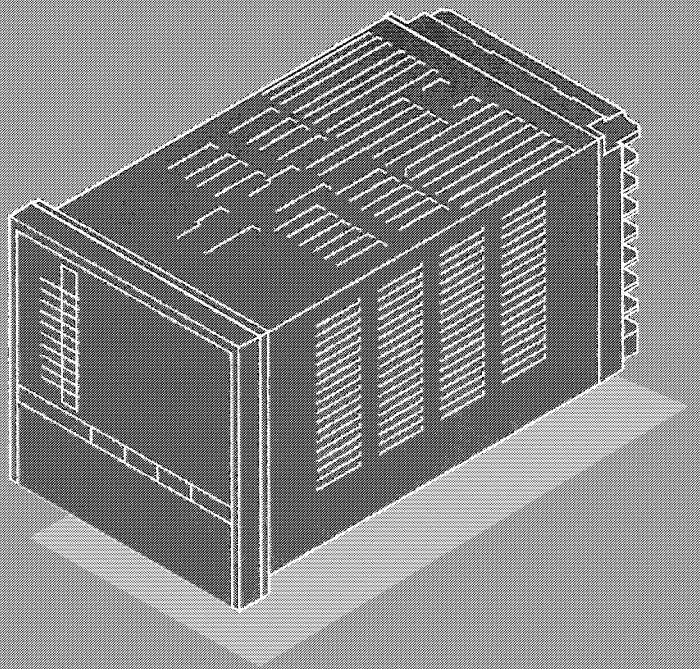
OMRON

ES100P Digital Controller

User's Manual



Cat. No. H069-E1-02

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 ES100P programmable type ES100, and explains its features and mode of use.
Before using your ES100P, thoroughly read and understand this manual in order to ensure correct use.

How to Read this Manual

■ ES100P manuals

A total of three manuals are provided for the ES100P series digital controller as follows:

● When using the general features of the ES100P series digital controller:

ES100P Digital Controller
User's Manual (Cat. No. H069-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:

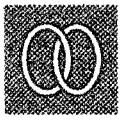
ES100 Support Software
ES/TOOLS Support Software
User's Manual (Cat. No. H071-E1-1)

■ 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 ES100P	Chapter 1 What is the ES100P?	This chapter describes the features of the ES100P, names of parts, and typical functions.
● Setting up the ES100P	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 ES100P.
● ES100P 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 ES100P.
● 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 ES100P	Chapter 6 Typical Examples	This chapter gives typical examples of control that can be achieved on the ES100P, 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 ES100P?

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 Programming Functions

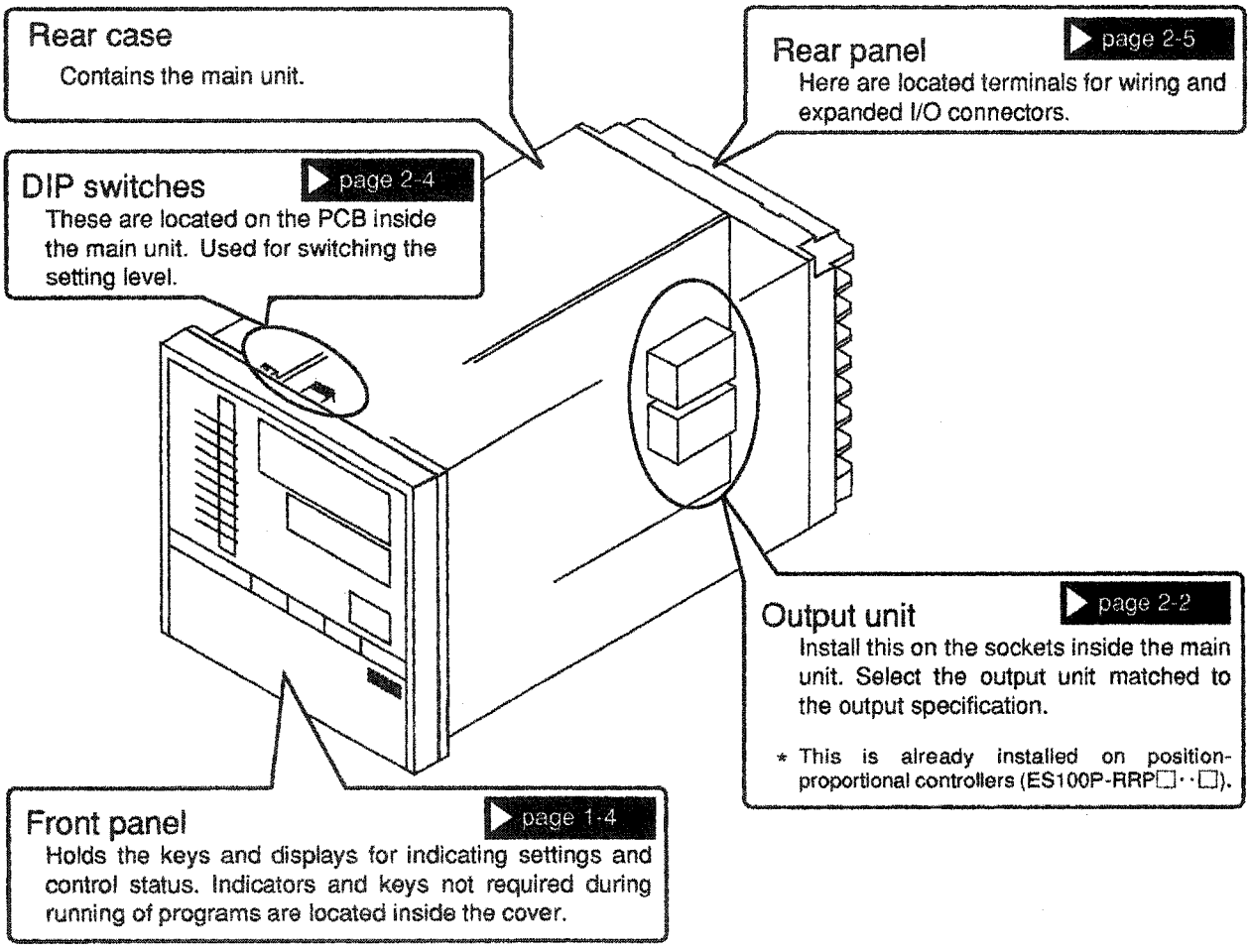
- You can set up to 99 program patterns consisting of up to 100 steps (a maximum of 400 steps) in a single pattern.
- You can not only use the pattern by switching, but can also run the same programs using the repeat function and linking patterns together.

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

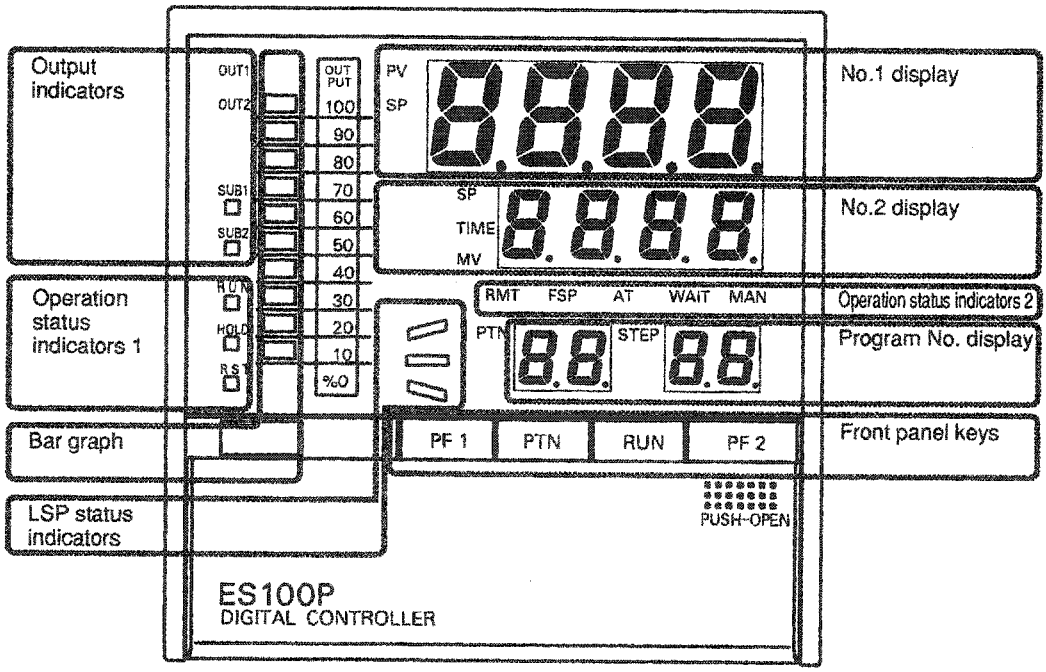
1.2 Names of Parts

■ Main parts

The figure below shows the main parts of the ES100P, 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 These indicators display the operation status.
RUN lights when the program is running.
HOLD lights when the program is in hold status.
RST lights when the control is in reset 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.
- FSP LED : Lights when the SP mode is set to a fixed value.
- AT LED : Flashes when auto-tuning is being executed.
- WAIT LED : Lights when the program is in wait status, and flashes when a wait alarm occurs.
- MAN LED : Lights when the current mode is the manual mode.

Program No. display When setting and running the program, the PTN display indicates the pattern No. and the STEP display indicates the step No. When setting table parameters, the STEP display indicates the table No.

LSP status indicators

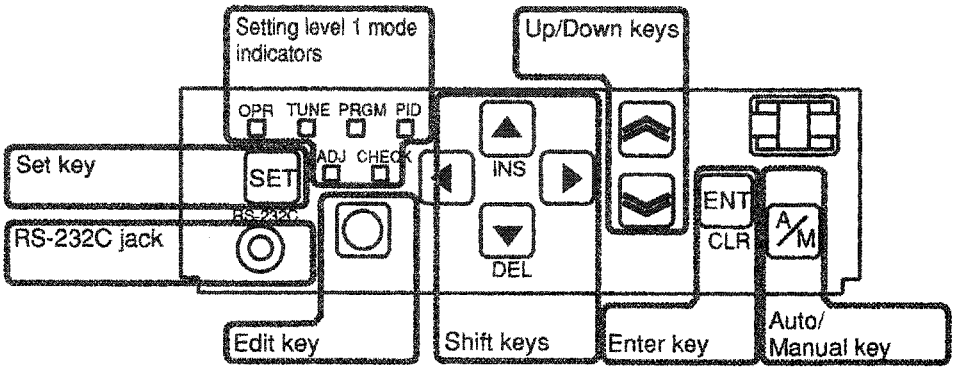
These indicators display the status of the local SP during execution of the program for the currently executing step.

- : Lights when the running program step is ramp up.
- : Lights when the running program step is soak.
- : Lights when the running program step is ramp down.

Front panel keys

The PF1 and PF2 keys are programmable function keys. The user can assign functions to these keys.
The PTN key advances patterns.
The RUN key starts execution of a program.

■ 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
PRGM LED : Program 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.

Up/Down 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.

Enter key

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

Edit key

This key is used for editing programs.

Auto/Manual key

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

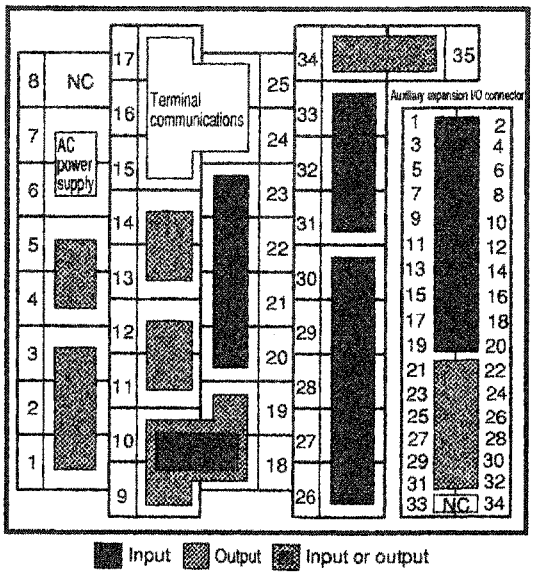
RS-232C jack

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 ES100P 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 inputs (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 ES100P. You can choose either of voltage input or current input in parameter settings.

● CT input

- Terminals are provided on standard ES100P (including heating-cooling models) for CT input for use in heater current detection.

● Potentiometer input

- Terminals are provided on position-proportional ES100P for potentiomenter input for use in valve opening measurement.

● Auxiliary input (digital input)

- Of the ES100P 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 run, reset and advance are assigned to the auxiliary input terminals
- On ES100P 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 ES100P.
- 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 ES100P provided with expanded I/O connectors, auxiliary outputs 3 to 10 cannot be used.

Terminal names and operation assignments

On the ES100P, 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 ES100P 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
Program 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 ES100P.
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 ES100P, you can use one of local SP (LSP), remote SP (RSP) and fixed (FSP) as the set point (SP). Each of these SPs is designated in an "SP mode."

● Local SP mode

Execution of programs is started in the local SP mode. In the local SP mode, the SP is calculated from the "local SP" parameter set for each of the programmed steps.
When another mode is switched to from the local SP mode during program execution, the SP changes. The program, however, continues to advance as instructed.

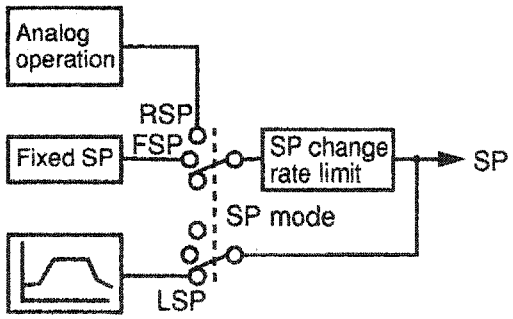
● Remote SP mode

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.

● Fixed SP mode

In the fixed SP mode, the setting of the "fixed SP" parameter is used as the SP. The fixed SP mode is set when performing control by a fixed value.

The SP change rate can be limited in the remote SP and fixed SP modes.



About setting modes

You can choose between settings made on the front panel, by serial communication and by BCD communications for use in parameter settings. Settings made on the front panel are called "local settings", serial communications (serial and BCD) 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"?

- ES100P 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.

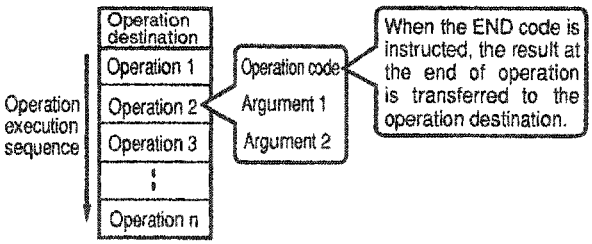
● Operation assignment table

- 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 ES100P 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

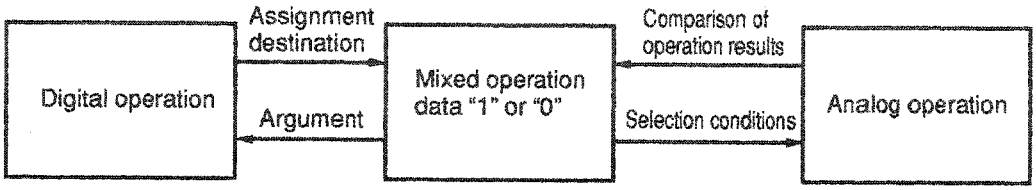
■ Analog operation assignments

- The analog operation process 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 ES100P is provided with 15 operation assignment tables. The settings of assignment destinations in unused tables should be set to "0" (disabled).
- 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 ES100P 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 "1" or "0". 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 ES100P after executing A.T. (auto-tuning)
- When PV disturbance or control cancellation caused by A.T. is not allowed in the system

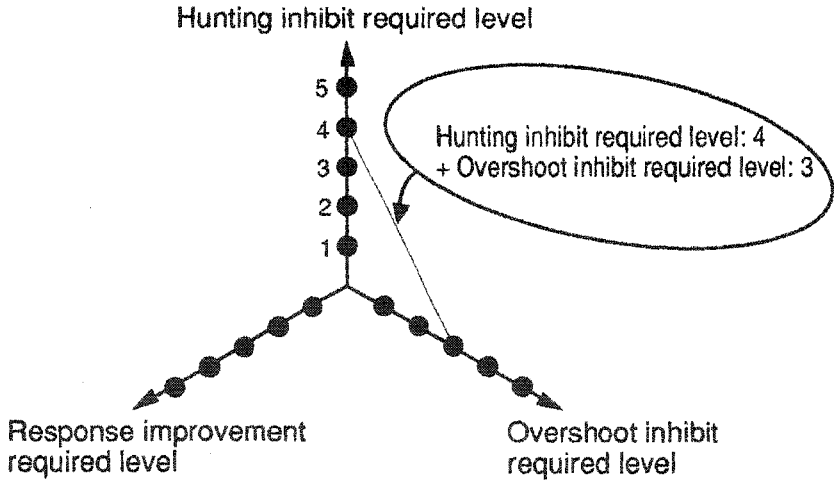
With the fine tuning function, three improvement required levels are set for improvement of control performance. Fuzzy logic inference is executed from the improvement requirements and the control state up to that point to automatically correct PID parameters.

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 ES100P

■ Output unit

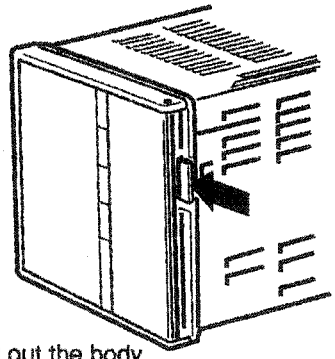
Four types of output unit are available for the ES100P. Select the output unit appropriate for how your ES100P is applied.

● Types of output unit

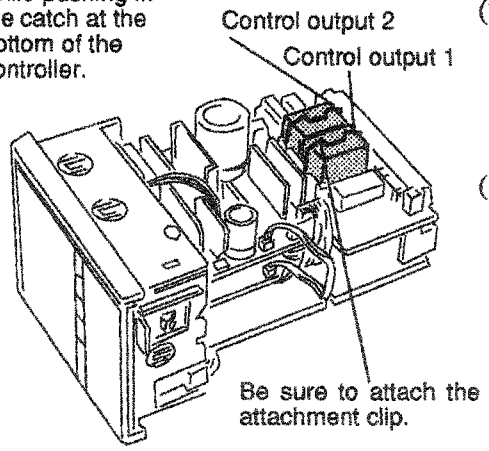
The following table shows the output units and their ratings.

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 600 Ω 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.

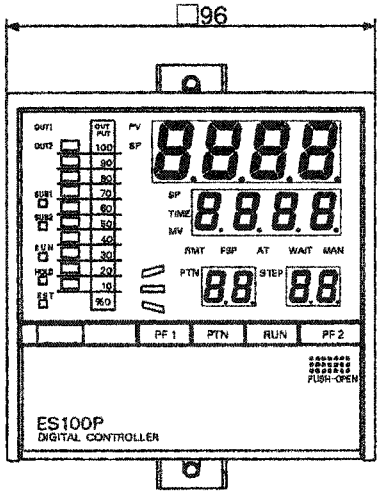
(2) Mount the output unit.
Insert the output unit for control output 1 into the on-board socket marked "OUTPUT1" and the output unit for control output 2 into the on-board socket marked "OUTPUT2."

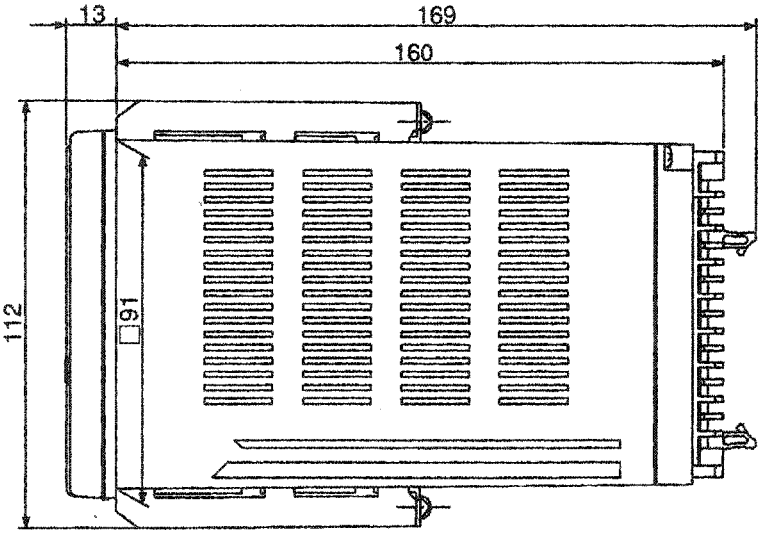
(3) Snap in the attachment clips to hold the output unit firmly in place.

Output unit of position-proportional controllers

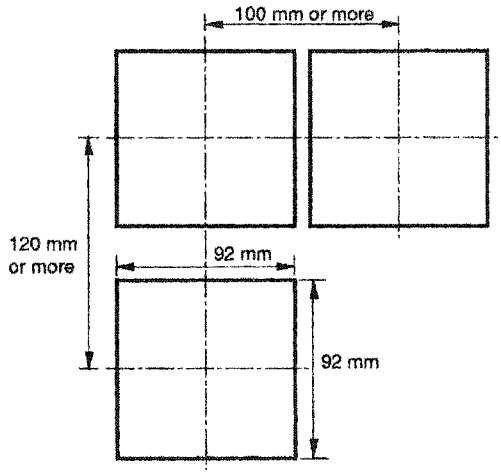
With position-proportional controllers (model ES100P-RRP), a relay output unit is provided at purchase. Therefore, this relay output unit does not need to be purchased separately.

■ External dimensions





■ Drilling mounting panels

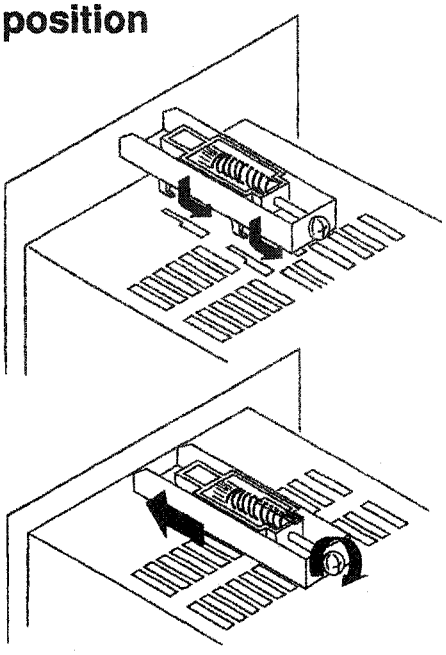


Recommended thickness of mounting panel: 1 to 8 mm

Mounting cutout: 92 mm square

When mounting two or more ES100P, 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 ES100P in position

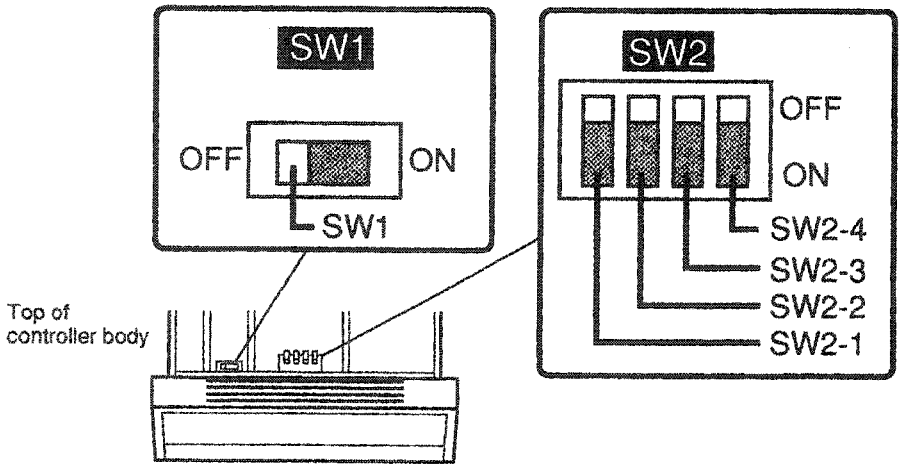


Slot the two fixtures (supplied) into the fixing slot on the rear case with the ES100P pushed into the mounting hole.
The fixing slots are located on the top and bottom of the rear case.

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.

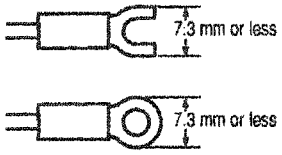
● Executing the switch functions
Switch functions excluding the communications test can be executed in the ES/TOOLS Support Software. However, note that when you execute a switch function from the ES/TOOLS Support Software, the switch settings may differ from the function (e.g. setting level) set on 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.

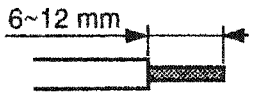
2.3 Wiring Terminals

■ 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.

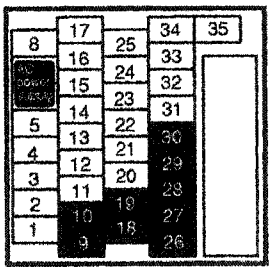


- When using soldered terminals, strip back the tip of the lead about 6 to 12 mm, and solder the tips of the exposed lead wire.

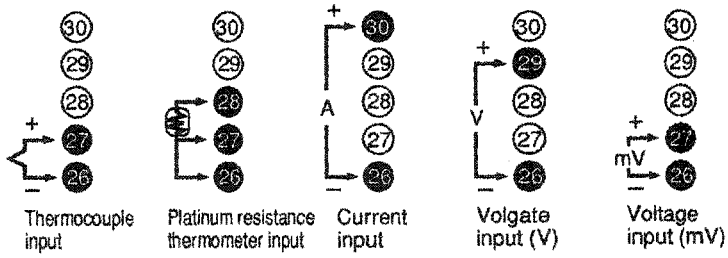


■ Input wiring

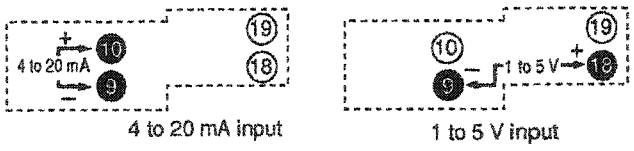
● Analog input



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

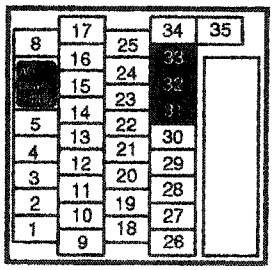


- Terminal Nos. 9, 10, 18 and 19 can be used for analog input only on 2-input type ES100P. So, check the model type before wiring inputs.
  Connect analog input 2 to terminal Nos. 9, 10, 18 and 19.
  The input type determines how terminals are wired.

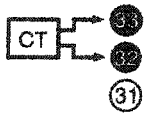


- Analog input 2 is insulated from internal circuits.

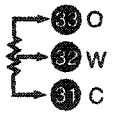
● CT input
● Potentiometer input



- 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.

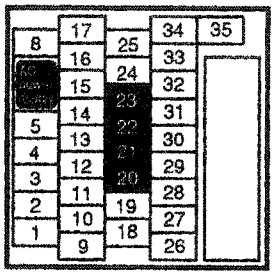


CT input

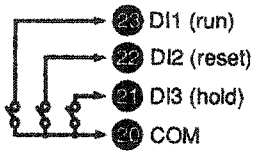


Potentiometer input

● Auxiliary input



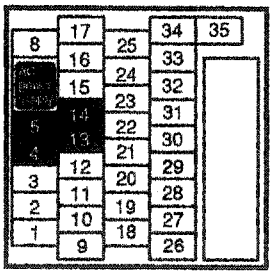
- Connect auxiliary inputs 1 to 3 (including COM terminal) to terminal Nos. 20 to 23. Run (DI1), reset (DI2) and hold (DI3) are assigned as switch inputs to these terminals before shipment from the factory. These terminals are enabled only on models ES100P-□□□D.



