

# OMRON

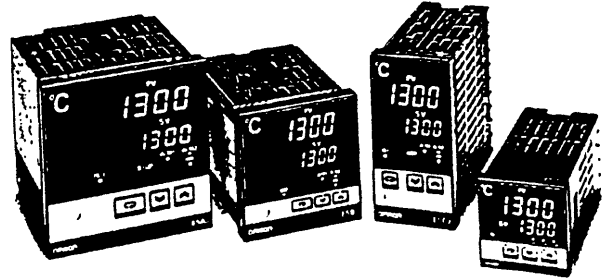
474, 459, 460, 434, 496, 514, 526.

## Temperature Controller

E5□J

### Fuzzy Self-tuning Temperature Controller with Advanced PID (2-PID) Control

- DIN-size:  
96 x 96 mm (E5AJ), 72 x 72 mm (E5BJ),  
48 x 48 mm (E5CJ), 48 x 96 mm (E5EJ)
- Fuzzy self-tuning continuously optimizes temperature control.
- Minimal user setup.
- Dual set point, selectable by external input.
- RUN/STOP operation (E5AJ/E5EJ) by external input.
- Front panel protection conforming to IP54 on E5AJ/E5EJ/E5BJ, IP66/NEMA4 with optional cover.
- Serial communications models (E5AJ/E5EJ).
- Relay, voltage or 12-bit 4-20 mA outputs.



## Ordering Information

### Temperature Controllers

Item	Standard	Communications		
		RS-232C	RS-422	RS-485
Model	E5AJ-A2HB E5EJ-A2HB E5BJ-A2HB	E5AJ-A2H01 E5EJ-A2H01	E5AJ-A2H02 E5EJ-A2H02	E5AJ-A2H03 E5EJ-A2H03

Item	Standard			Model with single function					
	Two alarm points; one event input			Two alarm points; without event input			Without alarm and event input		
	Relay output	Voltage output	Current output	Relay output	Voltage output	Current output	Relay output	Voltage output	Current output
Model	E5CJ-R2HB	E5CJ-Q2HB	E5CJ-C2B	E5CJ-R2	E5CJ-Q2	E5CJ-C2	E5CJ-R	E5CJ-Q	E5CJ-C

- Note:
1. Be sure to specify Control Output Unit and Current Transformer as necessary when ordering. (E5AJ/E5EJ/E5BJ)  
Example: E5AJ-A2HB, Relay-Output Unit E53-R, Current Transformer E54-CT1
  2. The heater burnout alarm is not available when the E5□J is used with the E53-C3.
  3. Ask your OMRON representative for the "E5AJ/E5EJ Communications Manual" when using a model incorporating a communications function.

### Current Transformers (CT) (Sold Separately)

Hole diameter	5.8 mm	12.0 mm
Model	E54-CT1	E54-CT3

- Note: The CT provided with the E5EH or E5EL cannot be used.  
No CT is required unless the heater burnout alarm function is used.

## ■ Temperature Ranges

Input (switch selectable)		Thermocouple				Platinum Resistance Thermometer
		K (CA) Chromel vs. alumel	J (IC)/L Iron vs. constantan	T (CC)/U Copper vs. constantan	N Nichrosil vs. nisil	JPt100/Pt100
Range	°C	-200 to 1,300	-100 to 850	-199.9 to 400.0	-200 to 1,300	-199.9 to 650.0
	°F	-300 to 2,300	-100 to 1,500	-199.9 to 700.0	-300 to 2,300	-199.9 to 999.9
Resolution (°C/°F) (main settings and alarm)		1	1	0.1	1	0.1

## Specifications

### ■ Ratings

Supply voltage	100 to 240 VAC, 50/60 Hz
Operating voltage range	85% to 110% of rated supply voltage
Power consumption	E5AJ/E5EJ: Approx. 10 VA (at 100 VAC) to 14 VA (at 240 VAC) E5BJ/E5CJ: Approx. 10 VA (at 100 VAC) to 12 VA (at 240 VAC)
Input	Thermocouple (K/J/T/L/U/N) or platinum resistance thermometer (JPt100/Pt100), selectable
Current Transformer input	Connect an exclusive Current Transformer unit (E54-CT1 or E54-CT3)
Control output	See Output Unit Ratings (Control Output Units are sold separately.)
Control mode	ON/OFF or PID control (2-PID) with fuzzy self-tuning.
Alarm output	E5AJ/E5BJ/E5EJ: Relay output, 2 independent SPST-NO contacts; 3 A, 250 VAC E5CJ: Common 2 outputs, 2 independent SPST-NO contacts, 1 A, 250 VAC
Setting method	Digital setting via Up and Down Keys
Indication method	Digital indications Character heights: E5AJ: PV: 15 mm, SV: 10.5mm E5EJ/E5BJ: PV: 14 mm, SV: 9.5 mm E5CJ: PV: 12 mm, SV: 8 mm
Event input	Contact input: ON: 1 kΩ max., OFF: 100 kΩ min. No-contact input: ON: residual voltage: 3 V max., OFF: leakage current: 1 mA max.
Other functions	Key protection Normal and reverse output selection Multiple SP (two set points; up to four set points available on E5AJ/E5EJ by engineering level) RUN/STOP (selected via external terminals) (E5AJ, E5EJ) Heater burnout detection

Note: It is possible to add other functions from the engineering level. Refer to the "E5□J Operation Manual", obtainable from your OMRON representative, for details.

### ■ Output Unit Ratings

No output is photoelectrically insulated from the event input.

Relay Output Unit (see note 2)	E53-R	SPDT, 5 A (E5CJ: 3 A) at 250 VAC (resistive load)
Voltage Output Unit (for driving SSR) (see note 3)	E53-Q	NPN, 40 mA (E5CJ: 20 mA) at 12 VDC (with short-circuit protection)
	E53-Q3	NPN, 20 mA at 24 VDC (with short-circuit protection)
	E53-Q4	PNP, 20 mA at 24 VDC (with short-circuit protection)
Current Output Unit (see note 1 and 4)	E53-C3	4 to 20 mA; DC: 600 Ω max.; resolution: 2,600

- Note:
- The current output is not a transmission output.  
The E53-C Current Output Unit cannot be used with the E5□J.
  - The contact configuration will be SPST-NO when used with the E5□J.
  - The Voltage Output Unit with an output current of 20 mA at 24 VDC (with short-circuit protection) can be produced.
  - No heater burnout alarm is available if the Current Output Unit is used with the E5□J.

## ■ Current Transformer Ratings

Max. continuous heater current	50 A
Dielectric strength	1,000 VAC
Vibration resistance	50 Hz, 98 m/s <sup>2</sup> (10G)
Weight	E54-CT1: Approx. 11.5 g; E54-CT3: Approx. 50 g
Accessories (E54-CT3 only)	Contact: 2; Plug: 2

## ■ Characteristics

Indication accuracy (see note 1)	(±0.5% of indication value or ±1°C, whichever greater) ±1 digit max.
Hysteresis	0.1° to 999.9°C/°F (in units of 0.1°C/°F) (during ON/OFF control action)
Proportional band	0.1° to 999.9°C/°F (in units of 0.1°C/°F)
Integral (reset) time	0 to 3,999 s (in units of 1 s)
Derivative (rate) time	0 to 3,999 s (in units of 1 s)
Alarm output setting range	Thermocouple (K/J/L/N): -1,999° to 9,999°C/°F (in units of 1°C/°F) Platinum resistance thermometer, thermocouple (T/U): -199.9° to 999.9°C/°F (in units of 0.1°C/°F)
Control period	Pulse output: 1 to 99 s (in units of 1 s)
Sampling period	500 ms
Output refresh time	500 ms
Display refresh time	500 ms
Insulation resistance (see note 2)	20 MΩ min. (at 500 VDC)
Dielectric strength	2,000 VAC, 50/60 Hz for 1 min between terminals of different polarities
Vibration resistance	Malfunition: 10 to 55 Hz, 9.8 m/s <sup>2</sup> (1G) for 10 min each in X, Y, and Z directions Destruction: 10 to 55 Hz, 19.6 m/s <sup>2</sup> (2G) for 2 hrs each in X, Y, and Z directions
Shock resistance	Malfunition: 196 m/s <sup>2</sup> (20G), 3 times each in 6 directions (98 m/s <sup>2</sup> (10G) applied to the relay) Destruction: 294 m/s <sup>2</sup> (30G), 3 times each in 6 directions
Life expectancy	Mechanical: 10,000,000 operations (relay alarm output) Electrical: 100,000 operations (relay alarm output)
Ambient temperature	Operating: -10°C to 55°C (with no icing) Storage: -25°C to 65°C (with no icing)
Ambient humidity	Operating: 35% to 85%
Memory protection	Non-volatile memory
Enclosure ratings	Front panel: E5AJ/E5EJ/E5BJ: IEC standard IP54 E5CJ: IEC standard IP50 (see note 3) Rear case: IEC standard IP20 Terminals: IEC standard IP00
Weight	E5AJ: Approx. 360 g, E5EJ: Approx. 280 g, E5BJ: Approx. 240 g, E5CJ: Approx. 170 g; Mounting adapter: approx. 10 g; Mounting bracket: Approx. 65 g

Note: 1. The indication accuracy of the K, T, and N thermocouples at a temperature of -100°C or less is ±2°C±1 digit maximum. The indication accuracy of the U thermocouple at any temperature is ±2°C±1 digit maximum.

