FP23A Series
Programmable Controller

Instruction Manual
(Detailed version)

Thank you for purchasing the Shimaden FP23A 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 (Detailed version).

SHIMADEN CO., LTD.

MFP023A-E01-B
Jun. 2023

Request

Make sure that this Instruction Manual (Detailed version) is given to the final user of the device.
Keep this manual at the work site during operation of the FP23A Series.

Preface

This Instruction Manual describes the basic functions and how to use FP23A Series Digital Controllers.

This Instruction Manual is meant for those will be involved in the wiring, installation, operation and routine maintenance of the FP23A 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 FP23A Series digital controllers are control instruments designed for industrial use to control temperature, humidity and other physical values.

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.
- FP23A digital controller with basic function MS (servo output) is a position-proportional controller for a control motor with limit switches.
It should therefore not be used to control motors not equipped with limit switches or motor with misaligned limit switches. Doing so could result in failure or damage to the motor.

Caution

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

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

  Fuse rating/characteristics: 250 VAC 1.0A/medium lagged or lagged type
- When wiring this device, tighten the terminal connections firmly.
- Use the device with the power voltage and frequency within their rated ranges.
- Do not apply a voltage or current outside of the input rating to the input terminal. Doing so might shorten the service life of this device or cause it to malfunction.
- The voltage and current of the load connected to the output terminal should be within the rated range. Exceeding this range may cause the temperature to rise which might shorten the service life of this device or cause it to malfunction.
- This device is provided with ventilation holes for heat to escape. Prevent metal objects or other foreign matter from entering these ventilation holes as this may cause this device to malfunction. Do not block these ventilation holes or allow dirt and dust to stick to these holes. Temperature buildup or insulation failure might shorten the service life of this device or cause it to malfunction.
- Repeated tolerance tests on voltage, noise, surge, etc. may cause this device to deteriorate.
- Never remodel this device or use it a prohibited manner.
- To ensure safe and proper use of this device, and to maintain its reliability, observe the precautions described in this manual.
- Do not operate the keys on the front panel of this device with a hard or sharp-tipped object. Be sure to operate the keys with your fingertips.
- When cleaning this device, do not use paint thinner or other solvents. Wipe gently with a soft, dry cloth.
- It takes 30 minutes to display the correct temperature after applying power to the digital controller. (Therefore, turn the power on more than 30 minutes prior to the operation.)
- 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.
- This device is designed for mounting on the panel. Only the device mounted on the front of the panel facing outward is of protection class of IP66.Do not use for the device not facing outward or in environment where water or solids in excess of IEC60529 may get inside.

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) Instruction Manual (A3 size paper - 4 pages) x 2 pcs.
(2) Mounting fixture (with screws) x 2 pcs.
(3) Terminal cover
(4) 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), attached to the Instruction Manual (basic)

Options (sold separately)

The following table shows the options available for this product.

Model Name	Model No.	Specification
Shunt resistor	QCS002	250Ω±0.1%, externally attached receiving impedance for mA input
Relay Unit	AP2MC	Converts open collector output to 2-point contact.

You can download the following from our website:
・Parameter setting tool “Parameter Assistant SR23 FP23”

■ Model codes selection table

Item	Code		Specification	
1.Series	FP23A-		96 x 96 mm DIN size, high-performance digital controller, 3 event outputs, 4 DI, 5 DO	
2.Basic functions	SS	1-input	Insulated universal input, 1-output control	
	SD		Insulated universal input, 2-output control	
	DL	2-Input *1	Insulated universal-input, independent 2-channel control	
	DS		Insulated universal input, 2-input operation/1-output control	*2
	DD		Insulated universal input, 2-input operation/2-output control	
	MS	1-input	Insulated universal input, servo output control	
3.Control Output 1	Y		Contact: 1c, Contact rating: 240 V AC, 2.5 A/resistive load, 1 A/ inductive load (CR absorber built-in for basic function MS, Rating: 240 V AC, 2 A)	*5
	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.	
	R		Contact, rating: 240V AC 2A without CR absorber	*6
4.Control Output 2 N-forced for basic functions SS Y- (contact output) is recommended for basic function DS	N-		None	
	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 rovided)	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.Additional external I/O signals (DI/DO) *4	0		None	
	1		DI5 to 10 (6 points), DO6 to 9 (4 points)	
	2		DI5 to 10 (6 points), DO 6 to 13 (8 points) (selectable for basic functions SS, SD)	
9.Communication function	0		None	
	5		RS-485	SHIMADEN protocol/ MODBUS communication protocol
	7		RS-232C	
10.Remarks	0		Standard firmware	
	9		Customized firmware	

*1 Independent 2-channel control, internal cascade control, 2-input operation/1-output control, 2-input operation/2-output control are all supported for basic functions DL, DS and DD.
(The product will be delivered with the basic function selected by you as the factory default setting. Control Output must be selected both for 1 and 2. Select contact (Y) when use is either unpredicted and/or unknown.)

*2 In 2-input operation/1-output control specification, the output for control is output to Control Output 1.

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

*4 When switching the start pattern No. by D1, 10 points of D1 (code 1 or 2) are required.

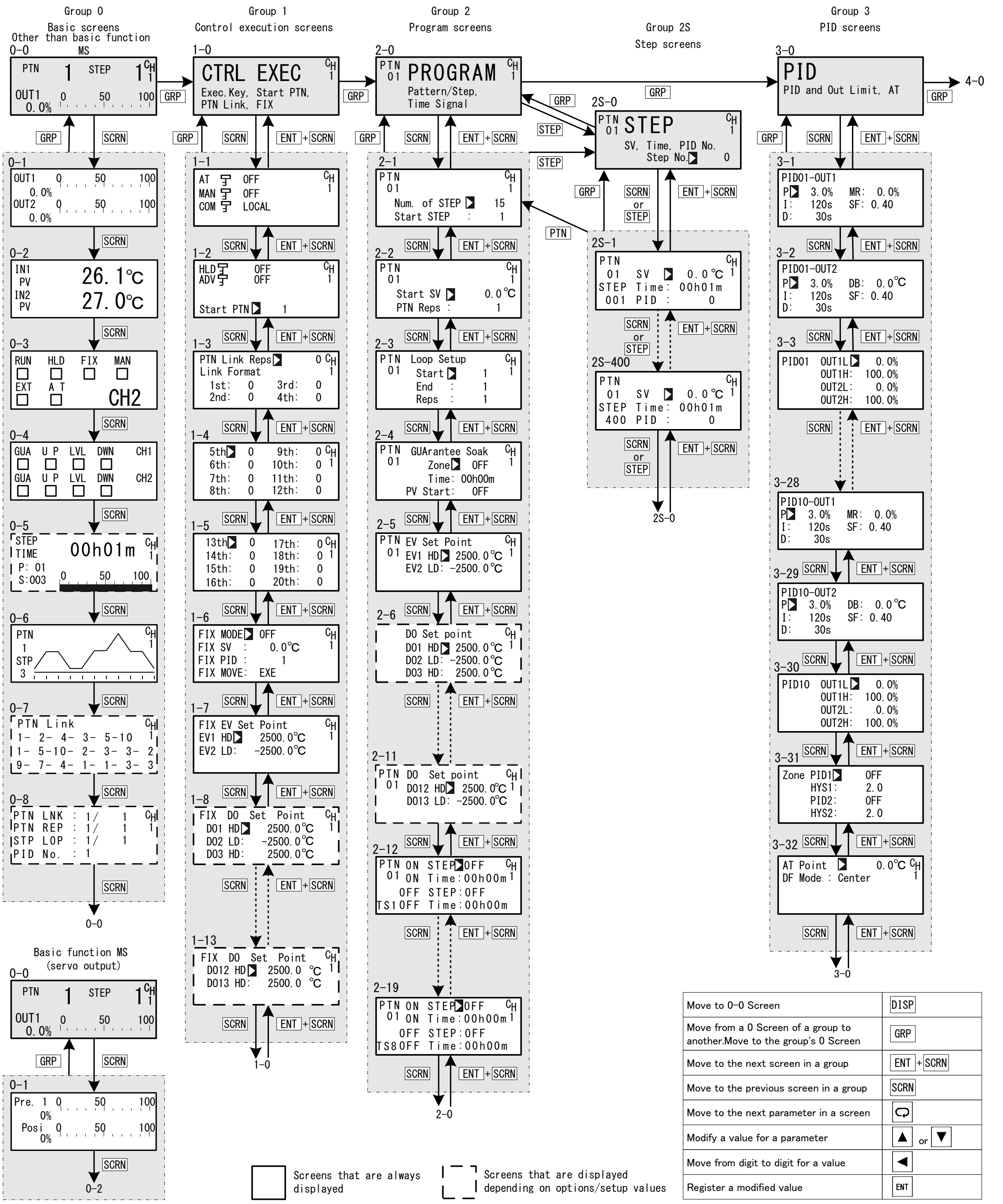
*5 With basic function MS, Y output must be selected when directly controlling control motor.

*6 With basic function MS, R output must be selected when controlling control motor via PLC, etc.

CONTENTS

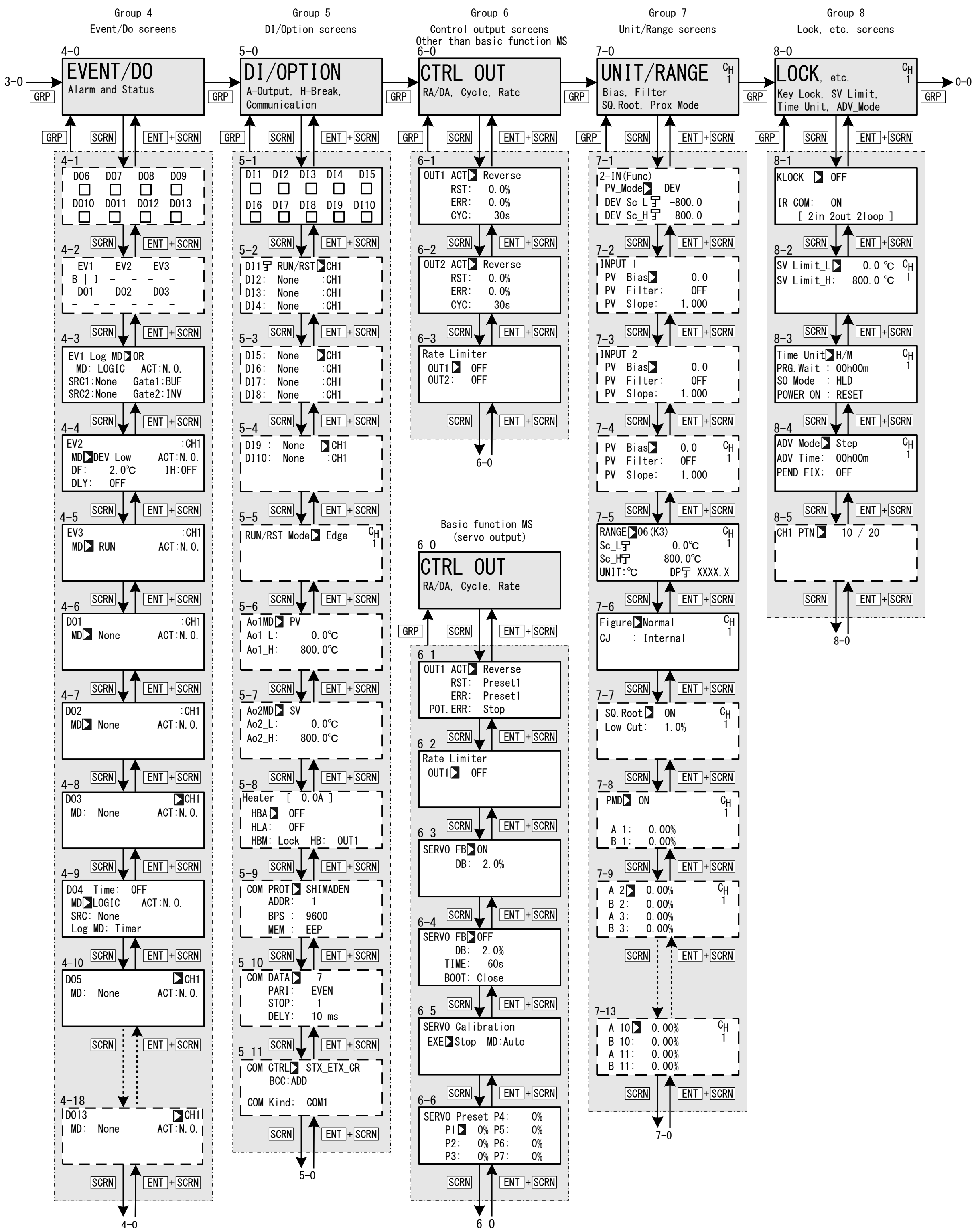
LCD Flow Chart

The following shows how to move between the LCD display screens of this device.
Screens with a dot-dash lines may not be displayed according to specifications, settings, etc.



Move to 0-0 Screen	DISP
Move from a 0 Screen of a group to another.Move to the group's 0 Screen	GRP
Move to the next screen in a group	ENT + SCRN
Move to the previous screen in a group	SCRN
Move to the next parameter in a screen	⮌
Modify a value for a parameter	▲ or ▼
Move from digit to digit for a value	◀
Register a modified value	ENT

When the 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
4-0
EVENT/DO
Alarm and Status
3-0
GRP
SCRN
ENT + SCRN
4-1
DO6 DO7 DO8 DO9
DO10 DO11 DO12 DO13
4-2
EV1 EV2 EV3
B | I - - - -
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.
4-18
DO13 CH1
MD: None ACT:N.O.
4-0
Group 5
DI/Option screens
5-0
DI/OPTION
A-Output, H-Break, Communication
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
RUN/RST Mode Edge CH 1
5-6
Ao1MD PV
Ao1_L: 0.0℃
Ao1_H: 800.0℃
5-7
Ao2MD SV
Ao2_L: 0.0℃
Ao2_H: 800.0℃
5-8
Heater [0.0A]
HBA OFF
HLA: OFF
HBM: Lock HB: OUT1
5-9
COM PROT SHIMADEN
ADDR: 1
BPS : 9600
MEM : EEP
5-10
COM DATA 7
PARI: EVEN
STOP: 1
DELY: 10 ms
5-11
COM CTRL STX_ETX_CR
BCC:ADD
COM Kind: COM1
5-0
Group 6
Control output screens
Other than basic function MS
6-0
CTRL OUT
RA/DA, Cycle, Rate
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
Basic function MS
(servo output)
6-0
CTRL OUT
RA/DA, Cycle, Rate
6-1
OUT1 ACT Reverse
RST: Preset1
ERR: Preset1
POT.ERR: Stop
6-2
Rate Limiter
OUT1 OFF
6-3
SERVO FB ON
DB: 2.0%
6-4
SERVO FB OFF
DB: 2.0%
TIME: 60s
BOOT: Close
6-5
SERVO Calibration
EXE Stop MD:Auto
6-6
SERVO Preset P4: 0%
P1 0% P5: 0%
P2: 0% P6: 0%
P3: 0% P7: 0%
6-0
Group 7
Unit/Range screens
7-0
UNIT/RANGE CH 1
Bias, Filter
SQ.Root, Prox Mode
7-1
2-IN(Func)
PV_Mode DEV
DEV Sc_L -800.0
DEV Sc_H 800.0
7-2
INPUT 1
PV Bias 0.0
PV Filter: OFF
PV Slope: 1.000
7-3
INPUT 2
PV Bias 0.0
PV Filter: OFF
PV Slope: 1.000
7-4
PV Bias 0.0 CH 1
PV Filter: OFF
PV Slope: 1.000
7-5
RANGE 06(K3) CH 1
Sc_L 0.0℃
Sc_H 800.0℃
UNIT:℃ DP XXXX.X
7-6
Figure Normal CH 1
CJ : Internal
7-7
SQ.Root ON CH 1
Low Cut: 1.0%
7-8
PMD ON CH 1
A 1: 0.00%
B 1: 0.00%
7-9
A 2 0.00% CH 1
B 2: 0.00%
A 3: 0.00%
B 3: 0.00%
7-13
A 10 0.00% CH 1
B 10: 0.00%
A 11: 0.00%
B 11: 0.00%
7-0
Group 8
Lock, etc. screens
8-0
LOCK, etc. CH 1
Key Lock, SV Limit,
Time Unit, ADV_Mode
0-0
8-1
KLOCK OFF
IR COM: ON
[2in 2out 2loop]
8-2
SV Limit_L 0.0℃ CH 1
SV Limit_H: 800.0℃
8-3
Time Unit H/M CH 1
PRG.Wait : 00h00m
SO Mode : HLD
POWER ON : RESET
8-4
ADV Mode Step CH 1
ADV Time: 00h00m
PEND FIX: OFF
8-5
CH1 PTN 10 / 20
8-0

1 INSTALLATION & WIRING

1-1 Installation Site

Caution

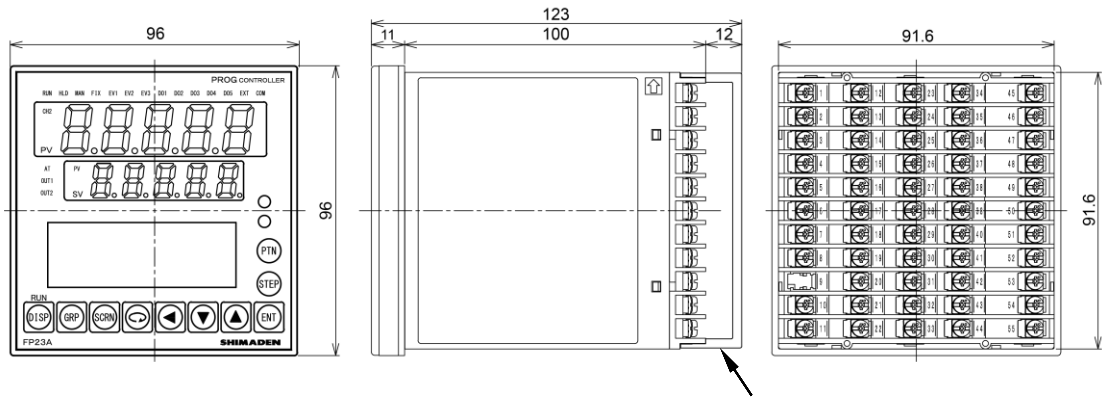
Do not use this device in the following sites.

Doing so might result in equipment failure or damage to this device, and in some case may result in electrical shock or fire.

- 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/or 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
- Outdoor
- Environment where water or solids in excess of protection class IP66 specified by IEC60529 may penetrate

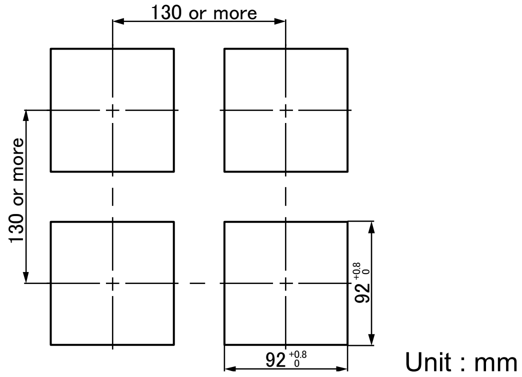
1-2 External Dimensions and Panel Cutout

■ Panel cutout



Unit : mm

■ **Panel cutout**



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.

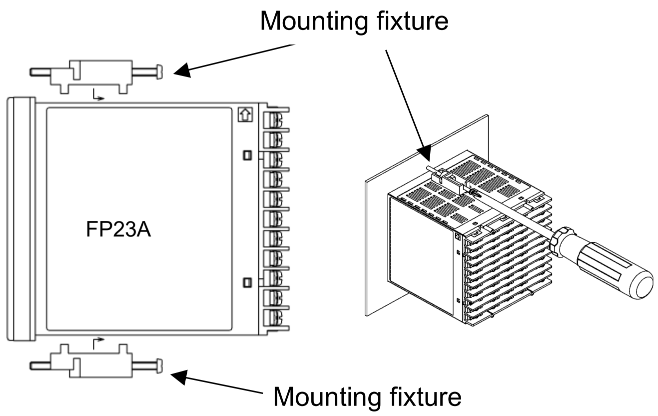
1. Drill mounting holes referring to the panel cutout dimensions shown above.
The applicable thickness of the mounting panel is 1.0 to 8.0 mm.

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 over-tighten the screws.

5. After completing wiring after installation, attach the terminal cover.



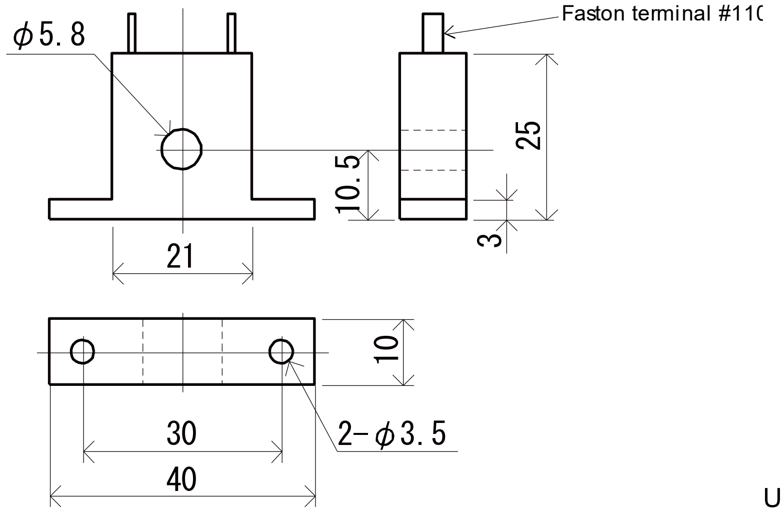
⚠ Caution

- This device is designed for mounting on the panel. Be sure to mount on the panel.
- Be sure to use the fitted gasket.
- If a gasket is cut or dislodged, replace it with a specified gasket.

1-4 Current Transformer (CT) for Heater Break Alarm

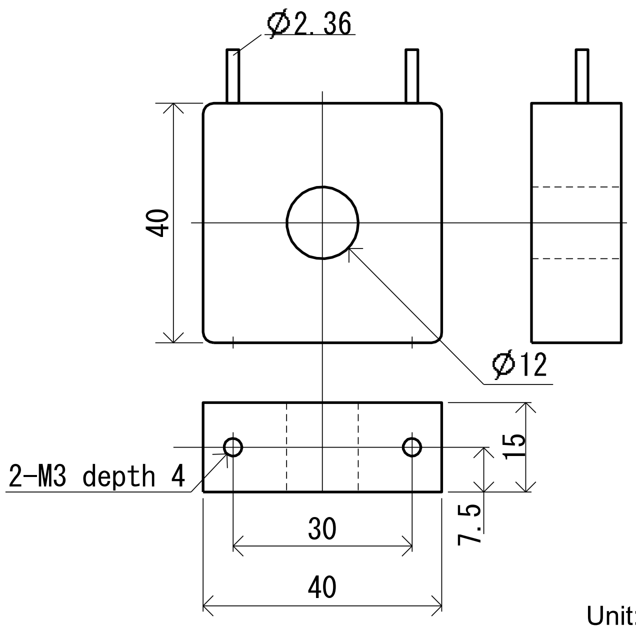
The CT can be used when the heater Break alarm (option) is selected in the product specifications. Either of the following CT is provided.

■ For 0 to 30A (QCC01)



Unit: mm

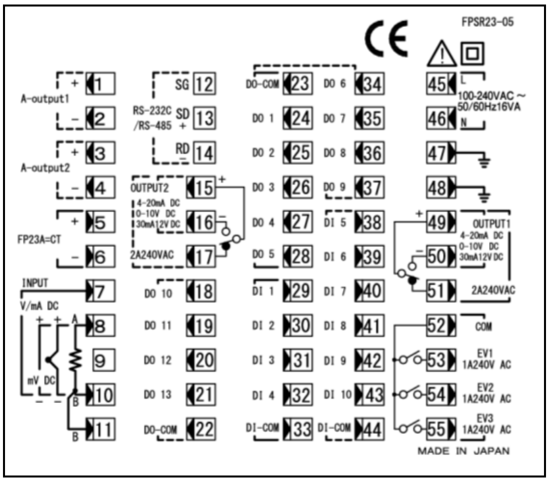
■ For 0 to 50A (QCC02)



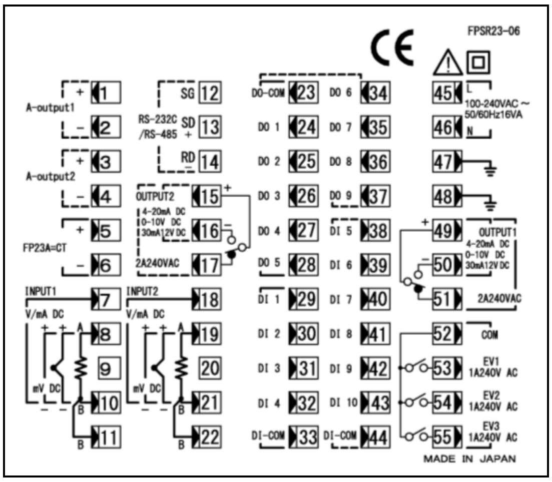
Unit: mm

1−5 Terminal Arrangement Diagrams

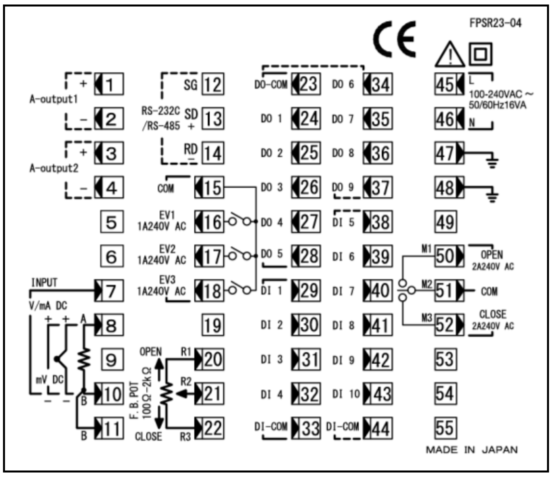
■ Basic functions SS, SD



■ Basic functions DL, DS, DD



■ Basic function MS



Terminal No.	Symbol	Description		
1	+	Analog Output 1 (optional)		
2	-			
3	+	Analog Output 2 (optional) or Sensor power supply (optional)		
4	-			
5	+	Heater break alarm CT input (optional) ~~SA~~		
6	-			
7	+	Input-1	V、mA	
8	+/A		mV、TC、RTD	
9	N.C.			
10	-/B		mV、TC、RTD、V、mA	
11	B		RTD	
45	L	Power supply		
46	N			
47		Grounding (internal shorting across terminals)		
48				
49	COM+	Control output 1		
50	NO -	~~SA~~	M1 Open	Control Output SA
51	NC		M2 COM	
52	COM		M3 Close	
53	EV1	Event output EV (standard) EV1 to 3		
54	EV2			
55	EV3			
23	COM	External control output DO1 to DO5 (standard)		
24	DO1		Darlington output	
25	DO2			
26	DO3			
27	DO4		Open collector output	
28	DO5			
29	DI1	External control input DI1 to DI4		
30	DI2			
31	DI3			
32	DI4			
33	COM			

Terminal No.	Symbol	Description		
34	DO6	External control output DO6 to DO9 Open collector output (optional)		
35	DO7			
36	DO8			
37	DO9			
38	DI5	External input DI5 to DI10 (optional)		
39	DI6			
40	DI7			
41	DI8			
42	DI9			
43	DI10			
44	COM			
12	SG	Communication function (optional)		
13	SD+			
14	RD-			
15	COM+	Control output 2	COM	Event output EV (standard) SA EV1 to 3
16	NO -	~~SA~~	EV1	
17	NC		EV2	
18			EV3	

18	+	PV Input 2	V、mA
19	+/A	2	mV、TC、RTD
20	NC		
21	-/B		mV、TC、RTD、V、mA
22	B		RTD

18	DO10	External control output DO10 to 13 (optional) 1
19	DO11	
20	DO12	
21	DO13	
22	COM	

20	R1	Open	Feedback potentiometer input SA
21	R2	COM	
22	R3	Close	

1 Applies to 1-input specification only
2 Applies to 2-input specification only
SA Applies to servo output only
~~SA~~ Does not apply to servo output

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

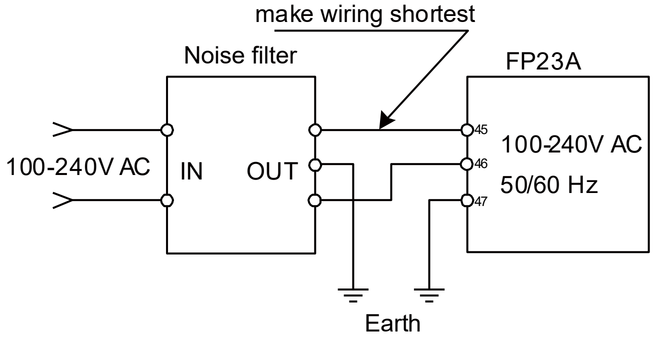
(1) Precautions for wiring

Caution

- Do not perform wiring while power is conducted. Doing so could result in electrical shock.
- 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:

- Make sure wiring is connected correctly in accordance with "1-5 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.
- Countermeasure against lightning surge will be required for signal line over 30m.
- 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.



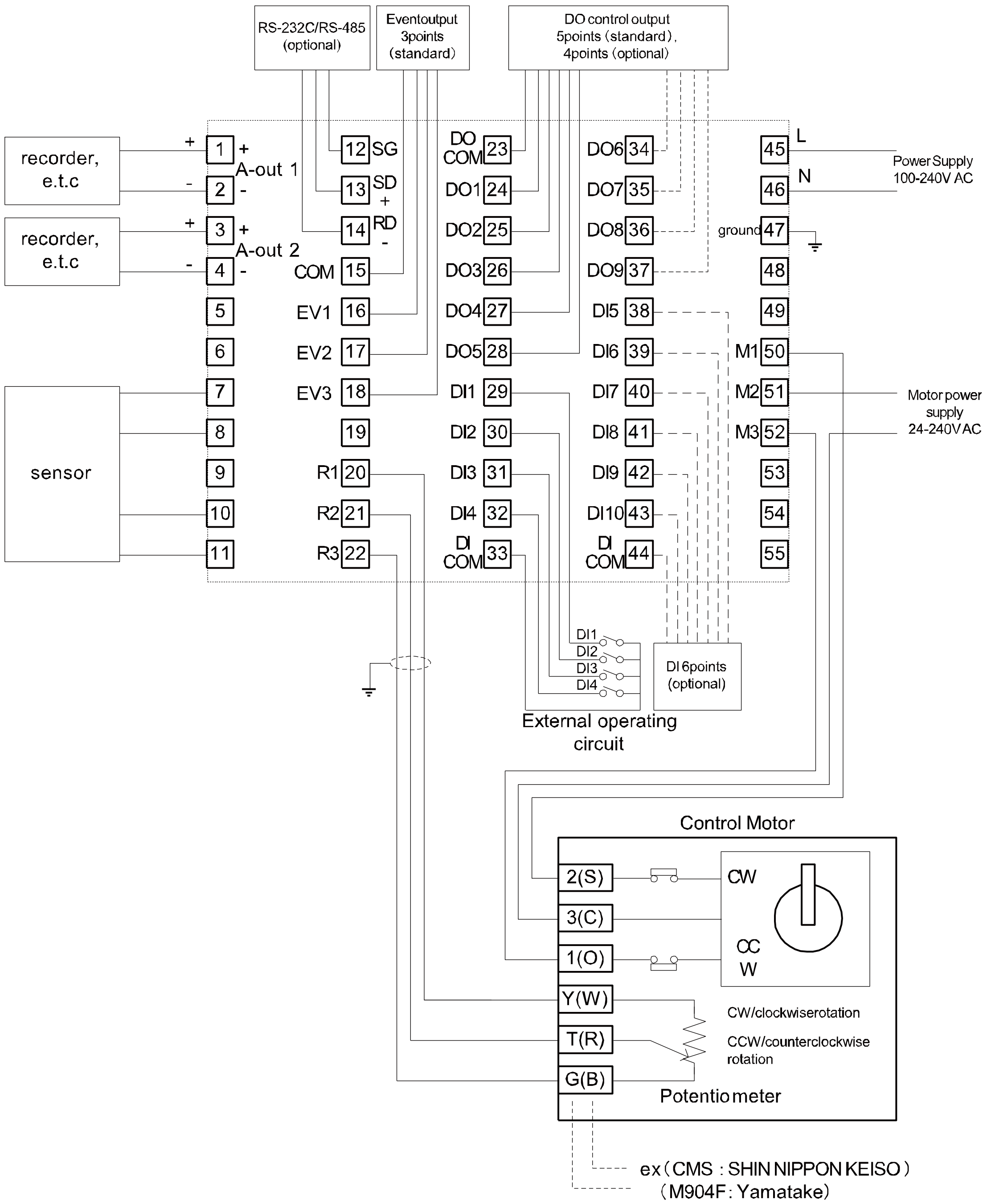
Recommended filter: RSEL-2003W from TDK

(2) Basic function MS (servo output) wiring example

This device is designed to connect a control motor directly via the terminal M1, M2, and M3.

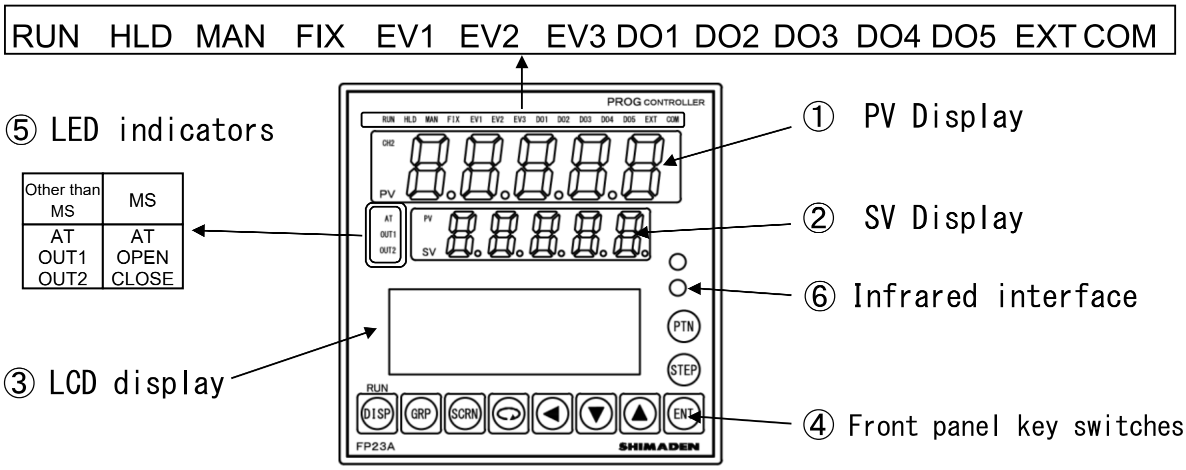
AC relay may have built-in CR absorber to protect its contact.
DC relay use is recommended, because if AC relay is used as auxiliary relay, it cannot recover from magnetic excitation.

The terminal 47 and 48 are ground terminals. One of these terminals should be connected to ground.
Use another terminal in case the shield of the signal lead is running short.
Do not use the ground terminals for the power system ground lead.



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

2 NAMES & FUNCTIONS OF PARTS ON FRONT PANEL



① PV 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 (scale over & etc.).

② SV 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) or an error message of CH2.

For other than 2-loop;

Displays the target set value (SV) or error messages.

For basic functions DL, DC, there are three display modes.

