OMRON ®

1/16 DIN Temperature Controller	**E5CS**

Automatic Adjustment and PID Control in a 48x48-mm Package

- Control accuracy to ±1% of full scale

- Selectable temperature ranges in °C or °F

- Easy-to-read 13.4-mm high LED display

- Models for thermocouple types J/L and K inputs and platinum RTD inputs

- PID and ON/OFF control modes

- Wide power supply range: 100 to 240 VAC, 50/60 Hz

- Tamper-proof setting, faulty sensor detection and controller diagnostics

C€ ℝ𝕌 ⑤

Ordering Information

■ TEMPERATURE CONTROLLERS

Item		Part number	
Sensor input type		Thermocouple (Types J/L and K)	Platinum RTD (Pt: 100 Ω, DIN and JIS standards)
Output	Contact	**E5CS-RKJ**	**E5CS-RP**
	Voltage	**E5CS-QKJ**	**E5CS-QP**

Temperature Ranges

Thermocouple Input Type

Input type	Type K						Type J/L				
Temperature range	0 to 200	0 to 300	0 to 400	0 to 500	0 to 600	0 to 999	0 to 999	0 to 200	0 to 300	0 to 400	0 to 500
Scale indication	°C	°C	°C/°F	°C/°F	°C/°F	°C/°F	°F	°C	°C	°C/°F	°C/°F
Unit of measure	1° C or F										

Platinum RTD Input Type

Temperature range	–50 to 50	0.0 to 50.0	–20 to 80	0.0 to 99.9	0 to 200	0 to 300	0 to 400	0 to 600	0 to 800
Scale indication	°C	°C	°C	°C/°F	°C/°F	°C	°C/°F	°F	°F
Unit of measure	1°C	0.1°C	1°C	0.1° C or F	1° C or F	1°C	1° C or F	1°F	1°F

■ ACCESSORIES (ORDER SEPARATELY)

Description		Part number
8-pin round socket	DIN rail or surface mounting (terminals on front)	**P2CF-08**
Protective cover	Hard plastic; protects front panel against dust, dirt and water drops	**Y92A-48**
Panel mounting adapter	Replacement for one supplied with each unit	**Y92F-30**
DIN rail mounting track	1 m (3.28 ft) length, 7.3 mm thick	**PFP-100N**
	50 cm (1.64 ft) length, 7.3 mm thick	**PFP-50N**
	End plate	**PFP-M**
	Spacer	**PFP-S**

Specifications ————————————————————————————————

Part number			E5CS-☐KJ	E5CS-☐P
Sensor input type			Thermocouple Type J/L (IC) and Type K (CA)	Platinum RTD (Pt: 100Ω) DIN or JIS standard
Supply voltage			100 to 240 VAC, 50/60 Hz; operates on 85 to 110% of rated voltage	
Power consumption			Approx. 7 VA	
Control output	Contact	Type	SPDT relay	
		Max. load	3 A, 250 VAC (resistive load)	
	Voltage	Logic load	12 VDC, 20 mA with short-circuit protection	
	Hysteresis		0.2% of full scale during ON/OFF control action	
	Response time	Output	2 seconds for output to change	
		Display	2 seconds for displayed indication to change	
	Service life	Mechanical	10 million operation minimum with contact output	
		Electrical	100,000 operations minimum with contact output	
Setting method			Digital setting via up and down keys	
Setting accuracy			Set value coincides with indicated value, so no relative error exists	
Indication accuracy			±1% of full scale, ±1 digit max.	
Display range			−999 to 999 (limited to input type)	
Control modes	Type		ON/OFF and PID with automatic tuning of proportional band, switch selectable	
	Proportional band		3% to 20% (in PID mode) automatically adjusted according to the rise time of the controlled system	
	Integral time		4 minutes, fixed (in PID mode)	
	Derivative time		0.4 minutes, fixed (in PID mode)	
	Proportional period		2 or 20 seconds, switch selectable	
	Sampling period		500 ms	
Materials			Plastic case	
Mounting			Fits 1/16 DIN panel cutout; includes panel mounting adapter	
Connections			8-pin round socket	
Weight			130 g (4.6 oz.) without mounting adapter	
Enclosure ratings		Front panel	IP50	
		Rear panel	IP20	
		Terminals	IP00	
Approvals		UL	Recognized, File Number E68481	
		CSA	Certified, File Number LR59623	
		CE	Conforms to EN50081-2, EN50082-2, EN61010-1 (IEC61010-1)	
Ambient temperature		Operating	−10°C to 55°C (14°F to 131°F)	
		Storage	−25°C to 65°C (−13°F to 149°F)	
Humidity			35 to 85% RH	
Insulation resistance			20 MΩ minimum at 500 VDC	
Dielectric strength			2,000 VAC, 50/60 Hz for 1 minute between current-carrying terminals of different polarity	
Vibration	Mechanical durability		10 to 55 Hz, 0.75 mm (0.03 in) double amplitude in X, Y, and Z directions for 2 hours each	
	Malfunction durability		2 to 55 Hz, 19.6 m/s^2 in X, Y, and Z directions for 10 minutes each	
Shock	Mechanical durability		294 m/s^2, in 6 directions, 3 times each	
	Malfunction durability		98 m/s^2, in 6 directions, 3 times each	
Memory protection			Non-volatile memory	

