E5CK Process Controller

User Manual

Cat. No. H78-E3-2

Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

DANGER! Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

⚠ **WARNING** Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

⚠ **Caution** Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

All OMRON products are capitalized in this manual. The word "Unit" is also capitalized when it refers to an OMRON product.

The abbreviation "Ch," which appears in some displays and on some OMRON products, often means "word" and is abbreviated "Wd" in documentation in this sense.

The abbreviation "PC" means Programmable Controller and is not used as an abbreviation for anything else.

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Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note   Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3...   1.   Indicates lists of one sort or another, such as procedures, checklists, etc.

How to Read Display Symbols

The following tables show the correspondence between the E5CK display symbols and alphabet characters.

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

The *Reference* Mark

This mark indicates that extra, useful information is being provided, such as supplementary explanations and how to apply functions.

Contents

SECTION 3
Preparations

SECTION 4
Applied Operation

SECTION 5
Parameters

SECTION 6
Using the Communications Function

SECTION 7
Troubleshooting

APPENDIX

About this Manual:

To ensure correct use, thoroughly read and understand this manual before using the E5CK.

Topic	*Manual Location*	*Type of Information*
Features of the E5CK	*Section 1 – Introduction*	Features of the E5CK, names of parts, and typical functions.
Set Up	*Section 2 – Preparations*	Operations such as installation, wiring and switch settings you must do before using the E5CK.
Basic E5CK Operations	*Section 3 – Basic Operation* *Section 5 – Parameters*	How to use the front panel keys and how to view the display when setting the parameters of the major E5CK functions.
Applied E5CK Operations	*Section 4 – Applied Operation* *Section 5 – Parameters*	Important functions of the E5CK and how to use the parameters for full use of the E5CK.
Communications with a Host Computer	*Section 6 – Using the Communications Function*	Communications commands, and program examples.
Calibration	*Section 4 – Applied Operation*	How the user should calibrate the E5CK.
Troubleshooting	*Section 7 – Troubleshooting*	What to do if any problems occur.

SECTION 1
Introduction

This Section introduces the E5CK. For details on how to use the controller and how to work with parameter settings, refer to Section 2 and subsequent Sections.

1–1   Nomenclature

1–1–1   Main Parts

1–1–2   Front Panel
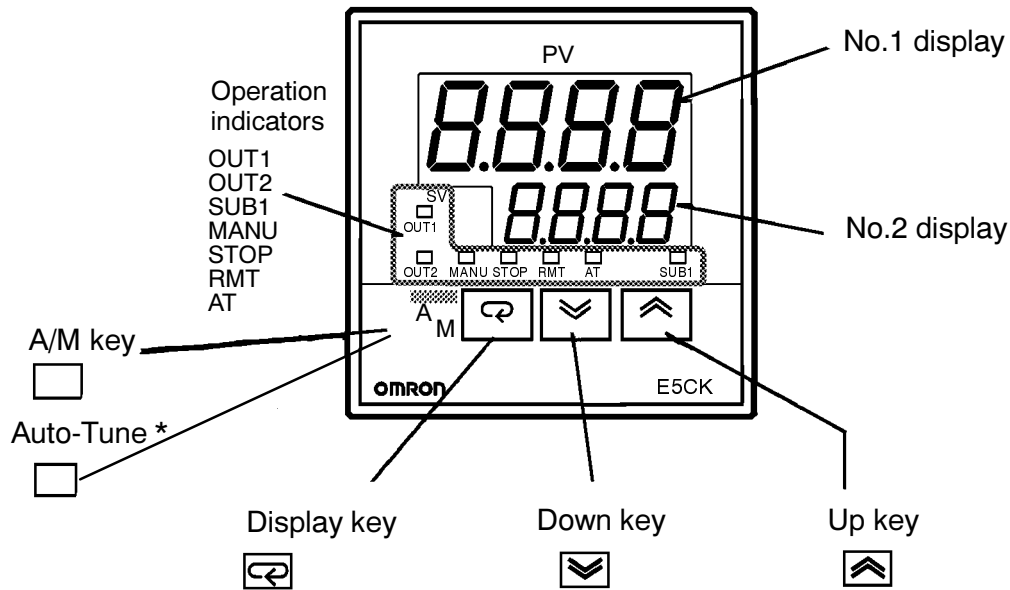
* E5CK-AA1-302 model displays an auto-tune button instead of the ☐ key

1–1–3   About the E5CK

- Select from many types of temperature and analog input (multiple input)
- Select output functions such as control output or alarm (output assignment)
- Use two set points (multi-SP function)
- Monitor the control loop by LBA (Loop Break Alarm)
- Use the communications function
- Calibrate input or transfer output
- Rely on the E5CK water-tight construction (NEMA 4: equivalent to IP66)

1–1–4   E5CK Displays

No.1 Display   Displays the process value or parameter symbols.

No.2 Display   Displays the set point, manipulated variable or parameter settings.

Operation Indicators

- OUT 1   Lit when *control output 1* is ON.
- OUT2   Lit when *control output 2* is ON.
- SUB1   Lit when the output function assigned to *auxiliary output 1* is ON.
- MANU   Lit when the manual operation mode is being used.
- STOP   Lit when control operation has been stopped.
- RMT   Lit during remote operation.
- AT   Flashes during auto-tuning.

1–1–5   Basic Operations Using Keys

☐ **key**
☐ **key**

Each press of this key switches between the auto and manual operations.
Note: E5CK-AA1-302 models do not have the ☐ key. Instead, they feature an auto-tune key. (☐ controls are in place within the programming.)

⇄ **key**

The functions of this key change according to how long it is pressed. Pressing this key for less than one second, lets you scroll through the parameters within the mode. Pressing this key for one second or more, brings up the the menu display and allows you to select which mode you need to adjust. In key operations from here on, *press the key* indicates that you must press the key for *less* than one second. For details on parameter switching and menu display items, refer to Parameters and Menus in Section 1.

⊼ ⊻ **key**

Each press of the ⊼ key increments or advances the values or settings on the No.2 display, while each press of the ⊻ key decrements or returns the values or settings on the No.2 display.

Some keys have more than one use. For example, when the ☐ key is held down simultaneously with the display key, or a key is held down continuously. For details, see Selecting Modes in Section 1. Also, refer to examples (using various key combinations) in Sections 3 and 4.

1–2   Input and Output
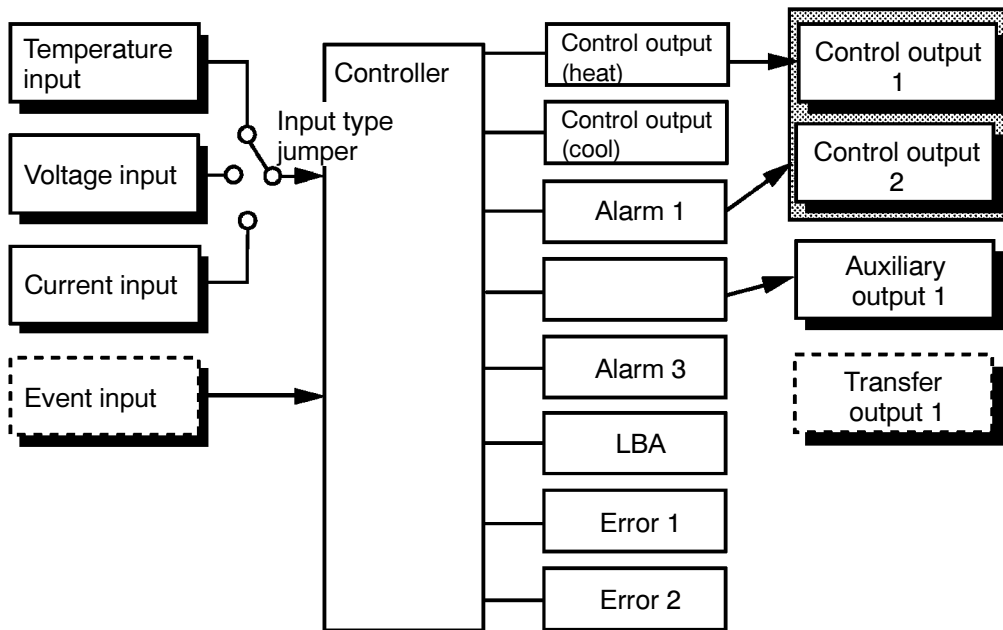
1–2–1   Input

The E5CK supports four different types of inputs.

Temperature Input/Voltage Input/Current Input

Only one of these inputs can be selected and connected to the controller:

*   Temperature input
*   Voltage input
*   Current input

Note: The above figure shows temperature input connected to the controller.

The following input sensors can be connected for temperature input:

*   Thermocouple: K, J, T, E, L, U, N, R, S, B, W, PLII
*   Platinum resistance thermometer: JPt100, Pt100

The following currents can be connected for current input:

*   4 to 20 mA, 0 to 20 mA

The following voltages can be connected for voltage input:

*   1 to 5 VDC, 0 to 5 VDC, 0 to 10 VDC

Event Input   When using event input, add on the Input Unit E53-CKB.

Select from the following five event inputs:

- Multi-SP
- Run/Stop
- Auto/Manual

1–2–2   Output

The E5CK supports these four outputs.

- Control output 1
- Control output 2
- Auxiliary output 1
- Transfer output

When using control outputs 1 and 2, set the output unit (sold separately). Eight output units are available to suit the output circuit configuration.

When using transfer output, add on the Transfer Output Option Board E53-CKF.

Note: The output functions of the E5CK do not operate for five seconds after the E5CK is turned ON.

Output Assignments   The E5CK supports the following eight output functions.

- Control output (heat)
- Control output (cool)
- Alarms 1 to 3
- LBA
- Error 1 (input error)
- Error 2 (A/D converter error)

Assign these output functions to control outputs 1 and 2 and auxiliary output 1. *Two guidelines are:*

- Only control output (heat), control output (cool), alarms 1 to 3, and LBA can be assigned to control outputs 1 and 2.
- Only alarms 1 to 3, LBA, and errors 1 and 2 can be assigned to auxiliary output 1.

In the example given in Section 1-2 (previous page), control output (heat) is assigned to control output 1; alarm 1 is assigned to control output 2; and, alarm 2 is assigned to auxiliary output 1. In this configuration, heating control output is connected to control output 1; and, alarm output is connected to control output 2 and auxiliary output 1.

In a heating and cooling control, assign control output (cool) to either control output 1 or control output 2.

Transfer Output   The E5CK supports the following five transfer outputs.

- Set point
- Set point during SP ramp
- Process value
- Heating side manipulated variable
- Cooling side manipulated variable

These transfer outputs can be output after being scaled. Reverse scaling is also possible because setting an upper limit value smaller than the lower limit value is allowed.

1–3   Parameters and Menus

1–3–1   Parameter Types

E5CK parameters are distributed between the following nine modes.

- Protect mode
- Manual mode
- Level 0 mode
- Level 1 mode
- Level 2 mode
- Setup mode
- Expansion mode
- Option mode
- Calibration mode

The settings of parameters in each of seven modes (excluding the protect mode and manual mode) can be checked and modified by selection on the menu display.

Protect Mode   **Limits use of the Menu and ☐ Keys.**
The protect function prevents unwanted modification of parameters and can also be used to prevent switching between the auto and manual operation.

Manual Mode   **Sets the controller to manual operation mode.**
You can only manually adjust the manipulated variable (MV) in this mode.

Level 0 Mode   **For normal operation.**
Change: the set point during operation, and start or stop Controller operation; and, (only in this mode) monitor the process value, ramp SP, and manipulated variable.

Level 1 Mode   **For adjusting primary control parameters.**
Execute: AT (auto-tuning); set alarm values; set the control period; and, set PID parameters.

Level 2 Mode   **For adjusting secondary control parameters.**
Set parameters for: limiting the manipulated variable and set point; switch

between the remote and local modes; set the loop break alarm (LBA), alarm hysteresis, and the digital filter value of inputs.

Setup Mode

For setting the basic specifications.
Set parameters for: input type, scaling, output assignments and direct/reverse operation.

Expansion Mode

For setting expanded functions.
Set: ST (self-tuning), SP setting limiter. Select: advanced PID or ON/OFF control. Specify the standby sequence resetting method. Initialize parameters; and, set the time for automatic return to the monitoring display.

Option Mode

For setting option functions.
Set: the communications conditions; transfer: output and event input parameters to match the type of Option Board installed in the Controller. *This mode will be accessible only when an option board is installed in the controller.*

Calibration Mode

For calibrating inputs and transfer output.
Calibrate the selected input type. *Transfer output can be calibrated only when the Transfer Output Option Board E53-CKF has been installed in the Controller*.

Menu Display

To select the menu display in any of the above modes (excluding the protect mode and manual mode), press the ⟲ key for 1 second minimum. If you select the desired mode using the ⟰ or ⟱ keys and press the ⟲ key, the top parameter in the specified mode is displayed.

When you have selected the menu display, the previous mode is selected. For example, if you selected the menu display while in the level 0 mode, the No.2 display changes to [*L u - 0*] as shown on the left.

Protected modes cannot be selected. Also, the menu display does not appear when modes are protected up to the level 1 mode.

Level 0 to 2 Modes

If you select [*L u - 0*] [*L u - 1*] or [*L u - 2*] in the menu display, the level 0, level 1 and level 2 modes, respectively, are selected.

These modes are selected with control still continuing.

Setup Mode
Expansion Mode
Option Mode
Calibration mode

If you select [*SEt*] [*EuE*] [*oPt*] or [*CLb*] in the menu display, the setup, expansion, option and calibration modes, respectively, are selected. When these modes are selected, the control is reset. So, control outputs and auxiliary output are turned OFF. When another mode is selected while in these modes, *reset is canceled*.

Protect Mode   To set the controller to the protect mode or to return to the level 0 mode from the protect mode, simultaneously press the ☐ key and ⮌ key for 1 second minimum.

Manual Mode   To set the controller to the manual mode, press the ☐ key for 1 second minimum in levels 0, 1 and 2. To return to the level 0 mode from the manual mode, press the ☐ key for 1 second minimum.

1–3–2   Selecting Modes

Operating Parameters

Mode Selection. Press the Display Key for 1 sec. minimum to switch to modes other than the manual or protect mode.

The figure below (Menu Display) shows all parameters in the order that they are displayed. Some parameters are not displayed, depending on the protect mode setting and the option boards used.

Menu Display
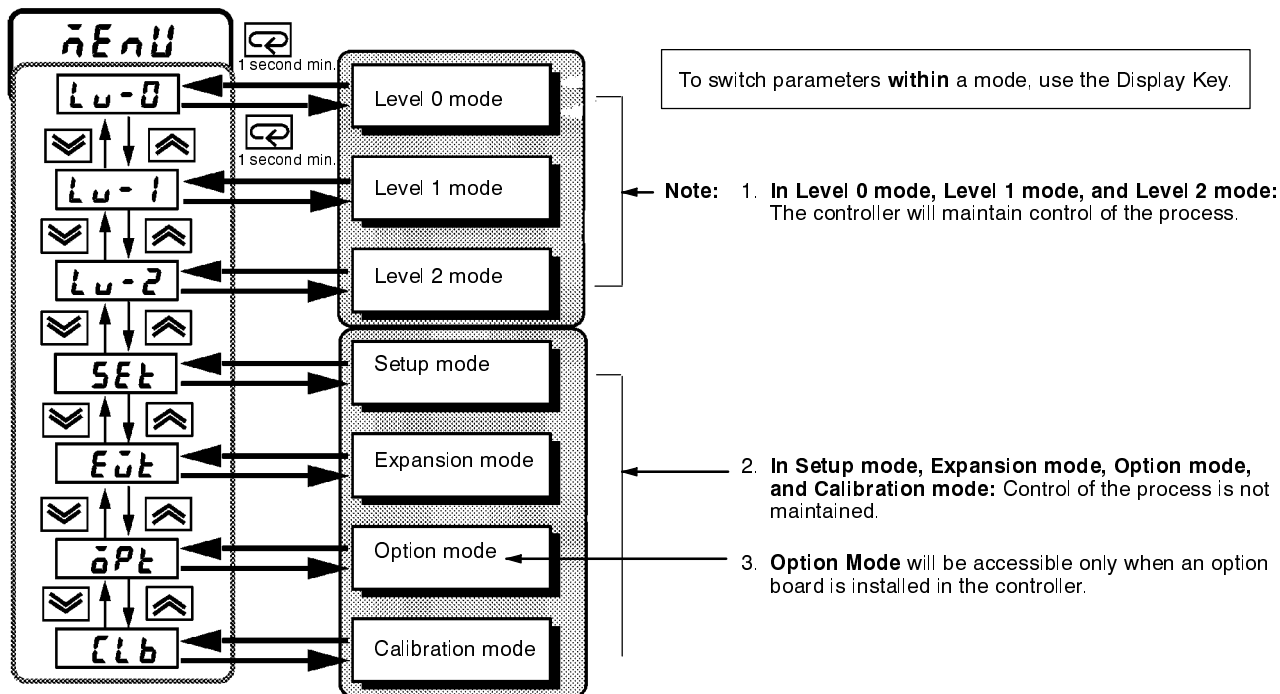
To switch parameters **within** a mode, use the Display Key.

Note: 1. **In Level 0 mode, Level 1 mode, and Level 2 mode:** The controller will maintain control of the process.

2. **In Setup mode, Expansion mode, Option mode, and Calibration mode:** Control of the process is not maintained.

3. **Option Mode** will be accessible only when an option board is installed in the controller.

To Access *Protect Mode*. Press and hold the A/M Key and the Display Key for more than 1 second.

To Return to the Main PV/SP Display. To Return to the Main PV/SP Display from the Protect Mode by pressing the A/M Key and the Display Key for more than 1 second.

To Access *Manual Mode*. Press and hold the A/M Key for more than 1 second.

1–3–3 Selecting Parameters

When not in the manual mode, press the ⟳ key (less than one second) to switch the parameter.

If you press the ⟳ key when at the final parameter, the display returns to the first parameter.
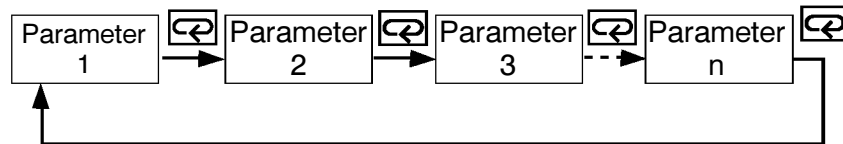
1–3–4 Writing the Settings to Memory

When you have changed a parameter setting, specify the parameter using the ⟰ or ⟱ keys, and either leave the setting for at least two seconds or press the ⟳ key. This writes the setting to memory.

When another mode is selected, the content of the parameters before the mode was selected is written to memory.

When turning the power OFF, you must first write the settings and parameter contents to memory (by pressing the ⟳ key or selecting another mode). The settings and parameter contents are sometimes not changed by simply pressing the ⟰ or ⟱ keys.

1–4 Communications Function

The E5CK can be provided with a communications function that allows you to check and set controller parameters from a host computer. If the communications function is required, add on the communications unit.
For details on the communications function, refer to Section 6.

RS-232C

When using the communications function on the RS-232C interface, add on the Communications Unit E53-CK0.

RS-485

When using the communications function on the RS-485 interface, add on the Communications Unit E53-CK03.

1−5 Calibration

The E5CK controller is calibrated before shipment from the factory. So, the user need not calibrate the E5CK controller during regular use.

However, if you must calibrate the E5CK controller, use the parameters provided for user to calibrate temperature input, analog input (voltage, current) and transfer output.
Also, note that calibration data is updated to the latest value each time the E5CK controller is calibrated.

Note: If you alter the factory-set calibration, you cannot automatically return to factory calibration settings.

Calibrating Inputs

The input type selected in the parameter is the item to be calibrated. The E5CK is provided with the following four calibration parameters.

- Thermocouple
- Platinum resistance thermometer
- Current input
- Voltage input

Note: Two parameters are provided for thermocouple and voltage input.

Calibrating Transfer Output

Transfer output can be calibrated when the Transfer Output Option Board E53-CKF is added on.

Registering Calibration Data

To calibrate these items, the user must prepare separate measuring devices and equipment. For details, refer to Section 4. For details on handling these measuring devices and equipment, refer to the respective manuals.

This section describes the operations you must do before turning ON the E5CK.

2–1   Setting Up

Information is provided on how to set the input-type jumper, and how to set up the output unit or option unit.

2–1–1   Remove Internal Mechanism from the Housing

First, pull the internal mechanism from the housing:

1, 2, 3...   1.   While pressing the hooks on the left and right sides of the front panel, pull out the internal mechanism.

2.   Hold both sides of the front panel as you pull the internal mechanism out toward you.
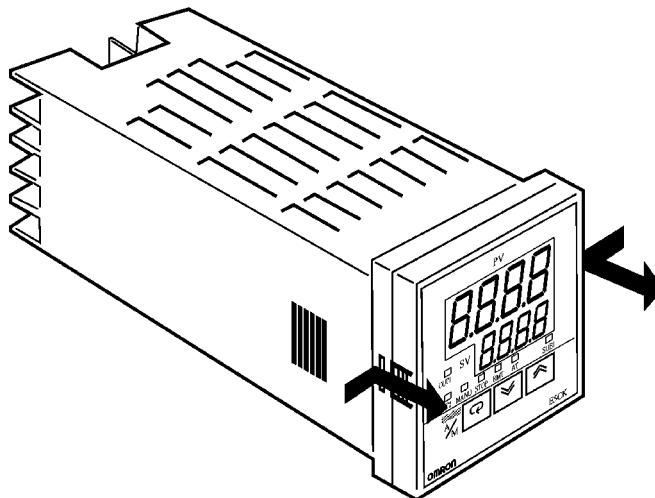
2–1–2   Setting the Input Type

For details on the jumper connector location, refer to Nomenclature in Section 1.

1, 2, 3...   1.   Set the input type jumper connector to a temperature input, voltage input or current input matched to the sensor connected to the input terminal.

I : Current input   V : Voltage input

TC.PT : Temperature input
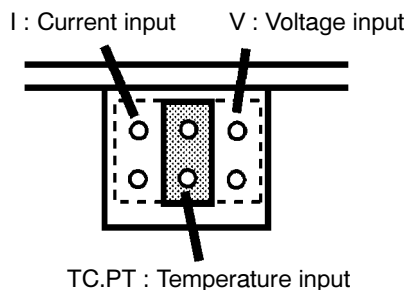
Note: The factory setting is "TC/PT (temperature input)."

Note: When removing or inserting the jumper connector, do not touch the pins with your fingers. Pull it out gently with a needle-nose pliers.

2.   When you have set the jumper connector, insert the internal mechanism into the housing.

3.   When inserting the internal mechanism, push in until you hear the hooks
     on the front panel click into place.

2–1–3   Setting Up the Output Unit

Output Unit List   The output units that can be set in the E5CK controller are listed here:

Model	Specifications (control output 1/control output 2)
E53-R4R4	Relay/Relay
E53-Q4R4	Voltage (NPN)/Relay
E53-Q4HR4	Voltage (PNP)/Relay
E53-C4R4	4 to 20 mA/Relay
E53-C4DR4	0 to 20 mA/Relay
E53-V44R4	0 to 10 V/Relay
E53-Q4Q4	Voltage (NPN)/Voltage (NPN)
E53-Q4HQ4H	Voltage (PNP)/Voltage (PNP)

Setup
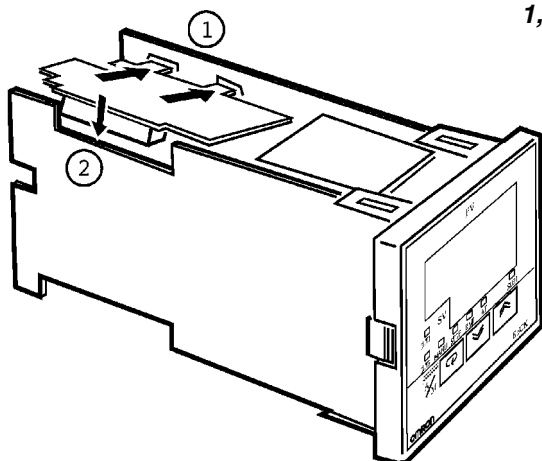
1, 2, 3...   1.   Two rectangular slots are provided on the
                    power board (on right side of controller).
                    Fit the two protrusions on the output unit
                    into these two slots.

               2.   With the output unit fitted into the power
                    board, fit the output unit into the connector
                    on the control board (on left side of con-
                    troller).

2–1–4   Setting Up the Option Unit

Option Unit List   The Option Units (or Option Boards) that can be connected to the E5CK con-
                                    troller are listed here:

Unit	Model	Specifications
Communications Unit	E53-CK01	Communications (RS-232C)
Communications Unit	E53-CK03	Communications (RS-485)
Input Unit	E53-CKB	Event input: 1 input
Transfer Output Option Board	E53-CKF	Transfer output: 4 to 20 mA

Setup
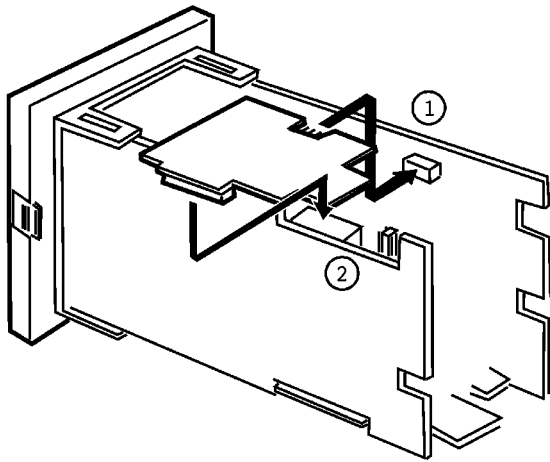
, **3...**   1.   Place the controller with the bottom facing up and fit the board horizontally into the connector on the power board (on right side of controller).
2.   With the power board connected, fit the board vertically into the connector on the control board (on left side of controller).

2–2   E5CK Installation

2–2–1   Before Installing the E5CK

If you remove the controller from its case, never touch or apply shock to the electronic parts inside.

Do not cover the top and bottom of the controller. (Ensure sufficient space around the controller to allow heat to escape.)

Use a voltage (100 to 240 VAC at 50 to 60 Hz). At power ON, the prescribed voltage level must be attained within two seconds.

When wiring input or output lines to your controller, keep the following points in mind to reduce the influence from inductive noise:

*   Allow adequate space between the high voltage/current power lines and the input/output lines.
*   Avoid parallel or common wiring with high voltage sources and power lines carrying large currents.
*   Using separating pipes, duct, and shielded line is also useful in protect ing the controller, and its lines form inductive noise.

Allow as much space as possible between the controller and devices that generate a powerful, high frequency (high-frequency welders, high-frequency sewing machines, and so forth) or surge. These devices may cause malfunctions.

If there is a large power-generating peripheral device and any of its lines, attach a surge suppressor or noise filter to the device to stop the noise 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.

Do not use the controller in places where icing, condensation, dust, corrosive gas (especially sulfurized gas or ammonia gas), shock, vibration, splashing liquid, or oil atmosphere occur. Also, avoid places where the controller is exposed to intense heat radiation (from a furnace, for example) or sudden temperature changes.

Ambient temperature must be kept between -10°C and 55°C (14°F to 131°F). Ambient humidity must be kept between 35%RH to 85%RH (with no icing or condensation). If the controller is installed inside a control board, the ambient temperature must be kept under 55°C, including the temperature around the controller. 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 and 65°C (-13°F to 149°F). The ambient humidity must be between 35%RH to 85%RH (with no icing or condensation).

Never place heavy objects on the controller or apply pressure to the controller. This could cause the controller to deform or deteriorate.

Do not use 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.

