SECTION 5
Input Shift for Temperature Controller

This section provides details on the input shift in relation with various Temperature Controllers.

5-1 Connection to E5CN or E5GN

5-1-1 Input Shift

The input shift type is displayed according to the input type of Sensor selected.

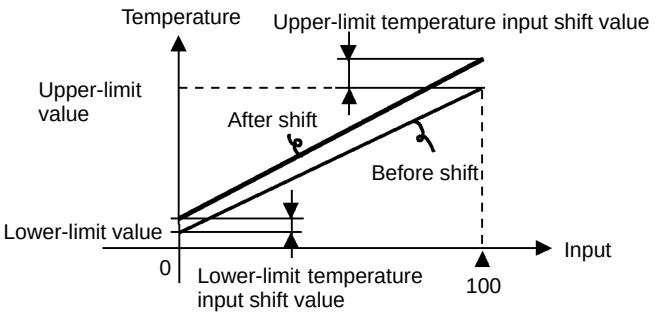
- Two-point shift compensation is used for the Non-contact Temperature Sensor only.
- The input temperature range is shifted by the temperature input shift value. For example, a display value of 200°C is shifted to 201.2°C if the shift value is 1.2°C.

Two-point Shift

Upper-limit temperature input shift value

Lower-limit temperature input shift value

- Set the input type to Non-contact Temperature Sensor (12 through 15).
- The input temperature range of Non-contact Temperature Sensors can be shifted by setting an individual value for the upper and lower points of the sensor range. This means that the shift can be applied equally across the range with separate values for each end of the range. For example, if the upper-limit value is set to “2°C” and the lower-limit value is set to “1°C,” the sensor range will be shifted by an average of 1.5°C at 50% input.
- Set the upper-limit value in the “upper-limit temperature input shift value” parameter and the lower-limit value in the “lower-limit temperature input shift value” parameter.



5-1-2 Input Shift Value Calculation (Two-point Shift)

When the ES1A Non-contact Temperature Sensor is connected to the E5CN or E5GN, an offset of several to several tens of a degree can occur.

For this reason, offset the display value by a one-point or two-point shift as described in this section. This offset occurs as a bias current for detecting controller sensor error flows to the output impedance of the Non-contact Temperature Sensor. Two-point shift can be carried out only on Non-contact Temperature Sensors and cannot be set for other input types.

Preparations

1, 2, 3... 1. Set to the temperature range matching the input specifications of the Non-contact Temperature Sensor. (ES1A is supported only on thermocouple input models of the E5CN or E5GN.)

2. Prepare a thermometer capable of measuring the temperature of the control target as shown in Figure 1 so that a one-point or two-point shift can be carried out.

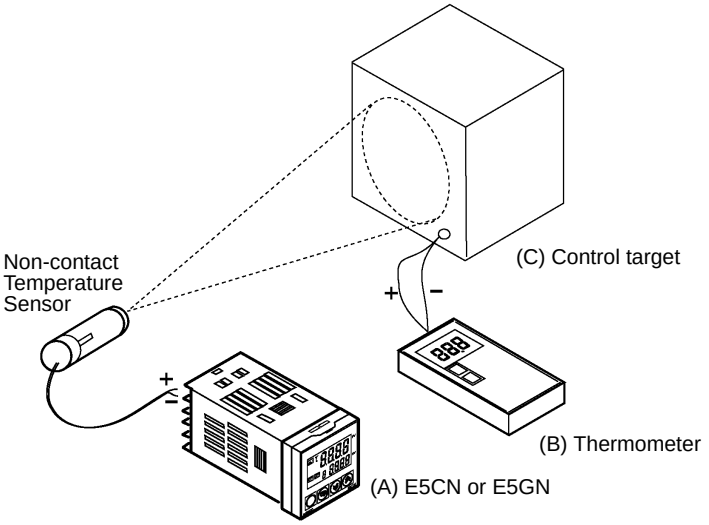
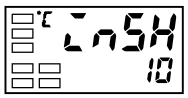


Figure 1: Configuration When Compensating a Non-contact Temperature Sensor

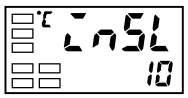
One-point Shift Method

1, 2, 3...

Adjustment level



Upper-limit temperature input shift value



Lower-limit temperature input shift value

1. In the configuration shown in Figure 1, bring the set point close to the value at which the temperature of the control target is to be controlled. Assume that the control target temperature (C) and the control target temperature (B) match.
2. Check the control target temperature (B) and the Controller display value (A). Take the following value as the input shift value and set the same numerical values to in5L and in5H.

control target temperature (B) - controller display value (A)

Figure 2 shows the effect of one-point temperature input shift.

3. After the input shift values have been set, check Controller display value (A) and control target temperature (B). If they are almost the same, this means that the temperature input shift is complete.

