Digital Controller

TTM-200 series

User's Manual

TOHO ELECTRONICS INC.

User's manual for digital controller TTM-200 series

Introduction

Thank you for purchasing Toho Electronics' TTM-200 series.
Before using the products, thoroughly read this manual for a better understanding of them.
Ensure to store this manual and use it whenever needed.

Precautions on the use of the products

Ensure to read this manual before using the equipment.
Take care to understand the following for the safe use of the equipment.
Ensure this manual to be in hands of a person using the equipment.

★ Precautions on safety

Alarms are defined and categorized into either one of four groups in this manual, depending on degrees of importance or risk in terms of the safe use of the equipment or prevention of accident or damage on the equipment. For each alarm, symbol is assigned as shown below.

★ Alarm symbols

Danger	Improper handling of the equipment may cause fatality or serious injury for an impending reality.	**Caution**	Improper handling of the equipment may cause injury or physical damage on it.
Warning	Improper handling of the equipment may cause fatality or serious injury.	**Reminder**	Care should be taken for ensuring safety.

An alarm categorized in the group of Caution may still yield to serious result, depending on circumstances.
Any symbol for the four groups intends to raise user's attention for important description. Carefully observe it.

★ Other symbols

	General caution, warning or prohibition without particularity		Instruction on ground connection for the equipment with safety grounding terminals		Hazard of pinched fingers on a particular portion of the equipment
	Possible injury caused by touching a particular portion of the equipment under specific conditions		Unspecific behaviors of general users		Hazard of injury due to high temperature under specific conditions
	Hazard of an electric shock under specific conditions		Hazard of injury such as an electric shock due to disassembling or modification of the equipment		Hazard of burst under particular conditions
	Supplementary explanation		Designation of reference for explanation	Note	Care for use or operation

Warnings

	Improper wiring to the equipment may cause a failure, such as fire. Upon completion of wiring, ensure to verify the proper wiring before turning on electricity.
	Do not turn on electricity until all wiring is complete. Do not touch portions of high voltages such as power supply terminals, as an electric shock may be resultant.
	Install appropriate protective circuits externally if a failure or abnormality of the equipment may seriously affect related systems.
	Do not use the equipment out of the specified range, as it may fail or catch fire.
	Do not under any circumstance to modify or disassemble the equipment, as a failure may be caused, resulting fire or an electric shock.
	Do not use the equipment in ambience of flammable or explosive gases.

Cautions

	Do not use the vacant terminals for wiring.
	Do not use a pointed object to operate keys.
	Do not turn on the power supply until wiring is fully complete in order to prevent an electric shock, failure or malfunctioning. For replacing a component connected on the equipment, ensure to turn off the power supply. For turning back on the power supply, do so after all wiring is complete.
	Ensure not to trap heat in the space surrounding the equipment in order to provide sufficient heat release.
	Do not put a metal piece or similar inside the equipment. A fire, an electric shock or failure may be caused.
	The equipment is designed for instrumentation. For its use in environments of high voltages or intense noises, take appropriate measures on the side of user's equipment.
	The equipment is designed for controlling physical values, such as temperatures, on general industrial facilities. Do not use it for subjects of control that may seriously affect human life.
	Turn off the power supply before cleaning the equipment, and wipe it with a soft dry cloth. Do not use thinners, as they may cause deformation or discoloration of the equipment.
	The equipment may cause radio disturbances in domestic settings. User is required to take appropriate measure.
	Ensure to tighten terminal screws at specified torque. Insufficient tightening the screws may cause an electric shock or fire.
	Ensure to observe precautions listed in this manual for the use of the equipment.
	Reprinting or duplicating this manual is prohibited.
	This manual may be revised without prior notice.

Precaution regarding Export Trade Control Ordinance

Investigation on client or application by an appropriate party is required so that the equipment is not used for mass destruction weapons and such (military application, military facilities, etc.).

Notation convention in this manual

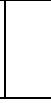
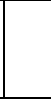
★ Summary notation

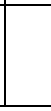
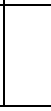
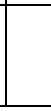
Abbreviations in alphabetical characters are used for the diagrams and text in this manual. Some major examples are as follows.

Abbreviation	Term
PV	Present value
SV	Setting value
AT	Auto-tuning
ENT	Determined
MV1	Primary operating amount
MV2	Secondary operating amount
CT	Current transformer
AI	Remote SV input

★ Notation of characters

For parameters and settings, numeric and alphabetic characters are inscribed as follows. (For initial setting, a character is comprised of eleven segments.)

0	1	2	3	4	5	6
						
7	8	9	Minus	Period	Slash	
						

A	B	C	D	E	F	G
						
H	I	J	K	L	M	N
						
O	P	Q	R	S	T(t)	U
						
V	W	X	Y	Z	n	v
						

Contents

6. Parameters

Various parameters of TTM-200 series are described in terms of their functions.
Read this chapter prior to their settings.

7. Appendix

Product specification, errors (troubles) and parameter setting table of TTM-200 series are described.

1. Overview

Features of products, confirmation of products, and model coding and the name of each component or part are described in this chapter.

1.1 Feature

★ Improved controllability due to new PID algorithm
(1) Time required to stabilize after start of control has been reduced (compared to Toho's other models).
(2) Jumpless control function is supported, where post-disturbance overshoots are suppressed.
(3) Selection can be made from three types of PIDs.
(PID auto-tuning with the overshoot suppression function is set as factory default.)

★ Full multi-input
Thermocouples (13 types), resistance temperature detector (2 types), voltage (5 types) and current (one type) are achieved as input specifications on a single unit. Their changes are possible through setting changes of parameters. ("K thermocouple" is set as factory default)

★ Compact-sized with dimension of 55 mm (TTM-204) or 65 mm (other than TTM-204) in depth

★ Sampling cycle of 200 ms

★ Loader communication function
Best suited for setting various parameters
Dedicated cable: Option (with charge) (See page 7-9 for specifications.)
Dedicated software: Option (free-of-charge)

★ Blind function and priority screen for a simplified operation
Blind function: Among multiple parameters, only those needed can be displayed.
Priority screen: By transferring the necessary parameter screen to the operating mode screen, indication as well as the setting would be possible without calling the parameter screens. (max. 20 screens)

★ The valve position proportional control is made possible without feedback resistance.

★ Bank function
Each process value (such as SV, PID constants) which varies in each process can be set at every bank, enabling the setting changes according to the content of the process. (max. 8 points)

★ Simple timer function
Control of "start or stop of control after predetermined time has elapsed" can be done on a single unit.
The independent use of timer is also allowed. (Independent 3 points)

★ Protective structure In compliance with IP66 or equivalent (TTM-204 only)

★ Applicable to various instrumentation systems, using manual control

★ Password function

★ Modification to the settings at factory default is possible.

★ Display colors of PVs (measurement values) can be changed to green, red or orange.

★ Ramp function enables the setting of gradient.

★ Soft-start function
During PID control, a limit can be applied to an operation volume for a predetermined period of time when the power switched.

★ Delay timer function
During ON/OFF control, the control output (primary/secondary) can be done with a predetermined lag time.

★ Program run function
A max. of 8-step program operation is possible.

★ Bank auto-switchover run function
A bank auto-switchover run is possible by using 8 banks at most.

1.2 Checking the product

Prior to the use, check the following.

★ Checking the model
The model number is printed on the box and side of the product. Check that the numbers thereon matches with the model that had been ordered.

★ Appearance
Check that no scratch or damage is present on the case, front panel or terminal block.

★ Check that accessories are included in the box. (See below for the list of the accessories.)
Mounting tool, brief operation manual and rubber packing (attached to the main frame)

1.3 Model table

TTM–20□–□–□□–□□□□□ –□
① ② ③④ ⑤⑥⑦⑧⑨⑩ ⑪

Symbol	Item	Description				Remarks
①	Size	4	48 x 48			
		5	96 x 48			
		7	72 x 72			
		9	96 x 96			
②	Color	Q	Color of case: Black			
		X	Color of case: Gray			Not available for 205,7,9.
③	Output 1	N	None	J	Voltage 0 - 5 VDC	
		R	Relay	F	Voltage 1 - 5 VDC	
		P	SSR drive voltage	G	Voltage 0 - 10 VDC	
		A	Open collector	I	Current 4 - 20 mADC	
		K	Voltage 0 - 1 VDC	H	Voltage 0 - 10 mVDC	
④	Output 2	N	None	J	Voltage 0 - 5 VDC	
		R	Relay	F	Voltage 1 - 5 VDC	
		P	SSR drive voltage	G	Voltage 0 - 10 VDC	
		A	Open collector	I	Current 4 - 20 mADC	
		K	Voltage 0 - 1 VDC	H	Voltage 0 - 10 mVDC	
⑤	Outputs 3 and 4	A	Open collector			Common
		R	Relay contact			Common
⑥	Outputs 5 and 6	A	Open collector			Not available for 204. *1
		R	Relay contact			Not available for 204. *1
⑦	Output 7	A	Open collector			Not available for 204. *3
		R	Relay contact (common independent)			Not available for 204. *3
⑧	AI input	Y	Remote SV input: Only voltage and current			Not available for 204.
⑨	Option	Case of TTM-204,207				
		ST	CT 1,2input			*2
		SV	CT 1 input, Event 2 input			*2
		UV	Event 1,2 input			
		STW	CT 1,2input, Event 3 input			Not available for 204.*2,*3
		SVW	CT 1 input, Event 2,3 input			Not available for 204.*2,*3
		UVW	Event 1,2,3 input			Not available for 204. *3
		Case of TTM-205,209				
		ST	CT 1,2input			*2
		SV	CT 1 input, Event 2 input			*2
		UV	Event 1,2 input			
		SVW	CT 1 input, Event 2,3,4 input			*2
		UVW	Event 1,2,3,4 input			
		STUV	CT 1,2 input, Event 1,2 input			*2
		STUVW	CT 1,2 input, Event 1,2,3,4 input			*2
⑩		M	Communication (RS-485)			
⑪	24 V power supply		Free power supply			
		L	24 VAC / 24 VDC			For models 205,207,209 are still under development.

*1 Output6 is not selectable for 207

*2 CT is not selectable, if there are only analogue output.

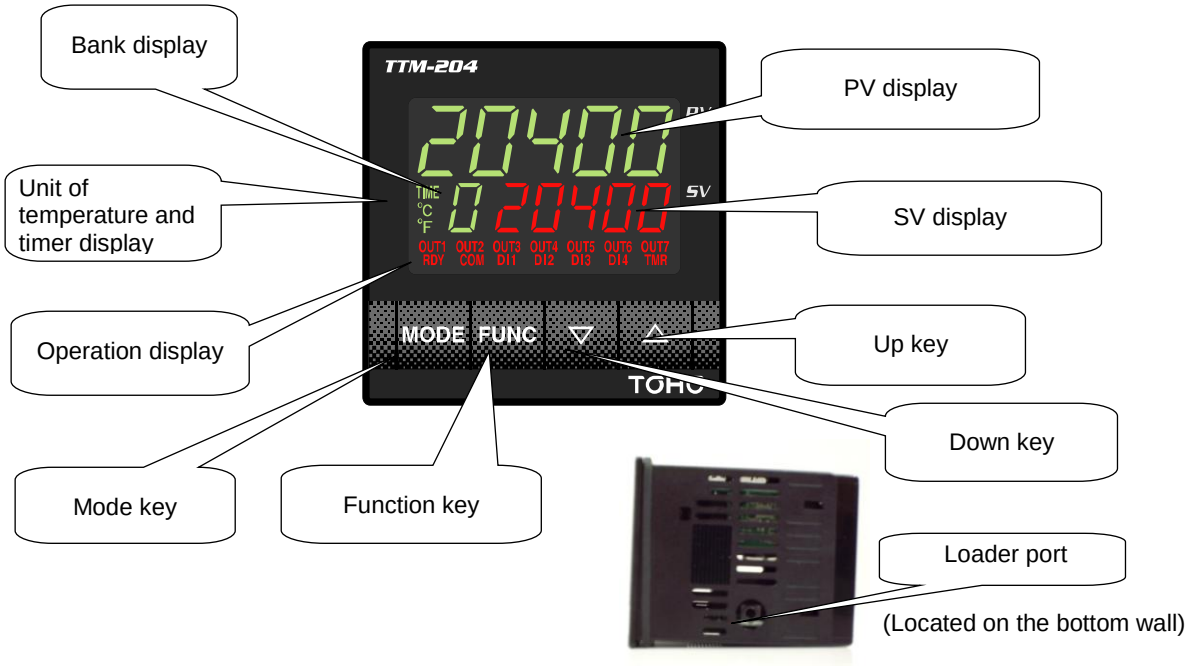
*3 Either W (only event3) or output7 should be selected for 207.

When the option from ④ is not added, the model code is omitted. Example. TTM-205-Q-RN-M

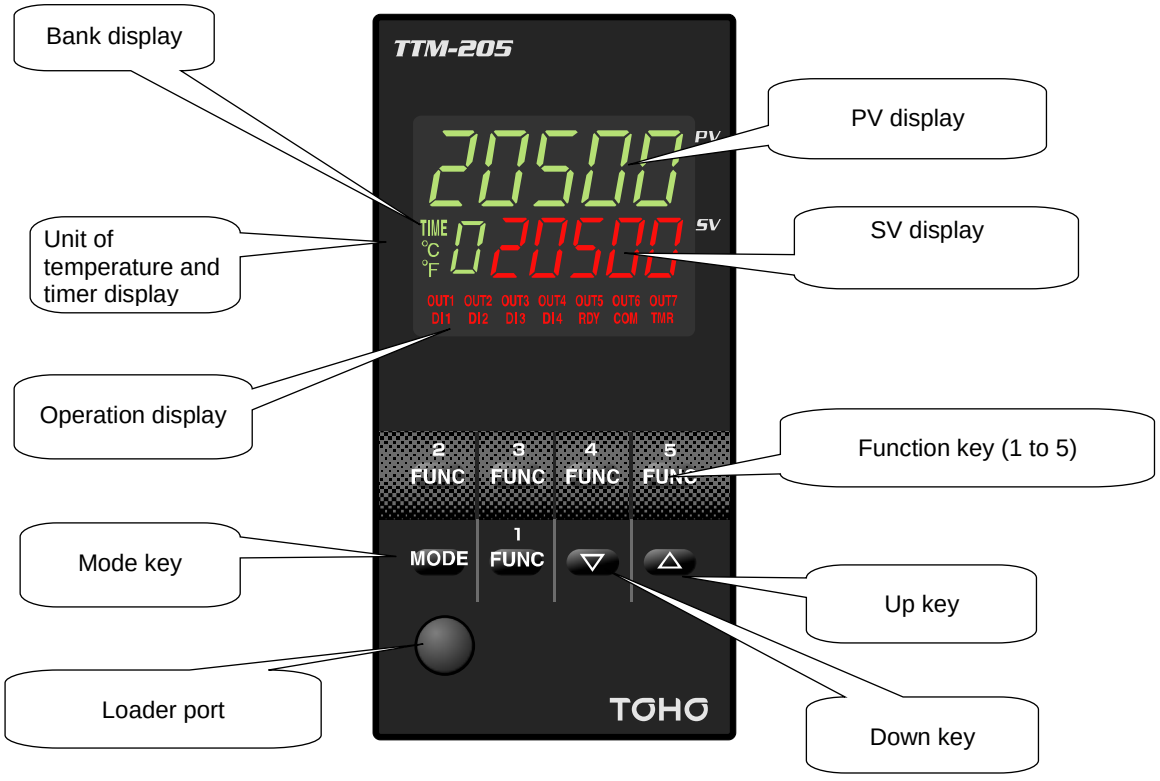
1.4 Names of parts and components

■ Front panel

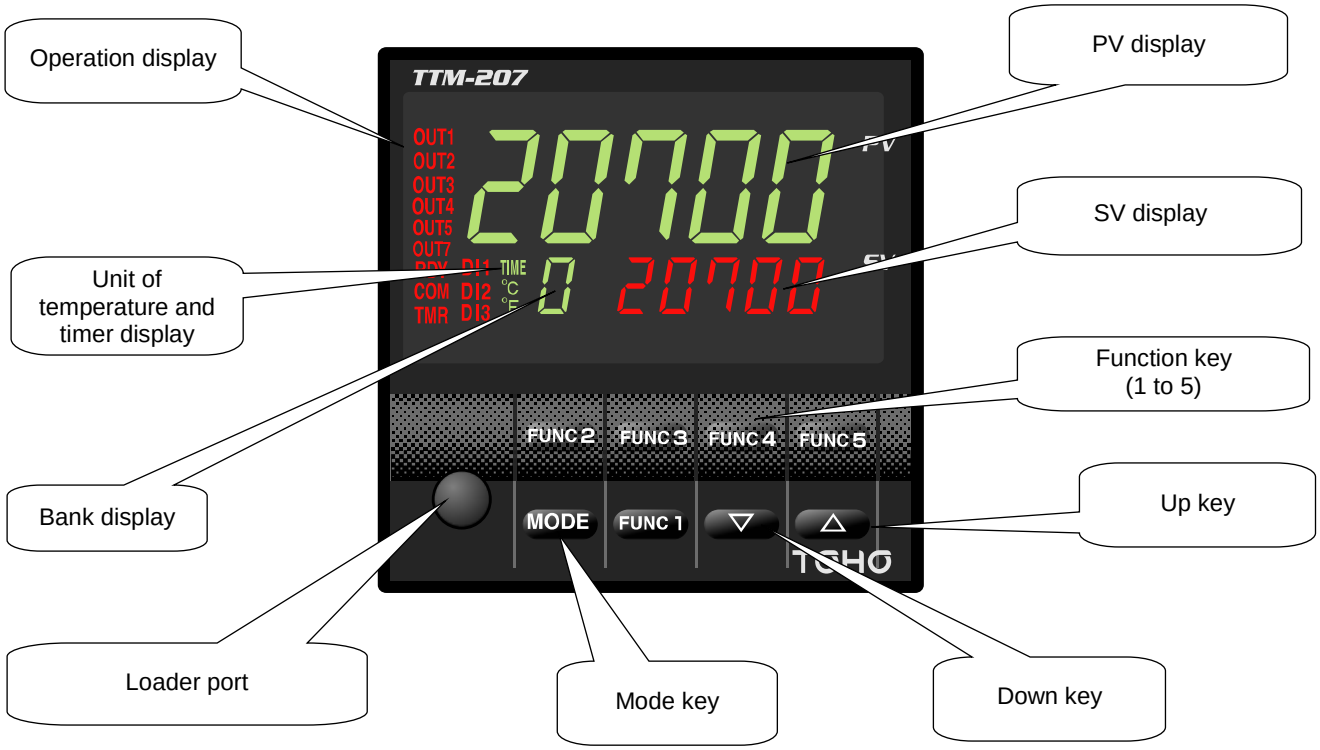
★ TTM-204 * The loader port is located in the bottom wall for TTM-204.



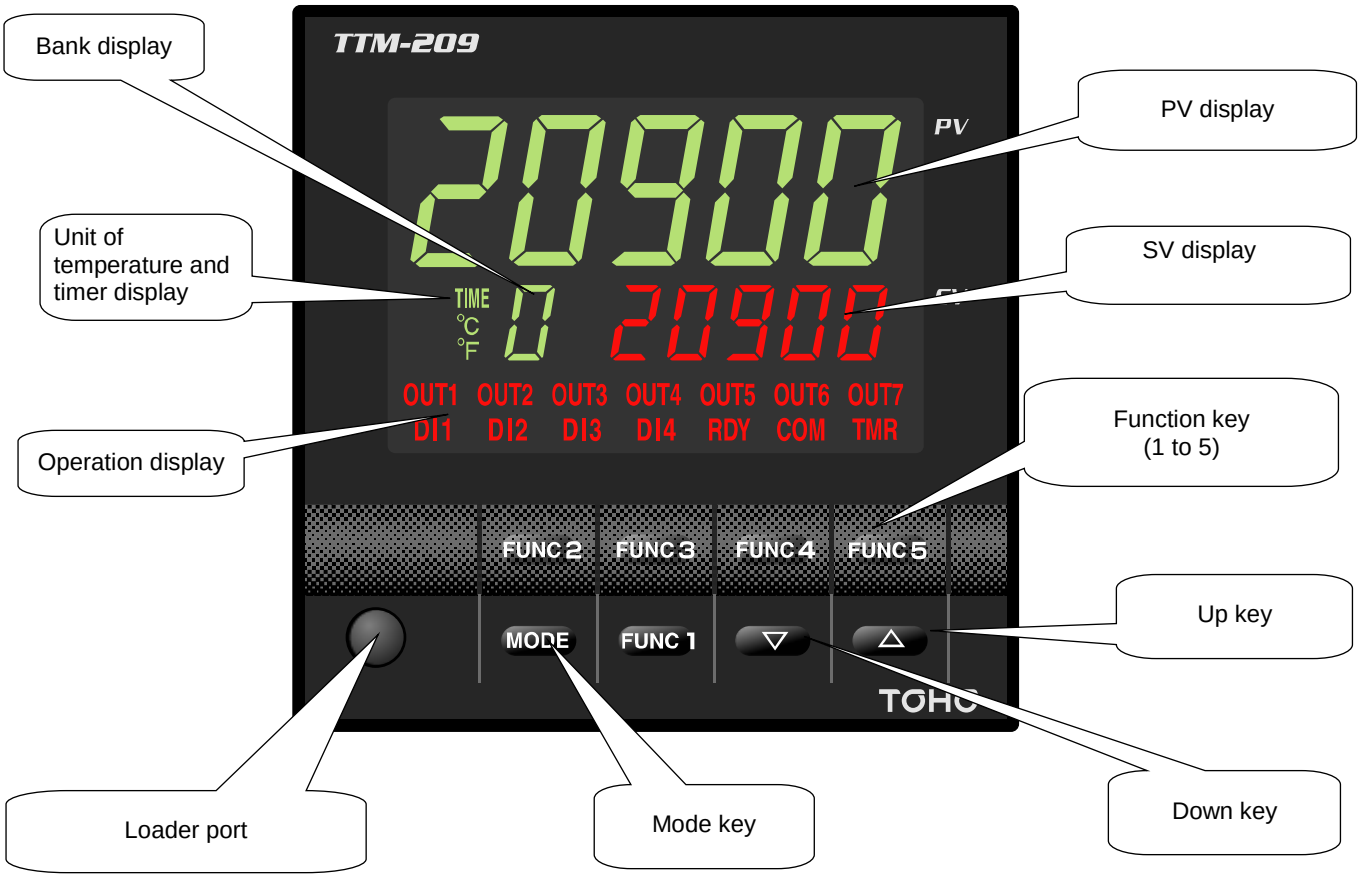
★ TTM-205



★ TTM-207



★ TTM-209



■ What the displays indicate

★ PV display — Measurement value (present value) display, each character display and timer setting time display

★ SV display — Setting value (target value) display, output operating amount display, display of setting value of each character, timer remaining time display and MVI (operating amount) display

★ Unit of temperature — The unit of temperature is displayed when setting data is for temperature. The display is determined depending on setting for "unit of temperature" in the symbol "°C" or "°F."

Timer display — Lights up when timer is set.

★ Bank display — The bank selected is displayed.

★ Behaviors of the displays

OUT 1	Output 1 monitor display. Turns on when output is ON.
OUT 2	Output 2 monitor display. Turns on when output is ON.
OUT 3	Output 3 monitor display. Turns on when output is ON.
OUT 4	Output 4 monitor display. Turns on when output is ON.
OUT 5	Output 5 monitor display. Turns on when output is ON.
OUT 6	Output 6 monitor display. Turns on when output is ON.
OUT 7	Output 7 monitor display. Turns on when output is ON.
DI 1	DI 1 monitor display. Turns on when DI 1 is operating.
DI 2	DI 2 monitor display. Turns on when DI 2 is operating.
DI 3	DI 3 monitor display. Turns on when DI 3 is operating.
DI 4	DI 4 monitor display. Turns on when DI 4 is operating.
RDY	RDY monitor display. Lights up when operation is in "READY (operation halted)."
COM	Communication monitor display. Blinks on and off when the communication function is operating (in communication).
TMR	Timer monitor display. Lights up when the timer function is operating.

■ Key operations

★ FUNC — Function key. Used when a set function is to be executed.

★ MODE — Mode key. Used when the screen is to be switched over.
Pressing it for 2 seconds changes the screen to the parameter screen.
Pressing it for 2 seconds changes the screen to the operating mode screen.

★ [△] — Up key. Used for increasing setting values.
Used for changing over the input setting mode.
Holding it pressed accelerates the increase speed.

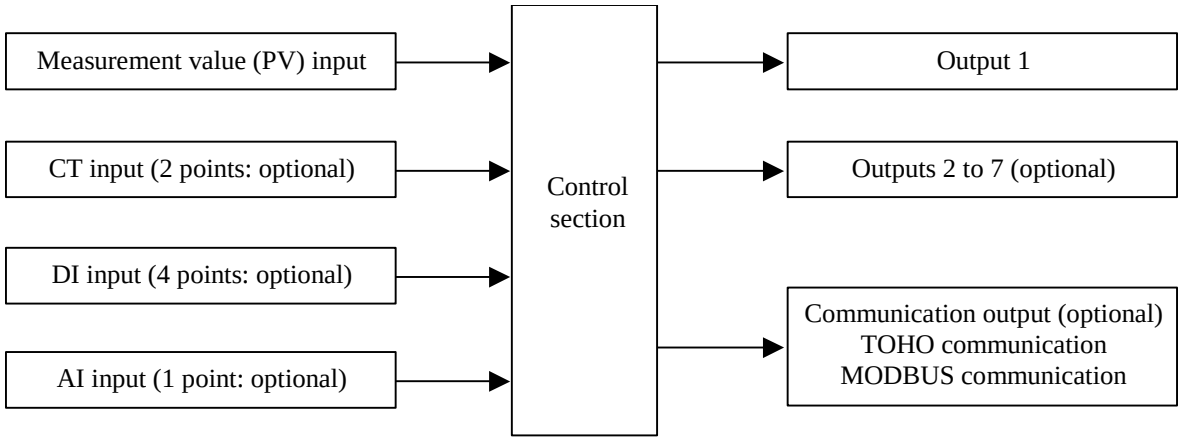
★ [▽] — Down key. Used for reducing setting values.
Used for changing over the input setting mode.
Holding it pressed accelerates the reduction speed.

■ Others

★ Loader port — Dedicated cables are connected for loader communication.

1.5 Input/output function and essential functions

Input and output functions are described. See corresponding pages for setting each function.



Assignment of outputs

Outputs 1 and 2	Primary output	Outputs 3 to 7	Primary output
	Secondary output		Secondary output
	Event output		Event output
	RUN output		RUN output
	RDY output		RDY output
	Timer 1 output		Timer 1 output
	Timer 1 ON delay output		Timer 1 ON delay output
	Timer 1 OFF delay output		Timer 1 OFF delay output
	Timer 1 ON+OFF delay output		Timer 1 ON+OFF delay output
	Timer 2 output		Timer 2 output
	Timer 2 ON delay output		Timer 2 ON delay output
	Timer 2 OFF delay output		Timer 2 OFF delay output
	Timer 2 ON+OFF delay output		Timer 2 ON+OFF delay output
	Timer 3 output		Timer 3 output
	Timer 3 ON delay output		Timer 3 ON delay output
	Timer 3 OFF delay output		Timer 3 OFF delay output
	Timer 3 ON+OFF delay output		Timer 3 ON+OFF delay output
	Transmission output		End output (during program run) *1
	End output (during program run)		

*1: Selectable only for a program run.

■ Input section

* The following types of inputs can be selected in the input section: measurement value input (1 point), CT input (2 points), DI input (4 points) and AI input (1 point).
Selectable points depend on models. See the model selection table.

★ Measurement value input

* The input of the controlled objects is selectable with a single unit using parameter setting.

Temperature input	Thermocouple	K, J, T, E, R, S, B, N, U and L
		WRe 5-26, PR40-20 and PLII
	Resistance temperature detector	Pt 100 and JPt 100
Analog input	Voltage	0 - 1 VDC, 0 - 5 VDC, 1 - 5 VDC
		0 - 10 VDC, 0 - 10 mVDC
	Current	4 - 20 mADC

*The K thermocouple is set as factory default.

★ CT input (optional)

* Heater disconnection failure is detected by CT (current detector) when the heater disconnection alarm is effective.
* Max. 2 points are selectable (to be designated at order placement).
For models TTM-204 and 207, a single point for the CT input is provided when a single point for the DI input is selected.
* Usable CT is "CTL-6-P-N-(S)." (For product specification, see page 7-9.)
* CT input is not selectable for analog output.

★ DI input (optional)

* The following functions can be executed with DI (digital) input.
The DI Input is an external no-voltage contact signals.
* List of functions due to DI

Close	Active
Bank switchover	Bank switchover
MD	READY
AUTO	MANUAL
Reverse operation	Forward operation
AT stop	AT start
Timer stop	Timer start
–	Step feed *1
–	Pause *1
–	Interlock *1

*1: Selectable only for a program run.

Close: Contact signal OFF
Active: Contact signal ON

* Max. 4 points are selectable (to be designated at order placement).
Up to 2 points are selectable for TTM-204.
DI 3 and DI 4 inputs are not selectable when input 7 is selected for TTM-207.
DI 2 input is to be selected when CT 1 input is selected for TTM-204 and 207.

★ AI input (optional)

* Voltage and current inputs only. (Voltages of 0 - 10 mV are excluded.)

■ Output section

* The number of outputs is 7 at most, which can be assigned individually for control output, event output, RUN/RDY output, timer output and transmission output.
  (Assignment of outputs is to be designated at order placement.)

★ Output (OUT) 1 and output (OUT) 2

* Target connection of output can be set.
  Primary output, secondary output, event output, RUN output, RDY output, timer 1 output, timer 2 output, timer 3 output, transmission output and end output

★ Output (OUT) 3, output (OUT) 4, output (OUT) 5, output (OUT) 6 and output (OUT) 7

* Target connection of output can be set.
  Primary output, secondary output, event output, RUN output, RDY output, timer 1 output, timer 2 output, timer 3 output and end output
* Some specifications are not selectable, depending on the model. Check them on the model table.

★ Selection of output types

* Outputs 1 and 2

Relay contact	250 VAC, 3 A (resistance loads) and 1a contact
Voltage for SSR drive	0 - 12 VDC (load resistance: 600 Ω or greater)
Open collector	24 VDC, 100 mA (load current)
Voltage	0 - 5 VDC, 1 - 5 VDC and 0 - 10 VDC (resistance loads: 1 kΩ or greater) 0 - 1 VDC and 0 - 10 mVDC (load resistance: 500 kΩ or greater)
Current	4 - 20 mADC (load resistance: 600 Ω or less)

* Outputs 3, 4, 5, 6 and 7

Relay contact	250 VAC, 1 A (resistance loads) and 1a contact
Open collector	24 VDC, 100 mA (load current)

* Transmission output function selection
  PV (measurement value) output
  SV (setting value) output
  MV 1 (primary operating amount) output
  MV 2 (secondary operating amount) output
  Control SV (setting value) output

  Forward and reverse operations can be switched over for all the outputs above.

★ Selectable outputs for each model

	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
TTM-204	○	○	○	○	×	×	×
TTM-205	○	○	○	○	○	○	○
TTM-207	○	○	○	○	○	×	○
TTM-209	○	○	○	○	○	○	○

* TTM-204: Outputs 3 and 4 are for common shared.
* TTM-207: Outputs 3 and 4 are for common shared.
  When DI 3 is selected, output 7 will not be selectable.
* TTM-205 and 209: Outputs 3 and 4 are for common shared.

★ Assignment of outputs

Each output can freely be assigned to output types.

Type of output	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
Primary output (heating)	○	○	○	○	○	○	○
Secondary output (cooling)	○	○	○	○	○	○	○
Transmission output	○	○	×	×	×	×	×
Event output	○	○	○	○	○	○	○
Timer output	○	○	○	○	○	○	○
End output *1	○	○	○	○	○	○	○

○: Output assignment possible
×: Output assignment not possible
* At factory shipment, the output 1 is assigned to the primary output, and the outputs 2 to 7 to the secondary outputs.
*1: Selectable only for a program run.

★ Details on output assignment targets

Each output can individually be assigned to the following item.

Output assignment targets
Primary output
Secondary output
Event output
RUN output
RDY output
Timer 1 output
Timer 1 ON delay output
Timer 1 OFF delay output
Timer 1 ON+OFF delay output
Timer 2 output
Timer 2 ON delay output
Timer 2 OFF delay output
Timer 2 ON+OFF delay output
Timer 3 output
Timer 3 ON delay output
Timer 3 OFF delay output
Timer 3 ON+OFF delay output
Transmission output
End output *1

*1: Selectable only for a program run.

■ Communication function

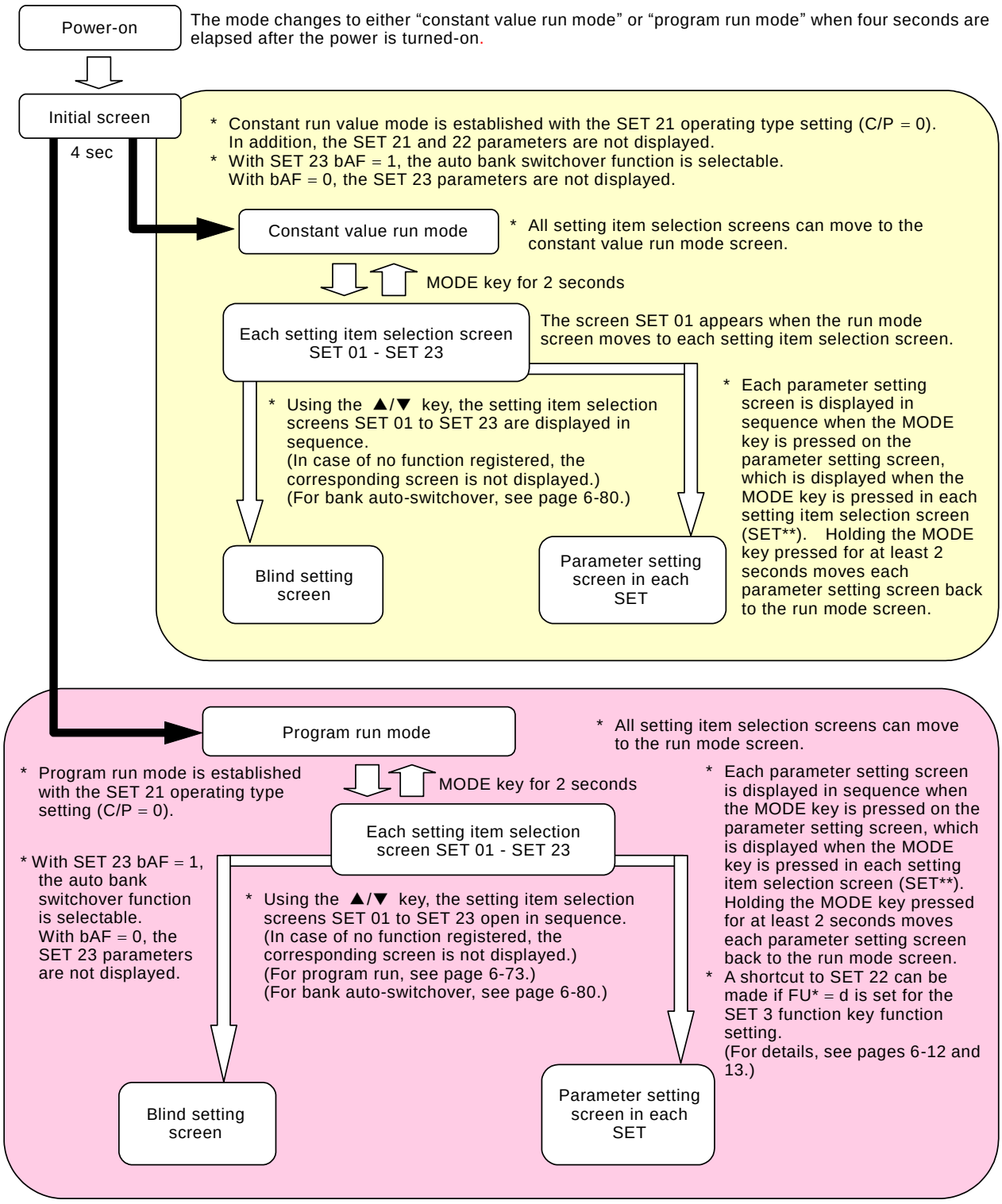
★ Communication

* This function is for communication with a host computer. (The communication function option is required.)
* Communication protocol TOHO protocol
MODBUS protocol (RTU mode)
MODBUS protocol (ASCII mode)
* Interface RS485
* For detailed specifications, see pages 6-65 and 66.

★ Loader communication

* This communication function is for setting all data of TTM-200 series in a lump.
* In order to use the loader communication, the dedicated software for the communication must be installed on the personal computer (PC) being used.
* To connect TTM-200 series to your PC, TOHO's dedicated connection cable "TTM-LOADER" (sold separately) is required.
(For the product specifications, see page 7-9.)
* When normal communication (or communication in option) is used (or active), the loader communication cannot be used.

1.6 Basic flow of setting



* The screen moves back to the run mode screen in case of no key operation in each setting item selection screen or parameter setting screen in each SET for about 2 minutes.
* For how to set the blind setting, see pages 4-27 and 28, the section 4-2-9 “Basic operation.”

2. Installation

Precautions on installation, installation method and outside dimensions are described in this chapter.

2.1 Precautions on installation

Warning

Ensure to turn the power supply off before beginning removal or reinstallation of the equipment in order to prevent an electric shock or equipment failure.

★ Ambient temperature and humidity (the equipment to be used in the specified range as listed below)
(1) Temperature range: 0 - 50 °C
(2) Humidity range: 20 - 90% PH (no dew condensation allowed)
(3) Installation gradient: Base plane ± 10 degrees

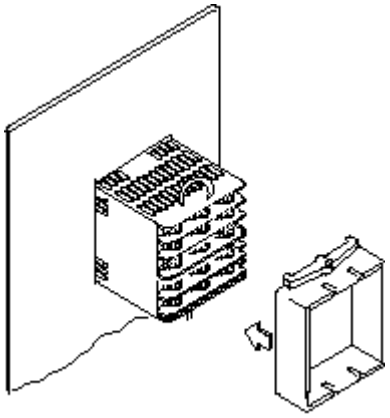
★ Do not install the equipment in the following places.
(1) Where temperature abruptly changes to generate dew
(2) Where corrosive or flammable gases are generated
(3) Where water, oil, steam or chemicals are received
(4) Where vibration or noise is directly applied
(5) Where dusty or salty ambience, or many iron scraps is present
(6) Where direct sunlight is received
(7) Where circuits may negatively be affected by static electricity, noise or magnetism
(8) Where direct warm or cool air is received from an air-conditioner

★ Precautions on installation
(1) Provide sufficient space for ventilation so that the ambient temperature does not rise to 50 °C or higher. In case that the temperature of 50 °C or higher is suspected, use a fan or air-conditioner to cool the ambience.
Take care that no cold air flows directly on the equipment.
(2) Do not install the equipment on a device that may generate large heat, such as heater and transformer.
(3) Install the equipment away as much distant as possible from high-voltage devices, power lines or power equipment.
(4) Do not block off the ventilation opening on the equipment. Ensure a sufficient gap between stacked units of equipment.

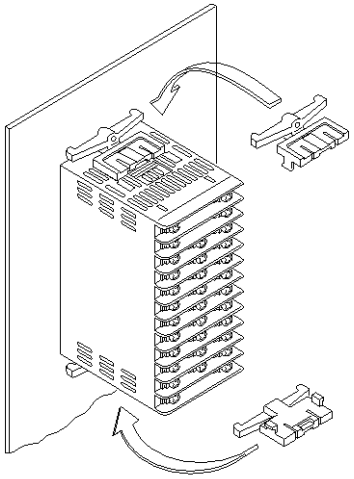
2.2 How to install or remove the equipment

★ Installation on a panel
(1) Make an opening on the panel.
(2) Insert the equipment into the opening.
(3) Install the mounting attachment from behind the panel. Ensure that the equipment is securely fixed.
* Conduct wiring after the equipment is installed.
* Turn on the power after the wiring.

TTM-204

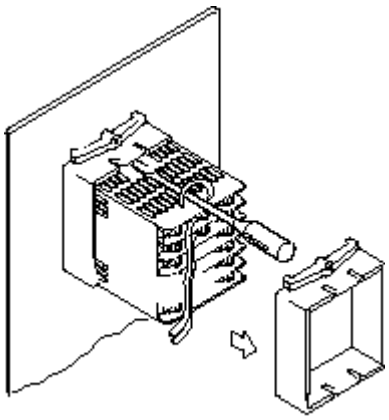


TTM-205/207/209

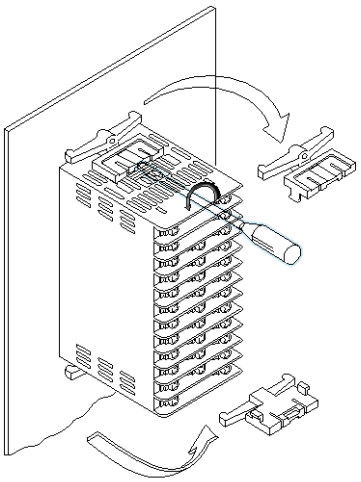


★ Removal from the panel
(1) Turn off the power.
(2) Disconnect the wiring.
(3) Insert a flat-head screw driver into the clearance formed between gabs on the equipment and attachment. Turn the screw driver clockwise or counterclockwise to dislocate the gabs to remove the attachment from the equipment.
(4) Remove the equipment from the panel.
* Ensure to conduct removal work after turning off the power.

TTM-204



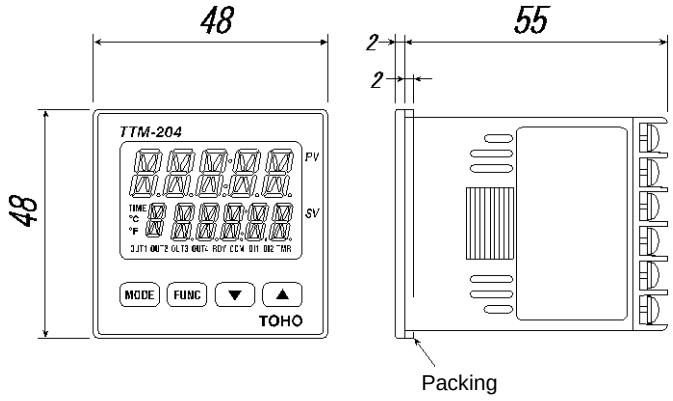
TTM-205/207/209



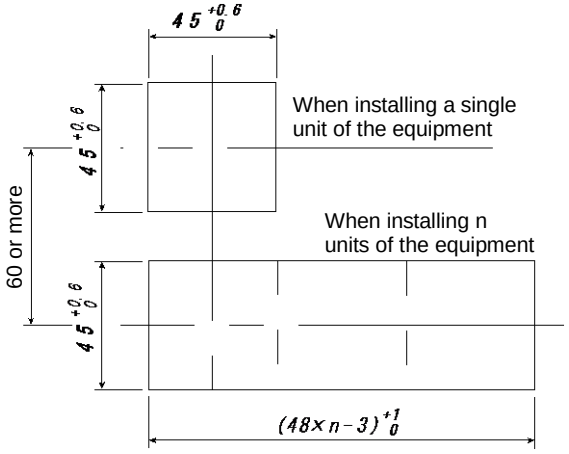
2.3 Outside dimensions and panel cutting dimensions

TTM-204

Outside dimensions

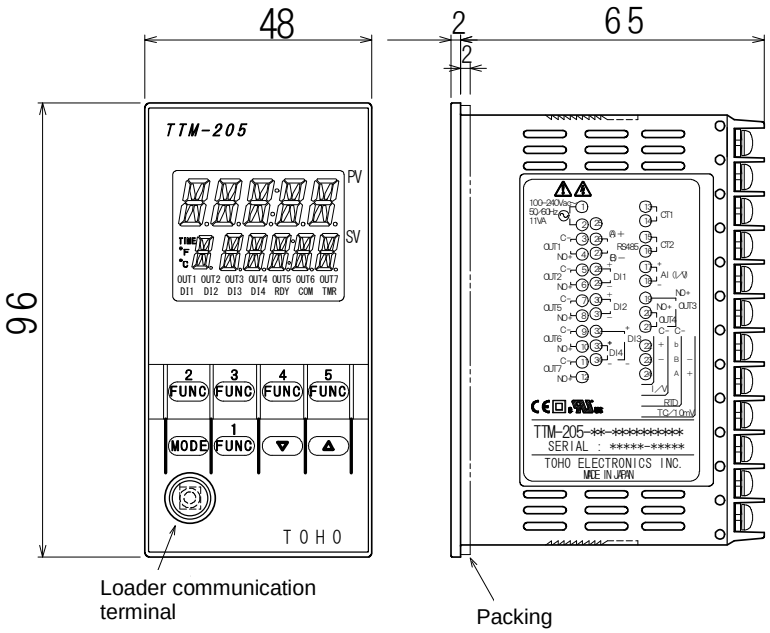


Panel cutting dimensions

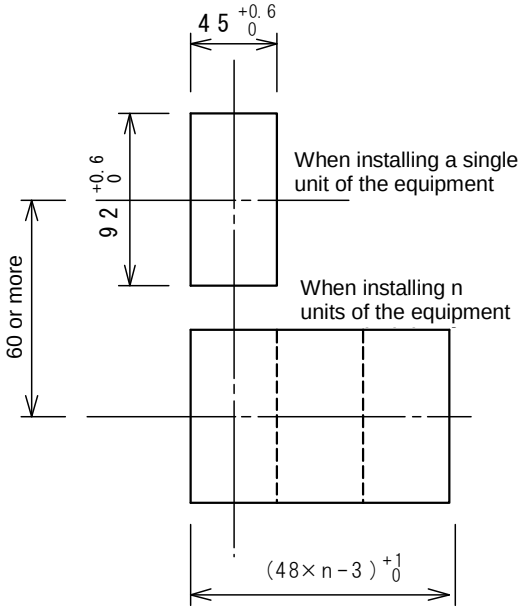


TTM-205

Outside dimensions

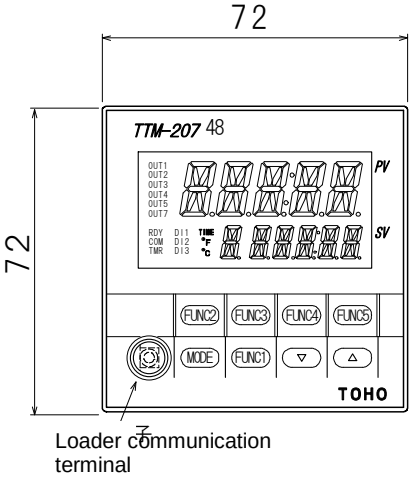


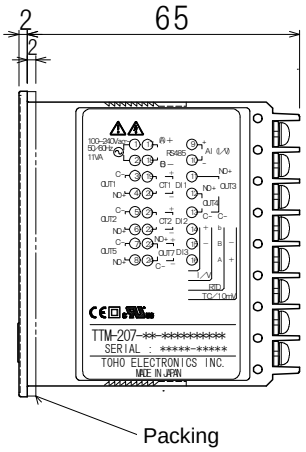
Panel cutting dimensions



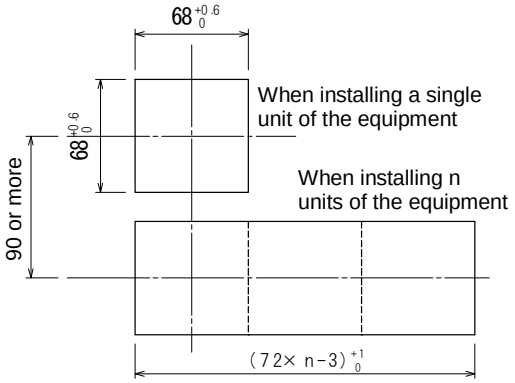
TTM-207

Outside dimensions



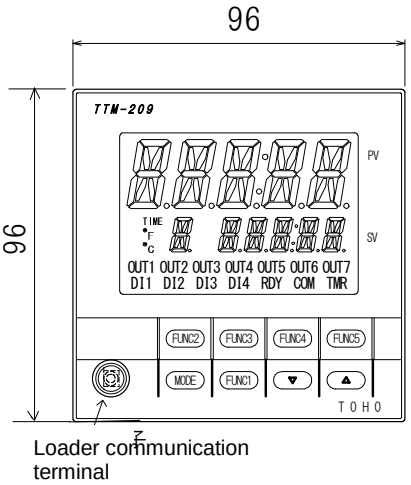


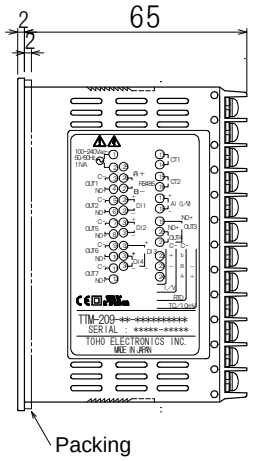
Panel cutting dimensions



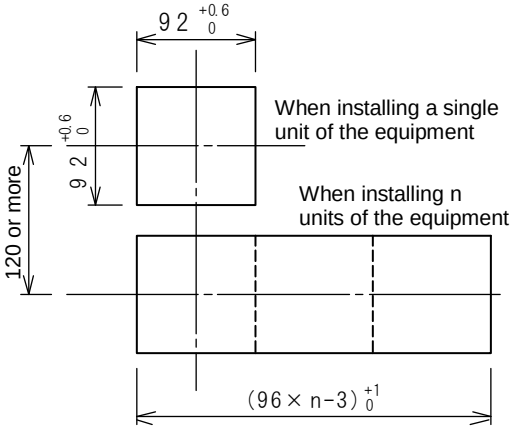
TTM-209

Outside dimensions





Panel cutting dimensions



3. Wiring

Precautions on wiring and arrangement of terminals are described in this chapter.

3.1 Precautions on wiring

⚠ Warning

Do not turn on the power until all wirings are complete in order to prevent an electric shock or equipment failure.

★ For inputs from a thermocouple, use the specified wires or compensating leads.

★ For inputs from a resistance temperature detector, use lead wires with small resistance and no resistance difference is present among the 3 wires (3-wire type).

★ Provide input signal lines away from power supply lines, power lines or load lines so as not to affect input signal lines with noise induction.

★ Wire the power supply for instruments such that they do not receive noises from the power supply for power devices.
The use of a noise filter is recommended in case that the equipment is vulnerable to noises.
Take note of the following points when using a noise filter.

◎ Install the noise filter as close to a temperature controller as possible.
Wire the instruments in as short a distance as possible to output lines (secondary side) of the noise filter and power terminals for the temperature controller.

◎ Isolate the noise filter input line (primary side) from its output line (secondary side).
High-frequency elements of noises may be induced, resulting in no provision of much noise attenuation effect as expected, in case of input and output wires being close one another, such as being bundled together or installed in a same duct or tube.

◎ Wire the grounding wire of the noise filter in as short a distance as possible.
A long grounding wire is like inserting an inductance, resulting in deteriorated high-frequency characteristics.

◎ Before installing the noise filter, peel off the paint applied on a mounting plate of the noise filter as appropriate, in order to reduce the contact resistance between the noise filter and equipment housing.

★ For the power supply, use and twist wires that cause less voltage drop.

★ It takes about 4 seconds for the unit to activate after its power is turned on. Use delay relays when using the equipment for generating signals for interlocking circuits.

★ When using the unit with 24 V power supply, supply the power from a SELV circuit (power supply secured with safety).

★ When using the unit with DC24V power source, set ①-terminal to plus (+), ②-terminal to minus (-).

★ The equipment is not attached with power supply switch fuses. Separately install fuses in proximity of the equipment, as needed.

◎ Recommended fuse rating: Rated voltage of 250 V and rated current of 1 A

★ Use crimping terminals that match the screw sizes.

◎ Size of crimping terminal: Terminal width of 6 mm or smaller
Crimping terminal recommended
Manufacturer: NICHIFU
Model: ICTV-1.25Y-3N (Y terminal)
ICTV-1.25-3S (round terminal)

◎ Tightening torque recommended: 0.5 N·m (5 kgf·m)

◎ Applicable wire
Use wires in sizes suitable for the terminals.
The use of shielded wires is recommended.
For Pt100 (resistance temperature detector), use identical wires of low lead resistance and no resistance difference among 3 wires.

★ For the communication ,use a shielded twisted pair cable.

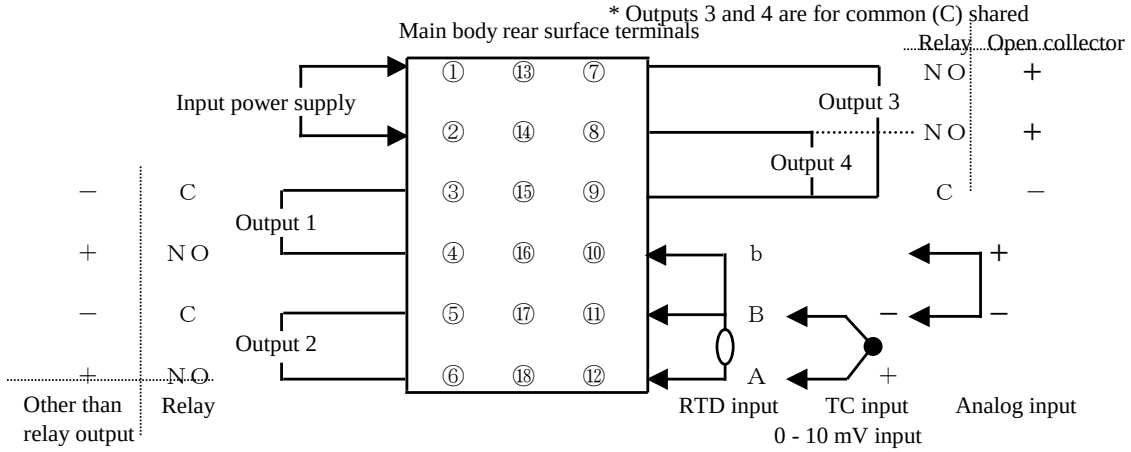
3.2 Terminal arrangement

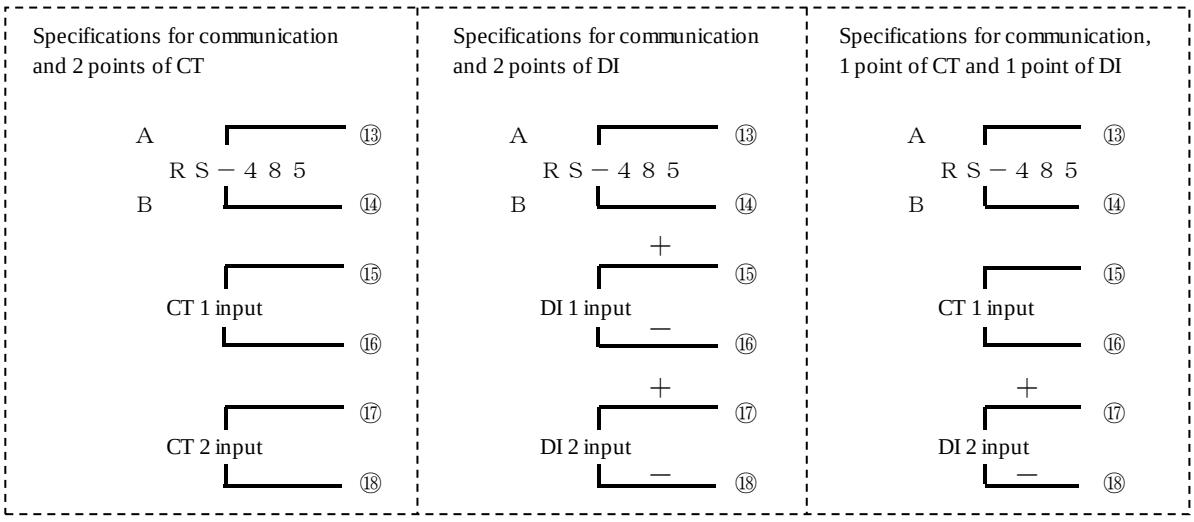
Notation for terminal arrangement is as follows.

C: Common
NO: Normal open
+, -: There is polarity for wiring.
A, B, b: There is designation for wiring.
CT: Current transformer input (no polarity)
DI: Digital input
RTD: Resistance temperature detector input
TC: Thermocouple input
I: Current input
V: Voltage input (excluding 0 - 10 mV)

* Parameters can be used for changing input types. (Multi-input)
* "NO" and "C" for outputs are for the equipment model with relay contact output. "+" and "-" for other than the equipment model with relay contact output.
* Terminal block is not provided in case the model selection is not made at the product model.

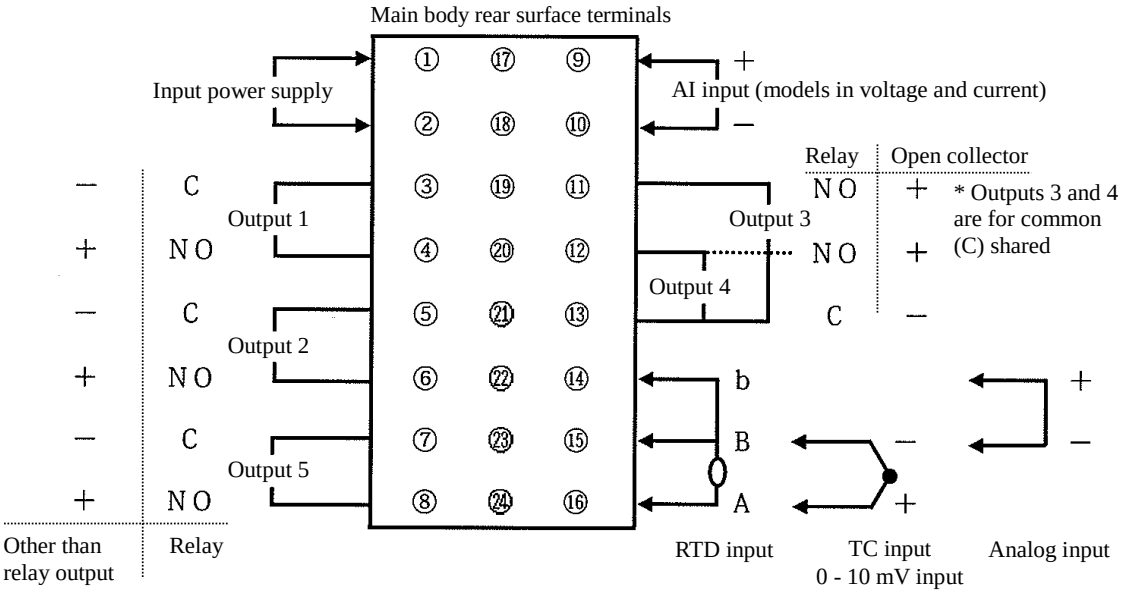
★ TTM-204





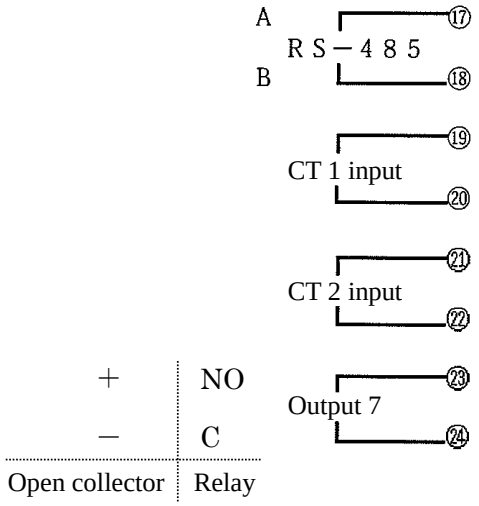
* Only the above can be selected for the model with CT and DI.

★ TTM-207

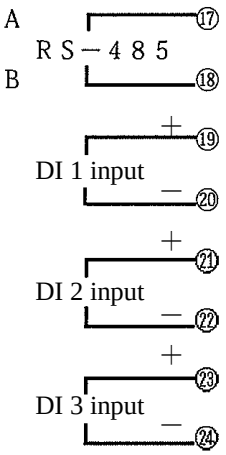


(The output 5 is only for an open collector.)

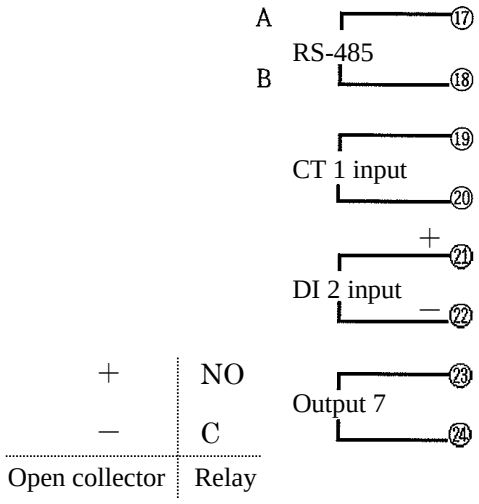
Communication + 2 points of CT + Output 7



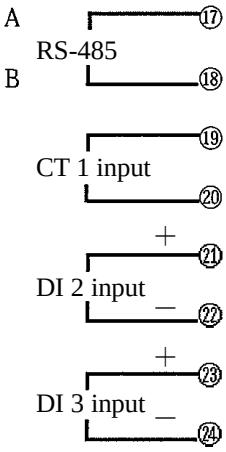
Communication + 3 points of DI



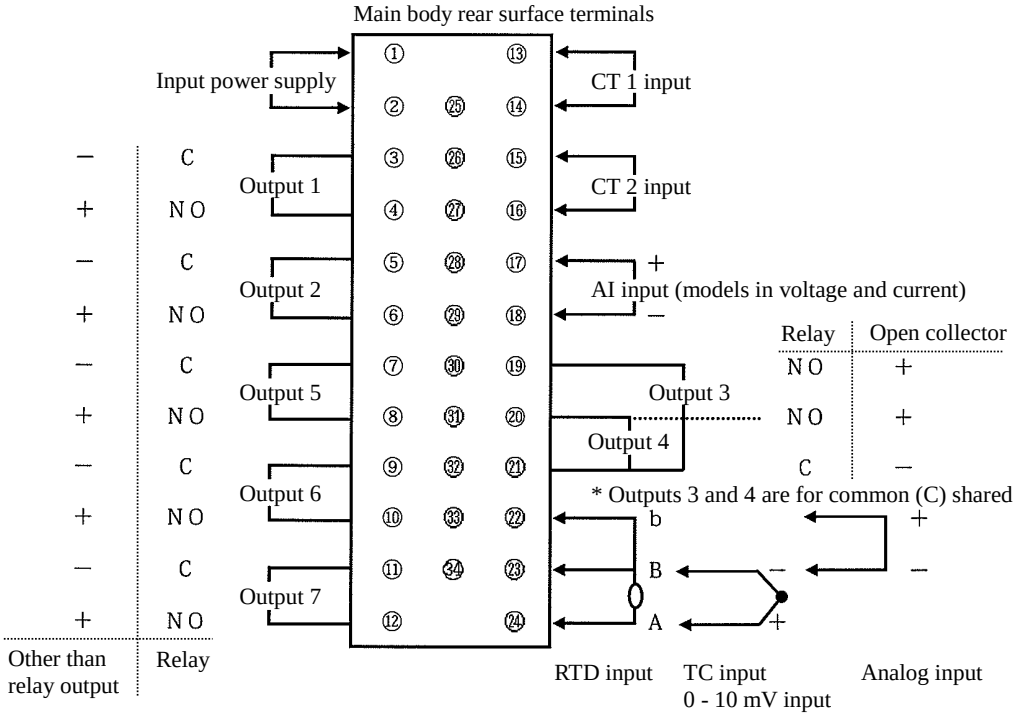
Communication + 1 point of CT + 1 point of DI + Output 7

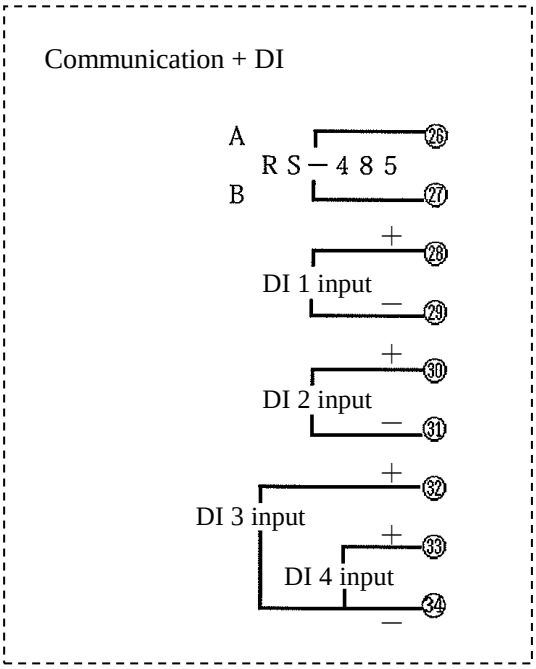


Communication + 1 point of CT + 2 points of DI



★ TTM-205/209


Main body rear surface terminals
Input power supply
CT 1 input
CT 2 input
AI input (models in voltage and current)
Output 1
Output 2
Output 3
Output 4
Output 5
Output 6
Output 7
Relay
Open collector
NO
C
* Outputs 3 and 4 are for common (C) shared
b
B
A
Other than relay output
Relay
RTD input
TC input
0 - 10 mV input
Analog input


Communication + DI
A
RS－485
B
DI 1 input
DI 2 input
DI 3 input
DI 4 input

3.3 Wiring to each terminal

In connection diagrams, left side of the terminal number represents inside the equipment while right side shows the external side of the equipment.

★ Power supply

TTM-204	Terminal Nos. ① and ②
TTM-205	
TTM-207	
TTM-209	

TTM-204

Type of power supply	Fluctuation range	Frequency	Power consumption
100 to 240 VAC	85 to 264 VAC	50/60 Hz	10 VA or less
24 VAC	21.6 to 26.4 VAC	50/60 Hz	4 W or less
24 VDC	21.6 to 26.4 VDC		4 W or less

TTM-205/207/209

Type of power supply	Fluctuation range	Frequency	Power consumption
100 to 240 VAC	85 to 264 VAC	50/60 Hz	11 VA or less
24 VAC	21.6 to 26.4 VAC	50/60 Hz	6 W or less
24 VDC	21.6 to 26.4 VDC		6 W or less

* Wire the power supply for instruments in such a way that they don't receive noise from the power supply of the power devices.
The use of a noise filter is recommended in case that the equipment is vulnerable to noises.
Take care the following when a noise filter is used.

◎ Install the noise filter as close to a temperature controller as possible.
Wire the instruments in as short a distance as possible to output lines (secondary side) of the noise filter and power terminals for the temperature controller.

◎ Isolate the noise filter input line (primary side) from its output line (secondary side).
High-frequency elements of noises may be induced, resulting in no provision of much noise attenuation effect as expected, in case of input and output wires being close one another, such as being bundled together or installed in a same duct or tube.

◎ Wire the grounding wire of the noise filter in as short a distance as possible.
A long grounding wire is equivalent to insert of an inductance, resulting in deteriorated high-frequency characteristics.

◎ Before installing the noise filter, peel off the paint applied on a mounting plate of the noise filter as appropriate, in order to reduce the contact resistance between the noise filter and equipment housing.

* For the power supply, use and twist wires that has lesser voltage drop.

* It takes about 4 seconds for the unit to activate after its power is turned on. Use delay relays when using the equipment for generating signals for interlocking circuits.

* In case of using the equipment with a 24 V power supply, supply the power from a SELV circuit (power supply secured with safety).

* The equipment is not supplied with power supply switch fuses. Separately install fuses in proximity of the equipment, as needed.

◎ Recommended fuse rating: Rated voltage of 250 V and rated current of 1A

* The input power supply and the input/output are isolated one anther on the equipment.

* Isolation diagram

Where relays and open collectors are included in outputs

Power supply circuit		
PV input	CPU circuit	Output 1
AI input		Output 2
CT input		Outputs 3 to 7
DI		Communication

Where outputs are SSRs, current outputs or voltage outputs

Power supply circuit		
PV input	CPU circuit	Output 1
AI input		Output 2
CT input		Outputs 3 to 7
DI		Communication

* No. of outputs depends on specifications and models.
* Outputs 3 to 7 are isolated.

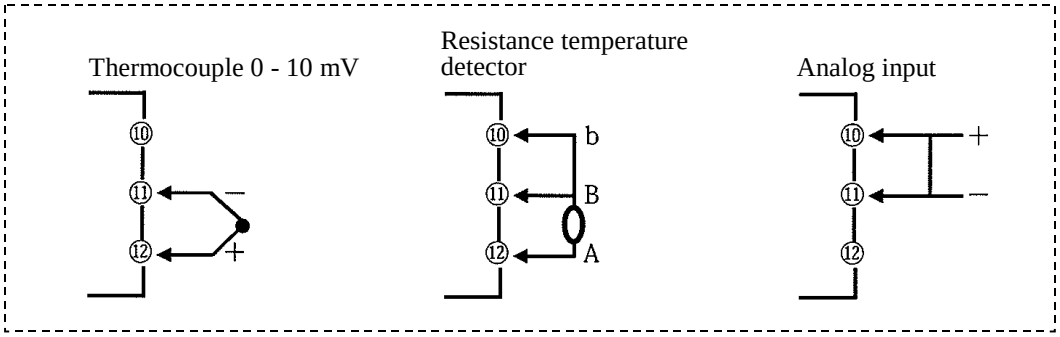
—— Isolated
------ Non-isolated

★ Input

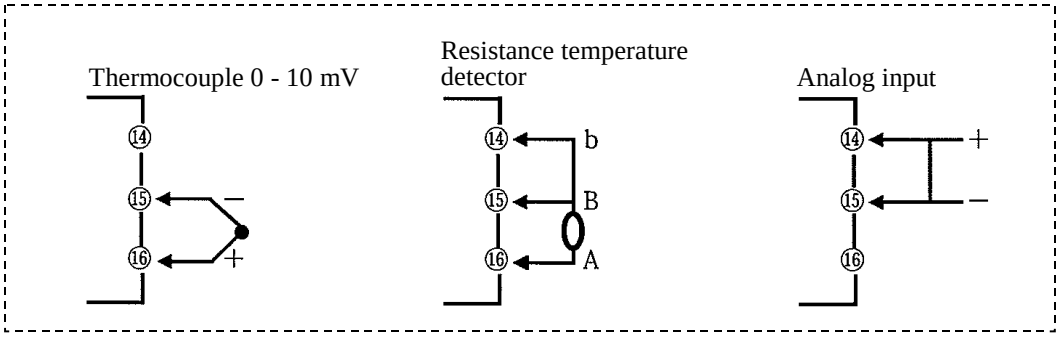
TTM-204	Terminal Nos. ⑩, ⑪ and ⑫
TTM-205	Terminal Nos. ㉒, ㉓ and ㉔
TTM-207	Terminal Nos. ⑭, ⑮ and ⑯
TTM-209	Terminal Nos. ㉒, ㉓ and ㉔

* Use sensors that match the types of inputs. (“K thermocouple” is set as factory default.)
* For thermocouple input, use wires or compensated leads.
* For input from resistance temperature detector, use wires that the wire resistance of leads is small and no resistance difference is present among 3 wires (3-wire type).
* Provide input signal lines distant from power supply lines, power lines or load lines so as not to affect input signal lines with noise induction.

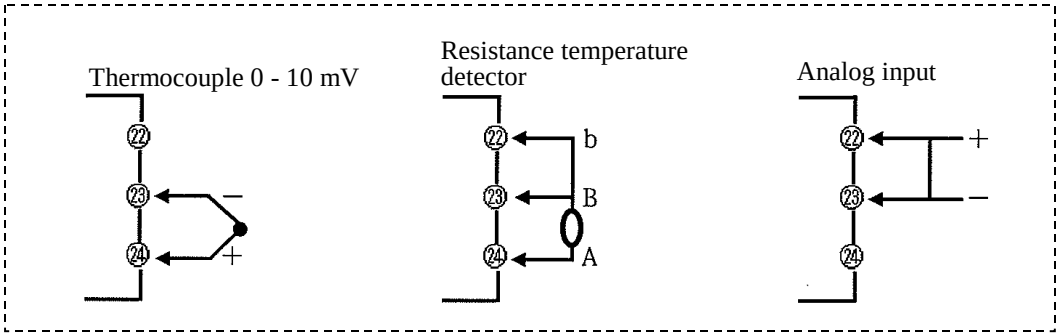
TTM-204



TTM-207



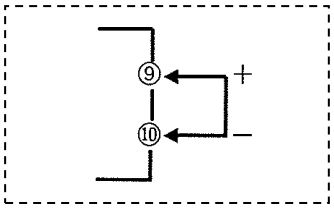
TTM-205/209



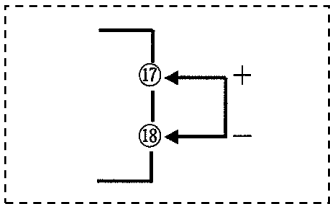
★ AI input (current and voltage only)

TTM-205	Terminal Nos. ⑰ and ⑱
TTM-207	Terminal Nos. ⑨ and ⑩
TTM-209	Terminal Nos. ⑰ and ⑱

TTM-207



TTM-205/209

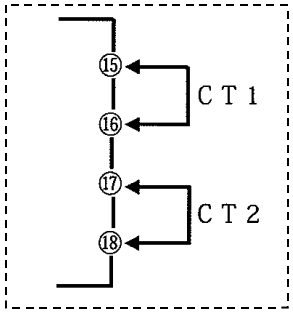


* AI input is optional.
(TTM-204 is not equipped with AI input.)
* Provide input signal lines distant from power supply lines, power lines or load lines so as not to affect input signal lines with noise induction.

★ CT (current detector) input

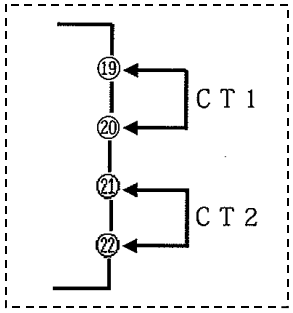
TTM-204	Terminal Nos. ⑮, ⑯, ⑰ and ⑱
TTM-205	Terminal Nos. ⑬, ⑭, ⑮ and ⑯
TTM-207	Terminal Nos. ⑲, ⑳, ㉑ and ㉒
TTM-209	Terminal Nos. ⑬, ⑭, ⑮ and ⑯

TTM-204



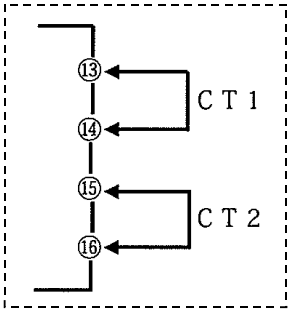
* When the event input (DI 1 or DI 2) is selected, CT 1 or CT 2 are not selectable.
* When the event input (DI 2) is selected, CT 2 is not selectable.

TTM-207



* When the event input (DI 1 or DI 2) is selected, CT 1 or CT 2 are not selectable.
* When the event input (DI 2) is selected, CT 2 is not selectable.

TTM-205/209

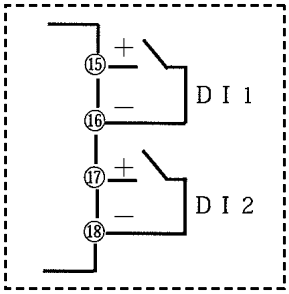


* CT input is optional.
* Heater disconnection failure is detected by CT (current detector) when the heater disconnection alarm is effective.
* CT possible to be used is "CTL-6-P-N"
* Max. 2 points are selectable (to be designated at order placement).
* CT input is not selectable for analog output.

★ Event (DI) input

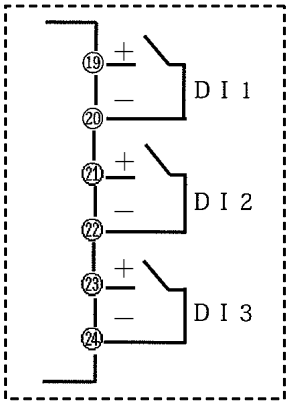
TTM-204	Terminal Nos. ⑮, ⑯, ⑰ and ⑱
TTM-205	Terminal Nos. ㉘, ㉙, ㉚, ㉛, ㉜, ㉝ and ㉞
TTM-207	Terminal Nos. ⑲, ⑳, ㉑, ㉒, ㉓ and ㉔
TTM-209	Terminal Nos. ㉘, ㉙, ㉚, ㉛, ㉜, ㉝ and ㉞

TTM-204



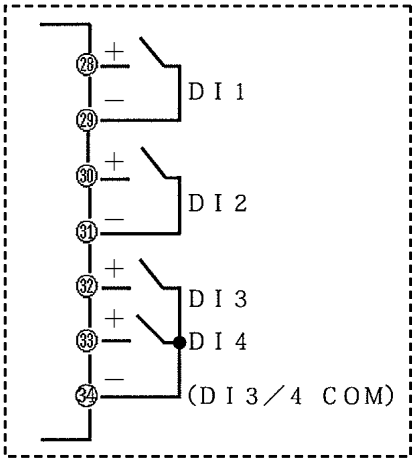
* When CT 1 or CT 2 is selected, DI 1 or DI 2 are not selectable.
* When CT 1 is selected, DT 1 is not selectable.

TTM-207



* When CT 1 or CT 2 is selected, DI 1 or DI 2 is not selectable.
* When CT 1 is selected, DI 1 is not selectable.
* When the output 7 is selected, DI 3 is not selectable.

TTM-205/209



* For TTM-205/209, the common for DI 3/DI 4 is shared.

* DI input is optional.
* Max. 4 points are selectable (to be designated at order placement).
* The following functions can be executed through the DI (digital) inputs. The DI inputs are external no-voltage contact signals.
* List of functions due to DI

Close		Active
Bank switchover		Bank switchover
During constant value run	MD	READY
During program run	Start	Stop
MD		MANUAL
Reverse operation		Forward operation
AT stop		AT start
Timer Stop		Timer Stop
Constant value run		Program run
–		Step feed (during program run) *1
–		Pause (during program run) *1
Interlock *1		–

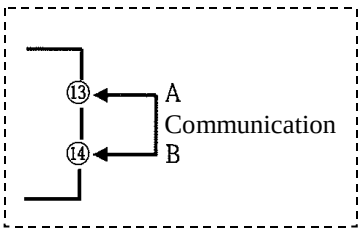
*1: Selectable only for a program run.

Close: Contact signal OFF
Active: Contact signal ON

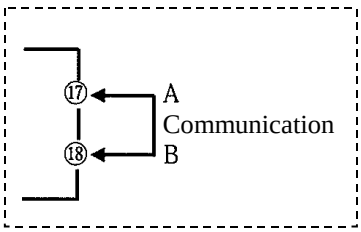
★ Communication function

TTM-204	Terminal Nos. ⑬ and ⑭
TTM-205	Terminal Nos. ㉖ and ㉗
TTM-207	Terminal Nos. ⑰ and ⑱
TTM-209	Terminal Nos. ㉖ and ㉗

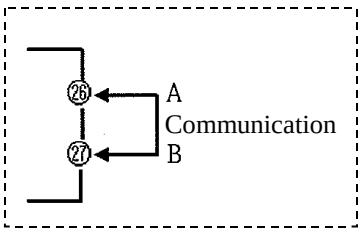
TTM-204



TTM-207



TTM-205/209



* There are two types of communication functions, the “communication” and “loader communication”. The “Communication” is optional.

★ Communication

* This function is for communication with a host computer. (The communication function option is required.)

* Communication protocol
  TOHO protocol
  MODBUS protocol (RTU mode)
  MODBUS protocol (ASCII mode)

* Interface
  RS485

★ Loader communication

* This communication function is for setting all data of TTM-200 series in a lump.

* In order to use the loader communication, the dedicated software for the communication must be installed on the personal computer (PC) being used.

* To connect TTM-200 series to your PC, TOHO’s dedicated connection cable “TTM-LOADER” (sold separately) is required.

★ Output

Model	Terminal No.						
	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
TTM-204	③ and ④	⑤ and ⑥	⑦ and ⑨	⑧ and ⑨			
TTM-205	③ and ④	⑤ and ⑥	⑲ and ㉑	⑳ and ㉑	⑦ and ⑧	⑨ and ⑩	⑪ and ⑫
TTM-207	③ and ④	⑤ and ⑥	⑪ and ⑬	⑫ and ⑬	⑦ and ⑧		㉓ and ㉔
TTM-209	③ and ④	⑤ and ⑥	⑲ and ㉑	⑳ and ㉑	⑦ and ⑧	⑨ and ⑩	⑪ and ⑫

● Assignment of outputs

Type of output	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
Primary output (heating)	○	○	○	○	○	○	○
Secondary output (cooling)	○	○	○	○	○	○	○
Transmission output	○	○	×	×	×	×	×
Event output	○	○	○	○	○	○	○
Timer output	○	○	○	○	○	○	○
End output	○	○	○	○	○	○	○

○: Output assignment possible
×: Output assignment not possible

● Type of output and specification

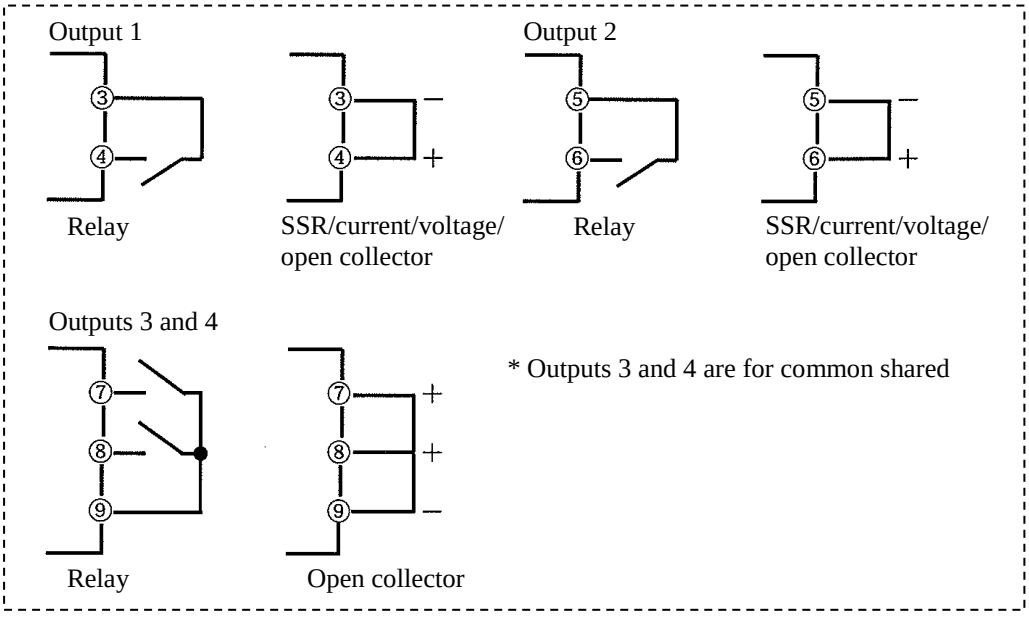
* Outputs 1 and 2

Relay contact	250 VAC, 3 A (resistance loads) and 1a contact
Voltage for SSR drive	0 - 12 VDC (load resistance: 600 Ω or greater)
Open collector	24 VDC, 100 mA (load current)
Voltage	0 - 5 VDC, 1 - 5 VDC and 0 - 10 VDC (resistance loads: 1 kΩ or greater) 0 - 1 VDC and 0 - 10 mVDC (load resistance: 500 kΩ or greater)
Current	4 - 20 mADC (load resistance: 600 Ω or less)

* Outputs 3, 4, 5, 6 and 7

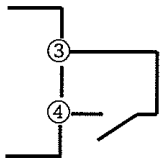
Relay contact	250 VAC, 1 A (resistance loads) and 1a contact
Open collector	24 VDC, 100 mA (load current)

TTM-204

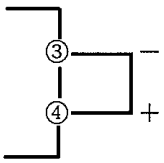


TTM-207

Output 1

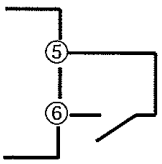


Relay

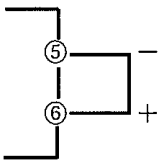


SSR/current/voltage/
open collector

Output 2

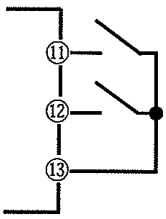


Relay

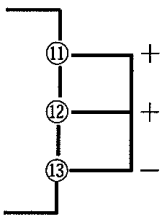


SSR/current/voltage/
open collector

Outputs 3 and 4

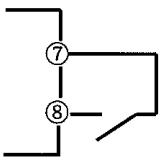


Relay

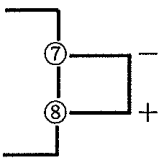


Open collector

Output 5



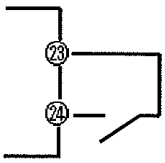
Relay



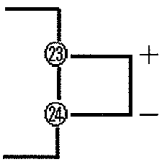
Open collector

* Outputs 3 and 4 are for common shared

Output 7

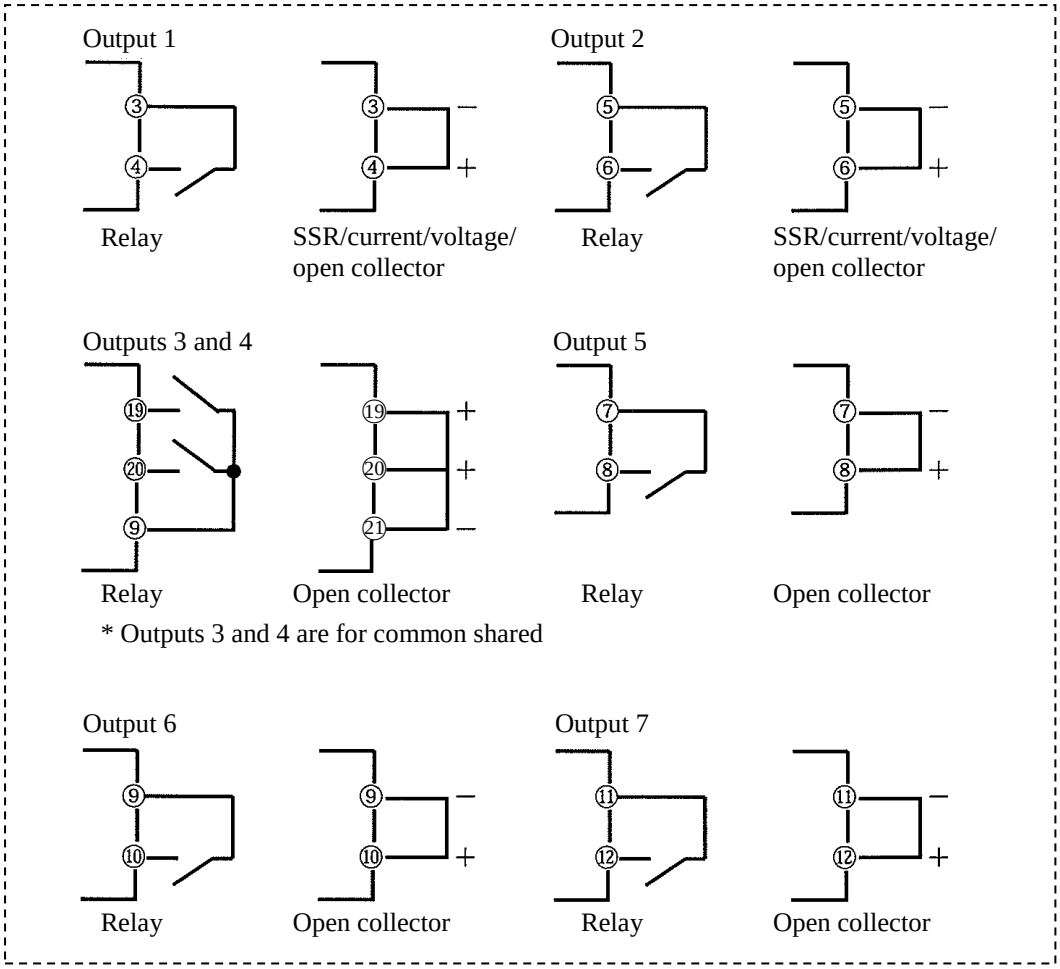


Relay



Open collector

TTM-205/209



* Max. 7 points of outputs are provided. They are usable for control output, event output, RUN/RDY output, transmission output, and timer outputs (3 points).
They should be designated at order placement. See the model table on page 1-3.

