

Digital Process Controller Series

E5□K

Advanced Process Digital Controllers with Fuzzy Logic

- Field configurable outputs, options.
- 100 ms sampling (for analog input).
- Advanced PID, or fuzzy self-tuning.
- Conforms to UL, CSA and CE standards.
- Water-resistant front panel meets IP66/NEMA 4X.
- Remote set point with optional event input board.
- Set point ramp.
- Serial communications available.
- Front panel programming.
- Heat only or heat/cool control.
- Auxiliary outputs (SPST) standard; two for E5AK/E5EK, one for E5CK.
- 3-year warranty.



Ordering Information

Stock Note: Shaded models are normally stocked.

Note: Order Control Output Boards and Option Boards separately below.

Description	DIN size	Supply voltage	Model
Standard model	1/4 DIN (96 x 96 mm)	100 to 240 VAC	E5AK-AA2-500
Position-proportional model (See Note 3)		100 to 240 VAC	E5AK-PRR2-500
Standard model		24 VAC/VDC	E5AK-AA2-500 AC/DC24
Position-proportional model (See Note 3)		24 VAC/VDC	E5AK-PRR2-500 AC/DC24
Standard model	1/8 DIN (48 x 96 mm)	100 to 240 VAC	E5EK-AA2-500
Position-proportional model (See Note 3)		100 to 240 VAC	E5EK-PRR2-500
Standard model		24 VAC/VDC	E5EK-AA2-500 AC/DC24
Position-proportional model (See Note 3)		24 VAC/VDC	E5EK-PRR2-500 AC/DC24
Standard model	1/16 DIN (48 x 48 mm)	100 to 240 VAC	E5CK-AA1-500
Standard model		24 VAC/VDC	E5CK-AA1-500 AC/DC24
Non-standard model with built-in quick auto-tune button (See <i>Nomenclature</i> section for details)		100 to 240 VAC	E5CK-AA1-302

- Note: 1. When using the heater burnout alarm function with a standard model, the Linear Output Module cannot be used for the control outputs (heat). 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.
2. E5EK-PRR2/E5AK-PRR2 controllers are supplied with dedicated relay output.
3. Position-proportional models are intended for motorized values (not 4-20 mA modulating valves). These use two relays (“open” and “close”) which will turn a motor clockwise or counter-clockwise, thus opening or closing the valve.
4. Part numbers ending in -500 include a Finger Safe cover.

■ Optional Output Boards

Stock Note: Shaded models are normally stocked.

Description	Specifications	Compatible controller	Max. quantity	Model
Relay	SPST, 5 A, 250 VAC	E5AK/E5EK	2	E53-R
SSR (solid state relay)	1 A, 75 to 250 VAC	E5AK/E5EK	2	E53-S
Voltage pulse	NPN, 12 VDC	E5AK/E5EK	2	E53-Q
	NPN, 24 VDC	E5AK/E5EK	2	E53-Q3
	PNP, 24 VDC	E5AK/E5EK	2	E53-Q4
Linear current	4 to 20 mA	E5AK/E5EK	2	E53-C3
	0 to 20 mA	E5AK/E5EK	2	E53-C3D
Linear voltage	0 to 10 VDC	E5AK/E5EK	2	E53-V34
	0 to 5 VDC	E5AK/E5EK	2	E53-V35
Relay/Relay	SPST/SPST, 5 A, 250 VAC	E5CK	1	E53-R4R4
Relay/Pulse	SPST, 5 A/NPN, 24 VDC	E5CK	1	E53-Q4R4
	SPST, 5 A/PNP, 24 VDC	E5CK	1	E53-Q4HR4
Relay/Linear current	SPST, 5 A/4 to 20 mA	E5CK	1	E53-C4R4
	SPST, 5 A/0 to 20 mA	E5CK	1	E53-C4DR4
Relay/Linear voltage	SPST, 5 A/0 to 10 VDC	E5CK	1	E53-V44R4
Pulse/Pulse	NPN/NPN, 24 VDC	E5CK	1	E53-Q4Q4
	PNP/PNP, 24 VDC	E5CK	1	E53-Q4HQ4H
Computer communications	RS-232C	E5AK/E5EK	3/1	E53-AK01
	RS-232C	E5CK	1	E53-CK01
	RS-422	E5AK/E5EK	3/1	E53-AK02
	RS-485	E5AK/E5EK	3/1	E53-AK03
		E5CK	1	E53-CK03
Event input	For remote set point	E5AK/E5EK	3/1	E53-AKB
	For remote set point	E5CK	1	E53-CKB
Transfer output	4 to 20 mA	E5AK/E5EK	3/1	E53-AKF
	4 to 20 mA	E5CK	1	E53-CKF

