SHIMAX

MAC5 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

Preface

This instruction manual is intended for those who will be involved in wiring, installation, operation and routine maintenance of the MAC5.

This manual describes the care, installation, wiring, function, and proper procedures regarding the operation of MAC5.

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」

MAC5 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.

lVoltage/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 MAC5, 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

MAC5A―	M	C	F―	E	C
1	2	3	4	5	6

1. Series   MAC5A―:96×96mm size digital controller
   MAC5B―:48×96mm size digital controller
   MAC5C―:72×72mm size digital controller
   MAC5D―:48×48mm size digital controller
2. Input   M:multi,
3. Control Output 1   C:contact, S:voltage pulse, I:current(4～20mA)
4. Power Supply F―:90 - 264V AC,
5. Event Output E:Event Output1・2 (two points)
6. Control Output 2・Event Output・Optional Selection
   N―:none, C―:contact, S―:voltage pulse, E―:Event out
   D-Digital input one point

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 water drops or direct sunlight exists.
(7) Where the altitude is above 2,000m.

「NOTE」: The environmental conditions comply with the IEC664.
   Installation category isⅡ 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.
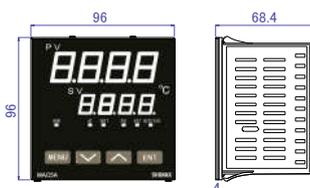(3) As this product provides mounting fixture, insert the product into the panel.

「NOTE」:
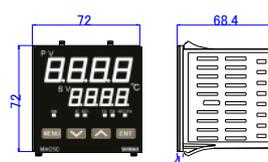
MAC 3 is a panel set-up type.

Please use the product after setting up to the panel.

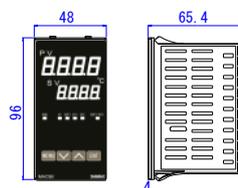## 3-3. External dimension and panel cutout (unit: mm)
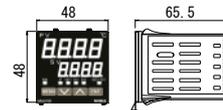
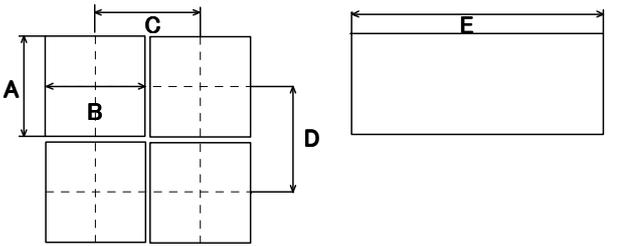MAC5A 96mm*96mm

MAC5C 72mm*72mm

MAC5B 48mm*96mm

MAC5D 48mm*48mm

MAC5 panel cutout (unit: mm)

	A	B	C	D	E
MAC5A	92 $^{+0.8}_{-0}$	92 $^{+0.8}_{-0}$	96min	96min	(96*N-4) $^{+0.8}_{-0}$
MAC5B	92 $^{+0.6}_{-0}$	45 $^{+0.6}_{-0}$	48min	96min	(48*N-3) $^{+0.6}_{-0}$
MAC5C	68 $^{+0.7}_{-0}$	68 $^{+0.7}_{-0}$	72min	72min	(72*N-4) $^{+0.7}_{-0}$
MAC5D	45 $^{+0.6}_{-0}$	45 $^{+0.6}_{-0}$	48min	48min	(48*N-3) $^{+0.6}_{-0}$

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.
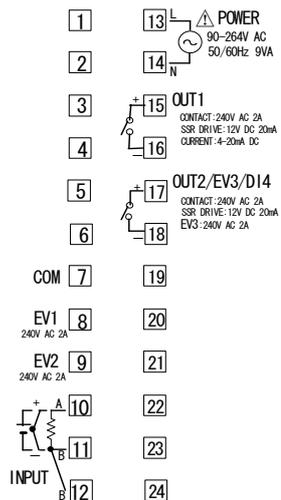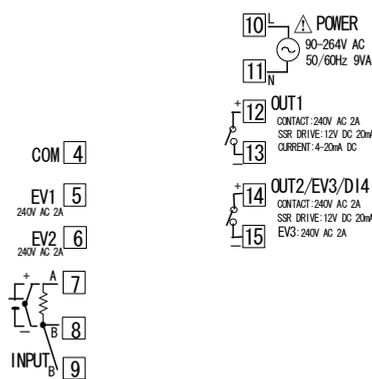
3-4. Wiring