2. The insulation resistance was measured with a Control Output Unit attached.

3. The model number of the exclusive watertight cover conforming to IP66, NEMA4 is as follows:  
For E5AJ: Y92A-96N; For E5BJ: Y92A-72N; For E5CJ: Y92A-48N; For E5EJ: Y92A-49N

## ■ Output Unit Characteristics

Relay unit life expectancy	Mechanical: 10,000,000 operations min. Electrical: 100,000 operations min.
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## ■ Communications (E5AJ/E5EJ)

Protocol		RS-232C, RS-422, RS-485
Transmission method		Half-duplex
Synchronization method		Start-stop synchronization (asynchronous method)
Baud rate		1,200/2,400/4,800/9,600/19,200 bps
Transmission code		ASCII
Communications	Write to Temperature Controller	Set point, alarm value, remote/local selection etc. (proportional band, integral time, derivative time) (see note 3)
	Read from Temperature Controller	Process value, output value, set point, alarm value, heater current value, initial status, etc. (proportional band, integral time, derivative time) (see note 3)

- Note:**
1. The maximum total cable length must not exceed the following limits.  
RS-422: 500 m, RS-232C: 15 m, RS-485: 500 m
  2. The number of connecting Units including the host computer via RS-485 or RS-422 is 32.
  3. If the E5AJ is in ON/OFF control mode or PID control mode (2-PID) with fuzzy self-tuning, an undefined error will result if the proportional band, integral time, or derivative time command is transmitted.

## Nomenclature

### E5CJ

#### Set Value (SV) Display

Displays the output value and set value of each setting item besides the set value.

#### Output Indicator

Lights when the control output is ON. In current output mode, however, the output indicator will not be lit.

#### Level Key

Press for 1 second minimum to change levels to set different groups of parameters.

#### Display Key

Press to shift the display to the next parameter.

#### Process Value (PV) display

Displays the process value, the character for the parameter being displayed on the SV display, and error messages.

#### Heater Burnout Indicator

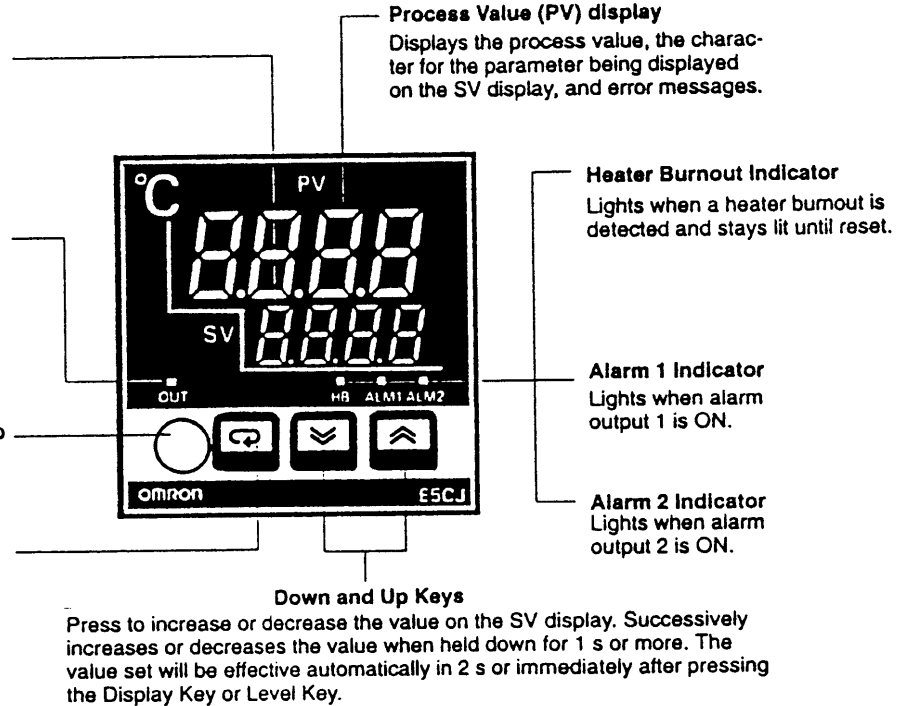
Lights when a heater burnout is detected and stays lit until reset.

#### Alarm 1 Indicator

Lights when alarm output 1 is ON.

#### Alarm 2 Indicator

Lights when alarm output 2 is ON.



#### Down and Up Keys

Press to increase or decrease the value on the SV display. Successively increases or decreases the value when held down for 1 s or more. The value set will be effective automatically in 2 s or immediately after pressing the Display Key or Level Key.

**Note:** There are models that do not incorporate HB, ALM1, and ALM2 indicators.

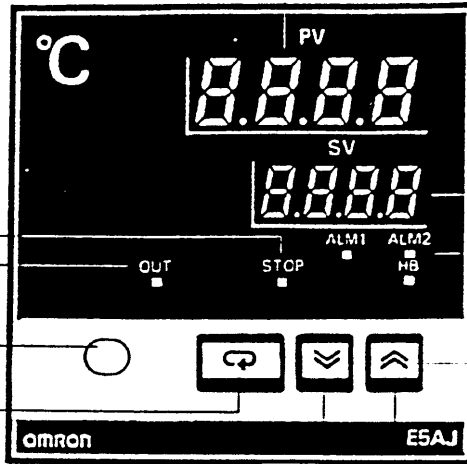
E5AJ/E5BJ/E5EJ

**Stop Indicator**  
Lights when the Temperature Controller is not in operation. The E5BJ or any other E5□J model with a communications function does not incorporate a stop indicator.

**Output Indicator**  
Lights when the control output is ON. In current output mode, however, the output indicator will not be lit.

**Level Key**  
Press for 1 second minimum to change levels to set different groups of parameters.

**Display Key**  
Press to shift the display to the next parameter.



**Process Value (PV) display**  
Displays the process value, the character for the parameter being displayed on the SV display, and error messages.

**Set Value (SV) Display**  
Displays the output value and set value of each setting item besides the set value.

**Alarm 1 Indicator**  
Lights when alarm output 1 is ON.

**Alarm 2 Indicator**  
Lights when alarm output 2 is ON.

**Heater Burnout Indicator**  
Lights when a heater burnout is detected and stays lit until reset.

**Down and Up Keys**

Press to increase or decrease the value on the SV display. Successively increases or decreases the value when held down for 1 s or more. The value set will be effective automatically in 2 s or immediately after pressing the Display Key or Level Key.

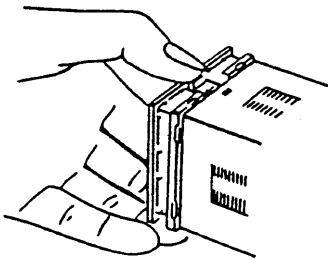
## Operation

**NOTICE:** Always turn off the power supply to the Temperature Controller before changing any switch settings.

### ■ Settings

#### E5CJ

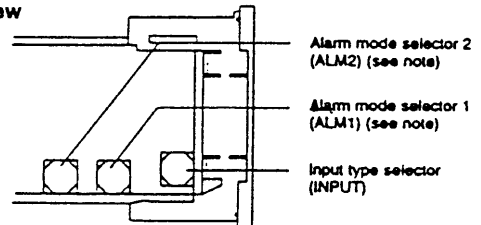
Remove the internal mechanism from the housing. Pull out the internal mechanism while pressing the hook at the bottom of the front panel.



#### Internal Switches

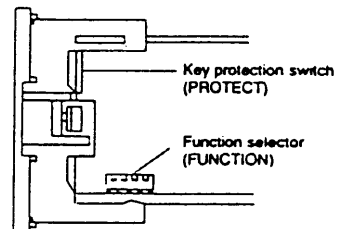
##### E5CJ

##### Top View



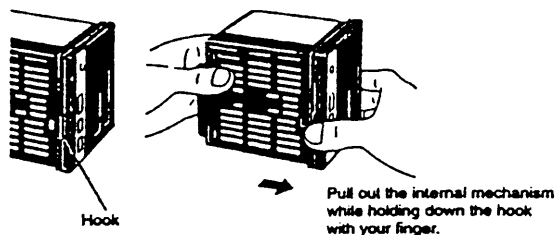
**Note:** A model with no alarm does not incorporate an alarm mode selector.

##### Bottom View

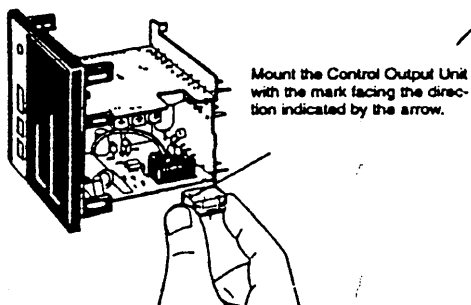


**E5AJ/E5BJ/E5EJ**

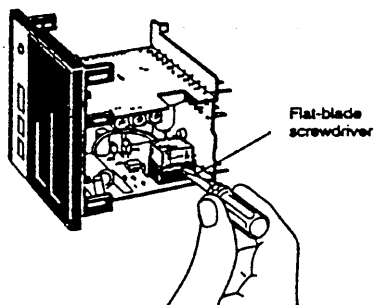
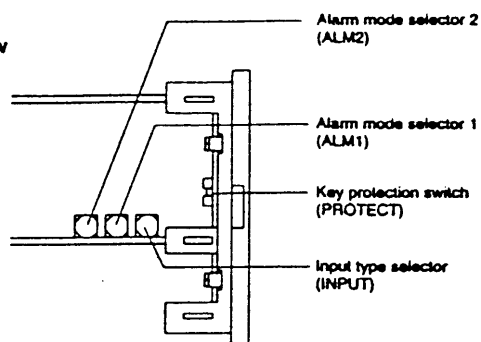
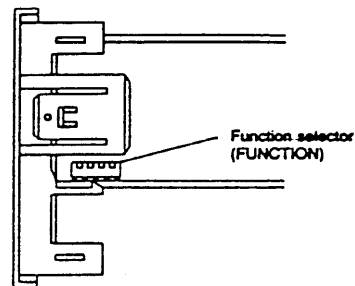
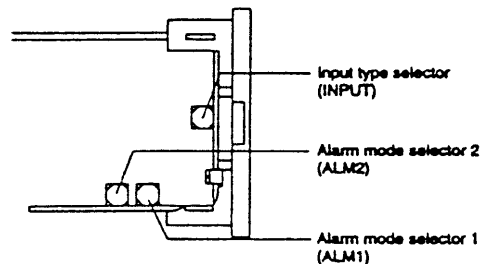
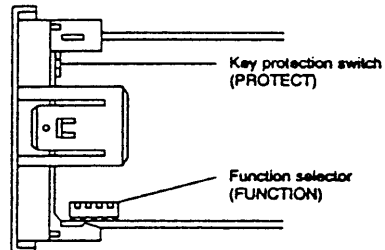
1. Remove the internal mechanism from the housing. Pull out the internal mechanism while pressing the hook at the bottom of the front panel.



