This manual is provided for reference only. It does NOT provide instructions on how to operate your chamber. Not all features or functions are applicable.

The Watlow 97 Limit Controller has been properly configured by TestEquity to match the chamber’s system requirements. Improper modifications to these setup values can result in unreliable and unsafe operation. Do not attempt to modify the setup values, unless you thoroughly understand what you are doing. Setup examples in the “Series 97 User’s Manual” are NOT applicable to this chamber. If there is any doubt, please call TestEquity before proceeding. The correct values are documented in the “Series 97 Limit Controller Setup Parameters” section of the TestEquity chamber manual.

NEVER select “Default Settings” in the Series 97 Limit Controller’s Factory Page. This will erase all the correct values which are documented in the “Series 97 Limit Controller Setup Parameters” section of the TestEquity chamber manual.
Series 97
User’s Manual

User Levels:
• New User ....................................................... go to page 1.1
• Experienced User .......................... go to page 2.1
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Installers:
• Installation ...................................................... go to page 2.1
• Wiring .............................................................go to page 3.1

1241 Bundy Blvd., P.O. Box 5580, Winona, Minnesota USA 55987-5580
Phone: (507) 454-5300, Fax: (507) 452-4507  http://www.watlow.com

WATLOW

ISO 9001
Registered Company
Winona, Minnesota USA

TOTAL
CUSTOMER
SATISFACTION
3 Year Warranty

0600-0021-0000 Rev D
February 2002
Supersedes: 0600-0021-0000 Rev C

Made in the U.S.A.
$15.00
Safety Information

We use note, caution and warning symbols throughout this book to draw your attention to important operational and safety information.

A "NOTE" marks a short message in the margin to alert you to an important detail.

A “CAUTION” safety alert appears with information that is important for protecting your equipment and performance. Be especially careful to read and follow all cautions that apply to your application.

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 safety alert symbol, ! (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.

The electrical hazard symbol, ⚡ (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 (507) 454-5300.

An applications engineer will discuss your application with you.

Please have the following information available when calling:

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

Your Feedback

Your comments or suggestions on this manual are welcome. Please send them to: Technical Writer, Watlow Winona, 1241 Bundy Blvd., P.O. Box 5580, Winona, MN 55987-5580; phone: (507) 454-5300; fax: (507) 452-4507. The Series 97 User’s Manual is copyrighted by Watlow Winona, Inc., © February 2002, with all rights reserved. (2194)
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About Watlow Winona
Watlow Winona is a division of Watlow Electric Mfg. Co., St. Louis, Missouri, a manufacturer of industrial electric heating products, since 1922. Watlow begins with a full set of specifications and completes an industrial product that is manufactured totally in-house, in the U.S.A.. Watlow products include electric heaters, sensors, controllers and switching devices. The Winona operation has been designing solid state electronic control devices since 1962, and has earned the reputation as an excellent supplier to original equipment manufacturers. These OEMs depend upon Watlow Winona to provide compatibly engineered controls which they can incorporate into their products with confidence. Watlow Winona resides in a 100,000 square foot marketing, engineering and manufacturing facility in Winona, Minnesota.
Chapter One
Overview

Introduction
Watlow’s Series 97 is a microprocessor-based controller with a single input, second auxiliary input and four outputs. Input 1 is used to measure temperature from a thermocouple or RTD sensor. Input 2 can be utilized as a remote reset switch or a hardware lockout switch. With up to four outputs, the controller is versatile in handling applications that require a high/low limit, alarms, retransmit and communications. The controller is so user friendly it can be set up to display safety and limit messages created by the end user to meet the exact application need.

The Series 97 limit controller is added to thermal applications to limit over-temperature conditions. The Series 97 controller provides safety assurance against instances where a high temperature runaway condition could occur from a shorted input sensor or an output device that could fail in a closed position.

The Series 97 is recommended for any application where thermal runaway could result in large product scrap costs, affect operator safety, cause damage to equipment, or create a fire hazard.

The Series 97 is manufactured by ISO 9001-registered Watlow Winona and reliably backed by a three-year warranty.

Figure 1.1 — Series 97 inputs and outputs.
# Setup Steps

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| **3** Configure the controller for your application. | Chapter Four explains the keys, displays and software navigation.  
Chapter Five explains features, such as alarms and control methods.  
Chapter Six lists parameter descriptions, ranges, 
Modbus numbers and other information. |
| **4** Set up communications.       | The controller must be equipped for communications, 
(97_ _ _ _ U - _ _ _ _ or 97_ _ _ _ R - _ _ _ _). See Chapter Five, Chapter Six and the Appendix. |
Figure 2.1 - Series 97 multiple panel cutout dimensions.

NOTE: Measurements between panel cutouts are the minimum recommended.

For rapid mounting, use Greenlee 1/16 DIN punch, die, draw stud, part number 60287.
Installing the Series 97 Controller

Installing and mounting requires access to the back of the panel.

1. Make the panel cutout using the tear-out mounting template found on the previous page, or the dimensions found in this chapter.