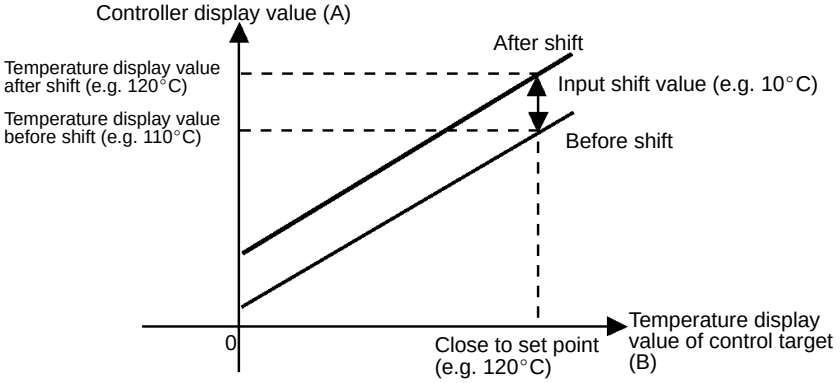


Figure 2: One-point Temperature Input Shift

Two-point Shift Method

Use two-point input shift to increase the accuracy of the display values across the range of the Sensor.

1, 2, 3...

1. Shift the Controller display value by two points, close to the room temperature and close to the value at which the temperature of the control target is to be controlled. For this reason, bring the control target temperature close to the room temperature and close to the set point, and check the control target temperature (B) and Controller display value (A).
2. Using equations (1) and (2), calculate the upper- and lower-limit temperature input shift values from the display value and temperature to be shifted that was obtained in step 1. Figure 3 shows the effect of a two-point temperature input shift.

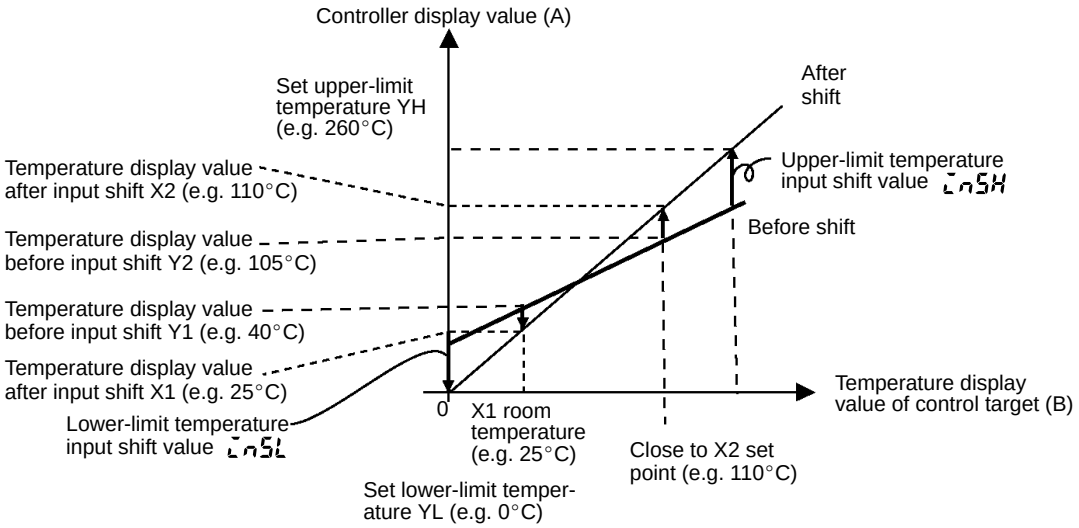


Figure 3: Two-point Temperature Input Shift

- Use the following equation to calculate the lower-limit temperature input shift value.

$$\text{InSL} = \frac{\text{YL - Y1}}{\text{Y2 - Y1}} \times \{(\text{X2 - Y2}) - (\text{X1 - Y1})\} + (\text{X1 - Y1}) \quad \text{...equation 1}$$

- Use the following equation to calculate the upper-limit temperature input shift value.

$$\text{InSH} = \frac{\text{YH - Y1}}{\text{Y2 - Y1}} \times \{(\text{X2 - Y2}) - (\text{X1 - Y1})\} + (\text{X1 - Y1}) \quad \text{...equation 2}$$

3. After the calculated values have been set to "InSL " and "InSH," check Controller display value (A) and control target temperature (B).
4. Although the input shift was carried out at two points, close to room temperature (ambient temperature) and close to the set point, select points close to each end of the Sensor range to improve accuracy across the full range of the Sensor measurement range.

Note Before selecting these values, check that they will not damage the Controller when applied.

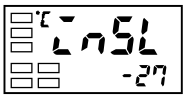
Example of Two-point Temperature Input Shift

In this example, the ES1A is used in the 160°C to 260°C specification.

In equations 1 and 2, the set lower-limit temperature YL is 0°C and set upper-limit temperature YH is 260°C. Check the temperature of the control target.

