MAC10 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.

Contents

SHIMAX CO.,LTD.

Preface

This instruction manual is intended for those who will be involved in wiring, installation, operation and routine maintenance of the MAC10.

This manual describes the care, installation, wiring, function, and proper procedures regarding the operation of MAC10.

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」

MAC10 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.

「⚠ WARNING」

● 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 IEC947.

● 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 0.2A 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.

● This instrument has basic insulation between the power supply and the input-output. When reinforced insulation is needed, the input/output terminals should be connected A: to a device with no exposed chargers, or B: to a device with basic insulation suitable for the highest voltage of power supply and input/output section.

● 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.

2.　Introduction

2-1. Check before use

Before using MAC10, 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

MAC10A―	M	C	F―	2	R
1	2	3	4	5	6

Item

1. Series	MAC10A-:96x96mm size digital controller
	MAC10B-:48x96mm size digital controller
	MAC10C-:72x72mm size digital controller
	MAC10D-:48x48mm size digital controller
2. Input	M:multi,　I:current
3.Control Output 1	C:contact,　S:voltage pulse,　I:current(4-20mA),
4. Power Supply	F-:100～240V(90～264V) AC
5. Event Output	N:none,　1:Event Output1 (one point)
	2:Event Output1,2 (two points)
6. Communication	N: none,　R: RS485

Check of accessories

　　　Instruction manual(excerpt edition): 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 0℃ or above 50℃
(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.
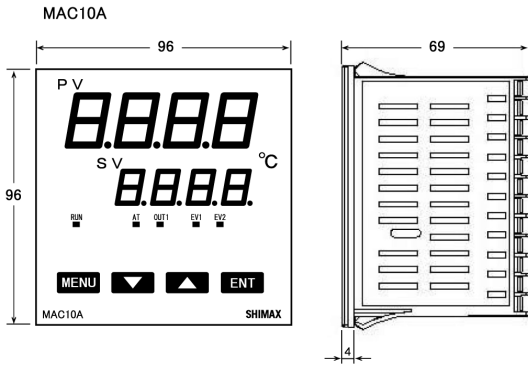

「NOTE」: The environmental conditions comply with the IEC664.
　　　　　Installation category is Ⅱ and the pollution degree is 2.

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.

3-3. External dimension and panel cutout

MAC10 external dimensions (unit: mm)

MAC10A

MAC10B

MAC10C

MAC10D

MAC10 panel cutout (unit: mm)

MAC10A 96×96size

In the case of horizontal proximity attachment by a single hole
N : Number

MAC10B 48×96size

In the case of horizontal proximity attachment by a single hole
N : Number

MAC10C 72×72size

In the case of horizontal proximity attachment by a single hole
N : Number

MAC10D 48×48size

In the case of horizontal proximity attachment by a single hole
N : Number
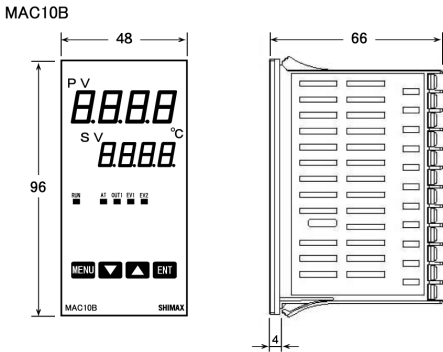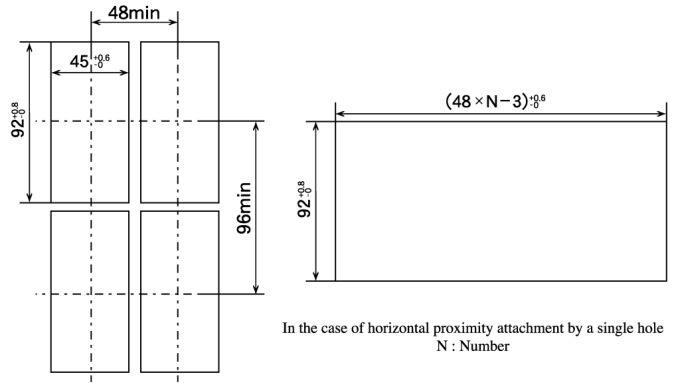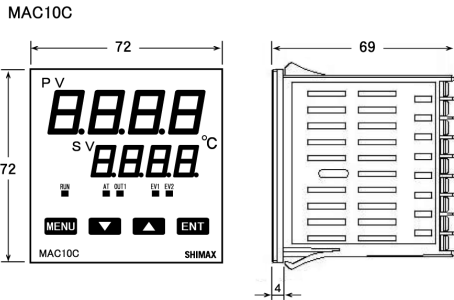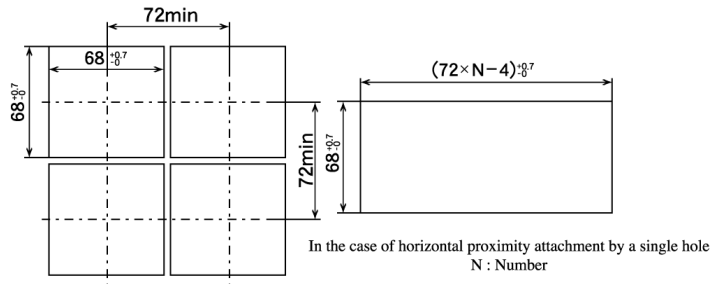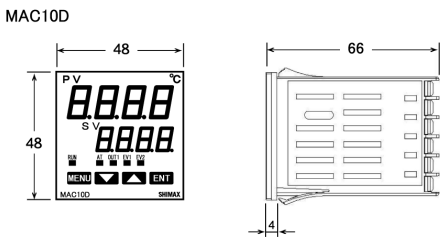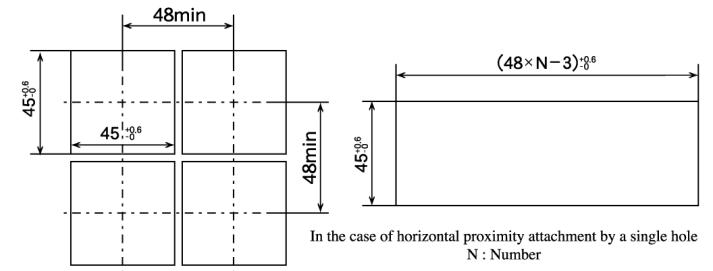
Note: Proximity attachment by a single hole is possible only in the case of horizontal direction. When an apparatus that was attached in vertical direction is removed, a dedicated detachment tool is required.

