

**TOHO ELECTRONICS INC.**

**TTM-300 SERIES**

**PROGRAM CONTROLLER**

**INSTRUCTION MANUAL**

Thank you for purchasing model TTM-300 series Program Controller. The units of Model TTM-300 series are The Easy-to-Use Program Controller to drive the units as per program capable 64 patterns(max.) x numbers of step, and also equipped the communication functions using RS-485 as an option. Please go through this Instruction Manual carefully and use the unit in proper manner.

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# 1. NOTICE/WARNING BEFORE OPERATION

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- Confirm the merchandises at hand shows the correct model and optional function.

For confirmation of model name, please refer to [8. ORDERING INFORMATION].

- The following symbol marks are used in this Instruction Manual for handling this model safely.

## **WARNING**

In case of mishandling, serious danger may occur to the operator such as death, electrocution and a skin burn.

## **CAUTION**

In case of mishandling, it may cause some damage to the unit or the operator getting slight injury.

## **CAUTION**

- Do not push the keys by sharp points(i.e. Ball-point-pen, metals) for prevention of its malfunction.

## **WARNING**

- Make sure the correct wiring connection before turning on electricity.  
Miswiring may cause malfunction of the unit and may cause a fire.
- Never remodel the unit for prevention of malfunction of unit and a fire.

- Types of Input(Thermocouple $\longleftrightarrow$ R.T.D.) and Output cannot be changed after receiving the unit.
- Check, if all the attachments are at your hand.

- Instruction Manual .....1 booklet
- Installation attachment .....1 piece (TTM-304)
- Fitting metals.....1 set (TTM-305,309)
- Unit seal .....1 seal paper

In case any of the above is missing or found a different included, inform to us accordingly.

- If you have selected an optional communication function and requiring "**Instruction Manual of Communication Function**", please ask us to mail it separately.
- Please put this Instruction Manual aside of the operator of unit.
- Copy or Reprint of this manual, wholly or partially, is not allowed.
- The contents of this manual may change without notice in future.
- Please be noted that we shall not be responsible to all of the defaults resulted by using of the unit.

## 2. INSTALLATION METHOD AND PARTS INDICATION

### 2.1 Name of Parts and Definition

#### LED LAMP

**RUN** :Light On at RUN mode

**OUT** :Light On when output of main controller. Blink Light on according to the operation volume at continuous proportion.

▲ :Light On when set value goes up.

▼ :Light On when set value goes down.

#### OPERATION KEYS

**MODE** : Changing the display in each mode.

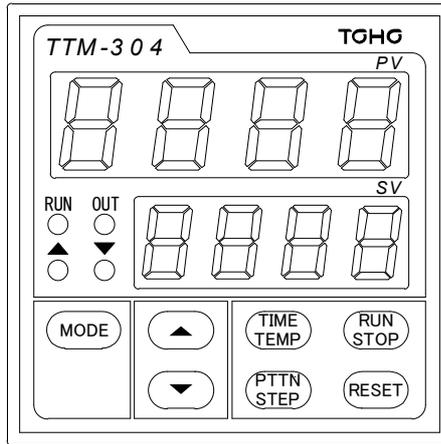
▲&▼ : Changing set values

**TIME/TEMP** : Changing "TIME" or "TEMPERATURE" indicate

**RUN/STOP** : Changing Reset mode or Run mode

**PTTN/STEP** : RUN mode→Changing PTTN/STEP confirmation mode

**RESET** : RUN mode→RESET mode

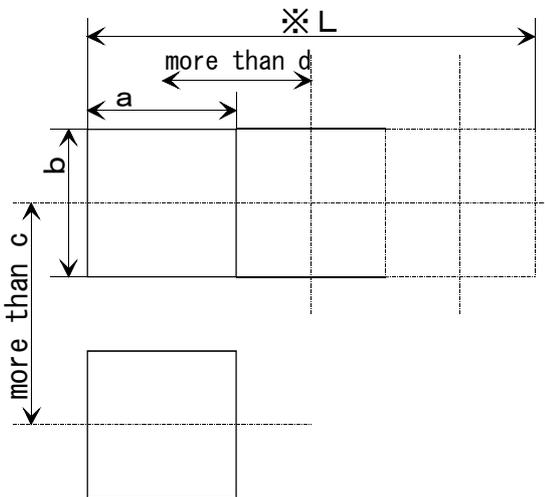


Indicate PV  
(Process Variable)

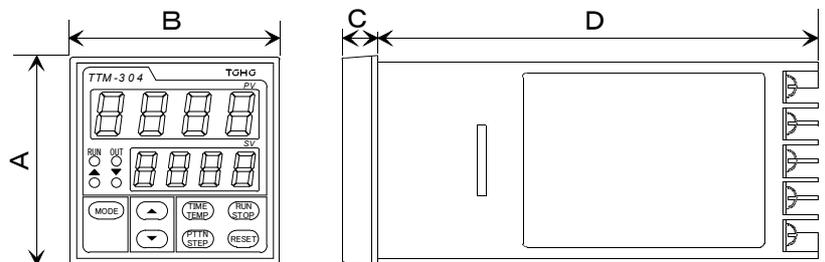
Indicate SV  
(Setting Value)

The details of Operation Keys to be referred to "6.OPERATION FLOW AND PARAMETER INFORMATION".

### 2.2 DIMENSIONS(Panel Cut)



### 2.3 OUTER DIMENSIONS



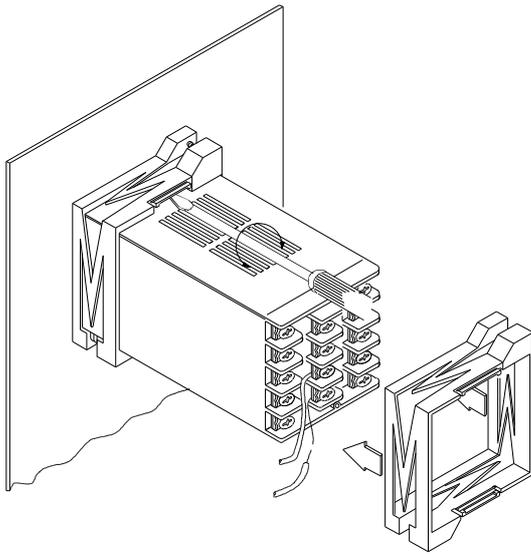
CART OF PANEL CUT & OUTER DIMENSIONS

MODEL	A	B	C	D	a	b	c	d
TTM-304	48	48	8	100	$45^{+0.6}_{-0}$	$45^{+0.6}_{-0}$	60	48
TTM-305	96	48	11	80	$45^{+0.6}_{-0}$	$92^{+0.8}_{-0}$	120	48
TTM-309	96	96	11	80	$92^{+0.8}_{-0}$	$92^{+0.8}_{-0}$	120	96

※In case of Continuous Mounting to N:  $L = (d \times N - 3) \begin{matrix} +1 \\ -0 \end{matrix}$

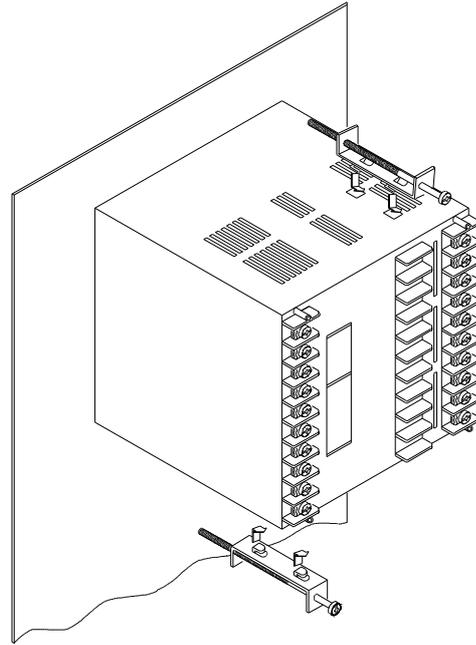
## 2.4 Mounting Method

In case of TTM-304



- In case of using crimp-style terminals, beware of other terminals not be damaged.

In case of TTM-305 & TTM-309



- Install one each of fitting metals both on upper/lower side and fasten it with a screw driver.

## 2.5 Location of installation:

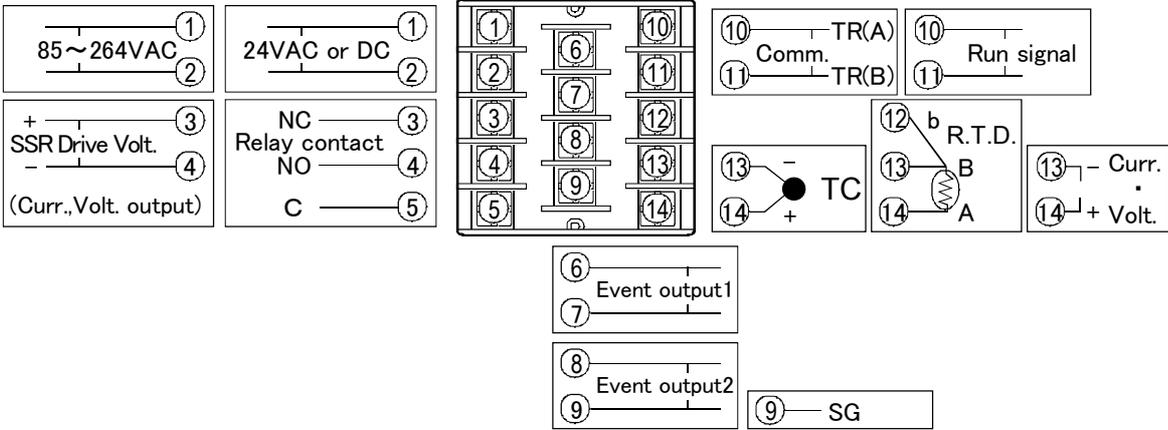
Install the unit at the following proper locations.

- Temperature and Humidity are within the limit of operation environment.
- Away from the gas of sulfide and corrosion.
- Less dust and oily smoke.
- Less mechanical vibration and shock.
- Away from High-Voltage wire, Welding machine and the generator of electric noise.
- Far away from the equipments using high-voltage ignition devices.
- Away from the influence of electromagnetic field.
- Away from the direct sunshine and not to be exposed by wind and rain.

