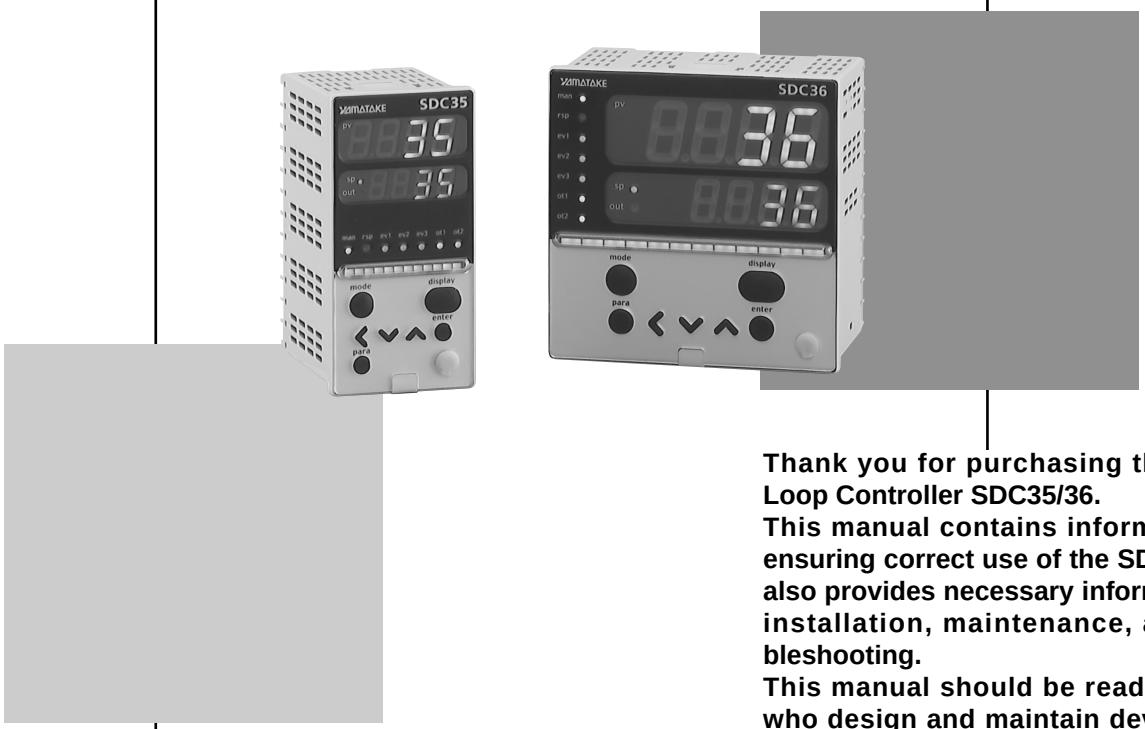
No. CP-SP-1150E

Single Loop Controller SDC35/36

User's Manual

"Installation & Configurations"



Thank you for purchasing the Single Loop Controller SDC35/36.
This manual contains information for ensuring correct use of the SDC35/36. It also provides necessary information for installation, maintenance, and troubleshooting.
This manual should be read by those who design and maintain devices that use the SDC35/36.
Be sure to keep this manual nearby for handy reference.

Yamatake Corporation

RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment.
Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical machines
- Aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

REQUEST

Ensure that this User's Manual is handed over to the user before the product is used.

Copying or duplicating this User's Manual in part or in whole is forbidden. The information and specifications in this User's Manual are subject to change without notice.

Considerable effort has been made to ensure that this User's Manual is free from inaccuracies and omissions.
If you should find any inaccuracies or omissions, please contact Yamatake Corporation.

In no event is Yamatake Corporation liable to anyone for any indirect, special or consequential damages as a result of using this product.

SAFETY REQUIREMENTS

To reduce risk of electric shock which could cause personal injury, follow all safety notices in this documentation.

This symbol warns the user of a potential shock hazard where hazardous live voltages may be accessible.

- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment must be impaired.
- Do not replace any component (or part) not explicitly specified as replaceable by your supplier.
- All wiring must be in accordance with local norms and carried out by authorized and experienced personnel.
- A switch in the main supply is required near the equipment.
- Main power supply wiring requires a (T) 500mA, 250V fuse(s) (IEC 127).

EQUIPMENT RATINGS

Supply voltages:	100 to 240Vac (operating power supply voltage 85 to 264Vac)
Frequency:	50/60Hz
Power consumption:	12VA maximum

EQUIPMENT CONDITIONS

Do not operate the instrument in the presence of flammable liquids or vapors.
Operation of any electrical instrument in such an environment constitutes a safety hazard.

Temperature:	0 to 50˚C
Humidity:	10 to 90%RH (non-condensing)
Vibration:	$2m/s^2$ (10 to 60Hz)
Over-voltage category:	Category II (IEC60364-4-443, EN60664-1)
Pollution degree:	Pollution degree 2

EQUIPMENT INSTALLATION

The controller must be mounted into a panel to limit operator access to the rear terminal.
Specifications of common mode voltage: The common mode voltages of all I/O except for main supply are less than 33Vrms, 46.7V peak and 70Vdc.

APPLICABLE STANDARDS

EN61010-1, EN61326

SAFETY PRECAUTIONS

■ About Icons

Safety precautions are for ensuring safe and correct use of this product, and for preventing injury to the operator and other people or damage to property. You must observe these safety precautions. The safety precautions described in this manual are indicated by various icons.
As the following describes the icons and their meanings, be sure to read and understand the descriptions before reading this manual:

⚠**WARNING**	Warnings are indicated when mishandling this product might result in death or serious injury to the user.
⚠**CAUTION**	Cautions are indicated when mishandling this product might result in minor injury to the user, or only physical damage to this product.

■ Examples

	Triangles warn the user of a possible danger that may be caused by wrongful operation or misuse of this product. These icons graphically represent the actual danger. (The example on the left warns the user of the danger of electric shock.)
	White circles with a diagonal bar notify the user that specific actions are prohibited to prevent possible danger. These icons graphically represent the actual prohibited action. (The example on the left notifies the user that disassembly is prohibited.)
	Black filled-in circles instruct the user to carry out a specific obligatory action to prevent possible danger. These icons graphically represent the actual action to be carried out. (The example on the left instructs the user to remove the plug from the outlet.)

⚠WARNING

	**Do not disassemble the SDC35/36.** **Doing so might cause electric shock or faulty operation.**
	**Before wiring, or removing/mounting the SDC35/36, be sure to turn the power OFF.** **Failure to do so might cause electric shock.**
	**Do not touch electrically charged parts such as the power terminals.** **Doing so might cause electric shock.**

⚠CAUTION

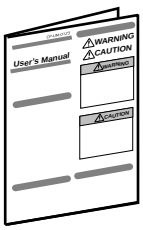
	**Use the SDC35/36 within the operating ranges recommended in the specifications (temperature, humidity, voltage, vibration, shock, mounting direction, atmosphere, etc.).**
	**Do not block ventilation holes.** **Doing so might cause fire or faulty operation.**
	**Wire the SDC35/36 properly according to predetermined standards. Also wire the SDC35/36 using specified power leads according to recognized installation methods.** **Failure to do so might cause electric shock, fire or faulty operation.**
	**Do not allow lead clippings, chips or water to enter the controller case.** **Doing so might cause fire or faulty operation.**
	**Firmly tighten the terminal screws with the specified torque as listed in the specifications.** **Insufficient tightening of terminal screws might cause electric shock or fire.**
	**Do not use unused/spare terminals on the SDC35/36 as transit terminals.** **Doing so might cause electric shock, fire, or faulty operation.**
	**We recommend attaching the terminal cover (sold separately) after wiring the SDC35/36.** **Failure to do so might cause electric shock, fire, or faulty operation.**
	**Use the relays within the recommended life.** **Failure to do so might cause fire or faulty operation.**
	**Use Yamatake Corporation's "SURGENON" if there is the risk of power surges caused by lightning.** **Lightning power surges might cause fire or faulty operation.**
	**Do not make incorrect connections. If the cables are connected incorrectly, this might cause the unit to malfunction.**
	**The controller requires 6 seconds to stabilize after power ON. Great care should be taken when the relay output from the controller is used as interlock signals.**

⚠CAUTION

	**The part between the control output 1 and control output 2 is not isolated. When necessary, use an appropriate isolator.**
	**Do not connect multiple loader cables to multiple units from one personal computer. The current coming from other circuits might cause the PV value indication error to occur.**
	**Do not connect any terminating resistor to both ends of the communication path when performing the RS-485 wiring. Doing so might cause the communication to fail.**
	**Always mount a switch for shut-down of the main power of this unit in an easily accessible area of the operator when performing electric wiring of this unit. Additionally, connect a slow-action type (T) fuse having a rated current of 0.5A and rated voltage of 250V to the wiring for the instrument power supply of the AC power supply model. (IEC127)**
	**Do not operate the key with a pencil or sharp-tipped object. Doing so might cause faulty operation.**

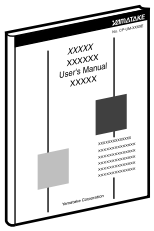
The Role of This Manual

Three manuals are available for the Single Loop Controller SDC35/36 (hereafter referred to as "this unit"). Read appropriate manuals according to your requirements. If you do not have your required manual, contact Yamatake Corporation or its dealer.
Additionally, you can download necessary manuals from "http://www.yamatake.com".



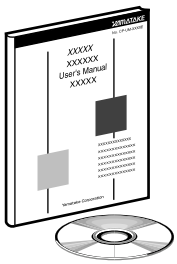
Single Loop Controller SDC35/36 User's Manual "Installation"
Manual No. CP-UM-5289E

This manual is supplied with the product. Personnel in charge of design and/or manufacture of a system using this unit must thoroughly read this manual. This manual describes the safety precautions, installation, wiring, list of parameters, and primary specifications. For further information about operation, refer to another manual, "Installation & Configurations".



Single Loop Controller SDC35/36 User's Manual "Installation & Configurations" **Manual No. CP-SP-1150E**

This manual. This manual is optional (sold separately). The manual describes the hardware and all functions of this unit. Personnel in charge of design, manufacture, operation, and/or maintenance of a system using this unit and those in charge of communication software of a system using the communication functions of this unit must thoroughly read this manual. This manual also describes the installation, wiring, connections for communication, all functions and settings of this unit, operating procedures, communication with host station, such as personal computer, communication addresses, troubleshooting, and detailed specifications.



Smart Loader Package SLP-C35 for Single Loop Controller SDC15/25/26/35/36 User's Manual **Manual No. CP-UM-5290E**

This manual is supplied with the Smart Loader Package. The manual describes the software used to make various settings for SDC15/25/26/35/36 using a personal computer. Personnel in charge of design or setting of a system using SDC15/25/26/35/36 must thoroughly read this manual. The manual describes installation of the software into a personal computer, operation of the personal computer, various functions, and setup procedures.

Organization of This User's Manual

This manual is organized as follows:

Chapter 1. OVERVIEW

This chapter describes the applications, features, model selection guide, and part names and functions of this unit. Since the part names described in this chapter are used in the subsequent descriptions, the part names and functions of this unit must be understood correctly in this chapter.

Chapter 2. OUTLINE OF FUNCTIONS

This chapter describes the outline and operation flow of the functions of this unit.

Chapter 3. INSTALLATION

This chapter describes the environmental conditions, installation dimensions, installation procedures, and necessary tools when installing this unit.

Chapter 4. WIRING

This chapter describes the wiring procedures, wiring precautions, and connection examples.

Chapter 5. DETAILED DESCRIPTION OF EACH FUNCTION

This chapter describes each function of this unit in detail.

Chapter 6. LIST OF DISPLAYS AND SETTING DATA

This chapter lists up the display items of this unit and their contents.

Chapter 7. CPL COMMUNICATION FUNCTION

This chapter describes how to communicate this unit with a host unit, such as a personal computer or PLC through Yamatake's standard CPL communication using RS-485.

Chapter 8. MODBUS COMMUNICATION FUNCTION

This chapter describes how to communicate this unit with a host unit, such as a personal computer or PLC through MODBUS communication.

Chapter 9. LIST OF COMMUNICATION DATA

This chapter shows the list of communication data inside the memory of this unit.

Chapter 10. MAINTENANCE AND TROUBLESHOOTING

This chapter describes the maintenance and inspection of this unit, as well as troubleshooting.

Chapter 11. CALIBRATION

This chapter describes how to calibrate this unit in order to keep the accuracy and to safely operate this unit for an extended period of time.

Chapter 12. DISPOSAL

This chapter describes safety precautions and how to dispose of this unit when the unit is no longer used.

Chapter 13. SPECIFICATIONS

This chapter describes the general specifications, performance specifications, and optional parts of this unit.

Contents

Chapter 5. DETAILED DESCRIPTION OF EACH FUNCTION

Chapter 6. LIST OF DISPLAYS AND SETTING DATA

Chapter 7. CPL COMMUNICATION FUNCTION

Chapter 8. MODBUS COMMUNICATION FUNCTION

Chapter 9. LIST OF COMMUNICATION DATA

Chapter 10. MAINTENANCE AND TROUBLESHOOTING

Chapter 11. CALIBRATION

Chapter 12. DISPOSAL

Chapter 13. SPECIFICATIONS

Appendix

Index

Conventions Used in This Manual

The following conventions are used in this manual:

Handling Precautions
: Handling Precautions indicate items that the user should pay attention to when handling the SDC35/36.

☞ : This indicates the item or page that the user is requested to refer to.

Note : Notes indicate useful user tips and information.

(1), (2), (3) : The numbers with the parenthesis indicate steps in a sequence or indicate corresponding parts in an explanation.

[para], [mode] etc. : These indicate keys on the keyboard of this unit, and messages and menus that appear on the personal computer screen.

>> : This indicates the operation results and the status after operation.

- **Numeric value and character display on LED**

Numeric values The 7-segment LED expresses numeric values as follows:

0		1		2		3		4	
5		6		7		8		9	

Alphabetical characters The 7-segment LED expresses alphabetical characters shown below. There are some alphabetical characters, which are not displayed on the LED.

A a		B b		C c		D d		E e	
F f		G g		H h		I i		J j	
K k		L l		M m		N n		O o	
P p		Q q		R r		S s		T t	
U u		V v		Y y		Z z		–	

Handling Precautions

As shown above, numeric value "2" and alphabetic character "Z" are shown in the same manner.

Accordingly, numeric value "5" and alphabetic character "S", as well as numeric value "9" and alphabetic character "Q" are also shown in the same manner.

Chapter 1. OVERVIEW

1 - 1 Overview

This unit is a compact controller having a mask of 48 X 96 mm or 96 X 96 mm and provides the following features:

- The depth is only 65 mm, providing excellent space-saving.
- The front panel is only 5 mm thick. This ensures excellent thin design.
- The display panel is large. This provides excellent visibility.
- [mode] key, [para] key, digit-shift keys, [display] key, and [enter] key are provided on the front panel. This ensures easy setup operation.
- Various input types are available, thermocouples (K, J, E, T, R, S, B, N, PLII, WRe5-26, Ni-NiMo, PR40-20, DIN U, DIN L, gold iron chromel), RTDs (Pt100, JPt100), current signals (4 to 20mAdc, 0 to 20mAdc), and voltage signals (0 to 10mVdc, -10 to +10mVdc, 0 to 1Vdc, 1 to 5Vdc, 0 to 5Vdc, and 0 to 10Vdc).
- The accuracy is ±0.1%FS and the sampling cycle time is 0.1 sec. This ensures high accuracy.
- For control output types, relay, voltage pulse for driving SSR, current output, and continuous voltage outputs are provided. Additionally, these control output types can be combined for control outputs 1 and 2.
- Three event output points or two event output points (independent contacts) are provided as standard functions.
- 2-point CT input, 4-point digital input, RSP input, and RS-485 can be combined as optional functions.
- Current output or continuous voltage output is provided as auxiliary output.
- The unit can be configured for the heat/cool control using the 2nd control output and/or event relay.
- The unit can be controlled by means of the ON/OFF control or fixed PID control method.
- In addition to the PID control, two algorithms, RationaLOOP and Just-FiTTER, are built-in, which ensures excellent controllability.
- The personal computer loader port is provided as standard function. The setup can be configured easily with use of the personal computer loader.
- Use of optional Smart Loader Package (SLP-C35) makes it possible to easily perform the read/write operation of the parameters.
  In addition to the table format setup, the operation and control status can be monitored using the trend display. This unit can be operated without use of program on the host unit.
- The unit conforms to the IEC directive and the CE marking is affixed on the unit.
  (Applicable standards: EN61010-1 and EN61326-1)

■ Model selection table

The following shows the model selection table of this unit:

Basic model No	Mounting	Control output	PV input	Power supply	Option 1	Option 2	Additional treatment	Specifications		Remarks
C35								SDC35 Mask size 48 mm X 96 mm		
C36								SDC36 Mask size 96 mm X 96 mm		
	T							Panel mounting type		
								Control output 1	Control output 2	
		R0						Relay output NO	Relay output NC	
		R1						Motor drive relay output OPEN side	Motor drive relay output CLOSE side	With MFB
		V0						Voltage pulse output (for SSR drive)	None	
		VC						Voltage pulse output (for SSR drive)	Current output	
		VD						Voltage pulse output (for SSR drive)	Continuous voltage output	
		VV						Voltage pulse output (for SSR drive)	Voltage pulse output (for SSR drive)	
		C0						Current output	None	
		CC						Current output	Current output	
		CD						Current output	Continuous voltage output	
		D0						Continuous voltage output	None	
		DD						Continuous voltage output	Continuous voltage output	
			U					Universal		
				A				AC Model (100 to 240Vac)		
				D				DC Model (24Vdc) (To be released soon)		
					1			Event relay outputs 3 points		
					2			Event relay output: 3 points, auxiliary output (current output)		
					3			Event relay output: 3 points, auxiliary output (voltage output)		
				(Note 3)	4			Event relay output: 2 points (independent contact)		
				(Note 3)	5			Event relay output: 2 points (independent contact), auxiliary output (current output)		
				(Note 3)	6			Event relay output: 2 points (independent contact), auxiliary output (voltage output)		
						0		None		
				(Notes 1, 2)		1		Current transformer input: 2 points, Digital input: 4 points		
				(Notes 1, 2)		2		Current transformer input: 2 points, Digital input: 4 points, RS-485 communication		
				(Notes 1, 2)		3		Current transformer input: 2 points, Digital input: 2 points, RSP input		
				(Notes 1, 2)		4		Current transformer input: 2 points, Digital input: 2 points, RSP input, RS-485 communication		
							00	No additional treatment		
							D0	Inspection Certificate provided		
							T0	Tropicalization treatment applied		
							K0	Anti-sulfide treatment applied		
							B0	Tropicalization treatment applied and Inspection Certificate provided		
							L0	Anti-sulfide treatment applied and Inspection Certificate provided		
							Y0	Complying with the traceability certification		

Note 1. Current transformer sold separately.

Note 2. When the control output is R1, the current transformer input is not applied. MFB input is applied instead.

Note 3. Can not be selected for the DC Model.

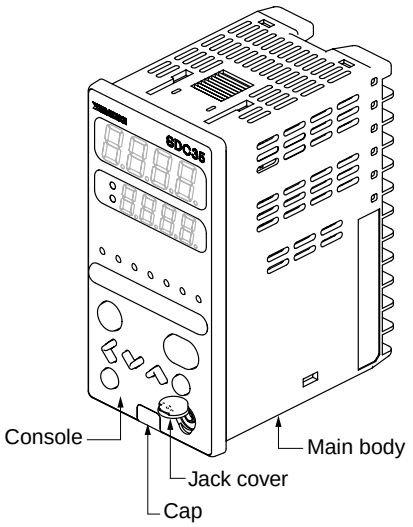
■ Accessories and optional parts

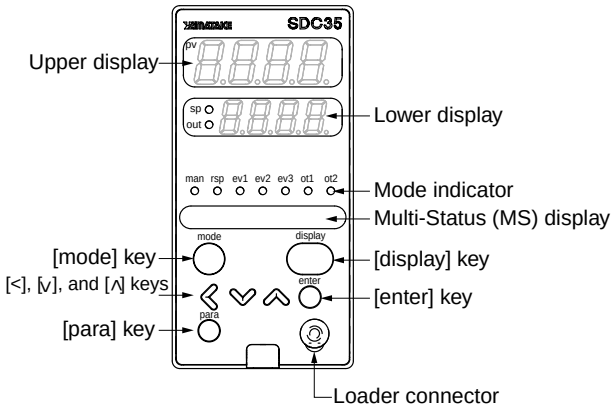
Name	Model No.
Mounting bracket	81409654-001 (Accessory)
Current transformer	QN206A (5.8mm hole dia.)
	QN212A (12mm hole dia.)
Hard cover	81446915-001 (for C35) 81446916-001 (for C36)
Terminal cover	81446912-001 (for C35) 81446913-001 (for C36)

1 - 2 Part Names and Functions

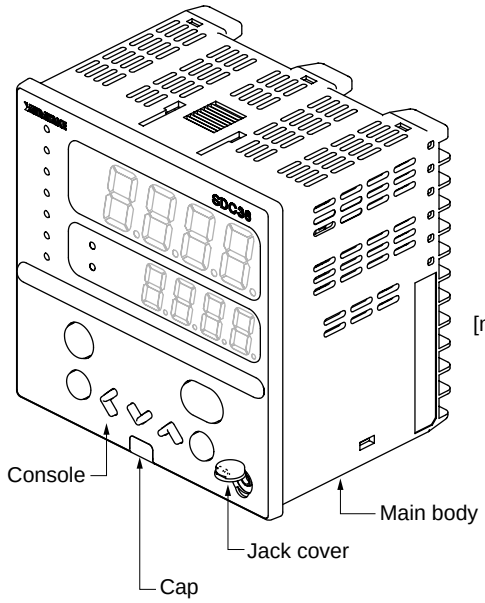
■ Main body and console

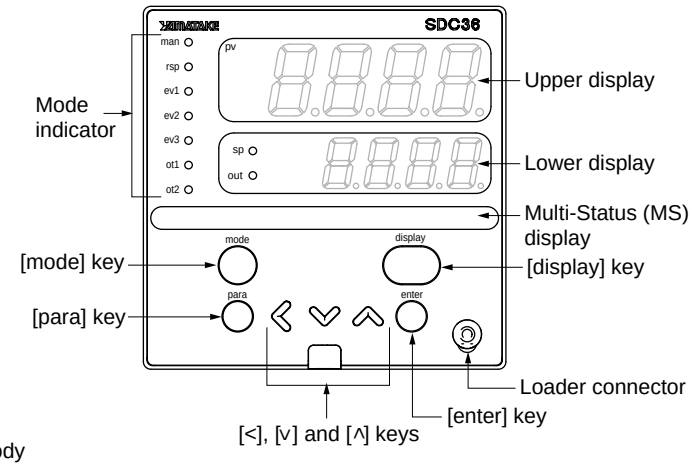
● C35





● C36





Main body: Contains the electronic circuit for I/O signals of measuring instruments, CPU, and memory.

Console: Contains the display panel showing numeric value and status, and operation keys.

Cap: Covers the slit, which is used to pull out the console from the main body.

! Handling Precautions

The user must not touch the cap. This cap is used only by Yamatake's engineers when repairing this controller. If the cap is pulled forcibly, this may be broken.

● Detailed description of console

[mode] key

When this key is kept pressed for 1 sec. or longer in the operation display mode, any of the following operations, which have been set previously, can be performed:

- AUTO/MANUAL mode selection
- RUN/READY mode selection
- Auto Tuning (AT) start/stop selection
- Local SP (LSP) group selection
- Release all Digital Output (DO) latches
- Local SP (LSP) group selection
- ON/OFF selection of communication Digital Input (DI) 1

When pressing the [mode] key in the setup display mode, the display is changed to the operation display.

[display] key

This key is used to change the display item in the operation display mode. When pressing this key in the bank selection, bank setup, or user function setup display mode, the display is changed to the operation display.

[para] key

When this key is kept pressed for 2s or longer in the operation display mode, the display is then changed to the bank selection display.

[<], [∨], [∧] keys

These keys are used to increase or decrease the numeric value, or to shift the digit.

The [∨] and [∧] keys are used to change the bank in the bank selection display mode. In the bank setup display mode, these keys are used to change the display item.

[enter] key

This key is used to start changing setup values. Additionally, the key is also used to set setup values currently being changed.

When pressing this key in the bank selection display mode, the bank is set and the display is changed to the bank setup display.

Upper display

This display shows the PV value or the name of each display item (display value or set value). If an alarm occurs in the operation display mode, the normal display and alarm code are displayed alternately.

The decimal point at the right end digit shows auto tuning (AT) status. The decimal point flashes twice repeatedly during execution of AT.

Lower display

This display shows the SP value, or the display value or set value of each display item. The decimal point at the right end digit shows the RUN/READY mode or communication status.

Mode indicators

[man]: AUTO/MANUAL mode indicator. Lights in MANUAL mode.

[rsp]: LSP/RSP mode indicator. Lights in RSP mode.

[ev1], [ev2], [ev3]: Event output 1 to 3 indicator. Lights when event relays are ON.

[ot1], [ot2]: Control output 1 and 2 indicator. Lights when the control output is ON. The indicators are always lit when the current output or continuous voltage output is used.

Multi-Status (MS) display

By combining the lighting conditions with the lighting status, three groups can be set for priority display.

For lighting conditions, the internal event ON status, DI ON status, and READY mode are provided.

For lighting status, flashing, reciprocating between left and right, and MV graph are provided.

Jack cover: This jack cover protects the loader connector. When connecting the loader, pull this cover upward by finger.

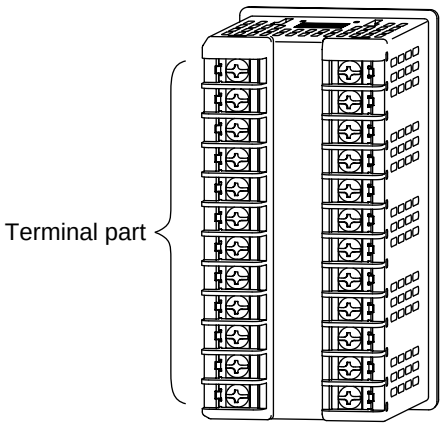
Loader connector: This connector is used for connecting to a personal computer using the dedicated cable supplied with the Smart Loader Package..

Handling Precautions

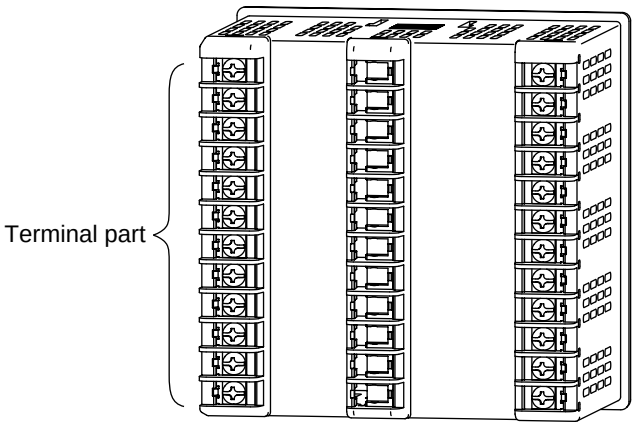
- To select the LSP group using the [mode] key, it is necessary to set a value of “2” or more in [LSP system group].
- To show the RUN/READY mode and communication status using the decimal point at the right end digit on the lower display, select “High function configuration” and make the [LED monitor] settings.
- Do not operate the key with a sharp object (such as tip of mechanical pencil or needle). Doing so might cause the unit to malfunction.
- If the jack cover is pulled forcibly, it may be broken. Never attempt to pull this cover forcibly.

■ Rear panel

● C35



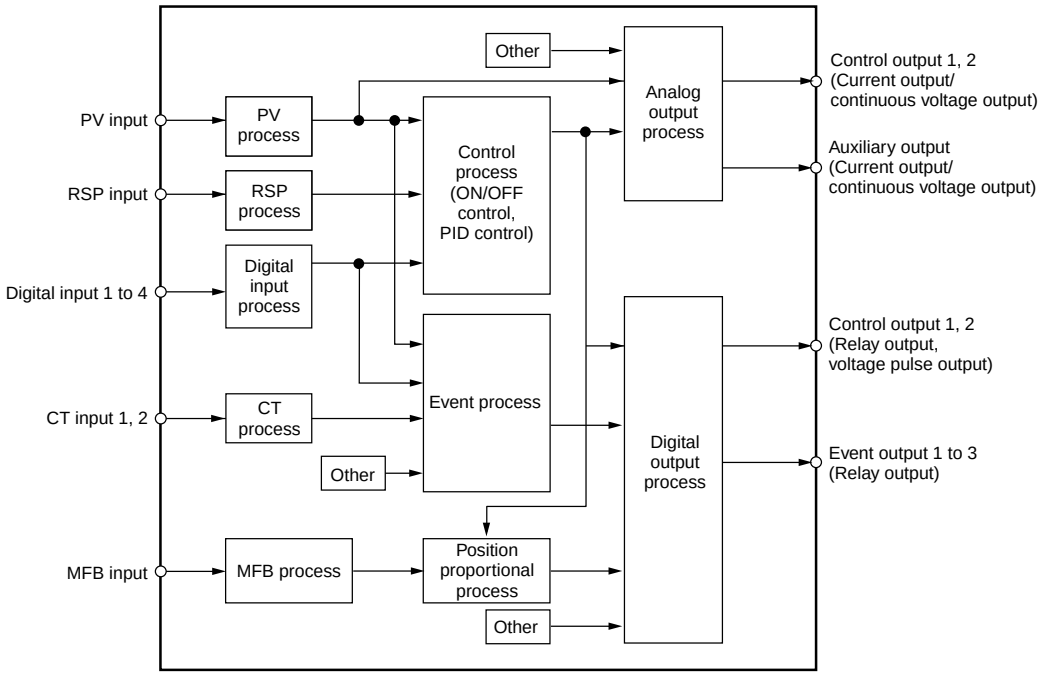
● C36



Terminal part: The power supply, input, and output are connected to the terminals. The M3 screw is used. When connecting to the terminal, always use a correct crimp type terminal lug suitable for the M3 screw. The tightening torque of the terminal screw is 0.4N·m or less.

Chapter 2. OUTLINE OF FUNCTIONS

2 - 1 Input/Output Configuration



- **PV input**

  Sensor or range is selected for the PV input. When the PV input is the DC voltage or DC current, the PV scaling high limit/low limit can be set.

- **Control output**

  When the control output type of the model is “R: Relay” or “V: Voltage pulse”, the control output becomes the ON-OFF control output or time proportional output. When the time proportional output is used, the time proportioning cycle time can be set. When the control output type of the model is “C: Current” or “D: Continuous voltage”, the control output becomes the continuous output (analog output). When the model has two control outputs, the heat/cool control can be used only with "Simple configuration".
  When the control output type of the model is “R1: Position proportional output + MFB”, the position proportional control can be performed using two relays.

- **Event output**

  When the model provides the event, the alarm or control mode set in [Event type] can be output as digital output (DO).

- **Digital input (DI)**

  When the model provides the DI, the function set with the DI assignments can be selected.

- **Current transformer (CT) input**

  When the model provides the CT input, the heater burnout alarm can be output from the event output.

- **Remote SP (RSP) input**

  When the model provides the RSP input, the range of the RSP input can be selected and the RSP input range scaling low limit/high limit can be set.

