

MAC 3 Series

Digital controller Instruction Manual

Thank you for purchasing SHIMAX product. Please check that the product is the one you ordered.
Please operate after you read the instruction manual and fully understand it.

[Notice]

Please ensure that this manual is given to the final user of the instrument.

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Preface

This instruction manual is intended for those who will be involved in wiring, installation, operation and routine maintenance of the MAC3.

This manual describes the care, installation, wiring, function, and proper procedures regarding the operation of MAC3.

Keep this manual on hand while using this device. Please follow the provided guidance.

1. Matters regarding safety

For matters regarding safety, potential damage to equipment and/or facilities and additional instructions are indicated as follows:

- This mark indicates hazardous conditions that could cause injury or death of personnel. Exercise extreme caution as indicated.

「 WARNING」

- This mark indicates hazardous conditions that could cause damage to equipment and/or facilities. Exercise extreme caution as indicated.

「 CAUTION」

- This mark indicates additional instructions and/or notes.

「NOTE」

「 WARNING」

MAC3 is designed for controlling temperature, humidity, and other physical subjects in general industrial facilities. It must not be used in any way that may adversely affect safety, health, or working conditions.

「 CAUTION」

To avoid damage to the connected equipment, facilities or the product itself due to a fault of this instrument, safety countermeasures must be taken before usage, such as proper installation of the fuse and the overheating protection device. No warranty, expressed or implied, is valid in the case of usage without having implemented proper safety countermeasures.

「 CAUTION」

- The □ mark on the plate affixed to the instrument:
On the terminal nameplate affixed to the case of your instrument, the □ mark is printed. This is to warn you of the risk of electrical shock which may result if the charger is touched while it is energized.
- The external power circuit connected to the power terminal of this instrument must have a means of turning off the power, such as a switch or breaker. Install the switch or breaker adjacent to the instrument in a position which allows it to be operated with ease, and with an indication that it is a means of turning off the power. Use a switch or breaker, which meets the requirements of IEC127.
- Fuse:
Since the instrument does not have a built-in fuse, do not forget to install a fuse in the power circuit to be connected to the power terminal. The fuse should be positioned between the switch or breaker and the instrument and should be attached to the L side of the power terminal.
Fuse Rating: 250V AC 0.5A/medium lagged or lagged type.
Use a fuse which meets the requirements of IEC127
- Load voltage/current to be connected to the output terminal and the alarm terminal should be within the rated range. Otherwise, the temperature will rise and shorten the life of the product and/or result in problems with the product.
- Voltage/current that differs from input specification should not be connected to the input terminal. It may shorten the life of the product and/or result in problems with the product.
- Input, output of voltage pulse, and output of electric current are not insulated. Therefore, do not ground an adjusted power terminal when a ground sensor is employed.
- A signal wire's common mode voltage to ground (signal wires other than contact output including power supply and event) should be less than 30V rms, 42.4V peak, and 60 VDC.

「 CAUTION」

- All the wires for the interior distribution, except for communication and contact output (including power supply and event), should be less than 30m in length. When the wire's length is 30m or more, or in the case of outdoor wiring, the suitable measure against a lightning surge is required.
- EMC standard (IEC61326) classifies MAC3 into Class A apparatus. Electromagnetic interference may occur when MAC3 is used at a business district or in the home. Please use after taking sufficient measures.

2. Introduction

2-1. Check before use

Before using MAC3, please check the model code, the exterior appearance and accessories. Also, make sure that there are no errors, impairs and shortages.

Confirmation of model code: Check that the product you ordered is being delivered properly.

Check the model code of the main body case against the following code table.

Example of model code

<u>MAC3A-</u>	<u>M</u>	<u>C</u>	<u>F-</u>	<u>E</u>	<u>C-</u>	<u>D</u>	<u>H</u>	<u>T</u>	<u>R</u>	<u>N</u>
1	2	3	4	5	6	7	8	9	10	11

Item

1. Series MAC3A-:96×96mm size digital controller
MAC3B-:48×96mm size digital controller
2. Input M:multi, V:voltage, I:current
3. Control Output 1 C:contact, S:voltage pulse, I:current(4~20mA)
4. Power Supply F-:90 - 264V AC, L-:21.6 - 26.4V DC/AC
5. Event Output N:none, E:Event Output 1 · 2 (two points)
6. Control Output 2 · Event Output · Optional Selection of DI
N:none, C-contact, S-voltage pulse, I-current (4~20mA)
E-: Event Output 3(one point), D-: external control input (DI4) one point
7. DI N:none, D: external control input (DI 1,2,3) three points
8. CT Input N: none, H: CT Input two points
9. Analog Output N: none, I: current (4~20mA)
10. Communication N: none, R: RS485
11. Program Function N: none, P: equipped

Example of model code

<u>MAC3D-</u>	<u>M</u>	<u>C</u>	<u>F-</u>	<u>E</u>	<u>C-</u>	<u>D</u>	<u>T</u>	<u>N</u>
1	2	3	4	5	6	7	8	9

Items

1. Series MAC3D-: 48×48mm size digital controller
2. Input M:multi, V: voltage, I:current
3. Control Output 1 C:contact, S:voltage pulse, I:current(4~20mA)
4. Power Supply F-:90 - 264V AC, L-:21.6 - 26.4V DC/AC
5. Event Output N:none, E:Event Output 1 · 2 (two points)
6. Control Output 2 · Event Output · Optional Selection of DI
N:none, C-contact, S-voltage pulse, I-current (4~20mA)
E-: Event Output 3(one point), D-: external control input (DI4) one point
7. DI · CT Input N: none, D: external control input (DI1,2,3) three points, H:CT Input two points
8. Analog Output · Communication N: none, T: current (4~20mA), R: RS485
9. Program Function N: none, P: equipped

Check of accessories

Instruction manual: 1 set

「NOTE」 : Please contact our agencies or business offices if you have any problem.
We welcome any kind of inquiry such as defect of the product, shortage of accessory and so on.

2-2. Caution for use

- (1) Do not operate the front panel keys with hard or sharp objects.
Do not fail to touch keys lightly with a fingertip.
- (2) Wipe gently with a dry rag and avoid using solvents such as thinner.

3. Installation and wiring

3-1. Installation site (environmental conditions)

「 CAUTION」

Do not use this product under the following conditions.
Otherwise, failure, damage and fire may occur.

- (1) Where flammable gas, corrosive gas, oil mist or dust generate or grow rife.
- (2) Where the temperature is below -10□ or above 55□.
- (3) Where the humidity is over 90%RH or where condensation occurs.
- (4) Where high vibration or impact occurs
- (5) Where inductive interference may easily affect the operation.
Or, in the region of strong electric circuit area.
- (6) Where waterdrops or direct sunlight exists.
- (7) Where the altitude is above 2,000m.

「NOTE」 : The environmental conditions comply with the IEC664.
Installation category is II and the pollution degree is 2.

3-2. Mounting

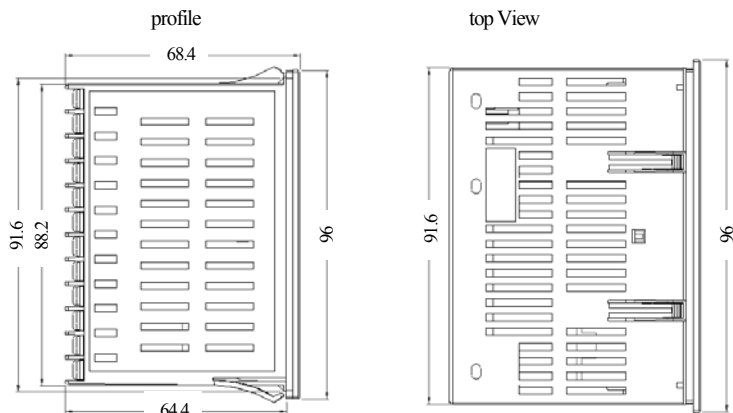
- (1) Machine the mounting hole by referring to the panel-cut illustration in Section 3-3.
- (2) Applicable thickness of the mounting panel is 1.2~2.8mm.
- (3) As this product provides mounting fixture, insert the product into the panel.

「NOTE」:MAC 3 is a panel set-up type.
Please use the product after setting up to the panel.

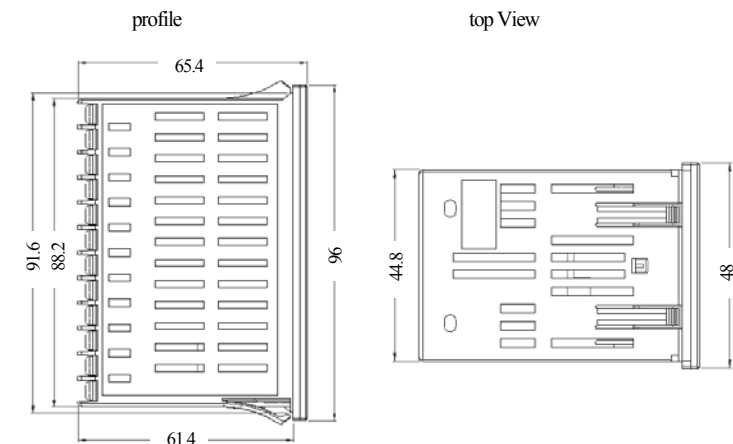
3-3. External dimension and panel cutout

MAC3 external dimensions (unit: mm)

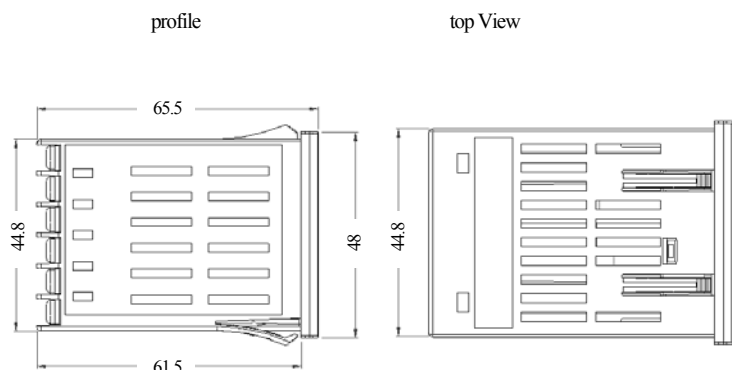
MAC3A (96×96 size)



MAC3B (48×96 size)

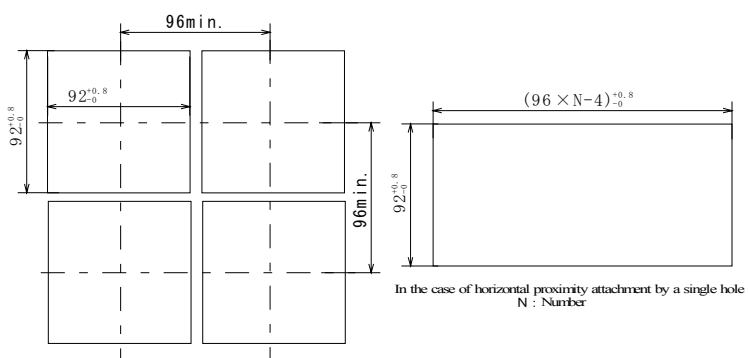


MAC3D (48×48 size)

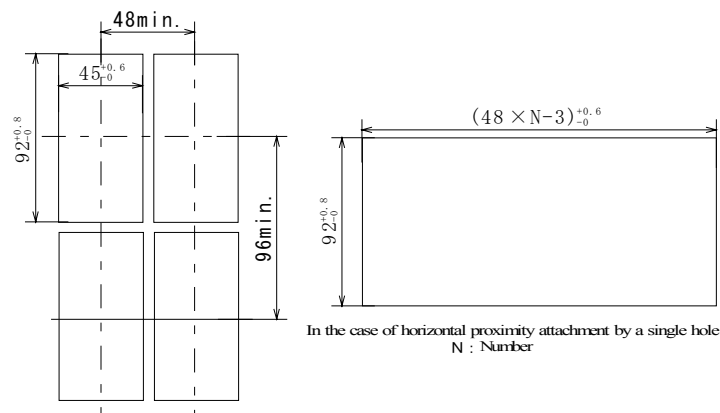


MAC3 panel cutout (unit: mm)

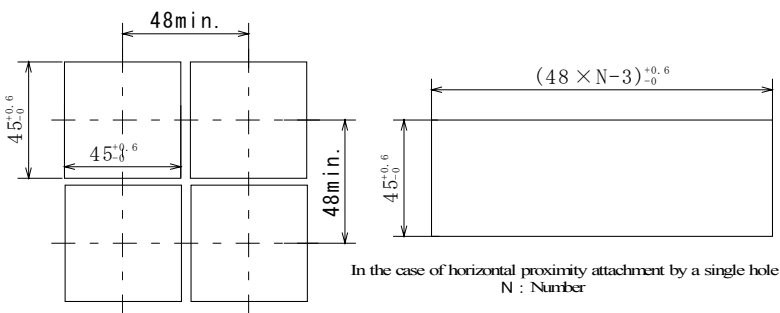
MAC3A (96×96 size)



MAC3B 48×96 size



MAC3D 48×48 size



Note: Proximity attachment by a single hole is possible only in the case of horizontal direction.

When an apparatus that was attached in vertical direction is removed, a dedicated detachment tool is required.

