OMRON

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 *Nomenclature* 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	0 to 10 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	24 VAC/VDC, 50/60 Hz
Operating voltage range			85% to 110% of rated supply voltage	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 kΩ max., OFF: 100 kΩ 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.

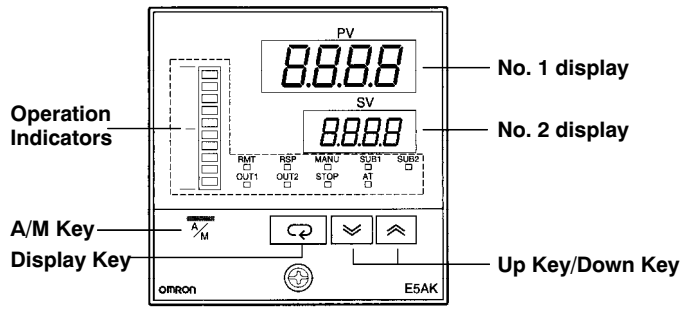
■ Heater Burnout Alarm

Max. heater current	Single-phase 50 A AC
Heater current value display accuracy	±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)

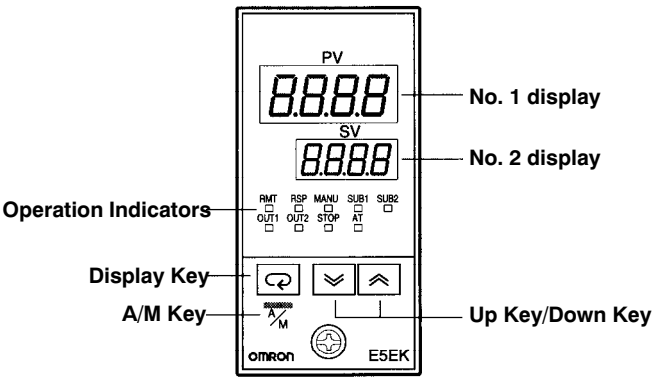
Note: 1. The heater burnout alarm is always OFF if the alarm is set to 0.0 A and always ON if the alarm is set to 50.0 A.
2. No heater burnout detection or heater current value measurement is possible if the control output (heat) is ON for less than 190 ms.

Nomenclature

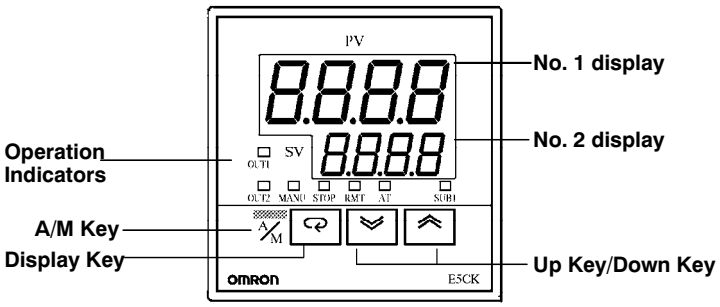
■ E5AK



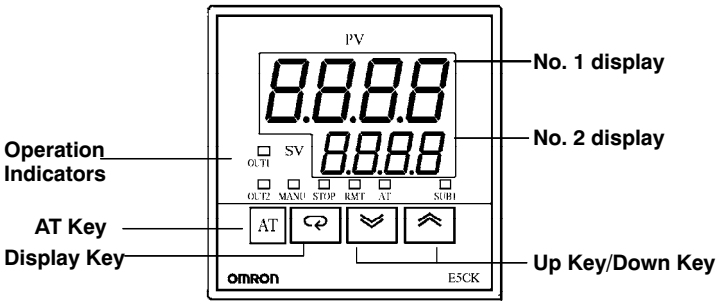
■ E5EK



■ E5CK



■ E5CK-302



Operation Indicators

- **OUT1**
  Lit when control output 1 turns ON.
- **OUT2**
  Lit when control output 2 turns ON.
- **SUB1**
  Lit when the output function assigned to auxiliary output 1 turns ON.
- **SUB2** (for E5AK and E5EK only)
  Lit when the output function assigned to auxiliary output 2 turns ON.
- **MANU**
  Lit when the manual operation mode is being used.
- **STOP**
  Lit when control operation has been stopped.
- **RMT**
  Lit during remote communications operation.
- **AT**
  Flashes during auto-tuning. Auto-tuning is completed when this LED stops flashing.
- **RSP** (for E5AK and E5EK only)
  Lit during remote SP operation.
- **Bar Graph** (for E5AK only)
  On a standard model (E5AK-AA2), this bar graph indicates the manipulated variable (heat) in 10% increments per single segment. On a position-proportional model (E5AK-PRR2), this bar graph indicates the valve opening in 10% increments per single segment.

