nd:  1    4th:  6
```

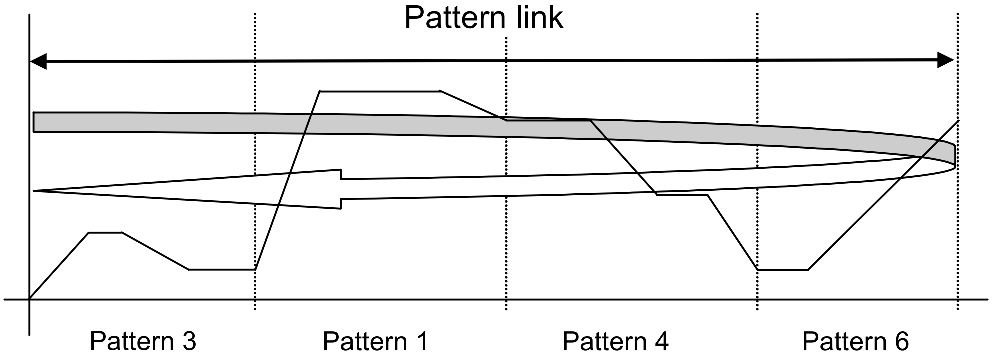
```
1-4
   5th▶  0     9th:  0
   6th:  0    10th:  0
   7th:  0    11th:  0
   8th:  0    12th:  0
```

```
1-5
  13th▶  0    17th:  0
  14th:  0    18th:  0
  15th:  0    19th:  0
  16th:  0    20th:  0
```

■ Pattern link execution function

Linked patterns can be executed repeatedly 1 to 9999 times.

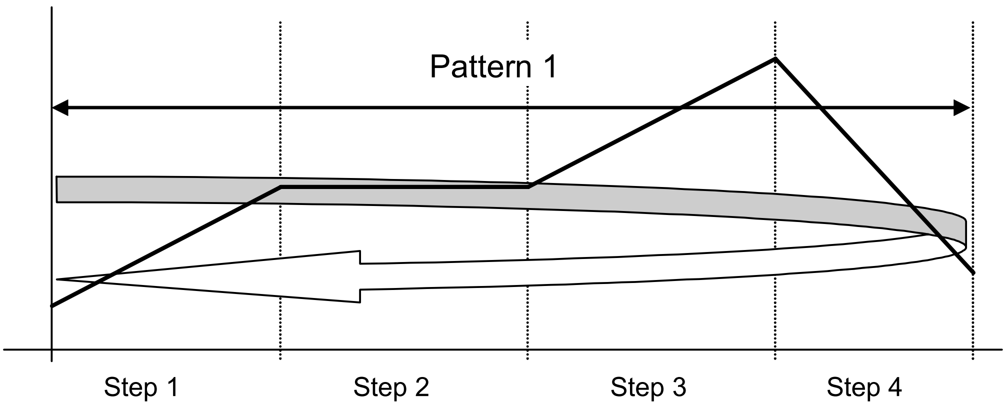
```
1-3
PTN Link Reps▶      2
Link Format
   1st:  3    3rd:  4
   2nd:  1    4th:  6
```



■ Pattern execution function

Any pattern can be executed repeatedly 1 to 9999 times

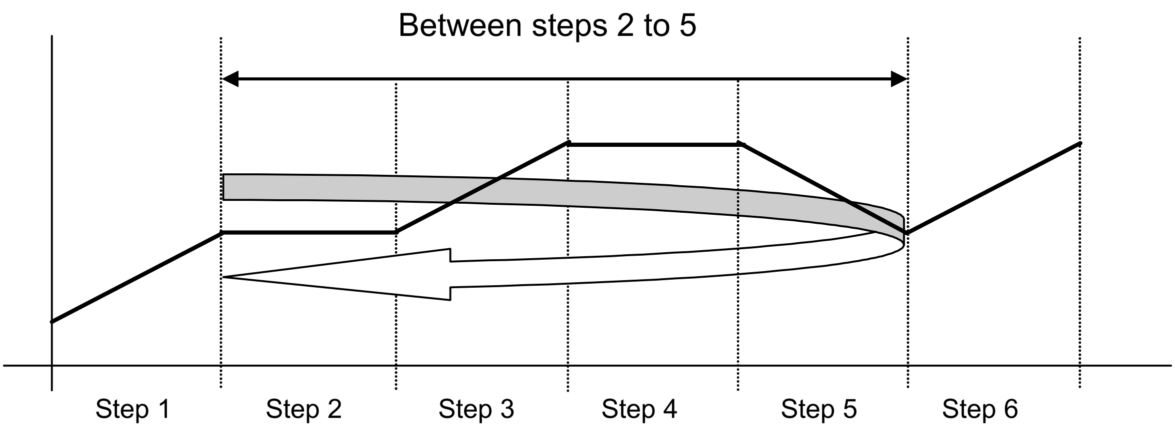
```
2-2
PTN
 01
    Start SV:      0.0℃
    PTN Reps▶         2
```



■ Step loop function

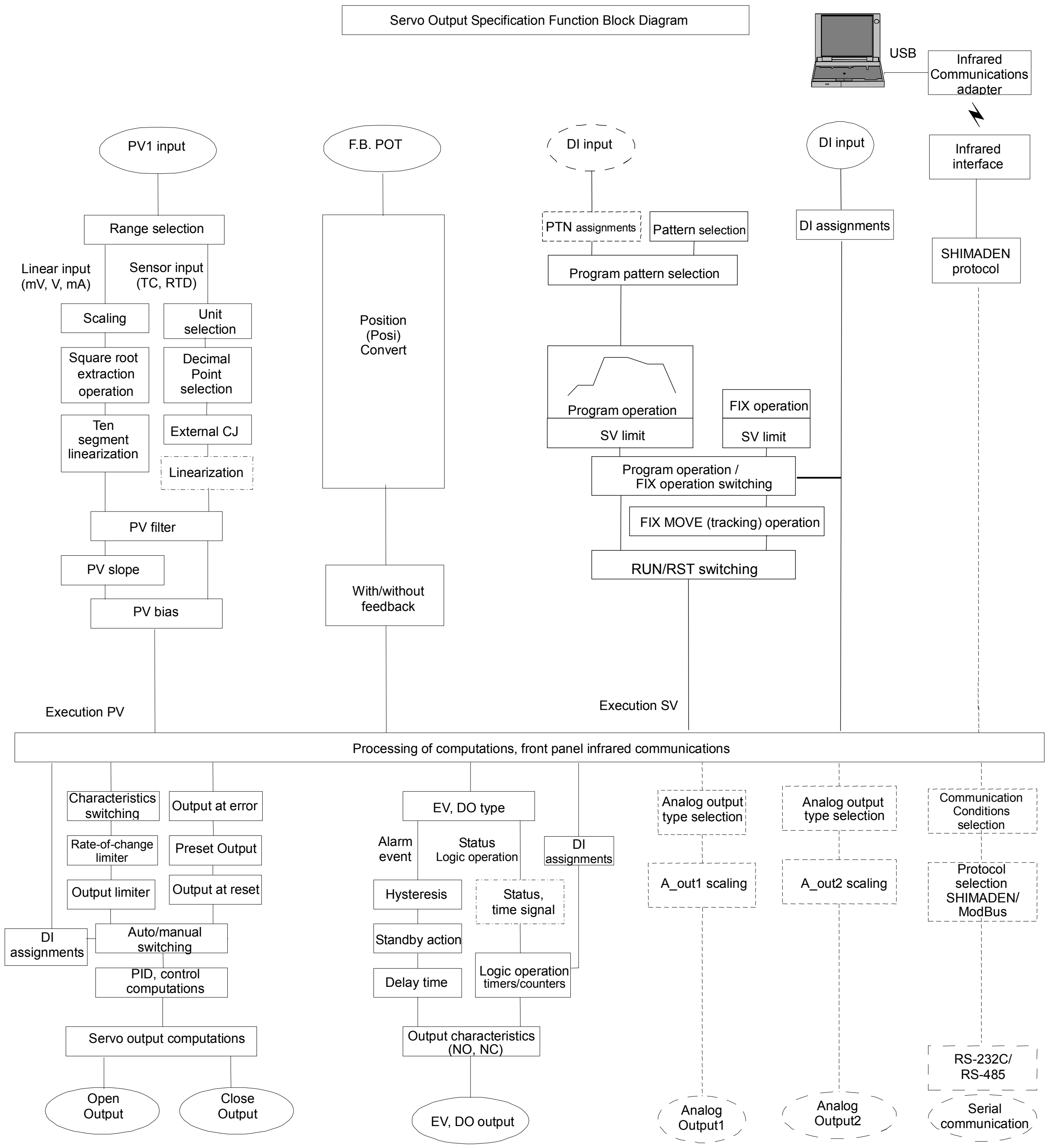
Any step can be executed repeatedly 1 to 9999 times.

```
2-3
PTN   Loop Setup
 01     Start▶    2
        End  :    5
        Reps :    2
```



4-4 CONTROL FUNCTION BLOCK DIAGRAMS

(1) Servo (with feedback/without feedback)



5 SETUP

5-1 Parameter Setup Procedure

Follow the procedure below to set up this device or change device settings when you use this device for the first time, change the operation parameters during use, or the control target device has been changed, for example.

Caution

With some operations, when you initialize this device, all parameter settings return to their factory defaults.
Before you initialize this device, note down and retain settings as required.

It is assumed that experienced personnel familiar with basic operation of this device will set up this device.
Users other than device manufacturers should thoroughly familiarize themselves with the functions to be used before they start to operate or set up this device.

Basic operations and setup of this device are described in detail from Chapter 6 onwards by following programming procedures.
Some screens and parameters are not displayed when option functions are not added on or when option functions are not selected.
For an overview of operation screens and how to move between screens, see "LCD Flow Chart" in the preface. For an overview of setup parameters, see "19 List of Parameters."

Set up parameters in the order shown below.

1. Confirm the Output Specification and Release the Key Lock.
   Perform this as necessary.
   For details, see "Chapter 6."
2. I/O Settings
   For details, see "Chapter 7."
3. I/O Auxiliary Settings
   For details, see "Chapter 8."
4. Program Settings
   Make "program initial settings," "step-related settings," "pattern-related settings," "pattern link-related settings," and "settings before program operation."
   For details, see "Chapter 9."
5. FIX Settings
   For details, see "Chapter 10."

6. PID Setting
For details, see "Chapter 11."

7. EVENT & DO Settings
For details, see "Chapter 12."

8. Option Settings (DI, AO, COM)
For details, see "Chapter 13."

9. Servo Functions Settings
After basic parameters are set or changed set servo relating parameters.
For details, see "Chapter 14".

10. Key Lock Setting
When setup of parameters are completed, set the key lock as necessary to prevent inadvertent operation.
For details, see "Chapter 15."

11. Monitoring, Executing & Stopping Operation
For details, see "Chapter 16."

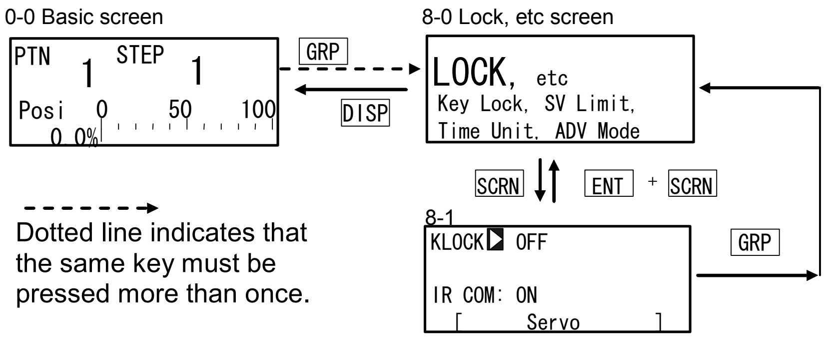
12. Operations During Control
For details, see "Chapter 17."

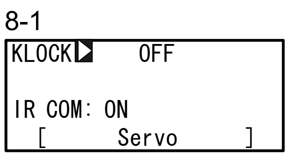
6 OUTPUT SPECIFICATION & KEY LOCK

Perform the following as necessary.

6-1 Confirming the Output Specification

The current output specification is displayed at the bottom row of the key lock, setting screen (No.8-1).
To call up the LOCK, etc. screen group (group 8) from the basic screen, press the GRP key.
Press the SCRN key in the LOCK, etc. screen group to switch to the screens for making and changing setups.



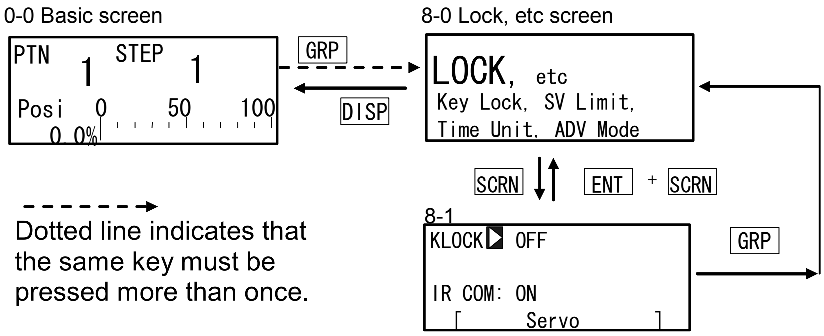


Servo: Servo output specification

6-2 Releasing the Key Lock

(1) Key lock screen display

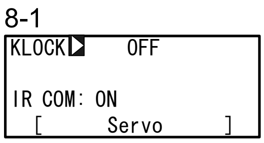
To call up the LOCK, etc. screen group (group 8) from the basic screen, press the [GRP] key.
Press the [SCRN] key in the LOCK, etc. screen group to switch to the screens for making and changing setups.



Select parameters in screens by pressing the [↩] key.
Set parameters by pressing the [◄] or [▼], [▲] key, and press the [ENT] key to fix and register settings.

(2) Releasing the key lock

When the key lock is applied, the (key mark) is displayed at the relevant parameter on the LCD screen indicating that the parameter cannot be set or its settings changed. The following shows the procedure for releasing the key lock.



Setting range	OFF, LOCK1, LOCK2, LOCK3
Initial value	OFF

OFF	Release the key lock
LOCK1	Locks parameters other than SV related, AT, MAN, or EVENT/DO action points
LOCK2	Locks parameters other than SV related
LOCK3	Locks all parameters (excluding the key lock parameter itself)

For details on parameters that are locked, see "19 List of Parameters."

7 INPUT SETTINGS

7-1 Infrared Communication

Allow the infrared communication using S5004 (Infrared Communication Adapter, selling separately). IR COM should be ON before the instrument parameters are set via infrared communication.
Parameter Assistant Software is also used for this communication. For details, see "Parameter Assistant Instruction Manual" which can be accessed from its Help menu.

```
8-1
KLOCK : OFF

IR COM▶ON
  [    Servo    ]
```

Setting range	ON, OFF
Initial value	ON

ON Infrared communication by S5004 is available.
OFF Infrared communication by S5004 is not available.

7-2 Measuring Range

Before performing setup, set control action to Reset State.
For details on operation to stop control, see "4-1 Control Modes."

(1) Range setting

```
7-2
RANGE▶06(K3)
Sc_L:      0.0℃
Sc_H:    800.0℃
UNIT:℃     DP   XXXX.X
```

Setting range	01 to 19, 31 to 58, 71 to 77, 81 to 87
Initial value	06 (K3)

When the range is changed in the above screen, the following confirmation message will be displayed.
Press the [▲] key to select YES, and press the [ENT] key to apply the setting.

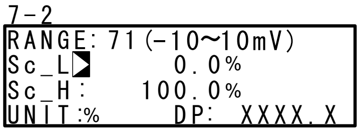
```
WARNING                      WARNING
Params Initialize     →      Params Initialize
     proceed? NO                  proceed? YES
```

Caution

- When the range is changed, the above warning message will be displayed, and parameters will be initialized.
  For details on parameters that are initialized, see "19 List of Parameters"

(2) Range scaling

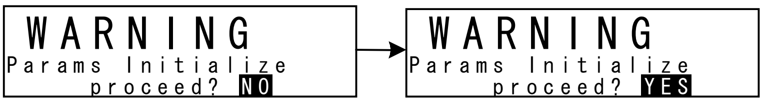
This item is set during voltage input and current input, and cannot be set during RTD and TC input. Set the measurement range (scaling). Sc_L is scaling of the lower limit side of PV, and Sc_H is scaling of the higher limit side of PV.



Settable range	-19999 to 30000 Unit
Measuring range	Minimum span: 10 Unit Maximum span: 30000 Unit Any setting within the above ranges is possible. (Note that Sc_L<Sc_H)
Initial value	Sc_L: 0 Unit Sc_H: 1000 Unit

The maximum span is (Sc_H - Sc_L) ≤ 30000.
When an Sc_L is set that causes the span to exceed 30000, a value that does not exceed span is automatically set to Sc_H.

When scaling is changed in the above screen, the following confirmation message will be displayed.
Press the ▲ key to select YES, and press the ENT key to apply the setting. The range will be changed.



Caution

- When the range is scaled, the above warning message will be displayed, and parameters will be initialized.
  For details on parameters that are initialized, see "19 List of Parameters."

■ Measuring Range Code Table

Input Type		Sensor Type	Code	Symbol	Measuring range	Measuring range
Universal Input	Thermo -couple	B *1	01	B	0.0 to 1800.0 °C	0 to 3300 °F
		R	02	R	0.0 to 1700.0 °C	0 to 3100 °F
		S	03	S	0.0 to 1700.0 °C	0 to 3100 °F
		K	04	K1	-100.0 to 400.0 °C	-150.0 to 750.0 °F
		K	05	K2	0.0 to 400.0 °C	0.0 to 750.0 °F
		K	06	K3	0.0 to 800.0 °C	0.0 to 1500.0 °F
		K	07	K4	0.0 to 1370.0 °C	0.0 to 2500.0 °F
		K *2	08	K5	-200.0 to 200.0 °C	-300.0 to 400.0 °F
		E	09	E	0.0 to 700.0 °C	0.0 to 1300.0 °F
		J	10	J	0.0 to 600.0 °C	0.0 to 1100.0 °F
		T *2	11	T	-200.0 to 200.0 °C	-300.0 to 400.0 °F
		N	12	N	0.0 to 1300.0 °C	0.0 to 2300.0 °F
		PL II	13	PLII	0.0 to 1300.0 °C	0.0 to 2300.0 °F
		PR40-20 *3	14	PR40-20	0.0 to 1800.0 °C	0 to 3300 °F
		WRe5-26	15	WRe5-26	0.0 to 2300.0 °C	0 to 4200 °F
		U	16	U	-200.0 to 200.0 °C	-300.0 to 400.0 °F
		L	17	L	0.0 to 600.0 °C	0.0 to 1100.0 °F
		K *4	18	K	10.0 to 350.0 K	10.0 to 350.0 K
		AuFe-Cr *5	19	AuFe-Cr	0.0 to 350.0 K	0.0 to 350.0 K
	RTD	Pt100 (new)JIS/IEC	31	Pt 1	-200.0 to 600.0 °C	-300.0 to 1100.0 °F
			32	Pt 2	-100.00 to 100.00 °C	-150.0 to 200.0 °F
			33	Pt 3	-100.0 to 300.0 °C	-150.0 to 600.0 °F
			34	Pt 4	-60.00 to 40.00 °C	-80.00 to 100.00 °F
			35	Pt 5	-50.00 to 50.00 °C	-60.00 to 120.00 °F
			36	Pt 6	-40.00 to 60.00 °C	-40.00 to 140.00 °F
			37	Pt 7	-20.00 to 80.00 °C	0.00 to 180.00 °F
			38	Pt 8 *6	0.000 to 30.000 °C	0.00 to 80.00 °F
			39	Pt 9	0.00 to 50.00 °C	0.00 to 120.00 °F
			40	Pt10	0.00 to 100.00 °C	0.00 to 200.00 °F
			41	Pt11	0.00 to 200.00 °C	0.0 to 400.0 °F
			42	Pt12 *7	0.00 to 300.00 °C	0.0 to 600.0 °F
			43	Pt13	0.0 to 300.0 °C	0.0 to 600.0 °F
			44	Pt14	0.0 to 500.0 °C	0.0 to 1000.0 °F

Input Type		Sensor Type	Code	Symbol	Measuring range	Measuring range
Universal Input	RTD	Pt100 (old) JIS/IEC	45	JPt 1	-200.0 to 500.0 °C	-300.0 to 900.0 °F
			46	JPt 2	-100.00 to 100.00 °C	-150.0 to 200.0 °F
			47	JPt 3	-100.0 to 300.0 °C	-150.0 to 600.0 °F
			48	JPt 4	-60.00 to 40.00 °C	-80.00 to 100.00 °F
			49	JPt 5	-50.00 to 50.00 °C	-60.00 to 120.00 °F
			50	JPt 6	-40.00 to 60.00 °C	-40.00 to 140.00 °F
			51	JPt 7	-20.00 to 80.00 °C	0.00 to 180.00 °F
			52	JPt 8 *6	0.000 to 30.000 °C	0.00 to 80.00 °F
			53	JPt 9	0.00 to 50.00 °C	0.00 to 120.00 °F
			54	JPt10	0.00 to 100.00 °C	0.00 to 200.00 °F
			55	JPt11	0.00 to 200.00 °C	0.0 to 400.0 °F
			56	JPt12 *7	0.00 to 300.00 °C	0.0 to 600.0 °F
			57	JPt13	0.0 to 300.0 °C	0.0 to 600.0 °F
			58	JPt14	0.0 to 500.0 °C	0.0 to 900.0 °F
	Voltage (mV)	-10 to 10 mV	71	-10 to 10 mV	Initial value : 0.0 to 100.0 Measuring range : Any value in the following ranges can be set by the scaling function. Scaling range : -19999 to 30000 counts Span : 10 to 30000 counts Scale over occurs when the input measured value exceeds 32000. When used with 0 to 20 mA, 4 to 20 mA current input, select either of measuring range codes 84 and 85, and attach a shunt resistor of 1/2W, 250Ω±0.1% to the input terminals.	
		0 to 10 mV	72	0 to 10 mV		
		0 to 20 mV	73	0 to 20 mV		
		0 to 50 mV	74	0 to 50 mV		
		10 to 50 mV	75	10 to 50 mV		
		0 to 100 mV	76	0 to 100 mV		
		-100 to 100 mV	77	-100 to 100 mV		
	Voltage (V)	-1 to 1 V	81	-1 to 1 V		
		0 to 1 V	82	0 to 1 V		
		0 to 2 V	83	0 to 2 V		
		0 to 5 V	84	0 to 5 V		
		1 to 5 V	85	1 to 5 V		
		0 to 10 V	86	0 to 10 V		
		-10 to 10 V	87	-10 to 10 V		

*1 : The accuracy of thermocouple B is not guaranteed at temperatures 400°C and 750°F or below.
*2 : Accuracy at temperatures -100°C (-148°F) or below ±(0.5%FS+1 digit).
*3 : Accuracy is ±(0.3%FS+1°C).
*4 : The accuracy of thermocouple K is ±(0.75%FS+1K)/10.0 to 30.0K, ±(0.30%FS+1K)/30.0 to 70.0K, ±(0.25%FS+1K)/70.0 to 350.0K.
*5 : The accuracy of thermocouple AuFe-Cr is ±(0.25%FS+1K).
*6 : The higher limit side scale over occurs when the input measured value exceeds 32.000.
*7 : The higher limit side scale over occurs when the input measured value exceeds 320.00.

7-3 Unit

Set the measurement unit.

```
7-2
RANGE:71(-10~10mV)
Sc_L:       0.0%
Sc_H:     100.0%
UNIT▶%      DP: XXXX.X
```

RTD, TC:

Setting range	°C, °F
Initial value	°C

Voltage, Current:

Setting range	°C, °F, %, None
Initial value	%

Only temperature (°C or °F) can be selected for RTD or TC input.
When the unit is changed in the above screen, the following confirmation message will be displayed at TC and RTD input. At voltage or current input, this warning message will not be displayed.
Press the ▲ key to select YES, and press the ENT key to apply the setting. The unit will be changed.

```
WARNING                          WARNING
Params Initialize        →       Params Initialize
    proceed? NO                      proceed? YES
```

Caution

- When the unit is changed, the above warning message will be displayed, and parameters will be initialized.
For details on parameters that are initialized, see "19 List of Parameters."

7-4 Decimal Point Position

(1) Decimal point position

This item can be set during voltage input, and cannot be set during RTD and TC input.
Set the decimal point position for PV display.

```
7-2
RANGE:71(-10~10mV)
Sc_L:       0.0%
Sc_H:     100.0%
UNIT:%      DP▶ XXXX.X
```

Setting range	xxxx.x to x.xxxx
Initial value	xxxx.x

(2) Switching the lowest digit past the decimal point

The lowest digit past the decimal point of measuring ranges determined by the range setting can be set.
Note, however, that this function cannot be used for measurement ranges without digits past the decimal point.
This screen is not displayed in the case of voltage input and current input.

```
7-3
Figure▶Normal
CJ    :Internal
```

Setting range	Normal, Short
Initial value	Normal

When "Figure" is changed in the above screen, the following confirmation message will be displayed.
Press the ▲ key to select YES, and press the ENT key to apply the setting.
"Figure" will be changed.

