

# Digital Controller E5EK

CSM\_E5EK\_DS\_E\_3\_1

## Advanced Digital Controllers Ideal for Worldwide Use

- Modular structure
- High-accuracy: 100 ms sampling (for analog input)
- Auto-tuning and fuzzy self-tuning
- Conforms to international EMC and safety standards.
- IP66/NEMA4 (indoor use) front face
- Remote set point
- Serial communications (RS-232C, RS-422 and RS-485) and transfer output (4 to 20 mA)
- Position-proportional control model
- Heating/cooling control



Refer to *Safety Precautions for All Temperature Controllers*.

Refer to *E5EK Operation* for operating procedures.

## Model Number Structure

### ■ Model Number Legend

E5EK-             -500  
          1      2

#### 1. Model

- AA: Standard model
- PRR: Position-proportional model
- T: Programmable type

#### 2. Number of alarms

- 2: Two alarms

# Ordering Information

## List of Models

| Description | Model                    | Specification                                   |
|-------------|--------------------------|-------------------------------------------------|
| Base Unit   | E5EK-AA2 AC100-240       | Standard model                                  |
|             | E5EK-AA2-500 AC100-240   | Standard model with terminal cover              |
|             | E5EK-PRR2 AC100-240      | Position-proportional model                     |
|             | E5EK-PRR2-500 AC100-240  | Position-proportional model with terminal cover |
|             | E5EK-TAA2 AC100-240      | Standard model                                  |
|             | E5EK-TAA2-500 AC100-240  | Standard model with terminal cover              |
|             | E5EK-TPRR2 AC100-240     | Position-proportional model                     |
|             | E5EK-TPRR2-500 AC100-240 | Position-proportional model with terminal cover |

**Note:** 1. When using the heater burnout alarm function with a standard model, the Linear Output Unit cannot be used for the control outputs (heat).  
 2. Be sure to specify the Current Transformer, Output Unit, and Option Unit when ordering.  
 3. The Digital Controller provides transfer outputs at 4 to 20 mA for the PV and other values and control outputs at 4 to 20 mA for the current outputs.

| Description | Model   | Specification       |
|-------------|---------|---------------------|
| Output Unit | E53-R   | Relay               |
|             | E53-S   | SSR                 |
|             | E53-Q   | Pulse (NPN) 12 VDC  |
|             | E53-Q3  | Pulse (NPN) 24 VDC  |
|             | E53-Q4  | Pulse (PNP) 24 VDC  |
|             | E53-C3  | Linear (4 to 20 mA) |
|             | E53-C3D | Linear (0 to 20 mA) |
|             | E53-V34 | Linear (0 to 10 V)  |
|             | E53-V35 | Linear (0 to 5 V)   |

**Note:** The Digital Controller uses a dedicated, high-resolution Output Unit. The E53-C Current Output Unit for the E5□X cannot be used with the Digital Controller.

| Description | Model    | Specification           |
|-------------|----------|-------------------------|
| Option Unit | E53-AKB  | Event input             |
|             | E53-EN01 | Communication (RS-232C) |
|             | E53-EN02 | Communication (RS-422)  |
|             | E53-EN03 | Communication (RS-485)  |
|             | E53-AKF  | Transfer output         |

**Note:** 1. The Option Unit can be used either by the E5AK or E5EK.  
 2. The E5AK allows a maximum of three Option Units to be mounted.  
 The E5EK allows only one Option Unit to be mounted.

## Inspection Report

The Digital Controller can be provided together with an inspection report.

Refer to the following legend with the suffix "K" when ordering a model provided together with an inspection report.

E5□K-AA2-K, E5□K-PRR2-K, E5□K-TAA2-K, E5□K-TPRR2-K, E53-AKF-K

## ■ Accessories (Order Separately)

| Name                | Model   | Hole diameter |
|---------------------|---------|---------------|
| Current Transformer | E54-CT1 | 5.8 mm        |
|                     | E54-CT3 | 12.0 mm       |

**Note:** No CT is required unless the heater burnout alarm function is used.

| Name           | Model     | Connectable models |
|----------------|-----------|--------------------|
| Terminal Cover | E53-COV08 | E5EK               |

### Unit Label

|       |         |
|-------|---------|
| Model | Y92S-L1 |
|-------|---------|

### Mounting Bracket

|       |        |
|-------|--------|
| Model | Y92H-5 |
|-------|--------|

**Note:** This mounting bracket set is included with the Temperature Controller.  
The set includes one bracket for the top and one for the bottom.

