FP23 Series
Programmable Controller

Instruction Manual

2-input

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.

MPF023-E02-A
Jan. 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 "2-input: 1-output/2-output" FP23 Series Controllers.
For details on "2-input: 1-output/2-output" and "servo 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.

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) Current transformer (CT) for heater break alarm (when the heater break alarm option is selected)
(2) 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.

■ 2-input specification

Item	Code	Specification	
1. Series	FP23-	Multi-function programmable controller, DIN 96 x 96 mm	
2. Basic functions *1	DL	Universal-input, independent 2-loop control,3 event outputs	
	DS	Universal-input, 2-input operation/1-output control, 3 event outputs *2	
	DD	Universal-input, 2-input operation/2-output control, 3 event outputs	
3. Control Output 1 *2	Y	Contact 1c, Contact rating: 240 V AC, 2.5 A/resistive load, 1A/ inductive load	
	I	Current 4 to 20 mA DC, Load resistance: 600Ω max.	
	P	SSR drive voltage 12 V±1.5 V DC, Load current: 30 mA max.	
	V	Voltage 0 to 10 V DC, Load current: 2 mA max.	
4. Control Output 2	Y-	Contact 1c, Contact rating: 240 V AC 2.5 A/resistive load, 1A/ inductive load	
	I-	Current 4 to 20 mA DC, Load resistance: 600Ω max.	
	P-	SSR drive voltage 12 V±1.5 V DC, Load current: 30 mA max.	
	V-	Voltage 0 to 10 V DC, Load current: 2 mA max.	
5. Heater Break alarm (for single phase) *3	00	None	
	31	Heater Break alarm (heater Current 30 A, CT provided)	Selectable only when Control Output 1 or 2 is Y or P
	32	Heater Break alarm (heater current 50 A, CT provided)	
6. Analog Output 1	0	None	
	3	0 to 10 mV DC, Output resistance: 10Ω	
	4	4 to 20 mA DC, Load resistance: 300Ω max.	
	6	0 to 10 V DC, Load current: 2 mA max.	
7. Analog Output 2/sensor power supply	0	None	
	3	0 to 10 mV DC, Output resistance: 10Ω	
	4	4 to 20 mA DC, Load resistance: 300Ω max.	
	6	0 to 10 V DC, Load current: 2 mA max.	
	8	Sensor power supply 24 V DC 25mA	
8. External I/O control signals (DI/DO) *4	0	4 DI, 5 DO	Standard
	1	10 DI, 9 DO	
9. Communication interface	0	None	
	3	RS-485 (not insulated)	SHIMADEN protocol/ MODBUS communication protocol
	5	RS-485	
	7	RS-232C	
10. Remarks	0	Without	
	9	With	

*1 Independent 2-loop control, 2-input operation/1-output control and 2-input operation/2-output control are all supported in the 2-output specification.
The controller is shipped with the function selected at BASIC FUNCTION set.

*2 In a 2-input operation/1-output control specification, output for control is output to Control Output1. Select the same specification as Control Output 2 for Control Output1 .

*3 In a 2-output specification, the heater break alarm is used either of Control Output 1 or 2.

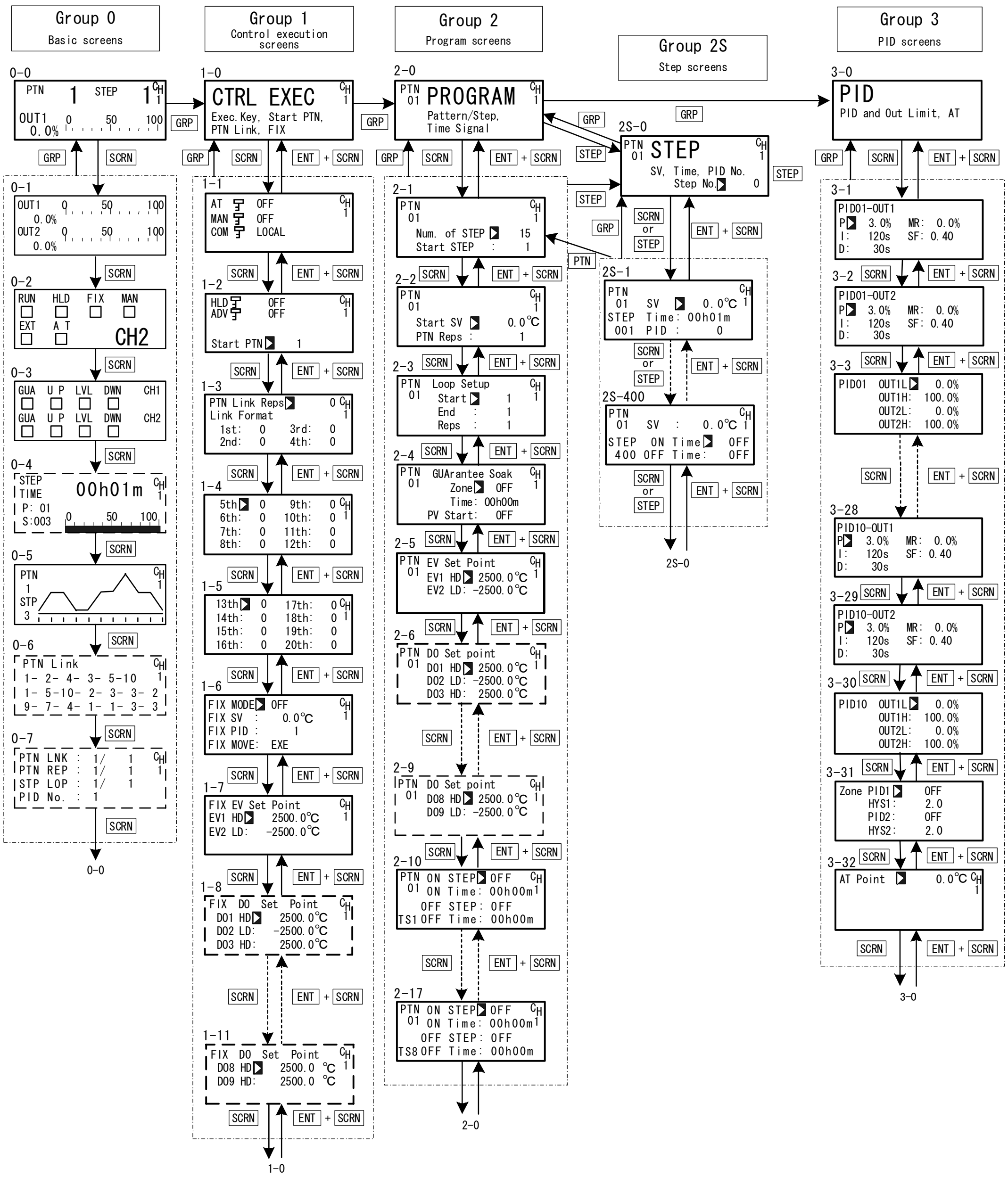
*4 When switching the start pattern No. by D1, 10 points of D1 (CODE1) are required.

Contents

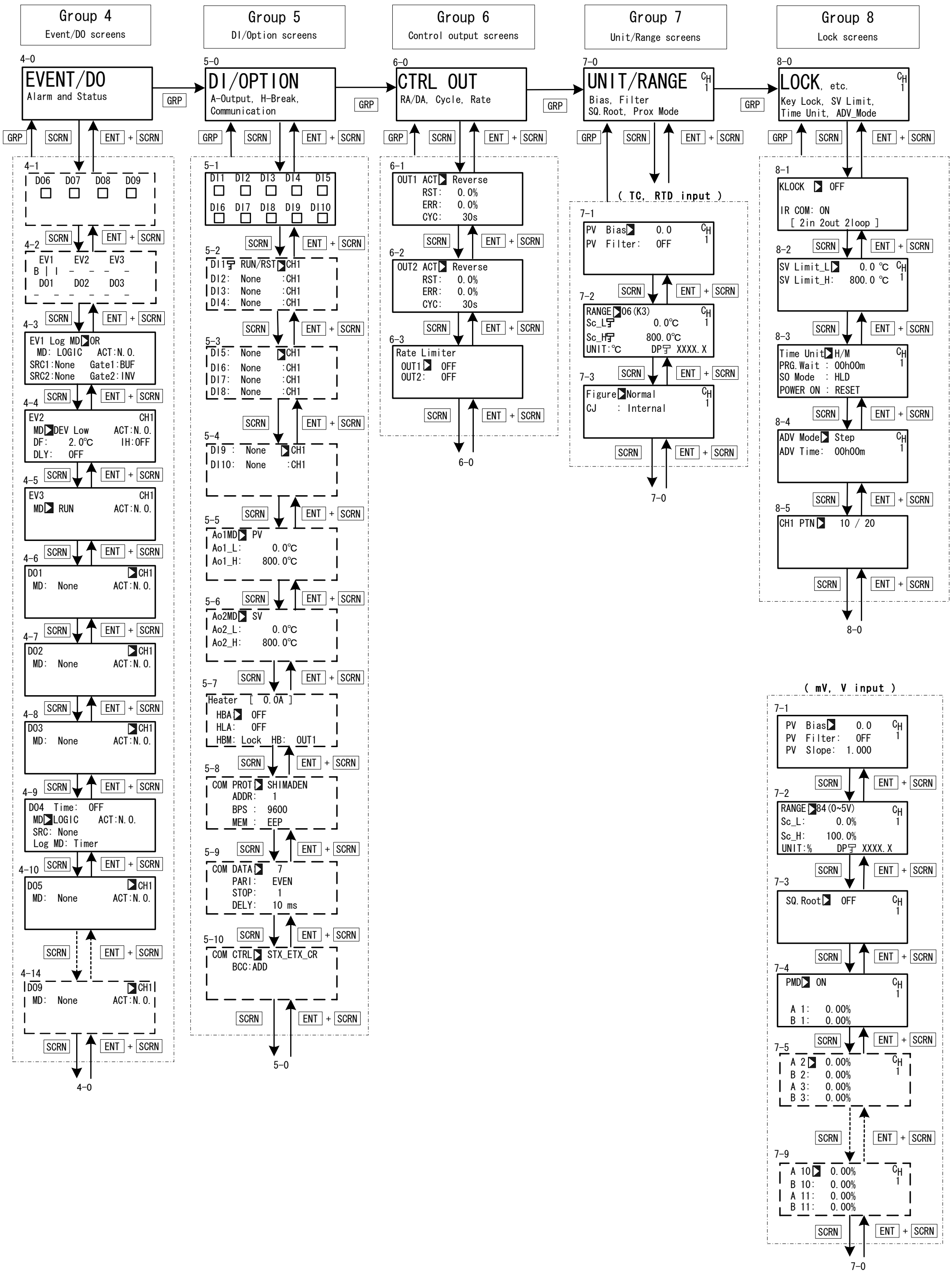
LCD Flow Chart

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

Standard screen	Screens that are always displayed
Non-standard screen	Screens that are displayed depending on options/setup values.



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, H-Break, Communication
6-0
CTRL OUT
RA/DA, Cycle, Rate
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 CH1
MD DEV Low ACT:N.O.
DF: 2.0℃ IH:OFF
DLY: OFF
4-5
EV3 CH1
MD RUN ACT:N.O.
4-6
DO1 CH1
MD: None ACT:N.O.
4-7
DO2 CH1
MD: None ACT:N.O.
4-8
DO3 CH1
MD: None ACT:N.O.
4-9
DO4 Time: OFF
MD LOGIC ACT:N.O.
SRC: None
Log MD: Timer
4-10
DO5 CH1
MD: None ACT:N.O.
4-14
DO9 CH1
MD: None ACT:N.O.
4-0
5-1
DI1 DI2 DI3 DI4 DI5
DI6 DI7 DI8 DI9 DI10
5-2
DI1 RUN/RST CH1
DI2: None :CH1
DI3: None :CH1
DI4: None :CH1
5-3
DI5: None CH1
DI6: None :CH1
DI7: None :CH1
DI8: None :CH1
5-4
DI9 : None CH1
DI10: None :CH1
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
Heater [0.0A]
HBA OFF
HLA: OFF
HBM: Lock HB: OUT1
5-8
COM PROT SHIMADEN
ADDR: 1
BPS : 9600
MEM : EEP
5-9
COM DATA 7
PARI: EVEN
STOP: 1
DELY: 10 ms
5-10
COM CTRL STX_ETX_CR
BCC:ADD
5-0
6-1
OUT1 ACT Reverse
RST: 0.0%
ERR: 0.0%
CYC: 30s
6-2
OUT2 ACT Reverse
RST: 0.0%
ERR: 0.0%
CYC: 30s
6-3
Rate Limiter
OUT1 OFF
OUT2: OFF
6-0
(TC, RTD input)
7-1
PV Bias 0.0 CH1
PV Filter: OFF
7-2
RANGE 06(K3) CH1
Sc_L 0.0℃
Sc_H 800.0℃
UNIT:℃ DP XXXX.X
7-3
Figure Normal CH1
CJ : Internal
7-0
8-1
KLOCK OFF
IR COM: ON
[2in 2out 2loop]
8-2
SV Limit_L 0.0 ℃ CH1
SV Limit_H: 800.0 ℃
8-3
Time Unit H/M CH1
PRG.Wait : 00h00m
SO Mode : HLD
POWER ON : RESET
8-4
ADV Mode Step CH1
ADV Time: 00h00m
8-5
CH1 PTN 10 / 20
8-0
(mV, V input)
7-1
PV Bias 0.0 CH1
PV Filter: OFF
PV Slope: 1.000
7-2
RANGE 84(0~5V) CH1
Sc_L: 0.0%
Sc_H: 100.0%
UNIT:% DP XXXX.X
7-3
SQ.Root OFF CH1
7-4
PMD ON CH1
A 1: 0.00%
B 1: 0.00%
7-5
A 2 0.00% CH1
B 2: 0.00%
A 3: 0.00%
B 3: 0.00%
7-9
A 10 0.00% CH1
B 10: 0.00%
A 11: 0.00%
B 11: 0.00%
7-0

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1 INSTALLATION & WIRING

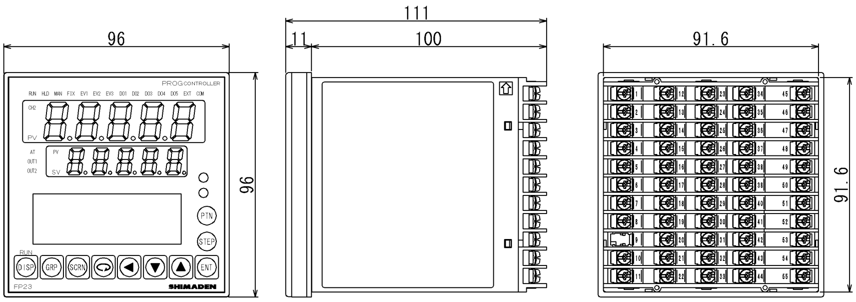
1-1 Installation Site

Caution

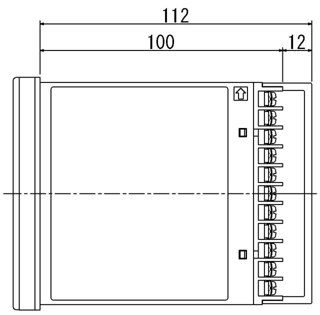
Do not use this device in the following sites. Doing so might result in malfunction or damage to this device and in some cases cause fire and/or dangerous situations.

- 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

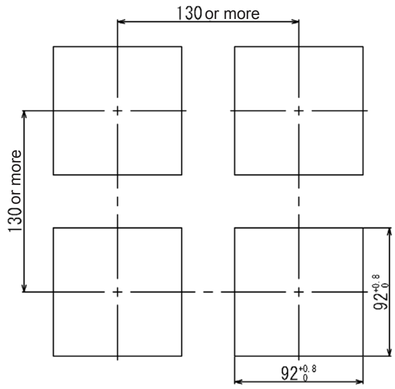


■ External dimensions



with terminal cover
Unit: mm

Panel cutout dimensions and space for gang mounting



Unit: mm

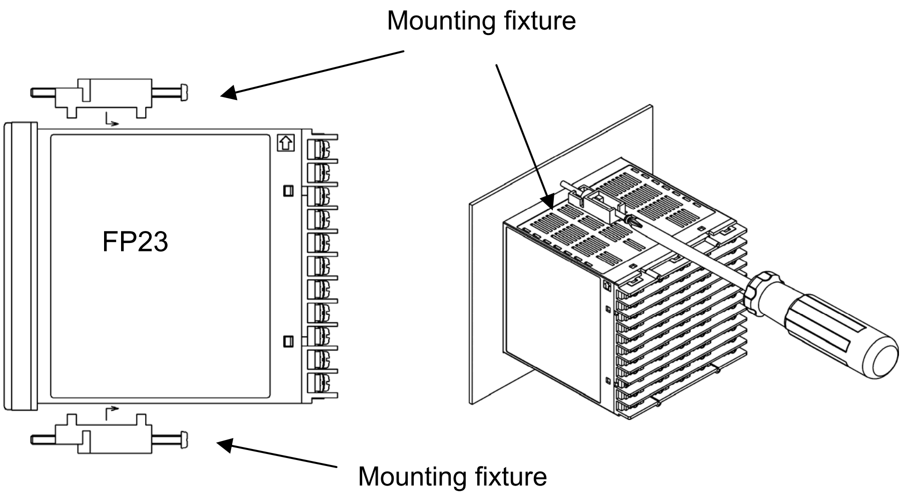
1-3 Mounting

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.

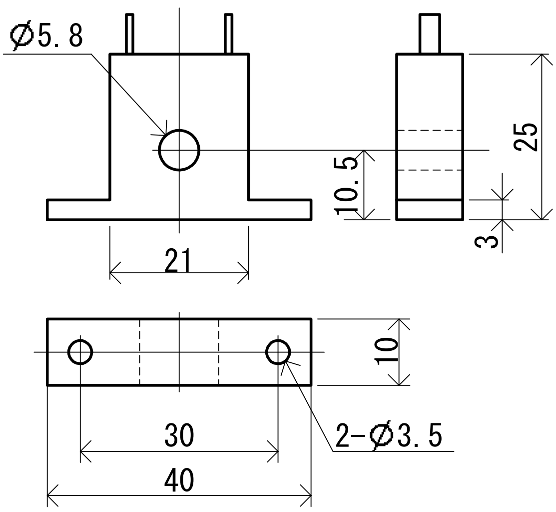
1. Drill mounting holes referring to the panel cutout dimensions described in the previous section.
   The applicable thickness of the mounting panel is 1.0 to 8.0 mm.
2. Press this device into the panel from the front of the panel.
3. Insert the mounting fixtures at the top and bottom of this device, 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 Current Transformer (CT) for Heater Break Alarm

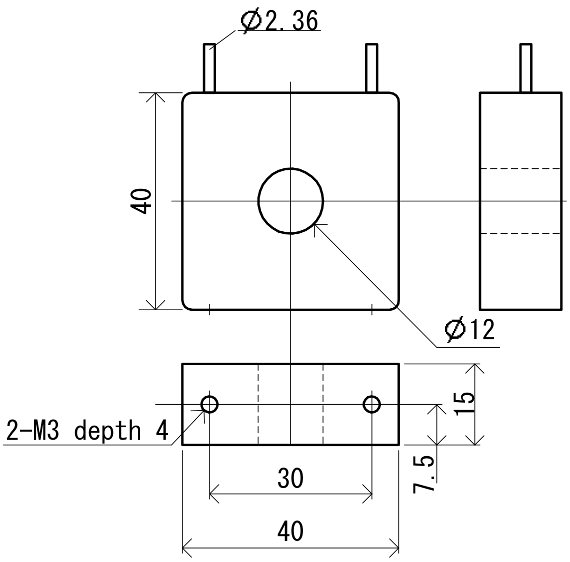
The CT can be used when the heater Break alarm (option) is selected in the product specifications.
Either of the following CT is provided.

