Advanced Process Digital Controllers

- Field configurable output and option boards
- 100 ms sampling (for analog input)
- Advanced PID, or fuzzy self-tuning
- Conforms to UL, CSA and CE standards
- IP66/NEMA4X front panel
- Remote set point (for E5EK and E5AK only)
- Set point ramp
- Serial communications (RS-232C, and RS-485; RS-422 for E5AK and E5EK only) and transfer output (4 to 20 mA)
- Front panel programming
- Heat/cool or standard operation
- Auto/manual and ON/OFF selections

Ordering Information

Order Control Output Boards and Option Boards separately below. Example: for a Relay Control Output, order the E53-R4R4 Output Board in addition to the E5CK-AA1-500 Process Controller. For E5AK or E5EK, order an E53-R output module.

Note: You can mount only one Output Board and one Option Board to E5EK or E5CK.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard models</td>
<td>Base Unit with terminal cover</td>
<td>E5AK-AA2-500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5EK-AA2-500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5CK-AA1-500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5CK-AA1-302</td>
</tr>
<tr>
<td>Position-proportional</td>
<td>Base Unit with terminal cover</td>
<td>E5AK-PRR2-500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5EK-PRR2-500</td>
</tr>
<tr>
<td>24 AC/DC models</td>
<td>Base Unit with terminal cover</td>
<td>E5AK-AA2-500 AC/DC 24V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5AK-PRR2-500 AC/DC 24V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5EK-AA2-500 AC/DC 24V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5EK-PRR2-500 AC/DC 24V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5CK-AA1-500 AC/DC 24V</td>
</tr>
</tbody>
</table>

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. Order Output and Option Boards separately.
3. E5EK-PRR2/E5AK-PRR2 controllers are supplied with relay output. The relay output is not compatible with any other module.
### Ordering Information Table - continued from previous page

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Module (for E5AK and E5EK only)</td>
<td>Relay</td>
<td>E53-R</td>
</tr>
<tr>
<td></td>
<td>SSR</td>
<td>E53-S</td>
</tr>
<tr>
<td></td>
<td>Pulse (NPN) 12 VDC</td>
<td>E53-Q</td>
</tr>
<tr>
<td></td>
<td>Pulse (NPN) 24 VDC</td>
<td>E53-Q3</td>
</tr>
<tr>
<td></td>
<td>Pulse (PNP) 24 VDC</td>
<td>E53-Q4</td>
</tr>
<tr>
<td></td>
<td>Linear (4 to 20 mA)</td>
<td>E53-C3</td>
</tr>
<tr>
<td></td>
<td>Linear (0 to 20 mA)</td>
<td>E53-C3D</td>
</tr>
<tr>
<td></td>
<td>Linear (0 to 10 V)</td>
<td>E53-V34</td>
</tr>
<tr>
<td></td>
<td>Linear (0 to 5 V)</td>
<td>E53-V35</td>
</tr>
</tbody>
</table>

Note: 1. The Digital Controller uses a dedicated, high-resolution Output Module. The E53-C Current Output Module for the E5□X cannot be used with the Digital Controller.
2. If the control period is less than 5 seconds, use solid state relay or pulse voltage.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Board (for E5CK only)</td>
<td>Relay/Relay (See note.)</td>
<td>E53-R4R4</td>
</tr>
<tr>
<td></td>
<td>Pulse (NPN)/Relay</td>
<td>E53-Q4R4</td>
</tr>
<tr>
<td></td>
<td>Pulse (PNP)/Relay</td>
<td>E53-Q4HR4</td>
</tr>
<tr>
<td></td>
<td>Pulse (PNP)/Pulse (PNP)</td>
<td>E53-Q4Q4</td>
</tr>
<tr>
<td></td>
<td>Linear (4 to 20 mA)/Relay</td>
<td>E53-C4R4</td>
</tr>
<tr>
<td></td>
<td>Linear (0 to 20 mA)/Relay</td>
<td>E53-C4DR4</td>
</tr>
<tr>
<td></td>
<td>Linear (0 to 10 V)/Relay</td>
<td>E53-V44R4</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option Board (for E5AK and E5EK only)</td>
<td>Communication (RS-232C)</td>
<td>E53-AK01</td>
</tr>
<tr>
<td></td>
<td>Communication (RS-422)</td>
<td>E53-AK02</td>
</tr>
<tr>
<td></td>
<td>Communication (RS-485)</td>
<td>E53-AK03</td>
</tr>
<tr>
<td></td>
<td>Event input</td>
<td>E53-AKB</td>
</tr>
<tr>
<td></td>
<td>Transfer output (4 to 20 mA)</td>
<td>E53-AKF</td>
</tr>
</tbody>
</table>

Note: 1. The E5AK allows a maximum of three Option Boards to be mounted. Refer to pages 25-26 for mounting combinations.
2. The E5EK and E5CK allows only one Option Board to be mounted.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option Board (for E5CK only)</td>
<td>Communication (RS-232C)</td>
<td>E53-CK01</td>
</tr>
<tr>
<td></td>
<td>Communication (RS-485)</td>
<td>E53-CK03</td>
</tr>
<tr>
<td></td>
<td>Event input</td>
<td>E53-CKB</td>
</tr>
<tr>
<td></td>
<td>Transfer output (4 to 20 mA)</td>
<td>E53-CKF</td>
</tr>
</tbody>
</table>

### ACCESSORIES (ORDER SEPARATELY)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Transformer (for E5AK and E5EK only)</td>
<td>5.8 mm</td>
<td>E54-CT1</td>
</tr>
<tr>
<td></td>
<td>12.0 mm</td>
<td>E54-CT3</td>
</tr>
</tbody>
</table>

Note: CT is required when the heater burnout alarm function is used.

<table>
<thead>
<tr>
<th>Item</th>
<th>Connectable Models</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal Cover</td>
<td>E5AK</td>
<td>E53-COV0809</td>
</tr>
<tr>
<td></td>
<td>E5EK</td>
<td>E53-COV08</td>
</tr>
<tr>
<td></td>
<td>E5CK</td>
<td>E53-COV07</td>
</tr>
</tbody>
</table>
### INPUT TYPES (SELECTABLE WITH INPUT JUMPER CONNECTOR)

#### Platinum Resistance Thermometer (RTD's)

<table>
<thead>
<tr>
<th>Input (field selectable)</th>
<th>JPt100</th>
<th>Pt100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>°C</td>
<td>°C</td>
</tr>
<tr>
<td></td>
<td>-199.9 to 650.0</td>
<td>-199.9 to 650.0</td>
</tr>
<tr>
<td></td>
<td>°F</td>
<td>°F</td>
</tr>
<tr>
<td></td>
<td>-199.9 to 999.9</td>
<td>-199.9 to 999.9</td>
</tr>
<tr>
<td>Input setting number</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

#### Thermocouple

<table>
<thead>
<tr>
<th>Input (field selectable) (see note)</th>
<th>K1</th>
<th>K2</th>
<th>J1</th>
<th>J2</th>
<th>T</th>
<th>E</th>
<th>L1</th>
<th>L2</th>
<th>U</th>
<th>N</th>
<th>R</th>
<th>S</th>
<th>B</th>
<th>W</th>
<th>PLII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range</td>
<td>°C</td>
<td>°F</td>
<td>-200 to 1,300</td>
<td>0.0</td>
<td>-100 to 500.0</td>
<td>0.0</td>
<td>-199.9 to 400.0</td>
<td>0</td>
<td>-100 to 850</td>
<td>0.0</td>
<td>-199.9 to 400.0</td>
<td>-200 to 1,300</td>
<td>0</td>
<td>100 to 1,800</td>
<td>0 to 2,300</td>
</tr>
<tr>
<td></td>
<td>°F</td>
<td>°F</td>
<td>-300 to 2,300</td>
<td>0.0</td>
<td>-100 to 900.0</td>
<td>0.0</td>
<td>-199.9 to 700.0</td>
<td>0</td>
<td>-100 to 1,500</td>
<td>0.0</td>
<td>-199.9 to 700.0</td>
<td>-300 to 2,500</td>
<td>0</td>
<td>300 to 3,200</td>
<td>0 to 4,100</td>
</tr>
<tr>
<td>Input setting number</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
</tbody>
</table>

