Power Series
User’s Manual

Microprocessor-Based
SCR Power Controller

WATLOW

TOTAL CUSTOMER SATISFACTION
3 Year Warranty

ISO 9001

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U.S. English

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Safety Information in this Manual

Note, caution and warning symbols appear throughout this book to draw your attention to important operational and safety information.

A “NOTE” marks a short message to alert you to an important detail.

A “CAUTION” safety alert appears with information that is important for protecting your equipment and performance.

A “WARNING” safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.

The ⚠️ symbol (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.

The ⚡ symbol (a lightning bolt in a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.

Technical Assistance

If you encounter a problem with your Watlow controller, see the Troubleshooting Table in the Appendix and review all of your configuration information to verify that your selections are consistent with your application: inputs; outputs; alarms; limits; etc. If the problem persists after checking the above, you can get technical assistance from your local Watlow representative, or by dialing +1 (507) 454-5300, 7:00 a.m. to 5:00 p.m. Central Standard Time.

An applications engineer will discuss your application with you.

Please have the following information available when you call:

- Complete model number
- All configuration information
- User’s Manual
- Diagnostic Menu readings

Warranty and return information are on the back cover of this manual.

Your Comments

Your comments or suggestions on this manual are welcome. Please send them to the Technical Literature Team, Watlow Winona, 1241 Bundy Boulevard, P.O. Box 5580, Winona, Minnesota, 55987-5580 U.S.; Telephone: +1 (507) 454-5300; fax: +1 (507) 452-4507. The Power Series User’s Manual is copyrighted by Watlow Electric Manufacturing, Inc., © 2015, with all rights reserved.
# Power Series

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Chapter One

Overview

Introduction

The Power Series is a state-of-the-art microprocessor-based Silicon Controlled Rectifier (SCR) power controller intended for controlling industrial heaters. This product is based on one package with several configurations that include single phase, three phase, and single phase-multizone capabilities. Each package configuration has a specific current rating depending on the number of phases switched. The switching capabilities include 65 to 250A rms at 50°C from 24 to 600V~ depending on the configuration or model number selected. See page 1.2 for additional information on the Power Series configuration options.

Figure 1.1 — Power Series features.

- **Removable Mounting Plate**
  Power Series snaps on a pre-mounted, removable plate.

- **Ground Lug**
  Built in, designed for easy ground connections.

- **Terminal Cover**
  Electrically touch-safe package.

- **Fuse Cover**
  Slides up and down for fuse maintenance and covers the high voltage components.

- **I/O Port**
  Input, retransmit output, communications, and alarms.

- **On-Board Fan**
  A fan is integrated into the package on forced air cooled models to eliminate separate power connection for fan.

- **Allen Wrench**
  Used to torque terminals 1 to 6 and ground lug.

- **Digital Programmer/Display**
  For controller configuration, setup, and monitoring features.

---

Overview, Chapter 1  Watlow Power Series 1.1
Single Phase

This configuration can be purchased with any or all the features available on the Power Series. The only limitations are the features selected by the customer upon purchase. It has the highest current rating of all configurations since it is only switching one phase of the ac line. It is intended for resistive heaters, but can also be used on transformer connected loads in the phase angle firing mode.

Three Phase, Two-Leg Configuration

This configuration is intended for zero cross firing into a stable resistive heater, i.e., nichrome element. Typically, a three phase, three-wire delta or ungrounded wye/star connected heater is most often used where only two of the three V~ line phases are switched. The third phase is a direct connection through a bussbar on board the Power Series and is controlled by the previous two phases. For this reason, a two-leg configuration should not be used for three phase grounded wye/star connected heaters. (For heaters that are required to be three phase grounded wye/star connected, see “Three Phase, Three-Leg Configuration” section below.)

Because this configuration does not allow phase angle firing, it should not be used on transformer coupled heaters and less stable resistance heaters such as silicon carbide, molybdenum disilicide, carbon graphite, or tungsten lamp heaters. This may cause premature heater failure or nuisance fuse blowing.

Heater current monitoring and kVA options are available with a three phase, two-leg configuration via the heater diagnostics option. Phase angle firing, including current limiting and heater bakeout, is not available.

Three Phase, Three-Leg Configuration

There are two Power Series configurations that include six SCR control. All features are available in these configurations.

The three-leg version is intended for phase angle firing into a transformer connected load or direct connection to heating that requires soft start and/or current limiting.

The four-wire configuration is intended for zero cross firing into a four-wire wye connected nichrome/resistive heater.

Single Phase, Multizone Configuration

This configuration is available in two and three single phase zones. Back-to-back SCRs are used and all of the features of a single phase unit are available. (Note that there is only one alarm relay and all zones in the controller must use the same control method.) This configuration is intended for applications with multiple command signals from independent control zones. The multizone platform offers reduced panel space compared to using multiple single phase power controllers.

Heater Diagnostics

Heater diagnostics is a key feature of the Power Series SCR power controller. Heater diagnostics may include all or only some of the features that require heater current monitoring, depending on the model selected. Heater current monitoring is only available with heater diagnostics installed on the controller. The features dependent on heater current monitoring are heater bakeout, current limiting, heater current and kVA monitoring, retransmit, and heater monitoring alarms such as open heater, heater out of tolerance, load balance, and shorted SCR detection/error. Heater diagnostics must also be installed if you need phase angle control with current limit.
The following two chapters will explain how to install the Power Series controller. Watlow power controllers are thoroughly tested before leaving the factory, so the Power Series controller is ready to install when you receive it.

Chapters 2 and 3 describe the steps required to install the Power Series controller. Refer to Chapter 2 for mounting information and Chapter 3 for input, power, and load wiring of the Power Series.

Before beginning installation, read through these chapters to gain an understanding of the entire installation. Consider the installation carefully. Plan the power, load, and input signal wiring before mounting the Power Series. Also consider the cabinet space, controller dimensions, wire bending radius, and airflow. Use good wiring practices to minimize electrical noise problems.

### Power Series Wire Bending Radius at Base Current and Ambient Temperature Rating and Replacement Semiconductor Fuses

Minimum recommended wire sizes are based on the NEC 30°C ambient with not more than three current carrying conductors in raceway or cable, while also considering the Power Series 50°C enclosure temperature and semiconductor fuse rating. Use copper conductors only.

The terminal lug wire range for all Power Series amperages is 350 MCM to 6 AWG. The recommended terminal torque is 180 in.-lbs. (20 Nm). Terminal lug ratings are for one wire per lug. Refer to page 3.1 for torque guidelines.

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Mounting the Power Series Controller

NOTE: The Power Series controller must be mounted vertically. When multiple units are used in one cabinet, it is best that they are mounted side-by-side when possible. If they are mounted one above the other, adequate spacing and airflow must be provided. See Enclosure Guidelines on page 2.3.

For models N20 through F30:
1. Determine the panel location for mounting the Power Series controller and punch or drill holes for the 4 mounting screws per the drawing below. The mounting plate can be used as a template.
2. Attach the Power Series mounting plate using 4 screws (customer supplied, #10 screw minimum, 1/4 inch screw maximum).
3. Align the heads of the shoulder screws on the back of the Power Series heat sink with the key slots on the mounting plate. Push the unit in, and then down until it snaps into place. Mounting is complete.

For F35 models:
F35 models are a bolt-down package. Drill and tap six holes per the above drawing for 1/4-inch 20 bolts.

Figure 2.2a — Power Series dimensions.  
Figure 2.2aa — F35 model only.

Figure 2.2b — Mounting plate dimensions.  
Figure 2.2c — Installing the controller.
Enclosure Guidelines

The Power Series must be mounted in a suitable electrical enclosure. It must have adequate wire bending space and cooling. The maximum ambient temperature in the enclosure must not exceed 50°C (122°F) for name plate rating. For other output ratings and enclosure ambient temperatures, see output rating curves on pages 2.5 and 2.6.

To maintain the proper cooling, the enclosure must be large enough to dissipate the heat generated by the Power Series, or there must be some form of active cooling:

1. Air circulation — fans bring air into the bottom of the enclosure and louver plates to allow the air to exit the top of the enclosure. Filters are not recommended as they can become plugged and block air flow. To maintain 80 percent of the CFM of a fan, the outlet must be four times the area of the fan inlet. Ensure that each Power Series is within an unobstructed airstream.

2. Vortex coolers operate on compressed air and provide good cooling on a sealed enclosure, but are noisy and consume a lot of air.

3. Cabinet air conditioners work well on sealed enclosures.

4. Heat pipe coolers work well on sealed enclosures, but do not provide as much cooling as vortex coolers or air conditioners.

To determine how much cooling is required:

1. Determine the amperage load on the Power Series. Multiply the amperage by 1.2 and then by the number of phases controlled. This is the output power dissipated by the SCRs in watts. Add the watts dissipated by the controller’s power supply (21W) and multiply the total power in watts by 3.41 to get BTUs per hour. Vortex coolers, heat pipe coolers, and air conditioner cooling are rated in BTUs removed.

2. Add up the watts generated by other electronics in the enclosure and multiply by 3.41 to get BTUs per hour.

3. Add up the total BTUs inside the enclosure and pick a cooling device that will remove that amount of BTUs.

4. For fan cooled enclosures, enclosure and fan manufacturers usually have free software programs and application notes to help size the fans for enclosures. If necessary, contact the Application Engineers at Watlow Controls for assistance.

Harsh Environment

The Power Series meets standards UL508, Pollution degree 3 for safety which states: “Conductive pollution occurs or non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.” However, Watlow recommends that the Power Series be used in a clean, dry environment to ensure long-term reliability.
Removing the Power Series Controller

1. To release the Power Series controller from the mounting plate, press in on the release tab at the top of the mounting plate.

2. When the release tab is in, push up on the controller from the bottom to release it from the mounting plate. **Beware of sharp edges on the heat sink when you push upward. This will take some force!**

3. The F35 model does not use the standard mounting plate. See page 2.2 for mounting instructions. To remove: reverse the mounting operation.

![Figure 2.4 — The F35 Power Series (right) is cooled with larger fans.](image)

Maintaining the Power Series

- **Cleaning:** The heatsink fins must be kept clean for proper cooling and the printed circuit board should be free of conductive residue condensation.
- **Calibration:** Not normally necessary. See pages 6.15-6.16 for data restore and backup.
- **Retorquing:** See page 3.1 for torque guidelines.
- **Software backup and refresh:** Not necessary; see page A.7, Power Series Backup.

**NOTE:** All Power Series controllers have been 100 percent tested before shipment.
Power Series Output Rating Curves

Fan Cooled

All curves are at 100% on with 90°C rated load wire and line wire connected. Note that each chart is slightly different on the amperage scale. The safe operating region is from 1 amp up to the specific curve for the output amperage code selected. For example: F25 Single-Phase is rated up to 200 amps at 50°C; F30 Single-Phase is rated for 250 amps at 50°C. See page 2.6 for Natural Convection Cooled output rating curves.
Power Series Output Rating Curves

Natural Convection

All curves are at 100% on and with 90°C rated load wire and line wire connected. Note that each chart is slightly different on the amperage scale. The safe operating region is from 1 amp up to the specific curve for the output amperage code selected. For example: N25 Single Phase is rated up to 140 amps at 50°C; N30 Single Phase is rated for 165 amps at 50°C.
Chapter Three
Wiring

Wiring the Power Series Controller

Wiring options depend on the model number. Check the terminal designation stickers on the right side of the controller and compare your model number to those shown here and with the model number breakdown in the Appendix (page A.10) of this manual.

Chapter 3 illustrates how to wire the inputs and outputs for all options. Refer to Figure 3.1 for terminal torque guidelines.

Torque Guidelines

• Properly torque terminals by holding for 30 seconds to allow for wires to settle and minimize loosening due to cold flow.
• Re-torque all terminals after 48 hours.
• Establish a maintenance program to re-torque line and load terminations every 3-6 months.

Figure 3.1 — Torque and wire stripping.
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 Power Series. Failure to do so could result in damage, and/or injury or death.

NOTE:
Input, retransmit and communications external terminals have been designed for protection in case of direct contact in accordance with European Standard EN50178.

NOTE:
Insure ground is wired with the same size wire as line and load connections to a ground of sufficient current carrying capacity. (Refer to Chapter 2, p. 2.1, Power Series Wire Bending Radius at Base Current and Ambient Temperature Rating.)

NOTE:
Torque and wire strip guidelines:
- Control wiring 1 thru 23.
- Strip wire to 0.24 inch (6mm). Torque to 8 in.-lbs. (0.9 Nm).
- Hold torque for 30 seconds to allow for wiring settling and cold flow. Re-torque after 48 hours.
- All line connections should be re-torqued every 3-6 months.

Figure 3.2a – Control Power and Alarm Wiring

Figure 3.2b – Retransmit Wiring

Figure 3.2c – Communications Wiring
NOTE:
Successful installation requires four steps:

- Choose the controller’s hardware configuration and model number (Appendix);
- Install the controller (Chapter Two);
- Wire the controller (Chapter Three); and
- Configure the controller (Chapters Four, Five and Six).

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 Power Series. Failure to do so could result in damage, and/or injury or death.
**Line Power/Output Wiring**

**Figure 3.4a – Single Phase Output Wiring**  
(Model PC1X-XXXX-XXXX)

- **NOTE:** Successful installation requires four steps:
  - Choose the controller’s hardware configuration and model number (Appendix);
  - Install the controller (Chapter Two);
  - Wire the controller (Chapter Three); and
  - Configure the controller (Chapters Four, Five and Six).

- **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 Power Series. Failure to do so could result in damage, and/or injury or death.

- **NOTE:** Torque and wire strip guidelines:
  - Connections 1 thru 6, and ground lug
  - Strip wire 1-1/8 in. (30mm). Torque to 180 in.-lbs. (20 Nm).
  - Hold torque for 30 seconds to allow for wiring settling and cold flow. Re-torque after 48 hours.
  - All load connections should be re-torqued every 3-6 months.

**Figure 3.4b – 3 Phase, 2-Leg, 4 SCR Output Wiring**  
(Model PC2X-XXXX-XXXX)

- **CAUTION:** Figure 3.4a shows the Watlow-recommended output wiring using the internal bussbar as a return current path and with ref. 2 not connected. Should a user choose a non-recommended wiring scheme, then ref. 2 or the internal bussbar must be connected to the appropriate line or neutral. Failure to follow these guidelines could cause damage to the Power Series.

- **CAUTION:** Figure 3.4b shows the Watlow-recommended output wiring using the internal bussbar as a return current path and with ref. 1 and 3 not connected. Should a user choose a non-recommended wiring scheme, then ref. 1 or ref. 3 or the internal bussbar must be connected to the appropriate line. Failure to follow these guidelines could cause damage to the Power Series.

**NOTE:** Our illustrations illustrate circuit breakers for branch circuit protection. Fuses can also be used.
**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 Power Series. Failure to do so could result in damage, and/or injury or death.

**WARNING:**
Install high or low temperature limit control protection in systems where an over temperature fault condition could present a fire hazard or other hazard. Failure to install temperature limit control protection where a potential hazard exists could result in damage to equipment, property and injury to personnel.

**NOTE:**
For reference connections 1 to 3, use QC 0.250 in. wide and 0.032 in. thick compatible connection which is fully insulated with nylon and has a metal grip ring.
For 14-16 AWG: Molex/ETC AA-5261; 3M MNG14-250DFIX C-54-503X or equivalent.

**NOTE:** 1. Phasing must be as shown.
2. Do not connect Ref. terminals.

**CAUTION:** Do not connect ref. connections with PC3 models. Failure to follow this guideline could cause damage to the Power Series.

**NOTE:** Wiring must be A, B, C rotation.

**NOTE:** Models PC8 and PC9 control legs are isolated so that they may be wired from phase-to-phase inside delta or phase-to-neutral, independent of how the other legs are wired.
Wiring Example

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 Power Series. Failure to do so could result in damage, and/or injury or death.

