

## Temperature Controllers E5CS

### Easy Setting Using DIP Switch and Simple Functions in DIN 48 × 48 mm-size Temperature Controllers

- Easy setting using DIP and rotary switches.
- Models with two alarms added to Series, ideal for applications requiring alarms.
- Multi-input (thermocouple/platinum resistance thermometer) models also available.
- Clearly visible digital display with character height of 13.5 mm.
- RoHS compliant.



**NEW**

## Model Number Structure

### ■ Model Number Legend

#### Plug-in Models

E5CS-□□□□U-□  
1 2 3 4 5

#### 1. Output type

- R: Relay
- Q: Voltage for driving SSR

#### 2. Number of alarms

- Blank: No alarm
- 1: 1 alarm
- 2: 2 alarms

#### 3. Input type

- KJ: Thermocouple
- P: Platinum resistance thermometer
- G: Thermistor
- T: Thermocouple/platinum resistance thermometer (multi-input)

#### 4. Power supply voltage

- Blank: 100 to 240 VAC
- D: 24 VAC/VDC

#### 5. Case color

- W: Light gray

**Note:** A functional explanation is provided here for illustration, but models are not necessarily available for all possible combinations. Refer to *Ordering Information* when ordering.

#### Examples

- Relay control output, without alarm, thermocouple input, plug-in construction, light gray case: E5CS-RKJU-W
- Relay control output, one alarm output, multi-input, plug-in construction, light gray case: E5CS-R1TU-W

## Ordering Information

### ■ List of Models

Size	Power supply voltage	Number of alarm points	Control output	TC/Pt universal input, Case color: Light gray	TC input, Case color: Light gray	Pt input, Case color: Light gray	Thermistor input
1/16 DIN 48 × 48 × 72.5 (W × H × D)	100 to 240 VAC	0	Relay	E5CS-RTU-W	E5CS-RKJU-W	E5CS-RPU-W	E5CS-RGU-W
			Voltage (for driving SSR)	E5CS-QTU-W	E5CS-QKJU-W	E5CS-QPU-W	E5CS-QGU-W
		1	Relay	E5CS-R1TU-W	E5CS-R1KJU-W	E5CS-R1PU-W	E5CS-R1GU-W
			Voltage (for driving SSR)	E5CS-Q1TU-W	E5CS-Q1KJU-W	E5CS-Q1PU-W	E5CS-Q1GU-W
		2 (See note.)	Relay	E5CS-R2TU-W	---	---	---
			Voltage (for driving SSR)	E5CS-Q2TU-W	---	---	---
	24 VAC/VDC	0	Relay	---	E5CS-RKJDU-W	E5CS-RPDU-W	E5CS-RGDU-W
			Voltage (for driving SSR)	---	E5CS-QKJDU-W	---	---
		1	Relay	---	E5CS-R1KJDU-W	E5CS-R1PDU-W	E5CS-R1GDU-W
			Voltage (for driving SSR)	---	E5CS-Q1KJDU-W	---	---

**Note:** Models with two alarm outputs always use the upper limit alarm mode for the alarm 2 output.

## ■ Accessories (Order Separately)

### Socket without Alarm (8 Pins)

Type	Model
Front Connecting Socket	P2CF-08
Back Connecting Socket (flush mounting)	P3G-08
Front Connecting Socket (with finger protection)	P2CF-08-E
Finger Safe Terminal Cover for P3G	Y92A-48G

### Protective Cover

Type	Model
Hard Protective Cover	Y92A-48B

### Socket with Alarm (11 Pins)

Type	Model
Front Connecting Socket	P2CF-11
Back Connecting Socket (flush mounting)	P3GA-11
Front Connecting Socket (with finger protection)	P2CF-11-E
Finger Safe Terminal Cover for P3G	Y92A-48G

## Specifications

### ■ Ratings

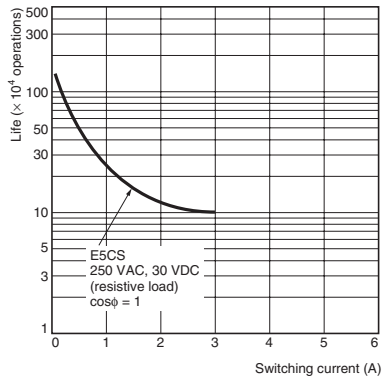
<b>Supply voltage</b>		100 to 240 VAC, 50/60 Hz	24 VAC/VDC 50/60 Hz
<b>Operating voltage range</b>		85% to 110% of rated supply voltage	
<b>Power consumption</b>		5 VA	3 VA/2 W
<b>Sensor input</b>		Thermocouple: K, J, L Platinum resistance thermometer: Pt100, JPt100 Thermistor: E52-THE□□ Multi-input (thermocouple/platinum resistance thermometer): K, J, L, T, U, N, R, Pt100, JPt100	
<b>Control output</b>	<b>Relay output</b>	SPDT, 250 VAC, 3 A (resistive load)	
	<b>Voltage output (for driving the SSR)</b>	12 VDC, 21 mA (with short-circuit protection circuit)	
<b>Control method</b>		ON/OFF or 2-PID (with automatic PID parameter setting function)	
<b>Alarm output</b>		SPST-NO, 250 VAC, 1A (resistive load)	
<b>Setting method</b>		Digital setting using front panel keys	
<b>Indication method</b>		3.5-digit, 7-segment digital display (character height: 13.5 mm) and deviation indicators	
<b>Other functions</b>		<ul style="list-style-type: none"> <li>• Setting change prohibit (key protection)</li> <li>• Input shift</li> <li>• Temperature unit change (°C/°F)</li> <li>• Direct/reverse operation</li> <li>• Temperature range, Sensor switching (K/J/L, Pt100/JPt100)</li> <li>• Switching is performed between a thermocouple and platinum resistance thermometer for multi-input models.</li> <li>• Control period switching</li> <li>• 8-mode alarm output</li> <li>• Sensor error detection (excluding thermistor models)</li> </ul>	
<b>Ambient temperature</b>		-10 to 55°C (with no condensation or icing)	
<b>Ambient humidity</b>		25% to 85%	
<b>Storage temperature</b>		-25 to 65°C (with no condensation or icing)	

## ■ Characteristics

<b>Setting accuracy</b>	Thermocouple (See note 1.): (±1% of indication value or ±2°C, whichever is greater) ±1 digit max. Platinum resistance thermometer (See note 2.): (±0.5% of indication value or ±1°C, whichever is greater) ±1 digit max. Thermistor (See note 3.): (1% FS of indication value) ±1 digit max.
<b>Indication accuracy (ambient temperature of 23°C)</b>	
<b>Influence of temperature</b>	R thermocouple inputs: (±2% of PV or ±10°C, whichever is greater) ±1 digit max. Other thermocouple inputs: (±2% of PV or ±4°C, whichever is greater) ±1 digit max. Platinum resistance thermometer inputs: (±1% of PV or ±2°C, whichever is greater) ±1 digit max. Thermistor: (±2% FS) ±1 digit max.
<b>Influence of voltage</b>	
<b>Hysteresis (for ON/OFF control)</b>	0.2% FS (0.1% FS for multi-input (thermocouple/platinum resistance thermometer) models)
<b>Proportional band (P)</b>	1 to 999°C (automatic adjustment using auto-tuning/self-tuning)
<b>Integral time (I)</b>	1 to 1,999 s (automatic adjustment using auto-tuning/self-tuning)
<b>Derivative time (D)</b>	1 to 1,999 s (automatic adjustment using auto-tuning/self-tuning)
<b>Alarm output range</b>	Absolute-value alarm: Same as the control range Other: 0% to 100% FS Alarm hysteresis: 0.2°C or °F (fixed)
<b>Control period</b>	2/20 s
<b>Sampling period</b>	500 ms
<b>Insulation resistance</b>	20 MΩ min. (at 500 VDC)
<b>Dielectric strength</b>	2,000 VAC, 50/60 Hz for 1 min between current-carrying terminals of different polarity
<b>Vibration resistance</b>	<b>Malfunction</b>
	<b>Destruction</b>
<b>Shock resistance</b>	<b>Malfunction</b>
	<b>Destruction</b>
<b>Life expectancy</b>	<b>Electrical</b>
<b>Weight</b>	Approx. 110 g (Controller only)
<b>Degree of protection</b>	Front panel: Equivalent to IP50, Enclosure Category 2 (IEC 60529), Rear case: IP20; Terminals: IP00
<b>Memory protection</b>	EEPROM (non-volatile memory) (number of writes: 1,000,000)
<b>EMC</b>	EMI Radiated: EN 55011 Group 1 Class A EMI Conducted: EN 55011 Group 1 Class A Radiated Electromagnetic Field Immunity: EN 61000-4-2: 4 kV contact discharge (level 2) 8 kV air discharge (level 3) RF-interference Immunity: EN 61000-4-3: 10 V/m (80-1000 MHz, 1.4-2.0 GHz amplitude modulated) (level 3) 10 V/m (900 MHz pulse modulated) Conducted Disturbance Immunity: EN 61000-4-6: 3 V (0.15 to 80 MHz) (level 2) Noise Immunity (First Transient Burst Noise): EN 61000-4-4 Burst Immunity: 2 kV power-line (level 3), 1 kV I/O signal-line (level 3) Surge Immunity: EN 61000-4-5: Power line: Normal mode 1 kV; Common mode 2 kV Output line (relay output): Normal mode 1 kV; Common mode 2 kV Voltage Dip/Interrupting Immunity: EN 61000-4-11 0.5 cycle, 100% (rated voltage)
<b>Approved standards</b>	UL 61010C-1 (listing) CSA C22.2 No.1010-1
<b>Conformed standards</b>	EN 61326, EN 61010-1, IEC 61010-1 VDE 0106 Part 100 (finger protection), when the terminal cover is mounted.