「⚠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.
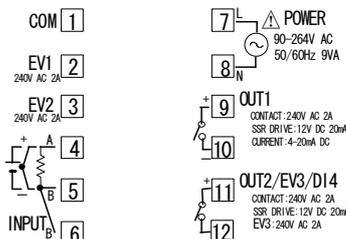
3-5. Terminal arrangement diagram

Terminal arrangement MAC5A,B
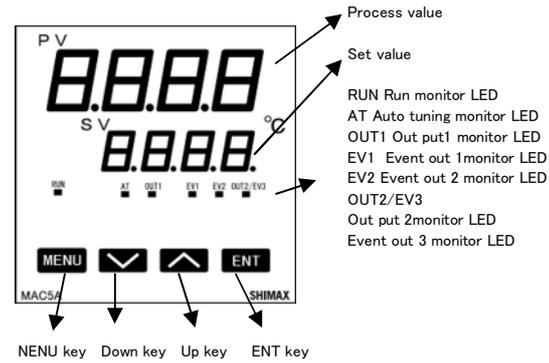
Terminal arrangement MAC5C

Terminal arrangement MAC5D

「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.

Process value
Set value
RUN Run monitor LED
AT Auto tuning monitor LED
OUT1 Out put1 monitor LED
EV1 Event out 1monitor LED
EV2 Event out 2 monitor LED
OUT2/EV3
Out put 2monitor LED
Event out 3 monitor LED

NENU key   Down key   Up key   ENT key

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).

(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)key
Press this key to move onto the next screen among the screens. Press (MENU) key for three seconds on the basic screen, then it jumps to the lead screen of Mode 1. Press key for three seconds on the lead screen of each Mode screens, then it jumps to the basic screen.
Press key for three seconds on the lead screen of (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.

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).

Press ENT key for 3 seconds on the output monitoring screen, then the shift between manual output and automatic output is carried out.

5. Description of screens

5-1. How to move to another screen

Basic Screen　　　　　　　**Operation Setting screens**

Press ENT three seconds

Press MENU three seconds

Press the ENTkey for 3 seconds on a basic screen, then it shifts to the lead screen of setting screens.

Press the MENUkey for 3 seconds on　FC५　, then it shifts to the basic screen

Mode setting screen

Press MNU three seconds

Press ENT key , then it shifts to the each MODE setting screen.

▼　　▲

Change the parameter

MENU

Press ENT to fix

Press MNU key , then it shifts to the next parameter setting screen in each MODE setting screen

Press MNU key

5-2. Setting Method

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

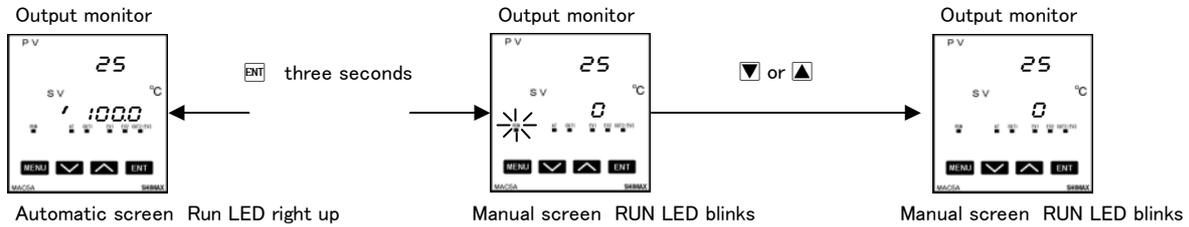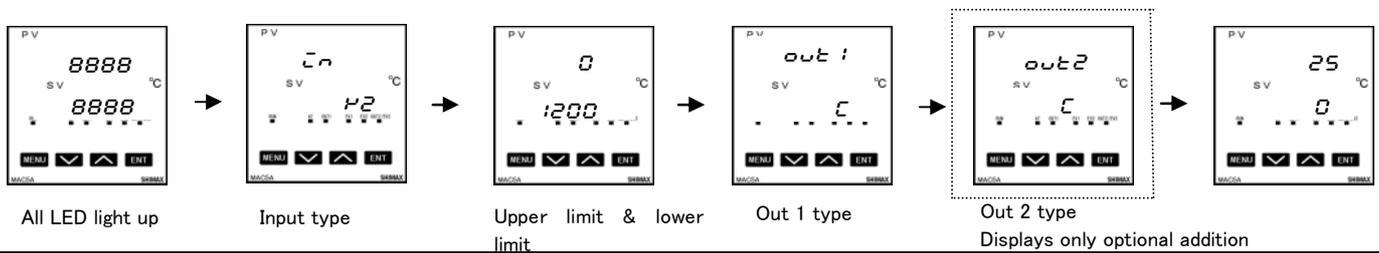| Output monitor		Output monitor		Output monitor
[ENT] three seconds	←	▼ or ▲	→	
Automatic screen Run LED right up		Manual screen RUN LED blinks		Manual screen RUN LED blinks

