The Series EHG CL is a powerful instrument that integrates a temperature process controller, high-low temperature alert, and power switching with a safety high limit that meets UL® 1998 and CE 60730 requirements. The optional display and communications modules can be easily upgraded in the field to provide a digital display, adjustable control parameters, RS-485 MODBUS communications and other interface features. The compact design, inherent reliability and integrated safety limit functions make this control a tremendous value. The control is designed for easy integration with Watlow heaters providing additional value to simplify the engineering and component count on new equipment. CE compliance and UL recognition will reduce time and costs necessary for global agency testing and validation for OEMs.

Features

Standard Base Module
- Two, type K thermocouple inputs: process temperature controller and safety limit
- Process temperature output: 10 amp “NO ARC” relay
- Safety limit: 10 amp relay
- On-off and PID temperature control algorithm: Upgraded via communications to PID algorithm (minimum cycle time 5 seconds)

Integrated Temperature Control
- Standard Molex Connectors
- Dimensions

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Width</th>
<th>Depth</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic unit</td>
<td>88.8 mm</td>
<td>40.2 mm</td>
<td>55.8 mm</td>
</tr>
<tr>
<td>Control with mounting bracket</td>
<td>88.8 mm</td>
<td>48.4 mm</td>
<td>55.8 mm</td>
</tr>
<tr>
<td>Control with communications module</td>
<td>88.8 mm</td>
<td>63.6 mm</td>
<td>55.8 mm</td>
</tr>
</tbody>
</table>

Optional Communications Module
- Field adjustable set point
- Access to PID parameters
- Modbus RTU Communications
- RS-485
- 3-character, 7-segment LED display
- User Interface Software

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Patent Pending
Navigating the Series EHG CL with the Front Panel

The three-character display normally shows the process temperature. To view and change the existing Set Point value follow the steps below:

1. Press the Mode Key once. The right decimal point will illuminate when viewing the Set Point value.
2. Press the Up-Arrow or Down-Arrow Key to change the Set Point.
3. Press the Mode Key again to return to the process temperature display.

The display will automatically return to showing the process temperature after three seconds.

To view or change parameter values follow the steps below:

1. Hold down both the Up-Arrow and Down-Arrow Keys for five seconds.
2. Press the Mode Key to view the other parameter prompts.
3. Press the Up-Arrow or Down-Arrow Key once to view a parameter’s value.
4. Press the Up-Arrow or Down-Arrow Key to increase or decrease that value.
5. Press the Mode Key to again display the prompt and again to display the next prompt.
6. Press the Mode Key at the Display Build Number prompt to return to the process value display.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter Name &amp; Description</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Relative Address</th>
<th>Data Type &amp; Read/Write</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numeric</td>
<td>Process Value Controller</td>
<td>-18 to 537°C (0 to 999°F)</td>
<td>20°C (68°F)</td>
<td>20</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>Numeric</td>
<td>Closed Loop Set Point</td>
<td>0°C (32°F) to SLA setting</td>
<td>150°C (302°F)</td>
<td>34</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>No Display</td>
<td>Heat Output Power</td>
<td>0 to 100%</td>
<td>0</td>
<td>22</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>No Display</td>
<td>Alert Status</td>
<td>Alert Low (7)</td>
<td>Alert None</td>
<td>31</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>No Display</td>
<td>Process Comparison Value</td>
<td>5 to 50°C (9 to 90°F)</td>
<td>20°C (68°F)</td>
<td>68</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>No Display</td>
<td>Limit Status</td>
<td>Bit 5 (0x0020)</td>
<td>0</td>
<td>63</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>No Display</td>
<td>Controller Sensor Status</td>
<td>Bit 2 (0x0004)</td>
<td>0</td>
<td>23</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>No Display</td>
<td>Limit Sensor Value</td>
<td>-18 to 537°C (0 to 999°F)</td>
<td>20°C (68°F)</td>
<td>60</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>[SLA]</td>
<td>Limit High Set Point</td>
<td>0 to 438°C (32 to 820°F)</td>
<td>200°C (392°F)</td>
<td>33</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>[Cnt]</td>
<td>Control Mode Select</td>
<td>on-off</td>
<td>on-off</td>
<td>42</td>
<td>unsigned integer RWE</td>
</tr>
</tbody>
</table>

Note:
All values above 999 will be rounded off to fit in the three-character display. Full values can be read with other interfaces.

