SR23A Series
Digital Controller

Instruction Manual
（Detailed version）

Thank you for purchasing the Shimaden SR23A Series Digital 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.

MSR023A-E01-C
Jun. 2023

Request

Make sure that this Instruction Manual is given to the final user of the device.
Keep this manual at the work site during operation of the SR23A Series Digital Controllers.

Preface

This Instruction Manual describes the basic functions and how to use SR23A Series Digital Controllers.

This Instruction Manual is meant for those will be involved in the wiring, installation, operation and routine maintenance of the SR23A Series Digital Controllers. 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 andor facilities, additional instructions are indicated by the following headings.

Safety Precautions

⚠ **Warning**

The SR23A 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 in the case of use resulting in an accident without having taken 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.
- SR23A 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 V AC 1.0 A/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 approximately 30 minutes to display the correct temperature after applying power to this device. (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, damage 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 optional RS-485 communication 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, externally attached receiving impedance for mA input
Relay Unit	AP2MC	Converts open collector output to contact output（2 built-in circuits）

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

■Model codes selection table

Item	Code		Specification	
1. Series	SR23A-		96x96mm DIN size, high-performance digital controller,3event 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	
	DC		Insulated universal-input, internal cascade control *2	
	DS		Insulated universal input, 2-input operation/1-output control *3	
	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: 240V AC, 2A) *6	
	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: servo output, Rating: 240 V AC, 2 A *7	
4. Control Output 2	N-		None (N-forced for basic functions SS, MS, no choice for others)	
	Y-		Contact: 1c, Contact rating: 240V 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.	
5. Remote setting input/ Heater break alarm (for single-phase)	04	Remote setting input	Not insulated	4 to 20 mA DC, Input resistance: 250Ω
	05			1 to 5 V DC, Input resistance: Approx. 500 kΩ
	06			0 to 10 V DC, Input resistance: Approx. 500 kΩ
	14		Insulated	4 to 20 mA DC, Input resistance: 250Ω
	15			1 to 5 V DC, Input resistance: Approx. 500 kΩ
	16			0 to 10 V DC, Input resistance: Approx. 500 kΩ
	31	Heater break alarm *4	Heater current: 30 A (CT provided)	Selectable when Y and P are included in Control Output 1 or 2
	32		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	Analog Output 2	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) *5	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, DC, 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.)

*2 In internal cascade control specification, slave output for control is output to Control Output 2.

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

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

*5 When switching the SV No. by DI, 10 points of DI (code 1 or 2) are required.

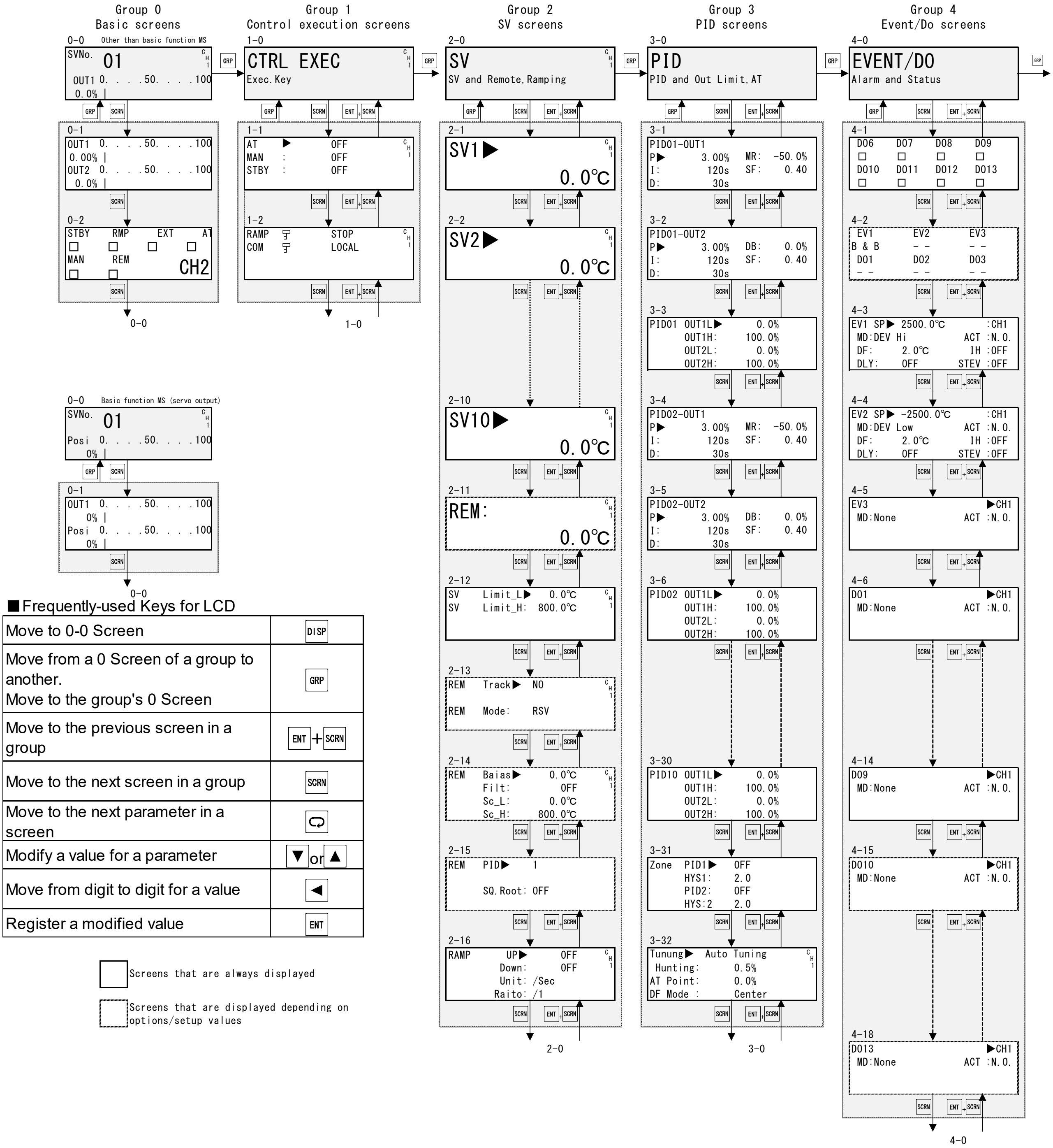
*6 With basic function MS, Y output must be selected when directly controlling control motor.

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

Contents

LCD Flow Chart

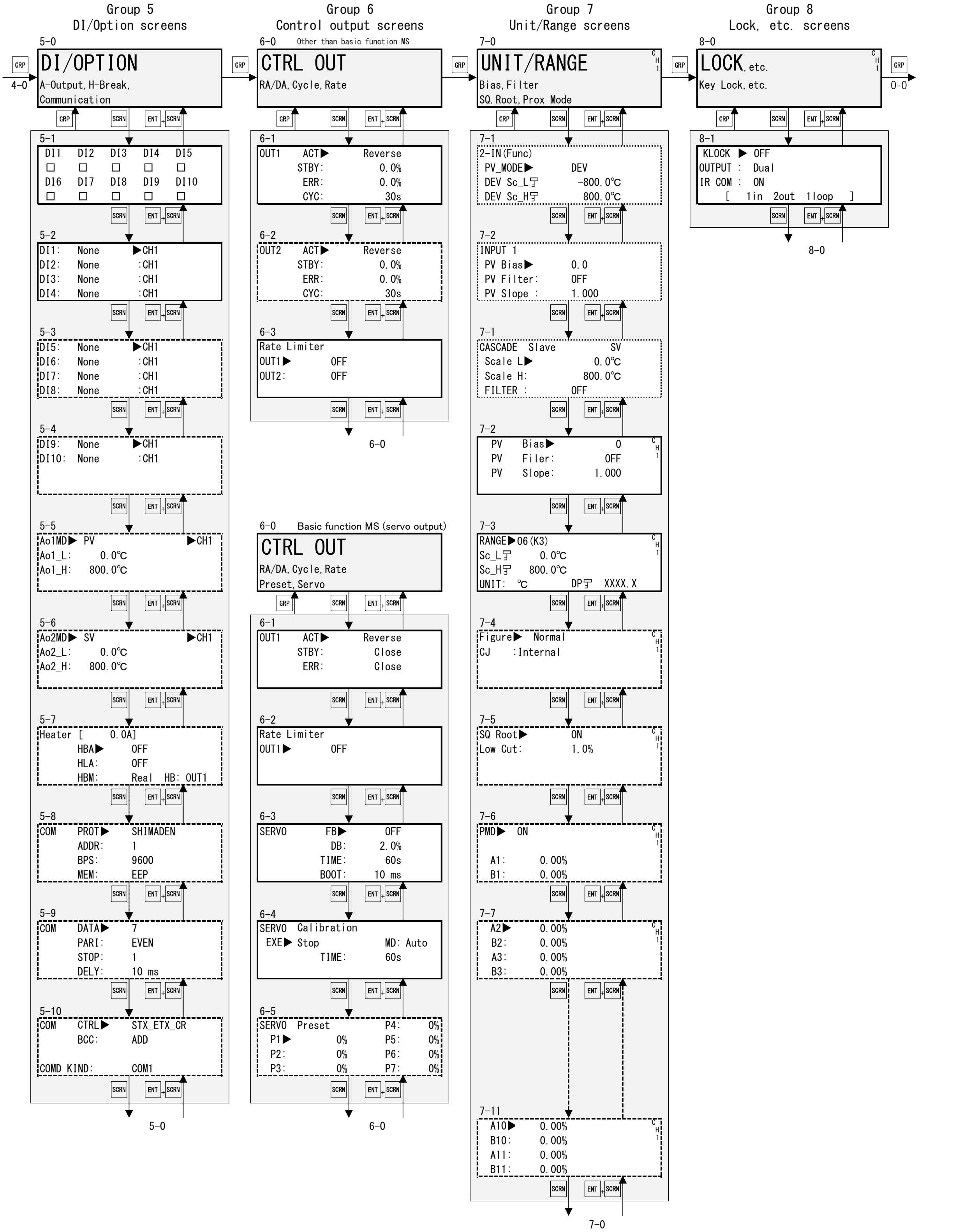
The following figure shows how to progress through the LCD screen hierarchy on this device.
Screens with a dot-dash lines may not be displayed according to specifications, settings, etc.



■Frequently-used Keys for LCD

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 previous screen in a group	ENT + SCRN
Move to the next 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 DISP key is pressed at a screen other than the 0-0 basic screen, returns to the 0-0 basic screen.


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: None ▶CH1
DI2: None :CH1
DI3: None :CH1
DI4: None :CH1
5-3
DI5: None ▶CH1
DI6: None :CH1
DI7: None :CH1
DI8: None :CH1
5-4
DI9: None ▶CH1
DI10: None :CH1
5-5
Ao1MD▶ PV ▶CH1
Ao1_L: 0.0℃
Ao1_H: 800.0℃
5-6
Ao2MD▶ SV ▶CH1
Ao2_L: 0.0℃
Ao2_H: 800.0℃
5-7
Heater [0.0A]
HBA▶ OFF
HLA: OFF
HBM: Real HB: OUT1
5-8
COM PROT▶ SHIMADEN
ADDR: 1
BPS: 9600
MEM: EEP
5-9
COM DATA▶ 7
PARI: EVEN
STOP: 1
DELY: 10 ms
5-10
COM CTRL▶ STX_ETX_CR
BCC: ADD
COMD KIND: COM1
5-0
Group 6
Control output screens
6-0 Other than basic function MS
CTRL OUT
RA/DA, Cycle, Rate
6-1
OUT1 ACT▶ Reverse
STBY: 0.0%
ERR: 0.0%
CYC: 30s
6-2
OUT2 ACT▶ Reverse
STBY: 0.0%
ERR: 0.0%
CYC: 30s
6-3
Rate Limiter
OUT1▶ OFF
OUT2: OFF
6-0
6-0 Basic function MS (servo output)
CTRL OUT
RA/DA, Cycle, Rate
Preset, Servo
6-1
OUT1 ACT▶ Reverse
STBY: Close
ERR: Close
6-2
Rate Limiter
OUT1▶ OFF
6-3
SERVO FB▶ OFF
DB: 2.0%
TIME: 60s
BOOT: 10 ms
6-4
SERVO Calibration
EXE▶ Stop MD: Auto
TIME: 60s
6-5
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
Bias, Filter
SQ.Root, Prox Mode
CH1
7-1
2-IN(Func)
PV_MODE▶ DEV
DEV Sc_L早 -800.0℃
DEV Sc_H早 800.0℃
7-2
INPUT 1
PV Bias▶ 0.0
PV Filter: OFF
PV Slope : 1.000
7-1
CASCADE Slave SV
Scale L▶ 0.0℃
Scale H: 800.0℃
FILTER : OFF
7-2
PV Bias▶ 0
PV Filer: OFF
PV Slope: 1.000
7-3
RANGE▶ 06(K3)
Sc_L早 0.0℃
Sc_H早 800.0℃
UNIT: ℃ DP早 XXXX.X
7-4
Figure▶ Normal
CJ :Internal
7-5
SQ Root▶ ON
Low Cut: 1.0%
7-6
PMD▶ ON
A1: 0.00%
B1: 0.00%
7-7
A2▶ 0.00%
B2: 0.00%
A3: 0.00%
B3: 0.00%
7-11
A10▶ 0.00%
B10: 0.00%
A11: 0.00%
B11: 0.00%
7-0
Group 8
Lock, etc. screens
8-0
LOCK, etc.
Key Lock, etc.
CH1
8-1
KLOCK ▶ OFF
OUTPUT : Dual
IR COM : ON
[1in 2out 1loop]
8-0
4-0
0-0
GRP
SCRN
ENT + SCRN

1 INSTALLATION & WIRING

1－1 Installation Site

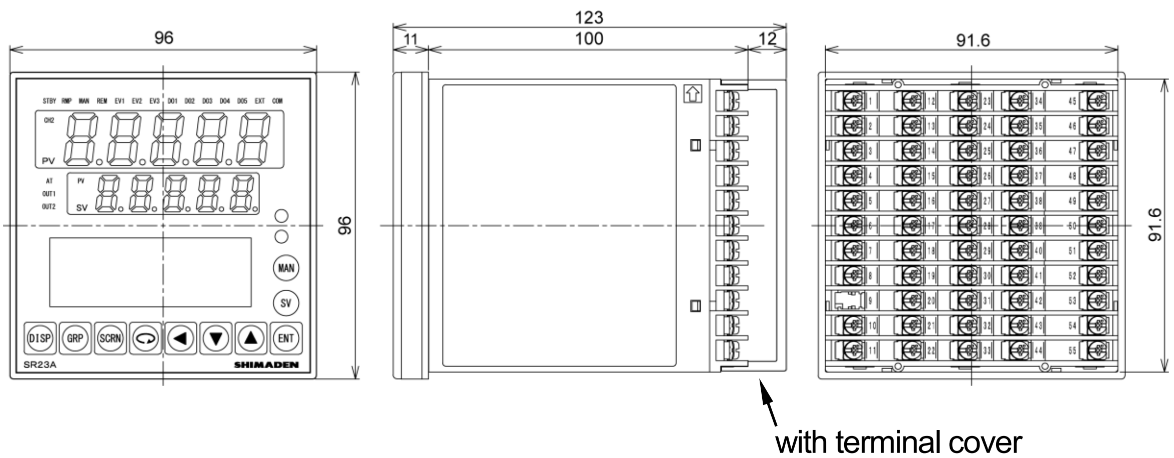
Caution

Do not use this device in the following sites. Doing so might result in equipment failure or damage to this device, and in some cases, 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

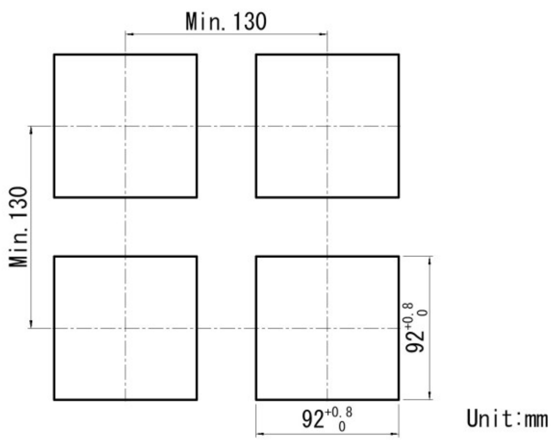
1－2 External Dimensions and Panel Cutout

■ External dimensions



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.

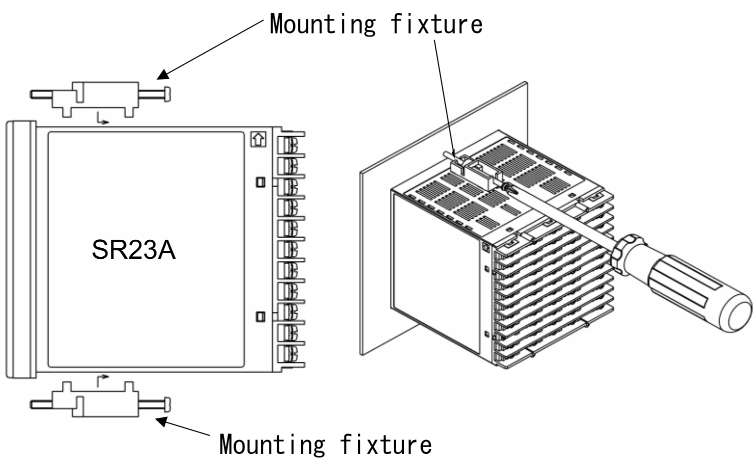
1. Drill mounting holes referring to the panel cutout dimensions shown above. The applicable thickness of the mounting panel is 1.0 to 8.0 mm.

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.



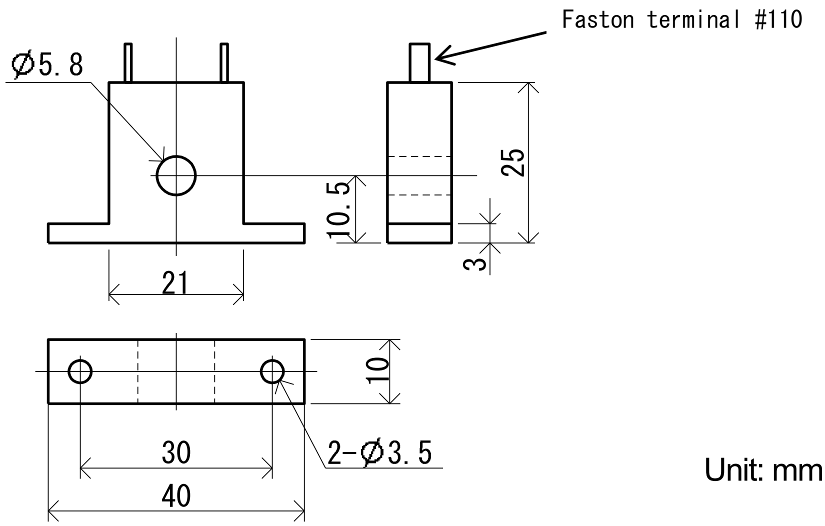
⚠ Caution

- 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 External dimensions of Current Transformer (CT) for Heater Break Alarm

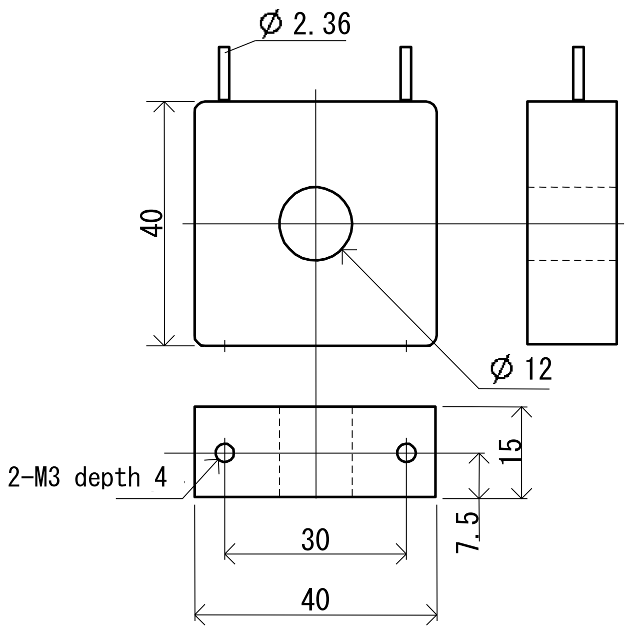
The CT can be used optionally if a heater break alarm is added.
Depending on the current selected in the code selection table, one of the following is included

■ For 0 to 30A (QCC01)



Unit: mm

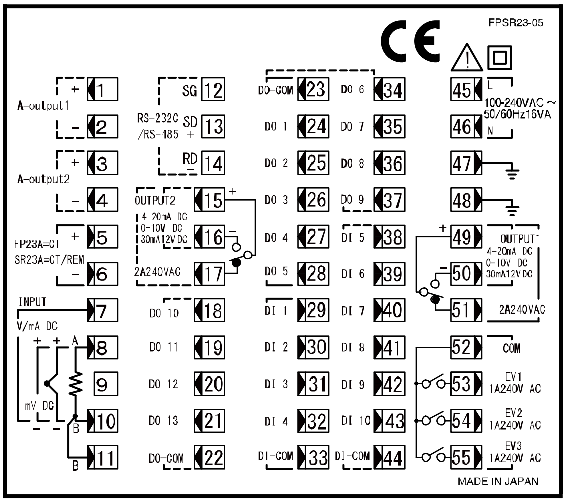
■ For 0 to 50 A (QCC02)



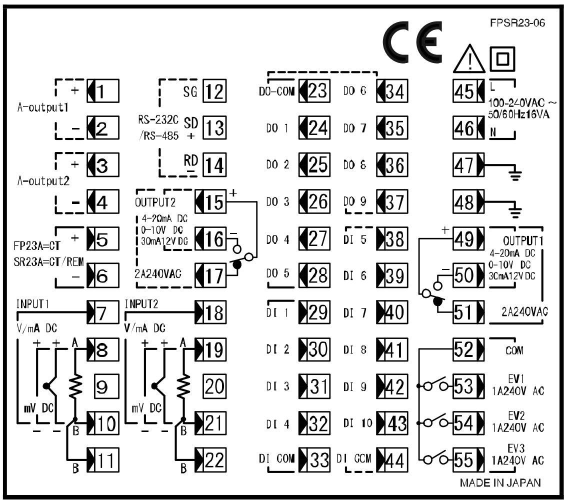
Unit: mm

1－5 Terminal Arrangement Diagrams

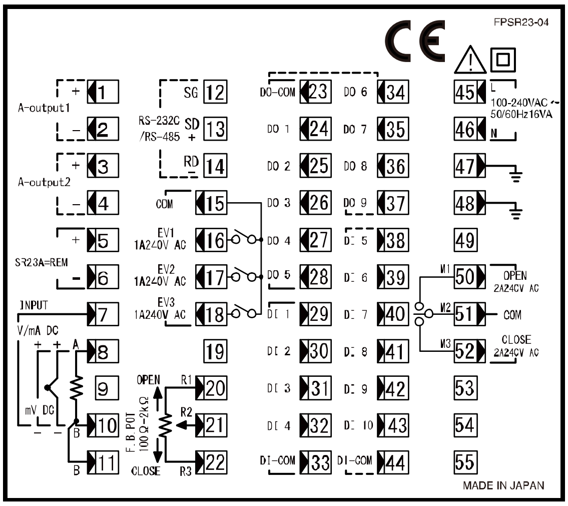
■ Basic functions SS, SD



■ Basic functions DL, DC, DS, DD



■ Basic functions MS



<table>
<tr><th rowspan="2">Terminal No.</th><th colspan="5">Description</th></tr>
<tr><th colspan="2">Basic functions SS, SD</th><th colspan="2">Basic functions DL, DC, DS, DD</th><th>Basic functions MS</th></tr>
<tr><td>1</td><td colspan="5" rowspan="2">Analog Output 1 (optional)</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td colspan="5" rowspan="2">Analog Output 2 (optional) or sensor power supply (optional)</td></tr>
<tr><td>4</td></tr>
<tr><td>5</td><td colspan="4" rowspan="2">Remote setting input or
heater break alarm CT input (optional)</td><td rowspan="2">Remote setting input</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td rowspan="5">PV1</td><td colspan="4">V, mA (+) input</td></tr>
<tr><td>8</td><td colspan="4">Thermocouple, mV (+) RTD (A) input</td></tr>
<tr><td>9</td><td colspan="4">NC</td></tr>
<tr><td>10</td><td colspan="4">Thermocouple, mV (-) RTD (B) input</td></tr>
<tr><td>11</td><td colspan="4">RTD (B) input</td></tr>
<tr><td>12</td><td colspan="5" rowspan="3">Communication function (optional)</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td colspan="2" rowspan="3">Control Output 2 (optional)</td><td colspan="2" rowspan="3">Control Output 2</td><td rowspan="4">Event output EV1 to EV3</td></tr>
<tr><td>16</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td><td colspan="2" rowspan="5">External control output
DO10 to DO13(optional)</td><td rowspan="5">PV2</td><td>V, mA (+)</td></tr>
<tr><td>19</td><td>TC, mV (+) RTD (A)</td><td>NC</td></tr>
<tr><td>20</td><td>NC</td><td rowspan="3">Feedback potentiometer input</td></tr>
<tr><td>21</td><td>TC, mV, V (-) RTD (B)</td></tr>
<tr><td>22</td><td>RTD (B)</td></tr>
<tr><td>23</td><td colspan="5" rowspan="6">External control output DO1 to DO5
DO1 to DO3 Darlington open collector output
DO4 to DO5 Open collector output</td></tr>
<tr><td>24</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td></tr>
<tr><td>29</td><td colspan="5" rowspan="5">External control input DI1 to DI4</td></tr>
<tr><td>30</td></tr>
<tr><td>31</td></tr>
<tr><td>32</td></tr>
<tr><td>33</td></tr>
</table>

Terminal No.	Description		
	Basic functions SS, SD	Basic functions DL, DC, DS, DD	Basic functions SS, SD
34	External control output DO6 to DO9 (optional) Open collector output		
35			
36			
37			
38	External control input DI5 to DI10 (optional)		
39			
40			
41			
42			
43			
44			
45	Power supply		
46			
47	Grounding (internal shorting across terminals)		
48			
49	Control Output 1		NC
50			Control Output
51			
52	Event output EV1 to EV3		
53			NC
54			NC
55			NC

For using this device as a current input (0 to 20 mA, 4 to 20 mA), install receiving resistor (250Ω) between the input terminals given below.

PV1 : Between terminals 7 to 10

PV2 : Between terminals 18 to 21

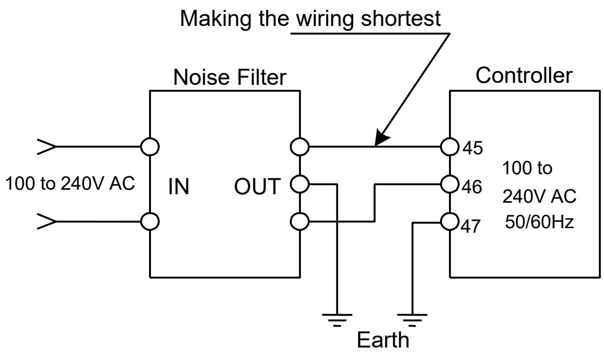
1—6 Wiring

⚠ 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.

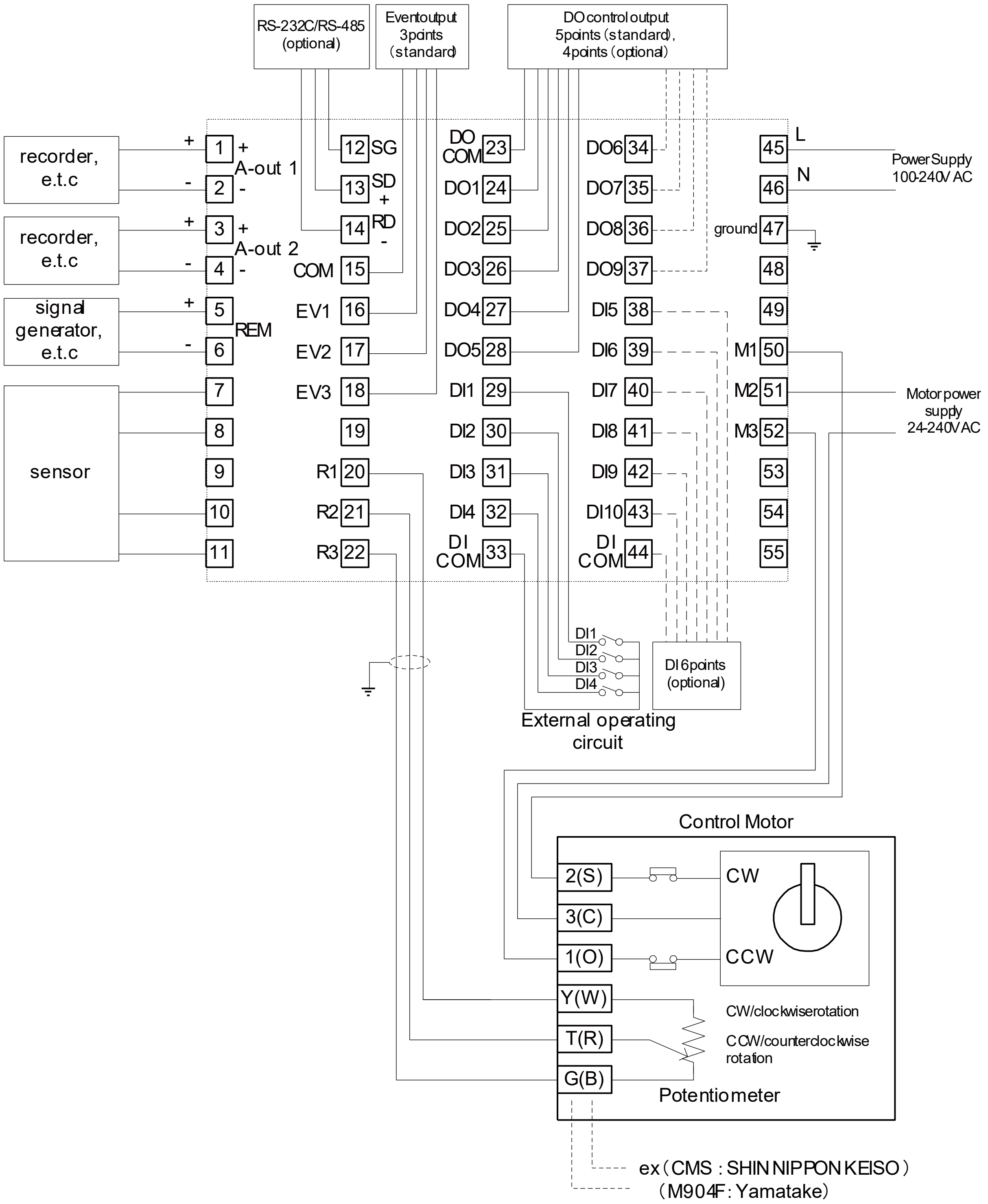
- Make sure wiring is connected correctly in accordance with "1-5 Terminal Arrangement Diagrams."
- Use crimped terminals that accommodate an M3 screw and that have a width of 6.2 mm or less.
- For thermocouple input, use a compensation wire compatible with the type of thermocouple.
- For RTD input, 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.
- Countermeasure against lightning surge will be required for signal line over 30m.
- 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 noise filter: RSEL-2003W from TDK

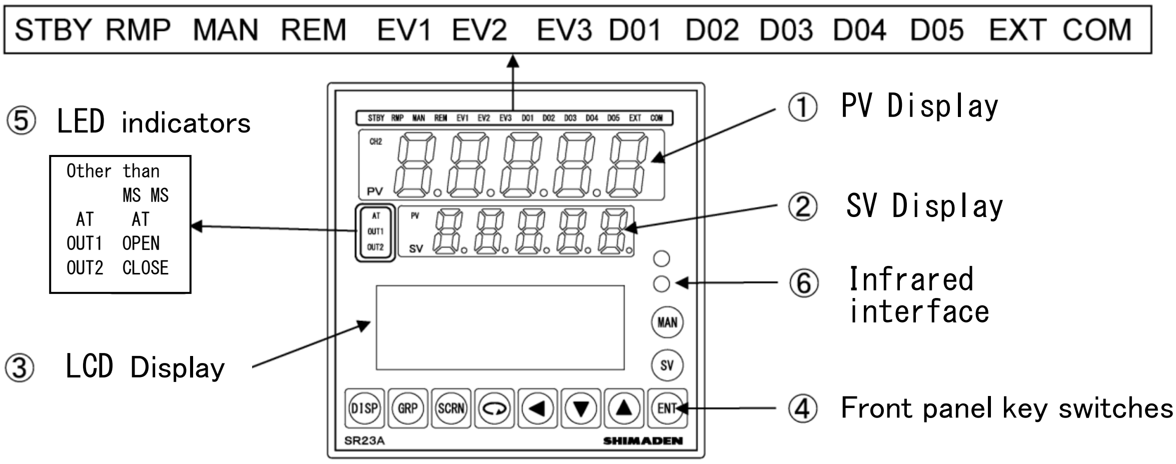
Basic function MS (servo output) wiring example

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 basic functions DL, DC

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

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

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

For other than the above basic specifications

Displays the current measured value (PV) or error messages.

② SV Display

For basic functions DL, DC

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

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

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

For other than the above basic specifications

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 “15-2 Flow of Basic Screen in 2-Loop Specification.”

Note

- For basic function DC, cascading operates with CH1 as the master and CH2 as the slave. For SR23A DC type products, CH1 will be “the master”, and CH2 will be “the slave”.
- 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. For 1-loop specification, only Display mode 1 is displayed.
- Display mode 2 or 3 is used only for 2-loop specification (independent 2-channel control and internal cascade control).
- 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.

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

For basic functions DL, DC, the following information for CH1 is shown for display mode 1 or display mode 3, and the following information for CH2 is shown for display mode 2. Information on each channel is displayed by switching the channels of each LCD screen.

- SV No. display — Displays the current target set value (SV) No.
- Output (OUT) display — Displays the control output value by a numerical value and a bar graph as a percentage (%).
- Channel display (CH1, CH2) — Displays the channel for screen display parameter data. Basic functions DL, DC, DS, DD only
- Screen title display — Displays the screen group title in the respective screen group top screen.
- Setup parameter display — Displays the parameters which can be selected and displayed by front key operation.

④ Front panel key switches

DISP	(Display key)	Displays the basic screen. Switches between 3 display modes.
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 ▼	(Close/ Down key)	Decrements parameters and numerical values during setup. Close output is set to ON manually for basic function MS.
OPEN ▲	(Open/Up key)	Increments parameters and numerical values during setup. Open output is set to ON manually for basic function MS.
ENT	(Entry key)	Registers data or parameter numerical values.
SV	(SV key)	Switches the execution SV No. in the basic screen. In screens other than the basic screen, the execution SV No. can be switched when the display is switched to the basic screen.
MAN	(Manual key)	Used for manual output (MAN). Switches to the output monitor screen whichever screen is displayed. With the output monitor displayed, you can use the ▲ ▼ keys to switch to manual output.