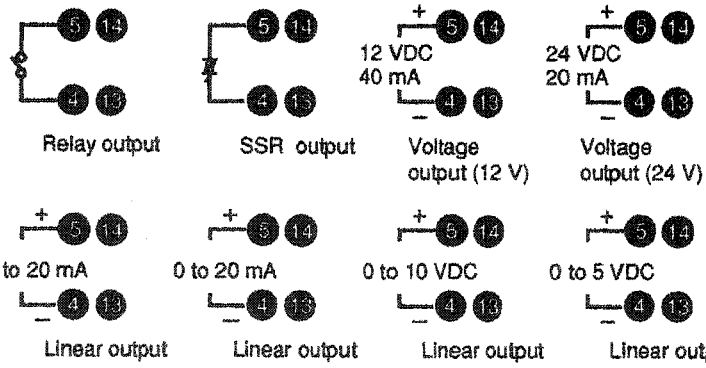
- Auxiliary inputs are insulated from internal circuits. However, note that auxiliary inputs are not insulated from transfer output and control output when a current or voltage output unit is installed.

■ Output wiring

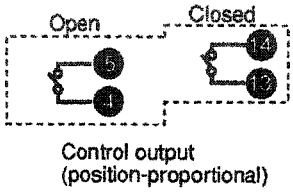
● Control output



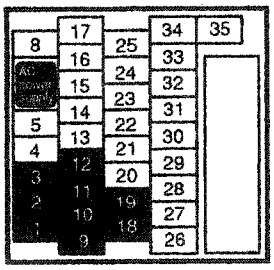
- Connect control outputs 1 to terminal Nos.4 and 5, and control outputs 2 to terminal Nos.13 and 14. Connect the control outputs to suit the output unit mounted on the ES100P. When connecting voltage or current output, check the polarity of the connection before wiring.
  For details on output units, see page 2-2.



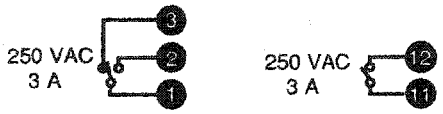
- When carrying out heating-cooling control, use control output 1 as heating output, and control output 2 as cooling output.



● Auxiliary output

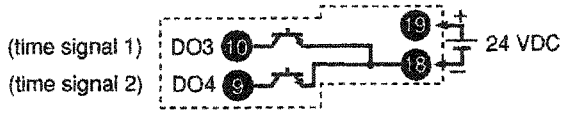


- Connect auxiliary outputs 1 to terminal Nos.1 to 3, and auxiliary outputs 2 to terminal Nos.11 and 12. These terminals are assigned as deviation upper limit alarm output before shipment from the factory.



Auxiliary output 1 Auxiliary output 2

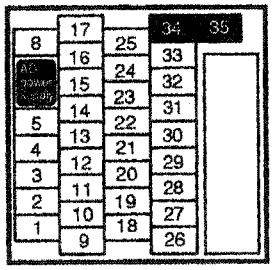
- Terminal Nos. 9, 10, 18 and 19 can be used for auxiliary output only on ES100P-□□□D models. So, check the model type before wiring outputs. Connect auxiliary outputs 3 and 4 to terminal Nos.9 and 10. The +24 V power supply should be connected to terminal Nos.18 and 19. These terminals are assigned as time signals 1 (DO3) and 2 (DO4) before shipment from the factory.



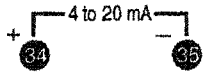
Auxiliary outputs 3, 4

- Auxiliary outputs are insulated from internal circuits.

● Transfer outputs



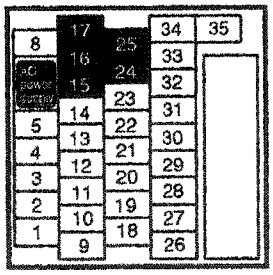
- Connect transfer output to terminal Nos.34 and 35. These terminals are enabled only on models ES100P-□□F□.



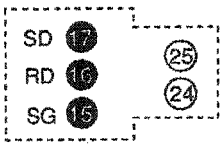
Transfer outputs

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

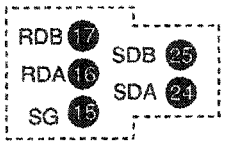
■ Wiring communication terminals



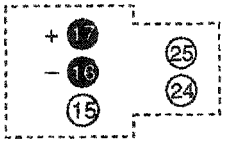
- Terminal Nos. 15 to 17, 24 and 25 are used for wiring communication terminal. The terminals of models ES100P-□□01□ are arranged for RS-232C communication, and the terminals of models ES100P-□□04□ are arranged for RS-422/485 communication. Check which model communication terminals are to be wired to before wiring.



RS232C



RS422



RS485

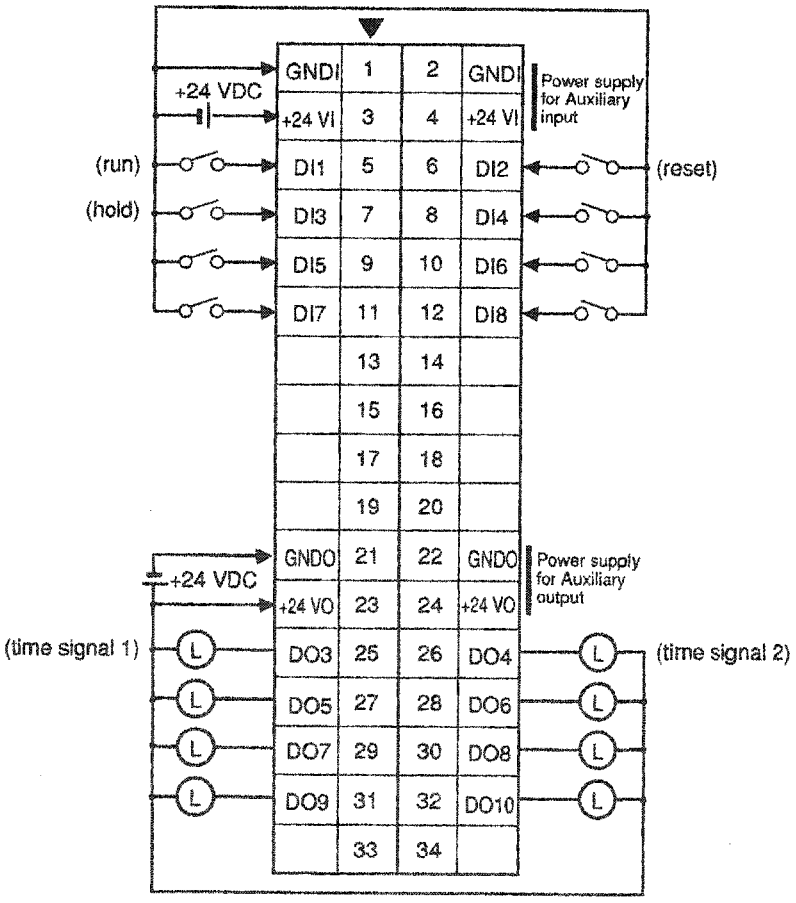
2.4 Wiring Expanded I/O Connectors

Expanded I/O connectors can be used on models ES100P-□□□□E. Either of the digital I/O terminals or BCD communications terminals can be selected for use in the parameter settings. (The ES100P is set for digital I/O before shipment from the factory.)

The following description assumes that the ES100P has been set for digital I/O. For details on using the ES100P 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.

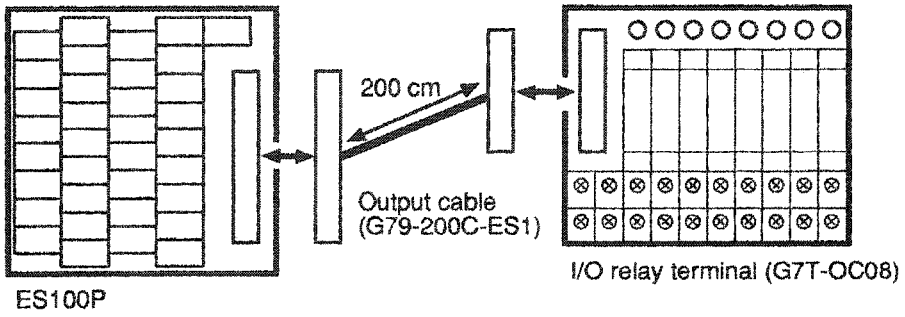
■ Compatible connectors

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

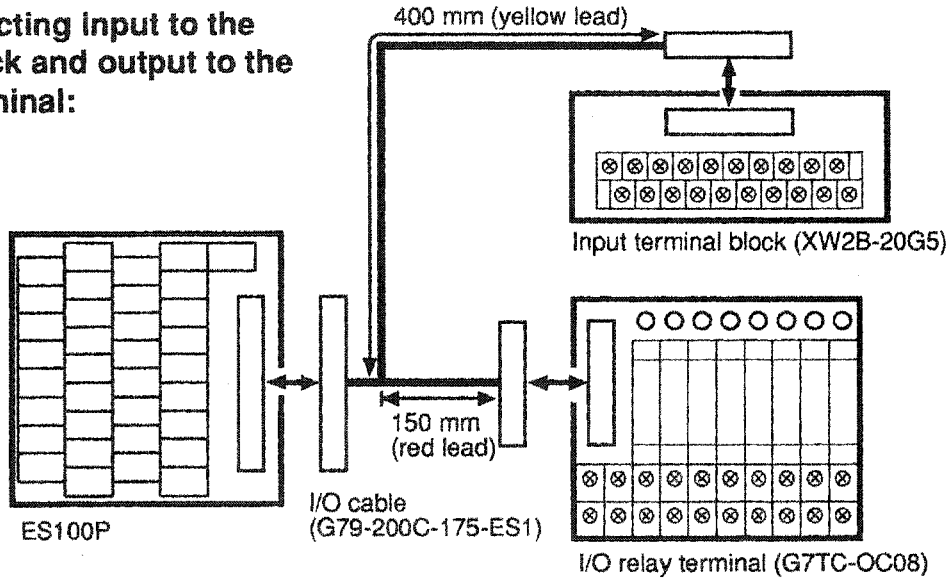
■ Connecting to I/O terminal block

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

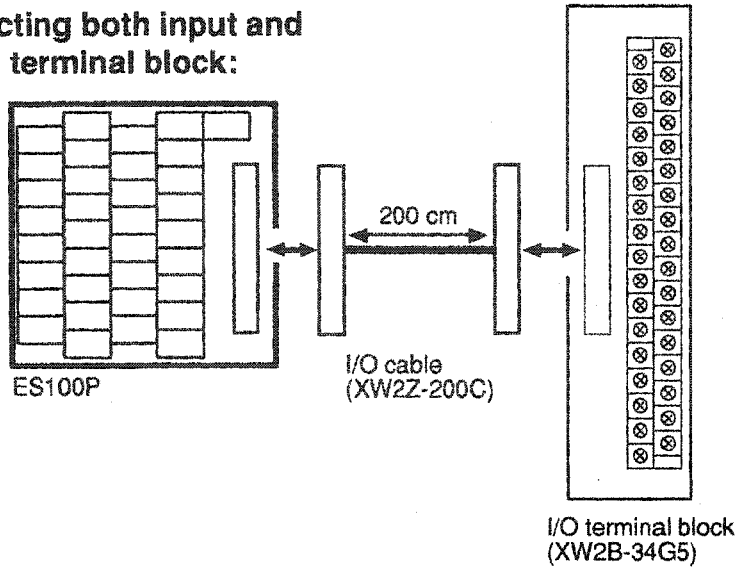
● When connecting output to the I/O relay terminal:



● 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:



CHAPTER 2

● 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 ES100P is to be applied.
Note that the setting level must be switched between setting level 1 and 2 by the parameters.

Set up the program.

Various patterns are available on the ES100P. These patterns can be switched and linked. Set up the program using the desired patterns.

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.
To forcibly stop operation, reset the ES100P.

Initializing parameters

Follow the procedure below to restore the ES100P 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 ES100P.
(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

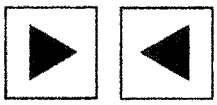
Designating setting modes

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 ES100P.

Designating parameters

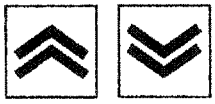
Use the shift keys to designate the desired parameter.
Press the ▼ key to designate the next parameter, and the ▲ key to designate the previous parameter.

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 STEP display.
Press the ▶ key to designate the next table No., and the ◀ key to designate the previous table No.
When setting up programs, the step 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.

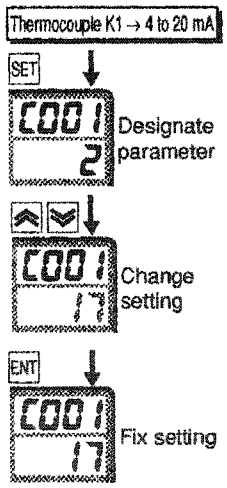
When setting the input type and scaling parameter, set to setting level 2.

● 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 (ES100P-□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.

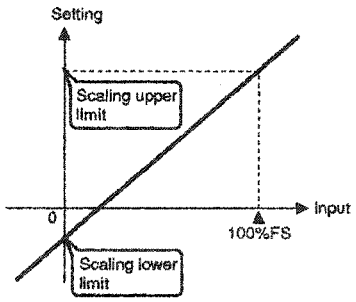
●Set the type code.
Press either the ∧ or ∨ keys until the No.2 display indicates code "17" (4 to 20 mA).

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.

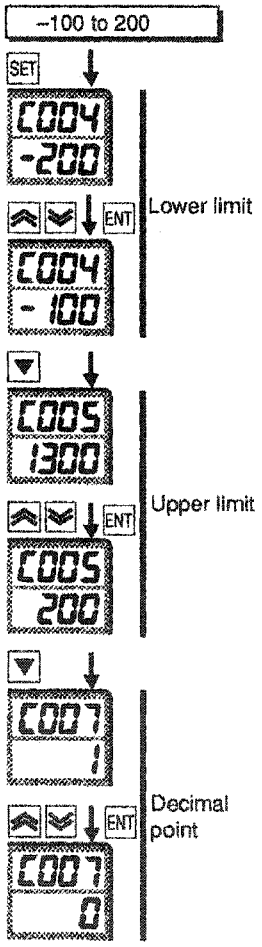
● Scaling



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.

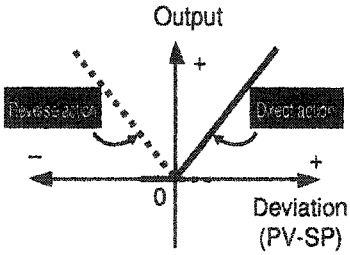
●Set the "scaling upper limit."
Press the ▼ key until the No.1 display indicates C005.

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

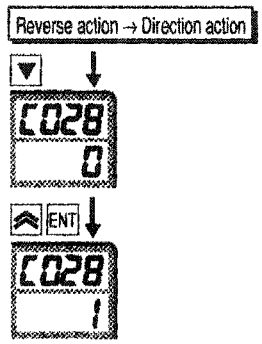


"Direct action" refers to control where the manipulated variable is adjusted according to the increase/decrease in the positive deviation. Alternatively, "reverse action" refers to control where the manipulated variable is adjusted according to the increase/decrease in the negative deviation.
For example, 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.

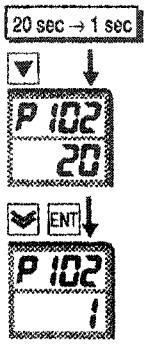
■ Control output cycle

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 1 pulse 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

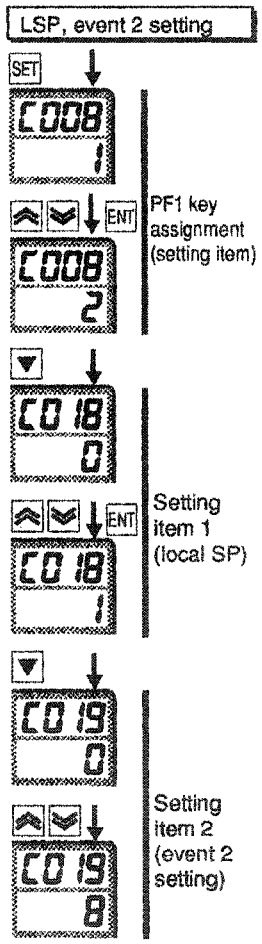
PF1 PF2

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.

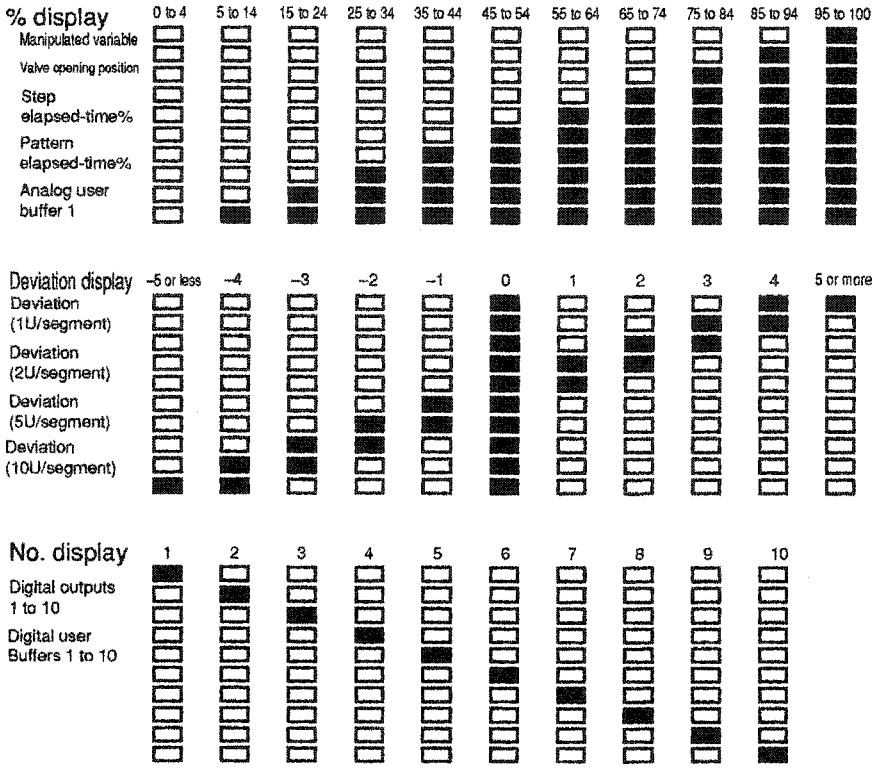
●Store the local SP.
Press either the ▲▲ or ▼▼ keys until the No.2 display indicates code "1" (local SP). When "1" is displayed, press the ENT key.

●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

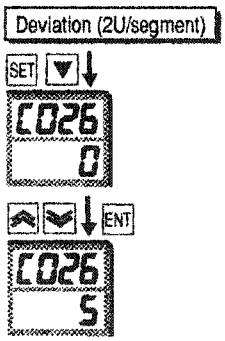
The user can select 11 display items and assign these to the bar graph on the front panel.
The figure below shows the bar graph displays for each of the display items.



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 "5 (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 STEP display.

CHAPTER 3

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

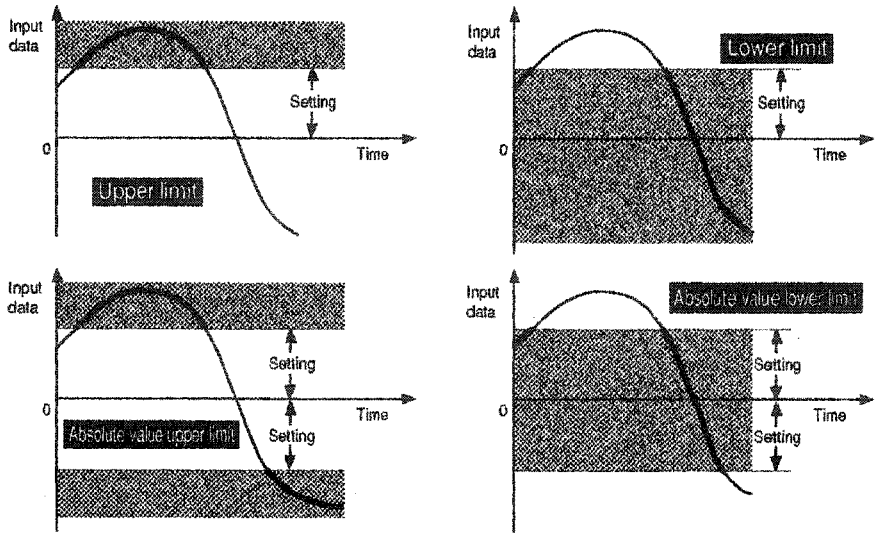
■ Event specifications

●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.

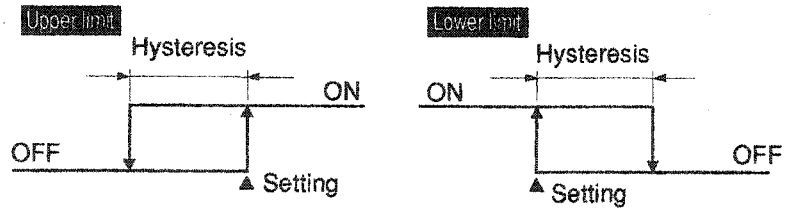
●Judgment conditions

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.



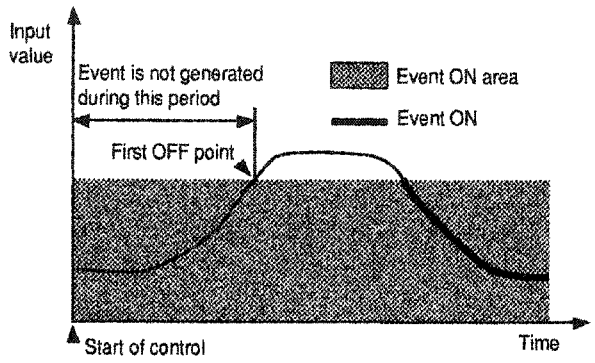
●Hysteresis

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:

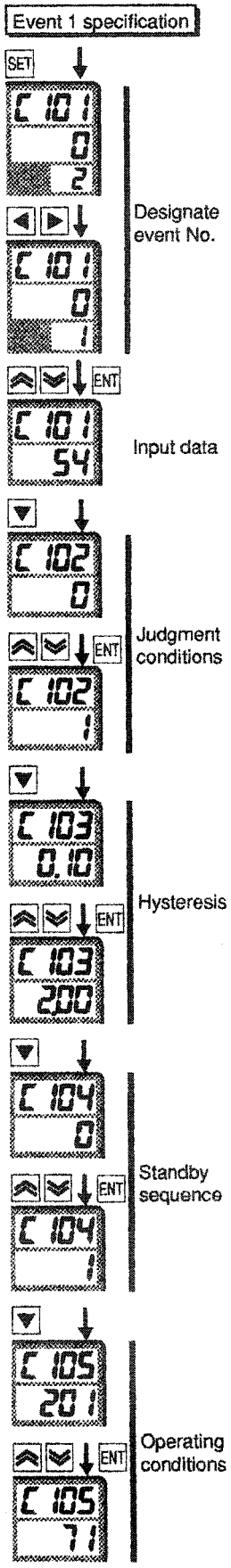
- when an event has begun operation according to the "operating conditions"
- when there is a standby sequence restart instruction
- when the power is turned ON
- when the status has changed from reset (stop) to run
- when an execution pattern or step has changed (including pattern and step operation)
- when a local SP setting in an execution step has been changed
- when advance, back, pattern advance or pattern restart has been executed.

●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 STEP 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.

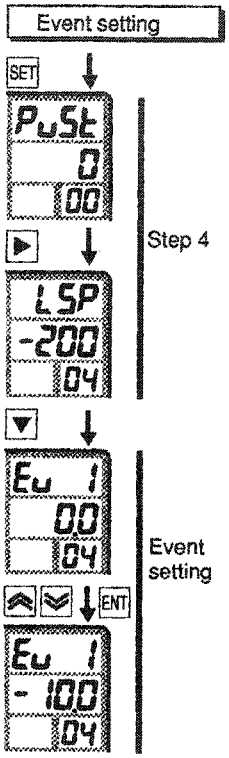
Press the [▼] key until the No.1 display indicates C 105.
Press either the [▲▲] or [▼▼] keys until the No.2 display indicates code "71" (Run/Stop). When "71" is displayed, press the [ENT] key.

■ 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 steps 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 step 4.



●Designate step 1.
Press the [SET] key until the PRGM LED lights. At this time, the No.1 display indicates PuSt. Press the [▶] key until the No.1 display indicates LSP, and the STEP 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.

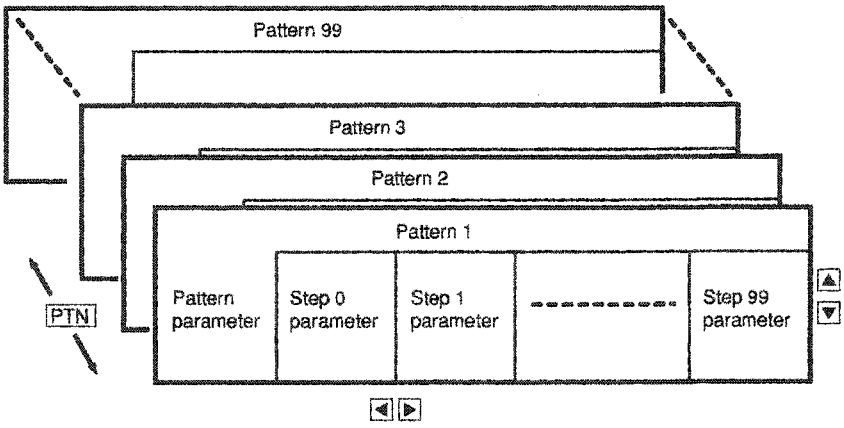
About non-set steps

When the program contains "non-set steps" to which step parameters have not been set, the program advances only to the step having the smallest step No. of the non-set steps.
For example, even if you press the [▶] key when only up to step 3 has been set, the program can advance only to step 4 and no further. Accordingly, when you set the steps according to the above example, the program must already be set at least up to step 3.

3.6 Setting up Programs

■ How programs are configured

Tables for programs are organized as follows.



You can set up to 99 program patterns consisting of up to 100 steps (in all, a total of 400 steps). Note, however, that the total number of steps cannot exceed 900. For example, four patterns is the limit when you are setting 100 steps to each pattern.
You can also set up programs made up of a combination of patterns by linking the patterns.

Follow the procedure below to set up a program.

(1) Designate the program setting mode (setting level 1).
Press the SET key until the PRGM LED lights.
(2) Designate the target pattern No.
Each press of the PTN key increments the pattern No. When the pattern No. reaches "99" and you press the PTN key, the pattern No. returns to "01".
(3) Set the operating conditions of each pattern in pattern parameters, and the operating conditions of each step in step parameters.
Pressing the ▶ key feeds the table parameters as follows:

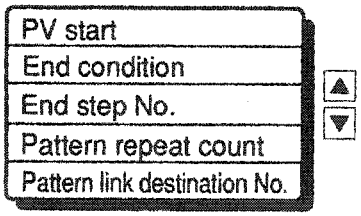
Pattern parameter → Step 0 parameter → Step 1 parameter

Pressing the ◀ key feeds the table parameters in the reverse direction. The STEP display indicates "00" for the pattern parameter, and "00" to "99" for step parameters.

About designating patterns

If you press the PTN key while the program is running, you designate in order only patterns to which parameters have been set. You can also designate target patterns directly in the "pattern No." parameter in the operation mode (setting level 1).

■ Pattern parameters



The following five pattern parameters are available:
- PV start
- End condition
- End step No.
- Pattern repeat count
- Pattern link destination No.

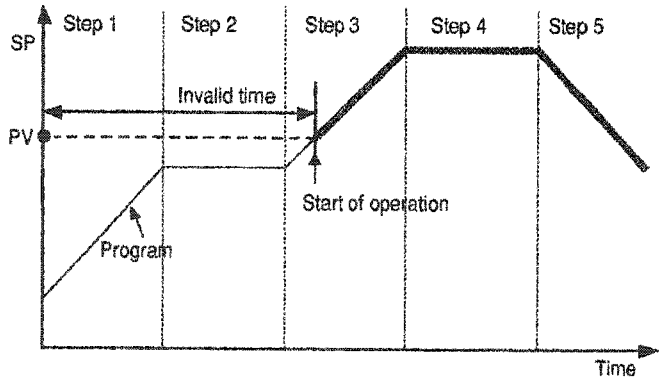
● PV start

The PV start setting designates from where a program will begin executing.