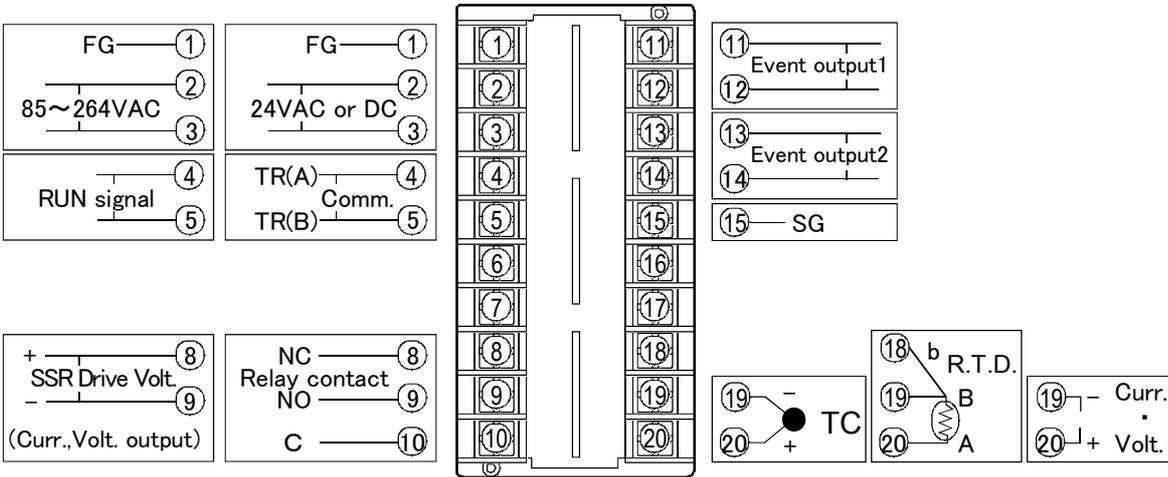
### 3. WIRING METHOD

#### 3.1 Terminal Connection Drawing

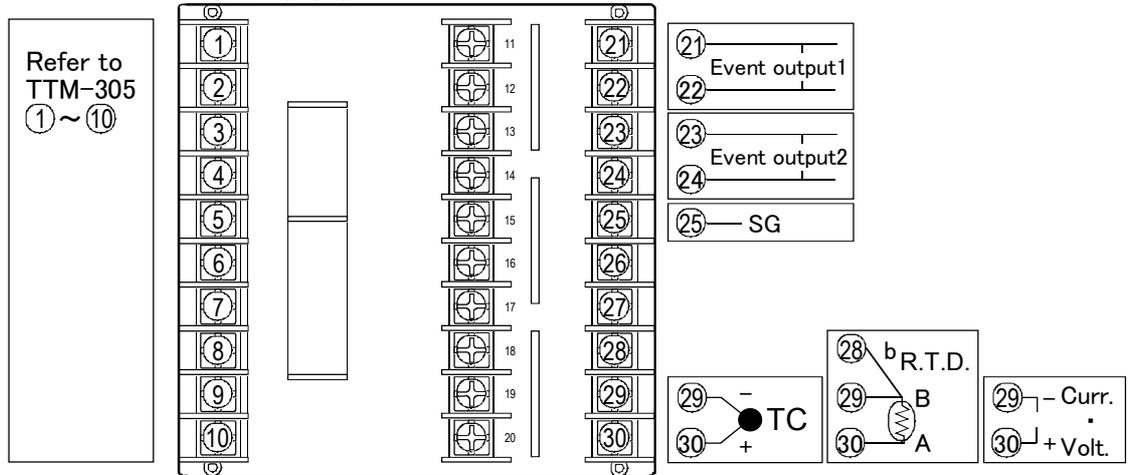
**TTM-304**



**TTM-305**

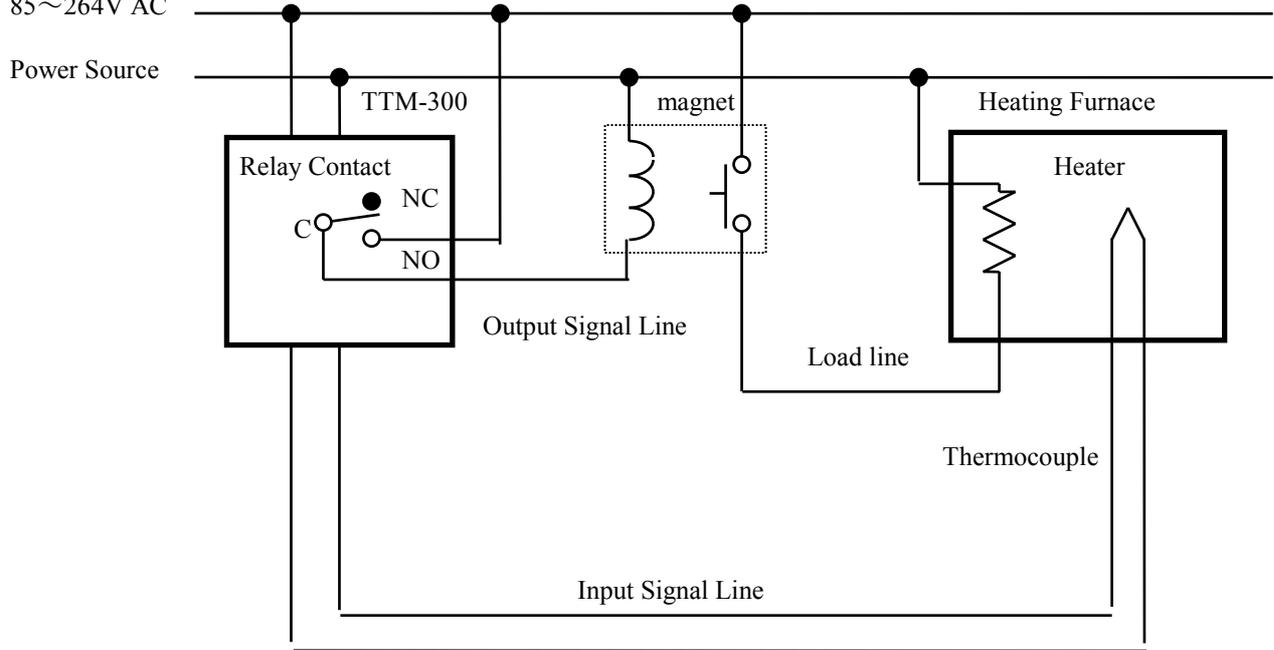


**TTM-309**



### 3.2 Example of Wiring:

In case of the Heating Furnace with voltage of 85~265V AC, Thermocouple Input and Relay Contact Output.



### 3.3 CAUTION AT WIRING CONNECTION

#### **⚠ WARNING**

- For prevention of electric shock, please do wiring connection only after turning off Power.

#### **⚠ CAUTION**

- This unit does not function for approx. 4 seconds after turning on Power.  
(No function at Output side)  
Please be cautious when this unit is used as Interlock circuit.
- For prevention of miswiring, please make sure to confirm the name labels i.e. Input terminal  
Power source terminal and Option terminals etc. beside the each wire.

- The crimp terminals for wiring should be fit with the nuts of M3.5. As for the wiring to center terminal, use the lead-wire and fasten on it.
- The wiring material to connect R.T.D. and this unit should be used the one having wire resistance less than 5Ω per wire.
- The wiring material to connect Thermocouple and this unit should be used the specified extension leadwire of thermocouple or leadwire itself.
- In case this unit should be used close to the noise generators, please use shield-wires.  
Please do not wire the Input/Output lines inside of the same duct and the pipes of electric wires.
- The signal wire of Input/Output should be away from power supply and loaded lines at least 50cm.

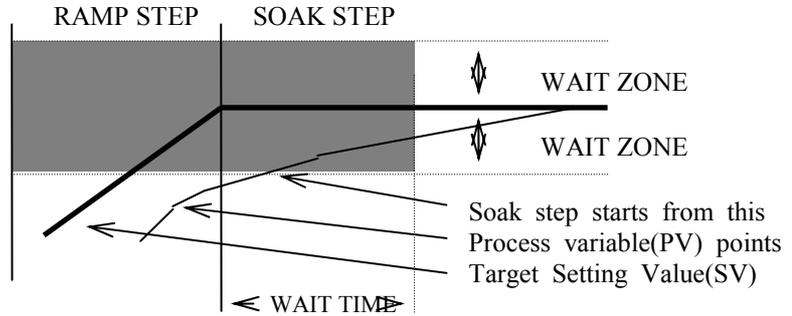
## 4. OPERATIONAL DEFINITIONS AND FUNCTIONS

- **WAIT OPERATION:** In case one step shifts to another step, the next step will not start even after step time elapsed if the process variable(PV) does not reach the wait zone or PV passed the wait zone.

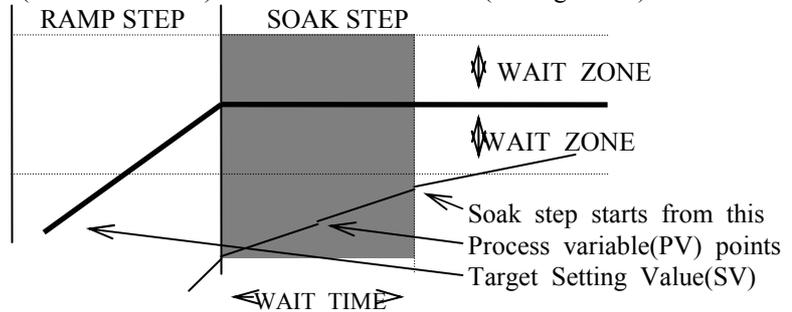
However, the next step will start when the wait time elapsed.

At the wait operation, the indication at SV blinks.

: Wait Zone... This means the deviation area between SV(Setting Value) and PV(Process variable) enable to start next step.



: Wait time... This means the maximum waiting period to start next step when PV(Process variable) does not reach to the SV(Setting Value).

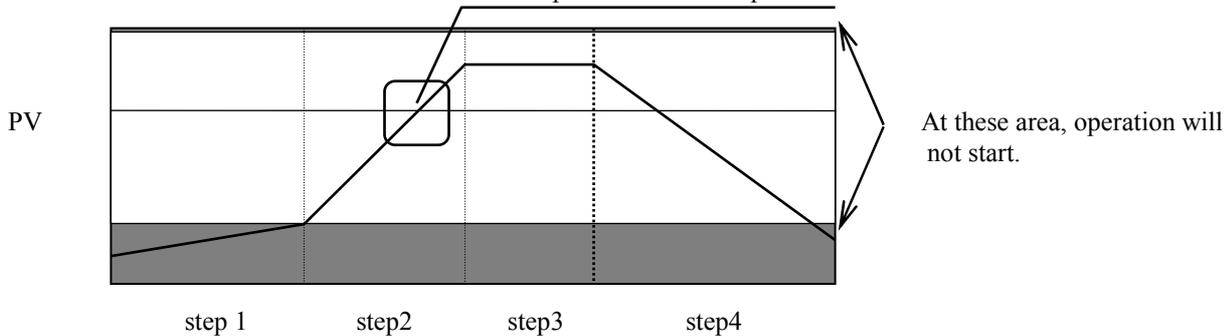


- **SV start:** It will start from the setting value at the starting time of operation which to be treated as the PV(Process variable) or the target SV(Setting Value).