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

#### Current/Voltage

<table>
<thead>
<tr>
<th>Input (field selectable)</th>
<th>Current input</th>
<th>Voltage input</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4 to 20 mA</td>
<td>1 to 5 V2</td>
</tr>
<tr>
<td></td>
<td>0 to 20 mA</td>
<td>0 to 5 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 to 10 V</td>
</tr>
<tr>
<td>Input setting number</td>
<td>17</td>
<td>19</td>
</tr>
</tbody>
</table>

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

RATINGS

<table>
<thead>
<tr>
<th>Model number</th>
<th>E5(^\square)K Standard</th>
<th>E5(^\square)K 24V AC/DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>100-240VAC, 50/60 Hz</td>
<td>24V AC/DC, 50/60 Hz</td>
</tr>
<tr>
<td>Operating voltage range</td>
<td>85% to 110% of rated supply voltage</td>
<td>85% to 110% of rated supply voltage</td>
</tr>
<tr>
<td>Power consumption</td>
<td>E5AK: 16 VA</td>
<td>9VA, 6W</td>
</tr>
<tr>
<td></td>
<td>E5EK: 15 VA</td>
<td>9VA, 6W</td>
</tr>
<tr>
<td></td>
<td>E5CK: 10 VA (at 100 VAC)</td>
<td>6VA, 3.5W</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14 VA (at 240 VAC)</td>
</tr>
<tr>
<td></td>
<td>Platinum resistance thermometer (RTD)</td>
<td>JPt100, Pt100</td>
</tr>
<tr>
<td></td>
<td>Current input</td>
<td>4 to 20 mA, 0 to 20 mA</td>
</tr>
<tr>
<td></td>
<td>Voltage input</td>
<td>1 to 5 V, 0 to 5 V, 0 to 10 V</td>
</tr>
<tr>
<td>Mean Time Between Failure</td>
<td>15.4 years (135,000 hours)</td>
<td></td>
</tr>
<tr>
<td>Control output (See Note 1.)</td>
<td>Relay</td>
<td>SPST, 250 VAC, 3 A (resistive load)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanical life expectancy: 10,000,000 operations min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Electrical life expectancy: 100,000 operations min.</td>
</tr>
<tr>
<td></td>
<td>Voltage (Pulse)</td>
<td>NPN: 20 mA at 12/24 VDC (with short-circuit protection)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PNP: 20 mA at 24 VDC (with short-circuit protection)</td>
</tr>
<tr>
<td></td>
<td>Linear voltage</td>
<td>0 to 10 VDC</td>
</tr>
<tr>
<td></td>
<td>Linear current</td>
<td>4 to 20 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resistant load impedance: 1 kΩ min.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resolution: Approximately 2600 steps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 to 20 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resistant load impedance: 500 Ω max.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resolution: Approximately 2600 steps</td>
</tr>
<tr>
<td>Auxiliary output</td>
<td>SPST-NO</td>
<td>E5AK: 3 A at 250 VAC (resistive load)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5EK: 3 A at 250 VAC (resistive load)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E5CK: 1A at 250 VAC (resistive load)</td>
</tr>
<tr>
<td>Control method (See Note 2.)</td>
<td>ON/OFF, Advanced PID Control (with auto-tuning) or Self-tuning</td>
<td></td>
</tr>
<tr>
<td>Setting method</td>
<td>Digital setting using front panel keys or communications features</td>
<td></td>
</tr>
<tr>
<td>Indication method - 7-seg. digital display and LEDs</td>
<td>E5AK: PV = 15 mm, SP = 10.5 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>E5EK: PV = 14 mm, SP = 9.5 mm</td>
<td></td>
</tr>
<tr>
<td>Potentiometer (Valve Positioning) (for E5AK and E5EK only)</td>
<td>100 Ω to 2.5 kΩ</td>
<td></td>
</tr>
<tr>
<td>Event input</td>
<td>Contact input</td>
<td>ON: 1 kΩ max.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF: 100 kΩ min.</td>
</tr>
<tr>
<td></td>
<td>No-contact input</td>
<td>ON: residual voltage: 1.5 V max.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OFF: leakage current: 0.1 mA max.</td>
</tr>
<tr>
<td>Transmission output</td>
<td>4 to 20 mA, permissible load impedance: 600 Ω max., resolution: Approximately 2600 steps</td>
<td></td>
</tr>
<tr>
<td>Remote SP input (for E5AK and E5EK only)</td>
<td>Current input</td>
<td>4 to 20 mA (Input impedance: 150 Ω)</td>
</tr>
<tr>
<td>Current Transformer input (for E5AK and E5EK only)</td>
<td>Connect only an Omron Current Transformer (E54-CT1 or E54-CT3)</td>
<td></td>
</tr>
<tr>
<td>Other functions</td>
<td>Standard</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>Option</td>
<td>Multiple SP, run/stop selection, transfer output functions, auto/manual Communications (RS-232C, RS-422, or RS-485), Loop Break Alarm, and Transfer Output.</td>
</tr>
<tr>
<td>Standards</td>
<td>UL</td>
<td>File No.: E68481</td>
</tr>
<tr>
<td></td>
<td>CSA</td>
<td>File No.: LR59623</td>
</tr>
<tr>
<td></td>
<td>CE</td>
<td>File No.: EN50081-2; EN50082-2; IEC 1010-1</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indication accuracy (See Note.)</td>
<td>Thermocouple: (±0.3% of indication value or ±1°C, whichever is greater) ±1 digit max.</td>
</tr>
<tr>
<td></td>
<td>Platinum resistance thermometer: (±0.2% of indication value or ±0.8°C, whichever is greater) ±1 digit max.</td>
</tr>
<tr>
<td></td>
<td>Analog input: ±0.2% (of indication value) ±1 digit max.</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>0.01% to 99.99% FS (in units of 0.01% FS)</td>
</tr>
<tr>
<td>Proportional band (P)</td>
<td>0.1% to 999.9% FS (in units of 0.1% FS)</td>
</tr>
<tr>
<td>Integral (reset) time (I)</td>
<td>0 to 3,999 s (in units of 1 s)</td>
</tr>
<tr>
<td>Derivative (rate) time (D)</td>
<td>0 to 3,999 s (in units of 1 s)</td>
</tr>
<tr>
<td>Control period</td>
<td>1 to 99 s (in units of 1 s)</td>
</tr>
<tr>
<td>Manual reset value</td>
<td>0.0% to 100.0% (in units of 0.1%)</td>
</tr>
<tr>
<td>Alarm setting range</td>
<td>-1,999 to 9,999 or -199.9 or 999.9 (decimal point position dependent on input type)</td>
</tr>
<tr>
<td>Sampling period</td>
<td>Temperature input: 250 ms scan rate</td>
</tr>
<tr>
<td></td>
<td>Analog input: 100 ms scan rate</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>200 MΩ min. (at 500 VDC)</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>2,000 VAC, 50/60 Hz for 1 min between terminals of different polarities</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>Malfunction: 10 to 55 Hz, 10 m/s² (approx. 1G) for 10 min each in X, Y, and Z directions</td>
</tr>
<tr>
<td></td>
<td>Mechanical: 10 to 55 Hz, 20 m/s² (approx. 2G) for 2 hrs each in X, Y, and Z directions</td>
</tr>
<tr>
<td>Shock resistance</td>
<td>Malfunction: 200 m/s² min. (approx. 20G), 3 times each in 6 directions (100 m/s² (approx. 10G) applied to the relay)</td>
</tr>
<tr>
<td></td>
<td>Mechanical: 300 m/s² min. (approx. 30G), 3 times each in 6 directions</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>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)</td>
</tr>
<tr>
<td></td>
<td>Storage: -25°C to 65°C (-13°F to 149°F) with no icing</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>Operating: 35% to 85% RH</td>
</tr>
<tr>
<td>Enclosure ratings</td>
<td>Front panel: NEMA 4X for indoor use (equivalent to IP66)</td>
</tr>
<tr>
<td></td>
<td>Rear case: IEC standard IP20</td>
</tr>
<tr>
<td></td>
<td>Terminals: IEC standard IP00</td>
</tr>
<tr>
<td>Memory protection</td>
<td>Non-volatile memory (number of writings: 100,000 operations)</td>
</tr>
<tr>
<td>Weight</td>
<td>E5AK: Approx. 450 g</td>
</tr>
<tr>
<td></td>
<td>E5EK: Approx. 320 g</td>
</tr>
<tr>
<td></td>
<td>Mounting bracket: Approx. 65 g</td>
</tr>
<tr>
<td></td>
<td>E5CK: Approx. 170 g</td>
</tr>
<tr>
<td></td>
<td>Adapter: Approx. 10 g</td>
</tr>
<tr>
<td>EMC</td>
<td>Emission Enclosure: EN55011 Group 1 class A</td>
</tr>
<tr>
<td></td>
<td>Emission AC Mains: EN55011 Group 1 class A</td>
</tr>
<tr>
<td></td>
<td>Immunity ESD: EN61000-4-2: 4 kV contact discharge (level 2)</td>
</tr>
<tr>
<td></td>
<td>8 kV air discharge (level 3)</td>
</tr>
<tr>
<td></td>
<td>10 V/m (amplitude modulated, 80 MHz to 1 GHz) (level 3)</td>
</tr>
<tr>
<td></td>
<td>10 V/m (pulse modulated, 900 MHz)</td>
</tr>
<tr>
<td></td>
<td>Immunity RF-interference: ENV50140: 10 V (0.15 to 80 MHz) (level 3)</td>
</tr>
<tr>
<td></td>
<td>Immunity Conducted Disturbance: ENV50141: 2 kV power-line (level 3)</td>
</tr>
<tr>
<td></td>
<td>Immunity Burst: EN61000-4-4: 2 kV I/O signal-line (level 4)</td>
</tr>
<tr>
<td>Standards - Approvals</td>
<td>UL1092, CSA22.2 No. 14, CSA22.2 No. 1010-1</td>
</tr>
<tr>
<td></td>
<td>Conforms to EN50081-2, EN50082-2, EN61010-1 (IEC1010-1)</td>
</tr>
<tr>
<td></td>
<td>Conforms to VDE0106/part 100 (Finger Protection)</td>
</tr>
</tbody>
</table>