## Specifications

### ■ Ratings

| Item                      | 100 to 240 VAC type                                                                                                                                                                                                                                                                        |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supply voltage            | 100 to 240 VAC, 50/60 Hz                                                                                                                                                                                                                                                                   |
| Power consumption         | E5EK: 15 VA                                                                                                                                                                                                                                                                                |
| Operating voltage range   | 85% to 110% of rated supply voltage                                                                                                                                                                                                                                                        |
| Input                     | Thermocouple: K, J, T, E, L, U, N, R, S, B, W, PLII<br>Platinum resistance thermometer: JPt100, Pt100<br>Current input: 4 to 20 mA, 0 to 20 mA<br>Voltage input: 1 to 5 V, 0 to 5 V, 0 to 10 V                                                                                             |
| Input impedance           | Current input: 150 Ω; Voltage input: 1 MΩ min.                                                                                                                                                                                                                                             |
| Control output            | Standard Model, Programmable Model<br>According to Output Unit (see <i>Output Unit Ratings and Characteristics</i> )<br>Position-proportional Model<br>2 Relay outputs: SPST-NO, 1 A at 250 VAC (including inrush current) *1                                                              |
| Auxiliary output          | SPST-NO, 3 A at 250 VAC (resistive load)                                                                                                                                                                                                                                                   |
| Control method *2         | ON/OFF or 2-PID control (with auto-tuning)                                                                                                                                                                                                                                                 |
| Setting method            | Digital setting using front panel keys                                                                                                                                                                                                                                                     |
| Indication method         | 7-segment digital display and LEDs                                                                                                                                                                                                                                                         |
| Potentiometer             | 100 Ω to 2.5 kΩ                                                                                                                                                                                                                                                                            |
| Event input               | Contact input: ON: 1 kΩ max., OFF: 100 kΩ min.<br>No-contact input: ON: residual voltage: 1.5 V max., OFF: leakage current: 0.1 mA max.                                                                                                                                                    |
| Transfer output           | 4 to 20 mA, permissible load impedance: 600 Ω max., resolution: approx. 2,600                                                                                                                                                                                                              |
| Remote SP input           | Current input: 4 to 20 mA (Input impedance: 150 Ω)                                                                                                                                                                                                                                         |
| Current Transformer input | Connect an exclusive Current Transformer (E54-CT1 or E54-CT3)                                                                                                                                                                                                                              |
| Other functions           | Standard<br>Manual output, heating/cooling control, SP limiter, loop burnout alarm, SP ramp, MV limiter, MV change rate limiter, input digital filter, input shift, run/stop, protect functions, scaling function.<br>Option<br>Multiple SP, run/stop selection, transfer output functions |
| Degree of protection      | Conforms to IEC IP66 and NEMA4 (Indoor use)                                                                                                                                                                                                                                                |

**Note:** Do not use the output from an inverter as the power supply. Refer to *Safety Precautions for All Temperature Controllers*.

\*1.All control outputs are isolated electrically from the input circuits.

\*2.The E5EK-AA2-DRT, E5EK-T, and E5EK-TP do not support fuzzy self-tuning.

### ■ Input Ranges

#### Platinum Resistance Thermometer

| Input (switch selectable) |    | JPt100          | Pt100           |
|---------------------------|----|-----------------|-----------------|
| Range                     | °C | –199.9 to 650.0 | –199.9 to 650.0 |
|                           | °F | –199.9 to 999.9 | –199.9 to 999.9 |
| Setting                   |    | 0               | 1               |