⑤ LED indicators

The contents of the STBY, RMP, MAN, REM, EXT and AT lamps differ according to display mode for basic functions DL, DC.

For basic functions DL, DC

For basic functions DL, DC

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 the above basic functions

Displays the action status.

■Status lamps

Common to all basic functions

STBY	green	Blinks when output is set to standby (STBY = ON) by control execution/standby.
RMP	green	Blinks during execution of ramp control, and lights while ramp control is paused.
MAN	green	Blinks when control output is set to manual operation (MAN).
REM	green	Lights when remote setting (REM) is set in SV No. selection.
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 external switch setting (EXT) is set when multi-SV No. selection (SV select) is switched to.
COM	green	Lights when communication (COM) mode is selected.
AT	green	Blinks during execution of auto tuning or lights during holding of auto tuning.

For basic functions SS, SD, DL, DC, DS, DD (other than MS)

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 1 is OFF.

For basic function MS

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

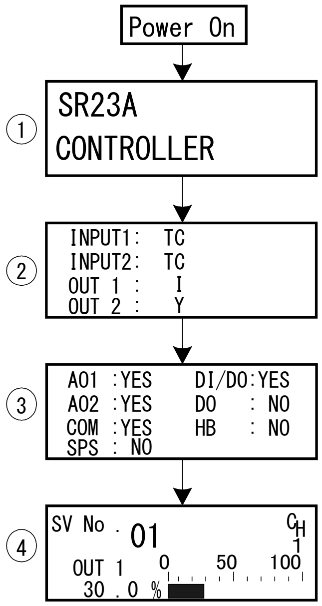
For basic functions DL, DC, DS, DD

CH2	green	Lights when it is under the Display mode 2. CH2 PV/SV values are displayed on PV/SV display respectively.
PV	green	Lights when it is under the Display mode 3. CH 1 PV values are displayed on PV display, and CH2 PV values are displayed on SV display.

3 BASIC OPERATIONS

3－1 Power ON

When the power is turned ON, the basic screen is displayed after the initial screen is displayed on the LCD for about three seconds.
When the SR23A 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, current (I) set for Output 1, and contact (Y) set for Output 2.

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

④ Basic screen (Monitor Group top screen)
The figure shows that OUT1 of SV No.1 is outputting at 30% in 2-loop (2-channel) specification.

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

The basic screen is the "SV No., output value display screen."

Note

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

LCD Display		Actual numbers	
DI/DO	DO	DI	DO
NO	NO	4	5
YES	NO	10	9
YES	YES	10	13

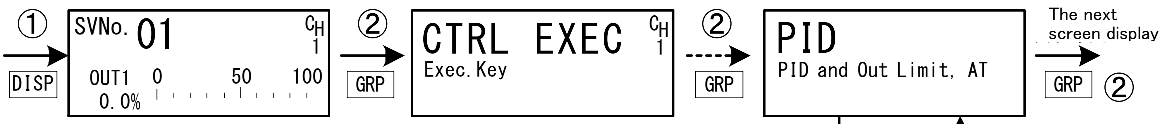
1 For operation of basic screen when 1-loop specification is selected, see "15-1 Flow of Basic Screen in 1-Loop Specification."

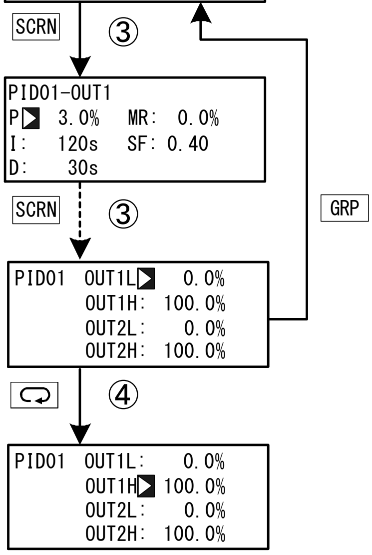
2 For operation of basic screen when 2-loop specification is selected, see "15-2 Flow of Basic Screen in 2-Loop Specification."

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.





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 to screen group top screens.

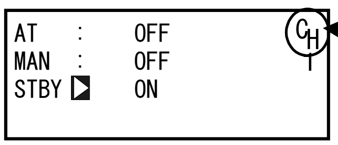
③ To switch setup screens within groups
Press the SCRN key to successively switch screens.

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

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

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

3－3 Changing and Registering Data

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

(1) Entering numerical values

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

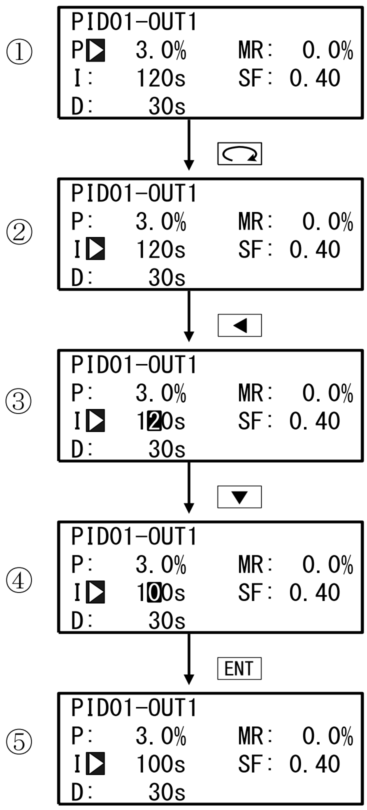
2. Press the [◀] or [▼], [▲] keys. The smallest digit of the numerical value blinks.

3. Press the [◀] key again. Move the blinking section in the numerical value to the digit to be changed, and change the value using the [▼] or [▲] key.

4. Press the [ENT] key. The numerical value is fixed and registered, and stops blinking.

■ Changing a numerical value setting (example)

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



① To move between screens

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

Next, press the [SCRN] key once.

② To move the cursor from P to I

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

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

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

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

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

⑤ To fix and register the setting

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

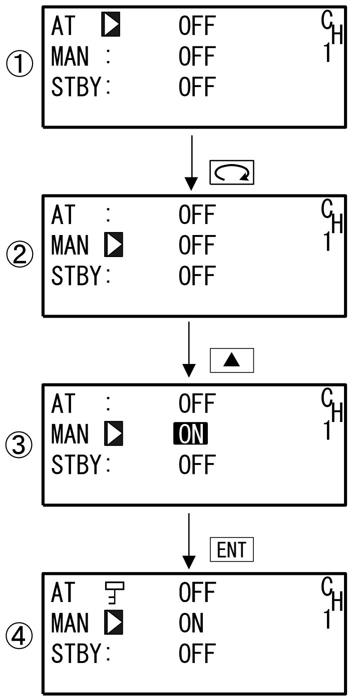
(2) Selecting setup items

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

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

■ Selecting a parameter (example)

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



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

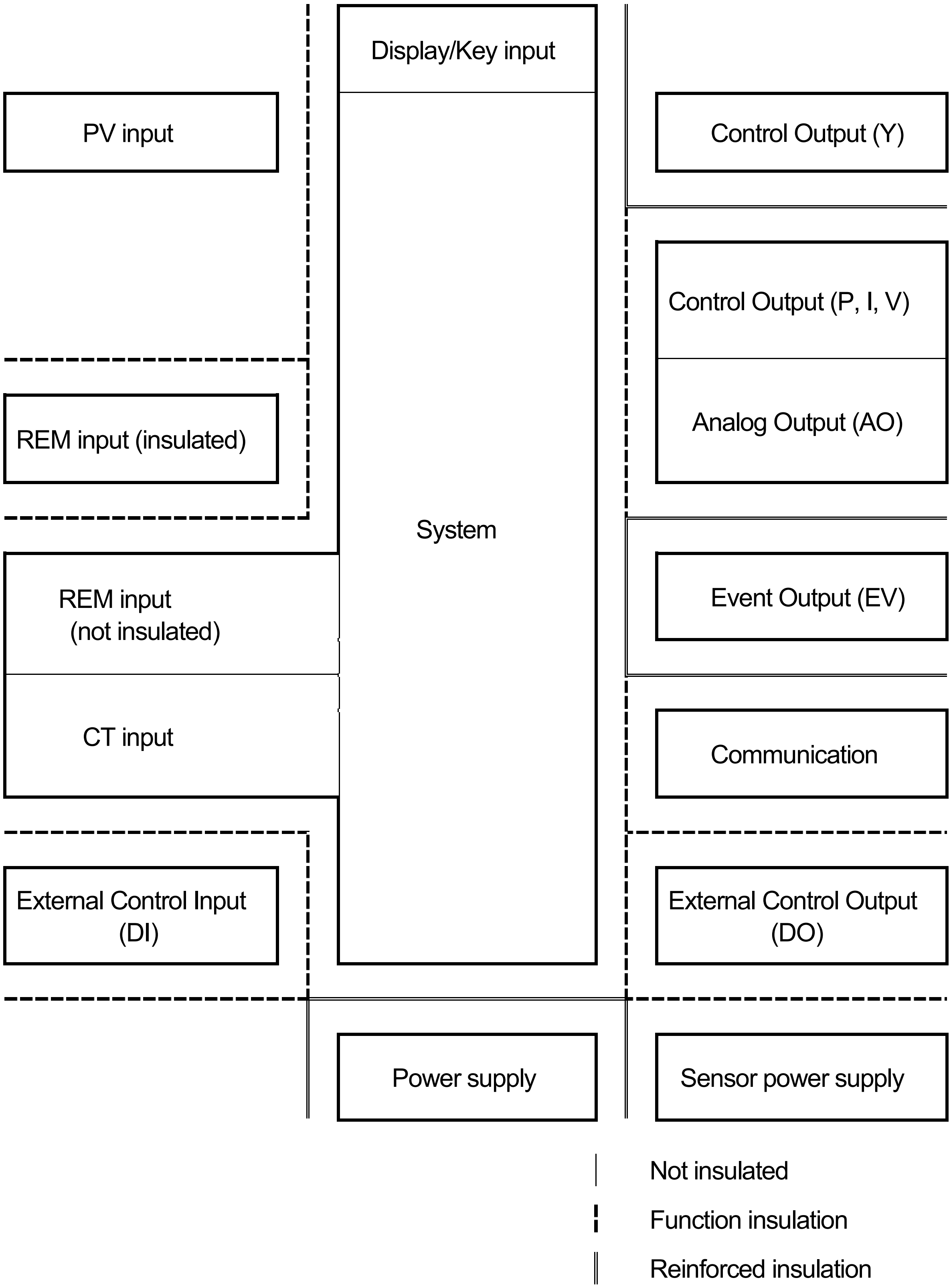
Press the ▲ key to change the display from OFF to ON.

④ To fix and register the setting

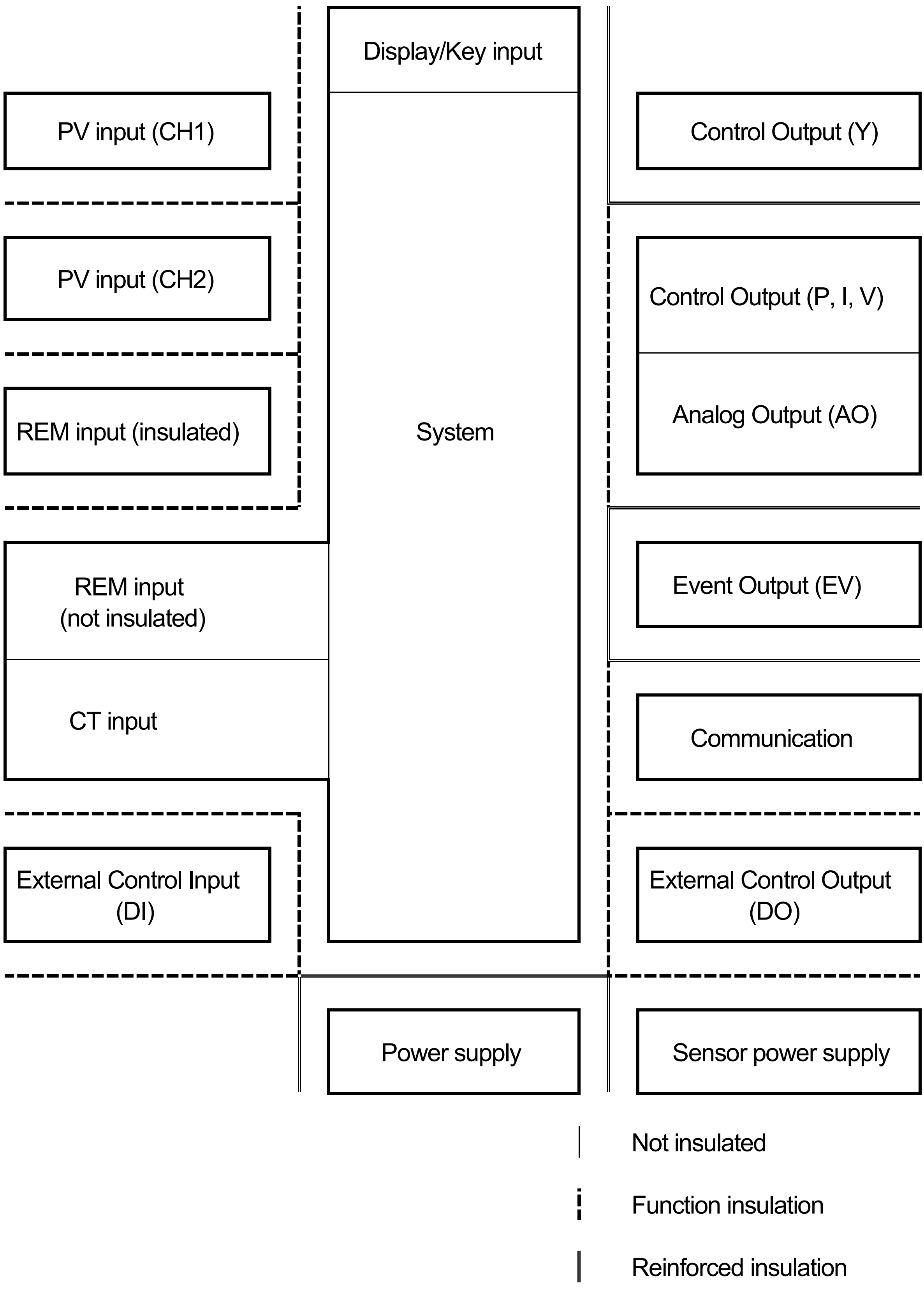
Press the ENT key to fix the new setting.
In this case, the key mark is displayed as AT can no longer be operated.

4 INSULATION BLOCK DIAGRAM

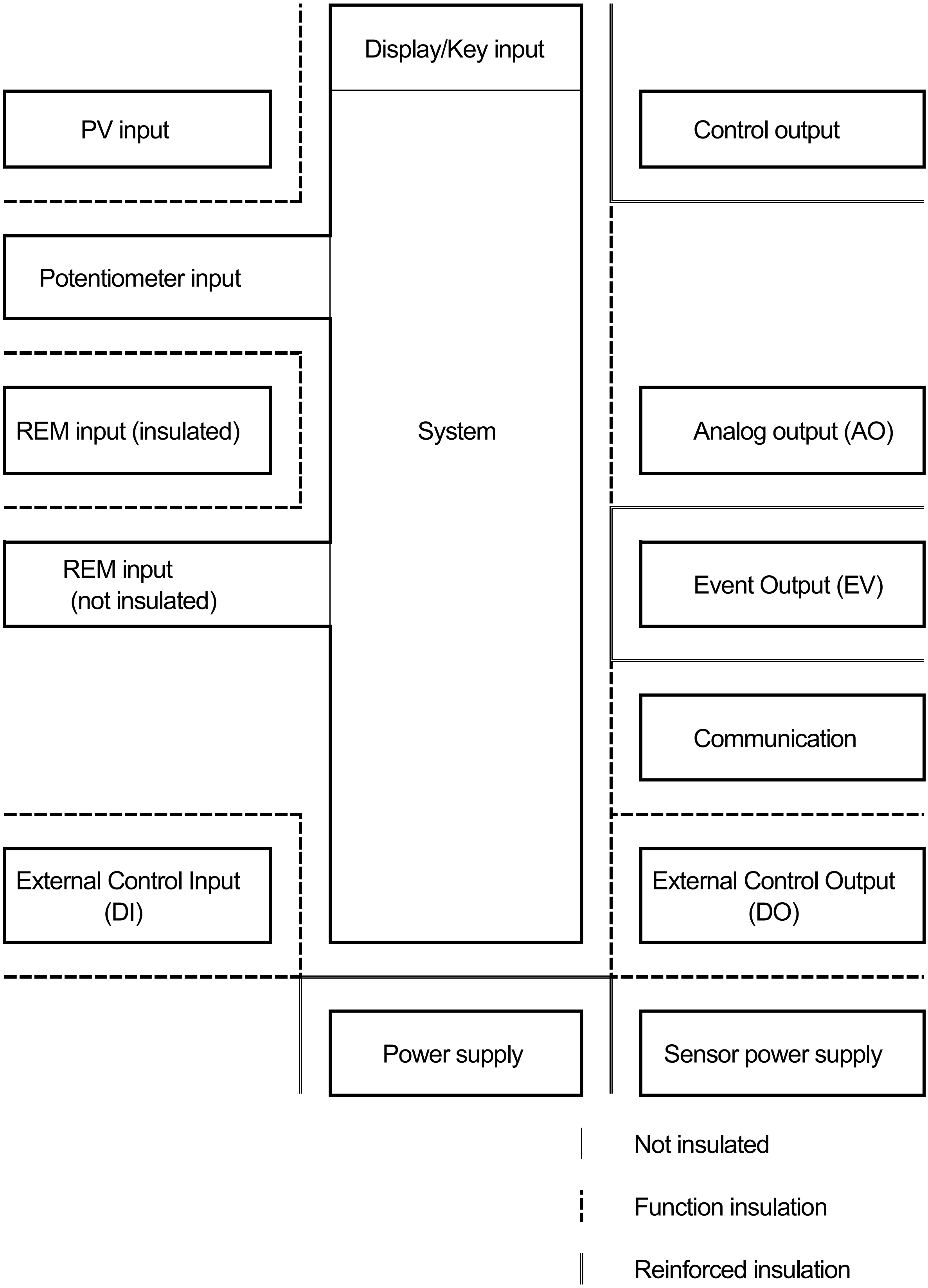
4—1 1-Input Standard Output (Basic Functions SS, SD)



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



4－3 Servo Output (Basic Function MS)



5 SETUP

5−1 Parameter Setup Procedure

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

⚠ **Caution**

With some operations, when you initialize this device, all parameter settings return to their factory defaults.

Before you initialize this device, note down and retain settings as required.

It is assumed that experienced personnel familiar with basic operation of this device will set up this device.
Users other than device manufacturers should thoroughly familiarize themselves with the functions to be used before they start to operate or set up this device.
Basic operations and setup of this device are described in detail from Chapter 6 onwards by each screen group.
Some screens and parameters are not displayed when optional functions are not added on or when optional functions are not selected.
For an overview of operation screens and how to move between screens, see "LCD Flow Chart" in the preface. For an overview of setup parameters, see "18 List of Parameters."

Set up parameters in the order shown below.

1. Confirm the Output Specifications and Release the Key Lock.
Perform this as necessary.
For details, see "Chapter 6."

2. I/O Settings.
For details, see "Chapter 7."

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

4. Set up the SV Value and Remort SV Value.
For details, see "Chapter 9."

5. PID Settings.
For details, see "Chapter 10."

6. EVENT & DO Settings.
For details, see "Chapter 11."

7. Option (DI, AO, HB, COM) Settings.
For details, see "Chapter 12."

8. Servo Setup.
For the basic function MS (servo output), there are settings dedicated to the servo.
Set while referring to “Chapter 13 SERVO SETUP.”

9. Key Lock Setting.
After parameters including optional functions are set or changed, set the key lock as necessary to prevent inadvertent operation.
For details, see "Chapter 14."

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

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

6　CONFIRMING OUTPUT SPECIFICATIONS & ACTION MODE/KEY LOCK

Perform the following as necessary.

6－1　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
[Cascade] : Cascade-controlled controller
[Servo] : Servo output controller

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

With basic functions DL, DC, 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.

⚠ Caution

- All parameters are initialized if action mode explained in this section is changed.For this reason, reconfiguration of parameters is required after the operation mode is changed.

6－2 Selection of Action Mode for Basic Functions DL,DC,DS,DD

This section describes functions for 2-input specification action mode.
This action mode is a fundamental part of the basic control. You should therefore get a thorough understanding the contents of this description. It should also be noted that changing the action mode will reset all parameter settings to the default settings. Inadvertently changing the operation will therefore involve a complex operation procedure.

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

There are 4 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.

■ **2-input,1-output (2 loop): Basic function DC**

This is internal cascade. Control by making output of CH1 (Master side) as SV value of CH2 (Slave side).

■ **Changes to 1-input, 1-output (1 loop): Equivalent to basic function SS**
Changes to 1-input, 2-output (1 loop): Equivalent to basic function SD

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.

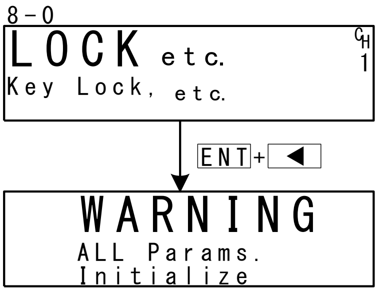
(2) Action mode in 2-input specification

1. Release the key lock if the key is locked.
For details on how to release the key lock, see “6-3 Releasing the Key Lock.”

2. Put the control action of the controller on standby (STBY: ON).
For using this device in 2-loop specification, put both CH1 and CH2 on standby.
For details on control standby operation, see "16-8 Control Standby (STBY)."

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 ENT key for at least 3 seconds by holding the ◀ 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.

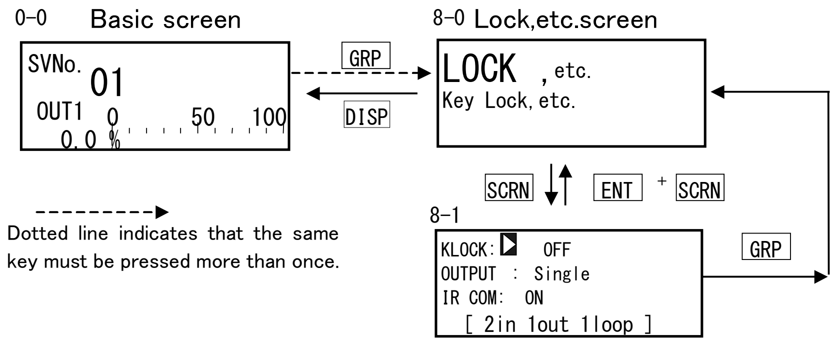
PV Display SV Display	Operation mode	Description
2-In 1LooP	2-Input (1loop)	Operates as a 2-input operation controller. This may be used by switching between 1-output and 2-output.
2-In 2LooP	2-Input (2loop)	Operates as 2 independent controllers. CoversCH1：INPUT1, OUT1, CH2：INPUT2, OUT2
2-In CAS	Cascade (2loop)	Controller that operates in cascade making CH1 as master and CH2 as slave.
1-In 1LooP	1-1nput (1loop)	1-channel controller. This may 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 action mode, go back to the top screen of Lock, etc. Screen Group (group 8) by pressing the ◀ key.

6－3 Key Lock

(1) Key lock screen display

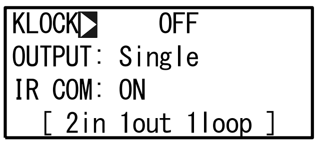
To call up the LOCK, etc. screen group (group 8) from the basic screen, press the GRP key. LOCK, etc Press the SCRN key in the LOCK, etc. screen group to switch to the screens for making and changing setups.
Select parameters in screens by pressing the ↩ key.
Set parameters by pressing the ◀, ▼ or ▲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

8-1



Setting item: OFF, LOCK1, LOCK2, LOCK3
Initial value: OFF

OFF	:	Releases the key lock
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 "18 List of Parameters."

7 I/O SETTINGS & INFRARED COMMUNICATION

7－1 Output Specifications (2-Output Specification)

When 1-input: 1-output/2-output or 2-input operation: 1-output/2-output is selected, output specification (OUTPUT: Single (1-output)/Dual (2- output) will be displayed. It will not be displayed for basic functions DL, DC, MS.

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.

Change the setting of the output specification after setting control action to the standby mode (STBY: ON).

For details on control standby operation, see "16-8 Control Standby (STBY)."

8-1

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

Setting item: 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.

7－2 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 item: ON, OFF
Initial value: ON

ON: Infrared communication by S5004 is available.

OFF: Infrared communication is not available.

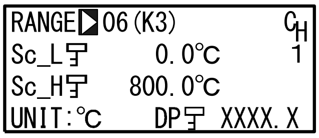
7－3 Measuring Range

Before performing setup or changes to the setup, set control action to the standby mode (STBY: ON).
For details on control standby operation, see "16-8 Control Standby (STBY)."

(1) Range setting

Set the code No. to RANGE referring the Measuring Range Code Table below.
Basic functions DS, DD use the same range for CH1 and CH2.

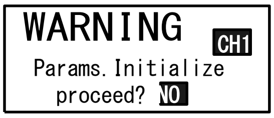
7-3



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 current input is 4 to 20 mA or 0 to 20 mA, select RANGE No.85 (1 to 5V) or 84 (0 to 5V), and attach 250Ω receiving impedance.

Caution



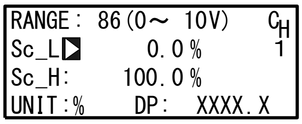
- When the range is changed, the left message will be displayed.
  Press the ▲ key to select YES, and press the ENT key to apply the setting. The range will be changed and parameters will be initialized.
  For details on parameters that are initialized, see “18 List of Parameters.”

(2) Range scaling

Set the measuring range (scaling) when the selection range is voltage input and current input (corresponding to code Nos.71 to 77, 81 to 87). Sc_L is scaling of the lower limit side of PV, and Sc_H is scaling of the higher limit side of PV. Reverse scaling is not possible.
Before performing setup or changes to the setup, set control action to the standby mode (STBY: ON).
For details on control standby operation, see "16-8 Control Standby (STBY)."

The key mark is displayed and this item cannot be set for RTD or TC input.

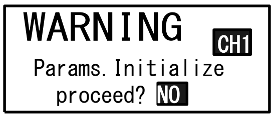
7-3



Setting range: -19999 to 30000 digit
: 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: 100.0 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.

⚠ **Caution**



- When the range is scaled, the left message will be displayed.
  Press the ▲ key to select YES, and press the ENT key to apply the setting. The scaling will be changed and parameters will be initialized.
  For details on parameters that are initialized, see “18 List of Parameters.”

■ Measuring Range Code Table

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

Input Type	Sensor Type			Code	Symbol	Measuring range	
Universal Input	RTD	Pt100	JIS/IEC	45	JPt 1	-200.0 to 500.0 °C	-300.0 to 900.0 ˚F
				46	JPt 2	-100.00 to 00.00 °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
			JIS/IEC	59	Pt15	0.000 to 50.000 °C	0.00 to 120.00 ˚F
			JIS	60	JPt15	0.000 to 50.000 °C	0.00 to 120.00 ˚F
	Voltage(mV)	-10 to 10mV		71	-10 to 10mV	Initial value: L= 0.0 : H=100.0 Display value: Any value in the following range 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.	
		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	When used with 0 to 20 mA, 4 to 20 mA current input, select either measuring range code 84 or 85, and attach a shunt resistor (1/2 W min., 250Ω) to the input terminals.	
		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°C (752 ˚F) or less; accurate to ±(0.2% FS + 1 digit) at 400 to 800°C (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°C (-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)

7−4 Unit

Select the unit to be used in the preset measuring range.
Before performing setup or changes to the setup, set control action to the standby mode (STBY: ON).
For details on control standby operation, see "16-8 Control Standby (STBY)."

Only temperature (°C, °F) can be selected for RTD and TC input.

7-3

```
RANGE: 86(0～ 10V)   CH
Sc_L:       0.0%      1
Sc_H:     100.0%
UNIT▶%    DP:  XXXX.X
```

Setting Item	RTD, TC	: °C, ℉
	Voltage, Current	: °C, ℉, %, None
Initial Value	RTD, TC	: °C
	Voltage, Current	: %

Caution

```
WARNING      CH1
 Params.Initialize
  proceed? NO
```

- When the unit is changed between °C and ℉, the left message will be displayed.
  Press the [▲] key to select YES, and press the [ENT] key to apply the setting. The unit will be changed and parameters will be initialized.
  For details on parameters that are initialized, see “18 List of Parameters.”
- At voltage input and current input, this message will not be displayed.

7－5 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).
Before performing setup or changes to the setup, set control action to the standby mode (STBY: ON).
For details on control standby operation, see "16-8 Control Standby (STBY)."
The key mark is displayed and this item cannot be set for RTD or TC input.

7-3

```
RANGE: 86(0～ 10V)   CH
Sc_L:        0.0%     1
Sc_H:      100.0%
UNIT:%      DP▶ XXXX.X
```

Setting range: XXXXX 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 60) with a decimal point.
This screen is not displayed for voltage input and current input.

7-4

```
Figure▶Normal        CH
CJ    : Internal      1
```

Setting item: Normal, Short
Initial value: Normal

Normal: Displays the measuring range (No. of digits) indicated in the Measuring Range Code Table.
Short: iscards the lowermost digit(s) past the decimal point of the measuring range indicated in the Measuring Range Code Table.

The EV/DO and PV Bias setting ranges do not change even if Figure is set to Short.
When EV/DO and PV Bias is set with Figure set to Short and Normal is switched to, the values of EV/DO and PV Bias sometimes change.

Caution

```
WARNING          CH1
 Params.Initialize
   proceed? NO
```

・When the lowest digit past the decimal point is changed, the left message will be displayed. Press the ▲ key to select YES, and press the ENT key to apply the setting. The lowest digit past the decimal point will be changed and parameters will be initialized.
For details on parameters that are initialized, see "18 List of Parameters."

7－6 Cold Junction Compensation

(1) Thermocouple cold junction compensation

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

7-4

```
Figure: Normal    CH
CJ     ▶Internal   1
```

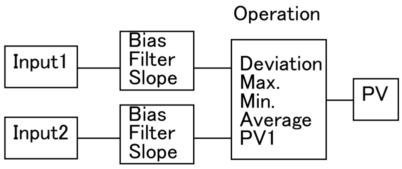
Setting item: Internal, External
Initial value: Internal

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.

8 I/O AUXILIARY SETTINGS

8－1 Setup of 2-Input Operation

This is setup in 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 standby.

7-1

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

Setting item: MAX, MIN, AVE, DEV, PV
Initial value: DEV

MAX: Maximum value Use larger input value as PV value.
MIN: Minimum 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: CH1 - PV Use PV1 (After making computation of Bias, Filter and Slope of Input 1) as PV value.

(2) Process when scaleover occurs

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

7-1

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

Setting range: 0, 1
Initial value: 0

0 : Proceed with control action with a PV value falling within the scale range if an input falls to scaleover, but the other input is within the scale. This is applicable only if MAX, MIN or AVE is selected.

1 : If any inputs fall to scaleover, follow the scaleover process set in this setting procedure.

(3) Bias, filter and slope

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

7-2

```
INPUT 1
PV Bias▶     0.0
PV Filter:   OFF
PV Slope:  1.000
```

For each one of setting operations:
see "8-3 (1) PV Bias" for PV Bias;
“8-3 (2) PV Filter” for PV Filter; and
“8-3 (3) PV Slope” for PV Slope.

8－2 Setting of Internal Cascade Control

This is setting of internal cascade control.
In general, 2 units of controllers are used for a cascade control and control is achieved by using the output of one (master unit) of them as SV value for the other (slave unit).

By using this device in 2-input specification, this cascade control may be achieved with one unit. This function is called the internal cascade function.
By making CH1 into the master and CH2 into the slave, OUT2 becomes the final control output.

(1) Scaling of slave SV

This is setting of scaling of SV of slave side (CH2).
Set SV range of the slave (CH2) for control output range of the master (CH1).
Reverse scaling is not possible.

7-1

```
CASCADE Slave SV
 Scale L▶     0.0℃
 Scale H:   800.0℃
 FILTER :  OFF
```

Setting range: Scale L: Within the measuring range of CH2
Scale H: Within the measuring range of CH2
Initial value: Scale L: Lower limit value of the Measuring range of CH2
Scale H: Higher limit value of the measuring range of CH2

Scale L: Set the SV lower limit value of the slave side for lower limit value of the output of the master side.

Scale H: Set the SV higher limit value of the slave side for higher limit value of the output of the master side.

(2) Slave SV filter

Set the filter which uses the control output of the master (CH1) side as SV for the slave (CH2) side.
Unstable control may occur if the output value is used as SV by input directly into the slave due to nonstop fluctuation of control output as its nature.
Make the SV of the slave side stable by using SV filter in such a case.

7-1

```
CASCADE Slave SV
 Scale L:     0.0℃
 Scale H:   800.0℃
 FILTER ▶ OFF
```

Setting range: OFF, 1 to 100 s
Initial value: OFF

FILTER: Set first order lag time constant for the slave side SV filter.

8－3 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.

7-2

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

Setting range: -10000 to 10000 digit
Initial value: 0

(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.

7-2

```
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 is only available on the screen during current/voltage.
Set the value of A in the following generation formula.

Executed PV ＝ A × X ＋ B
(A ＝ PV slope, B ＝ Bias, X ＝ PV input)

7-2

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

Setting range: 0.500 to 1.500
Initial value: 1.000

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

8－4 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.

7-5

```
SQ.Root▶ OFF        CH1
```

Setting item: OFF, ON
Initial value: OFF

(2) Low cut

This item functions only when the square root extraction operation function is enabled.

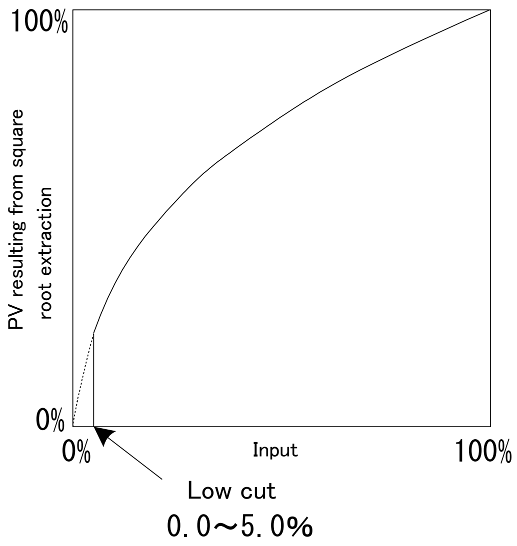
In square root extraction operation, results fluctuate considerably due to fluctuations of the input value near the signal zero. Low cut is a function for outputting "0" (zero) to PV at the preset input value or lower. Setting low cut prevents action from becoming unstable when there is noise on the input signal line.

7-5

```
SQ.Root▶ ON         CH1
Low Cut:  1.0%
```

Setting range: 0.0 to 5.0 %
Initial value: 1.0 %

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



8－5 Standard Control Output Setup

For control output setup of basic function MS (servo output), see "13-2 Control Output (Servo Output) Setup."

(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
    STBY:  0.0%
     ERR:  0.0%
     CYC:   30s
```

Setting item: 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 standby

This function maintains control output at a fixed value during a standby (STBY: ON, operation paused). Sets output value at standby. (Preset value)

6-1

```
OUT1 ACT: Reverse
    STBY▶  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 standby is set to 50% or more, the actual output at standby becomes 100%. When output at standby is set to 49.9% or less, the actual output at standby becomes 0%.
・ Output at standby is maintained without being affected even if an error occurs.

(3) Output 1 Output at error

Control operation stops when an error occurs. This item, however, is used to maintain output at a fixed value without setting the control output value at that time to 0% (or OFF). Set output when an error occurs.

6-1
```
OUT1 ACT:  Reverse
    STBY:   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 error becomes 100%.
  When output at error is set to 49.9% or less, the actual output at error becomes 0%
- Output at standby is given priority when an error has occurred at Standby (STBY = ON, controller operation paused).