**PV start...**Operation will start from the Ramp step including the PV at the starting time of Program operation.

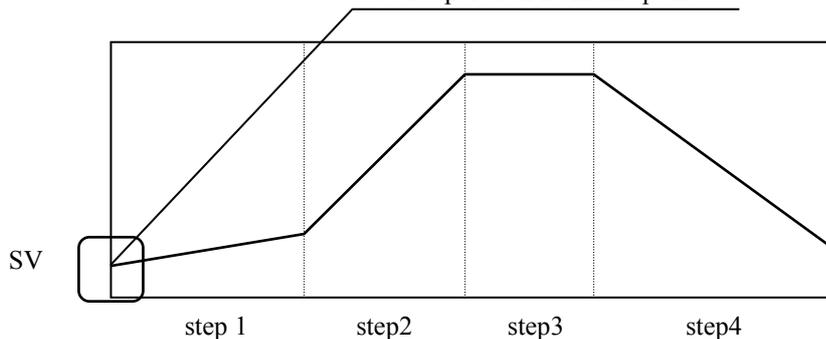
In case more than one step applied, it starts the one with smaller step number.

Start operation from this point.

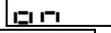
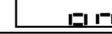


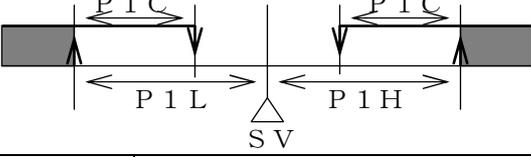
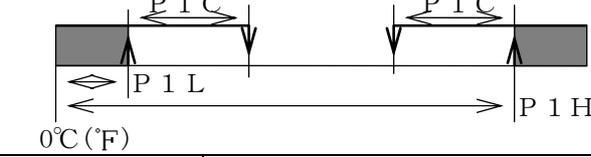
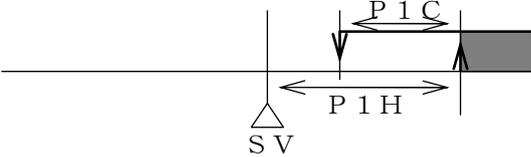
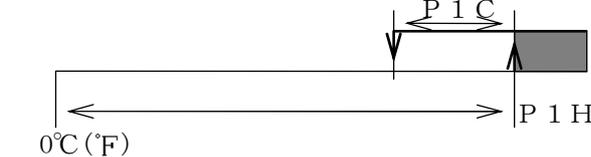
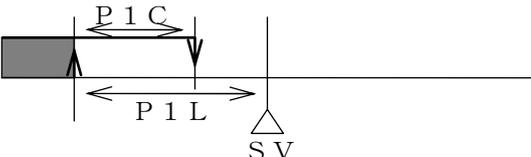
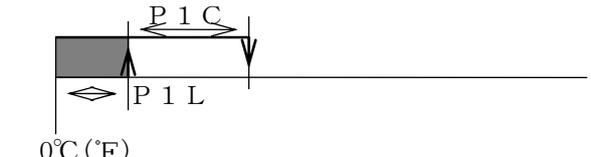
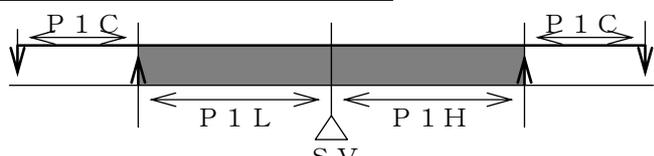
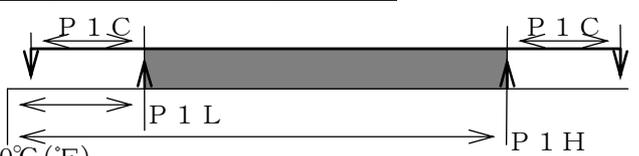
**SV start...**At the set time of Step 1, operation starts from the specified SV(Set Value) to the target set value(SV1) of Step 1.

Start operation from this point.

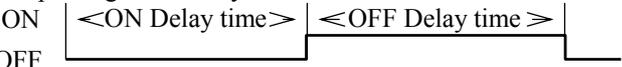
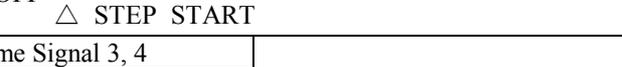
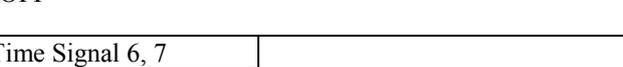
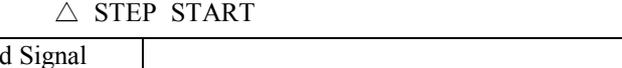
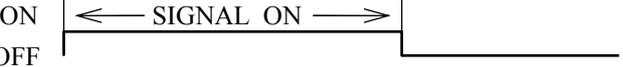
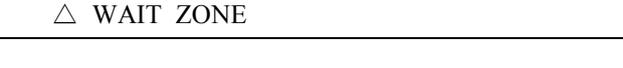
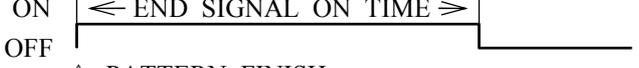


- EVENT OUTPUT: Process variable(PV) to be used as Event Output, Time Signal and End Signal.
  - : PV abnormal... In case Input indicates "Over" or "Under" by the cut-off of wire and short-circuit, Event Output turns ON.
  - : Stand-by sequence...After starting operation of steps, Event Output does not turn ON unless the process variable(PV) reach the value of OFF stage of Event Output.
  - : Event Output Hold...Event Output holds "ON" stage unless altering setting of additional function or resetting the power.

Process variable(PV) Event Output: Starts Event Output function by setting of SV deviation or Absolute Value against Process variable(PV). On the PV side indicator at "ON" stage, Output1 indicates alternately  and , and Output 2 indicates alternately  and .

Setting Value(SV) deviation(Example for Event Output 1)	Absolute Value(Example for Event Output 1)
<b>1) High and Low limit</b> 	<b>5) High and Low limit</b> 
<b>2) High limit</b> 	<b>6) High limit</b> 
<b>3) Low limit</b> 	<b>7) Low limit</b> 
<b>4) High and Low limit range</b> 	<b>8) High and Low limit range</b> 

• Time Signal, End Signal

<b>Time Signal 1, 2</b> At step operation, Event Output turns ON after passing ON Delay Time and turns OFF after passing OFF Delay Time. ON  OFF  △ STEP START	<b>Time Signal 5</b> Event Output turns ON while Wait zone. (Refer to page 6 Wait function) ON  OFF 
<b>Time Signal 3, 4</b> Event Output turns ON when step operates and turns OFF after passing Time Signal ON time. ON  OFF  △ STEP START	<b>Time Signal 6, 7</b> Event Output turns ON when time signal reach Wait zone and turns OFF after passing Time. ON  OFF  △ WAIT ZONE
<b>End Signal</b> Event Output turns ON after finishing pattern, and turns OFF after passing End Signal ON time. ON  OFF  △ PATTERN FINISH	

- LOOP ABNORMAL EVENT OUTPUT: Able to detect mis-attachment of the sensor.  
 Detecting function activates when the manipulated value lasts for a certain period either on its low or high limit. On such condition ,EVENT OUTPUT turns ON.  
 In addition , the LOOP ABNORMAL EVENT will not provide any power failure compensation.  
 If the power falls down during detecting LOOP ABNORMAL EVENT OUTPUT, the time recorded until such moment will be reset.

- OPERATION AT POWER ON:

RESET start... After the unit is activated from RESET mode, operation starts by pressing RUN/STOP key or RUN Signal input.

OPERATION at

Power failure... In case of Power failure while the unit is running program, the unit runs program continuously if the difference of the Process variable(PV) between  
a)the one at Reset and b)the one before Power failure limited within 10% or 10°C(18°F). In other cases, follow the same operation process of RESET start as described above.

Continuous operation...

$$10\% \text{ of a) or } 10^{\circ}\text{C}(18^{\circ}\text{F}) \leq a - b$$

- FUZZY Function: By Fuzzy logic, it compensates MV(Manipulation Value) worked out by PID control and controls not to "Overshoot" or "Undershoot".
- FUZZY Strength: This means the strength of compensation (Strength 1 ~ 5) against MV worked out by PID control.  
 Fuzzy strength 5 : Strongest compensation  
 Fuzzy strength 1 : Weakest compensation
- BLIND function: This function eliminates display of any mode.
- PROGRAM operation: It controls by the several patterns and steps(Inclination Straight line).

**At the end of program**, the display of Process variable(PV) indicates alternately

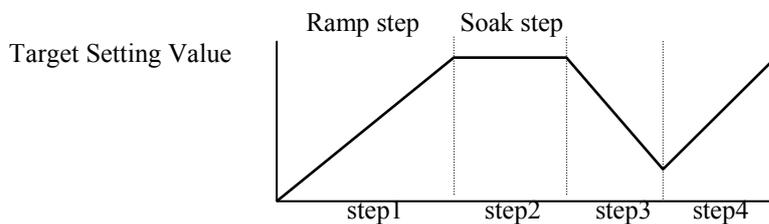


Pattern...One pattern means One program.

Step.....One step means one straight line consisted of one pattern.

Ramp Step...The step that Setting Value(SV) changes.

Soak Step...The step that Setting Value(SV) is stable.



- RUN Signal Input:  
 RUN mode ... RUN operation starts when the external contact input is closed.  
 RESET mode.. RUN operation stops when the external contact input is open.  
 After Stop position, the operation starts from the top of pattern when the external contact is closed again.  
 When the RUN signal input option is selected to be ON, RUN/RESET mode cannot be changed from the operation key board.

## 5. PRECAUTION OF PROGRAM DRIVE

- This unit can select the type of Input. The input type of Thermocouple can be selected from K, J, T, R, N and B. Also, the input type of R.T.D can be selected from Pt100 and JPt100.

At actual usage, the initial setting of input type at this unit is desperately needed.

For the setting of input type, please refer to "6.TYPER OF INPUT/OUTPUT" of "f) COMMON PARAMETER SETTING MODE". In case B Thermocouple is selected, the setting range below 399°C(750°F) is out of Instruction/Setting accuracy range of this unit.

### ! CAUTION

- In case of selection of Input type, the initial setting of input type at this unit is desperately needed.
- In case B Thermocouple is selected, do not control program below 399°C(750°F).

This unit is able to control several types such as ON/OFF control, PID control and PID + Fuzzy control.

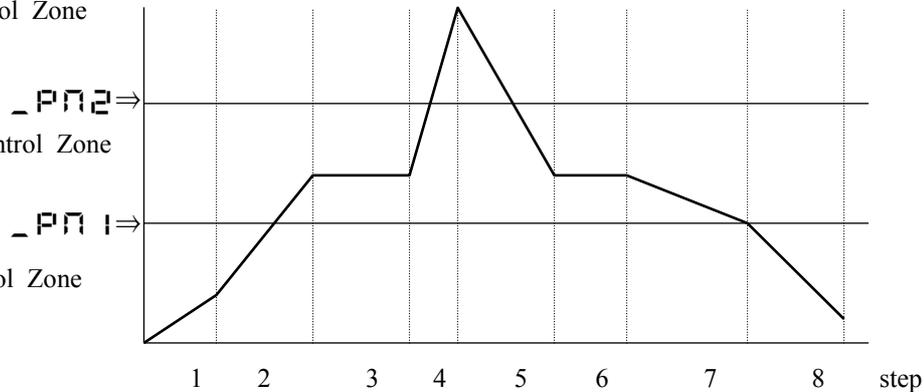
The setting of Input type should be done as per "5.TYPES OF CONTROL" of "f) COMMON PARAMETER SETTING MODE". The parameter for control is independently separated by Low Temperature Area, Middle Temperature Area and High Temperature Area, therefore, please make setting of each Control Temperature area. Also, please make setting of other control parameter as required.