Note:
The EHG CL does not support Modbus function code 16 (0x10) Write Multiple Registers. Parameter values must be written individually with function code 6 (0x06) Write Single Registers.
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter Name &amp; Description</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Relative Address</th>
<th>Data Type &amp; Read/Write</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HY5</strong>[HyS]**</td>
<td>On-Off Hysteresis</td>
<td>3 to 28°C (5 to 50°F)</td>
<td>3°C (6°F)</td>
<td>41</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td><strong>Pb</strong>[Pb]**</td>
<td>Proportional Band</td>
<td>0 to 68°C (0 to 122°F)</td>
<td>0°C or 0°F</td>
<td>37</td>
<td>signed integer RWE</td>
</tr>
<tr>
<td><strong>Int</strong>[Int]**</td>
<td>Integral</td>
<td>0 to 999</td>
<td>0</td>
<td>38</td>
<td>signed integer RWE</td>
</tr>
<tr>
<td><strong>dEv</strong>[dEv]**</td>
<td>Derivative</td>
<td>0 to 999</td>
<td>0</td>
<td>39</td>
<td>signed integer RWE</td>
</tr>
<tr>
<td><strong>Ct</strong>[Ct]**</td>
<td>Cycle Time</td>
<td>5 to 60</td>
<td>10</td>
<td>40</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td><strong>Abt</strong>[Abt]**</td>
<td>Ambient Temperature</td>
<td>0 to 106°C (0 to 190°F)</td>
<td>43°C (77°F)</td>
<td>24</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>Adr</strong>[Adr]**</td>
<td>Modbus Device Address</td>
<td>1 to 247</td>
<td>1</td>
<td>15</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td><strong>bAU</strong>[bAU]**</td>
<td>Modbus Baud Rate</td>
<td>Select the communication speed.</td>
<td>9,600 (15), 19,200 (16), 38,400 (17)</td>
<td>9,600</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td><strong>tU</strong>[tU]**</td>
<td>Temperature Units</td>
<td>Select the temperature scale.</td>
<td>°F (4), °C (5)</td>
<td>°C</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td><strong>rPP</strong>[rPP]**</td>
<td>Restore Programmed Parameters</td>
<td>Restore factory default settings.</td>
<td>Yes, No</td>
<td>No</td>
<td>- - - -</td>
</tr>
<tr>
<td><strong>brv</strong>[brv]**</td>
<td>Base Release Version</td>
<td>View the controller's base release version.</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>bPv</strong>[bPv]**</td>
<td>Base Prototype Version</td>
<td>View the controller's base prototype version.</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>bbu</strong>[bbu]**</td>
<td>Base Build Version</td>
<td>View the controller's base build number.</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>drv</strong>[drv]**</td>
<td>Display Release Version</td>
<td>View the interface's release version.</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>dPv</strong>[dPv]**</td>
<td>Display Prototype Version</td>
<td>View the interface's prototype version.</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>dbv</strong>[dbv]**</td>
<td>Display Build Version</td>
<td>View the interface's build number.</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>unsigned integer R</td>
</tr>
</tbody>
</table>

**Note:**
- All values above 999 will be rounded off to fit in the three-character display. Full values can be read with other interfaces.
- The EHG CL does not support Modbus function code 16 (0x10) Write Multiple Registers. Parameter values must be written individually with function code 6 (0x06) Write Single Registers.
### Keys and Indicator Lights

- **Alarm (flashing red)**: Indicates that the process temperature is higher than the Limit High Set Point.
- **Alert (solid red)**: Indicates that the process temperature is higher than the Closed Loop Set Point plus the High Temperature Alert Value.
- **In Range (solid yellow)**: Indicates that the process temperature is in the normal operating range (see figure at right).
- **Output (green)**: Indicates that the output is on.
- **Flashing Alert/Alarm (red) and In Range (yellow)**: If they are flashing together, that indicates an Ambient Alarm (controller temperature higher than 85°C). If they are flashing alternately, that indicates a Health Check Error.

