The Series EHG SL10 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
- High-low temperature alert: 2 amp, 30V (ac/dc), Form A 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></td>
<td>(3.496 in)</td>
<td>(1.582 in)</td>
<td>(2.196 in)</td>
</tr>
<tr>
<td>with mounting bracket</td>
<td>88.8 mm</td>
<td>48.4 mm</td>
<td>55.8 mm</td>
</tr>
<tr>
<td></td>
<td>(3.496 in)</td>
<td>(1.907 in)</td>
<td>(2.196 in)</td>
</tr>
<tr>
<td>with communications-display module &amp; mounting bracket</td>
<td>88.8 mm</td>
<td>63.6 mm</td>
<td>55.8 mm</td>
</tr>
<tr>
<td></td>
<td>(3.496 in)</td>
<td>(2.503)</td>
<td>(2.196 in)</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

The Series EHG SL10 User’s Guide is copyrighted by Watlow Winona, Inc., © February 2011, with all rights reserved. Patent Pending
Navigating the Series EHG SL10 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.
   This will display the Set Point High Limit prompt.
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>View the present Process Value.</td>
<td>-18 to 400°C (0 to 752°F)</td>
<td>20°C (68°F)</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Closed Loop Set Point</td>
<td>Set the set point that the controller will automatically control to.</td>
<td>0°C (32°F) to Set Point High Limit</td>
<td>150°C (302°F)</td>
<td>34</td>
</tr>
<tr>
<td>No Display</td>
<td>Heat Output Power</td>
<td>Read (via Modbus communications) the present heat output power level.</td>
<td>0 to 100%</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>No Display</td>
<td>Alert Status</td>
<td>Read (via Modbus communications) the present alert status.</td>
<td>Alert Low (7) Alert High (8) Alert None (6)</td>
<td>Alert None</td>
<td>31</td>
</tr>
<tr>
<td>No Display</td>
<td>Process Comparison Value</td>
<td>Set or read (via Modbus communications) the Process Comparison Value.</td>
<td>5 to 30°C (9 to 54°F)</td>
<td>20°C (68°F)</td>
<td>68</td>
</tr>
<tr>
<td>No Display</td>
<td>Limit Status</td>
<td>Read (via Modbus communications) the present condition of the limit.</td>
<td>Bit 5 (0x0020) 0 = Not tripped (process value below limit high set point) 1 = Tripped (process value exceeds limit high set point)</td>
<td>0</td>
<td>63</td>
</tr>
<tr>
<td>No Display</td>
<td>Controller Sensor Status</td>
<td>Read (via Modbus communications) the present status of the controller sensor.</td>
<td>Bit 2 (0x0004) 0 = Good 1 = Failure</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>No Display</td>
<td>Limit Sensor Value</td>
<td>View the present value of the limit sensor.</td>
<td>-18 to 400°C (0 to 752°F)</td>
<td>20°C (68°F)</td>
<td>60</td>
</tr>
<tr>
<td>SLA [SLA]</td>
<td>Limit High Set Point</td>
<td>Set the high process value that will trigger the limit.</td>
<td>0 to 220°C (32 to 428°F)</td>
<td>200°C (392°F)</td>
<td>43</td>
</tr>
<tr>
<td>HtA [HtA]</td>
<td>High Temperature Alert Value</td>
<td>The High Temperature Alert occurs when the process variable exceeds the set point by more than the value set here.</td>
<td>1 to 99°C (2 to 178°F)</td>
<td>20°C (36°F)</td>
<td>35</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 SL10 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>LtA</td>
<td>Low Temperature Alert Value</td>
<td>5 to 99°C (9 to 178°F)</td>
<td>20°C (36°F)</td>
<td>36</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>Cnt</td>
<td>Control Mode Select</td>
<td></td>
<td>on-off</td>
<td>42</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>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>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>Int</td>
<td>Integral</td>
<td>0 to 999</td>
<td>0</td>
<td>38</td>
<td>signed integer RWE</td>
</tr>
<tr>
<td>dEv</td>
<td>Derivative</td>
<td>0 to 999</td>
<td>0</td>
<td>39</td>
<td>signed integer RWE</td>
</tr>
<tr>
<td>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>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>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>bAU</td>
<td>Modbus Baud Rate</td>
<td></td>
<td>9,600 (15)</td>
<td>16</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>tU</td>
<td>Temperature Units</td>
<td></td>
<td>°F (4)</td>
<td>17</td>
<td>unsigned integer RWE</td>
</tr>
<tr>
<td>rPP</td>
<td>Restore Programmed Parameters</td>
<td>Yes</td>
<td>No</td>
<td>- - -</td>
<td>- - -</td>
</tr>
<tr>
<td>brv</td>
<td>Base Release Version</td>
<td>0 to 9999</td>
<td>- - -</td>
<td>48</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>bPv</td>
<td>Base Prototype Version</td>
<td>0 to 9999</td>
<td>- - -</td>
<td>49</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>bbu</td>
<td>Base Build Version</td>
<td>0 to 9999</td>
<td>- - -</td>
<td>50</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td>drv</td>
<td>Display Release Version</td>
<td>0 to 9999</td>
<td>- - -</td>
<td>11</td>
<td>unsigned integer R</td>
</tr>
</tbody>
</table>