■ **For 0 to 30A (CTL-6-S)**



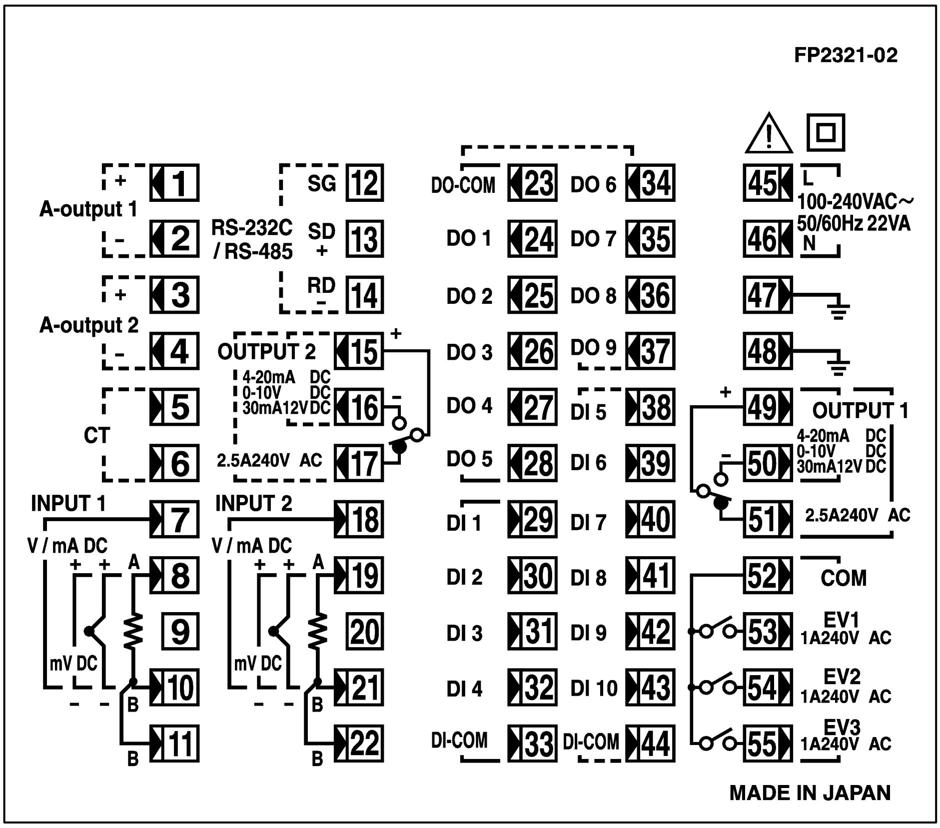
Unit: mm

■ **For 0 to 50A (CTL-12-S36-8)**



Unit: mm

1-5 Rear Terminal Arrangement Diagrams



Terminal No	Symbol	Description	
1 2	+ -	Analog output 1 (optional)	
3 4	+ -	Analog output 2 or Sensor Power Supply (optional)	
5 6	+ -	Heater break alarm CT input (optional)	
8 10	+ -	mV, Thermocouple input	Input 1
8 10 11	A B B	RTD input	
7 10	+ -	V, mA input	
45 46	L N	Power supply	
47 48		Grounding (internal shorting across terminals)	
49 50 51	COM+ NO - NC	Control output 1	
52 53 54 55	COM EV1 EV2 EV3	Event output EV (standard)	
23	COM	External control output DO (standard)	
24 25 26	DO1 DO2 DO3		Darlington output
27 28	DO4 DO5		Open collector output

Terminal No.	Symbol	Description
29 30 31 32 33	DI1 DI2 DI3 DI4 COM	External control output D1 (standard)
34 35 36 37	DO6 DO7 DO8 DO9	External control output DO Open collector output (optional)
38 39 40 41 42 43 44	DI5 DI6 DI7 DI8 DI9 DI10 COM	External input DI5 to DI10 (optional)
12 13 14	SG SD+ RD -	Communication function (optional)
15 16 17	COM+ NO - NC	Control output 2 (optional)

19 21	+ -	mV, Thermocouple input	Input 2
19 21 22	A B B	RTD input	
18 21	+ -	V, mA 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.

Note

Make sure that the input wiring is the shortest in case Input 1 and Input 2 share the same ground line. Otherwise, PV display accuracy might be affected.

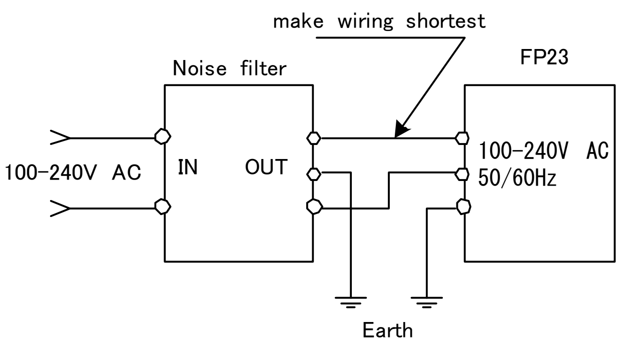
1-6 Wiring

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:

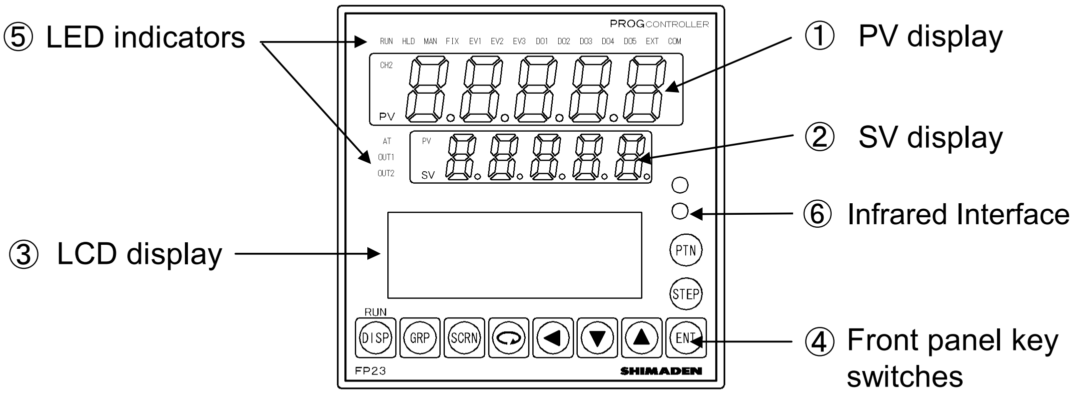
- Check that the wiring is free from mistakes according to "1-5 Rear Terminal Arrangement Diagrams."
- Use crimped terminals that accommodate an M3 screw and that have a width of 6.2 mm or less.
- For thermocouple input, use a compensation wire compatible with the type of thermocouple.
- For RTD input, 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 NAMES & FUNCTIONS OF PARTS ON FRONT PANEL

If the instrument is 2-loop specification, it has three kinds of display mode. The display mode can be switched to another by pressing DISP key on the front panel.



①PV display

For 2-loop;

Display mode 1: Displays the current measured value (PV) or an error message of CH1.

Display mode 2: Displays the current measured value (PV) or an error message of CH2.

Display mode 3: Displays the current measured value (PV) or an error message of CH1.

For other than 2-loop;

Displays the measured value (PV) or an error message.

②SV display

For 2-loop;

Display mode 1: Displays the target set value (SV) of CH1.

Display mode 2: Displays the target set value (SV) of CH2.

Display mode 3: Displays the current measured value (PV) of CH2.

For other than 2-loop;

Displays the target set value (SV).

Note

- When it is under Display mode 1, CH1 PV value is shown on the PV display, and CH1 SV value is shown on the SV display.
- Display mode 2 or 3 is only for 2-loop (Independent 2-channel) specification.
- When it is under Display mode 2 (when CH2 lamp lights), CH2 PV value is shown on the PV display, and CH2 SV value is shown on the SV display. When it is under Display mode 3 (when PV lamp lights), CH1 PV value is shown on the PV display, and CH2 PV value is shown on the SV display.
- For details, see “15-1 Flow of Basic Screen under 2-loop Specification”

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

For 2-loop, the following “CH1” information is displayed under Display mode 1 or 3, and the following “CH2” information is displayed under Display mode 2.

Pattern/step No. display

Displays the pattern/step No. in the Program mode.

In the FIX mode, "F" 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 is displayed by a numerical value and a bar graph as a percentage (%).

Channel (CH1 or CH2)

Displays the current channel for the data as one of the parameter values (2-loop specification only).

IN1/IN2 PV

Displays the PV values of INPUT1/INPUT2 (2-input specification only).

CH1/CH2 actions

Displays the actions of the channel that is not displayed on LED indicators. (2-loop specification only).

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.

④Front panel key switches

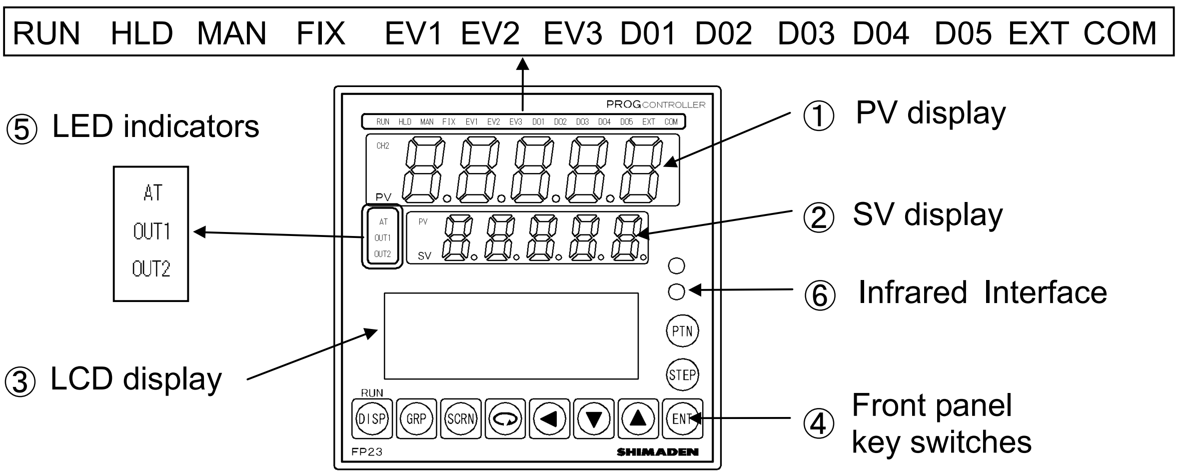
DISP	(Display key)	Displays the basic screen. Switches three Display mode.
GRP	(Group key)	Changes the screen group. Or, returns to the screen group top screen.
SCRN	(Screen key)	Switches the parameter display screen in a screen group.
↺	(Parameter key)	Selects the parameter to set up or change. The parameter to be changed is indicated by the cursor (►).
◄	(Shift key)	Moves the digit in set numerical values.
▼	(Down key)	Decrements parameters and numerical values during setup.
▲	(Up key)	Increments parameters and numerical values during setup.
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 0-7.

ENT + PTN : Hold (HLD) operation

ENT + STEP : Advance (ADV) operation

⑤LED indicators



Note that for 2-loop specification, each RUN, HLD, MAN, FIX, EXT, AT lamp shows different channel information depending on the Display mode.

For 2-loop;

Display mode 1: Displays the action status of CH1.

Display mode 2: Displays the action status of CH2.

Display mode 3: Displays the action status of CH1.

For other than 2-loop;

Displays the action status.

■ 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.

OUT1	green	When control output is current or voltage output, the brightness of this lamp changes according to fluctuation of Control Output 1, and during contact or SSR drive voltage output, this lamp lights when Control Output 1 is ON and goes Out when Control Output 1 is OFF.
OUT2	green	When control output is current or voltage output, the brightness of this lamp changes according to fluctuation of Control Output 2, and during contact or SSR drive voltage output, this lamp lights when Control Output 2 is ON and goes Out when Control Output 2 is OFF.

■ **Monitor lamps**

CH2	green	Lights when CH2 PV/SV values are displayed on PV/SV display respectively.
PV	green	Lights when CH2 PV value is displayed on SV display.

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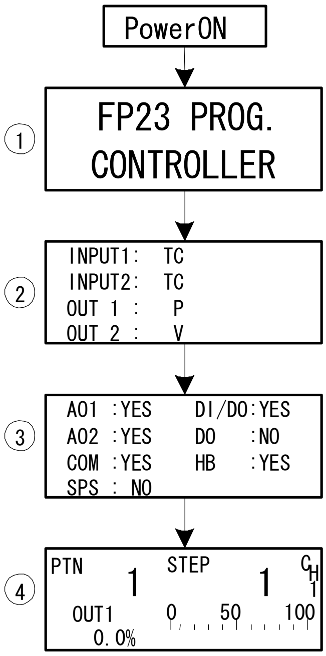
3 BASIC OPERATIONS

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 and Input2, SSR drive voltage (P) set for Output 1, and voltage output (V) set for Output 2.

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), DI (10 points) and DO (9 points) are installed (YES), and the heater break alarm are installed (YES), and SPS (sensor power supply) is not available (NO).

④ **Basic screen (Monitor Group top screen)**
The figure shows that Output 1 of PTN1 CH1 is 0% in a 2-loop (2-channel) specification.

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.

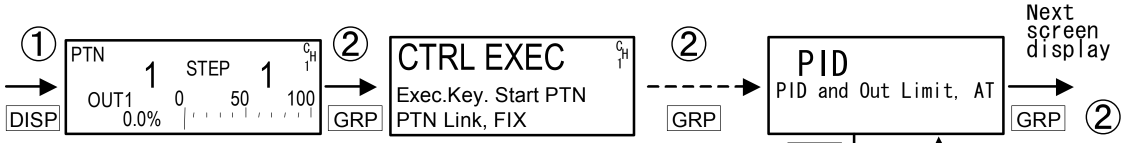
LCD Display		Actual numbers	
DI/DO	DO	DI	DO
NO	NO	4	5
YES	NO	10	9

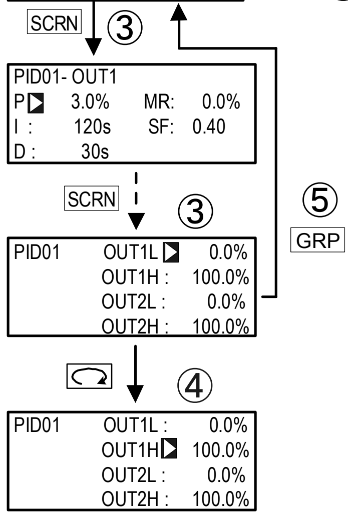
3-2 Switching LCD Screen Display and Moving the Cursor

(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.
The following shows an example of screens in the 1-input/1-output specification.





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.

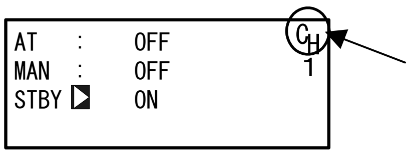
③ **To switch setup screens within groups**
Press the SCRN key to successively switch screens.

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.

(2) CH1, CH2: Switching channels

This is about the operation sequence for 2-loop operation.



Displayed under reversed mode and blinking

Press key for moving the cursor (: blinking) to CH and select channel with ▲ , ▼ keys. Press ENT for switching channels, and the contents for the selected channel will be displayed on the screen.

After having made the above-mentioned operations under the 2-loop specification, you will find the CH Number of the PV displayed on the basic screen (Group 0) when you return to the basic screen by pressing the GRP key or the like.
And then the screen display will change to the one for the switched channel.

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.

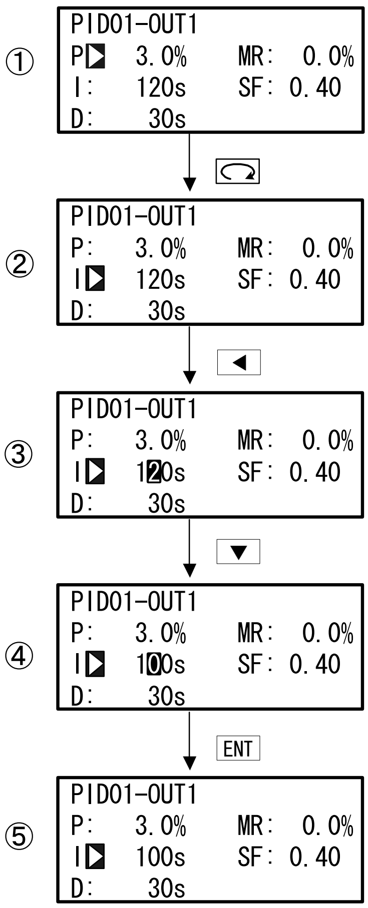
2. Press the [◄] or [▼] , [▲] keys. The smallest digit of the numerical value blinks.

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 **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.

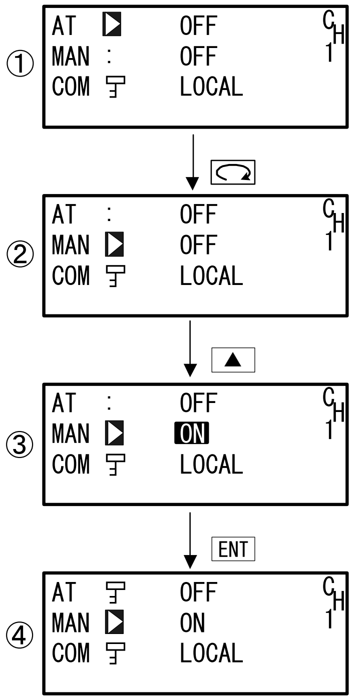
(2) Selecting setup items

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.

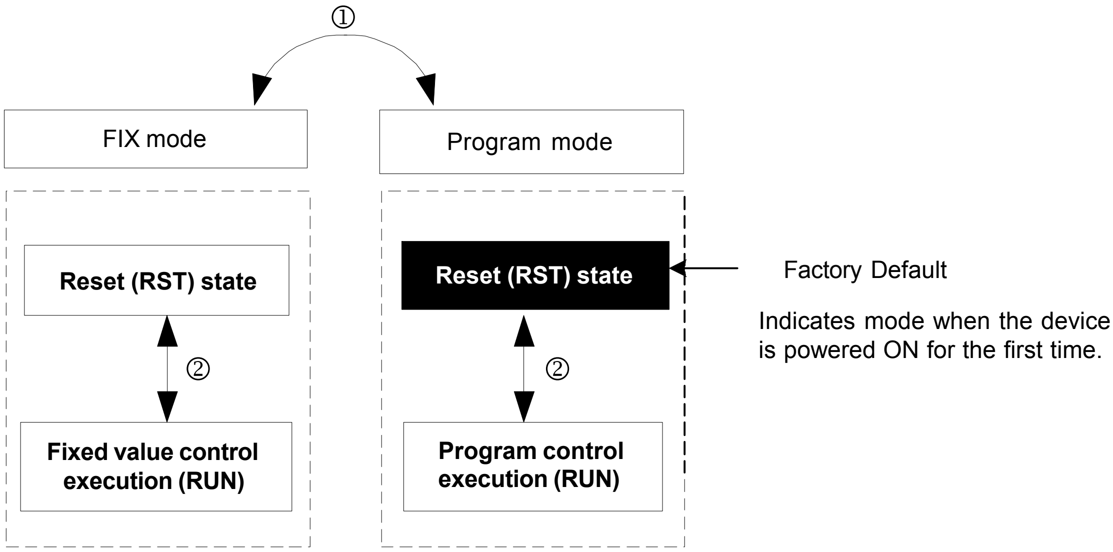
③ **To change the MAN setting from OFF to ON**
Press the ▲ key to change the display from OFF to ON.

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.



1. 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.
2. 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 "8-4(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	Type	Action
DEV Hi	Higher limit deviation	DEV In	Inside higher/lower limit deviation
DEV Low	Lower limit deviation	PV Hi	PV higher limit absolute value
DEV Out	Outside higher/lower limit deviation	PV Low	PV 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.
In this case, pattern 20 cannot be used in the program.

2-1
```
PTN                 CH
 20                  1
   Num. of STEP▶    0
   Start STEP   :    1
```
```
PTN                 CH
 01                  1
   Num. of STEP▶   40
   Start STEP   :    1
```

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

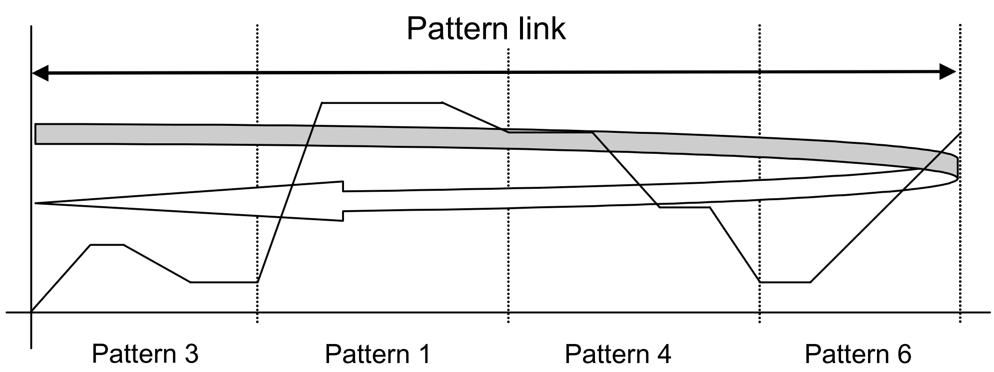
Each of the patterns can be linked.
The pattern link can be set in any order.
Linking is not performed when the pattern link is set to 0.

1-3
```
PTN Link Reps:     1 CH
Link Format          1
  1st▶  3   3rd:  4
  2nd:  1   4th:  6
```
1-4
```
  5th▶  0    9th:  0 CH
  6th:  0   10th:  0 1
  7th:  0   11th:  0
  8th:  0   12th:  0
```
1-5
```
 13th▶  0   17th:  0 CH
 14th:  0   18th:  0 1
 15th:  0   19th:  0
 16th:  0   20th:  0
```

■ Pattern link execution function

Linked patterns can be executed repeatedly 1 to 9999 times.