No. 1 Display
Displays the process value or parameter symbols.

No. 2 Display
Displays the set point, set point during SP ramp, manipulated variable, or parameter settings.

A/M Key
Press to select the auto operation or manual operation.

Up Key/Down Key
Press to increase or decrease the value on the No.2 display.

Display Key
Press quickly (for less than 1 s) to shift the display to the next parameter. When this key is pressed for 1 s or more, the menu screen will be displayed in any case.

- **AT**
  Press key for automatic tuning.
- **A/M**
  This feature is located in level one. (Replaced AT feature in level one).

Operation

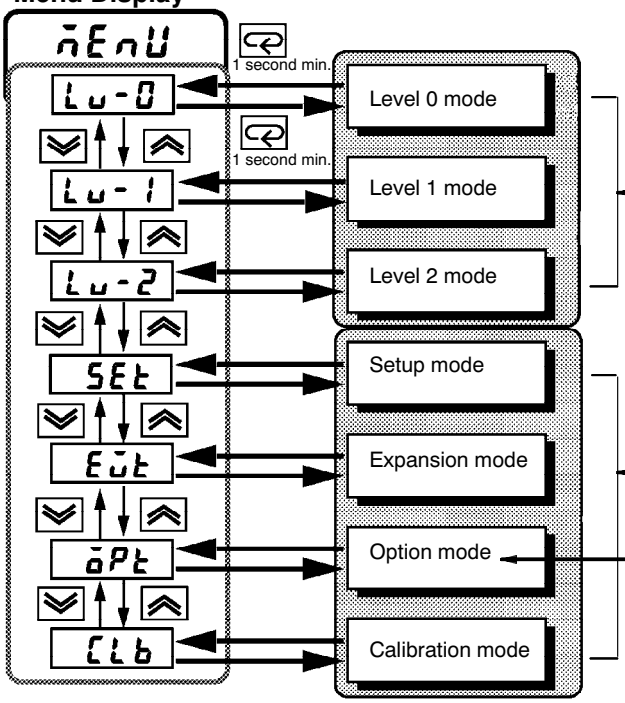
■ Operating Parameters

Mode Selection

Press the Display Key for 1 sec. min. to switch to modes other than the manual or protect mode.

The figure below (Menu Display) shows all modes in the order that they are displayed. Some parameters are not displayed, depending on the protect mode setting and the option boards used.

Menu Display



To Access *Protect Mode*

Press and hold the A/M Key and the Display Key for more than 1 second.

To Return to the Main PV/SP Display from the *Protect Mode*

Press and hold the A/M Key and the Display Key for more than 1 second.

To Access *Manual Mode*

Press and hold the A/M Key for more than 1 second.

To switch parameters **within** a mode, use the Display Key. Press the display key for less than one second to move between parameters.

Note: 1. **In Level 0 mode, Level 1 mode, and Level 2 mode:** The controller will maintain control of the process.

2. **In Setup mode, Expansion mode, Option mode, and Calibration mode:** Control of the process is not maintained. The outputs are inactive.

3. **Option Mode** will be accessible only when an option board is installed in the controller.

■ Parameters And Menus – For Setting The Controller

Protect Mode — **Limits use of the menu and A/M Keys.**
The protect function prevents unwanted modification of parameters and can also be used to prevent switching between the auto and manual operation.

Manual Mode — **Sets the controller to manual operation mode.**
You can only manually adjust the manipulated variable (MV) in this mode.

Level 0 Mode — **For normal operation.**
Change: the set point during operation, and start or stop Controller operation; and, (only in this mode) monitor the process value, ramp SP, and manipulated variable.

Level 1 Mode — **For adjusting primary control parameters.**
Execute: AT (auto-tuning); set alarm values; set the control period; and, set PID parameters.

Level 2 Mode — **For adjusting secondary control parameters.**
Set parameters for: limiting the manipulated variable and set point; switch between the remote and local modes; set the loop break alarm (LBA), alarm hysteresis, and the digital filter value of inputs.

Setup Mode — **For setting the basic specifications.**
Set parameters for: input type, scaling, output assignments and direct/reverse operation.

Expansion Mode — **For setting expanded functions.**
Set: ST (self-tuning), SP setting limiter. Select: advanced PID or ON/OFF control. Specify the standby sequence resetting method. Initialize parameters; and, set the time for automatic return to the monitoring display.