3-4. Wiring

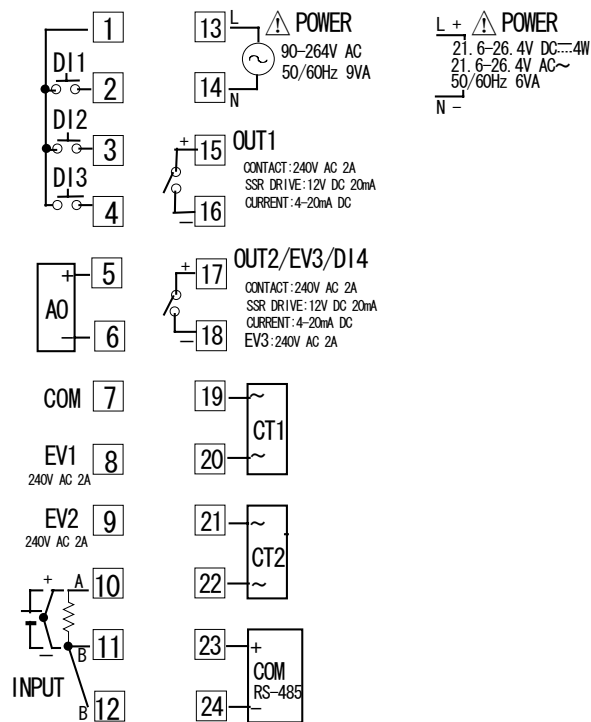
⚠ WARNING ⚠

- ⊙ Do not turn on electricity while wiring to avoid an electric shock.
- ⊙ Do not touch a terminal or live part while turning on electricity.

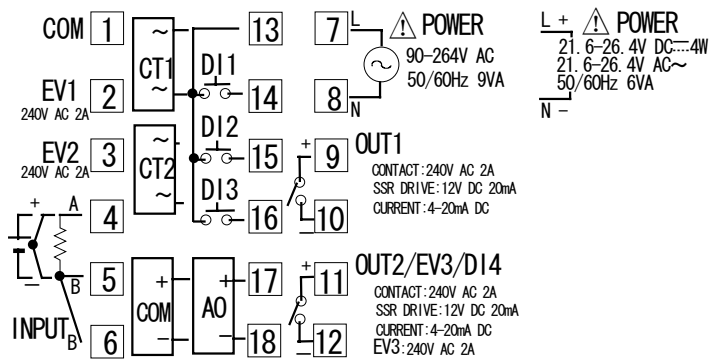
- (1) Make sure that wiring operation is properly done in line with a terminal wire diagram of section 3-5.
- (2) Choose a suitable compensation lead wire in the case of thermocouple input.
- (3) In the case of resistance bulb input, resistance value of each lead wire must be less than 5Ω and that of three lead wires must be equal.
- (4) Do not wire an input signal line inside of an electric wire pipe or a duct same with the high voltage line.
- (5) Shield wiring (single point grounding) is effective against static induction noise.
- (6) Wiring twisted at equal short intervals is effective against electromagnetic induction noise.

3-5. Terminal arrangement diagram

3-5. Terminal arrangement plan of MAC3A and MAC3B



「Note」 : If input type is thermocouple or voltage, errors may occur when terminal 11 and terminal 12 terminal are short-circuited

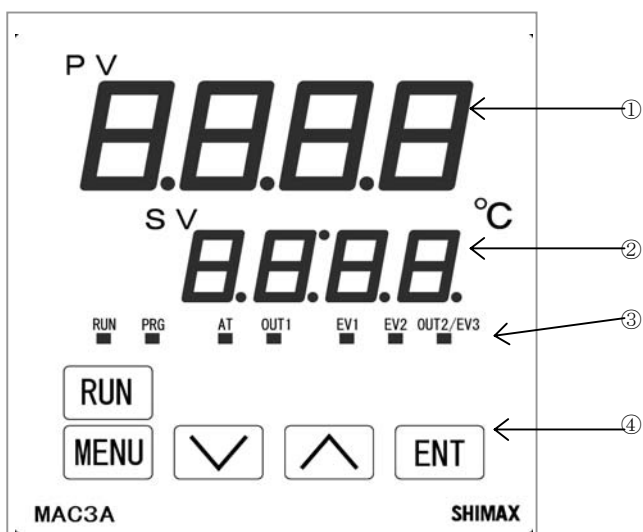


「Note」 : If input type is thermocouple or voltage, errors may occur when terminal 5 and terminal 6 terminal are short-circuited

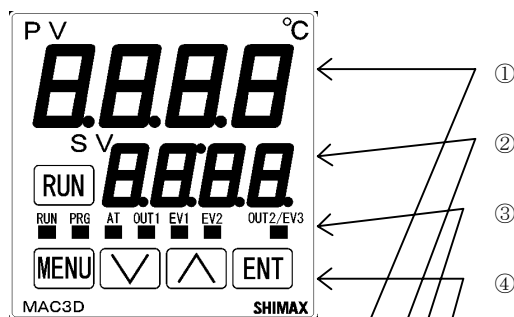
4. Description of front panel

4-1. Names of front panel.

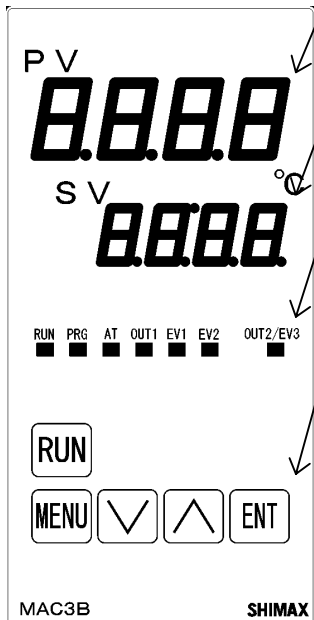
MAC3A 96×96 size front



MAC3D 48×48 size front



MAC3B 48×96 size front



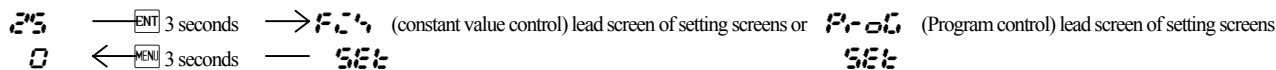
4-2. Explanation of front panel section

- ① : Display of measured value (PV) (red)
Measured value (PV) and type of setting is displayed on each setting screen.
- ② : Display of target value (SV) (green)
Target value and set value are displayed on each setting screen.
- ③ : Monitor LED
 - (1) RUN monitor LED RUN (green)
If RUN is performed with RUN key, operation mode1 screen, external control input (DI), and communication, it lights up, and put out by standby (reset). It blinks, if a manual output is chosen in output monitoring screen or external control input (DI).
 - (2) Program functional monitor LED PRG (green)
Lights up at the time of program control's standby or flat part control. Puts out at the time of FIX control selection.
 - (3) Auto tuning operation monitor LED AT (green)
If AT is chosen in ON or external control input (DI), blinks during AT execution. Lights up when AT is on standby, and puts out with AT automatic termination or release.
 - (4) control out put 1 monitor LED OUT (green)
At the time of a contact or a voltage pulse output, the it lights up with ON and lights off with OFF. Lights off with 0% power output, and lights up with 100% power. And blinks in intermediate ratio.
 - (5) Event output monitors LED EV1 and EV2 (yellow)
Lights up when the allotted event output turns to ON.
 - (6) Control out put 2/event output 3 monitors LED OUT2/EV3 (yellow)
When control output 2 is chosen, it operates like control output 1 monitor LED does. When event output 3 is chosen, it operates like event output monitor LED does.
- ④ : Key-switch section
 - (1) **MENU** (MENU)key
Press this key to move onto the next screen among the screens.
Press **MENU** (MENU) key for three seconds on the basic screen, then it jumps to the lead screen of Mode 1. Press **MENU** key for three seconds on the lead screen of each Mode screens, then it jumps to the basic screen.
Press **MENU** key for three seconds on the lead screen of FIX or PROG, then it jumps to the basic screen.
When a program control option is added, press **MENU**(MENU) key for three seconds on the screen of operation mode 2, then it jumps to the screen of operation Mode 1.
 - (2) **DOWN** (DOWN)key
Press **DOWN** (DOWN) key one time, and the shown value decreases by one numerical value.
One time press of **DOWN** key decreases by one numerical value. By pressing the key continuously, the value as well consecutively decreases. A decimal point of the smallest digit blinks at this time. This shows that a setting change is in progress.
In PROG, used as a shift key between each step setting screens(Steps 1-25), lead screen. Also used as a shift key between lead screen in each mode screens.
 - (3) **UP** (UP) key
Press **UP** (UP) key one time, and the shown value increases by one numerical value.
By pressing continuously, the value By pressing the key continuously, the value consecutively increases. A decimal point of the smallest digit blinks at this time. This shows that a setting change is in progress.
In PROG, used as a shift key between each step setting screens (Steps 1-25), lead screen. Also used as a shift key between lead screen in each mode screens.
 - (4) **ENT** (ENTRY/REGISTER)key
The setting data changed on each screen is determined (the decimal point of the minimum digit is also lighted off).
When a program control option is added, press **ENT** (ENT) key for three seconds on the screen of operation mode 1, then it jumps to the screen of operation Mode 2.
Press **ENT** key for 3 seconds on the output monitoring screen, then the shift between manual output and automatic output is carried out.
Press the key for 3 seconds on the basic screen, then it shifts to FIX or PROG head screen. Push at FIX-PROG and each mode screens' lead screen, then shifts to setting screen.
 - (5) **RUN** (RUN OPERATION/STOP)key
Push for 3 seconds at STBY (control stop), then FIX or PROG control starts.
Push for 3 seconds while FIX or PROG is in operation, then control is stopped.

5. Description of screens

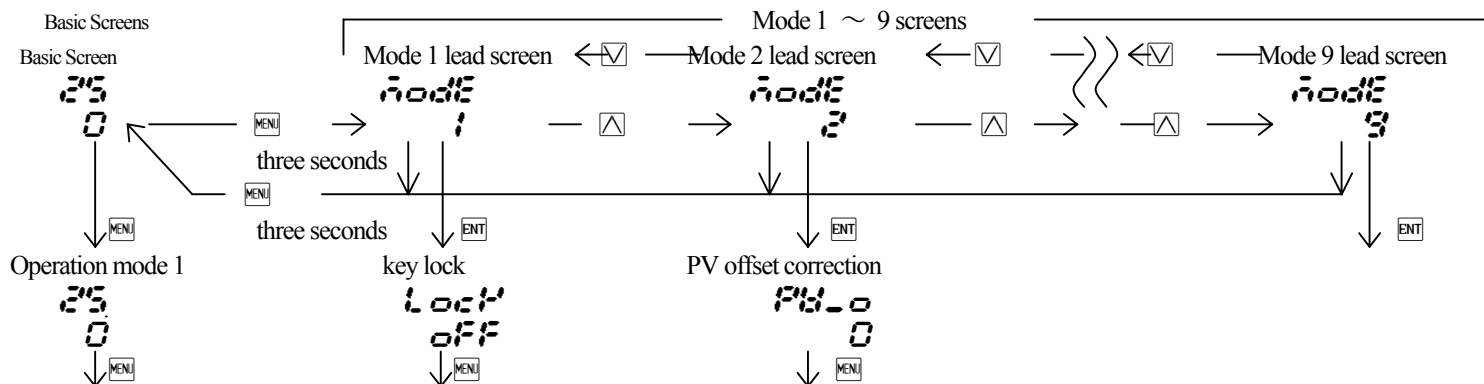
5-1. How to move to another screen

Basic Screen



Press the **ENT** key for 3 seconds on a basic screen, then it shifts to the lead screen of **FIX** (constant value control) setting screens, or to the lead screen of **PROG** (program control) setting screens.

Press the **MENU** key for 3 seconds on **FIX** or **PROG** the lead screen of setting screens, then it shifts to the basic screen. The shift is also possible when the program option is added and **FIX** is chosen on the operation mode 2 screen. The shift is possible when the program option is added and **PROG** is chosen on the operation mode 2 screen.



Every time you press the **MENU** key on a basic screen, it shifts to each screen of the basic screens.

Press the **MENU** key for 3 seconds on a basic screen, then it shifts to the lead screen of mode 1 screens.

Press the **Δ** key on the lead screen of mode 1 screens, then it further advances to mode 2, and mode 3. (Notes: If no corresponding option is found, the mode 4 - 9 is skipped)

Press the **∇** key on the lead screen of mode 1 screens, then it further advances to mode 9, and mode 8. (Notes: If no corresponding option is found, the mode 4 - 9 is skipped)

Press the **MENU** key for 3 seconds on the lead screen of mode 1 ~ 9 screens, then it shifts to the basic screen.

Press the **ENT** key on the lead screen of mode 1 ~ 9 screens, then it shifts to the first setting screen of each screens.

Press the **MENU** key on the first setting screen of each screens, then it shifts to the next screen. Every time you press the **MENU** key, it shifts to the next setting screen.

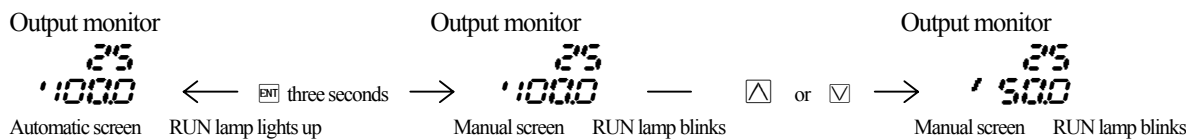
5-2. Setting Method

To change settings, display an appropriate screen and change the setting (value or function) by pressing **Δ** or **∇** key.

On the output monitor screen of basic screens, you can change the control output from "Automatic" to "manual", and save its change of setting. Display the output monitor screen, and then press **ENT** key for three seconds to shift from Automatic to Manual. Then by pressing **Δ** or **∇** key, you can adjust to the desirable output value. In this case, no need to press **ENT** key in order to determine the change of setting.

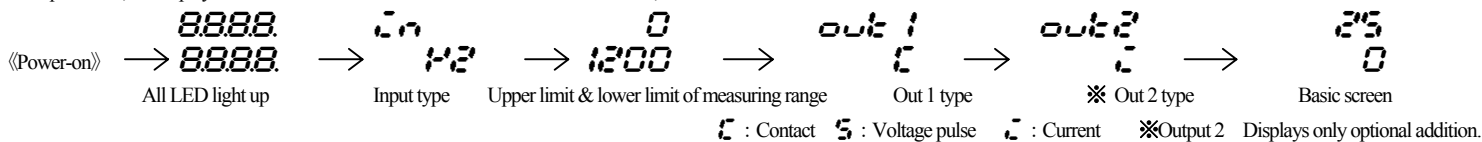
Press **ENT** key for three seconds as well to shift back to Automatic. Excluding when a keylock is OFF, Automatic⇔Manual switchover does not work while STBY<RST> and AT are in operation.