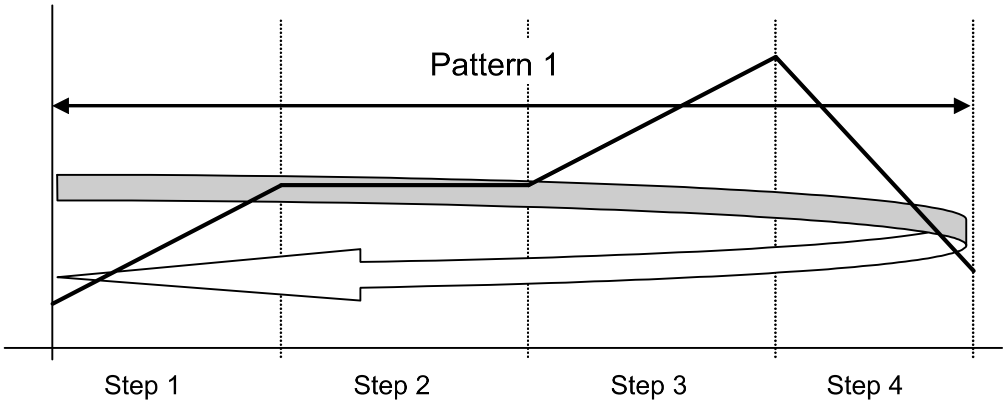
1-3
```
PTN Link Reps▶     2 CH
Link Format          1
  1st:  3   3rd:  4
  2nd:  1   4th:  6
```



■ Pattern execution function

Any pattern can be executed repeatedly 1 to 9999 times

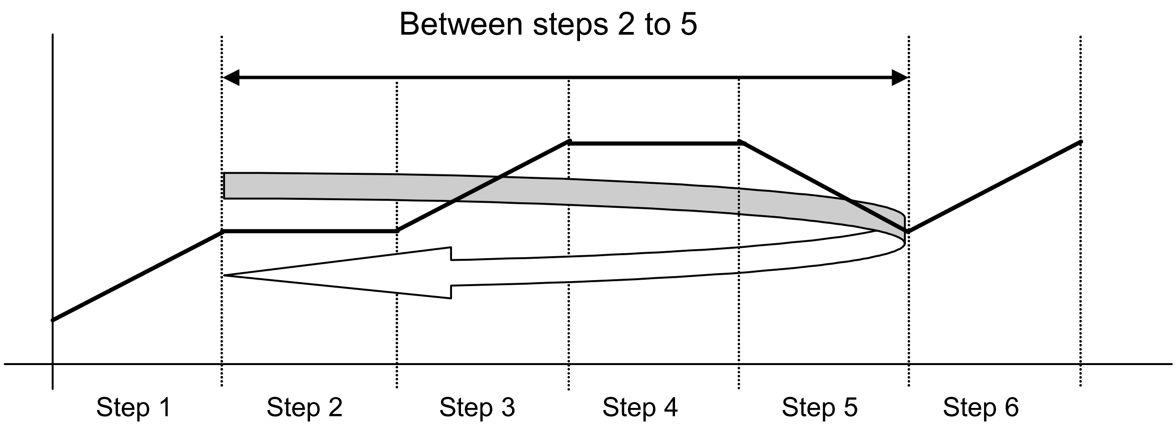
```
2-2
PTN                 CH
 01                  1
   Start SV:      0.0℃
   PTN Reps▶         2
```



■ Step loop function

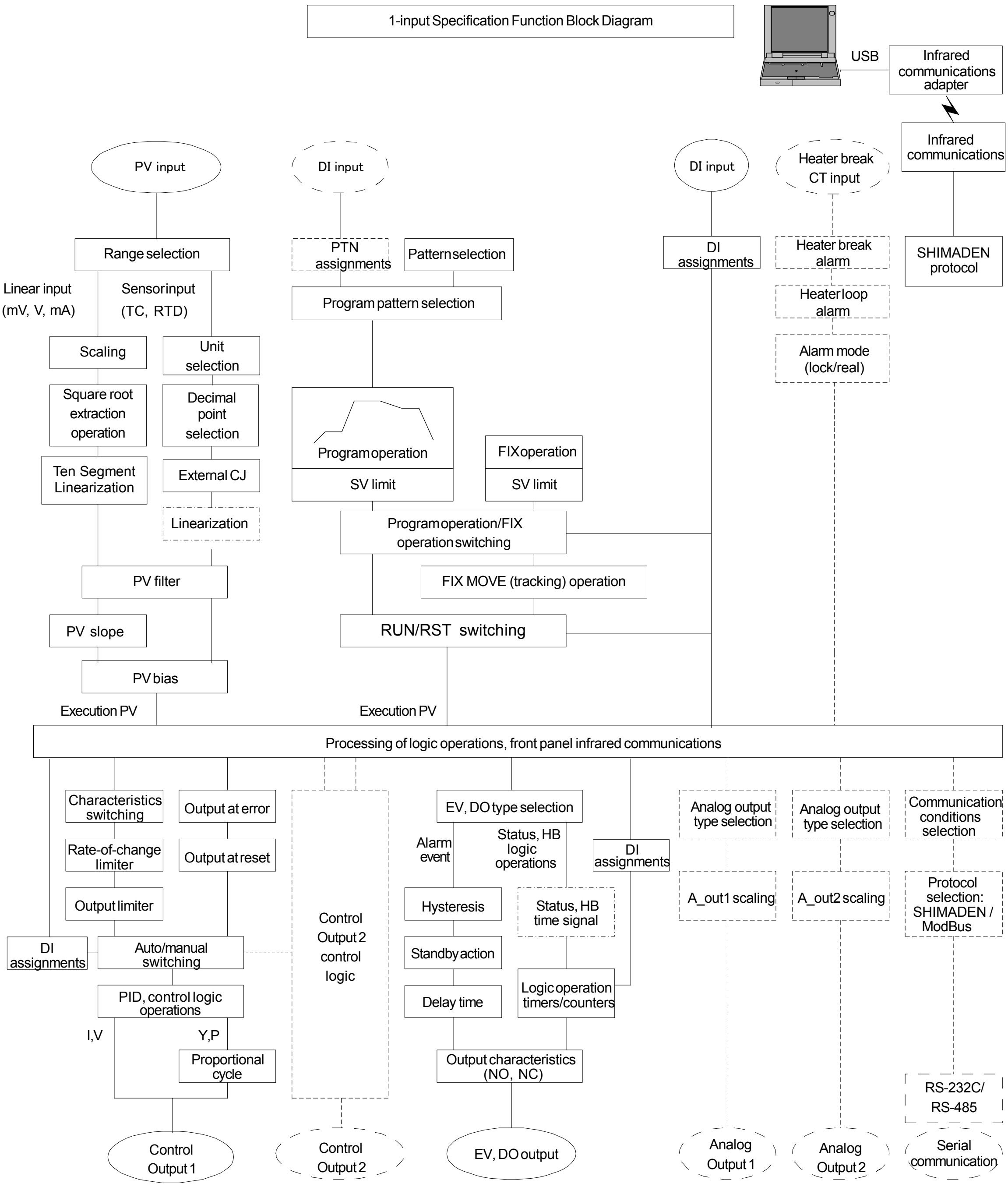
Any step can be executed repeatedly 1 to 9999 times.

```
2-3
PTN  Loop Setup      CH
 01    Start▶   2     1
       End  :   5
       Reps :   2
```

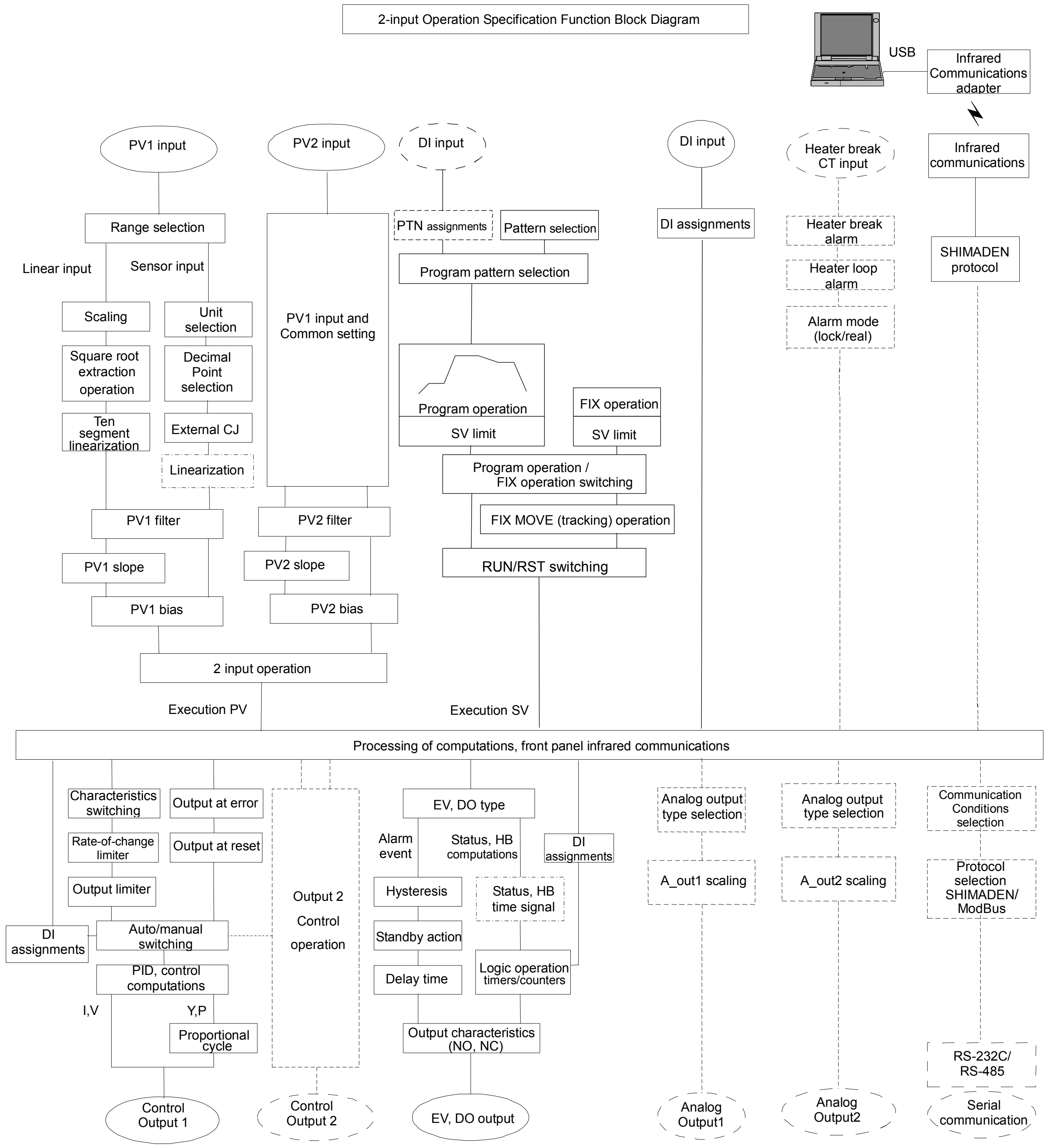


4-4 CONTROL FUNCTION BLOCK DIAGRAMS

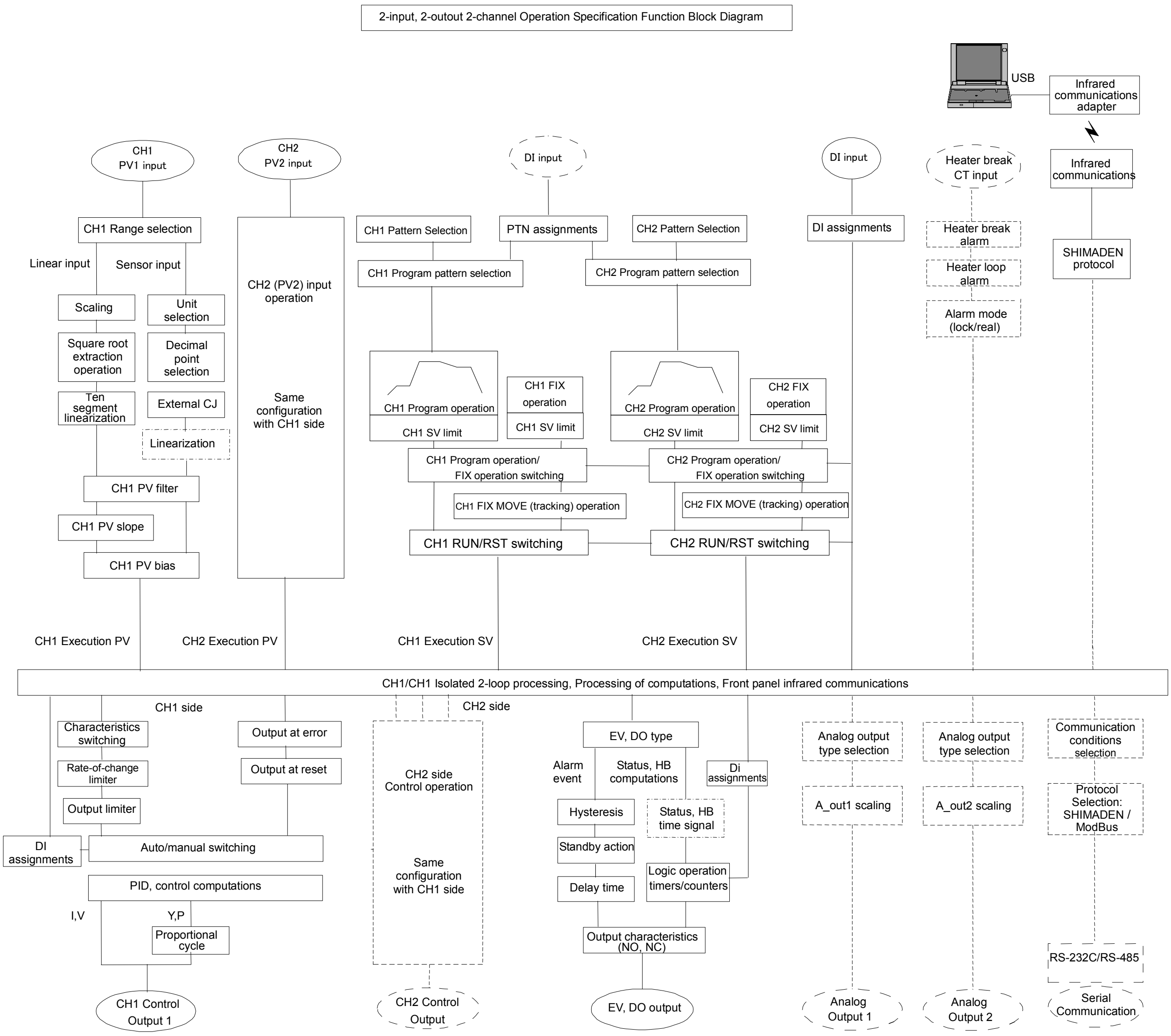
(1) 1-input, 1-output/2-output



(2) 2-input, 1-output/2-output



(3) 2-input, 2-output, Independent 2-channel



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 "18. 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, HB, COM,)
For details, see "Chapter 13."

9. Key Lock Setting
When setup of parameters are completed, set the key lock as necessary to prevent inadvertent operation.
For details, see "Chapter 14."

10. Monitoring, Executing & Stopping Operation
For details, see "Chapter 15."

11. Operations During Control
For details, see "Chapter 16."

6 OUTPUT SPECIFICATION & KEY LOCK

Perform the following as necessary.
This controller is delivered with the operation mode(s) (specification(s)) which you specified. However, you may modify the operation mode by making some operations on the screen(s) even after purchase and delivery.

6-1 Selection of operation mode under 2-input specification

⚠ **Caution**

- On the 2-input specification model, all parameters will be initialized by the change of operation mode explained in this section. For this reason, configuration of parameters is required after the operation mode is changed.

Here, functions and setup of this device with 2-input operation mode are described. This operation mode is related to the fundamental part of the basic control. Thus, you are requested and advised to make sure you thoroughly understand the contents of this description. Please be aware also that the operation sequence is intentionally made complicated to avoid unnecessary settings and/or changes being made.

(1) Operation mode under 2-input, 2-output specification

There are 3 types of 2-input operation modes as follow:

■ **2-input operation (1-loop): DS, DD (Model code)**

Make control action with an SV by processing of computation on 2 inputs.
The input operation may be chosen from among 4 methods, i.e. PV Max. value (MAX), PV Min. value (MIN), PV average value (AVE) and PV deviation value (DIV). The result is indicated as PV display.

(1) In 1-output specification, only OUT1 is operable and OUT2 is disabled.
(2) In 2-output specification, this is operated as a controller of 1-loop and 2-output.
Outputs may be combined as follows: Reverse + Reverse, Direct + Direct, Reverse + Direct. Therefore the controller may be used for 2-stage heating/2-stage cooling, heating/cooling, etc.

■ **2-input, 2-output (2-loop): DL (Model code)**

This mode is for using the channels (CH1: Input1 - OUT1, CH2: Input 2 – OUT2) as independents. This device works as 2 controllers.

■ 1-Input

This device works as an ordinary 1-input (1-loop) controller and Input 2 will be disabled.

(1) In 1-output specification, only OUT1 is operable, and OUT2 is disabled.
(2) In 2-output specification, this is operated as a controller of 1-loop and 2-output.
Outputs may be combined as follows: Reverse + Reverse, Direct + Direct, Reverse + Direct. Therefore the controller may be used for 2-stage heating/2-stage cooling, heating/cooling, etc.

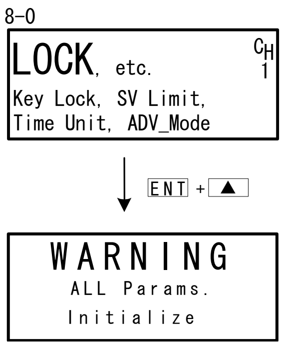
(2) Setting of Operation Mode under 2-Input Specification

1. Release the key lock if the key is locked.
For operation for releasing the key lock, see "6-2 Releasing the Key Lock."

2. Put the control action of the controller on reset (RST).
For using this device under 2-loop specification, put both CH1 and CH2 on reset.
For details on control reset operation, see "4-1 Control Modes".

3. Access to the operation mode setup screen.
Call up the top screen of Lock, etc. Screen Group (group 8) from the basic screen by pressing the GRP key several times.

4. Now, press the ◄ key for at least 3 seconds by holding the ENT key.



On the LCD screen, a warning will be indicated, and setup parameters in the following table will be displayed on the PV/SV display.

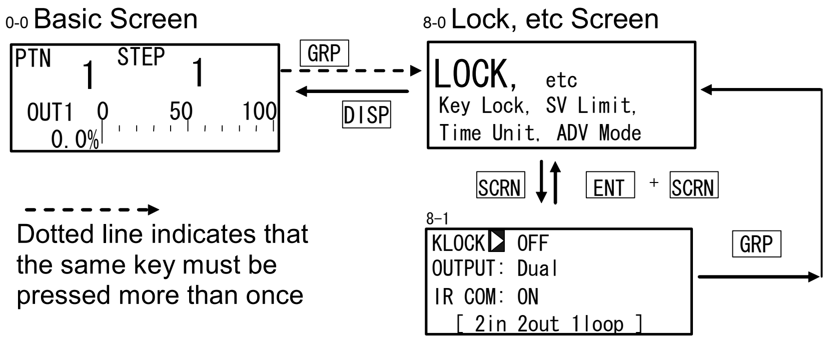
PV Display SV Display	Operation Mode	Description
2-In 1LooP	2-Input (1-loop)	Operates as a 2-input operation controller. This may be used by switching between 1-output and 2-output.
2-In 2LooP	2-Input (2-loop)	Operates as 2 independent controllers. Covers CH1: INPUT1, OUT1 and CH2: INPUT2, OUT2.
1-In 1LooP	1-Input (1-loop)	Controller with 1 channel, being able to be used by switching between 1-output and 2-output.

5. Select operation mode by pressing either the ▼ or ▲ key and confirm the registration by pressing the ENT key. This device will restart and resume.
If you do not want to change the operation mode, go back to the top screen of Lock, etc. Screen Group (group 8) by pressing the ◄ key.

6-2 Releasing the Key Lock

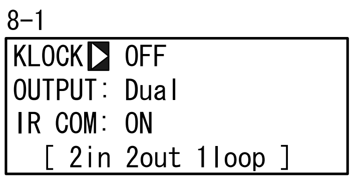
(1) Key lock screen display

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 "18 List of Parameters."

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7 I/O SETTINGS, INFRARED COMMUNICATION

7-1 Output Specifications (2-output specification)

When 1-input: 1-output/2-output or 2-input operation: 1-output/2-output is selected, output specification (OUTPUT: Single (1-output)/Dual (2- output)) will be displayed. It will not be displayed in independent 2-channel specification and cascade specification (2-loop control).