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 wires 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

Terminal arrangement plan of MAC10A and MAC10B
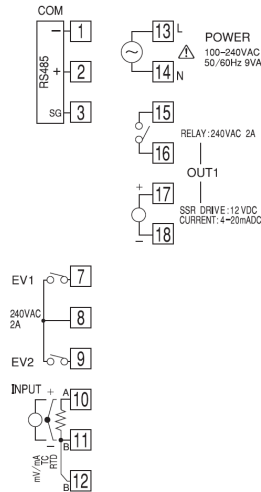
「Note」 : If input type is thermocouple or voltage, errors may occur when terminal 11 and terminal 12 terminal are short-circuited

Terminal arrangement plan of MAC10C
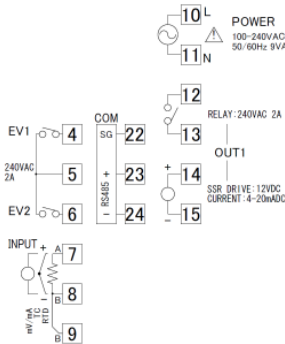
「Note」 : If input type is thermocouple or voltage, errors may occur when terminal 8 and terminal 9 terminal are short-circuited

Terminal arrangement plan of MAC10D
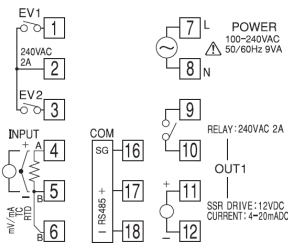
「Note」 : If input type is thermocouple or voltage, errors may occur when terminal 5 and terminal 6 terminal are short-circuited

4. Description of front panel

4-1 Names of front panel

MAC10A 96×96size front   **MAC10C 72×72size front**
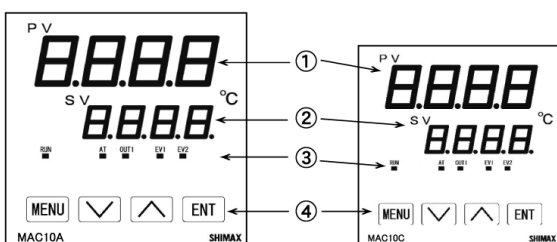
MAC10D 48×48size front   **MAC10B 48×96size front**
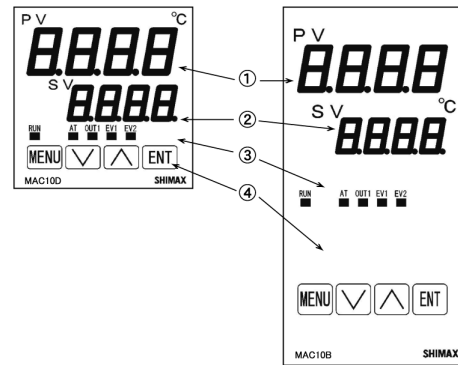
4-2. Explanation of front panel section

① : Display of process value (PV)   (red)

Process value and type of setting is displayed on each setting screen.

② : Display of set value (SV)   (green)

Set value is displayed on each setting screen.

③ : Monitor LED

(1) RUN monitor LED   RUN (green)

If RUN is performed with operation mode1 screen, and communication, it lights up, and put out by standby. It blinks, if a manual output is chosen in output monitoring screen.

(2) Auto tuning operation monitor LED   AT (green)

If AT is chosen in ON, blinks during AT execution. Lights up when AT is on standby, and puts out with AT automatic termination or release.

(3) Control output 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.

(4) Event output monitors LED   EV1 and EV2 (yellow)

Lights up when the allotted event output turns to ON.

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, then it jumps to the basic screen.

(2) ▼ (DOWN) key

Press ▼ (DOWN) key one time, and the shown value decreases by one numerical value. One time press of ▼ 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.

(3) ▲ (UP) key

Press ▲ (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.

> **Supplementary explanation of ▲ key and ▼ key**
> When you continue pressing up/down keys, and press an opposite key, change in the value becomes 1 stage faster. (When the key is pushed for 4 times, it becomes high-speed.)

(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).

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 head screen. Push at FIX and each mode screens' lead screen, then shifts to setting screen.

5. Description of screens

5-1. How to move to another screen

Basic screens
Operation & monitoring

Mode1 - 9 screens
Advanced settings

Power ON

Basic Screen
`25`
`0`

[MENU] 3sec

[MENU] 3sec

[MENU]

Operation mode 1
`25`
`5tby`

[MENU]

Output1 monitor
`25`
`, 0.0`

[MENU]

. . .

[ENT] 3sec

Mode1 lead screen
`ōodE`
`1`

[ENT]

System setting
screens

▼ ▲

Mode2 lead screen
`ōodE`
`2`

[ENT]

Input setting
screens

Mode3 lead screen
`ōodE`
`3`

[ENT]

Output setting
screens

Mode5 lead screen
`ōodE`
`5`

[ENT]

Event setting
screens

Mode9 lead screen
`ōodE`
`9`

[ENT]

Communication
setting screens

FIX lead Screen
`Fī4`
`5Et`

[ENT]

FIX parameter
setting screens

FIX Setting screens
Constant value control settings

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

Press the [▲] 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 [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 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.