●Use local SP in step 0. (setting: 0)
The program is executed as instructed from the beginning of the program.

●Slope priority PV start (setting: 1)
The program is executed from the point where the PV and SP in the pattern first match.
Accordingly, the section of the program up to where the PV and SP in the pattern first match is ignored. If a point where the PV and the SP in the pattern first match is not instructed in the program, the program is executed as instructed from the beginning of the program.

In the following example, the PV and local SP first match at step 3. So, the program is executed from that point. This is expressed as the solid line in the figure below, and the section of the program before that point is ignored.



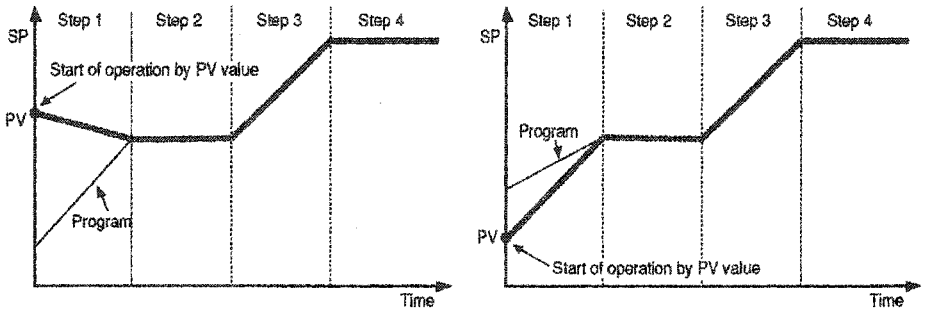
About step 0

Step 0 is not provided with slope when ramp and soak are used for the local SP. (See page 5-21.)
Nevertheless, generally, SP can be provided with slope when the program is started. SP at the start of the program can be provided with slope by setting the step time in step 0 to "0" and starting operation in effect from step 1.
Accordingly, in program examples throughout this manual, the program is started from step 1 (time of step 0 = 0).

●Time priority PV start (setting: 2)

The program is executed by using the PV at the start of the program as the SP. Accordingly, generally, in programs that actually run according to set instructions, the slope of step 1 changes.

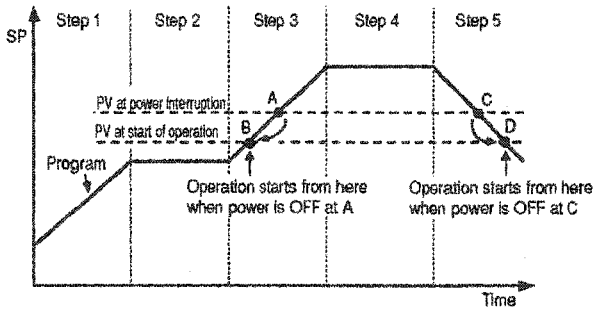
The following figures show one example each of a PV at the start of the program larger and smaller than the SP. In each of these examples, the program runs as instructed after advancing beyond step 1.



●Slope priority (incline judgment) PV start (setting: 3)

The program is executed from the point where the PV at the start of the program and the SP match. However, the program is started from the beginning of the area having the same incline (including incline 0) as the programmed incline information when the match point with the SP is searched for.

In the following example, digital operation is applied so that the pattern is restarted when a power interruption is reset. The start point of program operation when a power interruption occurs at points A or C differs from when the power was interrupted even if the PV is the same.
When a power interruption occurs at point A, the search area becomes step 1 onwards as step 3 is an upward inclining slope, and the program starts again after returning to point B. However, when a power interruption occurs at point C, the search area becomes step 5 onwards as step 5 is an downward inclining slope, and the program starts from point D.



Program incline information

During program operation, the program determines whether the currently executing step is an upward or downward inclining slope as "incline information." If the currently executing step is horizontal, the incline information remains as it is.
This information is lost when the controller is reset, however it is held when the pattern is restarted. Accordingly, when the "PV start" parameter is set to "3" (PV start with slope priority incline judgment) the program looks as if pattern restart is not executing as the start point of program operation does not change when the deviation is small.

● End condition

Designates the operation after the program ends.
- Reset (setting: 0)
- Fixed SP operation (setting: 1)

● End step No.

Set the program end step No. if you want to end program operation midway through the program. However, note that the program continues to run if the number designated to the "end step No." parameter is larger than the final step No. of the program.

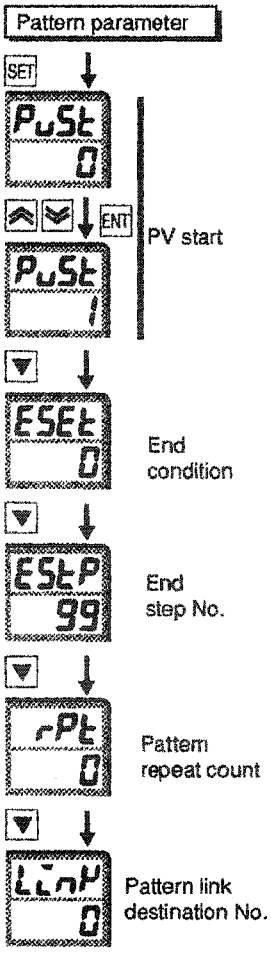
● Pattern repeat count

Designates the number of times a pattern is to be repeated from step 0 after the final step has ended. You can repeat the same pattern up to 9999 times. Number of pattern executions = pattern repeat count + 1.

● Pattern link destination No.

Designates where program execution is to start from after the final step has ended. In program operation, execution is resumed from step 0 in pattern-linked programs.
When a value has been set to the "pattern repeat count" parameter, the program advances to the pattern link destination No. after the same pattern has been repeated for the designated number of times. When set to "0", only the current pattern is executed and ends.
An endless loop is created by setting the current pattern No. as the pattern link destination No.

Setting Example



In this example, let's set slope priority PV start and reset after end of the program. Set pattern repeat and pattern link so that they do not function, and parameters other than "PV start" so that they are only verified. This example assumes that the parameters to be set have already been selected.

●Designate the program setting mode.
Press the SET key until the PRGM LED lights.

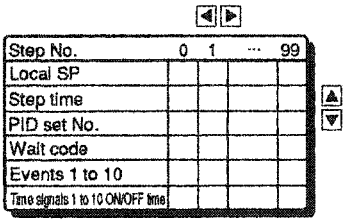
●Select the start method.
In this example, the "PV start" parameter is already selected. Press either the ∧ or ∨ key until the No.2 display indicates "1" (slope priority). When "1" is displayed, press the ENT key.

●Check the end condition.
Press the ▼ key to make sure that "0" (reset) is set.

●Check the final step.
Press the ▼ key to make sure that "99" (step 99) is set.

●Check the pattern repeat count and pattern link destination.
Press the ▼ key to make sure that "0" (repeat OFF) is set. Press the ▼ key again to make sure that "0" (pattern link destination OFF) is set.
★When an unwanted setting is displayed when checking the above parameters, change the setting using the ∨ or ∨ keys.

■ Step parameters



The following step parameters are available:

- Local SP
- Step time
- PID set No.
- Wait code
- Events 1 to 10
- Time signals 1 to 10 ON/OFF time

● Local SP
● Step time

The "local SP" and "step time" parameters are basic program parameters, and must be set at all times. The default for "program method" is "1" (ramp and soak)". So, the "local SP" parameter is the local SP at the point where the set step is reached.
The "program method" is normally used set to "1", so the program method will be omitted in the following description.

The time unit of the "step time" parameter is either of "0" (minutes:seconds) or "1" (hours:minutes) dependent on the setting of the "program time unit" parameter (setting level 2). Default is "1" (hours:minutes).
The "program time unit" parameter must be set before setting the "step time" parameter. The No.1 display indicates **C043** when the "program time unit" is displayed.

CHAPTER 3

● PID set No.

In this example, let's leave the default "0" (automatic selection) as it is.
For details on how to set this parameter, see 4-3 PID Switching (page 4-13).

● Wait code

In this example, let's leave the default "0" (no wait operation) as it is.
For details on how to set this parameter, see 4-6 Applying Programmed Operation (page 4-15).

● Event setting

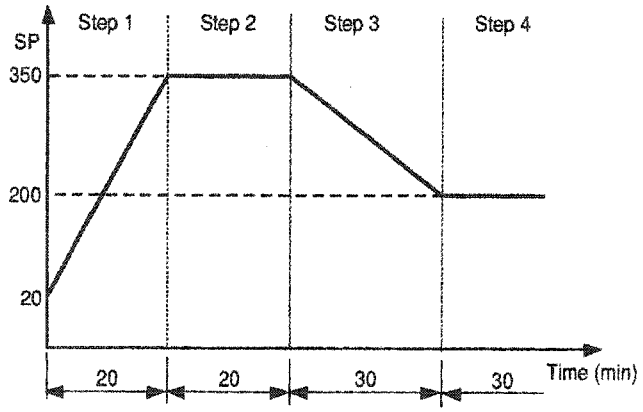
Set the event settings of events 1 to 10 matched to the event specifications. Events whose "input data" parameter is set to "0" (invalid) do not function.
For details on how to set event settings, see 3.5 Setting Events."

● Time signal

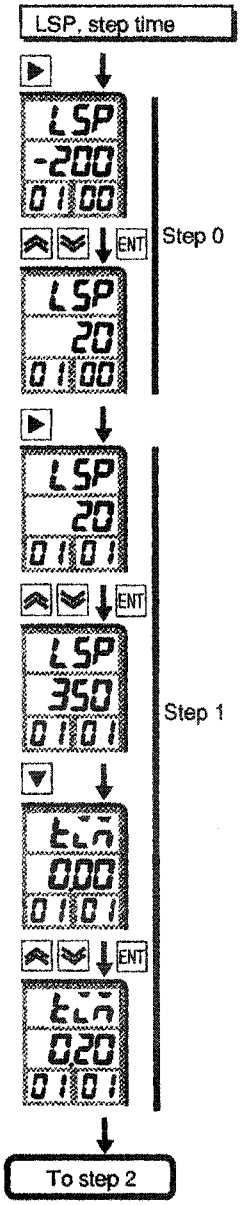
Let's leave the default "–0.01" (time signal invalid) as it is.
For details on how to this parameter, see 4-6 Applying Programmed Operation (page 4-17).

Setting Example

In this example, let's set up the following program.



Parameter		Step 0	Step 1	Step 2	Step 3	Step 4
LSP	Local SP	20	350	350	200	200
tim	Step time	0.00	0.20	0.20	0.30	0.30



The following describes how to set the "local SP" and "step time" parameters in the program. In this example, other step parameters use program defaults. This example also assumes that the pattern parameters of pattern 1 are set, and the program time unit is set to "1" (hours:minutes).

●Local SP of step 0

- When you have finished setting the pattern parameter, press the ▶ key. The No.1 display indicates LSP, and the STEP display remains at "00". If you are setting up a pattern for the first time, the No.2 display is dim.
- The local SP of step 0 is used as the SP at the start of the program.
- Press the ▲ or ▼ keys until the No.2 display indicates the value "20". When "20" is displayed, press the ENT key.

●Step time of step 0

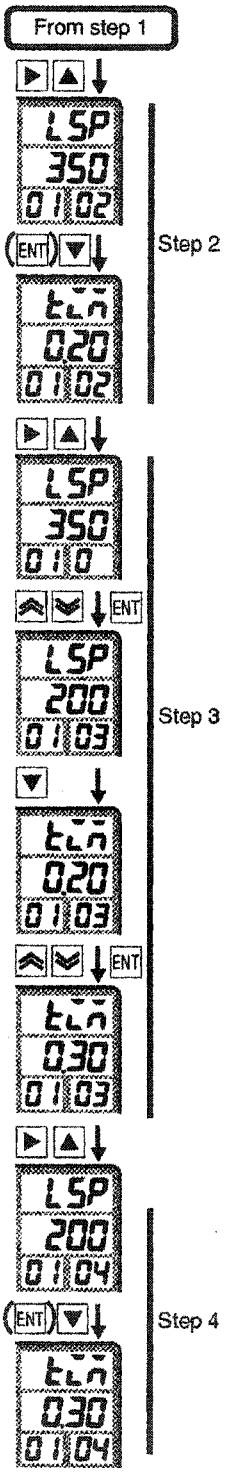
Programs are actually run from step 1 and not step 0. So, set the time of step 0 to "0" minutes. Here, the default "0.00" is used, so you need not set any value.

●Local SP of step 1

- Press the ▶ key, until the STEP display indicates "01". The settings of step 0 are displayed copied to the No.2 display. When setting parameters for the first time to step 1, the No.2 display is dim.
- Press the ▲ or ▼ keys until the No.2 display indicates the value "350". When "350" is displayed, press the ENT key.

●Step time of step 1

- Press the ▼ key until the No.1 display indicates tim.
- Press the ▲ or ▼ keys until the No.2 display indicates the value "0.20". When "0.20" is displayed, press the ENT key.



●Local SP of step 2

- Press the ▲ key to return to the "local SP" parameter.
- Press the ▶ key until the STEP display indicates "02". The settings of step 1 are displayed copied to the No.2 display.
- In this example, the settings of steps 1 and 2 are the same, so they need not be changed. When setting parameters to step 2 for the first time, the No.2 display is dim. This indicates that the settings have not been fixed. To fix the settings, press the ENT key.

●Step time of step 2

- Press the ▼ key until the No.1 display indicates tim.
- In this example, the settings of steps 1 and 2 are the same, so they need not be changed.

●Local SP of step 3

- Press the ▲ key to return to the "local SP" parameter.
- Press the ▶ key until the STEP display indicates "03". The settings of step 2 are displayed copied to the No.2 display. When setting parameters for the first time to step 3, the No.2 display is dim.
- Press the ≪ or ≫ keys until the No.2 display indicates the value "200". When "200" is displayed, press the ENT key.

●Step time of step 3

- Press the ▼ key until the No.1 display indicates tim.
- Press the ≪ or ≫ keys until the No.2 display indicates the value "0.30". When "0.30" is displayed, press the ENT key.

●Local SP of step 4

- Press the ▲ key to return to the "local SP" parameter.
- Press the ▶ key until the STEP display indicates "04". The settings of step 3 are displayed copied to the No.2 display. When setting parameters for the first time to step 4, the No.2 display is dim.
- In this example, the settings of steps 3 and 4 are the same, so they need not be changed. When setting parameters to step 4 for the first time, the No.2 display is dim. This indicates that the settings have not been fixed. To fix the settings, press the ENT key.

●Step time of step 4

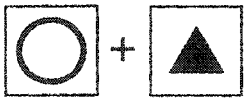
- Press the ▼ key until the No.1 display indicates tim.
- In this example, the settings of steps 3 and 4 are the same, so they need not be changed.

This completes setting of the local SP and step time parameters in the program.

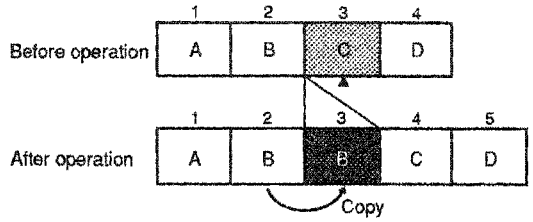
■ Editing steps

Steps can be inserted and deleted from programs by using the front panel keys.
The following examples all describe an editing operation carried out in step 3 of the program. A to D indicate step parameters.

● Inserting a step

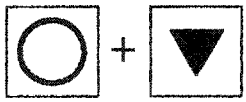


If you simultaneously press the ○ and ▲ keys, the content of the immediately previous step is copied to the currently selected step, and the contents of steps following the currently selected step are fed forward one step each.
Take a look at the following example. As you can see from this figure, if you simultaneously press the ○ and ▲ keys, the content of step 3 is substituted with the content of step 2, the content of step 4 is substituted with the content of step 3, and so forth.

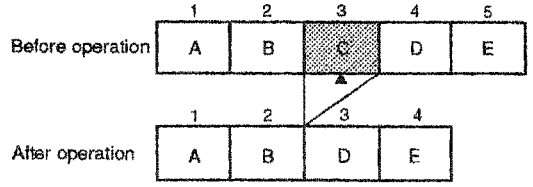


You cannot insert a step into a program already containing 99 steps (the maximum number of steps. When you attempt to do this, the No.1 display indicates error E 760 (number of program steps limit).

● Deleting a step

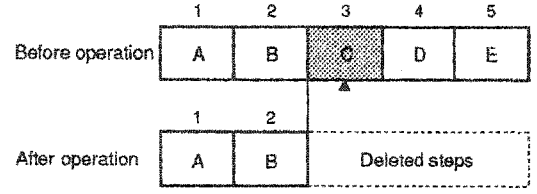


If you simultaneously press the ○ and ▼ keys, the currently selected step is deleted, and subsequent steps are fed backwards by one step each.
Take a look at the following example. As you can see from this figure, if you simultaneously press the ○ and ▼ keys, step 3 is deleted, and step 4 and subsequent steps are fed backwards by one step each.



● Deleting remaining steps

If you simultaneously press the ○ and ENT keys, the currently selected step and all subsequent steps are deleted.
Take a look at the following example. As you can see from this figure, if you simultaneously press the ○ and ENT keys, step 3 and all subsequent steps are deleted.



To batch delete the steps contained in a single pattern, select step 0 and simultaneously press the ○ and ENT keys.

3.7 Starting and Stopping Control

■ Starting operation

"Running" refers to starting program operation. Program operation can be started in one of two ways.

● By the RUN key

Hold the RUN key down for more than one second.

● By external switches

"Run" is already assigned to digital input 1 (DI1) on models ES100P-□□□□D and ES100P-□□□□E. This terminal or pin can be used as an operation start switch if a switch is connected.
For details, see Chapter 2 Preparations.

While the programming is running, the RUN LED lights.

■ Stopping operation

When the program has finished running, operation stops automatically. Operation can also be forcibly stopped by resetting the ES100P. There are three ways of resetting the ES100P.

● By the "reset" parameter

Program operation can be stopped at any point in the program where you have set the "reset" parameter to "1" in the operation mode (setting level 1).
When the program reaches the "reset" parameter, the ES100P is reset, and the No.1 display indicates **P005**. During reset, the RST LED lights.

● By external switches

"Reset" is already assigned to digital input 2 (DI2) on models ES100P-□□□□D and ES100P-□□□□E. This terminal or pin can be used as an operation stop switch if a switch is connected.
For details, see Chapter 2 Preparations.

● By the PF keys

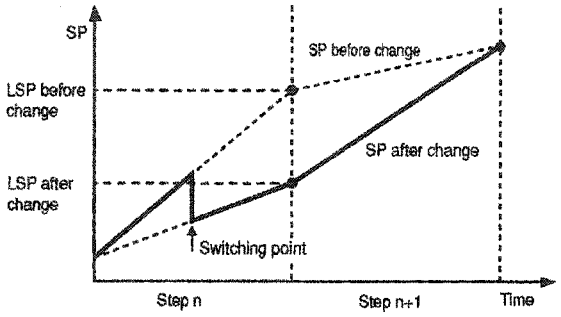
"Reset" can be assigned to either the PF1 or PF2 keys by setting the "PF key type" parameter to "4".
To forcibly stop program operation, press the PF key to which "reset" has been assigned.
For details on how to set the "PF key type" parameter, see 3-4 Key Display and Assignments.

3.8 Adjusting Control Operation

■ Changing currently executing patterns

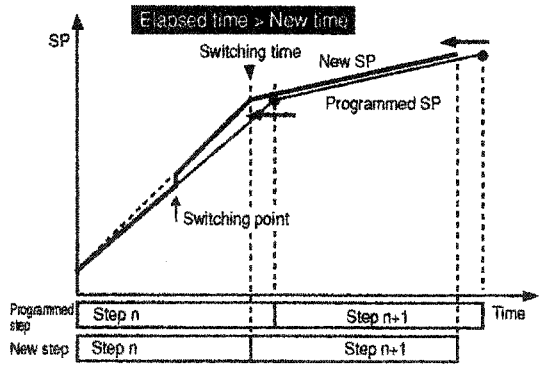
In the program method, any changes made to the program pattern while it is running effect the track (slope) of the SP. The following two items describe how program pattern changes effect the track of the SP. Use these examples as references for actual controller operation.

● Changing the local SP



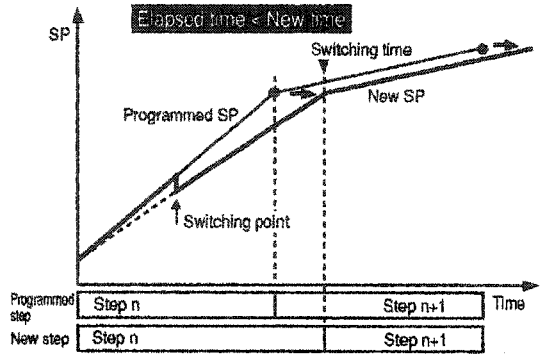
If you change the local SP during execution of a step, the switching point is substituted, and the SP moves to a new point on the track (line generated by connecting the start point of the step and the switching point).
As the start point of the next step is the local SP of the current step, the track of the next step also is effected.

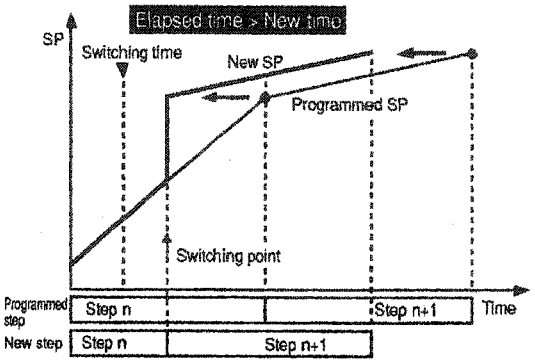
● Changing the step time



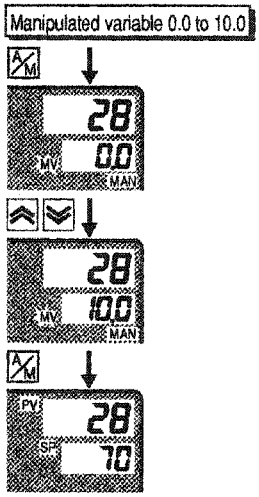
If you change the step time during execution of a step, the slope of the track changes, and the SP moves to a new point on the track. However, movement of the SP does not effect the slope of the next step.

If the new step time is shorter than the elapsed time, the program advances immediately to the next step.





■ Manual operation



Set the ES100P to the manual mode using a manual manipulated variable as the manipulated variable (MV).
First, switch to the manual mode. Alternately pressing the A/M key switches the ES100P between the automatic and manual modes. 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 ES100P-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.)

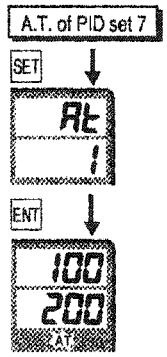
When you execute auto-tuning, the optimum PID parameters are automatically set by forcibly changing the manipulated variable to calculate the characteristics (limit cycle method) of the control target.

Auto-tuning saves the results to the PID set No. designated in the "A.T. execution" parameter in the tuning 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 **Rt**. 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.

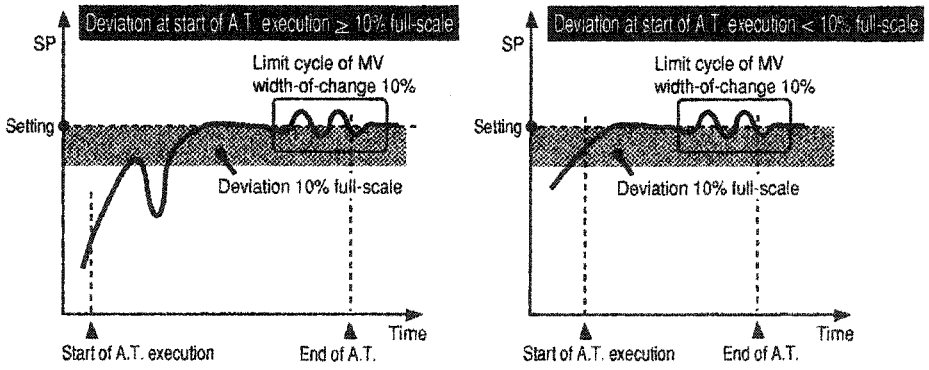
To execute auto-tuning on other PID sets, press the [^] or [v] keys, and press the [ENT] key when the No.2 display indicates the target PID set No.

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

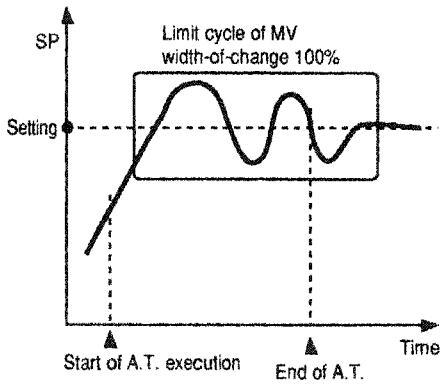
Auto-tuning cannot be executed in cascade control. Also, some functions are limited during execution of auto-tuning. For details on functions whose operations are limited, see page 7-7.

● 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.)

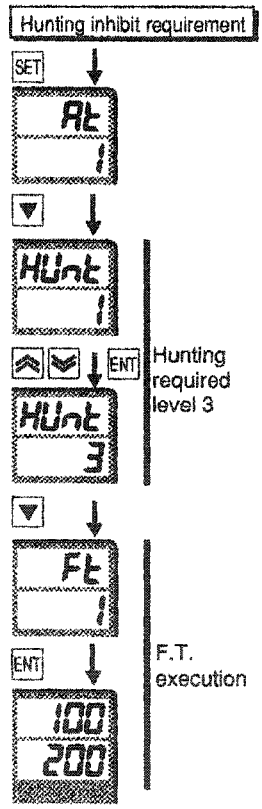
The parameters in the tuning mode (setting level 1) are used for fine tuning.

The required levels for improving the level of ES100P 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 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

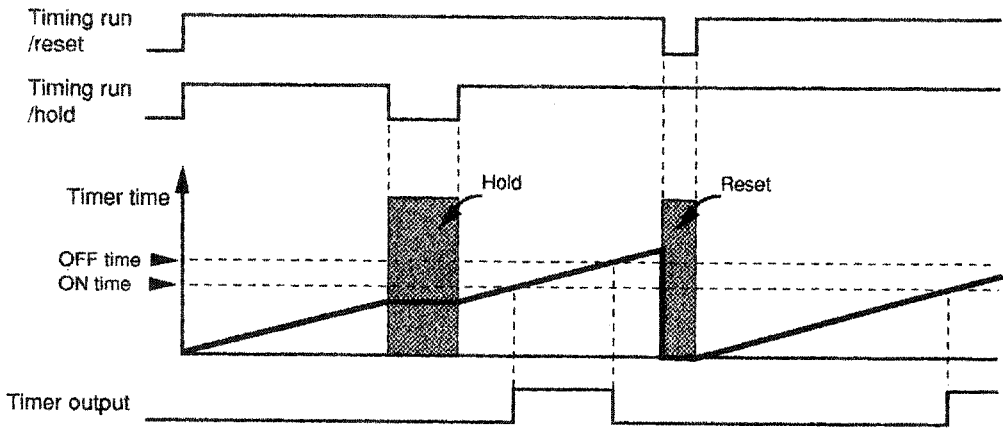
4.1 ON/OFF Timer

■ 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 STEP 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

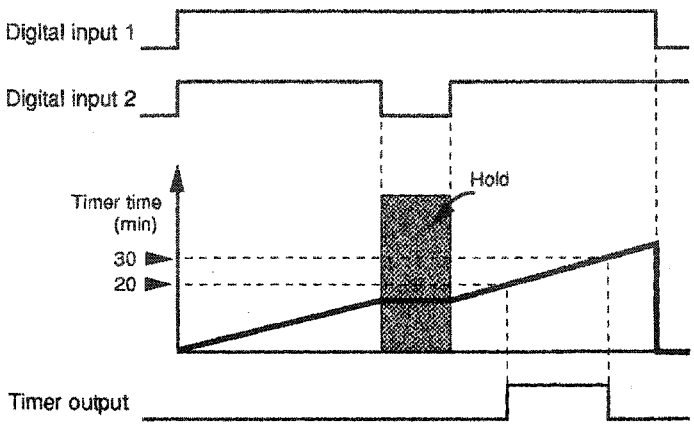
In this example, let's set the ON time to 20 minutes and the OFF time to 30 minutes to timer 2.
We shall also set the "timing run/reset input" parameter to digital input 1, and the "timing run/hold input" parameter to digital input 2.