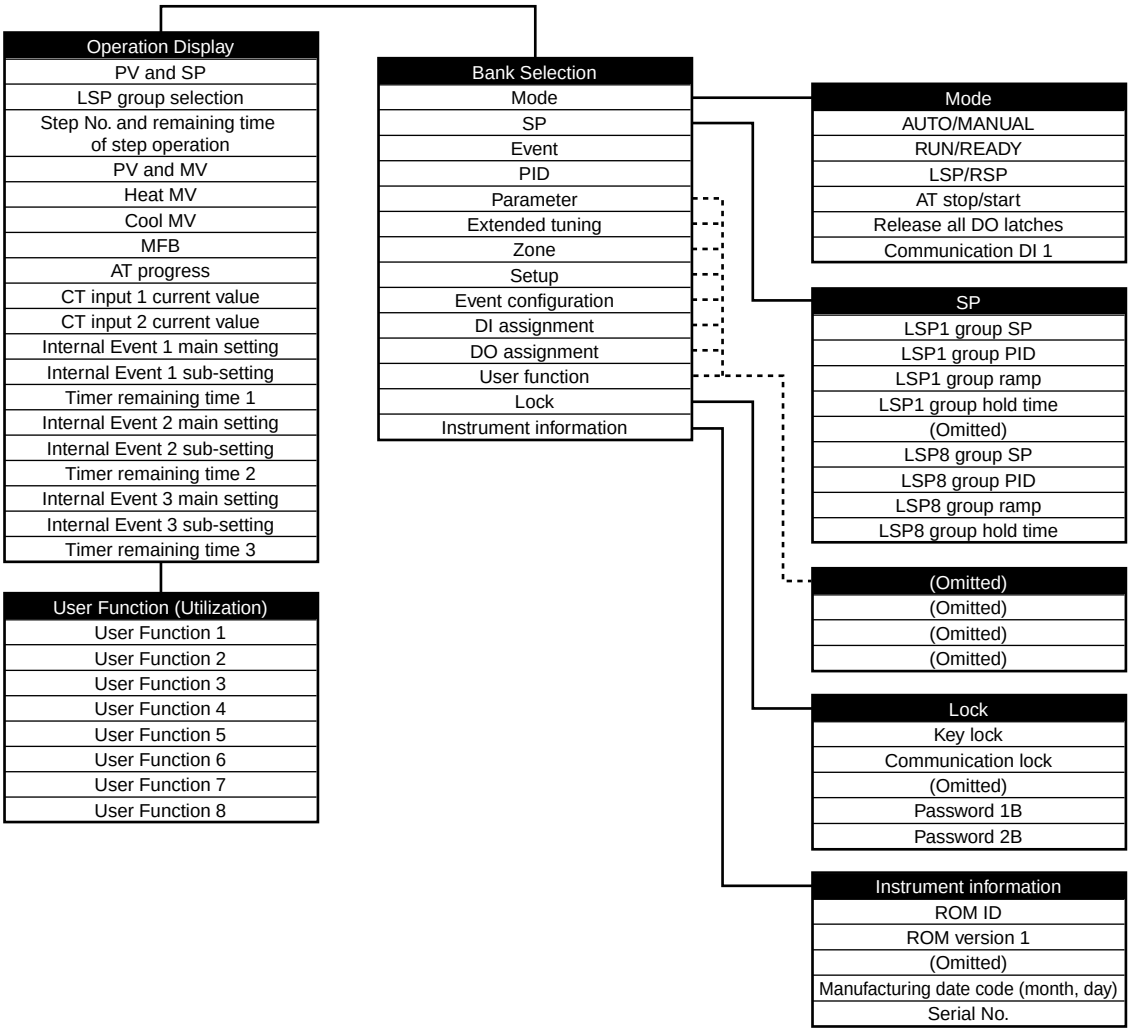
- **Motor Feed Back (MFB) input**

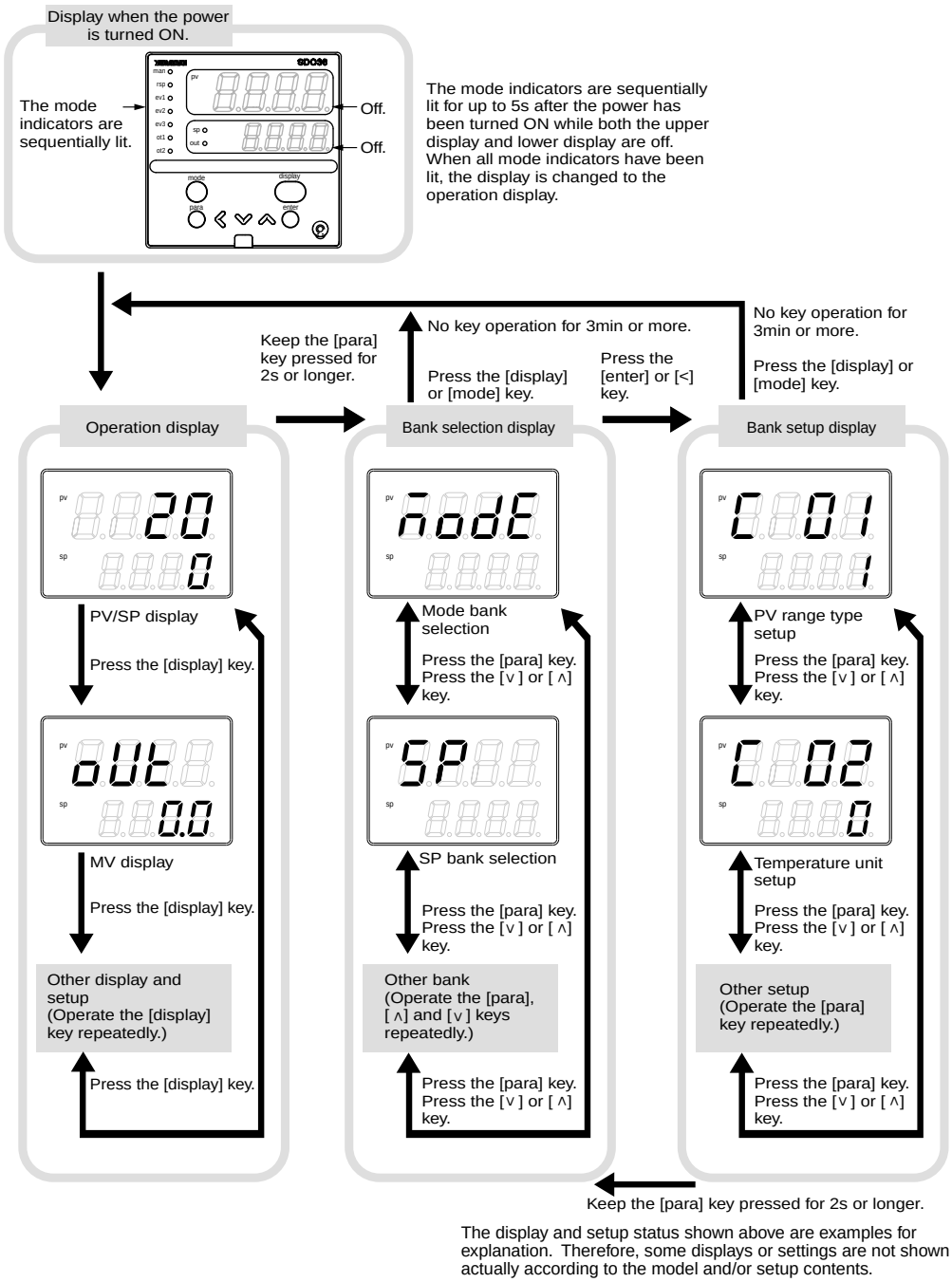
  When the model provides the position proportional output, the feedback data of the modutrol motor opening can be input.

2 - 2 Key Operation

Various displays or settings can be called up on the console through key operation.
The following describes the general flow of key operation:

The display and setting data are arranged as shown in the following tree-structure:





Handling Precautions

- For details about display and setup contents of the operation display, parameter setting display, and setup setting display, refer to
  ☞ 6-1 List of Operation Displays (on page 6-1),
  6-2 List of Parameter Setting Displays (on page 6-3) and
  6-3 List of Setup Setting Displays (on page 6-12).

  In the lists shown above, the banks to which each setting item is belonged are described.

- When pressing the [<] key with the [para] key kept pressed instead of pressing of the [para] key on the setting display, various displays and settings can be operated in the reverse order. However, the operation that both the [para] key and [<] key are kept pressed for 2s or longer, is invalid.
- When pressing the [<] key with the [display] key kept pressed instead of pressing the [display] key in the operation display mode, various displays and setting displays can be operated in the reverse order.

■ Data setting procedures

Two types of data setting procedures are provided, standard type and special type. A desired type can be selected using the setup bank [C71: Key operation mode/type].

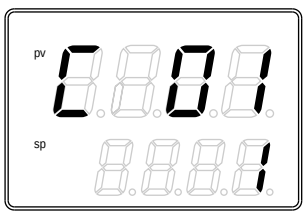
Standard type: The [enter] key is used to start changing the setup value and to set the value currently being changed.

Special type: The [<], [∨], or [∧] key is used to start changing the setup value. To set the value currently being changed, wait for 2s without pressing of any key. (However, only the standard type operation can be performed in the bank setup display mode.)

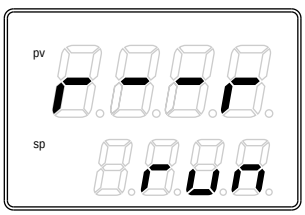
Type setup / Display mode	Setup bank C71 = 0	Setup bank C71 = 1
Operation display	Standard type	Special type
Bank setup display	Standard type	Standard type
User function setup display	Standard type	Special type

● Standard type

(1) Operate the [display], [para], [<], [∨], or [∧] key to display desired data to be set.
(How to display the data is explained in "General flow of key operation" described previously.)



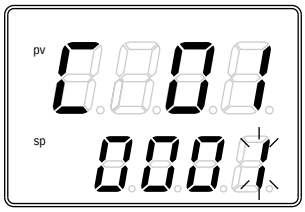
(This Figure shows the display when setting the PV range type of the setup setting [C01].)



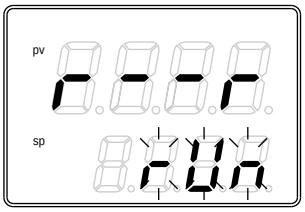
(This Figure shows the display when setting the RUN/Ready selection in the parameter setting [r--r].)

(2) Press the [enter] key.

>> When the display No. 2 shows a numeric value, the 1st digit starts flashing. Additionally, when the display No. 2 shows a character string, the entire character string starts flashing.
When a numeric value is displayed, the value can be increased or decreased or the flashing digit can be moved using the [<], [∨], or [∧] key.
When a character string is displayed, the entire flashing character string can be changed using the [∨], or [∧] key.



(This Figure shows the display when the 1st digit of "0001" is flashing.)

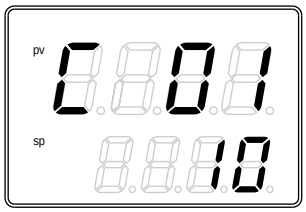


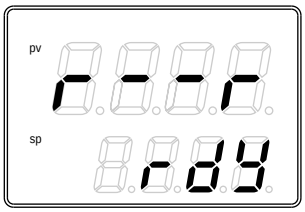
(This Figure shows the display when the entire character string "rUn" is flashing.)

⇩

(3) Press the [enter] key.

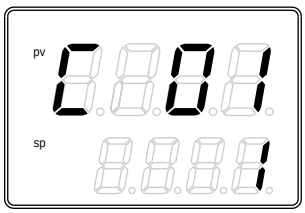
>> The flashing display is stopped, and then the data you have changed is set.



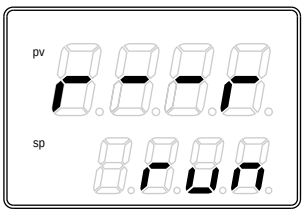


● **Special type**

(1) Operate the [display] or [para] key to display desired data to be set.
(How to display the data is explained in "General flow of key operation" described previously.)



(This Figure shows the display when setting the PV range type of the setup setting [C01].)

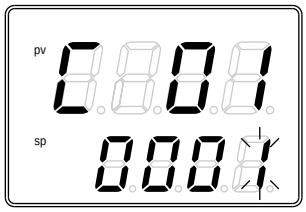


(This Figure shows the display when setting the RUN/Ready selection in the parameter setting [r--r].)

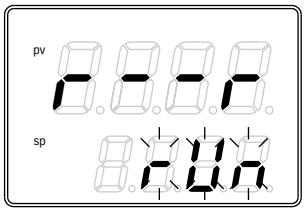
⇩

(2) Press any of the [<], [∨], and [∧] keys.

>> When the display No. 2 shows a numeric value, the 1st digit starts flashing. Additionally, when the display No. 2 shows a character string, the entire character string starts flashing.
When a numeric value is displayed, the value can be increased or decreased or the flashing digit can be moved using the [<], [∨], or [∧] key.
When a character string is displayed, the entire flashing character string can be changed using the [∨], or [∧] key.



(This Figure shows the display when the 1st digit of "0001" is flashing.)

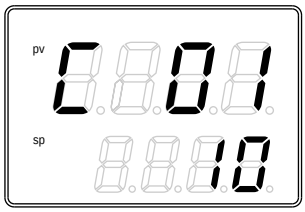


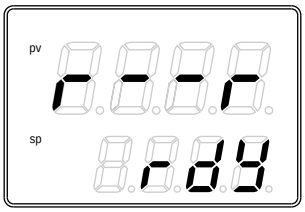
(This Figure shows the display when the entire character string "rUn" is flashing.)

⇩

(3) Release the key and wait for a while.

>> After 2s have elapsed, the flashing display is stopped, and then the data you have changed is set.





[!] Handling Precautions

- If the data does not start flashing even though the [enter] key is pressed (for a standard type) or the [<], [∨], or [∧] key is pressed (for a special type), this data cannot be changed.
  For example, when the RUN/READY is assigned in the DI Assignment, RUN/READY cannot be selected using the key on the front panel.
- If the character string cannot be changed using the [∨] key while the entire character string is flashing, press the [∧] key.
  On the contrary, if the character string cannot be changed using the [∧] key, press the [∨] key.
- When pressing the [para] key while the display is flashing on the bank setup display or user function setup display, the next data is displayed without changing of the data. Additionally, when pressing the [display] or [mode] key while the display is flashing, the display returns to the operation display without changing of the data.
- When pressing the [display] key while the display is flashing on the operation display, the next data is displayed without changing of the data.
- The MV (manipulated variable) display in the MANUAL mode continues the flashing status even after pressing of the key has been stopped. At this time, the flashing value is output as MV.

■ [mode] key operating procedures

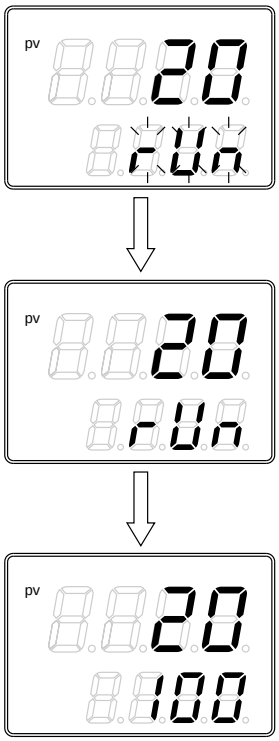
When the [mode] key is kept pressed for 1 sec. or longer on the operation display, the selection operation, which has been set using the [mode] key function (C72) of the setup setting, can be performed.

The Figure on the right shows an example that the [mode] key is pressed in the RUN/READY selection (C72 = 2) setting.

(1) If the current mode is the READY mode when the PV/SP is shown on the operation display, the character string "rUn" on the display No. 2 starts flashing.

(2) When the [mode] key is kept pressed for 1 sec. or longer, the READY mode is changed to the RUN mode and the flashing of the character string "rUn" is stopped.

(3) When pressing of the [mode] key is stopped, the display is returned to the original display.



[!] Handling Precautions

- If the MODE key function of the setup setting is set disabled (C72 = 0) or if the set selection operation is invalid, the selection operation cannot be performed using the [mode] key.
- When pressing the [mode] key on the parameter setting display or setup setting display instead of the operation display, the display is returned to the operation display. However, even though the [mode] key is kept pressed continually, the selection operation cannot be performed. In this case, stop pressing the key once, and then press the [mode] key.

■ User level

The user level of this unit can be selected from three levels, "Simple configuration", "Standard configuration", and "High function configuration" using [C79: User level] of the setup setting.

For details,

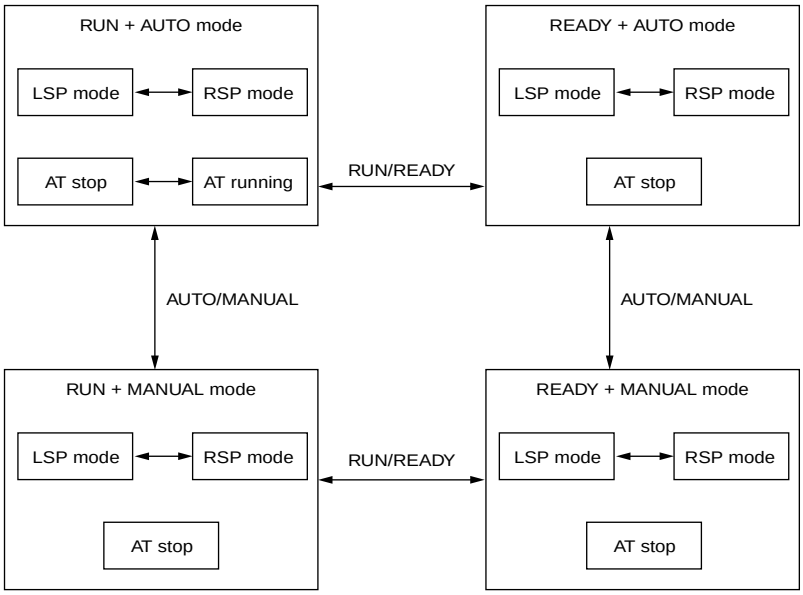
☞ refer to Chapter 6, LIST OF DISPLAYS AND SETTING DATA.

[!] Handling Precautions

Even though the user level is changed, the functions other than setting display cannot be changed. The user level is set to "Standard configuration" or "High function configuration" and more advanced functions are set. After that, when the setup is returned to "Simple configuration", this function setup cannot be displayed, but the function itself is operated.

2 - 3 Operation Modes

The following shows the transition of operation modes:



RUN: Control status
READY: Control stop status
AUTO: Automatic operation (This unit automatically determines the MV values.)
MANUAL: Manual operation (The MV values are operated manually.)
LSP: Local SP (The control is performed using the SP stored in the measuring instrument.)
RSP: Remote SP (The analog input from the external device is used as SP.)
AT: Auto tuning (The PID constants are set automatically using the limit cycle.)

Chapter 3. INSTALLATION

⚠CAUTION

Use the SDC35/36 within the operating ranges recommended in the specifications (temperature, humidity, voltage, vibration, shock, mounting direction, atmosphere, etc.).
Failure to do so might cause fire or faulty operation.

Do not block ventilation holes.
Doing so might cause fire or faulty operation.

■ Installation locations

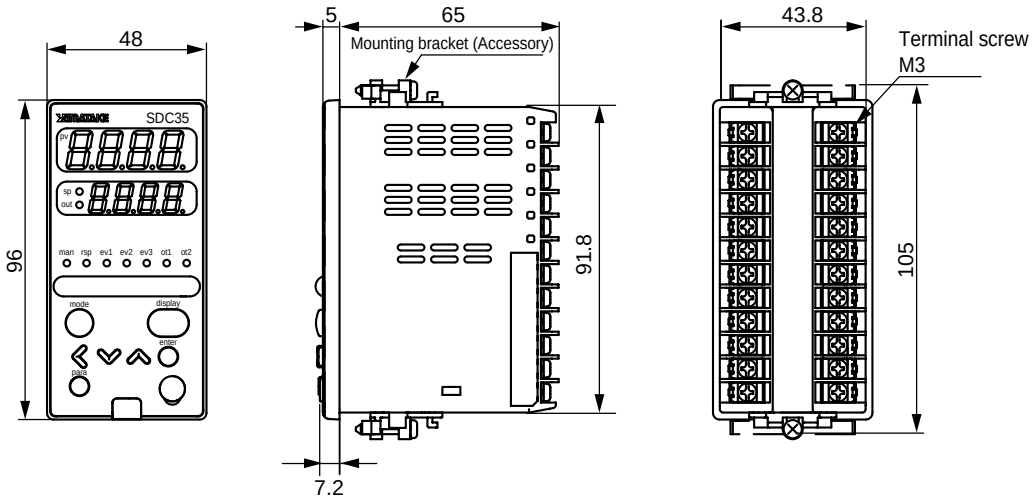
Install the controller in the following locations:

- Common mode voltage for I/O excluding the power supply and relay contact output:
  The voltage to the grounding line must be as follows:
  AC: 33V r.m.s. or less and 46.7V peak or less
  DC: 70Vdc or less
- Not at high or low temperature/humidity.
- Free from sulfide gas or corrosive gas.
- Less dust or soot.
- Appropriately processed locations to prevent direct sunlight, wind or rain.
- Less mechanical vibration and shock.
- Not close to the high voltage line, welding machine or electrical noise generating source.
- Minimum 15m away from the high voltage ignition device for a boiler.
- Less effect by the magnetic.
- No inflammable liquid or gas.

■ External Dimensions

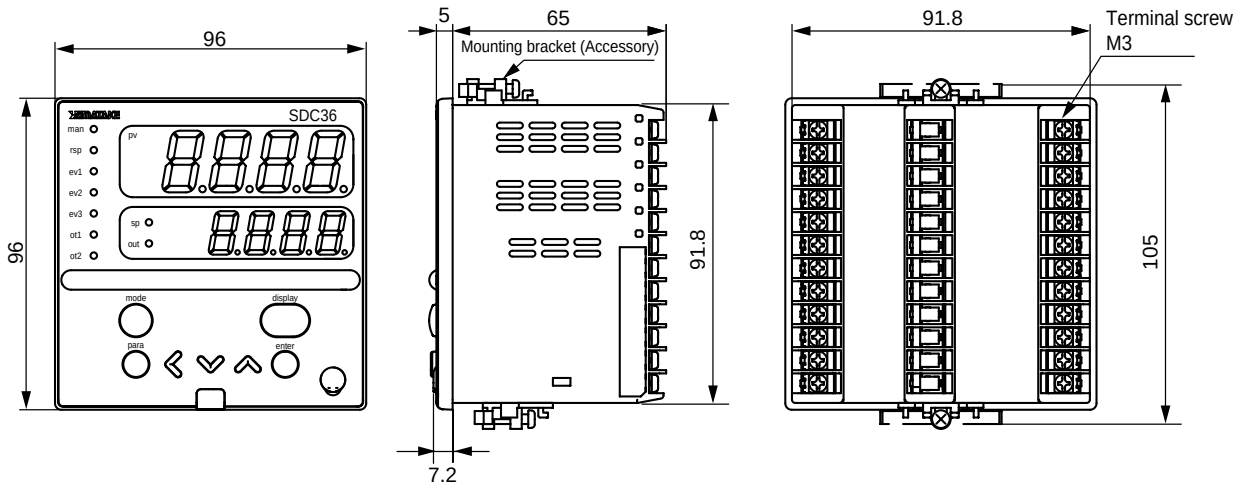
● C35

Unit: mm



● C36

Unit: mm



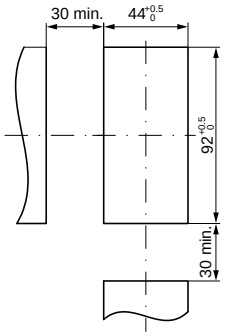
■ Panel Cutout Dimensions

Make the mounting holes according to the panel hole marking dimensions.

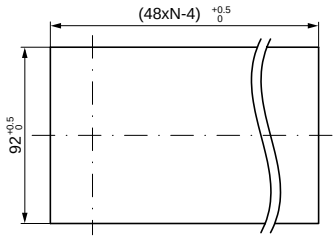
● C35

Unit: mm

Stand-alone mounting



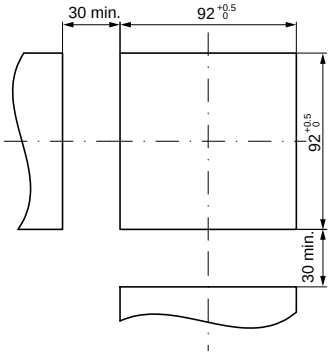
Gang-mounting



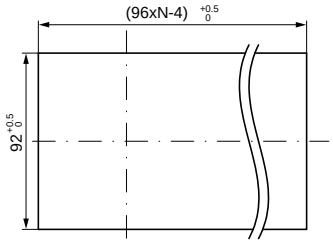
● C36

Unit: mm

Stand-alone mounting



Gang-mounting



Handling Precautions

- When three or more units are gang-mounted horizontally, the maximum allowable ambient temperature is 40°C.
- Provide a space of at least 30mm or more above and below the controller.

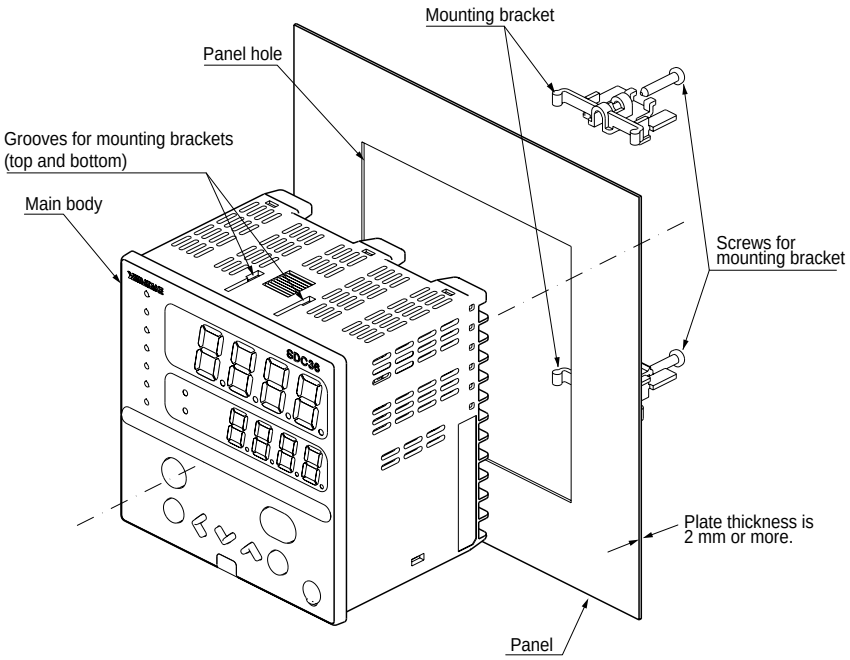
■ Mounting procedures

- The mounting must be horizontal within 10 degrees tilted on the back side lowering or within 10 degrees tilted on the back side rising.
- In the case of panel mounting type, the mounting panel should be used with a thickness of more than 2 mm of steel.

● Ordinal mounting

Tools:

Phillips-head screwdriver



(1) Insert this unit from the front of the panel.
(2) Fit the mounting bracket from the back of the panel.
(3) Push the mounting bracket against the panel until the hook of the mounting bracket is firmly engaged with the groove of the main body.
(4) Tighten the upper and lower screws of the mounting bracket.

[!] Handling Precautions

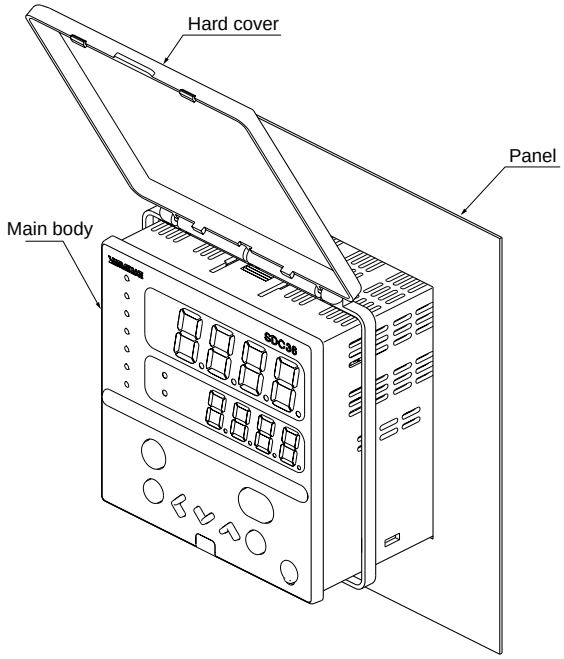
- To fasten this controller onto the panel, tighten a mounting bracket screws, and turn one more turn when there is no play between the bracket and panel. Excessive tightening of the screws may deform the controller case.

● Using a hard cover

For panel mounting type, it is possible to attach the hard cover to the front console. Use of hard cover makes it possible to prevent the settings from being changed due to accidental operation or to operate the unit in poor installation environment. The display can be seen with the cover kept closed. Raise the cover to operate the key.

Items to be prepared:

Hard cover (for SDC35) Part No. 81446915-001 (Optional unit)
Hard cover (for SDC36) Part No. 81446916-001 (Optional unit)



(1) As shown in the Figure, mount the hard cover.
(2) Insert this unit from the front of the panel.
(3) Fit the mounting bracket from the back of the panel.
(4) Push the mounting bracket against the panel until the hook of the mounting bracket is firmly engaged with the groove of the main body.
(5) Tighten the upper and lower screws of the mounting bracket.

[!] Handling Precautions

- To fasten this controller onto the panel, tighten a mounting bracket screws, and turn one more turn when there is no play between the bracket and panel. Excessively tightening the screws may deform the controller case.

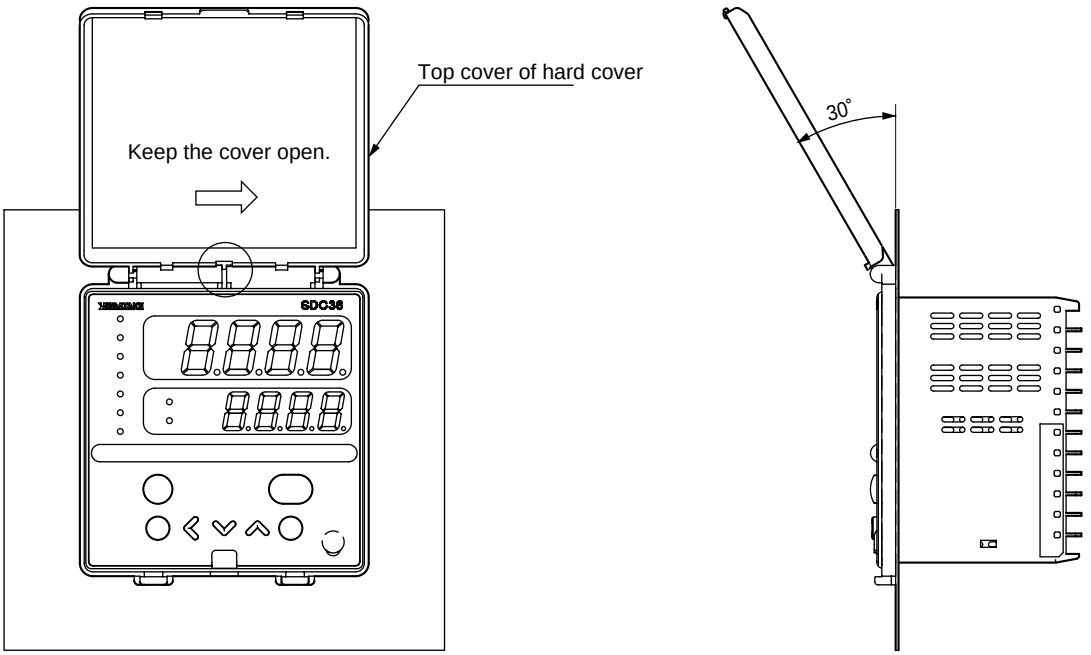
● How to use the hard cover

When operating the unit with the hard cover, flip the lower end of the cover upward. At this time, the cover is so designed that it can be kept open without holding the cover by hand.

After the cover has been flipped upward, slide it to the right as shown in the Figure.

The hard cover is then locked/latched at an angle of approximately 30 ˚to the panel surface. In this status, the key operation and loader connection can be made.

To return the cover to the previous position, slide the cover to the left and when released it flips downward and covers the unit.



Chapter 4. WIRING

⚠WARNING

- Before wiring, or removing/mounting the SDC35/36, be sure to turn the power OFF.
  Failure to do so might cause electric shock.
- Do not touch electrically charged parts such as the power terminals.
  Doing so might cause electric shock.