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 PL/G01/G01 thermocouple at any temperature: ±0.3% or ±2°C, whichever is greater ±1 digit maximum.


**OPTION BOARD RATINGS AND CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Event inputs</th>
<th>Contact input:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ON: 1 kΩ max., OFF: 100 kΩ min.</td>
</tr>
<tr>
<td></td>
<td>No-contact input:</td>
</tr>
<tr>
<td></td>
<td>ON: residual voltage 1.5 V max., OFF: leakage current 0.1 mA max.</td>
</tr>
</tbody>
</table>

| 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 |

<table>
<thead>
<tr>
<th>Transfer output</th>
<th>4 to 20 mA:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Permissible load impedance: E5AK and E5EK = 600 Ω max.</td>
</tr>
<tr>
<td></td>
<td>E5CK = 500 Ω max.</td>
</tr>
<tr>
<td></td>
<td>Resolution: E5AK and E5EK = approx. 2,600 steps</td>
</tr>
<tr>
<td></td>
<td>E5CK = approx. 2,600 steps</td>
</tr>
<tr>
<td></td>
<td>RS-232C Peer-to-peer only; maximum cable length = 15 m (49.2 feet)</td>
</tr>
<tr>
<td></td>
<td>RS-422 and RS-485 32 controller maximum to host computer; maximum cable length = 500 m (1640 feet)</td>
</tr>
</tbody>
</table>

**CURRENT TRANSFORMER RATINGS**

<table>
<thead>
<tr>
<th>Max. continuous heater current</th>
<th>50 Amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dielectric strength</td>
<td>1,000 VAC (for 1 min)</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>50 Hz, 98 m/s² (10G)</td>
</tr>
<tr>
<td>Weight</td>
<td>E54-CT1: approx. 11.5 g; E54-CT3: approx. 50 g</td>
</tr>
<tr>
<td>Accessories (E54-CT3 only)</td>
<td>Armature: 2; Plug: 2</td>
</tr>
</tbody>
</table>

**HEATER BURNOUT ALARM**

<table>
<thead>
<tr>
<th>Max. heater current</th>
<th>Single-phase 50 A VAC (See Note 1.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater current value display accuracy</td>
<td>±5% FS±1 digit max.</td>
</tr>
<tr>
<td>Heater burnout alarm setting range</td>
<td>0.1 to 49.9 A (in units of 0.1 A) (See Note 2.)</td>
</tr>
<tr>
<td>Min. detection ON time</td>
<td>190 ms (See Note 3.)</td>
</tr>
</tbody>
</table>

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

- **E5AK**
  - Operation Indicators
  - A/M Key
  - Display Key
  - No. 1 display
  - No. 2 display
  - Up Key/Down Key

- **E5EK**
  - Operation Indicators
  - A/M Key
  - Display Key
  - No. 1 display
  - No. 2 display
  - Up Key/Down Key

- **E5CK**
  - Operation Indicators
  - A/M Key
  - Display Key
  - No. 1 display
  - No. 2 display
  - Up Key/Down Key

- **E5CK-302**
  - Operation Indicators
  - AT Key
  - Display Key
  - No. 1 display
  - No. 2 display
  - Up Key/Down Key

**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.

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.
PARAMETERS DEFINITIONS

Refer to your User’s Manual for each parameter and the calibration mode in detail.

Level 0 Mode for E5AK and E5EK

PV/SV
The process value is displayed on the No.1 display and the set point is displayed on the No.2 display. When the multi-SP function is in use, the value of the current set point (SP0 or SP1 is displayed).

Set Point During SP Ramp
Monitors the set point when the SP ramp function is used.

Manipulated Variable (MV) Monitor for Heat
Monitors the manipulated variable (MV) for the heating output.

Valve Opening Monitor
Displays the valve position in percentage format.
Open = 100%
Closed = 0%

Manipulated Variable (MV) Monitor for Cool
When the Controller is in heating and cooling control operation, use this display to monitor the manipulated variable of the cooling output.

Run/Stop
Places the controller in RUN mode or in STOP mode.

Level 0 Mode for E5CK

PV/SV
The process value is displayed on the No.1 display and the set point is displayed on the No.2 display. When the multi-SP function is in use, the value of the current set point (SP0 or SP1 is displayed).

Set Point During SP Ramp
Monitors the set point when the SP ramp function is used.

Manipulated Variable (MV) Monitor for Heat
Monitors the manipulated variable (MV) for the heating output.

Manipulated Variable (MV) Monitor for Cool
When the Controller is in heating and cooling control operation, use this display to monitor the manipulated variable of the cooling output.

Run/Stop
Places the controller in RUN mode or in STOP mode.
Security

Using the Security Level Table:

Any mode marked with an X is displayed in the Security Level indicated.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Set value</th>
<th>Security Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 1 2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Calibration</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Option</td>
<td>x x x x x x</td>
<td></td>
</tr>
<tr>
<td>Expansion</td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>Setup</td>
<td>x x x x x</td>
<td></td>
</tr>
<tr>
<td>Level 2</td>
<td>x x x x x</td>
<td></td>
</tr>
<tr>
<td>Level 1</td>
<td>x x x</td>
<td></td>
</tr>
<tr>
<td>Level 0</td>
<td>x x x x</td>
<td></td>
</tr>
</tbody>
</table>

Example: 

Selecting Security Level 2:
Displays these modes: Level 0, Level 1 and Level 2 only.
Does NOT display these modes: Setup, Expansion, Option, Calibration

<table>
<thead>
<tr>
<th>Security Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest</td>
</tr>
<tr>
<td>Highest</td>
</tr>
</tbody>
</table>

When the set value is 5:
Only the PV/SP monitor and set point parameter can be used.