● 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



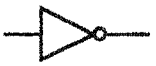
4.2 Digital Operation Assignments

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/reset, hold/hold cancel, 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 5-33.

■ Assignment examples

● Digital I/O assignment

Program operation starts when digital input 1 is set to "1", and stops when digital input 2 is set to "1".
When event outputs 1 and 2 are set to "1", they are output to digital outputs 1 and 2 as alarms. However, note that the output of alarm output 1 is held when digital input 3 is set to "1".

The following table shows the operation table assignments.

Operation Table

Table No.		1	2	3	4
Assignment Destination	d000	RUN	RST	DO1	DO2
Operation 1	Operation d010	BUF	BUF	OR	BUF
	Argument 1 d011	DI1	DI2	EV1	EV2
	Argument 2 d012	—	—	DO1	—
Operation 2	Operation d020	END	END	AND	END
	Argument 1 d021	—	—	N1	—
	Argument 2 d022	—	—	DI3	—
Operation 3	Operation d030			END	
	Argument 1 d031			—	
	Argument 2 d032			—	
Operation 4	Operation d040				
	Argument 1 d041				
	Argument 2 d042				

Settings

Assignment Destination	RUN	62
	RST	61
	DO1	1
	DO2	2
Operation	END	0
	BUF	1
	OR	3
	AND	4
Argument	DI1	1
	DI2	2
	DI3	3
	DO1	141
	EV1	21
	EV2	22
	N1	211

Table 1
Assigns table input 1 (DI1) to run (RUN) as it is (BUF).

Table 2
Assigns table input 2 (DI2) to reset (RST) as it is (BUF).

Table 3
Assigns event 1 output (EV1) to digital output 1 (DO1). However, note that output is held until digital input 3 (DI3) becomes "0".

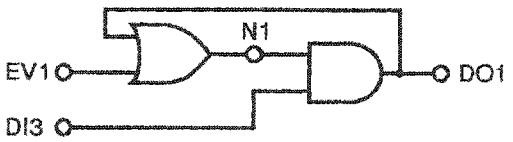


Table 4
Assigns event 2 output (DI2) to digital output 2 (DO2) as it is (BUF).

● BCD input assignment

By this function, you can select pattern Nos. according to BCD input, for example, to external thumb rotary switches. Eight tables 1 to 8 are provided for assigning BCD input. Digital inputs 1 to 8 are weighted as follows:

Digital input 1: 1 Digital input 5: 10
Digital input 2: 2 Digital input 6: 20
Digital input 3: 4 Digital input 7: 40
Digital input 4: 8 Digital input 8: 80

To designate pattern 54 after assigning BCD inputs, set digital input 3, digital input 5 and digital input 7 to "1".

The following table shows the operation table assignments.

Table No.		1	2	3	4	5	6	7	8
Assignment Destination	d000	PTN0	PTN1	PTN2	PTN3	PTN10	PTN20	PTN40	PTN80
Operation 1	Operation d010	BUF	BUF	BUF	BUF	BUF	BUF	BUF	BUF
	Argument 1 d011	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8
	Argument 2 d012	—	—	—	—	—	—	—	—
Operation 2	Operation d020	END	END	END	END	END	END	END	END
	Argument 1 d021	—	—	—	—	—	—	—	—
	Argument 2 d022	—	—	—	—	—	—	—	—

Settings

Assignment Destination	PTN0	40	Argument	DI1	1
	PTN1	41		DI2	2
	PTN2	42		DI3	3
	PTN3	43		DI4	4
	PTN10	111		DI5	5
	PTN20	112		DI6	6
	PTN40	113		DI7	7
	PTN80	114		DI8	8
Operation	BUF	1			
	END	0			

Number of patterns in use and assignments

When there are few patterns in use, the assignment destination of the upper order weighting can be abbreviated.
For example, you would set tables 1 to 6, or PTN0 to 3, PTN10, and PTN20 in the above example if you were using up to 20 patterns.

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:

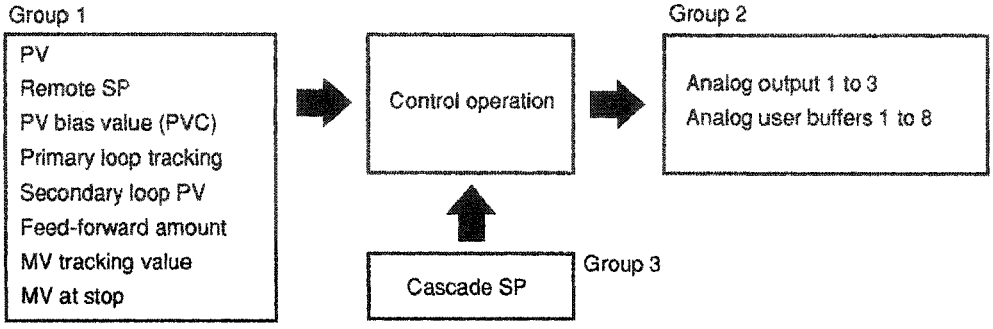
$(100 - (-200))/1500 = 0.2$

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.

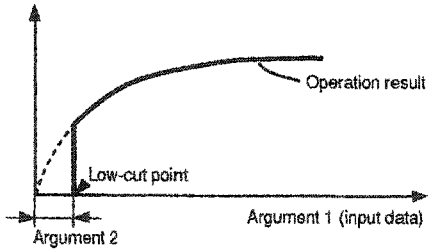
Symbol	Description	Argument 1	Argument 2
END	End of operation	—	—
MOV	Argument 1 is transferred directly to the operation result. Argument 2 is ignored.	Data	—
ADD	Argument 1 is added to argument 2 to obtain the operation result.	Data 1	Data 2
SUB	Argument 2 is subtracted from argument 1 to obtain the 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

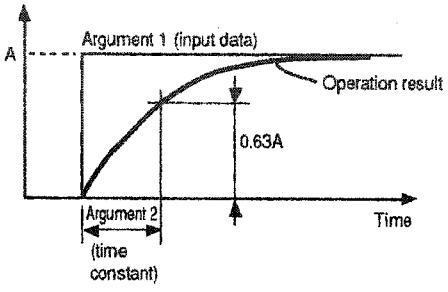
● Extraction of square root (SQR)

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



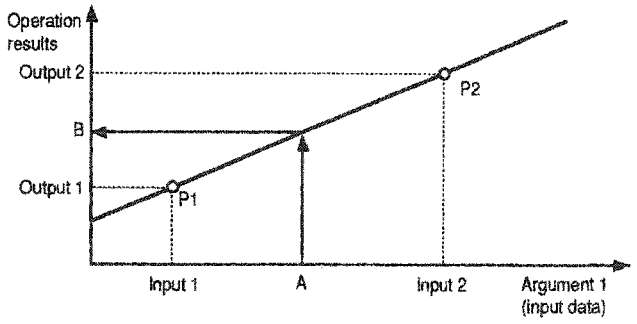
● First order lag filters (LAG1-4)

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



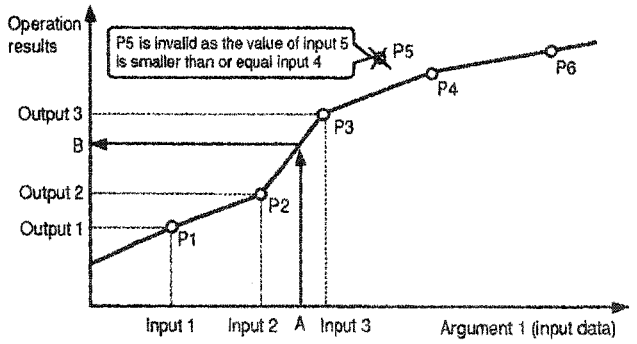
● Straight-line approximation (SCL1-4)

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.



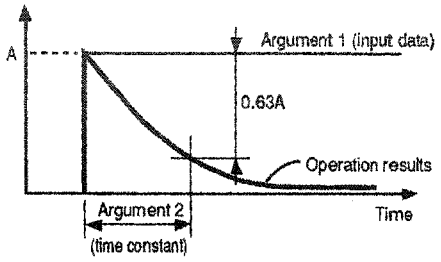
● Broken-line approximation (FNC1-4)

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.



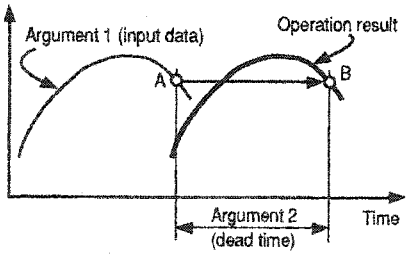
● Differential (LED1, 2)

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.



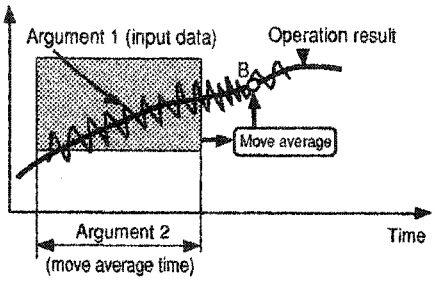
● Dead time (DED)

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
Operation 1 Argument 1	A011	AI1		MV	PV
Operation 1 Argument 2	A012	—		—	—
Operation 2 Operation	A020	END		END	END
Operation 2 Argument 1	A021	—		—	—
Operation 2 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.

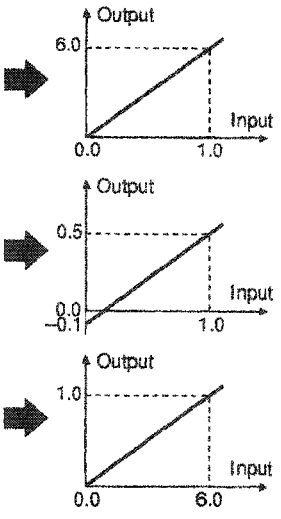
Operation 3
The data of the two inputs are added.

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 ES100P 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 "CMP" is set to "DA3".

● How to use operations

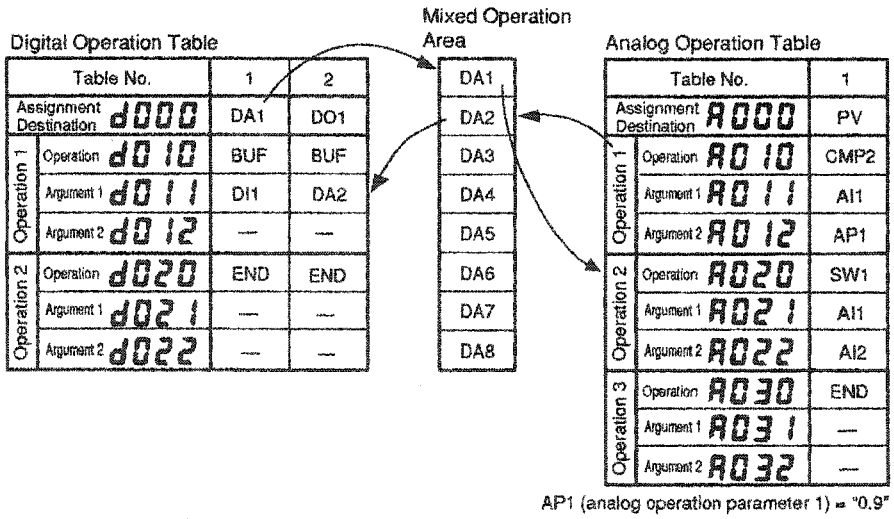
Operation results are as follows.

"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 ≥ argument 2, "DA1-8" is set to "1" then the operation result is "1.0"
When argument 1 < 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 ES100P, 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 program setting mode. Accordingly, the PID control parameters selected for each of step are used in the program.

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 STEP 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.

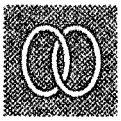
Set the lower limit of the manipulated variable (MV) in the "MV lower limit" parameter and the upper limit of the manipulated variable (MV) in the "MV upper limit" parameter. The following manipulated variables are given priority over the manipulated variable limitter:

- 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.

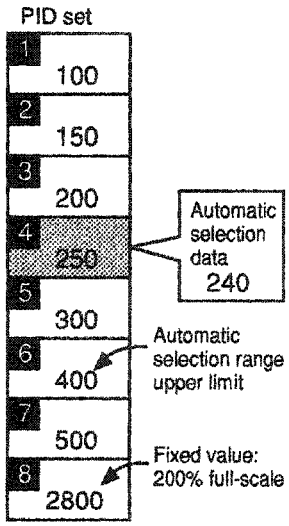
When PID set selection is set, set the upper limit of the range in which the PID set No. is automatically set in the "automatic selection range upper limit" parameter.



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 3-24. For details on fine tuning, see page 3-26.

■ PID set selection



If you set the "PID set No." parameter to "0" in the program 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 step.
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 automatic selection hysteresis" (specification setting mode, setting level 2) in order to prevent chattering during selection of the PID set.

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
	ALL MV lower limit	0.0
	ALH MV upper limit	100.0
	PvS 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 steps, 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 steps. In other words, the control target for tuning is only PID set 1.

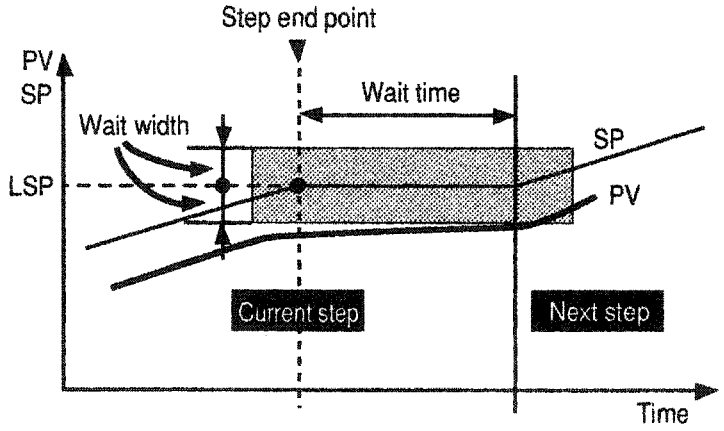
4.6 Applying Programmed Operation

Chapter 3 introduced how to set the "local SP" and "step time" parameters, the parameters for basic operation and events. This section describes the following:

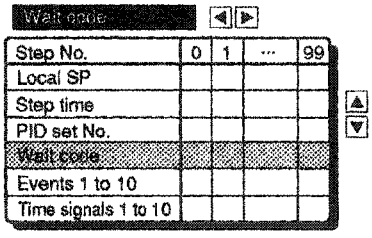
- The "wait code" step parameters and "time signals 1 to 10 ON/OFF time" parameters
- How to change currently executing patterns and steps.

■ Wait operation

"Wait" occurs at the end of a step in the program if PV is not within a set range to which the difference (deviation) between the PV and local SP has been set. This set range is called the "wait width."
During a wait operation, the program advances to the next step if the deviation is within the wait width.
The subsequent operation can be determined when a fixed time (wait time) has elapsed after a wait has occurred.



● Wait code



"Wait codes" designate the wait operation, and are set in the "wait code" parameter for each step of the program. Below are descriptions of the wait codes.

- 0: No wait
  Wait is not executed, and program advances to the next step.
- 1: Wait/wait alarm generated
  Wait is executed, and a wait alarm is generated after the wait time has elapsed. While the wait alarm is generated, the WAIT LED flashes.
- 2: Wait/advance to next step
  Wait is executed, and the program advances to the next step.
- 3: Wait/hold status
  Wait is executed, and the hold status is reached after the wait time has elapsed.
- 4: Hold status
  Hold status is reached unconditionally.

The hold status is canceled in the same way as a regular hold operation by executing a run operation.

● Setting parameters

Set the wait width and wait time in the "wait width" and "wait time" parameters, respectively, in the specification setting mode (setting level 2). The unit used for the wait time is dependent on the setting of the "program time unit" parameter.

Set the wait code in the "wait code" parameter for each step in the program setting mode (setting level 1).

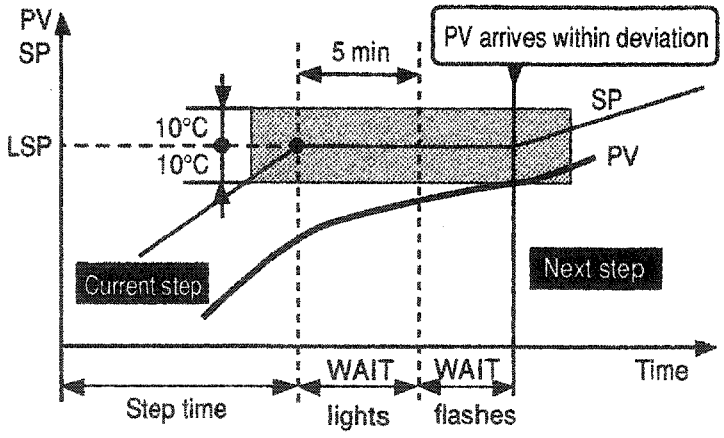
Setting Example

In this example, let's set up a program where the wait operation is used to advance the execution sequence to the next step after PV is within the deviation (wait width).

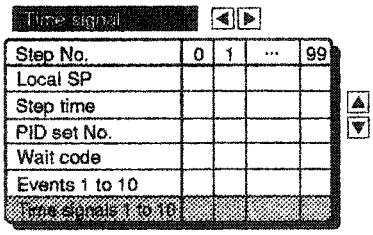
Set the wait width to 10°C, wait time to 5 minutes, and the wait code to "1" (wait/wait alarm generated).
This example assumes that the target steps have already been designated.

● Setting table

	Parameter	Setting
Specification setting mode (setting level 2)	C046 Wait width	10
	C047 Wait time	0500: 5 minutes
Program setting mode (setting level 1)	WAIT Wait code	1: Generate alarm



■ Time signals

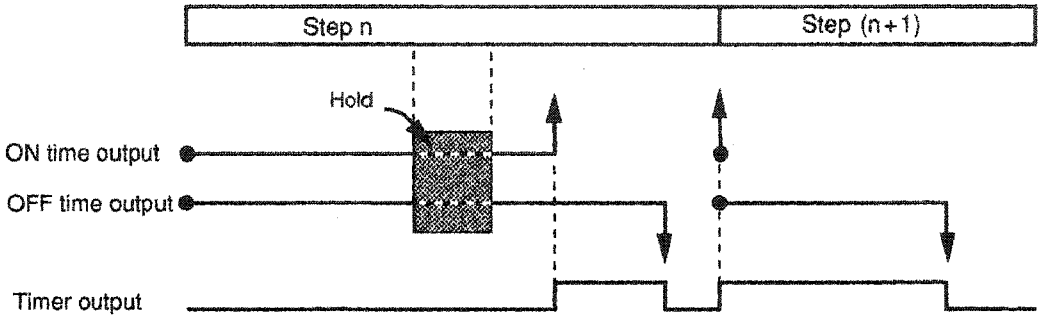


Time signals are timers synchronized with the program. Timers operate for both the ON and OFF times, and the timing operation starts from the beginning of a step.

Timing by time signals is paused during a hold or wait.

When the ON time is reached after start of timing, the time signal output is set ON, and when the OFF time is reached, the time signal output is set OFF. Time signal output is OFF at the end of the pattern even if repeating or linking patterns are designated.

The following figure shows the relationship between ON/OFF time and timer output.



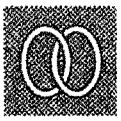
● Related parameters

Time signals (1 to 10) are one of the step parameters, and are set in the "time signals 1 to 10 ON time" and "time signals 1 to 10 OFF time" parameters.

Set the ON time in the "time signals 1 to 10 ON time" parameter, and the OFF time in the "time signals 1 to 10 ON time" parameter.

The unit used for the time signals is dependent on the setting of the "program time unit" parameter in the same way as the "step time" in the specification setting mode (setting level 2). So, the correct program time unit must be set before setting step parameters.

Setting of "–0.01" for both the "time signals 1 to 10 ON time" and "time signals 1 to 10 OFF time" parameters is invalid. The defaults of the "time signals 1 to 10 ON time" and "time signals 1 to 10 OFF time" parameters is "–0.01", which means that at initial operation the timer signals are not set all steps.



● Hold operation — A hold is one the operations programmed to a step, and causes timing of the step to pause. For details, see page 4-20.

● Pattern repeat/ Pattern link destination — These are pattern parameters in the program. For details, see page 3-16.

Setting Example

In this example, let's make the following settings:

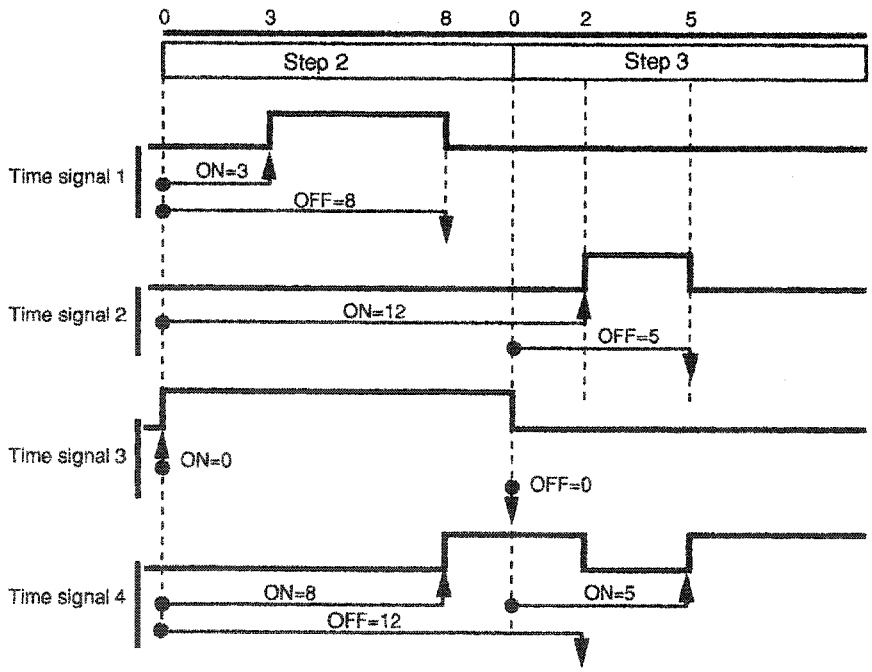
- Set steps 2 and 3 as the target steps.
  Set the step times of both steps 2 and 3 to 10 minutes.
- Set time signal 1 ON three minutes after start of step 2, and OFF eight minutes after start of step 2.
- Set time signal 2 ON 12 minutes after start of step 2, and OFF five minutes after start of step 3.
- Set time signal 3 ON only for the duration of step 2.
- Set time signal 4 to generate the OFF pulse of time signal 2.

Time signal 4 is set ON eight minutes after start of step 2, and OFF twelve minutes after start of step 2. Time signal is then set ON five minutes after start of step 3.

● Setting table

Time signal		Step 2	Step 3
1	ön 1 ON time	3.00	–0.01
	öF 1 OFF time	8.00	–0.01
2	ön 2 ON time	12.00	–0.01
	öF 2 OFF time	–0.01	5.00
3	ön 3 ON time	0.00	–0.01
	öF 3 OFF time	–0.01	0.00
4	ön 4 ON time	8.00	5.00
	öF 4 OFF time	12.00	–0.01

● Timer operation



■ Pattern operation

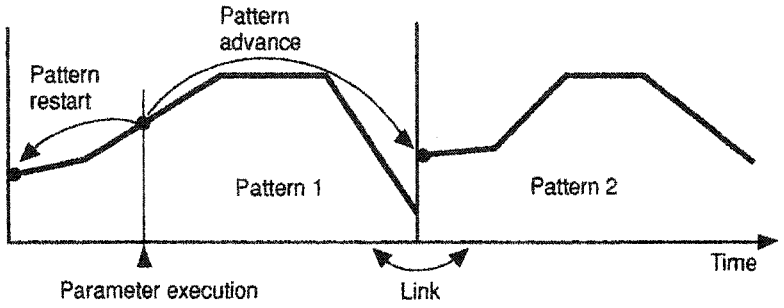
The ES100P is provided with functions for returning to the start of a pattern or advancing to a designated pattern during running of the program. These two functions can be used as assignment destinations in digital operation assignments, so the following is possible:

- Patterns can be switched by external switches (digital input).
- The start of operation point of the program can be manipulated at restoration after a power interruption in combination with the "PV start" parameter in the pattern parameters.

Pattern operation parameters are set in the operation mode (setting level 1). The OPR LED lights in the operation mode.

● Pattern advance

When you set the "pattern advance" parameter to "1", the program advances to the beginning of the link destination pattern that has been set to the currently executing pattern. So, the "pattern link destination No." must be set before executing the pattern advance operation.



● Pattern restart

When you set the "pattern restart" parameter to "1", the program is returned to the beginning of the currently executing pattern and operation is continued.

● Setting parameters

The "pattern advance" and "pattern restart" parameters are provided for pattern operations. After the pattern operation is executed, the parameter setting returns to "0".

Parameter	Setting
P017 Pattern advance	1
P018 Pattern restart	1

■ Step operation

The ES100P is provided with functions for returning to the start of a step or advancing to a designated step during running of the program. Step operation parameters are set in the operation mode (setting level 1). The OPR LED lights in the operation mode.

● Advance

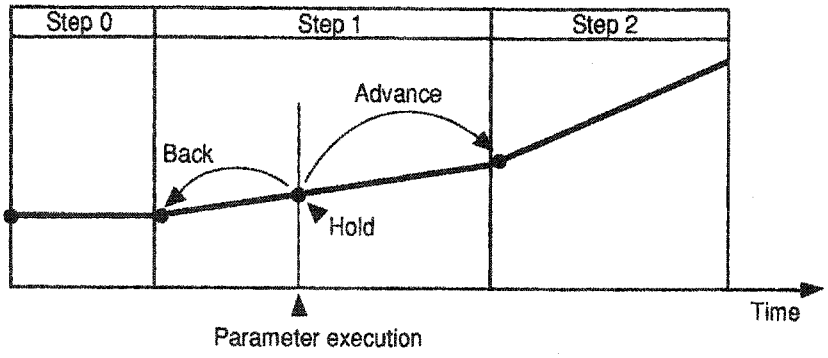
When you set the "advance" parameter to "1", the program advances to the beginning of the next step. If this is executed continuously, the program can be advanced one step at a time.

● Hold

When you set the "hold" parameter to "1", timing designated in the "step time" parameter is paused. The hold status is canceled in the same way as a regular hold operation by executing a run operation.

● Back

When you set the "back" parameter to "1", step timing is reset, and the program returns to the beginning of the currently executing step.
If back is executed in a hold status, the hold status is held even after returning to the beginning of the currently executing step.



● Setting Parameters

The "advance," "hold" and "back" parameters are provided for step operations. After the step operation is executed, the parameter setting returns to "0".

Parameter	Setting
P002 Advance	1
P003 Hold	1
P004 Back	1

Reset operation

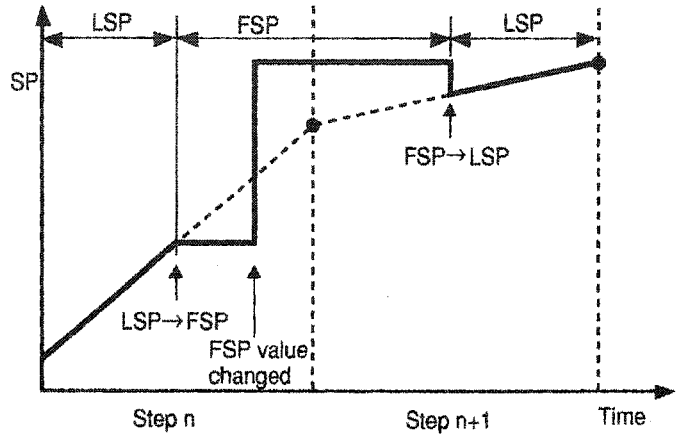
Step operations are also provided with a reset function. For details, see 3.7 Starting and Stopping Operation (page 3-21).