The setting of Key Input is valid in memory even if the power turned OFF.

High Temperature control Zone

Middle Temperature control Zone

Low Temperature control Zone



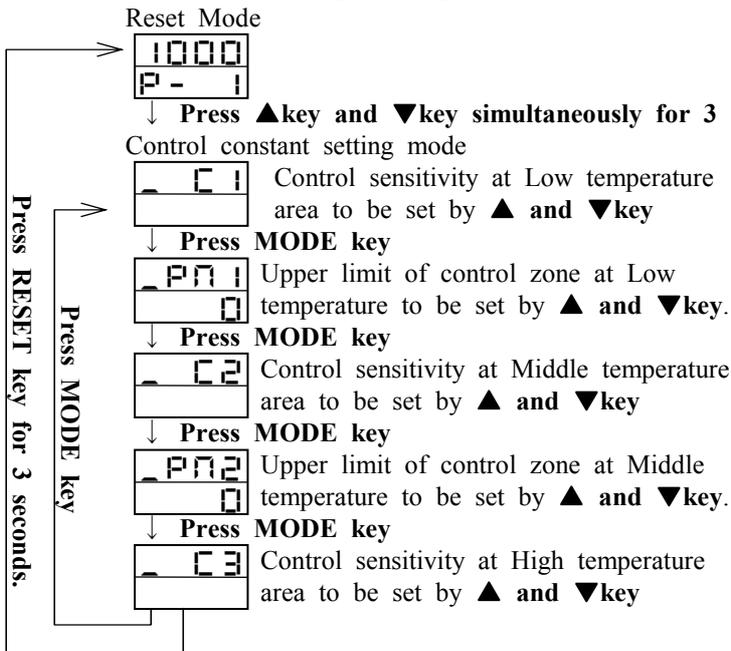
### ON/OFF CONTROL

Initial Value of control sensitivity of this unit is set "0". Please alter the setting as required.

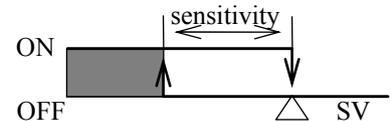
By setting the sensitivity, the point of ON and OFF can be differed.

The position of OFF point is the target Setting Value(SV) as shown below.

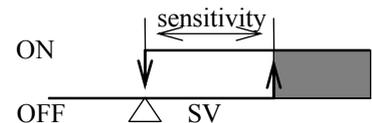
The deviation between the target Setting Value(SV) and the sensitivity Setting Value becomes ON position.



### REVERSE OPERATION



### NORMAL OPERATION



### SELECT PID CONTROL

The initial value of this "Control Parameter" is set i.e. Proportional Band(P) = 3.0, Integral time(I) = 0 and Differential Time(D)=0. Though the control can be done by this initial setting, but please do Auto-Tuning for getting better result in control. At the time of Auto Tuning, set the unit to the condition of actual control by connecting heater and sensors.

RESET mode

1000  
P-1

↓ Press ▲ and ▼ key simultaneously for 3 seconds

Control Constant Setting mode

P1 49  
3.0

↓ Press MODE key 49 Low Temperature Proportional band

I1 49  
0

↓ Press MODE key 49 Low Temperature Integral time

D1 50  
0

↓ Press MODE key 50 Low Temperature Differential time

PN1 52  
Low limit

↓ Press MODE key 52 Setting of High limit of Low Temp. area by ▲ and ▼ key.

P2 53  
3.0

↓ Press MODE key 53 Middle Temperature Proportional band.

I2 54  
0

↓ Press MODE key 54 Middle Temperature Integral time

D2 55  
0

↓ Press MODE key 55 Middle Temperature Differential Time.

PN2 57  
Mid. limit

↓ Press MODE key 57 Setting of High limit of Middle Temp area by ▲ and ▼ key.

P3 58  
3.0

↓ Press MODE key 58 High Temperature Proportional band.

I3 59  
0

↓ Press MODE key 59 High Temperature Integral time

D3 60  
0

↓ Press MODE key 60 High Temperature Differential Time

E 61  
2.0

↓ Press MODE key 61 Setting Proportional period by ▲ and ▼ key. However, no indication at the output of electric current/voltage.

FUZZY 62  
3

↓ Press MODE key 62 Setting the strength of Fuzzy by ▲ and ▼ key, but only for control type "5,6" PID+FUZZY. The strength of Fuzzy can be adjusted for controlling value of Overshoot.

Hold down MODE key for 3 seconds

### SELECT PID + FUZZY CONTROL

The parameter of this PID + Fuzzy Control is set at Initial setting Value beforehand. Should do Auto-Tuning.

At the time of Auto-Tuning, please set the unit to the condition of actual control by connecting heater and sensors.

Auto-Tuning start mode

AE-1  
Low-SV

64 Setting Auto-tuning temperature(Low Temperature). Activate Auto-Tuning of Low Temperature by RUN/STOP key.

AE-2  
Mid.-SV

↓ Press MODE key 65 Setting Auto-Tuning temperature(Mid. Temperature). Activate Auto-Tuning of Mid. Temperature by RUN/STOP key.

AE-3  
High-SV

↓ Press MODE key 66 Setting Auto-Tuning temperature(High Temperature). Activate Auto-Tuning of High Temperature by RUN/STOP key.

AE  
ALL

↓ Press MODE key 67 Activate Auto-Tuning of Low / Middle / High Temperature in turn by RUN/STOP key.

While Auto-Tuning in effect, the following displays shows alternately.

AE-\* → PV  
SV ← SV

AE-\* → PV  
ALL ← SV

The parameter for each temperature area to be set when Auto-Tuning finished. In case finishing Auto-Tuning forcibly, press RUN/STOP key or hold down RESET key for 3 seconds. In this case, parameter for each temperature area does not function.

## SETTING OF PROGRAM PATTERN

At first, set the number of Pattern and Step, and then to set the target Setting Value of Step per each pattern, Step time, Wait zone, Time Signal of Wait time, Operation number and End Signal.

a) RESET Mode

1000  
P - \*

↓ Press MODE and ▲ keys simultaneously for 3 seconds

f) COMMON PARAMETER SETTING Mode

P A E ① Setting Pattern number by ▲/▼ key.

↓ Press MODE key

S E P ② Setting Step number by ▲/▼ key.

↓ Press MODE key

·  
·  
·

P u S u ⑫ Select starting Setting Value PV or SV by ▲/▼ key.

↓ Press MODE key

S u S u ⑬ Select starting SV by ▲/▼ key  
Display shows if SV start selected.

↓ Press MODE key

Hold down RESET key for 3 seconds.

a) RESET Mode

1000  
P - \*\*

↓ Press PTTN/STEP key

P A E E Select Pattern number by ▲/▼ key.

↓ Press MODE key

Hold down MODE key for 3 seconds.

e) At Parameter per pattern setting mode,

indicate S u □ ~ G F □ repeatedly until the step number set at "f) COMMON PARAMETER Mode".

S u □ ④⑩ Setting target SV by ▲/▼ key

target sv

↓ Press MODE key

E □ ④⑪ Setting Step Time by ▲/▼ key.

step time

↓ Press MODE key

W Z □ ④⑫ Setting step wait zone by ▲/▼ key

wait zone

↓ Press MODE key

W T □ ④⑬ Setting step wait time by ▲/▼ key

wait time

↓ Press MODE key

O N □ ④⑭ Setting step Time signal ON time by ▲/▼ key. Indicates setting value if time signal function set at "1, 3, 5" per step.

on time

↓ Press MODE key

O F □ ④⑮ Setting step Time Signal OFF time by ▲/▼ key. Indicates setting value if time signal function set at "1" per step hour.

off time

↓ Press MODE key

Final Step

r u r ④⑯ Number of operation to be set by ▲/▼ key.

number

↓ Press MODE key

E O N ④⑰ Setting End Signal ON time by ▲/▼ key. Indicates when Event Output function set at "3" as End signal.

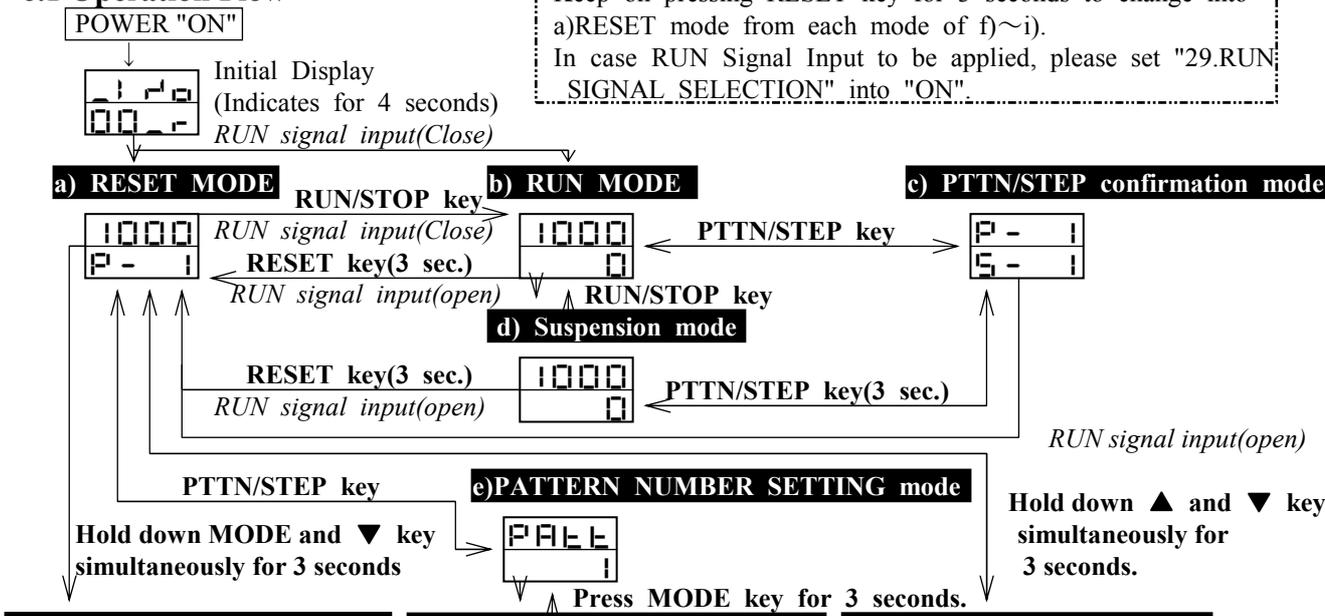
on time

Hold down RESET key for 3 seconds.