### Optional Communications Connectors

- **Up-Arrow Key**: Increases the displayed value.
- **Down-Arrow Key**: Decreases the displayed value.
- **Mode Key**: Toggles the display between the set point and process temperature. Enters edited values and advances to the next prompt.

### EHG CL Error Codes

<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flasing 888 Limit error</td>
<td>Sensor has exceeded SLA value or open thermocouple</td>
<td>• Set SLA to correct Safety Limit Value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check wiring of sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check sensor configuration</td>
</tr>
<tr>
<td>Flasing 888 Control error</td>
<td>Sensor has exceeded SLA value or open thermocouple</td>
<td>• Set SLA to correct Safety Limit Value</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check wiring of sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check sensor configuration</td>
</tr>
<tr>
<td>[Er3]</td>
<td>Limit Sensor Error</td>
<td>Limit sensor reading out of range (&lt; -13 or &gt; 640)</td>
<td>• Check wiring of sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check sensor configuration</td>
</tr>
<tr>
<td>[Er4]</td>
<td>Control Sensor Error</td>
<td>Control sensor reading out of range (&lt;-13 or &gt; 640)</td>
<td>• Check wiring of sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Check sensor configuration</td>
</tr>
<tr>
<td>[Er5]</td>
<td>Limit Ambient Error</td>
<td>Temperature at limit sensor cold junction (&gt; 185 degrees)</td>
<td>• Check to be certain the EHG CL is not in an ambient condition greater than 185 degrees C</td>
</tr>
<tr>
<td>[Er6]</td>
<td>Control Ambient Error</td>
<td>Temperature at control cold junction (&gt; 185 degrees)</td>
<td>• Check to be certain the EHG CL is not in an ambient condition greater than 185 degrees C</td>
</tr>
<tr>
<td>[Er9]</td>
<td>HMI Communications Fault</td>
<td>Loss of communication between base and display communications module. See Also E20.</td>
<td>• Check connection between EHG CL and display/communications module</td>
</tr>
</tbody>
</table>

**EHG CL Error Codes Diagram**

- **Limit High Set Point**: SLH
- **Closed Loop Set Point**: CLP
- **Normal Operating Range**: Nor
- **On-Off Hysteresis**: HyS
- **Ambient Alarm**: Amb
- **Health Check Error**: Hch

**Diagram Descriptions**

- **Control Relay**: off on
- **Temperature Alert Signal**: off on
- **Alert/Alarm**: flashing
- **In Range**: on
- **Output**: on
<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI</td>
<td>Alarm High</td>
<td>Process temp exceeds set point by value greater than alarm high setting</td>
<td>• Set HTA value to correct high temperature alert value</td>
</tr>
<tr>
<td>ALQ</td>
<td>Alarm Low</td>
<td>Process temp below set point by value greater than alarm low setting</td>
<td>• Set LTA value to correct Low temperature alert value</td>
</tr>
<tr>
<td>E91</td>
<td>Communications Queue Full</td>
<td>Communications buffer overflow</td>
<td>• Contact Technical Support at 1-507-494-5656</td>
</tr>
<tr>
<td>E10</td>
<td>EEPROM Error</td>
<td>EEPROM memory space fails CRC check (checksum for parameter space)</td>
<td>• Contact Technical Support at 1-507-494-5656</td>
</tr>
<tr>
<td>E11</td>
<td>CRC Error</td>
<td>Flash memory space fails CRC check (checksum for program space)</td>
<td>• Contact Technical Support at 1-507-494-5656</td>
</tr>
<tr>
<td>E12</td>
<td>CPU Clock Error</td>
<td>Clock frequency is &lt; 5 MHz or &gt; 13.1 MHz</td>
<td>• Contact Technical Support at 1-507-494-5656</td>
</tr>
<tr>
<td>E13</td>
<td>Stack Overflow</td>
<td>Stack has overflowed</td>
<td>• Contact Technical Support at 1-507-494-5656</td>
</tr>
<tr>
<td>E15</td>
<td>AI Function Error</td>
<td>Analog reference is &lt; 1.82 or &gt; 2.06 volts</td>
<td>• Contact Technical Support at 1-507-494-5656</td>
</tr>
</tbody>
</table>
| E16     | Process Comparison Error | Limit and control sensor readings differ by value greater than process comparison value | • Check setting of Process Comparison Value  
• Set Process Comparison Value to correct value  
• Check wiring of sensors |
| E17     | Data Store Error | Data store functions are not set up | • Check setting of Process Comparison Value  
• Check wiring of sensors |
| E20     | Base control firmware ID not supported | Base control firmware is not compatible with Display Module firmware | • Check firmware compatibility between Base Control and Display Module. Revision 20.0 and greater for Base Control and Display Module are compatible for EHG2-AAAA-0000. |
**Proportional Control**