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.

| All LED light up | Input type | Upper limit & lower limit | Out 1 type | Out 2 type
Displays only optional addition | |

5-4. Monitoring screen

Basic screen

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
Targeted value (PV) is displayed on the upper row as four-digit ,and targeted value (SV) is displayed on the lower row also as four-digit. (Notes:hereinafter measured value and targeted value are referred to as"PV" and "SV")
At the time of FIX, execution SV is displayed and change of setting is possible.

[MENU]

Action Mode1 screen

Initial value::ㄣㅏㄅㄾ(stanby)(Initial value at the time of constant value control)
Setting range::ㄣㅏㄅㄾ Control stop [Output OFF (0%)] operationㄷㄩㅁ conduct of control operation Choose ㄷㄩㅁ (RUN) by ▲key. Decide by[ENT] key, then Monitor LED's RUN lights up to start control operation.
Choose ㄣㅏㄅㄾ 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 andㄣㅏㄅㄾ is displayed.
Priority is given to DI when RUN is allotted to external control input.
DI. Key operation cannot be performed unless allotment is canceled.

[MENU]

Out put 1 monitoring screen
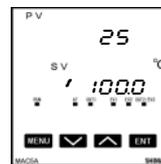
Manual output setting range: :0.0-100.0% (within output limiter) At the time of automatic output,monitor display only. Refer to Item 5-2 about automatic ⇔ manual switch over, and setting method at the time of manual operation. A manual output is canceled when an operation mode is made into ㄣㅏㄅㄾ When a power source is intercepted and re-switched on, it returns to the condition just before intercepting.

[MENU]

Out put 2 monitoring screen
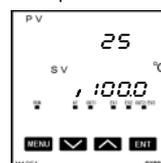
Contents are the same with that of an Output1. Output 2 monitoring screen displayed only when Output 2 option is added.

[MENU]

PID No, monitoring screen
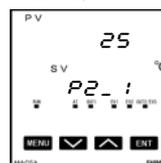
Chosen PID №. is displayed when FIX is in operation.
PID №. of output 1 is displayed in the first digital, and PID №. of output 2 is displayed in the third digital. The third digital is shown as ・ when there is no output 2 option. This screen is not displayed in the state of STBY .

[MENU]

AT (Auto tuning) execution screen
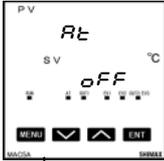
Initial value:: oFF
Setting range:: oFF、on

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 key lock 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, halfway release is performed on this screen.

Release of AT, STBY, EV operating point, setting of key lock, and mode 5 ～ 6 screen are operate able with key. Except in the setting of AT normal end, execution of AT is canceled compulsorily at the time of STBY(RST) selection and AT release setup.