In the case of two-output type, the switchover between automatic and manual is operatable through output 1 and output 2. The setting is altered simultaneously.



5-3. Power-on and initial screen display

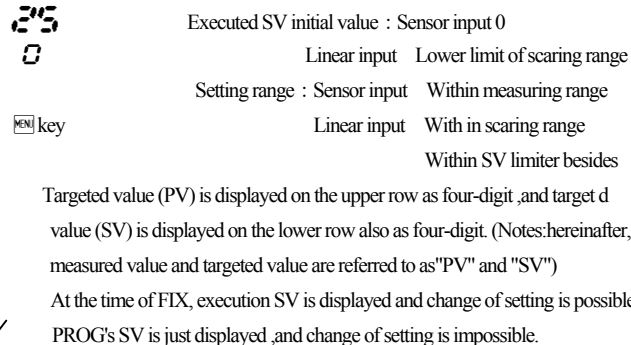
At power-on, the display section shows each screen of initial screens for one second, then moves on to the basic screen.



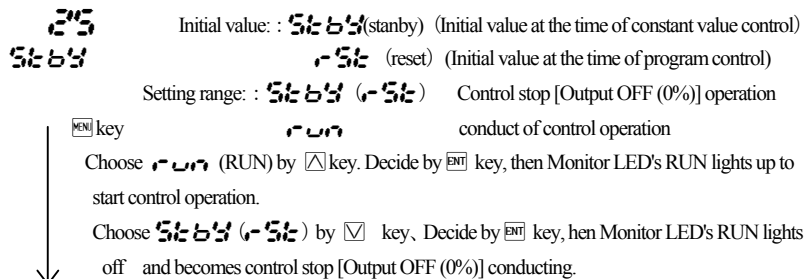
5-4. Explanation of each screen

(1) Basic Screens

Basic Screen



Action Mode 1 screen



Priority is given to DI when RUN is allotted to external control input. DI. Key operation cannot be performed unless allotment is canceled.

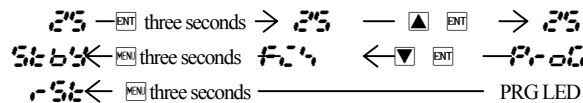
When measuring range, a unit, scaling, and output characteristics are changed it is initialized and **Stb's (r-st)** is displayed.

Press **ENT** key for 3 seconds, then it shifts to Action mode2 screen, when the program control option is added on this screen, **FIX** (constant value control) ←→ **PROG** (program control) switchover is possible choose.

Choose a program, then Monitor LED's PRG lights up.

Action mode1 screen

Action mode2 screen



Press **MENU** key for 3 seconds on Action mode2 screen, then it returns to Action mode1 screen.

Action mode2 screen is not displayed without a program option.

When PROG is allotted to DI, DI is given priority. Key operation cannot be performed unless allotment is canceled.

Press **MENU** key on Action mode1 screen, then it shifts to output 1 monitoring screen.

Output 1 monitoring screen

25 manual output setting range: :0.0-100.0% (within output limiter)
 1000 At the time of automatic output,monitor display only.
 [MEN] key Refer to Item 5-2 about automatic ↔ manual switchover,and setting method at the time of manual operation.
 A manual output is canceled when an operation mode is made into **Stby (rSt)**.
 When a power source is intercepted and re-switched on, it returns to the condition just before intercepting.
 When **Prog** is allotted to DI, DI is given priority. Automatic ma ↔ manual switchover is not performed with key operation,and only the output value at the time of manual operation can be changed.

Output 2 monitoring screen

25
 1000 Contents are the same with that of an output 1.
 [MEN] key Output 2 monitoring screen displays only when output 2 option is added.

CT1 current monitoring-screen

25 Current display range: 0.0-55.0A
 500 Displays at the time of CT input option addition, and the current value detected by CT sensor is displayed.
 [MEN] key Current value is displayed.

CT2 current monitoring screen

25
 300 Contents are the same with that of an output 1.
 [MEN] key

Monitoring screen of step's remaining time period

25
 99:59 Displays while program is in operation if program option is added.
 [MEN] key Step No in progress and remaining time are displayed by turns.
 (In ∞ setting, step No and ∞ are displayed by turns)
 A remaining time and an elapsed time is switchable by pressing the [ENT] key for 3 seconds. (Switchover is interlocked with the number of times of next screen pattern.)
 Decimal point of the minimum digit lights up in displaying elapsed time,
 This screen is not displayed without a program option.Not displayed in the state of program RST and FIX neither.

Monitoring screen for the remaining repeating time of pattern

25
 9999 Being displayed while program is in operation, when the program option is added,
 On-going step No and the remaining repeating time of pattern are displayed by turns.
 [MEN] key (In ∞ setting, step No and ∞ are displayed by turns)
 A remaining time and actually performed times are switchable by pressing the [ENT] key for 3 seconds. (Switchover is interlocked with front screen step time.)
 The decimal point of the minimum digit lights up when actually performed times being displayed.
 This screen is not displayed without a program option.Not displayed in the state of Program RST and FIX neither.

PID No monitoring screen

25
 P2_1 Chosen PID No is displayed when FIX is in operation.
 PID No chosen at each step and on-going step No are displayed by turns when PROG is in operation.
 [MEN] key is in operation.
 PID No of output 1 is displayed in the first digital, and PID No of output 2 is displayed in the third digital. The third digital is shown as _ when there is no output 2 option.
 This screen is not displayed in the state of STBY (RST).

HOLD (temporary stopping) execution screen

Hold Initial value: : off
 off Setting range: : off, on
 While HOLD is executed, on the basic screen,SV value and **Hold** is displayed by turns .
 If switched **on** while PROG is in operation , the operation temporary stops with as of then step time and SV value. While HOLD is in execution , SV value and **Hold** is displayed by turns in basic screen .
 HOLD is used in order to perform AT in the middle of an inclination step or to compensate the insufficient time of flat step.
 Controls is performed with SV value at the time of stopping,while HOLD is in execution
 HOLD is canceled if **off** is chosen while HOLD is in execution. The remaining time of the step is performed based on a program.

SKIP (skip)is unable to perform while HOLD is in execution.

When **Hold** is allotted to DI, DI is given priority.

Execution and release of HOLD with key operation is unable to perform.

This screen is not displayed without a program option.Not displayed in the state of program

rSt and FIX neither.

SKIP (skip) execution screen

SKIP Initial value: : off
 off Setting range: : off, on
 SKIP (skip) is the function that makes to end the on-going step compulsorily, and is to shift to the following step. The next step starts instantly, if performed.
 When SKIP is continuously performed, about 1 second interval is required from execution to the next one.
 Even if SKIP is allotted to DI, execution is able to perform with DI and key operation.
 [MEN] key SKIP cannot be performed while HOLD is in operation.
 This screen is not displayed without a program option. Not displayed in the state of program **rSt** and FIX neither.

AT (Auto Tuning) execution screen

AT Initial value: : off
 off Setting range: : off, on
 [MEN] key
 AT is performed by ON selection ,and canceled by OFF selection.
 Not displayed at the time of STBY(RST), a manual output, and P(proportional band)=OFF.
 Except in the setting of keylock OFF, AT is unable to perform in scale over.
 (At the time of DI allotment,execution of AT by DI can be performed.)
 Even in such a case,halway release is performed on this screen.
 Release of AT, STBY(RST), EV operating point, setting of keylock, and mode 5 ~ 9screen are operateable with key.
 Except in th setting of AT normal end, execution of AT is canceled compulsorily at the time of STBY(RST) selection and AT release setup.

EV1 (event 1) operating-point setting screen

EV1 Initial value: upper limit absolute value measuring range Scaling upper limit
 1200 lower limit absolute value measuring range Scaling lower limit
 upper limit deviation 2000
 [MEN] key lower limit deviation -1999
 within deviation 0
 outside deviation 2000
 CT1 or CT2 00
 guarantee 0
 Setting range: upper limit absolute value within measuring range within scaling limit
 lower limit absolute value within measuring range within scaling limit
 upper limit deviation -1999~2000 unit
 lower limit deviation -1999~2000 unit
 within upper-lower limit deviation 0~2000 unit
 outside upper-lower limit deviation 0~2000 unit
 CT1 or CT2 0~500 A
 The operating point of the alarm type allotted to EV1 is set up.
 No option, No display when **non, So, run, StP, PLE, End, Hold, ProG, dLSL**, and **uLSL** are allotted to EV1.
 The operation mode of each deviation alarm is **run**.
 Effective at the time of automatic output.
 Each deviation alarm serves as PV's deviation to Execution SV.
 Event operation other than each deviation alarm is always effective.

EV2 (event 2) operating-point setting screen

EV2 Initial value,setting range, contents are the same with EV1
 0
 [MEN] key

EV3 (event 3) operating-point setting screen

EV3 Initial value,setting range, contents are the same with EV1
 0
 [MEN] key
 When EV3 option is added, event 3 is displayed as the same contents with EV 1 and 2, irrespective of EV 1 and 2.

Latching release screen

L Rch Initial value: : **r-Set 1**
r-Set 1 Setting range: : **r-Set 1** release EV1
r-Set 2 release EV2
r-Set 3 release EV3
ALL release all EVs at a time

ENT key

On the latching setting screen of each EV mode, **r-Set** No. and **ALL** which chose **on** are displayed. If latching is **on**, once EV is outputted, EV output state is maintained even if EV is in the state of OFF. When EV is in a latching state, decimal point of the minimum digit blinks, and it shows that release of EV is possible. If **ENT** key is pressed, EV is released and a decimal point lights off.

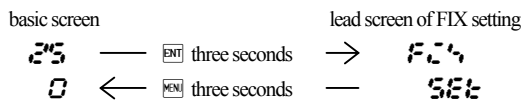
However, release is impossible when a state is in EV power range.

Return to basic screen

(2) FIX (constant value control) setting screens

At the time of no program option and with program option and **FIX** is chosen on Action mode2 screen of basic screens, lead screen of FIX setting screens is displayed when **ENT** key is pressed for 3 seconds.

If **ENT** key is pressed for 3 seconds on lead screen, it returns to basic screen.



FIX lead screen

FIX
SET No setting on this screen.
ENT key Press **ENT** key, then it shifts to the first setting screen SV1 setting screen.

SV1 setting screen

SV1 Initial value: At the time of sensor input 0
0 linear input time scaling lower limit
 Setting range: sensor input time within measuring range
ENT key linear input time within scaling range
 Moreover, within limit of SV limiter.
 When SV1 is Execution SV, being reflected in basic screen.
 Being initialized when measuring range, unit, and scaling are changed.

SV1 output1 PIDNo. setting screen

10 Initial value: 1
1 Setting range: 1, 2, 3
ENT key When SV1 is Execution SV, PIDNo. that will be used for control of output 1 is chosen from 1~3.

SV1 output2 PIDNo. setting screen

102 Initial value: 1
1 Setting range: 1, 2, 3
ENT key When SV1 is Execution SV, PIDNo. that will be used for control of output 2 is chosen from 1~3.
 Displayed when output 2 option is added.

SV2 setting screen

SV2 Initial value: same with SV1
0 Setting range: same with SV1
ENT key
 Displayed when SV2 is allotted to DI. When terminal of allotted DI short-circuits, it becomes Execution SV.
 When SV2 is Execution SV, it is reflected in basic screen.
 Being initialized when measuring range, unit, and scaling are changed.

SV2 output 1 PIDNo. setting screen

20 Initial value: 1
1 Setting range: 1, 2, 3
ENT key Displayed when SV2 is allotted to DI.
ENT key When SV2 is Execution SV, PIDNo. that will be used for control of output 1 is chosen from 1~3.

SV2 output 2 PIDNo. setting screen

202 Initial value: 1
1 Setting range: 1, 2, 3
ENT key Displayed when SV2 is allotted to DI.
 When SV2 is Execution SV, PIDNo. that will be used for control of output 2 is chosen from 1~3.
 Displayed when output 2 option is added.

SV3 setting screen

SV3 Initial value: same with SV1
0 Setting range: same with SV1
ENT key Displayed when SV3 is allotted to DI. When terminal of allotted DI short-circuits, it becomes Execution SV.
 When SV3 is Execution SV, it is reflected in basic screen.
 Being initialized when measuring range, unit, and scaling are changed.

SV3 output 1 PIDNo. setting screen

30 Initial value: 1
1 Setting range: 1, 2, 3
ENT key Displayed when SV3 is allotted to DI.
 When SV3 is Execution SV, PIDNo. that will be used for control of output 1 is chosen from 1~3.

SV3 output 2 PIDNo. setting screen

302 Initial value: 1
1 Setting range: 1, 2, 3
ENT key Displayed when SV3 is allotted to DI.
 When SV3 is Execution SV, PIDNo. that will be used for control of output 2 is chosen from 1~3.
 Displayed when output 2 option is added.

SV4 setting screen

SV4 Initial value: same with SV1
0 Setting range: same with SV1
ENT key Displayed when SV4 is allotted to DI.
 When terminal of allotted DI short-circuits, it becomes Execution SV.
 When SV4 is Execution SV, it is reflected in basic screen.
 Being initialized when measuring range, unit, and scaling are changed.

SV4 output 1 PIDNo. setting screen

40 Initial value: 1
1 Setting range: 1, 2, 3
ENT key Displayed when SV4 is allotted to DI.
 When SV4 is Execution SV, PIDNo. that will be used for control of output 1 is chosen from 1~3.

SV4 output 2 PIDNo. setting screen

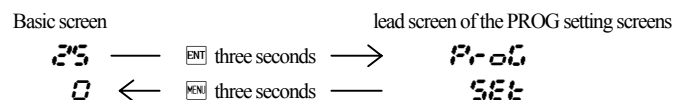
402 Initial value: 1
1 Setting range: 1, 2, 3
ENT key Displayed when SV4 is allotted to DI.
 When SV4 is Execution SV, PIDNo. that will be used for control of output 2 is chosen from 1~3.
 Displayed when output 2 option is added.