Press the [ENT] key for 3 seconds on a basic screen, then it shifts to the lead screen of `Fī4` (constant value control) setting screens.

Press the [MENU] key for 3 seconds on `Fī4` the lead screen of setting screens, then it shifts to the basic screen.

5-2. Setting Method

●Variables and settings

To change settings, display an appropriate screen and change the setting (value or function) by pressing [▲] or [▼] key, And press the [ENT] key (The decimal point of the minimum digit is also lighted off).

●Automatic and Manual output setting

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 [▲] 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 and AT are in operation.

Output monitor
`25`
`, 100.0`

← [ENT] three seconds →

Output monitor
`25`
`, 100.0`

Automatic screen   (RUN lamp lights up)

Manual screen   (RUN lamp blinks)
Press [▲] or [▼] key to change Manual output value.
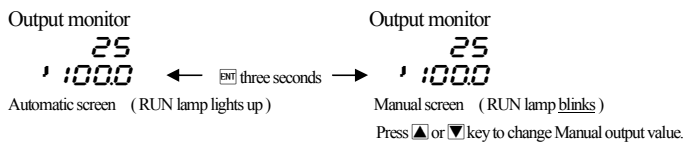
5-3. Power-on and initial screen display

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

Power-on → `8.8.8.8.` `8.8.8.8.` → `īn` `P2` → `0` `130.0` → `out1` `C` → `25` `0` → Basic screen

`8.8.8.8.` `8.8.8.8.`
All LED light up

`īn` `P2`
Input type

`0` `130.0`
Upper limit & lower limit
of measuring range

`out1` `C`
Outout 1 type
`C` :Contact `5` :Voltage pulse
`c` :Current

`25` `0`
Basic screen

5-4. Explanation of each screen

(1) Basic Screens

Basic Screen

25
0

MENU key

Executed SV initial value：Sensor input　0
　　　　　　　　　　　　Linear input　Lower limit of scaring range
Setting range：Sensor input　Within measuring range
　　　　　　　　Linear input　With in scaring range
　　　　　　　　Within SV limiter besides

Process value (PV) is displayed on the upper row as four-digit ,and set value (SV)
is displayed on the lower row also as four-digit. (Notes : hereinafter,
Process value and set value are referred to as"PV" and "SV")
Execution SV is displayed and change of setting is possible.

↓

Operation Mode 1 screen

25
StbY

MENU key

Initial value：**StbY**　(standby)
Setting range：**StbY**　Control stop [Output OFF (0%)] operation
　　　　　　　run　(run)　Conduct of control operation

Choose **run** by ▲ key, Decide by ENT key, then Monitor LED's RUN lights up to start
control operation.
Choose **StbY** by ▼ key, Decide by ENT key, then Monitor LED's RUN lights off and
becomes control stop [Output OFF (0%)] conducting.
When measuring range, a unit, scaling, and output characteristics are changed it is initialized
and **StbY** is displayed.

↓

Output 1 monitoring screen

25
100.0

MENU key

Manual output setting range : 0.0～100.0% (within output limiter)
At the time of automatic output, monitor display only.
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**.
When a power source is intercepted and re-switched on, it returns to the condition just
before intercepting.

↓

Event1 Timer elapsed time monitoring screen

25
0

MENU key

Displays at the time of Event1 Timer function is enabled, and the current elapsed time
(ON period, OFF period, or "**End**") is displayed.

↓

Event2 Timer elapsed time monitoring screen

25
0

MENU key

Contents are the same with that of an Event1 Timer elapsed time monitoring screen.

↓

FIX-SV No. setting screen

F_SU
1

MENU key

Setting range : 1～4
Chosen FIX-SV No. is displayed.

↓

AT (Auto Tuning) execution screen

At
oFF

MENU key

Initial value : **oFF**
Setting range : **oFF**, **on**

AT is performed by ON selection ,and canceled by OFF selection.
Not displayed at the time of STBY, a manual output, and P(proportional band) =OFF.
Except in the setting of keylock OFF, AT is unable to perform in scale over.
Even in such a case, halfway release is performed on this screen.
Release of AT, STBY, EV operating point, setting of keylock, and mode 5 ～ 9 screen are
operateable with key.
Except in th setting of AT normal end, execution of AT is canceled compulsorily at the time
of STBY selection and AT release setup.

↓

EV1 (event 1) operating-point setting screen

EU1
1200

MENU key

Initial value: upper limit absolute value　measuring range or Scaling upper limit
　　　　　　　lower limit absolute value　measuring range or Scaling lower limit
　　　　　　　upper limit deviation　**2000**
　　　　　　　lower limit deviation　**-1999**
　　　　　　　within deviation　**0**
　　　　　　　outside deviation　**2000**

Setting range: upper limit absolute value　within measuring range or scaling limit
　　　　　　　lower limit absolute value　within measuring range or 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

The operating point of the alarm type allotted to EV1 is set up.
No option,　No display when **non**, **So**, **run** 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

EU2
0

MENU key

Initial value,setting range, contents are the same with EV1

↓

Latching release screen

LAch
rSt1

MENU key

Initial value : **rSt1**
Setting range : **rSt1**　release EV1
　　　　　　　rSt2　release EV2
　　　　　　　ALL　release all EVs at a time

On the latching setting screen of each EV mode, **rSt** 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

Lead screen of FIX setting screens is displayed when ENT key is pressed for 3 seconds on a basic
screen. If ENT key is pressed for 3 seconds on lead screen, it returns to basic screen.

basic screen　　　　　　　　　　　　　　　　lead screen of FIX setting
25　　— ENT three seconds → 　　**FiX**
0　　 ← MENU three seconds — 　　**SEt**

FIX lead screen

FiX
SEt

ENT key

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

↓

SV1 setting screen

SU1
0

MENU key

Initial value : At the time of sensor input　0
　　　　　　　linear input time　scaling lower limit
Setting range : sensor input time　within measuring range
　　　　　　　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.