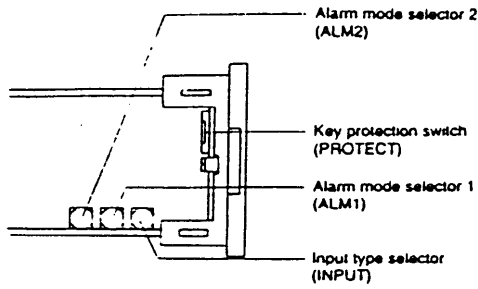
2. Connect a Control Output Unit to the vacant socket on the printed circuit board as shown below.



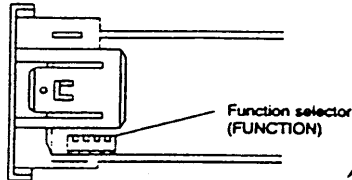
To remove a Control Output Unit, push it up with the tip of a flat-blade screwdriver as shown below.

**Internal Switches****E5AJ****Top View****Bottom View****E5BJ****Top View****Bottom View**

### E5EJ Top View



### Bottom View



## ■ Input Type Selector (INPUT)



This selector selects the temperature sensor to be used. It is factory-set to position 2 to designate a K-type (chromel-alumel thermocouple) temperature sensor. The following table lists the other possible settings for temperature sensors. Refer to temperature range charts under *Ordering Information* for further information.

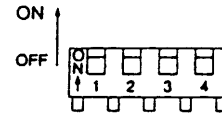
Switch setting	Temperature sensor code	Temperature range	
		°C	°F
0, 8	JPt100	-199.9 to 650.0	-199.9 to 999.9
1, 9	Pt100	-199.9 to 650.0	-199.9 to 999.9
2	K	-200 to 1,300	-300 to 2,300
3	J	-100 to 850	-100 to 1,500
4	T	-199.9 to 400.0	-199.9 to 700.0
5	L	-100 to 850	-100 to 1500
6	U	-199.9 to 400.0	-199.9 to 700.0
7	N	-200 to 1,300	-300 to 2,300

Note: JPt100: 100°C/139.16 Ω  
Pt100: 100°C/138.50 Ω

## Temperature Control in Fahrenheit

1. After setting all internal switch settings, set pin number 4 of the function switch to ON. This pin is normally set to OFF.
2. Insert the internal mechanism into the housing and turn on the Temperature Controller.
3. *d-U* will be displayed. Then press the Up Key to change the set value display into Fahrenheit.
4. Turn off the power 2 s after the set value display has changed to Fahrenheit.
5. Remove the internal mechanism from the housing, set pin number 4 of the function switch to OFF, replace it and turn on the power.

## ■ Function Selector (FUNCTION)



The DIP switch sets the operating parameters listed in the following table. All pins are factory-set to OFF.

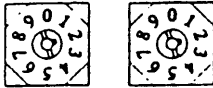
E5AJ/E5BJ/E5CJ/E5EJ

Function	Pin number	Pin setting	Setting
Control output	1	ON	Normal (cooling)
		OFF	Reverse (heating)
Control mode	2	ON	ON/OFF operation
		OFF	Advanced PID operation
		OFF	Advanced PID with fuzzy self-tuning.
	3	see note	ON/OFF operation
OFF		Advanced PID operation	
		OFF	Advanced PID with fuzzy self-tuning.
Not used.	4	Leave turned OFF.	

Note: The Temperature Controller will be in ON/OFF control mode regardless of the setting of pin 3 if pin 2 is set to ON.

### ■ Alarm Mode Selectors (ALM1, ALM2)

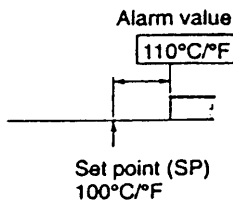
Alarm modes, listed in the following table, can be selected using this switch. The switch is factory-set to position 2, i.e., the upper-limit alarm mode.



Switch setting	Mode	Alarm output		Setting range
	Alarm operation	When X is positive	When X is negative	
0	No alarm	OFF		—
1	Upper- and lower-limit alarm (deviation)		Always ON	-1999 to 9999, or -199.9 to 999.9 (The decimal position varies with the input type.)
2	Upper-limit alarm (deviation)			
3	Lower-limit alarm (deviation)			
4	Upper- and lower-limit alarm (deviation)	Always OFF		
5	Upper- and lower-limit alarm with standby sequence (deviation)	Always OFF		
6	Upper-limit alarm with standby sequence (deviation)			
7	Lower-limit alarm with standby sequence (deviation)			
8	Absolute-value upper-limit alarm			
9	Absolute-value lower-limit alarm			

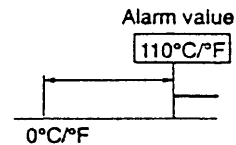
#### Deviation Alarm

If the alarm mode selector is set to a number between 1 to 7, alarm values are set to the width deviated from the set point as shown in the following illustration.



#### Absolute Alarm

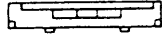
If the alarm mode selector is set to 8 or 9, alarm values are set to the absolute value based on 0°C/F as shown in the following illustration.





### ■ Key Protection Switch (PROTECT)

The key protection switch is factory-set to the OFF position.



SP → OFF → ALL

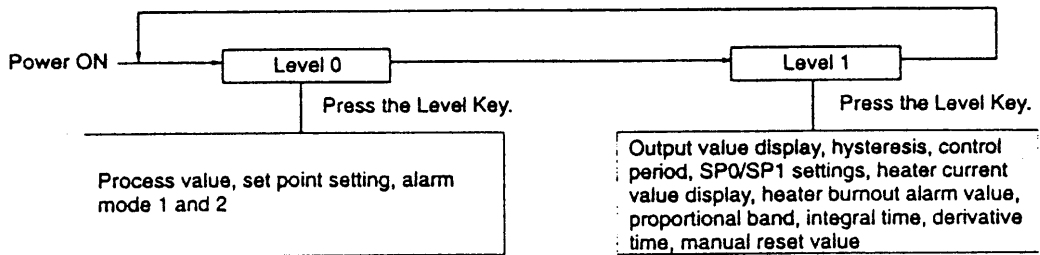
To write-protect set values, the settings of the set values must be changed.

Mode	Protection
SP	All set values other than the set point will be write-protected.
	The Level Key will not be valid. The Down and Up Keys will not be valid except set point setting.
OFF	No key protection will be valid.
	All keys will work normally.
ALL	All set values will be write-protected.
	The Level, Down, and Up Keys will not be valid.

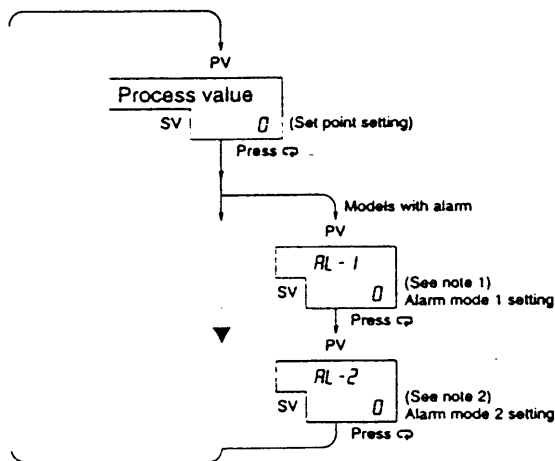
### ■ Inputting Parameters

The temperature Controller has two display levels 0 and 1, in which only specific parameters can be set. Level 0 is the initial level and is automatically entered upon power application. To change the mode to set or change a different group of parameters, hold down the Level Key for 1 second minimum. The display level mode changes as shown below. Actual displays vary with models and switch settings. If a display does not appear as expected, check your switch settings.

Besides the functions explained here, the Temperature Controller incorporates an alarm adjustment sensitivity function, set point limit function, display mode automatic reset function, input shift function, and two kinds of event inputs (incorporated by the E5AJ, and E5EJ only). Refer to the "E5□J Operation Manual", which can be obtained from your OMRON representative, for details on these functions.

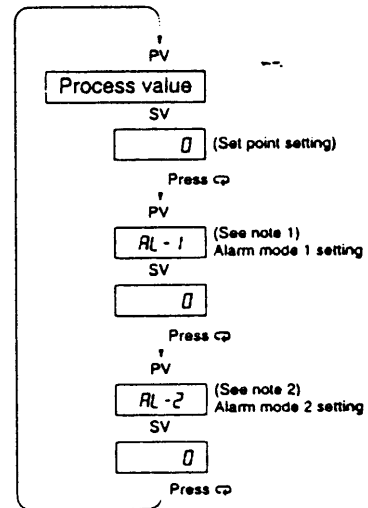


#### Level 0 E5CJ



- Note:
- Nothing is displayed if ALM1 is set to 0 (i.e., no alarm function is ON).
  - Nothing is displayed if ALM2 is set to 0 (i.e., no alarm function is ON).

#### E5AJ/E5BJ/E5EJ



- Note:
- Nothing is displayed if ALM1 is set to 0 (i.e., no alarm function is ON).
  - Nothing is displayed if ALM2 is set to 0 (i.e., no alarm function is ON).

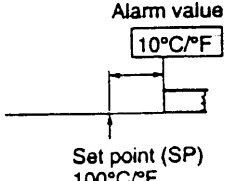
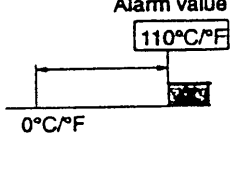
**Set Point Setting (°C or °F)**

Use the Down and UP Keys to set the set point. A model with event input allows the change of the set point (SP0 or SP1) that has been selected.