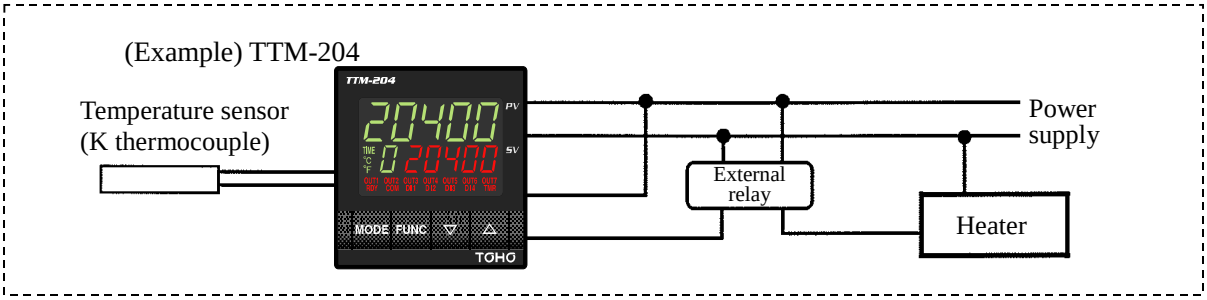
* No. of outputs selectable depends on models. In the table "★ Output" on page 3-12, cells filled with diagonal lines indicate that none is selectable. Selection can also be checked on the model table on page 1-3.

* "NO" and "C" for outputs are for the equipment model of relay contact output. "+" and "-" for outputs are for other than the equipment model of relay contact output. Properly wire outputs to target connections, as target connections are designated.
(Take sufficient care the polarity "+" and "-" when wiring.)

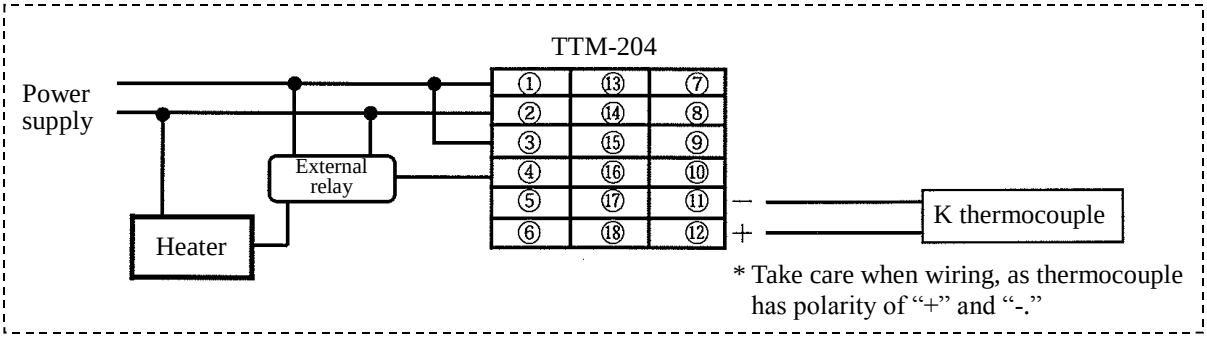
3-4 Examples of wiring

1) Input: K thermocouple, output 1: relay contact output and single phase 100 V

★ Configuration example



★ Connection configuration

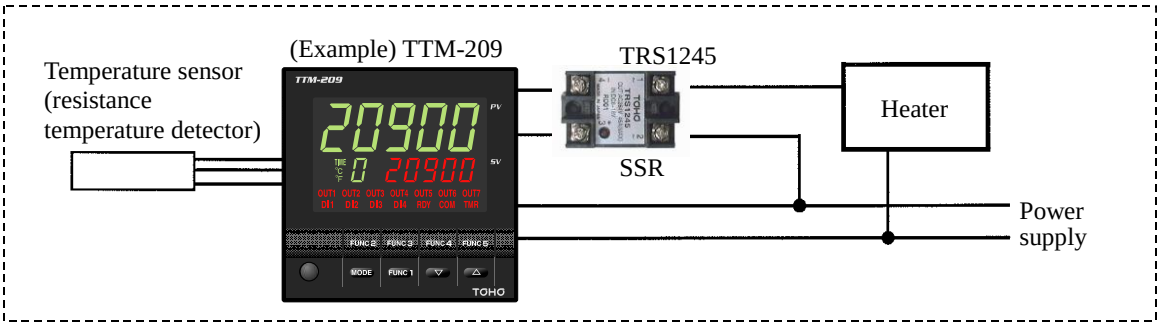


Terminal description for the above wiring example

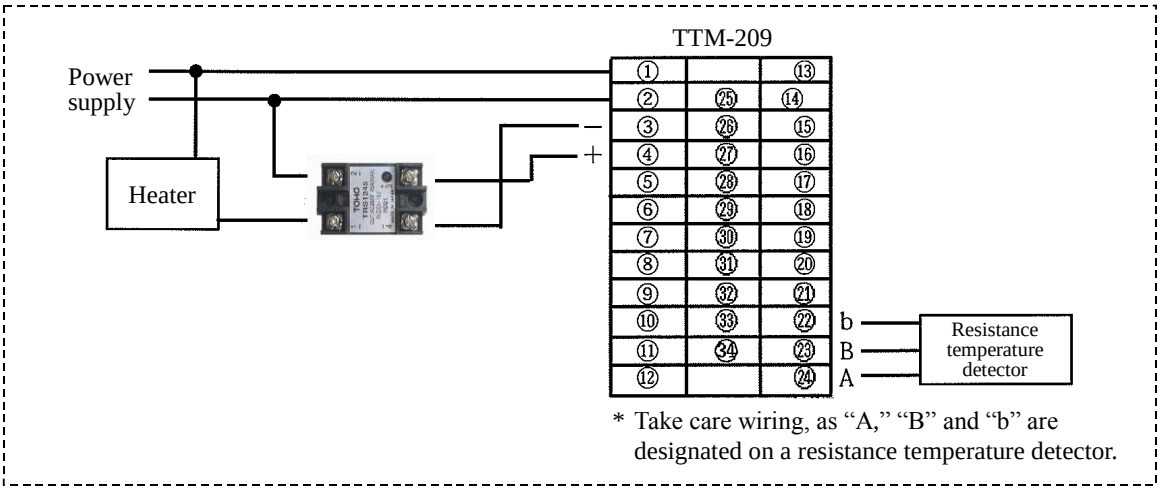
Terminal No.	Description	
①	Power supply	
②		
③	Output 1	Common
④		Normal open
⑤	Output 2	Not used in this case.
⑥		
⑦	Output 3 Output 4	Not used in this case.
⑧		
⑨		
⑩	Input	Not used in this case.
⑪		"-" side
⑫		"+" side
⑬	Communication	Not used in this case.
⑭		
⑮	CT or DI input	Not used in this case.
⑯		
⑰		
⑱		

2) Input: resistance temperature detector, output 1: SSR drive voltage and single phase 100 V

★ Configuration example



★ Connection configuration



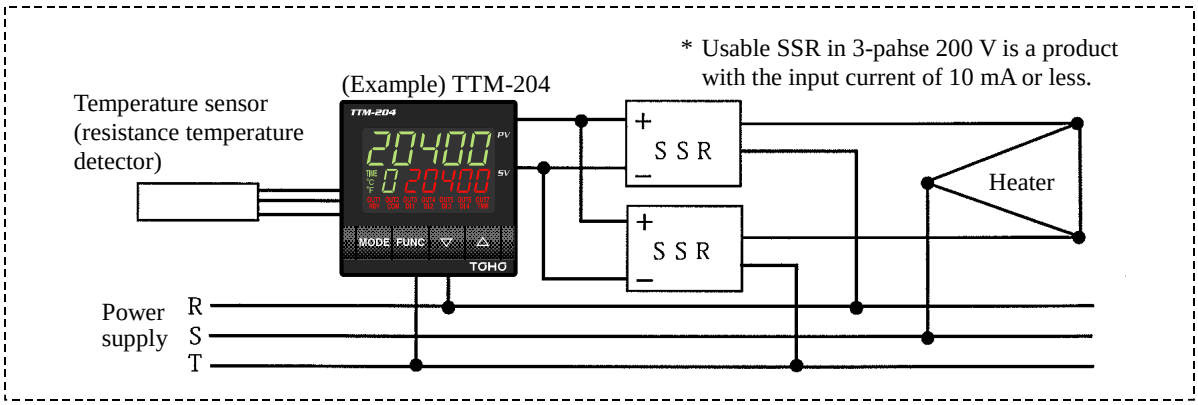
* Take care wiring, as "A," "B" and "b" are designated on a resistance temperature detector.

Terminal description for the above wiring example

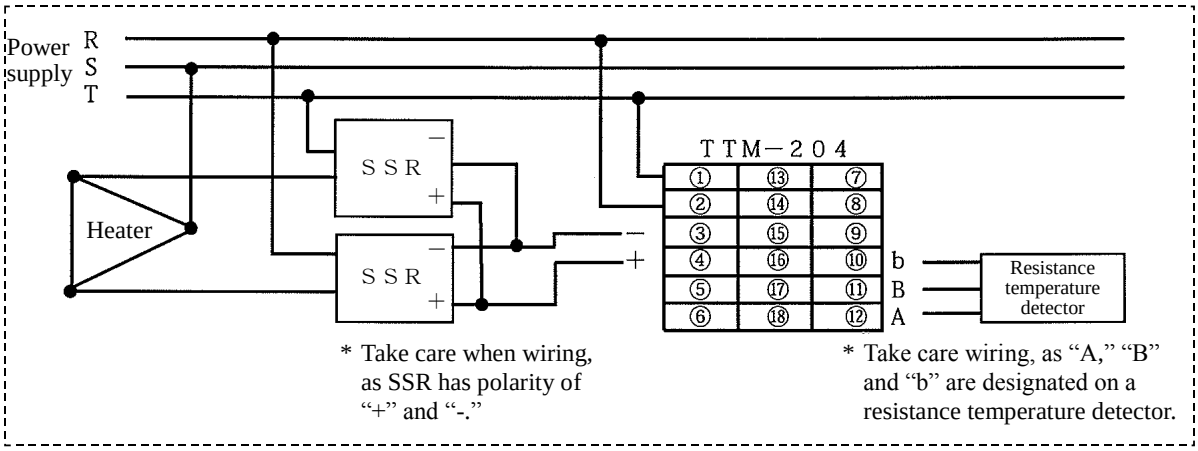
Terminal No.	Description		Terminal No.	Description	
①	Power supply		⑲	Output 3 Output 4	Not used in this case.
②			⑳		
③	Output 1	"-" side	㉑		
④		"+" side	㉒	Input	b
⑤	Output 2	Not used in this case.	㉓		B
⑥			㉔		A
⑦	Output 5	Not used in this case.	㉕	This terminal is not used.	
⑧			㉖	Communication	Not used in this case.
⑨	Output 6	Not used in this case.	㉗		
⑩			㉘	DI input	Not used in this case.
⑪	Output 7	Not used in this case.	㉙		
⑫			㉚		
⑬	CT input	Not used in this case.	㉛		
⑭			㉜		
⑮			㉝		
⑯			㉞		
⑰	AI input	Not used in this case.			
⑱					

3) Input: resistance temperature detector, output 1: SSR drive voltage and 3-phase 200 V

★ Configuration example



★ Connection configuration



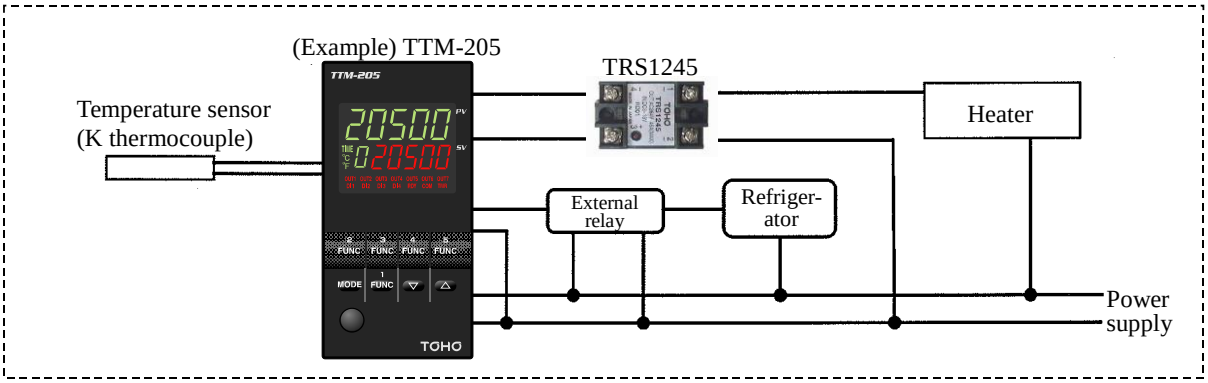
Terminal description for the above wiring example

Terminal No.	Description	
①	Power supply	
②		
③	Output 1	"-" side
④		"+" side
⑤	Output 2	Not used in this case.
⑥		
⑦	Output 3 Output 4	Not used in this case.
⑧		
⑨		
⑩	Input	b
⑪		B
⑫		A
⑬	Communication	Not used in this case.
⑭		
⑮	CT or DI input	Not used in this case.
⑯		
⑰		
⑱		

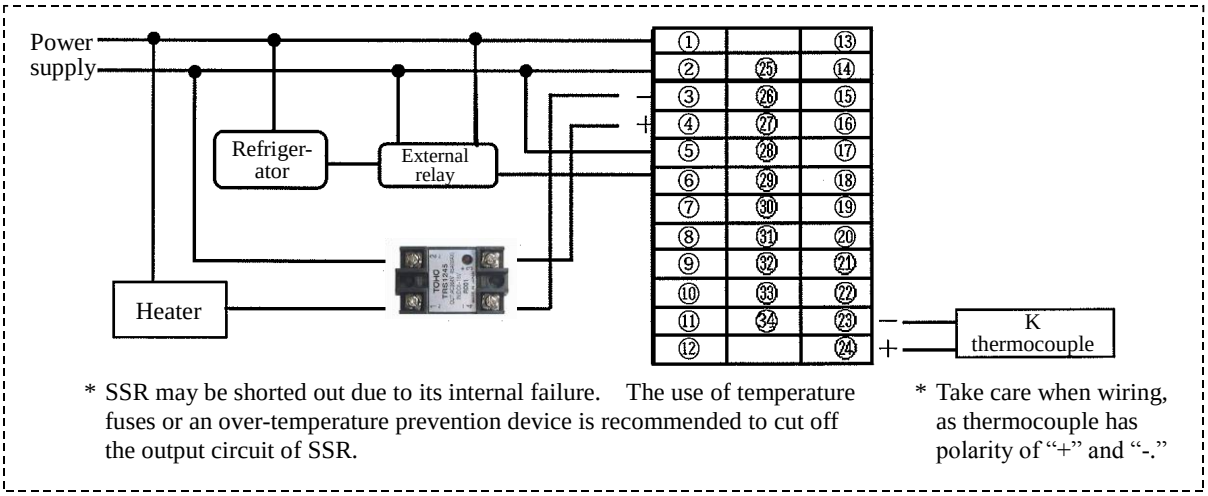
* SSR may be shorted out due to its internal failure. The use of "temperature fuses" or an "over-temperature prevention device" is recommended to cut off the output circuit of SSR.

4) Input: K thermocouple, output 1: SSR drive voltage, output 2: relay contact output and single phase 100 V (heating/cooling control)

★ Configuration example



★ Connection configuration



* SSR may be shorted out due to its internal failure. The use of temperature fuses or an over-temperature prevention device is recommended to cut off the output circuit of SSR.

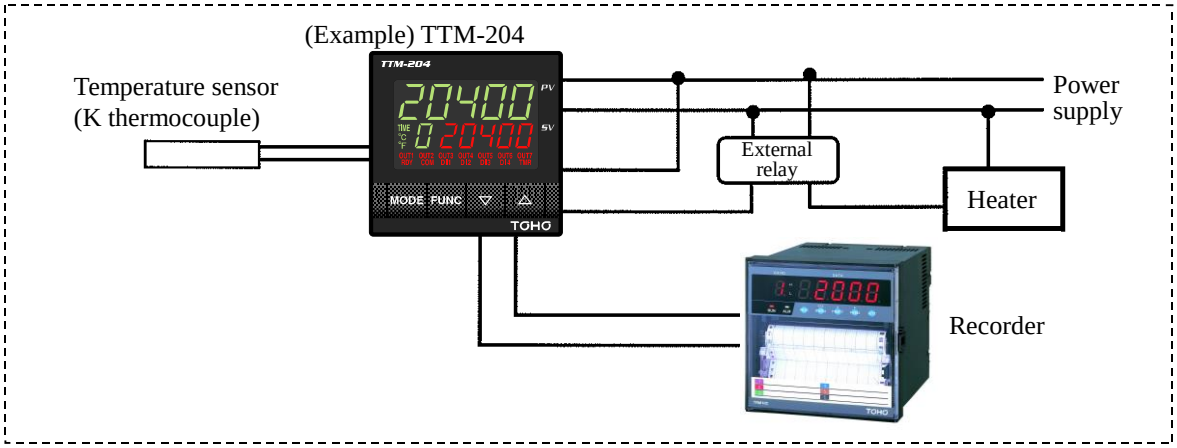
* Take care when wiring, as thermocouple has polarity of "+" and "-."

Terminal description for the above wiring example

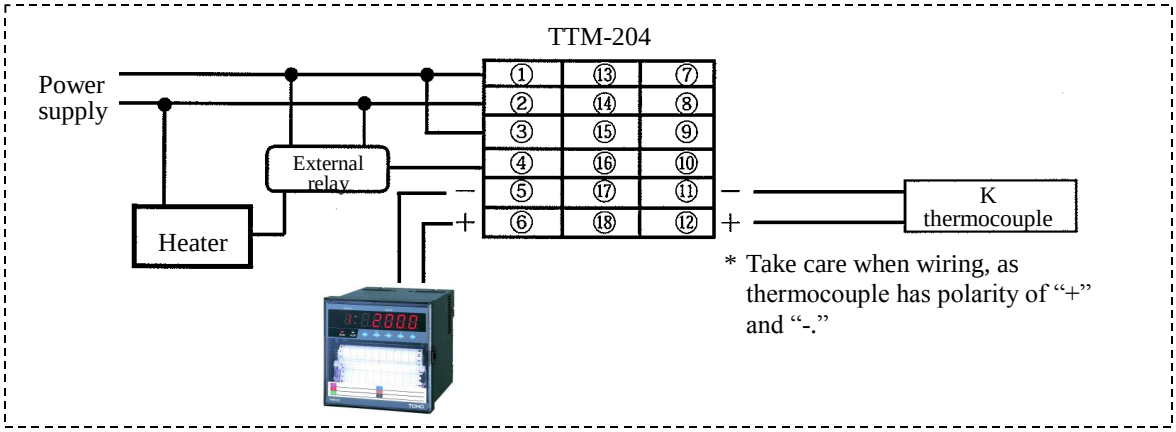
Terminal No.	Description		Terminal No.	Description	
①	Power supply		⑲	Output 3	Not used in this case.
②			⑳	Output 4	
③	Output 1	"-" side	㉑		
④		"+" side	㉒	Input	Not used in this case.
⑤	Output 2	Common	㉓		"-" side
⑥		Normal open	㉔		"+" side
⑦	Output 5	Not used in this case.	㉕	This terminal is not used.	
⑧			㉖	Communication	Not used in this case.
⑨	Output 6	Not used in this case.	㉗		
⑩			㉘	DI input	Not used in this case.
⑪	Output 7	Not used in this case.	㉙		
⑫			㉚		
⑬	CT input	Not used in this case.	㉛		
⑭			㉜		
⑮			㉝		
⑯			㉞		
⑰	AI input	Not used in this case.			
⑱					

5) Input: K thermocouple, output 1: relay contact output, output 2: transmission output and single phase 100 V

★ Configuration example



★ Connection configuration



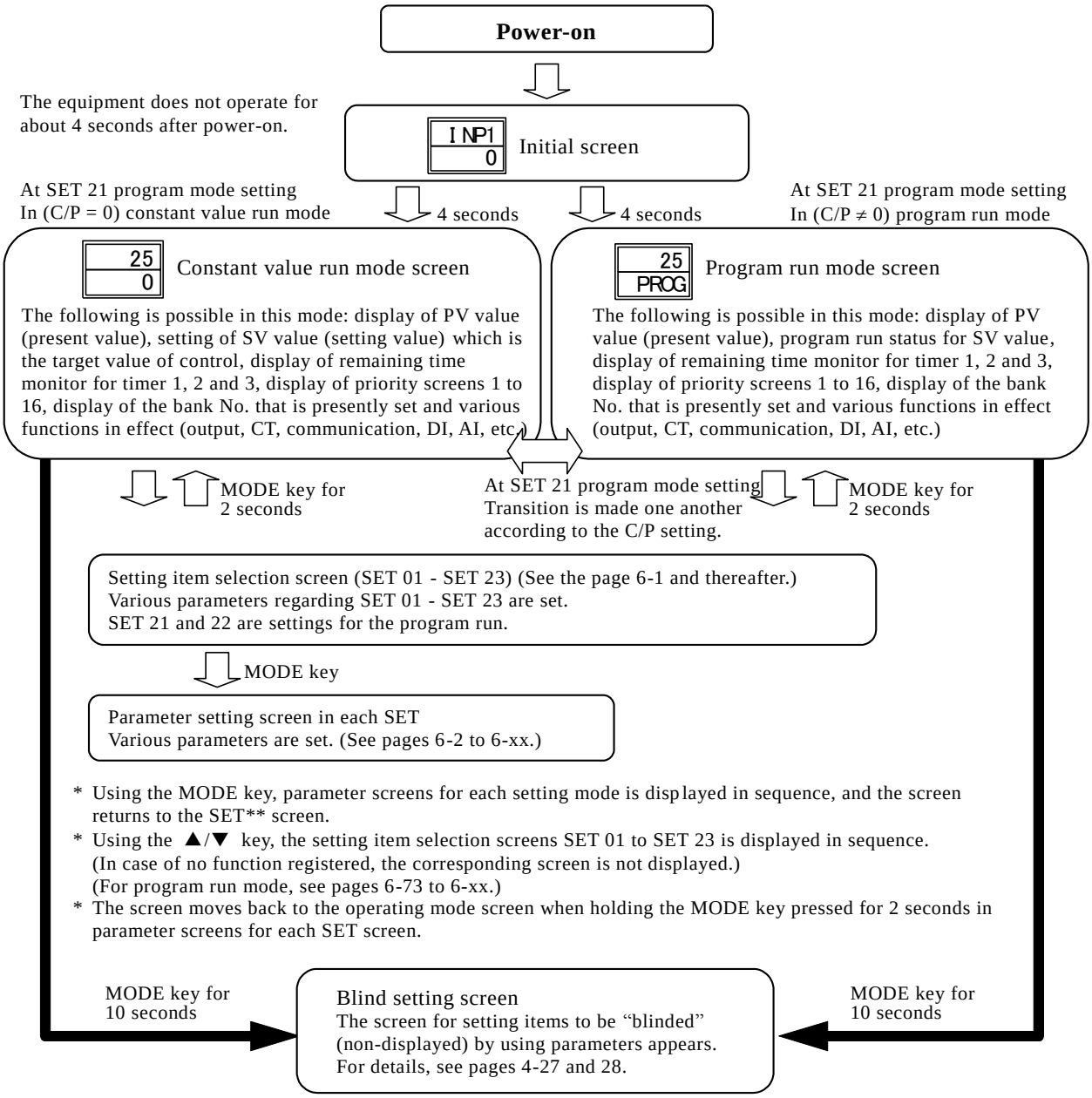
Terminal description for the above wiring example

Terminal No.	Description	
①	Power supply	
②		
③	Output 1	Common
④		Normal open
⑤	Output 2	"-" side
⑥		"+" side
⑦	Output 3 Output 4	Not used in this case.
⑧		
⑨		
⑩	Input	Not used in this case.
⑪		"-" side
⑫		"+" side
⑬	Communication	Not used in this case.
⑭		
⑮	CT or DI input	Not used in this case.
⑯		
⑰		
⑱		

4. Basic operation

Basic operation is described in this chapter.

4.1 Flow of setting mode



★ No key operation for about 2 minutes automatically moves the screen back to the operating mode screen.

★ If a function is not specified, corresponding SET screen is not displayed.

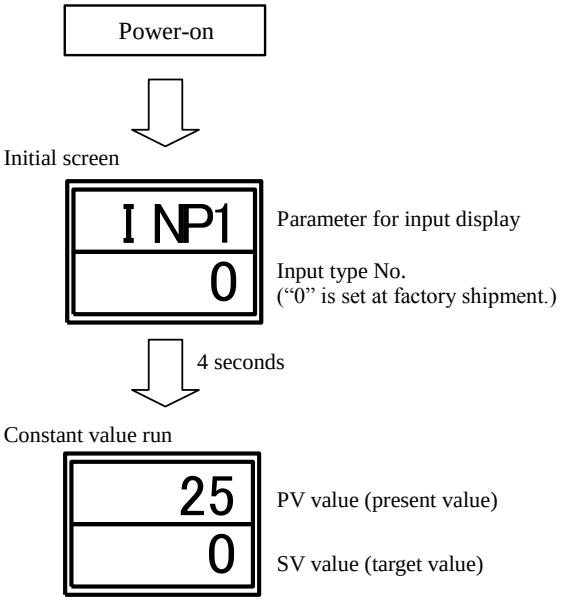
★ Holding the MODE key pressed for at least 2 seconds moves the setting item selection screen back to the operating mode screen or vice versa.

★ Use the ▲/▼ key to move the parameter setting screens.

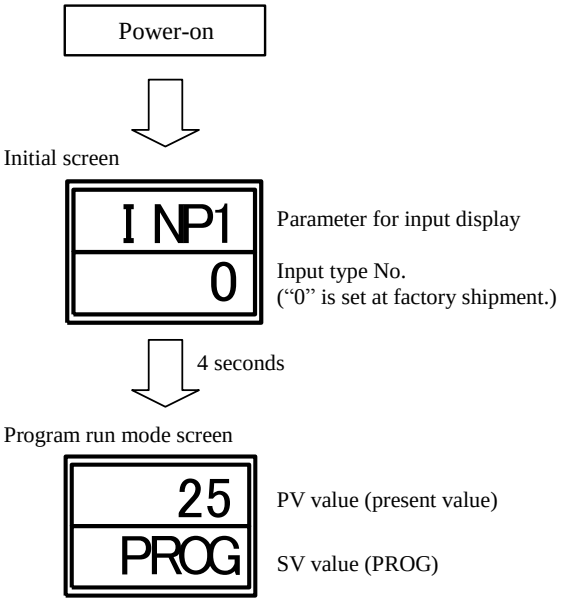
★ Use the MODE key to move each parameter setting screen.

■ Initial screen

The input type number is displayed right after the power turns on, and in 4 seconds, the run mode screen is displayed.



At SET 21 program mode setting
A (C/P ≠ 0) program run mode is established.



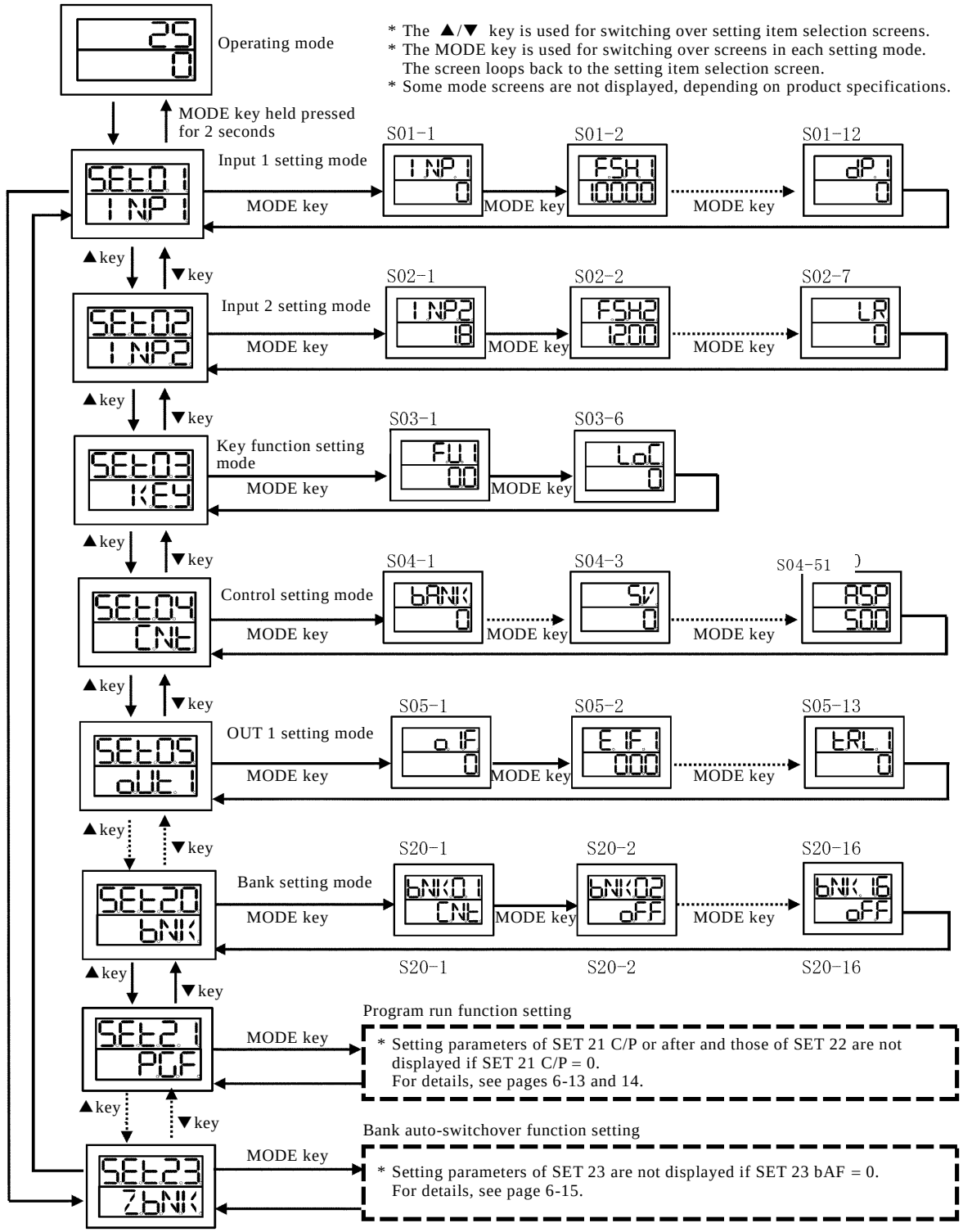
Input type No. and input type

No.	Input type
0	K thermocouple
1	J thermocouple
2	T thermocouple
3	E thermocouple
4	R thermocouple
5	S thermocouple
6	B thermocouple
7	N thermocouple
8	U thermocouple
9	L thermocouple
10	WRe5-26 thermocouple
11	PR40-20 thermocouple
12	PLII thermocouple
13	Pt100
14	JPt100
15	0 - 10 mVDC
16	0 - 1 VDC
17	0 - 5 VDC
18	1 - 5 VDC
19	0 - 10 VDC
20	4 - 20 mADC

4.2 Basic operation

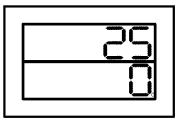
Flow of each setting item selection screen and each setting mode is described.

4.2.1 Switchover of parameters (flow as a whole)



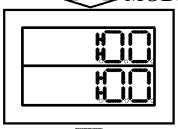
* Nos. located in upper left of each parameter screen is identical to the Nos. for items in each parameter screen.
Notation example S20-1: First item in the parameter screen SET 20.

Flow of each setting mode
Constant value run mode
SET21 program mode setting
A (C/P = 0) constant value run mode is established.



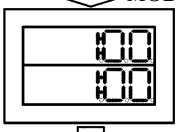
1. PV/SV screen

MODE key



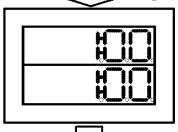
2. Timer 1 monitor

MODE key



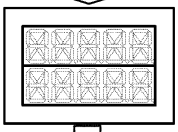
3. Timer 2 monitor

MODE key



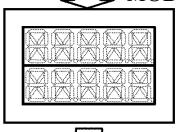
4. Timer 3 monitor

MODE key



5. Priority screen 1
(The priority screens from 1 to 16 displayed in sequence)

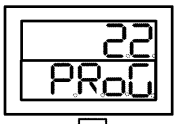
MODE key



20. Priority screen 16

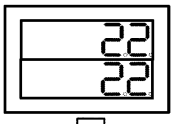
To item 1

Program run mode
SET21 program mode setting
A (C/P = 1) program run mode is established.



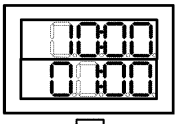
1. Program run screen

MODE key



2. Step SV value screen

MODE key

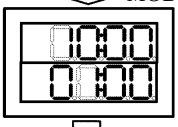


3. Step time monitor

MODE key

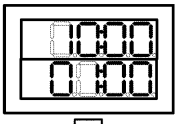
4. Program run start/stop screen

MODE key



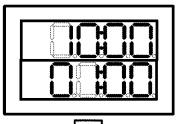
5. Timer 1 monitor

MODE key



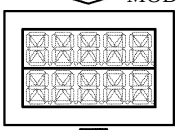
6. Timer 2 monitor

MODE key



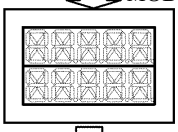
7. Timer 3 monitor

MODE key



8. Priority screen 1
(The priority screens from 1 to16 displayed in sequence)

MODE key



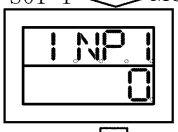
23. Priority screen 16

To item 1

SET 1: Input 1 setting mode

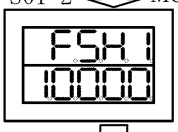
0. Setting item selection screen

S01-1 MODE key



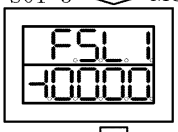
1 Input 1 type setting

S01-2 MODE key



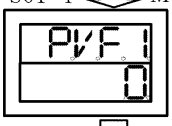
2. Scaling upper limit setting
* Displayed with current/voltage input.

S01-3 MODE key



3. Scaling lower limit setting
* Displayed with current/voltage input.

S01-4 MODE key

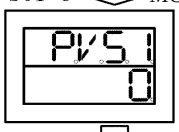


4. PV compensation function setting *1

S01-5 MODE key

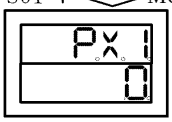
5. PV compensation gain setting
* Displayed during PV gain zero point compensation.

S01-6 MODE key



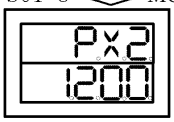
6. PV compensation zero setting
* Displayed during PV gain zero point compensation.

S01-7 MODE key



7. Lower limit setting before PV compensation
* Displayed during PV X-Y 2-point compensation

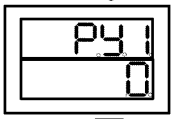
S01-8 MODE key



8. Upper limit setting before PV compensation
* Displayed during PV X-Y 2-point compensation

To SET 01, item 9

S01-9 MODE key

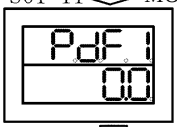


9. Lower limit setting after PV compensation
* Displayed during PV X-Y 2-point compensation

S01-10 MODE key

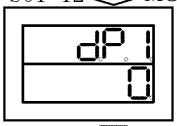
10. Upper limit setting after PV compensation
* Displayed during PV X-Y 2-point compensation

S01-11 MODE key



11. Input filter setting

S01-12 MODE key

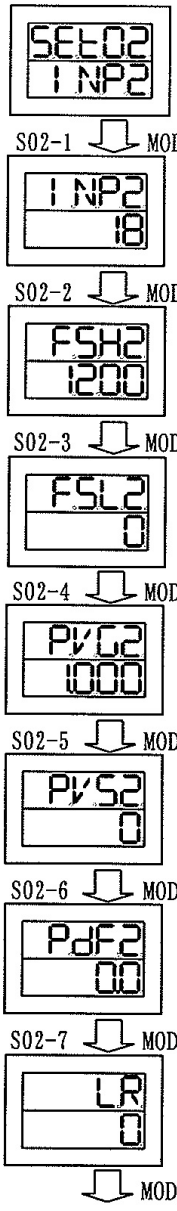


12. Decimal point setting

To SET 01, item 0

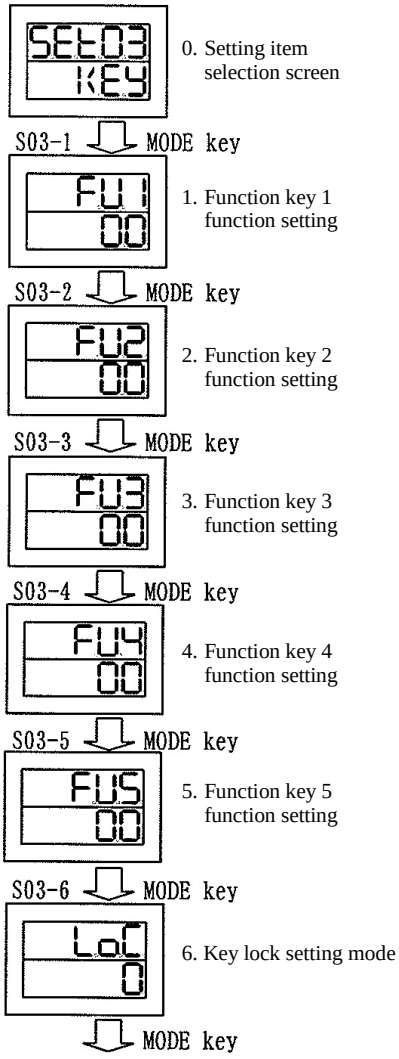
*1: PV compensation function setting
When (PVF1 = 0) is selected, select PV gain zero point compensation.
When (PVF1 = 1) is selected, select PV X-Y 2-point compensation.
For details, see pages 6-4 to 6-6.

SET 2: Input 2 setting mode



To SET 02, item 0

SET 3: Key function setting mode



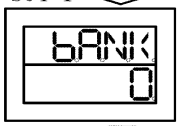
To SET 03, item 0

SET 4: Control setting mode

0. Setting item selection screen

MODE key

S04-1



1. Bank setting

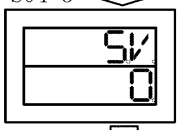
MODE key

S04-2

2. Bank upper limit setting

MODE key

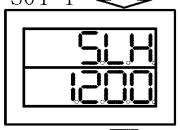
S04-3



3. Control setting

MODE key

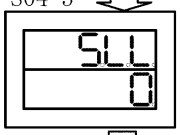
S04-4



4. SV limiter upper limit setting

MODE key

S04-5



5. SV limiter lower limit setting

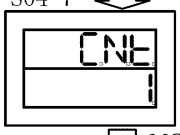
MODE key

S04-6

6. Control mode setting

MODE key

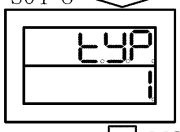
S04-7



7. Control type setting

MODE key

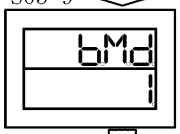
S04-8



8. PID control type setting

MODE key

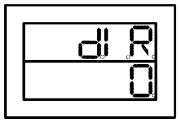
S05-9



9. Type B mode setting

MODE key

S04-10

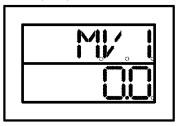


10. Forward/reverse operation setting

MODE key

To S04-11

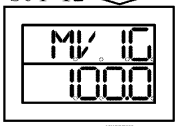
S04-11



11. Primary control operating amount

MODE key

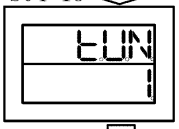
S04-12



12. Primary control output gain setting

MODE key

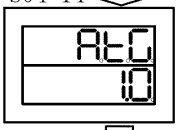
S04-13



13. Tuning type setting

MODE key

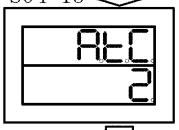
S04-14



14. AT coefficient setting

MODE key

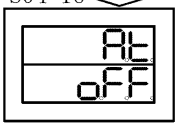
S04-15



15. AT sensitivity setting

MODE key

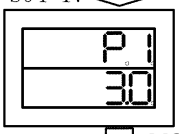
S04-16



16. AT start screen

MODE key

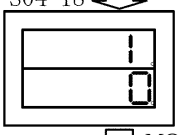
S04-17



17. Proportional band setting

MODE key

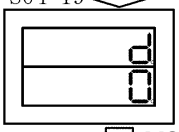
S04-18



18. Integral time setting

MODE key

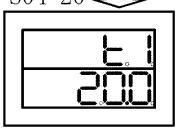
S04-19



19. Derivative time setting

MODE key

S04-20



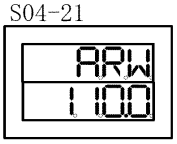
20. Primary control proportional cycle
Initial value Relay: 20 seconds
SSR: 2 seconds

MODE key

To S04-21

Continued to the next page

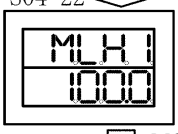
S04-21



21. Anti-reset windup

MODE key

S04-22



22. Setting of primary control operation amount limiter upper

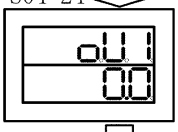
MODE key

S04-23

23. Setting of primary control operation amount limiter lower limit

MODE key

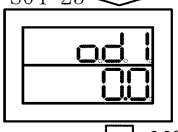
S04-24



24. Setting of primary control operation amount change rate limiter ascending

MODE key

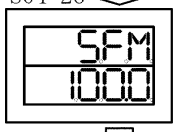
S04-25



25. Setting of primary control operation amount change rate limiter descending

MODE key

S04-26



26. Setting of primary controller soft start output

MODE key

S04-27

27. Setting of primary controller soft start time

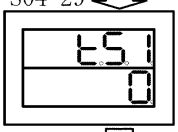
MODE key

S04-28

28. Setting of primary control operation amount at fault

MODE key

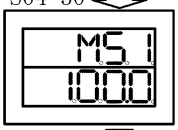
S04-29



29. Setting of primary control loop anomaly PV threshold

MODE key

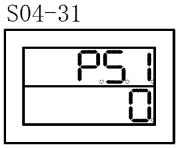
S04-30



30. Setting of primary control operation amount at fault and control amount threshold

MODE key

S04-31

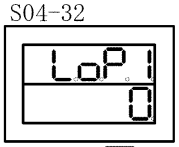


31. Setting of primary control loop anomaly PV threshold

MODE key

To S04-32

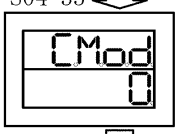
S04-32



32. Setting of primary control loop fault time

MODE key

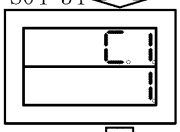
S04-33



33. Setting of primary control OFF point position selection

MODE key

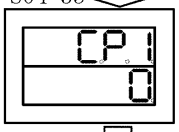
S04-34



34. Setting of primary control sensitivity

MODE key

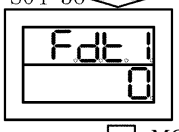
S04-35



35. Setting of primary control OFF point position

MODE key

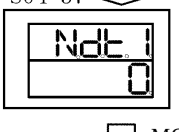
S04-36



36. Primary control safeguard off timer (0 to 99 minutes)

MODE key

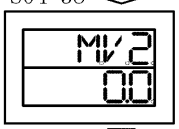
S04-37



37. Primary control safeguard on timer (0 to 99 minutes)

MODE key

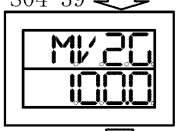
S04-38



38. Secondary control operation amount

MODE key

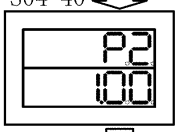
S04-39



39. Setting of secondary control output gain

MODE key

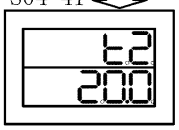
S04-40



40. Setting of secondary control proportional band (0.10 to 10.00 times)

MODE key

S04-41



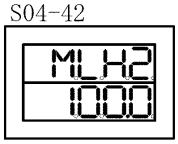
41. Setting of secondary control proportional interval

MODE key

To S04-42

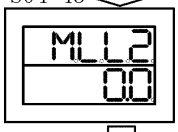
Continued to the next page

S04-42



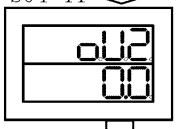
42. Setting of secondary control operation amount limiter upper limit

S04-43 MODE key



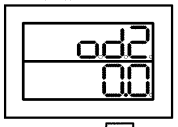
43. Setting of secondary control operation amount limiter lower limit

S04-44 MODE key



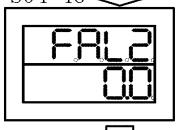
44. Setting of secondary control operation amount change rate limiter ascending

S04-45 MODE key



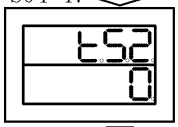
45. Setting of secondary control operation amount change rate limiter descending

S04-46 MODE key



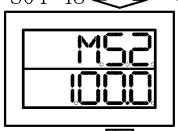
46. Setting of secondary control operation amount at fault

S04-47 MODE key



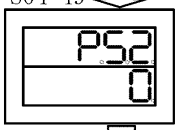
47. Setting of secondary control loop anomaly PV threshold

S04-48 MODE key



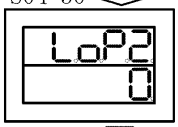
48. Setting of secondary control loop anomaly MV threshold

S04-49 MODE key



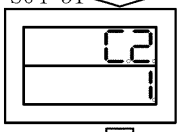
49. Setting of secondary control loop anomaly PV change threshold

S04-50 MODE key



50. Setting of secondary control loop fault time

S04-51 MODE key

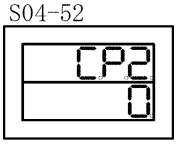


51. Setting of secondary control sensitivity

MODE key

To S04-52

S04-52

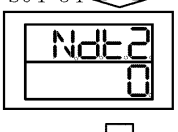


52. Setting of secondary control OFF point position

S04-53 MODE key

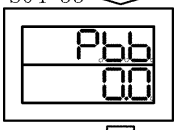
53. Secondary control safeguard off timer (0 to 99 minutes)

S04-54 MODE key



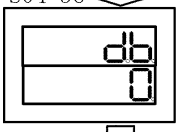
54. Secondary control safeguard on timer (0 to 99 minutes)

S04-55 MODE key



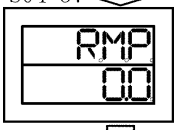
55. Setting of manual reset

S04-56 MODE key



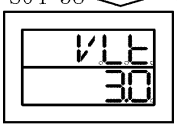
56. Setting of dead band

S04-57 MODE key



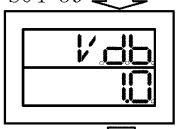
57. Setting of Ramp time

S04-58 MODE key



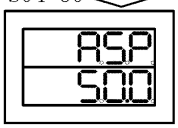
58. Setting of valve motor stroke time

S04-59 MODE key



59. Setting of valve motor drive dead band

S04-60 MODE key



60. Initial open ratio after AT completion

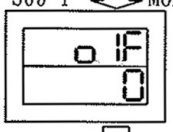
MODE key

To SET 04, item 0

SET 5: OUT 1 setting mode

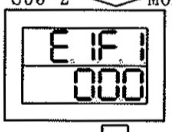
0. Setting item selection screen

S05-1 MODE key



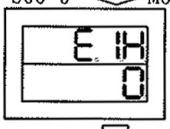
1. Target connection setting

S05-2 MODE key



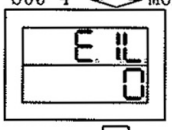
2. Event function 1 setting

S05-3 MODE key



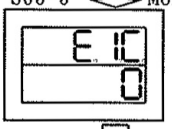
3. Event upper limit setting

S05-4 MODE key



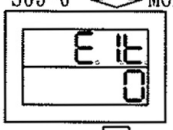
4. Event lower limit setting

S05-5 MODE key



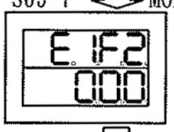
5. Event sensitivity setting

S05-6 MODE key



6. Event delay timer setting

S05-7 MODE key

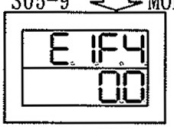


7. Event function 2 setting (PV abnormality)

S05-8 MODE key

8. Event function 3 setting (CT abnormality)

S05-9 MODE key

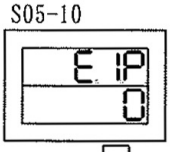


9. Event function 4 setting (Loop abnormality)

MODE Key

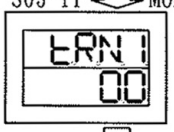
To S05-10

S05-10



10. Event polarity setting

S05-11 MODE key

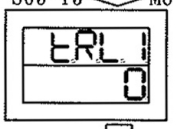


11. Transmission output function setting

S05-12 MODE key

12. Transmission scaling upper limit setting

S05-13 MODE key

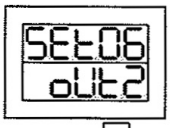


13. Transmission scaling lower limit setting

MODE key

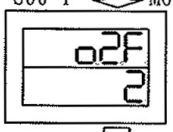
To SET 05, item 0

SET 6: OUT 2 setting mode



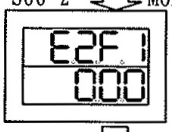
0. Setting item selection screen

S06-1 MODE key



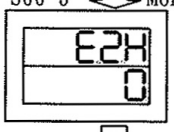
1. Target connection setting

S06-2 MODE key



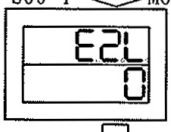
2. Event function 1 setting

S06-3 MODE key



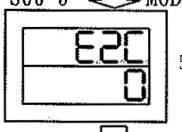
3. Event upper limit setting

S06-4 MODE key



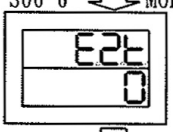
4. Event lower limit setting

S06-5 MODE key



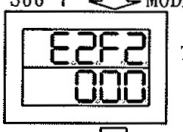
5. Event sensitivity setting

S06-6 MODE key



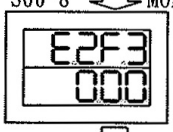
6. Event delay timer setting

S06-7 MODE key



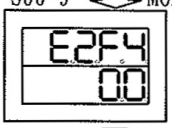
7. Event function 2 setting (PV abnormality)

S06-8 MODE key



8. Event function 3 setting (CT abnormality)

S06-9 MODE key

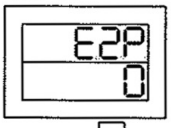


9. Event function 4 setting (Loop abnormality)

MODE key

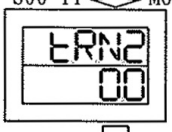
To S06-10

S06-10



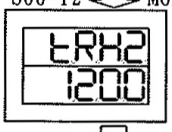
10. Event polarity setting

S06-11 MODE key



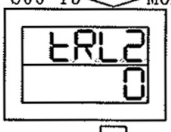
11. Transmission output function setting

S06-12 MODE key



12. Transmission scaling upper limit setting

S06-13 MODE key

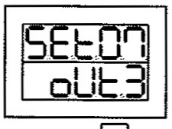


13. Transmission scaling lower limit setting

MODE key

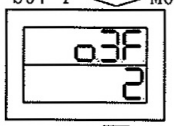
To SET 06, item 0

SET 7: OUT 3 setting mode



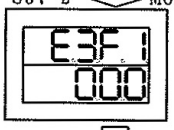
0. Setting item selection screen

S07-1 MODE key



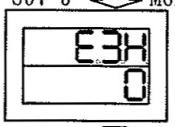
1. Target connection setting

S07-2 MODE key



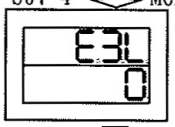
2. Event function 1 setting

S07-3 MODE key



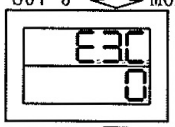
3. Event upper limit setting

S07-4 MODE key



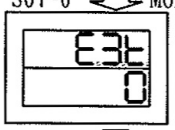
4. Event lower limit setting

S07-5 MODE key



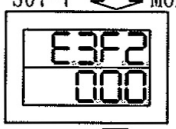
5. Event sensitivity setting

S07-6 MODE key



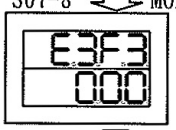
6. Event delay timer setting

S07-7 MODE key



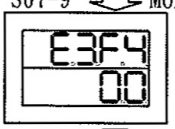
7. Event function 2 setting (PV abnormality)

S07-8 MODE key



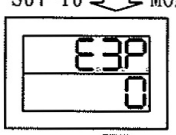
8. Event function 3 setting (CT abnormality)

S07-9 MODE key



9. Event function 4 setting (Loop abnormality)

S07-10 MODE key

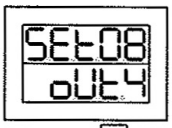


10. Event polarity setting

MODE key

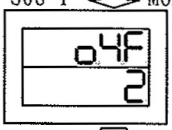
To SET 07, item 0

SET 8: OUT 4 setting mode



0. Setting item selection screen

S08-1 MODE key

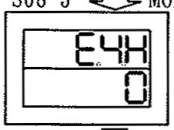


1. Target connection setting

S08-2 MODE key

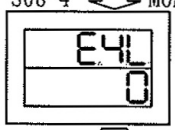
2. Event function 1 setting

S08-3 MODE key



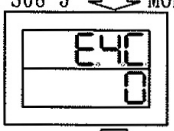
3. Event upper limit setting

S08-4 MODE key



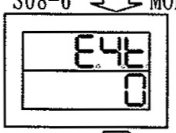
4. Event lower limit setting

S08-5 MODE key



5. Event sensitivity setting

S08-6 MODE key

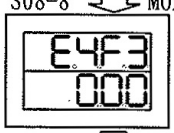


6. Event delay timer setting

S08-7 MODE key

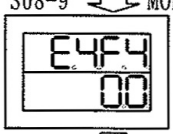
7. Event function 2 setting (PV abnormality)

S08-8 MODE key



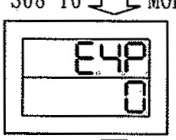
8. Event function 3 setting (CT abnormality)

S08-9 MODE key



9. Event function 4 setting (Loop abnormality)

S08-10 MODE key

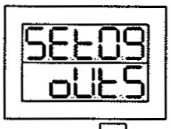


10. Event polarity setting

MODE key

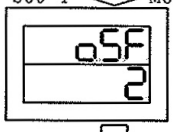
To SET 08, item 0

SET 9: OUT 5 setting mode



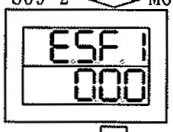
0. Setting item selection screen

S09-1 MODE key



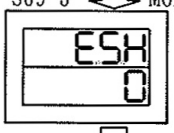
1. Target connection setting

S09-2 MODE key



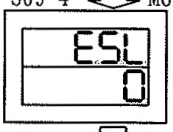
2. Event function 1 setting

S09-3 MODE key



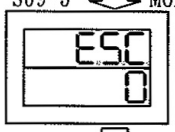
3. Event upper limit setting

S09-4 MODE key



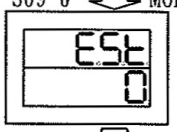
4. Event lower limit setting

S09-5 MODE key



5. Event sensitivity setting

S09-6 MODE key

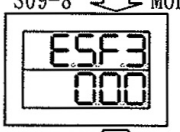


6. Event delay timer setting

S09-7 MODE key

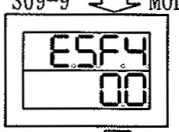
7. Event function 2 setting (PV abnormality)

S09-8 MODE key



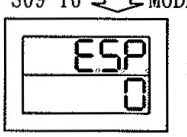
8. Event function 3 setting (CT abnormality)

S09-9 MODE key



9. Event function 4 setting (Loop abnormality)

S09-10 MODE key

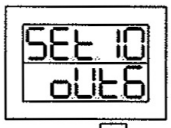


10. Event polarity setting

MODE key

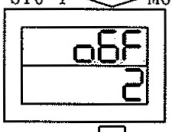
To SET 09, item 0

SET 10: OUT 6 setting mode



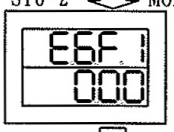
0. Setting item selection screen

S10-1 MODE key



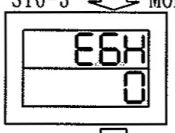
1. Target connection setting

S10-2 MODE key



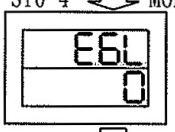
2. Event function 1 setting

S10-3 MODE key



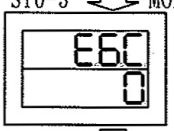
3. Event upper limit setting

S10-4 MODE key



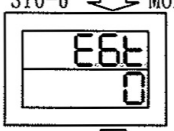
4. Event lower limit setting

S10-5 MODE key



5. Event sensitivity setting

S10-6 MODE key

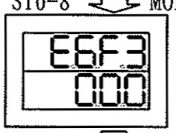


6. Event delay timer setting

S10-7 MODE key

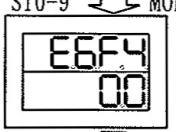
7. Event function 2 setting (PV abnormality)

S10-8 MODE key



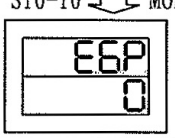
8. Event function 3 setting (CT abnormality)

S10-9 MODE key



9. Event function 4 setting (Loop abnormality)

S10-10 MODE key



10. Event polarity setting

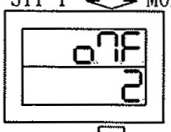
MODE key

To SET 10, item 0

SET 11: OUT 7 setting mode

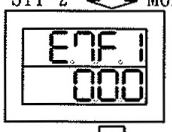
0. Setting item selection screen

S11-1 MODE key



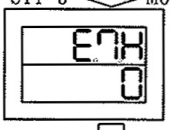
1. Target connection setting

S11-2 MODE key



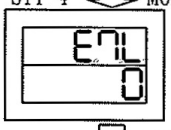
2. Event function 1 setting

S11-3 MODE key



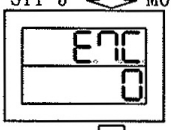
3. Event upper limit setting

S11-4 MODE key



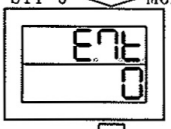
4. Event lower limit setting

S11-5 MODE key



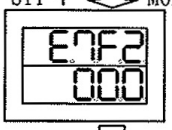
5. Event sensitivity setting

S11-6 MODE key



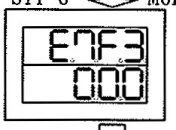
6. Event delay timer setting

S11-7 MODE key



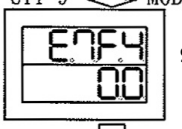
7. Event function 2 setting (PV abnormality)

S11-8 MODE key



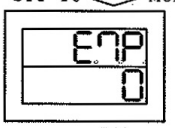
8. Event function 3 setting (CT abnormality)

S11-9 MODE key



9. Event function 4 setting (Loop abnormality)

S11-10 MODE key

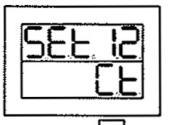


10. Event polarity setting

MODE key

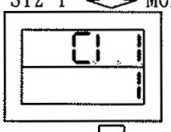
To SET 11, item 0

SET 12: CT setting mode



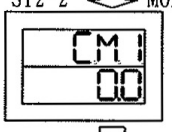
0. Setting item selection screen

S12-1 MODE key



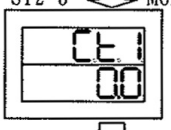
1. CT 1 target connection setting

S12-2 MODE key



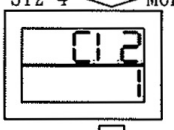
2. CT 1 current value monitor

S12-3 MODE key



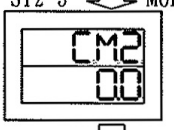
3. CT 1 abnormal current value setting

S12-4 MODE key



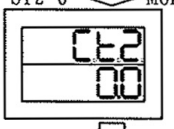
4. CT 2 target connection setting

S12-5 MODE key



5. CT 2 current value monitor

S12-6 MODE key

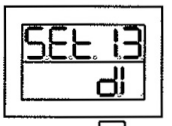


6. CT 2 abnormal current value setting

MODE key

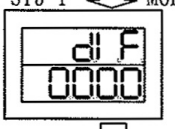
To SET 12, item 0

SET 13: DI setting mode



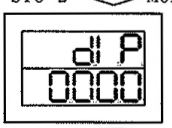
0. Setting item selection screen

S13-1 MODE key



1. Function setting

S13-2 MODE key

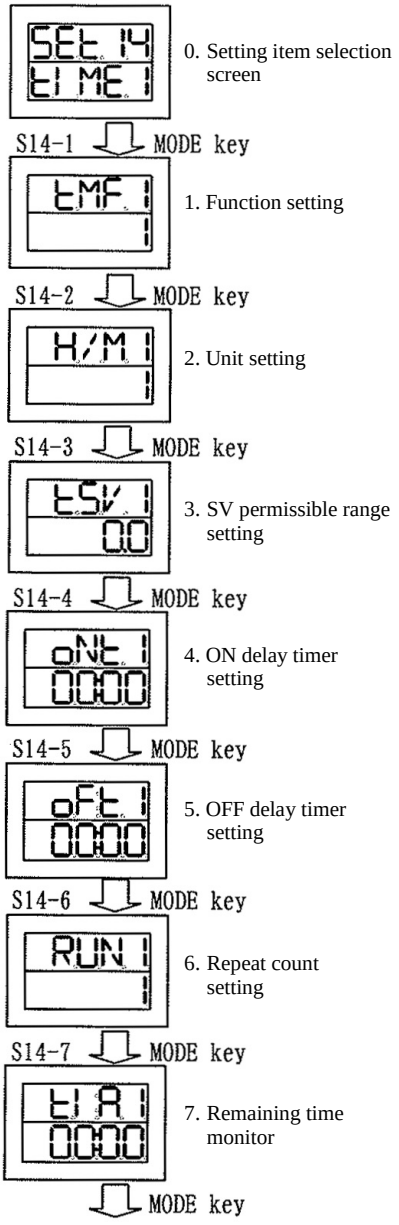


2. Polarity setting

MODE key

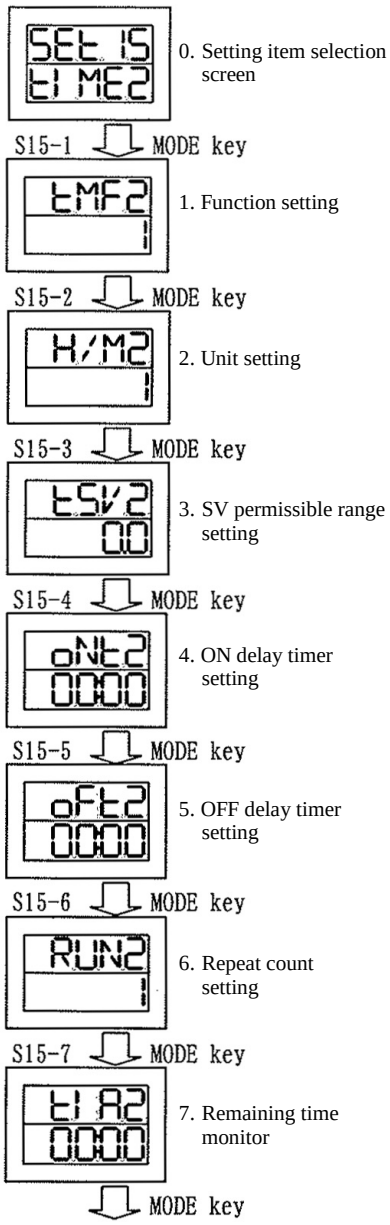
To SET 13, item 0

SET 14: Timer 1 setting mode



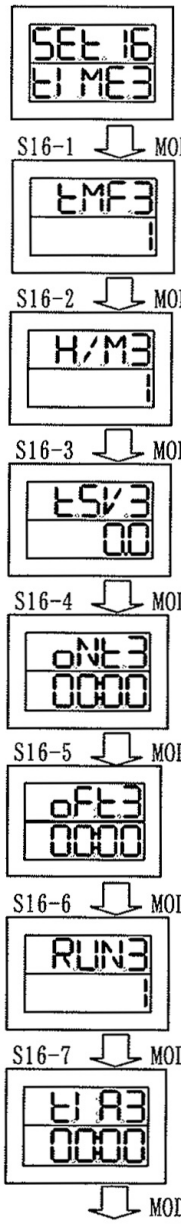
To SET 14, item 0

SET 15: Timer 2 setting mode



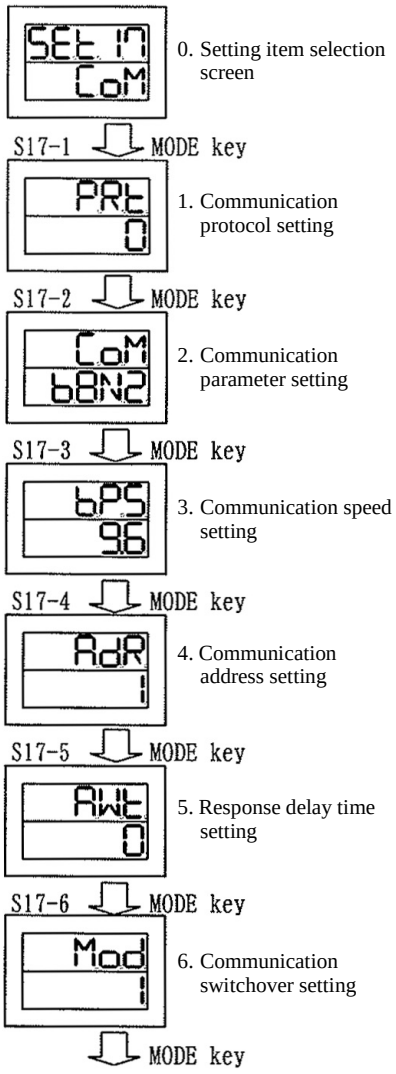
To SET 15, item 0

SET 16: Timer 3 setting mode



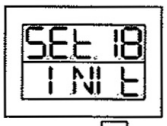
To SET 16, item 0

SET 17: Communication setting mode



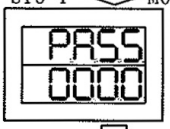
To SET 17, item 0

SET 18: Initial setting mode



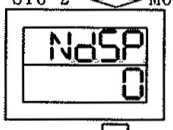
0. Setting item selection screen

S18-1 MODE key



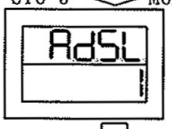
1. Password cancel

S18-2 MODE key



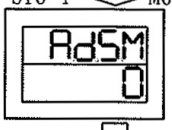
2. PV normal display color

S18-3 MODE key



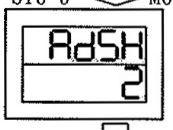
3. PV color auto-display low (0: green, 1: red, 2: orange)

S18-4 MODE key



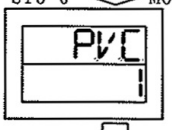
4. PV color auto-display middle (0: green, 1: red, 2: orange)

S18-5 MODE key



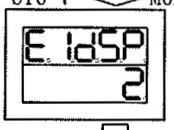
5. PV color auto-display high (0: green, 1: red, 2: orange)

S18-6 MODE key



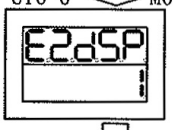
6. Switchover width for PV display color

S18-7 MODE key



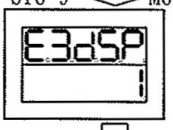
7. PV event at-output display color

S18-8 MODE key



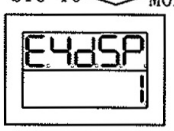
8. PV at-abnormality display color

S18-9 MODE key



9. CT at-abnormality display color

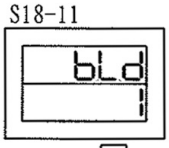
S18-10 MODE key



10. Loop at-abnormality display color

To S18-11

S18-11

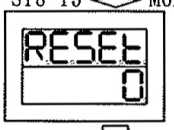


11. Blind temporary call setting

S18-12 MODE key

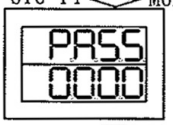
12. Setting value backup

S18-13 MODE key



13. Initialization of setting value

S18-14 MODE key

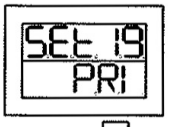


14. Password setting

MODE key

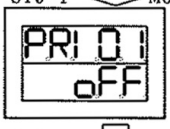
To SET 18, item 0

SET 19: Priority screen setting mode



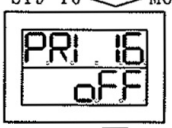
0. Setting item selection screen

S19-1 MODE key



1. Priority screen 1 setting

S19-16 MODE key



16. Priority screen 16 setting

MODE key

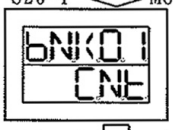
To SET 19, item 0

* Priority screens 1 - 16 displayed in sequence

SET 20: Bank setting mode

0. Setting item selection screen

S20-1 MODE key



1. Bank selection 1 setting

S20-16 MODE key

16. Bank selection 16 setting

MODE key

To SET 20, item 0

* Bank selections 1 - 16 displayed in sequence

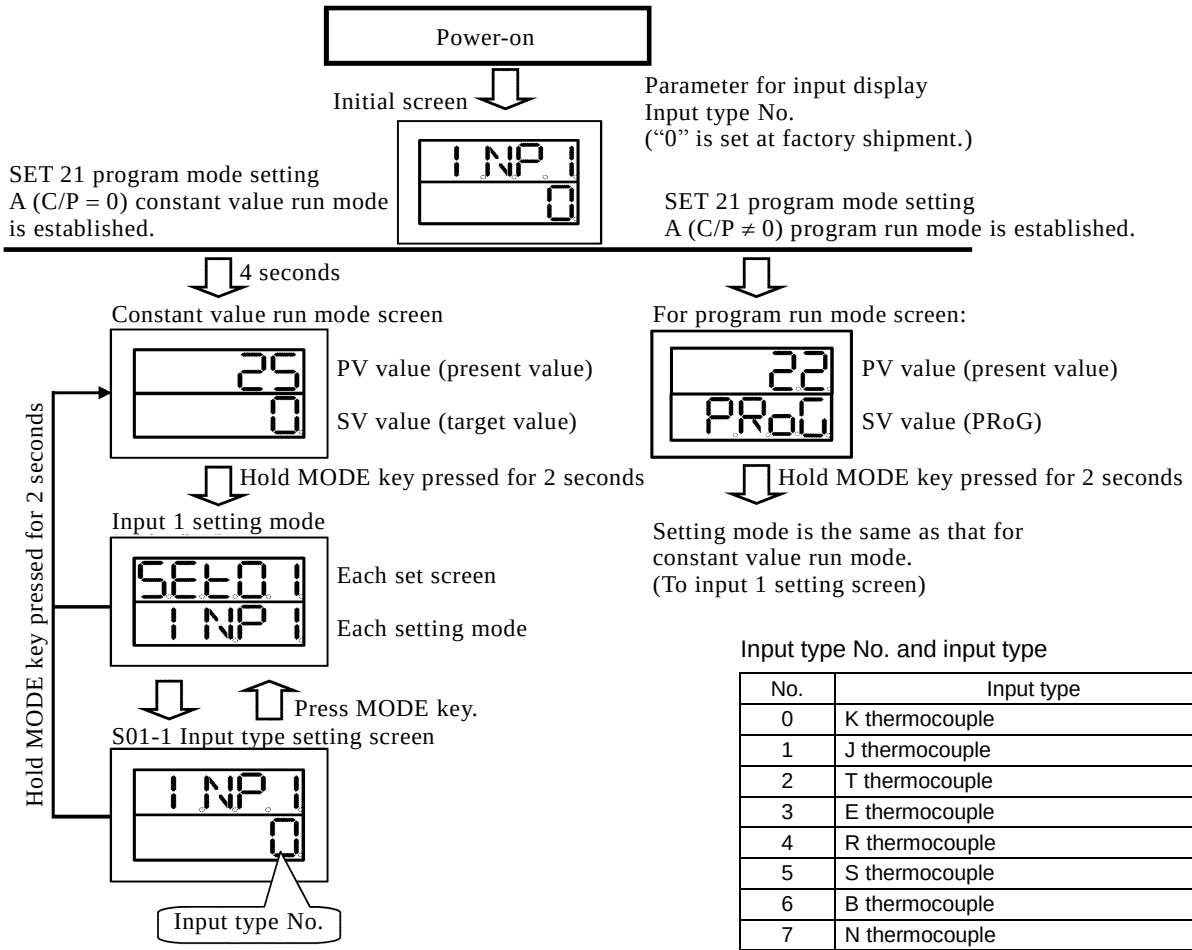
4.2.2 Description of setting item selection screen

Setting item selection screen	Description	
SET 01	Mode regarding input 1 setting	P6-2 to 7
SET 02	Mode regarding input 2 setting	P6-8 to 11
SET 03	Mode regarding key function setting	P6-12 and 13
SET 04	Mode regarding control content setting	P6-14 to 48
SET 05	Mode regarding output (OUT) 1 setting	P6-49 to 56
SET 06	Mode regarding output (OUT) 2 setting	
SET 07	Mode regarding output (OUT) 3 setting	
SET 08	Mode regarding output (OUT) 4 setting	
SET 09	Mode regarding output (OUT) 5 setting	
SET 10	Mode regarding output (OUT) 6 setting	
SET 11	Mode regarding output (OUT) 7 setting	
SET 12	Mode regarding CT setting	P6-57 and 58
SET 13	Mode regarding DI setting	P6-59 to 61
SET 14	Mode regarding timer 1 setting	P6-62 to 64
SET 15	Mode regarding timer 2 setting	
SET 16	Mode regarding timer 3 setting	
SET 17	Mode regarding communication setting	P6-65 and 66
SET 18	Mode regarding initial setting	P6-67 to 70
SET 19	Mode regarding priority screen setting	P6-71
SET 20	Mode regarding bank setting	P6-72
SET 21	Mode regarding program function setting	P6-73 to 76
SET 22	Mode regarding program setting	P6-77 to 79
SET 23	Mode regarding bank auto-switchover	P6-80 to 83

* For details of setting value content, see above-mentioned parameter settings (P6-2 to 83).
* For details of SET 21 to 23 setting modes, see P5-47 to 75.
* For setting screens for SET 21 to 23, see P5-52 (SET 21), P5-55 (SET 22) and P5-73 (SET 23).

4.2.3 Setting of input types

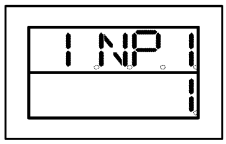
Settings for matching the input types being used is done.
* The factory default is set at “0: K thermocouple”.



Input type No. and input type

No.	Input type
0	K thermocouple
1	J thermocouple
2	T thermocouple
3	E thermocouple
4	R thermocouple
5	S thermocouple
6	B thermocouple
7	N thermocouple
8	U thermocouple
9	L thermocouple
10	WRe5-26 thermocouple
11	PR40-20 thermocouple
12	PLII thermocouple
13	Pt100
14	JPt100
15	0 - 10 mVDC
16	0 - 1 VDC
17	0 - 5 VDC
18	1 - 5 VDC
19	0 - 10 VDC
20	4 - 20 mADC

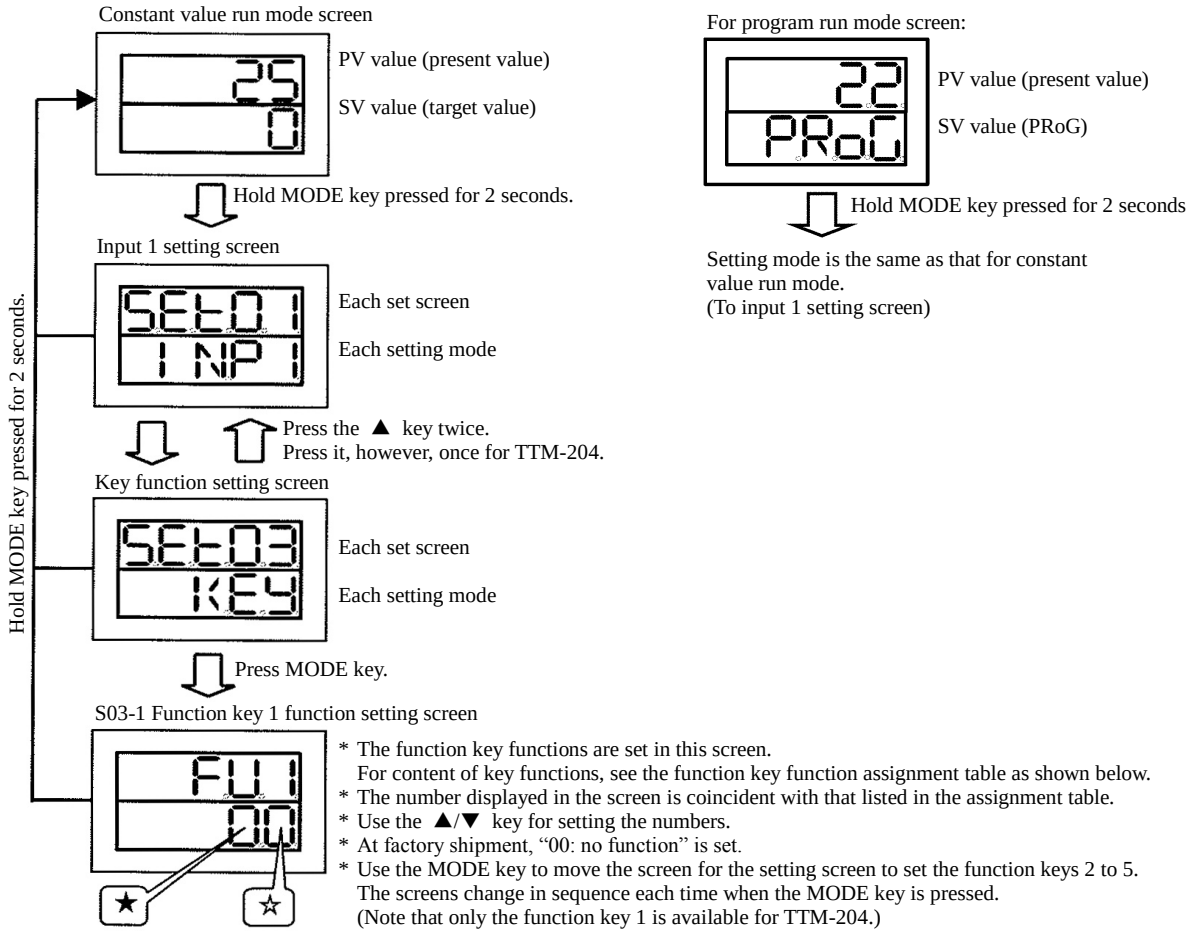
* Input types are set in this screen.
  Numbers for input types are identical to those located in upper right of the input type number table.
  In addition, what each number means is coincident with what is described in the input type number table.
* Use the ▲/▼ key for setting the numbers.
  The following is displayed when “0: K thermocouple,” which is set at factory shipment, is changed to “1: J thermocouple.”



* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.

4.2.4 Setting of key functions

How to set key functions is described.



* The function key functions are set in this screen.
For content of key functions, see the function key function assignment table as shown below.
* The number displayed in the screen is coincident with that listed in the assignment table.
* Use the ▲/▼ key for setting the numbers.
* At factory shipment, "00: no function" is set.
* Use the MODE key to move the screen for the setting screen to set the function keys 2 to 5.
The screens change in sequence each time when the MODE key is pressed.
(Note that only the function key 1 is available for TTM-204.)

Function key function assignment table

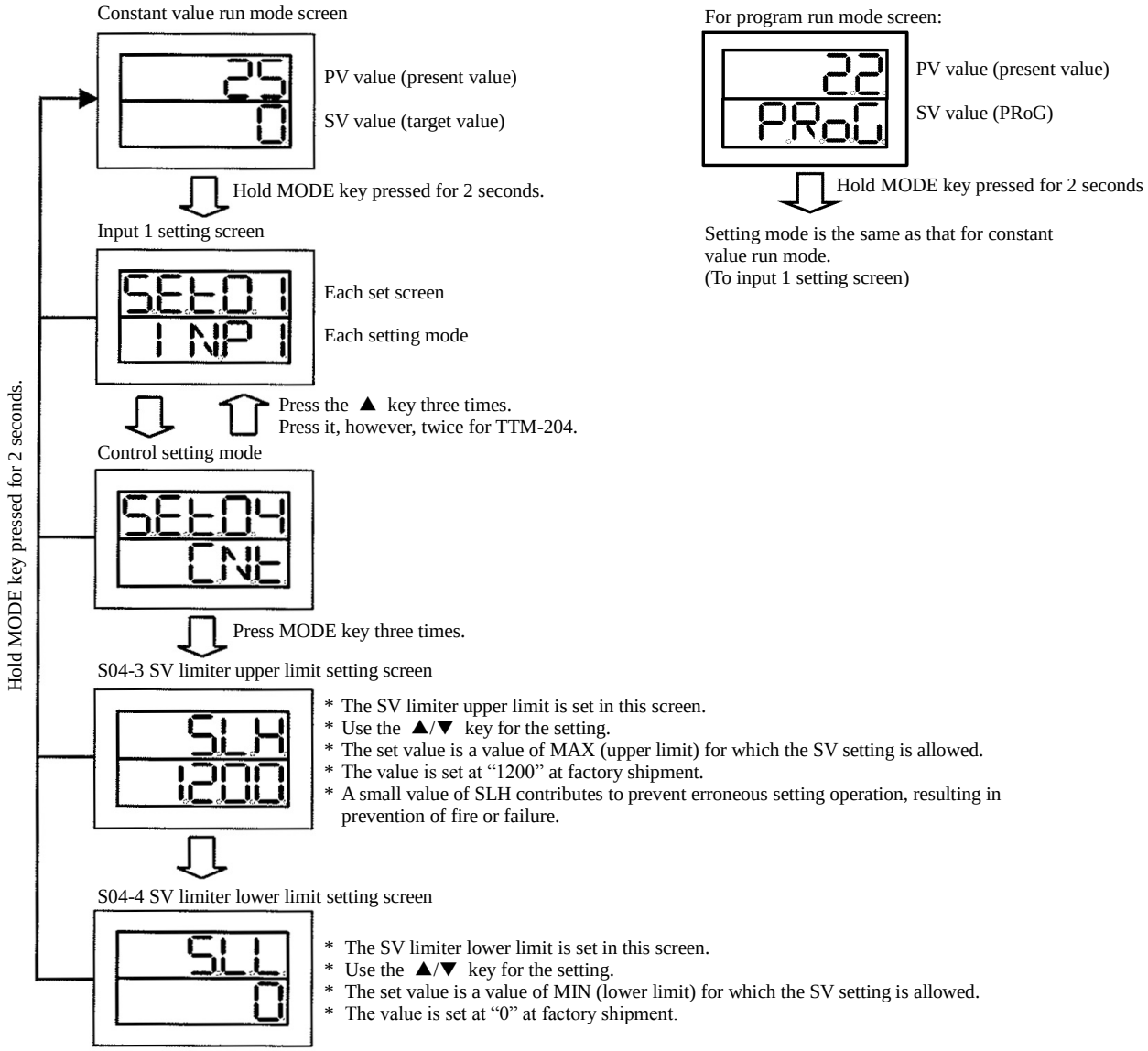
No. ★☆	Pressing time setting	No. ★☆	Function setting
0*	N/A	*0	No function
1*	Pressing time of 1 second	*1	Digit shift
2*	Pressing time of 2 seconds	*2	Control mode/control stop
3*	Pressing time of 3 seconds	*3	AT start/AT stop
4*	Pressing time of 4 seconds	*4	Timer start/reset
5*	Pressing time of 5 seconds	*5	Screen reverse feed
		*6	ENT
		*7	Bank switchover
		*8	AUTO/MANUAL switchover
		*9	SV/MV screen switchover
		*A	Constant value run/program run switchover
		*B	Step feed
		*C	Pause
		*D	SET 22 call-up function

Example 1: 23 → Two-second prolonged pressing makes the key effective, enabling the PID auto-tuning start/stop key setting.
Example 2: 44 → Four-second prolonged pressing makes the key effective, enabling the timer function start/reset key setting.

* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.
* The function key functions A to D are active only during a program run. They are also settable during a constant value run.