2. Check to see that the gasket is properly seated into the gasket channel on the front bezel and that it is not twisted. Make sure that the rounded surface of the gasket is the surface that is exposed from the gasket channel, as this is the surface that will mate to the panel surface. Insert the controller into the panel cutout.

3. With the controller inserted into the panel cutout, take the retention collar and slide it over the controller, making certain that the two locating holes in the retention collar are visible from the rear of the controller, with one hole pointing up and one pointing down. Then, take the mounting collar and slide it over the controller, making certain that one cantilever is pointing up and one is pointing down also. With one hand holding the controller and the other hand using a #2 Phillips screw driver, tighten the two screws in the mounting collar until the gap between the bezel and panel surface is .025” maximum. See figure below. Make sure that you cannot move the controller back and forth in the cutout. If you can, you do not have a proper seal.

---

**CAUTION:** Follow the installation procedure exactly to guarantee a proper NEMA 4X seal. Make sure the gasket between the panel and the rim of the case is not twisted and is seated properly. Failure to do so could result in damage to equipment.

**NOTE:** Be careful not to over-tighten the screws. This may cause the mounting cover to fail. Over-tightening occurs when the front bezel is touching the customer’s front panel.
Removing the Series 97 Controller

1. Hold the controller with one hand while using the other hand to loosen the screws with a #2 Phillips screwdriver until the end of the screw is flush or past the end of the cantilevers, see the figure below.

2. After the screws have been loosened, hold the controller with one hand while squeezing the two screws together with the other hand. Then simply slide the mounting collar off the controller.

Figure 2.3 - Removing the controller.
Notes
Chapter Three
Wiring

Power Wiring . . . . . . . . . . . . . . . . . . . . . . . 3.3
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Wiring the Series 97

Wiring options depend on the model number. Check the terminal designation stickers on either side of the controller and compare your model number to those shown here and with the model number breakdown on the inside back cover of this manual.

**NOTE:** Using the Diagnostics Menu (Factory Page) check Output 1 Hardware through Output 4 Hardware, [Oty1] through [Oty4]. See Chapter Six for information about the menu and range of settings for each output. These outputs may differ from those listed for the model number on the controller and described in this manual, indicating a customized hardware setup.

**Input-to-output Isolation**

The Series 97 uses optical and transformer isolation between the analog inputs and the controller outputs, including the communications interface. This isolation provides a barrier to prevent ground loops when using grounded sensors and/or peripheral equipment.

Here is a breakdown of the isolation barriers:

- Analog inputs 1 and 2 are grouped together.
- Outputs 1 through 4 are grouped together. This does not apply to Output 4 when it is configured for communications.
- If Output 4 is configured for communications, it is isolated from the the other inputs and outputs.

![Isolation Blocks](image)

Figure 3.2 — Isolation blocks.
Power Wiring

**CAUTION:**
If high voltage is applied to a low-voltage unit, irreversible damage will occur.

**WARNING:**
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

**CAUTION:**
Maintain isolation between input 1 and input 2 to prevent a ground loop. A ground loop may cause incorrect readings, dashes across the upper display or the display of error codes. Failure to follow this guideline could result in damage to equipment.

100 to 240V~ (ac), nominal (85 to 264 actual) 97 A

24 to 28V~ (ac/dc), nominal (21 to 30 actual) 97 B

---

**Sensor Installation Guidelines**

**Thermocouple inputs:** Extension wire for thermocouples must be of the same alloy as the thermocouple to limit errors.

When using a voltage input for the digital event on Input 2, use an ungrounded thermocouple on Input 1. If a grounded thermocouple is required, the signal to input 2 must be isolated to prevent possible ground loops.

**RTD input:** Each 1Ω of lead wire resistance can cause a +2°F error when using a two-wire RTD. A three-wire RTD sensor overcomes this problem. All three wires must have the same electrical resistance (i.e., same gauge, same length, multi-stranded or solid, same metal).
WARNING:
To avoid potential electric shock and damage to property and equipment, use National Electric Code (NEC) safety practices when wiring and connecting this unit to a power source and to electrical sensors or peripheral devices. Failure to do so could result in 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.

Figure 3.4 - System wiring example.
WARNING:
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

Sketch in your application on this page or a copy of it. See the wiring example in this chapter.

Figure 3.5 - Wiring notes.
NOTE:
Successful installation requires five steps:
- Choose the controller’s hardware configuration and model number (Appendix);
- Choose a sensor (Chapters 3 and 6, and Appendix);
- Install the controller (Chapter 2);
- Wire the controller (Chapter 3) and
- Configure the controller (Chapters 4, 5 and 6).

WARNING:
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

CAUTION:
Maintain isolation between input 1 and input 2 to prevent a ground loop. A ground loop may cause incorrect readings, dashes across the upper display or the display of error codes. Failure to follow this guideline could result in damage to equipment and product.
Output 1 Limit Output Wiring

Figure 3.7a – AC Outputs

- Electromechanical Relay without contact suppression
- Form C, 2 amps, off-state
- Impedance: 31MΩ

NOTE:
Successful installation requires five steps:

- Choose the controller’s hardware configuration and model number (Appendix);
- Choose a sensor (Chapters 3 and 6, and Appendix);
- Install the controller (Chapter 2);
- Wire the controller (Chapter 3) and
- Configure the controller (Chapters 4, 5 and 6).