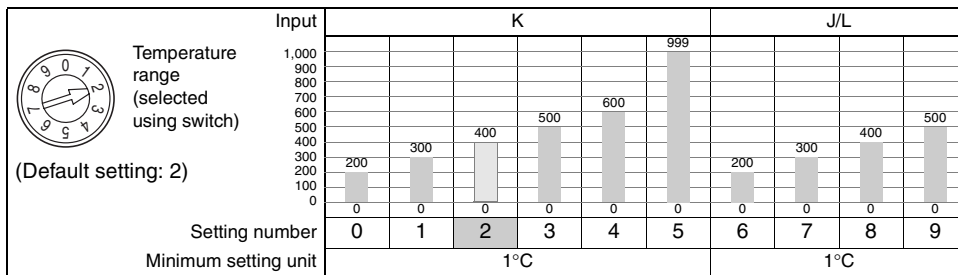
- Note:**
- The following exceptions apply to thermocouples.
    - U, L: ±2°C ±1 digit max.
    - R: ±3°C ±1 digit max. at 200°C or less
  - The following exception applies to platinum resistance thermometers.
    - Input set values 1 for E5CS-U: 1% FS ±1 digit max.
  - The following exceptions apply to thermistors.
    - When the unit setting is °C, temperature indication ranges exceeding the set temperature range ±10% FS may not be accurate.
    - When the unit setting is °F, the temperature range for the input setting numbers 4 and 9 (609 to 630°F) and temperature indication ranges exceeding the set temperature range -5% FS to +10% FS may not be accurate.

## ■ Electrical Life Expectancy Curve for Relays (Reference Values)



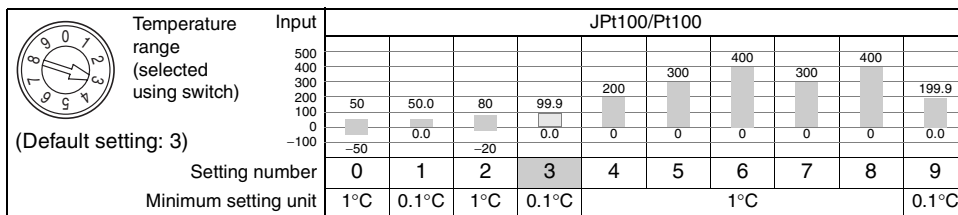
## ■ Temperature Range

### Thermocouple Input Models



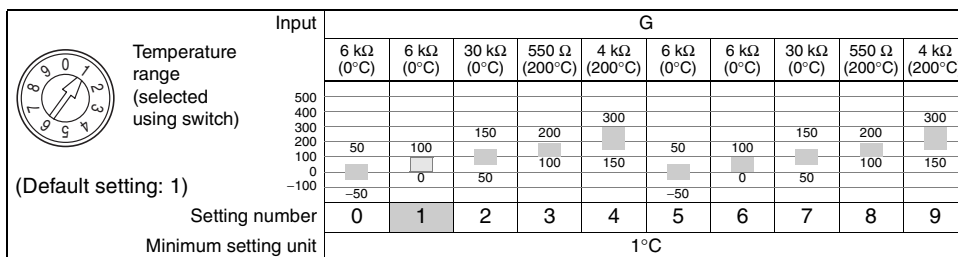
The shaded value indicates the default setting status.

### Platinum Resistance Thermometer Input Models



The shaded value indicates the default setting status.

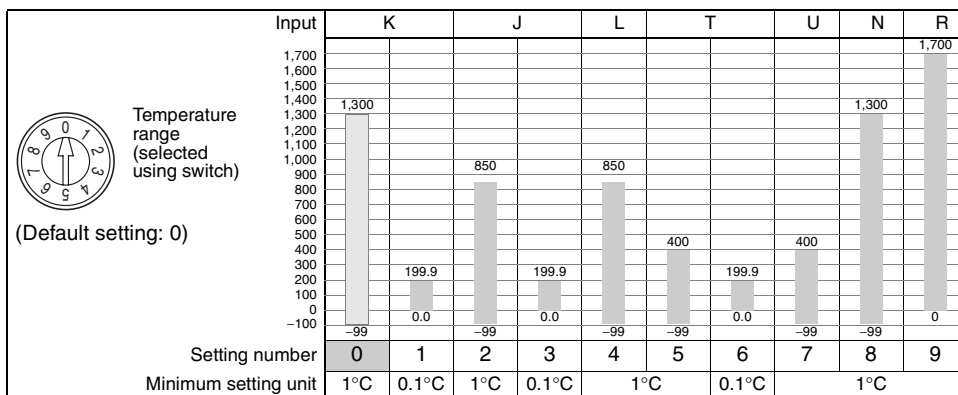
### Thermistor Input Models (For details on Sensors, refer to page 6.)



The shaded value indicates the default setting status.

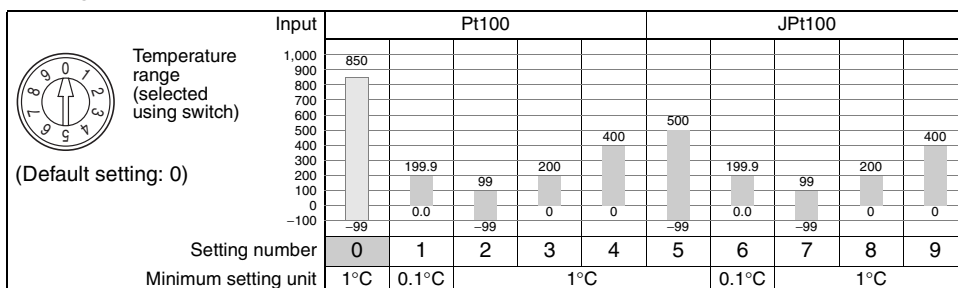
### Multi-input (Thermocouple/Platinum Resistance Thermometer) Models

#### • Using Thermocouple Sensors, Control Mode Switch 5: OFF



The shaded value indicates the default setting status.

#### • Using Platinum Resistance Thermometers, Control Mode Switch 5: ON



The shaded value indicates the default setting status.