4.2.5 How to set the SV limiter setting

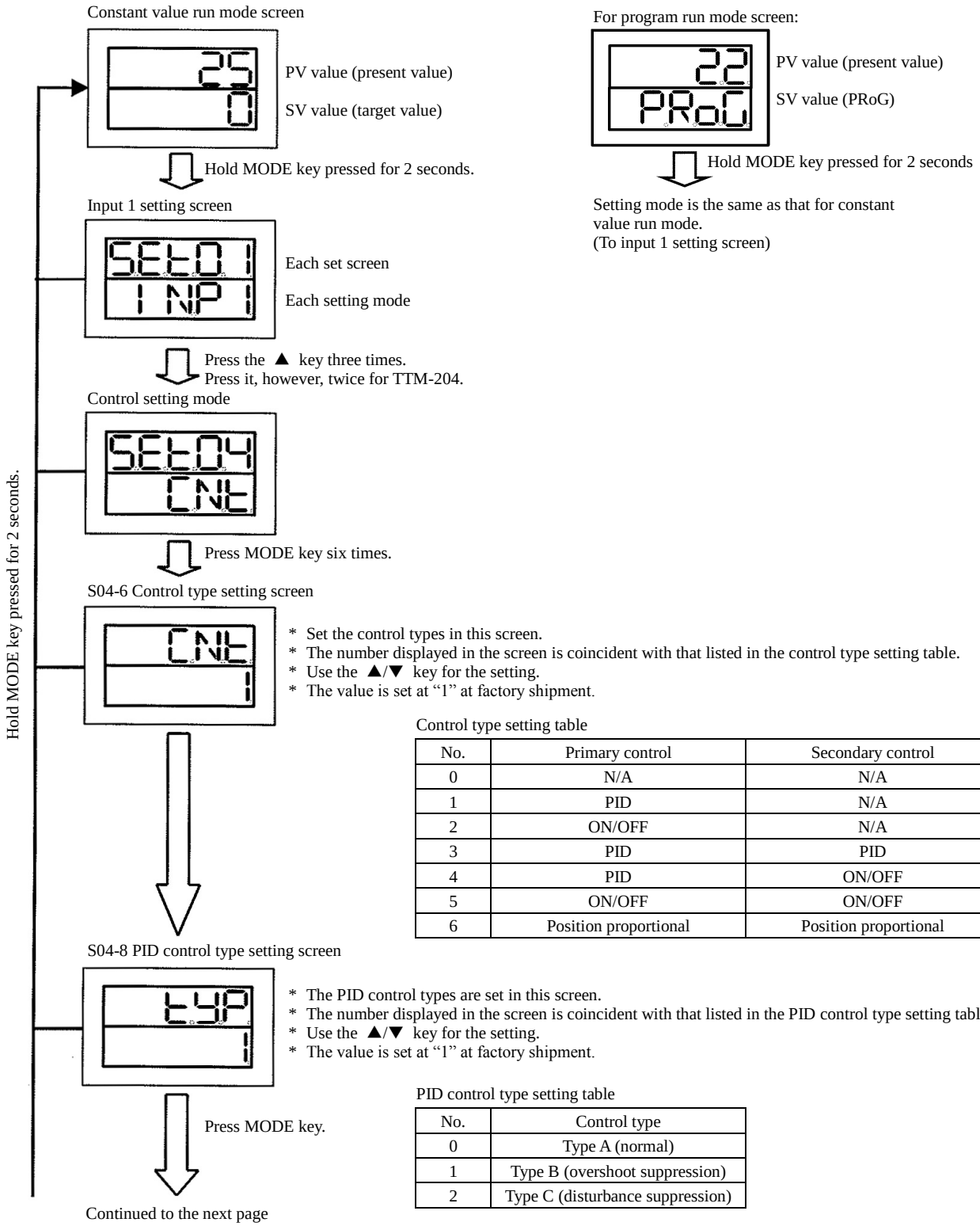
The SV limiter is for setting a settable range with upper and lower limits.
The range is a basis for setting the proportional band for the PID control.



* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.

4.2.6 How to set control types

How to set control types is described.



Control type setting table

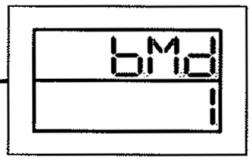
No.	Primary control	Secondary control
0	N/A	N/A
1	PID	N/A
2	ON/OFF	N/A
3	PID	PID
4	PID	ON/OFF
5	ON/OFF	ON/OFF
6	Position proportional	Position proportional

PID control type setting table

No.	Control type
0	Type A (normal)
1	Type B (overshoot suppression)
2	Type C (disturbance suppression)

Continued from the previous page

S04-9 Type B mode setting screen



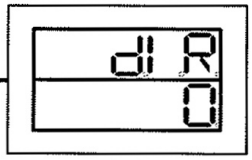
* The type of the PID Type B mode is set in this screen.
* The number displayed in the screen coincident with that listed in the Type B mode setting table.
* Use the ▲/▼ key for the setting.
* The value is set at "1" at factory shipment.

Press MODE key.

Type B mode setting table

No.	Overshoot
0	Overshoot suppression - Moderate
1	Overshoot suppression - Intermediate
2	Overshoot suppression - Intense

S04-10 Forward/reverse operation setting screen



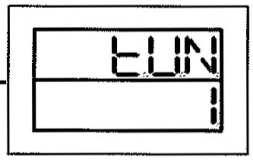
* Forward/reverse operation is set in this screen.
* The number displayed in the screen coincident with that listed in the forward/reverse operation setting table.
* Use the ▲/▼ key for the setting.
* The value is set at "0" at factory shipment.

Press MODE key three times.

Forward/reverse operation setting table

No.	Operation type
0	Forward operation
1	Reverse operation

S04-11 Tuning type setting screen



* The tuning types are set in this screen.
* The number displayed in the screen coincident with that listed in the tuning type setting table.
* Use the ▲/▼ key for the setting.
* The value is set at "1" at factory shipment.
* If the function is not specified for the equipment, corresponding screen is not displayed.

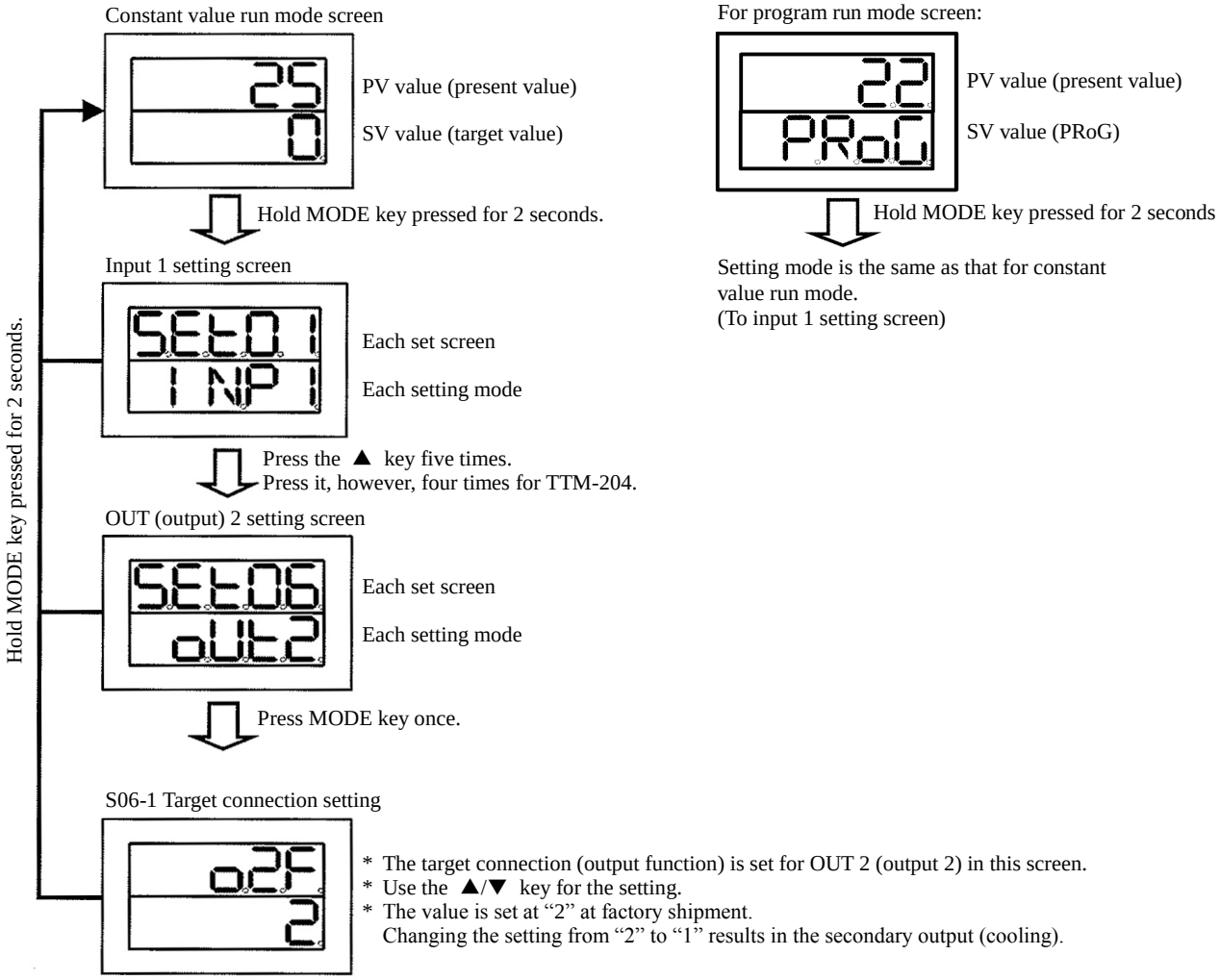
Tuning type setting table

No.	Type
1	Primary auto-tuning
2	Primary self-tuning
3	Secondary auto-tuning
4	Secondary self-tuning
5	Primary/secondary auto-tuning

* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.

4.2.7 How to set outputs

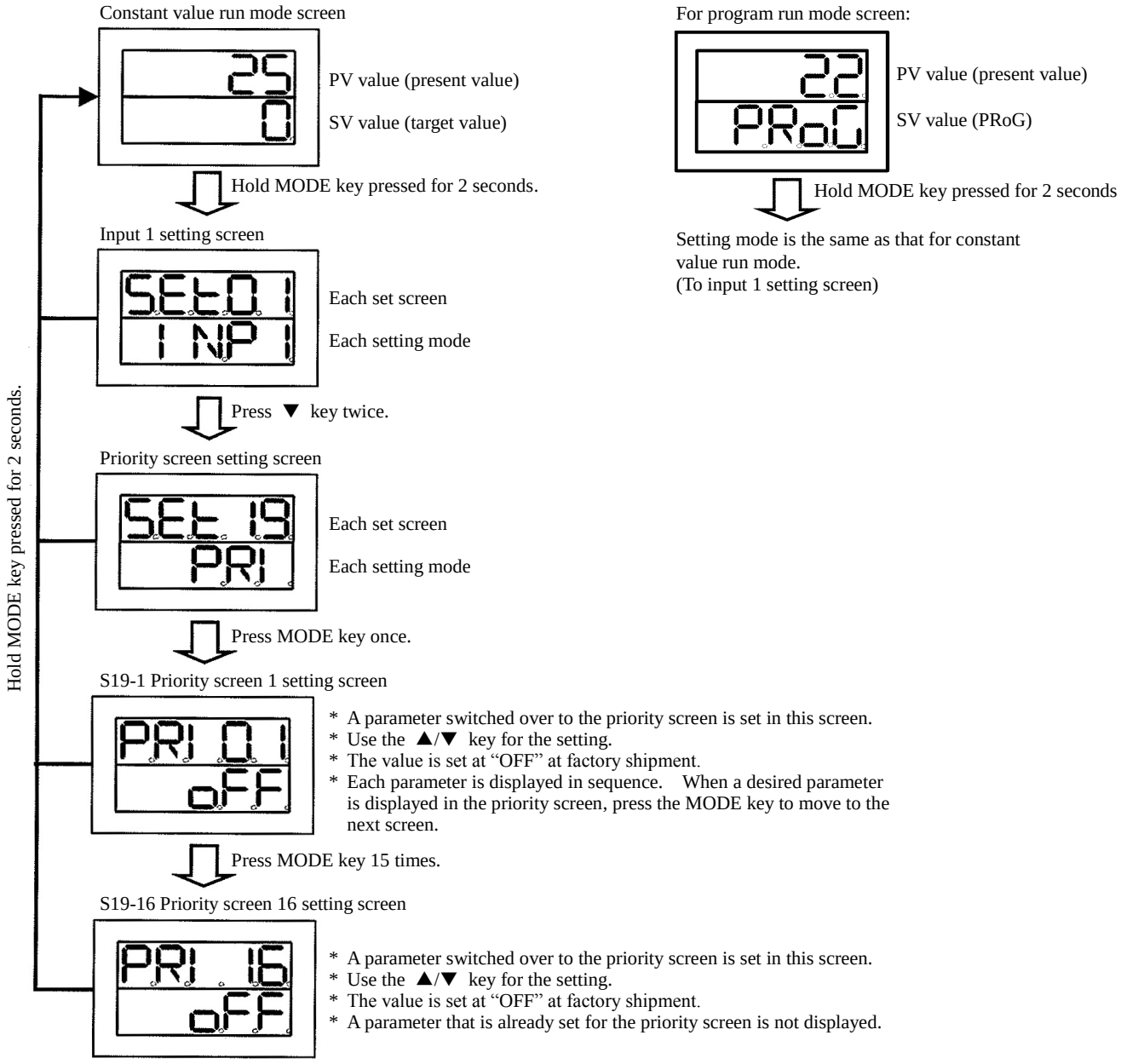
The description in this section is on how to set the OUT (output) 2 from the event output, which is set at factory shipment, to the secondary output.



* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.

4.2.8 How to set priority screens

How to set priority screens is described.

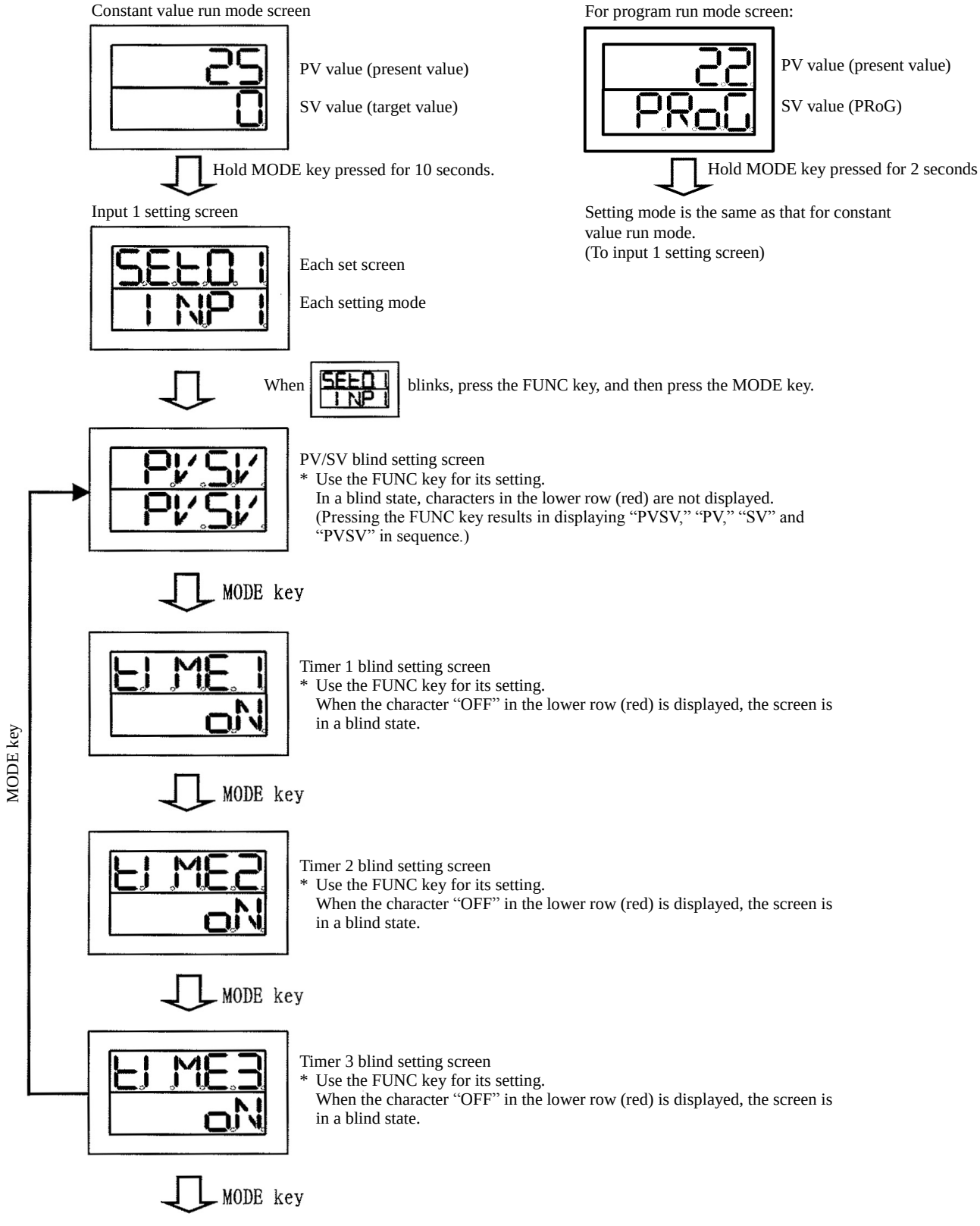


* Parameters are displayed in the operating mode screen in the sequence that they are set.

* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.

4.2.9 Switchover to the blind setting mode

How to set the blind function is described.



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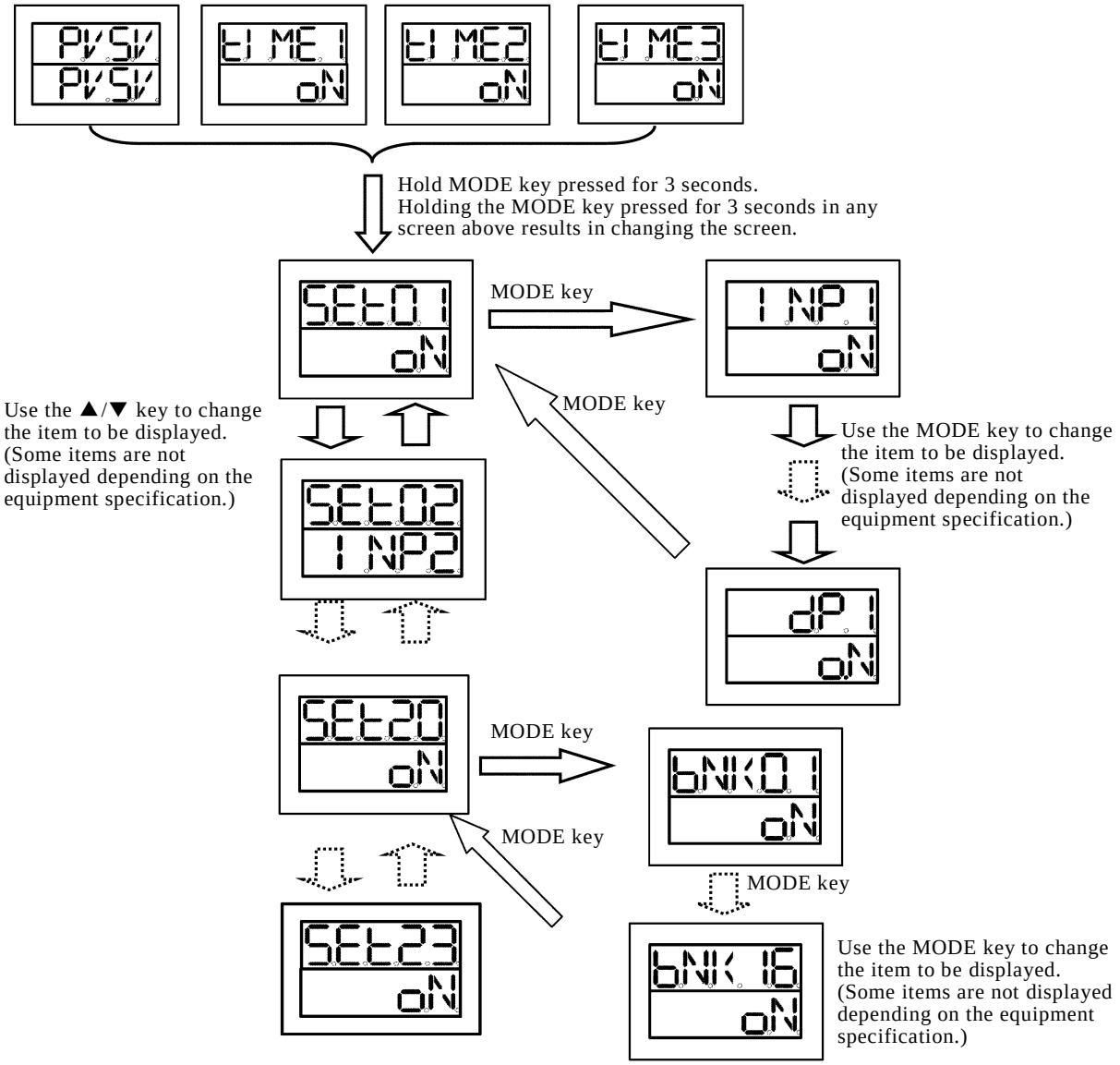
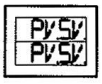


* Each SET item is also set for blind setting after moving the screen to the parameter screen, using the MODE key.

* Always use the FUNC key to set screens for the blind settings.
When the character "OFF" in the lower row (red) is displayed, the screen is in a blind state.

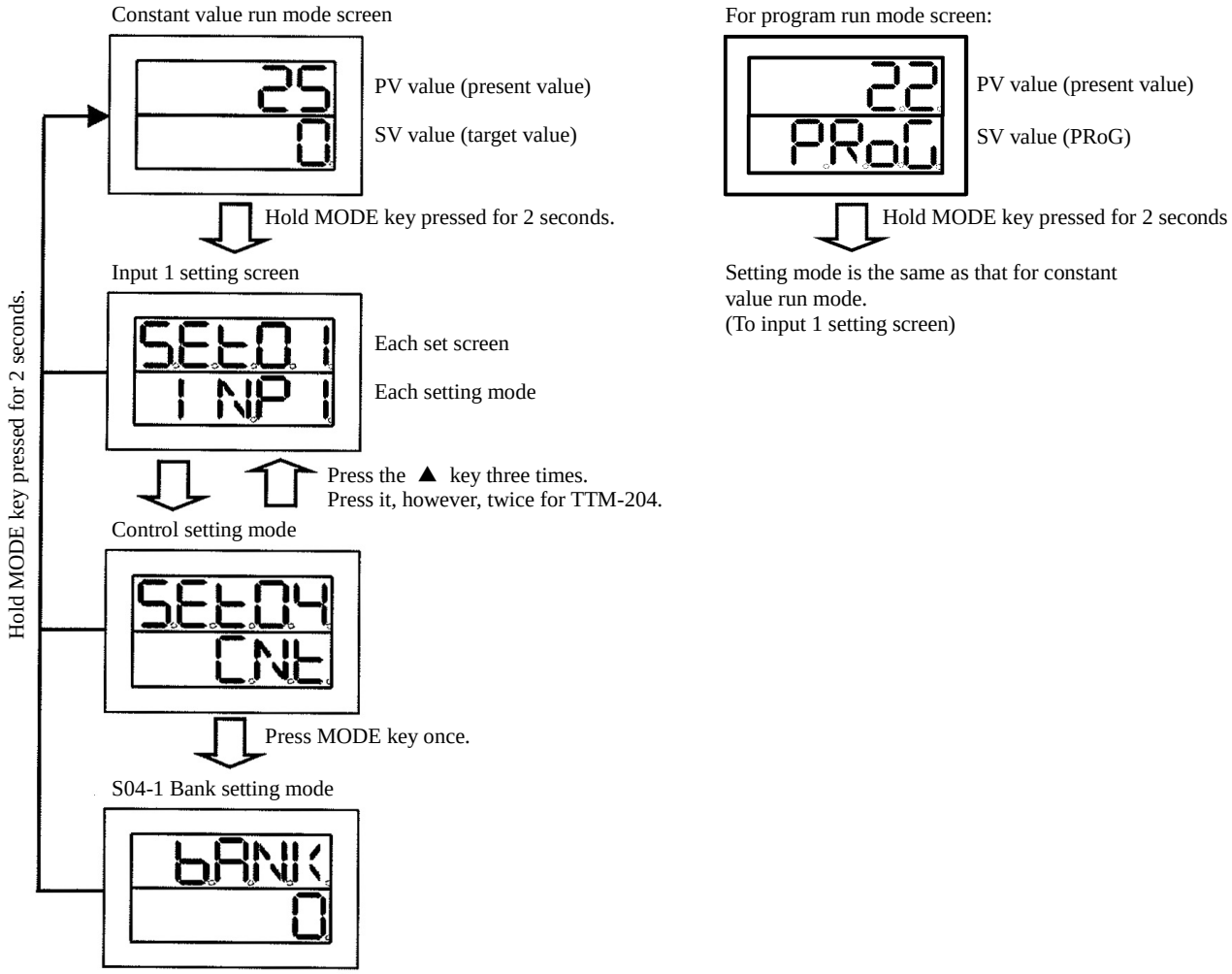
* Holding the MODE key pressed for 3 seconds in each screen results in returning to  .

* How to terminate the blind setting mode
1) After turning the power off, turn it back on. After the initial screen is displayed, the operating mode screen is displayed again.
2) Holding the MODE key pressed for 3 seconds in each SET screen moves the screen to the PV/SV blind setting screen.
Then, holding the MODE key pressed for about 10 seconds results in displaying the operating mode screen again.

* In the diagram above, only SET1 and SET20 are shown; other SET** are skipped.
The blind status of each parameter can also be settable for other SET**.

4.2.10 Switchover to the ON/OFF control

The ON/OFF control is set in BANK 1 for the initial setting at factory shipment.
How to set the ON/OFF control is described.



* Setting change to the ON/OFF control is conducted in the bank setting screen.
Changing "0" to "1" using the ▲ key results in the setting of the ON/OFF control.
Then, holding the MODE key pressed for 2 seconds, the screen moves back to the operating mode screen.
(In about 2 minutes, the screen automatically moves back to the operating mode screen.)
* The sensitivity range for the ON/OFF control is set at 1 °C at factory shipment.
* Setting the ON/OFF control results in displaying no items related to the PID control.

5. Operating the equipment

How to operate the equipment is described in this chapter.

5.1 Precautions on operating the equipment

Before beginning operation or turning on the power, check the following.

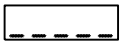
★ Operation for turning on the power

The equipment is not equipped with a power switch. Connecting a power will turn the power of the unit ON. The initial screen is displayed for about 4 seconds, and then the equipment operates.
The control mode for the control setting mode is set for RUN (control start) in factory default. After wiring is complete and the setting value (SV) is set, the control starts.
At factory default, the control method is set for the PID control.

* Proportional band: 3.0 %
Integration: 0 second
Derivation: 0 second
Proportional cycle: Relay contact output 20 seconds
SSR drive output 1 second

★ Behavior during input abnormality

Open or short (only for a resistance temperature detector) of input signals is determined as an input abnormality (such as burnout) by the equipment.

Input type	Display on the equipment	Operation of control output	Operation of event output
Thermocouple	 Overscale	Operating amount limiter lower limit	Analogous to the setting for at-input abnormality. (See pages 6-52)
Resistance temperature detector			
0 - 10 mVDC			
0 - 1 VDC	 Underscale		
0 - 5 VDC			
1 - 5 VDC			
0 - 10 VDC			
4 - 20 mADC			

* Burnout function: A function to forcibly move outputs of a controller toward upper limit or lower limit (safety side) in case the wires are disconnected on a thermocouple or resistance temperature detector.

★ Checking each parameter

Set each parameter such as setting value (SV) or PID to a value that is appropriate for the subject of control.
For details of setting each parameter, see the item 6 “Parameter setting.”
For details of switchover setting of RUN (control start) and READY (control stop), see pages 5-20 and 21.

★ Operation at power-outage (momentary outage)

There is no effect on operation in case of outage in 1 cycle or less.

1 cycle	50 Hz	20 ms
	60 Hz	16.7 ms

For DC power with the outage for 40 ms or shorter, there is no effect on operation.
In case of the outage for longer than 40 ms, the equipment is reset.

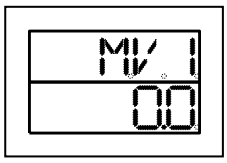
5.2 Operating monitor display

5.2.1 Operating amount monitor: SET 04 (control setting mode)

★ Output percentage at control is displayed.

1) Primary control operating amount monitor screen

S04-10 Primary control operating amount

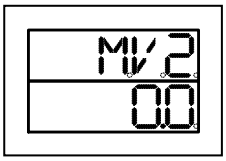


* Smaller number indicates smaller operating (output) amount; larger number indicates larger operating (output) amount.
* The control (output) amount is provided as output within the operating amount setting limiter setting range.

For setting the operating amount setting, see page 6-17.

2) Secondary control operating amount display screen

S04-33 Secondary control operating amount



* Smaller number indicates smaller operating (output) amount; larger number indicates larger operating (output) amount.
* The control (output) amount is provided as output within the operating amount setting limiter setting range.

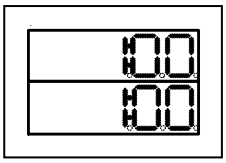
For setting the operating amount setting, see page 6-34.

5.2.2 Timer remaining time monitor: Run mode

★ Remaining time is displayed when the timer is operating.

Timer 1 remaining time monitor screen

Operating mode items 2, 3 and 4

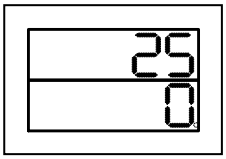


* Upper row: ON delay
  Lower row: OFF delay
* While operating, [:] blinks.
* ▲/▼ key to change remaining time
* Analogous to the remaining time monitor screens for timers 2 and 3

5.2.3 Temperature measurement monitor: Run mode

★ The present value being measured by the sensor is displayed.

Present measurement value monitor screen



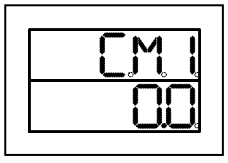
* Upper row: Measurement value
* Lower row: Target value

5.2.4 CT monitor: SET 12 (CT setting mode)

★ The present value being measured by CT (current transformer) is displayed.

1) CT 1 measurement value monitor screen

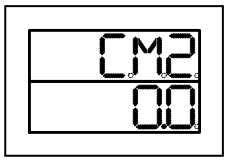
S12-2 CT 1 current value monitor



* The present value being measured by the current transformer (CT) is displayed.
* Measurement value: 0.0 - 50.0 A

2) CT 2 measurement value monitor screen

S12-5 CT 2 current value monitor



* The present value being measured by the current transformer (CT) is displayed.
* Measurement value: 0.0 - 50.0 A

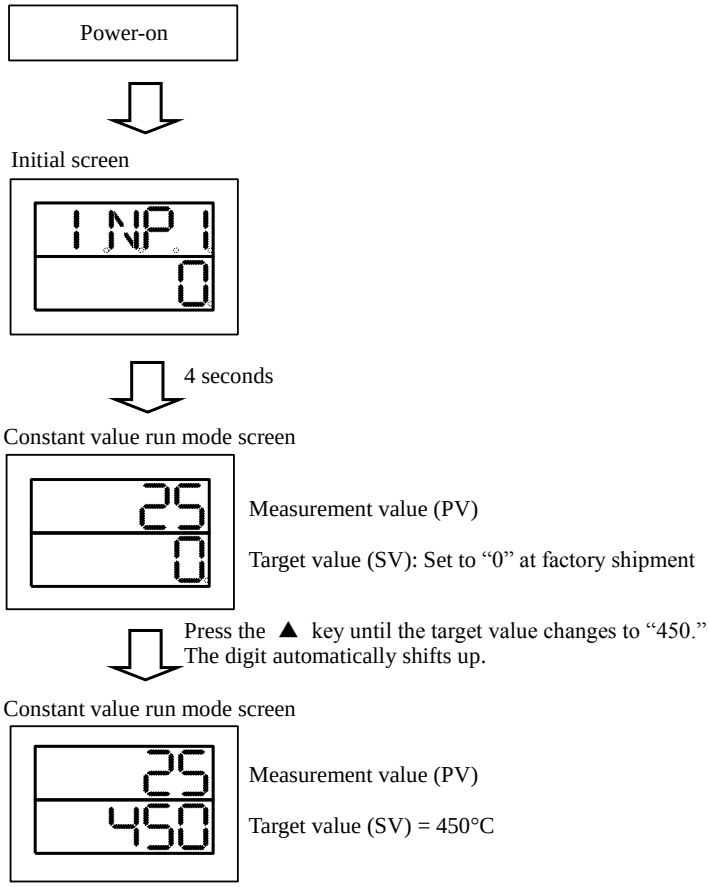
5.3 How to set run settings

The target value (SV) setting, control setting and event setting are described as examples for constant value run settings.

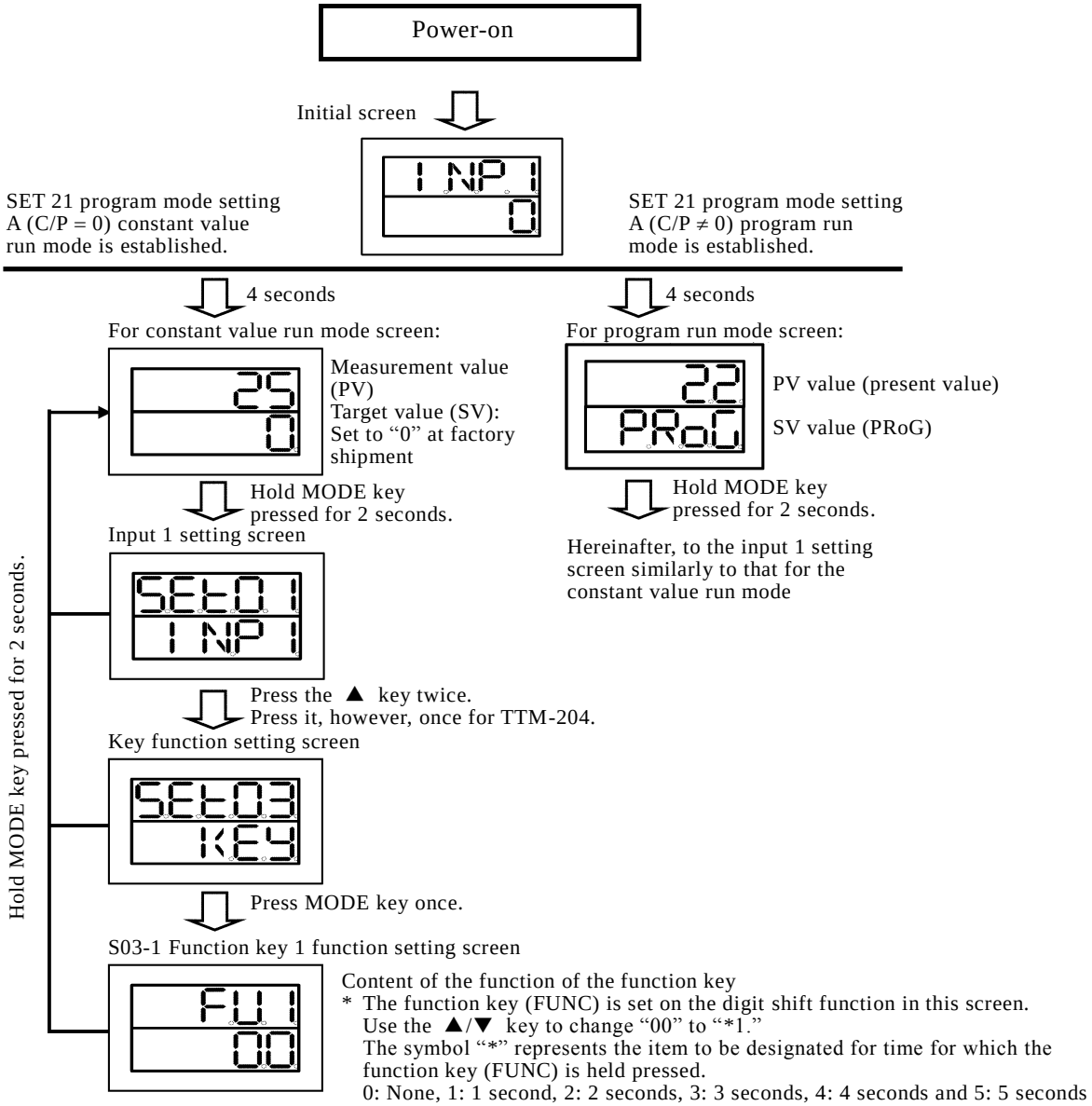
5.3.1 Target value (SV) setting

When the target value (SV) to be set at 450 °C

① Where setting it as is



② When setting the digit shift function by assigning it on the FUNC key

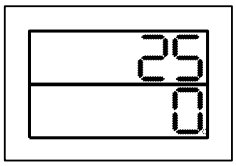


* Holding the MODE key pressed for 2 seconds moves each setting screen to the operating mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the operating mode screen.

Continued to the next page

Continued from the previous page

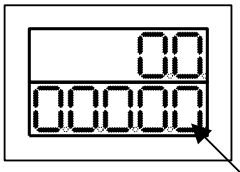
Operating mode screen



Measurement value (PV)

Target value (SV): Set to “0” at factory shipment

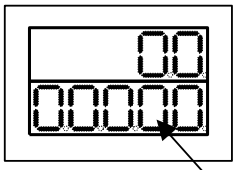
Target value setting screen



* Pressing the FUNC key blinks on and off the numerical character located rightmost.
  Pressing the MODE key changes the blinking character to lighting, which indicates determination of the setting.
  In addition, the blinking automatically changes to lighting in about 3 seconds to determine the setting.

Blinking

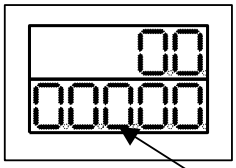
Target value setting screen



* Pressing once the FUNC key blinks on and off the second digit from right.
  In this state, change “0” to “5” using the ▲ key.
  Pressing the MODE key changes the blinking character to lighting, which indicates determination of the setting.
  In addition, the blinking automatically changes to lighting in about 3 seconds to determine the setting.

Blinking

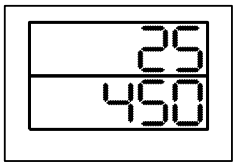
Target value setting screen



* Pressing once the FUNC key blinks on and off the third digit from right.
  In this state, change “0” to “4” using the ▲ key.
  Pressing the MODE key changes the blinking character to lighting, which indicates determination of the setting.
  In addition, the blinking automatically changes to lighting in about 3 seconds to determine the setting.

Blinking

Run mode screen



Measurement value (PV)

Target value (SV) = 450°C

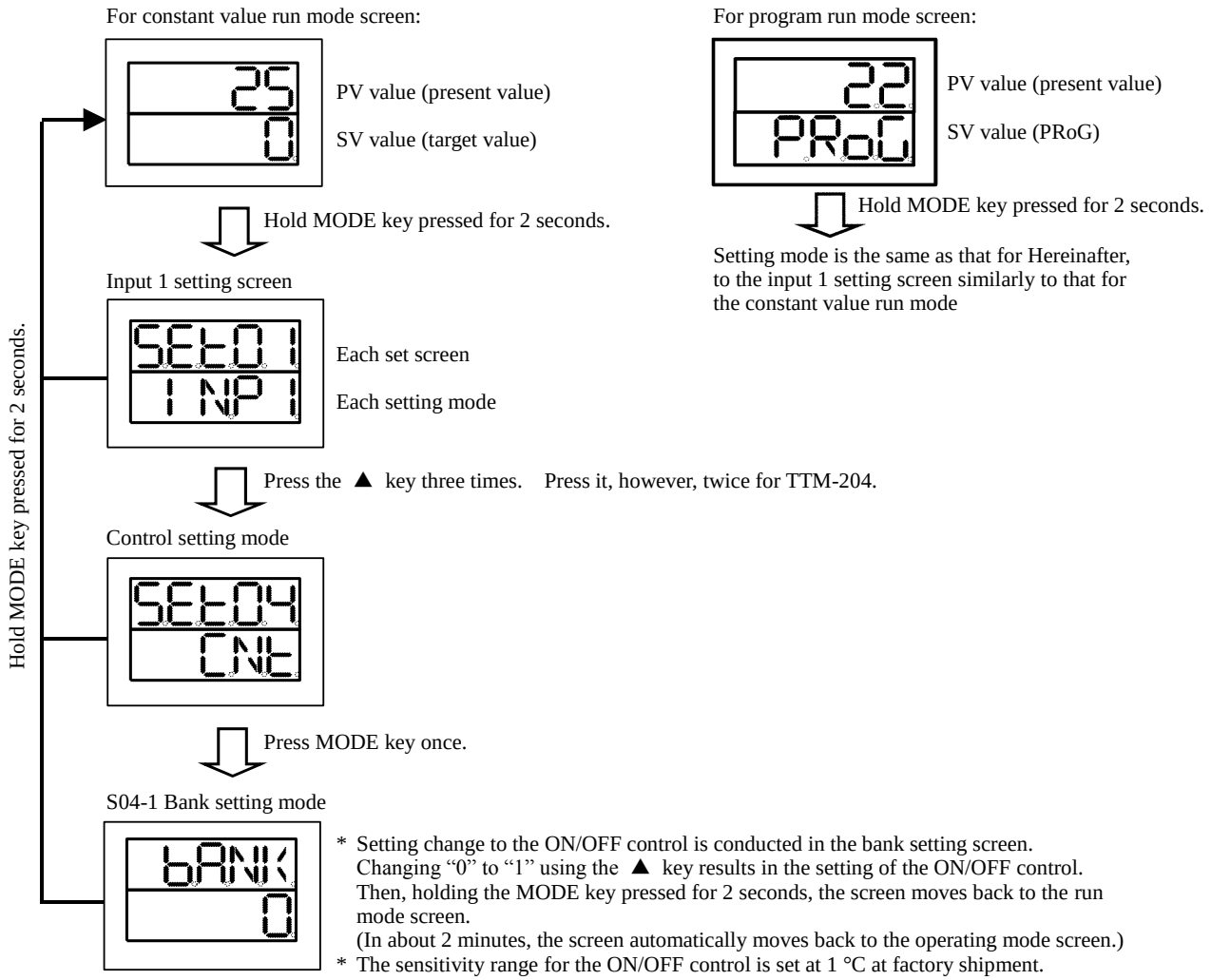
5.3.2 ON/OFF control setting

When a measurement value (PV) being controlled reaches the target value (SV), the control output is turned off. Then, the control output is turned on when the measurement value (PV) goes beyond the peak value, approaches the target value (SV), and goes beyond it. This move is repeated at a particular position.
The adjustment sensitivity (sensitivity range), in this case, is defined as the difference between the point where the control output turns off (measurement value) and point where the control output turns on.

★ Setting the ON/OFF control
The PID control is set as factory default.

As the ON/OFF control is preset at "1" of the bank function, the ON/OFF control can be set by changing the setting in the bank setting screen of the control setting mode.

1) How to change the setting in the bank



* Setting change to the ON/OFF control is conducted in the bank setting screen. Changing "0" to "1" using the ▲ key results in the setting of the ON/OFF control. Then, holding the MODE key pressed for 2 seconds, the screen moves back to the run mode screen.
(In about 2 minutes, the screen automatically moves back to the operating mode screen.)
* The sensitivity range for the ON/OFF control is set at 1 ℃ at factory shipment.
* Setting the ON/OFF control results in displaying no items related to the PID control.

Continued to the next page

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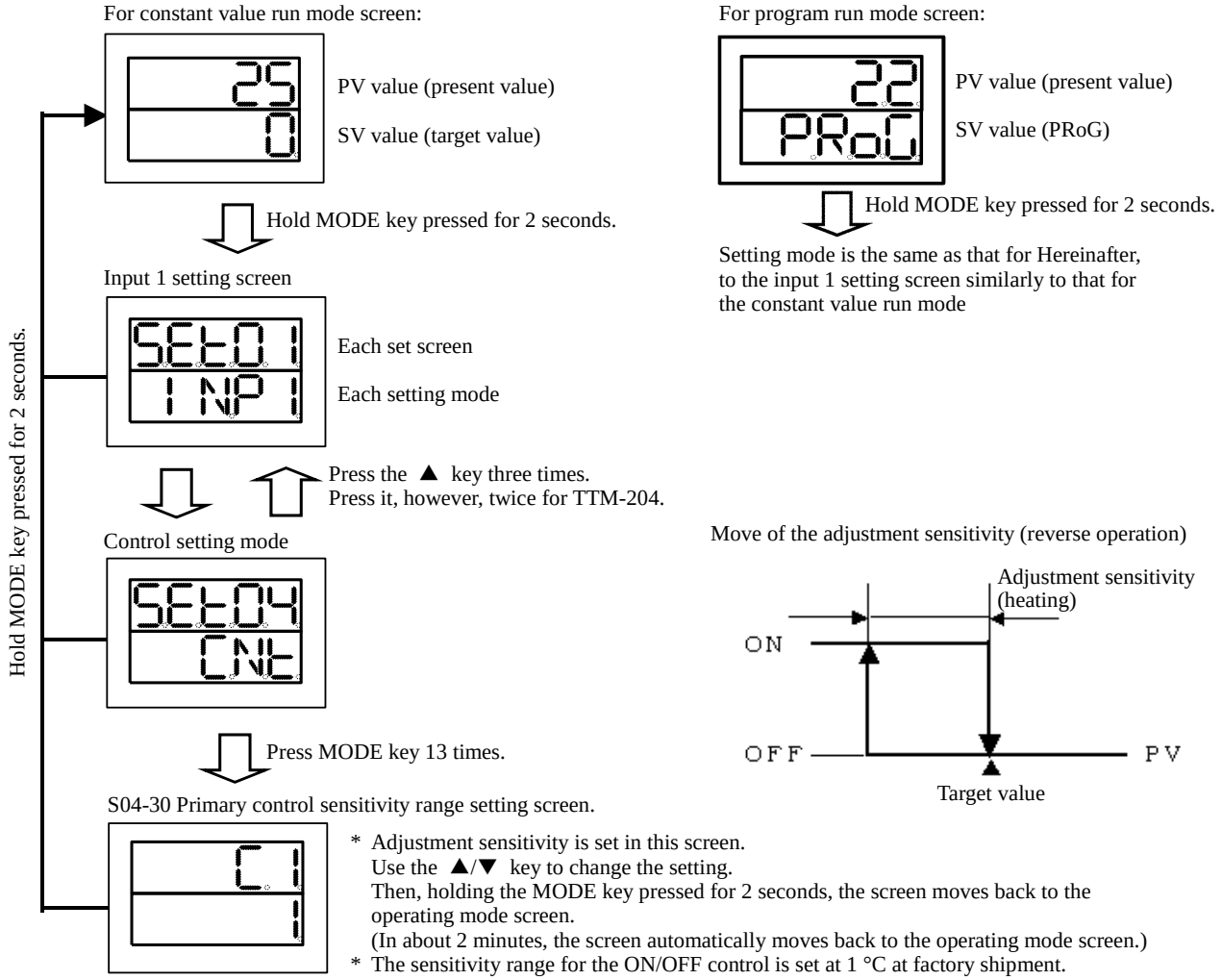
2) How to set the adjustment sensitivity
In order to stabilize the equipment operation, a particular range is provided for switching on and off in the ON/OFF control. This range is called "adjustment sensitivity (hysteresis or sensitivity range)." What is described below is how to set the adjustment sensitivity after the control method is changed to the ON/OFF control in the bank setting. (Adjustment sensitivity of 1 °C is set at factory shipment.)



* Adjustment sensitivity is set in this screen.
Use the ▲/▼ key to change the setting.
Then, holding the MODE key pressed for 2 seconds, the screen moves back to the operating mode screen.
(In about 2 minutes, the screen automatically moves back to the operating mode screen.)
* The sensitivity range for the ON/OFF control is set at 1 °C at factory shipment.
* Setting the ON/OFF control results in displaying no items related to the PID control.

* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

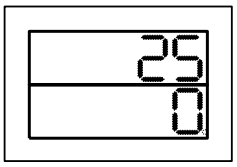
5.3.3 PID control setting

★ Setting the PID control
The "PID Control" is set as factory default, and the values for P = proportional band, I = integration, D = derivation and proportional cycle are provisional values.
Those values are as follows: P1 = 3.0, I = 0, D = 0, proportional cycle = 1 second (SSR type) or 20 seconds (relay type).

1) How to start auto-tuning (AT)
   * Execution of auto-tuning results in automatic setting of the most appropriate PID constant to the target value.
   * Auto-tuning cannot be executed in the RDY state or ON/OFF control.
   * Results of the auto-tuning are reflected to values of P, I and D.
   * For details of auto-tuning, see pages 5-22 to 24.

   ① In the auto-tuning start screen

For constant value run mode screen:

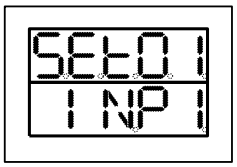


PV value (present value)

SV value (target value)

Hold MODE key pressed for 2 seconds.

Input 1 setting screen

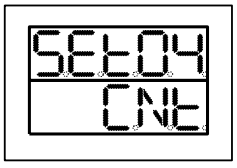


Each set screen

Each setting mode

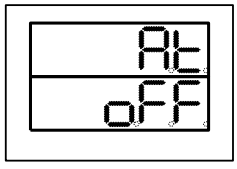
Press the ▲ key three times. Press it, however, twice for TTM-204.

Control setting mode



Press MODE key 15 times.

S04-15 AT start screen



* Auto-tuning is started in this screen.
  Use the ▲/▼ key for start and stop settings.
* During auto-tuning, the target value and "At" is alternately displayed for SV (red).
  Upon completion of auto-tuning, the target value is displayed.
  (The screen returns to the operating mode screen.)
* No operation is possible during auto-tuning, except operation of the ▲/▼ key.
* "OFF" is set at factory shipment.

For program run mode screen:

PV value (present value)

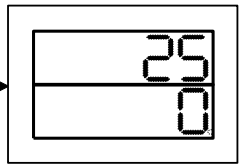
SV value (PRoG)

Hold MODE key pressed for 2 seconds.

Setting mode is the same as that for Hereinafter, to the input 1 setting screen similarly to that for the constant value run mode

② Start using the function key
Set the function key function to the AT start/stop function as the first step.

For constant value run mode screen:

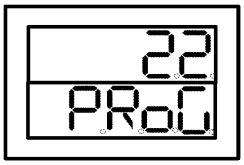


PV value (present value)

SV value (target value)

Hold MODE key pressed for 2 seconds.

For program run mode screen:



PV value (present value)

SV value (PRoG)

Hold MODE key pressed for 2 seconds.

Setting mode is the same as that for Hereinafter, to the input 1 setting screen similarly to that for the constant value run mode

Input 1 setting screen

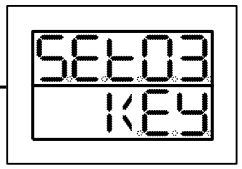
Each set screen

Each setting mode

Hold MODE key pressed for 2 seconds.

Press the ▲ key twice. Press it, however, once for TTM-204.

Key function setting screen

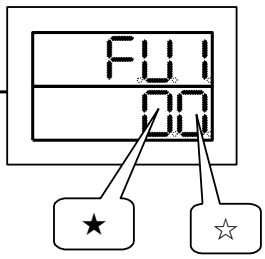


Each set screen

Each setting mode

Press MODE key.

S03-1 Function key 1 function setting screen

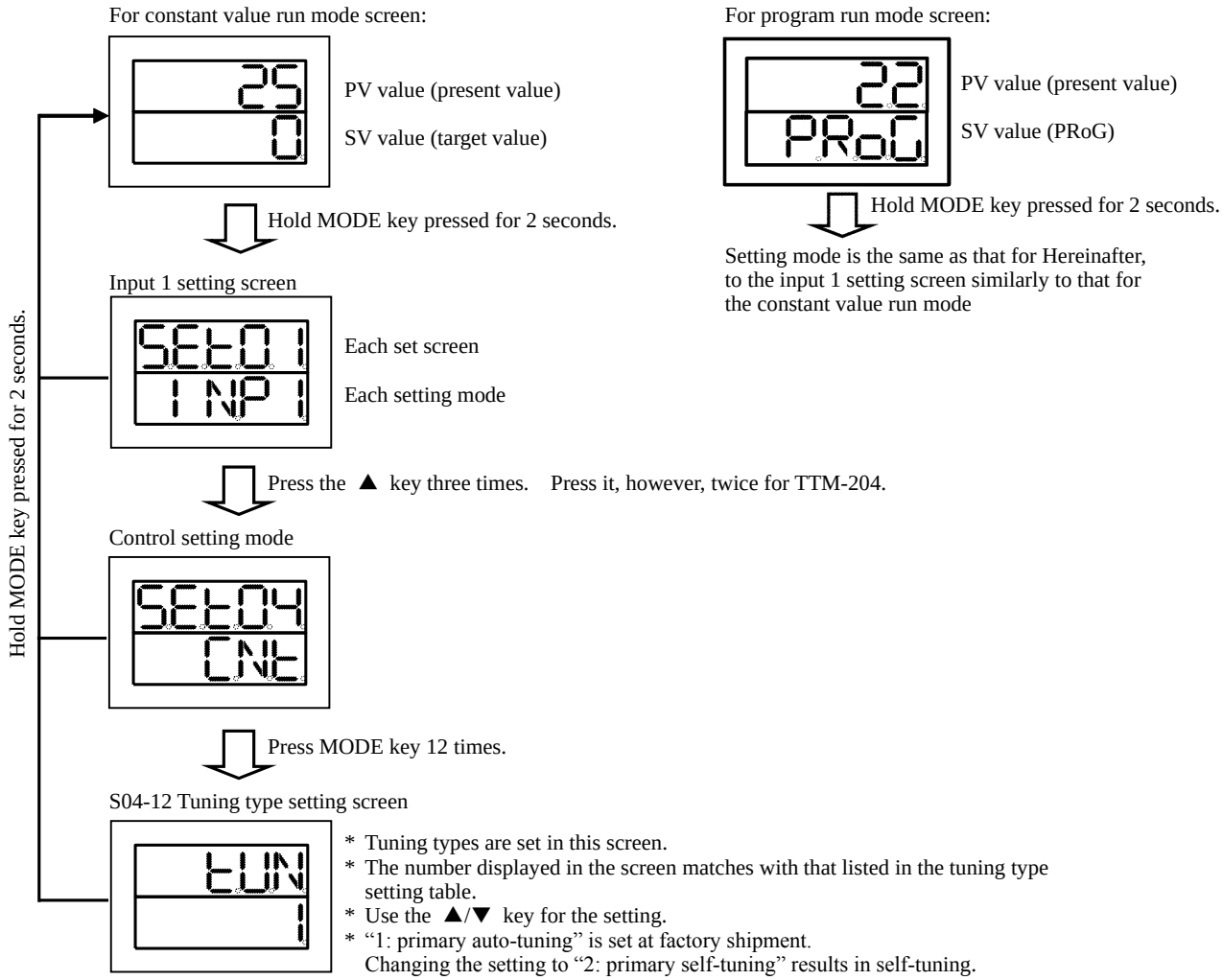


* The function key functions are set in this screen.
  For content of key functions, see the function key function assignment table on page 4-21.
* The number displayed in the screen is coincident with that listed in the assignment table.
* Use the ▲/▼ key for setting the numbers.
* At factory shipment, "00: no function" is set.
* Set the items as follows: ★ = time period in which the function key is pressed and ☆ = 3 (AT start/stop function).
* Use the MODE key to move the screen for the setting screen to set the function keys 2 to 5. The screens change in sequence each time when the MODE key is pressed. (Note that only the function key 1 is available for TTM-204.)

* With the above operation, the function key (FUNC) is set to the AT start/stop function key.
* AT starts and stops by pressing the function key (FUNC) in the run mode screen. In addition, AT stops when the ▲/▼ key is pressed during AT being effective.
* During auto-tuning, the target value and "At" is alternately displayed for SV (red).
* Upon completion of auto-tuning, the target value is displayed.
* Any function key is settable for the AT start/stop function, except on the model TTM-204.
* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

2) How to start self-tuning

* Self-tuning is a function to determine the PID constant when starting operation of the controller and when changing the target value.
  After determining the PID constant, self-tuning is not executed in the next start of operation, unless the target value is changed.
* Self-tuning is executed when so set in the tuning type setting in SET 04 (control setting mode).
  Auto-tuning is set at factory shipment.



* Tuning types are set in this screen.
* The number displayed in the screen matches with that listed in the tuning type setting table.
* Use the ▲/▼ key for the setting.
* "1: primary auto-tuning" is set at factory shipment.
  Changing the setting to "2: primary self-tuning" results in self-tuning.

Tuning type setting table

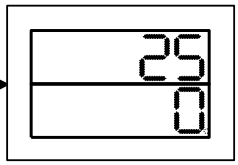
No.	Type
1	Primary auto-tuning
2	Primary self-tuning
3	Secondary auto-tuning
4	Secondary self-tuning
5	Primary/secondary auto-tuning

* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

3) How to manually set the PID constant

* The PID constant is set manually and individually in SET 04 (control setting mode).

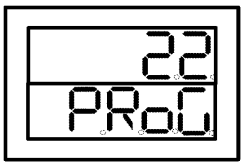
For constant value run mode screen:



PV value (present value)

SV value (target value)

For program run mode screen:



PV value (present value)

SV value (PRoG)

Hold MODE key pressed for 2 seconds.

Hold MODE key pressed for 2 seconds.

Setting mode is the same as that for Hereinafter, to the input 1 setting screen similarly to that for the constant value run mode

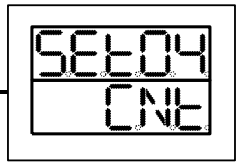
Input 1 setting screen

Each set screen

Each setting mode

Press the ▲ key three times. Press it, however, twice for TTM-204.

Control setting mode

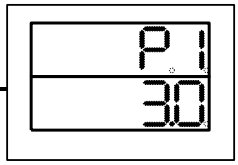


Each set screen

Each setting mode

Press MODE key 16 times.

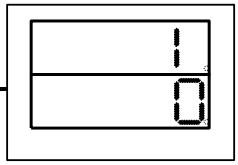
S04-16 Proportional band (P) setting screen



* Proportional band (P) is set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at "3.0" at factory shipment.

Press MODE key once.

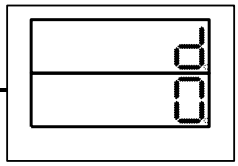
S04-17 Integral time (I) setting screen



* Integral time (I) is set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at "0" at factory shipment.
"0" indicates no integral operation.

Press MODE key once.

S04-18 Derivative time (D) setting screen



* Derivative time (D) is set in this screen.
* Use the ▲/▼ key for the setting.
* "0" indicates no derivative operation.

Hold MODE key pressed for 2 seconds.

* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

5.3.4 Heating/cooling PID control setting

★ Setting the heating/cooling PID control

For the heating/cooling control, the output is selected and set for the subject of control to other than the output 1, as well as the output function must be set to the secondary output, since the function is set, at factory shipment, to the event output.

In addition, the control type setting for the secondary output must be set to PID, since it is set to "N/A" at factory shipment.

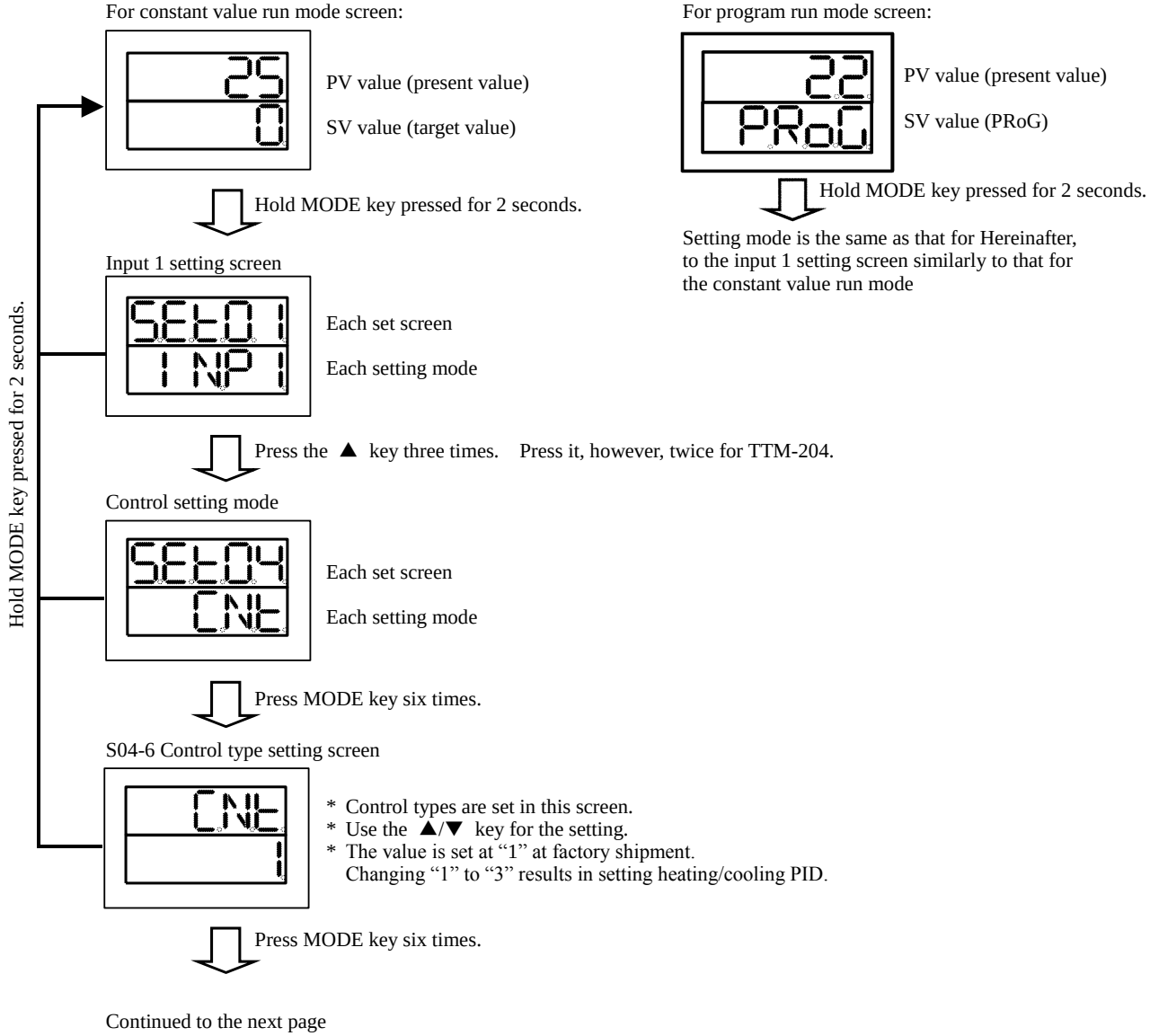
At factory shipment, values for heating is set to the PID control with tentative values for P = proportional band, I = integration, D = derivation and proportional cycle.

Those values are as follows: P1 = 3.0, I = 0, D = 0, proportional cycle = 1 second (SSR model) or 20 seconds (relay model).

Values of PID for cooling are as follows: P2 = 1.00 (a multiplication factor to the primary control proportional band), proportional cycle = 20 seconds for both SSR and relay models, and values of I and D being identical to those for the primary control.

* Setting when the output 1 (OUT 1) is for the heating control and the output 2 (OUT 2) for the cooling control

◎ Types of controls and how to set the output function



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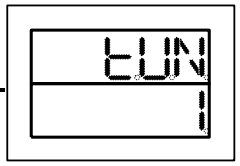
S04-12 Tuning type setting screen



* Tuning types are set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at "1" at factory shipment.
  Changing "1" to "5" results in "PID auto-tuning" for both primary and secondary controls.

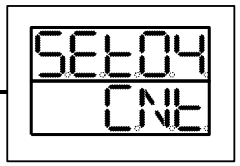
The above operations determine the setting of control types.

Output function (target connection) is to be set next.

Move the tuning type setting screen to the control setting mode screen, using the MODE key.

Hold MODE key pressed for 2 seconds.

Control setting mode

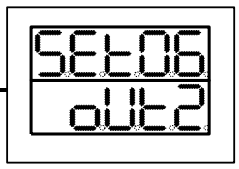


Each set screen

Each setting mode

Press ▲ key twice.

OUT 2 setting screen

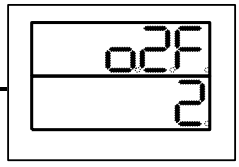


Each set screen

Each setting mode

Press MODE key once.

S06-1 Target connection setting screen



* The target connection (output function) is set for OUT 2 (output 2) in this screen.
* Use the ▼ key for the setting.
* The value is set at "2" at factory shipment.
  Changing the setting from "2" to "1" results in the secondary control (cooling) output.

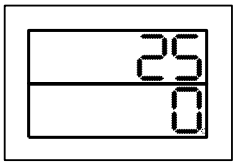
* For how to set PID, see page 5-9, item 5-3-3, "PID control setting."
  For the heating/cooling control, no self-tuning function is provided.

* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

5.3.5 Indicator setting

★ Setting as an indicator
Blinding the target value (SV) enables to use the screen as an indicator.

Constant value run mode screen



PV value (present value)

SV value (target value)

Hold MODE key pressed for 10 seconds.

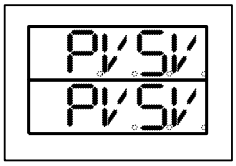
Input 1 setting screen

Each set screen

Each setting mode

When  blinks, press the FUNC key, and then press the MODE key.

PV/SV blind setting screen

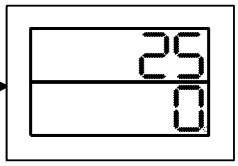


* Use the FUNC key for its setting.
In a blind state, characters in the lower row (red) are not displayed.
(Pressing the FUNC key results in displaying “PVSV,” “PV,” “SV” and “PVSV” in sequence.)
Pressing once the FUNC key displays only characters of “PV” in the lower row (red).
By turning the power off and back on, or holding the MODE key pressed for about 10 seconds in this state, only the upper row (green) is displayed.

The above operations determine the blind-setting of the target value (SV).

Setting for no provision of outputs is conducted next.

Constant value run mode screen



PV value (present value)

SV value (target value)

Hold MODE key pressed for 2 seconds.

Input 1 setting screen

Each set screen

Each setting mode

Press the ▲ key three times. Press it, however, twice for TTM-204.

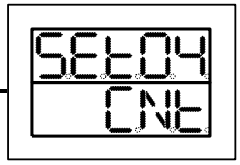
Hold MODE key pressed for 2 seconds.

Continued to the next page

Continued from the previous page

Hold MODE key pressed for 2 seconds.

Control setting mode

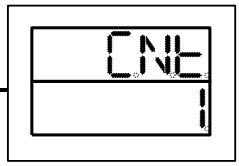


Each set screen

Each setting mode

Press MODE key six times.

S04-6 Control type setting screen

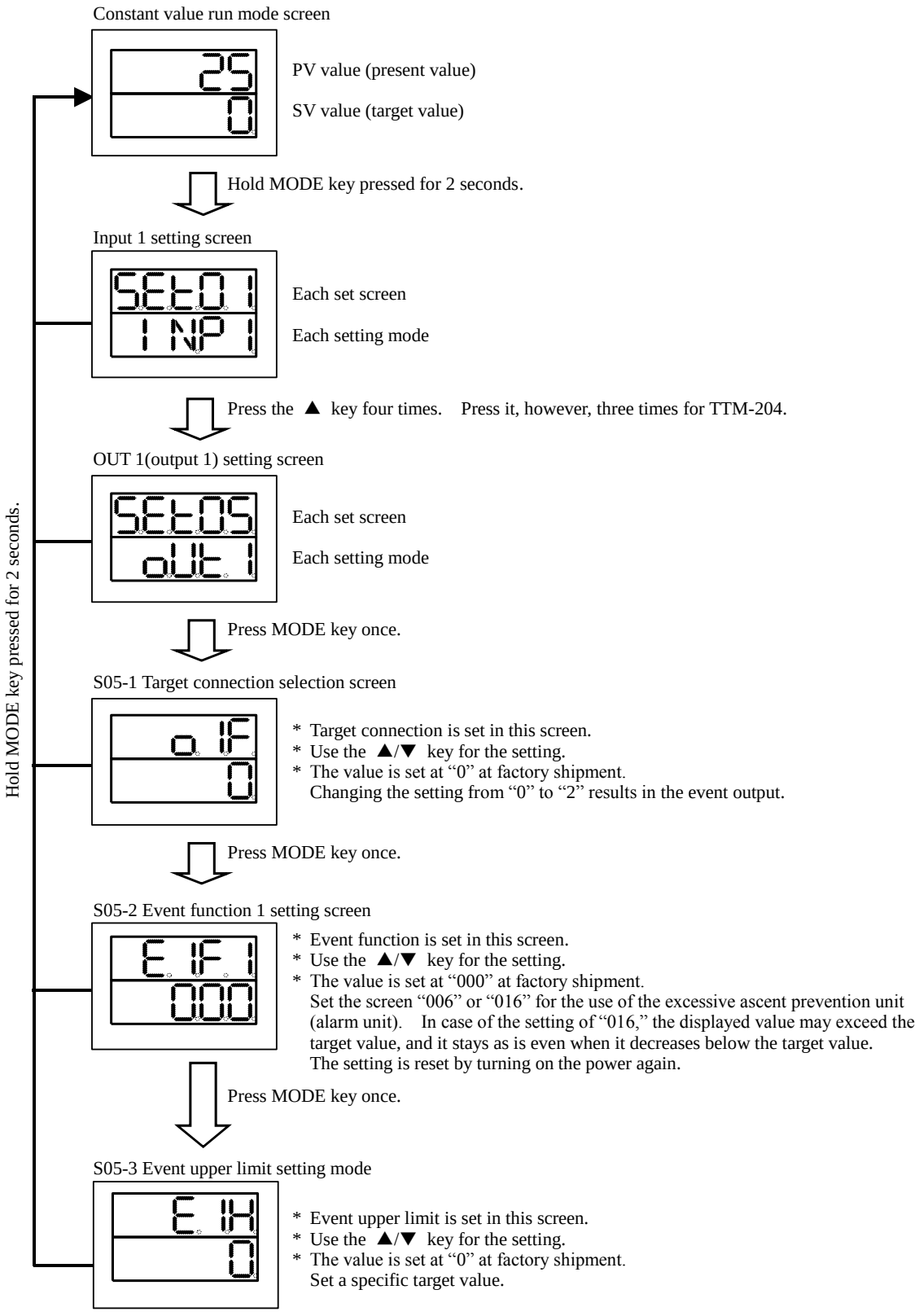


* Control types are set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at “1” at factory shipment.
  Changing the setting from “1” to “0” results in no provision of outputs.

* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

5.3.6 Excessive ascent prevention unit (alarm unit) setting

★ Setting for the excessive ascent prevention unit
Setting to use the OUT 1 (output 1) as the excessive ascent prevention unit in constant value run mode



* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

5.3.7 Event setting

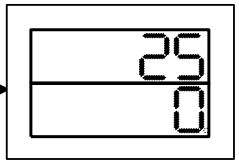
★ Setting the event setting value (alarm value)

When setting OUT 2 for the event setting value (alarm value)

Setting condition: Deviation lower limit, with standby function, 30 °C and sensitivity of 1 °C (no other functions)

This setting is not possible in case that no selection is made for outputs as an option.

For constant value run mode screen:



PV value (present value)

SV value (target value)

Hold MODE key pressed for 2 seconds.

Input 1 setting screen

Each set screen

Each setting mode

Press the ▲ key five times. Press it, however, four times for TTM-204

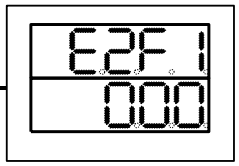
OUT 2 (output 2) setting screen

Each set screen

Each setting mode

Press MODE key twice.

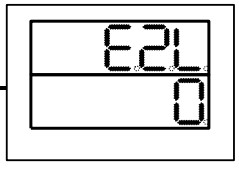
S06-2 Event function 1 setting screen



* Event functions are set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at "000" at factory shipment.
Setting "000" to "023" results in the type of alarm for the deviation lower limit and standby function.
Deviation lower limit: Range from the setting value (SV) being set
Standby function: Function that no alarm is generated until a value exceeds the alarm range.

Press MODE key once.

S06-4 Event lower setting screen

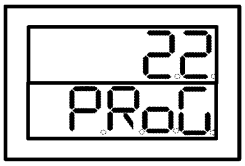


* Event lower target value is set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at "0" at factory shipment.
Setting "0" to "30" results in setting the deviation lower limit alarm value to 30 °C.
An alarm is generated in case that a value reaches 30 °C below the setting value (SV).
Example: SV = 200 °C and lower limit alarm = 170 °C or lower

Press MODE key six times.

Continued to the next page

For program run mode screen:



PV value (present value)

SV value (PRoG)

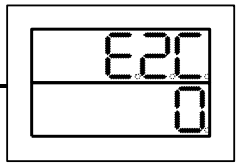
Hold MODE key pressed for 2 seconds.

Setting mode is the same as that for Hereinafter, to the input 1 setting screen similarly to that for the constant value run mode

Hold MODE key pressed for 2 seconds.

Continued from the previous page

5. Event sensitivity setting screen



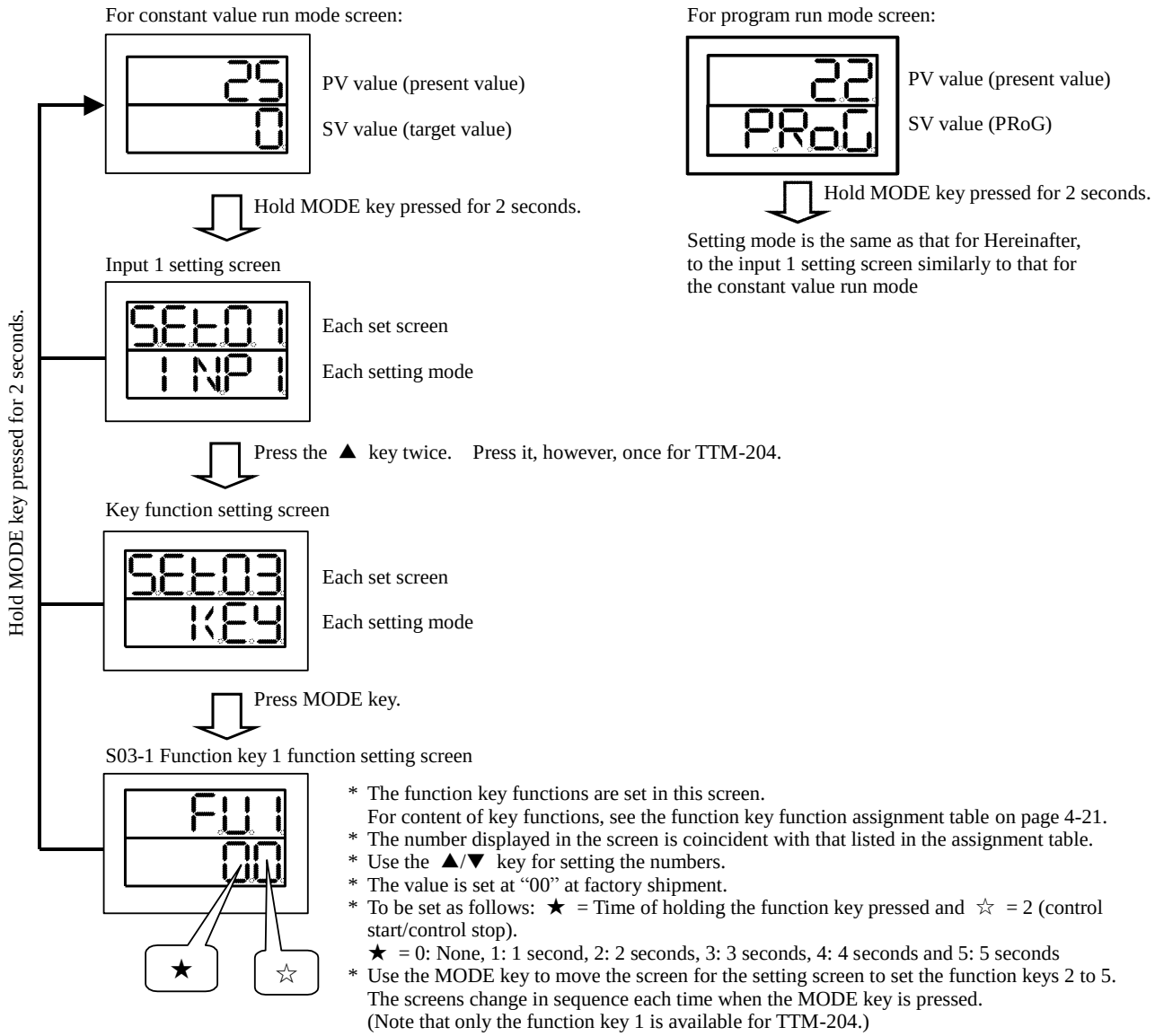
* Event sensitivity is set in this screen.
* Use the ▲/▼ key for the setting.
* The value is set at “0” at factory shipment.
  Setting “0” to “1” results in setting the sensitivity range of the lower limit alarm to 1 ℃.
  Temperature that an alarm enters: 170 ℃
  Temperature that an alarm cancels: 169 ℃

* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

5.3.8 How to set MD/READY

★ Start of control (RUN) or stop of control (READY) is selected.
Switchover of RUN/READY can be executed through the key operation with the FUNC key assigned, or through optional digital (DI) input or communication function.

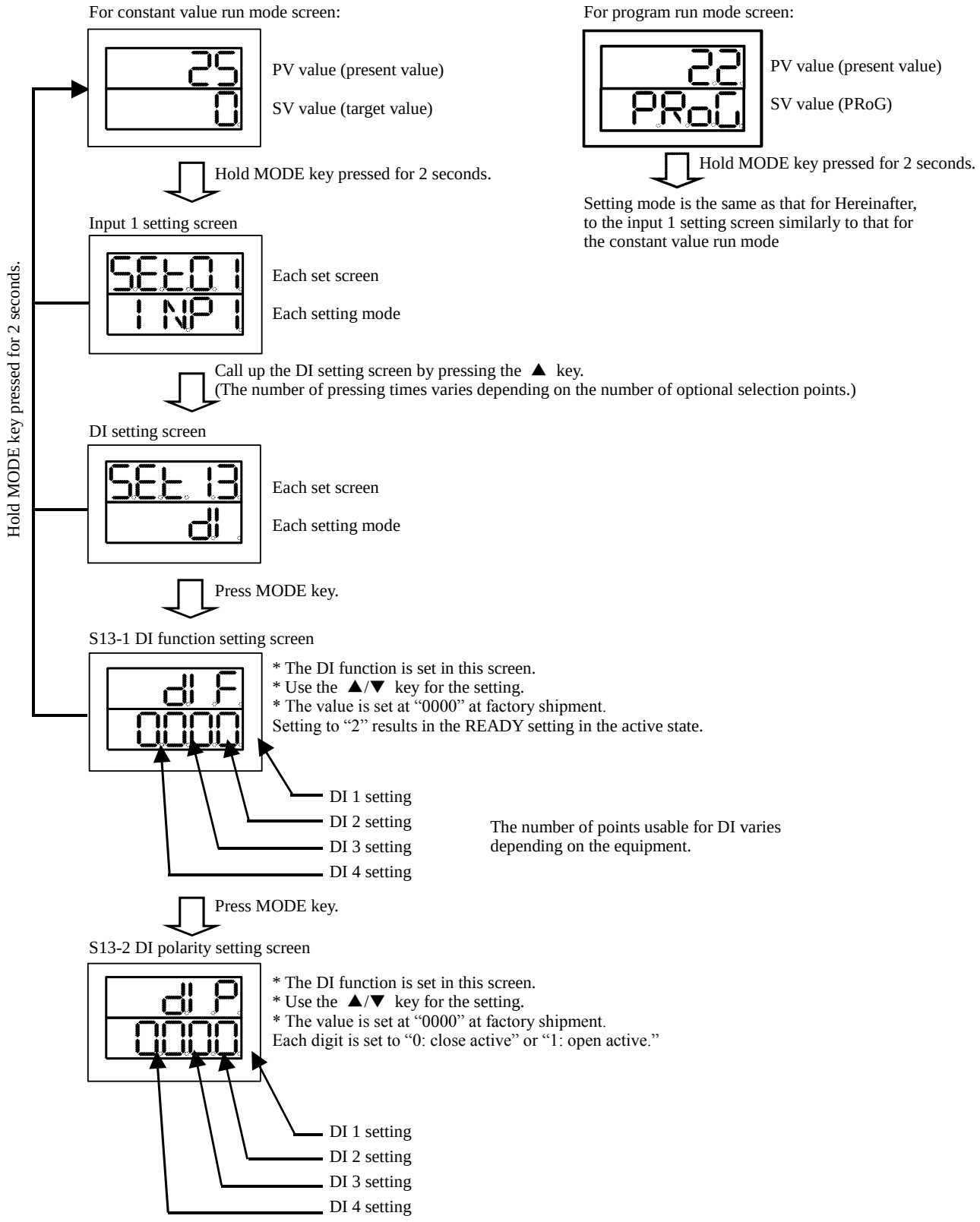
① Setting with the function key



* The function key functions are set in this screen.
  For content of key functions, see the function key function assignment table on page 4-21.
* The number displayed in the screen is coincident with that listed in the assignment table.
* Use the ▲/▼ key for setting the numbers.
* The value is set at "00" at factory shipment.
* To be set as follows: ★ = Time of holding the function key pressed and ☆ = 2 (control start/control stop).
  ★ = 0: None, 1: 1 second, 2: 2 seconds, 3: 3 seconds, 4: 4 seconds and 5: 5 seconds
* Use the MODE key to move the screen for the setting screen to set the function keys 2 to 5. The screens change in sequence each time when the MODE key is pressed. (Note that only the function key 1 is available for TTM-204.)

* The above operations determine the setting of the function (FUNC) key to be the control start (RUN) and control stop (READY).
* Pressing the function (FUNC) key in the operating mode screen results in operations of RUN and READY.
* Any function key can be assigned for RUN or READY on all equipment models except TTM-204.
* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

② Setting with the DI function (event input)
Optional DI function (event input) is required.



* Holding the MODE key pressed for 2 seconds moves each setting screen to the run mode screen.
* In about 2 minutes, each setting screen (or any setting screen) automatically moves back to the run mode screen.

5.4 How to set each function and description of function

5.4.1 Auto-tuning (AT) function

■ What the auto-tuning is

- Auto-tuning (AT) is a function to operate turning on and off a subject of control so that the PID parameter best suited for a set temperature is automatically calculated and set.
- For AT, ensure to wire the input 1 terminal and output terminal (such as power supply for heater), set the setting temperature (SV), and use the equipment in a state possible to be controlled.
- For the control type setting, select the PID control {forward operation (cooling)/reverse operation (heating)}, heating cooling PID control and position proportional control for using them when PID parameters are desired to be automatically set.
- Upon completion of the AT setting, the automatically set PID parameters are recorded and stored even when the power turns off. Repeat the operation, however, in case of power-off, halted AT or AT error during setting AT, since it causes no change of the PID parameters.

⦸ Prohibition of the use of AT

① As AT forcibly executes turn-on and -off operations, PV greatly varies depending on a subject of control. Do not use AT for a subject of control that cannot accept great fluctuation of PV.
② Do not use AT for a subject of control that provides fast response, such as pressure control or flow rate control.
③ Do not use AT for a subject of control that may have a problem when a great change is applied to the subject's outputs, such as heater and solenoid valve.
The operating amount limiter is effective for analog outputs but not for digital outputs during AT.
The operating amount change limiter is not effective during AT.

Note Precautions on the use of AT

① The AT start screen is not displayed when the ON/OFF control is set for the control type setting.
② The AT start screen is not displayed when the self-tuning is set for the tuning type setting.
③ The time from start to completion of AT varies depending on subjects of controls.
④ Best suited PID parameters may not be obtained depending on subjects of controls.
For such cases, manually adjust the PID parameters.
⑤ AT starts also when the manual control mode is set. The mode, however, returns to the manual control mode when AT stops. Set the control start in the control mode in order to reflect the AT result.
⑥ In case that abnormality, such as disconnected wire, is generated during AT, "ERR 02" is displayed and AT is forcibly stopped. Repeat AT.
⑦ No change of any setting is allowed during AT.
⑧ AT may not properly complete its operation in case of subjects of controls for which temperature change is very slow or in case of AT being executed in temperatures close to the ambience temperature due to incorrect provision of temperature change. ("ERR 02" is displayed 3 hours after AT starts.) For such a case, manually adjust the PID parameters.
⑨ Incompletion of AT in 3 hours may be caused by incorrect wiring of inputs and outputs, incorrect setting of input type or incorrect setting of forward/reverse switchover. Recheck the wiring and parameters.
⑩ Best suited PID parameters may not be obtained by AT in case that the operating amount limiter is set.
The operating amount limiter is not effective during AT for digital outputs.
⑪ Best suited PID parameters may not be obtained by AT in case that the operating amount change limiter is set.
⑫ AT for the primary control is not allowed in case that the secondary self-tuning is set for the tuning type setting.
⑬ Parameters of the anti-reset windup are also automatically calculated in case that AT is executed for the PID control type C.
Change the parameters to the initial values in case of changing the setting to type A or B, or not particularly using the anti-windup.
⑭ Appropriately set the loop abnormality, since it may be caused also during AT. AT does not stop at generation of the loop abnormality. The loop abnormality is not released even when AT stops.

Re-execution of AT

PID parameters calculated by AT are not necessarily best suited for all states.
Re-execute AT because best suited control may not be possible for cases listed below where settings or states are changed.

