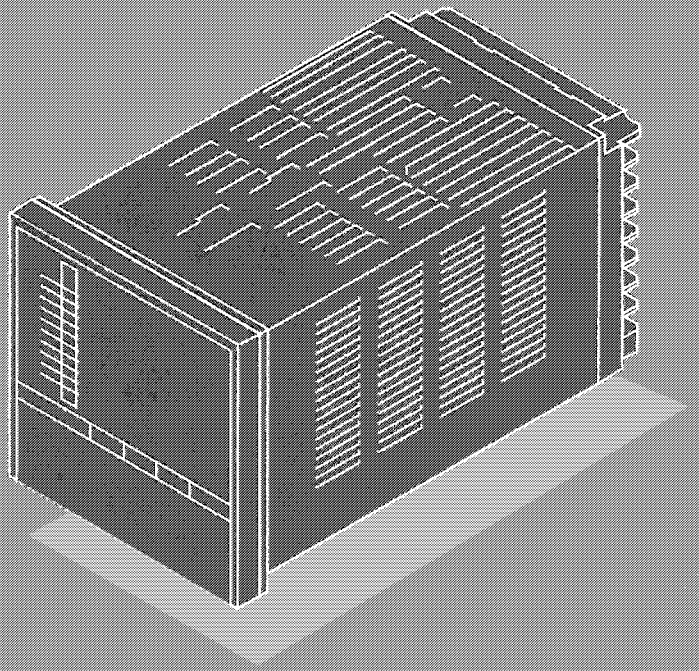
OMRON

ES100X Digital Controller

User's Manual



Cat. No. H070-E1-2

Preface

Thank you for your purchase of your ES100. This digital controller has been achieved as a result of three development concepts:

- Friendly
- Intelligent
- User-oriented

This User's Manual has been designed specifically for the ES100X fixed-control type ES100, and explains its features and mode of use.
Before using your ES100X, thoroughly read and understand this manual in order to ensure correct use.

How to read this Manual

■ ES100X manuals

A total of three manuals are provided for the ES100X as follows:

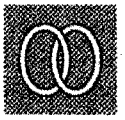
- When using the general features of the ES100X:
  ES100X Digital Controller
  User's Manual (Cat. No. H070-E1-2)
- When using the communications features:
  ES100 Digital Controller
  User's Manual (Communications Guide) (Cat. No. H072-E1-2)
- When using the support software:
  ES100 Support Software
  ES/TOOLS Support Software
  User's Manual (Cat. No. H071-E1-1)

■ The meaning of icons used in this manual

Icons are used in this manual in addition to explanatory text. Icons are used in order to visually represent information and facilitate understanding as you read through this manual. The three icons shown below are used throughout this manual. However, you will find some icons specific to certain chapters of the manual. For details on these icons, read the explanation at the beginning of the relevant chapter.
The following icons are used throughout this manual, and mean the following:

"Caution" mark
This mark indicates that the caution that follows must be heeded at all times.

"Reference" mark
This mark indicates that extra, useful information follows, such as supplementary explanations and how to apply functions.



"See" mark
This mark indicates that you can refer to additional information relating to the preceding explanation.

■ How this Manual is Organized

Purpose	Title	Description
● **Learning about the general features of the ES100X**	Chapter 1 What is the ES100X?	This chapter describes the features of the ES100X, names of parts, and typical functions.
● **Setting up the ES100X**	Chapter 2 Preparations	This chapter describes the operations that you must carry out (e.g. installation, wiring and switch settings) before you can use the ES100X.
● **ES100X operations**	Chapter 3 Basic Operation	This chapter describes how to use the front panel keys and how to view the display when setting the parameters of the major functions of the ES100X.
● **How to use parameters**	Chapter 3 Basic Operation Chapter 4 Applied Operation Chapter 5 Parameters	Chapter 4 describes more advanced ways of utilizing the major functions described in Chapter 3. Chapter 5 describes in detail the parameters related to these functions when setting parameters.
● **Learning about control using on the ES100X**	Chapter 6 Typical Examples	This chapter gives typical examples of control that can be achieved on the ES100X, and the key points to remember in each of the control methods.
● **Troubleshooting**	Chapter 7 Troubleshooting	This chapter describes what to do if any problems occur.

Caution in Installing this Controller

- When connecting input or output lines to your controller, keep the following points in mind to reduce the influence from external noise: Avoid parallel or common wiring with high voltage sources and power lines carrying large currents. Allow adequate space between the high voltage/ current lines and the input/output lines. Using separating pipes, duct work, and line shields is also useful in protecting the controller and its lines from external noise.
- Allow as much space as possible between the controller (including input/output cables) and devices that generate a powerful, high frequency (high-frequency welders, high-frequency sewing machines, and so forth). These devices may cause power surges and other malfunctions.
- If there is a large power-generating device near the controller and any of its lines, attach a surface absorber or noise filter to the device to stop the noise from affecting the controller system. In particular, motors, transformers, solenoids, and magnetic coils have an inductance component, and therefore can generate very strong noises.
- When mounting a noise filter, be sure to first check the filter's voltage and current capacity, then mount the filter as close as possible to the controller. You can also sometimes improve the controller's resistance to noise by grounding the controller to the control board.
- To reduce radiation nose and the influence of radiation noise, be sure to ground the control board. Also, be sure to ground the FG terminal of the external power supply.
- Do not use the controller in places where icing, condensation, dust, corrosive gas (especially sulfide gas or ammonia gas), shock, vibration, splashing liquid, or oil atmosphere occur. Also, avoid places where the controller can be subjected to intense heat radiation (like from a furnace) or sudden temperature changes.
- Ambient temperature must be kept between -10°C to 55°C. Ambient humidity must be kept between 35%RH to 85%RH (with no ice or condensation). If the controller is installed inside a control board, the ambient temperature must be kept under 55°C, including the temperature inside the control board. If the controller is subjected to heat radiation, use a fan to cool the surface of the controller to under 55°C.
- Store the controller at an ambient temperature between -25°C to 65°C. The ambient humidity must be between 35%RH to 85%RH (with no ice or condensation).
- Never place heavy objects on, or apply pressure to the controller that may cause it to deform during use or storage.
- Avoid using the controller in places near a radio, television set, or wireless installation—these devices can cause radio disturbances which adversely affect the performance of the controller.
- Use a stable voltage (100 to 240 V AC at 50 to 60 Hz). At power ON, the prescribed voltage level must be attained within two seconds.
- If you remove the controller from its case, never touch the electronic parts inside, nor allow static or any other kind of electrical source to contact the controller components.

Table of Contents

CHAPTER 1
WHAT IS THE ES100X?

1.1 Features

● Easy Operation

- You can easily set and adjust parameter settings using the support software (*1).
- You can quickly set operating instructions or frequently used parameters using programmable function keys.
- You can easily make optimum adjustments to control using the auto-tuning and fine tuning functions.

● Almost All Types of Control are Possible on a Single Unit.

- Control is facilitated by using the parameters provided exclusively for heating-cooling control.
- You can choose between floating and closed control on a position-proportional control system.
- Control is facilitated by using the cascade control parameters on a 2-input controller. Operation assignment functions are also supported for ratio control and feed-forward control.

● A Wide Range of I/O Functions

- Two inputs are available for analog input: analog input 1 and analog input 2. You can choose from thermocouple, platinum resistance thermometer, current input and voltage and input for analog input 1. You can choose from current input and voltage input for analog input 2.
- Two control outputs and one transfer output are available for analog output. Control outputs are configured in modules so that you can choose the electrical interface matched to the control target.
- A maximum of eight digital inputs and ten digital outputs are provided.
- Two communications functions are available: serial communications and BCD communications. (*2)

● I/O Functions Can be Re-assigned

- Digital and analog I/O are not fixed; you can use the digital operation assignment and analog operation assignment functions to assign the optimum I/O functions to the desired control target.
- Digital I/O signals can be assigned by the digital operation assignment function.
- You can use the analog operation assignment function to process data to achieve control operation for analog input. You can also use the analog operation assignment function to process control operation in order to output the control operation results as analog output.

● Enhanced Bank Functions

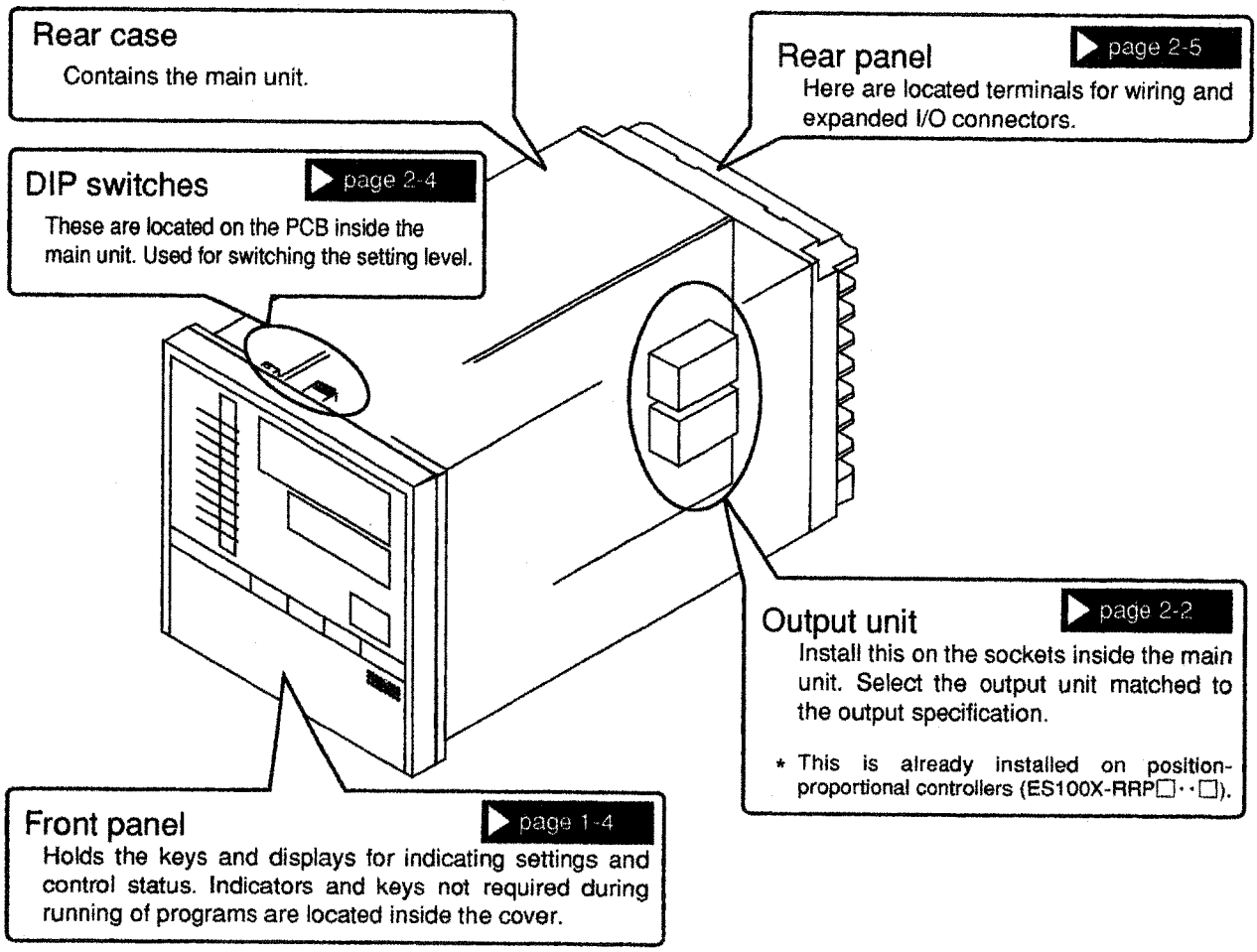
- You can set control data for up to eight banks.
- You can not only switch between banks for use by designating the bank, but can also run an abridged program for automatically switching between banks when each bank time has elapsed.

*1 ES/TOOLS Support Software is sold separately.
*2 See the ES100 Digital Controller User's Manual, Communications Guide.

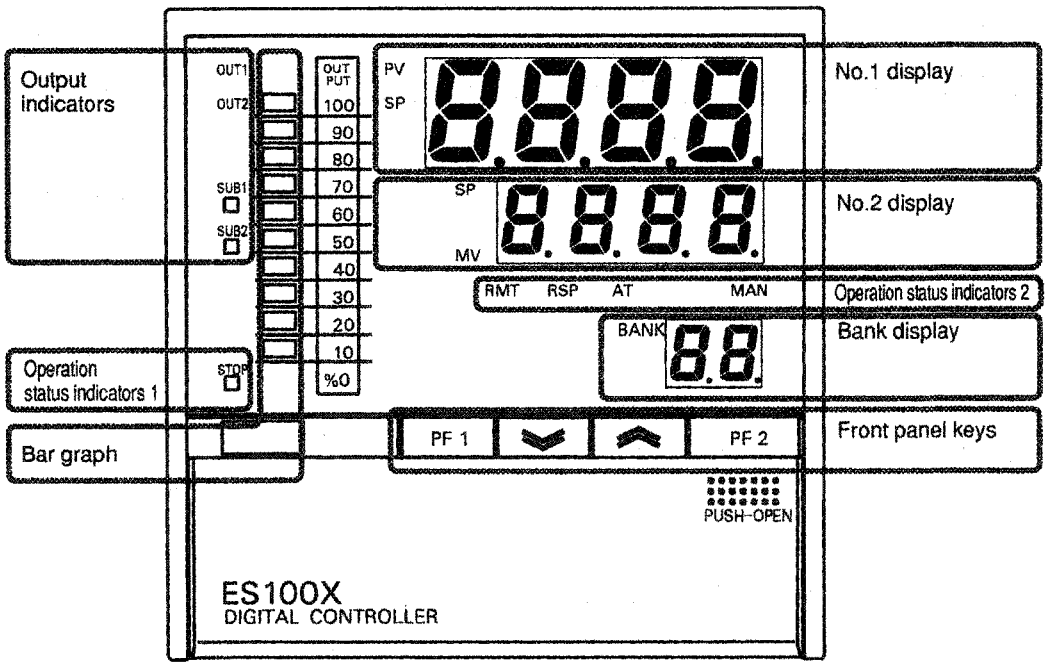
1.2 Names of Parts

■ Main parts

The figure below shows the main parts of the ES100X, and describes each of their functions.
For more details on these main parts, see the page numbers for each description.



■ Front panel



No.1 display

Displays parameter symbols when setting parameters. During setting of parameters, the PV and SP LEDs do not light.
Displays the process value (PV) or the set point (SP) during monitoring. Either of the PV or SP LEDs lights according to the display content.

No.2 display

Displays settings when setting parameters. During setting of parameters, the SP, and MV LEDs do not light.
Displays the process value (PV), elapsed time and the manipulated variable (MV) during monitoring. One of the SP or MV LEDs lights according to the display content.

Bar graph

This bar graph indicates the manipulated variable, valve opening position, elapsed-time%, and deviation. The user can designate in parameters which items are displayed on the bar graph.

Output indicators

The corresponding LEDs lights depending on which control outputs (OUT1, OUT2) and auxiliary outputs (SUB1, SUB2) are ON.

Operation status indicators 1

STOP lights when the control is in a stop status.

Operation status indicators 2

These indicators display the current control status.
- RMT LED : Lights when the current mode is set to remote or external.
- RSP LED : Lights when in the remote SP mode.
- AT LED : Flashes when auto-tuning is being executed.
- MAN LED : Lights when the current mode is the manual mode.

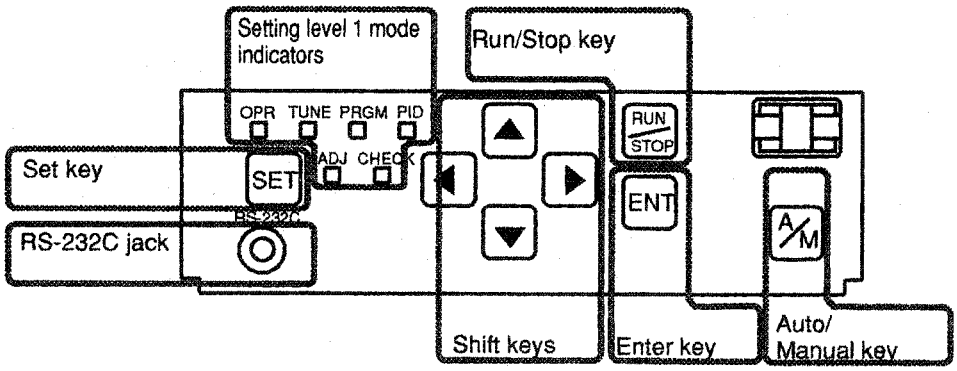
Bank display

When setting and running banks, the BANK display indicates the bank No. When setting table parameters, the BANK display indicates the table No.

Front panel keys

- The [PF1] and [PF2] keys are programmable function keys. The user can assign functions to these keys.
- Each press of the [∧] key increments values by 1, and each press of the [∨] key decrements values by 1. The display remains dim until the [ENT] key is pressed.

■ Front panel (inside cover)



Setting level 1 mode indicators

The LED corresponding to the mode set in setting level 1 lights. Correspondence between the LED and setting mode is as follows:

OPR LED : Operation mode
TUNE LED : Tuning mode
BANK LED : Bank setting mode
PID LED : PID set setting mode
ADJ LED : Adjustment mode
CHECK LED: Check mode

Set key

Designates the first parameter in each setting mode.

Shift keys

Pressing the ▼ key designates the next parameter.
Pressing the ▲ key designates the previous parameter.
Pressing the ▶ key designates the next table No.
Pressing the ◀ key designates the previous table No.

Enter key

This key is used to enter a setting. When pressed, the dim display changes to a lit display.

Auto/Manual key

Each press of this key switches between auto and manual modes.

Run/Stop key

Each press of this key switches between run (start control) and stop (stop control).

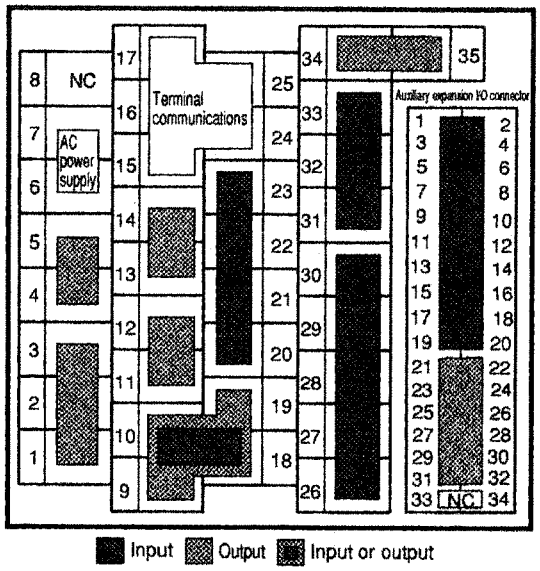
RS-232C jack

This RS-232C interface jack is for communicating with the ES/TOOLS support software (sold separately). Cables other than the dedicated cable (sold separately) cannot be used with the ES/Tools support software.

1.3 Input and Output

■ Layout of I/O terminals

The ES100X rear panel is provided with terminals and expanded I/O connectors. Input and output terminals are arranged in groups as shown in the figure below. The rear panel can be configured in a variety of ways depending on the model you have purchased.



■ Input

● Analog input 1

- A total of 26 analog input terminals are available: 17 temperature sensor input (thermocouple and platinum resistance thermometer), seven voltage inputs, and two current inputs. You can choose one of these 26 analog inputs in the "analog input 1 type" parameter.

● Analog input 2

- These terminals are available only on 2-input ES100X. You can choose either of voltage input or current input in parameter settings.

● CT input

- Terminals are provided on standard ES100X (including heating-cooling models) for CT input for use in heater current detection.

● Potentiometer input

- Terminals are provided on position-proportional ES100X for potentiomenter input for use in valve opening measurement.

● Auxiliary input (digital input)

- Of the ES100X on which auxiliary inputs can be used, up to eight auxiliary input terminals can be used on models provided with expanded I/O connectors, and up to three auxiliary input terminals can be used on models not provided with expanded I/O connectors.
- The application of the auxiliary input terminals can be designated by the digital operation assignment function. Before shipment from the factory, switch inputs for bank No. selections are assigned to the auxiliary input terminals
- On ES100X provided with expanded I/O connectors, the auxiliary input terminals cannot be used when using BCD communications. BCD communications is switched to in parameter settings.

■ Output

● Control output (analog output)

- Two control output terminals are provided: control output 1 and control output 2. You can choose between relay output, SSR output, voltage output and current output for each of these terminals depending on the type of output unit installed on the main unit.
- In position-proportional control systems, control output 1 is used for open output and control output 2 is used for closed output. So, a relay output unit is used as the output unit. This output unit is already installed in position-proportional controllers before shipment from the factory, so the user need not to obtain a separate output unit.

● Transfer output (current output)

- This terminal is exclusively for current output. Output data can be designated to this terminal by the analog operation assignment function. PV is assigned to this terminal before shipment from the factory.

● Auxiliary output (digital output)

- Ten auxiliary output terminals are provided: auxiliary outputs 1 to 10.
- Auxiliary outputs 1 and 2 are for relay output, and auxiliary outputs 3 to 10 are for open-collector output.
- Auxiliary outputs 3 to 10 sometimes cannot be used depending on the model of ES100X.
- Output data can be designated to auxiliary outputs by the digital operation assignment function. Event output is assigned to auxiliary outputs 1 and 2 before shipment from the factory.
- When using BCD communications on ES100X provided with expanded I/O connectors, auxiliary outputs 3 to 10 cannot be used.

Terminal names and operation assignments

On the ES100X, the functions of I/O terminals are determined by the "operation assignment function." That is, inputs correspond to arguments, and outputs correspond to assignment destinations. Sometimes, however, the terminal name differs from the name used in operation assignment. The purpose of this is to match the terminology used in conventional temperature controllers and digital controllers. The following table shows the correspondence between terminal names and the name used in operation assignment.

Terminal Name	Argument or Assignment Destination	Terminal Name	Argument or Assignment Destination
Control output 1	Analog output 1	Transfer output	Analog output 3
Control output 2	Analog output 2	Auxiliary input 1	Digital input 1
Auxiliary output 1	Digital output 1	Auxiliary input 2	Digital input 2
Auxiliary output 2	Digital output 2	Auxiliary input 3	Digital input 3

For details on the operation assignment function, see page 1-10.

1.4 Parameters and Setting Levels

The ES100X has two setting levels, setting level 1 and setting level 2. These two setting levels support different parameters.

● Setting level 2

This setting level is for determining the specifications of the controller. Running of programs is stopped when this setting level is entered.
Of the parameters in setting level 2, unit or reference information used in setting level 1 parameters must be set before the related setting level 1 parameter is accessed.
In setting level 2, parameters are distributed among the following setting modes:

Specification setting mode
Event setting mode
ON/OFF timer setting mode
Digital operation assignment setting mode
Analog operation assignment setting mode
Setting level 2 technical mode

● Setting level 1

This setting level is for setting performance or operating conditions.
In setting level 1, parameters are distributed among the following setting modes:

Manual mode parameter setting mode (available only in the manual mode)
Operation mode
Tuning mode
Bank setting mode
PID set setting mode
Adjustment mode
Check mode
(Setting level 1 technical mode)

Each of these modes except setting level 1 technical mode can be verified by lighting of their respective LEDs.

● Switching between setting levels

To switch between setting levels 1 and 2, you need to change the settings of the DIP switches located inside the main unit of the ES100X.
Setting levels 1 and 2 are each provided with a technical mode to set the technical parameters. You can enable (and disable) access and display of the technical modes by changing the DIP switch settings.

1.5 SP Mode

On the ES100X, you can use one of local SP (LSP) or remote SP (RSP) as the set point (SP). Each of these SPs is designated in an "SP mode."

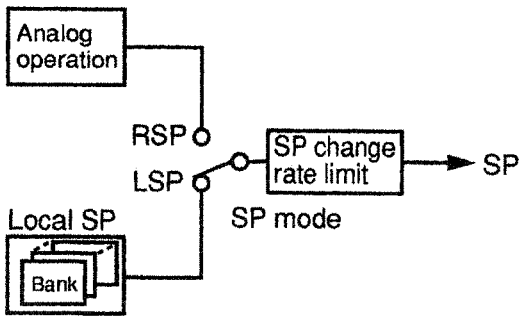
● Local SP mode

In the local SP mode, the SP is calculated from the "local SP" parameter set for each of the banks.
When remote SP is switched to from the local SP mode during operation, the SP changes. The bank time, however, continues to advance.

There are two ways of selecting banks; you can directly designate the bank No., and you can automatically switch between banks in the bank No. order when each bank time has elapsed. Selecting banks when each bank time has elapsed resembles programmed operation, so this is called "abridged program operation."

● Remote SP mode

In the remote SP mode, the result of analog operations that takes the assignment destination as the "RSP" is used as the SP. This SP is called the "remote SP."
The remote SP mode is set, for example, when controlling external analog input data (using analog input 2) as the SP.



About setting modes

You can choose between settings made on the front panel, by serial communication and by BCD communication for use in parameter settings. Settings made on the front panel are called "local settings," serial communication settings are called "remote settings", and BCD communication settings are called "external settings".
Note that the terms "local" and "remote" differ from "local" and "remote" used in the SP modes. Remember this when setting the SP mode and parameters.

1.6 Operation Assignment Function

■What is an "operation assignment"?

- ES100X I/O data is used according to the values set to tables. These tables describe how I/O data are is to be handled. Accordingly, you can use I/O data as it is as control data in the same way as on conventional digital controllers. Data can be further manipulated by "operations," so the optimum I/O functions can be achieved for the control target. This is referred to as the "operation assignment function."
  Tables describing how I/O data is to be handled are called "operation assignment tables."
- There are two operation assignment functions: the "digital operation assignment function" and "analog operation assignment function." The function to be used depends on the type of data that is to be handled.
- Moreover, "mixed analog/digital operation" for exchanging data between analog and digital operations also is possible.

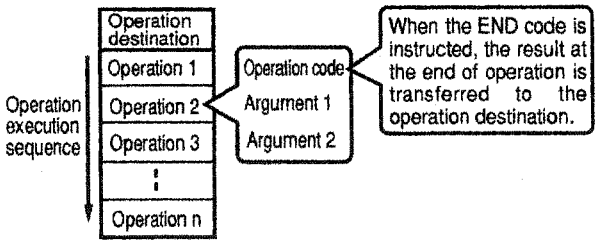
●Operation assignment table

- The content of operation assignment tables are described in the "digital/analog operation assignment" parameters.
- Operation assignment tables are made up of "operation blocks" and "assignment destinations."

Table 1	Table 2		Table n
Assignment Destination	Assignment Destination		Assignment Destination
Operation block	Operation block		Operation block

●About operations

- At the operation block, an operation that is executed using two arguments is handled as the basic unit. Each of these operations is given a No.
- Operations are executed from the smallest operation No. upwards, and end when the program reaches the operation END code.
- The result of each operation is output to the assignment destination.
- Table settings are executed in table No. order.



■ Digital operation assignments

- The digital operation processes external digital inputs, flags for internal ON/OFF timers, events and control status as arguments "1" or "0," and outputs to assignment destinations such as digital outputs, operating instructions and the digital user buffers.
- The ES100X is provided with 30 operation assignment tables. The settings of assignment destinations in unused tables should be set to "0" (disabled). The results of digital operations can also be used as the arguments for the subsequent operation.
- The operation block is made up of operations 1 to 4. This is shown in the following diagram.

Table 1	Table 2		Table 30
Assignment destination	Assignment destination		Assignment destination
Operations 1 to 4	Operations 1 to 4		Operations 1 to 4

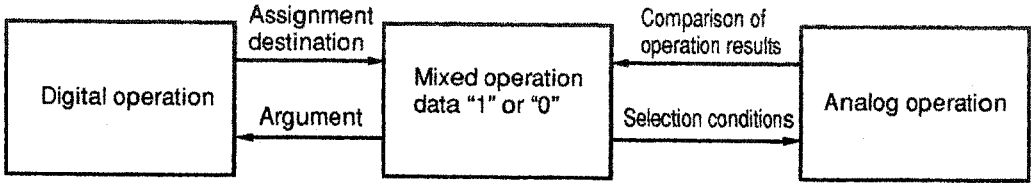
■ Analog operation assignments

- The analog operation processes external analog inputs, SP, PV and control operation data as arguments, and assigns the external results of operations to assignment destinations such as control outputs, transfer outputs and the analog user buffers.
- The ES100X is provided with 15 operation assignment tables. The settings of assignment destinations in unused tables should be set to "0" (disabled). The results of analog operations can also be used as the arguments for the subsequent operation.
- The operation block is made up of operations 1 to 15. This is shown in the following diagram.

Table 1	Table 2		Table 15
Assignment destination	Assignment destination		Assignment destination
Operations 1 to 15	Operations 1 to 15		Operations 1 to 15

■ Mixed analog/digital operation

- The ES100X is provided with a common data area for sharing the results of digital and analog operations.
- Up to eight sets of data for expressing the states "0" and "1" can be set to this data area.
- In digital operations, this area can be used for arguments or assignment destinations.
- In analog operations, the results of comparing the sizes of arguments are set as data "0" or "1". Also, arguments can be selected according to the value set to this data.
- Accordingly, you can select either of two sets of analog data using the results of digital operation, and assign the results of comparing the analog data to digital outputs.



1.7 Fine Tuning

Fine tuning is executed in the following cases:

- If you are not satisfied with the control performance of the ES100X after executing A.T. (auto-tuning)
- When PV disturbance or control cancellation caused by A.T. is not allowed in the system

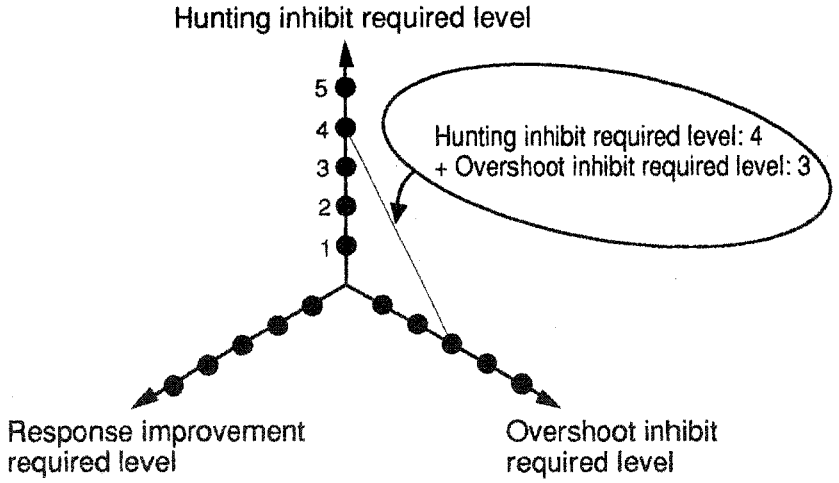
With the fine tuning function, three improvement required levels are set for improvement of control performance. Fuzzy logic inference is executed from the improvement requirements and the control state up to that point to automatically correct PID parameters.

There are three improvement required levels:

Hunting inhibit required level
Overshoot inhibit required level
Response improvement required level

The strength of each of these required levels can be designated in five stages.

If two levels of control are required for a control target, two required levels can be set simultaneously. For example, you can set the required level for the "hunting inhibit" and ""overshoot inhibit" parameters if both hunting and overshoot need to be improved. You cannot set three levels of control simultaneously for a control target.



CHAPTER 2 PREPARATIONS

2.1 Installing the ES100X

■ Output unit

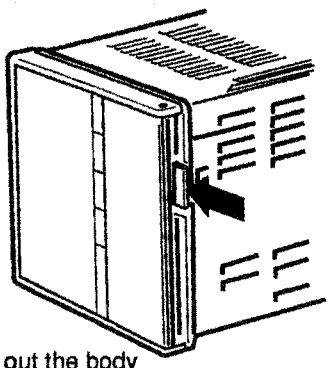
Four types of output unit are available for the ES100X. Select the output unit appropriate for how your ES100X is applied.

● Types of output unit

The following table shows the output units and their ratings.

Unit Type	Model	Rating
Relay Output Unit	E53-R	1c 250 V AC, 5 A (resistive load) Mechanical life: 1,000,000 uses or more Electrical life: 100,000 uses or more
SSR Output Unit	E53-S	1a 75 to 250 V AC, 1 A (resistive load)
Voltage Output Unit	E53-Q E53-Q3 E53-Q4	NPN type 12 V DC, 40 mA NPN type 24 V DC, 20 mA PNP type 24 V DC, 20 mA
Linear Output Unit	E53-C3	4 to 20 mA DC (load 600Ω or less) Possible for approx. 2600 resolution
	E53-C3D	0 to 20 mA DC (load 600Ω or less) Possible for approx. 2600 resolution
	E53-V34	0 to 10 VDC (load 1 kΩ or more) Possible for approx. 2600 resolution
	E53-V35	0 to 5 VDC (load 1 kΩ or more) Possible for approx. 2600 resolution

● Mounting the output unit



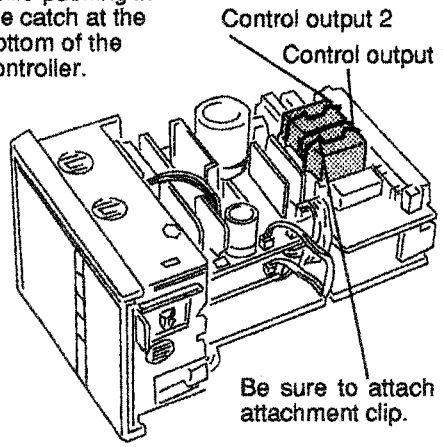
Pull out the body while pushing in the catch at the bottom of the controller.

Insert the output unit into the on-board socket following the procedure below.

(1) Pull out the controller body.
Push in the catch at the bottom of the controller to unlock the front panel from the rear panel. Pull out the body with the catch pushed in.

(2) Mount the output unit.
Insert the output unit for control output 1 into the on-board socket marked "OUTPUT1" and the output unit for control output 2 into the on-board socket marked "OUTPUT2."

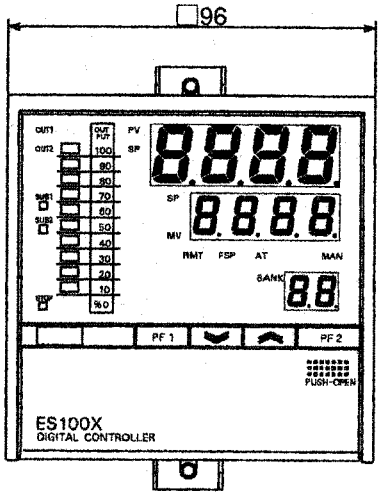
(3) Snap in the attachment clips to hold the output unit firmly in place.

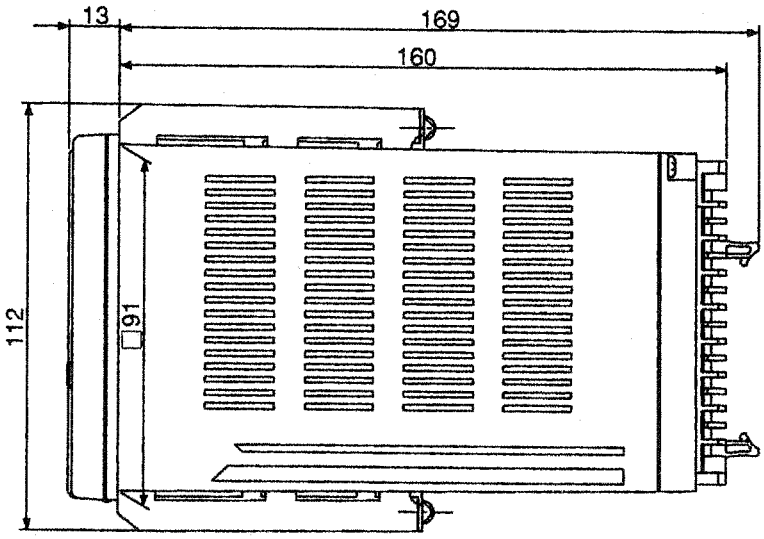


Output unit of position-proportional controllers

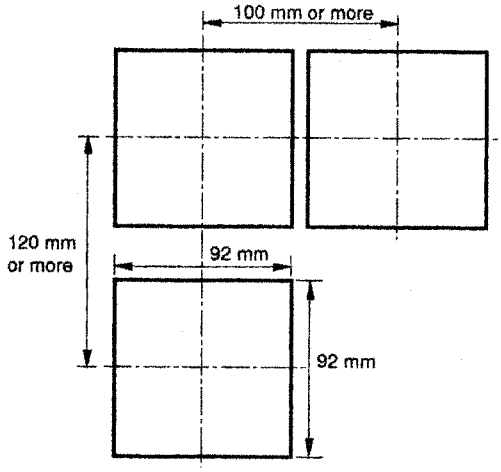
With position-proportional controllers (model ES100X-RRP), a relay output unit is provided at purchase. Therefore, this relay output unit does not need to be purchased separately.
Do not replace with other output units.

■ External dimensions





■ Drilling mounting panels

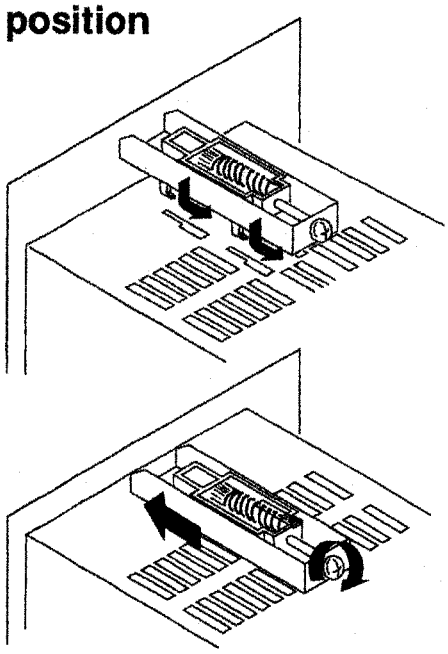


Recommended thickness of mounting panel: 1 to 8 mm

Mounting cutout: 92 mm square

When mounting two or more ES100X, mount the controllers at intervals of at least 100 mm in the horizontal direction and at least 120 mm in the vertical direction.

■ Securing the ES100X in position

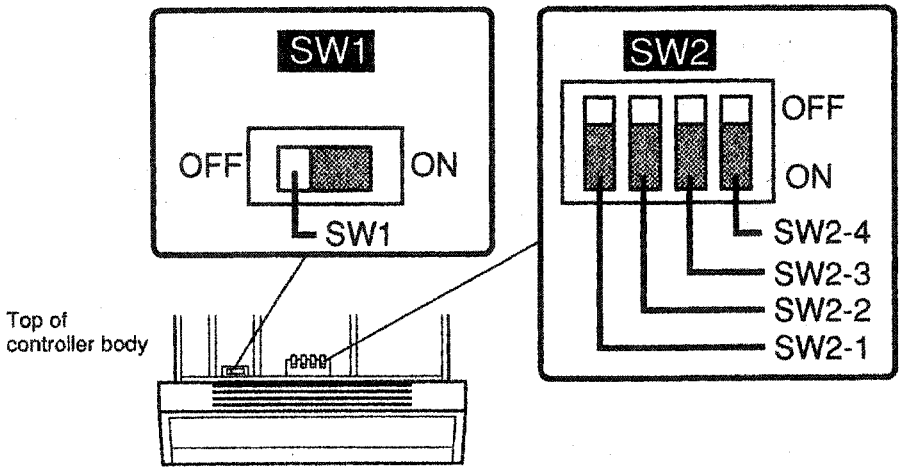


Slot the two fixtures (supplied) into the fixing slot on the rear case with the ES100X pushed into the mounting hole.
The fixing slots are located on the top and bottom of the rear case.

Tighten the fixture screw until the ratchet turns idly.

2.2 Setting the Switches

■ Switch names



■ Switch functions

The table below shows the combination of DIP switch settings for achieving the following six functions.

Function	Switch Positions				
	SW1	SW2-1	SW2-2	SW2-3	SW2-4
Setting level 2 Technical mode (enabled)	○	–	○	×	×
Setting level 2 Technical mode (disabled)	○	–	×	×	×
Setting level 1 Technical mode (enabled)	×	○	–	–	–
Setting level 1 Technical mode (disabled)	×	×	–	–	–
Communications test (disabled/enabled)	○	–	–	–	○
Initialization mode	○	–	–	○	×

○ : ON × : OFF – : ON/OFF

- All DIP switches are set to OFF before shipment from the factory.
- The "initialization mode" returns parameter settings to factory defaults.
- Set items marked "-" to the more frequently used switch setting. For example, if both switches SW2-1 and SW2-2 are set to ON, both the setting level 2 and 1 technical modes are enabled just by switching SW1.

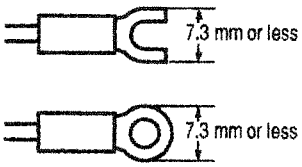
● Executing the switch functions
Switch functions excluding the communications test can be executed in the ES/TOOLS Support Software. However, note that when you execute a switch function from the ES/TOOLS Support Software, the switch settings may differ from the function (e.g. setting level) set on the switch.
To execute the function set on the switch as instructed in the switch settings, turn the power supply OFF then back ON again.

● Operation limitations
Note that regular functions such as setting operations and communications do not work when executing the communications test and when in the initialization mode.

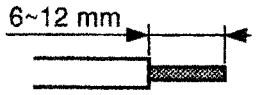
2.3 Wiring Terminals

■ Precautions when wiring

- Use ducts to separate input leads and power lines in order to protect the controller and its lines from external noise.
- We recommend using solderless terminals when wiring the controller.
- Tighten the terminal screws using a torque no greater than 78 N/cm (8 kgf/cm). Take care not to tighten the terminal screws too tightly.
- Use solderless terminals applicable to M3.5 screws.

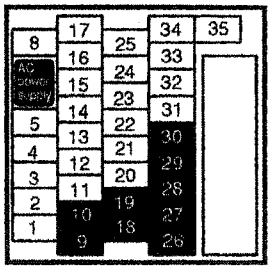


- When using soldered terminals, strip back the tip of the lead about 6 to 12 mm, and solder the tips of the exposed lead wire.

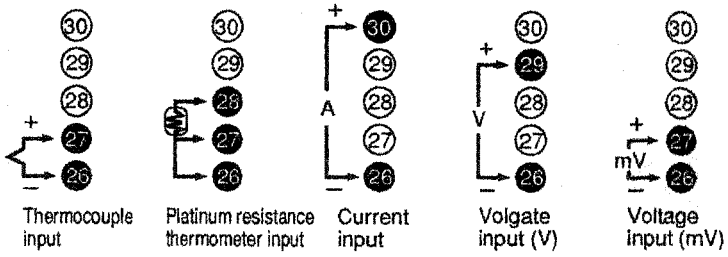


■ Input wiring

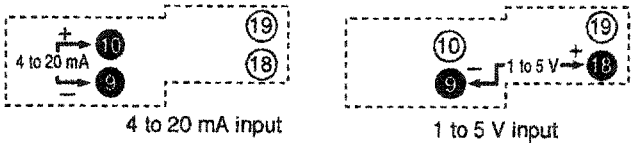
● Analog input



- Connect analog input 1 to terminal Nos. 26 to 30.
  The input type determines how terminals are wired.