For example, when the 2-output specification is changed into a 1-output specification (OUT1), the parameter value of “Dual” is changed into “Single”. Control output becomes the output of OUT1 only.

Select the output mode after setting control action to the Reset State.
For details on operation to stop control, see "4-1 Control Modes."

8-1

```
KLOCK : OFF
OUTPUT▶Dual
IR COM: ON
  [ 2in 2out 1loop ]
```

Setting range	ON, OFF
Initial value	ON

Single 1-output control action
Only OUT1 is used for control output.

Dual 2-output control action
OUT1 and OUT2 are used for control output.

♦Displaying the current operation mode

The current operation mode is displayed at the bottom line of the key lock and number of outputs setup screen (No. 8-1).

1in 1out 1loop	: 1-output controller
1in 2out 1loop	: 2-output controller
2in 1out 1loop	: 2-input operation/1-output controller
2in 2out 1loop	: 2-input operation/2-output controller
2in 2out 2loop	: Independent 2-channel controller

7-2 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
OUTPUT: Dual
IR COM▶ON
  [ 2in 2out 1loop ]
```

Setting range	ON, OFF
Initial value	ON

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

7-3 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

Set the code No. to RANGE referring to the Measuring Range Code Table below.
In 2-input (1-output/2-output) operation, a single measuring range is assigned for the two inputs.

7-2
```
RANGE▶06(K3)        CH1
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      CH1        WARNING      CH1
Params.Initialize   →   Params.Initialize
    proceed? NO             proceed? YES
```

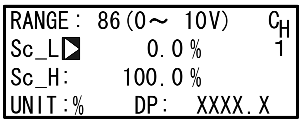
Caution

- 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 "18 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.

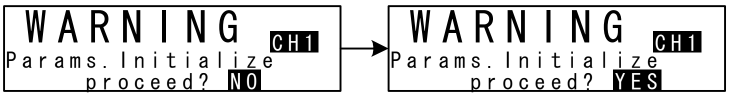
7-2



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 "18 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

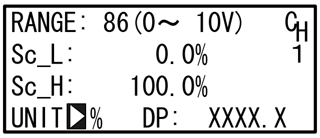
Input Type		Sensor Type	Code	Symbol	Measuring range	Measuring range
Universal Input	RTD	Pt100 (old) JIS/IEC	45	JPt 1	-200.0 to 500.0 °C	-300.0 to 900.0 °F
			46	JPt 2	-100.00 to 100.00 °C	-150.0 to 200.0 °F
			47	JPt 3	-100.0 to 300.0 °C	-150.0 to 600.0 °F
			48	JPt 4	-60.00 to 40.00 °C	-80.00 to 100.00 °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.

7-4 Unit

Set the measurement unit.

7-2



RTD, TC

Setting range °C, °F

Initial value °C

Voltage, Current

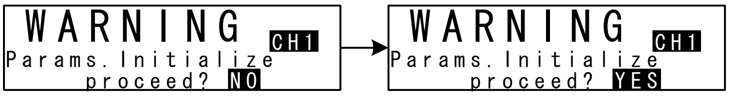
Setting range °C, °F, %, None

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.



Caution

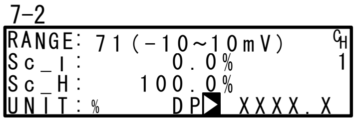
- When the unit is changed, the above warning message will be displayed, and parameters will be initialized.
  For details on parameters that are initialized, see "18 List of Parameters."

7-5 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

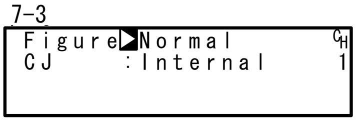


Setting range	xxxx.x to x.xxxx
Initial value	xxxx.x

(2) Switching the lowest digit past the decimal point

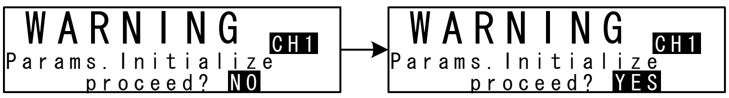
The lowest digit past the decimal point of measuring ranges determined by the range setting can be set.
Note, however, that this function cannot be used for measurement ranges without digits past the decimal point.
This screen is not displayed in the case of voltage input and current input.

7-3



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.



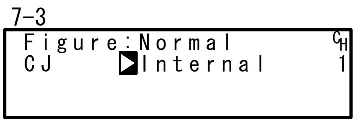
Caution

- 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 "18 List of Parameters."

7-6 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.

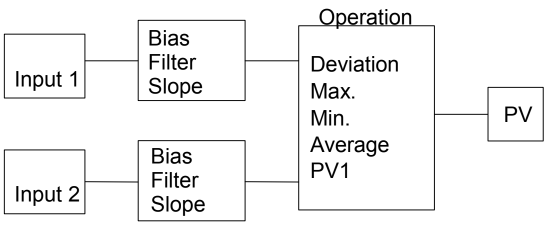


Setting range	Internal, External
Initial value	Internal

8 I/O AUXILIARY SETTINGS

8-1 Setup of 2-Input Operation

This is setup under 2-Input Operation Specification (1-loop).
This is a function for making operations for obtaining deviation, maximum, minimum, average, etc., between 2 inputs and then places the results in PV value.



In the setting only for 2-input operation specification, set operation and process for scaleover.
This may also process bias, filter and slope for each of 2 inputs before processing computing operation.

(1) Selection of PV Mode

This is the 2-input operation setting screen.
Select the operation method for obtaining PV value to be used in control action.
This operation is to be conducted after putting the control action on reset state.

7-1

```
2-IN(Func)
 PV_MODE▶ DEV
 DEV Sc_L    -800.0℃
 DEV Sc_H     800.0℃
```

Setting range MAX, MIN, AVE, DEV, PV
Initial value DEV

MAX	Max. value	Use larger input value as PV value.
MIN	Min. value	Use smaller input value as PV value.
AVE	Average value	Use average value of input values as PV value.
DEV	Deviation value	Use (Input 1 - Input 2) as PV value.
PV		Use PV1 (after making computation of Bias, Filter and Slope of Input 1) as PV value.

(2) Process when scaleover occurs

Set process to be taken when any PV scaleover occurs in 2-input operation.
This parameter may not be set when PV_MODE is set to DEV or PV.

7-1

```
2-IN(Func)
 PV_MODE:  AVE
 SO_MODE▶ 0
```

Setting range 0, 1
Initial value 0

0	Proceed with control action with a PV value falling within the scale range if an input falls to scaleover, but the other input is within the scale. This is applicable only if MAX, MIN or AVE is selected.
1	If any inputs fall to scaleover, follow the scaleover process set in this setting procedure.

(3) Bias, filter and slope

Set bias, filter and slope for each of inputs 1 and 2.

```
7-3
INPUT1
 PV Bias▶    0.0
 PV Filter:  OFF
 PV Slope: 1.000
```

```
7-4
INPUT2
 PV Bias▶    0.0
 PV Filter:  OFF
 PV Slope: 1.000
```

For details, see “8-2 PV compensation value”.

8-2 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    CH
 PV Filter:  OFF     1
 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    CH
 PV Filter▶  OFF     1
 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    CH
 PV Filter:  OFF     1
 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.

8-3 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        CH
                     1
```

Setting range ON, OFF
Initial value OFF

(2) Low cut

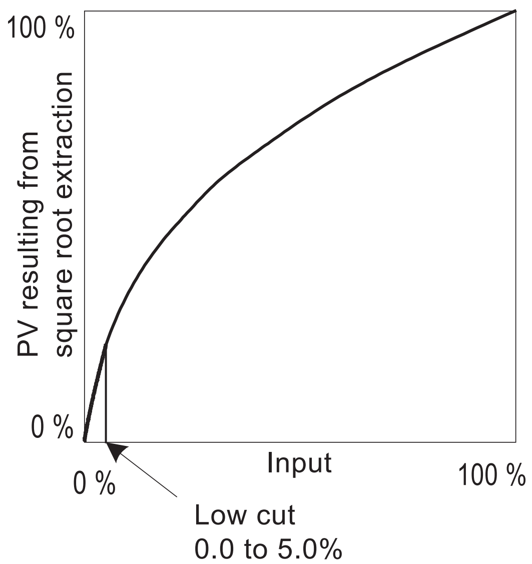
This item functions only when the square root extraction operation function is enabled.
Low cut processing is performed on the input before square root extraction operation is performed.

```
7-3
SQ.Root: ON         CH
Low Cut▶ 1.0%        1
```

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.



8-4 Control 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:    0.0%
     ERR:    0.0%
     CYC:     30s
```

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

Use this item to maintain control output at a fixed value in a reset state.

```
6-1
OUT1 ACT: Reverse
     RST▶    0.0%
     ERR:    0.0%
     CYC:     30s
```

Setting range	0.0 to 100.0%
Initial value	0.0%

Note

- In ON-OFF control (P=OFF), when output at reset is set to 50% or more, the actual output at reset becomes 100%.
  When output at reset is set to 49.9% or less, the actual output at error becomes 0%.
- Output at reset is maintained without being affected by whether or not an error has occurred.

(3) Output at error

Set the value to be output when an error occurs.

```
6-1
OUT1 ACT: Reverse
     RST:    0.0%
     ERR▶    0.0%
     CYC:     30s
```

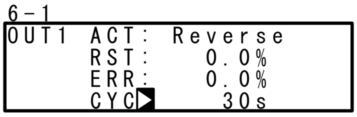
Setting range	0.0 to 100.0%
Initial value	0.0%

Note

- In ON-OFF control (P=OFF), when output at error is set to 50% or more, the actual output at reset becomes 100%.
  When output at reset is set to 49.9% or less, the actual output at error becomes 0%.
- Output at reset is given priority when an error has occurred at Reset State.

(4) Proportional cycle time

Set the proportional cycle time.
This setting item is for the contact and SSR drive voltage output specification.
The screen is not displayed in the case of the current and voltage output specification.



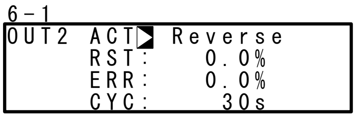
Setting range	1 to 120s
Initial value	30s: Contact output (Y) 3s: SSR drive output (P)

Note

- If a short time is set as the proportional cycle time in contact output, the contact life of the output relay may be adversely affected.
  Pay particular attention to this point when setting the proportional cycle time.
- If a long time is set as the proportional cycle time in a control system with a short delay time, the control result will be adversely affected.
- The proportional cycle time cannot be set during execution of auto tuning (AT) or ramp control action.

(5) Setting output 2

This setting item is available only when the 2-output specification is selected, and is not displayed for a 1-output specification.
The setup method and cautions for parameters are the same as those for Output 1.

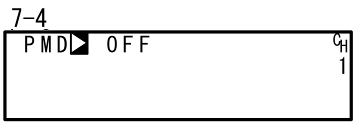


	Setting range	**Initial value**
ACT	:Reverse, Direct	Direct (in 1-loop) Reverse (in 2-loop)
RST	:0.0 to 100.0%	0.0%
ERR	:0.0 to 100.0%	0.0%
CYC	:1 to 120s	Contact output (Y) 30s SSR drive output (P) 3s

8-5 Setting the Ten-Segment Linearizer Approximation

(1) Enabling ten-segment linearizer approximation

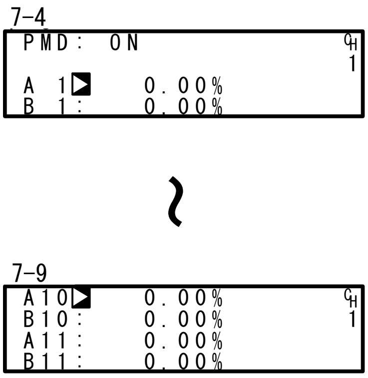
This function performs linearization based upon ten-segment approximation when the PV input is a non-linear signal.
This item is set during voltage input and current input.
The screen is not displayed during RTD and TC input.



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.

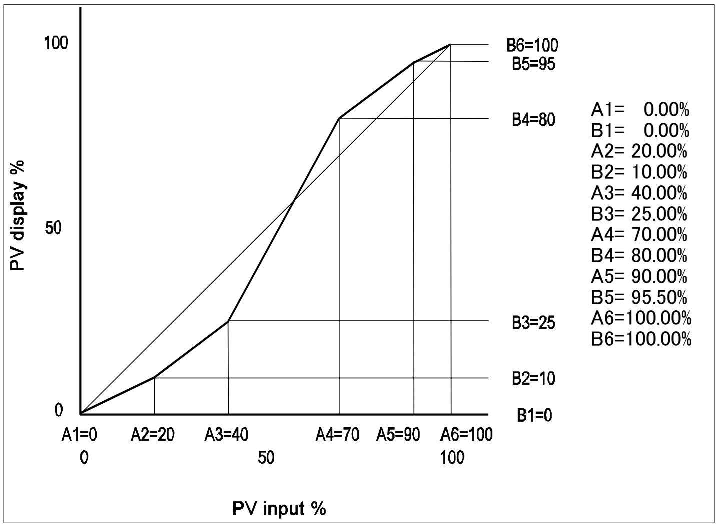


Up to 11 points can be set. 11 points (B1 to B11) can be set for PV display (%) on PV 11 inputs (A1 to A11). For each input point, B1 is set to A1, B2 for A2 and so forth until B11 is set to A11, and linear interpolation is executed between input points.
This item is set during voltage input and current 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.

8-6 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.
The rate-of-change limiter can be set to each of Output 1 (OUT1) and Output 2 (OUT2 is displayed only in the 2-output specification device).

```
6-2
Rate Limiter
 OUT1▶ OFF
 OUT2: OFF
```

Setting range
OUT1, OUT2: OFF, 0.1 to 100.0 %/s
Initial value
OUT1, OUT2: 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.

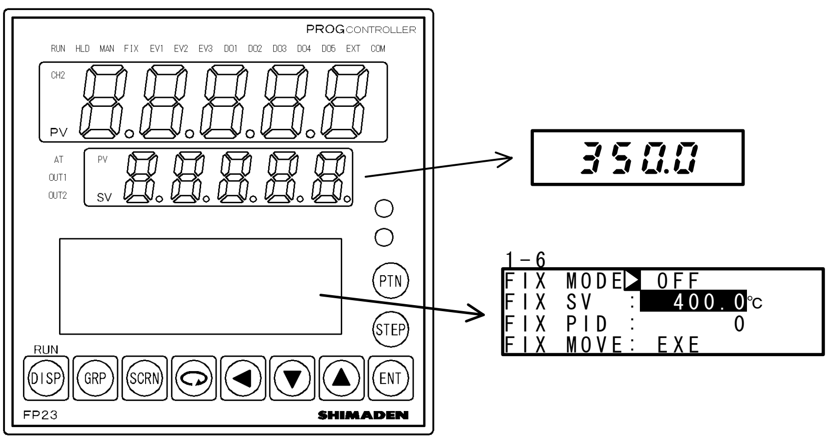
```
8-2
SV Limit_L▶    0.0℃ CH
SV Limit_H:  800.0℃ 1
```

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

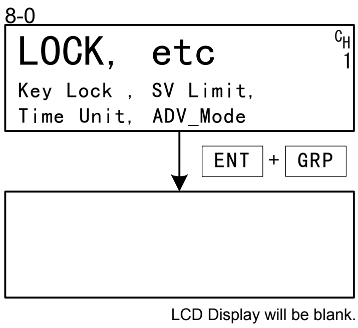


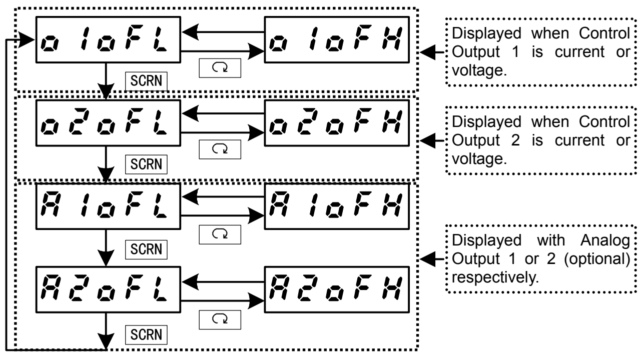
The white-inverted section indicates limiter over.

8-7 Compensating Control Output/Analog Output

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

1. Release the key lock if it is applied.
   For details on how to release the key lock, see "6-2 Releasing the Key Lock."
2. Set controller control action to the stop mode (reset).
   In 2-loop specification, both of the CH1 and CH2 should be set to reset state.
   For details on control stop operation, see "4-1 Control Modes."
3. 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.





PV Display	Description	PV Display	Description
o 1oFL	Control Output 1 lower limit value	o 1oFH	Control Output 1 higher limit value
o2oFL	Control Output 2 lower limit value	o2oFH	Control Output 2 higher limit value
A 1oFL	Analog Output 1 lower limit value	A 1oFH	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       CH
PRG.Wait : 00h00m     1
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       CH
PRG.Wait ▶ 00h00m     1
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       CH
PRG.Wait : 00h00m     1
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 "8-4 (3) Output at 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 "8-4 (3) Output at 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       CH
PRG.Wait : 00h00m     1
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 "16-5 Executing Advance (ADV)

```
8-4
ADV Mode▶ Step       CH
ADV Time: 00h00m      1
```

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       CH
ADV Time▶ 00h00m      1
```

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

Note

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

(7) CH1 pattern number

Set the pattern number of CH1.
The rest of the patterns are assigned to CH2 automatically.
This screen is displayed in 2-input, 2-loop specification.
This parameter setting should be done after the control operation mode is set to RST.

```
8-5
CH1 PTN▶  10 / 20
```

Setting range	0 to 20
Initial value	10

Note

- When this parameter value is changed, settings for patterns/steps are initialized. For example, if the pattern number of CH1 is changed from 10 (of 20) to 5 (of 20), then reconfigure the number to 10 (of 20), and the pattern 6 to 10 setting will all be initialized.
- The step numbers that can be assigned for each channel are pattern numbers x 20 steps.

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                  CH
 01   SV ▶      0.0℃  1
STEP  Time:   00h01m
 001  PID :        0
```

Setting range	Within SV limiter setting range
Initial value	0.0

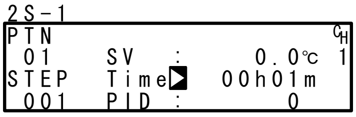
Note

```
2S-1
PTN                  CH
 01   SV ▶    400.0℃  1
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 "8-6 (2) SV limiter."

(2) Step Time

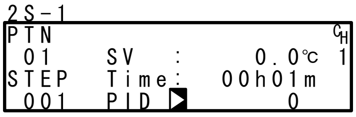
Set the time of step 1.



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

(3) Step PID No.

Set the PID No. of step 1 execution.



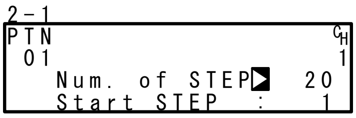
Setting range	0 to10
Initial value	0

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

The maximum step number varies according to the numbers assigned to CH1 and CH2, or assigned to other pattern/step numbers.
For example, if 20 patterns are assigned to CH1, and 0 step number is assigned to the pattern No.2 to 20, the step numbers of pattern No.1 can be set up to 400 steps, which is the maximum numbers.
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 "15-2 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

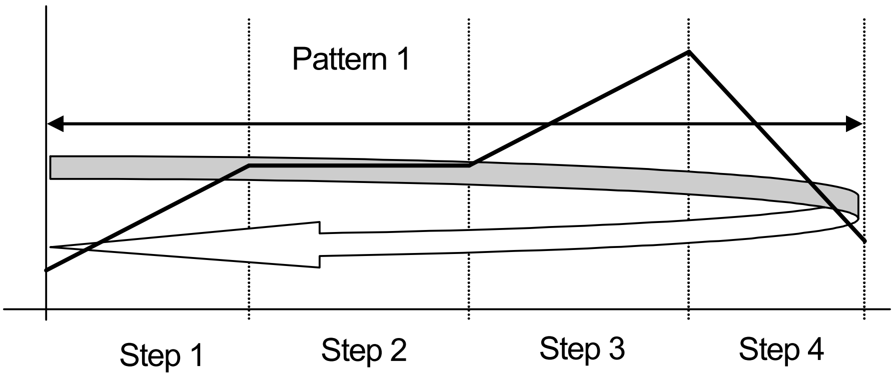
Note

- 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 "8-6 (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

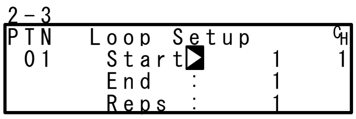


PTN 1 is executed three times.