Dimensions

Unit: mm (inch)
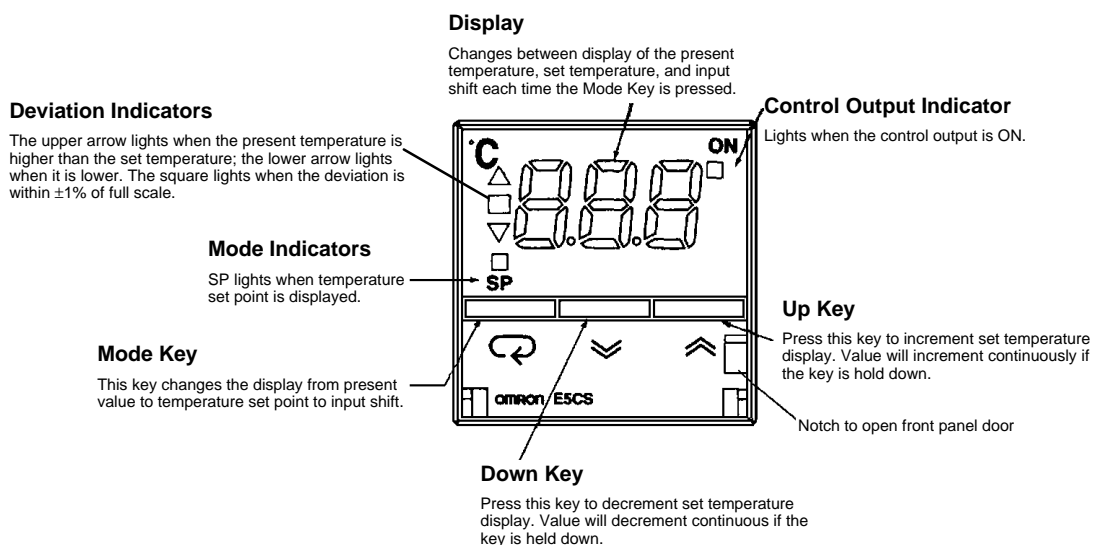
■ E5CS WITH TERMINAL ARRANGEMENT

94.5 (3.72)
72.5 (2.85)
8
6.25
14 (0.55)
48 (1.89)
44.8 (1.76)

℃

Terminal Arrangement (Bottom View)

④ ⑤
③ ⑥
② ⑦
① ⑧

■ E5CS WITH MOUNTING SOCKET

Track/Surface Mounting Socket P2CF-08

Eight M3.5 x 7.5 Sems screws

7.8
3
4.5
70 (2.76)
35.4
Two 4.5-dia. holes
50 (1.97)
20.3 (0.80)

Terminal Arrangement (Top View)

⑥ ⑤ ④ ③
⑦ ⑧ ① ②

Mounting Holes

Two 4.5-dia. holes or M4

40 (1.57)

Nomenclature

Display

Changes between display of the present temperature, set temperature, and input shift each time the Mode Key is pressed.

Deviation Indicators

The upper arrow lights when the present temperature is higher than the set temperature; the lower arrow lights when it is lower. The square lights when the deviation is within ±1% of full scale.

Control Output Indicator

Lights when the control output is ON.

Mode Indicators

SP lights when temperature set point is displayed.

Mode Key

This key changes the display from present value to temperature set point to input shift.

Up Key

Press this key to increment set temperature display. Value will increment continuously if the key is hold down.

Notch to open front panel door

omron/E5CS

Down Key

Press this key to decrement set temperature display. Value will decrement continuous if the key is held down.

Operation

■ SETTINGS BEFORE APPLYING POWER

Note: Always turn off the power supply to the temperature control-
ler before changing any switch settings.

