TOHO ELECTRONICS INC.

Program Controller TTM-P4/P9 Series
Instruction Manual

Thank you for purchasing our Program Controller TTM-P4/P9 Series. Please read this Instruction Manual carefully to use the product correctly. TTM-P4/P9 Series is a simplified program controller which enables program operation of up to 64 patterns x steps.

Contents

1. Cautions on Use

For safety purpose, following symbols are used in this manual.

⚠ Warning	The case that a user may receive fatal damage, electric shock, or severe burn injury when the product is incorrectly used.
⚠ Caution	The case that a user may receive minor damage or the equipment may get damage.

⚠ Warning	Verify correct wiring before turning on electricity since incorrect wiring may cause an equipment failure or a fire. Modification of this equipment may cause malfunctioning or a fire. Do not add modification on this equipment.
⚠ Caution	Wiring: Do not use empty terminals for irrelevant purposes. Operation: Do not use a sharp-pointed tool for operating keys.

- Hand over this operation manual to a person who actually operates the product.
- Do not reprint or duplicate this manual without permission.
- Content of this manual may be subject to modification without prior notice.
- We are not liable for any faults arising from misuse of the product.

Verification of the product
1) Verification of the model:
     Refer the model name printed in the packing box to the order sheet.
2) Verification of accessories:
     Instruction Manual (this manual)....................................... 1 copy
     Mounting attachment .... 1 pc (for TTM-P4)
     Mounting metal instrument... 1 set (for TTM-P9)
3) Model
     TTM-P4-0-R (relay output with optional ABE)
     TTM-P4-0-P (SSR output with optional ABE)
     TTM-P9-0-R (relay output with optional ABE)
     TTM-P9-0-P (SSR output with optional ABE)

Prior to control operation
- Non-volatile memory is used for storing settings, which stays in the storage even when the power is cut.
- Three thermocouple types (K, J, and R) are provided for this product.
   When you use the product, please match the thermocouple type with product setting.

2. Name and Size of Each Part

2.1 Name of each part

<u>LED Lamp</u>

RUN: Lights during operation mode

OUT: Lights as synchronized with main control output.
       For continuous proportional control, blinks depending
       on the volume of operation.

SET: Lights during parameter setting.

AL: Lights during alarm output.
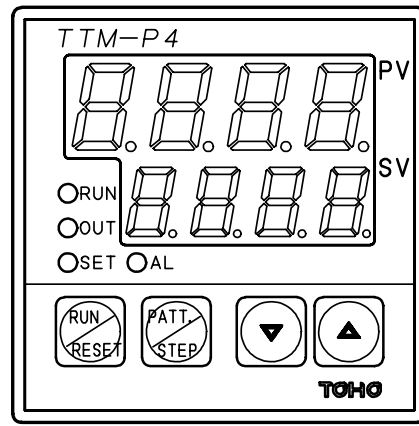
<u>Operation Key</u>

RUN/RESET key: RUN/RESET operation key

PATT./STEP key: PATTERN/STEP operation key

   key: Setting value and parameter change key

   key: Setting value and parameter change key

For the details of operation, see "6. Operation Flow and Parameter Description."

2.2 External dimensions and panel cut size

3. Wiring

3.1 TTM-P4 series

Operation signal
Output

SSR drive

Relay contact

+ ⎯ 2

N.O

Control output

− ⎯ 3

C

Power supply voltage
100 to 240VAC ± 10%

1		6	Reserved		11	
2		7	Reserved		12	
3		8	Reserved		13	
4		9			14	
5		10	DI (external input)		15	Reserved

Time signal output/ alarm

−

Thermocouple input (K/J/R)

+

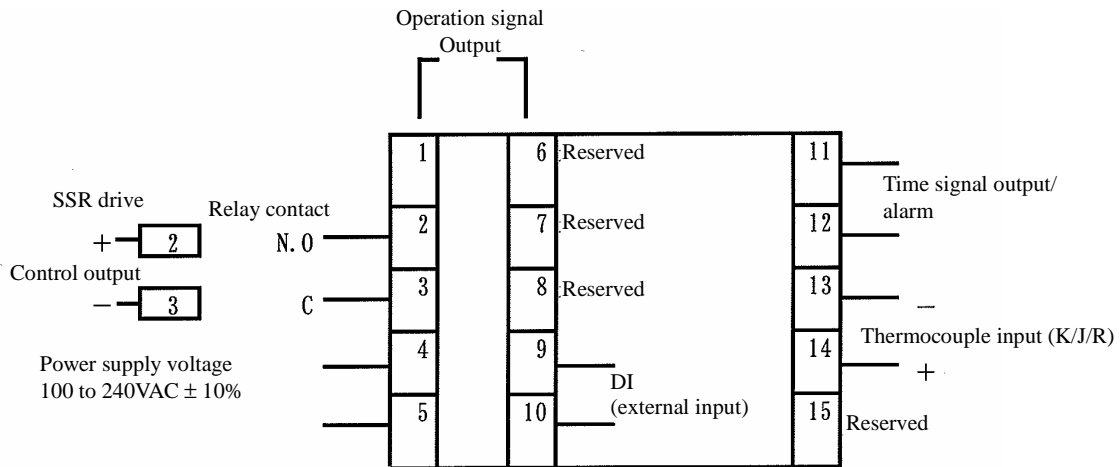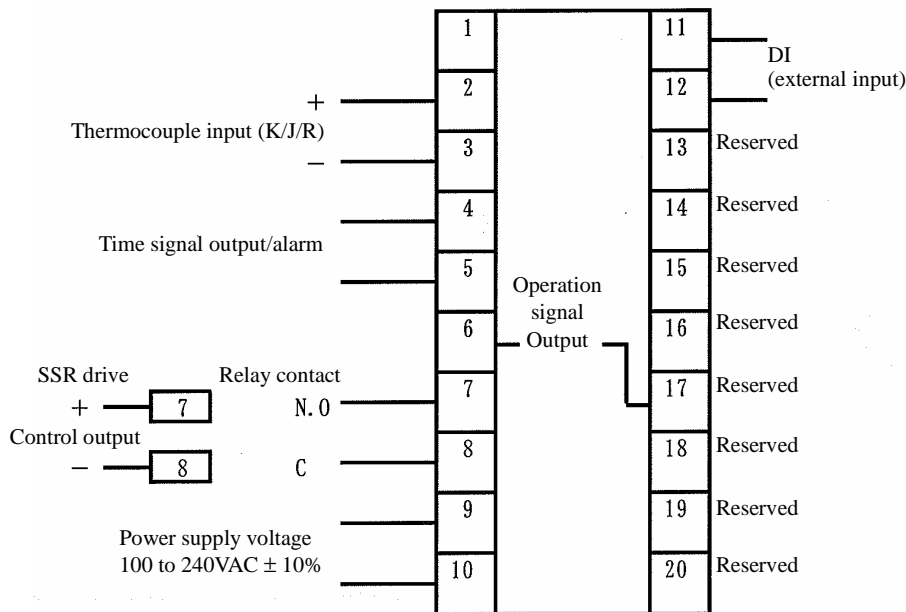## 3.2 TTM-P9 series