**Alarm 1, 2: AL-1, AL-2 (°C or °F)**

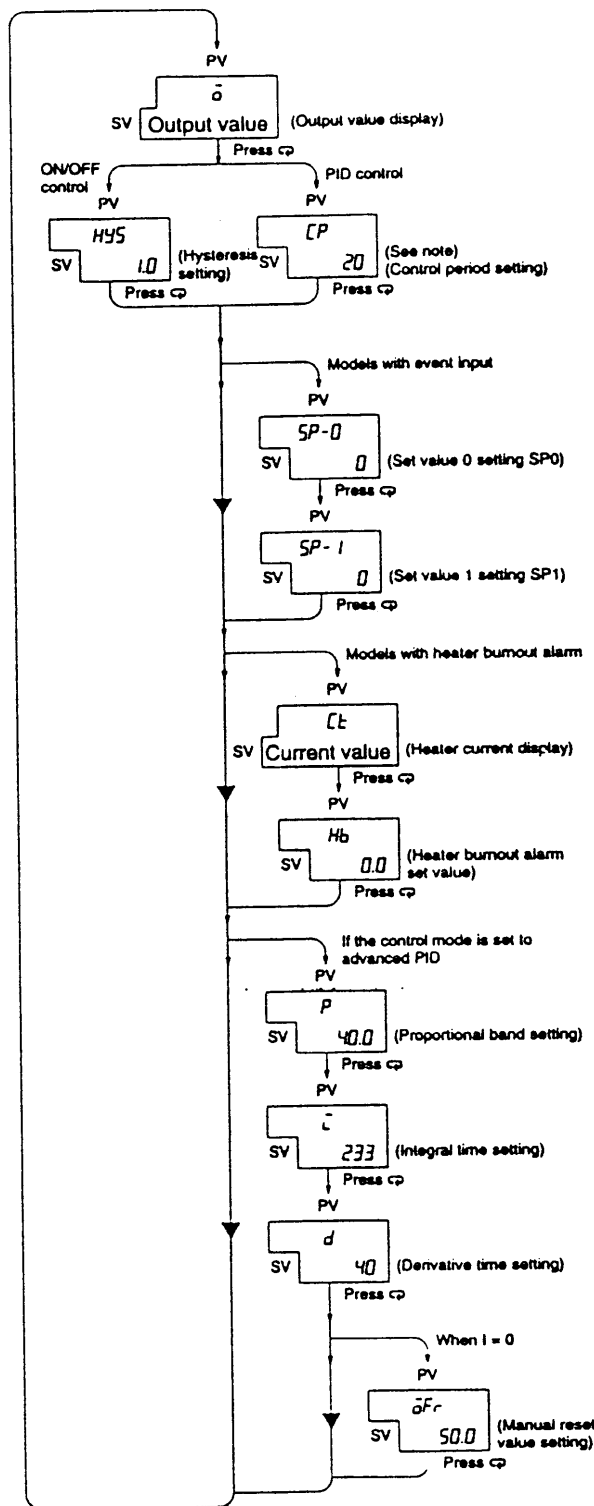
Alarm values can be set with Down and Up Keys. The alarm mode is factory set to upper-limit alarm (deviation) mode.

The alarm mode can be changed with the alarm mode selector. An alarm value can be set to the deviation width or absolute value according to the alarm mode.

Deviation alarm	Absolute-value alarm
Upper- and lower-limit alarm, upper-limit alarm, lower-limit alarm, upper- and lower-limit range alarm	Absolute-value upper-limit alarm, absolute-value lower-limit alarm
Set to the width deviated from the set point. 	Set to the absolute value based on 0°C/°F. 

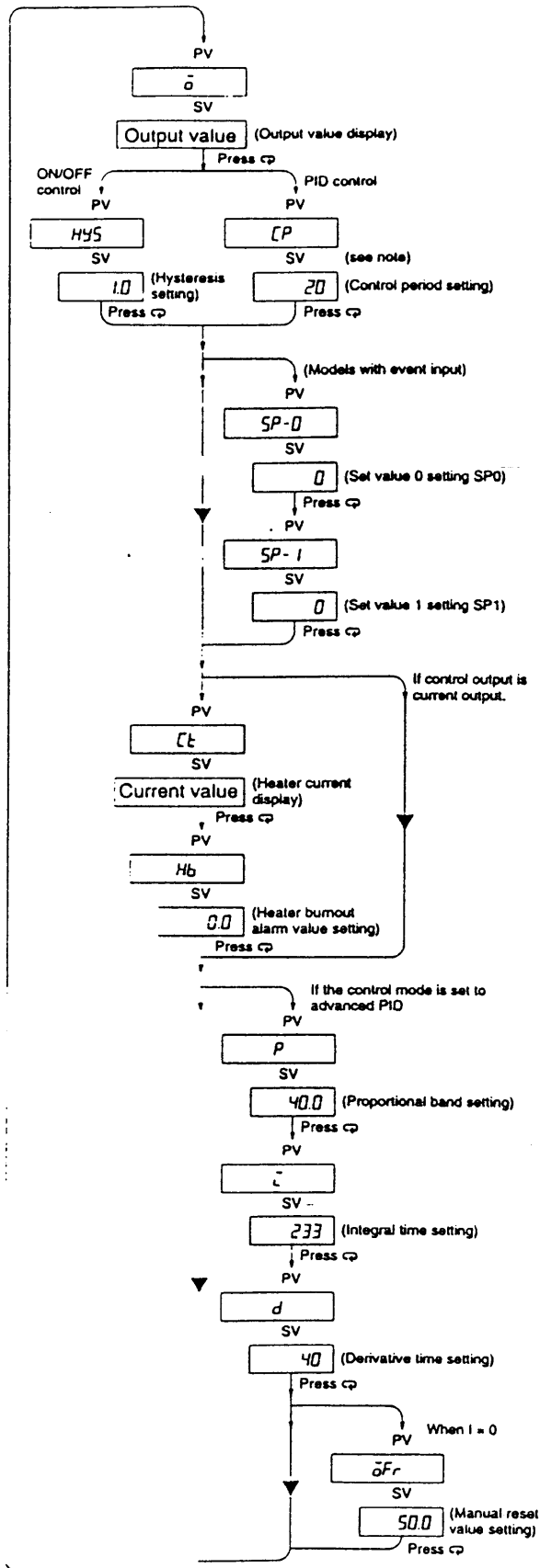
**Level 1**

**E5CJ**



**Note:** Nothing is displayed in current output mode.

ESAJ/E5BJ/E5EJ



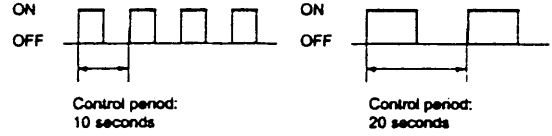
Note: Nothing is displayed in current output mode.

**Output Value Display:**  $\bar{o}$   
 Displayed range 0.0% to 100.0%

**Control Period:**  $\bar{C}P$

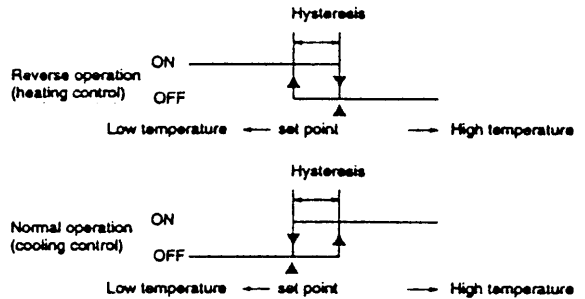
The control period can be set with the Down and Up Keys within a range of 1 to 99 s. The control period is factory-set to 20 s. In the case of advanced PID, the relay output or voltage output repeats turning ON and OFF, the cycle of which is called a control period. The duration that the output is ON is in proportion to the output value. The shorter the control period is, the smoother the control operation will be. If the control period is, however, too short, the life of the relay will be shortened. Therefore the control period should be 20 s minimum in the case of relay output.

**Output Value: 50.0%**



**Hysteresis:**  $\bar{H}YS$

The hysteresis value for the ON/OFF control can be set in a range from 0.0° to 999.9°C/°F while "HYS" is displayed on the PV display using the Up and Down Keys. The value is factory-set to 1.0°C/°F.



**Setting to a Temperature of 0 (°C or °F):**  $\bar{S}P-0$

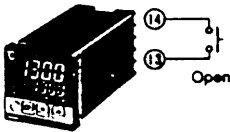
Use the Down and Up Keys to set the set point 0. It is possible to set the value regardless of whether the set value presently selected is on SP0 or SP1.

**Setting to a Temperature of 1: SP-1**

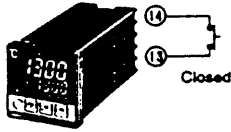
Use the Down and Up Keys to set the set point to 1. It is possible to set the value regardless of whether the set value presently selected is on SP0 or SP1.

**E5CJ**

The set point can be selected by opening or short-circuiting the EV1 terminals (terminals 13 and 14).

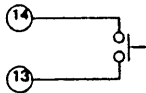


Set point 0 (SP0)



Set point 1 (SP1)

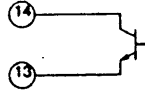
**Contact Input**



ON: The resistance is 1 kΩ max. when short-circuited.

OFF: The resistance is 100 kΩ min. when opened.

**No-contact Input (Open Collector)**

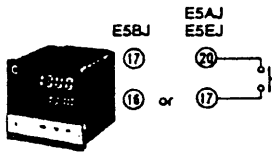


ON: The residual voltage is 3 V min.

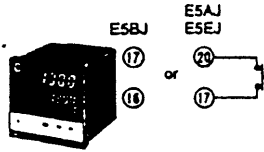
OFF: The current leakage is 1 mA max.

**E5AJ/E5BJ/E5EJ**

The set point can be selected by opening or short-circuiting the EV1 terminals (terminals 17 and 20). In the case of the E5BJ, however, the terminals 16 and 17 of which should be opened or short-circuited instead.

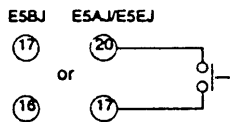


Set point 0 (SP0)



Set point 1 (SP1)

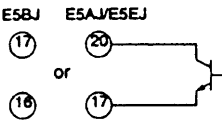
**Contact Input**



ON: The resistance is 1 kΩ max. when short-circuited.

OFF: The resistance is 100 kΩ min. when opened.

**No-contact Input (Open Collector)**



ON: The residual voltage is 3 V max.