# 6. OPERATION FLOW AND PARAMETER INFORMATION

## 6.1 Operation Flow

Keep on pressing RESET key for 3 seconds to change into a)RESET mode from each mode of f)~i).  
 In case RUN Signal Input to be applied, please set "29.RUN SIGNAL SELECTION" into "ON"



### f) Common Parameter setting mode

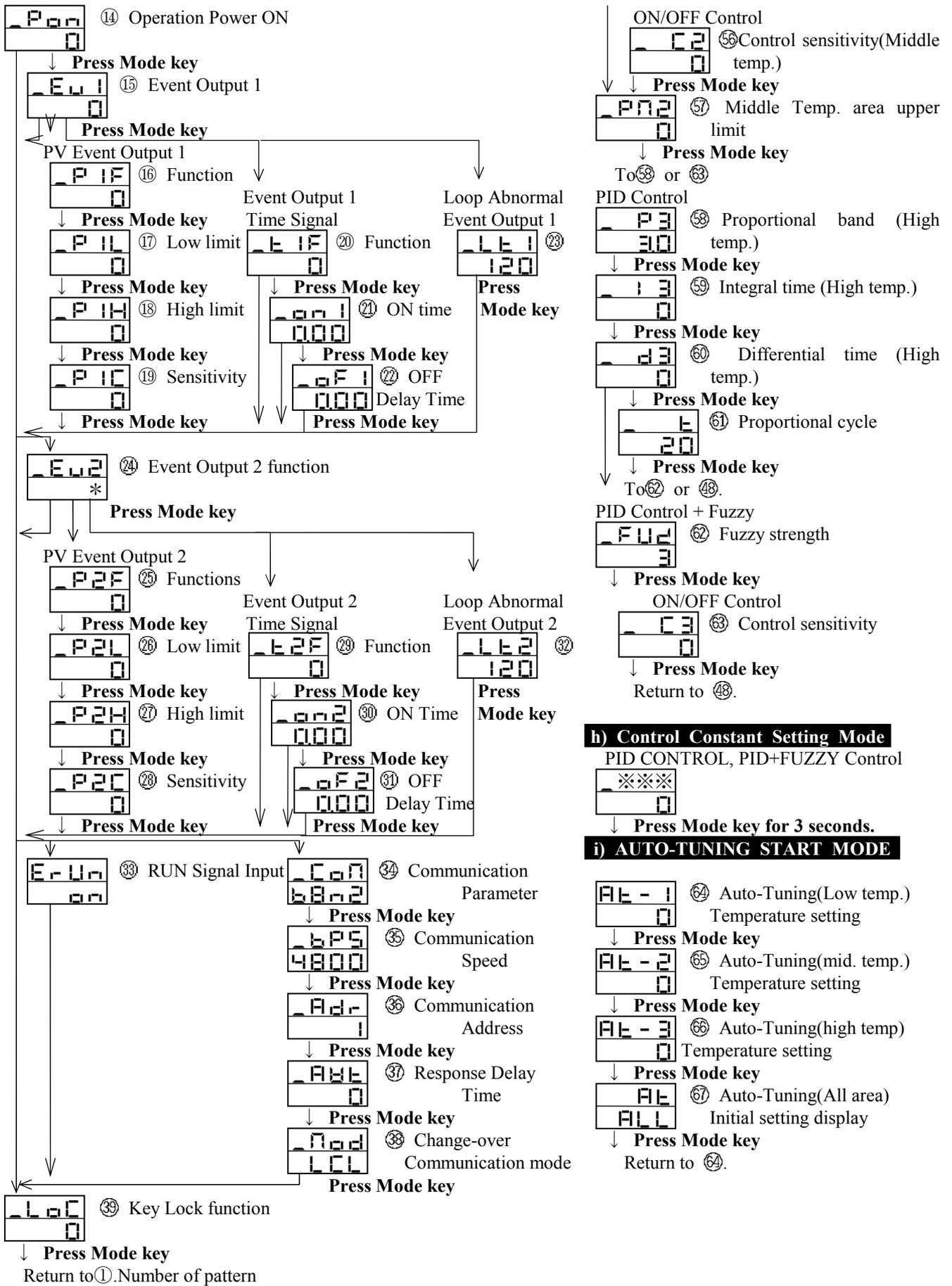
- PAT** ① Number of pattern
- ↓ Press Mode key
- SEP** ② Number of step
- ↓ Press Mode key
- PVS** ③ PV correction
- ↓ Press Mode key
- CF** ④ °C/°F selection
- ↓ Press Mode key
- CON** ⑤ Type of Control
- ↓ Press Mode key
- IO** ⑥ Type of Input/Output
- ↓ Press Mode key
- DP** ⑦ Select Decimal point.
- ↓ Press Mode key
- ALL** ⑧ Operation volume lower limit
- ↓ Press Mode key
- ULH** ⑨ Operation volume upper limit
- ↓ Press Mode key
- SLL** ⑩ SV limiter low
- ↓ Press Mode key
- SLH** ⑪ SV limiter high
- ↓ Press Mode key

### g) Parameter per Pattern setting mode

- SV** ⑫ Step SV
- ↓ Press Mode key
- ET** ⑬ Step time
- ↓ Press Mode key
- WZ** ⑭ Step wait zone
- ↓ Press Mode key
- WT** ⑮ Step wait time
- ↓ Press Mode key
- STON** ⑯ Step Time Signal ON time
- ↓ Press Mode key
- STOFF** ⑰ Step Time Signal OFF time
- ↓ Press Mode key
- Return to ⑫ except final step.
- NO** ⑱ Number of operation
- ↓ Press Mode key
- ESON** ⑲ End Signal ON time
- ↓ Press Mode key
- Return to ⑫
- PUSV** ⑳ start SV function
- ↓ Press Mode key
- SUSV** ㉑ SV start
- ↓ Press Mode key
- See next page ㉒

### h) Control constant setting mode

- PID Control**
- P** ㉓ proportional band (Low temp.)
- ↓ Press Mode key
- I** ㉔ Integral time (Low temp.)
- ↓ Press Mode key
- D** ㉕ Differential time (Low temp.)
- ↓ Press Mode key
- ON/OFF Control**
- CS** ㉖ Control sensitivity (Low temp.)
- ↓ Press Mode key
- PN** ㉗ Low Temp. area High limit
- ↓ Press Mode key
- To ㉓ or ㉔
- PID Control**
- P** ㉘ Proportional band (Middle temp.)
- ↓ Press Mode key
- I** ㉙ Integral time (middle temp.)
- ↓ Press Mode key
- D** ㉚ Differential Time (middle temp.)
- ↓ Press Mode key
- See next page ㉛



## 6.2 SPECIAL OPERATION

### 6.2.1 Setting of BLIND mode

BLIND mode cannot be applied to a)RESET mode, b)RUN mode, c)SUSPENSION mode and d)PATTERN STEP CONFIRMATION mode.

a) RESET mode

```
1000
P - 1
```

↓ Hold down RESET key for 10 seconds.

a) RESET mode

```

 
 
```

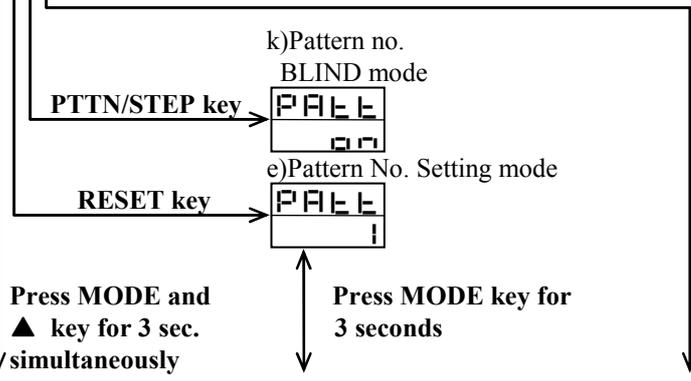
All LED display fade out in a moment.

↓ Press ▲ key, ▼ key and MODE key in turn.

j) BLIND mode

```
1000
blnd
```

Press ▲ key and ▼ key simultaneously for 3 seconds.



l) COMMON PARAMETER

BLIND mode

```
P A E E
  a a
```

↓ Press MODE key

⋮

```
l a c
  a a
```

m) PATTERN PER PARAMETER

BLIND mode

```
S u 1
  a a
```

↓ Press MODE key

⋮

```
E a a
  a a
```

n) CONTROL CONSTANT setting

BLIND mode

```
P I
  a a
```

↓ Press MODE key

⋮

```
c 3
  a a
```

o) AUTO-TUNING start

BLIND mode

```
A E - 1
  a a
```

↓ Press MODE key

⋮

```
A E
  a a
```

Indication at Setting Value

```
***
  a a
```

means Display exist, and

```
***
  a F F
```

means no Display.

For canceling BLIND mode, turn the Power OFF once and turn ON the Power again.

### 6.2.2 Alteration of Parameter per Pattern Setting while operation.

b) RUN mode

```
1000
  a
```

Press MODE key for 10 seconds.

e) Pattern No. Setting mode

```
P A E E
  1
```

↓ Press MODE key

g) Parameter per Pattern setting mode.

```
S u 1
  a
```

↓ Press MODE key

```
E 1
  0 0 0
```

↓ Press MODE key

```
⋮
```

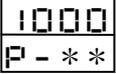
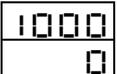
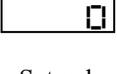
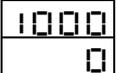
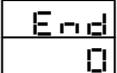
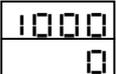
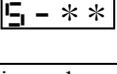
```
E a a
  a
```

Alteration of each setting value can be changed even while program operation, but not setting value of step.

6.2.3 Advanced Function

It advances next step to operated hold down ▲ key 2 sec, when program is running(RUN mode).