Thermocouple input (K/J/R)

+
−

Time signal output/alarm

SSR drive   Relay contact

+ ⎯ 7   N.O

Control output

− ⎯ 8   C

Power supply voltage
100 to 240VAC ± 10%

Operation
signal
Output

1		11	
2		12	
3		13	Reserved
4		14	Reserved
5		15	Reserved
6		16	Reserved
7		17	Reserved
8		18	Reserved
9		19	Reserved
10		20	Reserved

DI (external input)

3.3 Caution on wiring

⚠ Warning	Before wiring, be sure to turn off the power supply. Otherwise, you may get an electric shock.
⚠ Caution	This equipment does not execute control operation for about 4 seconds after the power is turned on. (Control output does not work. during the period) Pay attention when you use this equipment for interlock circuit. Confirm the wirings of the input terminal, power terminal, and optional terminal by reading the label at the side of the equipment.

- Use crimping terminals matching to M3.5 screws. Also, when you wire to the central terminals, tighten the wire directly.
- As for wire rods to be used for connecting this equipment with a thermocouple, use a specific compensating lead wire or wire itself.
- When you use this equipment near the source of noise, use a shielded wire. Also, do not wire the input/output line in the same duct or wire conduit.
- Leave the input/output signal line more than 50 cm away from the power and load lines.