WARNING:
Install high or low temperature limit control protection in systems where an over temperature fault condition could present a fire hazard or other hazard. Failure to install temperature limit control protection where a potential hazard exists could result in damage to equipment, property and injury to personnel.

NOTE: Our wiring example illustrates circuit breakers for branch circuit protection. Fuses can also be used.

Recommended fusing options to meet 200KA SCCR. All other untested combinations are defaulted to 5KA per UL508A and NEC guidelines.

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<td>170M1319</td>
</tr>
<tr>
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<td>0808-0102-0160</td>
<td>170M1319</td>
</tr>
<tr>
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<td>0808-0102-0250</td>
<td>170M1321</td>
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<tr>
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<td>170M1321</td>
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<td>200</td>
<td>0808-0102-0200</td>
<td>170M1320</td>
</tr>
</tbody>
</table>
Chapter Four
Navigation and Software

Keys and Displays

This chapter explains keys, displays and navigation skills. You’ll also find a complete software map.

**Alarm Indication LED:** Lit when an alarm is active.

**Upper Display:** Indicates operating levels - requested current, line voltage or power feedback levels for the parameter in the lower display.

**Lower Display:** Indicates the parameter whose value appears in the upper display.

**Home Key:** Returns to the Display Loop if in any other page or menu, or in the Display Loop, moves between like prompts of different zones or phases.

**Increment/Decrement Keys:** Moves to next or previous submenu if at the top item of a menu, or increments/decrements current menu item.

**Small LED:** Blinks with communications activity.

**Left/Right Keys:** Moves to the next or previous item in a submenu.

Figure 4.1 — Power Series keys and displays.
Navigating the Power Series

Choose a page (Setup or Factory) and press its key sequence. The page appears in the lower display.

**Setup Page** - for setting up the control, alarms, retransmit, and communications.

- **Setup Page**: From Display Loop, press ▼ and ◁ keys together for 2 sec.

**Factory Page** - for calibration and diagnostic information.

- **Factory Page**: From Setup Page, press ▼ and ◁ and ► keys together for 2 sec

**Display Loop** - for monitoring parameters and adjusting manual/digital input, and for clearing alarms if they are latched.

- **Display Loop**: From Setup or Factory Page, press the ▼ key.

NOTE:
The Load Activity Indicator in the Display Loop indicates different things, dependent on whether heater diagnostics is installed. With heater diagnostics installed, it indicates load current has been detected. Without heater diagnostics installed, it indicates the SCRs are being gated and line voltage is present.

Press▼ or ▲ to find a specific menu in a page. The menu appears in the upper display and the page remains in the lower display.

Press ► to enter the list of parameters in the menu displayed. The menu’s parameters appear in the lower display and the values in the upper display. To go backward through the parameter list press ◁.

Press▼ or ▲ to select a value, either alpha or numeric, within a specific parameter.
Navigation

The Display Loop is used to monitor parameters and adjust manual/digital input, and to clear alarms if they are latched.

Display Loop

Use the Increment/Decrement keys (▲▼) to select a Zone or Phase within the Display Loop. The Zone/Phase appears in the upper display.

Use the Left/Right arrow keys (◀▶) to select a parameter within a Zone or Phase. The parameter appears in the bottom display.

Use the Increment/Decrement keys (▲▼) to select a value, either alpha or numeric, within a parameter. The value appears in the upper display.

Use the Home key (●) to toggle between Zones/Phase 1, 2, or 3 sequentially.

NOTES:
What you see in each Page and in each Menu are factory set, depending on the options and settings of your controller. The input signal method indicator will change depending on the input signal method chosen — digital, current, or volts. Current operating parameters may be modified at any time with the use of the keypad or communications port.

NOTE: For an explanation of the parameters in the Display Loop, range information, Modbus address, and conditions for the parameter to appear, see pp. 6.1-6.4, Chapter Six, Parameters.
Setup Page Menus

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl</td>
<td>Control Algorithm</td>
</tr>
<tr>
<td>Opt1</td>
<td>Setup Control Zone 1</td>
</tr>
<tr>
<td>Opt2</td>
<td>Setup Control Zone 2</td>
</tr>
<tr>
<td>Opt3</td>
<td>Setup Control Zone 3</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Setup Control Zone 2</td>
</tr>
<tr>
<td>Opt2</td>
<td>Setup Control Zone 2</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Setup Control Zone 3</td>
</tr>
<tr>
<td>Opt3</td>
<td>Setup Control Zone 3</td>
</tr>
</tbody>
</table>

Factory Page Menus

<table>
<thead>
<tr>
<th>Menu</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ctrl</td>
<td>System Data Manipulation</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Global/Menu Lockouts</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Unit Information</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Diagnostics</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Factory Password</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Calibrate Analog Input Signal Zone 1</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Calibrate Analog Input Signal Zone 2</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Calibrate Analog Input Signal Zone 3</td>
</tr>
<tr>
<td>Ctrl</td>
<td>Calibrate Retransmit</td>
</tr>
</tbody>
</table>

**NOTE:** This prompt will only appear in Ctrl and if the controller is 3 phase.

---

**NOTE:** These menus and display prompts are only viewable in the Factory Mode using a password.

**NOTE:** For an explanation of the parameters in the Setup Page, (range information, Modbus address, and conditions for the parameter to appear), see Chapter Six, Parameters, pp. 6.5-6.14; for information on the Factory Page, see pp. 6.14-6.22.
Chapter Five
Control Methods and Features

Zero Cross

Zero cross (also known as burst firing) provides even output power with the lowest level of noise generation (RFI). Zero cross is the preferred method for controlling a resistive load.

The controller determines when the ac sine wave crosses the 0-volts point, then switches the load, minimizing RFI.

Zero cross control is available for all Power Series configurations.

Soft start and current limiting are not available with zero cross control.

Setup Page:
- Enter the Setup Page by holding ± for 3 seconds.
- When the display reads [Algo], press ® until [Off] is displayed. Press ▲▼ to select [ftb] fixed time base, zero cross or [urtb] variable time base, zero cross.

Figure 5.1a — Zero cross switching.

Fixed Time Base - Zero Cross

In the fixed time base control method, the selected percentage power level output is generated over a fixed time period (i.e. a fixed number of cycles), regardless of power level selected. Resolution of operator selectable power may be more precise than the fixed time base allows. Selected power output level is rounded to the closest possible power output value in full cycles as necessary.

Line voltage compensation is not used in the fixed time base control method.

Setup Page:
- Enter the Setup Page by holding ± for 2 seconds.
- When the display reads [Algo], press ® until [Off] is displayed. Press ▲▼ to select [ftb] fixed time base, zero cross.
- Press ® until [1sec] is displayed. Press ▲▼ to select [1sec] or [4sec].

Figure 5.1b — 40% power, fixed time base, 60 Hz, 1 sec time base.
Variable Time Base - Zero Cross

In the variable time base control method, an optimal ratio of cycles on to cycles off is used to generate the desired power output. The number of cycles needed to completely generate a desired power level is variable in single cycle increments. Line voltage compensation algorithms are used to adjust the percentage power output while operating in this mode. Variable time base operation gives the best response time and resolution and provides for the longest heater life.

In single cycle variable time base below 50 percent power, the unit is never on for more than one consecutive full cycle. Above 50 percent power, the unit is not off for more than one consecutive full cycle while maintaining the proper output.

Line voltage compensation is active if selected; however, it can be disabled.

DC Contactor - Zero Cross

DC contactor control mode is a specialized version of zero cross control in which the analog control input is always used and percentage power output is fixed at 100 percent or 0 percent.

The off/on thresholds are 2.0V/3.5V for voltage input; 5.0mA/8.0mA for current input. This means the unit is off for an input voltage (current) of 2.0V(5.0mA) or lower, and 100% on for an input voltage (current) of 3.5V(8.0mA) or higher. Maximum input voltage is 10.0V.

In contactor mode use a four second cycle time to improve heater diagnostics operation.

Phase Angle

The phase angle control method gates a limited portion of the line voltage cycle to the load based on percentage power selected. Soft start is always included when phase angle is selected. Phase angle control may not be selected in a 3 phase, 2-leg system.

Line voltage compensation will be used to adjust the percentage power output while operating in this mode if selected.

Current limiting is a valid option with phase angle if the unit is equipped with heater diagnostics.

Setup Page:
- Enter the Setup Page by holding  for 2 seconds.
- When the display reads , press until is displayed. Press to select variable time base, zero cross.

![Figure 5.2a — 50% variable time base](1 cycle on, 1 cycle off.)

![Figure 5.2b — 40% single cycle variable time base](1 cycle on, 1 cycle off, 1 cycle on, 2 cycles off.)

Line voltage compensation is not used under dc contactor control, the output is either 100 percent on or 100 percent off.

Setup Page:
- Enter the Setup Page by holding  for 2 seconds.
- When the display reads , press until is displayed. Press to select dc contactor.

NOTE: Heater Tolerance, Heater Open and Load Balance alarms do not work in DC Contactor control mode.

NOTE: Do not use variable time base settings in the temperature controller to drive a Power Series in contactor mode.

Phase Angle

![Figure 5.2c— Phase angle firing.](Phase angle firing.)

NOTE: The maximum output power is 99%. This is considered full on for the Power Series.)
Soft Start

Soft start is a variation of phase angle control executed on startup in which there is a gradual increase in power until the final selected power output is reached. If soft start is selected, the system will execute the soft start sequence each time a zone starts active control. This happens at power-on and on recovery from an alarm such as “Line Loss.” The soft start time is the time it takes to achieve 100 percent power after a zone restart. The actual time may be greater than the set time because of the resolution, but the actual time will never be less than the set time. Rate = 100.0 ÷ time. The actual power achieved is set by the temperature control input (see Figure 5.3a and 5.4a).

NOTE: Soft start is intended to be used only for slowly increasing power on the initial power request.

Soft start is available in single phase and 3 phase, 3-leg models only.

Soft start is always used in systems with phase angle control mode selected unless [soft] is set to [```0].

Maximum Rate of Change

The maximum rate of change is used during phase angle controlled normal operation (after a soft start sequence ends), to cause large changes in requested power to be implemented gradually. The maximum rate of change of the power is defined as the percentage of power change allowed every 0.1 second. This prevents a sudden increase or decrease in current from one phase angle level to another level from one cycle to the next into a nonlinear load that could be damaged or blow a fuse.

Setup Page:

Adjustable Maximum Rate of Change On Signal Change

1) To begin programming, enter the Setup Page holding ■  ◄ keys for 2 seconds.

2) The control rate is to be set. Press ▲ key until the display reads [SE|E] Press ▼ until [RFR|E] is in lower display. Use the ▲ or ▼ key to set the desired % output change per 0.1 seconds to reach the desired output power level when in phase angle control. The adjustable range is 0.1 to 100.0%.

3) Press ■ key to exit setup page and start the Power Series.

Examples: If the signal changes from 0% to 100%

The power applied to the heater should not change by more than 100.0% every 0.1 second. 100.0% rate setting means it will take 0.1 sec. to go from 0 to 100% power.

The power applied to the heater should not change by more than 50.0% every 0.1 second. 50.0% rate setting means it will take 0.2 sec. to go from 0 to 100% power.

The power applied to the heater should not change by more than 20.0% every 0.1 second. 20.0% rate setting means it will take 0.5 sec. to go from 0 to 100% power.

The power applied to the heater should not change by more than 10% every 0.1 second. 10.0% rate setting means it will take 1.0 sec. to go from 0 to 100% power.

NOTE: The default for Maximum Rate of Change is set to 10%/0.1 second.

NOTE: Repeat this procedure for each zone that you wish to configure.
Heater Bakeout

If a system is shut down for long periods, some heaters can absorb moisture. With a standard power controller, turning the power full "on" when moisture is present, can cause the fuses or the heater to blow. However, with the Power Series you can now "bake out" the moisture in a wet heater before applying full power and destroying the heater. During heater bakeout, the Power Series slowly increases voltage to the heater while monitoring the output current. If the heater achieves full output before the bakeout time expires, then the heater is dry and can be put into service. At all times, the output will not exceed the temperature controller set point.

If the output current reaches a user-specified trip point during the bakeout (as it would if arcing occurred in the heater), then the Power Series shuts off the output and activates an over-current trip error, \[HbOC\]. The operator should then lengthen the bakeout time and restart or just restart, depending on how long the initial bakeout ran. To start heater bakeout you must cycle the controller power. After a successful heater bakeout, the Power Series automatically switches to the operator pre-selected control mode (phase angle or zero cross).

NOTE: Heater bakeout is intended for magnesium oxide filled nichrome elements. A nichrome element heater can have a tolerance up to \(\pm 10\%\). This tolerance could add to the maximum heater current during normal operation. For example, a 50-amp heater could draw 55 amps and still be a good and dry heater.

Heater bakeout may be selected in single phase (phase to neutral) and 3 phase, 6 SCR systems with any pre-selected control mode. You must also have the heater diagnostics option installed on your Power Series.

Heater bakeout operates with an over-current trip. The operator must set the maximum current allowed during heater bakeout using the \[HbOC\] prompt. This will set the maximum allowable load during heater bakeout.

Setup Page:
- Enter the Setup Page by holding \[\text{Setup}\] for 2 seconds.
- When the display reads \[\text{Opt}1\] press \[\text{Set}\] until \[\text{Off}\] is displayed. Press \[\text{Up}\] until \[\text{OFF}\] is displayed.
- Use the \[\text{Up}\] keys to turn heater bakeout on.
- Press \[\text{Up}\] until \[\text{Hbo}\] appears in the lower display. Use the \[\text{Up}\] keys to set the desired heater bakeout time in minutes.
- Press \[\text{Up}\] until \[\text{HbC}\] appears in the lower display. Use the \[\text{Up}\] keys to set the desired maximum load current during the heater bakeout process.

NOTE: Repeat this procedure for each zone that you wish to configure.

---

Heater Tolerance Detection

Heater tolerance detection allows you to detect a failed heater or a heater that is beginning to fail. An alarm is triggered if the load current drops below or rises above specific levels.

For example, if you have five heaters that draw 20 amps each, for a total load current of 100 amps at 100 percent power, you could program the heater tolerance alarm to trigger if the load current drops below 80 amps at 100 percent power. This would indicate that one of the heaters has failed (open.) To monitor for a heater that is beginning to fail or age, you could watch for too little or too much current. For example, in Figure 5.4b the alarm is programmed to trigger if the load current drops below 90 amps, or rises above 110 amps at 100 percent power.

The Power Series automatically adjusts the set points, depending upon the percent power, as shown in the illustration below.

---

Figure 5.4a— Heater bakeout.

Figure 5.4b— Heater Tolerance Detection.
Current Limiting

The current limit uses the RMS current entered by the user. When a zone goes from 0.0% to a requested power greater than 0.0%, the software increments the output power by 0.1% increments per AC cycle until a current limit is detected. The software will continue to increment and decrement by 0.1% per AC cycle based on the current limit until the goal power is met. During normal operation (after the initial goal power is met), a detected current limit will cause decrements at 0.1% power per AC cycle until the current limit is no longer active. The software will continue to increment and decrement by 0.1% per AC cycle based on the current limit, until the goal power is again met.

Current limiting is available on units equipped with heater diagnostics, (P _ _ 1 - _ _ _ _ - _ _ _ _).

Current limiting is not available with 3 phase, 2-leg systems.

Current limiting is available under phase angle control operation.

Setup Page:

- Enter the Setup Page by holding ■ ◀ for 2 seconds.
- When the display reads [ALG], press ▼ until [OPC] [SET] [SET] is displayed. Press ► until [OFF] is displayed. Use the ▲ ◀ keys to turn current limit on.
- Press ► until [CL] appears in the lower display. Use the ▲ ◀ keys to set the desired current limit set point.