OFF: The current leakage is 1 mA max.

**Heater Current Value Display: Ct**

The display range is 0.0 to 55.0 A. FFFF will be displayed if the current exceeds 55.0 A. When the control output is ON, the current flowing to the heater is measured and displayed. If the control output is, however, turned ON for less than 190 ms, the current flow will not be measured and the current previously measured will be displayed.

**Heater Burnout Alarm Value Setting: Hb**

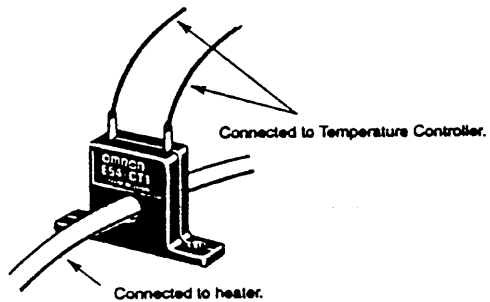
The current value to detect heater burnout can be set within a range of 0.0 to 50.0 A.

The current value is factory-set to 0.0 A. Check the normal heater current and the current at the time of heater burnout from the heater current value display, and set the set value to the mean value of the current values (i.e., set value = (normal current value + heater burnout current) ÷ 2).

If the difference between the normal heater current and heater burnout current is small, heater burnout detection will not be stable. For stable detection, the difference in current must be 1.0 A minimum if the heater input is less than 10.0 A and 2.5 A minimum if the heater input is 10.0 A or more.

- Note:**
1. Do not allow a current exceeding 50 A to flow in the CT; the maximum continuous heater current is 50 A.
  2. Set the value to 0.0 A if the heater burnout alarm is not used, in which case the alarm will not function at all.

**Current Transformer Connections**



- If the control mode is advanced PID with fuzzy self-tuning, the parameters  $P$ ,  $i$ ,  $d$ , or  $\delta Fr$  will not be displayed (i.e., there is no need to set these parameters). Fuzzy self-tuning always adjusts all PID constants to optimum values inside the Temperature Controller.

#### Proportional Band: $P$

When the character "P" is displayed on the PV display, the proportional band (P constant) can be changed using the Up and Down Keys. The new value will be displayed on the SV display. It can be set in a range from 0.1° to 999.9°C/°F in units of 0.1°C/°F. The value is factory-set to 40.0°C/°F.

#### Integral Time : $i$

When the character "i" is displayed on the PV display, the integral time (I constant) can be changed using the Up and Down Keys. It can be set in a range from 0 to 3,999 seconds in units of 1 second. The value is factory-set to 233 seconds.

#### Derivative Time : $d$

When the character "d" is displayed on the PV display, the derivative time (D constant) can be changed using the Up and Down Keys. It can be set in a range from 0 to 3,999 seconds in units of 1 second. The value is factory-set to 40 seconds.

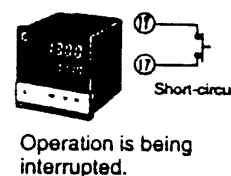
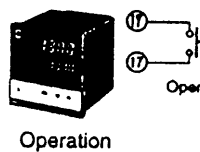
#### Manual Reset Value Setting (%) : $\delta Fr$

The necessary output value in balanced state will be set within a range of 0.0% to 100.0%. The output value is factory-set to 50.0%. In P or PD mode (i.e., when I is 0), the Temperature Controller will be balanced with a deviation value between the set point and process value. This deviation value is called the offset. By changing the manual reset value, the offset can be eliminated.

## Starting Control Operation

The E5□J will start control operations as soon as power is turned on until power is turned off. Turn off the power and then turn it back on after setting the desired parameters.

By short-circuiting the EV2 terminals (terminals 17 and 19) of the E5AJ/E5EJ incorporating event input, control operation can be interrupted. Each alarm will, however, operate even if control operation is being interrupted.



## Error Messages

The Temperature controller is provided with self-diagnostic functions, and will display an error message on the PV display when an error is detected.

Message	Error	Error output status		Item to be checked
		Control output	Alarm output	
S.Err (S.Err)	Input error	OFF (2 mA max.)	Processes the error as an abnormally high temperature error.	<ol style="list-style-type: none"> <li>Check if the input is outside the possible control range (i.e., <math>\pm 10\%</math> of the set temperature range) (see note).</li> <li>Check if the settings of the inputs are wrong.</li> <li>Check if there is any wiring mistake, wire burnout, or short-circuit.</li> </ol>
E111 (E111)	Memory error	OFF (2 mA max.)	OFF	Turn off and then turn on the Temperature Controller. If the display does not change then, repairs are necessary.
E333 (E333)	A/D converter error	OFF (2 mA max.)	OFF	If the display returns to normal, the Temperature Controller may have been influenced by noise. Check if noise is being generated.
R.Err (A.Err)	Calibration data error (displayed for 2 s when the Temperature Controller is turned on)	Normal operation (accuracy not guaranteed)		Re-calibration is necessary.

**Note:** When the input is within the possible control range but outside the possible display range (i.e., -1999 to 9999), cccc will be displayed if the value is smaller than -1999 and cccc will be displayed if the value is larger than 9999, however, the control and alarm output functions of the Temperature Controller will work normally.

## Fuzzy Self-tuning

Fuzzy self-tuning is a function that enables the E5□J to calculate the most suitable PID constants for the controlled object.

### Features

- The E5□J judges by itself when to perform fuzzy self-tuning.
- At the time of fuzzy self-tuning, the E5□J does not output any signal that disturbs the temperature or output value.

## Fuzzy Self-tuning Function

The fuzzy self-tuning function has three modes.

In SRT (step response tuning) mode, the PID constants are tuned using a step response method at the time the set point is changed.

In DT (disturbance tuning) mode, the PID constants are amended so that the controlled temperature will be within the target range set in advance when there is external disturbance.

In HT (hunting tuning) mode, when hunting occurs, the PID constants are amended to suppress the hunting.

### Startup Conditions of SRT

SRT will start if the following conditions are satisfied when the set point is changed or the E5□J is turned on.

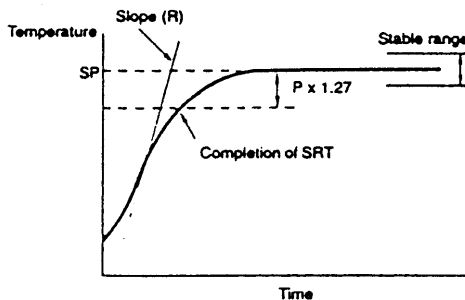
1. The new set point is different from the set point used at the time SRT was executed last.
2. The difference between the new set point and the last set point is larger than the value obtained from the calculation: present proportional band value (P) x approximately 1.27. (When the E5□J is turned on, the difference between the process value and set point is regarded as the set point changing range.)
3. The temperature is stable before changing the set point or the temperature is balanced while the E5AJ is turned on before any output is obtained.
4. The set point is changed in the direction that the controlled amount increases (i.e., the control amount is in the upper direction at the time of reverse operation and in the lower direction at the time of normal operation).

In the following cases, SRT will not be executed accurately. Therefore the E5□J must be tuned in DT or HT mode.

1. The maximum temperature slope (R) is not obtained before the process value reaches the value obtained from the calculation: present proportional band value (P) x approximately 1.27 (i.e., the maximum temperature slope (R) is not obtained before the SRT is finished). If the proportional band, obtained before SRT is finished, is larger than the previous proportional band, however, the PID constants will be renewed so that their values will be more accurate.
2. The set point is changed during SRT and the SRT completion conditions are satisfied, in which case no PID constant will be renewed..

### Stable Temperature Status

If the temperature is within the stable range for a specified period, it is deemed that the temperature is stable.

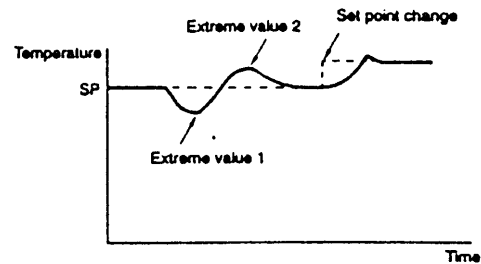


### Balanced Status

If the process value is within the stable range for 60 s when there is no output, it is deemed that the the temperature is balanced.

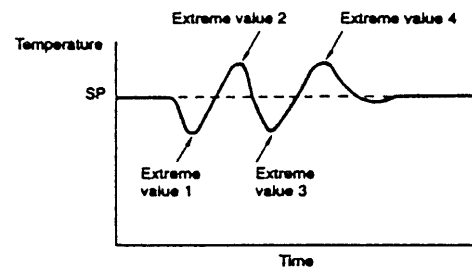
### Startup Conditions of DT

1. DT will start if the temperature that has been stable varies due to external disturbance and the deflection of the temperature exceeds the stable range, the default setting of which is  $\pm 1^\circ\text{C}$ , and then the temperature becomes stable, provided that the number of maximum temperature values is less than four.
  2. DT will start if the set point is changed under the condition that SRT does not start and the temperature becomes stable, provided that the number of maximum temperature values is less than four.
- If there are four or more maximum temperature values, HT will start.



### Startup Conditions of HT

HT will be ON when there is hunting with four or more maximum temperature values (extreme values) while SRT is not being executed.

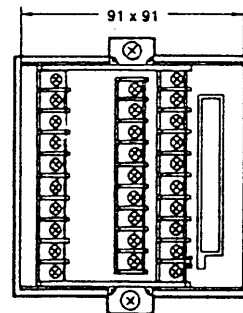
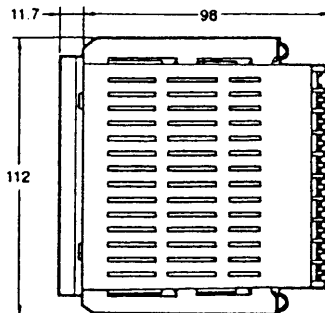
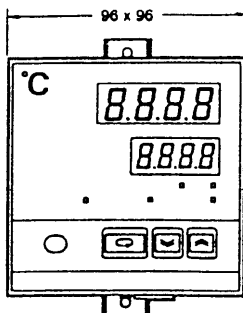
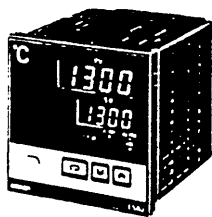


**Note:** In specific applications where temperature varies periodically due to disturbance, internal parameters need to be adjusted. For details, refer to "E5□J Operation Manual".