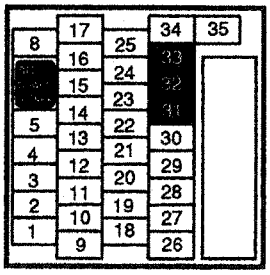


- Terminal Nos. 9, 10, 18 and 19 can be used for analog input only on 2-input type ES100X. So, check the model type before wiring inputs.
  Connect analog input 2 to terminal Nos. 9, 10, 18 and 19.
  The input type determines how terminals are wired.

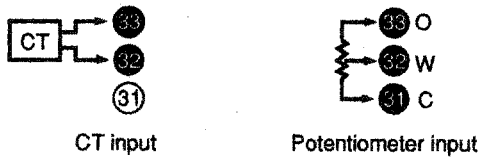


- Analog input 2 is insulated from internal circuits.

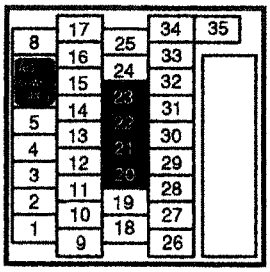
● CT input
● Potentiometer input



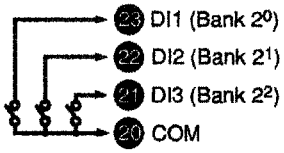
- On position-proportional controllers, connect the potentiometer input to terminal Nos. 31 to 33. On other types of controllers, connect CT input (heater current detection) to these terminals.
  The functions of these terminals are fixed, and cannot be changed by operation assignment, for example.



● Auxiliary input



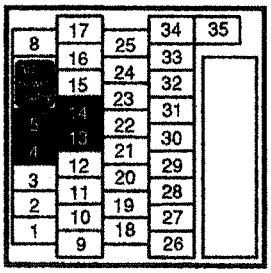
- Connect auxiliary inputs 1 to 3 (including COM terminal) to terminal Nos. 20 to 23. These terminals are assigned as external setting inputs for bank Nos. before shipment from the factory. For example, for bank 5 DI1 is set to ON, DI2 is set to OFF, and DI3 is set to ON. These terminals are enabled only on models ES100X-□□□D and ES100X-□□□B.



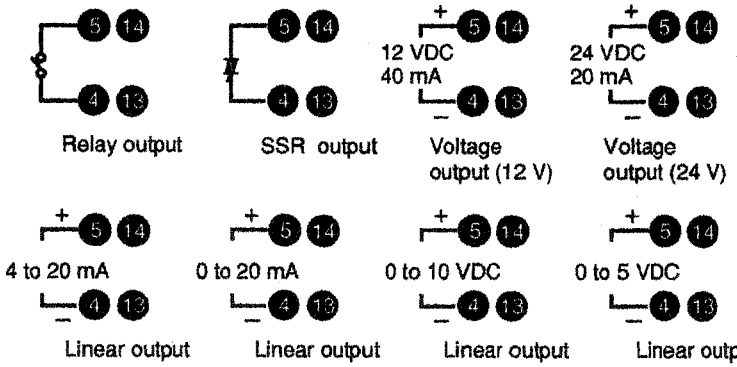
- Auxiliary inputs are insulated from internal circuits. However, note that auxiliary inputs are not insulated from transfer output and control output when a current or voltage output unit is installed.

■ Output wiring

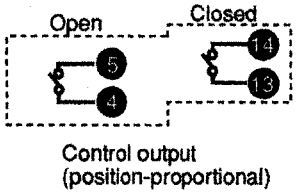
● Control output



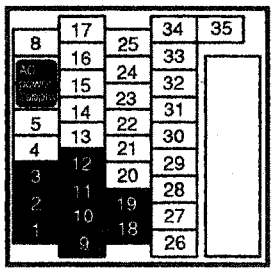
- Connect control outputs 1 to terminal Nos.4 and 5, and control outputs 2 to terminal Nos.13 and 14. Connect the control outputs to suit the output unit mounted on the ES100X. When connecting voltage or current output, check the polarity of the connection before wiring.
  For details on output units, see page 2-2.



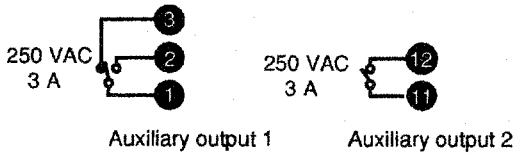
- Control outputs are insulated from internal circuits. However, note that control outputs are not insulated from auxiliary input and transfer output when a current or voltage output unit is installed.
- When carrying out heating-cooling control, use control output 1 as heating output, and control output 2 as cooling output.



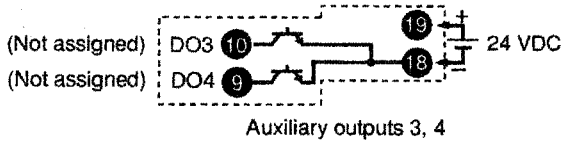
● Auxiliary output



- Connect auxiliary outputs 1 to terminal Nos.1 to 3, and auxiliary outputs 2 to terminal Nos.11 and 12. These terminals are assigned as deviation upper limit alarm output before shipment from the factory.

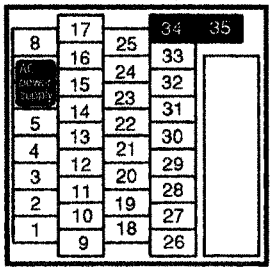


- Terminal Nos. 9, 10, 18 and 19 can be used for auxiliary output only on ES100X-□□□D models. So, check the model type before wiring outputs.
  Connect auxiliary outputs 3 and 4 to terminal Nos.9 and 10. The +24 V power supply should be connected to terminal Nos.18 and 19.
  Signal are not assigned to these terminals when the controller is shipped from the factory.

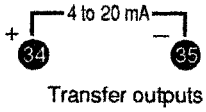


- Auxiliary outputs are insulated from internal circuits.

● Transfer outputs

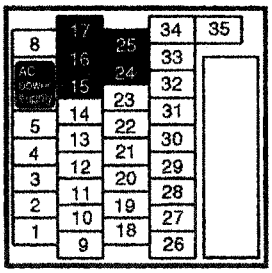


- Connect transfer output to terminal Nos.34 and 35.
  These terminals are enabled only on models ES100X-□□F□.

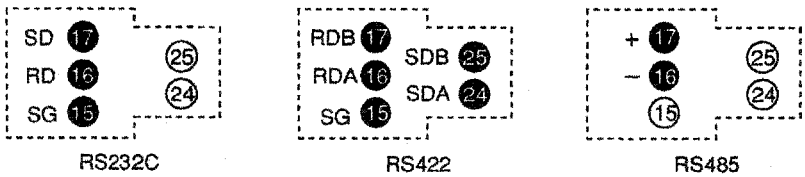


- Transfer outputs are insulated from internal circuits. However, note that transfer outputs are not insulated from control output and transfer output when a current or voltage output unit is installed.

■ Wiring communication terminals



- Terminal Nos. 15 to 17, 24 and 25 are used for wiring communication terminals. The terminals of models ES100X-□□01□ are arranged for RS-232C communication, and the terminals of models ES100X-□□04□ are arranged for RS-422/485 communication. Check which model communication terminals are to be wired to before wiring.



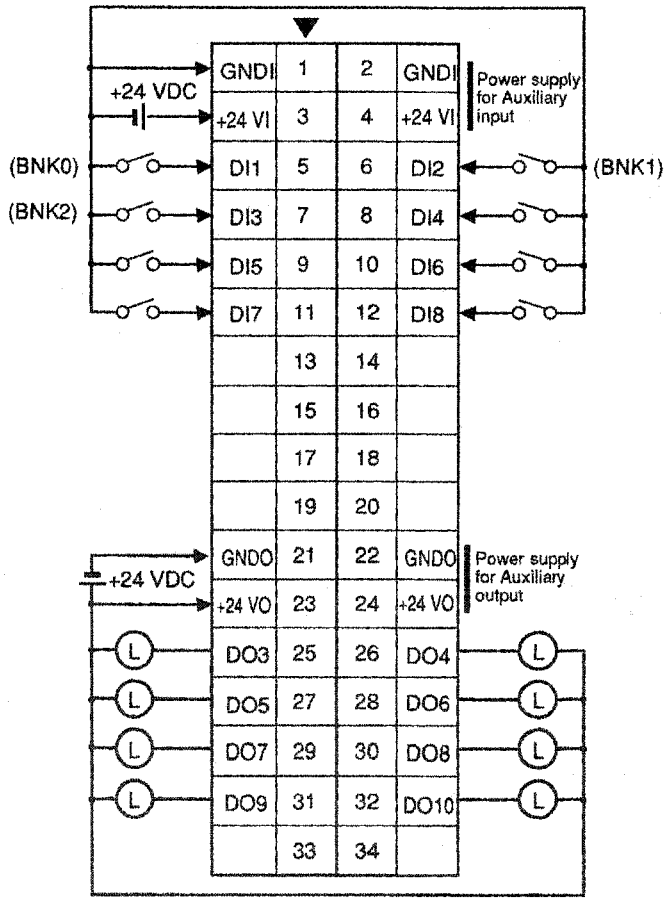
2.4 Wiring Expanded I/O Connectors

Expanded I/O connectors can be used on models ES100X-□□□□E. Either of the digital I/O terminals or BCD communications terminals can be selected for use in the parameter settings. (The ES100X is set for digital I/O before shipment from the factory.)

The following description assumes that the ES100X has been set for digital I/O. For details on using the ES100X for BCD communications, see the ES100 Digital Controller. User's Manual (Communications Guide) (Cat. No. H072-E1-1).

Digital inputs 1 to 8 and digital outputs 3 to 10 are provided for expanded I/O connectors. External 24 V DC power supplies are required for each of digital input and output.

■ Connections



- The following pins are connected to each other internally.
  1-2, 3-4, 21-22 and 23-24
- Items in parentheses ( ) indicate the defaults assigned to terminals before shipment from the factory.

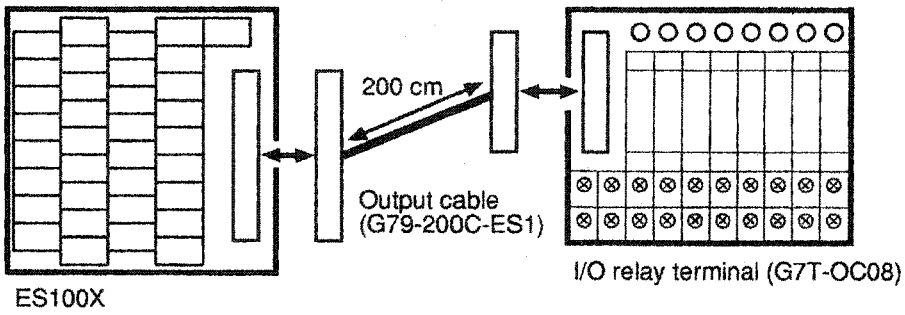
■ Compatible connectors

Use an OMRON XG4M-3430 connector or equivalent product as the connector for the cable for connecting to the expanded I/O connectors.

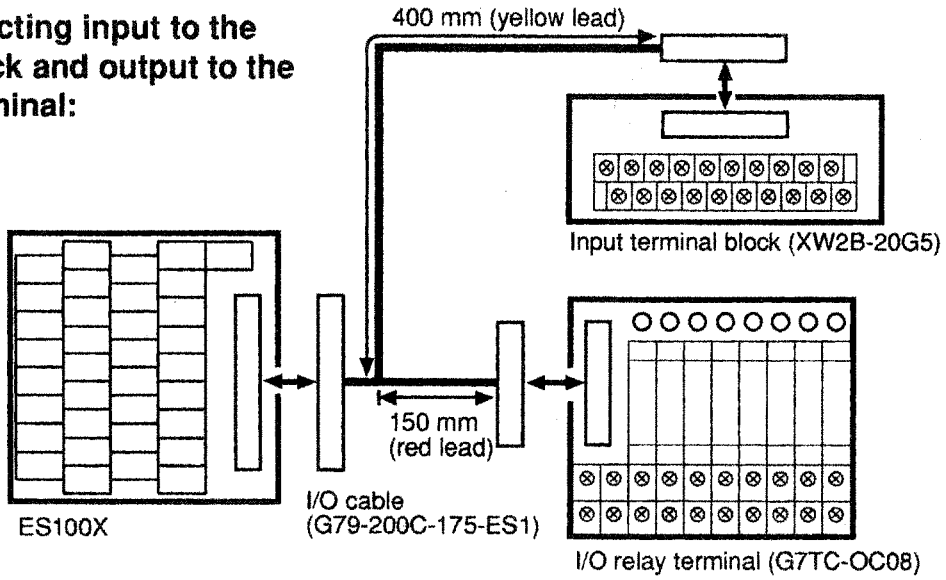
■ Connecting to I/O terminal block

We recommend the following connection configurations when connecting I/O of the expanded I/O connectors to a terminal block.

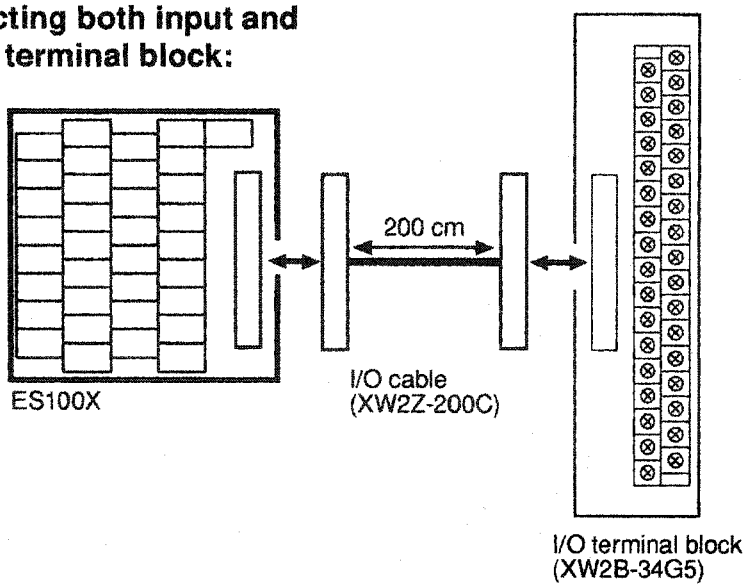
● When connecting output to the I/O relay terminal:



● When connecting input to the terminal block and output to the I/O relay terminal:



● When connecting both input and output to the terminal block:



● Terminal block wiring diagram

When using one of the above recommended connection configurations, the wiring at the terminal block is as follows.

I/O terminal block (XW2B-34G5)

GNDI	+24 VI	DI1	DI3	DI5	DI7					GNDO	+24 VO	DO3	DO5	DO7	DO9	
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
GNDI	+24 VI	DI2	DI4	DI6	DI8					GNDO	+24 VO	DO4	DO6	DO8	D10	

Input terminal block (XW2B-20G5)

+24 VI	GNDI	DI1	DI3	DI5	DI7				
1	3	5	7	9	11	13	15	17	19
2	4	6	8	10	12	14	16	18	20
+24 VI	GNDI	DI2	DI4	DI6	DI8				

I/O Relay Terminal (G7TC-OC08)

24 VO		DO3	DO4	DO5	DO6	DO7	DO8	DO9	DO10
+		0	1	2	3	4	5	6	7
−		C0	C1	C2	C3	C4	C5	C6	C7
GNDO									

CHAPTER 3
BASIC OPERATION

3.1 Operation Flow

Set the specifications.

Designate the input type, and set scaling, event specifications settings and other parameters matched to how the ES100X is to be applied.
Note that the setting level must be switched between setting level 1 and 2 by the parameters.

Set up the banks.

Various banks are available on the ES100X, enabling bank switching control. Set up the banks to be used for control.

Start control.

When you have finished setting the specifications and operating conditions, start operation.

Check control operation. Make adjustments.

Change and adjust settings such as SP and events while monitoring the control status. If necessary, switch to manual control.

Stop control.

When the program has stopped running, control stops.

Initializing parameters

Follow the procedure below to restore the ES100X parameter settings to the defaults set before shipment from the factory.

(1) Set switches SW1 and SW2-3 to ON.
(2) The No.1 display indicates CLEr.
(3) Press the ENT key. This executes initialization of the ES100X.
(4) When the No.1 display indicates CEnd this indicates that initialization has ended.
(5) Restore the switches to their original positions.

3.2 How to Use the Panel Keys

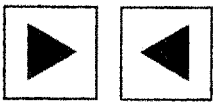
Designating setting modes

Press the SET key, and select the first parameter of each setting mode.
In setting level 1, each press of the SET key lights the setting mode indicator LEDs in order, so you can check the current setting mode of the ES100X.

Designating parameters

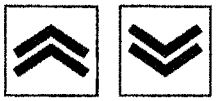
Use the shift keys to designate the desired parameter.
Press the ▼ key to designate the next parameter, and the ▲ key to designate the previous parameter.

Designating tables



Use the shift keys to designate the table No. in parameters that are organized in tables. The designated table No. is displayed on the BANK display.
Press the ▶ key to designate the next table No., and the ◀ key to designate the previous table No.
When setting up banks, the bank No. corresponds to the table No.

Changing settings



To change a setting, designate the setting using the ≪ or ≫ keys, and press the ENT key.
Pressing the ≫ key increments settings, and pressing the ≪ key decrements settings.
When pressing the ≪ or ≫ keys, the No.2 display for displaying settings remains dim until the ENT key is pressed.

When settings cannot be changed

Settings cannot be changed in the following instances:

- Key operations are disabled when the ≫, ≪ and ENT keys are protected in the "key protect" parameter. (See page 5-13.)
- Though settings change by pressing the ≫ and ≪ keys in the remote setting mode, the settings return to their original values when you press the ENT key and are not fixed as new settings.
- Local SP cannot be changed in the remote SP mode.

3.3 Setting I/O Specifications

■ Analog input

For analog input 1, the input type is designated and scaling is carried out. However, note that the input type is only set as scaling is automatically carried out when a temperature sensor is designated for input.
For analog input 2, the input type is only set; the scaling function is not supported. The display unit is fixed at % full-scale.

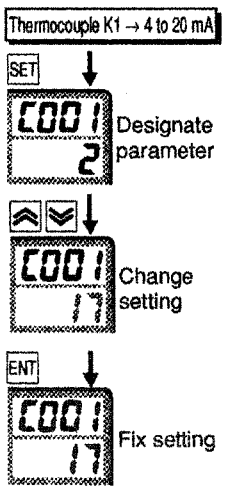
When setting the input type and scaling parameter, set to setting level 2.

● Designating the type of input

A total of 26 analog input terminals are available: 17 temperature sensors (thermocouple and platinum resistance thermometer), seven voltage inputs, and two current inputs. You can choose one of these 26 analog inputs in the "analog input 1 type" parameter.
For analog input 2, you can choose one of "4 to 20 mA" or "1 to 5 V" in the "analog input 2 type" parameter. However, note that these parameters can be set only on 2-input models (ES100X-□W□).

Setting Example

In this example, let's set the "analog input 1 type" parameter to "4 to 20 mA".



●Designate the "analog input 1 type" parameter.
The "analog input 1 type" parameter is the first parameter in the specification setting mode. Press the SET key until the No.1 display indicates C001.

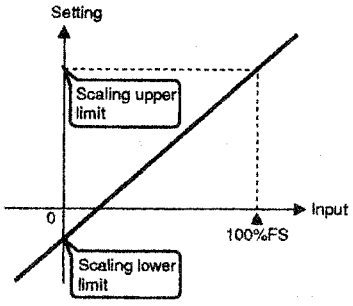
●Set the type code.
Press either the ⩓ or ⩔ keys until the No.2 display indicates code "17" (4 to 20 mA).

When "17" is displayed, press the ENT key.

About the temperature unit

When you have designated temperature sensor (setting: 0 to 16) for the "analog input 1 type" parameter, check the "temperature unit" parameter, and correctly set the temperature. You can designate either "°C" (parameter setting "0") or "°F" (parameter setting "1").
The "temperature unit" parameter is indicated as C003 on the No.1 display.

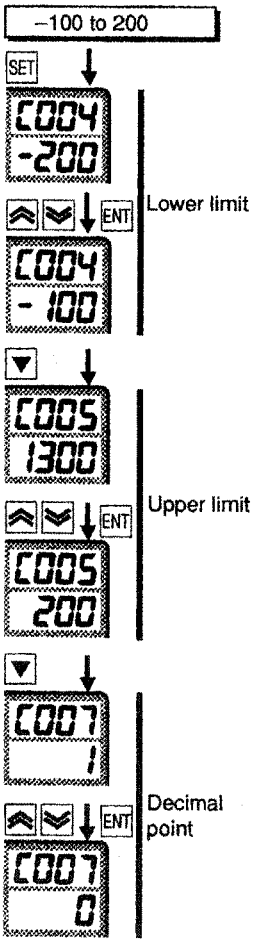
● Scaling



Engineering unit data can be set or displayed during monitoring by converting the engineering unit into the range 0% to 100% full-scale scaling unit. For example, if you set 0% full-scale as "0000" and 100% full-scale as "5000" when input is measurement data whose full-scale is 5 m, the minimum display unit is "mm". If you set the decimal point to "1" when the unit is set to "cm", the display becomes "000.0" to "500.0".
0% full-scale corresponds to the scaling lower limit, and is set in the "scaling lower limit" parameter. 100% full-scale corresponds to the scaling upper limit, and is set in the "scaling upper limit" parameter. The decimal point is set in the "decimal point" parameter.

Setting Example

In this example, let's set the scaling range to "–100 to 200."



●Set the "scaling lower limit."
Press the ▼ key until the No.1 display indicates C004.
When the current mode is not the specification setting mode when setting the scaling lower limit, press the SET key until C001 is displayed.

Press either the ≪ or ≫ keys until the No.2 display indicates "–100".
When "–100" is displayed, press the ENT key.

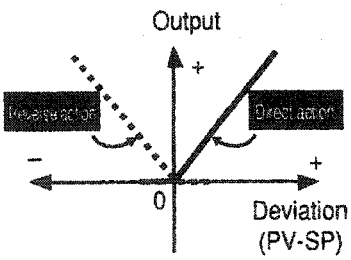
●Set the "scaling upper limit."
Press the ▼ key until the No.1 display indicates C005.

Press either the ≪ or ≫ keys until the No.2 display indicates "200".
When "200" is displayed, press the ENT key.

●Set the "decimal point."
Press the ▼ key until the No.1 display indicates C007.

Press either the ≪ or ≫ keys until the No.2 display indicates "0". When "0" is displayed, press the ENT key.

■ Direct/reverse action

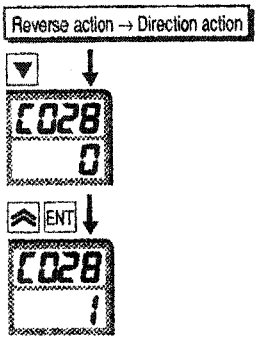


"Direct action" refers to control where the manipulated variable is adjusted according to the increase/decrease in the positive deviation. Alternatively, "reverse action" refers to control where the manipulated variable is adjusted according to the increase/decrease in the negative deviation.
For example, when the process value (PV) is lower (negative deviation) than the set point (SP) in a heating control system, the manipulated variable increases by the difference between the PV and SP values.
Accordingly, this becomes "reverse action" in a heating control system. Alternatively, this becomes "direct action" in a cooling control system.

Set the desired action in the "direct/reverse action" parameter. Before setting direct/reverse action, set the controller to setting level 2.

Setting Example

In this example, let's change from "reverse action" to "direct action."



●Designate the "Direct/reverse action" parameter.
Press the ▼ key until the No.1 display indicates C028.
When the current mode is not the specification setting mode when setting direct/reverse action, press the SET key until C001 is displayed.

●Change the parameter setting to "direct action."
Press the ≪ key to change the setting indicated on the No.2 display from "0" (reverse action) to "1" (direct action).
When "1" is displayed, press the ENT key.

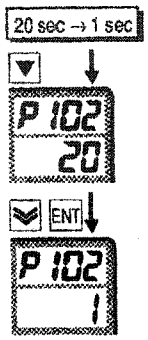
■ Control output cycle

When the output unit is pulsed output such as relay or SSR, set the pulse cycle in the "control output 1 pulse cycle" or "control output 2 pulse cycle" parameters. Though a shorter pulse cycle provides better control performance, the pulse cycle should be set taking the service life of the output unit into consideration when the output of the output unit is relay.

When setting the "control output 1 pulse cycle" and "control output 2 pulse cycle" parameters, set to setting level 1.

Setting Example

In this example, let's set the cycle of control output 1 to "1 sec."



●Designate the "control output pulse 1 cycle" parameter.
Press the ▼ key until the No.1 display indicates P102.
When the current mode is not the adjustment mode when setting the output cycle, press the SET key until P102 is displayed. Mode change can be verified by the ADJ LED.

●Change to "1 sec."
Press the ≫ key to change the setting indicated on the No.2 display from "20" to "1".
When "1" is displayed, press the ENT key.

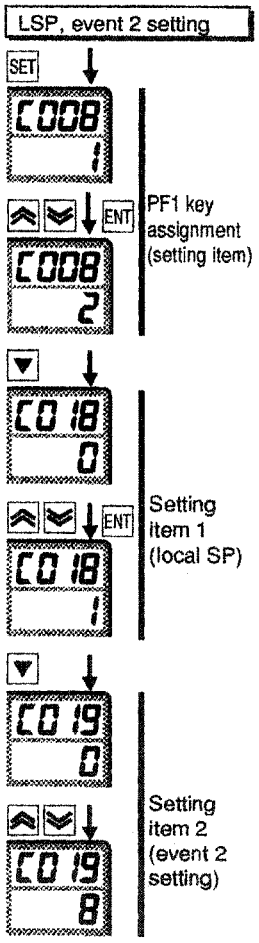
3.4 Key Display and Assignments

■ PF key

The PF1 and PF2 keys are programmable function keys. The user can assign two of 22 functions to these keys. When you have assigned monitor items or setting items to these keys, you can assign one of a further eight items to these keys.

When setting the parameter to be assigned to the PF key, set to setting level 2.

Setting Example



In this example, let's assign "setting item" to the PF1 key, and store "local SP" to "setting item 1" and "event 2 setting" to "setting item 2."

●Designate the "PF1 key type parameter."
Press the SET key until the No.1 display indicates C001. Then, press the ▼ key until the No.1 display indicates C008.

●Designate the setting item.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "2" (setting item).

●Designate the "setting item 1" parameter.
Press the ▼ key until the No.1 display indicates C018.

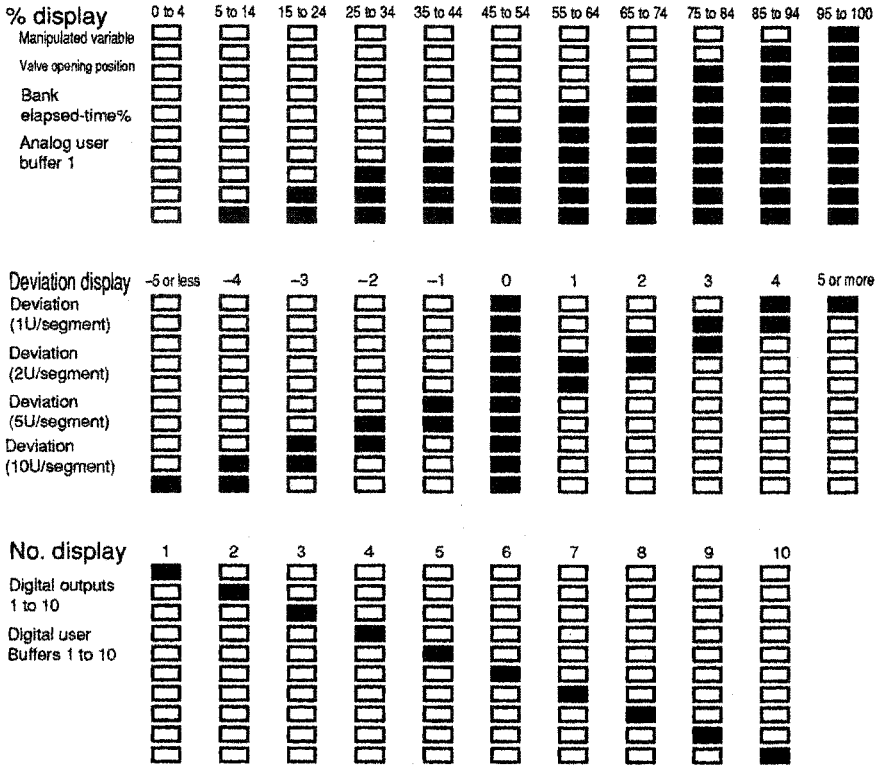
●Store the local SP.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "1" (local SP). When "1" is displayed, press the ENT key.

●Designate the "setting item 2" parameter.
Press the ▼ key until the No.1 display indicates C019.

●Store the event 2 setting.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "8" (event 2 setting). When "8" is displayed, press the ENT key.

■ Bar graph

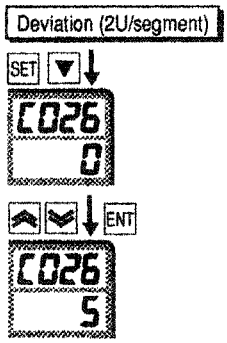
The user can select 11 display items and assign these to the bar graph on the front panel.
The figure below shows the bar graph displays for each of the display items.



When setting the parameters to be assigned to the bar graph, set to setting level 2.

Setting Example

In this example, let's display the deviation (2U/segment).



●Designate the "bar graph display item."
Press the SET key until the No.1 display indicates C001. Then, press the ▼ key until the No.1 display indicates C026.

●Assign the deviation (2U/segment).
Press either the ▲ or ▼ keys until the No.2 display indicates "8 (deviation: 2U/segment)". When "5" is displayed, press the ENT key.

About the engineering unit

Data after scaling is displayed using engineering units such as °C, m or g. However, "U" is used as the smallest unit of these engineering units. For example, 0.01 (m), the smallest unit of the data 50.02 (m) is taken as 1 (U).

3.5 Setting Events

■ What is an "event"?

Designated input data is compared with event settings based on specifications such as judgment conditions, hysteresis, standby sequence and operating conditions. An "event" is generated when the result conditions of these specifications are satisfied.

Event table ◀ ▶

Table No.	1	2	···	10
Input data				
Judgment conditions				
Hysteresis				
Standby sequence ON/OFF				
Operation conditions				

▲ ▼

A generated event is an argument of a digital operation, and is output to a designated assignment destination after digital operation. For example, to use an event as an alarm output, a digital operation that takes an event as the argument and the digital output as the assignment destination is performed.

Event specifications are organized in tables. Event 1 is set to table 1, event 2 is set to table 2, and so forth. In this way, the specifications for events 1 to 10 are set to tables 1 to 10. Tables are designated by pressing the ◀ or ▶ keys. Designated event Nos. can be verified on the BANK display.

Set to setting level 2 when setting the specifications of the events, and to setting level 1 when setting the event settings.

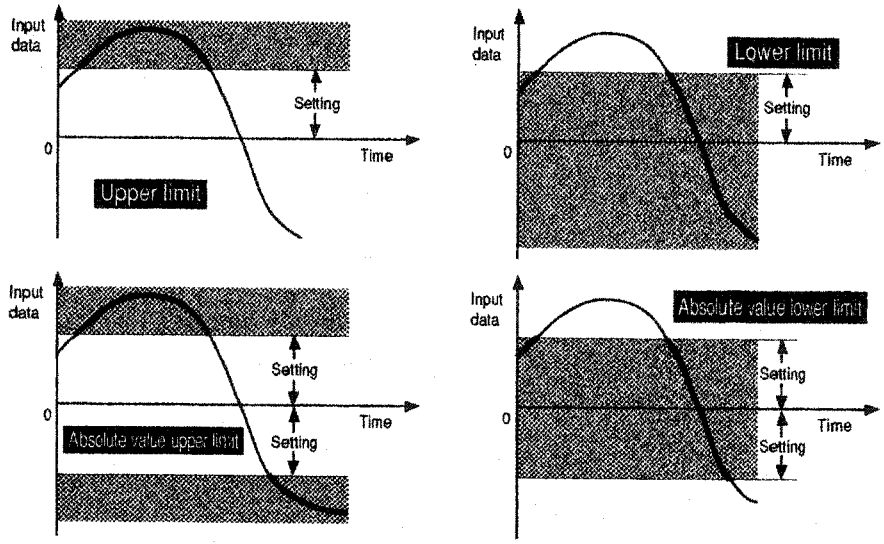
■ Event specifications

●Input data

Select which of 132 data items to apply the event generating function to. Designate the input data in the "input data" parameter. Some of the settings are arguments that can be used in analog operation assignments.

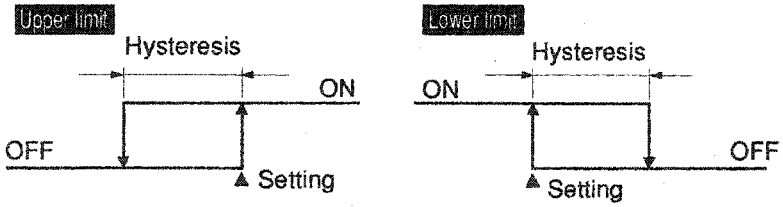
●Judgment conditions

Select one of upper limit, lower limit, absolute value upper limit or absolute value lower limit as the event judgment condition. Designate the judgment condition in the "judgment conditions" parameter.
The following figures show the relationship with input data, or the event judgment conditions. Events are ON when the input data value is in the hatched ▨ area of these figures.



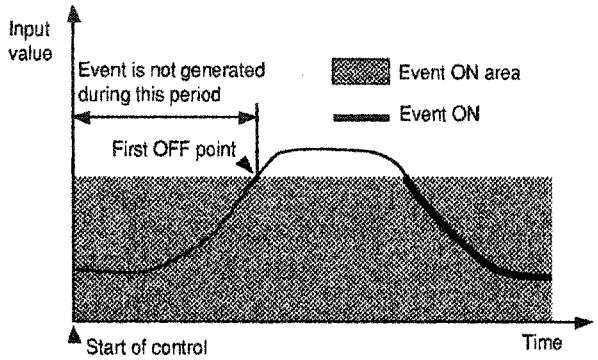
●Hysteresis

Events are set ON when the input data has reached the event setting. When the event is OFF, the event has hysteresis with respect to the setting. Set the hysteresis width in the "hysteresis" parameter.



●Standby sequence

The "standby sequence" is a function for unconditionally turning an event OFF even if the input data has satisfied the event ON conditions.



The standby sequence functions when the "standby sequence ON/OFF" parameter is set to ON.

After the standby sequence function has started, normal event operation resumes. However, the standby sequence restarts under the following conditions:

- when an event has begun operation according to the "operating conditions"
- when there is a standby sequence restart instruction
- when the power is turned ON
- when the status has changed from stop to run
- when a bank has been switched
- when a local SP setting in an execution bank has been changed

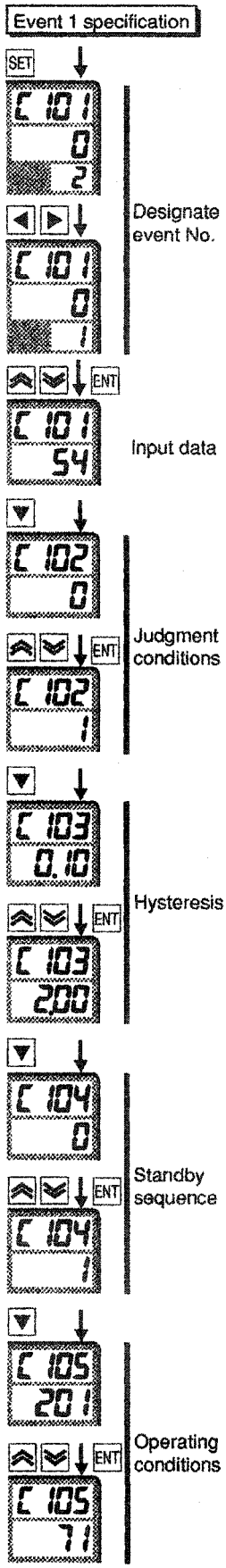
●Operating conditions

Designates the conditions under which an event is operated. The event is generated only when the digital data is designated as "1" (ON).

Designate the operating conditions in the "operating conditions" parameter. Some of the settings are arguments that can be used in digital operation assignments.

Setting Example

In this example, let's generate event 1 when PV is smaller than SP by a designated value.
Set hysteresis to 2% full-scale, the standby sequence to ON, and set the controller to operation enabled only during running.
This example assumes that the controller is set to setting level 2.



●Designate event 1.
Press the SET key until the No.1 display indicates C 101. Then, press the ◀ or ▶ keys until the BANK display indicates "1".

●Designate the input data.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "54" (deviation). When "54" is displayed, press the ENT key.

●Designate the judgment conditions.
Press the ▼ key until the No.1 display indicates C 102.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "1" (lower limit). When "1" is displayed, press the ENT key.

●Set the hysteresis width.
Press the ▼ key until the No.1 display indicates C 103.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "2.00". When "2.00" is displayed, press the ENT key.

●Set the standby sequence
Press the ▼ key until the No.1 display indicates C 104.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "1" (ON). When "1" is displayed, press the ENT key.

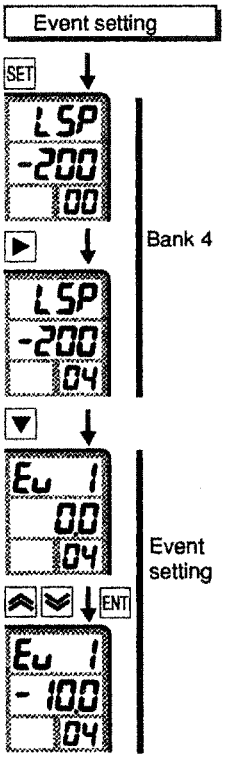
●Designate the operating conditions.
Press the ▼ key until the No.1 display indicates C 105.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "71" (Run/Stop). When "71" is displayed, press the ENT key.

■ Event settings

Events are generated based on the event specifications when the input data reaches the "event setting."
Set event settings 1 to 10 for each of the banks in the program in the "event 1 to 10 settings" parameters (program setting mode, setting level 1).

Setting Example

In this example, let's set the deviation lower limit to "–10.0" to event 1 of bank 4.

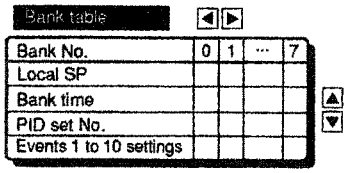


●Designate step 1.
Press the SET key until the BANK LED lights. At this time, the No.1 display indicates LSP. Press the ▶ key until the BANK display indicates "04".

●Designate event 1.
Press the ▼ key until the No.1 display indicates Eu 1.
Press the ▲ or ▼ keys until the No.2 display indicates "–10.0". When "–10.0" is displayed, press the ENT key.

3.6 Setting up Banks

■ How banks are configured



You can set up to eight banks.

Follow the procedure below to set up the banks.

(1) Designate the bank setting mode (setting level 1).
Press the [SET] key until the BANK LED lights.

(2) Designate the target bank.
Pressing the [▶] key increments the bank No. until "07" is displayed.
Pressing the [◀] key decrements the bank No. until the display returns to "00".

(3) Set the operation conditions for each bank in the "bank" parameters.

The bank No. can be verified on the BANK display.

■ Bank parameters

The following four bank parameters are provided:

- Local SP
- Bank time
- PID set No.
- Events 1 to 10

● Local SP
● Bank time

The "local SP" parameter and the "bank time" parameter must be set as it is the basic parameter for operation.
The "bank time" parameter is valid when the "bank selection method" parameter is set to "1" (time setting). The time setting of the "bank time" parameter is dependent on the "program time unit" parameter (setting level 2), and is either "0" (minutes:seconds) or "1" (hours:minutes). Default is "1" (hours:minutes). The "program time unit" parameter must be set before setting the "bank time" parameter.
The No.1 display indicates **C043** for the "program time unit" parameter.

● PID set No.

In this example, let's leave the default "0" (automatic selection) as it is.
For details on how to this parameter, see 4-5 PID Switching (page 4-12).

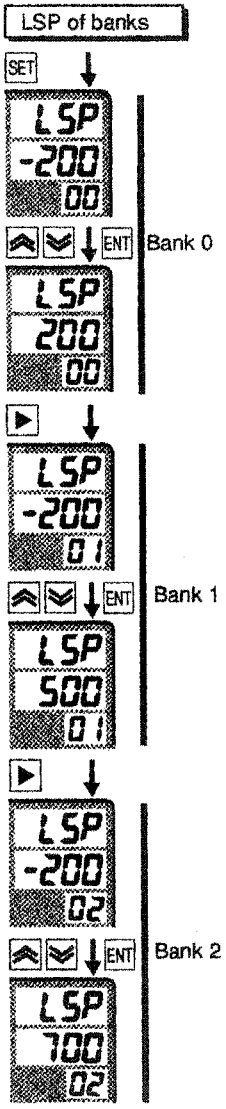
● Event settings

Set the event settings of events 1 to 10 matched to the event specifications.
Events whose "input data" parameter is set to "0" (invalid) do not function.
For details on how to set event settings, see 3.5 Setting Events."

Setting Example

In this example, let's set up banks 0 to 2.
The following describes an example for setting the "local SP" bank parameter. Leave other parameters at their defaults, and set the "bank selection method" parameter to "0" (bank No. designation) (bank time is invalid).

Parameter	Bank 0	Bank 1	Bank 2
LSP Local SP	200	500	700



●Bank 0

- Press the SET key until the BANK LED lights. The No.1 display indicates LSP, and the BANK display indicates "00".
- Press either the ≪ or ≫ keys until the No.2 display indicates "200". When "200" is displayed, press the ENT key.

●Bank 1

- When you press the ▶ key, the BANK display changes to "01". Press either the ≪ or ≫ keys until the No.2 display indicates "500". When "500" is displayed, press the ENT key.

●Bank 2

- When you press the ▶ key, the BANK display changes to "02". Press either the ≪ or ≫ keys until the No.2 display indicates "700". When "700" is displayed, press the ENT key.

3.7 Starting and Stopping Control

Switching between operation start and stop is performed by run/stop operation. Run/stop operation can be carried out in one of two ways.

● By the RUN/STOP key

If you press the RUN/STOP key for more than one second when operation has stopped, operation starts. Alternatively, if you press the RUN/STOP key for more than one second during operation, operation stops.

● By the PF keys

If you assign the run/stop function to a PF key, operation start and stop can be switched without having to open the front panel cover.
To assign the run/stop function, set the "PF1 key type" or "PF2 key type" parameters to "5" (run/stop).
The PF1 and PF2 keys assigned the run/stop function are used in the same way as the RUN/STOP key.

When operation has stopped, the STOP LED lights.

3.8 Adjusting Control Operation

■ Changing the SP

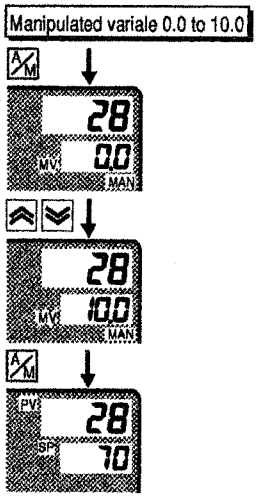
● Directly changing the "local SP" parameter

- Method 1
  Change the SP in the "local SP" parameter (bank setting mode, setting level 1). For details on how to set the "local SP" parameter, see the Setting Example (page 3-14) in 3.6 Setting up Banks.
- Method 2
  Set the "PF1 key type" or "PF2 key type" parameter (specification setting mode, setting level 2) to "2" (setting item selection), and the "setting item" parameter to "1" (L SP/local SP).
  When you press the assigned PF key after making the above settings, the No.1 display indicates L SP and the No.2 display indicates the local SP setting. This local SP setting can be changed to the set value by using the ⩓ or ⩔ keys.