The display mode can be switched to another by pressing the DISP key on the front panel.

For details, see “17-1 Flow of Basic Screen in 2-Loop Specification.”

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 “17-1 Flow of Basic Screen in 2-Loop Specification.”

③ LCD 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.

④ Front 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.
CLOSE ▼	(Down/CLOSE key)	Decrements parameters and numerical values during setup. When it is under the Manual mode, close output is set to on.
OPEN ▲	(Up/OPEN key)	Increments parameters and numerical values during setup. When it is unde the Manual mode, open output is set to on.
ENT	(Entry key)	Resisters data or parameter numerical values.
STEP	(Step key)	At a reset, increments the start step No. in the basic screen. (ENT must be pressed to resister.)
PTN	(Pattern key)	At a reset, increments the start pattern No. in the basic screen. (ENT must be pressed to resister.)
The following key combination operations are available in screens from 0-0.		
ENT + DISP		RUN/RST Switching operation
The following key combination operations are available in screens from 0-1 to 0-8.		
ENT + PTN		Hold (HLD) operation
ENT + STEP		Advance (ADV) operation

⑤ LED 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 (PTN 2bit, PTN 3bit, PTN 4bit, PTN 5bit, PTN 5BCD) are set to DI5 or DI8
COM	green	Lights during communication (COM) mode.
AT	green	Lights during auto tuning standby. Blinks during auto tuning execution.
SA 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.
SA OPEN	green	Lights when open output is on, and goes out when it is OFF.
CLOSE	green	Lights when close output is on, and goes out when it is OFF.

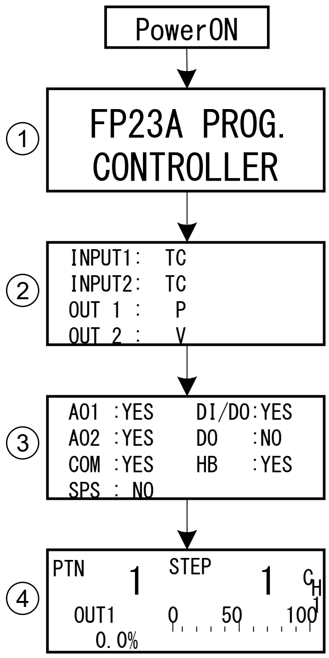
■ Monitor lamps

CH2	green	Lights during display mode 2. The PV and SV of CH2 are displayed on the PV and SV display.
PV	green	Lights during display mode 3. The PV of CH1 is displayed on the PV display, and the PV of CH2 is displayed on the SV display.

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 FP23A 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 & Input 2, 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.

Basic function	LCD Display		Actual numbers	
	DI/DO	DO	DI	DO
Other than basic function	NO	NO	4	5
	YES	NO	10	9
MS	YES	YES	10	13
MS (servo output)	NO	NO	4	5
	YES	NO	10	9

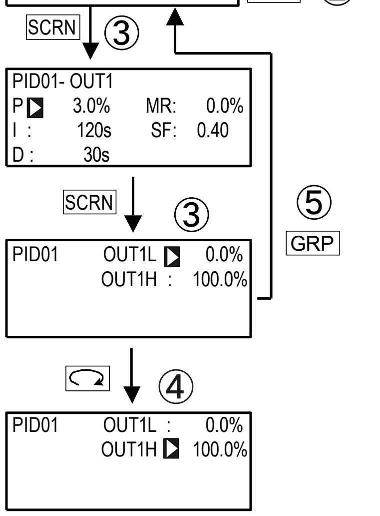
For operation of basic screen when 2-loop specification is selected, see "17-1 Flow of Basic Screen in 2-Loop Specification."

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

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

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

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

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

① **To move between screens**

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

② **To move the cursor from P to I**

Press the [⟲] key once to move the blinking cursor (▶) to I.

③ **To make the I numerical value blink and move to the 10's digit**

Press the [◀] key twice to move the blinking cursor to the 10's digit.

④ **To change the numerical value of the 10's digit to 0**

Press the [▼] key to change the display from "2" to "0".

⑤ **To fix and register the setting**

Press the [ENT] key to fix the new setting.

(2) Selecting setup items

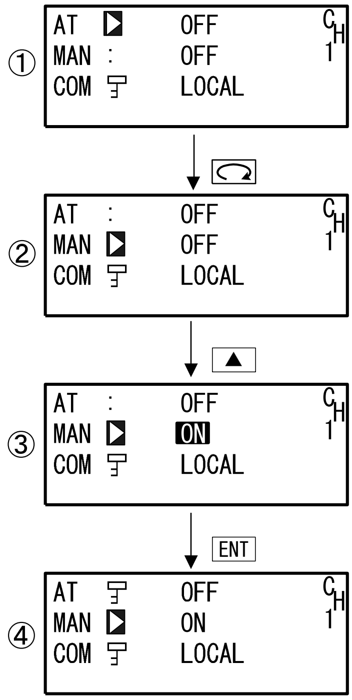
The settings of parameters marked by a key mark cannot be changed.

1. When there are two or more parameters, press the key to move the cursor ( ) to the parameter to be changed.

2. Change the parameter settings by the ▼ or ▲ key, check the setting, and press the ENT key to fix and register settings. The character stops blinking.

■ Selecting a parameter (example)

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



① **To move between screens**

Press the GRP key once in the initial screen to display the top screen of the execution screen (group 1).
Next, press the SCRN key once.

② **To move the cursor from AT to MAN**

Press the key once to move the blinking cursor ( ) to MAN.

③ **To change the MAN setting from OFF to ON**

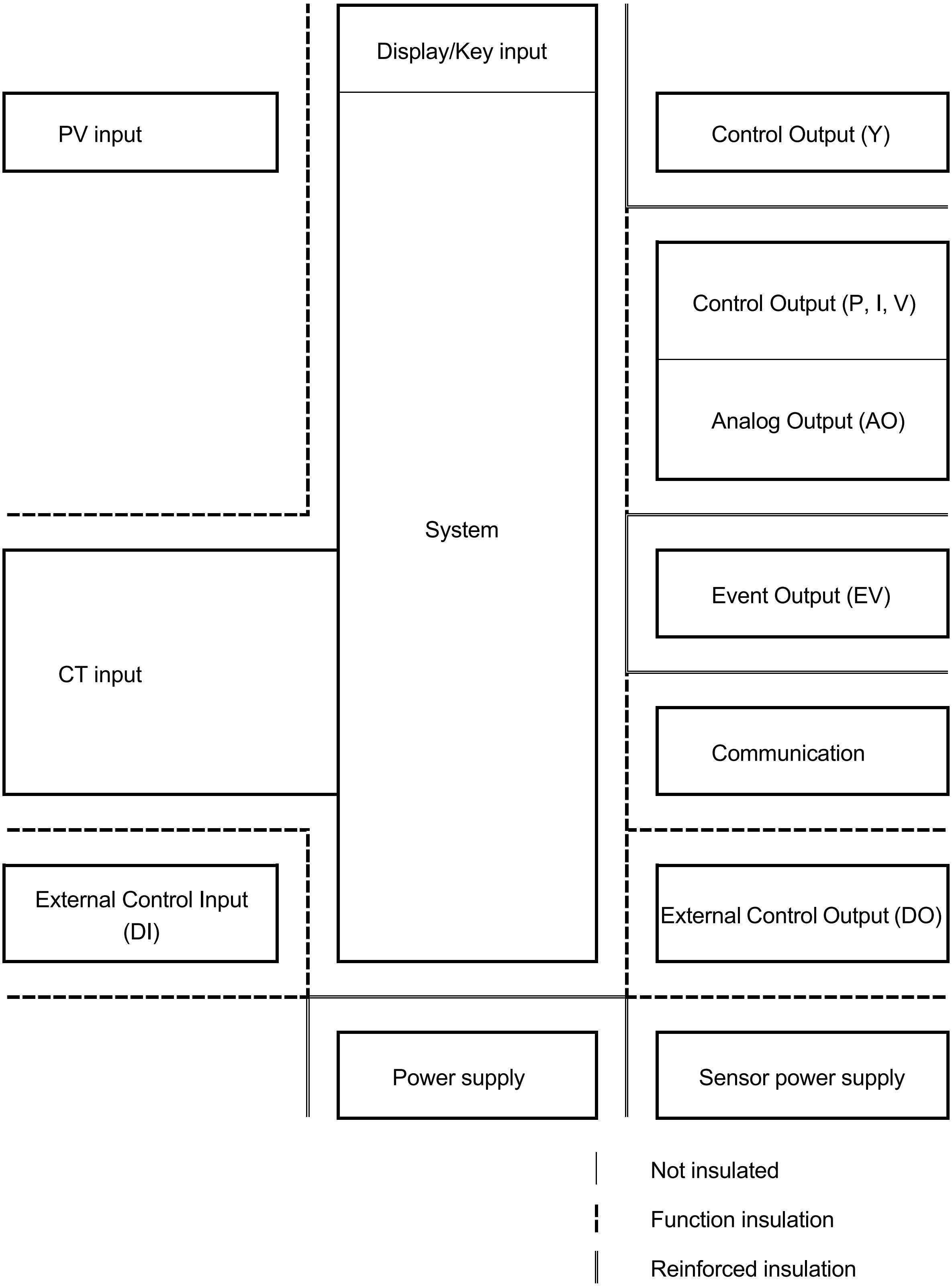
Press the ▲ key to change the display from OFF to ON.

④ **To fix and register the setting**

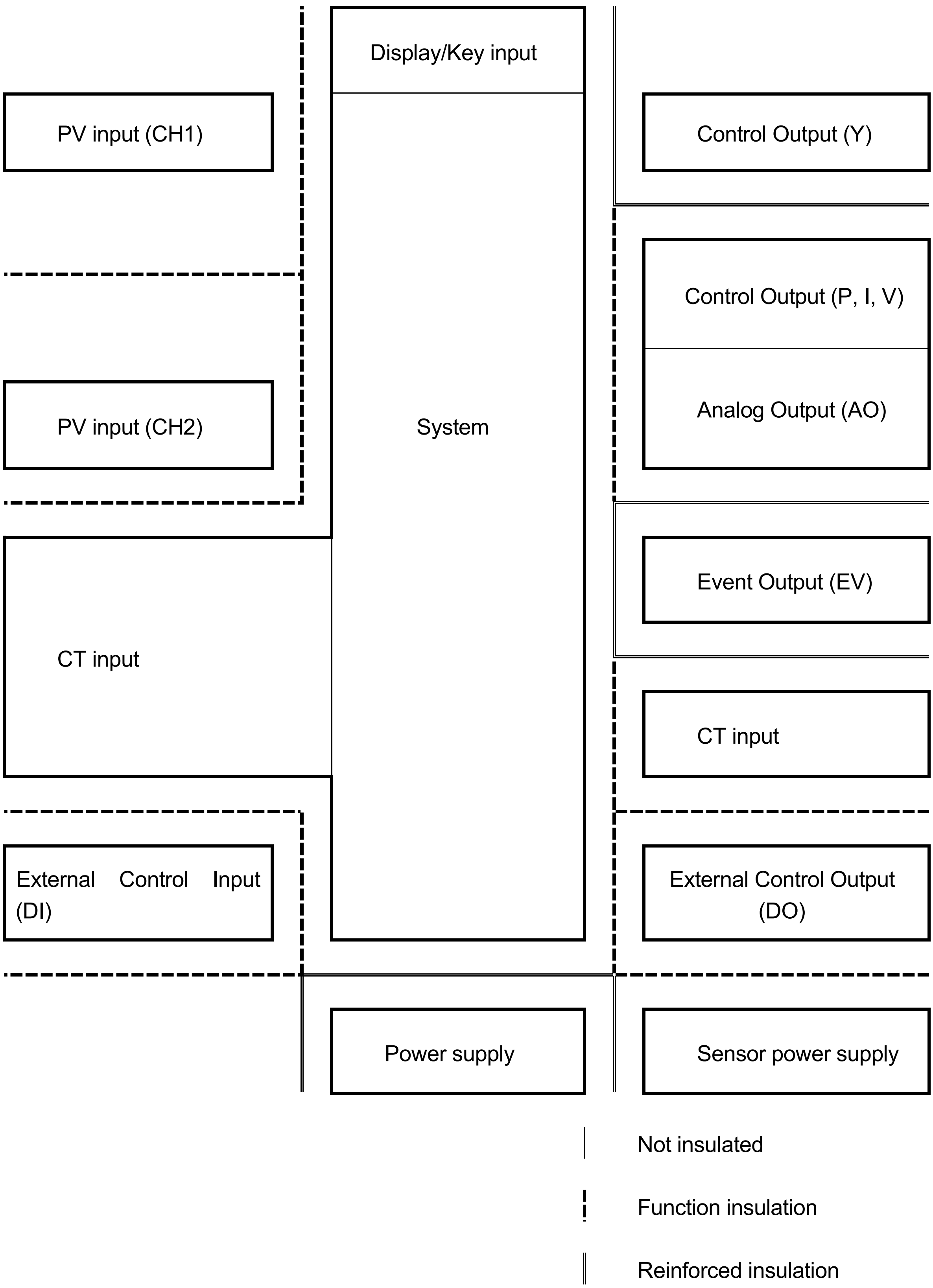
Press the ENT key to fix the new setting.
In this case, Auto Tuning can no longer be executed, and the key mark is displayed.

4 INSULATION BLOCK DIAGRAM

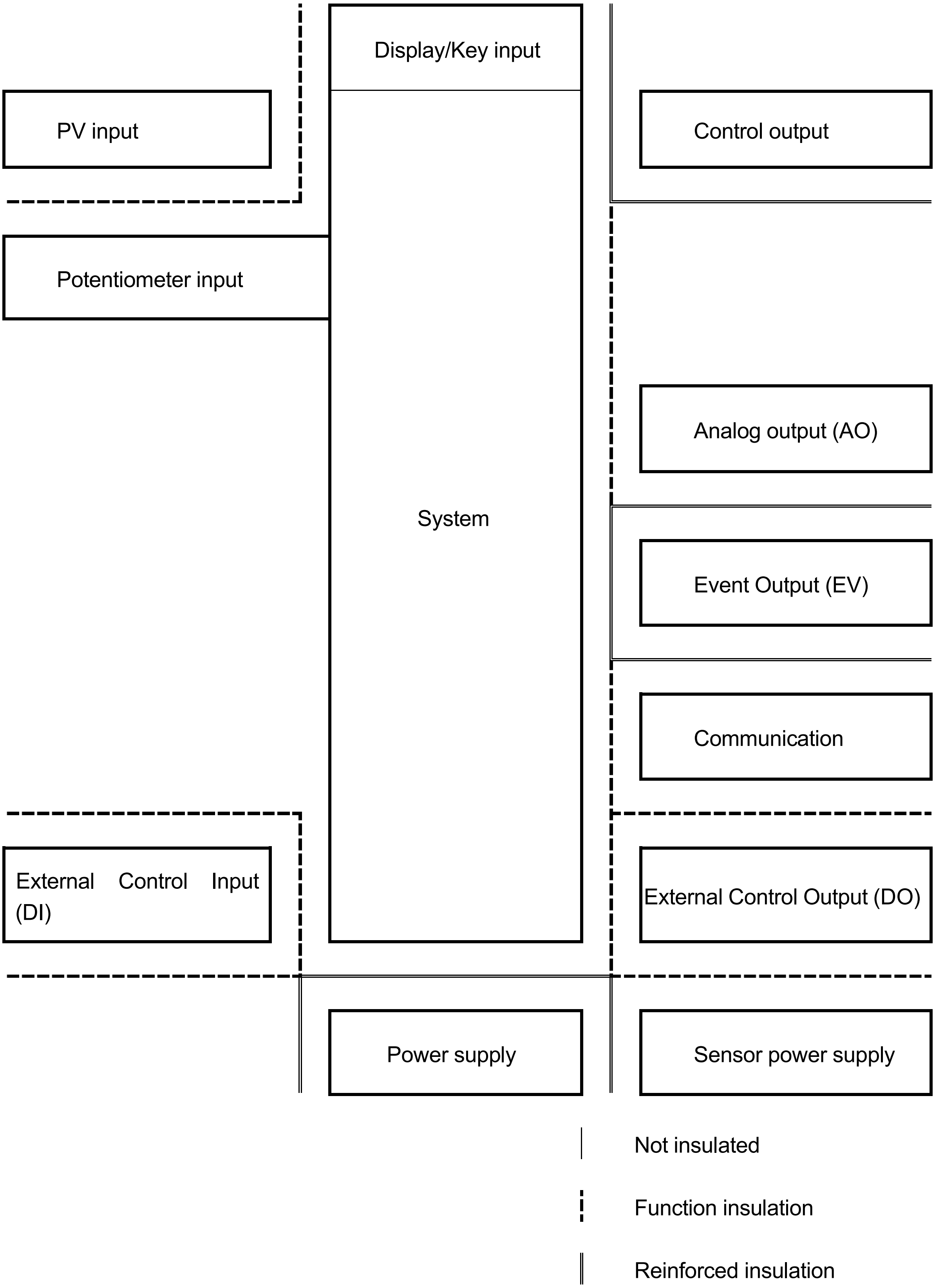
4-1 1-Input Standard Output (Basic Functions SS, SD)



4-2 2-Input Standard Outputs (Basic Functions DL, DS, DD)



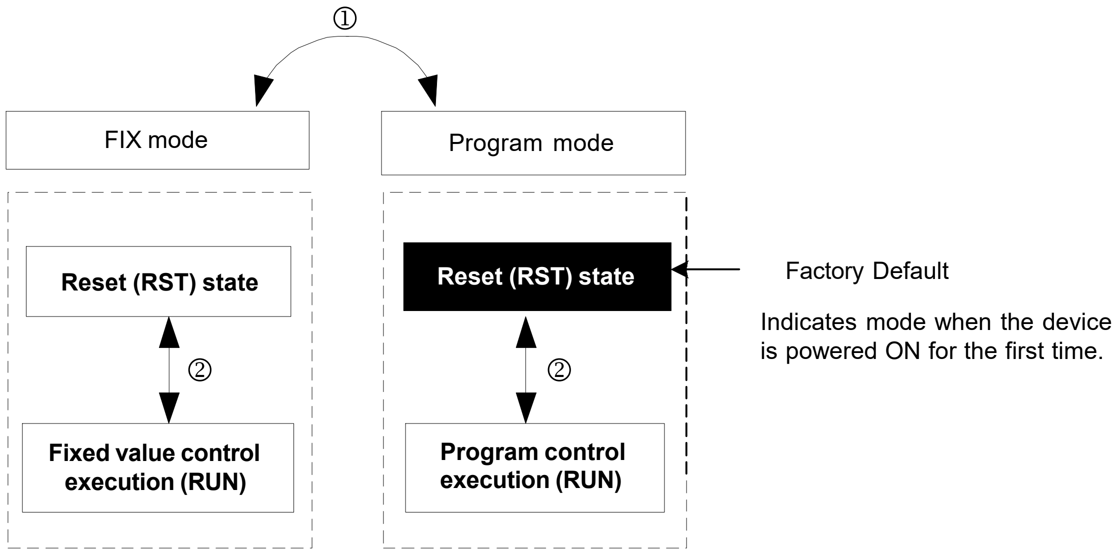
4-3 Servo Output (Basic Function MS)



5 CONTROL MODES & FUNCTION BLOCKS

5-1 Control Modes

The FP23A 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.

5-2 Reset State

The FP23A 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 "9-4(2) Output1 at reset."
Also, when the operation modes shown in the next page are assigned to EV/DO, EV/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
Posi.H	Position higher limit absolute value SA	Posi.L	Position lower limit absolute value SA

5-3 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 FP23A 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▶      0 CH
Link Format            1
  1st:  0    3rd:   0
  2nd:  0    4th:   0
```

1-4

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

1-5

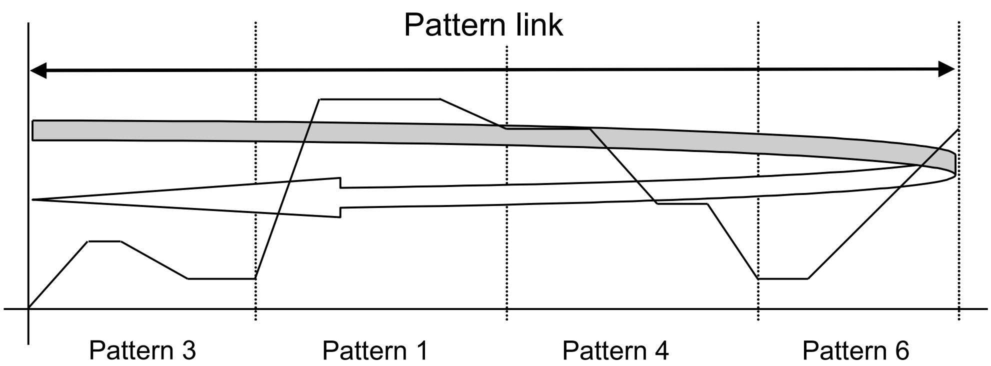
```
 13th▶  0    17th:   0 CH
 14th:  0    18th:   0 1
 15th:  0    19th:   0
 16th:  0    20th:   0
```

■ 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
```

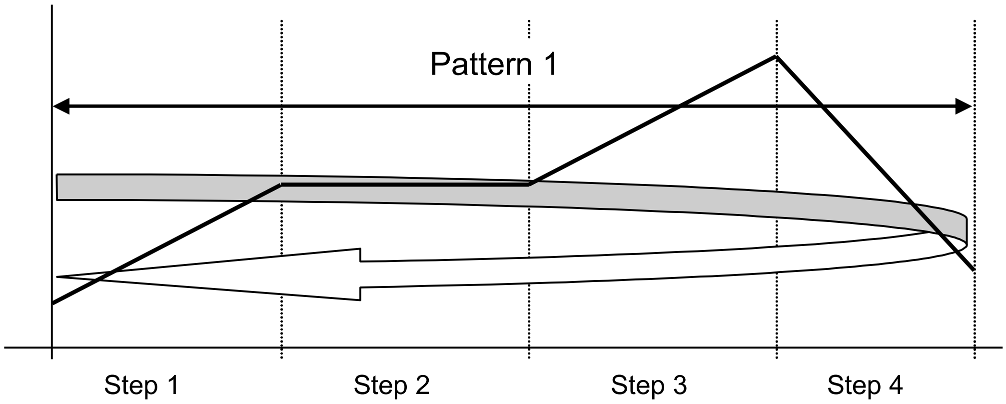


■ Pattern execution function

Any pattern can be executed repeatedly 1 to 9999 times

2-2

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

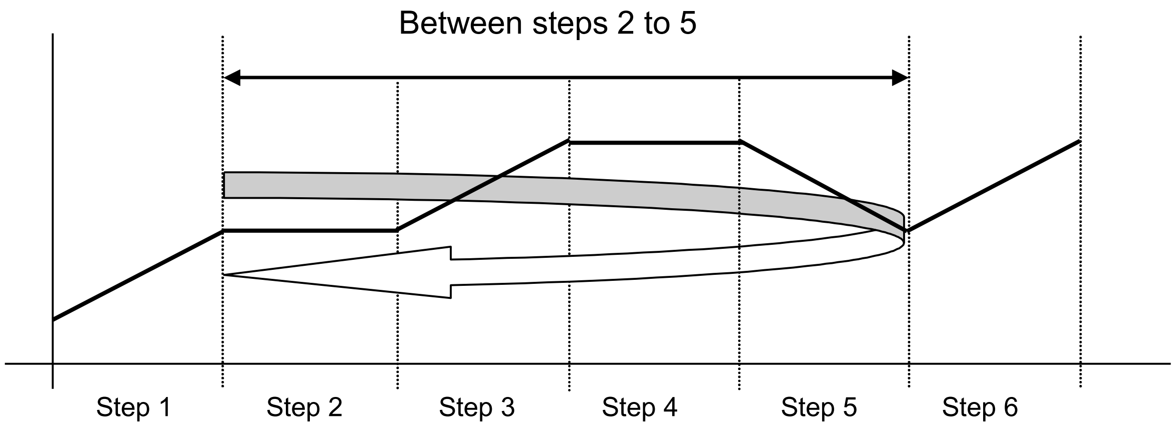


■ Step loop function

Any step can be executed repeatedly 1 to 9999 times.

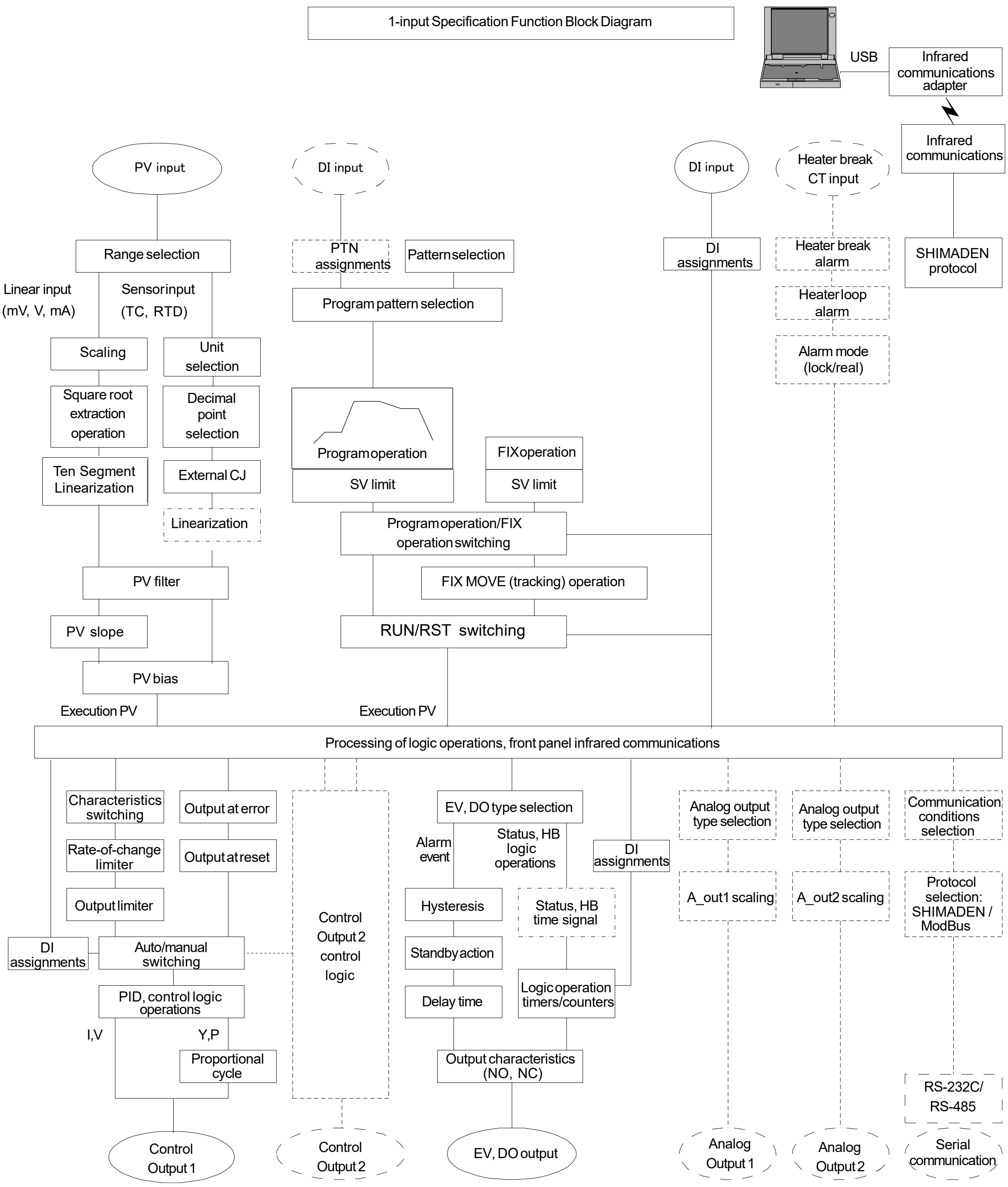
2-3

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

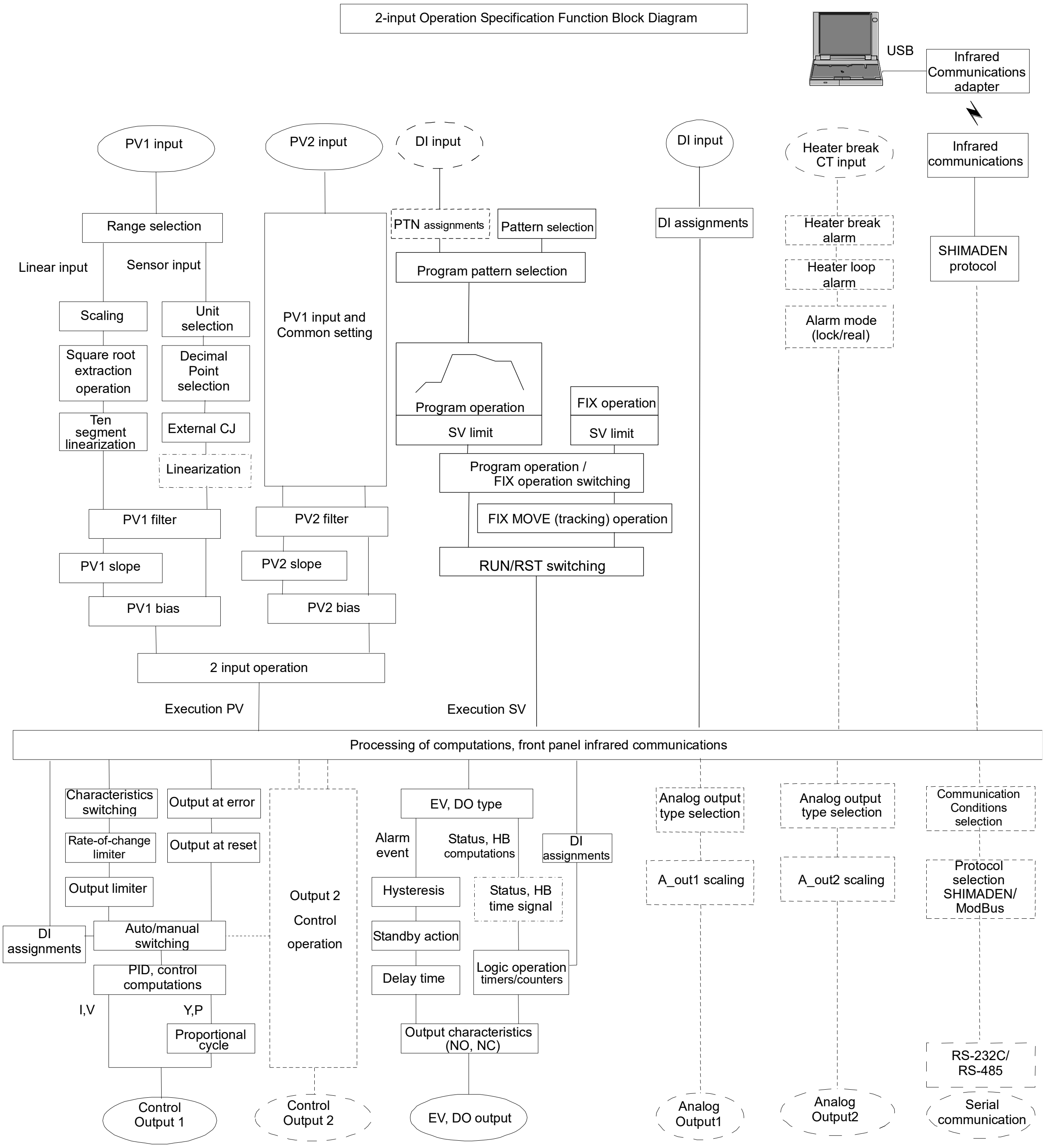


5-4 CONTROL FUNCTION BLOCK DIAGRAMS

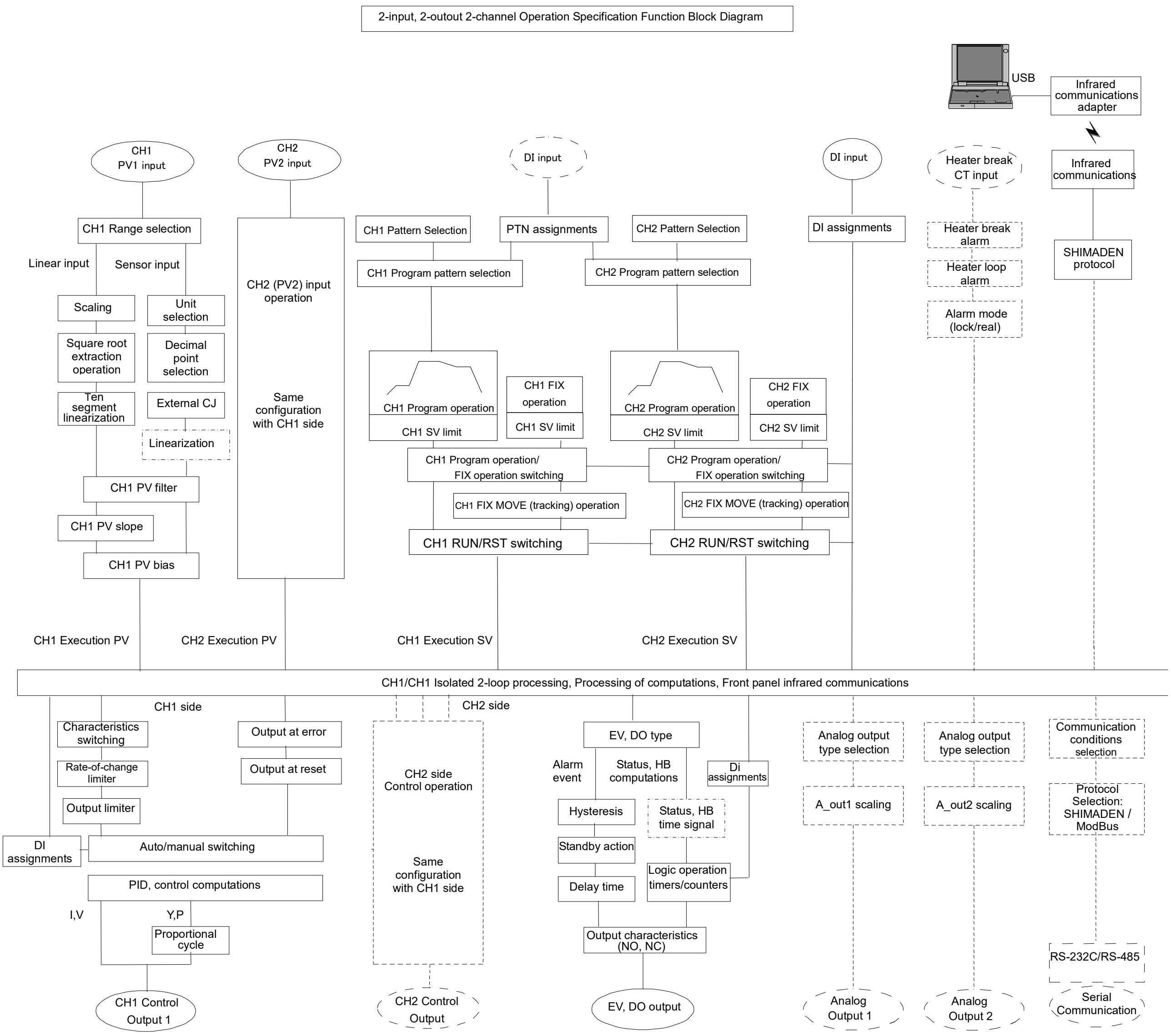
(1) 1-input, 1-output/2-output



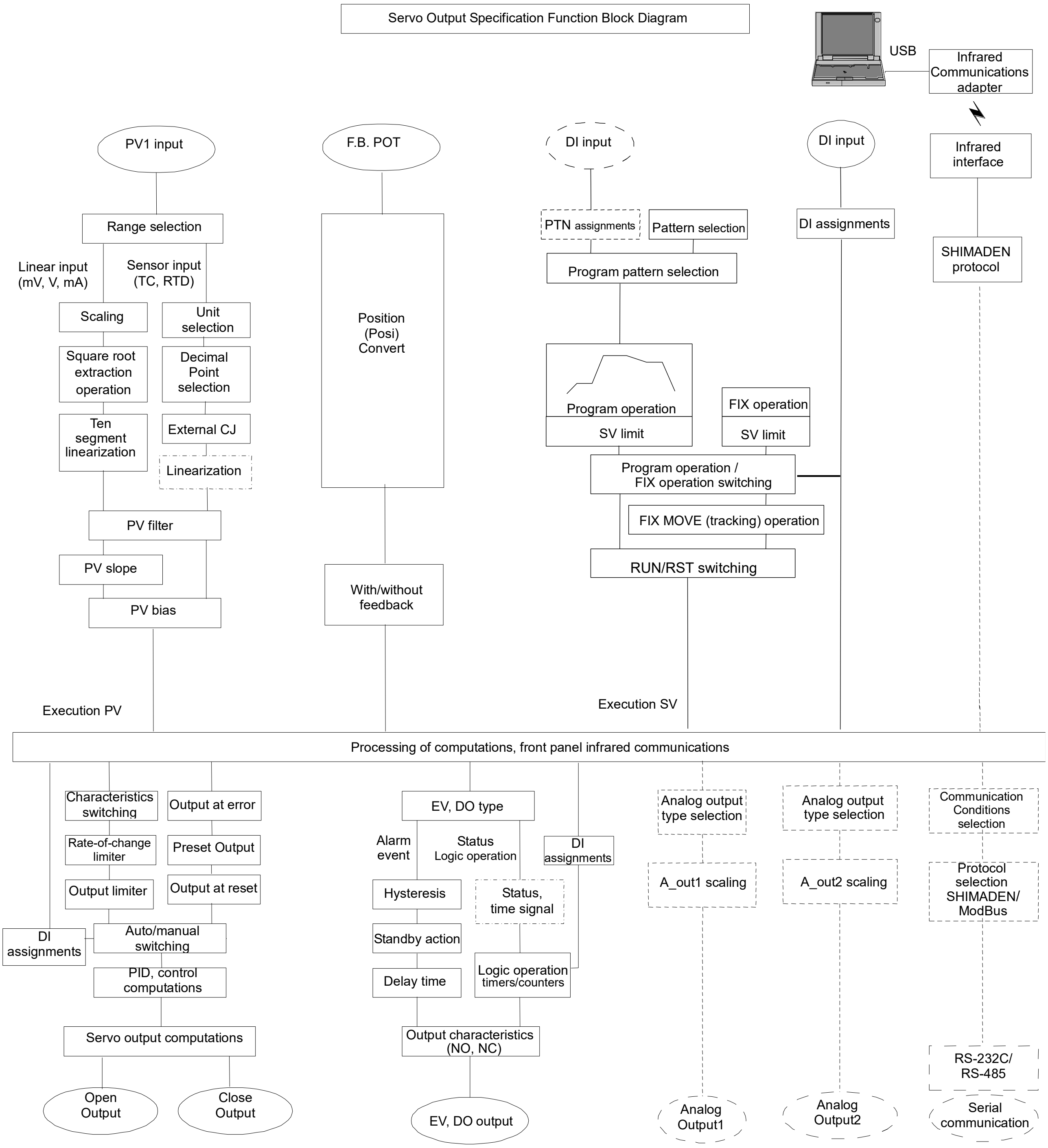
(2) 2-input, 1-output/2-output



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



(4) Servo (with feedback/without feedback)



6 SETUP

6-1 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 7 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 "20. 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 7."