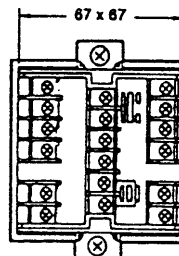
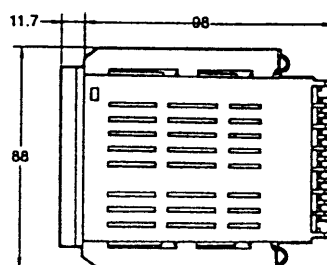
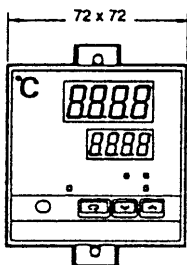
# Dimensions

Note: All units are in millimeters unless otherwise indicated.

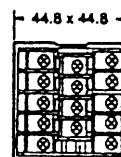
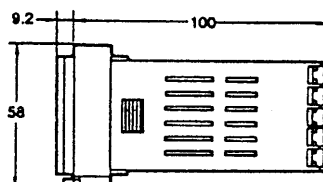
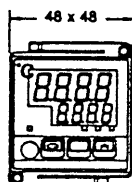
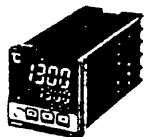
E5AJ



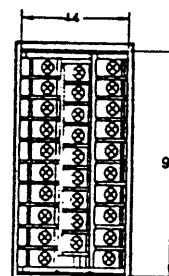
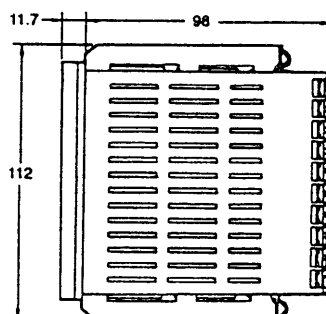
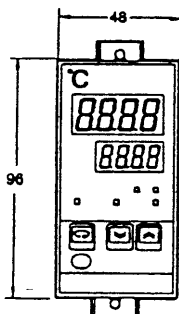
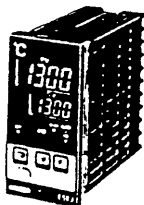
E5BJ



E5CJ

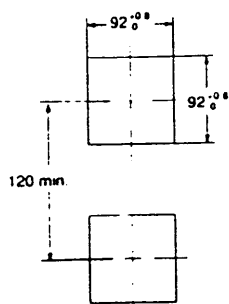


E5EJ

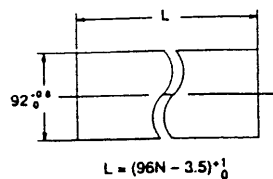


## Panel Cutout

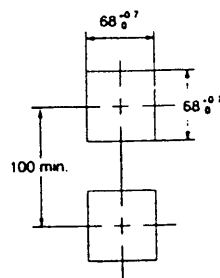
## E5AJ



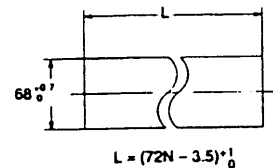
## Side-by-side Mounting of N Controllers



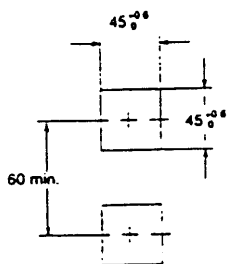
## E5BJ



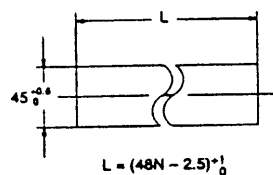
## Side-by-side Mounting of N Controllers



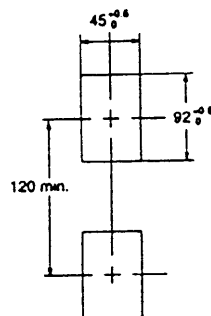
## E5CJ



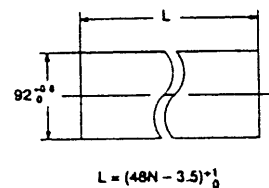
## Side-by-side Mounting of N Controllers



## E5EJ



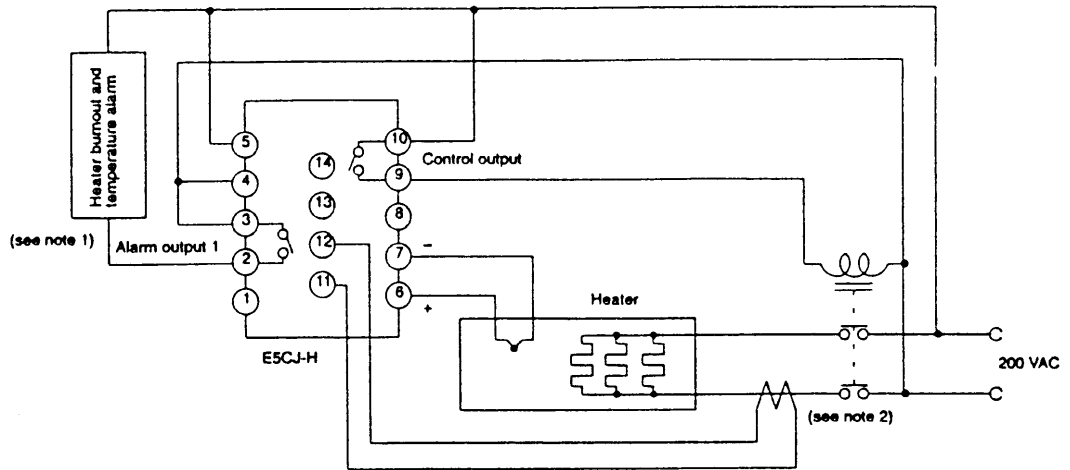
## Side-by-side Mounting of N Controllers



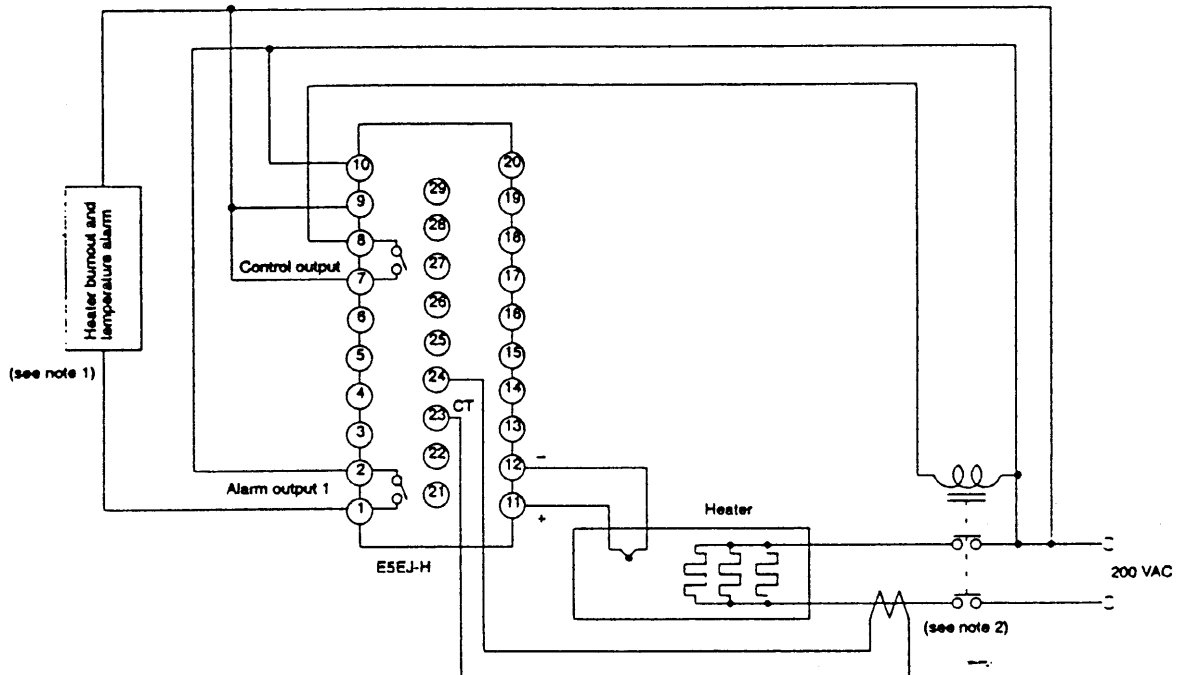
- Note:**
1. Recommended panel thickness is 1 to 4 mm for the E5CJ and 1 to 8 mm for the E5AJ, E5BJ, and E5EJ.
  2. Because mounting brackets are attached to the E5CJ, close side-by-side mounting is possible (in a single direction).



## E5CJ-H



## E5EJ-H



- Note:**
1. Alarm 1 is used as heater burnout alarm and temperature alarm for models incorporating a heater burnout alarm.
  2. Wire through the hole of the Current Transformer. The Current Transformer and the Temperature Controller can be connected regardless of polarity.

- Set the alarm mode selector to 0 (i.e., no alarm function is ON) so that alarm output 1 will output only heater burnout alarms.
- If the difference in current is small, increase the apparent electrical current by increasing the number of turns of the heater wire around the CT. The current displayed by the heater current value display increases in proportion to the number of turns of the heater wire.
- Use the K2CU-F□□A-□GS (incorporating gate input terminals) for detecting three-phase heater burnout.