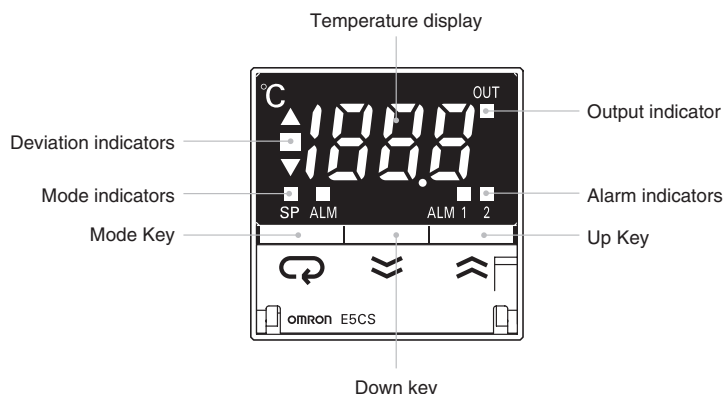
# External Connection Diagram

Sensor		Thermocouple (See note 3.)	Platinum resistance thermometer (See note 3.)	Thermistor
Plug-in models	Without alarms	<p>Voltage output models (See note 1.)</p> <p>Relay output models</p> <p>100 to 240 VAC 24 VAC/VDC (See note 2.)</p>	<p>Voltage output models (See note 1.)</p> <p>Relay output models</p> <p>100 to 240 VAC 24 VAC/VDC (See note 2.)</p>	<p>Voltage output models (See note 1.)</p> <p>Relay output models</p> <p>100 to 240 VAC 24 VAC/VDC (See note 2.)</p>
	With alarms	<p>Voltage output models (See note 1.)</p> <p>Two alarm points</p> <p>Relay output models</p> <p>100 to 240 VAC 24 VAC/VDC (See note 2.)</p>	<p>Voltage output models (See note 1.)</p> <p>Two alarm points</p> <p>Relay output models</p> <p>100 to 240 VAC 24 VAC/VDC (See note 2.)</p>	<p>Voltage output models (See note 1.)</p> <p>Relay output models</p> <p>100 to 240 VAC 24 VAC/VDC (See note 2.)</p>

- Note:** 1. The voltage output (12 VDC, 21 mA) is not electrically isolated from the internal circuits. When using a grounding thermocouple, do not connect output terminals 4 or 5 to ground. Otherwise, unwanted current paths will cause measurement errors.  
 2. Models with 100 to 240 VAC and 24 VAC/VDC are separate. Models using 24 VDC have no polarity.  
 3. Be sure to check the sensor type before using multi-output (thermocouple/platinum resistance thermometer) models.

## Nomenclature

### E5CS-U Plug-in Models



# Thermistors

## Element Interchangeable Thermistor

### Temperature Ranges

Temperature range	Color code	Nominal resistance	Thermistor constant	Lead wire
-50°C to 50°C	Blue	6 kΩ (0°C)	3390K	A pair of 0.12 dia. 7 Teflon-insulated stranded wires with 0.86 outer dia. each
0°C to 100°C	Black	6 kΩ (0°C)	3390K	
50°C to 150°C	Red	30 kΩ (0°C)	3450K	
100°C to 200°C	Yellow	0.55 kΩ (200°C)	4300K	
150°C to 300°C	Green	4 kΩ (200°C)	5133K	Flat glass-wool-shielded lead cable with 0.12 dia. 10 conductors and external dimensions of 2.5 × 1.55

### Specifications

Item	E52-THE□□
Coupling method	Element interchangeable thermistor
Class	JIS class 1
Protective tubing material	SUS304
Time constant	8 to 15 s in still water
Dissipation factor	2.4 to 2.8 mW/°C in still air
Lead wire heat resistive temperature	180°C

### Error

Detectable temperature	Error
-50°C to 100°C	±1°C max.
100°C to 350°C	±1% max. of detectable temperature

### Permissible Temperature

Detectable temperature	Operating temperature
-50°C to 50°C	100°C
0°C to 100°C	150°C
50°C to 150°C	200°C
100°C to 200°C	250°C
150°C to 300°C	350°C

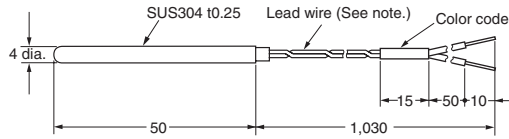
**Note:** Models with non-standard lead wire lengths and protective tubing lengths are available on request.

This Thermistor is a dedicated Thermistor for the E5C2 and E5CS.

## Exposed-lead Models

### E52-THE5A

#### Dimensions



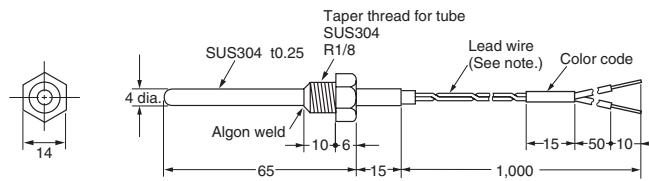
**Note:** The lead wires have no polarity.

Temperature range	Model
-50°C to 50°C	E52-THE5A -50-50°C 1M
0°C to 100°C	E52-THE5A 0-100°C 1M
50°C to 150°C	E52-THE5A 50-150°C 1M
100°C to 200°C	E52-THE5A 100-200°C 1M
150°C to 300°C	E52-THE5A 150-300°C 1M

## Exposed-lead Models with Screws

### E52-THE6D

#### Dimensions



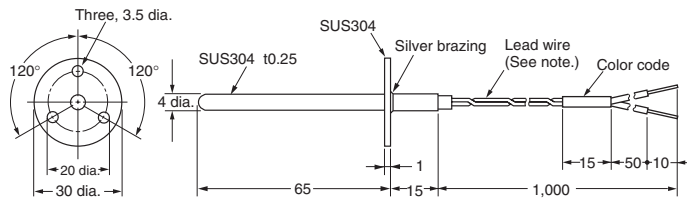
**Note:** The lead wires have no polarity.

Temperature range	Model
-50°C to 50°C	E52-THE6D -50-50°C 1M
0°C to 100°C	E52-THE6D 0-100°C 1M
50°C to 150°C	E52-THE6D 50-150°C 1M
100°C to 200°C	E52-THE6D 100-200°C 1M
150°C to 300°C	E52-THE6D 150-300°C 1M

## Exposed-lead Models with Flanges

### E52-THE6F

#### Dimensions



**Note:** The lead wires have no polarity.

Temperature range	Model
-50°C to 50°C	E52-THE6F -50-50°C 1M
0°C to 100°C	E52-THE6F 0-100°C 1M
50°C to 150°C	E52-THE6F 50-150°C 1M
100°C to 200°C	E52-THE6F 100-200°C 1M
150°C to 300°C	E52-THE6F 150-300°C 1M

**Note:** 1. The Thermistor lead cable can be extended with a standard lead wire for extension. If waterproof performance is required, be sure that the lead cable joint is of waterproof construction as well.

2. Be sure to specify the model and temperature range when ordering the Thermistor. The Thermistor has a color code according to the temperature range.

# Operation

## E5CS-U

### Deviation indicators

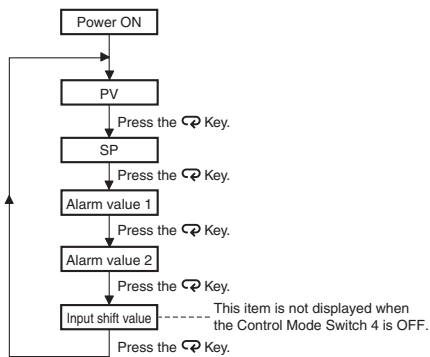
The  $\triangle$  indicator lights when the PV is greater than the SP and the  $\nabla$  indicator lights when the PV is less than the SP. The  $\square$  indicator (green) lights when the deviation is less than 1% FS (0.25% FS for multi-input models). These indicators flash during ST (self-tuning)/AT (auto-tuning).

### Mode indicators

The SP indicator lights when the setting temperature is being displayed. The ALM indicator lights when the alarm value 1 is being displayed and flashes when the alarm value 2 is being displayed.

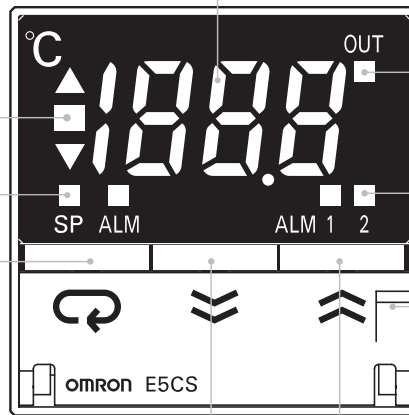
### Mode Key

When the power is turned ON, normally the display will use the display items in the following order each time the Mode Key is pressed.



### PV, SP, Alarm Value, Input Shift Display

The display switches each time the  $\curvearrowright$  Key is pressed.



### Output indicator

Lights when the control output is ON.

### Alarm indicators

ALM1 (Alarm 1): Lights when the alarm 1 output is ON.  
 ALM2 (Alarm 2): Lights when the alarm 2 output is ON.

Front door opening/closing groove

### Down Key

Pressing the Down Key decreases the SP/alarm value display. Keeping the Down Key pressed continues to decrease the display value.  
 When the internal protect switch is ON, the setting keys cannot be used.

### Up Key

Pressing the Up Key increases the SP/alarm value display. Keeping the Up Key pressed continues to increase the display value.  
 When the internal protect switch is ON, the setting keys cannot be used.