6.3 Detailed description of each parameter

No	Display	Name	Description
a)		Reset mode	<p>If this is displayed, the control is inactivated.</p>  ← ** :Displays the pattern number selected.
b)		Run mode	<p>This mode indicates the program operation is at run. LED lamp "RUN" lights on when it starts running. While a period of the Ramp step, LED display lamps for rising or falling light up, and they turn off when it moves to the Soak step. Pressing the TIME/TEMP key enables PV/SV display to be changed to Passing Time/Set Time display.</p>  ← Indicates process value(PV) or the Passing Time.  ← Indicates the set value(SV) on the run or the Set Time.
			<p>The Set value display blinks while the Wait is on operation.</p> 
			<p>Wait is on operation. And the process value appear alternately on a PV display area at the end of pattern operation.</p>  → 
d)		Suspension mode	<p>The programmed operation is temporarily suspended on this mode. When the run is suspended, the "RUN" LED lamp blinks and makes the time to be suspended, and maintain the controlled temperature at the point. By pressing TIME/TEMP key, PV/SV display is switched to the Passing Time/Set Time.</p>
c)		Pattern/Step check mode	<p>Pattern No. and Step No. are indicated during the RUN mode or Suspension mode. These displays change back automatically to either RUN mode or Suspension mode, if the key is not pressed for 30 seconds.</p>  ← Indicates the Pattern No. at the run.  ← Indicates the Step No. at the run.
e)		Pattern No. setting mode	<p>This mode enables to set the Pattern No. of the program to be run.</p>  ← ** Indicates the Pattern No.

f) Common Parameter setting mode

No	Character	Name	Description	Initial Value	Display conditions/Remarks																																
①	<b>_P A E</b>	Number of Pattern	Set Number of program patterns Setting range: 1 - 64 patterns	<b>8</b>	The product of pattern No. and Step Number should not exceeds 64 as the maximum.																																
②	<b>_S E P</b>	Number of Steps	Set Number of steps of each pattern. Setting range: 1 - 64 steps	<b>8</b>																																	
③	<b>_P U S</b>	PV correction	Add PV correction value to a process value to be entered. Setting range:-199.9 to 999.9°C/°F -199 to 999°C/°F	<b>0</b> or <b>0.0</b>																																	
④	<b>_C R F</b>	°C/°F Selection	Select °C/°F for the PV display. <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><b>0C</b></td><td>°C</td></tr> <tr><td><b>0F</b></td><td>°F</td></tr> </table>	<b>0C</b>	°C	<b>0F</b>	°F	<b>0C</b>																													
<b>0C</b>	°C																																				
<b>0F</b>	°F																																				
⑤	<b>_C n t</b>	Control type	Select the control type from the table below. <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><b>1</b></td><td>ON/OFF control, normal</td></tr> <tr><td><b>2</b></td><td>ON/OFF control, reversed</td></tr> <tr><td><b>3</b></td><td>PID control, normal</td></tr> <tr><td><b>4</b></td><td>PID control, reversed</td></tr> <tr><td><b>5</b></td><td>PID + fuzzy control, normal</td></tr> <tr><td><b>6</b></td><td>PID + fuzzy control, reversed</td></tr> </table>	<b>1</b>	ON/OFF control, normal	<b>2</b>	ON/OFF control, reversed	<b>3</b>	PID control, normal	<b>4</b>	PID control, reversed	<b>5</b>	PID + fuzzy control, normal	<b>6</b>	PID + fuzzy control, reversed	<b>4</b>	Auto-tuning is always Required, if Fuzzy control selected.																				
<b>1</b>	ON/OFF control, normal																																				
<b>2</b>	ON/OFF control, reversed																																				
<b>3</b>	PID control, normal																																				
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<b>5</b>	PID + fuzzy control, normal																																				
<b>6</b>	PID + fuzzy control, reversed																																				
⑥	<b>_I O</b>	Input /Output type	I/O types are indicated and input type can be selected. <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><b>_I O</b></td></tr> <tr><td><b>※※※※</b></td></tr> </table> Thermocouple Input Type <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td>※※</td><td>Input Type</td></tr> <tr><td><b>00</b></td><td>K thermocouple</td></tr> <tr><td><b>01</b></td><td>J thermocouple</td></tr> <tr><td><b>02</b></td><td>T thermocouple</td></tr> <tr><td><b>03</b></td><td>R thermocouple</td></tr> <tr><td><b>04</b></td><td>N thermocouple</td></tr> <tr><td><b>05</b></td><td>B thermocouple</td></tr> </table> RTD INPUT TYPE <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td>※※</td><td>Input Type</td></tr> <tr><td><b>10</b></td><td>PT100</td></tr> <tr><td><b>11</b></td><td>JPT100</td></tr> </table> No alteration possible <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><b>※※</b></td><td>Output type</td></tr> <tr><td><b>_R</b></td><td>Relay contact output</td></tr> <tr><td><b>_P</b></td><td>SSR drive output</td></tr> <tr><td><b>_U</b></td><td>Voltage output</td></tr> <tr><td><b>_I</b></td><td>Current output</td></tr> </table>	<b>_I O</b>	<b>※※※※</b>	※※	Input Type	<b>00</b>	K thermocouple	<b>01</b>	J thermocouple	<b>02</b>	T thermocouple	<b>03</b>	R thermocouple	<b>04</b>	N thermocouple	<b>05</b>	B thermocouple	※※	Input Type	<b>10</b>	PT100	<b>11</b>	JPT100	<b>※※</b>	Output type	<b>_R</b>	Relay contact output	<b>_P</b>	SSR drive output	<b>_U</b>	Voltage output	<b>_I</b>	Current output	<b>00_*</b> or <b>10_*</b>	The initial value varies by the types.
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<b>_I</b>	Current output																																				
⑦	<b>_d P</b>	Decimal point selection	Select if below decimal point is required or not. <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td><b>0</b></td><td>Decimal not required.</td></tr> <tr><td><b>0.0</b></td><td>Decimal required.</td></tr> </table>	<b>0</b>	Decimal not required.	<b>0.0</b>	Decimal required.	<b>0</b> or <b>0.0</b>	Decimal point is not displayed on R, N, B thermocouples.																												
<b>0</b>	Decimal not required.																																				
<b>0.0</b>	Decimal required.																																				
⑧	<b>_N L L</b>	Manipulated value lowest limiter	On proportional control, set the lowest value of manipulated control output. Setting range: 0.0%~ <b>_N L H</b> (Relay contact, SSR Output) -10.0%~ <b>_N L H</b> (Voltage, current output)	<b>0.0</b>	Displays when <b>_C n t</b> are 3,4,5,6.																																
⑨	<b>_N L H</b>	Manipulated value highest limiter	On proportional control, set the highest value of manipulated control output. Setting range: <b>_N L L</b> ~100.0% (Relay contact, SSR Output) <b>_N L L</b> ~110.0% (Voltage, current output)	<b>100.0</b>																																	

No	Character	Name	Description	Initial value	Display conditions/Remarks
----	-----------	------	-------------	---------------	----------------------------

⑩	<b>_SLL</b>	SV Limiter Low	Set Number of SV Limiter Low. Setting range: Setting range low~ ( <b>SLH</b> - 50) °C/°F		Initial value is different by input. Refer to “7.SETTING RANGE AND INDICATION RANGE TABLE”.																								
⑪	<b>_SLH</b>	SV Limiter High	Set Number of SV Limiter High. Setting range: ( <b>SLL</b> + 50) °C/°F ~Setting range high																										
⑫	<b>PuSu</b>	Start SV selection	Select the start SV at the starting of the run. <table border="1" style="margin-left: 20px;"> <tr> <td><b>Su</b></td> <td>SV start</td> </tr> <tr> <td><b>Pu</b></td> <td>PV start</td> </tr> </table>	<b>Su</b>	SV start	<b>Pu</b>	PV start	<b>Pu</b>																					
<b>Su</b>	SV start																												
<b>Pu</b>	PV start																												
⑬	<b>SuSu</b>	Starting temperature	Set the temperature value of SV start Setting Range: <b>SLL</b> ~ <b>SLH</b>	<b>0</b> or <b>0.0</b>	Displays when <b>PuSu</b> is <b>Su</b> .																								
⑭	<b>_Pon</b>	Power ON operation selection	Select operations for power input. <table border="1" style="margin-left: 20px;"> <tr> <td><b>0</b></td> <td>Reset and start</td> </tr> <tr> <td><b>1</b></td> <td>Operation at power</td> </tr> </table>	<b>0</b>	Reset and start	<b>1</b>	Operation at power	<b>0</b>																					
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<b>1</b>	Operation at power																												
⑮ ⑳	<b>_Eu1</b> <b>_Eu2</b>	Event 1, 2 functions	Select Event output functions 1 and 2. <table border="1" style="margin-left: 20px;"> <tr> <td><b>0</b></td> <td>Release function</td> </tr> <tr> <td><b>1</b></td> <td>PV event output</td> </tr> <tr> <td><b>2</b></td> <td>Time signal</td> </tr> <tr> <td><b>3</b></td> <td>End signal</td> </tr> <tr> <td><b>4</b></td> <td>Loop abnormal event</td> </tr> </table>	<b>0</b>	Release function	<b>1</b>	PV event output	<b>2</b>	Time signal	<b>3</b>	End signal	<b>4</b>	Loop abnormal event	<b>0</b>	Displays with options of Event output 1, 2.														
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⑰ ㉑	<b>_P1F</b> <b>_P2F</b>	Process value event output functions 1,2	Select Process value for event output functions 1 and 2. <table border="1" style="margin-left: 20px;"> <tr> <td><b>_P□F</b></td> <td></td> </tr> <tr> <td>*※</td> <td></td> </tr> <tr> <td>*</td> <td>FUNCTIONS(select with ▼ key)</td> </tr> <tr> <td><b>0</b></td> <td>Release functions</td> </tr> <tr> <td><b>1</b></td> <td>Deviation high/low limit</td> </tr> <tr> <td><b>2</b></td> <td>Deviation high limit</td> </tr> <tr> <td><b>3</b></td> <td>Deviation low limit</td> </tr> <tr> <td><b>4</b></td> <td>Deviation range for high and low limit</td> </tr> <tr> <td><b>5</b></td> <td>Absolute value high/low limit</td> </tr> <tr> <td><b>6</b></td> <td>Absolute value high limit</td> </tr> <tr> <td><b>7</b></td> <td>Absolute value low limit</td> </tr> <tr> <td><b>8</b></td> <td>Range of absolute value high and low limits</td> </tr> </table>	<b>_P□F</b>		*※		*	FUNCTIONS(select with ▼ key)	<b>0</b>	Release functions	<b>1</b>	Deviation high/low limit	<b>2</b>	Deviation high limit	<b>3</b>	Deviation low limit	<b>4</b>	Deviation range for high and low limit	<b>5</b>	Absolute value high/low limit	<b>6</b>	Absolute value high limit	<b>7</b>	Absolute value low limit	<b>8</b>	Range of absolute value high and low limits	<b>00</b>	Displays when <b>_Eu□</b> is <b>1</b> .
<b>_P□F</b>																													
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					<table border="1" style="margin-left: 20px;"> <tr> <td>※</td> <td>ADDITIONAL FUNCTIONS (select with ▲ key)</td> </tr> <tr> <td><b>0</b></td> <td>Release function</td> </tr> <tr> <td><b>1</b></td> <td>Event output hold</td> </tr> <tr> <td><b>2</b></td> <td>Stand-by sequence</td> </tr> <tr> <td><b>3</b></td> <td>Abnormal process value</td> </tr> <tr> <td><b>4</b></td> <td>Event output hold + stand-by sequence</td> </tr> <tr> <td><b>5</b></td> <td>Event output hold + Abnormal process value</td> </tr> <tr> <td><b>6</b></td> <td>Stand-by sequence + Abnormal process value</td> </tr> <tr> <td><b>7</b></td> <td>Event output hold + Stand-by sequence + Abnormal process value</td> </tr> </table>	※	ADDITIONAL FUNCTIONS (select with ▲ key)	<b>0</b>	Release function	<b>1</b>	Event output hold	<b>2</b>	Stand-by sequence	<b>3</b>	Abnormal process value	<b>4</b>	Event output hold + stand-by sequence	<b>5</b>	Event output hold + Abnormal process value	<b>6</b>	Stand-by sequence + Abnormal process value	<b>7</b>	Event output hold + Stand-by sequence + Abnormal process value						
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⑰ ⑱ ㉒ ㉓	<b>_P1L</b> <b>_P1H</b> <b>_P2L</b> <b>_P2H</b>	Process value event output 1 and 2. High/Low limit setting	Set the temperature of the process value event output Setting range: -199.9to 999.9°C/°F -199 to 999°C/°F	<b>0</b> or <b>0.0</b>	Displays according to the setting of process value event output function.																								