When the set value is 6:
Only the PV/SP monitor parameter can be used.

A/M Key Protect
This invalidates the function of the A/M Key.

- 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.

Note: For E5CK-302 models, this is done the same way, using the AT button.

MV Manual

- To Access Manual Mode
Press and hold the A/M Key for more than 1 second.

Range = -105% to 105%
Level 1 Mode

**AT Execute/Cancel**
Starts the Auto-tune function or cancels an active auto-tune. When an active auto-tune is cancelled, the original PID constants will be used again.
AT-1 = Limited MV change during Autotuning (±40% max.)
AT-2 = Full MV change during Autotuning (±100% max.)

**Note:** E5AK and E5EK can have up to 4 set points or 4 alarms

**Set Point 0**
Default set point when used with multi-SP function. This set point is active when the Event input is OFF.

**Set Point 1**
Used only with multi-SP function. This set point is active when the Event input is ON. This parameter is available only if an Event Input Option Board is installed.

**Alarm Value 1**
Available only when Control Output 2 is not used as a control output. This setting determines what the Alarm 1 set point will be.

**Alarm Value 2**
Available only when the alarm output function of the Controller is selected. This setting determines what the Alarm 2 set point will be. This alarm can be programmed to work on Control Output 2 or the SUB-1 output (user-selectable). Factory Default = Control Output 2.

**Note:** Alarm Value 3 is available only when SUB-1 or Control Output No. 1 is selected as AL-3.

**Proportional Band**
Range = 0.1% to 999.9%

**Integral Time**
Range = 0 to 3999 seconds

**Derivative Time**
Range = 0 to 3999 seconds
See Note at right.

**Cooling Coefficient**
Used when the Controller is in heat/cool control. This setting describes the ratio between the heating proportional band and the cooling proportional band.
\[ C = \frac{cooling\ band}{heating\ band}\]

**Dead Band**
Used when the Controller is in heating and cooling control. This setting determines the amount of overlap or dead band present in a heat/cool configuration. Range = -19.99 to 99.99. Negative values = overlap band. Positive values = Dead band.

**Manual Reset Value**
Available ONLY when the integral time parameter of the Controller in standard control is set to 0. The Controller must be in Standard or Advanced PID control and self-tune must be set to off.

**Hysteresis (Heat)**
Available when the Controller is in ON/OFF control. If PID control selected, this value will not appear on the menu.
Range = 0.01 to 99.99 FS, Default = 0.10.

**Hysteresis (Cool)**
Available when the Controller is in ON/OFF control in heating and cooling control.
Range = 0.01 to 99.99 FS, Default = 0.10.

**Control Period (Heat)**
Available only when the Controller has a relay or voltage output, or is in advanced PID control.
Range = 1 to 99 s. Default = 20 s.

**Control Period (Cool)**
Available when the Controller has a relay or voltage output, or is in advanced PID control in heating and cooling control.
Range = 1 to 99 s. Default = 20 s.

**Note:** This level 1 Mode ends here for the E5CK models only. For all other E5□K models in this data sheet, continue with the next page.
Level 1 Valve Positioning Model (for E5AK and E5EK only)

**Position Proportional Dead Band**
For valve positioning units only.
Used to adjust the dead band for a valve; displayed in percentage format.
Range = 0.1 - 10
Default = 2.0

**Heater Current Monitor**
Available when the heater burnout alarm is assigned.

**Heater Burnout Detection**
Available when the heater burnout alarm is assigned.
Activates the Heater Burnout Alarm when the heater current falls below the set value.
Range = 0.0 - 50.0A
Default = 0.0
Level 2 Mode

Remote/Local
Used for the communications function. Only accessible when communication option boards are installed. Determines whether the user will program the unit by the key pads on the face plate (local), by a computer, or PLC (remote).
Default = local.

SP Ramp Time Unit
Determines what unit of time to use on a set point ramp: minutes or hours. Self-tune must be set to OFF.
Default = minutes.

SP Ramp Set Value
Determines the maximum allowable degrees of change per Time Unit.
Example: SP Ramp Time Unit = minute SP0 = 100°F SP Ramp Set Value = 10°
It will take 5 minutes to ramp up to 150°F from 100°F.
Default = 0.

LBA Detection Time
Available only when the LBA (loop break alarm) function of the Controller is selected. This parameter is automatically set by Auto-tuning. Determines how long it will take the controller to detect a loop break.
Range = 0 to 9999 sec.
Default = 0

Manipulated Variable (MV) at Stop
Determines what percentage of Manipulated Variable (MV) will be when control has been stopped.
Default = 0%
Range = -5 to 105% for standard control; -105 to 105% for heat/cool control.

MV at PV Error
Determines what percentage of Manipulated Variable (MV) will be when an input error has been detected.
Default = 0%
Range = -5 to 105% for standard control; -105 to 105% for heat/cool control.

MV Upper Limit
Stops the MV from going higher than the set value. Default = 105%

MV Lower Limit
Stops the MV from going lower than the set value.
Default (heat only) = -5%
Default (heat/cool) = -105%
Default (cool only) = -105%

MV Change Rate Limit
Limits how fast the MV can change in % of FS per second.
Default = 0%
Range = 0 to 100%

Input Digital Filter
Sets the time constant for the digital filter.
Range = 0 to 9999 sec.
Default = 0

Alarm 1 Hysteresis
Available only when the Controller has an alarm output.
Range = 0 to 9999 sec.
Default = 0.2

Alarm 2 Hysteresis
Available only when the Controller has an alarm output.
Range = 0 to 9999 sec.
Default = 0.2

Alarm 3 Hysteresis
(Note: An example of this display is not shown here.)
Available only when the Controller has an alarm output.
Range = 0 to 9999 sec.
Default = 0.2

Input Shift Upper Limit
Available if the input type connected to the Controller is a thermocouple or platinum RTD.
Range = -199.9 to 999.9 °C/°F; default = 0 to 0 °C/°F

Input Shift Lower Limit
Available if the input type connected to the Controller is a thermocouple or platinum resistance thermometer.
Range = -199.9 to 999.9 °C/°F; default = 0 to 0 °C/°F
**Setup Mode**

### Input Type
Sets the input type connected to terminals 6 through 8.
Note: Set input jumper to current, voltage, or temperature setting before changing input type.
Default = 2 (K1 type thermocouple)

### Scaling Upper Limit
Used if the input type connected to the Controller is an analog input (voltage or current input).
Range = 1 to 9999
Default = 100

### Scaling Lower Limit
Used if the input type connected to the Controller is an analog input (voltage or current input).
Range = -1999 to -1
Default = 0

### Decimal Point
Used only if the input type connected to the Controller is an analog input (voltage or current input).
Range = 0 to 3
Default = 0

### °C/°F Selection
Used if the input type connected to the Controller is a temperature input (thermocouple or platinum resistance thermometer).
Default = °C

### Parameter Initialize
Returns the controller to Factory Default Settings.

### Control Output 1 Assignment
Assigns the Controller to have one of the following output functions: heating control, cooling control, alarm 1, alarm 2, alarm 3, and LBA (loop break alarm).
Default = heat

### Control Output 2 Assignment
Assigns the Controller to have one of the following output functions: heating control, cooling control, alarm 1, alarm 2, alarm 3, and LBA (loop break alarm).
Default = Alarm 1

### Auxiliary Output 1 Assignment
Enables the Controller to have one of the following outputs: alarm 1, alarm 2, alarm 3, LBA (loop break alarm).
Default = Alarm 1

### Alarm 1 Type
Provides a choice of 11 different alarm operations.
Default = 2 (See Alarm Summary Table for Alarm types available.)