### Protect Switch

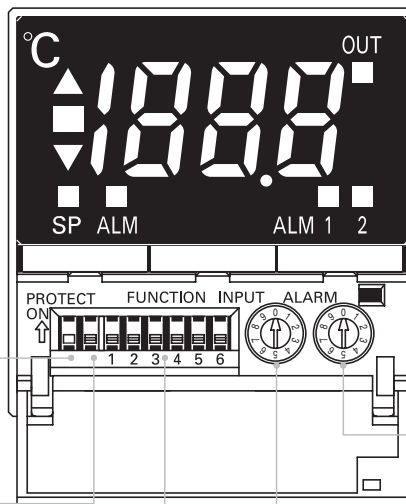
Turn ON to prevent changes to the setting temperature (alarm value).

### INIT Switch

This switch is for factory inspection purposes. Never touch this switch setting.

### Control Mode Switches

Switches for ON/OFF control and PID control settings.



### Alarm Mode Switch

(This switch is not provided on models without alarms. Alarm output 2 is always set to upper-limit alarm mode. An alarm output 2 mode switch is not provided.)

### Temperature Range Switch

Changes the temperature range.



# Settings before Turning ON the Power

## E5CS-U

### Opening the Front Door

Using your nail, press down the tab in the groove for opening the front door on the right side of the panel and pull the door open.

**Note:** The E5CS-U controller cannot be removed from the case.



Control mode switches Temperature range switch and alarm mode switch

## 1. Sensor Type Specification

Select the number on the temperature range switch to change the temperature range.

### Thermocouple (The default is 2.)

Input	K					J/L				
	0	1	2	3	4	5	6	7	8	9
SP range	200	300	400	500	600	999	200	300	400	500
Setting number	0	1	2	3	4	5	6	7	8	9

• The control range is -10% to +10% FS for each temperature range.

**Note:** The input indication range is the range that can be displayed for the control range (-99 to 1999). If the input is within the control range but exceeds the display range (-99 to 1999), values below -99 will be displayed as "ccc" and values above 1,999 will be displayed as "kkk."

### Platinum Resistance Thermometer (The default is 3.)

Input	JPt100/Pt100									
	0	1	2	3	4	5	6	7	8	9
SP range	50	50.0	80	99.9	200	300	400	300	400	199.9
Setting number	0	1	2	3	4	5	6	7	8	9

• The control range is -10% to +10% FS for each temperature range.

- Note:**
- The input indication range is the range that can be displayed for the control range (-99 to 1999). If the input is within the control range but exceeds the display range (-99 to 1999), values below -99 will be displayed as "ccc" and values above 1,999 will be displayed as "kkk."
  - If the range is changed from one in 0.1-degree units (e.g., 0.0 to 199.9 or 0.0 to 99.9) to a range in 1-degree units, the SP and alarm values will be multiplied by 10 (e.g., 0.5 will become 5). If the unit is changed in the reverse direction, the values will be divided by 10. Always set the SP and alarm values again after changing the range.
  - The temperature range for setting numbers 5 and 6 are the same as for 7 and 8, respectively.

### Thermistor (The default is 1.)

Input	G									
	6 kΩ (0°C)	6 kΩ (0°C)	30 kΩ (0°C)	550 Ω (200°C)	4 kΩ (200°C)	6 kΩ (0°C)	6 kΩ (0°C)	30 kΩ (0°C)	550 Ω (200°C)	4 kΩ (200°C)
SP range	50	100	150	200	300	50	100	150	200	300
Setting number	0	1	2	3	4	5	6	7	8	9

- Note:**
- The control range and the input indication range are -50 to 60°C for setting numbers 0 and 5, 0 to 160°C for setting numbers 2 and 7, 0 to 210°C for setting numbers 3 and 8, and 25 to 315°C for setting numbers 4 and 9. The ranges are -10% FS to +10% FS for each temperature range for other setting numbers.
  - If the setting number is changed and the temperature range exceeds 0°C, the minimum value of the setting temperature range will automatically be set as the SP. When the power is turned ON, the SP will be displayed.
  - Temperature ranges 0, 1, 2, 3, and 4 are the same as 5, 6, 7, 8, and 9, respectively.

## Multi-input (Thermocouple/Platinum Resistance Thermometer) Models

### • Using Thermocouple Sensors, Control Mode Switch 5: OFF

Input	K	J	L	T	U	N	R			
	0	1	2	3	4	5	6	7	8	9
SP range	1,300	199.9	850	199.9	850	400	199.9	400	1,300	1,700
Setting number	0	1	2	3	4	5	6	7	8	9

• The control range is -20°C to +20°C of the input temperature range.

- Note:**
- The input indication range is the range that can be displayed for the control range (-99 to 1999). If the input is within the control range but exceeds the display range (-99 to 1999), values below -99 will be displayed as "ccc" and values above 1,999 will be displayed as "kkk."
  - If unit is changed to 1 degree when the SP and alarm value for the temperature range are displayed in 0.1-units from 0.0 to 199.9 or 0.0 to 99.9, the values will be multiplied by 10 (e.g., 0.5 becomes 5). If the unit is changed in the reverse direction, the values will be divided by 10. After changing the range, set the SP and alarm value again.

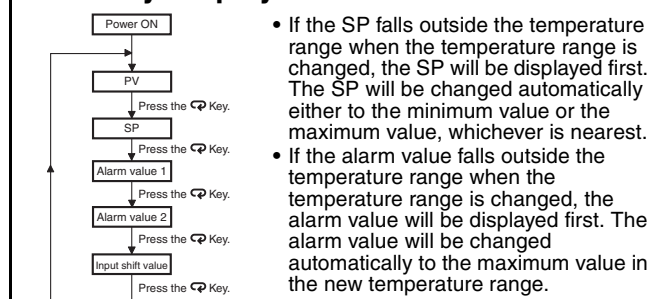
### • Using Platinum Resistance Thermometers, Control Mode Switch 5: ON

Input	Pt100					JPt100				
	0	1	2	3	4	5	6	7	8	9
SP range	850	199.9	99	200	0	500	199.9	99	200	400
Setting number	0	1	2	3	4	5	6	7	8	9

• The control range is -20°C to 20°C of the input temperature range.

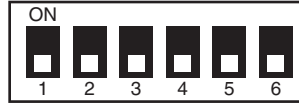
- Note:**
- The input indication range is the range that can be displayed for the control range (-99 to 1999). If the input is within the control range but exceeds the display range (-99 to 1999), values below -99 will be displayed as "ccc" and values above 1,999 will be displayed as "kkk."
  - If unit is changed to 1 degree when the SP and alarm value for the temperature range are displayed in 0.1-units from 0.0 to 199.9 or 0.0 to 99.9, the values will be multiplied by 10 (e.g., 0.5 becomes 5). If the unit is changed in the reverse direction, the values will be divided by 10. After changing the range, set the SP and alarm value again.

## Mode Key Display Order



## 2. Operation Settings


Use the control mode switches (  ) to change the control mode. (All switches are OFF for the default settings.)

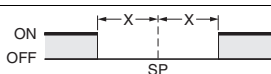
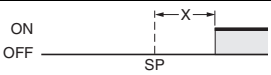

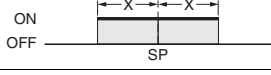
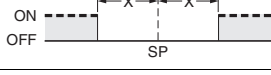
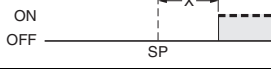
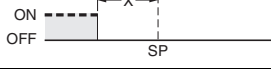
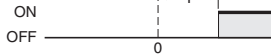


Function selection		1	2	3	4	5	6	
ON/OFF PID	PID control	ON						
	ON/OFF control	OFF						
Control period	2 s		ON					
	20 s		OFF					
Direct/reverse operation	Direct operation (cooling)			ON				
	Reverse operation (heating)			OFF				
Input shift display	Enabled				ON			
	Disabled				OFF			
Temperature Sensor selection	Thermocouple	K, L				ON		
		K, J				OFF		
	Platinum resistance thermometer	Pt100					ON	
		JPt100					OFF	
	Multi-input (thermocouple/platinum resistance thermometer)	Platinum resistance thermometer input					ON	
Thermocouple input						OFF		
Temperature unit	°F						ON	
	°C						OFF	

**Note:** The previous name Pt100 has been changed to JPt100 in accordance with revisions to JIS. The previous name J-DIN has been changed to L in accordance with revisions to DIN standards.

## 3. Alarm Modes

Select the number of the alarm mode switch  when changing the alarm mode. (The default is 2).