**Thermocouple**

| Input (switch selectable)<br>(See note.) |    | K1            | K2           | J1            | J2           | T               | E          | L1            | L2           | U               | N             | R          | S          | B            | W          | PLII       |
|------------------------------------------|----|---------------|--------------|---------------|--------------|-----------------|------------|---------------|--------------|-----------------|---------------|------------|------------|--------------|------------|------------|
| Range                                    | °C | –200 to 1,300 | 0.0 to 500.0 | –100 to 850   | 0.0 to 400.0 | –199.9 to 400.0 | 0 to 600   | –100 to 850   | 0.0 to 400.0 | –199.9 to 400.0 | –200 to 1,300 | 0 to 1,700 | 0 to 1,700 | 100 to 1,800 | 0 to 2,300 | 0 to 1,300 |
|                                          | °F | –300 to 2,300 | 0.0 to 900.0 | –100 to 1,500 | 0.0 to 750.0 | –199.9 to 700.0 | 0 to 1,100 | –100 to 1,500 | 0.0 to 750.0 | –199.9 to 700.0 | –300 to 2,300 | 0 to 3,000 | 0 to 3,000 | 300 to 3,200 | 0 to 4,100 | 0 to 2,300 |
| Setting                                  |    | 2             | 3            | 4             | 5            | 6               | 7          | 8             | 9            | 10              | 11            | 12         | 13         | 14           | 15         | 16         |

**Note:** Setting number is factory-set to 2 (K1).

Thermocouple W is W/Re5-26 (tungsten rhenium 5, tungsten rhenium 26).

**Current/Voltage**

| Input (switch selectable) | Current input                                                                                                                     |            | Voltage input |          |           |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------|---------------|----------|-----------|
|                           | 4 to 20 mA                                                                                                                        | 0 to 20 mA | 1 to 5 V      | 0 to 5 V | 0 to 10 V |
| Range                     | One of following ranges depending on results of scaling<br>–1999 to 9999<br>–199.9 to 999.9<br>–19.99 to 99.99<br>–1.999 to 9.999 |            |               |          |           |
| Setting                   | 17                                                                                                                                | 18         | 19            | 20       | 21        |

## ■ Characteristics

|                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Indication accuracy (See note 1.) | Thermocouple:<br>( $\pm 0.3\%$ of indication value or $\pm 1^\circ\text{C}$ , whichever greater) $\pm 1$ digit max.<br>Platinum resistance thermometer:<br>( $\pm 0.2\%$ of indication value or $\pm 0.8^\circ\text{C}$ , whichever greater) $\pm 1$ digit max.<br>Analog input: $\pm 0.2\%$ FS $\pm 1$ digit max.                                                                                                                                                                                    |
| Hysteresis                        | 0.01% to 99.99% FS (in units of 0.01% FS)                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Proportional band (P)             | 0.1% to 999.9% FS (in units of 0.1% FS)                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Integral (reset) time (I)         | 0 to 3,999 s (in units of 1 s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Derivative (rate) time (D)        | 0 to 3,999 s (in units of 1 s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Control period                    | 1 to 99 s (in units of 1 s)                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Manual reset value                | 0.0% to 100.0% (in units of 0.1%)                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Alarm setting range               | -1,999 to 9,999 or -199.9 or 999.9 (decimal point position dependent on input type or result of scaling)                                                                                                                                                                                                                                                                                                                                                                                              |
| Set time (See note 2.)            | 0 to 99 hrs 59 min or 0 to 99 min 59 s                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Program capacity (See note 2.)    | 4 patterns, 16 steps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Programming method (See note 2.)  | Time or ramp setting method                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Time accuracy (See note 2.)       | $\pm 0.2\%$ ( $\pm 500$ ms) of the set value                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Sampling period (See note 3.)     | Temperature input: 250 ms<br>Current/voltage input: 100 ms                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Insulation resistance             | 20 M $\Omega$ min. (at 500 VDC)                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Dielectric strength               | 2,000 VAC, 50/60 Hz for 1 min between terminals of different polarities                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Vibration resistance              | Malfunction: 10 to 55 Hz, 10 m/s <sup>2</sup> (approx. 1G) for 10 min each in X, Y, and Z directions<br>Destruction: 10 to 55 Hz, 20 m/s <sup>2</sup> (approx. 2G) for 2 hrs each in X, Y, and Z directions                                                                                                                                                                                                                                                                                           |
| Shock resistance                  | Malfunction: 200 m/s <sup>2</sup> min. (approx. 20G), 3 times each in 6 directions<br>(100 m/s <sup>2</sup> (approx. 10G) applied to the relay)<br>Destruction: 300 m/s <sup>2</sup> min. (approx. 30G), 3 times each in 6 directions                                                                                                                                                                                                                                                                 |
| Ambient temperature               | Operating: -10°C to 55°C (with no icing)/3-year warranty period: -10°C to 50°C<br>Storage: -25°C to 65°C (with no icing)                                                                                                                                                                                                                                                                                                                                                                              |
| Ambient humidity                  | Operating: 35% to 85%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Degree of protection              | Front panel: NEMA4 for indoor use (equivalent to IP66)<br>Rear case: IEC standard IP20<br>Terminals: IEC standard IP00                                                                                                                                                                                                                                                                                                                                                                                |
| Memory protection                 | Non-volatile memory (number of writings: 100,000 operations)                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Weight                            | E5AK: approx. 450 g<br>E5EK: approx. 320 g<br>Mounting bracket: approx. 65 g                                                                                                                                                                                                                                                                                                                                                                                                                          |
| EMC                               | Emission Enclosure: EN55011 Group 1 class A<br>Emission AC Mains: EN55011 Group 1 class A<br>Immunity ESD: EN61000-4-2: 4 kV contact discharge (level 2)<br>8 kV air discharge (level 3)<br>Immunity RF-interference: ENV50140: 10 V/m (amplitude modulated, 80 MHz to 1 GHz) (level 3)<br>10 V/m (pulse modulated, 900 MHz)<br>Immunity Conducted Disturbance: ENV50141: 10 V (0.15 to 80 MHz) (level 3)<br>Immunity Burst: EN61000-4-4: 2 kV power-line (level 3)<br>2 kV I/O signal-line (level 4) |
| Approved standards                | UL61010C-1, CSA 22.2 No. 61010-1<br>Conforms to EN61326-1: 2006, EN61010-1 (IEC61010-1)<br>Conforms to VDE0106/part 100 (Finger Protection), when the separately-ordered terminal cover is mounted.                                                                                                                                                                                                                                                                                                   |