```
WARNING                      WARNING
Params Initialize      →     Params Initialize
    proceed? NO                  proceed? YES
```

Caution

- When the lowest digit is changed, the above warning message will be displayed, and parameters will be initialized.
  For details on parameters that are initialized, see "19 List of Parameters."

7-5 Cold Junction Compensation

(1) Thermocouple cold junction compensation

Set whether to perform cold junction compensation during TC input internally or externally.
Normally, set to internal compensation. Set to external compensation when greater accuracy is required.

```
7-3
Figure:Normal
CJ    ▶Internal
```

Setting range	Internal, External
Initial value	Internal

8 I/O AUXILIARY SETTINGS

8-1 PV Compensation Value

(1) PV bias

This item is used to compensate for error in the indicated temperature, for example, in the sensor/connected peripherals.

```
7-1
PV Bias▶      0.0
PV Filter:    OFF
PV Slope:   1.000
```

Setting range	-10000 to 10000 Unit
Initial value	0 Unit

(2) PV filter

When the PV signal contains noise, the control result sometimes is adversely affected by fluctuation of PV signals.
The PV filter is used to decrease this influence and stabilize control.

```
7-1
PV Bias:      0.0
PV Filter▶    OFF
PV Slope:   1.000
```

Setting range	OFF, 1 to 100 s
Initial value	OFF

PV filtering is performed by First Order Lag computation.
The filter time constant can be set up to 100 seconds.

When a large time constant is set, noise removal performance increases. However, in control systems having a fast response, noise removal is adversely affected.

(3) PV slope

This item sets the PV slope during voltage input and current input.
The screen is not displayed during RTD and TC input.

```
7-1
PV Bias:      0.0
PV Filter:    OFF
PV Slope▶   1.000
```

Setting range	0.500 to 1.500
Initial value	1.000

Execution PV = A x X + B where, A=PV input, X=PV slope, B=Bias

When this item is used in combination with square root extraction operation and linearizer approximation, this slope is applied to the result of square root extraction operation and linearizer approximation.

8-2 Square Root Extraction Operation

Signals having square root characteristics such as in the measurement of flow rates can be linearized.
This item is set during voltage input and current input.
This item is not displayed in the case of RTD or TC input.

(1) Enabling the square root extraction operation

The square root extraction operation function is valid when SQ.Root is set to ON.

```
7-3
SQ.Root▶ OFF
```

Setting range	ON, OFF
Initial value	OFF

(2) Low cut

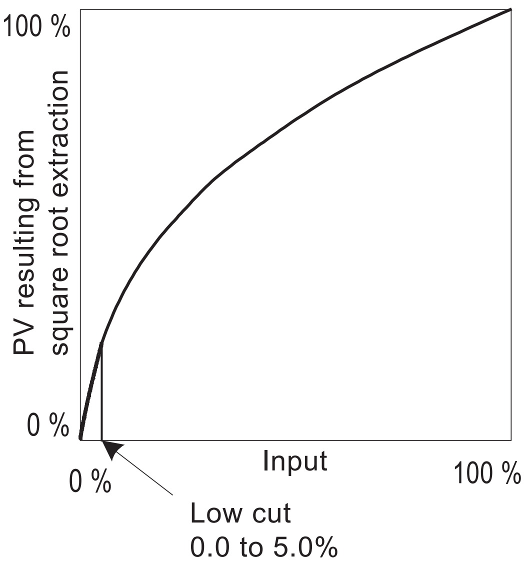
This item functions only when the square root extraction operation function is enabled.
Low cut processing is performed on the input before square root extraction operation is performed.

```
7-3
SQ.Root: ON
Low Cut▶ 1.0%
```

Setting range	0.0 to 5.0%
Initial value	1.0%

In square root operation, the PV fluctuates greatly by a slight fluctuation of the input value in the vicinity of signal zero.
"Low cut" is a function for outputting "0" (zero) to PV at the preset input value or lower.
Setting low cut prevents action from becoming unstable when there is noise on the input signal line.

The set value of low cut is 0.0 to 5.0% of the PV input range.



8-3 Setting the Ten-Segment Linearizer Approximation

(1) Enabling ten-segment linearizer approximation

This function performs linearization based upon ten-segment approximation when the PV input is a non-linear signal.
This item is set during voltage input and current input.
The screen is not displayed during RTD and TC input.

```
7-4
PMD▶ OFF
```

Setting range	ON, OFF
Initial value	OFF

(2) Setting input points

Set the input points in the case of ten-segment linearizer approximation input. Set PV display value (B) to PV input value (A).
When the value of B is smaller than the value of the previous A, values of B from then onwards are invalid.

```
7-4
PMD: ON

A 1▶    0.00%
B 1:    0.00%
```

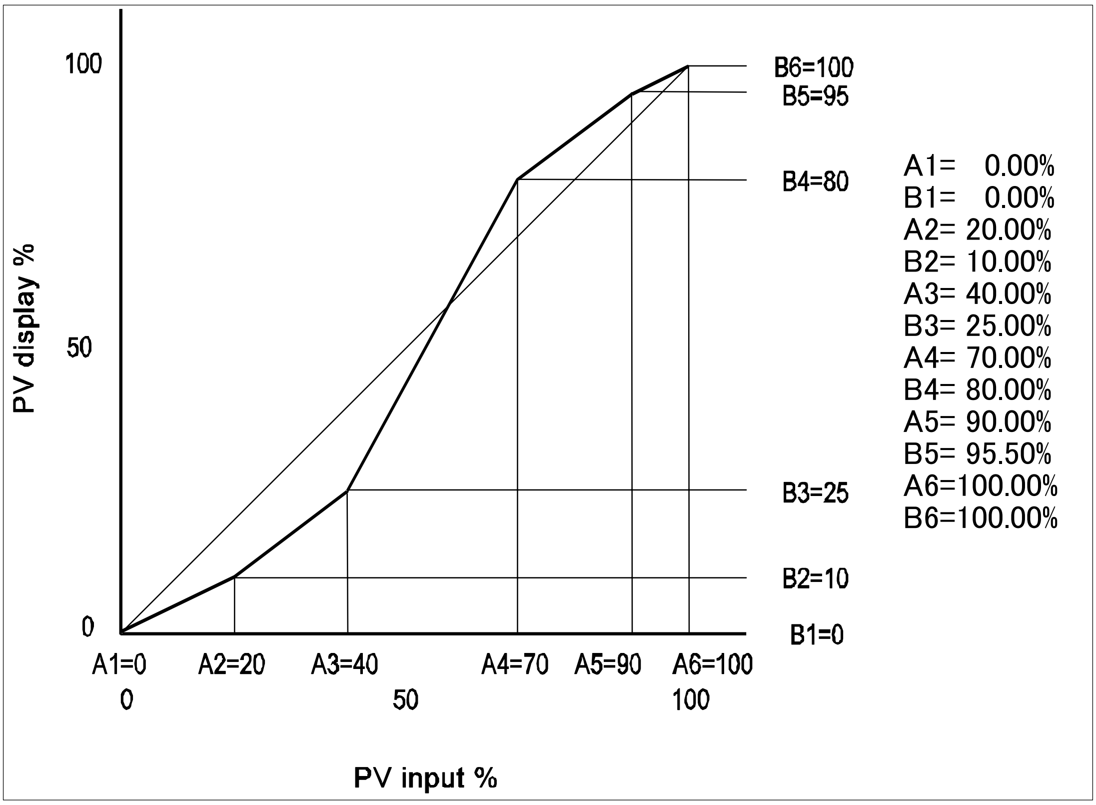
```
7-9
A10▶    0.00%
B10:    0.00%
A11:    0.00%
B11:    0.00%
```

Up to 11 points can be set. 11 points (B1 to B11) can be set for PV display (%) on PV 11 inputs (A1 to A11). For each input point, B1 is set to A1, B2 for A2 and so forth until B11 is set to A11, and linear interpolation is executed between input points.
This item is set during voltage input and current input.
The screen is not displayed during RTD and TC input.

Setting range	An, Bn: -5.00 to 105.00%
Initial value	An, Bn: 0.00%

■ Ten-segment linearizer setting (example)

In the following figure, A1, B1 to A6, B6 are used to set input points with four intermediate points.
For before A1 and from A6 onwards, the ramps of (AI, B1) to (A2, B2) and the ramps of (A5, B5) to (A6, B6) are applied.



Caution

- Set so that the relationship An < A (n+1) is satisfied.
  When the relationship becomes An ≥ A (n+1), A (n+1) onwards becomes invalid.

8-4 Limiters

(1) Output rate-of-change limiter

Set this setting item when a control target that is adverse to sudden changes in output is used.

```
6-2
Rate Limiter
 OUT1▶OFF
```

Setting range
  OUT1: OFF, 0.1 to 100.0 %/s
Initial value
  OUT1: OFF

(2) SV limiter

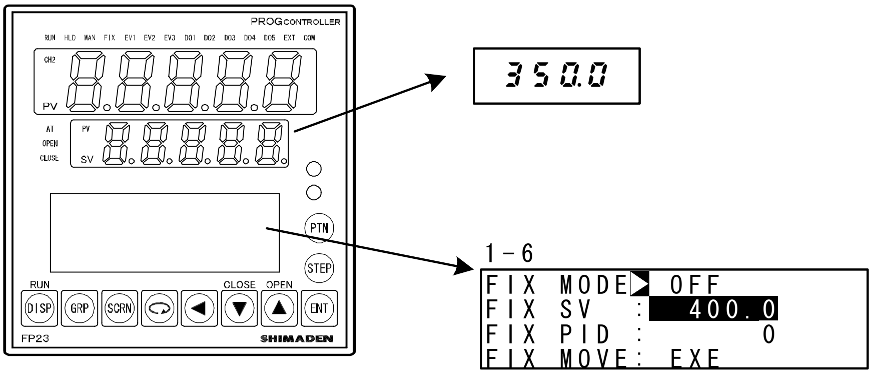
The SV limit is used to prevent a wrongful setting. Set the lower limit value and higher limit value of the SV value setting range.

```
8-2
SV Limit_L▶    0.0℃
SV Limit_H: 1370.0℃
```

Setting range		Within measuring range SV Limit L<SV Limit H)
Initial value		
	SV Limit_L	Lower limit value of measuring range
	SV Limit_H	Higher limit value of measuring range

If the preset SV value (FIX SV, Start SV, STEP SV) exceeds the SV limit, the SV value will be displayed inverted in white as shown below, and the SV value will be replaced internally with the limiter value, and the limit-cut SV value will be displayed on the SV display.

Ex) When FIX SV value is set to 400.0°C with RANGE 04(K1) –100.0 to 400.0°C, and then SV Limit_H is set to 350.0°C



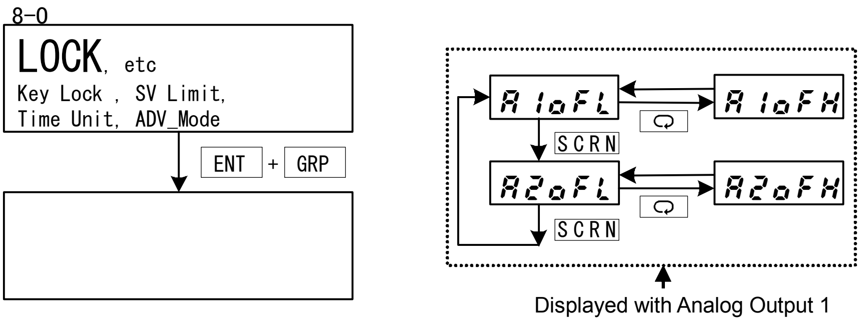
The white-inverted section indicates limiter over.

8-5 Compensating Control Output/Analog Output

Error that occurs in control output (at linear output) or analog output can be compensated.

1. Set the control action to the reset state.
For details on how to set to the reset state, see "4-1 Control modes."

2. Set the count value.
Call up the LOCK, etc. top screen (group 8) from the basic screen by the [GRP] key.
Move to the setup screen by holding down the [ENT] key and pressing the [GRP] key for at least 3 seconds, and select the output to compensate by pressing the [SCRN] and [↩] keys. Set the count value currently displayed on the SV display with the [▼] or [▲] key, and press the [ENT] key to fix and register settings



* LDC display will be blank

Displayed with Analog Output 1 or 2 (optional) respectively

PV Display	Description	PV Display	Description
A1oFL	Analog Output 1 lower limit value	A1oFH	Analog Output 1 higher limit value
A2oFL	Analog Output 2 lower limit value	A2oFH	Analog Output 2 higher limit value

When "0" is set, settings return to factory defaults.

4. When you have finished setting the above, press the [DISP] key to return to the LOCK, etc. screen.

9 PROGRAM SETTINGS

9-1 Program Initial Settings

(1) Time unit

Set the unit of time that is currently used in various items such as step time or time signal.
Set control action to Reset State before performing this operation.

```
8-3
Time Unit▶ H/M
PRG.Wait :  00h00m
SO Mode  :  HLD
POWER ON :  RESET
```

Setting range	H/M, M/S
Initial value	H/M

H/M	hours/minutes
M/S	minutes/seconds

(2) Program start delay time

The delay time until start of program control execution can be set.
The time unit is fixed to H/M.
The RUN lamp blinks for that duration that the delay time is active after program control execution is started.
Program control is started, and the RUN lamp lights after the preset delay time has elapsed.

```
8-3
Time Unit:  H/M
PRG.Wait ▶  00h00m
SO Mode  :  HLD
POWER ON :  RESET
```

Setting range	00h00m to 99h59m
Initial value	00h00m

(3) Input error mode

Set processing when a sensor breaks or a scale over or other error occurs during program control.

```
8-3
Time Unit:  H/M
PRG.Wait :  00h00m
SO Mode  ▶  HLD
POWER ON :  RESET
```

Setting range	HLD, RUN, RESET
Initial value	HLD

HLD	Sets a hold state until the device is restored from scale over or a reset is performed. Note, however, that this differs from a regular hold state in that the setting value of the output at error continues to be output. For details, see "14-2 (3) Output at input error."
RUN	Program action continues until the end of the program or a reset is input. Note, however, that this differs from a regular RUN state in that the setting value of the output at error continues to be output. For details, see "14-2 (3) Output at input error."
RESET	Releases and resets program operation.

(4) Power failure compensation

Set in which state of the device is to be restored when the power is turned ON again after a power failure during program execution.

```
8-3
Time Unit: H/M
PRG.Wait : 00h00m
SO Mode  : HLD
POWER ON ▶ RESET
```

Setting range RESET, CONTINUE
Initial value RESET

RESET During Program control, the state that was active before the power fail is not held, and the device is reset when the power is turned ON again.

CONTINUE During Program control, the state that was active before the power interrupt is held. (During FIX control, the state that was active before the power interrupt is held at all times.)
Excluding the following:
1. AT execution
2. Change in state of DI input
3. PID No. when the hysteresis of zone PID is taken into consideration

(5) Advance mode

Set the details of advance operation.
For details on advance operation, refer to "17-5 Executing Advance (ADV)".

```
8-4
ADV Mode▶ Step
ADV Time: 00h00m
```

Setting range Step, Time
Initial value Step

Step Advances the program by steps.
Time Advances the program by time.
When there is a part that exceeds the step width time in the time set here, that part becomes invalid, and the program advances to the start of the next step immediately when the step width time is exceeded.

(6) Advance time

Set the advance time when the advance mode is set to [Time].

```
8-4
ADV Mode: Time
ADV Time▶ 00h00m
```

Setting range 00:00 to 99:59
Initial value 00:00

Note

- When "00:00" is set, time advance does not function.

9-2 Step-related Settings

Make settings for each step.
The following describes setup operation using start pattern 1 and step 1 as an example.

(1) Step SV value

Set the SV value of step 1.

```
2S-1
PTN
 01    SV ▶      0.0℃
STEP   Time:   00h01m
 001   PID :        0
```

Setting range	Within SV limiter setting range
Initial value	0.0

Note

```
2S-1
PTN
 01    SV ▶    400.0℃
STEP   Time:   00h00m
 001   PID :        0
```

- When the STEP SV value exceeds the limit, the SV value is highlighted as shown left side.
- The SV value displayed reversed in white is replaced internally with the limiter value, and the SV value cut by the limiter is displayed on the SV display.
- For details, see "8-4 (2) SV limiter."

(2) Step Time

Set the time of step 1.

```
2S-1
PTN
 01    SV  :     0.0℃
STEP   Time▶   00h01m
 001   PID :        0
```

Setting range	00:00 to 99:59
Initial value	00:01

(3) Step PID No.

Set the PID No. of step 1 execution.

```
2S-1
PTN
 01    SV  :     0.0℃
STEP   Time:   00h01m
 001   PID ▶        0
```

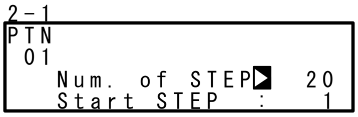
Setting range	0 to10
Initial value	0

When PID=0 is set, the previous execution step PID No. is looked up.
When PID=0 is set to the start step, the program is executed by PID No.1 at the start of the program.

9-3 Pattern-related Settings

(1) Number of steps

Set the number of steps to be used in the program pattern.



Setting range	0 to 400
Initial value	PTN1: 20 Other: 0

Set control action to a stopped (reset) state before performing this operation.

(2) Start step

Set the step at program start.

Setting range	0 to number of steps
Initial value	PTN1: 1 Other: 0

When "0" is set, that pattern becomes invalid.

Note

- This parameter can also be set before execution of program control in the basic screen. For details, see "16-2 Operations in Basic Screen."

(3) Start SV

Set the SV value at start of the program.
The start SV function is enabled only when the program is started from step 1.

Setting range	Within SV limiter setting range
Initial value	0.0

Note

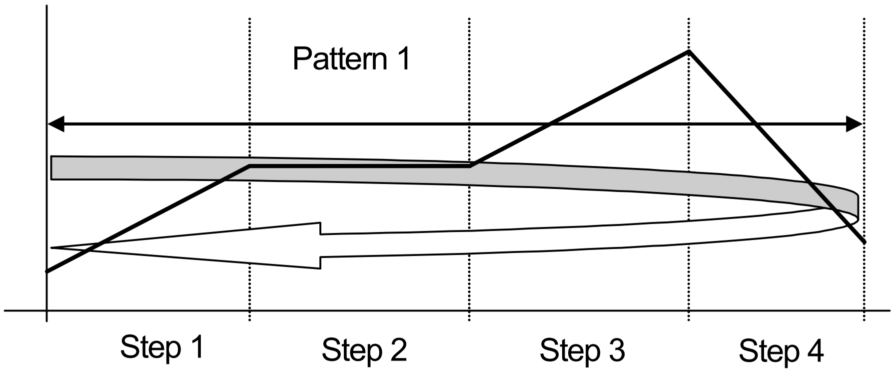
- When the Start SV value exceeds the limit, the SV value is highlighted as shown left side.
- The highlighted SV value is replaced internally with the limiter value, and the SV value cut by the limiter is displayed on the SV display.
- For details, see "8-4 (2) SV limiter."

(4) Pattern execution count

Set the execution count of the program pattern. When a pattern execution count smaller than the current execution count is set during program execution, the program pattern ends after execution up to the end step. (If the pattern is linked, the program moves to the next pattern.)

Setting range 1 to 9999
Initial value 1

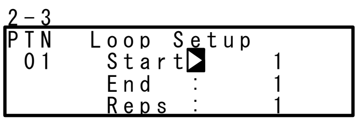
Ex) When the pattern execution count is set to "3" at PTN1 (from step 1 to 4)



PTN 1 is executed three times.

(5) Start step No. of step loop

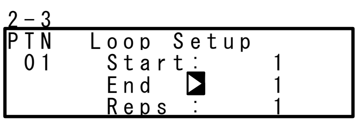
Set the start step No. during step loop.



Setting range 1 to number of steps
Initial value 1

(6) End step No. of step loop

Set the end step No. during step loop.



Setting range 1 to number of steps
Initial value 1

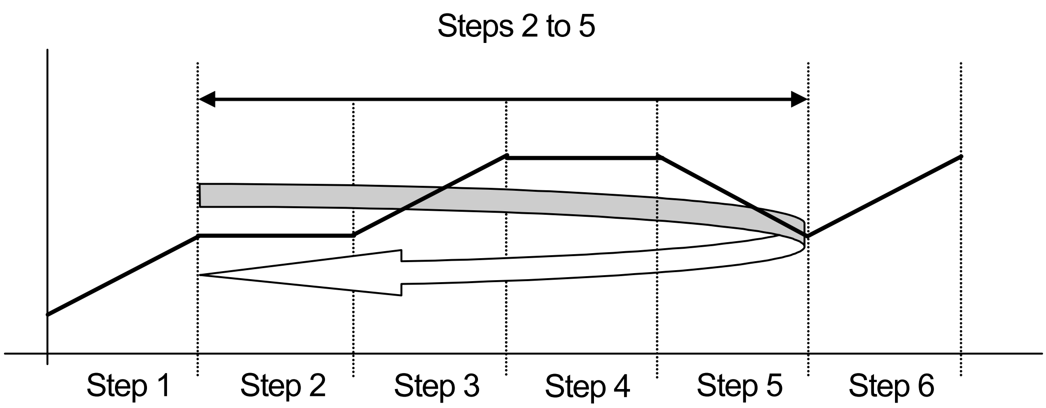
(7) Execution count of step loop

Set the execution count of the step loop.

```
2-3
PTN   Loop Setup
 01     Start:     2
        End  :     5
        Reps ▶     3
```

Setting range 1 to 9999
Initial value 1

Ex) When execution count is set to "3" at start step No.2 and end step No.5



Steps 2 to 5 are executed 3 times.

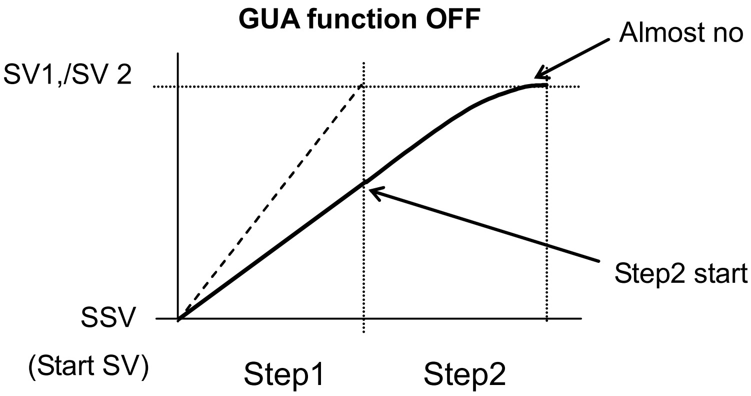
(8) Guarantee soak zone

Set the guarantee soak zone (hysteresis of guarantee soak function).
Set the setting value as a deviation with respect to the SV value of a flat step.

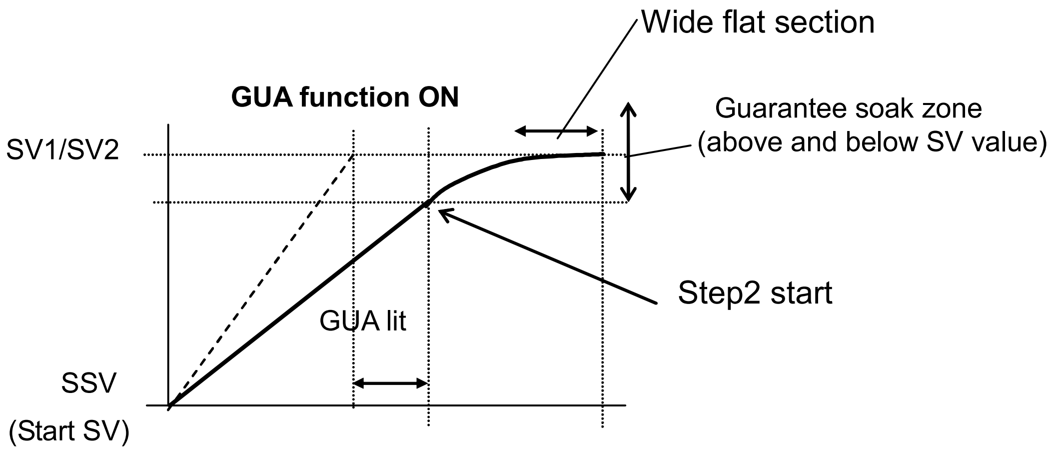
```
2-4
PTN   GUArantee Soak
 01        Zone▶  OFF
           Time:00h00m
     PV Start:    OFF
```

Setting range OFF,1 to 9999
Initial value OFF

> ***What is the guarantee soak (GUA) function?***
>
> During program control, when the SV value migrates from a ramp step to a flat step, the PV value sometimes can no longer track the SV value and the flat step time may become shorter on some control systems. This function is for avoiding this and assuring the time of the flat step.



Even if SV1 is not reached after step 1 time elapses, control migrates to step 2.



When the deviation between the step SV and PV of the flat step does not enter the guarantee soak zone when the ramp step switches to the flat step, the program does not move to the next step, and program execution stands by until this region is reached or the GUA time ends.
In this standby state, the GUA lamp lights in the status monitor screen (0-2).

Note

- Even if step 1 is flat (SSV = SV1) when the RST mode changes to the PROG mode, guarantee soak is performed.
- Even in steps where the step time is set to "00:00", guarantee soak is performed if the guarantee soak conditions are satisfied.

(9) Guarantee soak time

Set the guarantee soak time. Time measurement is performed at the same time that the ramp step time ends, and the program moves to the flat step regardless of whether the PV value is inside or outside the zone when the preset time is reached.
Note, however, that when "00:00" is set, GUA continues until PV reaches the zone.