Before applying power to the temperature controller, set the
following selector switches to specify the temperature range,
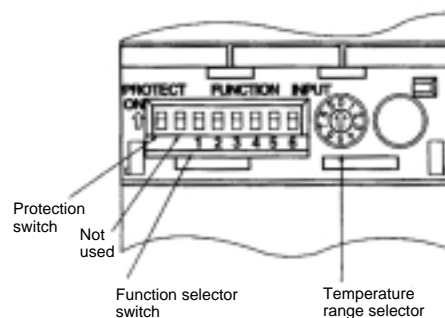functions and alarm mode.

■ SWITCH AND SELECTOR LOCATIONS

The temperature range selector and the alarm mode selector on
models where alarm is available, must all be set. A protection
switch on the in-line function selector switch can be set to protect
temperature settings. The following diagram shows the locations
of these switches behind the front panel door.

Select the desired temperature range by using the temperature
range selector switch (rotary DIP type). Be sure the set
temperature value is within the new range. Otherwise, the
temperature controller automatically shifts these values to the
maximum or minimum of the newly-set temperature range.

The protection switch prevents unauthorized changes to
temperature settings. When the switch is set to ON, the display
selector will operate, but the Up and Down keys will not.

The function selector switch is an 8-pin in-line DIP switch behind
the front panel door. Use it to select ON/OFF or PID control
action, proportional period, control output, input shift function,
temperature sensor input standard and scale indication for
dual-scale temperature ranges.

Protection switch
Not used
Function selector switch
Temperature range selector

■ FUNCTION SELECTOR SWITCH

The function selector switch is an 8-pin in-line DIP switch. The
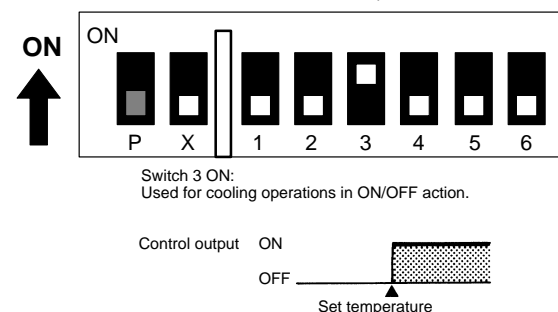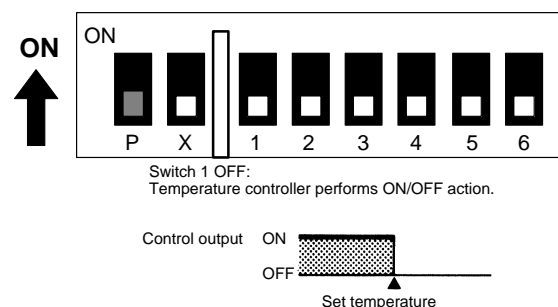following table shows the selection made by each switch position.

Function	Switch number	P	X	1	2	3	4	5	6
Key protection for Up/Down keys	Enables protection	ON							
	Disables protection	OFF							
Used for factory-authorized calibration only	Not used in normal operation		ON						
			OFF						
Control mode	PID action			ON					
	ON/OFF action			OFF					
Proportional period	2 seconds				ON				
	20 seconds				OFF				
Control output	Normal					ON			
	Reverse					OFF			
Input shift function	Enabled						ON		
	Disabled						OFF		
Temperature sensor input standard	Type K, L thermocouple, Pt100 = 138.50 Ω							ON	
	Type J, K thermocouple, JPt100 = 139.16 Ω							OFF	
Scale indication for dual-scale range selection	°F								ON
	°C								OFF
Factory-set switch settings		OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

■ CONTROL MODE SELECTION

ON/OFF Action

Switch 1 of the function selector DIP switch is factory-set to OFF, so the temperature controller performs ON/OFF control action. Set switch 3 to ON when the temperature controller is used to control a cooling device such as a chiller or freezer.
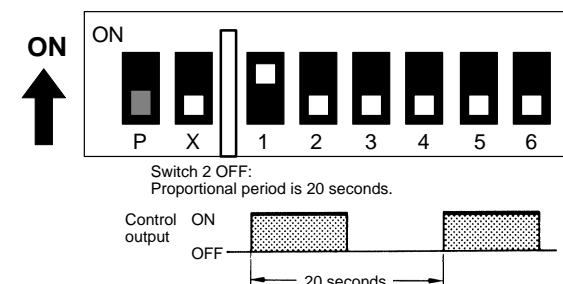