⚠CAUTION

- Wire the SDC35/36 properly according to predetermined standards.
  Also wire the SDC35/36 using specified power leads according to recognized installation methods.
  Failure to do so might cause electric shock, fire or faulty operation.
- Do not allow lead clippings, chips or water to enter the controller case.
  Doing so might cause fire or faulty operation.
- Firmly tighten the terminal screws with the specified torque as listed in the specifications.
  Insufficient tightening of terminal screws might cause electric shock or fire.
- Do not use unused/spare terminals on the SDC35/36 as relay terminals.
  Doing so might cause electric shock, fire, or faulty operation.
- We recommend attaching the terminal cover (sold separately) after wiring the SDC35/36.
  Failure to do so might cause electric shock, fire, or faulty operation.
- Use the relays within the recommended life.
  Failure to do so might cause fire or faulty operation.
- Use Yamatake Corporation's "SURGENON" if there is the risk of power surges caused by lightning.
  Lightning power surges might cause fire or faulty operation.
- Do not make incorrect connections. If the cables are connected incorrectly, this might cause the unit to malfunction.
- The controller requires 6 seconds to stabilize after power ON. Great care should be taken when the relay output from the controller is used as interlock signals.
- The part between the control output 1 and control output 2 is not isolated. When necessary, use an appropriate isolator.
- Do not connect multiple loader cables to multiple units from one personal computer. The current coming from other circuits might cause the PV value indication error to occur.
- Do not connect any terminating resistor to both ends of the communication path when performing the RS-485 wiring. Doing so might cause the communication to fail.
- Always mount a switch for shut-down of the main power of this unit in an easily accessible area of the operator when performing electric wiring of this unit. Additionally, connect a slow-action type (T) fuse having a rated current of 0.5A and rated voltage of 250V to the wiring for the instrument power supply of the AC power supply model. (IEC127)

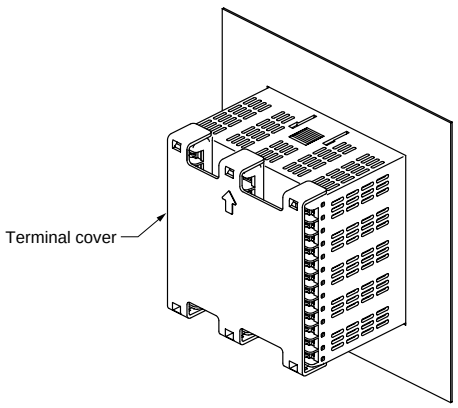
■ Terminal assignment label symbols

The following table shows the meanings of the symbols used for the terminal assignment label attached to the side panel of this unit:

Symbol	Contents
~	AC
⚠	Caution, Electric shock hazard
⚠	Caution

■ Wiring Precautions

- Before starting the wiring work, carefully check the label on the side panel of this unit to understand the model No. and terminal No. to carry out the wiring properly.
- Use an appropriate crimp type terminal lug suitable for the M3 screw to connect the terminals. The tightening torque of the terminal screw must be 0.4N·m or less.
- Pay special attention so that no crimp type terminal lugs are in touch with adjacent terminals.
- Keep the input/output signal cables 50cm or more away from the drive power cable and/or power cable. Additionally, do not lay the input/output signal cables and the drive power cable and/or power cable together in the same conduit or duct.
- When connecting this unit and other measuring instrument in parallel, carefully check the conditions necessary for other instrument before starting the instrumentation.
- The digital input is so designed that it is potential free input. A contact for micro current must be used.
- The heater current carrying conductor must be routed through the current transformer. Additionally, carefully check that the heater current does not exceed the allowable current limit stated in the specification. If the heater current exceeds the allowable current limit, this might cause damage to this unit.
- The input of the current transformer cannot be used for the phase angle control.
- An optional terminal cover is available to prevent electric shock. (Model No.: 81446912-001 for C35 or 81446913-001 for C36)



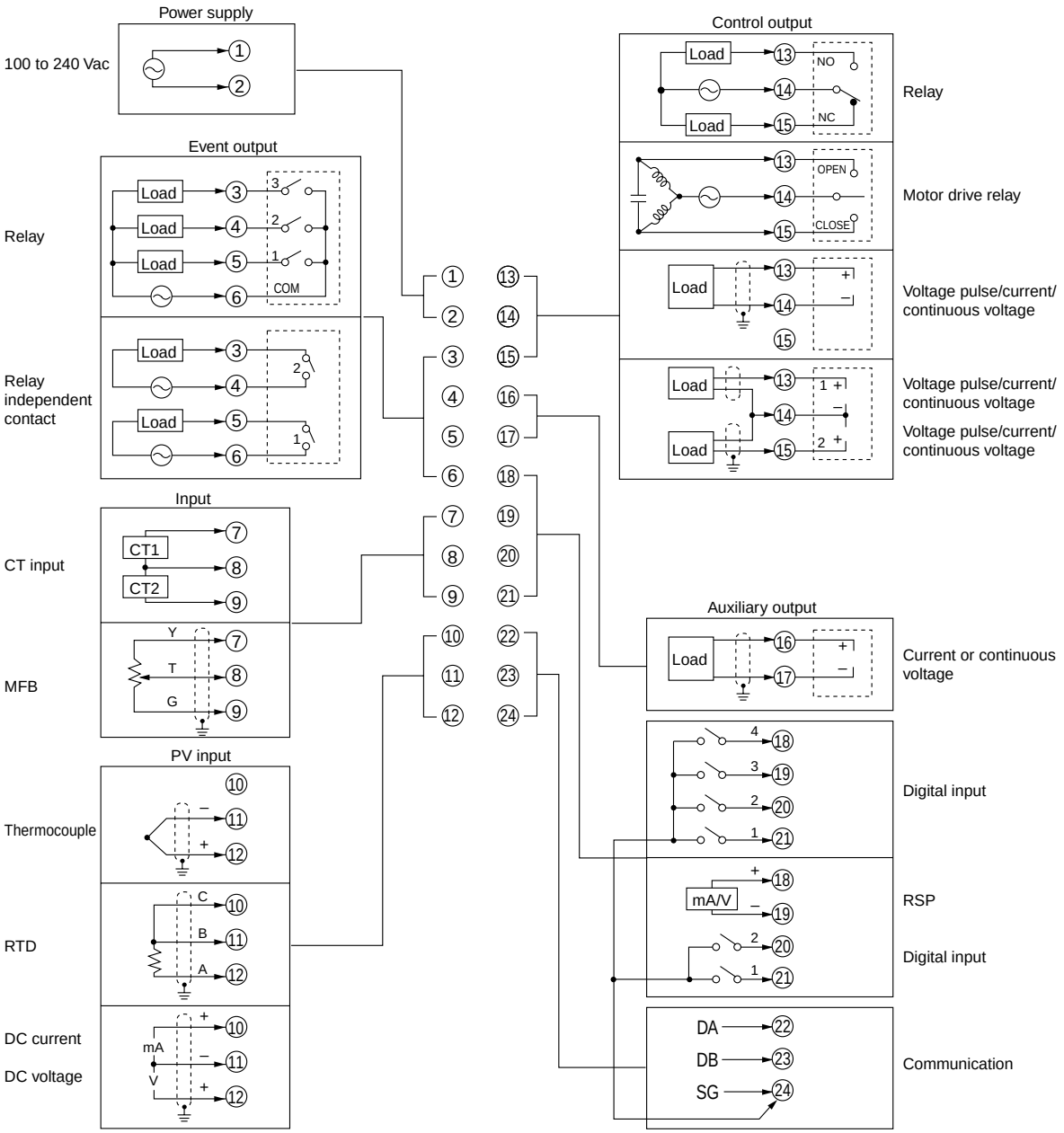
- The part between the control output 1 and control output 2 is not isolated. When necessary, use an appropriate isolator.

IMPORTANT **Terminating resistor**

- Do not connect any terminating resistor to both ends of the RS-485 communication path. Doing so might cause the communication failure.

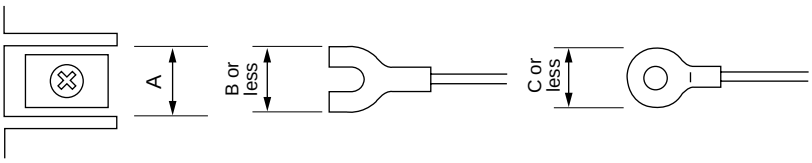
- When the motor power to be connected to the motor drive relay output is 100Vac or 200Vac, use an external auxiliary relay.
- Do not run the motor drive terminals (13), (14), and (15), and MFB input terminals (7), (8), and (9) in the same duct. Additionally, do not use 6-core cables for the wiring work.
  Doing so might cause the unit to malfunction due to noise at start-up of the motor.
- Devices and systems to be connected to this unit must have the basic insulation suitable for the maximum operating voltage levels of the power supply and input/output part.
- This unit has been designed to start functioning after an initial stabilization period of 5 seconds after power ON, in order to ensure stable operation. After that, the unit then enters the operation mode. However, to satisfy the specified accuracy, it is necessary to warm up the unit for at least 30 min.

● Wiring of C35/36



● Recommended crimp type terminal lugs

For wiring of C35/36, use an appropriate crimp type terminal lug suitable for the M3 screw.



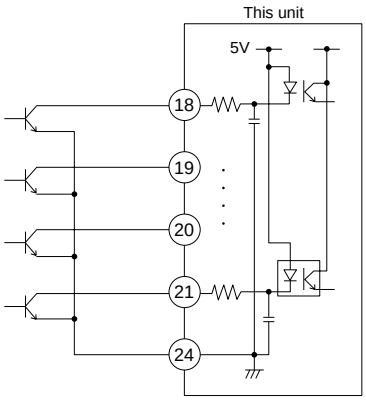
Applicable screw size	Terminal dimensions (mm)			Recommended crimp terminal JIS indication	Applicable electrical wire size	JST Mfg. Co. Model No. (Reference)
	A	B	C			
M3	6.1	5.8	5.8	RAV1.25 - 3	0.3 to 1.3mm^2 AWG22 to 16	V1.25 - 3 V1.25 B3A

Handling Precautions

- When installing this unit in a place where the vibration or impact is large, always use an appropriate round crimp type terminal lug to avoid loose terminal connections.
- Pay special attention so that no crimp type terminal lugs are in touch with adjacent terminals.

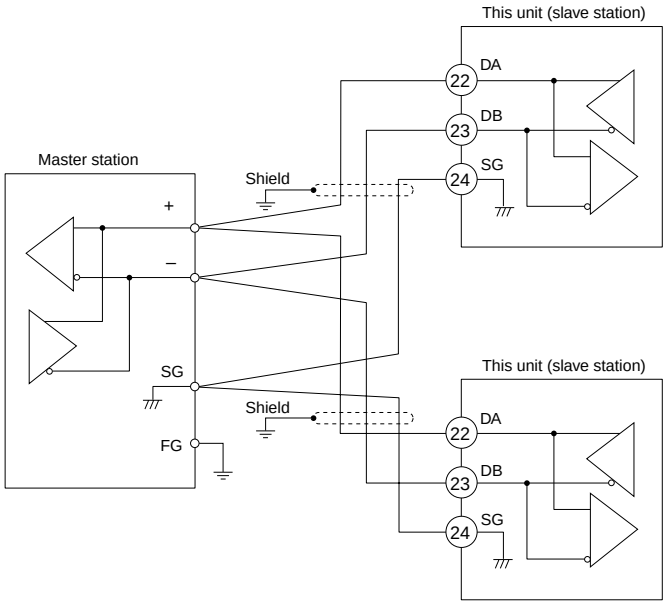
■ Connection of open collector output to digital input

The following shows a connection example when connecting to four digital input points.



■ Connection of communication (RS-485) cable

● 3-wire system



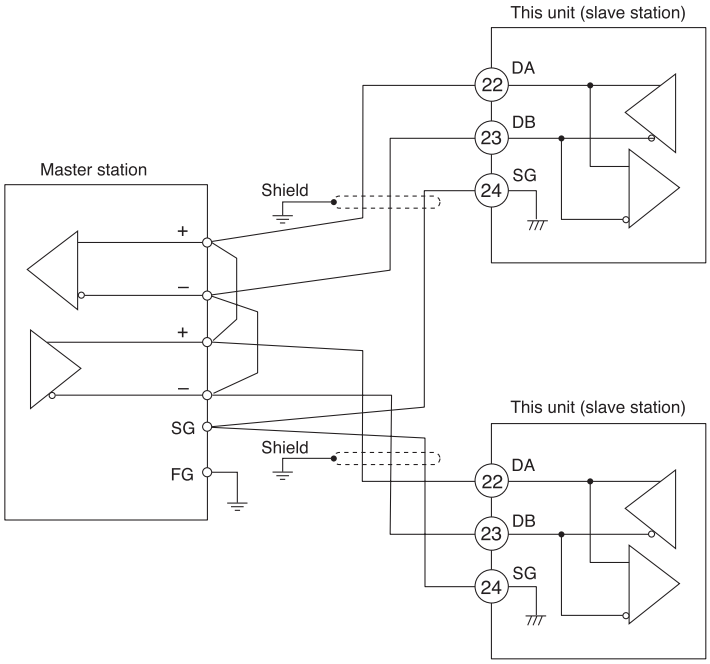
IMPORTANT **Terminating resistor**

- Do not connect any terminating resistor to both ends of the communication path. Doing so might cause the communication failure.
- Even though any units requiring the terminating resistor to exist in the communication path, do not connect any terminating resistor.

[!] Handling Precautions

- Do not connect DA and DB. Doing so might cause damage to this unit.
- Ground the shield line to one point on one end of the cable.
- Be sure to connect SG terminals each other.
  Failure to do so might cause unstable communications.

● **5-wire system**



IMPORTANT **Terminating resistor**

- Do not connect any terminating resistor to both ends of the communication path. Doing so might cause the communication failure.
- Even though any units requiring the terminating resistor to exist in the communication path, do not connect any terminating resistor.

Handling Precautions

- Do not connect DA and DB. Doing so might cause damage to this unit.
- Ground the shield line to one point on one end of the cable.
- Be sure to connect SG terminals each other.
  Failure to do so might cause unstable communications.

■ Connection with solid state relay (SSR)

To drive the SSR, a model having voltage pulse outputs (V0, VC, VV, or VD) must be used.

Generally, the SSR is classified into two groups, constant current type and resistor type. The following describes how to connect constant current type:

The two conditions listed below must be satisfied.

- Input current (maximum): Check that the input current is within the maximum allowable current or less, then the parallel connection can be made.
- Operating voltage range (input): Check that the voltage between the terminals of the voltage pulse output is within the specified range.

1. Yamatake's PGM10N/PGM10F series

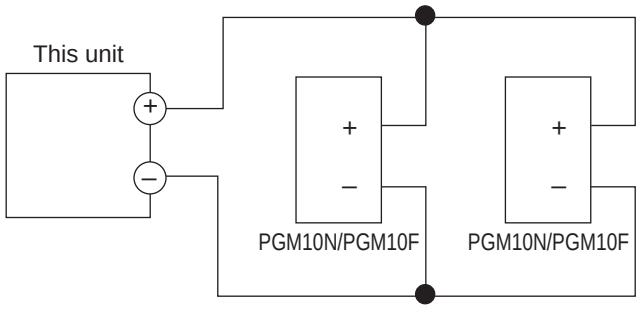
This example shows the calculation for the connection of the SDC35 and the PGM10N015.

(Note: For connection with other model number, check the specifications of each model.)

- Input current: Since the input current is 10mA or less, up to two units (10mA X 2 = 20mA < 24mA [maximum allowable current]) can be connected in parallel.
- Operating voltage range (input): The rating voltage is 3.5 to 30Vdc. Therefore, the voltage between the terminals is within the range.

Voltage between terminals (two PGM10N units)
= Open voltage - internal resistance X total drive current
= 19Vdc ±15% - 82Ω ±0.5% X 20mA
≒15 to 20V

Connection diagram



Number of connectable units

SSR to be used	Connection	V0 model	VV model
Yamatake PGM10N	Parallel connection	Up to 2 units	Up to 4 units (Note)
Yamatake PGM10F	Parallel connection	Up to 2 units	Up to 4 units (Note)

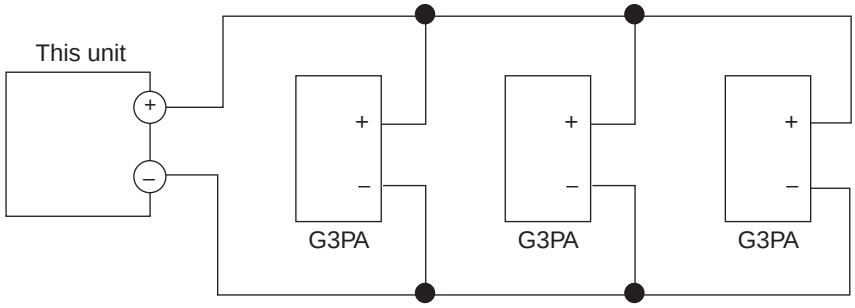
(Note) 2 units for each output

2. Omron's G3PA, G3PB, G3NA

- Input current: Since the input current is 7mA or less, up to three units (7mA X 3 = 21mA < 24mA [maximum allowable current]) can be connected in parallel.
- Operating voltage range (input): The rating voltage is 5 to 24Vdc or 12 to 24Vdc. Therefore, the voltage between the terminals is within the range.

Voltage between terminals (three G3PA units)
= Open voltage - internal resistance X total drive current
= 19Vdc ±15% - 82Ω ±0.5% X 21mA
≒14 to 20V

Connection diagram



Number of connectable units

SSR to be used	Connection	V0 model	VV model
Omron G3PA	Parallel connection	Up to 3 units	Up to 6 units (Note)
Omron G3PB	Parallel connection	Up to 3 units	Up to 6 units (Note)
Omron G3NA	Parallel connection	Up to 3 units	Up to 6 units (Note)

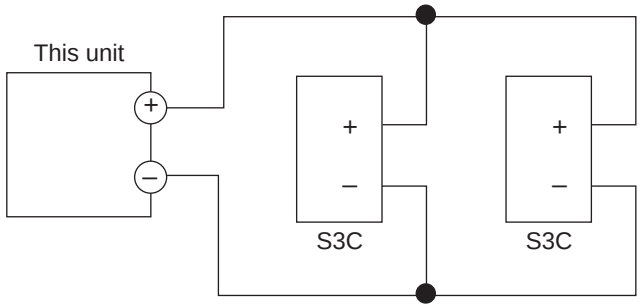
(Note) 3 units for each output

3. JEL SYSTEM's S3C series

- Input current: Since the input current is 10mA or less, up to two units (10mA X 2 = 20mA < 24mA [maximum allowable current]) can be connected in parallel.
- Operating voltage range (input): The rating voltage is 3 to 30Vdc. Therefore, the voltage between the terminals is within the range.

Voltage between terminals (two S3C units)
= Open voltage - internal resistance X total drive current
= 19Vdc ±15% - 82Ω ±0.5% X 20mA
≒15 to 20V

Connection diagram



Number of connectable units

SSR to be used	Connection	V0 model	VV model
JEL SYSTEM S3C	Parallel connection	Up to 2 units	Up to 4 units (Note)

(Note) 2 units for each output

■ Noise Preventive Measures

The power is taken from the single-phase instrument power supply to consider noise preventive measures.
If the noise from the power supply is large, an appropriate insulation transformer is added to the power supply and an appropriate line filter must be used.
(Yamatake's line filter model No.: 81446364-001)
If the noise has a fast rising edge, an appropriate CR filter must be used.
(Yamatake's CR filter model No.: 81446365-001)

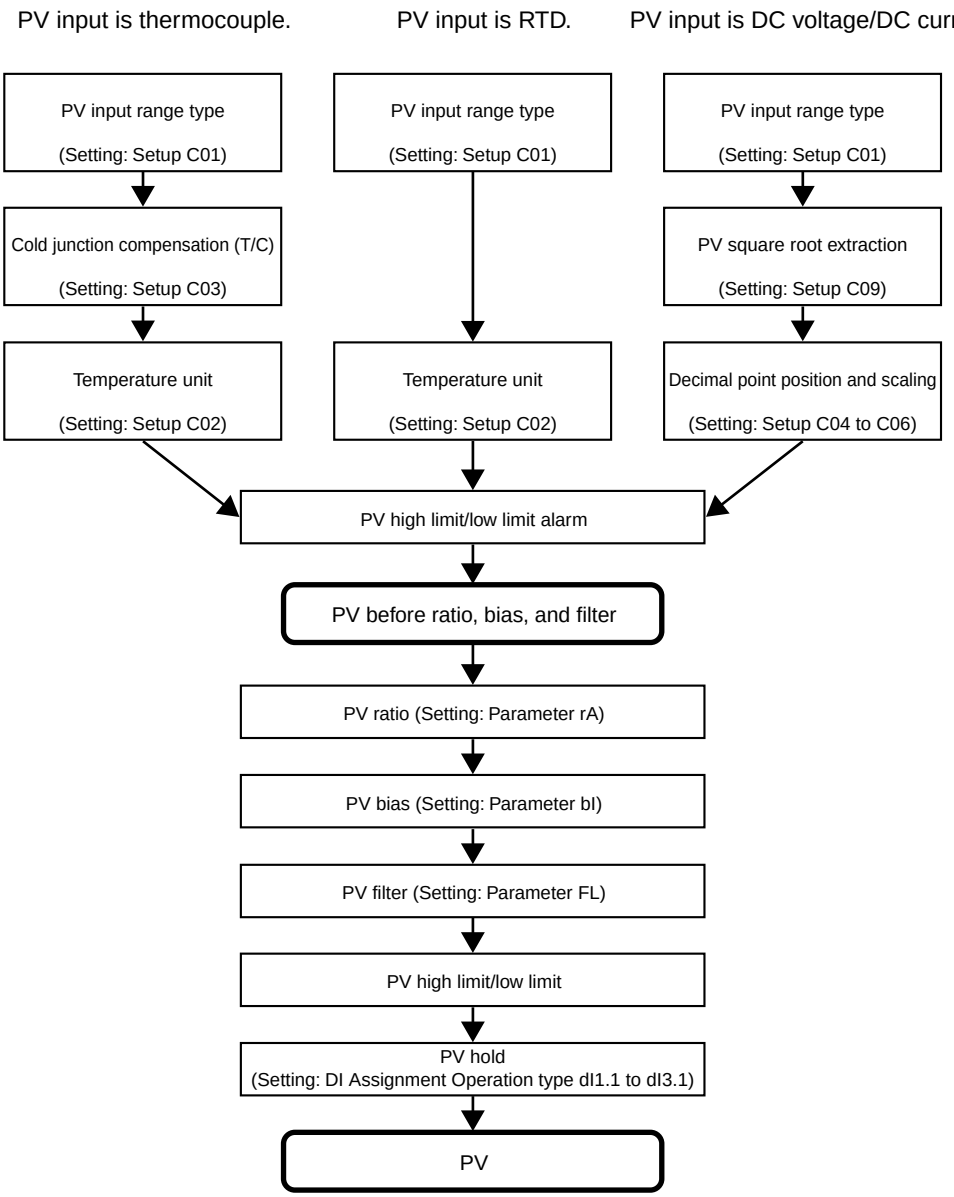
Handling Precautions

After the noise preventive measures have been taken, do not bundle the primary and secondary sides of the insulation transformer together or lay/route them in the same conduit or duct.

Chapter 5. DETAILED DESCRIPTION OF EACH FUNCTION

5 - 1 PV Input

The following shows the functional block diagram of the PV input:



■ PV input range type

When the PV input range type is thermocouple or RTD, the sensor type and temperature range can be selected. When the PV input range type is DC voltage or DC current, the signal type can be selected.

Item (Bank)	Display	Contents	Initial value	User level
PV input range type (Setup bank)	C 01	Refer to the PV input range table.	88	Simple, Standard, High function

● PV input range table (Thermocouple)

C01 set value	Sensor type	Range (Celsius)	Range (Fahrenheit)
1	K	–200 to +1200˚C	–330 to +2200˚F
2	K	0 to 1200˚C	0 to 2200˚F
3	K	0 to 800˚C	0 to 1500˚F
4	K	0.0 to 600.0˚C	0 to 1100˚F
5	K	0.0 to 400.0˚C	0 to 700˚F
6	K	–200.0 to +400.0˚C	–300 to +700˚F
7	K	–200.0 to +200.0˚C	-300 to +400˚F
8	J	0 to 1200˚C	0 to +2200˚F
9	J	0.0 to 800.0˚C	0 to 1500˚F
10	J	0.0 to 600.0˚C	0 to 1100˚F
11	J	–200.0 to +400.0˚C	–300 to +700˚F
12	E	0.0 to 800.0˚C	0 to +1500˚F
13	E	0.0 to 600.0˚C	0 to 1100˚F
14	T	–200.0 to +400.0˚C	–300 to +700˚F
15	R	0 to 1600˚C	0 to 3000˚F
16	S	0 to 1600˚C	0 to 3000˚F
17	B	0 to 1800˚C	0 to 3300˚F
18	N	0 to 1300˚C	0 to 2300˚F
19	PL II	0 to 1300˚C	0 to 2300˚F
20	WRe5-26	0 to 1400˚C	0 to 2400˚F
21	WRe5-26	0 to 2300˚C	0 to 4200˚F
22	Ni-NiMo	0 to 1300˚C	0 to +2300˚F
23	PR40-20	0 to 1900˚C	0 to +3400˚F
24	DIN U	–200.0 to +400.0˚C	–300 to +700˚F
25	DIN L	–100.0 to +800.0˚C	–150 to +1500˚F
26	Gold iron chromel	0.0 to 360.0K	0 to 360.0K

● PV input range table (RTD)

C01 set value	Sensor type	Range (Celsius)	Range (Fahrenheit)
41	Pt100	–200.0 to +500.0˚C	–300 to +900˚F
42	JPt100	–200.0 to +500.0˚C	–300 to +900˚F
43	Pt100	–200.0 to +200.0˚C	–300 to +400˚F
44	JPt100	–200.0 to +200.0˚C	–300 to +400˚F
45	Pt100	–100.0 to +300.0˚C	–150 to +500˚F
46	JPt100	–100.0 to +300.0˚C	–150 to +500˚F
47	Pt100	–100.0 to +200.0˚C	–150 to +400˚F
48	JPt100	–100.0 to +200.0˚C	–150 to +400˚F
49	Pt100	–100.0 to +150.0˚C	–150 to +300˚F
50	JPt100	–100.0 to +150.0˚C	–150 to +300˚F
51	Pt100	–50.0 to +200.0˚C	–50 to +400˚F
52	JPt100	–50.0 to +200.0˚C	–50 to +400˚F
53	Pt100	–50.0 to +100.0˚C	–50 to +200˚F
54	JPt100	–50.0 to +100.0˚C	–50 to +200˚F
55	Pt100	–60.0 to +40.0˚C	–60 to +100˚F
56	JPt100	–60.0 to +40.0˚C	–60 to +100˚F
57	Pt100	–40.0 to +60.0˚C	–40 to +140˚F
58	JPt100	–40.0 to +60.0˚C	–40 to +140˚F
59	Pt100	–10.00 to +60.00˚C	–10 to +140˚F
60	JPt100	–10.00 to +60.00˚C	–10 to +140˚F
61	Pt100	0.0 to 100.0˚C	0 to 200˚F
62	JPt100	0.0 to 100.0˚C	0 to 200˚F
63	Pt100	0.0 to 200.0˚C	0 to 400˚F
64	JPt100	0.0 to 200.0˚C	0 to 400˚F
65	Pt100	0.0 to 300.0˚C	0 to 500˚F
66	JPt100	0.0 to 300.0˚C	0 to 500˚F
67	Pt100	0.0 to 500.0˚C	0 to 900˚F
68	JPt100	0.0 to 500.0˚C	0 to 900˚F

● PV input range table (DC voltage/DC current)

C01 set value	Sensor type	Range
81	0 to10mV	The scaling and the decimal point position can be changed variably in a range of –1999 to +9999.
82	–10 to +10mV	
83	0 to 100mV	
84	0 to 1V	
86	1 to 5V	
87	0 to 5V	
88	0 to 10V	
89	0 to 20mA	
90	4 to 20mA	

! Handling Precautions

- When an input range has the decimal point display, the PV and/or SP can be displayed on the console of this unit so that they are displayed to the 1st digit after the decimal point or without the decimal point.
- For details about the accuracy of each PV range type, refer to Chapter 13, SPECIFICATIONS (on page 13-1).

■ Temperature unit

When the PV input range type is thermocouple or RTD, the temperature unit can be selected.

Item (Bank)	Display	Contents	Initial value	User level
Temperature unit (Setup bank)	C 02	0: Celsius (˚C) 1: Fahrenheit (˚F).	0	Simple, Standard, High function

• When the PV input range type is thermocouple or RTD, the display and setting can be configured.

■ Cold junction compensation (T/C)

When the PV input range type is thermocouple, either of the following can be selected:

• The cold junction compensation (T/C) is performed inside this unit.
• The cold junction compensation (T/C) is not performed inside this unit since an external cold junction compensation unit, such as ice bath is used.

Item (Bank)	Display	Contents	Initial value	User level
Cold junction compensation (T/C) (Setup bank)	C 03	0: Cold junction compensation (T/C) is performed (internal). 1: Cold junction compensation (T/C) is not performed (external).	0	High function

• When the PV input range type is thermocouple, the display and setting can be configured.

■ PV square root extraction dropout

When the PV input range type is DC voltage or DC current, a dropout value can be set so that the result of the PV square root extraction used to convert the pressure (differential pressure) into the flow becomes "0".

Item (Bank)	Display	Contents	Initial value	User level
PV square root extraction dropout (Setup bank)	C 09	0.0%: Square root extraction is not performed. 0.1 to 100.0%	0.0%	High function

- When the PV input range type is DC voltage or DC current, the display and setting can be made.
- Details of PV square root extraction

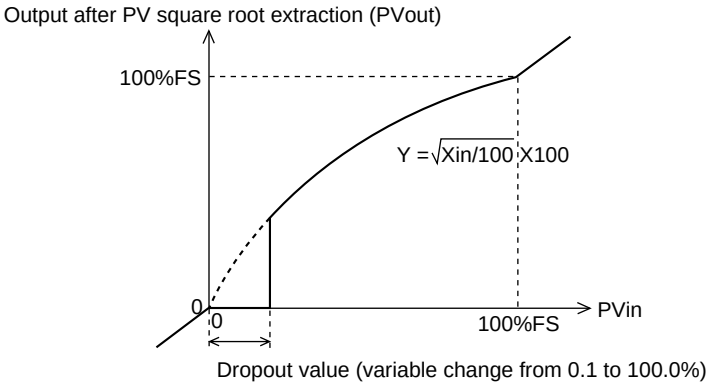
  The calculation input in % and the calculation result in % are expressed as PVin and PVout, respectively.

  When the PV input is the PV square root extraction dropout set value or more and less than 100.0%, the control formula becomes as shown below.

  $PVout = \sqrt{PVin/100} \times 100$

  When the PV input is larger than 0.0% and smaller than the PV square root extraction dropout set value, PVout = 0.0%.

  When the PV input is 0.0% or less or 100.0% or more, the square root extraction is not performed. Therefore, PVout = PVin.



■ Decimal point position

When the PV input range type is DC voltage or DC current or when the PV input range type is a part of the PV input range type of thermocouple or RTD, the decimal point position of the PV input can be set.

Item (Bank)	Display	Contents	Initial value	User level
Decimal point position (Setup bank)	C 04	0: No decimal point 1: 1 digit after decimal point 2: 2 digits after decimal point 3: 3 digits after decimal point	0	Simple, Standard, High function

- When the PV input range type is DC voltage or DC current, the display and setting can be made.
- When the PV input range type is thermocouple or RTD and it is a range having the decimal point stated in PV range table (on page 5-2) of 5-1 PV Input, "0: No decimal point" or "1: 1 digit after decimal point" can be displayed and set.

[!] Handling Precautions

As this setting is changed, the decimal point position of the parameters related to the decimal point position of the PV input is also changed. Actually, the decimal point position of the following settings are changed:

SP setting
SP low limit/high limit setting
RSP range low limit/high limit setting
SP ramp-up/ramp-down setting
Event setting and continuous output setting related to PV
Event setting and continuous output setting related to SP
Event setting and continuous output setting related to deviation (absolute deviation)

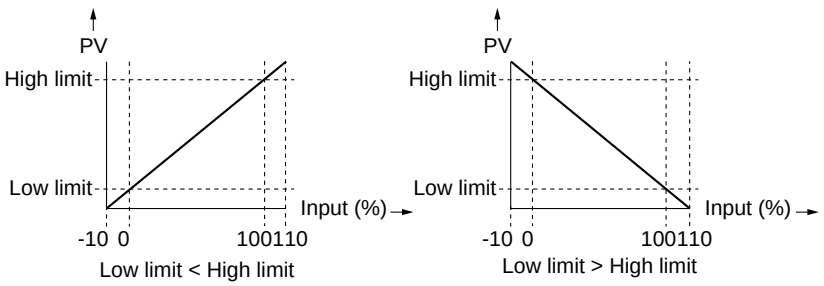
■ PV input range low limit/high limit

When the PV input range type is DC voltage or DC current, the scaling of the PV input can be set.

Item (Bank)	Display	Contents	Initial value	User level
PV input range low limit (Setup bank)	C 05	When the PV input range type is DC voltage or DC current, the following contents apply: -1999 to +9999 (no decimal point) -199.9 to +999.9 (1 digit after decimal point) -19.99 to +99.99 (2 digits after decimal point) -1.999 to +9.999 (3 digits after decimal point) When the PV input type is thermocouple or RTD, the range low limit and high limit values selected using the PV input range type are used.	0	Simple, Standard, High function
PV input range high limit (Setup bank)	C 06		1000	

- When the PV input range type is thermocouple or RTD, the setting item can be displayed, but the setting cannot be made.
- When the PV input range type is DC voltage or DC current, the display and setting can be made.

  The following describes the relationship between the PV input and PV when setting up the range low limit and high limit:



■ PV ratio and PV bias

The PV ratio and PV bias can be set to compensate the PV.

Item (Bank)	Display	Contents	Initial value	User level
PV ratio (Parameter bank)	rA	0.001 to 9.999	1.000	Standard, High function
PV bias (Parameter bank)	bI	-1999 to +9999 U	0U	Simple, Standard, High function

- Details of PV ratio and PV bias controls

  Assuming that the control input is PVin, control result is PVout, PV ratio is RA, and PV bias is BI, the following control formula is obtained:

  PVout = (PVin X RA) + BI

■ PV filter

This PV filter is a primary delay filter to be used if the PV repeatedly fluctuates rapidly and the control cannot be performed or if the PV fluctuates finely due to influence of noise, etc.
As a larger value is set, it becomes difficult to change the PV used for the control of this unit.
Normally, the PV filter is used with an initial value of "0.0".

Item (Bank)	Display	Contents	Initial value	User level
PV filter (Parameter bank)	FL	0.0: No filter 0.1 to 120.0s	0.0s	Simple, Standard, High function

$OUT = OUT_{-1} + (IN - OUT_{-1})/(T/Ts + 1)$

IN: Input to filter
OUT: Control output of current filter
OUT_{-1}: Control output of previous filter
T: Filter set value (s)
Ts: Sampling cycle time (0.1s)

■ PV hold

It is possible to set the PV to a fixed value using the PV hold, PV Max. hold, and PV Min. hold of the digital input (DI) functions.

PV hold: PV is set to a fixed value and it is not updated.
PV Max. hold: PV maximum value is held.
The PV value is updated only when the new PV value is larger than the currently held value.
PV Min. hold: PV minimum value is held.
The PV value is updated only when the new PV value is smaller than the currently held value.

When using the PV hold, PV Max. hold, or PV Min. hold, the PV indication on the upper display is flashing.

■ PV low limit/high limit and PV low limit/high limit alarms

PV low limit and PV high limit are provided for each PV input range type.
In principle, -10%FS of each range becomes the PV low limit while +110%FS becomes the PV high limit.
For details,
☞ refer to Operation in case of PV input failure (on page 10-2).
The PV is limited so that it is within a range between the PV low limit and PV high limit.
If the PV before activation of the PV ratio, PV bias, and PV filter is larger than the PV high limit, PV high limit alarm (AL01) occurs. On the contrary, if this PV is smaller than the PV low limit, the PV low limit alarm (AL02) occurs.

■ Zener barrier adjustment

When the PV input is RTD and uses the Zener barrier, the Zener barrier needs to be adjusted. Additionally, if three wiring resistances to the PV input terminal have any variation even though the Zener barrier is not used, the Zener barrier must also be adjusted.

When using an input other than RTD, this adjustment is not needed and cannot be performed.

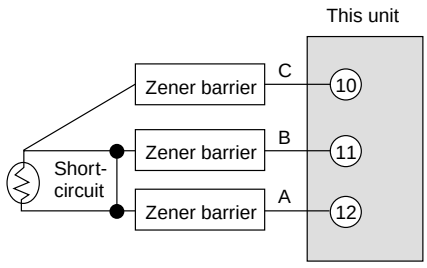
Item (Bank)	Display	Contents	Initial value	User level
Special function (Setup bank)	C 88	0 to 15 5: Zener barrier adjustment enabled.	0 (This value becomes zero (0) when the power is turned ON.)	High function
Zener barrier adjustment (Setup bank)	C 89	–20.000 to +20.00Ω (However, "–20.00" is displayed as "–19.99".) The value can be changed with the adjustment. The numeric value cannot be directly input with the manual operation.	0.00Ω	High function

● Adjusting procedures

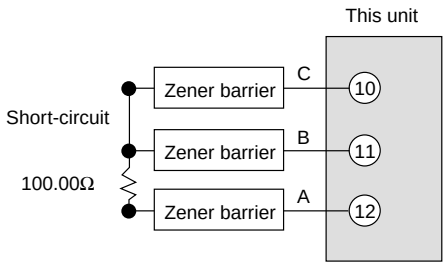
Follow the steps below to adjust the Zener barrier.