2–2–2   Dimensions

2–2–3   Panel Cutout

Unit (mm)

65 mm min

60 mm min

45 $^{+0.6}_{0}$

45 $^{+0.6}_{0}$

- Recommended panel thickness is: 1 to 5 mm.
- Maintain the specified vertical and horizontal mounting space between each controller. Controllers must not be closely mounted vertically or horizontally.
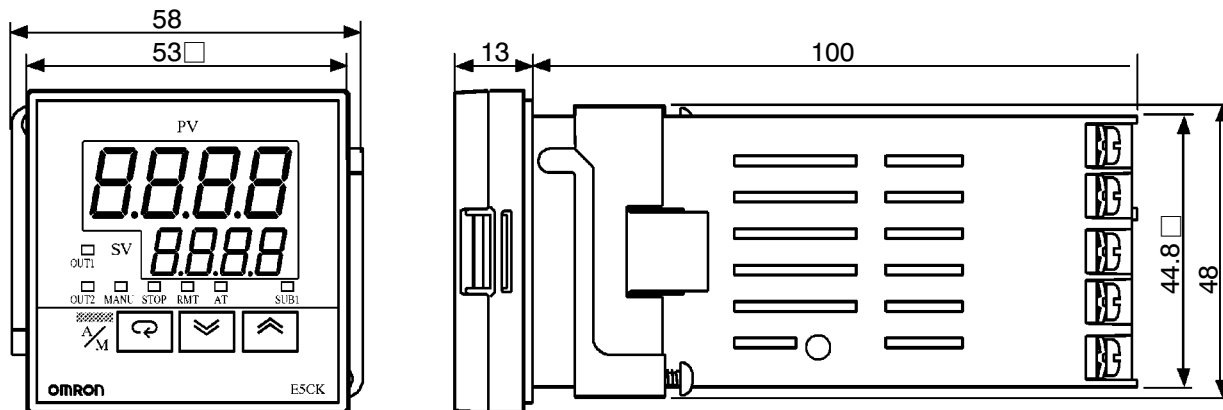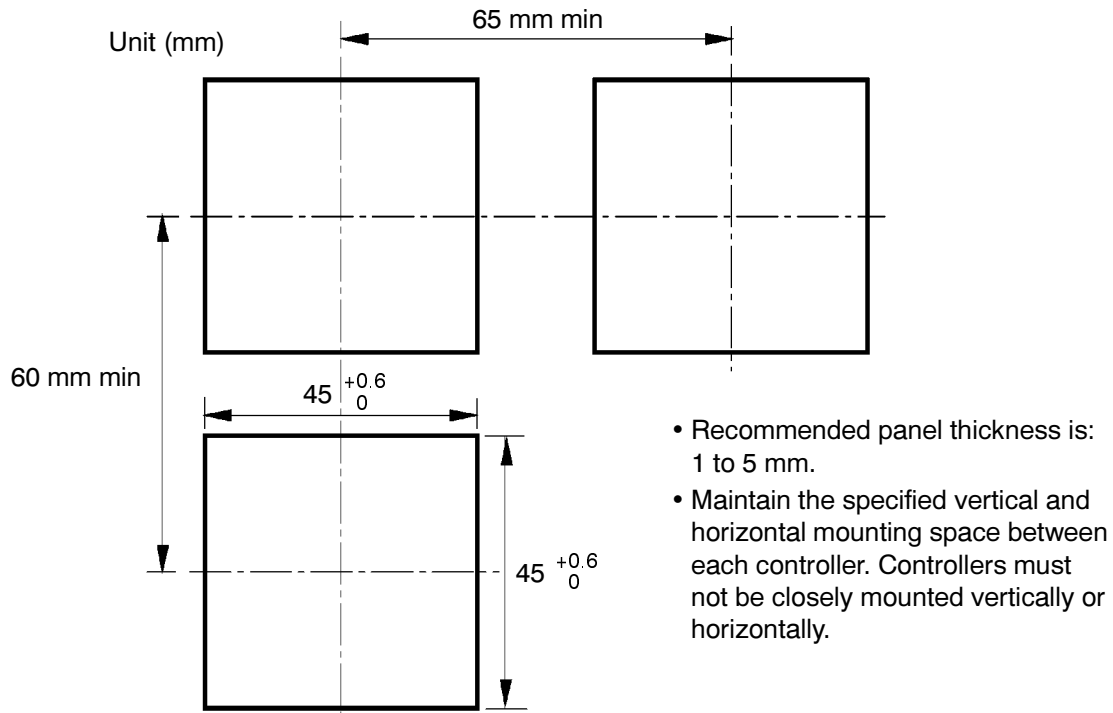
2–2–4   Installation Procedure

ertight
ket
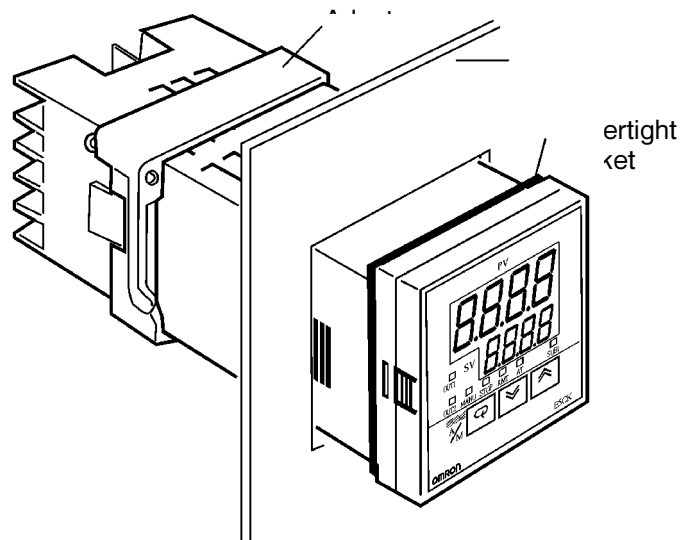
1, 2, 3...   1.   Insert the E5CK controller into the mounting hole in the panel at the position shown in the figure above.

2.   Push the adapter along the controller body from the terminals up to the panel and fasten temporarily.

3. Tighten the two mounting screws on the adapter. When tightening
    screws, tighten the two screws alternately keeping the torque to approx-
    imately 0.29 to 0.39 N·m, or 3 to 4 kgf·cm.

☞   *About the*   *E5CK-AA1-500 controller is provided with a terminal cover (E53-COV07). Fasten the*
       Terminal Cover   *terminal cover by using the snap pin. Refer to the figure below.*
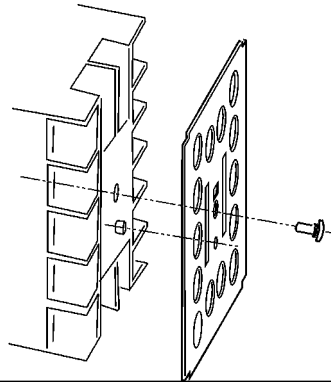
2–3   Wiring Terminals

2–3–1   Terminal Arrangement
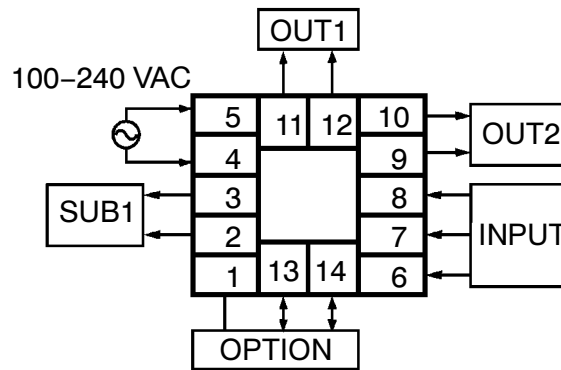
2–3–2   Wiring Precautions

Use wire 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.

Do not tighten the terminal screws too tightly: tighten the terminal screws
using a torque no greater than 0.78 N·m, or 8 kgf·cm max.

Use the following type of solderless terminals for M3.5 screws.

7.2mm max.

7.2mm max.

2–3–3 Wiring Procedure

In the following wiring diagrams, the left side of the terminal Nos. indicates the inside of the controller

Power Supply
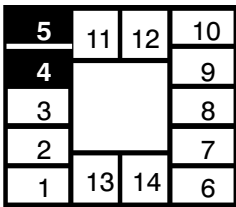
Input power to terminal Nos. 4 and 5. Power specifications are: 100 to 240VAC, 50/60Hz, approximately 15VA.

☞ *About the power blocks*

The E5CK has independent power supplies for each of the terminal blocks shown on the right. However, that the power supplies for blocks C (exclude relay output) and D are the same whether you have installed the option unit E53-CKB or E53-CKF.

Note: You can install only one option unit at a time in the controller.
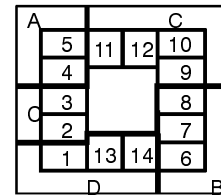
Input
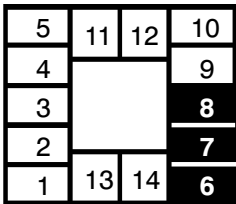
Connect the input to terminal Nos. 6 to 8 as follows according to the input type.

| Output Type | Thermocouple | Platinum resistance thermometer | Voltage input | Current input |

Connector Setting

TC · PT   V   I
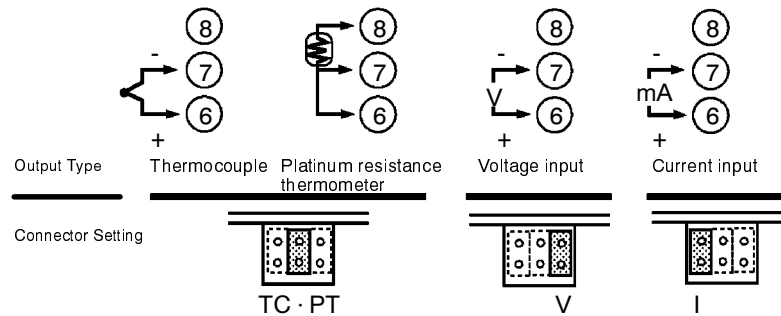
Match the inputs with the internal jumper settings for each input type. For thermocouple or platinum resistance thermometer inputs, set the inputs to a common position (TC/PT) as the temperature input. For details on jumper connector positions, refer to *Setting the Input Type* in Section 2.

Control Output
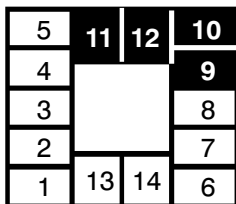
Terminal Nos. 11 and 12 are for control output 1 (OUT1). The five output types and internal equalizing circuits are available according to output unit:

Output Type	Relay	NPN	PNP	0 to 10V	4 to 20mA/0 to 20mA
Part No.	E53-R4R4	E53-Q4R4 E53-Q4Q4	E53-Q4HR4 E53-Q4HQ4H	E53-V44R4	E53-C4R4 E53-C4DR4
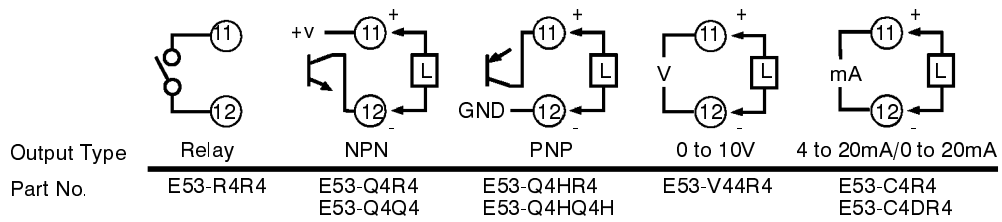
Terminal Nos. 9 and 10 are for control output 2 (OUT2). The three output types and internal equalizing circuits are available according to output unit:

Output Type	Relay	NPN	PNP
Part No.	E53-R4R4 /E53-V44R4 E53-Q4R4 /E53-C4R4 E53-Q4HR4/E53-C4DR4	E53-Q4Q4	E53-Q4HQ4H

The specifications for each output type are provided here:

Output Type	Specifications
Relay	250VAC, 3 A, SPST-NO
Voltage (NPN)	12VDC, 20 mA (with short-circuit protection)
Voltage (PNP)	12VDC, 20 mA (with short-circuit protection)
0 to 10V	0 to 10VDC, Permissible load impedance: 1 kΩ min., Resolution: 11 Bit
4 to 20mA	4 to 20 mA, Permissible load impedance: 500 Ω max., Resolution: 11 Bit
0 to 20mA	0 to 20 mA, Permissible load impedance: 500 Ω max., Resolution: 11 Bit

Auxiliary Output 1
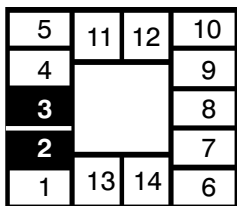
Terminal Nos. 2 and 3 are for auxiliary output 1 (SUB1).

The internal equalizing circuit for auxiliary output 1 is as follows:
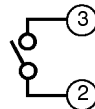
Relay specifications are as follows:
SPST-NO, 250VAC, 1A

Option
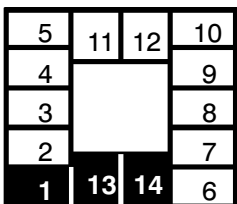
Terminal Nos. 1, 13 and 14 are valid only when the option unit is set in the controller.

The following four connections are possible depending on the type of option unit.

Output Type	RS-232C	RS-485	Event input	Transfer output
Part No.	E53-CK01	E53-CK03	E53-CKB	E53-CKF

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For details on RS-232C and RS-485 communications functions, refer to *Using the Communications Function* in Section 6.

Use event inputs under the following conditions

Contact input	ON: 1 kΩ max., OFF: 100 kΩ min.
No-contact input	ON: residual voltage 1.5V max., OFF: leakage current 0.1mA max.

Polarities during no-contact input are:
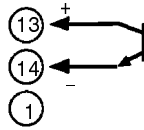
Transfer output specifications are:
4 to 20 mA, Load 500 Ω max.; resolution: 11 bit.

This Section describes an actual example for understanding the basic operation of the E5CK.

3–1   Control Example

To facilitate understanding basic E5CK controller operation, this Section describes the following control example.

In this example, we assume that the controller is operated under the following conditions.

- A humidity sensor of output 4 to 20 mA is connected to the controller. The measuring range of the humidity sensor is set to 10 to 95%.

- A humidifier is controlled by pulse output to maintain humidity at a constant 60%.

- An alarm is output when the humidity exceeds the upper limit value (70%) or lower limit value (50%).

3–1–1   Setup

Output unit: relay/relay type (E53-R4R4)

Input type jumper connector: "I (current input)"
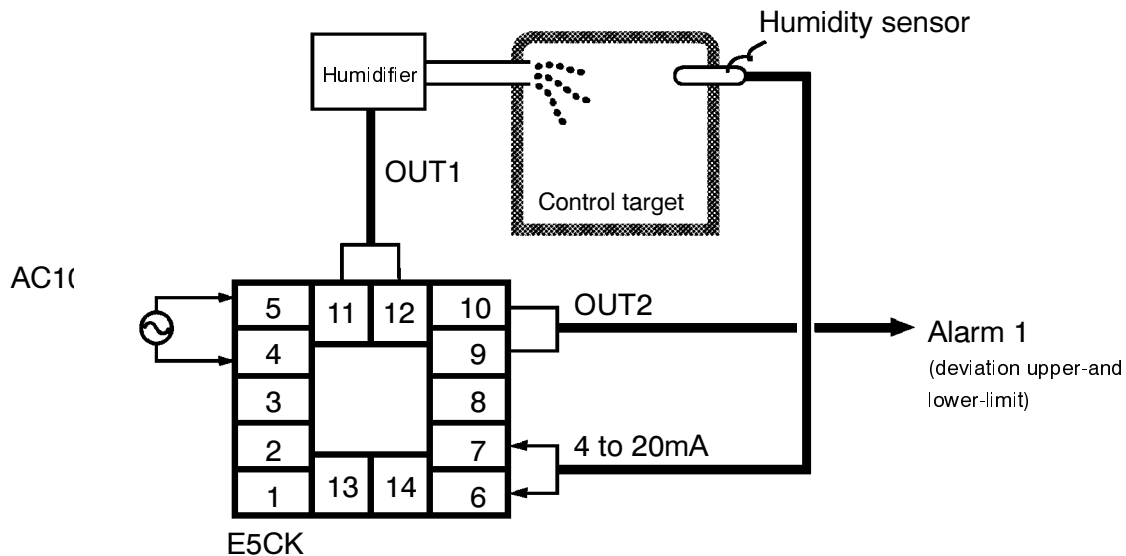
3–1–2   Input Type Connector
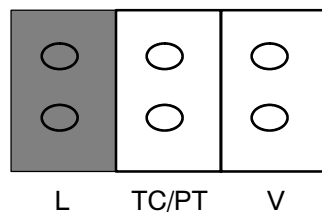
3–2 Setting Input Specifications

3–2–1 Input Type

`[ n - t`

Set the type No. (0 to 21) in the *input type* parameter. The factory setting is **2: K1 (thermocouple)**.

For details on input types and setting ranges, refer to *Setup Mode – Input Type* in Section 5.

3–2–2 Scaling

`[ n - H`

`[ n - L`

`dP`

When the voltage input and current input are selected, scaling matched to the control is required.

The *scaling upper limit*, *scaling lower limit* and *decimal point* parameters (setup mode) are used for scaling.

The *scaling upper limit* parameter sets the physical quantity to be expressed by the upper limit value of input, and the *scaling lower limit* parameter sets the physical quantity to be expressed by the lower limit value of input. The *decimal point* parameter sets the number of digits past the decimal point.

The following figure shows scaling example of 4 to 20 mA input. After scaling, the humidity can be directly read. In this case, the *decimal point* parameter is set to **1**.

3–2–3 Input Shift

`[ n S H`

`[ n S L`
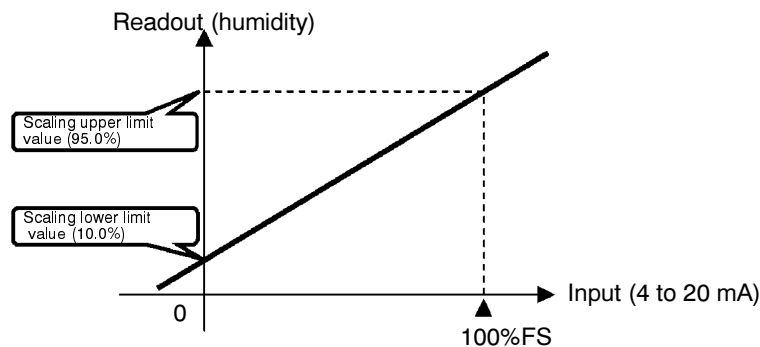
When temperature input is selected, scaling is not required. This is because temperature inputs are matched to the input type. However, note that the upper and lower limit values of the sensor can be shifted. For example, if both the upper and lower limit values are shifted by 1.2°C, the process value (before shift) is regarded as 201.2°C after shift when input is 200°C before shift.

To set input shift, set shift values in the *input shift upper limit* and *input shift lower limit* parameters (level 2 mode).
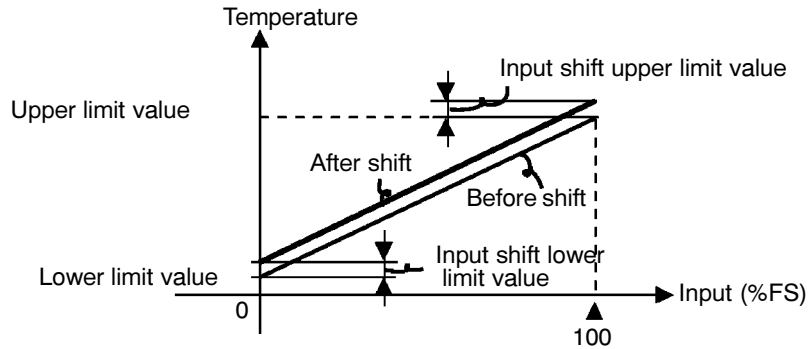
Setting Example
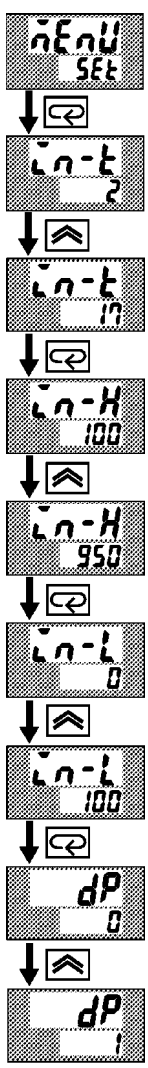
In this example, let's set the parameters as follows:

* *input type*   = **17 (4 to 20 mA)**
* *input type*   = **17 (4 to 20 mA)**
* *scaling upper limit value*   = **950**
* *scaling lower limit value*   = **100**
* *decimal point*   = **1**

(1) Press the ⮐ key for more than one second to get the menu display, and select [5Et] (setup mode) using the ⌃ or ⌄ keys.

(2) Press the ⮐ key to enter the setup mode. The top parameter in the setup mode [in-t] *input type* is displayed. The parameter default is **2**.

(3) Press the ⌃ key until the display indicates **17**.

(4) Press the ⮐ key to fix the set value. The display changes to [in-H] (*scaling upper limit value* parameter). The parameter default is **100**.

(5) Press the ⌃ key until the display indicates **950**.

(6) Press the ⮐ key to fix the set value. The display changes to [in-L] (*scaling lower limit value* parameter). The parameter default is **0**.

(7) Press the ⌃ key until the display indicates **100**.

(8) Press the ⮐ key to fix the set value. The display changes to [dP] (*decimal point* parameter). The parameter default is **0**.

(9) Press the ⌃ key until the display indicates **1**.

(10) Return the controller to level 0, PV/SP display.

The controller has been set up so the display will read **between 100.0 and 950.0**.

3–3 Setting Output Specifications

3–3–1 Output Assignments

Eight different output types are supported. The eight output types are shown in the table that follows.

- control output (heat)
- control output (cool)
- alarm output 1
- alarm output 2
- alarm output 3
- LBA, and
- error 1 (input error)
- error 2 (A/D converter error).

These functions are assigned to control outputs 1 and 2, and auxiliary output 1. Restrictions on assignment destination are placed on some of the outputs. The following table shows where outputs may be assigned.

Output Function / Assignment Destination	Control Output 1	Control Output 2	Auxiliary Output 1
Control output (heat)	●	●	
Control output (cool)	●	●	
Alarm 1	●	●	●
Alarm 2	●	●	●
Alarm 3	●	●	●
LBA	●	●	●
Error 1; input error			●
Error 2; A/D converter error			●

Heating and cooling control is carried out when control output (cool) is assigned, and standard control is carried out when output is not assigned. For details on heating and cooling control, refer to Selecting the Control Method in Section 4.

Factory settings are shown here:

Function	Rear Terminals
Control output (heat) =	Control output 1
Alarm 1 =	Control output 2
Alarm 2 =	Auxiliary output 1.

Output assignments are set in the *control output 1 assignment*, *control output 2 assignment* and *aux output 1 assignment* parameters (setup mode).

3–3–2   Direct/Reverse Operation

$$\bar{o} r E u$$

Reverse operation (or heating) refers to control where the manipulated value (MV) increases as the PV increases. In other words, as the value of the set point rises, the MV must also rise to attain the new SP. Thus, reverse operation involves an increasing MV and an increasing PV. In direct (or cooling) operation, the MV will still increase, but it will have the opposite effect on the PV. As the PV goes down, the MV must increase to lower the PV.

Direct/reverse operation is set in the [$\bar{o} r$ - r] *direct/reverse operation* parameter (setup mode).

Reverse operation: $\bar{o} r$ - r
Direct operation: $\bar{o} r$ - d

3–3–3   Control Period

$$\mathsf{C\ P}$$
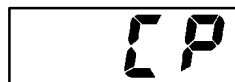
When the output unit is a pulse output such as relay, SSR, or voltage output, set the pulse output cycle (control period). *When the output unit is relay –* though a shorter pulse period provides better control performance, the control period should be set taking the life expectancy of the output unit into consideration.

The control period is set in the *control period (heat)* parameter (level 1 mode). Factory setting is **20 seconds**.

Note: For control periods less than five seconds, an SSR or a voltage output is recommended.

The *control period* represents a period of time. This period of time is directly related to how long the output will be on.

Example: If the manipulated variable (MV) is at 50% with a control period of 20 seconds, the output will turn ON and OFF (cycling) until the output has been ON for a total of 10 seconds within the 20 second control period. The MV = 25%. The output will be ON for 5 seconds within the 20 second period.

Setting Example

In this example, set the parameters as follows:

- *control output 1 assignment* = **control output (heat)**
- *control output 2 assignment* = **alarm output 1**
- *direct/reverse operation* = **reverse (heating) operation**
- *control period* = **20 secs**

All of the above settings in this example are factory settings. So, in this example, we are only going to <u>check</u> the parameter settings.
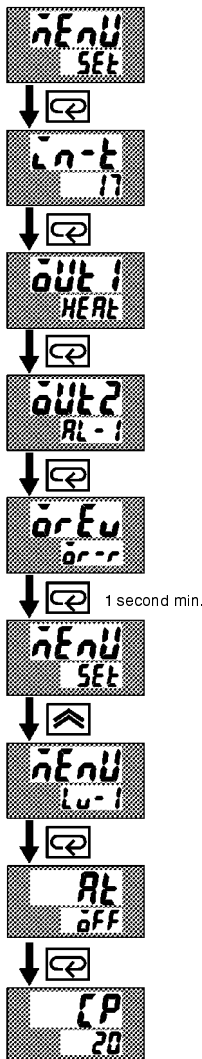
(1) Press the ⇄ key (display key) for more than one second, to access the menu display. Select [5Et] (setup mode) using the ⋀ or ⋁ keys.

(2) Press the ⇄ key for more than one second to enter the setup mode. The top parameter in the setup mode [in-t] "input type" is displayed. In this example, the parameter setting is **17 (4 to 20 mA)**.

(3) Press the ⇄ key until [out 1] ("control output 1 assignment" parameter) is displayed. Verify that the current setting is [HERt].

(4) As the setting in this example is to be left as it is, press the ⇄ key. The display changes to [out 2] (*control output 2 assignment* parameter). Verify that the current setting is [RL - 1].

(5) The setting in this example is to be left as it is, so press the ⇄ key until [orEu] ("direct/reverse operation" parameter) is displayed. Press the ⇄ key for more than one second to return to the menu display. Verify that the current setting is is [or - r] (reverse or heating).

(6) Press the ⇄ key for more than one second, to access the menu display. Select [Lu - 1] (level 1 mode).

(7) Press the ⇄ key for more than one second to enter the level 1 mode. The top parameter in the level 1 mode [Rt] *AT execute/cancel* is displayed.

(8) Press the ⇄ key until [CP] (*control period* parameter) is displayed. Verify that the current setting is **20**.

(9) Access the menu display again and return the controller to Level 0.

The controller is now ready to run the process.

3–4   Setting Alarm Type

Three alarm outputs are supported: alarms 1 to 3. Of these, only the alarms assigned to an output can be used.

Alarm output conditions are determined according to the combination of the *alarm type*, *alarm value* and *alarm hysteresis* parameter settings.

The contact conditions when alarm output is ON can be set to *open* or *closed* in the *close in alarm/open in alarm* parameter.

3–4–1   Alarm type
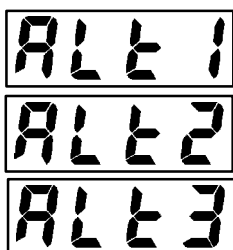
The following table shows the alarm types supported by the E5CK controller and the operations for each.

Alarm Type		Alarm Output Operation	
		When X is positive	When X is negative
1	Upper-and lower-limit alarm (deviation)		Always ON
2	Upper-limit alarm (deviation)		
3	Lower-limit alarm (deviation)		
4	Upper-and lower-limit range alarm (deviation)		Always OFF
5	Upper-and lower-limit alarm with standby sequence (deviation)		Always OFF
6	Upper-limit alarm with standby sequence (deviation)		
7	Lower-limit alarm with standby sequence (deviation)		
8	Absolute-value upper-limit alarm		
9	Absolute-value lower-limit alarm		
10	Absolute-value upper-limit alarm with standby sequence		
11	Absolute-value lower-limit alarm with standby sequence		

Note:

1.) A deviation is: deviation from SP.

2.) An absolute alarm is defined as a fixed value **X** with reference to **0**.

Alarm types are set independently for each alarm in the *alarm 1 to 3* parameters (setup mode). Factory setting is **2: Upper-limit alarm (deviation)**.

3–4–2   Alarm Value

$\boxed{AL - 1}$
$\boxed{AL - 2}$
$\boxed{AL - 3}$
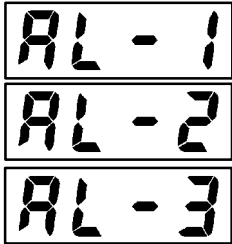
Alarm values are indicated by **X** in the table above. Alarm output operation differs according to whether the value of the alarm is positive or negative.

Alarm values are set independently for each alarm in the *alarm value 1 to 3* parameters (level 1 mode). Factory setting is **0**.

3–4–3   Alarm Hysteresis
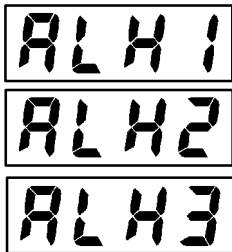
The hysteresis of alarm outputs when alarms are switched ON/OFF can be set as follows.

$\boxed{ALH1}$
$\boxed{ALH2}$
$\boxed{ALH3}$
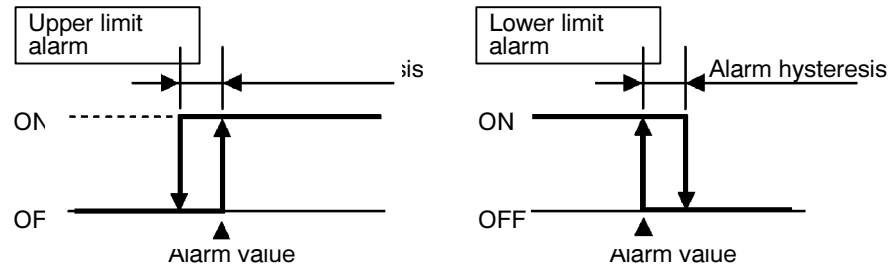
Alarm hysteresis is set independently for each alarm in the *alarm 1 to 3 hysteresis* parameters (level 2 mode). Factory setting is **0.02: 0.02%FS**.

Standby Sequence

Alarm functions with *standby sequence* suppress nuisance alarms when the controller is first powered up. The alarm output is suppressed until the temperature exceeds the alarm band or alarm limit one time.

3–4–4   Close In Alarm/Open In Alarm
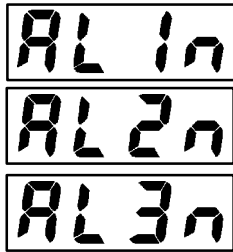
When the controller is set to *close in alarm*, the status of the alarm output function is output normally. When set to *open in alarm*, the status of the alarm output function is output inverted.

	Alarm	Output	Output LED
Close in alarm	ON	ON	Lit
	OFF	OFF	Not lit
Open in alarm	ON	OFF	Lit
	OFF	ON	Not lit

Alarm type and ***close in alarm/open in alarm (normally open/normally close)*** can be set independently for each alarm.

Close in alarm/open in alarm is set in the *alarm 1 to 3 open in alarm* parameters (setup mode). Factory setting is [n - o] *close in alarm*.

Summary of Alarm Operations

The figure below visually summarizes the above description of alarm operations, when alarm type is set to *lower limit alarm (deviation)*:
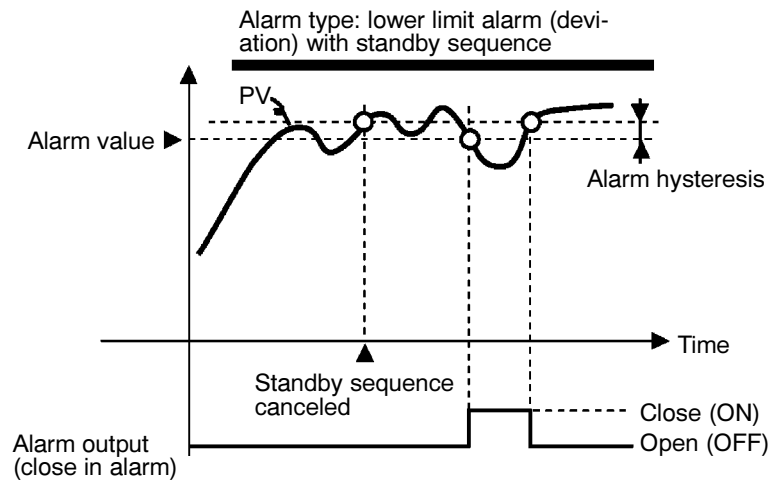
Setting Example
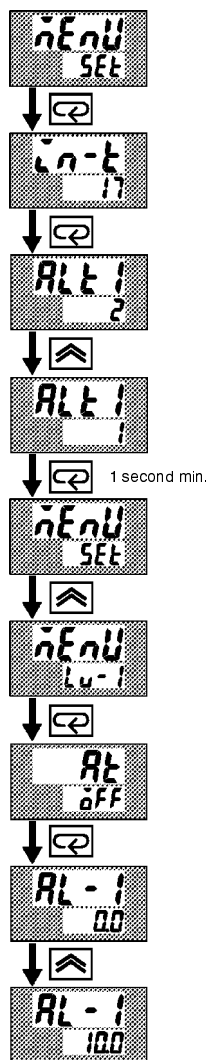
When a set point for a temperature exceeds ±10%, alarm1 will be output.
In this example, let's set the parameters as follows:

- *alarm type 1* = **1: (deviation upper-and lower-limit)**
- *alarm value 1* = **10**
- *alarm hysteresis* = **0.20**
- *close in alarm/open in alarm* = n - o: **close in alarm**

Meanings of parameters, *alarm hysteresis* and *open in alarm/close in alarm* are the same settings at the shipment, so settings for operations are omitted.