● Changing the SP while monitoring the PV

Set the "PF1 key type" or "PF2 key type" parameter (specification setting mode, setting level 2) to "1" (monitor item selection), and the "monitor item" parameter to "32" (PV/local SP [changeable]).
When you press the assigned PF key after making the above settings, the No.1 display indicates PV and the No.2 display indicates the local SP setting. The SP can be changed to the desired value by using the ⩓ or ⩔ keys while monitoring the displayed PV.

■ Manual operation



Set the ES100X to the manual mode when running using a manual manipulated variable as the manipulated variable (MV).
First, switch to the manual mode. Alternately pressing the A/M key switches the ES100X between the automatic and manual modes. In the manual mode, the MAN LED lights. When the MAN LED goes out while in the manual mode, the automatic mode is returned to.

To manually set the manipulated variable (MV), first select the manual mode parameter setting mode (setting level 1). In this mode, the No.1 display indicates [PV]. The No.2 display indicates [MV], and the MV LED flashes.

Set the manipulated variable (MV) using the ⩓ or ⩔ keys. (You need not press the ENT key.)

● Operation on position-proportional controllers

If you press the ⩓ key on position-proportional controllers (model ES100X-RRP□···□), control output 1 is set to output (OUT1 LED lights), and control outputs so that the valve opens.
If you press the ⩔ key, control output 2 is set to output (OUT2 LED lights), and control outputs so that the valve closes.

■ Auto-tuning (A.T.)

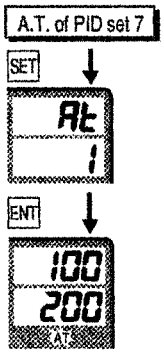
When you execute auto-tuning, the optimum PID parameters are automatically set by forcibly changing the manipulated variable to calculate the characteristics (limit cycle method) of the control target.

Auto-tuning saves the results to the PID set No. designated in the "A.T. execution" parameter in the turning mode (setting level 1).

To execute auto-tuning, designate the PID set No. in the "A.T. execution" parameter, and press the [ENT] key. During execution of auto-tuning, the No.1 and No.2 displays switch to the "monitor display" (see definition below) and the AT LED flashes.

To cancel A.T. execution, press [ENT] at the "A.T. execution" parameter.

Setting Example



In this example, let's save the auto-tuning results to PID set 1 (default).

Press the [SET] key until the TUNE LED lights. Press the [ENT] key until the No.1 display indicates AT. To start execution of auto-tuning, press the [ENT] key. During execution of auto-tuning, the No.1 and No.2 displays switch to the monitor display and the AT LED flashes.

Definition of "monitor display"
Generally, the No.1 display indicates the PV, and the No.2 display indicates the SP.

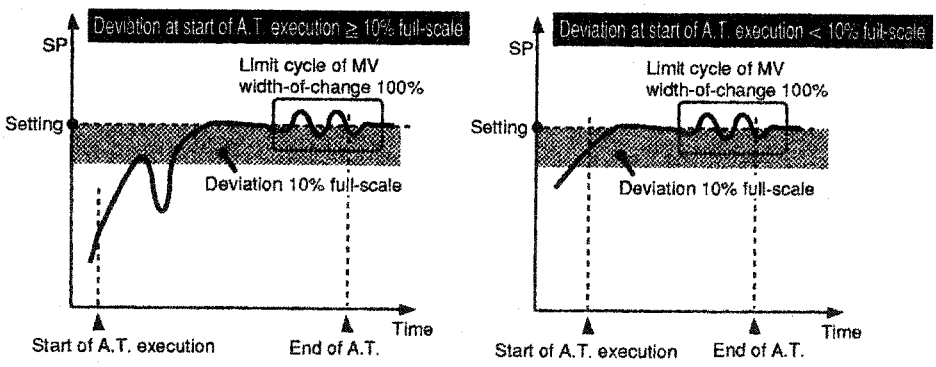
To execute auto-tuning on other PID sets, press the [^] or [v] keys, and press the [ENT] key when the No.2 display indicates the target PID set No.

A.T. execution conditions and operation limitations during auto-tuning

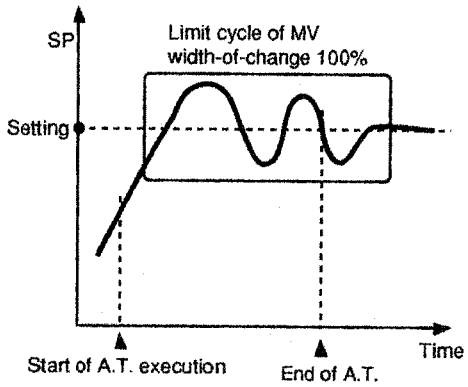
Auto-tuning cannot be executed in cascade control. Also, some functions are limited during execution of auto-tuning. For details on functions whose operations are limited, see page 7-7.

● About the limit cycle method

The timing by generating limit cycles are generated varies according to whether or not the deviation (DV) at the start of A.T. execution is 10% full-scale or less. PV at A.T. execution functions as follows.



However, note that PV at A.T. execution functions as follows in ON/OFF control, heating-cooling control, and position-proportional (floating) systems.



■ Fine tuning (F.T.)

The parameters in the tuning mode (setting level 1) are used for fine tuning.

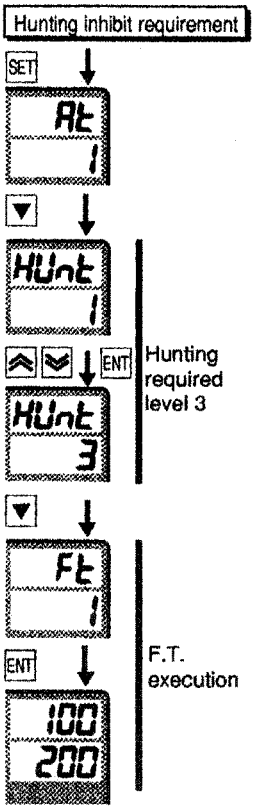
The required levels for improving the level of ES100X control performance are set in the "hunting inhibit required level," "overshoot inhibit required level," and "response improvement required level" parameters. However, note that only two of the improvement parameters can be set simultaneously. Each of these parameters can be set in five stages. The larger the parameter setting, the greater degree of requirement is.

When you have set the required level of improvement, execute fine tuning on the PID set No. designated in the "F.T. execution" parameter. When the PID set No. is designated to "0", the immediately previous fine tuning result is canceled.

After you have executed fine tuning, the settings of all improvement parameters are automatically reset to "0", so improvement parameters must be set again before executing fine tuning.

Setting Example

In this example, let's set the hunting inhibit required level to "3" and execute fine tuning.



Press the SET key until the TUNE LED lights.

Press the ▼ key until the No.1 display indicates HUnt.

Press the ▲ or ▼ keys until the No.2 display indicates "3'. When "3" is displayed, press the ENT key.

Press the ▼ key until the No.1 display indicates FL.
Press the ▲ or ▼ keys until the No.2 display indicates "7". When "7" is displayed, press the ENT key.

Press the ENT key.

Fine tuning limitations

- Only up to two of the improvement parameters can be set simultaneously.
- PID is not automatically corrected when the "I" parameter is set to "0" or ON/OFF control system.
- When "cascade open" is selected in a cascade control system, fine tuning is executed on the secondary loop PID parameters. Hence, the PID set No. setting is meaningless. The PID set No. setting is valid when "cascade closed" is selected.

What is "fine tuning"?

For a description of "fine tuning," see 1.7 Fine Tuning (page 1-12).

CHAPTER 4 APPLIED OPERATION

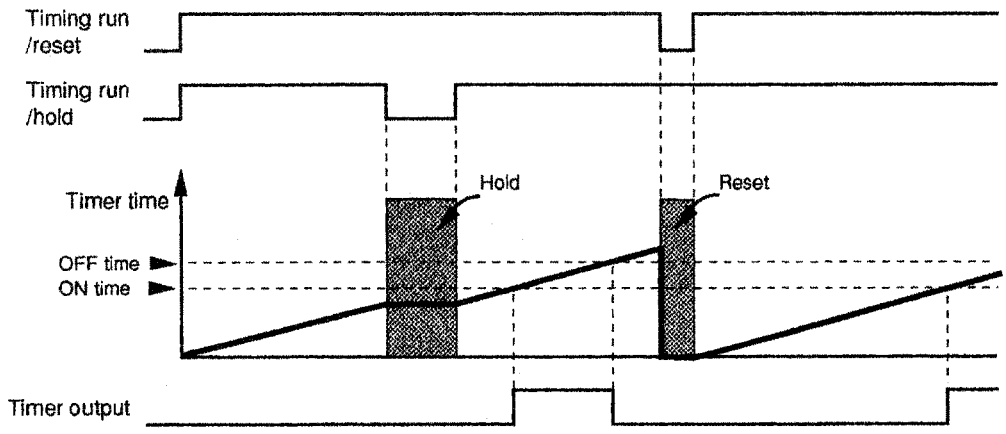
4.1 ON/OFF Timer

■ Timer operation

The timer is reset when the "timing run/reset input" signal is set to state "0". This has the same result as the timer being returned to the start of timing operation.
Also, the timer is paused when the "timing run/hold input" signal is set to state "0".

Accordingly, timing operation is carried out when both the "timing run/reset input" and the "timing run/hold input" signals are both set to "1".

After the timing operation has started, timer output is switched from OFF to ON when the ON time set by these timer parameters is reached, and from ON to OFF when the OFF time is reached.



■ Configuration of parameters

ON/OFF timer table

Table No.	1	2	3	4
Timing run/reset input				
Timing run/hold input				
Time unit				
ON time				
OFF time				

The ON/OFF timer parameters are organized in tables. Tables 1 to 4 are provided for timers 1 to 4, respectively. The following five parameters are set to each of the tables.

- Timing run/reset
- Timing run/hold
- Time unit
- ON time
- OFF time

■ Setting parameters

Set the parameters of the ON/OFF timer setting mode (setting level 2). The timer No. is displayed on the BANK display. Designate the desired timer No. by pressing the ◄ or ► keys.

The timing run/reset signal is set in the "timing run/reset input" parameter, and the timing run/hold signal is set in the "timing run/hold input" parameter. The target digital data for each of these signals is designated by codes. Select the desired digital data from the arguments used for digital operation assignments.

Set the time unit in the "time unit" parameter.
Set the ON time in the "ON time" parameter, and the OFF time in the "OFF time" parameter. Note that the set time varies according to the time unit as follows:

Time Unit	Setting Range
Seconds, minutes, hours	–1 to 9999
10 hours	–1 to 5000

When the "ON time" parameter is set to "–1", the timer output is not switched from OFF to ON. When the "OFF time" parameter is set to "–1", timer output is not switched from ON to OFF.

Setting Example

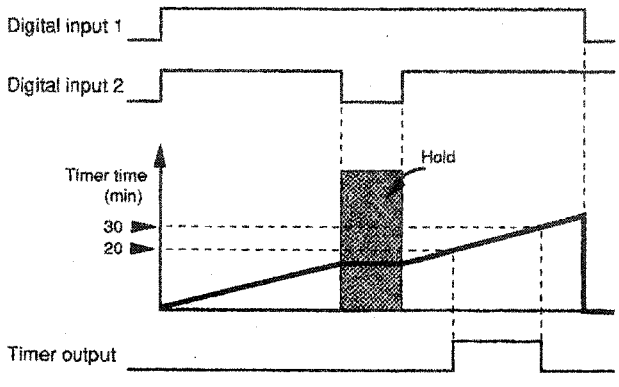
In this example, let's set the ON time to 20 minutes and the OFF time to 30 minutes to timer 2.
We shall also set the "timing run/reset input" parameter to digital input 1, and the "timing run/hold input" parameter to digital input 2.

● Setting table

Table 2

Parameter	Setting
C201 Timing run/reset input	1: digital input 1
C202 Timing run/hold input	2: digital input 2
C203 Time unit	1: Minutes
C204 ON time	20
C205 OFF time	30

● Timer operation



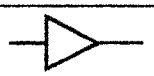
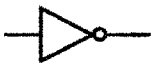
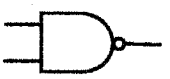
4.2 Digital Operation Assignments

Chapter 1 introduced the digital operation assignment function. This section describes how to assign digital operations.
Assigning digital operations involves preparing operation tables, and setting data to these tables using parameters. Use symbols when entering to the operation tables in order to make verification of settings easier.

Enter the operation end code "END" at the end of the operation.

■ Types of operation

The fundamental principle of digital operation assignment is that I/O terminals are connected to internal functions. "BUF" is used for connections for output without operation.
Six logical operations are available: NOT, OR, AND, NOR, NAND and XOR. These can be combined to make a single assignment content such as "output hold."
The following table lists these logical operations and their functions.

Operation	Symbol	Argument 1	Argument 2	Result	Operation	Symbol	Argument 1	Argument 2	Result
END		—	—	—	NOR		0	0	1
BUF		0	—	0			1	0	0
		1	—	1			0	1	0
NOT		0	—	1			1	1	0
		1	—	0	NAND		0	0	1
OR		0	0	0			1	0	1
		1	0	1			0	1	1
		0	1	1			1	1	0
		1	1	1	XOR		0	0	0
AND		0	0	0			1	0	1
		1	0	0			0	1	1
		0	1	0			1	1	0
		1	1	1					

Operating instructions and digital operation assignments

Operating instructions (run/stop, A.T. execution/stop, etc.) can be executed by one of the following methods:

- By setting the controller to the operation mode (setting level 1)
- By executing by PF1 or PF2 key to which the desired instruction is assigned
- By using the digital operation assignment function. (For example, operating instructions can be output from external switches if a digital input is assigned as an argument.)

"Key protect cancel" and "Integral reset/cancel" cannot be executed by any method other than digital operation assignment.
Check the content of digital operation assignments by the Digital operation assignment (assignment destinations) table on page 5-32.

■ Assignment Example

- Designate a bank No. by a combination of digital inputs 1 to 3.
  The weighting for each of these inputs is as follows:
  Digital input 1: 1 Digital input 2: 2 Digital input 3: 4
  For example, when designating "bank 5," the digital inputs are as follows:
  Digital input 1 = "1"
  Digital input 2 = "0"
  Digital input 3 = "1"
- When event output 1 is set to "1", it is output to digital output 1 as an alarm. However, note that the output of the alarm output is held when digital input 4 is set to "1".

The following table shows the operation table assignments.

Operation Table

Table No.		1	2	3	4
Assignment Destination	d000	BNK0	BNK1	BNK2	DO1
Operation 1	Operation d010	BUF	BUF	BUF	OR
	Argument 1 d011	DI1	DI2	DI3	EV1
	Argument 2 d012	—	—	—	DO1
Operation 2	Operation d020	END	END	END	AND
	Argument 1 d021	—	—	—	N1
	Argument 2 d022	—	—	—	DI4
Operation 3	Operation d030				END
	Argument 1 d031				—
	Argument 2 d032				—
Operation 4	Operation d040				
	Argument 1 d041				
	Argument 2 d042				

Settings

Assignment Destination	BNK0	40
	BNK1	41
	BNK2	42
	DO1	1
Operation	END	0
	BUF	1
	OR	3
	AND	4
Argument	DI1	1
	DI2	2
	DI3	3
	DI4	4
	DO1	141
	EV1	21
	N1	211

Tables 1 to 3

Assign digital inputs 1 to 3 (DI1 to 3) as they are (BUF) to bank Nos. 2^0 to 2^2 (BNK0 to BNK1)

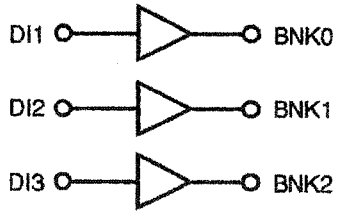
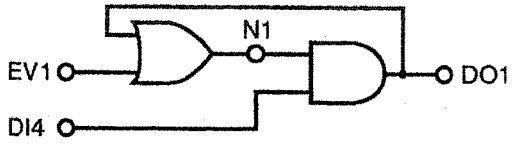


Table 4

Assigns event 1 output (EV1) to digital output 1 (DO1). However, note that output is held until digital input 4 (DI4) becomes "0".



CHAPTER 4

4.3 Analog Operation Assignments

Chapter 1 introduced the analog operation assignment function. This section describes how to assign analog operations.
Assigning analog operations involves preparing operation tables, and setting data to these tables using parameters. Use symbols when entering to the operation tables in order to make verification of settings easier.

Enter the operation end code "END" at the end of the operation.

■ About operation data

Operations are floating-point operations on seven effective digits with full-scale normalized to 0.0 to 1.0.
The data range is -3.40×10^{38} to 3.40×10^{38}.

In order to handle normalized data, data must be normalized before using numerical data for operations.
For example, when setting "–200 to 1300°C" as the input range, full-scale is 1500. So, if we normalize 100°C, the data is calculated as follows:

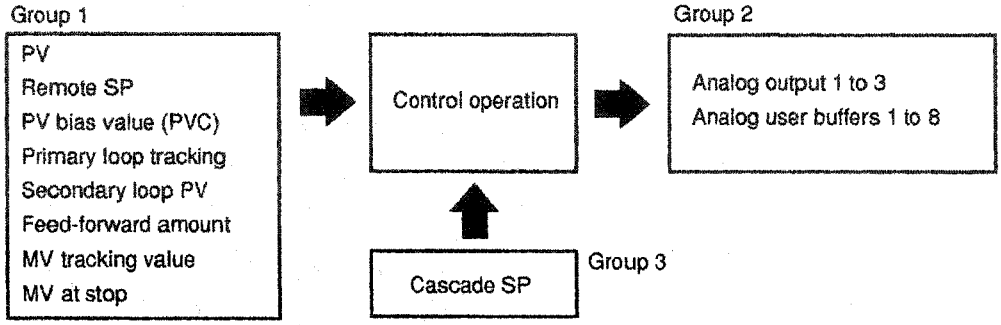
$(100 - (-200))/1500 = 0.2$

Accordingly, use the numerical value "0.2" as data equivalent to 100°C.

Time data is normalized by one of the following two methods:
- Normalize the time constant of first order lag filters and differential time to 1/100. (set 100 seconds to 1.0)
  For example, 30 seconds is normalized to "0.3"
- Normalize the dead time and move average time to 1/1000. (set 1000 seconds to 1.0)
  For example, 200 seconds is normalized to "0.2"

■ Sequence of operation execution

The sequence of operation execution is determined according to assignment destination group, and operations are executed in order of table No. within the same group.
In a cascade SP control system, operations are executed between the control operations of the primary and secondary loops.



■ Types of operation

The fundamental principle of analog operation assignments is that I/O terminals are connected to the internal functions within the analog system. "MOV" is used for connections when assignments do not require operation. 23 operations are available. These can be combined to achieve complex control operations.
The following table shows the types of analog operations and content of operation.

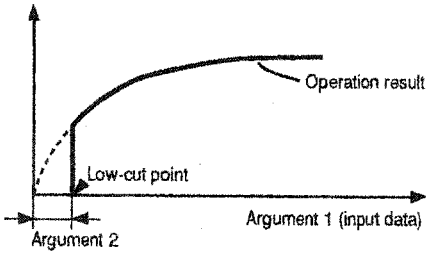
Symbol	Description	Argument 1	Argument 2
END	End of operation	—	—
MOV	Argument 1 is transferred directly to the operation result. Argument 2 is ignored.	Data	—
ADD	Argument 1 is added to argument 2 to obtain the operation result.	Data 1	Data 2
SUB	Argument 2 is subtracted from argument 1 to obtain the operation result.	Data 1	Data 2
MUL	Argument 1 is multiplied by argument 2 to obtain the operation result.	Data 1	Data 2
DIV	Argument 1 is divided by argument 2 to obtain the operation result.	Numerator	Denominator
ABS	The absolute value of argument 1 is taken to obtain the operation result. Argument 2 is ignored.	Data	—
AAV	Argument 1 is added to argument 2 and divided by 2 to obtain the operation result.	Data 1	Data 2
SLH	The larger of the two values argument 1 and argument 2 is taken to be the operation result.	Data 1	Data 2
SLL	The smaller of the two values argument 1 and argument 2 is taken to be the operation result.	Data 1	Data 2
SQR	The square root value of argument 1 is calculated taking argument 2 as the low-cut point to obtain the operation result. If argument 1 is smaller than or equal to 2 (low-cut point), the operation result becomes 0.	Data	Low-cut point
LAG1 to 4	First order lag of argument 1 is calculated taking argument 2 as the time constant to obtain the operation result.	Data	Time constant
SCL1 to 4	Straight-line approximation of argument 1 is calculated to obtain the operation result. Argument 2 is ignored.	Data	—
FNC1, 2	Broken-line approximation of argument 1 is calculated to obtain the operation result. Argument 2 is ignored.	Data	—
LED1, 2	The differential of argument 1 is calculated by taking argument 2 as the differential time to obtain the operation result.	Data	Differential time
DED	Argument 1 data is delayed by taking argument 2 as the dead time.	Data	Dead time
MAV	Argument 1 data is sampled by taking the time of argument 2 as the average time to obtain the moving average.	Data	Move average time
SW1 to 8 CMP1 to 8	Used for mixed operations. (See page 4-12.)	Data 1	Data 2

LAG1 to 4, LED1, 2, DED and MAV can be used only once in all tables. Also, data other than analog operation parameters 1 to 32 and fixed data cannot be used for argument 2.

■ Arguments and operation results

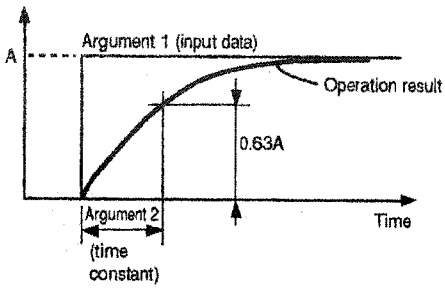
● Extraction of square root (SQR)

The operation result is "0" at the low-cut point.



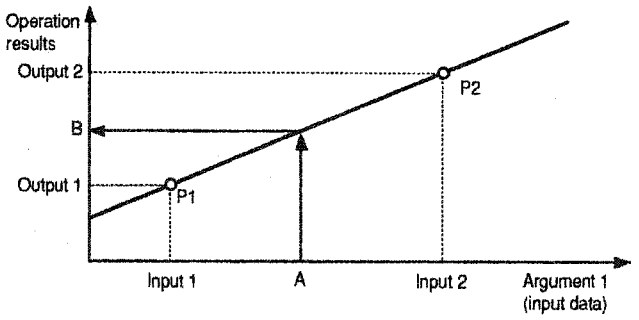
● First order lag filters (LAG1-4)

Argument 2 (time constant) influences argument 1 (input data) in such a way that the operation result is 0.63 times the input data.



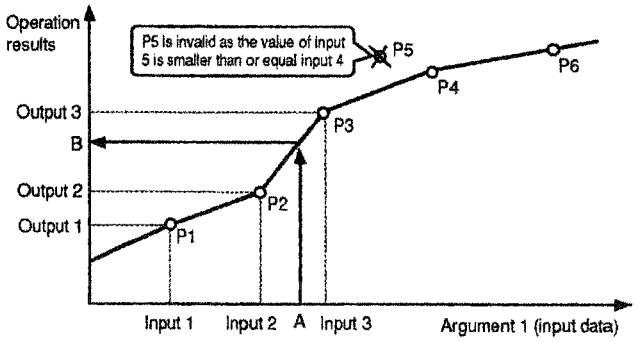
● Straight-line approximation (SCL1-4)

Approximation characteristics are determined by setting the 2-point (P1 and P2) coordinates (inputs 1 and 2, outputs 1 and 2) in the "straight-line approximation" parameter in the setting level 1 technical mode.
In the following example, the operation result becomes B when the operation is carried out on input A.



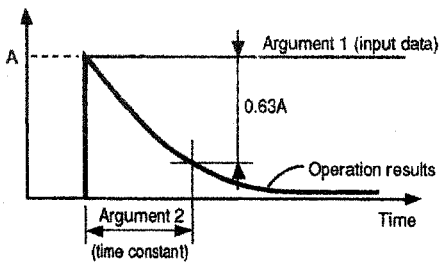
● Broken-line approximation (FNC1-4)

Approximation characteristics are determined by setting the 10-point (P1 to P10) coordinates (inputs 1 to 10, outputs 1 to 10) in the "broken-line approximation" parameter in the setting level 1 technical mode.
The points for determining the approximation characteristics must be set so that the value of the point Nos. increases in the ascending order. If the setting of an input or an output is smaller than the value of the previous point, that point is ignored.
The following figure shows an example of a broken-line approximation made up of six points. In the example, the operation result becomes B when the operation is carried out on input A. Also, point 5 is not used as a broken-line element as its value is smaller than that of input 4.



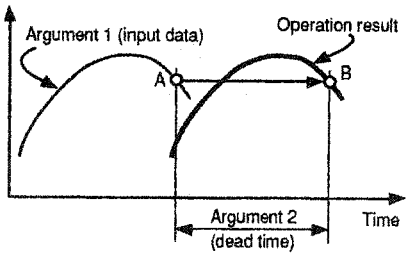
● Differential (LED1, 2)

Argument 2 (time constant) influences argument 1 (input data) in such a way that the operation result decreases by 0.63 times the input data.



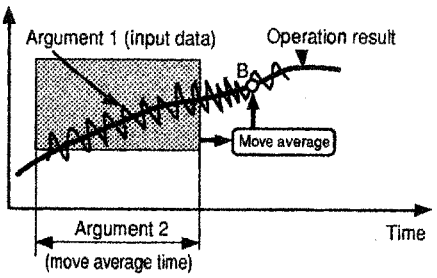
● Dead time (DED)

The operation result is delayed by the "dead time" (argument 2) applied to the input data (argument 1).
As input data is sampled to obtain the operation results, data between samplings is linear-interpolated to obtain the operation result.



● Move average (MAV)

Input data (argument 1) is sampled by taking the time of the move average time (argument 2) as the sampling period to obtain the moving average. Data between samplings is linear-interpolated.
The move average value produces a smooth curve on the input data as shown in the figure below. As such, it is effective for inputs containing a large noise component.



■ Assignment examples

● Analog I/O assignment

Analog input 1 is taken as the PV, and the manipulated variable (MV) is taken as control output 1 (analog output 1). Transfer output (analog output 3) is used to externally monitor PV.

The following table shows the operation table assignments.

Operation Table

Table No.		1	2	3	4
Assignment destination	A000	PV	—	AO1	AO3
Operation 1	Operation A010	MOV		MOV	MOV
	Argument 1 A011	AI1		MV	PV
	Argument 2 A012	—		—	—
Operation 2	Operation A020	END		END	END
	Argument 1 A021	—		—	—
	Argument 2 A022	—		—	—

Settings

Assignment destination	PV	1
	AO1	11
	AO3	13
	—	0
Assignment	END	0
	MOV	1
Argument	—	0
	PV	1
	AI1	41
	MV	60

Table 1
Assigns analog input 1 (AI1) to PV (PV) as it is (MOV).
Table 3
Assigns the manipulated variable (MV) to analog output 1 (AO1) as it is (MOV).
Table 4
Assigns PV (PV) to analog output 3 (AO3) as it is (MOV).
(Table 2 is not used, so disable its assignment destination.)

● Scale adjustment

When adjusting two inputs of two sensors with differing full-scales on a 2-input controller, normalized data is returned once to the temperature scale before it is calculated. (However, note that the decimal point is ignored in this instance.) After the data is calculated, it is changed back again to normalized data. Straight-line approximation is utilized to perform this data conversion.

In the following example, full-scale of analog input 1 is set to 0.0 to 600.0°C, full-scale of analog input 2 is set to –10.0 to 50.0°C, and the value obtained by adding the two inputs is assigned to PV.

Assignment Table

Table No.			1	
Assignment Destination		A000	PV	1
Operation 1	Operation	A010	SCL1	21
	Argument 1	A011	AI1	41
	Argument 2	A012	—	
Operation 2	Operation	A020	SCL2	22
	Argument 1	A021	AI2	42
	Argument 2	A022	—	
Operation 3	Operation	A030	ADD	2
	Argument 1	A031	N1	71
	Argument 2	A032	N2	72
Operation 4	Operation	A040	SCL3	23
	Argument 1	A041	N3	73
	Argument 2	A042	—	
Operation 5	Operation	A050	END	0
	Argument 1	A051	—	
	Argument 2	A052	—	

Operation 1
The data of analog input 1 is converted to the temperature scale.

Operation 2
The data of analog input 2 is converted to the temperature scale.

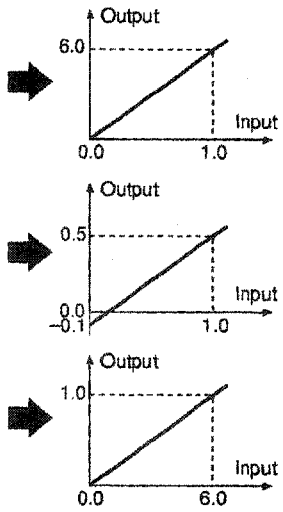
Operation 3
The data of the two inputs are added.

Operation 4
The result of addition is normalized.

The characteristics of each of these straight-line approximations are as follows.

Straight-line approximation: Technical parameter (level 1)

1	Input 1	P333	0.000
	Input 2	P334	1.000
	Output 1	P335	0.000
	Output 2	P336	6.000
2	Input 1	P337	0.000
	Input 2	P338	1.000
	Output 1	P339	–0.100
	Output 2	P340	0.500
3	Input 1	P341	0.000
	Input 2	P342	6.000
	Output 1	P343	0.000
	Output 2	P344	1.000



4.4 Mixed Analog/Digital Operation

Chapter 1 introduced the mixed operation assignment function. This section describes how to actually use this function.

The ES100X is provided with a common data area for sharing the results of digital and analog operations. Up to eight sets of data for expressing the states "1" and "0" can be set to this data area (DA1-8).
In digital operations, this area is used for arguments or assignment destinations. In analog operations, this data area is used for input and output of data comparison in "SW1-8" and "CMP1-8" operations.

● About operation No.

The No. used in "SW1-8" and "CMP1-8" operations corresponds to mixed operation data "DA1-8". For example, "DA2" is used in operation "SW2", and the result of operation "CMP3" is set to "DA3".

● How to use operations

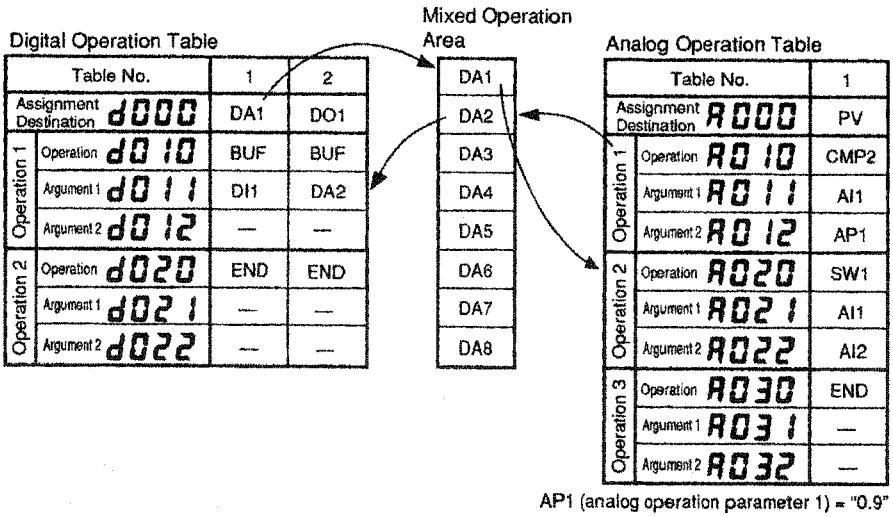
Operation results are as follows.

"SW1-8" operations:
When "DA1-8" is set to "1", argument 1 is taken as the operation result.
When "DA1-8" is set to "0", argument 2 is taken as the operation result.

"CMP1-8" operations:
When argument 1 is ≥ argument 2, "DA1-8" is set to "1" then the operation result is "1.0"
When argument 1 is < argument 2, "DA1-8" is set to "0" then the operation result is "0.0"

Operation Example

Analog input 1 and analog input 2 are switched by digital input 1, and either of these analog inputs is assigned to PV. The operation result is output to digital output 1 when analog input 1 reaches 90%.



AP1 (analog operation parameter 1) = "0.9"

About the "CMP" operation

When not using the result of "CMP" operation at the analog operation side, assign the result of "CMP" operation to a point in the table which will not effect the operation result. For example, if you assign "SW1" to operation 1 and "CPM2" to operation 2 in the above example, the operation result becomes the result of the "CMP2" operation, and the result of the "SW1" operation is not reflected on PV.

4.5 PID Switching

■ About PID sets

On the ES100X, parameters for PID control are used in groups. These groups are called "PID sets." PID sets are organized in tables, up to eight of which can be set.

PID control table ◀ ▶

Table No.	1	2	···	8
P				
I				
D				
MV lower limit				
MV upper limit				
PV bias value				
Automatic selection range upper limit				

▲ ▼

PID set Nos.1 to 8 are selected and set to the "PID set No." parameter in the bank setting mode. Accordingly, PID control parameters that vary at each selected bank can be used during operation.
If you set the "PID set No." parameter to "0", PID sets are automatically selected according to pre-set conditions.

● Setting parameters

Set the controller to the PID set setting mode (setting level 1).
The PID set No. is displayed on the BANK display. Designate the desired PID set by pressing either the ◀ or ▶ keys.

Set proportional band (P), integrated time (I) and differential time (D) to the "P", "I" and "D" parameters, respectively.

- When the "P" parameter is set to "0", ON/OFF control is selected. However, note that the "P" parameter cannot be set to "0.0" on position-proportional controllers.
- When the "I" parameter is set to "0", P control or PD control is selected. However, note that the "I" parameter cannot be set to "0" in floating control on position-proportional controllers.

Set the lower limit of the manipulated variable (MV) in the "MV lower limit" parameter and the upper limit of the manipulated variable (MV) in the "MV upper limit" parameter. The following manipulated variables are given priority over the manipulated variable limitter:

- Manual MV
- MV at stop
- MV at PV error

When position-proportional floating control has been selected, the manipulated variable limitter will not function.

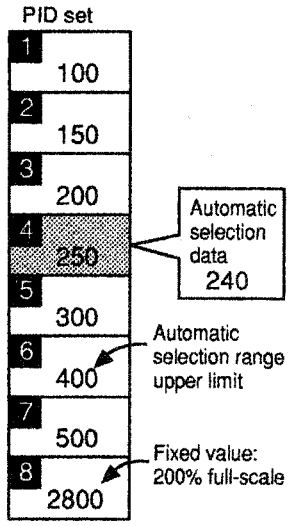
Set the "PV bias value" parameter in order to calculate a new offset PV after analog operation assignment. The value set in the "PV offset value" parameter is added to PV in use in order to calculate the new offset PV.

When PID set selection is set, set the upper limit of the range in which the PID set No. is automatically set in the "automatic selection range upper limit" parameter.

About tuning

It is easier to use the tuning function on proportional band (P), integrated time (I) and differential time (D) without setting in the PID control parameters.
First execute auto-tuning. If the results are not satisfactory, then execute fine tuning.
For details on auto-tuning, see page 3-18. For details on fine tuning, see page 3-20.

■ PID set selection



If you set the "PID set No." parameter to "0" in the bank setting mode, PID sets are automatically selected according to pre-set conditions.

The data that defines these conditions is set in the "PID set selection data" parameter in the specification setting mode (setting level 2). The data is selected from the arguments used for analog operation assignment.

Set the "automatic selection range upper limit" parameter so that the settings increase in the ascending order of the PID set No. However, note that PID set 8 is fixed to 200% full-scale, and need not be set.

By the above settings, the designated subsequent PID No. is automatically switched to each time the value set in the "PID set selection data" parameter exceeds the value set in the "automatic selection range upper limit" parameter even in the same bank.
For example, in the figure on the left the PID set No. is selected as follows when the "PID set selection data" parameter is set to PV; PID set 4 (200<PV≤250) is selected when PV is 240, and PID set 5 (250<PV≤300) is selected when PV is 280.

● Setting hysteresis

Set the hysteresis in the "PID set selection hysteresis" (specification setting mode, setting level 2) in order to prevent chattering during selection of the PID set.

CHAPTER 4

Setting Example

In this example, let's set the PID set selection data to PV, and the hysteresis during selection of the PID set to 2%.
As proportional band (P), integrated time (I) and differential time (D) are calculated by auto-tuning, the "P", "I" and "D" parameters are not set here. Also, let's set the manipulated variable limitter to 0.0 to 100.0, PV bias to OFF, and the automatic selection range upper limit to 50.
This example assumes that the PID set No. has already been designated.

● Setting table

	Parameter	Settings
Specification setting mode (setting level 2)	C038 PID set selection data	1: PV
	C039 PID set selection hysteresis	2.00
PID set setting mode (setting level 1)	P P I I d D	Calculated by auto-tuning
	oLL MV lower limit	0.0
	oLH MV upper limit	100.0
	PuS PV bias value	0
	AUt Automatic selection range upper limit	50

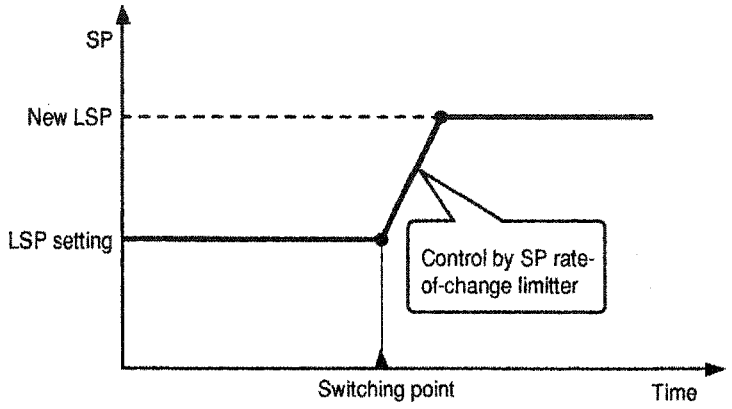
Operation when PID switching is not required

The default for the "PID set No." parameter is "0" (automatic selection) for all banks, and the default for the "automatic selection range upper limit" parameter is "200% full-scale" for all PID sets.
Accordingly, when operation of the program is started using these defaults, PID set 1 is selected for all banks. In other words, the control target for tuning is only PID set 1.

4.6 Applying SP Settings

■SP rate-of-change limitter

There are times when you may want to avoid sudden changes in the SP when changing the local SP (including bank switching).
On the ES100X, the per-second change in SP can be limited by the SP rate-of-change limitter function.
For example, if you change the SP by 60°C when the SP rate-of-change limitter is set to 30°C/minutes, the change in SP can be limited so that it takes two minutes to reach the new local SP.



The SP-rate-of-change limitter operates according to the setting of the "SP rise rate limit" and "SP fall rate limit" parameters depending on whether the SP change is in the rise or fall directions, respectively. To disable the SP-rate-of-change limitter, set both of these parameters to "0".

Setting Example

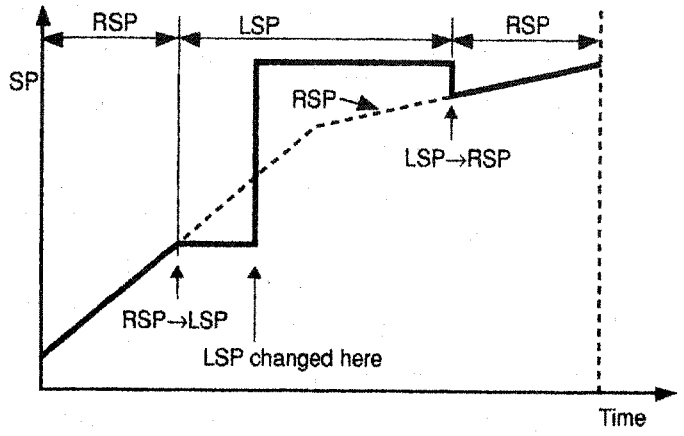
In this example, let's set the rate-of-change limit during rise to 20°C/minutes, and the rate-of-change limit during fall to 10°C/minutes.

●Setting table

	Parameter	Setting
Specification setting mode (setting level 2)	C048 Time unit of SP rate limits	1: U/minutes
Adjustment mode (setting level 1)	P114 SP rise rate limit	20.0
	P115 SP fall rate limit	10.0

■ Remote SP

On the ES100X , two SPs are used: local SP (LSP) and remote SP (RSP). These two SPs are switched in the "SP mode" parameter (operation mode, setting level 1).
The following figures shows an example of switching the remote SP mode and local SP mode during program operation. In this example, the following operations are carried out.
(1) The local SP mode is switched to from the remote SP mode.
(2) The local SP is changed.
(3) The remote SP mode is returned to from the local SP mode.



● Setting parameters

Operation mode (setting level 1)

Parameter	Setting
P008 SP mode	0: Local SP 1: Remote SP

SP tracking

When the "SP tracking" parameter is set to "1" (ON), the remote SP at the time of switching is held after the remote SP mode is switched to the local SP mode until the local SP is changed.
SP tracking is not carried out when the remote SP mode is switched to from the local mode.

4.7 Checking Data

The check mode (setting level 1) is used to monitor 30 data items. The following table shows the parameters and the items that each parameter monitors.

Parameter	Monitor Description
P201 Heater current monitor	Monitors CT input for use in heater current detection. When the current exceeds 55.0 A, 55.0 and - - - - are displayed alternately.
P202 Analog input 1 type monitor	Monitors the type of analog input 1.
P203 Analog input 2 type monitor	Monitors the type of analog input 2.
P204 PF1 key type monitor	Monitors the function assigned to the PF1 key.
P205 PF2 key type monitor	Monitors the function assigned to the PF2 key.
P207 PID set No. monitor	Monitors the PID set No. currently in use.
P208 ON/OFF timer 1 monitor P209 ON/OFF timer 2 monitor P210 ON/OFF timer 3 monitor P211 ON/OFF timer 4 monitor	Monitors the time of ON/OFF timers 1 to 4.
P212 ON/OFF counter 1 monitor P213 ON/OFF counter 2 monitor P214 ON/OFF counter 3 monitor P215 ON/OFF counter 4 monitor P216 ON/OFF counter 5 monitor P217 ON/OFF counter 6 monitor P218 ON/OFF counter 7 monitor P219 ON/OFF counter 8 monitor P220 ON/OFF counter 9 monitor P221 ON/OFF counter 10 monitor P222 ON/OFF counter 11 monitor P223 ON/OFF counter 12 monitor	Monitors the ON/OFF count of digital control outputs (relay, SSR, voltage pulse). The correspondence between ON/OFF counters 1 to 12 and target output is as follows: Counter 1: Control output 1 Counter 2: Control output 2 Counters 3 to 12: Digital outputs 1 to 10
P224 2-PID/2-PID + fuzzy logic monitor P225 Potentiometer input monitor P226 Heating-cooling/standard monitor P227 Cascade/standard monitor	Monitors the currently selected control system.
P228 BCD communications/digital I/O monitor	Monitors how the expansion auxiliary I/O connectors.
P229 Control operation cycle monitor	Monitors the cycle in which the manipulated variable is updated.
P230 ROM version No. monitor	Monitors the ROM version of the ES100X.