NOTE: Repeat this procedure for each zone that you wish to configure.

Inductive Load Adjustment

The effect of inductive loads on current readings with phase angle control can be factored in by requesting an Inductive Load Factor Adjustment. This feature is used to improve current measurement when phase angle firing into a transformer or other inductive loads.

The adjustment should be done with active phase angle control with a requested power of 5% to 50% in the zone of interest using a true RMS current meter.

NOTE: If an inductive load factor has been requested and the load is no longer inductive, the current reading will not be accurate. Use the [CLR] parameter in the [indF] prompt to remove the inductive factor.

Setup Page:

- Press ► until [Cur] appears in the lower display. The upper display shows the current calculated by the system with no inductive factor. Read the actual current measured by a true RMS meter; use the ▲ ◀ keys until that value is displayed.
- Press ◀ until [indF] appears in the lower display. Using the ▲ ◀ keys, select [AC] in the upper display. After 5 seconds, the prompt will read [Err] if the adjustment was successful, or [Err] if there was an error.
- To return to using no Inductive Load Factor, select [CLR].

NOTE: Using the inductive load factor parameter the Power Series displayed current can only be increased to match the current reading of a true RMS meter. The Power Series displayed current reading cannot be decreased below what it initially calculated and displayed. The maximum inductive load factor increase allowed is 50% of the non-inductive current measured initially by the Power Series. If you exceed the allowable adjustment then the Power Series will display [Err] in the upper display and [indF] in the lower display. In the event of an error push the up or down key to [Err] and start the process over.
Other Features

Baseline Voltage and Voltage Compensation

The baseline voltage is used by the controller to adjust the output so that the system power remains constant. This adjustment is called voltage compensation. The requested power is assumed to occur at the baseline voltage. If there are any deviations of the line voltage from the baseline voltage, the applied output power will be adjusted.

For example, the starting line voltage of the system is 121 volts and the baseline voltage is set to 121 volts. The requested power is set to 50.0 percent. After the system has been controlling, the line voltage drops to 110 volts. During the time that the line voltage is at 110 volts, the applied output power will be adjusted to \((121^2/110^2) \times 0.50 = 60.5\) percent so that the system power remains constant.

The baseline voltage is also used for adjusting operating parameters in the software. It is important to adjust the baseline voltage to the normal operating voltage of the unit to enable it to operate at maximum accuracy.

Menu Lock

Menu locks allow a user to restrict access to parameters. If a lock is set on a menu, the parameters become read only. The system will not allow parameter to be changed, either from the keypad or through communications.

Factory Page:

- Enter the Factory Page by holding \(\text{•} \downarrow \uparrow\) for 2 seconds.
- When the display reads \(\text{dReA}\), press \(\downarrow\) until \(\text{Loc}\) is displayed. Press \(\uparrow\) until \(\text{UnL}\) is displayed.

Use Global Lockout \(\text{LOC}\) to write protect all prompts by choosing locked \(\text{LOC}\). If set to unlocked \(\text{UnL}\), individual menu locks can be set by selecting each parameter in the Global/Menu Lockouts Menu and individually setting each to locked \(\text{LOC}\) or unlocked \(\text{UnL}\).

Input

Signal Selection

You need to configure the Power Series for current, voltage or digital.

Setup Page:

- Enter the Setup Page by holding \(\text{•} \downarrow \uparrow\) for 2 seconds.
- When the display reads \(\text{RLGo}\), press \(\downarrow\) until \(\text{CTR} \text{ Sel}\) is displayed. Press \(\uparrow\) until \(\text{In}\) is displayed.

Use the \(\downarrow\uparrow\) keys to select either current \(\text{nnA}\), volt \(\text{VOLT}\), or digital \(\text{DIG}\).

NOTE: Repeat this procedure for each zone that you wish to configure.

Analog is typically 0-5V (dc), 1-5V (dc), 0-10V (dc), 4-20mA.

Digital is used for keypad manual control or communications to control the Power Series.

Digital input is entered from the keypad in the Display Loop on the \(\text{In 1}\), \(\text{In 2}\) or \(\text{In 3}\) prompt.

Current inputs are hardware limited to 0 to 20mA, but may be scaled using the \(\text{nnA}+\) and \(\text{nnA}-\) prompts. Note that the power will be fully off at the current specified by prompt \(\text{nnA}+\) +.2mA, and fully on at the current specified by prompt \(\text{nnA}+\) -.2mA.

Voltage inputs are hardware limited to 0 to 10V, but may be scaled using the \(\text{VOL}+\) and \(\text{VOL}-\) prompts. Note that the power will be fully off at the current specified by prompt \(\text{VOL}+\) +.1V, and fully on at the current specified by prompt \(\text{VOL}+\) -.1V.
Alarms

An alarm takes some action, usually notifying an operator, when a control parameter leaves a defined range. A user can configure how and when an alarm is triggered and whether it turns off automatically when the alarm condition is over. A description of the alarms and errors, why they occur, and how to troubleshoot them can be found on pages A.4 - A.7.

Setup Page:
- Enter the Setup Page holding " for 2 seconds.

Alarm Standard
If an alarm is configured as “standard” [Std], the alarm indicators only occur while the alarm is active. The alarm indicators are the relay, which state is set in Active Relay State [Alg] as either energized on alarm or de-energized on alarm, and the display, which has an indicator LED in the upper display and the descriptive prompt for the active alarm. When the alarm becomes inactive (and no other alarms are active) the alarm indicators are turned off.

Alarm Latched & Unlatching an Alarm Indicator
If an alarm is configured as “latched” [Lat], the alarm indicators remain active until the user deactivates them. For a latched alarm, the descriptive prompt on the display in the Display Loop will read [Lat], and the user can switch to [UnLA], if the alarm is cleared, to turn off the alarm indicators. Once alarm indicators have been turned off, the operator does not have to reconfigure an alarm as latched.

Alarm Silencing
If an alarm is configured as “silenced” [Sil], the relay does not activate on the active alarm, although the display indicators are still visible. When the alarm becomes inactive (and no other alarms are active) the display alarm indicators are turned off.

Alarm Latched and Silenced
If an alarm is configured as “latched and silenced” [LasI], only the display alarm indicators are active until the user deactivates them. The alarm displays must be switched off once the alarm has been cleared. See unlatching an alarm indicator above.

Active Relay State
For maximum flexibility, the Power Series controller can generate alarms from the energized or de-energized state of the relay. Creating an alarm from the de-energized state of the relay is the most reliable method of alarm generation since a power loss or any other control malfunction would cause an alarm.
Communications

Overview

A Power Series controller can also be programmed and monitored by connecting it with a personal computer or programmable logic controller (PLC) via serial communications. To use this communications option, a Power Series must be equipped with an EIA/TIA 232/485 (P_ _ _ - _ _ - _ _ _ _ - 1 _ _ _) communications board.

To view or change controller settings with a personal computer, you need to run software that uses the Modbus™ RTU protocol to read or write to registers in the controller. See Chapter Six, Parameters, for the Modbus registers. These registers contain the parameter values that determine how the controller will function and the values that reflect the current input and output values of the system.

Parameters relating to communications appear in the Comms Menu (Setup Page). Match the Baud Rate [Ra_d] to that of the computer and select an Address [Rddr] (1 to 247, default is 1).

The Power Series supports a maximum read of up to 32 registers. See appendix A.8 for Modbus registers.
Retransmit

Retransmitting Output Load Current or Load Power

The retransmit feature allows an output to retransmit an analog signal that can serve as an input variable for another device such as a chart recorder to document system performance over time.

To use the retransmit feature a Power Series must be equipped with heater diagnostics and a universal retransmit board (P_ 1 - _ _ _ _ - 1 _ _).

Setup Page:
- Enter the Setup Page by holding ± ¬ for 2 seconds.
- When the display reads [algo], press ▼ until [retr] is displayed. Press ▲:
  - Select [CF9] to choose the type of output retransmitted, mA [mna] or volts [UOlt].
  - Select [type] to choose the type of information that will be retransmitted.
    - [nOne] retransmit not active.
    - [Cur] retransmits the load current of selected phase [phas] or zone [zonE] if it is a multizone unit.
    - [HUa] retransmits the load power of selected zone [zonE] in all models.
  - Select phase [phas] or zone [zonE] to choose the phase/zone that will represent your retransmit signal. A three phase unit can only be single zone.

To scale the retransmit output signal, set the low value load current or kVA to be retransmitted with [Cur_] or [HUa_] and set the high value load current or kVA to be retransmitted with [Cur^] or [HUa^]. For example, if you want 4-20mA to represent a 50A to 250A current, set [Cur_] to 50 and [Cur^] to 250. As the load current varies between 50 and 250A, the retransmit output will vary between 4mA and 20mA.

Current outputs are hardware limited to 0 to 20mA, but may be scaled using the [Cur_] and [Cur^] prompts.

Voltage outputs are hardware limited to 0 to 10V, but may be scaled using the [UOlt] and [UOlt^] prompts.

Figure 5.9a — Retransmitting a remote set point.

Figure 5.9b — Example circuit.
Fast Start Guide

Get Your Power Series Controlling Heat

Quick Setup - Single Phase Control

Apply power to the line and the electronics power supply. The displays will read [Load ___]. If line is not connected, you may continue to program but display will show a line alarm and baseline voltage cannot be automatically programmed.

1) To begin programming, enter the Setup Page holding ■ ▼ keys for 2 seconds.
2) The control algorithm is to be set. Press ▲ key until the display reads [SET] [ALGO] then press ▲ key until [ALGO] is in lower display.
   Select one of the following using the ▲ key.
   - cont: dc contactor
   - OFF: non-operational (factory default value)
   - Ft: fixed time base, zero cross
   - Ut: variable time base, zero cross
   - PH: phase angle
   Press ◄ to go back to [SET] [ALGO].

3) The control signal is to be set. Press ▼ key until [SET] [SIGNAL] is displayed.
   Press ▲ key until [IN] is in lower display.
   Using the ▲ key, select input signal type:
   - nA: current (factory default value)
   - Volt: voltage
   - d:9:9: keyboard or comm
   - OFF: off

4) The signal range is to be set or fixed.
   A) For choices of milliampere or volt, press ▲ key until [nA] or [Volt] is in lower display.
      Enter the lower signal range provided using ▲ or ▼ key. Press ▲ key until [nA] or [Volt] is in lower display. Enter the upper signal range provided using ▲ or ▼ key.
   B) For choices of keyboard or comm, press ▲ key until [dft] is in the lower display. Enter the value using the ▲ or ▼ key.

5) The baseline voltage is to be set. Press ▲ key until [BL] is in lower display. Using the ▲ or ▼ key, enter the nominal AC line voltage present at the top of the Power Series (like 120, 480 or 600). Alternatively, you may have the Power Series learn voltage value by pressing the ▲ key to [Learn]. Using the ▲ or ▼ key, select [Ref] and the Power Series will set the baseline voltage to that measured. Line voltage compensation, under voltage alarm, and some internal operating parameters not referenced here are based on this value.

6) Press ■ key to exit setup page and start the Power Series.
7) Other settings may be required based on your application.

Note on navigation: Use ■ ▼ keys to get into the setup page and ■ key to return home or if in the display loop, use to move between like prompts of different zones or phases.
Press ▼ or ▲ key to find a specific menu in a page. The menu appears in the upper display and the page title remains in the lower display.
Press ▲ key to enter the list of parameters in the menu displayed on top. The menu's parameters now will appear in the lower display and the values in the upper display. To navigate backwards through the parameter list, press ◄ key. When back at the page level, again use the ▼ or ▲ key to find a specific menu on a page.
Press ▼ or ▲ to select a value, either alpha or numeric, within a specific parameter while in a menu.
Fast Start Guide

Quick Setup - Three Phase Control
Apply power to the line and the electronics power supply. The displays will read [LOAD ___]. If line is not connected, you may continue to program but display will show a line alarm and baseline voltage cannot be automatically programmed.

1) To begin programming, enter the Setup Page holding ■ ◀ keys for 2 seconds.
2) The control algorithm is to be set. Press ▲ key until the display reads SET ALG0 then press ▶ key until [ALG0] is in lower display.
   Select one of the following using the ▲ key.
   - cont: dc contactor
   - tbb: non-operational (factory default value)
   - ftb: fixed time base, zero cross
   - urt: variable time base, zero cross
   - ph2: phase angle
   Press ◀ to go back to [SET] [ALG0].
3) The control signal is to be set. Press ▼ key until [SEL] [CTR] is displayed.
   Press ▶ key until [In] is in lower display.
   Using the ▲ key, select input signal type:
   - nna: current (factory default value)
   - uolt: voltage
   - dgn: keyboard or comms
   - off: off
4) The signal range is to be set or fixed.
   A) For choices of milliampere or volt, press ▶ key until [nnA_] or [uOL_] is in lower display.
   Enter the lower signal range provided using ▲ or ▼ key. Press ▶ key until [nnA_] or [uOL_] is in lower display. Enter the upper signal range provided using ▲ or ▼ key.
   B) For choices of keyboard or comms, press ▶ key until [dflt] is in the lower display. Enter the value using the ▲ or ▼ key.
5) The baseline voltage is to be set. Press ▶ key until [vl] is in lower display. Using the ▲ or ▼ key, enter the nominal AC line voltage present at the top of the Power Series (like 120, 240 or 600). Alternatively, you may have the Power Series learn voltage value by pressing the ▶ key to [lrn]. Using the ▲ or ▼ key, select [rE9] and the Power Series will set the baseline voltage to that measured. Line voltage compensation, under voltage alarm, and some internal operating parameters not referenced here are based on this value.
6) The load type is to be set. Press ▶ key until [type] is in lower display.
   Using the ▲ key, select load type:
   - 2Ld: 3 ph, 2-leg delta (PC2x-xxxx-xxxx)
   - 2Lod: 3 ph, 2-leg open delta (PC2x-xxxx-xxxx)
   - 2Lw: 3 ph, 2-leg ungrounded wye (PC2x-xxxx-xxxx)
   - ncn: unconfigured (PC2x-xxxx-xxxx, PC3x-xxxx-xxxx, PC4x-xxxx-xxxx)
   - 3Ld: 3 ph, 3-leg, 6 SCR inside delta (PC3x-xxxx-xxxx)
   - 3Ldo: 3 ph, 3-leg, 6 SCR delta or ungrounded wye (PC3x-xxxx-xxxx)
   - 3Ly: 3 ph, 3-leg, 6 SCR grounded wye (PC4x-xxxx-xxxx)
7) Press ■ key to exit setup page and start the Power Series.
8) Other settings may be required based on your application.

Note on navigation: Use ■ ◀ keys to get into the setup page and ■ key to return home or if in the display loop, use to move between like prompts of different zones or phases.
Press ▼ or ▲ key to find a specific menu in a page. The menu appears in the upper display and the page title remains in the lower display.
Press ▶ key to enter the list of parameters in the menu displayed on top. The menu's parameters now will appear in the lower display and the values in the upper display. To navigate backwards through the parameter list, press ◀ key. When back at the page level, again use the ▼ or ▲ key to find a specific menu on a page.
Press ▼ or ▲ to select a value, either alpha or numeric, within a specific parameter while in a menu.
# Display Loop

The resting-state display shows one of the following sets of data, depending on controller setup. The first prompt appears in the top display, the second in the bottom display.