(1) Turn OFF the power to the unit and make any of the wiring status 1 to 3 while referring to the Table below.

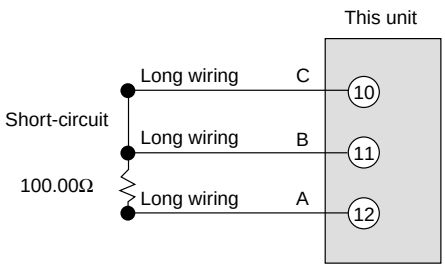
Applicable PV range type	Wiring status	Wiring contents
41 to 52, 63 to 68	1	Make A and B short-circuited with the RTD terminal.
41 to 52, 63 to 68	2	Remove the RTD, connect 100.00Ω-resistor to A and B of the Zener barrier, and make B and C short-circuited.
41 to 68	3	Remove the RTD at the top of the long extension wiring, connect 100.00Ω-resistor to A and B of the Zener barrier, and make B and C short-circuited.



Wiring status 1



Wiring status 2



Wiring status 3

(2) Turn ON the power to the unit and set “5” to [C88: Special function].

(3) Display [C89: Zener barrier adjustment].

Handling Precautions

(If [C01: PV range type] is not RTD or if [C88: Special function] is other than “5”, [C89: Zener barrier adjustment] is not displayed.)

(4) Press the [enter] key to display a difference in wiring resistance between the A and B lines on the lower display.

(5) Press the [enter] key to store the difference in wiring resistance between the A and B lines into this unit as an adjustment value.

(6) Turn OFF the power to the unit and connect the RTD correctly.

Handling Precautions

- The Zener barrier can be used only when the PV range type is 41 to 52 or 63 to 68.
- Use a Zener barrier having a DC resistance value of 70Ω or less.
- Adjust the Zener barrier with a resistance difference between the Zener barrier and long extension wiring of 20Ω or less. If this resistance difference is 20Ω or more, the Zener barrier cannot be adjusted and the adjustment value becomes 0.00Ω.
- Once the Zener barrier has been adjusted, the correction is performed with the same adjustment value even though the PV range type is changed to other RTD.
- To return the adjustment value to 0.00Ω, perform above steps (2) to (5) with nothing connected to the PV input terminal.

5 - 2 Mode

It is possible to set the AUTO/MANUAL mode selection, RUN/READY mode selection, LSP/RSP mode selection, Auto Tuning (AT) stop/start selection, release all digital output (DO) latches, and OFF/ON selection of communication digital input 1 (communication DI 1).

■ AUTO/MANUAL mode

The AUTO/MANUAL mode selection can be set.

Item (Bank)	Display	Contents	Initial value	User level
AUTO/MANUAL (Mode bank)	A--M	AUto: AUTO mode [Communication value is "0".] MAn: MANUAL mode [Communication value is "1".]	AUto	Simple, Standard, High function

- When the AUTO/MANUAL mode is changed, the display is automatically returned to the operation display.
- If the operation type of internal contacts 1 to 5 is set at “AUTO/MANUAL”, [A--M: AUTO/MANUAL] can be displayed, but the setting cannot be configured.
- When [CtrL: Control method] is set at "0" (ON/OFF control), [A--M: AUTO/MANUAL] cannot be displayed and set.
- When [bit 0: AUTO/MANUAL display] of [C73: MODE display setup] is set at "0" (no display), [A--M: AUTO/MANUAL] cannot be displayed and set.

■ RUN/READY mode

The RUN/READY mode selection can be set.

Item (Bank)	Display	Contents	Initial value	User level
RUN/READY (Mode bank)	r--r	rUn: RUN mode [Communication value is "0".] rdy: READY mode [Communication value is "1".]	rUn	Simple, Standard, High function

- If the operation type of internal contacts 1 to 5 is set at “RUN/READY”, [r--r: RUN/READY] can be displayed, but the setting cannot be configured.
- When [bit 1: RUN/READY display] of [C73: MODE display setup] is set at "0" (no display), [r--r: RUN/READY] cannot be displayed and set.

■ LSP/RSP mode

The LSP/RSP mode selection can be set.

Item (Bank)	Display	Contents	Initial value	User level
LSP/RSP (Mode bank)	L--r	LSP: LSP mode [Communication value is "0".] RSP: RSP mode [Communication value is "1".]	LSP	Simple, Standard, High function

- If the operation type of internal contacts 1 to 5 is set at “LSP/RSP”, [L--r: LSP/RSP] can be displayed, but the setting cannot be configured.
- When [bit 2: LSP/RSP display] of [C73: MODE display setup] is set at "0" (no display), [L--r: LSP/RSP] cannot be displayed and set.
- If the model does not have the RSP mode, [L--r: LSP/RSP] cannot be displayed and set.

■ Auto tuning (AT) stop/start

The AT stop/start selection can be set.

Item (Bank)	Display	Contents	Initial value	User level
Auto Tuning (AT) stop/start (Mode bank)	AT	At.oF: AT stop [Communication value is "0".] At.on: AT start [Communication value is "1".]	At.oF	Simple, Standard, High function

- The AT is stopped in the MANUAL or READY mode.
- If the PV high limit alarm (AL01) or PV low limit alarm (AL02) occurs, the AT is stopped.
- If the operation type of internal contacts 1 to 5 is set at "AT stop/start", [At: AT stop/start] can be displayed, but the setting cannot be made.
- When [CtrL: Control method] is set at "0" (ON/OFF control), [At: AT stop/start] cannot be displayed and set.
- When [bit 3: AT stop/start display] of [C73: MODE display setup] is set at "0" (no display), [At: AT stop/start] cannot be displayed and set.

For details about AT,

☞ refer to AT (on page 5-26) and AT function (on page 5-29).

■ Release all digital output (DO) latches

Release all digital output (DO) latches can be set.

Item (Bank)	Display	Contents	Initial value	User level
Release all digital output (DO) latches (Mode bank)	do.Lt	Lt.on: Latch is continued. [Communication value is "0".] Lt.oF: Latch is released. [Communication value is "1".])	Lt.on	Simple, Standard, High function

- If the operation type of internal contacts 1 to 5 is set at "Release all DO latches", [do.Lt: Release all DO latches] can be displayed, but the setting cannot be configured.
- When [bit 4: Release all DO latches display] of [C73: MODE display setup] is set at "0" (no display), [do.Lt: Release all DO latches] cannot be displayed and set.

■ Communication digital input 1 (communication DI 1)

Communication digital input 1 (communication DI 1) can be set.

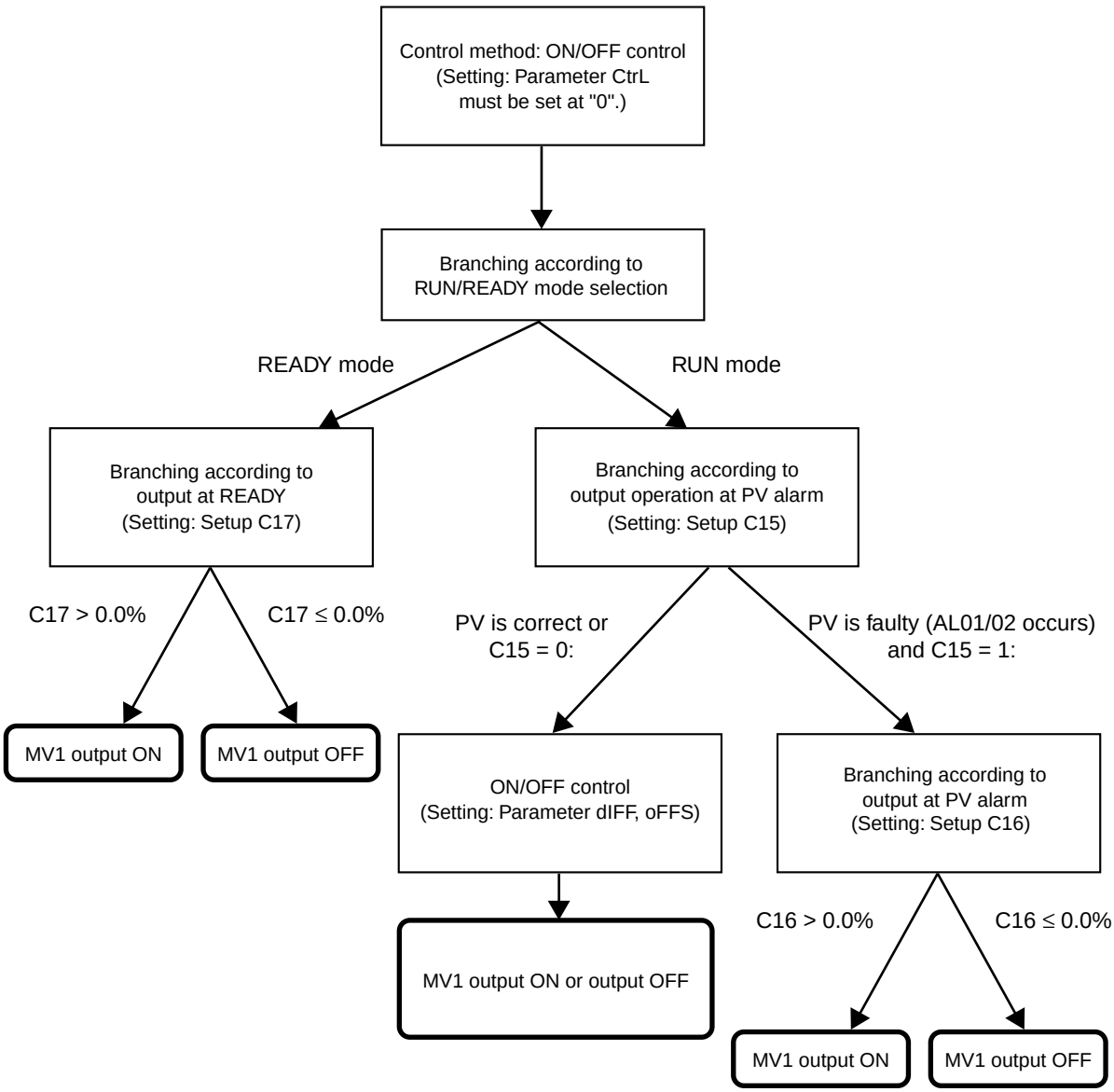
Item (Bank)	Display	Contents	Initial value	User level
Communication digital input 1 (communication DI 1) (Mode bank)	C.dI 1	DI.oF: Communication DI1. OFF [Communication value is "0".] DI.on: Communication DI1. ON [Communication value is "1".]	DI.oF	Simple, Standard, High function

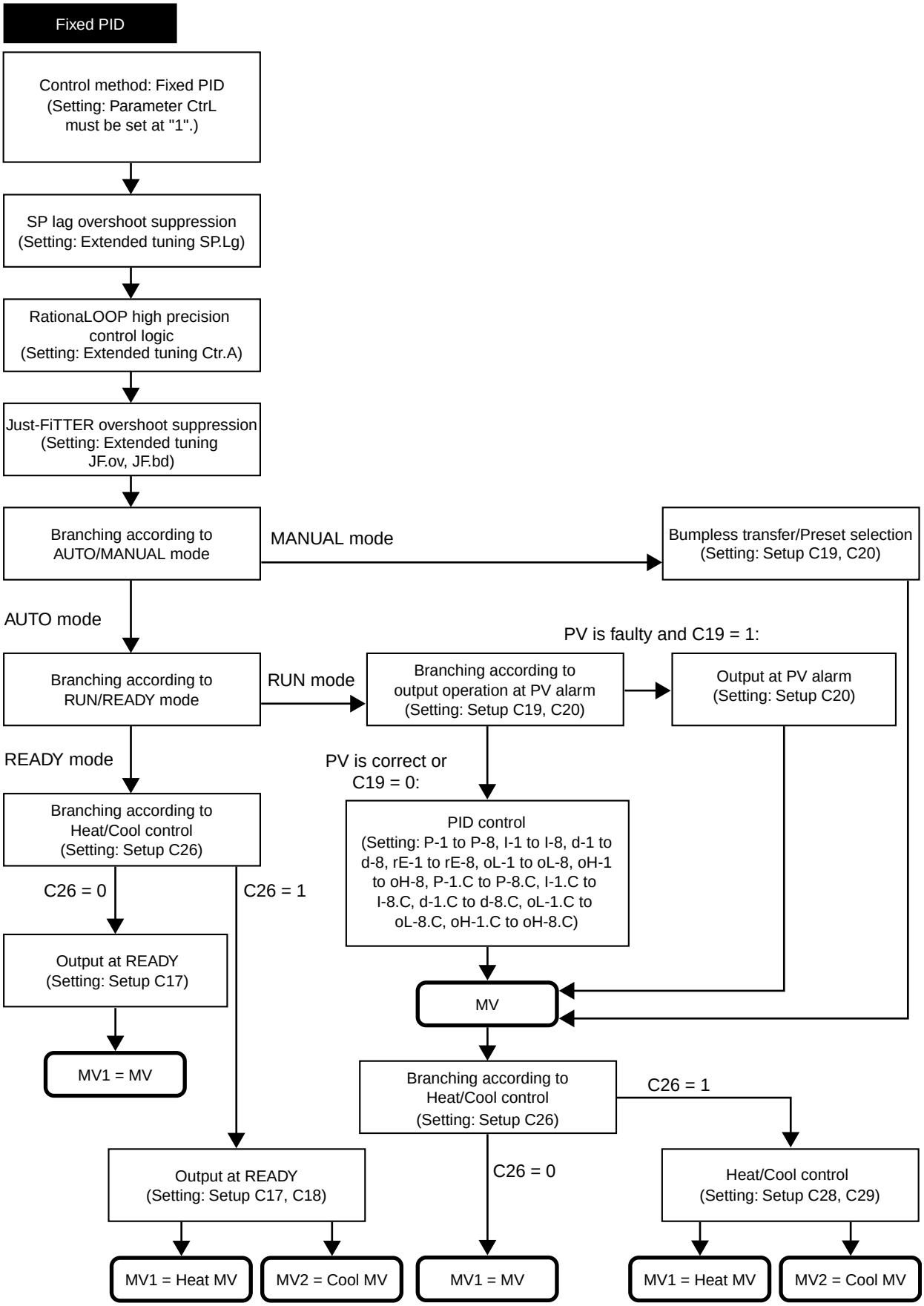
- Four communication DIs, DI1 to DI4, are provided. However, only communication DI 1 can be set using the key operation.
- The function (operation) with communication DI 1 can be set using the DI Assignment.
- When [bit 5: Communication DI 1 display] of [C73: MODE display setup] is set at "0" (no display), [C.DI1: Communication DI 1] cannot be displayed and set.

5 - 3 Control

The following shows the functional block diagram of the control (ON/OFF control, PID control, RationaLOOP control, and Heat/Cool control, etc.):

ON/OFF control




Fixed PID
Control method: Fixed PID
(Setting: Parameter CtrL
must be set at "1".)
SP lag overshoot suppression
(Setting: Extended tuning SP.Lg)
RationaLOOP high precision
control logic
(Setting: Extended tuning Ctr.A)
Just-FiTTER overshoot suppression
(Setting: Extended tuning
JF.ov, JF.bd)
Branching according to
AUTO/MANUAL mode
MANUAL mode
Bumpless transfer/Preset selection
(Setting: Setup C19, C20)
AUTO mode
PV is faulty and C19 = 1:
Branching according to
RUN/READY mode
RUN mode
Branching according to
output operation at PV alarm
(Setting: Setup C19, C20)
Output at PV alarm
(Setting: Setup C20)
READY mode
PV is correct or
C19 = 0:
Branching according to
Heat/Cool control
(Setting: Setup C26)
PID control
(Setting: P-1 to P-8, I-1 to I-8, d-1 to
d-8, rE-1 to rE-8, oL-1 to oL-8, oH-1
to oH-8, P-1.C to P-8.C, I-1.C to
I-8.C, d-1.C to d-8.C, oL-1.C to
oL-8.C, oH-1.C to oH-8.C)
C26 = 0
C26 = 1
Output at READY
(Setting: Setup C17)
MV
MV1 = MV
Branching according to
Heat/Cool control
(Setting: Setup C26)
C26 = 1
Output at READY
(Setting: Setup C17, C18)
C26 = 0
Heat/Cool control
(Setting: Setup C28, C29)
MV1 = Heat MV
MV2 = Cool MV
MV1 = MV
MV1 = Heat MV
MV2 = Cool MV

■ Control method

A desired control method can be selected from two kinds of control methods.

Item (Bank)	Display	Contents	Initial value	User level
Control method (Parameter bank)	CtrL	0: ON/OFF control 1: Fixed PID	0 or 1	Simple, Standard, High function

- When the control output type is the position proportional output, only [1: Fixed PID] can be selected.
- When the control output type is relay (R0), the initial value becomes "0". The initial value is "1" in other cases.
- "Fixed" of [1: Fixed PID] means that the PID constant is not changed automatically since the self-tuning (ST) provided for SDC15 is not run. However, the AT can be run even in the fixed PID control.
- The following table shows valid and invalid functions related to [1: Fixed PID], as well as other related parameters:

Classification of Heat/Cool control	Classification of RationaLOOP	Classification of control action	RationaLOOP function	AT	Just-FiTTER
Normal control	Normal PID	P control	X	❍✻	X
		PI control	X	❍✻	❍
		PD control	X	❍✻	X
		PID control	X	❍	❍
	RationaLOOP	P control	X	❍✻	X
		PI control	X	❍✻	❍
		PD control	X	❍✻	X
		PID control	❍	❍	❍
Heat/Cool control	Normal PID	P control	X	❍✻	X
		PI control	X	❍✻	❍
		PD control	X	❍✻	X
		PID control	X	❍	❍
	RationaLOOP	P control	X	❍✻	X
		PI control	X	❍✻	❍
		PD control	X	❍✻	X
		PID control	❍	❍	❍
Remarks				✻Adjustment result becomes the PID control.	
Related settings			Control algorithm	AT type	Just-FiTTER overshoot limit/ restraint/control coefficient
				MV low limit at AT	Just-FiTTER settling band
				MV high limit at AT	
				AT Proportional band adjust	
				AT Integral time adjust	
				AT Derivative time adjust	

■ Control action and Heat/Cool control

The control action (direct/reverse) and Heat/Cool control (enabled/disabled) can be selected.

Item (Bank)	Display	Contents	Initial value	User level
Control action (direct/reverse) (Setup bank)	C 14	0: Heat control (Reverse) 1: Cool control (Direct)	0	Simple, Standard, High function
Heat/Cool control (Setup bank)	C 26	0: Disabled. 1: Enabled.	0	Simple, Standard, High function

- When the control method is other than the ON/OFF control (CtrL ≠ 0), [C26: Heat/Cool control] can be displayed and set.
- When the Heat/Cool control is set disabled (C26 = 0), [C14: Control action] can be displayed and set.
- When the Heat/Cool control is set disabled (C26 = 0), both [C20: Preset MANUAL value] and [C22: Initial output of PID control] are changed to "0.0".
- When the Heat/Cool control is set enabled (C26 = 1), both [C20: Preset MANUAL value] and [C22: Initial output of PID control] are changed to "50.0".
- The reverse action (heat control) is a control that decreases (or turns OFF) the manipulated variable (MV) as the PV increases.
  The direct action (cool control) is a control that increases (or turns ON) the manipulated variable (MV) as the PV increases.

■ Special control outputs

The control output at PV alarm and control output at READY can be set.

Item (Bank)	Display	Contents	Initial value	User level
Output operation at PV alarm (Setup bank)	C 15	0: Control calculation is continued. 1: Output at PV alarm is output.	0	High function
Output at PV alarm (Setup bank)	C 16	-10.0 to +110.0%	0.0%	High function
Output at READY (Heat) (Setup bank)	C 17	-10.0 to +110.0%	0.0%	Standard, High function
Output at READY (Cool) (Setup bank)	C 18	-10.0 to +110.0%	0.0%	Standard, High function

- When the control method is other than the ON/OFF control (CtrL ≠ 0) and the Heat/Cool control is set enabled (C26 = 1), [C18: Output at READY (cool)] can be displayed and set.
- The PV alarm status means that AL01, 02, or 03 occurs.

■ MANUAL mode change

The control output when the AUTO mode is changed to the MANUAL mode can be set.

Item (Bank)	Display	Contents	Initial value	User level
Output operation at changing Auto/Manual (Setup bank)	C 19	0: Bumpless transfer 1: Preset	0	Standard, High function
Preset MANUAL value (Setup bank)	C 20	-10.0 to +110.0%	0.0 or 50.0%	Standard, High function

- When [C19: Output operation at changing Auto/Manual] is set at [0: Bumpless transfer], the manipulated variable (MV) when the AUTO mode is changed to the MANUAL mode is retained. When set at [1: Preset], the manipulated variable (MV) is set to [C20: Preset MANUAL value] when the AUTO mode is changed to the MANUAL mode.
- When the control method is other than ON/OFF control (CtrL ≠ 0), [C19: Output operation at changing Auto/Manual] and [C20: Preset MANUAL value] can be displayed and set.
- When the Heat/Cool control is not used (C26 = 0), the initial value of [C20: Preset MANUAL value] is [0.0]. On the contrary, when the Heat/Cool control is used (C26 =1), this initial value becomes [50.0].

Handling Precautions

When the unit is in the MANUAL mode if the power is turned ON, the set value of C20 becomes the initial manipulated variable (MV).

■ PID control initialization

Item (Bank)	Display	Contents	Initial value	User level
Initial output type (mode) of PID control (Setup bank)	C 21	0: Auto 1: Not initialized. 2: Initialized. (If SP value different from the current value is input.)	0	High function

- When the control method is other than the ON/OFF control (CtrL≠0), the display and setting can be performed.
- If the PID group is changed as the SP value or SP group is changed, the manipulated variable (MV) is stopped at its low limit or high limit, and then the PV may not change or may overshoot. To prevent such trouble, it is effective to initialize the PID control.
- The setting is “0” (Auto).
  It is judged automatically whether or not the PID control needs to be initialized as the SP value or SP group is changed. As a result, the PID control is initialized only when it is required.
- The setting is “1” (Not initialized).
  Even though the SP value or SP group is changed, the PID control is not initialized. This setting is effective when the continuation of the manipulated variable (MV) is important if the SP value or SP group is changed.
- The setting is “2” (Initialized).
  Every time the SP value or SP group is changed, the PID control is always initialized. This setting is effective when it is important that an increase or a decrease in manipulated variable (MV) immediately affects the relationship between the PV and SP when the SP value or SP group is changed.

■ Initial output of PID control

Item (Bank)	Display	Contents	Initial value	User level
Initial output of PID control (Setup bank)	C 22	–10.0 to +110.0%	0.0% or 50.0%	High function

- When the control method is other than the ON/OFF control (CtrL≠0), the display and setting can be performed.
- This value is used for the PID control immediately after the operation mode is changed from READY to RUN or the operation mode becomes RUN as the power is turned ON. This value greatly affects the manipulated variable (MV) when the operation mode is changed.
- When the setting of the Heat/Cool control (C26) is changed, the value is automatically set again. When [C26: Heat/Cool control] is changed to "Enabled" (C26=1), the value becomes "50.0%". On the contrary, when the setting is changed to "Disabled" (C26=0), the value becomes "0.0%".

■ PID decimal point position

Item (Bank)	Display	Contents	Initial value	User level
PID decimal point position (Setup bank)	C 23	0: No decimal point 1: 1 digit after decimal point (Decimal point of integral time and derivative time)	0	High function

- When the control method is other than the ON/OFF control (CtrL≠0), the display and setting can be performed.
- When this setting is set at "0", the integral time and derivative time settings become 0 to 9999s.
- When this setting is set at "1", the integral time and derivative time settings become 0.0 to 999.9s.

[!] Handling Precautions

When the setting of the PID decimal point position is changed, the integral time and derivative time values are divided by 10 (1/10) or multiplied by 10, and the control characteristics may be changed greatly.

After the setting has been changed, always set the integral time and derivative time to an appropriate value again.

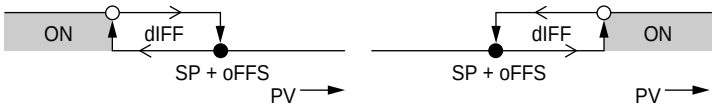
For example, if the setting of the PID decimal point position is changed from "0" to "1" with integral time of 120s, the integral time becomes 12.0s.

■ ON/OFF control

The ON/OFF control related items can be set.

Item (Bank)	Display	Contents	Initial value	User level
Differential (for ON/OFF control) (Parameter bank)	dIFF	0 to 9999U	5U	Simple, Standard, High function
ON/OFF control action point offset (Parameter bank)	oFFS	-1999 to +9999U	0U	High function

- [Differential (for ON/OFF control): dIFF] and [ON/OFF control action point offset: oFFS] can be displayed and set when the control method is the ON/OFF control (CtrL = 0).
- The following Figure shows the operation of the ON/OFF control:



Heat control (Reverse action) Cool control (Direct action)

● shows that the ON/OFF is changed at this value.

❍ shows that the ON/OFF is changed at a point that "1U" is added to this value.

- The following describes examples showing how to use the ON/OFF control action point offset:

  To turn OFF the output at 205˚C or more and turn ON the output at less than 190˚C with the heat control and SP = 200˚C, the differential is set to 15˚C and the offset is set to 5˚C.

  To turn OFF the output at 5˚C or less and turn ON the output at more than 10˚C with the cool control and SP = 10˚C, the differential is set to 5˚C and the offset is set to -5˚C.

■ PID control

In the fixed PID control, the PID control related items can be set.

Item (Bank)	Display	Contents	Initial value	User level
Proportional band (PID1) (PID bank)	P-1	0.1 to 999.9%	5.0%	Simple, Standard, High function
Integral time (PID1) (PID bank)	I-1	0 to 9999s (No integration control action when set at "0".)	120s	
Derivative time (PID1) (PID bank)	d-1	0 to 9999s (No derivative control action when set at "0".)	30s	
Manual reset (PID1) (PID bank)	rE-1	-10.0 to +110.0%	50.0%	
MV low limit (PID1) (PID bank)	oL-1	-10.0 to +110.0%	0.0%	Standard, High function
MV high limit (PID1) (PID bank)	oH-1	-10.0 to +110.0%	100.0%	
Proportional band for cool side (PID1) (PID bank)	P-1C	0.1 to 999.9%	5.0%	Simple, Standard, High function
Integral time for cool side (PID1) (PID bank)	I-1C	0 to 9999s (No integration control action when set at "0".)	120s	
Derivative time for cool side (PID1) (PID bank)	d-1C	0 to 9999s (No derivative control action when set at "0".)	30s	
Output low limit for cool side (PID1) (PID bank)	oL1C	-10.0 to +110.0%	0.0%	Standard, High function
Output high limit for cool side (PID1) (PID bank)	oH1C	-10.0 to +110.0%	100.0%	
Proportional band (PID 2)	P-2	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 2)	I-2		120s	
Derivative time (PID 2)	d-2		30s	
Manual reset (PID 2)	rE-2		50.0%	
MV low limit (PID 2)	oL-2	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 2)	oH-2		100.0%	
Proportional band for cool side (PID 2)	P-2C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 2)	I-2C		120s	
Derivative time for cool side (PID 2)	d-2C		30s	
Output low limit for cool side (PID 2)	oL2C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 2)	oH2C		100.0%	

(Note) For presence of the decimal point, when [C23: PID decimal point position] is set at “0”, the decimal point does not exist. When this setting is set at “1”, the decimal point exists.

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
Proportional band (PID 3)	P-3	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 3)	I-3		120s	
Derivative time (PID 3)	d-3		30s	
Manual reset (PID 3)	rE-3		50.0%	
MV low limit (PID 3)	oL-3	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 3)	oH-3		100.0%	
Proportional band for cool side (PID 3)	P-3C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 3)	I-3C		120s	
Derivative time for cool side (PID 3)	d-3C		30s	
Output low limit for cool side (PID 3)	oL3C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 3)	oH3C		100.0%	
Proportional band (PID 4)	P-4	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 4)	I-4		120s	
Derivative time (PID 4)	d-4		30s	
Manual reset (PID 4)	rE-4		50.0%	
MV low limit (PID 4)	oL-4	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 4)	oH-4		100.0%	
Proportional band for cool side (PID 4)	P-4C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 4)	I-4C		120s	
Derivative time for cool side (PID 4)	d-4C		30s	
Output low limit for cool side (PID 4)	oL4C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 4)	oH4C		100.0%	
Proportional band (PID 5)	P-5	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 5)	I-5		120s	
Derivative time (PID 5)	d-5		30s	
Manual reset (PID 5)	rE-5		50.0%	

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
MV low limit (PID 5)	oL-5	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 5)	oH-5		100.0%	
Proportional band for cool side (PID 5)	P-5.C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 5)	I-5.C		120s	
Derivative time for cool side (PID 5)	d-5.C		30s	
Output low limit for cool side (PID 5)	oL5.C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 5)	oH5.C		100.0%	
Proportional band (PID 6)	P-6	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 6)	I-6		120s	
Derivative time (PID 6)	d-6		30s	
Manual reset (PID 6)	rE-6		50.0%	
MV low limit (PID 6)	oL-6	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 6)	oH-6		100.0%	
Proportional band for cool side (PID 6)	P-6.C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 6)	I-6.C		120s	
Derivative time for cool side (PID 6)	d-6.C		30s	
Output low limit for cool side (PID 6)	oL6.C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 6)	oH6.C		100.0%	
Proportional band (PID 7)	P-7	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 7)	I-7		120s	
Derivative time (PID 7)	d-7		30s	
Manual reset (PID 7)	rE-7		50.0%	
MV low limit (PID 7)	oL-7	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 7)	oH-7		100.0%	

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
Proportional band for cool side (PID 7)	P-7.C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 7)	I-7.C		120s	
Derivative time for cool side (PID 7)	d-7.C		30s	
Output low limit for cool side (PID 7)	oL7.C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 7)	oH7.C		100.0%	
Proportional band (PID 8)	P-8	Same as PID 1	5.0%	Simple, Standard, High function
Integral time (PID 8)	I-8		120s	
Derivative time (PID 8)	d-8		30s	
Manual reset (PID 8)	rE-8		50.0%	
MV low limit (PID 8)	oL-8	Same as PID 1	0.0%	Standard, High function
MV high limit (PID 8)	oH-8		100.0%	
Proportional band for cool side (PID 8)	P-8.C	Same as PID 1	5.0%	Simple, Standard, High function
Integral time for cool side (PID 8)	I-8.C		120s	
Derivative time for cool side (PID 8)	d-8.C		30s	
Output low limit for cool side (PID 8)	oL8.C	Same as PID 1	0.0%	Standard, High function
Output high limit for cool side (PID 8)	oH8.C		100.0%	

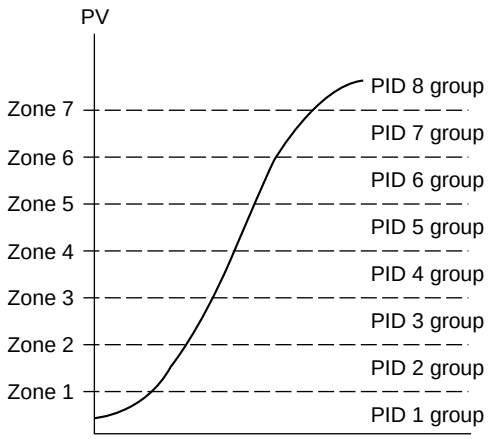
- When the control method is other than the ON/OFF control (CtrL ≠ 0), the display and setting can be configured.
- [... for cool side] related items can be displayed and set when [C26: Heat/Cool control] is set to [1: Enabled].
- When the Integral time (I-x) is set at “0s” or Integral time for cool side (I-x.C) is set at “0s” in the Heat/Cool control, no integration control action is performed. The Manual reset (rE-x) can be used in both the heat and cool controls.
- Parameter settings for the cool control are displayed only when the Heat/Cool control is set enabled.
- When the Integral time for heat side or cool side is "0s", the operation is processed with both Integral time for heat side and cool side set at "0s".
- If the setting is made so that the output low limit is greater than the output high limit, the operation is performed with the low limit swapped for the high limit automatically.

■ Zone PID

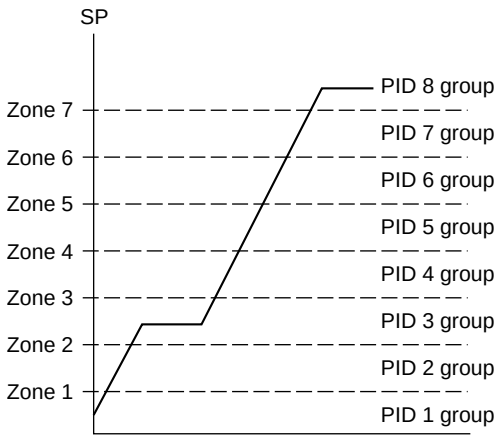
In the PID fixed control, the PID group auto change function by the SP or PV can be selected.

Item (Bank)	Display	Contents	Initial value	User level
zone PID operation (Setup bank)	C 24	0: Disabled. 1: Changed by SP. 2: Changed by PV.	0	High function
Zone 1 (Zone bank)	Zn-1	–1999 to +9999U	9999U	High function
Zone 2 (Zone bank)	Zn-2		9999U	
Zone 3 (Zone bank)	Zn-3		9999U	
Zone 4 (Zone bank)	Zn-4		9999U	
Zone 5 (Zone bank)	Zn-5		9999U	
Zone 6 (Zone bank)	Zn-6		9999U	
Zone 7 (Zone bank)	Zn-7		9999U	
Zone hysteresis (Zone bank)	Zn.dF	0 to 9999U	5U	

- When the PID fixed control (CtrL=1) is used, the display and setting can be performed.
- When [C24: Zone PID operation] is set at “0: Disabled.”, the PID group setting of the SP bank becomes valid.
- When the zone PID operation is set at “Enabled.” (C24=1 or 2), the PID group setting of the SP bank becomes invalid and the PID group is automatically changed as described in the following. Additionally, a hysteresis can be set so that the PID group is not changed frequently by a small change of the PV or SP at a position close to the zone set value.