CHAPTER 5 PARAMETERS

Setting Level 2

Setting Level 1

Conventions Used in This Chapter

Parameter name

Setting mode

Setting level

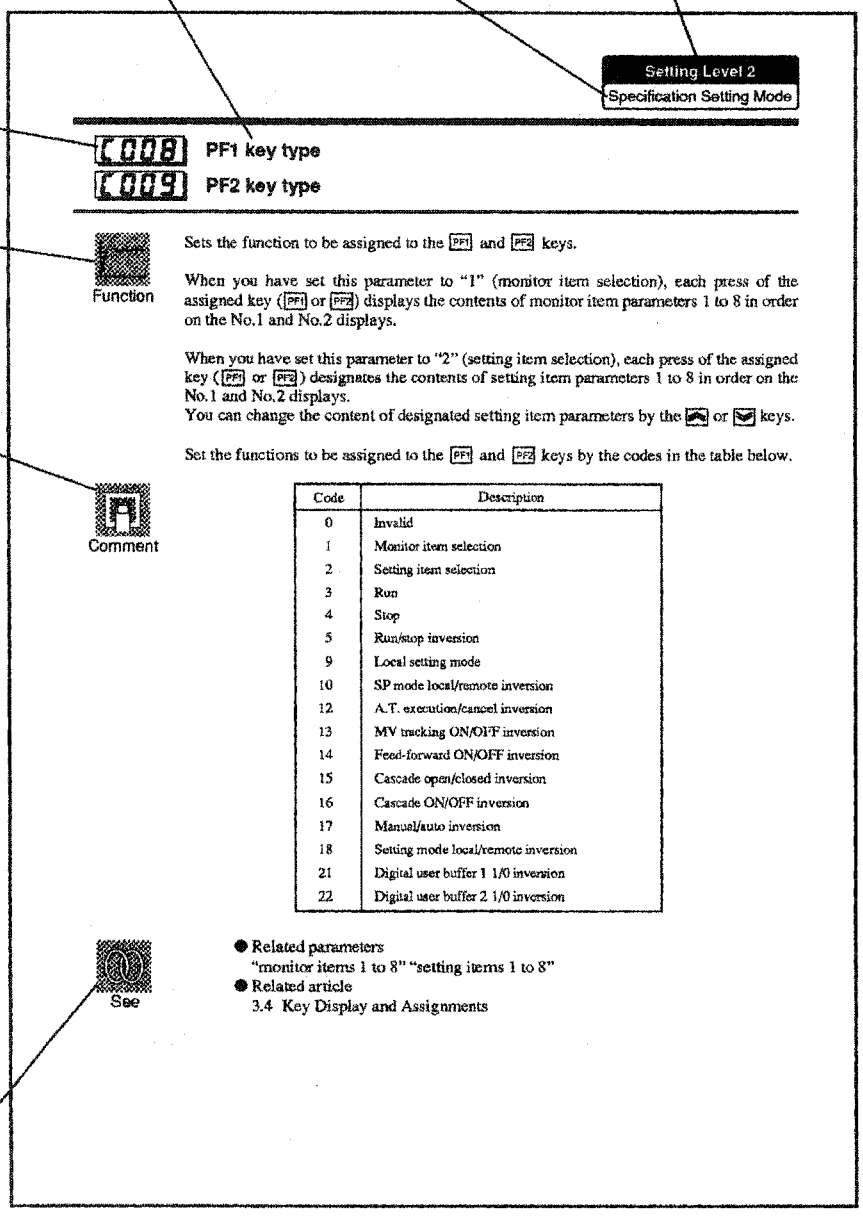
Symbol indicated on the display of the ES100X

Function
Describes the functions of the parameter.

Comment
Describes the function, range, unit, etc.

In the check mode, this item describes the monitor, and the icon changes as follows:

Additional Icons
Describes additional information required for each of the parameters. The icon on the page may change according to the description.




Related parameters and items


Example of how to use parameters


Models of the ES100X supporting the parameter currently being described
If this icon is not indicated, the parameter is supported by all models.


Precautions during setting


Useful things to know

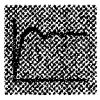
5.1 Specification Setting Mode

- The specification setting mode is used to set basic controller operations such as configuration of the I/O unit and controller, and assigning functions to programmable function keys [PF1] and [PF2].
- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON.
- To switch between the modes in setting level 2, use the [SET] key.
- The following table shows the parameters in the specification setting mode and the page where they are described.

Symbol	Parameter Name	Page	Symbol	Parameter Name	Page
C001	Analog input 1 type	5-4	C032	Potentiometer input	5-15
C002	Analog input 2 type	5-5	C033	Cascade/standard	5-16
C003	Temperature unit	5-5	C034	Operation at power ON	5-16
C004	Scaling lower limit	5-6	C035	MV at PV error (except position-proportional control)	5-17
C005	Scaling upper limit	5-6	C036	MV at PV error (position-proportional control)	5-17
C007	Decimal point	5-6	C037	SP tracking	5-18
C008	PF1 key type	5-7	C038	PID set selection data	5-19
C009	PF2 key type	5-7	C039	PID set selection hysteresis	5-19
C010 to C017	Monitor items 1 to 8	5-8	C040	BCD communications/digital I/O	5-19
			C041	Unit No. (communications)	5-20
			C042	Baud rate (communications)	5-20
C018 to C025	Setting items 1 to 8	5-8	C043	Program time unit	5-21
			C044	Bank selection method	5-21
			C048	Time unit of SP rate limits	5-22
C026	Bar graph display item	5-12	C049	Display refreshing cycle	5-22
C027	Key protect	5-13	C050	Line noise reduction	5-23
C028	Direct/reverse action	5-13	C051	Motor calibration execution	5-23
C029	Secondary loop direct/reverse action	5-14	C052	Travel time	5-23
C030	2-PID/2-PID + fuzzy	5-14			
C031	Heating-cooling/standard	5-15			

Setting Level 2
Specification Setting Mode

C001 Analog input 1 type

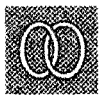

Function

Designates the type of input connected to analog input 1.
A total of 26 input types are available: 17 temperature sensor inputs, two current input, and seven voltage inputs.


Comment

Set the analog input type by the codes in the table below.

Code	Description		
0	R	0 to 1700(°C)	/0 to 3000(°F)
1	S	0 to 1700(°C)	/0 to 3000(°F)
Default ▶ 2	K1	–200 to 1300(°C)	/–300 to 2300 (°F)
3	K2	0.0 to 600.0(°C)	/0.0 to 999.9(°F)
4	J1	–100 to 850(°C)	/–100 to 1600(°F)
5	J2	0.0 to 400.0(°C)	/0.0 to 750.0(°F)
6	T	–199.9 to 400.0(°C)	/–199.9 to 700.0(°F)
7	E	0 to 600(°C)	/0 to 1100(°F)
8	B	100 to 1800(°C)	/300 to 3200(°F)
9	N	0 to 1300(°C)	/0 to 2300(°F)
10	L1	–100 to 850(°C)	/–100 to 1600(°F)
11	L2	0.0 to 400.0(°C)	/0.0 to 750.0(°F)
12	U	–199.9 to 400.0(°C)	/–199.9 to 700.0(°F)
13	W	0 to 2300(°C)	/0 to 4100(°F)
14	PL II	0 to 1300(°C)	/0 to 2300(°F)
15	JPt	–199.9 to 600.0(°C)	/–199.9 to 999.9(°F)
16	Pt	–199.9 to 600.0(°C)	/–199.9 to 999.9(°F)
17	4 to 20 mA		
18	0 to 20 mA		
19	0 to 10 mV		
20	0 to 100 mV		
21	±10 mV		
22	0 to 1 V		
23	1 to 5 V		
24	0 to 5 V		
25	0 to 10 V		


See

- Related parameters
  "scaling lower limit" "scaling upper limit" "decimal point" "temperature unit"
- Related article
  3.3 Setting I/O Specifications

C002 Analog input 2 type

Function

Designates the type of input connected to analog input 2.
Select either of current input (4 to 20 mA) and voltage input (1 to 5 V).

Comment

Set the analog input type by the codes in the table below.

	Code	Description
Default	0	4 to 20 mA
	1	1 to 5 V

Model

2-input (ES100X-□W□··□)

C003 Temperature unit

Function

Designates the temperature unit (setting: 0 to 16) when thermocouple or platinum resistance thermometer is selected at the "analog input type 1" parameter. Designate either of °C or °F.

Comment

Set the temperature unit by the codes in the table below.

	Code	Description
Default	0	°C
	1	°F

See

● Related parameter
"analog input 1 type"

Setting Level 2
Specification Setting Mode

C004 Scaling lower limit

C005 Scaling upper limit

C007 Decimal point

Function

Sets the lower limit, upper limit and decimal point when executing scaling on.

Comment

Set the "scaling lower limit" or "scaling upper limit" parameters by a numerical value, and the "decimal point" parameter by the codes in the table below.

Parameter	Setting Range	Unit	Default
Scaling lower limit	–1999 to scaling upper limit –1	U	–200
Scaling upper limit	Scaling lower limit +1 to 9999	U	1300
Decimal point	0 to 3	None	0

The following table shows the settings of the "decimal point" parameter.

	Code	Description	Setting Example
Default	0	No digits past the decimal point	1234
	1	1 digit past the decimal point	123.4
	2	2 digit past the decimal point	12.34
	3	3 digit past the decimal point	1.234

See

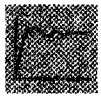
- Related parameters
  "analog input 1 type" "temperature unit"
- Related article
  3.3 Setting I/O Specifications

Reference

- About automatic settings
  When the settings of the "analog input 1 type" and "temperature unit" parameters have been changed, the scaling value corresponding to the input range is automatically set. For example, if you set the "analog input 1 type" parameter as "thermocouple K1," the "scaling lower limit" parameter is automatically set to "–200", the "scaling upper limit" parameter to "1300" and the "decimal point" parameter to "0".

C008 PF1 key type

C009 PF2 key type


Function

Sets the function to be assigned to the PF1 and PF2 keys.

When you have set this parameter to "1" (monitor item selection), each press of the assigned key (PF1 or PF2) displays the contents of monitor item parameters 1 to 8 in order on the No.1 and No.2 displays.

When you have set this parameter to "2" (setting item selection), each press of the assigned key (PF1 or PF2) designates the contents of setting item parameters 1 to 8 in order on the No.1 and No.2 displays.
You can change the content of designated setting item parameters by the ∧ or ∨ keys.


Comment

Set the functions to be assigned to the PF1 and PF2 keys by the codes in the table below.

Code	Description
0	Invalid
Default 1	Monitor item selection
2	Setting item selection
3	Run
4	Stop
5	Run/stop inversion
9	Local setting mode
10	SP mode local/remote inversion
12	A.T. execution/cancel inversion
13	MV tracking ON/OFF inversion
14	Feed-forward ON/OFF inversion
15	Cascade open/closed inversion
16	Cascade ON/OFF inversion
17	Manual/auto inversion
18	Setting mode local/remote inversion
21	Digital user buffer 1 1/0 inversion
22	Digital user buffer 2 1/0 inversion


See

- Related parameters
  "monitor items 1 to 8" "setting items 1 to 8"
- Related article
  3.4 Key Display and Assignments

Setting Level 2
Specification Setting Mode

C010	Monitor item 1	C014	Monitor item 5
C011	Monitor item 2	C015	Monitor item 6
C012	Monitor item 3	C016	Monitor item 7
C013	Monitor item 4	C017	Monitor item 8

Function

Designates items that can be monitored when monitor item selection has been assigned to the "PF1 key type" or "PF2 key type" parameters. Each press of either the PF1 or PF2 key allows you to monitor monitor items 1 to 8 in order.

Comment

32 monitors can be designated for each monitoring item.
Set the monitoring item by the codes on the monitor item list (page 5-9).
The default for the "monitor item 1" parameter is "1", for the "monitor item 2" parameter "2", and for "monitor items 3 to 8" parameters "0".

See

● Related parameters
"PF1 key type" "PF2 key type"

C018	Setting item 1	C022	Setting item 5
C019	Setting item 2	C023	Setting item 6
C020	Setting item 3	C024	Setting item 7
C021	Setting item 4	C025	Setting item 8

Function

Designates items that can be set when setting item selection has been assigned to the "PF1 key type" or "PF2 key type" parameters. Each press of either the PF1 or PF2 key allows you to monitor setting items 1 to 8 in order.

Comment

64 settings can be designated for each setting item.
Set the setting item by the codes on the setting item list (page 5-10).
The default for the "setting item 1" parameter is "1", and for "setting items 2 to 8" parameters "0".

See

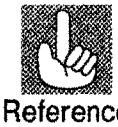
● Related parameters
"PF1 key type" "PF2 key type"

Setting Level 2
Specification Setting Mode

Monitor Item List

Code	Monitor		Monitor range	Unit
	No.1 display	No.2 display		
1	PV	SP	PV : −10 to 110%full-scale SP : 0 to 100%full-scale	U
2	PV	Manipulated variable (MV)	PV : −10 to 110%full-scale *1 MV : −5.0 to 105.0	U %
3	PV	Valve opening position *5	PV : -10 to 110%full-scale Valve opening: -10.0 to 110.0%full-scale	U %
4	PV	Deviation (DV)	PV : -10 to 110%full-scale DV : -110.0 to 110%full-scale width	U
5	PV	Bank elapsed time	PV : −10 to 110%full-scale	U
6	PV	Bank remained time	Time : 0.00 to 99.59	*2
7	Local SP	Bank elapsed time	LSP : 0 to 100%full-scale	U
8	Local SP	Bank remained time	Time : 0.00 to 99.59	*2
9	P	P	*3 0.0 to 999.9	%full-scale
10	I	I	*4 0 to 9999	sec
11	d	D	0 to 9999	sec
12	Eu 1	Event 1 setting	-200 to 200%full-scale	U or %
13	Eu 2	Event 2 setting		
14	Eu 3	Event 3 setting		
15	Eu 4	Event 4 setting		
16	Eu 5	Event 5 setting		
17	Eu 6	Event 6 setting		
18	Eu 7	Event 7 setting		
19	Eu 8	Event 8 setting		
20	Eu 9	Event 9 setting		
21	Eu 10	Event 10 setting		
22	AU 1	Analog user buffer 1	-999.9 to 999.9	%
23	AU 2	Analog user buffer 2		
24	AU 3	Analog user buffer 3		
25	AU 4	Analog user buffer 4		
26	AU 5	Analog user buffer 5		
27	AU 6	Analog user buffer 6		
28	AU 7	Analog user buffer 7		
29	AU 8	Analog user buffer 8		
30	Analog user buffer 1	Analog user buffer 2		
31	Secondary loop PV (PV2)	Secondary loop SP (SP2)	PV2 : −10.0 to 110.0 SP2 : 0.0 to 100.0	%
32	PV	Local SP (variable)	PV : −10.0 to 110.0%full-scale LSP : 0.0 to 100.0%full-scale	U

*1 In a position-proportional control system, the range is -999.9 to 999.9.
*2 The unit is either minutes: seconds or hours: minutes depending on the setting of the "program time unit" parameter.
*3 In a position-proportional control system, the range is 0.1 to 999.9.
*4 When floating control is selected in a position-proportional control system, the range is 1 to 9999.
*5 When the control system is not position-proportional, the range is 0.0.



Reference

- When setting is "0"
  When the "monitor item 1" parameter is set to "0", the setting of the monitor item is treated as "1" (PV/SP).
  When the "monitor items 2 to 8" parameters are set to "0", the parameter is invalid.
- Display at power ON
  The content of the "monitor item 1" parameter is displayed when the power is turned ON in setting level 1.

CHAPTER 5

Setting Level 2

Specification Setting Mode

Setting Item List

Code	Description		Setting Range	Unit
	No.1 Display	No.2 Display		
1	LSP	Local SP	0 to 100%full-scale	U
3	tim	Bank time	0.00 to 99.59	*1
4	P	P	*2 0.0 to 999.9	%full-scale
5	I	I	*3 0 to 9999	sec
6	d	D	0 to 9999	sec
7	Eu 1	Event 1 setting	−200 to 200%full-scale *5	U or %
8	Eu 2	Event 2 setting		
9	Eu 3	Event 3 setting		
10	Eu 4	Event 4 setting		
11	Eu 5	Event 5 setting		
12	Eu 6	Event 6 setting		
13	Eu 7	Event 7 setting		
14	Eu 8	Event 8 setting		
15	Eu 9	Event 9 setting		
16	Eu10	Event 10 setting		
17	AP 1	Analog operation parameter 1	−1.999 to 9.999	None
18	AP 2	Analog operation parameter 2		
19	AP 3	Analog operation parameter 3		
20	AP 4	Analog operation parameter 4		
21	AP 5	Analog operation parameter 5		
22	AP 6	Analog operation parameter 6		
23	AP 7	Analog operation parameter 7		
24	AP 8	Analog operation parameter 8		
25	AP 9	Analog operation parameter 9		
26	AP10	Analog operation parameter 10		
27	AP11	Analog operation parameter 11		
28	AP12	Analog operation parameter 12		
29	AP13	Analog operation parameter 13		
30	AP14	Analog operation parameter 14		
31	AP15	Analog operation parameter 15		
32	AP16	Analog operation parameter 16		
33	AP17	Analog operation parameter 17		
34	AP18	Analog operation parameter 18		
35	AP19	Analog operation parameter 19		
36	AP20	Analog operation parameter 20		

Code	Description		Setting Range	Unit
	No.1 Display	No.2 Display		
37	AP2 1	Analog operation parameter 21	−1.999 to 9.999	None
38	AP22	Analog operation parameter 22		
39	AP23	Analog operation parameter 23		
40	AP24	Analog operation parameter 24		
41	AP25	Analog operation parameter 25		
42	AP26	Analog operation parameter 26		
43	AP27	Analog operation parameter 27		
44	AP28	Analog operation parameter 28		
45	AP29	Analog operation parameter 29		
46	AP30	Analog operation parameter 30		
47	AP3 1	Analog operation parameter 31		
48	AP32	Analog operation parameter 32		
51	PV (monitor only)	Local SP	PV : −10.0 to 110.0%full-scale SP : 0.0 to 100.0%full-scale	U
52	FU	Fuzzy strength	0.0 to 100.0	%
53	HYS	ON/OFF control hysteresis	0.0 to 99.99	%
54	ārES	Manual reset	0.0 to 100.0	%
55	SLU	SP rise rate limit	0.0 to 100.0%full-scale	U
56	SLd	SP fall rate limit		
57	āLL	MV lower limit	−5.0 to upper limit −0.1	%
58	āLH	MV upper limit	Lower limit −0.1 to 105.0	
59	āLr	MV change rate limit	0.0 to 100.0	%/S
60	FSP2	Secondary loop fixed SP	0.0 to 100.0	%
61	P2	Secondary loop P	0.1 to 999.9	%
62	I2	Secondary loop I	0 to 9999	sec
63	d2	Secondary loop D	0 to 9999	sec
64	ār52	Secondary loop manual reset	0.0 to 100.0	%

*1 In a position-proportional control system, the range is −999.9 to 999.9.
*2 The unit is either minutes: seconds or hours: minutes depending on the setting of the "program time unit" parameter.
*3 In a position-proportional control system, the range is 0.1 to 999.9.
*4 When floating control is selected in a position-proportional control system, the range is 1 to 9999.
*5 When the control system is not position-proportional, the range is 0.0.


Reference

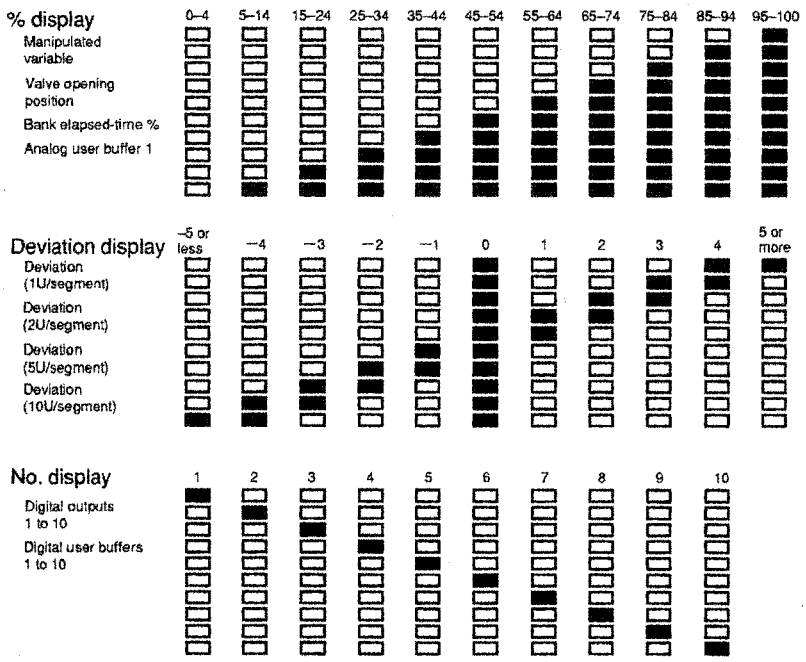
● When setting is "0"
When the "setting item 1" parameter is set to "0", the setting of the setting item is treated as "1" (LSP).
When the "setting items 2 to 8" parameters are set to "0", the parameter is invalid.

Setting Level 2
Specification Setting Mode

C026 Bar graph display item

Function

Designates the item to be displayed on the bar graph on the front panel.
11 display items are provided.
The figure below shows the bar graph displays for each of the display items.



Comment

Set the bar graph display item by the codes in the table below.

Code	Description
0	Manipulated variable (MV)
1	Valve opening position
2	Bank elapsed-time%
4	Deviation (1U per segment)
5	Deviation (2U per segment)
6	Deviation (5U per segment)
7	Deviation (10U per segment)
8	Digital output
9	Digital user buffers 1 to 10
10	Analog user buffer 1

The default varies according to the model of the ES100X.
Standard model: 0 (manipulated variable)
Position-proportional model: 1 (valve opening position)

See

● Related article
3.4 Key Display and Assignments

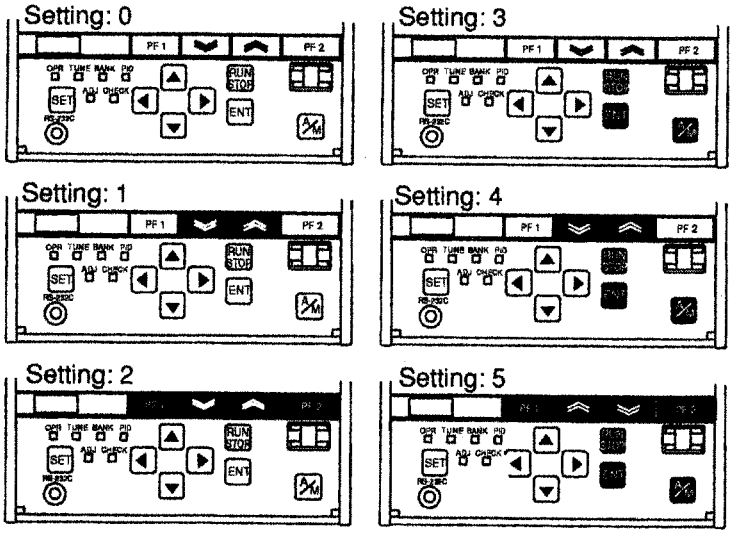
C027 Key protect

Function

Designates key protection.
The key protect function does not work in setting level 2 regardless of the setting of this parameter.
While executing the "key protect cancel" function during digital operation assignment, all front panel keys function regardless of the setting of this parameter.

Comment

You can designate one of six key protect patterns. In the following figure, keys inverted in black are disabled keys.



Default is "0" (key protect OFF)

C028 Direct/reverse action

Function

Designates the direction, direct or reverse, in which control is applied to the deviation. When direct action is set, increase the manipulated variable according to the positive deviation (current value is greater than the target value). When reverse action is set, decrease the manipulated variable according to the negative deviation (current value is smaller than the target value).

Comment

Set direct/reverse action by the codes in the table below.

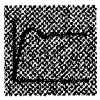
	Code	Description
Default	0	Reverse action
	1	Direct action

See

● Related article
3.3 Setting I/O Specifications

Setting Level 2
Specification Setting Mode

C029 Secondary loop direct/reverse action

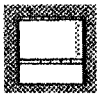

Function

Designates the direction, direct or reverse, in which control is applied to the deviation in the secondary loop when carrying out cascade control.


Comment

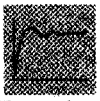
Set secondary loop direct/reverse action by the codes in the table below.

	Code	Description
Default	0	Reverse action
	1	Direct action


Model

2-input (ES100X-□W□··□)

C030 2-PID/2-PID + fuzzy

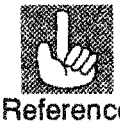

Function

Selects fuzzy logic control ON or OFF.
However, note that fuzzy logic control does not function when the "fuzzy strength" parameter is set to "0.0", and the "I" or "D" parameters is set to "0" even if 2-PID + fuzzy is selected.


Comment

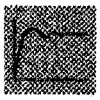
Set 2-PID/2-PID + fuzzy by the codes in the table below.

	Code	Description
Default	0	2-PID + fuzzy
	1	2-PID


Reference

Fuzzy inference is also used for fine tuning. However, the "2-PID/2-PID + fuzzy" parameter, is not related to fuzzy inference.

C031 Heating-cooling/standard

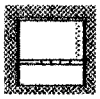

Function

Switches the control system to either heating-cooling or standard.
When this parameter is executed, the contents of analog operation assignment tables 2 and 3 are rewritten.


Comment

Set heating-cooling/standard by the codes in the table below.

	Code	Description
Default	0	Standard
	1	Heating-cooling

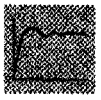

Model

Standard (ES100X-AAH□··□)


See

● Related article
6.1 Heating/Cooling Control

C032 Potentiometer input

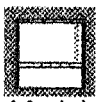

Function

Selects the position-proportional control system.


Comment

Set potentiometer input by the codes in the table below.

	Code	Description
Default	0	Not used (floating)
	1	Used (closed)


Model

Position-proportional (ES100X-RRP□··□)


See

● Related article
6.2 Position-proportional Control

C033 Cascade/standard

Function

Switches the control system between cascade and standard.

Comment

Set cascade/standard by the codes in the table below.

	Code	Description
Default	0	Standard
	1	Cascade

Model

2-input (ES100X-□W□··□)

See

● Related article
6.3 Cascade Control

C034 Operation at power ON

Function

Designates the operation at power has been turned ON.

- Continuation
  The run/stop status and auto/manual are held. In the auto mode, the manipulated variable is the default, and in the manual mode, the manipulated variable is the value at power interruption.
- Manual mode
  The run/stop status is held and the manual mode is entered. The manipulated variable is the value at the stop operation.
- Stop status
  When the stop status is entered, the auto/manual mode is held. If the mode was the auto mode at power interruption, the manipulated variable is the value at the stop operation. If the mode was the manual mode at power interruption, the manipulated variable is at held at the value at power interruption.

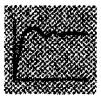
Comment

Set operation at power ON by the codes in the table below.

	Code	Description
Default	0	Continuation
	1	Manual mode
	2	Stop status

C035 MV at PV error (except position-proportional control system)

C036 MV at PV error (position-proportional control system)



Function

Sets the manipulated variable (MV) when either of the following errors occurs.

Parameter	Error Type
MV at PV error (except position-proportional control)	PV error, A/D error, internal voltage error, cold junction error (when cold junction compensating system is set to "internal")
MV at PV error (position-proportional control)	PV error, A/D error, internal voltage error, cold junction error (when cold junction compensating system is set to "internal") Potentiometer error (when closed system is set)

During reset, the manipulated variable (MV) at the stop operation is given priority. In the manual mode, the manual manipulated variable is given priority.

Comment

Set the manipulated variable (MV) at PV error by the codes in the table below.

Parameter	Setting Range	Unit	Default
MV at PV error (except position-proportional control)	–5.0 to 105.0	%	0.0
MV at PV error (position-proportional control)	–1, 0, 1	None	0

The following table shows the description of the "MV at PV error" (position-proportional control) parameter.

CHAPTER 5

Code	Description
–1	Closed side output ON (valve fully closed)
Default 0	No output (valve opening held)
1	Open side output ON (valve fully open)

Model

"MV at PV error (position-proportional control)" parameter: position-proportional (ES100X-RRP□-□)
"MV at PV error (not position-proportional control)" parameter: Standard (ES100X-AAH□-□)

See

● Related article
6.2 Position-proportional Control

Setting Level 2
Specification Setting Mode

C037 SP tracking

Function

Enables/disables SP tracking.
When set to "ON" and the SP mode is switched to the local SP mode from the remote SP mode during operation, the local SP is changed so that the local SP value is held at the SP value used immediately before switching.

Comment

Set SP tracking by the codes in the table below.

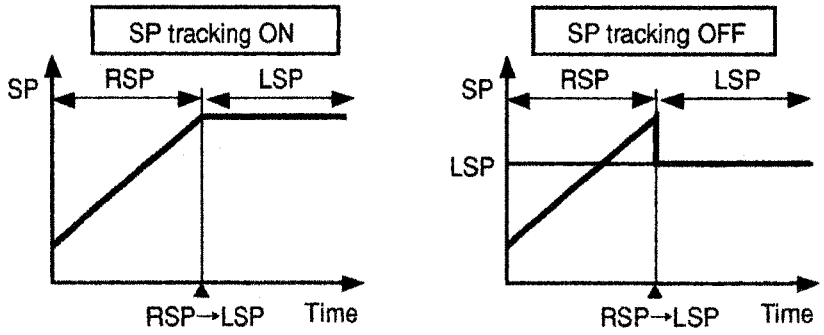
	Code	Description
	0	OFF
Default	1	ON

See

● Related parameter
"SP mode" (operation mode, setting level 1)

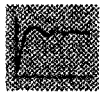
Example of use

The following figures illustrate how SP tracking works when the SP mode is switched from the remote SP mode to the local SP mode.



C038 PID set selection data

C039 PID set selection hysteresis

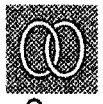

Function

These parameters are for automatic selection of PID sets.
With automatic selection of the PID set, the PID set No. is automatically set according to the setting of the "PID set selection data" parameter. The range in which the PID sets are selected is designated by the setting of the selection range to the "automatic selection range upper limit" parameter (PID setting mode: Setting level 1).
The "PID set selection hysteresis" parameter sets the hysteresis for preventing chattering during switching of PID sets.


Comment

- "PID set selection data" parameter
  Set the PID set selection data by the codes within the range 0 to 63 in the analog operation assignment (arguments) table on page 5-40. Default is "1" (PV).
- "PID set selection hysteresis" parameter

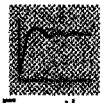
Setting Range	Unit	Default
0.10 to 99.99	%	0.50


See

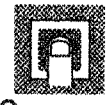
- ● Related parameter
  "automatic selection range upper limit" (PID set setting mode, setting level 1)
- ● Related article
  4.5 PID Switching

CHAPTER 5

C040 BCD communications/digital I/O

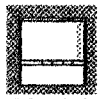

Function

Designates use of the expanded I/O connectors for BCD communications or digital I/O. Only one of the BCD communications terminals or digital I/O terminals can be used for expanded I/O connectors.


Comment

Set BCD communications/digital I/O by the codes in the table below.

	Code	Description
Default ▶	0	Digital I/O
	1	BCD communications


Model

Expanded I/O connector (ES100X-□··□E)

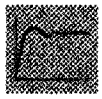

See

- ● Related article
  2.4 Wiring Expanded I/O Connectors

Setting Level 2
Specification Setting Mode

C041 Unit No. (communications)

C042 Baud rate (communications)


Function

Designates the unit No. and baud rate for terminal communications.

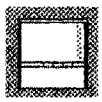

Comment

Set the "unit No." parameter by a numerical value, and the "baud rate" parameter by the codes in the table below.

Parameter	Setting Range	Unit	Default
Unit No.	0 to 99	None	0
Baud rate	0 to 4	None	3

The following table shows the descriptions of the "baud rate" parameter.

	Code	Description
	0	1200 bps
	1	2400 bps
	2	4800 bps
Default	3	9600 bps
	4	19200 bps


Model

Communications (RS-232C) (ES100X-□··□01□)
Communications (RS-422/485) (ES100X-□··□04□)

C043 Program time unit

Function

Designates the time unit of the "program time" parameter (bank setting mode, setting level 1). Accordingly, this "program time unit" parameter must be set before setting the "bank time" parameter.

Comment

Set the program time unit by the codes in the table below.

	Code	Description
	0	Minutes:seconds
Default	1	Hours:minutes

Note

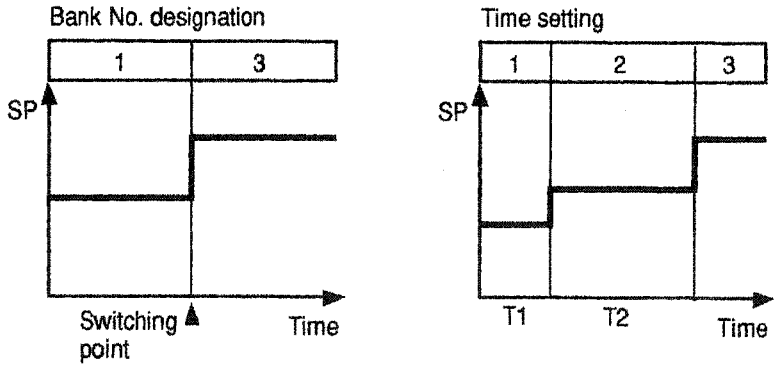
If you change the "program time unit" parameter setting after having set the time in the "bank time" parameter, only the display of the previously set time unit is changed. For example, if you changed the "program time unit" parameter to hours:minutes after setting "25.30" (25 minutes 30 seconds) using the minutes:seconds setting, the display changes to "0.25".

C044 Bank selection method

Function

Designates how banks are selected.

- No. designation
  The designated bank No. is switched to.
- Time setting
  Banks are switched to in bank No. order when each bank time has elapsed. When all banks have been switched to, bank 0 is returned to, and operation ends. This operation is called "abridged program operation."



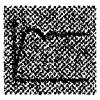
Comment

Set the program time unit by the codes in the table below.

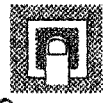
	Code	Description
Default	0	No. designation
	1	Time setting

Setting Level 2
Specification Setting Mode

C048 Time unit of SP rate limits


Function

Selects the time unit of SP rise/fall rate limits.


Comment

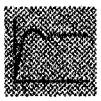
Set the time unit of SP rate limits by the codes in the table below.

	Code	Description
Default ▶	0	U/second
	1	U/minute
	2	U/hour

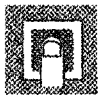

See

● Related parameters
"SP rise rate limit" "SP fall rate limit"
(adjustment mode, setting level 1)

C049 Display refreshing cycle


Function

Designates the display refreshing cycle for PV, manipulated variable, etc. in multiples of the control operation cycle.


Comment

Set the display refreshing cycle by the codes in the table below.

	Code	Description
Default ▶	0	1× of control operation cycle
	1	2× of control operation cycle
	2	5× of control operation cycle
	3	10× of control operation cycle

C050 Line noise reduction

Function

Matches the power frequency to reduce inductive noise in the analog input.

Comment

Set the line noise reduction by the codes in the table below.

	Code	Description
Default	0	50 Hz
	1	60 Hz

C051 Motor calibration execution

C052 Travel time

Function

"motor calibration execution" parameter
Calibrates the motor for reading the valve opening position. After calibrating the motor, the parameter automatically changes to the "travel time" parameter.
"travel time" parameter
Sets the time from valve fully open to valve fully closed.

CHAPTER 5

Comment

Parameter	Setting Range	Unit	Default
Motor Calibration Execution	None	None	None
Travel Time	1 to 999	Seconds	30

Model

Position-proportional (ES100X-RRP□··□)

See

● Related article
6.2 Position-proportion Control

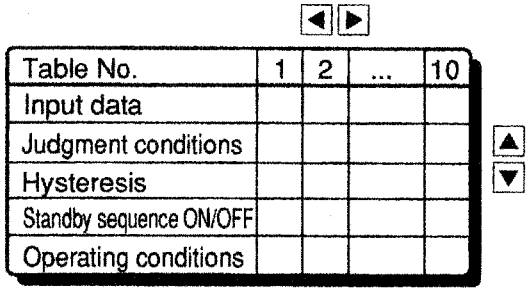
5.2 Event Setting Mode

- The event setting mode sets the specifications for events to be generated for each of the banks. Set the event setting mode in the "events 1 to 10 setting" parameters (bank mode, setting level 1).

- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON.

- To switch between the modes in setting level 2, use the [SET] key.

- Events 1 to 10 can be set.
  The parameters for each event are organized in tables.

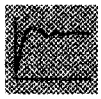


- The table No. corresponds to the event No. For example, the conditions of event 1 are set to table 1. To select the table No., press the [◀] or [▶] keys. To select parameters, press the [▲] or [▼] keys. The table No. is displayed on the BANK display.

- The following table shows the parameters in the event setting mode and the page where they are described.

Symbol	Parameter Name	Page
C 101	Input data	5-25
C 102	Judgment conditions	5-25
C 103	Hysteresis	5-26
C 104	Standby sequence ON/OFF	5-26
C 105	Operating conditions	5-26

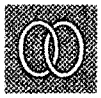
C 101 Input data


Function

Designates which data to apply the event function to.

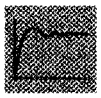

Comment

Set the input data by the codes within the range in the analog operation assignment (arguments) table on page 5-40. (default: "54" (deviation))
However, note that codes can be set only within the range 0 to 63.
When the "input data" parameter is set to "0", the event in the table will not function. Accordingly, when "0" is set, other parameters in this setting mode are invalid.


See

- Related article
  3.5 Setting Events

C 102 Judgment conditions

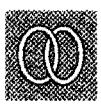

Function

Designates one of the following judgment conditions:
Upper limit
Lower limit
Absolute value upper limit
Absolute value lower limit
This parameter is invalid when the "input data" parameter is set to "0".


Comment

Set the judgment conditions by the codes in the table below.

	Code	Description
Default	0	Upper limit
	1	Lower limit
	2	Absolute value upper limit
	3	Absolute value lower limit


See

- Related parameter
  "input data"
- Related article
  3.5 Setting Events

Setting Level 2
Event Setting Mode

C 103 Hysteresis

Function

Sets hysteresis at event ON/OFF switching.
This parameter is invalid when the "input data" parameter is set to "0".

Comment

Setting Range	Unit	Default
0.00 to 99.99	%full-scale	0.10

See

- Related parameter
  "input data"
- Related article
  3.5 Setting Events

C 104 Standby sequence ON/OFF

Function

Enables or disables the standby sequence.
This parameter is invalid when the "input data" parameter is set to "0".

Comment

	Code	Description
Default	0	OFF
	1	ON

See

- Related parameter
  "input data"
- Related article
  3.5 Setting Events

C 105 Operating conditions

Function

Designates the conditions under which the event function is activated. The event is generated only when digital data is designated as "1" (ON) in this parameter. Parameters effected by the setting of this parameter are the "input data", "judgment conditions", "hysteresis", "standby sequence ON/OFF" and "event 1 value" parameters. This parameter is invalid when the "input data" parameter is set to "0".

Comment

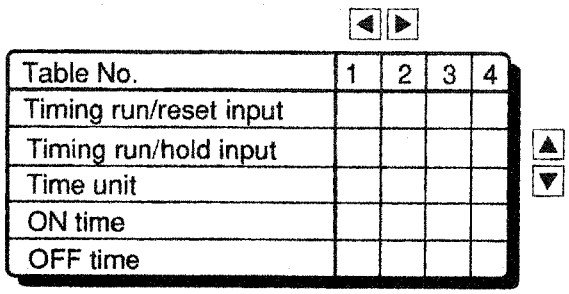
Set the operating conditions by the codes selected from the digital operation assignment (arguments) table on page 5-34.
However, note that codes can be set only within the range 0 to 202. To activate the event function at all times, set this parameter to "201" (ON at all times). (Default is 201)

See

- Related parameter
  "input data"
- Related article
  3.5 Setting Events

5.3 ON/OFF Timer Setting Mode

- The ON/OFF timer setting mode is for setting parameters for ON/OFF timer timing control and timer output ON/OFF time.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON.
- To switch between the modes in setting level 2, use the [SET] key.
- Timers 1 to 4 can be set.
  The parameters for each timer are organized in tables.



- The table No. corresponds to the timer No. For example, the conditions of timer 1 are set to table 1. To select the table No., press the [◀] or [▶] keys. To select parameters, press the [▲] or [▼] keys. The table No. is displayed on the BANK display.
- The following table shows the parameters in the ON/OFF timer setting mode and the page where they are described.

Symbol	Parameter Name	Page
C201	Timing run/reset input	5-28
C202	Timing run/hold input	5-28
C203	Time unit	5-28
C204	ON time	5-29
C205	OFF time	5-29

Setting Level 2
ON/OFF Timer Setting Mode

C201 Timing run/reset input

C202 Timing run/hold input

Function

The ON/OFF timers operate when data designated to these two parameters are both set to "1" (ON).
The timer is reset when the "timing run/reset input" parameter is set to "0" (OFF).
The timer is held when the "timer run/hold input" parameter is set to "0" (OFF).

Comment

Set the run/reset and run/hold inputs by the codes selected from the digital operation assignment (arguments) table on page 5-34.
However, note that codes can be set only within the range 0 to 202. (Default is "0" (OFF).)
Tables to which "0" is set do not function, and other parameters in the table are invalid.

See

● Related article
4.1 ON/OFF Timer

C203 Time unit

Function

Sets the time unit of the "ON time" and "OFF time" parameters. This parameter is invalid when either of the "timing run/reset input" or "timing run/hold input" parameters are set to "0".

Comment

Set the time unit by the codes in the table below.

	Code	Description
Default	0	Seconds
	1	Minutes
	2	Hours
	3	10 hours

Note

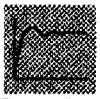
The time setting is handled as data with its own time unit. If this parameter is changed, the displayed time unit is changed for the previously set time setting. For example, if this parameter is changed to "minutes" after setting to "60" (60 seconds) in second units, the display indicates "1" (one minute).

See

● Related parameters
"timing run/reset input" "timing run/hold input" " ON time" OFF time"
● Related article
4.1 ON/OFF timer

C204 ON time

C205 OFF time



Function

Designates the timer output operation.
Sets timer output to ON when the time set in the "ON time" parameter has elapsed.
Sets timer output to OFF when the time set in the "OFF time" parameter has elapsed.
When "–1" is set these parameters are invalid, and the timer output state does not change.
These parameters are invalid when either of the "timing run/reset input" or "timing run/hold input" parameters are "0".

Comment

When the "time unit" parameter is set to "0" (seconds), "1" (minutes) and "2" (hours):

Setting Range	Unit	Default
–1 to 9999	Seconds, minutes, hours	–1

When the "time unit" parameter is set to "3" (10 hours).

Setting Range	Unit	Default
–1 to 5000	10 hours	–1

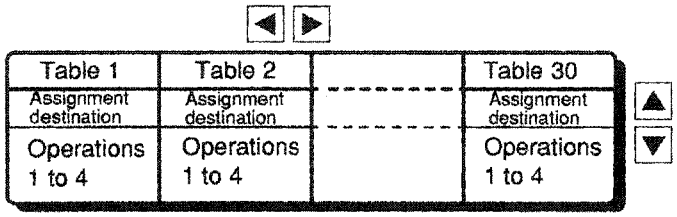
See

- Related parameters
  "timing run/reset input" "timing run/hold input" "time unit"
- Related article
  4.1 ON/OFF Timer

Setting Level 2
Digital Assignment Operation Setting Mode

5.4 Digital Operation Assignment Setting Mode

- The digital operation assignment setting mode is for assigning digital operation tables.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON.
- To switch between the modes in setting level 2, use the SET key.
- Digital operation assignment tables 1 to 30 can be set.
  The parameters for each operation block are organized in tables.