Changes on other than this equipment	Changes on this equipment		
Sensor (changed to different type)	Setting of input type	Control type setting	Forward/reverse operation setting
Output (heater or power supply)	Great change of SV	PID control type	Tuning type setting
Change of operation of controlled subject	SV limiter upper limit and lower limit	Type B mode	Primary/secondary control operating amount limiter
	Primary/secondary control proportional band setting	Integral time setting	Derivative time setting
	Anti-reset windup	Valve motor stroke time	

■ Special operation of AT

① AT starts also when READY is set for DI, using the AT start screen or AT start/stop based on the key function setting.
② AT continues when the control is changed from RUN to READY or vice versa, or changed from Manual to Auto or vice versa for DI during AT.
③ The operation switches over from reverse to forward or vice versa for DI even during AT.

■ How to start/stop AT

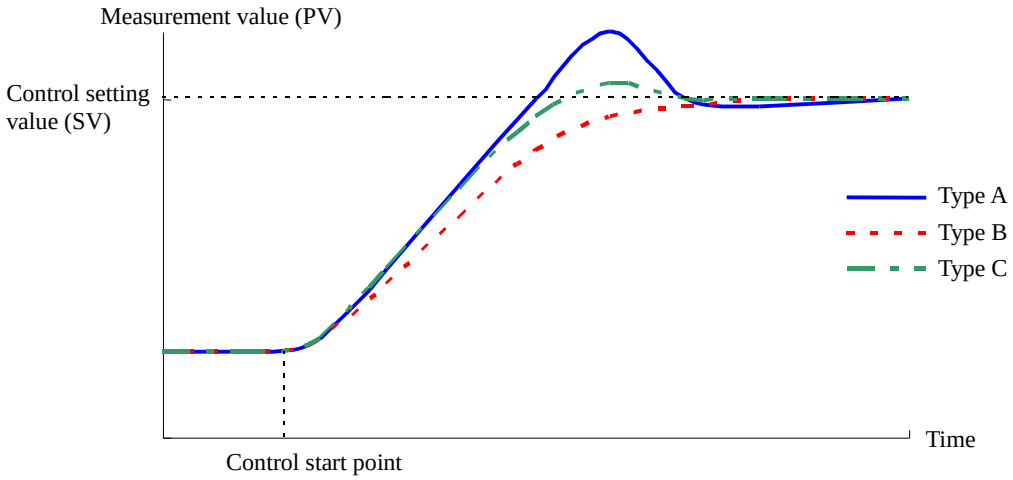
AT can start in any state, such as control stop, temperature in rise or control in stability, as long as the control is effective after power-on.

① Move to the setting item selection screen by prolonged pressing of the MODE key in the run mode (power-on initial screen).
② Have the control setting mode (SET 04) displayed by pressing the ▽/△ key in the setting item selection screen.
③ Have the AT start screen displayed by pressing the MODE key several times.
④ AT is executed by pressing the ▽/△ key. SV and AT alternately blinks on and off in the SV screen during AT. Press the ▽/△ key to stop AT. The screen returns to the AT start screen.
⑤ The screen returns to the AT start screen when AT is complete. Upon the completion, PID parameters are automatically set.
⑥ Prolonged pressing of the MODE key returns the mode to the operating mode.

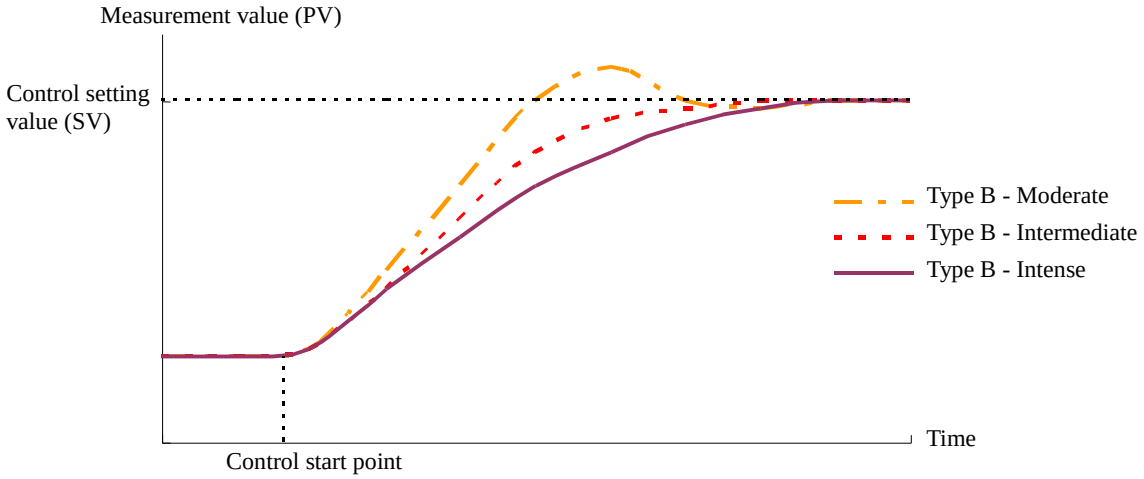
■ Post-AT control characteristics per control type

Note The control characteristics graph is an example and may differ depending on subjects of controls. Take care it.

Post-AT control characteristics for setting of PID control types A to C



Post-AT control characteristics for setting of PID control type B moderate to intense



5.4.2 Self-tuning function

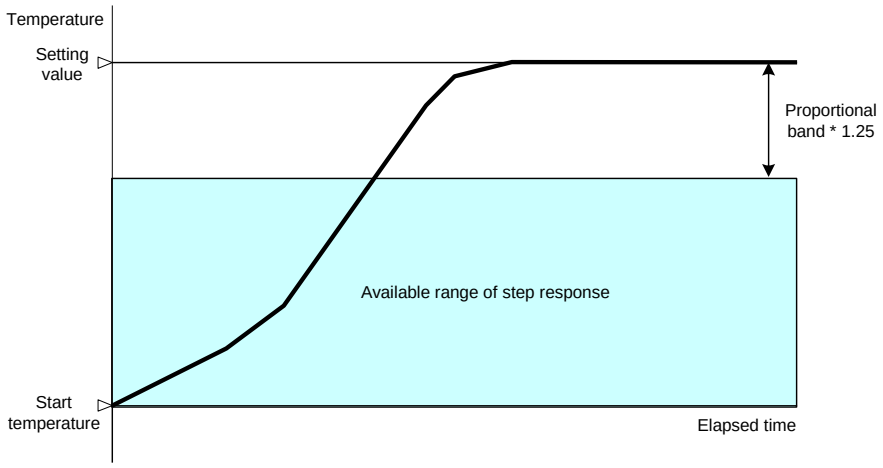
■ What the self-tuning is

- Self-tuning is defined as a function that automatically executes tuning without requiring operator to provide instructions and corrects the PID constant at the time of operation start (including power-on), change of setting value or generation of hunting.
- Ensure to execute the self-tuning in a controllable state after the input 1 terminal and output terminals (such as the power supply for heater) are wired, and the setting temperature (SV) is set.
- Use the self-tuning function when automatic setting of PID parameters are desired after selecting the PID control {forward operation (cooling)/reverse operation (heating)}, heating cooling PID control and position proportional control for the control type setting.
- The values are recorded for automatically-set PID parameters for which self-tuning is complete even when the power turns off.
  PID parameters, however, does not change in case that the power turns off during self-tuning.

● Tuning using step response

Self-tuning that uses the step response method starts if the following conditions are met at the time of starting operation (including power-on) or changing the setting values.

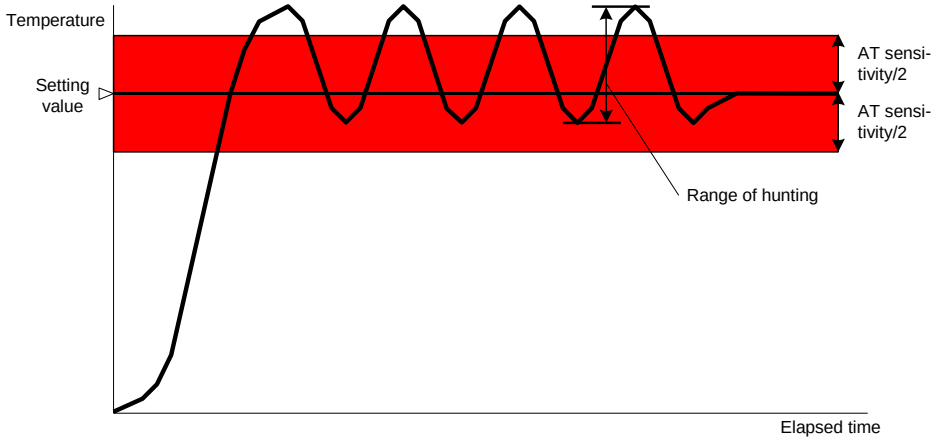
1) Tuning has not been executed for the present setting values. (Tuning was executed for the previous values.)
2) Deviation > proportional band × 1.25



● Tuning due to hunting

Auto-tuning starts when the following conditions are met for hunting generated after the setting values are reached.

1) Where the range of hunting is greater than the value of [AT sensitivity]/2 and the hunting does not terminate



Note Precautions on the use

Self-tuning is affected by the present control results, as it is a function to correct the PID constant using responses from the normal control.

Under the following environments, precise compensation may not be possible.

(1) Control system with large disturbances (when hunting-like operation appears due to disturbances)
(2) Control system with much time required for providing control outputs

Under the following cases, use auto-tuning.

(1) Where overshoot suppression is focused
(2) Where target follow-up characteristics are focused
(3) Where disturbance response is focused
(4) Control system with fast response (soldering gun, etc.)
(5) Control system with much dead time (constant-temperature bath, etc.)

5.4.3 Mode/manual function

■ Mode (MD)/manual (MAN) function

Controls set in the control mode and manual controls can be switched over using the FUNC key, DI or communication.

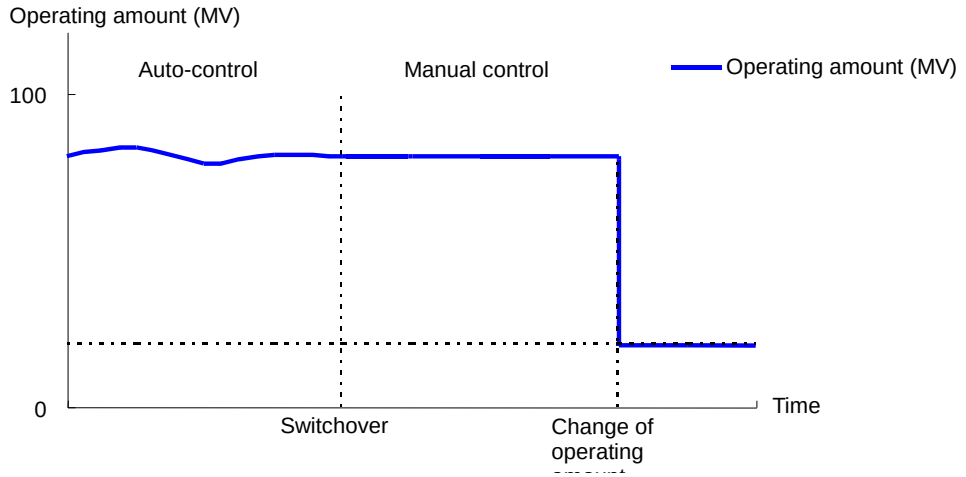
Changeable controls are RUN, READY, MANUAL and timer controls in the control mode (MD) of SET 4. The control mode (MD) can be changed using the ▽ key or △ key.

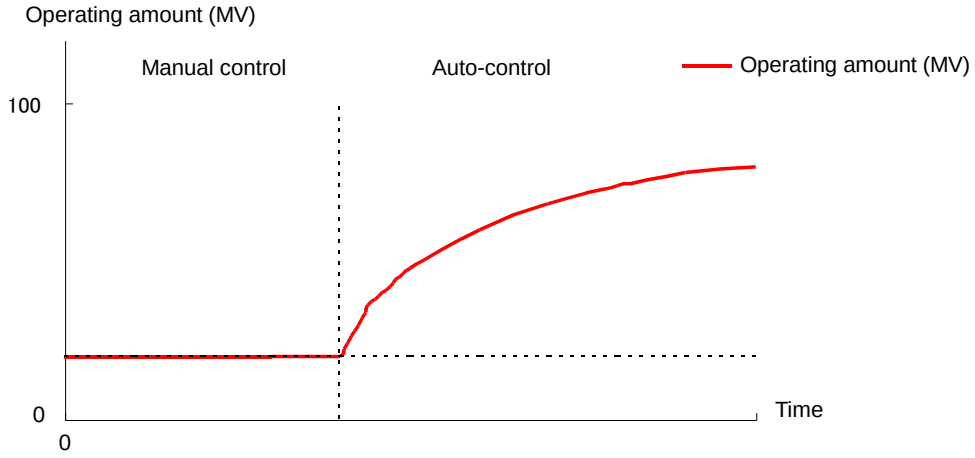
The following explanation is for switching over the control mode (MD) to RUN.

In the manual control, a control amount (outputs for control) is randomly set and provided as output regardless of the state of the subject of control.

The manual control is used when checking operations of operation ends such as heater and valve at the initial operation of a system, or when the normal control is not possible due to a sensor failure.

With the PID control, abrupt change of operating amount (control outputs) is suppressed when the auto-control and manual control are switched over one another. In addition, the balance-less/bump-less function is mounted for suppressing chances of damage on peripheral devices and negative effects to the control system due to such an abrupt change, resulting in control at ease.



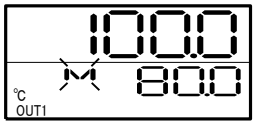


PV/SV screen at auto/manual

At RUN and READY

Control setting value (SV) can be set.

At manual



Operating amount can be set.

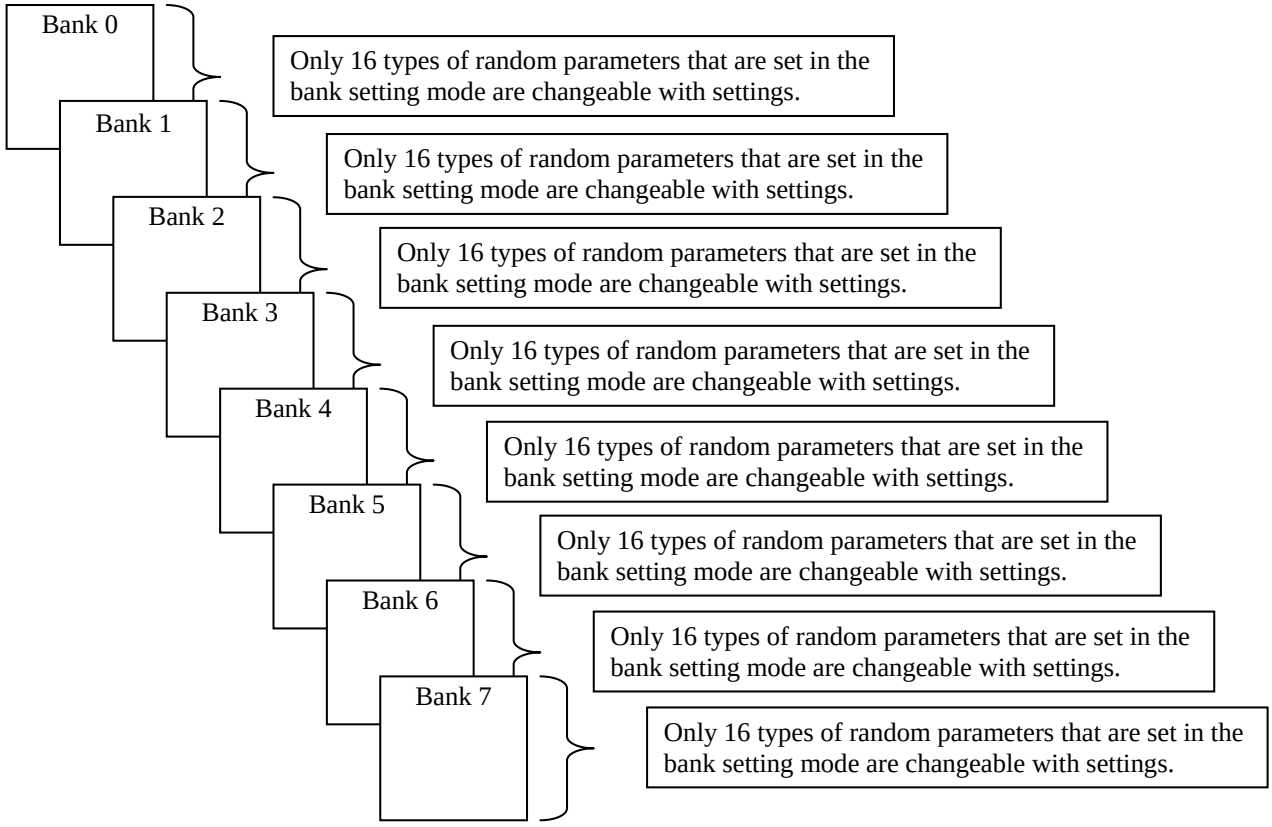
Note Use “SET 4/SV” for changing the control setting value (SV) in the manual control.

5.4.4 Bank function

■ What the bank function is

- The bank function is a function that enables a desired control to be effective through changing the bank settings for which parameters are preset in each bank and thereby no change of temperatures, PID values or alarm settings are required each time when different temperature controls or alarm settings are set on a single unit of this equipment.
  Eight memory banks, or banks 0 to 7, are available. A memory bank is what particular groups of setting values are integrated. In one setting value group, max. 16 types of parameters with bank functions can be set.

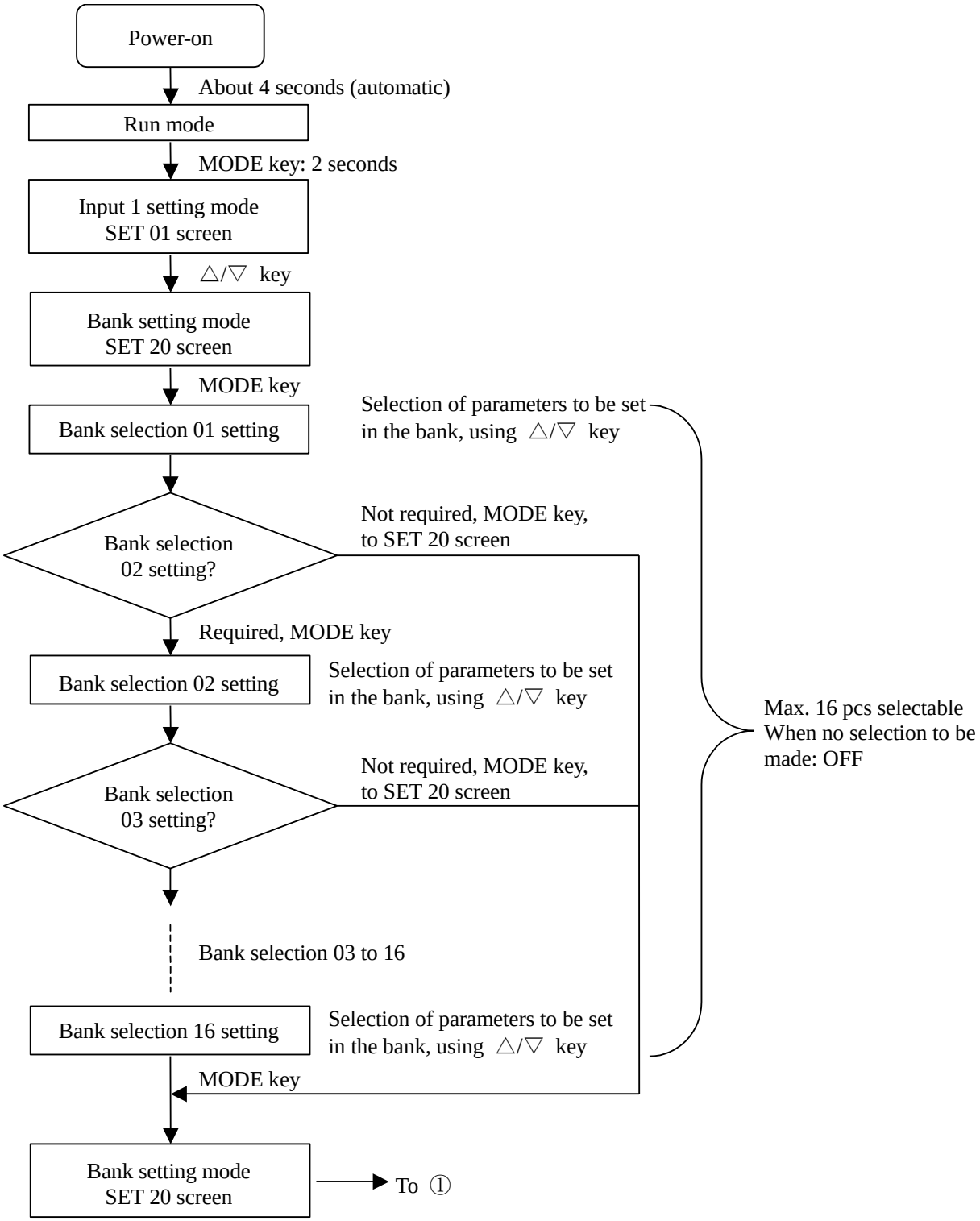
Sixteen types of parameters are those set in the "bank setting mode."
The parameters that are not set in the "bank setting mode" are common parameters for each bank.

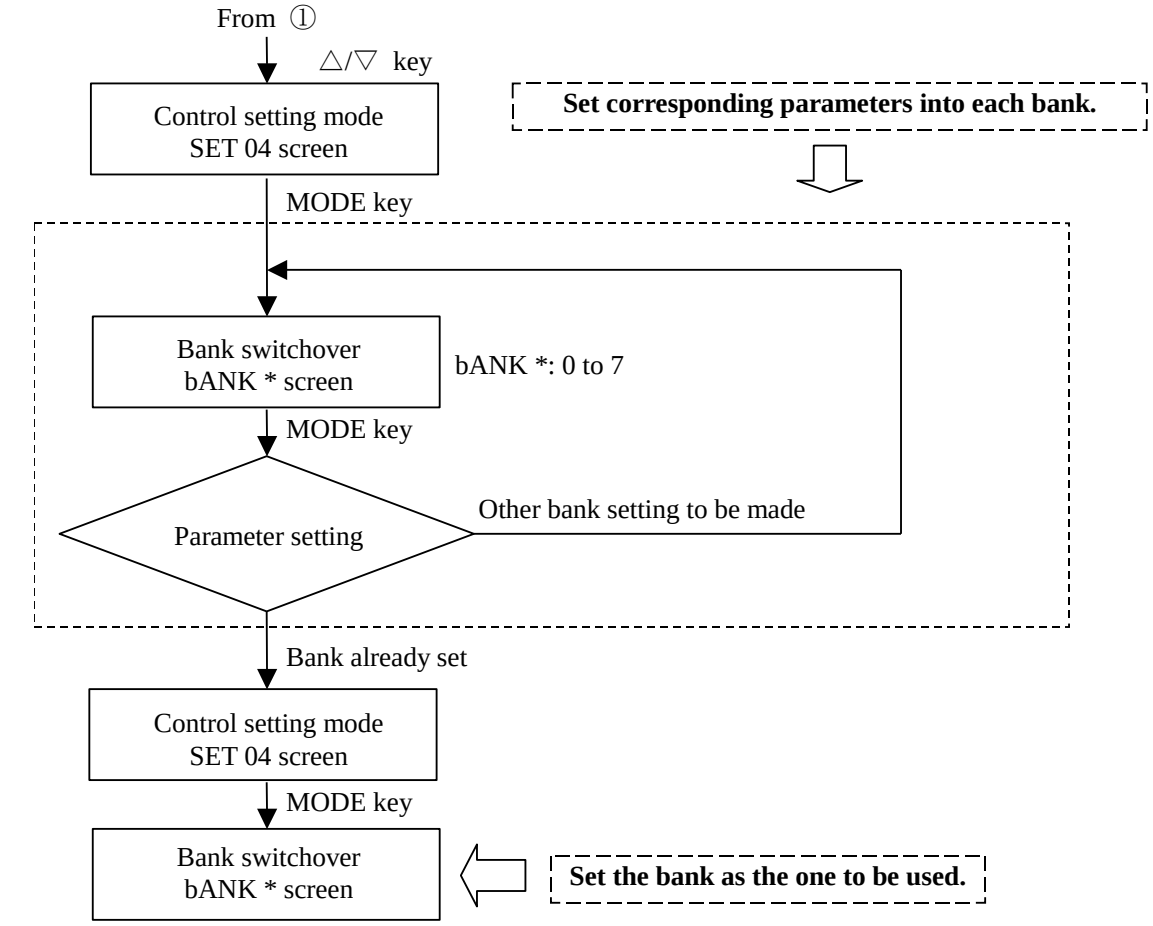


< How to set >

For setting the control setting mode (SET 04) ---see the page 6-14.
For setting the bank setting mode (SET 20) --- see the page 6-72.

■ Operation flow





Recording the switchover of banks

① Change of the control setting mode using "bank switchover" ---
The change is recorded when the MODE key is pressed (or when the screen moves to a next screen.)
Take care that none is recorded when the △/▽ key is used for switchover.

② FUNC key .....The change is recorded when the FUNC key is pressed.

③ DI .....The change is recorded when switchover is made in DI.

④ Communication .....Only parameters for which limits are set when communication is used for switchover. Recording is executed absolutely with "STR (store)" command.
STR.....See the chapter for communication in the operation manual.

Note Take care the switchover according to the items 2 to 4, since limiters may interfere with setting values for parameters.

< Parameters with limits >

① Input type setting.....INP 1, INP 2

② Decimal point position.....dP 1, dP 2

③ Celsius/Fahrenheit.....°C/°F

Example: Where the input type is changed from K thermocouple to T thermocouple
Setting values of SV limiter upper limit and lower limit change due to the setting range narrower with T thermocouple.

<Measure> Set the parameter that interferes with the limits into the bank setting mode.

5.4.5 Timer function

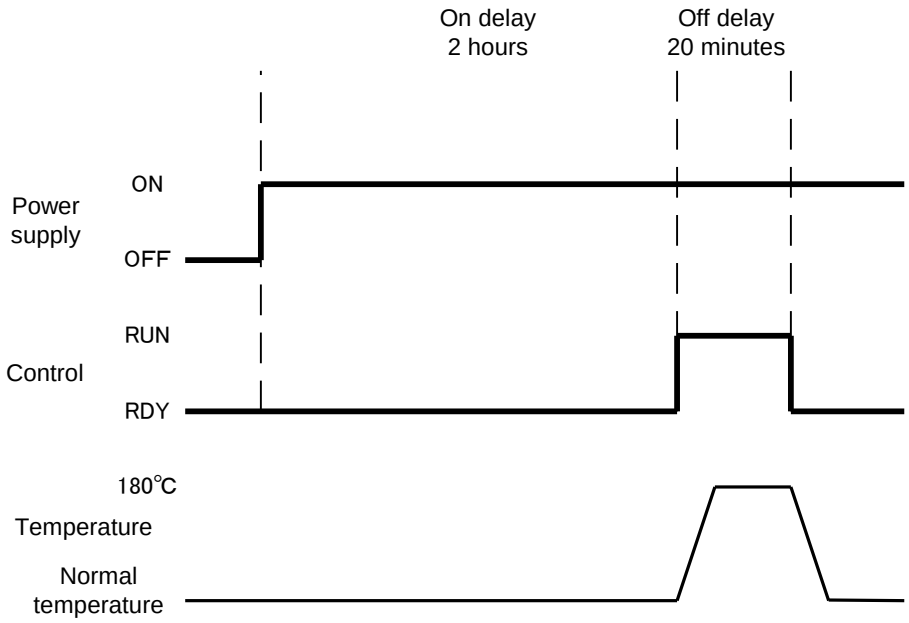
■ What the timer function is

- A function to generate an event for a predetermined time period or predetermined time after a trigger is activated.
  Some major examples of the use and settings are as follows.

■ Where automatic start/stop of control is desired after power-on (auto-start)
Example of setting for a control for 20 minutes at 180 °C, 2 hours after the power is turned on

	SEt04 CNt	Name	Setting content	Setting value
	SV	Control setting	180 °C	180
	Md	Control mode	Timer 1 makes the control start/stop.	TIME1

	SEt14 tIME1	Name	Setting content	Setting value
	tMF1	Function setting	Auto-start	1
	oNt1	On delay timer	2 hours	02:00
	oFt1	Off delay timer	20 minutes	00:20

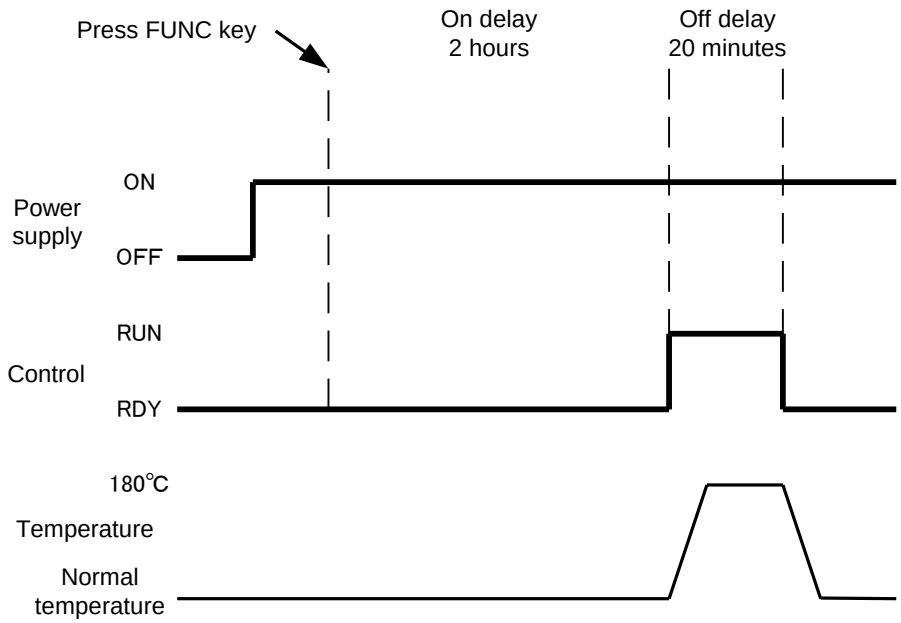


■ Where the control is desired to start/stop by pressing the FUNC key (manual start)
Example of setting for a control for 20 minutes at 180 °C, 2 hours after the FUNC key is pressed

	SEt03 KEY	Name	Setting content	Setting value
	FU1	Function key 1 function setting	No setting of time for the key held pressed/timer start/reset	04

	SEt04 CNt	Name	Setting content	Setting value
	SV	Control setting	180 °C	180
	Md	Control mode	Timer 1 makes the control start/stop.	TIME1

	SEt14 tIME1	Name	Setting content	Setting value
	tMF1	Function setting	Manual-start	2
	oNt1	On delay timer	2 hours	02:00
	oFt1	Off delay timer	20 minutes	00:20

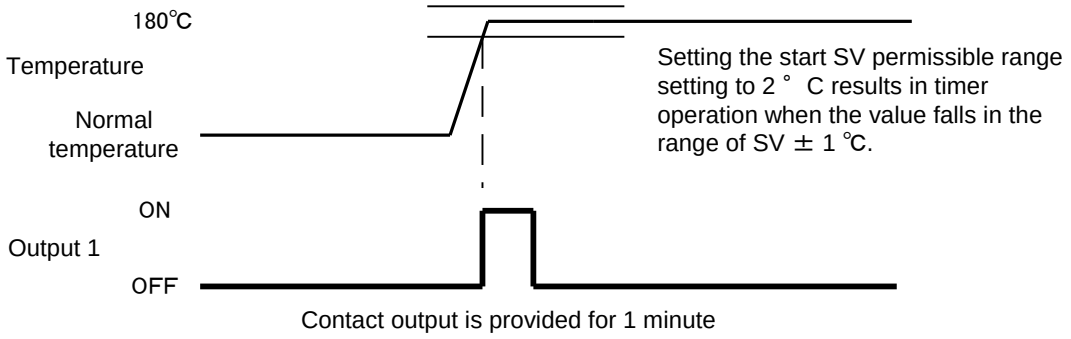


■ Where contact outputs are desired to be provided when a measurement value comes to a target value (SV start)
Setting example for output 1 to be provided for 1 minute after 180 ℃ is reached

	SEt04 CNt	Name	Setting content	Setting value
	SV	Control setting	180°C	180

	SEt5 oUt1	Name	Setting content	Setting value
	o1F	Target connection setting	Timer 1 output	5

	SEt04 tIME1	Name	Setting content	Setting value
	tMF1	Function setting	SV start	3
	tSV1	Start SV permissible range setting	Give range of 2 ℃	2
	oFt1	Off delay timer	1 minute	00:01



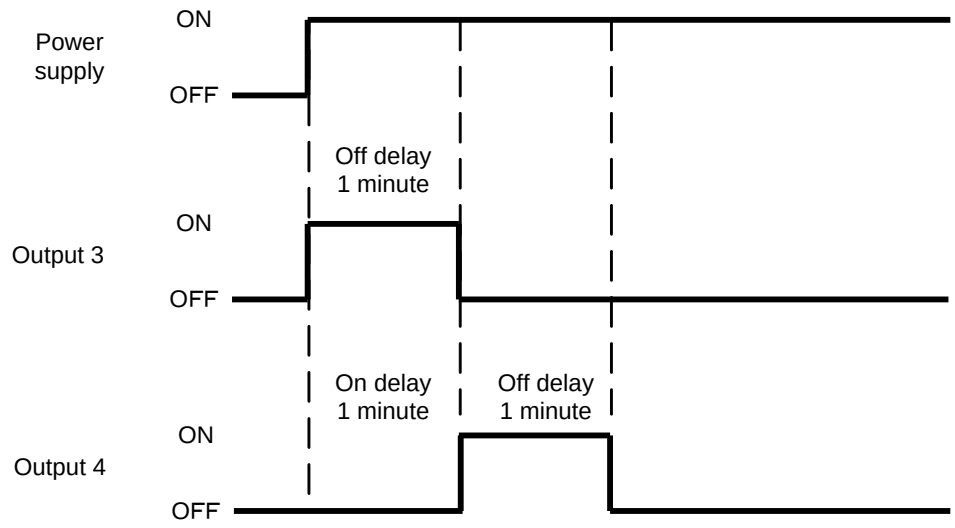
Contact output is provided for 1 minute

■ Where contact outputs 3 and 4 are desired to be provided in sequence (Event * start)
Setting example where the output 3 is provided using the timer 1 and then the timer 2 starts operation to provide the output 4 when the timer 1 terminates operation

	SEt7/8 oUt3/4	Name	Setting content	Setting value
	o3F	Target connection setting	Timer 1 output	5
	o4F	Target connection setting	Timer 2 output	9

	SEt14 tIME1	Name	Setting content	Setting value
	tMF1	Function setting	Auto-timer	1
	oNt1	On delay timer	0 minute	00:00
	oFt1	Off delay timer	1 minute	00:01

	SEt15 tIME2	Name	Setting content	Setting value
	tMF2	Function setting	Event 3 start	10
	oNt2	On delay timer	1 minute	00:01
	oFt2	Off delay timer	1 minute	00:01



■ Where the equipment is used as a simplified programmable controller (manual start and event * start)
Setting example where temperature is raised to 100 ℃ in 1 minute, maintained at 100 ℃ for 1 minute, and then lowered to 0 ℃ in 1 minute

	SEt03 KEY	Name	Setting content	Setting value
	FU1	Function key 1 function setting	No setting of time for the key held pressed/timer start/reset	04

	SEt7/8 oUt3/4	Name	Setting content	Setting value
	o3F	Target connection setting	Timer 1 output	5
	o4F	Target connection setting	Timer 2 output	9

	SEt14 tIME1	Name	Setting content	Setting value
	tMF1	Function setting	Manual-start	2
	oNt1	On delay timer	0 minute	00:00
	oFt1	Off delay timer	1 minute	00:02

	SEt15 tIME2	Name	Setting content	Setting value
	tMF2	Function setting	Event 3 start	10
	oNt2	On delay timer	2 minutes	00:02
	oFt2	Off delay timer	1 minute	00:01

	SEt20 bNK	Name	Setting content	Setting value
	bnk01		Control setting	SV
	bnk02		Ramp time setting	RMP

For the following setting, enter the inputs during the switchover in bANK (bank switching) in SET 4.
* Set bANK to “0.”

	SEt04 CNt	Name	Setting content	Setting value
	SV	Control setting	0 ℃	0
	RMP	Ramp time setting	Setting turned off	0.0

* Set bANK to “1.”

	SEt04 CNt	Name	Setting content	Setting value
	SV	Control setting	100 ℃	100
	RMP	Ramp time setting	To be raised by 100 ℃ in 1 minute	100.0

* Set bANK to “2.”

	SEt04 CNt	Name	Setting content	Setting value
	SV	Control setting	0 ℃	100
	RMP	Ramp time setting	To be raised by 100 ℃ in 1 minute	100.0

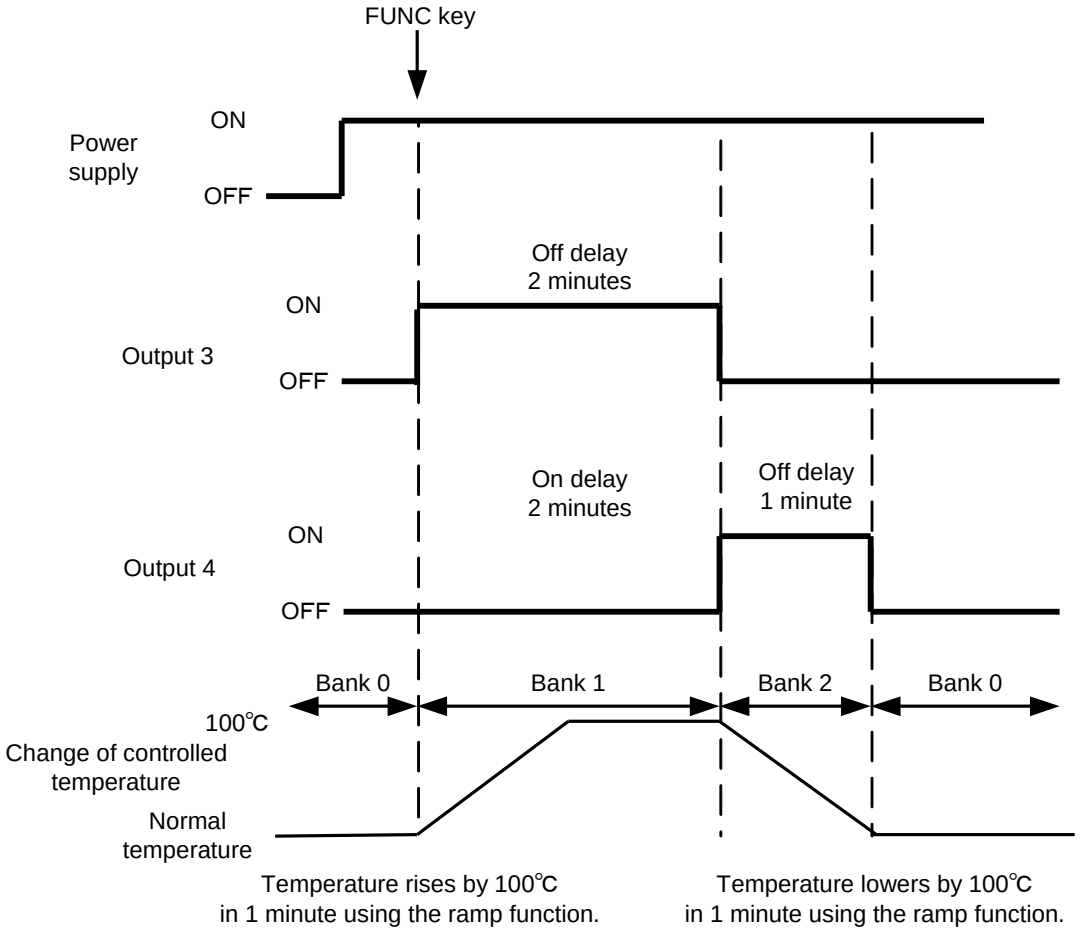
* The bank cannot be switched over unless DI is set after the bank setting is complete.

	SEt13 dI	Name	Setting content	Setting value
	dIF	Function setting	Both DI 1 and DI 2 to be switched over	0011

Wire the equipment upon completion of setting.

	204	205/209	207
Connect the output 3 with DI 1.	⑦－⑮ ⑨－⑯	⑲－ －	⑬－ ⑮－
Connect the output 4 with DI 2.	⑧－⑰ ⑨－⑱	⑳－ －	⑭－ ⑮－

Note When connecting the output and DI, select an open collector for the output.



■ Complementary explanation of “RDY lamp” lighting status
The table below shows an indication status of the RDY lamp when timer operation is set for control mode. The indication status varies depending on the SET 04 control MD status (MD/READY).

		Md						
		RDY	RUN	MAN	TIMEx			
					Before operation	On delay	Off delay	After operation
None		Blinking	Extinction	Extinction	Blinking	Blinking	Extinction	Blinking
func	Md	Blinking	Extinction	Extinction	Blinking	Blinking	Extinction	Blinking
Md⇔RdY	RdY	Lighting	Lighting	Lighting	Lighting	Lighting	Lighting	Lighting
di	Md	Blinking	Extinction	Extinction	Blinking	Blinking	Extinction	Blinking
Md⇔RdY	RdY	Lighting	Lighting	Lighting	Lighting	Lighting	Lighting	Lighting

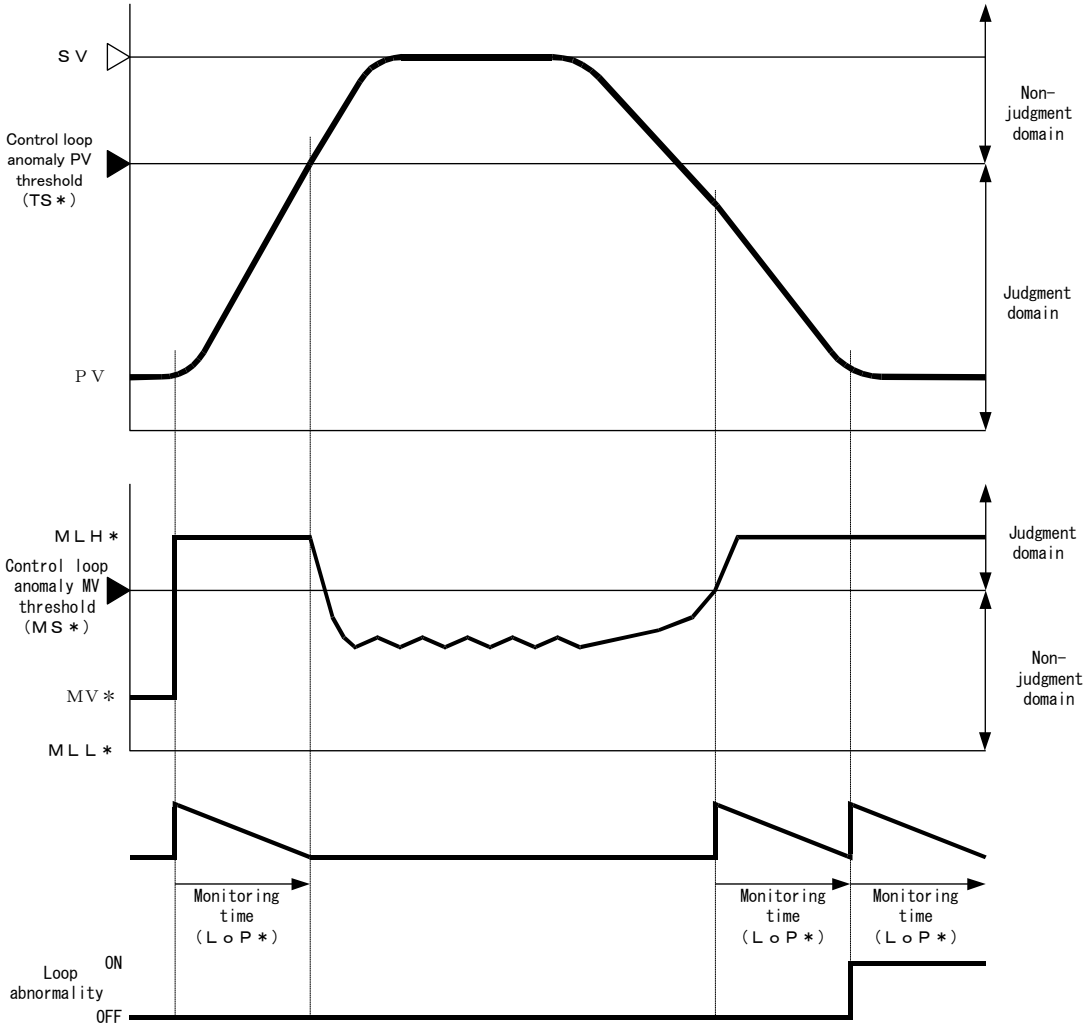
* The blinking interval shown in the table is 500 ms.
* At a forced stoppage due to the interlock function, the blinking interval of the RDY lamp becomes faster to 100 ms.

5.4.6 Loop abnormality function

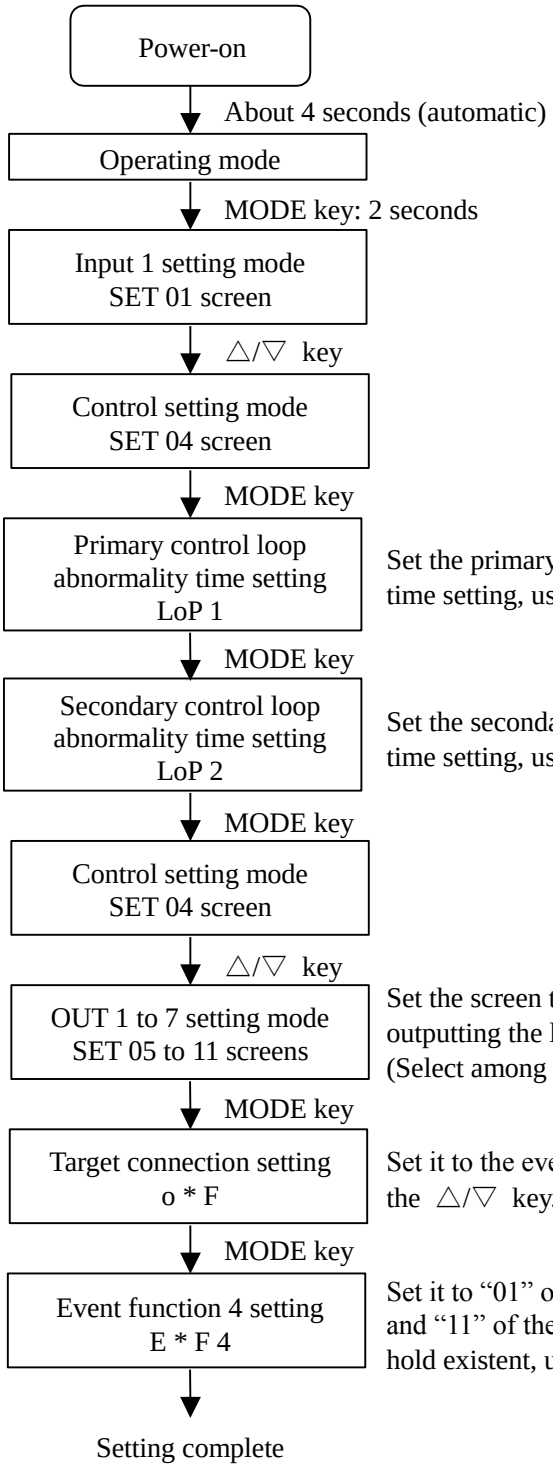
■ What the loop abnormality is

– The function is to detect an abnormality in the control loop.
– When a value falls in the judgment domain with respect to the conditions of the control loop anomaly MV threshold(MS*) and control loop anomaly PV threshold(tS*), the control loop anomaly PV change threshold is judged at each "LoP*" time.
– A loop abnormality is determined if each change threshold is judged to be equal to or below "PS*."
– When [PS* = 0] is true, only time judgment is executed using LOP*.
When the time satisfying threshold of TS* or MS* exceeds LOP*, the loop abnormality is determined as detected.
(The symbol "*" takes the following values: "1" for the primary control and "2" for the secondary control.)

The loop abnormality function is usable when one of OUT 1 to OUT 7 is selected for the event loop abnormality existent.
About primary control loop abnormality-related setting .....P6-26~29
About secondary control loop abnormality-related setting.....P6-39~42
About event function 4 loop abnormality(E1~7F4) setting.....P6-54



< How to set >



How to cancel the loop abnormality hold

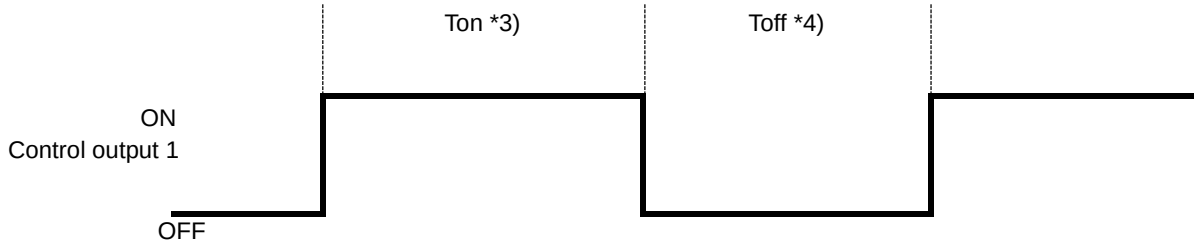
(1) Set the additional function setting of the event function 4 setting to "0: None."
(2) Turn off the power when no abnormality is present, and then turn it back on.

5.4.7 Current transformer (CT) abnormality function

■ What CT (current transformer) is

- CT is a function to detect that outputs are not properly turned on and off due to failure of relays or SSRs.
- For detection of failure, using CT, ensure to wire the CT terminal and output terminal (such as heater power supply), set the CT * target connection setting (CI *) and CT 1 abnormality current value setting (Ct 1), and establish the control effective.

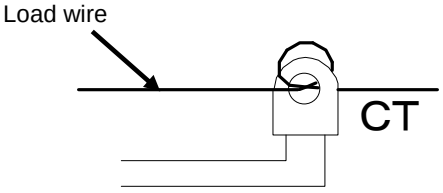
State of control output 1		Power distribution to heater	CT abnormality state
Output *	Operation lamp		
ON	Lighting	Existent *1)	Normal
		Nonexistent (output disconnection state)	Abnormal
OFF	Extinction	Existent (output short state)	Abnormal
		Nonexistent *2)	Normal



*1) Power distribution existent (normal) is determined when the CT 1 abnormal current value setting is larger than the CT current value in the period Ton.
*2) Power distribution nonexistent (normal) is determined when the CT 1 abnormal current value setting is smaller than the CT current value in the period Toff.
*3) State of the output disconnection is not detected when the ON time (Ton) of the control output 1 is 300 ms or smaller.
*4) State of the output short is not detected when the OFF time (Toff) of the control output 1 is 300 ms or smaller.

* Detection is unstable when the CT current value is small. To solve the issue, wind CT with load wires passing through the hole multiple times as illustrated below. Winding twice results in the detection current being larger by a multiplication factor of 2.

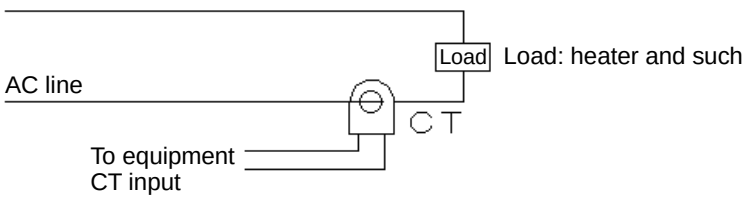
Note The detection accuracy is, however, deteriorated by a multiplication factor of 2.



■ Example of installation, setting calculation and parameter setting of CT

■ Single phase

Install CT in the location illustrated below.



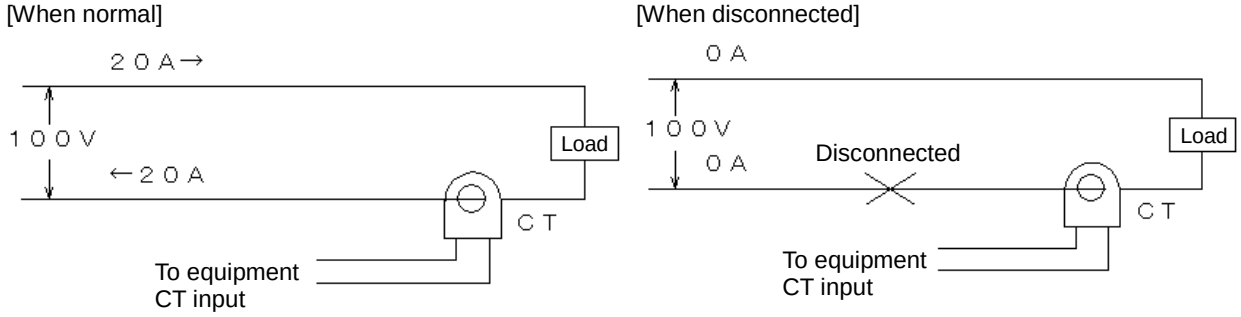
Note Wire in one way in any direction.

■ Calculation of the CT 1 abnormal current value setting
Detection current to be set is calculated with the following equation as an indication:

$$\therefore \text{ CT 1 abnormal current value setting value} = \frac{\text{Current normal value + current at heater disconnection}}{2}$$

Note Take care that the current in a multiplication factor of N flows when the load wire is wound around CT N times due to too small a measurement current. Sixty amperes or 6 times the actual current of 10 A flows when the load wire is wound around CT 6 times.

Example: Heater of 100 V, 2kW



The current on the heater is 20 A at normal and 0 A at disconnected, thus the CT 1 abnormal current value setting value is as follows.

$$\therefore \text{ CT 1 abnormal current value setting value} = \frac{\text{Current normal value + current at heater disconnection}}{2} = \frac{20 + 0}{2} = 10 \text{ [A]}$$

■ Example of parameter setting
The example shown below is identical to the above example, except where CT 1 is installed on the output 1 and CT abnormality is provided as output on the output 2.

	SEt6 oUt2	Name	Setting content	Setting value
	o2F	Target connection setting	Event output	2
	E2F3	Event function 3 setting (CT abnormality)	All modes, no added function, CT 1 abnormality	001

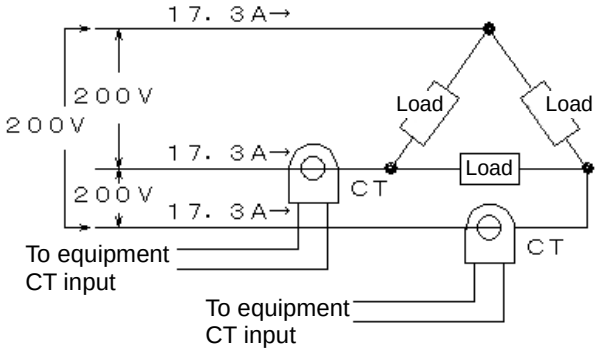
	SEt12 CT	Name	Setting content	Setting value
	CI1	CT 1 target connection setting	Connected to OUT 1 (allowed to be set in case of DO)	1
	Ct1	CT 1 abnormal current value setting		10.0

■ For 3-phase

■ Delta connection

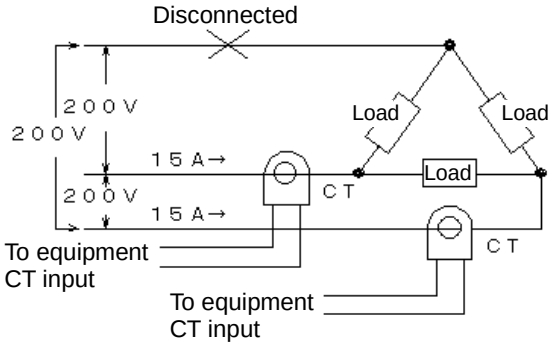
Example: Where 3 heaters of **200 V** and **2 kW** are used

[When normal]



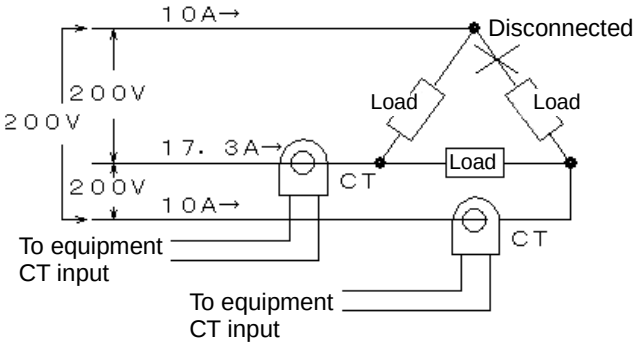
Normal current is **17.3 A** ($\fallingdotseq\sqrt{3} \times 10$ A) for each phase.

[When disconnected in between phases]



Current when disconnected = 10A×√3×(√3/2)
= 15A

[When disconnected on load side]



Current when disconnected = 10A×√3×(1/√3)
= 10A

The heater disconnection detection current value when disconnection occurs in between phases is as follows.

CT 1 abnormal current value setting value = (17.3 + 15)/2 ≒ **16.1** [A]

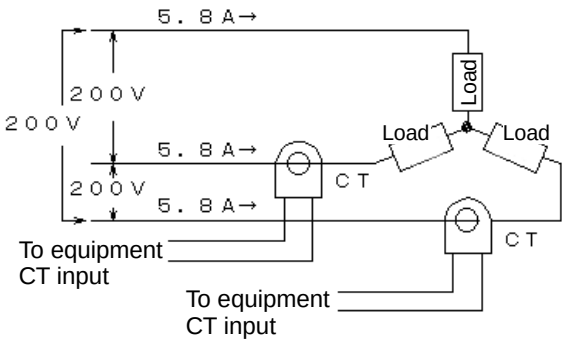
The heater disconnection detection current value when disconnection occurs on the load side is as follows.

CT 1 abnormal current value setting value = (17.3 + 10)/2 ≒ **13.65** [A]

For detection in both cases, the CT 1 abnormal current value setting value is to be **16.1 A**.

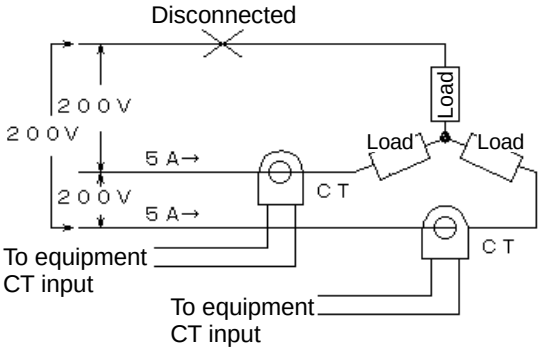
■ Star connection
Example: Where **3** heaters of **200 V** and **2 kW** are used

[When normal]



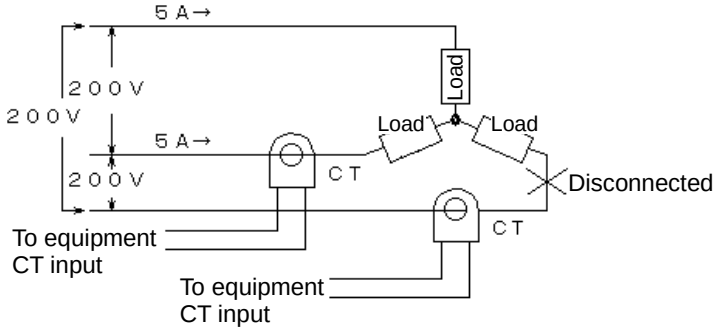
Normal current is **5.8 A** {≒10 A × (1/√3)} for each phase.

[When disconnected in between phases]



Current when disconnected in between phases = 10 A × (1/√3) × (√3/2) = **5A**

[When disconnected on load side]



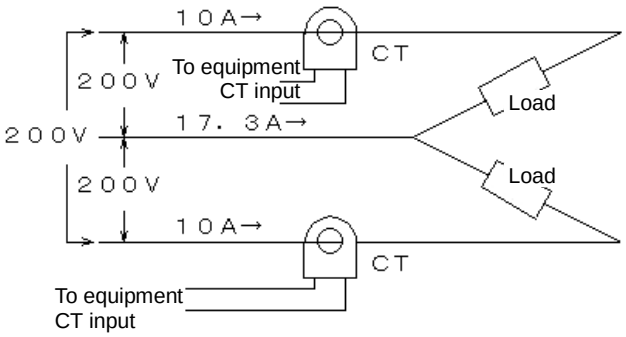
Current when disconnection occurs on the load side = 10 A × (1/√3) × (√3/2) = **5A**

The CT 1 abnormal current value setting value for this connection is **5.4 A** {= (5.8 + 5)/2}.

■ V connection

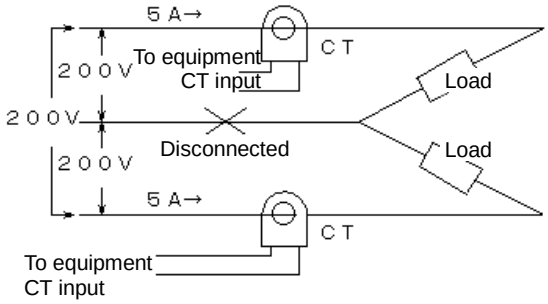
Example: Where **2** heaters of **200 V** and **2 kW** are used

[When normal]



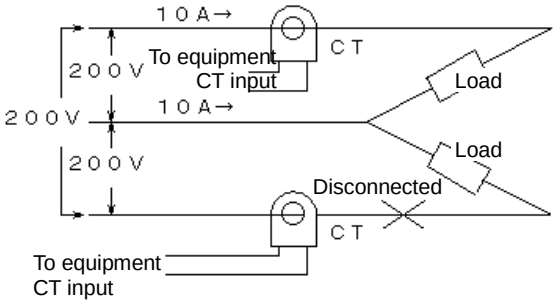
The current that flows in the target device for CT installation is **17.3 A** ($\fallingdotseq\sqrt{3} \times 10$ A).

[Disconnected on the common side]



Current when disconnected = 10A × (1/2)
= 5A

[When disconnected on load side]



Current when disconnected = 10A × 1
= 10A

The heater disconnection detection current value when disconnection occurs on the common side is as follows.

Heater disconnection detection current value = (17.3 +5)/2 ≒ **11.2** [A]

The heater disconnection detection current value when disconnection occurs on the load side is as follows.

Heater disconnection detection current value = (17.3 +10)/2 ≒ **13.7** [A]

Hence, the heater disconnection detection current value is to be **13.7 A** in order to detect disconnection in both cases.

■ Example of parameter setting

The following is an example when CT 1 and 2 are installed on the outputs 1 and 2 respectively in the connection shown above and CT abnormality is provided as output on the output 3.

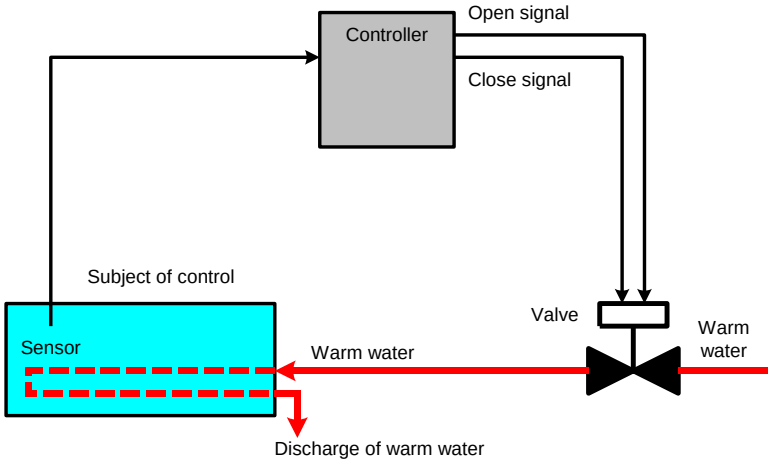
	SEt6 oUt2	Name	Setting content	Setting value
	o3F	Target connection setting	Event output	2
	E3F3	Event function 3 setting (CT abnormality)	All modes, no added function, CT 1 abnormality + CT 2 abnormality	003

	SEt12 CT	Name	Setting content	Setting value
	CI1	CT 1 target connection setting	Connected to OUT 1 (allowed to be set in case of DO)	1
	Ct1	CT 1 abnormal current value setting		13.7
	CI2	CT 2 target connection setting	Connected to OUT 2 (allowed to be set in case of DO)	2
	Ct2	CT 2 abnormal current value setting		13.7

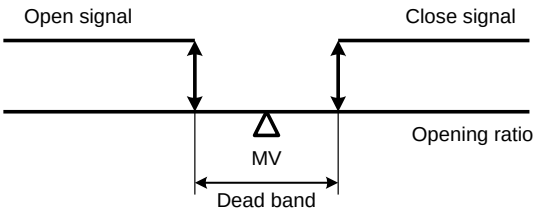
5.4.8 Position proportional control

■ What the position proportional control is

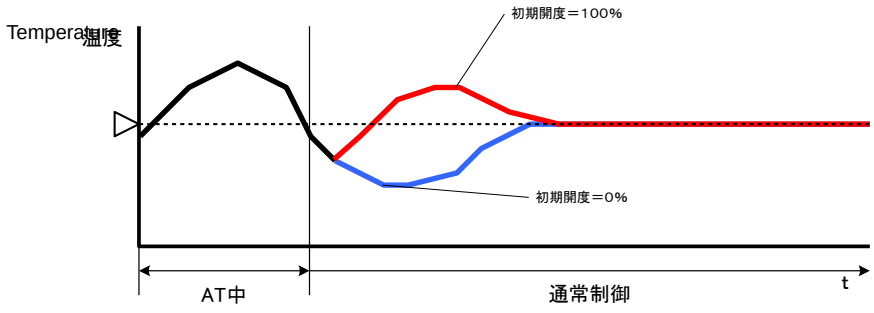
- In the position proportional control, the temperature of the subject is controlled through adjusting the flow rate, which depends on the valve opening ratio. The valve opening ratio is controlled by open or close signal that is output for the valve, where an operating amount is calculated by the PID control, taking into account the valve motor stroke time. The position proportional control can control a subject without feedback resistance.
- The valve motor stroke time is defined as time required for a valve from full close to full open.



- Valve motor drive dead band
  The controller for the position proportional control operates output of open or close signal such that the operating amount of the controller is coincident with the valve opening ratio. To save service life of the valve, frequent switchover operation for opening and closing the valve must be avoided as much as possible.
  Hence, a dead band is provided on the output switchover points for open and close signals, so that outputs of both the open and close signals are halted in this band range in order to reduce the frequency of open and close switchover operations.



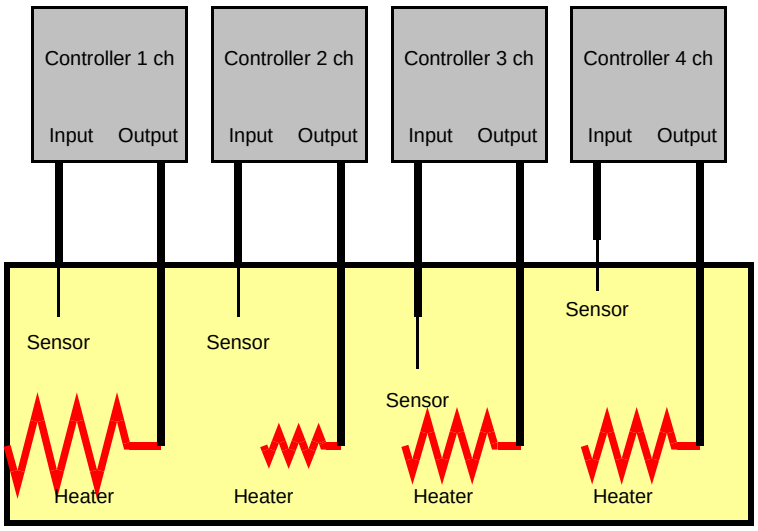
- Post-AT initial opening ratio
  The operating amount can be set for suppressing undershoot that is possibly generated right after the termination of AT.
  Example: Response in post-AT



5.4.9 Concurrent temperature ascent function

■ What the concurrent temperature ascent is

- When a concurrent temperature ascent control is executed for multiple channels using the RS-485 communication function, a target value can be reached for each channel at the same clock time, disregarding characteristics of each channel through assigning master or slave to the channels. The channel that requires the longest time for reaching the target value from the start of the control is assigned as a master and others as slaves.
- The concurrent temperature ascent function is activated when operation starts, including when power turns on, or setting value is changed, and terminated when the master reaches the target value.



- How to use the function
  1) Set the communication protocol setting (SEt 17) to TOHO protocol.
  2) Set the communication switchover setting (SEt 17) to a concurrent temperature ascent master for a channel that requires the longest time to reach the target value, and to concurrent temperature ascent slaves for others.
  3) Set the primary control sensitivity setting (SEt 04).
     Set the sensitivity to such a degree that no chattering is generated, as the slave sides are ON/OFF-controlled to the present temperature on the master during concurrent temperature ascent.

Note Precautions on the use

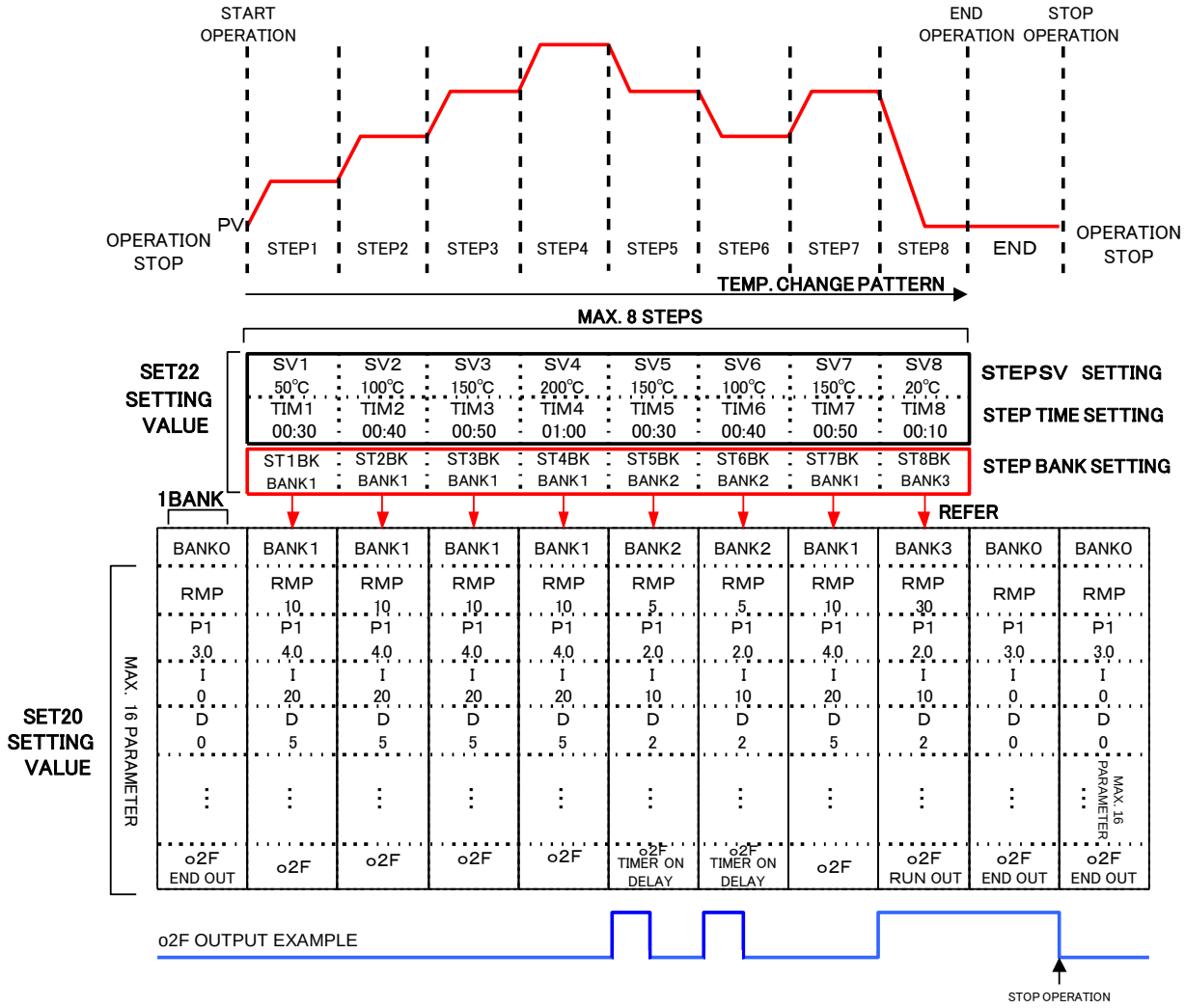
1) Conduct the auto-tuning for each channel as needed.
2) Do not execute external communication during the use of the concurrent temperature ascent function.

5.5 Explanation of the program run function

■ The digital controller TTM-200 Series can provide a simple program controller. This chapter explains the program run of TTM-200 Series.

- A program run of this product is established by automatically controlling "bank function" and "program step function." The process flow for establishing a program run is described below.

■ Program run operation explanation diagram



- A certain pattern of a status to be changed, such as temperature, is developed. The diagram above shows an example of a temperature change pattern. To automatically change this pattern, it is divided into the smallest units referred to as **STEP**.
- Set the auto run sequence of a STEP to the **SET 22** "program step" parameter.
- For "step bank setting" **of SET 22**, **SET 20** "bank function" is referred. With this reference, operations of "input, output, timer output, event input/output, control parameters, etc." for each step are determined.
- Parameters necessary for such control as "input," "output," "timer output," or "event" are set. The steps during an auto run sequence are automatically switched by the sequence, and banks set with control parameters are also switched. This mechanism provides a program run.
- This product allows a program run in eight steps at most.

5.5.1 Operation flow of the program run

- Digital controller: This section explains operation process of the program run using TTM-200. To perform a program run, the **SET 20**, **SET 21** and **SET 22** parameters must be set.
- The setting content is as follows:

  Set a parameter desired to change with setting value in the **SET 20** bank setting for each step. For the setting, select a parameter requiring to be switched during a program run from **SETs 1 to 17**.

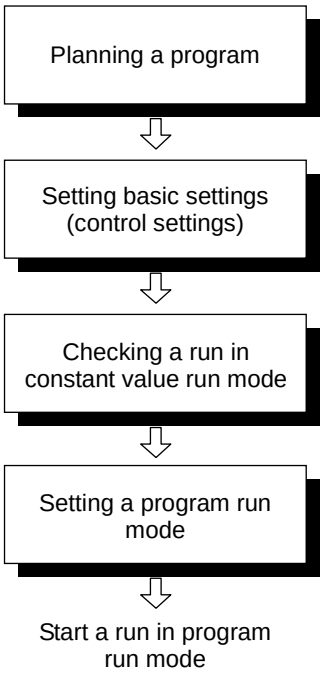
  For details of the bank setting, see operation explanation - bank function (P5-28 to 30).

  The **SET 21** program function setting sets a program run method. Also, the **SET 22** program setting sets a program run pattern. Perform the settings according to this manual.

Note No program is used in "constant value run mode" and "program run mode." In "constant value run mode," the SET 22 program is not displayed. A switchover in this mode is made with **SET 21 (C/P)**.

The diagram below shows a general process flow of a program run. Settings should be made along with the flow.

For setting and operation check in Items 2 to 4 below, see "How to set run settings" (P5-4 to 21) and "How to set each function and description of function" (P5-22 to 46).



1. Planning a program
   Plan setting parameters and operating statuses required for control.
   - Planning program run patterns
   - Planning setting parameters

2. Setting basic settings: Set necessary parameters in **SETs 1 to 19**.
   - "Input setting": Sensor type, temperature range, etc.
   - "Output setting": Output type, output method, presence of alarm setting, etc.
   - "Presence/absence of event function usage": DI polarity, etc.
     "Presence/absence of timer function usage": Timer operation method, time setting, etc.
     "Key setting": Presence/absence of Func key usage, etc.

3. Setting a bank
   - Set necessary parameters to the bank by switching **SETs 1 to 17** in a program run.

4. Checking an operation of constant value run mode
   - Check the bank settings by manually switching the bank in key operation or with DI.
     Check each of all set banks for planned control condition.

5. Set a program run mode.
   Set the **SET 21** program function setting and **SET 22** program setting in accordance with the program run chart.

6. Checking an operation of program run mode
   - Check operation status of each step by manually switching the step in key operation or with DI.

⚠ Caution: Before starting a program run:
Check program content and control status before starting an unattended run in order to prevent accidents during the program run.

5.5.2 SET 21 program function setting

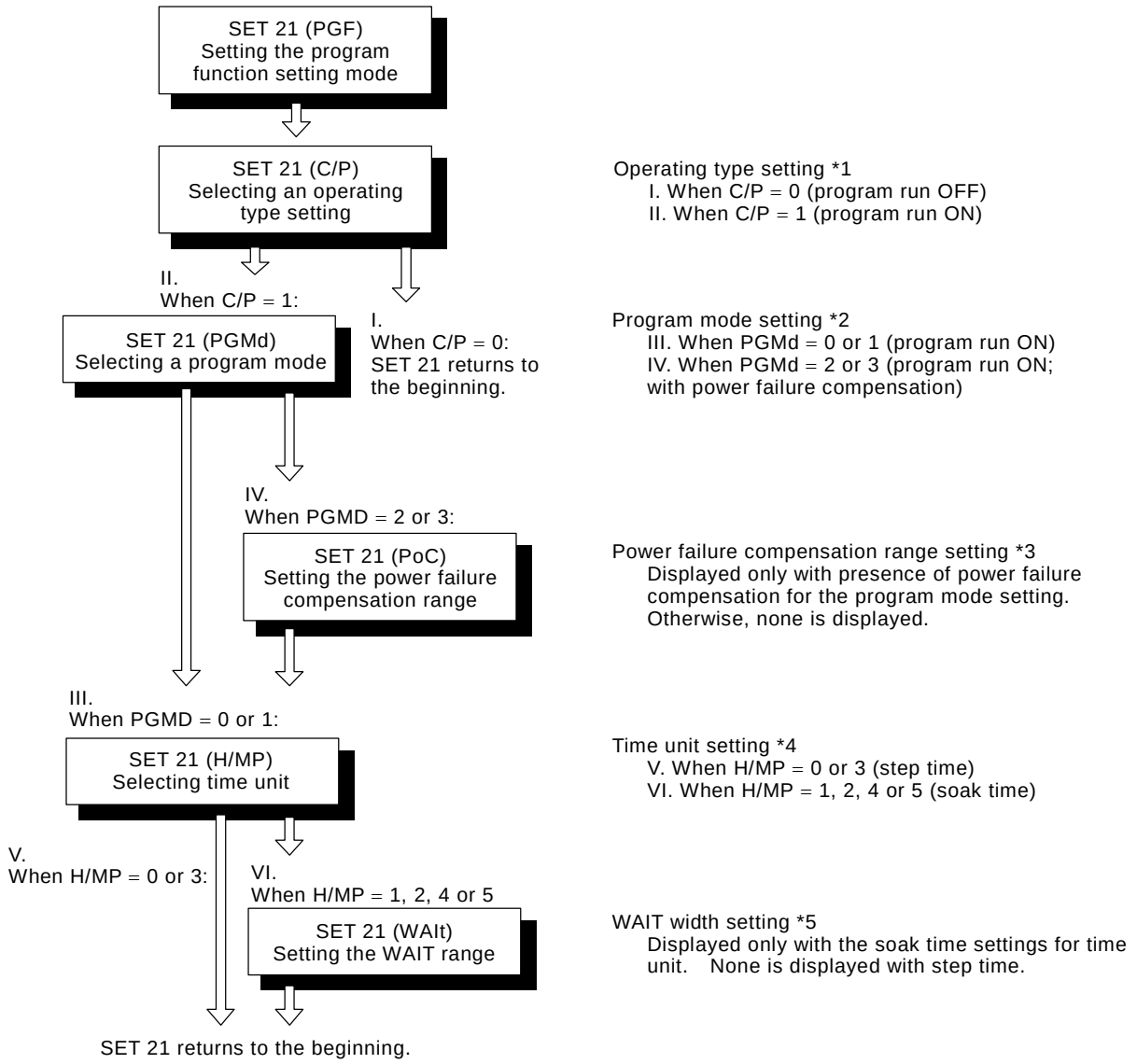
■ The **SET 21** program function setting is for setting operating method of a program run.

Set the setting values for the following: "program run mode," "power failure compensation range," "time unit," "WAIT range" and "Program run start/stop."

The flowchart below is for "**SET 21** program function setting."

Note Note that some screens do not appear depending on setting values. Characters indicated in parentheses are those displayed on a screen.

[Setting flow]



The next page describes the content of each setting value.

*1: Operating type setting (C/P)

Set "operating method."

Setting range Initial value: 0 in constant value run mode

0: Constant value run mode (program run mode OFF)
1: Program run mode (program run mode ON)

*2: Program rum mode setting (PGMd)

Set "return operating method" and "operation method after program run" in case of power failure during a program run.

Setting range Initial value: 0 Program 1 (without power failure compensation)

0: Program 1 (without power failure compensation)
1: Program 2 (without power failure compensation)
2: Program 1 (with power failure compensation)
3: Program 2 (with power failure compensation)

- Program 1: Control stops when a program run ends. When a run ends, ENd is displayed and control stops.
- Program 2: Control remains active at a status of the last step even after a program run ends. Control continues even though ENd is displayed after a run ends. Control becomes in a stop status by manual operation (key operation) or DI entry.

Note The SET 4 control mode setting (Md) becomes inactive in program rum mode (C/P = 1). Only constant value rum mode is active.

Regarding power failure compensation

Upon return from a power failure with "With power failure compensation," the run restarts from the step being in progress at the time of the power failure.
"Current step," "repetitive count" and "remaining time" are stored.
In case of power failure, the status returns to that last-stored in the step, and the run restarts provided that the setting condition of the power failure compensation range setting (PoC) is met.

Note Note that time error is generated within a step even though a run restarts from the middle of a program run if the return condition (power failure compensation range setting) is met.

Note The return conditions is that the difference of the PV values between at return and before return is smaller than the power failure compensation range setting (PoC) as shown in the formula below:
<Condition > Power failure compensation range setting (PoC) ≥ (PV value at return) – (PV value before return)

*3: Power failure compensation range setting (PoC)

Set the criteria range for the condition described above for return from a power failure.

Setting range Initial value: 0

Temperature input (°C): 0 to 999 (0.0 to 999.9)	Always return at 0.
Analog input (digit): 0 to 9999	Always return at 0.

Note Upon return from a power failure, no return operation is performed in case of disconnected or failed sensor regardless the (PoC) setting value. The run status is of program run in stoppage.

*4: Time unit setting (H/MP)

Set “time unit” and “step transfer condition (time countdown condition)” of a step.

Setting range Initial value: 0: Step time (hour: minute)

0: Step time (hour: minute)
1: Soak time 1 (hour: minute)
2: Soak time 2 (hour: minute)
3: Step time (minute: second)
4: Soak time 1 (minute: second)
5: Soak time 2 (minute: second)

Note Regarding meanings of “step,” “soak 1” and “soak 2”

“Step time”: The step proceeds in accordance with a set step time (SET 22 tIM*) regardless statuses of PV or SV. Therefore, a step proceeds to the next one when set time elapses.

“Soak time 1”: Time is count down if a PV falls within the set WAIT range even once. A step proceeds to the next one when set time elapses. Judgment is made with a set PV even if a ramp is set.

“Soak time 2”: Time is count down only within a set WAIT range.

For details, see “Complementary explanation of the program run” in Section 5.5.7 (P5-61 and 69).

*5: WAIT range setting (WAIt)

Set “range for a PV value” when using the “soak time 1 or 2” function.

Setting range Initial value: 2

(During temperature input)
Soak time 1: 0 to 999 (0.0 to 999.9)°C
Soak time 2: 0 to 999 (0.0 to 999.9)°C

(During analog input)
Soak time 1: 0 to 9999 (digit)
Soak time 2: 0 to 9999 (digit)

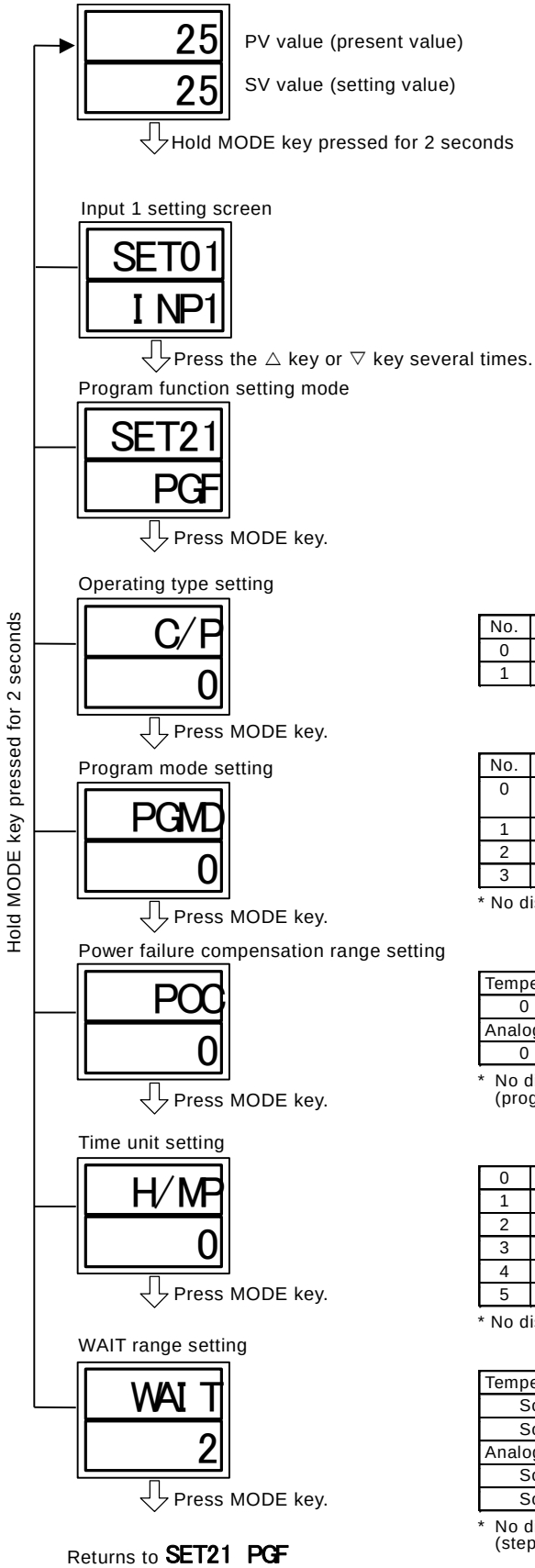
Note Complementary to the WAIT range setting

The operation for the soak time 2 (H/MP = 2) is the same as that for the soak time 1 in the WAIT range setting (WAIt = 0).