(1) Press the ⏎ (display) key for more than one second, to access the menu display. Select [SEt] (setup mode) using the ⋀ or ⋁ keys.

(2) Press the ⏎ key (for more than one second) to enter the setup mode. The top parameter in the setup mode [in-t] *input type* is displayed. In this example, the parameter setting is **17: 4 to 20 mA**.

(3) Press the ⏎ key until [ALt 1] (*alarm type 1* parameter) is displayed. Verify that the current setting is **2**: *deviation upper limit*.

(4) Press the ⋁ key to return to **1**: *deviation lower limit*.

(5) Press the ⏎ key (for more than one second) to access the menu display. Select [Lu-1] (level 1 mode) using the ⋀ or ⋁ keys.

(6) Press the ⏎ key (for more than one second) to enter the level 1 mode. The top parameter in the level 1 mode [At] *AT execute/cancel* is displayed.

(7) Press the ⏎ key until [AL - 1] (*alarm value 1* parameter) is displayed.

(8) In this example, the parameter setting is **10.0;** so, press the ⋀ key until **10.0** is displayed.

(9) Return the controller to Level 0 using the menu display.

The controller's alarm values have now been set for proper operation when the controller is in RUN mode.

☞ *About the Decimal Point of the Alarm Value*

The decimal point of the alarm value conforms to the setting of the decimal point parameter (setup mode). In this example, the decimal point parameter is set to 1. (During temperature input, the decimal point of the alarm value conforms to the sensor selected.)

3–5 Protect Mode

3–5–1 Security

SECr

This parameter allows you to protect (until start of operation) parameters that do not change during operation to prevent unwanted modification.

The set value of the *security* (protect) parameter specifies the range of protected parameters.

When this parameter is set to **0**, parameters are not protected.

When this parameter is set to **from 1 to 3**, the number of modes that can be displayed on the menu display is limited.
When set to **1**, levels 0 to 2, setup, expansion and option modes only can be selected. When set to **2**, only levels 0 to 2 modes can be selected. When set to **3**, only levels 0 and 1 modes can be selected.

When this parameter is set to **4 to 6**, operations in only the level 0 mode can be selected, and the mode is not displayed on the menu display.

When this parameter is set to **5**, only the *PV/SP* parameter can be used.

When this parameter is set to **6**, only the *PV/SP* parameter can be used. (The set point can not change.)

Default is **1**.

Understanding the Security Parameter

secr
1
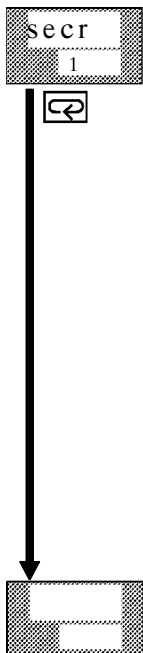
Using the Security-Level Table:
Any mode marked with an **X** is displayed in the Security Level indicated.

Example: Selecting Security Level 2:
Displays these modes: Level 0, Level 1 and Level 2 only.
Does NOT display these modes: Setup, Expansion, Option, Calibration

Mode	Set value						
↓	0	1	2	3	4	5	6
Calibration	x						
Option	x	x					
Expansion	x	x					
Setup	x	x					
Level 2	x	x	x				
Level 1	x	x	x	x			
Level 0	x	x	x	x	x	x	

⇐ **Security Level**

When the set value is **5**:
Only the **PV/SP monitor** and **set point** parameter can be used.

When the set value is **6**:
Only the **PV/SP monitor** parameter can be used.

⇑ Lowest
Security
Level (first
column)

⇑ Highest
Security
Level (last
column)

3–5–2   A/M Key Protect

ⴿEⴘP

This parameter disables use of the ☐ key during operation. For example, if you protect use of the ☐ key by the *A/M key protect* parameter (protect mode) during auto operation, the controller cannot be set to the manual mode, preventing manual operation of the controller during operation.
Note: E5CK-AA1-302 has this feature built into the programming.

Setting Example

For this example protect the setup, expansion, option and calibration modes. Set the parameters as follows:

security setting = **2 (Usable only in level 0 to 2 modes)**

↓ A/M + ↩
SECr
1

↓ ⌃
SECr
2

↓ A/M + ↩
38.8
60.0
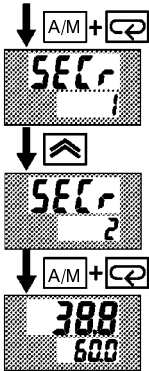
(1) Press the ☐ and ↩ keys simultaneously for 1 second minimum; the controller enters the protect mode.

(2) In the protect mode, the top parameter in the protect mode *security* is displayed. The parameter default is **1**. Press the ⌃ key to change the parameter setting to **2**.

(3) Press for 1 second minimum the ☐ and ↩ keys simultaneously; the display changes to the *PV/SP monitor* parameter (level 0 mode).

3–6   **Starting and Stopping Operation**

r - 5

You can start and stop operation by changing the setting of the *RUN/STOP* parameter (level 0 mode).

To stop operation, set the *run/stop* parameter to **[5toP]** (stop). In a stop state, the *STOP* LED lights.

3–6–1   Manipulated Variable at Stop

To set a specific output level during a stop, specify the manipulated variable (-5.0 to 105.0%) in the *MV at stop* parameter (level 2 mode). Factory setting is **0.0%**.

Setting Example

The following example describes the procedure to follow to stop control during operation of the controller.
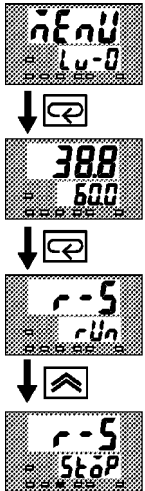
(1) Press the ⌨ (display) key for more than one second to access the menu display. Select [*L u - 0*] (level 0 mode) using the ⌃ or ⌄ keys.

(2) Press the ⌨ key (for more than one second) to enter the level 0 mode. The PV and SP are displayed.

(3) Press the ⌨ key until [*r - 5*] (*run/stop* parameter) is displayed.

(4) Press the ⌃ key to select [*5 t o P*] (stop). The STOP LED lights, and operation stops.

(5) Press the ⌨ key until the PV, SP are displayed again.

To resume operation, follow the above procedure to select [*r U n*] (RUN). The STOP LED goes out, and operation starts.

3–7   Adjusting Control Operation

3–7–1   Changing the Set Point

You can change the set point in the *set point* parameter in level 0 mode (default screen).

However, note that you cannot change the set point when the *security* parameter (protect mode) is set to **6**.

To change the set point, press the ⌃ or ⌄ keys to select the desired value. If you leave the setting for two seconds, the set point is updated to the new setting.

Setting Example

In the following example, let's change the temperature set point from 60°C to 50°C.
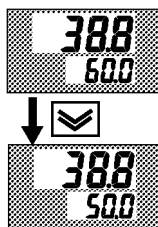
(1)   Select the PV/SP monitor display (default screen at power on).

(2)   Press the ⩔ key to change the setting to: **50°C**.

3–7–2   Manual Operation

To set manual operation and manually set the manipulated variable, press for 1 second minimum the ☐ key. The controller enters the manual mode.

The manipulated variable is displayed on the No.2 display. To change the manipulated variable, press the ⩕ or ⩔ keys. After two seconds, the manipulated variable is updated to the new setting.

Other modes cannot be selected while in the manual mode. To select other modes, press the ☐ key for 1 second minimum. The manual mode is quit.

The automatic return of display function does not work while in the manual mode.

When switching between manual and auto operation, the manipulated variable is subject to balance-less, bumpless operation.

If the power is interrupted during manual operation, manual operation is resumed at the manipulated variable at power interruption when the power is reset.

You can switch the AUTO/MANUAL function up to 100,000 times.

☞   *Balance-less, Bumpless Operation*   *To prevent sudden changes in the manipulated variable when switching between manual and auto operation, operation is resumed using the value that was active immediately before operation was switched, and the value is brought gradually closer to the value immediately after operation was switched.*

The following diagram summarizes manual operation.
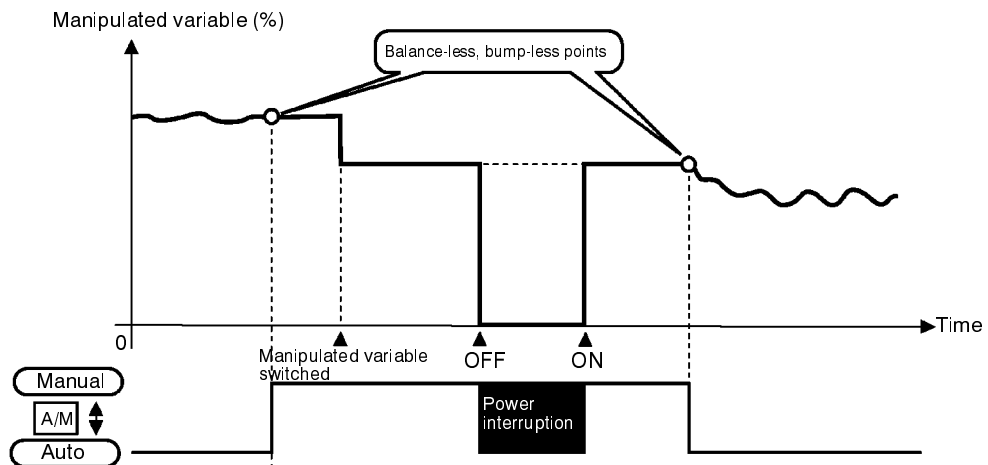
3–7–3   Auto-tuning

AT (auto-tuning) cannot be executed when the auto-tuning operation is cancelled, or during ON/OFF control, or when the controller is in STOP operation.

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

There are two types of auto-tuning available: 40% (AT-1) or 100% (AT-2). At AT-1, the MV will cycle 0 to 40% around the set point. At AT-2, the MV will cycle between fully ON and fully OFF (level 1 mode).

During heating and cooling control, only 100% AT can be executed. (So, [At - 1] (40% AT) will not be displayed.)

To cancel AT execution, specify [oFF] (*AT cancel*). In addition to AT, the E5CK is also provided with fuzzy self-tuning (ST) that allows automatic calculation of the PID parameters suited to the control target. However, note that the ST function operates only during standard control by temperature input. For further information on the ST, please refer to *Expansion Mode* in Section 5.

The controller has completed auto–tuning when the AT LED stops flashing.

Note: E5CK-AA1-302 has the auto-tune feature on the front panel for easy and quick use.

40% AT

To set the limit cycle of MV change width to 40%, select 40% AT to execute auto-tuning while fluctuations in the process value are kept to a minimum.

Note: Auto-tuning takes longer to execute compared with 100%AT.

The timing by which limit cycles are generated varies according to whether or not the deviation (DV) at the start of AT execution is 10% full-scale or less.
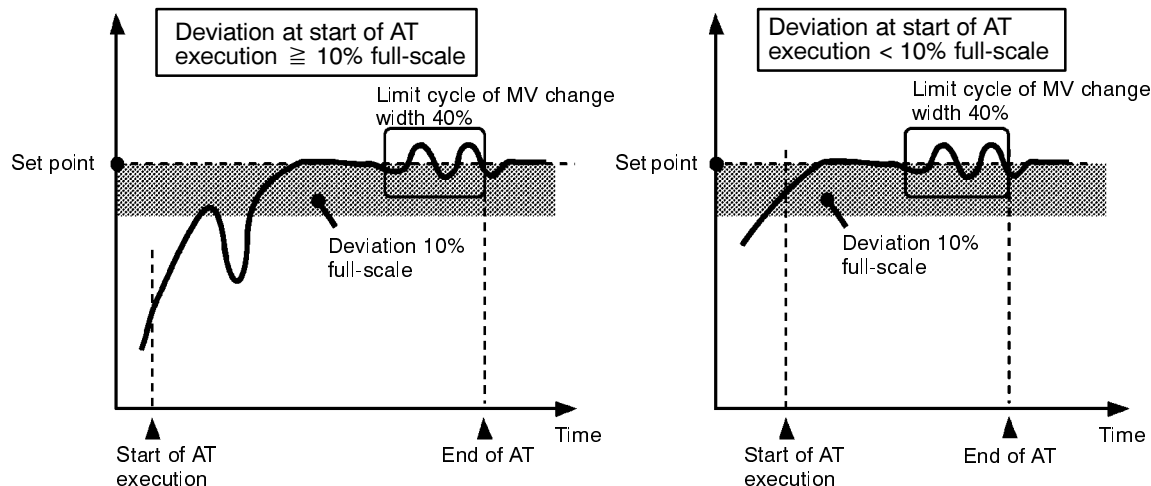
100% AT

In order to set the limit cycle of MV change width to 100%, select 100% AT to shorten the AT execution time without worrying about fluctuations in the process value.
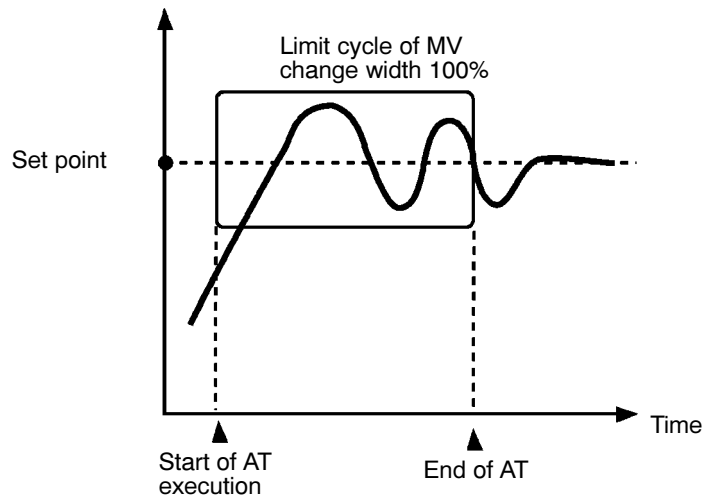
Setting Example

In this example, execute 40% AT.
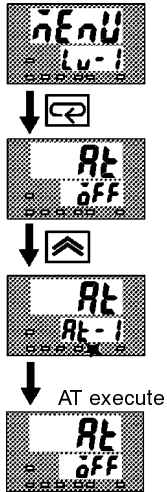
(1) Press the (Display) Key ⮐ (for more than one second) to access the display menu. Select [Ꮭᴜ⁻ᴵ] (level 1 mode) using the ⮝ or ⮟ keys.

(2) Press the ⮐ key (for more than one second) to enter the level 1 mode. The top parameter in the setup mode [ᴀᴛ] *AT execute/cancel* is displayed. In this example, the parameter setting is [ᴏꜰꜰ] *AT cancel.*

(3) Press the ⮝ key to specify [ᴀᴛ⁻ᴵ].

(4) The AT LED flashes, and AT execution starts. When the AT LED goes out (end of AT execution), the parameter automatically returns to [ᴏꜰꜰ] (*AT cancel*).

AT execute

☞ *About PID Parameters*

When control characteristics are already known, the PID parameters can be set directly to adjust control.
PID parameters are set in the proportional band (P), integrated time (I) and derivative time (D) parameters (level 1 mode).
For details on the setting ranges of these parameters, refer to Level 1 Mode in Section 5.

SECTION 4
Applied Operation

This section describes each of the parameters required when making full use of the E5CK features. As you read this section, refer to the parameter descriptions provided in Section 5.

4–1   Selecting the Control Method

When selecting the control method, set the parameters according to the following table.

Note: Parameters are factory-set to heating control.

Parameter / Control Method	Control output 1 assignment	Control output 2 assignment	Direct/Reverse operations
Heating control (Standard)	Control output (heat)	–	Reverse operation
Cooling control (Standard)	Control output (heat)	–	Direct operation
Heating and cooling control	Control output (heat)	Control output (cool)	Reverse operation

For details on how to assign outputs, refer to Setting Output Specifications in Section 3.

4–1–1   Heating and Cooling Control

When heat/cool control is selected, the *dead band* and *cooling coefficient* parameters can be used.

Note: If heat/cool control is not selected, dead band and cooling coefficient will not be visible.

Dead band

The dead band is set with the set point as its center. The dead band width is the set value of the *dead band* parameter (level 1 mode). Setting a positive value produces a dead band; setting a negative value produces an overlap band.
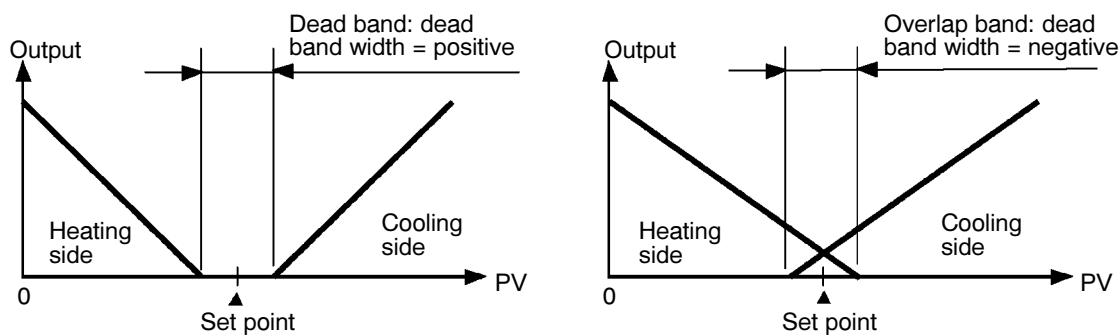
Cooling Coefficient

If the heating and cooling characteristics of the control target differ greatly, preventing satisfactory control characteristics from being obtained by the same PID parameters, adjust the proportional band (P at cooling side) using the cooling coefficient to balance control between the heating and cooling sides. In heating and cooling control, P at the heating or cooling side is calculated by the following formula:

Heating side P = P; Cooling side P = cooling coefficient $\times$ P

Manipulated Variable at Stop

In heating and cooling control, the manipulated variable output that is output when controller operation is stopped is dependent on the set value of the *MV at stop* parameter (level 2 mode) in the same way as for standard control.

However, note that in heating and cooling control, the manipulated variable at the cooling side is treated as a negative value for the sake of convenience. When the manipulated variable at STOP is a negative value, the manipulated variable is output to only the cooling side; when a positive value, the manipulated variable is output to only the heating side. The factory setting is **0**. If the controller is operated using the factory setting, the manipulated variable is not output to either the heating or the cooling sides.

☞ *Switching with Manual Operation*   *When the overlap band is set, the bumpless function that operates when switching between manual and automatic operation may not work.*

4–1–2 ON/OFF Control

Switching between advanced PID control and ON/OFF control is carried out by the *PID or ON/OFF* parameter (expansion mode). When this parameter is set to [$P\bar{\iota}d$], advanced PID control is selected, and when set to [$\bar{o}n\bar{o}F$], ON/OFF control is selected. Default is [$P\bar{\iota}d$].

Hysteresis

In ON/OFF control, hysteresis is provided in the program when switching between ON and OFF to stabilize operation. The hysteresis width provided during ON/OFF control is simply referred to as *hysteresis*. Control output (heat) and control output (cool) functions are set in the *hysteresis (heat)* and *hysteresis (cool)* parameters, respectively.

In standard control (heating or cooling control), hysteresis can be set only for the heating side.
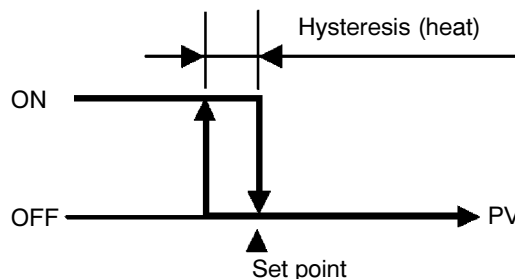
In heating and cooling control, a dead band can be set. So, 3-position control is made possible.
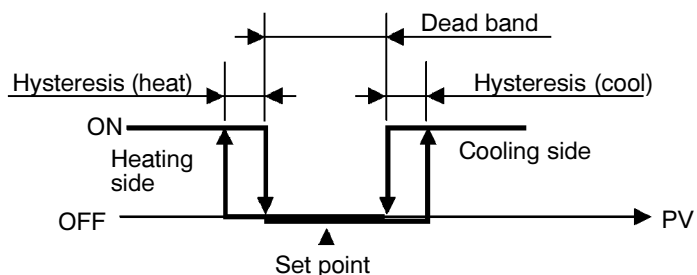
Parameters

Symbol	Parameter Name: Mode		Description
ō𝐔𝐭 ꞁ	Control output 1 assignment	: Setup	For specifying control method
ō𝐔𝐭 ꞇ	Control output 2 assignment	: Setup	For specifying control method
ōΓ𝐄 ᴜ	Direct/Reverse operation	: Setup	For specifying control method
𝐂 - d b	Dead band	: Level 1	Heating and cooling control
𝐂 - 𝐒𝐂	Cooling coefficient	: Level 1	Heating and cooling control
� ᴜ - 𝐒	MV at stop	: Level 2	Manipulated variable when control operation is stopped
𝐇𝐘𝐒	Hysteresis (heat)	: Level 1	ON/OFF control
𝐂𝐇𝐘𝐒	Hysteresis (cool)	: Level 1	ON/OFF control
𝐂 ᴨ 𝐭 𝐋	PID / ON/OFF	: Expansion	ON/OFF control

4–2   Operating Condition Restrictions

4–2–1   Manipulated Variable Restrictions

The upper-and lower-limit values of the manipulated variable can be restricted by the MV limiter, and the change rate of the manipulated variable can be restricted by the MV change rate limiter.

MV Limiter

The upper-and lower-limit values of the manipulated variable are set in the *MV upper limit* and *MV lower limit* parameters (level 2 mode). When the manipulated variable calculated by the E5CK is outside the range of the MV limiter, actual outputs are dependent on the set value of these parameters.
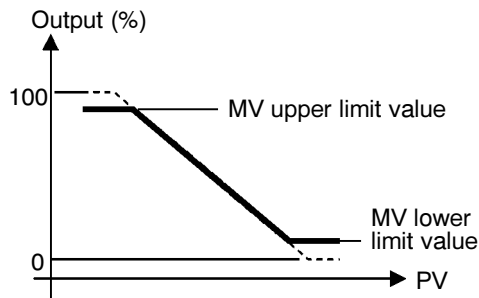
Output (%)

100 ┄ MV upper limit value

MV lower limit value

0 ─────────────────▶ PV

In heating and cooling control, the manipulated variable at the cooling side is treated as a negative value for convenience. The upper limit is set for the heating side (positive value), and the lower limit is set for the cooling side (negative value), as shown in the following figure.

Output (%)

100

MV lower limit value

MV upper limit value

Heating side   Cooling side

Set point   100   PV
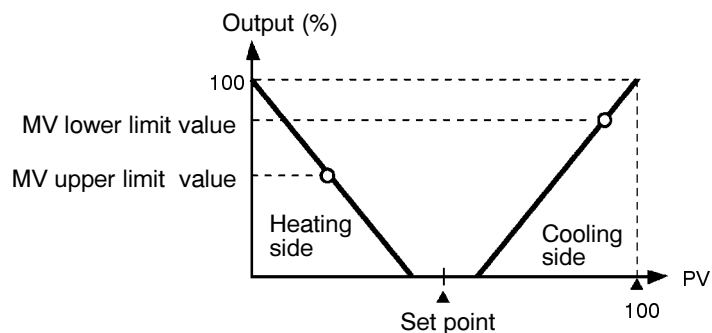
MV Change Rate Limiter

The *MV change rate limit* parameter (level 2 mode) sets the maximum permissible change width per second of the manipulated variable. If a change in the manipulated variable exceeds this parameter setting, the value calculated by the E5CK is reached by changing the value by the per-second value set in this parameter.
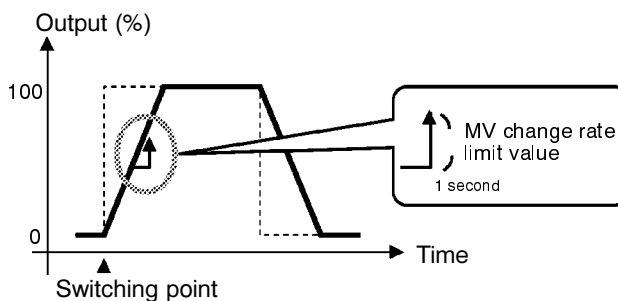
Limit Operation Conditions

The limiters are invalid or cannot be set when any of the following conditions occurs:

• During ON/OFF control
• During ST execution
• During AT execution (only by MV change rate limiter)
• During manual operation
• When operation is stopped
• When an error has occurred

4-2-2   Set Point Limiter

The setting range of the set point is limited by the set point limiter. The up-per-and lower-limit values of this set point limiter are set in the *Set point upper limit* and *Set point lower limit* parameters (expansion mode), respectively. Note that when the set point limiter is reset, the set point is forcibly changed to the upper-or lower-limit value of the set point limiter if the set point is out of the limiter range. Also, when the input type, temperature unit and scaling (sensor) range are changed, set point limiter is forcibly reset to the scaling (sensor) range.
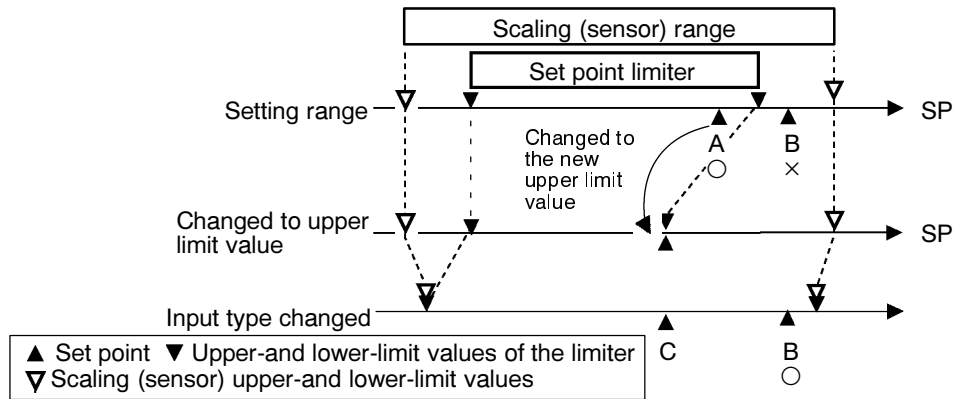
4-2-3   SP Ramp

With the SP ramp function, the controller operates according to the value (set point during SP ramp) limited by a change rate, instead of the changed set point when set point is changed. The interval in which the set point during SP ramp is limited is referred to as the *SP ramp*.
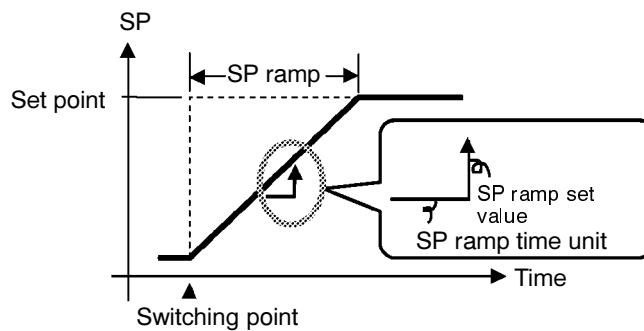
The change rate during the SP ramp is specified by the SP ramp set value and SP ramp time unit parameters. At the SP ramp set value default **0**, the SP ramp function is disabled.
The set point changing in SP ramp can be monitored in the Set point during SP ramp parameter (level 0 mode).

Operation at Start

The limiters are invalid or cannot be set when any of the following conditions occurs:

If the SP ramp function is enabled when the power is turned ON, and when STOP is switched to RUN process value may reach the set point after SP ramp in the same way as when the set point is changed. In this case, operation is carried out with the process value regarded as the set point before the change was made.

The direction of the SP ramp changes according to the relationship between the process value and the set point.
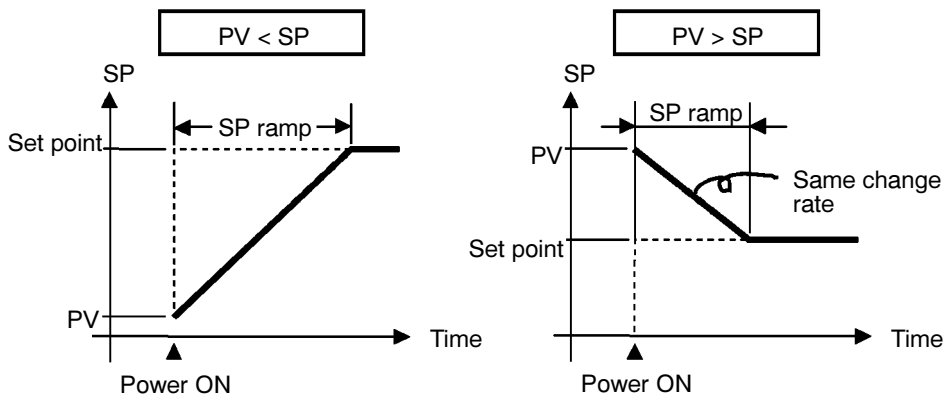
Restrictions During SP Ramp

Execution of auto-tuning starts after the end of SP ramp.

When the controller is switched to the manual mode, the set point changes continuously until SP ramp ends.

When an error occurs, the SP ramp function becomes invalid.

Parameters

Symbol	Parameter Name: Mode
ōL-H	MV upper limit : Level 2
ōL-L	MV lower limit : Level 2
ōrL	MV change rate limit : Level 2
SL-H	SP setting upper limit: Expansion
SL-L	SP setting lower limit: Expansion
SPrt	SP ramp set value : Level 2
SPrU	SP ramp time unit : Level 2

4–3 Using Option Functions

For details on the communications function, refer to *Using the Communications Function* in Chapter 6.

4–3–1 Event Input

When using event input, add on the Input Unit E53-CKB.

