This chapter describes procedures for each calibration operation. Read this chapter only when the controller must be calibrated.

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7.1 Parameter Structure

- To calibrate the E5EK-T controller, select [7Lb] in the menu display to select the calibration mode. [7A] is displayed.
- However, note that [7Lb] may not be displayed on the menu display when, for example, the user is calibrating the E5EK-T controller for the first time. If this happens, [7Lb] is displayed by changing the “security” parameter (protect mode) to “0”.
- The parameters in the calibration mode are structured as follows:

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<td>[5Z0]</td>
<td>[300]</td>
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<td>[310]</td>
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<td>[5C2S]</td>
<td>[5C2S]</td>
<td>[5C2S]</td>
</tr>
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- To select the desired parameter, press the key. Parameters are displayed in the following order:
  - Calibration of inputs → Calibration of transfer output → Storage of calibration data
If the E5EK-T controller does not support the transfer output function, calibration of transfer output is automatically deleted from the calibration procedure as follows:
  - Calibration of inputs → Storage of calibration data
- Only inputs that have been set in the “input type” parameter (setup mode) can be calibrated. To temporarily store data for each of the calibration parameters, press the key for 1 second.
- Transfer output can be calibrated only when the Communications unit (E53-AKF) is set in the controller. To adjust data items, press the or keys.
- The data store menu is displayed only when all calibration items have temporarily been stored.
- After calibrating input, you must always check indication accuracy. For details, see page 7-12.
• Parameters are displayed on the No.1 display, and the process value is displayed in Hexadecimal on the No.2 display.
• 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 stored as data even if the key is pressed.
• Once the E5AK-T controller has been calibrated by the user, [ ] is displayed preceded by the “.” mark when the calibration mode is next selected.
7.2 Calibrating Thermocouples

- Calibrate according to the type of thermocouple, thermocouple 1 group (K1, J1, L1, E, N, W, PLII) and thermocouple 2 group (K2, K2, L2, R, S, B, T, U).
- When calibrating, do not cover the bottom of the controller. Also, do not touch the input terminals (Nos.11 and 12) or compensating conductor on the E5EK-T controller.

**Preparations**

- Set the cold junction compensator designed for compensation of internal thermocouples to 0°C. However, make sure that internal thermocouples are disabled (tips are open).
- In the above figure, STV refers to a standard DC current/voltage source, and DMM refers to a precision digital multimeter. However, note that DMM is required only when the transfer output function is supported.
- Use the compensating conductor on the selected thermocouple. However, note that when thermocouple R, S, E, B, W and PLII is used, the cold junction compensator and the compensating conductor can be substituted with the cold junction compensator and the compensating conductor for thermocouple K.

![Diagram of cold junction compensator and compensating conductor connections]

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 thermocouple inside the cold junction compensator as shown in the figure below to create a contact or non-contact state for the cold junction compensator.
This example describes how to calibrate a thermocouple when the transfer output function is supported. If the transfer output function is not supported, skips steps (7) to (10).

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 [50 mV calibration display]. Set STV output to 50 mV. 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 display [0 mV calibration display]. Set STV output to 0 mV. 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 cold junction compensator. Press the key to display [310 mV calibration display]. Set STV output to 310 mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the key to temporarily store the calibration data.

5. Press the key to display [0 mV calibration display]. Set STV output to 0 mV. 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. 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 [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 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 [20 mA calibration display].

8. Set the output to 20 mA 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 "20 mA".

9. Press the key. The display changes to [4 mA calibration display].

10. Set the output to 4 mA 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 "4 mA".

11. Press the key until the display changes to the date save display. Press the key. The No.2 display changes to [YES], and two seconds later the calibration data is stored to internal memory. If you press the key when the No.2 display reads [NO], the calibration data is disabled.

12. This completes calibration of the thermocouple 1 group. Press the key to return the display to [Rd.].
CHAPTER 7 CALIBRATION

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

(1) When [ ] 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 [ ] (20 mV calibration display). Set STV output to 20 mV. 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 display [ ] (0 mV calibration display). Set STV output to 0 mV. 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 cold junction compensator. Press the key to display [ ] (310 mV calibration display). Set STV output to 310 mV. When the value on the No.2 display has stabilized (changes of several digits max.), press the key to temporarily store the calibration data.

(5) Press the key to display [ ] (0 mV calibration display). Set STV output to 0 mV. 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) 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 [ ] (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 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 [ ] (20 mA calibration display).

(8) Set the output to 20 mA 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 “20 mA”.

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

(10) Set the output to 4 mA 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 “4 mA”.

(11) Press the key until the display changes to the data store display. Press the key. The No.2 display changes to [YES], and two seconds later the calibration data is stored to internal memory. If you press the key when the No.2 display reads [], the calibration data is disabled.

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

Calibration: thermocouple 2
7.3 Calibrating Platinum Resistance Thermometers

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.11 and 12.

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, skips steps (7) to (10).

1. When \[ R_d \] 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 \( \text{key} \) to display \[ P_{300} \] (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 \( \text{key} \) to temporarily store the calibration data.

3. Press the \( \text{key} \) to display \[ P_{0} \] (0Ω calibration display). Short terminal No.11 to 13. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \text{key} \) to temporarily store the calibration data.