Set value	Alarm type	Alarm output operation
0, 9	Alarm function OFF	OFF
1	Upper- and lower-limit	
2	Upper-limit	
3	Lower-limit	
4	Upper- and lower-limit range	
5	Upper- and lower-limit with standby sequence (See note 2.)	
6	Upper-limit with standby sequence (See note 2.)	
7	Lower-limit with standby sequence (See note 2.)	
8	Absolute-value upper-limit	

**Note:** 1. No alarm. The alarm value (alarm operation display) will not be displayed when the setting is 0 or 9 even if the selection key is pressed.

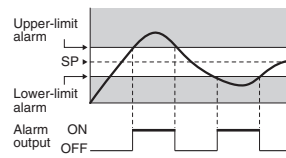
Alarm Setting Range

X: 0 to FS (full scale); Y: Within temperature range

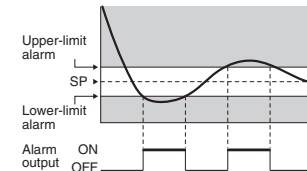
The value of X is the deviation setting for the SP (set point).

2. Standby Sequence Function (The standby sequence operates when the power is turned ON.)

**Rising Temperature**



**Dropping Temperature**



**Note:** Turn OFF the power before changing the DIP switch settings on the E5CS-U. Each of the switch settings will be enabled after the power is turned ON.

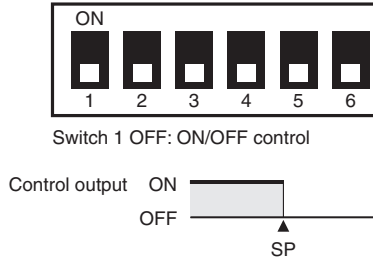
For details on the position of the temperature range switch, control mode switches, and alarm mode switch, refer to page 8.

## 4. Using the Control Mode Switches

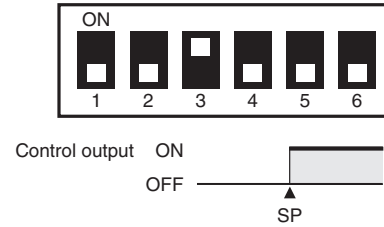
### (1) Using ON/OFF Control and PID Control

#### ON/OFF Control

The control mode is set to ON/OFF control as the default setting.

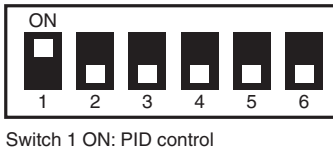


To perform cooling control of freezers, etc., turn ON switch 3.



#### PID Control

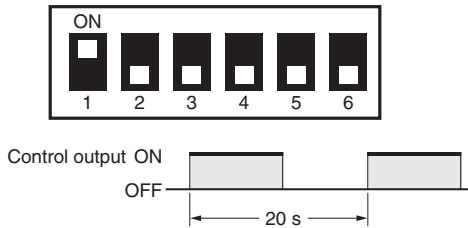
Turn ON switch 1 to use PID control.



#### 1. Set the control period.

**Performing Control via Relay Output, External Relay, or Conductor**

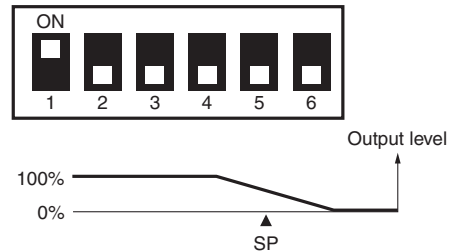
Switch 2: OFF (control period: 20 s)



#### 2. Set direct/reverse operation for the output.

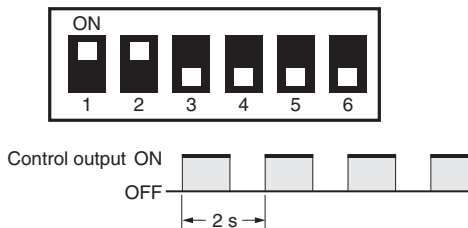
**Performing Heating Control for Heaters**

Switch 3: OFF



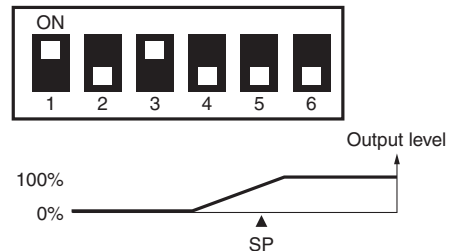
#### Quick Control Response Using an SSR

Switch 2: ON (control period: 2 s)



#### Performing Cooling Control for Freezers

Switch 3: ON

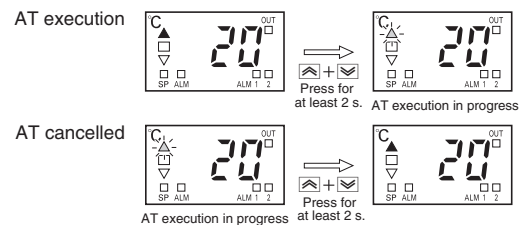


## ST (Self-tuning) Features

ST (self-tuning) is a function that finds PID constants by using step response tuning (SRT) when Controller operation begins or when the set point is changed. Once the PID constants have been calculated, ST is not executed when the next control operation is started as long as the set point remains unchanged. When the ST function is in operation, be sure to turn ON the power supply of the load connected to the control output simultaneously with or before starting Controller operation.

## Executing AT (Auto-tuning)

AT (auto-tuning) is executed by pressing the Up and Down Keys for at least 2 s while the PV is displayed. The deviation indicators flash during auto-tuning (AT) execution. AT will be cancelled by performing the same operation that AT is executing during AT operation. Flashing stops when AT is completed.



**Note:** One of the deviation indicators ( ) will flash.

**(2) Using the E5CS-U in Devices for Fahrenheit-scale Users**

**(Displaying in °F)**

Turn ON switch 6 to display temperatures in °F.



**Note:** Attached the enclosed °F label.

**Temperature Range for °F**

The temperature is set to °F using the same temperature range switch as °C.

**Thermocouple**

**Platinum Resistance Thermometer**

**Thermistor**

**Multi-input (Thermocouple/Platinum Resistance Thermometer)**

Control mode switch 5: OFF

**Multi-input (Thermocouple/Platinum Resistance Thermometer)**

Control mode switch 5: ON

Setting		°F
0	K	0 to 200
1		0 to 300
2		0 to 400
3		0 to 500
4		0 to 600
5		0 to 999
6	J/L	0 to 999
7		0 to 300
8		0 to 400
9		0 to 500

Setting		°F
0	Pt100	-50 to 50
1	or JPt100	0.0 to 50.0
2		-20 to 80
3		0.0 to 99.9
4		0 to 200
5		0 to 300
6		0 to 400
7		0 to 600
8		0 to 800
9		0.0 to 199.9

Setting		°F
0	G	-50 to 100
1		0 to 200
2		100 to 300
3		200 to 400
4		300 to 600
5		-50 to 100
6		0 to 200
7		100 to 300
8		200 to 400
9		300 to 600

Setting		°F
0	K	-99 to 1999
1		0.0 to 199.9
2	J	-99 to 1500
3		0.0 to 199.9
4	L	-99 to 1500
5	T	-99 to 700
6		0.0 to 199.9
7	U	-99 to 700
8	N	-99 to 1999
9	R	0 to 1999

Setting		°F
0	Pt100	-99 to 1500
1		0.0 to 199.9
2		-99 to 99
3		0 to 200
4		0 to 400
5	JPt100	-99 to 900
6		0.0 to 199.9
7		-99 to 99
8		0 to 200
9		0 to 400

**Note:** The control range for a thermocouple input or platinum resistance thermometer input is -10% to +10% FS of each temperature range. The control range for thermistors is 35 to 320°F for setting numbers 2 and 7, 35 to 420°F for setting numbers 3 and 8 and 80 to 630°F for setting numbers 4 and 9. The control range for thermistors is -5% to +10% FS of each temperature range for other setting numbers. The control range for multi-input (thermocouple/platinum resistance thermometer) models is -40 to +40°F of each temperature range.

**Using K, L/Pt100 Thermometers**

Turn ON switch 5 when using K, L/Pt100 Thermometers.



**Note:** The previous name J-DIN has been changed to L in accordance with revisions to DIN standards.

**(3) Setting Input Shift**

Turn ON switch 4, and after turning ON the power, press the Mode Key until *H0* (indicates input shift of 0) is displayed. Press the Up and Down Keys to set the shift value.