No	Character	Name	Description	Initial value	Display conditions/Remarks															
①⑨ ②⑧	_P1C _P2C	Process value event output 1 and 2. sensitivity	Set the sensitivity of the process value event output 1 and 2. Setting range: 0.0 to 999.9°C/°F 0 to 999°C/°F	0 or 0.0	Displays when _E□□ is 1.															
②⑩ ②⑨	_E1F _E2F	Event output 1 and 2. Time Signal functions	Select Time signals and event output 1 and 2. 1 ON Delay/OFF Delay Time for each step 2 ON Delay/Off Delay Time common for all steps 3 Time signal ON Time for each step 4 Time signal ON Time common for all steps 5 Time signal ON Time 6 Time signal ON Time for each step 7 Time signal ON Time common for all steps	1	Display when _E□□ is 2.  See "Time Signal and End Signal" on Page 7, for setting and operation of Time Signal functions.															
②⑪ ③⑩	_on1 _on2	Event output 1 2 Time Signal On Time. On Delay time	Set the Time signal ON Time. Setting range: 0 - 99 hrs.59 min. If select 2 for Time signal function, set ON Delay Time.	0.00	Displays when E□F are 2, 4, 7.															
②⑫ ③①	_oF1 _oF2	Event output 1 ,2 Time signal OFF Delay Time	Set the Time signal OFF Delay Time Setting range: 0 - 99 hrs.59 min.	0.00	Displays when E□F are 2.															
②⑬ ③②	_LE1 _LE2	Loop Abnormal Event Output 1,2	Set the detecting Time for loop abnormal event. Setting range: 1 - 9999 sec.	120	Displays when E□F are 4.															
③③	E-run	Selection of RUN Signal	Run signal input valid/invalid . <table border="1" style="margin-left: 20px;"> <tr><td>on</td><td>Valid</td></tr> <tr><td>oFF</td><td>Invalid</td></tr> </table>	on	Valid	oFF	Invalid	on	Displays in case of RUN signal input option.											
on	Valid																			
oFF	Invalid																			
③④	_Con	Communication parameter	Set the Communication parameter. <table border="1" style="margin-left: 20px;"> <tr><td>_Con</td></tr> <tr><td>□△○×</td></tr> <tr><td>□ BCC check (change by ▼key)</td></tr> <tr><td>n Invalid</td></tr> <tr><td>b Valid</td></tr> <tr><td>△ Data length(to be changed by ▼ key)</td></tr> <tr><td>7 7 bit</td></tr> <tr><td>8 8 bit</td></tr> <tr><td>○ Parity(to be changed by ▼ key)</td></tr> <tr><td>n None</td></tr> <tr><td>o Odd number</td></tr> <tr><td>E Even number</td></tr> <tr><td>× Stop bit(to be changed by ▼ key)</td></tr> <tr><td>1 1</td></tr> <tr><td>2 2</td></tr> </table>	_Con	□△○×	□ BCC check (change by ▼key)	n Invalid	b Valid	△ Data length(to be changed by ▼ key)	7 7 bit	8 8 bit	○ Parity(to be changed by ▼ key)	n None	o Odd number	E Even number	× Stop bit(to be changed by ▼ key)	1 1	2 2	b8n2	Displays when Communication option selected.
_Con																				
□△○×																				
□ BCC check (change by ▼key)																				
n Invalid																				
b Valid																				
△ Data length(to be changed by ▼ key)																				
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o Odd number																				
E Even number																				
× Stop bit(to be changed by ▼ key)																				
1 1																				
2 2																				

No	Character	Name	Description	Initial Value	Display condition/Remarks
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③⑤	_ b P S	Communication speed	Set Communication speed. Setting range: 1200,2400,4800,9600 Setting unit: BPS	4800											
③⑥	_ A d r	Communication Address	Set the own address. Setting range: 1 to 99 stations	1											
③⑦	_ A B E	Response delay	Set the interval time to switch to the transmission mode after receiving. Setting range: 0 to 250 mSEC	0	Displays when any communication option adopted.										
③⑧	_ M o d	Communication mode switch	Select Local/Communication mode. <table border="1" style="margin-left: 20px;"> <tr> <td>L C L</td> <td>Local mode</td> </tr> <tr> <td>C o m</td> <td>Communication mode</td> </tr> </table>	L C L	Local mode	C o m	Communication mode	L C L							
L C L	Local mode														
C o m	Communication mode														
③⑨	_ L o C	Key lock function	Select Key lock setting. <table border="1" style="margin-left: 20px;"> <tr> <td>0</td> <td>Unlock</td> </tr> <tr> <td>1</td> <td>Lock all parameters</td> </tr> <tr> <td>2</td> <td>Lock temperature parameter</td> </tr> <tr> <td>3</td> <td>Lock time parameter</td> </tr> <tr> <td>4</td> <td>Lock all parameters except program parameters (Lock all modes except for the pattern No. setting and the parameter per pattern setting)</td> </tr> </table>	0	Unlock	1	Lock all parameters	2	Lock temperature parameter	3	Lock time parameter	4	Lock all parameters except program parameters (Lock all modes except for the pattern No. setting and the parameter per pattern setting)	0	Communication mode switch display(_ M o d) can not be locked.
0	Unlock														
1	Lock all parameters														
2	Lock temperature parameter														
3	Lock time parameter														
4	Lock all parameters except program parameters (Lock all modes except for the pattern No. setting and the parameter per pattern setting)														

g) Parameter per pattern setting mode

No	Character	Name	Description	Initial Value	Display condition/Remarks
④⑩	S u □	Step □ temperature setting	Set the temperature value for step □. Setting range: S L L ~ S L H.	0	
④⑪	t □	Step □ time setting	Set the time for step □. Setting range: 0 - 99 hrs. 59 min.	0.00	
④⑫	W Z □	Step □ wait zone	Set a wait zone for step □. Setting range: 0 to 100 °C/°F	0	
④⑬	W T □	Step □ wait time	Set a wait time for step □. Setting range: 0 to 1 hr. 59 min.	0.00	
④⑭	o n □	Step □ time signal ON time ON Delay time	Set Time signal ON time. Setting range: 0 - 99 hrs. 59 min. When Time signal function 1 is selected, then set ON Delay time.	0.00	Displays when t □ F are 1, 3 and 6.
④⑮	o F □	Step □ time signal OFF Delay time	Set Time signal OFF Delay time Setting range: 0 - 99 hrs. 59 min.	0.00	Displays when t □ F is 1.
④⑯	r U n	Number of running time	Set the No. of running times per pattern. Setting range: 0 - 99 times (0 for infinite number)	1	Displays at the last step.
④⑰	E o n	End signal ON time	Set the End signal ON time. Setting range: 0 - 9999 sec. (0 for continuation)	0	Displays when E u □ is 3 at the last step.

h) Control constant setting mode

No	Character	Name	Description	Initial Value	Display condition/Remarks				
④⑧ ⑤③ ⑤④	- P1 - P2 - P3	Proportional bands for Temperature of "LOW", "MIDDLE", "HIGH"	Setting proportional bands for "Low", "Middle", "High" temperature area. Setting Range: 0.1- 200.0% (For SLL~SLH)	3.0	Displays when <b>_CnE</b> are 3, 4, 5, 6.				
④⑨ ⑤④ ⑤⑤	- I1 - I2 - I3	INTEGRAL TIME for Temperature "LOW", "MIDDLE", "HIGH"	Set the integral time for "Low", "Middle", "High" temperature area. Setting range: 0 - 3600 sec.	0					
⑤⑥ ⑤⑤ ⑥①	- d1 - d2 - d3	DIFFERENTIAL TIME for Temperature "LOW", "MIDDLE", "HIGH"	Set the differential time for "Low", "Middle", "High" temperature area Setting Range: 0 - 3600 sec.	0					
⑤① ⑤⑥ ⑥②	- C1 - C2 - C3	SENSITIVITY for temperature "LOW", "MIDDLE", "HIGH"	Set the control sensitivity "Low", "Middle", "High" temperature areas. Setting Range: 0.0 - 999.9 °C/°F 0 - 999 °C/°F	0 or 0.0	Displays when <b>_CnE</b> are 1, 2.				
⑤②	- PN1	Highest limit Low temperature area	Set the highest limit of the Low temperature area. Set range: Lowest limit of setting range~(range highest limit - 50) Setting unit: °C/°F	0					
⑤⑦	- PN2	Highest limit Middle temperature area	Set the highest limit of the middle temperature area. Setting range: <b>_PN1</b> ~ Highest limit of setting rang Setting unit: °C/°F	0					
⑥①	- T	Proportional cycle	Set a proportional cycle on PID control(Time proportional control) Setting range: 1 - 120 sec.	20	Displays when <b>_CnE</b> are 3, 4, 5, 6 and <b>_I r0</b> is **_r or **_P.				
⑥②	- FU2	Fuzzy strength	Set the fuzzy strength. <table border="1" style="margin-left: 20px;"> <tr> <td>1</td> <td>Adjust weakly</td> </tr> <tr> <td>5</td> <td>Adjust strongly</td> </tr> </table>	1	Adjust weakly	5	Adjust strongly	3	Displays when <b>_CnE</b> is 5 or 6.
1	Adjust weakly								
5	Adjust strongly								

i) Auto-tuning start mode

No	Character	Name	Description	Initial Value	Display condition/Remarks
⑥④	AL-1	Low temperature range Auto-tuning temperature set ,Start display	Temperature setting for auto tuning point at the Low temperature area. Press RUN/STOP key to start. Setting range: Low limit of setting range ~ <b>_PN1</b> °C/°F	0	
⑥⑤	AL-2	Mid. temperature range Auto-Tuning temperature set ,Start display	Temperature setting for Auto tuning point at the Middle temperature area. Press RUN/STOP key to start. Setting range: <b>_PN1</b> ~ <b>_PN2</b> °C/°F	0	
⑥⑥	AL-3	High temperature range Auto-Tuning temperature set ,Start display	Temperature setting for Auto tuning point at the High temperature area. Press RUN/STOP key to start. Setting range: <b>_PN2</b> ~ High limit of setting range °C/°F	0	
⑥⑦	AL	Auto-tuning for 3 temperature ranges, Start display	Press RUN/STOP key to start auto-tuning for all setting points of 3 temperature ranges.		