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

(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.

```
2-3
PTN   Loop Setup      CH
 01     Start:      1  1
        End  ▶      1
        Reps :      1
```

Setting range 1 to number of steps
Initial value 1

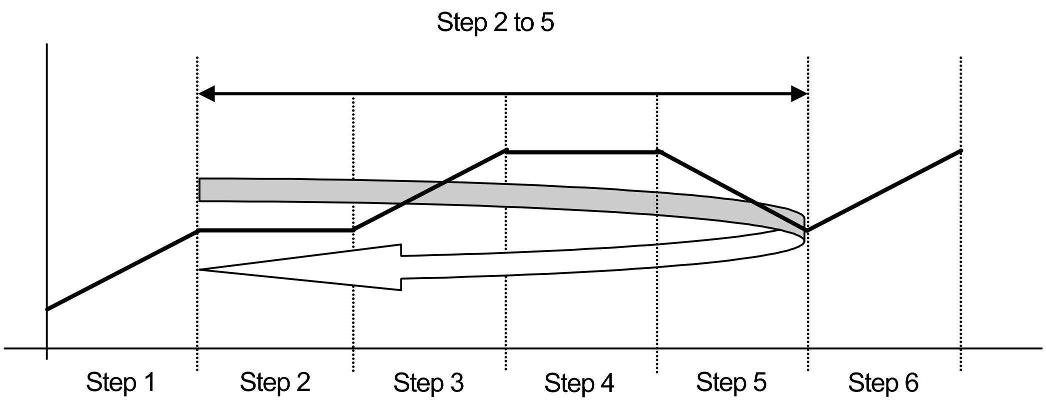
(7) Execution count of step loop

Set the execution count of the step loop.

```
2-3
PTN   Loop Setup      CH
 01     Start:      2  1
        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



Step 2 to 5 is executed 3 times.

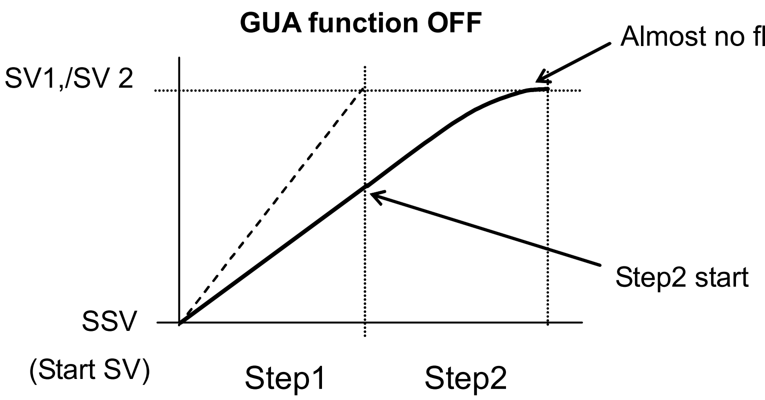
(8) Guarantee soak zone

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.

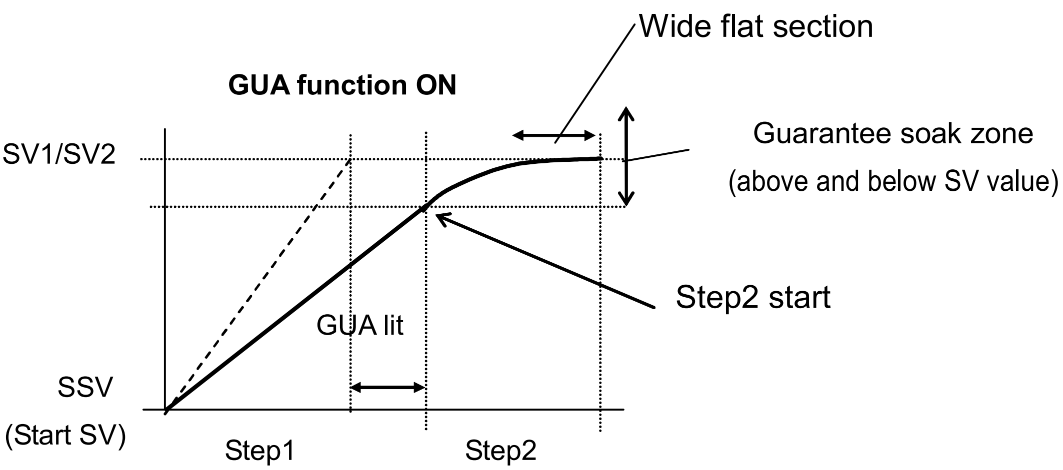
Setting range	OFF,1 to 9999
Initial value	OFF

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 the reset state, the GUA lamp ☐ lights in the status monitor screen (0-3).

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.

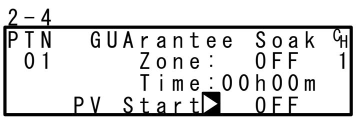
(9) Guarantee soak time

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.

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

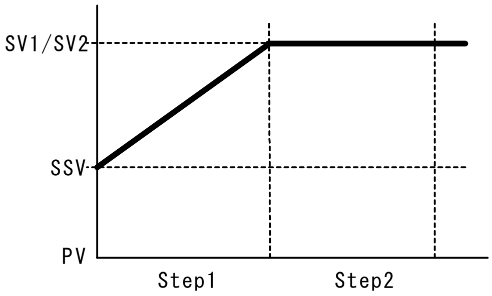
(10) PV start

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.

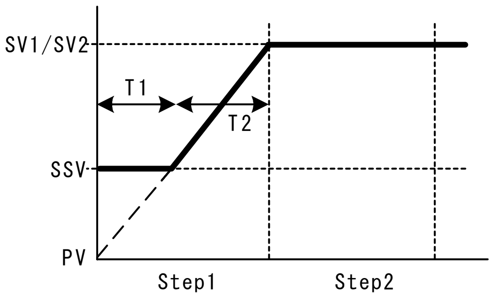


Setting range	ON/OFF
Initial value	OFF

①PV≤SSV<SV1



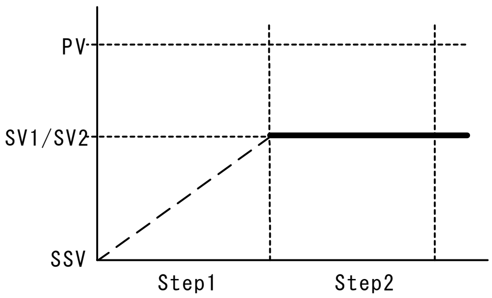
②SSV<PV≤SV1



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

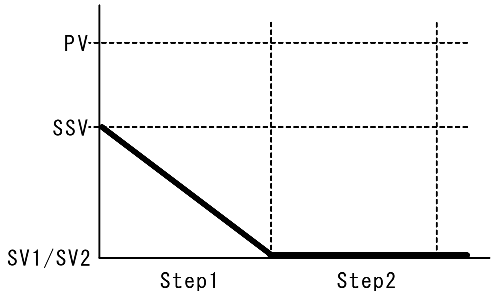
T2: Step1 time to be executed

③SSV<SV1<PV

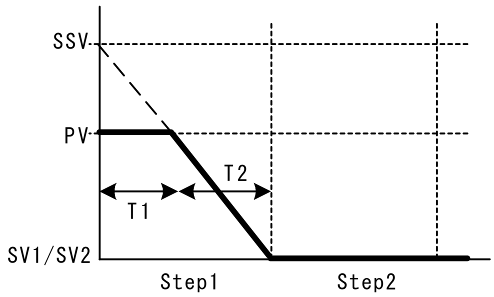


In this case, the program advances to step 2, and step 1 is omitted.

④PV≥SSV>SV1



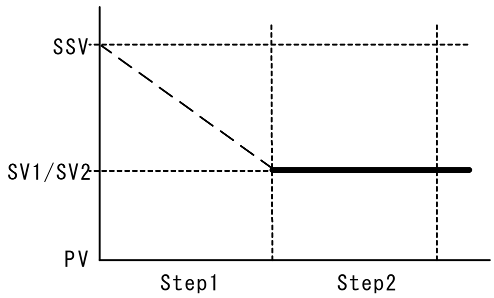
⑤SSV>PV≥SV1



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

T2: Step1 time to be executed

⑥SSV>SV1>PV



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

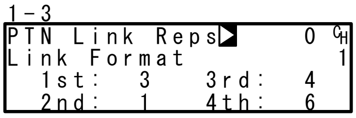
*1 PV start is enabled only when the start step time is set to "00m01s" or more.

*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.

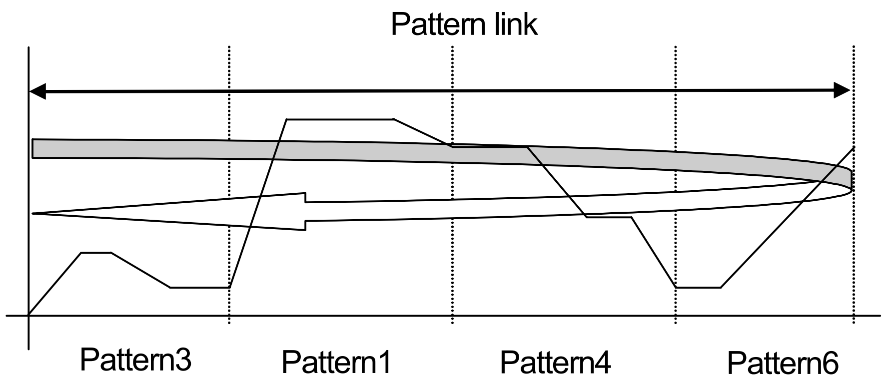
9-4 Pattern Link-related Settings

(1) Setting the pattern link execution count

Set the number of times that pattern link is executed.



Setting range	0 to 9999
Initial value	0

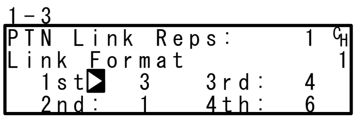


Note

- 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.



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

Note

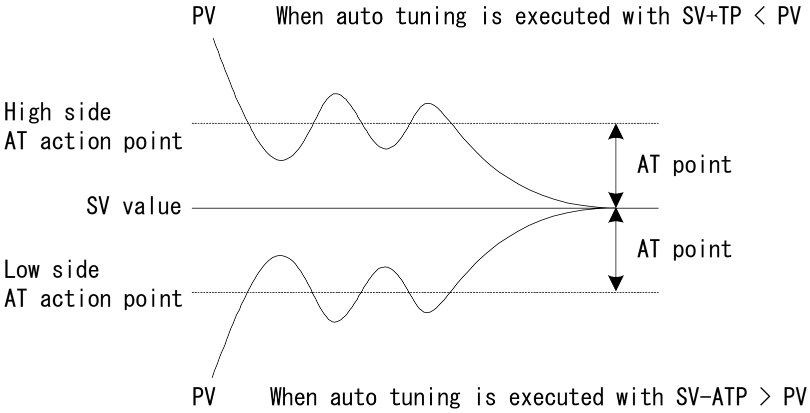
- When pattern 0 is set, the link to patterns set from then onwards becomes invalid.

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.
In case an action point is assigned to another channel, this is not displayed on the screen.

```
2-5
PTN  EV Set Point    CH
 01  EV1 HD▶  2500.0℃1
     EV2 LD: -2500.0℃
     EV3 HD:  2500.0℃
```

```
2-6
PTN  DO Set Point    CH
 01  DO1 HD▶  2500.0℃1
     DO2 LD: -2500.0℃
     DO3 HD:  2500.0℃
```

```
2-7
PTN  DO Set Point    CH
 01  DO4 HD▶  2500.0℃1
     DO5 LD: -2500.0℃
```

```
2-8
PTN  DO Set Point    CH
 01  DO6 HD▶  2500.0℃1
     DO7 LD: -2500.0℃
```

```
2-9
PTN  DO Set Point    CH
 01  DO8 HD▶  2500.0℃1
     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

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)

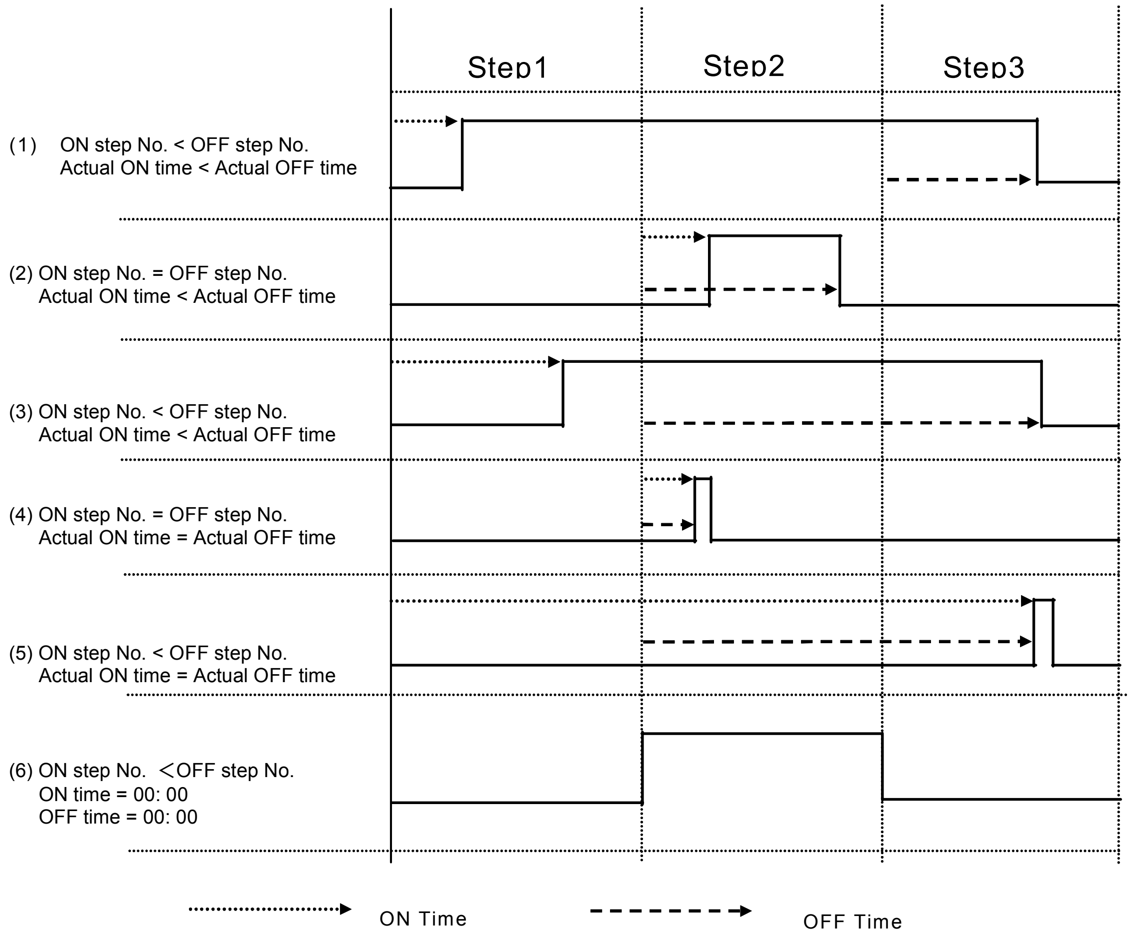
(3) Time signal (TS)

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   CH
 01  ON Time:00h00m  1
    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   CH
 01  ON Time▶00h00m  1
    OFF STEP:  OFF
TS1 OFF Time:00h00m
```

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

③Time signal OFF step No.

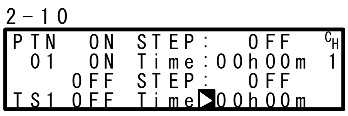
Set the step No. at which Time signal 1 (TS1) turns OFF.

```
2-10
PTN  ON STEP:  OFF   CH
 01  ON Time:00h00m  1
    OFF STEP▶  OFF
TS1 OFF Time:00h00m
```

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

④Time signal OFF time

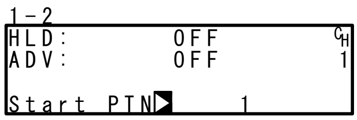
Set the time from the start of the step at which Time signal 1 (TS1) turns OFF up to when the signal actually turns OFF



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).



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

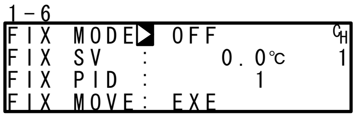
Note

- This pattern can also be set before program control execution in the basic screen. For details, see "15-2 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".



Setting range	ON, OFF
Initial value	OFF

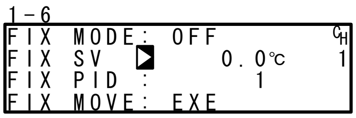
ON	FIX (fixed value control) mode
OFF	Program mode

Note

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

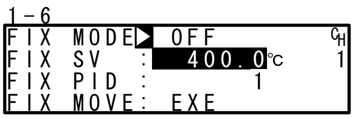
10-2 FIX SV Value

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



Setting range	Within SV limiter setting range
Initial value	0 Unit

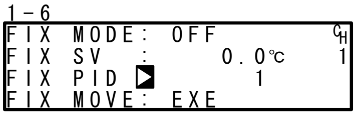
Note



- 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 "8-6 (2) SV limiter."

10-3 FIX PID No.

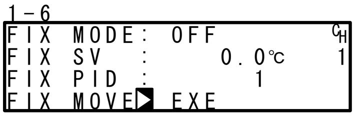
Set the PID No. during fixed value control (FIX mode: ON).
The PID No. cannot be set when Zone PID is enabled. ("Zone" is displayed.)



Setting range 1 to 10
Initial value 1

10-4 FIX MOVE

Make detailed settings for when the FP23 enters FIX mode.



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. In case an action point is assigned to another channel, this is not displayed on the screen.

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

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

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

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

1-11
```
FIX DO Set Point    CH
 DO8 HD▶  2500.0     1
 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

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)

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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 P1 value (proportional and 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 % 50.0 % (in 1-loop/2-output specification)

■ 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 Dead Band (DB)

This setting is for only the 1-loop 2-output specification.
Set the action range of output 2 (OUT2) taking the characteristics of the control target and energy savings into consideration.

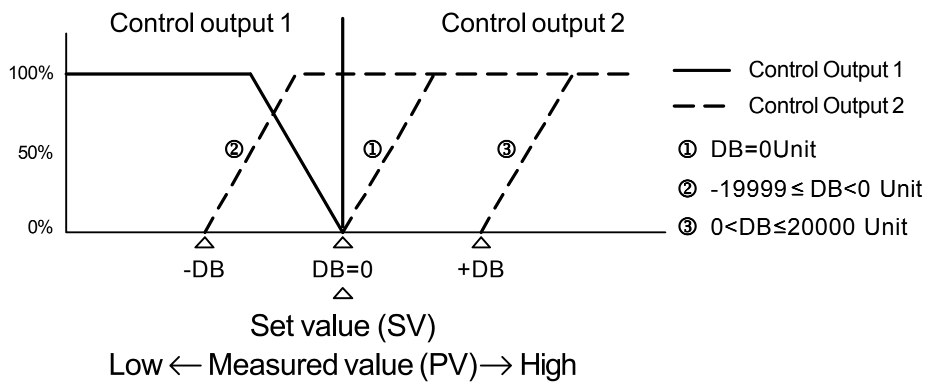
```
PID01-OUT2
P:   3.0%  DB▶  0.0℃
I:   OFF    SF: 0.40
D:    30s
```

Setting range	-19999 to 20000 Unit
Initial value	0 Unit

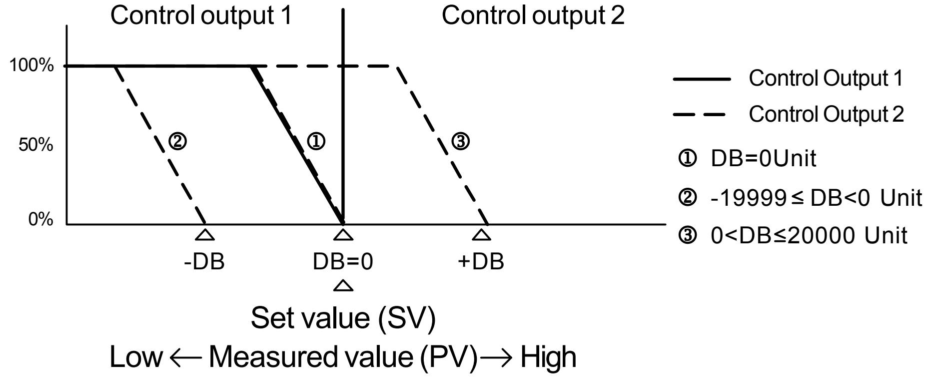
The patterns in the following figures show the relationship between output action and dead band.