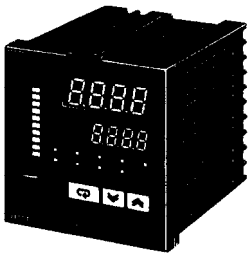
Option Mode — **For setting option functions.**
Set: the communications conditions; transfer: output and event input parameters to match the type of Option Board installed in the Controller. *This mode will be accessible only when an option board is installed in the controller.*

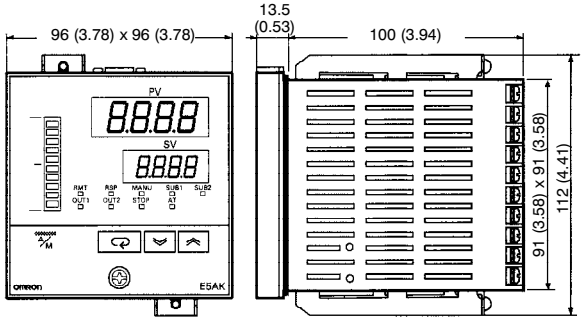
Calibration Mode — **For calibrating inputs and transfer output.**
Calibrate the selected input type. *Transfer output can be calibrated only when the Communications Unit (E53-CKF) has been installed in the Controller.*

Dimensions

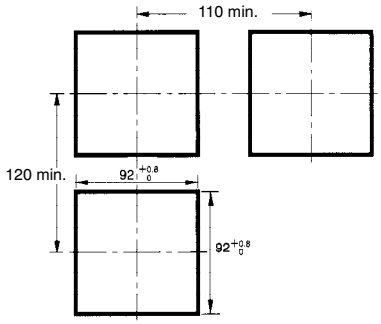
Unit: mm (inch)

■ E5AK



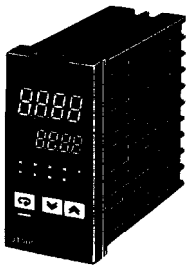


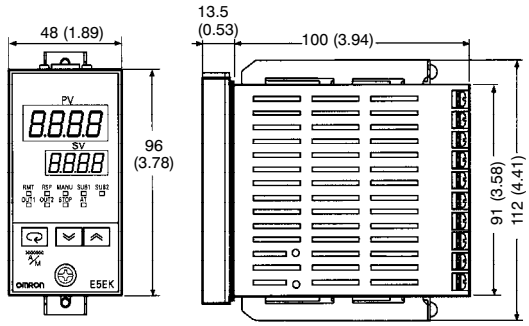
Panel Cutouts



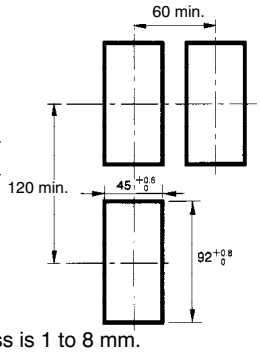
Note: 1. Recommended panel thickness is 1 to 8 mm.
2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted vertically or horizontally.

■ E5EK



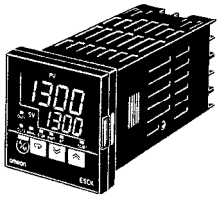


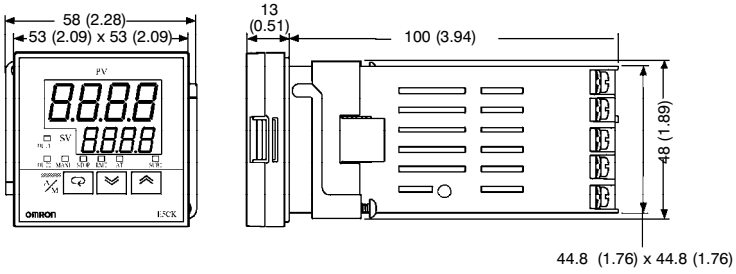
Panel Cutouts



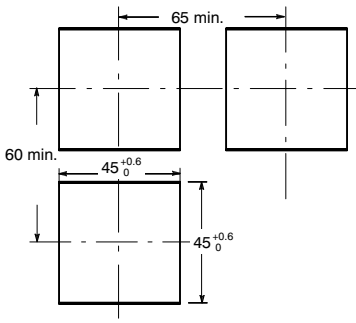
Note: 1. Recommended panel thickness is 1 to 8 mm.
2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted vertically or horizontally.

■ E5CK





Panel Cutouts



Note: 1. Recommended panel thickness is 1 to 5 mm.
2. Maintain the specified vertical and horizontal mounting space between each Unit. Units must not be closely mounted, either vertically or horizontally.