Input Assignments

```
┌─────────────────────────┐
│   Multi-SP function      │
├────────────┬────────────┤
│     0      │     1      │
└─────┬──────┴──────┬─────┘
      │             │
┌─────┴──────┐ ┌────┴───────┐
│  Run/Stop  │ │  Multi-SP  │
└─────┬──────┘ └────────────┘
      │
┌─────┴──────┐
│ Auto/Manual│
└────────────┘
```
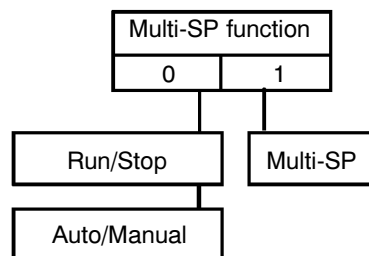
You can choose from the following three event inputs:

* RUN/STOP
* Auto/Manual
* Multi-SP

When selecting an option function, first determine whether or not the multi-SP function is to be used. You can select two of the remaining option functions only when the multi-SP function is not in use.

When using the multi-SP function, set the *multi-SP function* parameter (option mode) to **1: ON**. When using other functions, set this parameter to **0: OFF**.

When specifying event input other than the multi-SP function, specify event input in the *event input assignment 1* parameter (option mode). The following table shows the relationship between parameter settings and event input functions.

Setting	Function	
5ḃōP	ON : Stop	/OFF : Run
ñ8ñ	ON : Manual	/OFF : Auto

RUN/STOP

When event input is set to ON, controller operation is stopped and the STOP LED lights. The content of event input is reflected in the RUN/STOP parameter (level 0 mode).

Auto/Manual

When event input is set to ON, the controller is switched for manual operation, and the MANU LED lights.

Turn event input ON/OFF while the controller is ON.

Multi-SP

The set points set to the **set point 0** and **set point 1** parameters (level 1 mode) can be switched for use. Note that these parameters cannot be set when the multi-SP function is not selected.

The set point can be switched up to 100,000 times.

When event input is OFF, set point 0 is used, and when ON set point 1 is used.

When you have changed the set point, the set point of the currently selected parameter is changed.

When you have switched between set point 0 and set point 1, the SP ramp function works if the SP ramp function is enabled. The following examples shows how the set point changes when you switch from set point 0 and set point 1.

☞ *About the event*   *There is no order of priority when inputting events and operating the keys. Howev-*
   input and key   *er, because event input of run/stop or auto/manual must be carried out in either of*
   operation   *the physical ON/OFF states, parameters ultimately conform to event input even if*
                          an attempt is made to switch the setting by key operation.
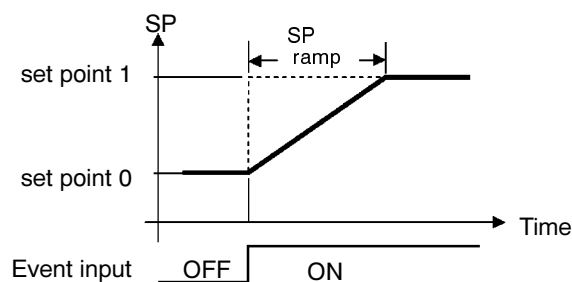
4–3–2   Transfer Output

When using transfer output, add on the Transfer Output Option Board E53-CKF.

You can select the following data items in the transfer output type parameter (option mode) as the transfer outputs:

• Set point

• Set point during SP ramp

• Process value

• Manipulated variable (heat)

• Manipulated variable (cool)

These transfer outputs can be scaled according to the settings of the *transfer output upper limit* and *transfer output lower limit* parameters before output.

Note: Setting of an upper limit value smaller than the lower limit value is allowed, so reverse scaling can also be carried out.

Also, the scale can be enlarged by the upper-and lower-limit width specified for each data item. The following example shows scaling of the reading side manipulated variable.
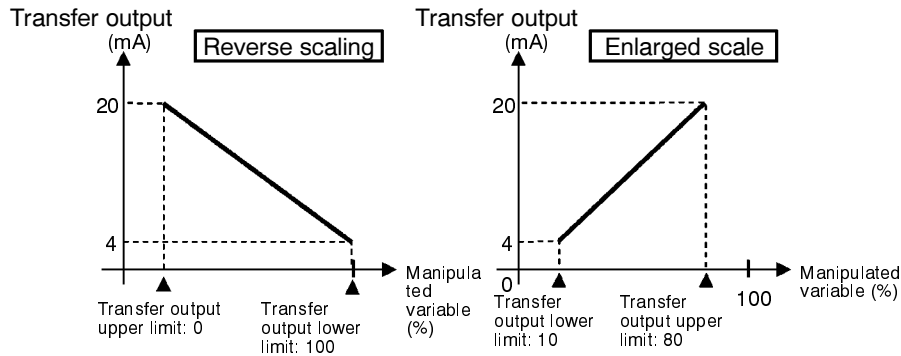
Parameters

Symbol	Parameter Name: Mode		Application
$E u - \bar{n}$	Multi-SP function	: Option	Event input functions
$E u - 1$	Event input assignment 1	: Option	Event input functions
$5P - 0$	Set point 0	: Level 1	Multi-SP
$5P - 1$	Set point 1	: Level 1	Multi-SP
$t r - t$	Transfer output type	: Option	Transfer output designation
$t r - H$	Transfer output upper limit	: Option	Transfer output scaling
$t r - L$	Transfer output lower limit	: Option	Transfer output scaling

4−4   LBA

The LBA (Loop Break Alarm) function can be used only when assigned to an output. Also, the LBA function does not work when a memory error or A/D converter error occurs.

LBA (Loop Break Alarm) is a function for judging that an error has occurred somewhere on the control loop and creating an alarm when the process value does not change with the manipulated variable at a maximum or minimum state. The LBA function can be used as a means for detecting a malfunctioning control loop.

LBA Detection Time

Normally, when output is set to maximum or minimum, the process value rises or falls after the dead time has elapsed. LBA is output if the process value does not change in the predicted direction after a fixed amount of time has elapsed. This fixed amount of time is the *LBA detection time*.

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LBA Detection Width

LBA operation sometimes becomes unstable when the process value fluctuates considerably due to the control characteristics. The LBA detection width is provided so that changes with respect to output can be correctly detected. Changes smaller than the detection width, due to LBA detection timing, are not regarded as changes.

LBA Detection Example

The following example describes what happens when a heater burnout at maximum output.
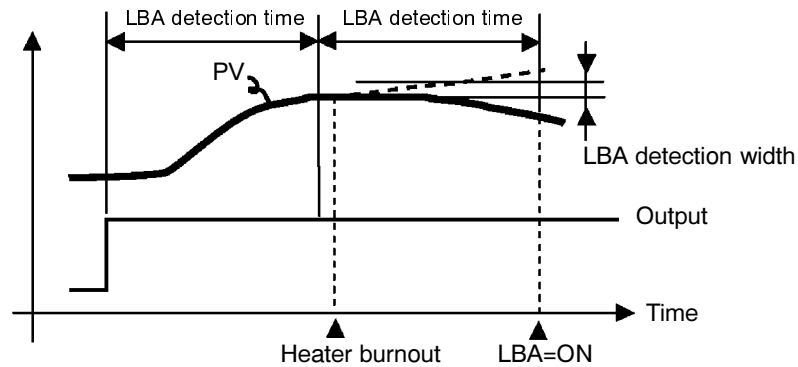
LBA judgment is carried out at each LBA detection time from the point of maximum output. In above figure, the process value (PV) is changing greatly at the 1st judgment timing, so LBA remains OFF.

At the 2nd judgment timing, the process value increases as indicated by the broken line of the process value is normal. This means that the change width exceeds the LBA detection width, and LBA output remains OFF.

If the heater burns out at the point shown in the above figure, the process value *decreases*. Accordingly, it is judged that *the process value is not changing in the increasing direction* at the 2nd judgment timing and the LBA output becomes ON.

Setting the LBA Detection

The LBA detection time is automatically set by auto-tuning (except in heating and cooling control).

If the optimum LBA detection time cannot be obtained by auto-tuning, set the time in the *LBA detection time* parameter (level 2 mode).

Determining the LBA Detection Time

Calculate the LBA detection time as follows:

1, 2, 3... 1. Set output to maximum.
2. Measure the time it takes for the input change width to reach the LBA detection width (default: 0.2 % full-scale).
3. Take a value twice that of the measurement time as the LBA detection time.
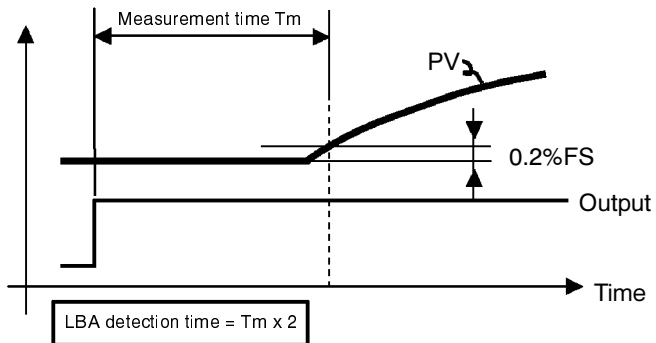
4. In the case of ON/OFF operation, set the LBA detection time to a value longer than the control period.

Parameters

Symbol	Parameter Name: Mode	Application
At	AT Execute/Cancel : Level 1	Automatic setting of LBA detection time
LbA	LBA detection time : Level 2	Setting of LBA detection time
LbAb	LBA detection width : Expansion	Changing of LBA detection width

4–5   Calibration

To calibrate the E5CK controller, select [*CLb*] in the menu display to select the calibration mode. [*Adj*] is displayed.

Note that [*CLb*] may not be displayed on the menu display unless the *security* parameter (in protect mode) has been changed to **0**.

The parameters in the calibration mode are configured as shown in the following figure.


```
Thermocouple 1: K1/J1/L1/E/N/W/PLII
Thermocouple 2: K2/J2/L2/R/S/B/T/U
Platinum resistance
thermometer: JPt100/Pt100
```

Only when transfer output function is supported
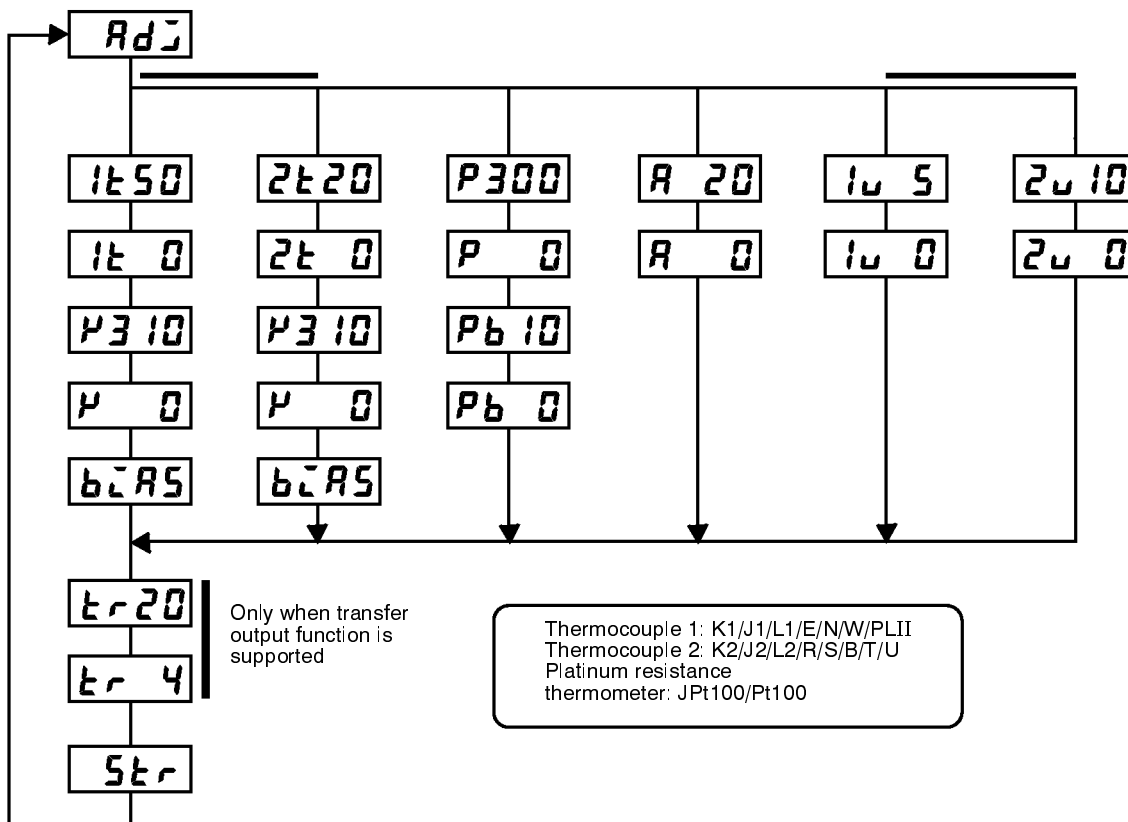
To select the desired parameter, press the ⃞ key. Parameters are displayed in this order:

- Calibration of inputs
- Calibration of transfer output
- Saving of calibration data

If the E5CK controller does not support the transfer output function, calibration of transfer output is automatically deleted from the calibration procedure as follows:

- Calibration of inputs → Saving of calibration data

Only inputs that have been set in the input type parameter (setup mode) can be calibrated. To temporarily save data for each of the calibration parameters, press the ⃟ key for 1 second.

Transfer output can be calibrated only when the Transfer Output Option Board E53-CKF is set in the controller. To adjust data items, press the ⃟ or ⃟ keys.

The data save menu is displayed only when all calibration items have temporarily been saved.

After calibrating input, you must always check indication accuracy. For further details, refer to *Checking Indication Accuracy* later in this section.

Calibration Item Menu

Parameters are displayed on the No.1 display, and the process value is displayed in Hexadecimal on the No.2 display.

libration item
rameter

Process value

Normally, the process value changes by several digits. The process value flashes, for example, when a sensor error causes the process value to stray from the calibration target range.

When the process value display is flashing, the process value is not saved as data even if the ⟩⟩ key is pressed.

Calibration Save Mark
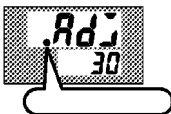
Once the E5CK controller has been calibrated by the user, [*Adj*] is preceded by the "." mark when the calibration mode is selected.

4–5–1   Calibrating Thermocouple

Calibrate according to the type of thermocouple, thermocouple 1 group (K1, J1, L1, E, N, W, PLII) and thermocouple 2 group (K2, J2, L2, R, S, B, T, U).

When calibrating, do not cover the bottom or top of the controller. Also, do not touch the input terminals (Nos. 6 and 7) and compensating conductor on the E5CK controller.

Preparations

AC100–240V
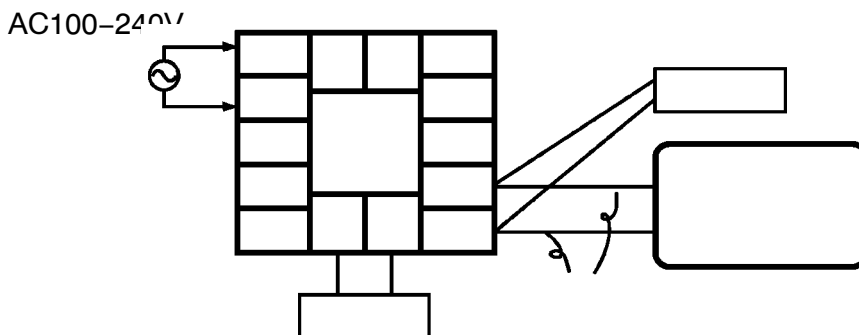
Set the cold junction compensator to 0°C. However, make sure that internal thermocouples are disabled (tips are open).

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In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter.

Use the compensating conductor selected thermocouple. However, note that when thermocouple R, S, E, B, W or PLII is used, the compensating conductor can be substituted with the compensating conductor for thermocouple K.

☞ *Connecting the Cold Junction Conductor*

Correct process values cannot be obtained if you touch the contact ends of the compensating conductor during calibration of a thermocouple. Accordingly, short (enable) or open (disable) the tip of the compensating conductor inside the cold junction compensator as shown in the figure below to create a contact or non-contact state for the cold junction compensator.
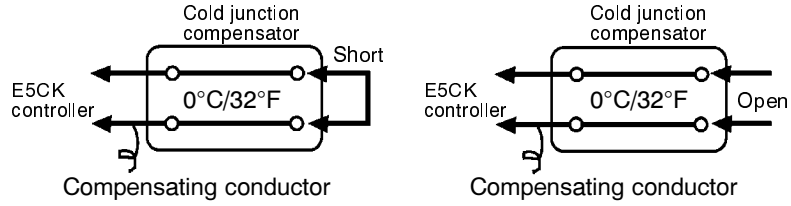
Calibrating Thermocouple 1
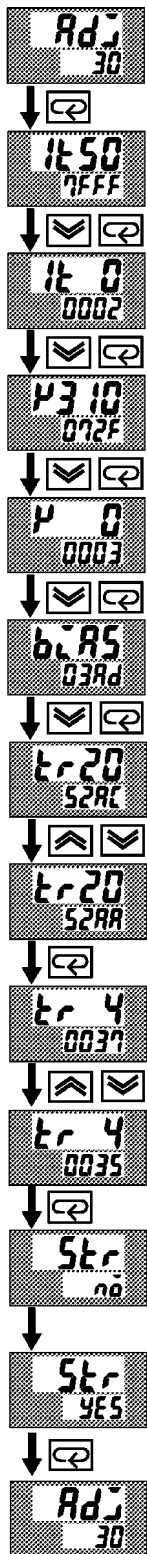
This example describes how to calibrate a thermocouple when the transfer output function is supported. If the transfer output function is not supported, skip steps 7 to 10.

1, 2, 3...   1.   When [*Ad*] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2.   First, calibrate the main input. Press the ⟳ key to display [*It 50*] (50mV calibration display). Set STV output to 50mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩗ key to temporarily save the calibration data.

3.   Press the ⟳ key to display [*It 0*] (0mV calibration display). Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩗ key to temporarily save the calibration data.

4.   Next, calibrate the cold junction compensator. Press the ⟳ key to display [*P3 10*] (310mV calibration display). Set STV output to 310mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩗ key to temporarily save the calibration data.

5.   Press the ⟳ key to display [*P 0*] (0mV calibration display). Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩗ key to temporarily save the calibration data.

6.   Finally, calibrate the bias compensation value. Disconnect the STV, and enable the thermocouple of the cold junction compensator. When doing this, make sure that the wiring on the STV is disconnected.
Make sure that the cold-junction compensator is set to 0°C and press the ⟳ key. The display changes to [*biAS*] (calibration display for the bias compensation value). When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩗ key to temporarily save the calibration data.

7.   Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step 11. Press the ⟳ key. The display changes to [*tr 20*] (20mA calibration display).

8.   Set the output to 20mA by the ⩗ or ⩘ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **20mA**.

9.   Press the ⟳ key. The display changes to [*tr 4*] (4mA calibration display).

10.   Set the output to 4mA by the ⩗ or ⩘ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **4mA**.

11.   Press the ⟳ key until the display changes to the data save display. Press the ⩘ key. The No.2 display changes to [*YES*], and two seconds later the calibration data is saved to internal memory. If you press the ⟳ key when the No.2 display reads [*no*], the calibration data is invalidated.

12. This completes calibration of the thermocouple 1 group. Press the ⏎ key to return the display to [ⵘⅆⵚ].

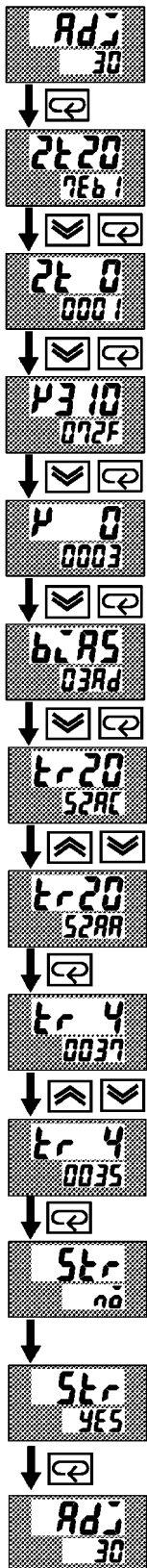## Calibrating Thermocouple 2

This example describes how to calibrate a thermocouple when the transfer output function is supported. If the transfer output function is not supported, skip steps 7 to 10.

1, 2, 3...

1. When [ⵘⅆⵚ] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2. First, calibrate the main input. Press the ⏎ key to display [*2ᵗ20*] (20mV calibration display). Set STV output to 20mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⌄ key to temporarily save the calibration data.

3. Press the ⏎ key to display [*2ᵗ 0*] (0mV calibration display). Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⌄ key to temporarily save the calibration data.

4. Next, calibrate the cold junction compensator. Press the ⏎ key to display [*μ3 10*] (310mV calibration display). Set STV output to 310mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⌄ key to temporarily save the calibration data.

5. Press the ⏎ key to display [*μ 0*] (0mV calibration display). Set STV output to 0mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⌄ key to temporarily save the calibration data.

6. Finally, calibrate the bias compensation value. Disconnect the STV, and enable the thermocouple of the cold junction compensator. When carrying this out, make sure that the wiring on the STV is disconnected. Make sure that the cold-junction compensator is set to 0°C and press the ⏎ key. The display changes to [*bⅈⵘ5*] (calibration display for the bias compensation value). When the value on the No.2 display has stabilized (changes of several digits max.), press the ⌄ key to temporarily save the calibration data.

7. Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step 11. Press the ⏎ key. The display changes to [*ᵗr20*] (20mA calibration display).

8. Set the output to 20mA by the ⌄ or ⌃ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **20mA**.

9. Press the ⏎ key. The display changes to [*ᵗr 4*] (4mA calibration display).

10. Set the output to 4mA by the ⌄ or ⌃ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **4mA**.

11. Press the ⟲ key until the display changes to the data save display. Press the ⌃ key. The No.2 display changes to [𝗒𝖤𝖲], and two seconds later the calibration data is saved to internal memory. If you press the ⟲ key when the No.2 display reads [𝗇ō], the calibration data is invalidated.

12. This completes calibration of the thermocouple 2 group. Press the ⟲ key to return the display to [𝖠𝖽ⁱ].

4–5–2   Calibrating Platinum Resistance Thermometer

Preparation

Use leads of the same thickness when connecting to the platinum resistance thermometer.

In the above figure, 6-dial refers to a precision resistance box, and DMM stands for a digital multimeter. However, note that the DMM is required only when the transfer output function is supported.

Connect (short) the leads from terminal Nos. 6 and 7.

Calibration
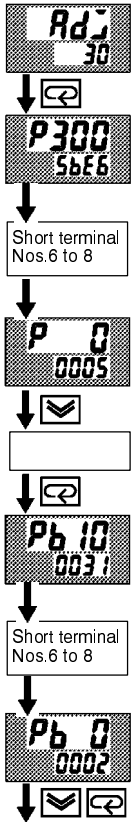
This example describes how to calibrate a platinum resistance thermometer when the transfer output function is supported. If the transfer output function is not supported, skip steps 7 to 10.
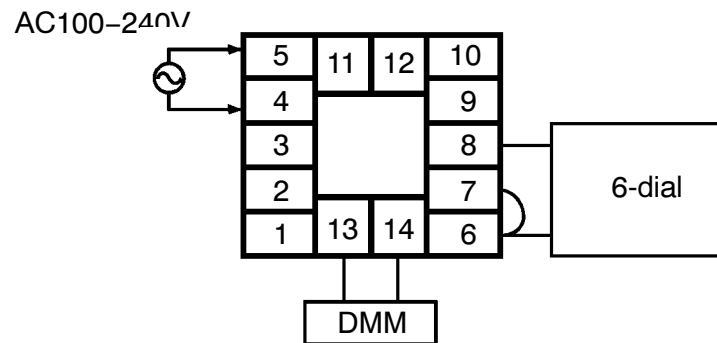
1, 2, 3... 1.   When [*Rd⁻*] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2.   First, calibrate the main input. Press the ⟳ key to display [*P300*] (300Ω calibration display). Set the 6-dial to 300Ω. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⟱ key to temporarily store the calibration data.

3.   Press the ⟳ key to switch [*P   0*] (0Ω calibration) display. Short terminal No.6 to 8. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⟱ key to temporarily store the calibration data.

4.   Next, calibrate the B-B' input. Change the wiring as shown in the following diagram. Make the connection across terminals 6 and 7 and the 6-dial as short as possible. Short terminals 6 and 8.
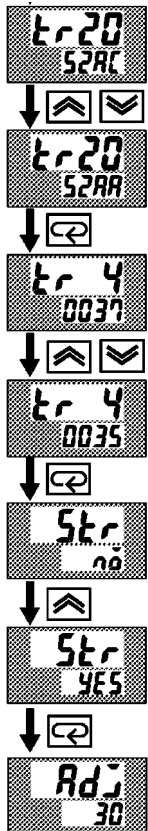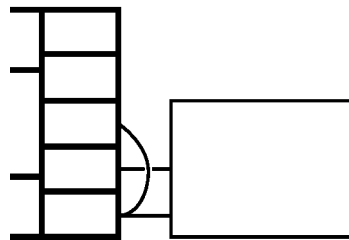
5.   Press the ⟳ key to display [*Pb 10*] (10Ω calibration display). Set the 6-dial to 10Ω.. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⟱ key to temporarily store the calibration data.

6.   Press the ⟳ key to display [*Pb 0*] (0Ω calibration display). Set the 6-dial to 10Ω.. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⟱ key to temporarily store the calibration data.

7.   Next, calibrate the transfer output function. *If the transfer output function is not supported, skip to step 11.* Press the ⟳ key. The display changes to [*tr20*] (20mA calibration display).

8.   Set the output to 20mA by the ⟱ or ⟰ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **20mA**.

9.   Press the ⟳ key. The display changes to [*tr 4*] (4mA calibration display).

10. Set the output to 4mA by the ⟱ or ⟰ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **4mA**.

11. Press the ⟲ key until the display changes to the data save display. Press the ⩘ key. The No.2 display changes to [𝚈𝙴𝚂], and two seconds later the calibration data is saved to internal memory. If you press the ⟲ key when the No.2 display reads [𝚗𝚘], the calibration data is invalidated.

12. This completes calibration of the platinum resistance thermometer. Press the ⟲ key to return the display to [𝚁𝚍𝚓].

4–5–3 Calibrating Current Input

Preparation
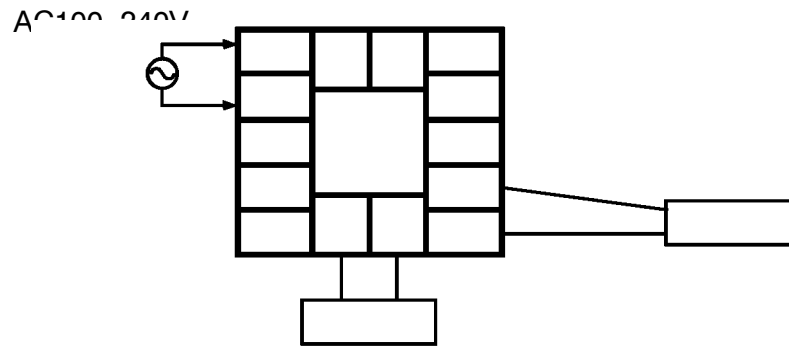
In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter. However, note that the DMM is required only when the transfer output function is supported.
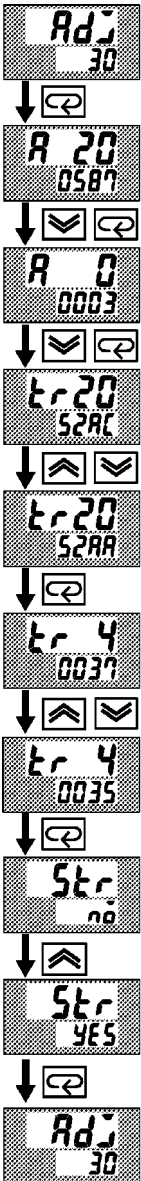
Calibration

This example describes how to calibrate a current input when the transfer output function is supported. If the transfer output function is not supported, skip steps 4 to 7.

1, 2, 3...   1.   When [$Rd\bar{J}$] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2.   Press the ⟳ key. The display changes to [R 20] (20mA calibration display). Set the STV output to 20mA. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩔ key to temporarily store the calibration data.

3.   Press the ⟳ key. The display changes to [R 0] (0mA calibration display). Set the STV output to 0 mA. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⩔ key to temporarily store the calibration data.

4.   Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step 8. Press the ⟳ key. The display changes to [$t r 20$] (20mA calibration display).

5.   Set the output to 20mA by the ⩔ or ⩓ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **20mA**.

6.   Press the ⟳ key. The display changes to [$t r$ 4] (4mA calibration display).

7.   Set the output to 4mA by the ⩔ or ⩓ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **4mA**.

8.   Press the ⟳ key until the display changes to the data save display. Press the ⩓ key. The No.2 display changes to [$yE5$], and two seconds later the calibration data is saved to internal memory. If you press the ⟳ key when the No.2 display reads [$n\bar{o}$], the calibration data is invalidated.

9.   This completes calibration of voltage input. Press the ⟳ key to return the display to [$Rd\bar{J}$].

4–5–4   Calibrating Voltage Input

Preparation
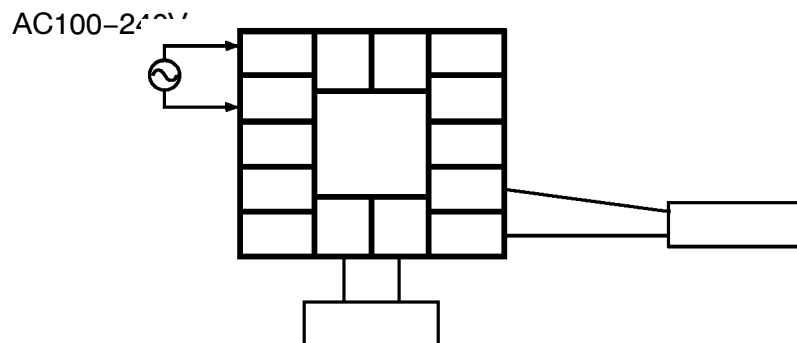
AC100–240V

In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter. However, note that the DMM is required only when the transfer output function is supported.