For details, see “Complementary explanation of the program run” in Section 5.5.7 (P5-61 and 69).

5.5.3 SET 21 program function setting screen

■ The program function setting screen is shown below.



No.	Setting range
0	Constant value run mode (initial value)
1	Program run mode

No.	Setting range
0	Program mode 1 (without power failure compensation) initial value
1	Program mode 2 (without power failure compensation)
2	Program mode 1 (with power failure compensation)
3	Program mode 2 (with power failure compensation)

* No display when C/P = 0 (normal)

Temperature input (initial value = 0)
0 to 999 (0.0 to 999.9) (°C)
Analog input (initial value = 0)
0 to 9999 (digit)

* No display when C/P = 0 (normal) or PGMd = 0 or 1 (program run without power failure compensation)

0	Hour: minute (step time) (initial value)
1	Hour: minute (soak time 1)
2	Hour: minute (soak time 2)
3	Minute: second (step time)
4	Minute: second (soak time 1)
5	Minute: second (soak time 2)

* No display when C/P = 0 (normal)

Temperature input (initial value = 2)
Soak time 1: 0 to 999 (0.0 to 999.9) (°C)
Soak time 2: 0 to 999 (0.0 to 999.9) (°C)
Analog input
Soak time 1: 0 to 9999 (digit)
Soak time 2: 0 to 9999 (digit)

* No display when C/P = 0 (normal) or H/MP = 0 or 3 (step time)

5.5.4 SET 22 program setting

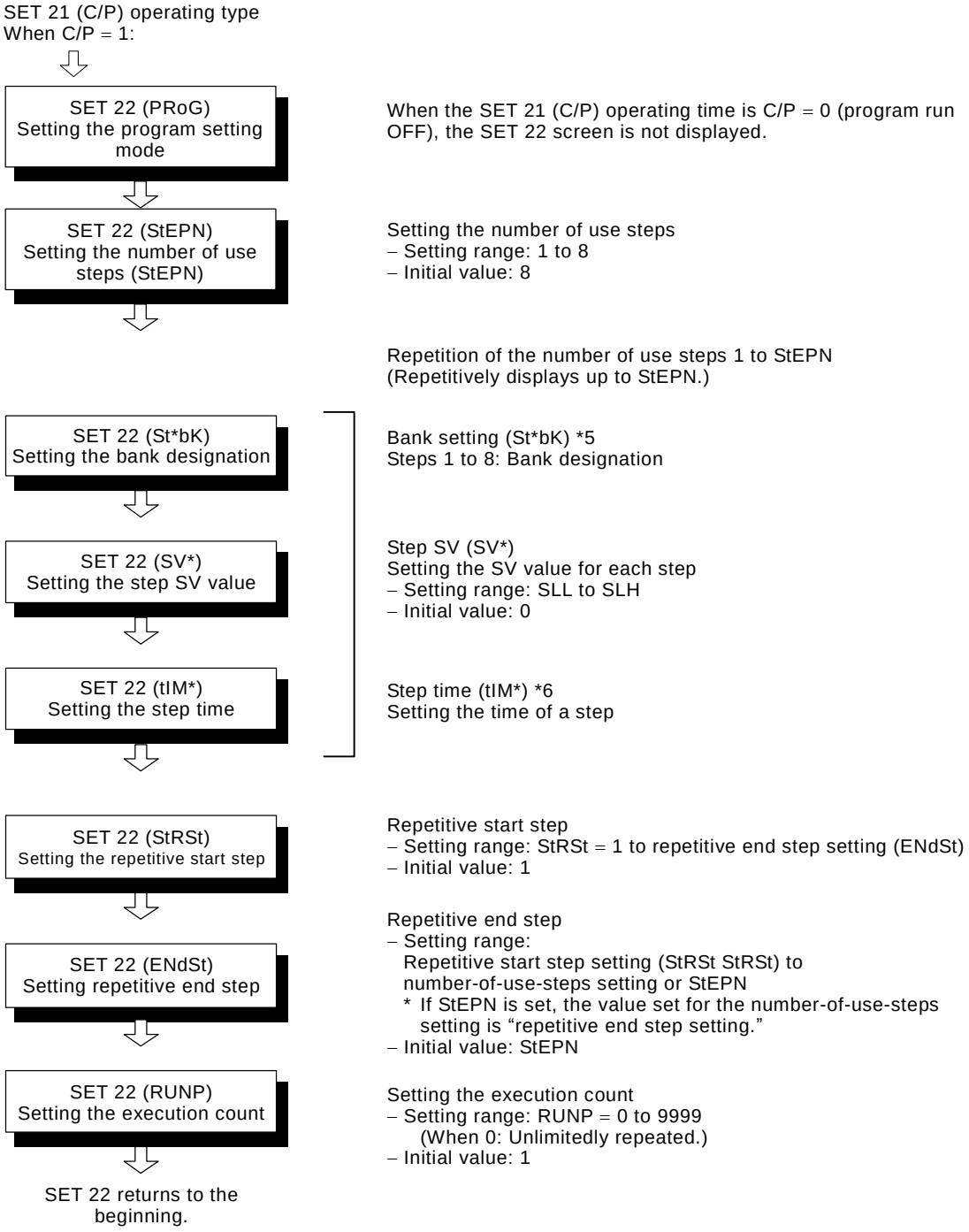
■ Set a pattern (program) of the program run in the SET 22 program setting.

[Setting items]

- Set "number-of-use-steps" of the program.
- Set "bank designation," "step SV value" and "step time" of each step.
- Set "repetitive start step," "repetitive end step" and "execution count."

[Setting flow]

The flowchart below is for "**SET 21** program function setting." Characters indicated in parentheses are those displayed on a screen.



Note Some screens do not appear depending on setting values.
This screen is not displayed in constant value run mode (C/P = 0).

*5: Bank setting (St*bK)

Switchover is made for each step of a program. "Bank No." can be designated.

Setting range: St*bK = 0 to 7 (The range depends on SET 4 bANKH.)
Initial value: St* bK = 0 (* = 1 to 8)

Note The symbol "*" of the parameter setting display "St*bK" indicates "step No." (The range depends on SET 22 StEPN.)

Note Effective only during a program run

Note When the bank automatic switching function is used (SET 23 BAF = 1), no display appears. The bank automatic switching function is prioritized over the "bank No." designation.

6: Step time (tIM)

Sets the step time of a program.

Setting range: tIM* = 00:00 to 99:59 Initial value: 00:00 to (* = 1 to 8)

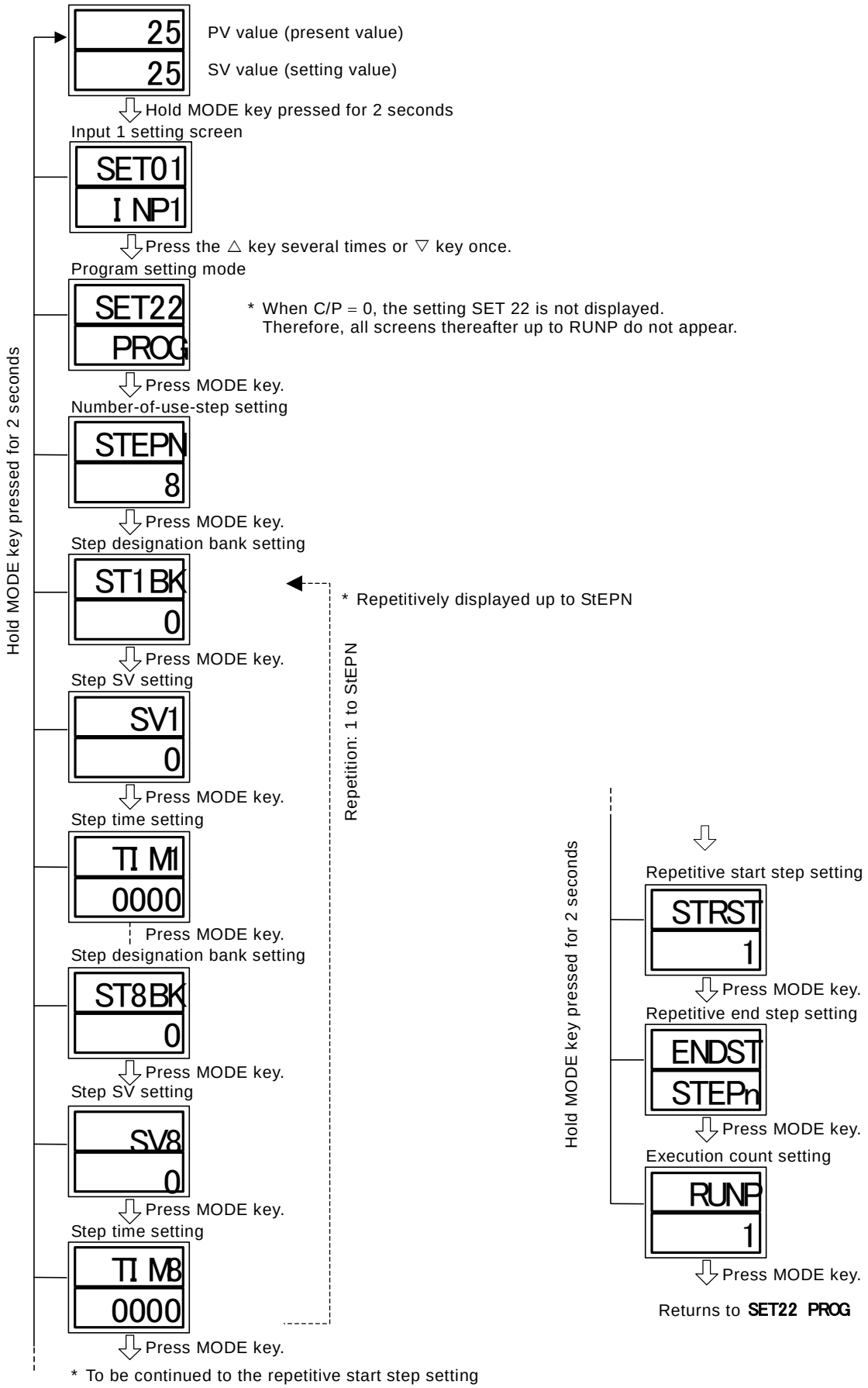
Note The symbol "*" of the parameter setting display "tIM*" indicates "step No." (The range depends on SET 22 StEPN.)

Note The time unit is set in the time unit setting (SET 21 H/MP).

Note With the setting value of "00:00," a run unlimitedly continues.

5.5.5 SET 22 program setting screen

■ The program setting screen is shown below.



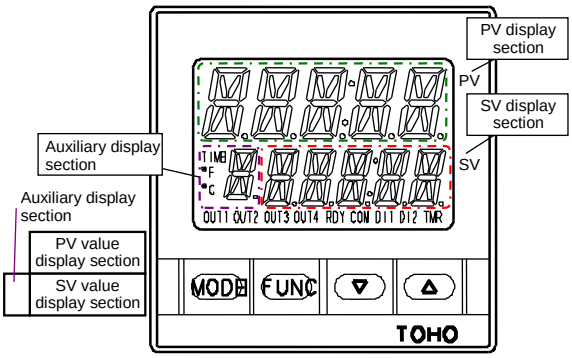
5.5.6 Explanation of the screen display and operation of a program run

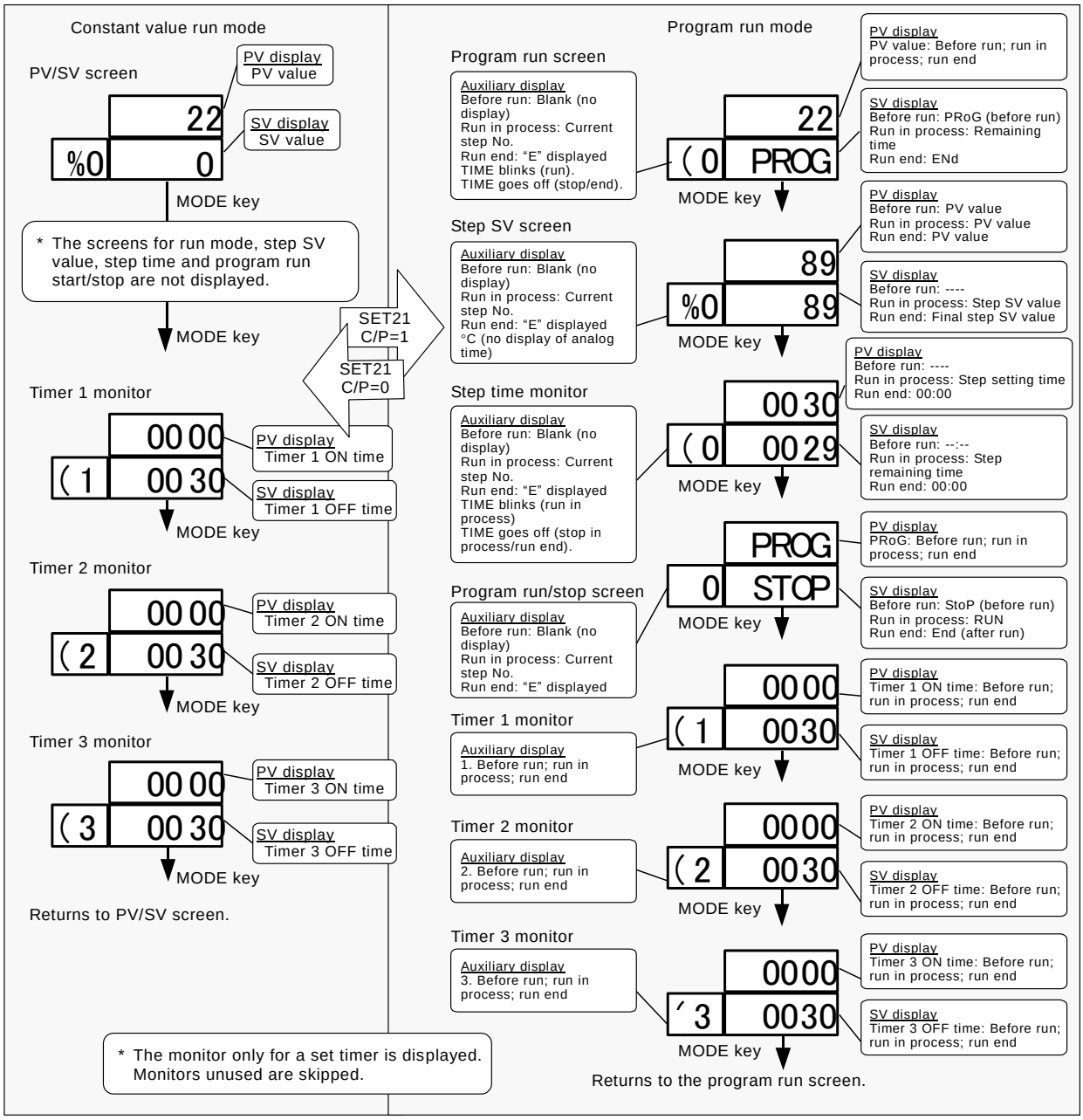
■ Switching the run screen

Switching between "constant value run," in which no program is used, and "program run," in which a program automatically executes a run, is performed with "**SET 21 C/P**."
This section describes "program run mode."

The diagram below shows that the display varies depending on the difference of run modes.

Note The diagram indicates an example of "TTM-204 operation panel display/operation section." The operation method for TTM-205, 207 and 209 is the same as that for TTM-204.

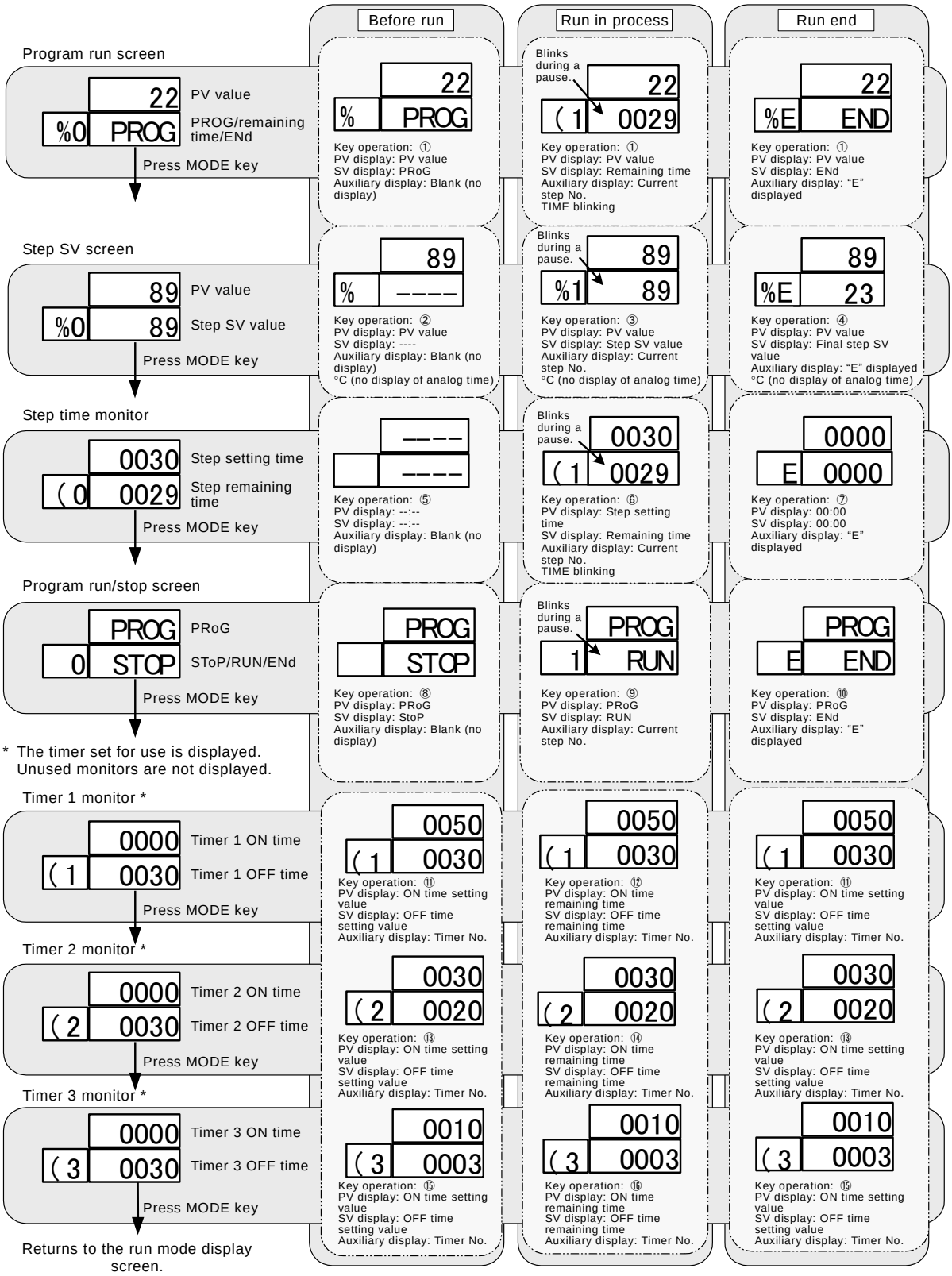




Details of "program run screen" are described in the next page, "Regarding operation and display of a program run."

■ Regarding operation and display of a program run

The diagram below shows "screen display during a program run." The screens are categorized into "before run," "run in process" and "run end" depending on run status.



The numbers of ① to ⑯ in the diagram indicate key operations. Details are shown in the "program run mode" operation list table in the next page.

■ Regarding the “program run mode” operation list table

“Program run” is categorized into “before run,” “run in process” and “run end” depending on run status, for which the operable keys vary. “Operation list table” indicates key operations corresponding to the status.

“In-stop” indicates before a run, “run in process” a run in process and “After-end” a run ended.

The INDEX ① to ⑯ in the diagram corresponds to “operation and display of a program run” in the previous page.

< Operation list table (1/3) >

INDEX	Screen	Key operation			Behavior
		Run status	Type	Operation method	
①	Program run screen	Before run Run in process Run end	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To step SV value display screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
②	Step SV value screen	Before run	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To step time monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	Run start
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
③		Run in process	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To step time monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	Setting: SV value increased
			▼	Depression	Setting: SV value decreased
④		Run end	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To step time monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	Run stop*4
			▲	Depression	No action
			▼	Depression	No action

Note *4: This key operation is ineffective if “start/stop” is set for the FUNC key or DI.

< Operation list table (2/3) >

INDEX	Screen	Key operation			Behavior
		Run status	Type	Operation method	
⑤	Step time monitor	Before run	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the program run start/stop screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	Run start
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
⑥		Run in process	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the program run start/stop screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	Setting: Remaining time increased
			▼	Depression	Setting: Remaining time decreased
⑦		Run end	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the program run start/stop screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	Run stop*4
			▲	Depression	No action
			▼	Depression	No action
⑧	Program run start/stop screen	Before run	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the timer 1 monitor screen*1
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	Run start
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
⑨		Run in process	MODE	Depression	To the timer 1 monitor screen*1
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	Step feed*3
			▼	Prolonged press of 2 seconds	Run stop*4
			▲	Depression	Run restart*2
			▼	Depression	In pause*2
⑩		Run end	MODE	Depression	To the timer 1 monitor screen*1
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	Run stop*4
			▲	Depression	No action
			▼	Depression	No action

Note *1: The timer monitor only displays the timer to be used. Timers unset are not displayed.
*2: This key operation is ineffective if “pause” is set for the FUNC key or DI.
*3: This key operation is ineffective if “step feed” is set for the FUNC key or DI.
*4: This key operation is ineffective if “start/stop” is set for the FUNC key or DI.

< Operation list table (3/3) >

INDEX	Screen	Key operation			Behavior
		Run status	Type	Operation method	
⑪	Timer 1 monitor*1	Before run Run end	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the timer 2 monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
⑫		Run in process	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the timer 2 monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	Setting time increased
			▼	Depression	Setting time decreased
⑬	Timer 2 monitor*1	Before run Run end	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the timer 3 monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
⑭		Run in process	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the timer 3 monitor screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	Setting time increased
			▼	Depression	Setting time decreased
⑮	Timer 3 monitor*1	Before run Run end	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the run mode display screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	No action
			▼	Depression	No action
⑯		Run in process	MODE	Prolonged press of 2 seconds	To the setting mode
			MODE	Depression	To the run mode display screen
			FU1-5	Depression	Follows the function key setting.
			▲	Prolonged press of 2 seconds	No action
			▼	Prolonged press of 2 seconds	No action
			▲	Depression	Setting time increased
			▼	Depression	Setting time decreased

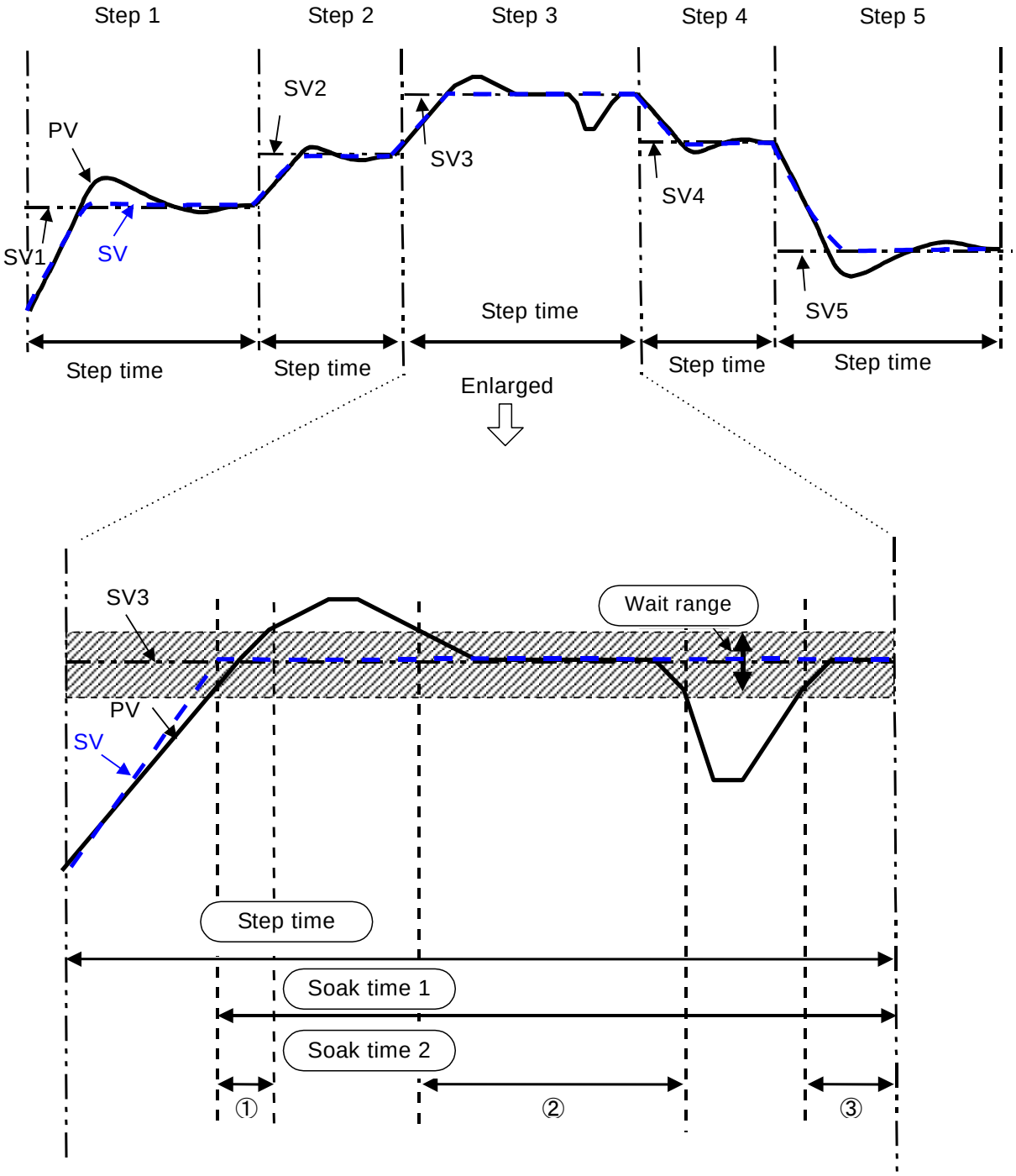
Note * 1: The timer monitor only displays the timer to be used. Timers unset are not displayed.

5.5.7 Complementary explanation of the program run

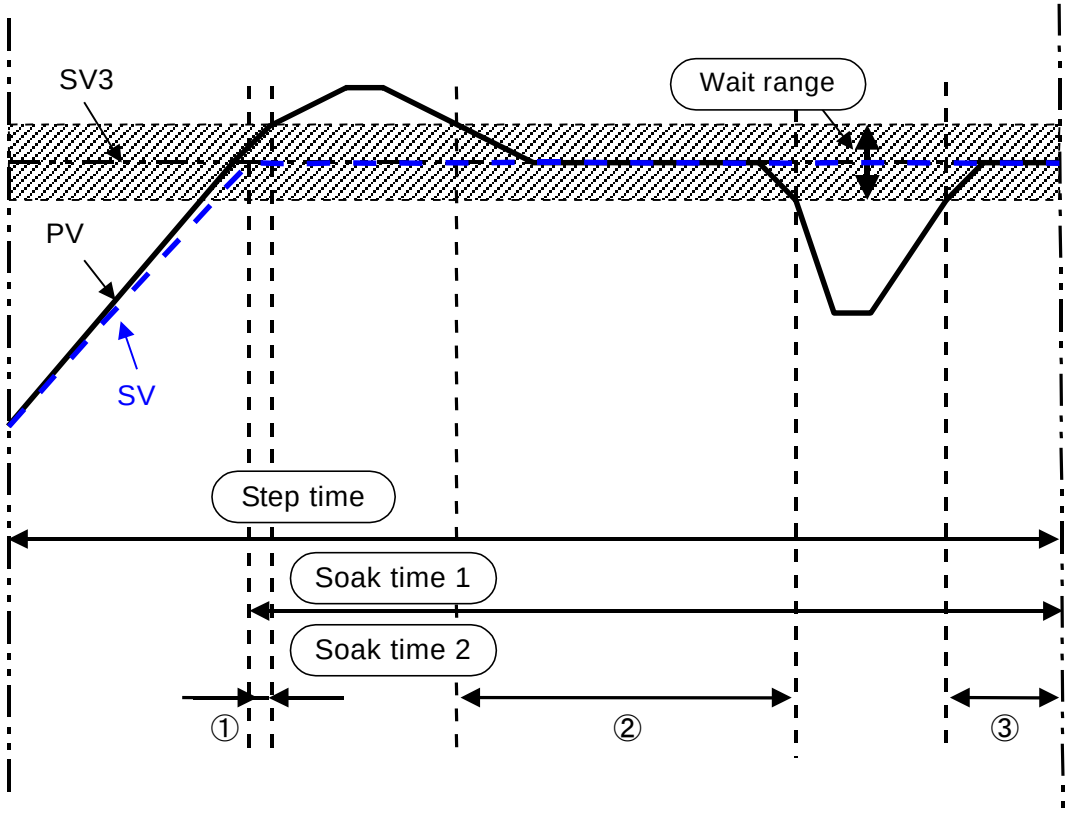
■ Regarding the time unit setting (H/MP)

Parameters for “step time” and “countdown condition” are provided in the program settings. “Countdown condition” can be selected with a setting value. The example below is for STEPn = 5 (step number 5).

The total time of each step is referred to as “step time” and a status terminated with temperature variation as “soak time.” The time unit setting (H/MP) is performed for “countdown condition” of “step time” according to the status.



If an increase rate of PV is larger than that of SV, the countdown begins after SV reaches SV3.



< Countdown condition >

Step time (H/MP = 0 or 3): The program steps proceed in accordance with the time set for each step. Time countdown begins regardless of the statuses of **PV** and **SV values** and a step proceeds to the next one upon set time elapsed.

Soak time 1 (H/MP = 1 or 4): When a **PV value** falls within the set wait range, time countdown begins. Judgment is made with a set **SV value** even if a ramp is set. A step proceeds to the next one after the countdown begins and the set time is elapsed.

Soak time 2 (H/MP = 2 or 5): Time countdown is executed within a set wait range (① + ② + ③). The countdown is halted while a value is out of the wait range. The countdown continues when the value comes back within the range. Judgment is made with a set **SV value** even if a ramp is set. A step proceeds to the next one after the countdown begins and the set time is elapsed.

Note If the soak time 1 or 2 is selected, the countdown begins based on comparison of the **PV value** with the **SV value**. The comparison of the **PV value** with **SV* (*= 1 to 8)** is executed within a common **wait range (WAIt)**.

Note The countdown generally begins based on the comparison between the **PV** and **SV values**; however, the countdown begins when the **current SV value = SV* (*= 1 to 8)** is established if the ramp function is used. No countdown is executed during temperature varying.

Note The ramp function cannot be used if a step time (H/MP = 0 or 3) is set.

Note SV3: The control setting value is only for the purpose of explanation but not actual setting for the main body.

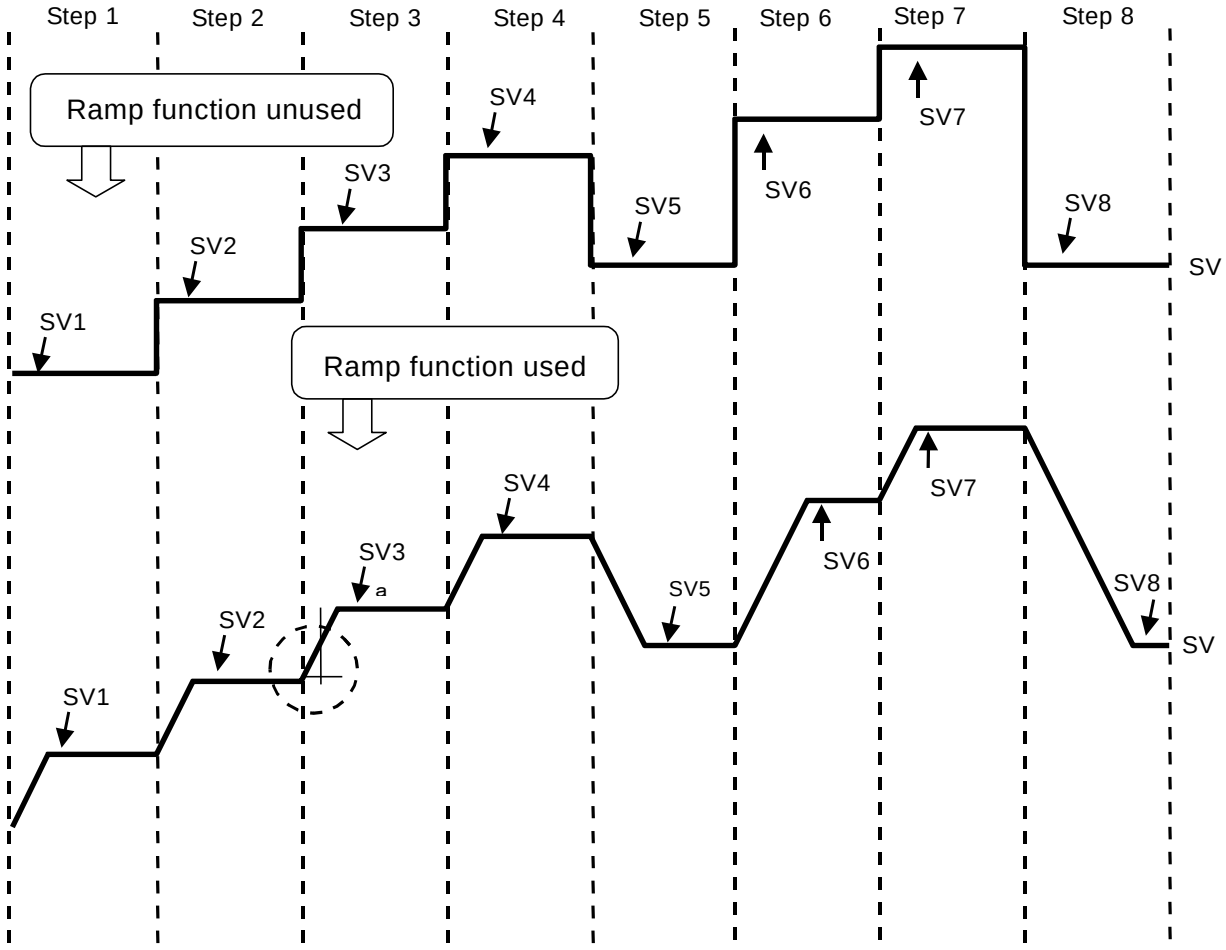
■ Regarding the ramp function

The ramp function can be used even during a program run. To use the function, first set a RMP for either one of the banks [SET 20 bNK01 to 16]. Next, set the RMP value for each bank. The function is executed with the RMP value designated by [SET 22 St*bK] during the program setting.

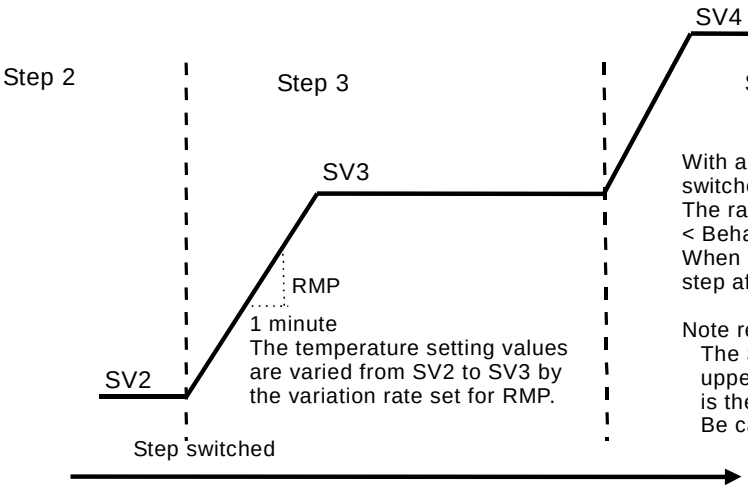
Note Note that the ramp function is ineffective if the step time [H/MP = 0 or 3] is set.

Note In the case of ramp setting (RMP = 0), the ramp function does not work.

Example for StEPN = 8



Ramp function used; enlarged diagram



With a ramp time set, SV* is ramp-controlled at step switchover.
The ramp is defined as the variation of SV* per minute.
< Behavior >
When a SV changes due to bank switchover at each step after starting a program run

Note regarding event output during a ramp:
The SV for deviation upper/lower limit, deviation upper limit, deviation lower limit and deviation range is the SV during a ramp.
Be careful that the SV is not a final target.

■ Regarding the time signal output function

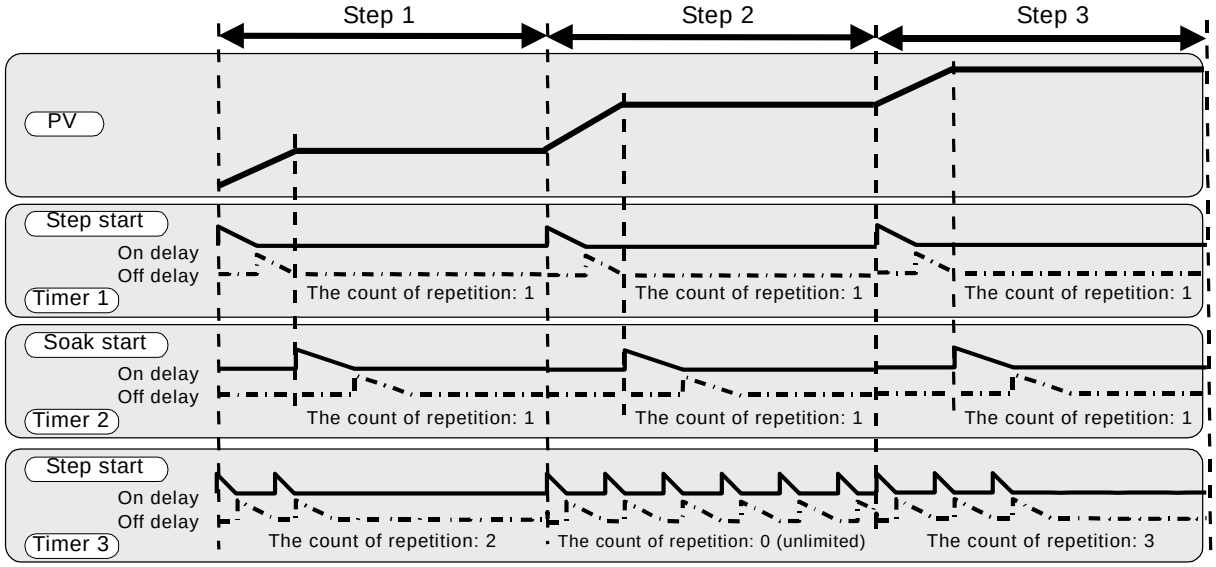
A signal of time signal can be output for each step during a program run. Timers 1 to 3 for step time are usable as is, as a timer independent from those is used for the signal.

Note The function is active only during a run. Timer operation is also halted during In-stop or After-end.

Note The timer is reset at step switchover and END transition.

Note Timer operation is skipped to make transition with a step time if a time longer than the step time is set.

Example for StEPN = 3



All three timers (Timers 1 to 3) are usable at each step. The diagram indicates an example of Timer 1 set for step start, Timer 2 for soak start and Timer 3 for step start. To use a timer for each step, parameters necessary for the timer function are first set in the bank [SET 20 bNK01 to 16]. For details, see Section 5.4.5 Timer function (P5-31 to 37).

To use **On** or **Off** outputs from Timers 1 to 3 as time signals, set the **output destination** [**o*F**] in "connection destination setting table" to either [**5 to 16**].

(Connection destination setting table)

	SEt05 oUt1 to SEt11 oUt7	Setting content		Initial value
1	**o1F to o7F**	**0**	Primary output	**o1F:0** **o2F:2 to o7F:2**
		1	Secondary output	
		2	Event output	
		3	RUN output	
		4	RDY output	
		5	Timer 1 output	
		6	Timer 1 during-on-delay output	
		7	Timer 1 during-off-delay output	
		8	Timer 1 during-[on + off]-delay output	
		9	Timer 2 output	
		10	Timer 2 during-on-delay output	
		11	Timer 2 during-off-delay output	
		12	Timer 2 during-[on + off]-delay output	
		13	Timer 3 output	
		14	Timer 3 during-on-delay output	
		15	Timer 3 during-off-delay output	
		16	Timer 3 during-[on + off]-delay output	
		17	Transmission output (for analog output)	
		18	Program run end output	

This section introduces the timer function. Timer behavior is determined by defining the following parameters: timer function setting [tMF 1 to tMF 3], unit setting [H/M 1 to H/M 3], SV start allowable range setting [tSV 1 to tSV 3], On delay timer [oNt 1 to oNt 3], Off delay timer [oFt 1 to oFt 3], repetition count setting [RUN 1 to RUN 3], etc.

(Timer function setting)

	SEt14 tIME1 to SEt16 tIME3	Setting content		Initial value
1	**tMF1 to tMF3**	**1**	Auto start	**1**
		2	Manual start	
		3	SV start	
		4	DI 1 start (settable when an option existent)	
		5	DI 2 start (settable when an option existent)	
		6	DI 3 start (settable when an option existent)	
		7	DI 4 start (settable when an option existent)	
		8	Event 1 start	
		9	Event 2 start	
		10	Event 3 start (settable when an option existent)	
		11	Event 4 start (settable when an option existent)	
		12	Event 5 start (settable when an option existent)	
		13	Event 6 start (settable when an option existent)	
		14	Event 7 start (settable when an option existent)	
		15	Step start	
		16	Soak start	

(Unit setting)

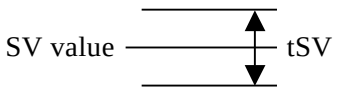
		Setting content		Initial value
2	**H/M1 to H/M3**	**1**	Hour/minute	**1**
		2	Minute/second	

If the SV start is set, set the temperature in °C or the digit width range which a timer starts.

(SV start permissible range setting)

		Setting content	Initial value
3	**tSV1 to tSV3**	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C)	**0**
		Voltage/current input **0 to 9999** (digit)	

- The allowable range is set in range of **tSV** with its center at the **SV value** as illustrated below.



- If **tSV** is set to 1.0 °C, the timer becomes active when a temperature falls within the **SV value** ± 0.5 °C.

Note If the ramp function is also used, **tSV** is attached to a **target SV value**.

Set the ON delay timer, OFF delay timer and repeat count for a timer.
Set the ON delay timer for Timers 1 to 3 using [oNt 1 to oNt 3].
Set the OFF delay timer for Timers 1 to 3 using [oFt 1 to oFt 3].
Set the repetition count for Timers 1 to 3 using [RUN 1 to RUN 3].

(ON delay timer/OFF delay timer/repeat count setting)

		Setting content	Initial value
4	**oNt1 to oNt3**	**0:00 to 99:59** (hour: minute or minute: second)	**0:00**
5	**oFt1 to oFt3**	**0:00 to 99:59** (hour: minute or minute: second)	**0:00**
6	**RUN1 to RUN3**	**0 to 99** counts (**0** for unlimited counts)	**1**

Note If [**tMF 1 to tMF 3**] (function setting) is used for the **SV start**, the **ON** delay timer screen is not displayed.

Remaining time of Timers 1 to 3 is displayed. Timers can be started from this screen.

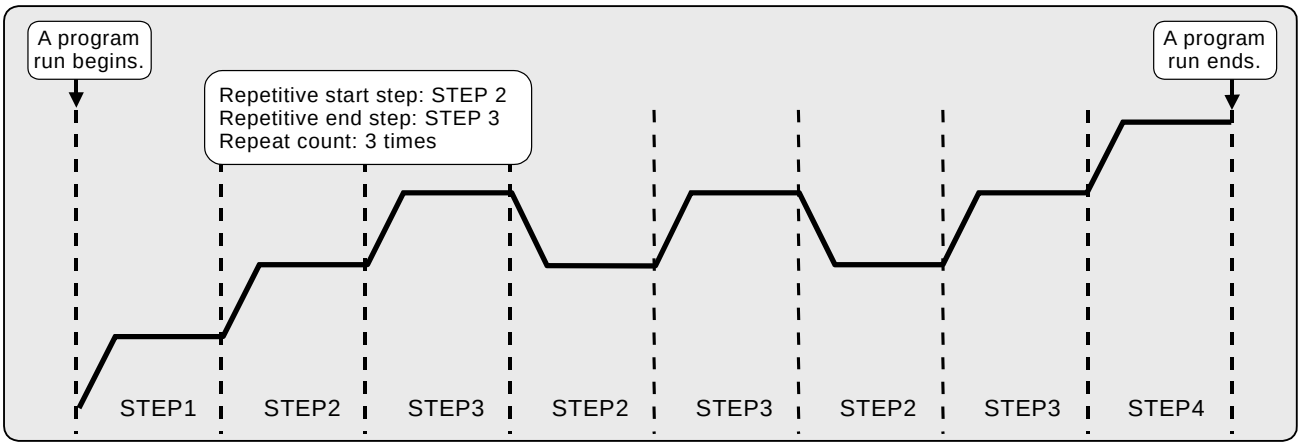
(Remaining time monitor)

		Setting content	Initial value
7	**tIA1 to tIA3**	**0:00 to 99:59** (hour: minute or minute: second) Start/stop of timer using ▲/▼ key	**0:00**

- When the **ON** delay timer and **OFF** delay timer are set, the setting value for the **ON** delay timer is displayed.
- When only the **OFF** delay timer is set, the setting value for the **OFF** delay timer is displayed.
- When the timer starts, the remaining time for the **ON** or **OFF** delay timer currently counting down is displayed.
  When the timer completes the countdown, "**0:00**" is displayed.
- For display during a program run, see Section 5.5.6 Explanation of the screen display and operation of a program run (P5-56 to 60).

■ Regarding repetitive run

A repetitive run of a designated step can be executed during a program run. Any step (as a whole or part) of program steps set in SET 22 can be repeated.
The diagram below shows an example of using this function where the steps 2 and 3 of total 4 steps are repeated 3 times.



The following parameters of SET 22 are used for the repetition setting in program setting mode.

	SEt22 PROG	Setting content	Initial value
5	**StRSt**	Repetitive start step setting Setting value range: 1 to repetitive end step setting [ENdSt]	**1**
6	**ENdSt**	Repetitive end step setting Repetitive start step setting [StRSt StRSt] up to the number-of-use-step setting or StEPN * If StEPN is set, the value set for the number-of-use-step setting is a setting for "repetitive end step setting."	**StEPN**
7	**RUNP**	Execution count setting Setting value range: RUNP = 0 to 9999 RUNP = 0: **Unlimited count**	**1**

In the above example, the setting values are: StRSt = 2, ENdSt = 3 and RUNP = 3.

Use the parameters listed below for the program step data setting in program setting mode.

(Setting regarding the program step data)

	SEt22 PROG	Setting content	Initial value
1	**StEPN**	Number-of-use-step setting Setting value range: n = 1 to 8	**8**
2	**St*bK**	Step* designated bank setting Setting value range: St*BK = 0 to 7 * = 1 to 8	**0**
3	**SV***	Step SV* value Setting range value: SV* = SLL to SLH * 1 to 8 * If SLL or SLH are set in a bank, the value of SLL or SLH is set for each bank.	**0**
4	**tIM***	Step* time Setting value range: TIM* = 00:00 to 99:59 * = 1 to 8 * With 00:00, a run unlimitedly continues.	**00:00**

■ Regarding switchover of the input types

If input 1 type [INP 1] is set in a bank, an operation of switching the input type can be executed during a program run by using the "step* designated bank setting [St*bK] " function.

Note Note that the input type must be selected from the same group as listed below. Input types from different groups should not be mixed. Otherwise, switching the decimal point malfunctions.

Input 1 type in Group A

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group A
0	K thermocouple	TC	-200.0 to +1372.0	1°C/0.1°C	Input type: thermocouple Decimal point: 0 or 0.0
1	J thermocouple	TC	-200.0 to +1200.0	1°C/0.1°C	
2	T thermocouple	TC	-200.0 to +400.0	1°C/0.1°C	
3	E thermocouple	TC	-200.0 to +1000.0	1°C/0.1°C	
7	N thermocouple	TC	-200.0 to +1300.0	1°C/0.1°C	
8	U thermocouple	TC	-200.0 to +400.0	1°C/0.1°C	
9	L thermocouple	TC	-200.0 to +900.0	1°C/0.1°C	
12	PL II thermocouple	TC	0.0 to +1390.0	1°C/0.1°C	

Input 1 type in Group B

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group B
4	R thermocouple	TC	-50 to +1768	1°C	Input type: Thermocouple Decimal point: 0
5	S thermocouple	TC	-50 to +1768	1°C	
6	B thermocouple	TC	0 to +1800	1°C	
10	WRe5-26 thermocouple	TC	0 to +2300	1°C	
11	PR40-20 thermocouple	TC	0 to +1880	1°C	

Input 1 type in Group C

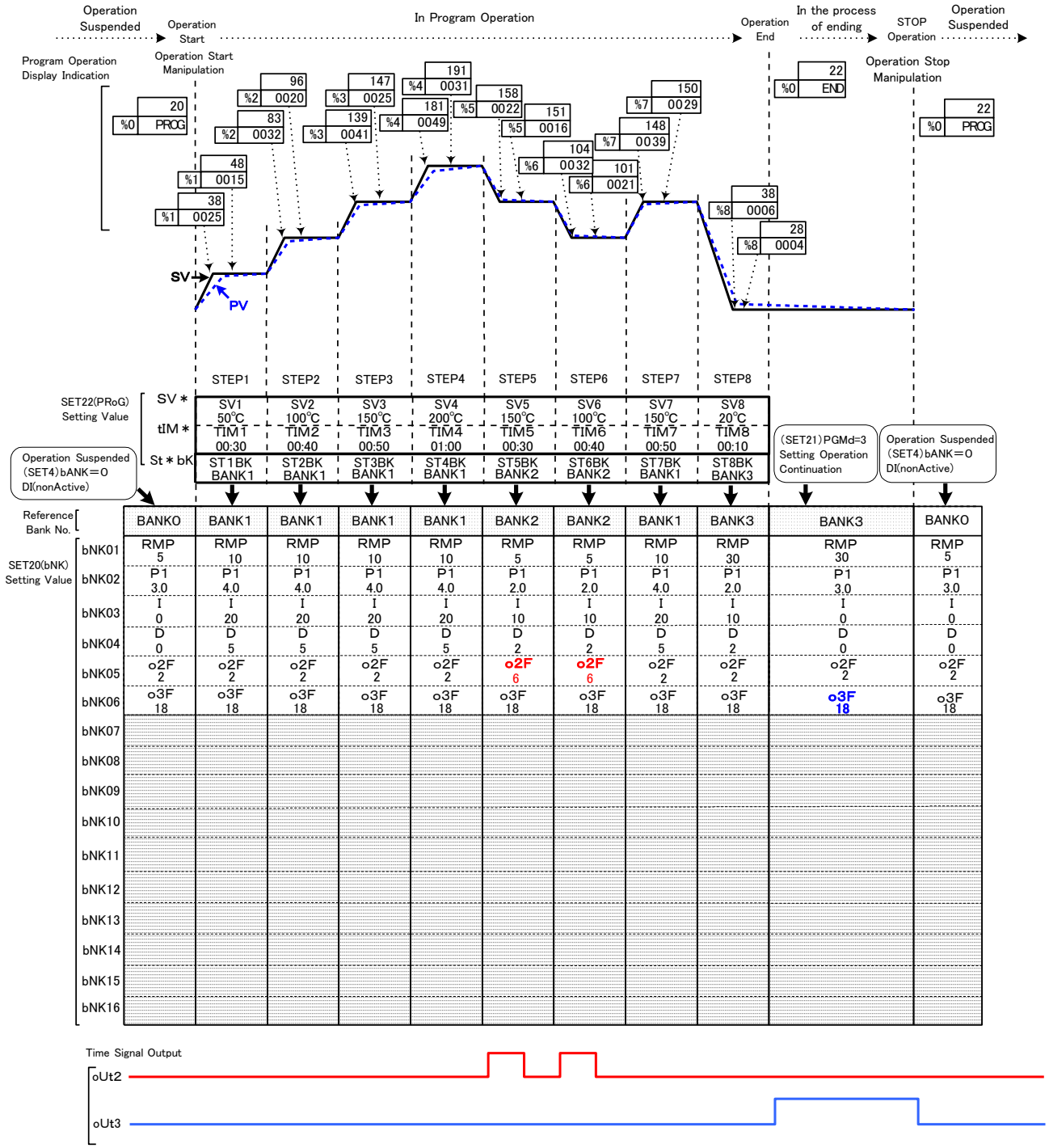
Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group C
13	Pt100	RTD	-200.0 to +850.0	1°C/0.1°C	Input type: Resistance temperature detector Decimal point: 0 or 0.0
14	JPt100	RTD	-200.0 to +510.0	1°C/0.1°C	

Input 1 type in Group D

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group D
15	0 - 10 mVDC	TC	-19999 to +29999 Display resolution to be 2000 or less	Random change of decimal point position allowed	Input type: Resistance temperature detector Decimal point: 0 or 0.0 0.00 or 0.000 or 0.0000
16	0 - 1 VDC	I/V			
17	0 - 5 VDC	I/V			
18	1 - 5 VDC	I/V			
19	0 - 10 VDC	I/V			
20	4 - 20 mADC	I/V			

* The decimal point setting for each bank can vary in a same group.

■ The diagram below shows an example of a program run with StEPN = 8.



■ Time Signal Output Setting
- (SET14)tMF1=15, (SET14)tSV1=0, (SET14)oNt1=00:15
  Step Start
- SET6)o2F=6
  When Bank 2, o2F=Timer 1 on Delay Output. Other banks are Event Output (nofunction)
- (SET7)o3F=18
  End Output

■ Program Function Setting
- (SET21)C/P=1, (SET21) PGMD=3, (SET21) PoC=0, (SET21) H/MP=2, (SET21) WAIt=5
  Program 2 (w/ Power Failure Compensation), 2: Soak Time 2 (Hr./Min.)
- (SET22) StEPN=8, (SET22) StRSt=1, (SET22) ENdSt=8, (SET22)RUNP=1
  Number-of-use-step: 8, repetitive start step: 1, repetitive end step: 8, execution count: 1

■ Other Settings
- Set to (SET4) Bank=0. Also, "0" is assumed when BANK switchover is ON by DI.

5.6 Explanation of the bank automatic switching function

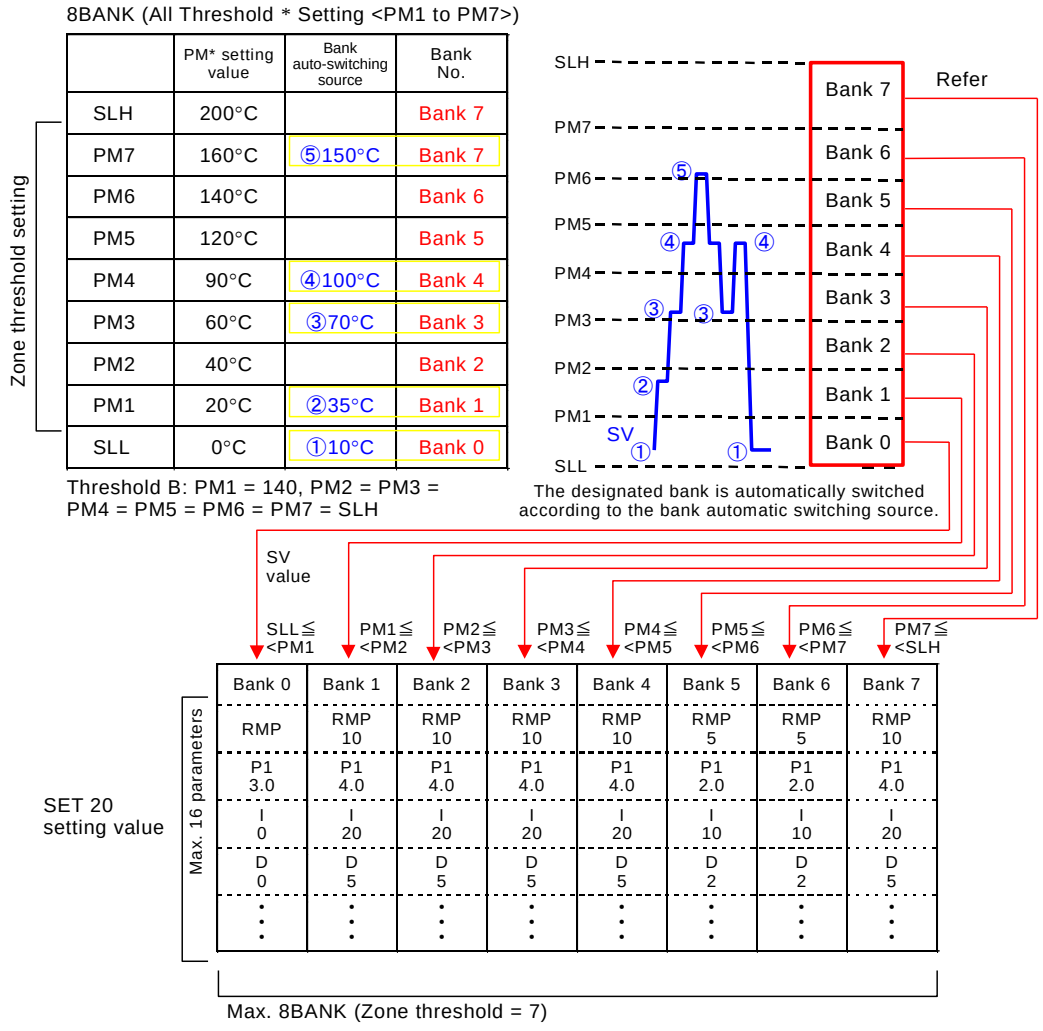
■ Regarding the bank automatic switching function

The bank function can be automatically switched for each temperature. Setting control parameters for each temperature beforehand enables realization of optimization and an accurate control. As parameters unrelated to control can also be set similarly to the case of the normal bank function, application for each temperature is possible for such functions as the timer and event functions.

Note Precaution when using this function together with the program run function

When using this function together with "program run," the setting is ineffective even when the bank designation is set using SET 22 "St*bK step* designated bank setting." All banks are used with priority when using the bank automatic switching function [SET 23 BAF = 1]. Note that a bank cannot be divided into parts for assigning one of them to, for example, a program run.

(Behavior diagram for explaining the bank automatic switching run)



- Eight banks at most (threshold = 7) can be used; the diagram is an example of all banks used. The bank can automatically be switched for each temperature. The zone threshold* setting < PM 1 to PM 7 > is set in the SV value setting range from SLL to SLH.
- The threshold required for automatic switching is set in SET 23 "bank automatic switching function setting mode."
- For this function, SET 20 "bank function" must be set beforehand.

5.6.1 Bank automatic switching setting

■ The operation procedure of bank automatic switching is explained below.

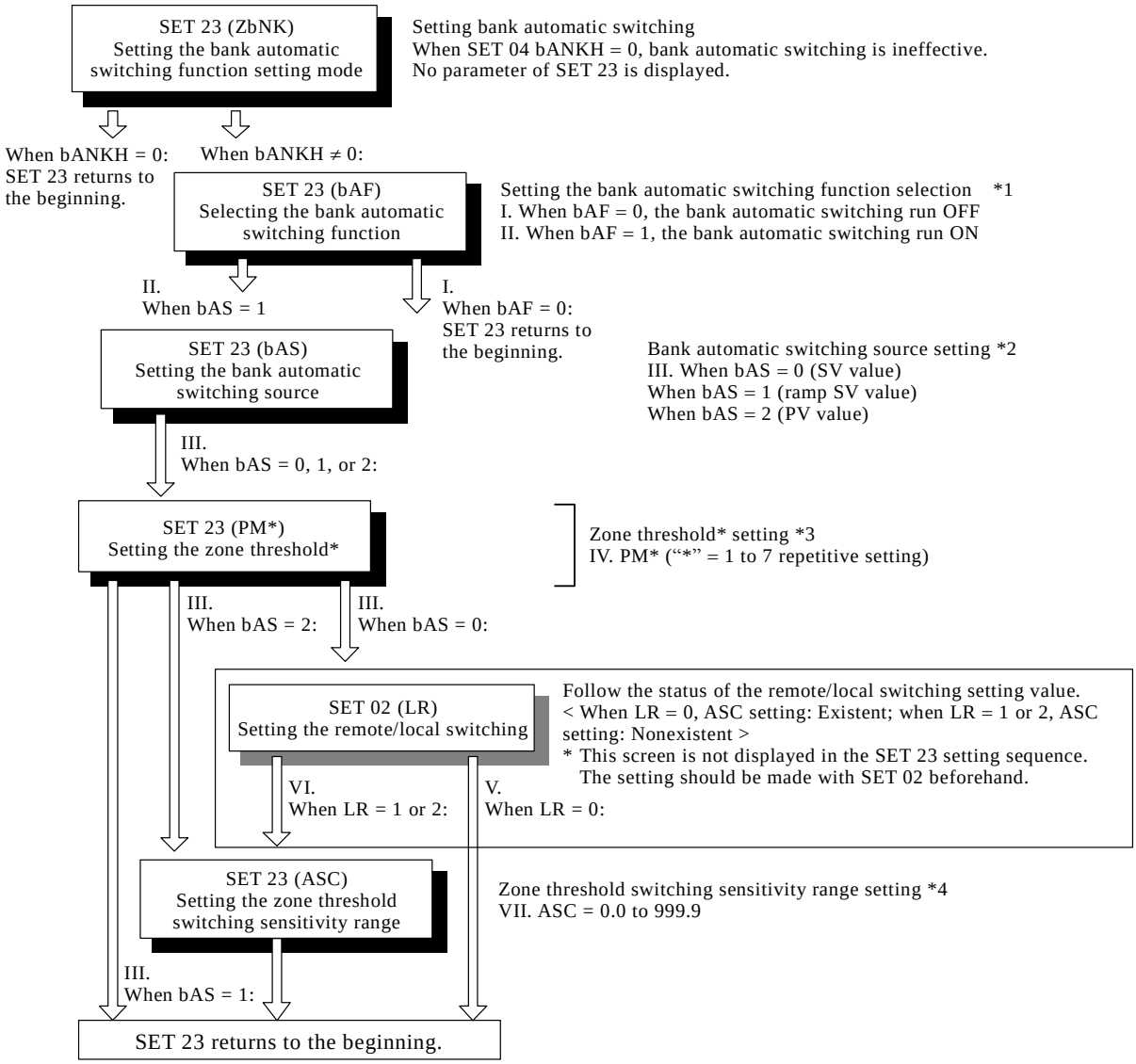
Switching conditions are set in the SET 23 parameter. The bank switching method (input, switching sensitivity, etc.) and switching threshold are set.

Parameters desiring to be switched are set for each threshold in the SET 20 bank setting.

For details of the bank setting method, see Section 5.4.4 Bank function (P5-28 to 30).

The diagram below shows the procedure of the SET 23 parameter setting. Follow the procedure for setting.

[Setting flow]



Note The automatic switching is ineffective if [SET 04 bANKH = 0].
In addition, be careful that the SET 23 parameter is not displayed.

Note The parameters of [bAS] and thereafter are not displayed if [bAF = 0].

The parameter contents of SET 23 are explained in the next page.

*1: Bank automatic switching function selection (bAF)
Set the bank automatic switching ON/OFF.

Setting range Initial value: 0 Bank automatic switching run OFF
0: Bank automatic switching run OFF
1: Bank automatic switching run ON

*2: Bank automatic switching source setting (bAS)
Select an input source. The bank is switched in accordance with the input of the source selected.

Setting range Initial value: 0 Select a SV value
0: Select a SV value {only local and remote (only option Y)}.
1: Select a ramp SV value
2: Select a PV value

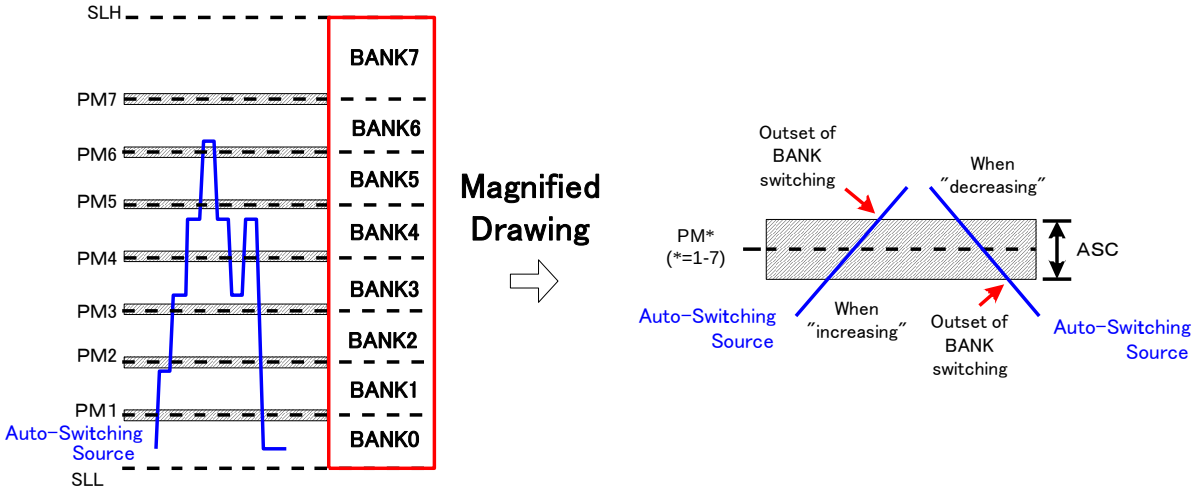
Note When [bAF = 1], the [SET 04 SV] value is selected for AT (auto tuning) regardless of the source setting, which is used for bank auto switching.
If the zone threshold* setting (PM*) is set, a bank matching the SV value is selected based on the result from AT (auto tuning). That is, a result from AT is reflected to the bank selected with a threshold. As such, if a [P, I, d] value is desired to set for each temperature, perform AT (auto tuning) after setting said value in the bank.

3: Zone threshold setting [PM 1 to PM 7]
A threshold is set for automatically switching a bank. Seven threshold values at most can be set for eight banks.

Setting range: SLL to SLH Initial value: SLH

*4: Zone threshold switching sensitivity range setting (ASC)
A sensitivity range set in ASC is provided for each threshold [PM*] used for bank automatic switching. (See the diagram below.) The sensitivity range is common to each threshold.

Setting range: During the temperature input 0 to 999 (0.0 to 999.9) (°C) Initial value: 0
During analog input 0 to 9999 (digit)



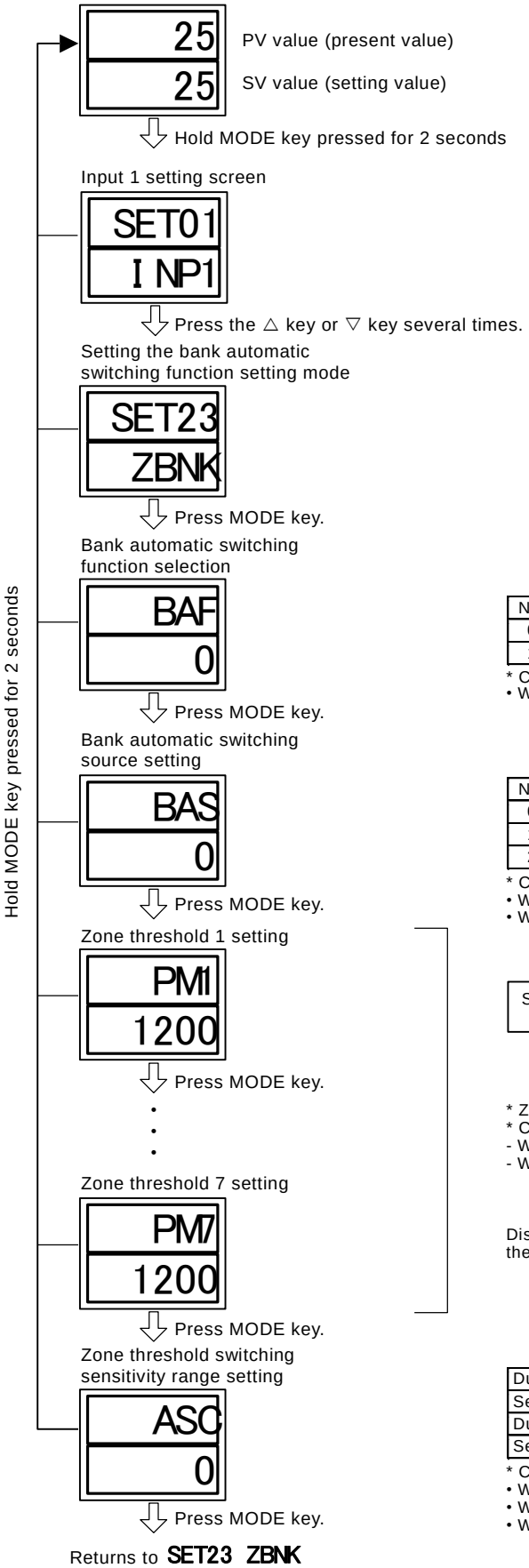
The sensitivity range is effective if a remote SV or PV is selected for the bank automatic switching source setting [bAS]. Other than this, the range is ineffective.

Note Condition on enabled ASC setting
When [bAS = 2]
When SET 02 [LR = 1, 2] with [bAS = 0]

Note Condition on unable ASC setting
When [bAS = 1]
When SET 02 [LR = 0], even though [bAS = 0]

5.6.2 SET 23 bank automatic switching function setting mode setting screen

■ The bank automatic switching function setting screen is shown below:



No.	Setting range
0	Bank automatic switching run OFF (initial value)
1	Bank automatic switching run ON

* Condition for non-display
• When SET 04 bANKH = 0

No.	Setting range
0	SV value (initial value)
1	Ramp SV value
2	PV value

* Condition for non-display
• When bAF = 0 (OFF)
• When SET 04 bANKH = 0

Setting range: PM* = SLL to SLH (initial value: 1200)
(*=1 to 7)

* Zone threshold 1-to-7 setting
* Condition for non-display
- When bAF = 0 (OFF)
- When SET 04 bANKH = 0

Displayed PM* varies depending on the bANKH value.

During temperature input (initial value = 2)
Setting range: 0 to 999 or (0.0 to 999.9) °C
During analog input
Setting range: 0 to 9999 digit

* Condition for non-display
• When bAF = 0 (OFF) and BAS = 0
• When BAS = 1 and SET 02 LR = 0
• When SET 04 bANKH = 0

5.6.3 Complementary explanation of the bank automatic switching function

Regarding the zone threshold* setting [**PM1 to PM7**]:
If all seven points at most are set with different values one another, eight zones can be established for each temperature allowing eight banks to be used. The setting range is from SLL to SLH. If all seven points are set to SLH, the threshold is integrated into one zone to provide the maximum value (applicable only for the bank 0). The initial value is set to this status.

Note The threshold values are PM7 to PM1 in sequence from the largest. Changing the sequence is not allowed. Therefore, a lower temperature should be set to a threshold with a smaller designation number. (The system is constructed in such a way.)

The following is an example of the setting.

■ Setting example of the auto bank switching function setting mode (initial value: PM1 to PM7 = 1200)

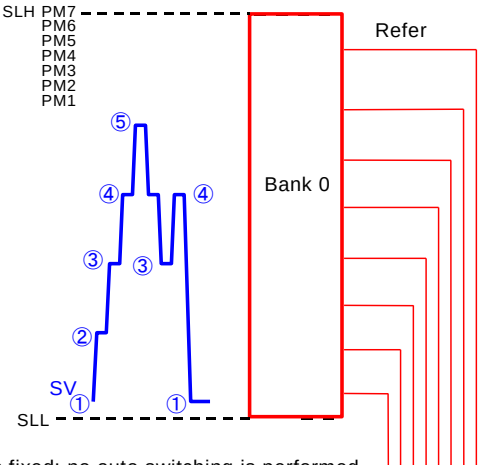
The initial setting status is shown. The SLH is set for all PM1 to PM7. No auto switching is performed.

When one bank is used
(zone threshold: SLH for all initial values):

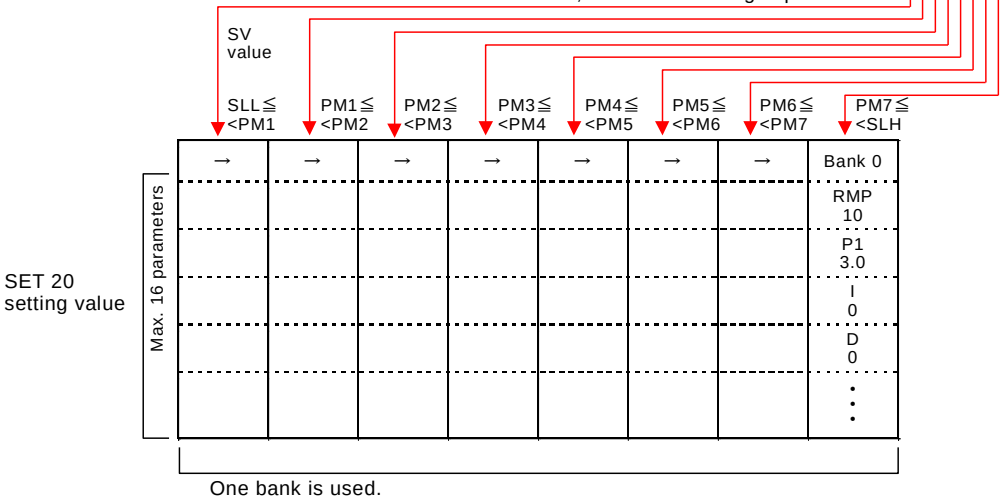
	PM* setting value	Bank auto-switching source	Bank No.
SLH	200°C		Bank 0
PM7	200°C	⑤150°C	Bank 0
PM6	200°C		Bank 0
PM5	200°C		Bank 0
PM4	200°C	④100°C	Bank 0
PM3	200°C	③70°C	Bank 0
PM2	200°C		Bank 0
PM1	200°C	②35°C	Bank 0
SLL	200°C	①10°C	Bank 0

Zone threshold setting

PM1=PM2=PM3=PM4=PM5=PM6=PM7=SLH



Bank 0 is fixed; no auto switching is performed.



■ Setting example of the bank automatic switching function setting mode (2 banks used)

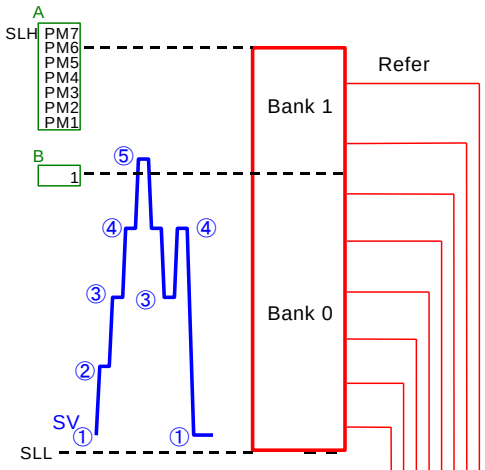
The example shows a threshold for auto switching to be of one point. In this case, Bank 0 and Bank 1 are used.

When two banks are used
(zone threshold: 1 point):

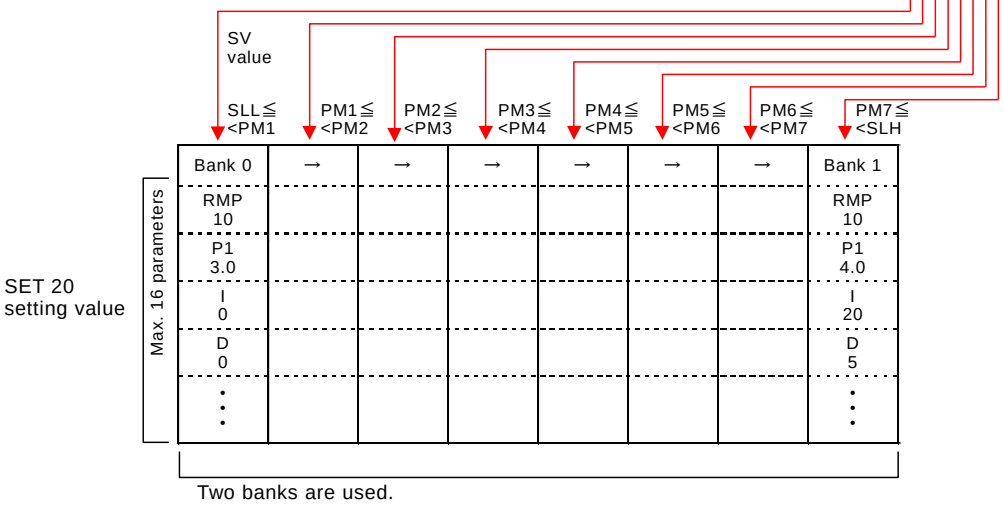
		PM* setting value	Bank auto-switching source	Bank No.
	SLH	200°C		Bank 1
A	PM7	200°C	⑤150°C	Bank 1
	PM6	200°C		Bank 1
	PM5	200°C		Bank 1
	PM4	200°C	④100°C	Bank 1
	PM3	200°C	③70°C	Bank 1
	PM2	200°C		Bank 1
B	PM1	140°C	②35°C	Bank 0
	SLL	0°C	①10°C	Bank 0

Zone threshold setting

Threshold B: PM1 = 140, PM2 = PM3 = PM4 = PM5 = PM6 = PM7 = SLH



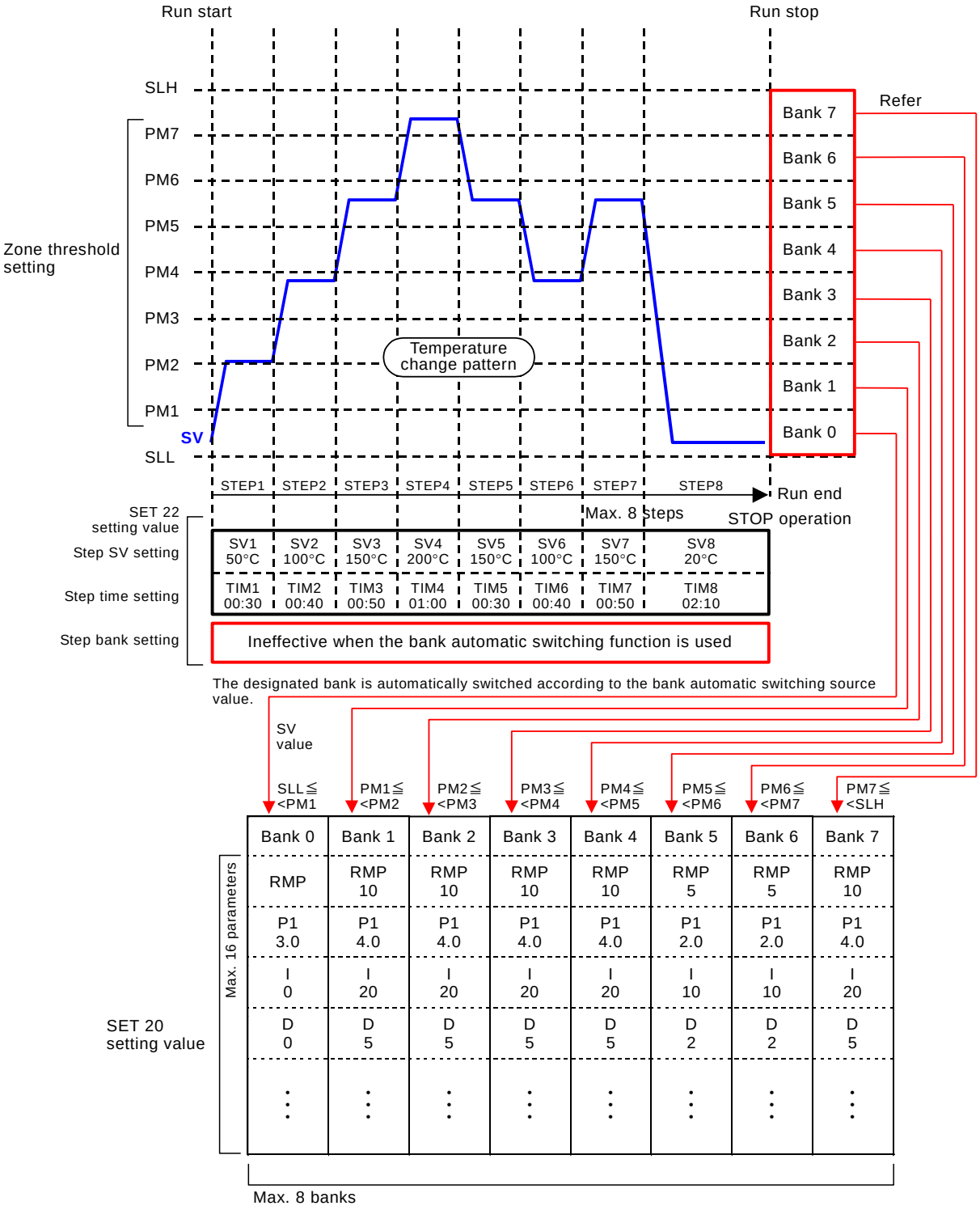
Bank 0 and Bank 1 are switched at 140°C as a threshold.



■ Setting example 3: Bank automatic switching function setting mode (when the program run function is also used)

This example shows use of both the program run and eight banks for the bank automatic switching function. The "designated bank" setting for a program run is ineffective in a bank automatic switching function run. The bank designation according to the bank automatic switching function is always prioritized over others.

Note Note that the SET 22 [St1bK to St8bK] step* designated bank setting is not also displayed.



■ Regarding the “bank function” priority

If multiple settings are set for the bank switching designation, bank switching is applied from of a function with a higher priority.

The following applies (“1” is of the highest priority).

1. “Bank automatic switching function”
   SET 23 [PM*] zone threshold* setting (“*”: Zone No.)

2. “Program run”
   SET 22 [**St*bK**] step* designated bank setting (“*”: Step No.)

3. “Switching with DI”
   SET 13 DIF = **** (when “*” = 1)

4. “Switching with the function key”
   SET 3 FU* = 7 (“*”: Key No.)

5. “Setting value of SET 4 bBNK”
   bBNK = * (“*”: Bank value)

Note Note that, if multiple designations of 1 to 5 above are set, the designation with a lower priority is disregarded.

■ Regarding switchover of the input types

If input 1 type [INP 1] is set in a bank, an operation of switching the input type can be executed during a program run by using the bank automatic switching function.

Note Note that the input type must be selected from the same group as listed below. Input types from different groups should not be mixed. Otherwise, switching the decimal point malfunctions.

Input 1 type in Group A

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group A
0	K thermocouple	TC	-200.0 to +1372.0	1°C/0.1°C	Input type: thermocouple Decimal point: 0 or 0.0
1	J thermocouple	TC	-200.0 to +1200.0	1°C/0.1°C	
2	T thermocouple	TC	-200.0 to +400.0	1°C/0.1°C	
3	E thermocouple	TC	-200.0 to +1000.0	1°C/0.1°C	
7	N thermocouple	TC	-200.0 to +1300.0	1°C/0.1°C	
8	U thermocouple	TC	-200.0 to +400.0	1°C/0.1°C	
9	L thermocouple	TC	-200.0 to +900.0	1°C/0.1°C	
12	PL II thermocouple	TC	0.0 to +1390.0	1°C/0.1°C	

Input 1 type in Group B

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group B
4	R thermocouple	TC	-50 to +1768	1°C	Input type: Thermocouple Decimal point: 0
5	S thermocouple	TC	-50 to +1768	1°C	
6	B thermocouple	TC	0 to +1800	1°C	
10	WRe5-26 thermocouple	TC	0 to +2300	1°C	
11	PR40-20 thermocouple	TC	0 to +1880	1°C	

Input 1 type in Group C

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group C
13	Pt100	RTD	-200.0 to +850.0	1°C/0.1°C	Input type: Resistance temperature detector Decimal point: 0 or 0.0
14	JPt100	RTD	-200.0 to +510.0	1°C/0.1°C	

Input 1 type in Group D

Setting No.	Input type	Connection	Measurement/ setting range	Designation resolution	Group D
15	0 - 10 mVDC	TC	-19999 to +29999 Display resolution to be 2000 or less	Random change of decimal point position allowed	Input type: Resistance temperature detector Decimal point: 0 or 0.0 0.00 or 0.000 or 0.0000
16	0 - 1 VDC	I/V			
17	0 - 5 VDC	I/V			
18	1 - 5 VDC	I/V			
19	0 - 10 VDC	I/V			
20	4 - 20 mADC	I/V			

* The decimal point setting for each bank can vary in a same group.

6. Explanation on parameters

Settings of various types of parameters are described in this chapter.

6.1 Input 1 type setting

■ Input 1 type setting

	SEt01 INP1	Setting content		Initial value
1	INP1	Press the MODE key for making a setting effective (including reverse feed).		**0**
		0 to 20	See the input 1 type setting table.	

Set the input type of the input 1.
The input 1 is for a multi-input for thermocouple, resistance temperature detector, voltage and current. Set according to the input being used.