Note: If the control period is less than 5 seconds, use an SSR (solid state relay) or pulse voltage output.

■ Accessories (Order Separately)

Stock Note: Shaded models are normally stocked.

Description	Specifications	Compatible controller	Max. quantity	Model
Current transformer; order only if using heater burnout alarm function	50 A load, 5.8 mm hole dia.	E5AK/E5EK	1	E54-CT1
	120 A load, 12 mm hole dia.	E5AK/E5EK	1	E54-CT3
Terminal cover (supplied with Standard models)	Provides finger protection from terminals (VDE0106 part 100)	E5AK	1	E53-COV0809
		E5CK	1	E53-COV07
		E5EK	1	E53-COV08
Software	For setup and monitoring; requires optional computer communications board	All	1	Thermo Tools (See Note)

Note: Contact Omron for current version information.

Input Types (selectable with input jumper connector)

Thermocouple

Input (field selectable) (See Notes)		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

- Note: 1. Setting number is factory-set to 2 (K1).
 2. Thermocouple W is W/Re5-26 (tungsten rhenium 5, tungsten rhenium 26).

Platinum Resistance Thermometer (RTD's)

Input (field 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

Current/Voltage

Input (field selectable)	Current input		Voltage input		
		4 to 20 mA	0 to 20 mA	1 to 5 V	0 to 5 V

Note: When a current/voltage input is selected, the decimal point is fully adjustable.

Specifications

■ Ratings

Model		E5□K Standard	E5□K 24V AC/DC	
Supply voltage		100–240 VAC, 50/60 Hz		
Operating voltage range		85% to 110% of rated supply voltage		
Power consumption	E5AK	16 VA	9 VA, 6 W	
	E5EK	15 VA	9 VA, 6 W	
	E5CK	10 VA (at 100 VAC) 14 VA (at 240 VAC)	6 VA, 3.5 W	
Input	Thermocouple	K, J, T, E, L, U, N, R, S, B, W, PLII		
	Platinum resistance thermometer (RTD)	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		
Mean Time Between Failure		15.4 years (135,000 hours)		
Control output (See Note 1)	Relay	SPST, 3 A at 250 VAC (resistive load) Mechanical life expectancy: 10,000,000 operations min. Electrical life expectancy: 100,000 operations min.		
	Voltage (pulse)	NPN	20 mA at 12/24 VDC (with short-circuit protection)	
		PNP	20 mA at 24 VDC (with short-circuit protection)	
	Linear voltage	0 to 10 VDC	Permissible load impedance: 1 kΩ min. Resolution: Approximately 2600 steps	
	Linear current	4 to 20 mA	Permissible load impedance: 500 Ω max. Resolution: Approximately 2600 steps	
		0 to 20 mA	Permissible load impedance: 500 Ω max. Resolution: Approximately 2600 steps	
Auxiliary output	SPST-NO	E5AK	3 A at 250 VAC (resistive load)	
		E5EK	3 A at 250 VAC (resistive load)	
		E5CK	1A at 250 VAC (resistive load)	
Control method (See Note 2)		ON/OFF, Advanced PID Control (with auto-tuning) or Self-tuning		
Setting method		Digital setting using front panel keys or communications features		
Indication method - 7-seg. digital display and LEDs		E5AK: PV = 15 mm, SP = 10.5 mm E5EK: PV = 14 mm, SP = 9.5 mm E5CK: PV = 12 mm, SP = 8 mm		
Potentiometer for valve positioning (for E5AK-PRR and E5EK-PRR only)		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.	
Transmission output		4 to 20 mA, permissible load impedance: 600 Ω max., resolution: Approximately 2600 steps		
Remote SP input (for E5AK and E5EK only)	Current input	4 to 20 mA (Input impedance: 150 Ω)		
Current Transformer input (for E5AK and E5EK only)		Connect only an Omron Current Transformer (E54-CT1 or E54-CT3)		
Other functions	Standard	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		
	Option	Multiple SP, run/stop selection, transfer output functions, auto/manual Communications (RS-232C, RS-422, or RS-485), Loop Break Alarm, and Transfer Output.		
Standards	UL	File No.: E68481		
	CSA	File No.: LR59623		
	CE	File No.: EN50081-2; EN50082-2; IEC 1010-1		