### Alarm 1 Open in Alarm
Synchronizes the alarm LED with the operation of the alarm. If the alarm is operating as a normally closed relay (open in alarm condition), this parameter should be set to ‘Open in Alarm’. If the alarm is operating as a normally open relay (close in alarm condition), this parameter should be set to ‘Close in Alarm’.

### Alarm 2 Type
Provides a choice of 11 different alarm operations.
Default = 2 (See Alarm Summary Table for Alarm types available.)

### Alarm 3 Type
Note: An example of this display is not shown here.
OPEN W/Alarm

### Direct/Reverse Operation
Choose between direct (cooling) or reverse (heating) control action.
Default = reverse (heating):
Direct (cooling) = MV increases with decreasing PV.
Reverse (heating) = MV increases with increasing PV.
Selecting a Control Method

When selecting a control method, refer to the following table for correct parameter setting.

<table>
<thead>
<tr>
<th>Control method</th>
<th>Control output 1 assignment</th>
<th>Control output 2 assignment</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td>Control output (heat)</td>
<td>---</td>
<td>Reverse</td>
</tr>
<tr>
<td>Cool</td>
<td>Control output (heat)</td>
<td>---</td>
<td>Direct</td>
</tr>
<tr>
<td>Heat/Cool</td>
<td>Control output (heat)</td>
<td>Control output (cool)</td>
<td>Reverse</td>
</tr>
<tr>
<td>Heat/Cool</td>
<td>Control output (cool)</td>
<td>Control output (heat)</td>
<td>Direct</td>
</tr>
</tbody>
</table>

■ CLOSE IN ALARM/OPEN IN ALARM

If the alarm is operating as a normally closed relay (open in alarm condition), this parameter should be set to ‘Open in Alarm’. If the alarm is operating as a normally open relay (close in alarm condition), this parameter should be set to ‘Close in Alarm’.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Alarm</th>
<th>Output LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close in alarm (N.O.)</td>
<td>ON</td>
<td>Lit</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Not lit</td>
</tr>
<tr>
<td>Open in alarm (N.C.)</td>
<td>ON</td>
<td>Lit</td>
</tr>
<tr>
<td></td>
<td>OFF</td>
<td>Not lit</td>
</tr>
</tbody>
</table>

Factory setting is “close in alarm” [וכר],
Expansion Mode

SP Setting Upper Limit
- Stops the set point from going higher than the SP setting upper limit.
- Default = 1300
- This setting has no effect on the input scaling values.

SP Setting Lower Limit
- Stops the set point from going any lower than the SP setting lower limit
- Default = -200
- This setting has no effect on the input scaling values.

PID/ON/OFF
- Selects the type of control method for the controller to use.
- Default = PID

Adaptive Tuning (Self Tuning)
- Only available if the Controller in standard control or advanced PID control has a temperature input.
- Default = OFF. If ON is selected, the controller will use fuzzy logic to self tune the PID values for optimum control.
- PID values will not be seen when ST (Self Tune) is on.

ST Stable Range
- Only available if the Controller is in standard control or advanced PID control with the Self Tune (ST) set to ON.

α
- Only available if the Controller is in advanced PID control with the ST set to OFF.
- This setting allows tailoring of the PID algorithm to emphasize control or fast response.
- Default = 0.65
- Fast Response = 0.0 → 0.65
- Stability Emphasis = 0.65 → 1

AT Calculated Gain
- Allows the controller to focus the auto-tune on increased response or more stability.
- Range = 0.1 (fast response) to 10 (increase stability).
- Available if the Controller is in advanced PID control with the ST set to OFF.
- Default = 1.0

Alarm Standby Sequence Reset Method
- Used with alarm settings to have a stand-by sequence applied to the alarm.
- Default = 0

Automatic Return of Display Mode
- Automatically returns the display of the controller to Level 0 PV/SP display after the set amount of time has elapsed if no buttons on the face plate have been used.
- Applies only in Levels 0 through 2. Default = 0. Range = 0 to 99 sec.

AT Hysteresis
- Only available if the Controller is in advanced PID control with the ST set to OFF.
- Default = 0.2% FS; Range = 0.1 to 9.9% FS

LBA Detection Width
- Only available only when the LBA (Loop Break Alarm) function of the Controller is selected.
- Range 0.0 → 999.9% FS
- Default = 0.2
Option Mode - ONLY Visible if an Option Board is Installed

E5\[K\]

### Multi-SP Function

 Specifies the number of set points that will be used. **Must be set to one** to use SP Ramp feature.

Available for the event input function. Default = 0

### Event Input Assignment 1

Available for the event input function. If multi-SP is set to 0, this parameter assigns event input function as: Run/Stop, Auto/Manual, or Protect Function. Default = Stop.

E5AK and E5EK only

### Event Input Assignment 2

Available for the event input function.

### Event Input Assignment 3

Available for the event input function.

### Event Input Assignment 4

Available for the event input function.

---

**COMMUNICATIONS FUNCTION**

Communications selections are ONLY available if a communications board is installed.

### Communication Stop Bit

Displayed when the communications function is in use.

Range = 1 to 2

Default = 2

### Communication Data Length

Displayed when the communications function is in use.

Range = 7 to 8

Default = 7

### Communication Parity

Displayed when the communications function is in use.

Range = None, Even, Odd

Default = Even

### Communication Baud Rate

Displayed when the communications function is in use.

Range = 1.2, 2.4, 4.8, 9.6, 19.2 k baud

Default = 9.6

### Communication Unit No.

Displayed when the communications function is in use.

Range = 0 — 99

Default = 0

(continued on next page)
Option Mode - ONLY Visible if an Option Board is Installed, continued

Transfer Output Type
Set when the transfer output function is in use. Determines which function the transfer output will re-transmit as a 4-20mA signal: SP, PV, SP Ramp, MV

Transfer Output Upper Limit
Set when the transfer output function is in use. Stops the transfer output from going higher than the Set Value.

Transfer Output Lower Limit
Set when the transfer output function is in use. Stops the transfer output from going lower than the Set Value.

Remote set point function is available on all E5AK/E5EK models, with or without an option board installed.

HBA Latch
Makes the heater burnout alarm remain activated when triggered. It must be reset manually.

Motor Calibration
Determines how long it takes a fully closed proportional valve to fully open.

Travel time
The amount of time it takes to determine the motor calibration parameter. Range = 1-999 sec. Default = 30 sec.

PV Dead Band
Determines the size of the dead band around the process variable in which the valve will take no control action. Range = 0-9999 Default = 0

Remote SP Enable
Enables the controller to use a remote setpoint. Default = off

Remote SP Upper Limit (Available when the remote SP is enable)
 Stops the RSP from going any higher than the set value. Default = 1300

Remote SP Lower Limit (Available when the remote SP is enable)
 Stops the RSP from going any lower than the set value. Default = -200

SP tracking (Available when the remote SP is enable)
Allows a smooth transition between a RSP and a local SP when enabled. When on, the LSP will become the RSP that was being used immediately before switching.
### ALARM MODE SELECTORS

Alarm outputs are available if they are allocated as outputs. Factory setting is "2: Upper-limit alarm (deviation)."

<table>
<thead>
<tr>
<th>Setting number</th>
<th>Alarm types</th>
<th>Alarm output</th>
<th>When X is positive</th>
<th>When X is negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upper- and lower-limit alarm (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>Upper-limit alarm (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>Lower-limit alarm (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>Upper- and lower-limit range alarm (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>Upper- and lower-limit alarm with standby sequence (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>6</td>
<td>Upper-limit alarm with standby sequence (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>7</td>
<td>Lower-limit alarm with standby sequence (deviation)</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>8</td>
<td>Absolute-value upper-limit alarm</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>9</td>
<td>Absolute-value lower-limit alarm</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>10</td>
<td>Absolute-value upper-limit alarm with standby sequence</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
<tr>
<td>11</td>
<td>Absolute-value lower-limit alarm with standby sequence</td>
<td></td>
<td>ON  X</td>
<td>X</td>
</tr>
</tbody>
</table>

#### Note:
1. A deviation is defined as deviation from SP.
2. An absolute alarm is defined as a fixed value X with reference to 0.
3. Standby sequence is defined as having the alarm outputs inactive until SP is reached on the initial power up of the Controller. After SP has been reached, alarms will function normally.