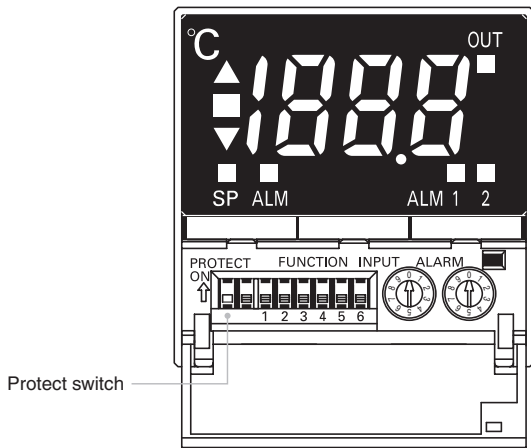
**Shift Example**

Input shift display	Measured temperature	Temperature display
<i>H0</i> (no shift)	100°C	100°C
<i>H9</i> (+9°C shift)	100°C	109°C
<i>L9</i> (-9°C shift)	100°C	91°C

**Note:** When control mode switch 4 is turned OFF (no input shift display), the input shift is not displayed but the shift value is enabled. To disable input shift, set the input shift value to *H0*. The shift range depends on the setting unit.

Setting unit	1°C	0.1°C
Compensation range	-99 to +99°C	-9.9 to +9.9°C
Input shift display	L99 to H99	L9.9 to H9.9

## 5. Protect Switch



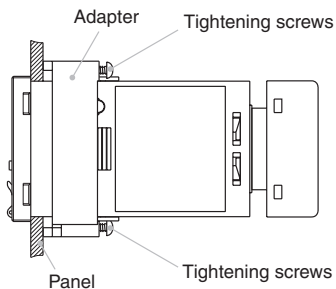
When the protect switch is ON, Up Key and Down Key operations are prohibited to prevent setting mistakes.

## Installation

- All models in the E5CS-U Series conform to DIN 43700 standards.
- The recommended panel thickness is 1 to 4 mm.
- Be sure to mount the E5CS-U horizontally.

### Mounting the E5CS-U

1. Insert the E5CS-U in the mounting hole in the panel.
2. Attach the adapter from the end with the terminals and press the adapter forward until it comes into contact with the panel to temporarily hold the Controller.
3. Tighten the two adapter screws, tightening them alternately a little at a time to maintain balance between them. The tightening torque is 0.29 to 0.39 N·m.



# Error Displays and Causes

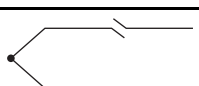
In addition to the alarm indicator, errors notification is provided on the display. Be sure to remove the cause of the error promptly.

Display status	Cause	Control output
PV displayed as <i>FFF</i>	(1) The PV is higher than the control temperature range (overflow). (2) Thermistor input: The Sensor is short-circuited.	Heating control (reverse operation): OFF Cooling control (direct operation): ON
PV displayed as ---	(1) The PV is lower than the control temperature range (underflow). (2) Thermistor input: The Sensor is burnt out.	Heating control (reverse operation): ON Cooling control (direct operation): OFF
<i>FFF</i> flashing	(1) Thermocouple or Pt input model: The PV is higher than the overflow temperature or a Sensor error has occurred. (2) Multi-input model: The PV is higher than the control temperature range or a Sensor error has occurred.	OFF
--- flashing	(1) Thermocouple or Pt input model: The PV is lower than the underflow temperature or a Sensor error has occurred. (2) Thermocouple model: The polarity is reversed. (3) Multi-input model: The PV is lower than the control temperature range or a Sensor error has occurred.	OFF
<i>E !!</i> displayed	A memory error (E11) has occurred. Turn the power ON again. If the display remains the same, the Controller must be repaired.	The control outputs and alarm outputs turn OFF.

**Note:** In models with an alarm, *FFF* appears or flashes on the display to indicate that the temperature has exceeded the maximum display temperature and the output is set according to the alarm mode. In the same way, --- appears or flashes on the display to indicate that the temperature has exceeded the minimum display temperature and the output is set according to the alarm mode.

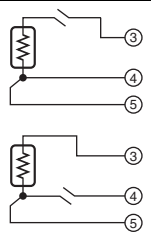
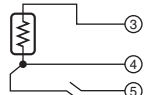
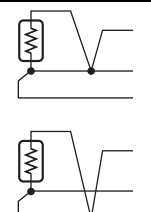
## Sensor Error Displays and Causes

### Thermocouple

Status	Display	Control output
Burnout 	<i>FFF</i> flashing	OFF

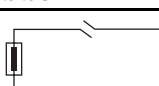

**Note:** The room temperature is displayed if an input short-circuit occurs.

### Platinum Resistance Thermometer

Status	Display	Control output
Burnout 	<i>FFF</i> flashing	OFF
	--- flashing	OFF
2 or 3 wires disconnected	<i>FFF</i> flashing	OFF
Short-circuit 	--- flashing	OFF

**Note:** The resistance value for platinum resistance thermometers is 100 Ω at 0°C and 140 Ω at 100°C.

### Thermistor

Status	Display	Control output
Burnout 	--- (See note.)	Heating control (reverse operation): ON Cooling control (direct operation): OFF
Short-circuit 	<i>FFF</i> (See note.)	Heating control (reverse operation): OFF Cooling control (direct operation): ON

**Note:** The display does not flash.

# Comparison with Previous Models

## ■ Model Number Legend

Previous model				E5CS			
<b>E5CS-</b> □□□ 1 2 3				<b>E5CS-</b> □□□□ <b>U-</b> □ 1 2 3 4 5			
Classification	Symbol	Meaning		Classification	Symbol	Meaning	
1	Control output	R Q	Relay Voltage	1	Control output	R Q	Relay Voltage
2	Alarm output	Blank 1	No alarms One alarm	2	Alarm output	Blank 1 2	No alarms One alarm Two alarms
3	Input type	KJ P G	Thermocouple (K, J) Platinum resistance thermometer (Pt100, JPt100) Interchangeable component thermistor	3	Input type	KJ P G T	Thermocouple (K, J) Platinum resistance thermometer (Pt100, JPt100) Interchangeable component thermistor Multi-input (thermocouple/platinum resistance thermometer) models
<b>Main Differences</b> The suffix "U" is added to plug-in models. The suffix "D" is added to models with a supply voltage of 24 VAC/VDC. The suffix "W" is added to models with a light gray case color.				4	Voltage specifications	Blank D	100 to 240 VAC 24 VAC/VDC
					Terminal appearance	U	Plug-in type
				5	Case color	W	Light gray

## ■ Display

Previous models	E5CS

The display digits can be increased up to 1,999.  
 The ALM2 display has been added.  
 The display "ON" has changed to "OUT" and "AL" has changed to "ALM."

## ■ Functions

The control method has been changed to 2-PID control.  
 An auto-tuning (AT) function has been added.  
 The deviation indicators flash during self-tuning (ST) and auto-tuning (AT).  
 The control calculation period has been improved from 2 s to 0.5 s.

## ■ External Dimensions

No change from previous models.

## ■ Terminal Arrangement

No change from previous models.

## ■ Compatible Sockets

No change from previous models.

## ■ DIP Switch and Rotary Switch Setting Methods

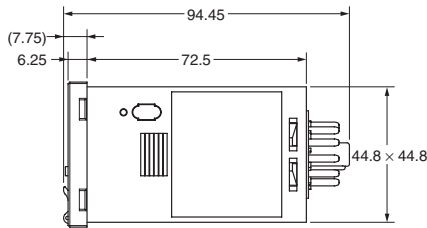
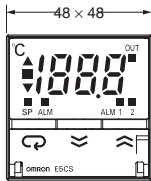
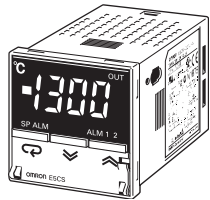
No change from previous models.

# Dimensions

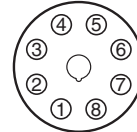
Note: All units are in millimeters unless otherwise indicated.