4. Terms and Functional Description

4.1 Event output

1. Deviation upper/lower limit ALd ← → ALd ← ALL → ← ALH → SV	5. Absolute value upper/lower limit ALd ← → ALd ˚F ← ALL → ← ALH →
2. Deviation upper limit ALd ← ALH → SV	6. Absolute value upper limit ALd ˚F ← ALH →
3. Deviation lower limit ALd ← ALL → SV	7. Absolute value lower limit ALd ˚F ← ALL →
4. Deviation upper/lower limit range ALd ALd ← ALL → ← ALH → SV	8. Absolute value upper/lower limit range ALd ALd ˚F ← ALL → ← ALH →
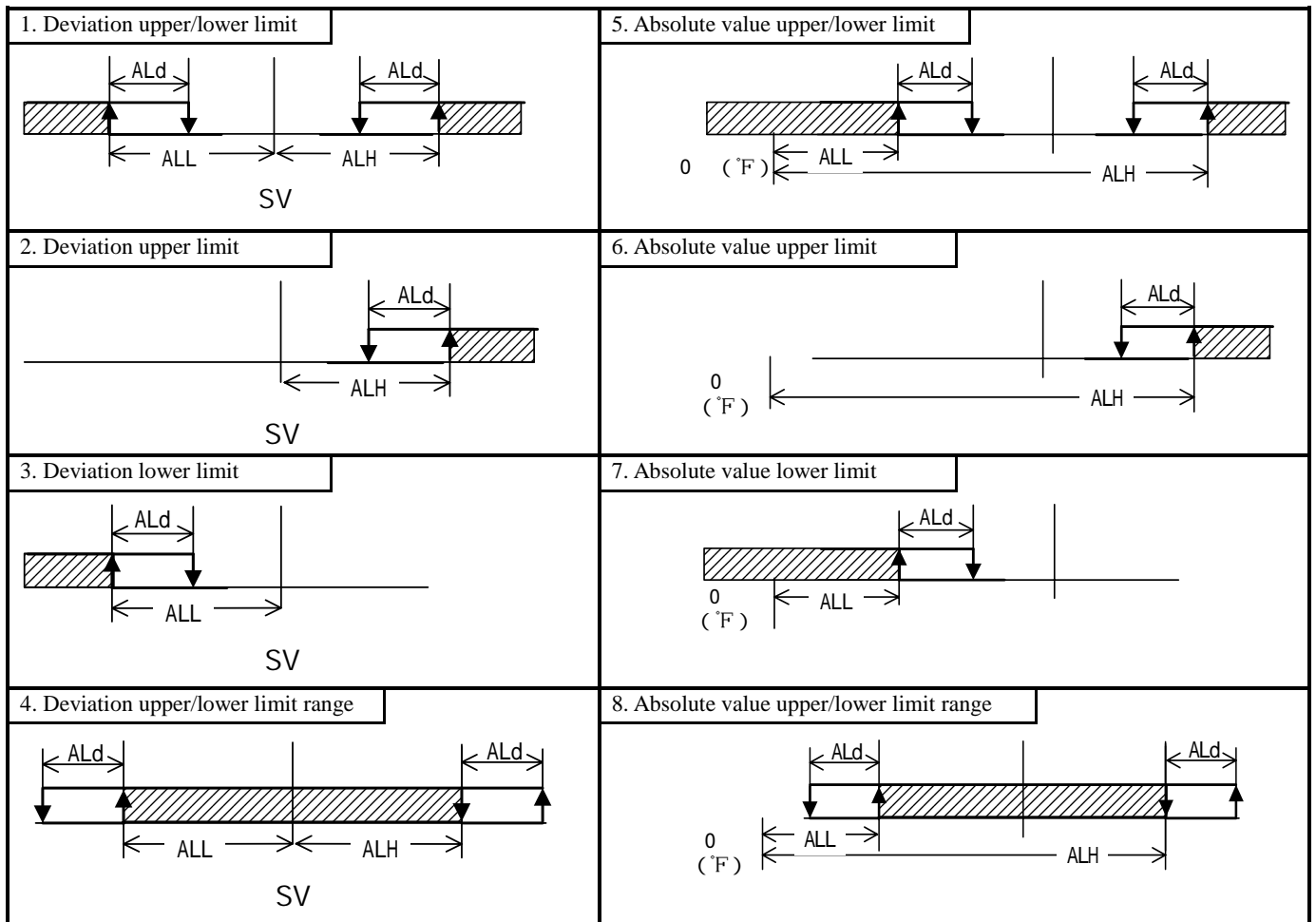
: Temperature alarm output operation range   ALL: Alarm output lower limit setting   ALH: Alarm output upper limit setting
ALd: Alarm output sensitivity

4

4.1 Wait operation

In case one step shifts to another step, the next step will not start even after step time
Elapsed if the process value(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 $\boxed{\quad\quad SV}$ blinks.

: Wait Zone... This means the deviation area between SV(Setting Value) and
PV(Process Value) enable to start next step.
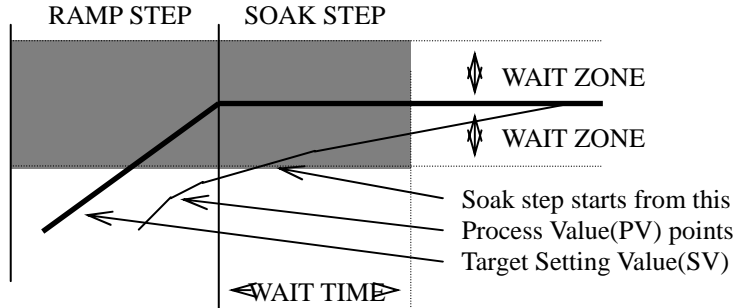
: Wait time... This means the maximum waiting period to start next step when
PV(Process Value) does not reach to the SV(Setting Value).
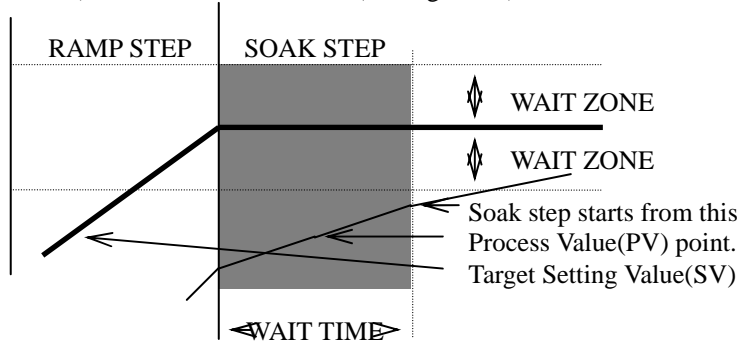
SV start   It will start from the setting value at the starting time of operation which to be treated as the
PV(Process Value) or the target SV(Setting Value).