PID group zone change by PV



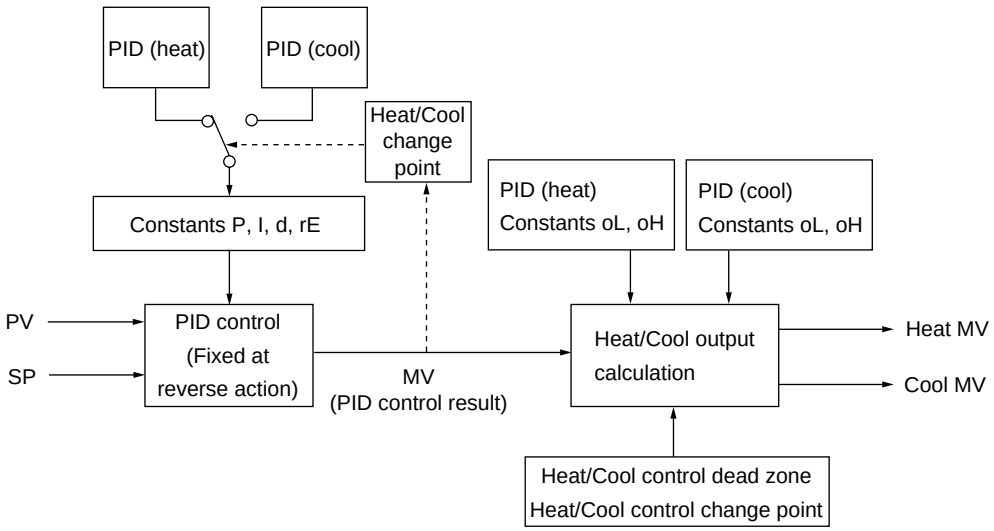
PID group zone change by SP

■ Heat/Cool control

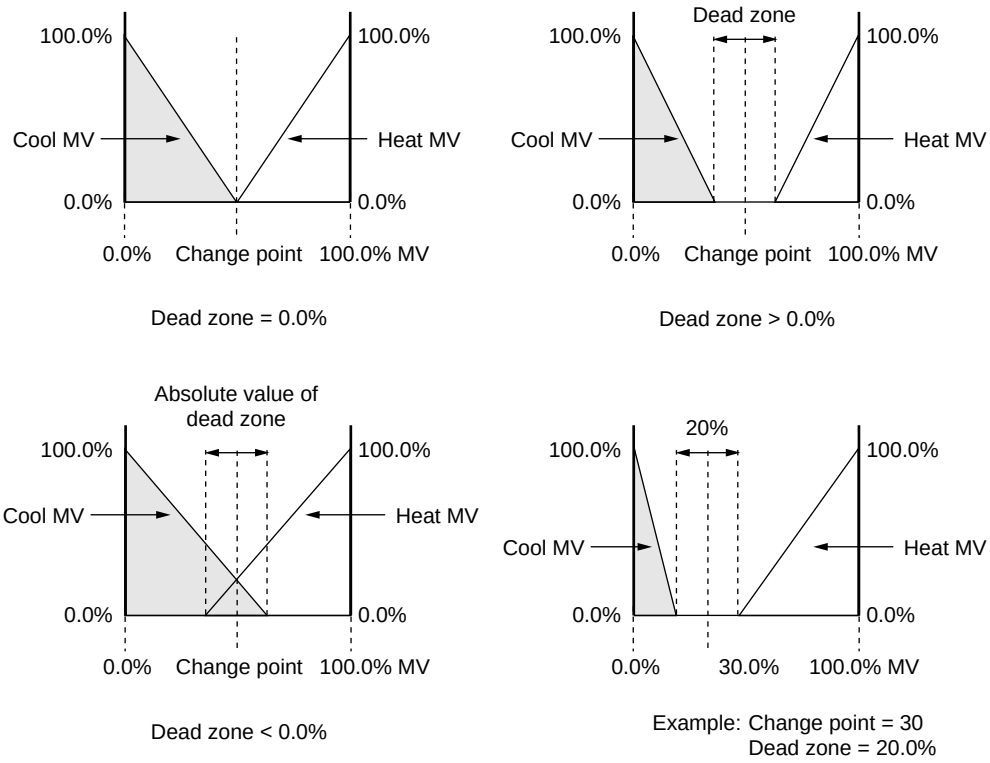
The Heat/Cool control related items, such as Heat/Cool, Heat/Cool control dead zone, and Heat/Cool change point can be set.

Item (Bank)	Display	Contents	Initial value	User level
Heat/Cool (Setup bank)	C 27	0: Normal 1: Energy saving	0	Standard, High function
Heat/Cool control dead zone (Setup bank)	C 28	-100.0 to +100.0%	0.0%	Simple, Standard, High function
Heat/Cool change point (Setup bank)	C 29	-10.0 to +110.0%	50.0%	High function

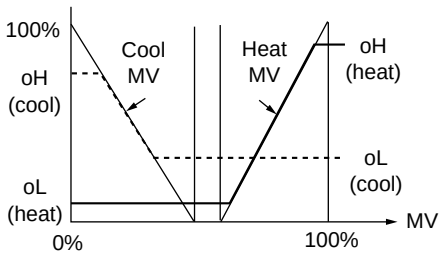
The following shows the Heat/Cool control calculation:



- When [C26: Heat/Cool control] is set to [1: Enabled], the display and setting can be made.
- When MV ≥ 50%, the control is changed to the PID (heat).
- When MV < 50%, the control is changed to the PID (cool).
- When [C27: Heat/Cool] is set to [1: Energy saving], the heat/cool change is suppressed to indirectly obtain the energy saving effect. However, when [C28: Heat/Cool control dead zone] is less than 0.0%, the energy saving effect cannot be obtained.
- How the relationship between the output (heat) and output (cool) is made for the PID control result (MV) is set.



Constants oL and oH function as shown in the Figure below.



■ Auto tuning (AT)

The following AT related items can be set:

Item (Bank)	Display	Contents	Initial value	User level
MV low limit at AT (Parameter bank)	AT.oL	-10.0 to +110.0%	0.0%	Simple, Standard, High function
MV high limit at AT (Parameter bank)	AT.oH	-10.0 to +110.0%	100.0%	
AT type (Extended tuning bank)	AT.tY	0: Normal (Standard control characteristics) 1: Immediate response (Control characteristics that respond immediately to external disturbance.) 2: Stability (Control characteristics having less up/down fluctuation of PV)	1	
AT Proportional band adjust (Extended tuning bank)	AT-P	0.00 to 99.99	1.00	High function
AT Integral time adjust (Extended tuning bank)	AT-I	0.00 to 99.99	1.00	
AT Derivative time adjust (Extended tuning bank)	AT-d	0.00 to 99.99	1.00	

- When the control method is other than the ON/OFF control (CtrL ≠ 0), the display and setting can be configured.
- The manipulated variable (MV) during execution of AT can be limited by the MV low limit at AT (At.oL) and MV high limit at AT (AT.oH).

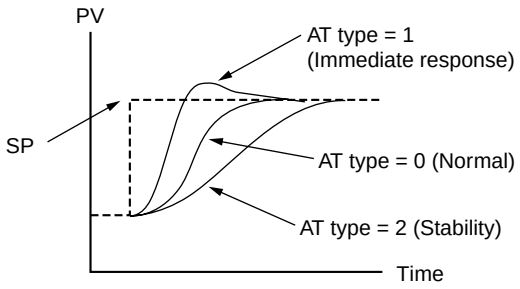
  When the Heat/Cool control is not used, the MV becomes a value limited by both the MV low limit at AT (At.oL)/MV high limit at AT (At.oH) and MV low limit (oL-x)/MV high limit (oH-x) of the PID constant.

  When the Heat/Cool control is used, the MV becomes a value limited by the MV low limit at AT (At.oL)/MV high limit at AT (At.oH), the heat MV becomes a value limited by the MV low limit (oL-x)/MV high limit (oH-x) of the PID constant, and the cool MV becomes a value limited by the output low limit for cool side (oLx.C)/output high limit for cool side (oHx.C) of the PID constant.
- The AT type (At.ty) is a setting item that the PID constant of the control characteristics suitable for the system is calculated by the AT.
  Set value 1 (immediate response) is adjusted to the process that the heater heating directly affects the PV to aim at the adjustment considering the immediate response.
  Set value 2 (stability) is adjusted to the process that the heater heating indirectly affects the PV to aim at the adjustment considering the stability.
- If the setting is made so that the MV low limit at AT is greater than MV high limit at AT, the operation is performed with the low limit swapped for the high limit automatically.

📖 Note

When compared to the AT functions of Yamatake's older models, set value 1 (immediate response) is close to the SDC10 and set value 0 (normal) is close to the SDC20/21 and SDC30/31.

The following figure shows the conceptual diagram expressing differences in control result using the PID constant calculated by each AT type:



Difference in PV change when SP is changed.

- For the AT Proportional band adjustment (At-P), AT Integral time adjustment (At-I), and AT Derivative time adjustment (At-d), the value that the PID constant calculated by the AT is multiplied by each coefficient is written into the set value of the PID constant. However, the coefficient must be a value in the PID constant setting range.

Note

- In the Heat/Cool control, it is possible to execute the AT only on the heat or cool side.
- Setting that the AT is activated for only the heat PID constant in the Heat/Cool control:
  50.0% <MV low limit at AT (At.oL) < MV high limit at AT (At.oH)
- Setting that the AT is activated for only the cool PID constant in the Heat/Cool control:
  MV low limit at AT (At.oL) < MV high limit at AT (At.oH) < 50.0%

For details about AT,

☞ refer to AT stop/start (on page 5-11) and AT function (on page 5-29).

■ Just-FiTTER

This Just-FiTTER function provides the effect of the overshoot suppression and the following items can be set:

Item (Bank)	Display	Contents	Initial value	User level
Just-FiTTER overshoot limit/restraint/control coefficient (Extended tuning bank)	JF.ov	0 to 100 (“0”: JF function disabled)	0	Standard, High function
Just-FiTTER settling band (Extended tuning bank)	JF.bd	0.00 to 10.00%	0.30%	High function

- When the control method is other than the ON/OFF control (CtrL ≠ 0), the display and setting can be configured.
- Function of Just-FiTTER overshoot limit/restraint/control coefficient (JF.ov)
  When the Just-FiTTER overshoot limit/restraint/control coefficient (JF.ov) is set to “0”, the Just-FiTTER function becomes invalid.
  When this coefficient is “1” or more, the effect of the overshoot limit/restraint/control becomes larger as the coefficient becomes larger.
- Function of Just-FiTTER settling band (JF.bd)
  When the % value of the width of the absolute value deviation to the PV range is larger than the set value, the Just-FiTTER function is started. When this value is smaller than the set value, this is judged as that the PV is settled by the Just-FiTTER function.

■ RationaLOOP

This RationaLOOP function suppresses the unstable trend if the immediate response to external disturbance is increased by the high precision control logic. The following items can be set:

Item (Bank)	Display	Contents	Initial value	User level
Control algorithm (Extended tuning bank)	CtrA	0: PID (Conventional PID) 1: RationaLOOP (High-performance PID)	0	Standard, High function

- When the control method is other than the ON/OFF control (CtrL ≠ 0), the display and setting can be made.

■ SP lag

This SP lag function suppresses changes in MV when the SP is changed. The following items can be set:

Item (Bank)	Display	Contents	Initial value	User level
SP lag constant (Extended tuning bank)	SP.Lg	0.0 to 999.9 (No effect when set at “0.0”.)	0.0	High function

- When the control method is other than the ON/OFF control (CtrL ≠ 0), the display and setting can be made.
- Function of SP lag constant (SP.Lg)
  When the SP lag constant is set at "0.0", the SP lag function becomes invalid.
  When this value is "0.1" or more, changes in MV when the SP is changed become smaller and the effect of the overshoot suppression becomes larger as the value becomes larger.

5 - 4 Auto Tuning (AT) Function

The auto tuning (AT) function is used when the PID constants are set automatically with the control method set at "Fixed PID" ([CtrL = 1]).

The AT function can be used when the control method is set to "Fixed PID".

■ Starting procedures

(1) Make sure that the PV input or operation end (heater power, etc.) is controllable.

(2) Using the [r- -r] setup of the mode bank, multi-status display, and LED monitor, make sure that the operation is in the RUN mode. If the indicator [rdy] is lit and the operation is in the READY mode, change the mode to the RUN mode.

(3) Make sure that the mode indicator [man] is off and the operation is in the AUTO mode. If the indicator [man] is lit and the operation is in the MANUAL mode, change the mode to the AUTO mode.

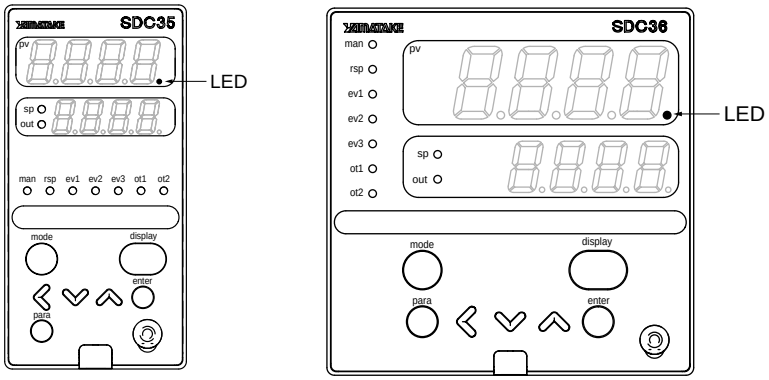
(4) Set the parameter setting [AT Stop/Start] to "AT start ([At] = [At.on])".

■ Stopping procedures

The AT function is completed automatically. To stop the AT function, which is running, change the parameter setting [AT Stop/Start] to AT stop ([At] = [At.oF]). Additionally, the AT function is stopped when changing the READY mode to the MANUAL mode.

● Display during execution of AT

The decimal point at the 1st digit of the upper display (right end digit) flashes twice repeatedly while the AT function is running. When the AT function is completed and the PID constants are changed, this LED goes off.

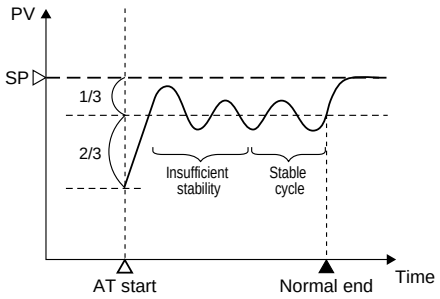


● Operation during execution of AT

The AT function calculates the PID constants using the limit cycle.

(1) When the AT function is started, a point, where the SP and PV deviations are split to "2:1", is determined as ON/OFF change point of the manipulated variable (MV).

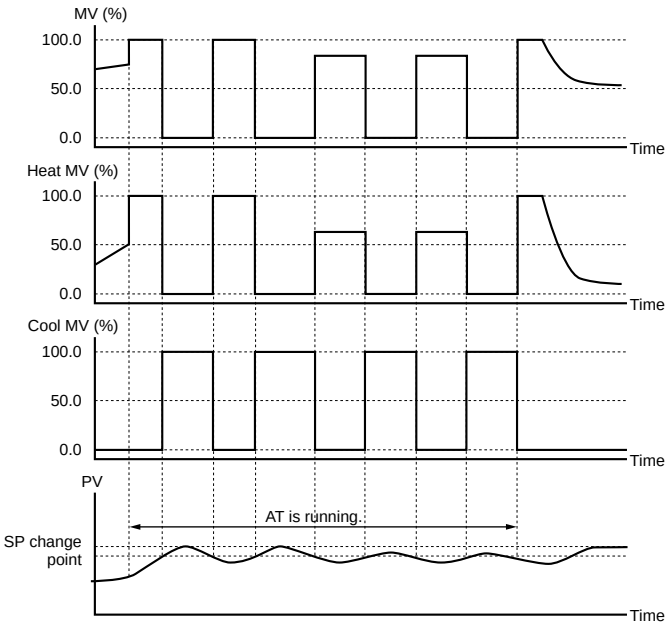
(2) When the limit cycle is judged as stable, the PID constants are changed and the AT function is completed.



In the Heat/Cool control, the AT function is run in the status that both the heat MV and cool MV are operated.

In the first half, the MV is changed to the MV low limit/MV high limit. In the latter half, the MV is changed in a slightly narrow range.

The following Figure shows an example of the AT execution when the Heat/Cool control dead zone is 0.0%, Heat/Cool control change point is 50.0%, MV low limit is 0.0%, and MV high limit is 100.0%:



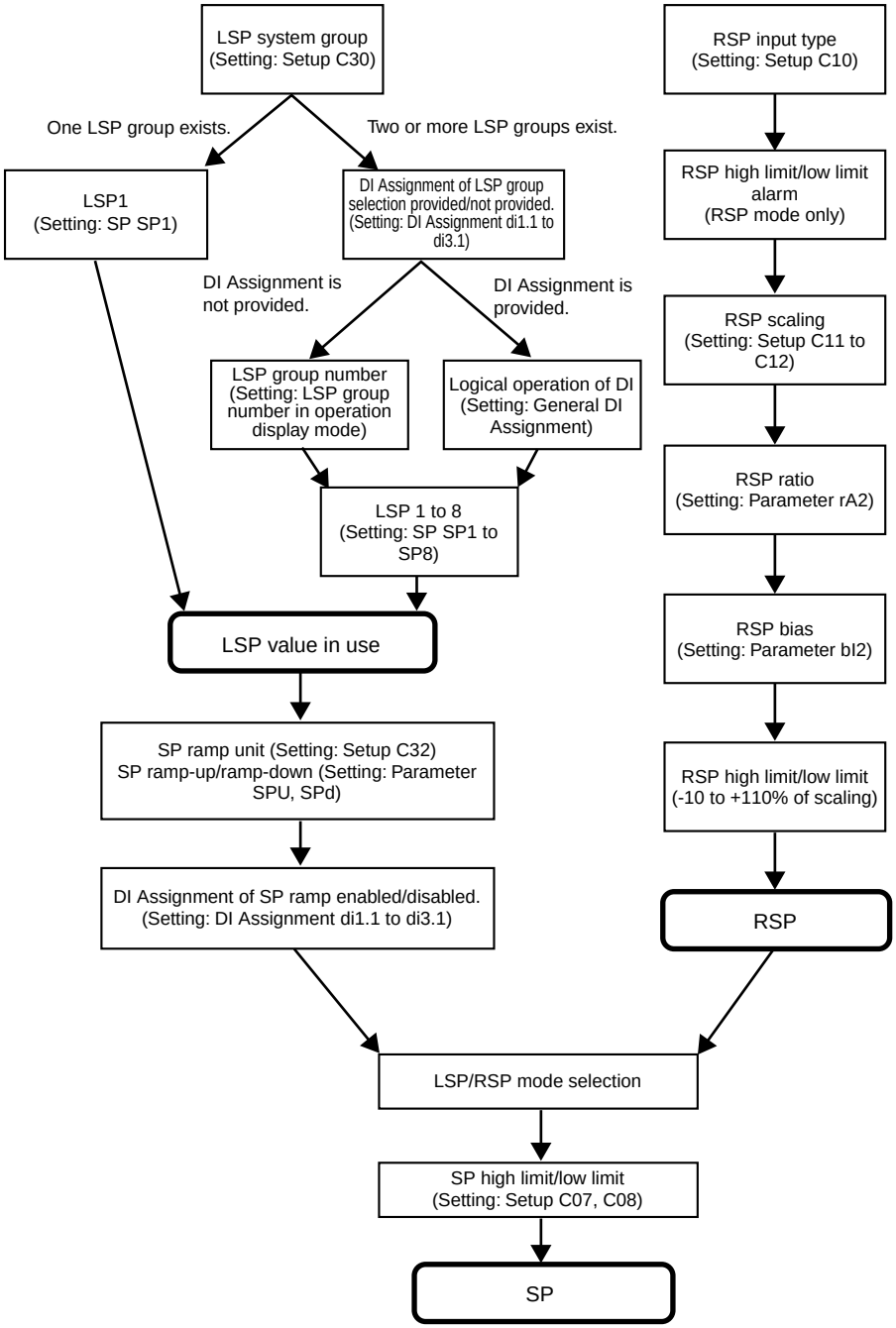
Handling Precautions

- Before starting the AT function, put the PV input and/or actuator (heater power, etc.) in the controllable status.
- When the control method is set at “ON/OFF control” ([CtrL] = 0), the AT function cannot be started. To operate the AT function, set the control method to “Fixed PID” ([CtrL] = 1).
- To start the AT, it is absolutely necessary that the operation is in the READY mode and AUTO mode, and no PV input errors occur.
- If the mode is changed to the READY mode or MANUAL mode or if the PV input error or power failure occurs during execution of the AT function, the AT function is stopped without changing of the PID constants.

- When the Heat/Cool control is not used, the MV becomes a value limited by both ranges, one range is between the MV low limit at AT (AT.oL) and MV high limit at AT (AT.oH), and the other is between the MV low limit (oL-x) and MV high limit (oH-x) of the PID constant. When there are no common portions in two ranges, the AT function is stopped automatically.
- When the Heat/Cool control is used, the MV becomes a value limited by the MV low limit at AT (At.oL)/MV high limit at AT (At.oH), the heat MV becomes a value limited by the MV low limit (oL-x)/MV high limit (oH-x) of the PID constant, and the cool MV becomes a value limited by the output low limit for cool side (oLx.C)/output high limit for cool side (oHx.C) of the PID constant.
- When the MV low limit at AT (AT.oL)/high limit (AT.oH), MV low limit (oL-x)/high limit (oH-x), output low limit for cool side (oLx.C)/high limit for cool side (oHx.C) of the PID constant are set unevenly, the PV may not be changed up or down even though the MV is changed by the AT. In this case, the AT is kept continued. Then, stop the AT manually, set the high limit and low limit of the manipulated variable again, and restart the AT.
- The number of limit cycles and period of time from the AT start to AT end may vary depending on the control subject.
- The MV ON and OFF are repeated several times during execution of the AT function to perform the limit cycle. (The OFF operation described here means MV limited by the MV low limit at AT ([At.oL]) or MV high limit at AT ([oL]). The default setting before shipment is “0%”. Additionally, the ON operation described here means MV limited by the MV high limit at AT ([At.oH]) or MV high limit at AT ([oH]). The default setting before shipment is “100%”. If this AT operation does not function correctly, take either of the following measures:
  (1) Change the MV low limit at AT ([At.oL]) or MV high limit at AT ([At.oH]) to an appropriate value, and then start the AT function.
  (2) Set the PID constants manually without use of AT.
- The AT progress value can be seen in the operation display mode. For details,
  ☞ refer to ■ Operation displays in section 6-1, List of Operation Displays (on page 6-1).
  When the Heat/Cool control is not used, the AT progress value decrements from [4] during execution of the AT function and becomes [0] at completion of the AT function.
  When the Heat/Cool control is used, the AT progress value decrements from [8] during execution of the AT function and becomes [0] at completion of the AT function.
  In both cases, the AT progress value may be “1” or “0” when the AT process is in the transient status.
- Appropriate PID constants cannot be obtained depending on the control subject. If this happens, set the PID constants manually.
- The MV ON/OFF change point determined when the AT function is started does not change even though the SP is changed while the AT is running.
  For details about AT function,
  ☞ refer to AT Stop/Start (on page 5-11) and AT (on page 5-26).

5 - 5 Set Point (SP)

The following shows the functional block diagram of the SP. For details about step operation,
☞ refer to 5-6, Step operation.



Note

LSP is a local SP and shows that the data is retained inside this unit.

On the contrary, SP by the analog input from the outside is called RSP or remote SP.

■ SP setup in operation display mode

The set value for LSP in use of LSP1 to 8 can be set.
The LSP set value is different from the SP display value during SP ramp.
However, the set value is displayed while the key is being operated to change the setting.

Item (Bank)	Display	Contents	Initial value	User level
SP (Operation display)	PV is shown on the upper display.	SP low limit to SP high limit U	0 U	Simple, Standard, High function

- When [bit 1: SP display] of [C74: PV/SP display setup] is set at "1" (display is provided), the display and setting can be made.
- The SP cannot be set in the RSP mode.

■ LSP system group

The LSP system group can be selected.

Item (Bank)	Display	Contents	Initial value	User level
LSP system group (Setup bank)	C 30	1 to 8	1	Simple, Standard, High function

■ SP ramp type

Either the standard ramp or multi-ramp can be selected.
Additionally, for details about step operation,
☞ refer to 5-6, Step operation (on page 5-41).

Item (Bank)	Display	Contents	Initial value	User level
SP ramp type (Setup bank)	C 31	1: Multi-ramp 2: Step operation The step operation is stopped when the power is turned ON again (READY). 3: Step operation The step operation is recovered when the power is turned ON again.	0	High function

- When this setting is set at “0”, the ramp-up and ramp-down use only one setting group (SP ramp-up and SP ramp-down of parameter bank) even though one LSP group or multiple LSP groups are used.
- When this setting is set at “1”, the ramp setting (ramp 1 to 8 of SP bank) common to the up/down to be set by LSP group is used.

■ RSP input type

The RSP input signal type can be selected.

Item (Bank)	Display	Contents	Initial value	User level
RSP input type (Setup bank)	C 10	0: 4 to 20mA 1: 0 to 20mA 2: 0 to 5V 3: 1 to 5V 4: 0 to 10V	0	Simple, Standard, High function

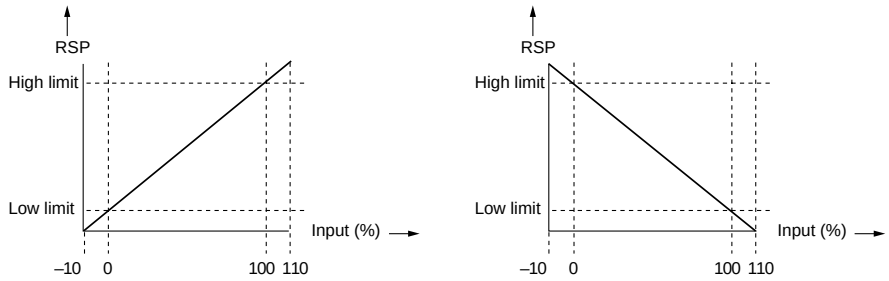
- When the model provides the RSP input, the display and setting can be performed.

■ RSP input range low limit/high limit

The scaling of the RSP input can be set.

Item (Bank)	Display	Contents	Initial value	User level
RSP input range low limit (Setup bank)	C 11	-1999 to +9999 (No decimal point) -199.9 to +999.9 (1 digit after the decimal point) -19.99 to +99.99 (2 digits after the decimal point) -1.999 to +9.999 (3 digits after the decimal point) The decimal point position is the same as that of the PV.	0U	Simple, Standard, High function
RSP input range high limit (Setup bank)	C 12		1000U	

- When the model provides the RSP input, the display and setting can be performed.
- The following shows the relationship between the RSP input and RSP based on the range low limit and high limit settings.



■ RSP ratio and RSP bias

The RSP ratio and RSP bias can be set to correct the RSP.

Item (Bank)	Display	Contents	Initial value	User level
RSP ratio (Parameter bank)	rA2	0.001 to 9.999	1.000	High function
RSP bias (Parameter bank)	bI2	-1999 to +9999U	0U	

- When the model provides the RSP input, the display and setting can be performed.
- Details of RSP ratio and RSP bias calculation

  Assuming that the calculation input is RSP_{in}, the calculation result is RSP_{out}, the RSP ratio is RA2, and the RSP bias is BI2, the following calculation formula is obtained.

  $RSP_{out} = (RSP_{in} \times RA2) + BI2$

■ RSP filter

This RSP filter is a primary delay filter to be used if the RSP deflects finely due to effect of the noise. As this set value is made larger, the RSP to be used for control of this unit becomes difficult to change. Normally, the RSP filter is used with the initial value (0.0).

Item (Bank)	Display	Contents	Initial value	User level
RSP filter (Parameter bank)	FL2	0.0 to 120.0	0.0	High function

• When the model provides the RSP input, the display and setting can be performed.

$OUT = OUT_{-1} + (IN - OUT_{-1})/(T/ Ts +1)$

IN: Input to the filter
OUT: Current filter calculation output
OUT_{-1}: Previous filter calculation output
T: Filter set value (second)
Ts: Sampling cycle time (0.1s)

■ RSP low limit/high limit and RSP low limit/high limit alarms

The RSP low limit and RSP high limit are provided for each RSP input type. Basically, -10%FS of each range is the RSP low limit and +110%FS of each range is the RSP high limit.
For details,
☞ refer to ■ Operation in case of RSP failure (on page 10-3).

The RSP is limited so that it is in a range from the RSP low limit to the RSP high limit. If the RSP before the RSP ratio, RSP bias, and RSP filter are activated is larger than the RSP high limit in the RSP mode, the RSP high limit alarm (AL05) occurs. If this RSP is smaller than the RSP low limit, the RSP low limit alarm (AL06) occurs. (Both the RSP high limit alarm and RSP low limit alarm do not occur in the LSP mode.) When the RSP is used as SP in the RSP mode, the limiting with the SP low limit and SP high limit also becomes valid.

■ RSP and LSP1 to 8

The RSP display and eight groups of LSP setup values can be set.

Item (Bank)	Display	Contents	Initial value	User level
RSP (SP bank)	rSP	RSP (Remote SP) Setting disabled.	—	Simple, Standard, High function
LSP (SP bank)	SP-1	SP low limit to SP high limit	0U	
	SP-2		0U	
	SP-3		0U	
	SP-4		0U	
	SP-5		0U	
	SP-6		0U	
	SP-7		0U	
	SP-8		0U	

• When the model provides the RSP input, the RSP can be displayed and set.
• The display and setting can be made for the LSP system group selected in [C30: LSP system group].

■ PID group number

The PID group numbers to the RSP and eight groups of LSPs can be set.

Item (Bank)	Display	Contents	Initial value	User level
PID group number (RSP) (SP bank)	P1 d.r	1 to 8	1	Standard, High function
PID group number (LSP) (SP bank)	P1 d.1		1	
	P1 d.2		1	
	P1 d.3		1	
	P1 d.4		1	
	P1 d.5		1	
	P1 d.6		1	
	P1 d.7		1	
	P1 d.8		1	

- When the model provides the RSP input, the PID group number (RSP) can be displayed and set.
- The PID group numbers (LSP) for the LSP system groups selected in [C30: LSP system group] can be displayed and set.

■ LSP group number

The LSP group number can be set.

Item (Bank)	Display	Contents	Initial value	User level
LSP group number (Operation display)	LSP	Numeric value at the rightmost digit of the display. 1 to LSP system group	1	Simple, Standard, High function

- When [C30: LSP system group] is set at “2” or more and [bit 2: LSP group number display] of the PV/SP display setup (setup C74) is set at “1” (display is provided), the display can be made.
- When the display is possible and the DI Assignment of the LSP group selection is not performed, the setting can be made.

■ DI Assignment of LSP group selection

The LSP group selection can be set for internal contacts 1 to 5 using the DI Assignment.

Item (Bank)	Display	Contents	Initial value	User level
DI Assignment Internal Contacts 1 to 5 Operation type (DI Assignment bank)	dI 1.1	0: No function 1: LSP group selection (0/+1) 2: LSP group selection (0/+2) 3: LSP group selection (0/+4) 4 to 20: Other functions	0	Simple, Standard, High function
	dI 2.1		0	
	dI 3.1		0	
	dI 4.1		0	
	dI 5.1		0	

• Details of LSP group selection with the internal contact function

The following shows the LSP group selection value according to the ON/OFF status of each internal contact:

LSP group selection (0/+1) OFF: 0 ON: 1
LSP group selection (0/+2) OFF: 0 ON: 2
LSP group selection (0/+4) OFF: 0 ON: 4

The value, that "1" is added to the sum of the LSP group selection values according to the ON/OFF status of each internal contact, becomes the LSP group number.

For example, when the sum of LSP group selection values of internal contact 1 to 5 is "1", the LSP group number becomes "2". However, if this value exceeds the value set in [C30: LSP system group], LSP groups, the number of which is the same as the value set in [C30: LSP system group], are selected.

• Even though the LSP system group is "1", the display and setting can be made, but the LSP group selection with the internal contact function becomes invalid.

■ SP ramp unit

The unit of the SP ramp-up/ramp-down can be set.

Item (Bank)	Display	Contents	Initial value	User level
SP ramp unit (Setup bank)	C 32	0: 0.1U/s 1: 0.1U/min 2: 0.1U/h	0	High function

• "0.1U" shows that the decimal point position of the PV is shifted one digit rightward.

Example: When the thermocouple input is in a range of -200 to +1200˚C, "0.1U" is "0.1˚C ".

Example: When the DC voltage input is in a range of 0.0 to 100.0, "0.1U" is "0.01".

[!] Handling Precautions

When using the DC voltage/DC current input with setting of 3 digits after the decimal point, "0.1U" is "0.0001".

However, the SP ramp-up/SP ramp-down setting cannot display 4 digits after the decimal point, the value is displayed without use of the decimal point.

■ SP ramp-up/ramp-down

The SP ramp-up and ramp-down can be set.