Input 1 type setting table

Setting No.	Input type	Connection	Measurement/ setting range	Indicator resolution	Accuracy
0	K thermocouple	TC	-200.0 to +1372.0	1°C / 0.1°C	Either larger ± (0.3 % + 1 digit) or ± 2°C Note: ± 3°C for - 100.0 to 0.0°C and ± 4°C for - 200.0 to - 100.0°C No specification for 400°C or lower for B thermocouple
1	J thermocouple	TC	-200.0 to +1200.0	1°C / 0.1°C	
2	T thermocouple	TC	-200.0 to + 400.0	1°C / 0.1°C	
3	E thermocouple	TC	-200.0 to +1000.0	1°C / 0.1°C	
4	R thermocouple	TC	-50 to +1768	1°C	
5	S thermocouple	TC	-50 to +1768	1°C	
6	B thermocouple	TC	0 to +1800	1°C	
7	N thermocouple	TC	-200.0 to +1300.0	1°C / 0.1°C	
8	U thermocouple	TC	-200.0 to +400.0	1°C / 0.1°C	Either larger ± (0.3 % + 1 digit) or ± 4°C ± 6°C for lower than 0°C
9	L thermocouple	TC	-200.0 to +900.0	1°C / 0.1°C	
10	WRe5-26 thermocouple	TC	0 to +2300	1°C	Either larger ± (0.6 % + 1 digit) or ± 4°C
11	PR40-20 thermocouple	TC	0 to +1880	1°C	± 9.4°C ± 1 digit No specification on accuracy for lower than 800°C
12	PL II thermocouple	TC	0.0 to +1390.0	1°C / 0.1°C	Either larger ± (0.3 % + 1 digit) or ± 2°C
13	Pt100	RTD	-200.0 to +850.0	1°C / 0.1°C	Either larger ± (0.3 % + 1 digit) or ± 0.9°C
14	JPt100	RTD	-200.0 to +510.0	1°C / 0.1°C	
15	0 - 10 mVDC	TC	-19999 to +29999 Display resolution to be 20000 or less *1	Random change of decimal point position allowed	±0.5 % ±1 digit of full scale
16	0 - 1 VDC	I/V			±0.3 % ±1 digit of full scale
17	0 - 5 VDC	I/V			
18	1 - 5 VDC	I/V			
19	0 - 10 VDC	I/V			
20	4 - 20 mADC	I/V			

*1 The display range of analog input is min. - 19999 digits and max. +29999 digits. The range, however, can be narrowed by setting the scaling upper limit (FSH 1) and lower limit (FSL 1) settings. See below for the narrowed display range.
<Where input is 0 - 10 mV/0 - 1 V/0 - 5 V/0 - 10V>
- Display of the lower limit side: Up to - 2 % of the full scale
- Display of the upper limit side: Up to + 12 % of the full scale

<Where input is 1 - 5 V/4 - 20 mA>
- Display of the lower limit side: Up to - 12 % of the full scale
- Display of the upper limit side: Up to + 12 % of the full scale

Full scale is defined as the range from FSL 1 to FSH 1.
The display range for temperature input (setting Nos. of 0 to 12 in the table above) is fixed.

Input 1 connection table

Model / Model No.		TTM-200 Series		
		204	205 209	207
Connection	Wiring	Terminal No.	Terminal No.	Terminal No.
TC	+ –	12 11	24 23	18 17
RTD	A B b	12 11 10	24 23 22	18 17 16
I/V	+ –	10 11	22 23	16 17

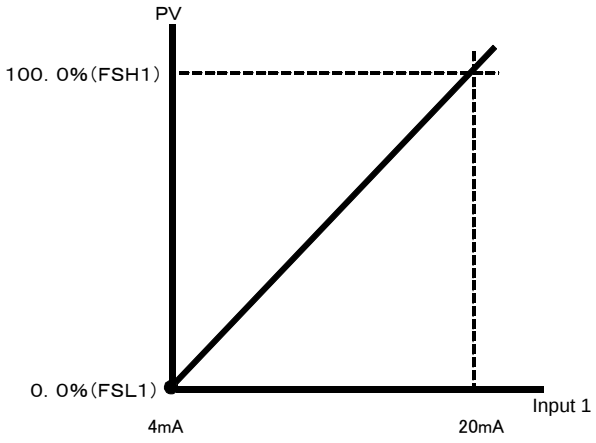
Note Switchover of the input types may result in change of each setting value due to limits being applied, such as SLH, SLL, tRH and tRL.

■ Display scaling upper limit/lower limit setting

	SEt01 INP1	Setting content	Initial value
2	FSH1	Voltage/current input only **FSL 1 to 29999** (digit)	**10000**
3	FSL1	Voltage/current input only **-19999 to FSH 1** (digit)	**-10000**

Display scaling upper limit/lower limit are set for the input 1.
This setting is possible only when the input 1 is set for voltage/current input.

Setting example: Where the input type is the 4 - 20 mA setting and the display range is 0.0 digit for 4 mA and 100.0 digits for 20 mA.
Set as INP 1: 20, FSH 1: 100.0, FSL 1: 0.0 and dP 1: 0.0.
* For this setting, the display range is - 12.0 to 112.0.
For -12.0 or smaller, the display is "underscale display."
For 112.0 or larger, the display is "overscale display."



Note

(1) Display resolution is 20,000 or less.
Take care it when the range from FSL 1 to FSH 1 is set larger than 20,000.
Setting example: Fluctuation or missing value of PV may be caused when the input 1 is set to the input type of 4 - 20 mA, FSL 1 to -19999 digits and FSH 1 to 29999 digits.
(2) Take care that setting values for FSH 1 and FSL 1 can be the same.

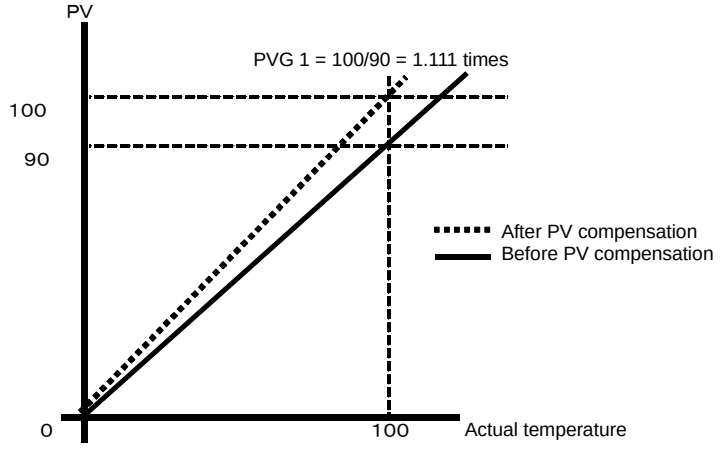
■ PV compensation gain/PV compensation zero setting

	SEt01 INP1	SETTING CONTENTS	INITIAL VALUE
4	PVF1	PV CORRECTION FUNCTION SETTING [3] 0 : PV Gain / Zero Point Correction 1 : PV X･Y 2-Point Correction	0
5	PVG1	PVCorrection Gain Setting 0.500~2.000(X)	1.000
6	PVS1	PV Correction Zero Setting Thermocouple -999.9~999.9(℃) -999~999(℃) Voltage-Current Input -9999~9999(digit)	0
7	PX1	PV Before Correction Lower Limit Value Setting [3] Setting Range : Setting Range Lower Limit to (PX 2 - 1℃) or Setting Range Lower Limit to (PX 2 –1.0℃) : Setting Range Lower Limit to (PX 2- 10-digits) Setting Units : 1℃ or 0.1℃, 1-digit	0
8	PX2	PV Before Correction Upper Limit Value Setting [3] Setting Range : (PX 1 + 1℃) to Setting Range Upper Limit , or (PX 1 + 1.0℃) to Setting Range Upper Limit : (PX 1 + 10-digits) to Setting Range Upper Limit Setting Units : 1℃ or 0.1℃, 1-digit	1200
9	PY1	PV After Correction Lower Limit Value Setting [3] Setting Range : Setting Range Lower Limit to (PY 2 - 1℃) or Setting Range Lower Limit (PY 2 –1.0℃) : Setting Range Lower Limit to (PY 2 - 10-digits) Setting Units : 1℃ or 0.1℃, 1-digit	0
10	PY2	PV After Correction Upper Limit Value Setting [3] Setting Range : (PY 1 + 1℃) to Setting Range Upper Limit , or (PY 1 + 1.0℃) to Setting Range Upper Limit : (PY 1 + 10-digits) to Setting Range Upper Limit Setting Units : 1℃ or 0.1℃, 1-digit	1200

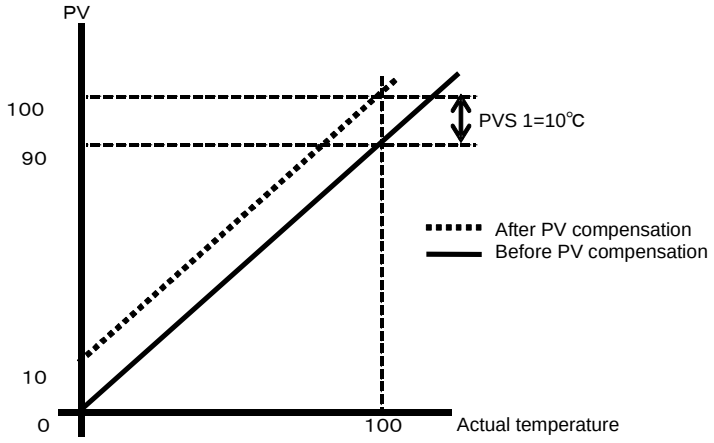
[3] When the PV Correction Function Setting (PVF1=0), PX1, PX2, PY1, PY2 are not indicated.

[3] When PV Correction Function Setting (PVF1=1), PVG1, PVS1 are not indicated.

[3] PV compensation gain setting: PV (measurement value) for the input 1 is multiplied by the compensation value.
Setting example: Where PV of the equipment is displayed for 90°C and the actual temperature is 100°C, and the display is to be compensated to 100°C, using the PV compensation gain setting.
The display after PV compensation is about 100°C = 90°C (before PV compensation) × 1.111.



PV compensation zero setting: PV (measurement value) for the input 1 is added by the compensation value.
Setting example: Where PV of the equipment is displayed for 90°C and the actual temperature is 100°C, and the display is to be compensated to 100°C, using the PV compensation zero setting.
The display after PV compensation is 100°C = 90°C (before PV compensation) + 10°C.



* See below for an equation for combination of the PV compensation gain setting and PV compensation zero setting.
PV of input 1 = before PV compensation × PV compensation gain setting + PV compensation zero setting

Note

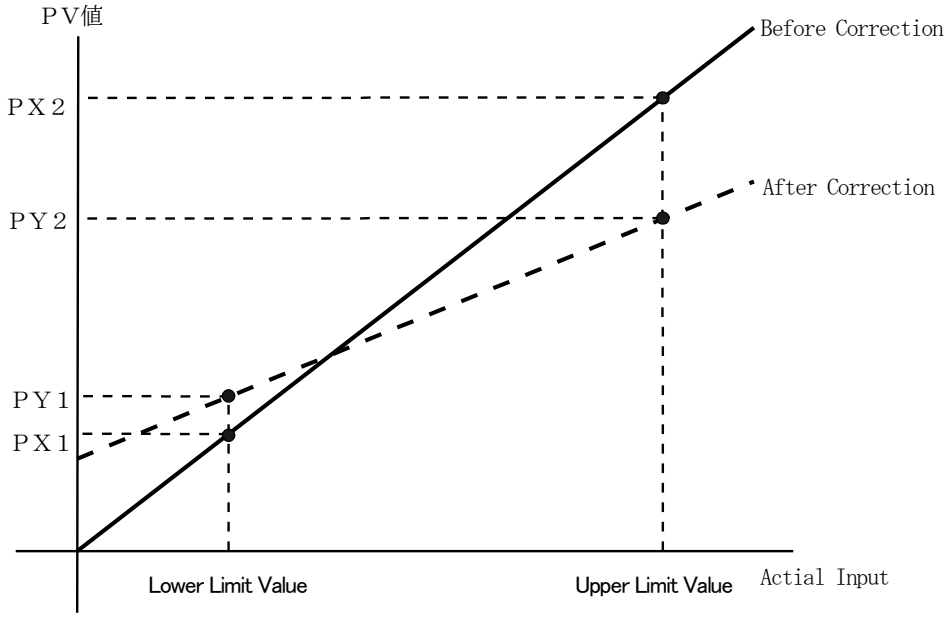
(1) Take care that stability of the measurement value may deteriorate when the PV compensation gain setting is large.
(2) Take care that the display range may change when the PV compensation gain setting is set to a multiplication factor of 1 or smaller.
Setting example: Where K thermocouple input for - 200.0 to 1372.0°C
PV compensation gain setting: Multiplied by 0.5 → -100.0 to 686.0°C
PV compensation gain setting: Multiplied by 0.1 → -20.0 to 137.2°C

(3) Take care that the display range may change when the PV compensation zero setting is set to a value other than 0.
Setting example: Where K thermocouple input for - 200 to 1372°C
PV compensation zero setting: +100°C → -100 to 1372°C
PV compensation zero setting: -100°C → -200 to 1272°C
* The display range for analog input is not affected by the PV compensation zero setting.

PV X-Y 2-POINT CORRECTION SETTING

Determine any two points within the input range (upper and lower limit), then convert to corrected value to the PUV of Input 1.

For Example)
When the PV of the product is;
90℃ indication but actual temp. is 100℃
310℃ indication but the actual temp. is 300℃
If these are to be corrected by 2-point Correction Setting;
PV before correction: PX 1 = 90℃, PX 2 = 310℃
PV after correction: PY 1 = 100℃, PX 2 = 300℃



PX 1 PV Before Correction Lower Limit Value Setting
Setting Range : Setting Range Lower Limit to (PX 2 － 1℃) or Setting Range Lower Limit to (PX 2 –1.0℃)
: Setting Range Lower Limit to (PX 2 – 10-digits)
Setting Units : 1℃ or 0.1℃, 1-digit

PX 2 PV Before Correction Upper Limit Value Setting
Setting Range : (PX 1 + 1℃) to Setting Range Upper Limit , or (PX 1 + 1.0℃) to Setting Range Upper Limit
: (PX 1 + 10-digits) to Setting Range Upper Limit
Setting Units : 1℃ or 0.1℃, 1-digit

PY 1 PV After Correction Lower Limit Value Setting
Setting Range : Setting Range Lower Limit to (PY 2 － 1℃) or Setting Range Lower Limit to (PY 2 –1.0℃)
: Setting Range Lower Limit to (PY 2 – 10-digits)
Setting Units : 1℃ or 0.1℃, 1-digit

PY 2 PV After Correction Upper Limit Value Setting
Setting Range : (PY 1 + 1℃) to Setting Range Upper Limit , or (PY 1 + 1.0℃) to Setting Range Upper Limit
: (PY 1 + 10-digits) to Setting Range Upper Limit
Setting Units : 1℃ or 0.1℃, 1-digit

NOTE: - As much as possible, set the difference in the value of Before Correction and After Correction bigger within the realizable range. When the difference is small, the margin of error might be bigger.
- When the slope of PX 1 and PX 2 (before correction) is set to 1 and when the slope after Correction becomes less than 1, the indication range in each input type becomes narrow.

■ PV filter setting

	SEt01 INP1	Setting content	Initial value
11	PdF1	**0.0 to 99.9** (seconds)	**0.0**

The PV filter setting is a function that demonstrates the CR filter effect on software through performing a first-order lag calculation for PV of the input 1.
The filter effect is set using the time constant [t].
(Time constant is defined as the time required for PV to reach about 63 % when an input changes in a step configuration.)
* CR filter --- a filter of first-order lag

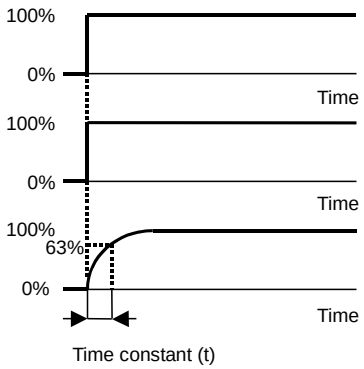
Note Application of PV filter

(1) Effect of noise is alleviated due to elimination of high-frequency noise when electric noise applies on inputs.
(2) Response can be delayed against abrupt change of an input.

■ Input signal

■ Input read in
When no digital PV filter exists
[Time constant (t) = 0]

When a digital PV filter exists
[Time constant (t) > 0]



■ Decimal point position setting

	SEt01 INP1	Setting content		Initial value
12	dP1	Thermocouple/resistance temperature detector input		**0**
		0	Unit of 1°C	
		0.0	Unit of 0.1°C	
		Current/voltage input		
		0	1/digit	
		0.0	0.1/digit	
		0.00	0.01/digit	
		0.000	0.001/digit	
		0.0000	0.0001/digit	

A decimal point position is set for PV of the input 1.

■ °C/°F switchover

	SEt01 INP1	Setting content		Initial value
13	C/F1	Press the MODE key for making a setting effective (including reverse feed).		**°C**
		°C	Celsius	
		°F	Fahrenheit	

Set the unit of temperature input.

Note Switchover of °C/°F may result in change of each setting value due to limits being applied, such as SLH, SLL, tRH and tRL.

6.2 Remote SV input type setting

■ Remote SV input type setting

	SEt02 INP2	Setting content		Initial value
1	INP2	Press the MODE key for making a setting effective (including reverse feed).		**18**
		16 to 20	See the remote SV input type setting table.	

Set the input type of the remote SV input.
The remote SV input is a multiinput of voltage and current. Set the remote SV input according to the input being used.

■ Remote SV input type setting table

Setting No.	Input type	Connection	Measurement/ setting range	Indicator resolution	Accuracy
16	0 - 1 VDC	I/V	-19999 to +29999 Display resolution to be 20000 or less	Random change of decimal point position allowed	± 0.3 % ± 1 digit of full scale
17	0 - 5 VDC	I/V			
18	1 - 5 VDC	I/V			
19	0 - 10 VDC	I/V			
20	4 - 20 mADC	I/V			

*1 The display range of analog input is min. - 19999 digits and max. +29999 digits. The range, however, can be narrowed by setting the scaling upper limit (FSH 2) and lower limit (FSL 2) settings. See below for the narrowed display range.
<Where input is 0 - 1 V/0 - 5 V/0 - 10V>
• Display of the lower limit side: Up to - 2 % of the full scale
• Display of the upper limit side: Up to + 12 % of the full scale
<Where input is 1 - 5 V/4 - 20 mA>
• Display of the lower limit side: Up to - 12 % of the full scale
• Display of the upper limit side: Up to + 12 % of the full scale

Full scale is defined as the range from FSL 2 to FSH 2.

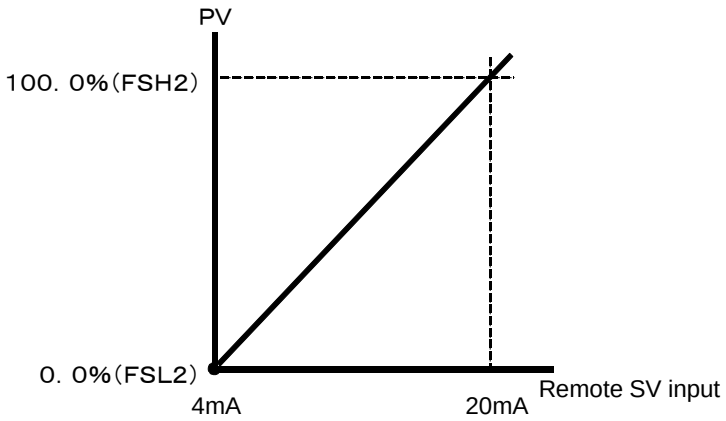
Remote SV input connection table

	Model	TTM-200 Series		
	Model No.	204	205 209	207
Connection	Wiring	Terminal No.	Terminal No.	Terminal No.
I/V	+ –	– –	17 18	11 12

■ Display scaling upper limit/lower limit setting

	SEt02 INP2	Setting content	Initial value
2	FSH2	**FSL 2** to SV setting range upper limit The unit depends on the input type setting for the input 1.	**1200**
3	FSL2	SV setting range lower limit to **FSH 2** The unit depends on the input type setting for the input 1.	**0**

Set the display scaling upper limit/lower limit for the remote SV input.
The input type of the remote SV input can be set only for voltage or current input.



Note

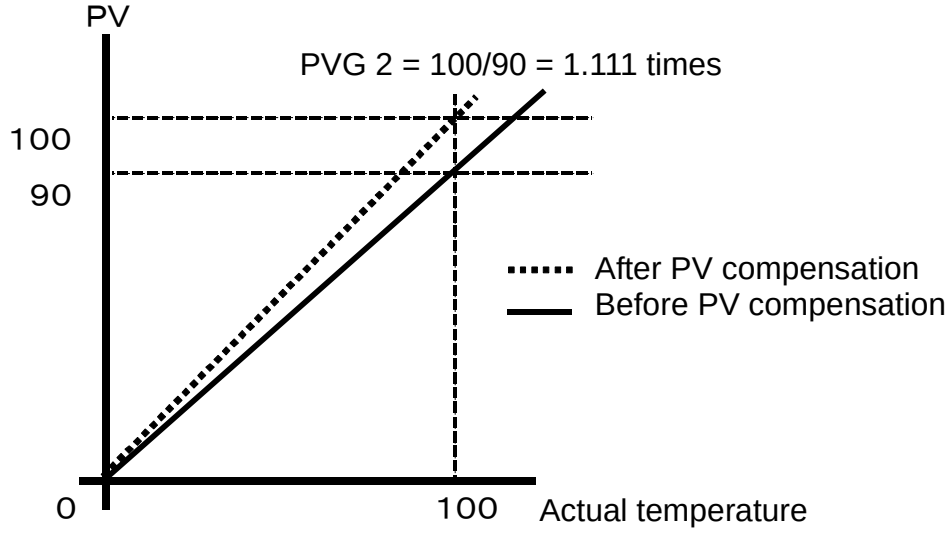
(1) Display resolution is 20,000 or less.
Take care it when the range from FSL 2 to FSH 2 is set larger than 20,000.
Setting example: Fluctuation or missing value of PV may be caused when the remote SV input is set to the input type of 4 - 20 mA, FSL 2 to -19999 digits and FSH 21 to 29999 digits.

(2) Take care that setting values for FSH 2 and FSL 2 can be the same.

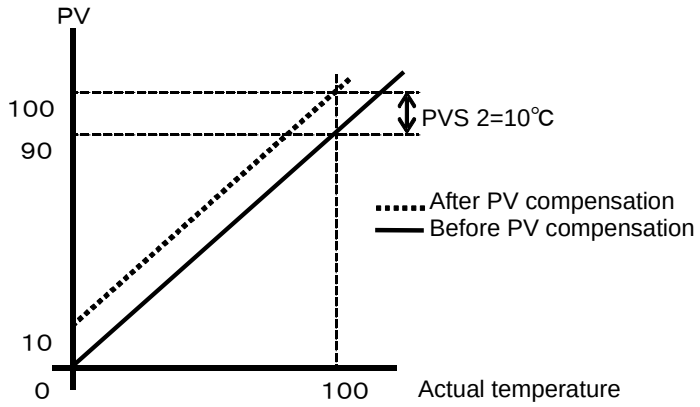
■ PV compensation gain/PV compensation zero setting

	SEt02 INP2	Setting content	Initial value
4	PVG2	**0.500 to 2.000** (times)	**1.000**
5	PVS2	Thermocouple/resistance temperature detector **-999.9 to 999.9** (°C) **-999 to 999** (°C)	**0**
		Voltage/current input **-9999 to 9999** (digit)	

PV compensation gain setting: PV (measurement value) for the remote SV input is multiplied by the compensation value.
Setting example: Where PV of the equipment is displayed for 90°C and the actual temperature is 100°C, and the display is to be compensated to 100°C, using the PV compensation gain setting.
The display after PV compensation is about 100°C = 90°C (before PV compensation) × 1.111.



PV compensation zero setting: PV (measurement value) for the remote SV input is added by the compensation value.
Setting example: Where PV of the equipment is displayed for 90°C and the actual temperature is 100°C, and the display is to be compensated to 100°C, using the PV compensation zero setting.
The display after PV compensation is 100°C = 90°C (before PV compensation) + 10°C.



* See below for an equation for combination of the PV compensation gain setting and PV compensation zero setting.
PV of remote SV input = before PV compensation × PV compensation gain setting + PV compensation zero setting

Note

(1) Take care that stability of the measurement value may deteriorate when the PV compensation gain setting is large.
(2) Take care that the display range may change when the PV compensation gain setting is set to a multiplication factor of 1 or smaller.
Setting example: Where K thermocouple input for - 200.0 to 1372.0°C
PV compensation gain setting: Multiplied by 0.5 → - 100.0 to 686.0°C
PV compensation gain setting: Multiplied by 0.1 → - 20.0 to 137.2°C
(3) Take care that the display range may change when the PV compensation zero setting is set to a value other than 0.
Setting example: Where K thermocouple input for - 200 to 1372°C
PV compensation zero setting: + 100°C → - 100 to 1372°C
PV compensation zero setting: - 100°C → - 200 to 1272°C
* The display range for analog input is not affected by the PV compensation zero setting.

■ PV filter setting

	SEt02 INP2	Setting content	Initial value
6	PdF2	**0.0 to 99.9** (seconds)	**0.0**

The PV filter setting is a function that demonstrates the CR filter effect on software through performing a first-order lag calculation for PV of the remote SV input.
The filter effect is set using the time constant [t].
(Time constant is defined as the time required for PV to reach about 63 % when an input changes in a step configuration.)
* CR filter --- a filter of first-order lag

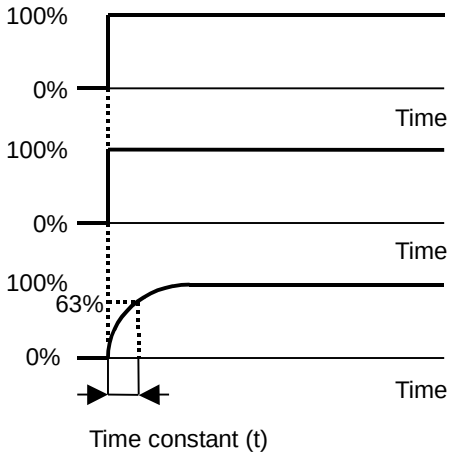
Note Application of PV filter

(1) Effect of noise is alleviated due to elimination of high-frequency noise when electric noise applies on inputs.
(2) Response can be delayed against abrupt change of an input.

■ Input signal

■ Input read in
When no digital PV filter exists
[Time constant (t) = 0]

When a digital PV filter exists
[Time constant (t) > 0]



■ Local/remote switchover

	SEt02 INP2	Setting content		Initial value
7	LR	**0**	Local	**0**
		1	Remote 1 (scaling at SLL , SLH)	
		2	Remote 2 (scaling at FSL 2, FSH 2)	

6.3 Function key function setting

■ Function settings for function keys 1 to 5

	SEt03 KEY	Setting content		Initial value
1 to 5	FU1 to FU5	Press the MODE key for making a setting effective.		00
		Function settings		
		*0	No function	
		*1	Digit shift	
		*2	Follow the Set21 C/P Operatioin Type Setting <Constant Operation Mode> Control Mode (MD) / Control Stop (RdY) <Program Mode> Program Start / Stop 3	
		*3	AT start/AT stop	
		*4	Timer start/reset	
		*5	Screen reverse feed	
		*6	ENT	
		*7	Bank switchover	
		*8	Control mode/manual	
		*9	SV/MV Display Switchover 3	
		*A	Constant Operation Mode / Program Mode switchover 3	
		*b	Step Forward 3	
		*C	Pause 3	
		*d	<For Program Operation Mode Only> 3 SET 22 Call-out Function (SET 22 Short-cut)	
		Pressing time setting		
		0*	None	
		1*	Pressing time 1 second	
		2*	Pressing time 2 seconds	
		3*	Pressing time 3 seconds	
		4*	Pressing time 4 seconds	
		5*	Pressing time 5 seconds	

Set functions for the function keys 1 to 5

(1) Digit shift
The digit shifts each time when the FUNC key is pressed: 1 → 10 → 100 → 1000 → 1.
Thereby, changes of setting values can be executed with ease.

(2) Control mode/control stop
Pressing the FUNC key results in changing the modes from control mode to control stop or vice versa.

(3) AT start/AT stop
The FUNC key is set to the auto-tuning start/stop key during the PID control.

(4) Timer start/reset
The FUNC key is set to the start/reset key when the timers 1 - 3 setting mode is set for manual start, as well as to the restart/reset key when a timer operation is once terminated.

(5) Screen reverse feed
Press the FUNC key when feeding a screen back to the one desired to display when it is passed beyond. (Reverse feed)
Note Take care that the reverse feed of SET 18 is not possible.

(6) ENT
The FUNC key is used as a setting recording key.
Take care that a move to the next parameter without recording results in a return of the setting to the one before the change.
Note For moving to another function from the ENT function, select the desired function and press the FUNC (ENT) key.

(7) Bank switchover
The FUNC key is used as a key for switching over the banks 0 to 7.

(8) Control mode/manual
Pressing the FUNC key results in the switchover from the control mode to the manual or vice versa.

(9) SV/MV SWITCH-OVER By pressing the FUNC-Key, The indication at the SV indication window can be changed to SV or MV.

(10) CONSTANT OPERATION MODE/PROGRAM OPERATION MODE SWITCH-OVER
By pressing the FUNC-key, mode can be switched to operation mode.
Switching between the Constant Operation Mode and the Program Mode can be done.

(11) STEP FORWARD
By pressing the FUNC-key, the steps can be forwarded during the program operation;
NOTE: This function is effective only when the Program Operation is being selected.
NOTE: When the bank no. at the auxiliary indication is not being shown, nothing happens even if the step forward key is pressed.

(12) PAUSE
By pressing the FUNC-key, the Program Operation can be stopped temporarily.
Switching between Pause – In Operation will be made.
NOTE: This function is effective only when the Program Mode is being selected.

(13) By pressing the FUNC-key, direct jump to SET 22 Parameter Setting Mode can be made.
To go back to the operation mode from SET 22, press MODE key for 2 seconds, or press the FUNC-key.
NOTE: This function is effective only when the Program Mode is being selected.

■Key Lock Setting

	SEt03 KEY	Setting Contents		Initial Value
6	LoC	0	Lock OFF	0
		1	All Lock	
		2	Operation Mode Lock	
		3	Lock except Operation Mode	
		4	All Lock (during RUN only) 3	
		5	Operation Mode Lock (during RUN only) 3	
		6	Lock except operation mode lock (during RUN only) 3	
		7	Parameter Mode Lock (during RUN only) 3	

Set the lock for keys.
Locked parameter settings cannot be changed using the △/▽ key.

LoC=4-7 limits the lock depending on the control condition.
The key-lock setting is effective only in (MD=RUN) during the constant operation, and in (in-operation or pause) during the program operation.

LoC=7 locks the parameter setting mode shift depending on the control condition.
Changing to Parameter Setting Mode cannot be made in (MD=RUN) during the constant operation, and in (in-operation or pause) during the program operation.
NOTE: Conditions in LoC=7 Key-Lock
It is necessary that either more than 1 Di is set at DIF=2, or more than 1 key function is FU=2.

6.4 Control function setting

■ Bank switchover/Bank Upper Limit Setting

	SEt04 CNt	Setting content	Initial value
1	bANK	**0 to 7** Bank 0 to 7	**0**
	bANKH	Bank Upper Limit Setting 0 to 7 3	**7**

Switching over to the banks 0 to 7 is executed.
Switchover to either one of the banks 0 to 7 results in that a parameter set in the memory bank is switched over to a setting value for each bank.

Note The setting is determined by pressing the MODE key or FUNC key (only for setting the screen reverse feed).

For the Bank Function, please refer to Operation Manual Bank Function (P5 – 28 up to 30).

■ Control setting

	SEt04 CNt	Setting content	Initial value
3	SV	SLL to SLH	**0**

Set a target value (SV) for a control.
Allowable setting range is from SLL (SV limiter lower limit) to SLH (SV limiter upper limit).

■ SV limiter upper limit/lower limit

	SEt04 CNt	Setting content	Initial value
4	SLH	Thermocouple/resistance temperature detector input **(SLL + 5.0)** to SV setting range upper limit (°C) **(SLL + 5)** to SV setting range upper limit (°C)	**1200**
		Voltage/current input **(SLL + 50)** to SV setting range upper limit (digit)	**12000**
5	SLL	Thermocouple/resistance temperature detector input SV setting range lower limit to **(SLH - 5.0)** (°C) SV setting range lower limit to **(SLH - 5)** (°C)	**0**
		Voltage/current input SV setting range lower limit to **(SLH - 50)** (digit)	

Set the SV upper limit/lower limit.

- SV limiter upper setting range
  For input of thermocouple/resistance temperature detector
  : (SLL + 5) to Input 1 setting range upper limit [°C] (Decimal point position setting 0)
  : (SLL + 5.0) to Input 1 setting range upper limit [°C] (Decimal point position setting 0.0)
  For input of voltage/current
  : (SLL + 50) to Input 1 setting range upper limit [digit]
- SV limiter lower setting range
  For input of thermocouple/resistance temperature detector
  : Input 1 setting range lower limit to (SLL - 5) [°C] (Decimal point position setting 0)
  : Input 1 setting range lower limit to (SLL - 5.0) [°C] (Decimal point position setting 0.0)
  For input of voltage/current
  : Input 1 setting range lower limit to (SLL - 50) [digit]

For input 1 setting range upper limit/lower limit, see the input 1 type setting table on page 6-2.

■ Control mode

	SEt04 CNt	Setting content		Initial value
6	Md	**RUN**	Control start	**RUN**
		MAN	Manual	
		RdY	Control stop	
		tIME1	Timer 1 operation	
		tIME2	Timer 2 operation	
		tIME3	Timer 3 operation	

Set the control mode.
Control stop (RdY): Primary/secondary operating amount limiter lower limit is output.
Control start (RUN): Normal control is executed.
Manual (MAN): Operating amount set in the primary/secondary operating amount is output.
Timer interlocking control (tIME 1 to 3): A control where the normal control and timer operation are interlocked is executed.

For start (RUN)/stop (RdY)/manual (MAN) of control, see section "5.4.3 Mode/manual function" on page 5-28.

For timer interlocking control (tIME 1 to 3), see section "5.4.5 Timer function" on pages 5-32 to 37.

■ Control type setting

	SEt04 CNt	Setting content			Initial value
7	CNt	**0**	Primary --- None	Secondary --- None	**1**
		1	Primary --- PID control	Secondary --- None	
		2	Primary --- ONOFF control	Secondary --- None	
		3	Primary --- PID control	Secondary --- PID control	
		4	Primary --- PID control	Secondary --- ONOFF control	
		5	Primary --- ONOFF control	Secondary --- ONOFF control	
		6	Primary --- position proportional	Secondary --- position proportional	

Set the control type (method).
Control types of primary and secondary control outputs that are set on this equipment can be assigned to the methods of 0 to 6.
For the content of the assignment, see the setting content listed above.

Note

(1) In case that the control type is set to 3 (primary/secondary PID control) and the tuning type to 3, 4 or 5, take care that the tuning type changes to 1 (primary tuning) in conjunction with the change of the control type.
(2) Take care that the position proportional control (CNt: 6) is selectable even when the primary/secondary control output is not set for the target connection setting.

■ PID control type/type B mode

	SEt04 CNt	Setting content		Initial value
8	tYP	**0**	type A (normal PID control)	**1**
		1	type B (overshoot suppression function)	
		2	type C (disturbance suppression function)	
9	bMd	**0**	Overshoot suppression --- moderate	**1**
		1	Overshoot suppression --- intermediate	
		2	Overshoot suppression --- intense	

Set the PID control type.
For the use of the equipment in setting of the control type to be the PID control, a selection can be made among three control types of 0 (type A) to 2 (type C), whichever is best suited for the application.

Note The type B mode can be set when the PID control type is set to 1 (type B). In the type B mode, a result from integration (I) or differentiation (d) of the auto-tuning is multiplied by a coefficient. The intermediate type is same value as it is. The type C (disturbance suppression function) cannot be set when the self-tuning is set in the tuning type setting.

For control characteristics of each control type, see section "5.4.1 Auto-tuning (AT) function" on pages 5-23 to 25.

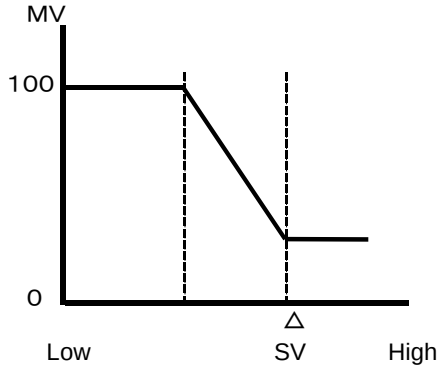
■ Forward/reverse operation setting

	SEt04 CNt	Setting content		Initial value
10	dIR	**0**	Reverse operation	**0**
		1	Forward operation	

Set the forward/reverse operation of the primary control.

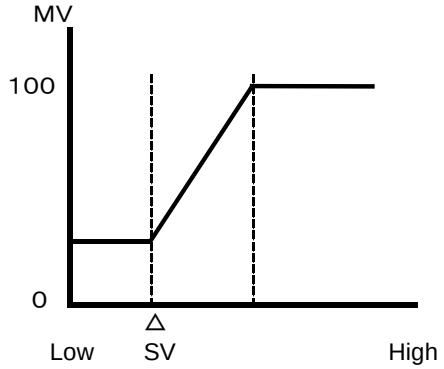
<Reverse operation>

- Reverse operation (heating control) is a control where the operating amount increases as PV (measurement value) lower than SV (setting value).



<Forward operation>

- Forward operation (cooling control) is a control where the operating amount increases as PV higher than SV.



Note Take care the following when setting the secondary control.

- The secondary control is automatically set to the forward operation when the primary control is set to 0 or the reverse operation.
- The secondary control is automatically set to the reverse operation when the primary control is set to 1 or the forward operation.

■ Primary control operating amount

	SEt04 CNt	Setting content	Initial value
11	MV1	**MLL 1 to MLH 1** (%)	**0.0**

The screen is for displaying the operating amount for the primary control.
The operating amount cannot be set for the normal control.
The operating amount can be set only when the control mode is set to manual.

■ Primary control output gain setting

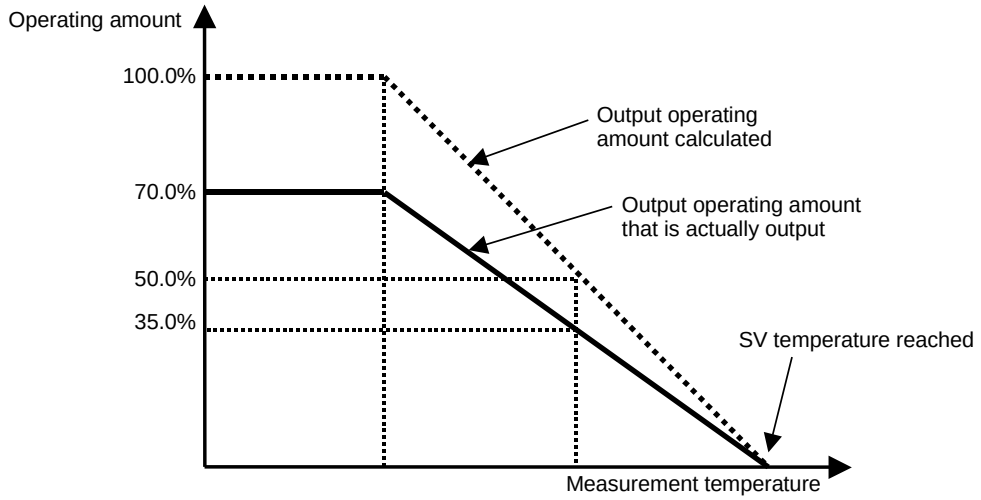
	SEt04 CNt	Setting content	Initial value
12	MV1G	**0.0 to 1000.0** (%)	**100.0**

The operating amount (MV 1) for the primary control is multiplied by a compensation value.
[Operating amount for the primary control] = [Operating amount for the primary control before compensation] × [Primary control output gain setting]

Note A change of the output gain setting may result in no provision of best suited PID parameter in AT.

Note Each limiter is output with a high priority, when the following is set: the primary control operating amount limiter upper limit setting or primary control operating amount limiter lower limit setting.

Change of the output amount when the output gain setting is set to 70.0 %



Setting example:

When control characteristics in 100 VAC is desired to be maintained also in 120 VAC;
100 VAC and 100 W → 120 VAC and 144 W, assuming that the heater resistance of 100 Ω is identical for both 100 VAC and 120 VAC
100 W ÷ 144 W = 69.4 %
Thus, by setting the output gain setting to 69.4 %, control characteristics in 120 VAC can be expected to be analogous to those in 100 VAC.
NOTE: In case the loop disconnection is used when the output gain setting is at 50.0%, make the working volume limiter the same as that of output gain.

■ Tuning type setting

	SEt04 CNt	Setting content		Initial value
13	tUN	**1**	Primary auto-tuning (for primary PID/position proportional)	**1**
		2	Primary self-tuning (for primary PID/position proportional)	
		3	Secondary auto-tuning (for primary PID/secondary PID)	
		4	Secondary self-tuning (for primary PID/secondary PID)	
		5	Primary/secondary auto-tuning (for primary PID/secondary PID)	

Set the auto-tuning or self-tuning of the primary/secondary control.

Note

(1) This setting is allowed only when either primary or secondary control is set for the PID control or position proportional control.
(2) AT of the primary control is not allowed when "4" (secondary self-tuning) is set.
(3) Take care that a change of the control type results in the tuning type of "1" (primary auto-tuning) due to interlock when the control type is set to "3" (primary/secondary PID control) and the tuning type to either one of "3" to "5."

<Auto-tuning>

In the auto-tuning, the PID constant is calculated using response in the ON/OFF control.
The PID constant calculated does not change unless the auto-tuning is re-executed.
Thus, the auto-tuning is suited for a subject of control where temperature cyclically changes, such as seal packaging machine.

<Self-tuning>

The self-tuning is a tuning method where the PID constant is automatically calculated based on observation of control wave shapes.
The self-tuning is suited for a control where subjects of control varies, where control or setting value changes, or where environment such as ambient temperature changes.
Tuning time is not required to set for the self-tuning, unlikely the auto-tuning.
The decimal point of Bank display blinks, when the wave shape is being observed.

■ AT gain setting

	SEt04 CNt	Setting content	Initial value
14	AtG	**0.1 to 10.0** (times)	**1.0**

The value of the proportional band to be calculated in AT is multiplied by a coefficient.

Note It is usually recommended that the initial value for the AT gain setting parameter is maintained as is.

■ AT sensitivity setting

	SEt04 CNt	Setting content	Initial value
15	AtC	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C)	**2**
		Voltage/current input **0 to 9999** (digit)	**20**

Set the sensitivity of ON/OFF operation during AT.
The ON/OFF operation is executed during AT.
An appropriate PID constant may not be calculated due to tuning results affected by a large fluctuation of the measurement value during AT.
In such a situation, appropriate tuning results are obtained through adjustment of the AT sensitivity.

In addition, in case of the small AT sensitivity, measurement values may fluctuate due to noises, and the control at normal temperatures may greatly be affected by external environments.
In such a situation, best-suited control characteristics may not be calculated due to recognition of external environments as subjects of control.

Note It is usually recommended that the initial value for the AT sensitivity setting parameter is maintained as is.

■ AT start screen

	SEt04 CNt	Setting content	Initial value
16	At	Use the ▲ / ▼ key for start and stop. PV/SV is displayed during AT.	**oFF**

The screen is used for starting AT.
Pressing the ▲ key or ▼ key allows start/stop of AT.

After setting the AT start/stop in the key function setting, pressing the FUNC key allows the AT start/stop. See page 6-12.

After setting the AT start/stop in the DI function setting, DI allows the AT start/stop. See pages 6-59 and 61.

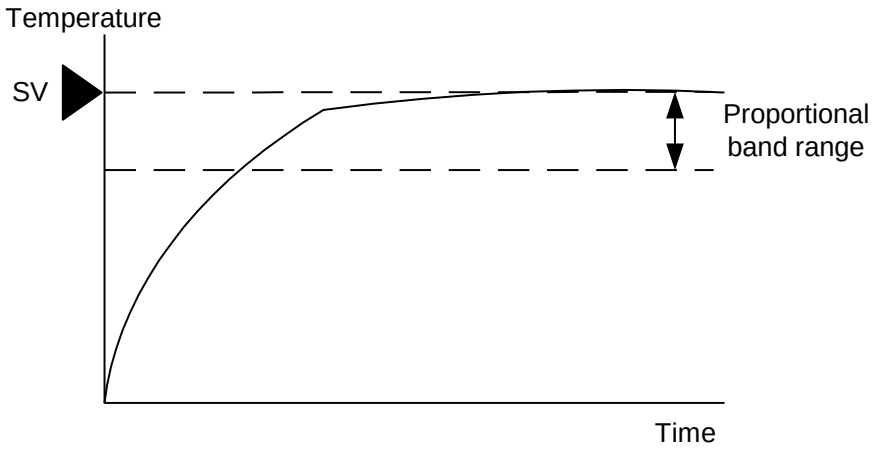
Note The AT start/stop is not allowed on the AT start screen when the AT start/stop is set for DI or the FUNC key.

■ Proportional band setting

	SEt04 CNt	Setting content	Initial value
17	P1	**0.1 to 200.0** (%)	**3.0**

Set the proportional band.

The proportional band for the heating cooling control is the one on the heating side.
The proportional band for the heating control is located as shown in the diagram below.
The proportional band for the cooling control is located in the upper side of SV in the diagram.



The proportional band range can be calculated, using the equation below.

Proportional band range = (SLH - SLL) × P 1

SLH: SV limiter upper limit
SLL: SV limiter lower limit

Example: When SLH = 1200°C, SLL = 0°C, and P 1 = 3.0 %;

(1200°C - 0°C) × 3 % = 36°C.

Thus, the output gradually decreases from the one at the temperature 36°C below SV.

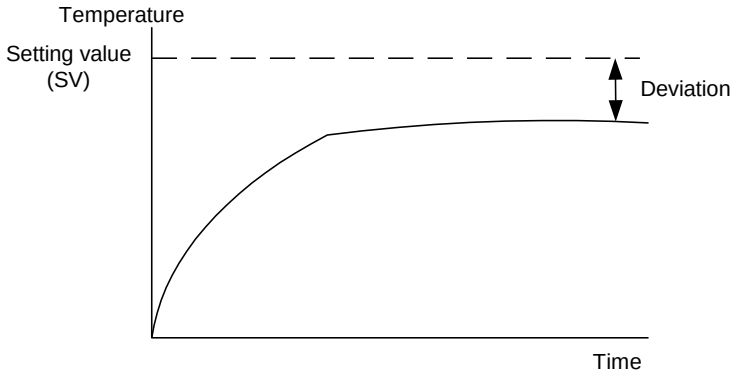
In general, wider proportional range results in a slower initial rise.
A narrower proportional range may result in that the control goes too far (overshoot), or forms waves (hunting) to cause unstable output, although the initial rise is faster.

■ Integral time setting

	SEt04 CNt	Setting content	Initial value
18	I	**0 to 3600** (seconds)	**0**

Set the integral time.
Setting of 0 second results in no integral operation.
Both heating and cooling sides share to use this setting in the heating cooling control. (Individual setting is not allowed.)

The integral operation is an operation that makes the deviation between the setting value and measurement value, which is generated in the proportional control, approach 0.



The integral time is a value, in the unit of second, that defines intensity of the integral operation.
A smaller time value setting is equivalent to a more intense operation. (Because the value deviated is attempted to return in the set time.)

■ Derivative time setting

	SEt04 CNt	Setting content	Initial value
19	d	**0 to 3600** (seconds)	**0**

Set the derivative time.
Setting of 0 second results in no derivative operation.
Both heating and cooling sides share to use this setting in the heating cooling control.

The derivative operation is an operation that works to return fast to the original control state by supplying a large operating amount against drastic disturbances.
The output provided by the derivative operation is proportional to the time derivative value of the measurement value.
The proportional and integral operations are corrective operations, so their responses tend to be slow to drastic temperature changes (or disturbances). The derivative operation supplements such a shortcoming.

The derivative time is a value, in the unit of second, that defines intensity of the derivative operation.
A larger time value setting is equivalent to a more intense operation. (Because the interval to pick a variance becomes larger.)

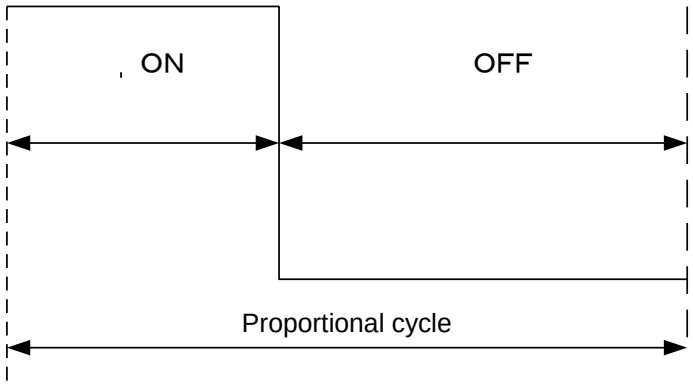
■ Primary control proportional cycle

	SEt04 CNt	Setting content	Initial value
20	t1	**0.1 to 120.0** (seconds)	**20.0** **(1.0)**

( ) When OUTPUT1 is SSR drive.

Set the primary control proportional cycle.
Relay contact output, voltage output for SSR drive or open collector output has only the state of ON or OFF for output, and thereby no proportional operation is offered.
Thus, to solve the issue, concept of time proportional operation is applied.
In the time proportional operation, ON/OFF is repeated in a proportional cycle (time cycle), where the ON state is maintained for a particular time period and the OFF state for the rest of the period.

Example: When the proportional cycle is 20 seconds and the operating amount (MV) is 40 %, the ON/OFF period is as follows.
ON: 8 seconds
OFF: 12 seconds



■ Anti-reset windup (ARW)

	SEt04 CNt	Setting content	Initial value
21	ARW	**0.0 to 110.0** (%) Function turned off at **110.0** (%) setting	**110.0**

Set the max. value of calculated integral operating amount.
Setting example: When ARW is set to 50 %, the operating amount accumulated in the integral operation reaches 50 %.

Anti-reset windup is an operation to suppress excessive integration of integral operation.
It is used to prevent overshoot, when a control contains an integral operation, by limiting the range of the effective integral operation.

Note

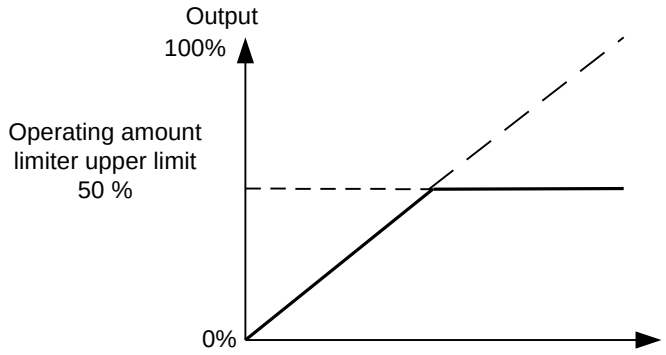
(1) When ARW is set to 0 %, integral operation is ineffective.
(2) The value of ARW is automatically set by auto-tuning after setting tYP (PID control type) to "2" (type C: disturbance suppression function).

■ Primary control operating amount limiter upper limit

	SEt04 CNt	Setting content	Initial value
22	MLH1	Digital output **MLL 1 to 100.0** (%)	**100.0**
		Analog output **MLL 1 to 110.0** (%)	

Set the primary control operating amount limiter upper limit.

A limit is set for the upper limit of the operating amount calculated.

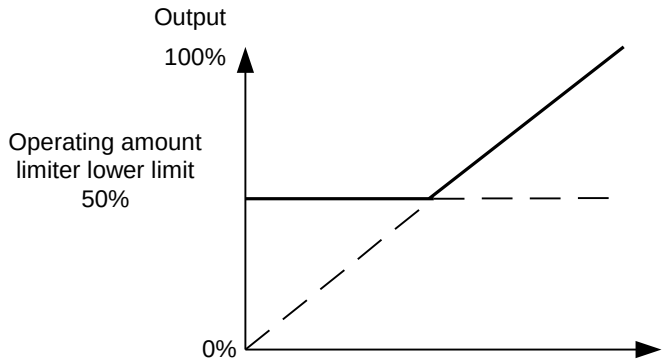


■ Primary control operating amount limiter lower limit

	SEt04 CNt	Setting content	Initial value
23	MLL1	Digital output **0.0 to MLH 1** (%)	**0.0**
		Analog output **-10.0 to MLH 1** (%)	

Set the primary control operating amount limiter lower limit.

A limit is set for the lower limit of the operating amount calculated.

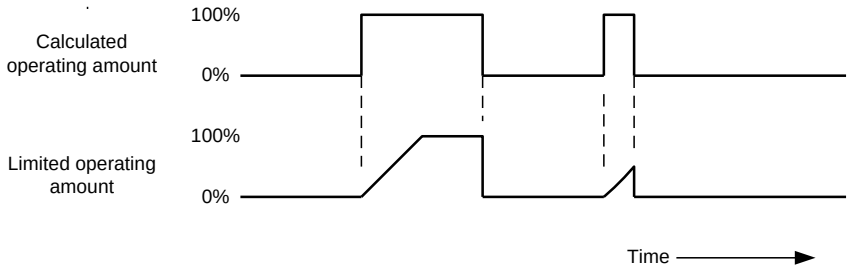


■ Primary control operating amount change limiter ascent setting

	SEt04 CNt	Setting content	Initial value
24	oU1	**0.0 to 549.9** (%) Function turned off at **0.0** (%) setting	**0.0**

Set the primary control operating amount change limiter ascent.

A limit is set to the ascent percentage of the operating amount change calculated.
An operating amount allowed with ascent for a second is set in the unit of percentage.



MLL 1 is set for the initial MV at power-on.

Note

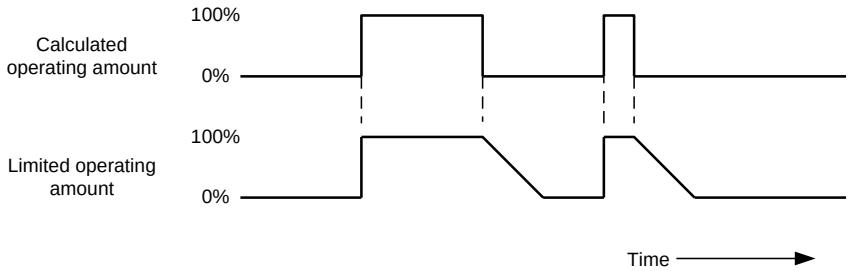
(1) The setting is effective also during AT.
(2) When the setting is changed, re-AT is required due to different control result.
(3) The setting value of 100 % allows ascent of only 20 % in the input sampling (200 ms).
In order to have ascent of 100 % in the input sampling (200 ms), set the setting value to 500 %.
(1 s ÷ 200 ms) × 100 % = 500 %
Set the setting value to 0.0 % (OFF) when ascent of 110 % from 0 % in a second is desired for an analog input.

■ Primary control operating amount change limiter descent setting

	SEt04 CNt	Setting content	Initial value
25	od1	**0.0 to 549.9** (%) Function turned off at **0.0** (%) setting	**0.0**

Set the primary control operating amount change limiter descent.

A limit is set to the descent percentage of the operating amount change calculated.
An operating amount allowed with descent for a second is set in the unit of percentage.



MLL 1 is set for the initial MV at power-on.

Note

(1) The setting is effective also during AT.
(2) When the setting is changed, re-AT is required due to different control result.
(3) The setting value of 100 % allows descent of only 20 % in the input sampling (200 ms).
In order to have descent of 100 % in the input sampling (200 ms), set the setting value to 500 %.
(1 s ÷ 200 ms) × 100 % = 500 %
Set the setting value to 0.0 % (OFF) when descent of 110 % from 0 % in a second is desired for an analog input.

■ Primary control soft-start output setting

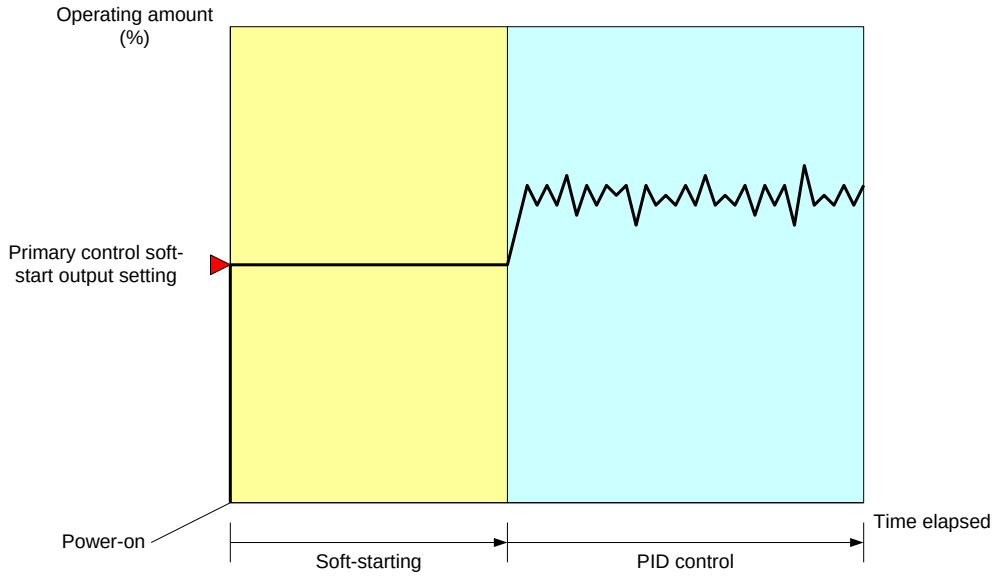
	SEt04 CNt	Setting content	Initial value
26	SFM	**ML 1 to MH 1** (%)	**100.0**

Set the primary control soft-start output setting.

A limit is set in a particular time period (or the primary control soft-start time) on the operating amount calculated.

■ Primary control soft-start time setting

	SEt04 CNt	Setting content	Initial value
27	SFt	**00:00 to 499:59** (minute seconds)	**000:00**



Note

(1) The SOFT START operates both when the power is switched ON and when the Control Mode is switched from "READY to RUN".
The switching of the Control Mode can be done with setting such as (SEt04 Md) (SEt03 FU*) and (SEt13 DIF)

(2) Soft-start is effective only during equipment operation. Note that the time elapses even after the mode changes to control stop, manual or AT.

(3) The set time can be changed during soft-start, where the set time is the time from power-on.
Example 1) When the set time is changed from 6 minutes to 4 minutes in 5 minutes after power-on, soft-start immediately stops.
Example 2) When the set time is changed from 6 minutes to 8 minutes in 5 minutes after power-on, soft-start will stop in 3 minutes.

■ Primary control abnormality operating amount setting

	SEt04 CNt	Setting content	Initial value
28	FAL1	Digital output **0.0 to 100.0** (%)	**0.0**
		Analog output **-10.0 to 110.0** (%)	

Set the primary control at-abnormality operating amount setting.
This operating amount is the one provided in case of failure of gauges and such.
<Conditions on the primary control at-abnormality operating amount>

- Burn-out
- Err 1 (AD abnormality error)
- Err 2 (AT error)

Note

(1) The operating amount is output without constraint from MLH 1 (primary control operating amount limiter upper limit) or MLL 1 (primary control operating amount limiter lower limit).
(2) Burn-out during the manual control results in outputting the operating amount that is set in MV 1 (primary control operating amount).
(3) The operating amount cannot be set during the control type of ON/OFF control. (No screen is displayed.)

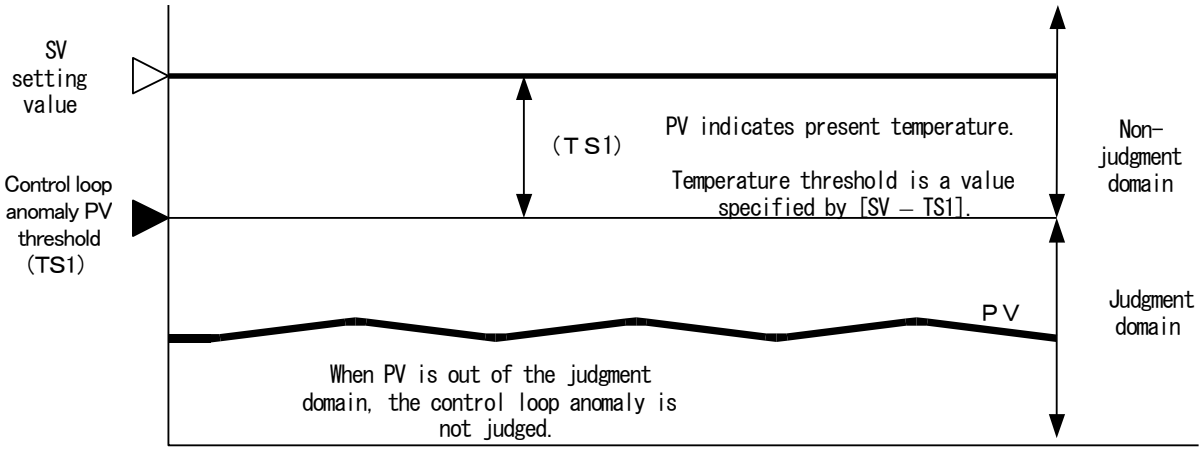
■ Primary control loop anomaly PV threshold

	SEt04 CNt	Setting content	Initial value
29	tS1	Thermocouple/resistance temperature detector input **0.0 to 999.9 (°C)0 to 999 (°C)**	**0**
		Voltage/current input **0 to 9999** (digit)	

Set the primary control loop anomaly PV threshold .

The function is to detect an abnormality in the control loop.
When width of tS1 has PV from an SV , a judgment of the loop anomaly acts.
The real judgment in PS1 and LoP1.

For details, see section "Loop abnormality function" on pages 5-38 and 39.



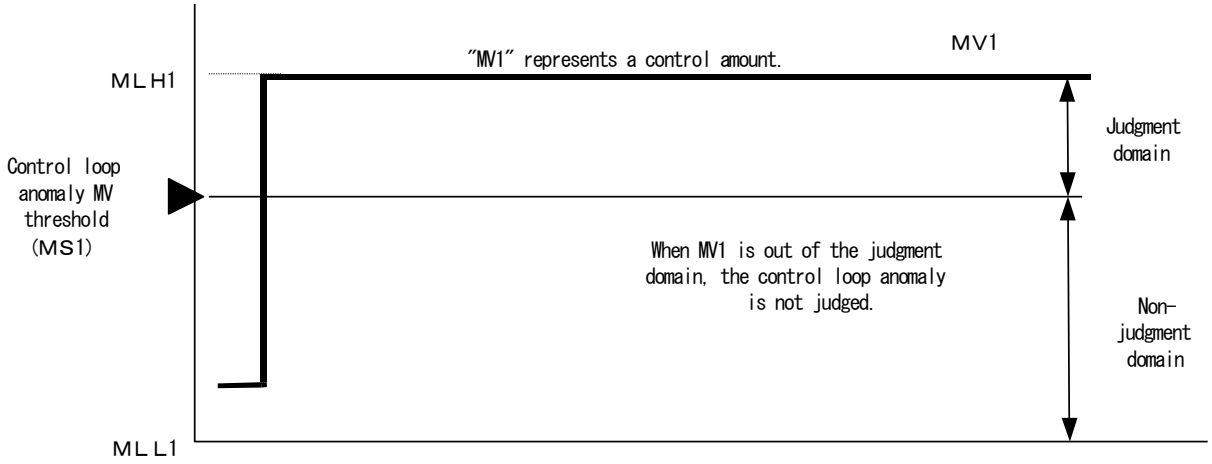
■ Primary control loop anomaly MV threshold

	SEt04 CNt	Setting content	Initial value
30	MS1	MV threshold **MLL1** to **MLH1** (%)	**100.0**

Set the primary control loop anomaly MV threshold.

The function is to detect an abnormality in the control loop.
When MV is more than the threshold, a judgment of the loop anomaly acts.
The real judgment in PS1 and LoP1.

For details, see section "Loop abnormality function" on pages 5-38 and 39.



■ Primary control loop anomaly PV change threshold

	SEt04 CNt	Setting content	Initial value
31	PS1	Thermocouple/resistance temperature detector input **0.0 to 999.9 (°C)0 to 999 (°C)** Applicable only for time judgment when PS 1 = 0 (LoP1)	**0**
		Voltage/current input **0 to 9999** (digit) Applicable only for time judgment when PS 1 = 0 (LoP1)	

Set the primary control loop anomaly PV change threshold.

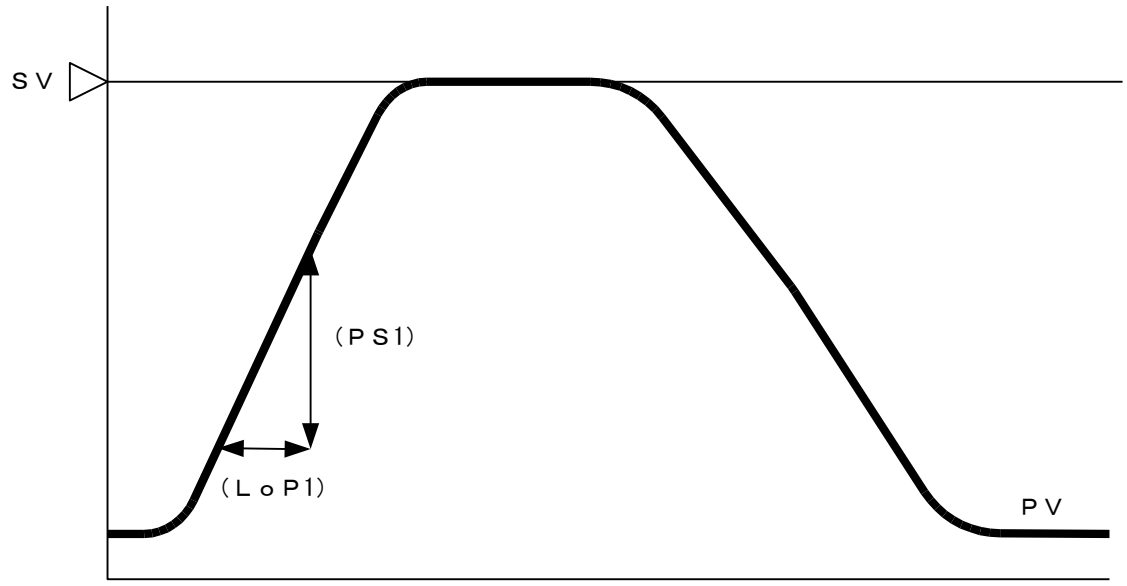
The function is to detect an abnormality in the control loop.

When the time satisfying threshold of TS1 or MS1 exceeds LOP1, the loop abnormality is determined as detected.

For details, see section "Loop abnormality function" on pages 5-38 and 39.

- The control loop anomaly PV change threshold is judged at each "LoP1" time.
- A loop abnormality is determined if each change threshold is judged to be equal to or below "PS1."
- When [PS1 = 0] is true, only time judgment is executed using LOP1.

When the time satisfying threshold of TS1 or MS1 exceeds LOP1, the loop abnormality is determined as detected.



■ Primary control loop abnormality time setting

	SEt04 CNt	Setting content	Initial value
32	LoP1	**0 to 9999** (seconds)	**0**

Set the primary control loop abnormality time setting.

The function is to detect an abnormality in the control loop.

- The control loop anomaly PV change threshold is judged at each "LoP1" time.
A loop abnormality is determined if each change threshold is judged to be equal to or below "PS1."

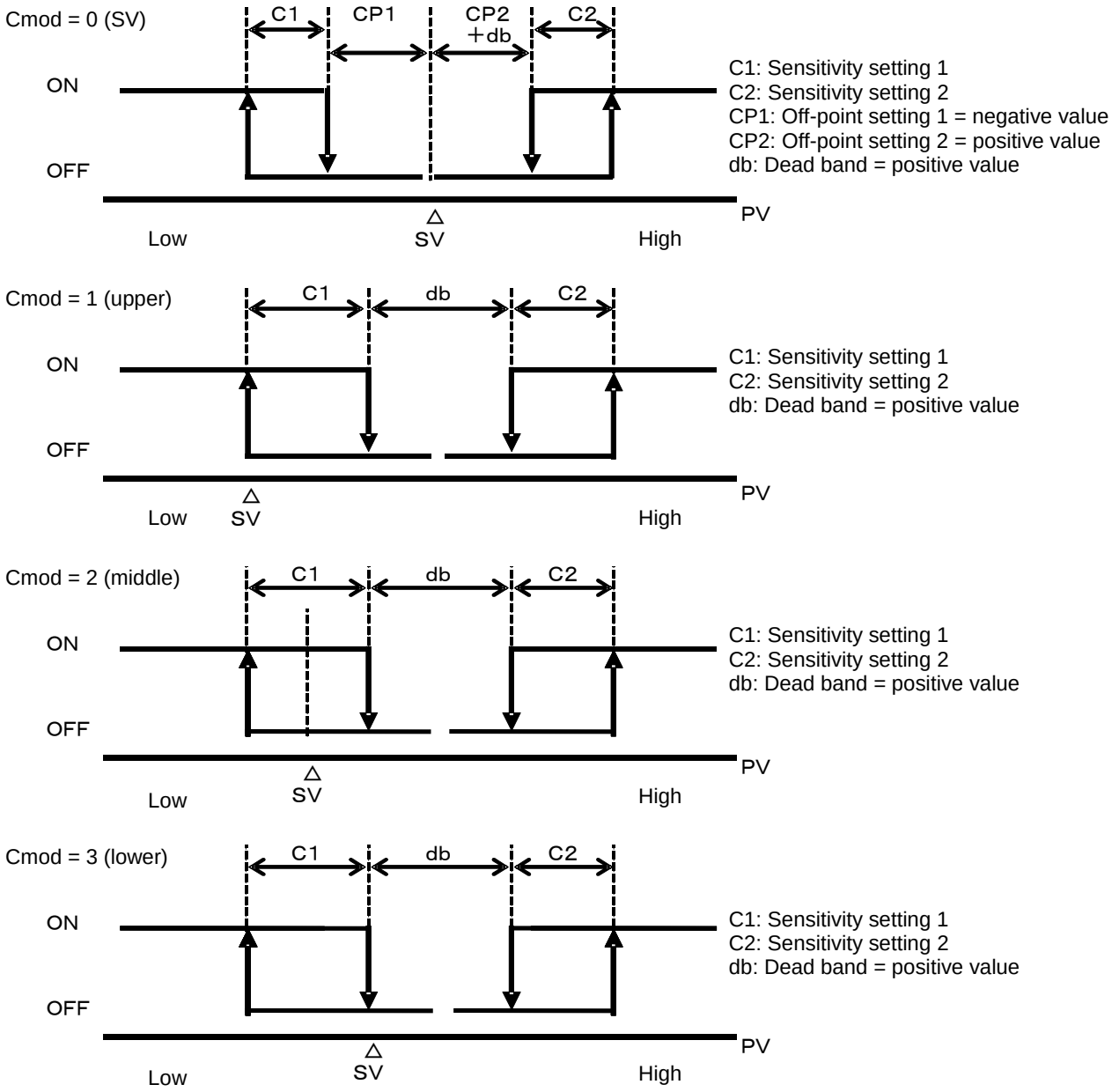
For details, see section "5.4.6 Loop abnormality function" on pages 5-38 and 39.

■ Primary control off-point position selection setting

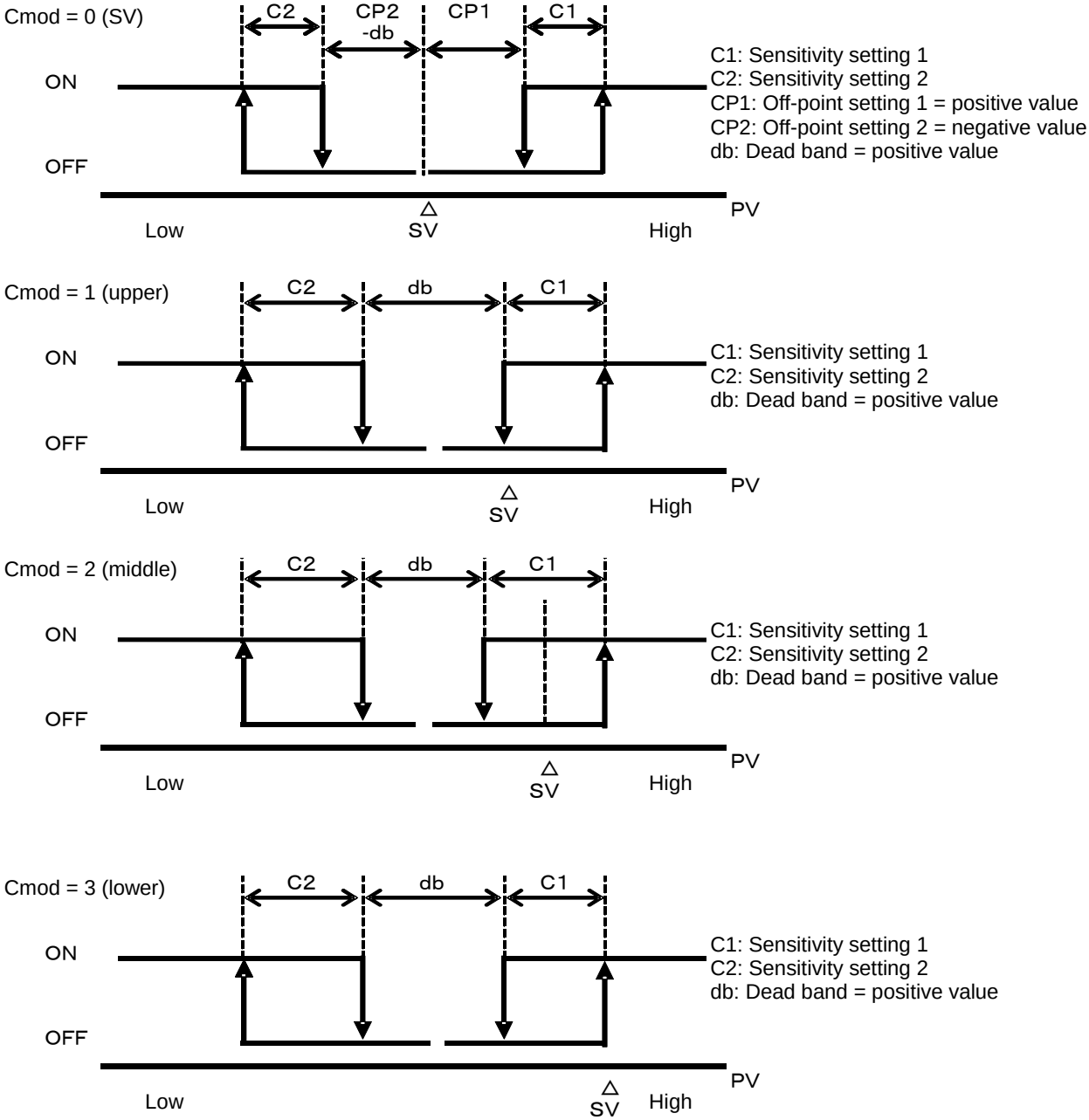
	SEt04 CNt	Setting content		Initial value
32	CMod	**0**	SV unit setting	**0**
		1	Upper	
		2	Middle	
		3	Lower	

Set the primary control off-point position selection.
Set the selection setting to "0" for allowing to set the off-point position of sensitivity in the SV setting unit of ℃ and such.
Set the selection setting to "1" to "3" for automatically setting the off-point position of the primary control to upper, middle or lower position with respect to SV.

<Reverse operation>



<Forward operation>



■ Primary control sensitivity setting

	SEt04 CNt	Setting content	Initial value
34	C1	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C)	**1**
		Voltage/current input **0 to 9999** (digit)	**10**

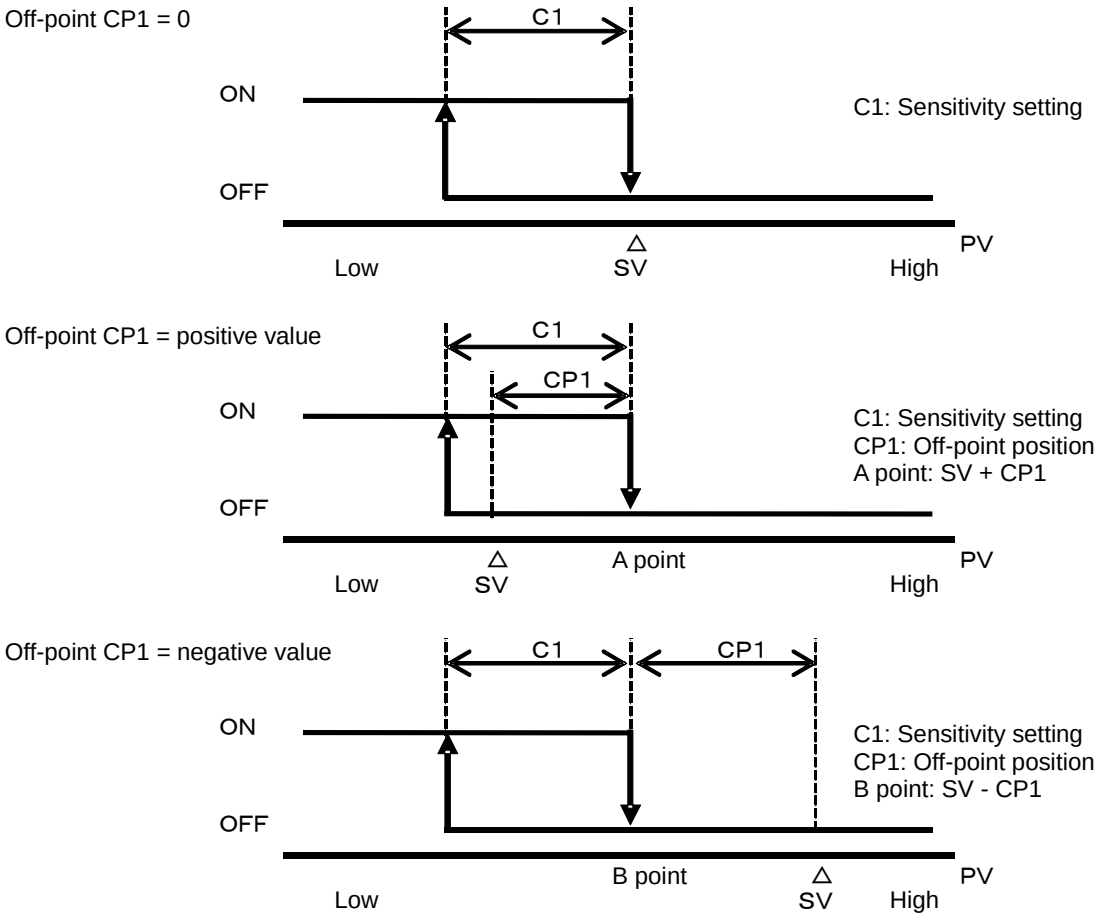
Set the primary control sensitivity.
Sensitivity (hysteresis) of ON/OFF operation is set. For heating control, the sensitivity is set below SV.

■ Primary control off-point position

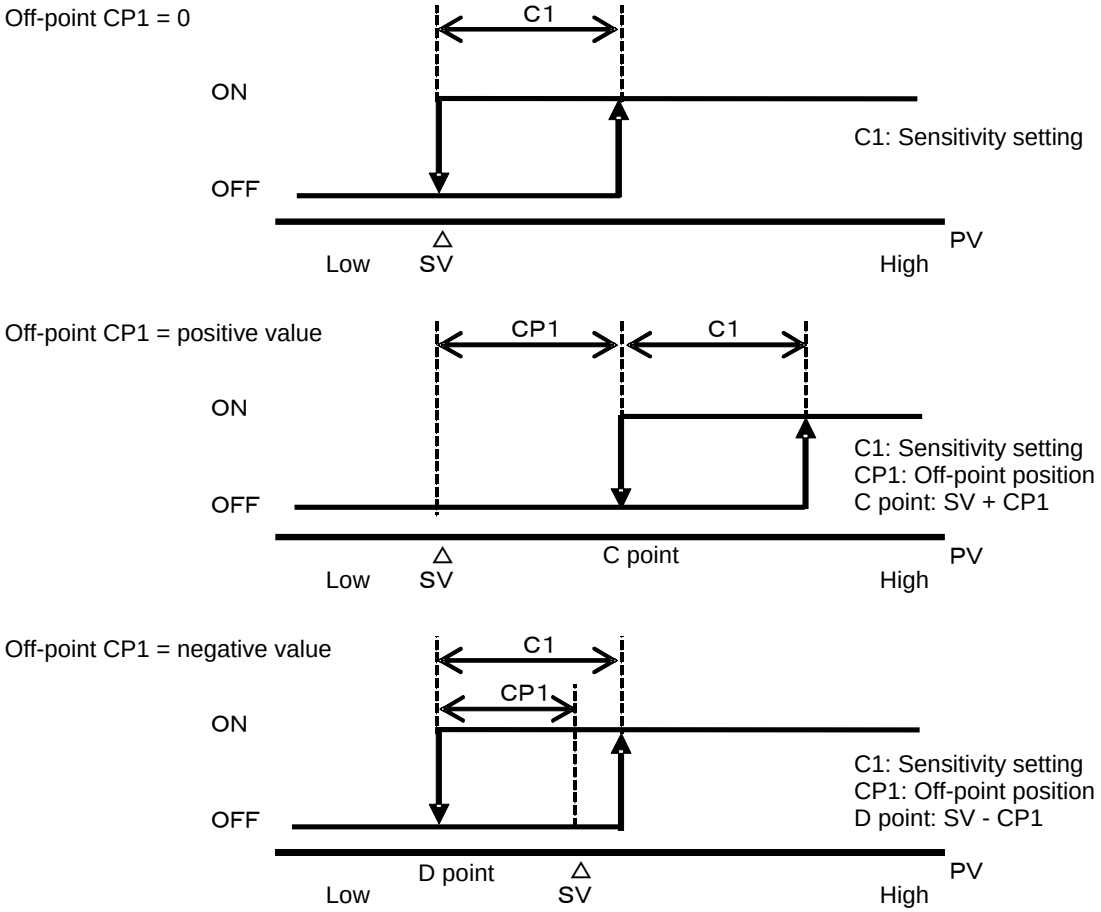
	SEt04 CNt	Setting content	Initial value
35	CP1	Thermocouple/resistance temperature detector input **-999.9 to 999.9** (°C) **-999 to 999** (°C)	**0**
		Voltage/current input **-9999 to 9999** (digit)	

Set the primary control off-point position.
Moving the off-point of the primary control sensitivity results in a move of entire range of the sensitivity.

< dIR=0 When primary control is Reverse operation >



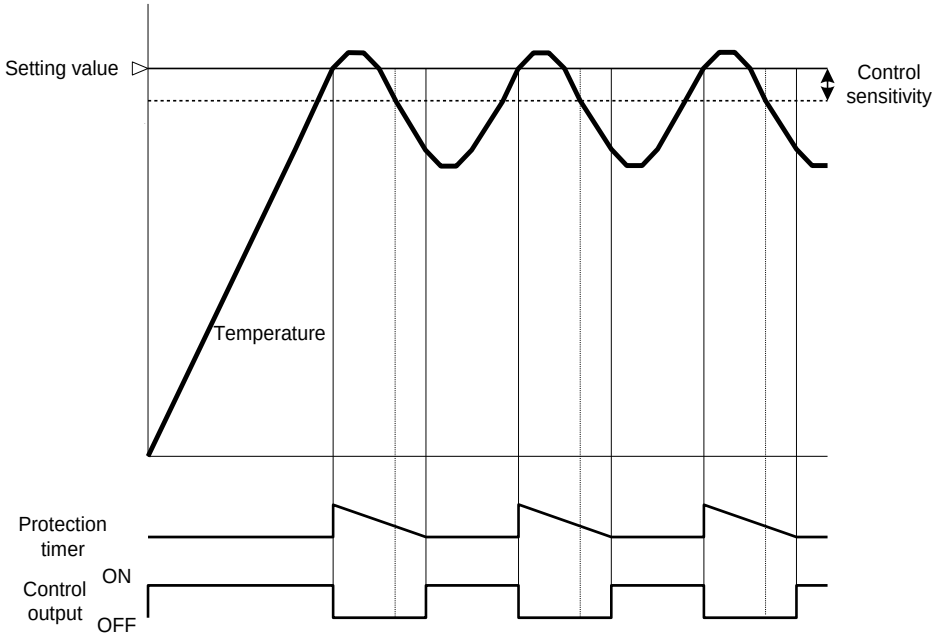
< dIR=1 When primary control is Forward operation >



■ Primary control protection timer

	SEt04 CNt	Setting content	Initial value
36	Fdt1	**0 to 99** (minutes)	**0**
37	Ndt1	**Main Control Protection on Timer 0~99(min.)** 3	**0**

BEHAVIOR DURING THE SETTING OF MAIN CONTROL PROTECTION OFF TIMER



■ Secondary control operating amount

	SEt04 CNt	Setting content	Initial value
38	MV2	**MLL 2 to MLH 2** (%)	**0.0**

The screen is for displaying the operating amount for the secndary control.
The operating amount cannot be set for the normal control.
The operating amount can be set only when the control mode is set to manual.

■ Secondary control output gain setting

	SEt04 CNt	Setting content	Initial value
39	MV2G	**0.0 to 1000.0** (%)	**100.0**

The operating amount (MV 1) for the secondary control is multiplied by a compensation value.
[Operating amount for the secondary control] = [Operating amount for the secondary control before compensation] × [Secondary control output gain setting]

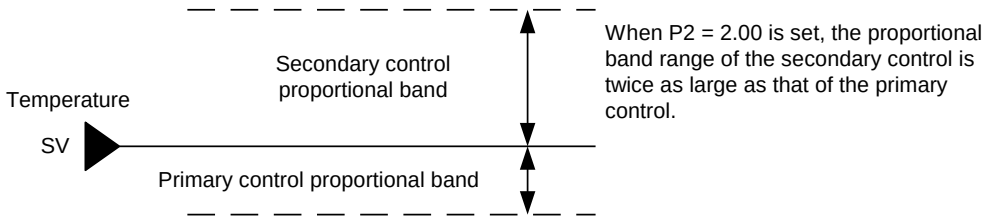
■ Secondary control proportional band setting

	SEt04 CNt	Setting content	Initial value
40	P2	**0.10 to 10.00** (times)	**1.00**

Set the secondary control proportional band.
The proportional band of the secondary control is set in a multiplication factor of 0.1 to 10 with respect to the proportional band of the primary control.

The proportional band of the secondary control is always set in opposite side to the proportional band of the primary control about SV.

Setting example: Where the proportional band range P2 of the secondary control is set to 2.00, P2 is twice as large as the proportional band range P1 of the primary control.