```
2-4
PTN  GUArantee Soak
 01       Zone:  OFF
          Time▶00h00m
     PV Start:   OFF
```

Setting range	00:00 to 99:59
Initial value	00:00

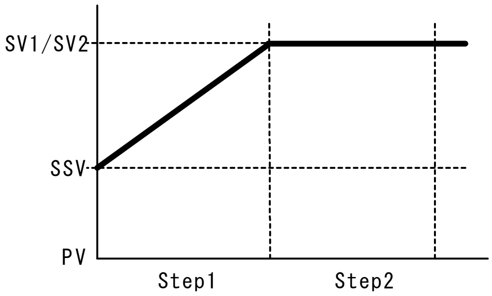
(10) PV start

When the start step at program execution is ramp control, and the value of difference between start SV value and PV value is larger, dead time occurs. To omit this dead time, set the PV value for the purpose of starting as the start SV. When PV start is OFF, execution starts from the start SV at all times.

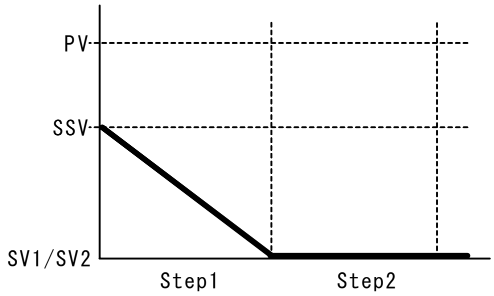
```
2-4
PTN  GUArantee Soak
 01       Zone:  OFF
          Time:00h00m
     PV Start▶   OFF
```

Setting range	ON/OFF
Initial value	OFF

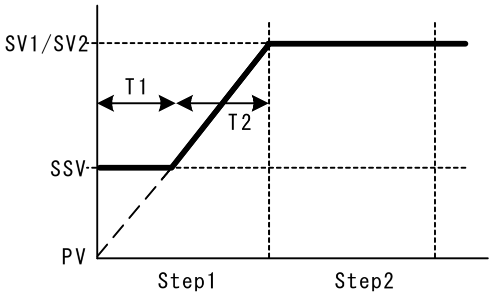
①PV≤SSV<SV1



④PV≥SSV>SV1



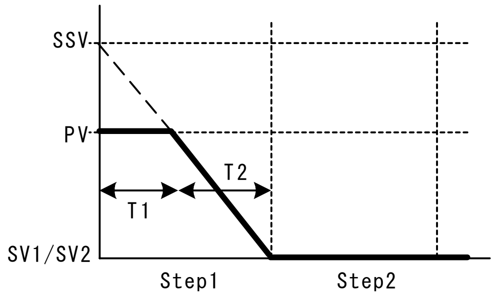
②SSV<PV≤SV1



T1: The time in this period is shortened to become PV start.

T2: Step1 time to be executed

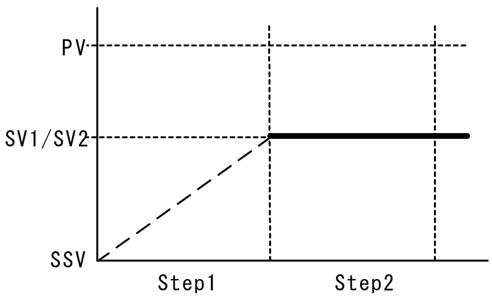
⑤SSV>PV≥SV1



T1: The time in this period is shortened to become PV start.

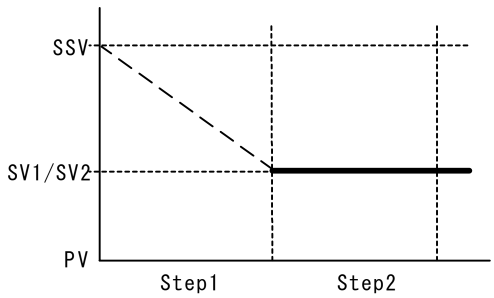
T2: Step1 time to be executed

③SSV<SV1<PV



In this case, the program advances to step 2, and step 1 is omitted.

⑥SSV>SV1>PV



In this case, the program advances to step 2, and step 1 is omitted.

*1 PV start is enabled only when the start step time is set to "00m01s" or more.

*2 Cautions in ② and ⑤ action
Due to the relationship with the device's internal resolution, an accurate SSV (start SV value) might not be calculated when the PV start function is started up by conditions such as a large step SV rate-of-change.

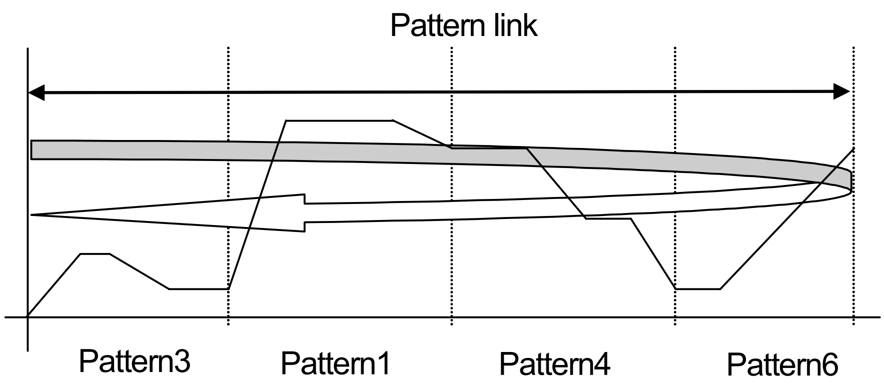
9-4 Pattern Link-related Settings

(1) Setting the pattern link execution count

Set the number of times that pattern link is executed.

```
1-3
PTN Link Reps▶     0
Link Format
  1st:  3   3rd:  4
  2nd:  1   4th:  6
```

Setting range	0 to 9999
Initial value	0



Note

- When "0" is set to the pattern link execution count, the link function is disabled.

(2) Pattern link

This setting is for linking (connecting) and operating each pattern by a program.
Set the pattern No. to be linked in order from 1st pattern.
Up to 20 patterns can be linked from 1st to 20th.
The same pattern can also be set repeatedly.

```
1-3
PTN Link Reps:     1
Link Format
  1st▶  3   3rd:  4
  2nd:  1   4th:  6
```

Setting range	0 to higher limit of assigned pattern
Initial value	0

Note

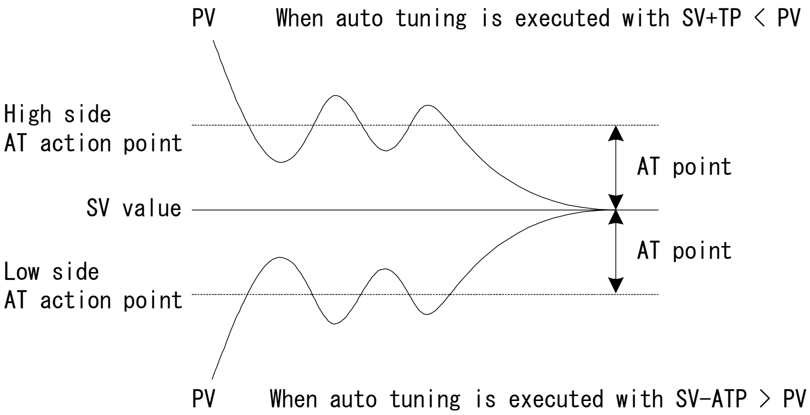
- When pattern 0 is set, the link to patterns set from then onwards becomes invalid.

9-5 Settings Before Program Operation

(1) Auto-tuning point

To avoid hunting resulting from limit cycle with SV value in executing Auto Tuning, set a hypothetical SV value to carry out Auto Tuning at a point away from the actual SV value.

Setting range	0, 1 to 10000 Unit
Initial value	0



Note

- For ATP (AT point), set the AT action points above and below the SV as a deviation.
- When auto tuning is executed with PV outside of the preset AT points above and below, auto tuning is performed at an AT point between PV and SV.
- When auto tuning is executed with the PV value inside the At action points above and below, auto tuning is performed using the SV value.
- When ATP is set to "0", the SV value becomes the AT action points.
- When zone PID SV is selected, AT points become invalid.

(2) Program EVENT/DO action points

Set the action points of each of EVENT/DO in the Program mode.
This screen is not displayed when an action other than the six actions shown below is set to EVENT/DO.

```
2-5
PTN EV Set Point
 01 EV1 HD▶  2500.0℃
    EV2 LD: -2500.0℃
    EV3 HD:  2500.0℃
```

```
2-6
PTN DO Set Point
 01 DO1 HD▶  2500.0℃
    DO2 LD: -2500.0℃
    DO3 HD:  2500.0℃
```

```
2-7
PTN DO Set Point
 01 DO4 HD▶  2500.0℃
    DO5 LD: -2500.0℃
```

```
2-8
PTN DO Set Point
 01 DO6 HD▶  2500.0℃
    DO7 LD: -2500.0℃
```

```
2-9
PTN DO Set Point
 01 DO8 HD▶  2500.0℃
    DO9 LD: -2500.0℃
```

Setting range

HD (DEV Hi)	Higher limit deviation	-25000 to 25000 Unit
LD (DEV Low)	Lower limit deviation	-25000 to 25000 Unit
OD (DEV Out)	Outside higher/lower limit deviation value	0 to 25000 Unit
ID (DEV In)	Inside higher/lower limit deviation value	0 to 25000 Unit
HA (PV Hi)	PV higher limit absolute value	Within measuring range
LA (PV Low)	PV lower limit absolute value	Within measuring range
PH (Posi.H)	Position higher limit absolute value	0 to 100 %
PL (Posi.L)	Position lower limit absolute value	0 to 100 %

Initial value

HD (DEV Hi)	Higher limit deviation value	25000 Unit
LD (DEV Low)	Lower limit deviation value	-25000 Unit
OD (DEV Out)	Outside higher/lower limit deviation value	25000 Unit
ID (DEV In)	Inside higher/lower limit deviation value	25000 Unit
HA (PV Hi)	PV higher limit absolute value	Within measuring range (higher limit value)
LA (PV Low)	PV lower limit absolute value	Within measuring range (lower limit value)
PH (Posi.H)	Position higher limit absolute value	100 %
PL (Posi.L)	Position lower limit absolute value	0 %

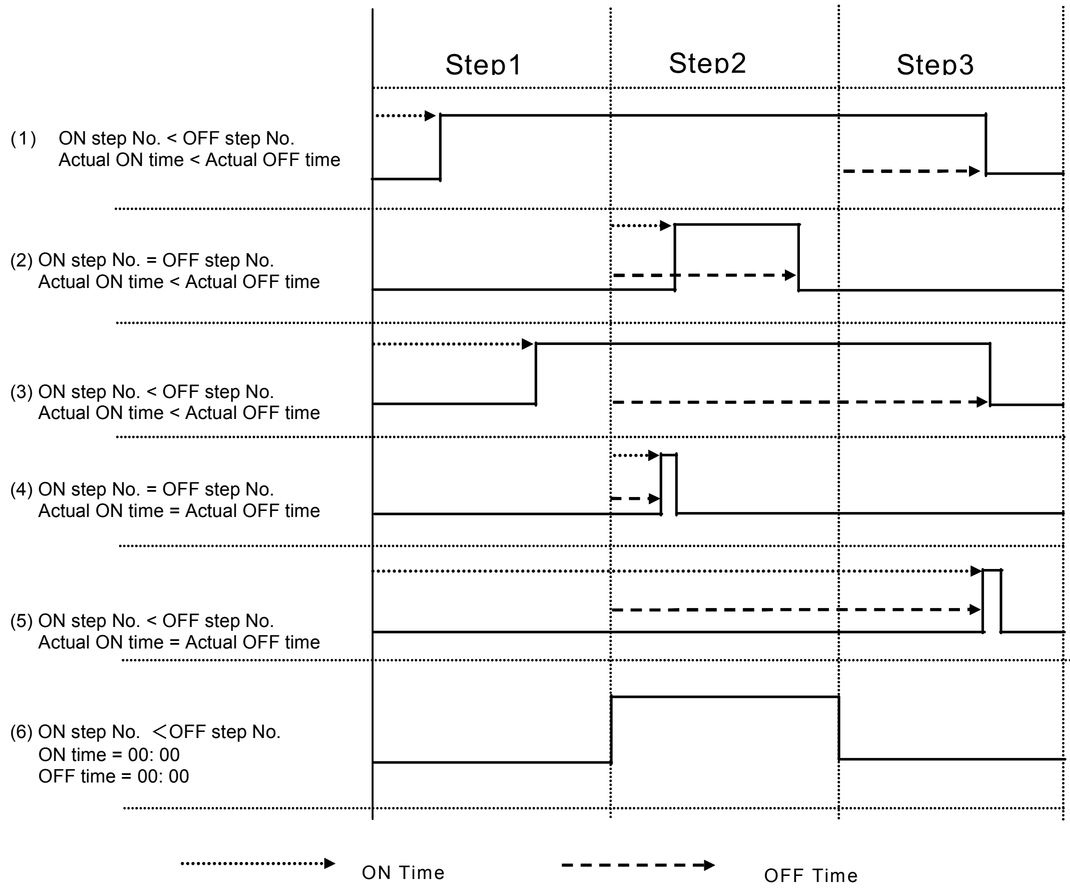
(3) Time signal (TS)

Eight time signals are available for each pattern.
The following screen descriptions are for Time Signal 1 (TS1).
To use a time signal as an external output, TS1 to TS8 must be assigned to EV1 to EV3 and DO1 to DO9 in the EVENT/DO screen group.

■Time signal enabling conditions

Though invalid conditions can be assigned, they do not function.

1) The ON step No. must already be set (must not be OFF).
2) The ON step No. ≤ the OFF step No.
   Note, however, that the actual ON time ≤ the actual OFF time.
   - When the ON step No. = OFF step No.
     TS turns ON for 1 second when the actual ON time = actual OFF time
   - When the ON step No. < OFF step No.
     TS turns ON for 1 second when the actual ON time = actual OFF time



Actual ON time: the time until Time Signal will be ON after the program has started
Actual OFF time: the time until Time Signal will be OFF after the program has started
ON time: Time signal ON time
OFF time: Time signal OFF time

< Other precautions relating to setting >

(1) The Time Signal (TS) tick is suspended during a Hold or Guarantee Soak.

(2) If TS turns ON when the OFF step assigned is OFF with the ON step and ON time both enabled, TS stays ON until the end of the pattern.

(3) When the OFF step or actual OFF time exceeds the end step time, TS output becomes OFF at the end of the pattern end step.
Note, however, that it becomes ON when the ON time at the next pattern is 00:00.

(4) When the ON time = step time, TS turns ON at the start of the next step. (including OFF time)

(5) When TS values have been changed in a Hold state during program execution, the values will not be updated until after the hold state is released.

①Time signal ON step No.

Set the step No. at which Time signal 1 (TS1) turns ON.

```
2-10
PTN   ON  STEP▶   OFF
 01   ON  Time:00h00m
     OFF  STEP:   OFF
TS1  OFF  Time:00h00m
```

Setting range	OFF, 1 to number of steps
Initial value	OFF

②Time signal ON time

Set the time from the start of the step at which Time signal 1 (TS1) turns ON up to when the signal actually turns ON.

```
2-10
PTN   ON  STEP:   OFF
 01   ON  Time▶00h00m
     OFF  STEP:   OFF
TS1  OFF  Time:00h00m
```

Setting range	00:00 to 99:59
Initial value	00:00

③Time signal OFF step No.

Set the step No. at which Time signal 1 (TS1) turns OFF.

```
2-10
PTN   ON  STEP:   OFF
 01   ON  Time:00h00m
     OFF  STEP▶   OFF
TS1  OFF  Time:00h00m
```

Setting range	OFF, 1 to number of steps
Initial value	OFF

④Time signal OFF time

Set the time from the start of the step at which Time signal 1 (TS1) turns OFF up to when the signal actually turns OFF

```
2-10
PTN   ON  STEP:    OFF
 01   ON  Time:00h00m
     OFF  STEP:    OFF
TS1  OFF  Time▶00h00m
```

Setting range	00:00 to 99:59
Initial value	00:00

(4) Start pattern No.

Set the start pattern No. when executing a program.
This screen belongs not to PROGRAM (program screen group) but to CTRL EXEC (execution screen group).

```
1-2
HLD:         OFF
ADV:         OFF

Start PTN▶     1
```

Setting range	1 to higher limit of assigned pattern
Initial value	1

Note

- This pattern can also be set before program control execution in the basic screen. For details, see "16-2 Operations in Basic Screen."

10 FIX SETTINGS

10-1 Switching the FIX Mode

The FP23 can be set to the FIX (fixed value control) mode.
Note that movement to the FIX mode when the Program mode is switched to the FIX mode varies according to the FIX MOVE setting.
For details, see "10-4 FIX MOVE".

```
1-6
FIX MODE▶ OFF
FIX SV  :     0.0℃
FIX PID :        1
FIX MOVE: EXE
```

Setting range	ON,OFF
Initial value	OFF

ON	FIX (fixed value control) mode
OFF	Program mode

Note

- Switching between the Program mode and the FIX mode is also possible in the basic screen.

10-2 FIX SV Value

Set the SV value during fixed value control (FIX mode: ON).

```
1-6
FIX MODE: OFF
FIX SV ▶      0.0℃
FIX PID :        1
FIX MOVE: EXE
```

Setting range	Within SV limiter setting range
Initial value	0 Unit

Note

```
1-6
FIX MODE▶ OFF
FIX SV  :   400.0℃
FIX PID :        1
FIX MOVE: EXE
```

- When the FIX SV value exceeds the limit, the SV value is highlighted as left side.
- The highlighted SV value is replaced internally with the limiter value, and the SV value cut by the limiter is displayed on the SV display.
- For details, see "8-4 (2) SV limiter."

10-3 FIX PID No.

Set the PID No. during fixed value control (FIX mode: ON).
The PID No. cannot be set when Zone PID is enabled. ("Zone" is displayed.)

```
1-6
FIX MODE: OFF
FIX SV  :     0.0℃
FIX PID ▶        1
FIX MOVE: EXE
```

Setting range	1 to 10
Initial value	1

10-4 FIX MOVE

Make detailed settings for when the FP23 enters FIX mode.

```
1-6
FIX MODE: OFF
FIX SV  :      0.0℃
FIX PID :        1
FIX MOVE▶ EXE
```

Setting range	EXE, EXE/STBY, EXE/TRCK
Initial value	EXE

EXE	Switch to RUN state when transferring to FIX mode.
EXE/STBY	Current (RUN/RST) state is maintained when transferring to FIX mode.
EXE/TRCK	In case of RST state, switch to RUN state when transferring to FIX mode. In case of RUN state, track the SV and PID No. that have been used just before, and switch to RUN state.

FIX MOVE	Before Move → After Move	Remarks
EXE	PRG RST → FIX RUN	Enters the RUN mode.
	PRG RUN → FIX RUN	Stays in the RUN mode.
EXE/STBY	PRG RST → FIX RST	Stays in the RST mode.
	PRG RUN → FIX RUN	Stays in the RUN mode.
EXE/TRCK	PRG RST → FIX RUN	Enters the RUN mode.
	PRG RUN → FIX RUN	Executing SV value and PID values are tracked.

Note

- When the FP23 moves from FIX mode to the Program mode, the FP23 maintains its current state (RUN or Reset).

10-5 FIX EVENT/DO Action Points

Set each of the EVENT/DO action points in the FIX mode.
This screen is not displayed when a mode other than the six actions shown below is set to EVENT/DO.

```
1-7
FIX EV Set Point
 EV1 HD▶  2500.0℃
 EV2 LD: -2500.0℃
 EV3 HD:  2500.0℃
```

```
1-8
FIX DO Set Point
 DO1 HD▶  2500.0℃
 DO2 LD: -2500.0℃
 DO3 HD:  2500.0℃
```

```
1-9
FIX DO Set Point
 DO4 HD▶  2500.0℃
 DO5 HD:  2500.0℃
```

```
1-10
FIX DO Set Point
 DO6 HD▶  2500.0℃
 DO7 HD:  2500.0℃
```

```
1-11
FIX DO Set Point
 DO8 HD▶  2500.0℃
 DO9 HD:  2500.0℃
```

Setting range

HD (DEV Hi)	Higher limit deviation	-25000 to 25000 Unit
LD (DEV Low)	Lower limit deviation	-25000 to 25000 Unit
OD (DEV Out)	Outside higher/lower limit deviation value	0 to 25000 Unit
ID (DEV In)	Inside higher/lower limit deviation value	0 to 25000 Unit
HA (PV Hi)	PV higher limit absolute value	Within measuring range
LA (PV Low)	PV lower limit absolute value	Within measuring range
PH (Posi.H)	Position higher limit absolute value	0 to 100 %
PL (Posi.L)	Position lower limit absolute value	0 to 100 %

Initial value

HD (DEV Hi)	Higher limit deviation value	25000 Unit
LD (DEV Low)	Lower limit deviation value	-25000 Unit
OD (DEV Out)	Outside higher/lower limit deviation value	25000 Unit
ID (DEV In)	Inside higher/lower limit deviation value	25000 Unit
HA (PV Hi)	PV higher limit absolute value	Within measuring range (higher limit value)
LA (PV Low)	PV lower limit absolute value	Within measuring range (lower limit value)
PH (Posi.H)	Position higher limit absolute value	100 %
PL (Posi.L)	Position lower limit absolute value	0 %

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11 PID SETTING

11-1 Proportional Band (P)

"Proportional band" refers to the range in which control output changes in proportion to the difference (deviation) between the measured value (PV) and the set value (SV). Here, set the percentage (%) that control output is made to change with respect to the measuring range.

When a wide proportional band is set, the change in the control output with respect to deviation decreases, and the offset (constant deviation) increases.
When a narrow proportional band is set, the change in the control output increases, and the offset decreases. If too narrow a proportional band is set, hunting (vibration) occurs, and action becomes similar to that of ON-OFF control.
When P=OFF is set, control becomes ON-OFF control, and auto tuning cannot be executed.

3-1

```
PID01-OUT1
P▶   3.0%    MR:  0.0%
I:   120s    SF: 0.40
D:    30s
```

Setting range	OFF, 0.1 to 999.9 %
Initial value	3.0 %

11-2 Integral Time (I)

Integral action is a function for correcting the offset (constant deviation) that occurs due to proportional action.
When a long integral time is set, offset correction action is weak, and it takes a long time to correct the offset. The shorter an integral time is set, the stronger the correction action becomes. However, if too short an integral time is set, hunting (vibration) occurs, and action becomes similar to that of ON-OFF control.

3-1

```
PID01-OUT1
P:   3.0%    MR:  0.0%
I▶   120s    SF: 0.40
D:    30s
```

Setting range	OFF, 1 to 6000 s
Initial value	120 s

When auto tuning is executed with I=OFF, the manual reset (MR) value is computed and automatically set.
For details on automatic setting of MR, see "11-4 Manual Reset (MR)."

11-3 Derivative Time (D)

Derivative action functions in two ways. It forecasts changes in the control output to reduce influence caused by external disturbance, and suppresses overshoot caused by integral action to improve control stability.

The shorter a derivative time is set, the weaker derivative action becomes. Alternatively, the longer a derivative time is set, the stronger derivative action becomes. However, if too long a derivative time is set, hunting (vibration) occurs, and action becomes similar to that of ON-OFF control.

3-1

```
PID01-OUT1
P:   3.0%    MR:  0.0%
I:   120s    SF: 0.40
D▶    30s
```

Setting range	OFF, 1 to 3600 s
Initial value	30 s

When auto tuning is executed with D=OFF, computation is performed only by PI value (proportional, integral).

11-4 Manual Reset (MR)

This function manually corrects offset that occurs when control action is performed by P or P+D (I=0) control.
When a + side MR value is set, the control result shifts to the + side, and when a – MR value is set, the control action shifts to the – side. The amount of shift is proportional to the size of the numerical value that is set.

3-1

```
PID01-OUT1
P:   3.0%    MR▶  0.0%
I:   OFF     SF: 0.40
D:    30s
```

Setting range	-50.0 to 50.0 %
Initial value	0.0 %

■ Automatic setting of MR

When auto tuning is executed with I=OFF, the manual reset (MR) value is computed and automatically set.
During PID control, MR is used as the target load ratio in PID initial operation.
For this reason, to reduce overshoot when the power is turned ON or when RST is switched to RUN, set a small MR value to lower this target load ratio.
When auto tuning is performed by PID control on the FP23, the load ratio is calculated so that offset is decreased even if there is no I action, and a value corresponding to the manual reset is automatically set.
This function enables control results superior to those enabled by regular PID control to be obtained.

11-5 Action Hysteresis (DF)

This item sets the hysteresis (DF) in ON-OFF control action when P is set to OFF.
When a narrow hysteresis is set, chattering is more likely to occur on the output.
When a wide hysteresis is set, chattering, etc. can be avoided and stable control action can be obtained.

3-1