Return to FIX lead screen

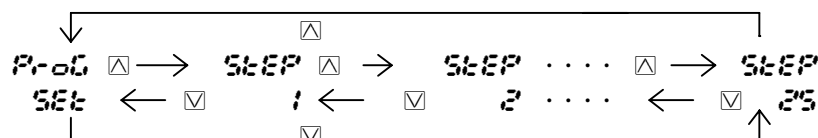
(3) PROG (program control) setting screens

Press **ENT** key for 3 seconds, lead screen of the PROG setting screens is displayed, When program option is added and **PROG** is chosen on Action mode2 screen of basic screens.

If **ENT** key is pressed for 3 seconds on lead screen, it returns to basic screen.



With **△**, **▽** key, it is possible to shift between 2 (24), PROG and step No. 1 ~ 25 lead screen.



Program basic setting screens

Program basic setting screens Lead screen

Prog No setting on this screen
Set Press Δ key to shift to step 1 lead screen.
 Press ∇ key to shift to step 25 lead screen.
 ENT key Press ENT key to shift to the first setting screen start mode setting screen.

Start mode setting screen

S-nd Initial value: **PV** (PV)
SV Setting range: **SV** (SV), **PV**
 This setting screen can decide if the start set point of program control should be PV, or should be the start SV which is set on the next screen.
 MEN key When PV is chosen, and when PV is closer to the set point of Step1 than start wasting SV,time is omissible.

Start SV setting screen

StSV Initial value : At the type of sensor input 0
0 linear input type scaling lower limit
 MEN key Setting range: sensor input type within measuring range
 linear input type within scaling range
 Moreover, within limit of SV limiter.
 When SV is chosen on start mode setting screen, this screen's set value becomes start set point.
 The basic screen SV display at the time of Program RST is the value set on this screen.

Termination step setting screen

End Initial value: 9
3 Setting range: 1~25 step
 MEN key Pattern termination step No of program control is set.

Number of execution Setting screen for repeating of program pattern

Pat Initial value: 1
1 Setting range: 1~9999 times, ∞
 MEN key The number of execution of a program pattern is set.

Time unit setting screen

t-Unit Initial value: **mm** : **SS** (minute:second)
mm : **SS** Setting range: **mm** : **SS**, **HH** : **mm**, **HH:MM**
 MEN key This decides if unit of the execution time set up at each step is minute:
 second ,hour: minute, or hour.

To program basic setting screens Lead screen

About PV start

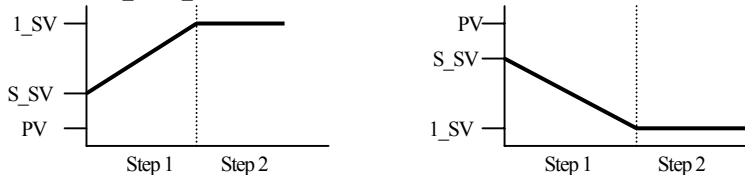
In start mode, when PV is chosen, and when PV is closer to the set point of Step1 than start SV, wasting time is omissible.

「example」 : PV at the time of "RST is 30°C, Start SV is 0 °C, Step 1's attainment SV 100 °C,
 Execution time of Step1 is 60 minutes
 Start at start SV, attainment time is 60 minutes.
 When starts at PV, 100-30=70°C ,therefore 60 minutes x 70%= 42 minutes = 18 minutes' shortening

However, depending on the spatial relationship between PV, Start SV, and attainment SV, it may become SV start or Step1 may be skipped.

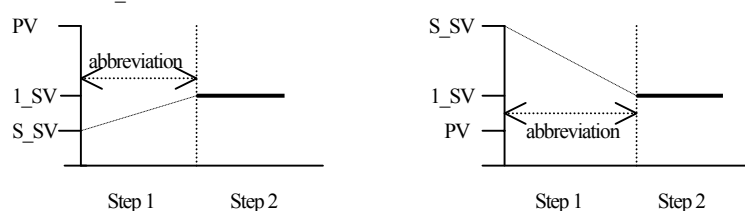
(1) case of SV start

$PV \leq S_SV$ (start SV) < 1_SV (step1 attainment SV)
 $PV \geq S_SV > 1_SV$



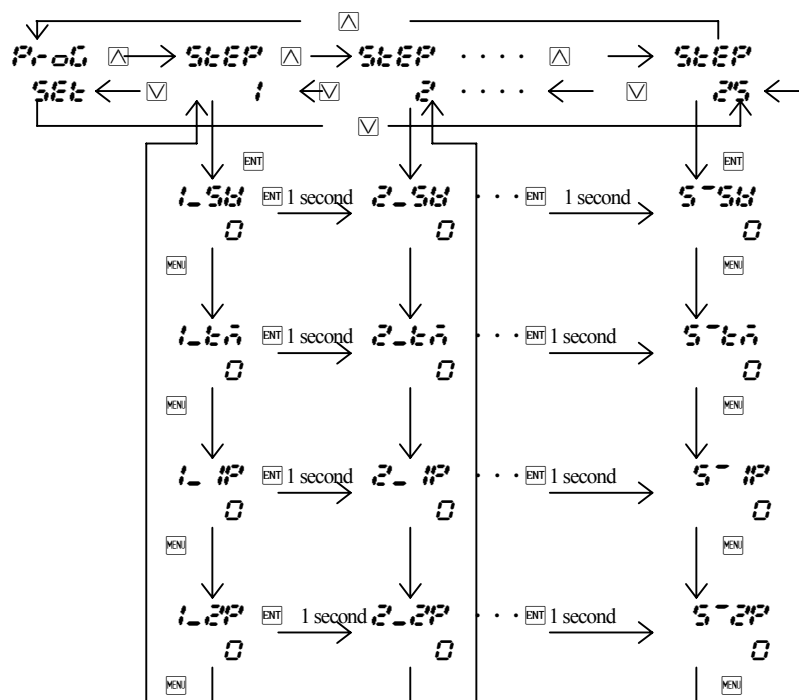
(2) When Step 1 is skipped and progresses to Step 2

$S_SV < 1_SV < PV$
 $S_SV > 1_SV > PV$
 $PV = 1_SV$



Step 1 setting screens ~ Step 25 setting screens

Screen sequence of step 1 setting screens ~ step 25 setting screens are as follows.



In each step setting screen, next to number, $\underline{\quad}$ for Steps 1~9, - for 10~ 19 and - for 20~ 25 are assigned to distinguish each of them.

(Step 1 SV = $\underline{1}$ -SV, step 11SV = $\text{-}1$ -SV and step 21SV= - 1-SV)

If the ENT key is pressed at each step lead screen, it shifts to SV setting screen of each step.

If the MEN key is pressed on SV setting screen, it shifts to execution time setting screen of each step.

After that, if MEN key key is pressed, then it shifts to output 1PIDNo., output 2PIDNo., and lead screen.

Moreover, it is if ENT key is pushed for 1 second on each setting screen, it advances to the next Step No.'s same setting item screen.

(1_SV→2_SV ··· →5_SV→1_SV)

Step 1 is explained, since all the setting content of each step are same.

Step1 SV setting screen

1-SV Initial value : At the time of sensor input 0
0 At the time of linear input scaling lower limit
 MEN key Setting range : At the time of sensor input within measuring range
 At the time of linear input scaling within the limits
 Within limit of SV limiter, and yet
 Attainment set value of Step 1 is set.
 Being initialized when measuring range, unit, and scaling are changed.

Step 1 execution-time setting screen

1-t Initial value: 00:01
99:59 Setting range: 00:00 to 99:59 (minute : second, hour : minute)
 MEN key Execution time of Step 1 is set.

Step1 output1 PIDNo. setting screen

1-IP Initial value: 1
1 Setting range: 1~3
 MEN key PIDNo used in Step1's control output 1 is chosen.

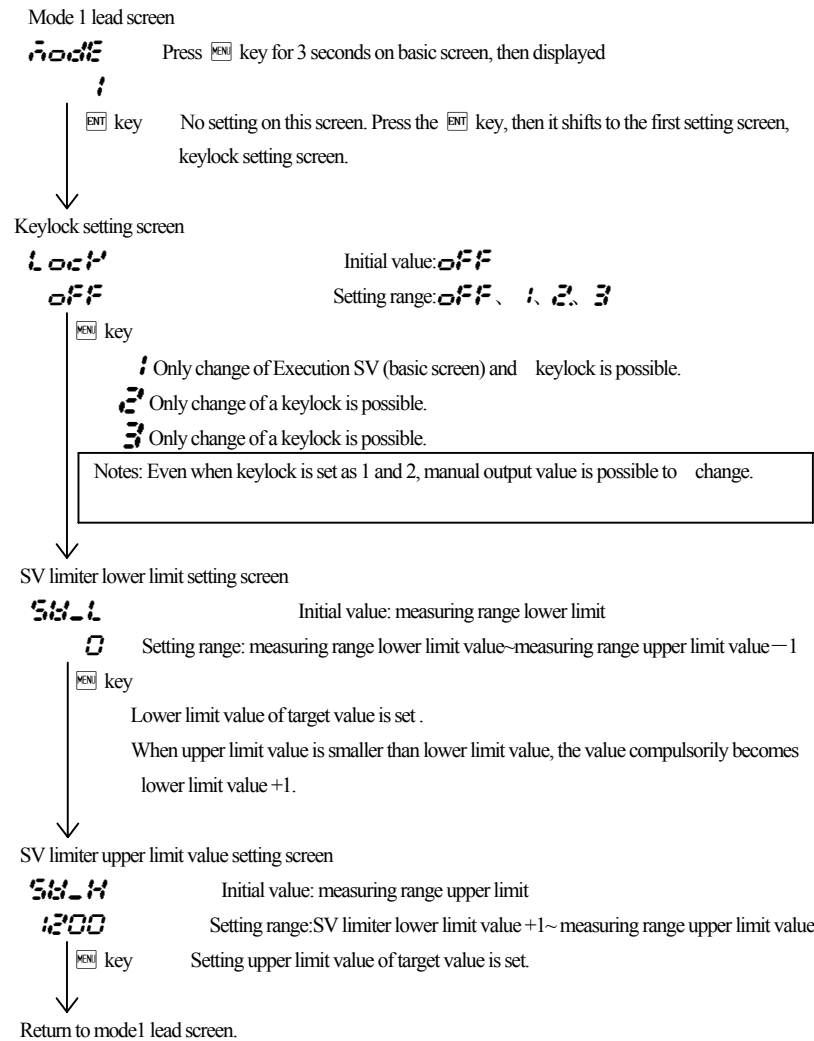
Step1 output 2 PIDNo. setting screen

1-2P Initial value: 1
1 Setting range: 1~3
 MEN key PIDNo used in Step1's control output 2 is chosen.

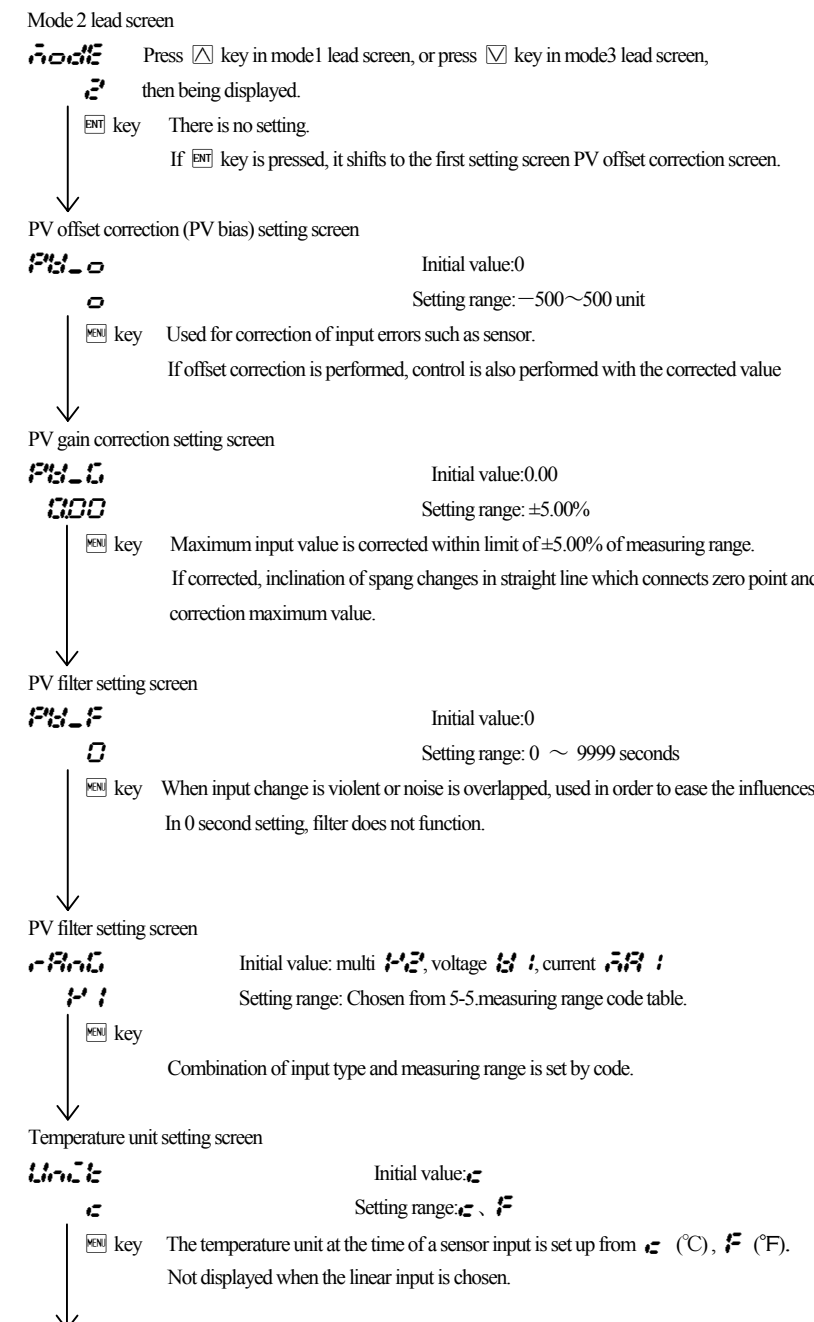
Displayed when output 2 option is added.