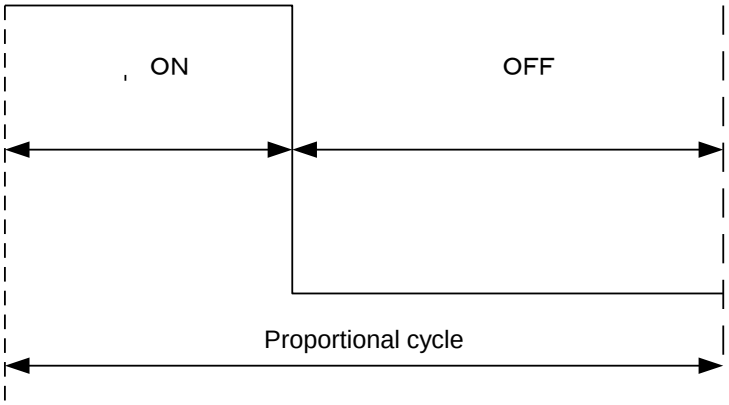


■ Secondary control proportional cycle

	SEt04 CNt	Setting content	Initial value
41	t2	**0.1 to 120.0** (seconds)	**20.0**

Set the secondary control proportional cycle.
Relay contact output, voltage output for SSR drive or open collector output has only the state of ON or OFF for output, and thereby no proportional operation is offered.
Thus, to solve the issue, concept of time proportional operation is applied.
In the time proportional operation, ON/OFF is repeated in a proportional cycle (time cycle), where the ON state is maintained for a particular time period and the OFF state for the rest of the period.

Example: When the proportional cycle is 20 seconds and the operating amount (MV) is 40 %, the ON/OFF period is as follows.
ON: 8 seconds
OFF: 12 seconds

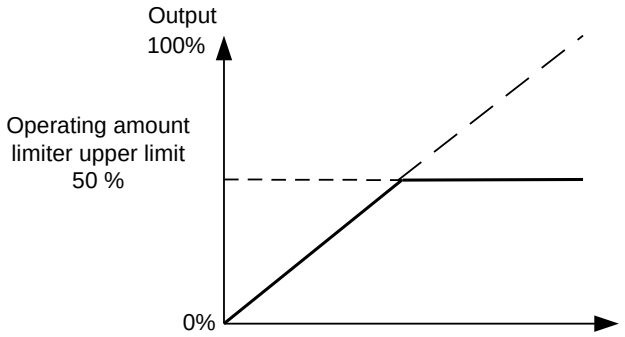


■ Secondary control operating amount limiter upper limit

	SEt04 CNt	Setting content	Initial value
42	MLH2	Digital output **MLL 2 to 100.0** (%)	**100.0**
		Analog output **MLL 2 to 110.0** (%)	

Set the secondary control operating amount limiter upper limit.

A limit is set for the upper limit of the operating amount calculated.

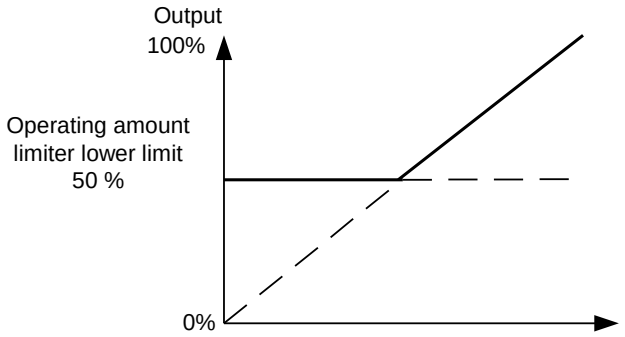


■ Secondary control operating amount limiter lower limit

	SEt04 CNt	Setting content	Initial value
43	MLL2	Digital output **0.0 to MLH 2** (%)	**0.0**
		Analog output **-10.0 to MLH 2** (%)	

Set the secondary control operating amount limiter lower limit.

A limit is set for the lower limit of the operating amount calculated.

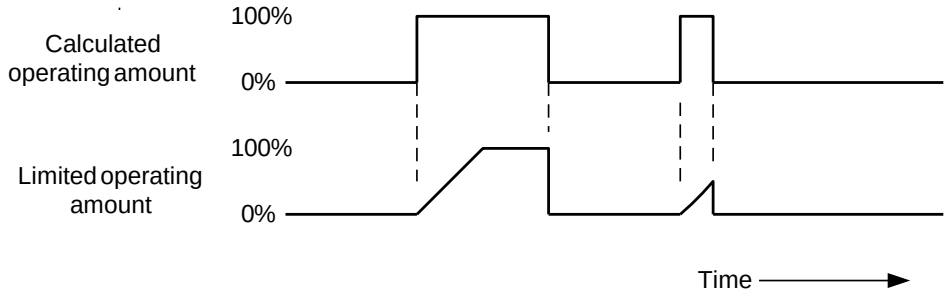


■ Secondary control operating amount change limiter ascent setting

	SEt04 CNt	Setting content	Initial value
44	oU2	**0.0 to 549.9** (%) Function turned off at **0.0** (%) setting	**0.0**

Set the secondary control operating amount change limiter ascent.

A limit is set to the ascent percentage of the operating amount change calculated.
An operating amount allowed with ascent for a second is set in the unit of percentage.



MLL 2 is set for the initial MV at power-on.

Note

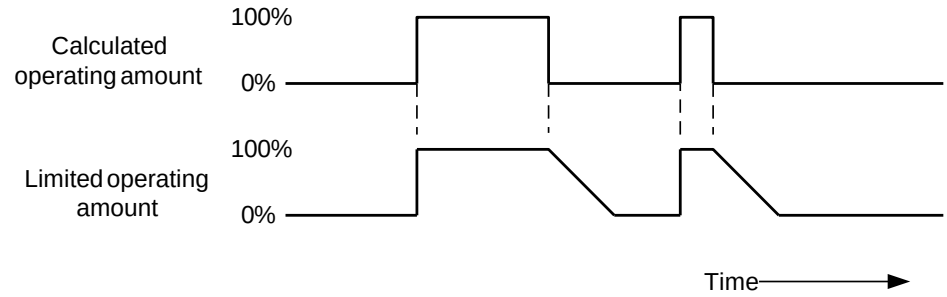
(1) The setting is effective also during AT.
(2) When the setting is changed, re-AT is required due to different control result.
(3) The setting value of 100 % allows ascent of only 20 % in the input sampling (200 ms).
In order to have ascent of 100 % in the input sampling (200 ms), set the setting value to 500 %.
(1 s ÷ 200 ms) × 100 % = 500 %
Set the setting value to 0.0 % (OFF) when ascent of 110 % from 0 % in a second is desired for an analog input.

■ Secondary control operating amount change limiter descent setting

	SEt04 CNt	Setting content	Initial value
45	od2	**0.0 to 549.9** (%) Function turned off at **0.0** (%) setting	**0.0**

Set the secondary control operating amount change limiter descent.

A limit is set to the descent percentage of the operating amount change calculated.
An operating amount allowed with descent for a second is set in the unit of percentage.



MLL 2 is set for the initial MV at power-on.

Note

(1) The setting is effective also during AT.
(2) When the setting is changed, re-AT is required due to different control result.
(3) The setting value of 100 % allows descent of only 20 % in the input sampling (200 ms).
In order to have descent of 100 % in the input sampling (200 ms), set the setting value to 500 %.
(1 s ÷ 200 ms) × 100 % = 500 %
Set the setting value to 0.0 % (OFF) when descent of 110 % from 0 % in a second is desired for an analog input.

■ Secondary control abnormality operating amount setting

	SEt04 CNt	Setting content	Initial value
48	FAL2	Digital output **0.0 to 100.0** (%)	**0.0**
		Analog output **-10.0 to 110.0** (%)	

Set the secondary control at-abnormality operating amount setting.
This operating amount is the one provided in case of failure of gauges and such.
<Conditions on the secondary control at-abnormality operating amount>

- Burn-out
- Err 1 (AD abnormality error)
- Err 2 (AT error)

Note

(1) The operating amount is output without constraint from MLH 2 (secondary control operating amount limiter upper limit) or MLL 2 (secondary control operating amount limiter lower limit).
(2) Burn-out during the manual control results in outputting the operating amount that is set in MV 2 (secondary control operating amount).
(3) The operating amount cannot be set during the control type of ON/OFF control. (No screen is displayed.)

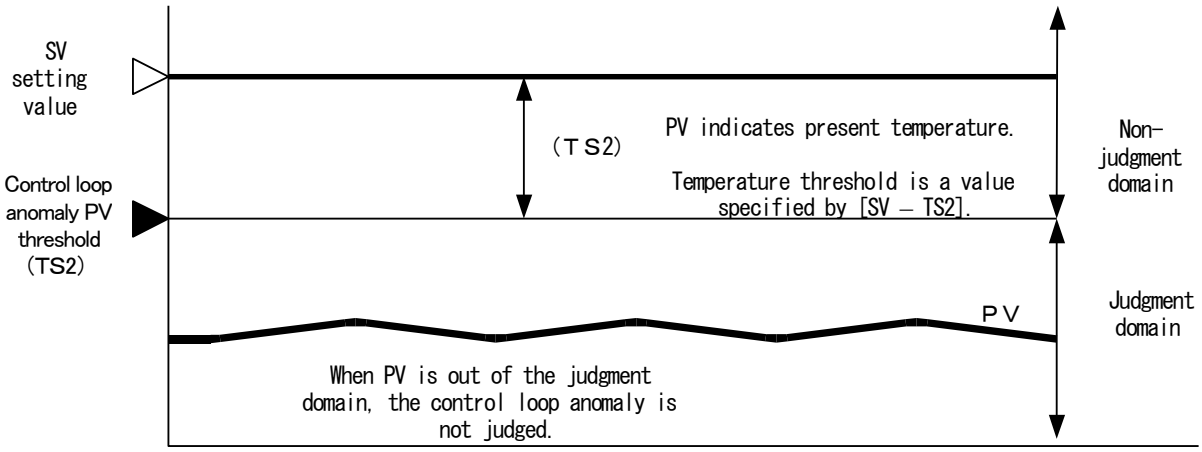
■ Secondary control loop anomaly PV threshold

	SEt04 CNt	Setting content	Initial value
47	tS2	Thermocouple/resistance temperature detector input **0.0 to 999.9 (°C)0 to 999 (°C)**	**0**
		Voltage/current input **0 to 9999** (digit)	

Set the secondary control loop anomaly PV threshold .

The function is to detect an abnormality in the control loop.
When width of tS1 has PV from an SV , a judgment of the loop anomaly acts.
The real judgment in PS2 and LoP2.

For details, see section "Loop abnormality function" on pages 5-38 and 39.



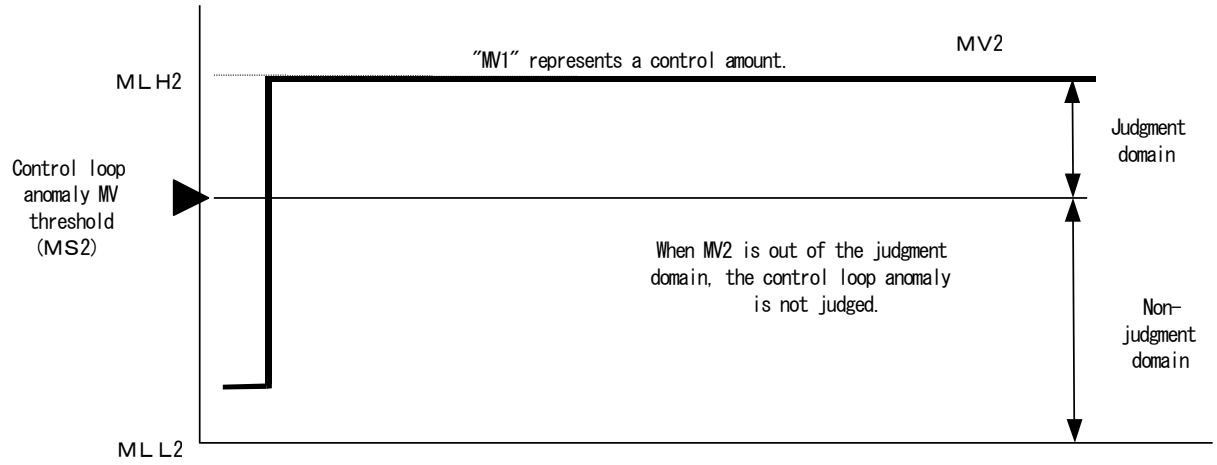
■ Secondary control loop anomaly MV threshold

	SEt04 CNt	Setting content	Initial value
48	MS2	MV threshold **MLL2** to **MLH2**(%)	**100.0**

Set the secondary control loop anomaly MV threshold.

The function is to detect an abnormality in the control loop.
When MV is more than the threshold, a judgment of the loop anomaly acts.
The real judgment in PS2 and LoP2.

For details, see section "Loop abnormality function" on pages 5-38 and 39.



■ Secondary control loop anomaly PV change threshold

	SEt04 CNt	Setting content	Initial value
49	PS2	Thermocouple/resistance temperature detector input **0.0 to 999.9 (°C)0 to 999 (°C)** Applicable only for time judgment when PS 2 = 0 (LoP2)	**0**
		Voltage/current input **0 to 9999** (digit) Applicable only for time judgment when PS 2 = 0 (LoP2)	

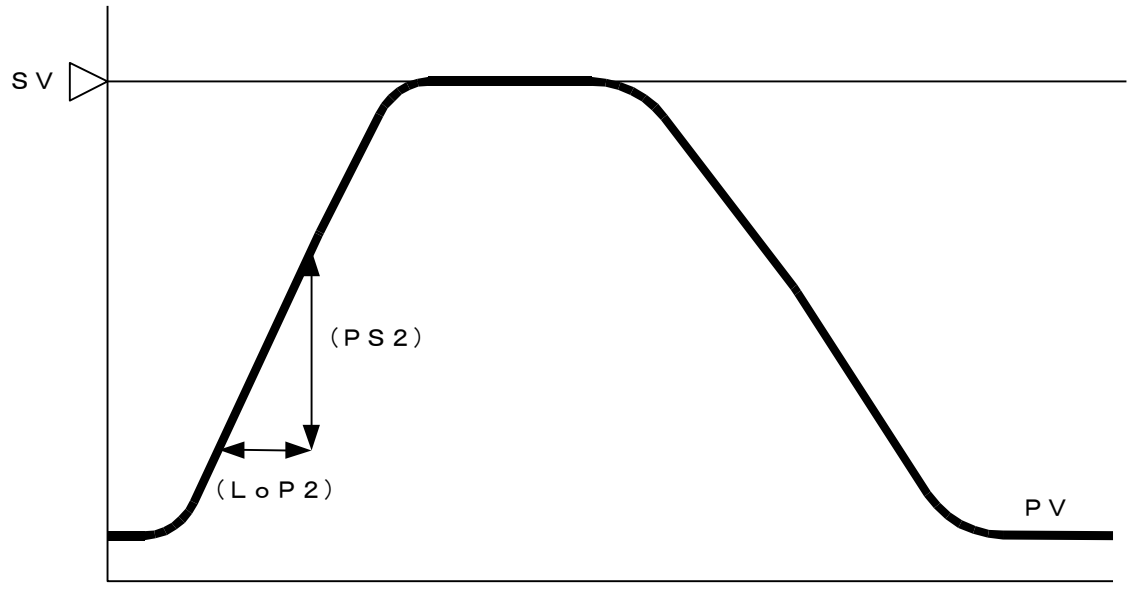
Set the secondary control loop anomaly PV change threshold.

The function is to detect an abnormality in the control loop.

When the time satisfying threshold of TS2 or MS2 exceeds LOP2, the loop abnormality is determined as detected.

For details, see section "Loop abnormality function" on pages 5-38 and 39.

- The control loop anomaly PV change threshold is judged at each "LoP2" time.
A loop abnormality is determined if each change threshold is judged to be equal to or below "PS2."
- When [PS2 = 0] is true, only time judgment is executed using LOP2.
When the time satisfying threshold of TS2 or MS2 exceeds LOP2, the loop abnormality is determined as detected.



■ Secondary control loop abnormality time setting

	SEt04 CNt	Setting content	Initial value
50	LoP2	**0 to 9999** (seconds)	**0**

Set the secondary control loop abnormality time setting.

The function is to detect an abnormality in the control loop.

- The control loop anomaly PV change threshold is judged at each "LoP2" time.
A loop abnormality is determined if each change threshold is judged to be equal to or below "PS2."

For details, see section "Loop abnormality function" on pages 5-38 and 39.

■ Secondary control sensitivity setting

	SEt04 CNt	Setting content	Initial value
51	C2	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C)	**1**
		Voltage/current input **0 to 9999** (digit)	**10**

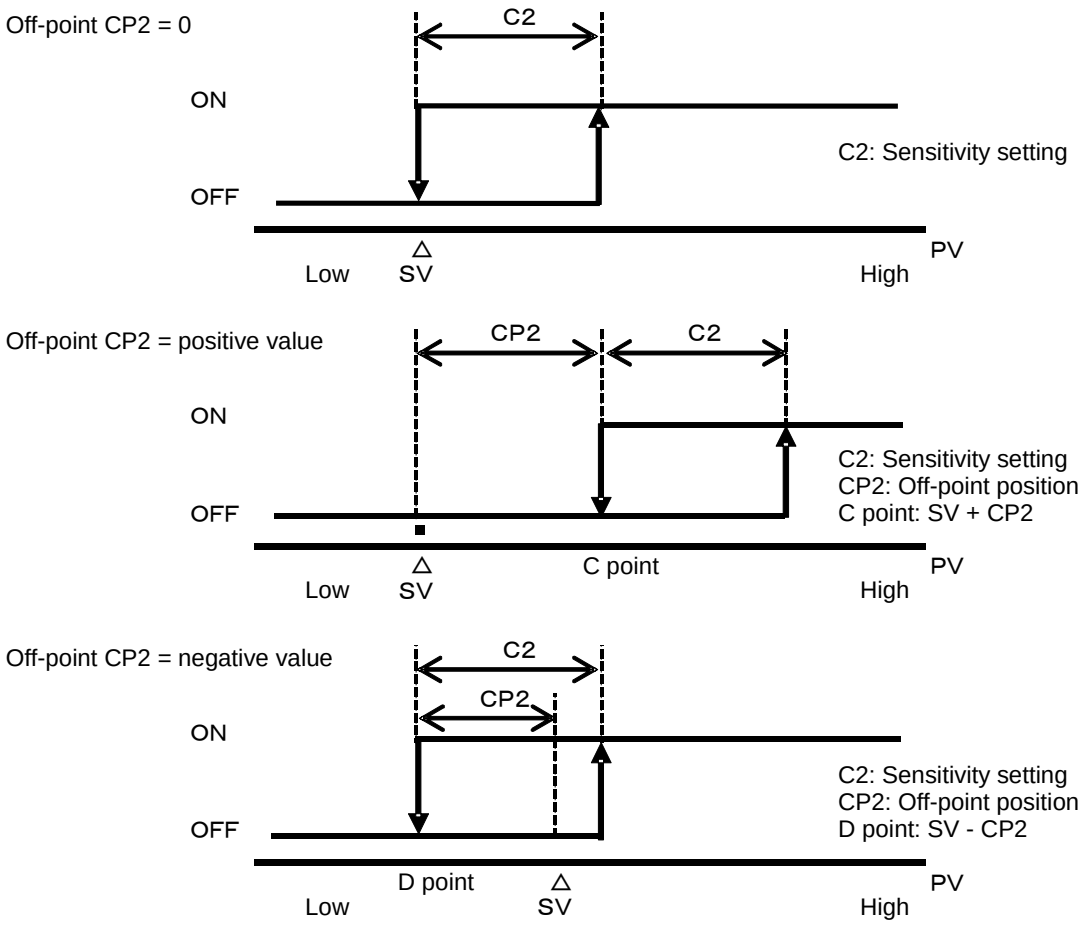
Set the secondary control sensitivity.
Sensitivity (hysteresis) of ON/OFF operation is set. For heating control, the sensitivity is set in the upper side of SV.

■ Secondary control off-point position

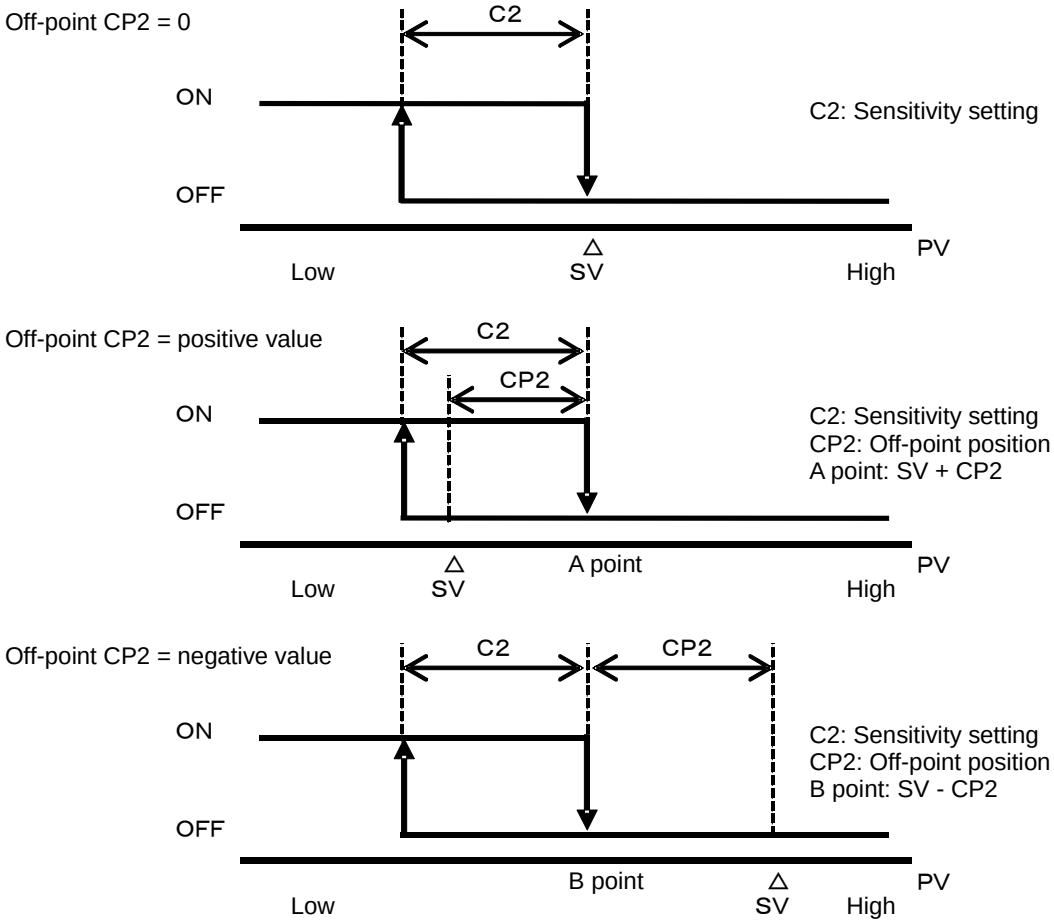
	SEt04 CNt	Setting content	Initial value
52	CP2	Thermocouple/resistance temperature detector input **-999.9 to 999.9** (°C) **-999 to 999** (°C)	**0**
		Voltage/current input **-9999 to 9999** (digit)	

Set the secondary control off-point position.
Moving the off-point of the secondary control sensitivity results in a move of entire range of the sensitivity.

< dIR=0 When secondary control is Forward operation >



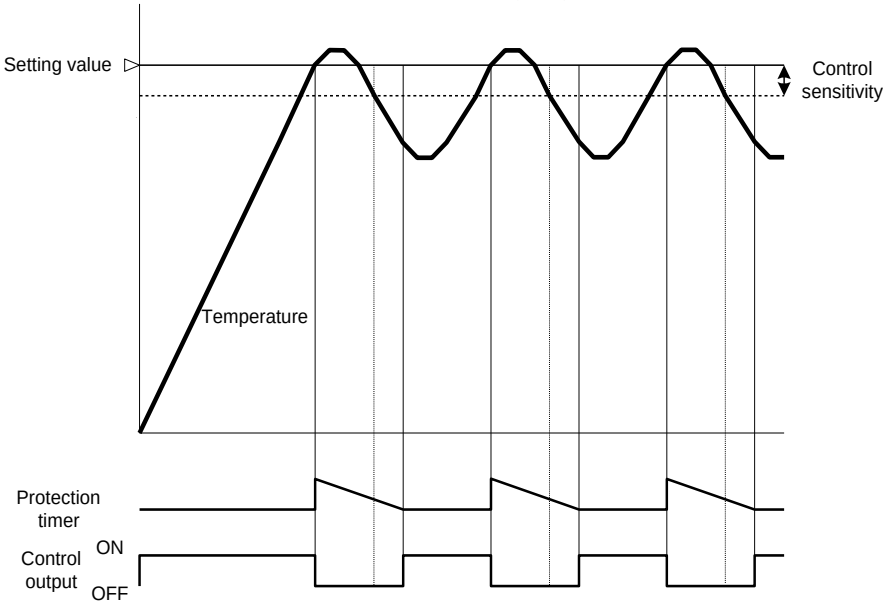
< dIR=1 When secondary control is Reverse operation >



■ Secondary control protection timer

	SEt04 CNt	Setting content	Initial value
53	Fdt2	**Sub-control Protection off Timer 0 to 99** (minutes)	**0**
54	Ndt2	**Sub-control Protection on Timer 0~99(min.)**	**0**

BEHAVIOR DUINRG SUB-CONTROL PROTECTION OFF TIMER (Fdt2) SETTING



■ Manual reset

	SEt04 CNt	Setting content	Initial value
55	Pbb	**0.0 to 100.0** (%), when CNt is 1, 2 or 6 **-100.0 to 100.0** (%), when CNt is 3 or 4	**0.0**

Set the manual reset.

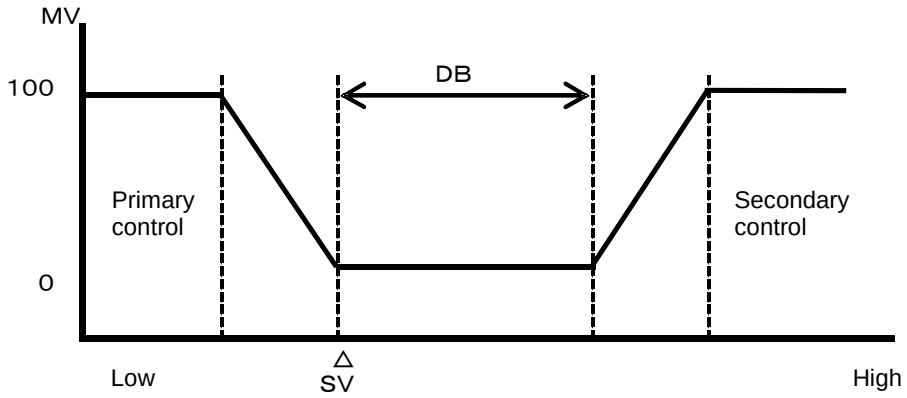
The operating amount is added by the value of the manual reset.
This value is to be set for canceling the off-set that is generated in the proportional control.
Set the manual reset as an indication to the operating amount that is stabilized in the proportional control.

■ Dead band setting

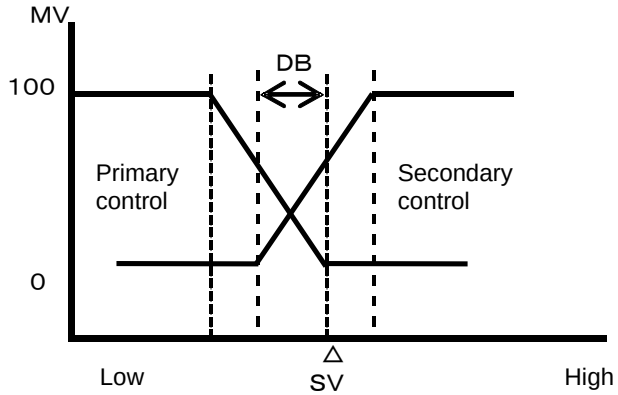
	SEt04 CNt	Setting content	Initial value
56	db	Thermocouple/resistance temperature detector input **-999.9 to 999.9** (°C) **-999 to 999** (°C)	**0**
		Voltage/current input **-9999 to 9999** (digit)	

Set the dead band.
The proportional band (or sensitivity) of the secondary control moves. The primary and secondary controls are separate when the value of the dead band is positive.

- When the value of the dead band setting is positive



- When the value of the dead band setting is negative



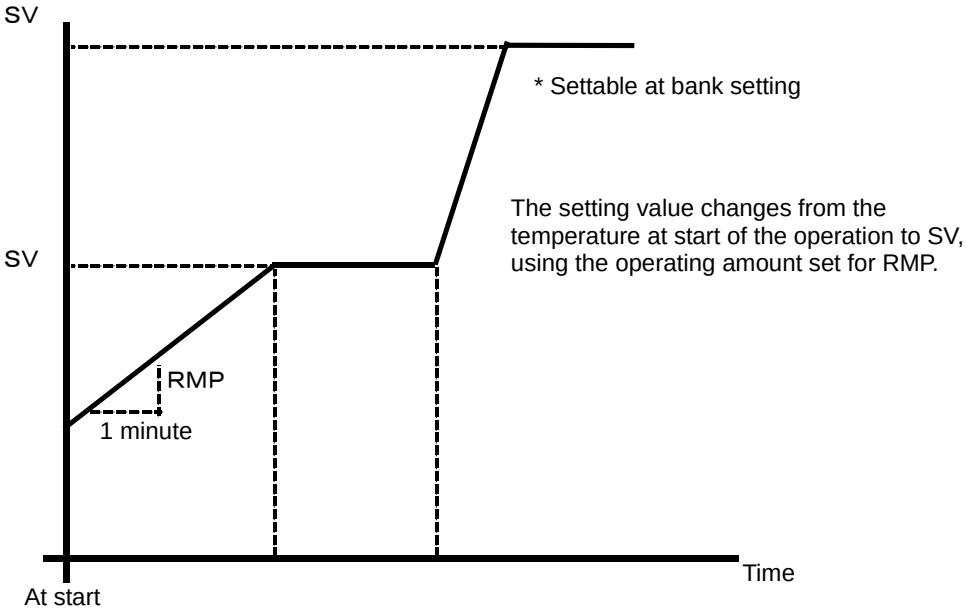
■ Ramp time setting

	SEt04 CNt	Setting content	Initial value
57	RMP	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C/minute)	**0.0**
		Voltage/current input **0 to 9999** (digit/minute)	**0**

Set the ramp time.
A change of SV per minute is set when SV is changed.
The ramp control starts from the present PV.

<Start condition>

(1) At power-on
(2) SV change when bank being switched over
(3) When RDY being switched over to RUN



Note Event output during ramp
The SV during ramp is equivalent to the SV for deviation upper/lower limit, deviation upper limit, deviation lower limit and deviation range.
Take care that SV is not a final target value.

Note In the case of ramp setting (RMP = 0), the ramp function does not work.

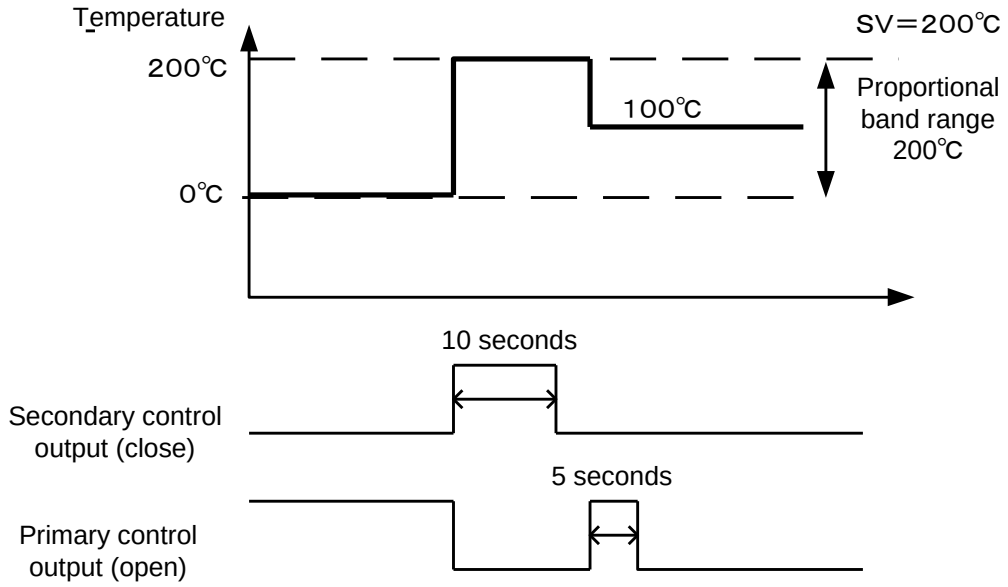
■ Valve motor stroke time

	SEt04 CNt	Setting content	Initial value
58	VLt	**0.1 to 999.9** (seconds)	**3.0**

Set the valve motor stroke time.

Output is generated for the time set for VLt (valve motor stroke time) when PV (measurement value) changes in range by the amount identical to the proportional band range.
For the valve motor stroke time, set the time period from full open to full close of the valve used.

Setting example: For the position proportional control of the heating control, where settings are as follows: SV of 200°C, proportional band range of 200°C and VLt of 10 seconds.
Output change is described as an example when the temperature changes as shown in the diagram below.
The temperature changes from 0 to 200°C, where the amount of the change is equivalent to the proportional band range. This change results in the secondary control output (close) being output for 10 seconds, which is equivalent to the setting time for VLt.
Then, the temperature changes from 200°C to 100°C, which is equivalent to the half the proportional band range. This change results in the primary control output (open) being output for 5 seconds, which is equivalent to a half the setting time for VLt.



Note Take care when selecting a valve, as the output is not turned off when the operating amount is in either 0 % or 100 %.

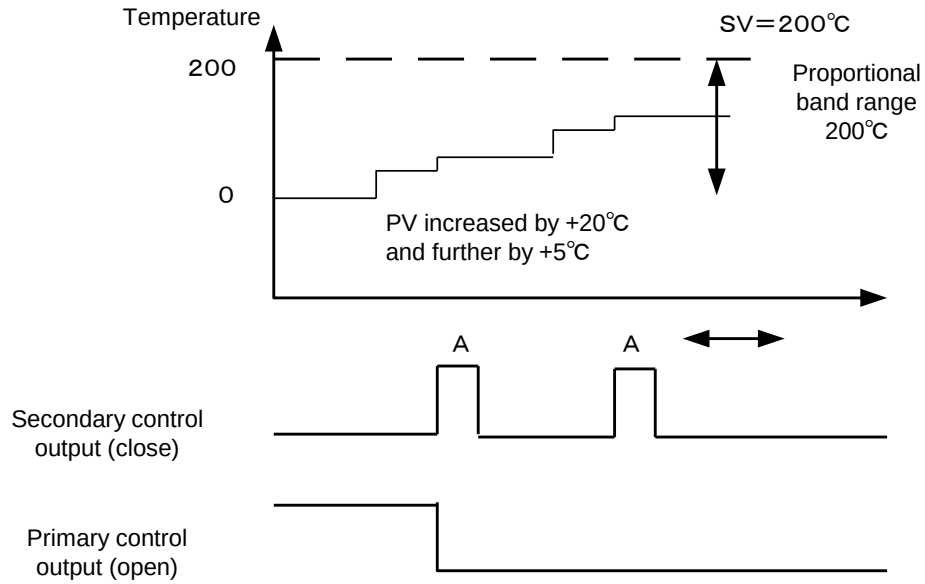
■ Valve motor drive dead band

	SEt04 CNt	Setting content	Initial value
59	Vdb	**0.0 to 100.0** (%)	**1.0**

Set a range such that the position proportional output is not provided even when the operating amount changes.

The range is represented as a ratio to the proportional band range.
When the proportional band is 200°C and Vdb (valve motor drive dead band) is set to 10.0 %, the actual range is 20°C.

Setting example: In such a case that the range of the valve motor drive dead band is 20°C as shown in the diagram below, no output is provided when the temperature increases by 20°C.
Then, further increase by 5°C results in the output equivalent to 25 % (= 25°C ÷ 200°C).
When VLt (valve motor stroke time) is 10.0 seconds, the resultant time value is 2.5 seconds.



■ Post-AT initial opening ratio

	SEt04 CNt	Setting content	Initial value
60	ASP	**0.0 to 100.0** (%)	**50.0**

Set the valve opening ratio for a value to be after the auto-tuning is conducted in the position proportional control.
The value of 50 % is normally appropriate.

After the auto-tuning is complete, the calculated operating amount is compared to the set operating amount in order to determine a first output.

6.5 Output (from OUT 1 to OUT 7) type setting

■ Outputs 1 to 7 target connection setting

	SEt05 oUt1 to SEt11 oUt7	Setting content		Initial value
1	o1F to o7F	**0**	Primary output	**o1F: 0** **o2F: 2** **to** **o7F: 2**
		1	Secondary output	
		2	Event output	
		3	RUN output	
		4	RDY output	
		5	Timer 1 output	
		6	Timer 1 during-on-delay output	
		7	Timer 1 during-off-delay output	
		8	Timer 1 during-[on + off]-delay output	
		9	Timer 2 output	
		10	Timer 2 during-on-delay output	
		11	Timer 2 during-off-delay output	
		12	Timer 2 during-[on + off]-delay output	
		13	Timer 3 output	
		14	Timer 3 during-on-delay output	
		15	Timer 3 during-off-delay output	
		16	Timer 3 during-[on + off]-delay output	
		17	Transmission output (for analog output)	
		18	End Output (during program mode)	

Set target connections for outputs 1 to 7.
This product allows free setting of output applications.
This product also allows duplicated setting of outputs 1 and 2 (such as setting the both outputs for either primary or secondary output).

Note Transmission output can be selected only when the output 1 or 2 at order placement for the product is of analog output.
As no analog output being available for outputs 3 to 7, they cannot be set for the transmission output.

For operation of the event function 1 of the event output, see section of event function 1 operation on page 6-51.

For operations of the event functions 2 to 4 of the event output, see section of event functions 2 to 4 operations on pages 6-52 to 54.

For operation of the timer output, see section "5.4.5 Timer function" on pages 5-32 to 37.

■ Event function 1/upper and lower limits/sensitivity/delay timer settings

	SEt05 oUt1 to SEt11 oUt7	Setting content	Initial value
2	E1F1 to E7F1	Function ****0** None ****1** Deviation upper and lower limits ****2** Deviation upper limit ****3** Deviation lower limit ****4** Deviation range ****5** Absolute value upper and lower limits ****6** Absolute value upper limit ****7** Absolute value lower limit ****8** Absolute value range Add-on function ***0*** None ***1*** Hold ***2*** Standby ***3*** Delay ***4*** Hold + standby ***5*** Hold + delay ***6*** Standby + delay ***7*** Hold + standby + delay Control mode interlocking function **0**** All modes **1**** RUN/MAN mode only **2**** RUN mode only	**000**
3	E1H to E7H	Thermocouple/resistance temperature detector input **-1999.9 to 2999.9** (°C) **-1999 to 2999** (°C) Voltage/current input **-19999 to 29999** (digit)	**0**
4	E1L to E7L	Thermocouple/resistance temperature detector input **-1999.9 to 2999.9** (°C) **-1999 to 2999** (°C) Voltage/current input **-19999 to 29999** (digit)	**0**
5	E1C to E7C	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C) Voltage/current input **0 to 9999** (digit)	**0**
6	E1t to E7t	**0 to 9999** (seconds)	**0**

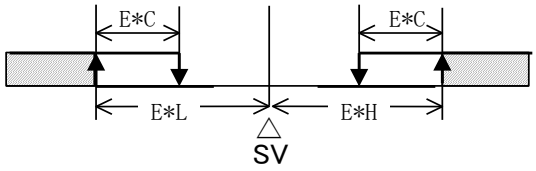
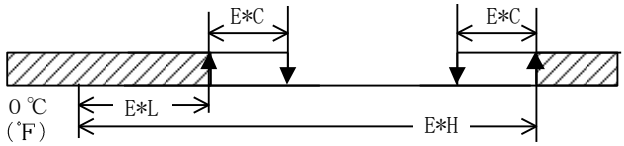
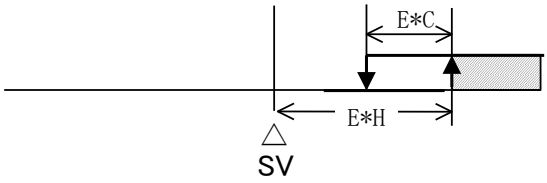
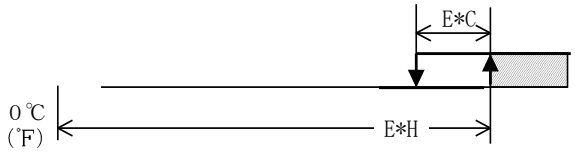
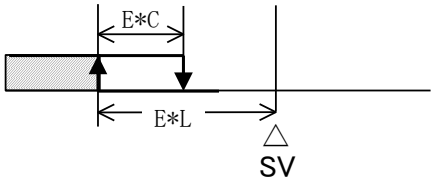
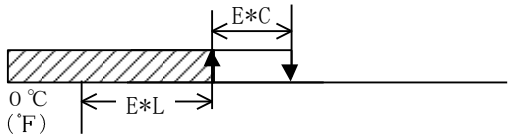
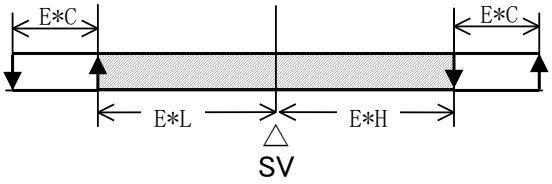
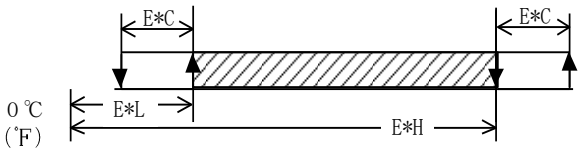
Event function 1/event upper and lower limits/event sensitivity/event delay timer is set.
Event function 1 is a function that compares PV to the event setting value, and that, if set conditions are met, signals are output (ON/OFF) from the outputs 1 to 7 assigned for the event output.
This function is effective for alarm of PV, and start/stop of other systems.
This function can be used when the target connection for the outputs 1 to 7 are set for the event output.

For the operation range and each setting value of the event function 1, see the event function 1 operation on page 6-51.

■ Event function 1 operation

The operation range (range for turn-on) of the event function 1 assigned for outputs 1 to 7 is set in terms of the event function 1 setting, and event upper limit, event lower limit and event sensitivity settings. See below for the event function 1 operation range.

■ Event function 1 operation range table

1 Deviation upper and lower limits	5 Absolute value upper and lower limits
	
2 Deviation upper limit	6 Absolute value upper limit
	
3 Deviation lower limit	7 Absolute value lower limit
	
4 Deviation range	8 Absolute value range
	

: Event function 1 operation range, △: Location of SV, E * C: Event sensitivity

E * H: Event upper limit setting (The chart in the table is for plus setting; for minus setting, the chart is to be reversed about SV or 0°C.)

E * L: Event lower limit setting (The chart in the table is for plus setting; for minus setting, the chart is to be reversed about SV or 0°C.)

Note Setting "none" for the event function 1 results in no operation. (For the symbol "*," a numerical character from 1 to 7 for actual output is to be put in.)

Explanation on the event function 1 add-on function/control mode interlocking function

Hold: A function that holds and continuously provides the event output after it is once provided, even when PV is out of the operation range of the event function 1

Note The event output held is released when the power returns or the event upper/lower limit setting changes.
In addition, the hold is released due to a SV change when the event range is set in terms of deviation.

Standby: A setting where no output is initially provided but the product stands by even when PV is within the operation range of the event function 1, at power-on or setting change. The event output is provided when PV is out of the operation range once and returns within it.
This function is an effective function for the product not to operate in case of PV going in the operation range at power-on or setting change.

Delay: A delay time is set where the time from PV being in the operation range of the event function 1 to event-outputting is to be delayed.
This function is an effective function for the product not to event-output for a predetermined time after PV being in the operation range.

Note No delay time is effective when PV moves from within the operation range of the event function 1 to out of the operation range.

Interlocking function: A control mode is set to operate the event function 1, using the control mode interlocking function.
A combination with standby-sequence is described in the next page.

1) State when no event has occurred

No event occurs when RUN/READY is switched over.

2) Standby state

No event occurs when RUN/READY is switched over.

3) State when an event has occurred (an event occurs when the event moves out from the standby state.)

By switching over from RUN to READY, the event turns to OFF. It goes to 2)standby state.

■ Event function 2 setting (PV abnormality)

	SEt05 oUt1 to SEt11 oUt7	Setting content		Initial value
7	E1F2 to E7F2	Function		**000**
		****0**	Nonexistent	
		****1**	Existent	
		Add-on function		
		0	None	
		1	Hold	
		2	Delay	
		3	Hold + delay	
		Control mode interlocking function		
		0**	All modes	
		1**	RUN/MAN mode only	
		2**	RUN mode only	

Set the event function 2 (PV abnormality).
Event function 2 is a function to output signals (ON/OFF) from the outputs 1 to 7 that are assigned for the event function 2 when an abnormality is generated in the input 1.
This function is effective when the event function 2 is set to **1.
This function is useful in case of improper setting of the input 1 type, alarming for input improper wiring, disconnection or short, or start/stop of other systems.
This function can be used when the target connection for the outputs 1 to 7 are set for the event output.

Note Take care that the event function 2 may event-output when input 1 type is being changed.

For the operation range of the event function 1 and each setting value, see section of event function 1 operation on page 6-51.

For the add-on function of the event function 2 and the control mode interlocking setting, see again section of event function 1 operation on page 6-51

Example of PV abnormal setting: In the case of PV Abnormal, No Added Function, Control Mode Interlock Full Mode, set to “001”.

■ Event function 3 setting (CT abnormality)

	SEt05 oUt1 to SEt11 oUt7	Setting content		Initial value
8	E1F3 to E7F3	Function		**000**
		****0**	None	
		****1**	CT 1 abnormality	
		****2**	CT 2 abnormality	
		****3**	CT 1 abnormality + CT 2 abnormality	
		Add-on function		
		0	None	
		1	Hold	
		2	Delay	
		3	Hold + delay	
		Control mode interlocking function		
		0**	All modes	
		1**	RUN/MAN mode only	
		2**	RUN mode only	

Set the event function 3 (CT abnormality).
Event function 3 is a function to detect the current flowing in the heater that is assigned in the outputs 1 to 7 as target connections, using the current transformer (CT) that is supplied as an accessory, and to compare the detected current to the CT abnormality current.
This function is useful for detecting disconnected wiring to the heater or adhesion of a relay contact that turns on and off the electricity to the heater.

For the details regarding the connection and setting of CT (current transformer), please refer to Operation Manual CT (P5-40 to 44).

■ Event function 4 (loop abnormality)

	SEt05 oUt1 to SEt11 oUt7	Setting content		Initial value
9	E1F4 to E7F4	Function		**00**
		***0**	Nonexistent	
		***1**	Existent	
		Add-on function		
		0*	None	
		1*	Hold	

Set the event function 4 (loop abnormality).
Event function 4 is a function that detects output abnormalities, and that outputs signals from the event output.
This function can be used when the event function 4 is set and the target connections of the outputs 1 to 7 are set to event outputs.

For details of the setting of the loop abnormality, see section "5.4.6 Loop abnormality function" on pages 5-38 and 39.

For the setting of the loop abnormality time, see section of primary/secondary control loop abnormality time setting on pages 6-29and 42

■ Event polarity setting

	SEt05 oUt1 to SEt11 oUt7	Setting content		Initial value
10	E1P to E7P	**0**	Normal open	**0**
		1	Normal close	

Set "close active" or "open active" for the event function setting.

Close active: Event function closes when the event output is in the active state.
Open active: Event function opens when the event output is in the active state.

■ Output 1 and 2 transmission output function setting

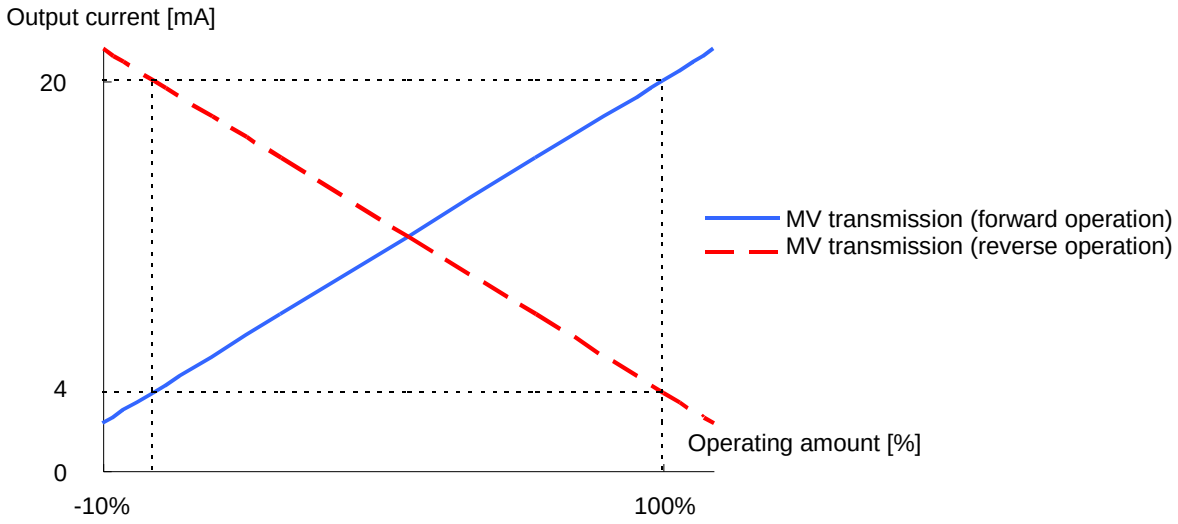
	SEt05 oUt1 to SEt06 oUt2	Setting content		Initial value
11	tRN1 tRN2	Transmission content selection		**tRN1=01** **tRN2=01**
		***1**	PV (measurement value) output	
		***2**	SV (setting value) output	
		***3**	MV 1 (primary control operating amount) output	
		***4**	MV 2 (secondary control operating amount) output	
		***5**	Control SV (Setting Value) output	
		Forward/reverse operation selection		
		0*	Forward operation	
		1*	Reverse operation	

Set the output content of transmission output.
The output 1 or output 2 being set for analog output can be used as a transmission output.
For using the output 1 or 2 as a transmission output, set 17 (transmission output) for the target connection of the output 1 or 2.

The transmission output is a function that delivers power of the conditions of the measurement value (PV), setting value (SV), primary control operating amount (MV 1) , secondary control amount (MV 2) and the control SV (SV Setting Value) output with either the voltage or current signal (designated by model assignment upon order).
Also, by setting the movement to either forward or reverse, the voltage or current signal can also be made to move forward or reverse.

Example: When transmitted in the following setting

	Output 1	Output 2
Output type	Current 4 - 20 mADC	Current 4 - 20 mADC
Output target connection setting	o1F=17	o2F=17
Transmission output function setting	tRN1=03	tRN2=13



■ Output 1 and 2 transmission scaling upper limit/lower limit setting

	SEt05 oUt1 to SEt06 oUt2	Setting content	Initial value
12	tRH1 to tRH2	Thermocouple/resistance temperature detector input **tRL* to 2999.9** (°C) **tRL* to 2999** (°C)	**1200**
		Voltage/current input **tRL* to 29999** (digit)	**12000**
13	tRL1 to tRL2	Thermocouple/resistance temperature detector input **-1999.9 to tRH*** (°C) **-1999 to tRH*** (°C)	**0**
		Voltage/current input **-19999 to tRH*** (digit)	

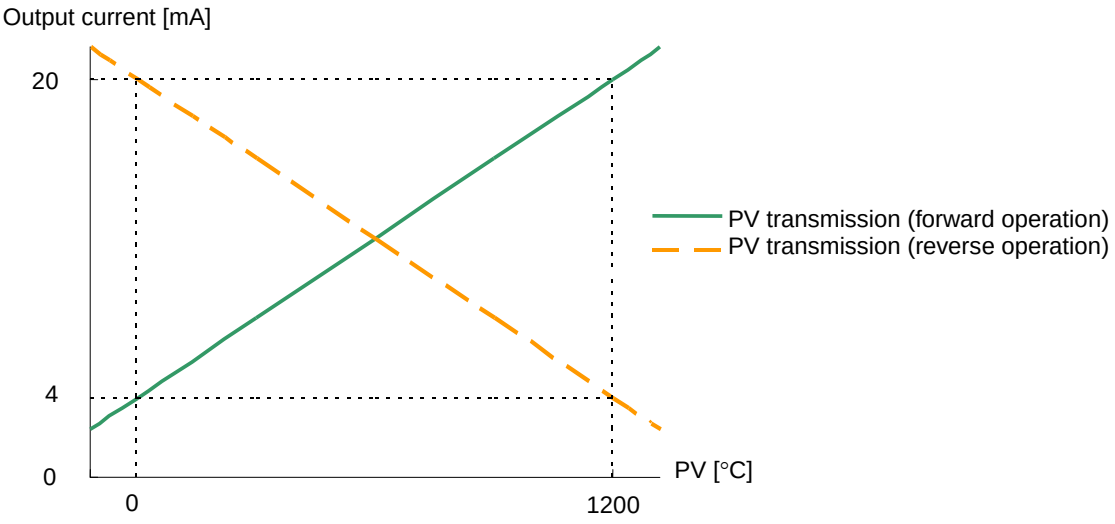
Set the transmission scaling upper limit/lower limit of the transmission output.
The output 1 or output 2 being set for analog output can be used as a transmission output.
For using the output 1 or 2 as a transmission output, set 17 (transmission output) for the target connection of the output 1 or 2.

This function is to scale the transmission output range with respect to the measurement/setting value.
The decimal point position is set in conjunction with the decimal point position setting (dP 1).

Note This function cannot be set when "3" or "4" (primary/secondary control operating amount) is set in the transmission output function setting.

Example: When transmitted in the following setting

	Output 1	Output 2
Output type	Current 4 - 20 mADC	Current 4 - 20 mADC
Output target connection setting	o1F=17	o2F=17
Transmission output function setting	tRN1=01	tRN2=11
Transmission scaling upper limit	tRH1=1200.0	tRH2=1200.0
Transmission scaling lower limit	tRL1=0.0	tRL2=0.0



6.6 Current transformer (CT) setting

■ CT 1 target connection setting

	SEt12 CT	Setting content		Initial value
1	CI1	**1**	Connected to OUT 1 (settable when D0)	**1**
		2	Connected to OUT 2 (settable when D0)	
		3	Connected to OUT 3 (settable when an option existent)	
		4	Connected to OUT 4 (settable when an option existent)	
		5	Connected to OUT 5 (settable when an option existent)	
		6	Connected to OUT 6 (settable when an option existent)	
		7	Connected to OUT 7 (settable when an option existent)	

Set the output measured by CT 1.

Note An analog output cannot be set for the target connection.

For outputting the event output, see section of event function 3 setting (CT abnormality) on page 6-53
For changing screen colors depending on the CT abnormalities, see section of CT at-abnormality display color on page 6-69
Note At-abnormality display color does not change unless the event function 3 setting (CT abnormality) is set.
Note Take care that the product does not properly operate when the subject of control is connected to an output that is set for the CT abnormality event.

■ CT 1 current value monitor

	SEt12 CT	Setting content	Initial value
2	CM1	**0.0 to 50.0** (A)	

This function is to display the measurement value of CT 1.

■ CT 1 abnormal current value setting

	SEt12 CT	Setting content	Initial value
3	Ct1	**0.0 to 30.0** (A) Function turned off at **0.0** (A) setting	**0.0**

This function is to set the current value for the CT 1 abnormality.

For the guide to setting value, please refer to Operation Manual CT (Current Transformer) (P5-40 to 44).

■ CT 2 target connection setting

	SEt12 CT	Setting content		Initial value
1	CI2	**1**	Connected to OUT 1 (settable when D0)	**1**
		2	Connected to OUT 2 (settable when D0)	
		3	Connected to OUT 3 (settable when an option existent)	
		4	Connected to OUT 4 (settable when an option existent)	
		5	Connected to OUT 5 (settable when an option existent)	
		6	Connected to OUT 6 (settable when an option existent)	
		7	Connected to OUT 7 (settable when an option existent)	

Set the output measured by CT 2.

Note An analog output cannot be set for the target connection.

In case the Even Output is needed, please refer to P6 – 53 Event Function 3 Setting (CT abnormal).

In case of changing the display color due to CT abnormality, please refer to P6 – 69CT Display color During the CT Abnormality.

Note At-abnormality display color does not change unless the event function 3 setting (CT abnormality) is set.

Note Take care that the product does not properly operate when the subject of control is connected to an output that is set for the CT abnormality event.

■ CT 2 current value monitor

	SEt12 CT	Setting content	Initial value
2	CM2	**0.0 to 50.0** (A)	

This function is to display the measurement value of CT 2.

■ CT 2 abnormal current value setting

	SEt12 CT	Setting content	Initial value
3	Ct2	**0.0 to 30.0** (A) Function turned off at 0.0 (A) setting	**0.0**

This function is to set the current value for the CT 2 abnormality.

For the target setting value, see section "5.4.7 Current transformer (CT) abnormality function" on pages 5-40 to 44.

6.7 DI setting

■ DI function setting

	SEt13 dI	Setting content			Initial value
1	dIF	Press the MODE key for making a setting effective (including reverse feed).			**0000**
		**** |||| |||+— DI 1 setting (settable when an option existent) ||+— DI 2 setting (settable when an option existent) |+— DI 3 setting (settable when an option existent) +— DI 4 setting (settable when an option existent)			
				Active	
		0	None	None	
		1	Bank switchover	Bank switchover	
		2	When Constant operation Mode MD When Program Mode Start	When Constant operation Mode READY When Program Mode stop	
		3	MD	MANUAL	
		4	Reverse operation	Forward operation	
		5	AT stop	AT start	
		6	Timer stop	Timer start	
		7	Constant Operation Mode	Program Mode 3	
		8	—	Step Forward 3 (during program mode)	
		9	—	Pause 3 (during program mode)	
		A	nerlock	— 3	

Set the DI function.

0: No DI function
1: Bank switchover is executed.
Bank selection table per DI 1 state

DI1	
0	Bank 0
1	Bank 1

DI2	DI1	
0	0	Bank 0
0	1	Bank 1
1	0	Bank 2
1	1	Bank 3

DI3	DI2	DI1	
0	0	0	Bank 0
0	0	1	Bank 1
0	1	0	Bank 2
0	1	1	Bank 3
1	0	0	Bank 4
1	0	1	Bank 5
1	1	0	Bank 6
1	1	1	Bank 7

0: Inactive
1: Active

The parameters change right after switchover when the bank is changed per DI.

2: ＜During Constant Operation Mode＞ Switching of Control Mode and STOP.
＜During the Program Mode＞ Switching of In-Operation and Operation Stop.
3: Switching of AUTO & MANUAL is done
4: Switching of Output Movement (forward / reverse movement) is done.
5: The Star & Stop of Auto-Tuning of PID Control is done.
Maintain the DI to active condition until the auto-tuning is completed.
In case the operation is suspended half-way, the auto-tuning will stop.

6: Start and Stop of the timer operation, which is set in "function setting - DI 1 to 4 start" for timers 1 to 3 (see SET 14 to 16 on page 6-59, are switched over.
Stopping the timer during operation results to midway termination (state of control stop or event output OFF).

Note Setting with DI supersedes the setting change of "communication" or "FUNC key."

Note Setting the function setting to the bank switchover may cause high-speed switchovers of banks when setting the DI function setting to a bank.
To solve this phenomenon, delete DI function setting DIF from the bank setting, set DIF to the bank switchover setting, and put the DIF into the bank.

Note Choose the open collector output when change DI by the event output.

7: CONSTANT OPERATION / PRGRAM MODE SWITCHING 3
Switching between the Constant Operation and the Program Mode will be made

8: STEP FORWARD 3
steps can be forwarded during the program mode.
NOTE: This function is effective only when the Program Mode is being selected.

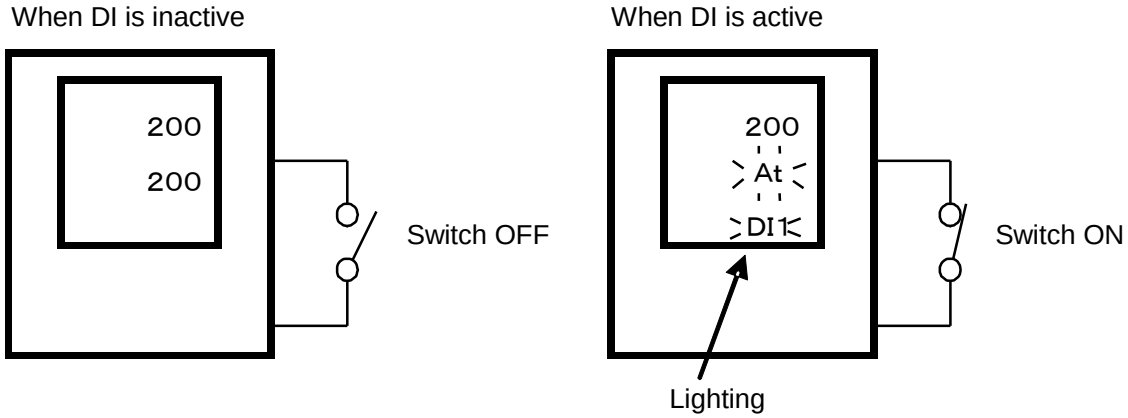
9: PAUSE 3
By pressing the FUNC-key, the Program Operation can be stopped temporarily.
Switching between Pause – In Operation will be made.
NOTE: This function is effective only when the Program Mode is being selected.

A: Inter-Lock 3
When the "DI = Non-Active", the Control Mode can be stopped forcibly.
Its priority is the highest over all the Control Mode Condition.
The setting of Control Mode Condition can be switched with (SEt04 Md) (SEt03 FU*) (SEt13 DIF).

NOTE: During Constant Operation Mode
When dIF=A, at the same time, the function-key function is set to FU1 – 5 = 2, to re-start the operation after DI=Active, press function key.

NOTE: During the Program Mode
With DI=Non-Active, it will forcibly go back to "Pre-Operation Condition". Re-start the operation after DI=Active.

Setting example: When "AT start" is assigned to DI 1 (close active)
Set dIF to 0005 and dIP to 0000.



Usable DIs for each product model
DIs indicated in the table are usable when DI types are optionally designated.

	TTM-204	TTM-205 TTM-209	TTM-207
DI1	○	○	○
DI2	○	○	○
DI3		○	○
DI4		○	

■ DI polarity setting

	SEt13 dI	Setting content	Initial value
2	dIP	**** |||| |||+— DI 1 setting (settable when an option existent) ||+— DI 2 setting (settable when an option existent) |+— DI 3 setting (settable when an option existent) +— DI 4 setting (settable when an option existent)	**0000**
		0 Close active	
		1 Open active	

"Close active" or "open active" is set for "DI function setting" described above.

Close active: DI is active when short (max. 333 Ω) is established between DI terminals.
Open active: DI is active when release (min. 500 kΩ) is established between DI terminals.

6.8 Timer function setting

■ Timer function setting

	SEt14 tIME1 to SEt16 tIME3	Setting content		Initial value
1	tMF1 to tMF3	**1**	Auto start	**1**
		2	Manual start	
		3	SV start	
		4	DI 1 start (settable when an option existent)	
		5	DI 2 start (settable when an option existent)	
		6	DI 3 start (settable when an option existent)	
		7	DI 4 start (settable when an option existent)	
		8	Event 1 start	
		9	Event 2 start	
		10	Event 3 start (settable when an option existent)	
		11	Event 4 start (settable when an option existent)	
		12	Event 5 start (settable when an option existent)	
		13	Event 6 start (settable when an option existent)	
		14	Event 7 start (settable when an option existent)	
		15	Step Start (during program mode) 3	
		16	Soak Start (during program mode) 3	

Set functions of timers 1 to 3.

Note Setting the control modes to TIME 1 to 3 or setting the target connection setting (o1F to o7F) to 5 to 16 is required for operating timers.

Note Triggers for starting timers are DI, FUNC key and △/▽ key, in this order from higher priority.

For details of the timer setting, see section "5.4.5 Timer function" on pages 5-32 to 37.

When the SV start is set, set the start SV permissible range setting.

■ Unit setting

	SEt14 tIME1 to SEt16 tIME3	Setting content		Initial value
2	H/M1 to H/M3	**1**	Hour/minute	**1**
		2	Minute/second	

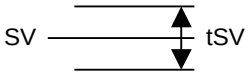
Set the unit of time for timers 1 to 3.

■ Start SV permissible range setting

	SEt14 tIME1 to SEt16 tIME3	Setting content	Initial value
3	tSV1 to tSV3	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C) Voltage/current input **0 to 9999** (digit)	**0**

When the SV start is set, it is set that at what temperature range (°C) the timer should start.

The permissible range is determined in the range of tSV with SV in the center as shown below.
When tSV is set to 1.0°C, the timer operates when the temperature falls within SV ± 0.5°C.



Note When the ramp action is used together, tSV is set to target SV value.

■ ON delay timer/OFF delay timer/repeat count setting

	SEt14 tIME1 to SEt16 tIME3	Setting content	Initial value
4	oNt1 to oNt3	**0:00 to 99:59** (hour: minute or minute: second)	**0:00**
5	oFt1 to oFt3	**0:00 to 99:59** (hour: minute or minute: second)	**0:00**
6	RUN1 To RUN3	**0 to 99** counts (**0** for unlimited counts)	**1**

Set the ON delay timer, OFF delay timer and repeat count setting of timers.

Use oNt 1 to 3 for setting the ON delay timer time of timers 1 to 3.
Use oFt 1 to 3 for setting the OFF delay timer time of timers 1 to 3.
Use RUN 1 to 3 for setting the repeat count of timers 1 to 3.

Note When the function setting of tMF 1 to 3 is set for the SV start, the ON delay timer screen is not displayed.

For the details on Timer Setting, please refer to Operation Manual Timer (P5 – 31 to 37).

■ Remaining time monitor

	SEt14 tIME1 to SEt16 tIME3	Setting content	Initial value
7	tIA1 to tIA3	**0:00 to 99:59** (hour: minute or minute: second) Start/stop of timer using ▲/▼ key	**0:00**

Remaining time of timers 1 to 3 is displayed.
Timers can be started on this screen.

When the ON delay timer and OFF delay timer are set, the setting value for the ON delay timer is displayed.
When only the OFF delay timer is set, the setting value for the OFF delay timer is displayed.

When the timer starts, the remaining time for the ON or OFF delay timer currently counting down is displayed.
When the timer completes the countdown, "0:00" is displayed.

6.9 Communication function setting

■ Communication protocol setting

	SEt17 CoM	Setting content		Initial value
1	PRt	Press the MODE key for making a setting effective (including reverse feed).		**0**
		0	TOHO protocol	
		1	MODBUS protocol (RTU mode)	
		2	MODBUS protocol (ASCII mode)	

Set the communication protocol (communication procedure).

For details of communication, see "TTM-200 series operation manual - communications."

■ Communication parameter setting

	SEt17 CoM	Setting content		Initial value
2	CoM	*****1**	Stop bit length 1 bit	**b8N2**
		*****2**	Stop bit length 2 bits	
		****N***	Parity none	
		****o***	Parity odd No.	
		****E***	Parity even No.	
		7*	Data length 7 bits	
		8*	Data length 8 bits	
		N***	BCC check nonexistent (settable for TOHO protocol)	
		b***	BCC check existent (settable for TOHO protocol)	
		For MODBUS (RTU) Settable only with **8N2, 8N2, 8o1, 8o2, 8E1 and 8E2.** For MODBUS (ASCII) Settable only with **7N1,7N2,7o1,7o2,7E1,7E2, 8N1,8N2,8o1,8o2,8E1,8E2**		

The following is set for communication data: stop bit length, parity and BCC check existent/nonexistent.

For details of communication, see "TTM-200 series operation manual - communications."

■ Communication speed setting

	SEt17 CoM	Setting content		Initial value
3	bPS	**2.4**	2400 bps	**9.6**
		4.8	4800 bps	
		9.6	9600 bps	
		19.2	19200 bps	
		38.4	38400 bps	

Set the communication speed.
The term bps (bits per second) refers to the number of bits allowed in communication in a second.

For details of communication, see "TTM-200 series operation manual - communications."

■ Communication address setting

	SEt17 CoM	Setting content		Initial value
4	AdR	TOHO protocol	**1 to 99** (stations)	**1**
		MODBUS protocol	**1 to 247** (stations)	

Set the address for communication.
Take care that no identical numbers are assigned for more than one unit of equipment.

For details of communication, see "TTM-200 series operation manual - communications."

■ Response delay time setting

	SEt17 CoM	Setting content	Initial value
5	AWt	**0 to 250** (ms)	**0**

Set the response delay time in communication.
Response delay time in communication is set for the time taken from when a host computer completes transmission of "request message" until when it gives up the line to become in the input state.

Note Communication may not be properly executed when the response delay time setting is for too short a time.
Note For the actual operation time, processing time of the product is added on the response delay time.

For details of communication, see "TTM-200 series operation manual - communications."

■ Communication switchover setting

	SEt17 CoM	Setting content		Initial value
6	Mod	**0**	Write inhibit	**1**
		1	Writable	
		2	Concurrent temperature ascent master	
		3	Concurrent temperature ascent slave	

Set the communication switchover.

When "0" is set, writing is inhibited.
When "1" is set, writing is enabled.
When "2" is set, master for the concurrent temperature ascent is established.
When "3" is set, slave for the concurrent temperature ascent is established.

For details of communication, see "TTM-200 series operation manual - communications."

6.10 Initial setting

■ Password input

	SEt18 INIt	Setting content	Initial value
1	PASS (Blinking)	**0000 to 9999** Change the 4-digit number and press the MODE key for canceling.	**0000**

To move to the initial setting mode, set the password.
A password is set for the product, key in the number in this screen, using the △/▽ key. Then, press the MODE key.
In the initial setting mode, the FUNC key is assigned for the digit shift function.
Key-in of the proper password number results in a move to the parameter setting of the initial setting mode.
Key-in of an improper password number results in a return to the SEt 18 screen.

■ PV normal display color

	SEt18 INIt	Setting content		Initial value
2	NdSP	**0** **1** **2** **3**	Green Red Orange Automatic (**NdSP** only)	**0**

Set the normal display color of PV.

Priority of the display colors is as follows.
1. PV normal display color (when **NdSP = 3**)
2. PV at-abnormality display color (**E2dSP**)
3. CT at-abnormality display color (**E3dSP**)
4. Loop at-abnormality display color (**E4dSP**)
5. PV at-event display color (**E1dSP**)
6. PV normal display color (when **NdSP = 0 to 2**)

Note For the PV normal display color (when **NdSP = 3**), the following functions are unavailable: the PV at-abnormality display color, CT at-abnormality display color, loop at-abnormality display color and PV at-event display color.

■ PV color auto-display low

	SEt18 INIt	Setting content		Initial value
3	AdSL	**0** **1** **2**	Green Red Orange	**1**

■ PV color auto-display middle

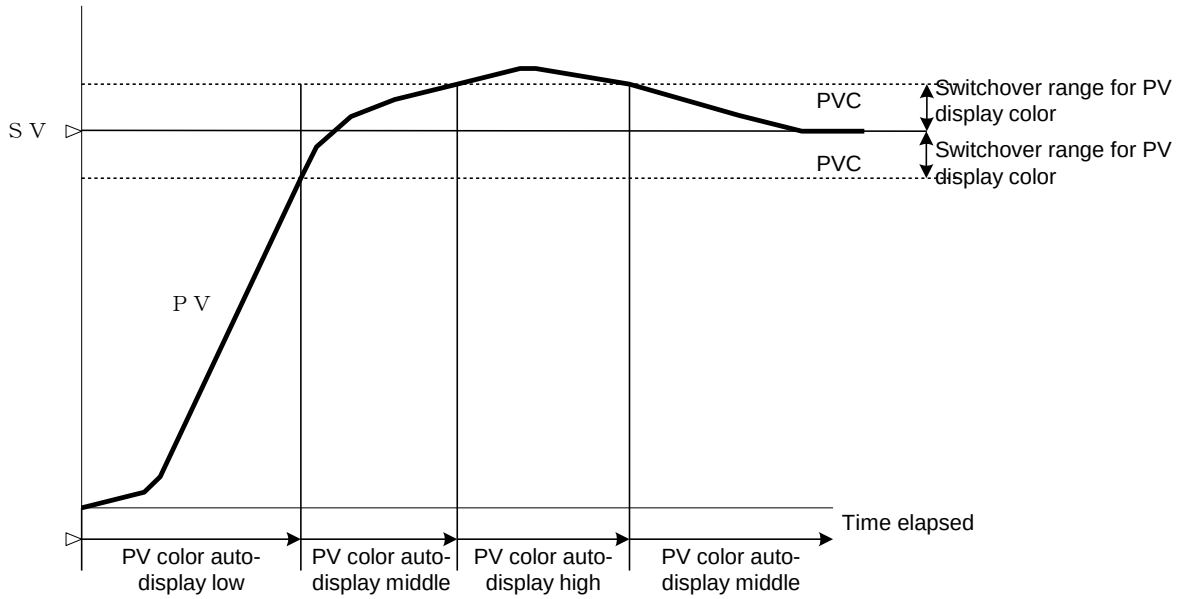
	SEt18 INIt	Setting content		Initial value
4	AdSM	**0** **1** **2**	Green Red Orange	**0**

■ PV color auto-display high

	SEt18 INIt	Setting content		Initial value
5	AdSH	**0** **1** **2**	Green Red Orange	**2**

■ Switchover range for PV display color

	SEt18 INIt	Setting content	Initial value
6	PVC	Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C) Voltage/current input **0 to 9999** (digit)	**1**



■ PV at-event display color

	SEt18 INIt	Setting content		Initial value
7	E1dSP	**0** **1** **2**	Green Red Orange	**2**

Set the display color for PV event.

■ PV at-abnormality display color

	SEt18 INIt	Setting content		Initial value
8	E2dSP	**0** **1** **2**	Green Red Orange	**1**

Set the display color for PV abnormality.

■ CT at-abnormality display color

	SEt18 INIt	Setting content		Initial value
9	E3dSP	**0** **1** **2**	Green Red Orange	**1**

Set the display color for CT abnormality.

■ Loop at-abnormality display color

	SEt18 INIt	Setting content		Initial value
10	E4dSP	**0** **1** **2**	Green Red Orange	**1**

Set the display color for loop abnormality.

■ Blind function effective/ineffective setting

	SEt18 INIt	Setting content		Initial value
11	bLd	**0**	Blind function nonexistent	**1**
		1	Blind function existent	

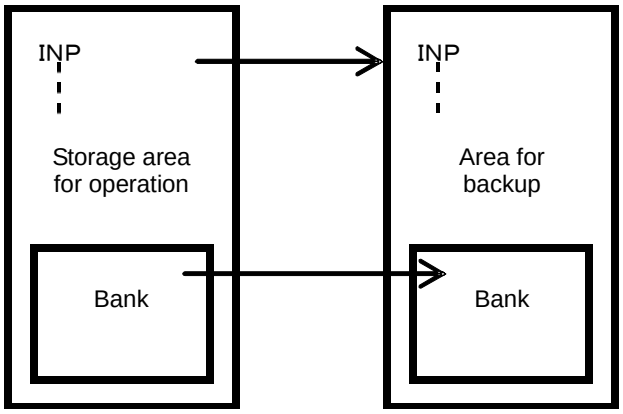
For displaying the screen blinded by using the blind function, set bLd to "0."
For not displaying the screen blinded, set bLd to "1."

■ Backup of the setting value

	SEt18 INIt	Setting content	Initial value
12	bKUP	Backup starts by a 2-second press of the FUNC key. "**SAVE**" is displayed during backup. Upon completion of backup, display of "**SAVE**" disappears.	

The setting value is backed up.
The data flow is shown below.

Backup explanation diagram



Settings for the priority screen function, bank function and blind function are also backed up.

Note During backing up, response in communication is on nak 2.

Note During backing up, switchover of DI is not reflected.

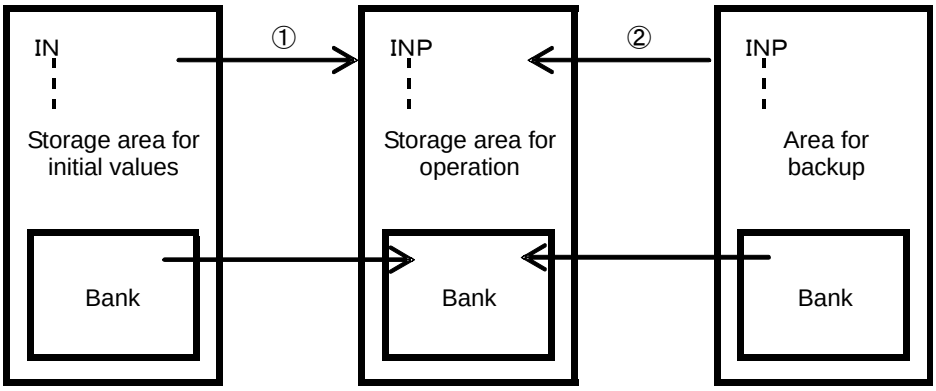
■ Initialization of setting values

	SEt18 INIt	Setting content		Initial value
13	RESEt	**0**	Setting at factory shipment	**0**
		1	Backup setting	
		Initialization starts by a 2-second press of the FUNC key. "**INIt**" is displayed during initialization. Upon completion of initialization, display of "**INIt**" disappears.		

Settings are initialized.

The data flow is shown below.

Initialization explanation diagram



① Operation when RESET is set to "0" (setting at factory shipment)
② Operation when RESET is set to "1" (backup setting)

Note The data backed up is not initialized even when initialization in the setting at factory shipment is executed.
In case that the data backed up is desired to initialize for the initial value at factory shipment, first execute initialization in the setting at factory shipment and then in the backup setting.

Note During backing up, response in communication is on nak 2.

Note During backing up, switchover of DI is not reflected.

Note When the communication parameter on the product mismatches the one on the host after initialization, no communication is possible.

Note Advancement of initialization results in no DI function.

Note When the initialization is executed, control action is initialized as well.

■ Password setting

	SEt18 INIt	Setting content	Initial value
14	PASS (Lighting)	**0000 to 9999** After changing the 4-digit number, a 2-second press of the FUNC key results in setting/canceling.	**0000**

Set the password.
When a password is set, set a desired number using the △/▽ key, and press the FUNC key for 2 seconds.
In the initial setting, the FUNC key is assigned for the digit shift function.

Note Do not forget the password.

Note In case of password forgotten, contact TOHO's sales department.

For contacting TOHO's sales department, see the last page of this user's manual.

6.11 Priority screen setting

■ Priority screens 1 to 16 setting

	SEt19 PRI	Setting content	Initial value
1	PRI01	Parameters for SEt 01 to SEt 17	**oFF**
2	PRI02		**oFF**
3	PRI03		**oFF**
4	PRI04		**oFF**
5	PRI05		**oFF**
6	PRI06		**oFF**
7	PRI07		**oFF**
8	PRI08		**oFF**
9	PRI09		**oFF**
10	PRI10		**oFF**
11	PRI11		**oFF**
12	PRI12		**oFF**
13	PRI13		**oFF**
14	PRI14		**oFF**
15	PRI15		**oFF**
16	PRI16		**oFF**

Set parameters frequently used or desired to display in the priority screen.
This enables a quick setting or display of the corresponding screen only by a press of the MODE key in the operating mode.
Max. 16 screens can be set.
Set to "OFF" when priority screens are not used.

Note Parameters not allowed with setting in the priority screens are listed below.
Take care that screens for such parameters are not displayed.

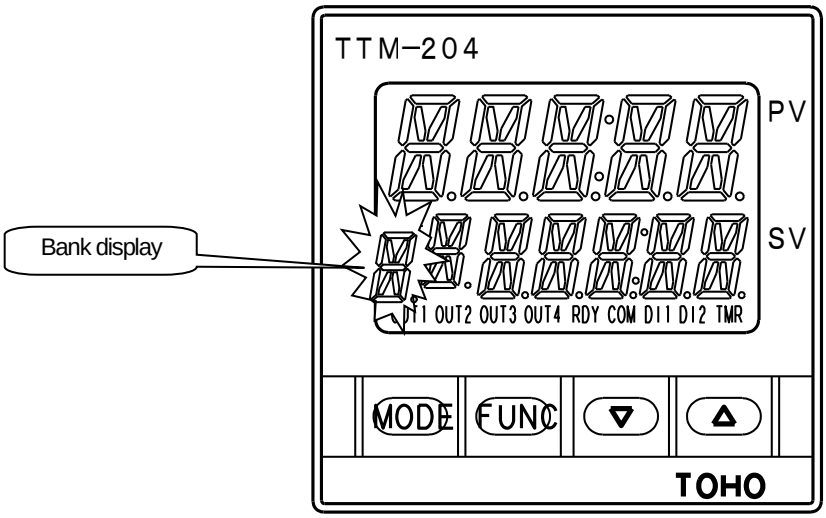
(1) All parameters in the initial value setting mode (SET 18)
(2) All parameters in the priority screen design mode (SET 19)
(3) All parameters in the bank setting mode (SET 20)
(4) All parameters of Program Function Setting (SET 21)
(5) All parameters of Program Setting (SET 22)
(6) All parameters of Bank Auto-Switch Function Setting (SET 23)
(7) Some parameters are not selectable, depending on ordered models.

6.12 Bank function setting

■ Banks 1 to 16 setting

	SEt20 bNK	Setting content	Initial value
1	bNK01	Parameters for SEt 01 to SEt 17	**cNT**
2	bNK02		**oFF**
3	bNK03		**oFF**
4	bNK04		**oFF**
5	bNK05		**oFF**
6	bNK06		**oFF**
7	bNK07		**oFF**
8	bNK08		**oFF**
9	bNK09		**oFF**
10	bNK10		**oFF**
11	bNK11		**oFF**
12	bNK12		**oFF**
13	bNK13		**oFF**
14	bNK14		**oFF**
15	bNK15		**oFF**
16	bNK16		**oFF**

Max. 16 of any parameter setting value can be changed in the banks 0 to 7.
For the no use of the bank, set the setting to "OFF."
When the bank function is set, the bank Nos. 0 to 7 are displayed in the bank display section.



Note Parameters with which no bank function is selectable are listed below. Take care that no screen is displayed.

(1) Bank switchover of the control setting mode (SET 04)
(2) All parameters in the initial value setting mode (SET 18)
(3) All parameters in the priority screen design mode (SET 19)
(4) All parameters in the bank setting mode (SET 20)
(5) All parameters of Program Function Setting (SET 21)
(6) All parameters of Program Setting (SET 22)
(7) All parameters of Bank Auto-Switch Function Setting (SET 23)
(8) Some parameters are not selectable, depending on ordered models.

6.13 PROGRAM FUNCTION SETTING

■Operation Type Setting

	SEt21 PGF	Setting Contents		Initial Value
1	C／P	Operation Type Setting [32]		0
		0	Constant Operation Mode	
		1	Program Mode	

※1 Operation Type Setting (C/P)

The program operation will take place when the Program Mode is set.

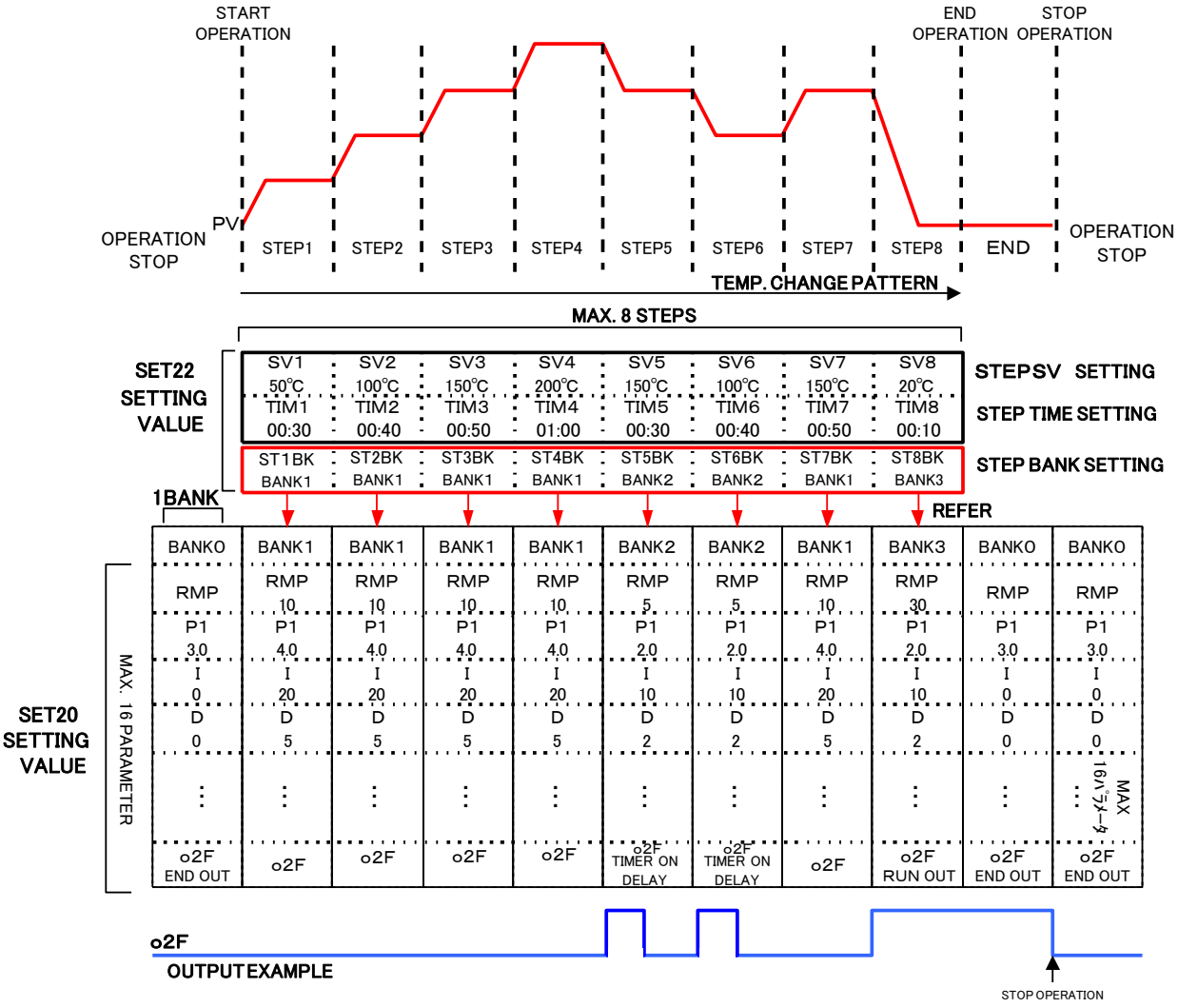
The Program Mode executes the program operation by automatically switching the “Bank Function” and “Program Step Function”.