4.7 Changing the SP Mode

The ES100P is provided with three SP settings: local SP (LSP), remote SP (RSP) and fixed SP (FSP).
These SPs are switched in the "SP mode" parameter in the operation mode (setting level 1).

● SP mode switching example

The figure below shows an example of switching between the local SP mode and fixed SP mode during running of the program. The figure represents the following switching operation:
(1) The fixed SP mode is switched to from the local SP mode at step n.
(2) The fixed SP is changed.
(3) The local SP mode is returned to from the fixed SP mode at step n+1.



● Setting the fixed SP

The fixed SP is set in the "fixed SP" parameter (adjustment mode, setting level 1) within the range 1 to 100% full-scale.
The No.1 display indicates **P 10 1** when setting the "fixed SP" parameter.

● Setting parameters

Operation mode (setting level 1)

Parameter	Setting
P008 SP mode	0: Local SP 1: Remote SP 2: Fixed SP

● Step time — Step parameters other than the SP are valid even if the SP mode is switched during running of the program. So, the program continues running as it is. The program stops running when the total step time is reached.

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

4.8 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.
P206 Pattern repeat execution count monitor	Monitors the number of times the same pattern has been repeated.
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 the expanded 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 ES100P.

CHAPTER 5 PARAMETERS

Setting Level 2

Setting Level 1

Conventions Used in This Chapter

Parameter name

Setting mode

Setting level

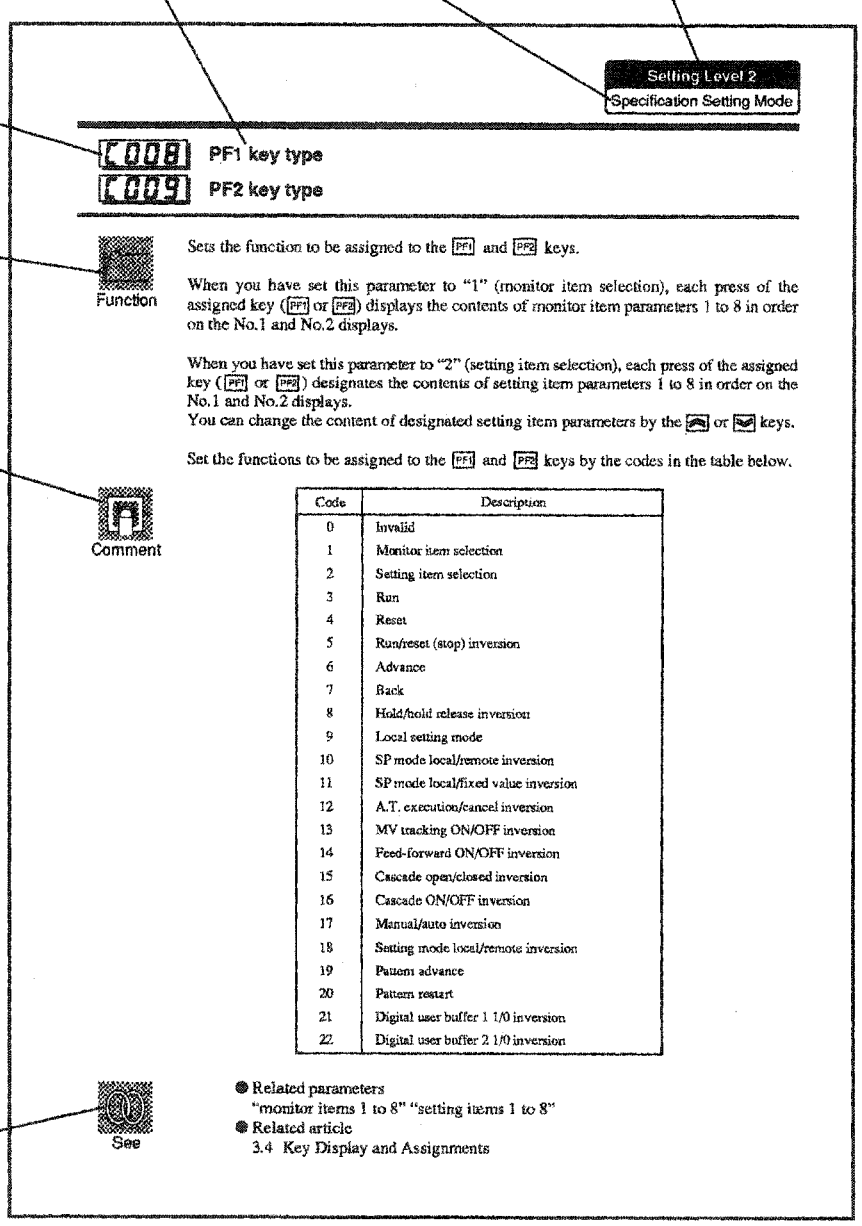
Symbol indicated on the display of the ES100P

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.



Code	Description
0	Invalid
1	Monitor item selection
2	Setting item selection
3	Run
4	Reset
5	Run/reset (stop) inversion
6	Advance
7	Back
8	Hold/hold release inversion
9	Local setting mode
10	SP mode local/remote inversion
11	SP mode local/fixed value 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
19	Pattern advance
20	Pattern restart
21	Digital user buffer 1 1/0 inversion
22	Digital user buffer 2 1/0 inversion


Related parameters and items


Precautions during setting


Example of how to use parameters


Useful things to know


Models of the ES100P supporting the parameter currently being described

If this icon is not indicated, the parameter is supported by all models.

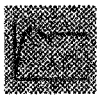
5.1 Specification Setting Mode

- 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
			C045	Program method	5-21
			C046	Wait width	5-22
C026	Bar graph display item	5-12	C047	Wait time	5-22
C027	Key protect	5-13	C048	Time unit of SP rate limits	5-23
C028	Direct/reverse action	5-13	C049	Display refreshing cycle	5-23
C029	Secondary loop direct/reverse action	5-14	C050	Line noise reduction	5-24
C030	2-PID/2-PID + fuzzy	5-14	C051	Motor calibration execution	5-24
C031	Heating-cooling/standard	5-15	C052	Travel time	5-24

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 (ES100P-□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 PV.

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

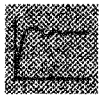
- Related parameters
  "analog input 1 type" "temperature unit"
- Related article
  3.3 Setting I/O Specifications

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

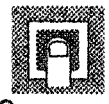
C009 PF2 key type


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	Reset
	5	Run/reset (stop) inversion
	6	Advance
	7	Back
	8	Hold/hold release inversion
	9	Local setting mode
	10	SP mode local/remote inversion
	11	SP mode local/fixed value 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
	19	Pattern advance
	20	Pattern restart
	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	Step elapsed time	PV : −10 to 110%full-scale	U
6	PV	Step remained time	Time : 0.00 to 99.59	*2
7	Local SP	Step elapsed time	LSP : 0 to 100%full-scale	U
8	Local SP	Step 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.

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
2	FSP	Fixed SP	0 to 100%full-scale	
3	tim	Step 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	Eu 10	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	AP 10	Analog operation parameter 10		
27	AP 11	Analog operation parameter 11		
28	AP 12	Analog operation parameter 12		
29	AP 13	Analog operation parameter 13		
30	AP 14	Analog operation parameter 14		
31	AP 15	Analog operation parameter 15		
32	AP 16	Analog operation parameter 16		
33	AP 17	Analog operation parameter 17		
34	AP 18	Analog operation parameter 18		
35	AP 19	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	AP31	Analog operation parameter 31		
48	AP32	Analog operation parameter 32		
49	Ptn	Pattern No.	0 to 99	None
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	MrES	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	MLL	MV lower limit	−5.0 to upper limit −0.1	%
58	MLH	MV upper limit	Lower limit −0.1 to 105.0	
59	MLr	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	MrS2	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

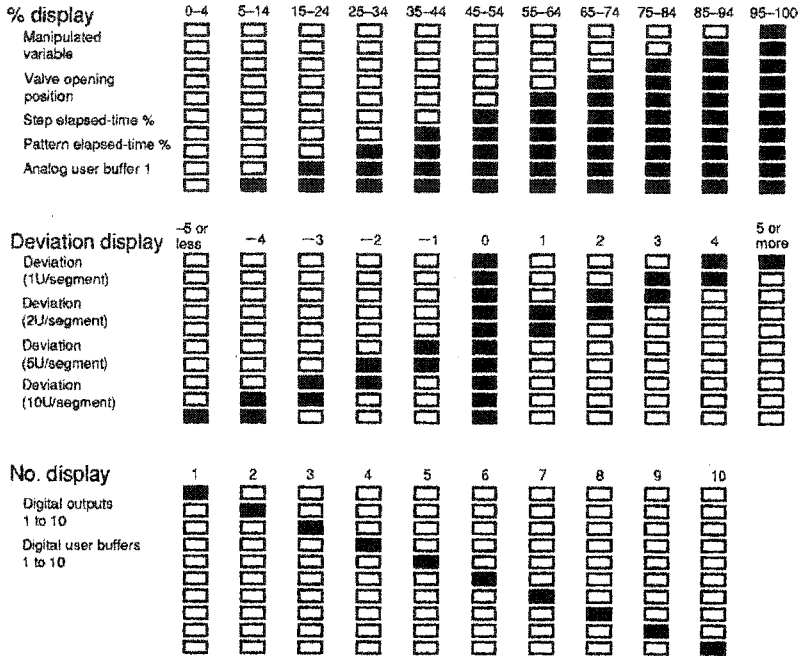
● When setting is "0"
When the "setting item 1" parameter is set to "0", the setting of the setting item is treated as "1" (LSP).
When the "setting items 2 to 8" parameters are set to "0", the parameter is invalid.

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	Step elapsed-time%
3	Pattern 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 ES100P.
Standard model: 0 (manipulated variable)
Position-proportional model: 1 (valve opening position)

See

● Related article
3.4 Key Display and Assignments

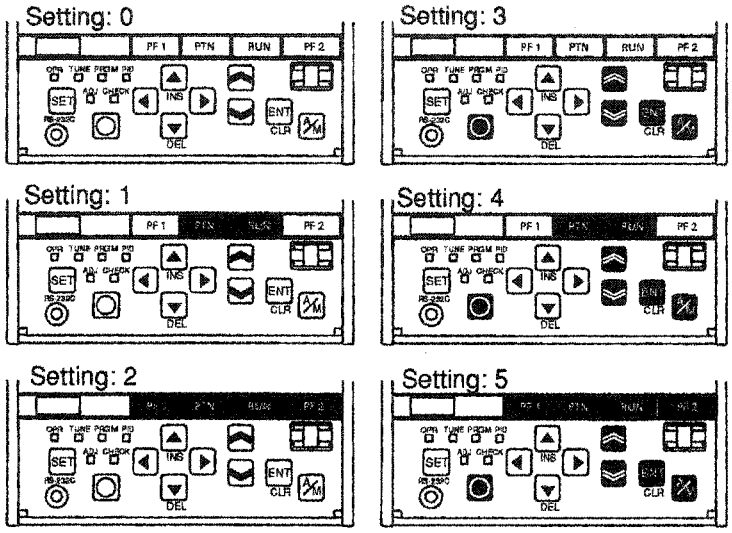
C027 Key protect

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.

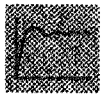
	Code	Description
Default	0	Reverse action
	1	Direct action

See

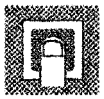
● Related article
3.3 Setting I/O Specifications

Setting Level 2
Specification Setting Mode

C029 Secondary loop direct/reverse action

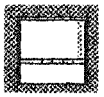

Function

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


Comment

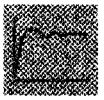
Set secondary loop direct/reverse action by the codes in the table below.

	Code	Description
Default	0	Reverse action
	1	Direct action

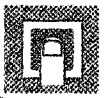

Model

2-input (ES100P-□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

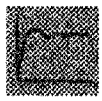
Set 2-PID/2-PID + fuzzy by the codes in the table below.

	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

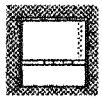

Function

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

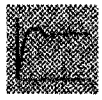

Model

Standard (ES100P-AAH□··□)


See

● Related article
6.1 Heating/Cooling Control

C032 Potentiometer input

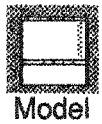

Function

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)

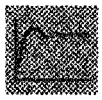

Model

Position-proportional (ES100P-RRP□··□)


See

● Related article
6.2 Position-proportional Control

C033 Cascade/standard

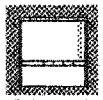

Function

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

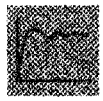

Model

2-input (ES100P-□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/reset 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/reset status is held and the manual mode is entered. The manipulated variable is the value at the stop operation.
- Reset status
  When the reset 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.

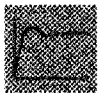

Comment

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

	Code	Description
Default	0	Continuation
	1	Manual mode
	2	Reset status

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

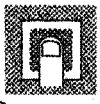
C036 MV at PV error (position-proportional control system)


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.

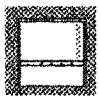

Comment

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

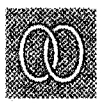
Parameter	Setting Range	Unit	Default
MV at PV error (except position-proportional control)	-5.0 to 105.0	%	0.0
MV at PV error (position-proportional control)	-1, 0, 1	None	0

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

	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 (ES100P-RRP□··□)
"MV at PV error (not position-proportional control)" parameter: Standard (ES100P-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 fixed SP mode from the local SP mode or remote SP mode during running of the program, the SP value in a new SP mode is held at the SP value used immediately before switching.

Comment

Set SP tracking by the codes in the table below.

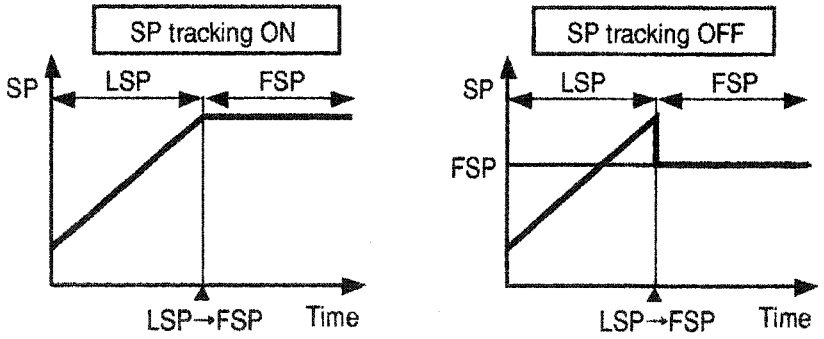
	Code	Description
	0	OFF
Default	1	ON

See

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

Example of use

The following figures illustrate how SP tracking works when the SP mode is switched from the local SP mode to the fixed 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 5-41. 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 (ES100P-□··□E)

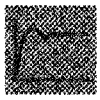
See

- 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.

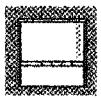

Comment

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 report	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) (ES100P-□··□01□)
Communications (RS-422/485) (ES100P-□··□04□)

C043 Program time unit

Function

Designates the time unit for the program. The "program time unit" parameter should be set before setting the following parameters.

- Specification setting mode (setting level 2)
  "wait time" parameter
- Program setting mode (setting level 1)
  "step time" parameter
  "time signals 1 to 10 ON time" parameter
  "time signals 1 to 10 OFF 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

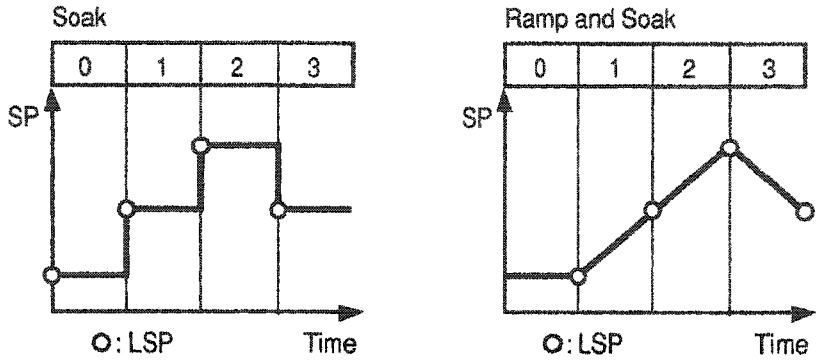
If you change the "program time unit" parameter setting after having set the times in the above four parameters, only the display of the previously set time unit is changed. For example, if you changed the "program time unit" parameter to hours:minutes after setting "25.30" (25 minutes 30 seconds) using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

C045 Program method

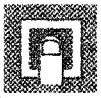
Function

Designates the track mode when running the program using the local SP mode.

- When set to "0" (soak), the local SP is held at a fixed value.
- When set to "1" (ramp and soak), the track is made by joining the local SP of the previous step and the local SP of the step currently being executed with a straight line.



Setting Level 2
Specification Setting Mode


Comment

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

	Code	Description
	0	Soak
Default	1	Ramp and soak


See

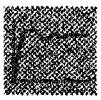
● Related parameter
"local SP" (program setting mode, setting level 1)


Note

In program method, the local SP will be used at the start of the program as step 0 has no previous step. Accordingly, set the step time of step 0 to "0" to provide the SP with a slope from the start of program operation. (Step 0 is skipped.)

C046 Wait width

C047 Wait time

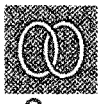

Function

Sets the specifications of the wait operation.
- The "wait width" parameter sets the deviation in which the wait operation functions.
- The "wait time" parameter sets the continuation time of the wait operation.


Comment

Parameter	Setting Range	Unit	Default
Wait width	0 to 100% full-scale	U	1%full-scale
Wait time	0.00 to 99.59	*1	0.00

*1: Designate the time unit of the "wait time" parameter in the "program time unit" parameter.


See

● Related parameters
"program time unit" (specification setting mode, setting level 2)
"wait code" (program setting mode, setting level 1)
● Related article
4.6 Applying Programmed Operation

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.

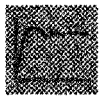
Comment

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

Setting Level 2
Specification Setting Mode

C050 Line noise reduction


Function

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

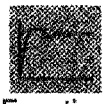

Comment

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

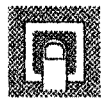
	Code	Description
Default	0	50 Hz
	1	60 Hz

C051 Motor calibration execution

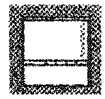
C052 Travel time


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.


Comment

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


Model

Position-proportional (ES100P-RRP□··□)


See

● Related article
6.2 Position-proportion Control

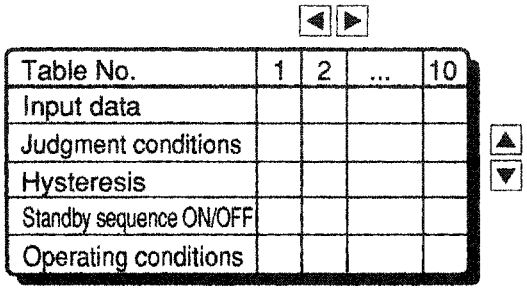
5.2 Event Setting Mode

- The event setting mode sets the specifications for events to be generated for each of the program steps. Set the event setting mode in the "events 1 to 10 setting" parameters (program setting 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.



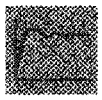
- The table No. corresponds to the event No. For example, the conditions of event 1 are set to table 1. To select the table No., press the [◀] or [▶] keys. To select parameters, press the [▲] or [▼] keys. The table No. is displayed on the STEP display.

- 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	5-26
C 102	Judgment conditions	5-26
C 103	Hysteresis	5-27
C 104	Standby sequence ON/OFF	5-27
C 105	Operating conditions	5-27

Setting Level 2
Event Setting Mode

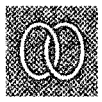
C 101 Input data


Function

Designates which data to apply the event function to.

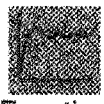

Comment

Set the input data by the codes within the range in the analog operation assignment (arguments) table on page 5-41.
However, note that codes can be set only within the range 0 to 63 (default: "54" (deviation)).
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

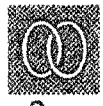

Function

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

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 value" parameters. This parameter is invalid when the "input data" parameter is set to "0".

Comment

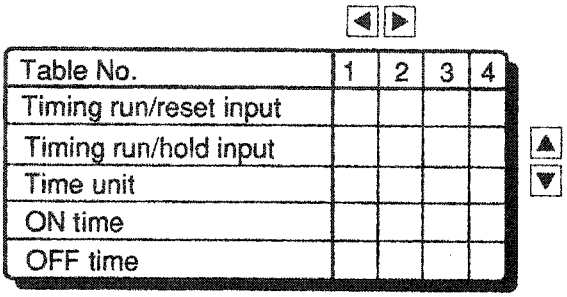
Set the operating conditions by the codes selected from the digital operation assignment (arguments) table on page 5-35.
However, note that codes can be set only within the range 0 to 202. To activate the event function at all times, set this parameter to "201" (ON at all times). (Default is 201)

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.

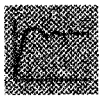


- The table No. corresponds to the timer No. For example, the conditions of timer 1 are set to table 1. To select the table No., press the [◀] or [▶] keys. To select parameters, press the [▲] or [▼] keys. The table No. is displayed on the STEP display.
- The following table shows the parameters in the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

Symbol	Parameter Name	Page
C201	Timing run/reset input	5-29
C202	Timing run/hold input	5-29
C203	Time unit	5-29
C204	ON time	5-30
C205	OFF time	5-30

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).

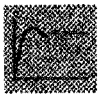

Comment

Set the run/reset and run/hold inputs by the codes selected from the digital operation assignment (arguments) table on page 5-35.
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).

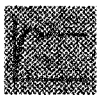

See

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

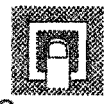
Setting Level 2
ON/OFF Timer Setting Mode

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".

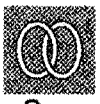

Comment

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).

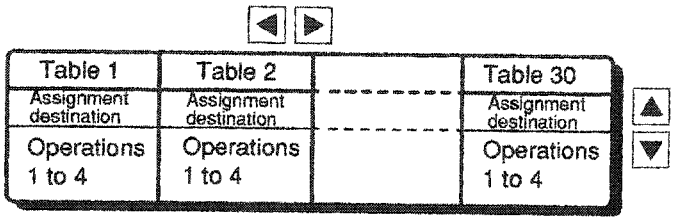
Setting Range	Unit	Default
–1 to 5000	10 hours	–1


See

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

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 STEP 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	5-32
d010	Operation 1	
d011	Operation 1, argument 1	5-34
d012	Operation 1, argument 2	
d020	Operation 2	5-32
d021	Operation 2, argument 1	5-34
d022	Operation 2, argument 2	
d030	Operation 3	5-32
d031	Operation 3, argument 1	5-34
d032	Operation 3, argument 2	
d040	Operation 4	5-32
d041	Operation 4, argument 1	5-34
d042	Operation 4, argument 2	

Setting Level 2
Digital Assignment Operation Setting Mode

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 5-33. 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

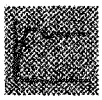
Code	Symbol	Description	Code	Symbol	Description
0	–	Invalid	71	RSP	Remote SP mode
1	DO1	Digital output 1	72	FSP	Fixed SP mode
2	DO2	Digital output 2	73	LCL	Local setting mode
3	DO3	Digital output 3	74	RMT	Remote setting mode
4	DO4	Digital output 4	75	EXT	External setting mode
5	DO5	Digital output 5	..	UNDF	Undefined
6	DO6	Digital output 6	79	EVR	Event standby sequence reset
7	DO7	Digital output 7	80	HDCC	Hold cancel
8	DO8	Digital output 8	81	PTAD	Pattern advance
9	DO9	Digital output 9	82	PTRS	Pattern restart
10	DO10	Digital output 10	..	UNDF	Undefined
..	UNDF	Undefined	91	RNRS	1: Run/0: Reset
21	DU1	Digital user buffer 1	92	HDUH	1: Hold/0: Hold cancel
22	DU2	Digital user buffer 2	93	MNAT	1: Manual mode/0: Auto mode
23	DU3	Digital user buffer 3	94	LRSP	1: Local SP mode/0: Remote SP mode
24	DU4	Digital user buffer 4	95	FRSP	1: Fixed SP mode/0: Remote SP mode
25	DU5	Digital user buffer 5	96	FLSP	1: Fixed SP mode/0: Local SP mode
26	DU6	Digital user buffer 6	97	LCRM	1: Local setting mode/0: Remote setting mode
27	DU7	Digital user buffer 7	98	EXRM	1: External setting mode/0: Remote setting mode
28	DU8	Digital user buffer 8	99	EXLC	1: External setting mode/0: Local setting mode
29	DU9	Digital user buffer 9	..	UNDF	Undefined
30	DU10	Digital user buffer 10	103	KPCC	1: Key protect cancel/0: Key protect ON
31	DU11	Digital user buffer 11	104	DRRV	1: Direct/reverse action inversion/0: Direct/reverse action inversion cancel
32	DU12	Digital user buffer 12	105	IR	1: Integration reset/0: Integration reset cancel
33	DU13	Digital user buffer 13	106	FFOF	1: Feed-forward OFF/0: Feed-forward ON
34	DU14	Digital user buffer 14	107	MVTR	1: MV tracking ON/0: MV tracking OFF
35	DU15	Digital user buffer 15	108	CSOF	1: Cascade OFF/0: Cascade ON
36	DU16	Digital user buffer 16	109	CSOP	1: Cascade open/0: Cascade closed
..	UNDF	Undefined	..	UNDF	Undefined
40	PTN0	Pattern No. 2^0 (weighted 1)	111	PTN10	Pattern No. 2^0 of 10^1 digit (weighted 10)
41	PTN1	Pattern No. 2^1 (weighted 2)	112	PTN20	Pattern No. 2^1 of 10^1 digit (weighted 20)
42	PTN2	Pattern No. 2^2 (weighted 4)	113	PTN40	Pattern No. 2^2 of 10^1 digit (weighted 40)
43	PTN3	Pattern No. 2^3 (weighted 8)	114	PTN80	Pattern No. 2^3 of 10^1 digit (weighted 80)
44	PTN4	Pattern No. 2^4 (weighted 16)	..	UNDF	Undefined
45	PTN5	Pattern No. 2^5 (weighted 32)	116	UNDF	Undefined
46	PTN6	Pattern No. 2^6 (weighted 64)	117	UNDF	Undefined
..	UNDF	Undefined	118	UNDF	Undefined
61	RST	Reset	119	UNDF	Undefined
62	RUN	Run	..	UNDF	Undefined
63	HOLD	Hold	121	DA1	Data 1 for mixed operation
64	ADV	Advance	122	DA2	Data 2 for mixed operation
65	BACK	Back	123	DA3	Data 3 for mixed operation
66	AT	A.T. execution	124	DA4	Data 4 for mixed operation
67	ATSP	A.T. cancel	125	DA5	Data 5 for mixed operation
68	MAN	Manual mode	126	DA6	Data 6 for mixed operation
69	AUTO	Auto mode	127	DA7	Data 7 for mixed operation
70	LSP	Local SP mode	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 Set either of binary or BCD for the pattern No.
When BCD is set, use "PTN0" to "PTN3" for 10^0 digits.
*3 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)
*4 UNDF (undefined) cannot be output.