```
PID01-OUT1
P:   OFF
DF▶    2.0 ℃
```

Setting range	1 to 9999 Unit
Initial value	20 Unit

11-6 Set Value Function (SF)

This function determines the strength for preventing overshooting that occurs during Expert PID control.
Set Value Function is valid only when integral action (PI or PID) is set.

3-1

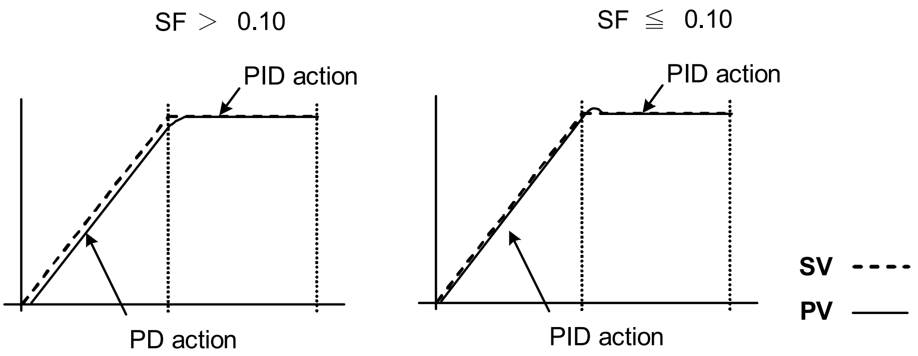
```
PID01-OUT1
P:    3.0%     MR:  0.0%
I:    OFF      SF▶0.40
D:     30s
```

Setting range	0.00 to 1.00
Initial value	0.40

SF = 0.00	Regular PID control is carried out, and the overshoot correction function is disabled.
SF → Small	Overshoot correction is small.
SF → Large	Overshoot correction is large.

■ Reference: About PID action according to set value function (SF)

During a ramp step, PID and PD action can be switched automatically by the SF value.
Overshooting in flat steps can be reduced by controlling a ramp step by PD section.



11-7 Output Limit Value (OUT1L to OUT1H)

This is the screen for setting the lower limit value and higher limit value of the control output corresponding to the PID No.

Though regular control is performed using the initial values as they are, these lower limit and higher limit values are used for control that requires higher accuracy.
In a heating control specification, set a lower limit value when the return value is slow arriving due to overshoot at the upper side. For control targets whose temperature immediately drops when the temperature rise is slow and output is lowered.

3-2

```
PID01  OUT1L▶    0.0%
       OUT1H:  100.0%
```

Setting range

Lower limit value	0.0 to 99.9 %
Higher limit value	0.1 to 100.0 %
	(Lower limit value < Higher limit value)

Initial value

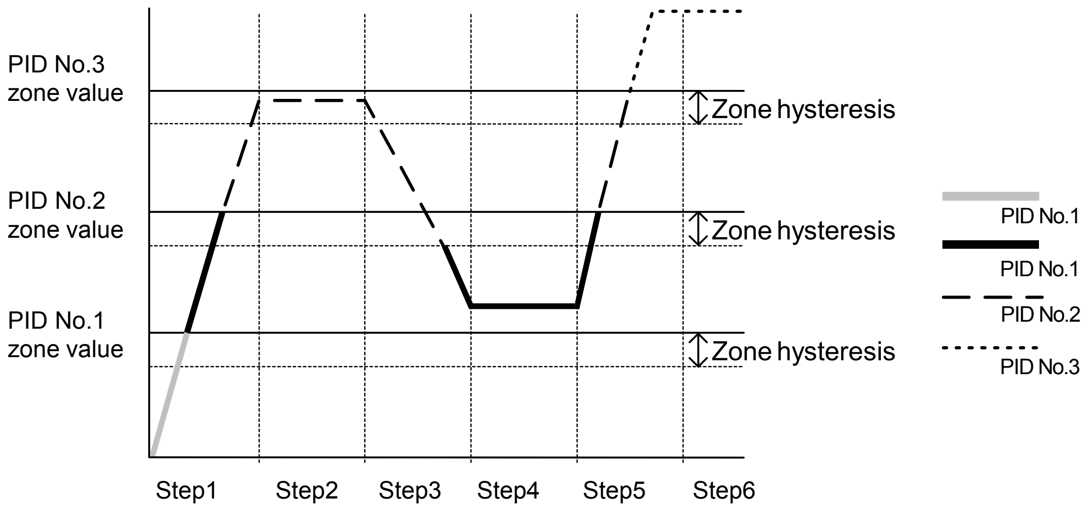
Lower limit value	0.0 %
Higher limit value	100.0 %

Note

- The output limiter is invalid during contact output or SSR drive voltage output when P=OFF is set and ON-OFF control is selected.

11-8 Zone PID

This function sets two or more zones in a measuring range and switches different PID values in each zone for use.
When this function is used, the optimum PID value can be set to each temperature range (zone) so that satisfactory controllability is obtained in a wide temperature range.



Note

- When the same zone value is set to multiple PID Nos., the PID No. having the smallest No. is executed.
- Even if the zone value or zone hysteresis is changed with the SV value inside zone hysteresis, the execution PID No. will not be changed until the SV No. leaves zone hysteresis.

(1) Selecting Zone PID

Select whether or not to use Zone PID.
When this function is used, further select whether to set the zone by SV or by PV.

3-21

```
Zone PID1▶      OFF
     HYS1:      2.0
```

Setting range	OFF, SV, PV
Initial value	OFF

OFF Zone PID function is disabled.
SV Zone PID function of SV is used.
PV Zone PID function of PV is used.

(2) Zone hysteresis

The hysteresis can be set with respect to the zone set value.
This hysteresis is valid for all zone set values.

3-21

```
Zone PID1:      ON
     HYS1▶      2.0
```

Setting range	0 to 10000 Unit
Initial value	20 Unit

(3) PID zone value

Set the zone value (temperature range) to be used by the Zone PID function for each PID No.

3-1

```
PID01-OUT1
P:   3.0%   MR:  0.0%
I:   120s   SF: 0.40
D:    30s  ZN▶   0.0℃
```

Setting range	Within measuring range
Initial value	0 Unit

Note

- When the same zone value is set to two or more PID Nos., the PID having the smallest No. is executed.
- To use the Zone PID function, zone setting and zone hysteresis must be set.

12 EVENT & DO SETTING

12-1 Monitor Screens

(1) DO monitor

4-1

```
DO6  DO7  DO8  DO9
 □    □    □    □
```

When DOx (x: 6 to 9) turns ON, □ is highlighted as ■.
DO6 to DO9 are optional, then they are not displayed when they are not installed.

(2) Logic monitor

4-2

```
  EV1     EV2     EV3
 B | I   F & F   -
  DO1     DO2     DO3
 B | I    - -     - -
```

This screen is displayed when LOGIC is assigned to one or more EVENT/DOs.

LOGIC	|: OR	&: AND	^: XOR
Input	B: Buffer	F: Flip flop	I: Inverter

The cursor position is highlighted.
In the screen as above, Buffer and Inverter are assigned to DO1 to make the device perform OR operation on both inputs.

12-2 EVENT/DO Action

Note that if you have changed this setting, action set points (SP) and hysteresis (DF) parameters are initialized.

4-3

```
EV1
 MD▶None        ACT:N.O.
```

Setting range	See "List of EVENT/DO Types".
Initial value	EV1: DEV Hi
	EV2: DEV Low
	EV3: RUN
	Others: None

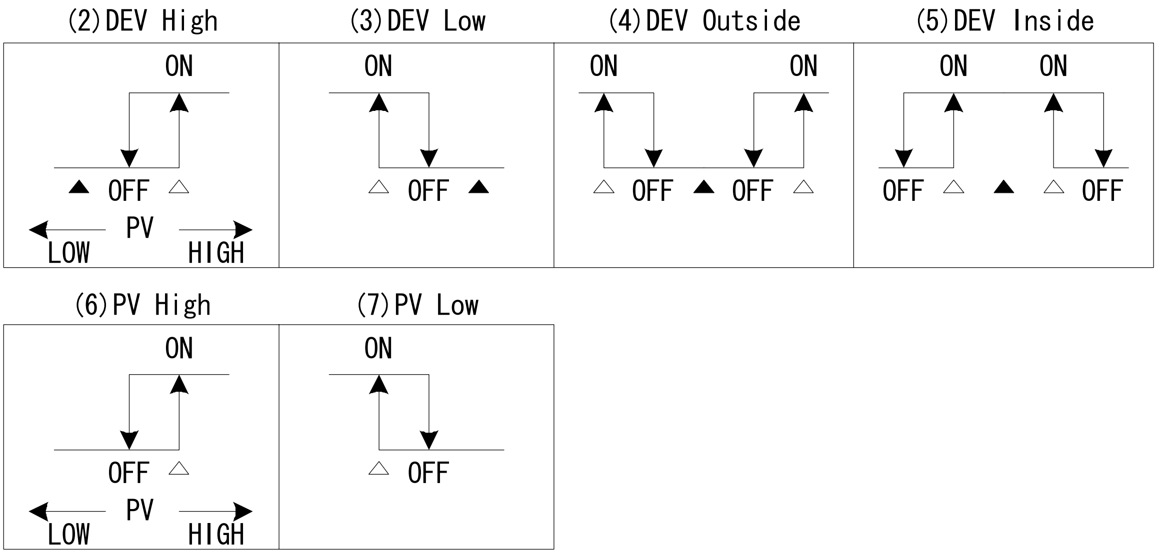
■ List of EVENT/DO Types

No.	Mode	Action
1	None	No action
2	DEV Hi	Higher limit deviation value
3	DEV Low	Lower limit deviation value
4	DEV Out	Outside higher/lower limit deviation
5	DEV In	Inside higher/lower limit deviation
6	PV Hi	PV higher limit absolute value
7	PV Low	PV lower limit absolute value
8	SO	Scale over
9	FIX	FIX mode
10	AT	Auto tuning execution in progress
11	MAN	Manual operation in progress

No.	Mode	Action
12	LOGIC	Logic operation (AND/OR/XOR)
	LOGIC	Logic operation (Timer/Count)
	Direct	Direct output
13	RUN	Program/FIX execution
14	HLD	Hold
15	GUA	Guarantee soak
16	STEP	Step signal
17	PRG.END	End signal
18 to 25	TS1 to TS8	Time signal 1 to 8
26	Posi.H	Positive higher limit absolute value
27	Posi.L	Positive lower limit absolute value
28	POT.ER	Feedback potentiometer (R2) error

*1 LOGIC operations (AND/OR/XOR) can be assigned only to EV1 to EV3, and DO1 to DO3.
*2 LOGIC operations (Timer/Count) can be assigned only to DO4 and DO5.
*3 Only DO6 to DO9 can be assigned to Direct. The Direct function can be used when the communication option is added on.
*4 Posi.H, Posi.L, and POT.ER can be assigned only when the controller is used with feedback potentiometer.

■ EVENT/DO Action Diagrams



△ Action set point ▲ Set value

* ON/OFF in the diagrams indicate operation mode.
EVENT/DO output conforms to the setting (OPEN/CLOSE) of output characteristics.

■ EVENT/DO Action in RST State

When the actions in the table below are assigned to EVENT/DO, EVENT/DO do not function in a Reset (RST) state.

Mode	Action	Mode	Action
DEV Hi	Higher limit deviation value	DEV In	Inside higher/lower limit deviation
DEV Low	Lower limit deviation value	PV Hi	PV higher limit absolute value
DEV Out	Outside higher/lower limit deviation	PV Low	PV lower limit absolute value
Posi.H	Position higher limit absolute value	Posi.L	Position lower limit absolute value

Note

- If Posi.H, Posi.L, or POT.ER is assigned to EVENT/DO then switched to "without feedback", the EVENT mode is changed to "None"

(1) Output characteristics

Set the action characteristics (ACT).

```
4-3
EV1
 MD:DEV Low   ACT▶N.O.
 DF:    2.0℃   IH:OFF
 DLY:   OFF
```

Setting range N.O., N.C.

Initial value N.O.

N.O.(normally open) When EVENT/DO turns ON, contacts are closed or output transistor turns ON.

N.C.(normally closed) When EVENT/DO turns ON, contacts are opened or output transistor turns OFF.

(2) Hysteresis

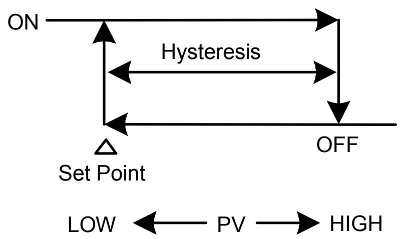
Set the hysteresis between ON action and OFF action. Setting hysteresis can avoid chattering, etc., and obtain stable action.
This item is displayed when Modes (MD) (2) to (7) are selected in EVENT/DO action.

```
4-3
EV1
 MD:DEV Low   ACT:N.O.
 DF▶    2.0℃   IH:OFF
 DLY:   OFF
```

Setting range 1 to 9999 Unit

Initial value 20 Unit

Ex) PV Low's case



(3) Delay time

This function is for turning EVENT/DO ON after the preset time has elapsed after an EVENT/DO source has been generated.
This item is displayed when Modes (MD) (2) to (7) are selected in the EVENT/DO action.

```
4-3
EV1
 MD:DEV Low   ACT:N.O.
 DF:    2.0℃    IH:OFF
 DLY▶   OFF
```

Setting range	OFF, 1 to 9999 s
Initial value	OFF

Note

- EVENT/DO is not output when the source of the signal output disappears during the delay time. When the source is generated again, counting of the time is performed from the beginning.
- When the delay time is set to OFF, EVENT/DO is output at the same time that the source of EVENT/DO is generated.
- When an EVENT/DO source is generated within the delay time operation, the delay time can be changed. Note, however, that the delay time is the time not from when measurement is performed from the newly set time but from the time that was measured from when the output source was generated.

(4) Inhibit Action

This function is for turning EVENT/DO ON when the PV value leaves the EVENT/DO action range and enters the range again without outputting EVENT/DO even if the PV value is in the action range at power ON.
Select this item taking Inhibit Action and event action at scale over into consideration.
This item is displayed when Modes (MD) (2) to (7) are selected in the EVENT/DO action.

```
4-3
EV1
 MD:DEV Low   ACT:N.O.
 DF:    2.0℃    IH▶OFF
 DLY:   OFF
```

Setting range	OFF, 1, 2, 3
Initial value	OFF

OFF	Inhibit action is not performed.
1	Inhibit action is executed at power ON and when the control state changes from RST to RUN.
2	Inhibit action is executed at power ON, when the control state changes from RST to RUN, and when the state of SV has changed.
3	Inhibit action is not performed (action OFF at scale over input error).

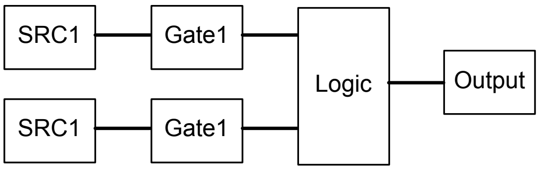
Note

- When IH is set to OFF, 1 or 2, EVENT/DO action turns ON when a scale over error occurs on the EVENT/DO set side.
- When IH is set to 3, EVENT/DO action turns OFF when a scale over error occurs on the EVENT/DO set side.
- To output an alarm when a scale over error occurs with IH set to 3, assign scale over (SO) to other EVENT/DO.

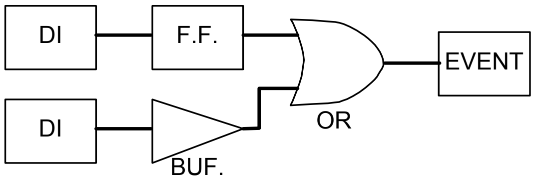
12-3 Event Logic Operations

Logic operations can be assigned to EV1 to EV3, and DO1 to DO3.
This function performs logic operations on inputs from two DIs or Time signals, and outputs the result to EVENT/DO. DI signal can also be output by communication. Simple sequences can be performed by using timer/count functions.

■ Event logic operation block diagram



■ Example



The screens below are for when [LOGIC] has been assigned to EV1.

(1) Logic operation mode (Log MD)

```
4-3
EV1 Log MD▶AND
 MD:LOGIC     ACT:N.O.
SRC1:None    Gate1:BUF
SRC2:None    Gate2:BUF
```

Setting range AND, OR, XOR
Initial value AND

AND	Logical product of 2 inputs	EVENT/DO turn ON when both of the two inputs turn ON.
OR	Logical sum of 2 inputs	EVENT/DO turn ON when either of the two inputs turns ON.
XOR	Exclusive OR of 2 inputs	EVENT/DO turn ON when one of the two inputs turns ON and the other turns OFF.

(2) Assigning logic operation input (SRC1, SRC2)

Assign the DI No. or time signal No. to two inputs (SRC1 & SRC2) for logic operation.

```
4-3
EV1 Log MD:AND
 MD:LOGIC     ACT:N.O.
SRC1▶None    Gate1:BUF
SRC2:None    Gate2:BUF
```

Setting range None, TS1 to TS8, DI1 to DI10
Initial value None (no assignment)

Note

- When another function is assigned to DI, the function also starts to operate when that DI signal is input.
- When the assignment to DI is set to None, the function does not operate.

(3) Logic operation input logic (Gate1, Gate2)

Set the logic of the two inputs for logic operation.

```
4-3
EV1 Log MD:AND
 MD:LOGIC     ACT:N.O.
SRC1:None    Gate1▶BUF
SRC2:None    Gate2:BUF
```

Setting range	BUF, INV, FF
Initial value	BUF

BUF (buffer)	The input signal is treated as it is.
INV (inverter)	The input signal is inverted, then treated as the logic signal.
FF (flip-flop)	The logic signal toggles each time the input signal turns from OFF to ON.

Note

- When the logic operation input is a time signal (TS1 to TS8), FF (flip-flop) cannot be set.

12-4 Timers/Counters

Timers and counters can be assigned to DO4 and DO5.

With this function, DI or TS is taken as input and EVENT/DO is taken as output, and EVENT/DO can be output after the preset time has elapsed after generation of an input, or when the input of the preset count is reached.

The timers and counters operate regardless of the control action of this device, and output a one-shot pulse of one second.

The screens below are for when [LOGIC] has been assigned to DO4 and DO5.

(1) Timer time

The time can be set within the range 1 to 5000 seconds only when the mode (Log MD) is set to timer.

```
4-9
DO4 Time▶  OFF
 MD:LOGIC     ACT:N.O.
 SRC:None
 Log MD:Timer
```

Setting range	OFF, 1 to 5000 s
Initial value	OFF

(2) Counter

The count can be set within the range 1 to 5000 only when the mode (Log MD) is set to counter.

```
4-9
DO4 Count▶  OFF
 MD:LOGIC     ACT:N.O.
 SRC:None
 Log MD:Counter
```

Setting range	OFF, 1 to 5000
Initial value	OFF

(3) Assigning input (SRC)

Assign the DI No. or TS No.

```
4-9
DO4 Time:  OFF
 MD:LOGIC     ACT:N.O.
 SRC▶None
 Log MD:Timer
```

Setting range	None, TS1 to TS8, DI1 to DI10
Initial value	None (no assignment)

Note

- When another function is assigned to DI, the function also starts to operate when that DI signal is input.
- When the assignment to DI is set to None, the function does not operate even if the DI signal is input.

(4) Mode (Log MD)

Select and set timer or counter.

```
4-9
DO4 Time:  OFF
 MD:LOGIC     ACT:N.O.
 SRC:None
 Log MD▶Timer
```

Setting range	Timer, Counter
Initial value	Timer

Timer	DO turns ON after DI is input and a preset time elapses.
Counter	DO turns ON when DI input count reaches the preset value.

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13 OPTION SETTINGS (DI, AO, COM)

13-1 DI

DI is digital input for external control based upon an externally input non-voltage contact signal or an open collector signal.
Actions can be selected, and assigned to DI2 to DI10.
Note, however, that DI1 is fixed to RUN/RST.
DI5 to DI10 are optional, and are not displayed when they are not available.

(1) DI monitor screen

□ is highlighted as ■ when a signal is input to DI regardless of whether or not DI is assigned.
DI5 to DI10 are optional, and are not displayed when they are not available.

```
5-1
 DI1  DI2  DI3  DI4  DI5
  □    □    □    □    □
 DI6  DI7  DI8  DI9  DI10
  □    □    □    □    □
```

(2) Selecting DI Action

```
5-2                    5-3                 5-4
DI1:  RUN/RST          DI5:  None          DI9:  None
DI2:  None             DI6:  None          DI10: None
DI3:  None             DI7:  None
DI4:  None             DI8:  None
```

This is the assignment to DI.

LG is displayed for the DI to be used by input (SRC) in event logic operations.

```
5-2
DI1:  RUN/RST
DI2:  None
DI3:  None              LG
DI4:  None
```

■ Restriction conditions when assigning DI

- RUN/RST is assigned (fixed) to DI1. This assignment cannot be changed.
- PTN2bit and PTN3bit can be assigned only to DI5 and DI8.
- PTN4bit and PTN5bit can be assigned only to DI5.

■ List of DI Types

<table>
<tr><th>Mode</th><th colspan="2">Action</th><th>No-action Conditions</th><th>Signal Detection</th></tr>
<tr><td>None</td><td colspan="2">No action (factory default)</td><td>- - - -</td><td>- - - -</td></tr>
<tr><td>RUN/RST</td><td colspan="2">Switching of Run/Reset (when ON: Run execution)</td><td>None</td><td>Edge</td></tr>
<tr><td>RST</td><td colspan="2">Forced Reset (when ON: Reset state)</td><td>None</td><td>Level</td></tr>
<tr><td>HLD</td><td colspan="2">Control suspension/restart (when ON: suspension state)</td><td>None</td><td>Level</td></tr>
<tr><td>ADV</td><td colspan="2">Execute advance (when ON: execute advance)</td><td>HLD</td><td>Edge</td></tr>
<tr><td>FIX</td><td colspan="2">Switching of FIX mode/Program mode (when ON: FIX mode)</td><td>None</td><td>Level</td></tr>
<tr><td>MAN</td><td colspan="2">Switching of control output between auto/manual (when ON: manual)</td><td>- - - -</td><td>Level</td></tr>
<tr><td>LOGIC</td><td colspan="2">Logic operation input [exclusive port] (when ON: input ON)</td><td>None</td><td>Level</td></tr>
<tr><td>PTN2bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 3 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN3bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 7 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN4bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 15 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN5bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 20 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>Preset1</td><td>Assignable to DI2</td><td rowspan="3">The external switching using Servo preset value is available by assigning Preset1 to 3 to DI2 only.</td><td>MAN, RST</td><td>Level</td></tr>
<tr><td>Preset2</td><td>Assignable to DI2 and DI3</td><td>MAN, RST</td><td>Level</td></tr>
<tr><td>Preset3</td><td>Assignable to DI2 to DI4</td><td>MAN, RST</td><td>Level</td></tr>
</table>

Note 1 The corresponding DI action details cannot be executed while parameters listed in the "No-action Conditions" column in the DI Assignments Table are being executed.

Note 2 Signal detection timing:

Level input Action is maintained with DI input ON.

Edge input Action is executed by DI input ON, and is maintained even if DI input turns OFF. Action is canceled by DI input ON again.

Note 3 DI input must be held at ON or OFF for at least 0.1 sec. to detect DI input.

Note 4 Once a function is assigned to a DI, the same function cannot be set by the front panel keys as DI is given priority.

Note 5 When the same action is assigned to two or more DIs, the DI having the smallest No. is valid under the following conditions, and DIs having a larger No. are invalid:

(1) When the same action is assigned to multiple DIs.
For example, assignment DI2 becomes invalid when MAN is assigned to DI1 and DI2.

(2) When action types (PTN2bit, PTN3bit, PTN4bit, PTN5bit) that use multiple DI terminals are assigned to multiple DIs.
For example, assignment to DI8 becomes invalid when PTN3bit is assigned to DI5 and DI8.

Note 6 When action types (PTN2bit, PTN3bit, PTN4bit, and PTN5bit) that use multiple DI terminals are assigned, the assigned action of the DI to be used will be cleared depending on the assignment.

When DI5 is assigned to PTN5bit with MAN assigned to DI6, MAN assigned to DI6 is canceled as the start pattern No. will be assigned to DI6.

Note 7 When a DI assignment is canceled during DI execution, the currently executing action is continued (excluding LOGIC operation).

Note 8 For details on logic operation, see "12-3 Event Logic Operations."

■ Selection of start pattern No.

The start pattern No. can be selected by the external input.
To use this function, PTN2bit, PTN3bit, PTN4bit, or PTN5bit must be assigned to DI5, or PTN2bit or PTN3bit must be assigned to DI8, and the EXT LED indicator must be set to light.

Ex: To assign [PTN5bit] to DI5, and select start pattern No.5

The start pattern No. is automatically assigned from DI5 to DI9, and the key mark is displayed. To select start pattern No.5, short across DI COM (terminal No.44) and DI5 (terminal No.38), and DI7 (terminal No.40) according to the following table.

DI (terminal No.)	Start Pattern No.																				
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DI5 (38)		*		*		*		*		*		*		*		*		*		*	
DI6 (39)			*	*			*	*			*	*			*	*			*	*	
DI7 (40)					*	*	*	*					*	*	*	*					*
DI8 (41)									*	*	*	*	*	*	*	*					
DI9 (42)																	*	*	*	*	*

* mark indicates short across DI COM (44).

Note

- When start pattern No.0 is selected (DI input in OPEN state), the start pattern No. becomes No.1.

13-2 Analog Output

This function is optional and is not displayed when it is not installed.
All of the following assignments are possible for both Analog Output 1 (Ao1) and Analog Output 2 (Ao2).

(1) Analog Output type