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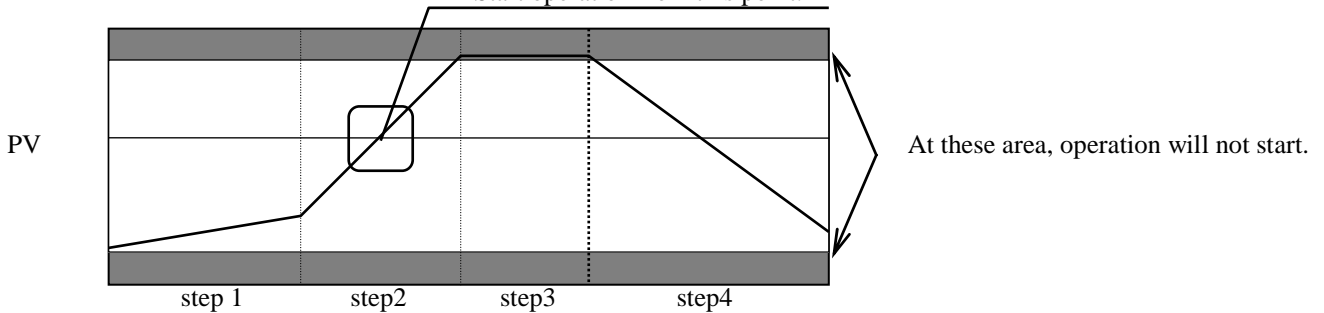
SV start   .At the set time of Step 1, operation starts from the specified SV(Set Value)
to the target set value(SV1) of Step 1.
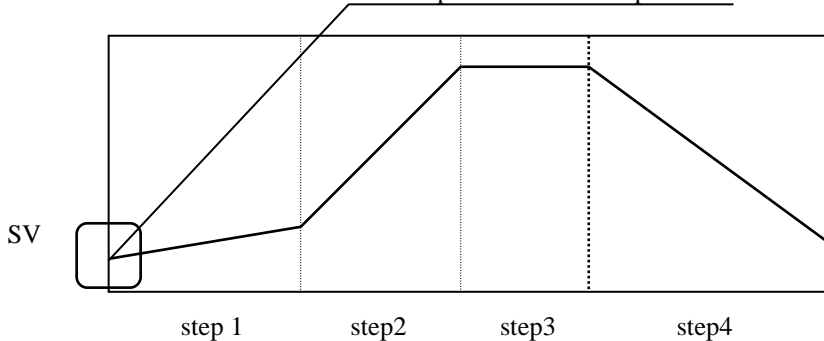
5. Before Program Operation

You can select the input type. Three thermocouple types (K, J, and R) are provided for this product.
In this Instruction Manual, the following symbol is used in order to use this equipment safely.

⚠ Caution	Before using this equipment, be sure to set the input type.

- This equipment can handle PID control. Because the control parameter can be set independently for low, medium, and high temperature, be sure to set each control temperature range.
  The setting by key input is stored even though the power is turned off.
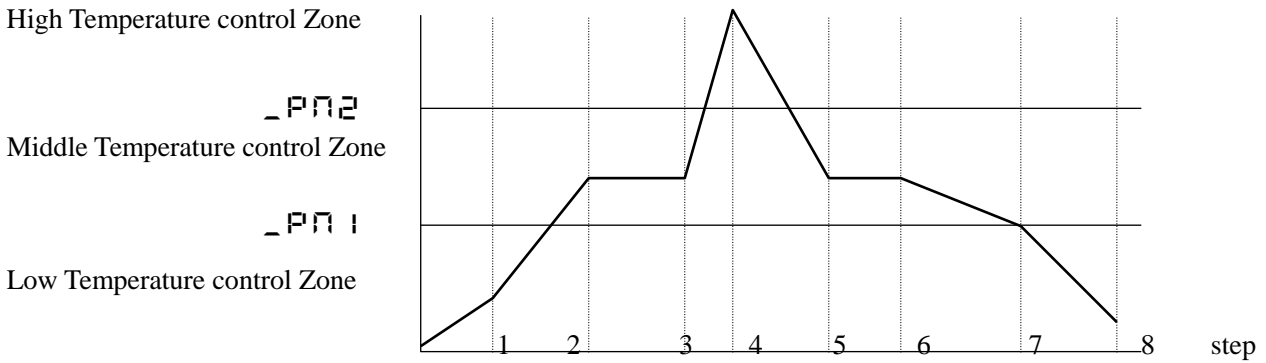
6. Operation Flow and Parameter Description