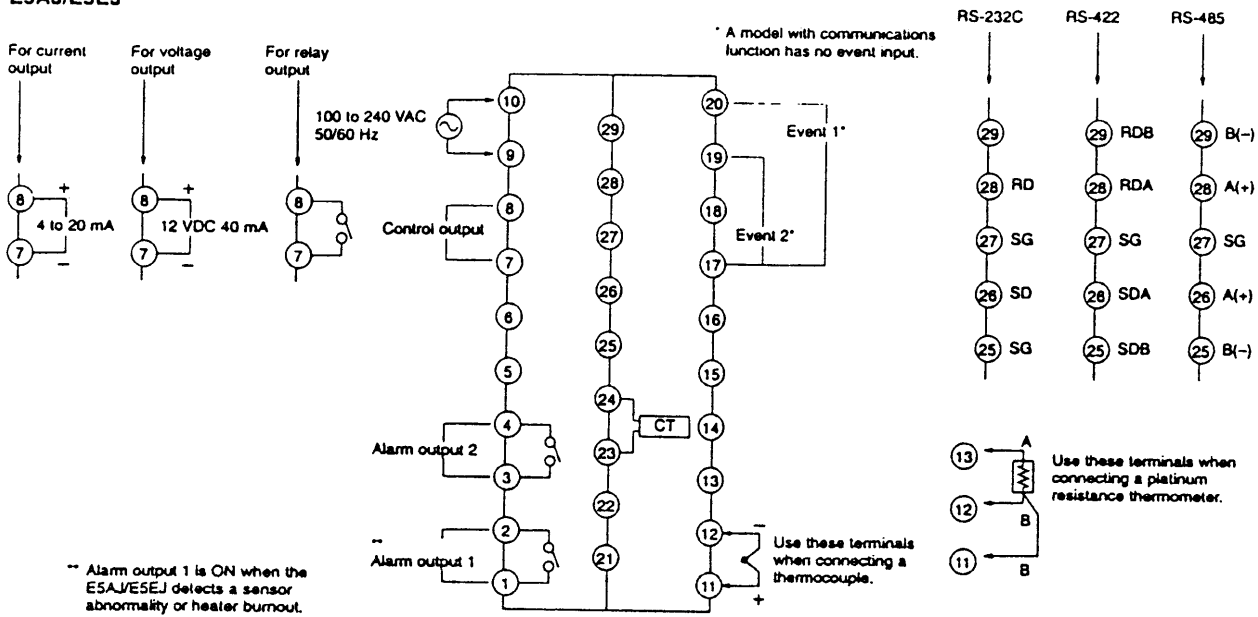
**Output Retention Reset**

Once the heater burnout alarm detects heater burnout, alarm output 1 will turn ON. To turn OFF alarm output 1, set the heater burnout alarm value to 0.0 A or turn off the Temperature Controller and then turn on the Temperature Controller.

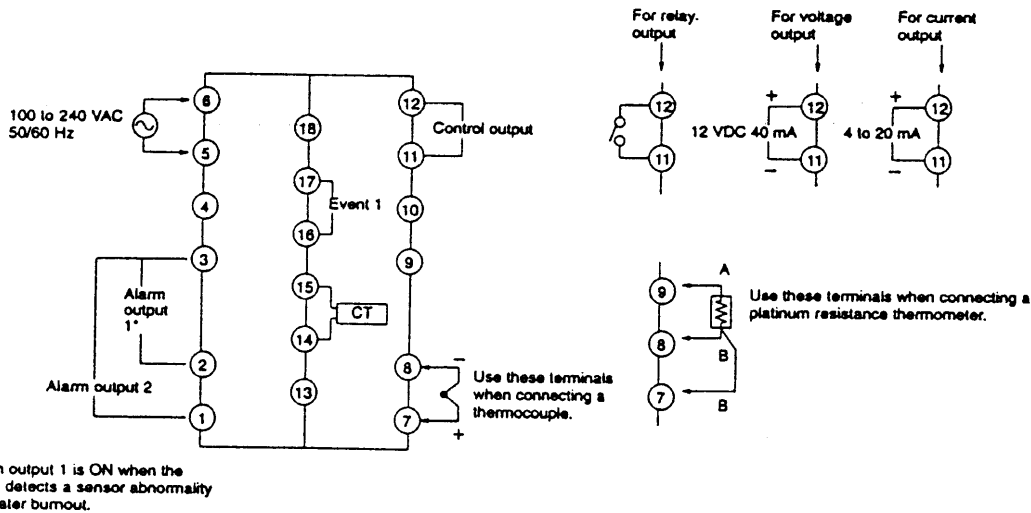
# Installation

Note: No event input is insulated from the voltage or current output.

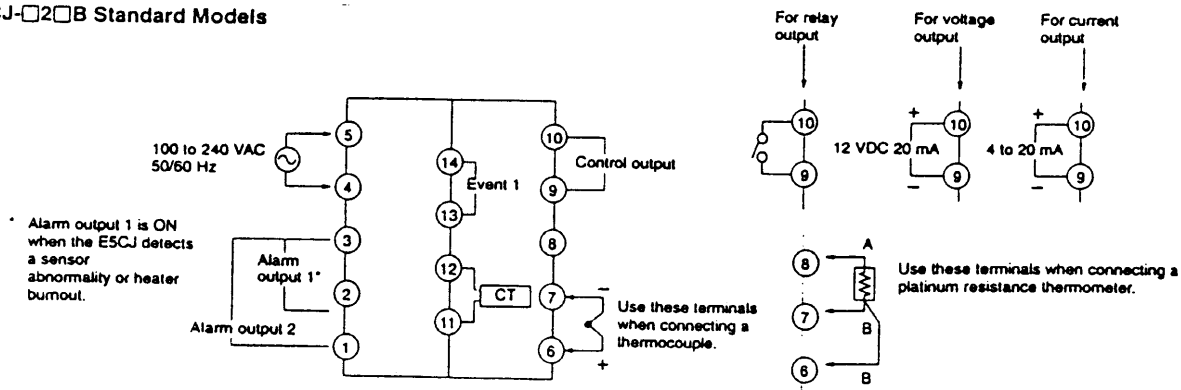
## E5AJ/E5EJ



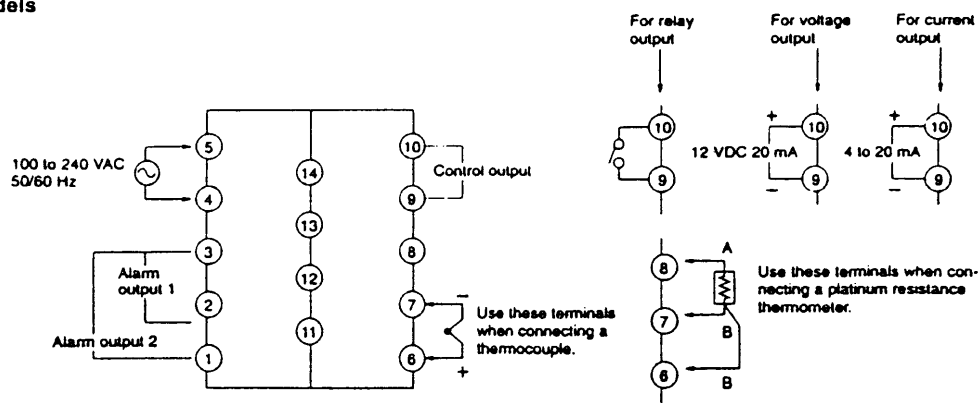
## E5BJ



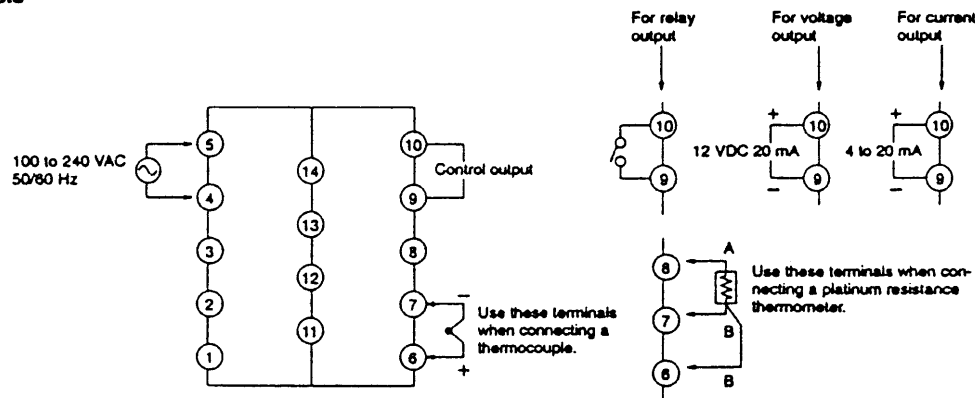
## E5CJ-□2□B Standard Models



## E5CJ-□2 Simple Models



## E5CJ-□ Simple Models



## Precautions

### Mounting

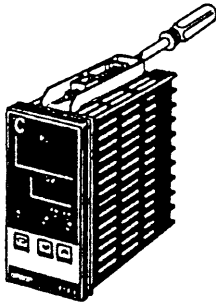
The dimensions of the Temperature Controller conform to DIN 43700. Recommended panel thickness is 1 to 8 mm for the E5AJ, E5BJ, and E5EJ, and 1 to 4 mm for the E5CJ.

Do not install the Temperature Controller in a location exposed to excessive dust or corrosive gases. Moreover, avoid locations subject to heavy vibration or shock, water or oil spray, or high temperatures. Any of these conditions will affect product life.

Isolate the Temperature Controller from equipment that generates strong, high-frequency noises such as high-frequency welders, because such equipment may prevent proper operation.

#### E5AJ/E5BJ/E5EJ

Two mounting brackets are provided with the Temperature Controller. Mount one of the brackets to the top and the other one to the bottom of the Temperature Controller. Turn the ratchets of the mounting brackets clockwise with a Phillips screwdriver until they snap. Insert the unit back into the case by pushing the unit until it clicks into place.



#### E5CJ

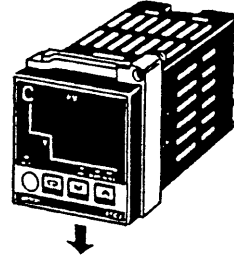
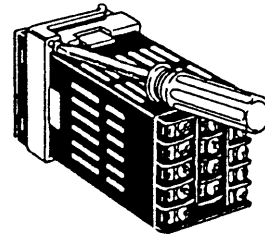
Insert the Temperature Controller into the square hole of the panel and insert an adapter from the backside so that there will be no space between the Temperature Controller and the panel. Then secure the Temperature Controller with a screw.