↓

SV2～4 setting screen are the same with that of an SV1 setting screen.

↓

Return to FIX lead screen

(3) Mode 1 screens

Mode 1 lead screen

ᴍodE   Press ᴹᴱᴺᵁ key for 3 seconds on basic screen, then displayed

1

ᴱᴺᵀ key   No setting on this screen. Press the ᴱᴺᵀ key, then it shifts to the first setting
↓   screen, keylock setting screen.

Keylock setting screen

Locᴷ   Initial value : oFF
oFF   Setting range : oFF、1, 2, 3, 5

ᴹᴱᴺᵁ key
    1   Execution SV (basic screen), Manual output value, and keylock level is possible.
    2   Manual output value and key lock level is possible.
    3   Only change of a keylock is possible.
    5   Change of key lock level and Basic screens are possible.

    ┌──┐
    │ Notes: Even when keylock is set as 1 and 2, manual output value is possible to change. │
    └──┘
↓

SV limiter lower limit setting screen

S8_L   Initial value : measuring range lower limit
    0   Setting range : measuring range lower limit value~measuring range upper limit value—1
ᴹᴱᴺᵁ key   And bLᴷ (SV display turn off)
         Lower limit value of set value is set .
         When upper limit value is smaller than lower limit value, the value compulsorily becomes
         lower limit value +1.
         When you choose bLᴷ pressing ▼ at lower limit value ,the SV display turn off at
↓   basic screen. But it will turn on at the setting screen.

SV limiter upper limit value setting screen

S8_H   Initial value : measuring range upper limit
1300   Setting range : SV limiter lower limit value +1~ measuring range upper limit value
ᴹᴱᴺᵁ key   Setting upper limit value of set value is set.
↓

Operating mode after power-on setting screen

Po_r   Initial value : EEP
EEP   setting range : EEP   RUN/STBY status save to non-volatile memory automatically.
ᴹᴱᴺᵁ key   STBY   Operation mode is STBY after power-on.
             RUN   Operation mode is RUN after power-on.

Return to mode1 lead screen.

(4) Mode 2 screens

Mode 2 lead screen

ᴍodE   Press ▲ key in mode1 lead screen, or press ▼ key in mode3 lead screen,
2   then being displayed.
        If ᴱᴺᵀ key is pressed, it shifts to the first setting screen PV offset correction screen.
ᴱᴺᵀ key

PV offset correction setting screen

Pᴠ_o   Initial value : 0
    0   Setting range :—500~500 Digits
ᴹᴱᴺᵁ key   Used for correction of input errors such as sensor.
            If offset correction is performed, control is also performed with the corrected value.
↓

PV gain correction setting screen

Pᴠ_G   Initial value : 0.00
0.00   Setting range : ±5.00%
ᴹᴱᴺᵁ key   Maximum input value is corrected within limit of ±5.00% of measuring range.
            If corrected, inclination of spang changes in straight line which connects zero point and
            correction maximum value.
↓

PV filter setting screen

Pᴠ_F   Initial value : 0
    0   Setting range : 0 ~ 100 seconds
ᴹᴱᴺᵁ key   When input change is violent or noise is overlapped, used in order to ease the
            influences.
            In 0 second setting, filter does not function.
↓

Mesuring range setting screen

rᴀnG   Initial value : multi input ᴷ2, current input ᴀᴀ1
ᴷ1   Setting range : Chosen from 5-5.measuring range code table.
ᴹᴱᴺᵁ key
        Combination of input type and measuring range is set by code.
↓

Input scaling lower limit value setting screen

Sc_L   Initial value : 0.0
0.0   Setting range : -1999 ~ 9989 digits
ᴹᴱᴺᵁ key   Scaling lower limit value at the time of linear input is set up.
            Displays at the time of linear input.
↓

Input scaling upper limit value setting screen

Sc_H   Initial value:100.0
100.0   Setting range: -1989 ~ 9999 digits
ᴹᴱᴺᵁ key   Scaling upper limit value at the time of linear input is set up.
            Displays at the time of linear input.

    ┌──┐
    │ NOTE : Suppose that the difference between a lower limit value and upper limit value is 10 │
    │   or less,or over 10000. 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 10000 count. │
    └──┘
↓

Input scaling Decimal point position Setting screen

dP   Initial value: the first place after decimal point (0.0)
0.0   Setting range: no decimal point 0~the third place after decimal point(0.000)
         Decimal point position of input scaling is set .
ᴹᴱᴺᵁ key   Displays at the time of linear input.
↓

Open thermocouple detection Setting screen

tc_b   Initial value : H
H   Setting range : H, L
         Direction of the open termocouple detection (High or low).
ᴹᴱᴺᵁ key   Displays at the time of Thermocouple input.
↓

Return to mode 2 lead screen.