<table>
<thead>
<tr>
<th>Display Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Register read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>System Information</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active Alarms (alpha)</td>
<td>Active (1)</td>
<td>Latched Active (2)</td>
<td>Latched Inactive (3)</td>
<td>Unlatched (4)</td>
</tr>
<tr>
<td>Display Loop Errors (alpha)</td>
<td>Inactive (0)</td>
<td>Active (1)</td>
<td>(See Appendix A.7 for values)</td>
<td>n/a</td>
</tr>
<tr>
<td>Load Activity Indicator</td>
<td>or</td>
<td>per display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line Frequency (Hz)</td>
<td>47 to 63</td>
<td>[47 to 63]</td>
<td>n/a</td>
<td>198 r</td>
</tr>
</tbody>
</table>

## Single Zone / Single Phase

<table>
<thead>
<tr>
<th>Input</th>
<th>Analog (mA or V) or Numeric (%)</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Register read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>or Input Signal</td>
<td>Displays mA/V analog input; selects numeric % power.</td>
<td>0.0 to 2000 [mA] (0 to 2000)</td>
<td>0.0</td>
<td>150 r [mA] 151 r [V] 5102 r/w [dig]</td>
<td>Active: Always. Appears in Display Loop.</td>
</tr>
</tbody>
</table>

0.0 to 1000 [V] (0 to 1000) | 0.0 to 1000 [%] (0 to 1000) | 0.1 increments | | | |
<table>
<thead>
<tr>
<th>Display Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Power (%)</strong></td>
<td>0.0 to 100.0 (0 to 1000)</td>
<td>0.0</td>
<td>159 r</td>
<td>Active: Always. Appears in Display Loop.</td>
</tr>
<tr>
<td><strong>Heater Bakeout Timeout</strong></td>
<td>9999 to 0 (minutes) (9999 to 0)</td>
<td>n/a</td>
<td>157 r [1]</td>
<td>Active if heater diagnostics option is installed and heater bakeout is running in the zone.</td>
</tr>
<tr>
<td><strong>Line Potential (Volts) rms</strong></td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>162 r</td>
<td>Active: Always. Appears in Display Loop.</td>
</tr>
<tr>
<td><strong>Load Current (Amps) rms</strong></td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>164 r</td>
<td>Active if heater diagnostics option is installed.</td>
</tr>
<tr>
<td><strong>Load Power (kVA)</strong></td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>156 r</td>
<td>Active if heater diagnostics option is installed.</td>
</tr>
<tr>
<td><strong>Two Zone, Single Phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Display Zone Selection</strong></td>
<td>1 to 2</td>
<td>1</td>
<td>n/a</td>
<td>Active with multizone configuration.</td>
</tr>
<tr>
<td><strong>Analog (mA or V) or Numeric (%) Input Signal</strong></td>
<td>0.0 to 100.0 (V) (0 to 1000)</td>
<td>0.0</td>
<td>mA, r [1][2]</td>
<td>Active with multizone configuration.</td>
</tr>
<tr>
<td><strong>Output Power (%)</strong></td>
<td>0.0 to 100.0 (0 to 1000)</td>
<td>0.0</td>
<td>159 r [1]</td>
<td>169 r [2]</td>
</tr>
<tr>
<td><strong>Heater Bakeout Timeout</strong></td>
<td>9999 to 0 (minutes) (9999 to 0)</td>
<td>n/a</td>
<td>157 r [1]</td>
<td>167 r [2]</td>
</tr>
</tbody>
</table>

6.2 Watlow Power Series Parameters, Chapter 6
### Display Parameter Range (Modbus Value) Default Modbus Address Conditions for
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Address read/write</th>
<th>Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uol1, Uol2</strong>&lt;br/&gt;Line Potential (Volts) rms</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>152 r [1] 172 r [2]</td>
<td>Active with multizone configuration.</td>
</tr>
<tr>
<td><strong>Cur1, Cur2</strong>&lt;br/&gt;Load Current (Amps) rms</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>154 r [1] 174 r [2]</td>
<td>Active with multizone configuration and heater diagnostics option is installed.</td>
</tr>
<tr>
<td><strong>Hur1, Hur2</strong>&lt;br/&gt;Load Power (kVA)</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>156 r [1] 166 r [2]</td>
<td>Active with multizone configuration and heater diagnostics option is installed.</td>
</tr>
</tbody>
</table>

### Three Zone, Single Phase

<table>
<thead>
<tr>
<th>Display Zone Selection</th>
<th>1 to 3</th>
<th>1</th>
<th>n/a</th>
<th>Active with multizone configuration.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In1, In2, In3</strong>&lt;br/&gt;Analog (mA or V) or Numeric (%) Input Signal Displays mA/V analog input; selects numeric % power.</td>
<td>0 to 2000 mA (0 to 2000)</td>
<td>mA, r[1][2][3]</td>
<td>150, 160, 170</td>
<td>151, 161, 171</td>
</tr>
<tr>
<td><strong>Hbt1, Hbt2, Hbt3</strong>&lt;br/&gt;Heater Bakeout Timeout Displays the time left on a heater bakeout cycle.</td>
<td>9999 to 0 [minutes] (9999 to 0)</td>
<td>n/a</td>
<td>157 r [1] 167 r [2] 177 r [3]</td>
<td>Active if heater diagnostics option is installed and heater bakeout is running in the zone.</td>
</tr>
<tr>
<td><strong>Uol1, Uol2, Uol3</strong>&lt;br/&gt;Line Potential (Volts) rms</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>152 r [1] 162 r [2] 172 r [3]</td>
<td>Active with multizone configuration.</td>
</tr>
</tbody>
</table>

### Notes:
What you see in each Page and in each Menu are factory set, depending on the options and settings in your controller. Current operating parameters may be modified at any time with the use of a keypad or serial input.
The Input Signal Method Indicator will change depending on the Input Signal Method chosen — process, current, or volts.
NOTE: For more information about how parameter settings affect the controller’s operation, see Chapter Five, Control Methods and Features.
### Display Parameter Table

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Cur1], [Cur2], [Cur3]</td>
<td><strong>Load Current (Amps) rms</strong></td>
<td>0.0 to 9999 [A]</td>
<td>n/a</td>
<td>154 r [1]</td>
<td>Active with multizone configuration and heater diagnostics option is installed.</td>
</tr>
<tr>
<td></td>
<td>Read measured line current.</td>
<td></td>
<td></td>
<td>164 r [2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>174 r [3]</td>
<td></td>
</tr>
<tr>
<td>[HUA1], [HUA2], [HUA3]</td>
<td><strong>Load Power (kVA)</strong></td>
<td>0 to 9999 [kVA]</td>
<td>n/a</td>
<td>156 r [1]</td>
<td>Active with multizone configuration and heater diagnostics option is installed.</td>
</tr>
<tr>
<td></td>
<td>Read calculated (est.) load power.</td>
<td></td>
<td></td>
<td>166 r [2]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>176 r [3]</td>
<td></td>
</tr>
</tbody>
</table>

#### Multi-Phase

| In | Analog (mA or V) or Numeric (%) Input Signal | 0.0 to 2000 [mA] (0 to 2000) | 0.0 | 151 r [V] | Active: Always. Appears in Display Loop. |
|    | Displays mA/V analog input; selects numeric % power. |                      |         | 150 r [mA] |                                                                                                  |
| Out | Output Power (%) | 0.0 to 10000 [%] (0 to 1000) | 0.0 | 159 r | Active: Always. Appears in Display Loop. |
| PhAS | Display Phase Selection 1 to 3 | 1 to 3 | n/a |     | Active with multiphase configuration. 3-ph, 2 leg models do not show **PhAS**. |
| Uol1, Uol2, Uol3 | **Line Potential (Volts) rms** | 0.0 to 9999 [V] (0 to 9999) | n/a | 152 r [1] | Active with multiphase configuration. 3-ph, 2 leg models do not show **Uol2**.          |
|         | Read measured line voltage. |                      |         | 162 r [2] |                                                                                                  |
|         |                                |                      |         | 172 r [3] |                                                                                                  |
| Cur1, Cur2, Cur3 | **Load Current (Amps) rms** | 0.0 to 9999 [A] (0 to 9999) | n/a | 154 r [1] | Active with multiphase configuration and heater diagnostics option is installed. 3-ph, 2 leg models do not show **Cur2**. |
|         | Read measured line current. |                      |         | 164 r [2] |                                                                                                  |
|         |                                |                      |         | 174 r [3] |                                                                                                  |
| HUA | Load Power (kVA) | 0 to 9999 [kVA] (0 to 9999) | n/a | 156 r | Active with multiphase configuration and heater diagnostics option is installed. |

**NOTE:** In 3 phase, 2-leg systems, **Cur2** is the current displayed; it is the average of phase 1 and phase 3 (**Cur1** and **Cur3**).
Setup Page

To enter the Setup Page, press the Home and Left keys ( ■  ◀ ) together while in the Display Loop. Each of the following menus in the Factory Page are selected by pressing the Increment/Decrement keys ( ▲  ▼ ). Each press of the button will scroll you up or down through these main menu options.

To select a parameter within a menu, use the Left/Right arrow keys ( ◀  ▶ ). The parameter appears in the bottom display.

To select a value for each parameter (either alpha or numeric), use the Increment/Decrement keys ( ▲  ▼ ). The value appears in the upper display.

Pressing the Home key (■ ) in this menu will return you to the Display Loop.

The Setup Page contains ten menus:

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Register read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>Setup Page Select</td>
<td>Control Algorithm</td>
<td>✔️</td>
<td>✔️</td>
<td>*NOTE: These menus are dependent on the hardware options that are installed in your controller. Please see the individual menus for the options that must be installed for each of these menus to appear.</td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>Control Zone 1</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>*Options Zone 1</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>Control Zone 2</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>*Options Zone 2</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>Control Zone 3</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>*Options Zone 3</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>Alarms</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>Configuration</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>*Comms</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>Configurations</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>✔️</td>
<td>Setup Control Algorithm</td>
<td>*Retransmit</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

This menu is used to set the control algorithm for the system. NOTE: Changing the algorithm will restart the system.

Power Control Algorithm Select
Select power control algorithm.

Fixed Time Base (See)
Set the fixed time base in seconds for selected zone.

NOTE: For more information about how parameter settings affect the controller's operation, see Chapter Five, Control Methods and Features.
### Display Parameter Range Default Modbus Conditions for Parameters to Appear

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UC</strong> Line Voltage Compensation</td>
<td><strong>ON</strong> on (0)</td>
<td><strong>ON</strong> on (0)</td>
<td>80 r/w</td>
<td>Active: Always.</td>
</tr>
</tbody>
</table>

Automatically adjusts output duty cycle to compensate for line voltage fluctuations. Occurs for requested power from 5% to 95% and only applies to variable time base or phase angle control methods.

Setup Control Zone 1, 2, and 3 Menus

**Setup Page**

*This menu is used to set up the control for the chosen zone.*

**Zone 1** is used if Input/Output Configuration is single phase, single zone, or three phase.

**Zone 1 and 2** are used if Input/Output Configuration is single phase, two zones.

**All zones are used if Input/Output Configuration is single phase, three zones.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In</strong> Input Signal Method Select (dig, mA, Volt)</td>
<td><strong>OFF</strong> off (0)</td>
<td><strong>nnR</strong> current (1)</td>
<td>5101 r/w [1]</td>
<td>Active: Always.</td>
</tr>
</tbody>
</table>

Select the input signal method for chosen zone.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>dFL</strong> Default Numeric Input Signal (%)</td>
<td>0% 0 percent to 1000 100 percent (0 to 1000)</td>
<td>0% (0)</td>
<td>5103 r/w [1]</td>
<td>Active if input signal method is set to <strong>dFL</strong>.</td>
</tr>
</tbody>
</table>

Selects the power-on level for chosen zone.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>nnR</strong> Analog Input Low Current (mA)</td>
<td>0.00 to <strong>nnR</strong> [0 to mA high -5mA]</td>
<td>0.00 (0)</td>
<td>5011 r/w [1]</td>
<td>Active if <strong>In</strong> is set to <strong>nnR</strong> current.</td>
</tr>
</tbody>
</table>

Sets current value which will correspond to 0% power if input is current type.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>nnR</strong> Analog Input High Current (mA)</td>
<td><strong>nnR</strong> [+ 5mA] to 9999 [low mA + 5mA to mA 9999]</td>
<td>2000 (2000)</td>
<td>5012 r/w [1]</td>
<td>Active if <strong>In</strong> is set to <strong>nnR</strong> current.</td>
</tr>
</tbody>
</table>

Sets current value which will correspond to 100% power if input is current type.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uol</strong> Analog Input Low Voltage (Volts)</td>
<td>0.00 to <strong>Uol</strong> [- 2.5V] [0 to V high -2.5V]</td>
<td>0.00 (0)</td>
<td>5013 r/w [1]</td>
<td>Active if <strong>In</strong> is set to <strong>Uol</strong> voltage.</td>
</tr>
</tbody>
</table>

Sets voltage value which will correspond to 0% power if input is voltage type.
<table>
<thead>
<tr>
<th>Display Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Register read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>[REQ]</td>
<td>3 ph, 2-leg delta (0)</td>
<td>3 ph, 2-leg open delta (1)</td>
<td>3 ph, 2-leg ungrounded wye (2)</td>
<td>3 ph, 3-leg, 6 SCR inside delta (4)</td>
</tr>
<tr>
<td>NOTE: The parameters available are dependent on the controller’s input/output configuration. The system does not operate unless this prompt is set to something other than [nonE].</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NOTE: Changing this parameter will restart the system.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: For more information about how parameter settings affect the controller’s operation, see Chapter Five, Control Methods and Features.
### Setup Options Zones 1, 2, and 3 Menus

**Setup Page**

This menu is used to set up the options for the chosen zone. This set of menus is available only if Heater Diagnostics is installed.

**Zone 1** is used if Input/Output Configuration is single phase, single zone, or three phase. **Zone 1 and Zone 2** are used if Input/Output configuration is single phase, two zones. **All zones** are used if Input/Output Configuration is single phase, three zones.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>Maximum Rate of Change (%/100msec)</td>
<td>0.0 to 1000 (0.0 to 100.0%) [.1% increments] (1 to 1000)</td>
<td>0.0 (100)</td>
<td>5104/r/w [1], 5204/r/w [2], 5304/r/w [3]</td>
<td>Active unless Input/Output configuration is 3 phase, 2-leg, or if [AL9] is set to [Ph2].</td>
</tr>
<tr>
<td>Soft</td>
<td>Soft Start Time (Sec)</td>
<td>0.0 to 1200 (0.0 to 120 seconds [.1 second increments]) (0 to 1200)</td>
<td>40 (40)</td>
<td>5105/r/w [1], 5205/r/w [2], 5305/r/w [3]</td>
<td>Active unless Input/Output configuration is 3 phase, 2-leg, or if [AL9] is set to [Ph2].</td>
</tr>
<tr>
<td>Soft</td>
<td>Reactance Delay for Transformer Loads</td>
<td>0.0 to 500 (0 to 500)</td>
<td>0.0 (0)</td>
<td>5108/r/w</td>
<td>Active if [AL9] is set to [Ph2] and [Type] is set to [3Ld] or [3Lld].</td>
</tr>
<tr>
<td>Heater</td>
<td>Bakeout Select (On/Off)</td>
<td>OFF (0) to On (1)</td>
<td>OFF (0) to On (1)</td>
<td>5110/r/w [1], 5210/r/w [2], 5310/r/w [3]</td>
<td>Active if heater diagnostics is installed. Active unless controller is 3 phase, 2 leg configuration.</td>
</tr>
<tr>
<td>heater</td>
<td>Bakeout Select Time</td>
<td>0 to 9999 (0 to 9999 minutes [1 minute increments]) (0 to 9999)</td>
<td>1440 minutes (1440)</td>
<td>5111/r/w [1], 5211/r/w [2], 5311/r/w [3]</td>
<td>Active if heater diagnostics is installed. Active unless controller is 3 phase, 2 leg configuration.</td>
</tr>
<tr>
<td>heater</td>
<td>Bakeout Over Current Trip</td>
<td>0 to Load Current Amps (1 Amp increment; maximum will be determined by Load Rating) (0 to Load Current Amps)</td>
<td>10.0% of load current</td>
<td>5116/r/w [1], 5216/r/w [2], 5316/r/w [3]</td>
<td>Active if heater diagnostics is installed. Active unless controller is 3 phase, 2 leg configuration.</td>
</tr>
</tbody>
</table>