(4) Output 1 Proportional cycle

This setting item is available only for contact output (Y) and SSR drive output (P). Output ON-OFF cycle is set in units of 1 second each.

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

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

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

Note

- If a short proportional cycle is set with contact output, the contact life of the output relay may be adversely affected. Pay particular attention to this point when setting the proportional cycle.
- If a long proportional cycle in a control system with a short delay time, control results will be adversely affected.
- The proportional cycle 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 and 2-loop specification are 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.

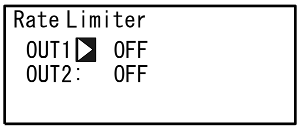
6-2
```
OUT2 ACT▶ Reverse
    STBY:   0.0%
     ERR:   0.0%
     CYC:    30s
```

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

(6) Rate-of-change limiter

This setting item limits the rate-of-change (%) per second.
This setting item can be set for each of output 1 (OUT1) and output 2 (OUT2, 2-output specification only).
Setting this item to OFF disables the rate-of-change limiter.
Set this setting item when a control target that is adverse sudden changes in output is used.

6-3



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

8－6 Ten-Segment Linear Approximation/Multi Bias Setting

・Ten-segment linear approximation

Ten-segment linear approximation can be set when type of input is “mV or V input, mA input.” It performs linearization based upon broken line approximation when the PV input is a non-linear signal.

・Multi bias

Multi bias can be set when the input type is "TC input, RTD input." It sets the PV bias value for each possible zone.

The various setup procedures are enabled on screen No. 7-5 to set the break point (or bias value).

(1) Enabling ten-segment linear approximation/multi bias

(a) Ten-segment linear approximation

Enabled by setting PMD to "Linearizer."

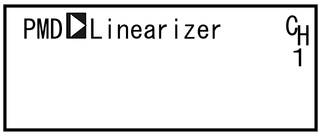
(b) Multi bias

Enabled by setting PMD to "PV-MBIAS (PV), PV-MBIAS (SV) or RSV-MBIAS (SV).”

For voltage or current input

This function performs linearization based upon ten-segment approximation when the PV input is a non-linear signal.

7-6

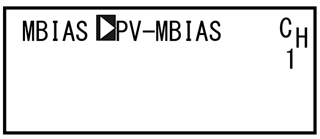


Setting item: OFF
Linearizer
PV-MBIAS (PV)
PV-MBIAS (SV)
RSV-MBIAS (SV)
Initial value: OFF

For RTD, TC input

Multi bias is a function to set the PV bias value for each-zone.

7-6



Setting item: OFF
PV-MBIAS (PV)
PV-MBIAS (SV)
RSV-MBIAS (SV)
Initial value: OFF

PV-MBIAS (PV): Performs multi PV bias operation with input PV value.
PV-MBIAS (SV): Performs multi PV bias operation with SV value.
RSV-MBIAS (SV): Performs remote SV bias operation with remote SV value.
(Displayed only with remote setting input specification.)

(2) Setting input point/multi bias

(a) 10-segment linear approximation

Sets input points for ten-segment linearizer approximation input (Linearizer). 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, linear interpolation is executed between input points.

7-5 to 7-10

```
PMD:  ON          CH
                   1
A 1▶     0.00%
B 1:     0.00%
```

```
A10▶  90.00%      CH
B10:  90.00%       1
A11: 100.00%
B11: 100.00%
```

Set the PV display value (B) to PV input value (A).

Setting range: An, Bn: -5.00 to 105.00%
Initial value: An, Bn: 0.00%
n ＝ 1 to 11

(b) Multi bias

Sets bias value for Enables you to divide PV (or SV) values into multiple zones (A1 to A11, 10 zones max.) and set “multi PV bias value (or multi remote bias value)” for each zone.
Set values independently of basic PV bias value (PV BIAS) and the remote bias value (REM BIAS).

7-5 to 7-10

```
MBIAS▶ PV-MBIAS(SV)

 A 1:   0.0℃
 B 1:   0.0℃
```

```
 A10:   0.0℃
 B10:   0.0℃
 A11:   0.0℃
 B11:   0.0℃
```

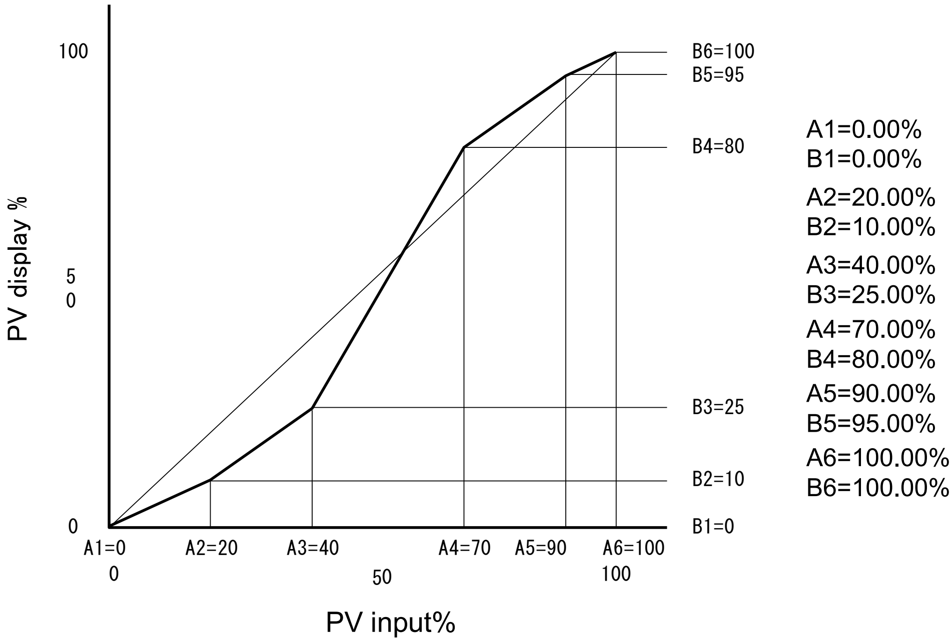
Set the PV display value (B) to PV input value (A).

Setting item: PV-MBIAS(PV)
: PV-MBIAS(SV)
: RSV-MBIAS(SV)
Initial value: An, Bn: 0℃
n ＝ 1 to 11

Mode	Setting Range	
	A1 to A11	B1 to B11
Linearizer	-5.00 to 105.00 %	-5.00 to 105.00 %
PV-MBIAS(PV)	PV input value (within measuring range)	PV bias value (±10,000 digits)
PV-MBIAS(SV)	SV value (within measuring range)	PV bias value (±10,000 digits)
RSV-MBIAS(SV)	Remote SV value (within measuring range)	Remote SV bias value (±10,000 digits)

■ 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.

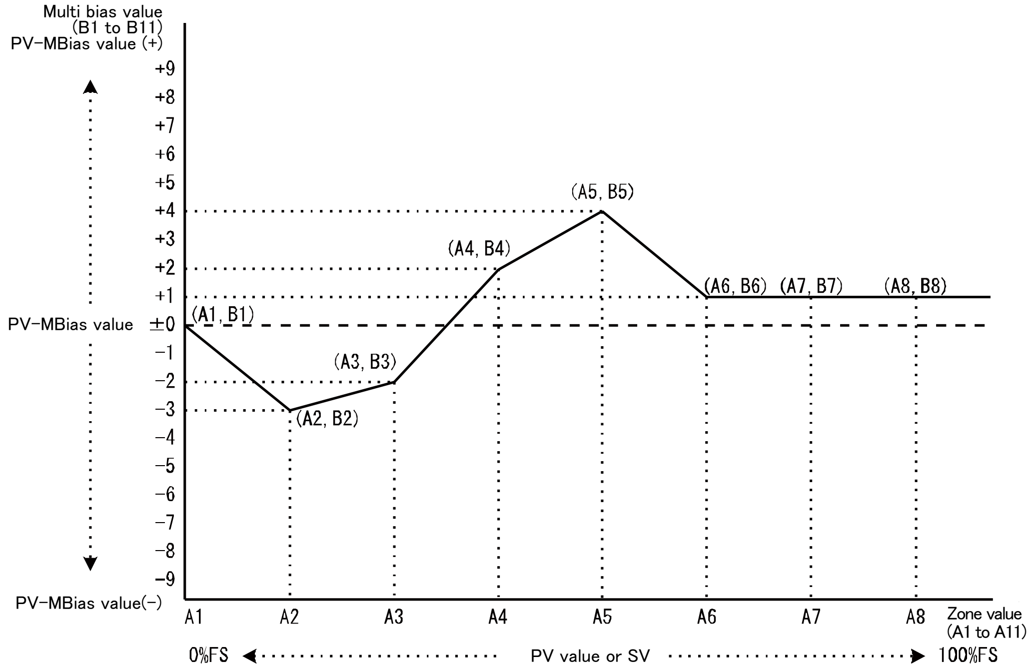


Caution

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

■ Multi bias setup example

An is the input axis of PV or SV and Bn is the output axis of the bias value.
For example, the input value of A2 is output with the bias value set at B2, and the input points are connected with a bias-corrected PV value.



Caution

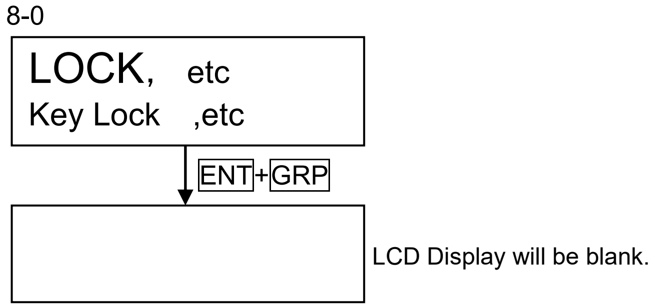
- Set An so the set value is An < A (n + 1).
- When the relationship becomes An ≥ A (n + 1), A (n + 1) onwards becomes invalid.

8－7 Compensating Control Output/Analog Output

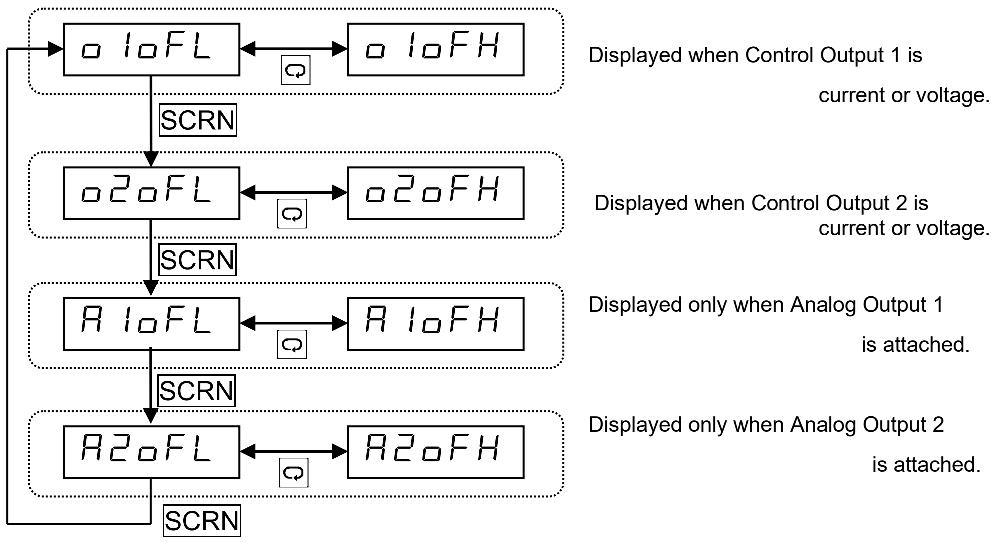
Can be set so control output or analog output is offset at two points (0% and 100%).

Offset method

1. Call up the LOCK, etc. top screen (group 8) from the basic screen by the GRP key.
Move to the setup screen by holding down the ENT key + GRP key for at least 3 seconds and set to output offset mode with the SCRN key + ↩ key.



2. Select the output to compensate and set the count value displayed in the SV display with the ▼ or ▲ key, and press the ENT key to enter the setting.



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

Setting range: ± 3000 digits
Initial value: 0

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

9 SV VALUE & REMOTE SV VALUE

9－1 Setting the SV Value

(1) SV limiter

The SV limiter is used to prevent input of wrong target set values.
Set the lower limit value (SV L) and higher limit value (SV H) of the set value (SV) setting range.

2-12
```
SV Limit_L▶     0.0℃ CH1
SV Limit_H:   800.0℃
```

Setting range: Within measuring range
(Note that 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

The SV limiter set here is valid on all execution SVs.
The remote execution SV monitor is not influenced by the SV limiter, and indicates the value corresponding to the remote input value.
The execution SV is restricted by the SV limit value.

Caution

- When the SV limiter is changed after the SV value is set, SV values that fall outside the limit are discarded, and sometimes the setting is disabled.
  To avoid this state, be sure to set the SV limiter before setting the SV value.

(2) Target set value (SV)

For details on how to set and change the currently executing SV, see "16-3 Setting the Execution SV No."
Operations in the SV setup screen are as follows:

1. Enter the set value by the [◀], [▼] or [▲] key.
2. Press the [ENT] key to fix and register the set value.

2-1
```
SV1▶            CH1
            0.0℃
```
```
SV1:            CH1
            0.0℃
```

This screen is for setting the SV value of each SV No.
In 2-loop specification, the channel number will be indicated on the rightmost area of the screen and the SV value may be set for each of CH1 and CH2.
If equipped with 2-loop specification, channel number can be changed by pressing the [↵] key on the SV setup screen. You can select CH2 with the [▲] key or CH1 with the [▼] key and enter the selection with the [ENT] key.

9－2 Setting the Remote SV Value

If you selected remote setting input, the remote-related features described in "9-4 (3) Low Cut" are available from this section. If the heater break alarm optional item is selected, the remote related features are not available.

(1) Monitoring the remote SV

The remote input signals are displayed in the REM set value monitor screen corresponding to the measuring range.
The remote SV value cannot be set by operating the front panel keys.

2-11

```
REM:
          0.0℃
```

The remote SV monitor displays the values corresponding to the remote input values without being influenced by the SV limit.

(2) Remote tracking

This function copies the remote SV value to the local SV value of any SV No.
The control program can be run while the SV value is changed by the analog remote signal, and fixed-value operation can be switched to by the remote SV value at a certain moment in time.

2-13

```
REM Track▶ NO
REM  Mode:  RSV
```

Selection item: NO, YES
Initial value: NO

■ **Operation at REM Track: YES**

When the execution SV is switched to by key operation from the remote SV, the remote SV value is written to the SV value of the newly switched to SV No.

When REM is assigned to DI, and the remote SV is switched to the execution SV by an external contact signal, the remote SV value is copied to the switch destination SV value.

When EXT is set by SV No. selection switching, and the execution SV selected by an external switch is switched to from the remote SV, the remote SV value is copied to the switch destination SV value. Remote tracking does not function when the remote SV value results in a scale over error.

■ **Operation at REM Track: NO**

Remote tracking does not function.

(3) Remote mode

Various computations can be performed on remote signals, and the result taken as the remote SV.
In 2-loop specification, CH1 and CH2 can be assigned individually.
Only when CH1 and CH2 are set within the same range, can both CH1 and CH2 be assigned simultaneously. In the RSV mode, the "Ratio" row in the following screen is not displayed.

2-13

```
REM Track:  NO

REM  Mode▶ RSV
```

Setting item: RSV, RT, RSV: CH2, RT: CH2,
RSV: CH1+2, RT: CH1+2
Initial value: RSV (Ratio is not displayed.)

RSV: The remote input is used as the regular RSV (remote SV) input. This is assigned to CH1.
RT: Computations are performed on the remote input signal values and used with ramp applied. This is assigned to CH1.
A bias can also be added to input signal values.

RSV:CH2	:	RSV is assigned to CH2.
RT:CH2	:	RT is assigned to CH2.
RSV:CH1+2	:	RSV is assigned to CH1 and CH2 simultaneously.
RT:CH1+2	:	RT is assigned to CH1 and CH2 simultaneously.

For details on RT, see "9-3 (1) Remote ratio.

9－3　Setting the Remote SV Compensation Value

(1) Remote ratio

This item is valid only when RT is selected in the Remote Mode.
Set the value of A in the following formula for generating the remote SV (REM SV):

$$\text{REM SV} = A \times X + B$$

(A: Remote ratio, B: Remote bias, X: Remote input signal)

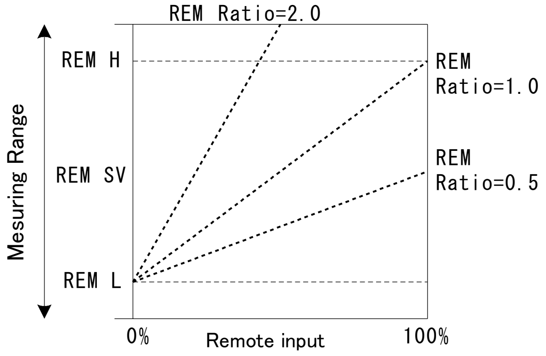
2-13

```
REM Track: NO

REM  Mode: RT
     Ratio▶ 1.000
```

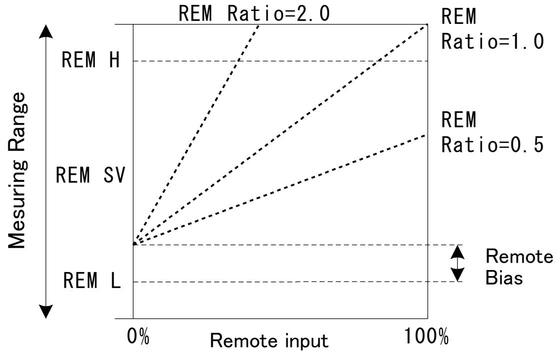
Setting range: 0.001 to 30.000
Initial value: 1.000

■ When ratio is set to remote (bias = 0)



REM H: Remote higher limit
REM L: Remote lower limit

■ When ratio and bias are set to remote



REM H: Remote higher limit
REM L: Remote lower limit

In the RT mode, generate the remote SV value by scaling the remote input signal, applying the remote ratio on the result of scaling, and applying a bias if required.

For details on remote bias, see "9-3 (2) Remote bias," and for details on remote scaling, see "9-3 (4) Remote scale."

Note

- When an extremely large remote ratio is set, the range that can be used as the remote signal input becomes extremely narrow, and when an extremely small remote ratio is set, the range of the remote SV becomes extremely narrow. Applying a large bias further narrows the usable range. Take the above points into consideration when using this function.
- The REM SV value obtained by generating and computing remote SV is subject to restrictions by the SV limit value.

(2) Remote bias

The REM SV value obtained by generating and computing remote SV is subject to restrictions by the SV limit value.

In RT mode : REM SV ＝ A × X ＋ B

In RSV mode : REM SV ＝ X ＋ B

（A: Remote ratio, B: Remote bias, X: Remote input signal）

2-14

```
REM Bias▶  0.0℃
   Filt:   OFF
   Sc_L:   0.0℃
   Sc_H: 800.0℃
```

The error of the remote input signal can be compensated.

Setting range: -10000 to 10000 digit

Initial value: 0

Though the remote bias can be set up to ±10000 digit, the assured accuracy is the range 0 to 100% of the remote signal input value.

Take care to prevent the value that is actually used from exceeding this accuracy range.

(3) Remote filter

Noise on the remote input signal line sometimes causes unstable control.
For this reason, this device incorporates a remote filter function for reducing the influence of noise to stabilize control.
Filtering is performed by first order lag computation.
Here, set that time constant.

2-14

```
REM Bias:    0.0 ℃
    Filt▶    OFF
    Sc_L:    0.0 ℃
    Sc_H:  800.0 ℃
```

Setting range: OFF, 1 to 300 s
Initial value: OFF

Setting a large time constant increases noise removal performance. This, however, sometimes adversely influences control systems that require a fast response speed.

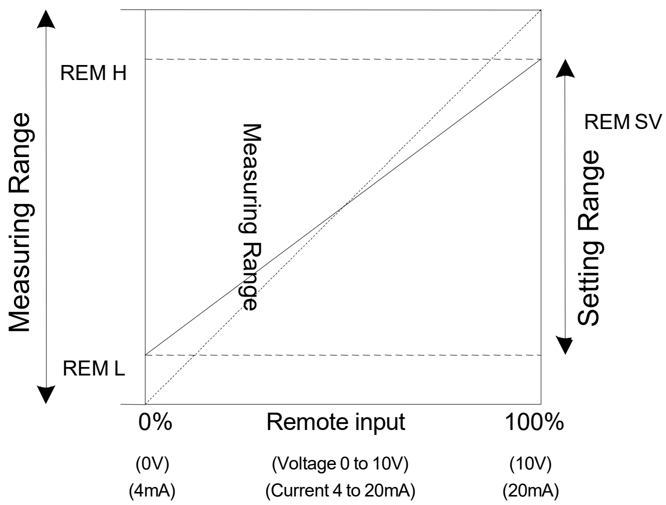
(4) Remote scale

Set the range that is to be used as SV by the remote input signal.
Set scaling within the measuring range.

2-14

```
REM Bias:    0.0℃
    Filt:    OFF
    Sc_L▶    0.0℃
    Sc_H:  800.0℃
```

Setting range: Within measuring range
(reverse scaling possible)
Sc_L ≤ REM L, REM H ≤ Sc_H
Initial value: Sc_L; Lower limit value of measuring range
Sc_H; Higher limit value of measuring range



Set the value of remote input signal 0% to REM L.
Set the value of remote input signal 100% to REM H.

For reverse scaling, set the value of remote input signal 0% to REM H, and the value remote input signal 100% to REM L.

9－4 Setting the Remote PID No. and Square Root Extraction Operation

Set square root extraction operation when remote signals undergo square root extraction operation to produce the execution SV, for example, in ratio control of flow rates.

(1) Setting the remote PID No.

The remote PID corresponding to the remote SV can be set.
Select the remote PID from PID No.1 to PID No.10.
Note, however, that the setting here becomes invalid when the zone PID function is in use.

2-15

```
REM PID▶    1

    SQ.Root: OFF
```

Setting range: 1 to 10
Initial value: 1

(2) Enabling remote square root extraction operation function

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

2-15

```
REM PID     1

    SQ.Root▶ OFF
```

Setting item: OFF, ON
Initial value: OFF

(3) Low cut

Low cut functions when square root extraction operation is valid.
In square root extraction operation, slight fluctuations of the input value near the signal zero cause the result to fluctuate considerably.
Low cut functions to set 0 (zero) to the REM signal when the input value is at the preset value or less.
This prevents action from becoming unstable when the REM input signal contains noise.

2-15

```
REM PID     1

    SQ.Root: ON
    Low Cut▶1.0%
```

Setting range: 0.0 to 5.0%
Initial value: 1.0%
If REM signal is 1.0% or below,
the value is adjusted to 0.

9－5 Setting the Ramp

This function gradually changes the set value without subjecting the load to sudden change when the target set value (SV) is changed.
Here, set four items: ascending ramp value (RAMP Up), descending ramp value (RAMP Down), ramp unit (RAMP Digit), and ramp ratio (RAMP Ratio).

(1) Ramp value

Set the ascending ramp value (RAMP Up) and descending ramp value (RAMP Down).
Ascending ramp or descending ramp is automatically selected at ramp execution.
When the ascending/descending ramp values are changed during execution of ramp control, they are immediately reflected in control.

2-16

```
RAMP   Up▶   OFF   CH
     Down:   OFF    1
     Unit:  /Sec
    Ratio:  /1
```

Setting range: RAMP Up: OFF, 1 to 10000
RAMP Down: OFF, 1 to 10000
Initial value: RAMP Up: OFF
RAMP Down; OFF

(2) Ramp unit time

Set the unit times of ascending ramp value (RAMP Up) and descending ramp value (RAMP Down).
Set either seconds (Sec) or minutes (Min) as the unit time of the rate-of-change.
When the ramp unit time is changed during execution of ramp control, it is immediately reflected in control.

2-16

```
RAMP   Up:   OFF   CH
     Down:   OFF    1
     Unit▶  /Sec
    Ratio:  /1
```

Setting item: /Sec, /Min
Initial value: /Sec

(3) Ramp ratio

Set this to use an even gentler slope in ramp control.
The amount of change per unit time can be set to 1/10 of the regular time.
When the ramp ratio is changed during execution of ramp control, it is immediately reflected in control.

2-16

```
RAMP   Up:   OFF   CH
     Down:   OFF    1
     Unit:  /Sec
    Ratio▶  /1
```

Setting item: /1, /10
Initial value: /1

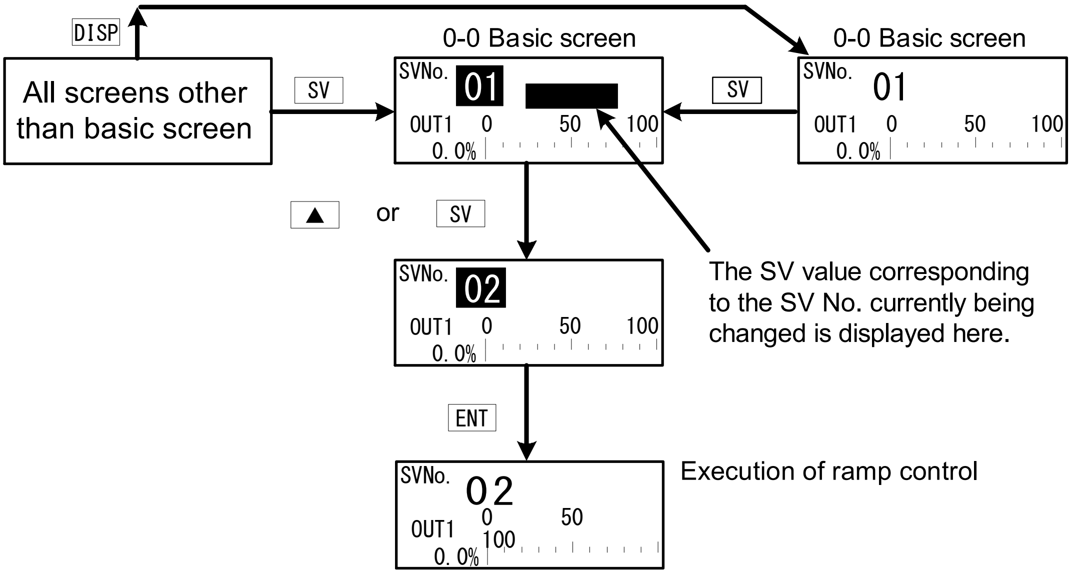
RAMP Ratio: /1 Ramp control is performed at the preset ramp unit time.
RAMP Ratio: /10 Ramp control is performed at 1/10 of the amount of change per unit.

(4) Executing ramp control

Ramp control is executed by switching the execution SV No.
For details on switching this SV No., see "16-2 Switching the Execution SV No.

During execution of ramp control, the RMP monitor lamp lights or RMP port of the status monitor (screen 0-2) flickers.

To abort ramp control and immediately execute fixed value control for switching to the target SV value, press the ENT and DISP keys simultaneously in the basic screen (group 0).
For details on operation of pausing/resuming ramp control, see "16-9 Pausing/Resuming Ramp Control (RAMP)."
While ramp control is paused, the RMP monitor lamp or □ for RMP in the status monitor (screen 0-2) is lit or is reversed.



For execution of ramp control, the following conditions must be satisfied.
These conditions are common to both front panel keys and external switch input.

- Execution of auto tuning must not be in progress (AT: ON).
- The mode must not be standby (STBY: ON).
- RAMP Up or RAMP Down must not be OFF.

Note

- Ramp control is not performed when the SV No. is switched to the remote SV. The same applies when the remote SV is switched to the local SV.
- When the power is turned OFF during ramp control, and then turned back ON again, ramp control is stopped, and the execution SV is switched to the SV No. that was used as the target SV No.

10 PID SETTING

10－1 Proportional Band (P)

Proportional band refers to the range in which the size of the control output changes in proportion to the difference (deviation) between the measured value (PV) and the set value (SV).
Sets 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) incrw weases. 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, ON-OFF control is established 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 %

10－2 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 "10-4 Manual Reset (MR)."

10－3 Derivative Time (D)

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

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

3-1

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

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

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

10－4 Manual Reset (MR)

This function sets I (integral time) to OFF, and manually corrects offset that occurs when control action is performed by P or P + D.
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%（1-loop, 2 output）

■ Automatic setting of MR

When auto tuning is executed, the manual reset (MR) value is computed and automatically set.
During PID control, the MR is used as the target load ratio in PID initial computation.
For this reason, to reduce overshoot when the power is turned ON or STBY ON → OFF, set a small MR value to lower this target load ratio.
When auto tuning is performed by PID control on this device, the load ratio is calculated so that offset is decreased even if there is no I action, and the 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.

10－5 Action Hysteresis (DF)

This item sets the hysteresis (DF) for ON-OFF control action when P = 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, however, ON-OFF cycling increases.

3-1

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

Setting range: 1 to 9999 digit
Initial value: 20 digit

10－6 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

```
Tuning : Auto Tuning   CH
 Hunting: 0.5%          1
AT Point: 0.0℃
DF Mode ▶ Center
```

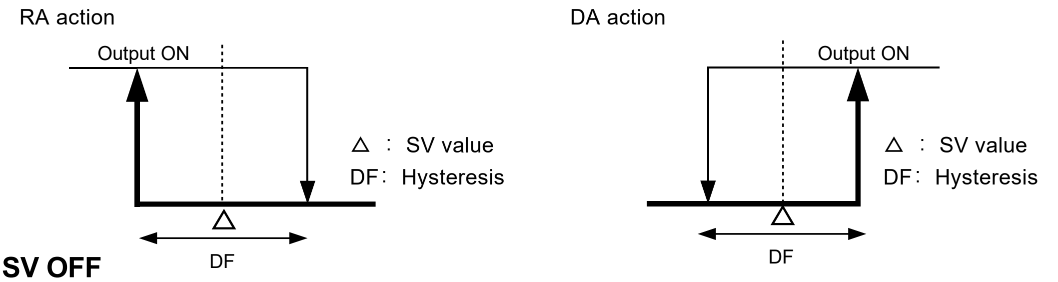
Setting range: Center, SV OFF, SV ON
Initial value: Center

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.

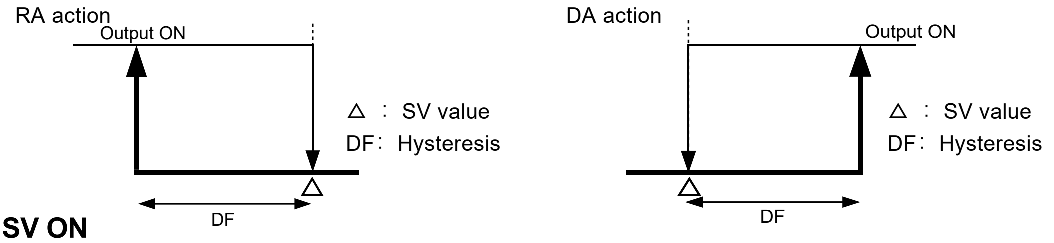
■ Two-Position Action

When conducting two-position action, frequent switching of output ON/OFF is prevented by utilizing hysteresis.

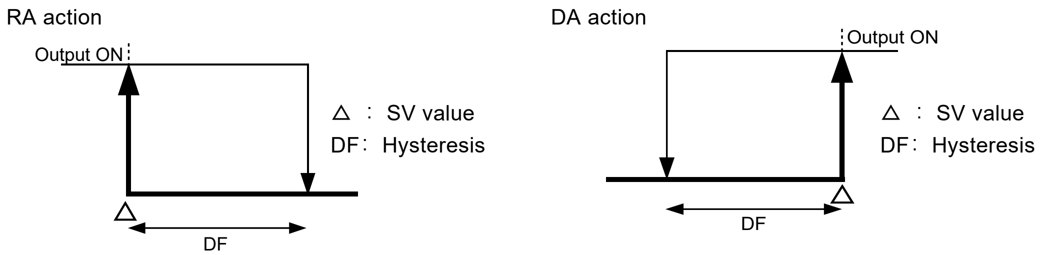
Center



SV OFF



SV ON



10－7 Dead Band (DB)

This setting is for only the 1-loop control, 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

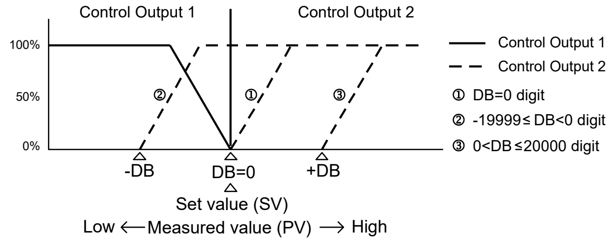
```
PID01-OUT2
P:   3.0%     DB▶  0.0
I:   OFF      SF: 0.40
D:    30s
```

Setting range: -19999 to 20000 digit
Initial value: 0 digit

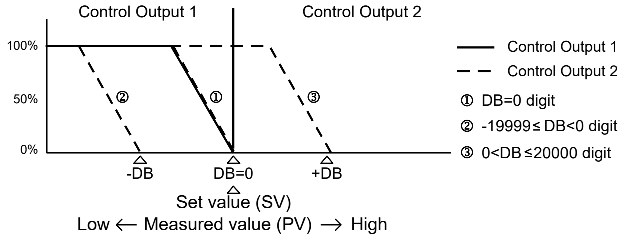
The patterns in the following figures show the relationship between output action and dead band.