EV1(Enent 1)operationg point setting screen

Initial value: upper limit absolute value measuring range Scaling upper limit lower limit absolute value measuring range Scaling lower limit

Upper limit deviation	2000
Lower limit deviation	-1999
Within deviation	0
Outside deviation	2000
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   -1999~2000unit
Lower limit deviation   -1999~2000unit
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, 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

EV2(Enent 2)operating point setting screen
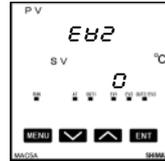
Initial value ,setting range, contents are the same with EV1

EV3(EVnent 3)operating point setting screen
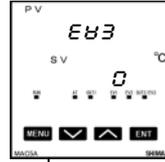
Initial value, setting range, contents are the same with EV1

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
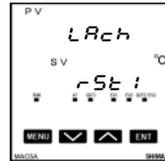
Initial value:: rSt 1
Setting range:: rSt 1 release EV1
rSt2 release EV2
rSt3 release EV3
ALL   release all EV at a time

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

Basic screen

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6. Operating setting

Basic screen
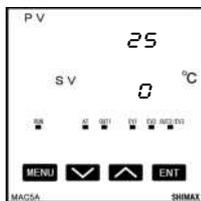
Press ENT three seconds →
← Press MENU three seconds

Operating setting screens

FCh
SEt
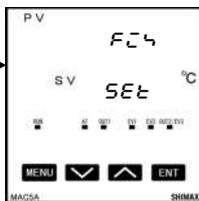
SV1 setting screen
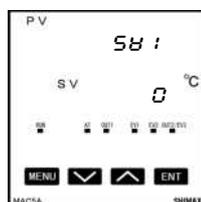
Initial value : At the time of sensor input   0
linear input time scaling lower limit
Setting range: sensor input time   within measuring range
linear input time within scaling range

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.

SV1 output1 PID No. setting screen
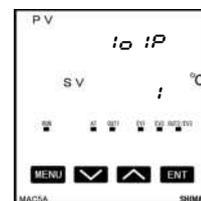
Initial value : 1
Setting range:1, 2, 3
When SV1 is Execution SV,PIDNo. that will be used for control of output 1is chosen from 1～3.

SV1 output2 PID No. setting screen

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

Displayed when output 2 option is added.

SV2-4 setting screen

PV **582**

SV **0** ℃

RUN · AT OUT1 · EV1 OUT2/EV2

MENU ∨ ∧ ENT

MAC5A SHIMAX
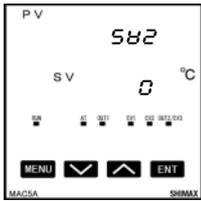
Initial value: same with SV1
Setting range: same with SV1

Displayed when SV2-4 is allotted to DI.When terminal of allotted DI short-circuits, it becomes Execution SV.
When SV2-4 is Execution SV, it is reflected in basic screen.
Being initialized when measuring range, unit, and scaling are changed.

MENU

↓

SV2 output1 PID No. setting screen

↓

SV2 output2 PID No. setting screen

↓

SV3 setting screen

↓

SV4 setting screen

↓

SV4 output2 PID No. setting screen

↓

PV **FCh**

SV **SEt** ℃

RUN · AT OUT1 · EV1 OUT2/EV2

MENU ∨ ∧ ENT

MAC5A SHIMAX
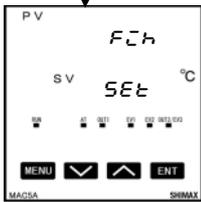
Operating setting screens

7.MODE setting

MODE 1 : Key lock and SV limit setting

MODE 2 : PV and scale setting

MODE 3 : OUT 1 setting

MODE 4 : OUT2 setting

MODE 5 : EV setting

MODE 6: DI setting

7-1 .MODE1 :Key lock and SV Limit setting

MODE 1 Key Lock and SV limit setting	
Display	**Description**
LocH oFF	Key lock Initial value:oFF
1	Only change of Execution SV (basic screen) and keylock is possible
2	Only change of a keylock is possible.
3	Shift between screen prohibited .Fixed only basic screen.
4	Shift between screen prohibited .Fixed only basic screen.