WARNING:
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

NOTE:
Switching inductive loads (relay coils, solenoids, etc.) with the mechanical relay, switched dc or solid-state relay output options requires use of an R.C. suppressor.

Watlow carries the R.C. suppressor Quencharc brand name, which is a trademark of ITW Pakron. Watlow Part No. 0804-0147-0000.
Output 2 Alarm Output Wiring

NOTE:
Successful installation requires five steps:
• Choose the controller’s hardware configuration and model number (Appendix);
• Choose a sensor (Chapters 3 and 6, and Appendix);
• Install the controller (Chapter 2);
• Wire the controller (Chapter 3) and
• Configure the controller (Chapters 4, 5 and 6).

NOTE:
Switching inductive loads (relay coils, solenoids, etc.) with the mechanical relay, switched dc or solid-state relay output options requires use of an R.C. suppressor.
Watlow carries the R.C. suppressor Quencharc brand name, which is a trademark of ITW Pakron. Watlow Part No. 0804-0147-0000.

WARNING:
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

Figure 3.8a – AC Outputs
• Electromechanical relay without contact suppression
97_ _ _ _ D _ _ _ _
Form C, 2 amps, off-state impedance: 31Ω
• Solid-state relay without contact suppression
97 _ _ _ _ K _ _ _ _
0.5 amps, off-state impedance: 31Ω

Figure 3.8b – Switched DC, Open Collector
97 _ _ _ _ C _ _ _ _
Switched DC configuration:
Maximum voltage: 28V (dc)
Maximum current: 30mA

Open collector configuration:
Maximum voltage: 42V (dc)
Maximum current: 200 mA

NOTE:
Successful installation requires five steps:
• Choose the controller’s hardware configuration and model number (Appendix);
• Choose a sensor (Chapters 3 and 6, and Appendix);
• Install the controller (Chapter 2);
• Wire the controller (Chapter 3) and
• Configure the controller (Chapters 4, 5 and 6).
NOTE:
Successful installation requires five steps:
• Choose the controller’s hardware configuration and model number (Appendix);
• Choose a sensor (Chapters 3 and 6, and Appendix);
• Install the controller (Chapter 2);
• Wire the controller (Chapter 3) and
• Configure the controller (Chapters 4, 5 and 6).

NOTE:
Switching inductive loads (relay coils, solenoids, etc.) with the mechanical relay, switched dc or solid-state relay output options requires use of an R.C. suppressor.
Watlow carries the R.C. suppressor Quencharc brand name, which is a trademark of ITW Pakron. Watlow Part No. 0804-0147-0000.

WARNING:
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.
Output 4 Wiring

NOTE:
Successful installation requires five steps:

- Choose the controller's hardware configuration and model number (Appendix);
- Choose a sensor (Chapters 3 and 6, and Appendix);
- Install the controller (Chapter 2);
- Wire the controller (Chapter 3) and
- Configure the controller (Chapters 4, 5 and 6).

NOTE:
Switching inductive loads (relay coils, solenoids, etc.) with the mechanical relay, switched dc or solid-state relay output options requires use of an R.C. suppressor.

Watlow carries the R.C. suppressor Quencharc brand name, which is a trademark of ITW Pakron. Watlow Part No. 0804-0147-0000.

WARNING:
To avoid damage to property and equipment, and/or injury of loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

NOTE:
Successful installation requires five steps:
• Choose the controller’s hardware configuration and model number (Appendix);
• Choose a sensor (Chapters 3 and 6, and Appendix);
• Install the controller (Chapter 2);
• Wire the controller (Chapter 3) and
• Configure the controller (Chapters 4, 5 and 6).

NOTE:
The CMC converter requires an external power supply when used with a laptop computer.

WARNING:
To avoid damage to property and equipment, and/or injury or loss of life, use National Electric Code (NEC) standard wiring practices to install and operate the Series 97. Failure to do so could result in such damage, and/or injury or death.

NOTE:
If the system does not work properly, it may need termination resistors at each end of the network. A typical installation would require a 120-ohm resistor across the transmit/receive terminals (19 and 21) of the last controller in the network and the converter box or serial card. Pull-up and pull-down resistors may be needed to maintain the correct voltage during the idle state.
Chapter Four
Navigation and Software

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Software Map ............................ .4.4
Task Charts .............................. .4.6
Keys and Displays

This chapter explains keys, displays and navigation skills, and presents charts showing how to accomplish basic and advanced tasks. You’ll also find a complete software map.

**Active Output (1-4) Indicator Lights:**
Lit when the corresponding output trips. Indicator light next to number 4 will flicker during communications activity if the communications option is used.

**Upper Display:**
Indicates actual process values during operation, the value for the parameter in the lower display, or the user programmed message.