RA: Reverse Action, DA: Direct Action

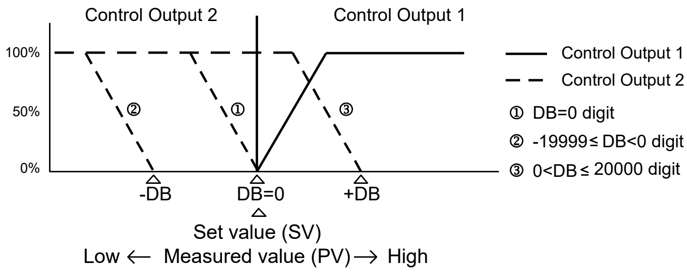
■ Control Output 1: RA, Control Output 2: DA. (RA + DA)



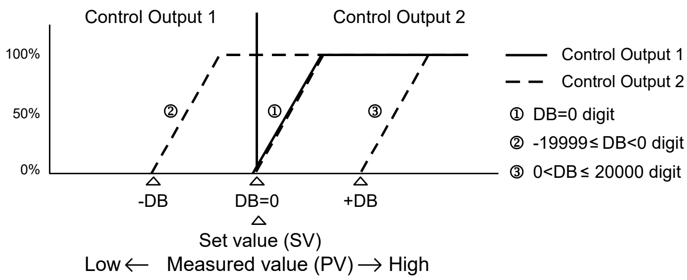
■ Control Output 1: RA, Control Output 2: RA. (RA + RA)



■ Control Output 1: DA, Control Output 2: RA. (DA + RA)



■ Control Output 1: DA, Control Output 2: DA. (DA + DA)



10－8 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

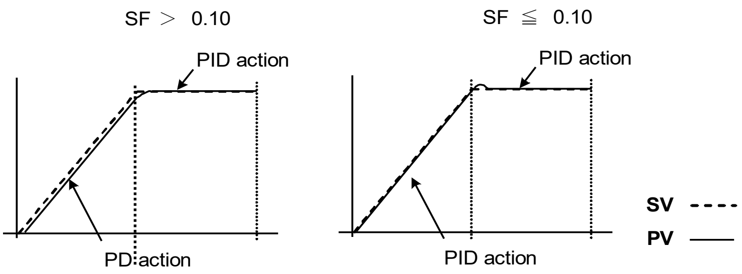
```
PID01-OUT1
P:   3.0%     MR:  0.0%
I:   OFF      SF▶0.40
D:    30s
```

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 orks strongly.

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

PID and PD action can be switched by the SF value during RAMP, REM or cascade.



10－9 Output Limit Value (OUT1L to OUT2H)

This is the screen for setting the lower limit value and higher limit value of the control output value 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, set a large higher limit value.

When any specification other than 1-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%
```

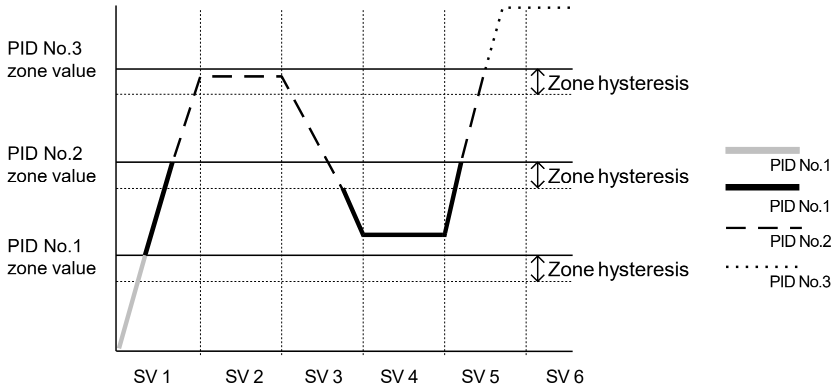
Setting range: Lower limit value: 0.0 to 99.9%
Higher limit value: 0.1 to 100.0%
（Note that lower limit value < Higher limit value）
Initial value: Lower limit value: 0.0%
Higher limit value: 100.0%

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.

10－10 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 as two or more SVs can be used for performing ramp control.



Note

- When the same zone value is set to multiple PID Nos., the PID No. having the smallest No. is executed.
- With SV in zone hysteresis state, the execution PID No. does not change until zone hysteresis disappears, even if zone value and zone hysteresis change.

(1) Selecting zone PID

Select whether or not to use zone PID.
When this function is used, select whether to set the zone by SV or by PV.
Zone PID2 is displayed in 2-loop or cascade specification.

3-31 Other than 2-loop & Cascade specification

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

2-loop & Cascade specification

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

Setting item: OFF, SV, PV
Initial value: OFF

OFF: Zone PID function is disabled.
PID No. is switched interlocked with the SV No.
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 or cascade specification.

3-31 Other than 2-loop

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

Cascade specification In 2-loop or cascade specification

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

Setting range: 0 to 10000 digit
Initial value: 20 digit

(3) PID zone value

Set the zone (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 hysteresis and Zone PID must be set.

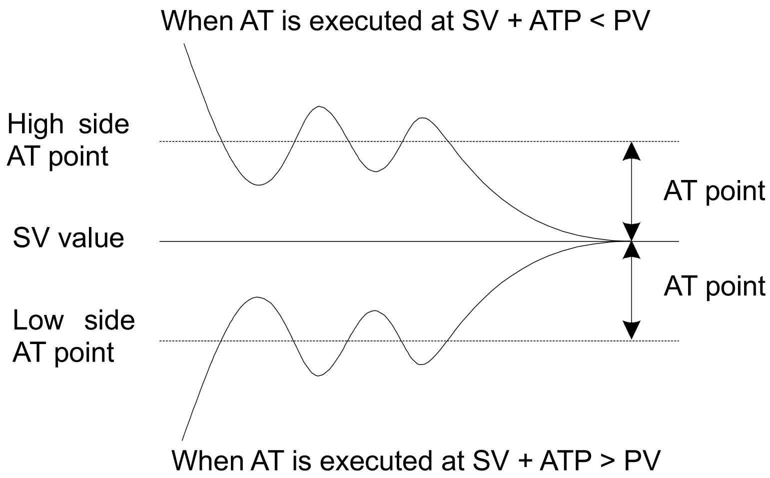
10－11 Auto Tuning Point

To avoid hunting caused by limit cycle using the SV value in execution of PID auto tuning, set the AT action at the point far from the SV value.

3-32

```
Tuning : Auto Tuning   CH
 Hunting: 0.5%          1
AT Point▶ 0.0 ℃
```

Setting range: 0 to 10000 digit
Initial value: 0 digit



Note

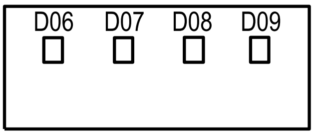
- For the AT Point setting, the AT action points above and below the SV value are automatically set.
- If auto tuning is executed when PV is outside the preset upper and lower AT action points, auto tuning is performed at the AT action point between the PV and SV.
- If auto tuning is executed when the PV value is inside the upper and lower AT action points, auto tuning is performed by the SV value.
- When AT Point is set to 0 (zero), the SV value becomes the AT action point.

11 EVENT & DO SETTINGS

11－1 Monitor Screens

(1) DO monitor

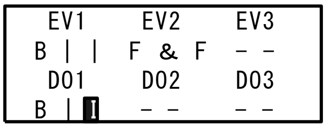
4-1



When a signal is output to DO, □ is lit reversed to ■. DO6 to DO9 are optional, and are not displayed when they are not available.

(2) Logic monitor

4-2



This screen is displayed when EV/DO is assigned to even a single point.

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

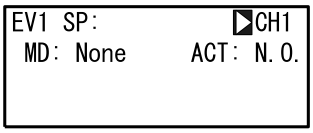
Becomes white reversed on black in an active state.

In the example above, Buffer and Inverter are assigned to EV1 to make the device perform OR operation on both inputs.

11－2 Channel Setting

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

4-3



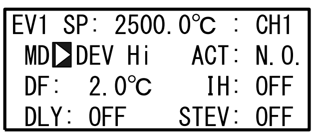
Setting item : CH1, CH2
Initial value: CH1

11－3 EVENT/DO Action

(1) Event mode (type) selection

Assign functions for events (EV) and external control outputs (DO).
Note that if you have changed this setting, action set points (SP) and hysteresis (DF) parameters are initialized.
Some of the types of events that can be assigned vary according to the EV No. and DO No.
DO6 to D013 are optional.
Logic operations assignable to EV1 to EV3 and DO1 to DO3 are AND, OR and XOR.
Logic operations assignable to DO4 and DO5 are Timer and Counter.

4-3



Setting item: See List of Event (EV/DO) Assignments.
Initial value: EV1: DEV Hi
EV2: DEV Low
Others: None

■ List of Event (EV/DO) Assignments

DO11 to DO13 are not available for basic functions DL, DC, DS, DD, MS.

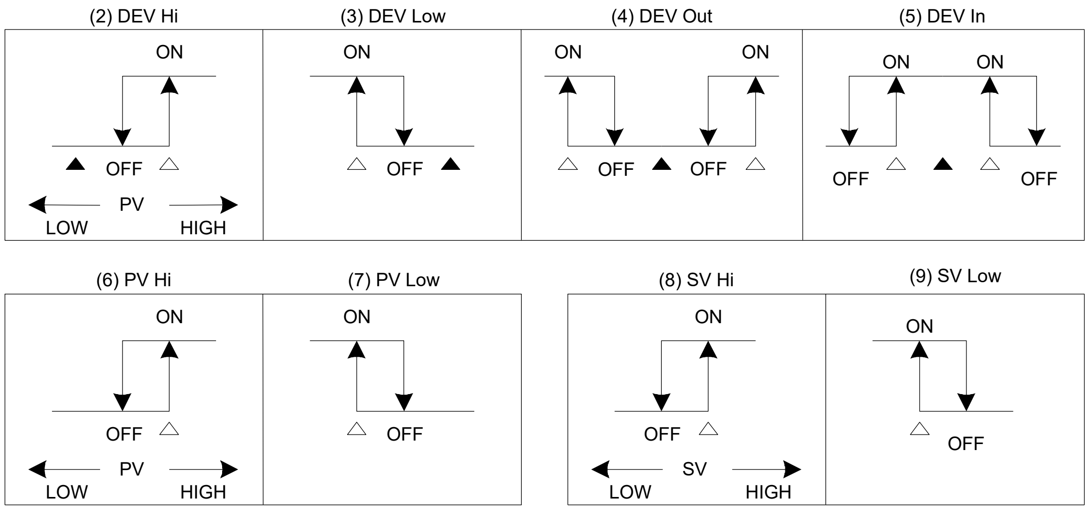
No.	Mode	Action	EV1 to EV3	DO1 to DO3	DO4 to DO5	DO6 to DO13
(1)	None	No action	○	○	○	○
(2)	DEV Hi	Higher limit deviation value	○	○	○	○
(3)	DEV Low	Lower limit deviation value	○	○	○	○
(4)	DEV Out	Outside higher/lower limit deviation	○	○	○	○
(5)	DEV In	Inside higher/lower limit deviation	○	○	○	○
(6)	PV Hi	PV higher limit absolute value	○	○	○	○
(7)	PV Low	PV lower limit absolute value	○	○	○	○
(8)	SV Hi	SV higher limit absolute value	○	○	○	○
(9)	SV Low	SV lower limit absolute value	○	○	○	○
(10)	AT	Auto tuning execution in progress	○	○	○	○
(11)	MAN	Manual operation in progress	○	○	○	○
(12)	REM	Remote operation in progress	○	○	○	○
(13)	RMP	Ramp control execution in progress	○	○	○	○
(14)	STBY	Control action not in progress	○	○	○	○
(15)	SO	PV, REM scale over	○	○	○	○
(16)	PV SO	PV scale over	○	○	○	○
(17)	REM SO	REM input scale over	○	○	○	○
(18)	LOGIC	Logic operation: AND, OR, XOR	○	○	——	——
		Logic operation: Timer, Counter	——	——	○	——
(19)	Direct	Direct output (with communication option)	——	——	——	○
Other than basic function MS (servo output)						
(20)	HBA	During heater break alarm output (optional)	○	○	○	○
(21)	HLA	Heater loop alarm output (optional)	○	○	○	○
Basic function MS (servo output)						
(20)	Posi.H	Position higher limit absolute value	○	○	○	○
(21)	Posi.L	Position lower limit absolute value	○	○	○	○
(22)	POT.ER	Feedback potentiometer (R2) error	○	○	○	○

: DLY configurable

MD Indication	EVENT (DO) Type	Setting Range	Initial Value
DEV Hi	Higher limit deviation value	-25000 to 25000 digit	25000 digit
DEV Low	Lower limit deviation value	-25000 to 25000 digit	-25000 digit
DEV Out	Outside higher/lower limit deviation	0 to 25000 digit	25000 digit
DEV In	Inside higher/lower limit deviation	0 to 25000 digit	25000 digit
PV Hi	PV higher limit absolute value	Within measuring range	Measuring range higher limit value
PV Low	PV lower limit absolute value	Within measuring range	Measuring range lower limit value
SV Hi	SV higher limit absolute value	Within SV setting range	Measuring range higher limit value
SV Low	SV lower limit absolute value	Within SV setting range	Measuring range lower limit value
Posi.H	Position higher limit absolute value	0 to 100%	100%
Posi.L	Position lower limit absolute value	0 to 100%	0%

For DEV Out and DEV In, two plus and minus action points are set when a deviation value is input.

■ EV/DO Action Diagrams



△Action point ▲SV value

- ON/OFF in the diagrams indicate operation mode.
  EV/DO output conforms to the setting of output characteristics.

(2) Output characteristics

Select the output characteristics.

4-3

```
EV1 SP: 2500.0℃ : CH1
 MD: DEV Hi   ACT▶N.O.
 DF:  2.0℃     IH: OFF
 DLY: OFF    STEV: OFF
```

Setting item: N.O., N.C.
Initial value: N.O.

N.O: When EV/DO is ON, output closes contacts or turns transistor ON.

N.C: When EV/DO is ON, output opens contacts or turns transistor OFF.

(3) Action hysteresis

This item is displayed when modes (2) to (9) in EV/DO action mode (MD) or modes (20) to (21) in basic function MS (servo output) are selected.

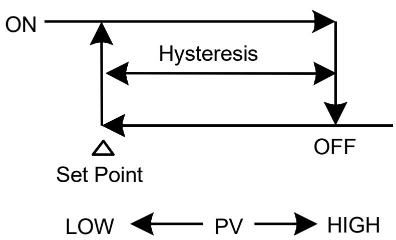
Set the action hysteresis (DF) between ON action and OFF action.
Setting a wide hysteresis can avoid chattering, etc. and obtain stable action.

4-3

```
EV1 SP: 2500.0℃ : CH1
 MD: DEV Hi   ACT  N.O.
 DF▶ 2.0℃     IH: OFF
 DLY: OFF    STEV: OFF
```

(1) to (9)	Setting Range: 1 to 9999 digit Initial Value: 20 digit
(20) to (21) Basic function MS only	Setting Range: 1 to 50 % Initial Value: 1 %

Ex) PV Low's case



(4) Delay time

This item is displayed when modes (2) to (9) in EV/DO action mode (MD) or modes (20) to (21) in basic function MS (servo output) are selected.

This function delays the time from when source of event occurs until EV/DO turns ON.

4-3

```
EV1 SP: 2500.0℃ : CH1
 MD: DEV Hi   ACT  N.O.
 DF:  2.0℃     IH: OFF
 DLY▶OFF     STEV: OFF
```

Setting range: OFF, 1 to 9999 s
Initial value: OFF

Note

- EV/DO does not turn ON when the source of the signal output disappears during the delay time. When the source is generated again, the event delay time up till then is cleared, counting of the item is performed from the beginning.
- When the delay time is set to OFF, output simultaneously when the source of EV/DO is generated.
- Delay time can be changed when source of EV/DO signal occurs and it is within the delay time action. Note, however, that the delay time is measured not from the moment that it is changed but from the moment that the output source is generated.
- The delay time for EV/DO action becomes invalid when a scale over occurs.

(5) Inhibit action

This item is displayed when modes (2) to (9) in EV/DO action mode (MD) or modes (20) to (21) in basic function MS (servo output) are selected.

Standby action is a function that turns EV/DO ON when it fails to be turned ON when power is applied or standby is reset despite PV value being in event action zone and when PV value re-enters event action zone after once leaving it.

Select either of the following taking standby action and event action at a scale-over into account.

4-3

```
EV1 SP: 2500.0℃ : CH1
 MD: DEV Hi   ACT  N.O.
 DF:  2.0℃     IH▶OFF
 DLY: OFF    STEV: OFF
```

Setting item: OFF, 1, 2, 3
Initial value: OFF

OFF: No standby action
1 : Inhibit action is executed at power ON or when the control state changes from standby to execution (STBY ON→OFF).
2 : Inhibit action is executed at power ON, when the control state changes from standby to execution (STBY ON→OFF) or when the state of SV is changed.
3 : Control mode (no inhibit action)

Note

- When IH is set to 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, event 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/DOs.

(6) Event action at standby

This item is displayed when modes (2) to (9) in EV/DO action mode (MD) or modes (20) to (21) in basic function MS (servo output) are selected.

Event action at inhibit (STEV) selects whether or not to perform EV/DO operation during standby.

4-3

```
EV1 SP: 2500.0℃ : CH1
 MD: DEV Hi   ACT  N.O.
 DF:  2.0℃     IH: OFF
 DLY: OFF    STEV▶OFF
```

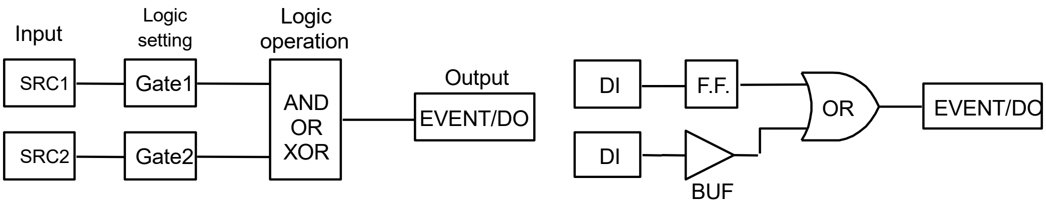
Setting item: OFF, ON
Initial value: OFF

OFF: EV/DO signal is disabled during inhibit.
ON : EV/DO signal is enabled during inhibit.

11－4 Event Logic Operations（EV1 to EV3, DO1 to DO3）

This function performs logic operations on inputs from two DI signals and outputs the result to EV/DO.
This function sets a logic gate to each of the two inputs, performs logic operation (AND, OR or XOR) on these inputs, and outputs the result to EV/DO.
Events that can be selected are EV1 to EV3 and DO1 to DO3.

■ Event logic operation block diagram and configuration example



(1) Logic operation mode（Log MD）

The following screen is displayed when logic operation (LOGIC) is selected as the operation mode (MD).

4-6

```
DO1  Log MD▶AND
 MD: LOGIC    ACT: N.O.
 SRC1: None  Gate1: BUF
 SRC2: None  Gate2: BUF
```

Setting item: AND, OR, XOR
Initial value: AND

AND Logical product: EV/DO turn ON when both of two logic inputs turn ON (logic 1).

OR Logical sum: EV/DO turn ON when either the two inputs turns ON (logic 1).

XOR Exclusive OR: EV/DO turn ON when one of the two inputs turns ON (logic 1) and the other turns OFF (logic 0).

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

Assign the DI No. to two inputs for which logic operation is to be performed.
DI that can be assigned are DI1 to DI10 (DI5 to DI10 are optional).

4-6

```
DO1  Log MD: AND
 MD: LOGIC    ACT: N.O.
 SRC1▶None  Gate1: BUF
 SRC2: None  Gate2: BUF
```

Setting item: None, DI1 to DI10
Initial value: None (no assignment)

Note

- When another function is assigned to DI and that DI signal is ON, logic operation is executed and the function assigned to DI acts simultaneously.
- When logic operation input is set to None, the input logic becomes logic 0 regardless of the BUF, INV and FF settings.

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

Set the logic of the two inputs for logic operation.

4-6

```
DO1  Log MD: AND
 MD: LOGIC    ACT: N.O.
 SRC1: None  Gate1▶BUF
 SRC2: None  Gate2: BUF
```

Setting item : BUF, INV, FF
Initial value: BUF

BUF: Buffer
DI signals are handled as input logic signals.

INV: Inverter
DI signals are reversed and handled as the input logic signal.

FF: Flip-flop
DI input signals are reversed and the result is handled as the input logic signal each time that the assigned DI turns ON.
When DI turns ON, that ON state is sustained even if it turns OFF later.
In this case, the input logic turns OFF when DI is ON again.

Note

- The DI monitor (screen 5-1) lights when input signal is introduced. When Gate is set to INV, logic becomes Logic 1 when DI signal is OFF, and Logic 0 when DI signal is ON. For this reason, the logic state becomes the reverse of the DI monitor. For details, see "12-1 (1) DI Monitor."
- When Gate is set to FF, the logic state toggles between Logic 1 and Logic 0 each time DI turns ON. For this reason, the logic state can be confirmed on the logic operation monitor.
- When DI assignment is set to None, no action is performed even if the DI signal is ON.

11－5 Timers/Counters

With this timer/counter function, DI is taken as input and DO is taken as output.
For timer, DO turns ON after a preset time elapses only if the DI signal is ON.
For counter, DO turns ON when DI signal count reaches the preset number of times.
In this case, it turns ON regardless of the control action of this device, and output a one-shot pulse of one second.
Only DO4 and DO5 can be assigned for the timers and counters.
The following screen is displayed only when the operation mode is set to logic operation (LOGIC).

(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.
If set to 1 second, the output state is continuous.

4-10

```
DO5 Time▶  OFF
 MD: LOGIC    ACT: N.O.
 SRC: DI3
 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 100 ms or more.

4-10

```
DO5 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)

DI that can be assigned are DI1 to DI10 (DI5 to DI10 are optional).

4-10

```
DO5 Time :   OFF
 MD: LOGIC    ACT: N.O.
 SRC▶None
 Log_MD: Timer
```

Setting item: None, DI1 to DI10
Initial value: None (no assignment)

Note

- When another function is assigned to DI and that DI signal turns ON, logic operation is executed and the function assigned to DI acts simultaneously.
- When DI assignment is set to None, no action is performed even if the DI signal is ON.

(4) Mode (Log MD)

Select and set timer or counter.

4-10

```
DO5 Time :   OFF
 MD: LOGIC    ACT: N.O.
 SRC: D13
 Log_MD▶Timer
```

Setting item: Timer, Counter
Initial value: Timer

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

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

12－1 DI

DI is digital control input signal for external control based upon an externally input non-voltage contact signal or an open collector signal.
Actions can be selected, and assigned to DI1 to DI10 (DI5 to DI10 are optional).

(1) DI monitor

□ is reversed to ■ when a signal is ON, regardless of whether it is assigned.
DI5 to DI10 are optional, and are not displayed when they are not available.

5-1

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

(2) Selecting DI action

This is the assignment to DI.
In 2-loop specification, assignment may be done to either CH1 or CH2, or to both CH1 and CH2 at the same time.
No channel assignment is displayed in 1-loop specification.

■ **Assignment to channels and assignment of DI types**

5-2 Assignment to channels

```
DI1: None   ▷CH1
DI2: None   :CH1
DI3: None   :CH1
DI4: None   :CH1
```

5-2 Assignment of DI types

```
DI1▷None   :CH1
DI2: None   :CH1
DI3: None   :CH1
DI4: None   :CH1
```

Setting item: CH1, CH2, CH1 + 2
Initial value: CH1

LG is displayed for the DI to be used by input (SRC) in event logic operations.
For details, see “11-4 (2) Assigning logic operation input (SRC1, SRC2).”

5-2 Assignment to channels

```
DI1: None   ▷CH1
DI2: None   :CH1
DI3: None   :CH1    LG
DI4: None   :CH1
```

■ List of DI Types

Mode	Action		No-action Conditions	Signal Detection
None	No action (factory default)		————	———
MAN	Switching of control output between auto/manual (at ON: manual)		AT, STBY *1	Level
REM	Switching of REM SV/LOCAL SV setting (at ON: REM SV setting)		AT	Level
AT	Switching of AT execution/stop (at ON "edge": AT execution)		MAN, STBY, RMP, REM	Edge
STBY	Switching of control execution/standby (at ON: standby)		None	Level
ACT	Switching of direct/reverse action on Output 1 characteristics (at ON: direct action)		AT, RMP	Level
ACT2	Switching of direct/reverse action on Output 2 characteristics (ON: direct action) (1 loop)		AT, RMP	Level
Pause	Switching of pause/resume of ramp control (at ON: ramp pause)		————	Level
LOGIC	Logic operation (at ON: execution of logic operation and output to EV/DO)		None	Level
Preset1	Assignable to DI2	External switching using servo preset value (position value) can only be set for D12.	MAN, STBY	Level
Preset2	Assignable to DI2 to DI3		MAN, STBY	Level
Preset3	Assignable to DI2 to DI4		MAN, STBY	Level
EXT_SV	External switching of SV No. Only DI7 can be set. (assigned to DI7 to DI10)		None	Level

Note

- The corresponding DI action details cannot be executed while parameters listed in the "No-action Conditions" column in the table of “List of DI Types” are being executed.
- Signal detection timing:
  (ON/OFF status must be maintained for at least 0.1 seconds to detect DI signal.)
  Level: Action is maintained with DI signal ON.
  Edge: Action is executed by DI signal ON, and is maintained even if it turns OFF.
  Action is canceled by DI input ON again.
- Once a function is assigned to a DI, the same function cannot be set by the front panel keys as DI is given priority.
- When the same action is assigned to two or more DIs, the DI having the smallest No. is valid, and DIs having a larger No. are invalid. (However, valid if on different channels) For example, assignment to DI2 becomes invalid when MAN is assigned to DI1 and DI2.
- When a DI assignment is canceled during DI execution, the action currently being executed continues (LOGIC: excluding LOGIC operation).
- If LOGIC and REM are assigned according to DI type, assignment to the channel is no longer possible.
  For details on logic operation, see "11-4 Event Logic Operations".

*1 Basic function MS (servo output) allows automatic/manual switching even during STBY.

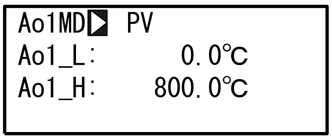
12－2 Analog Output (Ao1, Ao2)

Analogue output (Ao) is a function that converts the information from the device into industrial signals and outputs it. Typical signal types are 0 to 10 V or 0 to 10 mV for voltage and 4 to 20 mA for current.
Two optional analog outputs (Ao1, Ao2) can be installed on this device.
This function is optional and is not displayed when it is not installed.

(1) Analog output type (Ao1 MD, Ao2 MD)

Select the type of analog output to assign.

5-5



Setting item: PV, SV, DEV, OUT1, CH2_PV, CH2_SV, CH2_DEV, OUT2, Posi
Initial value: Ao1MD: PV
Ao2MD: SV

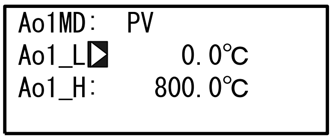
PV: Measured value (CH1)
SV: Set value (CH1)
DEV: Deviation value of PV and SV (CH1)
OUT1: Control Output 1
Posi: Position value
CH2_PV: Measured value (CH2)
CH2_SV: Set value (CH2)
CH2_DEV: Deviation value of PV2 and SV2 (CH2)
OUT2: Control Output 2 (only in 2-output specification)

In 2-loop, both Ao1 and Ao2 can be assigned type of analog output other than Posi.

(2) Scaling analog output (Ao1 L to Ao2 H)

Sets range for conversion corresponding to type of analog output.
Sets the lower limit/higher limit range (scale) of conversion range.
Reverse scaling is also possible if an inverted signal is required.

5-5



The following table shows setting ranges and initial values.
(Note that Ao1_L < Ao1_H or Ao2_L < Ao2_H)

Analog Output Type	Setting Range	Initial Value	
		Ao1_L, Ao2_L	Ao1_H, Ao2_H
PV, SV, CH2_PV, CH2_SV	Within measuring range	Measuring range lower limit value	Measuring range higher limit value
DEV, CH2_DEV	-100.0 to 100.0 %	-100.0 %	100.0 %
OUT1, OUT2	0.0 to 100.0%	0.0 %	100.0 %
Posi	0 to 100 %	0 %	100 %

Note

・With basic function MS, if “Posi” remains assigned to type of analog output and is switched to “without feedback”, the analog output type changes to “PV”.

12−3 Heater Break/Loop Alarm (other than Basic Function MS)

This function outputs an alarm when the heater has burned out during control (heater break) or when some trouble on the final control element causes a heater current to flow when output is OFF (heater loop error).

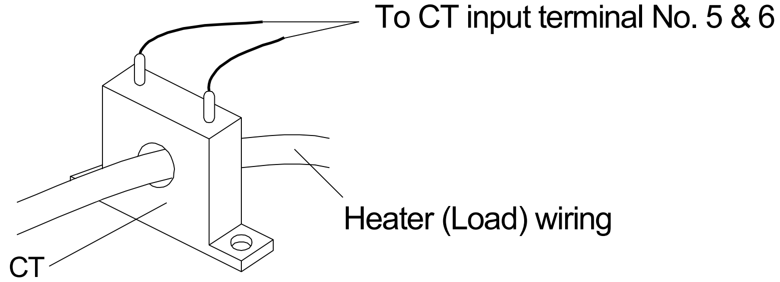
Alarm output is assigned to Event or DO, and HBA (heater break alarm) or HLA (heater loop alarm) is assigned to for use.

The 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 0.2 A.

(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).

5-7

```
Heater [  0.0A]
 HBA▶OFF
 HLA: OFF
 HBM: Real    HB: OUT1
```

Display range: 0.0 to 55.0 A

When the detection current exceeds 55.0 A, HB_HH is displayed and when the current cannot be detected, "----" is displayed.

(3) Heater break alarm current (HBA)

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

5-7

```
Heater [  0.0A]
 HBA▶OFF
 HLA: OFF
 HBM: Real   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.
The alarm output is maintained even if control output turns ON during alarm output.

5-7

```
Heater [  0.0A]
 HBA: OFF
 HLA▶OFF
 HBM: Real   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)

Select the real mode (Real) or the lock mode (Lock) as the alarm output mode.

5-7

```
Heater [  0.0A]
 HBA: OFF
 HLA: OFF
 HBM▶Real   HB: OUT1
```

Setting item: Real, Lock
Initial value: Lock

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

Lock : Once the alarm can be output, alarm output is locked (fixed), and is output continuously even if the heater current returns to normal. Alarm output is canceled by setting HBA and HLA to OFF or the power is turned 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 ouput1/output2.

5-7

```
Heater [  0.0A]
 HBA: OFF
 HLA: OFF
 HBM: Real   HB▶OUT1
```

Setting item: OUT1, OUT2
Initial value: OUT1

12－4 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	1/2 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

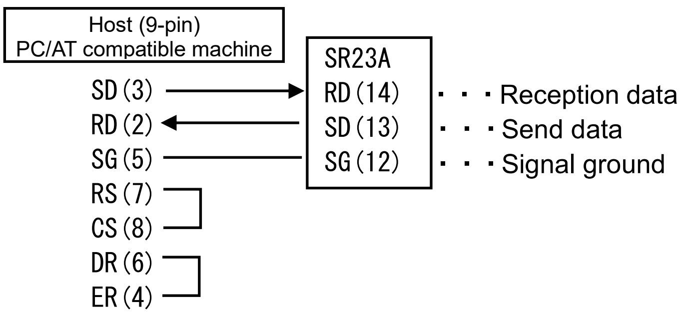
Data length	Fixed to 8 bits
Parity	EVEN/ODD/NONE
Stop bit	1 bit, 2 bits
Control code	None
Error check	CRC

* For details, see the description of protocols in Chapters 19 and 20.

(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



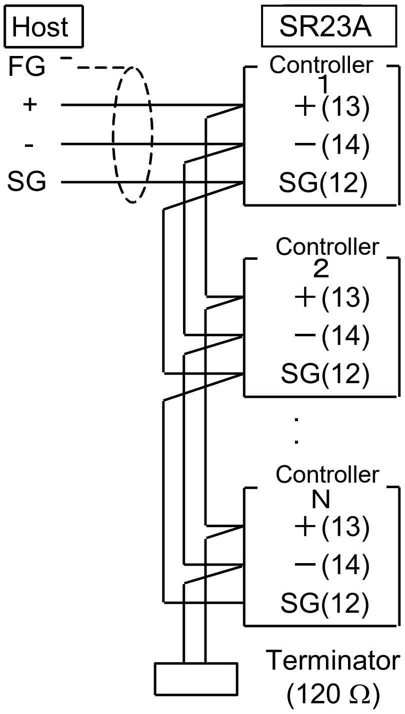
Numbers in parentheses ( ) are connector pin Nos.

When the RS-485 Interface Is Used

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

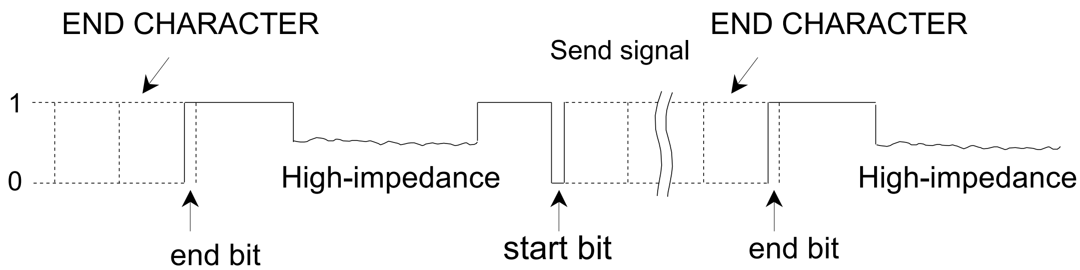
Mark state: - terminal < + terminal Space state: - terminal > + terminal

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.

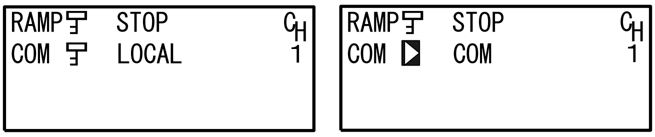
Setting the communication mode
Setting the communication mode types
* Setting the communication protocol
* Setting the device address
* Setting the communication speed
Setting the communication memory mode
* Setting the communication data length
* Setting the communication parity
* Setting the communication 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“12-4 (15) Communication mode”) is set to COM2; this is intended to prevent accidental operation by limiting operation to key operation and communication writing.

1-2



Setting item: LOCAL, 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. (COM lamp on front panel out)

COM Settings can be made by communication. (Settings 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
LOCAL mode ⇒ 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 SV 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 “12-4 (15) Communication mode”to COM1.

(5) Setting the communication protocol

5-8

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

Setting item: 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

5-8

```
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

5-8

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

Setting item : 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

5-8

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

Setting item: 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

5-9

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

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

(10) Setting the communication parity

5-9

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

Setting item: 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

5-9

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

Setting item: 1, 2
Initial value: 1

(12) Setting the communication delay time

5-9

```
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

- For 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 several hundred milliseconds to process a write command.

(13) Setting the communication control code

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

5-10

```
COM CTRL▶ STX_ETX_CR
     BCC: ADD

CMOD Kind: COM1
```

Setting item: 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.

5-10

```
COM CTRL: STX_ETX_CR
    BCC ▶ ADD

CMOD Kind: COM1
```

Setting item: 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 “19 SHIMADEN Protocol.”

(15) Communication mode type setting

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

5-10