Note:
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Note:
The EHG SL10 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.
### Alarm
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.

### Output (green)
Indicates that the output is on.

### In Range (solid yellow)
Indicates that the process temperature is in the normal operating range (see figure at right).

### 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.

### Output (green)
Indicates that the output is on.

### In Range (solid yellow)
Indicates that the process temperature is in the normal operating range (see figure at right).

### 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
- **Alert/Alarm** (flashing)
- **In Range** (flashing)
- **Output** (flashing)

### Optional Communications Connectors
- **Alert/Alarm** (flashing)
- **In Range** (flashing)
- **Output** (flashing)

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### Optional Communications Connectors
- **Alert/Alarm** (flashing)
- **In Range** (flashing)
- **Output** (flashing)

### Optional Communications Connectors
- **Alert/Alarm** (flashing)
- **In Range** (flashing)
- **Output** (flashing)

### Display Parameter Name & Description

<table>
<thead>
<tr>
<th>Display 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>[dPu]</strong> Display Prototype Version</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>12</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>[dPV]</strong> Display Build Version</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>13</td>
<td>unsigned integer R</td>
</tr>
</tbody>
</table>

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**Note:**
The EHG SL10 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

<table>
<thead>
<tr>
<th>Mode Key</th>
<th>Toggles the display between the set point and process temperature. Enters edited values and advances to the next prompt.</th>
<th>Up-Arrow Key</th>
<th>Increases the displayed value.</th>
<th>Down-Arrow Key</th>
<th>Decreases the displayed value.</th>
</tr>
</thead>
</table>

### Modbus Relative Address

<table>
<thead>
<tr>
<th>Display 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>[dPu]</strong> Display Prototype Version</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>12</td>
<td>unsigned integer R</td>
</tr>
<tr>
<td><strong>[dPV]</strong> Display Build Version</td>
<td>0 to 9999</td>
<td>- - - -</td>
<td>13</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.

**Note:**
The EHG SL10 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.

### Optional Communications Connectors

<table>
<thead>
<tr>
<th>Optional Communications Connectors</th>
<th>Flasing Alert/Alarm (red) and In Range (yellow)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>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.</td>
</tr>
</tbody>
</table>