**Lower Display:**
Indicates factory programmed message during operation, the value for the parameter in the lower display, or the user programmed message.

**Advance Key:**
Advances the lower display through the parameters. To reverse direction, press and hold $ while repeatedly pressing the 0 key.

**Up Key:**
Changes the upper display to a higher value, or up through a list of values. Moves from menu to menu in a page.

**Down Key:**
Changes the upper display to a lower value, or down through a list of values. Moves from menu to menu in a page.

**Reset Key:**
- Returns to the Home Page (process/actual display).
- Resets a latching alarm.
- Resets a latching input sensor error.
- Resets the limit.
- Silences an alarm.

Figure 4.2 — Series 97 keys and displays.
Navigating the Series 97

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

- **Operations Page**: press the keys together for three seconds.

- **Setup Page**: press the keys together for six seconds.

- **Factory Page**: press and Reset keys together for six seconds.

- **Home Page**: From anywhere, press the Reset Key.

Figure 4.3 — Navigating the Series 97.

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. To go backward through the parameter list press and together.

Press or to select a value, either alpha or numeric.

Press to set the value and go to the next parameter.
Navigation

Software Map

Figure 4.4 — Software Map.
Note: 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 Appendix.
Basic navigation for new users

Use this example task to learn how to use the keys and displays. Navigation skills are essential for setting up the controller. For more information about the control features available in the Series 97, see Chapter Five. For a table of all parameters and values, see Chapter Six.

Configure the controller

To configure the controller to suit your application, go to the Setup Page, enter the menus and set the parameters for the system, its inputs and outputs.

<table>
<thead>
<tr>
<th>Do this</th>
<th>Press these keys</th>
<th>You’ll see*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Go to the Setup Page from the Home Page.</td>
<td>✏Up-arrow and ✏Down-arrow keys for 6 seconds.</td>
<td>After three seconds the Operations Page appears in the lower display; after six seconds the Setup Page appears in the lower display. A menu is in the upper display.</td>
</tr>
<tr>
<td>2 Select a menu to enter.</td>
<td>✏Up-arrow key.</td>
<td>The Setup Page remains in the lower display while menu names appear in the upper display.</td>
</tr>
<tr>
<td>3 Go to a parameter.</td>
<td>✏Advance key.</td>
<td>The menu’s parameters appear in the lower display and the values appear in the upper display. (Note: When you enter a menu, the display changes. Instead of the Setup Page and menu, you see parameter and value.)</td>
</tr>
<tr>
<td>4 Choose a value.</td>
<td>✏Up-arrow key, until you reach the desired value.</td>
<td>Values appear in the upper display when the parameter is in the lower display.</td>
</tr>
<tr>
<td>5 Set a value and go on to the next parameter.</td>
<td>✏Advance key (when the chosen value is displayed).</td>
<td>You will see the chosen value in the upper display. After pressing the Advance key, the next parameter appears in the lower display, with one of its values in the upper display. Values auto-enter after five seconds.</td>
</tr>
</tbody>
</table>

Summary

To make a selection or choice: Press ✏Up-arrow key or ✏Down-arrow key.
To move or change location in a page or menu: Press ✏Advance key or Reset Key.

*What you see depends on the options included in your controller.
Chapter Five
Features

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Input
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   Filter Time Constant ............ 5.4
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Limit

The Series 97 limit controller is added to thermal applications to limit over- or under-temperature conditions. The Series 97 controller provides safety assurance against instances where a high temperature runaway condition could occur from a shorted input sensor or an output device that could fail in a closed position. A limit condition is latched and therefore requires operator intervention to clear it. This is done by pressing the Reset key after the limit condition has passed.

The Series 97 is recommended for any application where thermal runaway could result in large product scrap costs, affect operator safety, cause damage to equipment or create a fire hazard.
Input

Calibration Offset

Calibration offset allows a device to compensate for an inaccurate sensor, lead resistance or other factors that affect the input value. A positive offset increases the input value, and a negative offset decreases the input value.

The input 1 offset value can be viewed or changed with Calibration Offset 1 [CAL] (Limit Menu).

Figure 5.3 — Calibration offset.
Filter Time Constant

A time filter smooths an input signal by applying a first-order filter time constant to the signal. Either the displayed value or both the displayed and control values can be filtered. Filtering the displayed value makes it easier to monitor.

View or change the input 1 time filter with Filter Time Constant 1 [Ftr1] (Input 1 Menu). A positive value affects only the viewed values. A negative value affects both the viewed and control values.

![Unfiltered Input Signal](image1)

![Filtered Input Signal](image2)

Figure 5.4 — Filtered and unfiltered input signals.
Sensor Selection

You need to configure a controller to match the input device, which is normally a thermocouple or RTD. When you select an input device the controller automatically sets the input linearization to match the sensor. It also sets high and low limits, which in turn limit the range high and range low values.

Use Sensor Type 1 \[ SE_{n1} \] and Input 1 \[ In_{1} \] (Input 1 Menu) to select the appropriate sensor for input 1.