Item (Bank)	Display	Contents	Initial value	User level
SP ramp-up (Parameter bank)	SPU	0.0U: No ramp 0.1 to 999.9U (The unit of the ramp time is selected using the SP ramp unit.)	0.0U	High function
SP ramp-down (Parameter bank)	SPd		0.0U	

- The SP ramp-up/ramp-down setting is valid when [C31: SP ramp type] is set at "0: Standard".
- When an initial value of "0.0U" is set, the SP ramp function does not function. Therefore, when the ramp-up setting is set to "0.1U" or more and the ramp-down is set to "0.0U", the SP ramp function is enabled only during the ramp-up and disabled during the ramp-down. Additionally, the reverse operation can also be set so that the SP ramp function is enabled only during the ramp-down and disabled during the ramp-up.
- "0.1U" shows that the decimal point position of the PV is shifted one digit rightward.

  Example: When the thermocouple input is in a range of -200 to +1200˚C, "0.1U" is "0.1˚C ".

  Example: When the DC voltage input is in a range of 0.0 to 100.0, "0.1U" is "0.01".
- The ramp is started assuming that the current PV value is used as start point when the SP ramp-up or ramp-down is possible under the following conditions.

  The power is turned ON.

  READY+AUTO status is changed to RUN+AUTO status.

  RUN+MANUAL status is changed to RUN+AUTO status.

  The AT function is completed (both normal end and forced stop).

  Example: (1) When READY is changed to RUN with SP=100˚C, PV =25˚C, SPU=0.0, and SPd=1.0, the PV is not started.

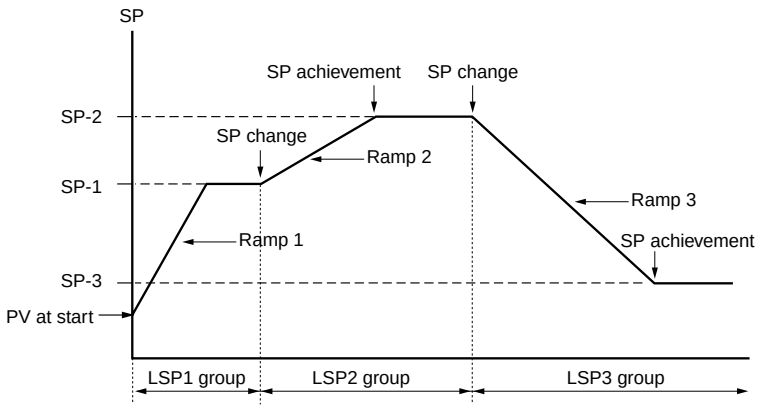
  (2) When READY is changed to RUN with SP=50˚C, PV=100˚C, SPU=0.0, and SPd=1.0, the PV is started.

■ SP multi-ramp

The SP multi-ramp set values can be set for eight groups of LSPs.

Item (Bank)	Display	Contents	Initial value	User level
Ramp (SP bank)	rmP.1	0.0U: No ramp. 0.1 to 999.9U (The time unit of the ramp is selected using the SP ramp unit.)	0.0U	High function
	rmP.2		0.0U	
	rmP.3		0.0U	
	rmP.4		0.0U	
	rmP.5		0.0U	
	rmP.6		0.0U	
	rmP.7		0.0U	
	rmP.8		0.0U	

- When [C31: SP ramp type] is set at “1: Multi-ramp”, the display and setting can be performed.
- In the standard ramp, the ramp-up and ramp-down are set individually. However, in the multi-ramp, the ramp common to the up and down is set.
- When this setting is set at “0.0U”, the SP ramp does not function.
- “rmp.1” corresponds to LSP1 while “rmp.8” corresponds to LSP8.
- “0.1U” shows that the decimal point position is shifted one digit right from the decimal point position of the PV.
  For example,
  ☞ refer to ■ SP ramp-up/ramp-down (on page 5-38).
- For details about conditions to start the ramp assuming that the current PV value is used as start point,
  ☞ refer to ■ SP ramp-up/ramp-down (on page 5-38).



LSP change and multi-ramp

Note

The multi-ramp function is applicable to an application that changes the SP change timing using the external switch or communication when performing the pattern operation as shown above.
To set the SP value hold time,

☞ refer to 5-6 Step operation (on page 5-41).

■ SP low limit/high limit

The SP low limit and high limit can be set to limit the SP range.

Item (Bank)	Display	Contents	Initial value	User level
SP low limit (Setup bank)	C 07	PV input range low limit to PV input range high limit	PV input range low limit	Standard, High function
SP high limit (Setup bank)	C 08	PV input range low limit to PV input range high limit	PV input range high limit	Standard, High function

• If the setting is made so that the SP low limit is greater than the SP high limit, the operation is performed with the low limit swapped for the high limit automatically.

[!] Handling Precautions

When [C01: PV input range type] is set, the SP low limit and high limit are initialized.

■ DI Assignment of SP ramp enabled/disabled

The SP ramp enabled/disabled can be set for the internal contact function using the DI assignment.

Item (Bank)	Display	Contents	Initial value	User level
DI Assignment Internal Contacts 1 to 5 Operation type (DI Assignment bank)	dI 1.1	0: No function 13: SP ramp enabled/disabled. 1 to 12, 14 to 20: Other functions	0	Simple, Standard, High function
	dI 2.1		0	
	dI 3.1		0	
	dI 4.1		0	
	dI 5.1		0	

• Details of SP ramp enabled/disabled with internal contact function

The following shows the SP ramp enabled/disabled setting with the internal contact ON/OFF:

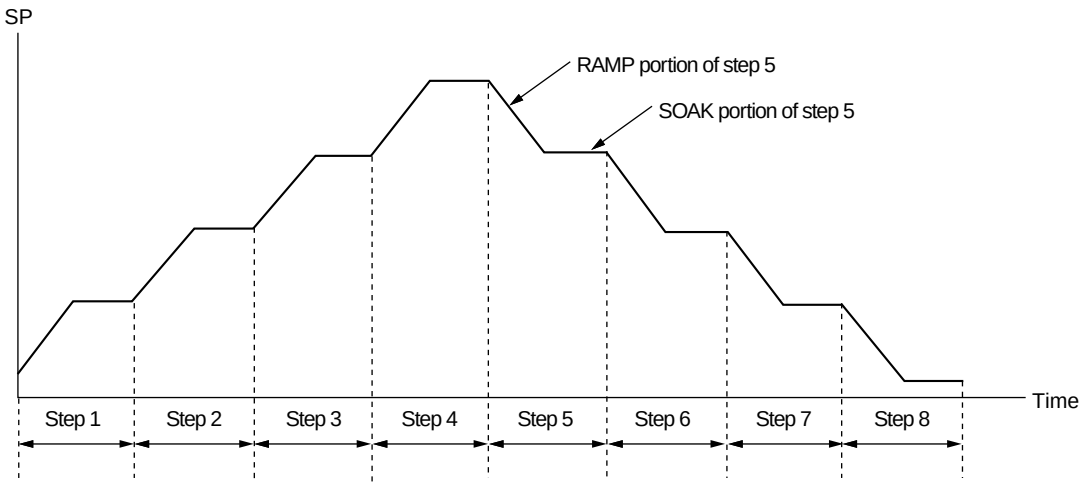
OFF: SP ramp enabled. ON: SP ramp disabled.

The SP ramp enabled/disabled is set for only one internal contact.

• When the SP ramp is set disabled, the SP ramp operation is stopped and the SP value becomes the final SP.

5 - 6 Step Operation

Use of up to eight SP groups makes it possible to perform the step operation, in which the SP is changed, as shown in the Figure below.
The step operation is set according to the LSP, ramp, and time of each step.
Additionally, the PID group No. to be used for each step can also be set.
In the step, the portion where the SP has the ramp is called “RAMP” and the portion where the SP is the constant value is called “SOAK”.
(The following Figure shows the RAMP and SOAK portions of step 5.)



Handling Precautions

- The step operation functions in the RUN mode. In the READY mode, the operation is stopped at the top of step 1.

■ LSP system group

The number of steps for the step operation can be determined using the LSP system group.

Item (Bank)	Display	Contents	Initial value	User level
LSP system group (Setup bank)	C 30	1 to 8	1	Simple, Standard, High function

■ SP ramp type

Whether or not the step operation is performed can be selected.
Additionally, the operation when the power is returned after a power cut occurrence during step operation can also be selected.

Item (Bank)	Display	Contents	Initial value	User level
SP ramp type (Setup bank)	C 31	0: Standard 1: Multi-ramp 2: Step operation The step operation is stopped when the power restarts (READY). 3: Step operation The step operation is recovered when the power restarts.	0	High function

- To make the step operation enabled, “2” or “3” is set.
- In case of set at “2”, the operation is stopped (READY mode) and returned to the top of the step when the power is returned after the power cut occurs while the step operation is running (RUN mode).
- In case of set at “3”, the operation is restarted from the step before a power cut occurs when the power is returned after the power cut occurs while the step operation is running (RUN mode). However, the SP and time before the power cut cannot be returned completely and the step operation is restarted as described in the following:

  If the operation before the power cut is SOAK, the operation is restarted from the beginning of the SOAK portion. If the operation before the power cut is RAMP and the PV alarm (AL01/02) does not occur, the RAMP operation is restarted from the SP same as PV. If the operation before the power cut is RAMP and the PV alarm (AL01/02) occurs, the operation moved to the SOAK portion next to the RAMP.

[!] Handling Precautions

- The operation of this unit with the setting set at “3” (step operation, operation is recovered when the power restarts) is different from that of Yamatake’s digital programmable controller model DCP-series (DCP31/32, DCP551/552). The DCP-series functions so that the SP, RAMP, or SOAK elapse time immediately before the power cut continues even after the power has been turned ON again. However, this unit functions so that the operation is returned to the start point of the RAMP or SOAK portions, which has been operated immediately before the power cut has occurred.
- When the setting is set at “3” (step operation, operation is recovered when the power restarts), it is also necessary to carefully check the number of EEPROM (nonvolatile memory) writing cycles. When the operation step proceeds in the RUN mode, the data is written into the EEPROM (nonvolatile memory) every time the RAMP or SOAK is changed. If the step operation is continued with a RAMP or SOAK operation time of 10min or less, the erase/write cycles of EEPROM may exceed its service life (approximately 100,000 cycles) within two years. Therefore, do not attempt to operate the unit in such manner.
- When the SP ramp type is set at “standard” or “multi-ramp” (C31 = 0, 1) and the operation mode is the RUN mode, the operation mode is automatically changed to the READY mode if the SP ramp type is changed to “step operation” (C31 = 2, 3).
- When the step operation is set enabled, the LSP mode is fixed and the LSP/RSP selection cannot be performed.

■ SP ramp unit

The ramp unit for the RAMP portion of the step operation can be set.

Item (Bank)	Display	Contents	Initial value	User level
SP ramp unit (Setup bank)	C 32	0: 0.1U/s 1: 0.1U/min 2: 0.1U/h	1	High function

• ”0.1U” shows that the decimal point position is shifted one digit right from the decimal point position of the PV.
Example: When the thermocouple input is in a range of –200 to +1200˚C, “0.1U” is equal to 0.1˚C.
Example: When the DC voltage input is in a range of 0.0 to 100.0, “0.1U” is equal to “0.01V”.

[!] Handling Precautions

When the DC voltage or DC current input is used with the setting, three digits after the decimal point, “0.1U” is equal to “0.0001”.

However, since the SP ramp-up or SP ramp-down setting cannot show four digits after the decimal point, the setting is shown without the decimal point.

■ STEP time unit

The time unit for the SOAK portion of the step operation can be set.

Item (Bank)	Display	Contents	Initial value	User level
STEP time unit (Setup bank)	C 33	0: 0.1s 1: 1s (“min. s” on the operation display) 2: 1min (“h. min” on the operation display)	0	High function

• When this setting is set at “0”, the time setting unit of the SP bank becomes “0.1s”.
• When this setting is set at “1”, the time setting unit of the SP bank becomes “s”. The decimal point is shown between “min” (2 digits) and “s” (2 digits) of the step remain time on the operation display.
• When this setting is set at “2”, the time setting unit of the SP bank becomes “min”. The decimal point is shown between “h” (2 digits) and “min” (2 digits) of the step remain time on the operation display.

[!] Handling Precautions

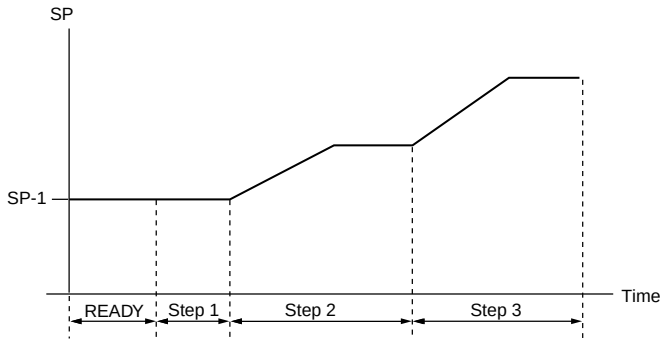
In the operation display mode, the step remaining time display follows the step operation time unit setting regardless of the RAMP and SOAK portions.

■ STEP PV start

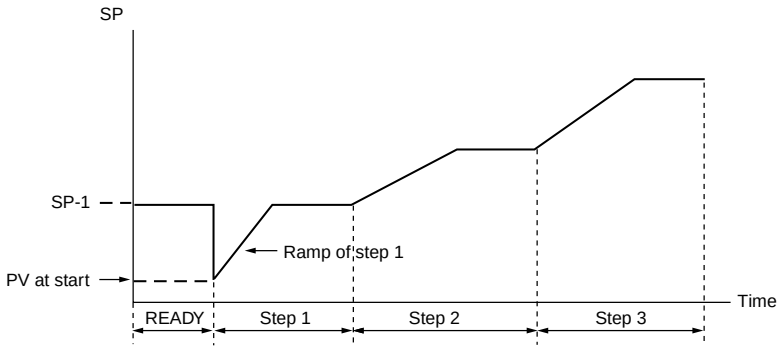
Whether or not the PV start exists and its type at start of the step operation can be set.

Item (Bank)	Display	Contents	Initial value	User level
STEP PV start (Setup bank)	C 34	0: None 1: Up start 2: Down start	0	High function

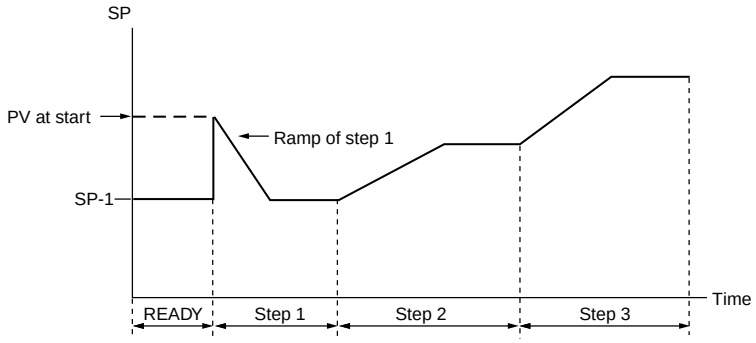
- When this setting is set at “0”, the step operation is started from the SOAK portion of step 1.
- When this setting is set at “1”, the step operation is started from the same SP as PV in the up RAMP portion of step 1 if PV<SP-1. If PV≥SP-1, the step operation is started from the SOAK portion of step 1.
- When this setting is set at “2”, the step operation is started from the same SP as PV in the down RAMP portion of step 1 if PV>SP-1. If PV≤SP-1, the step operation is started from the SOAK portion of step 1.



Operation start from SOAK of step 1



Operation start from up RAMP of step 1



Operation start from down RAMP of step 1

■ STEP loop

Whether or not the loop exists at the end of the step operation and the operation end status can be set.

Item (Bank)	Display	Contents	Initial value	User level
STEP loop (Setup bank)	C 35	0: Stop (No loop) 1: Loop 2: Final step continued. (No loop)	0	High function

- When this setting is set at “0”, the operation is stopped (READY mode) if the operation of the SOAK portion of the final step is completed.
- When this setting is set at “1”, the operation is returned to the RAMP portion of step 1 if the operation of the SOAK portion of the final step is completed. At this time, the RAMP operation is performed from SP to SP-1 of the final step regardless of the setting of [C34: STEP PV start]. Since the number of loop cycles is not limited, the loop operation is continued until the READY mode is selected.
- When this setting is set at “2”, the operation is continued with SP of the final step kept remained until the READY mode is selected if the SOAK portion of the final step is completed.

■ STEP operation LSP, PID group No., ramp, time

The SP change and PID group No. by step of the step operation can be set.

Item (Bank)	Display	Contents	Initial value	User level
LSP1 (Step 1) (SP bank)	SP-1	SP low limit (C07) to SP high limit (C08)	0	Simple, Standard, High function
PID group No. (Step 1) (SP bank)	Pid.1	1 to 8	1	Standard, High function
Ramp (Step 1) (SP bank)	rAP.1	0.0U: No ramp. 0.1 to 999.9U (The time unit of the ramp is selected in the SP ramp unit.)	0.0	
Time (Step 1) (SP bank)	tIM.1	0.0 to 999.9s (The time unit of the step operation is set at "0.1s".) 0 to 9999s (The time unit of the step operation is set at "1s".) 0 to 9999 min (The time unit of the step operation is set at "1min".)	0.0	
LSP (Step 2) (SP bank)	SP-2	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 2) (SP bank)	Pid.2		1	Standard, High function
Ramp (Step 2) (SP bank)	rAP.2		0.0	
Time (Step 2) (SP bank)	tIM.2		0.0	
LSP (Step 3) (SP bank)	SP-3	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 3) (SP bank)	Pid.3		1	Standard, High function
Ramp (Step 3) (SP bank)	rAP.3		0.0	
Time (Step 3) (SP bank)	tIM.3		0.0	
LSP (Step 4) (SP bank)	SP-4	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 4) (SP bank)	Pid.4		1	Standard, High function
Ramp (Step 4) (SP bank)	rAP.4		0.0	
Time (Step 4) (SP bank)	tIM.4		0.0	

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
LSP (Step 5) (SP bank)	SP-5	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 5) (SP bank)	PId.5		1	Standard, High function
Ramp (Step 5) (SP bank)	rAP.5		0.0	
Time (Step 5) (SP bank)	tIM.5		0.0	
LSP (Step 6) (SP bank)	SP-6	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 6) (SP bank)	PId.6		1	Standard, High function
Ramp (Step 6) (SP bank)	rAP.6		0.0	
Time (Step 6) (SP bank)	tIM.6		0.0	
LSP (Step 7) (SP bank)	SP-7	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 7) (SP bank)	PId.7		1	Standard, High function
Ramp (Step 7) (SP bank)	rAP.7		0.0	
Time (Step 7) (SP bank)	tIM.7		0.0	
LSP (Step 8) (SP bank)	SP-8	Same as step 1.	0	Simple, Standard, High function
PID group No. (Step 8) (SP bank)	PId.8		1	Standard, High function
Ramp (Step 8) (SP bank)	rAP.8		0.0	
Time (Step 8) (SP bank)	tIM.8		0.0	

- The display and setting for the number of steps set in [C30: LSP system group] can be performed.
- The PID group No. cannot be displayed and set if the ON/OFF control is used, if the PID group selection is set for the operation type of internal contact 1 to 5, or if the zone PID function is used.
- “0.1U” of the ramp shows that the decimal point position is shifted one digit right from the decimal point position of the PV.
- When the ramp is set at “0.0U”, the operation skips the RAMP and moves to the next SOAK. Additionally, when the LSPs of two continuous steps are the same, the operation skips the RAMP and moves to the next SOAK.
- When the time setting is set at “0.0” or “0”, the operation skips the SOAK and moves to the next RAMP.

■ Operation type of internal contact

The following shows the operation types related to the step operation.

📖 Note

For details about internal contact function,

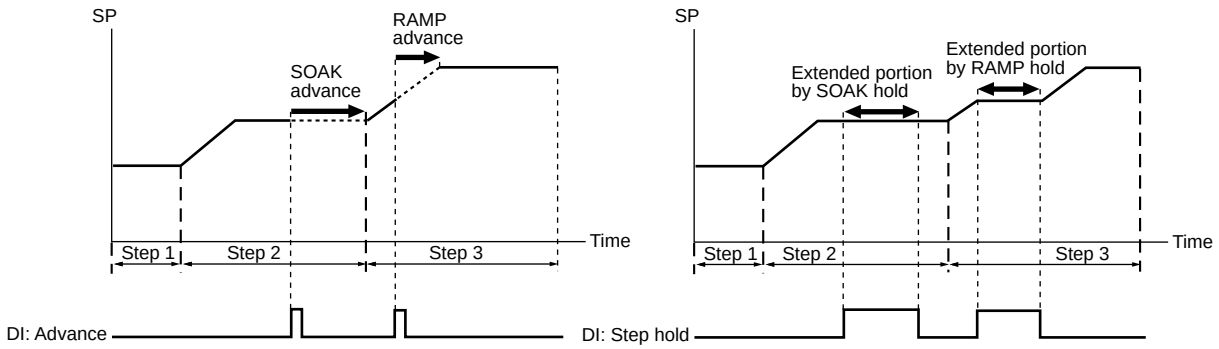
☞ refer to 5-7, DI (Digital Input) and Internal Contact (on page 5-49).

Item (Bank)	Display	Contents	Initial value	User level
Operation type of internal contact 1 (DI assignment bank)	dI 1.1	0 to 20 0: No function. 7: RUN/READY mode selection 19: Advance operation 20: Step hold (1 to 6 and 8 to 18 are functions, which do not directly relate to the step operation.)	0	Simple, Standard, High function
Operation type of internal contact 2 (DI assignment bank)	dI 2.1		0	
Operation type of internal contact 3 (DI assignment bank)	dI 3.1		0	
Operation type of internal contact 4 (DI assignment bank)	dI 4.1		0	
Operation type of internal contact 5 (DI assignment bank)	dI 5.1		0	

• When this setting is set at “7”, the operation mode is changed to the READY mode if the internal contact is changed from OFF to ON, and the operation mode is changed to the RUN mode if the internal contact is changed from ON to OFF.

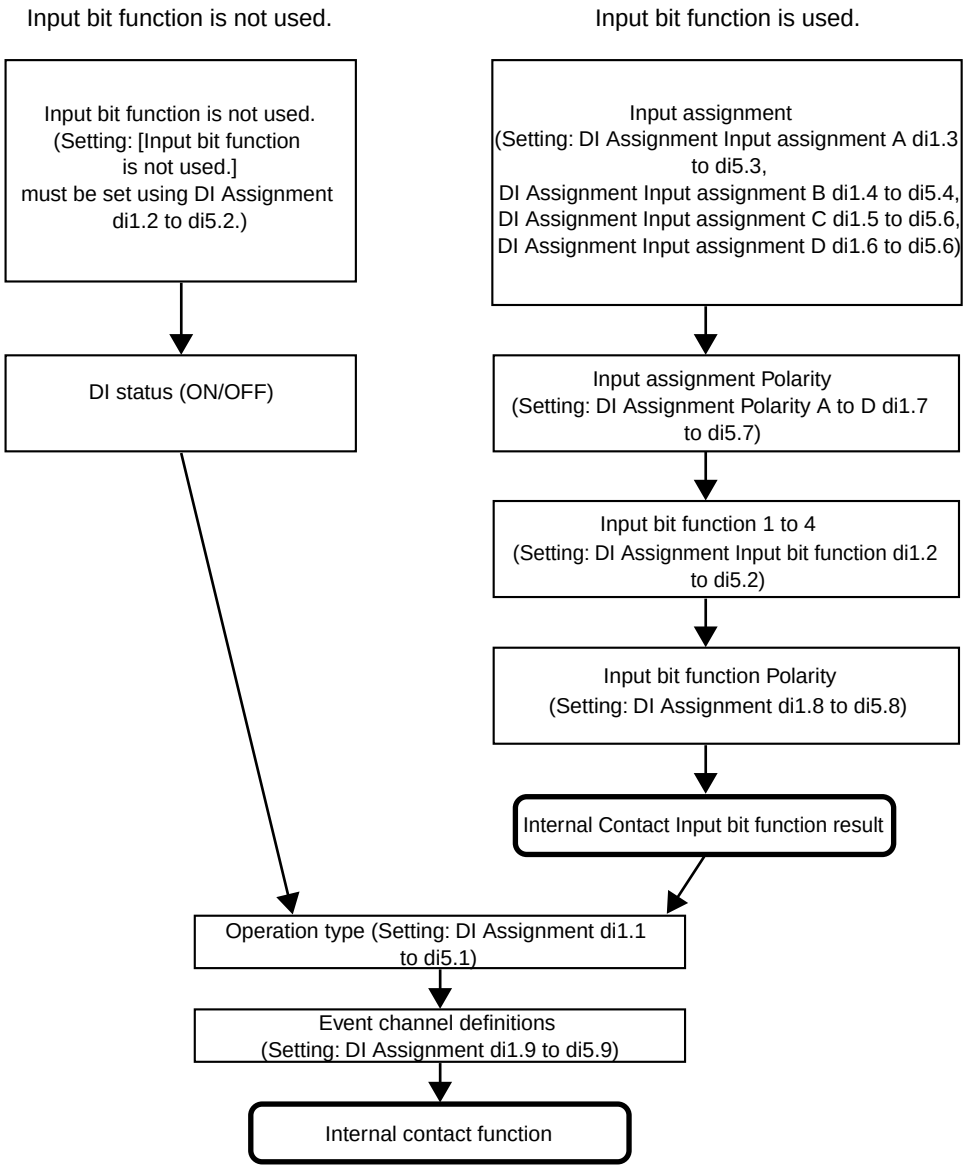
• When this setting is set at “19”, the SOAK is moved to the top of the next RAMP or the RAMP is moved to the next RAMP if the internal contact is changed from OFF to ON in the RUN mode. This operation is called “advance”.
When the advance operation is performed in the SOAK of the final step, the operation mode is changed to the READY mode, the operation is moved to the top of the RAMP of step 1 by loop, or the SOAK is continued according to the setting of [C35: Step operation loop].

• When this setting is set at “20”, the progress of the step operation is stopped if the internal contact becomes ON in the RUN mode. This operation status is called “step hold status”. When the advance operation is performed in the step hold status, the operation enters the step hold status at the top of the next RAMP or SOAK.



5 - 7 Digital Input (DI) and Internal Contact

The following shows the functional block diagram of the digital input (DI) and internal contact:



Handling Precautions

Even though five internal contacts 1 to 5 are provided, the number of digital inputs determined by the optional model is 0 to 4 points.
With the default settings before shipment, the operations of digital input 1 to 4 have already been connected to internal contacts 1 to 4.
To utilize the operation of internal contact 5, it is absolutely necessary to set the DI Assignment.

■ Operation type

The operation type by the internal contact function can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 1 Operation type (DI Assignment bank)	di 1.1	0 to 20 For details about function by each set value, refer to the Table shown on the next page.	0	Simple, Standard, High function
Internal Contact 2 Operation type (DI Assignment bank)	di 2.1		0	
Internal Contact 3 Operation type (DI Assignment bank)	di 3.1		0	
Internal Contact 4 Operation type (DI Assignment bank)	di 4.1		0	
Internal Contact 5 Operation type (DI Assignment bank)	di 5.1		0	

Handling Precautions

- For [1 to 3: LSP group selection], the value that “1” is added to the sum of weights (+ 1, + 2, +4), the internal contact of which is turned ON, becomes the LSP group number. However, if this value exceeds the value set in [C30: LSP system group], LSP groups, the number of which is the same as the value set in [C30: LSP system group], are selected.
- For [4 to 6: PID group selection], a value made by adding “1” to the sum of weights (+1, +2, +4), the internal contact of which is turned ON, becomes the PID group number. However, if this value exceeds “8”, eight PID groups are selected.
- Do not use [14: PV value hold], [15: PV Max. hold], and [16: PV Min. hold] with they mixed.
- Do not set the same operation type other than [0: No function] and [1 to 3: LSP group selection] for multiple internal contacts.
- When using the Heat/Cool control, do not use [12: Control action direct/reverse selection].
- For timer stop/start, set a target Event channel using [Event channel definition of internal contact].

The following Table shows the contents of the dI settings:

Set value	Function	Operation at OFF	Operation at ON
0	No function	None	None
1	LSP group selection (0/+1)	LSP No.: +0	LSP No.: +1
2	LSP group selection (0/+2)	LSP No.: +0	LSP No.: +2
3	LSP group selection (0/+4)	LSP No.: +0	LSP No.: +4
4	PID group selection (0/+1)	PID group No.: +0	PID group No.: +1
5	PID group selection (0/+2)	PID group No.: +0	PID group No.: +2
6	PID group selection (0/+4)	PID group No.: +0	PID group No.: +4
7	RUN/READY mode selection	RUN	READY
8	AUTO/MANUAL mode selection (Note 1)	AUTO	MANUAL
9	LSP/RSP mode selection	LSP	RSP
10	AT (Auto tuning) Stop/Start (Note 2)	AT Stop	AT Start
11	ST (Self-tuning) disabled/enabled	Invalid	Invalid
12	Control action direct/reverse selection	Set action	Reverse action of setting
13	SP ramp enabled/disabled	SP ramp enabled	SP ramp disabled
14	PV value hold	No-hold	Hold
15	PV Max. hold	No-hold	Hold
16	PV Min. hold	No-hold	Hold
17	Timer Stop/Start	Timer stop	Timer start
18	Release all DO latches	Continue if latch exists.	Latch release
19	Advance operation (Note 3)	Step operation continued.	Moves to next SOAK or RAMP.
20	Step hold	Step operation continued.	Hold

(Note 1) Signal edge from OFF to ON or from ON to OFF is valid during step operation.
(Note 2) Signal edge from OFF to ON or from ON to OFF is valid.
(Note 3) Signal edge from OFF to ON is valid.

■ Event channel definitions

When the operation type is the timer start/stop, a target Event channel can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 1 Event channel definition (DI Assignment bank)	dI 1.9	0: Invalid 1 to 8	0	High function
Internal Contact 2 Event channel definition (DI Assignment bank)	dI 2.9		0	
Internal Contact 3 Event channel definition (DI Assignment bank)	dI 3.9		0	
Internal Contact 4 Event channel definition (DI Assignment bank)	dI 4.9		0	
Internal Contact 5 Event channel definition (DI Assignment bank)	dI 5.9		0	

• When the operation type of the same internal contact No. is set at “Timer stop/start”, the display and setting can be made.

■ Input bit function

Four kinds of input bit functions are provided. The required functions can be configured by the user.

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 1 Input bit function (DI Assignment bank)	dI 1.2	0: Not used (Default input) 1: Function 1 ((A and B) or (C and D)) 2: Function 2 ((A or B) and (C or D)) 3: Function 3 (A or B or C or D) 4: Function 4 (A and B and C and D)	0	High function
Internal Contact 2 Input bit function (DI Assignment bank)	dI 2.2		0	
Internal Contact 3 Input bit function (DI Assignment bank)	dI 3.2		0	
Internal Contact 4 Input bit function (DI Assignment bank)	dI 4.2		0	
Internal Contact 5 Input bit function (DI Assignment bank)	dI 5.2		0	

- When the set value is “0”, the input bit function is not used and the default input is used. The following shows the default input of each internal contact:
  Internal Contact 1: digital input (DI) 1
  Internal Contact 2: digital input (DI) 2
  Internal Contact 3: digital input (DI) 3
  Internal Contact 4: digital input (DI) 4
  Internal Contact 5: OFF status
- In the input bit function, the logical operations (AND, OR) of each of internal contacts 1 to 5 are combined. In input bit functions 1 to 4, the combination of the logical operations may vary. The following shows one logical operation:

Logical AND	Logical OR
OFF and OFF = OFF	OFF or OFF = OFF
ON and OFF = OFF	ON or OFF = ON
ON and ON = ON	ON or ON = ON

- “OFF” is “contact open (OPEN)” or “0” when expressed using the numerical value.
- “ON” is “contact close (CLOSE)” or “1” when expressed using the numerical value.

■ Input assignment

The assignment of four inputs (A, B, C, D) used for the input bit function can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 1 Input assignment A (DI Assignment bank)	d1 1.3	0: Normally opened. (OFF, 0) 1: Normally closed. (ON, 1) 2: DI1 3: DI2 4: DI3 5: DI4 6 to 9: Undefined. 10: Internal Event 1 11: Internal Event 2 12: Internal Event 3 13: Internal Event 4 14: Internal Event 5 15: Internal Event 6 16: Internal Event 7 17: Internal Event 8 18: Communication DI1 19: Communication DI2 20: Communication DI3 21: Communication DI4 22: MANUAL mode 23: READY mode 24: RSP mode 25: AT running 26: During SP ramp 27: Undefined. 28: Alarm occurs. 29: PV alarm occurs. 30: Undefined. 31: mode key pressing status 32: Event output 1 status 33: Control output 1 status	2	High function
Internal Contact 1 Input assignment B (DI Assignment bank)	d1 1.4		0	
Internal Contact 1 Input assignment C (DI Assignment bank)	d1 1.5		0	
Internal Contact 1 Input assignment D (DI Assignment bank)	d1 1.6		0	
Internal Contact 2 Input assignment A (DI Assignment bank)	d1 2.3		3	
Internal Contact 2 Input assignment B (DI Assignment bank)	d1 2.4		0	
Internal Contact 2 Input assignment C (DI Assignment bank)	d1 2.5		0	
Internal Contact 2 Input assignment D (DI Assignment bank)	d1 2.6		0	
Internal Contact 3 Input assignment A (DI Assignment bank)	d1 3.3		4	
Internal Contact 3 Input assignment B (DI Assignment bank)	d1 3.4		0	
Internal Contact 3 Input assignment C (DI Assignment bank)	d1 3.5		0	
Internal Contact 3 Input assignment D (DI Assignment bank)	d1 3.6		0	
Internal Contact 4 Input assignment A (DI Assignment bank)	d1 4.3		5	
Internal Contact 4 Input assignment B (DI Assignment bank)	d1 4.4		0	
Internal Contact 4 Input assignment C (DI Assignment bank)	d1 4.5		0	
Internal Contact 4 Input assignment D (DI Assignment bank)	d1 4.6		0	

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 5 Input assignment A (DI Assignment bank)	di 5.3	0: Normally opened. (OFF, 0) 1: Normally closed. (ON, 1) 2: DI1 3: DI2 4: DI3 5: DI4 6 to 9: Undefined. 10: Internal Event 1 11: Internal Event 2 12: Internal Event 3 13: Internal Event 4 14: Internal Event 5 15: Internal Event 6 16: Internal Event 7 17: Internal Event 8 18: Communication DI1 19: Communication DI2 20: Communication DI3 21: Communication DI4 22: MANUAL mode 23: READY mode 24: RSP mode 25: AT running 26: During SP ramp 27: Undefined. 28: Alarm occurs. 29: PV alarm occurs. 30: Undefined. 31: mode key pressing status 32: Event output 1 status 33: Control output 1 status	0	High function
Internal Contact 5 Input assignment B (DI Assignment bank)	di 5.4		0	
Internal Contact 5 Input assignment C (DI Assignment bank)	di 5.5		0	
Internal Contact 5 Input assignment D (DI Assignment bank)	di 5.6		0	

• When the internal contact No. and its input bit functions 1 to 4 are set, the display and setting can be configured.