### Display Build Version
View the interface's build number.

### Display Prototype Version
View the interface's prototype version.
<table>
<thead>
<tr>
<th>Display</th>
<th>Description</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
</table>
| SL1     | Limit error                  | Sensor has exceeded SLA value or open thermocouple | • Set SLA to correct Safety Limit Value  
• Check wiring of sensor  
• Check sensor configuration |
| SL2     | Control error                | Sensor has exceeded SLA value or open thermocouple | • Set SLA to correct Safety Limit Value  
• Check wiring of sensor  
• Check sensor configuration |
| Er3     | Limit Sensor Error           | Limit sensor reading out of range (< -13 or > 640) | • Check wiring of sensor  
• Check sensor configuration |
| Er4     | Control Sensor Error         | Control sensor reading out of range (<-13 or > 640) | • Check wiring of sensor  
• Check sensor configuration |
| Er5     | Limit Ambient Error          | Temperature at limit sensor cold junction (> 185 degrees) | • Check to be certain the EHG SL10 is not in an ambient condition greater than 185 degrees C |
| Er6     | Control Ambient Error        | Temperature at control cold junction (> 185 degrees) | • Check to be certain the EHG SL10 is not in an ambient condition greater than 185 degrees C |
| Er9     | HMI Communications Fault     | Loss of communication between base and display communications module | • Check connection between EHG SL10 and display/communications module |
| Ah1     | Alarm High                   | Process temp exceeds set point by value greater than alarm high setting | • Set HTA value to correct high temperature alert value |
| Al0     | Alarm Low                    | Process temp below set point by value greater than alarm low setting | • Set LTA value to correct Low temperature alert value |
| Er9     | Communications Queue Full    | Communications buffer overflow, return to factory | • Contact Technical Support at 1-507-494-5656 |
| E10     | EEPROM Error                 | EEPROM memory space fails CRC check (checksum for parameter space), return to factory | • Contact Technical Support at 1-507-494-5656 |
| E11     | CRC Error                    | Flash memory space fails CRC check (checksum for program space), return to factory | • Contact Technical Support at 1-507-494-5656 |
| E12     | CPU Clock Error              | Clock frequency is < 5 MHz or > 13.1 MHz, return to factory | • Contact Technical Support at 1-507-494-5656 |
| E13     | Stack Overflow               | Stack has overflowed, return to factory            | • Contact Technical Support at 1-507-494-5656 |
| E15     | AI Function Error            | Analog reference is < 1.82 or > 2.06 volts, return to factory | • Contact Technical Support at 1-507-494-5656 |
| 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, return to factory | • Check setting of Process Comparison Value  
• Check wiring of sensors |
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 \( P_b \).

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 \( C_t \) prompt and hysteresis \( Hys \) prompt values can be changed either using the front panel or via Modbus communications.

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 \( Int \) 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 \( dE/w \) adjusts the output based on the rate of change in the temperature or process value. Too much derivative will make the system sluggish.

Mounting the Series EHG SL10

Watlow Controls
Wiring the Series EHG SL10 Power, Thermocouple and Heater Connections

View looking at the top of the controller.

Panel Mount Dimensions

- 45.72 mm (1.800 in)
- Drill and tap for #8-32

Mounting Bracket

The Series EHG SL10 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

With the control facing you this connector is on the right side.
Wiring the Series EHG SL10 Communications Ports

The graphic below reflects the control being held upright with the display facing the holder. As shown, there are two jacks on the top of the communications module (RJ45 like, with 4 pins on each) which can accommodate either a four or six 6 pin modular plug. Communications from a PC to any EHG SL10 controller on the network can be established by connecting it to either of the two available jacks. The other jack can then be connected to other EHG SL10 controllers on the network (32 maximum).

Looking at either of the jacks as shown in the graphic pin identification is from left to right.
- Left most pin, connects to ground terminal of converter
- Second pin from left, no connection
- Third pin from left, connects to converter A or T- / R-
- Right most pin connects to converter B or T+ / R+

![Diagram of wiring connections]
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 SL10 Integrated Temperature Controller
EHG2- CNTL- _ _ _ _
- 0000 basic control (purchased only as part of a heater assembly)

EHG2- MODU- _ _ _ _
- DISP with display module
- COMS with communications module
- DSCM with display & communications module

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 SL10 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 SL10. Failure to do so could result in such damage, and/or injury or death.