4. Next, calibrate the B-B' input. Change the wiring as follows:

Make the connection across terminal Nos.11 and 12 and the 6-dial as short as possible. Short terminal Nos.11 and 13.
(5) Press the key to display \([\text{Pb: } 10\Omega]\) (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 \([\text{Pb: } 0\Omega]\) (0Ω calibration display). Short terminal Nos.11 to 13. 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 \([\text{tr: } 20\text{mA}]\) (20 mA calibration display).

(8) Set the output to 20 mA 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 “20 mA”.

(9) Press the key. The display changes to \([\text{tr: } 4\text{mA}]\) (4 mA calibration display).

(10) Set the output to 4 mA 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 “4 mA”.

(11) Press the key until the display changes to the data store display. Press the key. The No.2 display changes to \([\text{yes}]\), and two seconds later the calibration data is stored to internal memory. If you press the key when the No.2 display reads \([\text{no}]\), the calibration data is disabled.

(12) This completes calibration of the platinum resistance thermometer. Press the key to return the display to \([\text{Rad:}]\).
7.4 Calibrating Current Input

Preparation

AC100-240V~
(AC/DC24V ≈)

SOURCE

DMM

10  21  22  20
9    19
8    18
7    17
6    16
5    15
4    14
3    13
2    12
1    11
23

STV

Calibration

- 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.

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, skips steps (4) to (7).

(1) When [\( \text{Ad} \)] 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) Press the \( \text{K} \) key. The display changes to [\( \text{Ad} \)] (20 mA calibration display). Set the STV output to 20 mA. When the value on the No.2 display has stabilized (changes of several digits max.), press the \( \text{V} \) key to temporarily store the calibration data.

(3) Press the \( \text{K} \) key. The display changes to [\( \text{Ad} \)] (0 mA 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 \( \text{V} \) 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 \( \text{K} \) key. The display changes to [\( \text{Ad} \)] (20 mA calibration display).

(5) Set the output to 20 mA by the \( \text{K} \) or \( \text{K} \) 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 “20 mA”.

(6) Press the \( \text{K} \) key. The display changes to [\( \text{Ad} \)] (4 mA calibration display).

(7) Set the output to 4 mA by the \( \text{K} \) or \( \text{K} \) 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 “4 mA”.

(8) Press the \( \text{K} \) key until the display changes to the data store display. Press the \( \text{K} \) key. The No.2 display changes to [\( \text{YES} \)], and two seconds later the calibration data is stored to internal memory. If you press the \( \text{K} \) key when the No.2 display reads [\( \text{no} \)], the calibration data is disabled.

(9) This completes calibration of the current input. Press the \( \text{K} \) key to return the display to [\( \text{Ad} \)].
7.5 Calibrating Voltage Input

Preparation

AC100-240V
(AC/DC24V ~)

SOURCE

1 2 3 4 5 6 7 8 9 10

21 22 20 19 18 17 16 15 14 13

12 11

23

DMM

STV

• 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.

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, skips steps (4) to (7).

(1) When [ ] 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 [ ] (5 V calibration display). Set the STV output to 5 V. 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 [ ] (0 V calibration display). Set the STV output to 0 V. 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 [ ] (20 mA calibration display).

(5) Set the output to 20 mA 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 “20 mA”.

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

(7) Set the output to 4 mA 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 “4 mA”.

Calibration: 0 to 5V, 1 to 5V

Cont’d on next page
Press the key until the display changes to the data store display. Press the key. The No.2 display changes to [YES], and two seconds later the calibration data is stored to internal memory. If you press the key when the No.2 display reads [NO], the calibration data is disabled.

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

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, skips steps (4) to (7).

(1) When [ADJ] 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 [10V calibration display]. Set the STV output to 10 V. 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 [0V calibration display]. Set the STV output to 0 V. 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 [20mA calibration display].

(5) Set the output to 20 mA 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 "20 mA".

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

(7) Set the output to 4 mA 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 "4 mA".

(8) Press the key until the display changes to the data store display. Press the key. The No.2 display changes to [YES], and two seconds later the calibration data is stored to internal memory. If you press the key when the No.2 display reads [NO], the calibration data is disabled.

(9) This completes calibration of the voltage input (0 to 10 V). Press the key to return the display to [ADJ].
7.6 Checking Indication Accuracy

Checking indication accuracy

- After calibrating input, be sure to check indication accuracy to make sure that the E5EK-T controller has been correctly calibrated.
- Operate the E5EK-T controller in the PV/Present SP monitor (level 0 mode) mode.
- 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 E5EK-T controller and cold junction compensator are connected by a compensating conductor for the input type (thermocouple) that is to be used during actual operation.

- Operation
Make sure that the cold junction compensator is 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.
7.6 Checking Indication Accuracy

**Current input**

- **Preparation**
  The following figure shows the required device connection.

AC100-240V~
(AC/DC24V ≃)

- **Operation**
  Set the STV to the current value equivalent to the check value.

**Voltage input**

- **Preparation**
  The following figure show the required device connection.

AC100-240V~
(AC/DC24V ≃)

- **Operation**
  Set the STV to the voltage value equivalent to the check value.