To step1 lead screen

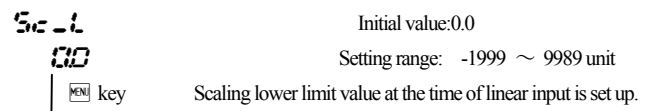
(4) Mode 1 screens



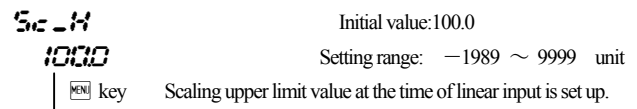
(5) Mode 2 screens



Input scaling lower limit value setting screen

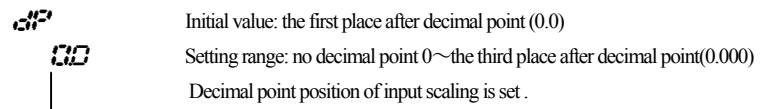


Input scaling upper limit value setting screen



NOTE : Suppose that the difference between a lower limit value and upper limit value is 10 or less, or over 10,000. In this setting, upper limit value is compulsorily changed into that of +10 or ± 10000 count. Upper limit value cannot be set as lower limit value of +10 count or less, or that of over 10,000 count.

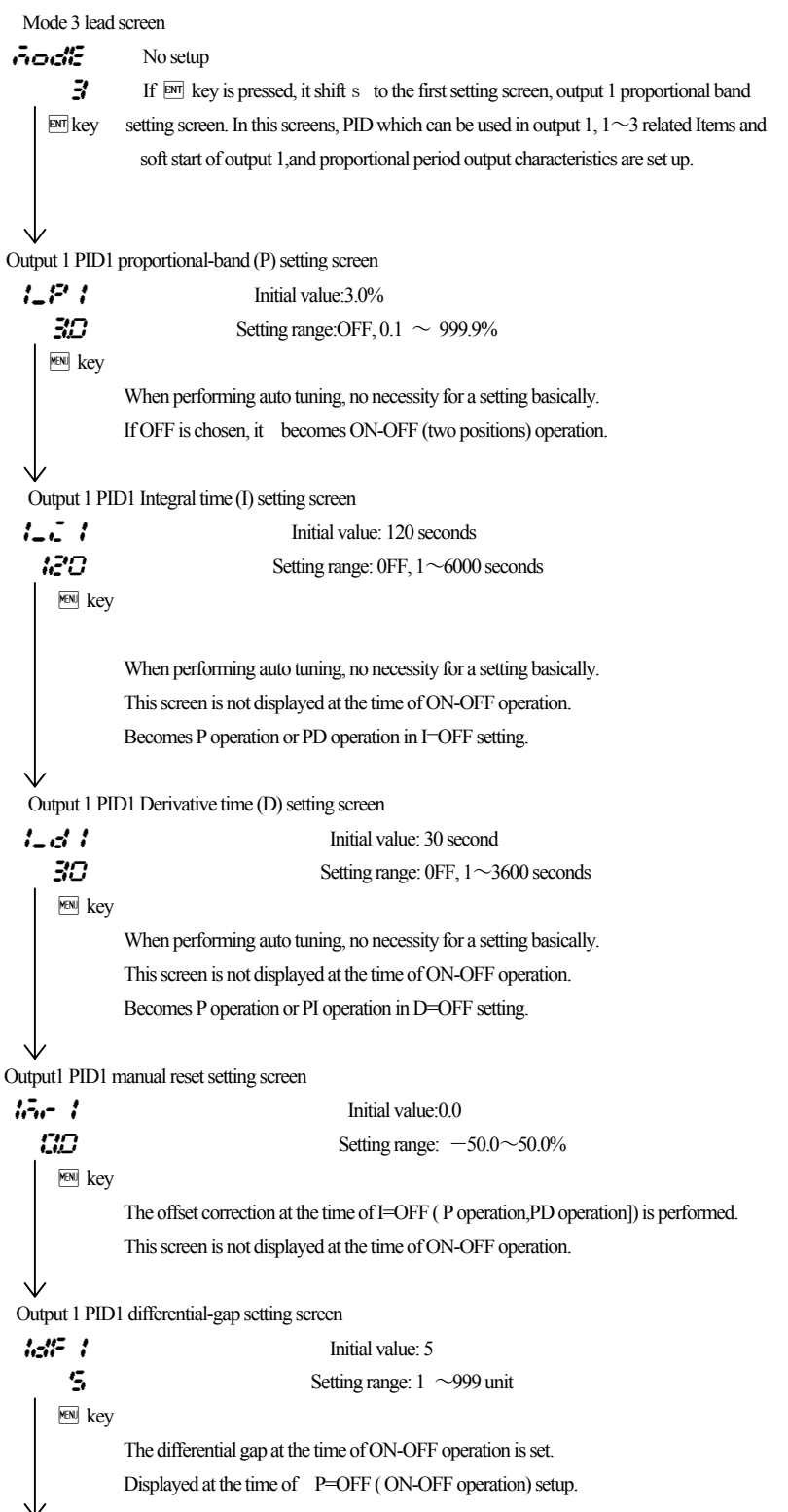
Input scaling Decimal point position Setting screen

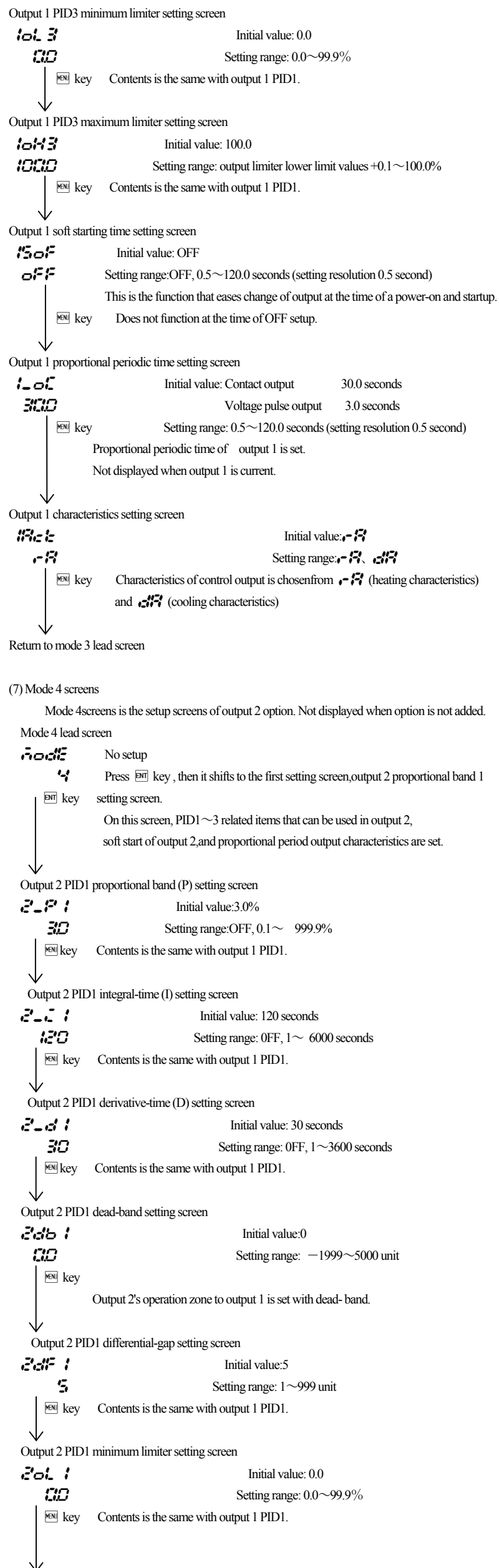
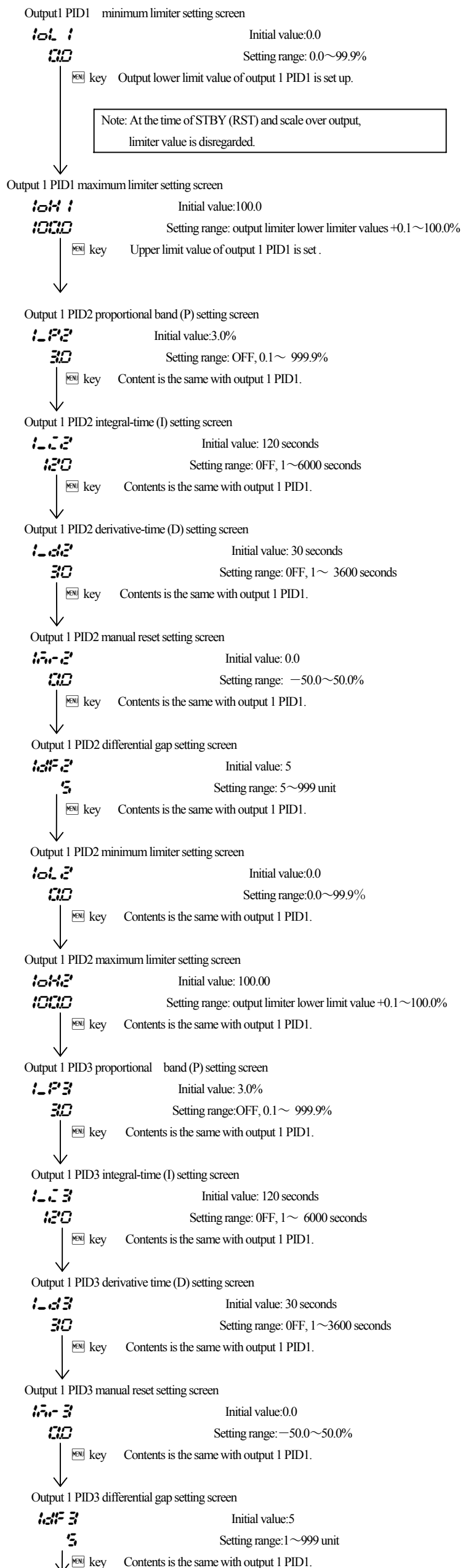


NOTE : The screen of input scaling serves as a monitor at the time of a sensor input. Setting change cannot be performed.

Return to mode 2 lead screen.

(6) Mode 3 screens





Output 2 PID1 maximum limiter setting screen
2041 Initial value:100.0
1000 Setting range: output limiter lower limit values +0.1~100.0 %
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID2 proportional-band (P) setting screen
2-P2 Initial value:3.0%
30 Setting range: OFF, 0.1~ 999.9%
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID2 integral-time (I) setting screen
2-I2 Initial value: 120 seconds
120 Setting range: OFF, 1~6000 seconds
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID2 derivative-time (D) setting screen
2-D2 Initial value: 30 seconds
30 Setting range: OFF, 1~3600 seconds
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID2 dead-band setting screen
2db2 Initial value:0.0
00 Setting range: -50.0~50.0%
 ↓ **ENT** key Contents are the same as output 2PID1 dead-band setting screen.

Output 2 PID2 differential-gap setting screen
2dF2 Initial value: 5
5 Setting range: 1~999 unit
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID2 minimum limiter setting screen
2oL2 Initial value: 0.0
00 Setting range: 0.0~99.9%
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID2 maximum limiter setting screen
2oH2 Initial value:100.0
1000 Setting range:output limiter lower limit values+0.1~100.0 %
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID3 proportional-band (P) setting screen
2-P3 Initial value:3.0%
30 Setting range:OFF, 0.1~999.9%
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID3 integral-time (I) setting screen
2-I3 Initial value: 120 seconds
120 Setting range: OFF, 1~6000 seconds
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID3 derivative-time (D) setting screen
2-D3 Initial value: 30 seconds
30 Setting range: OFF, 1~3600 second
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID3 dead-band setting screen
2db3 Initial value:0.0
00 Setting range: -50.0~50.0%
 ↓ **ENT** key Contents are the same as output 2 PID1 dead-band setting screen.

Output 2 PID3 differential-gap setting screen
2dF3 Initial value:5
5 Setting range: 1~999 unit
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID3 minimum limiter setting screen
2oL3 Initial value:0.0
00 Setting range: 0.0~99.9%
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 PID3 maximum limiter setting screen
2oH3 Initial value:100.0
1000 Setting range: output limiter lower limit values+0.1~100.0%
 ↓ **ENT** key Contents is the same with output 1 PID1.

Output 2 soft starting time setting screen
2Sof Initial value:OFF
off Setting range:OFF, 0.5~120.0 seconds (setting resolution 0.5 second)
 ↓ **ENT** key Contents is the same with output 1.

Output 2 proportional periodic-time setting screen
2-Pc Initial value: Contact output 30.0 seconds
300 Voltage pulse output 3.0 seconds
 ↓ **ENT** key Setting range: 0.5~120.0 seconds (setting resolution 0.5 second)
 Contents is the same with output 1.

Output 2 characteristics setting screen
2Pct Initial value:**off**
off Setting range:**off, on**
 ↓ **ENT** key Contents is the same with output 1.
 Return to mode 4 lead screen.

(8) Mode 5 screens

Mode 5 screens is the setup screens of event option. Not displayed when option is not added.

Mode 5 lead screen
mode No setup.
5 Press **ENT** key , it shifts to the first setting screen, event 1 operation-mode setting screen.
 ↓ **ENT** key

Event 1 operation-mode setting screen
E 1 a Initial value:**non**
non Setting range: Chosen from event type character table.

↓ **ENT** key
 Event type allotted to event 1 is chosen from character table.