Switch 1 OFF:
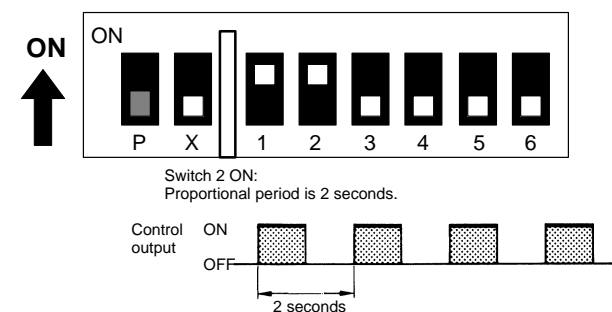Temperature controller performs ON/OFF action.

Switch 3 ON:
Used for cooling operations in ON/OFF action.

PID Action

Set switch 1 of the function selector DIP switch to ON to perform PID control action. Follow the steps described below.

Determining Proportional Period

Set switch 2 to OFF to select a proportional period of 20 seconds. This is used when the PID control action is performed with the contact output of the temperature controller, or when using an external relay or contactor.
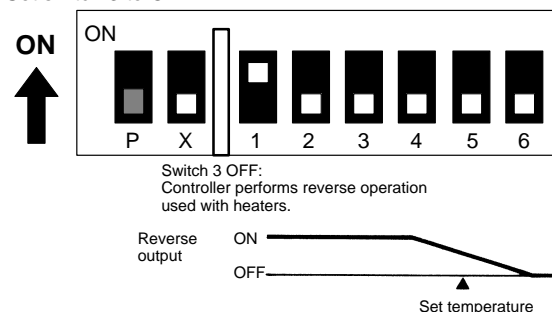

Switch 2 OFF:
Proportional period is 20 seconds.

When a quick response in required, set switch 2 to ON to select a proportional period of 2 seconds. Even when a solid state relay (SSR) is used, set the 2-second proportional period only when quick response is essential. Avoid using this setting with a contact output because it will shorten the relay's service life.
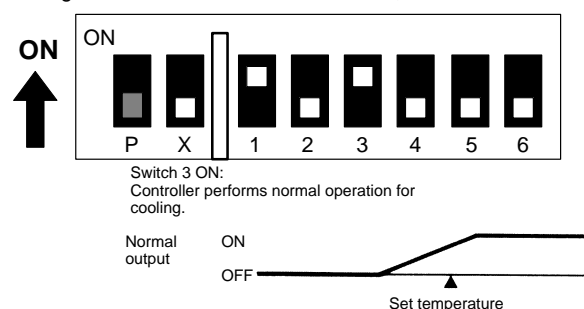

Switch 2 ON:
Proportional period is 2 seconds.

Determining Control Output Operation

If the temperature controller is used to control a heater, the control output can be set to perform a reverse (inverted) operation. Set switch 3 to OFF.

Switch 3 OFF:
Controller performs reverse operation used with heaters.

By contrast, if the temperature controller is used to control a cooling device such as a chiller or freezer, set switch 3 to ON.

Switch 3 ON:
Controller performs normal operation for cooling.

Auto-tuning of Proportional Band

Upon the initial power-up the proportional band is set to 3%. The optimum proportional band width, however, is automatically calculated and set within the range of 3 to 20%, according to the changes in the temperature of the controlled system. This automatic adjustment of the proportional band is performed regardless of whether the controlled system is a heating or cooling system.
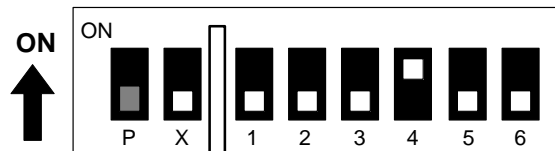
When the power is turned OFF once, and the ON again, the control action starts with the previous proportional band. However, the new proportional band is automatically calculated and set.

The calculation of the proportional band, however, is not carried out if the temperature of the controlled system changes at a faster rate than 7.5% of full scale per 2 seconds (e.g., faster then 3.75% per °C per second with eh full scale of 100°C). In this case, the previously calculated and set proportional band is used.

The temperature controller has an overshoot suppression function that reduced second and subsequent overshoots to a level less than the initial overshoot.

■ INPUT SHIFT FUNCTION

The temperature indication can be shifted by setting switch 4 to ON, and pressing the mode key repeatedly until the message "H0" (indicating input shift) is displayed on the main display. Then set the shift value by using the Up or Down key and cycle power.