```
COM CTRL: STX_ETX_CR
    BCC: ADD
CMOD Kind▶COM1
```

Setting item: 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 h 59 m 99:59 → 9959H

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

(17) List of communication data addresses

R: Read only support, W: Write only support, T: CH single parameter, B: Broadcast support

Data Addr. (Hex)	Parameter	Setting Range	R/W	T/B
0040	Series code 1	"S", "R"	R	-
0041	Series code 2	"2", "3"	R	-
0042	Series code 3	"A"	R	-
0043	Series code 4		R	-

0100	PV value	Within measuring range	R	T
0101	Execution SV value	Within setting value limiter	R	T
0102	Control Output 1	-5.0 to 105.0%	R	-
0103	Control Output 2	-5.0 to 105.0%	R	-
0104	Operation flag	(See the detailed explanation below.)	R	T
0105	Event output flag	(See the detailed explanation below.)	R	-
0106	Execution SV No.	0 (SV No.1) to 9 (SV No.10)	R	T
0107	Execution PID No.	0 (PID No.1) to 9 (PID No.10)	R	T
0108	Remote setting input value	Within measuring range	R	-
0109	HB current value	Current at output ON: 0.0 to 55.0 A	R	-
010A	HL current value	Current at output OFF: 0.0 to 55.0 A	R	-
010B	DI signal status flag	(See the detailed explanation below.)	R	-

- With measuring range number 59, 60 (0.000 to 50.000°C) for RTD input, PV, SV, and REM data will be rounded to 1/10 of the displayed data.
- Sc_HH, CJ_HH, b———=7FFFH
  Sc_LL, Sc_LL =8000H
  HBL, 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 signal 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	STOP	RMP	ESV	0	REM	STBY	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	Measurement unit		0: °C or K, 1: °F, 2: %, 3: NONE	R	T
0111	Measuring range		0 to 19: Thermocouple, 31 to 60: Resistor 71 to 77: Voltage mV, 81 to 87: Voltage V (See “7-3 Setting Range Code Table.”)	R	T
0112	Cold junction compensation		0:Internal, 1:External	R	T
0113	PV decimal point position		0: XXXXX, 1: XXXX.X, 2: XXX.XX, 3: XX.XXX, 4: X.XXXX	R	T
0114	PV display scaling	Lower limit value	Linearized input: -19,999 to 30,000 digits At resistor, thermocouple input: Measuring range is displayed.	R	T
0115		Higher limit value		R	T
0116	Number of digits past decimal point		0: Normal, 1: Short	R	T

0142	Servo position value	0 to 100 (enabled when feedback is ON)	R	-

0180	Execution SV No.	0 (SV No.1) to 9 (SV No.10)	W	T
0181	Execution SV No. (no ramping operation)	0 (SV No.1) to 9 (SV No.10)	W	T
0182	Control Output 1	0.0 to 100.0% (possible only in MAN)	W	-
0183	Control Output 2		W	-
0184	Auto tuning execution	0: OFF, 1: ON	W	T/B
0185	Manual operation	0: OFF, 1: ON	W	T/B
0186	Standby switching	0: OFF, 1: ON	W	T/B
0187	Remote setting input	0: LOCAL, 1: REMOTE	W	T/B
0189	External SV selection	0: KEY, 1: EXT	W	T/B
018B	Ramping operation stop	0: Resume, 1: Stop	W	T/B

018C	Communication mode	0: LOCAL, 1: COM	W	B
018D	EV/DO direct control	00 to FF (see detailed description below)	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.
  (in non-operation: bit = 0, in operation: bit = 1)

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
018D	DO13	DO12	DO11	DO10	DO9	DO8	DO7	DO6	DO5	DO4	DO3	DO2	DO1	EV3	EV2	EV1

Data Addr. (Hex)	Parameter			Setting Range	R/W	T/B
0200	32-bit data	PV measuring value	Upper	Within PV measuring range	R	T
0201			Lower	Within PV measuring range	R	T
0202		SV setting value	Upper	Within the setting range of SV	R	T
0203			Lower	Within the setting range of SV	R	T
0204		REM setting value	Upper	Within the setting range of SV	R	T
0205			Lower	Within the setting range of SV	R	T

- Data is long (4 bytes/2 words) data.
  When specifying read, therefore, the following conditions must be met:
  (1) Make the front data address an even number (0200, 0202, 0204).
  (2) Make the number of data an even number (1, 3, 5).

0244	Auto tuning execution	0: OFF, 1: ON (CH1/CH2 simultaneous)	W	B
0245	Manual operation in progress	0: OFF, 1: ON (CH1/CH2 simultaneous)	W	B
0246	Standby	0: OFF, 1: ON (CH1/CH2 simultaneous)	W	B
024B	Ramping action stop	0: Resume, 1: Stop (CH1/CH2 simultaneous)	W	B

0280	CH1 measuring value	CH1 Within the measuring range of PV	R	-
0281	CH2 measuring value	CH2 Within the measuring range of PV	R	-

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0300	SV No.1		Within the measuring range of SV	R/W	T
0301	SV No.2		Within the measuring range of SV	R/W	T
0302	SV No.3		Within the measuring range of SV	R/W	T
0303	SV No.4		Within the measuring range of SV	R/W	T
0304	SV No.5		Within the measuring range of SV	R/W	T
0305	SV No.6		Within the measuring range of SV	R/W	T
0306	SV No.7		Within the measuring range of SV	R/W	T
0307	SV No.8		Within the measuring range of SV	R/W	T
0308	SV No.9		Within the measuring range of SV	R/W	T
0309	SV No.10		Within the measuring range of SV	R/W	T
030A	SV value setting limiter	Lower limit	Within measuring range (note that SV Limit_L < SV Limit_H)	R/W	T
030B		Upper limit	Within measuring range (note that SV Limit_L < SV Limit_H)	R/W	T
030C	Ascending ramp value		0 to 10000	R/W	T
030D	Descending ramp value		0 to 10000	R/W	T
030E	Ramp unit		0: s, 1: m	R/W	T
030F	Ramp ratio		0: ×1, 1: ×10	R/W	T
0310	SV selection		0: KEY, 1: EXT	R/W	T
0314	Remote scale	Lower limit value	Within measuring range	R/W	-
0315		Higher limit value	Within measuring range	R/W	-
0316	Remote bias		-10000 to 10000 digit	R/W	-
0317	Remote filter		0 to 300 s	R/W	-
0318	Remote tracking		0: NO, 1: YES	R/W	-
0319	Remote PID selection		1 to 10	R/W	-
031A	Remote mode		0: RSV, 1: RT, 2: RSV=CH2, 3: RT=CH2 4: RSV=CH1+CH2, 5: RT=CH1+CH2	R/W	-
031F	Remote ratio		1.000 to 30.000	R/W	-
0322	Remote square root extraction operation		0: OFF, 1: ON	R/W	-
0323	Remote low cut		0.0 to 5.0%	R/W	-
0329	Cascade SV	Lower limit value	Within measuring range	R/W	-
032A		Higher limit value	Within measuring range	R/W	-
032C	Cascade slave SV filter		0: OFF, 1 to 100 s	R/W	-
032E	Tuning mode		0: AT, 1: ST	R/W	T
032F	Hunting width		0.1 to 100.0%	R/W	-

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0380	EV1	Logic 1 Logic operation source 1	Logic 1 (upper 8 bits) 0: BUF, 1: INV, 2: FF Logic operation source 1 (lower 8 bits) 0: None, 1: DI1, 2: DI2, 3: DI3, 4: DI4, 5: DI5, 6: DI6, 7: DI7, 8: DI8, 9: DI9, 10: DI10	R/W	-
0381		Logic 2 Logic operation source 2	Logic 2 (upper 8 bits) 0: BUF, 1: INV, 2: FF Logic operation source 2 (lower 8 bits) 0: None, 1: DI1, 2: DI2, 3: DI3, 4: DI4, 5: DI5, 6: DI6, 7: DI7, 8: DI8, 9: DI9, 10: DI10	R/W	-
0382		Logic operation mode	0: AND, 1: OR, 2: XOR	R/W	-
0384	EV2	(Same as above)	(Same as above)	R/W	-
0385		(Same as above)	(Same as above)	R/W	-
0386		(Same as above)	(Same as above)	R/W	-
0388	EV3	(Same as above)	(Same as above)	R/W	-
0389		(Same as above)	(Same as above)	R/W	-
038A		(Same as above)	(Same as above)	R/W	-
038C	DO1	(Same as above)	(Same as above)	R/W	-
038D		(Same as above)	(Same as above)	R/W	-
038E		(Same as above)	(Same as above)	R/W	-
0390	DO2	(Same as above)	(Same as above)	R/W	-
0391		(Same as above)	(Same as above)	R/W	-
0392		(Same as above)	(Same as above)	R/W	-
0394	DO3	(Same as above)	(Same as above)	R/W	-
0395		(Same as above)	(Same as above)	R/W	-
0396		(Same as above)	(Same as above)	R/W	-
0398	DO4	Logic operation source	0: None, 1: DI1, 2: DI2, 3: DI3, 4: DI4, 5: DI5, 6: DI6, 7: DI7, 8: DI8, 9: DI9, 10: DI10	R/W	-
039A		Logic operation mode	0: Timer, 1: Counter	R/W	-
039B		Logic operation timers/counters	0: OFF, 1 to 5000	R/W	-
039C	DO5	(Same as above)	(Same as above)	R/W	-
039E		(Same as above)	(Same as above)	R/W	-
039F		(Same as above)	(Same as above)	R/W	-

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0400	PID01-OUT1	Proportional band	0.0 to 999.9% (0.0 = OFF)	R/W	-
0401		Integral time	0 to 6000 s (0 = OFF)	R/W	-
0402		Derivative time	0 to 3600 s (0 = OFF)	R/W	-
0403		Manual reset	-50.0 to 50.0%	R/W	-
0404		Action hysteresis	1 to 9999 digit	R/W	-
0405		Output lower limit	0.0 to 100.0%	R/W	-
0406		Output higher limit	0.0 to 100.0%	R/W	-
0407		Set value function	0.00 to 1.00	R/W	-
0408	PID02-OUT1	(Same as above)	(Same as above)	R/W	-
0409				R/W	-
040A				R/W	-
040B				R/W	-
040C				R/W	-
040D				R/W	-
040E				R/W	-
040F				R/W	-
0410	PID03-OUT1	(Same as above)	(Same as above)	R/W	-
0411				R/W	-
0412				R/W	-
0413				R/W	-
0414				R/W	-
0415				R/W	-
0416				R/W	-
0417				R/W	-
0418	PID04-OUT1	(Same as above)	(Same as above)	R/W	-
0419				R/W	-
041A				R/W	-
041B				R/W	-
041C				R/W	-
041D				R/W	-
041E				R/W	-
041F				R/W	-

Data Addr. (Hex)		Parameter	Setting Range	R/W	T/B
0420	PID05-OUT1	Proportional band	0.0 to 999.9% (0.0 = OFF)	R/W	-
0421		Integral time	0 to 6000 s (0 = OFF)	R/W	-
0422		Derivative time	0 to 3600 s (0 = OFF)	R/W	-
0423		Manual reset	-50.0 to 50.0%	R/W	-
0424		Action hysteresis	1 to 9999 digit	R/W	-
0425		Output lower limit	0.0 to 100.0%	R/W	-
0426		Output higher limit	0.0 to 100.0%	R/W	-
0427		Set value function	0.00 to 1.00	R/W	-
0428	PID06-OUT1	(Same as above)	(Same as above)	R/W	-
0429				R/W	-
042A				R/W	-
042B				R/W	-
042C				R/W	-
042D				R/W	-
042E				R/W	-
042F				R/W	-
0430	PID07-OUT1	(Same as above)	(Same as above)	R/W	-
0431				R/W	-
0432				R/W	-
0433				R/W	-
0434				R/W	-
0435				R/W	-
0436				R/W	-
0437				R/W	-
0438	PID08-OUT1	(Same as above)	(Same as above)	R/W	-
0439				R/W	-
043A				R/W	-
043B				R/W	-
043C				R/W	-
043D				R/W	-
043E				R/W	-
043F				R/W	-

Data Addr. (Hex)		Parameter	Setting Range	R/W	T/B
0440	PID09-OUT1	Proportional band	0.0 to 999.9% (0.0 = OFF)	R/W	-
0441		Integral time	0 to 6000 s (0 = OFF)	R/W	-
0442		Derivative time	0 to 3600 s (0 = OFF)	R/W	-
0443		Manual reset	-50.0 to 50.0%	R/W	-
0444		Action hysteresis	1 to 9999 digit	R/W	-
0445		Output lower limit	0.0 to 100.0%	R/W	-
0446		Output higher limit	0.0 to 100.0%	R/W	-
0447		Set value function	0.00 to 1.00	R/W	-
0448	PID10-OUT1	(Same as above)	(Same as above)	R/W	-
0449				R/W	-
044A				R/W	-
044B				R/W	-
044C				R/W	-
044D				R/W	-
044E				R/W	-
044F				R/W	-
0460	PID01-OUT2	Proportional band	0.0 to 999.9% (0.0 = OFF)	R/W	-
0461		Integral time	0 to 6000 s (0 = OFF)	R/W	-
0462		Derivative time	0 to 3600 s (0 = OFF)	R/W	-
0463		Manual reset Dead band	-50.0 to 50.0% -19999 to 20000 digit	R/W	-
0464		Action hysteresis	1 to 9999 digit	R/W	-
0465		Output lower limit	0.0 to 100.0%	R/W	-
0466		Output higher limit	0.0 to 100.0%	R/W	-
0467		Set value function	0.00 to 1.00	R/W	-
0468	PID02-OUT2	(Same as above)	(Same as above)	R/W	-
0469				R/W	-
046A				R/W	-
046B				R/W	-
046C				R/W	-
046D				R/W	-
046E				R/W	-
046F				R/W	-

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0470	PID03-OUT2	Proportional band	0.0 to 999.9% (0.0 = OFF)	R/W	-
0471		Integral time	0 to 6000 s (0 = OFF)	R/W	-
0472		Derivative time	0 to 3600 s (0 = OFF)	R/W	-
0473		Manual reset Dead band	-50.0 to 50.0% -19999 to 20000 digit	R/W	-
0474		Action hysteresis	1 to 9999 digit	R/W	-
0475		Output lower limit	0.0 to 100.0%	R/W	-
0476		Output higher limit	0.0 to 100.0%	R/W	-
0477		Set value function	0.00 to 1.00	R/W	-
0478	PID04-OUT2	(Same as above)	(Same as above)	R/W	-
0479				R/W	-
047A				R/W	-
047B				R/W	-
047C				R/W	-
047D				R/W	-
047E				R/W	-
047F				R/W	-
0480	PID05-OUT2	(Same as above)	(Same as above)	R/W	-
0481				R/W	-
0482				R/W	-
0483				R/W	-
0484				R/W	-
0485				R/W	-
0486				R/W	-
0487				R/W	-
0488	PID06-OUT2	(Same as above)	(Same as above)	R/W	-
0489				R/W	-
048A				R/W	-
048B				R/W	-
048C				R/W	-
048D				R/W	-
048E				R/W	-
048F				R/W	-

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0490	PID07-OUT2	Proportional band	0.0 to 999.9% (0.0 = OFF)	R/W	-
0491		Integral time	0 to 6000 s (0 = OFF)	R/W	-
0492		Derivative time	0 to 3600 s (0 = OFF)	R/W	-
0493		Manual reset Dead band	-50.0 to 50.0% -19999 to 20000 digit	R/W	-
0494		Action hysteresis	1 to 9999 digit	R/W	-
0495		Output lower limit	0.0 to 100.0%	R/W	-
0496		Output higher limit	0.0 to 100.0%	R/W	-
0497		Set value function	0.00 to 1.00	R/W	-
0498	PID08-OUT2	(Same as above)	(Same as above)	R/W	-
0499				R/W	-
049A				R/W	-
049B				R/W	-
049C				R/W	-
049D				R/W	-
049E				R/W	-
049F				R/W	-
04A0	PID09-OUT2	(Same as above)	(Same as above)	R/W	-
04A1				R/W	-
04A2				R/W	-
04A3				R/W	-
04A4				R/W	-
04A5				R/W	-
04A6				R/W	-
04A7				R/W	-
04A8	PID10-OUT2	(Same as above)	(Same as above)	R/W	-
04A9				R/W	-
04AA				R/W	-
04AB				R/W	-
04AC				R/W	-
04AD				R/W	-
04AE				R/W	-
04AF				R/W	-

Data Addr. (Hex)		Parameter	Setting Range	R/W	T/B
04C0	CH1	No.1 PID zone	Within measuring range	R/W	-
04C1		No.2 PID zone	Within measuring range	R/W	-
04C2		No.3 PID zone	Within measuring range	R/W	-
04C3		No.4 PID zone	Within measuring range	R/W	-
04C4		No.5 PID zone	Within measuring range	R/W	-
04C5		No.6 PID zone	Within measuring range	R/W	-
04C6		No.7 PID zone	Within measuring range	R/W	-
04C7		No.8 PID zone	Within measuring range	R/W	-
04C8		No.9 PID zone	Within measuring range	R/W	-
04C9		No.10 PID zone	Within measuring range	R/W	-
04CA		Zone hysteresis	0 to 10000 digit	R/W	-
04CB		Zone PID mode	0: OFF, 1: SV, 2: PV	R/W	-
04CC	CH2	No.1 PID zone	Within measuring range	R/W	-
04CD		No.2 PID zone	Within measuring range	R/W	-
04CE		No.3 PID zone	Within measuring range	R/W	-
04CF		No.4 PID zone	Within measuring range	R/W	-
04D0		No.5 PID zone	Within measuring range	R/W	-
04D1		No.6 PID zone	Within measuring range	R/W	-
04D2		No.7 PID zone	Within measuring range	R/W	-
04D3		No.8 PID zone	Within measuring range	R/W	-
04D4		No.9 PID zone	Within measuring range	R/W	-
04D5		No.10 PID zone	Within measuring range	R/W	-
04D6		Zone hysteresis	0 to 10000 digit	R/W	-
04D7		Zone PID mode	0: OFF, 1: SV, 2: PV	R/W	-

04DF	Action hysteresis mode	0: Center 1: SVOFF 2: SVON	R/W	T

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0500	EV1	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: SV Hi 8: SV Low, 9: AT, 10: MAN, 11: REM, 12: RMP, 13: STBY, 14: SO, 15: PV SO, 16: REM SO, 17: LOGIC, 18: HBA, 19: HBL, 20: POT.ER, 21: Posi.H, 22: Posi.L	R/W	-
0501		Set value	(See “11-3 Event Action and DO Action”)	R/W	-
0502		Action hysteresis	1 to 9999 digit 1 to 50% (action mode Posi)	R/W	T
0503		Standby action	0: OFF, 1: 1, 2: 2, 3: 3	R/W	T
0504		Delay time	0 to 9999 s (0 = OFF)	R/W	T
0505		Output characteristics	0: N.O. , 1: N.C.	R/W	T
0506		Event at standby	0: OFF, 1: ON	R/W	T
0508	EV2	(Same as above)	(Same as above)	R/W	-
0509				R/W	-
050A				R/W	T
050B				R/W	T
050C				R/W	T
050D				R/W	T
050E				R/W	T
0510	EV3	(Same as above)	(Same as above)	R/W	-
0511				R/W	-
0512				R/W	T
0513				R/W	T
0514				R/W	T
0515				R/W	T
0516				R/W	T

・ 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	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: SV Hi 8: SV Low, 9: AT, 10: MAN, 11: REM, 12: RMP 13: STBY, 14: SO, 15: PV SO, 16: REM SO, 17: LOGIC, 18: HBA, 19: HBL, 20: POT.ER, 21: Posi.H, 22: Posi.L	R/W	-
0519		Set value	(See “11-3 Event Action and DO Action”)	R/W	-
051A		Action hysteresis	1 to 9999 digit 1 to 50% (action mode Posi)	R/W	T
051B		Standby action	0: OFF, 1: 1, 2: 2, 3:3	R/W	T
051C		Delay time	0 to 9999 s (0 = OFF)	R/W	T
051D		Output characteristics	0: N.O. , 1: N.C.	R/W	T
051E		Event at standby	0: OFF, 1: ON	R/W	T
0520	DO2	(Same as above)	(Same as above)	R/W	-
0521				R/W	-
0522				R/W	T
0523				R/W	T
0524				R/W	T
0525				R/W	T
0526				R/W	T
0528	DO3	(Same as above)	(Same as above)	R/W	-
0529				R/W	-
052A				R/W	T
052B				R/W	T
052C				R/W	T
052D				R/W	T
052E				R/W	T
0530	DO4	(Same as above)	(Same as above)	R/W	-
0531				R/W	-
0532				R/W	T
0533				R/W	T
0534				R/W	T
0535				R/W	T
0536				R/W	T

Data Addr. (Hex)		Parameter	Setting Range	R/W	T/B
0538	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: SV Hi 8: SV Low, 9: AT, 10: MAN, 11: REM, 12: RMP, 13: STBY, 14: SO, 15: PV SO, 16: REM SO, 17: LOGIC, 18: HBA, 19: HBL, 20: POT.ER 21: Posi.H, 22: Posi.L	R/W	-
0539		Set value	(See “11-3 Event Action and DO Action”)	R/W	-
053A		Action hysteresis	1 to 9999 digit 1 to 50% (action mode Posi)	R/W	T
053B		Standby action	0: OFF, 1: 1, 2: 2, 3: 3	R/W	T
053C		Delay time	0 to 9999 s (0 = OFF)	R/W	T
053D		Output characteristics	0: N.O. , 1: N.C.	R/W	T
053E		Event at standby	0: OFF, 1: ON	R/W	T
0540	DO6	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: SV Hi, 8: SV Low, 9: AT, 10: MAN, 11: REM ,12: RMP 13: STBY, 14: SO, 15: PV SO, 16: REM SO, 17: Direct, 18: HBA, 19: HBL, 20: POT.ER, 21: Posi.H, 22: Posi.L	R/W	-
0541		(Same as above)	(Same as above)	R/W	-
0542				R/W	T
0543				R/W	T
0544				R/W	T
0545				R/W	T
0546				R/W	T
0548	DO7	(Same as above)	(Same as above)	R/W	-
0549				R/W	-
054A				R/W	T
054B				R/W	T
054C				R/W	T
054D				R/W	T
054E				R/W	T

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0550	DO8	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: SV Hi, 8: SV Low, 9: AT, 10: MAN, 11: REM, 12: RMP, 13: STBY, 14: SO, 15: PV SO, 16: REM SO, 17: Direct, 18: HBA, 19: HBL, 20: POT.ER, 21: Posi.H, 22: Posi.L	R/W	-
0551		Set value	(See “11-3 Event Action and DO Action”)	R/W	-
0552		Action hysteresis	1 to 9999 digit 1 to 50% (action mode Posi)	R/W	T
0553		Standby action	0: OFF, 1: 1, 2: 2, 3: 3	R/W	T
0554		Delay time	0 to 9999 s (0 = OFF)	R/W	T
0555		Output characteristics	0: N.O. , 1: N.C.	R/W	T
0556		Event at standby	0: OFF , 1: ON	R/W	T
0558	DO9	(Same as above)	(Same as above)	R/W	-
0559				R/W	-
055A				R/W	T
055B				R/W	T
055C				R/W	T
055D				R/W	T
055E				R/W	T
0560	DO10	(Same as above)	(Same as above)	R/W	-
0561				R/W	-
0562				R/W	T
0563				R/W	T
0564				R/W	T
0565				R/W	T
0566				R/W	T
0568	DO11	(Same as above)	(Same as above)	R/W	-
0569				R/W	-
056A				R/W	T
056B				R/W	T
056C				R/W	T
056D				R/W	T
056E				R/W	T

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0570	DO12	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: SV Hi, 8: SV Low, 9: AT, 10: MAN, 11: REM, 12: RMP, 13: STBY, 14: SO, 15: PV SO, 16: REM SO, 17: Direct, 18: HBA, 19: HBL, 20: POT.ER, 21: Posi.H, 22: Posi.L	R/W	-
0571		Set value	(See "11-3 Event Action and DO Action")	R/W	-
0572		Action hysteresis	1 to 9999 digits 1 to 50% (action mode Posi)	R/W	T
0573		Standby action	0: OFF, 1: 1, 2: 2, 3: 3	R/W	T
0574		Delay time	0 to 9999 s (0 = OFF)	R/W	T
0575		Output characteristics	0: N.O. , 1: N.C.	R/W	T
0576		Event at standby	0: OFF, 1: ON	R/W	T
0578	DO13	(Same as above)	(Same as above)	R/W	-
0579				R/W	-
057A				R/W	T
057B				R/W	T
057C				R/W	T
057D				R/W	T
057E				R/W	T

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) 0: None, 1: MAN, 2: REM, 3: AT, 4: STBY, 5: ACT, 6: ACT2, 7: PAUSE, 8: DIR	R/W	-
0581	DI2	Channel information (upper 8 bits) 0: CH1, 1: CH2, 2: CH1+2 Operation mode (lower 8 bits) 0: None, 1: MAN, 2: REM, 3: AT, 4: STBY, 5: ACT, 6: ACT2, 7: PAUSE, 8: DIR, 9: Preset1, 10: Preset2, 11: Preset3	R/W	-
0582	DI3	Channel information (upper 8 bits) 0: CH1, 1: CH2, 2: CH1+2 Operation mode (lower 8 bits) 0: None, 1: MAN, 2: REM, 3: AT, 4: STBY, 5: ACT, 6: ACT2, 7: PAUSE, 8: DIR	R/W	-
0583	DI4	(Same as above)	R/W	-
0584	DI5	(Same as above)	R/W	-
0585	DI6	(Same as above)	R/W	-
0586	DI7	Channel information (upper 8 bits) 0: CH1, 1: CH2, 2: CH1+2 Operation mode (lower 8 bits) 0: None, 1: MAN, 2: REM, 3: AT, 4: STBY, 5: ACT, 6: ACT2, 7: PAUSE, 8: DIR, 12: EXT_SV	R/W	-
0587	DI8	Channel information (upper 8 bits) 0: CH1, 1: CH2, 2: CH1+2 Operation mode (lower 8 bits) 0: None, 1: MAN, 2: REM, 3: AT, 4: STBY, 5: ACT, 6: ACT2, 7: PAUSE, 8: DIR, 12: EXT_SV	R/W	-
0588	DI9	(Same as above)	R/W	-
0589	DI10	(Same as above)	R/W	-

Data Addr. (Hex)	Parameter			Setting Range	R/W	T/B
0590	Heater break alarm			0.0 to 50.0 A (0.0 = OFF)	R/W	-
0591	Heater loop alarm			0.0 to 50.0 A (0.0 = OFF)	R/W	-
0592	Heater break alarm mode			0: Lock, 1: Real	R/W	-
0597	HB selection			0: OUT1, 1: OUT2	R/W	-
05A0	Ao1	Mode		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	Scaling	Lower limit value	PV, CH2_PV → Within measuring range SV, CH2_SV → Within measuring range DEV, CH2_DEV → -100.0 to 100.0% OUT1, OUT2 → 0.0 to 100.0% PoSI → 0 to 100%	R/W	-
05A2	Ao1	Scaling	Higher limit value		R/W	-
05A4	Ao2	(Same as above)		(Same as above)	R/W	-
05A5	Ao2				R/W	-
05A6	Ao2				R/W	-
05B0	Communication memory mode			0: EEP, 1: RAM, 2: R_E	R/W	-
05B1	Communication mode types			0: COM1, 1: COM2	R/W	-
0600	OUT1	Output characteristics		0: Reverse, 1: Direct	R/W	-
0601	OUT1	Proportional cycle		1 to 120 s	R/W	-
0604	OUT2	Proportional cycle		1 to 120 s	R/W	-
0607	OUT2	Output characteristics		0: Reverse, 1: Direct	R/W	-
0608	Output 1 rate-of-change limiter			OFF to 100.0%/s (OFF: 0.0)	R/W	-
0609	Output 2 rate-of-change limiter			OFF to 100.0%/s (OFF: 0.0)	R/W	-
0610	Auto tuning points			0 to 10000 digit	R/W	T
0611	Key lock			0: OFF, 1: LOCK1, 2: LOCK2, 3: LOCK3	R/W	-
0614	Output mode selection			0: Single, 1: Dual	R/W	-
0619	OUT1	STBY Preset values		Other than basic function MS 0.0 to 100.0 Basic function MS (with FB) 0: Stop, 1: Preset1, 2: Preset2, 3: Preset3, 4: Preset4, 5: Preset5, 6: Preset6, 7: Preset7, Basic function MS (without FB) 0: Stop, 1: Close, 2: Open	R/W	-
061A	OUT1	Error output			R/W	-
061D	OUT2	(Same as above)		Applies only to basic functions other than MS 0.0 to 100.0	R/W	-
061E	OUT2				R/W	-

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
064F	Motor stroke time		5 to 300 s	R/W	-
0651	Servo feedback		0: OFF, 1: ON	R/W	-
0652	Servo dead band		0.2 to 10.0%	R/W	-
0654	Position at restart		0: None, 1: Close, 2: Open	R/W	-
0655	ZERO/SPAN adjustment mode		0: Auto, 1: Manual	R/W	-
0659	Potentiometer error		0: Stop, 1: Close, 2: Open	R/W	-
066A	External input position value	Preset1	0 to 100%	R/W	-
066B		Preset2		R/W	-
066C		Preset3		R/W	-
066D		Preset4		R/W	-
066E		Preset5		R/W	-
066F		Preset6		R/W	-
0670		Preset7		R/W	-

0700	PV slope	0.500 to 1.500	R/W	T
0701	PV bias	-10000 to 10000 digit	R/W	T
0702	PV filter	0: OFF, 1 to 100 s	R/W	T

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

070F	2-input scale-over action	0, 1	R/W	-

- For details, see “8-1 Setup of 2-Input Operation.”

0714	CH2 PV slope	0.500 to 1.500	R/W	-
0715	CH2 PV bias	-10000 to 10000 digit	R/W	-
0716	CH2 PV filter	0: OFF, 1 to 100 s	R/W	-

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

Data Addr. (Hex)	Parameter		Setting Range	R/W	T/B
0720	Ten-segment linearizer approximation/ multibias input point	A1	Ten-segment linearizer approximation (linearizer) input points 1 to 11: -5.00 to 105.00% Sensor input multi-bias input points 1 to 11: Within measuring range	R/W	T
0722		A2		R/W	T
0724		A3		R/W	T
0726		A4		R/W	T
0728		A5		R/W	T
072A		A6		R/W	T
072C		A7		R/W	T
072E		A8		R/W	T
0730		A9		R/W	T
0732		A10		R/W	T
0734		A11		R/W	T
0721	Ten-segment linearizer approximation/ multibias interpolation value	B1	Ten-segment linearizer approximation (linearizer) input points Interpolation values 1 to 11: -5.00 to 105.00% Sensor input multibias Bias values 1 to 11: ± 10000 digits	R/W	T
0723		B2		R/W	T
0725		B3		R/W	T
0727		B4		R/W	T
0729		B5		R/W	T
072B		B6		R/W	T
072D		B7		R/W	T
072F		B8		R/W	T
0731		B9		R/W	T
0733		B10		R/W	T
0735		B11		R/W	T
0736	Ten-segment linearizer approximation/multibias mode		At sensor input (TC, RTD) 0: OFF 1: PV-MBIAS(PV) 2: PV-MBIAS(SV) 3: RSV-MBIAS(SV) At linear input (mV, V, mA) 0: OFF 1: Linearizer 2: PV-MBIAS(PV) 3: PV-MBIAS(SV) 4: RSV-MBIAS(SV)	R/W	T
0737	Low cut at linear input		1.0 to 5.0%	R/W	T
0738	Square root operation at linear input		0: OFF, 1: ON	R/W	T

13 SERVO SETUP

13－1 Overview of Setup Procedure

⚠ Caution

This chapter describes servo output specifications and applies to basic function MS. Servo output is a controller for position-proportional control 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.	Setting Servo feedback Select FB = ON from the setting screen for FB parameter. This setting can be made only when STBY = ON is selected.	13-4(1)
3.	Check wiring for the feedback potentiometer.	—
4.	Setting of output action characteristics	13-2(1)
5.	Setting of output at standby	13-2(2)
6.	Setting of output at input error	13-2(3)
7.	Setting of output at feedback potentiometer error	13-2(4)
8.	Servo control (ZERO/SPAN adjustment)	13-5
9.	Confirmation/adjustment of servo dead band	13-4(2)

■ **For "without feedback"**

Procedure		Refer to
1.	Check wiring	—
2.	Setting Servo feedback Select FB = OFF from the setting screen for FB parameter. This setting can be made only when STBY = ON is selected.	13-4(1)
3.	Setting motor timing	13-4(3)

Procedure		Refer to
4.	Setting servo action on start-up Please be aware that the controller assumes the position of the motor to be 50% when BOOT is set to "Stop".	13-4(4)
5.	Setting of output action characteristics	13-2(1)
6.	Setting of output at standby	13-2(2)
7.	Setting of output at input error	13-2(3)
8.	Servo control (ZERO/SPAN adjustment)	13-5
9.	Confirmation/adjustment of servo dead band	13-4(2)

13－2 Control Output (Servo Output)

(1) Output action characteristics

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

6-1

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

Setting item: 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 standby

Set the output (position) at standby (STBY = ON, controller operation paused).

6-1 With Feedback

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

Setting item: Stop, Preset1 to Preset7
Initial value: Preset1

6-1 Without Feedback

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

Setting item: 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, see "13-3 (2) Setting Servo Preset Value".

Note

・Output at standby 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
     STBY:  Preset1
      ERR:  Preset1
  POT.ERR:  Stop
```

Setting item: Stop, Preset1 to Preset7
Initial value: Stop

6-1 Without Feedback

```
OUT1 ACT:   Reverse
     STBY:  Close
      ERR:  Close
```

Setting item: 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, see "13-3 (2) Setting Servo Preset Value".

Note

・Output at standby is given priority when an input error has occurred at standby (STBY = ON, controller operation paused).

(4) Output at feedback potentiometer error

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

6-1

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

Setting item: Stop, Close, Open
Initial value: Stop

Note

- Output at feedback potentiometer error is registered prior to that at standby 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.

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

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.

13－3 Externally Switching Servo Preset Value

(1) Mechanism and action of external switching

This function is for switching the output to preset position values through external signals. Switching through external contact point is available when using two or more preset (position) 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.

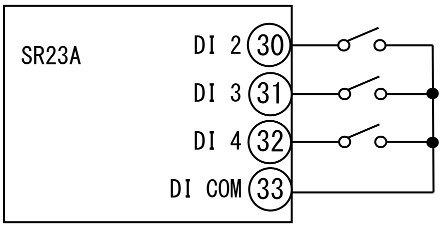
5-2

```
DI1 : None
DI2 ▶ None
DI3 : None
DI4 : None
```

Preset1: 1 preset value switching by DI2

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

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



Setting / Servo Preset	Preset3						
	Preset2						
	Preset1						
DI No.	P1	P2	P3	P	P5	P6	P7
DI 2	●	×	●	×	●	×	●
DI 3	×	●	●	×	×	●	●
DI 4	×	×	×	●	●	●	●

●: Switch ON, ×: Switch OFF

Note

- When switching is done by a decimal switch, an unexpected value might be generated momentarily.
  Switching between among DI2 to DI4 (3 bits) should be completed within the response time (100 ms) and should be maintained for at least 100 ms.