- To select the table No., press the ◀ or ▶ keys. To select parameters, press the ▲ or ▼ keys. The table No. is displayed on the BANK display.
- The following table shows the parameters in the digital operation assignment setting mode and the page where they are described.

Symbol	Parameter Name	Page
d000	Assignment destination	5-31
d010	Operation 1	
d011	Operation 1, argument 1	5-33
d012	Operation 1, argument 2	
d020	Operation 2	5-31
d021	Operation 2, argument 1	5-33
d022	Operation 2, argument 2	
d030	Operation 3	5-31
d031	Operation 3, argument 1	5-33
d032	Operation 3, argument 2	
d040	Operation 4	5-31
d041	Operation 4, argument 1	5-33
d042	Operation 4, argument 2	

d000 Assignment destination

Function

Designates the assignment destinations in the digital operation assignment table.

Comment

Set the assignment destination by the codes selected from the digital operation assignments (assignment destinations) table on page 5-32. For details on defaults, see Appendix, Parameter List.
Tables to which "0" is set do not function, and other parameters in the table are invalid.

See

● Related article
4.2 Digital Operation Assignments

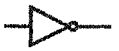
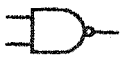
d010 Operation 1
d020 Operation 2
d030 Operation 3
d040 Operation 4

Function

Designates operations 1 to 4 in the digital operation assignment table.

Comment

Set the operations by the codes in the table below.

Code	Abbreviation	Symbol	Code	Abbreviation	Symbol
0	END		4	AND	
1	BUF		5	NOR	
2	NOT		6	NAND	
3	OR		7	XOR	

For details on defaults, see Appendix, Parameter List.
Use the abbreviation when setting up operation assignment tables.
When the "assignment destination" parameter is set to "0", these parameters are invalid.
When the operation end code "0" (END) has been set, subsequent operations in the table are invalid.

See

● Related parameters
"assignment destination" (digital operation assignment setting mode)
● Related article
4.2 Digital Operation Assignments

Setting Level 2

Digital Assignment Operation Setting Mode

Digital operation assignment – assignment destinations

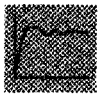
Code	Symbol	Description	Code	Symbol	Description
0	–	Invalid	..	UNDF	Undefined
1	DO1	Digital output 1	66	AT	A.T. execution
2	DO2	Digital output 2	67	ATSP	A.T. cancel
3	DO3	Digital output 3	68	MAN	Manual mode
4	DO4	Digital output 4	69	AUTO	Auto mode
5	DO5	Digital output 5	70	LSP	Local SP mode
6	DO6	Digital output 6	71	RSP	Remote SP mode
7	DO7	Digital output 7	..	UNDF	Undefined
8	DO8	Digital output 8	73	LCL	Local setting mode
9	DO9	Digital output 9	74	RMT	Remote setting mode
10	DO10	Digital output 10	75	EXT	External setting mode
..	UNDF	Undefined	..	UNDF	Undefined
21	DU1	Digital user buffer 1	79	EVR	Event standby sequence reset
22	DU2	Digital user buffer 2	..	UNDF	Undefined
23	DU3	Digital user buffer 3	91	RNRS	1: Run/0: Stop
24	DU4	Digital user buffer 4	..	UNDF	Undefined
25	DU5	Digital user buffer 5	93	MNAT	1: Manual mode/0: Auto mode
26	DU6	Digital user buffer 6	94	LRSP	1: Local SP mode/0: Remote SP mode
27	DU7	Digital user buffer 7	..	UNDF	Undefined
28	DU8	Digital user buffer 8	97	LCRM	1: Local setting mode/0: Remote setting mode
29	DU9	Digital user buffer 9	98	EXRM	1: External setting mode/0: Remote setting mode
30	DU10	Digital user buffer 10	99	EXLC	1: External setting mode/0: Local setting mode
31	DU11	Digital user buffer 11	..	UNDF	Undefined
32	DU12	Digital user buffer 12	103	KPCC	1: Key protect cancel/0: Key protect ON
33	DU13	Digital user buffer 13	104	DRRV	1: Direct/reverse action inversion/0: Direct/reverse action inversion cancel
34	DU14	Digital user buffer 14	105	IR	1: Integration reset/0: Integration reset cancel
35	DU15	Digital user buffer 15	106	FFOF	1: Feed-forward OFF/0: Feed-forward ON
36	DU16	Digital user buffer 16	107	MVTR	1: MV tracking ON/0: MV tracking OFF
..	UNDF	Undefined	108	CSOF	1: Cascade OFF/0: Cascade ON
50	BNK0	Bank No. 2^0 (weighted 1)	109	CSOP	1: Cascade open/0: Cascade closed
51	BNK1	Bank No. 2^1 (weighted 2)	..	UNDF	Undefined
52	BNK2	Bank No. 2^2 (weighted 4)	121	DA1	Data 1 for mixed operation
53	BNK3	Bank No. 2^3 (weighted 8)	122	DA2	Data 2 for mixed operation
54	BNK4	Bank No. 2^4 (weighted 16)	123	DA3	Data 3 for mixed operation
55	BNK5	Bank No. 2^5 (weighted 32)	124	DA4	Data 4 for mixed operation
56	BNK6	Bank No. 2^6 (weighted 64)	125	DA5	Data 5 for mixed operation
..	UNDF	Undefined	126	DA6	Data 6 for mixed operation
61	RST	Stop	127	DA7	Data 7 for mixed operation
62	RUN	Run	128	DA8	Data 8 for mixed operation

*1 Digital outputs 1 and 2 are relay output; digital outputs 3 to 10 are open-collector output.

*2 When using settings 61 to 82, the setting is ON when the operation result changes from 0 to 1. (pulsed instruction)
When using settings 91 to 109, operation is switched when the operation result changes. (toggled instruction)

*3 UNDF (undefined) cannot be output.

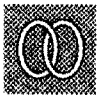
d011	**Operation 1, argument 1**	d031	**Operation 3, argument 1**
d021	**Operation 2, argument 1**	d041	**Operation 4, argument 1**


Function

Designates argument 1 for the operations in the digital operation assignment table.

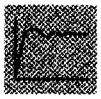

Comment

Set the arguments by the codes selected from the digital operation assignment (arguments) table on page 5-34. However, note some controllers have meaningless arguments. For details on defaults, see Appendix, Parameter List.
These parameters are invalid when the "assignment destination" parameter is set to "0". When these parameters are set to "0", the argument is treated as data fixed to "0".


See

- Related parameter
  "assignment destination" (digital operation assignment setting mode)
- Related article
  4.2 Digital Operation Assignments

d012	**Operation 1, argument 2**	d032	**Operation 3, argument 2**
d022	**Operation 2, argument 2**	d042	**Operation 4, argument 2**


Function

Designates argument 2 for the operations in the digital operation assignment table.


Comment

Set the arguments by the codes selected from the digital operation assignment (arguments) table on page 5-34. However, note some controllers have meaningless arguments. For details on defaults, see Appendix, Parameter List.
These parameters are invalid when the "assignment destination" parameter is set to "0". When these parameters are set to "0", the argument is treated as data fixed to "0". These parameters are also ignored in operations where argument 2 is not used.


See

- Related parameter
  "assignment destination" (digital operation assignment setting mode)
- Related article
  4.2 Digital Operation Assignments

Setting Level 2

Digital Assignment Operation Setting Mode

Digital operation assignment – arguments

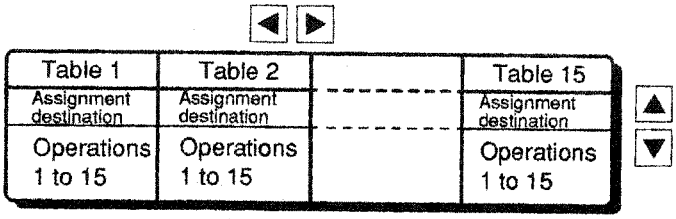
Code	Symbol	Description	Code	Symbol	Description	Code	Symbol	Description
0	–	Invalid	84	KPCC	Key protect cancel	168	DU8	Digital user buffer 8
1	DI1	Digital input 1	85	DRRV	Direct/reverse action inversion	169	DU9	Digital user buffer 9
2	DI2	Digital input 2	86	IR	Integration reset	170	DU10	Digital user buffer 10
3	DI3	Digital input 3	87	FFOF	Feed-forward OFF	171	DU11	Digital user buffer 11
4	DI4	Digital input 4	88	MVTR	Manipulated variable tracking ON	172	DU12	Digital user buffer 12
5	DI5	Digital input 5	89	CSOF	Cascade OFF	173	DU13	Digital user buffer 13
6	DI6	Digital input 6	90	CSOP	Cascade open	174	DU14	Digital user buffer 14
7	DI7	Digital input 7	..	UNDF	Undefined	175	DU15	Digital user buffer 15
8	DI8	Digital input 8	93	HBAL	Heater burnout alarm	176	DU16	Digital user buffer 16
..	UNDF	Undefined	94	CTAL	ON/OFF count alarm	..	UNDF	Undefined
21	EV1	Event 1	..	UNDF	Undefined	181	E200	Internal voltage error
22	EV2	Event 2	111	PEND	Program end output	182	E210	Cold-junction error
23	EV3	Event 3	112	STEP	Bank output	183	E300	A/D error
24	EV4	Event 4	..	UNDF	Undefined	184	E410	Analog input 1 error
25	EV5	Event 5	130	STP0	Bank No. 2^0	185	E420	Analog input 2 error
26	EV6	Event 6	131	STP1	Bank No. 2^1	186	E400	PV error
27	EV7	Event 7	132	STP2	Bank No. 2^2	187	E450	Potentiometer
28	EV8	Event 8	..	UNDF	Undefined	..	UNDF	Undefined
29	EV9	Event 9	141	DO1	Digital output 1	191	DA1	Data 1 for mixed operation
30	EV10	Event 10	142	DO2	Digital output 2	192	DA2	Data 2 for mixed operation
..	UNDF	Undefined	143	DO3	Digital output 3	193	DA3	Data 3 for mixed operation
61	TM1	ON/OFF timer 1	144	DO4	Digital output 4	194	DA4	Data 4 for mixed operation
62	TM2	ON/OFF timer 2	145	DO5	Digital output 5	195	DA5	Data 5 for mixed operation
63	TM3	ON/OFF timer 3	146	DO6	Digital output 6	196	DA6	Data 6 for mixed operation
64	TM4	ON/OFF timer 4	147	DO7	Digital output 7	197	DA7	Data 7 for mixed operation
..	UNDF	Undefined	148	DO8	Digital output 8	198	DA8	Data 8 for mixed operation
71	RUN	Run	149	DO9	Digital output 9	..	UNDF	Undefined
..	UNDF	Undefined	150	DO10	Digital output 10	200	0	0 fixed data (always ON)
73	AT	A.T. execution	..	UNDF	Undefined	201	1	1 fixed data (always ON) *3
74	MAN	Manual mode	161	DU1	Digital user buffer 1	202	1R	1 fixed data (always ON) *3
75	LSP	Local SP mode	162	DU2	Digital user buffer 2	..	UNDF	Undefined
76	RSP	Remote SP mode	163	DU3	Digital user buffer 3	211	N1	Operation results 1
78	LCL	Local setting mode	164	DU4	Digital user buffer 4	212	N2	Operation results 2
79	RMT	Remote setting mode	165	DU5	Digital user buffer 5	213	N3	Operation results 3
80	EXT	External setting mode	166	DU6	Digital user buffer 6	214	N4	Operation results 4
..	UNDF	Undefined	167	DU7	Digital user buffer 7			

*1 Digital outputs 1 and 2 are relay output; digital outputs 3 to 10 are open-collector output.
*2 This setting becomes the bit data when the bank No. is expressed in binary.
*3 Setting "202" changes to "1" from "0" when the power is turned ON. From then on, data becomes ON at all times in the same way as setting 201. For example, when using the setting as the input data of the ON/OFF timer, reset the timer while the setting is "0" at power ON. Also, when using the setting for operating instructions, the setting can be operated once only at the change from OFF to ON at power ON.
*4 Settings 111 to 112 are set to "1" for a designated time at output. Designate the time in the "one-shot pulse width" parameter (setting level 2 technical mode) setting level 2. (Default is 1 second.)
*5 UNDF (undefined) cannot be output.

Setting Level 2
Analog Operation Assignment Setting Mode

5.5 Analog Operation Assignment Setting Mode

- The analog operation assignment setting mode is for assigning analog operation tables.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON.
- To switch between the modes in setting level 2, use the [SET] key.
- Analog operation tables 1 to 15 can be set. Operations blocks 1 to 15 can be set.
- To select the table No., press the [◀] or [▶] keys. To select parameters, press the [▲] or [▼] keys. The table No. is displayed on the BANK display.



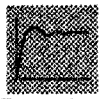
- The following table shows the parameters in the analog operation assignment setting mode and the page where they are described.

Symbol	Parameter Name	Page	Symbol	Parameter Name	Page	Symbol	Parameter Name	Page
A000	Assignment destination	5-36						
A010	Operation 1	5-37	A060	Operation 6	5-37	A110	Operation 11	5-37
A011	Operation 1, argument 1	5-39	A061	Operation 6, argument 1	5-39	A111	Operation 11, argument 1	5-39
A012	Operation 1, argument 2		A062	Operation 6, argument 2		A112	Operation 11, argument 2	
A020	Operation 2	5-37	A070	Operation 7	5-37	A120	Operation 12	5-37
A021	Operation 2, argument 1	5-39	A071	Operation 7, argument 1	5-39	A121	Operation 12, argument 1	5-39
A022	Operation 2, argument 2		A072	Operation 7, argument 2		A122	Operation 12, argument 2	
A030	Operation 3	5-37	A080	Operation 8	5-37	A130	Operation 13	5-37
A031	Operation 3, argument 1	5-39	A081	Operation 8, argument 1	5-39	A131	Operation 13, argument 1	5-39
A032	Operation 3, argument 2		A082	Operation 8, argument 2		A132	Operation 13, argument 2	
A040	Operation 4	5-37	A090	Operation 9	5-37	A140	Operation 14	5-37
A041	Operation 4, argument 1	5-39	A091	Operation 9, argument 1	5-39	A141	Operation 14, argument 1	5-39
A042	Operation 4, argument 2		A092	Operation 9, argument 2		A142	Operation 14, argument 2	
A050	Operation 5	5-37	A100	Operation 10	5-37	A150	Operation 15	5-37
A051	Operation 5, argument 1	5-39	A101	Operation 10, argument 1	5-39	A151	Operation 15, argument 1	5-39
A052	Operation 5, argument 2		A102	Operation 10, argument 2		A152	Operation 15, argument 2	

Setting Level 2

Analog Operation Assignment Setting Mode

A000 Assignment destination



Function

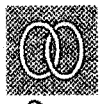
Designates the assignment destination in the analog operation assignment table.

Comment

Set the assignment destinations by the codes in the table below.

Code	Symbol	Description	Range
0	--	Invalid	
1	PV	PV	-0.1 to 1.1
2	RSP	Remote SP	0.0 to 1.0
3	PVC	PV bias value	-1.0 to 1.0
4	CSP	Cascade SP	0.0 to 1.0
5	CTV	Primary loop tracking	0.0 to 1.0
6	PV2	Secondary loop PV	-01. to 1.1
7	FFV	Feed-forward amount	-1.0 to 2.0
8	MTV	MV tracking value	-9.999 to 9.999
9	STP	MV at stop	
. .	UNDF	Undefined	
11	AO1	Analog output 1	-9.999 to 9.999
12	AO2	Analog output 2	
13	AO3	Analog output 3	
. .	UNDF	Undefined	
21	AU1	Analog user buffer 1	-9.999 to 9.999
22	AU2	Analog user buffer 2	
23	AU3	Analog user buffer 3	
24	AU4	Analog user buffer 4	
25	AU5	Analog user buffer 5	
26	AU6	Analog user buffer 6	
27	AU7	Analog user buffer 7	
28	AU8	Analog user buffer 8	

For details on defaults, see Appendix, Parameter List.
Tables to which "0" is set do not function, and other parameters in the table are invalid.



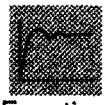
See

● Related article
4.3 Analog Operation Assignments

Setting Level 2

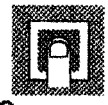
Analog Operation Assignment Setting Mode

A010	Operation 1	A060	Operation 6	A110	Operation 11
A020	Operation 2	A070	Operation 7	A120	Operation 12
A030	Operation 3	A080	Operation 8	A130	Operation 13
A040	Operation 4	A090	Operation 9	A140	Operation 14
A050	Operation 5	A100	Operation 10	A150	Operation 15



Function

Designates operations 1 to 15 in the analog operation assignment table.



Comment

Set the operations by the codes selected from the analog operations list on page 5-38. For details on defaults, see Appendix, Parameter List.
When the "assignment destination" parameter is set to "0", these parameters are invalid.
When the operation end code "0" (END) has been set, subsequent operations in the table are invalid.

See

- Related parameter
  "assignment destination" (analog operation assignment setting mode)
- Related article
  4.3 Analog Operation Assignments

Setting Level 2

Analog Operation Assignment Setting Mode

Analog operation assignment – operations

Code	Symbol	Operation	Argument 1	Argument 2
0	END	Operation end: Ignores subsequent operations in the table.	None	None
1	MOV	Transfer: argument 1 is transferred directly as the operation result.	Data	None
2	ADD	Addition: argument 1 + argument 2	Data 1	Data 2
3	SUB	Subtraction: argument 1 – argument 2		
4	MUL	Multiplication: argument 1 × argument 2		
5	DIV	Division: argument 1/argument 2		
6	ABS	Absolute value: |"argument 1"|	Data	None
7	AAV	Added average: (argument 1 + argument 2)/2	Data 1	Data 2
8	SLH	The larger of the two values argument 1 and argument 2 is taken as the operation result.	Data 1	Data 2
9	SLL	The smaller of the two values argument 1 and argument 2 is taken as the operation result.		
10	SQR	Square root: The square root of argument 1 is calculated taking argument 2 as the low-cut point to obtain the operation result.	Data	Low-cut point
11	LAG1	First order lag filter 1	Data	Time constant
12	LAG2	First order lag filter 2		
13	LAG3	First order lag filter 3		
14	LAG4	First order lag filter 4		
		Argument 2 is taken as the time constant. First order lag of argument 1		
21	SCL1	Straight-line approximation 1	Data	None
22	SCL2	Straight-line approximation 2		
23	SCL3	Straight-line approximation 3		
24	SCL4	Straight-line approximation 4		
		Conversion of argument 1 using straight-line approximation		
31	FNC1	Broken line approximation 1	Data	None
32	FNC2	Broken line approximation 2		
		Conversion of argument 1 using broken-line approximation		
41	LED1	Differential 1	Data	Differential time
42	LED2	Differential 2		
		Argument 2 is taken as the time constant Differential of argument 1		
45	DED	The dead time of argument 1 is calculated taking argument 2 as the dead time.	Data	Dead time
48	MAV	The move average is calculated taking argument 2 as the average time.	Data	Average time
51	SW1	Switch 1: When DA1=1, argument 1 is taken as the operation result. When DA1=0, argument 2 is taken as the operation result.	Data 1	Data 2
52	SW2	Switch 2: When DA2=1, argument 1 is taken as the operation result. When DA2=0, argument 2 is taken as the operation result.		
53	SW3	Switch 3: When DA3=1, argument 1 is taken as the operation result. When DA3=0, argument 2 is taken as the operation result.		
54	SW4	Switch 4: When DA4=1, argument 1 is taken as the operation result. When DA4=0, argument 2 is taken as the operation result.		
55	SW5	Switch 5: When DA5=1, argument 1 is taken as the operation result. When DA5=0, argument 2 is taken as the operation result.		
56	SW6	Switch 6: When DA6=1, argument 1 is taken as the operation result. When DA6=0, argument 2 is taken as the operation result.		
57	SW7	Switch 7: When DA7=1, argument 1 is taken as the operation result. When DA7=0, argument 2 is taken as the operation result.		
58	SW8	Switch 8: When DA8=1, argument 1 is taken as the operation result. When DA8=0, argument 2 is taken as the operation result.		
61	CMP1	Comparison 1: When argument 1 is ≥ than argument 2, DA1 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA1 = 0 and the operation result is taken as 0.0.	Data 1	Data 2
62	CMP2	Comparison 2: When argument 1 is ≥ than argument 2, DA2 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA2 = 0 and the operation result is taken as 0.0.		
63	CMP3	Comparison 3: When argument 1 is ≥ than argument 2, DA3 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA3 = 0 and the operation result is taken as 0.0.		
64	CMP4	Comparison 4: When argument 1 is ≥ than argument 2, DA4 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA4 = 0 and the operation result is taken as 0.0.		
65	CMP5	Comparison 5: When argument 1 is ≥ than argument 2, DA5 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA5 = 0 and the operation result is taken as 0.0.		
66	CMP6	Comparison 6: When argument 1 is ≥ than argument 2, DA6 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA6 = 0 and the operation result is taken as 0.0.		
67	CMP7	Comparison 7: When argument 1 is ≥ than argument 2, DA7 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA7 = 0 and the operation result is taken as 0.0.		
68	CMP8	Comparison 8: When argument 1 is ≥ than argument 2, DA8 = 1 and the operation result is taken as 1.0. When argument 1 is < than argument 2, DA8 = 0 and the operation result is taken as 0.0.		

LAG1 to 4, LED1, 2, DED and MAV can be used only once in all tables. Also, data other than analog operation parameters 1 to 32 and fixed data cannot be used for argument 2 of these operations.

Setting Level 2

Analog Operation Assignment Setting Mode

A011	Operation 1, argument 1	A061	Operation 6, argument 1	A111	Operation 11, argument 1
A021	Operation 2, argument 1	A071	Operation 7, argument 1	A121	Operation 12, argument 1
A031	Operation 3, argument 1	A081	Operation 8, argument 1	A131	Operation 13, argument 1
A041	Operation 4, argument 1	A091	Operation 9, argument 1	A141	Operation 14, argument 1
A051	Operation 5, argument 1	A101	Operation 10, argument 1	A151	Operation 15, argument 1

Function

Designates argument 1 for operations 1 to 15 in the analog operation assignment table.

Comment

Set the arguments by the codes selected from the analog operation assignment (arguments) table on page 5-40. For details on defaults, see Appendix, Parameter List. This parameter is invalid when the "assignment destination" parameter is set to "0". When this parameter is set to "0", the argument is treated as data fixed to "0".

See

- Related parameters
  "assignment destination" (analog operation assignment setting mode)
- Related article
  4.3 Analog Operation Assignments

A012	Operation 1, argument 2	A062	Operation 6, argument 2	A112	Operation 11, argument 2
A022	Operation 2, argument 2	A072	Operation 7, argument 2	A122	Operation 12, argument 2
A032	Operation 3, argument 2	A082	Operation 8, argument 2	A132	Operation 13, argument 2
A042	Operation 4, argument 2	A092	Operation 9, argument 2	A142	Operation 14, argument 2
A052	Operation 5, argument 2	A102	Operation 10, argument 2	A152	Operation 15, argument 2

Function

Designates argument 2 for operations 1 to 15 in the analog operation assignment table.

Comment

Set the arguments by the codes selected from the analog operation assignment (arguments) table on page 5-40. For details on defaults, see Appendix, Parameter List. This parameter is invalid when the "assignment destination" parameter is set to "0". When this parameter is set to "0", the argument is treated as data fixed to "0".

See

- Related parameters
  "assignment destination" (analog operation assignment setting mode)
- Related article
  4.3 Analog Operation Assignments

Setting Level 2

Analog Operation Assignment Setting Mode

Analog operation assignment – arguments

Code	Symbol	Description	Range	Code	Symbol	Description	Range
0	–	Invalid	0.0 to 1.0	80	N10	Operation result 10	-3.40×10^{38} to 3.40×10^{38}
1	PV	PV	–0.1 to 1.1	81	N11	Operation result 11	
2	RSP	Remote SP	0.0 to 1.0	82	N12	Operation result 12	
3	PVC	PV bias value	–1.0 to 1.0	83	N13	Operation result 13	
4	CSP	Cascade SP	0.0 to 1.0	84	N14	Operation result 14	
5	CTV	Primary loop tracking value	0.0 to 1.0	85	N15	Operation result 15	
6	PV2	Secondary loop PV	–0.1 to 1.1	..	UNDF	Undefined	
7	FFV	Feed-forward amount	–1.0 to 2.0	89	CSPL	Control operation cycle	*2
8	MTV	MV tracking value	–9.999 to 9.999	90	0.0	0.0 fixed data	0.0
9	STP	MV at stop	–9.999 to 9.999	91	1.0	1.0 fixed data	1.0
10	UNDF	Undefined		92	–1.0	–1.0 fixed data	–1.0
11	AO1	Analog output 1	–9.999 to 9.999	93	0.01	0.01 fixed data	0.01
12	AO2	Analog output 2		94	0.1	0.1 fixed data	0.1
13	AO3	Analog output 3		95	0.5	0.5 fixed data	0.5
..	UNDF	Undefined		96	2.0	2.0 fixed data	2.0
21	AU1	Analog user buffer 1	–9.999 to 9.999	97	10.0	10.0 fixed data	10.0
22	AU2	Analog user buffer 2		98	π	π fixed data	3.141592
23	AU3	Analog user buffer 3		..	UNDF	Undefined	
24	AU4	Analog user buffer 4		101	AP1	Analog operation parameter 1	–1.999 to 9.999
25	AU5	Analog user buffer 5		102	AP2	Analog operation parameter 2	
26	AU6	Analog user buffer 6		103	AP3	Analog operation parameter 3	
27	AU7	Analog user buffer 7		104	AP4	Analog operation parameter 4	
28	AU8	Analog user buffer 8		105	AP5	Analog operation parameter 5	
..	UNDF	Undefined		106	AP6	Analog operation parameter 6	
41	AI1	Analog input 1	–0.1 to 1.1	107	AP7	Analog operation parameter 7	
42	AI2	Analog input 2		108	AP8	Analog operation parameter 8	
..	UNDF	Undefined		109	AP9	Analog operation parameter 9	
51	SP	SP	0.0 to 1.0	110	AP10	Analog operation parameter 10	
52	LSP	Local SP		111	AP11	Analog operation parameter 11	
..	UNDF	Undefined		112	AP12	Analog operation parameter 12	
54	DV	Deviation	–1.1 to 1.1	113	AP13	Analog operation parameter 13	
55	PID	PID manipulated variable	–9.999 to 9.999	114	AP14	Analog operation parameter 14	
56	SP2	Secondary loop SP	0.0 to 1.0	115	AP15	Analog operation parameter 15	
57	FSP2	Secondary loop fixed SP	0.0 to 1.0	116	AP16	Analog operation parameter 16	
58	DV2	Secondary loop deviation	–1.1 to 1.1	117	AP17	Analog operation parameter 17	
59	MMV	Manual MV *1	–0.05 to 1.05	118	AP18	Analog operation parameter 18	
60	MV	MV *1	–0.05 to 1.05	119	AP19	Analog operation parameter 19	
61	VOP	Valve opening position	–0.1 to 1.1	120	AP20	Analog operation parameter 20	
62	VOPC	Control valve opening	–9.999 to 9.999	121	AP21	Analog operation parameter 21	
63	CT	Heater current	0.0 to 0.55	122	AP22	Analog operation parameter 22	
..	UNDF	Undefined		123	AP23	Analog operation parameter 23	
71	N1	Operation result 1	-3.40×10^{38} to 3.40×10^{38}	124	AP24	Analog operation parameter 24	
72	N2	Operation result 2		125	AP25	Analog operation parameter 25	
73	N3	Operation result 3		126	AP26	Analog operation parameter 26	
74	N4	Operation result 4		127	AP27	Analog operation parameter 27	
75	N5	Operation result 5		128	AP28	Analog operation parameter 28	
76	N6	Operation result 6		129	AP29	Analog operation parameter 29	
77	N7	Operation result 7		130	AP30	Analog operation parameter 30	
78	N8	Operation result 8		131	AP31	Analog operation parameter 31	
79	N9	Operation result 9		132	AP32	Analog operation parameter 32	

*1 In a position-proportional control system, the range is –9.999 to 9.999.

*2 Range becomes 0.1 to 1.0 in 0.1 second units

*3 UNDF (undefined) cannot be output.

5.6 Setting Level 2 Technical Mode

- Parameters in the setting level 2 technical mode are to be used with the defaults unless they are in special applications.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON. At switch SW2, set SW2-2 only to ON.
- To switch between the modes in setting level 2, use the SET key.
- The following table shows the parameters in the setting level 2 technical mode and the page where they are described.

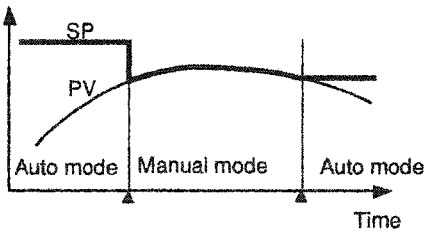
Symbol	Parameter Name	Page	Symbol	Parameter Name	Page
C301	PV tracking	5-42	C315	Fuzzy scale 1 adjustment	5-46
C302	Manual output method	5-42	C316	Fuzzy scale 2 adjustment	5-46
C303	Manual MV preset value	5-43	C317	Fuzzy I coefficient adjustment	5-46
C304	Cold junction compensating method	5-43	C318	Fuzzy adjustment bandwidth	5-47
C305	One-shot pulse width	5-44	C319	Fuzzy SP change judgment value	5-47
C306	Digital input response time	5-44	C320	Temporary A.T. execution judgment deviation	5-48
C307	External No. selection setting time	5-44	C321	Number of limit cycles	5-48
C310	A.T. calculated gain	5-45	C322	Bit length (communications)	5-49
C311	Limit cycle MV range	5-45	C323	Parity (communications)	5-49
C312	Balance rate during PD operation	5-45	C324	Stop bit (communications)	5-49
C313	2-PID control parameter α	5-46			
C314	2-PID control parameter β	5-46			

Setting Level 2
Technical Mode

C301 PV tracking

Function

Designates whether or not to track the local SP to PV in the manual mode.



Comment

Set PV tracking by the codes in the table below.

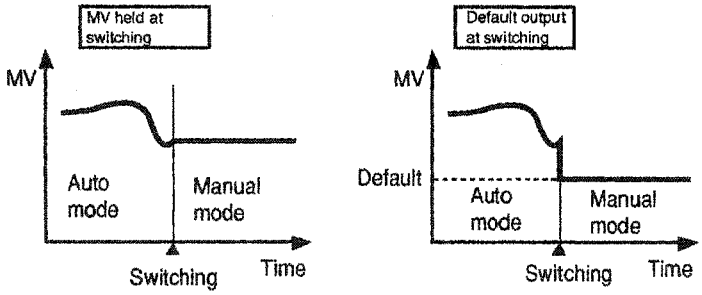
	Code	Description
Default	0	OFF
	1	ON

C302 Manual output method

Function

Designates which value of the manipulated variable (MV) is output at switching from auto mode to manual mode.

- When "MV held at switching" is designated, the manipulated variable (MV) in the auto mode at the time of switching is held.
- When "default output at switching" is designated, the manipulated variable is the value set at the parameter "manual MV preset value."



Comment

Set the manual output mode by the codes in the table below.

	Code	Description
Default	0	MV held at switching
	1	Default output at switching

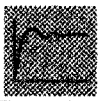
Model

Standard (ES100X-AAH□-□)

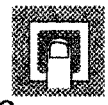
See

● Related parameter
"manual MV preset value"

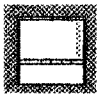
C303 Manual MV preset value


Function

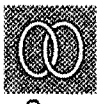
Sets the MV preset value when the "manual output method" parameter is set to "1" (default output during switching).


Comment

Setting Range	Unit	Default
–5.0 to 105.0	%	0.0


Model

Standard (ES100X-AAH□··□)


See

● Related parameter
"manual output method"

C304 Cold junction compensating method


Function

Designates whether or not to conduct cold junction compensation internally or externally when analog input 1 is set to thermocouple.

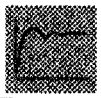

Comment

Set the cold junction compensating method by the codes in the table below.

	Code	Description
Default	0	Internal
	1	External

Setting Level 2
Technical Mode

C305 One-shot pulse width

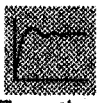

Function

Sets the pulse width (ON time) of the following one-shot pulsed width outputs:
Program end output: output at the end of bank 7 when the "bank selection method" parameter is set to "1" (time setting).
Bank output: output at bank switching


Comment

Setting Range	Unit	Default
0.1 to 10.0	Seconds	1.0

C306 Digital input response time

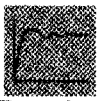

Function

This function prevents chattering during switching of PID sets. If the status is the same in the signal state (ON to OFF, OFF to ON) for the duration of the digital input response time, the change in the signal state is regarded as valid.


Comment

Setting Range	Unit	Default
0.1 to 10.0	Seconds	0.2

C307 External No. selection setting time

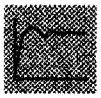

Function

This function prevents reading of transient Nos. during operation of switches when, for example, the external thumb rotary switches are being operated to select a bank No. If the same number continues after the No. has changed for the duration of the external No. selection time, that No. is regarded as valid.


Comment

Setting Range	Unit	Default
0.1 to 10.0	Seconds	1.0

C310 A.T. calculated gain

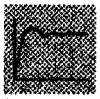

Function

Adjusts the PID parameters calculated by A.T.
To give priority to response, decrease the setting of this parameter. To give priority to stability, increase the setting of this parameter.


Comment

Setting Range	Unit	Default
0.1 to 10.0	None	1.0

C311 Limit cycle MV range

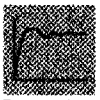

Function

Sets the MV range when the limit cycle is generated during A.T. execution.


Comment

Setting Range	Unit	Default
5.0 to 50.0	%	20.0

C312 Balance rate during PD operation


Function

Sets the rate of change of the manipulated variable (MV). This bump-less function is using during P or PD control.


Comment

Setting Range	Unit	Default
0.0 to 100.0	%/seconds	0.0

The bump-less function does not work when this parameter is set to "0.0".

Setting Level 2
Technical Mode

C313 2-PID control parameter α

C314 2-PID control parameter β

Function

Adjusts the parameters of various PID controls: differential priority type PID, deviation differential type PID, and proportional priority type PID.

Comment

Setting Range	Unit	Default
0.00 to 1.00	None	α = 0.65, β = 1.00

C315 Fuzzy scale 1 adjustment

C316 Fuzzy scale 2 adjustment

C317 Fuzzy I coefficient adjustment

Function

Changes the fuzzy control parameters to adjust the effectiveness of fuzzy control. After adjusting by the "fuzzy strength" parameter (adjustment mode, setting level 1), follow the procedure below to adjust the fuzzy control parameters.

(1) Adjustment by "fuzzy scale 1 adjustment" "fuzzy scale 2 adjustment" parameters
Increasing the setting of the "fuzzy scale 1 adjustment" parameter delays the response. In most cases, the overshoot when PV is traveling away from SP increases and vibration is reduced.
Decreasing the setting of the "fuzzy scale 1 adjustment" parameter speeds up the response. In most cases, the overshoot when PV is traveling away from SP decreases and vibration increases.
Increasing the setting of the "fuzzy scale 2 adjustment" parameter delays the response. In most cases, the overshoot when PV suddenly returns increases and vibration is reduced.
Decreasing the setting of the "fuzzy scale 2 adjustment" parameter speeds up the response. In most cases, the overshoot when PV suddenly returns decreases and vibration increases.

(2) Adjustment by "fuzzy I coefficient adjustment" parameter
Has almost the same adjustment effect as "fuzzy strength."

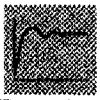
Comment

Setting Range	Unit	Default
0.1 to 10.0	None	1.0

See

● Related parameters
"fuzzy strength" (adjustment mode, setting level 1)

C318 Fuzzy adjustment bandwidth



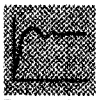
Function

Sets the adjustment bandwidth in which fuzzy logic control functions.
Increase this setting in control systems where an external disturbance disrupts PV.
Decrease this setting in stable control systems.

Comment

Setting Range	Unit	Default
0.000 to 9.999	%full-scale	0.250

C319 Fuzzy SP change judgment value



Function

In control where SP changes all the time, this parameter determines the conditions by which fuzzy control is to function. Basically, these conditions are valid only when an external disturbance has entered the controller in a fixed value control state. The conditions are not valid until SP changes. However, if SP changes within the setting range designated in the "fuzzy SP change judgment value" parameter, this will be regarded the same as fixed value control, and fuzzy control will function if an external disturbance enters the controller.
In order to make fuzzy control function more effectively, increase the setting of the "fuzzy SP change judgment value" parameter.

Comment

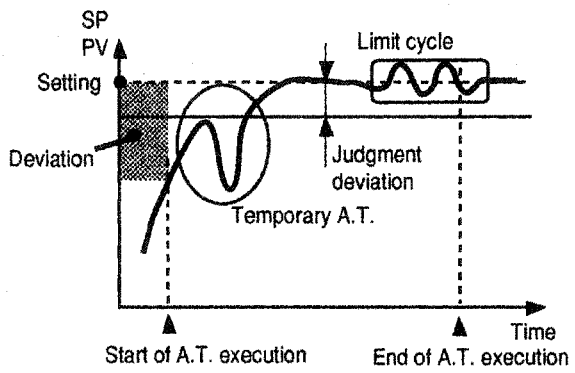
Setting Range	Unit	Default
0.000 to 9.999	%	0.010

Setting Level 2
Technical Mode

C320 Temporary A.T. execution judgment deviation

Function

Executes temporary deviation at the start of A.T. execution, if the deviation is greater than the deviation set in this parameter.



Comment

Setting Range	Unit	Default
0.0 to 100.0	%full-scale	10.0

To execute temporary A.T. regardless of the deviation at the start of execution of A.T., set the "temporary A.T. execution judgment deviation" parameter to "0.0". Alternately, when temporary A.T. execution is not to be executed regardless of the deviation at the start of A.T. execution, set the "temporary A.T. execution judgment deviation" parameter to "100.0".

C321 Number of limit cycles

Function

Determines the number of limit cycles during A.T. execution.
In applications where external disturbance is being generated at all times, set the number of limit cycles to "2" to accurately calculate the characteristics of the control target.

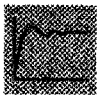
Comment

Setting Range	Unit	Default
1, 2	Times	1

C322 Bit length (communications)

C323 Parity (communications)

C324 Stop bit (communications)



Function

Sets the communication parameter for terminal communications.
Set the baud rate in the "baud rate (communications)" parameter.

Comment

Set the communication parameter by the codes in the tables below.

● Bit length (communications) parameter

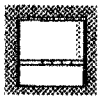
	Code	Description
Default	0	7
	1	8

● Parity (communications) parameter

	Code	Description
	0	None
Default	1	Even
	2	Odd

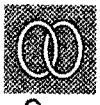
● Stop bit (communications) parameter

	Code	Description
	0	1
	1	1.5
Default	2	2



Model

Communications (RS-232C) (ES100X-□··□01□)
Communications (RS-422/485) (ES100X-□··□04□)



See

● Related parameter
"baud rate (communications)" (specification setting mode, setting level 2)

CHAPTER 5

Setting Level 1
Manual Mode

5.7 Manual MV Setting Mode

- The manual MV setting mode is enabled only in the manual mode.
- Each press of the A/M key alternately switches between the auto and manual modes. The MAN LED lights in the manual mode.
- Set the manipulated variable (MV) manually in the manual MV setting mode.
- To switch to setting level 1 from setting level 2, set DIP switch 1 to OFF.
- To switch between the modes in setting level 1, use the SET key.
- In the manual MV setting mode, the No.1 display indicates PV. The No.2 display indicates the manipulated variable (in position-proportional control systems, the valve opening position is displayed), and the MV LED flashes.


Comment

- Standard controller
  Each press of the ∧ key increments the manipulated variable by 0.1%, and each press of the ∨ decrements the manipulated variable by 0.1%. The manipulated variable can be set within the range –5.0 to 105.0 (%).
- Position-proportional controller
  If you press the ∧ key, control output 1 is set to output (OUT1 LED lights) so that the valve opens.
  If you press the ∨ key, control output 2 is set to output (OUT2 LED lights) so that the valve closes. The displayed value is the valve opening position, and is displayed within the range –10.0 to 110.0 (%).


See

● Related article
3.8 Adjusting Control Operation

5.8 Operation Mode

- The operation mode is for setting operating instruction parameters for control operation. The OPR LED lights in the operation mode.
- To switch to setting level 1 from setting level 2, set DIP switch 1 to OFF.
- To switch between the modes in setting level 1, use the SET key.
- The following table shows the parameters in the operation mode and the page where they are described.

Symbol	Parameter Name	Page
P006	Bank No.	5-52
P007	Setting mode	5-52
P008	SP mode	5-53
P010	MV tracking	5-53
P011	Cascade open	5-54
P012	Cascade OFF	5-54
P013	Feed-forward OFF	5-55
P014	Reset event standby sequence	5-55
P015	ON/OFF timer reset	5-56
P016	ON/OFF counter reset	5-56

Setting Level 1
Operation Mode

P006 Bank No.

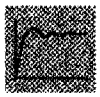

Function

Designates the bank No.


Comment

Setting Range	Unit	Default
0 to 7	None	0

P007 Setting mode


Function

Designates the parameter setting mode.
- Local: Enables the front panel keys.
- Remote: Enables serial communications.
- External: Enables BCD communications.


Comment

Set the setting mode by the codes in the table below.

	Code	Description
Default	0	Local
	1	Remote
	2	External

P008 SP mode

Function

Sets the SP to be used in the program.
- Local: Sets the local SP.
- Remote: Sets the remote SP.

Comment

Set the SP mode by the codes in the table below.

	Code	Description
Default	0	Local
	1	Remote

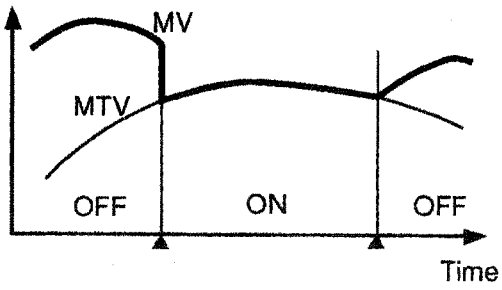
See

- Related parameters
  "local SP" (bank setting mode, setting level 1)
- Related article
  1.5 SP Mode

P010 MV tracking

Function

Designates whether or not to make the manipulated variable (MV) track the manipulated variable tracking value (MTV).



Comment

Set MV tracking by the codes in the table below.

	Code	Description
Default	0	MV tracking OFF
	1	MV tracking ON

Setting Level 1
Operation Mode

P011 Cascade open


Function

Designates whether cascade is open or closed.
Set the "cascade open" parameter to "open" when carrying out control by only the secondary loop control independent of the primary loop, for example, when adjusting the PID of the secondary loop during cascade control. Set to "closed" during normal operation.
This parameter is valid only during cascade control.

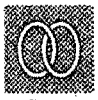

Comment

Set cascade open by the code in the table below.