6.1 State transitions between modes

Operation keys will be used to switch between modes.
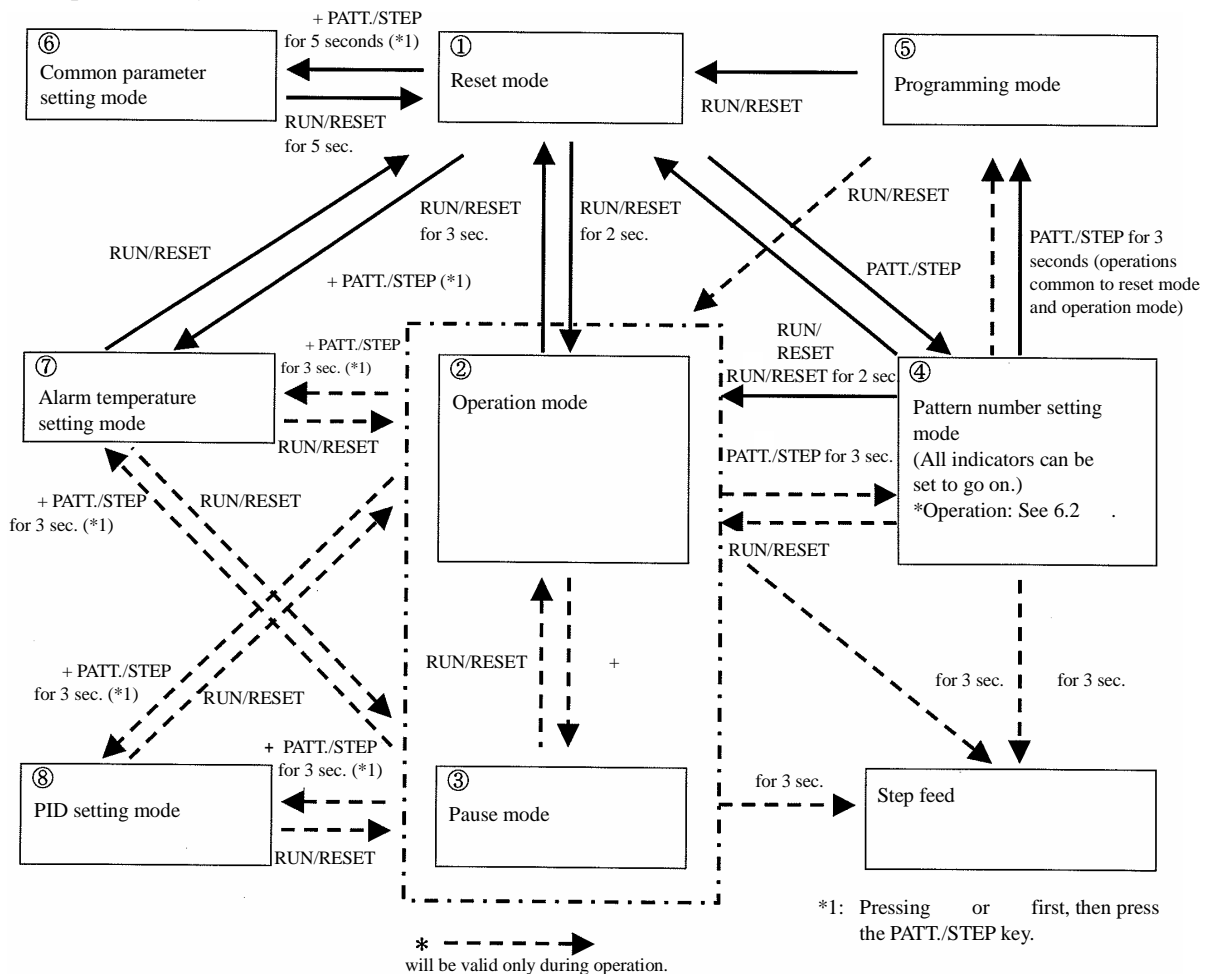
6.2 Detailed description of modes

Reset mode
- This mode will stop control. (The system becomes this mode when the power is turned on.)

Operation mode
- This mode will conduct programmed run control. (The RUN lamp lights.)
- The SV display will blink while a wait operation is in process in the wait zone or wait time.
- After a patterned operation is complete, the SV display will display "End" and stop the control.   The PV display will display the current temperature.
- Holding the   key down for 3 seconds during operation will enable step feed.

Pause mode
- This mode will pause programmed run control. (The RUN lamp blinks.) It will stop the time and maintain the control temperature measured at that point in time.

Pattern number setting mode
- This mode will set the pattern number of the program to be executed.
- Use the   and   keys to set a pattern number.
- When the system shifted from "operation mode," holding the   key down for 3 seconds will enable step feed.
- When the system shifted from "operation mode," pressing the PATT./STEP key will display the time elapsed and time setting.
  PV screen: time elapsed, SV screen: time setting
- Pressing the   and   simultaneously while holding down the PATT./STEP will turn on all the indicators.
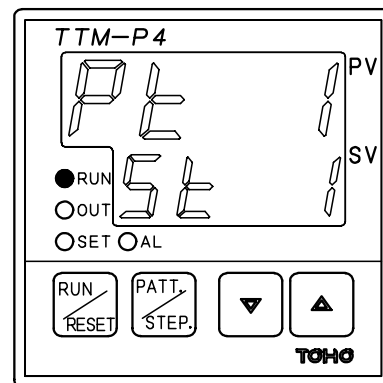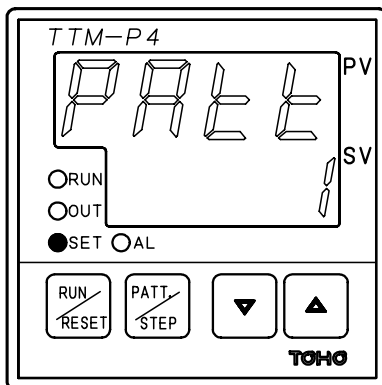
<Display when shifted from reset mode>
PV: Displays the pattern number selection character.
SV: Displays the pattern number setting.
Lamp: Turns on the SET lamp.

<Display when shifted from operation mode>
PV: Displays the pattern number being executed or the time elapsed.
SV: Displays the step number being executed or the time setting.

Programming mode (The SET lamp lights.)
- This mode will set the program for each pattern.
- Setting the time to 0 minutes will invalidate that particular step.

From reset mode

↓   Press PATT./STEP.

From operation mode

| Pattern number setting mode | ◄──── | Hold PATT./STEP down for 3 seconds. |

Hold PATT./STEP down
for 3 seconds.

PV `Su  1`   Set step 1 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  1`   Set step 1 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  2`   Set step 2 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  2`   Set step 2 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  3`   Set step 3 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  3`   Set step 3 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  4`   Set step 4 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  4`   Set step 4 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  5`   Set step 5 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  5`   Set step 5 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  6`   Set step 6 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  6`   Set step 6 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  7`   Set step 7 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  7`   Set step 7 time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `Su  8`   Set step 8 temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t  8`   Set step 8 time.
SV `0.00`

↓   Press the PATT./STEP key.