Setting Level 2

Digital Assignment Operation Setting Mode

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

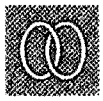


Function

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

Comment

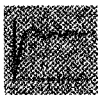
Set the arguments by the codes selected from the digital operation assignment (arguments) table on page 5-35. However, note some controllers have meaningless arguments. For details on defaults, see Appendix, Parameter List.
These parameters are invalid when the "assignment destination" parameter is set 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**

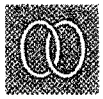


Function

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 5-35. 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

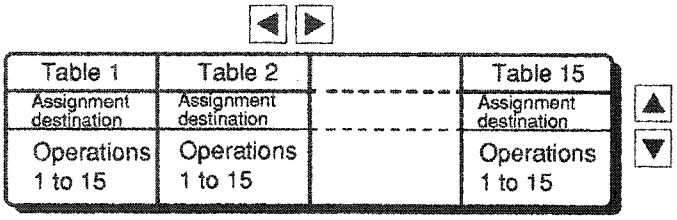
Digital operation assignment – arguments

Code	Symbol	Description	Code	Symbol	Description	Code	Symbol	Description
0	–	Invalid	84	KPCC	Key protect cancel	164	DU4	Digital user buffer 4
1	DI1	Digital input 1	85	DRRV	Direct/reverse action inversion	165	DU5	Digital user buffer 5
2	DI2	Digital input 2	86	IR	Integration reset	166	DU6	Digital user buffer 6
3	DI3	Digital input 3	87	FFOF	Feed-forward OFF	167	DU7	Digital user buffer 7
4	DI4	Digital input 4	88	MVTR	MV tracking ON	168	DU8	Digital user buffer 8
5	DI5	Digital input 5	89	CSOF	Cascade OFF	169	DU9	Digital user buffer 9
6	DI6	Digital input 6	90	CSOP	Cascade open	170	DU10	Digital user buffer 10
7	DI7	Digital input 7	91	WAIT	Wait	171	DU11	Digital user buffer 11
8	DI8	Digital input 8	92	WTAL	Wait alarm	172	DU12	Digital user buffer 12
..	UNDF	Undefined	93	HBAL	Heater burnout alarm	173	DU13	Digital user buffer 13
21	EV1	Event 1	94	CTAL	ON/OFF count alarm	174	DU14	Digital user buffer 14
22	EV2	Event 2	..	UNDF	Undefined	175	DU15	Digital user buffer 15
23	EV3	Event 3	111	PEND	Program end output	176	DU16	Digital user buffer 16
24	EV4	Event 4	112	STEP	Step output	..	UNDF	Undefined
25	EV5	Event 5	113	ADV	Advance output	181	E200	Internal voltage error
26	EV6	Event 6	114	BACK	Back output	182	E210	Cold-junction error
27	EV7	Event 7	..	UNDF	Undefined	183	E300	A/D error
28	EV8	Event 8	120	PTN0	Pattern No. 2^0	184	E410	Analog input 1 error
29	EV9	Event 9	121	PTN1	Pattern No. 2^1	185	E420	Analog input 2 error
30	EV10	Event 10	122	PTN2	Pattern No. 2^2	186	E400	PV error
..	UNDF	Undefined	123	PTN3	Pattern No. 2^3	187	E450	Potentiometer
41	TS1	Time signal 1	124	PTN4	Pattern No. 2^4	..	UNDF	Undefined
42	TS2	Time signal 2	125	PTN5	Pattern No. 2^5	191	DA1	Data 1 for mixed operation
43	TS3	Time signal 3	126	PTN6	Pattern No. 2^6	192	DA2	Data 2 for mixed operation
44	TS4	Time signal 4	..	UNDF	Undefined	193	DA3	Data 3 for mixed operation
45	TS5	Time signal 5	130	STP0	Step No. 2^0	194	DA4	Data 4 for mixed operation
46	TS6	Time signal 6	131	STP1	Step No. 2^1	195	DA5	Data 5 for mixed operation
47	TS7	Time signal 7	132	STP2	Step No. 2^2	196	DA6	Data 6 for mixed operation
48	TS8	Time signal 8	133	STP3	Step No. 2^3	197	DA7	Data 7 for mixed operation
49	TS9	Time signal 9	134	STP4	Step No. 2^4	198	DA8	Data 8 for mixed operation
50	TS10	Time signal 10	135	STP5	Step No. 2^5	..	UNDF	Undefined
..	UNDF	Undefined	136	STP6	Step No. 2^6	200	0	0 fixed data (always ON)
61	TM1	ON/OFF timer 1	..	UNDF	Undefined	201	1	1 fixed data (always ON) *3
62	TM2	ON/OFF timer 2	141	DO1	Digital output 1	202	1R	1 fixed data (always ON) *3
63	TM3	ON/OFF timer 3	142	DO2	Digital output 2	..	UNDF	Undefined
64	TM4	ON/OFF timer 4	143	DO3	Digital output 3	211	N1	Operation results 1
..	UNDF	Undefined	144	DO4	Digital output 4	212	N2	Operation results 2
71	RUN	Run	145	DO5	Digital output 5	213	N3	Operation results 3
72	HOLD	Hold	146	DO6	Digital output 6	214	N4	Operation results 4
73	AT	A.T. execution	147	DO7	Digital output 7			
74	MAN	Manual mode	148	DO8	Digital output 8			
75	LSP	Local SP mode	149	DO9	Digital output 9			
76	RSP	Remote SP mode	150	DO10	Digital output 10			
77	FSP	Fixed SP mode	..	UNDF	Undefined			
78	LCL	Local setting mode	161	DU1	Digital user buffer 1			
79	RMT	Remote setting mode	162	DU2	Digital user buffer 2			
80	EXT	External setting mode	163	DU3	Digital user buffer 3			

*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 pattern No. and number of steps are 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 11 to 114 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.

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 STEP display.



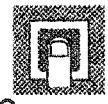
- The following table shows the parameters in the analog operation assignment setting mode and the page where they are described.

Symbol	Parameter Name	Page	Symbol	Parameter Name	Page	Symbol	Parameter Name	Page
A000	Assignment destination	5-37						
A010	Operation 1	5-38	A060	Operation 6	5-38	A110	Operation 11	5-38
A011	Operation 1, argument 1	5-40	A061	Operation 6, argument 1	5-40	A111	Operation 11, argument 1	5-40
A012	Operation 1, argument 2		A062	Operation 6, argument 2		A112	Operation 11, argument 2	
A020	Operation 2	5-38	A070	Operation 7	5-38	A120	Operation 12	5-38
A021	Operation 2, argument 1	5-40	A071	Operation 7, argument 1	5-40	A121	Operation 12, argument 1	5-40
A022	Operation 2, argument 2		A072	Operation 7, argument 2		A122	Operation 12, argument 2	
A030	Operation 3	5-38	A080	Operation 8	5-38	A130	Operation 13	5-38
A031	Operation 3, argument 1	5-40	A081	Operation 8, argument 1	5-40	A131	Operation 13, argument 1	5-40
A032	Operation 3, argument 2		A082	Operation 8, argument 2		A132	Operation 13, argument 2	
A040	Operation 4	5-38	A090	Operation 9	5-38	A140	Operation 14	5-38
A041	Operation 4, argument 1	5-40	A091	Operation 9, argument 1	5-40	A141	Operation 14, argument 1	5-40
A042	Operation 4, argument 2		A092	Operation 9, argument 2		A142	Operation 14, argument 2	
A050	Operation 5	5-38	A100	Operation 10	5-38	A150	Operation 15	5-38
A051	Operation 5, argument 1	5-40	A101	Operation 10, argument 1	5-40	A151	Operation 15, argument 1	5-40
A052	Operation 5, argument 2		A102	Operation 10, argument 2		A152	Operation 15, argument 2	

A000 Assignment destination


Function

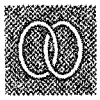
Designates the assignment destination in the analog operation assignment table.


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

CHAPTER 5

Setting Level 2

Analog Operation Assignment Setting Mode

A01	Operation 1	A06	Operation 6	A11	Operation 11
A02	Operation 2	A07	Operation 7	A12	Operation 12
A03	Operation 3	A08	Operation 8	A13	Operation 13
A04	Operation 4	A09	Operation 9	A14	Operation 14
A05	Operation 5	A10	Operation 10	A15	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 5-39. 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	Argument 2 is taken as the time constant. First order lag of argument 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			
21	SCL1	Straight-line approximation 1	Conversion of argument 1 using straight-line approximation	Data	None
22	SCL2	Straight-line approximation 2			
23	SCL3	Straight-line approximation 3			
24	SCL4	Straight-line approximation 4			
31	FNC1	Broken line approximation 1	Conversion of argument 1 using broken-line approximation	Data	None
32	FNC2	Broken line approximation 2			
41	LED1	Differential 1	Argument 2 is taken as the time constant Differential of argument 1	Data	Differential time
42	LED2	Differential 2			
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 5-41. 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 5-41. 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	Manipulated variable tracking value	–9.999 to 9.999	90	0.0	0.0 fixed data	0.0
9	STP	Manipulated variable 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	
53	FSP	Fixed SP		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.

CHAPTER 5

5.6 Setting Level 2 Technical Mode

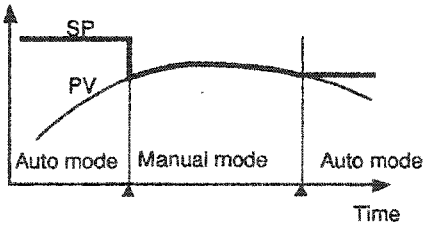
- Parameters in the setting level 2 technical mode is to be used with the defaults unless they are in special applications.
- To switch to setting level 2 from setting level 1, set DIP switch 1 to ON. At switch SW2, set SW2-2 only to ON.
- To switch between the modes in setting level 2, use the SET key.
- 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	5-43	C313	2-PID control parameter α	5-48
C302	Manual output method	5-43	C314	2-PID control parameter β	5-48
C303	Manual MV preset value	5-44	C315	Fuzzy scale 1 adjustment	5-48
C304	Cold junction compensating method	5-44	C316	Fuzzy scale 2 adjustment	5-48
C305	One-shot pulse width	5-45	C317	Fuzzy I coefficient adjustment	5-48
C306	Digital input response time	5-45	C318	Fuzzy adjustment bandwidth	5-49
C307	External No. selection setting time	5-45	C319	Fuzzy SP change judgment value	5-49
C308	Pattern versus PV lag reduction	5-46	C320	Temporary A.T. execution judgment deviation	5-50
C309	Pattern No. at reset	5-46	C321	Number of limit cycles	5-50
C310	A.T. calculated gain	5-47	C322	Bit length (communications)	5-51
C311	Limit cycle MV range	5-47	C323	Parity (communications)	5-51
C312	Balance rate during PD operation	5-47	C324	Stop bit (communications)	5-51

C301 PV tracking

Function

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



Comment

Set PV tracking by the codes in the table below.

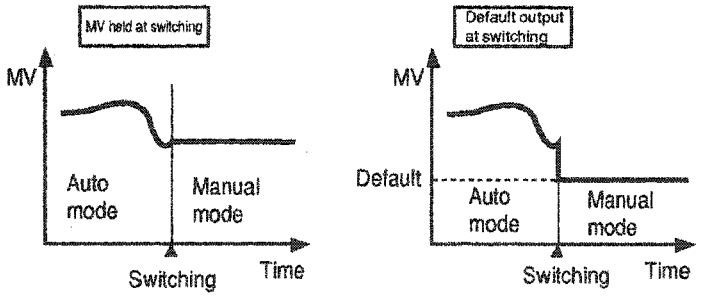
	Code	Description
Default	0	OFF
	1	ON

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

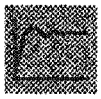
Standard (ES100P-AAH□··□)

See

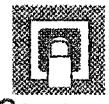
● Related parameter
"manual MV preset value"

CHAPTER 5

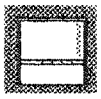
C303 Manual MV preset value


Function

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


Comment

Setting Range	Unit	Default
–5.0 to 105.0	%	0.0

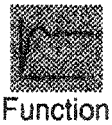

Model

Standard (ES100P-AAH□·· □)


See

● Related parameter
"manual output method"

C304 Cold junction compensating method


Function

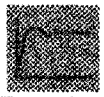
Designates whether or not to conduct cold junction compensation internally or externally when analog input 1 is set to thermocouple.


Comment

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

	Code	Description
Default	0	Internal
	1	External

C305 One-shot pulse width

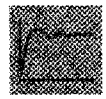

Function

Sets the pulse width (ON time) of the following one-shot pulsed width outputs:
Program end output: output at the end of the program
Step output: output when the step advances
Advance output: output at an advance operation
Back output: output at a back operation

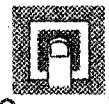

Comment

Setting Range	Unit	Default
0.1 to 10.0	Seconds	1.0

C306 Digital input response time

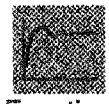

Function

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.

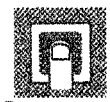

Comment

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 pattern 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

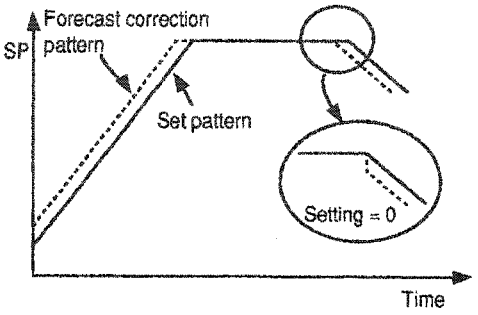
Setting Range	Unit	Default
0.1 to 10.0	Seconds	1.0

Setting Level 2
Technical Mode

C308 Pattern versus PV lag reduction

Function

Determines tracking characteristics to the program pattern.
ES100P uses 2-PID control. However, compared with PID, overshoot during migration from the ramp band to the soak band is inhibited. On the other hand, tracking characteristics in the ramp band worsen. Overshoot inhibit and good tracking characteristics can both be maintained by carrying out control on a program pattern to which a PV lag reduction amount has been added (called the "forecast correction pattern") instead of the preset program pattern. In order to accurately maintain the ramp band time, pattern versus PV lag reduction is set to OFF only during migration from the soak band to the ramp band.



Comment

Set the pattern versus PV lag reduction by the codes in the table below.

	Code	Description
Default	0	Control of forecast correction pattern. OFF during migration from the ramp band to the soak band
	1	Control of forecast correction pattern
	2	Control of set pattern

C309 Pattern No. at reset

Function

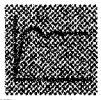
When running a program that uses the pattern link function, this parameter designates which pattern No. should be returned to from the pattern No. after stopping the program by reset operation during or after running the program.
For example, when running a program in which pattern 1 is linked through to pattern 5, the pattern No. returned to after running of the program is stopped by reset operation is pattern 5 when this parameter is set to "0", and pattern 1 that was being run when this parameter is set to "1". In both cases, the beginning of both patterns is returned to.

Comment

Set the pattern No. at reset by the codes in the table below.

	Code	Description
Default	0	Return to pattern at reset
	1	Return to pattern at running of program

C310 A.T. calculated gain

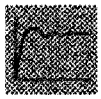

Function

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

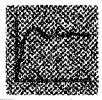

Function

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".

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.

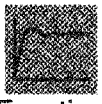
Comment

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."

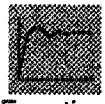
Comment

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

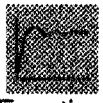

Function

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

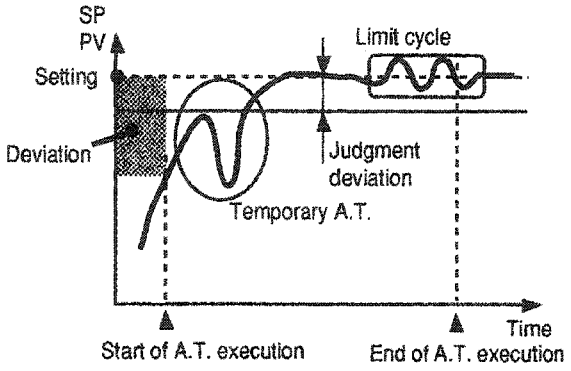
Setting Range	Unit	Default
0.000 to 9.999	%	0.010

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.

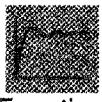
Comment

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

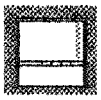
	Code	Description
Default	0	7
	1	8

● 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) (ES100P-□··□01□)
Communications (RS-422/485) (ES100P-□··□04□)


See

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

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
P001	Pattern No.	5-54
P002	Advance	5-54
P003	Hold	5-54
P004	Back	5-54
P005	Reset	5-54
P007	Setting mode	5-55
P008	SP mode	5-55
P010	MV tracking	5-56
P011	Cascade open	5-56
P012	Cascade OFF	5-57
P013	Feed-forward OFF	5-57
P014	Reset event standby sequence	5-58
P015	ON/OFF timer reset	5-58
P016	ON/OFF counter reset	5-58
P017	Pattern advance	5-59
P018	Pattern restart	5-59

Setting Level 1
Operation Mode

P001 Pattern No.

Function

Designates the pattern to run.
This parameter cannot be set while the pattern is running.

Comment

Setting Range	Unit	Default
0 to 99	4	None

P002 Advance

P003 Hold

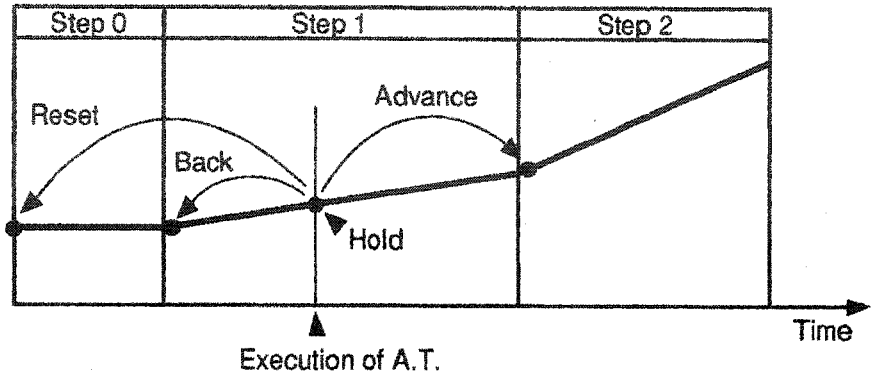
P004 Back

P005 Reset

Function

When these parameters are set to "1", a program-related operation is carried out. After the operation has ended, the setting returns to "0". These parameters designate the following operations.

- "advance" parameter
  Advances the program to the next step. When advance is executed in the hold status, the hold status is maintained at the beginning of the next step.
- "hold" parameter
  Pauses running of the program. The hold status is canceled by carrying out a run operation or executing the hold cancel instruction.
- "back" parameter
  Returns programs to the beginning of the currently executing step. When the back operation is executed in the hold status, the hold status is held even after the back execution.
- "reset" parameter
  Stops program execution.



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.
- Fixed value: Sets the fixed SP.


Comment

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

	Code	Description
Default	0	Local
	1	Remote
	2	Fixed value


See

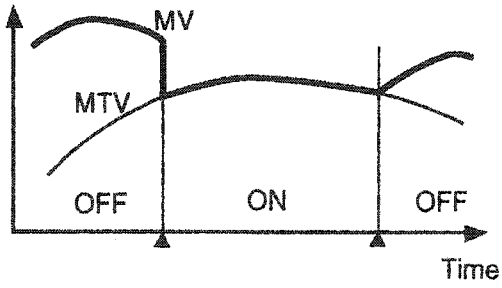
- Related parameters
  "local SP" (program setting mode, setting level 1)
  "fixed SP" (adjustment mode, setting level 1)
- Related article
  1.5 SP Mode

Setting Level 1
Operation Mode

P010 MV tracking

Function

Designates whether or not to make the manipulated variable (MV) track the MV 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

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

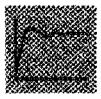
Model

2-input (ES100P-□W□··□)

See

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

P012 Cascade OFF

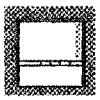

Function

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 (ES100P-□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

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

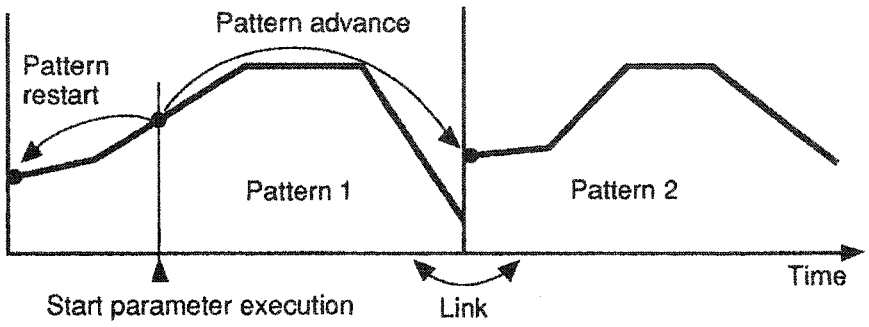
When this parameter is set to "0", the ON/OFF counter reset function is disabled.

P017 Pattern advance

P018 Pattern restart

Function

- "pattern advance" parameter
  When this parameter is set to "1", the pattern advances to the beginning of the next pattern during operation of a linked parameter. After this parameter is executed, the parameter setting returns to "0".
- "pattern restart" parameter
  When this parameter is set to "1", the pattern returns to the beginning of the currently executing pattern, and operation is continued. After this parameter is executed, the parameter setting returns to "0".
  However, note that the point to which the pattern is returned sometimes is not the beginning of the pattern when the "PV start" parameter is set to "1" (slope priority) or "3" (PV start with slope priority incline judgment)



See

- Related parameter
  "PV start" (program setting mode, setting level 1)
- Related articles
  3.6 Setting up Programs
  4.6 Applying Programmed Operation

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	5-60
HUnt	Hunting inhibit required level	5-61
oS	Overshoot inhibit required level	5-61
SPEd	Response improvement required level	5-61
Ft	F.T. execution	5-61

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

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

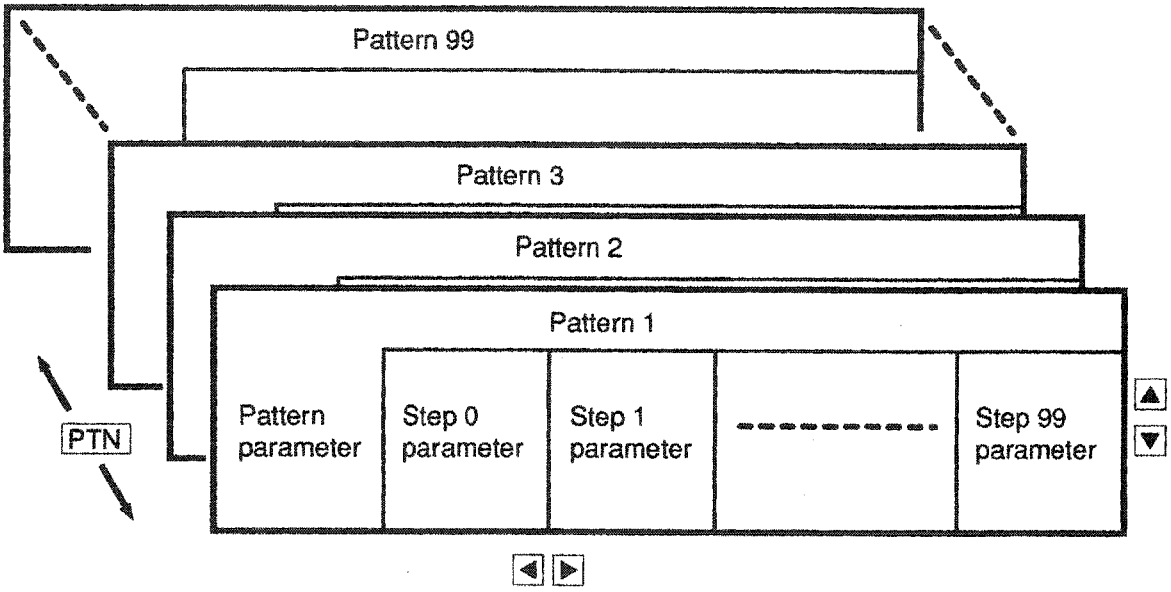
When this parameter is set to "0", the previous tuning operation is canceled.

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 Program Setting Mode

- The program setting mode is for setting the program parameters of each pattern. The PGRM LED lights in the program 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.
- You can set up to 99 program patterns consisting of up to 99 steps (in all, a total of 400 steps). Parameters are organized in tables as follows.



- Pattern Nos. are selected by the PTN key or in the "pattern No." parameter.
- To select steps, use the ◀ or ▶ keys. To move between pattern parameters and step parameters, use the ▲ or ▼ keys.

• The following table shows the pattern parameters and the page where they are described.

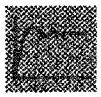
Symbol	Parameter Name	Page
PuSt	PV start	5-64
ESEt	End condition	5-64
ESTP	End step No.	5-65
rPt	Pattern repeat count	5-65
LinK	Pattern link destination No.	5-65

• The following table shows the step parameters and the page where they are described.

Symbol	Parameter Name	Page
LSP	Local SP	5-66
tIM	Step time	5-66
PId	PID set No.	5-67
WAIt	Wait code	5-67
Eu 1 ~ Eu 10	Events 1 to 10 setting	5-68
on 1 ~ on 10	Time signals 1 to 10 ON time	5-69
oF 1 ~ oF 10	Time signals 1 to 10 OFF time	5-69

Setting Level 1
Program Setting Mode

PuSt PV start


Function

Designates from where a program will begin executing.
The following table shows the relationship between the SP at the start of operation and where operation will start executing for each starting method.

Starting Method	SP at Start of Operation	Operation Start Point
SP start	Local SP of step 0	Beginning of step 0
PV start (slope priority)	PV at start of operation	When the PV at start of operation and the local SP first match
PV start (time priority)	PV at start of operation	Beginning of step 0
PV start (slop priority incline judgment)	PV at start of operation	When the PV at start of operation and the local SP first match within the time that the incline information matches


Comment

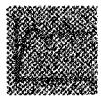
Set PV start by the codes in the table below.

	Code	Description
Default	0	SP start
	1	PV start (slope priority)
	2	PV start (time priority)
	3	PV start (slope priority incline judgment)


See

- Related parameter
  "pattern restart" (operation mode)
- Related article
  3.6 Setting up Programs

EnEt End condition


Function

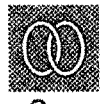
Designates the operation after program has ended.
- Reset: Program execution ends and the control is reset.
- Fixed SP mode: Program execution ends, and control continues in the fixed SP mode.

When patterns are repeated or linked, this parameter setting is applied only to the final pattern.


Comment

Set the end condition by the codes in the table below.

	Code	Description
Default	0	Reset
	1	Fixed SP mode


See

- Related article
  3.6 Setting up Programs

EStP End step No.

Function

Designates the step No. where program execution ends.
Program execution ends at the step having the smaller No. of the final pre-set step No. and end step No. designated in this parameter.

Comment

Setting Range	Unit	Default
0 to 99	None	99

See

● Related article
3.6 Setting up Programs

rPt Pattern repeat count

Function

Designates the number of times a pattern is to be repeated. The number of pattern executions is calculated as follows:
Number of pattern executions = pattern repeat count + 1

Comment

Setting Range	Unit	Default
0 to 9999	Times	0

See

● Related article
3.6 Setting up Programs

LinP Pattern link destination No.

Function

Sets the pattern where program execution starts after the pattern ends.
Program execution continues from the pattern No. designated in the "pattern link destination No." parameter after the pattern ends.

Comment

Setting Range	Unit	Default
0 to 99	None	0

See

● Related article
3.6 Setting up Programs

Setting Level 1
Program Setting Mode

LSP Local SP

Function

Sets the local SP for each step. In the program method, the local SP is the local SP at the end of the step.
This parameter is valid in the local SP mode.

Comment

Setting Range	Unit	Default
0 to 100%FS	U	0

See

- Related parameters
  "program method" (specification setting mode, setting level 2)
  "SP mode" (operation mode, setting level 1)
- Related article
  3.6 Setting up Programs

tLn Step time

Function

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

Comment

Setting Range	Unit	Default
0.00 to 99.59	*1	0.00

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

See

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

PID set No.

Function

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

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

Wait code

Function

Designates the operation when the wait conditions at each step have been satisfied.

- No wait
  Wait is not executed, and program advances to the next step.
- Wait/wait alarm generated
  Wait is executed, and a wait alarm is generated after the wait time has elapsed. While the wait alarm is generated, the WAIT LED flashes.
- Wait/advance to next step
  Wait is executed, and the program advances to the next stop.
- Wait/hold status
  Wait is executed, and the hold status is reached after the wait time has elapsed.
- Hold status
  The hold status is reached unconditionally after the step time has elapsed. To advance to the next step, cancel hold by RUN operation, for example.

Comment

Set the wait codes by the codes in the table below.

	Code	Description
Default	0	No wait
	1	Wait/wait alarm generated
	2	Wait/advance to next step
	3	Wait/hold status
	4	Hold status

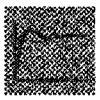
See

- Related parameters
  "wait width" "wait time" (specification setting mode, setting level 2)
- Related article
  4.6 Applying Programmed Operation

CHAPTER 5

Setting Level 1
Program Setting Mode

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


Function

Sets the value of events 1 to 10 for each step.
The event setting of step 0 is used in the reset status.