	Code	Description
Default	0	Closed
	1	Open

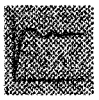

Model

2-input (ES100X-□W□-□)


See

- Related parameter
  "cascade/standard" (specification setting mode, setting level 2)
- Related article
  6.3 Cascade Control

P012 Cascade OFF

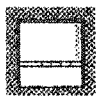

Function

Set the "cascade OFF" parameter to "OFF" when carrying out primary loop control independently (secondary loop is ignored) during cascade control.
This parameter is valid only during cascade control.

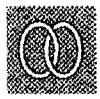

Comment

Set cascade OFF by the codes in the table below.

	Code	Description
Default	0	Cascade ON
	1	Cascade OFF


Model

2-input (ES100X-□W□-□)


See

- Related parameter
  "cascade/standard" (specification setting mode, setting level 2)
- Related article
  6.3 Cascade Control

P013 Feed-forward OFF

Function

Designates whether or not feed-forward control is disabled.

Comment

Set feed-forward OFF by the codes in the table below.

	Code	Description
Default	0	Feed-forward ON
	1	Feed-forward OFF

Reference

Default is "feed-forward ON." However, the feed-forward variable becomes 0% unless the feed-forward variable (FFV) is assigned by analog operation assignment. This means that feed-forward control does not function.

P014 Reset event standby sequence

Function

Resets the standby sequence for events incorporating a standby sequence when the "reset event standby sequence" parameter is set to "1". After this parameter is executed, the parameter setting returns to "0".

See

- Related parameter
  "standby sequence ON/OFF" (event setting mode, setting level 2)
- Related article
  3.5 Setting Events

Setting Level 1
Operation Mode

P015 ON/OFF timer reset


Function

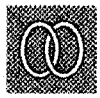
Resets a designated No. ON/OFF timer.


Comment

Set feed-forward OFF by the codes in the table below.

Setting Range	Unit	Default
0 to 4	None	0

When this parameter is set to "0", the ON/OFF timer reset function is disabled.


See

● Related article
4.1 ON/OFF Timer

P016 ON/OFF counter reset


Function

Resets a designated No. ON/OFF counter.


Comment

Setting Range	Unit	Default
0 to 12	None	0

When this parameter is set to "0", the ON/OFF counter reset function is disabled.

5.9 Tuning Mode

- The tuning mode is for setting the parameters for auto-tuning (A.T.) and fine tuning (F.T.)
  The TUNE LED lights in the tuning mode.
- To switch to setting level 1 from setting level 2, set DIP switch 1 to OFF.
- To switch between the modes in setting level 1, use the SET key.
- The following table shows the parameters in the tuning mode and the page where they are described.

Symbol	Parameter Name	Page
AT	A.T. execution	5-57
HUnt	Hunting inhibit required level	5-58
oS	Overshoot inhibit required level	5-58
SPEd	Response improvement required level	5-58
Ft	F.T. execution	5-58

AT A.T. execution

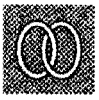
Function

This parameter executes the following:
- Saves the PID value resulting from auto-tuning to the designated PID set No. when auto-tuning is not being carried out.
- Cancels auto-tuning when auto-tuning is currently being executed.

Auto-tuning cannot be executed when cascade control is selected.

Comment

Setting Range	Unit	Default
1 to 8	None	1



See

● Related article
3.8 Adjusting Control Operation

Setting Level 1
Tuning Mode

HUnt Hunting inhibit required level

oS Overshoot inhibit required level

SPEd Response improvement required level


Function

These parameters set the required improvement level during execution of fine tuning. These parameters designate the following operations.

- "hunting inhibit required level" parameter
  Sets the required inhibit level for inhibiting hunting.
- "overshoot inhibit required level" parameter
  Sets the required inhibit level for inhibiting overshoot.
- "response improvement required level" parameter
  Sets the required improvement level when improving response.

Only two of the above parameters can be set simultaneously.


Comment

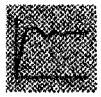
Setting Range	Unit	Default
0 to 5	None	0

A larger setting increases the required level. When this parameter is set to "0", the required level setting is invalid.

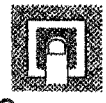

See

- Related parameter
  "F.T. execution"
- Related articles
  1.7 Fine Tuning
  3.8 Adjusting Control Operation

Ft F.T. execution

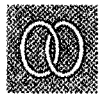

Function

Designates the PID set No. for which fine tuning (F.T.) is to be executed based on the hunting inhibit, overshoot inhibit and response improvement required levels.


Comment

Setting Range	Unit	Default
0 to 8	None	1

When this parameter is set to "0", the previous tuning operation is canceled.


See

- Related parameters
  "hunting inhibit required level" "overshoot inhibit required level" "response improvement required level"
- Related articles
  1.7 Fine Tuning
  3.8 Adjusting Control Operation

5.10 Bank Setting Mode

- The bank setting mode is for setting bank parameters.
  The BANK LED lights in the bank setting mode.

- To switch to setting level 1 from setting level 2, set DIP switch 1 to OFF.

- To switch between the modes in setting level 1, use the [SET] key.

- Up to eight banks can be set.
  Parameters are organized in tables as follows.

Bank Table ◀ ▶

Bank No.	0	1	···	7
Local SP				
Bank time				
PID set No.				
Events 1 to 10 setting				

▲ ▼

- Select the bank No. in the "bank No." parameter.
- To select bank Nos., use the [◀] or [▶] keys. To select bank parameters, use the [▲] or [▼] keys.

- The following table shows the parameters in the bank setting mode and the page where they are described.

CHAPTER 5

Symbol	Parameter Name	Page
LSP	Local SP	5-60
tim	Bank time	5-60
Pid	PID set No.	5-61
Ev 1 ~ Ev 10	Events 1 to 10 setting	5-61

Setting Level 1
Bank Setting Mode

LSP Local SP

Function

Sets the local SP for each bank.
This parameter is valid in the local SP mode.

Comment

Setting Range	Unit	Default
0 to 100%full-scale	U	0% FS

See

- Related parameters
  "SP mode" (operation mode, setting level 1)
- Related article
  3.6 Setting up Banks

tim Bank time

Function

Sets the bank time in either minutes:seconds or hours:minutes. Set the "program time unit" parameter before setting the "bank time" parameter.

Comment

Setting Range	Unit	Default
0.00 to 99.59	*1	0.00

*1 Set this unit in the "bank time unit."

See

- Related parameter
  "program time unit" (specification setting mode, setting level 2)
- Related article
  3.6 Setting up Banks

PID set No.

Function

Designates the PID set No. to be used in banks.

Comment

Setting Range	Unit	Default
0 to 8	None	0

When this parameter is set to "0", the PID set is automatically set.

See

- Related parameters
  "PID set selection data" "PID set selection hysteresis" (specification setting mode, setting level 2)
  All parameters in the PID set setting mode (setting level 1)
- Related article
  4.5 PID Switching

Event 1 setting / Event 2 setting / Event 3 setting / Event 4 setting / Event 5 setting / Event 6 setting / Event 7 setting / Event 8 setting / Event 9 setting / Event 10 setting

Function

Sets the value of events 1 to 10 for each bank.
The event setting of bank 0 is used in the stop status when running the abridged program.

Comment

Setting Range	Unit	Default
–200 to 200%full-scale	U or %	0

See

- Related parameters
  All parameters in the event setting mode (setting level 2)
- Related article
  3.5 Setting Events

Setting Level 1
PID Set Setting Mode

5.11 PID Control Parameter Mode

- The PID set setting mode is for setting the PID sets used in the bank parameters. The PID LED lights in the PID setting mode.

- To switch to setting level 1 from setting level 2, set DIP switch 1 to OFF.
- To switch between the modes in setting level 1, use the [SET] key.

- PID sets 1 to 8 can be set. The parameters for each PID set are organized in tables as shown below.

PID control table ◀ ▶

Table No.	1	2	···	8
P				
I				
D				
MV lower limit				
MV upper limit				
PV bias value				
Automatic selection range upper limit				

▲ ▼

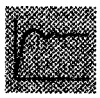
- The table No. corresponds to the PID set No. To select the table No., press the [◀] or [▶] keys. To select parameters, press the [▲] or [▼] keys. The table No. is displayed on the BANK display.

- The following table shows the parameters in the PID set setting mode and the page where they are described.

Symbol	Parameter Name	Page
P	P	5-63
I	I	5-63
d	D	5-63
nLL	MV lower limit	5-64
nLH	MV upper limit	5-64
PuS	PV bias value	5-64
AUt	Automatic selection range upper limit	5-64

Setting Level 1
PID Set Setting Mode

P



Function

Sets proportional band P.

Comment

Setting Range	Unit	Default
0.0 to 999.9	%full-scale	10.0

When this parameter is set to "0.0", ON/OFF control is selected.
In a position-proportional control system, this parameter cannot be set to "0.0".

I

Function

Sets integrated time I.

Comment

Setting Range	Unit	Default
0 to 9999	Seconds	240

When this parameter is set to "0", P control or PD control is selected.
In a position-proportional floating control system, this parameter cannot be set to "0".

CHAPTER 5

D

Function

Sets differential time D

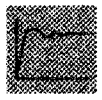
Comment

Setting Range	Unit	Default
0 to 9999	Seconds	40

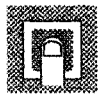
Setting Level 1
PID Set Setting Mode

MV lower limit

MV upper limit


Function

Sets the upper and lower limits of the manipulated variable (MV).
In a position-proportional floating control system, the manipulated variable limitter is not provided. So, this parameter is invalid.

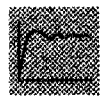

Comment

Parameter	Setting Range	Unit	Default
MV lower limit	–5.0 to MV upper limit –0.1	%	0.0
MV upper limit	MV lower limit +0.1 to 105.0	%	100.0


Note

The following manipulated variables (MV) are given priority over the manipulated variable limitter:
- Manual MV
- MV at stop
- MV at PV error

PV bias value

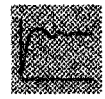

Function

The value set to this parameter is added to PV after analog operation assignment to calculate a new biased PV.

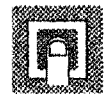

Comment

Setting Range	Unit	Default
–100 to 100%full-scale	U	0

Automatic selection upper range limit


Function

Sets the upper limit of the range within which the PID set No. is automatically set.
The automatic selection upper range limit of PID set 8 is fixed at 200% full-scale, and need not be set.
The settings of the "automatic selection upper range limit" parameter are applied to the "PID set selection data" parameter.


Comment

Setting Range	Unit	Default
–100 to 100%full-scale	U	0


See

- Related parameter
  "PID set selection data" (specification setting mode, setting level 2)
- Related article
  4.5 PID Switching

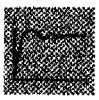
5.12 Adjustment Mode

- The adjustment mode is for settings parameters used for making adjustments, for example, during setup.
  The ADJ LED lights in the adjustment mode.
- To switch to setting level 1 from setting level 2, set DIP switch 1 to OFF.
- To switch between the modes in setting level 1, use the SET key.
- The following table shows the parameters in the adjustment mode and the page where they are described.

Symbol	Parameter Name	Page	Symbol	Parameter Name	Page
P 102	Control output 1 pulse cycle	5-65	P 112	SP setting lower limit	5-69
P 103	Control output 2 pulse cycle	5-65	P 113	SP setting upper limit	5-69
P 104	Fuzzy strength	5-66	P 114	SP rise rate limit	5-69
P 105	Cooling coefficient	5-66	P 115	SP fall rate limit	5-69
P 106	Heater burnout alarm setting	5-66	P 116	MV change rate limit	5-70
P 107	Position-proportional dead band	5-67	P 117	Secondary loop fixed SP	5-70
P 108	Switching output hysteresis	5-67	P 118	Secondary loop P	5-71
P 109	ON/OFF count alarm settings	5-68	P 119	Secondary loop I	5-71
P 110	ON/OFF control hysteresis	5-68	P 120	Secondary loop D	5-71
P 111	Manual reset	5-68	P 121	Secondary loop manual reset	5-71

P 102 Control output 1 pulse cycle

P 103 Control output 2 pulse cycle



Function

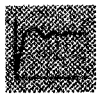
Sets the ON/OFF cycle when control outputs 1 or 2 are pulsed output such as relay, SSR or voltage.
Set these parameters taking the service life of the output unit and actuator into consideration.

Comment

Setting Range	Unit	Default
1 to 120	Seconds	20

Setting Level 1
Adjustment Mode

P 104 Fuzzy strength


Function

Sets the % of fuzzy strength.
Regardless of the set fuzzy strength, fuzzy logic control will not function during ON/OFF control ("P" parameter set to "0"), or when either the "I" or "D" parameters are set to "0".


Comment

Setting Range	Unit	Default
0.0 to 100.0	%	50.0

P 105 Cooling coefficient


Function

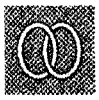
Sets the cooling coefficient at the cooling side, P, when heating-cooling control is selected. P for cooling control is calculated as follows:
Cooling control P = cooling coefficient × P
(In this case, P here is used for the heating side.)


Comment

Setting Range	Unit	Default
0.01 to 99.99	None	1.00


Model

Standard (ES100X-AAH□··□)


Link

● Related article
6.1 Heating/Cooling Control

P 106 Heater burnout alarm setting


Function

Sets the detection value at which the heat burnout alarm is generated.

Setting Level 1
Adjustment Mode

Comment

Setting Range	Unit	Default
0.0 to 50.0	A	0.0

When set to "0.0", the heater burnout detection function is disabled, and heater burnout alarm output is turned OFF. When set to "50.0", alarm output is turned ON unconditionally.

Model

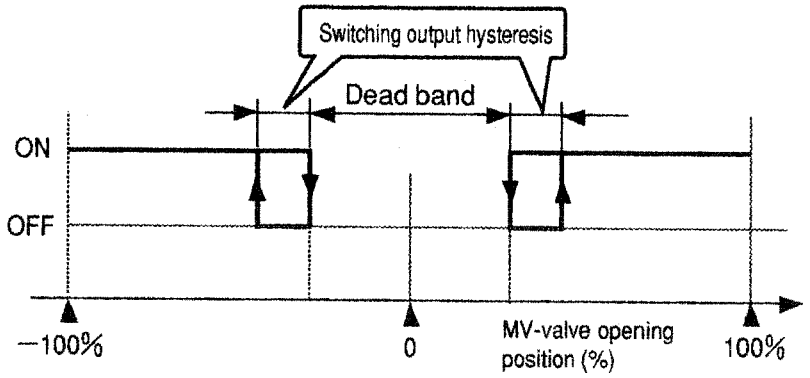
Standard (ES100X-AAH□··□)

P 107 Position-proportional dead band

P 108 Switching output hysteresis

Function

"position-proportional dead band" parameter
In a position-proportional control system, sets the manipulated variable for turning both the open side and closed output side outputs to OFF and the difference between the valve openings.
"switching output hysteresis" parameter
Sets the switching output hysteresis.



Comment

Parameter	Setting Range	Unit	Default
Position-proportional dead band	0.1 to 10.0	%	2.0
Switching output hysteresis	0.1 to 20.0	%	0.8

Model

Position-proportional (ES100X-RRP□··□)

See

● Related article
6.2 Position-proportional Control

Setting Level 1
Adjustment Mode

P 109 ON/OFF count alarm settings

Function

Sets control output 1 (for pulsed output such as relay, SSR and voltage) and the detection value at which the ON/OFF count alarm is generated.

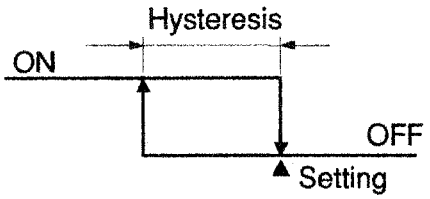
Comment

Setting Range	Unit	Default
0 to 9999	100 times	0

P 110 ON/OFF control hysteresis

Function

Sets the operation hysteresis during ON/OFF control.



Comment

Setting Range	Unit	Default
0.0 to 99.99	%full-scale	0.20

P 111 Manual reset

Function

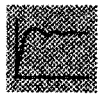
Sets the required manipulated variable to remove offset during P or PD control.

Comment

Setting Range	Unit	Default
0.0 to 100.0	%	50.0

P 1 12 SP setting lower limit

P 1 13 SP setting upper limit



Function

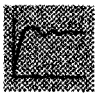
Sets the upper and lower limits when setting SP.

Comment

Parameter	Setting Range	Unit	Default
SP setting lower limit	0% full-scale to SP setting upper limit -1	U	0%FS
SP setting upper limit	SP setting lower limit +1 to 100% full-scale	U	100%FS

P 1 14 SP rise rate limit

P 1 15 SP fall rate limit



Function

Limits the rise and fall rate-of-change of SP.
At the start of operation or when the power is turned ON, the SP equals PV.
Set the "time unit of SP rate limits" parameter before setting these parameters.

Comment

Parameter	Setting Range	Unit	Default
SP rise rate limit	Width from scalling upper limit to scalling lower limit	*1	0
SP fall rate limit	Width from scalling upper limit to scalling lower limit	*1	0

*1 The unit is one of U/seconds, U/minutes or U/hours depending on the setting of the "time unit of SP rate limits" parameter.

When the "SP rise rate limit" parameter is set to "0.0", the rate-of-change limitter in the rise direction will not function.
When the "SP fall rate limit" parameter is set to "0.0", the rate-of-change limitter in the fall direction will not function.

See

● Related parameter
"time unit of SP rate limits" (specification setting mode, setting level 2)

Setting Level 1
Adjustment Mode

P116 MV change rate limit


Function

Sets the permissible rate-of-change per second when limiting the rate-of-change of the manipulated variable (MV).
The MV change rate limitter does not function in the manual mode, during A.T. execution, in an OF/OFF control system, when MV tracking is ON and when the controller is in stop status.


Comment

Setting Range	Unit	Default
0.0 to 100.0	%	50.0

When this parameter is set to "0.0", this parameter is invalid.

P117 Secondary loop fixed SP


Function

Sets the secondary loop fixed SP when carrying out secondary loop independent control during cascade control.


Comment

Setting Range	Unit	Default
0.0 to 100.0	%	0.0


Model

2-input (ES100X-□W□··□)

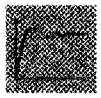

See

- Related parameter
  "cascade/standard" (specification setting mode, setting level 2)
- Related article
  6.3 Cascade Control

P118 Secondary loop P

P119 Secondary loop I

P120 Secondary loop D


Function

Sets the proportional band (P), integral time (I) and differential time (D) for the secondary loop during cascade control.


Comment

Parameter	Setting Range	Unit	Default
Secondary loop P	0.1 to 999.9	%	100.0
Secondary loop I	0 to 9999	Seconds	60
Secondary loop D	0 to 9999	Seconds	0

In a position-proportional floating control system, the setting range of the "secondary loop I" parameter becomes 1 to 9999.

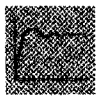

Model

2-input (ES100X-□W□··□)


See

- Related parameter
  "cascade/standard" (specification setting mode, setting level 2)
- Related article
  6.3 Cascade Control

P121 Secondary loop manual reset


Function

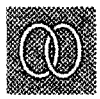
Sets the manual reset amount for secondary loop during cascade control.


Comment

Setting Range	Unit	Default
0.0 to 100.0	%	50.0


Model

2-input (ES100X-□W□··□)


See

- Related parameter
  "cascade/standard" (specification setting mode, setting level 2)
- Related article
  6.3 Cascade Control

Setting Level 1
Check Mode

5.13 Check Mode

- The check mode is for monitoring various data items.
  The CHECK LED lights in the check mode. In the check mode, parameters are not set; they are only monitored.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to OFF.
- To switch between the modes in setting level 1, use the SET key.
- The following table shows the parameters in the check mode and the page where they are described.

Symbol	Parameter Name	Page	Symbol	Parameter Name	Page
P201	Heater current monitor	5-72	P212 ~ P223	ON/OFF counters 1 to 12 monitors	5-75
P202	Analog input 1 type monitor	5-73			
P203	Analog input 2 type monitor	5-73			
P204	PF1 key type monitor	5-74	P224	2-PID/2-PID + fuzzy logic monitor	5-75
P205	PF2 key type monitor	5-74	P225	Potentiometer input monitor	5-76
P207	PID set No. monitor	5-74	P226	Heating-cooling/standard monitor	5-76
P208 ~ P211	ON/OFF timers 1 to 4 monitors	5-74	P227	Cascade/standard monitor	5-76
			P228	BCD communications/digital I/O monitor	5-77
			P229	Contorol operation cycle monitor	5-77
			P230	ROM version No. monitor	5-77

P201 Heater current monitor

Function

Monitors the value of heater current input (CT).

Comment

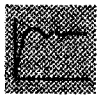
Range	Unit
0.0 to 55.0	A

When the current exceeds 55.0 A, 55.0 and - - - - are displayed alternately.

Model

Standard (ES100X-AAH□··□)

P202 Analog input 1 type monitor



Function

Monitors the type of analog input 1.

Comment

The monitor item is displayed using the same code as designated in the "analog input 1 type" parameter. For details, see page 5-4.

See

● Related parameter
"analog input 1 type" (specification setting mode, setting level 2)

P203 Analog input 2 type monitor

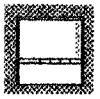
Function

Monitors the type of analog input 2.

Comment

The monitor item is displayed using the codes in the table below.

Code	Description
0	4 to 20 mA
1	1 to 5 V



Model

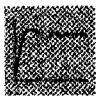
2-input (ES100X-□W□-□)

CHAPTER 5

Setting Level 1
Check Mode

P204 PF1 key type monitor

P205 PF2 key type monitor


Function

Monitors the type of the PF keys.

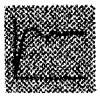

Comment

The monitor item is displayed using the same code as designated in the "PF1 key type" and "PF2 key type" parameters. For details, see page 5-7.


See

● Related parameter
"PF1 key type" "PF2 key type" (specification setting mode, setting level 2)

P207 PID set No. monitor


Function

Monitors the PID set No. currently in use.


Comment

Range	Unit
1 to 8	None

P208 ON/OFF timer 1 monitor

P209 ON/OFF timer 2 monitor

P210 ON/OFF timer 3 monitor

P211 ON/OFF timer 4 monitor


Function

Monitors the time that the ON/OFF timers have operated.


Comment

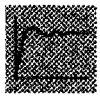
Range	Unit
0 to 9999	*1

*1 Designate the unit in the "time unit" parameter.


See

● Related parameter
"time unit" (ON/OFF timer setting mode, setting level 2)

P212	ON/OFF counter 1 monitor	P218	ON/OFF counter 7 monitor
P213	ON/OFF counter 2 monitor	P219	ON/OFF counter 8 monitor
P214	ON/OFF counter 3 monitor	P220	ON/OFF counter 9 monitor
P215	ON/OFF counter 4 monitor	P221	ON/OFF counter 10 monitor
P216	ON/OFF counter 5 monitor	P222	ON/OFF counter 11 monitor
P217	ON/OFF counter 6 monitort	P223	ON/OFF counter 12 monitor



Function

Monitors the ON/OFF count of the counters. The correspondence between the counters and outputs is as follows:

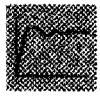
Counter 1: Control output 1
Counter 2: Control output 2
Counters 3 to 12: Digital outputs 1 to 10

Comment

Range	Unit
0 to 9999	100 times

CHAPTER 5

P224 2-PID/2-PID + fuzzy logic monitor



Function

Monitors the currently selected control system , 2-PID or 2-PID + fuzzy logic control.

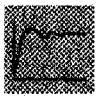
Comment

The monitor item is displayed using the codes in the table below.

Code	Description
0	2-PID + fuzzy
1	2-PID

Setting Level 1
Check Mode

P225 Potentiometer input monitor



Function

Monitors the currently selected potentiometer input, closed or floating, in position-proportional control.

Comment

The monitor item is displayed using the codes in the table below.

Code	Description
0	Floating
1	Closed

Model

Position-proportional (ES100X-RRP□··□)

P226 Heating-cooling/standard monitor

Function

Monitors the currently selected control system, heating-cooling or standard.

Comment

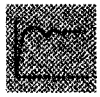
The monitor item is displayed using the codes in the table below.

Code	Description
0	Standard
1	Heating-cooling

Model

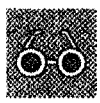
Standard (ES100X-AA□··□)

P227 Cascade/standard monitor



Function

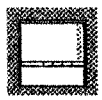
Monitors the currently selected control system, cascade or standard.



Comment

The monitor item is displayed using the codes in the table below.

Code	Description
0	Standard
1	Cascade



Model

2-input (ES100X-□W□··□)

P228 BCD communications/digital I/O monitor

Function

Monitors the status of the expanded I/O connectors.

Comment

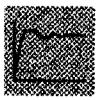
The monitor item is displayed using the codes in the table below.

Code	Description
0	Digital I/O
1	BCD communications

Model

Expanded I/O connector (ES100X-□··□E)

P229 Control operation cycle monitor



Function

Monitors the cycle in which the manipulated variable is updated.
This monitor is matched with the control operation cycle (analog assignment execution cycle).

Comment

The monitor item is displayed using the codes in the table below.

Range	Unit
0 to 10	0.1 seconds

P230 ROM version No. monitor

Function

Monitors the ROM version No.

5.14 Setting Level 1 Technical Mode

- The setting level 1 technical mode is used for designating parameters to be used for analog operation.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to OFF. At switch SW2, set SW2-1 only to ON.
- To switch between the modes in setting level 1, use the SET key.
- The following table shows the parameters in the technical mode (level 1) and the page where they are described.

Symbol	Parameter Name	Page
P301 ~ P332	Analog operation parameters 1 to 32	5-79
P333 ~ P348	Straight-line approximation 1 to 4	5-80
P349 ~ P388	Broken-line approximation 1, 2	5-81

Setting Level 1
Technical Mode

P301	Analog operation parameter 1	P317	Analog operation parameter 17
P302	Analog operation parameter 2	P318	Analog operation parameter 18
P303	Analog operation parameter 3	P319	Analog operation parameter 19
P304	Analog operation parameter 4	P320	Analog operation parameter 20
P305	Analog operation parameter 5	P321	Analog operation parameter 21
P306	Analog operation parameter 6	P322	Analog operation parameter 22
P307	Analog operation parameter 7	P323	Analog operation parameter 23
P308	Analog operation parameter 8	P324	Analog operation parameter 24
P309	Analog operation parameter 9	P325	Analog operation parameter 25
P310	Analog operation parameter 10	P326	Analog operation parameter 26
P311	Analog operation parameter 11	P327	Analog operation parameter 27
P312	Analog operation parameter 12	P328	Analog operation parameter 28
P313	Analog operation parameter 13	P329	Analog operation parameter 29
P314	Analog operation parameter 14	P330	Analog operation parameter 30
P315	Analog operation parameter 15	P331	Analog operation parameter 31
P316	Analog operation parameter 16	P332	Analog operation parameter 32

Function

These are used as arguments in analog operations.
The "analog operation parameter 31" parameter is used as the manipulated variable at stop, and the "analog operation parameter 32" parameter is used as the dead band during heating-cooling control.

Comment

Setting Range	Unit	Default
–1.999 to 9.999	None	0.0

See

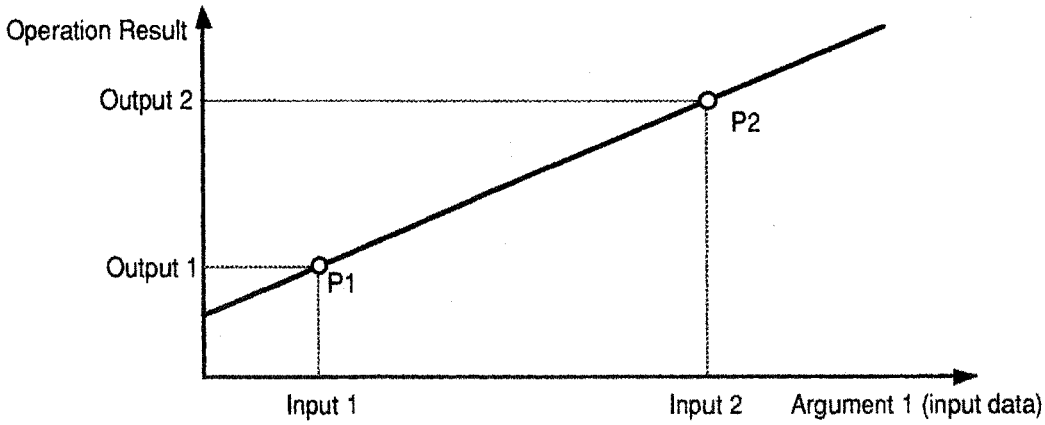
● Related article
6.1 Heating/Cooling Control

Setting Level 1
Technical Mode

P333	Straight-line approximation 1, input 1	P341	Straight-line approximation 3, input 1
P334	Straight-line approximation 1, input 2	P342	Straight-line approximation 3, input 2
P335	Straight-line approximation 1, output 1	P343	Straight-line approximation 3, output 1
P336	Straight-line approximation 1, output 2	P344	Straight-line approximation 3, output 2
P337	Straight-line approximation 2, input 1	P345	Straight-line approximation 4, input 1
P338	Straight-line approximation 2, input 2	P346	Straight-line approximation 4, input 2
P339	Straight-line approximation 2, output 1	P347	Straight-line approximation 4, output 1
P340	Straight-line approximation 2, output 2	P348	Straight-line approximation 4, output 2

Function

Sets the points defining the characteristics of straight-line approximation in analog operation.
Set the two input points 1 and 2 in "straight-line approximation 1 to 4" parameters.
If input point 1 is ≥ input point 2, the settings are invalid, and this will result in a straight-line approximation where input data equals output data.



Comment

Setting Range	Unit	Default
–1.999 to 9.999	None	0.0

See

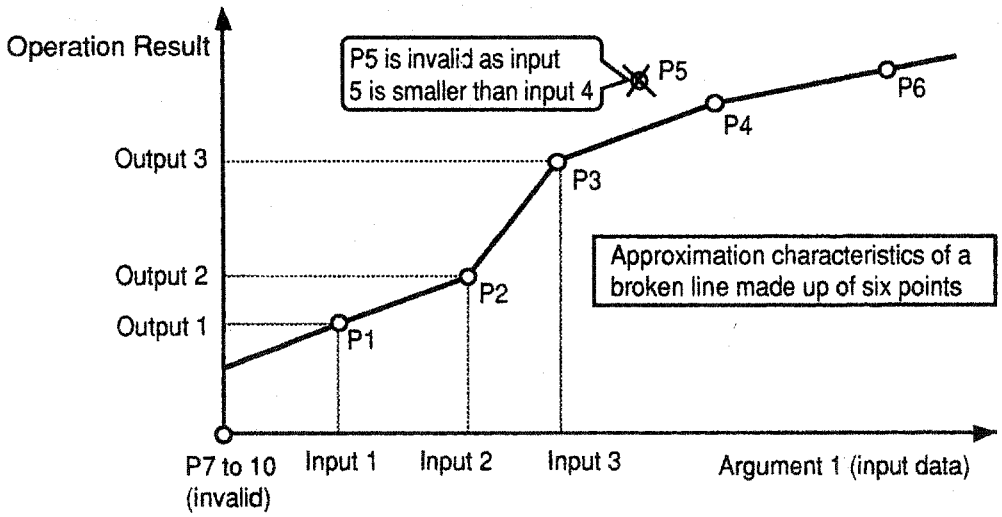
- Related parameter
  "operation" (analog operation assignment setting mode, setting level 2)
- Related article
  4.3 Analog Operation Assignments

P349	Broken-line approximation 1, input 1	P369	Broken-line approximation 2, input 1
P350	Broken-line approximation 1, input 2	P370	Broken-line approximation 2, input 2
P351	Broken-line approximation 1, input 3	P371	Broken-line approximation 2, input 3
P352	Broken-line approximation 1, input 4	P372	Broken-line approximation 2, input 4
P353	Broken-line approximation 1, input 5	P373	Broken-line approximation 2, input 5
P354	Broken-line approximation 1, input 6	P374	Broken-line approximation 2, input 6
P355	Broken-line approximation 1, input 7	P375	Broken-line approximation 2, input 7
P356	Broken-line approximation 1, input 8	P376	Broken-line approximation 2, input 8
P357	Broken-line approximation 1, input 9	P377	Broken-line approximation 2, input 9
P358	Broken-line approximation 1, input 10	P378	Broken-line approximation 2, input 10
P359	Broken-line approximation 1, output 1	P379	Broken-line approximation 2, output 1
P360	Broken-line approximation 1, output 2	P380	Broken-line approximation 2, output 2
P361	Broken-line approximation 1, output 3	P381	Broken-line approximation 2, output 3
P362	Broken-line approximation 1, output 4	P382	Broken-line approximation 2, output 4
P363	Broken-line approximation 1, output 5	P383	Broken-line approximation 2, output 5
P364	Broken-line approximation 1, output 6	P384	Broken-line approximation 2, output 6
P365	Broken-line approximation 1, output 7	P385	Broken-line approximation 2, output 7
P366	Broken-line approximation 1, output 8	P386	Broken-line approximation 2, output 8
P367	Broken-line approximation 1, output 9	P387	Broken-line approximation 2, output 9
P368	Broken-line approximation 1, output 10	P388	Broken-line approximation 2, output 10

Function

Sets the points defining the characteristics of broken-line approximation in analog operation.
Up to ten points can be designated for broken-line approximations 1 and 2.
If input point n is ≥ input point n + 1, the point n + 1 becomes invalid.

Setting Level 1
Technical Mode



Comment

Setting Range	Unit	Default
–1.999 to 9.999	None	0.0

See

● Related parameter
"operation" (analog operation assignment setting mode, setting level 2)

CHAPTER 6
TYPICAL EXAMPLES

6.1 Heating/Cooling Control

■ Key points in heating/cooling control

● Designating heating/cooling control

A standard ES100X (model ES100X-AA H□··□) can be used as a controller for heating-cooling control if you set the "heating-cooling/standard" parameter to "heating-cooling." Mount the output unit for heating at control output 1, and the output unit for cooling at control output 2.

● Setting the output characteristics

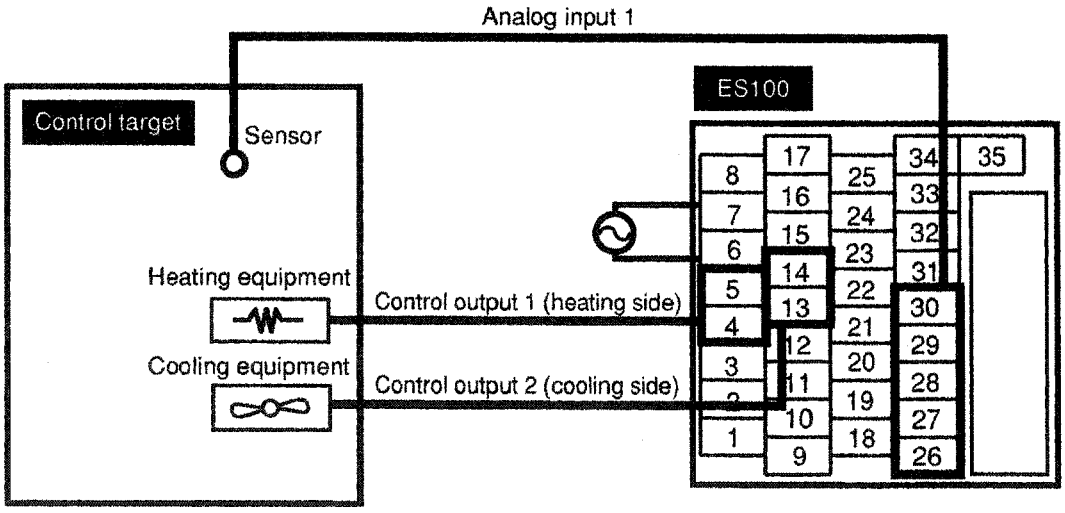
Set the dead band or overlap band and the manipulated variable (MV) at stop in the "analog operation parameters."

● Tuning

Auto-tuning or fine tuning can be used for tuning the ES100X.
If the cooling and heating characteristics of the control target differ considerably, and satisfactory control characteristics cannot be obtained using the same PID control parameter settings, then adjust the control sensitivity balance at the heating and cooling sides in the "cooling coefficient" parameter.

■ Connection example

The following diagram shows an example of a basic connection for heating/cooling control.

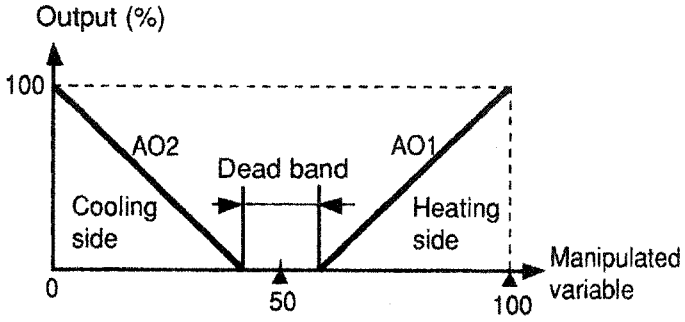


- Wire the analog input to suit the analog input type.
- Use control output 1 for the heating side, and control output 2 for the cooling side. Choose the type of output unit matched to how the ES100X is to be applied.
- Connect other terminals matched to how the ES100X is to be applied.

■ Designating heating/cooling control

When carrying out heating/cooling control, the "heating-cooling/standard" parameter must be set to "1" (heating-cooling) (specification setting mode, setting level 2).
As execution of this parameter sets the output characteristics for heating-cooling control, the area in the analog operation assignment table where analog output 1 (control output 1) and analog output 2 (control output 2) are set as assignment destinations is changed.

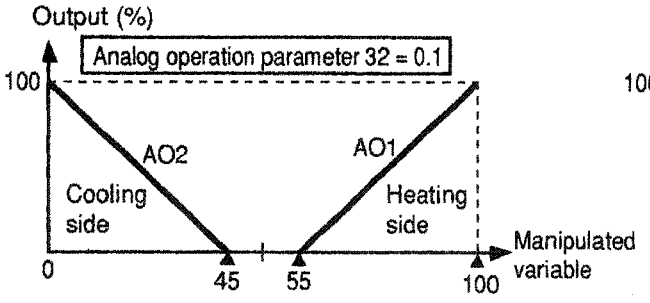
The following diagram shows the output characteristics during heating-cooling control on the ES100X.

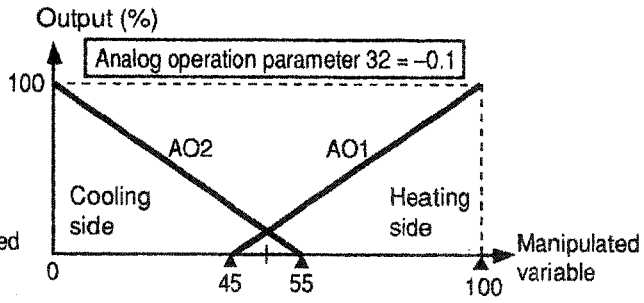


■ Dead band

Set the dead band or overlap band, if required, in the "analog operation parameter 32" (technical mode, setting level 1).
Use normalized data as the settings. For example, designate a setting of "0.05" for a 5% value. Setting a plus value to "analog operation parameter 32" produces a dead band, whole setting a minus value produces an overlap band.

The figure on the left below shows the dead band produced when setting the "analog operation parameter 32" to "0.1". The figure on the right shows the overlap band produced when setting the "analog operation parameter 32" to "–0.1".





About DIP switch settings

In a heating-cooling control system, the parameters in the technical mode (level 1) are used, so set DIP switch SW2-1 to ON.
For details, see 2-2 Setting Switches (page 2-4).

■ Manipulated variable at stop

Set the manipulated variable (MV) at stop in "analog operation parameter 31."

In a heating-cooling control system that does not incorporate a dead band or overlap band, the control output is 0 when the manipulated variable is 50%. If you set the "heating-cooling/standard" parameter to "1" (heating-cooling) so that the control output at stop is 0 (zero), "analog operation parameter 31" is changed to "0.500" (manipulated variable 50%).

To set output during "stop", set the corresponding manipulated variable in "analog operation parameter 31" using normalized data as the setting.

■ Adjustment

Adjust PID by executing auto-tuning and fine tuning.

Adjust the control sensitivity balance at the heating and cooling sides in the "cooling coefficient" parameter (adjustment mode, setting level 1). Cooling control P can be changed at a fixed rate with respect to the heating control side.

Cooling control P = Cooling coefficient × heating control P

■ Parameter list

The following table lists the parameters relating to heating-cooling control. All these parameters are set in setting level 1, except for the "heating-cooling/standard" parameter which is set in setting level 2.

Parameter		Setting	Application
C03 1	Heating-cooling/ standard	1: Heating/ cooling	For designation of heating/cooling control
P332	Analog operation parameter 32	–1.999 to 9.999	Dead band
P331	Analog operation parameter 31	–1.999 to 9.999	MV at stop
P 105	Cooling coefficient	0.01 to 99.99	

About changing operation assignments

Control output functions are already set to the operation assignment table in addition to output characteristics.
These settings, however, can be changed, so pay attention when setting operation assignments.

6.2 Position-proportional Control

■ Key points in position-proportional control

● Designating position-proportional control

Use the position-proportional ES100X (model: ES100X-RRP□-□).

● Switching between closed and floating

Designate closed control or floating control in the "potentiometer input" parameter matched to how the ES100X is to be applied.

● Measuring the valve opening

In a position-proportional closed control system, both the valve opening and travel time are measured if you execute the "motor calibration execution" parameter.

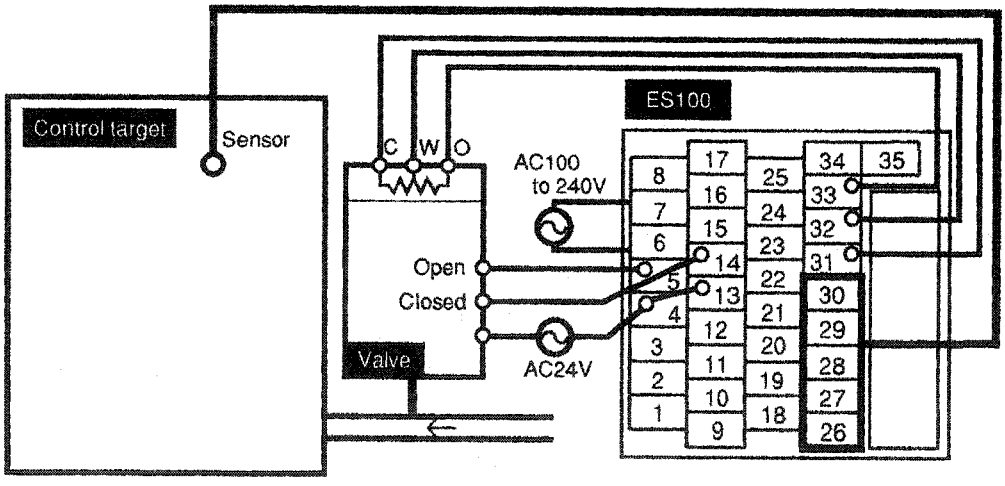
In a position-proportional floating control system, motor calibration need not be carried out, however, set the time from valve fully open to valve fully closed in the "travel time" parameter.

● Tuning

Tune the position-proportional ES100X by executing auto-tuning and fine tuning.

■ Connection example

The following diagram shows an example of a basic connection for position-proportional control.



- Wire the analog inputs to suit the analog input type.
- A relay output unit is already mounted in position-proportional ES100X (model: ES100X-RRP□-□) before shipment from the factory.
- In a position-proportional floating control system, a potentiometer need not be connected unless you are monitoring valve opening.
- Connect other terminals depending on how the ES100X is to be applied.