When the room temperature X1 is 25°C, the display value on Controller Y1 will be 40°C, and when the temperature close to the set point X2 is 110°C, the display value on Controller Y2 will be105°C.

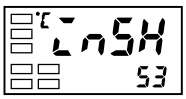
Adjustment level



Lower-limit temperature input shift value

Lower-limit temperature input shift value

$$\text{in5L} = \frac{0 - 40}{105 - 40} \times \{(110 - 105) - (25 - 40)\} + (25 - 40) = -27.3(°C)$$



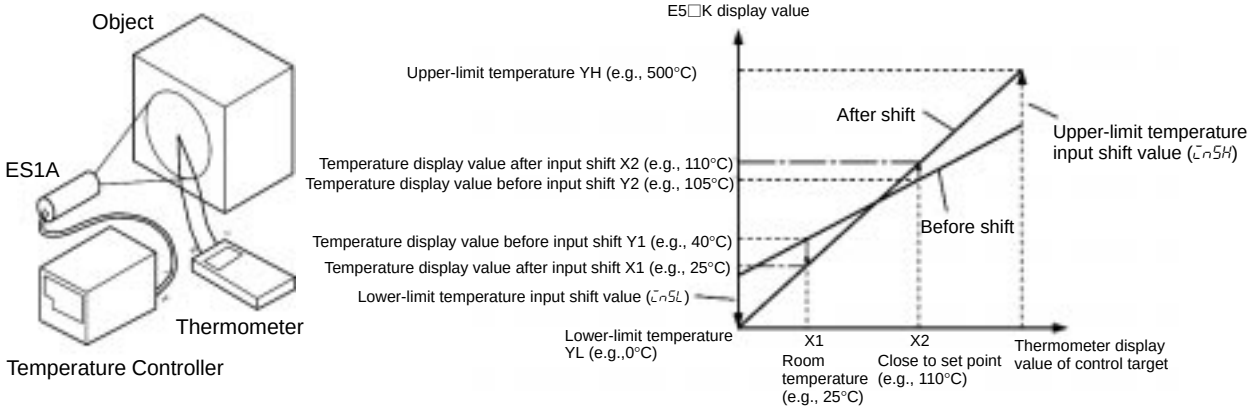
Upper-limit temperature input shift value

Upper-limit temperature input shift value

$$\text{in5H} = \frac{260 - 40}{105 - 40} \times \{(110 - 105) - (25 - 40)\} + (25 - 40) = 52.7(°C)$$

5-2 Connection to Temperature Controller other than E5CN and E5GN

5-2-1 Two-point Shift (Connection to E5AK, E5CK, or E5CK)



1, 2, 3...

1. Shift the Controller display value by two points, close to room temperature and close to the value at which the temperature of the control target is to be controlled. For this reason, bring the control target temperature close to room temperature and close to the set point, and check the thermometer reading and the display value of the E5□K at each of these temperature points. If greater temperature measurement accuracy in the sensing range is required, check the thermometer reading and the display value of the E5□K at a point in the sensing range instead of room temperature.
2. Use the following equations to calculate the upper- and lower-limit temperature input shift values.

   • Lower-limit temperature input shift value

$$\text{in5L} = \frac{\text{YL} - \text{Y1}}{\text{Y2} - \text{Y1}}\{(\text{X2} - \text{Y2}) - (\text{X1} - \text{Y1})\} + (\text{X1} - \text{Y1})$$

   • Upper-limit temperature input shift value

$$\text{in5H} = \frac{\text{YH} - \text{Y1}}{\text{Y2} - \text{Y1}}\{(\text{X2} - \text{Y2}) - (\text{X1} - \text{Y1})\} + (\text{X1} - \text{Y1})$$

Example: K2 is selected as the input type.

Lower-limit temperature YL = 0°C
Upper-limit temperature YH = 500°C
Room temperature X1 = 25°C
Temperature display value of Temperature Controller Y1 = 40°C
Temperature close to set point X2 = 110°C
Temperature display value of Temperature Controller Y2 = 105°C

Lower-limit temperature input shift value

$$\text{InSL} = \frac{0 - 40}{105 - 40} \times \{(110 - 105) - (25 - 40)\} + (25 - 40) = -27.3(°C)$$

Upper-limit temperature input shift value

$$\text{InSH} = \frac{500 - 40}{105 - 40} \times \{(110 - 105) - (25 - 40)\} + (25 - 40) = 126.5(°C)$$

5-2-2 One-point Shift (Connection to Temperature Controller with Input Shift Function)

1, 2, 3...

1. Check the control target temperature and the display value of the Temperature Controller when the temperature of the object is close to the set point.
2. Input the control target temperature minus the display value of the Temperature Controller as an input shift into the Temperature Controller.
3. If the Temperature Controller is the E5AK, E5EK, or E5CK, make sure that the upper-limit temperature shift value is the same as the lower-limit temperature input shift value.