2. I/O Settings
   For details, see "Chapter 8."

3. I/O Auxiliary Settings
   For details, see "Chapter 9."

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 "Chapter10."

5. FIX Settings
   For details, see "Chapter 11."

6. PID Setting

For details, see "Chapter 12."

7. EVENT & DO Settings

For details, see "Chapter 13."

8. Option Settings (DI, AO, HB, COM,)

For details, see "Chapter 14."

9. Servo Functions Settings

After basic parameters are set or changed set servo relating parameters.

For details, see "Chapter 15"

10. Key Lock Setting

When setup of parameters are completed, set the key lock as necessary to prevent inadvertent operation.

For details, see "Chapter 16."

11. Monitoring, Executing & Stopping Operation

For details, see "Chapter 17."

12. Operations During Control

For details, see "Chapter 18."

7 CONFIRMING OUTPUT SPECIFICATIONS & ACTION MODE/KEY LOCK

Perform the following as necessary.

7-1 Confirming the Output Specifications

The current output specification is displayed at the bottom row of the key lock, number of outputs setting screen (No. 8-1).

8-1

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

[◇in 1out □loop] : 1-output controller

[◇in 2out □loop] : 2-output controller

[Servo] : Servo output controller

◇ : No. of inputs □ : Represents the number of loops.

With basic functions DL, DS, DD, this controller is delivered set to the action mode (control mode) specified by the customer. The customer may however alter action mode by performing some operations on the screen after purchase.
It cannot be changed with other 1-inputs or servo outputs.

7-2 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 specification as follows:

■ 2-input operation (1 loop): Basic functions DS, DD

Make control action with an SV by processing of computation on 2 inputs.
The input operation may be chosen from among 5 methods, i.e. PV (1CH) PV maximum value (MAX), PV minimum value (MIN), PV average value (AVE) and PV deviation value (DEV). The result of operations 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): Basic function DL

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.

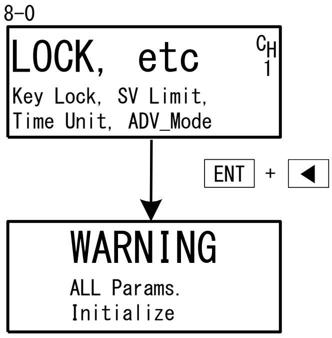
(2) Setting of Operation Mode under 2-Input Specification

1. Release the key lock if the key is locked.
For operation for releasing the key lock, see "7-3 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 "5-1 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.

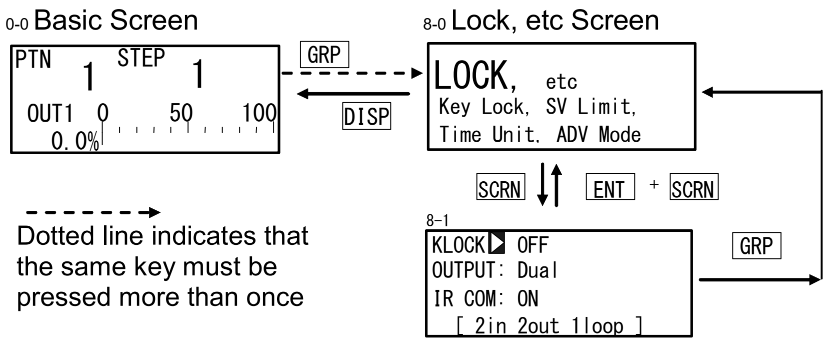
PV Display SV Display	Operation Mode	Description
2-In 1LooP	2-Input (1-loop)	Operates as a 2-input operation controller. This may be used by switching between 1-output and 2-output.
2-In 2LooP	2-Input (2-loop)	Operates as 2 independent controllers. Covers CH1: INPUT1, OUT1 and CH2: INPUT2, OUT2.
1-In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

7-3 Key Lock

(1) Key lock screen display

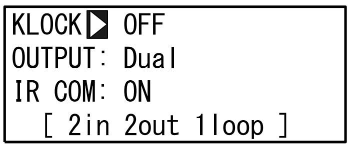
To call up the LOCK, etc. screen group (group 8) from the basic screen, press the GRP key.
Press the SCRN key in the LOCK, etc. screen group to switch to the screens for making and changing setups.
Select parameters in screens by pressing the ⟲ key.
Set parameters by pressing the ◀, ▼ or ▲ key, and press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

8-1



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

OFF Release the key lock
LOCK1 Locks parameters other than SV related, AT, MAN, or EV/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 "20 List of Parameters."

8 I/O SETTINGS, INFRARED COMMUNICATION

8-1 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 "5-1 Control Modes."

8-1

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

Setting range	Single, Dual
Initial value	Single

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.

8-2 Infrared Communication

Allow the infrared communication using S5004 (Infrared Communication Adapter, selling separately).
Set to ON to employ infrared communication.
Parameter setting tool “Parameter Assistant SR23 FP23” is used to set the device for infrared communication. You can download it free of charge from the Shimaden website.
For details, see Instruction Manual for Infrared Communication Adapter S5004, Infrared Communication Adapter S5004 USB Driver Installation Procedure and Instruction Manual for Parameter Assistant SR23 FP23, which can be accessed from Parameter Assistant SR23 FP23 Help menu.

*This function for infrared communication is not available without the infrared adapter S5004.
S5004 is no longer sold. Please contact our sales office for inquiries.

8-1

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

Setting range	ON, OFF
Initial value	ON

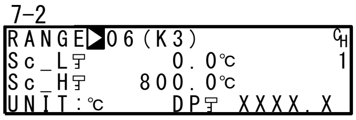
ON Infrared communication by S5004 is available.
OFF Infrared communication is not available.

8-3 Measuring Range

Before performing setup, set control action to Reset State.
For details on operation to stop control, see "5-1 Control Modes."

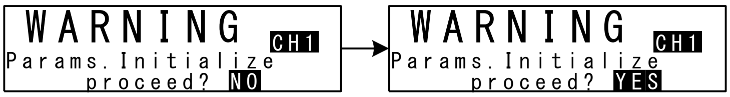
(1) Range setting

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.



Setting range	01 to 19, 31 to 60, 71 to 77, 81 to 87
Initial value	06 (K3) K T/C 0.0 to 800°C

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.

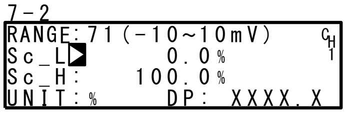


Caution

- 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 "20 List of Parameters."

(2) Range scaling

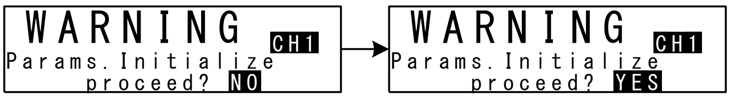
This item is set during voltage input and current input, and cannot be set during RTD and TC input. Set the measurement range (scaling). Sc_L is scaling of the lower limit side of PV and Sc_H is scaling of the higher limit side of PV.



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

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 "20 List of Parameters."

■ Measuring Range Code Table

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

Input Type		Sensor Type	Code	Symbol	Measuring range	Measuring range
Universal Input	RTD	JPt100 (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	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	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 10mV	71	-10 to 10mV	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 digit Span : 10 to 30000 digit 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 10mV	72	0 to 10mV		
		0 to 20mV	73	0 to 20mV		
		0 to 50mV	74	0 to 50mV		
		10 to 50mV	75	10 to 50mV		
		0 to 100mV	76	0 to 100mV		
		-100 to 100mV	77	-100 to 100mV		
	Voltage (V)	-1 to 1V	81	-1 to 1V		
		0 to 1V	82	0 to 1V		
		0 to 2V	83	0 to 2V		
		0 to 5V	84	0 to 5V		
		1 to 5V	85	1 to 5V		
		0 to 10V	86	0 to 10V		
		-10 to 10V	87	-10 to 10V		

*1 Inaccurate at 400℃ (752°F) or less; accurate to ±(0.2% FS + 1 digit) at 400 to 800℃ (752 to 1472˚F)

*2 At 200°C (392°F) or below, accurate to ±(0.2% FS + 1 digit)

*3 At -100° C (-148°F) or below, accurate to ±(0.5% FS + 1 digit); at -100 to 0℃ (-148 to 32°F), accurate to ±(0.2% FS + 1 digit).

*4 Accurate to ±(0.2% FS + 1 digit)

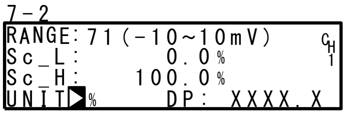
*5 At 400°C (752 °F) or less, accurate to ±(0.5% FS + 1 digit); at 400 to 800°C (752 to 1472 °F), accurate to ±(0.3% FS + 1 digit)

*6 At 10.0 to 30.0 K, accurate to ±(0.75% FS + 1 digit); at 30.0 to 70.0 K, accurate to ±(0.3% FS + 1 digit), 70.0 to 350.0 K, accurate to ±(0.25% FS + 1 digit)

*7 Accurate to ±(0.2% FS + 1 digit)

8-4 Unit

Set the measurement unit.
Before performing setup, set control action to Reset State.
For details on control reset operation, see "5-1 Control Modes".



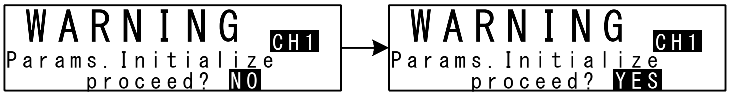
RTD, TC

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.



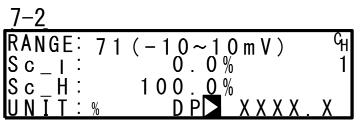
Caution

- 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 "20 List of Parameters."

8-5 Decimal Point Setting

(1) Decimal point position

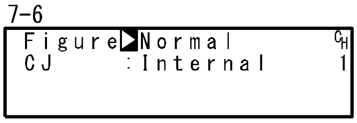
Set the decimal point position in the PV display screen when the measuring range is voltage input and current input (corresponding to code Nos.71 to 77, 81 to 87).
The key mark is displayed and this item cannot be set for RTD or TC input.
Before performing setup, set control action to Reset State.
For details on control reset operation, see "5-1 Control Modes".



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.
This item is valid when the measurement ranges are RTD and TC input (corresponding code no. 01 to 19 and 31 to 58) with a decimal point.
This screen is not displayed in the case of voltage input and current input.

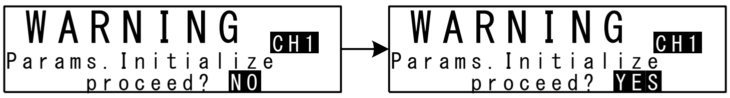


Setting range	Normal, Short
Initial value	Normal

Normal — Displays the measuring range (No. of digits) indicated in the Measuring Range Code Table.

Short — Discards the lowermost digit(s) past the decimal point of the measuring range indicated in the Measuring Range Code Table.

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.



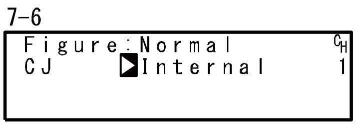
Caution

- 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 "20 List of Parameters."

8-6 Cold Junction Compensation

(1) Thermocouple cold junction compensation

Set whether to perform cold junction compensation during TC input (corresponding to code Nos. 01 to 19) internally or externally.
Normally, set to internal compensation. Set to external compensation when greater accuracy is required.



Setting range	Internal, External
Initial value	Internal

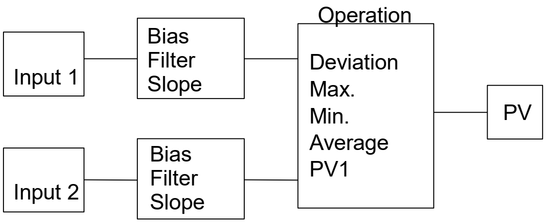
Internal — Detects the terminal temperature of the device and perform internal temperature compensation.

External — The thermocouple’s electromotive power, which offsets external reference contact temperature to 0°C, is introduced into the unit for use.

9 I/O AUXILIARY SETTINGS

9-1 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:  MAX
 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.

```
7-2
INPUT1
 PV Bias▶     0.0
 PV Filter:   OFF
 PV Slope:  1.000
```

```
7-3
INPUT2
 PV Bias▶     0.0
 PV Filter:   OFF
 PV Slope:  1.000
```

For details, see "9-2 PV compensation value".

9-2 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.

```
7-4
 PV Bias▶     0.0     CH
 PV Filter:   OFF      1
 PV Slope:  1.000
```

Setting range	-10000 to 10000 digit
Initial value	0 digit

(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.

```
7-4
 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.

```
7-4
 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
(A = PV slope, B = PV bias, X = PV input)

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.

9-3 Square Root Extraction Operation

This setting is only for voltage input and current input (corresponding to code Nos. 71 to 77, 81 to 87).
Signals having square root characteristics such as in the measurement of flow rates can be linearized.
This item is not displayed for 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.

```
7-7
SQ.Root▶ OFF        CH
                     1
```

Setting range	ON, OFF
Initial value	OFF

(2) Low cut

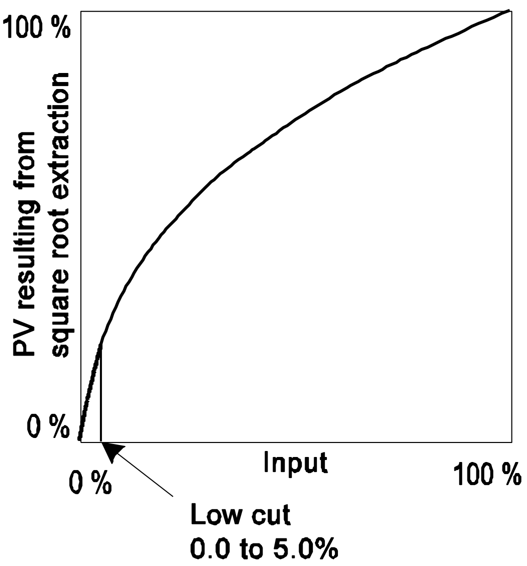
This item functions only when the square root extraction operation function is enabled. Low cut processing is performed on the input before square root extraction operation is performed.

```
7-7
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.



9-4 Control Output

(1) 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 1 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 1 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
```

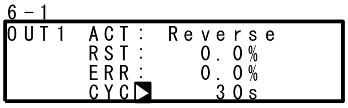
Setting range	0.0 to 100.0%
Initial value	0.0%

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) Output 1 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.
In control systems having a fast response, favorable control results can be obtained if a short proportional cycle (cycle time) is set.



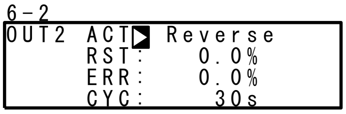
Setting range	1 to 120s
Initial value	30s: Contact output (Y) 3s: SSR drive output (P)

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.

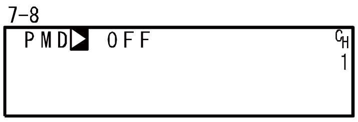


	Setting range	Initial value
ACT	:Reverse, Direct	Direct (in 1-loop) Reverse (in 2-loop)
RST	:0.0 to 100.0%	0.0%
ERR	:0.0 to 100.0%	0.0%
CYC	:1 to 120s	Contact output (Y) 30s SSR drive output (P) 3s

9-5 Setting the Ten-Segment Linearizer Approximation

(1) Enabling ten-segment linearizer approximation

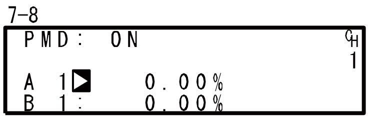
This item is set during voltage input and current input.
The screen is not displayed during RTD and TC input.
This function performs linearization based upon ten-segment approximation when the PV input is a non-linear signal.



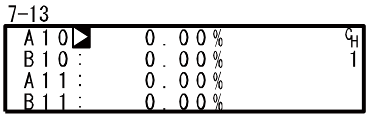
Setting range	ON, OFF
Initial value	OFF

(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.z



to

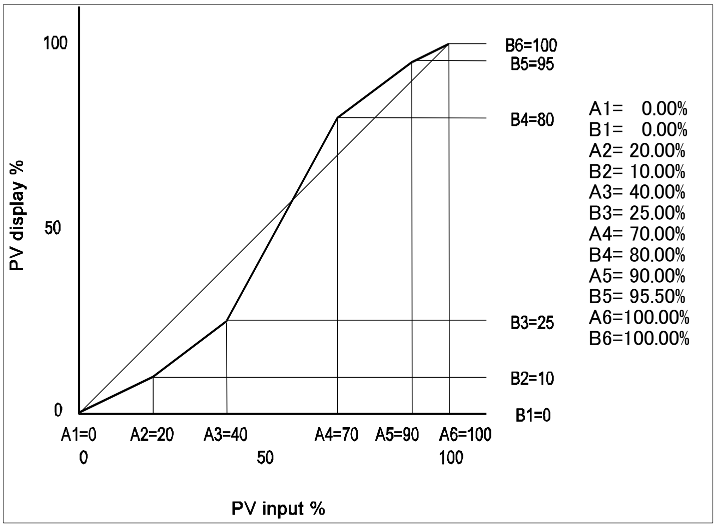


Up to 11 points can be set. 11 points (B1 to B11) can be set for PV display (%) on PV 11 inputs (A1 to A11). For each input point, B1 is set to A1, B2 for A2 and so forth until B11 is set to A11, and linear interpolation is executed between input points.
This item is set during voltage input and current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



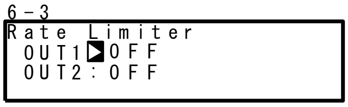
Caution

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

9-6 Limiters

(1) Output rate-of-change limiter

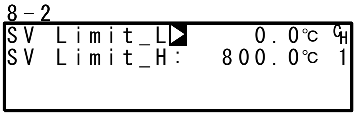
Set this setting item when a control target that is adverse to sudden changes in output is used. The rate-of-change limiter can be set to each of Output 1 (OUT1) and Output 2 (OUT2 is displayed only in the 2-output specification device).



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.



Setting range Within measuring range (SV Limit_L<SV Limit_H)

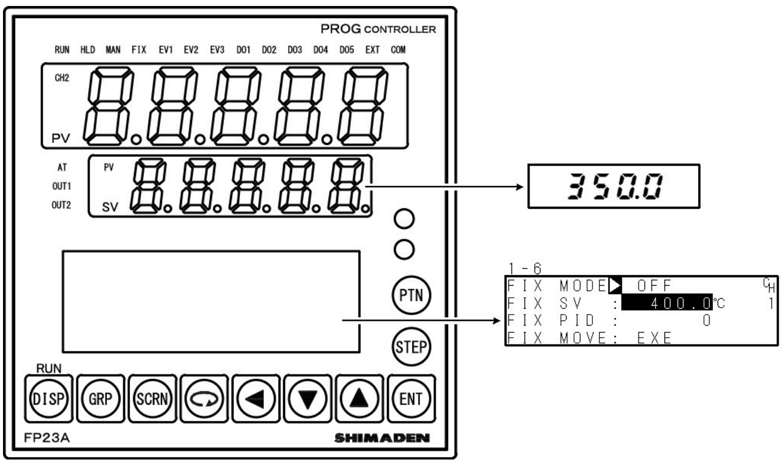
Initial value

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

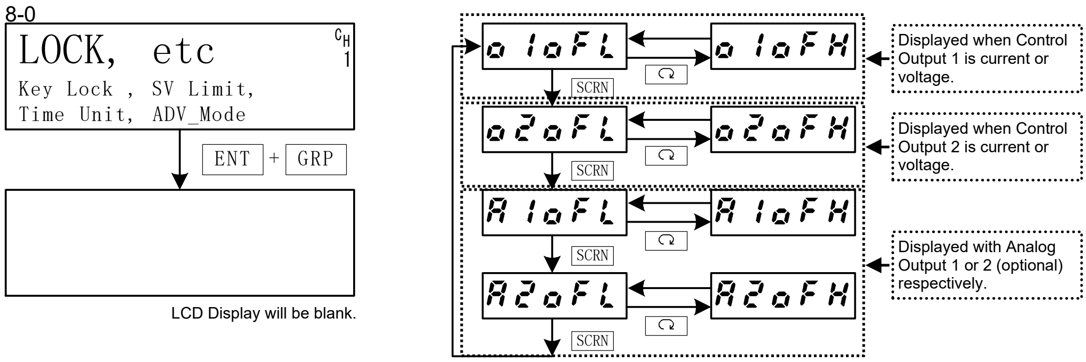


The white-inverted section indicates limiter over.

9-7 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 "7-3 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 "5-1 Control Modes."
3. Set the count value.
   Call up the LOCK, etc. top screen (group 8) from the basic screen by the DISP 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.

Setting range: Control Output 1 or 2: o*oFL : -1500～3000
o*oFH: -3500～1800
Analog Output 1 or 2: A*oFL : -3000～3000
A*oFH: -3000～2000 * : 1 to 2

Initial value : 0

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

10 PROGRAM SETTINGS

10-1 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 "9-4 (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 "9-4 (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
```

Stting 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 "18-5 Executing Advance (ADV)"

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

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
PEND FIX : OFF
```

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

Note

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

(7) FIX Switching at Program End

Check whether or not to switch to FIX mode at program end.

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

Setting range	OFF,ON
Initial value	OFF

If FIX is assigned to external control input DI during the sequence from "DI1 Type" to "DI10 Type" (screen 5-2, 5-3 and 5-4), setting ON will not enable switching to FIX mode at program end. It will not switch to FIX but Reset status upon program termination.

ON	Shift to Fix control
OFF	No shift to FIX control

(8) 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

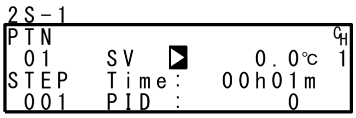
- When this parameter value is changed, settings for patterns/steps are initialized. For example, if the pattern number of CH1 is changed from 10 (of 20) to 5 (of 20), then reconfigure the number to 10 (of 20), and the pattern 6 to 10 setting will all be initialized.
- The step numbers that can be assigned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

10-2 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

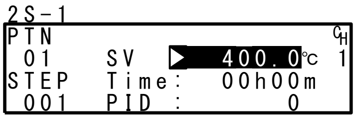
Set the SV value of step 1.



Setting range Within SV limiter setting range

Initial value 0.0

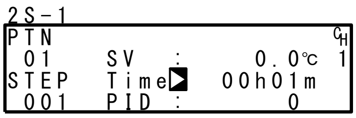
Note



- 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 "9-6 (2) SV limiter."

(2) Step Time

Set the time of step 1.

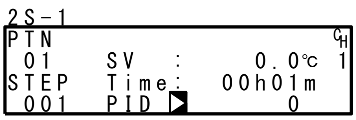


Setting range 00:00 to 99:59

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.

10-3 Pattern-related Settings

(1) Number of steps

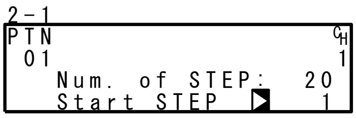
Set the number of steps to be used in the program pattern.

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



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 "17-3 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 "9-6 (2) SV limiter."

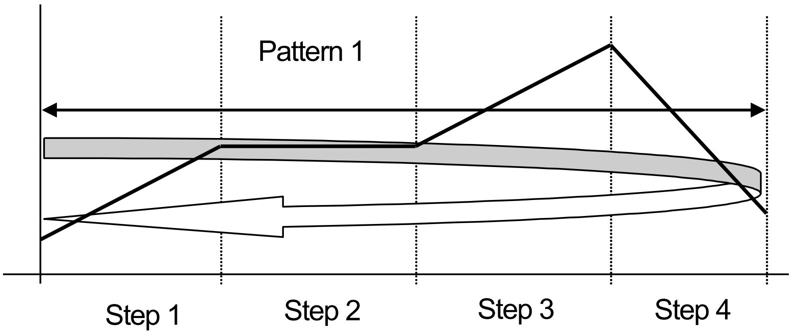
(4) Pattern execution count

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.)

```
2-2
PTN                 CH
 01                  1
    Start SV:   0.0℃
    PTN Reps▶      3
```

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.

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

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.

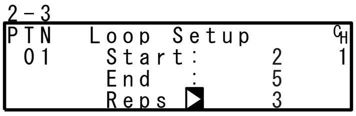
```
2-3
PTN  Loop Setup     CH
 01    Start:   1    1
       End  ▶   1
       Reps :   1
```

Setting range 1 to number of steps

Initial value 1

(7) Execution count of step loop

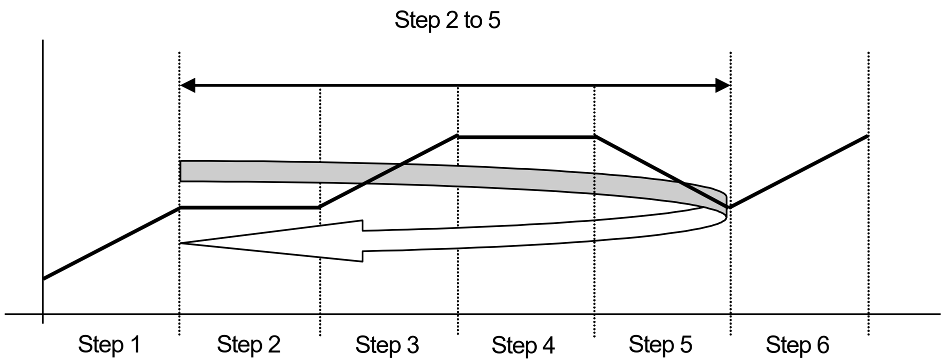
Set the execution count of the step loop.



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

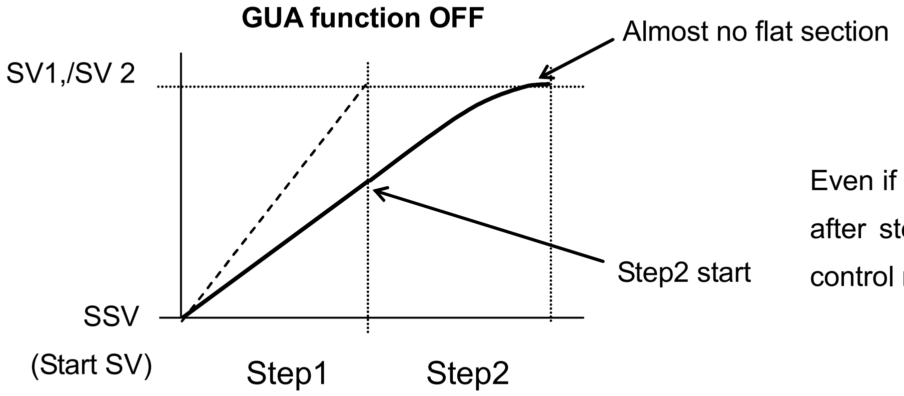
Set the guarantee soak zone (hysteresis of guarantee soak function).
Set the setting value as a deviation with respect to the SV value of a flat step.

Setting range OFF,1 to 9999

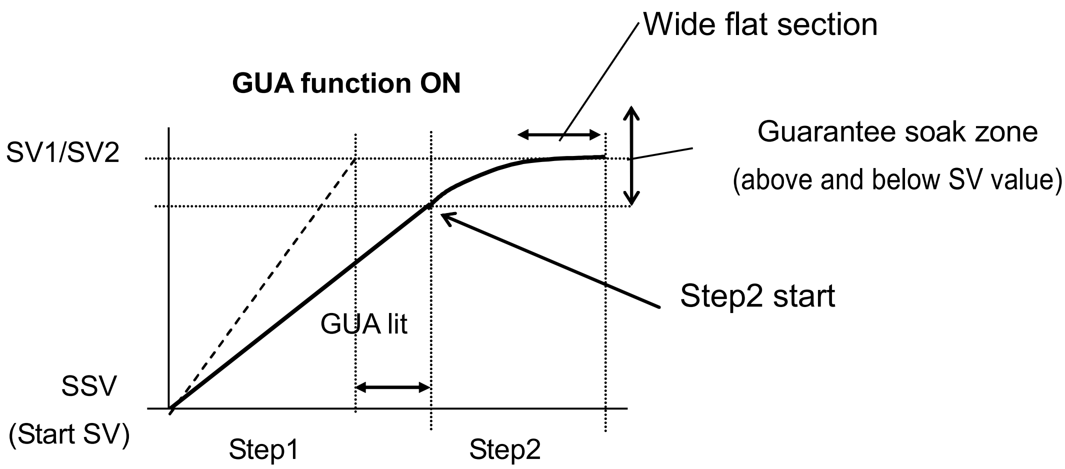
Initial value OFF

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 (0-4).

Note

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

(9) Guarantee soak time

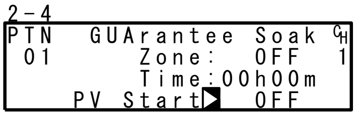
Set the guarantee soak time. Time measurement is performed at the same time that the ramp step time ends, and the program moves to the flat step regardless of whether the PV value is inside or outside the zone when the preset time is reached.
Note, however, that when "00:00" is set, GUA continues until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

```
2-4
PTN  GUArantee Soak CH
 01      Zone:  OFF  1
         Time▶00h00m
     PV Start:  OFF
```

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

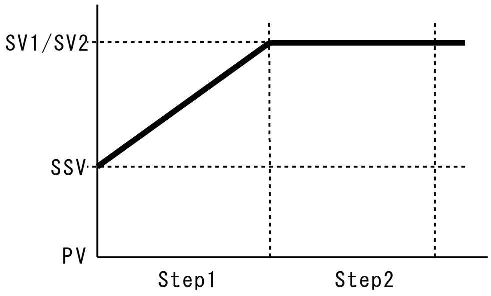
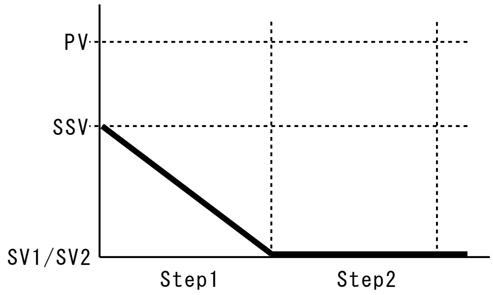
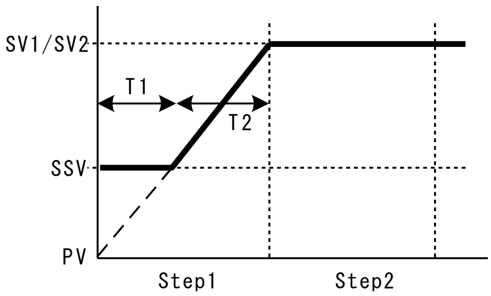
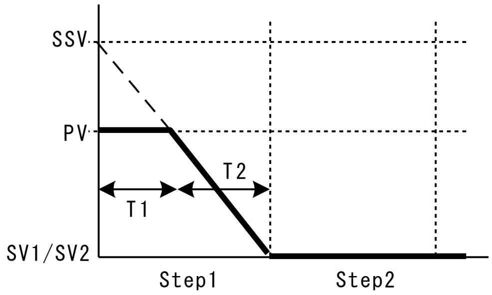
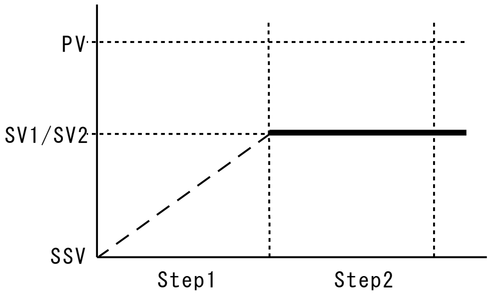
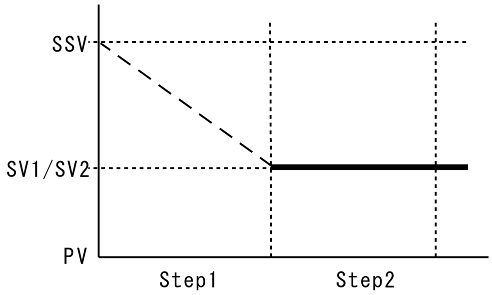
(10) PV start

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



Setting range ON/OFF

Initial value OFF

①PV≤SSV<SV1 	④PV≥SSV>SV1 
②SSV<PV≤SV1  T1: The time in this period is shortened to become PV start. T2: Step1 time to be executed	⑤SSV>PV≥SV1  T1: The time in this period is shortened to become PV start. T2: Step1 time to be executed
③SSV<SV1<PV  In this case, the program advances to step 2, and step 1 is omitted.	⑥SSV>SV1>PV  In this case, the program advances to step 2, and step 1 is omitted.