Set it to values up to the maximum step. (This varies according to the number of patterns.)

PV `Su`   Set step   temperature.
SV `0`

↓   Press the PATT./STEP key.

PV `t`   Set step   time.
SV `0.00`

↓   Press the PATT./STEP key.

- If, in setting a temperature for a specific step, you set it to a value lower than the minimum in the setting range (displayed as " ‒ "), then the steps following that particular step will be invalid and the setting parameter will not be displayed.   The patterned run will come to an end in the step before the one set as " ‒ "
- In changing a setting during operation, you cannot change the step temperature or step time during operation.
- If, when starting the PV, you set the temperature setting in step 1 to the minimum in the temperature setting range, the time for step 1 will be valid.   (The PV will be normally started in and after step 2.)
- If all steps are set to their initial values (0°C), setting a temperature will automatically set the next step to the same temperature as well.
- Setting a step time to a value higher than the maximum in the setting range (displayed as " ‾ ") will cause the product to run continuously at the set temperature in that particular step.

Common parameter setting mode (The SET lamp lights.)
- This mode will set the parameter common to each pattern and step.

From reset mode

Hold the   key and the PATT./STEP key down for 5 seconds

[A]

PV `_PuS` Set the PV correction zero point.
SV `0`

↓   Press the PATT./STEP key.

PV `_PuG` Set the PV correction gain.
SV `1.00`

↓   Press the PATT./STEP key.

PV `_Cnt` Toggle between forward and reverse actions.
SV `2`   `1`:Forward action (cooling) /`2`: reverse action (heating)

↓   Press the PATT./STEP key.

PV `_In` Switch between sensor types.
SV `1`   `1`: K thermocouple /`2`: J thermocouple / `3`: R thermocouple

↓   Press the PATT./STEP key.

PV `_SLH` Set the SV limiter upper limit.
SV `1200`

↓   Press the PATT./STEP key.

PV `_SLL` Set the SV limiter lower limit.
SV `0`

↓   Press the PATT./STEP key.

PV `_PAt` Set the number of patterns.
SV `8`

↓   Press the PATT./STEP key.

PV `PuSu` Select PV or SV start.
SV `Pu` `Pu`: PV start /`Su`: SV start

↓   Press the PATT./STEP key.

PV `SuSu` Set a starting temperature for starting the SV.
SV `0`   (This will not be displayed at PV start.)

↓   Press the PATT./STEP key.

PV `_t` Set a proportional period.
SV `20`

↓   Press the PATT./STEP key.

PV `_Yd` Set a weight zone.
SV `0`

↓   Press the PATT./STEP key.

PV `_Yt` Set a wait time.
SV `0.00`

↓   Press the PATT./STEP key.

PV `_ALF` Select a time signal and an alarm output type.
SV `00`   For settings, see Table 1.

↓   Press the PATT./STEP key.

PV `_ALd` Alarm output sensitivity
SV `1`   (This will not be displayed when a time signal output is selected.)

↓   Press the PATT./STEP key.

	↓	
PV	`ヒ5оп`	Set a time signal ON time.
SV	`0.00`	(This will not be displayed when an alarm output is selected.)
	↓	Press the PATT./STEP key.
PV	`ヒ5оF`	Set a time signal OFF time.
SV	`0.00`	(This will not be displayed when an alarm output is selected.)
		(The time signal will be invalid when set to 0 minutes.)
	↓	Press the PATT./STEP key.
PV	`ヒ 1. 1`	Select a time signal for pattern 1 and step 1.
SV	`оFF`	ON/OFF (This will not be displayed when an alarm output is selected or the time signal is invalid.)
	↓	Press the PATT./STEP key.
PV	`ヒ 1. 2`	Select a time signal for pattern 1 and step 2.
SV	`оFF`	ON/OFF (This will not be displayed when an alarm output is selected or the time signal is invalid.)
	↓	Press the PATT./STEP key.

⋮ From this time on, time signal selections will be set similarly up to pattern   and step   .
⋮ (This will not be displayed when an alarm output is selected.)
⋮ * The number of steps will vary according to a setting concerning the number of patterns.

	↓	Press the PATT./STEP key.
PV	`Erчп`	Select an external operation.
SV	`оFF`	`оп`: External operation /`оFF`: Internal operation
	↓	Press the PATT./STEP key.
PV	`_Lоⅼ`	Lock the key.
SV	`оFF`	`оп`: Locked /`оFF`: Unlocked
	↓	Press the PATT./STEP key.
PV	`_ P 1`	Set a proportional band for PID No. 1 (cold).
SV	`3.0`	
	↓	Press the PATT./STEP key.
PV	`_ 1 1`	Set an integration time for PID No. 1 (cold).
SV	`0`	
	↓	Press the PATT./STEP key.
PV	`_ d 1`	Set a differentiation time for PID No. 1 (cold)
SV	`0`	
	↓	Press the PATT./STEP key.
PV	`_Pп 1`	PID range
SV	`0`	Set intermediate point 1.
	↓	Press the PATT./STEP key.
PV	`_ P2`	Set a proportional band for PID No. 2 (medium).
SV	`3.0`	
	↓	Press the PATT./STEP key.
PV	`_ 1 2`	Set an integration time for PID No. 2 (medium).
SV	`0`	
	↓	Press the PATT./STEP key.
PV	`_ d2`	Set a differentiation time for PID No. 2 (medium)
SV	`0`	
	↓	Press the PATT./STEP key.
PV	`_Pп2`	PID range
SV	`0`	Set intermediate point 2.
	↓	Press the PATT./STEP key.
PV	`_ P3`	Set a proportional band for PID No. 3 (hot).
SV	`3.0`	
	↓	Press the PATT./STEP key.
PV	`_ 1 3`	Set an integration time for PID No. 3 (hot).
SV	`0`	
	↓	Press the PATT./STEP key.

