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Digital Controller E5EK

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
- AC/DC24V types are also available.



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-AA2 AC/DC24	Standard model
	E5EK-AA2-500 AC/DC24	Standard model with terminal cover
	E5EK-PRR2 AC100-240	Position-proportional model
	E5EK-PRR2-500 AC100-240	Position-proportional model with terminal cover
	E5EK-PRR2 AC/DC24	Position-proportional model
	E5EK-PRR2-500 AC/DC24	Position-proportional model with terminal cover
	E5EK-TAA2 AC100-240	Standard model
	E5EK-TAA2-500 AC100-240	Standard model with terminal cover
	E5EK-TAA2 AC/DC24	Standard model
	E5EK-TAA2-500 AC/DC24	Standard model with terminal cover
	E5EK-TPRR2 AC100-240	Position-proportional model
	E5EK-TPRR2-500 AC100-240	Position-proportional model with terminal cover
	E5EK-TPRR2 AC/DC24	Position-proportional model
	E5EK-TPRR2-500 AC/DC24	Position-proportional model with terminal cover

- Note:**
- When using the heater burnout alarm function with a standard model, the Linear Output Unit cannot be used for the control outputs (heat).
 - Be sure to specify the Current Transformer, Output Unit, and Option Unit when ordering.
 - 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:**
- The Option Unit can be used either by the E5AK or E5EK.
 - 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
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Specifications

■ Ratings

Item	AC100-240V type	AC/DC24V type
Supply voltage	AC100 to 240V, 50/60 Hz	AC/DC24V, 50/60 Hz
Power consumption	E5EK: 15 VA	12 VA, 8 W
Operating voltage range	85% to 110% of rated supply voltage	
Input	Thermocouple: K, J, T, E, L, U, N, R, S, B, W, PLII Platinum resistance thermometer: JPt100, Pt100 Current input: 4 to 20 mA, 0 to 20 mA 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	<u>Standard Model, Programmable Model</u> According to Output Unit (see <i>Output Unit Ratings and Characteristics</i>) <u>Position-proportional Model</u> 2 Relay outputs: SPST-NO, 1 A at 250 VAC (including inrush current) (See note 1.)	
Auxiliary output	SPST-NO, 3 A at 250 VAC (resistive load)	
Control method (See note 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. 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	<u>Standard</u> 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. <u>Option</u> Multiple SP, run/stop selection, transfer output functions	
Degree of protection	Conforms to IEC IP66 and NEMA4 (Indoor use)	

Note: 1. All control outputs are insulated from the input circuit.

2. Fuzzy self-tuning is available when using the Digital Controller in standard control operation with temperature input.

■ 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) (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 -1999 to 9999 -199.9 to 999.9 -19.99 to 99.99 -1.999 to 9.999				
Setting	17	18	19	20	21