■ Polarity of input assignment

The polarity of four input assignments (A, B, C, D) used for the input bit function can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 1, Polarity A to D (DI Assignment bank)	di 1.7	The digits are called 1st digit, 2nd digit, 3rd digit, and 4th digit from the right end. 1st digit: Input assignment A Polarity setting 2nd digit: Input assignment B Polarity setting 3rd digit: Input assignment C Polarity setting 4th digit: Input assignment D Polarity setting 0: Direct 1: Reverse	0000	High function
Internal Contact 2, Polarity A to D (DI Assignment bank)	di 2.7		0000	
Internal Contact 3, Polarity A to D (DI Assignment bank)	di 3.7		0000	
Internal Contact 4, Polarity A to D (DI Assignment bank)	di 4.7		0000	
Internal Contact 5, Polarity A to D (DI Assignment bank)	di 5.7		0000	

• When the internal contact No. and its input bit functions 1 to 4 are set, the display and setting can be configured.

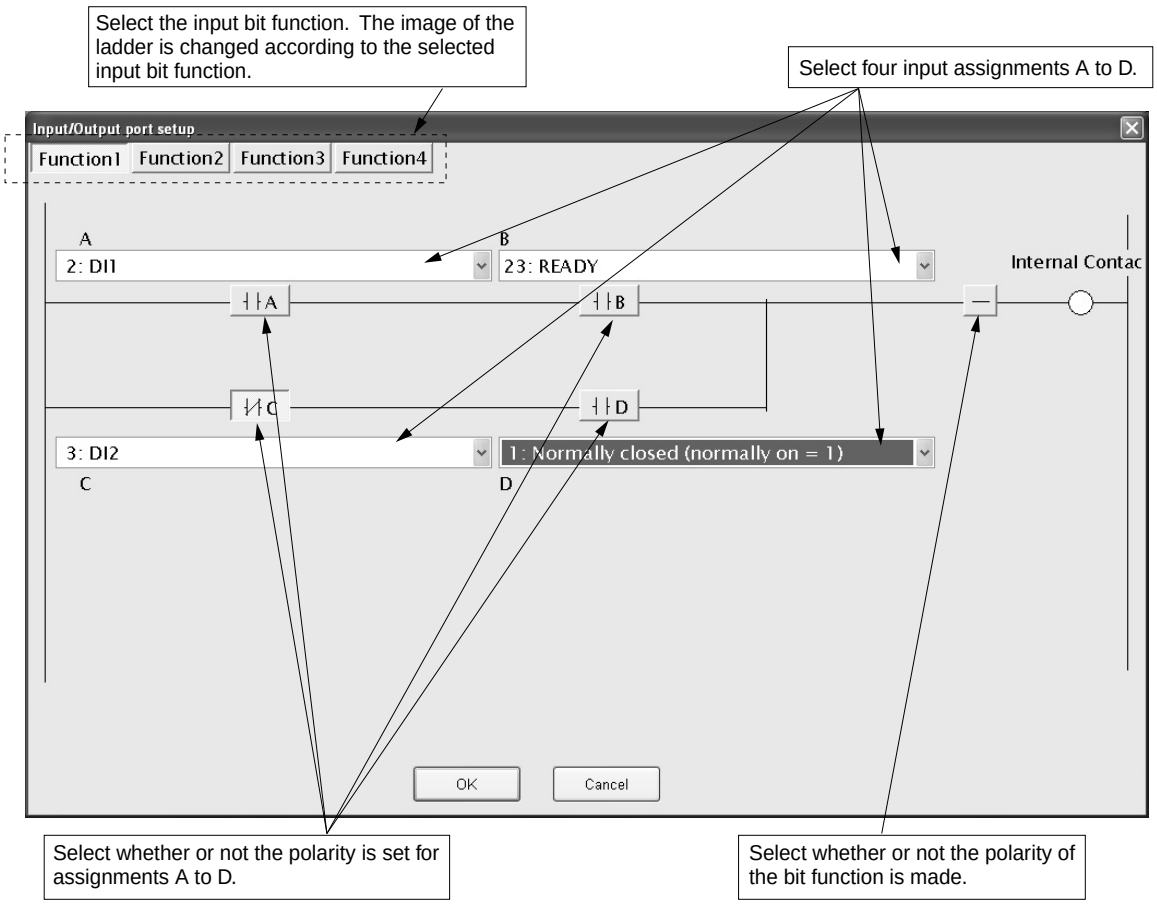
■ Polarity of input bit function

The polarity of the input bit function (functions 1 to 4) can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Contact 1 Polarity (DI Assignment bank)	dI 1.8	0: Direct 1: Reverse	0	High function
Internal Contact 2 Polarity (DI Assignment bank)	dI 2.8		0	
Internal Contact 3 Polarity (DI Assignment bank)	dI 3.8		0	
Internal Contact 4 Polarity (DI Assignment bank)	dI 4.8		0	
Internal Contact 5 Polarity (DI Assignment bank)	dI 5.8		0	

■ DI Assignment setting with Smart Loader Package SLP-C35

When setting [DI Assignment] with the Smart Loader Package SLP-C35, select [Edit (E)] → [Input port setup (O)] in that order from the [Input] menu. The input bit function, input assignment, polarity of input assignment, and polarity of input bit function can be easily set using visual images as shown below.

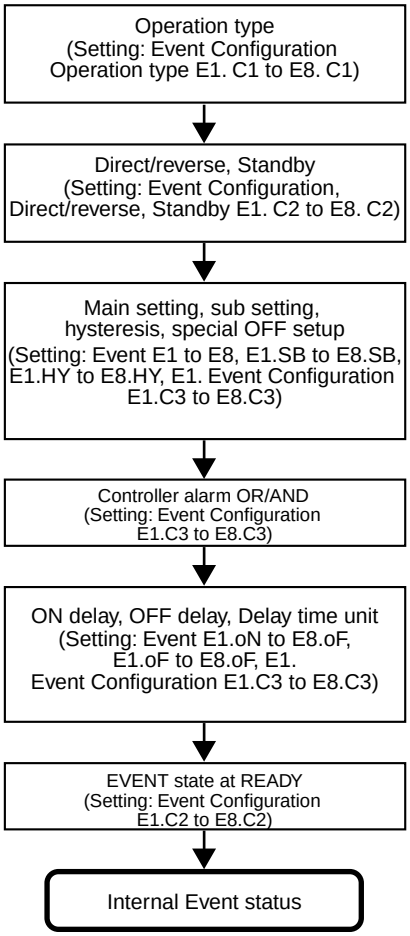


[!] Handling Precautions

In addition to the selection through the menu, the Input port setup window can also be opened using the following procedures:
Click the input/output port setup icon .
Right-click in the input bit function setting window.
Press the [Ctrl] and [P] keys at the same time.

5 - 8 Internal Event

The result of the internal event process can be output to the control output or event output through the digital output (DO) process.
For details,
☞ refer to 2-1, Input/Output Configuration (on page 2-1).



The following shows the functional block diagram of the internal event:

! Handling Precautions

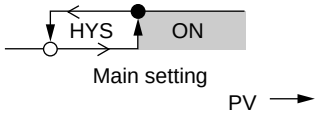
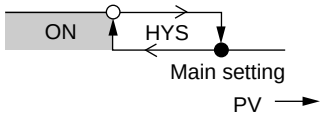
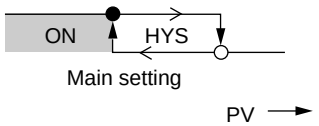
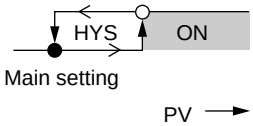
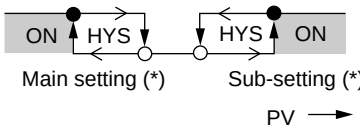
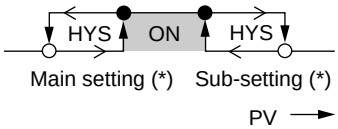
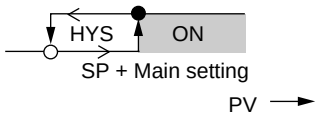
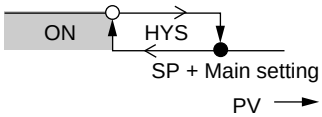
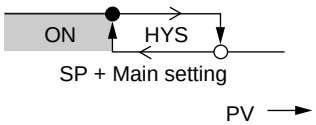
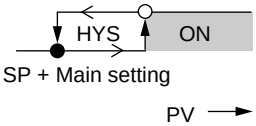
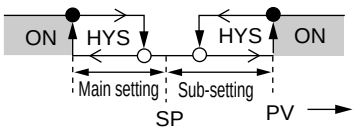
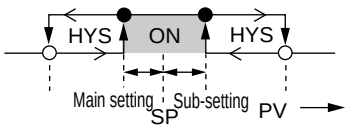
Even though eight internal events 1 to 8 are provided, the number of event outputs determined by the optional model is 0 to 3 points. With the default settings before shipment, the operations of internal events 1 to 3 can be output to event outputs 1 to 3. To utilize the operations of internal events 4 to 8, it is absolutely necessary to set the DO Assignment.

■ Operation

According to the operation type, direct/reverse, main setting, sub setting, hysteresis, and other settings, the operation of the internal event becomes as follows:

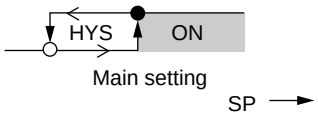
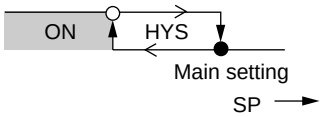
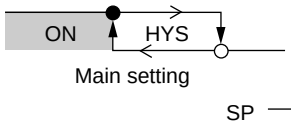
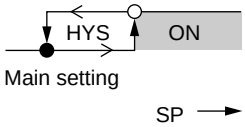
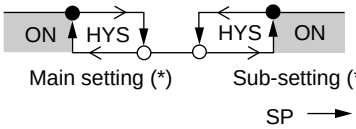
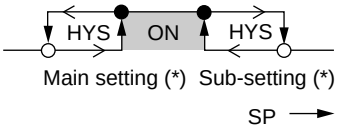
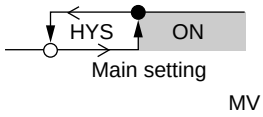
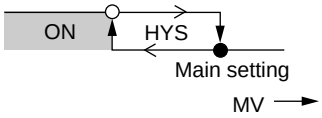
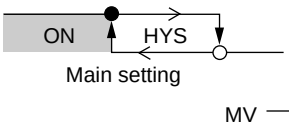
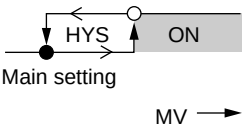
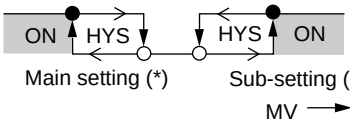
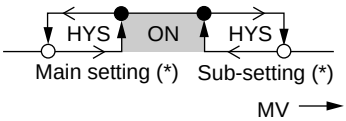
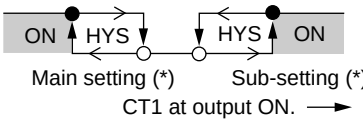
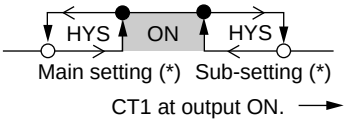
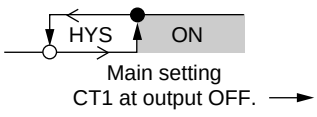
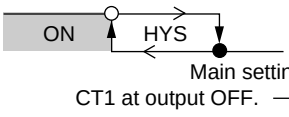
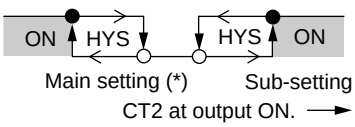
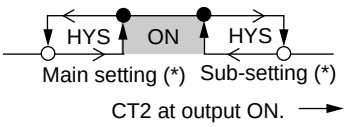
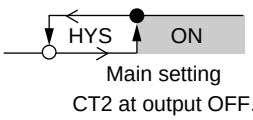
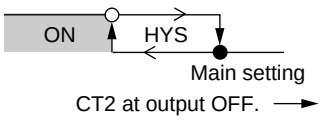
[List of internal event operations]

Note
For details about unit (U), refer to the attached glossary.

Operation type	Set value of operation type	Direct action ● shows that the ON/OFF is changed at this value. ❍ shows that the ON/OFF is changed at a point that "1U" is added to this value.	Reverse action ● shows that the ON/OFF is changed at this value. ❍ shows that the ON/OFF is changed at a point that "1U" is added to this value.
No event	0	Always OFF	Always OFF
PV high limit	1		
PV low limit	2		
PV high/low limit	3		
Deviation high limit	4		
Deviation low limit	5		
Deviation high/ low limit	6		
Deviation high limit (Final SP reference)	7	Same as the direct action of the deviation high limit when the SP ramp is not used. The difference is that the SP ramp does not use the current SP, but it uses the final SP.	Same as the reverse action of the deviation high limit when the SP ramp is not used. The difference is that the SP ramp does not use the current SP, but it uses the final SP.
Deviation low limit (Final SP reference)	8	Same as the direct action of the deviation low limit when the SP ramp is not used. The difference is that the SP ramp does not use the current SP, but it uses the final SP.	Same as the reverse action of the deviation low limit when the SP ramp is not used. The difference is that the SP ramp does not use the current SP, but it uses the final SP.
Deviation high/ low limit (Final SP reference)	9	Same as the direct action of the deviation high/low limit when the SP ramp is not used. The difference is that the SP ramp does not use the current SP, but it uses the final SP.	Same as the reverse action of the deviation high/low limit when the SP ramp is not used. The difference is that the SP ramp does not use the current SP, but it uses the final SP.

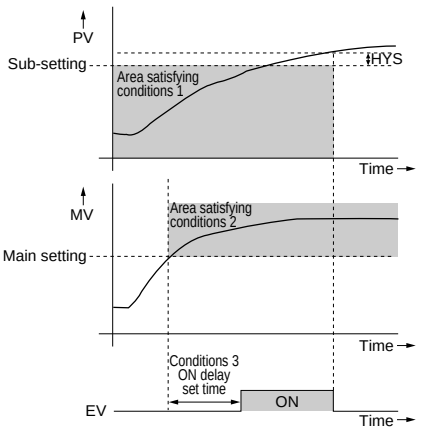
* If the setting is made so that the main setting is greater than the sub setting, the operation is performed with the main setting swapped for the sub setting automatically.

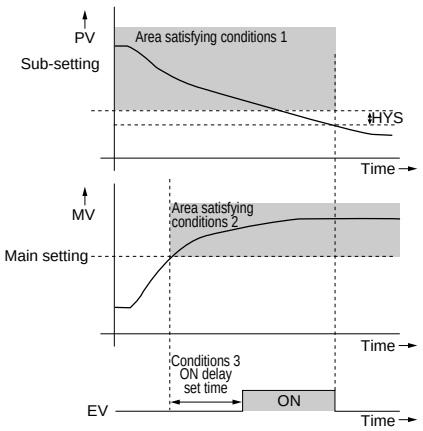
(To be continued to the next page.)

Operation type	Set value of operation type	Direct action ● shows that the ON/OFF is changed at this value. ❍ shows that the ON/OFF is changed at a point that "1U" is added to this value.	Reverse action ● shows that the ON/OFF is changed at this value. ❍ shows that the ON/OFF is changed at a point that "1U" is added to this value.
SP high limit	10		
SP low limit	11		
SP high/low limit	12		
MV high limit	13		
MV low limit	14		
MV high/low limit	15		
Heater 1 burnout/ Over-current	16		
Heater 1 short-circuit	17		
Heater 2 burnout/ Over-current	18		
Heater 2 short-circuit	19		

* If the setting is made so that the main setting is greater than the sub setting, the operation is performed with the main setting swapped for the sub setting automatically.

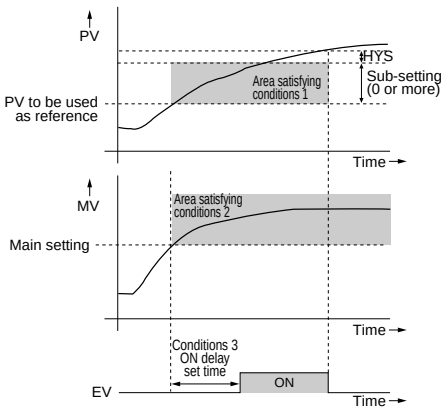
(To be continued to the next page.)

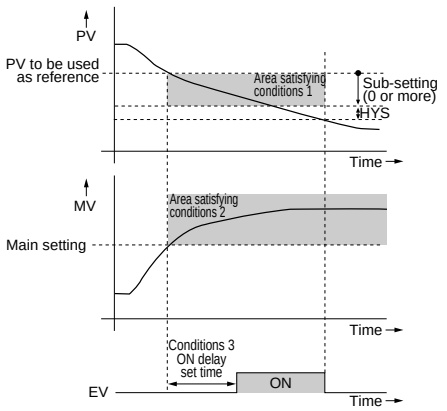
<table>
<tr><th>Operation type</th><th>Set value of operation type</th><th>Direct action</th><th>Reverse action</th></tr>
<tr><td>Loop diagnosis 1</td><td>20</td><td colspan="2">The event is turned ON when any change in PV corresponding to increase/decrease in Manipulated variable (MV) is not observed.
This event is used to detect any fault at the operation end.
● Setting items
• Main setting: Manipulated variable (MV)
• Sub-setting: PV
• ON delay time: Diagnosis time
● Operation specifications
The event is turned ON when the value does not reach the PV set in the sub-setting within the diagnosis time (ON delay time) (conditions 1) even though the MV exceeding the main setting is held (conditions 2).
● CAUTION
When setting the ON delay, it is necessary to put in "High function configuration".
The default setting of the ON delay before shipment is 0.0s.</td></tr>
<tr><td></td><td></td><td>Heat control
 

ON delay is started when conditions 1 and 2 are satisfied.</td><td>Cool control
 

ON delay is started when conditions 1 and 2 are satisfied.</td></tr>
</table>

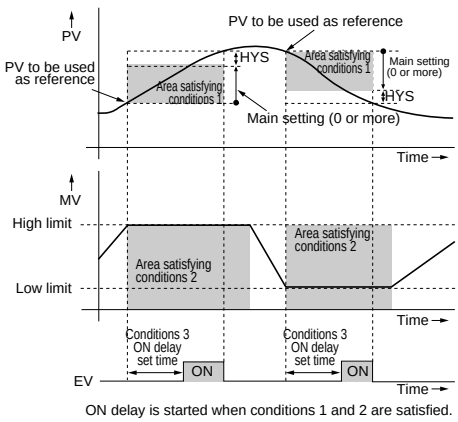
(To be continued to the next page.)

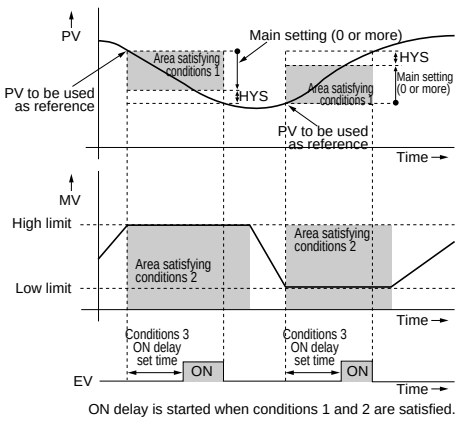
<table>
<tr><th>Operation type</th><th>Set value of operation type</th><th>Direct action</th><th>Reverse action</th></tr>
<tr><td>Loop diagnosis 2</td><td>21</td><td colspan="2">The event is turned ON when any change in PV corresponding to increase/decrease in Manipulated variable (MV) is not observed.
This event is used to detect any fault at the operation end.
● Setting items
• Main setting: Manipulated variable (MV)
• Sub-setting: Change in PV from the point that the MV exceeds the main setting.
• ON delay time: Diagnosis time
● Operation specifications
The event is turned ON when the MV exceeding the main setting is held (conditions 2) and the PV does not reach the value that the sub-setting is added to (subtracted from) the PV at the point that the MV exceeds the main setting within the diagnosis time (ON delay time) (conditions 1).
● CAUTION
When setting the ON delay, it is necessary to put in "High function configuration".
The default setting of the ON delay before shipment is 0.0s.</td></tr>
<tr><td></td><td></td><td>Heat control
 

ON delay is started when conditions 1 and 2 are satisfied.</td><td>Cool control
 

ON delay is started when conditions 1 and 2 are satisfied.</td></tr>
</table>

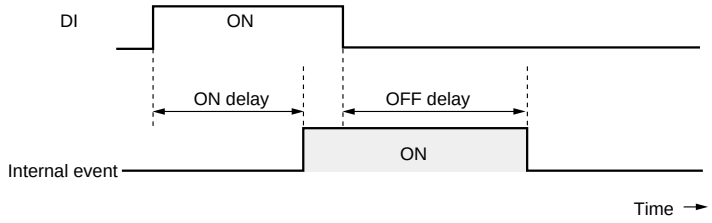
(To be continued to the next page.)

<table>
<tr><th>Operation type</th><th>Set value of operation type</th><th>Direct action</th><th>Reverse action</th></tr>
<tr><td>Loop diagnosis 3</td><td>22</td><td colspan="2">The event is turned ON when any change in PV corresponding to increase/decrease in Manipulated variable (MV) is not observed. This event is used to detect any fault at the operation end.
● Setting items
• Main setting: Change in PV from the point that the MV reaches the high limit (100%) or low limit (0%).
• Sub-setting: Range of absolute value of deviation (PV-SP) allowing the event to turn OFF.
• ON delay time: Diagnosis time
• OFF delay time: A period of time from power ON allowing the event to turn OFF.
● Operation specifications
The direct action is used for the heat control and is turned ON in the following cases:
• The increase in PV becomes smaller than the main setting after the diagnosis time (ON delay time) has elapsed after the MV had reached the high limit.
• The decrease in PV becomes smaller than the main setting after the diagnosis time (ON delay time) has elapsed after the MV had reached the low limit.
The reverse action is used for the cool control and is turned ON in the following cases:
• The decrease in PV becomes smaller than the main setting after the diagnosis time (ON delay time) has elapsed after the MV had reached the high limit.
• The increase in PV becomes smaller than the main setting after the diagnosis time (ON delay time) has elapsed after the MV had reached the low limit.
In the following cases, the event is turned OFF with the priority over the above conditions:
• The absolute value of the deviation (PV-SP) becomes less than the sub-setting.
However, the event is turned OFF when the absolute value of the deviation is less than the (sub setting – hysteresis) value after the absolute value of the deviation has become the sub setting or more.
• A period of time after the operation has been started by power ON is less than the OFF delay time.
● CAUTION
When setting the ON delay and OFF delay, it is necessary to put in " High function configuration".
The default settings of the ON delay and OFF delay before shipment are 0.0s.</td></tr>
<tr><td></td><td></td><td>Heat control
 

ON delay is started when conditions 1 and 2 are satisfied.</td><td>Cool control
 

ON delay is started when conditions 1 and 2 are satisfied.</td></tr>
</table>

(To be continued to the next page.)

Operation type	Set value of operation type	Direct action	Reverse action
Alarm (status)	23	ON if alarm occurs (alarm code AL01 to 99). OFF in other cases.	OFF if alarm occurs (alarm code AL01 to 99). ON in other cases.
READY (status)	24	ON in the READY mode. OFF in the RUN mode.	OFF in the READY mode. ON in the RUN mode.
MANUAL (status)	25	ON in the MANUAL mode. OFF in the AUTO mode.	OFF in the MANUAL mode. ON in the AUTO mode.
RSP (status)	26	ON in the RSP mode. OFF in the LSP mode.	OFF in the RSP mode. ON in the LSP mode.
During AT (Status)	27	ON when AT is executed. OFF when AT is stopped.	OFF when AT is executed. ON when AT is stopped.
During SP ramp	28	ON during SP ramp. OFF when SP ramp is not performed or is completed.	OFF during SP ramp. ON when SP ramp is not performed or is completed.
Control action (status)	29	ON during direct action (cooling). OFF during reverse action (heating).	OFF during direct action (cooling). ON during reverse action (heating).
ST setting standby (status)	30	Invalid in this unit. Always OFF.	Invalid in this unit. Always ON.
During estimated position control (status)	31	ON during estimated position control. OFF when not estimated.	OFF during estimated position control. ON when not estimated.
Timer (status)	32	The direct and reverse action settings are disabled for the timer event. When using the timer event, it is necessary to set the operation type of the DI assignment to "Timer Start/Stop". Additionally, when setting the event channel designation of the DI assignment, multiple timer events are controlled from individual internal contacts (DI). ● Setting items • ON delay time: A period of time necessary for the event change from OFF to ON after DI has been changed from OFF to ON. • OFF delay time: A period of time necessary for the event change from ON to OFF after DI has been changed from ON to OFF. ● Operation specifications • The event is turned ON when DI ON continues for ON delay time or longer. • The event is turned OFF when DI OFF continues for OFF delay time. • In other cases, the current status is continued.  ● CAUTION When setting the ON delay and OFF delay, it is necessary to put in "High function configuration". The default settings of the ON delay and OFF delay before shipment are 0.0s. The default setting of the event channel designation of the DI assignment before shipment is "0". In this case, the timer event start/stop can be set for all internal events from one internal contact (DI). Additionally, as one or more event channel designation is set, the timer event start/stop can be set for one internal event specified by one internal contact (DI). However, when setting the event channel of the DI assignment, it is necessary to put in "High function configuration".

■ Operation type

The operation type of the internal event can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 1 Configuration 1 Operation type (Event Configuration bank)	E 1.C 1	0: No event 1: PV high limit 2: PV low limit 3: PV high/low limit 4: Deviation high limit 5: Deviation low limit 6: Deviation high/low limit 7: Deviation high limit (Final SP reference) 8: Deviation low limit (Final SP reference) 9: Deviation high/low limit (Final SP reference) 10: SP high limit 11: SP low limit 12: SP high/low limit 13: MV high limit 14: MV low limit 15: MV high/low limit 16: CT1 heater burnout/over-current 17: CT1 heater short-circuit 18: CT2 heater burnout/over-current 19: CT2 heater short-circuit 20: Loop diagnosis 1 21: Loop diagnosis 2 22: Loop diagnosis 3 23: Alarm (status) 24: READY (status) 25: MANUAL (status) 26: RSP (status) 27: During AT execution (status) 28: During SP ramp (status) 29: Control direct action (status) 30: ST setting standby (status) (Invalid in this unit.) 31: During estimated position control (status) 32: Timer (status)	0	Simple, Standard, High function
Internal Event 2 Configuration 1 Operation type (Event Configuration bank)	E 2.C 1		0	
Internal Event 3 Configuration 1 Operation type (Event Configuration bank)	E 3.C 1		0	
Internal Event 4 Configuration 1 Operation type (Event Configuration bank)	E 4.C 1		0	
Internal Event 5 Configuration 1 Operation type (Event Configuration bank)	E 5.C 1		0	
Internal Event 6 Configuration 1 Operation type (Event Configuration bank)	E 6.C 1		0	
Internal Event 7 Configuration 1 Operation type (Event Configuration bank)	E 7.C 1		0	
Internal Event 8 Configuration 1 Operation type (Event Configuration bank)	E 8.C 1		0	

■ Direct/reverse, standby, and EVENT state at READY

Direct/reverse, standby, and EVENT state at READY accompanying with the operation type can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 1 Configuration 2 (Event Configuration bank)	E 1.C 2	The digits are called 1st digit, 2nd digit, 3rd digit, and 4th digit from the right end. 1st digit: Direct/reverse setup 0: Direct 1: Reverse 2nd digit: Standby setup 0: None 1: Standby 2: Standby + Standby at SP change 3rd digit: EVENT state at READY setup 0: Continued. 1: Forced OFF 4th digit: Undefined. 0: Undefined.	0000	Simple, Standard, High function
Internal Event 2 Configuration 2 (Event Configuration bank)	E2.C 2		0000	
Internal Event 3 Configuration 2 (Event Configuration bank)	E 3.C 2		0000	
Internal Event 4 Configuration 2 (Event Configuration bank)	E 4.C 2		0000	
Internal Event 5 Configuration 2 (Event Configuration bank)	E 5.C 2		0000	
Internal Event 6 Configuration 2 (Event Configuration bank)	E 6.C 2		0000	
Internal Event 7 Configuration 2 (Event Configuration bank)	E 7.C 2		0000	
Internal Event 8 Configuration 2 (Event Configuration bank)	E 8.C 2		0000	

- When the internal event configuration 1 operation type is set at [0: No event], the internal event configuration 2 (direct/reverse, standby, and EVENT state at READY) is not displayed.
- For details about internal event operation with the direct/reverse setting,
  ☞ refer to the List of internal event operations (on pages 5-57 to 5-62).

[!] Handling Precautions

- "Standby" is a function that does not turn ON the event even though the event currently used satisfies the ON conditions (before polarity) when the instrument power is turned ON or when the READY mode is changed to the RUN mode. The event is turned ON when the ON conditions are satisfied again once the OFF conditions have been satisfied.
- "Standby + Standby at SP change" means that the standby is set again when the SP is changed (SP value and LSP group number) in addition to the standby functions. However, when the same SP value is written or when the SP value is not changed even though the LSP group number is changed, the unit does not enter the standby mode.

■ Alarm OR, special OFF setup, and delay time unit

Alarm OR, special OFF setup, and delay time unit accompanying with the operation type can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 1 Configuration 3 (Event Configuration bank)	E 1.C 3	The digits are called 1st digit, 2nd digit, 3rd digit, and 4th digit from the right end. 1st digit: Alarm OR setup 0: None 1: Alarm direct + OR operation 2: Alarm direct + AND operation 3: Alarm reverse + OR operation 4: Alarm reverse + AND operation 2nd digit: Special OFF setup 0: As usual. 1: When EV main setting is “0”, the event is set to “OFF”. 3rd digit: Delay time unit setup 0: 0.1s 1: 1s 2: 1min. 4th digit: Undefined. 0: Undefined.	0000	High function
Internal Event 2 Configuration 3 (Event Configuration bank)	E 2.C 3		0000	
Internal Event 3 Configuration 3 (Event Configuration bank)	E 3.C 3		0000	
Internal Event 4 Configuration 3 (Event Configuration bank)	E 4.C 3		0000	
Internal Event 5 Configuration 3 (Event Configuration bank)	E 5.C 3		0000	
Internal Event 6 Configuration 3 (Event Configuration bank)	E 6.C 3		0000	
Internal Event 7 Configuration 3 (Event Configuration bank)	E 7.C 3		0000	
Internal Event 8 Configuration 3 (Event Configuration bank)	E 8.C 3		0000	

- When the internal event configuration 1 operation type is set at [0: No event], the internal event configuration 3 (alarm OR, special OFF setup, and delay time unit) is not displayed.

The following shows the relationship among alarm OR setting, alarm occurred/not occurred, and internal event ON/OFF:

Alarm OR setting	Alarm (AL01 to 99) occurred/not occurred	Internal event ON/OFF status before alarm OR process	Internal event ON/OFF status after alarm OR process
None	Not occurred	OFF	OFF
	Not occurred	ON	ON
	Occurred.	OFF	OFF
	Occurred.	ON	ON
Alarm direct + OR operation	Not occurred	OFF	OFF
	Not occurred	ON	ON
	Occurred.	OFF	ON
	Occurred.	ON	ON
Alarm direct + AND operation	Not occurred	OFF	OFF
	Not occurred	ON	OFF
	Occurred.	OFF	OFF
	Occurred.	ON	ON
Alarm reverse + OR operation	Not occurred	OFF	ON
	Not occurred	ON	ON
	Occurred.	OFF	OFF
	Occurred.	ON	ON
Alarm reverse + AND operation	Not occurred	OFF	OFF
	Not occurred	ON	ON
	Occurred.	OFF	OFF
	Occurred.	ON	OFF

■ Main setting, sub setting, and hysteresis

Main setting, sub setting, and hysteresis accompanying with the operation type can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 1 Main setting (Event bank)	E 1	-1999 to +9999 The decimal point position may vary so that it meets the operation type. The above value becomes 0 to 9999 in some operation types.	0	Simple, Standard, High function
Internal Event 1 Sub-setting (Event bank)	E 1.Sb	-1999 to +9999 The decimal point position may vary so that it meets the operation type. The above value becomes 0 to 9999 in some operation types.	0	
Internal Event 1 Hysteresis (Event bank)	E 1.HY	0 to 9999 The decimal point position may vary so that it meets the operation type.	5	
Internal Event 2 Main setting (Event bank)	E2	Same as Internal Event 1 Main setting.	0	
Internal Event 2 Sub-setting (Event bank)	E2.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 2 Hysteresis (Event bank)	E2.HY	Same as Internal Event 1 Hysteresis.	5	
Internal Event 3 Main setting (Event bank)	E3	Same as Internal Event 1 Main setting.	0	
Internal Event 3 Sub-setting (Event bank)	E3.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 3 Hysteresis (Event bank)	E3.HY	Same as Internal Event 1 Hysteresis.	5	
Internal Event 4 Main setting (Event bank)	E4	Same as Internal Event 1 Main setting.	0	
Internal Event 4 Sub-setting (Event bank)	E4.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 4 Hysteresis (Event bank)	E4.HY	Same as Internal Event 1 Hysteresis.	5	
Internal Event 5 Main setting (Event bank)	E5	Same as Internal Event 1 Main setting.	0	
Internal Event 5 Sub-setting (Event bank)	E5.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 5 Hysteresis (Event bank)	E5.HY	Same as Internal Event 1 Hysteresis.	5	
Internal Event 6 Main setting (Event bank)	E6	Same as Internal Event 1 Main setting.	0	
Internal Event 6 Sub-setting (Event bank)	E6.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 6 Hysteresis (Event bank)	E6.HY	Same as Internal Event 1 Hysteresis.	5	
Internal Event 7 Main setting (Event bank)	E7	Same as Internal Event 1 Main setting.	0	
Internal Event 7 Sub-setting (Event bank)	E7.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 7 Hysteresis (Event bank)	E7.HY	Same as Internal Event 1 Hysteresis.	5	

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 8 Main setting (Event bank)	E8	Same as Internal Event 1 Main setting.	0	Simple, Standard, High function
Internal Event 8 Sub-setting (Event bank)	E8.Sb	Same as Internal Event 1 Sub setting.	0	
Internal Event 8 Hysteresis (Event bank)	E8.HY	Same as Internal Event 1 Hysteresis.	5	

- When the internal event configuration 1 operation type is set at [0: No event], the internal event main setting, sub-setting, and hysteresis are not displayed.
- For details about internal event operation with main setting, sub-setting, and hysteresis,

☞ refer to the List of internal event operations (on pages 5-57 to 5-62).