Switch 4 ON: Input shift function enabled.

Fine adjustment of the temperature indication and the resulting controlled temperature is possible without changing or affecting the set point.

The input shift value can be set within the range from –99.9 to 99 (°F or °C).

For ranges that have resolution to 0.1, the input shift value can be set within the range from –9.9 to 9.9 (°F or °C. The input shift function may be useful to make small temperature corrections to the control system.

Note that the offset value remains effective even after switch 4 has been set to OFF. If the compensation action is not needed, be sure to set the offset value to 0.

For example:

● correction of known sensor calibration errors

● correction of known steady temperature offset between the heated work piece (load) and sensor. This is useful for applications where the sensor cannot be located exactly at the work piece.

● alignment of temperature indications in a multi-zone/multi-controller application, e.g., at ambient temperature

Note that the input shift changes the value of the controlled temperature when used in closed loop control. For example, with a set point and indication of 100°C and input shift set at +10°C, the controlled temperature will be 90°C.

Main display	Set input shift value	Temperature measured by sensor	Displayed temperature
H 0	0 offset	100°C	100°C
H 9	offset by +9°	100°C	109°C
L 9	offset by –9°	100°C	91°C

■ MATCHING THE CONTROLLER TO SENSOR STANDARD

Use switch 5 of the function selector DIP switch to match the controller to the thermocouple or RTD sensor to be used.

With switch 5 ON, the controller will accept DIN standard sensors for K and L thermocouples and Pt100 RTDs. With switch 5 OFF, the controller accepts JIS standard sensors for K and J thermocouples and JPt100 RTDs.
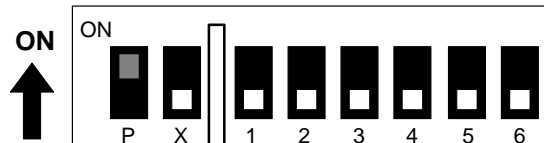
■ SELECTING SCALE INDICATION

Some dual-scale (°C/°F) temperature scale ranges may be selected by rotary DIP switch. To specify the scale indication to be displayed, used switch 6 on the function selector DIP switch.

With switch 6 set to ON, the controller displays Fahrenheit scale. With switch 6 set to OFF, the controller displays Celsius scale.

■ SETTING KEY PROTECTION

Protect against unauthorized changes in temperature values by disabling the operation of Up and Down keys. Set function selector DIP switch "P" to ON. To enable changes from the front panel, simultaneously press the hidden write protection key (lower left corner) with the Up and Down keys. If the internal protection switch is set to OFF, changes can be made simply by pressing the Up and Down keys.

■ SELECTING A SCALE RANGE

Use the rotary DIP switch to select the temperature scale range. The tables below show the switch setting number for each range. The temperature indication range is the set temperature range (full scale) ±10%, unless otherwise noted.

If the set temperature is shifted outside of changing the scale range, the set temperature is displayed. It is then automatically changed to the maximum or minimum value of the newly set temperature scale range.

Thermocouple Input Type

Thermocouple input models are factory-set to switch position 2 for a temperature range of 0° to 400°, using a type K thermocouple.

In Celsius ranges, the display can indicate temperatures 10% beyond the set temperature range. In Fahrenheit ranges, the display can indicate temperatures from 5% below the range to 10% above the range.

Do not set the temperature range selector to a setting for which a range does not exist.

Thermocouple type	Type K						Types J/L				
Switch setting	0	1	2	3	4	5	6	6	7	8	9
Temperature range	0 to 200	0 to 300	0 to 400	0 to 500	0 to 600	0 to 999	0 to 999	0 to 200	0 to 300	0 to 400	0 to 500
Scale indication	°C	°C	°C/°F	°C/°F	°C/°F	°C/°F	°F	°C	°C	°C/°F	°C/°F
Unit of measure	1° C or F										

Platinum RTD Type

Platinum RTD input models are factory-set to switch position 3 for a temperature range of 0.0° to 99.9°.

In Celsius ranges, the display can indicate temperatures up to 10% beyond the set temperature range. In Fahrenheit ranges, the display can indicate temperatures from 5% below the range to 10% above the range.

Switch setting	0	1	2	3	4	5	6	7	8
Temperature range	−50 to 50	0.0 to 50.0	−20 to 80	0.0 to 99.9	0 to 200	0 to 300	0 to 400	0 to 600	0 to 800
Scale indication	°C	°C	°C	°C/°F	°C/°F	°C	°C/°F	°F	°F
Unit of measure	1°C	0.1°C	1°C	0.1° C or F	1° C or F	1°C	1° C or F	1°F	1°F

Note: 1. Do not set the selector switch to position 9. This will cause error message "FFF" or "‒‒‒" to be displayed.