7-2. MODE2:Scale and PV setting

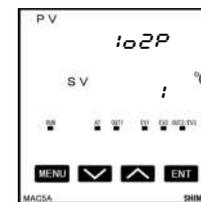| MODE 2 Scale and PV setting	
Display	**Description**
PY_o o	**PV offset correction (PV bias) setting screen** Setting range:-500~500 unit Used for correction of input errors such as sensor. If offset correction is performed, control is also performed with the corrected value
PY_G 0.00	**PV gain correction setting screen** Initial value:0.00 Setting range: ±5.00% 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.
PY_F 0	**PV filter setting screen** Initial value:0 Setting range: 0 ~ 9999 seconds When input change is violent or noise is overlapped, used in order to ease the influences. In 0 second setting, filter does not function.
rAnG P1	**Measuring range setting screen** Initial value multi P2 Setting range: Chosen from 7-7.measuring range code table.
UnCt c	**Temperature unit setting screen** Initial value:c The temperature unit at the time of a sensor input is set up from c (℃) , F (℉). Not displayed when the linear input is chosen.
Sc_L 0.0	**Input scaling lower limit value setting screen** Initial value:0.0 Setting range: -1999 ~ 9989 unit Scaling lower limit value at the time of linear input is set up
Sc_H 100.0	**Input scaling upper limit value setting screen** Initial value:100.0 Setting range: -1989 ~ 9999 unit Scaling upper limit value at the time of linear input is set up. **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
dP	**Input scaling Decimal point position Setting screen** Initial value: the first place after decimal point (0.0) Setting range: no decimal point 0~the third place after decimal point(0.000) Decimal point position of input scaling is set **Note:** The screen of input scaling serves as a monitor at the time of a sensor input. setting change cannot be performed.

7-3.MODE3-4:Out 1-2 setting

MODE 3-4 Out 1-2 setting	
Display	**Description**
L_P1 3.0	**Output 1 PID1 proportional-band (P) setting screen** Initial value:3.0% Setting range:OFF, 0.1 ～ 999.9% When performing auto tuning, no necessity for a setting basically. If OFF is chosen, it becomes ON-OFF (two positions) operation.
I_C1 120	**Output 1 PID1 Integral time (I) setting screen** Initial value: 120 seconds Setting range: 0FF, 1～6000 seconds 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
I_d1 30	**Output 1 PID2 Derivative time (D) setting screen** Initial value: 30 second Setting range: 0FF, 1～3600 seconds 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.
Inr1 0.0	**Output1 PID2 manual reset setting screen** Initial value:0.0 Setting range: －50.0～50.0% 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.
IdF1 5	**Output 1 PID2 differential-gap setting screen** Initial value: 5 Setting range: 1 ～999 unit The differential gap at the time of ON-OFF operation is set Displayed at the time of P=OFF (ON-OFF operation) setup
IoL1 0.0	**Minimum limiter setting screen** Initial value:0.0 Setting range: 0.0～99.9% Output lower limit value of output 1 PID1 is set up. **:Note:At the time of STBY and scale over output** limiter value is disregarded
IoH1 100.0	**Output 1 PID2 maximum limiter setting screen** Initial value:100.0 Setting range: output limiter lower limiter values +0.1～100.0%
L_P2	**Output 1 PID2 proportional band (P) setting screen** **Same as Output 1 PID1**
L_P3	**Output 1 PID3 proportional band (P) setting screen** **Same as Output 1 PID1 & PID2**
ISoF oFF	**Output 1 soft starting time setting screen** Initial value: 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. Does not function at the time of OFF setup
I_oC 30.0	**Output 1 proportional periodic time setting screen** Initial value: Contact output 　　30.0 seconds Voltage pulse output 　　3.0 seconds 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.
IAct rA	**Output 1 characteristics setting screen** Initial value:rA Setting range:rA、dA Characteristics of control output is chosen from rA (heating characteristics) and dA (cooling characteristics)

7-4. MODE 5:Event setting

MODE 5 Event setting	
Display	**Description**
E1_m non	**Event 1 operation-mode setting screen** Initial value:non **Setting range: Chosen from event type character table page 12.**
E1_d 5	**Event 1 differential-gap setting screen** Initial value:5unit Setting range: 1～999 unit 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.
E1_S oFF	**Event 1 standby operation setting screen** Initial value::oFF 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-o 　　　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 Change in measuring range, scaling, unit, and the event 1 mode make it initialize
E1_L oFF	**Event 1 latching setting screen** Initial value:oFF Setting range:oFF、on 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
E1_A no	**Event 1 output characteristics setting screen** Initial value:no Setting range:no、nc Not displayed when event 1 mode is 　　　non If nc is chosen,relay turns to ON about 1.8 seconds later when power source is switched on,and turns to OFF in event output range
E2_m	**Event 2 operation-mode setting screen** Same as Event 1
E3_m	**Event 3 operation-mode setting screen** Same as Event 1&2