**Note:**
- Display [Rate] requires [AL9] set to [Ph2] and [Type] set to [3Ld] or [3Lld].
- [Soft] is active if Input/Output Configuration is 3 phase, 2-leg.
- [Soft] requires [AL9] set to [Ph2].
- [Soft] requires [Type] set to [3Ld] or [3Lld].
- [Soft] is active if Input/Output Configuration is 3 phase, 2-leg.
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Limit Select (On/Off)</td>
<td>0</td>
<td>OFF off (0)</td>
<td>OFF off (0)</td>
<td>5112 r/w [1]</td>
<td>Active if heater diagnostics is installed.</td>
</tr>
<tr>
<td></td>
<td>On</td>
<td>0</td>
<td>5212 r/w [2]</td>
<td>5312 r/w [3]</td>
<td></td>
</tr>
<tr>
<td>Current Limit Set Point (A)</td>
<td>0 to 20</td>
<td>0 to Load Current Amps</td>
<td>10.0% of load current</td>
<td>5113 r/w [1]</td>
<td>Active if heater diagnostics is installed.</td>
</tr>
<tr>
<td></td>
<td>0 to 20</td>
<td>0 to Load Current Amps</td>
<td>5213 r/w [2]</td>
<td>5313 r/w [3]</td>
<td></td>
</tr>
<tr>
<td>Low Tolerance Set Point (A)</td>
<td>0 to 20</td>
<td>0 to High Tolerance Set Point</td>
<td>0 (0)</td>
<td>5114 r/w [1]</td>
<td>Active if heater diagnostics is installed.</td>
</tr>
<tr>
<td></td>
<td>0 to 20</td>
<td>0 to High Tolerance Set Point</td>
<td>5214 r/w [2]</td>
<td>5314 r/w [3]</td>
<td>This set point will only be used if the requested power is above 20%.</td>
</tr>
<tr>
<td>High Tolerance Set Point (A)</td>
<td>0 to 20</td>
<td>0 to maximum system current</td>
<td>maximum system current</td>
<td>5115 r/w [1]</td>
<td>Active if heater diagnostics is installed.</td>
</tr>
<tr>
<td></td>
<td>0 to 20</td>
<td>0 to maximum system current</td>
<td>5215 r/w [2]</td>
<td>5315 r/w [3]</td>
<td>This set point will only be used if the requested power is above 20%.</td>
</tr>
<tr>
<td>Inductive Load Factor Request</td>
<td>-1</td>
<td>invalid request</td>
<td>idle (0)</td>
<td>5106 r/w [1]</td>
<td>Active if heater diagnostics is installed.</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>idle (0)</td>
<td>5206 r/w [2]</td>
<td>5306 r/w [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>request inductive load factor adjustment</td>
<td>1 amp increments</td>
<td>5107 r/w [1]</td>
<td>Active if heater diagnostics is installed.</td>
</tr>
<tr>
<td></td>
<td>1 amp increments</td>
<td>1 amp increments</td>
<td>5207 r/w [2]</td>
<td>5307 r/w [3]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>active load factor adjustment</td>
<td>1 amp increments</td>
<td>5108 r/w [1]</td>
<td>Active unless Input/Output configuration is 3 phase, 2-leg.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>active load factor adjustment</td>
<td>5208 r/w [2]</td>
<td>5308 r/w [3]</td>
<td>Active if heater diagnostics is set to Ph2E.</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>clears factor</td>
<td>1 amp increments</td>
<td>5109 r/w [1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>clears factor</td>
<td>5209 r/w [2]</td>
<td>5309 r/w [3]</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Control Methods and Features.
## Setup Alarms Configuration Menu

**Setup Page**

This menu is used to set up the alarm configuration. For a definition of the alarm types — standard, latched, silenced, latched and silenced, see page 5.7.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>🔒 Active Relay State</td>
<td>energized on alarm (0)</td>
<td><strong>Active: Always.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>de-energized on alarm (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒 Global Alarm Configuration</td>
<td>all alarms active (0)</td>
<td><strong>Active: Always.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>silenced (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched and silenced (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>off (4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒 Heater Open Alarm Config.</td>
<td>active (0)</td>
<td><strong>Active if heater diagnostics is installed.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>silenced (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched and silenced (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒 Heater Tolerance Alarm Config.</td>
<td>active (0)</td>
<td><strong>Active if heater diagnostics is installed.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>silenced (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched and silenced (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒 Heat Sink Over Temperature Alarm Config.</td>
<td>active (0)</td>
<td><strong>Active if</strong> <strong>[gLb]</strong> <strong>is set to OFF.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>silenced (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched and silenced (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒 Heat Sink Over Temperature Alarm Temperature</td>
<td>Value equal to <strong>[SaC]</strong> or less. User adjustable. See Factory Menu for actual safety shutdown temp.</td>
<td><strong>Active: Always.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>Output will de-energize at this heatsink shut down temperature (degrees C). The default maximum temperature is model number dependent.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒 Line Loss Alarm Configuration</td>
<td>active (0)</td>
<td><strong>Active if</strong> <strong>[gLb]</strong> <strong>is set to OFF.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>silenced (2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>🔒</td>
<td>latched and silenced (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Watlow Power Series Parameters, Chapter 6
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P bRL</strong></td>
<td>Phase Balance Alarm Config.</td>
<td>active (0)</td>
<td><strong>Std</strong> active (0)</td>
<td>864 r/w</td>
<td>Active if controller is 3 phase, 3-leg configuration. Active if <code>glbl</code> is set to <code>OFF</code>.</td>
</tr>
<tr>
<td><strong>LbRL</strong></td>
<td>Load Balance Alarm Config.</td>
<td>active (0)</td>
<td><strong>Std</strong> active (0)</td>
<td>865 r/w</td>
<td>Active if heater diagnostics is installed. Active if <code>glbl</code> is set to <code>OFF</code>. Active if controller is 3 phase.</td>
</tr>
<tr>
<td><strong>Ld :F</strong></td>
<td>Load Balance Percentage</td>
<td>0 to 100</td>
<td>0 (0 to 100)</td>
<td>991 r/w</td>
<td>Active if heater diagnostics is installed. Active if controller is 3 phase.</td>
</tr>
<tr>
<td><strong>Fr EQ</strong></td>
<td>Frequency Out of Tolerance Alarm Configuration</td>
<td>active (0)</td>
<td><strong>Std</strong> active (0)</td>
<td>866 r/w</td>
<td>Active if <code>glbl</code> is set to <code>OFF</code>.</td>
</tr>
<tr>
<td><strong>UC</strong></td>
<td>Voltage Compensation Alarm Config.</td>
<td>active (0)</td>
<td><strong>Std</strong> active (0)</td>
<td>867 r/w</td>
<td>Active if <code>glbl</code> is set to <code>OFF</code>.</td>
</tr>
<tr>
<td><strong>OU</strong></td>
<td>Over Voltage Alarm Config.</td>
<td>active (0)</td>
<td><strong>Std</strong> active (0)</td>
<td>868 r/w</td>
<td>Active if <code>glbl</code> is set to <code>OFF</code>.</td>
</tr>
<tr>
<td><strong>C bJD</strong></td>
<td>Comms Watchdog Alarm Config.</td>
<td>active (0)</td>
<td><strong>Std</strong> active (0)</td>
<td>869 r/w</td>
<td>Active if communications is installed. Active if <code>glbl</code> is set to <code>OFF</code>.</td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Control Methods and Features.
### Setup Comm Configuration Menu

**Setup Page**

This menu is used to set up the communications parameters. This menu is not available unless Serial Communications is installed.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Register read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addr</td>
<td>Unit Address Select</td>
<td><img src="image" alt="1 to 247" /></td>
<td><img src="image" alt="1" /></td>
<td></td>
<td>Active if serial communications option is installed.</td>
</tr>
<tr>
<td>brd</td>
<td>Unit Baud Rate Select</td>
<td><img src="image" alt="1200 baud" />, <img src="image" alt="2400 baud" />, <img src="image" alt="4800 baud" />, <img src="image" alt="9600 baud" /></td>
<td><img src="image" alt="9600 baud" /></td>
<td></td>
<td>Active if serial communications option is installed.</td>
</tr>
<tr>
<td>ljd</td>
<td>Watchdog Select (On/Off)</td>
<td><img src="image" alt="off (0)" />, <img src="image" alt="on (1)" /></td>
<td><img src="image" alt="off (0)" /></td>
<td></td>
<td><img src="image" alt="85 r/w" /> Active if serial communications option is installed.</td>
</tr>
<tr>
<td>sec</td>
<td>Watchdog Timeout (Sec)</td>
<td><img src="image" alt="0 to 9999" /></td>
<td><img src="image" alt="9999" /></td>
<td></td>
<td><img src="image" alt="86 r/w" /> Active if serial communications option is installed and <img src="image" alt="on" />.</td>
</tr>
<tr>
<td>ljr</td>
<td>Watchdog Failure Output Power Select</td>
<td><img src="image" alt="0 percent" />, <img src="image" alt="100 percent" /></td>
<td><img src="image" alt="0 percent" /></td>
<td></td>
<td><img src="image" alt="87 r/w" /> Active if serial communications option is installed and <img src="image" alt="on" />.</td>
</tr>
</tbody>
</table>

### Setup Retransmit Configuration Menu

**Setup Page**

This menu is used to set up the retransmit parameters. The menu is not available unless Retransmit and Heater Diagnostics are installed.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Register read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfr</td>
<td>Retransmit Config. Select</td>
<td><img src="image" alt="mA (0)" />, <img src="image" alt="volts (1)" /></td>
<td><img src="image" alt="mA (0)" />, <img src="image" alt="volts (1)" /></td>
<td></td>
<td><img src="image" alt="870 r/w" /> Active if retransmit and heater diagnotics options are installed.</td>
</tr>
<tr>
<td>type</td>
<td>Retransmit Type Select</td>
<td><img src="image" alt="OFF none (0)" />, <img src="image" alt="CUR current (1)" />, <img src="image" alt="HUA kVA (2)" /></td>
<td><img src="image" alt="CUR current (1)" />, <img src="image" alt="HUA kVA (2)" /></td>
<td></td>
<td><img src="image" alt="871 r/w" /> Active if retransmit and heater diagnotics options are installed.</td>
</tr>
<tr>
<td>Display</td>
<td>Parameter</td>
<td>Range (Modbus Value)</td>
<td>Default</td>
<td>Modbus Register read/write</td>
<td>Conditions for Parameters to Appear</td>
</tr>
<tr>
<td>---------</td>
<td>-----------</td>
<td>----------------------</td>
<td>---------</td>
<td>---------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>PHR5</td>
<td>Retransmit Phase Select</td>
<td><img src="image1" alt="Image" /> phase 1 (1) <img src="image2" alt="Image" /> phase 2 (2) <img src="image3" alt="Image" /> phase 3 (3)</td>
<td><img src="image4" alt="Image" /> phase 1 (1)</td>
<td>872 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if controller is three phase. Active if <img src="image5" alt="Image" /> <img src="image6" alt="Image" /> is set to <img src="image7" alt="Image" /> or <img src="image8" alt="Image" />.</td>
</tr>
<tr>
<td>ZONE</td>
<td>Retransmit Zone Select</td>
<td><img src="image9" alt="Image" /> zone1 (1) <img src="image10" alt="Image" /> zone2 (2) <img src="image11" alt="Image" /> zone3 (3)</td>
<td><img src="image12" alt="Image" /> zone1 (1)</td>
<td>873 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if controller is multi zone. Active if <img src="image13" alt="Image" /> <img src="image14" alt="Image" /> is set to <img src="image15" alt="Image" /> or <img src="image16" alt="Image" />.</td>
</tr>
<tr>
<td>CUR-</td>
<td>Minimum Amps Retransmit</td>
<td><img src="image17" alt="Image" /> to <img src="image18" alt="Image" /> (0 to Maximum Amps Retransmit)</td>
<td><img src="image19" alt="Image" /> (0)</td>
<td>876 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image20" alt="Image" /> <img src="image21" alt="Image" /> is set to <img src="image22" alt="Image" />.</td>
</tr>
<tr>
<td>CUR+</td>
<td>Maximum Amps Retransmit</td>
<td><img src="image23" alt="Image" /> to <img src="image24" alt="Image" /> load current (Minimum Amps Retransmit to load current)</td>
<td><img src="image25" alt="Image" /> load current</td>
<td>877 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image26" alt="Image" /> <img src="image27" alt="Image" /> is set to <img src="image28" alt="Image" />.</td>
</tr>
<tr>
<td>HUR-</td>
<td>Minimum kVA Retransmit</td>
<td><img src="image29" alt="Image" /> to <img src="image30" alt="Image" /> (0 to Maximum kVA Retransmit)</td>
<td><img src="image31" alt="Image" /> (0)</td>
<td>878 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image32" alt="Image" /> <img src="image33" alt="Image" /> is set to <img src="image34" alt="Image" />.</td>
</tr>
<tr>
<td>HUR+</td>
<td>Maximum kVA Retransmit</td>
<td><img src="image35" alt="Image" /> (Minimum kVA Retransmit to 9999) <img src="image36" alt="Image" /> (9999)</td>
<td><img src="image37" alt="Image" /> (9999)</td>
<td>879 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image38" alt="Image" /> <img src="image39" alt="Image" /> is set to <img src="image40" alt="Image" />.</td>
</tr>
<tr>
<td>RKL</td>
<td>Retransmit Output Low Current (mA)</td>
<td><img src="image41" alt="Image" /> (0 to Retransmit Output High Current)</td>
<td><img src="image42" alt="Image" /> (0)</td>
<td>882 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image43" alt="Image" /> is set to <img src="image44" alt="Image" />.</td>
</tr>
<tr>
<td>RKH</td>
<td>Retransmit Output High Current (mA)</td>
<td><img src="image45" alt="Image" /> (Retransmit Output Low Current to 2000)</td>
<td><img src="image46" alt="Image" /> (2000)</td>
<td>883 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image47" alt="Image" /> is set to <img src="image48" alt="Image" />.</td>
</tr>
</tbody>
</table>

NOTE: For more information about how parameter settings affect the controller's operation, see Chapter Five, Control Methods and Features.
### Factory Page

To enter the Factory Page, press the Home, Left and Right keys (➡️ ⬅️ ⬅️) together while in the Setup Page. Each of the following menus in the Factory Page are selected by pressing the Increment/Decrement keys (▲ ▼). Each press of the button will scroll you up or down through these main menu options.

To select a parameter within a menu, use the Left/Right arrow keys (⬅️ ➡️). The parameter appears in the bottom display.

To select a value for each parameter (either alpha or numeric), use the Increment/Decrement keys (▲ ▼). The value appears in the upper display.

Pressing the Home key (■) in this menu will return you to the Display Loop.

The Factory Page contains nine menus.

The Factory Mode parameters of the Factory Page are used for calibration of the Power Series. Since the Power Series is precalibrated at the factory; field calibration may only be necessary in the event that field service work is performed. Field calibration procedures are available at Watlow’s website, http://www.watlow.com/.