Calibration: 0 to 5 V, 1 to 5 V

This example describes how to calibrate voltage input when the transfer output function is supported. If the transfer output function is not supported, skip steps 4 to 7.
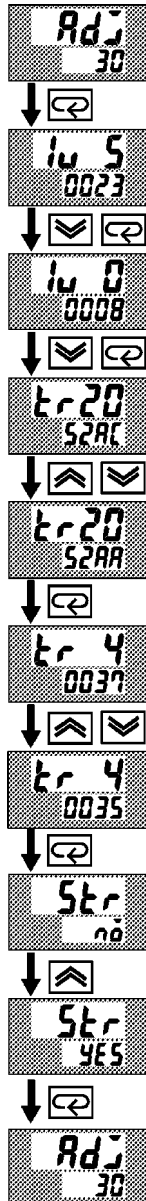
1, 2, 3...   1.   When [*Rdj*] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2.   Press the key. The display changes to [*iu 5*] (5 V calibration display). Set the STV output to 5V. When the value on the No.2 display has stabilized (changes of several digits max.), press the key to temporarily store the calibration data.

3.   Press the key. The display changes to [*iu 0*] (0V calibration display). Set the STV output to 0V. When the value on the No.2 display has stabilized (changes of several digits max.), press the key to temporarily store the calibration data.

4.   Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step (8). Press the key. The display changes to [*tr20*] (20mA calibration display).

5.   Set the output to 20mA by the or keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **20mA**.

6.   Press the key. The display changes to [*tr 4*] (4mA calibration display).

7.   Set the output to 4mA by the or keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **4mA**.

8.   Press the key until the display changes to the data save display. Press the key. The No.2 display changes to [*YES*], and two seconds later the calibration data is saved to internal memory. If you press the key when the No.2 display reads [*no*], the calibration data is invalidated.

9.   This completes calibration of voltage input (0 to 5V, 1 to 5V). Press the key to return the display to [*Rdj*].

Calibration: 0 to 10V
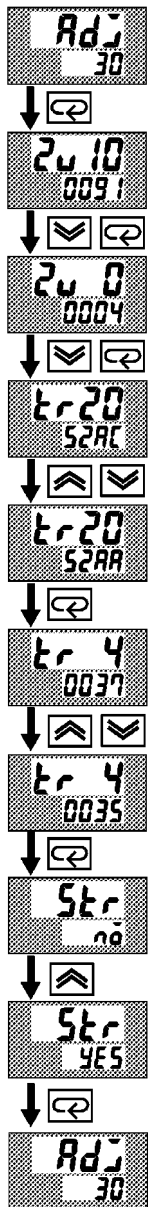
This example describes how to calibrate voltage input when the transfer output function is supported. If the transfer output function is not supported, skip steps 4 to 7.

1, 2, 3...   1.   When [*Rdᴶ*] is displayed, the 30-minute timer is displayed on the No.2 display and counts down. This timer serves as a guide for the aging time when aging is required.

2.   Press the ⟲ key. The display changes to [*2u 10*] (10V calibration display). Set the STV output to 10V. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⟱ key to temporarily store the calibration data.

3.   Press the ⟲ key. The display changes to [*2u 0*] (0V calibration display). Set the STV output to 0V. When the value on the No.2 display has stabilized (changes of several digits max.), press the ⟱ key to temporarily store the calibration data.

4.   Next, calibrate the transfer output function. If the transfer output function is not supported, skip to step 8. Press the ⟲ key. The display changes to [*tr20*] (20mA calibration display).

5.   Set the output to 20mA by the ⟱ or ⟰ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **20mA**.

6.   Press the ⟲ key. The display changes to [*tr 4*] (4mA calibration display).

7.   Set the output to 4mA by the ⟱ or ⟰ keys while monitoring the voltage on the digital multimeter. In the example on the left, the display indicates that the value two digits smaller than before calibration is **4mA**.

8.   Press the ⟲ key until the display changes to the data save display. Press the ⟰ key. The No.2 display changes to [*YES*], and two seconds later the calibration data is saved to internal memory. If you press the ⟲ key when the No.2 display reads [*no*], the calibration data is invalidated.

9.   This completes calibration of voltage input (0 to 10V). Press the ⟲ key to return the display to [*Rdᴶ*].

4–5–5   Checking Indication Accuracy

After calibrating input, check indication accuracy to make sure that the E5CK controller has been correctly calibrated.

*   Operate the E5CK controller in the PV/SP monitor mode (level 0).

*   Check the indication accuracy at the upper and lower limits and midpoint.

Thermocouple

Preparation. The following figure shows the required device connection. Make sure that the E5CK controller and cold junction compensator are connected by a compensating conductor for the input type that is to be used during actual operation.
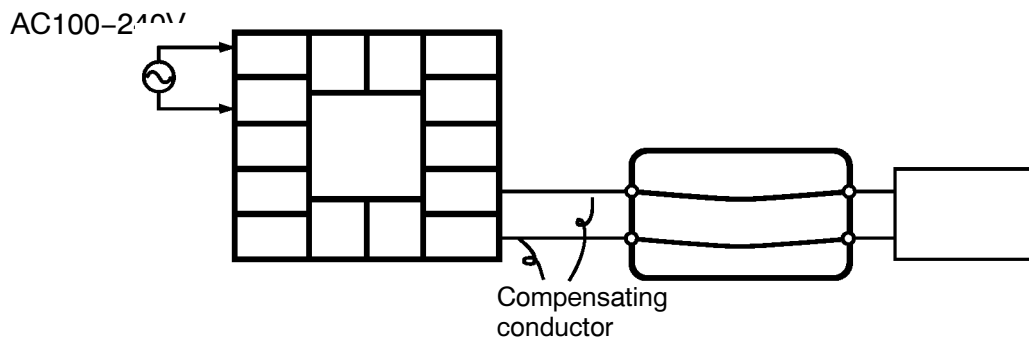
Operation. Set the cold junction compensator at 0°C, and set STV output to the voltage equivalent to the starting power of the check value.

Platinum Resistance Thermometer

Preparation. The following figure shows the required device connection.
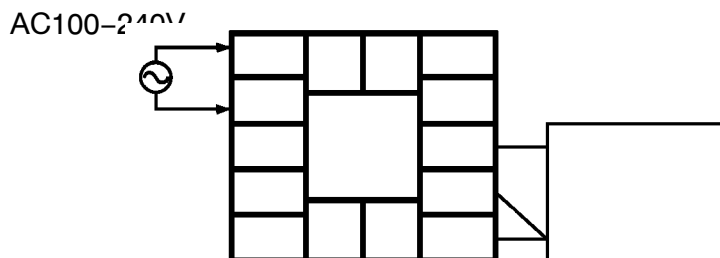
Operation. Set the 6-dial to the resistance equivalent to the check value.

Current or Voltage Input

Preparation. The following figure shows the required device connection.
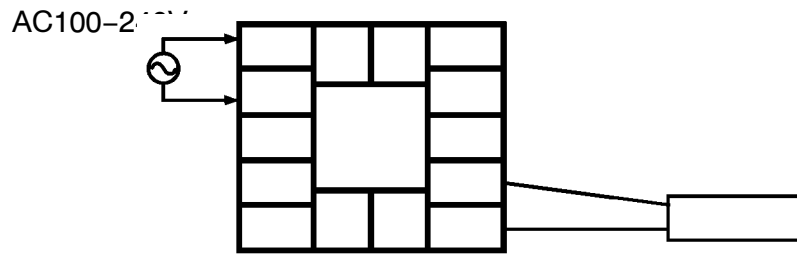
Operation. Set the STV to the current or voltage value equivalent to the check value.

This section describes the parameters of the E5CK. Use this section as a reference guide.

Conventions Used in Section 5

Icons used in this chapter:

Indicates the functions of the parameter.

Function

Indicates the range and defaults of the parameter setting.

Comment

Indicates monitor-dedicated parameters.
Describes the range of the monitor values.

Monitor

Indicates a procedure using parameters in operating instructions.

Example
of use

Indicates related parameters and items.

See

Indicates models of the E5CK supporting the parameter being described.

Model

About parameter display:

On the E5CK controller, only parameters that can be used are displayed.
These parameters are displayed only when the *Conditions of Use* on the
right of the parameter heading are satisfied. However, note that the settings
of protected parameters are still valid and are not displayed, regardless of
the conditions of use.

$R E$ **AT Execute/cancel**

Conditions of Use
The controller must be in operation.

5–1   Protect Mode

The protect mode is for disabling (protecting) the functions of the menu key

or ☐ key. Before changing parameters in this mode, first make sure that

protecting the ☐ key will not cause any problems in operation.

To select this mode, press the ☐ key and ⟨⟩ key simultaneously for 1

second minimum. To exit this mode, press the ☐ key and ⟨⟩ key down

again simultaneously for 1 second minimum.

The following table shows the parameters supported in this mode.

Symbol	Parameter Name
5ECr	Security
ΡΕЧΡ	[A/M] key protect

5ECr Security

Function

Comment

This parameter specifies which parameters are protected. However, note
that the protect mode and manual mode cannot be protected.

Understanding the Security Parameter

Using the Security-Level Table (shown below). Any mode marked with
an **X** is displayed in the Security Level indicated.

```
secr
  1
 ⟨⟩
```

Mode	Set value						
↓	0	1	2	3	4	5	6
Calibration	x						
Option	x	x					
Expansion	x	x					
Setup	x	x					
Level 2	x	x	x				
Level 1	x	x	x	x			
Level 0	x	x	x	x	x	x	

⇐ **Security Level**

When the set value is **5**:
Only the **PV/SP monitor** and **set point**
parameter can be used.

When the set value is **6**:
Only the **PV/SP monitor** parameter can
be used.

⇑
Lowest
Security
Level (first
column)

⇑
Highest
Security
Level
(last
column)

Example:

Selecting Security Level 2 displays these modes:
Level 0, Level 1 and Level 2 only.

Selecting Security Level 2 does NOT display these modes:
Setup, Expansion, Option, Calibration

Default is **1**. Only the calibration mode is protected.

Related information:
Refer to *Protect Mode in Section 3.*

See

| 𝐻𝐸𝑌𝑃 | **[A/M] key protect**

Invalidate the function of the ⏎ key. In other words, you cannot switch between the auto and manual operations by key operation.

Function

[*ōn*] : ☐ key protect ON

[*ōFF*] : ☐ key protect canceled

Default = [*ōFF*]

Comment

Related information:
Refer to *Protect Mode in Section 3.*

See

5–2   Manual Mode

In this mode, manual operations are possible, and the MANU LED lights.

When this mode is selected, the manipulated variable that was active immediately before the mode was switched to the output. When changing the manipulated variable, change it using the ⏶ or ⏷ keys.

To select this mode when in the level 0 to 2 modes, press the ☐ key for 1 second minimum. To exit this mode, press the ☐ key for 1 second minimum. The mode changes to the level 0 mode.

Manual MV is the only parameter available in this mode.

Manual MV

Function

Set the manipulated variable for manual operation.

The process value is displayed on the No.1 display, and the manipulated variable is displayed on the No.2 display. Change the manipulated variable using the ⌃ or ⌄ keys.

388 — Process value
16.0 — Manipulated variable
[MANU] LED
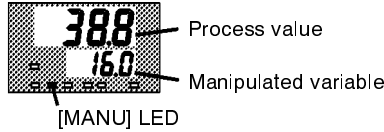
The manual manipulated variable is held when the power is interrupted.

Comment

Control Method	Setting Range	Unit	Default
Standard	-5.0 to 105.0	%	0
Heating and cooling	-105.0 to 105.0	%	0

See

Related information:
Refer to: *Adjusting Control Operation* in Section 3.

5–3   Level 0 Mode

The parameters in this mode can be used only when the security parameter (protect mode) is set at **0 to 4**.

This mode is used for monitoring the process value (PV), set point (SP) and manipulated variable (MV) during operation and for checking and setting the SP setting value. It is also used for starting and stopping controller operation.

To select this mode when in the levels 1 and 2, setup, expansion, option and calibration modes, press the ⟳ key for 1 second minimum. The display changes to the menu display. If you select [*L u - 0*] then press ⟳ key for 1 second minimum, the controller enters the level 0 mode.

To select parameters in this mode, press the ⟳ key. To change parameter settings, use the ⌃ or ⌄ keys.

The following table shows the parameters supported in this mode.

Symbol	Parameter Name
	PV/SP
$SP\text{-}\bar{m}$	Set point during SP ramp
$\bar{o}$	MV monitor (heat)
$C\text{-}\bar{o}$	MV monitor (cool)
$r\text{-}S$	Run/Stop

PV/SP

The process value is displayed on the No.1 display, and the set point is displayed on the No.2 display. The set point can be set.

Process value
Set point

Function

When the multi-SP function is in use, the value of whichever is set, set point 0 or 1, is linked.

The decimal point position is dependent on the selected sensor during temperature input and on the results of scaling during analog input.

The process value is displayed on the No.1 display, and the set point is displayed on the No.2 display.

The decimal point position is dependent on the selected sensor during temperature input and on the results of scaling during analog input.
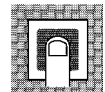
Process value

Comment

Monitor Range	Unit
Scaling lower limit -10%FS to scaling upper limit +10%FS	EU

During temperature input, the range of the currently selected sensor is taken as the monitor range.

Set point

Setting Range	Unit	Default
SP setting lower limit to SP setting upper limit	EU	0

See

Related information:
Refer to: *Adjusting Control Operation* in Section 3.

Related parameters:
Input type, Scaling upper limit, Scaling lower limit, Decimal point (setup mode), SP setting upper limit, SP setting lower limit (expansion mode)

`SP-ṁ` **Set point during SP ramp**

Conditions of Use
The SP ramp function must be enabled.

Function

Sets the set point.

Monitor

Monitor Range	Unit	Default
SP setting lower limit to SP setting upper limit	EU	0

See

Related information:
Refer to *Adjusting Control Operation*, in Section 3.

Related parameters:
PV/SP (level 0 mode,)
SP ramp time unit, SP ramp set value (level 2 mode),
Set point upper limit, Set point lower limit (expansion mode)

Related parameters:
SP setting upper limit, SP setting lower limit (expansion mode),
Multi-SP function (option mode),
Set point 0, Set point 1 (level 1 mode)
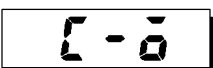
`ō` **MV monitor (heat)**

`C-ō` **MV monitor (cool)**

Function

This parameter cannot be set.

Monitors the manipulated variable on the heating or cooling side.

The manipulated variable in a standard control system is checked in the *MV monitor (heat)* parameter.

Monitor

The *MV monitor (cool)* parameter can be used only during heating and cooling control.

MV monitor (heat)

Control	Monitor Range	Unit
Standard	-5.0 to 105.0	%
Heating and cooling	0.0 to 105.0	%

MV monitor (cool)

Control	Monitor Range	Unit
Heating and cooling	0.0 to 105.0	%

r - 5 Run/Stop

Function

This parameter is used for checking the operating status of the controller, and for specifying start and stop of operation.

When the RUN/STOP function is assigned to event input, STOP is set when event input is ON, and RUN is set when event input is OFF. There is no order of priority in key operations.

Example of use

To start operation, set this parameter to [*rUn*] press the [⌃] or [⌄] keys.

To stop operation, set this parameter to [*StoP*]. When operation is stopped, the STOP LED lights.

Default is [*rUn*]

See

Related information:
Refer to *Starting and Stopping Operation* in Section 3.

5–4   Level 1 Mode

The parameters in this mode can be used only when the "security" parameter (protect mode) is set to **0** to **3**.

This mode contains the main parameters for adjusting control. These parameters include parameters for executing AT (auto-tuning), setting the alarm values, setting the control period, and setting PID parameters.

To select this mode when in the levels 0 and 2, setup, expansion, option and calibration modes, press the ⏎ key for 1 second minimum. The display changes to the menu display. If you select [*L u - 1*] then press the ⏎ key for 1 second minimum, the controller enters the level 1 mode.

To select parameters in this mode, press the ⏎ key. To change parameter settings, use the ⏫ or ⏬ keys.

The following table shows the parameters supported in this mode.

Symbol	Parameter Name
At	AT Execute/Cancel
SP-0	Set point 0
SP-1	Set point 1
AL-1	Alarm value 1
AL-2	Alarm value 2
AL-3	Alarm value 3
P	Proportional band
ī	Integral time
d	Derivative time
C-SC	Cooling coefficient
C-db	Dead band
ōF-r	Manual reset value
HYS	Hysteresis (heat)
CHYS	Hysteresis (cool)
CP	Control period (heat)
C-CP	Control period (cool)

| Rt | **AT Execute/Cancel** |

Conditions of Use
The controller must be in operation, control must be advanced PID control, and ST must be set to OFF.

Note: Model E5CK-AA1-302 has the auto-tune feature on the front panel.

The ☐ key has been placed within the programming modes.

Function

Selects the limit cycle of MV change width (40% or 100%) for execution. After AT execution, the PID and the LBA detection time (LBA: Loop Break Alarm) parameters are set automatically.

During heating and cooling control, only 100% AT can be executed.

Example of use

When this parameter is selected, the setting becomes [oFF].

To execute 40%AT, select [$Rt - 1$], and to execute 100% AT, select [$Rt - 2$]. During execution of auto-tuning, the AT LED flashes. However, note that during heating and cooling control, [$Rt - 1$] is not displayed.

When AT execution ends, the parameter setting automatically returns to [oFF].

See

Related information
Refer to *Adjusting Control Operation* in Section 3.

Related parameters:
Run/Stop (level 0 mode),
Proportional band, Integral time, Derivative time (level 1 mode),
LBA detection time (level 2 mode)

| $5P-0$ | **Set point 0** |
| $5P-1$ | **Set point 1** |

Conditions of Use
The multi-SP function must be in operation.

Function

When event input is OFF, *the set point 0* parameter is used, and when ON, the *set point 1* parameter is used.

When the *set point* parameter has been changed, the setting of whichever is selected in event input, set point 0 or set point 1, is linked and changed.

The decimal point position is dependent on the selected sensor during temperature input and on the results of scaling during analog input.
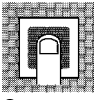
Comment

Setting Range	Unit	Default
Scaling lower limit to Scaling upper limit	EU	0

See

Related information:
Refer to *How to Use Option Functions in Section 4.*
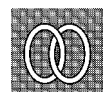
Related parameters:
Multi-SP function (option mode),
Set point (level 0 mode),
Input type, Scaling upper limit, Scaling lower limit,
Decimal point (setup mode)

$AL-1$ Alarm value 1

$AL-2$ Alarm value 2
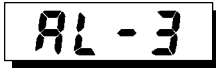
$AL-3$ Alarm value 3

Conditions of Use
Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the "alarm value 3" parameter cannot be used.

Function

This parameter is used for monitoring or changing the alarm values of alarm outputs 1 to 3.

During temperature input, the decimal point position is dependent on the currently selected sensor, and during analog input on the results of scaling.

Comment

Setting Range	Unit	Default
-1999 to 9999	EU	0

See

Related information:
Refer to *Adjusting Control Operation* in Section 3.

Related parameters:
Input type, Scaling upper limit, Scaling lower limit, Decimal point, Control output 1 assignment, Control output 2 assignment, Auxiliary output 1 assignment, Alarm 1 type, Alarm 2 type, Alarm 3 type, Alarm 1 open in alarm,

Alarm 2 open in alarm, Alarm 3 open in alarm (setup mode,)
Alarm 1 hysteresis, Alarm 2 hysteresis, Alarm 3 hysteresis (level 2 mode),
Standby sequence reset method (expansion mode)

Proportional band

Integral time

Derivative time

Conditions of Use
Control must be advanced PID control, and ST must be set to OFF.

Function

Sets the PID parameters. However, note that the PID parameter settings are changed to optimum values when auto-tuning is executed, and self-tuning is selected.

Comment

Parameter	Setting Range	Unit	Default
Proportional band	0.1 to 999.9	%FS	10.0
Integral time	0 to 3999	Second	233
Derivative time	0 to 3999	Second	40

See

Related parameter:
AT Execute/Cancel (level 1 mode)

`C-SC` **Cooling coefficient**

Conditions of Use
The control must be either heating and cooling control, or advanced PID control.

Function

In heating and cooling control, P at the cooling side is calculated by the following formula:
Cooling side P = cooling coefficient $\times$ P

Comment

Setting Range	Unit	Default
0.01 to 99.99	None	1.00

See

Related information
Refer to *Selecting the Control Method* in Section 4.

Related parameter
Proportional band (level 1 mode)

`C-db` **Dead band**

Conditions of Use
The control system must be heating and cooling control.

Function

Sets the output dead band width in a heating and cooling control system. A negative setting sets an overlap band.

Comment

Setting Range	Unit	Default
-19.99 to 99.99	%FS	0.00

See

Related information:
Refer to *Selecting the Control Method* in Section 4.

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`ōF-r`   ## Manual reset value

Conditions of Use
The control must be either standard control or advanced PID control, ST must be set to OFF, and the *integral time* parameter must be set to 0.

Function

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

Comment

Setting Range	Unit	Default
0.0 to 100.0	%	50.0

`HYS`   ## Hysteresis (heat)

`CHYS`   ## Hysteresis (cool)

Conditions of Use
The control system must be ON/OFF control.

Function

Sets the hysteresis for ensuring stable operation at ON/OFF switching.

In standard control, use the *hysteresis (heat)* parameter. The *hysteresis (cool)* parameter cannot be used.

In heating and cooling control, the hysteresis can be set independently for heating and cooling. Use the hysteresis (heat) parameter to set the heating side hysteresis, and use the hysteresis (cool) parameter to set the cooling side hysteresis.

Comment

Parameter	Setting Range	Unit	Default
Hysteresis (heat)	0.01 to 99.99	%FS	0.10
Hysteresis (cool)	0.01 to 99.99	%FS	0.10

See

Related information:
Refer to *Selecting the Control Method* in Section 4.

Related parameters:
Control output 1 assignment, Control output 2 assignment (setup mode), PID/ON/OFF (expansion mode)

```
[ P
```
Control period (heat)
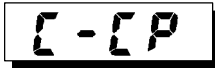
```
[ - [ P
```
Control period (cool)

Conditions of Use
Relay or voltage output must be set as the outputs, and the control must be set to advanced PID control.

Function

Sets the pulse output period. Set the control period taking the control characteristics and life expectancy of the controller into consideration.

In standard control, use the *control period (heat)* parameter. The *control period (cool)* parameter cannot be used.

In heating and cooling control, the control period can be set independently for heating and cooling. Use the control period (heat) parameter to set the heating side control period, and use the control period (cool) parameter to set the cooling side control period.

Comment

Parameter	Setting Range	Unit	Default
Control period (heat)	1 to 99	Second	20
Control period (cool)	1 to 99	Second	20

See

Related information:
Refer to *Setting Output Specifications in Section 3.*

Related parameters:
Control output 1 assignment, Control output 2 assignment (setup mode)

5–5　Level 2 Mode

The parameters in this mode can be used only when the "security" parameter (protect mode) is set to **0** to **2**.

This mode contains the auxiliary parameters for adjusting control. These parameters include parameters for limiting the manipulated variable and set point, parameters for switching between remote and local operation, and parameters for setting the LBA (Loop Break Alarm), alarm hysteresis, and input digital filter values.

To select this mode when in the levels 0 and 1, setup, expansion, option and calibration modes, press the ⟳ key for 1 second minimum. The display changes to the menu display. If you select [*L u - 2*] using the ⩓ ⩔ key then press the ⟳ key for 1 second minimum, the controller enters the level 2 mode.

To select parameters in this mode, press the ⟳ key. To change parameter settings, use the ⩓ or ⩔ keys.

The parameters supported in this mode are:

Symbol	Parameter Name
r - L	Remote/Local
SPrU	SP ramp time unit
SPrt	SP ramp set value
LbA	LBA detection time
ōu - S	MV at stop
ōu - E	MV at PV error
ōL - H	MV upper limit
ōL - L	MV lower limit
ōrL	MV change rate limit
ĩnF	Input digital filter
ALH1	Alarm 1 hysteresis
ALH2	Alarm 2 hysteresis
ALH3	Alarm 3 hysteresis
ĩnSH	Input shift upper limit (temperature)
ĩnSL	Input shift lower limit (temperature)

[r - L]   **Remote/Local**

Conditions of Use
The communications function must be in use.

Function

Switches between remote and local operation.

To change the parameter setting during remote operation, use the communications function. To change the parameter setting during local operation, change the setting on the E5CK controller.

You can check the parameter setting by both communications and on the E5CK controller regardless of whether the controller is switched to remote or local operation.

Comment

Setting Range	Default
[rñt]: remote / [LCL]: local	[LCL]

[5PrU]   **SP ramp time unit**

[5Prt]   **SP ramp set value**

Conditions of Use
ST must be set to OFF.

Function

Specifies the change rate during SP ramp operation. Set the maximum permissible change width per unit of time (minute or hour) as the *SP ramp set value*. However, note that when set to **0**, the SP ramp function is disabled.

The time unit and SP ramp set value are independent of each other. For example, when setting 30 per minute, set the SP ramp set value parameter to **30** and the *SP ramp time unit* parameter to [ñ] (minute). However, if you change the time unit only to [H] (hour), the set time becomes 30 per hour.

During temperature input, the decimal point position of the SP ramp set value is dependent on the currently selected sensor, and during analog input on the results of scaling.

Comment

Parameter	Setting Range	Unit	Default
SP ramp time unit	[ñ]: minute/ [H]: hour	None	ñ
SP ramp set value	0 to 9999	EU	0

During temperature input, the range of the currently selected sensor is taken as the setting range for the *SP ramp set value* parameter.

See

Related information:
Refer to *Operating Condition Restrictions* in Section 4.

Related parameters:
Input type, Scaling upper limit, Scaling lower limit, Decimal point (setup mode)

LBA (Loop Break Alarm) detection time

Conditions of Use
The LBA (Loop Break Alarm) function must be assigned as an output.

Function

This parameter is automatically set by AT execution (excluding AT execution in a ON/OFF control).

The LBA is output if the change width of the process value falls below 0.2 %full-scale of the time preset to this parameter when the manipulated variable is set in the *MV upper limit* or *MV lower limit* parameters.

The LBA function is disabled when this parameter is set to "0".

Setting Range	Unit	Default
0 to 9999	Second	0

Comment

See

Related information:
Refer to *LBA* in Section 4.
How to Use Error Output in Section 7.

Related parameters:
AT Execute/Cancel (level 1 mode),
Control output 1 assignment, Control output 2 assignment, Auxiliary output 1 assignment (setup mode)

`⊼u-5`   **MV at stop**

`⊼u-E`   **MV at PV error**

Function

The *MV at stop* parameter sets the manipulated variable when operation stops.

The *MV at PV error* parameter sets the manipulated variable when an input error occurs.

Comment

The setting ranges during standard control and heating and cooling control are different.

The manipulated variable at the cooling side during heating and cooling control is expressed as a negative value.

Control Method	Setting Range	Unit	Default
Standard	-5.0 to 105.0	%	0
Heating and cooling	-105.0 to 105.0	%	0

See

Related information:
MV at stop: Refer to *Starting and Stopping Operation* in Section 3.
MV at PV error: Refer to *How to Use the Error Display* in Section 7.

`oL-H`   **MV upper limit**

`oL-L`   **MV lower limit**

`orL`   **MV change rate limit**

Conditions of Use
The control must be advanced PID control, and ST must be set to OFF.

Function

The *MV upper limit* and *MV lower limit* parameters set the upper and lower limits of the manipulated variable. When the manipulated variable calculated by the E5CK controller is outside of the upper-and lower-limit range, the upper limit or lower limit set to these parameters is output, respectively.

The *MV change rate limit* parameter sets the maximum permissible change width per second of the manipulated variable. If a change in the manipulated variable causes this parameter setting to be exceeded, the calculated value is reached while changing the value by the per-second value set in this parameter.

Comment

MV upper limit

The setting ranges during standard control and heating and cooling control are different. Also, the manipulated variable at the cooling side during heating and cooling control is expressed as a negative value.

Control Method	Setting Range	Unit	Default
Standard	MV lower limit +0.1 to 105.0	%	105.0
Heating and cooling	0.0 to 105.0	%	105.0

MV lower limit

The setting ranges during standard control and heating and cooling control are different. Also, the manipulated variable at the cooling side during heating and cooling control is expressed as a negative value.

Control Method	Setting Range	Unit	Default
Standard	-5.0 to MV upper limit -0.1	%	-5.0
Heating and cooling	-105.0 to 0.0	%	-105.0

MV change rate limit

Setting Range	Unit	Default
0.0 to 100.0	%	0.0 : OFF

See

Related information:
Refer to *Operating Condition Restrictions* in Section 4.

⌐ınF   **Input digital filter**

Function
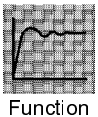
Sets the time constant of the input digital filter. The following figures shows the effect on data after passing through the digital filter.

Comment
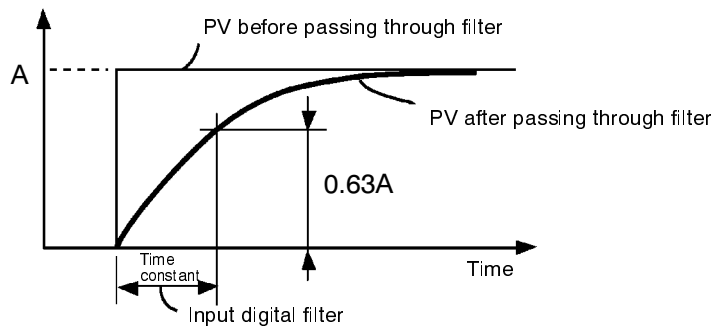
Setting Range	Unit	Default
0 to 9999	Second	0

ALH1   **Alarm 1 hysteresis**

ALH2   **Alarm 2 hysteresis**

ALH3   **Alarm 3 hysteresis**

Conditions of Use
**Alarms must be assigned as outputs. For example, if alarm outputs 1
and 2 only are assigned as outputs, the *alarm 3 hysteresis* parameter
cannot be used.**

Function

This parameter is for setting the hysteresis of alarm outputs **1** to **3**.

Comment

Setting Range	Unit	Default
0.01 to 99.99	%FS	0.02

See

Related information:
Refer to *Setting Alarm Type* in Section 3.

Related parameters:
Alarm 1 type, Alarm 2 type, Alarm 3 type, Alarm 1 open in alarm, Alarm 2
open in alarm, Alarm 3 open in alarm (setup mode),
Alarm value 1, Alarm value 2, Alarm value 3 (level 1 mode)

InSH   **Input shift upper limit**

InSL   **Input shift lower limit**

Conditions of Use
**The input type must be set to temperature input (thermocouple or plati-
num resistance thermometer).**

Function

Sets each of the shift amounts for the input shift upper and lower limit val-
ues.

Comment

Setting Range	Unit	Default
-199.9 to 999.9	°C or °F	0.0

See

Related information:
Refer to *Setting Input Specifications* in Section 3.

Related parameter:
Input type (setup mode)

5–6 Setup Mode

The parameters in this mode can be used only when the *security* parameter (protect mode) is set to **0** and **1**.