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

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

10–4 Pattern Link-related Settings

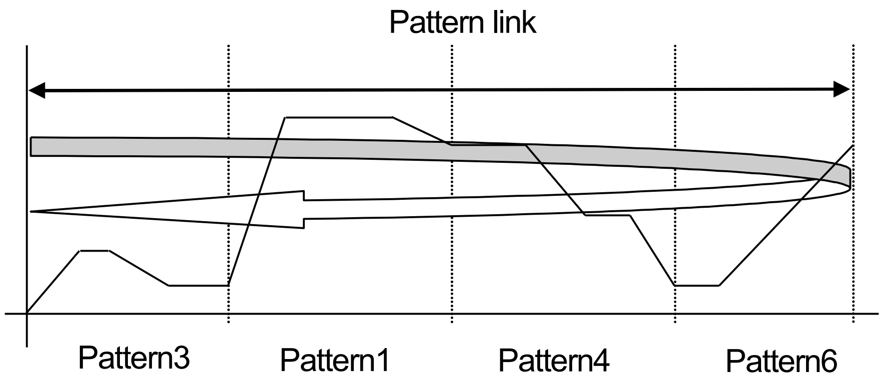
(1) Setting the pattern link execution count

Set the number of times that pattern link is executed.

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

Setting range 0 to 9999

Initial value 0



Note

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

(2) Pattern link

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

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

Setting range 0 to higher limit of assigned pattern

Initial value 0

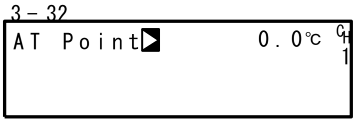
Note

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

10-5 Settings Before Program Operation

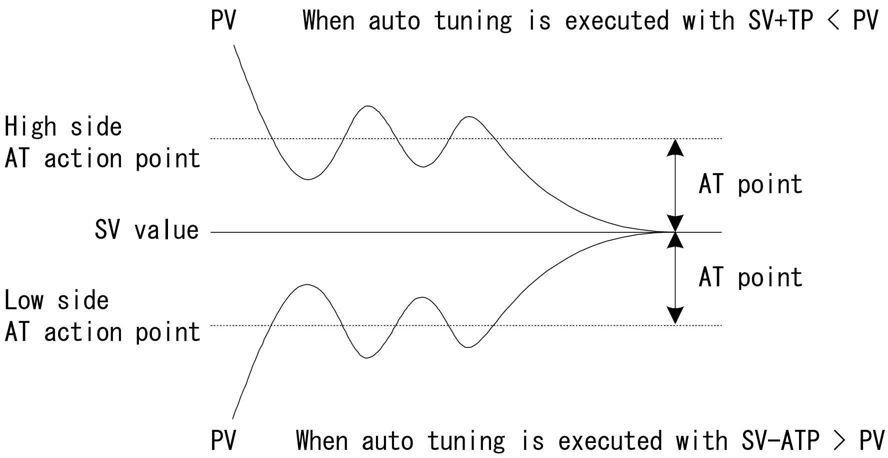
(1) Auto-tuning point

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 digit

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 EV/DO in the Program mode.
This screen is not displayed when an action other than the eight actions shown below is set to EV/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℃

2-10
PTN  DO  Set Point      CH
 01  DO10 HD▶   2500.0℃1
     DO11 LD:  -2500.0℃

2-11
PTN  DO  Set Point      CH
 01  DO12 HD▶   2500.0℃1
     DO13 LD:  -2500.0℃
```

Setting range

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

Initial value

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

(3) Time signal (TS)

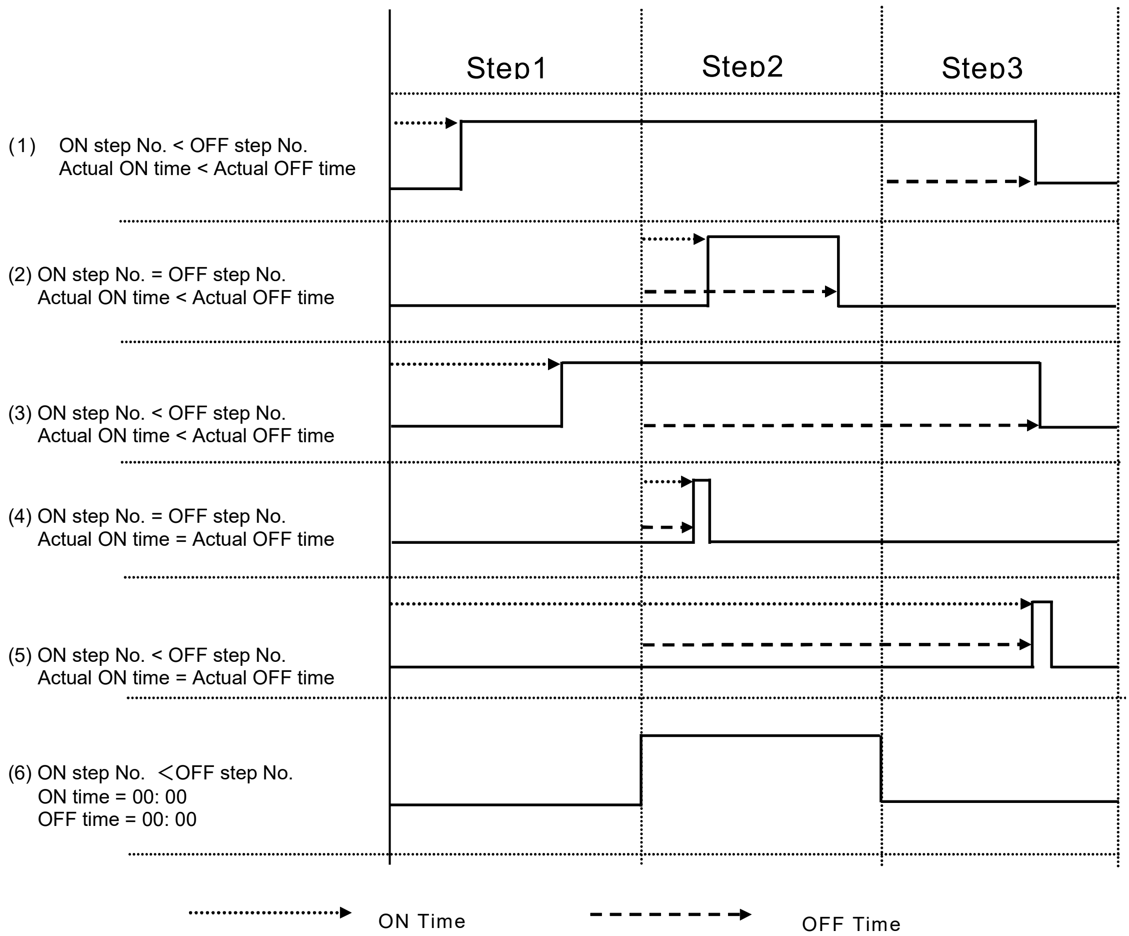
Eight time signals are available for each pattern.
The following screen descriptions are for Time Signal 1 (TS1).
To use a time signal as an external output, TS1 to TS8 must be assigned to EV1 to EV3 and DO1 to DO13 in the EV/DO screen group.

■ 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.

① Time signal ON step No.

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

2-12
```
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

② Time 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.

2-12
```
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

③ Time signal OFF step No.

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

2-12
```
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

④ Time signal OFF time

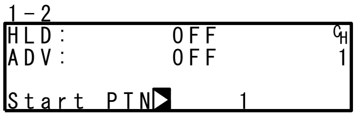
Set the time from the start of the step at which Time signal 1 (TS1) turns OFF up to when the signal actually turns OFF

2-12
```
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

(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

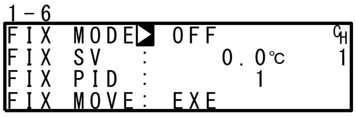
Note

- This pattern can also be set before program control execution in the basic screen.
  For details, see "17-3 Operations in Basic Screen."

11 FIX SETTINGS

11-1 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 "11-4 FIX MOVE".



Setting range	ON, OFF
Initial value	OFF

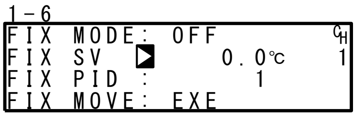
ON	FIX (fixed value control) mode
OFF	Program mode

Note

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

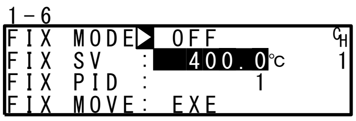
11-2 FIX SV Value

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



Setting range	Within SV limiter setting range
Initial value	0 digit

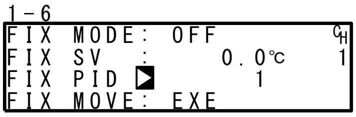
Note



- 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 "9-6 (2) SV limiter."

11-3 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.)

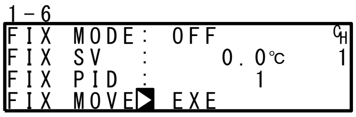


Setting range 1 to 10

Initial value 1

11-4 FIX MOVE

Make detailed settings for when the FP23A 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	For RST state, switch to RUN state when transferring to FIX mode. For 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 FP23A moves from FIX mode to the Program mode, the FP23A maintains its current state (RUN or Reset).

11-5 FIX EVENT/DO Action Points

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

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
```

1-12
```
FIX DO Set Point      CH
 DO10 HD▶ 2500.0      1
 DO11 HD: 2500.0
```

1-13
```
FIX DO Set Point      CH
 DO12 HD▶ 2500.0      1
 DO13 HD: 2500.0
```

Setting range

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

Initial value

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

12 PID SETTING

12-1 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 %

12-2 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 "12-4 Manual Reset (MR)."

12-3 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).

12-4 Manual Reset (MR)

This function is to set I (integral time) to OFF, and 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.

12-5 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 digit
Initial value	20 digit

(1) Hysteresis Mode

Sets Hysteresis Mode during ON/OFF action selection.
Likewise, the set mode will be reflected in all OUT1, 2/PID1–10.

3-32

```
AT Point  ▶      0.0 ℃ CH
DF Mode : Center        1
```

Setting range	Center, SV OFF, SV ON
Initial value	Center

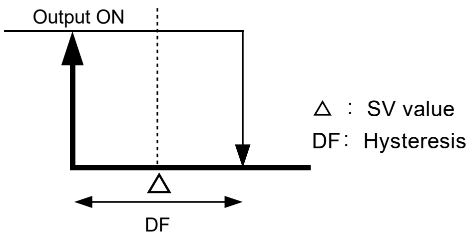
Center Mode in which the center position of hysteresis is the SV value.
SV OFF Mode in which output OFF position of hysteresis is the SV value.
SV ON Mode in which output ON of hysteresis is the SV value.

■ Two-Position Action

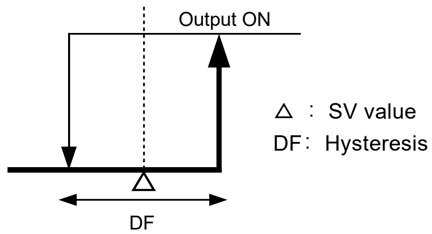
When performing two-position action, one prevents frequent ON, OFF output action by using hysteresis.

Center

RA action

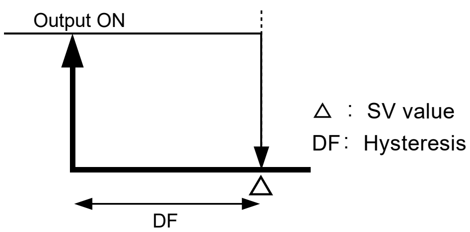


DA action

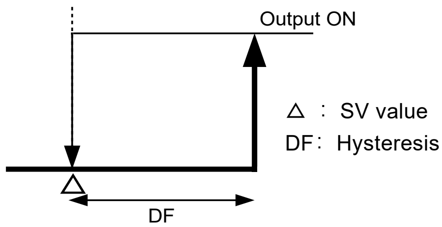


SV OFF

RA action

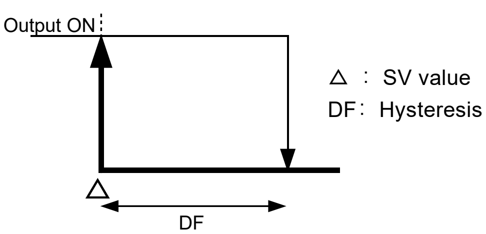


DA action

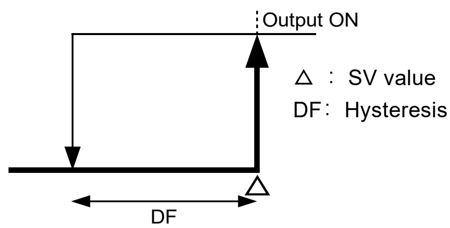


SV ON

RA action



DA action



12-6 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.

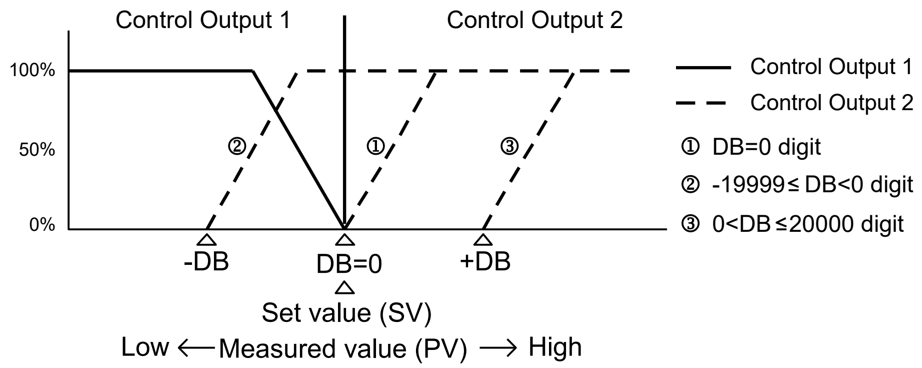
```
3-2
PID01-OUT2
P:   3.0%    DB▶  0.0
I:   OFF     SF: 0.40
D:    30s
```

Setting range -19999 to 20000 digit

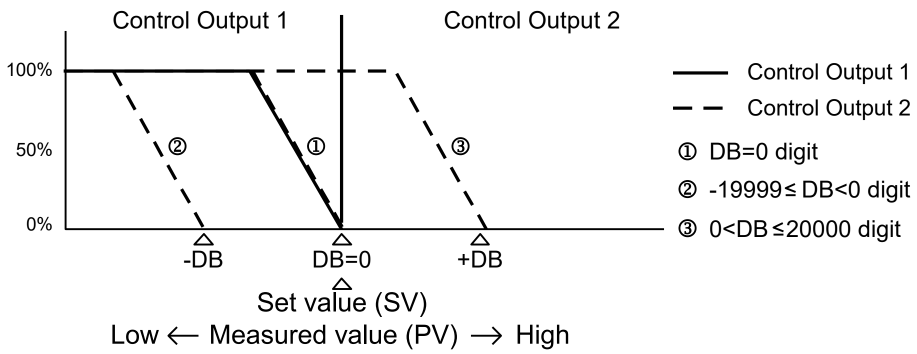
Initial value 0 digit

The patterns in the following figures show the relationship between output action and dead band.
RA: Reverse Action, DA: Direct Action

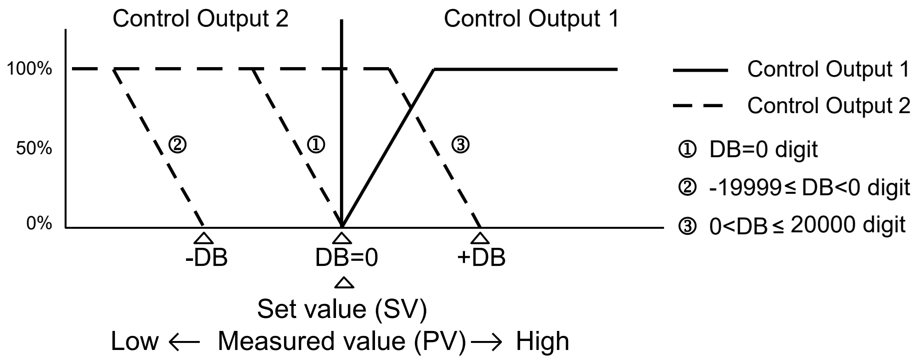
■ Control output 1: RA, Control output 2: DA (RA+DA)



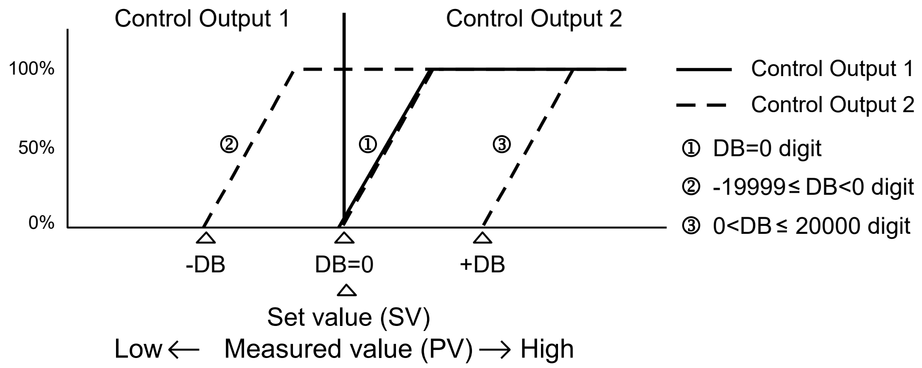
■ Control output 1: RA, Control output 2: RA (RA+RA)



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



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



12-7 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

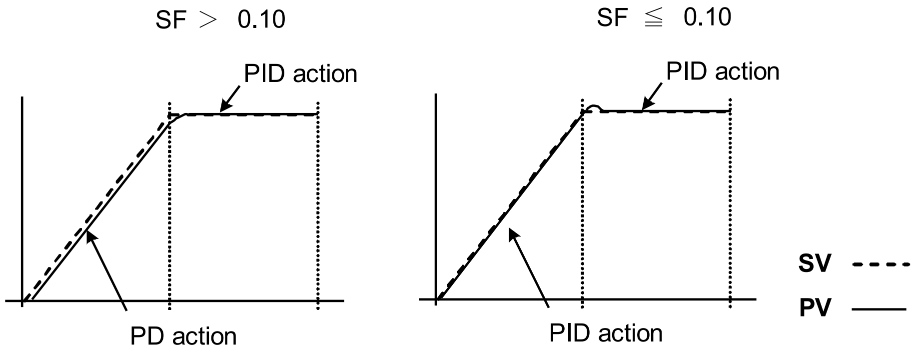
```
PID01-OUT1
P:   3.0%     MR:  0.0%
I:   OFF      SF▶0.40
D:    30s
```

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 works weakly.
SF → Large: Overshoot correction works strongly.

■ 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.



12-8 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.

3-3

```
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

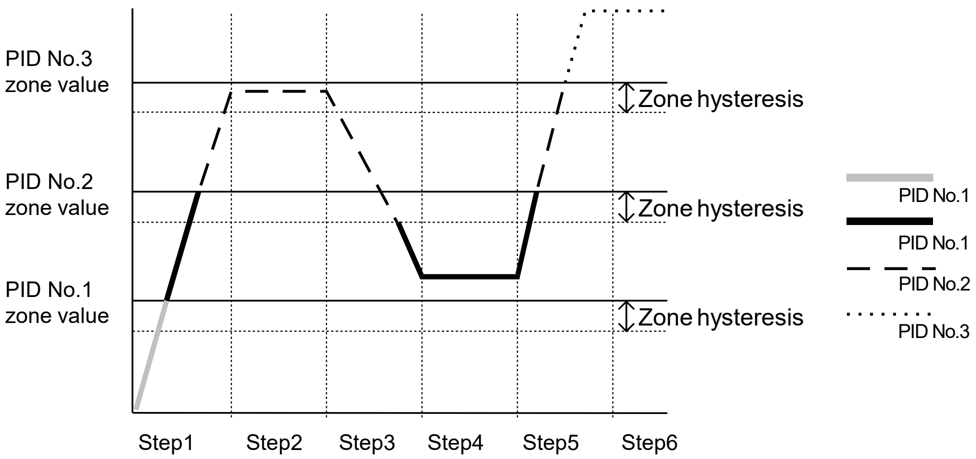
Lower limit value	0.0 %
Higher limit value	100.0 %

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.

12-9 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
```

Setting range OFF, SV, PV

Initial value OFF

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

(2) Zone hysteresis

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

Initial value 20 digit

(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 digit

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.

13 EVENT & DO SETTING

13-1 Monitor Screens

(1) DO monitor

```
4-1
 DO6   DO7   DO8   DO9
 □     □     □     □
DO10  DO11  DO12  DO13
 □     □     □     □
```

When DOx (x: 6 to 13) turns ON, □ is highlighted as ■.
DO6 to DO9 are optional, then they are not displayed when they are not installed.

(2) Logic monitor

```
4-2
   EV1      EV2      EV3
 B | I    F & F     - -
   DO1      DO2      DO3
 B | I     - -      - -
```

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

13-2 Channel Setting

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

```
4-3
EV1                  ▶CH1
 MD:None       ACT:N.O.
```

Setting range	CH1, CH2
Initial value	CH1

13-3 EVENT/DO Action

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

```
4-3
EV1                  :CH1
 MD▶None       ACT:N.O.
```

Setting range	See "List of EV/DO Types".
Initial value	EV1: DEV Hi EV2: DEV Low EV3: RUN DO1 to 13: None

■ List of EV/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
18-25	TS1～TS8	Time signal 1 to 8
26	HBA	Heater break alarm output (option) ~~SA~~
27	HLA	Heater loop alarm output (option) ~~SA~~

No.	Mode	Action
26	Posi.H	Positive higher limit absolute value SA
27	Posi.L	Positive lower limit absolute value SA
28	POT.ER	Feedback potentiometer (R2) error SA

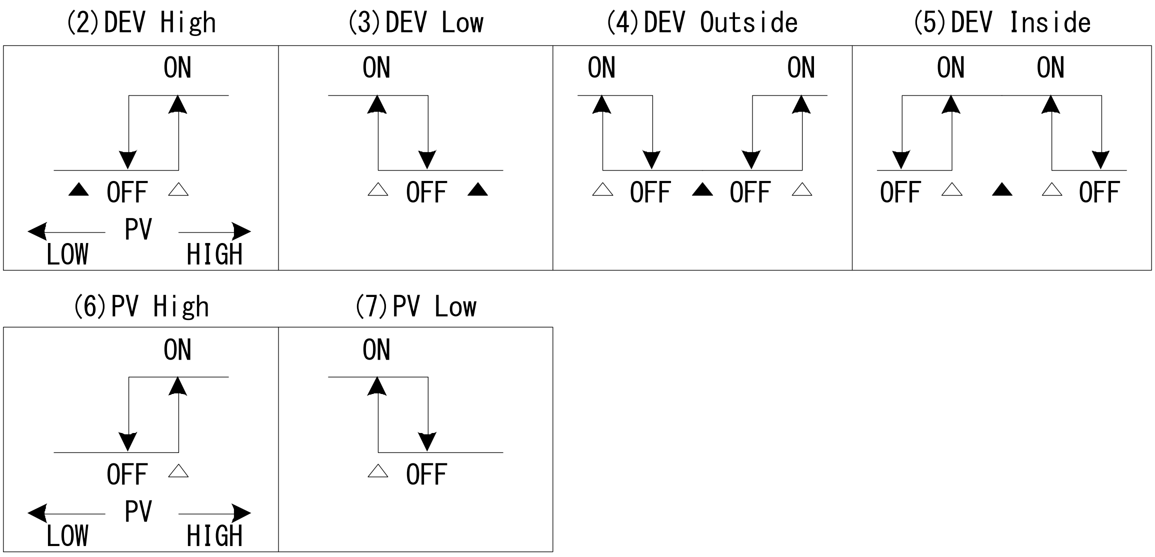
*1 LOGIC operations (AND/OR/XOR) can be assigned only to EV1 to EV3, and DO1 to DO3.

*2 LOGIC operations (Timer/Count) can be assigned only to DO4 and DO5.

*3 Only DO6 to DO13 can be assigned to Direct. The Direct function can be used when the communication option is added on.

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

■ EV/DO Action Diagrams



△ Action set point ▲ Set value

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

EVENT/STATUS output action

(9) FIX	: Output while FIX mode is set.
(10) AT	: Output while AT is executed in program mode or FIX mode.
(11) MAN	: Output while MAN action is executed in program mode or FIX mode.
(13) RUN	: Output while RUN action is executed in program mode or FIX mode.
(14) HLD	: Output while HLD state is in program mode.
(15) GUA	: Output while GUA state is occurring in program mode.
(16) STEP	: When switching from step to another step in program mode, output for a second.
(17) PRG.END	: When the last pattern is finished in program mode, output for a second.
(18-25) TS1～TS8	: Output in ON/OFF state set by the time signal setting in program mode.

For details of the time signal, see "10-5 (3) Time signal".

■ EV/DO Action in RST State

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

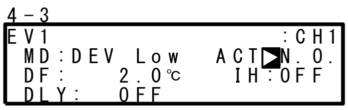
Mode	Action	Mode	Action
DEV Hi	Higher limit deviation value	DEV In	Inside higher/lower limit deviation
DEV Low	Lower limit deviation value	PV Hi	PV higher limit absolute value
DEV Out	Outside higher/lower limit deviation	PV Low	PV lower limit absolute value
Posi.H SA	Position higher limit absolute value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

Note

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

(1) Output characteristics

Set the action characteristics (ACT).

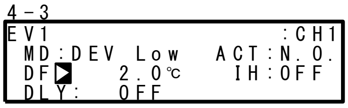


Setting range	N.O., N.C.
Initial value	N.O.

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

(2) Action Hysteresis

Set the action hysteresis (DF) between ON action and OFF action.
This item is displayed when modes (2) to (7) in EV/DO action mode (MD) or modes (26) to (27) in basic function MS (servo output) are selected.



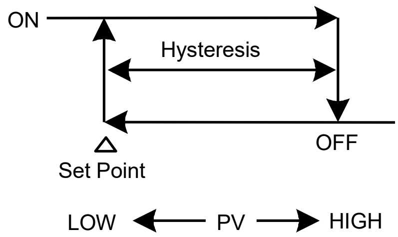
(2) to (7)

Setting range	1 to 9999 digit
Initial value	20 digit

(26) to (27)

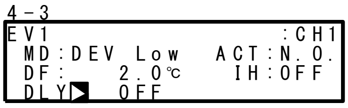
Setting range	1 to 50 %
Initial value	1 %

Ex) PV Low's case



(3) Delay time

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



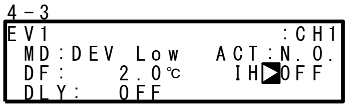
Setting range	OFF, 1 to 9999 s
Initial value	OFF

Note

- EV/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, EV/DO is output at the same time that the source of EV/DO is generated.
- When an EV/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 EV/DO ON when the PV value leaves the EV/DO action range and enters the range again without outputting EV/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 EV/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).

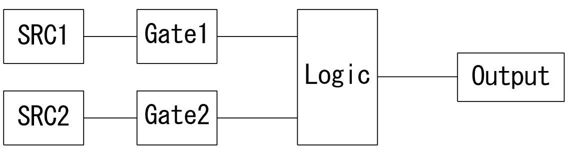
Note

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

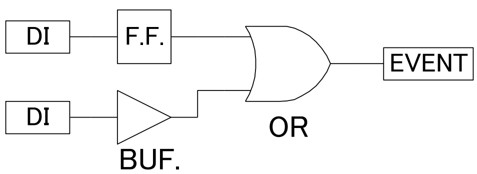
13-4 Event Logic Operations

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 EV/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 to EV3, DO1 to DO3.

(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	EV/DO turn ON when both of the two inputs turn ON.
OR	Logical sum of 2 inputs	EV/DO turn ON when either of the two inputs turns ON.
XOR	Exclusive OR of 2 inputs	EV/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), TS1 to TS8, TS1-C2 to TS8-C2 FF (flip-flop) cannot be set.

13-5 Timers/Counters

Timers and counters can be assigned to DO4 and DO5.

With this function, DI or TS is taken as input and EV/DO is taken as output, and EV/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.

14 OPTION SETTINGS (DI, AO, HB, COM)

14-1 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).
DI5 to DI10 are optional, and are not displayed when they are not available.

(1) DI monitor screen

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

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

(2) 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.

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

(4) RUN / RST DI mode

Set switching of RUN/RST mode of DI action whether by DI Level input or by Edge input.

```
5 - 5
RUN/RST Mode ▶ Edge     CH
                         1
```

Setting range Edge, Level

Initial value Edge

Edge Switch Run/Reset (Edge)
Level Switch Run/Reset (Level)

■ Restriction conditions when assigning DI

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

■ List of DI Types

<table>
<tr><th>Mode</th><th colspan="2">Action</th><th>No-action Conditions</th><th>Signal Detection</th></tr>
<tr><td>None</td><td colspan="2">No action (factory default)</td><td>- - - -</td><td>- - - -</td></tr>
<tr><td>RUN/RST</td><td colspan="2">Switching of Run/Reset (at ON: Run execution)</td><td>None</td><td>Edge/ Level *</td></tr>
<tr><td>RST</td><td colspan="2">Forced Reset (at ON: Reset state)</td><td>None</td><td>Level</td></tr>
<tr><td>HLD</td><td colspan="2">Control suspension/restart (at ON: suspension state)</td><td>None</td><td>Level</td></tr>
<tr><td>ADV</td><td colspan="2">Execute advance (at ON: execute advance)</td><td>HLD</td><td>Edge</td></tr>
<tr><td>FIX</td><td colspan="2">Switching of FIX mode/Program mode (at ON: FIX mode)</td><td>None</td><td>Level</td></tr>
<tr><td>MAN</td><td colspan="2">Switching of control output between auto/manual (at ON: manual)</td><td>AT</td><td>Level</td></tr>
<tr><td>LOGIC</td><td colspan="2">Logic operation input [exclusive port] (when ON: input ON)</td><td>None</td><td>Level</td></tr>
<tr><td>PTN2bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 3 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN3bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 7 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN4bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 15 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN5bit</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 20 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>PTN5BCD</td><td colspan="2">Selection of start pattern No. by DI input (selectable from 19 patterns)</td><td>FIX</td><td>Level</td></tr>
<tr><td>Preset1</td><td>Assignable to DI2</td><td rowspan="3">The external switching using Servo preset value is available by assigning Preset1 to 3 to DI2 only.</td><td>MAN, RST</td><td>Level</td></tr>
<tr><td>Preset2</td><td>Assignable to DI2 and DI3</td><td>MAN, RST</td><td>Level</td></tr>
<tr><td>Preset3</td><td>Assignable to DI2 to DI4</td><td>MAN, RST</td><td>Level</td></tr>
</table>

Note 1 The corresponding DI action details cannot be executed while parameters listed in the "No-action Conditions" column in the 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)
(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, PTN5bit, and PTN5BCD) 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 "13-4 Event Logic Operations".
Note 9 LOGIC cannot be set to CH.

* The signal detection differs depending on whether switching of RUN/RST mode of DI action is set by Level input or Edge input.

■ Selection of start pattern No.

The start pattern No. can be selected by the external input.
To use this function, PTN2bit, PTN3bit, PTN4bit, PTN5bit, or PTN5BCD must be assigned to DI5, or PTN2bit or PTN3bit must be assigned to DI8, and the EXT lamp must be set to light.

Ex1: 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).

Ex1: To assign [PTN5BCD] to DI5, and select start pattern No.10

The start pattern No. is automatically assigned from DI5 to DI9, and the key mark is displayed.
PTN5BCD is specified as Binary-coded decimal, which is intended for use on a thumb rotary switch, the specification method is different from PTN 5bit.
To select start pattern No.10, short across DI COM (terminal No.44) and DI9 (terminal No.42) 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
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.

14-2 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

```
5-6
Ao1MD▶ PV
Ao1_L:      0.0℃
Ao1_H:   1370.0℃
```

Setting range Ao1, Ao2 : PV, SV, DEV, OUT1, CH2_PV, CH2_SV, CH2_DEV, OUT2, Posi

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
Posi	Position value		

(2) Scaling Analog Output

```
5-6
Ao1MD: PV
Ao1_L▶      0.0℃
Ao1_H:   1370.0℃
```

■ Setting ranges and defaults

Reverse scaling is also possible if an inverted signal is required.

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%
	Posi	0 to 100%	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%
	Posi	0 to 100%	100%

Note

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

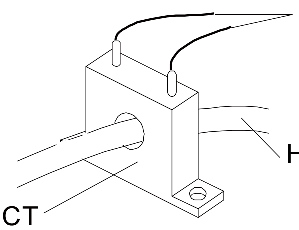
14-3 Setting of the Heater Break/Heater Loop Alarms

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 EV/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 (QCC01)
For 50A CT (QCC02)



(2) Heater current monitor

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

```
5-8
Heater [  0.0A]
 HBA▶  OFF
 HLA:  OFF
 HBM: Lock  HB: OUT1
```

Display range 0.0 to 55.0 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.

```
5-8
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 EV/DO in EV/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.

```
5-8
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 EV/DO in EV/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.

```
5-8
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.