(2) Setting servo preset value

■For "with feedback (FB = ON)"

You may switch the position output to any preset value through DI2 to DI4.
7 preset values can be assigned to P1 to P7 respectively. Switching is enabled by assigning "Preset1/2/3" to DI2 to DI4.

6-5

```
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, see the preceding section "13-3 (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.

13－4 Setting Servo Operations

(1) Setting servo feedback

Sets whether feedback potentiometer is to be used or not (with or without Servo feedback).

Set 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 item: ON, OFF
Initial value: ON

(2) Setting servo 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.

For the dead band (DB) and hysteresis, see "13-6 (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.

6-3

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

Setting range: 5 to 300 s
Initial value: 60 s

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.

6-3

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

Setting item: 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.

13－5 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 operation

Zero/span adjustment can be performed only at standby.
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 standby 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 performed if zero side and span side 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.

② Conducting ZERO/SPAN adjustment manually

Adjustment may be started at either the zero side or span side. Count values for both zero side and span side are displayed on the right side of the LCD.

⚠ **Caution**

- Make sure zero side count value is less than span side 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.

■ 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

Adjust either at the zero or span side.
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.
This section contains a description for zero/span automatic adjustment.
For ZERO/SPAN manual adjustment, see the next section "13-5 (3) ZERO/SPAN manual adjustment".
For points to be attended to when conducting ZERO/SPAN adjustment, see "13-5 (1) Points for ZERO/SPAN adjustment and 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.

6-4

```
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 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 this instancee 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 motor to the CLOSE position or the fully opened position to the Open position.

6-4

```
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.
The following is a close or open adjustment, depending on the boot status.

```
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.
Conduct output for motor action time and the position where it stops is regarded as the close 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 contains a description for zero/span manual adjustment.
For ZERO/SPAN automatic adjustment, see the preceding section "13-5 (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 "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.

6-4

```
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 key and press the ENT key to enter.
The number stops 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 key and press the ENT key to enter. The number stops blinking.

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

Caution

- Make sure zero side count value is less than span side 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 this instance, 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 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.

6-4

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

① **Mode switching**

Set the MD (mode) to "Manual".

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:     ---
 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 motor to the ZERO (CLOSE) position by pressing the key.

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

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 key.

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

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

(4) Dead band (DB) adjustment

The following have the same content as that described in the section "13-4 (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%

13－6 Servo Functions

(1) Priority of actions at servo output

Priority at servo output is as follows:

① MAN 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

(2) MAN actions at servo output

Switching to MAN mode at servo output is possible for both STBY ON and OFF. (top priority)
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 of the following at the preset DI signal (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 Signal = OFF"**

PID control output is performed.

(4) Output limiter

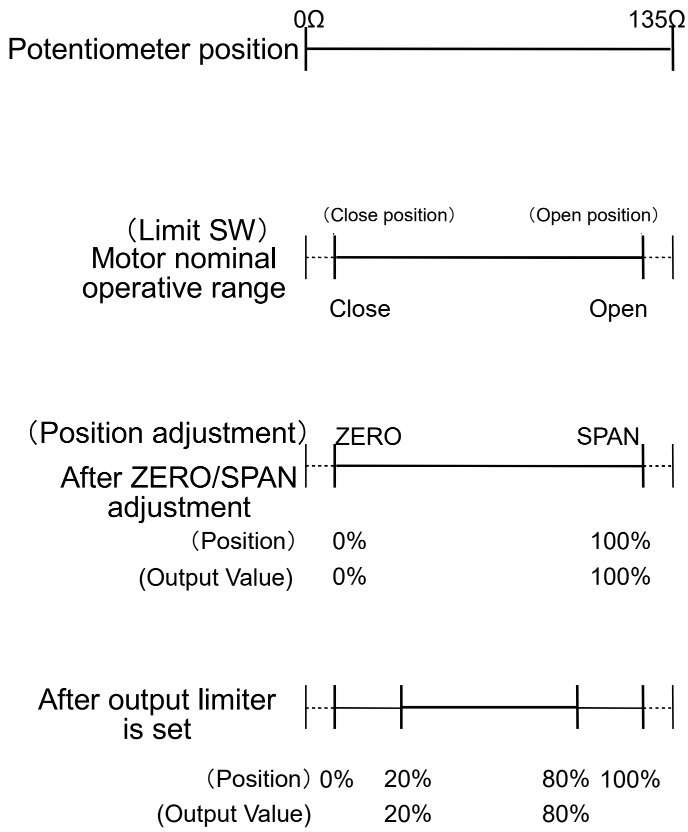
Action under the MAN mode and Preset output may not be affected by the output limiter. The action at PID control output is as follows:

For "with feedback (FB = ON) ", output limiter is enabled.
For "without feedback (FB = OFF)," output limiter is disabled (0 to 100%).

(5) Servo action

■ **Control output value and position**

- The motor opening is controlled with control output value obtained through PID computation as the target position value taking dead band (DB) into account. (Control output value → target position value)
- 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, see "10-8 Output Limit Value (OUT1L to OUT1H)") at lower limit = 20% and higher 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 more 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%.

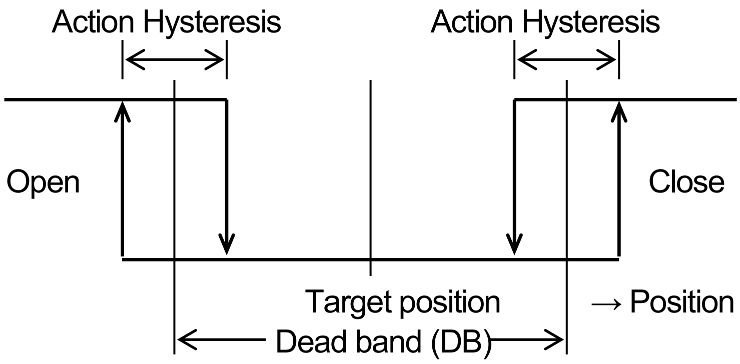
At 0%	Outputs Close signals for approx. 5% of the motor timing (TIME) every 30 seconds.
At 100%	Outputs Open signals for approx. 5% of the motor timing (TIME) every 30 seconds.

(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%.



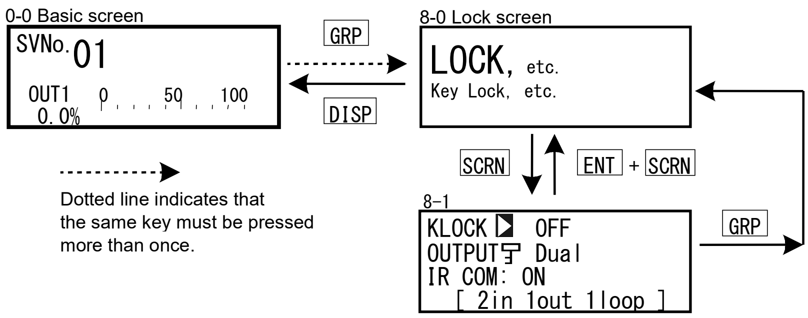
14 KEY LOCK SETTINGS

Perform the following as necessary.

14－1 Setting Key Lock

(1) Displaying the key lock screen

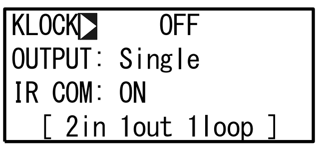
To call up the LOCK, etc. screen group (group 8) from the basic screen, press the GRP key. Press the SCRN key in the LOCK, etc. screen group to switch to the screens for setting and changing values.
Select parameters in screens by pressing the ↩ key.
Set parameters by pressing the ◀, ▼ or ▲ key, and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



(2) Key lock

When the 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 item: OFF, LOCK1, LOCK2, LOCK3
Initial value: OFF

OFF: Releases the key lock.
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)

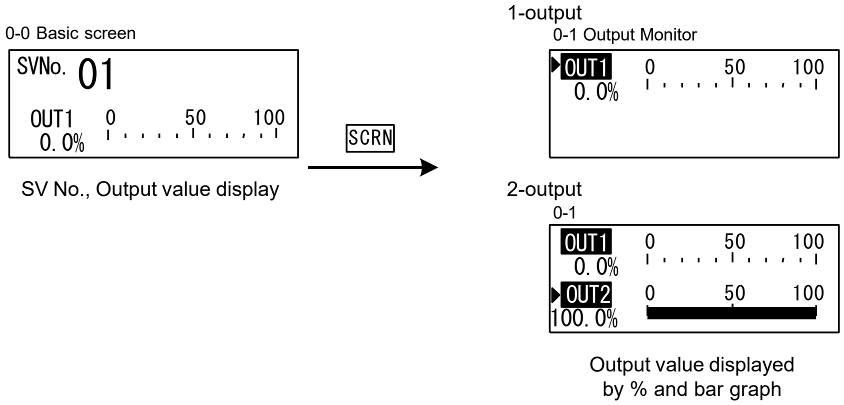
For details on parameters that are locked, see "18 List of Parameters."

15 MONITORING, EXECUTING & STOPPING OPERATION

Various monitor functions are grouped in the basic screen group (group 0).
The configuration of this basic screen group and display contents of the screens differ according to the specifications of the device and selected optional items.

15－1 Flow of Basic Screen in 1-Loop Specification

(1) 1-input

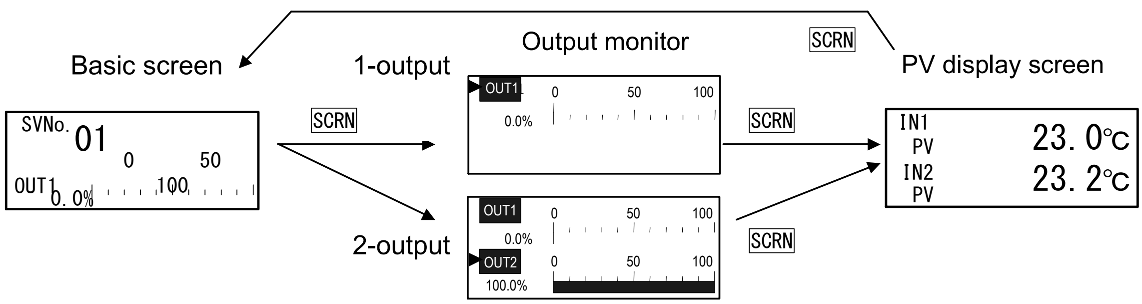


When the 2-output specification is selected, the output monitor displays Output 1 on the upper row and Output 2 on the lower row as a percentage (%) of the output value and a bar graph.

As the above, when OUT1 is highlighted, or OUT1 and OUT2 are both highlighted, this means that the controller is in the Manual mode (MAN=ON).
Under the manual mode, output value can be set using front key switches.

(2) 2-input

For 2-input, there is a PV display screen in addition to the basic screen and output monitor.
PV display screen is display only.

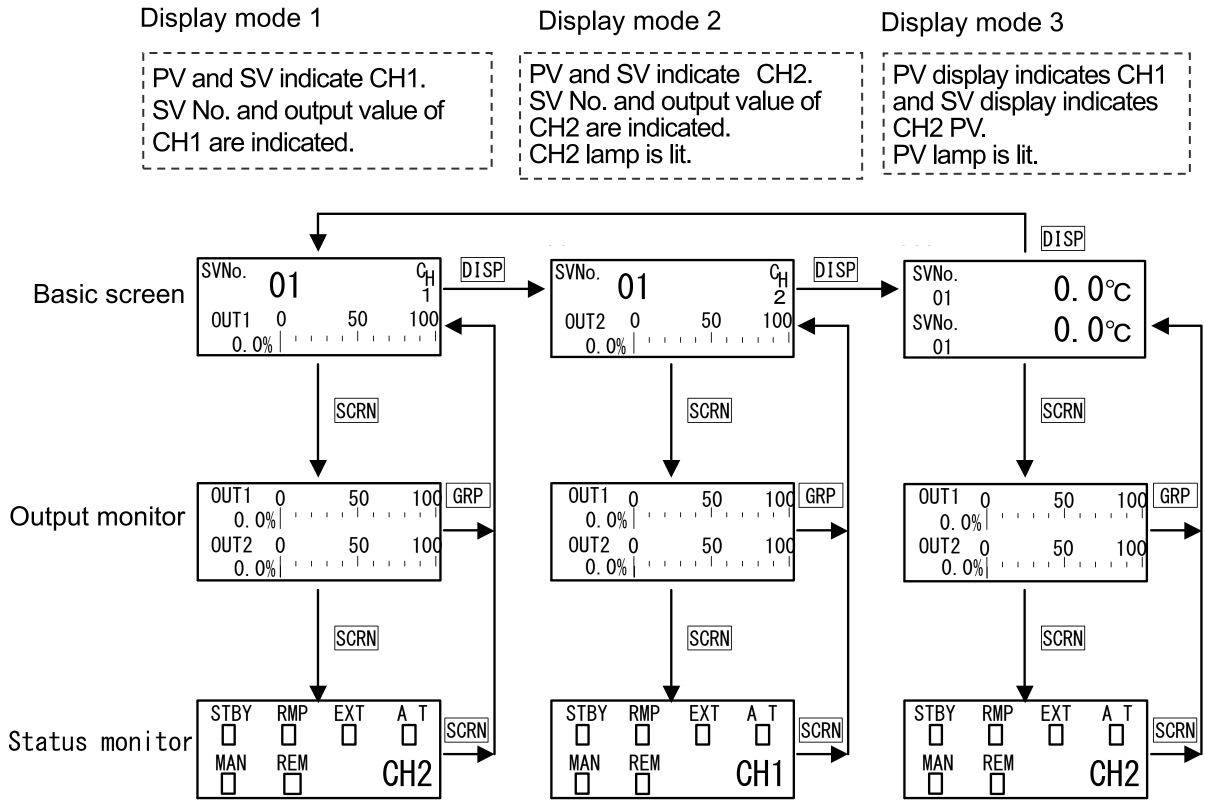


If OUT1 and OUT2 on the output monitor are highlighted as shown in the above figure, this device is in manual operation mode so that output value may be changed by using front keys. For further information, see "16-7 Setting Control Output (MAN)."

15－2 Flow of Basic Screen in 2-Loop Specification

(1) For independent 2-channel

The flow of LCD display screens will be changed as follows according to the display contents on the PV and SV displays.



On LCD display screen, the contents of CH1 are displayed when display mode is 1 or 3, and those of CH2 are displayed when the display mode is 2.

The output monitor displays Output 1 (OUT1) on the upper row and Output 2 (OUT2) on the lower row with ratio of output value (%) and a bar chart.
OUT1 corresponds to Channel 1 and OUT2 corresponds to Channel 2.
When both of OUT1 and OUT2 are highlighted simultaneously, or either one of them is highlighted, this means the output is the Manual mode (MAN=ON), and the side for which the cursor (▶) is displayed on the left side of its output name is currently selected.
Output value may be changed with ◀ , ▼ and ▲ keys.
For switching output (between OUT1 and OUT2), press the ↩ key.

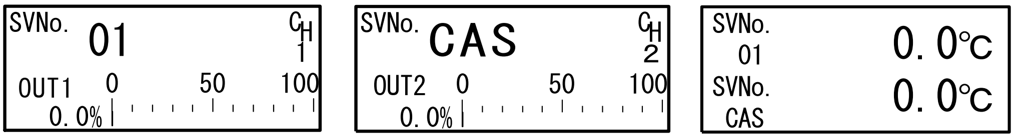
Status of the channel displayed in PV display is indicated to 6 types of status lamps (STBY, RMP, EXT, AT, MAN, REM) located on the front panel of this device.

In 2-loop specification, the status of the other channel is displayed on the "status monitor screen."
For details, see "16-1 (4) Status Monitor."

(2) For internal cascade

For internal cascade, CH2 SV No. is displayed as CAS to get CH1 output. The basic screen changes as shown below.
The rest are the same with those for the aforementioned "15-2 (1) For independent 2-channel."

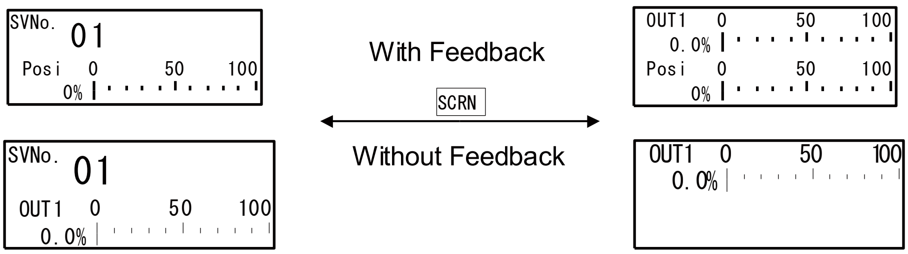
0-0



15－3 Expansion of Basic Screen with Basic Function MS (Servo Output)

(1) Control output (OUT1/Posi)

0-0 Basic Screen　　　　0-1 Output monitor



Display SV No. and position value/output value

Upper row Display output value (assumed position) with % and a bar grap
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).
For details about manual mode, see “16-7 Setting Control Output (Man)”.

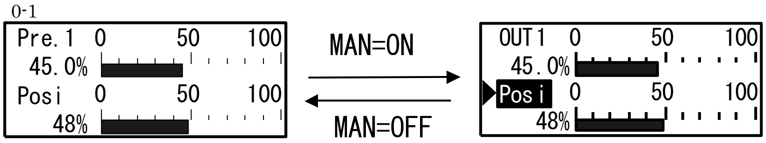
(2) Output with preset value (Preset1 to 7)

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

■ For "with feedback"

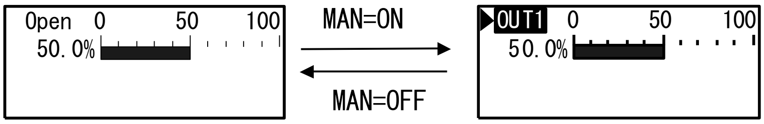
Instead of OUT1, any from "Pre.1" to "Pre.7" will be displayed.
When the mode is switched to the Manual operation mode (MAN = ON), control using preset value is disabled, OUT1 value is displayed, and the operation for open output ON or close output ON may be available.
When returning the normal control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

0-1



■ For "without feedback"

Instead of OUT1, any from "Stop", "Close", "Open" 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

15－4 Operations in Basic Screen

(1) Switching the SV No.

In the "CH1 SV No. Output value display screen" and "CH2 SV No. Output value display screen" of the basic screen, switching of active SV No. of the displayed channel may be achieved by manipulating the [SV] key. Setting and changing the active SV value may also be achieved with the [◄] and [▲] or [▼] keys.
For switching displayed channel in 2-loop specification, press the [DISP] key.

(2) Output monitor screen

The output monitor displays the outputs and position values (Posi) of Control Output 1 (OUT1) and Control Output 2 (OUT2) as a percentage (%) or bar graph.
In the Manual Output mode, output values can be set or changed by the [◄], [▲], and [▼] keys. With servo output, you can perform open output ON/close output ON. In 2-output specification, select the output value of the side to be set or changed using the cursor displayed in front of the output name.

(3) Status monitor

Status of the channel displayed in PV display is indicated to 6 types of status lamps (STBY, RMP, EXT, AT, MAN, REM) located on the front panel of this device.
In 2-loop specification, the status of the other channel is displayed on the "status monitor screen."
For details, see "16-1 (4) Status Monitor."

16 OPERATIONS DURING CONTROL

16－1 Monitoring Control

(1) Basic screen

See "15-1 Flow of Basic Screen in 1-Loop Specification" for the basic screen in 1-loop specification and its manipulation.
See "15-2 Flow of Basic Screen in 2-Loop Specification" for the basic screen in 2-loop specification and its manipulation.
For information on basic screen and operation in servo output specification, see “15-3 Expansion of Basic Screen for Servo Output.”

The basic screen is the "SV No., output value display screen.”
In 2-loop (2-channel) specification, there are "display mode 1," "display mode 2" and "display mode 3." These displays may be switched by pressing the DISP key.

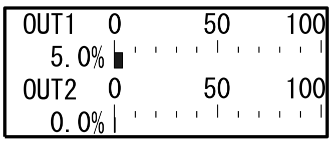
PV display part, SV display part and 6 types of status lamps (STBY, RMP, EXT, AT, MAN, REM) are interlocked.
The contents of CH1 are displayed when the monitor lamp CH2 is off, and those of CH2 are displayed when the lamp is on.
Switching of displayed channel may be achieved on the basic screen.

Moreover, at the display mode 3, PV value for CH1 will be displayed on the PV display, SV value for CH2 on the SV display and the 6 types of status lamps indicate the contents of CH1.
These displays of PV and SV will not be changed even upon displaying other screen groups by pressing the GRP key from the basic screen.
The basic screen is resumed by pressing the DISP key: it is the one displayed just before pressing the GRP key.

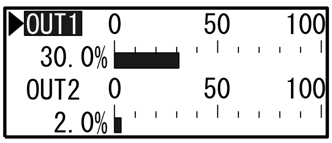
(2) Output monitor

① For basic functions other than MS (standard output)

0-1



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

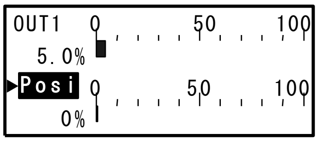


During manual output (when OUT1 and/or OUT2 are highlighted), OUT1 or OUT2 can be selected by the ↩ key, and output can be adjusted by operating the ◀, ▲ or ▼ key.

For further information, see "16-7 Setting Control Output (MAN)."

② For basic function MS (servo output)
The output values of Control Output 1 (OUT1) and Position values (Posi) are displayed on the upper or the lower row respectively, as a % and a bar graph.
When used without feedback, Posi is not displayed.

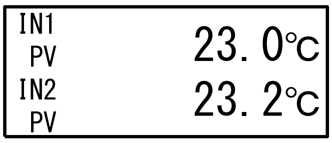
0-1



During manual output (when OUT1 or Posi is highlighted), open output or close output can be set to ON by operating the ▲ or ▼ key.

For details, see "13-2 Overview of Setup Procedure"

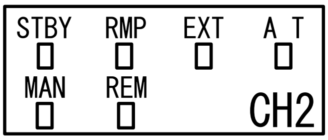
(3) PV monitor



This screen is displayed only for 2-input operation.
The PV value for input 1 is displayed on the upper row and that for input 2 is displayed on the lower row.
This is used for monitoring these two inputs at the same time.

(4) Status monitor

0-2

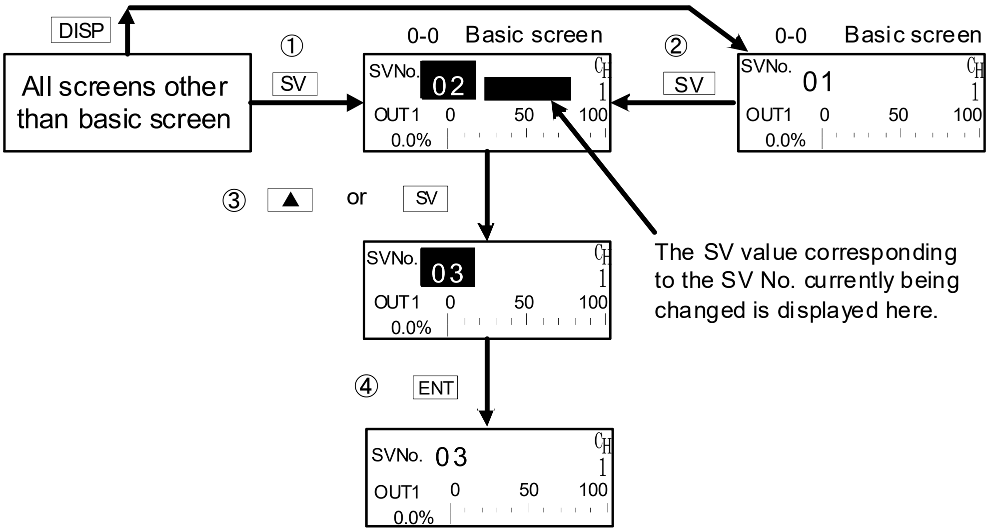


This screen is displayed only when the 2-loop mode is selected.
This indicates the status of the channel not indicated with lamps and the CH No. is indicated in the lower right corner of the screen.
When any condition is detected, each of the □ located subjacent to each parameter display will blink, or ■ is lit reversed.

STBY: Blinks when output is set to standby (STBY = ON) by control execution/standby.
RMP: Blinks during execution of ramp control, and lights while ramp control is paused.
EXT: Lights when external switch setting (EXT) is set when multi-SV No. selection (SV select) is switched to.
AT: Blinks during execution of auto tuning or lights during holding of auto tuning.
MAN: Blinks when control output is set to manual operation (MAN).
REM: Lights when remote setting (REM) is set in SV No. selection.

16－2 Switching the Execution SV No.

① When you press the SV key in a screen display other than the basic screen, the basic screen is displayed, and the number of the SV No. blinks and can be changed.
② When you press the SV key, the number of the SV No. is incremented and blinks, and can be changed.
③ The SV No. can be changed using the ▲ or ▼ key.
Also, pressing the SV key increments the number of the SV No.
④ When the number of the SV No. is fixed and registered by the ENT key, the number stops blinking.



In case some values will be set for CH1 and CH2, press the DISP key to switch them.
For internal cascade, SV No. of CH2 may not be set since it is the output of CH1.
When SV No. switching is set to external switching (EXT_SV assigned to DI7 and EXT indicator lit), the SV No. cannot be changed using the keys on the front panel of this device.

16－3 Setting the Execution SV Value

Follow the procedure below to set or change the SV value currently being executed.

1. When you press the ◄, ▲ or ▼ key in the basic screen (0-0), the smallest digit of the SV display blinks, and the SV value can be set or changed.
2. Press the ◄ key to move to the blinking section on the numerical value to the digit to be changed, and change the SV value using the ▲ or ▼ key.

To set or change an already set SV value instead of the SV value currently being executed, see "9-1 Setting the SV Value."
For internal cascade, SV value of CH2 may not be set since the SV value of CH2 is the output of CH1.

16－4 Externally Switching the SV No.

When two or more target set values (SV) are used, selection of the execution SV No. can be switched by an external contact.
Only DI7 to DI10 can be set.
This function can be used only when the optional external I/O control function is installed.

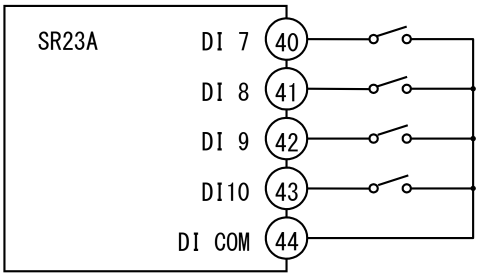
When EXT_SV is assigned to DI7, DI8 to DI10 automatically become the SV No. external switched assignments, and other functions can no longer be assigned.

In 2-loop specification, assignment is limited to either CH1 or CH2, or to both CH1 and CH2 at the same time.
You cannot assign CH1 and CH2 independently of each other.

5-3

```
DI5:  None    :  CH1
DI6:  None    :  CH1
DI7▶ EXT_SV   :  CH1
DI8  EXT_SV      CH1
```

Select the SV No. as shown in the table below and switch to this SV No. corresponding to the signal input of DI7 to DI10.



SV No. / DI No.	1	2	3	4	5	6	7	8	9	10
DI 7	△	×	●	×	●	×	●	×	●	△
DI 8	×	●	●	×	×	●	●	×	×	●
DI 9	×	×	×	●	●	●	●	×	×	△
DI10	×	×	×	×	×	×	×	●	●	●

●: Switch ON ×: Switch OFF △: Switch not defined

Note

- When switching is performed, for example, by a decimal switch, sometimes an SV No. other than the expected SV No. is switched to momentarily at the moment that the contact is switched. The switching among the four bits of DI7 to DI10 should be completed within the response time (100 ms) and should be maintained for at least 100 ms.

16－5 Auto Tuning

(1) Executing and stopping auto tuning

Select execution/stop of PID auto tuning (AT).
During execution of auto tuning, the optimum PID constants are calculated according to the limit cycle method, and those values are used to automatically perform control action.
During execution of auto tuning, hunting caused by the limit cycle occurs near the SV value.
You can move the hunting origin point by setting the AT point.
Hunting near the SV value can be prevented by setting the auto tuning point to perform auto tuning when the value leaves the SV value.
For details on setting this auto tuning point, see "10-11 Auto Tuning Point."

1-1

```
AT  ▶    OFF     CH
MAN :    OFF      1
STBY:    OFF
```

Setting item: ON, OFF
Initial value: OFF

Auto tuning is executed when AT is set to ON.
The AT LED indicator on the status monitor (screen 0-2) blinks during execution of auto tuning, lights during standby, and goes out when auto tuning ends or stops.

When "AT execution/stop switching" is assigned to DI, auto tuning can be executed by external contacts, but cannot be executed by front panel key switches.

For execution of auto tuning, the following conditions must be satisfied.
These conditions are common to both front panel keys and external switch input.

- The mode must not be the manual output (MAN) mode.
- Execution of ramp control must not be in progress.
- P must not be set to OFF (ON-OFF control).
- The mode must not be standby (STBY: ON, action stopped).
- Remote SV must not be in use.
- The mode must not be zone PID.
- The PV value must not be causing the scale over error.
- Self-tuning must not be set.
- Preset is not output.
- The controller has not be causing the potentiometer error.

Note

- It is sometimes better to correct the PID obtained by auto tuning depending on the control target, control loop wasted time, and other factors.
- When the output limiter is used, set the output limiter before execution of AT.
- Auto tuning action is stopped in the following instances:
  (1) When a scale over error occurs
  (2) During a power failure
  (3) When the ON or OFF time of the control output has exceeded about 200 minutes
  (4) When the standby (STBY) mode is set

(2) Selecting the PID tuning mode

PID auto-tuning using the limit cycle method is the default tuning mode for Tuning.

3-32

```
Tuning▶Auto Tuning  CH
 Hunting: 0.5%       1
AT Point:  0.0℃
```

Setting item: Auto Tuning, Self Tuning
Initial value: Auto Tuning

16—6　Self Tuning

Various restrictions are applied to use of self tuning.
For details on self tuning, see "16-10 Tuning Functions.”

Select self tuning for Tuning.

3-32

```
Tuning▶Self Tuning  CH
 Hunting: 0.5%       1
AT Point:  0.0℃
```

Setting item: Auto Tuning, Self Tuning
Initial value: Auto Tuning

Caution

- This device is a high-precision, high-function controller. Use of the auto tuning (AT) function is recommended as optimum PID constants can be obtained more easily than by self tuning.
- On the following types of control targets, self tuning sometimes does not function normally, inappropriate PID constants are calculated and set, and the optimum control result is not obtained. For this reason, do not use self tuning:
  - Control targets that cause cyclical external disturbance
  - Control target with extremely short or long dead band
  - When the measured value (PV value) contains noise and is unstable
- For 2-output and each of the specifications for internal cascade slave side, the tuning mode is fixed to [Tuning: Auto Tuning].
- When used basic function MS (without FB), the tuning mode is fixed to [Tuning: Auto Tuning].

16－7 Setting Control Output (MAN)

Select auto (AUTO)/manual (MAN) of control output.
Normally, operation is performed automatically. This item, however, is used to manually set the control
During manual output, the preset value continues to be output, and feedback control is not performed.
Also, the MAN status lamp or status monitor blinks.

(1) Switching auto/manual

1-1