This mode contains the parameters for setting the basic specifications of the E5CK controller. These parameters include parameters for specifying the input type, scaling, output assignments, and direct/reverse operation.

To select this mode when in the levels 0 to 2, expansion, option and calibration modes, press the ⮌ key for 1 second minimum. The display changes to the menu display. If you select [𝖲𝖤𝗍] using the ⌃ ⌄ key then press the ⮌ key for 1 second minimum, the controller enters the setup mode.

To select parameters in this mode, press the ⮌ key. To change parameter settings, use the ⌃ or ⌄ keys.

The following table shows the parameters supported in this mode.

Symbol	Parameter Name
ᴉ𝗇-𝗍	Input type
ᴉ𝗇-𝖧	Scaling upper limit
ᴉ𝗇-𝖫	Scaling lower limit
𝖽𝖯	Decimal point
𝖽-𝖴	°C/°F selection
ᴉ𝗇ᴉ𝗍	Parameter initialize
ō𝗎𝗍 1	Control output 1 assignment
ō𝗎𝗍2	Control output 2 assignment
𝖲𝗎𝖻 1	Auxiliary output 1 assignment
𝖠𝖫𝗍 1	Alarm 1 type
𝖠𝖫 ᴉ𝗇	Alarm 1 open in alarm

Symbol	Parameter Name
ALt2	Alarm 2 type
AL2n	Alarm 2 open in alarm
ALt3	Alarm 3 type
AL3n	Alarm 3 open in alarm
ōrEu	Direct/Reverse operation

In-t Input type

Function

Comment

Match the setting (software) of this parameter with the setting (hardware) of the input type jumper connector.

Set the input types to be connected to terminal Nos. 6 to 8 by the input type codes in the table below.

Set the code according to the following table. Default is **2: K1 thermocouple**.

Set value	Input Type				Jumper Position	
0	JPt	-199.9 to 650.0 (°C)	/-199.9 to 999.9 (°F)	Platinum resis-tance thermom-eter	TC·PT	
1	Pt	-199.9 to 650.0 (°C)	/-199.9 to 999.9 (°F)			
2	K1	-200 to 1300 (°C)	/-300 to 2300 (°F)	Thermo-couple	TC·PT	
3	K2	0.0 to 500.0 (°C)	/0.0 to 900.0 (°F)			
4	J1	-100 to 850 (°C)	/-100 to 1500 (°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	L1	-100 to 850 (°C)	/-100 to 1500 (°F)			
9	L2	0.0 to 400.0 (°C)	/0.0 to 750.0 (°F)			
10	U	-199.9 to 400.0 (°C)	/-199.9 to 700.0 (°F)			
11	N	-200 to 1300 (°C)	/-300 to 2300 (°F)			
12	R	0 to 1700 (°C)	/0 to 3000 (°F)			
13	S	0 to 1700 (°C)	/0 to 3000 (°F)			
14	B	100 to 1800 (°C)	/300 to 3200 (°F)			
15	W	0 to 2300 (°C)	/0 to 4100 (°F)			
16	PLⅡ	0 to 1300 (°C)	/0 to 2300 (°F)			
17	4 to 20mA			Current input	I	
18	0 to 20mA					
19	1 to 5V			Voltage input	V	
20	0 to 5V					
21	0 to 10V					

Related information:
Refer to *Setting Input Specifications* in Section 3.

See

Related parameters:
When input type is set to temperature input:
°C/°F selection (setup mode)
When input type is set to voltage input or current input:
Scaling upper limit, Scaling lower limit, Decimal point (setup mode)

| `in-H` | **Scaling upper limit** |

| `in-L` | **Scaling lower limit** |

| `dP` | **Decimal point** |

Conditions of Use
The input type must be set to analog input (voltage or current input).

Function

This parameter can be used only when voltage input or current input is selected as the input type.

When voltage input or current input is selected as the input type, scaling is carried out. Set the scaling upper limit in the *scaling upper limit* parameter and the scaling lower limit in the s*caling lower limit* parameter.

The *decimal point* parameter specifies the decimal point position of parameters (set point, etc.) whose unit is set to EU (Engineering Unit).

Comment

Scaling upper limit, Scaling lower limit

Parameter	Setting Range	Unit	Default
Scaling upper limit	Scaling lower limit +1 to 9999	EU	100
Scaling lower limit	-1999 to scaling upper limit -1	EU	0

Decimal point: default :0

Set Value	Example
0	1234
1	123.4
2	12.34
3	1.234

See

Related information:
Refer to *Setting Input Specifications* in Section 3.

Related parameter:
Input type (setup mode)

๋n๋t **Parameter initialize**

Function

Returns parameter settings to their defaults. However, note that the following parameters are not affected by execution of this parameter:
input type, scaling upper limit, scaling lower limit, decimal point and °C/°F selection.

Example of use

When this parameter is selected, [๗ŏ] (no) is first displayed. To initialize parameters, press the ⊼ key to specify [YE5] ("yes").

d-U **°C/°F selection**

Conditions of Use
The input type must be set to temperature input (thermocouple or platinum resistance thermometer).

Function

This parameter can be used when thermocouple or platinum resistance thermometer is selected as the input type.

Set the temperature input unit to either of "°C" or "°F".

Comment

Setting Range	Default
Ɛ : °C / F : °F	Ɛ

See

Related information:
Refer to *Setting Input Specifications* in Section 3.

Related parameter:
Input type (setup mode)

ōUt 1   Control output 1 assignment

ōUt2   Control output 2 assignment

Function

Assigns the output functions to either of control output 1 or 2.

The following six output functions can be assigned as outputs: Control output (heat), Control output (cool), Alarms 1 to 3, and LBA.

Errors 1 and 2 cannot be assigned as outputs.

When the output function assigned to control output 1 is ON, the OUT1 LED lights. However, note that the OUT1 LED does not light when control output (heat) or control output (cool) are assigned to linear outputs such as current and voltage.

When the output function assigned to control output 2 is ON, the OUT2 LED lights.

Comment

Symbol	HEAt	CōōL	AL - 1	AL - 2	AL - 3	LbA
Function	Control output (heat)	Control output (cool)	Alarm 1	Alarm 2	Alarm 3	LBA

Defaults:
Control output 1 = [HEAt], *Control output 2* = [AL - 1]

See

Related information
Refer to *Setting Output Specifications* in Section 3.

Related parameters:
Alarm-related parameters
Heating and cooling related parameter
LBA detection time (level 2 mode)

5Ub 1   Auxiliary output 1 assignment

Function

Assigns output functions to auxiliary output 1. The following six output functions can be assigned as outputs: Alarms 1 to 3, LBA, Error 1 (input error), and Error 2 (A/D converter error).

Control output (heat) and control output (cool) cannot be assigned as outputs.

When the output function assigned to auxiliary output 1 is ON, the SUB1 LED lights.

Comment

Symbol	*RL - 1*	*RL - 2*	*RL - 3*	*LbR*	*5.Err*	*E333*
Function	Alarm 1	Alarm 2	Alarm 3	LBA	Error 1	Error 2

Defaults: [*RL - 2*]

See

Related information
Refer to *Setting Output Specifications* in Section 3.

Related parameter
Alarm-related parameter. LBA detection time (level 2 mode).

RLt1 Alarm 1 type

RLt2 Alarm 2 type
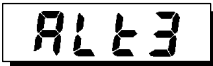
RLt3 Alarm 3 type

Conditions of Use
Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the *alarm 3 type* parameter cannot be used.

Function

Alarm 1 to 3 type parameters specify the operation of the alarm by the one of the set values in the following table. For details of operation at an alarm, refer to Section 3.

Comment

Set Value	Settings	Set Value	Settings
1	Upper-and lower-limit alarm (deviation)	7	Lower-limit alarm with standby sequence (deviation)
2	Upper-limit alarm (deviation)	8	Absolute-value upper-limit alarm
3	Lower-limit alarm (deviation)	9	Absolute-value lower-limit alarm
4	Upper-and lower-limit range alarm (deviation)	10	Absolute-value upper-limit alarm with standby sequence
5	Upper-and lower-limit alarm with standby sequence (deviation)	11	Absolute-value lower-limit alarm with standby sequence
6	Upper-limit alarm with standby sequence (deviation)		

Defaults: Deviation upper limit

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Related information:
Refer to *Setting Alarm Type, in Section 3*

See

Related parameters:
Alarm value 1, Alarm value 2, Alarm value 3 (level 1 mode),
Alarm 1 hysteresis, Alarm 2 hysteresis, Alarm 3 hysteresis (level 2 mode),
Alarm 1 open in alarm, Alarm 2 open in alarm, Alarm 3 open in alarm, Control output 1 assignment, Control output 2 assignment (setup mode)

| AL 1n | **Alarm 1 open in alarm** |

| AL2n | **Alarm 2 open in alarm** |

| AL3n | **Alarm 3 open in alarm** |

Conditions of Use
Alarms must be assigned as outputs. For example, if alarm outputs 1 and 2 only are assigned as outputs, the *alarm 3 open in alarm* parameter cannot be used.

Function

Selects the output states of alarms 1 to 3.

When the controller is set to *close in alarm*, the status of the alarm output function is output as it is. When set to *open in alarm*, the status of the alarm output function is output inverted. The following table shows the relationship between alarm output functions, output and output LEDs.

	Alarm	**Output**	**Output LED**
Close in alarm	ON	ON	Lit
	OFF	OFF	Not lit
Open in alarm	ON	OFF	Lit
	OFF	ON	Not lit

Comment

Setting Range	**Default**
n-$\bar{o}$: Close in alarm/ n-C :Open in alarm	n-$\bar{o}$

Related information:
Refer to *Setting Output Specifications* in Section 3.

Related parameters:
Alarm value 1, Alarm value 2, Alarm value 3 (level 1 mode),
Alarm 1 hysteresis, Alarm 2 hysteresis, Alarm 3 hysteresis (level 2 mode),
Alarm 1 open in alarm, Alarm 2 open in alarm, Alarm 3 open in alarm,
Control output 1 assignment, Control output 2 assignment (setup mode)

Direct/Reverse operation

Direct operation (or normal operation) refers to control where the manipulated variable is increased according to the increase in the process value. Alternatively, *reverse operation* refers to control where the manipulated variable is increased according to the decrease in the process value.

Setting Range	Default
ōr-r : Reverse operation/ ōr-d :Direct operation	ōr-r

Related information:
Refer to *Setting Output Specifications* in Section 3.

5–7   Expansion Mode
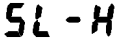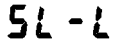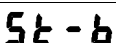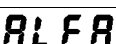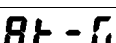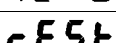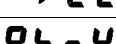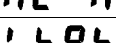
The parameters in this mode can be used only when the *security* parameter (protect mode) is set to **0** and **1**.

This mode contains the parameters for setting expanded functions. These parameters include parameters for setting ST (self-tuning), setting the SP setting limiter, selecting advanced PID and ON/OFF control, specifying the standby sequence reset method, resetting the parameters, and automatic return of display mode.

To select this mode when in the levels 0 to 2, setup, option and calibration modes, press the ⟳ key for 1 second minimum. The display changes to the menu display. If you select [*Eⁱⁱⁱt*] using the ⌃ ⌄ key then press the ⟳ key for 1 second minimum, the controller enters the expansion mode.

To select parameters in this mode, press the ⟳ key. To change parameter settings, use the ⌃ or ⌄ keys.

The parameters supported in this mode are:

Symbol	Parameter Name
SL-H	SP setting upper limit
SL-L	SP setting lower limit
CntL	PID / ON/OFF
St	ST
St-b	ST stable range
ALFA	α
At-G	AT calculated gain
rESt	Standby sequence reset method
rEt	Automatic return of display mode
At-H	AT hysteresis
LbAb	LBA detection width

`5L-H` **Set point upper limit**

`5L-L` **Set point lower limit**

Function

Limits the upper and lower limits of the set point. When the set point exceeds the settings of the *Set point upper limit* and *Set point lower limit* parameters, the E5CK controller regards the settings of the Set point upper limit and Set point lower limit parameters as the set points.

When the input type is changed to temperature input, the set point upper and lower limits are changed to the upper and lower limits of the currently selected sensor. And when the input type is changed to analog input, the set point upper and lower limits are changed to the scaling upper and lower limits.

During temperature input, the decimal point position is dependent on the currently selected sensor, and during analog input on the results of scaling.

Comment

Parameter	Setting Range	Unit	Default
SP setting upper limit	SP setting lower limit +1 to scaling upper limit	EU	1300
SP setting lower limit	Scaling lower limit to SP setting upper limit -1	EU	-200

During temperature input, the range becomes the range of use of the selected sensor instead of the scaling upper and lower limit values.

See

Related information:
Refer to *Operating Condition Restrictions* in Section 4.

Related parameters:
Input type, Scaling upper limit, Scaling lower limit, Decimal point (setup mode)

`CntL` **PID / ON/OFF**

Function

Selects advanced PID control or ON/OFF control.

Comment

Setting Range	Default
`PId` : advance PID/ `onoF` :ON/OFF	`PId`

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Related information:
Refer to *Selecting the Control Method* in Section 4.

Related parameters:
Hysteresis (heat), Hysteresis (cool) (level 1 mode)

| 5ᵗ | **ST** |

| 5ᵗ-ᵇ | **ST stable range** |

Conditions of Use
The input type must be set to temperature input, and the control must be either standard control or advanced PID control.

When the ST parameter is set to ON, the self-tuning (ST) function is active. During operation of the ST function, the power on the load side connected to the control output must be turned ON at the same time or before start of E5CK operation.

The *ST stable range* parameter sets the stable range width during self-tuning. However, note that this parameter cannot be used when the ST parameter is set to OFF.

Parameter	Setting Range	Unit	Default
ST	*oFF* : ST function OFF/ *on* : ST function ON	None	*oFF*
ST stable range	0.1 to 999.9	°C or °F	15.0

Related information:
Refer to *Fuzzy self-tuning* in Appendix A.

Related parameters:
Input type (setup mode)
PID/ON/OFF (expansion mode)

ALFA α

Conditions of Use
The control must be advanced PID control, and ST must be set to OFF.

Function

Sets advanced PID-control parameter α.

Comment

Setting Range	Unit	Default
0.00 to 1.00	None	0.65

See

Related parameter:
PID/ON/OFF (expansion mode)

At-G **AT calculated gain**

Conditions of Use
The control must be advanced PID control, and ST must be set to OFF.

Function

Sets the gain when adjusting the PID parameters by auto-tuning. To give priority to response, decrease the set value of this parameter. To give priority to stability, increase the set value of this parameter.

Comment

Setting Range	Unit	Default
0.1 to 10.0	None	1.0

See

Related parameters:
AT Execute/Cancel (level 1 mode),
PID/ON/OFF (expansion mode)

rESt Standby sequence reset method

Function

Selects the conditions for enabling reset after the standby sequence of the alarm has been canceled.

Condition A:
Control started (including power ON), and set point, alarm value or input shift value changed

Condition B:
Power ON

Comment

Setting Range	Default
0: Condition A / 1: Condition B	0

See

Related parameters:
Alarm 1 type, Alarm 2 type, Alarm 3 type (setup mode)

rEt Automatic return of display mode

Function

If you do not operate any of the controller keys for the time set in this parameter when in levels 0 to 2 modes, the display automatically returns to the PV/SP display.

When this parameter is set to **0**, this function is disabled.

This parameter is invalid while the menu is displayed.

Comment

Setting Range	Unit	Default
0 to 99	Second	0

AT hysteresis

Conditions of Use
The control must be advanced PID control, and ST must be set to OFF.

Function

The levels of limit cycle operations during AT execution are given hysteresis at event ON/OFF switching. This parameter sets this hysteresis width.

Comment

Setting Range	Unit	Default
0.1 to 9.9	%FS	0.2

LBA detection width

Conditions of Use
The LBA (Loop Break Alarm) function must be assigned as an output.

Function

This parameter can be used when LBA is assigned as an output.

When the change width of the manipulated variable is below the width set in this parameter, the controller regards this as detection of an LBA.

Comment

Setting Range	Unit	Default
0.0 to 999.9	%FS	0.2

5–8   Option Mode
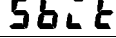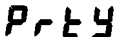
The parameters in this mode can be used only when the *security* parameter (protect mode) is set to **0** and **1**.

You can select this mode only when the option unit is set in the controller: E53-CK01; E53-CK03; E53-CKB; E53-CKF. In this mode, you can set the communications conditions, transfer output and event input parameters to match the type of option unit set in the controller.

To select this mode when in the levels 0 to 2, setup, expansion and calibration modes, press the ⟲ key for 1 second minimum. The display changes to the menu display. If you select [*ōPt*] using the ⤒ ⤓ key then press the ⟲ key for 1 second minimum, the controller enters the option mode.

To select parameters in this mode, press the ⟲ key. To change parameter settings, use the ⤒ or ⤓ keys.

The following table shows the parameters supported in this mode.

Symbol	Parameter Name
Eu-ñ	Multi-SP function
Eu-1	Event input assignment 1
Sbīt	Communication stop bit
LEn	Communication data length
Prty	Communication parity
bPS	Communication baud rate
U-nō	Communication unit No.
tr-t	Transfer output type
tr-H	Transfer output upper limit
tr-L	Transfer output lower limit

| *Eu-ñ* | **Multi-SP function** |

Conditions of Use
The event input function must be in use.

This parameter specifies the number of set points (SP) when using the multi-SP function. When set to **0**, the multi-SP function cannot be used.

Function

Comment

Setting Range	Unit	Default
0 to 1	None	0

See

Related information:
Refer to *How to Use Option Functions* in Section 4.

Related parameter:
Event input assignment 1 (option mode)

Model

Option unit:
Event Input Unit E53-CKB

$E u - 1$ **Event input assignment 1**

Conditions of Use
Event input must be specified when the event input function is in use.

Function

This parameter specifies event input other than the multi-SP function. The following two functions can be specified: RUN/STOP and Manual/Auto.

Event input is disabled while the menu is displayed.
It is also disabled in set up, expansion, option and calibration modes.

Comment

Symbol	Function	Event Input Operation	
$5 t \bar{o} P$	Run/Stop	ON: Stop,	ON : Run
$\bar{n} R n$	Manual/Auto	ON: Manual,	OFF : Auto

See

Related information:
Refer to *How to Use Option Functions* in Section4.

Related parameter:
Event input assignment 1 (option mode)

Model

Option unit:
Event Input Unit E53-CKB

`5bιt`   **Communication stop bit**

`LEn`   **Communication data length**

`Prty`   **Communication parity**

`bPS`   **Communication baud rate**

`U-no`   **Communication unit No.**

Conditions of Use
The communications function must be in use.

Function

These parameters set the communications conditions. Make sure that the stop bit, data length, parity and baud rate of the host computer and the E5CK controller are matching. These parameters are valid when the power is turned ON again or when level 0 to 2 modes are switched.

When connecting two or more E5CK controllers to the host computer, set unit Nos. that will not conflict with the unit Nos. of other controllers.

Comment

Communication stop bit parameter

Setting Range	Unit	Default
1, 2	Bits	2

Communication data length parameter

Setting Range	Unit	Default
7, 8	Bits	7

Communication parity parameter

Setting	Default
`nonE` : None/ `EuEn` :Even/ `odd` :Odd	`EuEn`

Communication baud rate parameter

Setting Range	Unit	Default
1.2, 2.4, 4.8, 9.6, 19.2	kbps	9.6

Communication unit No. parameter

Setting Range	Unit	Default
0 to 99	None	0

See

Related information:
Refer to *How to Use Option Features* in Section 4.

Related parameter:
Remote/Local (level 2 mode)

Option unit:
RS-232C Unit E53-CK01, RS-485 Unit E53-CK03

Model

Transfer output type

Transfer output upper limit

Transfer output lower limit

Conditions of Use
The transfer output function must be in use.

Function

These parameters set the transfer output conditions.

The *transfer output type* parameter selects one of the following as the transfer output type, and assigns this to transfer output:
Set point, Set point during SP ramp, Process value, Manipulated variable (heat), and Manipulated variable (cool).
However, note that *manipulated variable (cool)* can be selected only during heating and cooling control.

The *transfer output upper limit* and *transfer output lower limit* parameters are used for scaling of transfer output. The setting range varies according to this output data. Also, a lower limit value larger than the upper limit value may be set.

During temperature input, the decimal point position of the set point, set point during SP ramp or process value is dependent on the currently selected sensor, and during analog input on the results of scaling.

Comment

Transfer Type		Transfer Output Lower Limit to Transfer Output Upper Limit
5P	Set point	Set point lower limit value to Set point upper limit value
5P-n	Set point during SP ramp	Set point lower limit value to Set point upper limit value

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Transfer Type		Transfer Output Lower Limit to Transfer Output Upper Limit
P_u	Process value	Scaling lower limit to scaling upper limit
$\bar{o}$	Manipulated variable (heat)	-5.0% to 105.0%
$C-\bar{o}$	Manipulated variable (cool)	0.0% to 105.0%

The output ranges of the set point, set point during SP ramp or process value when temperature input is selected are the ranges supported by the selected sensor.

When you have selected the *manipulated variable (heat)* parameter, the transfer output lower limit during heating and cooling control becomes **0.0**.

Related information:
Refer to *How to Use Option Functions* in Section 4.

Option unit:
Transfer Output Option Board E53-CKF

See

Model

5–9   Calibration Mode
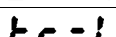
The parameters in this mode can be used only when the *security* parameter (protect mode) is set to **0**. When selecting this mode for the first time after the E5CK has left the factory, return the security parameter to **0**.

This mode contains the parameters for user calibration of inputs and outputs. Only parameters relating to input types specified in the *input type* parameter (setup mode) can be used. Also, related output parameters can be used only when the Transfer Output Option Board E53-CKF is added on.

To select this mode when in the levels 0 to 2, setup, expansion and option modes, press the [⇄] key for 1 second minimum. The display changes to the menu display. If you select [*CLb*] using the [⋀] [⋁] key then press the [⇄] key for 1 second minimum, the controller enters the calibration mode.

For details on parameters in the calibration mode, refer to *Calibration* in Section 4.

SECTION 6
Using the Communications Function

This section explains communications with a host computer and communications commands.

6–1   Outline of the Communications Function

6–1–1   Outline

The communications function allows you to monitor and set E5CK parameters by a program prepared and running on a host computer connected to the E5CK controller. This chapter describes operations as viewed from the host computer.

When using the communications function, the option unit for RS-232C or RS-485 communications must be added on. The E5CK communications function allows you to:
- Read/write parameters
- Do operating instructions
- Selecting the setting level

The communications function assumes the following conditions:
- Writing of parameters is possible in during remote operation. Also, parameters cannot be written during execution of auto-tuning;
- Writing parameters are provided with a setting level. Writing conditions are as follows depending on the setting level:
     Setting level 1: No restrictions
     Setting level 0: Writing of parameters in the setup and expansion modes only is prohibited.

For details on switching between setting levels. refer to Issuing Special Commands, within Section 6-4-1.

The *RUN/STOP*, *remote/loca*l and *AT execute/cancel* parameters are set aside from other parameters as special commands for instructing operations.

6–1–2   Transfer Procedure

The host computer sends a *command frame* to the controller, and the controller returns a *response frame* corresponding to the content of the command sent by the host computer. In other words, a response frame is returned for each command frame sent.
The following diagram shows command frame/response frame operations.
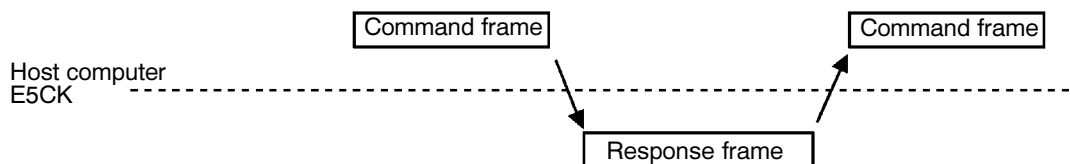
6–1–3   Interface

The host computer carries out communications conforming to the RS-232C or RS-485 interface specifications. Option units supporting the RS-232C and RS-485 specifications are as follows:
- Option units
  E53-CK01 (RS-232C)
  E53-CK03 (RS-485)

6–2   Preparing for Communications

For details on wiring when using the communications, see Chapter 2 Preparations.

6–2–1   Cable Connections

RS-232C

Only one controller can be connected to the host computer.

The cable length should not exceed 15 meters.

Use shielded twisted-pair cables (AWG28 or more) for the cables.
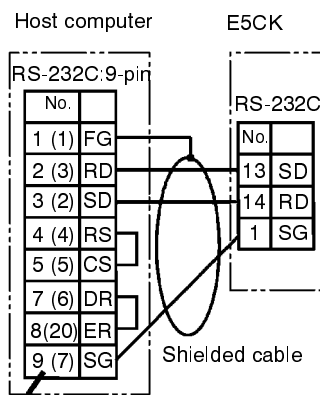
Figures in parentheses ")( )" shows No. for 25–pin connector.

RS-485

Up to 32 controllers, including a computer, can be connected to the host computer.

The total cable length should not exceed 500 meters. Use shielded twisted-pair cables (AWG28 or more) for the cables.

Attach terminators to the controllers at both ends of a series of controllers connected in an open configuration. For example, in the above configuration, connect the terminator to the host unit and the unit No.30, and do not connect terminators to unit Nos.0 to 29. Use terminators having a resistance of 120Ω (1/2 W). The total resistance of both ends should be at least 54Ω .

Host computer
RS-485

Terminator (120Ω 1/2W)
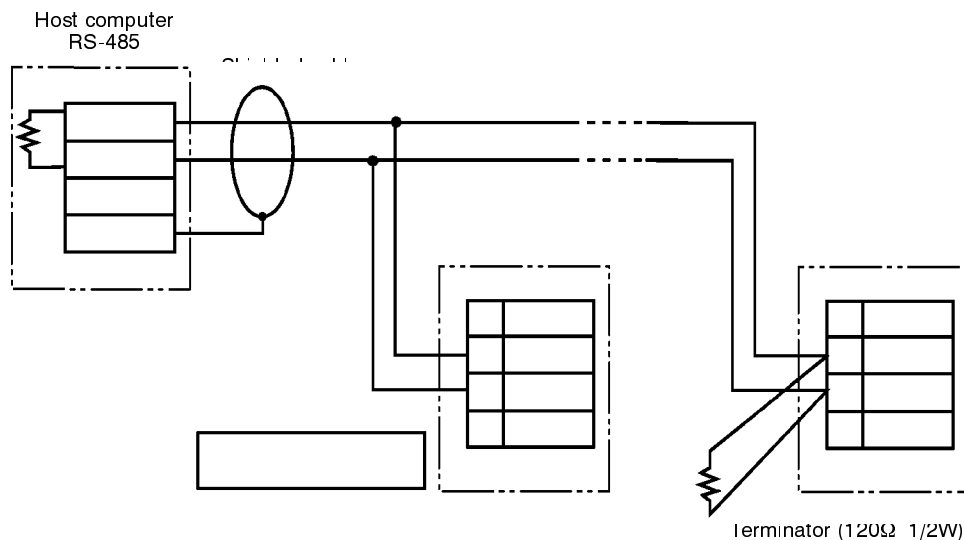
6–2–2 Setting the Communications Specifications

Match the communications specifications of the host computer and E5CK controller. When two or more controllers are connected to the host computer, make sure that the communications specifications of all controllers are the same.

This section describes how to set the communications specifications of the E5CK controller. For details on the host computer, see the relevant manual supplied with the host computer.

Communications Parameters

Set the communications specifications of the E5CK in the controller's communications parameters. The communications parameters are set on the front panel of the E5CK controller.

The following table shows the communications parameters provided on the E5CK controller and their respective settings.

Parameter/Symbol		Setting	Set Value
Unit No.	U-no	0 to 99	■ to 99
Baud rate	bPS	1.2/2.4/4.8/9.6/19.2 (kbps)	1.2/2.4/4■ /19.2
Bit length	LEn	7/8 (bit)	■ /8
Parity	Prty	None/even/odd	nonE /EuEn odd
Stop bit	Sbit	1/2	■ 1/

Inverted items are factory-settings.

6–3   Command Configuration

Command configuration is as follows:

Command

	2B	1B	2B	4B	2B	2B
@	Unit No.		Command code	Data	FCS	* CR

Command type
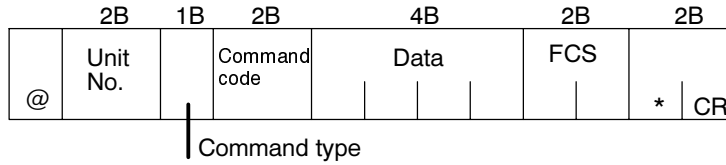
Response

Command configuration – paired with a response:
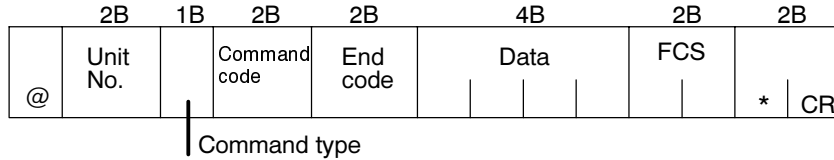
	2B	1B	2B	2B	4B	2B	2B
@	Unit No.		Command code	End code	Data	FCS	* CR

Command type

"@"
The start character. This character must be inserted before the leading byte.

Unit No.
Specifies the "unit No." of the E5CK. If there are two or more transmission destinations, specify the desired destination using "unit No."

Command type
Specifies the command type by codes "1" to "3": parameter read, parameter write and special commands.

Command code
Specifies the command for each command type. With parameter read/write commands, this becomes the parameter No.

Data
Specifies the set value or setting content. In the parameter read command, set dummy data "0000". In the response, this is inserted only when the end code is "00".

End code
Sets the communication results. For details on the types and meanings of end codes, see 6.5 How to Read Communications Error Information (page 6-10).

FCS (Frame Check Sequence)
Set the frame check results from the start character to the data section. For details on the frame check, see 6.6 Program Example (page 6-12).

"*" "CR (Carriage Return) code"
Indicates the end (terminator) of the command or response block.

6–4 Commands and Responses

This section describes commands and response in detail. The conventions used in this section and data restrictions are as follows:

1, 2, 3... 1. Data is expressed in 1-byte units and in ASCII code.

2. When the read or write data is a numerical value, the data to be set must conform to these conditions:

- The decimal point [.] is not indicated in fractions.