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

- Alarm value = 10°C/°F
- Set point (SP) 100°C/°F
- 110°C/°F

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

- Alarm value = 328°C/°F
- Set point (SP) 325°C/°F
- 328°C/°F
### HOW TO USE THE ERROR DISPLAY

When an error has occurred, the No.1 display alternately indicates error codes together with the current display item. This section describes how to check error codes on the display, and the actions that must be taken to remedy the problem.

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
<th>Meaning</th>
<th>Action</th>
<th>Operation at Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Input Error</td>
<td>Input is in error.</td>
<td>Check the wiring of inputs, disconnections, and shorts, and check the input type and the input type jumper connector.</td>
<td>For control output functions, output the manipulated variable matched to the setting of the “MV at PV error” parameter (level 2 mode). Alarm output functions are activated when the upper limit is exceeded.</td>
</tr>
<tr>
<td>E</td>
<td>Memory Error</td>
<td>Internal memory operation is in error</td>
<td>First, turn the power OFF then back ON again. If the display remains the same, the E5AK/E5EK Controller must be repaired. If the display is restored to normal, the probable cause may be external noise affecting the control system. Check for external noise.</td>
<td>Control output functions turn OFF (2 mA max. at 4 to 20 mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.</td>
</tr>
<tr>
<td>E</td>
<td>A/D Converter Error</td>
<td>Internal circuits are in error</td>
<td>First, turn the power OFF then back ON again. If the display remains the same, the E5AK/E5EK Controller must be repaired. If the display is restored to normal, the probable cause may be external noise affecting the control system. Check for external noise.</td>
<td>Control output functions turn OFF (2 mA max. at 4 to 20 mA output, and output equivalent to 0% in case of other outputs). Alarm output functions turn OFF.</td>
</tr>
<tr>
<td>E</td>
<td>Calibration Data Error</td>
<td>Calibration data is in error</td>
<td>Must repair.</td>
<td>Both control output functions and alarm output functions are active. However, note that the readout accuracy is not assured.</td>
</tr>
<tr>
<td>E</td>
<td>Display Range Over</td>
<td>Though not an error, this is displayed when the process value exceeds the display range when the control range (setting range ±10%) is larger than the display range (-1999 to 9999).</td>
<td></td>
<td>Control continues, allowing normal operation.</td>
</tr>
</tbody>
</table>
**FUZZY SELF-TUNING**

Fuzzy self-tuning is a function that enables the E5\-K to calculate the most suitable PID constants for the control output.

**Features**
- The E5\-K determines by itself when to perform fuzzy self-tuning.
- During fuzzy self-tuning, the E5\-K does not output any signal that disturbs the temperature or output value.

**Fuzzy Self-tuning Function**
The fuzzy self-tuning function has three modes.
- In SRT (step response tuning) mode, the PID constants are tuned using a step response method at the time the set point is changed.
- In DT (disturbance tuning) mode, the PID constants are amended so that the controlled temperature will be within the target range set in advance when there is external disturbance.
- In HT (hunting tuning) mode, when hunting occurs, the PID constants are amended to suppress the hunting.

**Startup Conditions of SRT**
SRT will start if conditions 1 to 5 are satisfied when the set point is changed, or the E5\-K is turned on.
1. The new set point is different from the set point used at the time SRT was last executed.
2. The difference between the new set point and the last set point is larger than the value obtained from the calculation: present proportional band value (P) x approximately 1.27+4.
3. The temperature is stable before changing the set point, or the temperature is balanced while the E5\-K is turned on before any output is obtained.
4. The set point is changed in the direction that the controlled amount increases (i.e., the control amount is in the upper direction at the time of reverse operation and in the lower direction at the time of normal operation).
5. No SRT has been executed with the current set point.

In the following cases, SRT will not be executed accurately. Therefore the E5\-K must be tuned in DT or HT mode.
1. The maximum temperature slope (R) is not obtained before the process value reaches the value obtained from the calculation: present proportional band value (P) x approximately 1.27 (i.e., the maximum temperature slope (R) is not obtained before the SRT is finished). If the proportional band, obtained before SRT is finished, is larger than the previous proportional band, however, the PID constants will be renewed, so their values will be more accurate.
2. The set point is changed during SRT, and the SRT completion conditions are satisfied; and, no PID constant will be renewed.

**Stable Temperature Status**
If the temperature is within the stable range for a specified period, the temperature is considered *stable*.

**Balanced Status**
If the process value is within the stable range for 60 s when there is no output, the the temperature is considered *balanced*. 

---

**Note:** You must turn ON the power supply to the LOAD either before or simultaneously with the start of Temperature Controller operation.

Dead time will be measured from the time the Temperature Controller starts operating. If a load, such as a heater, is turned on after the Temperature Controller is turned on, dead time longer than the actual value will be measured, and inappropriate PID constants will be obtained.

If an extremely large amount of dead time is measured, the control amount will be set to 0% for a short period of time before being returned to 100%, and the constants will then be retuned. Retuning is performed only for large amounts of dead time, so be sure to follow the precaution given above when starting operation.
Startup Conditions of DT

1. DT will start if the temperature that has been stable varies due to external disturbance and the deflection of the temperature exceeds the stable range, and then the temperature becomes stable, provided that the number of maximum temperature values is less than four.

2. DT will start if the set point is changed under the condition that SRT does not start and the temperature becomes stable, provided that the number of maximum temperature values is less than four. If there are four or more maximum temperature values, HT will start.

Balanced Status

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

Startup Conditions of HT

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

Temperature

Note: In specific applications where temperature varies periodically due to disturbance, internal parameters need to be adjusted. For details, refer to your User’s Manual.
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.
**E5CK-302**

The E5CK-302 model has the same dimension and cutouts as the E5CK.

**ACCESSORIES (ORDER SEPARATELY)**

**Terminal Cover for E5AK**

- E53-COV0809

**Terminal Cover for E5EK**

- E53-COV08

**Terminal Cover for E5CK**

- E53-COV07

**Current Transformer (E5AK and E5EK only)**

- E54-CT1

- E54-CT3
## Installation

### REMOVE CONTROLLER FROM REAR HOUSING

**E5AK and E5EK**

To pull out the internal mechanism from the housing, use a Phillips screwdriver matching the screw on the lower part of the front panel.

1. Turn the screw counterclockwise while pressing the hook on the upper part of the front panel.
2. Carefully pull out the internal mechanism while holding the left and right sides of the front panel.

---

First, while pressing the hooks on the left and right sides of the front panel, pull the internal mechanism from the housing.
### SETTINGS

Note: Always turn off the power supply to the Digital Controller before changing any switch settings.

On a standard model, set up the Output Modules for control outputs 1 and 2 before mounting the Controller.

On a position-proportional model, the Relay Output Module is already set. Do not change that set-up parameter. Do not replace with other Output Modules.

#### Setting Up and Removing the Output Module

**Setting Up the Output Module**

When setting up the Output Modules, pull out the internal mechanism from the housing and insert the Output Modules into the sockets for control outputs 1 and 2.

**Removing the Output Module**

To replace the Output Module, use a flat-blade screwdriver to push up the Output Module.

#### Setting Up the Option/Output Board

**E5AK**

1. Remove the Power Board and Option Boards in the order shown in the following diagram.

2. Insert the Option Boards into the sockets for options 1 to 3. The following diagram shows the relationship between the Option Boards and mounting positions.

3. Mount the option boards and the power board in the order shown.
E5EK
1. Remove the Power Board in the order shown in the following diagram.

![Diagram of Power Board removal](image1)

2. Insert the Option Board into the socket for option 1. The following diagram shows the relationship between the Option Board and mounting position.