■ Characteristics

Indication accuracy (See note 1.)	Thermocouple: (±0.3% of indication value or ±1°C, whichever greater) ±1 digit max. Platinum resistance thermometer: (±0.2% of indication value or ±0.8°C, whichever greater) ±1 digit max. Analog input: ±0.2% FS ±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.)	±0.2% (±500 ms) of the set value
Sampling period (See note 3.)	Temperature input: 250 ms Current/voltage input: 100 ms
Insulation resistance	20 MΩ 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 ² (approx. 1G) for 10 min each in X, Y, and Z directions Destruction: 10 to 55 Hz, 20 m/s ² (approx. 2G) for 2 hrs each in X, Y, and Z directions
Shock resistance	Malfunction: 200 m/s ² min. (approx. 20G), 3 times each in 6 directions (100 m/s ² (approx. 10G) applied to the relay) Destruction: 300 m/s ² 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 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) Rear case: IEC standard IP20 Terminals: IEC standard IP00
Memory protection	Non-volatile memory (number of writings: 100,000 operations)
Weight	E5AK: approx. 450 g E5EK: approx. 320 g Mounting bracket: approx. 65 g
EMC	Emission Enclosure: EN55011 Group 1 class A Emission AC Mains: EN55011 Group 1 class A Immunity ESD: EN61000-4-2: 4 kV contact discharge (level 2) 8 kV air discharge (level 3) Immunity RF-interference: ENV50140: 10 V/m (amplitude modulated, 80 MHz to 1 GHz) (level 3) 10 V/m (pulse modulated, 900 MHz) Immunity Conducted Disturbance: ENV50141: 10 V (0.15 to 80 MHz) (level 3) Immunity Burst: EN61000-4-4: 2 kV power-line (level 3) 2 kV I/O signal-line (level 4)
Approved standards	UL1092, CSA22.2 No. 142, CSA22.2 No. 1010-1 Conforms to EN50081-2, EN50082-2, EN61010-1 (IEC1010-1) 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 ±2°C ±1 digit maximum. The indication accuracy of the U, L1, and L2 thermocouples at any temperature is ±2°C ±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 ±3°C ±1 digit maximum.
The indication accuracy of the W thermocouple at any temperature is (±0.3% of the indicated value or ±3°C, whichever is greater) ±1 digit maximum.
The indication accuracy of the PLII thermocouple at any temperature is (±0.3% or ±2°C, whichever is greater) ±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 Ω max., resolution: approx. 2,600
E53-C3D		0 to 20 mA, permissible load impedance: 600 Ω max., resolution: approx. 2,600
E53-V34	Linear voltage output	0 to 10 VDC, permissible load impedance: 1 kΩ min., resolution: approx. 2,600
E53-V35		0 to 5 VDC, permissible load impedance: 1 kΩ 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: ON: 1 kΩ max., OFF: 100 kΩ min. No-contact input: 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 Transmission code: ASCII
E53-AKF	Transfer output	4 to 20 mA: Permissible load impedance: 600 Ω max. 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 ² (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	±5% FS±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.)

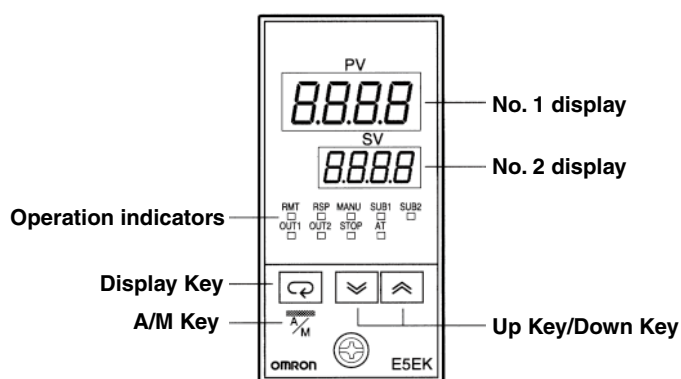
Note: 1. Use the K2CU-F□□A-□GS (with gate input terminals) for the detection of three-phase heater burnout.

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

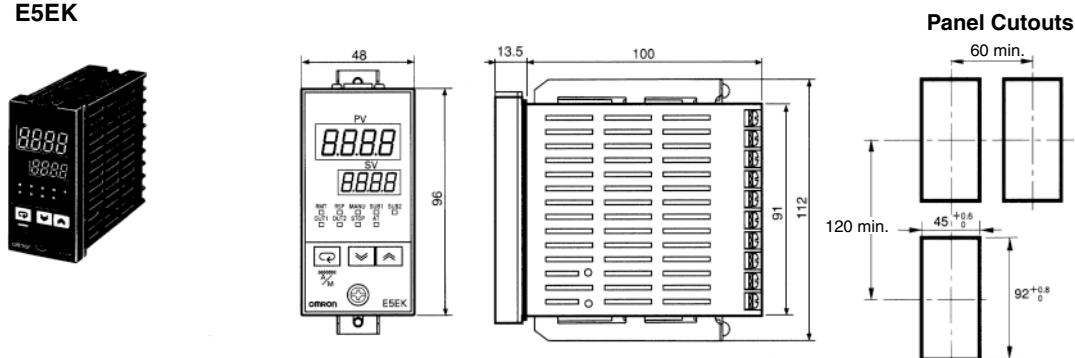
E5EK



Dimensions

Note: All units are in millimeters unless otherwise indicated.