- The leftmost bit of minus numerical data must be expressed as given in this example:

  10.0=[0100], -150.0=[A500], -15=[F015]

6–4–1 Reading/Writing Parameters

Reading parameters

X: Any value acceptable
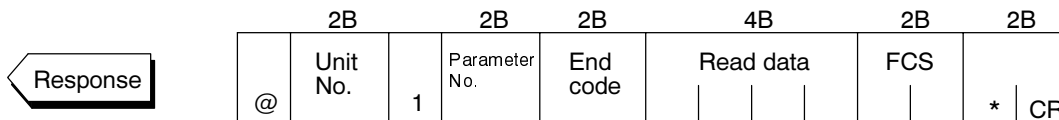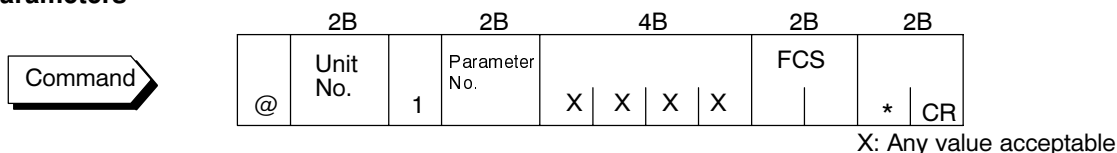
Writing parameters
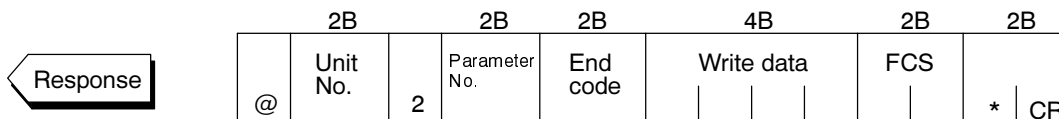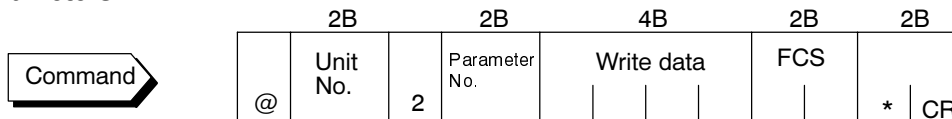
Reading or writing of the parameters of a specified controller is executed.

- Writing is possible only during remote operation.

- Reading is impossible during executing auto-tuning.

- The following are set aside as special commands.

  RUN/STOP

  remote/local

  AT execute/cancel

☞ *Writing the Set Value*   *With X format "MA" and "ME" commands (see Appendix), you can select non-volatile RAM or RAM as the memory for the set value. The limit for the number of times that non-volatile RAM can be written to is 100,000 times. When the number of times that the set point is written exceeds this limit, set RAM write mode as the memory.*

Parameter No.	Parameter	Data Setting and Monitor Range	Mode
00	PV monitor (see note *1)	Scaling lower limit -10% to scaling upper limit +10% (see note *2)	Level 0
86	SP monitor during SP ramp (see note *1)	Set point lower limit to set point upper limit	
04	MV monitor (heat) (see note *1)	–5.0 to 105.0 (see note *3)	
42	MV monitor (cool) (see note *1)	0.0 to 105.0	
01	Set point	Set point lower limit to set point upper limit	
02	Alarm value 1	–1999 to 9999	Level 1
03	Alarm value 2	–1999 to 9999	
41	Alarm value 3	–1999 to 9999	
19	Proportional band	0.1 to 999.9	
20	Integral time	0 to 3999	
21	Derivative time	0 to 3999	
22	Cooling coefficient	0.01 to 99.99	
09	Dead band	–19.99 to 99.99	
23	Manual reset value	0.0 to 100.0	
06	Hysteresis (heat)	0.01 to 99.99	
43	Hysteresis (cool)	0.01 to 99.99	
07	Control period (heat)	1 to 99	
08	Control period (cool)	1 to 99	
44	SP ramp time unit	0: Minutes, 1: Hours	Level 2
45	SP ramp set value	0 to 9999	
46	LBA detection time	0 to 9999	
47	MV at stop	–5.0 to 105.0 (see note *4)	
48	MV at PV error	–5.0 to 105.0 (see note *4)	
50	MV upper limit	MV lower limit +0.1 to 105.0	
49	MV lower limit	–5.0 to MV upper limit –0.1 (see note *5)	
51	MV change rate limit	0.0 to 100.0	
56	Input digital filter	0 to 9999	
25	Alarm 1 hysteresis	0.01 to 99.99	
26	Alarm 2 hysteresis	0.01 to 99.99	
52	Alarm 3 hysteresis	0.01 to 99.99	
53	Input shift upper limit	–999.9 to 999.9	
54	Input shift lower limit	–999.9 to 999.9	

*1 Possible only during reading

*2 During temperature input, the range becomes the range of use of the selected sensor.

*3 During heating and cooling control, the range becomes 0.0 to 105.0.

*4 During heating and cooling control, the range becomes -105.0 to 105.0.

*5 During heating and cooling control, the range becomes -105.0 to MV upper limit -0.1.

About invalid parameters

Currently, if a command is used for invalid parameters (parameters that do not satisfy the conditions of use in Section 5), the "undefined" error (end code: 1C) is output.

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Parameter No.	Parameter	Data Setting Range	Mode
57	Input type	0 to 21 (see note *1)	Setup
59	Scaling upper limit	Scaling lower limit +1 to 9999	
58	Scaling lower limit	–1999 to scaling upper limit –1	
60	Decimal point	0 to 3	
30	°C/°F selection	0 : °C, 1 : °F	
61	Control output 1 assignment	0 to 4, 6 (see note *2)	
62	Control output 2 assignment	0 to 4, 6 (see note *2)	
63	Auxiliary output 1 assignment	2 to 4, 6 to 8 (see note *3)	
65	Alarm 1 type	1 to 11 (see note *4)	
66	Alarm 1 open in alarm	0: closed in alarm, 1: open in alarm	
67	Alarm 2 type	1 to 11 (see note *4)	
68	Alarm 2 open in alarm	0: closed in alarm, 1: open in alarm	
69	Alarm 3 type	1 to 11 (see note *4)	
70	Alarm 3 open in alarm	0: closed in alarm, 1: open in alarm	
71	Direct/Reverse operation	0: Reverse operation, 1: Direct operation	
28	Set point upper limit (see note *5)	Set point lower limit +1 to scaling upper limit	
27	Set point lower limit (see note *5)	Scaling lower limit to Set point upper limit –1	Expansion
72	PID / ON/OFF	0: Advanced PID, 1: ON/OFF	
73	ST	0 : OFF, 1 : ON	
34	ST stable range width	0.1 to 999.9	
35	α	0.00 to 1.00	
85	AT calculated gain	0.1 to 10.0	
37	Standby sequence reset method	0, 1 (see note *6)	
36	Automatic return of display mode	0 to 99	
93	AT hysteresis	0.1 to 9.9	
55	LBA detection width	0.0 to 999.9	

*1 See Section 5.
*2 0: Control output (heat), 1: Control output (cool), 2: Alarm 1, 3: Alarm 2, 4: Alarm 3, 6: LBA.
*3 2: Alarm 1, 3: Alarm 2, 4: Alarm 3, 6: LBA, 7: Error 1, 8: Error 2
*4 See Section 5.
*5 During temperature input, the range becomes the range of use of the selected sensor.
*6 See Section 5.

☞   *Reading*   To read the E5CK controller status, use the X format "RX" command. For details,
            the status   see X Format Head List in the Appendix.

Issuing Special Commands
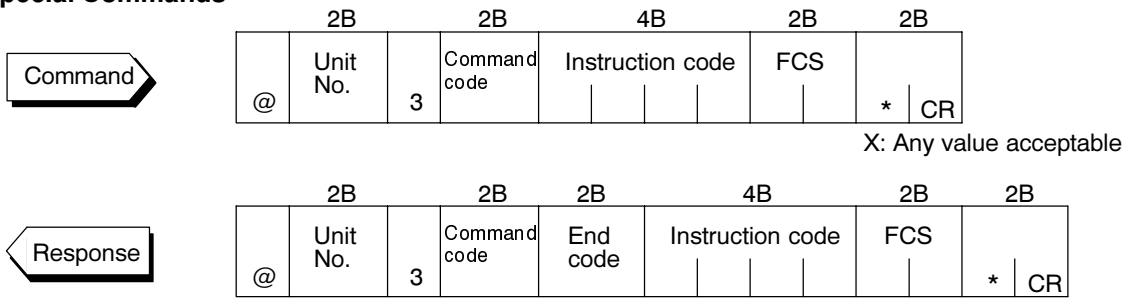
The following functions are issued as special commands.

Run/Stop

Runs or stops programs. This command cannot be issued in setting level 1.

Remote/Local

Selects remote operation or local operation.

AT Execute/Cancel

Executes or cancels auto-tuning. This command cannot be issued in setting level 1.

Move to setting level 1

Issue this command when writing parameters in setup and expansion modes.

Software reset

A response is not returned to this command. Also, communications with the E5CK cannot be carried out for five seconds after reset.

These special commands are available on the E5CK controller:

Command No.	Command	Instruction Code
00	Run/Stop	0000: Run, 0001: Stop
02	Remote/Local	0000: Local, 0001: Remote
07	AT Execute/Cancel	0000: Cancel, 0001: 40%AT execution, 0002: 100% AT execution
09	Move to setting level 1	0000
11	Software reset	0000

☞ About Setting Levels

To return to setting level 0 from setting level 1, issue the software reset command. If the parameter write command is issued for the setup and expansion modes in setting level 0, an error occurs, and the end code (OD = Command cannot be executed) is returned.

6–5　How to Read Communications Error Information

The result of communications on the E5CK can be checked by the end code in the response frame. Use this end code to remedy errors that may occur.

	2B	1B	2B	2B	4B	2B	2B	
@	Unit No.		Command code	End code	Data	FCS	*	CR

Command type
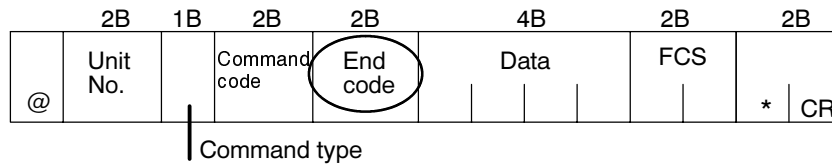
End code	00	Code name	Normal end

Description

Communications ended normally without a transmission error or any other error being generated.

End code	0D	Code name	Command cannot be executed

Description

Writing was carried out during local operation.

Writing was carried out during executing auto-tuning.

An attempt was made to execute 40% AT during heating and cooling control.

An attempt was made to switch run/stop in setting level 1.

An attempt was made to execute AT in setting level 1.

Action

Issue the parameter read or write commands in conditions other than above.

End code	10	Code name	Parity error

Description

Parity check error was detected in the received data.

Action

Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.

End code	11	Code name	Framing error

Description

Stop bit cannot be detected.

Action

Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.

☞   *About the Unit No.*   *Responses are not returned unless the target unit for communications and the unit No. in the command match.*

End code	12	Code name	Overrun error

Description

The receive buffer overflowed.

Action

Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.

End code	13	Code name	FCS error

Description

The FCS (Frame Check Sequence) do not match.

Action

Check the FCS program.

End code	14	Code name	Format error

Description

The received command length does not match the length defined in the frame format.

**Description
Action**

Check the communications condition. If the communications condition of the host computer and E5CK controller match, then a probable cause is a problem in the communications circuit of one or both of the host computer and E5CK controller.

End code	15	Code name	Setting range error

Description

Numerical values or code values in the data are not within the setting range.

Action

Check the parameter and read or write data of special commands.

Undefined Error
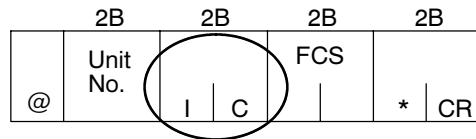
Description

An undefined header code has been received.

A currently invalid parameter (e.g. the scaling command during temperature input) has been received.

Action   Check the parameter No.

6–6   Program Example

6–6–1   How to Use Programs

The program described below is for obtaining corresponding response frame data when some of the command frame data is input.

The input format is as follows. The FCS and terminator are automatically generated and need not be input.

	2B	1B	2B	4B	2B	2B
@	Unit No.		Command code	Data	FCS	* CR

Command type

Input data | Automatically generated
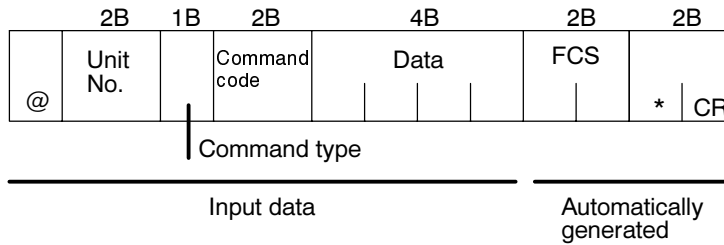
The output format is as follows. The content of the response frame is displayed as it is.

	2B	1B	2B	2B	4B	2B	2B
@	Unit No.		Command code	End code	Data	FCS	* CR

Command type
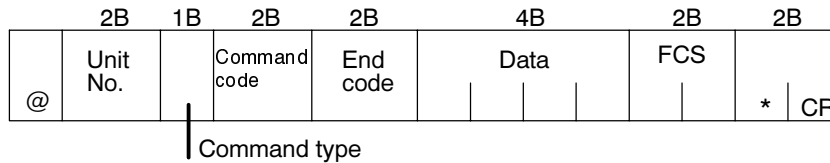
Procedure

1, 2, 3...   1.   Read the program.

2.   Enter *RUN*.

3.   When *send data*: is displayed, enter the command data (from @ to the command string).

4.   The content of the response frame is displayed following *receive data:*.

Conditions When Running a Program

Set the communications condition as follows:

• Baud rate: 9600 bps

• Bit length : 7 bits

• Parity : Even

• Stop bit: 2

• Make sure that the communications cable is properly connected.

6–6–2   Program List (Language: IBM PC COMPATIBLE MACHINE)

```
1000 ' --------------------------------------------------------------------------------
1010 ' PROGRAM : E5CK Communication Program
1020 ' ------------------- For IBM PC COMPATIBLE MACHINE
1030 ' VERSION  :  1.00
1040 ' Copyright (C) 1995 OMRON Corporation All Rights Reserved.
1050 ' --------------------------------------------------------------------------------
1060 ' ----- RS-232C SPEED: 9600BPS, PARITY: EVEN, DATA: 7, STOP: 2 -------------------
1070   OPEN "COM: 9600, E, 7, 2, CD0, CS0, DS0, RB256, RS "FOR RANDAM AS #1 LEN=256
1080   REPEAT
1090 ' ---------- Make Command
1100   PRINT "send data : " ;
1110   INPUT SEND$
1110 ' ---------- FCS calculation ----------------------------------------------------
1130   FCS=0
1140   FOR IFCS=1 TO LEN (SEND$)
1150   FCS=FCS XOR ASC (MID$ (SEND$, IFCS, 1))
1160   NEXT
1170   FCS$=RIGHT$ ("0"+HEX$ (FCS), 2)
1180 ' ----- Send data to communication port -----------------------------------------
1190   PRINT #1, SEND$+FCS$+"*"
1200 ' ----- Receive data from communication port ------------------------------------
1210   RECCNT=0: TMP$=""
1220   DRECLOOP:
1230   IF LOC (1) <> 0 THEN DREC1
1240   RECCNT=RECCNT+1
1250   IF RECCNT=5000 THEN *DRECERR ELSE DRECLOOP
1260   'DREC1
1270   TMP$=TMP$+INPUT$ (LOC (1), #1)
1280   IF RIGHT$ (TMP&, 1)=CHR$ (13) THEN DRECEND
-----       ELSE RECCNT=0: GOTO DRECLOOP
1290   DRECERR:
1300   TMP$="No response !!"
1310   DRECEND:
1320   RECV$=TMP$
1330   PRINT "response: "; RECV$
1340 ' ----- Repeat to make Command --------------------------------------------------
1350   GOTO REPEAT
1360 ' ----- END ---------------------------------------------------------------------
1370   CLOSE #1
1380   END
```

6–6–3   Examples of Use

Set the Unit No. to "00"

- In the following examples, data is shown in individual blocks to make the examples easier to understand. However, when actually creating programs, do not leave spaces between frame items. Also, response are displayed without spaces between frame items.

Set the Set Point to "300.0"

- Input data

  @ 00 2 01 3000

  ├─────── 300.0
  ├─────── Set point
  └─────── Write parameter

- Response

  @ 00 2 01 00 3000 (FCS) *

  └─────── Normal end
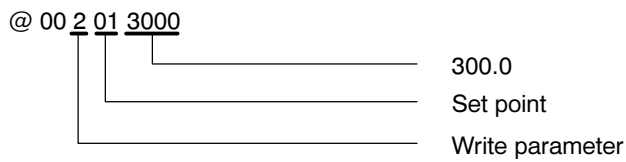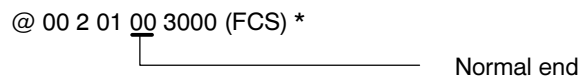
Start Running

- Input data

  @ 00 3 00 0000

  ├─────── Run
  ├─────── Run/Stop
  └─────── Special command

- Response

  @ 00 3 00 00 0000 (FCS) *

  └─────── Normal end
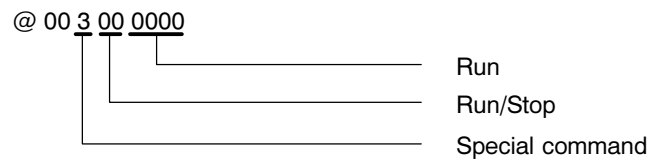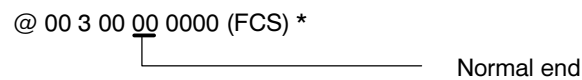
Monitor Process Value

- Input data

  @ 00 1 00 0000

  ├─────── Dummy data
  ├─────── Monitor process value
  └─────── Read parameter

- Response

  @ 00 1 00 00 2000 (FCS) *

  ├─────── Process value = 2000
  └─────── Normal end
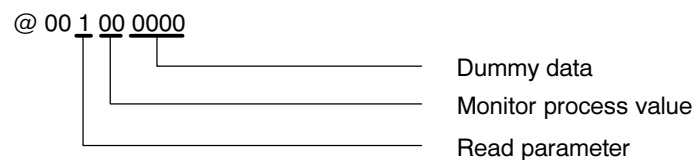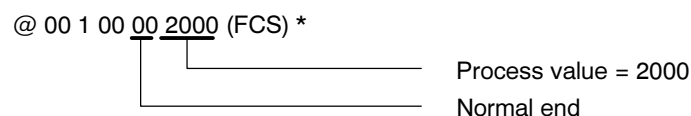
SECTION 7
Troubleshooting

This section explains how to determine and remedy E5CK troubleshooting problems.

7–1   Initial Checks

If trouble occurs, first of all check the following.

1, 2, 3...   1.   **Power supply**
Make sure that the power supply is ON. Also, make sure that the power supply is within the rated voltage range.

2.   **Input type jumper connectors**
Make sure that the jumper connectors are at their correct positions. The following table shows the operations when the jumper connector positions do not match the input type parameter settings.

Jumper Connector	Parameter	Operation
TC • PT	Current (0 to 20mA)	Fixed at scaling lower limit value
	Current (4 to 20mA)	*S.Err*
	Voltage (0 to 10V, 0 to 5V)	Fixed at scaling lower limit value
	Voltage (1 to 5V)	*S.Err*
I	Temperature input	*S.Err*
	Voltage (0 to 10V, 0 to 5V)	Fixed at scaling lower limit value
	Voltage (1 to 5V)	*S.Err*
V	Temperature input	*S.Err*
	Current (0 to 20mA)	Fixed at scaling lower limit value
	Current (4 to 20mA)	*S.Err*

3.   **Wiring**
Make sure that all cables are properly connected.

4.   **Communications condition**
When communicating using the RS-232C or RS-485 communications interfaces, make sure that the baud rate and other communications condition settings on the host computer and E5CK controller are matching, and are within the permissible ranges.

If there appears to be nothing wrong after checking the E5CK controller, and the same phenomenon continues, check the controller in more detail, for example, on the error display.

7–2   How to Use Error Display

When an error has occurred, 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 be taken to remedy the problem.

5.Err	**Input error**

Meaning

Input is in error.

Action

Check the wiring of inputs, disconnections, and shorts, and check the input type and the input type jumper connector.

Operation at error

For control output functions, output the manipulated variable matched to the setting of the *MV at PV error* parameter (level 2 mode). Alarm output functions are activated when the upper limit is exceeded.

E111	**Memory error**

Meaning

Internal memory operation is in error.

Action

First, turn the power OFF then back ON again. If the display remains the same, the E5CK controller must be repaired. If the display is restored to normal, then a probable cause can be external noise affecting the control system. Check for external noise.

Operation at error

Control output functions turn OFF (2mA max. at 4 to 20mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.

E333	**A/D converter error**

Meaning

Internal circuits are in error.

Action

First, turn the power OFF then back ON again. If the display remains the same, the E5CK controller must be repaired. If the display is restored to normal, then a probable cause can be external noise affecting the control system. Check for external noise.

Operation at error

Control output functions turn OFF (2mA max. at 4 to 20mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.

A.Err	**Calibration data error**

This error is output only during temperature input, and is displayed for two seconds when the power is turned ON.

Meaning

Calibration data is in error.

Action

Must repair.

Operation at error

Both control output functions and alarm output functions operate. However, note that readout accuracy is not assured.

cccc / ɔɔɔɔ	**Display range over**

Meaning

Though not an error, this is displayed when the process value exceeds the display range when the control range (setting range ±10%) is larger than the display range (–1999 to 9999).
- When less than **-1999**   [cccc]
- When greater than **9999** [ɔɔɔɔ]

Operation

Control continues, allowing normal operation.

ɔɔɔ	**Overflow error**

When shown on the Temp Controller's display, this signifies an "overflow" error. The user's system temperature has risen above the maximum display scale range. Check the thermocouple or output device. Also perform the "bare wire test." Remove the thermocouple sensor and apply a bare wire jumper/short between the two terminals. If the temperature controller displays the existing ambient temperature, the controller is fine. If not, the controller has malfunctioned, and a replacement is needed.

7–3   How to Use Error Output

The E5CK controller allows you to assign error output to terminals as outputs.
For details on output assignments, see Setting Output Specifications in Section 3.

LBA

LBA (Loop Break Alarm) can be used as a means for detecting loop breaks when the control loop is not functioning normally. For details, see Section 4.

LBA allows you to detect the following errors:
- Heater burnout
- Output error (contact weld, damaged transistors, etc.)
- Sensor error (constant input values, etc.)

If you use the LBA function, set the loop break detection time matched to the control characteristics in the *LBA detection time* parameter (level 2 mode).

Input errors

If you assign error 1 as the output, an error can be output when input is in error. When this error occurs, remedy by following the description for *Input error* in this section.

A/D converter error

If you assign error 2 as the output, an error can be output when the A/D converter is in error. When this error occurs, remedy by following the description for *A/D converter error* in this section.

7–4   Checking Operation Restrictions

With the E5CK controller, auto-tuning or self-tuning sometimes do not operate depending on the way functions are combined. The table below summarizes the main operating restrictions.
If the E5CK controller is not operating properly, first check whether operating conditions violate the restrictions in this table.

Restriction	Inoperable or Invalid Functions			
	ST Execution	AT Execution	Limiter Function	Other
At analog input	✕			
At heating and cooling control	✕	Not possible only with 40%AT		
At ON/OFF control	✕	✕	Manipulated variable MV change rate	
ST = ON	–	✕	Manipulated variable MV change rate	SP ramp function
At AT execution	–	–	MV change rate	Parameter setting
At stop	✕	✕	Manipulated variable MV change rate	

Note: Items marked by a **X** indicates combinations of conditions not acceptable during ST or AT execution.
Items marked by **–** are impossible combinations.

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APPENDIX

Specifications

Ratings

Supply Voltage	AC100–240V, 50/60 Hz
Operating Voltage Range	85% to 110% of rated supply voltage
Power Consumption	Approx. 15VA
Input	Thermocouple : K, J, T, E, L, U, N, R, S, B, W, PLII *1, *2 Platinum resistance thermometer : JPt100, Pt100 Voltage input : 4 to 20mA, 0 to 20mA Current input : 1 to 5V, 0 to 5V, 1 to 10V
Control Output	According to output unit (see *Output Unit Ratings and Characteristics*)
Auxiliary Output	SPST-NO, 1A at 250 VAC (resistive load)
Control Method	Advanced PID or ON/OFF control
Setting Method	Digital setting using front panel keys
Indication Method	7-segment digital display and LEDs
Other Functions	According to option unit (see *Option Unit Ratings and Characteristics*)
Ambient Temperature	Operating : -10°C to 55°C (with no icing)/3-year warranty period: -10°C to 50°C Storage : -25°C to 65°C (with no icing)
Ambient Humidity	35% to 85% RH

*1 Thermocouple W is W/Re5-26.
*2 The following table shows the setting ranges and indication ranges for each of the inputs.

Setting No.	Input*	Setting Range		Indication Range	
0	JPt100	−199.9 to 650.0(°C)	/−199.9 to 999.9(°F)	−199.9 to 735.0(°C)	/−199.9 to 999.9(°F)
1	Pt100	−199.9 to 650.0(°C)	/−199.9 to 999.9(°F)	−199.9 to 735.0(°C)	/−199.9 to 999.9(°F)
2	K1	−200 to 1300(°C)	/−300 to 2300(°F)	−350 to 1450(°C)	/−560 to 2560(°F)
3	K2	0.0 to 500.0(°C)	/0.0 to 900.0(°F)	−50.0 to 550.0(°C)	/−90.0 to 990.0(°F)
4	J1	−100 to 850(°C)	/−100 to 1500(°F)	−195 to 945(°C)	/−260 to 1660(°F)
5	J2	0.0 to 400.0(°C)	/0.0 to 750.0(°F)	−40.0 to 440.0(°C)	/−75.0 to 825.0(°F)
6	T	−199.9 to 400.0(°C)	/−199.9 to 700.0(°F)	−199.9 to 460.0(°C)	/−199.9 to 790.0(°F)
7	E	0 to 600(°C)	/0 to 1100(°F)	−60 to 660(°C)	/−110 to 1210(°F)
8	L1	−100 to 850(°C)	/−100 to 1500(°F)	−195 to 945(°C)	/−260 to 1660(°F)
9	L2	0.0 to 400.0(°C)	/0.0 to 750.0(°F)	−40.0 to 440.0(°C)	/−75.0 to 825.0(°F)
10	U	−199.9 to 400.0(°C)	/−199.9 to 700.0(°F)	−199.9 to 460.0(°C)	/−199.9 to 790.0(°F)
11	N	−200 to 1300(°C)	/−300 to 2300(°F)	−350 to 1450(°C)	/−560 to 2560(°F)
12	R	0 to 1700(°C)	/0 to 3000(°F)	−170 to 1870(°C)	/−300 to 3300(°F)
13	S	0 to 1700(°C)	/0 to 3000(°F)	−170 to 1870(°C)	/−300 to 3300(°F)
14	B	100 to 1800(°C)	/300 to 3200(°F)	−70 to 1970(°C)	/10 to 3490(°F)
15	W	0 to 2300(°C)	/0 to 4100(°F)	−230 to 2530(°C)	/−410 to 4510(°F)
16	PLII	0 to 1300(°C)	/0 to 2300(°F)	−130 to 1430(°C)	/−230 to 2530(°F)
17 18 19 20 21	4 to 20mA 0 to 20mA 1 to 5V 0 to 5V 0 to 10V	One of following ranges depending on results of scaling and decimal pt. selection. −1999 to 9999 −199.9 to 999.9 −19.99 to 99.99 −1.999 to 9.999		-10 to 110% of setting range. Note, however that max. value is -1999 to 9999	

*Grounded

Characteristics

Indication Accuracy		Thermocouple: (0.3% of indication value or 1°C, whichever greater) 1 digit max. (*1) Platinum resistance thermometer: (0.2% of indication value or 0.8°C whichever greater) 1 digit max. Analog input: 0.2% 1 digit max.
Hysteresis		0.01 to 99.99%FS (in units of 0.1%FS)
Proportional Band (P)		0.1 to 999.9% FS (in units of 0.1%FS)
Integral (reset) Time (I)		0 to 3999 s (in units of 1 second)
Derivative (rate) Time (D)		0 to 3999 s (in units of 1 second)
Control Period		1 to 99 s (in units of 1 second)
Manual Reset Value		0.0 to 100.0% (in units of 0.1%)
Alarm Setting Range		-1999 to 9999 or -199.9 to 999.9 (decimal point position dependent on input type)
Sampling Period		Temperature input: 250 ms, Analog input: 100 ms
Insulation Resistance		20 MΩ min. (at 500 VDC)
Dielectric Strength		2000 VAC, 50/60Hz for 1 min (between terminals of different polarities)
Vibration Resistance	Malfunction	10 to 55 Hz, 10 m/s^2 (1G) for 10 min each in X, Y, and Z directions
	Mechanical	10 to 55 Hz, 20 m/s^2 (2G) for 2hrs each in X, Y, and Z directions
Shock Resistance	Malfunction	200 m/s^2 min. (20G), 3 times each in 6 directions (100 m/s^2 (10G) applied to the relay)
	Mechanical	300 m/s^2 min. (30G), 3 times each in 6 directions
Weight		Approx. 170 g, adapter: approx. 10 g
Enclosure Ratings		Front panel: NEMA4 for indoor use (equivalent to IP66) Rear case: IEC standard IP20 Terminals: IEC standard IP00
Memory Protection		Non-volatile memory (Write operation : 100000 max.)

*1 The indication accuracy of the K1, T, and N thermocouples at a temperature of -100°C or less is ±2°C ±1 digit maximum. The indication accuracy of the U, L1 and L2 thermocouples at any temperature is ±2°C ±1 digit maximum.
The indication accuracy of the B thermocouple at a temperature of 400°C or less is unrestricted.
The indication accuracy of the R and S thermocouples at a temperature of 200°C or less is ±3°C ±1 digit maximum.
The indication accuracy of the W thermocouple is ±1 digit max. of whichever is the greater of ±0.3% or ±3°C of the indicated value.
The indication accuracy of the PLII thermocouple is ±1 digit max. of whichever is the greater of ±0.3% or ±2°C of the indicated value.