- Note: 1.** The indication accuracy of the K1, T, and N thermocouples at a temperature of -100°C or less is  $\pm 2^\circ\text{C} \pm 1$  digit maximum. The indication accuracy of the U, L1, and L2 thermocouples at any temperature is  $\pm 2^\circ\text{C} \pm 1$  digit maximum.  
The indication accuracy of the B thermocouple at a temperature of 400°C or less is unrestricted.  
The indication accuracy of the R and S thermocouples at a temperature of 200°C or less is  $\pm 3^\circ\text{C} \pm 1$  digit maximum.  
The indication accuracy of the W thermocouple at any temperature is ( $\pm 0.3\%$  of the indicated value or  $\pm 3^\circ\text{C}$ , whichever is greater)  $\pm 1$  digit maximum.  
The indication accuracy of the PLII thermocouple at any temperature is ( $\pm 0.3\%$  or  $\pm 2^\circ\text{C}$ , whichever is greater)  $\pm 1$  digit maximum.
- 2.** For Programmable Models.
- 3.** The sampling period of the standard model with CT and remote SP inputs is 250 ms.

## ■ Output Unit Ratings and Characteristics

| Model   |                       | Specifications                                                                        |
|---------|-----------------------|---------------------------------------------------------------------------------------|
| E53-R   | Relay output          | 5 A at 250 VAC (resistive load)                                                       |
| E53-S   | SSR output            | 1 A at 75 to 250 VAC (resistive load)                                                 |
| E53-Q   | Voltage output        | NPN: 40 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)                                  |
| E53-C3  | Linear current output | 4 to 20 mA, permissible load impedance: 600 $\Omega$ max., resolution: approx. 2,600  |
| E53-C3D |                       | 0 to 20 mA, permissible load impedance: 600 $\Omega$ max., resolution: approx. 2,600  |
| E53-V34 | Linear voltage output | 0 to 10 VDC, permissible load impedance: 1 k $\Omega$ min., resolution: approx. 2,600 |
| E53-V35 |                       | 0 to 5 VDC, permissible load impedance: 1 k $\Omega$ min., resolution: approx. 2,600  |

**Note:** An output relay (1 A at 250 VAC) is mounted on the position-proportional model. (When replacing, use the E53-R.)

## ■ Option Unit Ratings and Characteristics

| Model    |                 |         | Specifications                                                                                                                                              |
|----------|-----------------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| E53-AKB  | Event input     |         | Contact input:<br>ON: 1 k $\Omega$ max., OFF: 100 k $\Omega$ min.<br>No-contact input:<br>ON: residual voltage 1.5 V max., OFF: leakage current 0.1 mA max. |
| E53-EN01 | Communications  | RS-232C | Transmission method: Half-duplex                                                                                                                            |
| E53-EN02 |                 | RS-422  | Synchronization method: Start-stop synchronization (asynchronous method)                                                                                    |
| E53-EN03 |                 | RS-485  | Baud rate: 1.2/2.4/4.8/9.6/19.2 kbps<br>Transmission code: ASCII                                                                                            |
| E53-AKF  | Transfer output |         | 4 to 20 mA:<br>Permissible load impedance: 600 $\Omega$ max.<br>Resolution: approx. 2,600                                                                   |

**Note:** Event input is used for switching the target value, run or stop command, or automatic and manual mode with an external signal input.