(5) Mode 3 screens

Mode 3 lead screen

ᴍodE   No setting on this screen.
3   If ᴱᴺᵀ key is pressed, it shifts to the first setting screen, output 1 proportional band
ᴱᴺᵀ key   setting screen. In this screens, PID settings in output 1 and soft start of output 1, and
         proportional period output characteristics are set up.
↓

Output 1 PID proportional-band (P) setting screen

P   Initial value : 3.0%
3.0   Setting range : OFF, 0.1 ~ 999.9%
ᴹᴱᴺᵁ key
         When performing auto tuning, no necessity for a setting basically.
         If OFF is chosen, it becomes ON-OFF (two positions) operation.
↓

Output 1 PID Integral time (I) setting screen

I   Initial value: 120 seconds
120   Setting range: OFF, 1~6000 seconds
ᴹᴱᴺᵁ key
         When performing auto tuning, no necessity for a setting basically.
         This screen is not displayed at the time of ON-OFF operation.
         Becomes P operation or PD operation in I=OFF setting.
↓

Output 1 PID Derivative time (D) setting screen

d   Initial value: 30 second
30   Setting range: 0FF, 1~3600 seconds
ᴹᴱᴺᵁ key
         When performing auto tuning, no necessity for a setting basically.
         This screen is not displayed at the time of ON-OFF operation.
         Becomes P operation or PI operation in D=OFF setting.
↓

Output1 PID manual reset setting screen

ĀΓ   Initial value : 0.0

0.0   Setting range : −50.0 ～ 50.0%

↓ MENU key

    The offset correction at the time of I=OFF (P operation,PD operation]) is performed.

    This screen is not displayed at the time of ON-OFF operation.

↓

Output 1 ON-OFF operation lowside differential-gap setting screen

dFL   Initial value : 5

5   Setting range : 1 ～ 999 unit

↓ MENU key

    The lowside differential gap at the time of ON-OFF operation is set.

    Displayed at the time of P=OFF (ON-OFF operation) setup.

↓

Output 1 ON-OFF operation highside differential-gap setting screen

dFH   Initial value : 5

5   Setting range : 1 ～ 999 unit

↓ MENU key

    The highside differential gap at the time of ON-OFF operation is set.

    Displayed at the time of P=OFF (ON-OFF operation) setup.

↓

Output1 PID minimum limiter setting screen

oL   Initial value : 0.0

0.0   Setting range : 0.0～99.9%

↓ MENU key   Output lower limit value of output 1 PID is set up.

> Note: At the time of STBY and scale over output,
> limiter value is disregarded.

↓

Output 1 PID maximum limiter setting screen

oH   Initial value :100.0

100.0   Setting range : output limiter lower limiter values +0.1～100.0%

↓ MENU key   Upper limit value of output 1 PID is set .

↓

Output 1 soft starting time setting screen

SoF   Initial value : OFF

oFF   Setting range :OFF, 0.5～120.0 seconds (setting resolution 0.5 second)

    This is the function that eases change of output at the time of a power-on and startup.

↓ MENU key   Does not function at the time of OFF setup.

↓

Output 1 proportional periodic time setting screen

oC   Initial value : Contact output   30.0 seconds

30.0   Voltage pulse output   3.0 seconds

↓ MENU key   Setting range : 0.5～120.0 seconds (setting resolution 0.5 second)

    Proportional periodic time of output 1 is set.

    Not displayed when output 1 is current output.

↓

Output 1 characteristics setting screen

Act   Initial value : ΓA

ΓA   Setting range : ΓA, dA

↓ MENU key   Characteristics of control output is chosen from ΓA (heating characteristics)

           and dA (cooling characteristics).

↓

Return to mode 3 lead screen

(6) Mode 5 screens

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

Mode 5 lead screen

ĀodE   No setting on this screen.

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

E1_Ā   Initial value : non

non   Setting range : Chosen from event type character table.

↓ MENU key

    Event type allotted to event 1 is chosen from character table.

↓

Event type character table

Character	Type
non	No allotment
HA	Upper limit absolute value alarm
LA	Lower limit absolute value alarm
So	Scale over alarm
Hd	Maximum deviation alarm
Ld	Minimum deviation alarm
Īd	Within deviation alarm
od	Without deviation alarm
run	RUN signal

※ 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

E1_d   Initial value : 1Digits

1   Setting range : 1～999 Digits

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

    Not displayed, when the event 1 mode are as follows. non, So, run.

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

↓

Event 1 standby operation setting screen

E1_S

oFF   Initial value : oFF

↓ MENU key   Setting range : oFF, 1, 2

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 is switched,

                        When AUTO/MAN is switched.

    Not displayed, when the event 1 mode are as follows. ;non、So、run.

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

Event 1 Delay mode setting screen

E1_P   Initial value : dELY

dELY   Setting range : dELY, tĀr1, tĀr2

↓ MENU key   Event1 delay mode : Delay, Timer1, Timer2

             Refer to <u>6-4 Event Delay & Timer function</u>.

    Not displayed, when the event 1 mode are as follows non.

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

Event1 ON Delay time setting screen

E1dn   Initial value : OFF

oFF   Setting range : OFF, 1～8000 second

↓ MENU key   ON Delay time of Event1 delay function is set.

    Not displayed, when the event 1 mode is non, or Delay mode is Timer.

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

↓

Event1 OFF Delay time setting screen

E1dF   Initial value : OFF

oFF   Setting range : OFF, 1～8000 second

↓ MENU key   OFF Delay time of Event1 delay function is set.

    Not displayed, when the event 1 mode is non, or Delay mode is Timer.

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

↓

Event 1 Timer ON time setting screen

E1tn   Initial value : 1

1   Setting range : 1～600

↓ MENU key   ON period of Event1 Timer function is set.

    Not displayed, when the event 1 mode is non, or Delay mode is Delay.

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

↓

Event 1 Timer OFF time setting screen

E1tF   Initial value : 0

0   Setting range : 0～600

↓ MENU key   OFF period of Event1 Timer function is set.

    Not displayed, when the event 1 mode is non, or Delay mode is Delay.

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

↓

Event 1 Timer unit setting screen

E ItＵ   Initial value : 񑊐Ｃ𝓃

񑊐Ｃ𝓃   Setting range : 񑊐Ｃ𝓃(minute), **SEC**(second)

[MENU] key   Time unit of Event1 Timer function is set.