## Output Unit Ratings and Characteristics

Relay output*	SPST, 250 VAC, 3A (resistive load) Mechanical life expectancy: 10,000,000 operations min Electrical life expectancy: 100,000 operations min
Voltage Output (NPN)	NPN, 12 VDC, 20 mA (with short-circuit protection)
Voltage Output (PNP)	PNP, 12 VDC, 20 mA (with short-circuit protection)
Linear Voltage Output	0 to 10 VDC, Permissible load impedance: 1 kΩ min., Resolution: Approx. 2600
Linear Current Output	4 to 20 mA, Permissible load impedance: 500 Ω max., Resolution: Approx. 2600
	0 to 20 mA, Permissible load impedance: 500 Ω max., Resolution: Approx. 2600

*If a relay output is used, the Control Period should not be less than 5 seconds.

Option Unit Ratings and Characteristics

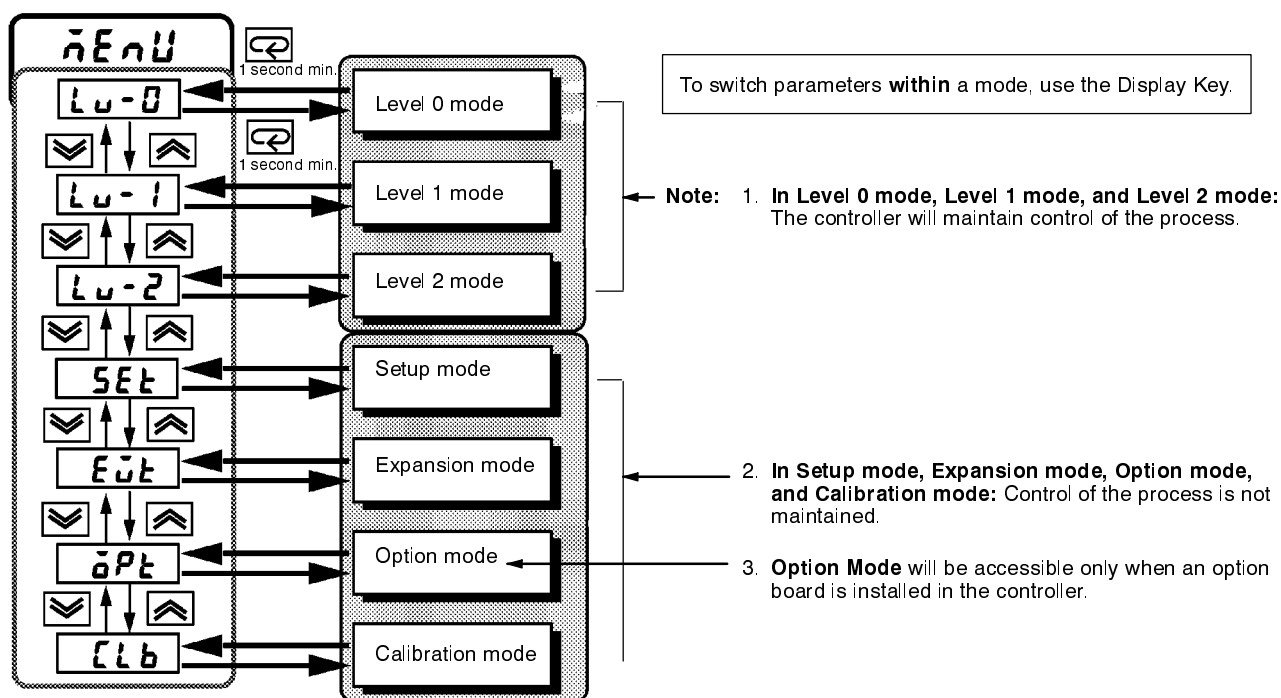|		
Event inputs	Contact input	ON: 1 kΩ max., OFF: 100 kΩ min.
	No-contact input	ON: residual voltage 1.5 V max., OFF: leakage current 0.1 mA max.
Communications	Interface :RS-232C or RS-485 Transmission method :Half-duplex Synchronization method :Start-stop synchronization (asynchronous method) Baud rate :1.2/2.4/4.8/9.6/19.2 kbps	
Transfer output	4 to 20 mA, Permissible load impedance: 500 Ω max. Resolution: Approx. 2600	

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Control Block Diagram
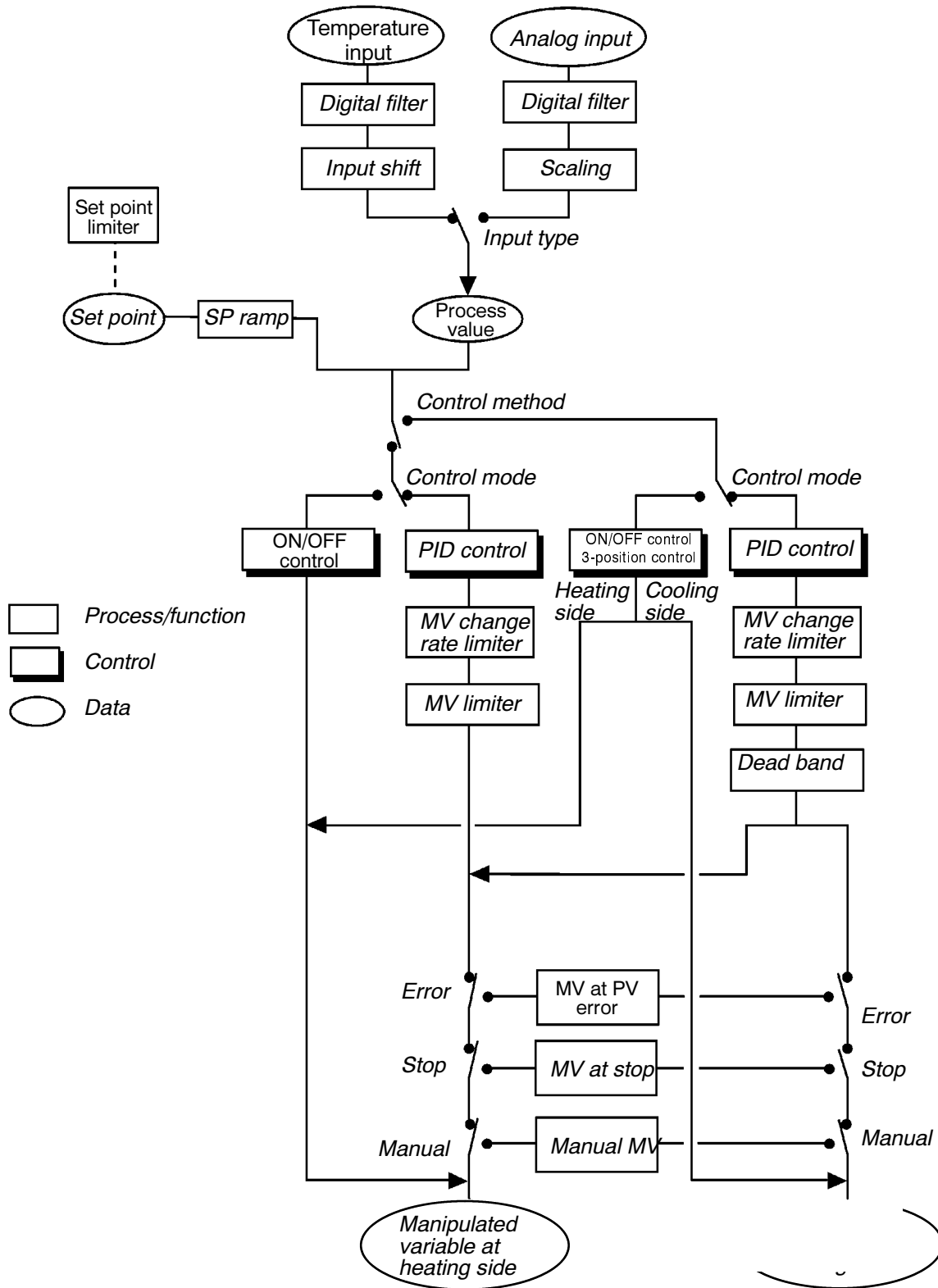
Parameter Operations List

Switching to modes other than manual or protect mode is carried out by mode selection in the menu display.

The figure below shows all parameters in the order that they are displayed. Some parameters are not displayed depending on the protect mode setting and conditions of use.

Menu Display

To switch parameters **within** a mode, use the Display Key.

Note: 1. **In Level 0 mode, Level 1 mode, and Level 2 mode:** The controller will maintain control of the process.

2. **In Setup mode, Expansion mode, Option mode, and Calibration mode:** Control of the process is not maintained.

3. **Option Mode** will be accessible only when an option board is installed in the controller.

To Access *Protect Mode.* Press and hold the A/M Key and the Display Key for more than 1 second.

To Return to the Main PV/SP Display. To Return to the Main PV/SP Display from the Protect Mode by pressing   the A/M Key and the Display Key for more than 1 second.

To Access *Manual Mode.* Press and hold the A/M Key for more than 1 second.

NOTE: For E5CK-AA1-302 models, the ⌐A/M⌐ option can be accessed through Level 1. It has replaced the Auto-tune.

Fuzzy Self-Tuning

Fuzzy self-tuning is a function that enables the E5CK to calculate the most suitable PID constants for the controlled object.

Features

The E5CK determines by itself when to perform fuzzy self-tuning.

At the time of fuzzy self-tuning, the E5CK does not output any signal that disturbs the temperature or output value.

Fuzzy Self–tuning Function

The fuzzy self-tuning function has three modes.

In SRT(step response tuning) mode, the PID constants are tuned using a step response method at the time the set point is changed. In DT(disturbance tuning) mode, the PID constants are amended so that the controlled temperature will be within the target range set in advance when there is external disturbance.
In HT(hunting tuning) mode, when hunting occurs, the PID constants are amended to suppress the hunting.

Note: Be sure to turn on the power supply to the load either before or simultaneously with the start of Temperature Controller operation. Dead time will be measured from the time the Temperature Controller starts operating. If a load such as a heater is turned on after the Temperature Controller is turned on, dead time longer than the actual value will be measured and inappropriate PID constants will be obtained. If an extremely large amount of dead time is measured, the control amount will be set to 0% for a short period of time before being returned to 100%, and the constants will then be returned. Retuning is performed only for large amounts of dead time, so be sure to follow the precaution given above when starting operation.

Startup Conditions of SRT

SRT will start if all of conditions 1 to 4 or condition 5 are satisfied when the set point is changed or the E5CK is turned ON.

(1)   The new set point is different from the set point used at the time SRT was executed last.

(2)   The difference between the new set point and the last set point is larger than the value obtained from the calculation: present proportional band value(P) x approximately 1.27+4.(When the E5CK is turned on, the difference be-

tween the process value and set point is regarded as the set point changing range.)

(3) The temperature is stable before changing the set point or the temperature is balanced while the E5CK is turned on before any output is obtained.

(4) The set point is changed in the direction that the controlled amount increases (i.e., the control amount is in the upper direction at the time of reverse operation and in the lower direction at the time of normal operation).

(5) SRT has not been carried out even once with the current set point.

In the following cases, SRT will not be executed accurately. Therefore the E5CK must be tuned in DT or HT mode.

(1) The maximum temperature slope(R) is not obtained before the process value reaches the value obtained from the calculation: present proportional band value(P) x approximately 1.27(i.e., the maximum temperature slope(R) is not obtained before the SRT is finished). If the proportional band, obtained before SRT is finished, is larger than the previous proportional band, however, the PID constants will be renewed so that their values will be more accurate.

(2) The set point is changed during SRT and the SRT completion conditions are satisfied, in which case no PID constant will be renewed.

Stable Temperature Status

If the temperature is within the stable range for a specified period, it is deemed that the temperature is stable.
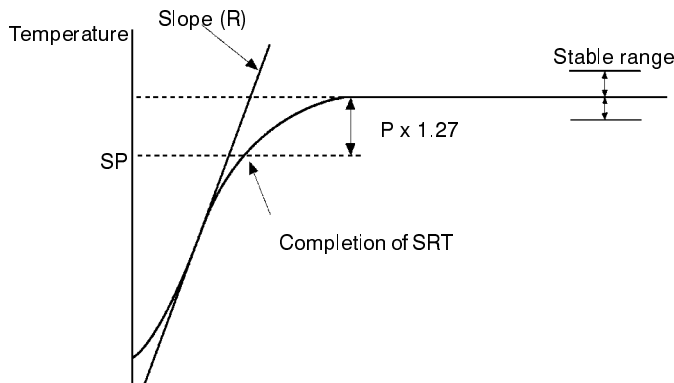
Balanced Status

If the process value is within the stable range for 60s when there is no output, it is deemed that the temperature is balanced.

Startup Conditions of DT

(1) DT will start if the temperature that has been stable varies due to external disturbance and the deflection of the temperature exceeds the stable range, and then the temperature becomes stable, provided that the number of maximum temperature values is less than four.

(2) DT will start if the set point is changed under the condition that SRT does not start and the temperature becomes stable, provided that the number of maximum temperature values is less than four. If there are four or more maximum temperature values, HT will start.
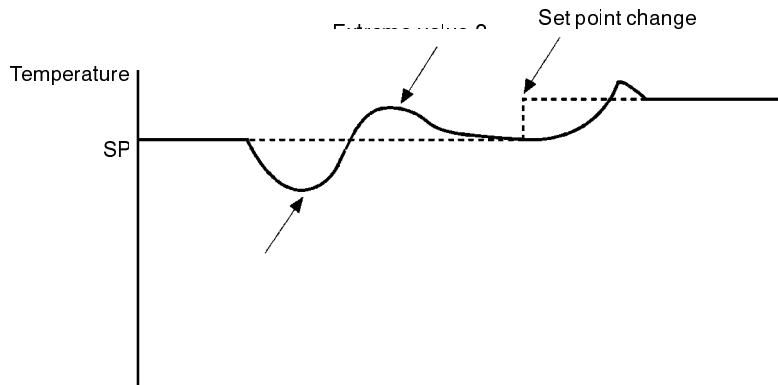
Startup Conditions of HT

HT will be ON when there is hunting with four or more maximum temperature values (extreme values) while SRT is not being executed.
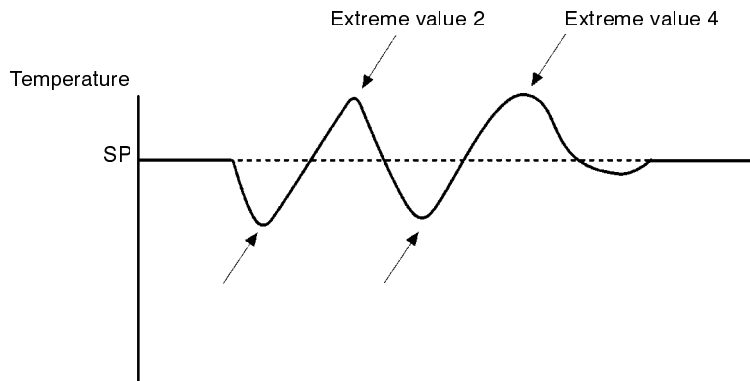
Note: In specific applications where temperature varies periodically due to disturbance, internal parameters need to be adjusted.

Model List

Description	Type Name	Specification
Base unit	E5CK-AA1-500	Base unit
	E5CK-AA1-302	Base unit
Output unit	E53-R4R4	Relay/relay
	E53-Q4R4	Pulse (NPN)/relay
	E53-Q4HR4	Pulse (PNP)/relay
	E53-C4R4	Linear (4 to 20mA)/relay
	E53-C4DR4	Linear (0 to 20mA)/relay
	E53-V44R4	Linear (0 to 10V)/relay
	E53-Q4Q4	Pulse (NPN)/pulse (NPN)
	E53-Q4HQ4H	Pulse (PNP)/pulse (PNP)
Option unit	E53-CK01	RS-232C
	E53-CK03	RS-485
	E53-CKB	Event input : 1 point
	E53-CKF	Transfer output (4 to 20mA)
Terminal cover	E53-COV07	Terminal cover for E5CK

The output unit is required for E5CK-AA1. When adding an Option Unit, refer to Section 2.

X Format

Format

The E5CK controller supports communications in the X format which is used in other Omron controllers such as ES100, E5AJ/EJ and E5AX/EX. Commands are structured as follows and are paired with a response.

Command
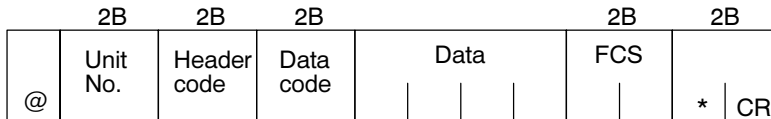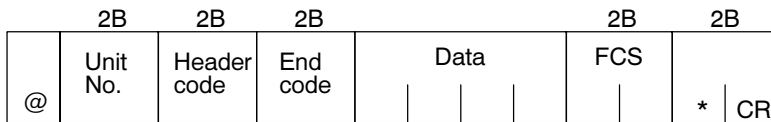
	2B	2B	2B		2B	2B
@	Unit No.	Header code	Data code	Data	FCS	* CR

Response

	2B	2B	2B		2B	2B
@	Unit No.	Header code	End code	Data	FCS	* CR

"@"
The start character. This character must be inserted before the leading byte.

Unit No.
Specifies the "unit No." of the E5CK. If there are two or more transmission destinations, specify the desired destination using "unit No."

Header Code/Data Code
Specifies the command type. For details on the command type, see page A-12.

Data
Specifies the set value or setting content. The data length varies according to the command.

End Code
Sets the communication results. For details on the types and meanings of end codes, see 6.5 How to Read Communications Error Information (page 6-10).

FCS (Frame Check Sequence)
Set the frame check results from the start character to the data section. For details on the frame check, see 6.6 Program Example (page 6-12).

"*" "CR (Carriage Return) Code"
Indicates the end (terminator) of the command or response block.

X FORMAT HEAD LIST

Header Code	Data Code	Command Content	R/W	Data	Remarks
IC	01	Undefined error	-	None	Error response
MB	01	Remote/Local	Write	4B	
MA	01	RAM write mode	Write	None	
ME	01	Backup mode			
MW	01	RAM data batch save			
R%	01	Alarm value 1 read	Read	4B	
	02	Alarm value 2 read			
	03	Alarm value 3 read			
RB	01	Proportional band read			
RN	01	Integrated time read			
RV	01	Derivative time read			
RC	01	Cooling coefficient read	Read	4B	During heating and cooling control
RD	01	Dead band read			
RI	01	Input shift upper limit read	Read	4B	
	02	Input shift lower limit read			
RL	01	SP setting limit read	Read	8B	Upper-and lower-limit batch read
RO	01	Manipulated variable read	Read	4B	
RS	01	Set point read			
RX	01	Process value read	Read	8B	with status
W%	01	Alarm value 1 write	Write	4B	
	02	Alarm value 2 write			
	03	Alarm value 3 write			
WB	01	Proportional band write			
WN	01	Integrated time write			
WV	01	Derivative time write			
WC	01	Cooling coefficient write	Write	4B	During heating and cooling control
WD	01	Dead band write			
WI	01	Input shift upper limit write	Write	4B	
	02	Input shift lower limit write			
WS	01	Set point write			

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RX (process value read) command status
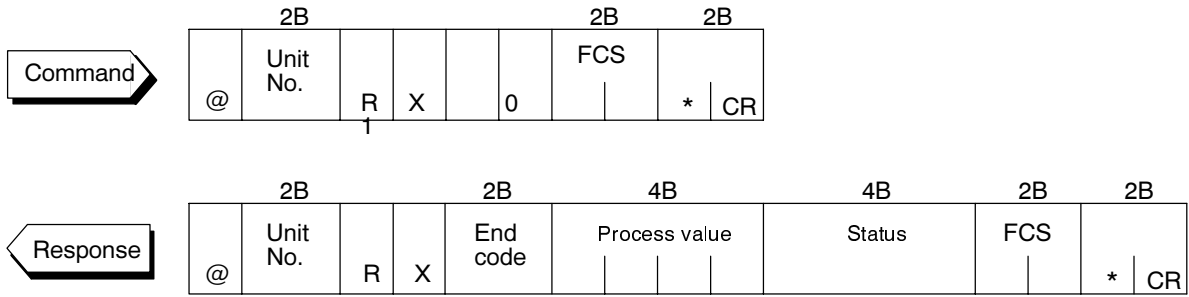
Bit	Content	"1"	"0"
0	Run/Stop	Stop	Run
1	Setting level	1	0
2	Input error	ON	OFF
3	A/D converter error	ON	OFF
4	LBA	ON	OFF
5			
6			
7	EEP	RAM≠EEP	RAM=EEP
8	Alarm 1	ON	OFF
9	Alarm 2	ON	OFF
10	Alarm 3	ON	OFF
11	AT	AT execution	OFF
12	RAM mode	RAM mode	Backup mode
13	Auto/Manual	Manual	Auto
14			
15	Remote/Local	Remote	Local

ASCII Code List

Hex		0	1	2	3	4	5	6	7	Upper 4 bits
	Bin	0000	0001	0010	0011	0100	0101	0110	0111	
0	0000			SP	0	@	P		p	
1	0001			!	1	A	Q	a	q	
2	0010			"	2	B	R	b	r	
3	0011			#	3	C	S	c	s	
4	0100			$	4	D	T	d	t	
5	0101			%	5	E	U	e	u	
6	0110			&	6	F	V	f	v	
7	0111			'	7	G	W	g	w	
8	1000			(	8	H	X	h	x	
9	1001			)	9	I	Y	i	y	
A	1010			*	:	J	Z	j	z	
B	1011			+	;	K	[	k	{	
C	1100			,	<	L	¥	l	¦	
D	1101			-	=	M	]	m	}	
E	1110			.	>	N	^	n	~	
F	1111			/	?	O	_	o	DEL	

Lower 4 bits

Setting List

Mode		Parameter Name	Setting Range	Unit	Default	Remarks	Setting
Protect	SECr	Security	0 to 6	None	1		
	PEYP	[A/M] key protect	ON/OFF	None	OFF		
Manual		Manual MV	-5.0 to 105.0 *1	%	0.0		
Level 0	SP	Set point	Set point lower limit to Set point upper limit	EU	0		
	r-S	Run/Stop	Run/Stop	None	RUN		
Level 1	At	AT Execute/Cancel	OFF/AT-1/AT-2	None	OFF	During running	
	SP-0	Set point 0	Set point lower limit to Set point upper limit	EU	0	Multi-SP	
	SP-1	Set point 1	Set point lower limit to Set point upper limit	EU	0	Multi-SP	
	AL-1	Alarm value 1	-1999 to 9999	EU	0		
	AL-2	Alarm value 2	-1999 to 9999	EU	0		
	AL-3	Alarm value 3	-1999 to 9999	EU	0		
	P	Proportional band	0.1 to 999.9	%FS	10.0		
	ι	Integral time	0 to 3999	sec	233		
	d	Derivative time	0 to 3999	sec	40		
	C-SC	Cooling coefficient	0.01 to 99.99	None	1.00	At heating and cooling control	
	C-db	Dead band	-19.99 to 99.99	%FS	0.00	At heating and cooling control	
	oF-r	Manual reset value	0.0 to 100.0	%	50.0		
	HYS	Hysteresis (heat)	0.01 to 99.99	%FS	0.10		
	CHYS	Hysteresis (cool)	0.01 to 99.99	%FS	0.10	At heating and cooling control	
	CP	Control period (heat)	1 to 99	sec	20		
	C-CP	Control period (cool)	1 to 99	sec	20	At heating and cooling control	
Level 2	r-L	Remote/Local	RMT/LCL	None	LCL		
	SPrU	SP ramp time unit	M(Minutes) / H(Hours)	None	M		
	SPrt	SP ramp set value	0 to 9999	EU	0		
	LbA	LBA detection time	0 to 9999	Sec	0		
	ñu-S	MV at stop	-5.0 to 105.0 *1	%	0.0		
	ñu-E	MV at PV error	-5.0 to 105.0 *1	%	0.0		
	oL-H	MV upper limit	MV lower limit + 0.1 to 105.0 *2	%	105.0		
	oL-L	MV lower limit	-5.0 to MV upper limit -0.1 *3	%	-5.0		
	orL	MV change rate limit	0.0 to 100.0	%/sec	0.0		
	ιnF	Input digital filter	0 to 9999	sec	0		
	ALH1	Alarm 1 hysteresis	0.01 to 99.99	%	0.02		
	ALH2	Alarm 2 hysteresis	0.01 to 99.99	%	0.02		
	ALH3	Alarm 3 hysteresis	0.01 to 99.99	%	0.02		
	ιnSH	Input shift upper limit	-199.9 to 999.9	°C	0.0	Temperature input	
	ιnSL	Input shift lower limit	-999.9 to 999.9	°C	0.0	Temperature input	

*1 During heat and cooling control, the lower limit becomes -105.0%.
*2 During heat and cooling control, the setting range becomes 0.0 to 105.0%.
*3 During heat and cooling control, the setting range becomes -105.0 to 0.0%.

NOTE: E5CK-AA1-302 has Auto-tune [A/T] on front panel, and placed the auto-manual key [A/M] in Level 1.

Mode		Parameter Name	Setting Range	Unit	Default	Remarks	Setting
Setup	`in-t`	Input type	0 to 21	None	2		
	`in-H`	Scaling upper limit	Scaling lower limit +1 to 9999 *4	EU	-100	Analog input	
	`in-L`	Scaling lower limit	-1999 to SP setting upper limit -0.1 *4	EU	0	Analog input	
	`dP`	Decimal point	0 to 3	None	0	Analog input	
	`d-U`	°C/°F selection	°C/°F	None	°C	Temperature input	
	`init`	Parameter initialize	Yes/No	None	NO		
	`oUt1`	Control output 1 assignment	Heat/Cool/Alarm 1/Alarm 2/Alarm 3/LBA	None	HEAT		
	`oUt2`	Control output 2 assignment	Heat/Cool/Alarm 1/Alarm 2/Alarm 3/LBA	None	AL-1		
	`SUb1`	Auxiliary output 1 assignment	Alarm 1/Alarm 2/Alarm 3/LBA/S.ERR/ E333	None	AL-2		
	`ALt1`	Alarm 1 type	0 to 11	None	2	Output assignment needed	
	`AL1n`	Alarm 1 open in alarm	N-O/N-C	None	N-O	Output assignment needed	
	`ALt2`	Alarm 2 type	0 to 11	None	2	Output assignment needed	
	`AL2n`	Alarm 2 open in alarm	N-O/N-C	None	N-O	Output assignment needed	
	`ALt3`	Alarm 3 type	0 to 11	None	2	Output assignment needed	
	`AL3n`	Alarm 3 open in alarm	N-O/N-C	None	N-O	Output assignment needed	
	`orEu`	Direct/Reverse operation	OR-R/OR-D	None	OR-R		
Expansion	`SL-H`	Set point upper limit	Set point lower limit +1 to scaling upper limit *2	None	1300 *4		
	`SL-L`	Set point lower limit	Scaling upper limit to Set point lower limit -1 *2	None	-200 *4		
	`CntL`	PID/ON/OFF	PID / ON/OFF	None	PID		
	`St`	ST	OFF/ON	None	OFF		
	`St-b`	ST stable range	0.1 to 999.9	°C/°F	15.0	ST=ON	
	`ALFA`	α	0.01 to 1.00	None	0.65		
	`At-G`	AT calculated gain	0.1 to 10.0	None	1.0		
	`rESt`	Standby sequence reset setting method	0/1	None	0		
	`rEt`	Automatic return of display mode	0 to 99	Sec	0		
	`At-H`	AT hysteresis	0.1 to 9.9	%FS	0.2		
	`LbAb`	LBA detection width	0.0 to 999.9	%FS	0.2		
Option	`Eu-n`	Multi-SP function	0/1	None	0		
	`Eu-1`	Event input assignment 1	STOP/MAN	None	STOP		
	`Sbit`	Communication stop bit	1/2	bits	2		
	`LEn`	Communication data length	7/8	bits	7		
	`PrtY`	Communication parity	None/Even/Odd	None	EVEN		
	`bPS`	Communication baud rate	1.2/2.4/4.8/9.6/19.2	kbps	9.6		
	`U-no`	Communication unit No.	0 to 99	None	0		
	`tr-t`	Transfer output type	SP/SP-M/PV/O/C-O	None	SP		
	`tr-H`	Transfer output upper limit	*5	*5	*5		
	`tr-L`	Transfer output lower limit	*5	*5	*5		

*4 When temperature input is selected, the sensor range selected in the "input type" parameter (setup mode) corresponds to the scaling upper and lower limit value.

*5 Set the transfer output type parameter according to the following table.

Transfer Output Type		Transfer Output Lower Limit to Transfer Output Upper Limit
SP	:Set point	Set point lower limit to Set point upper limit
SP-M	:Set point during SP ramp	Set point lower limit to Set point upper limit
PV	:Process value	Scaling lower limit to scaling upper limit
O	:Manipulated variable (heat)	-5.0 to 105.0%
C-O	:Manipulated variable (cool)	0.0 to 105.0%

- The output ranges of the SP setting, set point or process value when temperature input is selected are the ranges supported by the selected sensor.
- When the heating side manipulated variable or cooling side manipulated variable is selected, the transfer output lower limit in a heating and cooling control becomes "0.0".

Calibration Mode

```
┌──────────┐
│          │
└──────────┘
```

```
Adj
 │
 ├──────────┬──────────┬──────────┬──────────┬──────────┐
 │          │          │          │          │          │
1t50       2t20       P300       A 20       1u 5       2u10
1t 0       2t 0       P  0       A  0       1u 0       2u 0
Y3 10      Y3 10      Pb10
Y  0       Y  0       Pb 0
biAS       biAS
 │
tr20    ─┐  Only when transfer output
         │  function is supported
tr 4    ─┘
Str
```

┌───┐
│ Thermocouple 1   : K1/J1/L1/E/N/W/PLII   │
│ Thermocouple 2   : K2/J2/L2/R/S/B/T/U   │
│ Platinum resistance   │
│ thermometer   : JPt100/Pt100   │
└───┘

Index

Revision History

E5CK Process Controller

User Manual

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.

Cat. No. H78-E3-2

↑

Revision
code

The following table outlines the changes made to the manual during each revision. Page numbers refer to previous version.

Revision code	Date	Revised content
E1-1	September 1995	Original Production of the Source Document
E3-1	January 1996	Original Production in USA
E3-2	April 1998	**Page 2, 3, 33, 36, 74, 133, and 142:** Information added regarding E5CK-AA1-302. This model displays auto-tune (AT) key instead of A/M key. **Page 107**: Section 6–2–1, RS-232C cable connection corrected. **Page 113:** Section 6–4–1, Instruction code corrected for command number 02. **Page 137:** Model E5CK-AA1-302 added to model list.