Range Low and Range High

The controller constrains the set point to a value between range high and range low. Range high cannot be set higher than the sensor high limit or lower than range low. Range low cannot be set lower than the sensor low limit or higher than range high.

Use Range Low 1 \[ rL_{1} \] and Range High 1 \[ rH_{1} \] (Input 1 Menu) to select or view values for the corresponding input 1 parameters.

Figure 5.5 — Sensor ranges.
**Event Input**

With an event input an operator can perform certain operations on a system by opening or closing a switch or applying a dc logic signal to the controller. This feature can add convenience, safety or security to a system.

Use Event Input Status [E S] (Monitor Menu) to read the state of the event input parameter.

Use Event Function [E Fn] (Input 2 Menu) to select how an event will affect the system.
- **nonE** Events will not affect the system.
- **L rSt** Clear Limit.
- **LOC** Lock out key board.
- **ALr** Clear an alarm.

Use Event Condition [E cn] (Input 2 Menu) to select what condition will trigger an event.
- **Lo** Low generates an event while the voltage is low (switch closed).
- **h i** High generates an event while the voltage is high (switch open).
- **r iSE** Rise changes the event state when the voltage changes from low to high.
- **FALL** Fall changes the event state when the voltage changes from high to low.

---

*Figure 5.6 — Event inputs.*
Retransmit

The retransmit output can be used to transmit an analog signal representing the value of the input process variable. The retransmit signal can be configured as either a milliamp or a voltage signal. In choosing the type of retransmit signal the operator must take into account the input impedance of the external device and the required signal type, either voltage or milliamps.

A typical application might use the retransmit option to record a process value with a chart recorder.

![Diagram of a control system including a temperature controller, limit controller, heat-treat oven, and chart recorder.]

Figure 5.7 — Retransmit example.

In the example a Series 96 is being used to control the temperature of a heat-treat oven and the Series 97 is being used as a safety limit with a retransmit output. Output 4 of the Series 97 must be equipped for retransmit (97_ _ _ _ M - _ _ _ _).

The temperature of the limit process value is being recorded on a chart recorder. The oven temperature range stays between 600 to 900°F. The chart recorder requires a 4-20mA signal.

Set $\text{[Aout]}$ Analog Output 4 (Output 4 Menu) to $\text{[Proc]}$ Process 1 and $\text{[Proc]}$ Process 4 (Output 4 Menu) to $\text{[4-20]}$ to tag the input 1 process value as the parameter to be retransmitted. Set Analog Output High $\text{[A`hi]}$ to 900 to set the high range for the retransmit signal. Set Analog Output Low $\text{[A`Lo]}$ to 600 to set the low range for the retransmit signal. Set Analog Output Offset $\text{[ACAL]}$ to 0, assuming no calibration offset is required.

The retransmit output will be 4mA until the oven temperature is greater than 600°F, at which point the signal will increase with temperature to 20mA at 900°F and will not exceed 20mA.
Alarms

An alarm takes some action, usually notifying an operator, when the process temperature 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.

Alarm Set Points

The alarm high set point defines the temperature that will trigger a high side alarm. The alarm high set point must be higher than the alarm low set point and lower than the high limit of the sensor range.

The alarm low set point defines the temperature that will trigger a low side alarm. The alarm low set point must be lower than the alarm high set point and higher than the low limit of the sensor range.

Process alarm set points for output 2 can be viewed or changed with Alarm 2 High \( A2h \) and Alarm 2 Low \( A2L \) (Alarm Menu).

Alarm Hysteresis

Alarm hysteresis is a zone inside each alarm set point. This zone is defined by adding the hysteresis value to the alarm low set point or subtracting the hysteresis value from the alarm high set point.

An alarm state is triggered when the process value reaches the alarm high or alarm low set point. Alarm hysteresis defines how far the process must return into the normal operating range before the alarm can be cleared.

The alarm hysteresis value for output 2 can be viewed or changed with Hysteresis 2 \( hYS2 \) (Output 2 Menu).

Figure 5.8 — Alarm settings.
**Process**

A process alarm uses one or two absolute set points to define an alarm condition.

The alarm process value of output 2 can be viewed or changed with Alarm 2 High \( [A2h] \) and Alarm 2 Low \( [A2L] \) (Alarm Menu).

**Alarm Latching**

A latched alarm will remain active after the alarm condition has passed. It can only be deactivated by the user. An alarm that is not latched will deactivate automatically when the alarm condition has passed.

Alarm 2 Latching \( [LA2] \) (Output 2 Menu) allows you to view or change whether the output 2 alarm will latch.

Clear a latched alarm by pressing the Reset key after the alarm condition has passed.

---

**Figure 5.9 — Alarm latching.**
Alarm Silencing

Alarm silencing has two uses:

1. It is often used to allow a system to warm up after it has been started up. With alarm silencing on, an alarm is not triggered when the process temperature is initially lower than the alarm low set point. The process temperature has to enter the normal operating range beyond the hysteresis zone in order to activate the alarm function.