```
AT  :  OFF        CH
MAN ▶  OFF         1
STBY:  OFF
```

Setting item: ON, OFF
Initial value: OFF

The mode changes to the Manual Output mode when MAN (manual) row is selected by the cursor and ON is selected and registered.
When "AT control output auto/manual switching" is assigned to DI, auto/manual switching can be executed by external contacts.
For 2-loop, each channel may be independently switched between Auto and Manual.
For 2-output control of 1-loop control (1-input operation and 2-input operation), this is simultaneously switched for 2 outputs.

For manual execution, the following conditions must be satisfied.
These conditions are common to both front panel keys and external switch input.

- Execution of auto tuning must not be in progress (AT: ON). (Other than basic function MS)
- The mode must not be standby (STBY: ON).

Note

When this device is turned OFF under the manual mode (MAN=ON) and turned ON again, this device still starts up under the Manual mode.

(2) Output value

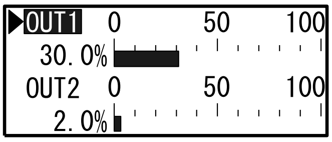
① Basic functions other than MS (standard output)
This operation can be executed on OUT1/OUT2 that are in the Manual Output mode.
When OUT1/OUT2 are displayed in reverse, this indicates that these outputs are in the Manual Output mode.
The output value and output bar graph for OUT2 are displayed in 2-output specification and 2-loop specification.

1. Press the DISP key to call up the basic screen.

2. Press the SCRN key to display the output monitor screen (0-1).

3. When the cursor (▶) is not at the target output, move the cursor using the key, and select OUT1 or OUT2 that is displayed in reverse.

0-1

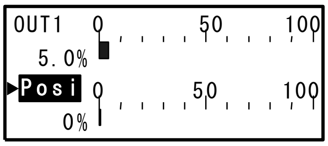


4. Increment/decrement the output value by the ◀, ▼ or ▲ key.
With manual output, values need not be fixed and registered by the ENT key.

② Basic function MS (servo output)

The output values of Control Output 1 (OUT1) and Position values (Posi) are displayed on the upper or the lower row respectively, as a % and a bar graph. When used without feedback, Posi is not displayed.

0-1



During manual output (when OUT1 or Posi is highlighted), open output or close output can be set to ON by operating the ▲ or ▼ key.

(3) MAN key operations

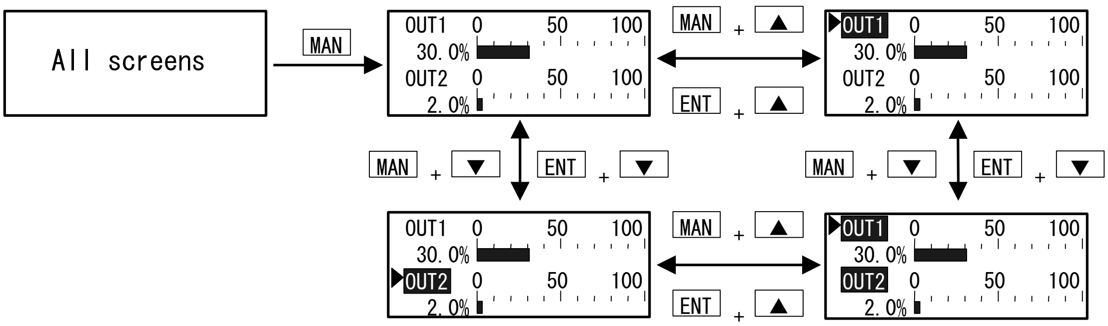
This device is provided with a key exclusively for manual output so that you can switch to the output monitor screen (0-1) by pressing the MAN key in any screen display.
After displaying the output monitor screen, the simple manual output operation will be available with the following procedure.

■ Simple operation of OUT1

1. Press the MAN key to call up the output monitor screen.
2. Press the ▲ key while holding down the MAN or the ENT key.
   The letters OUT1 are highlighted and setting switches to manual output (MAN: ON).
3. Set the OUT1 output value by the ◄, ▼ or ▲ key.
4. Press the ▲ key again while holding down the MAN or ENT key.
   The setting returns to auto (MAN: OFF).

■ Simple operation of OUT2

1. Press the MAN key to call up the output monitor screen.
2. Press the ▼ key while holding down the MAN or ENT key.
   The letters OUT2 are highlighted and setting switches to manual output (MAN: ON).
3. From here on, the procedure is the same as for OUT1.



Note

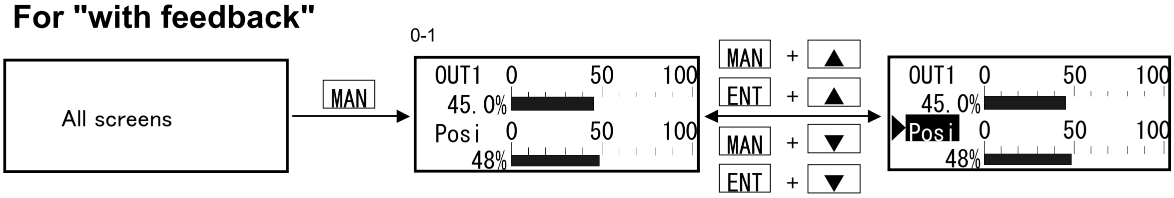
1For 1-loop specification, both Output 1 and Output 2 are switched to manual output (MAN: ON) with either one of [MAN] + [▲] and [ENT] + [▲] , or [MAN] + [▼] and [ENT] + [▼].These may not be set separately.

In 2-loop, it is required to pay attention to the status of the output side that is not indicated by the status lamps. For instance, if OUT2 (CH2) is set to manual mode when the MAN status lamp indicates OUT1 (CH1), the front lamp indication turns to CH1. Verification of manual mode status of OUT2 must be done with OUT2 highlighted on the output monitor (0-1) or the blinking of □ of MAN on the status monitor (0-2), but not with front status lamp(s).

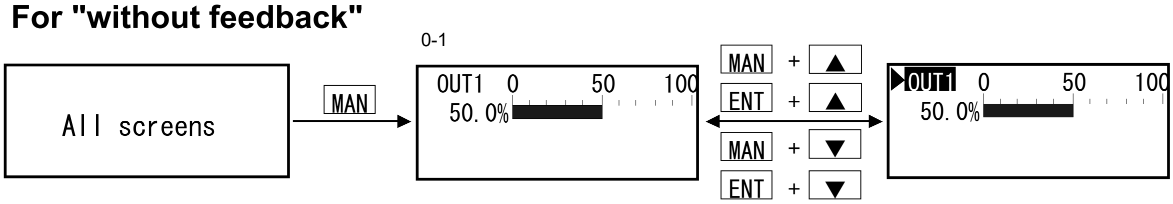
■ Simple operation of OUT1/Posi

1. Press the [MAN] key to call up the output monitor screen.
2. Press the [▲] or [▼] key while holding down the [MAN] or [ENT] key.
   The letters OUT1/Posi is highlighted and seeeting switches to manual output (MAN = ON) mode.
3. Set open output ON/close output ON by the [▼] key or [▲] key.
4. Press the [MAN] or [ENT] key again while holding down the [▲] or [▼] key.
   The mode setting returns to auto (MAN = OFF).

■ For "with feedback"



■ For "without feedback"



With basic function MS, you can switch to MAN operation while AT is being executed. However, auto tuning is stopped automatically when the mode is switched to Manual mode.

Note

- When this device is turned OFF under the Manual mode (MAN = ON) and turned ON again, this device still starts up under the Manual mode.

16－8 Control Standby (STBY)

This function is for setting control output, event output or external output (DO) to a standby state (stop), and standing by for input, etc. to stabilize before starting control.

Analog output acts regardless of the execution/standby setting.

Control output in standby mode becomes the preset output at standby (initial value 0%), and the STBY status lamp or status monitor blinks.

With feedback, it starts to control from specified preset position value or at "Stop". When it is used without feedback, it starts to control from "Stop", "Close" or "Open" which is specified in advance.

When "control execution/standby switching" is assigned to DI, execution/standby switching can be executed by external contacts.

1-1