*NOTE: To enter the Factory Mode requires a password. Call Watlow at +1 (507) 454-5300, and ask an applications engineer for this password. Once the password is entered, the controller is in Factory Mode. The controller’s power must be cycled to exit the Factory Mode.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="retr U." /></td>
<td>Re transmit Output Low Voltage (Volts)</td>
<td>0.000 to <img src="image" alt="retr U." /> (0 to Retransmit Output High Voltage)</td>
<td>0.00 (0)</td>
<td>880 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image" alt="CFG" /> is set to <img src="image" alt="Uolt" />.</td>
</tr>
<tr>
<td><img src="image" alt="retr U." /></td>
<td>Re transmit Output High Voltage (Volts)</td>
<td><img src="image" alt="retr U." /> to 1.000 (Retransmit Output Low Voltage to 1000)</td>
<td>1.00 (1000)</td>
<td>881 r/w</td>
<td>Active if retransmit and heater diagnostics options are installed. Active if <img src="image" alt="CFG" /> is set to <img src="image" alt="Uolt" />.</td>
</tr>
</tbody>
</table>

---

**Factory Page**

**Go to a factory menu.**

**Requires factory password to access calibration parameters.**

**System Data Manipulation**

**Global/Menu Lockouts**

**Unit Information**

**Diagnostics**

**Factory Password**

**Calibrate Analog Input Signal Zone 1**

**Calibrate Analog Input Signal Zone 2**

**Calibrate Analog Input Signal Zone 3**

**Calibrate Retransmit**
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Backup Data Set</strong></td>
<td>no backup requested (0)</td>
<td>951 r/w</td>
<td>Active: Always.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Default Data Set</strong></td>
<td>disable restore (0)</td>
<td>952 r/w</td>
<td>Active: Always.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Restore Data Set</strong></td>
<td>disable restore (0)</td>
<td>950 r/w</td>
<td>Active: Always.</td>
</tr>
</tbody>
</table>

**System Data Manipulation Menu**

*NOTE: These prompts (Backup, Default, and Restore Data Set) allow the user to manipulate the EEPROM contents. See Appendix, p. A.7, for more information.*

**Factory Page**

This menu is used to maintain the standard and backup system data.

- **Backup Data Set**: Stores appropriate user configurable parameters into backup memory. See page A.7 for Power Series Backup information.
- **Default Data Set**: Sets the appropriate parameters to the factory default values. See page A.7 for Power Series Backup information.
- **Restore Data Set**: Restores the appropriate user configurable parameters from backup memory. See page A.7 for Power Series Backup information.

*NOTE: See “Backup Data Set” above for description of the Modbus values 0 - 5.*
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>mLOC</td>
<td>Enable NVOL Storage</td>
<td>enable (0)</td>
<td>OFF (1)</td>
<td>959 r/w</td>
<td>Active: Always.</td>
</tr>
<tr>
<td></td>
<td>Enable/disable non-volatile memory.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L LOC</td>
<td>Global/Menu Lockouts Menu</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Factory Page</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>This menu is used to set the lockout parameters. Locked means that the parameters in the menu cannot be changed.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gLOC</td>
<td>Global Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (1)</td>
<td>1350 r/w</td>
<td>Active: Always.</td>
</tr>
<tr>
<td></td>
<td>Sets the state of global lockout which allows all prompts to be write protected. If set to unlocked, individual menu locks can be set.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C t r</td>
<td>Control Setup Menus Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1351 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on all control setup menus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O pt</td>
<td>Options Setup Menus Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1352 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on all options setup menus.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A l r</td>
<td>Alarms Setup Menu Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1353 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on alarm configuration menu.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C O m t</td>
<td>Comms Setup Menu Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1354 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on communications menu.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>r E r</td>
<td>Retransmit Setup Menu Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1355 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on retransmit menu.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c A n</td>
<td>Analog Input Factory Menus Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1356 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on input calibration menu.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c r E r</td>
<td>Retransmit Cal Factory Menu Lockout</td>
<td>Unlocked (0)</td>
<td>Unloc (0)</td>
<td>1357 r/w</td>
<td>Active if gLOC is set to Unloc.</td>
</tr>
<tr>
<td></td>
<td>Sets lock on retransmit calibration menu.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Display Parameters

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address read/write</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>System Data Factory Menu Lockout</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Diagnostics Factory Menu Lockout</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
</tr>
</tbody>
</table>

### Unit Information Menu

#### Factory Page

This menu is used to read unit information that is stored during manufacture.

<table>
<thead>
<tr>
<th><img src="image.png" alt="Image" /></th>
<th>Unit Serial Number High Digits</th>
<th><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> (0 to 9999)</th>
<th><img src="image.png" alt="Image" /></th>
<th><img src="image.png" alt="Image" /></th>
<th><img src="image.png" alt="Image" /> r</th>
<th><img src="image.png" alt="Image" /></th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Unit Serial Number Low Digits</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> (0 to 9999)</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /> r</td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Manufactured Date (ymmh)</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> year (00 to 99)</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> month (00 to 52)</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Hardware Version</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> (0 to 9999)</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /> r</td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Software Version</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> (0 to 9999)</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /> r</td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Software Build Number</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> (0 to 9999)</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /> r</td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td>Unit Voltage Rating (Volts)</td>
<td><img src="image.png" alt="Image" /> to <img src="image.png" alt="Image" /> (0 to 680)</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /> r</td>
<td><img src="image.png" alt="Image" /></td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Control Methods and Features.
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>4R8A</td>
<td>Unit Current Rating (Amps)</td>
<td>0 to 245 (0 to 245)</td>
<td>n/a</td>
<td>50 r</td>
<td>Active: Always.</td>
</tr>
<tr>
<td>20NC</td>
<td>Number Zones Configured</td>
<td>n/a</td>
<td>52 r</td>
<td></td>
<td>Active: Always.</td>
</tr>
<tr>
<td>OPc</td>
<td>Configuration Installed Options</td>
<td>n/a</td>
<td>54 r</td>
<td></td>
<td>Active: Always.</td>
</tr>
<tr>
<td>6C</td>
<td>Heat Sink Temp (*C)</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>1590 r</td>
<td>Active: Always.</td>
</tr>
<tr>
<td>8Lc</td>
<td>Heat Sink Alarm Temp</td>
<td>0 to 5dc (0 to 9999)</td>
<td>n/a</td>
<td>990 r/w</td>
<td>Active: Always. Same as alarm temp in Setup Menu.</td>
</tr>
<tr>
<td>5dc</td>
<td>Factory Safety Shutdown Temp</td>
<td>Factory set.</td>
<td>n/a</td>
<td>57 r</td>
<td>Active: Always.</td>
</tr>
<tr>
<td>HlC</td>
<td>Record High Heat Sink Temp</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>1591 r</td>
<td>Active: Always.</td>
</tr>
<tr>
<td>H-5H</td>
<td>Accum Hours (10K - 100M)</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>1960 r</td>
<td>Active: Always. Masked if hours &lt;10000</td>
</tr>
<tr>
<td>H-5H</td>
<td>Accum Hours (0 - 9999)</td>
<td>0 to 9999 (0 to 9999)</td>
<td>n/a</td>
<td>1961 r</td>
<td>Active: Always.</td>
</tr>
</tbody>
</table>
### Diagnostics Menu

**Factory Page**

This menu is to select diagnostics.

<table>
<thead>
<tr>
<th>Rd</th>
<th>Select A/D Channel</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects an analog to digital channel to read.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ad</th>
<th>Select A/D Channel</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Selects an analog to digital channel to read.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Read Selected A/D Counts</th>
<th>0 to 4095</th>
<th>n/a</th>
<th>n/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reads the selected analog to digital channel.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Line Loss Alarms:**
The following nine parameters indicate line loss alarms that have occurred since power was last cycled. The parameters will only appear if there has been a line loss alarm and only for the line/s on which a line loss alarm has occurred. They will continue to appear until power is cycled again.

<table>
<thead>
<tr>
<th>L_A1</th>
<th>Most Recent Line Loss Alarm Type</th>
<th>(1) under voltage</th>
<th>(0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicates which phase 1, 2 or 3 experienced the alarm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L_A2</th>
<th>Previous Line Loss Alarm Type</th>
<th>(2) extra zero cross</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(4) no zero cross</td>
<td>(8) invalid line polarity</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>L_A3</th>
<th>Least Recent Line Loss Alarm Type</th>
<th>(16) no zero cross</th>
<th>(32) invalid frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(64) load half cycle loss</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| L_ = | Indicates which phase 1, 2 or 3 experienced the alarm | | |
|      | | | |

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Control Methods and Features.
Factory Mode

The Factory Mode parameters of the Factory Page are used for calibration of the Power Series. Since the Power Series is precalibrated at the factory, field calibration may only be necessary in the event that field service work is performed. Field calibration procedures are available at Watlow’s website, http://www.watlow.com/.

NOTE: To enter the Factory Mode requires a password. Call Watlow at +1 (507) 454-5300, and ask an applications engineer for this password. Once the password is entered, the controller is in Factory Mode. The controller’s power must be cycled to exit the Factory Mode.
### Watlow Power Series Parameters

**Calibrate Analog Input Signal Zones 1, 2, and 3 Menus**

**Factory Page**

This menu is used to set up the analog inputs.

**Input 1** is used if Input/Output Configuration is single phase, single zone or three phase.

**Input 1 and Input 2** are used if Input/Output Configuration is single phase, two zones.

**All zones** are used if Input/Output Configuration is single phase, three zones.

---

**NOTE:** Care should be taken to allow a buffer between each of the settings and their respective hardware limits to prevent unexpected operation because of noise or signal variations.

---

**Low mA Cal Point**

Sets the low current value for the corresponding analog input calibration.

<table>
<thead>
<tr>
<th>Range (Modbus Value)</th>
<th>Default (0000)</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000 to 9999 [or 9999 whichever is smaller]</td>
<td>0000</td>
<td>5411 r/w</td>
<td>Active if in factory mode.</td>
</tr>
</tbody>
</table>

---

**High mA Cal Point**

Sets the high current value for the corresponding analog input calibration.

<table>
<thead>
<tr>
<th>Range (Modbus Value)</th>
<th>Default (16000)</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low mA Cal Point to 20000</td>
<td>16000</td>
<td>5412 r/w</td>
<td>Active if in factory mode.</td>
</tr>
</tbody>
</table>

---

**Low V Cal Point**

Sets the low voltage value for the corresponding analog input calibration.

<table>
<thead>
<tr>
<th>Range (Modbus Value)</th>
<th>Default (1000)</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to High V Cal Point</td>
<td>1000</td>
<td>5413 r/w</td>
<td>Active if in factory mode.</td>
</tr>
</tbody>
</table>

---

**High V Cal Point**

Sets the high voltage value for the corresponding analog input calibration.

<table>
<thead>
<tr>
<th>Range (Modbus Value)</th>
<th>Default (9000)</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low V Cal Point to 9999</td>
<td>9000</td>
<td>5414 r/w</td>
<td>Active if in factory mode.</td>
</tr>
</tbody>
</table>

---

**Calibrate Analog Input Request**

Request analog input signal calibration.

<table>
<thead>
<tr>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>Err</code> invalid calibration (-1)</td>
<td><code>dLE</code> calibration inactive (0)</td>
<td>5415 r/w</td>
<td>Active if in factory mode.</td>
</tr>
<tr>
<td><code>req</code> enables calibration request (1)</td>
<td></td>
<td>5425 r/w</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** The values entered in the preceding prompts are used with the corresponding analog to digital counts. The parameter `Err` will be displayed if the calibrations fails; otherwise the parameter will return to `dLE`.

---

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.

---

Watlow Power Series

Parameters 6.21
### Calibrate Retransmit Menu

**Factory Page**

*This menu is used to calibrate the retransmit output. This menu is available if Retransmit is installed.*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range (Modbus Value)</th>
<th>Default</th>
<th>Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rtr</strong> Re transmit Cal mA Low</td>
<td>Selects the low current value for retransmit cal.</td>
<td><strong>UOL</strong> to <strong>UOL</strong> [or <strong>999</strong> whichever is smaller] (0 to Retransmit Cal mA High [or 9999])</td>
<td><strong>4000</strong> (4000)</td>
<td>5710 r/w</td>
<td>Active if in factory mode. Active if retransmit option is installed.</td>
</tr>
<tr>
<td><strong>Rtr</strong> Re transmit Cal mA High</td>
<td>Set the high current value for retransmit cal.</td>
<td><strong>Rtr</strong> to <strong>2000</strong> (Retransmit Cal mA Low to 20000)*</td>
<td><strong>16000</strong> (16000)</td>
<td>5711 r/w</td>
<td>Active if in factory mode. Active if retransmit option is installed.</td>
</tr>
<tr>
<td><strong>UOL</strong> Re transmit Cal Volts Low</td>
<td>Set the low voltage value for retransmit cal.</td>
<td><strong>UOL</strong> to <strong>UOL</strong> (0 to Retransmit Cal Volts High)</td>
<td><strong>1000</strong> (1000)</td>
<td>5720 r/w</td>
<td>Active if in factory mode. Active if retransmit option is installed.</td>
</tr>
<tr>
<td><strong>UOL</strong> Re transmit Cal Volts High</td>
<td>Set the high voltage value for retransmit cal.</td>
<td><strong>UOL</strong> to <strong>9999</strong> (Retransmit Cal Volts Low to 9999)</td>
<td><strong>9000</strong> (9000)</td>
<td>5721 r/w</td>
<td>Active if in factory mode. Active if retransmit option is installed.</td>
</tr>
<tr>
<td><strong>Cal</strong> Cal Retransmit Request</td>
<td>Request a retransmit calibration.</td>
<td><strong>Err</strong> invalid calibration (-1) <strong>dLE</strong> calibration inactive (0) <strong>-E9</strong> enables calibration request (1)</td>
<td><strong>dLE</strong> calibration inactive (0)</td>
<td>5700 r/w</td>
<td>Active if in factory mode. Active if retransmit option is installed.</td>
</tr>
</tbody>
</table>

*NOTE: The display prompts are set to two decimal places because of the resolution of the display. The comms registers are set and stored with three decimal places of resolution.*

---

**NOTE:** For more information about how parameter settings affect the controller's operation, see Chapter Five, Features.
# Troubleshooting