2. Alarm silencing also allows the operator to disable the alarm output while the controller is in an alarm state. The process temperature has to enter the normal operating range beyond the hysteresis zone in order to activate the alarm output function.

Alarm Silencing 2 [Sil2] (Output 2 Menu) allows you to view or change whether alarm silencing is on. If Alarm Annunciation 2 [Anu2] (Output 2 Menu) is set to `YES`, the output 2 indicator light will remain on and an alarm message will appear in the display, even though the alarm is silenced.

Figure 5.10 — Alarm silencing.
Communications

Overview

A Series 97 controller can also be programmed and monitored by connecting it to a personal computer or programmable logic controller (PLC) via serial communications. To use this communications option, a Series 97 must be equipped with an output 4 communications board for EIA/TIA-485 (97_ _ - _ _ _U - _ _ _ _), which allows as many as 32 controllers on a 4,000-foot-long network, or EIA/TIA-232 (97_ _ - _ _ _R - _ _ _ _), which allows a single controller to be connected to a computer.

The Series 97 uses an 8-N-1 data format (eight data bits, no parity, one stop bit and one start bit).

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. 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. The parameters chapter lists the modbus address and range for each parameter. Refer to setup parameter table for setup order.

Communications parameters appear in the Output 4 Menu (Setup Page). Match the Baud Rate $b_{Rud}$ to that of the computer and select an Address $Addr$ for each Series 97.

The wiring chapter shows how to wire a Series 97 controller for EIA/TIA-485 or EIA/TIA-232 communications.

The Appendix provides technical information about programming for Modbus RTU.

NOTE: For more information about communicating with Watlow controllers, go to www.watlow.com and download the Data Communications Reference: Electronic User’s Manual. It is located under Literature, User’s Manuals, English and search on data communications reference.
Notes
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Parameters

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NOTE: To see how all the pages, menus and parameters are grouped, refer to the gatefold back cover of this manual.

For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
### Table 6.2 — Set up parameters in this order.

| Column                  | °C or °F | Output 1 | Output 2 | Output 3 | Output 4 | Sensor Type | Input 1 | Input 2 | Range High 1 | Range Low 1 | Decimal 1 | Calibration Offset 1 | Input Software Filter 1 | Event Function | Event Condition | Analog Output 4 | Analog Output High | Analog Output Low | Analog Output Offset | Alarm Hysteresis 2, 3, 4 | Alarm Latching 2, 3, 4 | Alarm Silencing 2, 3, 4 | Alarm Active Sides 2, 3, 4 | Alarm Logic 2, 3, 4 | Alarm 2, 3, 4 High | Alarm 2, 3, 4 Low |
|-------------------------|----------|----------|----------|----------|----------|-------------|----------|----------|---------------|--------------|-----------|----------------------|-------------------------|----------------|----------------|------------------|-----------------|-----------------|---------------------|------------------|------------------|---------------------|------------------|----------------|----------------|
| °C or °F                |          |          |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Output 1               |          | Out 1   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Output 2               |          | Out 2   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Output 3               |          | Out 3   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Output 4               |          | Out 4   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Sensor Type            |          | Sen 1   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Input 1                |          | In 1    |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Range High 1           |          | r h 1   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Range Low 1            |          | r L 1   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Decimal 1              |          | D E C 1 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Calibration Offset 1   |          | C a l 1 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Input Software Filter 1|          | F t r 1 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Input 2                |          | In 2    |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Event Function         |          | E F n   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Event Condition        |          | E C n   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Analog Output 4        |          | R o u t 4 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Analog Output High      |          | R h 4   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Analog Output Low       |          | R L 4   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Analog Output Offset    |          | R C a l 4 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm Hysteresis 2, 3, 4|          | H y s 2 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm Latching 2, 3, 4  |          | L a t 2 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm Silencing 2, 3, 4 |          | S i l 2 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm Active Sides 2, 3, 4 |          | A c t 3 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm Logic 2, 3, 4     |          | L o g 3 |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm 2, 3, 4 High      |          | A h 3   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |
| Alarm 2, 3, 4 Low       |          | A l 3   |          |          |          |              |          |          |               |              |           |                      |                          |                |                |                  |                 |                 |                     |                  |                  |                     |                  |                |                |

**Key:**
- **D** = Changing will change the default
- **C** = Changing will convert the temperature scale
- **O** = Other effect

---

**Changing this Affects this**

- °C or °F
- °C-F
- Output 1
- Output 2
- Output 3
- Output 4
- Sensor Type
- Input 1
- Input 2
- Range High 1
- Range Low 1
- Decimal 1
- Calibration Offset 1
- Input Software Filter 1
- Event Function
- Event Condition
- Analog Output 4
- Analog Output High
- Analog Output Low
- Analog Output Offset
- Alarm Hysteresis 2, 3, 4
- Alarm Latching 2, 3, 4
- Alarm Silencing 2, 3, 4
- Alarm Active Sides 2, 3, 4
- Alarm Logic 2, 3, 4
- Alarm 2, 3, 4 High
- Alarm 2, 3, 4 Low
Home Page

The resting-state display shows the following set of data. The first prompt appears in the top display, the second in the bottom.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>97</td>
<td>Upper Display</td>
<td></td>
<td></td>
<td></td>
<td>Active: Always</td>
</tr>
<tr>
<td>SAFE</td>
<td>Lower Display</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Monitor the processes determined by the Upper Display \( UdSP \) and Lower Display \( LdSP \) parameters Display Menu.