2. When changing scale ranges where the unit of measure changes 1° to 0.1° or vice versa, the set temperature also changes to reflect the unit of measure. For example, with a set temperature of 100°, a change from a scale range with 1° resolution to 0.1° makes the set temperature 10°; with a set temperature of 15°, a change in scale range resolution from 0.1° to 1° makes the set temperature 150°.
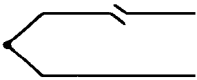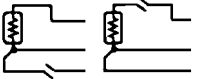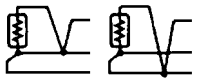
■ DIAGNOSTIC ERROR MESSAGES

The E5CS temperature controller has self-diagnostic functions that display the following error messages to simplify troubleshooting.

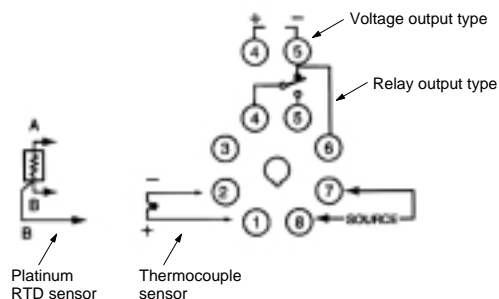| Message	Cause	Control output
FFF	Temperature has risen beyond temperature scale range	OFF during heating (reverse) operation ON during cooling (normal) operation
‒ ‒ ‒	Temperature has fallen below temperature scale range	ON during heating (reverse) operation OFF during cooling (normal) operation
FFF (blinks)*	(1) Failure has occurred in thermocouple or platinum RTD (2) Temperature has risen much beyond scale range	OFF
‒ ‒ ‒ (blinks)*	(1) Failure has occurred in platinum RTD (2) Polarities (positive and negative) of thermocouple are reversed (3) Temperature has fallen much below scale range	OFF
E 11 or E33 *	(1) Memory failure (E11) display (2) Analog-to-digital converter failure (E33) display Turn the power OFF then back ON again. If the display remains the same, the E5CS controller must be repaired.	Both control outputs are OFF

Note: *Key operations are disabled.

■ SENSOR FAILURE INDICATION

Condition		Display	Control output
Thermocouple sensor			
Break in sensor		FFF blinks	OFF
Short-circuit		Ambient temperature	OFF
Platinum RTD sensor			
Break in sensor		FFF blinks	OFF
		$---$ blinks	OFF
	Disconnection of two or three wires	FFF blinks	OFF
Short-circuit		$---$ blinks	OFF

Note: The resistance of the platinum RTD is 100 Ω at 0°C and increases to 140 Ω at 100°C.
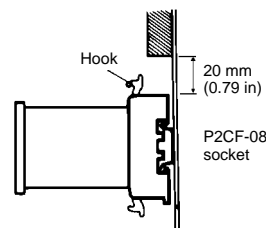
Installation

■ INTERNAL CONNECTIONS (TOP VIEW)

■ TRACK MOUNTING

Be sure to allow 20 mm (0.79 in) of clearance above and below the socket to release the hooks securing the temperature controller to the P2CF socket.

Precautions

■ ENVIRONMENT

Do not install the temperature controller in a location where there is a lot of dust or corrosive gases. Also avoid a location where the temperature controller is subjected to heavy vibration, shock, splashes of water or oil, and high temperatures.
Separate the temperature controller from equipment that generates strong, high-frequency electrical noise such as welding equipment.

■ SENSOR INPUT CONNECTIONS

The lead wires connecting the platinum RTD to the temperature controller must be separated from the power lines an the load lines, wherever possible, to prevent them from being inducted by electrical noise.

Use the specified compensating conductors for the thermocouple input type temperature controllers.

Use lead wires having a small resistance for the platinum RTD type temperature controllers.

■ USE IN SEQUENCED CIRCUITS

Several seconds are required until the relay is turned ON after the power has been applied to the temperature controller. Be sure to take this time lag into consideration when designing a sequence circuit which incorporates this temperature controller.

■ HOUSING

The case of E5CS is not designed to be opened. Do not attempt to open it.

To clean the case, sue a neutral detergent or alcohol. Do not use organic solvents such as thinners or benzene, or strong acid or alkali solutions.

NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.