```
5-5
Ao1MD▶ PV
Ao1_L:       0.0℃
Ao1_H:    1370.0℃
```

Setting range PV, SV, DEV, OUT1, Posi
Initial value Ao1: PV
Ao2: SV

PV : Measured value
DEV : Deviation of PV and SV
SV : Target set value
OUT1 : Control Output 1
Posi : Position value

(2) Scaling Analog Output

```
5-5
Ao1MD: PV
Ao1_L▶       0.0℃
Ao1_H:    1370.0℃
```

■ Setting ranges and defaults

(Ao1_L < Ao1_H, or Ao2_L < Ao2_H)

Description	Analog output Type	Setting Range	Default
Ao1_L analog output 1 lower limit scaling Ao2_L analog output 2 lower limit scaling	PV, SV	Within measuring range	Setting range lower limit value
	DEV	-100.0 to 100.0%	
	OUT1	0.0 to 100.0%	0.0%
	Posi	0 to 100%	0%
Ao1_H analog output 1 higher limit scaling Ao2_H analog output 2 higher limit scaling	PV, SV	Within measuring range	Setting range higher limit value
	DEV	-100.0 to 100.0%	
	OUT1	0.0 to 100.0%	100.0%
	Posi	0 to 100%	100%

Note

- If "Posi" is assigned to an analog output type, then switched to "without feedback", the analog output type is changed to "PV".

13-3 Communication

(1) Setting communication

For details, refer to the separate manual "FP23 Series Programmable Controller, Communications Interface (RS-232C/RS-485)."
This section explains only setting items.

5-7

```
COM PROT▶ SHIMADEN
    ADDR:   1
    BPS :  9600
    MEM :  EEP
```

PROT: Communication protocol

Setting range	SHIMADEN, MOD_ASC, MOD_RTU
Initial value	SHIMADEN

ADDR: Communication address

Setting range	1 to 98
Initial value	1

BPS: Communication speed

Setting range	2400, 4800, 9600, 19200 bps
Initial value	9600 bps

MEM: Communication memory mode

Setting range	EEP, RAM, R_E
Initial value	EEP

5-8

```
COM DATA▶   7
    PARI:   EVEN
    STOP:   1
    DELY:  10 ms
```

DATA: Communication data length

Setting range	7, 8
Initial value	7

PARI: Communication parity

Setting range	EVEN, ODD, NONE
Initial value	EVEN

STOP: Communication stop bit

Setting range	1, 2
Initial value	1

DELY: Communication delay time

Setting range	1 to 50 ms
Initial value	10 ms

5-9

```
COM CTRL▶ STX_ETX_CR
     BCC: ADD
```

CTRL: Control code

Setting range	STX_ETX_CR, STX_ETX_CRLF, @_: _CR
Initial value	STX_ETX_CR

BCC: Block Check Character

Setting range	ADD, ADD_two's cmp, XOR, None
Initial value	ADD

(2) Communication Mode (COM)

Select whether or not to set or change various data using the front panel keys (local) or by communication (option).

1-1

```
AT :    OFF
MAN:    OFF
COM     LOCAL
```

```
AT :    OFF
MAN:    OFF
COM▶    LOCAL
```

Setting range	LOCAL, COM
Initial value	LOCAL

In the LOCAL mode, the key sign is displayed at the communication selection, indicating that changing from LOCAL (local) to COM (communication) by the front panel keys isn't possible.
Even in the LOCAL mode, the Communication mode can be changed from LOCAL to COM by sending commands to the FP23 from the host.
In the COM mode, the Communication mode can also be changed from COM to LOCAL by operating the front panel keys.

LOCAL Settings can be made using the front panel keys.
(Settings cannot be made by communication.)

COM Settings can be made by communication.
(Settings cannot be made by the front panel keys.)

14 SERVO SETUP

14-1 Overview of Setup Procedure

Caution

- This product is a position-proportional controller for a control motor with limit switches. Please ensure that you always use this for the control motor with limit switches.

The procedure from the checking of setting status up to output adjustment of servo functions is shown as follows:
Please refer to the description of the relevant operation screen for the details.

■ In case of "With Feedback"

Procedure	Refer to
1. Check wiring	—
2. Select FB = ON from the setting screen for FB parameter. This setting can be made only when STBY = ON is selected	14-4 (1)
3. Check wiring for the feedback potentiometer.	—
4. Setting of action characteristics (ACT)	14-2 (1)
5. Setting of output at RST	14-2 (2)
6. Setting of output at ERR	14-2 (3)
7. Setting of output at feedback potentiometer error	14-2 (4)
8. Servo ZERO/SPAN adjustment	14-5
9. Confirmation/adjustment of DB (Dead Band)	14-4 (2)

■ In case of "Without Feedback"

Procedure	Refer to
1. Check wiring	—
2. Select FB = OFF from the setting screen for FB parameter. This setting can be made only when STBY = ON is selected.	14-4 (1)
3. Setting motor timing (TIME)	14-4 (3)
4. Setting servo action on start-up (BOOT) Please be aware that the controller assumes the position of the motor to be 50% when BOOT is set to "Stop"	14-4 (4)
5. Setting of Action Characteristics (ACT)	14-2 (1)

6.	Setting of output at RST	14-2 (2)
7.	Setting of output at ERR	14-2 (3)
8.	Servo ZERO/SPAN adjustment	14-5
9.	Confirmation/adjustment of DB (Dead Band)	14-4 (2)

14-2 Control Output (Servo Output)

(1) Action characteristics

Select either reverse action (heating specifications) or direct action (cooling specifications) as the output characteristics.

6-1

```
OUT1 ACT:  Reverse
     RST▶  Preset1
     ERR:  Preset1
 POT.ERR:  Stop
```

Setting range	Reverse, Direct
Initial value	Reverse

Reverse By this action, the smaller the measured value (PV) than the set value (SV), the higher the output.
This action is generally used for heating control.

Direct By this action, the larger the measured value (PV) than the set value (SV), the higher the output.
This action is generally used for cooling control.

Note

- Output characteristics cannot be switched during execution of auto tuning (AT).

(2) Output at reset

Set the output (position) at reset (RST, controller operation paused).

6-1 With Feedback

```
OUT1 ACT:  Reverse
     RST▶  Preset1
     ERR:  Preset1
 POT.ERR:  Stop
```

Setting range	Stop, Preset1 to Preset7
Initial value	Preset1

6-1 Without Feedback

```
OUT1 ACT:  Reverse
     RST▶  Close
     ERR:  Close
```

Setting range	Stop, Close, Open
Initial value	Close

The action differs according to whether the setting is at "With Feedback" or "Without Feedback".

With Feedback Stop, or relevant servo preset value (P1 to P7) is applied.

Without Feedback Any one of these actions (Stop, Close or Open) is conducted.

For more information, please refer to "14-3 (2) Setting Servo preset value".

Note
- Output at reset is maintained without being affected even if an input error occurs.

(3) Output at input error

Setting the output (position) to be applied when and if control operation is stopped due to scale over (SO) which might occur during input measurement.

6-1 With Feedback

```
OUT1 ACT:  Reverse
     RST▶ Preset1
     ERR:  Preset1
 POT.ERR:  Stop
```

Setting range Stop、Preset1 to Preset7
Initial value Stop

6-1 Without Feedback

```
OUT1 ACT:  Reverse
     RST▶ Close
     ERR:  Close
```

Setting range Stop, Close, Open
Initial value Close

The action differs according to whether the setting is at "With Feedback" or "Without Feedback".

With Feedback	Stop, or relevant servo preset value (P1 to P7) is applied.
Without Feedback	Any one of these actions (Stop, Close or Open) is conducted.

For more information, please refer to "14-3 (2) Setting Servo preset value".

Note
- Output at reset is given priority when an input error has occurred at reset (RST, controller operation paused).

(4) Output at feedback potentiometer error

Setting for "With Feedback".
Set the output for feedback potentiometer error.

6-1

```
OUT1 ACT:  Reverse
    STBY:  Preset1
     ERR:  Preset1
 POT.ERR▶ Stop
```

Setting range Stop, Close, Open
Initial value Stop

Note
- Output at feedback potentiometer error is registered prior to that at reset or at input error.

(5) Rate-of-change limiter

This setting item limits the rate-of-change (%) per second. Setting this item to OFF disables the rate-of-change limiter.
This setting is used to avoid sudden changes in output.

6-2

```
Rate Limiter
 OUT▶ OFF
```

Setting range	OFF, 0.1 to 100.0%/s
Initial value	OFF

Note

- Repetitive occurrence of control output value which deviates beyond the threshold values of dead band (DB) may cause hunting to the control motor. To prevent this, set a larger value for dead band (DB) or set the output rate-of-change limiter.

14-3 Externally Switching Servo Preset Value

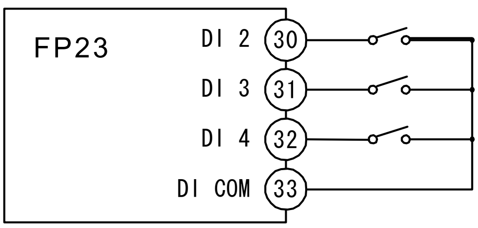
(1) Mechanism and action of external switching

This function is for switching the output to preset values through external signals. Switching through external contact point is available when using two or more preset values. Only DI2 to DI4 can be set.
In case one external switching point is assumed to be set, assign "Preset1" to DI2 in order to operate the controller using the position value that has been set to preset value 1 (P1) by input signal to DI2.
Similarly, when external switching are for 2 or 3 points, set "Preset2" to DI2, or when external switching is points are for 4 to 7, assign "Preset3" to DI2.
In case all signals for DI2 to DI4 are OFF, the controller outputs not by the preset values, but by PID control.
Moreover, when external switching of servo preset values is set, no other function may be assigned since the preset values are automatically assigned to DI2 and DI3 if "Preset2" is set to DI2, or assigned to DI2 to DI4 if "Preset3" is set to DI2.

5-2

```
DI1 ╤ RUN/RST
DI2 ▶ None
DI3 : None
DI4 : None
```

Preset1: 1 preset value switching by DI2
Preset2: 3 preset values (max.) switching by DI2 and DI3
Preset3: 7 preset values (max.) switching by DI2 to DI4



Setting / Servo Preset / DI No.	Preset3						
	Preset2						
	Preset1						
	P1	P	P3	P4	P5	P	P7
DI 2	●		●		●		●
DI 3		●	●			●	●
DI 4				●	●	●	●

● : Indicates that the switch is ON.

Note

- When switching is done by a decimal switch, an unexpected value might be generated momentarily. To prevent this, be sure to set the decimal switch within the period of 100ms.

(2) Setting Servo preset value

■ **In case of "With Feedback (FB = ON)"**

You may switch the position output to any preset value through DI2 to DI4.
7 preset values can be assigned toP1 to P7 respectively. Switching is enabled by assigning "Preset1/2/3" to DI2 to DI4.

6-6

```
SERVO Preset  P4:    0%
    P1▶   0%  P5:    0%
    P2:   0%  P6:    0%
    P3:   0%  P7:    0%
```

Setting range	0 to 100%
Initial value	0%

When one preset value is to be used, set it to P1 and assign the "Preset1" to DI2.
When up to 3 preset values are to be used, set them to P1 to P3 and assign the "Preset2" to DI2.
When up to 7 preset values are to be used, set them to P1 to P7 and assign the "Preset3" to DI2.
For more information on how to switch preset values, refer to the preceding section "14-3 (1) Mechanism and action of external switching".

■ **In case of "Without Feedback (FB = OFF)"**

The method of assignment for DI2 to DI4 is the same as that for "With Feedback". However, the action is automatically set to P1 = Stop, P2 = Close, P3 = Open, and P4 to P7 = Stop.

14-4 Setting Servo Operations

(1) Setting Servo Feedback

Set whether feedback potentiometer is to be used or not (With or Without Servo Feedback).

Set it to ON for conducting feedback control with position signal from potentiometer. The feedback function is disabled when set to OFF.

6-3

```
SERVO FB▶ ON
      DB:   2.0%
```

Setting range	ON, OFF
Initial value	ON

(2) Setting Servo Dead Band

Set the dead band for action between "Open" and "Close" outputs.
Making the dead band smaller allows for more precise control.
However, if the dead band becomes too small, hunting may occur in output because the control motor may go too far due to its own inertia.
For the dead band (DB) and hysteresis, please refer to the "14-6 (6) Interrelation between Dead Band (DB) and hysteresis".

6-3

```
SERVO FB:  ON
      DB▶  2.0%
```

Setting range	0.2 to 10.0%
Initial value	2.0%

(3) Setting motor timing

This setting is necessary for "Without Feedback (FB = OFF)".
Set the timing of the control motor required for full-stroke rotation. In case of "Without Feedback", the controller calculates the motor position from Open/Close signal timing.

6-4

```
SERVO FB:  OFF
      DB:  2.0%
    TIME▶  60s
    BOOT:  Close
```

Setting range	5 to 300s
Initial value	60s

Note

- The motor's controllability may be adversely affected if wrong timing is set.
  Please check the motor's specifications.

(4) Setting Servo action on start-up

This setting is necessary for "Without Feedback (FB = OFF)".
In case of "Without Feedback", the motor position may become undetectable. To avoid such inconvenience, this function is provided for entering the control operation after setting the motor position to either fully closed or fully opened.

6-4

```
SERVO FB:  OFF
      DB:  2.0%
    TIME:   60s
    BOOT▶  Close
```

Setting range	Stop, Close, Open
Initial value	Close

Stop Enter the control operation with the motor position as it is.
Enter the control operation by assuming the position of the motor to be 50% since the actual position is undetectable.

Close Enter the control operation after setting to the fully closed position by outputting the Close signal for motor timing.
Note that the motor moves to the fully closed position on start-up.

Open Enter the control operation after setting to the fully opened position by outputting the Open signal for motor timing.
Note that the motor moves to the fully opened position on start-up.

14-5 Servo Adjustment

Make sure to carry out ZERO/SPAN adjustment when activating. After having carried out the adjustment initially, readjust as necessary.

(1) Points for ZERO/SPAN adjustment and the operation

This ZERO/SPAN adjustment can be carried out only at reset.
This can be conducted only through the ZERO/SPAN adjustment screen.
Do not move to any other screen during ZERO/SPAN adjustment; otherwise the ZERO/SPAN adjustment process will automatically stop.

Note that the adjustment process is stopped in open status if the adjustment is ended at the open position when the output at reset is set to Stop.

Caution

- Ensure that the wiring of motors (M1, M2, M3) and feedback potentiometer (R1, R2, R3) is correct before conducting ZERO/SPAN adjustment, otherwise the open position and close position may be inversely adjusted or the proper action may not be achieved
- Proper action may not be achieved if the SPAN position and the ZERO position are inversely adjusted.
- Adjusting the distance between ZERO and SPAN too narrowly may cause hunting that may harm the service life of the motor or cause failure.
- In the above cases, check the wiring and readjust the ZERO/SPAN.

■ **In case of "With Feedback (FB = ON)"**

① **Conducting ZERO/SPAN adjustment automatically**

Caution

- "ERROR" is indicated when the ZERO/SPAN distance is less than approximately 10% of the feedback potentiometer. If so, perform the automatic adjustment process once again, or perform an adjustment manually.

② **Conducting ZERO/SPAN adjustment manually**

Starting an adjustment either at the ZERO or the SPAN position may make no difference. Count values are always indicated at the right-position end at both the ZERO and SPAN lines on the LCD screen.

Caution

- Make sure to make adjustments so that the SPAN position count value is larger than the ZERO position count value.
- Both of the count values shown on the right-side end will be highlighted when the ZERO/SPAN distance is less than approximately 10% of the feedback potentiometer.
- In the cases above, no proper action may be guaranteed. Check and perform the adjustment process once again.

■ **In case of "Without Feedback (FB = OFF) "**

① **Conducting ZERO/SPAN adjustment automatically**

An adjustment operation may differ according to the setting of the servo action (BOOT) for starting.

In case of "BOOT = Stop or Close"	Conduct adjustment with the control motor at fully closed position.
In case of "BOOT = Open"	Conduct adjustment with the control motor at fully opened position.

② **Conducting ZERO/SPAN adjustment manually**

Conduct adjustment either at the ZERO or the SPAN position.
Hold down the Close key or the Open key until the motor stops.

(2) ZERO/SPAN automatic adjustment

There are automatic and manual adjustments for ZERO/SPAN adjustment.

In this section, you will find a description for ZERO/SPAN automatic adjustment.

For ZERO/SPAN manual adjustment, refer to the next section "14-5 (3) ZERO/SPAN manual adjustment".

For points to be attended to when conducting ZERO/SPAN adjustment, refer to the section "14-5 (1) Points for ZERO/SPAN adjustment and the operation".

■ In case of "With Feedback"

The following is the procedure to be taken for automatically adjusting the fully closed position of the control motor to ZERO and the fully open position to SPAN.

6-5

```
SERVO  Calibration
 EXE:  Stop   MD▶Auto
```

① **Mode switching**

Set the MD (mode) to "Auto" (Automatic).

```
SERVO  Calibration
 EXE▶ Stop   MD:  Auto
```

② **Starting automatic adjustment**

Start ZERO/SPAN automatic adjustment by setting EXE to "Start" and pressing the ENT key.

```
SERVO  Calibration
 EXE▶ Start  MD:  Auto
          ZERO
```

③ **Fix of ZERO position**

"ZERO" blinks on the LCD screen at first, then Open output is turned ON for approx. 6 seconds, then the Close output will be turned ON. The ZERO position will be fixed at the point where the final control motor stopped and no fluctuation of feedback signal is detected.

```
SERVO  Calibration
 EXE▶ Start  MD:  Auto
          SPAN
```

④ **Fix of SPAN position**

Then, "SPAN" blinks on the LCD screen and Open output is turned ON. The SPAN position will be fixed at the point where the control motor stopped and no fluctuation of feedback signal is detected.

The automatic adjustment will be completed and the blinking of the "SPAN" indication will stop when the ZERO/SPAN positions are fixed.

Caution

- "ERROR" is indicated and no data is acquired when any abnormality has occurred in the feedback potentiometer, or when ZERO/SPAN distance is less than approximately 10% of the feedback potentiometer during ZERO/SPAN adjustment.
- Stop the ZERO/SPAN adjustment once if "ERROR" is indicated. (Press the ▼ key to change EXE = Start to Stop and press the ENT key to confirm.)
- In the case mentioned above or if continuing the adjustment procedure with incorrect wiring of the motor and/or feedback potentiometer, Open-Close position may act inversely or hunting may occur, and no proper action may be guaranteed. If so, check and perform the adjustment procedure once again.

■ In case of "Without Feedback"

The following is the procedure to be taken for automatically adjusting the fully closed position of the control motor to the Close position or the fully opened position to the Open position.

6-5

```
SERVO  Calibration
 EXE: Stop  MD▶Auto
```

① **Mode switching**

Set the MD (mode) to "Auto" (Automatic).

```
SERVO  Calibration
 EXE▶Stop  MD: Auto
```

② **Starting manual adjustment**

Start ZERO/SPAN automatic adjustment by setting EXE to "Start" and pressing the ENT key.

```
SERVO  Calibration
 EXE▶Start MD: Auto
        ZERO
```

③ **Fix the ZERO position at the closed position (in the case of "BOOT = Stop or Close")**

The "ZERO" blinks on the LCD screen and Close output is turned ON.

```
SERVO  Calibration
 EXE▶Start MD: Auto
        SPAN
```

④ **Fix the SPAN position at the open position (in case of "BOOT = Open")**

The "SPAN" blinks on the LCD screen and Open output is turned ON.

Open output continues to be ON for the motor timing and consider the stop point as the open position.

The automatic adjustment will be completed and the blinking on the LCD display will stop when the closed or open position is fixed.

(3) ZERO/SPAN manual adjustment

In this section, ZERO/SPAN manual adjustment procedure is described.
For ZERO/SPAN automatic adjustment, refer to the preceding section "14-5 (2) ZERO/SPAN automatic adjustment".

ZERO/SPAN positions may be manually adjusted.
This procedure may be used when you do not want to make a fully closed or fully opened control operation, or when the ZERO position or SPAN position is set at an arbitrary position.

For points to be attended to when conducting ZERO/SPAN adjustment, refer to the section "14-5 (1) Points for ZERO/SPAN adjustment and the operation".

■ In case of "With Feedback"

The following is the procedure to be taken for manually adjusting the fully closed position of the motor to Close and the fully opened position to Open. Set ZERO as the Close position and SPAN as the Open position.

6-5

```
SERVO  Calibration
 EXE: Stop   MD▶Manual
 ZERO〒    ---     4.5
 SPAN〒    ---    65.5
```

① Mode switching

Set the MD (mode) to "Manual".

```
SERVO  Calibration
 EXE▶Start MD: Manual
 ZERO:     ---     4.0
 SPAN:     ---    65.0
```

② Starting manual adjustment

Start ZERO/SPAN manual adjustment by setting EXE to "Start" and pressing the [ENT] key.

```
SERVO  Calibration
 EXE: Start MD: Manual
 ZERO▶    CLOSE   3.5
 SPAN:     ---    65.0
```

③ Fix of ZERO position

Move the cursor to ZERO and turn the Close output to ON by pressing the [▼] (CLOSE) key.
Move the motor to the ZERO position by pressing the [▼] (CLOSE) key and press the [ENT] key so that the numerical indication will stop blinking.

```
SERVO  Calibration
 EXE: Start MD: Manual
 ZERO:     ---     3.5
 SPAN▶    OPEN   62.5
```

④ Fix of SPAN position

Move the cursor to SPAN and turn the Open output to ON by pressing the [▲] (OPEN) key.
Move the motor to the SPAN position by pressing the [▲] (OPEN) key and press the [ENT] key so that numerical indication will stop blinking.

ZERO or SPAN position may be set manually with the above mentioned procedure.

Caution

- Make sure to make adjustments so that the SPAN position count value is larger than the ZERO position count value.
- Both of the count values shown in the right-side end on the LCD will be highlighted when the ZERO/SPAN distance is less than approximately 10% of the feedback potentiometer.
- In the case mentioned above, Open-Close position may act inversely or hunting may occur in this circumstance. No proper action may be guaranteed. If so, check and perform the adjustment procedure again.

■ In case of "Without Feedback"

The following is the procedure to be taken for manually adjusting the fully closed position of the motor to the Close position or the fully opened position to the Open position.
Conduct the following procedure after setting the Close position as ZERO and the Open position as SPAN.
Conduct the adjustment at either of the ZERO or SPAN position for manual adjustment in a "Without Feedback" configuration.

6-5

```
SERVO  Calibration
 EXE: Stop   MD▶Manual
 ZERO:    ---
 SPAN:    ---
```

① **Mode switching**

Set the MD (mode) to "Manual".

```
SERVO  Calibration
 EXE▶Start MD: Manual
 ZERO:    ---
 SPAN:    ---
```

② **Starting manual adjustment**

Start ZERO/SPAN manual adjustment by setting EXE to "Start" and pressing the [ENT] key.

```
SERVO  Calibration
 EXE: Start MD: Manual
 ZERO▶    CLOSE
 SPAN:    ---
```

③ **Fix of ZERO position**

Move the cursor to ZERO and turn the Close output to ON by pressing the [▼] (CLOSE) key.

Move the final control element to the ZERO (Close) position by pressing the [▼] (CLOSE) key.