Comment

Setting Range	Unit	Default
–200 to 200%FS	U or %	0


See

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

on 1	Time signal 1 ON time	oF 1	Time signal 1 OFF time
on 2	Time signal 2 ON time	oF 2	Time signal 2 OFF time
on 3	Time signal 3 ON time	oF 3	Time signal 3 OFF time
on 4	Time signal 4 ON time	oF 4	Time signal 4 OFF time
on 5	Time signal 5 ON time	oF 5	Time signal 5 OFF time
on 6	Time signal 6 ON time	oF 6	Time signal 6 OFF time
on 7	Time signal 7 ON time	oF 7	Time signal 7 OFF time
on 8	Time signal 8 ON time	oF 8	Time signal 8 OFF time
on 9	Time signal 9 ON time	oF 9	Time signal 9 OFF time
on 10	Time signal 10 ON time	oF 10	Time signal 10 OFF time

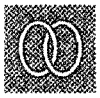
Function

Sets the ON and OFF times for time signals 1 to 10 for each step. Set the times in either minutes:seconds or hours:minutes. Set the "program time unit" parameter before setting the "step time" parameter.

Comment

Setting Range	Unit	Default
–0.01 to 99.59	*1	–0.01

*1 Set this unit in the "program time unit" parameter. When this parameter is set to "–0.01", this parameter is invalid.



See

- Related parameter
  "program time unit" (specification 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 program step 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.
- 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.

[◀][▶]

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

[▲]
[▼]

- 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	5-71
I	I	5-71
d	D	5-72
nLL	MV lower limit	5-72
nLH	MV upper limit	5-72
PuS	PV bias value	5-72
AUt	Automatic selection range upper limit	5-73

P

Function

Sets proportional band P.

Comment

Setting Range	Unit	Default
0.0 to 999.9	%FS	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".

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).

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

In a position-proportional floating control system, the manipulated variable limitter will not function.

PV bias value

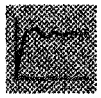
Function

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%FS	U	0

AUt 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%FS	U	0

See

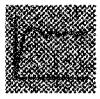
- Related parameter
  "PID set selection data" (specification setting mode, setting level 2)
- Related article
  4.5 PID Switching

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
P101	Fixed SP	5-75	P112	SP setting lower limit	5-79
P102	Control output 1 pulse cycle	5-75	P113	SP setting upper limit	5-79
P103	Control output 2 pulse cycle	5-75	P114	SP rise rate limit	5-79
P104	Fuzzy strength	5-76	P115	SP fall rate limit	5-79
P105	Cooling coefficient	5-76	P116	MV change rate limit	5-80
P106	Heater burnout alarm setting	5-76	P117	Secondary loop fixed SP	5-80
P107	Position-proportional dead band	5-77	P118	Secondary loop P	5-81
P108	Switching output hysteresis	5-77	P119	Secondary loop I	5-81
P109	ON/OFF count alarm settings	5-78	P120	Secondary loop D	5-81
P110	ON/OFF control hysteresis	5-78	P121	Secondary loop manual reset	5-81
P111	Manual reset	5-78			

P101 Fixed SP


Function

Sets the SP to be used in the fixed SP mode.


Comment

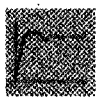
Setting Range	Unit	Default
0 to 100%FS	U	0


See

- Related parameter
  "SP mode" (operation mode)
- Related articles
  1.5 SP Mode
  3.8 Adjusting Control Operation

P102 Control output 1 pulse cycle

P103 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

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	1.0


Model

Standard (ES100P-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

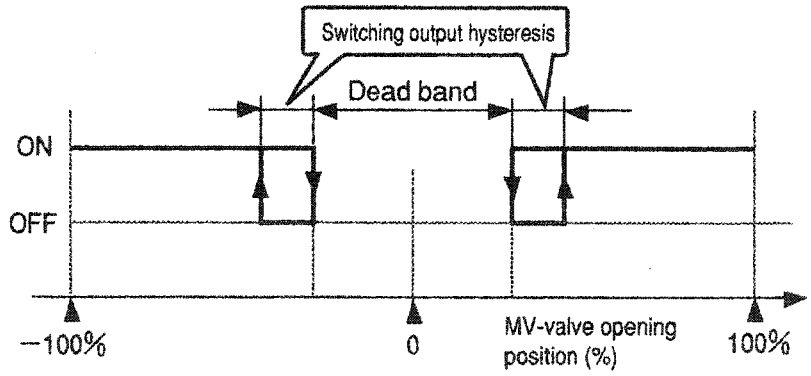
Standard (ES100P-AAH□□··□)

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 (ES100P-RRP□··□)

See

● Related article
6.2 Position-proportional Control

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.

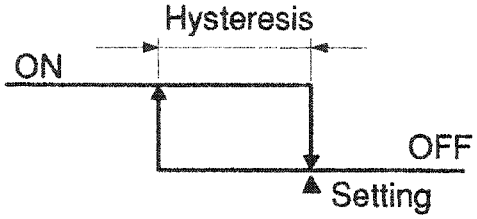
Comment

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	%FS	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

P112 SP setting lower limit

P113 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

P114 SP rise rate limit

P115 SP fall rate limit

Function

Limits the rise and fall rate-of-change of SP.
The SP rate-of-change limitter will not function in the local SP mode when running a program. At the start of operation (excluding program execution) 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 reset.


Comment

Setting Range	Unit	Default
0.0 to 100.0	%	50.0

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

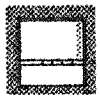
P117 Secondary loop fixed SP


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 (ES100P-□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

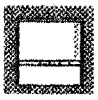

Function

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 (ES100P-□W□··□)


See

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

CHAPTER 5

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 (ES100P-□W□··□)


See

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

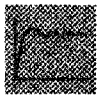
Setting Level 1
Check Mode

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	5-83	P212 ~ P223	ON/OFF counters 1 to 12 monitors	5-86
P202	Analog input 1 type monitor	5-83			
P203	Analog input 2 type monitor	5-84			
P204	PF1 key type monitor	5-84	P224	2-PID/2-PID + fuzzy logic monitor	5-87
P205	PF2 key type monitor	5-84	P225	Potentiometer input monitor	5-87
P206	Pattern repeat execution count monitor	5-85	P226	Heating-cooling/standard monitor	5-88
P207	PID set No. monitor	5-85	P227	Cascade/standard monitor	5-88
P208 ~ P211	ON/OFF timers 1 to 4 monitors	5-86	P228	BCD communications/digital I/O monitor	5-89
			P229	Contorol operation cycle monitor	5-89
			P230	ROM version No. monitor	5-89

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 (ES100P-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)

Setting Level 1
Check Mode

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 (ES100P-□W□··□)

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)

P206 Pattern repeat execution count monitor

Function

Monitors the number of times the same pattern has been repeated.

Comment

Range	Unit
0 to 9999	Times

P207 PID set No. monitor

Function

Monitors the PID set No. currently in use.

Comment

Range	Unit
1 to 8	None

Setting Level 1
Check Mode

P208	ON/OFF timer 1 monitor	P210	ON/OFF timer 3 monitor
P209	ON/OFF timer 2 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

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

P225 Potentiometer input monitor

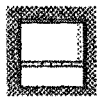
Function

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 (ES100P-RRP□··□)

Setting Level 1
Check Mode

P226 Heating-cooling/standard monitor


Function

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


Comment

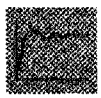
The monitor item is displayed using the codes in the table below.

Code	Description
0	Standard
1	Heating-cooling


Model

Standard (ES100P-AAH□··□)

P227 Cascade/standard monitor

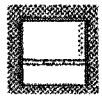

Function

Monitors the currently selected control system, cascade or standard.


Comment

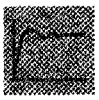
The monitor item is displayed using the codes in the table below.

Code	Description
0	Standard
1	Cascade


Model

2-input (ES100P-□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

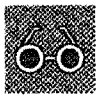
Model

Expanded I/O connector (ES100P-□··□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).

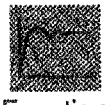


Comment

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

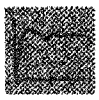
Monitors the ROM version No.

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	5-91
P333 ~ P348	Straight-line approximations 1 to 4	5-92
P349 ~ P388	Broken-line approximations 1, 2	5-93

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

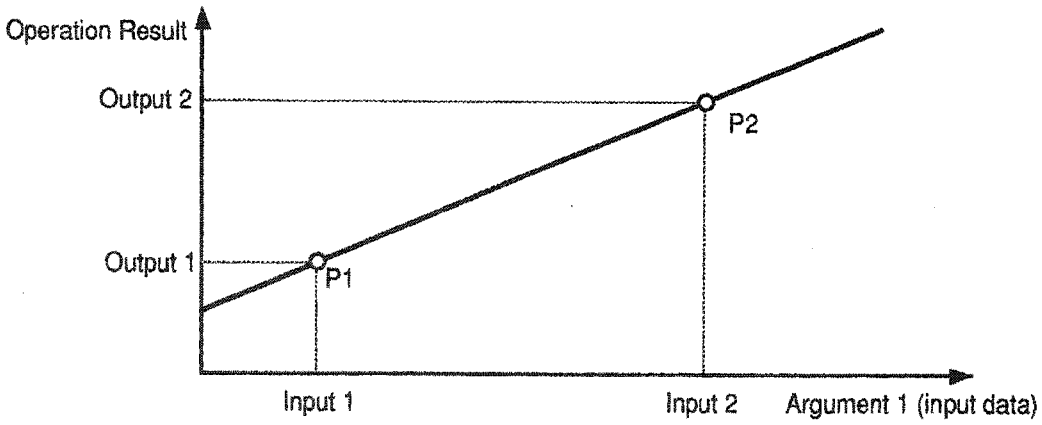
● Related article
6.1 Heating/Cooling Control

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

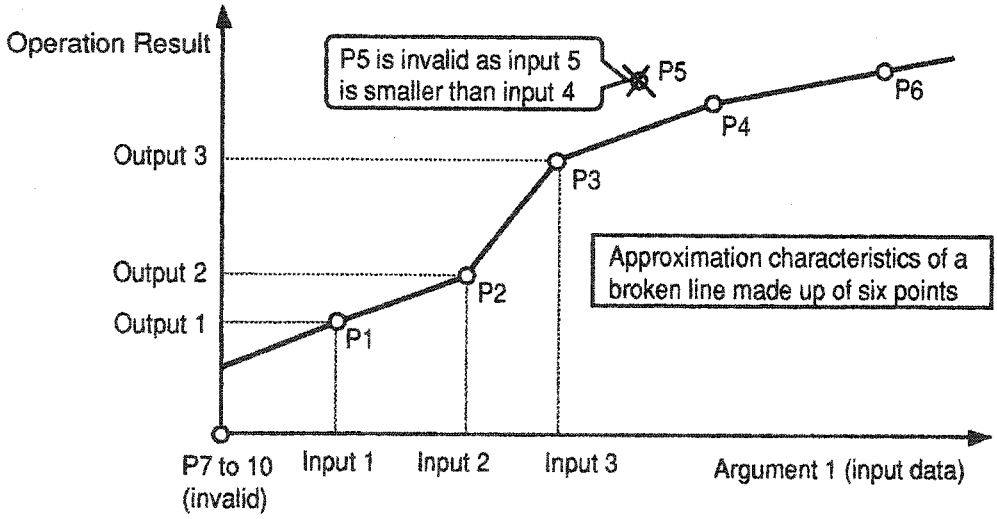
- Related parameter
  "operation" (analog operation assignment setting mode, setting level 2)
- Related article
  4.3 Analog Operation Assignments

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 ES100P (model ES100P-AAH□··□) 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

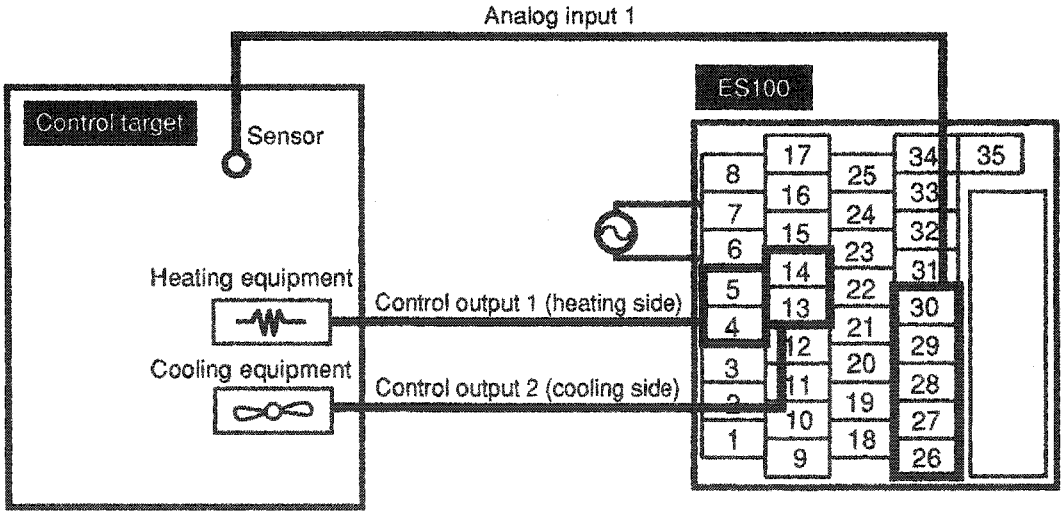
Set the dead band or overlap band and the manipulated variable (MV) at stop in the "analog operation parameters."

● Tuning

Auto-tuning or fine tuning can be used for tuning the ES100P.
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.

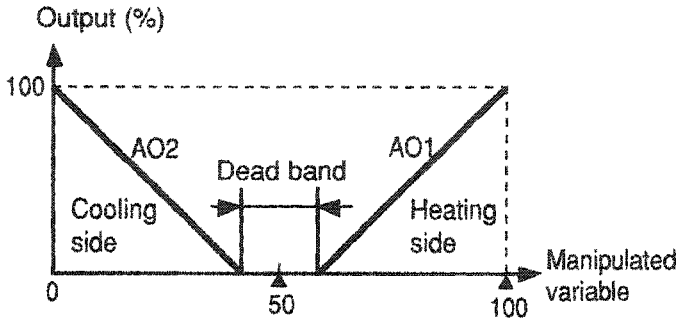


- Wire the analog input to suit the analog input type.
- Use control output 1 for the heating side, and control output 2 for the cooling side. Choose the type of output unit matched to how the ES100P is to be applied.
- Connect other terminals matched to how the ES100P is to be applied.

■ 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.

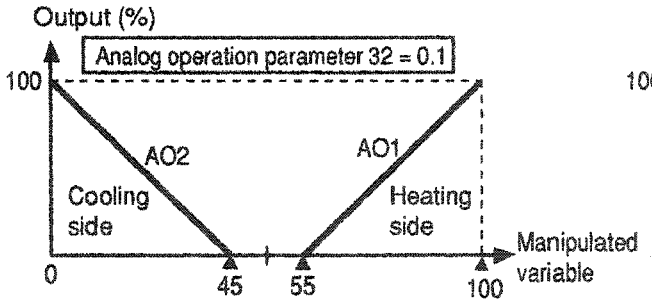
The following diagram shows the output characteristics during heating-cooling control on the ES100P.

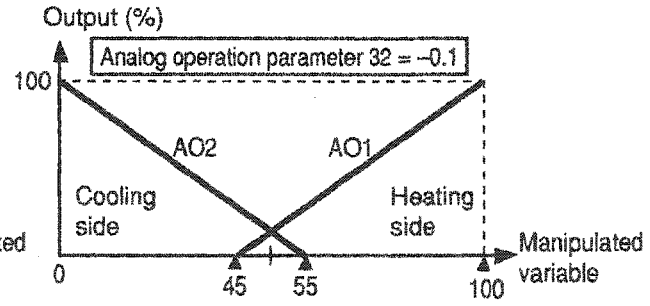


■ Dead band

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 an 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
P105	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 ES100P (model: ES100P-RRP□··□).

● Switching between closed and floating

Designate closed control or floating control in the "potentiometer input" parameter matched to how the ES100P 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.

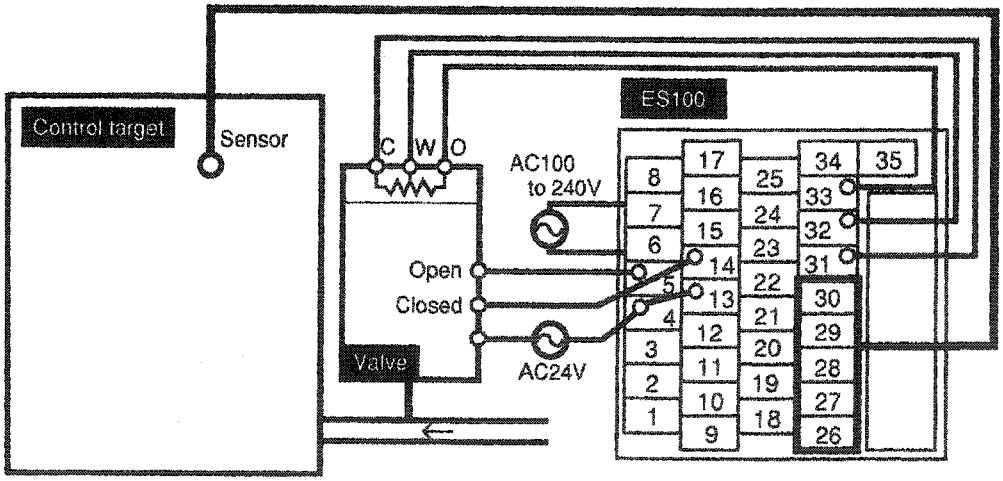
In a position-proportional floating control system, motor calibration need not be carried out, however, set the time from valve fully open to valve fully closed in the "travel time" parameter.

● Tuning

Tune the position-proportional ES100P 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 ES100P (model: ES100P-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 ES100P is to be applied.

■ Designating position-proportional control

Position-proportional control is designated according to which model of the ES100P you are using. Always use a position-proportional ES100P (model: ES100P-RRP□··□).

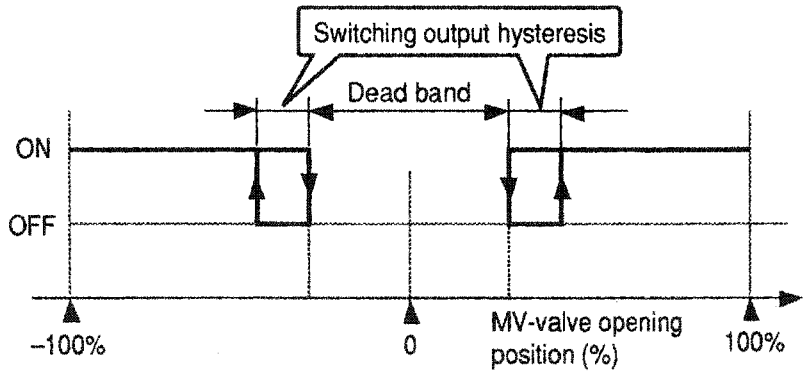
Select closed control or floating control in the "potentiometer input" parameter (specification setting mode, setting level 2).

■ 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 ES100P, for example, in a floating control system in which the valve opening 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.

Checking travel time

When motor calibration is executed, the program automatically advances to the "travel time" parameter, and the controller indicates the travel time after it has been measured.

■ Valve opening monitor

On position-proportional ES100P, 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 (%)

About the manipulated variable limitter

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

6.3 Cascade Control

■ Key points in cascade control

● Designating cascade control

2-input ES100P (model: (ES100P-□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 ES100P 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

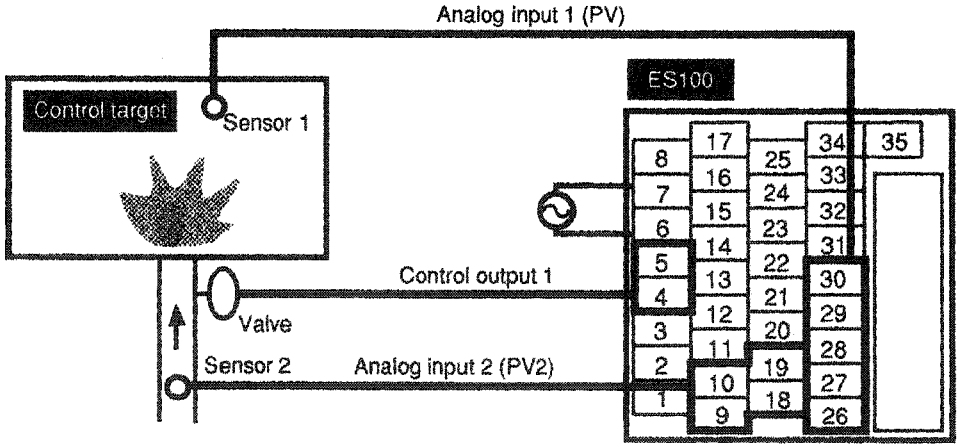
Independently operate the secondary loop of the ES100P by executing the "cascade open" parameter to calculate the optimum PID characteristics.

● 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.

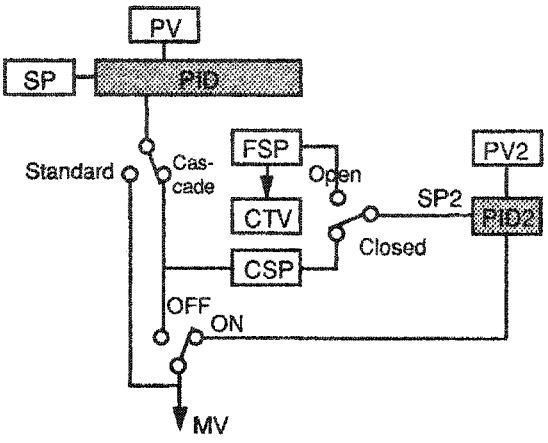


- Set analog input 1 as the primary loop PV, and analog input 2 as the secondary loop PV (PV2).
- Select the control output and type of output unit matched to how the ES100P is to be applied.
- Connect other terminals depending on how the ES100P is to be applied.

■ 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 ES100P 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.

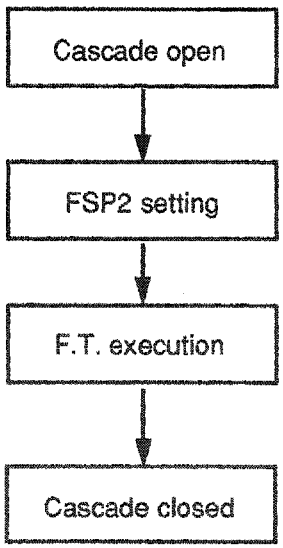
Either of secondary loop fixed SP (FSP2) or cascade SP (CSP) can be selected for the secondary loop SP (SP2).

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 Feed-forward Control

■ Key points in feed-forward control

● Basic concept of feed-forward control

On a 2-input ES100P (model: ES100P-□W□-□), the feed-forward variable (FFV) is calculated from analog input 2 in order to adjust the manipulated variable.

● Feed-forward variable (FFV)

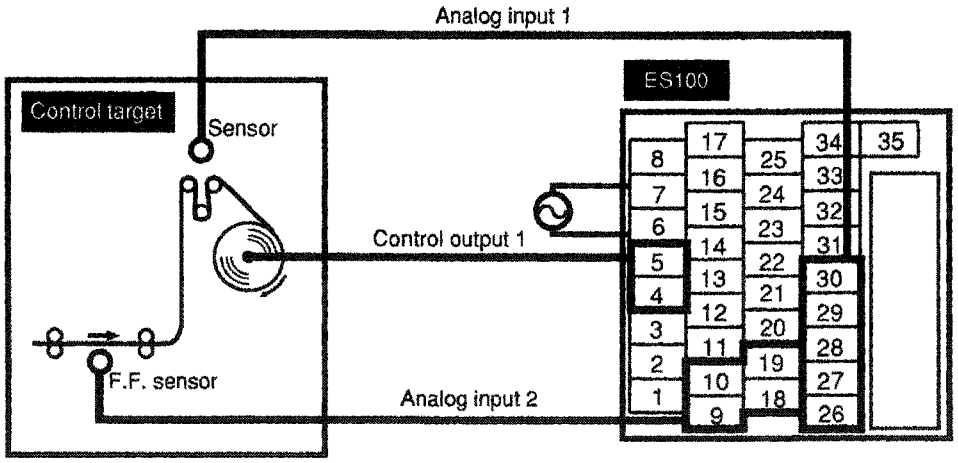
The feed-forward variable is calculated as the result of analog operation on analog input 2. The calculated feed-forward variable acts directly on the manipulated variable (MV).

● 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 ES100P is to be applied.
- Connect other terminals depending on how the ES100P 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.

- Operation 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).

■ 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.

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 (%)."

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 ES100P, 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 ES100P matched to how the ES100P 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 ES100P 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 ES100P 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 ES100P, 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 ES100P. • 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.

■E 150 Pattern not set

● Error generating conditions	This error occurs when a pattern has not been set (including patterns to which a link has been set).
● Cause	Probable causes are that the program has not been set up, or that the setting of the "pattern link destination No." parameter is in error.
● Remedy	Set up a program containing the pattern (including patterns to which a link has been set). Review the "pattern link destination No." parameter.

■E 160 Number of program steps limit

● Error generating conditions	This error occurs when the number of steps in the pattern is greater than 100. The total number of steps is greater than 400.
● Cause	This error occurs when an attempt is made to add a step to a program to which the maximum number of steps (400) already has been set. This error occurs when an attempt is made to insert a step into a pattern already containing 100 steps.
● Remedy	Check the number of steps in the program.

■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 ES100P by a method other than auto-tuning.

7.3 Judging Symptoms to Find the Cause of Trouble

When 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 ES100P 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 ES100P. 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	●	
Pattern No. change		Run status
Pattern edit		Run status
Run operation	●	
Step operation Advance/hold/back/reset	●	Reset status
Program operation	●	Reset status Hold status
Hold cancel	●	
Pattern operation Advance/restart	●	Reset status
Remote SP mode	●	
Fixed SP operation	●	
Auto-tuning execution	●	Cascade control Reset 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.

● SP does not change as programmed.
- A probable cause is that a remote SP or fixed SP is in use.

→ Check the "SP mode" parameter.

● Steps do not advance.
- The program has advanced to a step that satisfies the conditions for generating a wait.

→ Check the "wait code" and "wait width" parameters.
- A probable cause is a hold status.

→ Check the HOLD LED.
In order to cancel hold, either carry out a run operation, or assign the hold cancel function to a PF key or digital operation assignment table, and then execute the conditions for canceling hold.

● Program is reset midway during execution.
- A probable cause is that the end step No. is smaller than the final step No.

→ Set the "end step No." parameter to "99".