↓

PV `_ d3` Set a differentiation time for PID No. 3 (hot)
SV `0`

    ↓   Press the PATT./STEP key.

PV `At - 1` Start the automatic tuning of PID No. 1 (cold).
SV `0` Temperature setting for automatic tuning   →   [RUN/RESET] key

    ↓   Press the PATT./STEP key.

PV `At - 2` Start the automatic tuning of PID No. 2 (medium).
SV `0` Temperature setting for automatic tuning   →   [RUN/RESET] key

    ↓   Press the PATT./STEP key.

PV `At - 3` Start the automatic tuning of PID No. 3 (hot).
SV `0` Temperature setting for automatic tuning   →   [RUN/RESET] key

    ↓   Press the PATT./STEP key.

[A]

Start the automatic tuning.

When the automatic tuning is complete, the product will switch back to the automatic tuning startup screen.
Automatic tuning possible even when locked

* Changing the setting concerning the number of patterns will switch the settings for the temperature settings for pattern parameters, time settings, and time signal selections for common parameters back to the initial settings.

Selecting time signals and alarm outputs

PV `_ ALF`
SV `00`

Action types (to be set by using the   key)

`0`	Nil (this selects a time signal)
`1`	Deviation upper and lower limit alarm
`2`	Deviation upper limit alarm
`3`	Deviation lower limit alarm
`4`	Deviation upper and lower limit range alarm
`5`	Absolute value upper and lower limit alarm
`6`	Absolute value upper limit alarm
`7`	Absolute value lower limit alarm
`8`	Absolute value upper and lower limit range alarm

Additional functions (to be set by using the   key)

`0`	No additional functions
`1`	Output held
`2`	Standby sequence
`3`	Output held + standby sequence

Alarm temperature setting mode (The SET lamp lights.)
- This mode will set the alarm temperature.
- Use the PATT./STEP key to select an alarm output lower limit "`_ ALL`" and an alarm output upper limit "`_ ALH`" (This may not be displayed depending on the type of action selected for an alarm output.)
* If no key is pressed for 10 seconds after the temperature setting is changed, then the product will switch automatically to "reset mode."

```
                            ┌─────────────────┐
                            │ From reset mode │
                            └────────┬────────┘
                                     │
          ┌──────────────────────────▶│  Hold the      key and the PATT./STEP
          │                           │  key down simultaneously.
          │                           │
          │         PV  ┌──────────┐
          │             │ _ A L L  │  Set an alarm output lower limit.
          │         SV  ├──────────┤
          │             │    0     │
          │             └──────────┘
          │              ↓   Press the PATT./STEP key.
          │         PV  ┌──────────┐
          │             │ _ A L H  │  Set an alarm output upper limit.
          │         SV  ├──────────┤
          │             │          │
          │             └──────────┘
          │              ↓   Press the PATT./STEP key.
          │                   │
          └───────────────────┘
```
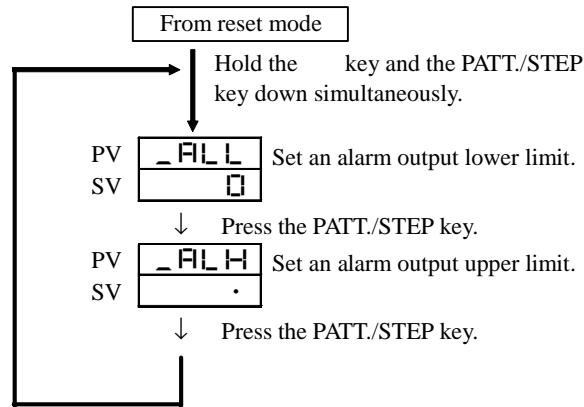
PID setting mode (The SET lamp lights.)
- This mode will set the PID constant (only during operation).

6.2 Parameter description

Program setting mode parameters

Character	Description	Initial value	Setting range
Su	Set a step temperature	0	Setting range (K: 0 to 1200 °C/J: 0 to 800°C/R: 0 to 1300°C
t	Set a step time	0.00	0 to 99 hours 59 minutes