Some processes need to maintain a temperature or process value closer to the set point than on-off control can provide. Proportional control provides closer control by adjusting the output when the temperature or process value is within a proportional band. When the value is in the band, the controller adjusts the output based on how close the process value is to the set point.

The closer the process value is to the set point, the lower the output power. This is similar to backing off on the gas pedal of a car as you approach a stop sign. It keeps the temperature or process value from swinging as widely as it would with simple on-off control. However, when the system settles down, the temperature or process value tends to “droop” short of the set point.

With proportional control the output power level equals (set point minus process value) divided by the proportional band value.

Adjust the proportional band with Proportional \( P_b \).

**Proportional plus Integral (PI) Control**

The droop caused by proportional control can be corrected by adding integral control. When the system settles down, the integral value is tuned to bring the temperature or process value closer to the set point. Integral determines the speed of the correction, but this may increase the overshoot at startup or when the set point is changed. Too much integral action will make the system unstable. Integral is cleared when the process value is outside of the proportional band.

Integral \( \text{Int} \) is measured in minutes per repeat. A low integral value causes a fast integrating action.

**Proportional plus Integral plus Derivative (PID) Control**

Use derivative control to minimize the overshoot in a PI-controlled system. Derivative \( dE_u \) adjusts the output based on the rate of change in the temperature or process value. Too much derivative will make the system sluggish.

**On-Off Control**

On-off control switches the output either full on or full off, depending on the input, set point and hysteresis values. The hysteresis value indicates the amount the process value must deviate from the set point to turn on the output. Increasing the value decreases the number of times the output will cycle. Decreasing hysteresis improves controllability. With hysteresis set to the lowest value of 3°C or 5°F, the process value would stay closer to the set point, but the output would switch on and off more frequently, and may result in the output “chattering.” Both the control mode (\( Cnt \) prompt) and hysteresis (\( Hys \) prompt) values can be changed either using the front panel or via Modbus communications.
Wiring the Series EHG CL Power, Thermocouple and Heater Connections

View looking at the top of the controller.

Pins on the top of the Series EHG CL

- L1 (black)
- L2 (white)

Power and relay connectors

- L1 (black)
- L2 (white)

Control Power Cord Coiled, Terminated Long
Part Number: 4800-0022

Control Power Cord Coiled, Terminated Short
Part Number: 4800-0021

Control Power Cord Coiled, Jumpered Long
Part Number: 4800-0012

Control Power Cord Coiled, Jumpered Short
Part Number: 4800-0011

With the control facing you this connector is on the right side.

Panel Mount Dimensions

- 45.72 mm (1.800 in)

Mounting Bracket

The Series EHG CL mounting bracket lets you mount the controller in any of four angles. After disconnecting both wiring connectors, gently rotate the controller counterclockwise until it unlocks from the mounting bracket. Re-orient the controller on the mounting bracket and gently rotate it clockwise until it locks.