Note: 1. All control outputs are insulated from the input circuit.
2. Fuzzy self-tuning is available only when using the Digital Controller in standard control operation with temperature input.

■ Characteristics

Indication accuracy (See Note)		Thermocouple: ±0.3% of indication value or ±1°C, whichever is greater, ±1 digit max. Platinum resistance thermometer: ±0.2% of indication value or ±0.8°C, whichever is greater, ±1 digit max. Analog input: ±0.2% (of indication value) ±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)
Sampling period	Temperature input	250 ms scan rate
	Analog input	100 ms scan rate
Insulation resistance		200 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
	Mechanical	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)
	Mechanical	300 m/s ² min. (approx. 30G), 3 times each in 6 directions
Ambient temperature	Operating	-10°C to 55°C (14°F to 131°F) with no icing; with 3-year warranty period: -10°C to 50°C (14°F to 122°F)
	Storage	-25°C to 65°C (-13°F to 149°F) with no icing
Ambient humidity	Operating	35% to 85% RH
Enclosure ratings	Front panel	NEMA 4X 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
	E5CK	Approx. 170 g
	Adapter	Approx. 10 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)
Standards - Approvals		UL1092, CSA22.2 No. 14, CSA22.2 No. 1010-1 Conforms to EN50081-2, EN50082-2, EN61010-1 (IEC1010-1) Conforms to VDE0106/part 100 (Finger Protection)

Note: Indication Accuracy -

Of the K1, T, and N thermocouples at a temperature of -100°C or less: ±2°C ±1 digit maximum.

Of the U, L1, and L2 thermocouples at any temperature: ±2°C ±1 digit maximum.

Of the B thermocouple at a temperature of 400°C or less: unrestricted.

Of the R and S thermocouples at a temperature of 200°C or less: ±3°C ±1 digit maximum.

Of the W thermocouple at any temperature: ±0.3% of the indicated value or ±3°C, (whichever is greater) ±1 digit maximum.

Of the PLII thermocouple at any temperature: ±0.3% or ±2°C, whichever is greater ±1 digit maximum.

■ Option Board Ratings and Characteristics

Event inputs		Contact input: ON: 1 k Ω max., OFF: 100 k Ω min. No-contact input: ON: residual voltage 1.5 V max., OFF: leakage current 0.1 mA max.
Communications	Interface	RS-232C and RS-485; RS-422 for E5AK and E5EK only
	Transmission method	Half-duplex
	Synchronization method	Start-stop synchronization (asynchronous method)
	Baud rate	1.2/2.4/4.8/9.6/19.2 kbps
Transfer output		4 to 20 mA: Permissible load impedance: E5AK and E5EK = 600 Ω max. E5CK = 500 Ω max. Resolution: E5AK and E5EK = approx. 2,600 steps E5CK = approx. 2,600 steps RS-232C Peer-to-peer only; maximum cable length = 15 m (49.2 feet) RS-422 and RS-485 32 controller maximum to host computer; maximum cable length = 500 m (1640 feet)

■ Current Transformer Ratings

Part number	E54-CT1	E54-CT3
Max. continuous heater current	50 amps	120 amps (See Note 1)
Dielectric strength	1,000 VAC (for 1 min)	
Vibration resistance	50 Hz, 98 m/s ² (10G)	
Weight	Approx. 11.5 g	Approx. 50 g
Accessories	--	Armature: 2; Plug: 2

Note: 1. Use within the max. heater current rating of controller table shown below.

■ Heater Burnout Alarm

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

Note: 1. 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.

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