E5EK

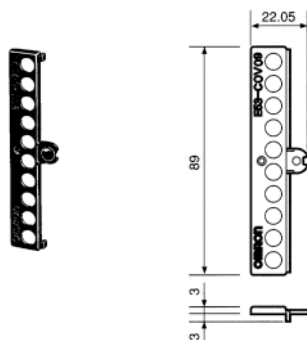
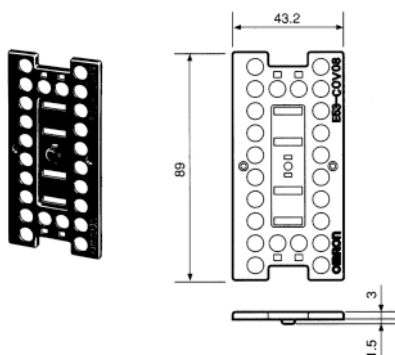


- Note:
1. Recommended panel thickness is 1 to 8 mm.
 2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted vertically or horizontally.

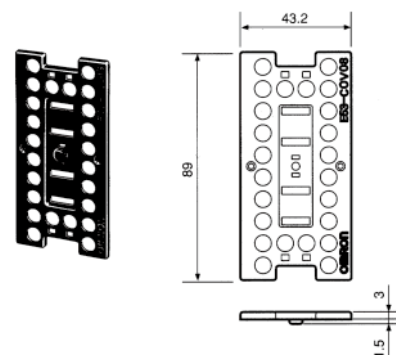
Accessories (Order Separately)

Terminal Cover

E53-COV0809

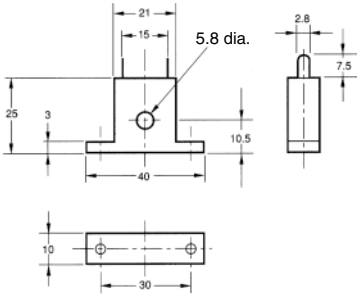
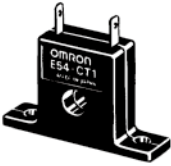


E53-COV08

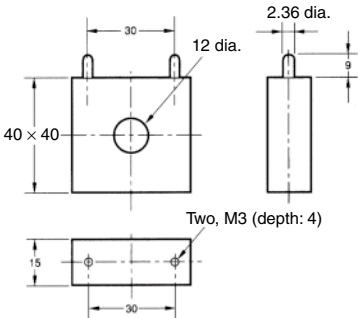


Current Transformer

E54-CT1

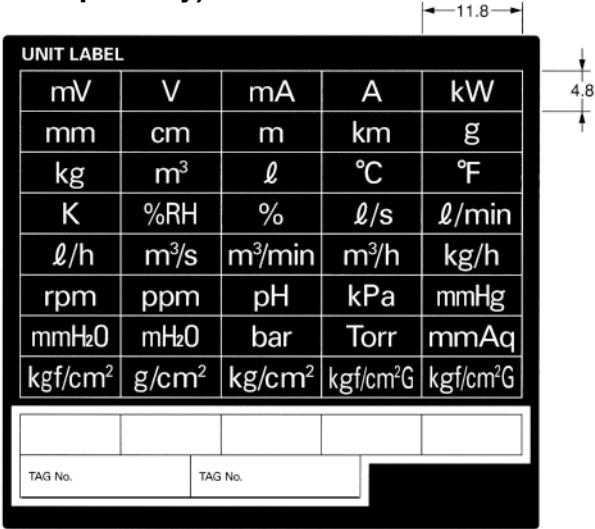


E54-CT3



Unit Label (Order Separately)

Y92S-L1



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.

Safety Precautions for All Temperature Controllers

Refer to the precautions of individual product for more specific details.

Warning

The following products contain lithium batteries. Do not disassemble, deform under pressure, heat to over 100°C, or incinerate these products. The lithium battery may ignite or explode. Applicable models: E5ZE, E5LD, and E5LC.