## ■ Current Transformer Ratings

|                            |                                                |
|----------------------------|------------------------------------------------|
| Dielectric strength        | 1,000 VAC (for 1 min)                          |
| 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) | Armature: 2; Plug: 2                           |

## ■ Heater Burnout Alarm

|                                       |                                                 |
|---------------------------------------|-------------------------------------------------|
| Max. heater current                   | Single-phase 50 A VAC (See note 1.)             |
| Heater current value display accuracy | $\pm 5\%$ FS $\pm 1$ digit max.                 |
| Heater burnout alarm setting range    | 0.1 to 49.9 A (in units of 0.1 A) (See note 2.) |
| Min. detection ON time                | 190 ms (See note 3.)                            |

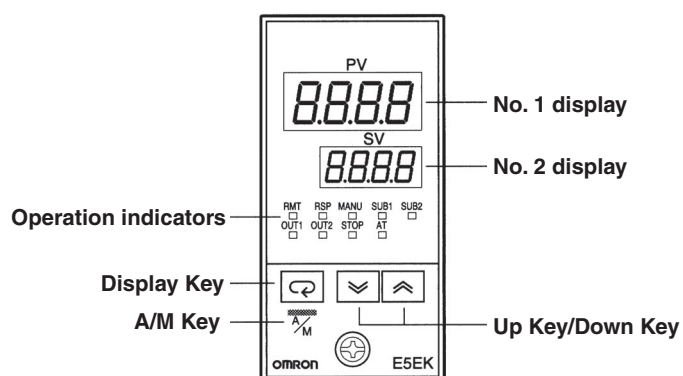
**Note:** 1. Use the K2CU-F□□A-□GS (with gate input terminals) for the detection of three-phase heater burnout.

2. The heater burnout alarm is always OFF if the alarm is set to 0.0 A and always ON if the alarm is set to 50.0 A.

3. No heater burnout detection or heater current value measurement is possible if the control output (heat) is ON for less than 190 ms.

# Nomenclature

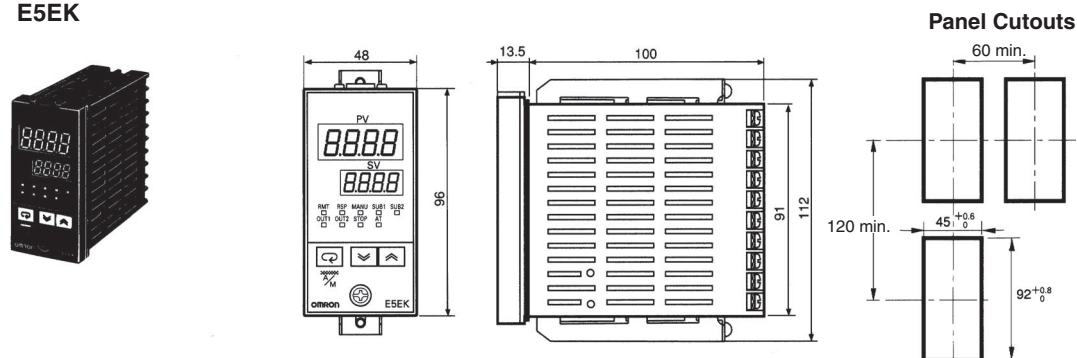
E5EK



## Dimensions

**Note:** All units are in millimeters unless otherwise indicated.

E5EK

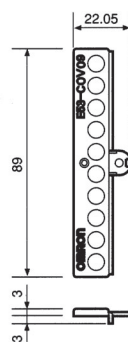
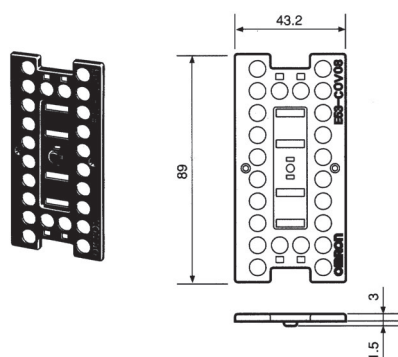


- Note:**
1. Recommended panel thickness is 1 to 8 mm.
  2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted vertically or horizontally.