## Controller

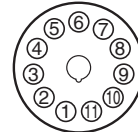
### E5CS-U



Terminal Arrangement (Bottom View)

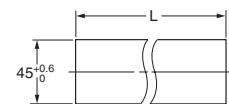
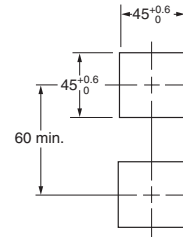


Models without alarms



Models with alarms

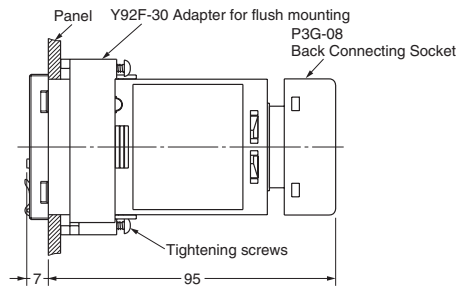
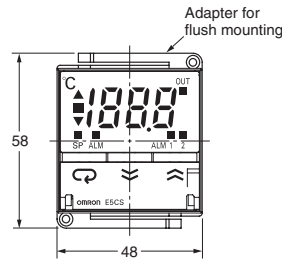
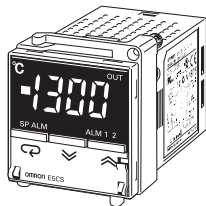
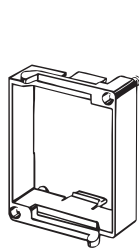
Panel Cutout Dimensions



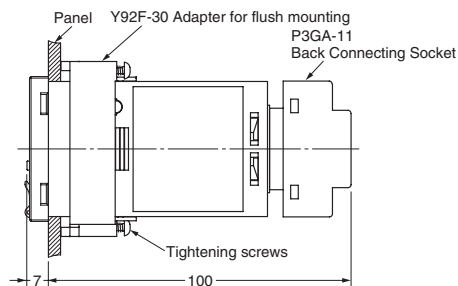
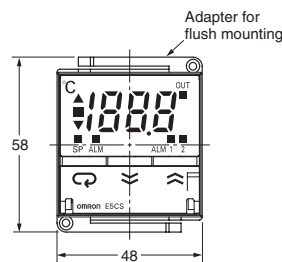
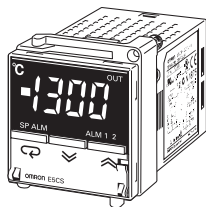
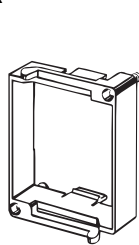
$L = (48 \times N - 2.5)^{+1}_0$   
Mounting side-by-side  
(group mounting of N Controllers)

Note: The external dimensions are the same for both models with and without alarms.

### E5CS-U + Adapter for Flush Mounting (Enclosed) + Back Connecting Socket (Order Separately) (Without Alarms)



### E5CS-U + Adapter for Flush Mounting (Enclosed) + Back Connecting Socket (Order Separately) (With Alarms)



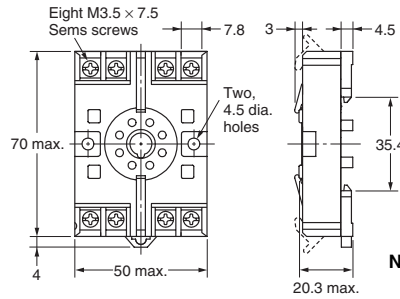
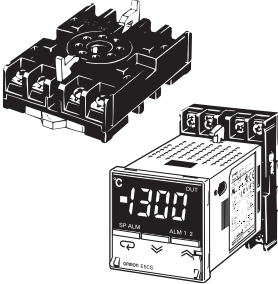
Note: Use the P2CF-08 and P3G-08 Sockets for models without alarms, and use the P2CF-11 and P3GA-11 Sockets for models with alarms.



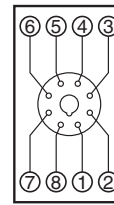
## ■ Accessories (Order Separately)

### 8-pin Sockets without Alarms

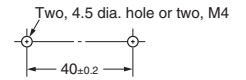
#### P2CF-08 Front Connecting Socket



Terminal Arrangement/  
Internal Connections  
(Top View)



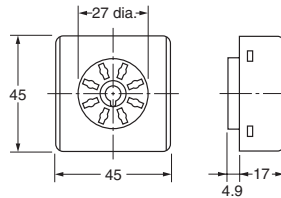
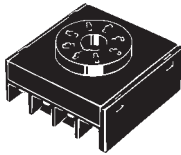
Mounting Hole Dimensions



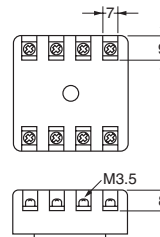
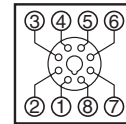
**Note:** DIN Track mounting is also possible.

**Note:** The P2CF-08-E Socket with finger protection is also available.

#### P3G-08 Back Connecting Socket



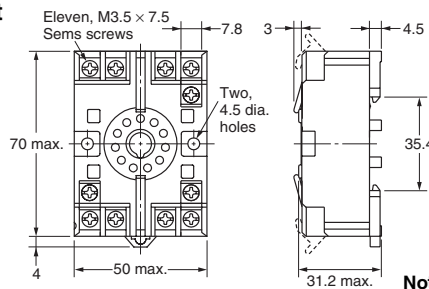
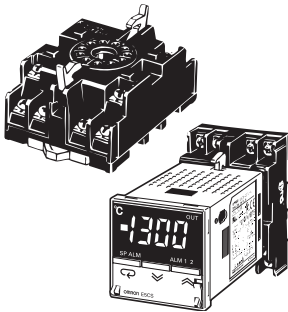
Terminal Arrangement  
(Bottom View)



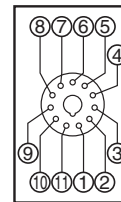
**Note:** The Y92A-48G Finger Safe Terminal Cover is also available.

### 11-pin Sockets with Alarms

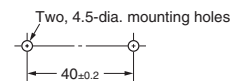
#### P2CF-11 Front Connecting Socket



Terminal Arrangement/  
Internal Connections  
(Top View)



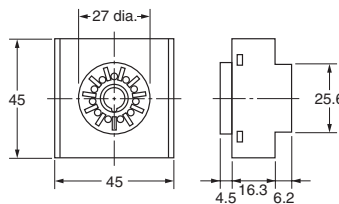
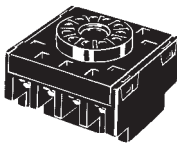
Mounting Hole Dimensions



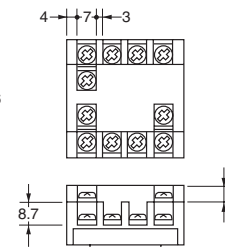
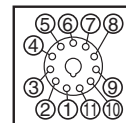
**Note:** DIN Track mounting is also possible.

**Note:** The P2CF-11-E Socket with finger protection is also available.

#### P3GA-11 Back Connecting Socket



Terminal Arrangement  
(Bottom View)



**Note:** The Y92A-48G Finger Safe Terminal Cover is also available.

**Note:** Do not use any other types of Sockets. Doing so will adversely affect the accuracy.

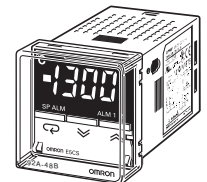
### Applicable Thermistors

Use Element Interchangeable Thermistors (E52-THE5A, E52-THE6D, and E52-THE6F) to connect to the E5CS-□GU. For details on Sensors, refer to page 6.

### Hard Protective Cover

The Y92A-48B Hard Protective Cover is available for the following applications.

- To protect the set from dust and dirt.
- To prevent the panel from being accidentally touched causing displacement of set values.
- To provide effective protection against water droplets.



# Precautions

## CAUTION

Do not touch the terminals while power is being supplied. Doing so may occasionally result in minor injury due to electric shock.



Do not allow pieces of metal, wire clippings, or fine metallic shavings or filings from installation to enter the product. Doing so may occasionally result in electric shock, fire, or malfunction.



Do not use the product where subject to flammable or explosive gas. Otherwise, minor injury from explosion may occasionally occur.



Never disassemble, modify, or repair the product or touch any of the internal parts. Minor electric shock, fire, or malfunction may occasionally occur.



### CAUTION - Risk of Fire and Electric Shock

- This product is UL listed as Open Type Process Control Equipment. It must be mounted in an enclosure that does not allow fire to escape externally.
- More than one disconnect switch may be required to de-energize the equipment before servicing the product.
- Signal inputs are SELV, limited energy. (See note 1.)
- Caution: To reduce the risk of fire or electric shock, do not interconnect the outputs of different Class 2 circuits. (See note 2.)



If the output relays are used past their life expectancy, contact fusing or burning may occasionally occur. Always consider the application conditions and use the output relays within their rated load and electrical life expectancy. The life expectancy of output relays varies considerably with the output load and switching conditions.



Loose screws may occasionally result in fire. Tighten terminal screws to the specified torque of 0.5 N·m.