7-5 .MODE6:DI setting

MODE 6 Digital input setting	
Display	Description
ᴅ4_ᴁ	DI 4 mode setting screen
∩on	initial value:∩on
	Setting range: chosen from DI operation character table

7-6 .DI operation character table

DI character	Operation type	Input detection	Contents
∩on	No allotment		
Sᴁ2	2nd SV	level	With closed DI terminal Execution SV = 2nd SV
Sᴁ3	3rd SV	level	With closed DI terminal Execution SV = 3rd SV
Sᴁ4	4th SV	level	With closed DI terminal Execution SV = 4th SV
⌐u∩	control RUN	level	RUN with closed DI terminal, STBY with open one.
ᴁᴀ∩	manual input	level	Manual with closed DI terminal,auto with open one.
ᴀᵗ	auto tuning	edge	AT-start with rise edge.
L·⌐S	latching release	edge	All latching are released by rise edg.
Locᴴ	super key lock	level	Super key lock with closed DI terminal. Release with opened.

7-7 .Measuring range code table

Input type			code	Measuring Range	
				unitcod ᴄ (℃)	unit code ᶠ (℉)
M U L T I I N P U T	Thermo couple	R	⌐ 1	0 ～1700	0 ～3100
		K	ᴴ 1	−199.9 ～400.0	−300 ～ 700
		K	ᴴ2	0 ～1200	0 ～2200
		K	ᴴ3	0.0 ～300.0	0 ～ 600
		*6K	ᴴ4	0.0～800	0 ～ 1500
		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	∩1	0 ～1300	0 ～2300
		*1 B	ᵇ1	0 ～1800	0 ～3300
		*3 Wre5-26	Sᵖ26	0 ～2300	0 ～4200
		*4 PLⅡ	PLᴄ2	0 ～1300	0 ～2300
	Resistance bulb Pt100		P 1	−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
			JP 1	−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)	0～10	ᴁ 1		
		0～100	ᴁ2		Scaling range：−1999～9999 count
		−10～10	ᴁ3		
		0～20	ᴁ4		Scaling range：−1999～9999 count
		0～50	ᴁ5		Span：10～10000 count

· When Sᴁ2 ～ Sᴁ4 are conducted during AT execution, they are performed at the time of AT termination.

· When Sᴁ2 ～ Sᴁ4 are allotted to to each DI, priority is given to 2-3-4 in order. ᴀᵗ can be performed at the time of a RUN-automatic output.