Not displayed, when the event 1 mode is 𝓃o𝓃, or Delay mode is Delay.

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

↓

Event 1 latching setting screen

E I_L   Initial value : oFF

oFF   Setting range : oFF, o𝓃

[MENU] key

When latching is set as o𝓃, once event is output, even if event is OFF state event output state is held. Not displayed when event 1 mode is 𝓃o𝓃.

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

↓

Event 1 output characteristics setting screen

E I_A   Initial value : 𝓃o

𝓃o   Setting range : 𝓃o, 𝓃c

[MENU] key   Output characteristics event 1 is chosen from 𝓃o : normal open,

𝓃c : normal closing.

Not displayed when event 1 mode is 𝓃o𝓃.

> Note : If 𝓃c is chosen, relay turns to ON within 1.5 seconds when power source is switched on, and turns to OFF in event output range.

↓

Event 2 setting screens

Following contents are the same with that of an Event1 setting screens.

↓

Return to mode 5 lead screen

(7) Mode 9 screens

A group of Mode 9 screens are communication of RS-485 option setting screens.

When the option is not added, these screens are not displayed.

For details, please refer to the instruction manual for communication interface.

5-5. measuring rangecode table

Input type			Code	Measureing Range		
				Unit : ℃		
Multi input	Thermo-couple	K	Ｈ I	0	～	1300
		K	Ｈ2	-50.0	～	999.9
		J	J I	0	～	600
		J	J2	0.0	～	600.0
	Resistance Bulb Pt100		P I	-100.0	～	200.0
			P2	-100	～	200
			P3	-199.9	～	300.0
			P4	-200	～	300
	Volatage(mV) 0 ～ 50		񑊐 I	Scaling Range : -1999～9999 Digit		
Current(mA)	4 ～ 20		񑊐A I	Span :10～10000 Digit		
	0 ～ 20		񑊐A2	Change of decimal point's position is possible (no decimal pont, 0.1, 0.01, 0.001)		

Thermocouple   K, J : JIS/IEC   Resistance bulb   Pt100 : JIS/IEC

Setup of factory shipment is   Multi input : Thermocouple   Ｈ I (0 ～ 1300℃)

Current input : 4-20mA   񑊐A I (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.

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.

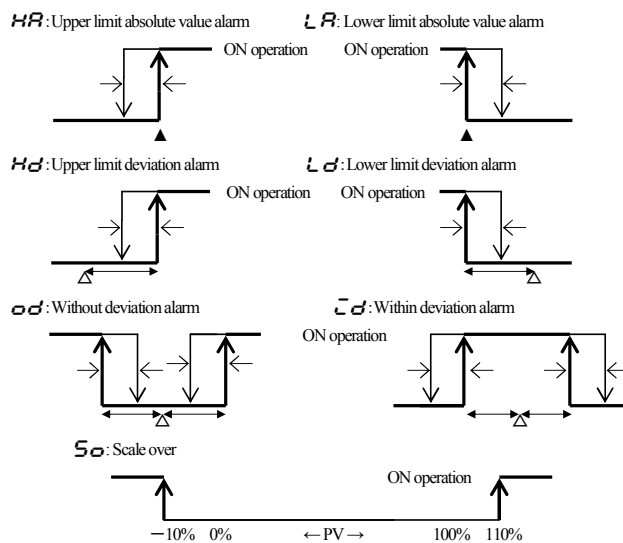Soft- start functions in the following conditions :

・At the time of the power-on in automatic operation, STBY→RUN, and normal return from scale over.

・Output 1 setting is not ON-OFF operation (Setup of proportional band (P) is other than OFF)

・Soft starting time is not OFF

6-3. Event Selection Alarm Operation Figure

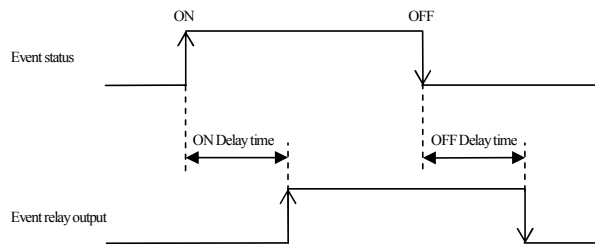The figure of alarm operation figure allotted to event 1～2 is shown.

△ : SV   ▲ or ←→ : Alarm operating point setting value
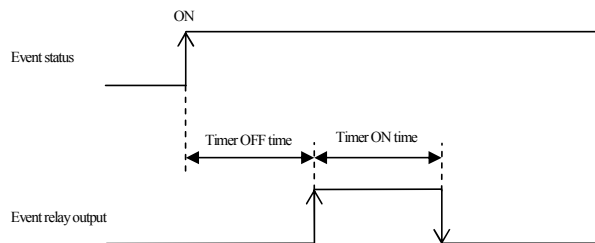
→ ← : Differential gap

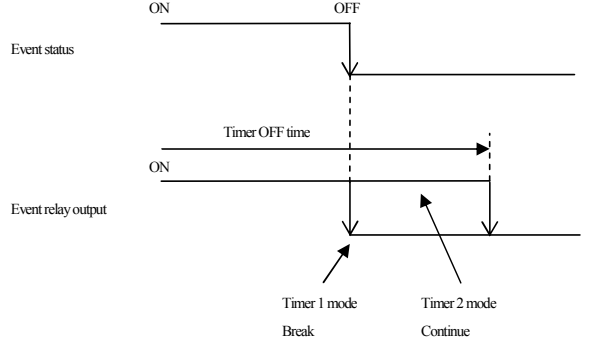HA : Upper limit absolute value alarm   LA : Lower limit absolute value alarm

Hd : Upper limit deviation alarm   Ld : Lower limit deviation alarm

od : Without deviation alarm   Cd : Within deviation alarm

So : Scale over

−10% 0%   ←PV→   100% 110%

6-4. Event Delay & Timer function

(1)Delay mode

(2)Timer mode

※Difference of Timer 1 and Timer 2

Timer 1 mode   Timer 2 mode

Break   Continue

6-5. 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.