Unexpected operation may result in equipment damage or accidents if the settings are not appropriate for the controlled system. Set the Temperature Controller as follows:

- Set the parameters of the Temperature Controller so that they are appropriate for the controlled system.
- Turn the power supply to the Temperature Controller OFF before changing any switch setting. Switch settings are read only when the power supply is turned ON.
- Make sure that the INIT switch in the control mode switches is turned OFF before operating the Temperature Controller.



A malfunction in the Temperature Controller may occasionally make control operations impossible or prevent alarm outputs, resulting in property damage. To maintain safety in the event of malfunction of the Temperature Controller, take appropriate safety measures, such as installing a monitoring device on a separate line.



- Note:**
- A SELV circuit is one separated from the power supply with double insulation or reinforced insulation, that does not exceed 30 V r.m.s. and 42.4 V peak or 60 VDC.
  - A class 2 power supply is one tested and certified by UL as having the current and voltage of the secondary output restricted to specific levels.

## ■ Precautions for Safe Use

Be sure to observe the following precautions to prevent operation failure, malfunction, or adverse affects on the performance and functions of the product. Not doing so may occasionally result in unexpected events.

- The product is designed for indoor use only. Do not use the product outdoors or in any of the following locations.
  - Places directly subject to heat radiated from heating equipment.
  - Places subject to splashing liquid or oil atmosphere.
  - Places subject to direct sunlight.
  - Places subject to dust or corrosive gas (in particular, sulfide gas and ammonia gas).
  - Places subject to intense temperature change.
  - Places subject to icing and condensation.
  - Places subject to vibration and large shocks.
- Use and store the product within the rated temperature and humidity ranges. Group-mounting two or more Temperature Controllers, or mounting Temperature Controllers above each other may cause heat to build up inside the Temperature Controllers, which will shorten their service life. In such a case, use forced cooling by fans or other means of air ventilation to cool down the Temperature Controllers.
- To allow heat to escape, do not block the area around the product. Do not block the ventilation holes on the product.
- Use the specified size (M3.5, width of 7.2 mm or less) crimped terminals for wiring. To connect bare wires to the terminal block, use copper braided or solid wires with a gage of AWG24 to AWG18 (equal to a cross-sectional area of 0.205 to 0.832 mm<sup>2</sup>). (The stripping length is 5 to 6 mm.) Up to two wires of the same size and type, or two crimp terminals can be inserted into a single terminal.
- Be sure to wire properly with correct polarity of terminals. Do not wire any of the I/O terminals incorrectly.
- Do not wire the terminals that are not used.
- The voltage output (control output) is not electrically isolated from the internal circuits. When using a grounded temperature sensor, do not connect any of the control output terminals to ground. Otherwise unwanted current paths will cause measurement errors.
- To avoid inductive noise, keep the wiring for the Temperature Controller's terminal block away from power cables carrying high voltages or large currents. Also, do not wire power lines together with or parallel to Temperature Controller wiring. Using shielded cables and using separate conduits or ducts is recommended. Attach a surge suppressor or noise filter to peripheral devices that generate noise (in particular, motors, transformers, solenoids, magnetic coils or other equipment that have an inductance component). When a noise filter is used at the power supply, first check the voltage or current, and attach the noise filter as close as possible to the temperature controller. Allow as much space as possible between the Temperature Controller and devices that generate powerful high frequencies (high-frequency welders, high-frequency sewing machines, etc.) or surge.
- Use the product within the rated load and power supply.

10. Use a switch, relay, or other contact so that the power supply voltage reaches the rated voltage within 2 seconds. If the applied voltage is increased gradually, the power supply may not be reset or malfunctions may occur.
11. When using PID operation (self-tuning), turn ON the power supply to the load (e.g., heater) at the same time or before turning the power supply to the Temperature Controller ON. If power is turned ON for the Temperature Controller before turning ON power supply to the load, self-tuning will not be performed properly and optimum control will not be achieved.
12. Design the system (e.g., control panel) to allow for the 2 seconds of delay required for the Temperature Controller's output to stabilize after the power is turned ON.
13. A switch or circuit breaker should be provided close to this unit. The switch or circuit breaker should be within easy reach of the operator, and must be marked as a disconnecting means for this unit.
14. Approximately 30 minutes is required for the correct temperature to be displayed after turning the power supply to the Temperature Controller ON. Turn the power supply ON at least 30 minutes prior to starting control operations.
15. Be sure that the platinum resistance thermometer type and the input type set on the Temperature Controller are the same.
16. When extending the thermocouple lead wires, always use compensating conductors suitable for the type of thermocouple. Do not extend the lead wires on a platinum resistance thermometer. Use only low-resistance wire (5  $\Omega$  max. per line) for lead wires and make sure that the resistance is the same for all three wires.
17. Static electricity may damage internal components. Always touch grounded metal to discharge any static electricity before handling the Temperature Controller.
18. Do not use paint thinner or similar chemical to clean with. Use standard grade alcohol.
19. Use tools when separating parts for disposal. Contact with the sharp internal parts may cause injury.

## ■ Precautions for Correct Use

### Service Life

Use the Temperature Controller within the following temperature and humidity ranges:

Temperature:  $-10$  to  $55^{\circ}\text{C}$  (with no icing or condensation)  
 Humidity: 25% to 85%

If the Controller is installed inside a control board, the ambient temperature must be kept to under  $55^{\circ}\text{C}$ , including the temperature around the Controller.

The service life of electronic devices like Temperature Controllers is determined not only by the number of times the relay is switched but also by the service life of internal electronic components. Component service life is affected by the ambient temperature: the higher the temperature, the shorter the service life and, the lower the temperature, the longer the service life. Therefore, the service life can be extended by lowering the temperature of the Temperature Controller.

When two or more Temperature Controllers are mounted horizontally close to each other or vertically next to one another, the internal temperature will increase due to heat radiated by the Temperature Controllers and the service life will decrease. In such a case, use forced cooling by fans or other means of air ventilation to cool down the Temperature Controllers. When providing forced cooling, however, be careful not to cool down the terminals sections alone to avoid measurement errors.

### Measurement Accuracy

When extending or connecting the thermocouple lead wire, be sure to use compensating wires that match the thermocouple type. Do not extend the lead wire of the platinum resistance thermometer. If the lead wire of the platinum resistance thermometer must be extended, be sure to use wires that have low resistance and keep the resistance of the three lead wires the same.

Mount the Temperature Controller so that it is horizontally level.

If the measurement accuracy is low, check whether the input shift has been set correctly.

### Waterproofing

The degree of protection is as shown below. Sections without any specification on their degree of protection or those with IP□0 are not waterproof.

Front panel: IP50, Enclosure Category 2 (IEC 60529)

Rear case: IP20, terminals: IP00

# Warranty and Application Considerations

## Read and Understand this Catalog

Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

## Warranty and Limitations of Liability

### WARRANTY

OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, REGARDING NON-INFRINGEMENT, MERCHANTABILITY, OR FITNESS FOR PARTICULAR PURPOSE OF THE PRODUCTS. ANY BUYER OR USER ACKNOWLEDGES THAT THE BUYER OR USER ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. OMRON DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED.

### LIMITATIONS OF LIABILITY

OMRON SHALL NOT BE RESPONSIBLE FOR SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS, OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED ON CONTRACT, WARRANTY, NEGLIGENCE, OR STRICT LIABILITY.

In no event shall the responsibility of OMRON for any act exceed the individual price of the product on which liability is asserted.

IN NO EVENT SHALL OMRON BE RESPONSIBLE FOR WARRANTY, REPAIR, OR OTHER CLAIMS REGARDING THE PRODUCTS UNLESS OMRON'S ANALYSIS CONFIRMS THAT THE PRODUCTS WERE PROPERLY HANDLED, STORED, INSTALLED, AND MAINTAINED AND NOT SUBJECT TO CONTAMINATION, ABUSE, MISUSE, OR INAPPROPRIATE MODIFICATION OR REPAIR.

## Application Considerations

### SUITABILITY FOR USE

OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

Take all necessary steps to determine the suitability of the product for the systems, machines, and equipment with which it will be used.

Know and observe all prohibitions of use applicable to this product.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

## Disclaimers

### PERFORMANCE DATA

Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON *Warranty and Limitations of Liability*.

### CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons. Consult with your OMRON representative at any time to confirm actual specifications of purchased product.

### DIMENSIONS AND WEIGHTS

Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

### ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.

To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. H139-E1-01 **In the interest of product improvement, specifications are subject to change without notice.**

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