```
SERVO  Calibration
 EXE: Start MD: Manual
 ZERO:    ---
 SPAN▶    OPEN
```

④ **Fix of SPAN position**

Move the cursor to SPAN and turn the Open output to ON by pressing the [▲] (OPEN) key.

Move the motor to the SPAN position by pressing the [▲] (OPEN) key.

Set the ZERO or SPAN position manually with the above-mentioned procedure.

(4) Adjustment of Dead Band (DB)

The following have the same content as that described in the section "14-4 (2) Setting Servo Dead Band".
To prevent hunting events caused by excessive sensitivity, conduct procedures for adjusting of dead band.
Set the dead band for Open and Close outputs.
Making the dead band smaller allows for more precise control.
However, if the dead band becomes too small, hunting may occur in output because the control motor may go too far due to its own inertia.

6-3

```
SERVO FB:  ON
     DB▶  2.0%
```

Setting range	0.2 to 10.0%
Initial value	2.0%

14-6 Servo Functions

(1) Priority of actions at Servo output

Priority at Servo Output is as follows:

① MAN output (action for which the first priority is given)
② Output at feedback potentiometer error (in case of "With Feedback")
③ Output at reset
④ Output with preset value
⑤ Output at error
⑥ PID control output

(2) MAN Actions at Servo Output

Switching to MAN mode at Servo output is possible both during operation and at reset. (The action for which the first priority is given)
Under the MAN mode at Servo output, the motor is not controlled by setting the OUT value, but directly controlled by Open/Close key operation.

(3) Interrelation between assignment of preset output and control action

The action differs according to the setting condition.

■ **In case of "With Feedback (FB = ON)"**

Assign P1 to P7 at the preset DI Input (DI2, DI3, DI4).
Switching from preset output to PID control output is made as a bumpless action (but within the proportional band).

■ **In case of "Without Feedback (FB = OFF)"**

Select either one of the following at the preset DI Input (DI2, DI3, DI4).

- P1 Stop
- P2 Close action
- P3 Open action
- P4 to P7 Stop

Switching from preset output to PID control output is not made as a bumpless action.

■ **In case of "DI Input = OFF"**

PID control output is performed.

(4) Output limiter

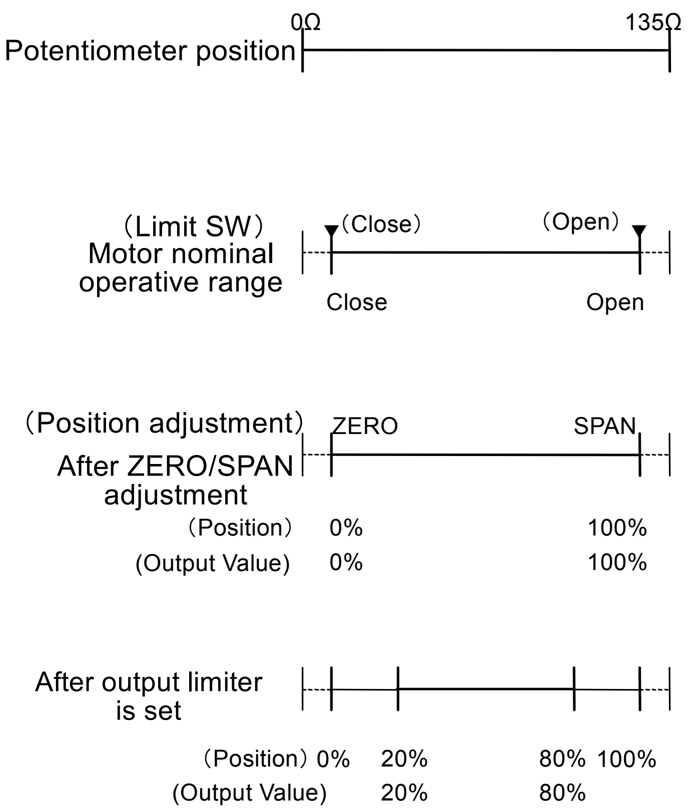
Action under the MAN mode and Preset output may not be affected by the output limiter. The action is as follows at PID control output.

In case of "With Feedback (FB = ON) "	Output limiter is enabled.
In case of "Without Feedback (FB = OFF) "	Output limiter is disabled

(5) Servo Action

■ Control output value and position

- The motor position is controlled with control output value obtained through PID computation as the target position value with considering the dead band (DB).
- Output limiter (for details, refer to "11-7 Output Limit Value (OUT1L to OUT1H)") is for output value at PID control, but not for position limiter.
- In case of "With Feedback", the position of the control motor may be controlled by the output limiter.
- The interrelation among feedback potentiometer, motor nominal operative range, operative range after ZERO/SPAN adjustment, and output limiter is as follows:



* Operative range by the output limiter (for details, refer to "11-7" Output Limit Value (OUT1L to OUT1H)) at lower limit = 20% and upper limit = 80%

■ In case of "With Feedback"

Caution

- **Operation in case the wiring (R1) is open-circuited**
  Position value becomes 0% or less (minus (-)) and Open signal is to be continuously output.
- **Operation in case the wiring (R2) is open-circuited**
  "ERROR" is indicated and becomes the output operation status selected at the output when the feedback potentiometer error is detected (POT. ER).
- **Operation in case the wiring (R3) is open-circuited**
  Position value becomes 100% or larger and Close signal is to be continuously output.

■ In case of "Without Feedback"

The following action is taken when control output is continuously output at 0% or 100%.

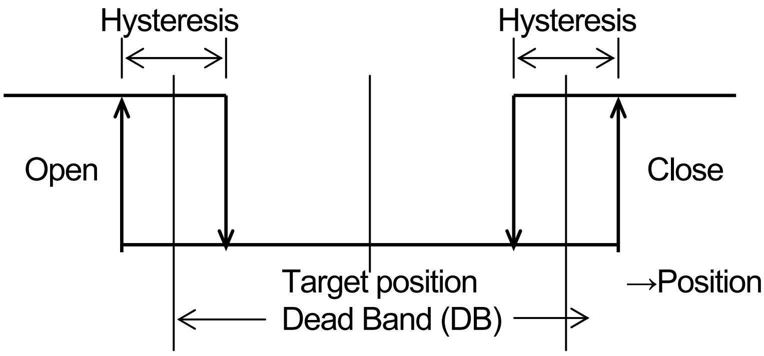
At 0%	Outputs Close signals for approx. 5% of the motor timing (TIME) every 30 seconds.
At 100%	Outputs Open signals for approx. 5% of the motor timing (TIME) every 30 seconds.

(6) Interrelation between Dead Band (DB) and hysteresis

There is the following interrelation between dead band and hysteresis.

Hysteresis is one fourth (1/4) of Dead Band (DB).

If DB is less than 1.2%, hysteresis is fixed to 0.3%
If DB is equal to 0.2%, hysteresis is fixed to 0.2%



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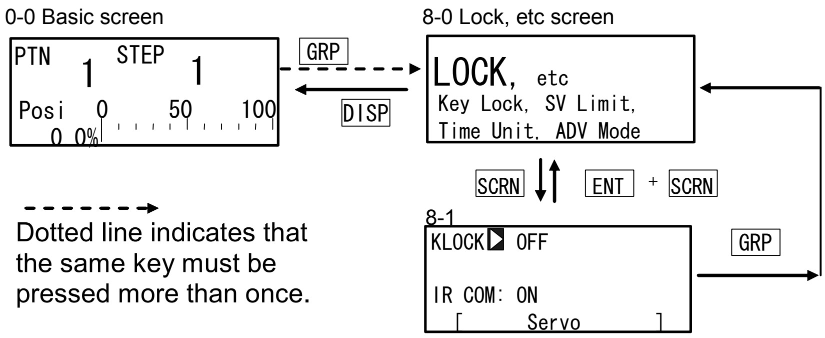
15 KEY LOCK SETTING

15-1 Setting Key Lock

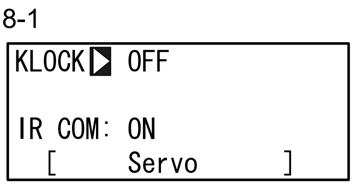
(1) Displaying the key lock screen

To call up the LOCK, etc. screen group (group 8) from the basic screen, press the GRP key.
Press the SCRN key in the LOCK, etc. screen group to switch to the screens for making and changing setups.
Select parameters in screens by pressing the ⮌ key.
Set parameters by pressing the ◄ , ▼ or ▲ key, and press the ENT key to fix and register settings.



(2) Key lock

When Key lock is applied, (key mark) is displayed at the relevant parameter on the LCD screen and the parameter cannot be set or changed.



Setting range	OFF, LOCK1, LOCK2, LOCK3
Initial value	OFF

OFF	Releases the key lock.
LOCK1	Locks parameters other than SV-related, AT, MAN, and EVENT/DO parameters.
LOCK2	Locks parameters other than SV-related parameters.
LOCK3	Locks all parameters. (excluding the key lock parameter itself)

For details on parameters that are locked, see "19 List of Parameters."

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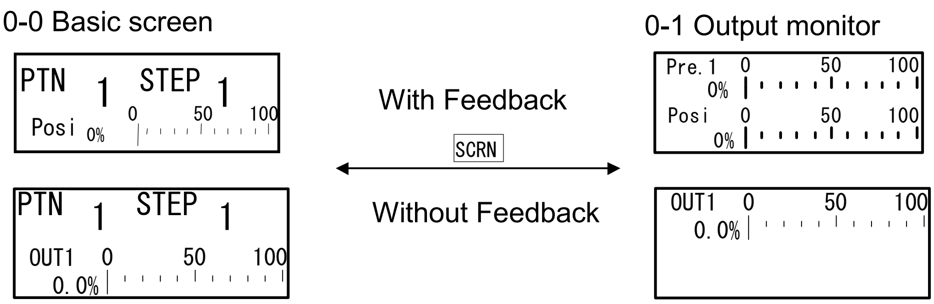
16 MONITORING, EXECUTING & STOPPING OPERATION

16-1 Flow of Basic Screen

(1) Control output (OUT1/Posi)



Display PTN No., STEP No. and position value/output value

Upper row Display output value (assumed position) by % and bar graph

Lower row Display position value (in case “With Feedback”)

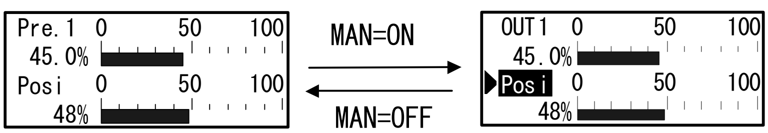
When used with Feedback, the output monitor displays OUT1 (control output) on the upper row and Posi (position value) on the lower row as a percentage (%) of the output value and a bar graph.
When OUT1 or Posi is highlighted, this means that the controller is in the Manual mode (MAN=ON).
Under the Manual mode, the motor can be controlled directly by holding the ▲ key to perform Open output ON, or by holding the ▼ key to perform Close output ON.
For details about Manual mode, refer to "17-3 Switching Auto/Manual of Control Output".

(2) Output with preset value (Preset1 to 7)

In case preset value is assigned, the display on the Basic screen (No. 0-0) and Output monitor (No. 0-1) and controller's operation may be the following.

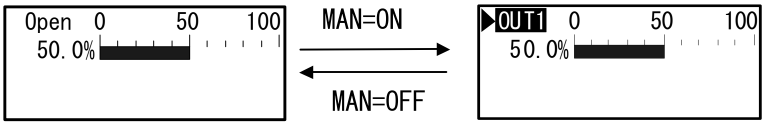
■ In case with Feedback

Instead of OUT1, any from Pre.1 to Pre.7 will be displayed.
When the mode is switched to the Manual operation mode (MAN=ON), control using preset value is disabled, OUT1 value is displayed, and the operation for open output ON or close output ON may be available.
When returning the normal control mode from the Manual mode (MAN=OFF), OUT1 display is switched to preset value (any from Pre.1 to Pre.7), and the controller change to the state that is assigned to preset.



■ In case without Feedback

Instead of OUT1, any from Stop, Open or Close will be displayed.
When the mode is switched to the Manual operation mode (MAN=ON), control using preset value is disabled, OUT1 value is displayed, and the operation for open output ON or close output ON may be available.
When returning the normal control mode from the Manual mode (MAN=OFF), OUT1 displays its status (any from Stop, Close, Open), and the controller change to the state that is assigned to preset.



■ Operation when returning from Manual mode

When the Manual mode is set to OFF (MAN=OFF), the output operation is performed in order of the following precedence (the smaller number is the higher priority).

(1) Manual output (top priority)
(2) Output at feedback potentiometer error (in case of "with Feedback")
(3) Output at standby
(4) Output with preset value
(5) Output at error
(6) PID control output

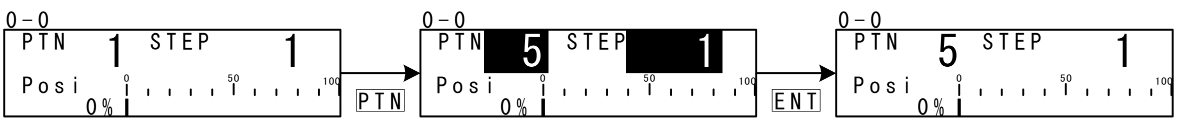
16-2 Operations in Basic Screen

The following operations are possible in the Basic screen in a reset state:

(1) Setting the start pattern
(2) Setting the start step
(3) Setting FIX mode (switching to/from the Program mode and the FIX mode)
(4) Changing FIX SV value (can be changed while execution)
(5) Start/Stop Program control/Fixed value control

(1) Setting the start pattern

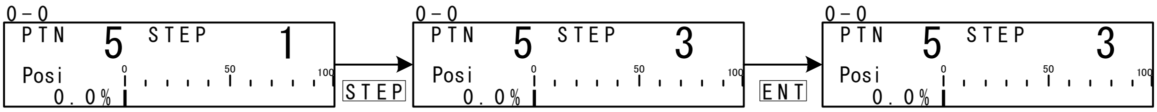
Set the start pattern before the program is started.
When the PTN key is pressed in Basic screen group top screen, the program pattern No. on the LCD display blinks and is incremented. (It can also be changed by the ▲ or ▼ key if it is blinking.)
When you press the ENT key after changing the program pattern No. to fix the setting, blinking stops.



Press 4 times

(2) Setting the start step

Set the start step before the program is started.
When the STEP key is pressed in Basic screen group top screen, the program step No. on the LCD display blinks and is incremented. (It can also be changed by the ▲ or ▼ key if it is blinking.)
When you press the ENT key after changing the program step No. to fix the setting, blinking stops.

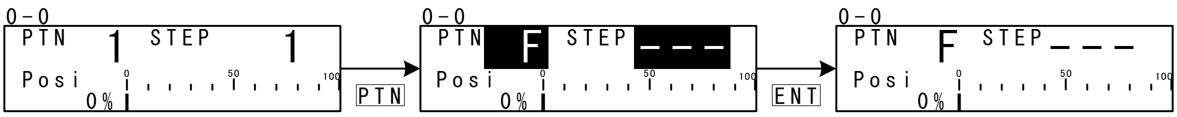


Press 2 times

When "0" is set to the start step, that pattern is not executed. To execute control, set a value other than "0" to the start step.

(3) Setting the FIX mode

When the PTN key is pressed in Basic screen group top screen, the program pattern No. on the LCD display blinks and is incremented. (It can also be changed by the ▲ or ▼ key if it is blinking.)
When "F" is selected, and the ENT key is pressed to fix the setting, blinking stops.



Note

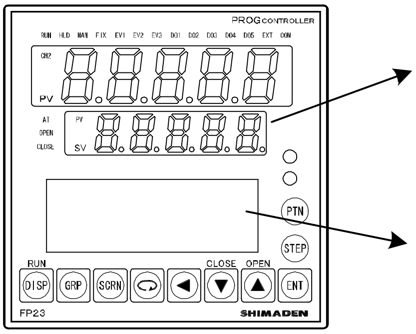
- When the mode is changed from the Program mode to the FIX mode, the move operation changes depending on the FIX MOVE setting.
  For details, see "10-4 FIX MOVE."

(4) Setting the FIX SV value (only in FIX mode)

In the FIX mode, pressing the ◄ , ▼ or ▲ key in Basic screen group top screen causes the lowermost digit in the SV display to blink.

Press the ◄ key to move the blinking section on the numerical value to the digit to be changed, and press the ▲ or ▼ key to change the SV value. After changing the SV value, press the ENT key to fix the setting. The blinking section on the numerical value stops.

16-3 Displaying the Step No. and SV



The following table shows the relationship between the start step No. in Reset state and the SV display.

Start Step No.	SV display	
	Program mode	FIX mode
0	Starting SV	
1	Starting SV	
2 to 400	Previous step's SV	
- - -		FIX SV

16-4 How to Start / Stop Control

Check the following again before starting control:

1. The LCD display shows the Basic screen.

2. Confirm if the FP23 is in the desired control mode (Program or FIX).

3. The LCD display shows the desired start pattern/start step.

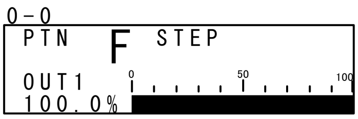
In the Basic screen, press the ENT + DISP keys, to start (RUN lamp lit) / stop control.

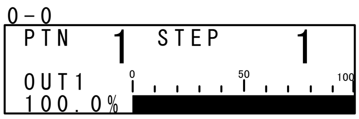
17 OPERATIONS DURING CONTROL

17-1 Monitoring Control

(1) Basic screen

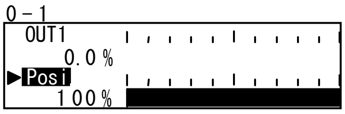
During program control, the currently executing pattern and step are displayed.
During fixed value control, "F" is displayed on the pattern display, and "- - - " is displayed on the step display indicating that the display is off.



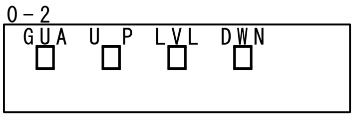


(2) Output value display

The output values of Control Output 1 (OUT1) and position value (Posi) are displayed on the upper and lower sections, respectively, as a % and a bar graph.
During manual output, output can be adjusted by operating the ▲ or ▼ key. For details, refer to "17-3 Switching Auto/Manual of Control Output".



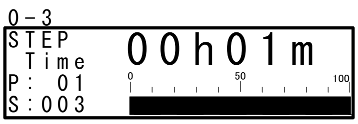
(3) Monitoring program status



GUA	Lights in guarantee soak.
UP	Lights at execution of ascending step.
LVL	Lights at execution of flat step.
DWN	Lights at execution of descending step.

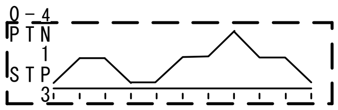
(4) Monitoring the remaining step time

This screen is displayed only during program control.
The remaining time of the currently executing step is displayed. The display returns to the Basic screen when a stop (RST) is input by DI or when the mode has moved to the FIX mode by DI.



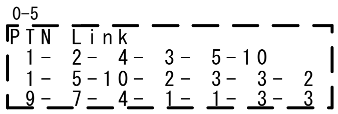
(5) Monitoring the program

This screen graphically displays the program pattern.
With programs exceeding ten steps, you can scroll the monitor display in 1-step increments by pressing the ▲ key to display the next ten steps, or pressing the ▼ key to display the previous ten steps.



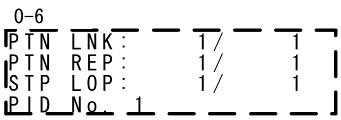
(6) Monitoring the pattern link

This screen is displayed only during program control.
The pattern link settings and execution state are displayed.
The currently executing pattern No. is displayed blinking.



(7) Monitoring information during control execution

This screen is displayed only during control execution.
The states of the following four parameters are displayed.
Note, however, that only the PID No. is displayed during fixed value control (FIX).



PTN LNK	Indicates the pattern link execution count and setting count.
PTN REP	Indicates the pattern execution count and setting count.
STP LOP	Indicates the execution count and setting count of the step loop.
PID No.	Indicates the PID No. currently in use.

17-2 Executing and Stopping Auto Tuning

Auto tuning (AT) can be executed and stopped.
During execution of auto tuning, the AT LED indicator blinks, lights during auto tuning standby, and go out when auto tuning ends or stops.

```
1-1
AT ▶       OFF
MAN:       OFF
COM        LOCAL
```

Setting range ON, OFF
Initial value OFF

> ***What is "auto tuning?"***
>
> Auto tuning automatically calculates the optimum PID constants by the limit cycle method so that control is executed using these values.

Note

- As auto tuning is affected by the output limiter during execution, set the lower and higher limit values of the control output value before executing auto tuning. (Normally, set the lower limit value to 0% and the higher limit value to 100%.)

♦Auto tuning cannot be executed

	Program Mode	**FIX Mode**
Reset state (RST)	Auto tuning cannot be executed	Auto tuning cannot be executed
Manual output (MAN)	Auto tuning cannot be executed	Auto tuning cannot be executed
Zone PID set to "PV"	Auto tuning cannot be executed	Auto tuning cannot be executed
PV value scale over	Auto tuning cannot be executed	Auto tuning cannot be executed
PID P=OFF (ON-OFF control)	Auto tuning standby	Auto tuning cannot be executed
Preset Output	Auto tuning can not be executed	Auto tuning can not be executed
Feedback potentiometer error	Auto tuning can not be executed	Auto tuning can not be executed

♦Auto tuning end conditions

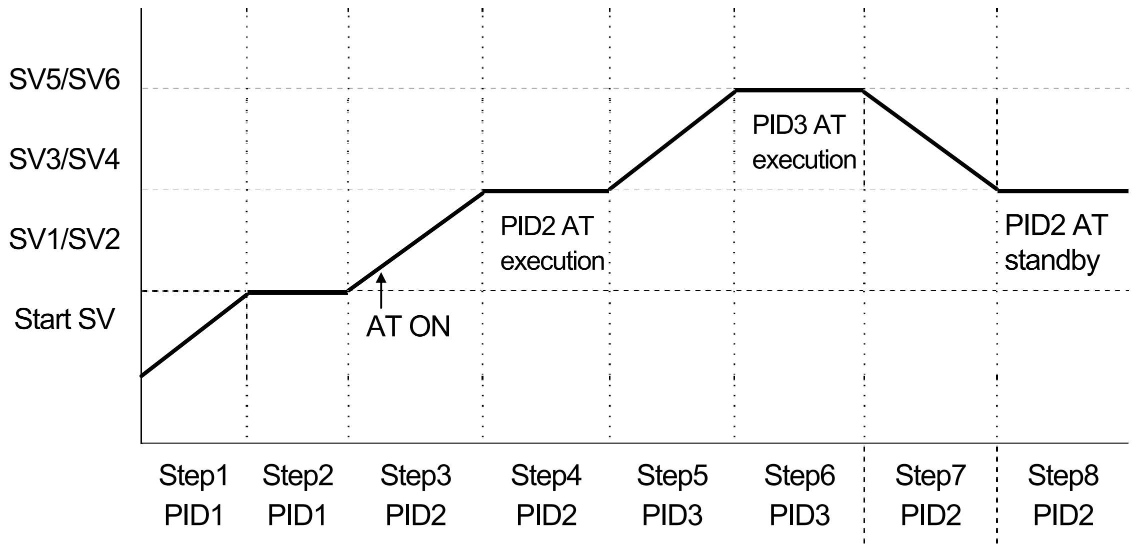
	Program Mode	FIX Mode
When the RUN state changes to the reset (RST) state	End of auto tuning	End of auto tuning
When output has elapsed for about 200 minutes in a 0% or 100% state	End of auto tuning	End of auto tuning
At power interruption	End of auto tuning	End of auto tuning
When PID computation has ended	- - -	End of auto tuning
When computation of all PID Nos. (No.1 to No.10) has ended	End of auto tuning	- - -
When PV value has exceeded the scale	End of auto tuning	End of auto tuning
During preset output	End of auto tuning	End of auto tuning
Feedback potentiometer error	End of auto tuning	End of auto tuning

♦About auto tuning during program control

Once AT has been executed, the program judges whether the current step is a ramp section or a flat section, and stands by for the next step in an AT standby state (lamp lit) on ramp sections. At flat sections, AT is executed (lamp blinks) using the PID No. of that step.
Note, however, that under the following conditions, the above operation sometimes is not performed.

(1) If the FP23 is in Hold state, AT is executed even if the current step is a ramp section.
(2) AT forcibly ends at PV scale over.
(3) The state changes to the AT standby state when P=OFF (ON-OFF control).
(4) For PID Nos. obtained by AT execution once and set with appropriate PID values, the state is the AT standby state even on flat sections until the program ends, and AT is not executed as long as AT is not performed again.

The following shows an example of AT execution at Step3.



Step3 AT is in a standby state as the step is a ramp section. (AT LED lit)
Step4 AT of flat section PID2 is executed (AT LED blinks), and becomes a standby state at the remaining time (AT LED lit).
Step5 AT is in a standby state as the step is a ramp section. (AT LED lit)
Step6 AT of flat section PID3 is executed (AT LED blinks), and becomes a standby state at the remaining time (AT LED lit).
Step7 AT is in a standby state as the step is a ramp section. (AT LED lit)
Step8 AT is in a standby state (AT LED lit) as computation of PID2 has ended at Step4.
*1 AT also ends (AT LED Out) at program end (Step8).
*2 In this example, AT of PID1 is not performed.

Note

- When there is not enough step execution time at flat sections and AT does not end, AT execution of that No. is carried out to the next time.

♦About auto tuning during fixed value control (FIX)

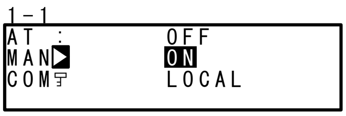
During FIX control, the AT lamp blinks from the moment that AT is started.
When AT ends, the AT lamp automatically goes out.

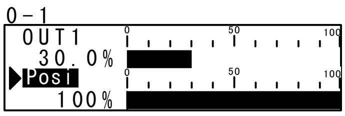
17-3 Switching Auto/Manual of Control Output

Normally, automatic operation is performed. However, use this item to manually set control output, for example, during device testing.
During manual output, note that the set value is continually output and feedback control is not performed.
During manual output, the MAN LED indicator and status monitor are displayed blinking.

Setting range	OFF, ON
Initial value	OFF

(1) Open/Close output during Manual output operations





1. Set "With Feedback" ("FB=ON") to display "Posi".

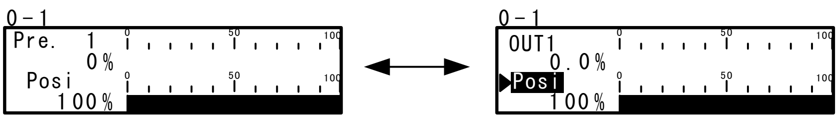
2. In the setup screen (No. 1-1), select MAN (manual) using the cursor (▶), and select and register ON to switch to manual output.

3. Next, to perform control output manually, move to the basic screen (group 0) by the [DISP] key, and move to the output value display (No. 0-1) screen by the [SCRN] key.

4. Confirm that the cursor ▶ is displayed at the left of "Posi". Using the [▲] or the [▼] key, you can operate to Open output ON/Close output ON.
There is no need to register and fix settings by the [ENT] key.

(2) Simple key-based manual output operations

In the output value display screen (No. 0-1), you can switch automatic/manual by pressing the [ENT] + [▲] keys, or the [ENT] + [▼] keys.



[ENT] + [▲] or [ENT] + [▼]

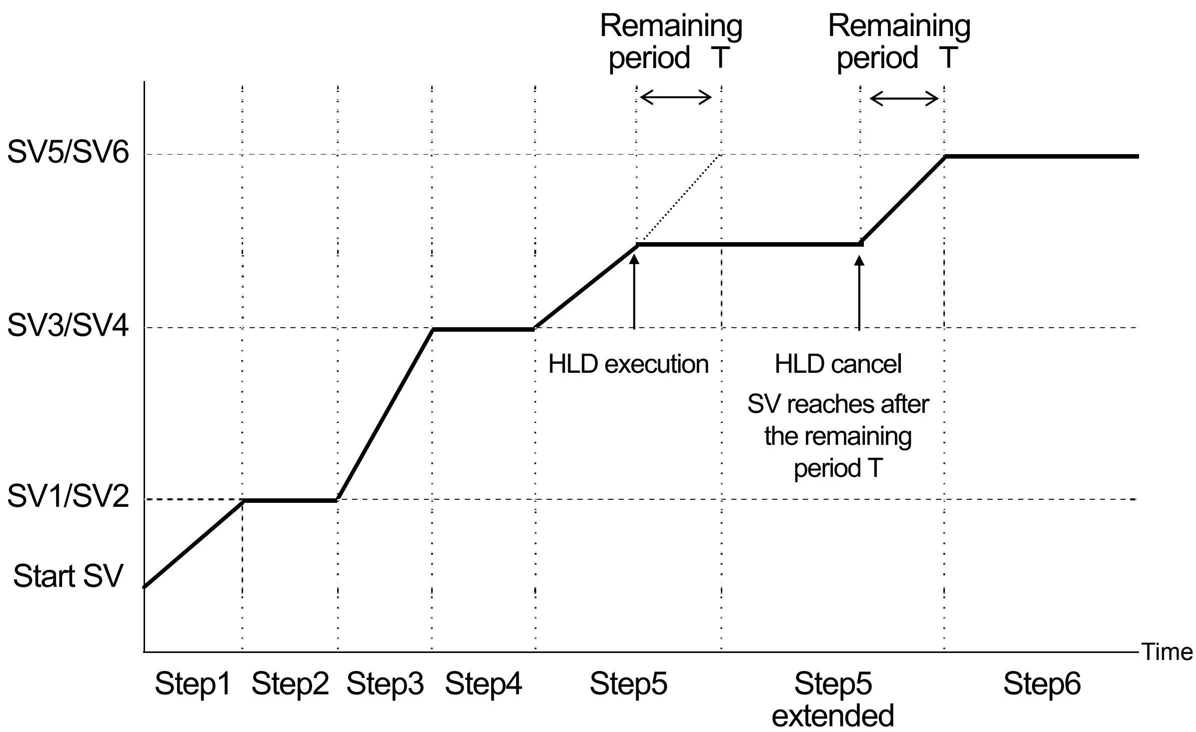
17-4 Temporarily Holding (HLD) and Resuming Program Execution

Hold is a function for temporarily holding program control. When this function is set to ON, HLD is executed, and when it is set to OFF, HLD is canceled.
During HLD execution, the HLD LED indicator and status monitor are lit.