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

The operations page contains three menus:

<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>OPER</td>
<td>Operations Page Select</td>
<td>Monitor Limit</td>
<td>L LIM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPER</td>
<td>Operations Page Select</td>
<td>Alarm (if any alarms are active)</td>
<td>L LIM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPER</td>
<td>Operations Page Select</td>
<td>Go to an operations menu.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MON</td>
<td>Monitor Menu</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPER</td>
<td>Operations Page</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P1</td>
<td>Process 1</td>
<td></td>
<td></td>
<td></td>
<td>Active if Operations Page Mode (Lockout Menu) is not set to \textbf{\textcolor{red}{h _dE}}.</td>
</tr>
<tr>
<td>LST</td>
<td>Limit Status</td>
<td>Monitor the condition of limit.</td>
<td>SAFE (0)</td>
<td>SAFE (0)</td>
<td>319 r Active if Operations Page Mode (Lockout Menu) is not set to \textbf{\textcolor{red}{h _dE}}.</td>
</tr>
<tr>
<td>LST</td>
<td>Limit Status</td>
<td></td>
<td>_L (1)</td>
<td>_L (1)</td>
<td></td>
</tr>
<tr>
<td>LST</td>
<td>Limit Status</td>
<td></td>
<td>_L (2)</td>
<td>_L (2)</td>
<td></td>
</tr>
<tr>
<td>AL2</td>
<td>Alarm 2 Status</td>
<td>Monitor alarm 2 status.</td>
<td>_L (0)</td>
<td>_L (0)</td>
<td>106 r Active if Output 2 (Output 2 Menu) is set to \textbf{\textcolor{red}{AL}} and Operations Page Mode (Lockout Menu) is not set to \textbf{\textcolor{red}{h _dE}}.</td>
</tr>
<tr>
<td>AL2</td>
<td>Alarm 2 Status</td>
<td></td>
<td>_L (1)</td>
<td>_L (1)</td>
<td></td>
</tr>
<tr>
<td>AL2</td>
<td>Alarm 2 Status</td>
<td></td>
<td>_L (2)</td>
<td>_L (2)</td>
<td></td>
</tr>
<tr>
<td>AL3</td>
<td>Alarm 3 Status</td>
<td>Monitor alarm 3 status.</td>
<td>_L (0)</td>
<td>_L (0)</td>
<td>110 r Active if Output 3 (Output 3 Menu) is set to \textbf{\textcolor{red}{AL}} and Operations Page Mode (Lockout Menu) is not set to \textbf{\textcolor{red}{h _dE}}.</td>
</tr>
<tr>
<td>AL3</td>
<td>Alarm 3 Status</td>
<td></td>
<td>_L (1)</td>
<td>_L (1)</td>
<td></td>
</tr>
<tr>
<td>AL3</td>
<td>Alarm 3 Status</td>
<td></td>
<td>_L (2)</td>
<td>_L (2)</td>
<td></td>
</tr>
<tr>
<td>AL4</td>
<td>Alarm 4 Status</td>
<td>Monitor alarm 4 status.</td>
<td>_L (0)</td>
<td>_L (0)</td>
<td>114 r Active if Output 4 (Output 4 Menu) is set to \textbf{\textcolor{red}{AL}} and Operations Page Mode (Lockout Menu) is not set to \textbf{\textcolor{red}{h _dE}}.</td>
</tr>
<tr>
<td>AL4</td>
<td>Alarm 4 Status</td>
<td></td>
<td>_L (1)</td>
<td>_L (1)</td>
<td></td>
</tr>
<tr>
<td>AL4</td>
<td>Alarm 4 Status</td>
<td></td>
<td>_L (2)</td>
<td>_L (2)</td>
<td></td>
</tr>
<tr>
<td>ESE</td>
<td>Event Input Status</td>
<td>Monitor the event input status.</td>
<td>FALSE (0)</td>
<td>FALSE (0)</td>
<td>201 r Active if Input 2 (Input 2 Menu) is set to \textbf{\textcolor{red}{E _In}} (event input), \textbf{\textcolor{red}{EFn}} is not set to \textbf{\textcolor{red}{none}} and Operations Page Mode (Lockout Menu) is not set to \textbf{\textcolor{red}{h _dE}}.</td>
</tr>
<tr>
<td>ESE</td>
<td>Event Input Status</td>
<td></td>
<td>TRUE (1)</td>
<td>TRUE (1)</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
### Display | Parameter | Range | Default | Modbus Address read/write | Conditions for Parameters to Appear
--- | --- | --- | --- | --- | ---
| **L [m]** Limit Menu | **OPER** Operations Page | | | | 
| **L Lo** Low Limit Set Point | | | | | 
 Sets the low limit point.
| **L hi** High Limit Set Point | | | | | 
 Sets the high limit point.
| **CAL** Calibration Offset | | | | | 
 Sets the input 1 calibration offset.