RA: Reverse Action, DA: Direct Action

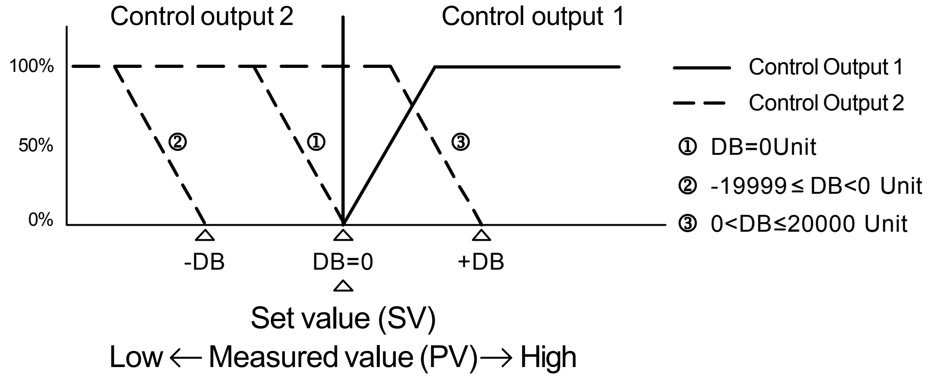
■ Control output 1:RA, Control output 2: DA (RA+DA)



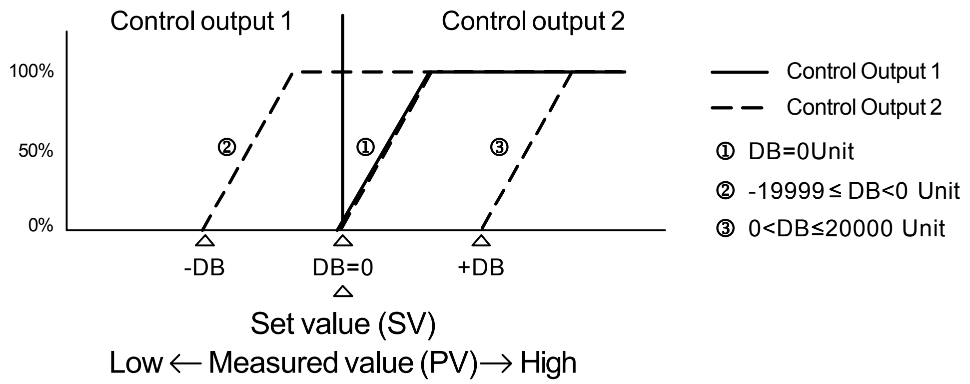
■ Control output 1:RA, Control output 2: RA (RA+RA)



■ Control output 1:DA, Control output 2: RA (DA+RA)



■ Control output 1:DA, Control output 2: DA (DA+DA)



11-7 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

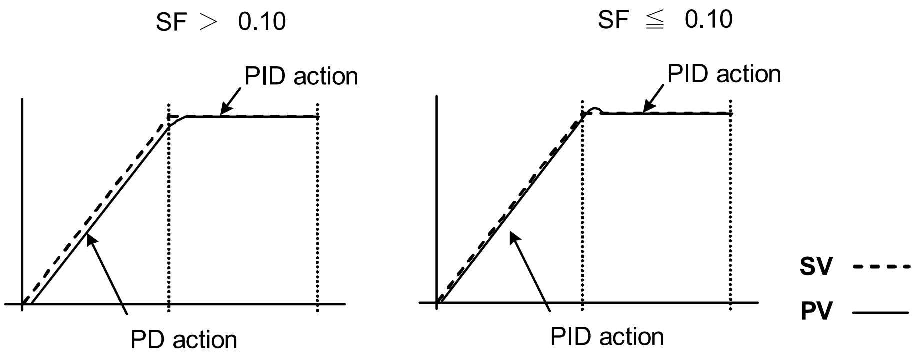
```
PID01-OUT1
P:   3.0%    MR:  0.0%
I:   OFF     SF▶0.40
D:    30s
```

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.



11-8 Output Limit Value (OUT1L to OUT2H)

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.

When the 2-output specification is selected, OUT1 is displayed on the upper row, and OUT2 is displayed on the lower row.

3-2

```
PID01  OUT1L▶    0.0%
       OUT1H:  100.0%
       OUT2L:    0.0%
       OUT2H:  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

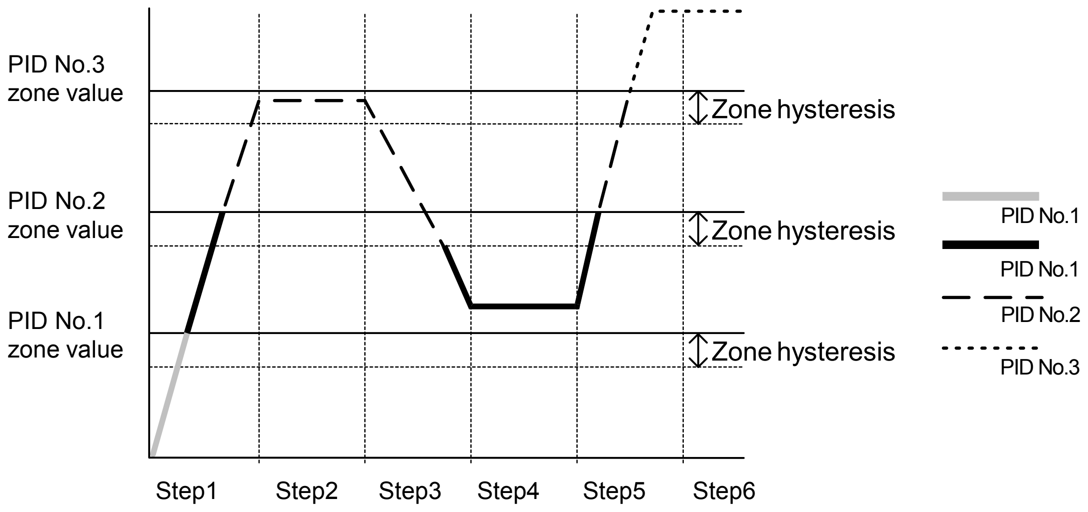
Lower limit value	0.0 %
Higher limit value	100.0 %

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.

11-9 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.
Zone PID2 is displayed in 2-loop specification.

3-31 Other than 2-loop

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

2-loop

```
Zone PID1▶    OFF
     HYS1:    2.0
     PID2:    OFF
     HYS2:    2.0
```

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.
Zone HYS2 is displayed in 2-loop specification.

3-31 Other than 2-loop

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

2-loop

```
Zone PID1:      OFF
     HYS1▶      2.0
     PID2:      SV
     HYS2:      2.0
```

Setting range	0 to 1000 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

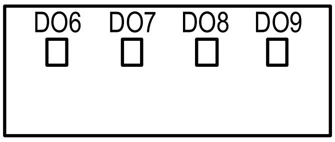
- When the same zone value is set to two or more PID Nos., the PID having the smallest No. is executed.
- To use the Zone PID function, zone setting and zone hysteresis must be set.

12 EVENT & DO SETTING

12-1 Monitor Screens

(1) DO monitor

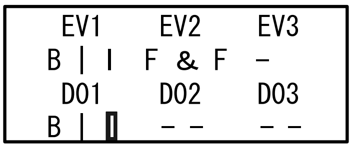
4-1



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



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

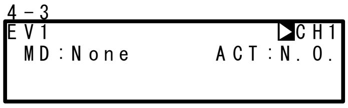
LOGIC	|: OR	&: AND	^: XOR
Input	B: Buffer	F: Flip flop	I: Inverter

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 Channel Setting

Set channel(s) corresponding to event action.
This may be set only in the 2-input 2-loop specification.

4-3

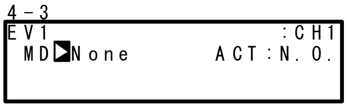


Setting range	CH1, CH2
Initial value	CH1

12-3 EVENT/DO Action

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

4-3



Setting range	See "List of EVENT/DO Types".
Initial value	EV1: DEV Hi EV2: DEV Low EV3: RUN DO1 to 9: None

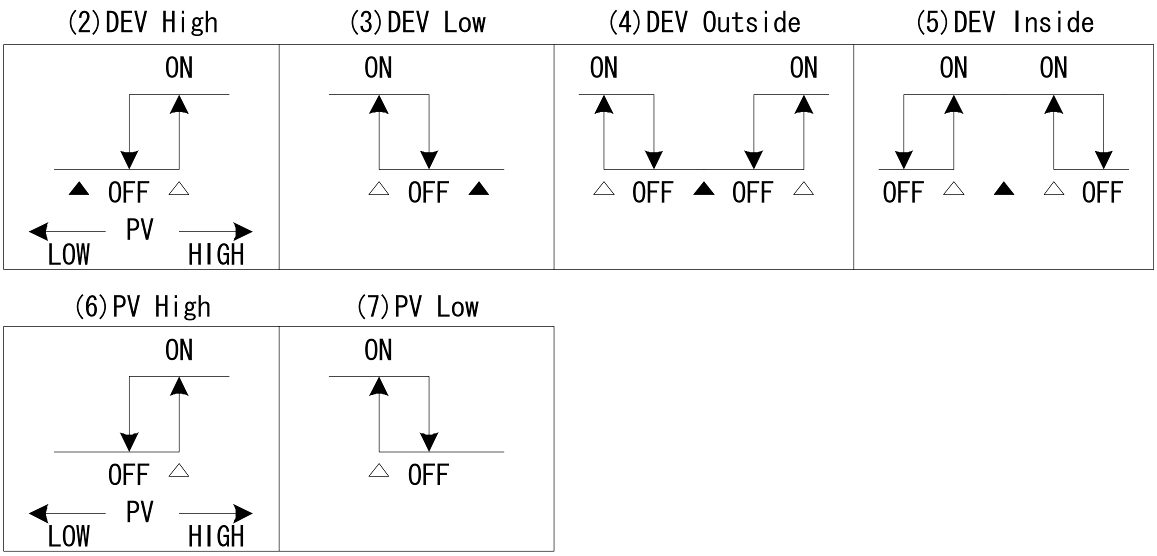
■ List of EVENT/DO Types

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	HBA	Heater break alarm output (option)
27	HLA	Heater loop alarm output (option)

*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.

■ EVENT/DO Action Diagrams



△ Action set point ▲ Set value

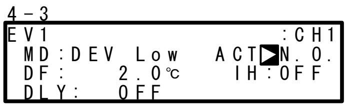
* "ON" "OFF" indicates the action states.
EVENT/DO output conforms to the setting (OPEN/CLOSE) of output characteristics.

■ 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

(1) Output characteristics



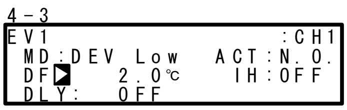
Setting range N.O., N.C.
Initial value N.O.

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

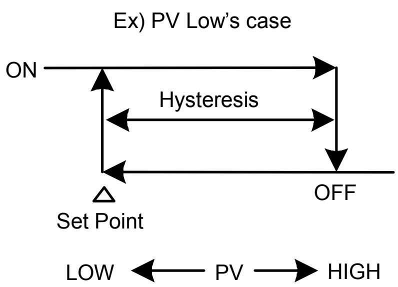
N.C.(normally closed) When EVENT/DO turns ON, contacts are opened or output transistor turns OFF.

(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 (2) to (7) are selected in EVENT/DO action.

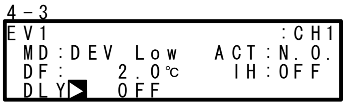


Setting range 1 to 9999 Unit
Initial value 20 Unit



(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 (2) to (7) are selected in the EVENT/DO action.



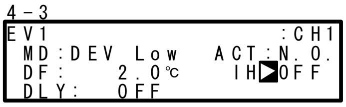
Setting range	OFF, 1 to 9999 s
Initial value	OFF

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 (2) to (7) are selected in the EVENT/DO action.



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).

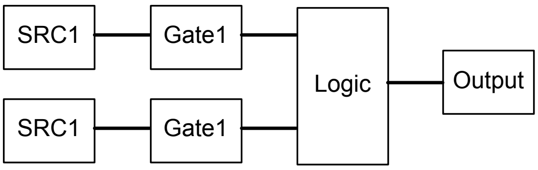
Note

- 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.

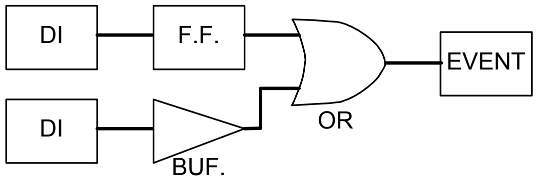
12-4 Event Logic Operations

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



■Configuration 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, TS1-C2 to TS8-C2, 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.

12-5 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.
The pulse width of DI must be 100ms or more.

```
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, TS1-C2 to TS8-C2, 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, HB, 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 (CH1).

(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) Assignment of a Channel to DI

This is the assignment to DI.
In case of 2-loop specification, assignment may be done to either CH1 or CH2, or to both CH1 and CH2 at the same time.

```
5-2
DI1〒 RUN/RST  ▶CH1
DI2:  None     :CH1
DI3:  None     :CH1
DI4:  None     :CH1
```

Setting range	CH1, CH2, CH1+2
Initial value	CH1

(3) List of DI Types.

One of the parameters (Modes) descried in the Table “List of DI Types” can be assigned to DI.

```
5-2
DI1〒 RUN/RST▶CH1
DI2:  None   :CH1
DI3:  None   :CH1
DI4:  None   :CH1
```

```
5-3
DI5:  None    ▶CH1
DI6:  None    :CH1
DI7:  None    :CH1
DI8:  None    :CH1
```

```
5-4
DI9:  None    ▶CH1
DI10:None     :CH1
```

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

```
DI1〒 RUN/RST  ▶CH1
DI2:  None     :CH1
DI3:  None     :CH1    LG
DI4:  None     :CH1
```

■ 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

Mode	Action	No-action Conditions	Signal Detection
None	No action (factory default)	----	----
RUN/RST	Switching of Run/Reset (when ON: Run execution)	None	Edge
RST	Forced Reset (when ON: Reset state)	None	Level
HLD	Control suspension/restart (when ON: suspension state)	None	Level
ADV	Execute advance (when ON: execute advance)	HLD	Edge
FIX	Switching of FIX mode/Program mode (when ON: FIX mode)	None	Level
MAN	Switching of control output between auto/manual (when ON: manual)	AT	Level
LOGIC	Logic operation input [exclusive port] (when ON: input ON)	None	Level
PTN2bit	Selection of start pattern No. by DI input (selectable from 3 patterns)	FIX	Level
PTN3bit	Selection of start pattern No. by DI input (selectable from 7 patterns)	FIX	Level
PTN4bit	Selection of start pattern No. by DI input (selectable from 15 patterns)	FIX	Level
PTN5bit	Selection of start pattern No. by DI input (selectable from 20 patterns)	FIX	Level

Note 1 The corresponding DI action details cannot be executed while parameters listed in the "No-action Conditions" column in the List of DI Types 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 (however, valid if on different channels)
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 (however, valid if on different channels)
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 "12-4 Event Logic Operations".

Note 9 LOGIC cannot be set to CH.

■ 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 lamp 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, CH2_PV, CH2_SV, CH2_DEV,OUT2
Initial value	Ao1: PV Ao2: SV

PV	Measured value (CH1)	CH2_PV	Measured value (CH2)
SV	Target set value (CH1)	CH2_SV	Target set value (CH2)
DEV	Deviation of PV and SV (CH1)	CH2_DEV	Deviation of PV and SV (CH2)
OUT1	Control Output 1	OUT2	Control Output 2

(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, CH2_PV, CH2_SV	Within measuring range	Setting range lower limit value
	DEV, CH2_DEV	-100.0 to 100.0%	
	OUT1, OUT2	0.0 to 100.0%	0.0%
Ao1_H analog output 1 higher limit scaling Ao2_H analog output 2 higher limit scaling	PV, SV, CH2_PV, CH2_SV	Within measuring range	Setting range higher limit value
	DEV, CH2_DEV	-100.0 to 100.0%	
	OUT1, OUT2	0.0 to 100.0%	100.0%

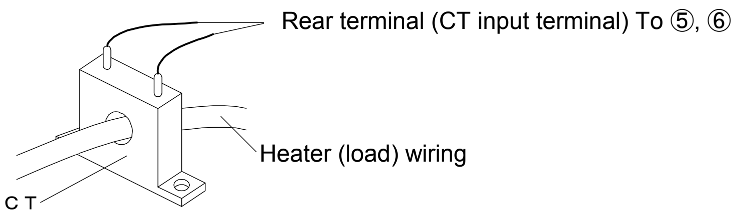
13-3 Setting the Heater Break/Heater Loop Alarms

This function is optional and is not displayed when it is not available.
This function outputs an alarm when the heater has burned out during control (heater break) or when some trouble on the final control element causes a heater current to flow when output is OFF (heater loop error).
Alarm output is assigned to EVENT/DO (external output), and HBA (heater break alarm) or HLA (heater loop alarm) is assigned for use.
Heater Break Alarm and Heater Loop Alarm can be used when Control Output 1 or Control Output 2 is a contact (Y) or SSR drive voltage (P).
These alarms cannot be used if control output is current (I) or voltage (V).
Hysteresis is fixed to 0.2A.

(1) Connecting the Current Transformer (CT)

Pass the load wire through the hole of the CT (provided with this device).
Wire from the CT terminal to the CT input terminal on this device.
The wire has no polarity.

For 30A CT CTL－6－S
For 50A CT CTL－12－S36－8



(2) Heater current monitor

The monitor displays the current value detected by the current transformer (CT).

```
5-7
Heater [  0.0A]
 HBA▶  OFF
 HLA:  OFF
 HBM: Lock  HB: OUT1
```

Display range 0.0 to 50.0 A

- "HB_HH" is displayed on the LCD display screen when the detection current exceeds 55.0A.
- "----" is displayed on the LCD display screen when the current cannot be detected.

(3) Heater Break Alarm current (HBA)

An alarm is output when the current of the load wire is smaller than the preset value.

```
5-7
Heater [  0.0A]
 HBA▶  OFF
 HLA:  OFF
 HBM: Lock  HB: OUT1
```

Setting range	OFF, 0.1 to 50.0 A
Initial value	OFF

Note

- To use Heater Break Alarm, HBA must be assigned for EVENT/DO in EVENT/DO group.

(4) Heater Loop Alarm current (HLA)

An alarm is output when the current of the load wire is greater than the preset value.

```
5-7
Heater [  0.0A]
 HBA:  OFF
 HLA▶  OFF
 HBM: Lock  HB: OUT1
```

Setting range	OFF, 0.1 to 50.0 A
Initial value	OFF

Note

- To use Heater Loop Alarm, HLA must be assigned for EVENT/DO in EVENT/DO group.

(5) Heater Break/Heater Loop Alarm mode (HBM)

You can select the real mode or the lock mode as the alarm output mode.

```
5-7
Heater [  0.0A]
 HBA:  OFF
 HLA:  OFF
 HBM▶ Lock  HB: OUT1
```

Setting range	Real, Lock
Initial value	Real

Real Once the alarm is output, alarm output is canceled when the heater current returns to normal.

Lock Once the alarm is output, alarm output is locked (fixed), and is output continuously even if the heater current returns to normal.
Alarm output can be canceled by setting HBA/HLA to OFF or turning the power OFF.

(6) Heater Break detection Selection (HB)

Select the control output at which Heater Break is detected.
This parameter can be set when another choice besides the 1-output specification is selected, and specified either Y/Y, P/P, Y/P, or P/Y for output 1/output 2.

```
5-7
Heater [  0.0A]
 HBA:  OFF
 HLA:  OFF
 HBM: Lock  HB▶ OUT1
```

Setting range	OUT1, OUT2
Initial value	OUT1

13-4 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.

5-8

```
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

5-9

```
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

5-10

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

CTRL: Control code

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

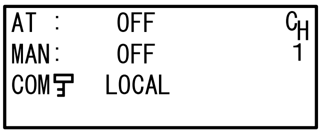
BCC: Block Check Character

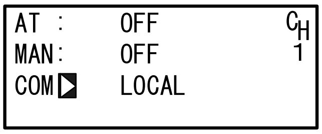
Setting range	ADD, ADD_two's cmp, XOR, None
Initial value	ADD

(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





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.)

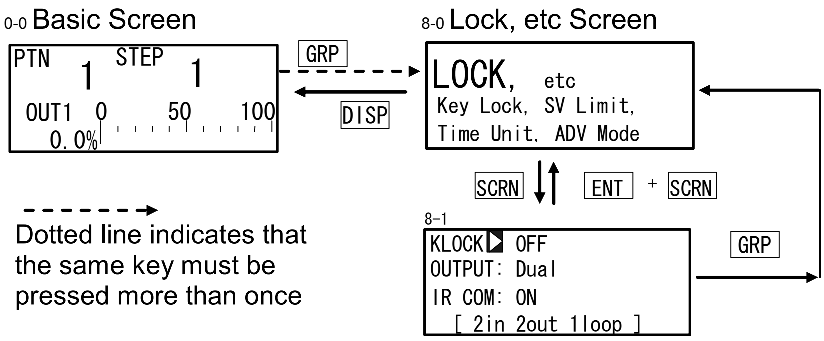
14 KEY LOCK SETTING

14-1 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.

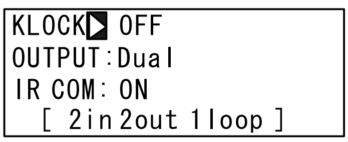
Set parameters by pressing the ◀ ▼ or ▲ key, and press the ENT key to fix and register settings.



(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.

8-1



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

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 "18 List of Parameters."