Event type character table

Character	Type	Character	Type
non	No allotment	ct2	Control loop alarm 2
HR	Upper limit absolute value alarm	stp	Step signal
LR	Lower limit absolute value alarm	P-E	Pattern termination signal
So	Scale over alarm	End	Program termination signal
hd	Maximum deviation alarm	Hold	Hold signal
Ld	Minimum deviation alarm	ProG	Program signal
cd	Within deviation alarm	u-SL	Up slope signal
od	Without deviation alarm	d-SL	Down slope signal
run	RUN signal	GUR	Guarantee signal
ct 1	Control loop alarm 1		

※ Being initialized if measuring range, scaling, and unit are changed.

※ Deviation alarm is possible to output at the time of RUN+AUTO.

In other events, output is always possible.

Event 1 differential-gap setting screen

E 1 d Initial value:5unit
5 Setting range: 1~999 unit

↓ **ENT** key ON-OFF differential gap of event 1 is set .

Not displayed, when the event 1 mode are as follows.**non, So, run, stp, P-E, Hold, ProG, u-SL, d-SL.**

Change in measuring range, scaling, unit, and the event 1 mode make it initialize.

Event 1 standby operation setting screen

E 1 S **off** Initial value: : **off**
off Setting range: : **off, 1, 2**

↓ **ENT** key **off** : No standby operation, **1** : standby-operation only at the time of a power-on.

2 : Standby-operation in the following cases. ;At the time of power-on.

When each alarm's operating point is changed,

When deviation alarm's SV is performed,

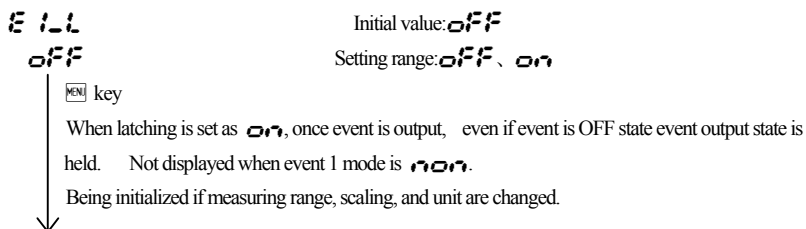
When RUN/STBY (RST) is switched,

When AUTO/MAN is switched.

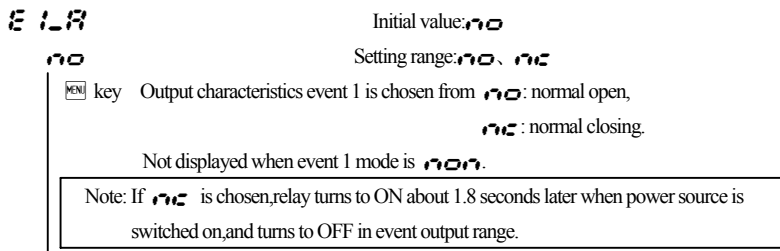
Not displayed, when the event 1 mode are as follows. ;**non, So, run, stp, P-E, Hold, ProG, u-SL, d-SL.**

Change in measuring range, scaling, unit, and the event 1 mode make it initialize.

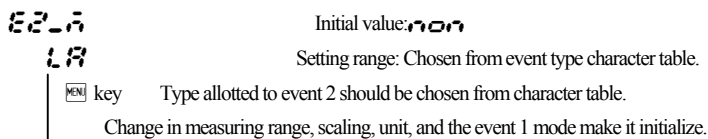
Event 1 latching setting screen



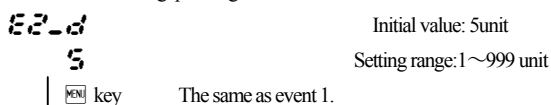
Event 1 output characteristics setting screen



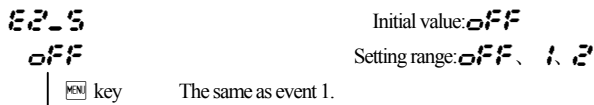
Event 2 mode setting screen



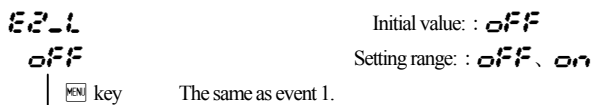
Event 2 differential-gap setting screen



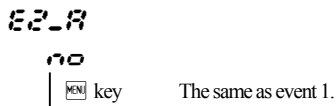
Event 2 standby operation setting screen



Event 2 latching setting screen

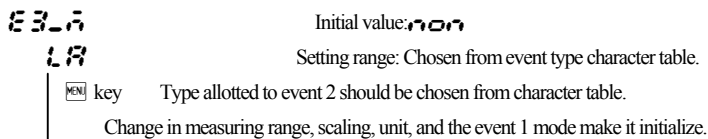


Event 2 output characteristics setting screen

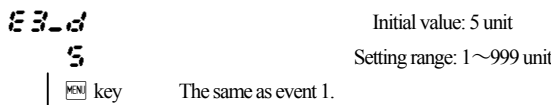


Event 3 mode setting screen

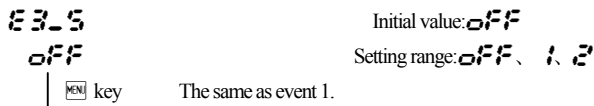
Notes: Apart from event 1-2, event 3 is displayed when being added as additional option.



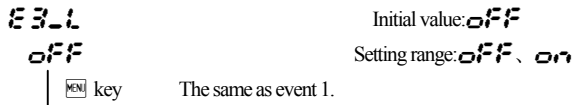
Event 3 differential-gap setting screen



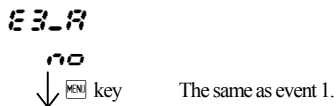
Event 3 standby operation setting screen



Event 3 latching setting screen



Event 3 output characteristics setting screen



Return to mode 5 lead screen

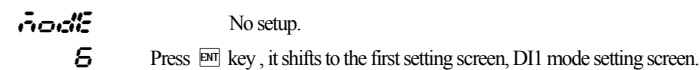
(9) Mode 6 screens

Mode 6 screens is the setup screens of external control input (DI) option.

Not displayed when option is not added.

DI input is a no-voltage contact or open collector

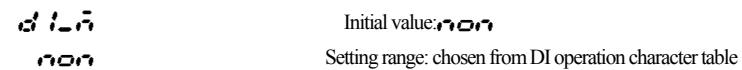
Mode 6 lead screen



key

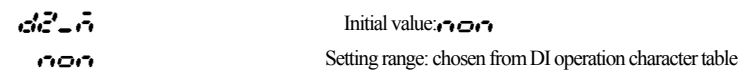
In MAC 3D (48x48), when option of CT OUTPUT is added, DI 1~DI3 cannot be chosen and not displayed.

DI 1 mode setting screen



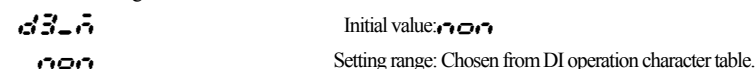
Choose DI operation that is allotted to DI 1 from character table.

DI 2 mode setting screen



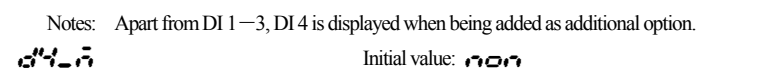
Choose DI operation that is allotted to DI 2 from character table.

DI 3 mode setting screen



Choose DI operation that is allotted to DI 3 from character table.

DI 4 mode setting screen



Choose DI operation that is allotted to DI 4 from character table.

Return to mode 6 lead screen

DI operation character table and restrictions concerning DI

DI operation character table

DI character	Operation type	Input detection	Contents
<i>NON</i>	No allotment		
<i>SV2</i>	2nd SV	level	With closed DI terminal Execution SV = 2nd SV
<i>SV3</i>	3rd SV	level	With closed DI terminal Execution SV = 3rd SV
<i>SV4</i>	4th SV	level	With closed DI terminal Execution SV = 4th SV
<i>RUN</i>	control RUN	level	RUN with closed DI terminal, STBY with open one.
<i>Prog</i>	program	level	Program with closed DI terminal. Constant value with opened.
<i>MAN</i>	manual input t	level	Manual with closed DI terminal, auto with open one.
<i>AT</i>	auto tuning	edge	AT-start with rise edge.
<i>Hold</i>	hold	level	Program's time stops temporarily.
<i>SKIP</i>	skip	edge	Shift to the next program's step.
<i>L-RS</i>	latching release	edge	All latching are released by rise edge.
<i>Lock</i>	super key lock	level	Super keylock with closed DI terminal. Release with opened.

- When *SV2* ~ *SV4* are conducted during AT execution, they are performed at the time of AT termination.
- When *SV2* ~ *SV4* are allotted to each DI, priority is given to *2-3-4* in order.
- *AT* can be performed at the time of a RUN-automatic output.
- When *AT* is allotted to, release in the middle of AT operation is carried out by off-key operation chosen in AT screen.
- While AT is performed, if STBY (RST) or a manual output is performed, AT is released.
- Even when a keylock is not OFF, conducting of DI is effective.
- The same operation other than *NON* is impossible to allot to DI1-DI4 at a time.
- Operation allotted to DI takes priority over DI. Key operation cannot be performed.
- Execution of DI operation is possible to perform. But neither release of AT nor numerical change of SV and manual output is possible to perform.
- In DI input, 5VDC 0.5mA per point is impressed. Use endurable switch, transistor and so on.
- Wiring distance of DI should be less than **30m**.

(10) Mode 7 screens

The Mode 7 screens is the setup screens of analog output option.

Not displayed when option is not added.

In MAC 3D (48x48),when communication option is added,it is impossible to choose and display.

Mode 7 lead screen

mode 7 No setup
 When **ENT** key is pressed, it shifts to the first setting screen, analog output mode setting screen.
ENT key

Analog output mode setting screen

AN Initial value: *non* (does not output)
 Setting range: *PV* PV
non *SV* execution SV
out 1 control out put 1
out 2 control out put 2
ct 1 CT OUTPUT 1
ct 2 CT OUTPUT 2
out 2, ct 1, ct 2 is displayed when option is added.
 Data type allotted to analog output are chosen.

Analog output scaling lower limit value setting screen

AS_L Initial value: the following table
 Setting range: the following table
0
ENT key
 Lower limit value of range allotted to analog output is set up.
 However, $AS_L < AS_H$ Lower limit value is given priority

MODE		Setting range	Initial value
PV	sensor input	within measuring range	measuring range lower limit value
	SV	linear input	scaling lower limit value
OUT1, OUT2		0.0~99.9	0.0
CT1, CT2		0.0~49.9	0.0

Analog output scaling upper limit value setting screen

AS_H Initial value: the following table
 Setting range: the following table
1200
ENT key
 Upper limit value of range allotted to analog output is set up.
 However, $AS_L < AS_H$ Lower limit value is given priority

MODE		Setting range	Initial value
PV	sensor input	within measuring range	measuring range upper limit value
	SV	linear input	scaling upper limit value
OUT1, OUT2		0.1~100.0	100.0
CT1, CT2		0.1~ 50.0	50.0

Lower limit value takes priority, therefore upper limit value cannot be set below the value of lower limit value +1. When a lower limit value is set more than upper limit value, upper limit value is pushed to the level of lower limit value +1.

Analog output limiter lower limit value setting screen

AL_L Initial value: 0.0
00 Setting range: 0.0~100.0%
ENT key
 The lower limit value of analog output value (4-20mA) is set up by %.
 For example, output value of a lower limit value in each setup are: 8mA(25.0), 12mA(50.0), 16mA(75.0) and 20mA(100.0) respectively.

Analog output limiter upper limit value setting screen

AL_H Initial value: 100.0
1000 Setting range: 0.0~100.0%
ENT key
 Upper limit value of analog output value (4-20mA) is set up by %.
 If set as the same value as **AL_L** and **AL_H**, it is fixed to the value.

Return to mode 7 lead screen

Note: An analog output limiter can be made into reverse scaling.
 Example: Output range :0°C (4mA)~ 1200°C (20mA) can be 0°C (20mA) ~ 1200°C (4mA).
 Set **AL_L** as 100% and **AL_H** as 0.0%.

(11) Mode 8 screens

Mode 8 screens is the setup screens of CT OUTPUT option.

Not displayed when option is not added.

In MAC 3D (48x48),when DI 1~3 are added,it is impossible to choose and display.

Mode 8 lead screen

mode 8 No setup
 Press **ENT** key, it shifts to the first setting screen, CT1 mode setting screen.
ENT key

CT1 mode setting screen

CL1 Initial value: *non*
 Setting range: *non, out 1, out 2, EB 1, EB 2, EB 3*
non **ENT** key
 Object detected by CT (current) sensor is chosen.
 In the case of a current output, *out 1* is not displayed.
out 2 is not displayed without current output or output 2 option.
EB 1, 2 and *3* are not displayed without any option, respectively.

CT1 delay time setting screen

CL1 Initial value: 0.5
05 Setting range: 0.5~30.0 seconds
ENT key
 When control loop abnormal alarm is allotted to event, delay time from switchover of operation (ON-OFF) to detection start is set up.

CT2 mode setting screen

CL2 Initial value: *non*
 Setting range: *non, out 1, out 2, EB 1, EB 2, EB 3*
non **ENT** key
 The same as CT1 mode setting screen.

CT2 delay time setting screen

CL2 Initial value: 0.5
05 Setting range: 0.5~30.0 seconds
ENT key
 The same as CT1 delay time setting screen

Return to mode 8 lead screen

About control loop abnormal alarm

When the targeted output of a control loop abnormal alarm is ON, if current detected by CT is lower than the allotted event's operating point (Setting Value of a basic screens, event operating point setting screen) alarm output is issued as breaking alarm.

When the targeted output is OFF, if detected current is higher than the allotted event's operating point (short-circuit, earth fault, etc.)

(12) Mode 9 screens

Mode 9 screens is the setup screens of communication (RS-485) option.