7.Trouble Shooting

7-1. Cause and Treatment of Main Defects

Contents of defects	Cause	Treatment
Error message display	Refer to "7-2 cause and treatment of error display".	Refer to "7-2 cause and treatment of error display".
PV display is not normal	Mismatch of instrument and input.	Type code, check of specification.
	Fault in the wiring.	Check of wiring.
Display disappeared and does not operate	Power is not supplied.	Check of a power supply (voltage of terminal, switch, fuse, wiring).
	Abnormality of instrument.	Check of instrument, repair, exchange.
Key operation impossible	Keylocked.	Release of keylock.
	Abnormality of instrument.	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	Scale over in upper limit	1.wire breaking of thermocouple and mV 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 and mV input wiring, replacement of thermocouple 2.check of resistance bulb A 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	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 reverse, check of wiring and an input transmitter 2.check of resistance bulb B wiring, replacement of resistance bulb
		(B: Wiring of MAC10A/B's terminal No.11, Wiring of MAC10C's terminal No.8, Wiring of MAC10D's terminal No.5)	
_b---_	Breaking of resistance bulb input	1.wire breaking of b	1.check of resistance bulb wiring
		(b: Wiring of MAC10A/B's terminal No.12, Wiring of MAC10C's terminal No.9, wiring of MAC10D's terminal No.6)	
		2.multiple wire breaking combinations in ABb (A and B, A and b, B and b, all of ABb)	2.replacement of resistance bulb
CJHH	Cold junction (CJ) temperature of thermocouple input is scale over in upper limit side	When ambient temperature of a meter exceeds 80℃	1.make Ambient temperature of meter within use environment condition temperature 2. Check the meter when ambient temperature is not over 80℃
CJLL	Cold junction (CJ) temperature of thermocouple input is scale over in lower limit side	When ambient temperature of meter becomes less than −20℃	1.make Ambient temperature of meter within use environment condition temperature 2. Check the meter when ambient temperature is not less than -20℃

8. Numeric value and character display on LED

Numeric values

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9

Alphabetical characters

| A	b	Cc	d	E	F	G	Hh	I	J	K	L	M	N
A	B	C	D	E	F	G	H	I	J	K	L	M	N
o	P	q	r	S	t	U	V	X	Y	Z	−	_	
O	P	Q	R	S	T	U	V	W	X	Y	Z	—	__

9. Specification

Display

Display method	Digital display	MAC10A (96x96 size)	PV red 7 segment LED	4 figure (height of character about 20mm)
			SV green 7 segment LED	4 figure (height of character about 13mm)
		MAC10B (48x96 size)	PV red 7 segment LED	4 figure (height of character about 12mm)
			SV green 7 segment LED	4 figure (height of character about 9 mm)
		MAC10C (72x72 size)	PV red 7 segment LED	4 figure (height of character about 16mm)
			SV green 7 segment LED	4 figure (height of character about 16 mm)
		MAC10D (48x48 size)	PV red 7 segment LED	4 figure (height of character about 12mm)
			SV green 7 segment LED	4 figure (height of character about 9mm)
		Status display	RUN (green), AT (green), OUT 1(green), EV1 (yellow), EV2 (yellow)	

Display accuracy   ±(0.5%FS+1digit) CJ errors not included
Accuracy maintenance range   23±5℃
Display range   -10%～110% of measuring range, but 0～1300℃ of TC(K type) is -30～1320℃, -50.0～999.9℃ of TC(K type) is -80.0～1030.0℃

Display resolution	Changes with measuring range and scaling.
Input scaling	Possible at the time of linear(mV, current) input -1999～9999
	(span 10～10000 count, decimal point position no decimal point, 0.1, 0.01, 0.001)

Setting

Setting system	By four front keys（ MENU ▼ ▲ ENT ）
SV Setting range	Same with measuring range
Setting lock	Communication and key seting (five levels)

Operations	Level	Lock content
Communication &	OFF	No lock
Key setting	1	Possible to change Execution SV, Manual output value, and keylock level.
	2	Possible to change Manual output value and keylock level.
	3	Possible to change keylock level.
	5	Possible to change basic screens and keylock level.

(Setting lock level 4 is unavailable)

SV setting limiter	Same with measuring range (lower limit ＜ upper limit)
Unit setting	At the time of sensor input, ℃

Input

Sampling period	0.25 second
PV filter	0～100 second
PV offset compensation	±500 unit
PV gain correction	±5.00%

■Thermocouple

Input resistance	500kΩ or more
External resistance tolerance level	100Ω or less
Influence of lead-wire resistance	0.23µV/Ω(up scale), -0.34µV/Ω(down scale) (Typical value)
Burnout	Standard equipment (up scale or down scale)
Measuring range	Refer to 5-5 measuring range code table.
Compensation accuracy	±2℃ (ambient temperature 18～28℃) At the time of vertical plural proximity attachment ±3℃
of reference junction	±3℃（ambient temperature 0～50℃) At the time of vertical plural proximity attachment ±4℃
	Several minutes after power-on, accuracy is not guaranteed. Reaches the accuracy level within 10 minutes after power-on.
Tracking of a reference junction	Below the ambient temperature of 0.5 ℃ / min, relative compensation accuracy of reference junction ±1℃

■Resistance bulb

Stipulated current	Approx. 0.25mA
Lead wire resistance tolerance level	5Ω or less per wire (Resistance of three lines should be equal)
Influence of lead-wire	5Ω or less per wire 0.2%FS
	10Ω or less per wire 0.5%FS
	20Ω or less per wire 1.0%FS
Measuring range	Refer to 5-5 measuring range code table.