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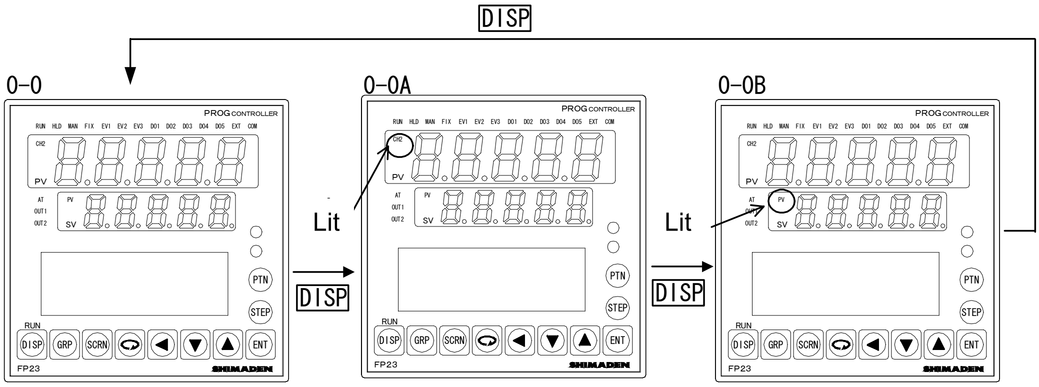
15 MONITORING, EXECUTING & STOPPING OPERATION

To execute Program control or Fixed value control, the basic screen (No.0-0) must be displayed.
When another screen is displayed, press the DISP key to move to the basic screen.

15-1 Flow of Basic Screen under 2-loop Specification

As this section indicates that the basic screen contents and transition, you may skip this section in case another choice besides the 2-loop specification is selected.
Under the 2-loop specification, three Display Modes are offered as the Basic screen on the LCD screen; Display mode 1: Screen 0-0 - Basic screen for CH1, Display mode 2: Screen 0-0A - Basic screen for CH2, and Display mode 3: Screen 0-0B - PV Basic screen.
By pressing the DISP key, the LCD screen will be switched to another to display the desired channel which is under control operation.



Display mode 1 Display mode 2 Display mode 3

The channel number and the contents on the Basic screen are linked to the PV display, SV display, and status lamps (RUN, HLD, MAN, FIX, EXT, AT). For example, when the CH2 lamp does not illuminates, CH1 information is displayed, or when the CH2 lamp illuminates, CH2 information is displayed.
By using DISP key Display/channel mode switching is available at the Basic screen only.
When the Display mode 3 is selected, PV of CH1 is displayed on the PV display, PV of CH2 is displayed on the SV display, and statuses of CH1 are reflected on the status lamps respectively.

■ Information offered according to Display modes on 7-segment LED/Status lamps

	Display mode 1	Display mode 2	Display mode 3
Status lamps	CH1	CH2	CH1
7-segment LED, upper	CH1 PV	CH2 PV *1	CH1 PV
7-segment LED, lower	CH1 SV	CH2 SV	CH2 PV *2

*1 CH2 lamp on PV display lits.
*2 PV lamp on SV display lits

Even if the Basic screen transits to another by pressing the GRP key, PV/SV display shows values for the current channel. The Basic screen, which returns by pressing a DISP key, indicates the contents that are shown just before the pressing the GRP key.

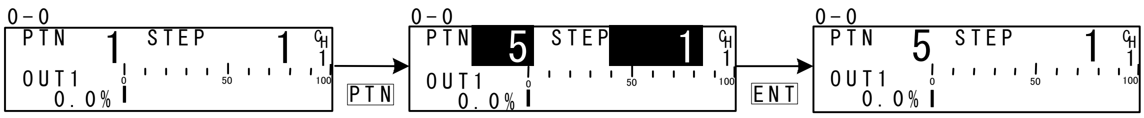
15-2 Operations in Basic Screen

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 (between 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

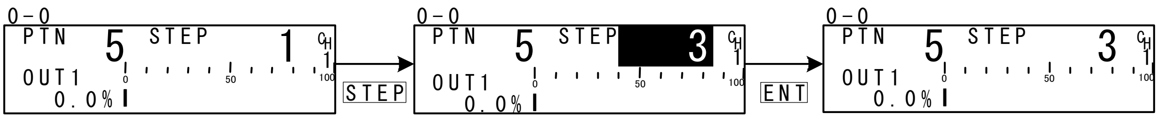
Set the start pattern before the program is started.
When the PTN key is pressed in Basic screen group top screen, the program pattern No. on the LCD display blinks and is incremented. (It can also be changed by the ▲ or ▼ key if it is blinking.)
When you press the ENT key after changing the program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

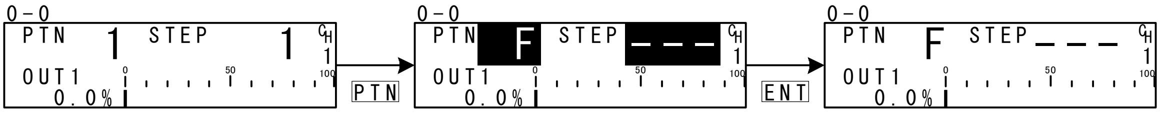


Press 2 times

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

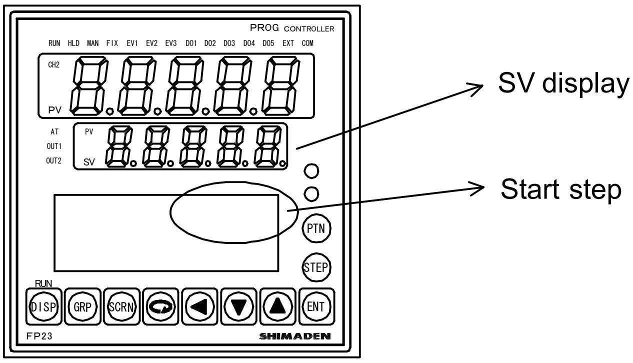
- When the mode is changed from the Program mode to the FIX mode, the move operation changes depending on the FIX MOVE setting.
  For details, see "10-4 FIX MOVE."

(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.

15-3 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

15-4 How to Start / Stop Control

Check the following again before starting control:

1. The LCD display shows the Basic screen (In 2-loop specification, the Basic screen of the controlling channel)
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.

Start control operation after confirming these items.

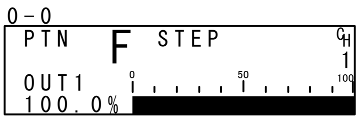
In the Basic screen (In 2-loop specification, the Basic screen of the controlling channel), press the ENT + DISP keys, to start (RUN lamp lit) / stop control.

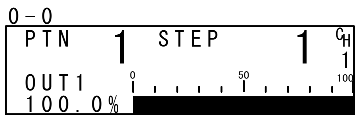
16 OPERATIONS DURING CONTROL

16-1 Monitoring Control

(1) Basic screen

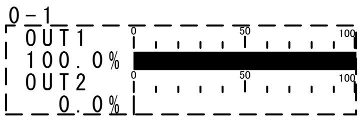
During program control, the currently executing pattern and step are displayed.
During fixed value control, "F" is displayed on the pattern display, and "- - - " is displayed on the step display indicating that the display is off.



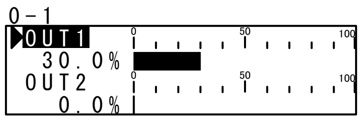


(2) Output value display

The output values of Control Output 1 (OUT1) and Control Output 2 (OUT2: option) are displayed on the upper and lower sections, respectively, as a % and a bar graph.
In the 1-output specification, OUT2 is not displayed.

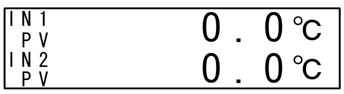


During manual output, OUT1 or OUT2 can be selected by the ⟲ key, and output can be adjusted by operating the ◄, ▲ or ▼ key. For details, refer to “16-3 Switching Auto/Manual of Control Output”.



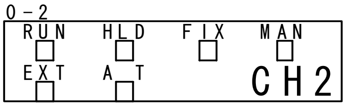
(3) PV monitor

This screen is shown only in case of 2-input operation.
This is a monitoring screen to check input 1 or input 2 PV value, different from execution PV value.



(4) Status monitor

This screen is displayed only in case of 2-loop specification.
This is a status monitor screen for the another channel, different from Basic screen.

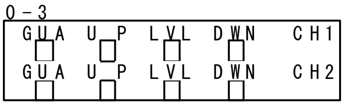


When any condition is detected, each of the □ located subjacent to each parameter display will blink, or ■ is lit reversed.

RUN	Lights during control is being executed. Blinks during program start delay time (PRG.Wait).
HLD	Lights when the program is paused in Program mode. Blinks when the pause caused by an input error in the Program mode or in the Fix mode.
FIX	Lights in the FIX mode.
MAN	Blinks when control output is set to manual operation (MAN).
EXT	Lights when start pattern No. selection (PTN2bit, PTN3bit, PTN4bit, PTN5bit) are set to DI5 to DI8.
AT	Lights during auto tuning standby. Blinks during auto tuning execution.

(5) Monitoring program status

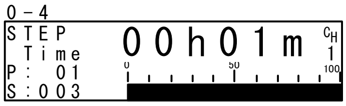
This screen shows program execution for CH1 and CH2 status.
CH1 status is shown in the upper low, CH2 status is shown in the lower low.



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.

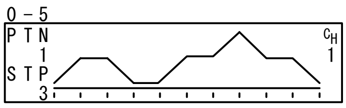
(6) Monitoring the remaining step time

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.



(7) 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.



(8) 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.

```
0-6
PTN Link           CH
 1- 2- 4- 3- 5-10   1
 1- 5-10- 2- 3- 3- 2
 9- 7- 4- 1- 1- 3- 3
```

(9) 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).

```
0-7
PTN LNK:    1/    1 CH
PTN REP:    1/    1 1
STP LOP:    1/    1
PID No      1
```

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.

16-2 Executing and Stopping Auto Tuning

Auto tuning (AT) can be executed and stopped.
During execution of auto tuning, the AT LED indicator or ☐ of status monitor (screen 0-3) blinks, lights during auto tuning standby, and go out when auto tuning ends or stops.

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

♦Auto tuning end conditions

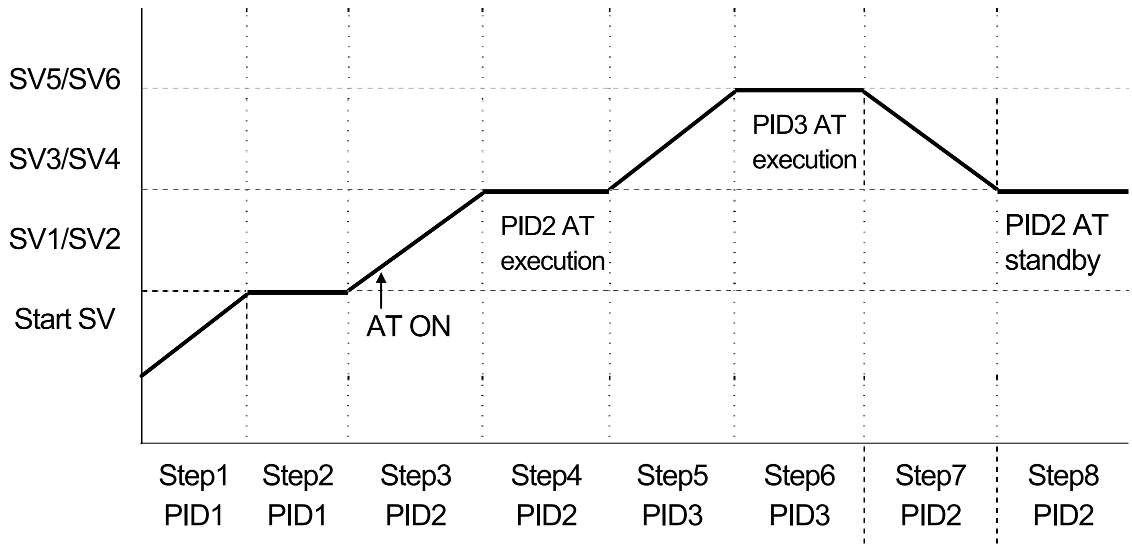
	Program Mode	**FIX Mode**
When the RUN state changes to the reset (RST) state	End of auto tuning	End of auto tuning
When output has elapsed for about 200 minutes in a 0% or 100% state	End of auto tuning	End of auto tuning
At power interruption	End of auto tuning	End of auto tuning
When PID operation 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

♦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 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 the case of 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.

16-3 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 monitor lamp and status monitor (screen 0-2) are displayed blinking.

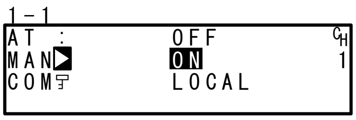
Setting range	OFF, ON
Initial value	OFF

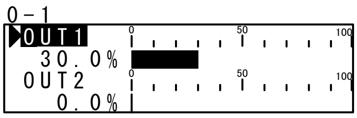
The manual execution conditions (common to front panel keys and external switch input) are as follows:

(1) AT must not be in progress.
(2) The FP23 must not be in a Reset (RST) state.

(1) Manual output operations

In a 1-output specification, the output value of OUT2 and the output bar graph are not displayed on the screen.





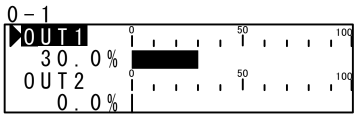
1. In the setup screen (1-1), select MAN (manual) using the cursor, and select ON to register manual output.
2. Next, to perform control output manually, move to the basic screen (group 0) by the DISP key, and move to the output value display (0-1) screen by the SCRN key. At this time, make sure that the cursor (▶) is displayed at the top left of the LCD screen.
3. You can select OUT1 or OUT2 by the ⮐ key, and adjust the output by the ◀, ▲ or ▼ key.
   There is no need to register and fix settings by the ENT key.

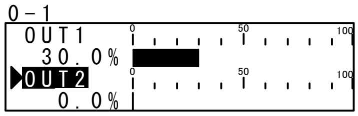
Note

In the case of 2-loop specification, switching to Manual control mode has to be done in each channel.

(2) Simple key-based manual output operations

In the output value display screen (0-1), you can switch automatic/manual by pressing the ENT + ▲ keys for OUT1, or the ENT + ▼ keys for OUT2.

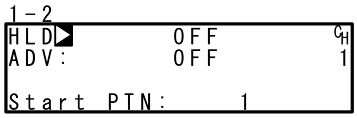




ENT + ▲ or ENT + ▼

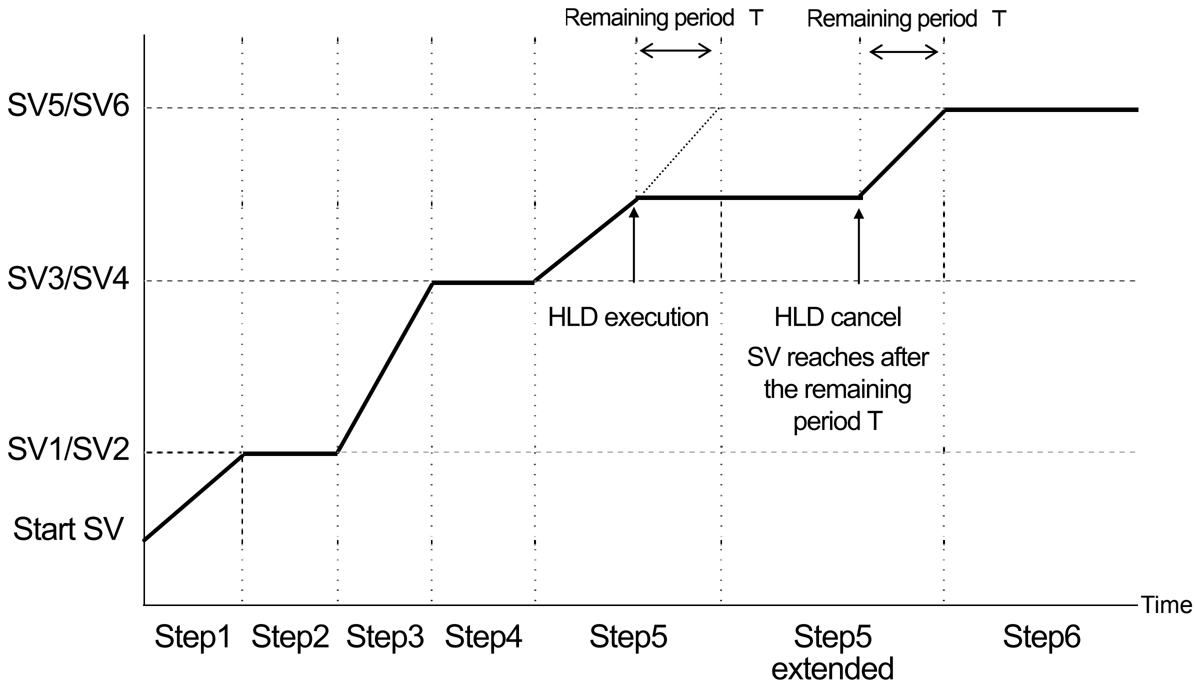
16-4 Temporarily Holding (HLD) and Resuming Program Execution

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 monitor lamp, and ☐ of the status monitor (screen 0-2) are lit.



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

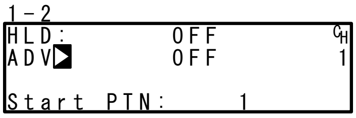
*5 During HLD, changes to parameters are not reflected until HLD is canceled even if start V, step SV and time signal related parameters are changed.

16-5 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."

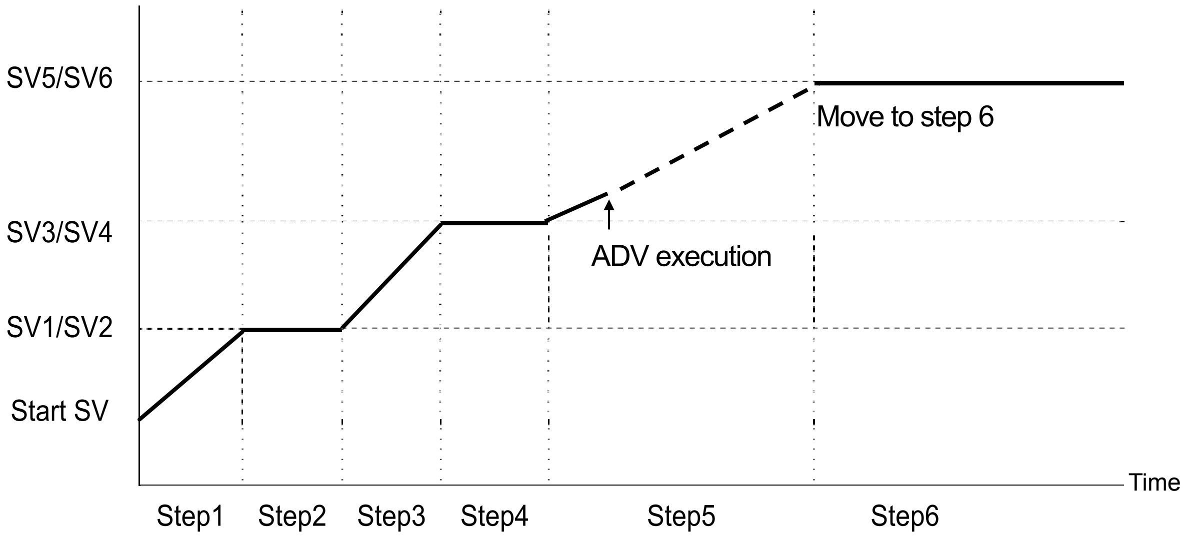


Setting range	ON, OFF
Initial value	OFF

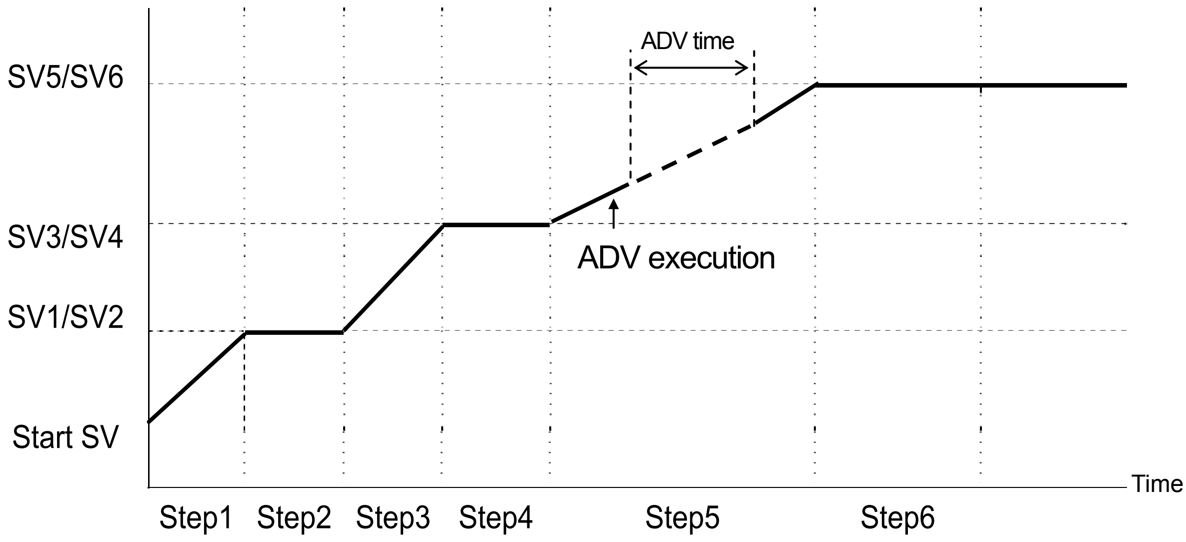
Note

- 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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17 ERROR DISPLAYS

17-1 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-Ad2	Input 2 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.