APPENDICES

SPECIFICATIONS

■ Electrical Specifications

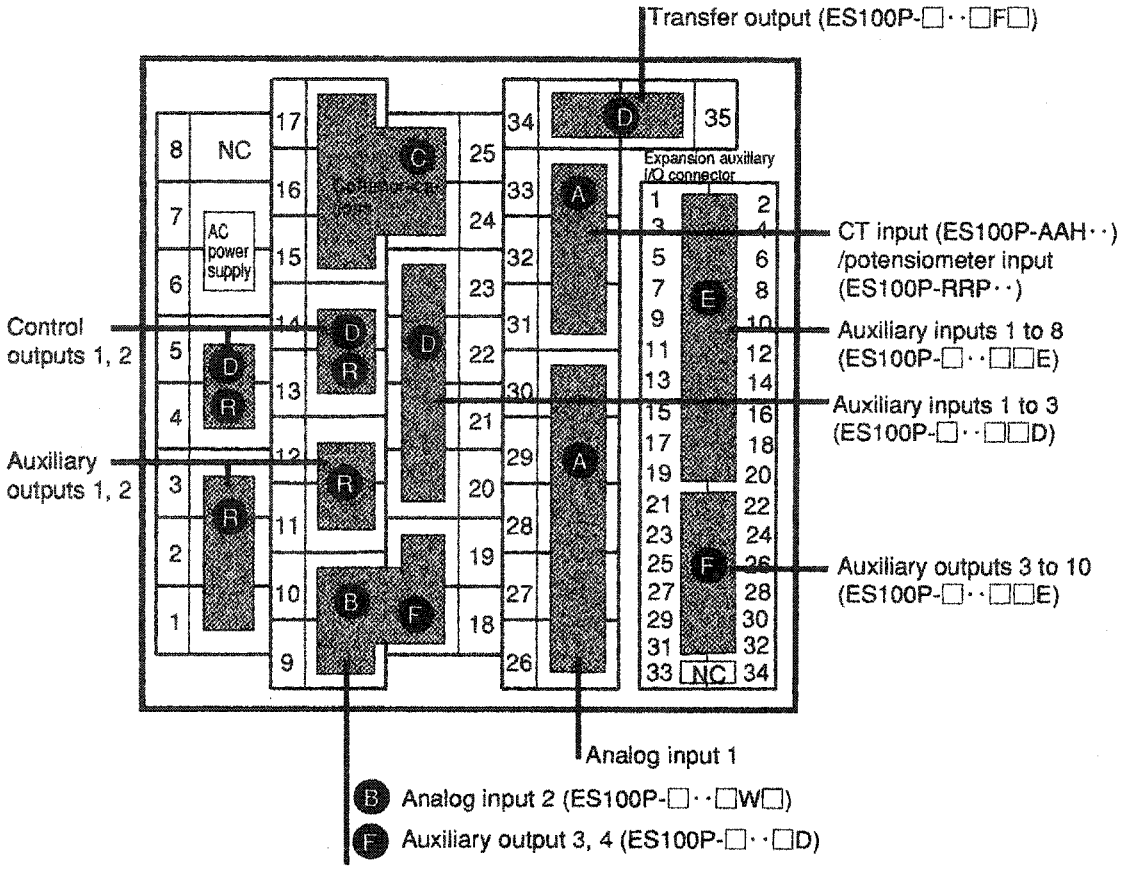
Item		Specification
Analog Input 1	Type	R, S, K, J, T, E, B, N, L, U, W, PLII, JPt, Pt 4 to 20 mA, 0 to 20 mA, 0 to 10 mV, 0 to 100 mV, ±10 mV, 0 to 1 V, 1 to 5 V, 0 to 5 V, 0 to 10 V
	Readout Accuracy (*1)	Thermocouple input: (larger of ±0.1% SP or 1°C) ±1 digit Resistance bulb input: (larger of ±0.1% 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 ES100P.
- The application of the terminals varies according to the model of ES100P at blocks to which a specific model of the ES100P is stipulated.

HOW TO USE THE CURRENT DETECTOR

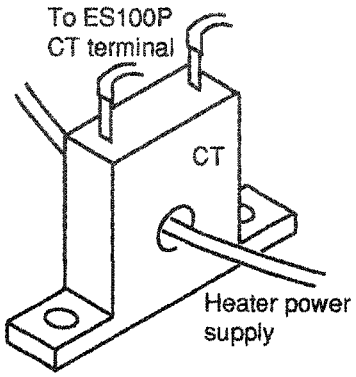
■ How Heater Burnout Detection Works

- 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 ES100P 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 ES100P power supply ON. If the heater power supply is turned ON after turning the ES100P 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 ES100P. The lead from the CT to the ES100P is neutral. For detail examples of use, see the next page.

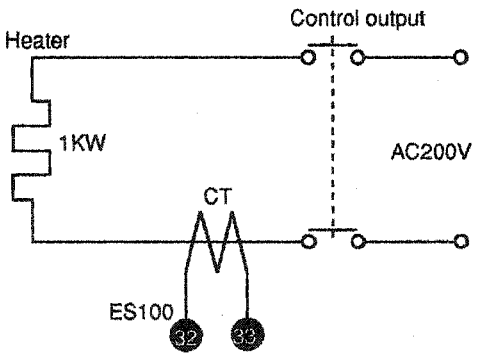
■ How to Use the Heater Burnout Alarm Setting

● 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

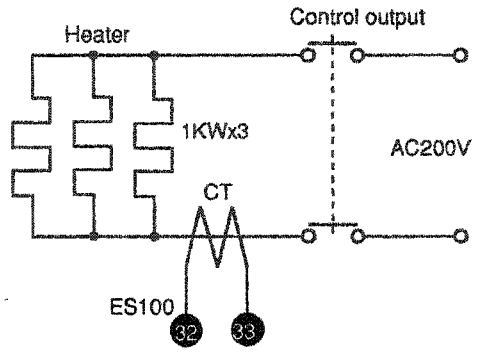


Current at normal operation = 1000/200 = 5 A

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

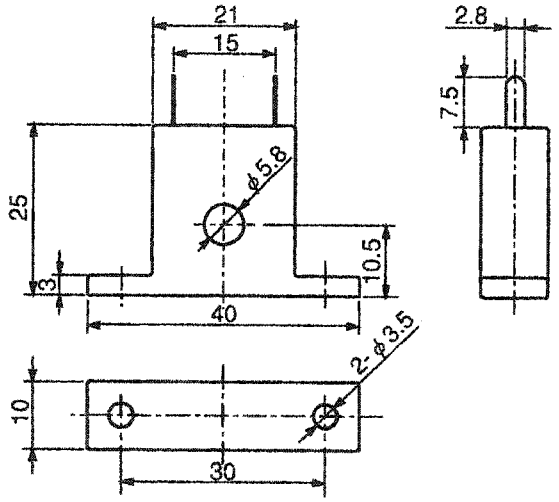
● Rating

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

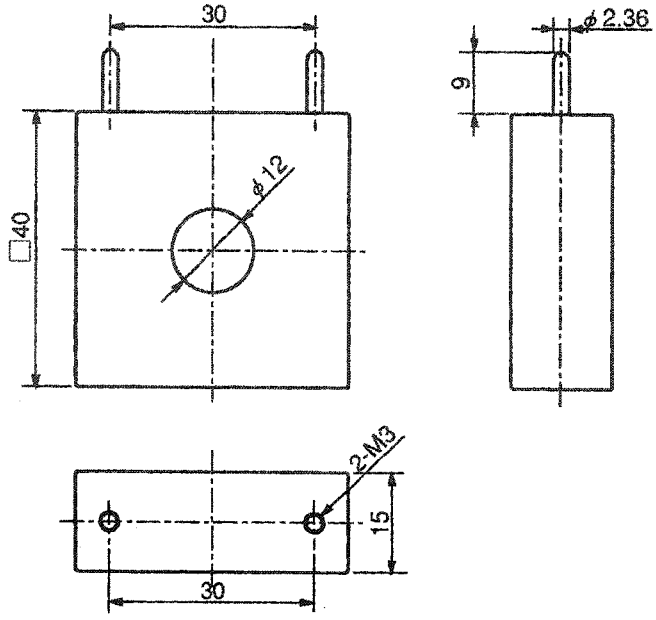
*1 The continuous maximum heater current of the ES100P is 50 A.

● External Dimensions

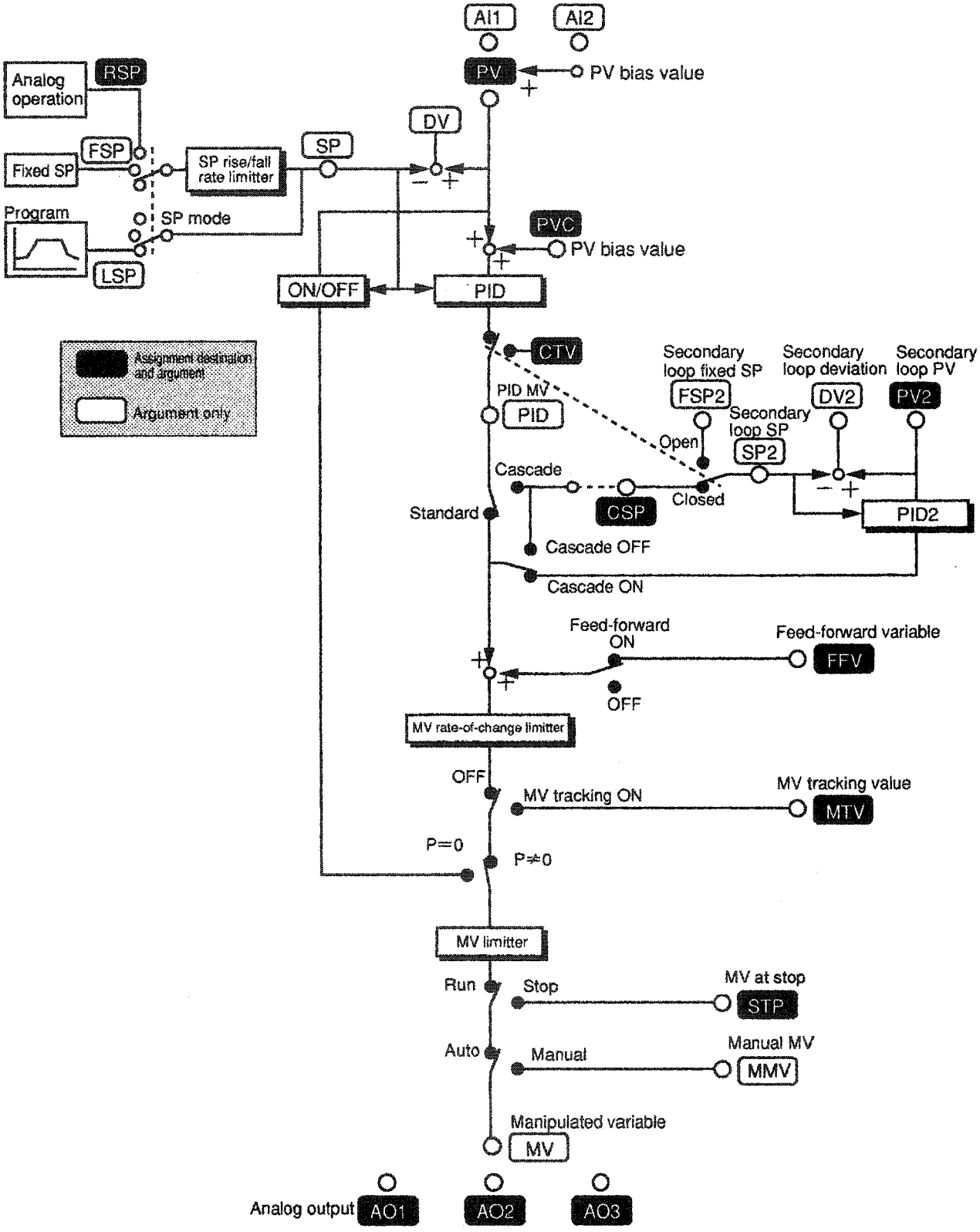
E54-CT1



E54-CT3

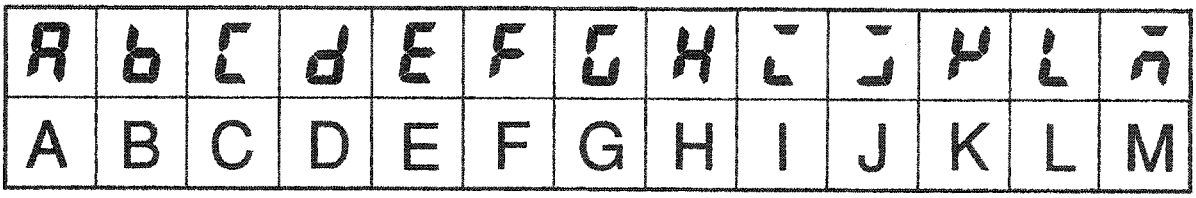


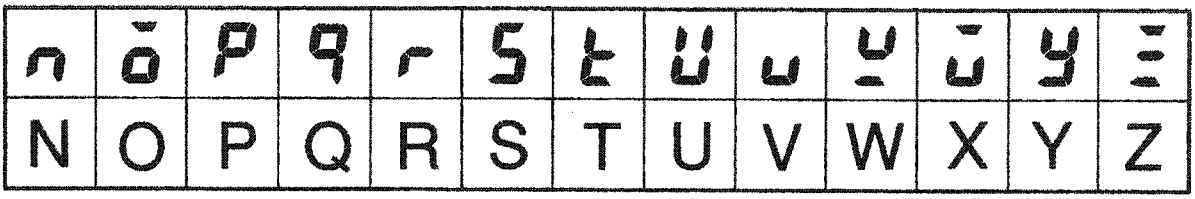
CONTROL BLOCK DIAGRAM



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 ES100P 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 ES100P set before shipment from the factory.

Model	2-PID + Fuzzy	2-PID
ES100P-AAH	200 ms	100 ms
ES100P-AAHFD	200 ms	100 ms
ES100P-AAHFE	200 ms	100 ms
ES100P-AAWHFE	200 ms	200 ms
ES100P-AAH01FE	200 ms	200 ms
ES100P-AAH04FE	200 ms	200 ms
ES100P-AAWH01FE	200 ms	200 ms
ES100P-AAWH04FE	200 ms	200 ms
ES100P-RRPFD	200 ms	200 ms
ES100P-RRPFE	200 ms	200 ms
ES100P-RRPWFE	200 ms	200 ms
ES100P-RRP01FE	200 ms	200 ms
ES100P-RRP04FE	200 ms	200 ms
ES100P-RRPW01FE	200 ms	200 ms
ES100P-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)	2-input
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)	2-input
C030	2-PID/2-PID + fuzzy	0 to 1		0 (2-PID + fuzzy)	
C031	Heating-cooling/standard	0 to 1		0 (standard)	Position-proportional
C032	Potentiometer input	0 to 1		0 (floating)	2-input
C033	Cascade/standard	0 to 1		0 (standard)	
C034	Operation after 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	Communications
C040	BCD communications/digital I/O	0 to 1		0 (digital I/O)	Communications
C041	Unit No. (communications)	0 to 99		0	Communications
C042	Baud rate (communications)	0 to 4		3 (9600 BPS)	
C043	Program time unit	0 to 1		1 (hours: minutes)	
C045	Program method	0 to 1		1 (ramp and soak)	
C046	Wait width	0 to 100% full-scale width	U	1% full-scale width	
C047	Wait time	0.00 to 99.59	*2	0.00	
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				Position-proportional
C052	Travel time	1 to 999	sec	30	Position-proportional

*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) 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	Operation*, Argument 1	0 to 214
D0*2	Operation*, Argument 2	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	Operation*, Argument 1	0 to 132
A**2	Operation*, Argument 2	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 to 1
C302	Manual output method	0 to 1		0 to 1
C303	MV preset value	-0.5 to 105.0	%	-5.0 to 105.0
C304	Cold junction compensating method	0 to 1		0 to 1
C305	One-shot pulse width	0.1 to 10.0	seconds	0.1 to 10.0
C306	Digital input response time	0.1 to 10.0	seconds	0.1 to 10.0
C307	External No. selection setting time	0.1 to 10.0	seconds	0.1 to 10.0
C308	Pattern versus PV lag reduction	0 to 2		0 to 2
C309	Pattern No. at reset	0 to 1		0 to 1
C310	A.T. calculated gain	0.1 to 10.0		0.1 to 10.0
C311	Limit cycle MV range	5.0 to 50.0	%	5.0 to 50.0
C312	Balance rate during PD operation	0.0 to 100.0	%/seconds	0.0 to 100.0
C313	2-PID control parameter α	0.00 to 1.00		0.00 to 1.00
C314	2-PID control parameter β	0.00 to 1.00		0.00 to 1.00
C315	Fuzzy scale 1 adjustment	0.00 to 99.99		0.00 to 99.99
C316	Fuzzy scale 2 adjustment	0.00 to 99.99		0.00 to 99.99
C317	Fuzzy I coefficient adjustment	0.00 to 99.99		0.00 to 99.99
C318	Fuzzy adjustment bandwidth	0.000 to 9.999	%FS	0.000 to 9.999
C319	Fuzzy SP change judgment value	0.000 to 9.999	%FS	0.000 to 9.999
C320	Temporary A.T. execution judgment deviation	0.0 to 100.0	%FS	0.0 to 100.0
C321	Number of limit cycles	0 to 2	times	0 to 2
C322	Bit length (communications)	0 to 1		0 to 1
C323	Parity (communications)	0 to 2		0 to 2
C324	Stop bit (communications)	0 to 2		0 to 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)
P001	Pattern No.	0 to 99		0 (not set)
P002	Advance	0 to 1		0
P003	Hold	0 to 1		0
P004	Back	0 to 1		0
P005	Reset	0 to 1		0
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)
P017	Pattern advance	0 to 1		0
P018	Pattern restart	0 to 1		0

◆ 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)

◆ Program Setting Mode

Display	Parameter Name	Setting Range	Unit	Default (content)
PVST	PV start	0 to 2		0 (SP restart)
ESET	End condition	0 to 1		0 (reset status)
ESTP	End step No.	0 to 99		99
RPT	Pattern repeat count	0 to 9999	Times	0
LINK	Pattern link destination No.	0 to 99		0

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	0.00
PID	PID set No.	0 to 8		0 (automatic selection)
WAIT	Wait code	0 to 4		0 (no wait)
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
ON1	Time signal 1 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF1	Time signal 1 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON2	Time signal 2 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF2	Time signal 2 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON3	Time signal 3 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF3	Time signal 3 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON4	Time signal 4 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF4	Time signal 4 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON5	Time signal 5 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF5	Time signal 5 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON6	Time signal 6 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF6	Time signal 6 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON7	Time signal 7 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF7	Time signal 7 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON8	Time signal 8 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF8	Time signal 8 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON9	Time signal 9 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF9	Time signal 9 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)
ON10	Time signal 10 ON time	-0.01 to 99.59	*1	-0.01 (invalid)
OF10	Time signal 10 OFF time	-0.01 to 99.59	*1	-0.01 (invalid)

*1 The setting becomes one of minutes:seconds or hours:minutes depending on the setting of the "program time unit" parameter (specification setting mode, setting level 2).

◆ 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
P101	Fixed SP	0 to 100%FS	U	0%FS
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)
P206	Pattern repeat execution count monitor	0 to 9999	times	0
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 (ES100P-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) (ES100P- □···□D/E)

Table No.	1	2	3	4 to 10	11	12	13	14	15 to 30
Assignment Destination	62 (RUN)	61 (RST)	63 (HOLD)	–	1 (DO1)	2 (DO2)	3 (DO3)	4 (DO4)	–
Operation 1	1 (BUF)	1 (BUF)	1 (BUF)	0 (END)	1 (BUF)	1 (BUF)	1 (BUF)	1 (BUF)	0 (END)
Argument 1	1 (DI1)	2 (DI2)	3 (DI3)	–	21 (EV1)	22 (EV2)	41 (TS1)	42 (TS2)	–
Argument 2	–	–	–	–	–	–	–	–	–
Operations 2 to 4	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)	0 (END)
Argument 1	–	–	–	–	–	–	–	–	–
Argument 2	–	–	–	–	–	–	–	–	–

◆ Analog Operation Assignment Table

(a) Standard (ES100P-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 (ES100P-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 (ES100P- □···□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 (ES100P- □···□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	–	–	–	–	–	–	–	–	–	–

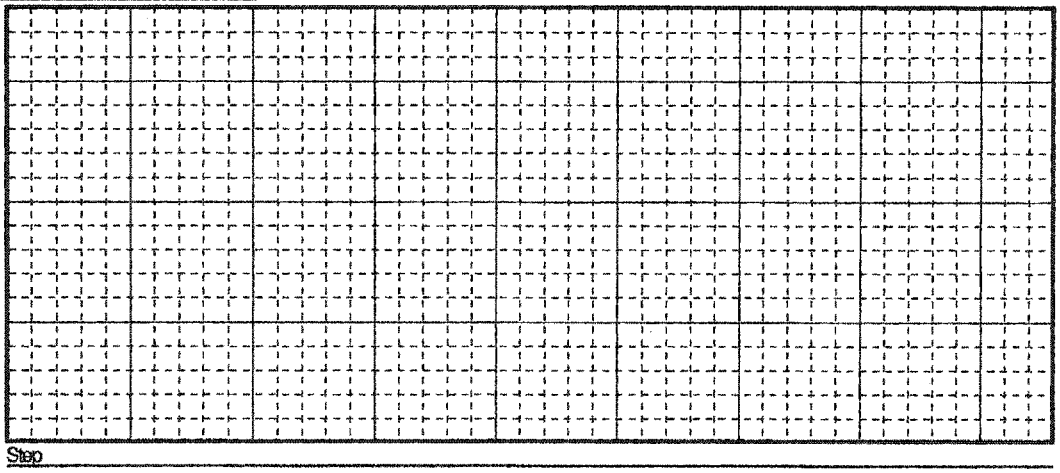
MODEL LIST

Model	Control Method	Analog Input 2	Transfer Output	Serial Communications	External I/O
ES100P-AAH	Heating-cooling/standard	×	×	×	×
ES100P-AAHFD	Heating-cooling/standard	×	○	×	◎
ES100P-AAHFE	Heating-cooling/standard	×	○	×	○ (expansion)
ES100P-AAWHFE	Heating-cooling/standard	○	○	×	○ (expansion)
ES100P-AAH01FE	Heating-cooling/standard	×	○	RS-232C	○ (expansion)
ES100P-AAH04FE	Heating-cooling/standard	×	○	RS-422/485	○ (expansion)
ES100P-AAWH01FE	Heating-cooling/standard	○	○	RS-232C	○ (expansion)
ES100P-AAWH04FE	Heating-cooling/standard	○	○	RS-422/485	○ (expansion)
ES100P-RRPFD	Position-proportional	×	○	×	◎
ES100P-RRPFE	Position-proportional	×	○	×	○ (expansion)
ES100P-RRPWFE	Position-proportional	○	○	×	○ (expansion)
ES100P-RRP01FE	Position-proportional	×	○	RS-232C	○ (expansion)
ES100P-RRP04FE	Position-proportional	×	○	RS-422/485	○ (expansion)
ES100P-RRPW01FE	Position-proportional	○	○	RS-232C	○ (expansion)
ES100P-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)

PROGRAM SETTING TABLES

Pattern No.



PV start	End condition	End step No.	Pattern repeat count	Pattern link destination No.
PuSt	ESEt	EStP	rPt	LinK

Parameters			Step 0	1	2	3	4	5	6	7	8	9	10
Local SP		LSP											
Step time		tim											
PID set No.		Pid											
Wait code		uAit											
Event	1	Eu 1											
	2	Eu 2											
	3	Eu 3											
	4	Eu 4											
	5	Eu 5											
	6	Eu 6											
	7	Eu 7											
	8	Eu 8											
	9	Eu 9											
	10	Eu 10											
	ON 1	on 1											
	OFF1	oF 1											
	ON 2	on 2											
	OFF 2	oF 2											
	ON 3	on 3											
	OFF 3	oF 3											
	ON 4	on 4											
	OFF 4	oF 4											
	ON 5	on 5											
	OFF 5	oF 5											
	ON 6	on 6											
	OFF 6	oF 6											
	ON 7	on 7											
	OFF 7	oF 7											
	ON 8	on 8											
	OFF 8	oF 8											
	ON 9	on 9											
	OFF 9	oF 9											
	ON10	on 10											
	OFF10	oF 10											

PID set		1	2	3	4	5	6	7	8
P	P								
I	i								
D	d								
Manipulated variable upper limit	oLL								
Manipulated variable lower limit	oLH								
PV offset value	PuS								
Automatic selection range upper limit	AUt								

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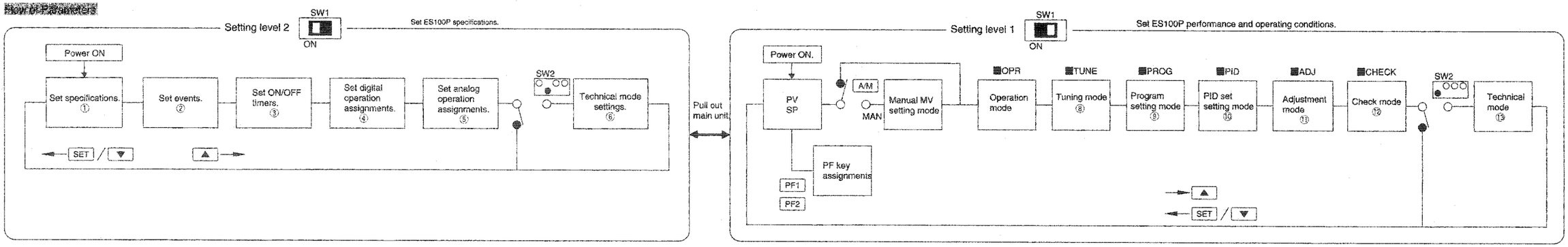
PARAMETERS & OPERATION PROCEDURE ES100P

Flow of Parameters



Details of Parameters for Settings

Setting Level 2 (For details of setting level 1, see reverse side.)

Specification 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	Program method	
C046	Wait width	○
C047	Wait time	
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

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

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 Parameter Mode ⑬

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
C308	Pattern versus PV lag reduction
C309	Pattern No. at reset
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)

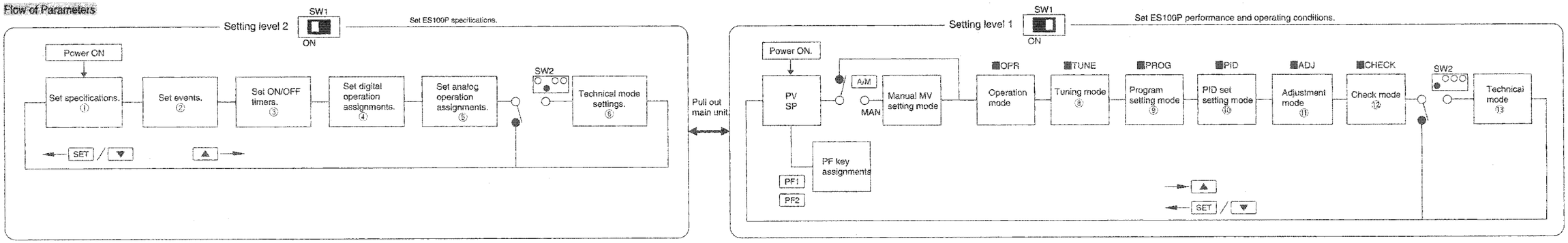
Parameters

● Parameters that must be set and checked.

○ Frequently used parameters

PARAMETERS & OPERATION PROCEDURE ES100P

Flow of Parameters



Details of Parameter Settings

Setting Level 1 (For details of setting level 2, see reverse side.)

Operation Mode ■OPR ⑦

P001	Pattern No.
P002	Advance
P003	Hold
P004	Back
P005	Reset
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
P017	Pattern advance
P018	Pattern restart

Program Setting Mode ■PRGM ⑨

PuSt	PV start ○
ESEt	End condition
ESTP	End step No.
rPt	Pattern repeat count
LinP	Patten link destination No.

Step 0		Step 99	
LSP	Local SP ●	LSP	Local SP ●
tin	Step ●	tin	Step ●
Pid	PID set No.	Pid	PID set No.
uAct	Wait code ○	uAct	Wait code ○
Eu 1	Event 1 ○	Eu 1	Event 1 ○
Eu 10	Event10	Eu 10	Event 10
on 1	Time signal 1 ON	on 1	Time signal 1 ON
on 10	Time signal 10 ON	on 10	Time signal 10 ON
oF 1	Time signal 1 OFF	oF 1	Time signal 1 OFF
oF 10	Time signal 10 OFF	oF 10	Time signal 10 OFF

Pattern 1
Pattern 2
Pattern 99
PTN
◄ Step No. ►

Adjustment Mode ■ADJ ⑪

P101	Fixed SP
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

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
P206	Pattern repeat execution count 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

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

AT	A.T. execution ○
HUnt	Hunting inhibit required level
oS	Overshoot inhibit required level
SPEd	Response improvement required level
FT	F.T. execution

PID Setting Mode ■PID ⑩

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 upper limit	AUt	Automatic selection range upper limit

◄ PID Set No. ►

● Parameters that must be set and checked.

○ Frequently used parameters

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