Thermocouple and heater connector
Specifications

Power
- Isolated Universal Power Supply: 85 to 264V~ (ac) 50/60Hz
- Up to 2400 W with 10A switching capability

NO-ARC Relay
- 10A switching
- 4.5 million cycles

Environmental
- Ambient operating temperature range 0 to 70 °C (32 to 158 °F)

Agency Approvals
- UL® 1998/C-UL®
- CE 60730
- SEMI-S2

Ordering Information
- Series EHG CL Integrated Temperature Controller
  - EHG2-AAAA-AAAA-0 to 537°C (0 to 999°F)
  - Display Module - EHG2-CLOO-COMS
  - Communications Module - EHG2-CLOO-COMS
  - Display with Communications Module - EHG2-CLOO-DSCM

Additional Power Cables
- 4800-0012: jumpered long cable
- 4800-0022: terminated long cable
- 4800-0011: jumpered short cable
- 4800-0021: terminated short cable

Warranty
The Series EHG CL is warranted to be free of defects in material and workmanship for 24 months after delivery to the first purchaser for use, providing that the units have not been misapplied. Since Watlow has no control over their use, and sometimes misuse, we cannot guarantee against failure. Watlow's obligations hereunder, at Watlow's option, are limited to replacement, repair or refund of purchase price, and parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse or abuse.

WARNING:
To avoid damage to property and equipment, and/or injury or loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series EHG CL. Failure to do so could result in such damage, and/or injury or death.
Declaration of Conformity

Series EHG® CL

WATLOW
1241 Bundy Blvd.
Winona, MN 55987 USA

Declares that the following product:
Designation: Series EHG® CL
Model Numbers: EHG2-AAAA- additional number or letters.
Classification: Electronic Thermostat with Integrated Temperature Limiter Protective Control,
Control Relay = 2CK, Limit Relay = 2BJ
Installation Category II, Pollution degree 2, Software Class B
Rated Supply Source: 100 to 240 V~ (ac), 50 or 60 Hz
IP Code: IP20
Rated Power: 5 VA Unit power, 10 A Resistive Heater Load

Meets the essential requirements of the following European Union Directives by using the relevant standards show below to indicate compliance.

EN 60730-1 2010 Edition 4 Automatic electrical controls for household and similar use
EN 60730-2-9 2010 Temperature Sensing Controls, Class B Emissions
EN 61000-4-2 2008 Electrostatic Discharge Immunity
EN 61000-4-3 2010 Radiated Field Immunity
EN 61000-4-4 2011 Electrical Fast-Transient / Burst Immunity
EN 61000-4-5 2006 Surge Immunity
EN 61000-4-6 2008 Conducted Immunity
EN 61000-4-8 2009 Power frequency magnetic field immunity
EN 61000-4-11 2004 Voltage Dips, Short Interruptions and Voltage Variations
    Immunity
EN 61000-4-28 2009 Variation of power frequency immunity – Level 2
EN 61000-3-2 2006 Harmonic Current Emissions
EN 61000-3-3 2005 Voltage Fluctuations and Flicker
SEMI F47 2000 Specification for Semiconductor Processing Equipment Voltage Sag Immunity – Figure R1-1

2006/95/EC Low-Voltage Directive
EN 61010-1 2010 Edition 3 Safety Requirements of electrical equipment for measure-
    ment, control and laboratory use. Part 1: General requirements
EN 60730-1 2010 Edition 4 Automatic electrical controls for household and similar use
EN 60730-2-9 2011 Edition 3.1 Temperature Sensing Controls

Compliant with 2002/95/EC RoHS Directive

Per 2002/96/EC WEEE Directive  Please Recycle Properly

Joe M. Millanes  Winona, Minnesota, USA
Name of Authorized Representative  Place of Issue

Title of Authorized Representative  Date of Issue

Signature of Authorized Representative

Watlow Controls  9  EHG CL User’s Guide