Caution

Do not touch any of the terminals while the power is being supplied. Doing so may result in electric shock.



Do not allow pieces of metal or wire cuttings to get inside the Temperature Controller. Doing so may result in electric shock, fire, or malfunction.



Do not attempt to disassemble, repair, or modify the Temperature Controller. Any attempt to do so may result in electric shock, fire, or malfunction.



Do not use the Temperature Controller in locations subject to flammable or explosive gases. Doing so may result in an explosion.



The switching capacity and switching conditions will significantly affect the longevity of the output relays. Use the Temperature Controller within the rated load, and do not use the Temperature Controller beyond the number of operations specified under electrical life. Using the Temperature Controller beyond its electrical life may result in contact welding or burning.



Use Temperature Controller settings that are appropriate for the controlled system. Failure to do so may cause unexpected operation resulting in damage to equipment or personal injury.



Prepare a circuit with an overheating prevention alarm and implement other safety measures to ensure safe operation in the event of a malfunction. Loss of operational control due to malfunction may result in a serious accident.



Tighten the terminal screws to the following torque:

M3.5 screws: 0.74 to 0.90 N·m

M3 screws: 0.40 to 0.56 N·m

E5GN: Terminals 1 to 6: 0.23 to 0.25 N·m

Terminals 7 to 9: 0.12 to 0.14 N·m



Failure to tighten terminal screws to the correct torque may result in fire or malfunction.

Make sure there will be no adverse affects from the device connected to the Temperature Controller before using the hardware test mode. Devices connected to the Temperature Controller may reach a dangerous state during the test.



Operating Environment Precautions

- Do not use the Temperature Controller in the following locations:
 - Locations exposed to radiated heat from heating devices
 - Locations subject to exposure to water or oil
 - Locations subject to direct sunlight
 - Locations subject to dust or corrosive gases (in particular, sulfide gas and ammonia gas)
 - Locations subject to severe changes in temperature
 - Locations subject to icing or condensation
 - Locations subject to excessive shock or vibration
- Use and store the Temperature Controller within the rated temperature or humidity range specified for each model. When two or more Temperature Controllers are mounted horizontally close to each other or vertically next to one another, the internal temperature will increase due to the heat they radiate and the service life of the products will decrease. In such cases, forced cooling by fans or other means of air ventilation will be required to cool down the Temperature Controllers.
- Allow enough space around the Temperature Controller to ensure proper heat dissipation. Do not block the ventilating holes.
- Be sure to wire properly with correct polarity of terminals.
- To wire the E5AN, E5EN, or E5CN using crimp terminals, use crimp terminals designed for M3.5 screws and with a width of 7.2 mm max.



- When wiring the E5GN, use a cable gauge of AWG24 (0.205 mm²) to AWG14 (2.081 mm²) for terminals 1 to 6, and use a cable gauge of AWG28 (0.081 mm²) to AWG22 (0.326 mm²) for terminals 7 to 9. The exposed current-carrying part to be inserted into terminals must be 5 to 6 mm.
- After wiring is completed, do not pull on or bend a terminal block lead wire with a force of 30 N or higher.
- Do not connect anything to unused terminals.
- Make sure that the power supply voltages and loads are within specification and rating ranges before using the Temperature Controller.
- To avoid inductive noise, keep the wiring for the Temperature Controller's terminal board away from power cables carrying high voltages or large currents. Also, do not wire power lines together with or parallel to Temperature Controller wiring. Using shielded cables to separate pipes and ducts is recommended. Attach surge absorbers or noise filters to peripheral devices that generate noise (e.g., motors, transformers, solenoids, magnetic coils, or other equipment that has an inductance element). If using a noise filter with the power supply, be sure to confirm the voltage and the current, and then mount the power supply as near as possible to the Temperature Controller. Set up the Temperature Controller, along with its power supply, as far away as possible from devices that generate strong, high-frequency waves, such as high-frequency welders and high-frequency machines, and from devices that generate surges.
- Make sure that the rated voltage is attained within two seconds of turning the power ON.
- Allow at least 30 seconds for the Temperature Controller to warm up.
- When using self-tuning, turn ON power for the load (e.g., heater) at the same time as or before supplying power to the Temperature Controller. If power is turned ON for the Temperature Controller before turning ON power for the load, self-tuning will not be performed properly and optimum control will not be achieved.