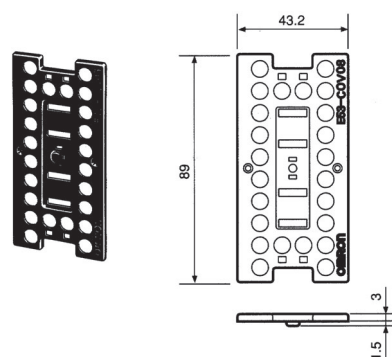
## Accessories (Order Separately)

### Terminal Cover

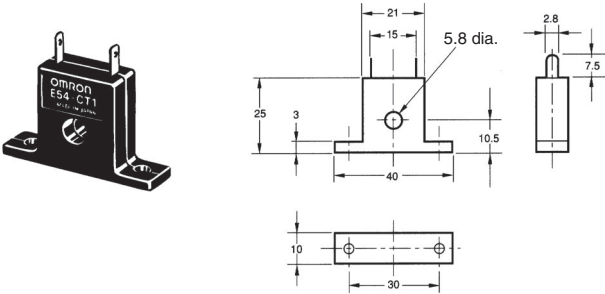
E53-COV0809



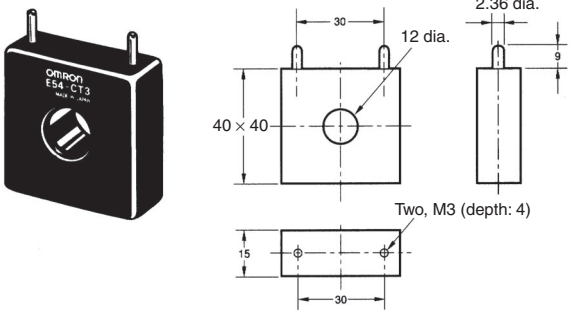
E53-COV08



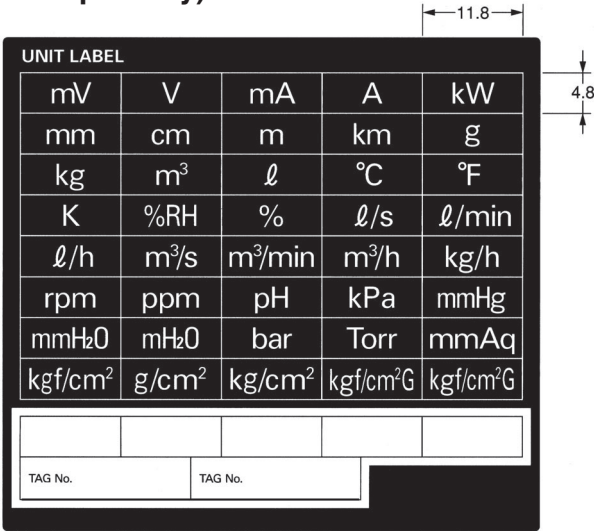
Current Transformer  
E54-CT1



E54-CT3



Unit Label (Order Separately)  
Y92S-L1



Waterproof Packing  
Y92S-P5 (for DIN 48 × 96)



Order the Waterproof Packing separately if it becomes lost or damaged.

The Waterproof Packing can be used to achieve an IP66 degree of protection.

(Deterioration, shrinking, or hardening of the waterproof packing may occur depending on the operating environment. Therefore, periodic replacement is recommended to ensure the level of waterproofing specified in IP66. The time for periodic replacement depends on the operating environment. Be sure to confirm this point at your site. Consider one year a rough standard. OMRON shall not be liable for the level of water resistance if the customer does not perform periodic replacement.)

The Waterproof Packing does not need to be attached if a waterproof structure is not required.

ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.  
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

In the interest of product improvement, specifications are subject to change without notice.



## 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.

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## 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.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.
- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

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.

### PROGRAMMABLE PRODUCTS

OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

## Disclaimers

### CHANGE IN SPECIFICATIONS

Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

### DIMENSIONS AND WEIGHTS

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

### 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.

### ERRORS AND OMISSIONS

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2009.4

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