· When ᴀᵗ 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 ∩on 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**.

```
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℃ (752℉).

*2 thermo couple   In K, T, U,accuracy is±0.5%FS for 0～−100℃ (−148℉) and ±1.0%FS if it is below−100℃

*3 thermo couple   Wre 5-26: Product of Hoskins Mfg. co.,

*4 thermo couple   PLⅡ : Platinel

*5 thermo couple   U:DIN43710

*6 thermo couple   K4 This function will add from the shipment in January, 2008.

* Setup of factory shipment is Multi input: thermo couple ᴴ2   0-1200℃

8. Supplementary Explanation of Function

8-1 .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).

8-2.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

8-3.Event Selection Alarm Operation Figure

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

L·ᴀ: Lower limit absolute value alarm   ᴴᴀ: Upper limit absolute value alarm

△: SV   ▲: Alarm operating point setting value

Hᴅ : Upper limit deviation alarm   Lᴅ : Lower limit deviation alarm

oᴅ : Without deviation alarm   ᴄᴅ : Within deviation alarm

So: Scale over
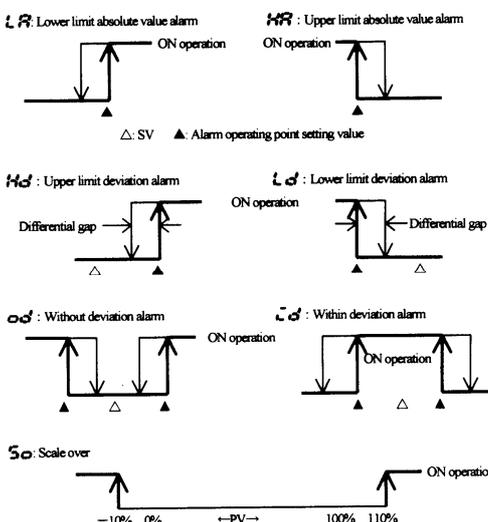
8-4.AT (Auto Tuning)

・If AT is performed by FIX (constant value control)、AT monitor LED blinks and light is put out by termination or intermediate release.
・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 v

8-5 .Output-characteristics figure

2-output -characteristics is shown in the following figure.
◎ Conditions: P operation, manual reset ($\overline{\cap}\cap$) -50.0%

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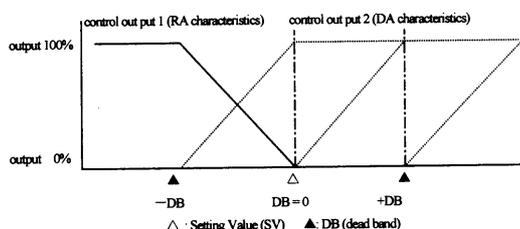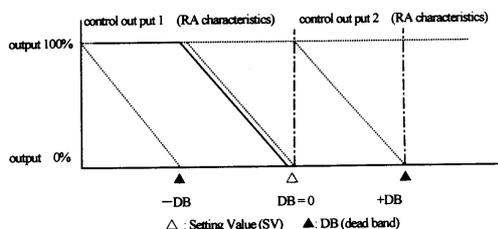
2) OUT 1RA (heating)・ OUT 2 RA (heating)

9. Trouble Shooting

9-1. 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	Key locked. Abnormality of instrument.	Release of key lock. Check of instrument, repair, exchange.

9-2. Cause and Treatment of Error Display

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 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 (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 everse, check of wiring and an input transmitter 2.check of resistance bulb B wiring, replacement of resistance bulb
		*B: Wiring of MAC5A, 5B's terminal No.11,Wirring of MAC5C 's terminal No,8 Wiring of MAC 5D's terminal No.5	
b--- (B———)	Breaking of resistance bulb input	1.wire breaking of b*	1.check of resistance bulb wiring
		*b: Wiring of MAC 5A, 5B's terminal No.12,Wirring of MAC5C 's terminal No,9 wiring of MAC 5D'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 (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 (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℃

10. Specification

Display
  Display method Digital display:
    MAC5A (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)
    MAC5B(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)
    MAC5C(72x72 size)   PV red 7 segment LED   4 figure (height of character about 16mm)
                     SV green 7 segment LED   4 figures (height of character about 11 mm)
    MAC5D (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), , AT (green), OUT 1(green)
                     EV1 (yellow), EV2 (yellow), OUT2 /EV3 (yellow)
    Display accuracy   : ±(0.30%FS+1digit)CJ errors not included, B thermo couple below 400℃ is not guaranteed.
                     Display accuracy during EMC examination is ±5%FS.
    Accuracy maintenance range   : 23±5℃
    Display range   : −10% to 110% of measuring range, but Pt100's −200 to 600℃ is −240 to 680℃
    Display resolution   : Changes with measuring range and scaling.
    Input scaling   : Possible at the time of voltage input and current input −1999−9999 (span 10 to 10000 count, decimal point position
                   no decimal point 0.1, 0.01, 0.001)
Setting Setting system   : By four front keys (PGM ▼ ▲ ENT)
    SVSetting range   : Same with measuring range
    Setting lock   : Key setting (four levels), DI (one level)

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

    SV setting limiter   :Same with measuring range (lower limit ＜ upper limit)
    Unit setting   :Settable at the time of sensor input ℃,° F
Input   Multi input
    Thermocouple   :500Ω or more, external resistance tolerance level 100Ω or less
    input resistance
    Influence of lead-wire   :1.2μV／10Ω
    Burnout   :Standard equipment (Up Scale only)
    Measuring range   :Item 5-5. Refer to measuring range code table.