![Diagram of Option Board insertion](image2)

3. Mount the option boards and the power board in the order shown.

E5CK
1. Two rectangular holes are provided on the Power Board (right side of Controller). Fit the two protrusions of the output board into these two holes.

![Diagram of Power Board orientation](image3)

2. With the output board fitted into the Power Board, fit the output board into the connector on the control board (left side of Controller).

![Diagram of Output Board connection](image4)

Set up the Option Board
1. Place the bottom of the Controller facing up, fit the board horizontally into the connector on the power board (right side of controller).

![Diagram of Option Board placement](image5)

2. With the Power Board connected, fit the board vertically into the connector on the control board (left side of Controller).
MOUNTING CONTROLLER

E5AK and E5EK

1. Insert the controller into the panel’s mounting hole at the position shown in the figure below.
2. Fit the mounting bracket (accessory) into the mounting slots on the top and bottom of the rear case.
3. Tighten the mounting bracket screws on the upper and lower parts in small increments alternately and equally until the ratchet start to slide.

E5CK

1. Insert the E5CK Controller into the cutout on the panel, as shown in the figure here.
2. Push the adapter along the Controller body from the terminals up to the panel, and fasten temporarily.
3. Tighten the two mounting screws on the adapter. When tightening screws, tighten the two screws alternately keeping the torque to approximately 0.29 to 0.39 N•m, or 3 to 4 kgf•cm.
**MOUNTING TERMINAL COVER**

**E5AK and E5EK**

1. Fasten the terminals covers as follows by using the plastic pins. Plastic pins are provided with the terminal covers.

![E5AK and E5EK terminal covers](image)

**E5CK**

1. The E5CK-AA1-500 Controller is provided with a Terminal Cover (E53-COV07). Fasten the Terminal Cover as follows by using the plastic pin.

![E5CK terminal cover](image)

**WIRING TERMINALS FOR E5AK**

**E5AK Terminal Arrangement**

![E5AK terminal arrangement diagram](image)

**Wiring**

In the following wiring diagrams, the left side of the terminal numbers indicate the inside of the Controller.

**Power Supply**

Input power to terminal numbers 9 and 10. Power specifications are as follows: 100 to 240 VAC, 50/60 Hz, approx. 16 VA

![Power supply diagram](image)
**WIRING TERMINALS FOR E5EK**

**E5EK Terminal Arrangement**

AC100–240V
50/60 Hz

- TRSF: Transfer output
- EV1/2: Event input
- PTMR: Potentiometer
- RSP: Remote SP input

**Power supply**
Input power to terminal numbers 9 and 10. Power specifications are as follows: 100 to 240 VAC, 50/60 Hz, approx. 15 VA

**WIRING TERMINALS FOR E5CK**

**E5CK Terminal Arrangement**

- SUB1
- SUB2

**Wiring Precautions**
- To protect the Controller and its lines from external noise, use the wire ducts to separate input leads and power lines.
- Use solderless terminals when wiring the Controller.
- Tighten the terminal screws using a torque no greater than 0.78 N·m, or 8 kgf·cm max. DO NOT tighten the terminal screws too tightly.

**Power Supply**
Input 100 to 240 VAC to terminal numbers 4 and 5.
### SENSOR INPUT WIRING

**E5AK**
Connect the sensor input to terminal numbers 11 to 14 and 33 as follows according to the input type.

![Diagram for E5AK](image)

**E5EK**
Connect the sensor input to terminal numbers 11 to 14 and 23 as follows according to the input type.

![Diagram for E5EK](image)

**E5CK**
Connect the sensor input to terminal numbers 6 to 8 as indicated here, according to the input type.

![Diagram for E5CK](image)

Match the inputs with the internal jumper settings for each input type. For thermocouple or platinum resistance thermometer inputs, set the internal jumper to a common position (TC/PT) as the temperature input.
**CONTROL OUTPUT**

**E5AK Control Output**

Terminal numbers 7 and 8 are for control output 1 (OUT1), and terminal numbers 5 and 6 are for control output 2 (OUT2). The following diagrams show the available Output Modules and their internal circuits.

```
+-------------------+-------------------+-------------------+-------------------+
| 10 9 8 7 6 5 4 3 2 1 | 30 31 32 20       |
|                   |                   |
```

With E53-□□ Output Modules, approx. 2 V is output for one second after the power is interrupted.

**E5EK Control Output**

Terminal numbers 7 and 8 are for control output 1 (OUT1), and terminal numbers 5 and 6 are for control output 2 (OUT2). The following diagrams show the available Output Modules and their internal circuits.

```
+-------------------+-------------------+-------------------+-------------------+
| 10 9 8 7 6 5 4 3 2 1 | 21 22 33 12       |
|                   |                   |
```

**E5AK-PRR2/E5EK-PRR2 Controllers**

The E5AK-PRR2 and E5EK-PRR2 Controllers are supplied with relay output. This relay output is not compatible with any other module.

When replacing the Output Module, use the E53-R. The following diagrams show the relationship between terminals and open/close relay settings.

```
+-------------------+-------------------+-------------------+-------------------+
| 8 6               | 8 6               | 8 6               | 8 6               |
| 7 5               | 7 5               | 7 5               | 7 5               |
| Relay             | SSR               | NPN               | PNP               |
|                   |                   |                   |                   |
```

```
+-------------------+-------------------+-------------------+-------------------+
| 8 6               | 8 6               | 8 6               | 8 6               |
| mA                | V                 | GND               | GND               |
| 7 5               | 7 5               | 7 5               | 7 5               |
|                   |                   |                   |                   |
```

```
+-------------------+-------------------+-------------------+-------------------+
| 8 6               | 8 6               | 8 6               | 8 6               |
| mA                | V                 | GND               | GND               |
| 7 5               | 7 5               | 7 5               | 7 5               |
|                   |                   |                   |                   |
```

```
+-------------------+-------------------+-------------------+-------------------+
| 8 6               | 8 6               | 8 6               | 8 6               |
| mA                | V                 | GND               | GND               |
| 7 5               | 7 5               | 7 5               | 7 5               |
|                   |                   |                   |                   |
```

```
+-------------------+-------------------+-------------------+-------------------+
| 8 6               | 8 6               | 8 6               | 8 6               |
| mA                | V                 | GND               | GND               |
| 7 5               | 7 5               | 7 5               | 7 5               |
|                   |                   |                   |                   |
```

With E53-V□□ Output Modules, approx. 2 V is output for one second after the power is interrupted.
E5CK Control Output

Terminal numbers 11 and 12 are for control output 1 (OUT1). The five output types and internal circuits are available according to the Output Board.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 11 12 10</td>
<td>E53-R4R4 E53-Q4R4 E53-Q4HR4 E53-V44R4 E53-C4R4</td>
</tr>
<tr>
<td>4 9</td>
<td>E53-Q4Q4 E53-Q4HQ4H</td>
</tr>
<tr>
<td>3 8</td>
<td>E53-Q4R4 E53-C4R4</td>
</tr>
<tr>
<td>2 7</td>
<td>E53-Q4HR4 E53-C4DR4</td>
</tr>
<tr>
<td>1 13 14 6</td>
<td></td>
</tr>
</tbody>
</table>

Terminal numbers 9 and 10 are for control output 2 (OUT2). The three output types and internal circuits are available according to the Output Board.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 9</td>
<td>E53-R4R4 E53-V44R4 E53-Q4R4 E53-C4R4</td>
</tr>
<tr>
<td>8</td>
<td>E53-Q4Q4 E53-Q4HQ4H</td>
</tr>
<tr>
<td>7</td>
<td>E53-Q4R4 E53-C4R4</td>
</tr>
<tr>
<td>6</td>
<td>E53-Q4HR4 E53-C4DR4</td>
</tr>
<tr>
<td>5 20 19 18</td>
<td></td>
</tr>
<tr>
<td>4 17 16 15</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

AUXILIARY OUTPUT

E5AK

Terminal numbers 3 and 4 are for auxiliary output 1 (SUB1) and terminal numbers 1 and 2 are for auxiliary output 2 (SUB2). The following diagrams show the internal equalizing circuits for the auxiliary outputs:

Output specifications are as follows: SPST-NO, 3 A at 250 VAC

E5CK

Terminal numbers 2 and 3 are for auxiliary output 1 (SUB1). The internal equalizing circuit for auxiliary output 1 is as follows:

Output specifications are as follows: SPST-NO, 3 A at 250 VAC

E5EK

Terminal numbers 3 and 4 are for auxiliary output 1 (SUB1) and terminal numbers 1 and 2 are for auxiliary output 2 (SUB2). The following diagrams show the internal equalizing circuits for the auxiliary outputs:

Output specifications are as follows: SPST-NO, 3 A at 250 VAC
**CT INPUT/POTENTIOMETER (FOR E5AK AND E5EK ONLY)**

**E5AK CT Input/Potentiometer**

When using the HBA function on the E5AK-AA2 Controller, connect CT input (CT) to terminal numbers 15 to 17. When monitoring the valve opening on the E5AK-PRR2 Controller, connect the potentiometer (PTMR) to terminal numbers 15 to 17. Connect each of these inputs as follows:

For details on CT inputs, refer to Appendix, About Current Transformer in your User's Manual. For details on the potentiometer, refer to the Instruction Manual for the valve connected to the Controller. The variable resistance range is 100 Ω to 2.5 kΩ.

**E5EK CT Input/Potentiometer**

When using the HBA function on the E5EK-AA2 Controller, connect CT input (CT) to terminal numbers 15 to 17. When monitoring the valve opening on the E5EK-PRR2 Controller, connect the potentiometer (PTMR) to terminal numbers 15 to 17. Connect each of these inputs as follows:

For details on CT inputs, refer to Appendix, About Current Transformer in your User's Manual. The potentiometer cannot be used simultaneously with remote SP input. For details on the potentiometer, refer to the Instruction Manual for the valve connected to the Controller. The variable resistance range is 100 Ω to 2.5 kΩ.

**REMOTE SP INPUT (FOR E5AK AND E5EK ONLY)**

**E5AK Remote SP Input**

Connect the input (RSP) to be used as the remote SP to terminal numbers 21 and 22. Only 4 to 20 mA inputs can be connected. Connect the input as follows:

**E5EK Remote SP Input**

Connect the input (RSP) to be used as the remote SP to terminal numbers 15 and 16. However, note that the potentiometer cannot be used simultaneously with remote SP input. Only 4 to 20 mA inputs can be connected. Connect the input as follows:
OPTION BOARD WIRING

E5AK

Connect event inputs 1 and 2 (EV1/2) to terminal numbers 18 to 20, and event events 3 and 4 (EV3/4) to terminal numbers 24 to 26. However, note that terminal numbers 18 to 20 cannot be used on Controllers with a communications function. Connect the event inputs as follows:

<table>
<thead>
<tr>
<th>Terminal</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>21</th>
<th>22</th>
<th>23</th>
<th>24</th>
<th>25</th>
<th>26</th>
<th>27</th>
<th>28</th>
<th>29</th>
<th>30</th>
<th>31</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>24</td>
<td>25</td>
<td>26</td>
<td>27</td>
<td>28</td>
<td>29</td>
<td>30</td>
<td>31</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>19</td>
<td>18</td>
<td>17</td>
<td>16</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Terminals 18 and 24 (COM) are connected internally.

Use event inputs under the following conditions:

<table>
<thead>
<tr>
<th>Contact input</th>
<th>ON: 1 kΩ max.</th>
<th>OFF: 100 kΩ min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-contact input</td>
<td>ON: Residual voltage 1.5 V max.</td>
<td>OFF: Leakage current 0.1 mA max.</td>
</tr>
</tbody>
</table>

Communications

Terminal numbers 18 to 20, 31 and 32 can be used only on Controllers with Communications Units (E53-AK01/02/03). For details on wiring, refer to Chapter 6, Using the Communications Function in your User’s Manual.
E5EK

Connect event inputs 1 and 2 (EV1/2) to terminal numbers 18 to 20. However, note that terminal numbers 18 to 20 cannot be used on Controllers with a communications function. Connect the event inputs as follows:

<table>
<thead>
<tr>
<th>10</th>
<th>21</th>
<th>22</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td></td>
<td>11</td>
</tr>
</tbody>
</table>

Use event inputs under the following conditions:

<table>
<thead>
<tr>
<th>Contact input</th>
<th>ON: 1 kΩ max., OFF: 100 kΩ min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-contact input</td>
<td>ON: Residual voltage 1.5 V max., OFF: Leakage current 0.1 mA max.</td>
</tr>
</tbody>
</table>

**Communications**

Terminal numbers 18 to 20, 31 and 32 can be used only on Controllers with Communications Units (E53-AK01/02/03). For details on wiring, refer to Chapter 6, Using the Communications Function in your User’s Manual.

**E5CK**

Terminal numbers 1, 13, and 14 are valid only when the Option Board is set in the Controller

The following four connections are possible depending on the model of the Option Board.
**CONNECTION EXAMPLE OF DIGITAL CONTROLLER AND SSR**

![Connection Diagram]

**E5AK/E5EK**
Digital Controller with Voltage Output (12 VDC, 40 mA max.)

**E5CK**
Digital Controller with Voltage Output (12 VDC, 20 mA max.)

See the Process and Temperature Controller Catalog GCTC11 for further information on External SSR.
Precautions

**PRECAUTIONS WHEN WIRING**

- Use wire ducts to separate input leads and power lines in order to protect the Controller and its lines from external noise.
- Solderless terminals are recommended when wiring the Controller.
- Tighten the terminal screws using a torque no greater than 0.78 N•m or 8 kgf•cm max. Take care not to tighten the terminal screws too tightly.

**Power Blocks**

The E5AK/E5EK has independent power supplies for each of the terminal blocks shown below.

**OPERATING ENVIRONMENT**

- Keep within the rated ambient operating temperature, ambient operating humidity, and storage temperature ranges.
- Use the Unit according to the vibration resistance, shock resistance, and enclosure ratings.
- Do not use the Unit in places with corrosive gas or excessive dust.
- Do not use the Unit near machines generating high-frequency noise.

**CORRECT USE**

**Mounting**

- The dimensions of the Digital Controller conform to DIN 43700.
- Recommended panel thickness is 1 to 8 mm.
- Mount the Unit horizontally.

**Connection**

- To reduce inductive noise influence, the lead wires connecting the input type to the Digital Controller must be separated from the power lines and load lines.
- Use the specified compensating conductors for thermocouples. Use lead wires having a small resistance for platinum resistance thermometers.

**Connection Example**

- Wire the terminals of the Unit using solderless terminals.
- The tightening torque applied to the terminal screws of the Unit must be approximately 0.78 N•m or 8 kgf•cm.

Use the following type of solderless terminals for M3.5 screws.

- [Illustration of solderless terminal]

* Uses same internal power supply

Note: Terminals 21 and 22 of the E5EK belong to the B block when a transfer output is set to option 1 and to the C block for other Option Boards.
**OPERATION**

- For models with alarm functions: The alarm outputs of a model with an alarm function may not turn ON properly when the model malfunctions. The use of alarm equipment with the model is recommended.
- The parameters and internal switch are set before shipping so that the Unit will function normally. Change the settings of the parameters and internal switch according to the application, if necessary.
- Several seconds are required until the relay is turned ON after power has been supplied to the Digital Controller. You must take this time delay into consideration when designing sequenced circuits which incorporate a Digital Controller.
- Do not use excessive force when pulling out the internal mechanism from the housing. Protect the internal connector or electronic parts of the Unit from shock. Protect against static discharge when changing the settings of the internal switch. Changing the settings on a grounded conductive mat is recommended.
- When connecting the Control Output Unit to the Temperature Controller or Digital Controller, make sure that the Control Output Unit is a suitable type. The use of an improper type of Control Output Unit may cause the system to malfunction.
- The heater burnout alarm will not be available if the Linear Output Unit is used.