Common parameter setting mode parameters

Character	Description	Initial value	Setting range	
_PuS	Set the PV correction zero point	0	-199 to +199°C	
_PuG	Set the PV correction gain	1.00	0.50 to 2.00 times	
_Cnt	Forward/reverse switchover	2	1: Forward action (cooling)/2: reverse action (heating)	
_ I n	Sensor switchover	1	1: K thermocouple/2: J thermocouple/3: R thermocouple	
_SLH	SV limiter upper limit	1200	SLL + 50°C to setting range upper limit	
_SLL	SV limiter lower limit	0	0°C to SLH-50°C	
_PAt	Set the number of patterns	8	1 to 15 patterns	
PuSu	Select PV/SV start	PV	PV: PV start/SV: SV start	
SuSu	Set an SV start temperature	0	Lower limit to upper limit of the temperature setting range	
_ t	Proportional period	R (relay output): 20 S (SSR output): 2	1 to 120 seconds	
_ Ud	Wait zone	0	0 to 100°C	
_ Ut	Wait time	0.00	0 to 99 hours 59 minutes	
_ALF	Time signal/alarm output type	00 (time signal)	0: Nil (time signal) 1: Deviation upper and lower limit 2: Deviation upper limit 3: Deviation lower limit 4: Deviation upper and lower limit range 5: Absolute value upper and lower limit 6: Absolute value upper limit 7: Absolute value lower limit 8: Absolute value upper and lower limit range	0: No additional functions 1: Output held 2: Standby sequence 3: Output held + standby sequence
_ALt	Alarm output sensitivity	1	0 to 199°C	
tSon	Time signal ON time	0.00	0 to 99 hours 59 minutes	
tSoF	Time signal OFF time	0.00	0 to 99 hours 59 minutes	
Erun	Select an external operation	OFF	ON: external operation /OFF: internal operation	
_LoC	Lock the key	OFF	ON/OFF	

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PID setting parameters

Character	Description	Initial value		Setting range
	PID No.	1 (cold)	3 (hot)	
_ P	Proportional band P	3.0%	3.0%	0.1 to 200.0 %
_ ¦	Integration time I	0 second	0 second	0 to 3600 seconds
_ d	Differentiation time D	0 second	0 second	0 to 3600 seconds
Ah -	AT temperature setting	0°C	0°C	As per the PID range setting
_Pn ¦	PID range intermediate point 1	0°C		Between minimum and maximum in the temperature setting range -50°C
_Pn2	PID range intermediate point 2	0°C		Intermediate point 1 to the maximum in the temperature setting range

Alarm temperature setting mode parameters

Character	Description	Initial value	Setting range
_ALL _ALH	Alarm output lower and upper limits	Upper limit: 0 Lower limit: 0	-1999 to +9999°C

7. Setting and Display Ranges

Input type	Display range	Setting range
Thermocouple K	-40 to +132°C	0 to 1200°C
Thermocouple J	-31 to +850°C	0 to 800°C
Thermocouple R	-20 to +1755°C	0 to 1300°C

8. List of Types

Size

Symbol	Size (mm)
4	48 x 48
9	96 x 96

Control output

Symbol	Output type
R	Relay output
P	SSR output

* The following specifications are always selected.
　　　1) Time signal output/alarm output
　　　2) Operating signal output
　　　3) DI (external input)

9. Specifications and Rating

9.1 General specifications

Storage cell		Each setting value is stored in EEPROM.
Power supply voltage		100 to 240 VAC ±10%, 50/60Hz (free power supply)
Power consumption		10 VA or less
Insulation resistance		Measuring terminal – case: 500 VDC, 20 MΩ Power supply terminal – case: 500 VDC, 20 MΩ
Withstand voltage		Measuring terminal – case: 1000 VAC for 1 minute Power supply terminal – case: 1500 VAC for 1 minute
Operating environment	Ambient temperature	0 to 50°C
	Ambient humidity	20 to 90%RH (no condensation)
Storage environment	Ambient temperature	-25 to +70°C (no freezing and condensation)
	Ambient humidity	5 to 95%RH (no condensation)
Weight		TTM-P4 ..... 180 g or less TTM-P9 ..... 380 g or less
Installation environment		- No corrosive gas, dust, and oil - Place far from the source of electric noise and less affected by the electro-magnetic field - No mechanical vibration and shock - No direct sunlight - Indoor - Max. 2,000 m above sea level - 2 or less of pollution degree
Installation		Installation category II
Control type		PID control
Control output		Relay output and SSR output

9.2 Rating and performance

Input	Thermocouple		Selection of thermocouples K, J, and R When a wire is disconnected: Indicated as " − − − − "
	Sampling period		0.5 seconds
	Indication accuracy		Measured value ±(0.3% + 1 digit) or ±2°C, whichever is larger (Ambient temperature: 23°C ±10°C
Output	Rating	Relay output	Contact type: 1a contact Contact capacity: 250 VAC, 3 A (resistance load) Minimum load: 5 VDC, 100 mA
		SSR output	Output voltage: 0 VDC/12 VDC Output voltage accuracy: ±1 V (Ambient temperature: 0 to 50°C) Load resistance: 600 Ω or more
Time signal/alarm output			Contact type: 1a contact Contact capacity: 250 VAC, 2.4 A (resistance load) Minimum load: 5 VDC, 10 mA
Operation signal			Contact type: 1a contact Contact capacity: 250 VAC, 2.4 A (resistance load) Minimum load: 5 VDC, 10 mA
DI (external input)			Minimum input time: 500 ms OFF voltage: Max. 6 VDC ON current: Max. 6 mA Allowable resistance between terminals: ON: Max. 333 Ω OFF: Min. 500 KΩ
Timer accuracy			Setting time ±(1.5% + 0.5 seconds)
Display	PV display		TTM-P4: 4-digit 7-segment LED (green), character height 10 mm TTM-P9: 4-digit 7-segment LED (green), character height 14 mm
	SV display		4-digit 7-segment LED (red), character height 8 mm
	Lamp		RUN, OUT, SET, and AL: Red LED

10. Maintenance and Inspection

10.1 Error indication:　Er r 0: Memory error (Abnormality of EEPROM)

Er r 1: A/D conversion error (Abnormality of A/D conversion)

Er r 2: Automatic tuning error

TOHO ELECTRONICS INC.