```
5-8
Heater [  0.0A]
 HBA:  OFF
 HLA:  OFF
 HBM: Lock  HB▶ OUT1
```

Setting range	OUT1, OUT2
Initial value	OUT1

14-4 Communication

Two communication interfaces, RS-232C and RS-485, are supported as optional items with this device. Using these communication interfaces, you can set or read various data from a personal computer.
The RS-232C and RS-485 communication interface are data communication standards determined by the EIA (Electronic Industries Alliance) of the United States.These standards stipulate electrical and mechanical so-called “hardware” information, and do not define the software aspects of data transfer procedures. For this reason, communication is not possible unconditionally even between devices that support the same interface.
For this reason, the user must be fully familiar with and understand data transfer specifications and transfer procedures.
Using the RS-485 interface allows nodes of multiple devices to be connected in multidrop.
Though there are currently few personal computers that support the RS-485 interface, the RS-485 interface can be used by connecting a third-party RS-232C/RS-485 converter.

(1) Communication protocol and specifications

This device supports Shimaden protocol and MODBUS (RTU/ASCII) communication protocol.

■ Common to each protocol

Signal level	EIA RS-232C, RS-485 compliant
Communication system	RS-232C 3-line half-duplex system RS-485 2-line half-duplex multidrop (bus) system
Synchronization system	Start-stop synchronization
Communication distance	RS-232C 15 m max. RS-485 500 m max. (depending on connection conditions)
Communication speed	2400/4800/9600/19200 bps
Transmission procedure	Non-procedural
Communication delay time	1 to 50 ms
Number of connectable devices	RS-232C 1 RS-485 31 max. (depending on connection conditions)

■ SHIMADEN standard protocol

This is a SHIMADEN proprietary communication protocol.
The table below shows the specifications of this protocol.

Data length	7/8 bits
Parity	EVEN, ODD, NONE
Stop bit	1 bits, 2 bits
Communication address	01 to 98
Communication memory mode	EEP/RAM/R_E
Communication BBC	ADD/ADD_two's cmp/XOR/NONE

■ MODBUS communication protocol

This is a communication protocol developed for PLCs by Modicon Inc.
Though the specifications of this protocol are open, only the communication protocol is defined in this protocol, and physical layers such as communication medium are not stipulated.
The table below shows the specifications of this protocol.

◆ ASCII mode

Data length	Fixed to 7 bits
Parity	EVEN, ODD, NONE
Stop bit	1 bit, 2 bits
Control code	CRLF
Error check	LRC

◆ RTU mode

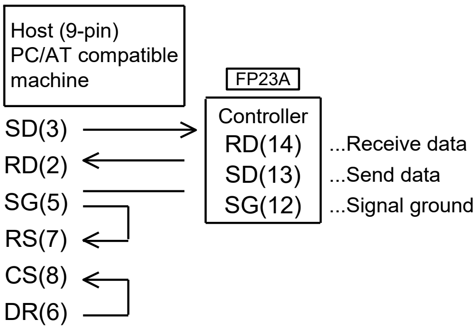
Data length	Fixed to 8 bits
Parity	EVEN, ODD, NONE
Stop bit	1 bit, 2 bits
Control code	None
Error check	CRC

* For details, see the description of protocols in Chapters 21 and 22.

(2) Connection with host equipment

This device is connected to the host computer.
The following shows connection examples.
For details, see the User's Manual for the host computer.

When the RS-232C Interface Is Used



Numbers in parentheses ( ) are connector pin Nos.

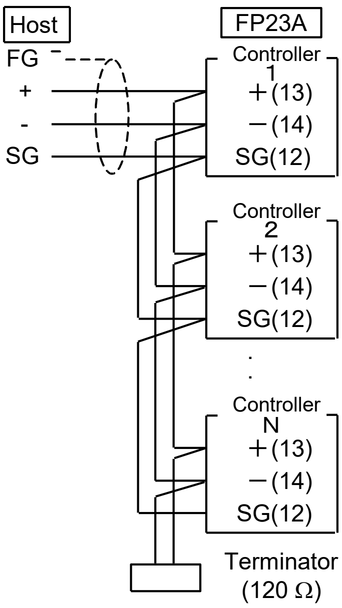
When the RS-485 Interface Is Used

The I/O logical level of this device is basically as follows:

Mark state: − terminal < + terminal Space state: − terminal > + terminal

Note, however, that the + terminal, and – terminal of this device are high-impedance before transmission is started, and the above levels are output during transmission.

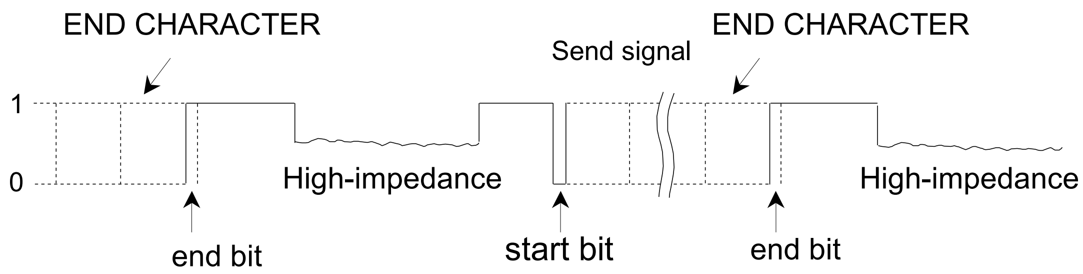
If necessary, attach a terminator of about 1/2 W 120Ω to the endmost terminal (between + and - terminals). Operation when a terminator attached to two or more units is not guaranteed.



■ About tri-state output control

When the RS-485 interface is used, the connection becomes a multidrop connection.
For this reason, to avoid conflict between send signals, the transmission output is held at high-impedance at all times during reception or when communication is not performed.

In 3-state control, a delay of several milliseconds after end of transmission of the end bit of the end character up to the return to high impedance is generated.
To absorb this delay time, be sure to set a delay time of at least 10 milliseconds before transmission restarts immediately after the host computer finishes reception.



(3) Communication setup parameters

This device has 12 communication setup parameters, of which two are reserved exclusively for SHIMADEN protocol.

Setting the communication mode

Setting the communication mode types

◆ Setting the communication protocol

◆ Setting the device address

◆ Setting the communication speed

Setting the communication memory mode

◆ Setting the communication data length

◆ Setting the communication parity

◆ Setting the communication stop bit

◆ Setting the communication delay time

◆ Setting the communication control code: SHIMADEN standard protocol only

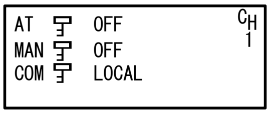
◆ Setting the BCC data operation method: SHIMADEN standard protocol only

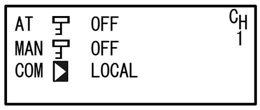
Parameters indicated by a star (◆) cannot be changed by communication; they can only be set or changed using the keys on the front panel.

(4) Setting the communication mode

Select whether or not to set or change various data using the front panel keys (local) or by communication (optional).
This parameter is valid when the communication mode type (in“14-4 (15) Communication mode”) is set to COM2; this is intended to prevent accidental operation by limiting operation to key operation and communication writing.

1-1





Setting rangeLOCAL, COM

Initial value LOCAL

In LOCAL (local mode), the key mark is displayed at the communication mode parameter selection, indicating that changing from LOCAL (local mode) to COM (communication mode) by the front panel keys isn’t possible.
Even in LOCAL (local mode), the communication mode can be changed from LOCAL local mode) to COM (communication mode) by sending commands from the host to this device.
In COM (communication mode), the communication mode can also be changed from COM to LOCAL by operating the front panel keys.
The COM (communication mode) and LOCAL (local mode) selections can be set by communications.

LOCAL Settings can be made or changed using the front panel keys, but cannot be performed by communication.
Reading data through communication is possible. (COM lamp on front panel out)

COM Settings can be made by communication.
ettings cannot be made or changed by the front panel keys.
(COM lamp on front panel lit)

Table indicating whether communication mode can be changed or not

	Change by key operation	Change by communication
Switch from LOCAL mode to COM mode	Not available	Available
Switch from COM mode to LOCAL mode	Available	Available

Note

When the communication mode is set to COM, changing of all communication setup parameters is prevented by the key lock.

To prevent uncontrollable situations such as host program runaway, communication between this device and the host can be forcibly terminated by holding down the ENT and STEP keys simultaneously for at least three seconds.

If you want to perform a key operation while in communication mode, or if you want to write data by communication while in local mode, set the communication mode type (CMOD KIND) in “14-4 (15) Communication mode”to COM1.

(5) Setting the communication protocol

5-9

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

Setting range SHIMADEN, MOD_ASC, MOD_RTU

Initial value SHIMADEN

Set the communication protocol.

SHIMADEN: SHIMADEN standard protocol
MOD_ASC: MODBUS communication protocol (ASCII mode)
MOD_RTU: MODBUS communication protocol (RTU mode)

There are two MODBUS communication protocol modes, ASCII mode and RTU mode. Either of these modes can be selected. Note, however, that all devices on the same network must be set to the same MODBUS communication protocol mode.
In the ASCII mode, 1-byte (8-bit) data is converted to two ASCII code characters before it is transferred.
In the RTU mode, 1-byte (8-bit) data is transferred as it is.
For this reason, it can be said that the transfer efficiency of the RTU mode is better than that of the ASCII mode.

(6) Setting the device address

5-9

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

Setting range 1 to 98

Initial value 1

For the RS-232C interface, the connection between the slave and host computer is a 1-to-1 connection. However, for the RS-485 interface, the connection becomes a multidrop connection, which means that a maximum of 31 SR23A units can be connected.
However, actual communication must be performed by a 1-to-1 connection. For this reason, unique addresses (machine Nos.) are provided for each of the devices.
Addresses are set within the range 01 to 98, and addresses can be set to a maximum of 31 machines.
The preset address is used as the address for infrared communication with the front panel of the device.
For details, see the Instruction Manual for Infrared Communication Adapter S5004 and the Instruction Manual for Parameter Assistant SR23 FP23.

*This function for infrared communication is not available without the infrared adapter S5004.
S5004 is no longer sold. Please contact our sales office for inquiries.

(7) Setting the communication speed

5-9

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

Setting range 2400, 4800, 9600, 19200 bps

Initial Value 9600 bps

Select from 2400, 4800, 9600, 19200 bps as the communication speed, and set.

(8) Setting the communication memory mode

5-9

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

Setting range EEP, RAM, R_E

Initial value EEP

This device uses non-volatile memory (EEPROM) for storing parameter setups.
The number of write cycles for EEPROM is already determined. Frequently rewriting SV data, for example, in EEPROM by communication will shorten the EEPROM’s life.
To prevent this, when the data is frequently rewritten by communication, the EEPROM can also be set so that it is not rewritten and only RAM data is overwritten. This will prolong the life of the EEPROM.

EEP In this mode, the EEPROM is rewritten each time that data is changed by communication. For this reason, data is held on the device even if the device is turned OFF.

RAM In this mode, only RAM data is rewritten and data in EEPROM is not rewritten even if data is changed by communication. For this reason, data in RAM is cleared when the device is turned OFF, and the device starts up with the data in EEPROM when it is turned ON again.

R_E In this mode, SV1 to SV10, OUT, and COM mode data is written only to RAM. Other data is written to EEPROM.

(9) Setting the communication data length

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

SHIMADEN standard protocol	Setting Range	7 bit, 8 bit
	Initial Value	7 bit
MODBUS-ASCII	Setting Range	7 bit
	Initial Value	7 bit
MODBUS-RTU	Setting Range	8 bit
	Initial Value	8 bit

(10) Setting the communication parity

5-10

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

Setting range EVEN, ODD, NONE

Initial value EVEN

Set the parity check method for detecting errors in data in data communication.

(11) Setting the communication stop bit

5-10

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

Setting range 1, 2

Initial value 1

(12) Setting the communication delay time

5-10

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

Setting range	1 to 50 ms
Initial value	10 ms

Set the minimum delay time from reception of the communication command up to transmission.

Note

- In the case of the RS-485 interface, it sometimes takes time to perform tri-state control due to the line converter, which may cause signals to collide. This can be avoided at this time by lengthening the delay time. Particular care must be taken when communication is set to a low speed (2400 bps).
- The actual delay time from reception of the communication command up to transmission is the total time required to process commands by the software added to the above delay time. In particular, it sometimes takes about 400 ms to process commands in the case of the write command.

(13) Setting the communication control code

This setting item is available only in the SHIMADEN standard protocol. Set the communication control code.

5-11

```
COM CTRL▶ STX_ETX_CR
    BCC:  ADD

CMOD KIND: COM1
```

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

(14) Setting the communication BCC data operation method

This setting item is available only in the SHIMADEN standard protocol.

5-11

```
COM CTRL:  STX_ETX_CR
    BCC▶ ADD

CMOD KIND: COM1
```

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

There are four operation methods for the BCC (Block Check Character) data:

ADD	Addition operation
ADD_two's cmp	The two’s complement of the lower 1 byte of the addition operation result is taken.
XOR	XOR (exclusive OR) operation is performed.
None	BCC operation is not performed.

For details, see “21 SHIMADEN Protocol.”

(15) Communication mode type setting

Selects restrictions for key operation and communication writing for the communication/local modes.

5-11