■ Designating position-proportional control

Position-proportional control is designated according to which model of the ES100X you are using. Always use a position-proportional ES100X (model: ES100X-RRP□··□).

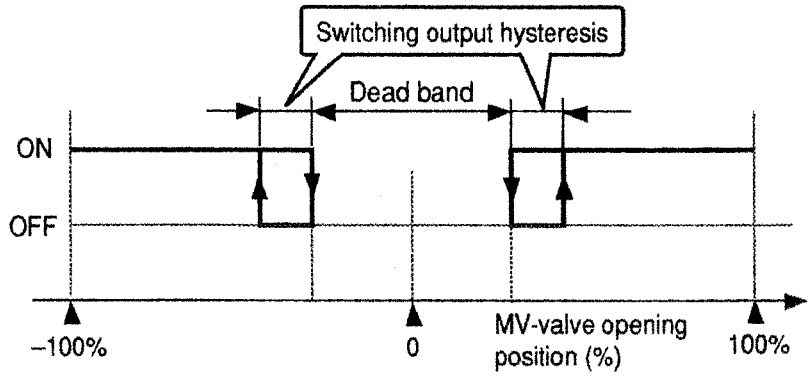
Select closed control or floating control in the "potentiometer input" parameter (specification setting mode, setting level 2).

■ Operation at error

In order to designate the valve status when a PV error has occurred, set the desired setting in the "MV at PV error" parameter (specification setting mode, setting level 2).
Designate one of "–1" (fully closed), "0" (held) or "1" (fully open).
The setting of the "MV at PV error" parameter is also applied when a potentiometer error occurs.

■ Dead band and hysteresis

When a non-sensitive band (dead band) and hysteresis is required during open/closed switching of the valve, set the desired setting to the "position-proportional dead band" and "switching output hysteresis" parameters (adjustment mode, setting level 1), respectively.
The following figure illustrates the relationship between valve opening and dead band, and hysteresis.



■ Motor calibration

When a potentiometer is connected to the ES100X, for example, in a floating control system in which the valve opeing is monitored and a closed control system, execute the "motor calibration" parameter.
The travel time, the time from valve fully open to valve fully closed, also is measured at the same time, so the "travel time" parameter need not be set.

In a floating control system that does not incorporate a potentiometer, motor calibration is not executed. So, the travel time from valve fully open to valve fully closed must be set in the "travel time" parameter.

About the manipulated variable limitter

In a position-proportional floating control system, the "MV lower limit" and "MV upper limit" parameters are invalid. So, set a hardware limitter at the valve if required.

■ Valve opening monitor

On position-proportional ES100X, the "PV/valve opening position" is already set to a PF key as a monitor item. So, the valve opening can be monitored on the bar graph if a potentiometer is connected to the controller. However, note that motor calibration must be executed in order to monitor the valve monitor.

■ Parameter list

The following table lists the parameters relating to position-proportional control.

Parameter	Setting
C032 Potentiometer input	0: Not used (floating)/ 1: Used (closed)
C036 MV at PV error (position-proportional)	–1: Fully closed/0: Hold/ 1: Fully open
C051 Motor calibration execution	None
C052 Travel time	1 to 999 (seconds)
P107 Position-proportional dead band	0.1 to 10.0 (%)
P108 Switching output hysteresis	0.1 to 20.0 (%)

6.3 Cascade Control

■ Key points in cascade control

● Designating cascade control

2-input ES100X (model: (ES100X-□W□··□) can be used as a controller for cascade control if you set the "cascade/standard" parameter to "cascade." Analog input 2 is set as input for the secondary loop.

● Cascade connection

The manipulated variable (MV) of the primary loop is transferred internally by the ES100X as the SP for the secondary loop. So wiring between both loops is not required.

● Secondary loop control method

This control assumes that a high-response system is in operation. This is set to PI control.

● Adjusting secondary loop PID

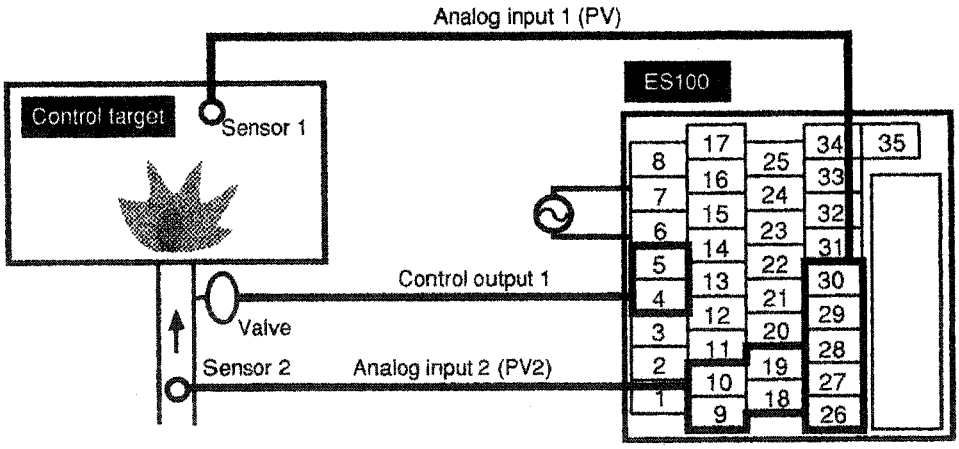
Independently operate the secondary loop of the ES100X by executing the "cascade open" parameter to calculate the optimum PID characteristics.

● Tuning

Auto-tuning cannot be used for cascade control. Fine tuning is used.

■ Connection example

The following diagram shows an example of a basic connection for cascade control.

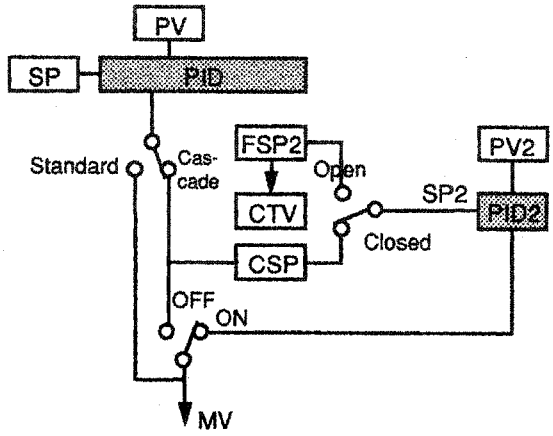


- Set analog input 1 as the primary loop PV, and analog input 2 as the secondary loop PV (PV2).
- Select the control output and type of output unit matched to how the ES100X is to be applied.
- Connect other terminals depending on how the ES100X is to be applied.

■ Designating cascade control

When carrying out cascade control, set the "cascade/standard" parameter to "1" (cascade) (specification setting mode, setting level 2). Executing this parameter allows the ES100X to operate as a controller with built-in secondary loop PID.

Cascade control parameters are already assigned to the analog operation assignment table before shipment from the factory. The secondary loop circuit is configured as follows.



In a cascade control system, set the "cascade OFF" parameter to "1" (cascade OFF) (operation mode, setting level 1) when temporarily carrying out primary loop operations. The "cascade OFF" parameter is valid only during cascade control.

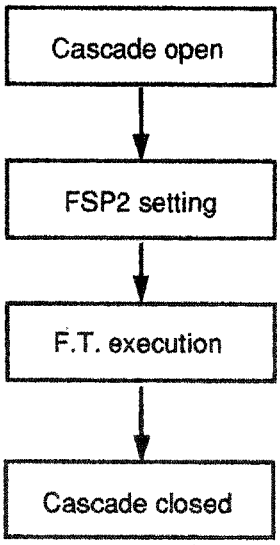
Either of secondary loop fixed SP (FSP2) or cascade SP (CSP) can be selected for the secondary loop SP (SP2).

Analog input 2 is secondary loop PV (PV2).

The primary loop tracking value (CTV) is the primary loop manipulated variable default when primary loop PID operation is started.

■ Adjusting secondary loop

In a cascade control system, the PID of the secondary loop must be calculated. Follow the procedure below to carry this out.



(1) Set the "cascade open" parameter to "1" (open) (operation mode, setting level 1).

(2) Set the value in the vicinity of expected PV2 when it would be stable to the "secondary loop fixed SP" parameter (adjustment mode, setting level 1) as the secondary loop fixed SP.

(3) Execute fine tuning while monitoring external disturbance response and the response when SP is changed.

(4) Set the "cascade open" parameter to "0" (closed) (operation mode, setting level 1).

About A.T. and F.T.

In a cascade control system, auto-tuning cannot be executed. Fine tuning can be executed, however, it must be executed for both the primary and secondary loops. Also, the PID set No. at execution of fine tuning on the secondary loop is meaningless.

■ Adjustment

Execute fine tuning to adjust PID. Auto-tuning cannot be executed.

To cancel cascade control, set the "cascade OFF" parameter to "1" (OFF) (operation mode, setting level 1). To resume cascade control, set this parameter to "0" (ON).

■ Parameter list

The following table lists the parameters relating to cascade control. All these parameters are set in setting level 1, except for the "cascade/standard" parameter which is set in setting level 2.

Parameter		Setting	Application
C029	Secondary loop direct/ reverse action	0: Reverse action/ 1: Direct action	Secondary loop control operation
C033	Cascade/standard	1: Cascade	Cascade control designation
P011	Cascade open	0: Closed/1: Open	Secondary loop PID adjustment
P012	Cascade OFF	0: ON/1:OFF	Primary loop independent control
P117	Secondary loop fixed SP	0.0 to 100.0 (%)	Secondary loop PID adjustment
P118	Secondary loop P	0.1 to 999.9 (%)	Secondary loop PID adjustment
P119	Secondary loop I	0 to 9999 (seconds)	Secondary loop PID adjustment
P120	Secondary loop D	0 to 9999 (seconds)	Secondary loop PID adjustment
P121	Secondary loop manual reset	0.0 to 100.0 (%)	Offset value

6.4 Ratio Control

■ Key points in ratio control

● Basic concept of ratio control

On a 2-input ES100X (model: ES100X-□W□··□), control is carried out in such a way that analog input 1 is maintained at a fixed ratio to analog input 2.

● Remote SP

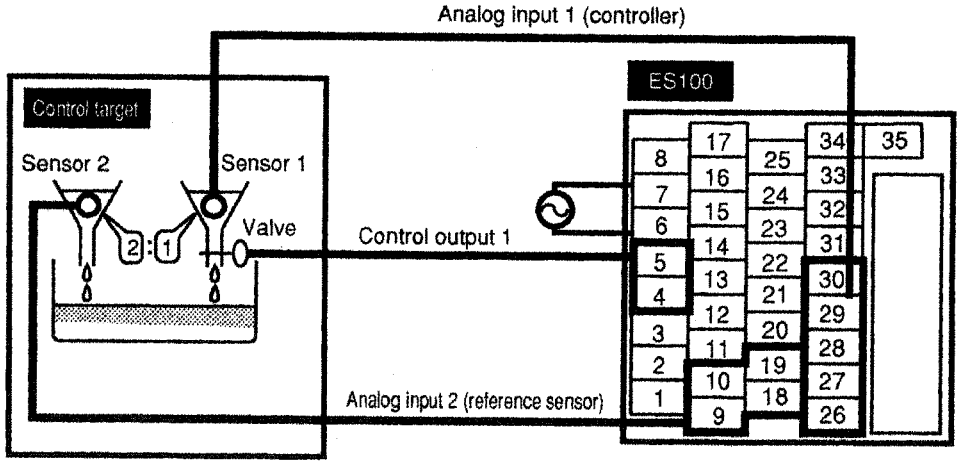
The remote SP held at a fixed ratio to analog input 2 is used as the SP. The analog operation table to which RSP is set as the assignment destination is changed as the remote SP.
Set the SP mode to remote SP.

● Tuning

Tune the ratio controller by executing auto-tuning and fine tuning.

■ Connection example

The following diagram shows an example of a basic connection for ratio control.



- Connect analog input 1 to the PV, and analog input 2 to the remote SP.
- Select the control output and type of output unit matched to how the ES100X is to be applied.
- Connect other terminals depending on how the ES100X is to be applied.

About DIP switches

In a ratio control system, the parameters in the technical mode (level 1) are used, so set DIP switch SW2-1 to ON.
For details, see 2-2 Setting Switches (page 2-4).

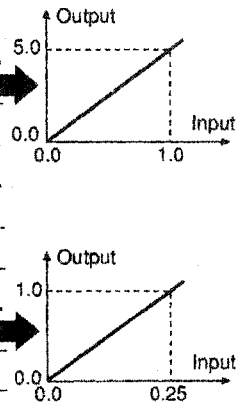
■ Achieving ratio control

Ratio control is achieved by the analog operation assignment function. The target control ratio is applied to analog input 2, and the result is taken as SP. Consequently, control is carried out in such as way that analog input 1 is maintained at a fixed ratio to analog input 2.

■ RSP assignments

Table No.		6
Assignment destination		RSP
1	Operation 1	SCL1
	Argument 1	AI2
	Argument 2	—
2	Operation 2	MUL
	Argument 1	N1
	Argument 2	AP1
3	Operation 3	SCL2
	Argument 1	N2
	Argument 2	—
4	Operation 4	END
	Argument 1	—
	Argument 2	—

AP1=0.050



Analog operation assignment table 6 (assignment destination "RSP") is assigned as follows. In the example on the left, control is carried out so that AI1 becomes 5% of AI2 (0 to 5000 liter).

Operation 1: "SCL1"

First of all, in order to match AI1 to the unit convert AI2 to the engineering unit from the normalized data by utilizing straight-line approximation.

Set the approximation characteristics in the "straight-line approximation 1" parameter. In the example, 0 to 100 (%) is converted to 0 to 5000 liter.

Operation 2: "MUL"

The fixed ratio is applied to the result of operation 1. The setting of the "analog operation 1" parameter is used as the ratio.

The example shows 5/100 (AI1 set to "0 to 250" liter). So, set "0.050" to the "analog operation 1" parameter.

Operation 3: "SCL2"

The engineering data is returned to normalized data by straight-line approximation of result of operation 2.

■ As remote SP is used, set the "SP mode" parameter to "1" (remote).

■ Adjustment

Adjust PID by executing auto-tuning and fine tuning.

To change the ratio, change "analog assignment parameter 1".

About normalized data

In operation assignments, set all values as normalized data. For example, set the value as "0.200" when the setting is "20 (%)."

■ Parameter list

The following table lists the parameters relating to ratio control. All these parameters are set in setting level 1, except for analog operation assignment setting mode parameters which are set in setting level 2.

Parameter	Setting	Application
A0□0 Operations 1 to 4 □: 1 to 4	*1	Ratio control operation
A0□1 Operations 1 to 4, argument 1 □: 1 to 4	*1	Ratio control operation
A0□2 Operations 1 to 4, argument 2 □: 1 to 4	*1	Ratio control operation
P008 SP mode	1: Remote	Remote SP used
P301 Analog operation parameter 1	–1.999 to 9.999	Control ratio
P333 to P336 Straight-line approximation 1	–1.999 to 9.999	Scaling
P337 to P340 Straight-line approximation 2	–1.999 to 9.999	Inverse scaling

*1 For details on the parameter settings, see the analog operation assignment (operations) and the analog operation assignment (arguments) tables.

6.5 Feed-forward Control

■ Key points in feed-forward control

● Basic concept of feed-forward control

On a 2-input ES100X (model: ES100X-□W□-□), the feed-forward variable (FFV) is calculated from analog input 2 in order to adjust the manipulated variable.

● Feed-forward variable (FFV)

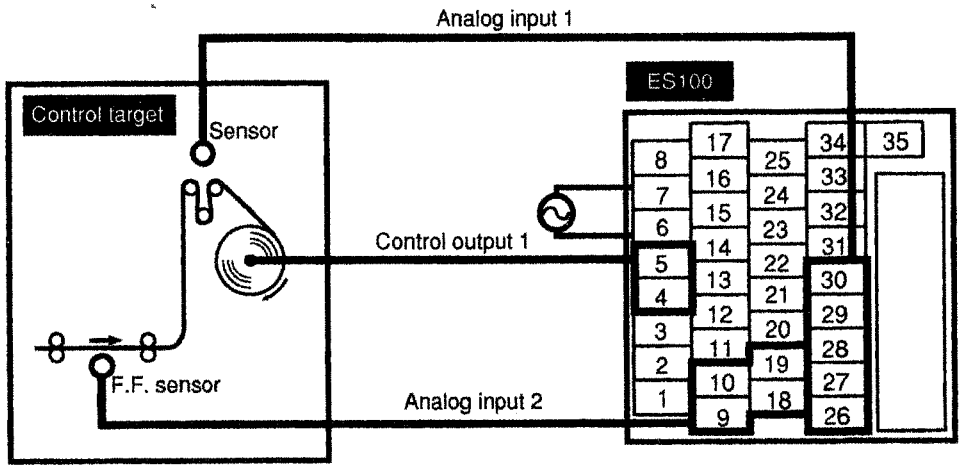
The feed-forward variable is calculated as the result of analog operation on analog input 2. The calculated feed-forward variable acts directly on the manipulated variable.

● Tuning

Tune the Feed-forward controller by executing auto-tuning and fine tuning.

■ Connection example

The following diagram shows an example of a basic connection for feed-forward control.



- Connect analog input 2 to the feed-forward sensor.
- Select the control output and type of output unit matched to how the ES100X is to be applied.
- Connect other terminals matched to how the ES100X is to be applied.

About DIP switches

In a feed-forward control system, the parameters in the technical mode (level 1) are used, so set DIP switch SW2-1 to ON.
For details, see 2-2 Setting Switches (page 2-4).

■ Achieving feed-forward control

Feed-forward control is achieved by the analog operation assignment function. The feed-forward variable (FFV) is calculated by analog operation based on the value of analog input 2.
Accordingly, in a feed-forward control system, it is assumed that the characteristics of the control system can be ascertained up to a level where analog operations can be assigned.

■ FFV assignments

Table No.		6
Assignment Destination		FFV
1	Operation 1	SCL1
	Argument 1	AI2
	Argument 2	—
2	Operation 2	FNC1
	Argument 1	N1
	Argument 2	—
3	Operation 3	END
	Argument 1	—
	Argument 2	—

Assign the following to the analog operation assignment table.

Assignment destination: "FFV"

Operation 1: "SCL1"
Convert AI2 to the engineering unit by applying straight-line approximation. Set the approximation characteristics in the "straight-line approximation 1" parameter.

Operations 2: "FNC1"
Assign the operation so that the feed-forward variable is calculated based on analog input 2. In the example on the left, the feed-forward variable is calculated using broken-line approximation.

■ Adjustment

Adjust PID by executing auto-tuning and fine tuning.

Monitor the control state, and adjust the content of operation assignments (for example, broken-line approximation characteristics).

To cancel feed-forward control, set the "feed-forward OFF" parameter to "1" (OFF) (operation mode, setting level 1). To resume feed-forward control, set this parameter to "0" (ON).

About normalized data

In operation assignments, set all values as normalized data. For example, set the value as "0.200" when the setting is "20 (%)".

■ Parameter list

The following table lists the parameters relating to feed-forward control. All these parameters are set in setting level 1, except for analog operation assignment setting mode parameters which are set in setting level 2.

Parameters	Setting	Application
A000 Assignment Destination		
A0□0 Operation 1 to n □: 1 to n	*1	FFV operation
A0□1 Operation 1 to n, argument 1 □: 1 to n	*1	FFV operation
A0□2 Operation 1 to n, argument 2 □: 1 to n	*1	FFV operation
P333 to P336 Straight-line approximation	–1.999 to 9.999	Scaling
P013 Feed-forward OFF	0: ON/1: OFF	

*1 For details on the parameter settings, see the analog operation assignment (operations) and the analog operation assignment (arguments) tables.

CHAPTER 7 TROUBLESHOOTING

Conventions Used in This Chapter

When a trouble occurs, follow the procedure below to check the trouble, and carry out the appropriate remedy.

Check installation of the digital controller.

Check the power supply, wiring and expansion I/O auxiliary connectors to make sure that they are correctly connected.

↓

Check the error display.

If an error is displayed, check the cause of the error according to the conditions in which the error occurred, and remedy the error.

↓

Check the operation restrictions, and check parameter settings.

If you cannot find the cause of the error in the above two steps, judge the symptoms and find the cause of the trouble by checking operation restrictions and parameter settings.

7.1 Initial Checks

When trouble occurs, first of all check the following and remedy the cause. If there appears to be nothing wrong after checking the ES100X, and the same symptom continues, check the controller in more detail, for example, on the error display.

● Power supply

Make sure that the power supply is ON. Also, make sure that the power supply is within the rated voltage range.

● DIP switch settings

Make sure that the DIP switch settings are correct.

● Output unit

Make sure that the appropriate output unit (number and type) is mounted on the ES100X matched to how the ES100X is applied.

● Wiring and connectors

Make sure that the terminals and expansion auxiliary I/O connectors are correctly connected.

Also, make sure that cables are not disconnected, contacted, or incorrectly connected.

● Communications protocol

When operating an ES100X that supports a communication function, make sure that the baud rate and other communications protocol settings are matching, and are within the permissible ranges.

7.2 How to Use the Error Display

When an error has occurred, or when special action is required, the No.1 display alternately indicates error codes together with the current display item.
This section describes how to check error codes on the display, and the actions you must take to remedy the trouble.

■ "FAIL" errors

When the No.2 display indicates FAIL, the ES100X needs repairing. Contact your nearest dealer. The following table lists FAIL error codes and their meaning.

No.1 Display	No.2 Display	Description
E000	FAIL	WDT error
E100	FAIL	RAM R/W error
E110	FAIL	RAM sum error
E120	FAIL	Calibration data error
E200	FAIL	Internal voltage error
E210	FAIL	Cold junction error
E300	FAIL	A/D error

■ E400 PV error

● Error generating conditions

The PV error is generated when PV ≤ –10% full-scale or PV ≥ 110% full-scale.

● Cause

Probable causes are that an input of type different to that designated in parameters is connected to analog input, and that analog input has not been correctly wired.

This is probably because the operation result, when an operation in the analog assignment table that takes PV as its assignment destination is executed, has satisfied the alarm generation conditions.
Another probable cause is that the operation table is in error, or that the wrong operation conditions have been selected.

● Remedy

Check the wiring of the corresponding analog inputs.

Check the content of the analog assignment table that takes PV as its assignment destination. If there are no problems in the operation conditions, you can also limit the analog operation using the HIGH (SLH) or LOW(SLL) selectors.

Heater current monitor

The current for heater current detection (CT) can be monitored in the "heater current monitor" parameter. If 55.0 and - - - - are displayed alternately on the No.2 display, this indicates that the current has exceeded the permissible rating of 55.0 A. Check the wiring of the CT input.

■E410 Analog input 1 error
E420 Analog input 2 error

● Error generating conditions	These errors are generated when the following conditions are satisfied. AI1 or AI2 ≤ -10% full-scale AI1 or AI2 ≥ 110% full-scale However, note that this excludes analog operation assignment tables to which PV is assigned as the assignment destination.
● Cause	Probable causes are that an input of type different from that designated in parameters is connected to analog input, and that analog input has not been correctly wired.
● Remedy	• Check the wiring of the corresponding analog inputs. • Delete unused analog inputs from the analog operation assignment table. For example, if analog input 2 is not being used on a 2-input ES100X, delete analog operation assignment tables to which AI2 has been assigned.

■E450 Potentiometer error
E700 Motor calibration error

● Error generating conditions	These errors occur only on position-proportional ES100X. • Potentiometer error Potentiometer input has exceeded the permissible range. • Motor calibration error In a position-proportional closed control system, either the power has been turned ON or run operation has been executed with motor calibration not having end normally.
● Cause	• Potentiometer error A probable cause is disconnection or shorting of the potentiometer input. • Motor calibration error A probable cause is that motor calibration has not been executed or has ended in error.
● Remedy	• Potentiometer error Check the wiring of the potentiometer input. • Motor calibration error Check the wiring of control output, and execute the "motor calibration execution" parameter.

■E850 A.T. error

● Error generating conditions	This error occurs when auto-tuning cannot be executed
● Cause	Probable causes are that the connection with the control target is abnormal, or that the response from the control target cannot be obtained within the fixed time.
● Remedy	Check the wiring. If there is a problem in response, tune the ES100X by a method other than auto-tuning.

7.3 Judging Symptoms to Find the Cause of Trouble

When a trouble occurs and error codes are not displayed on the controller, judge the symptom to find the cause of the trouble. Follow the procedure below to do this.

(1) Make sure that the operation restrictions of the ES100X are not being violated.
(2) Check the items described in 7.1 Initial Checks (output unit mounting, wiring, etc.) once again.
(3) Check parameter settings (including operation assignments). If the parameter settings are in error, correct the settings.

■ Operation restrictions

The following table lists the operation restrictions of the ES100X. In particular, many operations cannot be carried out during auto-tuning. So, you will be able to pin-point the cause faster by checking whether or not the trouble occurred during auto-tuning.

Operation	Restriction (operation is invalid when one of the conditions is satisfied)	
	During A.T.	Other
Parameter setting *1	●	
Change bank No.	●	Bank selection method is set to time setting
Run operation	●	
Remote SP mode	●	
Auto-tuning execution	●	Cascade control Stop status Manual mode MV tracking ON Fine tuning executing or canceled
Fine tuning execution	●	Fine tuning executing or canceled
Fine tuning cancel	●	Fine tuning executing or canceled
Direct/reverse action inversion and inversion cancel	●	
Integral reset	●	Floating control
Integral reset cancel	●	
MV tracking ON	●	
Feed-forward OFF/ON	●	
Cascade open		When not in cascade control Cascade OFF
Cascade closed		When not in cascade control
Cascade OFF		When not in cascade control Cascade open
Cascade ON		When not in cascade control

*1 Parameter settings are not restricted in setting level 2.
*2 Items marked by an "●" cannot be operated during A.T. execution.
*3 The above table omits details that can be checked on the error display.

■ Checking parameters

Sometimes operations do not proceed well if the parameters are incorrectly set.
This item summarizes symptoms that can be solved by checking parameter settings. The following description omits details that can be checked on the error display. For details on parameter settings, see Chapter 5 Parameters.

● Parameters cannot be set.

- If panel keys do not function, the panel keys are disabled by the key protect function.

→ Check the "key protect" parameter.
Key operations can be carried out without changing the "key protect" parameter if the key protect cancel/enable function is provided by digital operation assignment.

- A probable cause is that the current setting mode is "remote" or "external" when settings are not entered.

→ Check the "setting mode" parameter

● No control output

- Check the output unit.
- A probable cause is that MV tracking is ON.

→ Check the "MV tracking" parameter.

● No increase in manipulated variable

- A probable cause is a narrow MV limitter width.

→ Check the "MV upper limit" and "MV lower limit" parameters.

- A probable cause is that the rate-of-change limit width of the manipulated variable rate-of-change limitter is too small.

→ Check the "MV change rate limit" parameter.

● Offset is generated.

- A probable cause is that the "I" parameter is set to "0".

→ Check the "I" parameter.

- A probable cause is that an integral reset has been applied.

→ Make sure that you are not using a digital operation assignment table that takes "IR" as it assignment destination.

● The set local SP changes.

- A probable cause is that the remote SP mode was switched to when SP tracking was ON.

→ Check the "SP mode" and "SP tracking" parameter.

APPENDICES

SPECIFICATIONS

■ Electrical Specifications

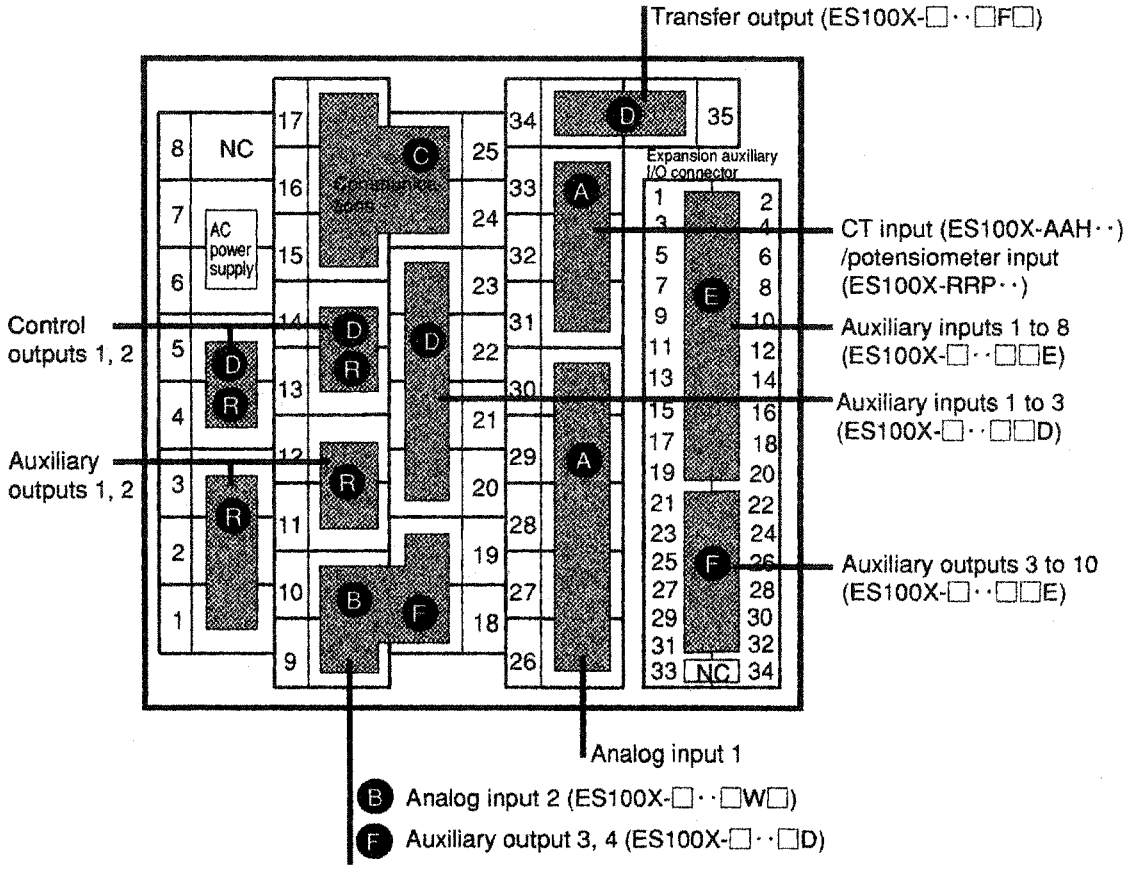
Item		Specification
Analog Input 1	Type	R, S, K, J, T, E, B, N, L, U, W, PLII, JPt, Pt 4 to 20 mA, 0 to 20 mA, 0 to 10 mV, 0 to 100 mV, ±10 mV, 0 to 1 V, 1 to 5 V, 0 to 5 V, 0 to 10 V
	Readout Accuracy (*1)	Thermocouple input: (larger of ±0.1% SP or 1°C) ±1 digit Resistance bulb input: (larger of ±0.1% SP or 0.5°C) ±1 digit Current/voltage input: ±0.1% full-scale ±1 digit
	Input Impedance	Thermocouple input: 1 MΩ or more Current input: Approx. 150 Ω Voltage input: Approx. 1 MΩ
	Platinum Resistance Thermometer Specified Current	1 mA
Analog Input 2	Type	4 to 20 mA, 1 to 5 V
	Readout Accuracy	±0.1% full-scale ±1 digit
	Input Impedance	Current input: Approx. 150 Ω Voltage input: Approx. 1 MΩ
Potentiometer Input		100 Ω to 2.5 kΩ
Auxiliary Inputs		• No-voltage contact signal input or 24 V DC input (*2) 3 or 8 points External power supply: 24 V DC (+10%/-15%) (expansion auxiliary I/O connection models only) • Input conditions During contact input: ON: 1 KΩ or less, OFF: 100 KΩ or more During no-contact input: ON: Residual voltage 3 V or less, OFF: 100 KΩ or more
Auxiliary Outputs		• Relay output 250 VAC, 3A 1c/ 1 point, 1a 1 point Mechanical life expectancy: 10,000,000 uses or more Electrical life expectancy: 100,000 uses or more • Open-collector output (*2) 2 or 8 points External power supply: 24 V DC (+10%/-15%) Max. voltage load: external power supply or less Max. current load: 100 mA or less Residual voltage at power ON: 3 V or more Leakage current at power OFF: 0.3 mA or less
Transfer Output		4 to 20 mA Accuracy ±0.3% full-scale Full-scale resolution approx. 2600 (approx. 6 μA/bit) Load 600 Ω or less
Sampling Cycle		100 ms or more
Memory Protection		Lithium cell backup (10 years at room temperature)

*1 Sensor tolerances
K/T sensors -100°C or less
R/S/W sensors 200°C or less
U sensor ±2°C ±1 digit
B sensor 400°C or less, ±6°C ±1 digit
The readout accuracy when not internally using cold junction compensation is (smaller of ±0.1% full-scale or 1°C) ± 1 digit. Note, however, that the readout accuracy of R, S sensors 200°C or less reading is ±1.5°C ±1 digit, and the readout accuracy of an L sensor (at 0.0 to 400.0°C) or U sensor is ±1°C ± 1 digit.

*2 When using an external power supply, the following current is consumed by the internal circuits:
• Open-collector output 1 mA per output
• No-voltage contact input 2 mA per output

Item	Specification
Supply Voltage	100 to 240 VAC 50/60 Hz common
Allowable Voltage Range	85% to 110% of power voltage
Power Consumption	Approx. 20 VA (at 100 V AC) to 25 V A (at 240 V AC)
Insulation Resistance	20 MΩ or more (at 500 V DC)
Dielectric Strength	2000 V AC 50/60 MHz common 1 minute (across charging terminals having different polarity)
Vibration Resistance	(1) Malfunction 10 to 150 Hz single amplitude, smaller of 0.5 mm or 63.6 m/S2 (2) Endurance 10 to 150 Hz single amplitude, smaller of 0.75 mm or 98 m/S2
Shock Resistance	(1) Malfunction: 196 m/S2 or more, 3 times in all 6 directions (2) Endurance: 294 m/S2 or more, 3 times in all 6 directions Shock applied to front direction must be 196 m/S3 or more
Ambient Operating Temperature	-10 to 55°C (no freezing)
Ambient Operating Humidity	35 to 85% RH (no condensation)
Storage Temperature	-25 to 65°C (no freezing)
External Dimensions (W × H × D)	96 × 96 × 182 mm (W × H × D)
Weight	750 g

■ Insulation of Terminals



- Blocks Ⓐ are not insulated from internal circuits.
- Blocks Ⓑ and Ⓕ are mutually insulated (also insulated from internal circuits).
- Ⓡ indicates relay contact output.
- Control output becomes blocks Ⓓ when voltage output unit or current output unit has been mounted on the ES100X.
- The application of the terminals varies according to the model of ES100X at blocks to which a specific model of the ES100X is stipulated.

HOW TO USE THE CURRENT DETECTOR

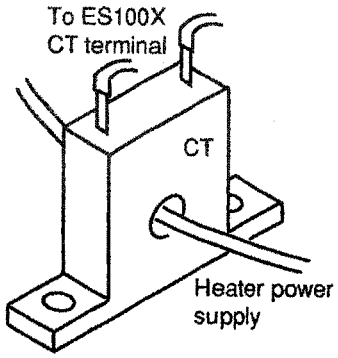
■ How Heater Burnout Detection Works

- Insert the heater lead through the current detector (CT) port.
- When current flows through this lead, the current detector generates AC current matched to the current value. The ES100X measures this AC current to calculate the current flowing to the heater.
  This current can be checked at the "heater current monitor" parameter and is displayed as **P20 1**.
- If the heater is burned out, the current measured at the current detector becomes 0. This value is compared with the value set to the "heater burnout alarm setting" parameter which is displayed as **P 106** to generate a "heater burnout alarm."
- The "heater burnout alarm" is defined by argument "93" (HBAL) in digital operation assignments, and can be output as an alarm signal by assigning the argument to digital output.

■ Precautions

- Turn the heater power supply ON at the same time as or before turning the ES100X power supply ON. If the heater power supply is turned ON after turning the ES100X power supply ON, the "heater burnout alarm" is output.
- Control is continued even when the "heater burnout alarm" is output. So, remedy the condition such as repaires which are caused by "heater burnout alarm."
- Detection of the heater burnout alarm occurs only if the control output is ON continuously for 200 ms or more.
- The rated current may sometimes differ slightly from the actual current flowing to the heater. Use the heater current monitor in an actual operating state, and use the measured current value to set the "heater burnout alarm setting" parameter.
- Maintain a difference of 1.0 A or more between the current in a normal state and the current in a burnout state. If the difference is less than 1.0 A, detection may become unstable.
- Heater burnout cannot be detected when controlling the heater by a phase control system or by a cycle control system. Also, 3-phase heaters cannot be used.
- When not using the heater burnout detection function, set the "heater burnout alarm setting" parameter to "0.0" (disabled).

■ Connection



Connect the CT terminal to the CT terminal (32, 33) of the ES100X. The lead from the CT to the ES100X is neutral. For detail examples of use, see the next page.

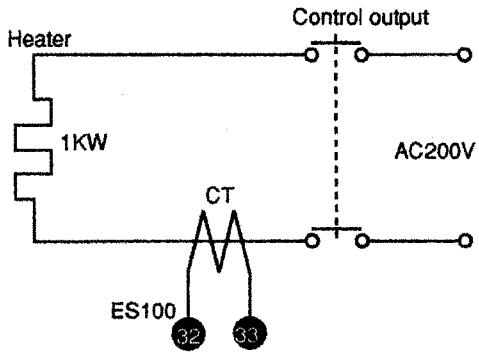
■ How to Use the Heater Burnout Alarm Setting

● How to calculate the heater current burnout setting

- Calculate the heater burnout current by the following equation:
  Setting = (Current at normal operation + Current at burnout)/2
- Set the current at burnout when two or more heaters are connected to the CT terminal as the value measured when the heater having the smallest current value burns out. (when the current of all the heaters is the same, the value of when any one heater burns out)
- Make sure that the following condition is satisfied:
  Current at normal operation - Current at heater burnout ≥ 1A
  When resultant current is less than 1 A, detection is unstable.
- Setting range is 0.1 to 49.9 A.
  Heater burnout detection is not carried out when the setting is "0.0" or "50.0". When the setting is "0.0", the heater burnout alarm is set to "OFF," and when the setting is "50.0", the heater burnout alarm is set to "ON."
- Set the total current at normal heater operation to 50 A or less.
  When the total current is 55.0 A or more, and the "heater current monitor" is functioning, 55.0 and - - - - are displayed alternately.
- Measure the actual currents by monitoring in the "heater current monitor" parameter. This is because calculated values sometimes differ from measured values.

● Example of Use

Example 1: when using one 200 V AC, 1 kW heater

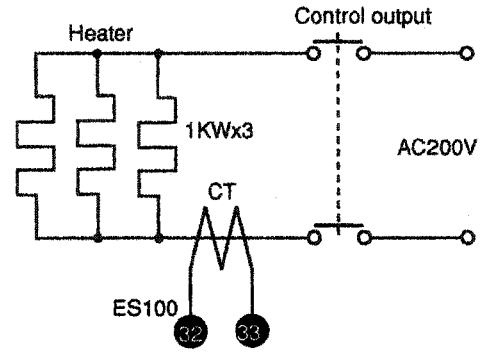


Current at normal operation = 1000/200 = 5 A

Current at heater burnout = 0 A

Setting = (5 + 0)/2 = 2.5 A (≤ 49.9 A)

Example 2: when using three 200 V AC, 1 kW heaters



Current at normal operation = 1000/200 × 3 = 15 A

Current at heater burnout = 1000/200 × 2 = 10 A

Setting = (15 + 10)/2 = 12.5 A (≤ 49.9 A)

(current at normal operation - current at heater burnout = 15 – 10 = 5A (≥1A))

■ About CT

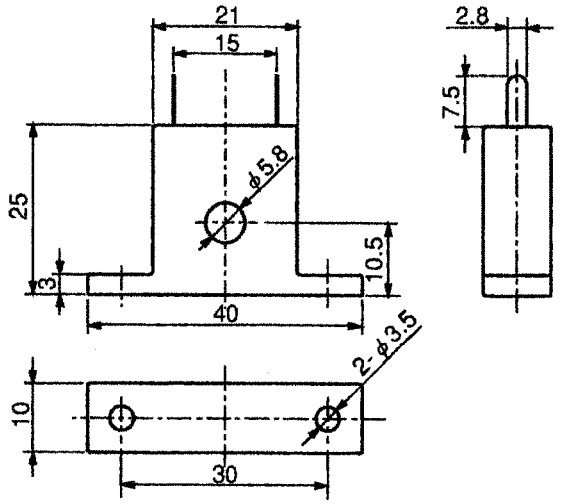
● Rating

Item	Rating	
Model	E54-CT1	E54-CT3
Max. Continuous Heater Current	50 A	120 A (*1)
Dielectric Strength	1000V AC (1 min)	
Vibration Resistance	50 Hz (approx. 10 G)	
Weight	Approx. 11.5 g	Approx. 50 g
Accessories	None	2 armatures 2 Plugs

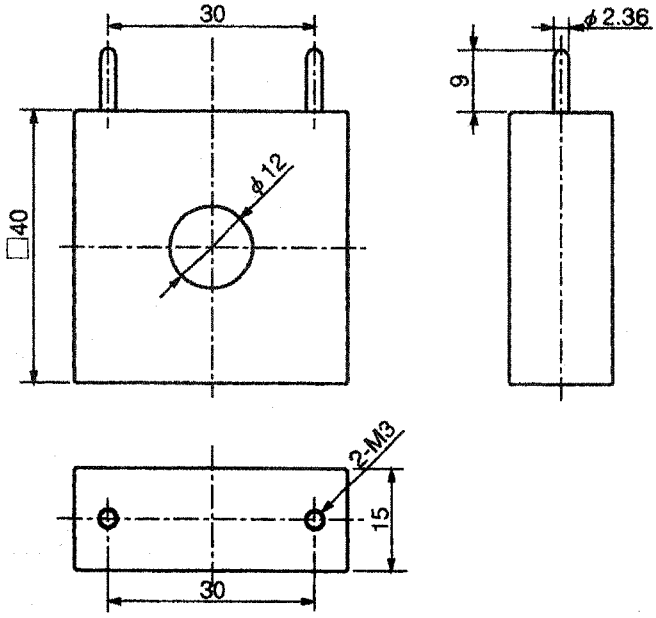
*1 The continuous maximum heater current of the ES100X is 50 A.