Setting Range

0 : Constant Operation Mode (Program Mode OFF)

1 : Program Mode (Program Mode ON)

■Behavior during the Program Mode



■Program Mode Setting / Power Failure Compensation Range Setting

	SEt 21 PGF	Setting Contents	Initial Value
2	PGMd	Program Mode Setting 3	0
		0 Program 1 (w/o Power Failure Compensation)	
		1 Program 2 (w/o Power Failure Compensation)	
		2 Program 1 (w/ Power Failure Compensation)	
		3 Program 2 (w/ Power Failure Compensation)	
		※Program 1 : After the operation, control stops. ※Program 2: After the operation, the control continues.	
3	PoC	Power Failure Compensation Range Setting <Always resume at 0> 3	0
		During Temperature Input	
		0～999 (0. 0～999. 9) (℃)	
		During Analog Input	0
		0～9999 (digit)	

＊2 Program Mode Setting (PGMd)
This is to set the operation condition of "POWER FAILURE COMPENSATION WITH / WITHOUT" setting and "PROGRAM OPERATION END" during the program mode.

Setting Range
0: Program 1 (Without Power Failure Compensation)
1: Program 2 (Without Power Failure Compensation)
2: Program 1 (With Power Failure Compensation)
3: Program 2 (With Power Failure Compensation)

Program 1: The control stops after ending the program operation.
END indication appears after the operation. After the END indication appears, the control will stop.

Program 2: The control continues after ending the program operation.
The END indication appears after the operation, but the control will continue.
Operate the key or use DI to stop the control.

NOTE: The SET4 Control Mode Setting (Md) becomes ineffective with Program Mode (C/P=1). This is effective only with Constant Operation.

Re: Power Failure Compensation
This is a function in which, when the power recovers, the operation restarts from the STEP before the power failure when the function is set to "With Power Failure Compensation". The present step, repeat no. of times, remaining time is being stored.
When the setting condition of the Power Failure Compensation Rage Setting (PoC) has been satisfied, it will return to the condition last stored by the STEP, and the operation restarts.

＊3 Power Failure Compensation Range Setting (PoC)
This is to set the PV value range of the recovery decision during the power recovery.

Setting Range
Temperature Input (℃) 0 – 999 (0.0 – 999.9)
Analog Input (digit) 0 – 9999

NOTE: The condition of recovery is when the difference between the PV value at the time of recovery and the PV value before the power failure is smaller than the power failure compensation range setting (PoC).

PoC ≧ (PV value at the time of recovery) – (PV value before the power failure)

NOTE: After the power recovery, when the sensor is either disconnected or defective, the recovery action will not take place regardless of the PoC setting value. The operation condition will be "Program Operation Stop".

■Time Setting

	SEt21 PGF	Setting Contents		Initial Value
4	H/MP	Time Setting 3		0
		0	Step Time (Hr./Min.)	
		1	Soak Time 1(Hr./Min.)	
		2	Soak Time 2 (Hr./Min.)	
		3	Step Time (Min./Sec.)	
		4	Soak Time 1 (Min./Sec.)	
		5	Soak Time 2 (Min./Sec.)	
		※Step Time : After a lapse of set time, it will proceed to the next step. ※Soak Time 1 : Once it enters within the set WAIt range, the time count starts. After a lapse of time, it will proceed to the next step. ※Soak Time 2 : Only when it enters the set WAIt range, the time count starts. After a lapse of time, it will proceed to the next step.		

＊4 Time Unit Setting (H/MP)

It sets the time unit and countdown condition.

With the Step Time＊ Setting (tIM＊), the step duration time for every Step can be set, and the condition of the countdown against this value can be set.

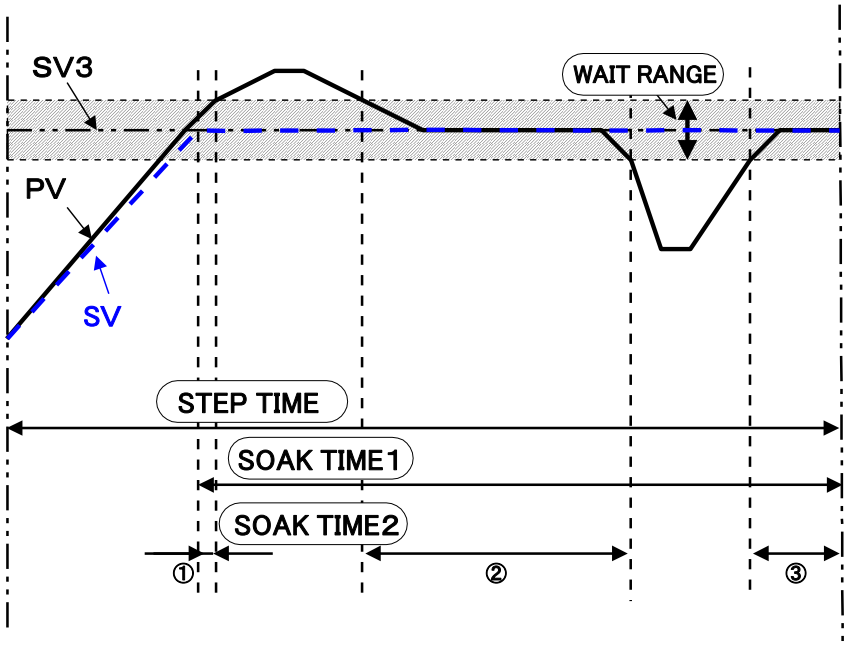
After the set time elapse (completion of countdown), it will proceed to the next step.

Setting Range

0, 3: (Step Time) The countdown starts regardless of the condition of PV/SV value.

1, 4: (Soak Time 1) The countdown starts once the PV value is entered within the set wait range.

2, 5: (Soak Time 2) Countdown is done if the PV value is entered only to the set wait range (①+②+③). The countdown does not take place when the PV value is outside the wait range.



NOTE: The determination is made with the set SV value even if the ramp is being set.

NOTE: When Soak Time 1 and Soak Time 2 is selected, the countdown starts by the comparison between the PV and SV value. It will be determined by PV Value, SV＊(＊=1 to 8) and wait range (WAIt).

NOTE: The countdown starts with the comparison of the PV Value and SV Value, but when the ramp function is being used, the countdown starts when it becomes; Present SV Value = SV＊(＊=1 to 8).

NOTE: When the step time is being set, the ramp function cannot be used.

NOTE: SV3 is a Control Setting Value.

■Wait Range Setting

	SEt21 PGF	Setting Contents	Initial Value
5	WAIt	Wait Range Setting 3	2
		During Temperature Input	
		Soak Time 1 0～999 (0. 0～999. 9) (℃)	
		Soak Time 2 0～999 (0. 0～999. 9) (℃)	
		※During H/MP(Soak Time 2)、the behavior will be identical to that of (Soak Time 1) with Setting=0	
		During Analog Input	
		Soak Time 1 0～9999 (digit)	
		Soak Time 2 0～9999 (digit)	
		※During H/MP(Soak Time 2)、the behavior will be identical to that of (Soak Time 1) with Setting=0	

＊5 WAIT RANGE SETTING (WAIt)

Time Unit Setting (H/MP) sets the condition of countdown (Range against PV Value) during the setting of (Soak Time 1) (Soak Time 2).

Please refer to Time Unit Setting (H/MP) for the explanation of its action.

Setting Range

(During Temp. Input)

Soak Time 1: 0 to 999 (0.0 to 999.9)℃

Soak Time 2: 0 to 999 (0.1 to 999.9)℃

(During Analog Input)

Soak Time 1: 0 to 9999 (digit)

Soak Time 2: 0 to 9999 (digit)

NOTE: RE: Behavior during WAIT Range Setting (Setting Value = 0)

Even if the H/MP (Soak Time 2) is being set, when the Setting Value = 0, the behavior would be the same as that of (Soak Time 1).

NOTE: Regarding the AT (Auto-Tuning) behavior during the program in operation.

The AT can be done while the program is in operation. The SV Value which operates the AT is the SV* (Step SV) Value that is set in each steps. Also, this condition applies also during RMP in operation with set RMP movement.

6.14 PROGRAM SETTING

■Setting No. of Steps to be Used / Step SV＊ Setting / Step Time＊ Setting

	SEt22 PROG	SETTING CONTENTS	INITIAL VALUE
1	StEPN	Setting of no. of steps used 3 Setting Value Range n=1～8	8
2	St＊bK	Step＊ Designated Bank Setting 3 Setting Value Range St*BK=0～7 ＊=1～(StEPN Setting Value)	0
3	SV＊	Step SV＊ Setting 3 Setting Value Range SV*=SLL～SLH ＊=1～(StEPN Setting Value) ※When the SLL and SLH is set at the Bank, the value of the SLL,SLH will be set on each bank.	0
4	tIM＊	Step Time＊ Setting 3 Setting Value Range TIM*=00:00～99:59 ＊=1～(StEPN Setting Value)	00:00

Sets the Program Step Data of the Program Setting Mode.

＊1 No. of Steps Used Setting (StEPN)
This is to set the "Max. No. of Steps" which is used in the programmed operation.

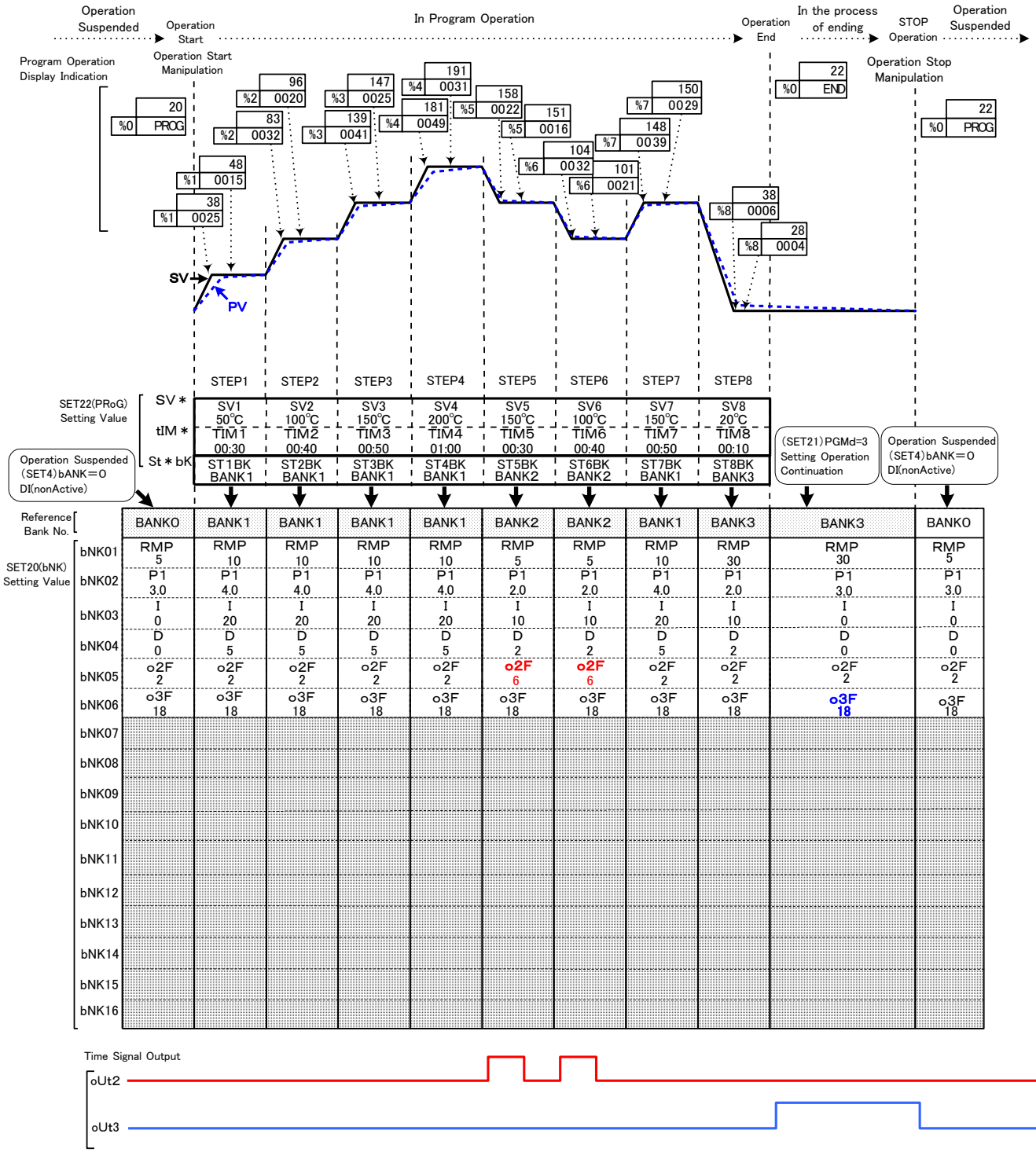
＊2 Step＊ Designated Bank Setting (St＊bK)
This is to set the "Bank Nos." which the system refers in every step.

＊3 Step SV＊ Setting (SV＊)
This is to set the target value (temperature or analog value) of the control in every steps.

＊4 Step Time＊ Setting (tIM＊)
This is to set the Step Duration Time of every steps.

The next page shows the behavior diagram of the "No. of Steps Used Setting / Step SV＊ Setting / Step Time＊ Setting".

■Setting No. of Steps to be Used / Step SV＊ Setting / Step Time＊ Setting Behavior Diagram



*** Time Signal Output Setting ***
*(SET14)tMF1=15, (SET14)tSV1=0, (SET14)oNt1=00:15
Step Start
*(SET6)o2F=6
When Bank 2, o2F=Timer 1 on Delay Output. Other banks are Event Output (nofunction)
*(SET7)o3F=18
End Output
*** Program Function Setting ***
*(SET21)C/P=1, (SET21) PGMD=3, (SET21)PoC=0, (SET21)H/MP=2, (SET21)WAIt=5
Program 2 (w/ Power Failure Compensation), 2: Soak Time 2 (Hr./Min.)
*(SET22) StEPN=8, (SET22) StRSt=1, (SET22) ENdSt=8, (SET22)RUNP=1
*** Other Settings ***
*Set to (SET4) Bank=0. Also, "0" is assumed when BANK switchover is ON by DI.

■Repeat Start Step Setting / Repeat End Step Setting / Setting the Times of Execution / Setting the no. of Execusion / No. of Times Monitor

	SEt22 PROG	Setting Contents	Initial Value
5	StRSt	Repeat Start Step Setting 3 Setting Value Range **1～Repeat End Step Setting (ENdSt)**	1
6	ENdSt	Repeat End Step Setting 3 **Repeat Start Step Setting (StRSt StRSt)～ Setting No. of Steps to be used or StEPN** ※When set to StEPN, the value which is set under the Setting No. of Steps to be Used will be "Repeat End Step Setting".	StEPN
7	RUNP	No. of Execution Setting / No. of Execution Monitor 3 Setting Value Range **RUNP=0～9999** (When RUNP=0, Infinite)	1

Setting the condition of repeated operation during the programmed operation

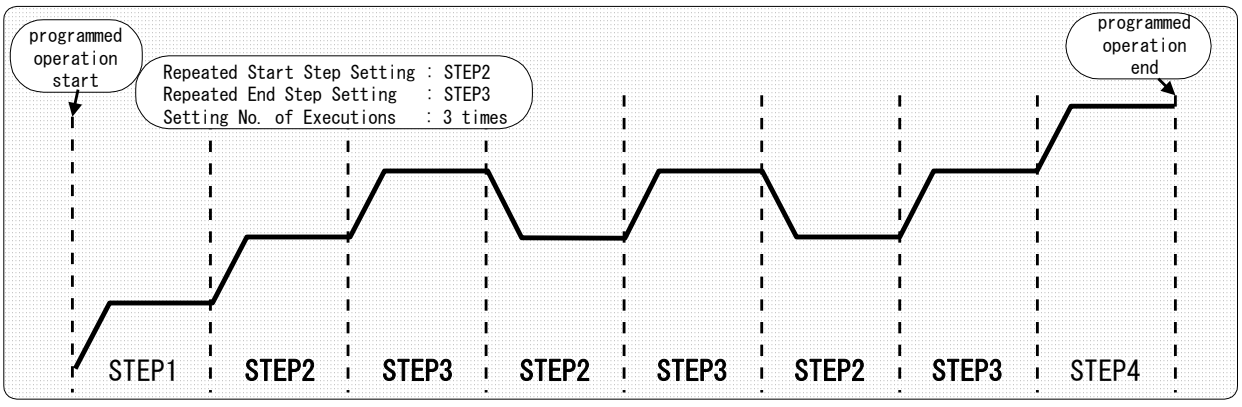
＊5 Repeated Start Step Setting (StRSt)
This is to set the starting point of the repetition (Step No. of which the repetition starts)

＊6 Repeated End Step Setting (ENdSt)
This is to set the end point of the repetition (Step No. of which the repetition ends)

＊7 Setting No. of Executions / No. of Executions Monitor (RUNP)
This is to set the no. of time of repetition at the start point and end point.

NOTE: The setting value of the "No. of Executions Setting " and "No. of Executions" done will be shown alternately only on the display of the controller unit.

■Repeat Operation Behavior Diagram



Above is usage example of Repeat Operation Function

6.15 BANK AUTOMATIC SWITCHING FUNCTION SETTING

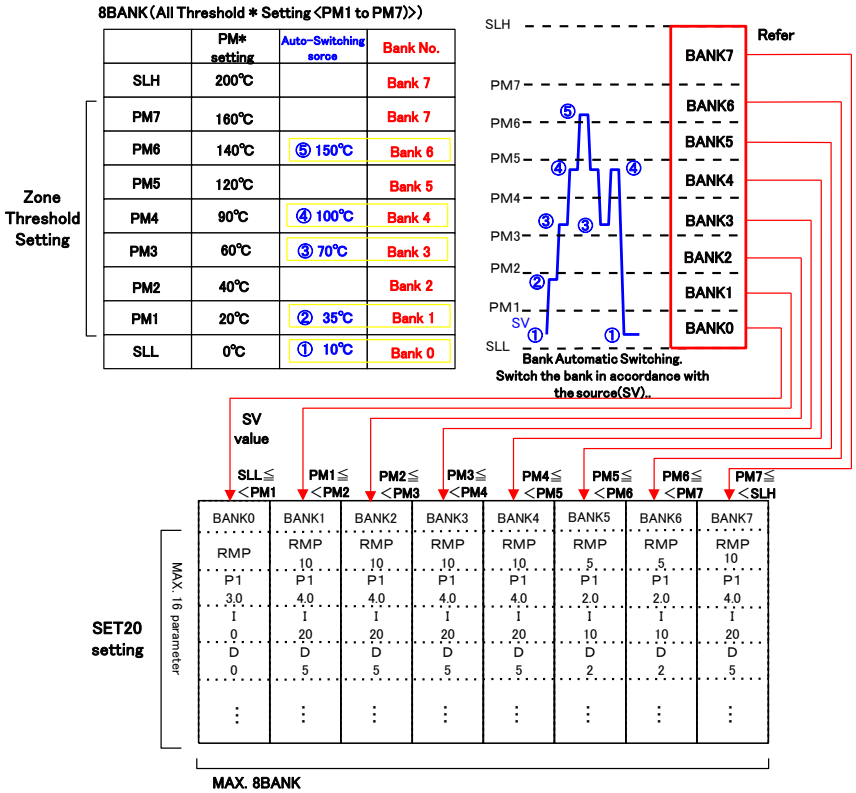
■Bank Automatic Switching Function Selection

	SEt 23 ZbNK	Setting Contents	Initial Value
1	bAF	Bank Automatic Switching Function Selection 3 0 Bank Auto-Switching Operation OFF 1 Bank Auto-Switching Operation ON ※In case the "Bank Auto-Switching Operation ON" is set; ・The Bank Switching Setting with the FUNC Key will be invalid. ・The Bank Switching Setting by DI will be invalid. ▲▼ key operation will not be possible either. ※When SET04 bANKH=0, the setting will be invalid. There will be no indication either.	0

※1 Bank Automatic Switching Function Selection (bAF)
This is to set the Bank Automatic Switching ON/OFF. When ON, the bank will be switched automatically with the selected input by the Bank Automatic Switching Source Setting (bAS).

Setting Range : When 0: Bank Automatic Switching Operation OFF
When 1: Bank Automatic Switching Operation ON

■Behavior Diagram when Bank Automatic Switching is ON



NOTE: When the Bank Automatic Switching Function is (SET23 bAF = 1), please note the following points in case the parameters "SV, SLL, SLH" is set at SET 20 (Bank);

・The value of the "SV, SLL, SLH" set at the Bank will be invalid.

・The Bank registration of "SV, SLL, SLH" will be erased and will go back to the default value.
If (SET 23 bAF = 0) again, the bank registration of "SV, SLL, SLH" are erased, so there is a need to reset.

■Bank Automatic Switching Source Setting

	SEt23 ZbNK	Setting Contents		Initial Value
2	bAS	Bank Automatic Switching Source Setting 3		00
		Function		
		*0	Select SV value	
		*1	Select ramp SV value	
		*2	Select PV value	
		Control Mode Interlock Function		
		0*	All Mode	
		1*	RUN/MAN Mode Only	
		2*	RUN Mode Only	
		※Select the source for the SV value to which the Bank Automatic Switching will be done. ※When "SET04 bANKH=0", the setting will be invalid. There will be no indication either.		

※2 Bank Automatic Switching Source Setting (bAS)

Select source to which the Bank Automatic Switching will be done. Switch the bank in accordance with the source selected.

Setting Range : When 0, select SV Value <Local and Remote (only Option Y)>

: When 1, select ramp SV value.

: When 2, select PV value

NOTE: The behavior of AT (Auto-Tuning) when (bAF = 1).

- Regardless of the source setting to which the Bank Automatic Switching will be done, it will select SET04(SV). After the completion of the AT (Auto-Tuning), it will go back to Bank Automatic Switching Source Setting (bAS).
- In case the Zone Threshold＊Setting (PM＊) is set, at the same time the parameter (P, I, D) is set to the bank, the PID value obtained from the AT (Auto-Tuning) will be reflected to the Bank No. according to the threshold.

■Zone Threshold＊ Setting

	SEt23 ZbNK	Setting Contents		Initial Value
3	PM＊	Zone Threshold＊ Setting 3		1200
		Setting Range SV Limiter Lower Limit (SLL) to SV Limiter Upper Limit (SLH) <PM* <= PM*+1> (PM＊) will depend on the setting value of bANKH		
		PM7	PM6～SLH	
		PM6	PM5～SLH	
		PM5	PM4～SLH	
		PM4	PM3～SLH	
		PM3	PM2～SLH	
		PM2	PM1～SLH	
		PM1	SLL～SLH	
		※Setting of the Threshold is done for the Bank Automatic Switching which will be done for ＊ = 1 to 7 (8 bank row). ※When SET04 bANKH=0, the setting will be invalid. There will be no indication either.		

※ 3 Setting of the Threshold is done for the Bank Automatic Switching which will be done for the Zone Threshold＊Setting (PM1 to PM7) ＜Max. 8 banks＞

Setting Range: SLL to SLH
Threshold can be set to max. of 7 (8 banks).
The initial value set is 1200 for PM1 to PM7. The bank switching by selected source will not be done.

NOTE: The setting range is PM＊SV Limiter Lower Limit (SLL) to SV Limiter Upper Limit, but when the value of the PM(＊・1) is set exceeding the PM(＊), the PM (＊) will be changed together.

The selectable range of the Zone Threshold＊Setting (PM＊) will depend on the setting value of bANKH.

SET04 bANKH=	Selectable PM*
0	PM No Indication
1	＊ = 1
2	＊ = 1～2
3	＊ = 1～3
4	＊ = 1～4
5	＊ = 1～5
6	＊ = 1～6
7	＊ = 1～7

Note: the parameters indicated will vary depending on the value of SET04 BANKH.

■Zone Threshold Switching Sensitivity Range Setting

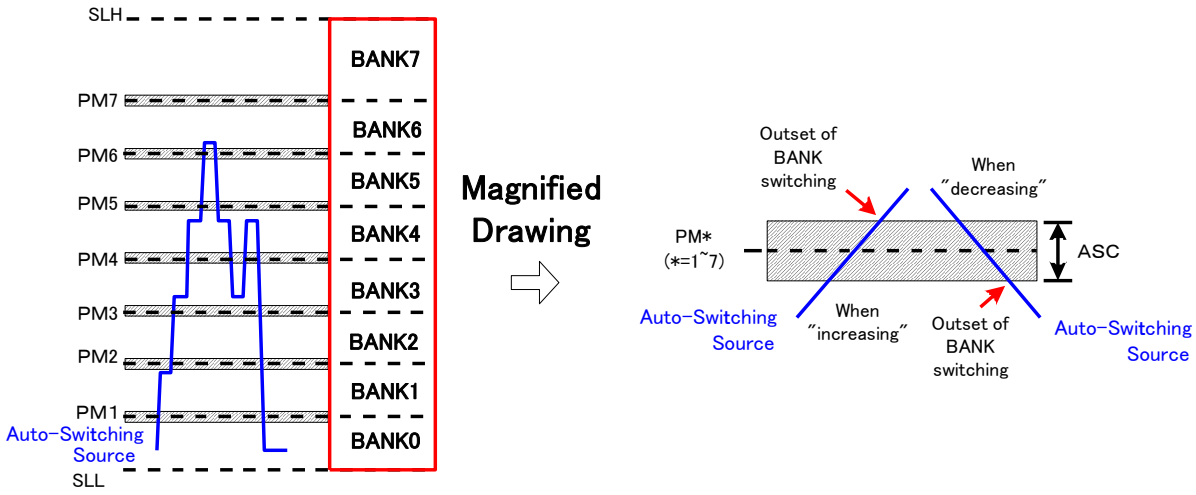
	SEt 23 ZbNK	Setting Contents	Initial Value
4	ASC	Zone Threshold Switching Sensitivity Range Setting 3 During Temperature Input 0～999 (0. 0～999. 9) (℃) During Analog Input 0～9999 (digit) ※Sets the sensitivity setting for the threshold of the bank auto-switching. At bAF=0(OFF) and bAS=*0 or *1, there will be nol indication when the SET02 LR=0. ※When SET04 bANKH=0, the setting becomes invalid. There will be no indications either.	2

※4 Zone Threshold Switching Sensitivity Range Setting (ASC)
Sets the Sensitivity Range to each intermediate points to which the bank auto-switching is done.

Setting Range : During the Temperature Input 0～999 (0. 0～999. 9) (℃)
During the Analog Input 0～9999 (digits)

NOTE: With Threshold (PM 1 to PM 7), it will be common value.
NOTE: It will be ±(ASC/2) with (PM1 to PM7) as the center.
As for the behavior, please refer to the "Zone Threshold Switching Sensitivity Range Setting Behavior Diagram" below.

■Zone Threshold Switching Sensitivity Range Setting Behavior Diagram
With each PM＊Value as the center, the value set by ASC shall be the sensitivity range.



NOTE: This setting is effective only when the Bank Automatic Switching Source Setting (bAS) is selected either Remote SV or PV.
＜Conditions when ASC can be set＞
When (bAS = 2)
When SET02 (LR = 1, 2) at (bAS = 0)
＜Conditions when ASC cannot be set＞
When (bAS = 1)
(bAS = 0) but when SET02 (LR = 0).

7. Appendix

Product specifications and accessories are described in this chapter.

7.1 Product specifications

7.1.1 Rating and performance

(1) Input section

1) No. of input points
One point for TTM-204, and up to 2 points for TTM-205, 207 or 209
* The second point on TTM-205, 207 or 209 cannot be selected for thermocouple, resistance temperature detector or voltage 0 - 10 mV.

2) Input type
① Input 1: Multi-input of thermocouple, resistance temperature detector, voltage and current
② Input 2: Multi-input of voltage and current (excluding voltage 0 - 10 mV)

3) Input type switchover
Switchover of input type per setting

4) Measurement temperature range
See the table 1.

5) Setting temperature range
Identical to the measurement temperature range.

6) Measurement resolution
See the table 1.

7) Sampling cycle
0.2 seconds

8) Input specifications
① Thermocouple input
a) Measurement accuracy
In standard environment conditions (23 ± 10 °C)
Thermocouples of K, J, T, E, R, S, B and N:
Either larger ± (0.3 % + 1 digit) or ± 2 °C of the indicated value
Note: ±3 °C for -100 to 0 °C and ±4 °C for -200 to -100 °C
No specification for 400 °C or lower for B thermocouple
Thermocouples of U and L:
Either larger ± (0.3 % + 1 digit) or ± 4 °C of the indicated value
± 6 °C for 0 °C or lower
WRe 5-26: Either larger ± (0.6 % + 1 digit) or ± 4 °C of the indicated value
PR 40-20: ± 9.4 °C ± 1 digit
No accuracy specified for lower than 800 °C
PL II: Either larger ± (0.3 % + 1 digit) or ± 2 °C of the indicated value
b) Effect from external resistance
Within 0.5 μV/1Ω
c) Input resistance
1 MΩ as standard
d) Handling of disconnection
“ ” (overscale) displayed
Control output: Operating amount limiter lower limit
② Resistance temperature detector input
a) Measurement accuracy
In standard environment conditions (23 ± 10 °C)
Either larger ± (0.3 % + 1 digit) or ± 0.9 °C of the indicated value
b) Allowable conductor wire resistance
10 Ω or less (per wire; 3 wires to be with identical resistance)
c) Measurement current
2 mA
d) Handling of disconnection
“ ” (overscale) displayed (for all of A, B and b)
Control output: Operating amount limiter lower limit
③ Voltage input and Current input
a) 0 - 1 VDC
I) Measurement accuracy
In standard environment conditions (23 ± 10 °C), ± 0.3 % ± 1 digit of FS
II) Input resistance
1 MΩ or larger
III) When disconnected
“ ” (underscale) displayed
Control output: Operating amount limiter lower limit
b) 0 - 5 VDC
I) Measurement accuracy
In standard environment conditions (23 ± 10 °C), ± 0.3 % ± 1 digit of FS
II) Input resistance
1 MΩ or larger
III) When disconnected
“ ” (underscale) displayed
Control output: Operating amount limiter lower limit
c) 1 - 5 VDC
I) Measurement accuracy
In standard environment conditions (23 ± 10 °C), ± 0.3 % ± 1 digit of FS
II) Input resistance
1 MΩ or larger
III) When disconnected
“ ” (underscale) displayed
Control output: Operating amount limiter lower limit

d) 0 - 10 VDC
   I) Measurement accuracy
      In standard environment conditions (23 ± 10 °C), ± 0.3 % ± 1 digit of FS
   II) Input resistance
      1 MΩ or larger
   III) When disconnected
      “ ” (underscale) displayed
      Control output: Operating amount limiter lower limit

e) 0 - 10 mVDC
   I) Measurement accuracy
      In standard environment conditions (23 ± 10 °C), ± 0.5 % ± 1 digit of FS
   II) Input resistance
      1 MΩ or larger
   III) When disconnected
      “ ” (underscale) displayed
      Control output: Operating amount limiter lower limit

f) Current input 4 - 20 mADC
   I) Measurement accuracy
      In standard environment conditions (23 ± 10 °C), ± 0.3 % ± 1 digit of FS
   II) Input resistance
      Approx. 250 Ω
   III) When disconnected
      “ ” (underscale) displayed
      Control output: Operating amount limiter lower limit

9) Isolation
   Isolated from power circuit and non-isolated from CPU circuit
10) Connection method
   Terminal block

Table 1 Measurement range and indicator resolution

Input type		Standards	Measurement/measurement range	Indicator resolution
Thermocouple	K	JIS C 1602-1995	-200.0 to +1372.0	1°C / 0.1°C
	J	JIS C 1602-1995	-200.0 to +1200.0	1°C / 0.1°C
	T	JIS C 1602-1995	-200.0 to +400.0	1°C / 0.1°C
	E	JIS C 1602-1995	-200.0 to +1000.0	1°C / 0.1°C
	R	JIS C 1602-1995	-50 to +1768	1°C
	S	JIS C 1602-1995	-50 to +1768	1°C
	B	JIS C 1602-1995	0 to 1800	1°C
	N	JIS C 1602-1995	-200.0 to +1300.0	1°C / 0.1°C
	U	DIN	-200.0 to +400.0	1°C / 0.1°C
	L	DIN	-200.0 to +900.0	1°C / 0.1°C
	WRe5-26	ASTM	0 to 2300	1°C
	PR40-20	ASTM	0 to 1880	1°C
	PLII	ASTM	0.0 to 1390.0	1°C / 0.1°C
Resistance temperature detector	Pt100Ω	JIS C 1604-1997	-200.0 to +850.0	1°C / 0.1°C
	J Pt100Ω	JIS C 1604-1997	-200.0 to +510.0	1°C / 0.1°C
Voltage	0 - 1 VDC		-19999 to +29999 Display range of 20000 or less	Random change of decimal point position allowed
	0 - 5 VDC			
	1 - 5 VDC			
	0 - 10 VDC			
	0 - 10 mVDC			
Current	4 - 20 mADC			

When the measurement range is set to be smaller than the maximum range for the voltage or current input, display is possible up to -2 % from the lower limit and +12 % from the upper limit in the setting that allows the input of 0 V.
Display is possible up to -12 % from the lower limit and +12 % from the upper limit for DC 1 to 5 and DC 4 to 20 mA.

(2) Control output section

1) No. of output points
   2 points

2) Output type (fixed per model designation)

① Relay contact output

a)	Contact type	1a contact
b)	Contact capacity	250 VAC, 3A (resistance loads)
c)	Min. loads	5 VDC, 100 mA
d)	Mechanical life	5 million counts or more
e)	Electric life	100 thousand counts or more (More than 80 thousand counts at the UL approval)
f)	Isolation	Isolated from power circuit and CPU circuit

② Voltage output for SSR drive

a)	Output type	ON/OFF
b)	Output voltage	12 VDC
c)	Output voltage accuracy	±1 V (23 ± 10 °C)
d)	Load resistance	600 Ω or larger
e)	Leak current	21 μA or smaller (at output off)
f)	Isolation	Isolated from power circuit and CPU circuit

③ Open collector output

a)	Output type	Open collector
b)	Output rating	24 VDC, 100 mA
c)	Leak current	0.3 mA or smaller (at output tuned off)
d)	Residual voltage	3 V or smaller (at output tuned on)
e)	Isolation	Isolated from power circuit and CPU circuit

④ Voltage 0 - 1 VDC output

a)	Output type	Continuous
b)	Output accuracy	±0.3 % (23 ± 10 °C)
c)	Output resolution	Better than display resolution
d)	Load resistance	500 kΩ or larger
e)	Isolation	Isolated from power circuit and CPU circuit

⑤ Voltage 0 - 5 VDC output

a)	Output type	Continuous
b)	Output accuracy	±0.3 % (23 ± 10 °C)
c)	Output resolution	Better than display resolution
d)	Load resistance	1 kΩ or larger
e)	Isolation	Isolated from power circuit and CPU circuit

⑥ Voltage 1 - 5 VDC output

a)	Output type	Continuous
b)	Output accuracy	±0.3 % (23 ± 10 °C)
c)	Output resolution	Better than display resolution
d)	Load resistance	1 kΩ or larger
e)	Isolation	Isolated from power circuit and CPU circuit

⑦ Voltage 0 - 10 VDC output

a)	Output type	Continuous
b)	Output accuracy	±0.3 % (23 ± 10 °C)
c)	Output resolution	Better than display resolution
d)	Load resistance	1 kΩ or larger
e)	Isolation	Isolated from power circuit and CPU circuit

⑧ Voltage 0 - 10 mVDC output

a)	Output type	Continuous
b)	Output accuracy	±0.3 % (23 ± 10 °C)
c)	Output resolution	Better than display resolution
d)	Load resistance	500 kΩ or larger
e)	Isolation	Isolated from power circuit and CPU circuit

⑨ Voltage 4 - 20 mADC output

a)	Output type	Continuous
b)	Output accuracy	±0.3 % (23 ± 10 °C)
c)	Output resolution	Better than display resolution
d)	Load resistance	600 kΩ or smaller
e)	Isolation	Isolated from power circuit and CPU circuit

3) Connection method
   Terminal block

(3) Auxiliary output section

1) No. of output points (see the table below)
2 points (TTM-204) Common shared
4 points (TTM-207)
For TTM-207, outputs 3 and 4 are for common shared and outputs 5 and 7 are for common independent. When DI 3 exists, 4 points for 207.
5 points (TTM-205, 207 and 209)
For TTM-205 and 209, outputs 3 and 4 are for common shared and outputs 5 to 7 are for common independent.

2) Output type (fixed per model designation)

① Relay contact output

a)	Contact type	1a contact
b)	Contact capacity	250 VAC, 1A (resistance loads)
c)	Min. loads	5 VDC, 100 mA
d)	Mechanical life	5 million counts or more
e)	Electric life	100 thousand counts or more (More than 80 thousand counts at the UL approval)
f)	Isolation	Isolated from power circuit and CPU circuit

② Open collector output

a)	Output type	Open collector
b)	Output rating	24 VDC, 100 mA
c)	Leak current	0.3 mA or smaller (at output tuned off)
d)	Residual voltage	3 V or smaller (at output tuned on)
e)	Isolation	Isolated from power circuit and CPU circuit

3) Connection method
Terminal block

Assignment of output functions

Type of output	Control output		Auxiliary output				
	Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7
Primary output (heating)	○	○	○	○	○	○	○
Secondary output (cooling)	○	○	○	○	○	○	○
Transmission	○	○	×	×	×	×	×
Event	○	○	○	○	○	○	○
End output	○	○	○	○	○	○	○

○: Output assignment possible
×: Output assignment not possible
Assured accuracy for the transmission output is -10 % to +10 % of the output range.

(4) CT input section

1)	No. of input points	2 points
2)	Measurement current range	0 - 50.0 A
3)	Setting current range	0.0 - 30.0 A (at-ON current/at-OFF current)
4)	Setting resolution	0.1 A
5)	Setting accuracy	±5 % of full span (1.0 A or less to be out of accuracy)
6)	Disconnection detection	300 ms or longer for ON time of control output
7)	Adhesion detection	300 ms or longer for OFF time of control output
8)	Isolation	Isolated from power circuit and non-isolated from CPU circuit
9)	Connection method	Terminal block

(5) Event input section

1)	No. of input points	2 points (TTM-204 DI 1 and 2: Common independent) 3 points (TTM-207 DI 1, 2 and 3: Common independent) 4 points (TTM-205 and 209 DI 1 and 2: Common independent, and DI 3 and 4: Common shared)
2)	Input specification	No-voltage contact input
3)	Input polarity	Active switchover possible for each input Close active/open active
4)	Function	See the operation specifications.
5)	At-ON current	Max. 10 mADC
6)	At-OFF voltage	Max. 6 VDC
7)	Min. input time	200 ms
8)	Allowable resistance value between terminals	At ON, max. 333 Ω and at OFF, min. 500 kΩ
9)	Isolation	Isolated from power circuit and CPU circuit
10)	Connection method	Terminal block

(6) Communication

Communication is in the use exclusively from loader communication.

1)	Communication specification	RS-485 (1:31)
2)	Communication terminal	RS-485 dedicated terminal
3)	Protocol	TOHO 100-model protocol/MODBUS (RTU)/MODBUS (ASCII)
4)	Information direction	Half-duplex
5)	Synchronization system	Asynchronous
6)	Transmission code	ASCII
7)	Interface	RS-485 (2-wire)
8)	Communication speed	2400/4800/9600/19200/38400 bps
9)	Communication distance	500 m
10)	Response delay time	0 - 250 ms
11)	Character	
	① Start bit	1 bit fixed
	② Stop bit	1/2 bits
	③ Data length	7/8 bits
	④ Parity	None/odd No./even No.
	⑤ BCC check	Nonexistent/existent * For MODBUS setting, BCC check is ineffective
	⑥ Address	1 - 99 stations * For MODBUS setting, 1 - 247 stations
12)	Isolation	Isolated from power circuit and CPU circuit
13)	Connection method	Terminal block

(7) Loader communication

Loader communication is in the use exclusively from communication.

1)	Communication specification	TTL (1:1)
2)	Communication terminal	Loader communication dedicated terminal
3)	Protocol	TOHO 100-model protocol/MODBUS (RTU)/MODBUS (ASCII)
4)	Information direction	Half-duplex
5)	Synchronization system	Asynchronous
6)	Transmission code	ASCII
7)	Interface	TTL level
8)	Communication speed	2400/4800/9600/19200/38400 bps
8)	Response delay time	0 - 250 ms
10)	Character	
	① Start bit	1 bit fixed
	② Stop bit	1/2 bits
	③ Data length	7/8 bits
	④ Parity	None/odd No./even No.
	⑤ BCC check	Nonexistent/existent * For MODBUS setting, BCC check is ineffective
	⑥ Address	1 - 99 stations * For MODBUS setting, 1 - 247 stations
11)	Isolation	Isolated from power circuit and non-isolated from CPU circuit
12)	Connection method	ϕ2.5, 3-pin mini-jack

(8) Display and operation section

1) Measurement value display section

LCD display (with LED back light and emission colors of red, green and orange)

TTM-204/205	5-digit	Character height of 10 mm
TTM-207	5-digit	Character height of 13 mm
TTM-209	5-digit	Character height of 20 mm

2) Setting value display section

LCD display (with LED back light and emission colors of red)

TTM-204/205	5-digit	Character height of 8 mm
TTM-207	5-digit	Character height of 8 mm
TTM-209	5-digit	Character height of 10 mm

3) Auxiliary display section

LCD display (with LED back light and emission colors of green)

TTM-204/205	1-digit	Character height of 8 mm
TTM-207	1-digit	Character height of 8 mm
TTM-209	1-digit	Character height of 10 mm

4) LCD lamp

LCD display (with LED back light and emission colors of red)

	TTM-204 (9 pcs)	TTM-207 (12 pcs)	TTM-205 and 209 (14 pcs)
Output 1 monitor	○	○	○
Output 2 monitor	○	○	○
Output 3 monitor	○	○	○
Output 4 monitor	○	○	○
Output 5 monitor		○	○
Output 6 monitor			○
Output 7 monitor		○	○
RDY lamp	○	○	○
COM lamp	○	○	○
DI 1 monitor	○	○	○
DI 2 monitor	○	○	○
DI 3 monitor		○	○
DI 4 monitor			○
Timer lamp	○	○	○

5) Operation section
Key switch, 4 pcs (TTM-204) or 8 pcs (TTM-205, 207 and 209)

UP	: △	TTM-204
DOWN	: ▽	
Function 1	: FUNC 1	
Mode	: MODE	TTM-205, 207 and 209
Function 2	: FUNC 2	
Function 3	: FUNC 3	
Function 4	: FUNC 4	
Function 5	: FUNC 5	

(6) Other functions
The following functions are equipped with. For details, see the operation specification.

1) Process control — Signals are output for matching the measurement value to the setting value.
2) Blind function — Any parameter can be set to non-display.
3) Priority screen function — Any parameter screen can be displayed in the run mode screen. (Max. 16 points)
4) Key assignment function — FUNC keys 1 to 5 can be assigned for designated specifications.
5) Timer function — Function of simplified timer can be set as listed below. Setting accuracy: ± (1.5 % + 0.5 second) of setting time
6) Bank function — A series of parameters for setting can be switched over.
7) Program run function — A simple program run of eight steps at most is possible.

7.1.2 Environmental conditions

(1) Standard environment conditions
1) Temperature range — 23 ± 10 °C
2) Humidity range — 45 - 75 %RH
3) Installation gradient — Base plane ± 3 degrees
4) Vibration condition — 0 G

(2) Use environment conditions
1) Temperature range — 0 - 50 °C
2) Humidity range — 20 - 90 %RH (no dew condensation allowed)
3) Installation gradient — Base plane ± 10 degrees

(3) Storage environment conditions
1) Temperature range — -20 - +70 °C (no freeze or dew condensation allowed)
2) Humidity range — 5 - 95 %RH (no dew condensation allowed)

(4) Power supply voltage — 100 - 240 VAC, 50/60 Hz
(Allowable voltage range: 85 - 110 %)
24 VAC/DC, 50/60 Hz (205,207,209 are under development.)
(Allowable voltage range: 90 - 110 %)

(5)	Power consumption	100 - 240 VAC: 10 VA or less (TTM-204) 100 - 240 VAC: 11 VA or less (other than TTM-204) 24 VAC/DC: 4 W or less (TTM-204)	
(6)	Warm-up time	30 minutes	
(7)	Momentary power outage	No effect of power outage in a single cycle. (Reset at power outage for more than a cycle) For DC power with the outage for 40 ms or shorter, there is no effect on operation.	
(8)	Isolation resistance	Measurement terminal - case Power terminal - case	00 VDC, 20 MΩ 500 VDC, 20 MΩ
(9)	Withstand voltage	Measurement terminal - case Power terminal - case	1000 VAC for a minute 1500 VAC for a minute
(10)	Weight	TTM-204: 120 g or less TTM-205: 210 g or less TTM-207: 260 g or less TTM-209: 300 g or less	
(11)	Protection structure	IP66 or equivalent (on the front surface): Only for TTM-204 For TTM-205, 207 and 209, no IP regulation applicable. (Due to installation for loader communication)	

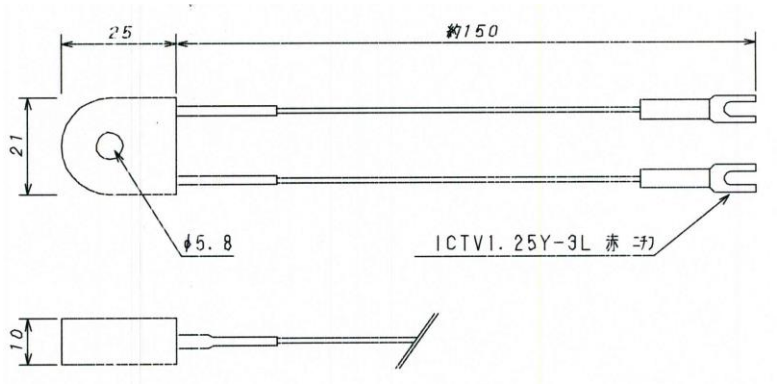
7.2 Accessories

7.2.1 Current transformer

★ Current transformer is used to measure current values of a heater through connecting it to TOHO's digital controller TTM-200 series and the heater.
Model: CTL-6-P-H-(S)
Product specifications

Current applicable	0.1 - 80.0 A rms (50/60 Hz) * This is specification for CT main frame.
Max. allowable current	80 A rms continuous
Withstand voltage	2000 VAC for a minute (between through-hole and output terminal)
Isolation resistance	500 VDC, 100 MΩ or larger (between through-hole and output terminal)
Use temperature range	-20 to 70 °C
Storage temperature range	-30 to 90 °C
Weight	Approx. 16 g
Accessories	None

Outside dimension

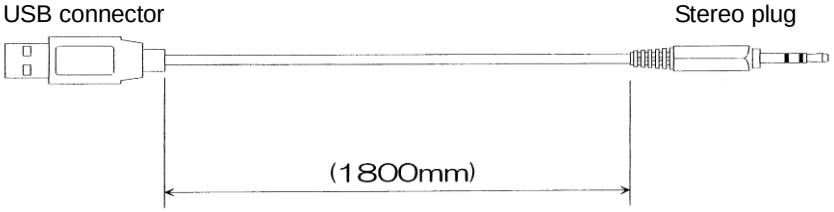


7.2.2 Loader cable

★ Loader cable is used to connect TOHO's digital controller TTM-200 series and a personal computer (PC) and such so that various values are set and read on the PC, using the dedicated loader software installed on it.
Model: TTM-LOADER
Product specifications

OS to meet	Windows XP
USB I/F standards	In compliance with USB Specification 2.0
DTE speed	Up to 38400 bps
Connector specification	PC side: USB Controller side: ϕ2.5 mm stereo jack
Consumption current	90 mA
Use temperature range	0 to 50 °C
Use humidity range	20 to 90 %RH (no dew condensation allowed)
Storage temperature range	-10 to 60 °C (no freeze or dew condensation allowed)
Storage humidity range	5 to 95 %RH (no dew condensation allowed)
Power supply voltage	Bus-powered (to be supplied from PC side)
Weight	40 g

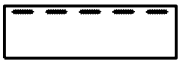
Outside dimension



7.3 Error (abnormality) display

Content of error is displayed when an abnormality is generated on this product.

7.3.1 Display on measurement value (PV) side

Display	Content	Handling	Operation at error
 Over display	* When input exceeds the display range upper limit * When thermocouple is disconnected * When input of 0 to 10 mV is disconnected * When terminal A, B or b is disconnected for resistance temperature detector	* Make the input fall within the display range. * Correct the disconnection.	* At-abnormality operating amount FAL 1 or FAL 2 is output.
 Under display	* When input exceeds the display range lower limit * When current/voltage input of other than 0 to 10 mV is disconnected	* Make the input fall within the display range. * Correct the disconnection.	* At-abnormality operating amount FAL 1 or FAL 2 is output.

* Input range: Input type measurement range described in the section 6-1, input 1 type setting, on page 6-2.

7.3.2 Display on target value (SV) side

Display	Content	Handling	Operation at error
ERR0	At memory error	Request for a repair if re-power-on does not solve the error.	For output in relay, SSR or open collector, output OFF is resulted, and for analog output, output 0 % is resulted.
ERR1	When an input A/D switchover error or excessive input is provided.	Remove the excessive input. Request for a repair if re-power-on does not solve the error.	At-abnormality operating amount FAL 1 or FAL 2 is output.
ERR2	At auto-tuning error	Auto-tuning error is displayed when an input is burned out or when it takes longer than 3 hours for auto-tuning. For a subject of control that cannot be auto-tuned, manually set the PID value.	At-abnormality operating amount FAL 1 or FAL 2 is output.
LoC	When a parameter is changed during key-locking.	Release the key-lock.	No change of setting value is allowed, displaying “LoC.”
DI	When target value (setting value) assigned for DI input is attempted to change	Release the assignment for DI.	No change of setting value is allowed, displaying “DI.”
FUNC	When setting value assigned for FUNC function is attempted to change	Release the assignment for FUNC function.	No change of setting value is allowed, displaying “FUNC.”
REMO	When setting value assigned for the local/remote function is attempted to change	Release the assignment of the local/remote function	No change of setting value is allowed, displaying “REMO.”
ZBNK	When setting value assigned for the auto bank switching function is attempted to change	Release the assignment of the auto bank switching function.	No change of setting value is allowed, displaying “ZBNK.”

7.4 Troubleshooting

Check corresponding items listed below to abnormal operation of this product before requesting for a repair. In case of no normal operation restored, contact TOHO's sales department to return the product for a repair.

Symptom	Description	Check item
Too much difference of temperatures	(1) Input type does not match the one of the main frame. (2) Resistance temperature detector is not properly connected. (3) Resistance temperature detector is disconnected or shorted. (4) The product is affected by noise from the power line due to wires for lead and power supply being laid in the same tubing. (5) Copper wire is used for connecting this product with thermocouple. (6) Input compensation (PV compensation) is not properly set. Setting at factory shipment is "0 °C."	(1) Check the sensor type and properly set the input type on the main frame. (2) Check the mounting location and polarity of the resistance temperature detector to properly connect it. (3) Check the resistance temperature detector for disconnection or short. (4) Separately wire them. (5) Connect lead wires of the thermocouple directly to the product or use compensated leads suited for the thermocouple. (6) Enter the appropriate value for the input compensation value.
No communication possible	(1) Inappropriate communication software (2) Use of non-recommended converter	(1) Check the software protocol for inappropriateness. (2) Check connection devices for abnormality.
No output provided (no turn-on)	(1) Control mode is set for READY. At factory shipment, the setting is RUN. (2) Target control operation is not set. At factory shipment, the setting is "reverse operation." (3) Too large a sensitivity value is set for the ON/OFF operation. At factory shipment, the setting is "1.0 °C." (4) The setting is "control stop" due to assignment of the function key for "control start/stop." (5) Setting value is set with incorrect decimal point position without noticing the position being shown as "0.0."	(1) Set the control mode to RUN in the setting mode of SET 4, item 5. Currently, display lamp is lighting as RDY, indicating the state of control stop. (2) Check the settings of "reverse operation (heating)" and "forward operation (cooling)." (3) Set an appropriate value for the adjustment sensitivity. (4) Have the state of control start by a single press of the FUNC key. (5) Check settings of the decimal point position and value.
No rise in temperature	(1) Target control operation is not set. At factory shipment, the setting is "reverse operation." (2) Heater is disconnected or deteriorated. (3) Insufficient capacity of heater. (4) Cooling is operating. (5) An overheat protector for a peripheral device is operating.	(1) Check the settings of "reverse operation (heating)" and "forward operation (cooling)." (2) Check the heater for disconnection or deterioration. Consider the use of heater disconnection alarm (option) to detect abnormality. (3) Check that the heater has a sufficient heating capacity. (4) Check the operation for cooling being effective. (5) Set the temperature setting of the overheat protector higher than that of this product.

Symptom	Description	Check item
Control unstable * Overshoot * Undershoot * Hunting	(1) ON/OFF control is selected. At factory shipment, the setting is PID control. ON/OFF control is set in the bank 1.	(1) Change the control type from ON/OFF control to PID control (self-tuning/auto-tuning) in the setting mode of SET 4, item 6. For self-tuning, turn on the power supplies for this product and load side simultaneously or for load side first.
	(2) Proportional cycle is long, compared to ascent/descent speed of temperature.	(2) Set the proportional cycle shorter. Controllability is better as the proportional cycle is shorter, however, take into account life of relays in case of the use of relay output.
	(3) PID constant is inappropriate.	(3) Change the PID constant. 1) Re-execute auto-tuning. 2) Manually set the PID constant.
No operation	(1) Control mode is set to READY.	(1) Set the control mode to RUN in the setting mode of SET 4, item 5. Currently, display lamp is lighting as RDY, indicating the state of control stop.
	(2) The setting is “control stop” due to assignment of the function key for “control start/stop.”	(2) Have the state of control start by a single press of the FUNC key.
Key ineffective	(1) Key lock is set.	(1) Check the setting of key lock in the key function setting mode of SET 3, item 6.
No event output is provided.	(1) Setting of each item for event output is inappropriate.	(1) Check settings related to the event output. 1) Target connection setting 2) Event function 1 setting 3) Event function 2 setting 4) Event function 3 setting 5) Event function 4 setting 6) Event delay timer 7) Event polarity setting
	(2) Event setting value is inappropriate.	(2) Check the event upper limit/lower limit value.
No loader communication possible	(1) Loader cable is not correctly connected. (2) Dedicated loader software is not appropriately installed. (3) Communication port does not fit the personal computer (PC).	(1) Check the loader cable connection. (2) Re-install the dedicated loader software. (3) Re-check the communication port on the PC and re-set the communication port on the software side.
Function key ineffective	(1) Key lock is set. (2) A pressing time is set for the function key.	(1) Check the setting of key lock in the key function setting mode of SET 3, item 6. (2) Check the pressing time of the function key in the function key function setting mode of SET 3, item 1.
No timer operation	(1) Timer stop is set in the DI function. (2) Target connection setting is inappropriate.	(1) Check the setting of DI, ON or OFF. (2) Check that the target connection of the target connection setting corresponds to timer.
No stop of event	(1) Hold function is set for the event function setting.	(1) Check that the Hold function is set for each event function setting.

7.5 Setting list

7.5.1 Run mode

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Present value (PV)		Sensor input designation range		°C		
Target value (SV)		SV limiter upper limit SV limiter lower limit	1200 0	°C		
Timer 1 monitor		01:00 ← on delay 01:00 ← off delay		Hour, minute and second		
Timer 2 monitor						
Timer 3 monitor						
Priority screen 1		SET 01 to SET 17	None	None		
Priority screen 2						
Priority screen 3						
Priority screen 4						
Priority screen 5						
Priority screen 6						
Priority screen 7						
Priority screen 8						
Priority screen 9						
Priority screen 10						
Priority screen 11						
Priority screen 12						
Priority screen 13						
Priority screen 14						
Priority screen 15						
Priority screen 16						

7.5.2 Input 1 setting mode (SET 01)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Input type	INP1	0: K thermocouple 1: J thermocouple 2: T thermocouple 3: E thermocouple 4: R thermocouple 5: S thermocouple 6: B thermocouple 7: N thermocouple 8: U thermocouple 9: L thermocouple 10: WRe5-26 11: PR40-20 12: PLII 13: Pt100 14: JPt100 15: 0 - 10 mVDC 16: 0 - 1 VDC 17: 0 - 5 VDC 18: 1 - 5 VDC 19: 0 - 10 VDC 20: 4 - 20 mADC	0			
Scaling upper limit	FSH1	FSL1 to 29999	10000	Digit		
Scaling lower limit	FSL1	-19999 to FSH1	-10000	Digit		
PV compensation function setting	PVF1	0: PV gain zero point compensation 1: PV X-Y2 point compensation	0			
PV compensation gain	PVG1	0.500 to 2.000	1.000	Times		
PV compensation zero	PVS1	Temperature: -999.9 to 999.9 -999 to 999 Analog: -9999 to 9999	0	°C Digit		
PV before-compensation lower limit value setting	PX1	Setting range: Setting range lower limit to (PX2 - 1°C) Setting range lower limit to (PX2 - 10 digits) Setting unit: 1°C or 0.1°C; 1 digit	0			
PV before-compensation upper limit value setting	PX2	Setting range: (PX1 + 1°C) to setting range upper limit (PX1 + 10 digits) to setting range upper limit Setting unit: 1°C or 0.1°C; 1 digit	1200			
PV after-compensation lower limit value setting	PY1	Setting range: Setting range lower limit to (PY2 - 1°C) Setting range lower limit to (PY2 - 10 digits) Setting unit: 1°C or 0.1°C; 1 digit	0			
PV after-compensation upper limit value setting	PY2	Setting range: (PY1 + 1°C) to setting range upper limit (PY1 + 10 digits) to setting range upper limit Setting unit: 1°C or 0.1°C; 1 digit	1200			
Input filter	PdF1	0.0 to 99.9	0.0	second		
Decimal point position	dP1	Temperature: 0/0.0 Analog: 0/0.0/0.00 0.000/0.0000	0	°C Digit		
Unit of temperature		°C, °F	°C			

Note The characters (PVF1, PX1, PX2, PY1 and PY2) are selectable only on Ver3.xx or later.

7.5.3 Input 2 setting mode (SET 02)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Input type	INP2	16: 0 - 1 VDC 17: 0 - 5 VDC 18: 1 - 5 VDC 19: 0 - 10 VDC 20: 4 - 20 mADC	18	None		
Scaling upper limit	FSH2	**FSL 2** to SV setting range upper limit	1200			
Scaling lower limit	FSL2	SV setting range lower limit to **FSH 2**	0			
PV compensation gain	PVG2	0.500 to 2.000	1.000	Times		
PV compensation zero	PVS2	-999 to 999	0	Digit		
PV filter	PdF2	0.0 to 99.9	0.0	Second		
Local/remote switchover	LR	0: Local 1: Remote 1 (Scaled with SLL , SLH) 2: Remote 2 (Scaled with FSL 2, FSH 2)	0	None		

7.5.4 Key function setting mode (SET 03)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Function key 1 function Function key 2 function Function key 3 function Function key 4 function Function key 5 function	FU1 to FU5	*0: No function *1: Digit shift *2: Control mode (MD)/control stop (RDY) *3: AT start/AT stop *4: Timer start/stop *5: Screen reverse feed *6: ENT *7: Bank switchover *8: AUTO/MANUAL *9: SV/MV screen switchover *A: Constant value run mode/ Program mode switchover *1 *B: Step feed *1 *C: Pause *1 *d: SET 22 call-up function *1	0.0	None		
		0*: None 1*: Pressing time of 1 second 2*: Pressing time of 2 seconds 3*: Pressing time of 3 seconds 4*: Pressing time of 4 seconds 5*: Pressing time of 5 seconds		Second		
Key lock	LoC	0: Lock OFF 1: Lock all 2: Lock of run mode 3: Lock of other than run mode 4: Lock all (only during a run) *1 5: Lock of run mode (only during a run) *1 6: Lock of other than run mode (only during a run) *1 7: Lock of parameter mode (only during a run) *1	0	None		

*1: Selectable only on Ver3.xx or later

7.5.5 Control setting mode (SET 04) (1/4)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Bank switchover	bANK	0: Bank 0 1: Bank 1 2: Bank 2 3: Bank 3 4: Bank 4 5: Bank 5 6: Bank 6 7: Bank 7	0	None		
Bank upper limit setting	bANKH	0 to 7	7	None		
Control setting	SV	SLL to SLH	0	°C		
SV limiter upper limit	SLH	Temperature: (SLL + 5.0) to SV setting range upper limit (SLL + 5) to SV setting range upper limit Analog: (SLL + 50) to SV setting range upper limit	1200	°C Digit		
SV limiter lower limit	SLL	Temperature: SV setting range lower limit to (SLH - 5.0) SV setting range lower limit to (SLH - 5) Analog: SV setting range lower limit to (SLH - 50)	0	°C Digit		
Control mode	Md	RDY: Control stop RUN: Control start MAN: Manual TIME 1: Timer 1 operation TIME 2: Timer 2 operation TIME 3: Timer 3 operation	RUN	None		
Control type	CNt	0: Primary nonexistent Secondary nonexistent 1: Primary PID control Secondary nonexistent 2: Primary ON/OFF control Secondary nonexistent 3: Primary PID control Secondary PID control 4: Primary PID control Secondary ON/OFF control 5: Primary ON/OFF control Secondary ON/OFF control 6: Primary position proportional Secondary position proportional	1	None		

7.5.5 Control setting mode (SET 04) (2/4)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
PID control type	tYP	0: Type A (normal PID) 1: Type B (overshoot suppression) 2: Type C (disturbance suppression)	1	None		
Type B mode (overshoot suppression)	bMd	0: Moderate 1: Intermediate 2: Intense	1	None		
Forward operation/reverse operation	dIR	0: Reverse operation 1: Forward operation	0	None		
Primary control operating amount	MV1	MLL1 to MLH1	0.0	%		
Primary control output gain	MV1G	0.0 to 1000.0	100.0	%		
Tuning type	tUN	1: Primary auto-tuning 2: Primary self-tuning 3: Secondary auto-tuning (at primary PID/secondary PID) 4: Secondary self-tuning (at primary PID/secondary PID) 5: Primary/secondary auto-tuning (at primary PID/secondary PID)	1	None		
Auto-tuning coefficient	AtG	0.1 to 10.0	1.0	Times		
Auto-tuning sensitivity	AtC	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	2	°C Digit		
Auto-tuning start	At	Start/stop with the ▲/▼ key PV/SV displayed during AT	OFF	None		
Proportional band	P1	0.1 to 200.0	3.0	%		
Integral time	I	0 to 3600	0	Second		
Derivative time	d	0 to 3600	0	Second		
Primary control proportional cycle	t1	0.1 to 120.0	20.0 (relay) 1.0 (SSR)	Second		
Anti-reset windup	ARW	0.0 to 110.0 (Function turned off at 110.0)	110.0	%		
Primary control operating amount limiter upper limit	MLH1	Digital output: MLL to 100.0 Analog output: MLL to 110.0	100.0	%		
Primary control operating amount limiter lower limit	MLL1	Digital output: 0.0 to MLH1 Analog output: -10.0 to MLH1	0.0	%		

7.5.5 Control setting mode (SET 04) (3/4)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Primary control operating amount change limiter ascent	oU1	0.0 to 549.9	0.0	%		
Primary control operating amount change limiter descent	od1	0.0 to 549.9	0.0	%		
Primary control soft-start output	SFM	MLL1 to MLH1	100.0	%		
Primary control soft-start time	SFT	00:00 to 499:59 Function turned off with 00:00 (second) setting	000:00	Second		
Primary control at-abnormality operating amount	FAL1	Digital output: 0.0 to 100.0 Analog output: -10.0 to 110.0	0.0	%		
Primary control loop anomaly PV threshold	tS1	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	0	°C Digit		
Primary control loop anomaly MV threshold	MS1	MLL1 to LH1	100.0	%		
Primary control loop anomaly PV change threshold	PS1	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	0	°C Digit		
Primary control loop abnormality time	LoP1	0 to 9999	0	Second		
Primary control off-point position selection	CMod	0: SV unit setting 1: Upper 2: Middle 3: Lower	0	None		
Primary control sensitivity setting	C1	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	1	Digit		
Primary control off-point position	CP1	Temperature: -999.9 to 999.9 -999 to 999 Analog: -9999 to 9999	0	°C Digit		
Primary control protection off timer	Fdt1	0 to 99	0	Minute		
Primary control protection on timer	Ndt1	0 to 99	0	Minute		
Secondary control operating amount	MV2	MLL2 to MLH2	0.0	%		
Secondary control output gain	MV2G	0.0 to 100.0	100.0	%		
Secondary control proportional band	P2	0.10 to 10.0	1.00	Times		
Secondary control proportional cycle	t2	0.1 to 120.0	20.0	Second		
Secondary control operating amount limiter upper limit	MLH2	Digital output: MLL2 to 100.0 Analog output: MLL2 to 110.0	100.0	%		
Secondary control operating amount limiter lower limit	MLL2	Digital output: 0.0 to MLH2 Analog output: -10.0 to MLH2	0.0	%		
Secondary control operating amount change limiter ascent	oU2	0.0 to 549.9	0.0	%		
Secondary control operating amount change limiter descent	od2	0.0 to 549.9	0.0	%		

Note (Ndt1) is selectable only on Ver3.xx or later.

7.5.5 Control setting mode (SET 04) (4/4)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Secondary control at-abnormality operating amount	FAL2	Digital output: 0.0 to 100.0 Analog output: -10.0 to 110.0	0.0	%		
Secondary control loop anomaly PV threshold	tS2	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	0	°C Digit		
Secondary control loop anomaly MV threshold	MS2	MLL2 to MLH2	100.0	%		
Secondary control loop anomaly PV change threshold	PS2	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	0	°C Digit		
Secondary control loop abnormality time	LoP2	0 to 9999	0	Second		
Secondary control sensitivity	C2	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	0	°C Digit		
Secondary control off-point position	CP2	Temperature: -999.9 to 999.9 -999 to 999 Analog: -9999 to 9999	0	°C Digit		
Secondary control off protection timer	Fdt2	0 to 99	0	Minute		
Secondary control protection on timer	Ndt2	0 to 99	0	Minute		
Manual reset	Pbb	0.1 to 100.0	0.0	%		
Dead band	db	Temperature: -999.9 to 999.9 -999 to 999 Analog: -9999 to 9999	0	°C Digit		
Ramp time	RMP	Temperature: 0.0 to 999.9 Analog: 0 to 9999	0.0	°C/minute Digit /minute		
Valve motor stroke time	VLt	0.1 to 999.9	3.0	Second		
Valve motor drive dead band	Vdb	0.0 to 100.0	1.0	%		
Post-AT initial opening ratio	ASP	0.0 to 100.0	50.0	%		

Note (Ndt2) is selectable only on Ver3.xx or later.

Note The (RMP) function will turn OFF at setting value "0" or "0.0".

7.5.6 OUT 1 and 2 setting modes (SET 05 and 06) (1/3)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Target connection	o1F o2F	0: Primary output 1: Secondary output 2: Event output 3: RUN output 4: RDY output 5: Timer 1 output 6: Timer 1 during-on-delay output 7: Timer 1 during-off-delay output 8: Timer 1 during-[on + off]-delay output 9: Timer 2 output 10: Timer 2 during-on-delay output 11: Timer 2 during-off-delay output 12: Timer 2 during-[on + off]-delay output 13. Timer 3 output 14: Timer 3 during-on-delay output 15: Timer 3 during-off-delay output 16: Timer 3 during-[on + off]-delay output 17: Transmission output 18: End output *1	OUT1: 0 OUT2: 2	None		
Event function 1	E1F1 E2F1	Function **0: None **1: Deviation upper and lower limits **2: Deviation upper limit **3: Deviation lower limit **4: Deviation range **5: Absolute value upper and lower limits **6: Absolute value upper limit **7: Absolute value lower limit **8: Absolute value range Add-on function *0*: None *1*: Hold *2*: Standby *3*: Delay *4*: Hold + standby *5*: Hold + delay *6*: Standby + delay *7*: Hold + standby + delay Control mode interlocking function 0**: All modes 1**: RUN/MAN mode only 2**: RUN mode only	000	None		
Event upper limit	E1H E2H	Temperature: -1999.9 to 2999.9 -19999 to 2999 Note that, for thermocouples R, S and B, the value of WRe 5-26 or PR 40-20 is -1999 to 9999. Analog: -19999 to 29999	0	°C Digit		

*1: Selectable only on Ver3.xx or later.

7.5.6 OUT 1 and 2 setting modes (SET 05 and 06) (2/3)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Event lower limit	E1L E2L	Temperature: -1999.9 to 2999.9 -19999 to 2999 Note that, for thermocouples R, S and B, the value of WRe 5-26 or PR 40-20 is -1999 to 9999. Analog: -19999 to 29999	0	°C Digit		
Event sensitivity	E1C E2C	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to9999	0	°C Digit		
Event delay timer	E1t E2t	0 to 9999	0	Second		
Event function 2 (PV abnormality)	E1F2 E2F2	Function **0: Nonexistent **1: Existent Add-on function *0*: None *1*: Hold *2*: Delay *3*: Hold + delay Control mode interlocking function 0**: All modes 1**: RUN/MAN mode only 2**: RUN mode only	000	None		
Event function 3 (CT abnormality)	E1F3 E2F3	Function **0: Nonexistent **1: CT 1 abnormality **2: CT 2 abnormality **3: CT 1 abnormality + CT 2 abnormality Add-on function *0*: Nonexistent *1*: Hold *2*: Delay *3*: Hold + delay Control mode interlocking function 0**: All modes 1**: RUN/MAN mode only 2**: RUN mode only	000	None		
Event function 4 (loop abnormality)	E1F4 E2F4	Function *0: Nonexistent *1: Existent Add-on function 0*: Nonexistent 1*: Hold	00	None		
Event polarity	E1P E2P	0: Normal open 1: Normal close	00	None		

7.5.6 OUT 1 and 2 setting modes (SET 05 and 06) (3/3)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Transmission output function	tRN1 tRN2	Transmission content *1: PV (Measurement value) *2: SV (Setting value) *3: MV 1 (Primary control operating amount) *4: MV 2 (Secondary control operating amount) *5: Control SV (Setting value) output *1 Forward/reverse operation 0*: Forward operation 1*: Reverse operation	00	None		
Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Transmission scaling upper limit	tRH1 tRH2	Temperature: tRL* to 2999.9 tRL* to 2999 Note that, for thermocouples R, S and B, the value of WRe 5-26 or PR 40-20 is tRL* to 9999. Analog: tRL* to 29999	1200	°C Digit		
Transmissions scaling lower limit	tRL1 tRL2	Temperature: -1999.9 to tRH* -1999 to tRH* Analog: -19999 to tRH*	0	°C Digit		

*1: Selectable only on Ver3.xx or later.

7.5.7 OUT 3 to 7 setting modes (SET 07, 08, 09, 10 and 11) (1/2)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Target connection	o3F o4F o5F o6F o7F	0: Primary output 1: Secondary output 2: Event output 3: RUN output 4: RDY output 5: Timer 1 output 6: Timer 1 during-on-delay output 7: Timer 1 during-off-delay output 8: Timer 1 during-[on + off]-delay output 9: Timer 2 output 10: Timer 2 during-on-delay output 11: Timer 2 during-off-delay output 12: Timer 2 during-[on + off]-delay output 13. Timer 3 output 14: Timer 3 during-on-delay output 15: Timer 3 during-off-delay output 16: Timer 3 during-[on + off]-delay output 18: End output *1	2	None		
Event function 1	o3F o4F o5F o6F o7F	Function **0: None **1: Deviation upper and lower limits **2: Deviation upper limit **3: Deviation lower limit **4: Deviation range **5: Absolute value upper and lower limits **6: Absolute value upper limit **7: Absolute value lower limit **8: Absolute value range Add-on function *0*: None *1*: Hold *2*: Standby *3*: Delay *4*: Hold + standby *5*: Hold + delay *6*: Standby + delay *7*: Hold + standby + delay Control mode interlocking function 0**: All modes 1**: RUN/MAN mode only 2**: RUN mode only	000	None		
Event upper limit	E3H E4H E5H E6H E7H	Temperature: -1999.9 to 2999.9 -19999 to 2999 Note that, for thermocouples R, S and B, the value of WRe 5-26 or PR 40-20 is -1999 to 9999. Analog: -19999 to 29999	0	°C Digit		

*1: Selectable only on Ver3.xx or later.

7.5.7 OUT 3 to 7 setting modes (SET 07, 08, 09, 10 and 11) (2/2)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Event lower limit	E3L E4L E5L E6L E7L	Temperature: -1999.9 to 2999.9 -1999 to 2999 Note that, for thermocouples R, S and B, the value of WRe 5-26 or PR 40-20 is -1999 to 9999. Analog: -19999 to 29999	0	°C Digit		
Event sensitivity	E3C E4C E5C E6C E7C	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999	0	°C Digit		
Event delay timer	E3t E4t E5t E6t E7t	0 to 9999	0	Second		
Event function 2 (PV abnormality)	E3F2 E4F2 E5F2 E6F2 E7F2	Function **0: Nonexistent **1: Existent Add-on function *0*: None *1*: Hold *2*: Delay *3*: Hold + delay Control mode interlocking function 0**: All modes 1**: RUN/MAN mode only 2**: RUN mode only	000	None		
Event function 3 (CT abnormality)	E3F3 E4F3 E5F3 E6F3 E7F3	Function **0: Nonexistent **1: CT 1 abnormality **2: CT 2 abnormality **3: CT 1 abnormality + CT 2 abnormality Add-on function *0*: Nonexistent *1*: Hold *2*: Delay *3*: Hold + delay Control mode interlocking function 0**: All modes 1**: RUN/MAN mode only 2**: RUN mode only	000	None		
Event function 4 (loop abnormality)	E3F3 E4F3 E5F3 E6F3 E7F3	Function *0: Nonexistent *1: Existent Add-on function 0*: Nonexistent 1*: Hold	00	None		
Event polarity	E3P E4P E5P E6P E7P	0: Normal open 1: Normal close	00	None		

7.5.8 CT setting mode (SET 12)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
CT 1 target connection	CI1	1: Connected to OUT 1 2: Connected to OUT 2 3: Connected to OUT 3 4: Connected to OUT 4 5: Connected to OUT 5 6: Connected to OUT 6 7: Connected to OUT 7	1	None		
CT 1 current value monitor	CM1	0.0 to 50.0		A		
CT 1 abnormal current value setting	Ct1	0.0 to 30.0 (Turned off with 0.0)	0.0	A		
CT 2 target connection	CI2	1: Connected to OUT 1 2: Connected to OUT 2 3: Connected to OUT 3 4: Connected to OUT 4 5: Connected to OUT 5 6: Connected to OUT 6 7: Connected to OUT 7	1	None		
CT 2 current value monitor	CM2	0.0 to 50.0		A		
CT 2 abnormal current value setting	Ct2	0.0 to 30.0 (Turned off with 0.0)	0.0	A		

7.5.9 DI setting mode (SET 13)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
DI function	dIF	※, ★, ☆ and ◎ ◎: DI 1 setting ☆: DI 2 setting ★: DI 3 setting ※: DI 4 setting	0000	None		

DI content (function) assignment table

		Active
0	None	None
1	Bank switchover	Bank switcher
2	MD	READY
3	AUTO	MANUAL
4	Reverse operation	Forward operation
5	AT stop	AT start
6	Timer stop	Timer start
7	Constant value run mode	Program run mode *1
8		Step feed *1
9		Pause *1
A		Interlock *1

*1: Selectable only on Ver3.xx or later.

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
DI polarity	dIP	※, ★, ☆ and ◎ ◎: DI 1 setting ☆: DI 2 setting ★: DI 3 setting ※: DI 4 setting Function assignment 0: Close active 1: Open active	0000	None		

7.5.10 Timer 1 to 3 setting modes (SET 14, 15 and 16)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Timer function	tMF1 tMF2 tMF3	1: Auto-start 2: Manual start 3: SV start 4: DI 1 start 5: DI 2 start 6: DI 3 start 7: DI 4 start 8: Event 1 start 9: Event 2 start 10: Event 3 start 11: Event 4 start 12: Event 5 start 13: Event 6 start 14: Event 7 start 15: Step start *1 16: Soak start *1	1	None		
Unit	H/M1 H/M2 H/M3	1: Hour/minute 2: Minute/second	1	Hour/ minute/ second		
Start SV permissible range	tSV1 tSV2 tSV3	Temperature: 0.0 to 999.9 0 to 999 Analog: 0 to 9999		°C Digit		
ON delay timer	oNT1 oNT2 oNT3	0:00 to 99:59	0:00	Hour/ minute/ second		
OFF delay timer	oFt1 oFt2 oFt3	0:00 to 99:59	0:00	Hour/ minute/ second		
Repeat count	RUN1 RUN2 RUN3	0 - 99 (infinite with 0)	1	Count		
Remaining time monitor	tIA1 tIA2 tIA3	0:00 - 99:59 Start/stop with the ▲/▼ key	0:00	Hour/ minute/ second		

*1: Selectable only on Ver3.xx or later.

7.5.11 Communication setting mode (SET 17)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Communication protocol	PRt	0: TOHO 1: MODBUS (RTU) 2: MODBUD (ASCII)	0	None		
Communication parameter	CoM	***1: 1 bit ***2: 2 bits **N*: Nonexistent **o*: Odd No. **E*: Even No. *7**: 7 bits*2 *8**: 8 bits N***: Without BCC *3 b***: With BCC *3 Caution: For MODBUS (RTU), only 8N1, 8N2, 8o1, 8o2, 8E1 and 8E2 are settable. For MODBUS (ASCII), only 7N1, 7N2, 7o1, 7o2, 7E1, 7E2, 8N1, 8N2, 8o1, 8o2, 8E1 and 8E2 are settable.	b8N2	None		
Communication speed	bPS	2.4: 2400 4.8: 4800 9.6: 9600 19.2: 19200 38.4: 38400	9.6	bps		
Communication address	AdR	TOHO: 1 to 99 MODBUS: 1 to 247	1	Station		
Response delay time in communication	AWt	0 to 250	0	ms		
Communication switchover	Mod	0: Write inhibit 1: Writable 2: Concurrent temperature ascent master 3: Concurrent temperature ascent slave	1			

*2: “Modbus (RTU)” should not be set.
*3: Only TOHO protocol can be set.

7.5.12 Initial setting mode (SET 18)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Password cancel screen	PASS (Blinking)	0000 to 9999 Change the 4-digit value and press the MODE key for release.	0000	None		
PV normal state display color	NdSP	0: Green	0	None		
PV auto color display low	AdSL	1: Red	1			
PV auto color display middle	AdSM	2: Orange	0			
PV auto color display high	AdSH	3: Auto (only NdSP)	2			
PV display color switchover	PVC	Thermocouple/resistance temperature detector input 0.0 to 999.9 (°C) 0 to 999 (°C)	1	°C		
		Voltage/current input 0 to 9999 (digit)		Digit		
PV at-event display color	E1dSP	0: Green	2	None		
PV at-abnormality display color	E2dSP	1: Red	1			
CT at-abnormality display color	E3dSP	2: Orange	1			
Loop at-abnormality display color	E4dSP		0			
Blind function effective/ineffective	bLd	0: Function existent 1: Function nonexixtent	0	None		
Setting value backup	bKUP	Backup begins by pressing the FUNC key for 2 seconds. "**SAVE**" is displayed during backup; terminated light indicates completed backup.		None		
Setting value initialization	RESEt	0: At-factory-shipment setting 1: Backup setting Initialization begins by pressing the FUNC key for 2 seconds. "**INIt**" is displayed during initialization: terminated light indicates completed initialization.	0	None		
Password setting	PASS (Lighting)	0000 to 9999 After a 4-digit numerical value is changed, pressing the FUNC key for 2 seconds confirms or cancels the change.	0000	None		

7.5.13 Priority screen setting mode (SET 19)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Priority screen 01	PRI01	Parameters for SET 01 to SET 17	OFF	None		
Priority screen 02	PRI02		OFF			
Priority screen 03	PRI03		OFF			
Priority screen 04	PRI04		OFF			
Priority screen 05	PRI05		OFF			
Priority screen 06	PRI06		OFF			
Priority screen 07	PRI07		OFF			
Priority screen 08	PRI08		OFF			
Priority screen 09	PRI09		OFF			
Priority screen 10	PRI10		OFF			
Priority screen 11	PRI11		OFF			
Priority screen 12	PRI12		OFF			
Priority screen 13	PRI13		OFF			
Priority screen 14	PRI14		OFF			
Priority screen 15	PRI15		OFF			
Priority screen 16	PRI16		OFF			

7.5.14 Bank setting mode (SET 20)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Bank selection 01	bNK01	Parameters for SET 01 to SET 17	cNT	None		
Bank selection 02	bNK02		OFF			
Bank selection 03	bNK03		OFF			
Bank selection 04	bNK04		OFF			
Bank selection 05	bNK05		OFF			
Bank selection 06	bNK06		OFF			
Bank selection 07	bNK07		OFF			
Bank selection 08	bNK08		OFF			
Bank selection 09	bNK09		OFF			
Bank selection 10	bNK10		OFF			
Bank selection 11	bNK11		OFF			
Bank selection 12	bNK12		OFF			
Bank selection 13	bNK13		OFF			
Bank selection 14	bNK14		OFF			
Bank selection 15	bNK15		OFF			
Bank selection 16	bNK16		OFF			

7.5.15 Program function setting mode (SET 21)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Operating type setting	C/P	0: Constant value run mode 1: Program run mode	0	None		
Program mode setting	PGMd	0: Program mode 1 (without power failure compensation) 1: Program mode 2 (without power failure compensation) 2: Program mode 1 (with power failure compensation) 3: Program mode 2 (with power failure compensation) Program 1: Control stops after a run ends. Program 2: Control continues after a run ends.	0	None		
Power failure compensation range setting	PoC	Setting value range Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C) Voltage/current input **0 to 9999** (digit) If the setting is 0, the power failure is always restored.	0	°C Digit		
Time unit setting	H/MP	0: Step time (hour; minute) 1: Soak time 1 (hour; minute) 2: Soak time 2 (hour; minute) 3: Step time (minute; second) 4: Soak time 1 (minute; second) 5: Soak time 2 (minute; second) Step time: To the next step after predetermined time elapses Soak time 1: Counted with a falling-in within the set WAIT range Soak time 2: Counted only in the set WAIT range	0	None		
WAIT range setting	WAIt	Setting value range Thermocouple/resistance temperature detector input **0.0 to 999.9** (°C) **0 to 999** (°C) Voltage/current input **0 to 9999** (digit) If “0” is set for Soak time 2, then operation is for Soak time 1.	2	None		

Note SET 21 is selectable only on Ver3.xx or later.

7.5.16 Program setting mode (SET 22)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Number-of-use-step setting	StEPN	Setting value range n = 1 to 8	8	None		
Step designation bank setting	St*bK	Setting value range St*BK = 0 to 7 **"*" = 1 to (StEPN setting value)**	0	None		
Step SV setting	SV*	Setting value range SV* = SLL to SLH **"*" = 1 to (StEPN setting value)** * If SLL and SLH are set in a bank, the values of SLL and SLH are set for each bank.	0	°C Digit		
Step time setting	tIM*	Setting value range TIM* = 00:00 to 99:59 **"*" = 1 to (StEPN setting value)**	0.00	Hour, minute and second		
Repetitive start step setting	StRSt	Setting value range 1 to repetitive end step setting (ENdSt)	1	None		
Repetitive end step setting	ENdSt	Setting value range Repetitive start step setting (StRSt StRSt) to the number-of-use-step setting or StEPN * If a setting is made with StEPN, the value set in the number-of-use-step setting becomes "repetitive end step setting."	StEPN	None		
Repetitive count setting	RUNP	Setting value range RUNP = 0 to 9999 RUNP = 0: **Unlimited count**	1	Times		

Note SET 22 is selectable only on Ver3.xx or later.

7.5.17 Bank automatic switching function setting mode (SET 23)

Setting data	Character	Setting (monitor) value	Initial value	Unit	Setting value	Blind
Bank automatic switching function selection	bAF	0: Bank automatic switching run OFF 1: Bank automatic switching run ON * With “Bank automatic switching run ON” setting: - Bank switching setting by using the FUNC key is ineffective. - Bank switching setting by using DI is ineffective. ▲/▼ key operation is not also allowed. * When SET 04 bANKH = 0, the setting is neither effective nor displayed.	0	None		
Bank automatic switching source setting	bAS	Function: *0: Selects a SV value. *1: Selects a ramp SV value. *2: Selects a PV value. Control mode interlock function: 0*: All modes 1*: Only RUN/MAN mode 2*: Only RUN mode * Selects a source for the SV value for performing auto bank switching. * When SET 04 bANKH = 0, the setting is neither effective nor displayed.	0.0	None		
Zone threshold setting	PM*	SLL to SLH * Sets a threshold for bank automatic switching of [“*” = 1 to 7] (example of 8 banks). * When SET 04 bANKH = 0, the setting is neither effective nor displayed.	1200	°C Digit		
Zone threshold sensitivity range setting	ASC	During temperature input 0 to 999 (0.0 to 999.9) (°C) During analog input 0 to 9999 (digit) * Sets a sensitivity setting for a threshold for performing bank automatic switching. None is displayed if bAF = 0 (OFF) and bAS = *0 or *1 and SET 02 LR = 0. * When SET 04 bANKH = 0, the setting is neither effective nor displayed.	0	°C Digit		

Note SET 23 is selectable only on Ver3.xx or later.