Precautions for Correct Use

14. In order that power can be turned OFF in an emergency by the person operating the Temperature Controller, install the appropriate switches and circuit breakers, and label them accordingly.
15. Turn OFF the power before drawing out the Temperature Controller body. Do not touch or apply excessive force to the terminals or electronic parts. When inserting the body, make sure that electronic parts do not come in contact with the case.
16. When the terminal block for the E5GN is detached, do not touch or apply excessive force to any electronic parts.
17. Use alcohol to clean the Temperature Controller. Do not use thinner or other solvent-based substances.
18. Inverters with an output frequency of 50/60 Hz are available, but they may cause the internal temperature of Temperature Controller to rise, possibly resulting in smoke or burning. Do not use an inverter output to supply power to a Temperature Controller.

● Service Life

1. Use the Temperature Controller within the specified temperature and humidity ranges. If the product is installed inside a control panel, the temperature around the Temperature Controller and not the temperature around the control panel must be kept within the specified temperature range.
2. The service life of electronic devices such as Temperature Controllers is determined not only by the number of switching operations performed by the relay, but also by the service life of the internal electronic components. The service life of these components depends on the ambient temperature: it will be shorter if the ambient temperature is high and longer if the ambient temperature is low. For this reason, the service life of the product can be extended by keeping the internal temperature of the Temperature Controller low.
3. If several Temperature Controllers are mounted side-by-side or are arranged vertically, the heat generated by them may cause the internal temperature of the products to rise, thus reducing their service life. To prevent this, take steps to ensure that the Temperature Controllers are cooled, such as installing fans. When providing forced cooling, however, be careful not to cool down the terminal sections alone to avoid measurement errors.

● Measurement Accuracy

1. When extending the lead wires for thermocouples, use a compensating conductor appropriate for the type of thermocouple use.
2. When extending the lead wires for platinum resistance thermometers, use lead wires with low resistance, and make the resistance in the 3 lead wires equal.
3. The type of Temperature Sensor and the input type for the Temperature Controller must be set the same.
4. There are two types of platinum resistance thermometers: Pt and JPt. Accurate measurement will not be possible if the input type for the Temperature Sensor is not set correctly.
5. Mount the Temperature Controller horizontally.
6. If significant errors occur, check to see if the input shift has been set correctly.

● Waterproofing

Sections without any specification on their degree of protection or those with IP□0 specifications are not waterproof.

● EN/IEC Compliance

Installing the following fuse in the power supply terminal block is recommended if the Temperature Controller is used in applications requiring EN/IEC compliance.

Recommended fuse: A T2A, 250-VAC, time lag fuse with low breaking capacity

● Operating Precautions

1. It takes approximately five seconds for the outputs to turn ON from the moment the power is turned ON. Due consideration must be given to this time when incorporating Temperature Controllers in a sequence circuit.
2. When using the self-tuning capability of the E5□N, E5□K, or E5□J, supply power to the load (e.g., heater) at the same time as or before supplying power to the Temperature Controller. If power is turned ON for the Temperature Controller before turning ON power for the load, self-tuning will not be performed properly and optimum control will not be achieved. When starting operation after the Temperature Controller has warmed up, turn OFF the power and then turn it ON again at the same time as turning ON power for the load. (Instead of turning the Temperature Controller OFF and ON again, switching from STOP mode to RUN mode can also be used in this case.)
3. The reception of the Temperature Controller may be affected if it is used close to radios, television sets or wireless devices.

Parameter Displays

The following displays are used to represent the characters for parameter names on the Temperature Controller.

● Seven-segment Digital Display

A	b	C	d	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

● Eleven-segment Digital Display

A	b	C	d	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

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

Read and Understand This Catalog

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