■Voltage (mV)

Input resistance	500kΩ or more
Input voltage range	Refer to 5-5 measuring range code table.

■Current input (mA)

Reception resistance	60Ω or less (built-in)
Input range	Refer to 5-5 measuring range code table.

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 (DFL,DFH)	1～999 unit
Integration Time (I)	OFF, 1～6000 seconds (PD operation by OFF setting)
Derivative time (D)	OFF, 1～3600 seconds (PI operation by OFF setup) } P operation if both I and D are OFF.
Manual Reset (MR)	±50.0% (effective when set as I = OFF)
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	Possible to choose either RA (heating) or DA (cooling)
Manual output	0.0～100.0% (set resolution 0.1)

■Control output 1

Contact	Normal open (1a) 250VAC / 30VDC 2A (resistance load)
Voltage pulse (SSR drive)	13±2V DC MAX20mA
Current	4 - 20mA DC load resistance 500Ω or less, Display accuracy ±1% (accuracy maintenance range 23℃±5℃),
	Load regulation ±0.2%, resolution approx. 1/10000

Event 1, 2 (Option)

Output rating   Contact   Normal open (1a)   250VAC / 30VDC 2A (resistance load, EV1・EV2 and common)

Kind of event   Refer to following table.

Function	Character	Note
No allotment	non	
Upper limit absolute value Alarm	HA	
Lower limit absolute value alarm	LA	
Scale over alarm	So	HHHH, LLLL, B----　Operates, when displayed.
Upper limit deviation value Alarm	Hd	
Lower limit deviation value alarm	Ld	
Within deviation alarm	⁻d	
Without deviation alarm	od	
RUN signal	run	Operates during FIX in operation.

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

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 is switched over standby operation, at the time of AUTO/MAN switchover

Latching   Alarm operation maintenance function

     (Release is done by key operation or power OFF. In the case of release by 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 within 1.5 second and becomes OFF at event power range.

■Delay function

Delay time   OFF, 1～8000 second

Time accuracy   ±(0.67% of Setup time + 1 second)

■Timer function

ON time   1～600

OFF time   0～600

Unit of timer   minute or second

Time accuracy   ±(0.67% of Setup time + 1 second)

Break in the timer operation   Acceptable at event turns off (Timer 1 mode) or unacceptable(Timer 2 mode)

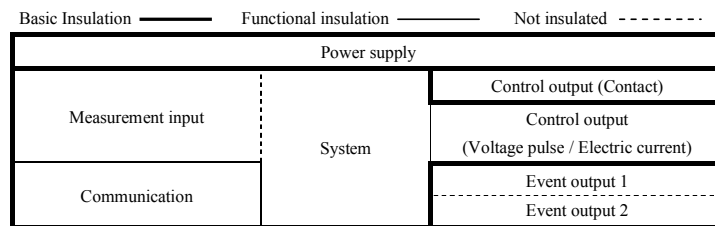## Communication (Option)

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   9600 or 19200 bps

Data format   Start 1bit, Stop 1 or 2 bits, Data length 8 bits, Parity without, odd number, even number

Slave address   1～255

Master mode function   None

Parameter preservation mode   Choose from RAM, MIX and EEP mode.

Error detection   SHIMAX Standard   Choose from None, ADD, complement of ADD +2, exclusive OR

     MODBUS RTU   CRC-16

     MODBUS ACII   LRC

Flow control   None

Delay   1～250ms (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)

General specification

Data retention	Non-volatile memory (EEPROM)
Temporary dead time	No influence within 0.02 second 100% dip

Use environmental condition

Temperature	0～50 ℃
Humidity	Below 90%RH (no dew condensation)
Height	Altitude of 2000m or less
Category	Ⅱ
Contamination degree	2

Storage temperature Conditions	-20～65 ℃
Supply voltage	100～240V (90～264V) AC 50/60Hz
Power consumption	100～240V AC Maximum 9VA
Insulated class	Class I apparatus
Input noise removal ratio	Normal 40dB or higher
Impulse-proof noise	Power-source Normal 100ns/1μs±1500V
Insulation resistance	Between input/output terminal and power supply terminal 500V DC 20MΩ or higher
	Between communication and other input/output terminals 500V DC 20MΩ or higher
Withstand voltage	Between input/output terminal and power supply terminal 1800V AC 1 minute
	Between communication and other input/output terminals 500V AC 1 minute
	Between control output1(Voltage pulse or current) and other input/output terminals 500V AC 1 minute
Case material	PPO or PPE
Case color	Light gray
Outside dimension	MAC10A H96×W96×D69mm (depth in panel 65mm)
	MAC10B H96×W48×D66mm (depth in panel 62mm)
	MAC10C H72×W72×D69mm (depth in panel 65mm)
	MAC10D H48×W48×D66mm (depth in panel 62mm)
Thickness of applied panel	1.2～2.8mm

Size of attachment hole

	Individually attachment	Horizontal plural proximity attachment (N=number of equipment)
MAC10A	H92×W92mm	W(96×N-4) mm H92mm
MAC10B	H92×W45mm	W(48×N-3) mm H92mm
MAC10C	H68×W68mm	W(72×N-4) mm H68mm
MAC10D	H45×W45mm	W(48×N-3) mm H45mm

Mass

MAC10A	About 220g
MAC10B	About 160g
MAC10C	About 160g
MAC10D	About 120g

Isolation Between event output 1 and 2 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	System	Control output (Contact)
		Control output (Voltage pulse / Electric current)
Communication		Event output 1
		Event output 2

The contents of this instruction are subject to change without notice.

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