```
COM CTRL:  STX_ETX_CR
    BCC:ADD

CMOD KIND▶COM1
```

Setting range	COM1, COM2
Initial value	COM1

If you want to perform key operation when in COM (communication mode), set “communication mode type” to COM1.

Table indicating whether parameters can be changed in each mode

Communication mode types	COM1		COM2	
Communication mode	COM	LOCAL	COM	LOCAL
Key operation	Available	Available	Not available	Available
Communication writing	Available	Available	Available	Not available

If "communication mode type" is modified by communication command, it becomes as follows:

Communication mode	LOCAL	COM
Communication writing	COM1 ⇒ COM2 available	COM1 ⇒ COM2 available
	COM2 ⇒ COM1 not available	COM2 ⇒ COM1 available

(16) Outline of communication data address

• Data address and reading/writing the data address

The data address expresses binary (16-bit data) in hexadecimal by every 4-bit blocks.

- R/W Data that can be read and written
- R Read-only data
- W Write-only data

When a read-only data address is specified in the Write command (W), a data address error occurs, and the “data format, data address and data number error of the text section” of error response codes “0 (30H)” and “8 (38H)” are returned.

• Reading/writing parameters in 2-loop specification

In 2-loop specification, the value of the parameter corresponding to each loop can be read by sub-address = 1/2 for the SHIMADEN standard protocol, and by slave address = device address/device address + 1 for the MODBUS communication protocol.

Details of parameters having values for each of these loops are indicated by “T” (support of sub-address) at the right edge of the communication data addresses given below.

• Reading/writing “reserved” in the parameter section

When an address not in the list or address indicated as “<reserved>” are read by the Read command (R), "0000H" is returned.
When a part indicated as “<reserved>” is written by the write (W) command, the normal response codes "0 (30H)" and "0 (30H)" are returned. Data, however, is not rewritten.

• Reading/writing option-related parameters

When the data address of parameters for unmounted options are specified, the “specification, option error” of error response codes "0 (30H)" and "C (43H)" are returned for both the Read command (R) and Write command (W).

• Parameters not displayed on the front panel

Even parameters that are not indicated (used) on the front panel display can be read/written by communication depending on the operation and setup specifications.

• Handling of data

As each data is binary (16-bit data) without a decimal point, the data type and presence of a decimal point must be checked.

Ex: How to express data with a decimal point

		Hex data
20.0%	200 →	00C8
100.00℃	10000 →	2710
-40.00℃	-4000 →	F060

For the data of unit Digit, the decimal point position is determined by the measuring range. Otherwise, data is handled as signed binary (16-bit data: -32768 to 32767).

• Logic/logic operation source parameters

With the logic/logic operation source, binary 16-bit data is expressed by two data items for a single address, divided into the upper 8 bits and the lower 8 bits.

Ex: EV1 logic 1 01H (INV)
Logic operation source 1 08H (TS8)

Address	Upper 8 bits	Lower 8 bits	Data
0380	01H	08H	0108H

Likewise, the channel information/operation mode of EV1 to 3 and DO1 to 13 are expressed as two data items for a single address.

• Execution of broadcast

In the SHIMADEN standard protocol, use the “B” command.
In the MODBUS communication protocol, set “0” to the slave address.
Parameters that can be broadcast are indicated by “B” (broadcast) at the right edge of the communication addresses shown below.

• Annotation of time data

For details of how time data (h/m/s) is annotated, refer to the following example:

Ex	1 s	00: 01 → 0001H	59 s	00:59 → 0059H
	1 h	01: 00 → 0100H	99 h59 m	99:59 → 9959H

60 s (0060H) will result in a write error.

(17) List of communication data addresses

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0040	S_CODE1	Series code 1 “F”, “P”	R	-
0041	S_CODE2	Series code 2 “2”, “3”	R	-
0042	S_CODE3	Series code 3 “A”	R	-
0043	S_CODE4	Series code 4	R	-
0100	PV_W	PV value : Within measuring range	R	T
0101	SV_W	Execution SV value : Within setting value limiter	R	T
0102	OUT1_W	Control output 1 : -5.0 to 105.0%	R	-
0103	OUT2_W	Control output 2 : -5.0 to 105.0%	R	-
0104	EXE_FLG	Operation flag (See the detailed explanation below.)	R	T
0105	EV_FLG	Event output flag (See the detailed explanation below.)	R	-
0107	EXE_PID	Execution PID No.: 0 (PID No..1) to 9 (PID No.10)	R	T
0109	HB_W	HB current value (current at output ON) 0.0 to 55.0A	R	-
010A	HL_W	HL current value (current at output OFF) 0.0 to 55.0A	R	-
010B	DI_FLG	DI input state flag (See the detailed explanation below.)	R	-

- Sc_HH, CJ_HH, b---- =7FFFH
  Sc_LL, CJ_LL =8000H
  The HBL and HLA display is -----. HB current value when output is OFF, and HL current value when output is ON =7FFEH
- The table below shows the details of the operation flag, EV output flag and the DI input state flag (EXE_FLG, EV_FLG, DI_FLG).
  (during no action: bit=0, during action: bit=1)

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
EXE_FLG	0	0	0	0	Z/S	0	AT WAIT	COM	0	0	0	0	0	0	MAN	AT
EV_FLG	DO13	DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1	EV3	EV2	EV1
DI_FLG	0	0	0	0	0	0	DI10	DI9	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0110	UNIT	Measurement unit 0:°C 1:°F 2: % 3: K 4: NONE	R	T
0111	RANGE	Measuring range 0 to 19: Thermocouple 31 to 58: Resistor 71 to 77: Voltage mV 81 to 87: Voltage V (See "■ Measuring Range Code Table".)	R	T
0112	CJ	Cold junction compensation 0: Internal 1: External	R	T
0113	DP	PV decimal point position 0: XXXXX 1: XXXX.X 2: XXX.XX 3: XX.XXX 4: X.XXXX	R	T
0114	SC_L	PV scaling lower/upper limit At linear input: -19999 to 30000 digit At resistor, thermocouple input: Measuring range is displayed	R	T
0115	SC_H		R	T
0116	DPFLG	Number of digits past decimal point 0: Normal 1: Short	R	T

0120	E_PRG	Program action flag (See the detailed explanation below.)	R	T

- The table below shows the details of the program operation flag.
  (during no action: bit=0, during action: bit=1)

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
PRG EXE _FLG	PRG	0	0	0	0	UP	LVL	DW	RUN WAIT	0	SO HLD	0	ADV	GUA	HLD	RUN

0121	E_PTN	Program execution pattern No. : 1 to 20	R	T
0122	E_LNK	Program execution link count : 0 to 9999	R	T
0123	E_RPT	Program execution pattern count : 1 to 9999	R	T
0124	E_STP	Program execution step No. : 0 to 400	R	T
0125	E_TIM	Program execution remaining step time : 00: 01 to 99:59	R	T
0126	E_PID	Program execution PID No. : 0 to 10	R	T
0129	E_STPRPT	Program execution step count : 1 to 9999	R	T

- The above seven parameters return 7FFE excluding when E_PRG is in the program mode and in a RUN state.

0142	POSI	Servo opening value (enabled when feedback is ON) : 0 to 100	R	-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0182	OUT1_W	Control system output 1/2 (possible only in MAN mode) : 0.0 to 100.0%	W	-
0183	OUT2_W		W	-
0184	AT	Auto tuning execution 0: OFF 1: ON	W	T/B
0185	MAN	Manual operation 0: OFF 1: ON	W	T/B

018C	COM	Communication mode 0: LOC 1: COM	W	B
018D	COMDI	EV1 to 3, DO1 to 13 direct control	W	B

- When the action mode for EV1 to 3 and DO1 to 5 is set to LOGIC and to DIRECT for DO6 to 13 , the signals of EV1 to 3 and DO1 to 13 can be operated directly by writing to 018D.

  When another logic operation cause is set for EV1 to 3 and DO1 to 5, these outputs are OR outputs.
- The table below gives the details of 018D data.
  (during no operation: bit = 0, during operation: bit = 1)

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
COMDI	DO13	DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1	EV3	EV2	EV1

0190	RUN/RST	Program reset 0: RESET 1: RUN	W	T/B
0191	HLD	Program hold 0: OFF 1: ON	W	T/B
0192	ADV	Program Advance 0: OFF 1: ON	W	T/B

0244	AT	Auto tuning execution (CH1/CH2 simultaneous) 0: OFF 1: ON	W	B
0245	MAN	Manual operation (CH1/CH2 simultaneous) 0: OFF 1: ON	W	B
0250	RUN/RST	Program reset (CH1/CH2 simultaneous) 0: RESET 1: RUN	W	B
0251	HLD	Program hold (CH1/CH2 simultaneous) 0: OFF 1: ON	W	B
0252	ADV	Program Advance (CH1/CH2 simultaneous) 0: OFF 1: ON	W	B

0280	PV1	CH1 measuring range: Within measuring range	R	-
0281	PV2	CH2 measuring range: Within measuring range	R	-

0300	FIX_SV	FIX mode SV value: Within SV limiter setting range	R/W	T
030A	SV_L	Lower limit SV value setting limiter : Within measuring range (note that SV Limit_L<SV Limit_H)	R/W	T
030B	SV_H	Upper limit SV value setting limiter : Within measuring range (note that SV Limit_L<SV Limit_H)	R/W	T

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0380	EV1_LSRC/LOG1	EV1 logic 1/logic operation cause1 Logic 1 (upper 8 bits) 0: BUF 1: INV 2: FF Logic operation cause1 (lower 8 bits) 0: None 1: TS1 2: TS2 3: TS3 4: TS4 5: TS5 6: TS6 7: TS7 8: TS8 9: TS1-C2 10: TS2-C2 11: TS3-C2 12: TS4-C2 13: TS5-C2 14: TS6-C2 15: TS7-C2 16: TS8-C2 17: DI1 18: DI2 19: DI3 20: DI4 21: DI5 22: DI6 23: DI7 24: DI8 25: DI9 26: DI10	R/W	-
0381	EV1_LSRC/LOG2	EV1 logic 2/logic operation cause2 (same as above)	R/W	-
0382	EV1_LMD	EV1 logic operation mode 0: AND 1: OR 2: XOR	R/W	-
0384	EV2_LSRC/LOG1	EV2 logic 1/logic operation cause1 (same as above)	R/W	-
0385	EV2_LSRC/LOG2	EV2 logic 2/logic operation cause2 (same as above)	R/W	-
0386	EV2_LMD	EV2 logic operation mode 0: AND 1: OR 2: XOR	R/W	-
0388	EV3_LSRC/LOG1	EV3logic 1/logic operation cause1 (same as above)	R/W	-
0389	EV3_LSRC/LOG2	EV3logic 2/logic operation cause2 (same as above)	R/W	-
038A	EV3_LMD	EV3 logic operation mode 0: AND 1: OR 2: XOR	R/W	-
038C	DO1_LSRC/LOG1	DO1logic 1/logic operation cause1 (same as above)	R/W	-
038D	DO1_LSRC/LOG2	DO1logic 2/logic operation cause2 (same as above)	R/W	-
038E	DO1_LMD	DO1 logic operation mode 0: AND 1: OR 2: XOR	R/W	-
0390	DO2_LSRC/LOG1	DO2logic 1/logic operation cause1 (same as above)	R/W	-
0391	DO2_LSRC/LOG2	DO2logic 2/logic operation cause2 (same as above)	R/W	-
0392	DO2_LMD	DO2 logic operation mode 0: AND 1: OR 2: XOR	R/W	-
0394	DO3_LSRC/LOG1	DO3logic 1/logic operation cause1 (same as above)	R/W	-
0395	DO3_LSRC/LOG2	DO3logic 2/logic operation cause2 (same as above)	R/W	-
0396	DO3_LMD	DO3 logic operation mode 0: AND 1: OR 2: XOR	R/W	-
0398	DO4_SRC1	DO4 logic operation cause	R/W	-
039A	DO4_LMD	DO4 logic operation mode 0: Timer 1: Counter	R/W	-
039B	DO4_LTM	DO4 logic operation counter OFF, 1 to 5000s	R/W	-
039C	DO5_SRC1	DO5 logic operation cause	R/W	-
039E	DO5_LMD	DO5 logic operation mode 0: Timer 1: Counter	R/W	-
039F	DO5_LTM	DO5 logic operation counter OFF, 1 to 5000s	R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0400	PB1	PID01-OUT1	Proportional band: 0.0 to 999.9% (0.0=OFF)	R/W	-
0401	IT1		Integral time: 0 to 6000Sec (0=OFF)	R/W	-
0402	DT1		Derivative time: 0 to 3600Sec (0=OFF)	R/W	-
0403	MR1		Manual reset: -50.0 to 50.0%	R/W	-
0404	DF1		Action Hysteresis: 1 to 9999 digit	R/W	-
0405	O11_L		Output lower limit: 0.0 to 100.0%	R/W	-
0406	O11_H		Output upper limit: 0.0 to 100.0%	R/W	-
0407	SF1		Set value function: 0.00 to 1.00	R/W	-
0408	PB2	PID02-OUT1	Same as above	R/W	-
0409	IT2			R/W	-
040A	DT2			R/W	-
040B	MR2			R/W	-
040C	DF2			R/W	-
040D	O12_L			R/W	-
040E	O12_H			R/W	-
040F	SF2			R/W	-
0410	PB3	PID03-OUT1	Same as above	R/W	-
0411	IT3			R/W	-
0412	DT3			R/W	-
0413	MR3			R/W	-
0414	DF3			R/W	-
0415	O13_L			R/W	-
0416	O13_H			R/W	-
0417	SF3			R/W	-
0418	PB4	PID04-OUT1	Same as above	R/W	-
0419	IT4			R/W	-
041A	DT4			R/W	-
041B	MR4			R/W	-
041C	DF4			R/W	-
041D	O14_L			R/W	-
041E	O14_H			R/W	-
041F	SF4			R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0420	PB5	PID05-OUT1	Proportional band: 0.0 to 999.9% (0.0=OFF)	R/W	-
0421	IT5		Integral time: 0 to 6000 Sec (0=OFF)	R/W	-
0422	DT5		Derivative time: 0 to 3600 Sec (0=OFF)	R/W	-
0423	MR5		Manual reset: -50.0 to 50.0%	R/W	-
0424	DF5		Action Hysteresis: 1 to 9999 digit	R/W	-
0425	O15_L		Output lower limit: 0.0 to 100.0%	R/W	-
0426	O15_H		Output upper limit: 0.0 to 100.0%	R/W	-
0427	SF5		Set value function: 0.00 to 1.00	R/W	-
0428	PB6	PID06-OUT1	Same as above	R/W	-
0429	IT6			R/W	-
042A	DT6			R/W	-
042B	MR6			R/W	-
042C	DF6			R/W	-
042D	O16_L			R/W	-
042E	O16_H			R/W	-
042F	SF6			R/W	-
0430	PB7	PID07-OUT1	Same as above	R/W	-
0431	IT7			R/W	-
0432	DT7			R/W	-
0433	MR7			R/W	-
0434	DF7			R/W	-
0435	O17_L			R/W	-
0436	O17_H			R/W	-
0437	SF7			R/W	-
0438	PB8	PID08-OUT1	Same as above	R/W	-
0439	IT8			R/W	-
043A	DT8			R/W	-
043B	MR8			R/W	-
043C	DF8			R/W	-
043D	O18_L			R/W	-
043E	O18_H			R/W	-
043F	SF8			R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0440	PB9	PID09-OUT1	Proportional band: 0.0 to 999.9% (0.0=OFF)	R/W	-
0441	IT9		Integral time: 0 to 6000 Sec (0=OFF)	R/W	-
0442	DT9		Derivative time: 0 to 3600 Sec (0=OFF)	R/W	-
0443	MR9		Manual reset: -50.0 to 50.0%	R/W	-
0444	DF9		Action Hysteresis: 1 to 9999 digit	R/W	-
0445	O19_L		Output lower limit: 0.0 to 100.0%	R/W	-
0446	O19_H		Output upper limit: 0.0 to 100.0%	R/W	-
0447	SF9		Set value function: 0.00 to 1.00	R/W	-
0448	PB10	PID10-OUT1	Same as above	R/W	-
0449	IT10			R/W	-
044A	DT10			R/W	-
044B	MR10			R/W	-
044C	DF10			R/W	-
044D	O10_L			R/W	-
044E	O10_H			R/W	-
044F	SF10			R/W	-
0460	PB21	PID01-OUT2	Proportional band: 0.0 to 999.9% (0.0=OFF)	R/W	-
0461	IT21		Integral time: 0 to 6000 Sec (0=OFF)	R/W	-
0462	DT21		Derivative time: 0 to 3600 Sec (0=OFF)	R/W	-
0463	MR21/DB21		Manual reset: -50.0 to 50.0% Dead band: -199999 to 20000 digit	R/W	-
0464	DF21		Action Hysteresis: 1 to 9999 digit	R/W	-
0465	O21_L		Output lower limit: 0.0 to 100.0%	R/W	-
0466	O21_H		Output upper limit: 0.0 to 100.0%	R/W	-
0467	SF21		Set value function: 0.00 to 1.00	R/W	-
0468	PB22	PID02-OUT2	Same as above	R/W	-
0469	IT22			R/W	-
046A	DT22			R/W	-
046B	MR22/DB22			R/W	-
046C	DF22			R/W	-
046D	O22_L			R/W	-
046E	O22_H			R/W	-
046F	SF22			R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0470	PB23	PID03-OUT2	Proportional band: 0.0 to 999.9% (0.0=OFF)	R/W	-
0471	IT23		Integral time: 0 to 6000 Sec (0=OFF)	R/W	-
0472	DT23		Derivative time: 0 to 3600 Sec (0=OFF)	R/W	-
0473	MR23/DB23		Manual reset: -50.0 to 50.0% Dead band: -199999 to 20000 digit	R/W	-
0474	DF23		Action Hysteresis: 1 to 9999 digit	R/W	-
0475	O23_L		Output lower limit: 0.0 to 100.0%	R/W	-
0476	O23_H		Output upper limit: 0.0 to 100.0%	R/W	-
0477	SF23		Set value function: 0.00 to 1.00	R/W	-
0478	PB24	PID04-OUT2	Same as above	R/W	-
0479	IT24			R/W	-
047A	DT24			R/W	-
047B	MR24/DB24			R/W	-
047C	DF24			R/W	-
047D	O24_L			R/W	-
047E	O24_H			R/W	-
047F	SF24			R/W	-
0480	PB25	PID05-OUT2	Same as above	R/W	-
0481	IT25			R/W	-
0482	DT25			R/W	-
0483	MR25/DB25			R/W	-
0484	DF25			R/W	-
0485	O25_L			R/W	-
0486	O25_H			R/W	-
0487	SF25			R/W	-
0488	PB26	PID06-OUT2	Same as above	R/W	-
0489	IT26			R/W	-
048A	DT26			R/W	-
048B	MR26/DB26			R/W	-
048C	DF26			R/W	-
048D	O26_L			R/W	-
048E	O26_H			R/W	-
048F	SF26			R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0490	PB27	PID07-OUT2	Proportional band: 0.0 to 999.9% (0.0=OFF)	R/W	-
0491	IT27		Integral time: 0 to 6000 Sec (0=OFF)	R/W	-
0492	DT27		Derivative time: 0 to 3600 Sec (0=OFF)	R/W	-
0493	MR27/DB27		Manual reset: -50.0 to 50.0% Dead band: -199999 to 20000 digit	R/W	-
0494	DF27		Action Hysteresis: 1 to 9999 digit	R/W	-
0495	O27_L		Output lower limit: 0.0 to 100.0%	R/W	-
0496	O27_H		Output upper limit: 0.0 to 100.0%	R/W	-
0497	SF27		Set value function: 0.00 to 1.00	R/W	-
0498	PB28	PID08-OUT2	Same as above	R/W	-
0499	IT28			R/W	-
049A	DT28			R/W	-
049B	MR28/DB28			R/W	-
049C	DF28			R/W	-
049D	O28_L			R/W	-
049E	O28_H			R/W	-
049F	SF28			R/W	-
04A0	PB29	PID09-OUT2	Same as above	R/W	-
04A1	IT29			R/W	-
04A2	DT29			R/W	-
04A3	MR29/DB29			R/W	-
04A4	DF29			R/W	-
04A5	O29_L			R/W	-
04A6	O29_H			R/W	-
04A7	SF29			R/W	-
04A8	PB210	PID10-OUT2	Same as above	R/W	-
04A9	IT210			R/W	-
04AA	DT210			R/W	-
04AB	MR210/DB210			R/W	-
04AC	DF210			R/W	-
04AD	O210_L			R/W	-
04AE	O210_H			R/W	-
04AF	SF210			R/W	-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
04C0	ZSP1	CH1 side No.1 PID zone: Within measuring range	R/W	-
04C1	ZSP2	CH1 side No.2 PID zone: Within measuring range	R/W	-
04C2	ZSP3	CH1 side No.3 PID zone: Within measuring range	R/W	-
04C3	ZSP4	CH1 side No.4 PID zone: Within measuring range	R/W	-
04C4	ZSP5	CH1 side No.5 PID zone: Within measuring range	R/W	-
04C5	ZSP6	CH1 side No.6 PID zone: Within measuring range	R/W	-
04C6	ZSP7	CH1 side No.7 PID zone: Within measuring range	R/W	-
04C7	ZSP8	CH1 side No.8 PID zone: Within measuring range	R/W	-
04C8	ZSP9	CH1 side No.9 PID zone: Within measuring range	R/W	-
04C9	ZSP10	CH1 side No.10 PID zone: Within measuring range	R/W	-
04CA	ZHYS	CH1 zone hysteresis: 0 to 10000 digit	R/W	-
04CB	ZPID	CH1 zone PID mode 0: OFF 1: SV 2: PV	R/W	-
04CC	ZSP21	CH2 side No.1 PID zone: Within measuring range	R/W	-
04CD	ZSP22	CH2 side No.2 PID zone: Within measuring range	R/W	-
04CE	ZSP23	CH2 side No.3 PID zone: Within measuring range	R/W	-
04CF	ZSP24	CH2 side No.4 PID zone: Within measuring range	R/W	-
04D0	ZSP25	CH2 side No.5 PID zone: Within measuring range	R/W	-
04D1	ZSP26	CH2 side No.6 PID zone: Within measuring range	R/W	-
04D2	ZSP27	CH2 side No.7 PID zone: Within measuring range	R/W	-
04D3	ZSP28	CH2 side No.8 PID zone: Within measuring range	R/W	-
04D4	ZSP29	CH2 side No.9 PID zone: Within measuring range	R/W	-
04D5	ZSP210	CH2 side No.10 PID zone: Within measuring range	R/W	-
04D6	ZHYS2	CH2 zone hysteresis: 0 to 10000 digit	R/W	-
04D7	ZPID2	zone PID mode 0: OFF 1: SV 2: PV	R/W	-

04DF	DFMD	Hysteresis Mode: 0:Center 1:SVOFF 2:SVON	R/W	T

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0500	EV1_MD	Event1	CH information/operation mode Channel information (upper 8 bits) 0: CH1 1: CH2 Operation mode (lower 8 bits) 0: None 1: DEV Hi 2: DEV Low 3: DEV Out 4: DEV In 5: PV Hi 6: PV Low 7: S0 8: FIX 9: AT 10: MAN 11: LOGIC 12: RUN 13: HLD 14: GUA 15: STEP 16: PRG.END 17: TS1 18: TS2 19: TS3 20: TS4 21: TS5 22: TS6 23: TS7 24: TS8 25: Posi.H 26: Posi.L 27: POT.ER 28: HBA 29: HBL	R/W	-
0502	EV1_DF		Action Hysteresis 1 to 9999 digit 1 to 50% (26 and 27 above)	R/W	-
0503	EV1_STB		Standby action 0: OFF 1: 1 2: 2 3: 3	R/W	-
0504	EV1_TM		Delay time 0 to 9999Sec (0=OFF)	R/W	-
0505	EV1_CHR		Output characteristics 0: N.O. 1: N.C.	R/W	-
0508	EV2_MD	Event2	Same as above	R/W	-
050A	EV2_DF			R/W	-
050B	EV2_STB			R/W	-
050C	EV2_TM			R/W	-
050D	EV2_CHR			R/W	-
0510	EV3_MD	Event3	Same as above	R/W	-
0512	EV3_DF			R/W	-
0513	EV3_STB			R/W	-
0514	EV3_TM			R/W	-
0515	EV3_CHR			R/W	-

- If using SHIMADEN protocol in 2-loop specification, EV1_MD can be written with sub-addresses of 1 or 2, but the EV1_DF, EV1_STB, EV1_TM, EV1_CHR parameters can only be written to the sub-address corresponding to the channel assigned in the channel information of EV1_MD.

  The same applies for EV2_MD to EV3_MD and DO1_MD to DO13_MD.

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0518	DO1_MD	DO1	CH information/operation mode Channel information (upper 8 bits) 0: CH1 1: CH2 Operation mode (lower 8 bits) 0: None 1: DEV Hi 2: DEV Low 3: DEV Out 4: DEV In 5: PV Hi 6: PV Low 7: S0 8: FIX 9: AT 10: MAN 11: LOGIC 12: RUN 13: HLD 14: GUA 15: STEP 16: PRG.END 17: TS1 18: TS2 19: TS3 20: TS4 21: TS5 22: TS6 23: TS7 24: TS8 25: Posi.H 26: Posi.L 27: POT.ER 28: HBA 29: HBL	R/W	-
051A	DO1_DF		Action Hysteresis 1 to 9999 digit 1 to 50% (26 and 27 above)	R/W	-
051B	DO1_STB		Standby operation 0: OFF 1: 1 2: 2 3: 3	R/W	-
051C	DO1_TM		Delay time 0 to 9999 Sec (0=OFF)	R/W	-
051D	DO1_CHR		Output characteristics 0: N.O. 1: N.C.	R/W	-
0520	DO2_MD	DO2	Same as above	R/W	-
0522	DO2_DF			R/W	-
0523	DO2_STB			R/W	-
0524	DO2_TM			R/W	-
0525	DO2_CHR			R/W	-
0528	DO3_MD	DO3	Same as above	R/W	-
052A	DO3_DF			R/W	-
052B	DO3_STB			R/W	-
052C	DO3_TM			R/W	-
052D	DO3_CHR			R/W	-
0530	DO4_MD	DO4	Same as above	R/W	-
0532	DO4_DF			R/W	-
0533	DO4_STB			R/W	-
0534	DO4_TM			R/W	-
0535	DO4_CHR			R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0538	DO5_MD	DO5	CH information/operation mode Channel information (upper 8 bits) 0: CH1 1: CH2 Operation mode (lower 8 bits) 0: None 1: DEV Hi 2: DEV Low 3: DEV Out 4: DEV In 5: PV Hi 6: PV Low 7: S0 8: FIX 9: AT 10: MAN 11: LOGIC 12: RUN 13: HLD 14: GUA 15: STEP 16: PRG.END 17: TS1 18: TS2 19: TS3 20: TS4 21: TS5 22: TS6 23: TS7 24: TS8 25: Posi.H 26: Posi.L 27: POT.ER 28: HBA 29: HBL	R/W	-
053A	DO5_DF		Action Hysteresis 1 to 9999 digit 1 to 50% (26 and 27 above)	R/W	-
053B	DO5_STB		Standby action 0: OFF 1: 1 2: 2 3: 3	R/W	-
053C	DO5_TM		Delay time 0 to 9999Sec (0=OFF)	R/W	-
053D	DO5_CHR		Output characteristics 0: N.O. 1: N.C.	R/W	-
0540	DO6_MD	DO6	Same as above	R/W	-
0542	DO6_DF			R/W	-
0543	DO6_STB			R/W	-
0544	DO6_TM			R/W	-
0545	DO6_CHR			R/W	-
0548	DO7_MD	DO7	Same as above	R/W	-
054A	DO7_DF			R/W	-
054B	DO7_STB			R/W	-
054C	DO7_TM			R/W	-
054D	DO7_CHR			R/W	-
0550	DO8_MD	DO8	Same as above	R/W	-
0552	DO8_DF			R/W	-
0553	DO8_STB			R/W	-
0554	DO8_TM			R/W	-
0555	DO8_CHR			R/W	-
0558	DO9_MD	DO9	Same as above	R/W	-
055A	DO9_DF			R/W	-
055B	DO9_STB			R/W	-
055C	DO9_TM			R/W	-
055D	DO9_CHR			R/W	-

Data Addr. (Hex)	Parameter	Setting Range		R/W	T/B
0560	DO10_MD	DO10	CH information/operation mode Channel information (upper 8 bits) 0: CH1 1: CH2 Operation mode (lower 8 bits) 0: None 1: DEV Hi 2: DEV Low 3: DEV Out 4: DEV In 5: PV Hi 6: PV Low 7: S0 8: FIX 9: AT 10: MAN 11: LOGIC 12: RUN 13: HLD 14: GUA 15: STEP 16: PRG.END 17: TS1 18: TS2 19: TS3 20: TS4 21: TS5 22: TS6 23: TS7 24: TS8 25: Posi.H 26: Posi.L 27: POT.ER 28: HBA 29: HBL	R/W	-
0562	DO10_DF		Action Hysteresis 1 to 9999 digit 1 to 50% (26 and 27 above)	R/W	-
0563	DO10_STB		Standby action 0: OFF 1: 1 2: 2 3: 3	R/W	-
0564	DO10_TM		Delay time 0 to 9999 Sec (0=OFF)	R/W	-
0565	DO10_CHR		Output characteristics 0: N.O. 1: N.C.	R/W	-
0568	DO11_MD	DO11	Same as above	R/W	-
056A	DO11_DF			R/W	-
056B	DO11_STB			R/W	-
056C	DO11_TM			R/W	-
056D	DO11_CHR			R/W	-
0570	DO12_MD	DO12	Same as above	R/W	-
0572	DO12_DF			R/W	-
0573	DO12_STB			R/W	-
0574	DO12_TM			R/W	-
0575	DO12_CHR			R/W	-
0578	DO13_MD	DO13	Same as above	R/W	-
057A	DO13_DF			R/W	-
057B	DO13_STB			R/W	-
057C	DO13_TM			R/W	-
057D	DO13_CHR			R/W	-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0580	DI1	Channel information (upper 8 bits) 0: CH1 1: CH2 2: CH1+2 Operation mode (lower 8 bits) 1: RUN/RST (fixed)	R/W	-
0581	DI2	Channel information (upper 8 bits) 0: CH1 1: CH2 2: CH1+2 Operation mode (lower 8 bits) 0: None 1: RUN/RST 2: RST 3: HLD 4: ADV 5: FIX 6: MAN 7: LOGIC 12: Preset1 13: Preset2 14: Preset3	R/W	-
0582	DI3	Same as above	R/W	-
0583	DI4	Same as above	R/W	-
0584	DI5	Channel information (upper 8 bits) 0: CH1 1: CH2 2: CH1+2 Operation mode (lower 8 bits) 0: None 1: RUN/RST 2: RST 3: HLD 4: ADV 5: FIX 6: MAN 7: LOGIC 8: PTN2bit 9: PTN3bit 10: PTN4bit 11: PTN5bit 12: PTN5BCD	R/W	-
0585	DI6	Channel information (upper 8 bits) 0: CH1 1: CH2 2: CH1+2 Operation mode (lower 8 bits) 0: None 1: RUN/RST 2: RST 3: HLD 4: ADV 5: FIX 6: MAN 7: LOGIC	R/W	-
0586	DI7	Same as above	R/W	-
0587	DI8	Channel information (upper 8 bits) 0: CH1 1: CH2 2: CH1+2 Operation mode (lower 8 bits) 0: None 1: RUN/RST 2: RST 3: HLD 4: ADV 5: FIX 6: MAN 7: LOGIC 8: PTN2bit 9: PTN3bit	R/W	-
0588	DI9	Channel information (upper 8 bits) 0: CH1 1: CH2 2: CH1+2 Operation mode (lower 8 bits) 0: None 1: RUN/RST 2: RST 3: HLD 4: ADV 5: FIX 6: MAN 7: LOGIC	R/W	-
0589	DI10	Same as above	R/W	-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0590	HBA	Heater break alarm 0.0 to 50.0A (0.0=OFF)	R/W	-
0591	HLA	Heater loop alarm 0.0 to 50.0A (0.0=OFF)	R/W	-
0592	HBM	Heater break mode 0: Lock 1: Real	R/W	-
0597	HB_SEL	HB selection 0: OUT1 1: OUT2	R/W	-

05A0	AO1_MD	Analog output mode 1 0: PV 1: SV 2: DEV 3: OUT1 4: CH2_PV 5: CH2_SV 6: CH2_DEV 7: OUT2 8: Posi	R/W	-
05A1	AO1_L	Analog output 1 scaling PV, CH2_PV → Within measuring range SV, CH2_SV → Within SV limiter setting range DEV, CH2_DEV → -100.0 to 100.0% OUT1, OUT2 → 0.0 to 100.0% Note that Ao1 Sc_L ≠ Ao1 Sc_H Posi 0 to 100%	R/W	-
05A2	AO1_H		R/W	-
05A4	AO_MD	Same as above	R/W	-
05A5	AO2_L		R/W	-
05A6	AO2_H		R/W	-

05B0	COM MEM	Communication memory mode 0: EEP 1: RAM 2: R_E	R/W	-
05B1	COM_KIND	Communication mode type, 0=COM1, 1=COM2	R/W	-

0600	ACTMD	Output characteristics (1-output side) 0: Reverse 1: Direct	R/W	-
0601	01_CYC	Output 1 proportional cycle: 1 to 120 Sec	R/W	-
0604	02_CYC	Output 2 proportional cycle: 1 to 120 Sec	R/W	-
0607	ACTMD2	Output characteristics (2-output side) 0: Reverse 1: Direct	R/W	-
0608	OUT1_LMT	Output 1 rate-of-change limiter OFF to 100.0 %/s (OFF: 0.0)	R/W	-
0609	OUT2_LMT	Output 2 rate-of-change limiter OFF to 100.0 %/s (OFF: 0.0)	R/W	-
0610	ATP	Auto tuning points: 0 to 10000 digit	R/W	T
0611	KLOCK	Key lock 0: OFF 1: LOCK1 2: LOCK2 3: LOCK3	R/W	-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0614	OUT_MD	Output mode selection 0: Single 1: Dual	R/W	-
0619	O1ST_PR	Output 1 STBY preset value and error output	R/W	-
061A	ERROUT1	Without servo option mounted 0.0 to 100.0 With servo option mounted (FB ON) 0: Stop 1: Preset1 2: Preset2 3: Preset3 4: Preset4 5: Preset5 6: Preset6 7: Preset7 With servo option mounted (FB OFF) 0: Stop 1: Close 2: Open	R/W	-
061D	O2ST_PR	Same as above	R/W	-
061E	ERROUT2		R/W	-

064F	MORTOR_TM	Motor stroke time: 5 to 300 sec	R/W	-
0651	SER_FB	Servo feedback 0: OFF 1: ON	R/W	-
0652	SER_DB	Servo dead band: 0.2 to 10.0 %	R/W	-
0654	MAN_ST_DRC	Set position at restart 0: None 1: Close 2: Open	R/W	-
0655	ZS_MD	Zero span adjustment mode 0: Auto 1: Manual	R/W	-
0659	POT_ERR	Potentiometer error 0: Stop 1: Close 2: Open	R/W	-
066A	DI_SRV_PRE1	External input opening value preset 1: 0 to 100%	R/W	-
066B	DI_SRV_PRE2	External input opening value preset 2: 0 to 100%	R/W	-
066C	DI_SRV_PRE3	External input opening value preset 3: 0 to 100%	R/W	-
066D	DI_SRV_PRE4	External input opening value preset 4: 0 to 100%	R/W	-
066E	DI_SRV_PRE5	External input opening value preset 5: 0 to 100%	R/W	-
066F	DI_SRV_PRE6	External input opening value preset 6: 0 to 100%	R/W	-
0670	DI_SRV_PRE7	External input opening value preset 7: 0 to 100%	R/W	-

0700	PV_BS1	INPUT 1/2 PV slope: 0.500 to 1.500	R/W	T
0701	PV_B1	INPUT 1/2 PV bias: -10000 to 10000 digit	R/W	T
0702	PV_F1	INPUT 1/2 PV filter: OFF, 1 to 100 sec (OFF=0)	R/W	T

0706	CJ	Cold junction compensation 0: Internal 1: External	R/W	T

070F	SCO_MD	Action at occurrence of scale over: 0, 1	R/W	-

- For details, refer to "9-1 Setup of 2-Input Operation" in the Instruction Manual.

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0714	PV_BS3	INPUT 2 PV slope: 0.500 to 1.500	R/W	-
0715	PV_B3	INPUT 2 PV bias: -10000 to 10000 digit	R/W	-
0716	PV_F3	INPUT 2 PV filter: OFF, 1 to 100 sec (OFF=0)	R/W	-

• The above three parameters are setting items on the 2-input side in the case of 2-input operations.

071E	RUN_DI_MD	RUN / RST DI mode 0: Edge 1: Level	R/W	-

0720	A1	Ten-segment linearizer input 1: -5.00 to 105.00%	R/W	T
0721	B1	Ten-segment linearizer output 1: -5.00 to 105.00%	R/W	T
0722	A2	Ten-segment linearizer input 2: -5.00 to 105.00%	R/W	T
0723	B2	Ten-segment linearizer output 2: -5.00 to 105.00%	R/W	T
0724	A3	Ten-segment linearizer input 3: -5.00 to 105.00%	R/W	T
0725	B3	Ten-segment linearizer output 3: -5.00 to 105.00%	R/W	T
0726	A4	Ten-segment linearizer input 4: -5.00 to 105.00%	R/W	T
0727	B4	Ten-segment linearizer output 4: -5.00 to 105.00%	R/W	T
0728	A5	Ten-segment linearizer input 5: -5.00 to 105.00%	R/W	T
0729	B5	Ten-segment linearizer output 5: -5.00 to 105.00%	R/W	T
072A	A6	Ten-segment linearizer input 6: -5.00 to 105.00%	R/W	T
072B	B6	Ten-segment linearizer output 6: -5.00 to 105.00%	R/W	T
072C	A7	Ten-segment linearizer input 7: -5.00 to 105.00%	R/W	T
072D	B7	Ten-segment linearizer output 7: -5.00 to 105.00%	R/W	T
072E	A8	Ten-segment linearizer input 8: -5.00 to 105.00%	R/W	T
072F	B8	Ten-segment linearizer output 8: -5.00 to 105.00%	R/W	T
0730	A9	Ten-segment linearizer input 9: -5.00 to 105.00%	R/W	T
0731	B9	Ten-segment linearizer output 9: -5.00 to 105.00%	R/W	T
0732	A10	Ten-segment linearizer input 10: -5.00 to 105.00%	R/W	T
0733	B10	Ten-segment linearizer output 10: -5.00 to 105.00%	R/W	T
0734	A11	Ten-segment linearizer input 11: -5.00 to 105.00%	R/W	T
0735	B11	Ten-segment linearizer output 11: -5.00 to 105.00%	R/W	T
0736	APPR	Ten-segment linearizer 0: OFF 1: ON	R/W	T
0737	LCUT	Low cut at linear input: 1.0 to 5.0%	R/W	T
0738	SQRT	Square root operation at linear input 0: OFF 1: ON	R/W	T

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0800	PRG_MD	Program mode 0: PROG 1: FIX	R/W	T
0802	ST_PTN	Start pattern No.: 1 to 20	R/W	T
0805	LNK_PTN	Link repeat count: 0 to 9999	R/W	T
0806	Link_01/02	Link information 01-02 upper 8 bits/lower 8 bits	R/W	T
0807	Link_03/04	Link information 03-04 upper 8 bits/lower 8 bits	R/W	T
0808	Link_05/06	Link information 05-06 upper 8 bits/lower 8 bits	R/W	T
0809	Link_07/08	Link information 07-08 upper 8 bits/lower 8 bits	R/W	T
080A	Link_09/10	Link information 09-10 upper 8 bits/lower 8 bits	R/W	T
080B	Link_11/12	Link information 11-12 upper 8 bits/lower 8 bits	R/W	T
080C	Link_13/14	Link information 13-14 upper 8 bits/lower 8 bits	R/W	T
080D	Link_15/16	Link information 15-16 upper 8 bits/lower 8 bits	R/W	T
080E	Link_17/18	Link information 17-18 upper 8 bits/lower 8 bits	R/W	T
080F	Link_19/20	Link information 19-20 upper 8 bits/lower 8 bits	R/W	T
0810	ADV_MD	Advance mode 0: Step 1: Time	R/W	T
0811	ADV_TM	Advance time: 00:00 to 99:59 sec/min	R/W	T
0812	PRG_WAIT	Program execution standby time: 00:00 to 99:59	R/W	T
0813	CH1_PTN	CH1 number of program patterns: 0 to 20 * It takes about one second to rewrite this parameter. So, attention must be paid when continuously writing parameters.	R/W	-
0815	EFIX	FIX Switching at Program End 0: OFF 1: ON	R/W	T
0819	TIM_MD	Time mode 0: H/M 1: M/S	R/W	T
081A	SHT_MD	Momentary stop mode 0: RESET 1: CONTINUE	R/W	T
081B	SCO_PMD	Input error mode 0: HLD 1: RUN 2: RESET	R/W	T

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0820	FIX_PID	FIX MODE PID No.: 0 to 10	R/W	T
0821	FIX_MOVE	FIX MOVE 0: EXE 1: EXE/STBY 2: EXE/TRCK	R/W	T
0830	FIX_EV1	FIX MODE EV1 action point DEV_Hi, DEV_Low assignment: -25000 to 25000 digit DEV_Out, DEV_In assignment: 0 to 25000 digit v_Hi, PV_Low assignment: Within measuring range	R/W	-
0831	FIX_EV2	Same as above	R/W	-
0832	FIX_EV3	Same as above	R/W	-
0833	FIX_D01	Same as above	R/W	-
0834	FIX_DO2	Same as above	R/W	-
0835	FIX_DO3	Same as above	R/W	-
0836	FIX_DO4	Same as above	R/W	-
0837	FIX_DO5	Same as above	R/W	-
0838	FIX_DO6	Same as above	R/W	-
0839	FIX_DO7	Same as above	R/W	-
083A	FIX_DO8	Same as above	R/W	-
083B	FIX_DO9	Same as above	R/W	-
083C	FIX_DO10	Same as above	R/W	-
083D	FIX_DO11	Same as above	R/W	-
083E	FIX_DO12	Same as above	R/W	-
083F	FIX_DO13	Same as above	R/W	-

■ About data of address “0902” onwards

The pattern No. and step No. must be specified to address “0902” onwards for reading and writing/ Before reading/writing data of address “0902” onwards write the pattern No. at address “0900”

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0900	PTN_NO	Pattern No. Note	R/W	-
0901	STP_NO	Step No. Note	R/W	-

Note: Becomes a write to RAM regardless of the memory mode.

0902	P_ST_PTN	Pattern start step No.: Within number of steps range	R/W	T
0903	P_ED_STP	Number of pattern steps * It takes about one second to rewrite this parameter. So, attention must be paid when continuously writing parameters.	R/W	-
0904	Reserved	Reserved		-
0905	P_RTP	Pattern repeat execution count: 1 to 9999	R/W	-
0906	P_ST_SV	Pattern start SV value: Within SV limiter setting range	R/W	-
0907	P_GUA_Z	Pattern guarantee soak zone OFF, 1 to 9999 (OFF=0)	R/W	-
0908	P_GUA_T	Pattern guarantee soak zone time: 00:00 to 99:59 (unit: sec or min)	R/W	-
0909	P_PV_ST	Pattern PV start 0: OFF 1: ON	R/W	-
090A	P_RPT_ST	Pattern repeat start step No.: 1 to number of steps	R/W	-
090B	P_RTP_ED	Pattern repeat end step No.: 1 to number of steps	R/W	-
090C	P_STP_RPT	Pattern loop execution count: 1 to 9999	R/W	-
090D	Reserved	Reserved		-
090E	Reserved	Reserved		-
090F	Reserved	Reserved		-
0910	Reserved	Reserved		-
0911	Reserved	Reserved		-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0912	P_EV1	Pattern EV1 action point DEV_Hi, DEV_Low assignment: -25000 to 25000 digit DEV_Out, DEV_In assignment: 0 to 25000 digit PV_Hi, PV_Low assignment: Within measuring range Posi.H, Posi.L: 0 to 100%	R/W	-
0913	P_EV2	Same as above	R/W	-
0914	P_EV3	Same as above	R/W	-
0915	P_DO1	Same as above	R/W	-
0916	P_DO2	Same as above	R/W	-
0917	P_DO3	Same as above	R/W	-
0918	P_DO4	Same as above	R/W	-
0919	P_DO5	Same as above	R/W	-
091A	P_DO6	Same as above	R/W	-
091B	P_DO7	Same as above	R/W	-
091C	P_DO8	Same as above	R/W	-
091D	P_DO9	Same as above	R/W	-
091E	P_DO10	Same as above	R/W	-
091F	P_DO11	Same as above	R/W	-
0920	P_DO12	Same as above	R/W	-
0921	P_DO13	Same as above	R/W	-

0922	P_TS1_ST	Pattern time signal 1 ON step No.: OFF, 1 to number of steps (OFF=0)	R/W	-
0923	P_TS1_ED	Pattern time signal 1 OFF step No.: OFF, 1 to number of steps (OFF=0)	R/W	-
0924	P_TS1_ON	Pattern time signal 1 ON time: 00:00 to 99:59 (unit: sec or min)	R/W	-
0925	P_TS1_OFF	Pattern time signal 1 OFF time: 00:00 to 99:59 (unit: sec or min)	R/W	-
0926	P_TS2_ST	Same as above	R/W	-
0927	P_TS2_ED		R/W	-
0928	P_TS2_ON		R/W	-
0929	P_TS2_OFF		R/W	-
092A	P_TS3_ST	Same as above	R/W	-
092B	P_TS3_ED		R/W	-
092C	P_TS3_ON		R/W	-
092D	P_TS3_OFF		R/W	-

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
092E	P_TS4_ST	Pattern time signal 4 ON step No.: OFF, 1 to number of steps (OFF=0)	R/W	-
092F	P_TS4_ED	Pattern time signal 4 OFF step No.: OFF, 1 to number of steps (OFF=0)	R/W	-
0930	P_TS4_ON	Pattern time signal 4 ON time: 00:00 to 99:59 (unit: sec or min)	R/W	-
0931	P_TS4_OFF	Pattern time signal 4 OFF time: 00:00 to 99:59 (unit: sec or min)	R/W	-
0932	P_TS5_ST	Same as above	R/W	-
0933	P_TS5_ED		R/W	-
0934	P_TS5_ON		R/W	-
0935	P_TS5_OFF		R/W	-
0936	P_TS6_ST	Same as above	R/W	-
0937	P_TS6_ED		R/W	-
0938	P_TS6_ON		R/W	-
0939	P_TS6_OFF		R/W	-
093A	P_TS7_ST	Same as above	R/W	-
093B	P_TS7_ED		R/W	-
093C	P_TS7_ON		R/W	-
093D	P_TS7_OFF		R/W	-
093E	P_TS8_ST	Same as above	R/W	-
093F	P_TS8_ED		R/W	-
0940	P_TS8_ON		R/W	-
0941	P_TS8_OFF		R/W	-

0950	STEP_SV	Step SV value: Within measuring range	R/W	-
0951	STEP_TM	Step time: 00:00 to 99:59 (unit: sec or min)	R/W	-
0952	STEP_PID	Step PID No.: 0 to 10	R/W	-

15 SERVO SETUP

15-1 Overview of Setup Procedure

⚠ Caution

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

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

■ For "With Feedback"

Procedure	Refer to
1. Check wiring	—
2. Select FB = ON from the setting screen for FB parameter. This setting can be made only when STBY = ON is selected	15-4(1)
3. Check wiring for the feedback potentiometer.	—
4. Setting of action characteristics (ACT)	15-2(1)
5. Setting of output at RST	15-2(2)
6. Setting of output at ERR	15-2(3)
7. Setting of output at feedback potentiometer error	15-2(4)
8. Servo ZERO/SPAN adjustment	15-5
9. Confirmation/adjustment of DB (Dead Band)	15-4(2)

■ For "Without Feedback"

Procedure	Refer to
1. Check wiring	—
2. Select FB = OFF from the setting screen for FB parameter. This setting can be made only when STBY = ON is selected.	15-4(1)
3. Setting motor timing (TIME)	15-4(3)
4. Setting servo action on start-up (BOOT) Please be aware that the controller assumes the position of the motor to be 50% when BOOT is set to "Stop"	15-4(4)
5. Setting of Action Characteristics (ACT)	15-2(1)
6. Setting of output at RST	15-2(2)

7.	Setting of output at ERR	15-2(3)
8.	Servo ZERO/SPAN adjustment	15-5
9.	Confirmation/adjustment of DB (Dead Band)	15-4(2)

15-2 Control Output (Servo Output)

(1) Action characteristics

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

6-1

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

Setting range Reverse, Direct

Initial value Reverse

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

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

Note

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

(2) Output at reset

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

6-1 With Feedback

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

Setting range Stop, Preset1 to Preset7

Initial value Preset1

6-1 Without Feedback

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

Setting range Stop, Close, Open

Initial value Close

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

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

For more information, please refer to "15-3 (2) Setting Servo preset value".

Note

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

(3) Output at input error

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

6-1 With Feedback

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

Setting range Stop、Preset1 to Preset7

Initial value Stop

6-1 Without Feedback

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

Setting range Stop, Close, Open

Initial value Close

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

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

For more information, please refer to "15-3 (2) Setting Servo preset value".

Note

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

(4) Output at feedback potentiometer error

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

6-1

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

Setting range Stop, Close, Open

Initial value Stop

Note

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

(5) Rate-of-change limiter

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

6-2

```
Rate Limiter
 OUT▶ OFF
```

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

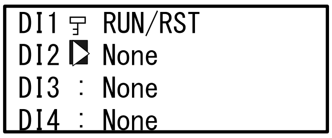
Note

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

15-3 Externally Switching Servo Preset Value

(1) Mechanism and action of external switching

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

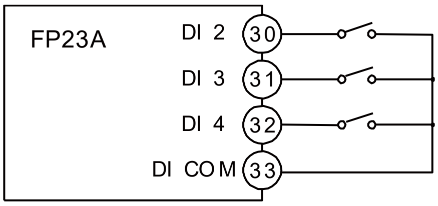


5-2

Preset1: 1 preset value switching by DI2

Preset2: 3 preset values (max.) switching by DI2 and DI3

Preset3: 7 preset values (max.) switching by DI2 to DI4



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

● : Indicates that the switch is ON.

Note

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

(2) Setting Servo preset value

■ For points"With Feedback (FB = ON)"

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

6-6

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

Setting range	0 to 100%
Initial value	0%

When one preset value is to be used, set it to P1 and assign the "Preset1" to DI2.
When up to 3 preset values are to be used, set them to P1 to P3 and assign the "Preset2" to DI2.
When up to 7 preset values are to be used, set them to P1 to P7 and assign the "Preset3" to DI2.
For more information on how to switch preset values, refer to the preceding section "15-3 (1) Mechanism and action of external switching".

■ For "Without Feedback (FB = OFF)"

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

15-4 Setting Servo Operations

(1) Setting Servo Feedback

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

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

6-3

```
SERVO FB▶ ON
      DB:   2.0%
```

Setting range	ON, OFF
Initial value	ON

(2) Setting Servo Dead Band

Set the dead band for action between "Open" and "Close" outputs.
Making the dead band smaller allows for more precise control.
However, if the dead band becomes too small, hunting may occur in output because the control motor may go too far due to its own inertia.
For the dead band (DB) and hysteresis, please refer to the "15-6 (6) Interrelation between Dead Band (DB) and hysteresis".

6-3