17-2 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 or the heater lead when the above messages are displayed. If the input or the heater lead is not in error and there is another probable cause, contact your dealer.

17-3 Heater Current Abnormalities (option)

When a heater current abnormality is detected during execution of control on this device the following error codes are displayed on the LCD.

Display	Cause
HB_HH	The heater current exceeds 55.0A.

18 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.
(CH1), (CH2)	Related only to a 2-loop specification.
Description of 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.

18-1 Execution Screen Group (group 1)

Symbol	Description of 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: Communications 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	Description of 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	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range higher limit value	2
FIX DO Set Point DO1 to DO9 *	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	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range higher limit value	2

18-2 Program Screen Group (group 2)

Symbol	Description of 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	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range higher limit value	2

Symbol	Description of Function	Setting Range	Initial Value	Lock
DO Set Point DO1 to DO9 *	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	25000 Unit -25000 Unit 25000 Unit 25000 Unit Measuring range higher limit value Measuring range higher limit value	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

18-3 Step Screen Group (group 2S)

Symbol	Description of 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

18-4 PID Screen Group (group 3)

Symbol	Description of 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 % -50.0 % (1-loop,2-out)	1
SF	No.1 set value function (OUT1)	0.00 to 1.00	0.40	1
ZN *	No.1 PID zone (CH1)	Within measuring range	0 Unit	1
PID (01 to 10) -OUT2				
P	No.1 proportional band (OUT2) (CH2)	OFF, 0.1 to 999.9 %	3.0 %	1
I	No.1 integral time (OUT2) (CH2)	OFF, 1 to 6000 s	120 s	1
D	No.1 differential time (OUT2) (CH2)	OFF, 1 to 3600 s	30 s	1
DF *	No.1 hysteresis (OUT2) (CH2)	1 to 9999 Unit	20 Unit	1
DB *	No.1 dead band (OUT2)	-19999 to 20000 Unit	0 Unit	1
MR	No.1 manual reset (CH2)	-50.0 to 50.0 %	0.0 %	1
SF	No.1 target value function (OUT2) (CH2)	0.00 to 1.00	0.40	1
ZN *	No.1 PID zone (CH2)	Within measuring range	0 Unit	1
PID01-10 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
OUT2L	No.1 output limiter lower limit value (OUT2)	0.0 to 100.0 %	0.0 %	1
OUT2H	No.1 output limiter higher limit value (OUT2)	0.0 to 100.0 %	100.0 %	1
Zone PID1	Zone 1 PID mode	OFF: No switching PV: PV zone switching SV: SV zone switching	OFF	1
HYS1 *	Zone 1 hysteresis	0 to 10000 Unit	20 Unit	1
PID2	Zone 2 PID mode (CH2)	OFF: No switching PV: PV zone switching SV: SV zone switching	OFF	1
HYS2 *	Zone 2 hysteresis (CH2)	0 to 10000 Unit	20 Unit	1
AT Point *	Auto tuning point	0 to 10000 Unit	0	1

18-5 EVENT/DO Screen Group (group 4)

Symbol	Description of Function	Setting Range	Initial Value	Lock
EV1 to EV3, DO1 to DO9				
MD	EV1 to 3 DO1 to 9 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 TS2 : Time signal 2 TS3 : Time signal 3 TS4 : Time signal 4 TS5 : Time signal 5 TS6 : Time signal 6 TS7 : Time signal 7 TS8 : Time signal 8 HBA : Heater Break Alarm output (*4) HLA : Heater Loop Alarm output (*4)	EV1: DEV Hi EV2: DEV Low EV3: RUN DO1 to 9: None	1
ACT	EV1 to EV3 DO1 to DO9 output characteristics	N.O.: Normally open N.C.: Normally closed	N.O.	1
DF *	EV1 to EV3 DO1 to DO9 hysteresis	1 to 9999 Unit	20 Unit	1
IH	EV1 to EV3 DO1 to DO9 standby action	OFF, 1/2/3	OFF	1
DLY	EV1 to EV3 DO1 to DO9 delay time	OFF, 1 to 9999 s	OFF	1

Symbol	Description of Function	Setting Range	Initial Value	Lock
EV1 to EV3 / DO1 to DO3				
SRC1 SRC2	Source input1 Source input 2	None/TS1 to TS8/TS1-C2 to TS8-C2/ DI1 to DI10	None	1
Gate1 Gate2	Gate input1 Gate input 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/TS1-C2 to TS8-C2/ 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, Count) can be assigned only to DO4 and DO5.

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

*4 This function is optional and is not displayed when it is not installed.

18-6 DI/Option Screen Group (group 5)

Symbol	Description of Function	Setting Range	Initial Value	Lock
- - -	DI assignment channel (in 2-loop)	CH1/CH2/CH1+2	CH1	1
DI1	DI1 assignment	RUN/RST (fixed)	---	1
DI2	DI2 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC	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	Description of Function	Setting Range	Initial Value	Lock
Ao1MD	Analog output 1 type	PV : CH1 Measurement value SV : CH1 Setting value DEV : CH1 Deviation value OUT1 : Output 1 CH2_PV : CH2 Measurement value CH2_SV : CH2 Measurement value CH2_DEV : CH2 Measurement value OUT2 : Output 2	PV	1
Ao1_L *	Analog output 1 lower limit side scaling	PV, SV, CH2_PV, CH2_SV: Within measuring range DEV, CH2_DEV2 : -100.0 to 100.0 % OUT1, OUT2 : 0.0 to 100.0 %	Setting range lower limit value	1
Ao1_H *	Analog output 1 higher limit side scaling	PV, SV, CH2_PV, CH2_SV: Within measuring range DEV, CH2_DEV2 : -100.0 to 100.0 % OUT1, OUT2 : 0.0 to 100.0 %	Setting range higher limit value	1
Ao2MD	Analog output 2 type	PV : CH1 Measurement value SV : CH1 Setting value DEV : CH1 Deviation value OUT1 : Output 1 CH2_PV : CH2 Measurement value CH2_SV : CH2 Measurement value CH2_DEV : CH2 Measurement value OUT2 : Output 2	SV	1
Ao2_L *	Analog output 2 lower limit side scaling	PV, SV, CH2_PV, CH2_SV: Within measuring range DEV, CH2_DEV2 : -100.0 to 100.0 % OUT1, OUT2 : 0.0 to 100.0 %	Setting range lower limit value	1
Ao2_H *	Analog output 2 higher limit side scaling	PV, SV, CH2_PV, CH2_SV: Within measuring range DEV, CH2_DEV2 : -100.0 to 100.0 % OUT1, OUT2 : 0.0 to 100.0 %	Setting range higher limit value	1
Heater	Heater current value monitor	0.0 to 50.0A	- - -	- - -
HBA	Heater Break alarm	OFF, 0.1 to 50.0 A	OFF	1
HLA	Heater loop alarm	OFF, 0.1 to 50.0 A	OFF	1
HBM	Heater Break mode	Lock: Lock Real: Real	Lock	1
HB	Heater current detection selection	OUT1: Control Output 1 OUT2: Control Output 2 (*1)	OUT1	1

*1 HB can be selected when another choice besides 1-output is specified, and the output1/output2 is any combination from Y/Y, P/P, Y/P or P/Y.

Symbol	Description of Function	Setting Range	Initial Value	Lock
COM PROT	Communication protocol	SHIMADEN, MOD_ASC, MOD_RTU	SHIMADEN	1
ADDR	Communication address	1 to 98	1	1
BPS	Communication speed	2400 bps 4800 bps 9600 bps 19200 bps	9600 bps	1
MEM	Communication 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
DATA	Communication data length	7: 7 bit 8: 8 bit	7	1
PARI	Communication data parity	EVEN/ODD/None	EVEN	1
STOP	Communication stop bit	1/2	1	1
DELY	Communication delay time	1 to 50 ms	10 ms	1
CTRL*1	Communication control code	STX_ETX_CR STX_ETX_CRLF @_: _CR	STX_ETX_CR	1
BCC *1	Communication 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.

18-7 Control Output Screen Group (group 6)

Symbol	Description of Function	Setting Range	Initial Value	Lock
OUT1 ACT	Output 1 control characteristics	Reverse: Reverse characteristics Direct: Direct characteristics	Reverse	1
RST	Output preset value at output 1 reset	0.0 to 100.0 %	0.0 %	1
ERR	Output preset value at output 1 error	0.0 to 100.0 %	0.0 %	1
CYC	Output 1 proportional cycle time	1 to 120 s	Contact (Y) : 30 s SSR (P) : 3 s	1
OUT2 ACT *1	Output 2 control characteristics	Reverse: Reverse characteristics Direct: Direct characteristics	Direct (1-loop) Reverse (2-loop)	1
RST *1	Output preset value at output 2 reset	0.0 to 100.0 %	0.0 %	1
ERR *1	Output preset value at output 2 error	0.0 to 100.0 %	0.0 %	1
CYC *1	Output 2 proportional cycle time	1 to 120 s	Contact (Y) : 30 s SSR (P) : 3 s	1
Rate Limiter				
Out1	Output 1 rate-of-change limiter	OFF, 0.1 to 100.0 %/s	OFF	1
Out2 *1	Output 2 rate-of-change limiter	OFF, 0.1 to 100.0 %/s	OFF	1

*1 Control output 2 is optional and is not displayed when it is not installed.

18-8 Unit/Range Screen Group (group 7)

Symbol	Description of Function	Setting Range	Initial Value	Lock
2-IN(func)				
PV_MODE	PV1/PV2 Input mode	MAX : Max. value in 2-input MIN : Min. value in 2-input AVE : Average value in 2-input DEV : Deviation value in 2-input PV : Input 1 PV	DEV	1
SO_MODE	Scale over mode	0/1	0	1
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
INPUT1				
PV Bias *	PV bias	-10000～10000 Unit	0 Unit	1
PV Filter	PV filter	OFF,1～100 Sec	OFF	1
PV Slope * *1	PV slope	0.500～1.500 Unit	1.000	1
INPUT2				
PV Bias *	PV bias	-10000～10000 Unit	0 Unit	1
PV Filter	PV filter	OFF,1～100 Sec	OFF	1
PV Slope * *1	PV slope	0.500～1.500 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 *4	Low cut (Voltage input)	0.0 to 5.0 %	1.0 %	1
PMD *5	Linearizer approximation	OFF : Approximation OFF ON : Approximation ON	OFF	1
A1 to A11 *5	Linearizer approximation input 1 to 11	-5.00 to 105.00 %	0.00 %	1
B1 to B11 *5	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 “square root function = ON”.
*5 This screen is displayed only in the case of RTD and TC input.

18-9 Lock, etc. Screen Group (group 8)

Symbol	Description of Function	Setting Range	Initial Value	Lock
KLOCK	Key lock	OFF : Release LOCK1 : Other than SV, CONTROL LOCK2 : Other than SV LOCK3 : All	OFF	- - -
OUTPUT	Output mode	Single : 1-output Dual : 2-output	1-output: Single 2-output: Dual	1
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
CH1 PTN	CH1 assigned pattern number	0 to 20	10	1

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19 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.

19-1 Product Model Code

FP23-	D□	□	□-	□□	□	□	□	□	□

19-2 CTRL EXEC Parameters

Item	CH1	CH2
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	CH1	CH2
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		

19-3 PROG STEP Parameters

PTN No. ________

Item	CH1	CH2
Num. of STEP		
Start STEP		
Start SV		
PTN Reps		
Loop setup		
Start		
End		
Reps		
GUArantee Soak		
Zone		
Time		
PV Start		

Item	CH1	CH2
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	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

PTN No. ________

Item	CH1	CH2
Num. of STEP		
Start STEP		
Start SV		
PTN Reps		
Loop setup		
Start		
End		
Reps		
GUArantee Soak		
Zone		
Time		
PV Start		

Item	CH1	CH2
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	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

STEP No. ________

Item	CH1	CH2
SV		
Time		
PID		

19-4 PID Parameters

OUT1 (CH1)

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

OUT2 (CH2)

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

Zone PID

Item	Set Value
Zone PID1	
Zone HYS1	
Zone PID2	
Zone HYS2	
AT Point	

19-5 EVENT/DO Parameters

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

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

19-6 DI/Options Parameters

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

Item		Set Value
HBA		
HLA		
HBM		
HB		
COM	PROT	
	ADDR	
	BPS	
	MEM	
	DATA	
	PARI	
	STOP	
	DELY	
	CTRL	
	BCC	

19-7 Control Output Parameters

Item	OUT1	OUT2
ACT		
RST		
ERR		
CYC		
Rate Limiter		

19-8 Unit/Measuring Range Parameters

2-input related

Item		Set Value
2-IN (FUNC)	PV_MODE	
	SO_MODE	

Item		Set Value
INPUT1	PV Bias	
	PV Filter	
	PV Slope	
INPUT2	PV Bias	
	PV Filter	
	PV Slope	

Input setting

Item	CH1	CH2
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.	CH1		CH2	
n	An	Bn	An	Bn
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

19-9 Lock, etc. Parameters

Item	Set value
KLOCK	
OUTPUT	
IR COM	

Item	CH1 set value	CH2 set value
SV Limit_L		
SV Limit_H		
Time Unit		
PRG.Wait		
SO Mode		
POWER ON		
ADV Mode		
ADV Time		

20 SPECIFICATIONS

20-1 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
COM	Green	Lights when the communication mode is ON
EXT	Green	Lights when start pattern external switching is assigned
AT	Green	Lights when auto tuning is in standby, brinks when it is being executed
OUT1	Green	Control Output 1
OUT2	Green	Control Output 2
CH2	Green	Lights when CH2 PV and SV are displayed (in 2-loop)
PV	Green	Lights when CH1 PV and CH2 SV (7-segment LED in LED display) are displayed (in 2-loop)

- 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)

20-2 Setting

- 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)

20-3 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, or input and CT input.

20-4 Control

◆ Control output	1-output specification, 2-output specification In the case of independent 2-channel control (CH1, CH2) specification, control output 2 is the output on CH2 side.
◆ Control system (common to Control Output 1 and 2)	
	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)
Dead band (DB)	-19999 to 20000 Unit (Control Output 2 in 1-loop/2-out specification)
Hysteresis (DF)	1 to 9999 Unit (at ON-OFF action, available when P = OFF)
Proportional cycle	1 to 120 seconds (at contact or SSR drive voltage output)
◆ Control output type/rating	(common to Control Outputs 1 and 2)
	Y: Contact 1c, contact rating 240 V AC/2.5A resistive load, 1A inductive load
	I: Current 4 to 20 mA DC/load resistance 600Ω max.
	P: SSR drive voltage 12 V±1.5 V DC/load current 30 mA max.
	V: Voltage 0 to 10 V DC/load current 2 mA max.
Output accuracy	±0.5% FS (5 to 100% output/within accuracy maintaining temperature range)
Resolution	Approx. 1/14000 (during current or voltage output)
◆ Operation/output update cycle	
	0.1 seconds (100 msec)
◆ Control output characteristics	
	Reverse (for heating)/Direct (for cooling), Control Outputs 1 and 2 set individually (heating/cooling, 2-stage heating/2-stage cooling selectable in 1-loop, 2-output specification)
◆ Higher/lower output limiter setting range	Higher limit/lower limit (set individually for each PID No.) 0.0 to 100.0% (lower limit < higher limit)
◆ Output rate-of-change	OFF, 0.1 to 100.0%/seconds (set individually for control outputs limiter 1 and 2)
◆ Control output at error	0.0 to 100.0% (set individually for Control Outputs 1 and 2)
◆ Control output at standby	
	0.0 to 100.0% (set individually for Control Outputs 1 and 2)
◆ Manual control	
Auto/manual switching	Balanceless/bumpless action (simultaneous for Control Outputs 1 and 2)
Output setting range	0.0 to 100.0% set individually for Control Output 1 and 2
Setting resolution	0.1%
◆ Isolation	Insulated between Control Output and the system. Not insulated between Control Outputs.

20-5 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

20-6 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 from the following 27 types (to designate output) In the case of independent 2-channel control (CH1, CH2) specification, assignment will be done to eigher CH1 or CH2.
◆ 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) HBA — ON during Heater Break alarm action 28) HLA — ON during Heater Loop alarm action Direct cannot be set for event, but for DO.
◆ Setting range	DEV Hi, Low — -25000 to 25000 Unit DEV Out, In — 0 to 25000 Unit PV Hi, Low — Within measuring range
Hysteresis	1 to 9999 Unit (when DEV, PV or SV is selected)
Action delay time	OFF, 1 to 9999 Unit (when DEV, PV or SV is selected)
Standby action	Selectable from 3 types (when DEV, PV or SV 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 alarm output and various I/O, or alarm output and the system.

20-7 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.
  In the case of independent 2-channel control (CH1, CH2) specification, assignment will be done to eigher CH1 or CH2.
  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.)
  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.

20-8 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)
- Setting/selection: Individual setting (individual input), selectable from 12 types
  Input types: In the case of independent 2-channel control (CH1, CH2) specification, assignment will be done to eigher CH1 or CH2 or both.

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)

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

20-9 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: In the case of independent 2-channel control (CH1, CH2) specification, TS1 to TS8 (CH1), TS1 to TS8 (CH2), 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

20-10 2-input Specification

- **Input types**: Input 1 and Input 2, individual selection, individual setting, universal input, multi range
  Thermocouple input, R.T.D. input, voltage input (mV, V), current input (mA)
- **Input and control specifications**
  Specifications to be decided by combinations of input and control output.

  1-loop control specification
  1) 2-input operation (PV1, PV2) and 1-output
  MAX Max. value input of PV1 and PV2, 1-output/2-output control specification
  MIN Min. value input of PV1 and PV2, 1-output/2-output control specification
  AVE Average value input of PV1 and PV2, 1-output/2-output control specification
  DEV Deviation value input of PV1 - PV2, 1-output/2-output control specification
  PV Taking PV value of PV1
  2) 2-input operation (PV1, PV2) and 2-output

  2-loop control specification
  1) Independent 2-channel control specification
- **Isolation**: Insulated between Input 2 and DI input, or input and various outputs
  Not insulated between Input 1 (standard input) and Input 2, input and the system, input and remote input, or input and CT input

20-11 Heater Break Alarm (option)

◆ Alarm action	HBA alarm ON when control output is ON and heater break is detected HLA alarm ON when control output is OFF and heater loop error is detected
Alarm detection	HBA is detected at heater current ≤ setting current value, when control output is ON HLA is detected at heater current ≥ setting current value, when control output is OFF Hysteresis at heater Break or loop error detection 0.2 A
◆ Current detection	Heater current detection by external CT (supplied CT for exclusive use/single phase)
Current detection selection	Selectable from Control Output 1 or Control Output 2 only when control output is Y or P
Sampling cycle	0.2 seconds (200 msec)
Minimum action confirmation time	0.2 seconds (200 msec) or longer (regardless of whether control output is ON or OFF)
◆ Current setting	Heater break, heater loop alarm set individually
Setting range	OFF, 0.1 to 50.0 A (OFF = suspension of alarm action)
Setting resolution	0.1 A
◆ Current display	0.0 to 55.0 A
Display accuracy	3% FS (sine wave 50 Hz)
Sampling cycle	0.2 seconds (200 msec)
Minimum action confirmation time	0.2 seconds (200 msec) or longer (regardless of whether control output is ON or OFF)
◆ Output	Assigned to EVENT, DO output
Output hold	Selectable between Lock mode and Real mode
◆ Isolation	Insulated between CT input and DI input, or CT input and various outputs. Not insulated between CT input and sensor input, or CT input and the system.

20-12 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 In the case of independent 2-channel control (CH1, CH2) specification, assignment will be done to eigher CH1 or CH2.
◆ Output types	Selectable from 8 types PV, SV, DEV, OUT1, CH2_PV, CH2_SV, CH2_DEV, OUT2
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, CH2_PV, CH2_SV: within measuring range DEV, CH2_DEV: within -100.0 to 100.0%; OUT1, OUT2 within 0.0 to 100.0%; reverse scaling possible
◆ 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)

20-13 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.

20-14 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

20-15 Infrared Communication

- Communication system — Direct communication is possible with a 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)

20-16 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.

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

Temperature and Humidity Control Specialists

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