## All Units

<table>
<thead>
<tr>
<th>Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No LED Display</strong></td>
<td>• Controller power not present.</td>
<td>• Insure that the unit is plugged in and the power is on.</td>
</tr>
<tr>
<td></td>
<td>• Display not seated properly.</td>
<td>• Check the display to make sure it is flush with plastic.</td>
</tr>
<tr>
<td></td>
<td>• Bent or broken pins.</td>
<td>• Pull off the display and check the connection pins; repair or replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Faulty (malfunctioning) unit.</td>
<td>• Return the unit to the factory for repair.</td>
</tr>
<tr>
<td><strong>Display Locked</strong></td>
<td>• System error.</td>
<td>• Record error and address the cause of the error.</td>
</tr>
<tr>
<td></td>
<td>• System error (no problem found).</td>
<td>• Record error and cycle controller power. If the problem persists, contact factory for assistance.</td>
</tr>
<tr>
<td></td>
<td>• System error not displayed.</td>
<td>• Cycle controller power. If the problem persists, contact factory for assistance or return the unit to the factory for repair.</td>
</tr>
<tr>
<td></td>
<td>• Alarm.</td>
<td>• Record alarm and address the cause of the alarm.</td>
</tr>
<tr>
<td></td>
<td>• Alarm (no problem found).</td>
<td>• Record alarm and cycle controller power. If the problem persists, contact factory for assistance.</td>
</tr>
<tr>
<td><strong>No Heat</strong></td>
<td>• Heater or load wire is not connected.</td>
<td>• Check the load or load wire; connect if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Blown fuse.</td>
<td>• Check the fuses and replace any if necessary.</td>
</tr>
<tr>
<td></td>
<td>• [(\text{SE})] &gt; [(\text{ALG}\text{9})] is set to [(\text{OFF})].</td>
<td>• See page 6.5 to set power control algorithm.</td>
</tr>
<tr>
<td></td>
<td>• Incorrect input wiring.</td>
<td>• Check the input wiring and ensure that it is connected properly. (See pages 3.2-3.3 for wiring.)</td>
</tr>
<tr>
<td></td>
<td>• Line not connected or off, or the voltage is too low. Controller will indicate [(\text{AL}	ext{L}\text{L}\text{L}	ext{R})] (Line Loss Alarm)</td>
<td>• Be careful to not over heat anything.</td>
</tr>
<tr>
<td></td>
<td>• Internal malfunction (core PCB, open SCR, gate drive inoperative, core to power supply and LM connection, power supply and line monitor PCB not seated properly on SCR).</td>
<td>• Insure that line power is connected and is on at the appropriate voltage.</td>
</tr>
<tr>
<td></td>
<td>• Return the unit to the factory for repair.</td>
<td>• Return the unit to the factory for repair.</td>
</tr>
<tr>
<td><strong>Partial Heat</strong></td>
<td>• Line input voltage low.</td>
<td>• Insure that line power is connected and is on at the appropriate voltage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Return the unit to the factory for repair.</td>
</tr>
<tr>
<td><strong>Full or Partial Uncontrollable Heat</strong></td>
<td>• Shorted SCR.</td>
<td>• If the controller has heater diagnostics installed, a shorted SCR will cause an error and shut down the remaining good SCRs. Return the unit to the factory for repair.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If the controller does not have heater diagnostics installed, if output power (% [(\text{Out})] reads [(\text{00})]) and there is power to the heater, the SCR is shorted; return the unit to the factory for repair.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Input out of calibration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Internal malfunction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Return the unit to the factory for repair.</td>
</tr>
</tbody>
</table>
**All Units (continued)**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent Nuisance Fuse Blowing</td>
<td>• Improper fuse current rating.</td>
<td>• Refer to page 2.1; insure the fuses have the correct current rating.</td>
</tr>
<tr>
<td></td>
<td>• Fuses improperly torqued.</td>
<td>• Refer to page A.6 for guidelines on proper torquing of fuses.</td>
</tr>
<tr>
<td></td>
<td>• Inadequate ventilation or cooling in the cabinet.</td>
<td>• Refer to page 2.3 for enclosure guidelines and how to determine how much cooling is required.</td>
</tr>
<tr>
<td></td>
<td>• Intermittent short in heater.</td>
<td>• Replace heater.</td>
</tr>
</tbody>
</table>

**Single Phase Units**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Heat</td>
<td>• Power not routed through the internal bussbar. Controller will indicate [ALR L INE] (Line Loss Alarm)</td>
<td>If power is not routed through or connected to the internal bussbar, Ref. 2 must be connected to another line or to neutral. (See page 3.4 for wiring.)</td>
</tr>
</tbody>
</table>

**Multizone Units**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Heat</td>
<td>• Reference not connected.</td>
<td>Reference connections to other lines or neutral must be made appropriately for each zone. (See page 3.5 for wiring.)</td>
</tr>
<tr>
<td>No current monitor on the display.</td>
<td>• Two phases are 180° out of phase of each other.</td>
<td>When using the multizone feature, the 2 or 3 zones should be wired so that no two phases are 180° out of phase. See wiring diagram page 3.5, Figure 3.5C.</td>
</tr>
</tbody>
</table>

**3 Phase, 2-Leg Units**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Heat</td>
<td>• Power not routed through the internal bussbar. Controller will indicate [ALR L INE]. Load Type Select [TYPE] for 3 phase is set to unconfigured [none].</td>
<td>If power is not routed through or connected to the internal bussbar, Ref. 1 or 3 (not both) must be connected to middle line. (See page 3.4 for wiring.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In the Setup Page, Setup Control Zone 1 menu, select the load type for Zone 1.</td>
</tr>
</tbody>
</table>

**3 Phase, 3-Leg Units**

<table>
<thead>
<tr>
<th>Indication</th>
<th>Probable Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Heat</td>
<td>• Reference is not connected for 3 phase, 3-leg grounded wye unit.</td>
<td>• For 3 phase, 3 grounded wye models only, reference connections must be connected to neutral. (See page 3.5 for wiring.)</td>
</tr>
<tr>
<td></td>
<td>• Load Type Select [TYPE] for 3 phase is set to unconfigured [none].</td>
<td>• In the Setup Page, Setup Control Zone 1 menu, select the load type for Zone 1.</td>
</tr>
<tr>
<td></td>
<td>• Inductive load causing half cycle line loss errors [hCYL]. Reactance delay [rdLy] is set too low.</td>
<td>• Increase [rdLy] value until the half cycle line loss errors no longer occur.</td>
</tr>
<tr>
<td>Phase angle control ramps output power up, develops a [hCYL] error and shuts down</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Troubleshooting Alarms and Errors

<table>
<thead>
<tr>
<th>Alarm / Error</th>
<th>Condition For Alarm or Error To Occur</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alarms</strong></td>
<td>Any alarms that are active will be represented in binary. As an example, if a Comms Watchdog and a Phase Balance Alarm exists, Modbus register 180 will contain 0x0210. Comms Watchdog = 0000001000000000 Phase Balance = 0000000000010000</td>
</tr>
<tr>
<td><strong>Heater Open Alarm</strong></td>
<td>Alarm will occur when ≤ 2amps is detected (as measured by the Power Series) for &gt; 20% requested power.</td>
</tr>
<tr>
<td><strong>Heater Tolerance Alarm</strong></td>
<td>Alarm will occur when the load current detected is less than the value set in the Setup Page &gt; Options Menu &gt; toL or is greater than the value set in toL-. This will accomplish both the overcurrent condition alarm and the heater failure low current alarm. This will only occur if requested power is greater than 20 percent.</td>
</tr>
<tr>
<td><strong>Heat Sink Over Temperature Alarm</strong></td>
<td>Alarm will occur when the heat sink temperature is greater than the value set in the Setup Page &gt; <strong>AL</strong> &gt; [<strong>AL</strong>]&lt;.</td>
</tr>
<tr>
<td><strong>Line Loss Alarm</strong></td>
<td>Alarm will occur when the zero cross signal does not occur. Caused by loss of line polarity, zero cross or voltage level signal. Also caused by zero cross timing out of tolerance. This alarm will also occur when line voltage is &lt; one-half baseline voltage.</td>
</tr>
<tr>
<td><strong>Phase Balance Alarm</strong></td>
<td>Alarm will occur when measured voltage of one phase of a 3 phase, 3-leg system is &gt; 20% different from any other.</td>
</tr>
<tr>
<td><strong>Load Balance Alarm</strong></td>
<td>Alarm will occur when the load current is determined to be out of balance. User specified in the Setup Page &gt; [<strong>AL</strong>] &gt; [<strong>ld</strong>]&lt;. Default to 100%.</td>
</tr>
<tr>
<td><strong>Frequency Out of Tolerance Alarm</strong></td>
<td>Alarm will occur if frequency is not within 47 to 63 Hz.</td>
</tr>
<tr>
<td><strong>Line Compensation Alarm</strong></td>
<td>Alarm will occur if the voltage compensation routines cannot compensate for input line voltage changes; occurs for requested power from 5% to 95%, ur,b, Ph2,k control if [<strong>UL</strong>] = [<strong>ON</strong>].</td>
</tr>
<tr>
<td><strong>Line Over Voltage Alarm</strong></td>
<td>Alarm will occur if the line voltage is greater than the maximum rated voltage of the device. Caused by line voltage being over line voltage rating +10%.</td>
</tr>
<tr>
<td><strong>Communications Watchdog Alarm</strong></td>
<td>Alarm will occur if no communications is detected for time specified in [<strong>OU</strong>]&lt; Watchdog timeout. Not available unless Serial Communications is installed.</td>
</tr>
<tr>
<td>Shut-down</td>
<td>Auto Recovery</td>
</tr>
<tr>
<td>----------</td>
<td>--------------</td>
</tr>
<tr>
<td>See individual alarms below.</td>
<td>See individual alarms below.</td>
</tr>
<tr>
<td>No</td>
<td>181 r/w (0-4)*</td>
</tr>
<tr>
<td>No</td>
<td>182 r/w (2) (0-4)*</td>
</tr>
<tr>
<td>No</td>
<td>183 r/w (4) (0-4)*</td>
</tr>
<tr>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Yes if ( L_2 \rightarrow ) Yes</td>
<td>185 r/w (0-4)*</td>
</tr>
<tr>
<td>Yes if ( L_1 \rightarrow ) Yes</td>
<td>186 r/w (0-4)*</td>
</tr>
<tr>
<td>No</td>
<td>187 r/w (0-4)*</td>
</tr>
<tr>
<td>No</td>
<td>188 r/w (0-4)*</td>
</tr>
<tr>
<td>No</td>
<td>189 r/w (0-4)*</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

*Inactive - 0, Active - 1, Latched Active - 2, Latched Inactive - 3, Unlatched - 4
Analog to digital failure error.

**Alarm / Error** | **Condition For Alarm or Error To Occur**
--- | ---
**Err** | System Errors
| Any system-level errors that are active will be represented in binary. As an example, if the power source is losing half cycles and an over temperature condition exists, Modbus register 195 will contain 0x00C0. Over temperature Error = 0000000001000000 Half Cycle Loss = 0000000010000000
| Heater Bakeout Overcurrent = 0x0001
| SCR Short = 0x0002
| System Configuration = 0x0004
| AD Reference Fail = 0x0008
| Checksum Error = 0x0010
| Ram Error = 0x0020
| Over Temperature Error = 0x0040
| Half Cycle Loss = 0x0080
| Phase Rotation = 0x0100

**Err** | Heater Bakeout Overcurrent Error
| Error will occur when the maximum heater current during heater bakeout has been exceeded.

**Err** | Shorted SCR Error
| The shorted SCR error is detected by measuring current when the SCR is de-energized and comparing this reading to the current measured when the SCR is energized. A shorted SCR error is activated if the de-energized current reading is at least 10A and 25% or more of the energized current reading.

**Err** | Analog to Digital Failure Error
| Analog to digital failure error.

**Err** | Checksum Error
| Invalid checksum in non-volatile memory error.

**Err** | Ram Error
| Error will occur when RAM failure is detected.

**Err** | Over Temperature Error
| Error will occur when heat sink temperature is greater than factory shutdown temperature $S_d^C$.

**Err** | Half Cycle Line Loss Error
| Error will occur if a load half cycle loss is detected during five consecutive zone restart attempts.

**Err** | Phase Rotation Error
| Incorrect phasing. Error will occur on a three-phase system with a 3Ld load or on a multizone (PC8 and PC9) operating on a three-phase power supply under phase angle control if the phasing is incorrect. Must be A,B,C phase rotation (CW).

---

**Checking and Replacing Fuses**

Ensure that all high voltage power is off. Slide the fuse cover down. Using an ohmmeter, measure the dc resistance of the fuse to determine if it is open. (Typical dc resistance is less than 1 ohm.) If fuse is open, replace it by removing the old fuse using a 1/2 inch socket and a #3 Phillips screwdriver. Be careful not to drop washers off the bolt or screw ends. If they have dropped into the case, shake them out gently.

The bolt will have 2 washers. The bottom machine screw will have 2 or 3 washers, depending on the size of the SCR in the unit. **It is important that the washers are replaced in the exact order in which they were removed.** Take care installing the fuse so that its orientation matches the image that is printed on the PC board.

With the new Cooper Bussman fuse in the unit, torque the bolt to 44 inch-pounds and the screw as follows: For models PXX-F20X-XXXX and PXX-N20X-XXXX torque to 26 in.-lbs. (2.93 Nm.). For models PXX-F25X-XXXX, PXX-N25X-XXXX, PXX-F30X-XXXX, PXX-F35X-XXXX, and PXX-N30X-XXXX, torque to 44 in.-lbs. (4.95 Nm.). Close fuse cover. If unit was taken off the wall, observe all terminal torque specs when reconnecting wires. Unit should now be ready to resume operation. Reapply power to the controller and line/load terminals.

---

**Figure A.6 — Fuse location.**

Note: The fuse must be a Cooper Bussman to retain SCCR rating.
Power Series Backup

There are three prompts which allow the user to manipulate the EEPROM contents: Backup Data Set, Default Data Set, and Restore Data Set. Each of these prompts have a choice of `all`, `sys`, `n1`, `n2`, or `n3`.

There are two sets of data stored in the controller; the first is the User EEPROM and it is what is read on every power on. The second is the Backup EEPROM.

The Default Data Set prompt will update the chosen configuration parameters in the User EEPROM to values that are listed in the manual as default. It will update the chosen input and retransmit calibration parameters in the User EEPROM to the values that are stored in the Backup EEPROM by the factory.

The Backup Data Set prompt will update the chosen configuration parameters in the Backup EEPROM from the current values stored in the User EEPROM. It will NOT overwrite the calibration parameters.

The Restore Data Set prompt will update the chosen configuration parameters in the User EEPROM from the current values stored in the Backup EEPROM. It will NOT overwrite the calibration parameters.

<table>
<thead>
<tr>
<th>Shutdown</th>
<th>Auto Recovery</th>
<th>Modbus Number</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r</td>
<td>See individual errors below for recommendations.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (1)</td>
<td>It's likely the heater is too wet for heater bakeout time selected. Increase heater bakeout time, cycle power to restart heater bakeout process.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (2)</td>
<td>Check output with test instrument while Power (%) is at 0%. If there is an output, return to the factory for a new SCR. If there is no output, check current calibration.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (4)</td>
<td>Cycle control power. If problem persists, return to factory for repair.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (8)</td>
<td>Cycle control power. If problem persists, return to factory for repair.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (16)</td>
<td>Cycle control power. If problem persists, return to factory for repair.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (32)</td>
<td>Cycle control power. If problem persists, return to factory for repair.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (64)</td>
<td>Provide more cabinet ventilation or cooling. Check the fan; if faulty, return to factory for repair. Check to see that the heat sink is clean. Cycle control power to clear error. Return to factory for SCR voltage drop and thermistor evaluation.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (128)</td>
<td>Line voltage is losing half cycles or SCR is not gating properly. If load is inductive, increase r until error no longer occurs. Cycle control power to clear error.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>195 r, (256)</td>
<td>Three phase power is connected with incorrect phasing. Swap any two incoming phases. Cycle control power to clear error message.</td>
</tr>
</tbody>
</table>

Appendix Watlow Power Series
### Modbus Register Numbers

#### Relative Parameter Numbers (For Absolute Numbers, add 40001 to the Relative Number.)

<table>
<thead>
<tr>
<th>Register Number</th>
<th>Parameter Description</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unit Serial Number High Digits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Unit Serial Number Low Digits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Software Version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Manufactured Date (yymm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Hardware Version</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Software Build Number</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Unit Current Rating (Amps)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Unit Voltage Rating (Volts)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Number Zones Configured</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hardware Configured Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Configuration Installed Options</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Power Control Algorithm Select</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Fixed Time Base (Sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Factory Safety Shutdown Temp</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Load Type Select (Control Zone 1 only, 3 Phase only.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Load Power (kVA) Zone 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Heater Bakeout Timeout Zone 1</td>
<td></td>
<td></td>
<td></td>
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<td>Retransmit Type Select</td>
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#### Additional Devices

- **Retransmit Type Select**
- **870 Retransmit Config. Select**
- **869 Comms Watchdog Alarm Configuration**
- **870 Retransmit Config. Select**
- **871 Retransmit Type Select**
  
**Appendix**
Specifications

Power Bases
- Single phase, (2 SCRs)
- 3 phase, 2-leg control, (4 SCRs)
- Resistive load only, zero cross firing only
- 3 phase, 3-leg control, (6 SCRs)
- 3 phase, 3-leg control, (6 SCRs) for 4 wire wye loads
- Multizone, two and three single phase zones

Output Control Options
- Zero cross contactor, \( V = (dc) \) input
- Zero cross control, fixed time base
- Time base 1 or 4 seconds with digital programmer
- Zero cross control, variable time base
- Phase angle control and phase angle control with current limit (not for 3 phase, 2-leg models)
- Soft start factory default 4 seconds upon power-up, and adjustable from 0.0 to 120 seconds
- Soft start upon input signal change, output rate of change adjustable to limit max rate of change from 0.1 to 100% per 0.1 second. Factory default 10%.
- Current transformer included when required
- Line voltage compensated (variable time base and phase angle controllers only)
- Standby or non-operational mode

Output Voltage and Current Rating
- 24V~(ac) to 120V~(ac) (+10%, -15%)
- 200V~(ac) to 480V~(ac) (+10%, -15%)
- 200V~(ac) to 600V~(ac) (+10%, -15%)
- 65 through 250 amps per pole, model dependent; see Output Amperage Chart and Rating Curves
- Minimum load 1 amp rms ac
- Typical leakage current 5mA
- SCCR 200kA with fusing recommendations on page 3.6.