■ ON delay and OFF delay

ON delay is a function that delays the timing, at which the internal event status is changed from OFF to ON.

OFF delay is a function that delays the timing, at which the internal event status is changed from ON to OFF.

However, when the operation type is set at [20: Loop diagnosis 1], [21: Loop diagnosis 2], [22: Loop diagnosis 3], or [32: Timer], the ON delay and OFF delay are operated as another function.

For details,

☞ refer to the List of internal event operations (on pages 5-57 to 5-62).

ON delay and OFF delay can be set.

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 1 ON delay (Event bank)	E 1.on	0.0 to 999.9s (Delay time unit is “0.1s”.) 0 to 9999s (Delay time unit is “1s”.) 0 to 9999min (Delay time unit is “1min”.)	0.0s or 0s or 0min	High function
Internal Event 1 OFF delay (Event bank)	E 1.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 2 ON delay (Event bank)	E2.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 2 OFF delay (Event bank)	E2.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 3 ON delay (Event bank)	E3.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 3 OFF delay (Event bank)	E3.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 4 ON delay (Event bank)	E4.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 4 OFF delay (Event bank)	E4.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	

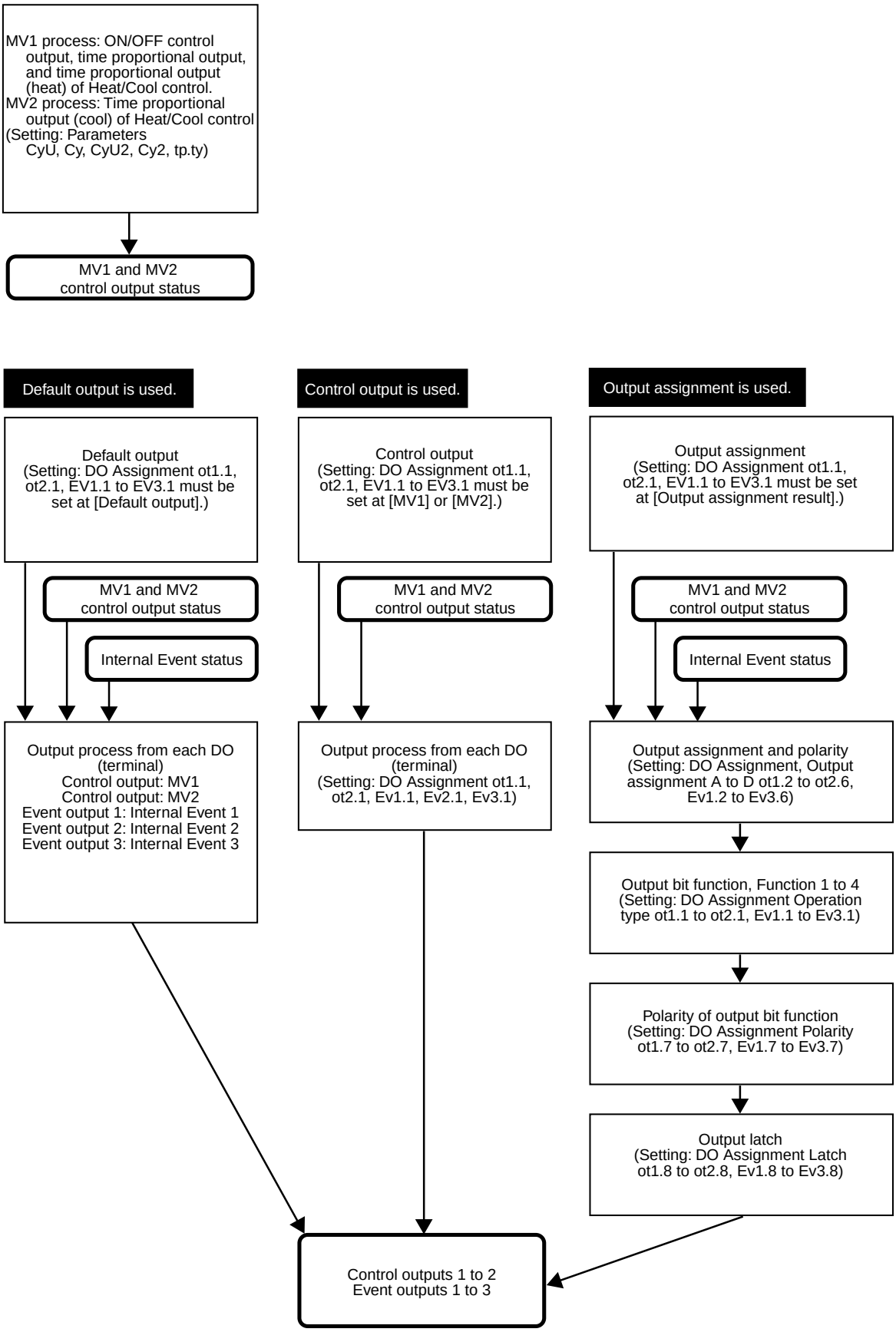
(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
Internal Event 5 ON delay (Event bank)	E5.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	High function
Internal Event 5 OFF delay (Event bank)	E5.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 6 ON delay (Event bank)	E6.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 6 OFF delay (Event bank)	E6.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 7 ON delay (Event bank)	E7.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 7 OFF delay (Event bank)	E7.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 8 ON delay (Event bank)	E8.on	Same as internal event 1 ON delay.	0.0s or 0s or 0min	
Internal Event 8 OFF delay (Event bank)	E8.oF	Same as internal event 1 ON delay.	0.0s or 0s or 0min	

- When the internal event configuration 1 operation type is set at [0: No event], the internal event ON delay and OFF delay are not displayed.

5 - 9 Digital Output (DO)

The following shows the functional block diagram of the digital output (DO):



■ MV1/MV2 process

The time proportional cycle and time proportional cycle mode of MV1/MV2 can be set.

Item (Bank)	Display	Contents	Initial value	User level
Time proportional unit 1 (for MV1) (Parameter bank)	CyU	0: 1s unit 1: Cycle fixed at 0.5s. 2: Cycle fixed at 0.25s. 3: Cycle fixed at 0.1s If the set value is other than “0”, the time proportional cycle 1 (Cy) cannot be set.	0	High function
Time proportional cycle 1 (for MV1) (Parameter bank)	Cy	5 to 120s (Output destination of MV1 includes the relay output.) 1 to 120s (Output destination of MV1 does not include the relay output.) If the time proportional unit 1 (CyU) ≠ 0, this setting becomes invalid and the setting becomes impossible.	10 or 2s	Simple, Standard, High function
Time proportional unit 2 (for MV2) (Parameter bank)	CyU2	0: 1s unit 1: Cycle fixed at 0.5s. 2: Cycle fixed at 0.25s. 3: Cycle fixed at 0.1s If the set value is other than “0”, the time proportional cycle 2 (Cy2) cannot be set.	0	High function
Time proportional cycle 2 (for MV2) (Parameter bank)	Cy2	5 to 120s (Output destination of MV2 includes the relay output.) 1 to 120s (Output destination of MV2 does not include the relay output.) If the time proportional unit 2 (CyU2) ≠ 0, this setting becomes invalid and the setting becomes impossible.	10 or 2s	Simple, Standard, High function
Time proportional cycle mode (Parameter bank)	tPLy	0: Controllability aiming type 1: Operation service life aiming type (ON/OFF operation is performed only once within the time proportional cycle.	0 or 1	High function

- MV1 is the general term for the ON/OFF control output, time proportional output, and time proportional output for heat side of the Heat/Cool control. MV2 is the time proportional output for cool side of the Heat/Cool control.
- When MV1 is connected only to the voltage pulse output in the DO Assignment, the display and setting of the time proportional unit 1 (CyU) can be performed.
- When MV1 is connected to any of the relay control output, voltage pulse control output, and event output in the DO Assignment, the display and setting of the time proportional cycle 1 (Cy) can be made. However, when the time proportional unit 1 (CyU) is other than “0”, the display and setting of the time proportional cycle 1 (Cy) cannot be performed.
- When the Heat/Cool control is used and MV2 is connected only to the voltage pulse output in the DO Assignment, the display and setting of the time proportional unit 2 (CyU2) can be performed.
- When the Heat/Cool control is used and MV2 is connected to any of the relay control output, voltage pulse control output, and event output in the DO Assignment, the display and setting of the time proportional cycle 2 (Cy2) can be made. However, when the time proportional unit 2 (CyU2) is other than “0”, the display and setting of the time proportional cycle 2 (Cy2) cannot be performed.
- The initial value of the time proportional cycle 1 (Cy) is “10” when the control output 1 is the relay output and it is “2” in other cases.
- The initial value of the time proportional cycle 2 (Cy2) is “10” when a model with one control output point is used and it is “2” when other models are used.

- The setting of the time proportional cycle mode (tP.ty) is valid to the time proportional outputs of both MV1 and MV2.
- When MV1 is connected to the relay control output or event output in the DO Assignment and the time proportional cycle 1 (Cy) is set at less than “5s”, the operation is performed at intervals of 5s.
- When MV2 is connected to the relay control output or event output in the DO Assignment and the time proportional cycle 2 (Cy2) is set at less than “5s”, the operation is performed at intervals of 5s.

[!] Handling Precautions

- The following shows the resolution of the time proportional output by the setting of the time proportional unit 1 and 2 (CyU/CyU2):
  When this setting is set at “0” (1s unit), the resolution becomes “1/1000” (seconds of the time proportional cycle X 1/1000).
  When this setting is set at “1” (Cycle fixed at “0.5s”), the resolution becomes “1/500 (1ms)”.
  When this setting is set at “2” (Cycle fixed at “0.25s”), the resolution becomes “1/250 (1ms)”.
  When this setting is set at “3” (Cycle fixed at “0.1s”), the resolution becomes “1/100 (1ms)”.
- The time proportional cycle is operated for a period of time approximately 2.4% longer than the setting. Care should be taken when using the timer function with the time proportional output. Use the ON delay/ OFF delay and DI timer stop/start functions with the timer function of the internal event, if the ON/OFF output having more precise time is needed.

■ Operation type

The outputs of the control outputs 1 to 2 and event outputs 1 to 3 can be set using the operation type of the DO Assignment.

Item (Bank)	Display	Contents	Initial value	User level
Control output 1 Operation type (DO bank)	ot 1.1	0: Default output 1: MV1 2: MV2 3: Function 1 ((A and B) or (C and D)) 4: Function 2 ((A or B) and (C or D)) 5: Function 3 (A or B or C or D) 6: Function 4 (A and B and C and D)	0	High function
Control output 2 Operation type (DO bank)	ot2.1		0	
Event output 1 Operation type (DO bank)	Ev 1.1		0	
Event output 2 Operation type (DO bank)	Ev2.1		0	
Event output 3 Operation type (DO bank)	Ev3.1		0	

- When the control output is the relay output or voltage pulse output, the display and setting can be made.
- When the event output is provided, the display and setting can be made.
- MV1 is the ON/OFF control output, time proportional output, and time proportional output (heat) of the Heat/Cool control.
- MV2 is the time proportional output (cool) of the Heat/Cool control.
- When the set value is “0” (default output), the operation becomes as follows according to the output:
  Control output 1: Control output status of MV1 is output.
  Control output 2: Control output status of MV2 is output.
  Event output 1: Result of Internal Event 1 is output.
  Event output 2: Result of Internal Event 2 is output.
  Event output 3: Result of Internal Event 3 is output.
- In the output bit function, the logical operations (AND, OR) of each control output and each event output are combined. In output bit functions 1 to 4, the combination of the logical operations may vary. The following shows one logical operation:

Logical AND	Logical OR
OFF and OFF = OFF	OFF or OFF = OFF
OFF and ON = OFF	OFF or ON = ON
ON and OFF = OFF	ON or OFF = ON
ON and ON = ON	ON or ON = ON

■ Output assignment

The assignments of four inputs (A, B, C, D) used for the output bit function can be set.

Item (Bank)	Display	Contents	Initial value	User level
Control output 1 Output assignment A (DO Assignment bank)	ot 1.2	0: Normally opened. (OFF, 0) 1: Normally closed. (ON, 1) 2: Internal Event 1 3: Internal Event 2 4: Internal Event 3 5: Internal Event 4 6: Internal Event 5 7: Internal Event 6 8: Internal Event 7 9: Internal Event 8 10 to 13: Undefined. 14: MV1 15: MV2 16 to 17: Undefined. 18: DI1 19: DI2 20: DI3 21: DI4 22 to 25: Undefined. 26: Internal Contact 1 27: Internal Contact 2 28: Internal Contact 3 29: Internal Contact 4 30: Internal Contact 5 31 to 33: Undefined. 34: Communication DI1 35: Communication DI2 36: Communication DI3 37: Communication DI4 38: MANUAL mode 39: READY mode 40: RSP mode 41: AT running 42: During SP ramp 43: Undefined. 44: Alarm occurred. 45: PV alarm occurred. 46: Undefined. 47: mode key pressing status 48: Event output 1 status 49: Control output 1 status	14	High function
Control output 1 Output assignment B (DO Assignment bank)	ot 1.3		0	
Control output 1 Output assignment C (DO Assignment bank)	ot 1.4		0	
Control output 1 Output assignment D (DO Assignment bank)	ot 1.5		0	
Control output 2 Output assignment A (DO Assignment bank)	ot2.2		15	
Control output 2 Output assignment B (DO Assignment bank)	ot2.3		0	
Control output 2 Output assignment C (DO Assignment bank)	ot2.4		0	
Control output 2 Output assignment D (DO Assignment bank)	ot2.5		0	
Event output 1 Output assignment A (DO Assignment bank)	Eu 1.2		2	
Event output 1 Output assignment B (DO Assignment bank)	Eu 1.3		0	
Event output 1 Output assignment C (DO Assignment bank)	Eu 1.4		0	
Event output 1 Output assignment D (DO Assignment bank)	Eu 1.5		0	
Event output 2 Output assignment A (DO Assignment bank)	Eu2.2		3	
Event output 2 Output assignment B (DO Assignment bank)	Eu2.3		0	
Event output 2 Output assignment C (DO Assignment bank)	Eu2.4		0	

(To be continued to the next page.)

Item (Bank)	Display	Contents	Initial value	User level
Event output 2 Output assignment D (DO Assignment bank)	Eu2.5	Same as those on the previous page.	0	Same as that on the previous page.
Event output 3 Output assignment A (DO Assignment bank)	Eu3.2		4	
Event output 3 Output assignment B (DO Assignment bank)	Eu3.3		0	
Event output 3 Output assignment C (DO Assignment bank)	Eu3.4		0	
Event output 3 Output assignment D (DO Assignment bank)	Eu3.5		0	

- When the object control output is the relay output or voltage pulse output, and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.
- When the object event output is provided and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.

■ Polarity of output assignment

The polarity of four output assignments (A, B, C, D) used for the output bit function can be set.

Item (Bank)	Display	Contents	Initial value	User level
Control output 1 Polarity A to D (DO Assignment bank)	ot 1.6	The digits are called 1st digit, 2nd digit, 3rd digit, and 4th digit from the right end. 1st digit: Output assignment A Polarity setting 2nd digit: Output assignment B Polarity setting 3rd digit: Output assignment C Polarity setting 4th digit: Output assignment D Polarity setting 0: Direct 1: Reverse	0000	High function
Control output 2 Polarity A to D (DO Assignment bank)	ot2.6		0000	
Event output 1 Polarity A to D (DO Assignment bank)	Ev 1.6		0000	
Event output 2 Polarity A to D (DO Assignment bank)	Ev2.6		0000	
Event output 3 Polarity A to D (DO Assignment bank)	Ev3.6		0000	

- When the object control output is the relay output or voltage pulse output, and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.
- When the object event output is provided and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.

[!] Handling Precautions

The output relay may be turned ON and OFF repeatedly at a high-speed depending on the conditions.
To avoid such faulty operation, always strictly observe the following cautions:

Control output 1: When any of [Output assignment A, B, C, D] (ot1.2 to ot1.5) is set at [49: Control output 1 status], do not set [1: Reverse] for the same symbol of [Output assignment A, B, C, D Polarity].
Event output 1: When any of [Output assignment A, B, C, D] (Ev1.2 to Ev1.5) is set at [48: Event output 1 status], do not set [1: Reverse] for the same symbol of [Output assignment A, B, C, D Polarity].

■ Polarity of output bit function

The polarity after the output bit function (functions 1 to 4) can be set.

Item (Bank)	Display	Contents	Initial value	User level
Control output 1 Polarity (DO Assignment bank)	ot 1.7	0: Direct 1: Reverse	0	High function
Control output 2 Polarity (DO Assignment bank)	ot2.7		0	
Event output 1 Polarity (DO Assignment bank)	Eu 1.7		0	
Event output 2 Polarity (DO Assignment bank)	Eu2.7		0	
Event output 3 Polarity (DO Assignment bank)	Eu3.7		0	

- When the object control output is the relay output or voltage pulse output, and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.
- When the object event output is provided and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.

■ Latch

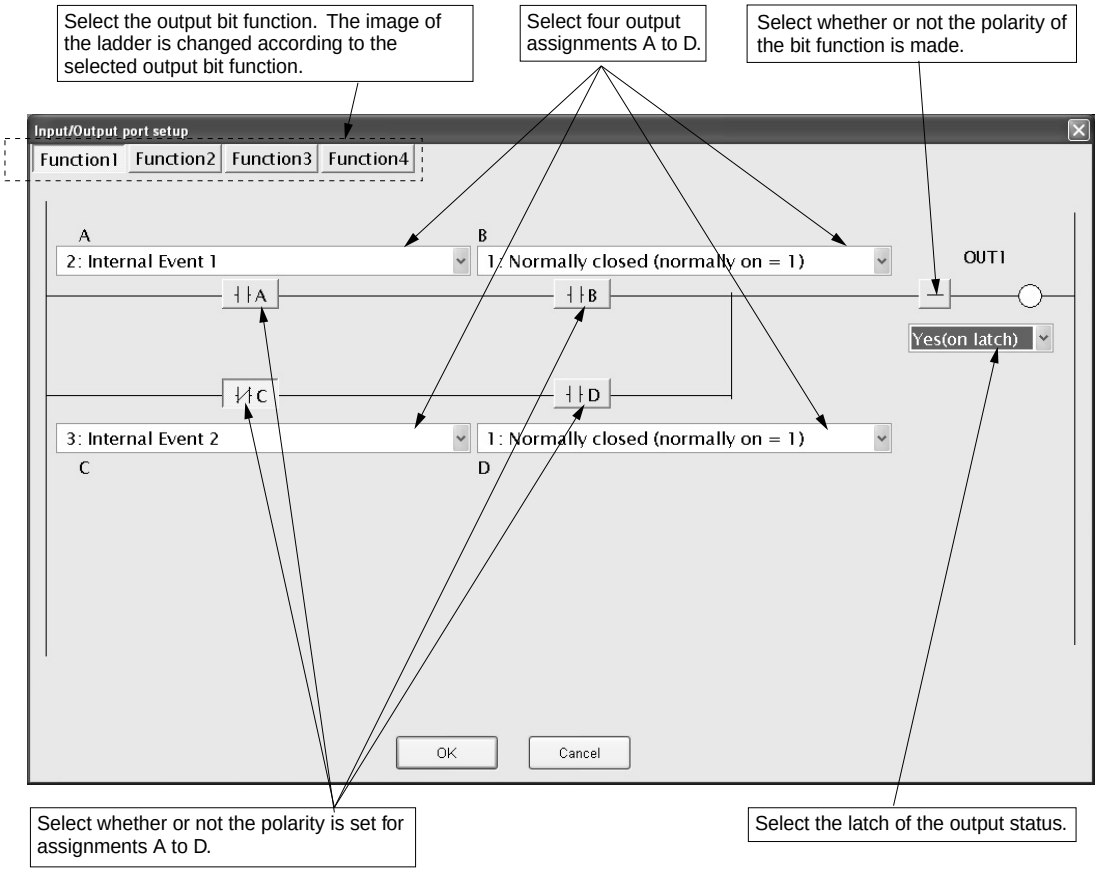
The latch of the output ON status or output OFF status can be set.

Item (Bank)	Display	Contents	Initial value	User level
Control output 1 Latch (DO Assignment bank)	ot 1.8	0: None 1: Latched (Latched when turned ON.) 2: Latched (Latched when turned OFF except for initialization at power ON.)	0	High function
Control output 2 Latch (DO Assignment bank)	ot2.8		0	
Event output 1 Latch (DO Assignment bank)	Eu 1.8		0	
Event output 2 Latch (DO Assignment bank)	Eu2.8		0	
Event output 3 Latch (DO Assignment bank)	Eu3.8		0	

- When the object control output is the relay output or voltage pulse output, and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.
- When the object event output is provided and the operation type of the DO Assignment is set for output bit functions 1 to 4, the display and setting can be made.
- To release the latch status, it is necessary to turn OFF the power, and turn it ON again, to release all DO latches (key operation or communication), or to change the latch setting of the DO Assignment to “0” (none).

■ DO Assignment setting with Smart Loader Package SLP-C35

When setting [DO Assignment] with the Smart Loader Package SLP-C35, select [Edit (E)] → [Input/Output port setup (O)] in that order from the menu. The output bit function, output assignment, polarity of output assignment, and polarity of output bit function can be easily set using visual images as shown below.



Handling Precautions

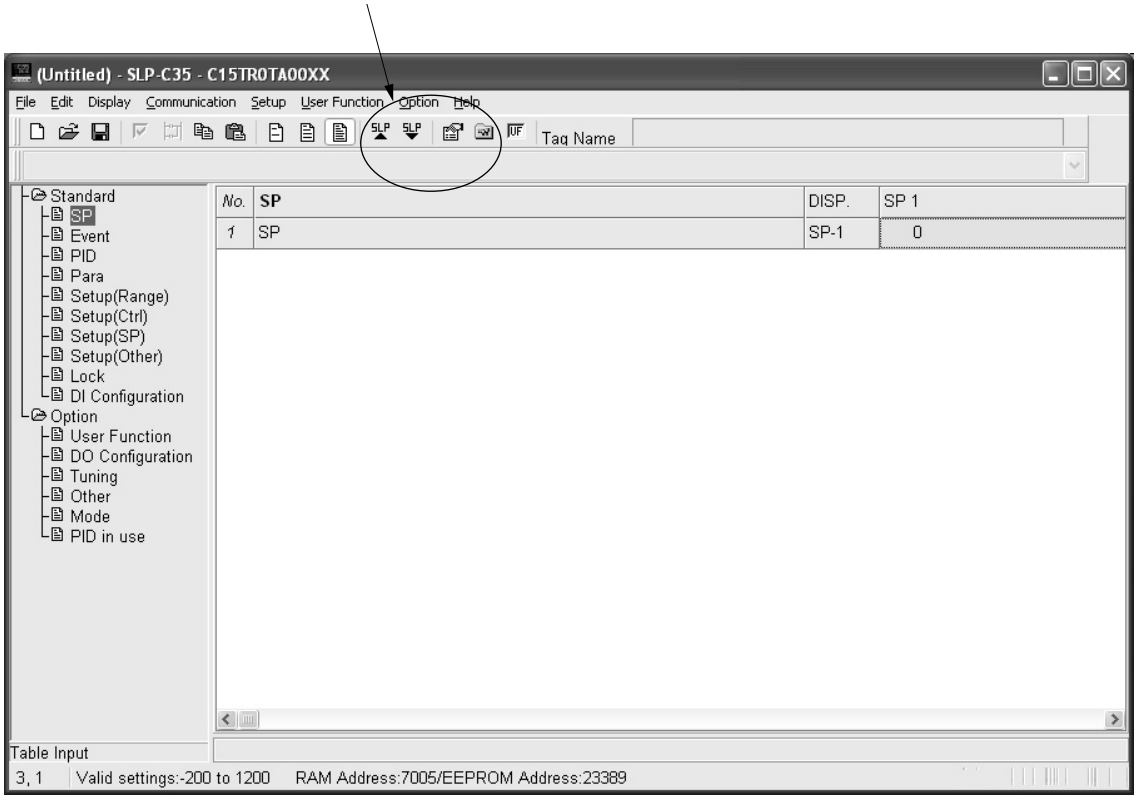
In addition to the selection through the menu, the Input port setup window can also be opened using the following procedures:
Click the input/output port setup icon .
Right-click in the input bit function setting window.
Push the [P] key while pressing the [Ctrl] key.

5 - 10 Application Examples

This section describes examples of applications using the assignment functions of this unit.

■ Examples of applications using assignment functions

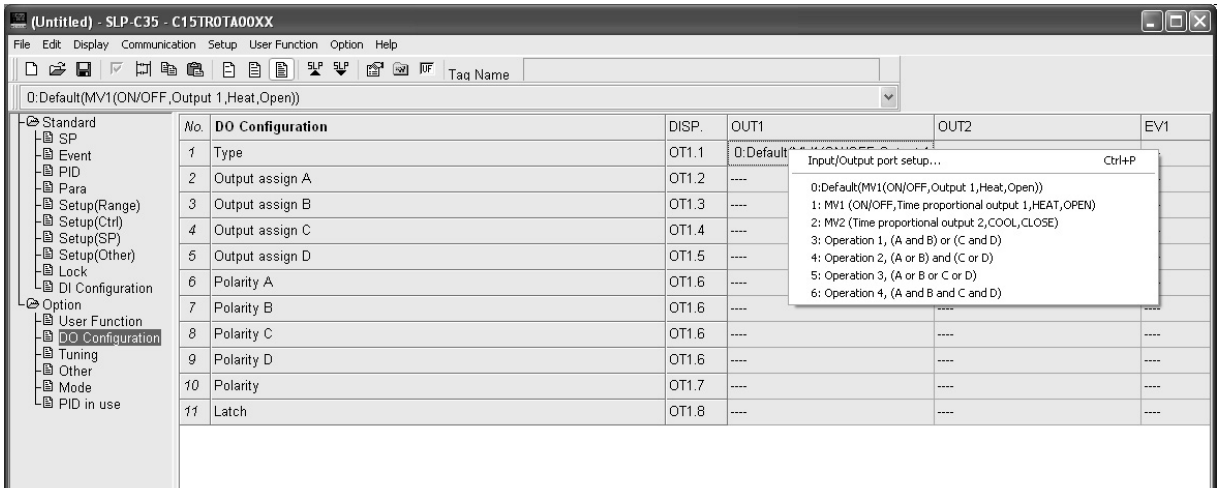
The following shows setting examples with the Smart Loader Package SLP-C35. To use assignment functions, it is absolutely necessary to set the user level to "High function configuration".



● Example 1 Logical OR of the heater burnout and PV high limit alarm is output.

Conditions: PV high limit is set to Internal Event 1.
Heater burnout is set to Internal Event 2.
Logical OR of the above events is output to the EV1 relay.

(1) Select [Standard] → [Event] and set [Internal Event 1] to [1: PV high limit].
(2) Similarly, set [Internal Event 2] to [16: Heater 1 break/Heater over current].
(3) Select [Option] → [DO Assignment] and right-click on the operation type of [Event output 1] to select [Input/Output port setup].



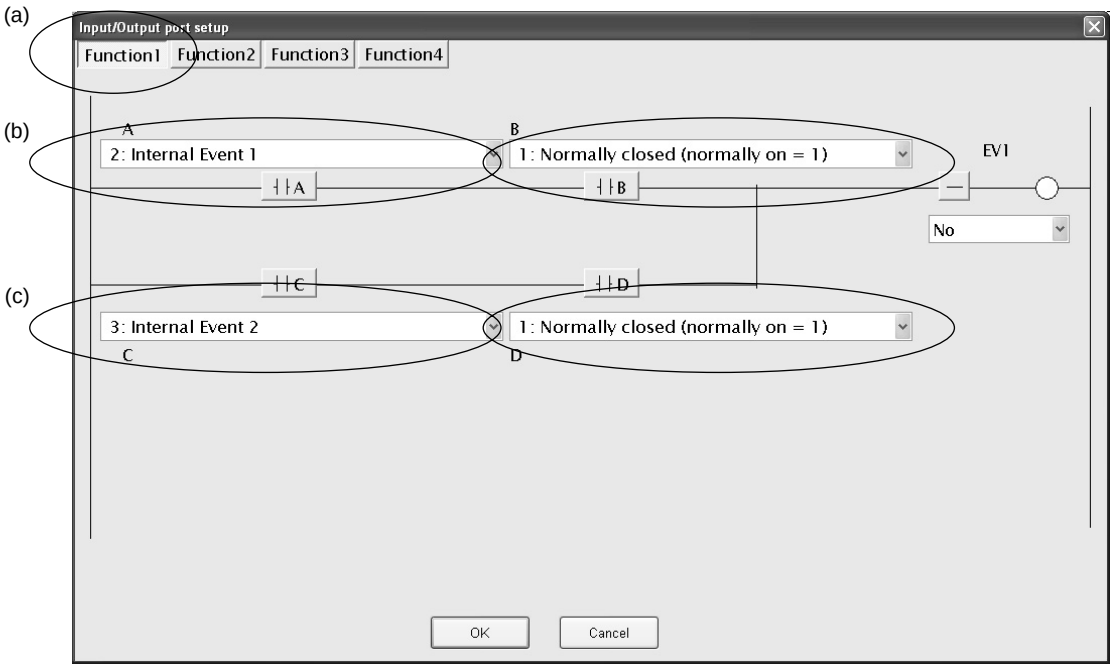
(4) In the Input/Output port setup window, set the following items:

(a) In this example, since the logical OR of two functions needs to be output, select [Function 1].

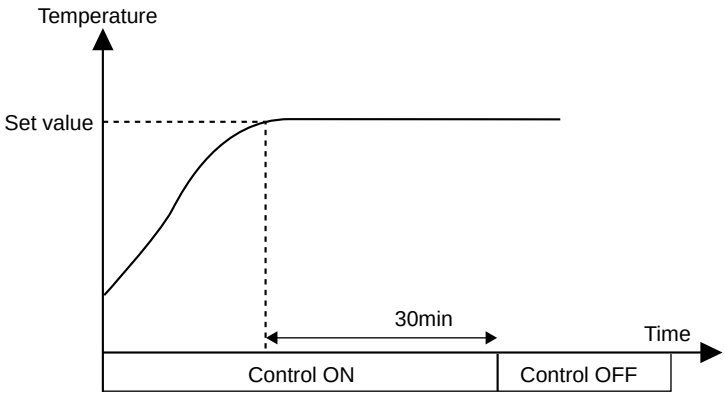
(b) Select [PV high limit] of Internal Event 1 for output assignment A.

(c) Similarly, select [Heater break] of Internal Event 2 for output assignment C.

(d) Select [Normally closed] for output assignment B and D.



● **Example 2 The operation is started by the external switch, and then it is stopped automatically 30min after the temperature has reached the set value.**



◆ **Explanation**

The timer start-up conditions are set to logical AND of DI1 and PV status EVs. The ON delay timer setting decides the time period after which the operation is stopped automatically when the temperature has reached the set value.
The mode (RUN/READY) is changed based on a combination of DI1 and timer ON-OFF.

Status	Control OFF status	Timer counting after starting of operation	Operation stop by time-up
DI1	OFF	ON	ON
Timer (Internal EV2)	OFF	OFF	ON
Status of Internal Contact 2	ON	OFF	ON
Mode	READY	RUN	READY

◆ **Setting example**

• Event

Event	Display	Internal Event 1	Internal Event 2
Operation type	Ex.C1	32: Timer	4: Deviation high limit
Direct/reverse	Ex.C2	----	0: Direct
Standby	Ex.C2	----	0: No standby
EVENT state at READY	Ex.C2	0: EVENT state at READY is continued.	0: EVENT state at READY is continued.
Alarm OR	Ex.C3	0: None	0: None
Special OFF setup	Ex.C3	----	0: As usual.
Delay time unit	Ex.C3	2.1min	0: 0.1s
Event main setting (low limit)	Ex	----	0
Event sub-setting (high limit)	Ex.SB	----	----
Hysteresis	Ex.HY	----	5
ON delay	Ex.ON	30	0
OFF delay	Ex.OF	0	0

Note. The internal event No. is indicated at the mark of "x" shown in the display column.