```
1-2
HLD▶      OFF
ADV:      OFF

Start PTN:     1
```

Setting range	OFF, ON
Initial value	OFF

In the following example, the remaining Step5's period is used to reach SV5 after HLD is canceled.



*1 HLD is enabled even in the guarantee soak.

*2 ADV cannot be executed during HLD.

*3 HLD operation by key entry or communication is enabled only when DI is not assigned. (DI input is given priority.)

*4 When a program is executed with HLD DI input ON, program execution is dependent on the SV value of the PV start function.

Ex: When PV start is ON, hold by SV value of PV start
When PV start is OFF, hold by start SV

*5 During HLD, changes to parameters are not reflected until HLD is canceled even if start SV, step SV and time signal related parameters are changed.

17-5 Executing Advance (ADV)

Advance is a function for forcibly moving to the next step (or time) from the current step (or time) during program execution.

1. Step move: Program advance in step units (single steps).
2. Time move: Program advance in time units.

For details on the setting of move action by ADV execution and ADV time when time move is set, see "9-1 (5), Advance mode," and "9-1 (6), Advance time."

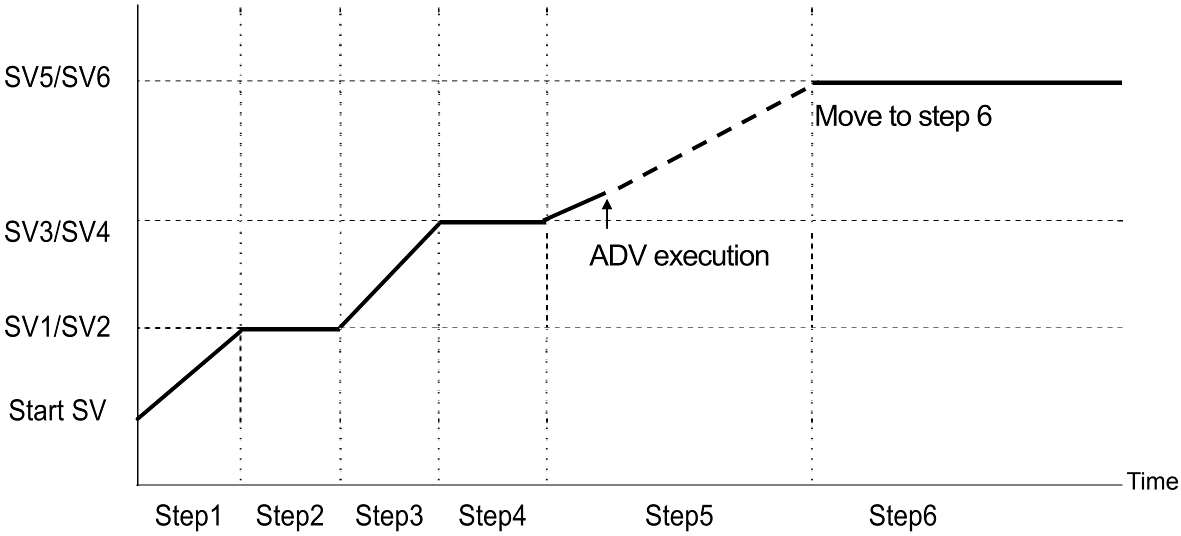
```
1-2
HLD:        OFF
ADV▶        OFF