Tightening screw

### Dismounting

Loosen the screw of the adapter for dismounting.



### Connection Example

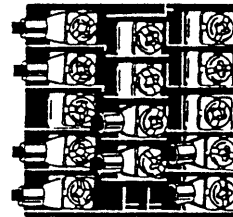
#### With Solderless Terminal

Use M3.5 x 8 solderless terminals with the Temperature Controller's M3.5 self-rising pressure plate screws.

#### Solder-dipped Leads

Strip 6 to 12 mm of the lead wires and carefully arrange the wire tips.

Do not tighten the terminal screw with excessive force, because doing so may damage them. The terminal block of the Temperature Controller is constructed so that the lead wires can be connected to all the terminals from the same direction.



### Input Type Connection

To reduce inductive noise influence, the lead wires connecting the input type to the Temperature Controller must be separated from the power lines and load lines.

Use the specified compensating conductors for thermocouples. Use lead wires having a small resistance for platinum resistance thermometers.

### Sequenced Circuits

Several seconds are required until the relay is turned ON after power has been supplied to the Temperature Controller. Therefore, take this time delay into consideration when designing sequenced circuits which incorporate a Temperature Controller.

## ■ Watertight Cover

- Four sizes (96 x 96, 72 x 72, 48 x 96, 48 x 48) are available.
- Conforms to IP66 or NEMA4 (indoors).

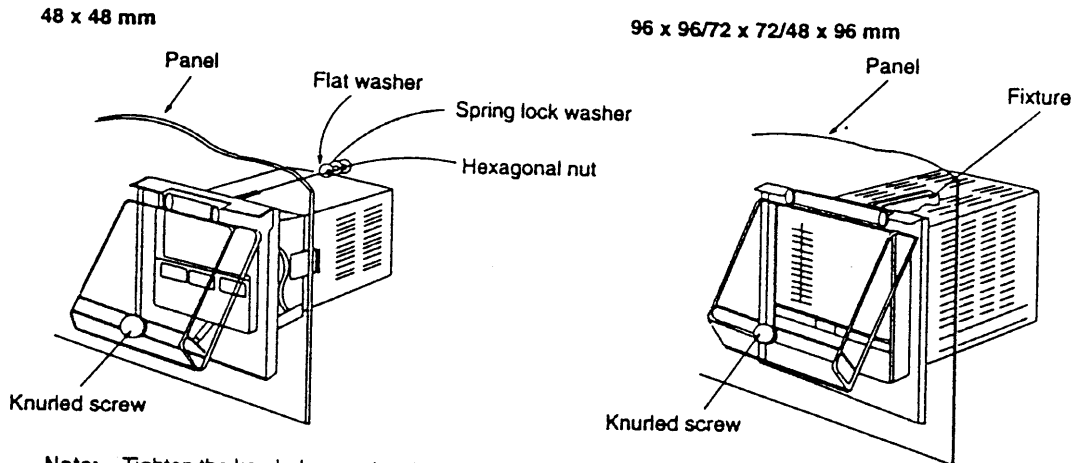
### Ordering Information

Model	Y92A-96N	Y92A-72N	Y92A-49N	Y92A-48N
Size	96 x 96 mm	72 x 72 mm	48 x 96 mm	48 x 48

### Materials

Front cover	94V-2 polycarbonate
Packing	Chloroprene rubber
Panel	SUS304

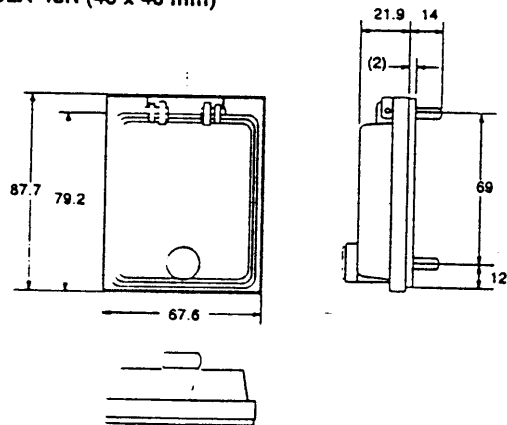
### Nomenclature



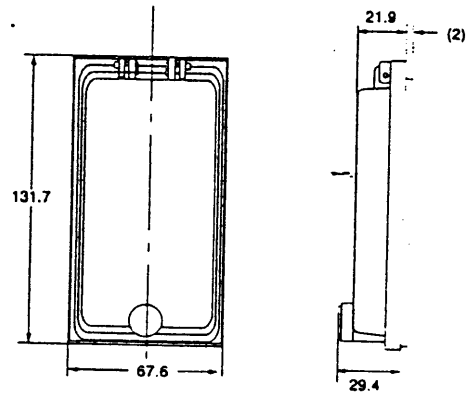
**Note:** Tighten the knurled screw to a torque of  $0.03 \text{ N} \cdot \text{m}$  ( $3 \text{ kgf} \cdot \text{cm}$ ) and the hexagonal nut to a torque of  $0.05 \text{ N} \cdot \text{m}$  ( $5 \text{ kgf} \cdot \text{cm}$ ).

### Dimensions

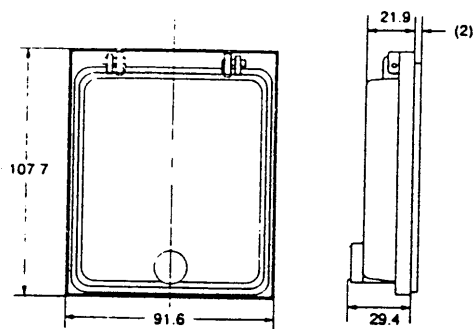
Y92A-48N (48 x 48 mm)



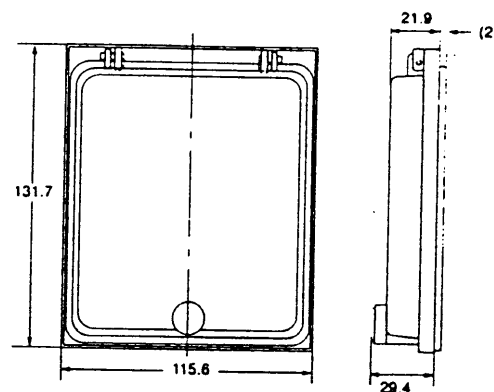
Y92A-49N (48 x 96 mm)



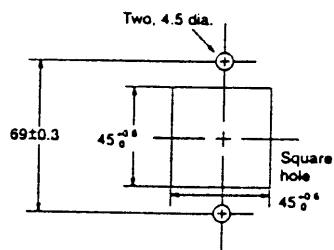
Y92A-72N (72 x 72 mm)



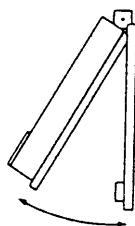
Y92A-96N (96 x 96 mm)

**Panel Cutout**

Y92A-48N (48 x 48 mm)

**Precautions**

It is possible to open or close the front cover by untightening or tightening the knurled screw.



Be sure to take the space required for the opening and closing of the front cover into consideration when installing the Watertight Cover.

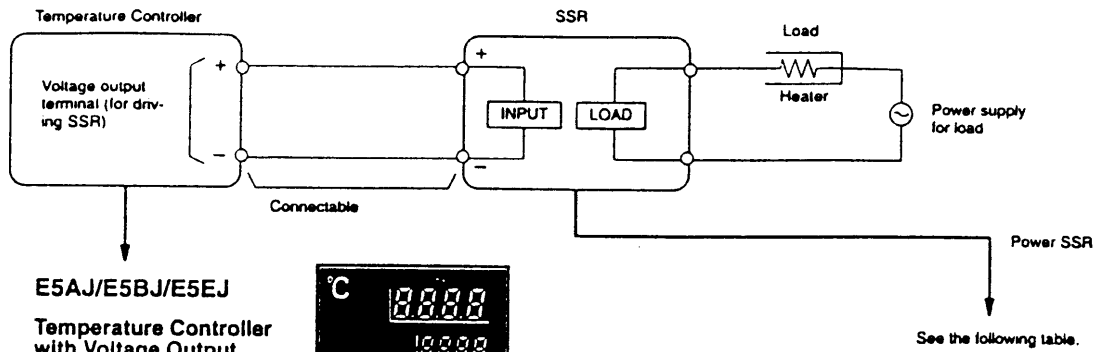
The front cover is made of polycarbonate, which can be cleaned using water, methanol, or ethanol.

Regularly check the packing, the quality of which will deteriorate over the process of time.

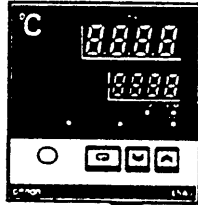
The front cover can be mounted in any direction.

## ■ SSR

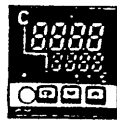
### Connection Example of Temperature Controller and SSR



**E5AJ/E5BJ/E5EJ**  
Temperature Controller  
with Voltage Output  
(12 VDC, 40 mA max.)



**E5CJ**  
Temperature Controller  
with Voltage Output  
(12 VDC, 20 mA max.)



Model	G3PA	G3NH	G3NA	G3NE	G3B
Appearance					
SSRs connected in parallel	E5AJ/E5BJ/E5EJ: 8 pcs. E5CJ: 4 pcs.	E5AJ/E5BJ/E5EJ: 8 pcs. E5CJ: 4 pcs.	E5AJ/E5BJ/E5EJ: 8 pcs. E5CJ: 4 pcs.	E5AJ/E5BJ/E5EJ: 2 pcs. E5CJ: 1 piece	E5AJ/E5BJ/E5EJ: 5 pcs. E5CJ: 2 pcs.
Rated input voltage	5 to 24 VDC	5 to 24 VDC	5 to 24 VDC	E5□J: 12 VDC E5CJ: 5 VDC	5 to 24 VDC
Features	Thin, monoblock construction with heat sink	For high-power heater control	Standard model with screw terminals	Compact, low-cost model with tab terminals	Socket, model with 5-A switching capacity