● External Dimensions

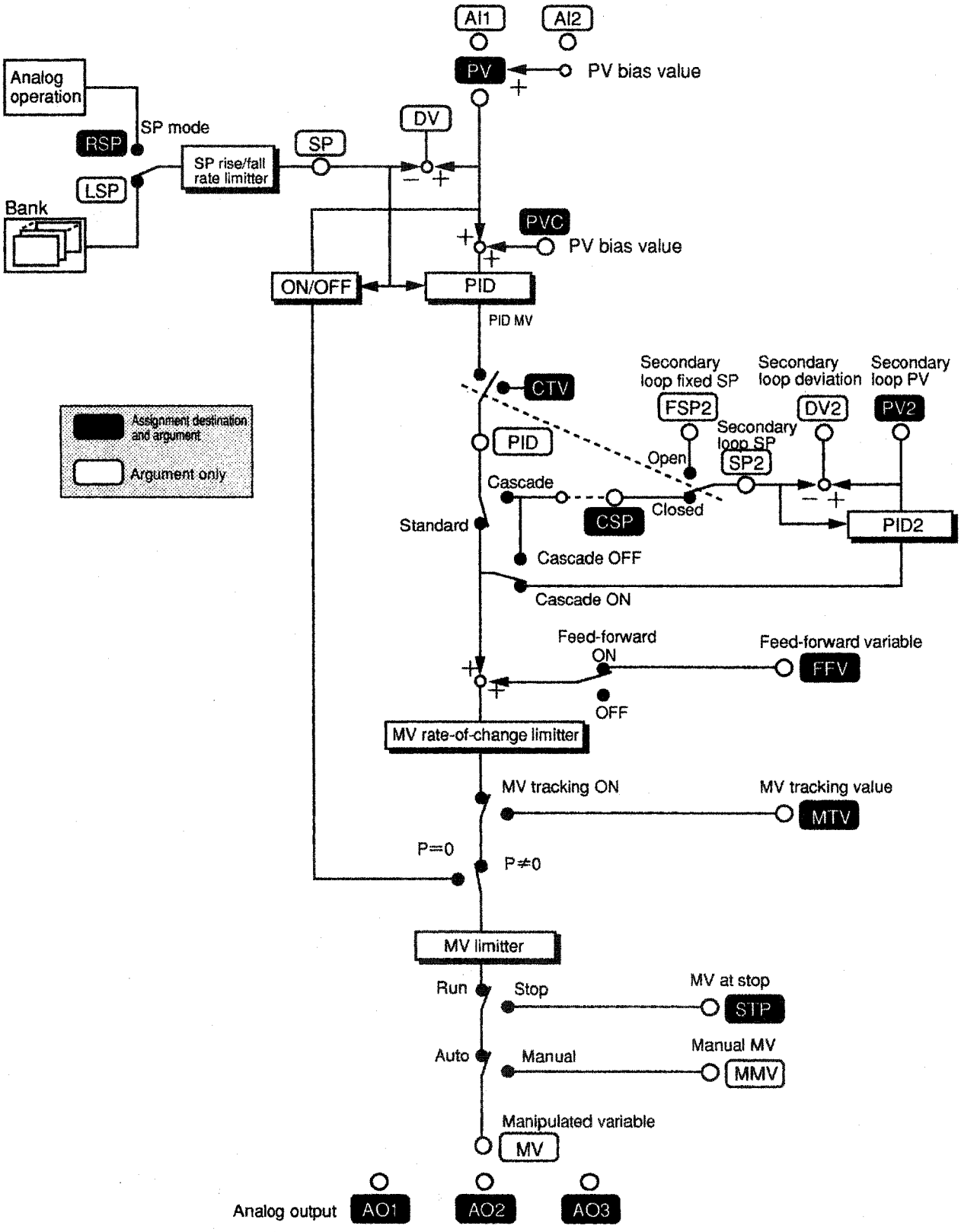
E54-CT1



E54-CT3

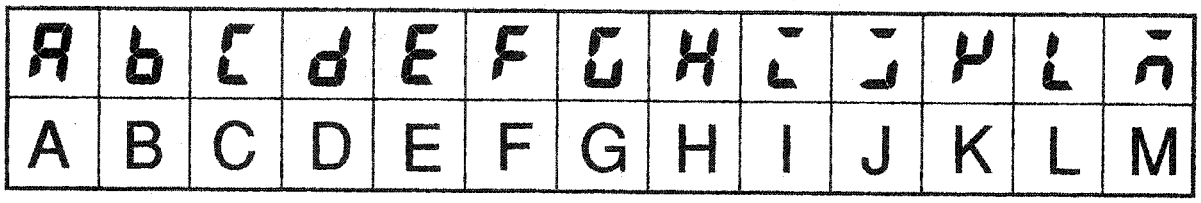


CONTROL BLOCK DIAGRAM

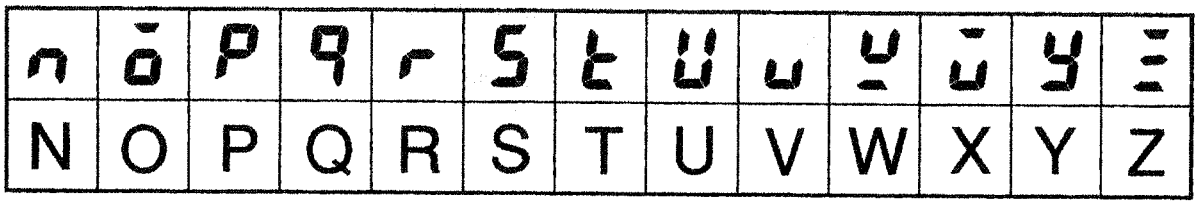


HOW TO READ DISPLAY SYMBOLS

The following tables shows the correspondence between the symbols displayed on the No.1 display and alphabet characters.
The parameter list uses alphabet characters. Refer to the tables below when reading the parameter list.



A	B	C	D	E	F	G	H	I	J	K	L	M



N	O	P	Q	R	S	T	U	V	W	X	Y	Z

CONTROL OPERATION CYCLE

The ES100X uses a control operation cycle of 100 ms minimum. However, the control operation cycle changes according to the model of controller and the content of the specifications settings, and operates at an automatically calculated value. The control operation cycle in actual operation can be checked at the "control operation cycle monitor" parameter and is displayed as P229 (check mode, setting level 1).
For example, if the value in the "control operation cycle monitor" parameter is set to "2", this indicates that the control operation cycle is 200 ms.

The following factors determine the control operation cycle:
- Fuzzy control logic
- Heating-cooling control
- Cascade control
- Digital operation assignment settings
- Analog operation assignment settings
- Number of events used
- Number of ON/OFF timers used
- Input type (temperature input)
- Terminal communications baud rate
- BCD communications

The following table shows the control operation cycle for each model of the ES100X set before shipment from the factory.

Model	2-PID + Fuzzy	2-PID
ES100X-AAH	200 ms	100 ms
ES100X-AAHFB	200 ms	100 ms
ES100X-AAHFD	200 ms	100 ms
ES100X-AAHFE	200 ms	100 ms
ES100X-AAWHFB	200 ms	100 ms
ES100X-AAWHFE	200 ms	100 ms
ES100X-AAH01FE	200 ms	100 ms
ES100X-AAH04FE	200 ms	200 ms
ES100X-AAWH01FE	200 ms	200 ms
ES100X-AAWH04FE	200 ms	100 ms
ES100X-RRPFB	200 ms	100 ms
ES100X-RRPFD	200 ms	100 ms
ES100X-RRPFE	200 ms	100 ms
ES100X-RRPWFB	200 ms	100 ms
ES100X-RRPWFE	200 ms	100 ms
ES100X-RRP01FE	200 ms	100 ms
ES100X-RRP04FE	200 ms	100 ms
ES100X-RRPW01FE	200 ms	200 ms
ES100X-RRPW04FE	200 ms	200 ms

(2-PID + fuzzy) and (2-PID) in the table are determined by the value set to the "2-PID/2-PID + fuzzy" parameter (specification setting mode, setting level 2). This is indicated as C030 on the display.
The default set at the factory is "0" (2-PID + fuzzy).

PARAMETER LISTS

Setting Level 2

◆ Specification Setting Mode

Display	Parameter Name	Setting Range	Unit	Default (content)	Model
C001	Analog input 1 type	0 to 25		2 (K1)	
C002	Analog input 2 type	0 to 1		0 (4 to 20 mA)	
C003	Temperature unit	0 to 1		0 (C°)	
C004	Scaling lower limit	-1999 to upper limit-1	U	-200	
C005	Scaling upper limit	lower limit+1 to 9999	U	1300	
C007	Decimal point	0 to 3		0 (0 digits past decimal point)	
C008	PF1 key type	0 to 16		1 (monitor item selection)	
C009	PF2 key type	0 to 16		1 (monitor item selection)	
C010	Monitor item 1	0 to 29		1 (PV/SP)	
C011	Monitor item 2	0 to 29		2 (step elapsed time)	
C012	Monitor item 3	0 to 29		0 (invalid)	
C013	Monitor item 4	0 to 29		0 (invalid)	
C014	Monitor item 5	0 to 29		0 (invalid)	
C015	Monitor item 6	0 to 29		0 (invalid)	
C016	Monitor item 7	0 to 29		0 (invalid)	
C017	Monitor item 8	0 to 29		0 (invalid)	
C018	Setting item 1	0 to 50		1 (LSP/local SP)	
C019	Setting item 2	0 to 50		0 (invalid)	
C020	Setting item 3	0 to 50		0 (invalid)	
C021	Setting item 4	0 to 50		0 (invalid)	
C022	Setting item 5	0 to 50		0 (invalid)	
C023	Setting item 6	0 to 50		0 (invalid)	
C024	Setting item 7	0 to 50		0 (invalid)	
C025	Setting item 8	0 to 50		0 (invalid)	
C026	Bar graph display item	0 to 8		*1	
C027	Key protect	0 to 5		0 (no disabled keys)	
C028	Direct/reverse action	0 to 1		0 (reverse action)	
C029	Secondary loop direct/reverse action	0 to 1		0 (reverse action)	
C030	2-PID/2-PID + fuzzy	0 to 1		0 (2-PID + fuzzy)	
C031	Heating-cooling/standard	0 to 1		0 (standard)	
C032	Potentiometer input	0 to 1		0 (floating)	
C033	Cascade/standard	0 to 1		0 (standard)	
C034	Operation at power ON	0 to 2		0 (standard)	
C035	MV at PV error (except position-proportional)	-5.0 to 105.0	%	0.00	
C036	MV at PV error (position-proportional)	-1 to 1		0 (no output)	
C037	SP tracking	0 to 1		1 (ON)	
C038	PID set selection data	0 to 63		1 (PV)	
C039	PID set selection hysteresis	0.10 to 99.99	%FS	0.50	
C040	BCD communications/digital I/O	0 to 1		0 (digital I/O)	
C041	Unit No. (communications)	0 to 99		0	
C042	Baud rate (communications)	0 to 4		3 (9600 BPS)	
C043	Program time unit	0 to 1		1 (hours: minutes)	
C044	Bank select	0 to 1		0 (No. selection)	
C048	Time unit of SP rate limits	0 to 2		1 (U/minutes)	
C049	Display refreshing cycle	0 to 3		0 (1 times)	
C050	Line noise reduction	0 to 1		0 (50 Hz)	
C051	Motor calibration execution				
C052	Travel time	1 to 999	sec	30	

*1 With position-proportional models, 1 (valve measurement opening). Otherwise, 0 (manipulated variable).
*2 Setting is minutes:seconds or hours:minutes depending on the setting of the "program time unit" parameter in the specification setting mode.

◆ Event Setting Mode

Display	Parameter Name	Setting range	Unit	Defaults of Tables 1, 2	Defaults of Tables 3 to 10
C101	Input data	0 to 63		54 (deviation)	0 (invalid)
C102	Judgment conditions	0 to 3		0 (upper limit)	0 (upper limit)
C103	Hysteresis	0.00 to 99.99	%FS	0.10	0.10
C104	Standby sequence ON/OFF	0 to 1		0 (OFF)	0 (OFF)
C105	Operating conditions	0 to 202		201 (ON at all times)	201 (ON at all times)

◆ ON/OFF Timer Setting Mode

Display	Parameter Name	Setting Range	Unit	Defaults of Tables 1 to 4
C201	Timing run/reset input	0 to 202		0 (invalid)
C202	Timing run/hold input	0 to 202		0 (invalid)
C203	Time unit	0 to 3		0 (seconds)
C204	ON time	*1 -1 to 9999	*2	-1 (invalid)
C205	OFF time	*1 -1 to 9999	*2	-1 (invalid)

*1 The setting range becomes -1 to 5000 when the "time unit" parameter (ON/OFF timer setting mode, setting level 2) is set to 10 hours.

*2 The setting becomes one of seconds, minutes, hours and 10 hours depending on the setting of the "time unit" parameter (ON/OFF timer setting mode).

◆ Digital Operation Assignment Setting Mode (See table for defaults.)

Display	Parameter Name	Setting Range
D000	Assignment destination	0 to 128
D0*0	Operation*	0 to 7
D0*1	Argument 1 of operation*	0 to 214
D0*2	Argument 2 of operation*	0 to 214

*: 1 to 4

◆ Analog Operation Assignment Setting Mode (See table for defaults.)

Display	Parameter Name	Setting Range
A000	Assignment destination	0 to 28
A**0	Operation*	0 to 48
A**1	Argument 1 of operation*	0 to 132
A**2	Argument 2 of operation*	0 to 132

*: 1 to 15

◆ Technical Mode (level 2)

Display	Parameter Name	Setting Range	Unit	Default (content)
C301	PV tracking	0 to 1		0 (None)
C302	Manual output method	0 to 1		0 (At MV hold)
C303	Manual MV preset value	-0.5 to 105.0	%	0.0
C304	Cold junction compensating method	0 to 1		0 (Internal)
C305	One-shot pulse width	0.1 to 10.0	seconds	1.0
C306	Digital input response time	0.1 to 10.0	seconds	0.2
C307	External No. selection setting time	0.1 to 10.0	seconds	1.0
C310	A.T. calculated gain	0.1 to 10.0		1.0
C311	Limit cycle MV range	5.0 to 50.0	%	20.0
C312	Balance rate during PD operation	0.0 to 100.0	%/seconds	0.0
C313	2-PID control parameter α	0.00 to 1.00		0.65
C314	2-PID control parameter β	0.00 to 1.00		1.00
C315	Fuzzy scale 1 adjustment	0.00 to 99.99		1.0
C316	Fuzzy scale 2 adjustment	0.00 to 99.99		1.0
C317	Fuzzy I coefficient adjustment	0.00 to 99.99		1.0
C318	Fuzzy adjustment bandwidth	0.000 to 9.999	%FS	0.250
C319	Fuzzy SP change judgment value	0.000 to 9.999	%FS	0.010
C320	Temporary A.T. execution judgment deviation	0.0 to 100.0	%FS	10.0
C321	Number of limit cycles	1, 2	times	1
C322	Bit length (communications)	0 to 1		0 (7)
C323	Parity (communications)	0 to 2		1 (even)
C324	Stop bit (communications)	0 to 2		2 (2)

Setting Level 1

◆ Manual MV Setting Mode

Display	Parameter Name	Setting Range	Unit	Default
0	Manual MV	*1 -5 .0 to 105.0	%	0.0

*1 In position-proportional controllers, the valve measurement opening is displayed in the range -10.0 to 110.0.

◆ Operation Mode

Display	Parameter Name	Setting Range	Unit	Default (content)
P006	Bank No.	0 to 7		0 (not set)
P007	Setting mode	0 to 2		0 (local)
P008	SP mode	0 to 2		0 (local)
P010	MV tracking	0 to 1		0 (OFF)
P011	Cascade open	0 to 1		0 (closed)
P012	Cascade OFF	0 to 1		0 (ON)
P013	Feed-forward OFF	0 to 1		0 (ON)
P014	Reset event standby sequence	0 to 1		0 (none)
P015	ON/OFF timer reset	0 to 4		0 (invalid)
P016	ON/OFF counter reset	0 to 12		0 (invalid)

◆ Tuning Mode

Display	Parameter Name	Setting Range	Unit	Default (content)
AT	A.T. execution	1 to 8		1 (PID set 1)
HUNT	Hunting inhibit required level	0 to 5		0 (invalid)
OS	Overshoot inhibit required level	0 to 5		0 (invalid)
SPED	Response improvement required level	0 to 5		0 (invalid)
FT	F.T. execution	0 to 8		1 (PID set 1)

◆ Bank setting mode

Display	Parameter Name	Setting Range	Unit	Default (content)
LSP	Local SP	0 to 100 %FS	U	0 %FS
TIM	Step (bank) time	0.00 to 99.59	*1	0
PID	PID set No.	0 to 8		0 (automatic selection)
EV1	Event 1 setting	-200 to 200 %FS	U: %	0 %FS
EV2	Event 2 setting	-200 to 200 %FS	U: %	0 %FS
EV3	Event 3 setting	-200 to 200 %FS	U: %	0 %FS
EV4	Event 4 setting	-200 to 200 %FS	U: %	0 %FS
EV5	Event 5 setting	-200 to 200 %FS	U: %	0 %FS
EV6	Event 6 setting	-200 to 200 %FS	U: %	0 %FS
EV7	Event 7 setting	-200 to 200 %FS	U: %	0 %FS
EV8	Event 8 setting	-200 to 200 %FS	U: %	0 %FS
EV9	Event 9 setting	-200 to 200 %FS	U: %	0 %FS
EV10	Event 10 setting	-200 to 200 %FS	U: %	0 %FS

◆ PID Setting Mode

Display	Parameter Name	Setting Range	Unit	Default
P	P	0.0 to 999.0	%FS	10.0
I	I	0 to 9999	seconds	240
D	D	0 to 9999	seconds	40
MLL	MV lower limit	-5.0 to upper limit -0.1	%	0.0
MLH	MV upper limit	Lower limit + 0.1 to 105.0	%	100.0
PVS	PV bias value	-100 to 100%FS	U	0
AUT	Automatic selection range upper limit	-200 to 200%FS	*1	2800

*1 The setting becomes one of U or % depending on the setting of the "PID set selection data" parameter (specification setting mode, setting level 2).

◆ Adjustment Mode

Display	Parameter Name	Setting Range	Unit	Default
P102	Control output 1 pulse cycle	1 to 120	seconds	20
P103	Control output 2 pulse cycle	1 to 120	seconds	20
P104	Fuzzy strength	0.0 to 100.0	%	50.0
P105	Cooling coefficient	0.01 to 99.99		1.00
P106	Heater burnout alarm setting	0.0 to 50.0	A	0.0
P107	Position-proportional dead band	0.1 to 10.0	%	2.0
P108	Switching output hysteresis	0.1 to 20.0	%	0.8
P109	ON/OFF count alarm settings	0 to 9999	100 times	0
P110	ON/OFF control hysteresis	0.00 to 99.99	%FS	0.20
P111	Manual reset	0.0 to 100.0	%	50.0
P112	SP setting lower limit	0% full-scale to upper limit-1	U	0%FS
P113	SP setting upper limit	Lower limit +1 to 100 % FS	U	100%FS
P114	SP rise rate limit	0 to 100% full-scale width	*1	0% full-scale width
P115	SP fall rate limit	0 to 100% full-scale width	*1	0% full-scale width
P116	MV change rate limit	0.0 to 100.0	%/S	50.0
P117	Secondary loop fixed SP	0.0 to 100.0	%	0.0
P118	Secondary loop P	0.1 to 999.9	%	100.0
P119	Secondary loop I	*2 0 to 9999	seconds	60
P120	Secondary loop D	0 to 9999	seconds	0
P121	Secondary loop manual reset	0.0 to 100.0	%	50.0

*1 The setting becomes one of U/seconds, U/minutes or U/hours depending on the setting of the "SP rate-of-change limitter time unit" parameter (specification setting mode, setting level 2).

*2 When position-proportional floating control is selected, this range becomes 1 to 9999.

◆ Check Mode

Display	Parameter Name	Setting Range	Unit	Default (content)
P201	Heater current monitor	0.0 to 50.0	A	
P202	Analog input 1 type monitor	0 to 25		2 (K1)
P203	Analog input 2 type monitor	0 to 1		0 (4 to 20 mA)
P204	PF1 key type monitor	0 to 16		1 (monitor item selection)
P205	PF2 key type monitor	0 to 16		1 (monitor item selection)
P207	PID set No. monitor	1 to 8		1 (PID set 1)
P208	ON/OFF timer 1	0 to 9999	*1	0
P209	ON/OFF timer 2	0 to 9999	*1	0
P210	ON/OFF timer 3	0 to 9999	*1	0
P211	ON/OFF timer 4	0 to 9999	*1	0
P212	ON/OFF counter 1 monitor	0 to 9999	100 times	0
P213	ON/OFF counter 2 monitor	0 to 9999	100 times	0
P214	ON/OFF counter 3 monitor	0 to 9999	100 times	0
P215	ON/OFF counter 4 monitor	0 to 9999	100 times	0
P216	ON/OFF counter 5 monitor	0 to 9999	100 times	0
P217	ON/OFF counter 6 monitor	0 to 9999	100 times	0
P218	ON/OFF counter 7 monitor	0 to 9999	100 times	0
P219	ON/OFF counter 8 monitor	0 to 9999	100 times	0
P220	ON/OFF counter 9 monitor	0 to 9999	100 times	0
P221	ON/OFF counter 10 monitor	0 to 9999	100 times	0
P222	ON/OFF counter 11 monitor	0 to 9999	100 times	0
P223	ON/OFF counter 12 monitor	0 to 9999	100 times	0
P224	2-PID/2-PID + fuzzy logic monitor	0 to 1		0 (2-PID + fuzzy)
P225	Potentiometer input monitor	0 to 1		0 (floating)
P226	Heating-cooling/standard monitor	0 to 1		0 (standard)
P227	Cascade/standard monitor	0 to 1		0 (standard)
P228	BCD communications/digital I/O monitor	0 to 1		0 (digital I/O)
P229	Control operation cycle monitor	0 to 10	0.1 seconds	2 (0.2 seconds)
P230	ROM version No. monitor	1 to 2		2 (Ver. 2.0)

*1 The setting becomes one of seconds, minutes, hours and 10 hours depending on the setting of the "time unit" parameter (ON/OFF timer setting mode, setting level 2).

◆ Technical Mode (level 1)

Display	Parameter Name	Setting Range	Unit	Default	
P301	Analog operation parameter 1	-1.999 to 9.999		0.0	
P302	Analog operation parameter 2	-1.999 to 9.999		0.0	
P303	Analog operation parameter 3	-1.999 to 9.999		0.0	
P304	Analog operation parameter 4	-1.999 to 9.999		0.0	
P305	Analog operation parameter 5	-1.999 to 9.999		0.0	
P306	Analog operation parameter 6	-1.999 to 9.999		0.0	
P307	Analog operation parameter 7	-1.999 to 9.999		0.0	
P308	Analog operation parameter 8	-1.999 to 9.999		0.0	
P309	Analog operation parameter 9	-1.999 to 9.999		0.0	
P310	Analog operation parameter 10	-1.999 to 9.999		0.0	
P311	Analog operation parameter 11	-1.999 to 9.999		0.0	
P312	Analog operation parameter 12	-1.999 to 9.999		0.0	
P313	Analog operation parameter 13	-1.999 to 9.999		0.0	
P314	Analog operation parameter 14	-1.999 to 9.999		0.0	
P315	Analog operation parameter 15	-1.999 to 9.999		0.0	
P316	Analog operation parameter 16	-1.999 to 9.999		0.0	
P317	Analog operation parameter 17	-1.999 to 9.999		0.0	
P318	Analog operation parameter 18	-1.999 to 9.999		0.0	
P319	Analog operation parameter 19	-1.999 to 9.999		0.0	
P320	Analog operation parameter 20	-1.999 to 9.999		0.0	
P321	Analog operation parameter 21	-1.999 to 9.999		0.0	
P322	Analog operation parameter 22	-1.999 to 9.999		0.0	
P323	Analog operation parameter 23	-1.999 to 9.999		0.0	
P324	Analog operation parameter 24	-1.999 to 9.999		0.0	
P325	Analog operation parameter 25	-1.999 to 9.999		0.0	
P326	Analog operation parameter 26	-1.999 to 9.999		0.0	
P327	Analog operation parameter 27	-1.999 to 9.999		0.0	
P328	Analog operation parameter 28	-1.999 to 9.999		0.0	
P329	Analog operation parameter 29	-1.999 to 9.999		0.0	
P330	Analog operation parameter 30	-1.999 to 9.999		0.0	
P331	Analog operation parameter 31	-1.999 to 9.999		0.0	
P332	Analog operation parameter 32	-1.999 to 9.999		0.0	
P333	Straight-line approximation 1, input 1	-1.999 to 9.999		0.0	
P334	Straight-line approximation 1, input 2	-1.999 to 9.999		0.0	
P335	Straight-line approximation 1, output 1	-1.999 to 9.999		0.0	
P336	Straight-line approximation 1, output 2	-1.999 to 9.999		0.0	
P337	Straight-line approximation 2, input 1	-1.999 to 9.999		0.0	
P338	Straight-line approximation 2, input 2	-1.999 to 9.999		0.0	
P339	Straight-line approximation 2, output 1	-1.999 to 9.999		0.0	
P340	Straight-line approximation 2, output 2	-1.999 to 9.999		0.0	
P341	Straight-line approximation 3, input 1	-1.999 to 9.999		0.0	
P342	Straight-line approximation 3, input 2	-1.999 to 9.999		0.0	
P343	Straight-line approximation 3, output 1	-1.999 to 9.999		0.0	
P344	Straight-line approximation 3, output 2	-1.999 to 9.999		0.0	
P345	Straight-line approximation 4, input 1	-1.999 to 9.999		0.0	
P346	Straight-line approximation 4, input 2	-1.999 to 9.999		0.0	
P347	Straight-line approximation 4, output 1	-1.999 to 9.999		0.0	
P348	Straight-line approximation 4, output 2	-1.999 to 9.999		0.0	

Display	Parameter Name	Setting Range	Unit	Default	
P349	Broken-line approximation 1, input 1	-1.999 to 9.999		0.0	
P350	Broken-line approximation 1, input 2	-1.999 to 9.999		0.0	
P351	Broken-line approximation 1, input 3	-1.999 to 9.999		0.0	
P352	Broken-line approximation 1, input 4	-1.999 to 9.999		0.0	
P353	Broken-line approximation 1, input 5	-1.999 to 9.999		0.0	
P354	Broken-line approximation 1, input 6	-1.999 to 9.999		0.0	
P355	Broken-line approximation 1, input 7	-1.999 to 9.999		0.0	
P356	Broken-line approximation 1, input 8	-1.999 to 9.999		0.0	
P357	Broken-line approximation 1, input 9	-1.999 to 9.999		0.0	
P358	Broken-line approximation 1, input 10	-1.999 to 9.999		0.0	
P359	Broken-line approximation 1, output 1	-1.999 to 9.999		0.0	
P360	Broken-line approximation 1, output 2	-1.999 to 9.999		0.0	
P361	Broken-line approximation 1, output 3	-1.999 to 9.999		0.0	
P362	Broken-line approximation 1, output 4	-1.999 to 9.999		0.0	
P363	Broken-line approximation 1, output 5	-1.999 to 9.999		0.0	
P364	Broken-line approximation 1, output 6	-1.999 to 9.999		0.0	
P365	Broken-line approximation 1, output 7	-1.999 to 9.999		0.0	
P366	Broken-line approximation 1, output 8	-1.999 to 9.999		0.0	
P367	Broken-line approximation 1, output 9	-1.999 to 9.999		0.0	
P368	Broken-line approximation 1, output 10	-1.999 to 9.999		0.0	
P369	Broken-line approximation 2, input 1	-1.999 to 9.999		0.0	
P370	Broken-line approximation 2, input 2	-1.999 to 9.999		0.0	
P371	Broken-line approximation 2, input 3	-1.999 to 9.999		0.0	
P372	Broken-line approximation 2, input 4	-1.999 to 9.999		0.0	
P373	Broken-line approximation 2, input 5	-1.999 to 9.999		0.0	
P374	Broken-line approximation 2, input 6	-1.999 to 9.999		0.0	
P375	Broken-line approximation 2, input 7	-1.999 to 9.999		0.0	
P376	Broken-line approximation 2, input 8	-1.999 to 9.999		0.0	
P377	Broken-line approximation 2, input 9	-1.999 to 9.999		0.0	
P378	Broken-line approximation 2, input 10	-1.999 to 9.999		0.0	
P379	Broken-line approximation 2, output 1	-1.999 to 9.999		0.0	
P380	Broken-line approximation 2, output 2	-1.999 to 9.999		0.0	
P381	Broken-line approximation 2, output 3	-1.999 to 9.999		0.0	
P382	Broken-line approximation 2, output 4	-1.999 to 9.999		0.0	
P383	Broken-line approximation 2, output 5	-1.999 to 9.999		0.0	
P384	Broken-line approximation 2, output 6	-1.999 to 9.999		0.0	
P385	Broken-line approximation 2, output 7	-1.999 to 9.999		0.0	
P386	Broken-line approximation 2, output 8	-1.999 to 9.999		0.0	
P387	Broken-line approximation 2, output 9	-1.999 to 9.999		0.0	
P388	Broken-line approximation 2, output 10	-1.999 to 9.999		0.0	

OPERATION ASSIGNMENT TABLE DEFAULTS

◆ Digital Operation Assignment Table

(a) Standard (ES100X-AAH)

Table No.	1	2	3	4 to 10	11	12	13 to 30
Assignment Destination	–	–	–	–	1 (DO1)	2 (DO2)	–
Operation 1	0 (END)	0 (END)	0 (END)	0 (END)	1 (BUF)	1 (BUF)	0 (END)
Argument 1	–	–	–	–	21 (EV1)	22 (EV2)	–
Argument 2	–	–	–	–	–	–	–
Operations 2 to 4	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–	–

(b) I/O (including expansion auxiliary I/O) (ES100X- □···□B/D/E)

Table No.	1	2	3	4 to 10	11	12	13 to 30
Assignment Destination	50 (BNK0)	51 (BNK1)	52 (BNK2)	–	1 (DO1)	2 (DO2)	–
Operation 1	1 (BUF)	1 (BUF)	1 (BUF)	0 (END)	1 (BUF)	1 (BUF)	0 (END)
Argument 1	1 (DI1)	2 (DI2)	3 (DI3)	–	21 (EV1)	22 (EV2)	–
Argument 2	–	–	–	–	–	–	–
Operations 2 to 4	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–	–

◆ Analog Operation Assignment Table

(a) Standard (ES100X-AAH)

Table No.	1	2	3	4	5	6 to 15
Assignment Destination	1 (PV)	11 (AO1)	–	–	9 (STP)	–
Operation 1	1 (MOV)	1 (MOV)	0 (END)	0 (END)	1 (MOV)	0 (END)
Argument 1	41 (AI1)	60 (MV)	–	–	131 (AP31)	–
Argument 2	–	–	–	–	–	–
Operations 2 to 15	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–

(b) Position-proportional (ES100X-RRP□···□)

Table No.	1	2	3	4	5	6 to 15
Assignment Destination	1 (PV)	11 (AO1)	–	–	9 (STP)	–
Operation 1	1 (MOV)	3 (SUB)	0 (END)	0 (END)	2 (ADD)	0 (END)
Argument 1	41 (AI1)	60 (MV)	–	–	62 (VOPC)	–
Argument 2	–	62 (VOPC)	–	–	131 (AP31)	–
Operations 2 to 15	0 (END)	END	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–

(c) Transfer output (ES100X- □···□F□)

Table No.	1	2	3	4	5	6 to 15
Assignment Destination	1 (PV)	11 (AO1)	–	13 (AO3)	9 (STP)	–
Operation 1	1 (MOV)	1 (MOV)	0 (END)	1 (MOV)	1 (MOV)	0 (END)
Argument 1	41 (AI1)	60 (MV)	–	1 (PV)	131 (AP31)	–
Argument 2	–	–	–	–	–	–
Operations 2 to 15	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–

(d) 2-input (ES100X- □···□W□···□)

Table No.	1	2	3	4	5	6	7	8	9	10 to 15
Assignment Destination	1 (PV)	11 (AO1)	–	–	9 (STP)	2 (RSP)	6 (PV2)	4 (CSP)	5 (CTV)	–
Operation 1	1 (MOV)	1 (MOV)	0 (END)	0 (END)	1 (MOV)	1 (MOV)	1 (MOV)	1 (MOV)	1 (MOV)	0 (END)
Argument 1	41 (AI1)	60 (MV)	–	–	131 (AP31)	42 (AI2)	42 (AI2)	55 (PID)	57 (FSP2)	–
Argument 2	–	–	–	–	–	–	–	–	–	–
Operations 2 to 15	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–	–	–	–	–

MODEL LIST

Model	Control Method	Analog Input 2	Transfer Output	Serial Communications	External I/O
ES100X-AAH	Heating-cooling/standard	×	×	×	×
ES100X-AAHFB	Heating-cooling/standard	×	○	×	×
ES100X-AAHFD	Heating-cooling/standard	×	○	×	◎
ES100X-AAHFE	Heating-cooling/standard	×	○	×	○ (expansion)
ES100X-AAWHFB	Heating-cooling/standard	○	○	×	×
ES100X-AAWHFE	Heating-cooling/standard	○	○	×	○ (expansion)
ES100X-AAH01FE	Heating-cooling/standard	×	○	RS-232C	○ (expansion)
ES100X-AAH04FE	Heating-cooling/standard	×	○	RS-422/485	○ (expansion)
ES100X-AAWH01FE	Heating-cooling/standard	○	○	RS-232C	○ (expansion)
ES100X-AAWH04FE	Heating-cooling/standard	○	○	RS-422/485	○ (expansion)
ES100X-RRPFB	Position proportional	×	○	×	×
ES100X-RRPFD	Position-proportional	×	○	×	◎
ES100X-RRPFE	Position-proportional	×	○	×	○ (expansion)
ES100X-RRPWFB	Position-proportional	○	○	×	○ (expansion)
ES100X-RRPWFE	Position-proportional	○	○	×	○ (expansion)
ES100X-RRP01FE	Position-proportional	×	○	RS-232C	○ (expansion)
ES100X-RRP04FE	Position-proportional	×	○	RS-422/485	○ (expansion)
ES100X-RRPW01FE	Position-proportional	○	○	RS-232C	○ (expansion)
ES100X-RRPW04FE	Position-proportional	○	○	RS-422/485	○ (expansion)

External I/Os are as follows:

×: Only two auxiliary outputs (relays)

○: Three auxiliary inputs (terminals), two auxiliary outputs (relays)

◎: Three auxiliary inputs (terminals), two auxiliary outputs (open-collector), two auxiliary outputs (relay)

○ (expansion): Eight auxiliary inputs (expansion auxiliary I/O connector), eight auxiliary outputs (open-collector, expansion auxiliary I/O connector), two auxiliary outputs (relay)

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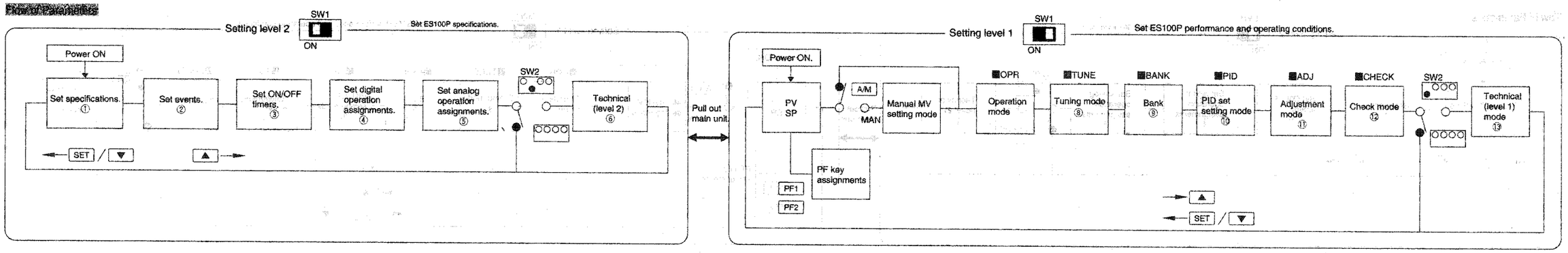
PARAMETERS & OPERATION PROCEDURE ES100X

Flow of Parameters



Details of Parameter Settings **Setting Level 2** (For details of setting level 1, see reverse side.)

Basic Parameter Setting Mode ①

C001	Analog input 1 type	●
C002	Analog input 2 type	
C003	Temperature unit	●
C004	Scaling lower limit	●
C005	Scaling upper limit	●
C007	Decimal point	●
C008	PF1 key type	○
C009	PF2 key type	○
C010	Monitor item 1	○
⋮	⋮	⋮
C017	Monitor item 8	○
C018	Setting item 1	○
⋮	⋮	⋮
C025	Setting item 8	○
C026	Bar graph display item	
C027	Key protect	
C028	Direct/reverse action	●
C029	Secondary loop direct/reverse action	
C030	2-PID/2-PID + fuzzy	
C031	Heating-cooling/standard	
C032	Potentiometer input	
C033	Cascade/standard	
C034	Operation at power ON	
C035	MV at PV error *1	
C036	MV at PV error *2	
C037	SP tracking	
C038	PID set selection data	
C039	PID set selection hysteresis	
C040	BCD communications/digital I/O	
C041	Unit No. (communications)	
C042	Baud rate (communications)	
C043	Program time unit	
C044	Bank select	
C048	Time unit of SP rate limits	
C049	Display refreshing cycle	
C050	Line noise reduction	
C051	Motor calibration execution	
C052	Travel time	

Parameters

*1 Except position-proportional
*2 Position-proportional

Event Setting Mode ②

Event 1		Event 10	
C101	Input data	C101	Input data
C102	Judgment conditions	C102	Judgment conditions
C103	Hysteresis	C103	Hysteresis
C104	Standby sequence ON/OFF	C104	Standby sequence ON/OFF
C105	Operating conditions	C105	Operating conditions

Parameters
Events Nos.

ON/OFF Timer Setting Mode ③

Timer 1		Timer 10	
C201	Timing run/reset input	C201	Timing run/reset input
C202	Timing run/hold input	C202	Timing run/hold input
C203	Time unit	C203	Time unit
C204	ON time	C204	ON time
C205	OFF time	C205	OFF time

Parameters
Timer Nos.

Digital Operation Assignment Setting Mode ④ 1 to 8

Table 1		Table 30	
d000	Assignment destination	d000	Assignment destination
d0*0	Operation*	d0*0	Operation*
d0*1	Argument 1 of operation*	d0*1	Argument 1 of operation*
d0*2	Argument 2 of operation*	d0*2	Argument 2 of operation*

Parameters
Table Nos.

Analog Operation Assignment Setting Mode ⑤ 1 to 8

Table 1		Table 15	
A000	Assignment destination	A000	Assignment destination
A**0	Operation**	A**0	Operation**
A**1	Argument 1 of operation**	A**1	Argument 1 of operation**
A**2	Argument 2 of operation**	A**2	Argument 2 of operation**

Parameters
Table Nos.

Technical Parameters ⑥

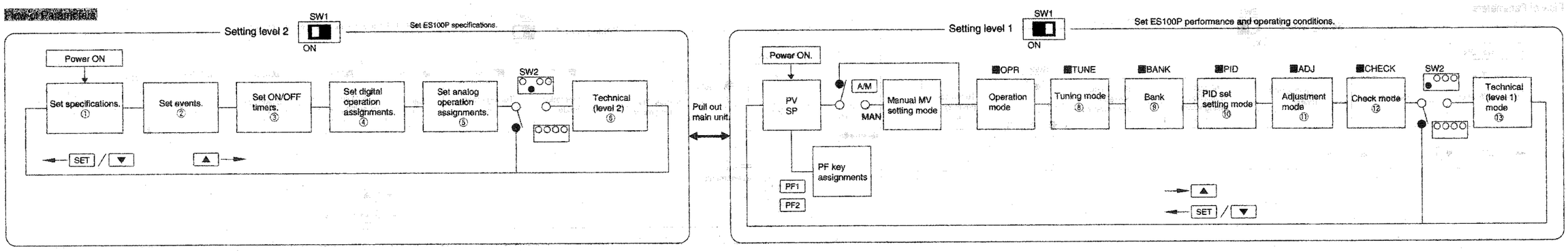
C301	PV tracking	
C302	Manual output method	
C303	Manual MV preset value	
C304	Cold junction compensating method	
C305	One-shot pulse width	
C306	Digital input response time	
C307	External No. selection setting time	
C310	A. T. calculated gain	
C311	Limit cycle MV range	
C312	Balance rate during PD operation	
C313	2-PID control parameter α	
C314	2-PID control parameter β	
C315	Fuzzy scale 1 adjustment	
C316	Fuzzy scale 2 adjustment	
C317	Fuzzy I coefficient adjustment	
C318	Fuzzy adjustment bandwidth	
C319	Fuzzy SP change judgment value	
C320	Temporary A.T. execution judgment deviation	
C321	Number of limit cycles	
C322	Bit length (communications)	
C323	Parity (communications)	
C324	Stop bit (communications)	

Parameters

● Parameters that must be set and checked.
○ Frequently used parameters

PARAMETERS & OPERATION PROCEDURE ES100X

Flow of Parameters



Details of Parameter Settings

Setting Level 1 (For details of setting level 2, see reverse side.)

Operation Mode ■OPR 7

Parameters

P006	Bank No.
P007	Setting mode ○
P008	SP mode
P010	MV tracking
P011	Cascade open
P012	Cascade OFF
P013	Feed-forward OFF
P014	Reset event standby sequence
P015	ON/OFF timer reset
P016	ON/OFF counter reset

Bank-setting mode ■BANK 9

Parameters

Bank 0		Bank 7	
LSP	Local SP ●	LSP	Local SP ●
tim	Step	tim	Step
Pid	PID set No.	Pid	PID set No.
Eu 1	Event 1 ○	Eu 1	Event 1 ○
Eu 10	Event 10	Eu 10	Event 10

◄ Bank No. ►

Adjustment Mode ■ADJ 11

Parameters

P102	Control output 1 pulse cycle ○
P103	Control output 2 pulse cycle
P104	Fuzzy strength
P105	Cooling coefficient
P106	Heater burnout alarm setting
P107	Position-proportional dead band
P108	Switching output hysteresis
P109	ON/OFF count alarm settings
P110	ON/OFF control hysteresis
P111	Manual reset
P112	SP setting lower limit
P113	SP setting upper limit
P114	SP rise rate limit
P115	SP fall rate limit
P116	MV change rate limit
P117	Secondary loop fixed SP
P118	Secondary loop P
P119	Secondary loop I
P120	Secondary loop D
P121	Secondary loop manual reset

Check Mode ■CHECK 12

Parameters

P201	Heater current monitor
P202	Analog input 1 type monitor
P203	Analog input 2 type monitor
P204	PF1 key type monitor
P205	PF2 key type monitor
P207	PID set No. monitor
P208	ON/OFF timer 1
P211	ON/OFF timer 4
P212	ON/OFF counter 1 monitor
P223	ON/OFF counter 12 minitor
P224	2-PID/2-PID + fuzzy logic monitor
P225	Potentiometer input monitor
P226	Heating-cooling/standared monitor
P227	Cascade/standard monitor
P228	BCD communications/digital I/O monitor
P229	Control operation cycle monitor
P230	ROM version No. monitor

Technical Mode 13

Parameters

P301	Operation 1
P332	Operation 32
P333	Straight-line approximation 1 input 1
P348	Straight-line approximation 4 output 2
P349	Broken-line approximation 1 input 1
P388	Broken-line approximation 2 output 10

Tuning Mode ■TUNE 8

Parameters

AT	A.T. execution ○
HUnt	Hunting inhibit required level
oS	Overshoot inhibit required level
SPEd	Response improvement required level
Ft	F.T. execution

PID Set Setting Mode ■PID 10

Parameters

PID Set 1		PID Set 8	
P	P	P	P
i	I	i	I
d	D	d	D
oLL	MV lower limit	oLL	MV lower limit
oLH	MV upper limit	oLH	MV upper limit
Pus	PV bias value	Pus	PV bias value
AUt	Automatic selection range	AUt	Automatic selection range

◄ PID Set No. ►

● Parameters that must be set and checked.

○ Frequently used parameters

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