```
SERVO FB:  ON
      DB▶  2.0%
```

Setting range	0.2 to 10.0%
Initial value	2.0%

(3) Setting motor timing

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

6-4

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

Setting range	5 to 300s
Initial value	60s

Note

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

(4) Setting Servo action on start-up

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

6-4

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

Setting range	Stop, Close, Open
Initial value	Close

Stop	Enter the control operation with the motor position as it is. Enter the control operation by assuming the position of the motor to be 50% since the actual position is undetectable.
Close	Enter the control operation after setting to the fully closed position by outputting the Close signal for motor timing (TIME). Note that the motor moves to the fully closed position on start-up.
Open	Enter the control operation after setting to the fully opened position by outputting the Open signal for motor timing (TIME). Note that the motor moves to the fully opened position on start-up.

15-5 Servo Adjustment

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

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

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

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

⚠ Caution

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

■ For "With Feedback (FB = ON)"

① Conducting ZERO/SPAN adjustment automatically

The adjustment process is automatically conducted in the order of the zero side → span side.

⚠ Caution

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

②Conducting ZERO/SPAN adjustment manually

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

⚠ Caution

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

■ For "Without Feedback (FB = OFF) "

① Conducting ZERO/SPAN adjustment automatically

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

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

② Conducting ZERO/SPAN adjustment manually

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

(2) ZERO/SPAN automatic adjustment

There are automatic and manual adjustments for ZERO/SPAN adjustment.
In this section, you will find a description for ZERO/SPAN automatic adjustment.

For ZERO/SPAN manual adjustment, refer to the next section "15-5 (3) ZERO/SPAN manual adjustment".

For points to be attended to when conducting ZERO/SPAN adjustment, refer to the section "15-5 (1) Points for ZERO/SPAN adjustment and the operation".

■ For "With Feedback"

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

6-5

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

① Mode switching

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

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

② Starting automatic adjustment

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

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

③ Fix of ZERO position

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

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

④ Fix of SPAN position

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

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

⚠ Caution

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

■ For "Without Feedback"

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

6-5

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

① **Mode switching**

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

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

② **Starting manual adjustment**

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

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

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

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

Conduct output for motor action time and the position where it stops is regarded as the close position.

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

④ **Fix the SPAN position at the open position (For "BOOT = Open")**

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

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

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

(3) ZERO/SPAN manual adjustment

In this section, ZERO/SPAN manual adjustment procedure is described.

For ZERO/SPAN automatic adjustment, refer to the preceding section "15-5 (2) ZERO/SPAN automatic adjustment".

ZERO/SPAN positions may be manually adjusted.

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

For points to be attended to when conducting ZERO/SPAN adjustment, refer to the section "15-5 (1) Points for ZERO/SPAN adjustment and the operation".

■ For "With Feedback"

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

6-5
```
SERVO  Calibration
 EXE:  Stop   MD▶ Manual
 ZERO〒     ---      4.5
 SPAN〒     ---     65.5
```

① Mode switching

Set the MD (mode) to "Manual".

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

② Starting manual adjustment

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

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

③ Fix of ZERO position

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

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

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

④ Fix of SPAN position

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

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

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

⚠ Caution

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

■ In case of "Without Feedback"

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

6-5
```
SERVO  Calibration
 EXE: Stop   MD▶Manual
 ZERO      ---
 SPAN      ---
```

① Mode switching

Set the MD (mode) to "Manual".

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

② Starting manual adjustment

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

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

③ Fix of ZERO position

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

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

④ Fix of SPAN position

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

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

(4) Adjustment of Dead Band (DB)

The following have the same content as that described in the section "15-4 (2) Setting Servo Dead Band".
To prevent hunting events caused by excessive sensitivity, conduct procedures for adjusting of dead band.
Set the dead band for Open and Close outputs.
Making the dead band smaller allows for more precise control.
However, if the dead band becomes too small, hunting may occur in output because the control motor may go too far due to its own inertia.

6-3
```
SERVO FB:  ON
      DB▶  2.0%
```

Setting range	0.2 to 10.0%
Initial value	2.0%

15-6 Servo Functions

(1) Priority of actions at Servo output

Priority at Servo Output is as follows:

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

(2) MAN Actions at Servo Output

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

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

The action differs according to the setting condition.

■ For "With Feedback (FB = ON)"

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

■ For "Without Feedback (FB = OFF)"

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

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

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

■ For "DI Input = OFF"

PID control output is performed.

(4) Output limiter

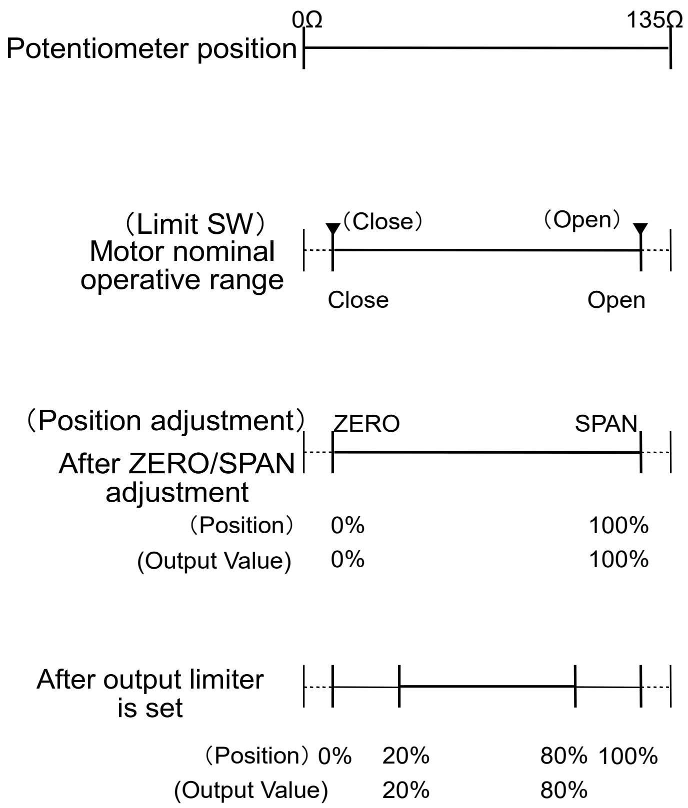
Action under the MAN mode and Preset output may not be affected by the output limiter.
The action is as follows at PID control output.

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

(5) Servo Action

■ Control output value and position

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



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

■ For "With Feedback"

⚠ Caution

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

■ For "Without Feedback"

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

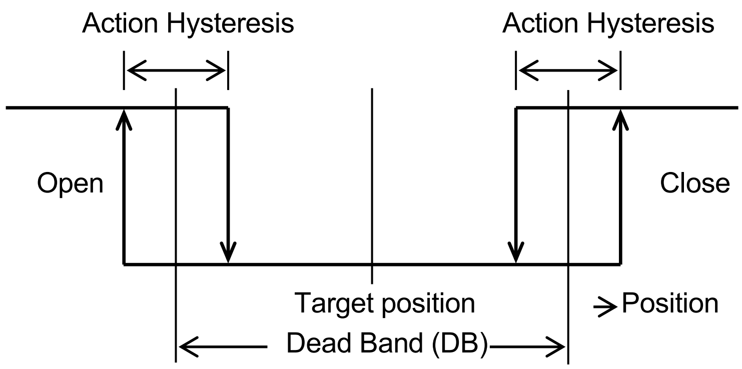
At 0%	Outputs Close signals for approx. 5% of the motor timing (TIME) every 30 seconds.
At 100%	Outputs Open signals for approx. 5% of the motor timing (TIME) every 30 seconds.

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

There is the following interrelation between dead band and hysteresis.

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

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



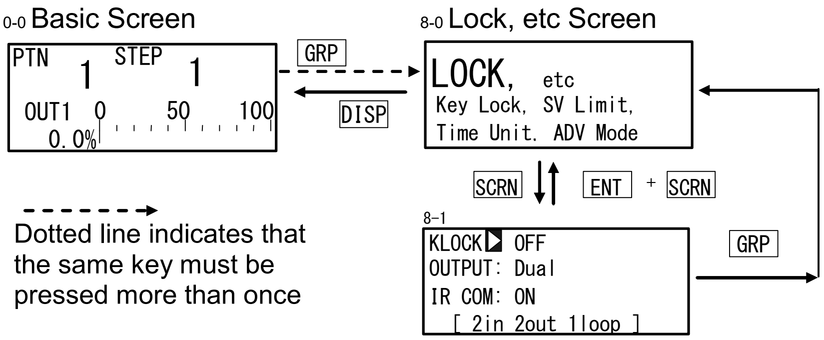
16 KEY LOCK SETTING

16-1 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.

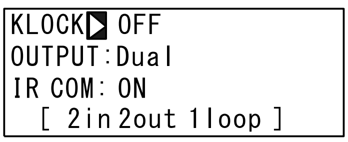
Set parameters by pressing the ◀ ▼ or ▲ key, and press the ENT key to fix and register settings.



(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 EV/DO parameters.
LOCK2　Locks parameters other than SV-related parameters.
LOCK3　Locks all parameters. (excluding the key lock parameter itself)

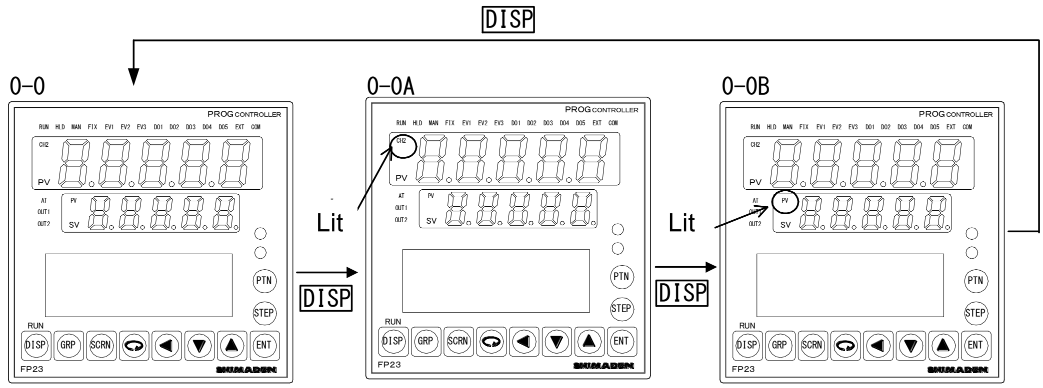
For details on parameters that are locked, see "20 List of Parameters."

17 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.

17-1 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

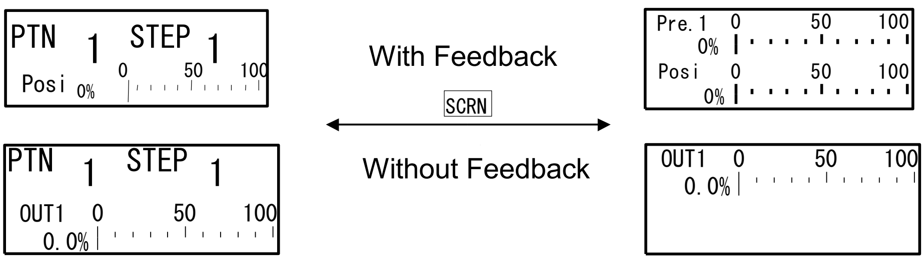
Even if the Basic screen transits to another by pressing the GRP key, PV/SV display shows values for the current channel. The Basic screen, which returns by pressing a DISP key, indicates the contents that are shown just before the pressing the GRP key.

17-2 Expansion of Basic Screen with Basic Function MS (Servo Output)

(1) Control output (OUT1/Posi)

0-0 Basic screen

0-1 Output monitor



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

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

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

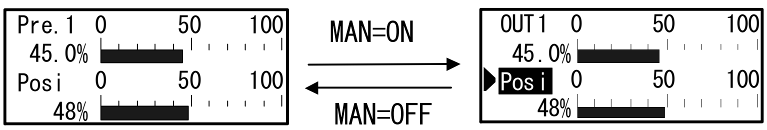
When used with Feedback, the output monitor displays OUT1 (control output) on the upper row and Posi (position value) on the lower row as a percentage (%) of the output value and a bar graph. When OUT1 or Posi is highlighted, this means that the controller is in the Manual mode (MAN=ON).
Under the Manual mode, the motor can be controlled directly by holding the ▲ key to perform Open output ON, or by holding the ▼ key to perform Close output ON.
For details about Manual mode, refer to "18-3 Switching Auto/Manual of Control Output".

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

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

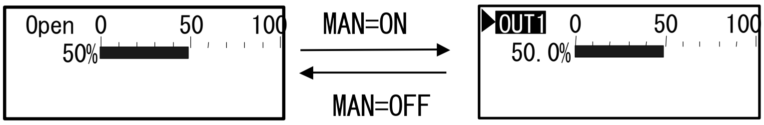
■ For with Feedback

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



■ For without Feedback

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



■ Operation when returning from Manual mode

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

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

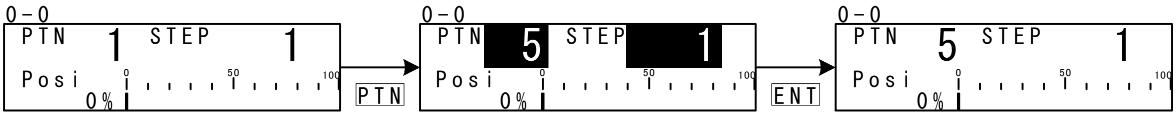
17-3 Operations in Basic Screen

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

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

(1) Setting the start pattern

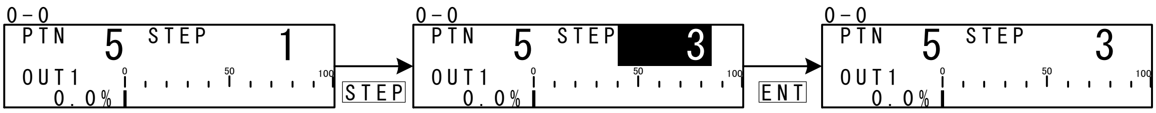
Set the start pattern before the program is started.
When the PTN key is pressed in Basic screen group top screen, the program pattern No. on the LCD display blinks and is incremented. (It can also be changed by the ▼ or ▲ key if it is blinking.)
When you press the ENT key after changing the program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



Press 4 times

(2) Setting the start step

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

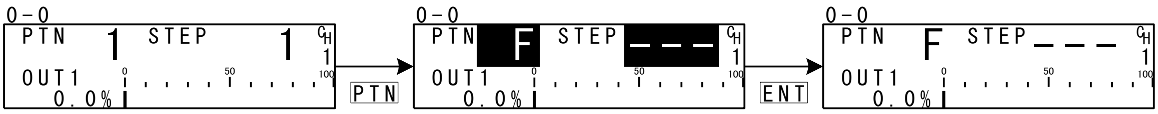


Press 2 times

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

(3) Setting the FIX mode

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



Note

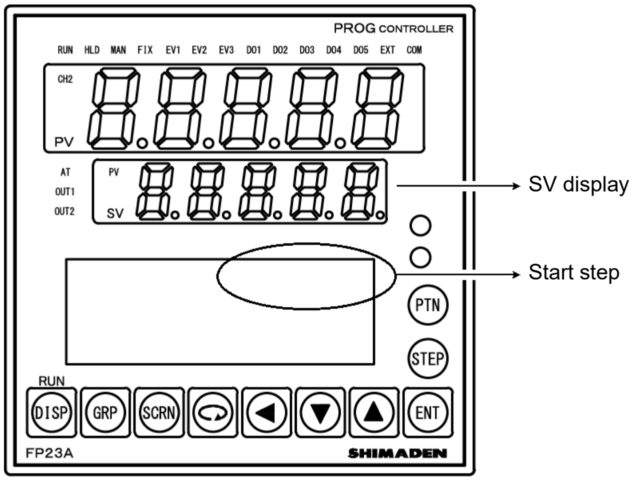
- When the mode is changed from the Program mode to the FIX mode, the move operation changes depending on the FIX MOVE setting.
For details, see "11-4 FIX MOVE."

(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.

17-4 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	
2～400	Previous step's SV	
— — —		FIX SV

17-5 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 FP23A 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.

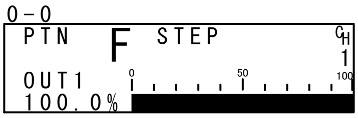
In the Basic screen (In 2-loop specification, the Basic screen of the controlling channel), press the ENT + DISP keys, to start (RUN lamp lit) / stop control.

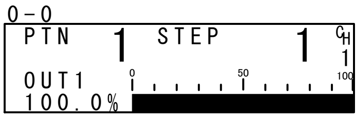
18 OPERATIONS DURING CONTROL

18-1 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.

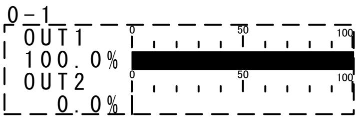




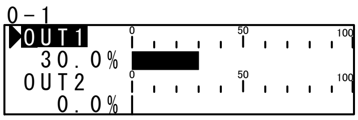
(2) Output value display

■ For basic functions other than MS

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.

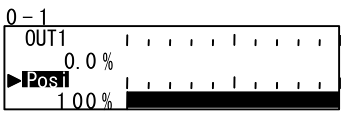


During manual output, OUT1 or OUT2 can be selected by the key, and output can be adjusted by operating the ◀, ▼ or ▲ key. For details, refer to “18-3 Switching Auto/Manual of Control Output”.



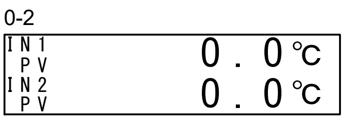
■ For basic function MS

The output values of Control Output 1 (OUT1) and position value (Posi) are displayed on the upper and lower sections, respectively, as a % and a bar graph.
During manual output, output can be adjusted by operating the ▲ or ▼ key. For details, refer to "18-3 Switching Auto/Manual of Control Output".



(3) PV monitor

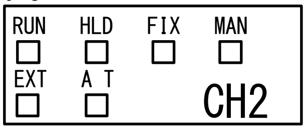
This screen is shown only for 2-input operation.
This is a monitoring screen to check input 1 or input 2 PV value, different from execution PV value.



(4) Status monitor

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

0-3



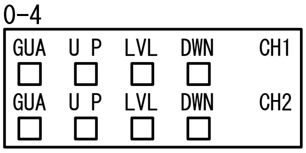
When any condition is detected, each of the □ located subjacent to each parameter display will blink, or ■ is lit reversed.

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 PTN5BCD) 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.

0-4

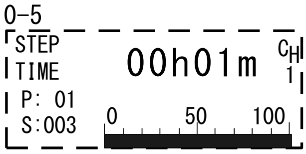


GUA	Lights in guarantee soak.
UP	Lights at execution of ascending step.
LVL	Lights at execution of flat step.
DWN	Lights at execution of descending step.

(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.

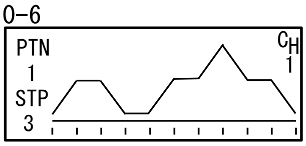
0-5



(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.

0-6



(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.