## 7.SETTING RANGE AND INDICATION RANGE TABLE

### 7.1 Setting range and Indicating range of Thermocouple input

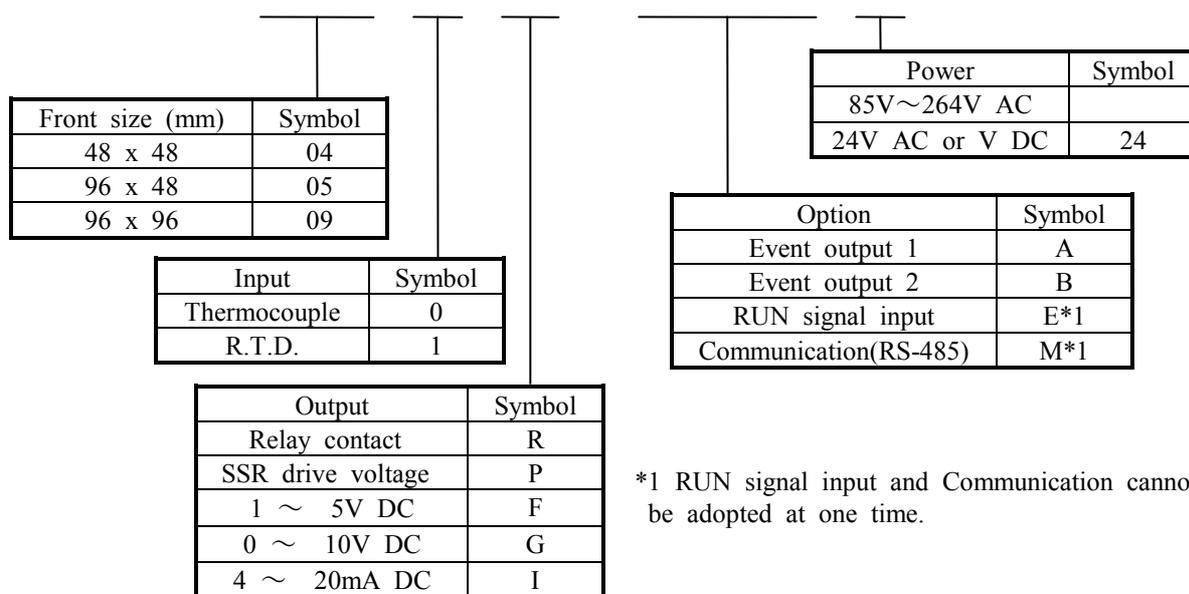
Input type		Setting range	Setting range (with decimals)	Indication range	Indication range (with decimals)
K (JIS) (IEC)	°C	0 ~ 1300	0.0 ~ 999.9	-40 ~ 1372	-40.0 ~ 999.9
	°F	0 ~ 2500		-40 ~ 2501	
J (JIS) (IEC)	°C	0 ~ 800	0.0 ~ 800.0	-31 ~ 850	-31.0 ~ 850.0
	°F	0 ~ 1450	0.0 ~ 999.9	-24 ~ 1563	-24.0 ~ 999.9
T (JIS) (IEC)	°C	-200 ~ 400	-199.9 ~ 400.0	-231 ~ 407	-199.9 ~ 407.0
	°F	-330 ~ 750	-199.9 ~ 750.0	-385 ~ 765	-199.9 ~ 765.0
R (JIS) (IEC)	°C	0 ~ 1700		0 ~ 1755	
	°F	32 ~ 3100		32 ~ 3192	
N (JIS) (IEC)	°C	0 ~ 1300	0.0 ~ 999.9	0 ~ 1335	0.0 ~ 999.9
	°F	32 ~ 2372		32 ~ 2435	
B (JIS) (IEC)	°C	0 ~ 1800		-20 ~ 1820	
	°F	32 ~ 3270		-4 ~ 2435	

### 7.2 Setting range and Indicating range of R.T.D.

Input type		Setting range	Setting range (with decimals)	Indication range	Indication range (with decimals)
Pt100(JIS) (IEC)	°C	-199 ~ 500	-199.9 ~ 500.0	-199 ~ 539	-199.9 ~ 539.1
	°F	-199 ~ 950	-199.9 ~ 950.0	-199 ~ 999	-199.9 ~ 999.9
JPt100(JIS)	°C	-199 ~ 500	-199.9 ~ 500.0	-199 ~ 529	-199.9 ~ 529.0
	°F	-199 ~ 950	-199.9 ~ 950.0	-199 ~ 984	-199.9 ~ 984.4

## 8.ORDERING INFORMATION

TTM - 3 □ □ - □ - □ N - □ □ □ - □



## 9. STANDARD SPECIFICATIONS

### 9.1 General specifications

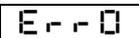
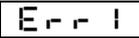
Memory tip	Semi-conductor non-volatile memory tip	
Input/Output isolation	Between Output area(control, event output) and Input area (process, CPU) and Power source	
Power voltage	85~264V AC 50/60Hz or 24V AC/DC $\pm$ 10% (ordered products)	
Power consumption	TTM-304	11VA(264V AC), 7VA(24V AC), 5W(24V DC)
	TTM-305	12VA(264V AC), 8VA(24V AC), 5W(24V DC)
	TTM-309	12VA(264V AC), 8VA(24V AC), 5W(24V DC)
Momentary power cut off	Within 1 cycle(20mS), Cut 100% power off on 100V AC at max. power consumption	
Insulation resistance	Between measuring terminal and the case itself, between power terminal and the case itself, 500V DC 20M $\Omega$	
Voltage resistance	Between measuring terminal and the case itself 1000V 1 min. between power terminal and the case itself 1500V 1 min.	
Operation environment	Temperature	0~55 $^{\circ}$ C
	Humidity	35%~85%RH (Avoid making dew)
	Set angle	Datum surface $\pm$ 10 degrees
	Vibration	0~0.2G
Transportation/ storage condition	Temperature	-20~65 $^{\circ}$ C
	Humidity	35 ~85%RH

### 9.2 Standard and performance

PV input area	Input type	Thermocouple	K, J, T, R, N, B switchable Effect of outer resistance approx.0.2 $\mu$ V/ $\Omega$ Indicating over, when wire is disconnected
		R.T.D.	Pt100, JPt100 switchable Allowable lead wire resistance 5 $\Omega$ or less(per wire)
	Sampling time	0.5 sec. (same as output change frequency)	
	PV correct.	-199.9~999.9 $^{\circ}$ C( $^{\circ}$ F) or -199~999 $^{\circ}$ C( $^{\circ}$ F)	
Display/ Setting	Display type	PV/character	4-digit 7 segment LED(green) letter height 10mm (For TTM-309, letter height 15mm )
		Set value	4-digit 7 segment LED(red) Letter height 8mm
		Output display	LED lamp (red)
		Run condition	LED lamp (red)
		Set value increase	LED lamp (green)
		Set value decrease	LED lamp (green)
	Accuracy of Indication /Setting	Thermocouple	$\pm$ 0.3% of indicated value +1 digit, or $\pm$ 3 $^{\circ}$ C(6 $^{\circ}$ F), whichever larger. Below 399 $^{\circ}$ C(750 $^{\circ}$ F) on accuracy for B type thermocouple is out of guaranteed accuracy
		R. T. D.	$\pm$ 0.3% of indicated value +1 digit, or $\pm$ 0.9 $^{\circ}$ C(1.8 $^{\circ}$ F), whichever larger.
Setting method	Set all parameters with the front keys.		
Lock functions	Locks for all parameters, for temperature parameters, for time parameters, and the lock except for program parameters		
Control/output	Control type	Select from ON/OFF control, PID control, PID control + fuzzy	
	Power ON	Relay contact output, SSR drive voltage output,0 ~10V DC output area Approx. 4 sec output 0% output 1~5V DC output 4~20mA DC output Approx. 4 sec. -10.0% output	
	PV abnormal	Relay contact output, SSR drive voltage output,0 ~10V DC output: 0% output (output OFF) 1~5V DC output, 4~20mA DC output: -10.0% output	

	Standards	Relay contact output : contact specification 1c contact capacity 250V AC3A(resistance load). SSR drive voltage output: OFF time; 0V DC ON time; 12V DC Loaded resistance over 600Ω. (It may vary according to a calculation with SSR inner resistance.) 1~5V DC output : Output voltage 1~5V DC Loaded resistance over 1KΩ. Possible output range 0.6 ~5.4V DC. 0~10V DC output: Output voltage 0~10V DC Loaded resistance over 1KΩ. Possible output range 0 ~11V DC. 4~20mA DC output: Output current 4~20mA DC Loaded resistance below 600Ω.
Program area	Number of patterns/steps	Number of pattern x No. of steps : Max.64 can be set.
	Step time	0 ~99 hrs. 59 min.
	Time accuracy	Set value ±(0.5% + 0.5 sec.)
	Run times	0 ~99 times (0 for continuation)
	Wait action	Wait zone: 0 ~100°C(°F) Wait time: 0~1 hr.59 min.
Additional Function	Event output	Contact specification 1a contact point Contact capacity 250V AC 0.5A(resistance load) or 125V AC 1A (resistance load)
	RUN signal input	OFF time voltage: 32V DC ON time current: 6mA DC Allowable resistance between terminals : ON time: max.333KΩ OFF time: min. 500KΩ Minimum input time: 500mSEC and over
	Communication	Communication standard: in accordance with RS-485 Network : Multi-drop method (Max. 31 stations for each) Communication distance: Max. 500m Communication address : 1 ~99 stations

## 10.MAINTENANCE AND INSPECTIONS

Troubles	Check points
Display does not come out.	Is instrument correctly inserted in the case? Are power terminals correctly connected? Is power sufficiently supplied?
 display	Memory error. If this still appears after putting power again , repair the unit.
 display	A/D conversion error. If this still appears after putting power again, repair the unit.
 display	Auto-tuning error. The display can be released by entering any key operation. Be sure to check the following points, then try auto-tuning again. Is a sensor correctly connected? Does process value indicate normal? Is control output normal? Does temperature correctly rise(or fall)?
 display  display Unstable process value	Is the sensor normal? (Does another unit make the same error?) Is the sensor correctly connected? Is the type of sensor correctly setup? Is correct value installed for the sensor correction value? No noise mixing?
Unable to start	Is the process value appropriate for any of the run steps after selecting PV Start?
Insufficient control	Value setting of PID constant, control sensitivity and fuzzy strength all proper?
Temperature does not increase(or decrease)	Is output terminal correctly connected? Is control type correctly set up?

If any of the troubles still exists after following the above instruction, or for any other cases, contact our Sales Department.



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