Alarms
- Single alarm relay
- Latching or non-latching
- Alarm silencing (inhibit) on power up for alarm
- Alarm indication LEDs, shorted SCR, open heater, fuse
- Electromechanical relay, form C contact, software configurable
- Minimum load current 10mA @ 5V=(dc)
- Rated resistive loads: 3 amps @ 250V=(dc) max., inductive load rating 1.5 amps with a power factor ≥ 0.4 without contact suppression

Heater Bakeout
- For single phase (phase to neutral) and 3 phase 6 SCR models only (not for 3 phase, 2-leg models)
- Soft start with over current trip, runs until programmed bakeout time expires, then goes zero cross or phase angle firing. Factory default of 24 hours.
- Adjustable 0 - 9999 minutes with over current trip
- Internal current transformer included

Command Signal Input
Analog
- DC contactor 3.5 to 10V=(dc), must turn off at 2.5V=(dc)
- Field selectable linear voltage and current of high and low points within 0-20mA and 0-10V=(dc)
- Manual control through front panel
- Factory default 0-20mA input
- Voltage input impedance 11kΩ nominal
- Current input impedance 1000Ω nominal

Digital
- On-board digital programmer/display and optional serial communications
- Field selectable and scalable within 0-20mA, 800Ω maximum load or 0-10V=(dc), 1KΩ minimum load.
- The default is 4-20mA.
- Resolution: mA ranges = 5µA nominal
  \( V=(dc) \) ranges = 2.5mV nominal
- Calibration accuracy:
  \( V=(dc) \) ranges = ±20µA
- Temperature Stability: 100ppm°C

Digital Programmer/Display and Communications Capabilities
- Programming functions
  - Adjust input and output control type, alarms and soft start.
  - Heater bakeout and current limit prompts also.
- Monitoring functions
  - Display input and output values along with actual output current
  - Data retention of digital programmer/display upon power failure via nonvolatile memory

Serial Communications
- RS-232 for single drop control
- EIA-485 for single or multidrop control
- 32 units maximum can be connected. With additional 485 repeater hardware, up to 247 units may be connected
- Isolated
- Modbus™ RTU protocol
- 1200, 2400, 4800, 9600, 19200 baud rates
- Data format 8 data bits, no parity, one stop bit

Controller Power Supply
- Universal line voltage input range 100 to 240V~(ac) (+10%, -15%) @ 55VA maximum
- 50/60Hz ± 5% line frequency independent
- Controller line voltage for electronic power supply can be run on separate line voltage

Natural Convection and Fan Cooled Models
- Cabinet venting may be required
- Power Dissipation (Watts)
  - Approximately 1.25 watts/amp per controlled leg
- Isolation
  - Command signal to load and line/load to ground
  - 2200V~(ac) minimum
- On-board semiconductor fuses provide SCR protection
- Mounting
  - Back panel mount on F35 models
  - Other amperage ratings: Removable mounting plate
  - Heat sink fins must be mounted in vertical orientation

High Current Terminals
- Touch safe
- 3/8 inch Allen head compression terminals will accept #6 AWG to 350 MCM wire. Allen wrench adapter (included) for 3/8 inch socket, or 10 mm, 6 point only.
- Wire strip to 30 mm (1-1/8 inch)

Controller Terminals
- Touch safe
- 2.5 mm (1/8 inch) blade screwdriver, accepts 12-22 AWG or 2 No.
- Wire strip to 6 mm (0.24 inch)
- Requires 90C wire insulation rating on line and load terminals.

Operating Environment
- 50°C (122°F) base rating
- 0 to 60°C (32 to 140°F) fan cooled
- 0 to 65°C (32 to 149°F) natural convection cooled
- 0 to 90% RH, non-condensing
- Meets EN50178, Pollution degree 3

Storage Temperature
- -40 to 85°C (-40 to 185°F)

Dimensions
- Width x height x depth 191 mm x 354 mm x 200 mm on N20 through F30 models (7.5 in x 14.0 in x 7.9 in)
- 337 mm x 421 mm x 234.1 mm on F35 models (13.3 in x 16.6 in x 9.2 in)

Fan
- 120 V~(ac), 50/60 Hz, 14/12W, 0.20/0.16A on F35 models

Shipping Weight
- 10.3 kg. (23 lbs.) on N20 through F30 models
- 17.2 kg. (38 lbs.) on F35 models

Agency Approvals
- UL 508 and C-UL listed, file #E73741
- CE marked, see Declaration of Conformity on page A.14

Appendix Watlow Power Series A.9
Ordering Information
(1528)

To order, complete the code number to the right with the information below:

Power Series = Microprocessor-Based Solid State Power Controller

Package Style
C = 65 to 250 Amps

Phase
1 = 1-phase
2 = 3-phase, 2-leg control (4 SCRs)
3 = 3-phase, 3-leg control (6 SCRs)
4 = 3-phase, 4-wire, wye connected load
8 = 2 single-phase zones (specify 01 or 03 for Custom)
9 = 3 single-phase zones (specify 01 or 03 for Custom)

Heater Diagnostics (includes current limit)
0 = None
1 = Heater Diagnostics (Current Limiting and Heater Bakeout are only available on single-phase and 3-phase, 3-leg Controllers)

Output Amperage Rating
(See Amperage Chart below; insert code number here.)

Output Voltage Rating
A = 24 to 120V~
B = 200 to 480V~
C = 200 to 600V~

Communications
0 = None
1 = EIA/TIA 232/485 communications, isolated (field selectable)

Feedback/Retransmit
0 = None
1 = Load current feedback (0 to 10V or 0 to 20mA scalable retransmit output) (Must have heater diagnostics selected.)

Custom
00 = None
AA = No Watlow logo with agency approval marks
AB - ZZ = Custom, consult factory for options
01 = Select for PC8 or PC9 using single-phase power supply, Watlow logo
03 = Select for PC8 or PC9 using multi-phase power supply, Watlow logo

Amperage Chart @ 50°C (122°F)

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<th>3 Single Phase Zones</th>
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<td>N25</td>
<td>140A</td>
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NOTE: User documentation may be available in French, German, Spanish, Italian, and Dutch, as well as English. Check Watlow's website (www.watlow.com/) for availability.

NOTE: See semiconductor fuses and holders on pages 2.1 and 3.6.
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A.12  Appendix  Watlow Power Series
Declaración de Conformidad

Power Series Power Controller

WATLOW Electric Manufacturing Company
1241 Bundy Blvd.
Winona, MN 55987 USA

Declares that the following products:

Designation: Power Series Power Control
Model Numbers: PC (1, 2, 3, 4, 8 or 9)(0 or 1) – (N or F)(20, 25 or 30)(A, B or C) – (0 or 1)(0 or 1)
any two letters or numbers.
Classification: Power Control, Installation Category III, Pollution degree 3, IP00
Unit Supply: 100-240 V~ (85 – 264)(ac), 50 or 60 Hz, 60 VA
Load Supply: 24 to 600 V~ (ac), 50 or 60 Hz, 65 to 250 A depending on model.

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

EN 61326-1: 2013 Electrical equipment for measurement, control and laboratory use – EMC requirements (Industrial Immunity, Class A¹,², ⁵ Emissions)
Not for use in a Class B environment without additional filtering.
EN 61000-4-2:2009 Electrostatic Discharge Immunity
EN 61000-4-3:2010 Radiated Field Immunity 10V/m 80 MHz - 1GHz, 3V/m 1.4GHz-2.7GHz
EN 61000-4-4:2012 Electrical Fast-Transient / Burst Immunity
EN 61000-4-6:2014 Conducted Immunity
EN 61000-4-11:2004 Voltage Dips, Short Interruptions and Voltage Variations
EN 61000-3-2:2009 Harmonic Current Emissions⁴
EN 61000-3-3:2013 Voltage Fluctuations and Flicker (Unit Supply)
EN 61000-3-11:2000 Voltage Fluctuations and Flicker³ (Load Supply)

NOTES
¹Use of an external filter is required to comply with conducted emissions limits. See note 5 below.
²A Line Impedance Stabilization Network (LISN) was used for conducted emissions measurements.
³To comply with flicker requirements will require a reduced source impedance.
⁴Phase angle control mode will not pass harmonics, burst fire control mode meets requirements.

2006/95/EC Low-Voltage Directive

These devices contain lead solder and are not RoHS compliant.
They are Industrial Control Devices and fall outside the scope of 2011/65/EU Directive.

⁵Required External EMI Filters for Power Series with More Than 6 Amp Loads
An external ElectroMagnetic Interference (EMI) filter must be used in conjunction with the Power Series for loads in excess of six amperes (6A) at 150 to 250 KHz. Watlow has verified that the following tank filters will suppress EMI created by SCR power controllers to comply with the conducted emissions limits.

<table>
<thead>
<tr>
<th>Description</th>
<th>Crydom Filter</th>
<th>Watlow Filter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-Phase 230 V~ (ac)</td>
<td>1F25</td>
<td>14-0019</td>
</tr>
<tr>
<td>Three-Phase 440 V~ (ac)</td>
<td>3F20</td>
<td>14-0020</td>
</tr>
</tbody>
</table>

Watlow Power Series
WARNING:
Tank filters may suppress desirable communications carried on power lines in the 150 to 250 KHz region. The filters may suppress carrier current such as that used for infant monitors and medical alert systems. Verify that suppressed carrier current or other desirable communications on power lines creates no hazard to people or property.

WARNING:
All filter installation and wiring must be performed by qualified personnel and conform to local and national electrical codes. Failure to observe this warning could result in damage to property, and or injury to death for personnel.

In-line power filters have been shown to properly suppress EMI; however, these filters must be rated for the entire load current and are generally more expensive than the tank filter specified. An In-line filter may be required if carrier current communications are used on site.

Joe Millanes
Name of Authorized Representative
Winona, Minnesota, USA
Place of Issue
September 2014
Date of Issue

Directory of Operations
Title of Authorized Representative
Signature of Authorized Representative
**Power Series Software Map**

**Display Loop**

(See the Power Series User's Manual)

### Setup Page

**Control Algorithm**
- Power Control Algo Select
- Fixed Time Base
- Line Voltage Comp

**Control Zone 1**
- Input Signal Method Select
- Default Numeric Input Sig
- Set Analog Input Lo Cur
- Set Analog Input Hi Cur
- Set Analog Input Lo Volt
- Set Analog Input Hi Volt
- Learn Input Learn Req
- Baseline Volt Read/Adj
- Baseline Volt Learn Req
- Load Type Select
- Max Rate of Change
- Soft Start Time

**Options Zone 1**
- Heater Bakeout Select
- HBO Select Time
- HBO Current Trip
- Cur Limit Select
- Cur Limit Set Point
- Lo Tol Set Point
- Hi Tol Set Point
- Induct Load Factor Req
- Inductive Current

**Control Zone 2**
- Input Signal Method Select
- Default Numeric Input Sig
- Set Analog Input Lo Cur
- Set Analog Input Hi Cur
- Set Analog Input Lo Volt
- Set Analog Input Hi Volt
- Learn Input Learn Req
- Baseline Volt Read/Adj
- Baseline Volt Learn Req
- Max Rate of Change
- Soft Start Time

**Options Zone 2**
- Heater Bakeout Select
- HBO Select Time
- HBO Current Trip
- Cur Limit Select
- Cur Limit Set Point
- Lo Tol Set Point
- Hi Tol Set Point
- Induct Load Factor Req
- Inductive Current

**Control Zone 3**
- Input Signal Method Select
- Default Numeric Input Sig
- Set Analog Input Lo Cur
- Set Analog Input Hi Cur
- Set Analog Input Lo Volt
- Set Analog Input Hi Volt
- Learn Input Learn Req
- Baseline Volt Read/Adj
- Baseline Volt Learn Req
- Max Rate of Change
- Soft Start Time

**Options Zone 3**
- Heater Bakeout Select
- HBO Select Time
- HBO Current Trip
- Cur Limit Select
- Cur Limit Set Point
- Lo Tol Set Point
- Hi Tol Set Point
- Induct Load Factor Req
- Inductive Current

### Diagnostics
- Select A/D Channel
- Read Selected A/D Counts

### Factory Page

**System Data Manipulation**
- Backup Data Set
- Default Data Set
- Restore Data Set
- Enable NVOL Storage

**Global/Menu Lockouts**
- Global Lockout
- Control Setup Menus Lock
- Alrms Setup Menu Lock
- Comms Setup Menu Lock
- Retrans Setup Menu Lock
- Analog Input Menu Lock
- Retrans Menu Lock
- Sys Data Menu Lock
- Diag Menu Lock

**Unit Information**
- Unit Serial # Hi Digits
- Unit Serial # Lo Digits
- Mfg Date
- Hardware Version
- Software Version
- Software Build #
- Unit Volt Rating
- Unit Curt Rating
- # Zones
- Installed Options
- Heat Sink Temp
- Safety Shutdown Temp
- Hi Heat Sink Temp
- Accum Hours
- Accum Hours

**Comms Configurations**
- Unit Address Select
- Unit Baud Rate Select
- Watchdog Select
- Watchdog Timeout
- Watchdog Fail Output Pwr Sel

**Comms Alarms Configuration**
- Active Relay State
- Global Alarm
- Heater Open Alarm
- Heat Sink Alarm
- Line Loss Alarm
- Phase Bul Alarm
- Load Bul Alarm
- Load Bul Percent
- Freq Out of Tol Alarm
- Volt Comp Alarm
- Over Volt Alarm
- Comms Watchdog Alarm

**Retransmit Configuration**
- Retrans Select
- Retrans Type Select
- Retrans Phase Select
- Retrans Zone Select
- Min Amps Retrans
- Max Amps Retrans
- Min kVA Retrans
- Max kVA Retrans
- Set Retrans Output Lo Cur
- Set Retrans Output Hi Cur
- Set Retrans Output Lo Volt
- Set Retrans Output Hi Volt

**Line Loss Alarms:**
- Most Recent
- Line Loss
- Alarm Type
- Previous
- Line Loss
- Alarm Type
- Least Recent
- Line Loss
- Alarm Type

**Diagnostics**
- Display Test
- Select Discrete Input
- Read Selected Input Value
- Retrans Set Test Word

The Factory Page also includes calibration parameters that are not necessary for everyday use of the controller. Calibration parameters and procedures are explained in the Power Series User's manual.
How to Reach Us

Contact

Your Authorized Watlow Distributor is:

• Phone: +1 (507) 454-5300.
• Fax: +1 (507) 452-4507.
• For technical support, ask for an Applications Engineer.
• To place an order, ask for Customer Service.
• To discuss a custom option, ask for the Power Series Product Manager.

Warranty

The Watlow Power Series is warranted to be free of defects in material and workmanship for 36 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.

Returns

• Call or fax Customer Service for a Return Material Authorization (RMA) number before returning a controller.
• Put the RMA number on the shipping label, along with a written description of the problem.
• A restocking charge of 20% of the net price is charged for all standard units returned to stock.