```
0-7
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).

```
0-8
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

18-2 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
Preset Output	Auto tuning can not be executed	Auto tuning can not be executed
Feedback potentiometer error	Auto tuning can not be executed	Auto tuning can not be executed

■ Auto tuning end conditions

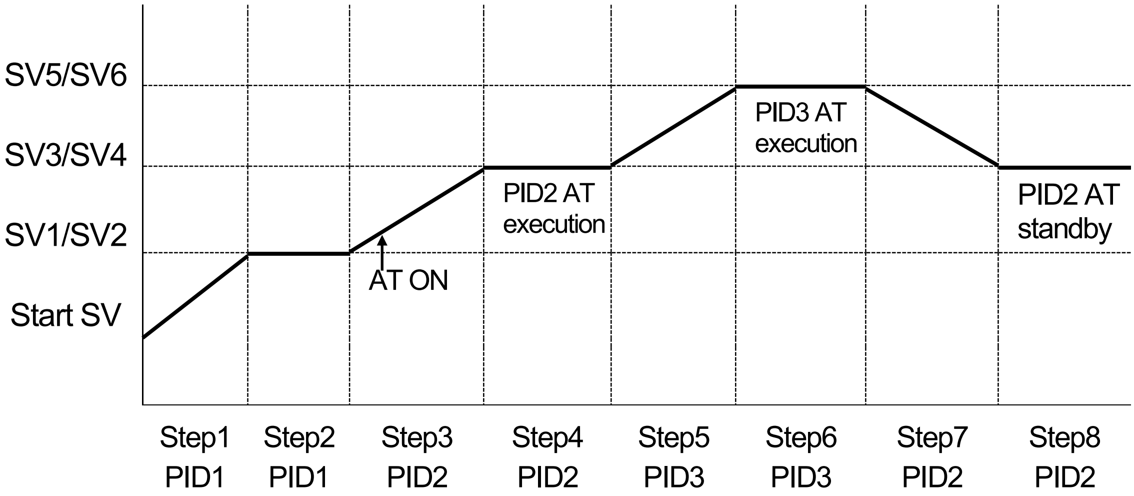
	Program Mode	FIX Mode
When the RUN state changes to the reset (RST) state	End of auto tuning	End of auto tuning
When output has elapsed for about 200 minutes in a 0% or 100% state	End of auto tuning	End of auto tuning
At power interruption	End of auto tuning	End of auto tuning
When PID operation has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

■ About auto tuning during program control

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

(1) If the FP23A 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.

18-3 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

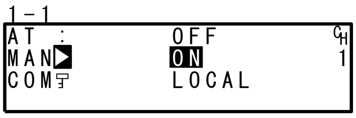
The manual execution conditions (common to front panel keys and external switch input) are as follows:

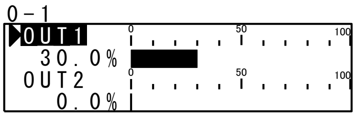
(1) AT must not be in progress.
(2) The FP23A must not be in a Reset (RST) state.

(1) Manual output operations

■ For basic functions other than MS

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.

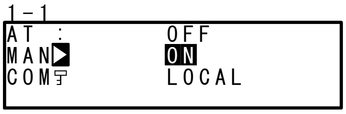
3. You can select OUT1 or OUT2 by the ↩ key, and adjust the output by the ◀, ▼ or ▲ key.

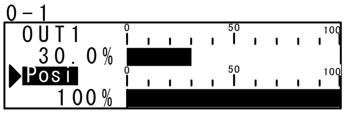
There is no need to register and fix settings by the ENT key.

Note

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

■ For basic function MS





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

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

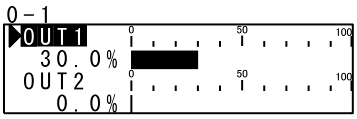
3. Next, to perform control output manually, move to the basic screen (group 0) by the [DISP] key, and move to the output value display (No. 0-1) screen by the [SCRN] key.

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

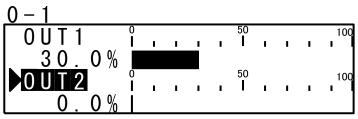
(2) Simple key-based manual output operations

■ For basic functions other than MS

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.



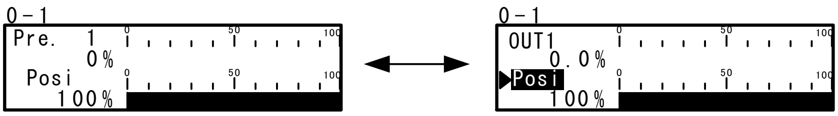
[ENT] + [▲]



[ENT] + [▼]

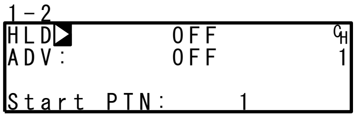
■ For basic function MS

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



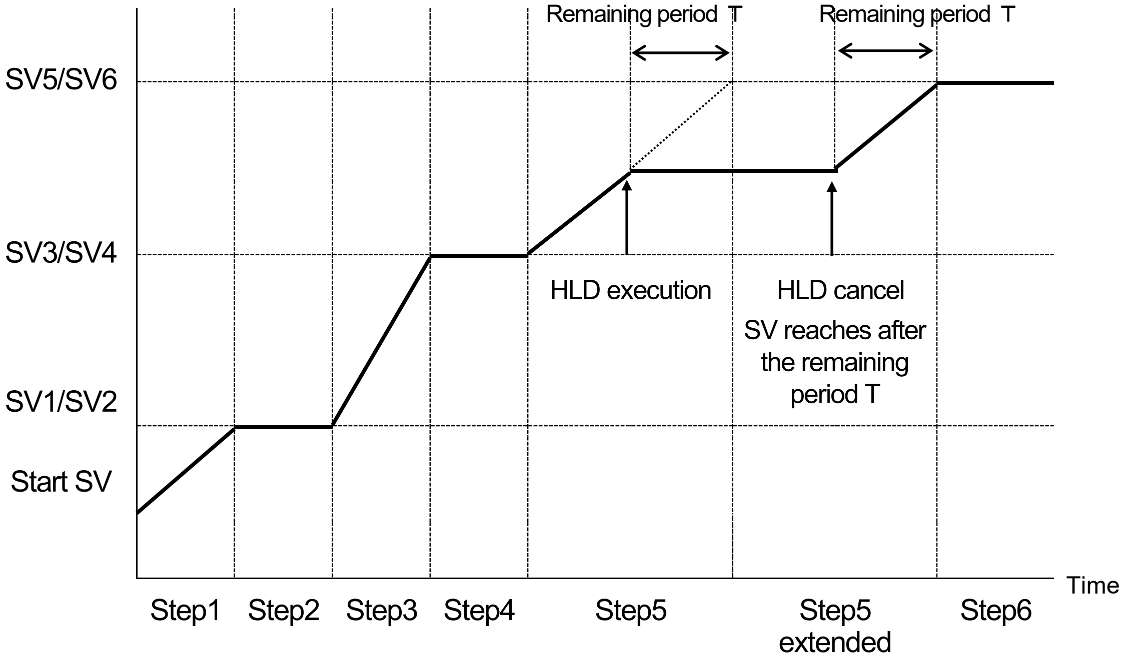
18-4 Temporarily Holding (HLD) and Resuming Program Execution

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.



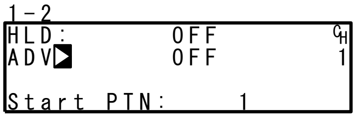
*1 HLD is enabled even in the guarantee soak.
*2 ADV cannot be executed during HLD.
*3 HLD operation by key entry or communication is enabled only when DI is not assigned. (DI input is given priority.)
*4 When a program is executed with HLD DI input ON, program execution is dependent on the SV value 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.

18-5 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 "10-1 (5) Advance mode." and "10-1 (6) Advance time."

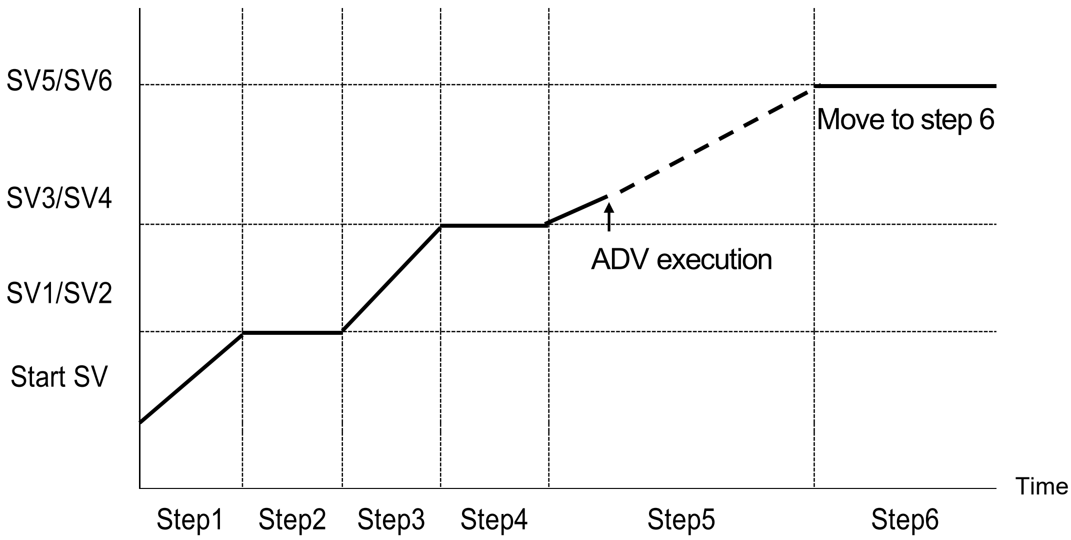


Setting range	ON, OFF
Initial value	OFF

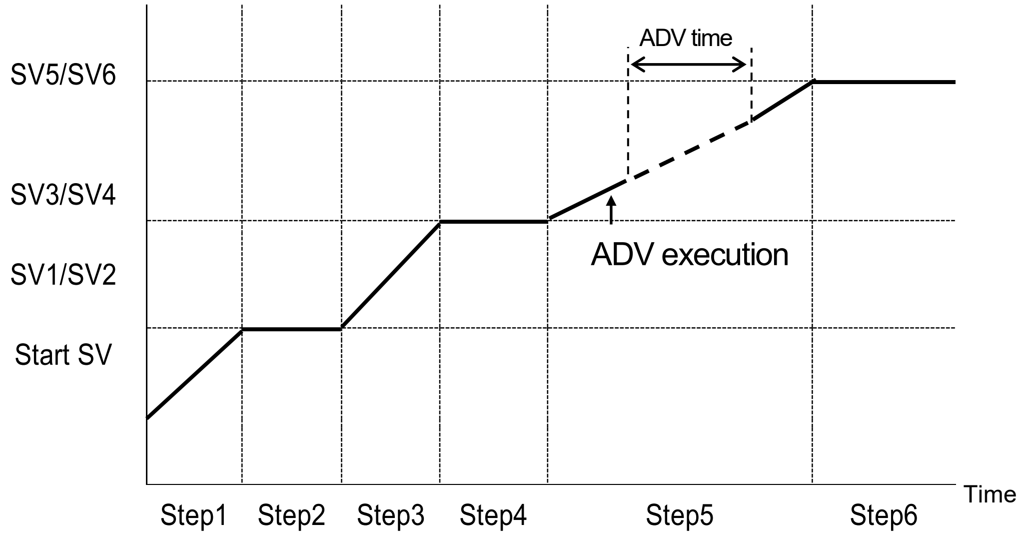
Note

- 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.

19 ERROR DISPLAYS

19-1 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.

19-2 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.

19-3 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.

19-4 Feedback Potentiometer Error

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

Display	Cause
ERROR	Feedback potentiometer error

20 LIST OF PARAMETERS

This chapter lists all of the parameters used by the FP23A.
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, digit setting or PV scaling setting has been changed. Parameters marked by * may need to be confirmed again when the above settings have been changed.

20-1 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 digit	3
FIX PID	FIX PID No. selection	1 to 10	1	1
FIX MOVE	FIX move selection	EXE EXE/STBY EXE/TRCK	EXE	1
FIX EV Set Point EV1 to EV3 *	FIX EV action point setting	DEV_Hi :-25000 to 25000 digit DEV_Low :-25000 to 25000 digit DEV_Out :0 to 25000 digit DEV_In :0 to 25000 digit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 digit -25000 digit 25000 digit 25000 digit Measuring range higher limit value Measuring range lower limit value 100% 0%	2

Symbol	Description of Function	Setting Range	Initial Value	Lock
FIX DO Set Point DO1 to DO13*	FIX DO action point setting	DEV_Hi :-25000 to 25000 digit DEV_Low :-25000 to 25000 digit DEV_Out :0 to 25000 digit DEV_In :0 to 25000 digit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 digit -25000 digit 25000 digit 25000 digit Measuring range higher limit value Measuring range lower limit value 100% 0%	2

20-2 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 digit	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 digit	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 digit DEV_Low :-25000 to 25000 digit DEV_Out :0 to 25000 digit DEV_In :0 to 25000 digit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 digit -25000 digit 25000 digit 25000 digit Measuring range higher limit value Measuring range lower limit value 100% 0%	2
DO Set Point DO1 to DO13 *	DO action point setting	DEV_Hi :-25000 to 25000 digit DEV_Low :-25000 to 25000 digit DEV_Out :0 to 25000 digit DEV_In :0 to 25000 digit PV_Hi :Within measuring range PV_Low :Within measuring range Posi.H :0 to 100% Posi.L :0 to 100%	25000 digit -25000 digit 25000 digit 25000 digit Measuring range higher limit value Measuring range lower limit value 100% 0%	2
TS1 to TS8				
ON STEP	Time signal ON step	OFF, 1 to number of steps	OFF	1
ON Time	Time signal ON time	00:00 to 99:59	00:00	1
OFF STEP	Time signal OFF step	OFF, 1 to number of steps	OFF	1
OFF Time	Time signal OFF time	00:00 to 99:59	00:00	1

20-3 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 digit	3
Time	Step time	00:00 to 99:59	00:01	1
PID	Step PID No.	0 to 10	0	1

20-4 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 digit	20 digit	1
MR	No.1 manual reset (OUT1)	-50.0 to 50.0 %	0.0 %	1
SF	No.1 set value function (OUT1)	0.00 to 1.00	0.40	1
ZN *	No.1 PID zone (OUT1)	Within measuring range	0 digit	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 digit	20 digit	1
DB *	No.1 dead band (OUT2)	-19999 to 20000 digit	0 digit	1
MR	No.1 manual reset (CH2)	-50.0 to 50.0 %	0.0 %	1
SF	No.1 Set value function (OUT2) (CH2)	0.00 to 1.00	0.40	1
ZN *	No.1 PID zone (CH2)	Within measuring range	0 digit	1
PID01-1 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 digit	20 digit	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 digit	20 digit	1
AT Point *	Auto tuning point	0 to 10000 digit	0	1
DF Mode	Hysteresis Mode	Center SV OFF SV ON	Center	1

20-5 EVENT/DO Screen Group (group 4)

Symbol	Description of Function	Setting Range	Initial Value	Lock
EV1 to EV3, DO1 to DO13				
MD	Operation mode	None : No action DEV Hi : Higher limit deviation DEV Low : Lower limit deviation DEV Out : Outside higher/lower limit deviation DEV In : Inside higher/lower limit deviation PV Hi : PV higher limit absolute value PV Low : PV lower limit absolute value SO : Scale over FIX : In FIX mode AT : Auto tuning execution in progress MAN : Manual output LOGIC : Logic operation (*1 *2) Direct : Direct output (*3) RUN : RUN HLD : Program hold GUA : Guarantee soak zone STEP : Step signal PRG.END : Program end signal TS1 : Time signal 1 to TS8 : Time signal 8 Posi.H : Position higher limit absolute value (*4) Posi.L : Position lower limit absolute value (*4) POT.ER : Feedback potentiometer error (*4)	EV1: DEV Hi EV2: DEV Low EV3: RUN DO1 to 13: None	1
ACT	Output characteristics	N.O.: Normally open N.C.: Normally closed	N.O.	1
DF *	Hysteresis	1 to 9999 digit Posi.H, Posi.L: 1 to 50%	20 digit	1
IH	Standby action	OFF, 1/2/3	OFF	1
DLY	Delay time	OFF, 1 to 9999 s	OFF	1
EV1 to EV3 / DO1 to DO3				
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 DO13 with communication interface.
*4 This function is optional and is not displayed when it is not installed.

20-6 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)	RUN/RST	1
DI2	DI2 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC Preset1 Preset2 Preset3	None	1
DI3 DI4 DI6 DI7 DI9 DI10	DI3 assignment DI4 assignment DI6 assignment DI7 assignment DI9 assignment DI10 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC	None	1
RUN/RST MODE	RUN/RST DI mode	Edge Level	Edge	1
DI5	DI5 assignment	None RUN/RST RST HLD ADV FIX MAN LOGIC PTN2bit PTN3bit PTN4bit PTN5bit PTN5BCD	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:CH1Deviation value OUT1: Output value 1 CH2_PV: CH2 Measurement value CH2_SV: CH2 Setting value CH2_DEV: CH2 Deviation value OUT2: Output value 2 Posi: Position value	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 % Posi : 0 to 100%	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 % Posi : 0 to 100%	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 value 1 CH2_PV : CH2 Measurement value CH2_SV : CH2 Setting value CH2_DEV: CH2 Deviation value OUT2 : Output value 2 Posi : Position value	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 % Posi : 0.0 to 100%	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 % Posi : 0.0 to 100%	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	OUT1	1
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

Symbol	Description of Function	Setting Range	Initial Value	Lock
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
CMOD	Communication mode type	COM1, COM2	COM1	1

*1 SHIMADEN protocol only
- DI5 to DI10 and Ao1MD to BCC are optional and are not displayed when they are not installed.

20-7 Control Output Screen Group (group 6)

■ For basic functions other than MS

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.

■ For basic function MS

Symbol	Description of Function	Setting Range	Initial Value	Lock
OUT1 ACT	Output characteristics	Reverse: Reverse characteristics Direct: Direct characteristics	Reverse	1
RST	Output at reset	With FB: Stop, Preset1 to 7 Without FB: Stop, Close, Open	w FB: Preset1 w/o FB: Close	1
ERR	Output at error	With FB: Stop, Preset1 to 7 Without FB: Stop, Close, Open	w FB: Preset1 w/o FB: Close	1
POT.ER	Feedback potentiometer error	With FB (only): Stop, Close, Open	Stop	1

Symbol		Description of Function	Setting Range	Initial Value	Lock
Rate Limiter	OUT1	Output 1 rate-of-change limiter	OFF, 0.1 to 100.0 %/s	1	1
Servo	FB	Feedback potentiometer	ON: with feedback potentiometer OFF: without feedback potentiometer	ON	1
	DB	Dead band	0.2 to 10.0 %	2.0 %	1
Servo calib-ration	MD	Mode for ZERO/SPAN adjustment	Auto: Automatic control Manual: Manual control	Auto	1
	EXE	Execution of ZERO/SPAN adjustment	Stop Start	Stop	1
	ZERO	ZERO adjustment manually	Open Close	---	1
	SPAN	SPAN adjustment manually	Open Close	---	1
Servo preset	P1 P2 P3 P4 P5 P6 P7	Servo preset values	0 to 100%	0 %	1

20-8 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 digit	0 digit	1
PV Filter	PV filter	OFF, 1 to 100 Sec	OFF	1
PV Slope * *1	PV slope	0.500 to 1.500 digit	1.000 digit	1
INPUT1				
PV Bias *	PV bias	-10000 to 10000 digit	0 digit	1
PV Filter	PV filter	OFF, 1 to 100 Sec	OFF	1
PV Slope * *1	PV slope	0.500 to 1.500 digit	1.000 digit	1
INPUT2				
PV Bias *	PV bias	-10000 to 10000 digit	0 digit	1
PV Filter	PV filter	OFF,1 to 100 Sec	OFF	1
PV Slope * *1	PV slope	0.500 to 1.500 digit	1.000 digit	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 digit	0 digit	1
Sc_H *	PV higher limit side scaling	-19989 to 30000 digit	1000 digit	1

Symbol	Description of Function	Setting Range	Initial Value	Lock
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.

20-9 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 : No action CONTINUE : With action	RESET	1
ADV Mode	Advance mode	Step : Step Time : Time	Step	1
ADV Time	Advance time	00:00 to 99:59	00:00	1
PEND FIX	FIX Switching at Program End	ON Move to Fix control OFF Do not shift to FIX control	OFF	1
CH1 PTN	CH1 assigned pattern number	0 to 20	10	1

21 EXPLANATION OF SHIMADEN PROTOCOL

21-1 Communication Procedure

(1) Master and slave

The host (personal computer or PLC) is the master.
This device is the slave.
Communication starts by the communication command from the master, and ends by the communication response from the slave.
Note, however, that a communication response is not performed when an error (e.g. communication format error or BCC error) occurs, or when a broadcast command is issued.

(2) Communication procedure

Communication is performed by a response being returned by the slave to the master. During communication, the transmission right shifts between the master and the slave.

(3) Timeout

This device regards instances where reception of the end character does not end within one second of receiving the start character as a timeout, disables that command, and stands by for the next command (new start character).

21-2 Communication Format

This device supports various protocols, and so various selections can be made by the communication format (control codes, BCC operation method) or communication data format (data bit length, parity, stop bit length).
However, for ease of use and to avoid confusion when setting up communications, we recommend using the following format:

	Recommended Format	
Control code	STX_ETX_CR	
BCC operation method	ADD	
Data bit length	7	8
Parity	EVEN	NONE
Stop bit length	1	1

(1) Outline of communication format

The formats of the communications commands sent from the master and the communication response formats sent from the slave comprise three blocks: basic format section I, text section and basic format section II.

Basic format sections I and II are common to the Read command (R), Write command (W) and during communication responses. Note, however, that the operation result data at that time is inserted as the BCC data of i ((13) and (14)). The text section differs according to factors such as the command type, data address and communication response.

■ Communication command format

Start character	Device address		Subaddress	Command type	Start data address				Number of data	Data	Text end character	BCC data		End character (delimiter)	
a	b		c	d	e				f	g	h	i		j	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
STX	0	1	1	R	0	1	0	0	0	- - - -	ETX	D	A	CR	- -
STX	0	2	1	W	0	1	8	C	0	,* * * *	ETX	0	B	CR	- -
Basic format section I				Text section							Basic format section II				

■ Communication response format

Start character	Device address		Subaddress	Command type	Response code		Data	Text end character	BCC data		End character (delimiter)	
a	b		c	d	e		g	h	i		j	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(11)	(12)	(13)	(14)	(15)	(16)
STX	0	1	1	R	0	0	, * * * *	ETX	3	E	CR	- -
STX	0	2	1	W	0	0	- - - -	ETX	4	F	CR	- -
Basic format section I				Text section				Basic format section II				

(2) Details of basic format section I

a: Start character [(1): 1 digit/STX (02H) or "@" (40H)]

- The start character indicates the start of the communication message.
- When the start character is received, it is judged to be the 1st character of a new communication message.
- Select the start character and text end character as a pair.

STX (02H) - - - Select by ETX (03H)
"@" (40H) - - - - Select by ": "(3AH)

b: Device address [(2), (3): 2 digits]

- Specify the device to communicate with.
- Specify the address within the range 1 to 98 (decimal).
- Binary 8-bit data (1: 0000 0001 to 98: 0110 0010) is divided into upper 4 bits and lower 4 bits, and converted to ASCII data.
  (2): Data obtained by converting the upper 4 bits to ASCII
  (3): Data obtained by converting the lower 4 bits to ASCII
- Device address=0 (30H, 30H) cannot be used as the device address as it is used when the broadcast instruction is issued.

c: Subaddress [(4): 1 digit]

- In a 1-loop specification, the subaddress is fixed to 1 (31H).
  In a 2-loop specification, channel 1 can be accessed by 1 (31H) and channel 2 can be accessed by 2 (32H).

(3) Details of basic format section II

h: Text end character [(12): 1 digit/ETX (03H)] or ": " (3AH)]

- Indicates the end of the text.

i: BCC data [(13), (14): 2 digits]

- The BCC (Block Check Character) data is for checking if there is an error in the communication data.
- When BCC operation results in a BCC error, a no-response state is entered.
- There are four types of BCC operation as shown below. These can be set on the front panel screen.

(1) ADD
Addition operation is performed from start character (1) through to text end character (12) in ASCII data single characters (1-byte).

(2) ADD_two's cmp

Addition operation is performed from start character (1) through to text end character (12) in ASCII data 1-character (1-byte) units, and the two's complement of the lower 1 byte of the operation result is taken.

(3) XOR

Exclusive OR is performed from after (device address ((2)) the start character through to text end character (12) in ASCII data 1-character (1-byte) units.

(4) None

BCC operation is not performed. ((13), (14) is omitted.)

- BCC data is operated in 1-byte (8-bit) units regardless of the data bit length (7 or 8).
- The lower 1-byte data of the result of the above operation is divided into upper 4 bits and lower 4 bits, and converted to ASCII data.

  (13): Data obtained by converting the upper 4 bits to ASCII

  (14): Data obtained by converting the lower 4 bits to ASCII

Example 1: iRead command (R) at BCC i ADD setting

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(12)	(13)	(14)	(15)	(16)
STX	0	1	1	R	0	1	0	0	9	ETX	E	3	CR	LF
02H	+30H	+31H	+31H	+52H	+30H	+31H	+30H	+30H	+39H	+03H	=1E3H			

Lower 1 byte of add result (1E3H)

(13): "E" = 45H, (14): "3" = 33H

Example 2: iRead command (R) at BCC i ADD_two's cmp setting

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(12)	(13)	(14)	(15)	(16)
STX	0	1	1	R	0	1	0	0	9	ETX	1	D	CR	LF
02H	+30H	+31H	+31H	+52H	+30H	+31H	+30H	+30H	+39H	+03H	=1E3H			

Lower 1 byte of add result (1E3H)
Two's complement of lower 1 byte (E3H)

(13): "1" = 31H, (14): "D" = 44H

Example 3: iRead command (R) at BCC i XOR setting

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(12)	(13)	(14)	(15)	(16)
STX	0	1	1	R	0	1	0	0	9	ETX	5	9	CR	LF
02H	30H	A31H	A31H	A52H	A30H	A31H	30H	30H	39H	03H	=59H			

Note that A=XOR
Lower 1 byte of operation result (59H)

(13): "5" = 35H, (14): "9" = 39H

j: End character (delimiter) [(15), (16): 1 digit or 2 digits/CR or CR LF]

- Indicates the end of the communication message.
- The following two types can be selected as the end character:
  (15), (16): CR (0DH) (LF is not appended by CR alone.)
  (15), (16): CR (0DH) and LF (0AH)

Note

A response is not performed when an error such as follows is recognized in the basic format section:

- A hardware error occurred.
- The device address and subaddress differ from the address of the specified device.
- The character specified by the previous communication format is not at the specified position.
- The BCC operation result differs from the BCC data.

Data conversion converts binary data to ASCII data in 4-bit blocks.

Hex <A> to <F> are expressed in uppercase characters and are converted to ASCII data.

(4) Outline of text section

The text section differs according to the command type and communication response. For details, see “21-3 Details of Read Command (R)” and “21-4 Details of Write Command (W).”

d: Command type [(5): 1 digit]

- No response is made when a character other than "R", "W" and "B" is recognized.

"R" (52H/uppercase character):

Indicates a Read command or a Read command response.

This is used to read (load) various FP23 data from a master personal computer or PLC.

"W" (57H/uppercase character):

Indicates a Write command or a Write command response.

This is used to write (change) various FP23 data from a master personal computer or PLC.

"B" (42H/uppercase character):

Indicates a broadcast command.

This is used to batch write (change) data to all devices that support the broadcast command from a master personal computer or PLC.

e: Start data address [(6), (7), (8), (9): 4 digits]

• Specifies the read start data address of the Read command (R) or the write start data of the Write (W) command.

• The start data address is specified by binary 16-bit (1 word/0 to 65535) data.
The 16-bit data is divided into 4-bit blocks and then converted to ASCII data.

Binary (16 bits)	D15,D14,D13,D12 0 0 0 0	D11,D10,D9,D8 0 0 1 1	D7, D6, D5, D4 0 0 0 0	D3, D2, D1, D0 1 0 1 0
Hex	0H	3H	0H	AH
ASCII data	"0" 30H (6)	"3" 33H (7)	"0" 30H (8)	"A" 41H (9)

• For details on data addresses, see "14-4(17) List of Communication data addresses."

f: Number of data [(10): 1 digit]

• Specifies the number of read data in the Read command (R) and the number of write data in the Write command (W).

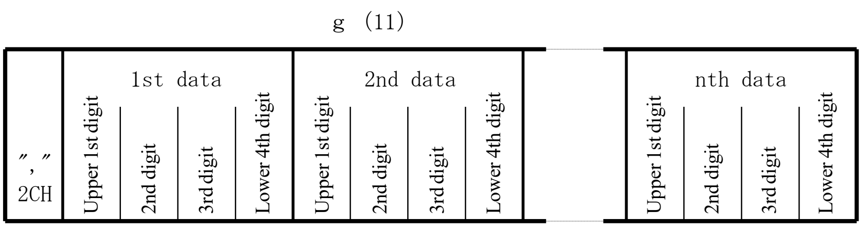
• The number of data is specified by converting binary 4-bit data to ASCII data.

• With the Read command (R), the number of data can be specified within the range 1: "0" (30H) to 10: "9" (39H).
With the Write command (W), the number of data is fixed at 1: "0" (30H).
The actual number of data is "number of data=specified data numerical value + 1".

g: Data [(11): Number of digits determined by number of data]

• Specifies the number of write data (change data) of the Write command (W) or read data during a Read command (R) response.

• The following shows the data format:



• The data is always prefixed by a comma (", "2CH) to indicate that what follows the comma is the data.

• The number of data follows the number of data (f: (10)) in the communication command format.

• One item of data is expressed in binary 16-bit (1 word) units without a decimal point.
The position of the decimal point is determined by each data.

• 16-bit data is divided into 4-bit blocks, and each block is converted to ASCII data.

• For details of data, see "21-3 Details of Read Command (R)" and "21-4 Details of Write Command (W)."

e: Response code [(6), (7): 2 digits]

- Specifies the response code for the Read command (R) and Write command.
  Binary 8-bit data (0 to 255) is divided into upper 4 bits and lower 4 bits, and each is converted to ASCII data.
  (6): Data obtained by converting upper 4 bits to ASCII
  (7): Data obtained by converting lower 4 bits to ASCII

- In the case of a normal response, "0" (30H) and "0" (30H) are specified.
  In the case of an error response, the error code No. is specified after conversion to ASCII data.
  For details on response codes, see “21-6 Details of Response Codes.”

21-3 Details of Read Command (R)

The Read command (R) is used to read (load) various types of data of this device from a master personal computer or PLC.

(1) Format of Read command (R)

• The following shows the format of the text section of the Read command (R).
Basic format section I and basic format section II are common to all commands and command responses.

Text section

d	e				f
(5)	(6)	(7)	(8)	(9)	(10)
R 52H	0 30H	4 34H	0 30H	0 30H	9 39H

- D ((5)) indicates the Read command.
  It is fixed to “R” (52H).
- E ((6) to (9)) specifies the start data address of the data to read.
- F ((10)) specifies the number of data (words) to read.

- The above command is as follows:

Read start data address	=0400H	(Hex)
	=0000 0100 0000 0000	(binary)
Number of read data	=9H	(Hex)
	=1001	(binary)
	=9	(decimal)

  (actual number of data) =10 (9+1)

  In other words, in this example, reading of 10 continuous items of data from data address 0400H is specified.

(2) Format of normal response to Read command (R)

- The following shows the format (text section) of a normal response to the Read command (R). Basic format section I and basic format section II are common to all commands and command responses.

Text section

d (5)	e (6)	(7)	g (11)													
				1st data				2nd data					10th data			
R 52H	0 30H	0 30H	, 2CH	0 30H	0 30H	1 31H	E 45H	0 30H	0 30H	7 37H	8 38H		0 30H	0 30H	7 37H	8 38H

- <R(52H)> indicating a response to the Read command (R) is inserted at d ((5)).
- <00(30H and 30H)> indicating a normal response to the Read command (R) is inserted at e ((6) and (7)).
- The response data to the Read command (R) is inserted at g ((11)).

  <","(2CH)> indicating the data of the data description is inserted at the beginning of the text section.
  Data in inserted following the beginning of the text section in order from <data of the read start data address> for the number of <read data number>.
  Nothing is inserted between data items.
  One item of data is expressed in binary 16-bit (1 word) units without a decimal point, and is converted to ASCII data in 4-bit blocks before it is inserted.
  The position of the decimal point is determined by each data.
  The number of characters of the response data is “number of characters=1+4 x number of read data”.

- In actual terms, the following data is returned in order as the response data to the Read command (R).

Read start data address (0400H) →

Number of read data (9H: 10 data)

	Data address 16 bits (1 word)	Data 16 bits (1 word)	
	Hex	Hex	Decimal
0	0400	001E	30
1	0401	0078	120
2	0402	001E	30
3	0403	0000	0
4	0404	0000	0
5	0405	0000	0
6	0406	03E8	1000
7	0407	0028	40
8	0408	001E	30
9	0409	0078	120
	040A	001E	30
	040B	0000	0
	040C	0000	0

(3) Format of error response to Read command (R)

- The following shows the format (text section) of an error response to the Read command (R). Basic format section I and basic format section II are common to all commands and command responses.

Text section

d	e	
(5)	(6)	(7)
R	0	7
52H	30H	37H

- <R(52H)> indicating a response to the Read command (R) is inserted at d ((5)).
- A response code indicating an error response to the Read command (R) is inserted at e ((6) and (7)). Response data is not inserted in the case of an error response.
  For details on error codes, see "21-6 Details of Response Codes."

21-4 Details of Write Command (W)

The Write command (W) is used to write (change) various data on this device from a master personal computer or a PLC.

Caution

To use the Write command in the communication mode type COM2, the communication mode must be changed from LOC to COM.
The communication mode cannot be changed using the keys on the front panel.
To change the communication mode, send the following command from the master.

■Command format

When ADDR=1, CTRL=STX_ETX_CR, BCC=ADD

STX	0	1	1	W	0	1	8	C	0	,	0	0	0	1	ETX	E	7	CR
02H	30H	31H	31H	57H	30H	31H	38H	43H	30H	2CH	30H	30H	30H	31H	03H	45H	37H	0DH

If a normal response is returned to the above command, the COM LED on the front panel lights and the communication mode switches to COM.

(1) Format of Write command (W)

- The following shows the format of the text section in the case of the Write command (W).
  Basic format section I and basic format section II are common to all commands and command responses.

Text section

d	e				f	g				
(5)	(6)	(7)	(8)	(9)	(10)	(11)				
							Write data			
W	0	4	0	1	0	,	0	0	7	D
57H	30H	34H	30H	31H	30H	2CH	30H	30H	37H	44H

- d ((5)) indicates the Write command.
  It is fixed to "W" (57H).
- e ((6) to ((9)) specifies the start data address of the write (change) data.
- f ((10)) specifies the number of write (change) data.
  The number of write data is fixed to 1: "0" (30H)
- g ((11)) specifies the write (change) data.

  <","(2CH)> indicating the data of the data description is inserted at the beginning of the write.
  Next, the write data is inserted.
  One item of data is expressed in binary 16-bit (1 word) data without a decimal point, and is converted to ASCII data in 4-bit blocks before it is inserted.
  The position of the decimal point is determined by each data.

- The above command is as follows:

Write leading start address	=0401H	(Hex)
	=0000 0100 0000 0001	(binary)
Number of write data	=0H	(Hex)
	=0000	(binary)
	=0	(decimal)
(actual number of data)	=1 (0+1)	
Write data	=007DH	(Hex)
	=0000 0000 0111 1110	(binary)
	=125	(decimal)

In other words, in this example, writing (change) of one item of data (125 decimal) to data address 0401H is specified.

Write start data address
(300H) → 0
Number of writer data
1 (0H)

Data address 16 bits (1 word)		Data 16 bits (1 word)	
Hex	Decimal	Hex	Decimal
0400	1024	00C8	200
0401	1025	007D	125
0402	1026	0078	120

(2) Format of normal response to Write command (W)

- The following shows the format (text section) of a normal response to the Write command (W). Basic format section I and basic format section II are common to all commands and command responses.

Text section

d	e	
(5)	(6)	(7)
W 57H	0 30H	0 30H

- <W(57H)> indicating a response to the Write command (W) is inserted at d ((5)).
- Response codes <00(30H and 30H)> indicating a normal response to the Write command (W) are inserted at e ((6) and (7)).

(3) Format of error response to Write command (W)

- The following shows the format (text section) of an error response to the Write command (W). Basic format section I and basic format section II are common to all commands and command responses.

Text section

d	e	
(5)	(6)	(7)
W 57H	0 30H	9 39H

- <W(57H)> indicating a response to the Write command (W) is inserted at d ((5)).
- A response code indicating an error response to the Read command (R) is inserted at e ((6) and (7)). For details on error codes, see "21-6 Details of Response Codes."

21-5 Details of Broadcast Command (B)

The Broadcast command (B) is used to batch write (change) data to all devices that support the broadcast command from a master personal computer or PLC.

The broadcast command does not have a communication response.

(1) Format of broadcast command

For details of parameters that can be broadcasted, see B on the right side of "14-4(17) List of communication data addresses."

Ex: AT (auto tuning) execution
Device address: 00, sub-address: 1 or 2

STX	0	0	1	B	0	1	8	4	,	0	0	0	1	ETX	9	2	CR
02H	30H	30H	31H	42H	30H	31H	38H	34H	2CH	30H	30H	30H	31H	03H	39H	32H	0DH

21-6 Details of Response Codes

(1) Type of response codes

Communication responses to the Read command (R) and Write command (W) must contain a response code.
There are two types of response codes: normal response code and error response code.
Response codes are expressed as binary 8-bit data (0 to 255). The table below shows the details of response codes.

Response Code List

Response Code		Code Type	Description
Binary	ASCII		
0000 0000	"0","0":30H,30H	Normal response	Normal response code for Read command (R) or Write command (W)
0000 0001	"0","1":30H,31H	Hardware error in text section	A hardware error such as framing overrun or parity has been detected in the data of the text section.
0000 0111	"0","7":30H,37H	Format error in text section	The format of the text section differs from the predetermined format.
0000 1000	"0","8":30H,38H	Data format data address, number of data error in text section	The format of the text section differs from the predetermined format, or the data address and number of data are other than specified.
0000 1001	"0","9":30H,39H	Data error	The write data exceeds the settable range of that data.
0000 1010	"0","A":30H,41H	Execution command error	An execution command (e.g. MAN) was received when it could not be accepted.
0000 1011	"0","B":30H,42H	Write mode error	When data that must not be rewritten depending on the data type, a write command containing that data was received.
0000 1100	"0","C":30H,43H	Specification, option error	A write command containing data of an unmounted specification or option was received.

(2) Order of priority of response codes

The smaller the value of the response code becomes, the higher the priority of the response code. When multiple response codes have been issued, the response code having the higher or highest priority is returned.

22 EXPLANATION OF MODBUS COMMUNICATION PROTOCOL

The MODBUS communication protocol has two transfer modes: ASCII mode and RTU mode.

22-1 Outline of Transfer Mode

(1) ASCII mode

The 8-bit binary data in commands is divided into upper 4 bits (Hex) and lower 4 bits (Hex), each of which is sent as ASCII characters.

■ Data configuration

Start bit	1 bit
Data bit	7 bits/fixed
Parity bit	EVEN, ODD, NONE selectable
Stop bit	1 bit, 2 bits selectable
Error check	LRC (Longitudinal Redundancy Check)
Data communication interval	1 sec or less

(2) RTU mode

The 8-bit binary data in commands is sent as it is.

■ Data configuration

Start bit	1 bit
Data bit	8 bits/fixed
Parity bit	EVEN, ODD, NONE selectable
Stop bit	1 bit, 2 bits selectable
Error check	CRC-16 (Cyclic Redundancy Check)
Data communication interval	3.5 character transmission time or less

22-2 Configuration of Messages

(1) ASCII mode

In this mode, messages are configured to begin with a start character [: (colon) (3AH)], and end with an end character [CR (carriage return) (ODH)] followed by a LF (line feed) (0AH)].

Header (:)	Slave address	Function code	Data	Error check LRC	Delimiter (CR)	Delimiter (LF)

(2) RTU mode

In this mode, messages begin after an idle time of 3.5 characters transfer time or more, and end after an idle time of 3.5 characters transfer time or more has elapsed.

Idle 3.5 characters	Slave address	Function code	Data	Error check CRC	Idle 3.5 characters

22-3 Slave Address

The slave address is the device No. of the slave, and is set within the range 0 to 99.
The master recognizes each of the slaves by specifying the slave address in request messages.
The slave notifies the master of which slave is responding by setting and returning its own slave address to the response message.

Slave address 0 is the broadcast address and can specify all slaves.
In the case of a broadcast, slaves do not return a response.

In the 1-loop specification, the slave address is the same as the device address.
In the 2-loop specification, the slave address of channel 1 is the same as the device address, and the slave address of channel 2 is the device address+1.

22-4 Function Codes

A function code is a code for instructing the type of operation to the slave.

Function Code	Details
03 (03H)	Reads setting values and information from slaves.
06 (06H)	Writes to slave.

These function codes are also used for indicating whether the response message returned to the master by the slave is a normal response (positive response) or that some error has occurred (negative response).

In a positive response, the original function code is set and returned.

In a negative response, the MSB of the original function code is set to “1” and returned.
For example, when “10H” has been mistakenly set as the function code, and the request message has been sent to the slave, “1” is set to the MSB and returned as “90H” as this function code is non-existent.
Also, in the case of a negative response, an error code is set to the response message and returned to notify the master of which type of error has occurred.

Error Code	Details
1 (01H)	illegal Function (non-existent function)
2 (02H)	illegal data address (non-existent data address)
3 (03H)	illegal data value (value out of setting range)

22-5 Data

The structure of data differs according to the function code.
With request messages from the master, data is configured by data item, number of data and setting data.
With response messages from a slave, data is configured by number of bytes or data in response to the request, and in the case of a negative response, an error code.
The valid data range is -32768 to 32767 (8000H to 7FFFH).

22-6 Error Check

The error check method differs according to the transfer mode.

(1) ASCII mode

As the error check for the ASCII mode, calculate the LRC up to the end of the data from the slave address, convert the resulting 8-bit data to two ASCII characters and append it to the data.

■ LRC calculation method

1. Create a message in the RTU mode.
2. Add up to the end of the data from the slave address, and substitute with x.
3. Take the 2's complement (invert bits) of x, and substitute with x.
4. Add "1" to x, and substitute with x.
5. Append to the data taking x to be the LRC.
6. Convert the message to ASCII characters.

(2) RTU mode

As the error check for the RTU mode, calculate the CRC-16 up to the end of the data from the slave address, and append the resulting 16-bit data to the data in order lower bits then upper bits.

■ CRC-16 calculation method

By the CRC method, the information to be sent is divided by a generating polynomial, and the information is appended with the remainder and then sent.

Generating function: $X^{16} + X^{15} + X^{2} + 1$

1. Initialize the data of CRC (taken to be x) to (FFFFH).
2. Exclusive-OR the 1st data with x, and substitute with x.
3. Shift x to the right by one bit, and substitute with x.
4. If the shift results in a carry, exclusive-OR the result of (3) with a fixed value (A001H), and substitute with x. If the shift does not result in a carry, go to step 5.
5. Repeat steps 3 and 4 until x is shifted eight times.
6. Exclusive-OR the next data with x, and substitute with x.
7. Repeat steps 3 to 5.
8. Repeat steps 3 to 5 until the last data.
9. Append the data to the message in order lower bits then upper bits taking x to be CRC-16.

22-7 Examples of Messages

(1) ASCII mode

■ Reading device No.1 FIX mode SV

• Request message from master

Header	Slave address	Function code	Data address	Number of data	Error check LRC	Delimiter
(:)	(01H)	(03H)	(0300H)	(0001H)	(F8H)	(CR• LF)
1	2	2	4	4	2	2

← Number of characters (17)

• Slave response message in normal operation (when FIX mode SV=10.0°C)

Header	Slave address	Function code	Function code	Data	Error check LRC	Delimiter
(:)	(01H)	(03H)	(02H)	(0064H)	(96H)	(CR• LF)
1	2	2	2	4	2	2

← Number of characters (15)

• Slave response message in erroneous operation (when a data item has been mistaken)

Header	Slave address	unction code	Error code	Error check LRC	Delimiter
(:)	(01H)	(83H)	(02H)	(7AH)	(CR• LF)
1	2	2	2	2	2

← Number of characters (11)

In a response message during normal operation, “1” is set to the MSB of the function code (83H). An error code 02H (non-existent data address) is returned as the response message for the error content.

■ Writing device No.1, FIX mode SV=10.0°C

• Request message from master

Header	Slave address	Function code	Data address	Data	Error check LRC	Delimiter	
(:)	(01H)	(06H)	(0300H)	(0064H)	(92H)	(CR• LF)	
1	2	2	4	4	2	2	←Number of characters (17)

• Slave response message in normal operation (when FIX mode SV=10.0°C)

Header	Slave address	Function code	Data address	Data	Error check LRC	Delimiter	
(:)	(01H)	(06H)	(0300H)	(0064H)	(92H)	(CR• LF)	
1	2	2	4	4	2	2	← Number of characters (17)

• Response message on slave in erroneous operation (when a value outside of the range is set)

Header	Slave address	Function code	Error code	Error check LRC	Delimiter	
(:)	(01H)	(86H)	(03H)	(76H)	(CR• LF)	
1	2	2	2	4	2	←Number of characters (13)

In a response message during occurrence of an error, “1” is set to the MSB of the function code (86H). An error code 03H (value outside of setting range) is returned as the response message for the error content.

(2) RTU mode

■ Reading device No.1, FIX mode SV

• Request message from master

Idle 3.5 characters	Slave address (01H)	Function code (03H)	Data address (0300H)	Number of data (0001H)	Error check CRC (844EH)	Idle 3.5 characters	
	1	1	2	2	2		← Number of characters (8)

• Slave response message in normal operation (when FIX mode SV=10.0°C)

Idle 3.5 characters	Slave address (01H)	Function code (03H)	Number of response bytes (02H)	Data (0064H)	Error check CRC (B9AFH)	Idle 3.5 characters	
	1	1	1	2	2		← Number of characters (7)

• Slave response message in erroneous operation (when a data item has been mistaken)

Idle 3.5 characters	Slave address (01H)	Function code (83H)	Error code * (02H)	Error check LRC (C0F1H)	Idle 3.5 characters	
	1	1	1	2		←Number of characters (5)

In a response message during normal operation, “1” is set to the MSB of the function code (83H). An error code 02H (non-existent data address) is returned as the response message for the error content.

■ Setting device No.1, FIX mode SV=10.0°C

• Request message from master

Idle 3.5 characters	Slave address (01H)	Function code (06H)	Data address (0300H)	Data (0064H)	Error check CRC (8865H)	Idle 3.5 characters	
	1	1	2	2	2		← Number of characters (8)

• Slave response message in normal operation (when FIX mode SV=10.0°C)

Idle 3.5 characters	Slave address (01H)	Function code (06H)	Data address (0300H)	Data (0064H)	Error check CRC (8865H)	Idle 3.5 characters	
	1	1	2	2	2		← Number of characters (8)

• Response message on slave in erroneous operation (when a value outside of the range is set)

Idle 3.5 characters	Slave address (01H)	Function code (86H)	Error code (03H)	Error check CRC (0261H)	Idle 3.5 characters	
	1	1	1	2		← Number of characters (5)

In a response message during occurrence of an error, “1” is set to the MSB of the function code (86H). An error code 03H (value outside of setting range) is returned as the response message for the error content.

23 ASCII Code Table

	b7～b5	000	001	010	011	100	101	110	111
b4～b1		0	1	2	3	4	5	6	7
0000	0	NUL	TC7(DLE)	SP	0	＠	P	｀	p
0001	1	TC1(SOH)	DC1	！	1	A	Q	a	q
0010	2	TC2(STX)	DC2	”	2	B	R	b	r
0011	3	TC3(ETX)	DC3	＃	3	C	S	c	s
0100	4	TC4(EOT)	DC4	＄	4	D	T	d	t
0101	5	TC5(ENQ)	TC8(NAK)	％	5	E	U	e	u
0110	6	TC6(ACK)	TC9(SYN)	＆	6	F	V	f	v
0111	7	BEL	TC10(ETB)	’	7	G	W	g	w
1000	8	FE0(BS)	CAN	（	8	H	X	h	x
1001	9	FE1(HT)	EM	）	9	I	Y	i	y
1010	A	FE2(LF)	SUB	＊	：	J	Z	j	z
1011	B	FE3(VT)	ESC	＋	；	K	［	k	｛
1100	C	FE4(FF)	IS4(FS)	，	＜	L	＼	l	｜
1101	D	FE5(CR)	IS3(GS)	−	＝	M	］	m	｝
1110	E	SO	IS2(RS)	．	＞	N	＾	n	～
1111	F	SI	IS1(US)	／	？	O	＿	o	DEL

24 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.

24-1 Product Model Code

FP23A—	□□	□	□—	□□	□	□	□	□	□

24-2 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		
FIX DO10 Set Point		
FIX DO11 Set Point		
FIX DO12 Set Point		
FIX DO13 Set Point		

24-3 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		
DO10 Set Point		
DO11 Set Point		
DO12 Set Point		
DO13 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		
DO10 Set Point		
DO11 Set Point		
DO12 Set Point		
DO13 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		

24-4 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	OUT2L	OUT2H
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									

Zone PID

Item	Set Value
Zone PID1	
Zone HYS1	
Zone PID2(CH2)	
Zone HYS2(CH2)	
AT Point	

24-5 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			―――	―――	―――	―――

Item	DO10	DO11	DO12	DO13
CH				
MD				
ACT				
DF				
IH				
DLY				

24-6 DI/Options Parameters

Item	Set Value	CH set
DI1		
DI2		
DI3		
DI4		
DI5		
DI6		
DI7		
DI8		
DI9		
DI10		
RUN/RST MODE		
Ao1MD		———
Ao1 L		———
Ao1 H		———
Ao2MD		———
Ao2 L		———
Ao2 H		———

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

24-7 Control Output Parameters

■ For basic functions other than MS

Item	OUT1	OUT2
ACT		
RST		
ERR		
CYC		
Rate Limiter		

■ For basic function MS

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

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

24-8 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				

24-9 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		
PEND FIX		
CH1 PTN		

25 SPECIFICATIONS

25-1 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: 19 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
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)

■ **For basic functions other than MS**

OUT1	Green	Control Output 1
OUT2	Green	Control Output 2

■ **For basic function MS**

OPEN	Green	Lights when open output is ON
CLOSE	Green	Lights when close output is ON

- Display accuracy: ±(0.1% + 1digit) of measuring range (See Measuring Range Code Table for individual ranges.)
  - TC input: ±(0.1% FS + 1°C)
  - Pt input: ±(0.1% FS + 0.1°C)
  - mV, V input: ±(0.1% FS + 1 digit)
  - mA input: Depends on accuracy of externally attached resistor
    (When ±0.1%FS accuracy is required, specify when ordering)
- Temperature range for maintaining display accuracy
  23°C±5°C
- Display resolution: 0.0001, 0.001, 0.01, 0.1, 1 (differs depending on measuring range)
- Sampling cycle: 0.1 seconds (100 msec)

25-2 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)

25-3 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, C(WRe5-26), {L, U (DIN43710)}, K, AuFe-Cr (Kelvin scale). For details, see Measuring Range Code Table.
  - Display range: ±10% of measuring range
    Note: However, it will not go lower than -273.15°C.
  - 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 digit
  - 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.

25-4 Control

■ For basic functions other than MS

- 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)
  - Set value function — OFF, 0.01 to 1.00
  - Manual reset (MR) — -50.0 to 50.0% (available when I = OFF)
  - Dead band (DB) — -19999 to 20000 digit (Control Output 2 in 1-loop/2-out specification)
  - Hysteresis (DF) — 1 to 9999 digit (at ON-OFF action, available when P = OFF)
  - Proportional cycle — 1 to 120 seconds (at contact or SSR drive voltage output)
- Hysteresis Mode — Select from the 3 modes below
  Center mode, SV OFF mode, SV ON mode
- 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.

■ For basic function MS

- Control system — Expert PID control with auto tuning function
  - Multi-PID — By PID Nos.01 to 10 (10 types)
    Individual PID set on each step and FIX SV
  - Zone PID — Selectable between individual PID and zone PID (max. 10 zones)
  - Proportional band (P) — OFF, 0.1 to 999.9% (OFF: ON-OFF action)
  - Integral time (I) — OFF, 1 to 6000 seconds (OFF: P or PD control)
  - Derivative time (D) — OFF, 1 to 3600 seconds (OFF: P or PI control)
  - Set value function — OFF, 0.01 to 1.00
  - Manual reset (MR) — -50.0 to 50.0% (available when I = OFF)
- Hysteresis Mode — Select from the 3 modes below
  Center mode, SV OFF mode, SV ON mode
- Operation/output update cycle
  0.1 seconds (100 msec)
- Control output characteristics
  Reverse (for heating)/Direct (for cooling)
- Higher/lower output limiter setting range
  Higher limit/lower limit (set individually for each PID No.)
  - Setting range — 0.0 to 100.0% (lower limit < higher limit)
- Output rate-of-change limiter
  OFF, 0.1 to 100.0%/seconds
- Control output — Output for servo actuator drive
  Support for both feedback potentiometer with/without
- Control output type/rating
  R: Contact output, rating240V AC 2A
  Y: Contact output, rating240V AC 2A, built-in CR absorber
- Output update cycle — 50msec
- Control output at error
  Stop, Preset (0 to 100%) (with feedback potentiometer)
  Stop, Close, Open (without feedback potentiometer)
- Control output at reset
  Stop, Preset (0 to 100%) (with feedback potentiometer)
  Stop, Close, Open (without feedback potentiometer)
- Output at potentiometer error
  Stop, Close, Open (with feedback potentiometer)
- Manual control
  - Auto/manual switching
    Balanceless/bumpless transfers (with feedback potentiometer)
  - Manual output — Open/Close output
- Positioning — With percentage, as numerically and bar graph on LCD.
  Display resolution 1%
  Display range -10 to 110%
- Positioning ZERO/SPAN adjustment
  Supports automatic adjustment, manual adjustment available
- Dead Band (DB) — 0.2 to 10.0% of input signal
- Hysteresis (DF) — 25% of the DB
  When DB is equal to or lower than 1.2%, fixed to 0.3%.
- Feedback potentiometer
  100 to 2kΩ/3 wire system
- Isolation — Insulated between between Servo Output and various I/O, or Servo Output and the system.

25-5 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 to 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 digit
  - Time (1) — 0 to 99 hours 59 minutes
  - Time (2) — 0 to 99 minutes 59 seconds

25-6 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
	Direct cannot be set for event, but for DO.	

■ For basic functions other than MS

27) HBA	ON during Heater Break alarm action
28) HLA	ON during Heater Loop alarm action

■ For basic function MS

27) Posi.H	Positioning higher limit absolute value
28) Posi.L	Positioning lower limit absolute value
29) POT.ER	Feedback potentiometer error

Direct cannot be set for events, but for DOs.
Posi. H, Posi. L, and POT. ER can be assigned only when the controller is used with feedback potentiometer.

◆ Setting range	DEV Hi, Low	-25000 to 25000 digit
	DEV Out, In	0 to 25000 digit
	PV Hi, Low	Within measuring range
	Posi. H, L	0 to 100%
Hysteresis	1 to 9999 digit (DEV, PV, SV) 1 to 50% (When Posi is selected)	
Action delay time	OFF, 1 to 9999 digit (when DEV, PV, SV or Posi is selected)	
Standby action	Selectable from 4 types (when DEV, PV, SV or Posi is selected)	
	OFF	No standby action
	1	At power ON, or at RST -> RUN
	2	At power ON, at RST -> RUN, or at execution SV is changed
	3	At input error (SO), when action is OFF
Output characteristics switching	Selectable between normally open and normally closed.	
◆ Isolation	Insulated between event output and various I/O, or event output and the system.	

25-7 External Control Output (DO)

- Number of outputs — 13 points in total; standard 5 and 8 optional.

DO1 to DO3	Darlington output	3 points.
DO4 to DO5	Open collector output	2 points.
DO6 to DO13	Open collector output	8 points. (optional)

- Output rating — Open collector output 24 V DC/8mA 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 DO13 with communication option. Posi.H, Posi.L, and POT.ER can be assigned only when the controller is used with feedback potentiometer.)
  Details of setting range, hysteresis, action delay time and stand by action are the same as those for event outputs.
- Output characteristics switching
  Normal open and normal close selectable.
- Isolation — Insulated between DO and various I/O, or DO and the system.
  Not insulated between DOs.

25-8 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,
    voltage application 2.5 mA max. per 1 input.
  - Input holding time — 0.1 seconds (100 msec) min.
- Setting/selection — Individual setting (individual input), selectable from 12 types
  In the case of independent 2-channel control (CH1, CH2) specification, assignment will be done to eigher CH1 or CH2 or both.
  - Input types

1) None	No action (no assignment)
2) RUN/RST	Switching of Run/Reset (when ON: Run execution)
3) RST	Forced Reset (when ON: Reset state)
4) HLD	Control suspension/restart (when ON: suspension state)
5) ADV	Execute advance (when ON: execute advance)
6) FIX	Switching of FIX mode/Program mode (when ON: FIX mode)
7) MAN	Switching of control output between auto/manual (when ON: manual)
8) LOGIC	Logic operation input [exclusive port] (when ON: input ON)
9) PTN2bit	Selection of start pattern No. by DI input (selectable from 3 patterns)
10) PTN3bit	Selection of start pattern No. by DI input (selectable from 7 patterns)
11) PTN4bit	Selection of start pattern No. by DI input (selectable from 15 patterns)
12) PTN5bit	Selection of start pattern No. by DI input (selectable from 20 patterns)
13) PTN5BCD	Selection of start pattern No. by DI input (selectable from 19 patterns)
14) Preset 1 to 3	Preset No. switching by DI2 to DI4.

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

25-9 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

25-10 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

25-11 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.

25-12 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 9 types
  PV, SV, DEV, OUT1, CH2_PV, CH2_SV, CH2_DEV, OUT2 Posi
  - Output rating: Individual selection (individual output)
    0 to 10 mV DC/output resistance 10Ω
    0 to 10 V DC/load current 2 mA max.
    4 to 20mA DC/load resistance 300Ω max.
- Output accuracy: ±0.1% FS (of indicated value)
- Output resolution: Approx. 1/14000
- Output update cycle: 0.1 second (100 msec)
- Output scaling: PV, SV, 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)

25-13 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.

25-14 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 mode type
  COM1 or COM2
- 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)t
  - 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

25-15 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)

25-16 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
  - Overvoltage category: II
  - Pollution degree: 2 (IEC60664)
- Storage temperature: -20 to 65°C
- Power voltage: 100 to 240 V AC ±10% (50/60 Hz)
- Power consumption: Max. 16 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 and EN61010-1, EN IEC 61010-2-030
  - EMC: EN61326-1
- 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
  Across power terminals and ground terminals: 1500 V AC for 1 minute
- Protective structure: Front operating panel only is dust-proof and drip-proof. (equivalent to IP66)
- Case material: PC resin molding (equivalent to UL94V-1)
- External dimensions: (H x W x D) 96 x 96 x 111 mm (panel depth: 100 mm)
- Mounting: Imbedded in panel (using mounting fixtures)
- Thickness of usable panel: 1.0 to 8.0 mm
- Size of panel cutout: 92 (H) x 92 (W) mm
- Weight: 600 g max.

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

Temperature and Humidity Control Specialists

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