Start PTN:     1
```

Setting range	ON, OFF
Initial value	OFF

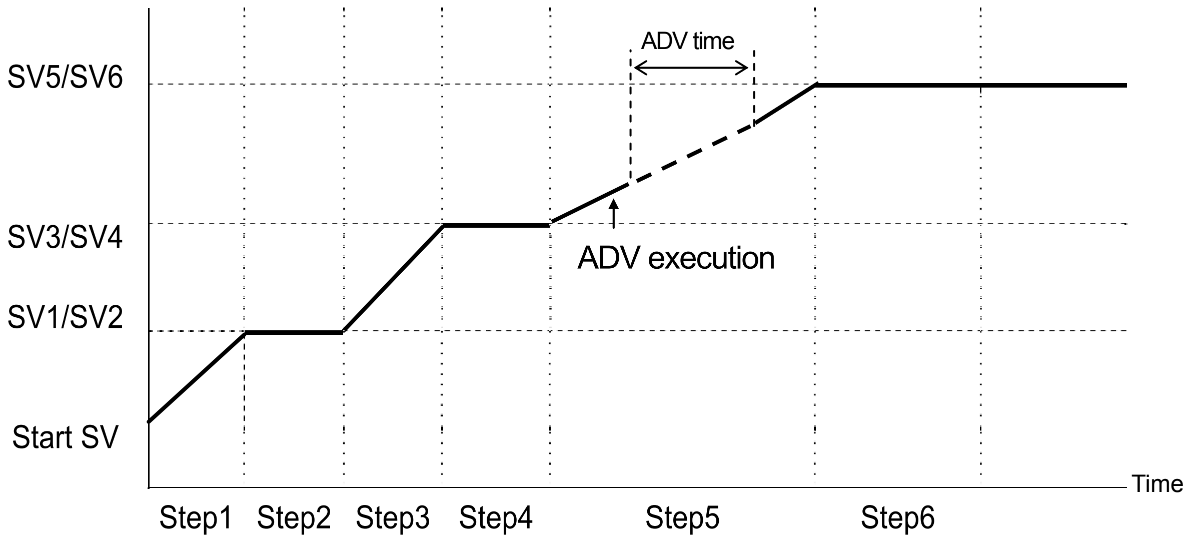
Note

- ADV is disabled for about two second after ADV is executed.
- In a guarantee soak (GUA) state, GUA is canceled on both the step and time, and the program only moves to the next step.
- Advance cannot be executed during a hold (HLD).

Example) Move by step (forcibly end Step 5 and move to Step 6)



Example) Move by time (move by ADV time only)



Note

- In time selection, when the ADV time is greater than the remaining time of that step, advance beyond the next step is not performed, and the program only advances to the next step in the same way as in step selection.

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18 ERROR DISPLAYS

18-1 Operation Check Abnormalities at Power ON

This device displays the following error codes on the PV display when an error is detected.

Display	Cause	
E-roM	ROM error	In any of the states shown on the left, all outputs turn OFF or become 0%.
E-rAM	RAM error	
E-EEP	EEPROM error	
E-Ad1	Input 1 A/D error	
E-SPc	Hardware error	

Request

- If any of the messages shown in the table are displayed, repair or replacement is required. Immediately turn the power OFF, and contact your dealer.

18-2 PV Input Abnormalities

When a PV input-related abnormality is detected during execution of control on this device, the following error codes are displayed on the PV display.

Display	Cause
Sc_LL	The PV value exceeded the measuring range lower limit (-10%FS).
Sc_HH	The PV value exceeded the measuring range higher limit (+110%FS).
	RTD burnout
	Thermocouple burnout
b----	One or two RTD-B burnout or all leads of the RTDs burnout. Action of this device in this case is PV moving excessively towards the higher limit.
CJ_LL	Reference junction compensation (-20°C) is at the lower limit. (thermocouple input)
CJ_HH	Reference junction compensation (+80°C) is at the higher limit. (thermocouple input)

Request

- Check input when the above messages are displayed. If the input lead is not in error and another probable cause might be assumed, contact your dealer.

18-3 Feedback Potentiometer Error

When used with the feedback and open-circuit of feedback potentiometer "R2" is detected, the following error code is displayed on the LCD.

Display	Cause
ERROR	Feedback potentiometer error

19 LIST OF PARAMETERS

This chapter lists all of the parameters used by the FP23.
Parameters that cannot be set by the user are not listed.

Symbol	Indicates the parameter symbol displayed on the LCD screen.
Function	Indicates the display or setup details.
Setting range	Indicates the range of parameters or numerical values that can be set.
Initial Value	Indicates the factory default. (Excluding instances where this device is shipped with values customized to customer specified values)
Lock	Number indicates the level at which key lock is valid.
*	Indicates a parameter that may be initialized when one of a range setting, unit setting or PV scaling setting has been changed. Parameters marked by * may need to be confirmed again when the above settings have been changed.

19-1 Execution Screen Group (group 1)

Symbol	Function	Setting Range	Initial Value	Lock
AT	Auto Tuning	ON/OFF	OFF	2
MAN *	Manual output	ON/OFF	OFF	2
COM	Communication mode	LOC: Local settings COM: Communication settings	LOC	2
HLD	Hold	ON/OFF	OFF	1
ADV	Advance	ON/OFF	OFF	1
Start PTN	Start pattern No.	1 to 20	1	1
PTN Link Reps	Pattern link execution count	0 to 9999	0	1
Link Format 1st to 20th	Pattern link settings	0 to assigned pattern higher limit	0	1
FIX MODE	FIX mode selection	ON/OFF	OFF	1
FIX SV *	FIX SV value setting	Within SV limit setting range	0 Unit	3
FIX PID	FIX PID No. selection	1 to 10	1	1
FIX MOVE	FIX move selection	EXE EXE/STBY EXE/TRCK	EXE	1

Symbol	Function	Setting Range	Initial Value	Lock
FIX EV Set Point EV1 to EV3 *	FIX EV action point setting	DEV_Hi :-25000 to 25000 Unit DEV_Low :-25000 to 25000 Unit DEV_Out :0 to 25000 Unit DEV_In :0 to 25000 Unit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range lower limit value 100% 0%	2
FIX DO Set Point DO1 to DO 9 *	FIX DO action point setting	DEV_Hi :-25000 to 25000 Unit DEV_Low :-25000 to 25000 Unit DEV_Out :0 to 25000 Unit DEV_In :0 to 25000 Unit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range lower limit value 100% 0%	2

19-2 Program Screen Group (group 2)

Symbol	Function	Setting Range	Initial Value	Lock
Num.of STEP	Number of steps	0 to assigned step higher limit	20	1
Start STEP	Start step	0 to number of steps	1	1
Start SV *	Start SV	Within SV limiter setting range	0 Unit	3
PTN Reps	Pattern execution count	1 to 9999 times	1	1
Loop Setup				
Start	Start step No.	1 to number of steps	1	1
End	End step No.	1 to number of steps	1	1
Reps	Execution count	1 to 9999 times	1	1
GUArantee Soak				
Zone *	Guarantee soak zone	OFF, 1 to 9999 Unit	OFF	1
Time *	Guarantee soak time	00:00 to 99:59	00:00	1
PV Start	PV start	ON/OFF	OFF	1
EV Set Point EV1 to EV3 *	EV action point setting	DEV_Hi :-25000 to 25000 Unit DEV_Low :-25000 to 25000 Unit DEV_Out :0 to 25000 Unit DEV_In :0 to 25000 Unit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range lower limit value 100% 0%	2
DO Set Point DO1 to DO 9 *	DO action point setting	DEV_Hi :-25000 to 25000 Unit DEV_Low :-25000 to 25000 Unit DEV_Out :0 to 25000 Unit DEV_In :0 to 25000 Unit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range lower limit value 100% 0%	2
TS1 to TS8				
ON STEP	Time signal ON step	OFF, 1 to number of steps	OFF	1
ON Time	Time signal ON time	00:00 to 99:59	00:00	1
OFF STEP	Time signal OFF step	OFF, 1 to number of steps	OFF	1
OFF Time	Time signal OFF time	00:00 to 99:59	00:00	1

19-3 Step Screen Group (group 2S)

Symbol	Function	Setting Range	Initial Value	Lock
STEP001 to 400				
SV *	Step SV	Within SV limiter setting range	0 Unit	3
Time	Step time	00:00 to 99:59	00:01	1
PID	Step PID No.	0 to 10	0	1

19-4 PID Screen Group (group 3)

Symbol	Function	Setting Range	Initial Value	Lock
PID (01 to 10) -OUT1				
P	No.1 proportional band (OUT1)	OFF, 0.1 to 999.9 %	3.0 %	1
I	No.1 integral time (OUT1)	OFF, 1 to 6000 s	120 s	1
D	No.1 differential time (OUT1)	OFF, 1 to 3600 s	30 s	1
DF *	No.1 hysteresis (OUT1)	1 to 9999 Unit	20 Unit	1
MR	No.1 manual reset (OUT1)	-50.0 to 50.0 %	0.0 %	1
SF	No.1 set value function (OUT1)	0.00 to 1.00	0.40	1
ZN *	No.1 PID zone (OUT1)	Within measuring range	0 Unit	1
PID (01 to 10) OUT1L	No.1 output limiter lower limit value (OUT1)	0.0 to 100.0 %	0.0 %	1
OUT1H	No.1 output limiter higher limit value (OUT1)	0.0 to 100.0 %	100.0 %	1
Zone PID1	Zone PID mode	OFF: PV: PV zone switching SV: SV zone switching	OFF	1
HYS1 *	Zone hysteresis	0 to 10000 Unit	20 Unit	1
AT Point *	Auto tuning point	0 to 10000 Unit	0	1

19-5 EVENT/DO Screen Group (group 4)

Symbol	Function	Setting Range	Initial Value	Lock
EV1 to EV3, DO1 to DO9				
MD	Operation mode	None : No action DEV Hi : Higher limit deviation DEV Low : Lower limit deviation DEV Out : Outside higher/lower limit deviation DEV In : Inside higher/lower limit deviation PV Hi : PV higher limit absolute value PV Low : PV lower limit absolute value SO : Scale over FIX : In FIX mode AT : Auto tuning execution in progress MAN : Manual output LOGIC : Logic operation (*1 *2) Direct : Direct output (*3) RUN : RUN HLD : Program hold GUA : Guarantee soak zone STEP : Step signal PRG.END : Program end signal TS1 : Time signal 1 to TS8 : Time signal 8 Posi.H : Position higher limit absolute value (*4) Posi.L : Position lower limit absolute value (*4) POT.ER :Feedback potentiometer error (*4)	EV1: DEV Hi EV2: DEV Low EV3: RUN DO1 to 9 :None	1
ACT	Output characteristics	N.O.: Normally open N.C.: Normally closed	N.O.	1
DF *	Hysteresis	1 to 9999 Unit	20 Unit	1
IH	Standby action	OFF, 1/2/3	OFF	1
DLY	Delay time	OFF, 1 to 9999 s	OFF	1
EV1 to EV3 / DO1 to DO3		(when MD = LOGIC)		
SRC1, SRC2	Source input1/2	None/TS1 to TS8/DI1 to DI10	None	1
Gate1, Gate2	Gate input1/2	BUF/INV/FF	BUF	1
Log MD	Logic operation mode	AND/OR/XOR	AND	1
DO4, DO5		(when MD = LOGIC)		
SRC	Source input	None/TS1 to TS8/DI1 to DI10	None	1
Log MD	Logic operation mode	Timer / Counter	Timer	1
Time	Timer	OFF, 1 to 5000 s	OFF	1
Count	Counter	OFF, 1 to 5000	OFF	1

*1 Logic operation (AND, OR, XOR) can be assigned only to LOGIC EV1 to EV3, and DO1 to DO3.

*2 Logic operation (Timer, Counter) can be assigned only to DO4 and DO5.

*3 Direct output can be assigned only to DO6 to DO9 with communication option.

*4 Posi.H, Posi.L, and POT.ER can be assigned only when the controller is used with feedback potentiometer.

19-6 DI/Option Screen Group (group 5)

Symbol	Function	Setting Range	Initial Value	Lock
DI1	DI1 assignment	RUN/RST (fixed)	RUN/RST	1
DI2	DI2 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC Preset1 Preset2 Preset3	None	1
DI3 DI4 DI6 DI7 DI9 DI10	DI3 assignment DI4 assignment DI6 assignment DI7 assignment DI9 assignment DI10 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC	None	1
DI5	DI5 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC PTN2bit PTN3bit PTN4bit PTN5bit	None	1
DI8	DI8 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC PTN2bit PTN3bit	None	1

Symbol	Function	Setting Range	Initial Value	Lock
Ao1MD	Analog output 1 type	PV : Measurement value SV : Setting value DEV : Deviation value OUT1 : Output 1 Posi : Position value	PV	1
Ao1_L *	Analog output 1 lower limit side scaling	PV, SV : Within measuring range DEV : -100.0 to 100.0 % OUT1 : 0.0 to 100.0 % Posi : 0 to 100%	Setting range lower limit value	1
Ao1_H *	Analog output 1 higher limit side scaling	PV, SV : Within measuring range DEV : -100.0 to 100.0 % OUT1 : 0.0 to 100.0 % Posi : 0 to 100%	Setting range higher limit value	1
Ao2MD	Analog output 2 type	PV : Measurement value SV : Setting value DEV : Deviation value OUT1 : Output 1 Posi : Position value	SV	1
Ao2_L *	Analog output 2 lower limit side scaling	PV, SV : Within measuring range DEV : -100.0 to 100.0 % OUT1 : 0.0 to 100.0 % Posi : 0 to 100%	Setting range lower limit value	1
Ao2_H *	Analog output 2 higher limit side scaling	PV, SV : Within measuring range DEV : -100.0 to 100.0 % OUT1 : 0.0 to 100.0 % Posi : 0 to 100%	Setting range higher limit value	1
COM PROT	Communication protocol	SHIMADEN, MOD_ASC, MOD_RTU	SHIMADEN	1
ADDR	Address	1 to 98	1	1
BPS	Speed	2400, 4800, 9600, 19200 bps	9600 bps	1
MEM	Memory mode	EEP : Write to EEPROM, RAM RAM : Write to RAM only R_E : Write to EEPROM other than SV, COM mode, out	EEP	1
COM DATA	Data length	7: 7-bit, 8: 8-bit	7	1
PARI	Data parity	EVEN, ODD, None	EVEN	1
STOP	Stop bit	1, 2	1	1
DELY	Delay time	1 to 50 ms	10 ms	1
COM CTRL*1	Control code	STX_ETX_CR, STX_ETX_CRLF, @_: _CR	STX_ETX_CR	1
BCC *1	BCC check	ADD, ADD_two's cmp, XOR, None	ADD	1

*1 SHIMADEN protocol only

- DI5 to DI10 and Ao1MD to BCC are optional and are not displayed when they are not installed.

19-7 Control Output Screen Group (group 6)

Symbol		Function	Setting Range	Initial Value	Lock
OUT1 ACT		Output characteristics	Reverse: Reverse characteristics Direct: Direct characteristics	Reverse	1
RST		Output at reset	With FB: Stop, Preset1 to 7 Without FB: Stop, Close, Open	w FB: Preset1 w/o FB: Close	1
ERR		Output at error	With FB: Stop, Preset1 to 7 Without FB: Stop, Close, Open	w FB: Preset1 w/o FB: Close	1
POT.ER		Feedback potentiometer error	With FB (only): Stop, Close, Open	Stop	1
Rate Limiter		OUT1	OFF, 0.1 to 100.0 %/s	OFF	1
Servo	FB	Feedback potentiometer	ON: with feedback potentiometer OFF: without feedback potentiometer	ON	1
	DB	Dead band	0.2 to 10.0 %	2.0 %	1
Servo calib-ration	MD	Mode for ZERO/SPAN adjustment	Auto: Automatic control Manual: Manual control	Auto	1
	EXE	Execution of ZERO/SPAN adjustment	Stop Start	Stop	1
	ZERO	ZERO adjustment manually	Open Close	---	1
	SPAN	SPAN adjustment manually	Open Close	---	1
Servo preset	P1 P2 P3 P4 P5 P6 P7	Servo preset values	0 to 100%	0 %	1

19-8 Unit/Range Screen Group (group 7)

Symbol	Function	Setting Range	Initial Value	Lock
PV Bias *	PV bias	-10000 to 10000 Unit	0 Unit	1
PV Filter	PV filter	OFF, 1 to 100 Sec	OFF	1
PV Slope * *1	PV slope	0.500 to 1.500 Unit	1.000	1
RANGE	Measuring range	01 to 19: Thermocouple 31 to 58: RTD 71 to 77: Voltage (mV) 81 to 87: Voltage (V)	06	1
Sc_L *	PV lower limit side scaling	-19999 to 29990 Unit	0 Unit	1
Sc_H *	PV higher limit side scaling	-19989 to 30000 Unit	1000 Unit	1
UNIT *	Measurement unit	RTD, TC : °C, °F I, V :%, °C, °F, None	RTD, TC : °C I, V :%	1
DP *	Decimal point position	XXXXX. XXXX.X XXX.XX XX.XXX X.XXXX	XXXX.X	1
Figure * *2	Number of digits past decimal point	Normal : Digits past decimal point Short : No digits past decimal point	Normal	1
CJ *3	Cold junction compensation	Internal : Internal compensation External : External compensation	Internal	1
SQ.Root * *4	Square root extraction	OFF : No operation ON : Operation	OFF	1
Low cut *5	Low cut (Voltage input)	0.0 to 5.0 %	1.0 %	1
PMD *4	Linearizer approximation	OFF : Approximation OFF ON : Approximation ON	OFF	1
A1 to A11 *4	Linearizer approximation input 1 to 11	-5.00 to 105.00 %	0.00 %	1
B1 to B11 *4	Linearizer approximation output 1 to 11	-5.00 to 105.00 %	0.00 %	1

*1 This screen is not displayed in the case of RTD and TC input.
*2 This screen is not displayed in the case of voltage and current input.
*3 This screen is displayed only in the case of TC input.
*4 This screen is displayed only in the case of RTD and TC input.
*5 This screen is displayed only in the case of "square root function = ON".

19-9 Lock, etc. Screen Group (group 8)

Symbol	Function	Setting Range	Initial Value	Lock
KLOCK	Key lock	OFF : Release LOCK1 : Other than SV, CONTROL LOCK2 : Other than SV LOCK3 : All	OFF	- - -
IR COM	Front panel communication	ON : Enabled OFF : Disabled	ON	1
SV Limit_L *	SV limiter lower limit value	Within measuring range. Note that L<H	Measuring range lower limit value	1
SV Limit_H *	SV limiter higher limit value	Within measuring range. Note that L<H	Measuring range higher limit value	1
Time Unit	Time unit	H/M: Hours/minutes M/S: Minutes/second	H/M	1
PRG.Wait	Program control execution delay time	00h00m to 99h59m	00h00m	1
SO Mode	Input error mode	HOLD : Hold state RUN : RUN continued RESET : Reset state	HOLD	1
POWER ON	Power interruption compensation	RESET CONTINUE	RESET	1
ADV Mode	Advance mode	Step : Step Time : Time	Step	1
ADV Time	Advance time	00:00 to 99:59	00:00	1

20 PARAMETER SETUP RECORD SHEETS

Lots of parameters are set on this device before use.
Users will find these sheets will come in handy to restore a system in the event of a malfunction, for example, if they keep a detailed record of the product model No. they are using and the values set on this device.
We recommend that you fully utilize these record sheets by making a blank copy of these tables and entering the required values on the copied record sheet.

20-1 Product Model Code

FP23-	MS	□	N-	00	□	□	□	□	□

20-2 CTRL EXEC Parameters

Item	Set value
AT	
MAN	
HLD	
ADV	
Start PTN	
PTN-Link Reps	
Link Format	
1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	
9th	
10th	
11th	
12th	
13th	
14th	
15th	
16th	
17th	
18th	
19th	
20th	

Item	Set value
FIX MODE	
FIX SV	
FIX PID	
FIX MOVE	
FIX EV1 Set Point	
FIX EV2 Set Point	
FIX EV3 Set Point	
FIX DO1 Set Point	
FIX DO2 Set Point	
FIX DO3 Set Point	
FIX DO4 Set Point	
FIX DO5 Set Point	
FIX DO6 Set Point	
FIX DO7 Set Point	
FIX DO8 Set Point	
FIX DO9 Set Point	

20-3 PROG STEP Parameters

PTN No. ____________

Item	Set Value
Num. of STEP	
Start STEP	
Start SV	
PTN Reps	
Loop setup	
Start	
End	
Reps	
Guarantee Soak	
Zone	
Time	
PV Start	

Item	Set Value
EV1 Set Point	
EV2 Set Point	
EV3 Set Point	
DO1 Set Point	
DO2 Set Point	
DO3 Set Point	
DO4 Set Point	
DO5 Set Point	
DO6 Set Point	
DO7 Set Point	
DO8 Set Point	
DO9 Set Point	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

PTN No. _______

Item	Set Value
Num. of STEP	
Start STEP	
Start SV	
PTN Reps	
Loop setup	
Start	
End	
Reps	
Guarantee Soak	
Zone	
Time	
PV Start	

Item	Set Value
EV1 Set Point	
EV2 Set Point	
EV3 Set Point	
DO1 Set Point	
DO2 Set Point	
DO3 Set Point	
DO4 Set Point	
DO5 Set Point	
DO6 Set Point	
DO7 Set Point	
DO8 Set Point	
DO9 Set Point	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

STEP No. ____________

Item	Set Value
SV	
Time	
PID	

20-4 PID Parameters

OUT1

PID No.	P	I	D	DF	MR	SF	ZN	OUT1L	OUT1H
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									

Zone PID

Item	Set Value
Zone PID1	
Zone HYS1	
AT Point	

20-5 EVENT/DO Parameters

Item	EV1	EV2	EV3	DO1	DO2	DO3
MD						
ACT						
DF						
IH						
DLY						
Log MD						
SRC1						
GATE1						
SRC2						
GATE2						

Item	DO4	DO5	DO6	DO7	DO8	DO9
MD						
ACT						
DF						
IH						
DLY						
Log MD			---	---	---	---
SRC			---	---	---	---
Time /Count			---	---	---	---

20-6 DI/Options Parameters

Item	Set Value
DI1	
DI2	
DI3	
DI4	
DI5	
DI6	
DI7	
DI8	
DI9	
DI10	
Ao1MD	
Ao1 L	
Ao1 H	
Ao2MD	
Ao2 L	
Ao2 H	

Item		Set Value
COM	PROT	
	ADDR	
	BPS	
	MEM	
	DATA	
	PARI	
	STOP	
	DELY	
	CTRL	
	BCC	

20-7 Control Output Parameters

Item	Set Value
ACT	
RST	
ERR	
POT.ERR	
Rate Limiter	
SERVO FB	
DB	
TIME	
BOOT	
SERVO Calibration	
MD	
EXE	
ZERO	
SPAN	

Item	Set Value
SERVO Preset	
P1	
P2	
P3	
P4	
P5	
P6	
P7	

20-8 Unit/Measuring Range Parameters

Input setting

Item	Set Value
PV Bias	
PV Filter	
PV Slope	
RANGE	
Sc_L	
Sc_H	
UNIT	
DP	
Figure	
CJ	
SQ. Root	
Low Cut	
PMD	

Input point set values

Input point No.	Set Value	
n	An	Bn
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

20-9 Lock, etc. Parameters

Item	Set Value
KLOCK	
IR COM	

Item	Set Value
SV Limit_L	
SV Limit_H	
Time Unit	
PRG.Wait	
SO Mode	
POWER ON	
ADV Mode	
ADV Time	

21 SPECIFICATIONS

21-1 Display

◆ LED display	Measured value (PV): 7-segment red LED 5 digits, height of characters 16 mm Set value (SV) : 7-segment green LED 5 digits, height of characters 11 mm		
◆ LCD display	PTN No., STP No., Graph Pattern, control output value, various parameter displays 128 x 32 dot matrix liquid crystal display with yellow-green LED backlight		
◆ Action display lamps	17 action statuses display. Lights on or blinks depending on the status		
	RUN	Green	Lights when control is executed, brinks when program execution is waiting
	HLD	Green	Lights when program operation is stopped temporarily, brinks when it is stopped by input error
	MAN	Green	Lights when manual control is in operation
	FIX	Green	Lights when FIX (fixed value control) mode
	EV1 to EV3	Orange	Lights when event output is ON
	DO1 to DO5	Orange	Lights when DO output is ON
	EXT	Green	Lights when start pattern external switching is assigned
	COM	Green	Lights when the communication mode is ON
	AT	Green	Lights when auto tuning is in standby, brinks when it is being executed
	OPEN	Green	Lights when open output is ON
	CLOSE	Green	Lights when close output is ON
◆ Display accuracy	±(0.1% + 1digit) of measuring range (See Measuring Range Code Table for individual ranges.)		
TC input	±(0.1% FS + 1°C)		
Pt input	±(0.1% FS + 0.1°C)		
mV, V input	±(0.1% FS + 1 digit)		
mA input	Depends on accuracy of externally attached resistor (When ±0.1%FS accuracy is required, specify when ordering)		
◆ Temperature range for maintaining display accuracy	23°C±5°C		
◆ Display resolution	0.0001, 0.001, 0.01, 0.1, 1 (differs depending on measuring range)		
◆ Sampling cycle	0.1 seconds (100 msec)		

21-2 Settings

◆ Local setting	By 10 front panel key switches
◆ SV setting range	Same as measuring range (within setting limiter)
◆ Higher/lower setting limiter	Any value in measuring range (lower limit value < higher limit value)

21-3 Input

- Universal-input, multi-range
  Thermocouple input, RTD input, voltage input (mV, V), current input (mA)
- Thermocouple (TC)
  Input type: B, R, S, K, E, J, T, N, PLII, PR40-20, WRe5-26, {L, U (DIN43710)}, K, AuFe-Cr (Kelvin scale). For details, see Measuring Range Code Table.
  Display range: ±10% of measuring range.
  Allowable range of external resistance
  100Ω max.
  Input resistance: Approx. 500 kΩ
  Cold junction compensation
  Selectable between internal and external cold junction compensation
  Internal cold junction compensation accuracy
  ±1°C (in range of 18 to 28°C)
  Burnout functions: Standard feature (up scale)
- RTD input type: JIS Pt100 /JPt100 3-wire type. For details, see Measuring Range Code Table.
  Display range: ±10% of measuring range (not lower than -273.15°C)
  Lead wire tolerance: 10Ω max. per wire
  Amperage: Approx. 1.1mA
- Voltage input (mV, V) type
  -10 to 10, 0 to 10, 0 to 20, 0 to 50, 10 to 50, 0 to 100, -100 to 100 mV
  -1 to 1, 0 to 1, 0 to 2, 0 to 5, 1 to 5, 0 to 10, -10 to 10 V
  Universal-input, programmable scaling
  For details, see Measuring Range Code Table.
  Input resistance: Approx. 500 kΩ
- Current input (mA) type
  4 to 20, 0 to 20 mA: universal-input and programmable scaling
  For details, see Measuring Range Code Table.
  Receiving resistance: 250Ω by external resistor
- Common functions
  Sampling cycle: 0.1 seconds (100 msec)
  PV bias: ±10000 Unit
  PV slope: Input value x 0.500 to 1.500
  PV filter: OFF, 1 to 100 seconds
- Input operation: Possible with voltage or current input
  Square root extraction operation
  Low cut range 0.0 to 5.0% FS
  Linearizer approximation
  Number of input points: 11
- Isolation: Insulated between input and DI input, or input and various outputs.
  Not insulated between input and the system.

21-4 Control

(1) Control output

- Control system — Expert PID control with auto tuning function
  - Multi-PID — By PID Nos.01 to 10 (10 types)
    Individual PID set on each step and FIX SV
  - Zone PID — Selectable between individual PID and zone PID (max. 10 zones)
  - Proportional band (P) — OFF, 0.1 to 999.9% (OFF: ON-OFF action)
  - Integral time (I) — OFF, 1 to 6000 seconds (OFF: P or PD control)
  - Derivative time (D) — OFF, 1 to 3600 seconds (OFF: P or PI control)
  - Manual reset (MR) — -50.0 to 50.0% (available when I = OFF)
- Operation/output update cycle
  0.1 seconds (100 msec)
- Control output characteristics
  Reverse (for heating)/Direct (for cooling)
- Higher/lower output limiter setting range
  Higher limit/lower limit (set individually for each PID No.)
  - Setting range — 0.0 to 100.0% (lower limit < higher limit)
- Output rate-of-change limiter
  OFF, 0.1 to 100.0%/seconds

(2) Servo output

- Control output — Output for servo actuator drive
  Support for both feedback potentiometer with/without
- Control output type/rating
  R: Contact output, rating 240V AC 2A
  Y: Contact output, rating 240V AC 2A, built-in CR absorber
  S: Combination of SSR and Contact, 240V AC 2A
- Output update cycle — 50msec
- Control output at error
  Stop, Preset (0 to 100%) (with feedback potentiometer)
  Stop, Close, Open (without feedback potentiometer)
- Control output at reset
  Stop, Preset (0 to 100%) (with feedback potentiometer)
  Stop, Close, Open (without feedback potentiometer)
- Output at potentiometer error
  Stop, Close, Open (with feedback potentiometer)
- Manual control
  - Auto/manual switching
    Balanceless/bumpless transfers (with feedback potentiometer)
  - Manual output — Open/Close output
- Positioning — With percentage, as numerically and bar graph on LCD.
  Display resolution 1%
  Display range -10 to 110%
- Positioning ZERO/SPAN adjustment
  Supports automatic adjustment, manual adjustment available
- Dead Band (DB) — 0.2 to 10.0% of input signal
- Hysteresis (DF) — 25% of the DB
  When DB is equal to or lower than 1.2%, fixed to 0.3%.
- Feedback potentiometer
  100 to 2000Ω/3 wire system
- Isolation — Insulated between between Servo Output and various I/O, or Servo Output and the system

21-5 Program Function

- Number of patterns — Max. 20 patterns
- Number of steps — Max. 400 steps
- Step time — 0 minutes 0 seconds to 99 minutes 59 seconds or 0 hours 0 minutes to 99 hours 59 minutes
- Pattern execution counts — Repeatable to 9999 times max.
- Step loop count — Repeatable to 9999 times max.
- Pattern link setting — Connectable to 20 patterns max. Executable to 9999 times max.
- Link execution setting — Repeatable to 9999 times max.
- Program settings — By front panel keys or communication
  - Level — Same as measuring range
  - Time (1) — 0 to 99 hours 59 minutes/step
  - Time (2) — 0 to 99 minutes 59 seconds/step
  - Ramp settings — Automatic computation by setting time and level. Ascend, descend, ramp control
  - Timer — Sets the delay time for start of program operation. 00 hours 00 minutes to 99 hours 59 minutes
- Setting resolution
  - Level — 0.1 or 1 (varies according to measuring range)
  - Time — 1 minute or 1 second
- Advance function — Program moves to next step during operation.
- Hold function — Progress of program time is stopped temporarily during operation.
- Time signal setting
  - Number of registrations — Max. 8 points per pattern (TS1~TS8). Assigned to event output or DO
  - Time (1) — 0 to 99 hours 59 minutes
  - Time (2) — 0 to 99 minutes 59 seconds
  - Resolution — 1 minute or 1 second
- Guarantee soak zone — When the program moves from a ramp step to a flat step, the program does not move to the next step if the PV value is not in the set zone range or is not more than the preset time.
  - Setting resolution — 0 to 9999 Unit
  - Time (1) — 0 to 99 hours 59 minutes
  - Time (2) — 0 to 99 minutes 59 seconds

21-6 Event Output

◆ Number of outputs	Total 3: EV1 to EV3	
◆ Output rating	240 V AC/1.0A resistive load common to contact outputs (normally open contacts)	
◆ Output update cycle	0.1 seconds (100 msec)	
◆ Setting/selection	Individual setting (individual output), selectable (to designate output)	
◆ Output types	1) None	No action (no assignment)
	2) DEV Hi	Higher limit deviation alarm
	3) DEV Low	Lower limit deviation alarm
	4) DEV Out	Outside higher/lower limit deviation alarm
	5) DEV In	Inside higher/lower limit deviation alarm
	6) PV Hi	PV higher limit alarm
	7) PV Low	PV lower limit alarm
	8) SO	ON at scale over
	9) FIX	ON in FIX mode
	10) AT	ON during execution of auto tuning
	11) MAN	ON during manual control
	12) LOGIC	ON during logic operation output
	13) RUN	ON during control execution
	14) HLD	ON during program hold
	15) GUA	ON during guarantee soak
	16) STEP	ON during step move
	17) PRG. END	ON at program end
	18) TS1	ON during time signal 1
	|	
	25) TS8	ON during time signal 8
	26) Direct	ON during direct output by communication
	27) Posi.H	Positioning higher limit absolute value
	28) Posi.L	Positioning lower limit absolute value
	29) POT.ER	Feedback potentiometer error
	Direct cannot be set for events, but for DOs.	
	Posi.H, Posi.L, and POT.ER can be assigned only when the controller is used with feedback potentiometer.	
◆ Setting range	DEV Hi, Low	-25000 to 25000 Unit
	DEV Out, In	0 to 25000 Unit
	PV, Hi, Low	Within measuring range
	Posi H, L	0 to 100%
Hysteresis	1 to 9999 Unit (when DEV, PV or Posi is selected)	
Action delay time	OFF, 1 to 9999 seconds (when DEV, PV or Posi is selected)	
Standby action	Selectable from 3 types (when DEV, PV or Posi is selected)	
	OFF No standby action	
	1 At power ON, or at RST -> RUN	
	2 At power ON, at RST -> RUN, or at execution SV is changed	
	3 At input error (SO), when action is OFF	
Output characteristics switching	Selectable between normally open and normally closed	
◆ Isolation	Insulated between event output and various I/O, or event output and the system	

21-7 External Control Output (DO)

- Number of outputs: 9 points in total; standard 5 and 4 optional

DO1 to DO3	Darlington output	3 points
DO4 to DO5	Open collector output	2 points
DO6 to DO9	Open collector output	4 points (optional)

- Output rating: Open collector output 24 V DC/8 mA max., ON voltage 0.8V max.
  Darlington output 24 V DC/50mA max., ON voltage 1.5V max.
- Output update cycle: 0.1 seconds (100 msec)
- Setting/selection: Individual setting (individual output), selectable.
  Details are the same as those for event outputs.
  (However, LOGIC can be assigned to only DO1 to DO5. Direct can be assigned to only DO6 to DO9 with communication option. Posi.H, Posi.L, and POT.ER can be assigned only when the controller is used with feedback potentiometer.)
  Details of setting range, hysteresis, action delay time and stand by action are the same as those for event outputs.
- Output characteristics switching
  Normal open and normal close selectable
- Isolation: Insulated between DO and various I/O, or DO and the system.
  Not insulated between DOs.

21-8 External Control Input (DI)

- Number of inputs: 10 points in total; standard 4 and 6 optional
  DI1 to DI4 4 points
  DI5 to DI10 6 points (optional)
- Input rating: Non-voltage contact or open collector
  Input specifications: Photocoupler input
  5 V DC, 2.5 mA max. Voltage application per 1 input
  Input holding time: 0.1 seconds (100 msec) min.
- Setting/selection: Individual setting (individual input), selectable
  Input types:

1) None	No action (no assignment)
2) RUN/RST	Switching of Run/Reset (when ON: Run execution)
3) RST	Forced Reset (when ON: Reset state)
4) HLD	Control suspension/restart (when ON: suspension state)
5) ADV	Execute advance (when ON: execute advance)
6) FIX	Switching of FIX mode/Program mode (when ON: FIX mode)
7) MAN	Switching of control output between auto/manual (when ON: manual)
8) LOGIC	Logic operation input [exclusive port] (when ON: input ON)
9) PTN2bit	Selection of start pattern No. by DI input (selectable from 3 patterns)
10) PTN3bit	Selection of start pattern No. by DI input (selectable from 7 patterns)
11) PTN4bit	Selection of start pattern No. by DI input (selectable from 15 patterns)
12) PTN5bit	Selection of start pattern No. by DI input (selectable from 20 patterns)
13) Preset 1 to 3	Preset No. switching by DI2 to DI4.

- Isolation: Insulated between DI and various I/O, or DI and the system
  Not insulated between DIs.

21-9 Logic Operation Functions

◆ Number of logic	Assignable to 8 points in total: EV1 to EV3 3 points, DO1 to DO5 5 points DO4 and DO5 are exclusively for timer and counter operation.
◆ Logic operation inputs	TS1 to TS8, and DI1 to DI10, can be assigned individually to source 1 and 2
◆ Input logic conversion	Input logic conversion possible individually on source 1 and 2 (EV1 to EV3, DO1 to DO3 output) 1) BUF By external control input logic 2) INV Inversion of external control input logic 3) FF Flip-flop logic operation of external control input (When a time signal is assigned to a source, flip-flop cannot be set.)
◆ Logic operation (1)	Logic operation output by source 1 and 2 (EV1 to EV3, DO1 to DO3 output) 1) AND Output by logical product 2) OR Output by logical sum 3) XOR Output by exclusive OR
◆ Logic operation (2)	Logic operation Output by source 1 (DO4, DO5 output) 1) Timer operation OFF, 1 to 5000 seconds 2) Counter operation OFF, 1 to 5000 counts

21-10 Analog Output (option)

◆ Number of Outputs	Maximum 2, A_o1, A_o2 individual setting, individual output Only A_o1 when sensor power supply (optional) is selected
◆ Output types	Selectable from 5 types PV, SV, DEV, OUT1, Posi
Output rating	Individual selection (individual output) 0 to 10 mV DC/output resistance 10Ω 0 to 10 V DC/load current 2 mA max. 4 to 20mA DC/load resistance 300Ω max.
◆ Output accuracy	±0.1% FS (of indicated value)
◆ Output resolution	Approx. 1/14000
◆ Output update cycle	0.1 second (100 msec)
◆ Output scaling	PV, SV within measuring range DEV, within -100.0 to 100.0% OUT1, 0.0 to 100.0%, reverse scaling possible Posi, within 0 to 100%
◆ Isolation	Insulated between analog outputs and various I/O or analog outputs and the system. Not insulated between analog outputs (A_o1 and A_o2)

21-11 Sensor Power Supply (option)

- Number of outputs: 1
  Output from Analog Output 2 (A_o2) terminal
  When the sensor power supply (SPS) is selected, Analog Output 2 (A_o2) is unusable.
- Output rating: 24 V DC/25 mA (max).
- Isolation: Insulated between SPS and various I/O, SPS and analog output 1, or SPS and the system.

21-12 Communication (option)

- Communication type: RS-232C, RS-485
- Communication system:
  RS-232C 3-line half-duplex system
  RS-485 2-line half-duplex multidrop (bus) system
- Communication distance
  RS-232C 15 m max.
  RS-485 500 m max. (depending on connection conditions)
- Number of connectable devices
  RS-232C 1
  RS-485 32 (including the host, differs depending on connection conditions)
- Synchronization system: Start-stop synchronization
- Communication speed: 2400, 4800, 9600, 19200 bps
- Communication (device) address
  1 to 98
- Communication delay time
  1 to 50 msec
- Communication memory mode
  EEP, RAM, r_E
- Communication protocol (1) SHIMADEN protocol
  Data length: 7 bit, 8bit
  Parity: EVEN, ODD, NONE
  Stop bit: 1bit, 2bit
  Control code: STX_ETX_CR, STX_ETX_CRLF, @_: _CR
  Checksum (BCC): ADD, ADD_two's cmp, XOR, None
  Communication code: ASCII
- Communication protocol (2) MODBUS ASCII mode
  Data length: 7 bit (fixed)
  Parity: EVEN, ODD, NONE
  Stop bit: 1bit, 2bit
  Control code: _CRLF
  Error check: LRC check
  Function code: 03H and 06H (Hex) supported
  1) 03H Read data
  2) 06H Write data
- Communication protocol (3) MODBUS RTU mode
  Data length: 8 bit (fixed)
  Parity: EVEN, ODD, NONE
  Stop bit: 1bit, 2bit
  Control code: None
  Error check: CRC 16
  Function code: 03H and 06H (Hex) supported
  1) 03H Read data
  2) 06H Write data

21-13 Infrared Communication

- Communication system: Serial communication with PC through the infrared communication adapter (sold separately)
- Number of connectable devices: 1
- Infrared communication specification
  - Synchronization system: Start-stop synchronization
  - Communication speed: 9600 bps
  - Data format: 7E1 (7 bits, even parity, 1 stop bit)
  - Control code: STX_ETX_CR
  - Checksum (BCC): ADD
  - Communication code: ASCII
- Communication protocol: SHIMADEN protocol (extended)

21-14 General Specifications

- Data storage: Non-volatile memory (EEPROM)
- Operating environment conditions
  - Temperature: -10 to 50°C
  - Humidity: 90% RH max. (no dew condensation)
  - Elevation: 2000 m above sea level or lower
  - Category: II
  - Pollution class: 2
- Storage temperature: -20 to 65°C
- Power voltage: 100 to 240 V AC ±10% (50/60 Hz)
- Power consumption: Max. 22 VA
- Input noise removal ratio: Normal mode 40 dB min. (50/60 Hz)
Common mode 120 dB min. (50/60 Hz)
- Applicable standards: Safety IEC61010-1:2001 and EN61010-1:2001
EMC EN61326
- Insulation resistance: Across I/O terminals and power terminals: 500 V DC 20MΩ min.
Across power terminals and ground terminals: 500 V DC 20MΩ min.
- Dielectric strength: Across I/O terminals and power terminals: 2300 V AC for 1 minute (faradic current 5mA)
Across power terminals and ground terminals: 1500 V AC for 1 minute (faradic current 5mA)
- Protective structure: Front operating panel only is dust-proof and drip-proof. (equivalent to IP66, NEMA4X)
- Case material: PC resin molding (equivalent to UL94V-1)
- External dimensions: 96 x 96 x 111 mm (panel depth: 100 mm) (H x W x D)
- Mounting: Imbedded in panel (using mounting fixtures)
- Thickness of usable panel: 1.0 to 8.0 mm
- Size of panel cutout: 92 (H) x 92 (W) mm
- Weight: 600 g max.

The contents of this Instruction Manual are subject to change without notice.

Temperature and Humidity Control Specialists

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