```
AT   :   OFF        CH
MAN  :   OFF         1
STBY▶    OFF
```

Setting item: OFF, ON
Initial value: OFF

ON: Control action is stopped, and control output becomes the preset output at standby (initial value 0%).
OFF: Regular automatic control is performed.

For details on how to set output at standby, see "8-5 (2) Output 1 Output at Standby" and "13-3 (2) Setting of Servo Preset Values."

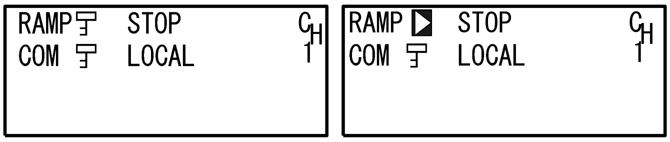
Note

When this device is turned OFF with the Manual Mode set (STBY=ON) and turned ON again, this device starts up with the Standby Mode continued.

16－9 Pausing/Resuming Ramp Control (RAMP)

Ramp control is a function for not suddenly changing SV when it is switched but is a function for ensuring that SV changes according to a fixed ramp (rate-of-change).
This function enables this device to be used as a simple programmable controller.
Ramp control can be paused, resumed and aborted during execution.
You can also interrupt ramp control.
During execution of ramp control (RUN), the RMP status lamp blinks and lights when ramp execution is paused (PAUSE).

1-2



Setting item: RUN, PAUSE, QUICK
Initial value: STOP

STOP: RAMP: STOP indicates that the ramp control is not executed and cannot be changed.
PAUSE: When RAMP control is executing (RAMP: RUN), and set to RAMP: PAUSE, ramp control is paused, and control changes to fixed-value control using the execution SV value at that time. The RMP status is lit.
RUN: Paused ramp control can be resumed by RAMP: RUN setting.
After ramp control is executed, the display changes to RAMP: RUN, the RMP LED indicator blinks, and the indicated SV No. changes towards to the target SV value.
Start ramp control by switching the execution SV No.
QUICK: Aborts ramp control, and immediately switches to the SV value of the target SV No.

For details on setting ramp control, see "9-5 Setting the Ramp."

16－10 Tuning Functions

This section describes the PID constant tuning function.
Adjustment of PID constant (P: proportional band, I: integral time, D: derivative time) that are used in PID control is generally referred to as "tuning."
This devise supports the following PID constant tuning methods:

1. Auto tuning (AT)
2. Self tuning

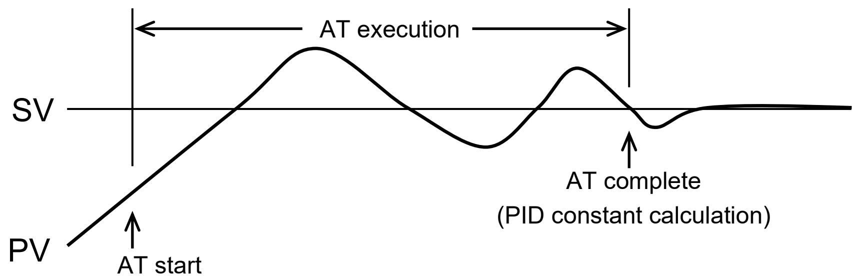
Caution

- This device is a high-precision, high-function controller. Use of the auto tuning (AT) function is recommended as optimum PID constants can be obtained more easily than by self tuning.
- On the following types of control targets, self tuning sometimes does not function normally, inappropriate PID constants are calculated and set, and the optimum control result is not obtained. For this reason, do not use self tuning:
  - Control targets that cause cyclical external disturbance
  - Control target with extremely short or long dead band
  - When the measured value (PV value) contains noise and is unstable
- For 2-output and each one of the specifications for internal cascade slave side, the tuning mode is fixed to [Tuning: Auto Tuning].
- When used without feedback, the tuning mode is fixed to Auto Tuning.

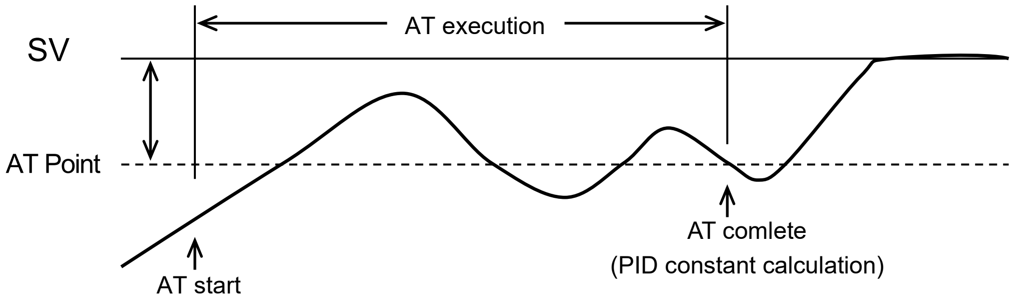
16-10-1 Auto tuning (AT)

■ System operation in Auto tuning

The limit cycle method is recommended for auto tuning of this device.
By this method, the control output is turned ON/OFF, to measure the amplitude and dead band of the measured value (PV), and calculate the PID constants.



As the measured value is affected by the set value (SV), set auto tuning point (AT point) to prevent excessive measured values.



■ Conditions for starting up Auto tuning

- When [Tuning : Auto Tuning] is selected in the tuning screen and AT is set ON (by front panel keys, DI signal or communications)

■ Conditions for not starting up Auto tuning

- When standby operation (STBY) is being executed
- When output is manual output (MAN)
- When remote SV control (REM) is being executed
- When ramp control (RMP) is being executed
- When P = OFF (ON-OFF control)
- When PV zone PID is set
- When the PV value causes a scale over (SO) error
- When it is used without feedback in servo output
- When potentiometer error occurs during preset output in servo output

■ Canceling Auto tuning during execution

- AT is canceled by setting to OFF (by front panel keys, DI signal, or communications).
- When 200 minutes is exceeded with the control output value at the 0% or 100%
- When standby operation (STBY) is being executed
- When the PV value causes a scale over (SO) error
- When it is used without feedback in servo output
- When potentiometer error occurs during preset output in servo output
- During a power outage

Note

- Auto tuning sometimes is not performed correctly when the measured value (PV) contains noise and is unstable. Either stabilize the measurement input, or use a PV filter, for example, to stabilize the measured value before executing auto tuning.
- When the output limiter is used, set the output limiter before execution of AT. Note however, that control output operates between 0% to 100% (ON-OFF) regardless of the output limiter when output is contact output or SSR drive voltage output.
- With some control targets, optimum PID constants are sometimes not obtained. Correcting the PID constants obtained by auto tuning may provide better results.

16-10-2 Self tuning

Self tuning is a function provided for performing tuning more easily than auto tuning. Self tuning is executed after tuning conditions are automatically judged.
This device supports two methods of self tuning:

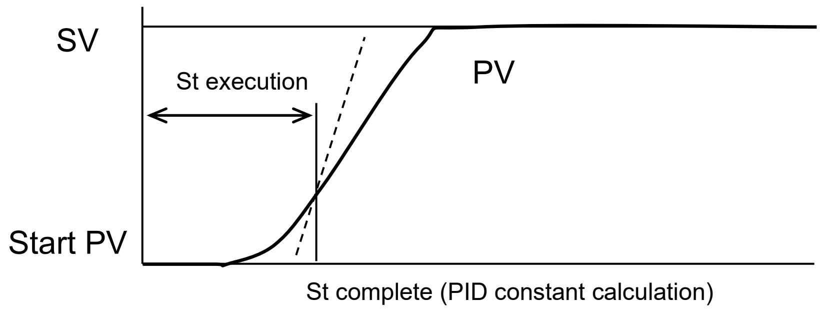
1. Self tuning by step response (St)
2. Self tuning by hunting suppression (Hu)

These self tuning modes cannot be specified by users, as these are automatically selected by the device.

(1) Self tuning by step response (St)

With self tuning by step response, tuning is automatically performed by the step response method and PID constants are set by measuring fluctuations in the measured value (PV) when a fixed deviation and stable control output are being output, for example, when the power is turned ON, standby mode (STBY) is changed to execution (STBY OFF), or the setting value (SV) is changed.

Step response tuning



When self tuning by step response is started up, control computation is performed using the preset PID constants, and when tuning ends successfully, control computation is performed using the PID constants obtained and set by tuning.
Accordingly, when tuning is not to start up or is canceled, control computation will be continued using the PID constants set so far.

■ **Conditions for starting up Self tuning**

When [Tuning: Self Tuning] is selected in the tuning screen

・Immediately after power ON
・When standby (STBY) is changed to execution (STBY OFF)
・When the SV value is changed

■ Conditions for not starting up Self tuning

- In 2-output specification
- In slave specification of internal cascade control mode (2-input specification)
- When standby operation (STBY) operation is being executed
- When output is manual output (MAN)
- When remote SV control (REM) is being executed
- When ramp control (RMP) is being executed
- When P = OFF (ON-OFF control)
- When the PV value causes a scale over (SO) error
- When zone PID is set
- When setting up the output rate-of-change limiter
- When step output (error between control output before and after startup) is 10% or less
- When it is used without feedback in servo output
- When potentiometer error occurs during preset output in servo output

■ Conditions for canceling self tuning by the step response

When the following operations are performed during self tuning by the step response, or conditions are satisfied, self tuning is canceled and control continues using the PID constants that were previously set:

- When the control characteristics (Reverse/Direct) are changed
- When the output limiter is changed
- When the control output is changed

* As control is performed using the PID constants that were set when self tuning was started up, when the proportional band is large, and the deviation between the set value and the measured value is small, the control output will immediately fluctuate. For this reason, tuning becomes more likely to be canceled.

- When 10 hours have elapsed after tuning is started
- When the measured value fluctuates due to noise, etc., and it is judged that computation by the step

Caution

■When the following conditions are not observed in self tuning by step response, accurate tuning results cannot be obtained, and inappropriate PID constants sometimes are calculated and set:

- The control target and control loop must be operating correctly.
- The measured value (PV) must be in a stable state when self tuning is started up.
- The power of control terminals such as heaters must be ON when self tuning is started up.

■ If inappropriate PID constants are set, and stable control results cannot be obtained by the above conditions, perform the following to remedy this:

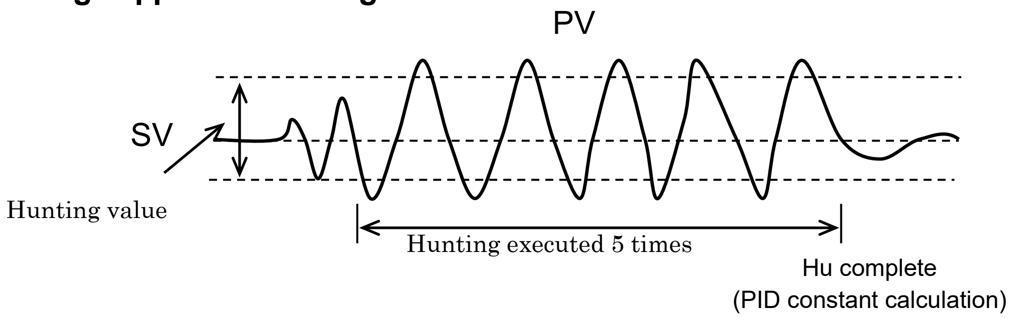
- Correct the PID constants obtained by self tuning.
- Execute auto tuning (AT).

(2) Self tuning by hunting suppression (Hu)

■ System operation in hunting suppression

Hunting suppression self tuning is a function that automatically returns measured value in a stable direction when hunting occurs for the measured value (PV) due to changes in the conditions of the control target.

Hunting suppression tuning



■ Conditions for starting up Self tuning

When [Tuning: Self Tuning] is selected in the tuning screen

- When the set value (SV) crosses (±0.02% FS or more) and fluctuates vertically
- When vertical fluctuation is repeated at a Hunting value or more set in the tuning screen

■ Conditions for not starting up Self tuning

- In 2-output specification
- In slave specification of internal cascade control mode (2-input specification)
- When standby operation (STBY) operation is being executed
- When output is manual output (MAN)
- When remote SV control (REM) is being executed
- When ramp control (RMP) is being executed
- When P = OFF (ON-OFF control)
- When the PV value causes a scale over (SO) error
- When zone PID is set
- When setting up the output rate-of-change limiter
- During self tuning by step response
- When it is used without feedback in servo output
- When potentiometer error occurs during preset output in servo output

■ Tuning standby conditions

When the following conditions occur, operation stands by for desirable startup conditions to be generated:

- When the current fluctuation width attenuates (gets smaller) to 25% or less from the previous fluctuation width
- When the 5th fluctuation width attenuates (gets smaller) to 25% or less from the initial fluctuation width
- When the PID constants are changed
- When the control characteristics (Reverse/Direct) are changed
- When the output limiter is changed

The aim of hunting suppression tuning when hunting occurs is to suppress hunting that occurs when the PID constants do not match the actual control target (e.g. small P, small I, large D).
As the aim is to suppress vibration, when vibration is caused by cyclic external disturbance, for example, the PID constants may be slightly corrected (e.g. larger P, larger I), which might result in increased vibration.

If this happens, the PID constants must be adjusted by the following methods:

- Reduce cyclic external disturbance.
- Set up the PID constants by auto tuning (AT).

17 ERROR DISPLAYS

17—1 Operation Check Abnormalities at Power ON

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

<table>
<tr><th>PV display</th><th colspan="2">Cause</th></tr>
<tr><td>E-rom</td><td>ROM error</td><td rowspan="6">In any of the states shown on the left, all outputs turn OFF or become 0%.</td></tr>
<tr><td>E-rAm</td><td>RAM error</td></tr>
<tr><td>E-EEP</td><td>EEPROM error</td></tr>
<tr><td>E-Ad1</td><td>Input 1 A/D error</td></tr>
<tr><td>E-Ad2</td><td>Input 2 A/D error</td></tr>
<tr><td>E-SPc</td><td>Hardware error</td></tr>
</table>

Request

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

17—2 PV Input Abnormalities

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

PV display	Cause
Sc_LL	PV value fell below the measuring range lower limit (-10% FS). PV value fell below -240°C for R.T.D.
Sc-HH	The PV value exceeded the measuring range higher limit (+110% FS). RTD-A burnout. Thermocouple burnout.
b————	One or two RTD-B leads burnout, orall leads of the RTDs burnout
CJ_LL	Cold junction compensation (-20°C) is at the lower limit. (Thermocouple input)
CJ_HH	Cold junction compensation (+80°C) is at the higher limit. (Thermocouple input)

17－3 REM Input Abnormalities

When an abnormality is detected in the remote setting input during execution of REM SV on this device, the following errors are displayed.

SV display	LCD Display	Cause
rE_LL	SC_LL	REM input falls below lower limit of measuring range (-10%).
rE_HH	SC_HH	RREM input exceeds higher limit of measuring range (+110%)

* When the remote setting input is between -10% and 0% of the measuring range, the remote SV display shows 0% of the measuring range.

* When the remote setting input is between 100% and 110% of the measuring range, the remote SV display shows 100% of the measuring range.

Request

- Check remote setting input when the above messages are displayed. If the input is not in error and there is another probable cause, contact your dealer.

17－4 Heater Current Abnormalities

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

LCD Display	Cause
HB_HH	The heater current exceeds 55.0 A.

17－5 Feedback Potentiometer Error

When used with the feedback, and feedback potentiometer error, the following error codes are displayed on the LCD.

LCD Display	Cause
ERROR	Open-circuit of feedback potentiometer “R2”

18 LIST OF PARAMETERS

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

Display symbol: Indicates the parameter symbol displayed on the LCD screen.
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 setting.
(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 range setting, unit setting or PV scaling setting has been changed.
Parameters marked by * may need to be confirmed again when the above settings have been change.

18－1 Basic Screen Group (group 0)

Display Symbol	Description of Function	Setting Range	Initial Value	Lock
SV No. (CH1)	Target set value No. (CH1)	1 to 10, REM	1	2
OUT1	OUT1 output value	0.0 to 100.0 %	–	1
SV No. (CH2)	Target set value No. (CH2)	1 to 10, REM	1	2
OUT2	OUT2 output value	0.0 to 100.0 %	–	1
Posi	Position value	0 to 100 %	–	1

18－2 Execution Screen Group (group 1)

Display Symbol	Description of Function	Setting Range	Initial Value	Lock
AT (CH1)	Auto tuning execution	OFF: Auto tuning stop ON: Auto tuning execution	OFF	2
MAN (CH1)	Switching of manual output action	OFF: Automatic control ON: Manual output	OFF	2
STBY (CH1)	Standby switching	OFF: Execute ON: Standby	OFF	2
AT (CH2)	Auto tuning execution	OFF: Auto tuning stop ON: Auto tuning execution	OFF	2

MAN (CH2)	Switching of manual output action	OFF: Automatic control ON: Manual output	OFF	2
STBY (CH2)	Standby switching	OFF: Execute ON: Standby	OFF	2
RAMP (CH1)	Ramp control	STOP: Execution OFF PAUSE: Execution paused RUN: Execution continued	STOP	2
RAMP (CH2)	Ramp control	STOP: Execution OFF PAUSE: Execution paused RUN: Execution continued	STOP	2
COM	Communication state	LOCAL: Set on unit COM: Set by communication	LOCAL	2

18－3 SV Screen Group (group 2)

Display Symbol	Description of Function	Setting Range	Initial Value	Lock
SV1 (CH1/CH2) *	Target set value1	Within setting limiter range	0 or value of lower limit side of the measuring range, whichever is larger	3
SV2 (CH1/CH2) *	Target set value2			
SV3 (CH1/CH2) *	Target set value3			
SV4 (CH1/CH2) *	Target set value4			
SV5 (CH1/CH2) *	Target set value5			
SV6 (CH1/CH2) *	Target set value6			
SV7 (CH1/CH2) *	Target set value7			
SV8 (CH1/CH2) *	Target set value8			
SV9 (CH1/CH2) *	Target set value9			
SV10 (CH1/CH2)*	Target set value10			
REM	Remote monitor	Within remote scale range (display only)		—
SV Limit_L (CH1/CH2) *	Target set value lower limit value limiter	Within measuring range	Measuring range lower limit value	1
SV Limit_H (CH1/CH2) *	Target set value higher limit value limiter	Within measuring range	Measuring range higher limit value	1
REM Track	Remote tracking	NO YES	NO	1
REM Mode *	Remote mode	RSV: Remote SV RT: Remote ratio	RSV	1
REM Ratio *	Remote ratio	0.001 to 30.000	1.000	1
REM Bias *	Remote bias	-10000 to 0000 digit	0	1
REM Filt	Remote filter	OFF, 1 to 300 s	OFF	1

Display Symbol	Description of Function	Setting Range	Initial Value	Lock
REM Sc_L *	Lower limit side remote scale	Within measuring range	Measuring range lower limit value	1
REM Sc_H *	Higher limit side remote scale		Measuring range higher limit value	1
REM PID	Remote SV PID No.	1 to 10	1	1
REM SQ. Root	Remote square root extraction operation	OFF ON	OFF	1
REM Low Cut	Remote square root extraction operation Low cut	0.0 to 5.0 %	1.0 %	1
RAMP Up (CH1/CH2)*	Ascending ramp value	OFF, 1 to 10000 digit	OFF	1
RAMP Down (CH1/CH2)*	Descending ramp value	OFF, 1 to 10000 digit	OFF	1
RAMP Unit/ (CH1/CH2)	Ramp unit	/s /m	/s	1
RAMP Ratio (CH1/CH2)	Ramp unit	/1 /10	/1	1

18－4 PID Screen Group (group 3)

Display Symbol			Description of Function	Setting Range	Initial Value	Lock
PID01 PID02 PID03 PID04 PID05 PID06 PID07 PID08 PID09 PID10	OUT1	P	Proportional band	OFF, 0.1 to 999.9 %	3.0 %	1
		I	Integral time	OFF, 1 to 6000 s	120 s	1
		D	Derivative time	OFF, 1 to 3600 s	30 s	1
		DF *	Action hysteresis	1 to 9999 digit	20 digit	1
		MR	Manual reset	-50.0 to 50.0 %	0.0 % -50.0 % (1-loop/2-output)	1
		SF	Set value function	0.00 to 1.00	0.40	1
		ZN *	PID zone	Within measuring range	0	1
	OUT2	P	Proportional band	OFF, 0.1 to 999.9 %	3.0 %	1
		I	Integral time	OFF, 1 to 6000 s	120 s	1
		D	Derivative time	OFF, 1 to 3600 s	30 s	1
		DF *	Action hysteresis	1 to 9999 digit	20 digit	1
		MR	Manual reset	-50.0 to 50.0 %	0.0 %	1
		DB *	Dead band	-1999 to 20000 digit	0 digit	1
		SF	Set value function	0.00 to 1.00	0.40	1
		ZN *	PID zone	Within measuring range	0 digit	1
	OUT1L		Output limit lower limit value (OUT1)	0.0 to 99.9 %	0.0 %	1
	OUT1H		Output limit higher limit value (OUT1)	0.1 to 100.0 %	100.0 %	1
	OUT2L		Output limit lower limit value (OUT2)	0.0 to 99.9 %	0.0 %	1
	OUT2H		Output limit higher limit value (OUT2)	0.1 to 100.0 %	100.0 %	1
Zone	PID1		CH1 zone PID mode	OFF SV: SV zone switching PV: PV zone switching	OFF	1
	HYS1 *		CH1 zone hysteresis	0 to 10000 digit	20	1
	PID2		CH2 zone PID mode	OFF SV: SV zone switching PV: PV zone switching	OFF	1
	HYS2 *		CH2 zone hysteresis	0 to 10000 digit	20	1
REM	PID		Remote SV PID No.	1 to 10	1	1
Tuning			Tuning mode	Auto Tuning Self Tuning	Auto Tuning	1
Hunting			Hunting	0.1 to 100.0 %	0.5 %	1
AT Point *(CH1/CH2)			Auto tuning point	0 to 10000 digit	0	1

18－5 EVENT/DO Screen Group (group 4)

<table>
<tr><th colspan="2">Display Symbol</th><th>Description of Function</th><th>Description of Function</th><th>Initial Value</th><th>Lock</th></tr>
<tr><td rowspan="5">EV1
EV2
EV3
DO1
DO2
DO3
DO4
DO5
DO6
DO7
DO8
DO9
DO10
DO11
DO12
DO13</td><td>SP *</td><td>Operation value</td><td>Other than basic function MS
Within measuring range (PV)
Within the setting range of SV (SV)
-25000 to 25000 digit (DEV Hi, DEV Low)
0 to 25000 digit (DEV Out, DEV In)
Basic function MS
0 to 100 %（Posi）</td><td>DEV Hi : 25000
DEV Low : -25000
DEV Out : 25000
DEV In : 25000
PV Hi: Measuring range higher limit value
PV Low: Measuring range lower limit value
SV Hi: Measuring range higher limit value
SV Low: Measuring range lower limit value
Posi.H : 100 %
Posi.L : 0 %</td><td>2</td></tr>
<tr><td>CH1</td><td>Channel assignment</td><td>CH1
CH2</td><td>CH1</td><td>1</td></tr>
<tr><td>MD</td><td>Operation mode</td><td>AT: Auto tuning execution in progress
MAN: Manual operation in progress
REM: Remote operation in progress
RMP: Ramp control execution in progress
STBY: Control action not in progress
SO: PV, REM scale over
PV SO: PV scale over
REM SO: REM scale over
LOGIC: Logic operation output
(EV1 to EV3, DO1 to DO5)
Direct: Direct output (DO6 to DO13)
Other than basic function MS
HBA: Heater break alarm output
HLA: Heater loop alarm output
Basic function MS
Posi.H: Position higher limit absolute value
Posi.L: Position lower limit absolute value
POT.ER: Feedback potentiometer error</td><td>EV1; DEV Hi
EV2; DEV Low
EV3; None
DO1 to DO13; None</td><td>1</td></tr>
<tr><td>ACT</td><td>Output characteristics</td><td>N.O.: Normally open
N.C.: Normally closed</td><td>N.O.</td><td>1</td></tr>
<tr><td>DF *</td><td>Action hysteresis</td><td>1 to 9999 digit</td><td>20</td><td>1</td></tr>
</table>

	IH	Standby action	OFF: None 1: At power ON or at STBY ON -> OFF 2: At power ON, at STBY ON -> OFF or SV change 3: At input error	OFF	1
	DLY	Delay time	OFF, 1 to 9999 s	OFF	1
	STEV	Event output at standby	OFF ON	OFF	1

Display Symbol		Description of Function	Description of Function	Initial Value	Lock
EV1 EV2 EV3 DO1 DO2 DO3	Log MD	Logic operation mode	AND OR XOR	AND	1
	SRC1	Logic operation source 1	None, DI1 to DI10	None	1
	SRC2	Logic operation source 2		None	1
	Gate1	Logic operation gate source 1	BUF INV FF	BUF	1
	Gate2	Logic operation gate source 2		BUF	1
DO4 DO5	Time	Timer (action time)	OFF, 1 to 5000 s	OFF	1
	Count	Counter (action count)	OFF, 1 to 5000	OFF	1
	SRC	Logic operation source selection	DI1 to DI10	None	1
	Log_MD	Logic operation mode	Timer Counter	Timer	1

*1: Logic operation (AND, OR, XOR) can be assigned only to LOGIC EV1 to EV3, and DO1 to DO3.
*2: Logic operation (Timer, Counter) can be assigned only to DO4 and DO5.
*3: Direct output can be assigned only to DO6 to DO13(With optional communication only)
*4: Posi.H, Posi.L, or POT.ER can be assigned when feedback potentiometer is used.

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

Display Symbol		Description of Function	Description of Function	Initial Value	Lock
		DI assignment channel (only in 2-loop)	CH1 CH2 CH1+2	CH1	1
DI1		DI1 assignment	None: No action (factory default) MAN: Switching of control output between auto/manual REM: Switching of REM SV/LOC SV setting AT: Switching of AT execution/stop STBY: Switching of control execution/standby ACT: Switching of direct/reverse action on Output 1 characteristics (ON: direct action) Pause: Switching of pause/resume of ramp control Logic: Logic operation EXT_SV: External switching of SV No. (Only DI7 can be set, assigned to DI7 to DI10.) Other than basic function MS ACT2: Switching of direct/reverse action on Output 2 characteristics Basic function MS only Preset1: Only DI2 can be set (assigned only to DI2) Preset2: Only DI2 can be set (assigned to DI2 to DI3) Preset3: Only DI2 can be set (assigned to DI2 to DI4)	None	1
DI2		DI2 assignment			
DI3		DI3 assignment			
DI4		DI4 assignment			
DI5		DI5 assignment			
DI6		DI6 assignment			
DI7		DI7 assignment			
DI8		DI8 assignment			
DI9		DI9 assignment			
DI10		DI10 assignment			
Ao1 Ao2	MD	Analog output type assignment	PV: Measured value SV: Set value DEV: Deviation value OUT1: Control Output 1 CH2_PV：CH2 PV CH2_SV：CH2 SV CH2_DEV: CH2 Deviation value Other than basic function MS OUT2: Control Output 2 Basic function MS only Posi: Position output value	PV (Ao1) SV (Ao2)	1
	_L*	Analog output lower limit scaling	Setting Range (PV, SV, CH2_PV, CH2_SV) -100.0 to 100.0 %(DEV, CH2_DEV) 0.0 to 100.0 %(OUT1, OUT2) 0 to 100 %(Posi)	Setting Range lower limit value	1
	_H*	Analog output higher limit scaling		Setting Range higher limit value	1
Heater		Heater current value monitor	0.0 to 55.0A display only	—	—
HB		Heater current detection selection	OUT1 OUT2	OUT1	1
HBM		Heater break alarm mode	Lock Real	Lock	1
HBA		Heater break alarm current value	OFF, 0.1 to 50.0 A	OFF	1
HLA		Heater loop alarm current value	OFF, 0.1 to 50.0 A	OFF	1

18－7 Communication (group 5)

Display Symbol		Description of Function	Description of Function	Initial Value	Lock
	PROT	Communication protocol	SHIMADEN: Shimaden MOD_ASC: Modbus ASCII MOD_RTU: Modbus RTU	SHIMADEN	1
	ADDR	Device No.	1 to 98	1	1
	BPS	Communication speed	2400, 4800, 9600, 19200	9600	1
	MEM	Memory mode	EEP, RAM, R_E	EEP	1
	DATA	Data length	7, 8	7	1
	PARI	Parity	EVEN, ODD, NONE	EVEN	1
	STOP	Stop bit	1, 2	1	1
	DELY	Delay time	1 to 50 ms	10 ms	1
	CTR *	Control	STX_ETX_CR, STX_ETX_CRLF, @_:_CR	STX_ETX_CR	1
	BCC *	Checksum	ADD, ADD_two's cmp, XOR, None	ADD	1
	CMOD	Communication mode types	COM1, COM2	COM1	1

* SHIMADEN standard protocol only

18－8 Control Output Screen Group (group 6)

Display Symbol		Description of Function	Description of Function		Initial Value	Lock
OUT1	ACT	Output characteristics	Reverse: Reverse characteristics Direct: Direct characteristics		Reverse	1
	STBY	Output at standby	Other than servo	0.0 to 100.0 %	0.0 %	1
			With servo FB	Stop Preset1 to 7	Preset1	
			Without servo FB	Stop,Close Open	Close	
	ERR	Output at error	Other than servo	0.0 to 100.0 %	0.0 %	1
			With servo FB	Stop Preset1 to 7	Preset1	
			Without servo FB	Stop,Close Open	Close	
	CYC	Proportional cycle	1 to 120 S		Contact (Y): 30s SSR (P): 3s	1
	POT. ERR	Potentiometer output error	Basic function MS + With FB (only) Stop, Close, Open		Stop	1
OUT2	ACT	Output characteristics	Reverse: Reverse characteristics Direct: Direct characteristics		Direct (1-loop) Reverse (2-loop)	1
	STBY	Output at standby	0.0 to 100.0 %		0.0 %	1
	ERR	Output at error	0.0 to 100.0 %		0.0 %	1
	CYC	Proportional cycle	1 to 120 s		Contact (Y): 30s SSR (P): 3s	1
Rate Limiter	OUT1	Output 1 rate-of-change limiter	OFF, 0.1 to 100.0 %/s		OFF	1
	OUT2	Output 2 rate-of-change limiter	OFF, 0.1 to 100.0 %/s		OFF	1

Display Symbol		Description of Function	Description of Function	Initial Value	Lock
Servo	FB	Feedback potentiometer	ON: with feedback potentiometer OFF: Without feedback potentiometer	ON	1
	DB	Servo Dead band	0.2 to 10.0 %	2.0 %	1
	TIME	Motor timing	Without feedback (only): 5 to 300 s	60 s	1
	BOOT	Setting servo operations on start-up	Without feedback (only): Stop, Close, Open	Close	1
Servo Calibration	MD	Zero/span adjustment mode	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

18－9 Unit/Range Screen Group (group 7)

Display Symbol		Description of Function	Description of Function	Initial Value	Lock
2-IN(Func)	PV MODE	2-Input operation PV mode	MAX: 2-input maximum value MIN: 2-input minimum value AVE: 2-input average value DEV: 2-input deviation value PV: Input 1	DEV	1
	SO MODE	2-Input operation scale-over mode	0: Control by normal side PV 1: Perform scale-over processing	0	1
INPUT 1 INPUT 2	PV Bias *	PV bias	-10000 to 10000 digit	0 digit	1
	PV Slope *	PV slope	0.500 to 1.500 digit	1.000 digit	1
	PV Filter	PV filter	OFF, 1 to 100 s	OFF	1
CASCADE	Slave SV	Slave side SV	Control Output	–	--
	Scale L *	Cascade control slave input scale lower limit side	Within measuring range	Measuring rangelower limit value	1
	Scale H *	Cascade control slave input scale higher limit side	Within measuring range	Measuring rangehigher limit value	1
	FILTER	Cascade control slave input filter	OFF, 1 to 100 s	OFF	1
PV Bias (CH1/CH2) *		PV bias	-10000 to 10000 digit	0 digit	1
PV Filter (CH1/CH2)		PV filter	OFF, 1 to 100 s	OFF	1
PV Slope (CH1/CH2) *		PV slope	0.500 to 1.500 digit	1.000 digit	1
RANGE (CH1/CH2)		Measuring range	01 to 19：TC 31 to 60：RTD 71 to 77：Voltage（mV） 81 to 87：Voltage（V）	06	1
Sc_L (CH1/CH2) *		Input lower limit side scale	-19999 to 29990 digit	0 digit	1
Sc_H (CH1/CH2) *		Input higher limit side scale	-19989 to 30000 digit	1000 digit	1
UNIT (CH1/CH2) *		Measurement unit	°C, °F, %, None	RTD, TC: °C I, V: %	1
DP (CH1/CH2) *		Decimal point position	XXXXX. XXXX.X XXX.XX XX.XXX X.XXXX	XXXX.X	1
Figure (CH1/CH2) *		Selection of number of digits past decimal point	Normal, Short	Normal	1
CJ (CH1/CH2)		Cold junction compensation	Internal, External	Internal	1

Display Symbol	Description of Function	Description of Function	Initial Value	Lock
SQ. Root (CH1/CH2) *	Square root extraction operation (at linear input)	OFF, ON	OFF	1
Low Cut (CH1/CH2)	Square root extraction low cut	0.0 to 5.0 %	1.0 %	1
PMD /MBIAS	Ten-segment linear approximation/ Multi bias	OFF Linearizer PV-MBIAS（PV） PV-MBIAS（SV） RSV- MBIAS（SV）	OFF	1
A1 to A11	Linearizer	-5.00 to 105.00 %	0.00 %	1
	PV-MBIAS (PV)	Within measuring range	0℃	
	PV-MBIAS (SV)	Within measuring range		
	RSV-MBIAS（SV）	Within measuring range		
B1 to B11	Linearizer	-5.00 to 105.00 %	0.00 %	1
	PV-MBIAS (PV)	-10000 to 10000 digit	0℃	
	PV-MBIAS (SV)	-10000 to 10000 digit		
	RSV- MBIAS（SV）	-10000 to 10000 digit		

18－10 Lock, etc. Screen Group (group 8)

Display Symbol	Description of Function	Description of Function	Initial Value	Lock
KLOCK	Key lock	OFF : Release LOCK1: Other than SV, CONTROL LOCK2: Other than SV LOCK3: All	OFF	
OUTPUT	Number of outputs	Single Dual	1- output: Single 2- 2-output: Dual	1
IR COM	Infrared communications	ON: Enabled OFF: Disabled	ON	1

19 EXPLANATION OF SHIMADEN PROTOCOL

19－1 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. There is however no communication response if an error such as communication format error or BCC error occurs.
There is also no communication response for broadcast command.

(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).

19－2 Communication Format

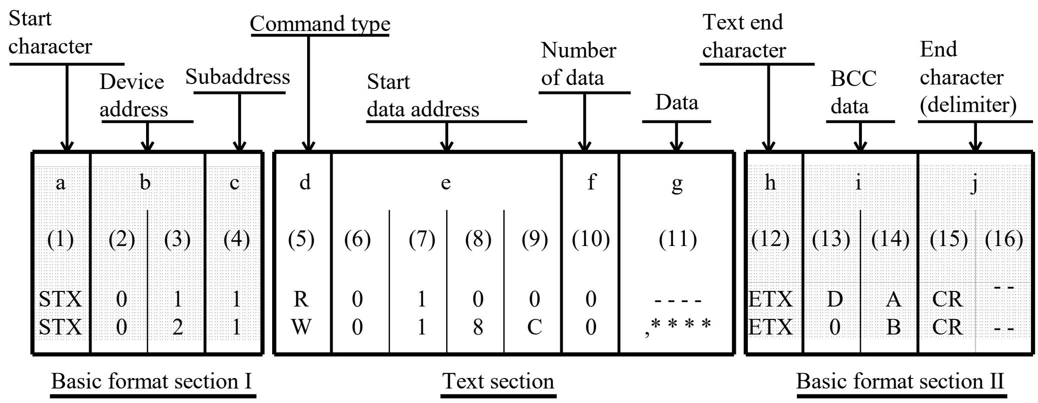
This device supports various protocols, and so various selections can be made by the communication format (control codes, BCC operation method) or communication data format (data bit length, parity, stop bit length).
However, for ease of use and to avoid confusion when setting up communications, we recommend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

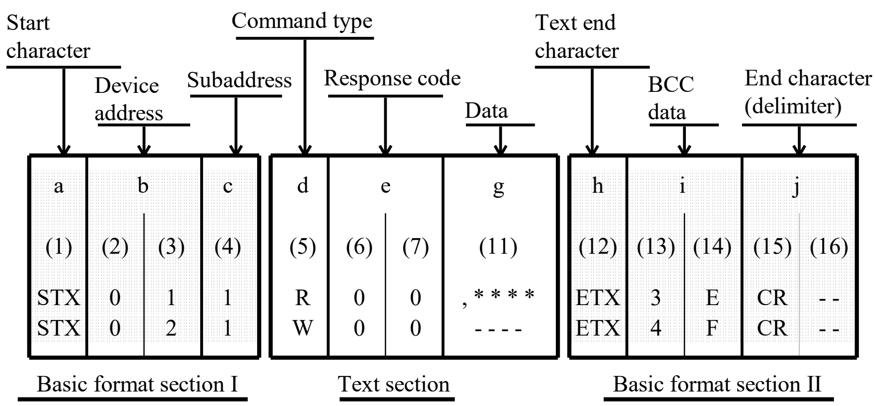
(1) Outline of communication format

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



■ Communication response format



(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 “19-3 Details of Read Command (R)” and “19-4 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 types of data of this device 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 types of data on this device 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 "0"	3H "3"	0H "0"	AH "A"
ASCII data	30H (6)	33H (7)	30H (8)	41H (9)

- For details on data addresses, see “12 OPTION SETTING” and “12- 4 (17) 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:

g (11)

″,″ 2CH	1st data				2nd data					nth data			
	Upper 1st digit	2nd digit	3rd digit	Lower 4th digit	Upper 1st digit	2nd digit	3rd digit	Lower 4th digit		Upper 1st digit	2nd digit	3rd digit	Lower 4th digit

- 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 “19-3 Details of Read Command (R)” and “19-4 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 “19-6 Details of Response Codes.”

19－3 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 52H	0 30H	7 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 “19-6 Details of Response Codes.”

19－4 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 write 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 “19-6 Details of Response Codes.”

19－5 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 “12- 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

19－6 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.

20 EXPLANATION OF MODBUS COMMUNICATION PROTOCOL

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

20－1 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 s 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

20－2 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

20－3 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 1-loop specification, the slave address is the same as the device address.
In 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.

20－4 Function Code

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

Function Code	Details
03 (03H)	Reads setting value 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, for 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)

20－5 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).

20－6 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 polynomial: $X^{16} + X^{15} + X^2 + 1$

1. Initialize CRC data (taken to be X). (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.

20－7 Examples of Messages

(1) ASCIImode

■ Reading device No.1, SV1

・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 (SV1 = 10.0°C)

Header	Slave address	Function code	Number ofresponse bytes	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	Function 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 occurrence of an error, “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, SV1 = 10.0°C

・Request message from master

Heade r (:)	Slave address (01H)	Function code (06H)	Data address (0300H)	Number of data (0064H)	Error check LRC (92H)	Delimiter (CR・LF)	
1	2	2	4	4	2	2	Number of characters (17)

・Slave response message in normal operation (SV1 = 10.0°C)

Header (:)	Slave address (01H)	Function code (06H)	Data address (0300H)	Data (0064H)	Error check LRC (92H)	Delimiter (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 (01H)	Function code (86H)	Error code (03H)	Error check LRC (76H)	Delimiter (CR・LF)	
1	2	2	2	2	2	Number of characters (11)

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, SV1**

・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 (SV1 = 10.0°C)

Idle 3.5 characters	Slave address (01H)	Functio n code (03H)	Number ofresponse 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 CRC (C0F1H)	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 (83H). An error code 02H (non-existent data address) is returned as the response message for the error content.

■ Writing device No.1, SV1 = 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 (SV1 = 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.

21 ASCII CODE TABLE

	b7 to b5	000	001	010	011	100	101	110	111
b4 to 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

22 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.

22－1 Product Model Code

SR23A-	□□	□	□－	□□	□	□	□	□	□

22—2 SV Parameters

SV No.	CH1	CH2
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Item	CH1	CH2
SV Limit_L		
SV Limit_H		
REM Bias		———
REM Filter		———
REM Sc_L		———
REM Sc_H		———
REM Track		———
REM Mode		———
REM Ratio		———
REM SQ.Root		———
REM Low Cut		———
REM PID		
RMP UP		
RMP Down		
RMP Unit		
RMP Ratio		

22－3 PID Parameters

OUT1 (CH1)

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

OUT2 (CH2)

PID No.	P	I	D	DF	MR/DB	SF	Zone	OUT2L	OUT2H
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

DF Mode

DF Mode	

Zone PID

Item	Setting value
Zone PID1	
Zone HYS1	
Zone PID2（CH2）	
Zone HYS2（CH2）	

Tuning

Item	CH1	CH2
Tuning		
Hunting		
AT Point		

22－4 EVENT/DO Parameters

Item	EV1	EV2	EV3	DO1	DO2	DO3	DO4	DO5
SP								
CH								
MD								
ACT								
DF								
IH								
DLY								
STEV								
Log MD								
SRC1								
GATE1								
SRC2								
GATE2								

Item	DO6	DO7	DO8	DO9	DO10	DO11	DO12	DO13
SP								
CH								
MD								
ACT								
DF								
IH								
DLY								
STEV								

22－5 DI/Options Parameters

Item	Setting value	CH SETTING
DI1		
DI2		
DI3		
DI4		
DI5		
DI6		
DI7		
DI8		
DI9		
DI10		
Ao1 MD		———
Ao1 L		———
Ao1 H		———
Ao2 MD		———
Ao2 L		———
Ao2 H		———

Item		Setting value
HBA		
HLA		
HBM		
HB		
COM	PROT	
	ADDR	
	BPS	
	MEM	
	DATA	
	PARI	
	STOP	
	DELY	
	CTRL	
	BCC	
	CMOD	

22－6 Control Output Parameters

<table>
<tr><th colspan="3">Item</th><th>OUT1</th><th>OUT2</th></tr>
<tr><td colspan="3">ACT</td><td></td><td></td></tr>
<tr><td colspan="3">STBY</td><td></td><td></td></tr>
<tr><td colspan="3">ERR</td><td></td><td></td></tr>
<tr><td colspan="3">Pot.ERR
(Basic function MS)</td><td></td><td></td></tr>
<tr><td colspan="3">CYC</td><td></td><td></td></tr>
<tr><td colspan="3">Rate Limiter</td><td></td><td></td></tr>
<tr><td rowspan="15">SERVO (Basic function MS)</td><td colspan="2">FB</td><td></td><td></td></tr>
<tr><td colspan="2">DB</td><td></td><td></td></tr>
<tr><td colspan="2">TIME</td><td></td><td></td></tr>
<tr><td colspan="2">BOOT</td><td></td><td></td></tr>
<tr><td rowspan="4">Calibration</td><td>MD</td><td></td><td></td></tr>
<tr><td>EXE</td><td></td><td></td></tr>
<tr><td>ZERO</td><td></td><td></td></tr>
<tr><td>SPAN</td><td></td><td></td></tr>
<tr><td rowspan="7">Preset</td><td>P1</td><td></td><td></td></tr>
<tr><td>P2</td><td></td><td></td></tr>
<tr><td>P3</td><td></td><td></td></tr>
<tr><td>P4</td><td></td><td></td></tr>
<tr><td>P5</td><td></td><td></td></tr>
<tr><td>P6</td><td></td><td></td></tr>
<tr><td>P7</td><td></td><td></td></tr>
</table>

22－7 Unit Measuring Range Parameters

2-input related, internal cascade related

Item		Setting value
2-IN (FUNC)	PV_MODE	
	SO_MODE	

Item		Setting value
CASCADE	Scale_L	
	Scale_H	
	FILTER	

Input settings

Item	CH1/INPUT1	CH2/INPUT2
PV Bias		
PV Filter		
PV Slope		
RANGE		
Sc_L		
Sc_H		
UNIT		
DP		
Figure		
CJ		
SQ. Root		
Low Cut		
PMD/MBIAS		

PMD setting value/Multi bias

PMD No.	CH1		CH2	
N	An	Bn	An	Bn
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

22－8 Lock, etc. Parameters

Item	Setting value
KLOCK	
OUTPUT	
IR COM	

23 SPECIFICATIONS

23－1 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 : SV No., OUT% graph, control output value, various parameter display
  128 x 32 dot matrix STN liquid crystal display (positive)
  with yellow-green LED backlight
- Lamp indication : 19 action statuses display. Light on or blinking when status is enabled.

STBY	Green	Blinks when control output is set to standby (STBY = ON)
RMP	Green	Blinks during execution of ramp control, and lights during ramp control is paused
MAN	Green	Blinks when control output is set to manual operation
REM	Green	Lights when remote setting (REM) is set in SV No. selection
EV1 to EV3	Orange	Lights when each EV acts
DO1 to DO5	Orange	Lights when each DO acts
EXT	Green	Lights when SV No. can be selected by external switch
COM	Green	Lights when communication mode is ON
AT	Green	Blinks during execution of auto tuning or lights during holding of auto tuning
CH2	Green	Lights when CH2 PV and SV are displayed
PV	Green	Lights when CH1 PV and CH2 PV (7-segment LED in LED display) are displayed

■ Other than basic function MS

OUT1	Green	Control output (1-output side)
OUT2	Green	Control output (2-output/CH2 side)

■ Basic function (MS)

OPEN	Green	Servo output (open side)
CLOSE	Green	Servo output (close side)

- Display accuracy ±(0.1% + 1 digit) of measuring range (See Measuring Range Code Table for individual ranges.)

TC input	Internal cold junction temperature compensation ±(0.1% FS + 1 digit + 1°C) External cold junction temperature compensation ± (0.1% FS + 1 digit)
Pt input	±(0.1% FS + 1digit + 0.1°C)
mV, V input	±(0.1% FS + 1 digit)
mA input	±(0.1% FS + 1 digit) Depends on accuracy of externally attached resistor

- 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 s (100 ms)

23－2 Setting

- Local setting : By 10 front panel key switches
  - Setting range : Same as the measuring range of input type
  - Multi-SV value setting : Up to 10 points (SV1 to SV10) settable
  - Multi-SV value selection : Front panel key switches or external control input (binary code) (when DI option is selected)
- Remote setting input By external analog signals, not insulated (standard)/insulated (optional)
  Remote setting is alternative of heater break alarm.
  - Setting accuracy : ±(0.1% FS + 1 digit)
  - Setting signal : Select from following 3 types (specified when placing order)

Signal type	Input resistance
0 to 10V DC	570kΩ
1 to 5V DC	600kΩ
4 to 20mA DC	250Ω

  - Sampling cycle : 0.2 s (100 ms)
  - Remote scaling : Possible within measuring range (reverse scaling possible)
  - Remote bias : ±10000 digits
  - Remote filter : OFF, 1 to 300 s
  - Remote square root Low cut range: 0.0 to 5.0% FS (at mV, V)
  - Remote ratio : 0.001 to 30.000
  - Local/remote switching : Front panel key switches or external control input
  - Direct tracking function : Remote set value switchable to local set value by bumpless transfers
- Ramp control : Increment/decrement ramp control
  - Ramp value setting range : Ascending/descending individual setting
    OFF, 1 to 10000 digit/m or s (when multiplier = 1)
    OFF, 0.1 to 1000.0 digit/m or s (when multiplier = 0.1)
  - Ramp unit time : digit/s, digit/m
  - Ramp unit multiplier : x 1, x 0.1
- Higher/lower limit setting limiter : Any value set within measuring range (lower limit < higher limit)
- Remote insulation : Selectable with or without (specified when placing order)
  In insulation specification, insulated from other inputs and outputs (dielectric strength: 500 V AC for 1 m)

23—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)} AuFe-Cr (Kelvin scale).
  For details, see Measuring Range Code Table.
  - Display range : ±10% of measuring range (not lower than -273.15°C)
  - Allowable range of external resistance : 100Ω max.
  - Input resistance : 500kΩ min.
  - 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 -240°C)
  - Lead wire tolerable resistance: 10Ω max. per wire (value for all 3 wires must be equal)
  - Amperage : Approx. 1 mA
- Voltage (mV, V)
  - Input types : -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 : 500kΩ min.
- Current (mA)
  - Input type : 4 to 20, 0 to 20 mA: Universal-input and programmable scaling by receiving resistance to 0 to 5, 1 to 5 V inputs
    Universal-input, programmable scaling
  - Receiving resistance : 250Ω by external resistance
- Common functions
  - Sampling cycle : 0.1 s (100 ms)
  - PV bias : ±10000 digits
  - PV slope : Input value x 0.500 to 1.500
  - PV filter : OFF, 1 to 100 s
- Input operation : Possible with voltage or current input
  - Square root extraction Operation : Low cut range 0.0 to 5.0% FS
  - Multi-bias function : Linear input: Linearizer, PV-MBIAS (PV), PV-MBIAS (SV), RSV-MBIAS (SV)
    : Sensor input: PV-MBIAS (PV), PV-MBIAS (SV), RSV-MBIAS (SV)
    Bias Zone: 10 Segments (11-point setting)
    Bias value setting range: ±10,000 digits
- Isolation : Isolated from other inputs and outputs (dielectric strength: 500 V AC for 1 m)

23－4 Control

23-4-1 Basic functions SS, SD, DL, DC, DS, DD (standard output specification)

・Control output	: 1-output specification, 2-output specification In independent 2-channel control (CH1, CH2) specification, control output 2 is the output on CH2 side.
・Control system	: Expert PID control with auto tuning, self tuning functions (common to Control Output 1 and 2)
Multi-PID	: By PID Nos. 01 to 10 (10 types) Individual PID set on each SV No. (and remote SV)
Zone PID	: Selectable between individual PID and zone PID (10 zones max.)
Proportional band (P)	: OFF, 0.1 to 999.9% (OFF: ON-OFF action)
Integral time (I)	: OFF, 1 to 6000 s (OFF: P or PD control)
Derivative time (D)	: OFF, 1 to 3600 s (OFF: P or PI control)
Manual reset (MR)	: -50.0 to 50.0% (enabled when I = OFF)
Dead band (DB)	: -19999 to 20000 digits (Control Output 2 in 1-loop/2-out specification)
Hysteresis mode	: Select from the 3 modes below Center mode, SV OFF mode, SV ON mode
Hysteresis (DF)	: 1 to 9999 digits (enabled when P = OFF)
Self tuning	: Selectable from Auto tuning or self tuning, by step response system
Proportional cycle	: 1 to 120 s (at contact or SSR drive voltage output)
・Control output type/rating (common to Control Outputs 1 and 2)	
: Contact output (Y)	: contact (1c), 240 AC/2.5 A, resistive load, 1A inductive load
Current output (I)	: 4 to 20 mA DC, Load resistance: 600Ω max.
SSR drive voltage(P)	: 12 V ± 1.5 V DC, Load current: 30 mA max.
Voltage output (V)	: 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 updating cycle	: 0.1 s (100 ms)
・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. and Control Outputs 1 and 2)
Setting range	: 0.0 to 100.0% (lower limit < higher limit)
・Output rate-of-change Limiter	: OFF, 0.1 to 100.0%/seconds (set individually for Control Outputs 1 and 2)
・Control output at error	: 0.0 to 100.0% (set individually for Control Output 1 and 2)
・Control output at standby	: 0.0 to 100.0% (set individually for Control Output 1 and 2)
・Manual control	
Auto/manual switching	: Balanceless/bumpless transfers (simultaneous for Control Outputs 1 and 2)
Output setting range	: 0.0 to 100.0% (set individually for Control Outputs 1 and 2)
Setting resolution	: 0.1%
・Isolation	: Insulated between Control Output and various I/O, or Control Output and the system Not insulated between I, P and V of Control Outputs 1 and 2

23-4-2 Basic function MS (servo output specification)

· Control system	: Expert PID control with auto tuning, self tuning functions
Multi-PID	: By PID Nos. 01 to 10 (10 types) Individual PID set on each SV No. (and remote SV)
Zone PID	: Selectable between individual PID and zone PID (10 zones max.)
Proportional band (P)	: OFF, 0.1 to 999.9% (OFF: ON-OFF action)
Integral time (I)	: OFF, 1 to 6000 s (OFF: P or PD control)
Derivative time (D)	: OFF, 1 to 3600 s (OFF: P or PI control)
Manual reset (MR)	: -50.0 to 50.0% (enabled when I = OFF)
Self tuning	: Selectable from Auto tuning or self tuning, by step response system
· Operation/output updating cycle	: 0.1 s (100 ms)
· Control output characteristics	: Reverse (for heating)/Direct (for cooling), Control Outputs 1 and 2 set individually (heating/cooling, 2-stage4 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. and Control Outputs 1 and 2)
Setting range	: 0.0 to 100.0% (lower limit < higher limit)
· Output rate-of-change limiter	: OFF, 0.1 to 100.0%/seconds (set individually for Control Outputs 1 and 2)
· Control output	: Output for servo actuator drive Support for both feedback potentiometer with/without
· Control output type/rating	: Contact output (R): 240 V AC 2A Contact output (Y): 240V AC 2A, built-in CR absorber
· Output updating cycle	: 50 ms
· Control output at error	: Stop, Preset (0 to 100%) (with feedback potentiometer) Stop, Close, Open (without feedback potentiometer)
· Control output at standby	: 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	: By front key switch MAN
Manual output	: Open/Close output
· Position display	: 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 mode	: Select from the 3 modes below Center mode, SV OFF mode, SV ON mode
· Hysteresis	: One fourth (1/4) of dead band (DB) When DB is equal to or lower than 1.2%, fixed to 0.3%.
· Feedback potentiometer	: 100Ω to 2kΩ/3 wire system
· Isolation	: Insulated between Control Output and various I/O, or Control Output and the system

23－5 Event Output

・Number of outputs		: 3 points in total EV1 to EV3
・Output rating		: 240V AC/1.0 A resistive load, common to contact outputs (normally open contacts)
・Output updating cycle		: 0.1 s (100 ms)
・Setting/selection		: Individual setting (individual output), selectable from 23 types (to designate output) Assigned to either CH1 or CH2 for independent 2-channel control or internal cascade control specifications
・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 absolute value alarm
	7) PV Low	: PV lower limit absolute value alarm
	8) SV Hi	: SV higher limit absolute value alarm
	9) SV Low	: SV lower limit absolute value alarm
	10) AT	: ON during execution of auto tuning
	11) MAN	: ON during manual control operation
	12) REM	: ON while remote SV is in action
	13) RMP	: ON while ramp control is in action
	14) STBY	: ON while control is out of action
	15) SO	: ON when PV and REM scale over error occurs
	16) PV SO	: ON when PV scale over error occurs
	17) REM SO	: ON when REM scale over error occurs
	18) LOGIC	: ON during logic operation output by DI or communication
	■ Other than basic function MS	
	19) HBA	: ON during heater break alarm action
	20) HLA	: ON during heater loop alarm action
	■ Basic function (MS)	
	21) Posi.H	: Position higher limit absolute value alarm
	22) Posi.L	: Position lower limit absolute value alarm
	23) POT.ER	: Feedback potentiometer error
・Setting range		: DEV Hi, Low: -25000 to 25000 digits
	DEV Out, In	0 to 25000 digit
	PV	Within measuring range
	SV Hi, Low	SV Hi, Low: Within the setting range of SV
	Pogi.H,L	Pogi.H,L 0 to 100%
Hysteresis		: 1 to 9999 digit (when DEV, PV or SV is selected)
Action delay time		: OFF, 1 to 9999 s (when DEV, PV or SV is selected)
Standby action		: Selectable from 4 types (when DEV, PV or SV is selected) OFF No standby action 1) At power ON, or at STBY ON → OFF 2) At power ON, or at STBY ON → OFF or when 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

23−6 External Control Output (DO)

- Number of outputs : 13 or 9 points in total; standard 5, and 8 or 4 can be added optionally
  - DO1 to DO3 : Darlington open collector output 3 points
  - DO4 to DO5 Open collector output 2 points
  - DO6 to DO9 Open collector output 4 points (optional)
  - D10 to D13 Open collector output 4 points (basic functions SS, SD optional)
- Output rating
  - : Open collector output : 24 V DC/8 mA max., ON voltage 0.8 V or lower
  - Darlington open collector output: 24 VDC/50 mA max., ON voltage 1.5 V or lower
- Output updating cycle : 0.1 s (100 ms)
- Setting/selection : Individual setting (individual output), selectable from 24 types
  Assigned to either CH1 or CH2 for independent 2-channel control or internal cascade control specifications
- 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 absolute value alarm
  7) PV Low : PV lower limit absolute value alarm
  8) SV Hi : SV higher limit absolute value alarm
  9) SV Low : SV lower limit absolute value alarm
  10) AT : ON during execution of auto tuning
  11) MAN : ON during manual control operation
  12) REM : ON while remote SV is in action
  13) RMP : ON while ramp control is in action
  14) STBY : ON while control is out of action
  15) SO : ON when PV and REM scale over error occurs
  16) PV SO : ON when PV scale over error occurs
  17) REM SO : ON when REM scale over error occurs
  18) LOGIC : ON during logic operation output by DI or communication
  19) Direct : ON during Direct output by communication (can be optionally equipped for communication)

  ■ Other than basic function MS
  20) HBA : ON during heater break alarm action
  21) HLA : ON during heater loop alarm action

  ■ Basic function (MS)
  22) Posi.H : Position higher limit absolute value alarm
  23) Posi.L : Position lower limit absolute value alarm
  24) POT.ER : Feedback potentiometer error

  Details are the same as those for event outputs.
  Details of setting range, hysteresis, action delay time and standby action are the same as those for event outputs.
- Output characteristics switching : Selectable between normally open and normally closed
- Isolation : Insulated between DO and various I/O, or DO and the system
  Not insulated between DOs

23－7 Digital 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 s (100 ms) or more
- Setting/selection : Individual setting (individual input), selectable
  Assigned to either CH1 or CH2 for independent 2-channel control or internal cascade control (CH1/CH2) specifications
  Input types:
  1) None : No action (no assignment)
  2) MAN : Switching of control output between auto/manual
  3) REM : Switching of remote SV action/local SV action
  4) AT : Execution/stop of auto tuning
  5) STBY : Switching of execution/standby of control action
  6) ACT : Switching of direct action (DA)/reverse action (RA) on Output 1 output characteristics
  7) ACT2 : Switching of direct action (DA)/reverse action (RA) on Output 2 characteristics
  8) Pause : Pause/restart of ramp control
  9) LOGIC : Occurrence of logic operation
  10) EXT_SV : Multi-SV switching by DI7 to DI10 (only when DI option is selected)
  ■ Basic function (MS)
  11) Preset1 : Assignable to servo preset DI2
  12) Preset2 : Assignable to servo preset DI2 and DI3
  13) Preset3 : Assignable to servo preset DI2 to DI4
- Isolation : Insulated between DI and various I/O, or DI and the system
  Not insulated between DIs.

23－8 Logic Operation Functions

- Number of logic operation outputs
  :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.
- Number of logic operation inputs: 10 external control input points, DI1 to DI10, can be assigned individually to source 1 and source 2.
- Input logic conversion : Input logic conversion possible individually on source 1 and source 2
  (EV1 to EV3, DO1 to DO3)
  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
- Logic operation (1) : Logic operation output by source 1 and source 2
  (EV1 to EV3, DO1 to DO3)
  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)
  1) Timer operation
  : OFF, 1 to 5000 s
  2) Counter operation
  : OFF, 1 to 5000 counts

23－9 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
2-loop control specification
1) 2-input, 1-loop specification
Input operation specified by 2 inputs (PV1, PV2)
MAX: Maximum value input of PV1 and PV2, 1-output/2-output control specification
MIN: Minimum 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: CH1-PV used as PV value
2) 2-input, internal cascade control specification
2-loop control specification by internal cascade control
3) 2-input, 2-channel specification
Independent 2-channel (2-loop) 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)

23－10 Setting the Heater Break Alarm

・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 : Heater break detection; Heater current setting current, when control output is ON
Heater loop error detection; Heater current setting current, when control output is OFF
Hysteresis at heater break or loop error detection; 0.2 A
Remote input cannot be used when heater break alarm is selected.

・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

Minimum time for action confirmation : 0.2 s (200 ms) 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 s (200 ms)
Minimum time for action Confirmation : 0.2 s (200 ms) or longer (regardless of whether control output is ON or OFF)

・Output : Assigned to EV/DO output
Output retention : Selectable between Lock mode and Real mode

・Isolation : Insulated from inputs and outputs other than those of the system

23−11 Analog Output

- Number of outputs : 2 max., Ao1, Ao2 individual setting, individual output
  Only Ao1 when sensor power supply (optional) is selected.
  Assigned to either CH1 or CH2 for independent 2-channel control or internal cascade control (CH1/CH2) specifications
- Output types (assignments): Selectable from 5 types
  1) PV : Measured value (measured value in execution) (CH1, CH2)
  2) SV : Set value (set value in execution) (CH1, CH2)
  3) DEV : Deviation value (measured value in execution - set value in execution) (CH1, CH2)
  4) OUT1 : Control Output 1
  5) OUT2 : Control Output 2 (in 2-output specification)
- 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 20 mA DC/load resistance 300Ω max.
- Output accuracy : ±0.1% FS (of indicated value)
- Output resolution : Approx. 1/14000
- Output updating cycle : 0.1 s (100 ms)
- Output scaling : PV, SV; within measuring range, DEV: within -100.0 to 100.0%
  OUT1, OUT2; Within 0.0 to 100.0% (reverse scaling available)
- Isolation : Insulated between analog outputs and various I/O, or analog outputs and the system
  Not insulated between Analog outputs (Ao1 and Ao2) or from P, I, V control output.

23−12 Sensor Power

- Number of outputs : 1
  Output from Analog Output 2 (Ao2) terminal
  When the sensor power supply is selected, Analog Output 2 (Ao2) is unusable.
- Output rating : 24 V DC ± 1 V/25 mA (max.)
- Isolation : Insulated from the system and various inputs

23−13 Infrared Communication

- Communication system : Direct communication with a PC is possible on the front of the panel via infrared communication adapter S5004 (sold separately) through USB connection.
- Number of connectable devices: 1
- Infrared communication specification
  Synchronization system: Start-stop synchronization
  Communication speed: 9600 bps (fixed)
  Data format : 7E1 (7-bit, even parity, 1 stop bit)
  Control code : STX_ETX_CR
  Checksum (BCC) : ADD (fixed)
  Communication code: ASCII code
- Communication protocol : Shimaden standard (extended) protocol

23－14 Communication

・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 (differs depending on connection conditions including the host)
・Synchronization system	: Start-stop synchronization
・Communication speed	: 2400, 4800, 9600, 19200 bps
・Communication (device) address	: 1 to 98
・Communication delay time	: 1 to 50 m/s
・Communication memory mode	: EEP, RAM, R_E
・Communication modes	: Selectable between COM1 and LOC
・Communication mode types	: Selectable between COM1 and COM2

・Communication protocol (1)	: SHIMADEN standard protocol
Data length	: 7-bit, 8-bit
Parity	: EVEN, ODD, NONE
Stop bit	: 1-bit, 2-bit
Control code	: STX_ETX_CR, STX_ETX_CRLF, @_: _CR
Checksum (BCC)	: ADD, ADD_two's cmp, XOR, None
Communication code	: ASCII code

・Communication protocol (2)	: MODBUS communication protocol
ASCII mode	: ASCII mode
Data length	: 7-bit (fixed)
Parity	: EVEN, ODD, NONE
Stop bit	: 1-bit, 2-bit
Control code	: CRLF
Error check	: LRC check
RTU mode: Binary mode	
Data length	: 8-bit (fixed)
Parity	: EVEN, ODD, NONE
Stop bit	: 1-bit, 2-bit
Control code	: None
Error check	: CRC check

・Function code	: 03H and 06H (Hex) supported for
1) 03H	: Read data
2) 06H	: Write data

23－15 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.
Over-voltage 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	: 16 VA max.
・Input noise removal ratio	: Normal mode 40 dB or more (50/60 Hz) Common mode 120 dB or more (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 terminal 500 V DC 20MΩ or more. Across power terminals and ground terminal 500 V DC 20MΩ or more.
・Dielectric strength	: Across I/O terminals and power terminal 2300 V AC for 1m. Across power terminals and ground terminal 1500 V AC for 1m.
・Protective structure	: Front operating panel only is dust-proof and drip-proof. (equivalent to IP66, NEMA4X)
・Case material	: PC resin molding (equivalent to UL94V-1)
・External dimensions	: (H x W x D): 96 x 96 x 111 mm (panel depth: 100 mm) Panel depth is 112 mm when terminal cover is installed.
・Mounting	: Imbedded in panel (using mounting fixtures)
・Thickness of usable panel	: 1.0 to 8.0 mm
・Size of panel cutout	: (H x W): 92 x 92 mm
・Weight	: 600 g max.

Temperature and Humidity Control Specialists

SHIMADEN CO., LTD.

https://www.shimaden.co.jp/

Head Office: 2-30-10 Kitamachi, Nerima-ku, Tokyo 179-0081 Japan
Phone: +81-3-3931-7891 Fax: +81-3-3931-3089 E-mail: exp-dept@shimaden.co.jp

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