    Compensation accuracy of reference junction
                   : ±1℃ (ambient temperature 18-28℃) At the time of vertical plural proximity attachment ±2℃
                   ±2℃(ambient temperature 0-50℃) At the time of vertical plural proximity attachment ±3℃
                   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 ℃ / min, compensation accuracy of reference junction ±1℃
    Resistance bulb stipulated
    current resistance bulb : Approx. 0.25mA
    Lead wire resistance
    tolerance level   :5Ω or less per wire (Resistance of three lines should be equal)
    Influence of lead-wire resistance   :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 :Item 5-5. Refer to measuring range code table.
    Voltage (mV) Input resistor   :500kΩ or more
    Input voltage range :Item 5-5. Refer to measuring range code table.
    Voltage input (V) Input resistor   :500kΩ or more
    Input voltage range   :Item 5-5. Refer to measuring range code table.
    Current input (mA) reception Resistance:250Ω (built-in)
    Input range:Item 5-5. Refer to measuring range code table.
    Sampling period   :0.25 second
    PV filter   :0 to 9999 second
    PV offset compensation   : ±500 unit
    PV gain correction   : ±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 to 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 to 6000 seconds (PD operation by OFF setting)
    Manual Reset (MR)   :±50.0% (effective when set as I = OFF)
    Output 2 dead band   : −1999 to 5000 unit
    Output limiter (OL, OH) :0.0 to 100.0% (OL<OH) (set resolution 0.1)
    Soft start   :OFF, 0.5 to 120.0 seconds (set resolution 0.5)
    Proportional period   :0.5 to 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 to 100.0% (set resolution 0.1)
        ＊ Each parameter,(P, I, D, DF, MR, OL, and OH) of Outputs 1 and Outputs 2, belongs to 1to 3 categories.
  Control output 1
    Contact   :normal open (1a) 240V AC 2A (resistance load)
    Voltage pulse (SSR drive) :12V DC+1.0 to −1.5V MAX20mA
    Current   :4 to 20mA DC load resistance 500Ω or less Display accuracyaccuracy±1% (accuracy maintenance range 23℃±5℃)
                   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 to −1.5V MAX20mA

Event 1・2   :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	*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	*īd*	
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
                 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 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 out put 2 and

DI4.   : Item and contents are same with event 1 and 2.
DI (option)   : DI4 is exclusive selection option with control output 2, Event3   Number of input   : One
      Input rating   : 5V DC 0.5mA
      Input minimum retention time: 0.25 second
      Input of operation   : Non−voltage contact or open collector
      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.
īAn	Manual output	level	Manual with closed DI terminal. Auto with opened.
At	Auto tuning	edge	AT starts with rise edge.
LSrS	Latching release	edge	With rise edge, all latching released
LocP	Super key lock	level	Super key lock with closed DI terminal. Release with opened.

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 ℃
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	: 90−264V AC 50/60Hz
Power consumption	: 100VAC 6VA 200VAC 8VA 240VAC 9VA
Applicable standard	Safety : IEC1010−1 and EN61010−1:2001

EMC : EN61326−1:1997+Amendment1:1998+Amendment2:2001
(EMI: Class A, EMS: Annex A)
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 MAC5 A	: H96×W96×D69mm (depth in panel 65mm)
MAC5 B	: H96×W48×D66mm (depth in panel 62mm)
MAC5C	: H72×W72×D66mm (depth in panel 62mm)
MAC5 D	: H48×W48×D66mm (depth in panel 62mm)
Thickness of applied panel	: 1.2−2.8mm

Size of attachment hole

MAC5A	: H92×W92mm	Attachment hole size of horizontal plural proximity attachment	W(96×N−4) mm	H92mm
MAC5B	: H92×W45mm	N=number of equipment	W(48×N−3) mm	H92mm
MAC5C	: H68×W68mm		W(72×N−4) mm	H68mm
MAC3D	: H45×W45mm		W(48×N−3) mm	H45mm

Weight	MAC5A	: About 200g
	MAC5B	: About 140g
	MAC5C	: About 140g
	MAC5D	: About 100g
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

Not insulation   Basic insulation

Power supply		
Mesurement Input (PV)		Control output1 (contact)
External control input 4(DI4)		Control output1 (voltage pulse/Current)
Event out1(EV1)	System	Control output 2 (contact)
Event out2(EV2)		Control output 2 (voltage pulse/Current)
Event out3(EV3)		