Not displayed when it is not added. See the attached Communication Instruction Manual (in the appendix : "at the time of communication option added") about communication,

5-5. measuring range code table

Input type		code	Measuring Range		
			unit code $^{\circ}\text{C}$	unit code $^{\circ}\text{F}$	
MULTI INPUT	Thermo couple	R	r1	0 ~ 1700	0 ~ 3100
		K	P1	-199.9 ~ 400.0	-300 ~ 700
		K	P2	0 ~ 1200	0 ~ 2200
		K	P3	0.0 ~ 300.0	0 ~ 600
		J	J1	0 ~ 600	0 ~ 1100
		T	t1	-199.9 ~ 200.0	-300 ~ 400
		E	E1	0 ~ 700	0 ~ 1300
		S	S1	0 ~ 1700	0 ~ 3100
		*5 U	U1	-199.9 ~ 200.0	-300 ~ 400
		N	n1	0 ~ 1300	0 ~ 2300
		*1 B	b1	0 ~ 1800	0 ~ 3300
		*3 Wre5-26	S-26	0 ~ 2300	0 ~ 4200
		*4 PLII	PL2	0 ~ 1300	0 ~ 2300
Resistance bulb	Pt100	P1		-200 ~ 600	-300 ~ 1100
		P2		-100.0 ~ 200.0	-150.0 ~ 400.0
		P3		0.0 ~ 100.0	0.0 ~ 200.0
		P4		- 50.0 ~ 50.0	- 60.0 ~ 120.0
		P5		-100.0 ~ 300.0	-150.0 ~ 600.0
	*6	JP1		-200 ~ 500	-300 ~ 900
		JP2		-100.0 ~ 200.0	-150.0 ~ 400.0
		JP3		0.0 ~ 100.0	0.0 ~ 200.0
		JP4		-50.0 ~ 50.0	- 60.0 ~ 120.0
		JP5		100.0 ~ 300.0	-150.0 ~ 600.0
Voltage (mV)	*7	0 ~ 10	a1	Scaling range : -1999~9999 count Span : 10~10000 count	Possible to change decimal point position (No Decimal point , 0.1, 0.01, 0.001)
		0 ~ 100	a2		
		-10 ~ 10	a3		
		0 ~ 20	a4		
		0 ~ 50	a5		
Voltage(V)	1 ~ 5	0 ~ 5	b1		
		- 1 ~ 1	b2		
		0 ~ 1	b3		
		0 ~ 2	b4		
		0 ~ 10	b5		
		0 ~ 10	b6		
Current(mA)	4 ~ 20	0 ~ 20	AA1		
		0 ~ 20	AA2		

thermo couple B,R,S,K,E,J,T,N:JIS/IEC

resistance bulb Pt100:JIS/IEC

JPt100: former JIS

- *1 thermo couple Accuracy is not guaranteed below B:400°C (752 °F).
- *2 thermo couple In K, T, U, accuracy is $\pm 0.5\%$ FS for 0 ~ -100°C (-148 °F) and $\pm 1.0\%$ FS if it is below -100°C
- *3 thermo couple Wre 5-26: Product of Hoskins Mfg. co.,
- *4 thermo couple P L II : Platinel
- *5 thermo couple U:DIN43710
- *6 resistance bulb accuracy of Pt/JPt $\pm 50.0^{\circ}\text{C}$, 0.0 ~ 100.0°C is $\pm 0.3\%$ FS.
- *7 voltage(mV) 0 ~ 10mV, accuracy of 0 ~ 10mV is $\pm 0.3\%$ of input range.

* Setup of factory shipment is Multi input: thermo couple P2 0-1200°C
Voltage input :1-5V a1 0.0-100.0
Current input :4-20mA AA1 0.0-100.0

6. Supplementary Explanation of Function

6-1. Auto return function

When there is no key operation 3 minutes or more, on the screen except for basic screen and each monitoring screen, screen automatically shifts to basic screen. (Auto return).

6-2. Output Soft Start Function

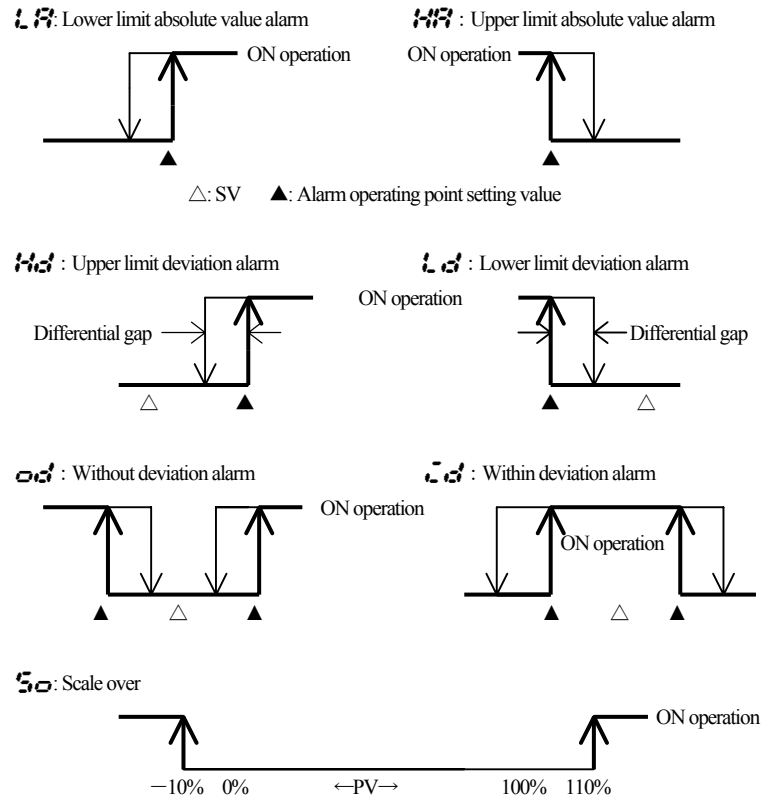
This is the function to increase the control output gradually with set-up time at the time of power-on, STBY → RUN, and normal return from scale over. This is effective for controlling the excessive current to loads, such as a heater.

1) Soft- start functions in the following conditions.

- At the time of the power-on in automatic operation, STBY(RST) → RUN, and normal return from scale over.
- Setup of proportional band (P) is other than OFF
- Soft starting time is not OFF

6-3. Event Selection Alarm Operation Figure

The figure of alarm operation figure allotted to event 1 ~ 3 is shown.



6-4. AT (Auto Tuning)

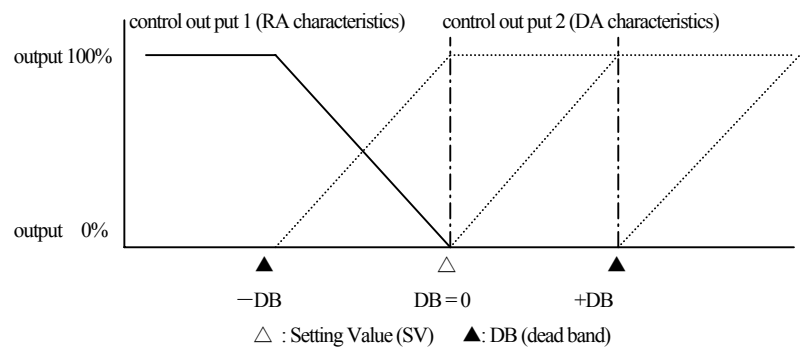
- If AT is performed by FIX (constant value control), AT monitor LED blinks and light is put out by termination or intermediate release.
- When auto tuning is ended in inclination step or chosen all PID(s), it is in standby state until one pattern is completed. then lights up, then puts out when one pattern is completed.
- When AT is not completed within 1 pattern, AT conducting is released when one pattern is completed.
- Even in inclination step, AT is performed if it is in HOLD state.
- AT at the time of 2 output specification is as follows.
At the time of heating / cooling operation and cooling / heating operation = OUT1, OUT2 common - PID value
At the time of heating / heating operation and cooling / cooling operation, only OUT1 performs AT.
OUT 2 output while performing AT is 0% or output limiter lower limit value.

6-5. 2 output-characteristics figure

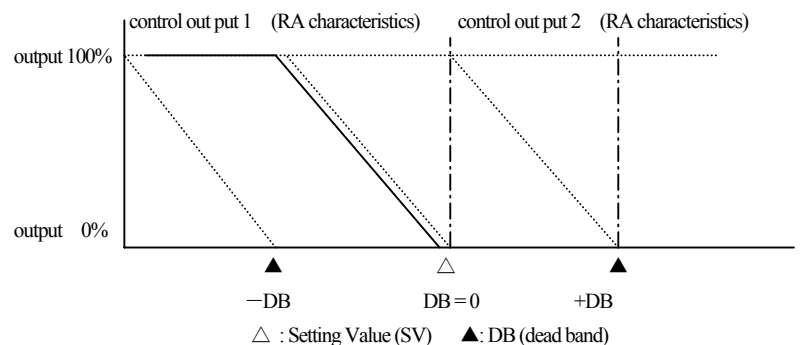
2-output -characteristics is shown in the following figure.

© Conditions: P operation, manual reset (RST) -50.0%

1) OUT 1 RA (heating) • OUT 2 DA (cooling) operation



2) OUT 1 RA (heating) • OUT 2 RA (heating)



7. Trouble Shooting

7-1. Cause and Treatment of Main Defects

Contents of defects	Cause	Treatment
Error message display	Refer to cause and treatment of error display	Refer to cause and treatment of error display
PV display is not normal	Mismatch of instrument and input. Fault in the wiring.	Type code, check of specification. Check of wiring.
Display disappeared and does not operate	Power is not supplied. Abnormality of instrument.	Check of a power supply (voltage of terminal, switch, fuse, wiring).
Key operation impossible	Keylocked. Abnormality of instrument.	Release of keylock. Check of instrument, repair, exchange.

7-2. Cause and Treatment of Error Display

(1) Abnormality Display of Measurement Input

Error display	Contents	Cause	Treatment
HHHH (HHHH)	Scale over in upper limit	1.wire breaking of thermocouple input 2.wire breaking of resistance bulb input A 3.when input exceeds upper limit of measuring range by 10%	1.wire breaking check of thermocouple input wiring, replacement of thermocouple 2.check of resistance bulbA wiring, replacement of resistance bulb 3.check of input voltage value and current value, input transmitter and specification (matching of incoming signal and meter specification)
LLLL (L L L L)	Scale over in lower limit	1.when input exceeds lower limit of measuring range by 10% 2.wire breaking of resistance bulb input B*	1.polarity of input is everse, check of wiring and an input transmitter 2.check of resistance bulb B wiring, replacement of resistance bulb
*B: Wiring of MAC3A, 3B's terminal No.11, Wiring of MAC 3D's terminal No.5			
b--- (B ---)	Breaking of resistance bulb input	1.wire breaking of b* *b: Wiring of MAC 3A, 3B's terminal No.12, wiring of MAC 3D's terminal No.6	1.check of resistance bulb wiring
		2.multiple wire breaking combinations in Abb (A and B, A and b, B and b, all of ABB)	2.replacement of resistance bulb
C JHH (C J HH)	Cold junction (CJ) temperature of thermocouple input is scale over in upper limit side	When ambient temperature of a meter exceeds 80°C	1.make Ambient temperature of meter within use environment condition temperature 2. Check the meter when ambient temperature is not over 80°C
C JLL (C J L L)	Cold junction (CJ) temperature of thermocouple input is scale over in lower limit side	When ambient temperature of meter becomes less than -20°C	1.make Ambient temperature of meter within use environment condition temperature 2. Check the meter when ambient temperature is not less than -20°C

8. Specification

Display

Display method	Digital display: MAC3A (96 x 96 size)	PV red 7 segment LED	4 figure (height of character about 20mm)
		SV green 7 segment LED	4 figure (character quantity about 13mm)
	MAC3B(48x96 size)	PV red 7 segment LED	4 figure (height of character about 12mm)
		SV green 7 segment LED	4 figures (height of character about 9 mm)
	MAC3D(48x48 size)	PV red 7 segment LED	4 figure (height of character about 12mm)
		SV green 7 segment LED	4 figures (height of character about 9mm)
Status display: RUN (green), PRG (green), AT (green), OUT 1(green) EV1 (yellow), EV2 (yellow), OUT2 /EV3 (yellow)			
Display accuracy	: $\pm(0.25\%FS+1\text{digit})$ CJ errors not included, B thermo couple below 400°C is not guaranteed. Display accuracy during EMC examination is $\pm 5\%FS$.		
Accuracy maintenance range	: $23 \pm 5^\circ\text{C}$		
Display range	: -10%-110% of measuring range, but Pt100's -200~600°C is -240~680°C		
Display resolution	: Changes with measuring range and scaling.		
Input scaling	: Possible at the time of voltage input and current input -1999-9999 (spang 10 – 10000 count, decimal point position no decimal point 0.1, 0.01, 0.001)		

Setting

Setting system	: By five front keys (\square , \square , \square , \square , \square) .
S V Setting range	: Same with measuring range
Setting lock	: Communication and key setting (three levels), DI (one level)

Operations	Level	Lock Content
Communication & Key setting	OFF	No lock
	1	Execution SV and a manual numerical change are possible. And change of a keylock level is possible.
	2	Possible to change numerical value manually and keylock level.
	3	Possible to change keylock level.
DI Setting		Super Key Lock (Shift between screens prohibited. Fixed only to the basic screen.)

* Regardless of the setting lock by communication & key setting, the \square key is always effective.

However, even \square key is not received when super keylock by DI is performed.

SV setting limiter	: Same with measuring range (lower limit < upper limit)
Unit setting	: Settable at the time of sensor input °C, ° F

Input

Multi input

Thermocouple input resistance	: 500 Ω or more, external resistance tolerance level 100 Ω or less
Influence of lead-wire	: $1.2 \mu\text{V} / 10\Omega$
Burnout	: Standard equipment (Up Scale only)
Measuring range	: Item 5-5. Refer to measuring range code table.
Compensation accuracy of reference junction	: $\pm 1^\circ\text{C}$ (ambient temperature 18-28°C) At the time of vertical plural proximity attachment $\pm 2^\circ\text{C}$ $\pm 2^\circ\text{C}$ (ambient temperature 0-50°C) At the time of vertical plural proximity attachment $\pm 3^\circ\text{C}$ Several minutes after power-on, accuracy is not guaranteed. Reaches the accuracy level within 5 minutes after power-on.

Tracking of a reference junction

: Below the ambient temperature of 0.5 °C / min, compensation accuracy of reference junction $\pm 1^\circ\text{C}$

Resistance bulb stipulated

current resistance bulb	: Approx. 0.25mA
Lead wire resistance tolerance level	: 5 Ω or less per wire (Resistance of three lines should be equal)
Influence of lead-wire resistance	: 5 Ω or less per wire 0.2%FS 10 Ω or less per wire 0.5%FS 20 Ω or less per wire 1.0%FS

Measuring range : Item 5-5. Refer to measuring range code table.

Voltage (mV) Input resistor	: 500k Ω or more
Input voltage range	: Item 5-5. Refer to measuring range code table.
Voltage input (V) Input resistor	: 500k Ω or more
Input voltage range	: Item 5-5. Refer to measuring range code table.

Current input (mA) reception

Resistance	: 250 Ω (built-in)
Input range	: Item 5-5. Refer to measuring range code table.

Sampling period	: 0.25 second
PV filter	: 0 - 9999 second
PV offset compensation	: ± 500 unit
PV gain correction	: $\pm 5.00\%$ PV filter

Control

Control system	: PID control with an auto tuning function or ON-OFF operation	
Proportional band (P)	: OFF and 0.1 - 999.9% of measuring range (ON-OFF operation by OFF setting)	
ON-OFF Differential-gap (DF)	: 1 - 999 unit	} If both I and D are OFF, P operation.
Integration Time (I)	: OFF, 1- 6000 seconds (PD operation by OFF setting)	
Manual Reset (MR)	: $\pm 50.0\%$ (effective when set as I = OFF)	
Output 2 dead band	: -1999 - 5000 unit	

Output limiter (OL, OH) : 0.0 - 100.0% (OL<OH) (set resolution 0.1)
 Soft start : OFF, 0.5 - 120.0 seconds (set resolution 0.5)
 Proportional period : 0.5 - 120.0 seconds (set resolution 0.5)
 Control output characteristic : Output 1, output 2. Possible to choose either RA (heating) or DA (cooling).
 Manual output : 0.0 - 100.0% (set resolution 0.1)
 * Each parameter,(P, I, D, DF, MR, OL, and OH) of Outputs 1 and Outputs 2, belongs to 1~3 categories.

Control output 1

Contact : normal open (1a) 240V AC 2A (resistance load)
 Voltage pulse (SSR drive) : 12V DC+1.0--1.5V MAX20mA
 Current : 4 - 20mA DC load resistance 500Ω or less Display accuracyaccuracy±1% (accuracy maintenance range 23°C±5°C)
 Load regulation ±0.2%, resolution approx. 1/12000

Control out put 2 (option) : Control out put 2 is exclusive option of event 3 and DI4.

Contact : normal open (1a) 240V AC 2A (resistance load)
 Voltage pulse (SSR drive) : 12V DC+1.0--1.5V MAX20mA
 Current : 4 - 20mA DC load resistance 500Ω or less ,display accuracy±1% (accuracy maintenance range 23°C±5°C)
 Load regulation ±0.2%, resolution approx. 1/200

Program function (option)

Number of pattern : 1
 Number of steps : Maximum 25
 PID selection : Each output has three kinds. PID1, PID2, and PID3.
 Time setting : 0 minute 0 second~99 minutes 59 seconds or 0 hour 0 minute~99 hours 59 minutes or 0.0 - 999.9 hours ,and ∞ (infinity)
 Time setup resolution : 1 second or 1 minute or 0.1 hour
 Time accuracy : ± (Setup time × 0.005 +0.25 second)
 In a step Setting parameter : SV, time, PID№
 Number of repeats : 1 - 9999 times, and ∞
 Time signal : Possible to allot to Event (1 second for changeover, 3 seconds for patter end, 3 seconds for program end)
 PV start function : With
 Guarantee soak function : Without
 Time hold facility : Possible at front key, DI allotment, or communication
 Step skip : Possible at front key, DI allotment, or communication
 Power failure compensation : without (setting contents being held.However, elapsed time, execution step, and number of execution are reset.)

Event 1 · 2 (option) : 2 sets

Output rating : Contact Normal open (1a) 240V AC 2A (resistance load) EV1 · EV2 and common
 Kind of event : Refer to following table.

Function	Character	Note
No allotment	<i>non</i>	
Upper limit absolute value Alarm	<i>HR</i>	
Lower limit absolute value alarm	<i>LR</i>	
Scale over alarm	<i>So</i>	HHHH, LLLL, B---- Operates, when displayed.
Upper limit deviation value Alarm	<i>Hd</i>	
Lower limit deviation value alarm	<i>Ld</i>	
Within deviation alarm	<i>Id</i>	
Without deviation alarm	<i>od</i>	
RUN signal	<i>run</i>	Operates during PROG and FIX in operation.
Control loop alarm (Heater breaking / loop)	<i>ct1</i>	When contact/voltage pulse output is ON Breaking alarm, when it is below EV set.
	<i>ct2</i>	When contact/voltage pulse output is OFF Loop alarm, when it is more than EV set.
Step signal	<i>STEP</i>	Operate for 1 second at the time of step switchover
Pattern end signal	<i>P-E</i>	Operate for 3 seconds at the time of pattern end
Program end signal	<i>End</i>	For 3 seconds at the time of program end
Hold signal	<i>Hold</i>	Operates during time hold.
Program signal	<i>Prog</i>	Operates by program selection
Upslope signal	<i>u-sl</i>	Operates when the inclination of program control rises (including Hold status)
Downslope signal	<i>d-sl</i>	Operates when the inclination of program control descends (including Hold status)
Guarantee signal	<i>GUR</i>	Operates when approaches the targeted value exceeding the EV value.

Setting range : Upper limit absolute value alarm, Lower limit absolute value alarm within measuring range
 Upper limit deviation alarm, Lower limit deviation alarm -1999 - 2000 unit
 Within deviation alarm, without deviation alarm 0 - 2000unit
 Control loop alarm 0.0-50.0A

Standby operation

: OFF No standby operation
 1 Only at the Time of Power-on, standby operation
 2 At the Time of power switch on, each alarm operating point is changed, deviation alarm's execution SV is changed, and RUN/STBY (RST) is switched over standby operation, at the time of AUTO/MAN switchover

Latching

: Alarm operation maintenance function(Release is done by key operation, DI, or power OFF.
 In the case of release by DI and power OFF, all alarms are called off simultaneously)

- Differential gap : 1 - 999 unit
- Output characteristic : Choose from normal open (NO) or normal closing (NC).
If NC is chosen and power is turned on, relay becomes ON about 1.8 seconds and becomes OFF at event power range.
- Event3 (Option) : Event3 is exclusive selection option of control output 2 and DI4.
: Item and contents are same with event 1 and 2.
- DI 1-2-3 (option) : Set of 3 In MAC 3D, exclusive selection option with CT input .
- Input rating : 5V DC 0.5mA
- Allotment function : Refer to following table.

Character	Kinds of operation	Input detection	Contents
non	No allotment	level	
SV2	2nd SV	level	With closed DI terminal, Execution SV = 2nd SV
SV3	3rd SV	level	With closed DI terminal, Execution SV = 3rd SV
SV4	4th SV	level	With closed DI terminal, Execution SV = 4th SV
run	Control RUN	level	RUN with closed DI terminal. STBY(RST) with opened.
Prog	Program	level	Program with closed DI terminal. Constant value with opened.
MAN	Manual output	level	Manual with closed DI terminal. Auto with opened.
At	Auto tuning	edge	AT starts with rise edge.
Hold	Hold	level	Program time stops temporary.
SKIP	Skip	edge	Shifts to the following step of program.
LRS	Latching release	edge	With rise edge, all latching released
Lock	Super keylock	level	Super keylock with closed DI terminal. Release with opened.

- Input minimum retention time : 0.25 second
- Input of operation : Non-voltage contact or open collector
- DI4 (option) : DI4 is exclusive selection option with control output 2, Event3
- Number of input : One
: Item and contents are same with DI 1, DI 2 and DI 3.
- Communication function(option) : Output and an exclusive selection option for MAC 3D.
Read attached communication instructions manual that detailed about communication function.
- Communicative type : EIA standard RS-485
- Communication system : Two-wire system half duplex multi-drops (bus) system
- Synchro system : Asynchronous system
- Communication distance : Maximum 500m (depends on conditions)
- Communication Speed : 1200, 2400, 4800, 9600, 19200 or 38400bps
- Data format : Start 1bit, Stop 1-2 bits, Data length 7 or 8 bits, Parity without, odd number, even number
- Master function : Chooses from SV, OUT1, OUT2 (1:n number of slaves maximum 31)
※ When MAC3 is a master, slave address range must be continuation.
※ When MAC3 is a master, bus connection with other host PCs is not allowed.
※ Input range of master machine and slave machine should be equal, at the time of cascade control
- Slave address : 1-255
- Parameter preservation mode : Choose from RAM, MIX and EEP mode.
- Error detection : None, Choose from ADD, complement of ADD +2, exclusive OR, CRC-16 and LRC
- Flow control : none
- Delay : 1 - 500ms (resolution 1ms)
- Communication code : ASCII code or binary code
- Protocol : SHIMAX Standard or MODBUS ASCII, MODBUS RTU protocol
- Termination resistance : 120Ω (external connection)
- Number of connection : Maximum 32 sets (depends on conditions, host is included)
- Analog output(AO) : In MAC 3D, exclusive selection option with communication function
- Output kind : Choose from PV, SV, OUT1, OUT2, CT1, and CT2.
- Output rating : 4-20mA DC 300Ω or less, Display accuracy $\pm 0.3\%$ (accuracy maintenance range $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$)
Load regulation $\pm 0.05\%$, Resolution approx 1/50,000
- Scaling function : with (range depends on output type) analog output lower limit value < analog output upper limit value
- Output limiter : 0.0 - 100.0% (reverse setting is possible)
- CT 1 · CT2 input : In MAC 3D, exclusive selection option with DI · D2 · D3
- Detection method : Current judging system by CT sensor
- Detection range : 0.0-55.0A
- Sampling period : 125ms
- Detection accuracy : $\pm 5\%$ FS
- Detection delay time : 0.5 - 30.0 seconds
- Alarm output : Assigned to event
- Detection Objects : Assigned to OUT1, OUT2, EV1, EV2, and EV3.
- Alarm operating point setting range : 0.0-50.0A
- Recommended CT sensors : Products of U_RD co., CTL-6-L, CTL-6-V, CTL-6-P-H, CTL-6-S-H, CTL-12L-8

General specification

- Data save : By nonvolatile memory (EEPROM)
- Temporary dead time : no influence within 0.02 second 100% dip
- Use environmental condition : Temperature: -10~55 °C
- Humidity : Below 90%RH (no dew condensation)
- Hight : Altitude of 2000m or less
- Category : II
- Contamination degree : 2
- Storage temperature Conditions : -20~65 °C
- Supply voltage : 90-264V AC 50/60Hz or 21.6-26.4V AC (50/60Hz)/DC
- Power consumption : 90-264V AC maximum 9VA 21.6-26.4V AC maximum 6 VA 21.6-26.4V DC maximum 4W
- Applicable standard Safety : IEC1010-1 and EN61010-1:2001
- EMC : EN61326-1:1997+Amendment1:1998+Amendment2:2001
(EMI: ClassA, EMS: AnnexA)
EN61000-3-2 : 2000 EN61000-3-3 : 1995+Amendment 1 : 2001
- Oscillation : IEC60068-2-6/1995
- Insulated class : Class I apparatus
- Input noise removal ratio : Normal 50dB or higher
- Impulse-proof noise : Power-source Normal 100ns/1 μs ± 1500V
- Insulation resistance : Between input/output terminal and power supply terminal 500V DC 20Ω or higher
: Between analog output or communication and other input/output terminals 500V DC 20Ω or higher
- Withstand voltage : Between input/output terminal and power supply terminal 1500V AC 1 minute or 1800V AC 1 second
: Between analog output or communication and other input/output terminals 500V AC 1 minute or 600V AC 1 second
- Resistance to vibration : Frequency 10~ 55~10Hz, amplitude 0.75mm (one side amplitude) · · · 100m/S² Direction 3 directions
Sweep speed 1 octave/minute (about 5 minutes for both-way/cycle) Number of sweep 10 times
- Case material : PPO or PPE
- Case color : Light gray (Mansel value 3.73B7.77/0.25)
- Outside dimension MAC3 A : H96×W96×D69mm (depth in panel 65mm)
- MAC3 B : H96×W48×D66mm (depth in panel 62mm)
- MAC3 D : H48×W48×D66mm (depth in panel 62mm)
- Thickness of applied panel : 1.2-2.8mm
- Size of attachment hole
- MAC3A : H92×W92mm Attachment hole size of horizontal plural proximity attachment W(96×N-4) mm H92mm
- MAC3B : H92×W45mm N=number of equipment W(48×N-3) mm H92mm
- MAC3D : H45×W45mm W(48×N-3) mm H45mm
- Weight MAC3A : About 220g :
- MAC3B : About 160g
- MAC3D : About 120g

Isolation : Except for input, system and contact, all control output are no-isolation
Between event output EV1 and EV2 1 is not insulated
Others are basic insulation or functional insulation.
Refer to the following insulation block chart.

Insulation block chart

———— Basic insulation ————— Functional insulation Not insulated

Power supply		
Measurement input (PV)	System	Control output 1 (contact)
		Control output 1 (a voltage pulse / current)
Control output 2 (contact)		
Control output 2 (voltage pulse / current)		
External control input 1 (DI1)		Event output 1 (EV1)
External control input 2 (DI2)		Event output 2 (EV2)
External control input 3 (DI3)		Event output 3 (EV3)
External control input 4 (DI4)		Analog output (AO)
Current transformer 1 (CT1)		Communication
Current transformer 2 (CT2)		