### Alarm Menu | Operations Page

| **A2Lo** Alarm 2 Low | | | | | 
 Sets the low alarm set point for output 2.
| **A2hi** Alarm 2 High | | | | | 
 Sets the high alarm set point for output 2.
| **A3Lo** Alarm 3 Low | | | | | 
 Sets the low alarm set point for output 3.

### Operations Page / Alarm and Limit Menus

| Display | Parameter | Range | Default | Modbus Address read/write | Conditions for Parameters to Appear
--- | --- | --- | --- | --- | ---
| **AL** Alarm Menu | **OPER** Operations Page | | | | 
 Active if Output 2 (Output 2 Menu) is set to [AL] (Alarm), Alarm Active Sides 2 (Output 2 Menu) is not set to [h], Output 2 is present (97 _ _-_ D _ _-_ _ _ _ or 97 _ _-_ K _ _-_ _ _ _ ) and Operations Page Mode (Lockout Menu) is not set to [h dE].

**Note:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>[A3h]</td>
<td>Alarm 3 High</td>
<td>Process: high limit of selected sensor range</td>
<td>Process: high limit of selected sensor range</td>
<td>341 r/w</td>
<td>Active if Output 3 (Output 3 Menu) is [AL] (Alarm), Alarm Sides 3 (Output 3 Menu) is set to [Lo], Output 3 is present (97 _ <em>-</em> _ _ D <em>-</em> _ _ _) and Operations Page Mode (Lockout Menu) is not set to [hide].</td>
</tr>
<tr>
<td>[A4l]</td>
<td>Alarm 4 Low</td>
<td>Process: low limit of selected sensor range to Alarm 4 High -1</td>
<td>Process: low limit of selected sensor range</td>
<td>none*</td>
<td>Active if Output 4 (Output Menu 4) is [AL] (Alarm), Alarm Sides 4 (Output Menu 4) is not [h], Output 4 is a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ _) and Operations Page Mode (Lockout Menu) is not set to [hide].</td>
</tr>
<tr>
<td>[A4h]</td>
<td>Alarm 4 High</td>
<td>Process: high limit of selected sensor range</td>
<td>Process: high limit of selected sensor range</td>
<td>none*</td>
<td>Active if Output 4 (Output Menu 4) is [AL] (Alarm), Alarm Sides 4 (Output Menu 4) is not [h], Output 4 is a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ _) and Operations Page Mode (Lockout Menu) is not set to [hide].</td>
</tr>
</tbody>
</table>

*Output 4 parameters cannot be changed with the Modbus interface.

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

The setup page contains 8 menus.

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>[En]</td>
<td>Setup Page</td>
<td>[lnP]</td>
<td>Input 1</td>
<td>[lnP]</td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to [hidE].</td>
</tr>
<tr>
<td></td>
<td>Go to a setup menu.</td>
<td></td>
<td>Input 2 (if present)</td>
<td>[lnP]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output 3 (if present)</td>
<td>[Out]</td>
<td>Output 4 (if present)</td>
<td>[Out]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Display</td>
<td>[d isp]</td>
<td>Global</td>
<td>[d ip sp]</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>[InP]</th>
<th>Input 1 Menu</th>
<th>[Set]</th>
<th>Setup Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>[En]</td>
<td>Sensor Type 1</td>
<td>[tc]</td>
<td>Sets the input hardware type of input 1.</td>
</tr>
<tr>
<td></td>
<td>[rtd]</td>
<td>Thermocouple (0)</td>
<td>RTD (1)</td>
</tr>
<tr>
<td></td>
<td>If Sensor Type is set to thermocouple</td>
<td>[J]</td>
<td>J (0)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[K]</td>
<td>K (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[T]</td>
<td>T (2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[E]</td>
<td>E (3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[N]</td>
<td>N (4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[C]</td>
<td>C (5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[D]</td>
<td>D (6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[PT2]</td>
<td>PT2 (7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[R]</td>
<td>R (8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[S]</td>
<td>S (9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[B]</td>
<td>B (10)</td>
</tr>
<tr>
<td></td>
<td>If Sensor Type is set to RTD</td>
<td>[rtd]</td>
<td>RTD (1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[RTD_DIN]</td>
<td>RTD_DIN (11)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[RTD_JIS]</td>
<td>RTD_JIS (12)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inp1</th>
<th>Input 1</th>
<th>[lnP]</th>
<th>Sets the input linearization parameter of the input 1.</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ln]</td>
<td>Input 1</td>
<td>[lnP]</td>
<td>If Sensor Type (Input 1 Menu) is changed to thermocouple: [J].</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If Sensor Type is changed to RTD: [d in].</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to [hidE].</td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>rL1</td>
<td>Range Low 1</td>
<td>*</td>
<td>*</td>
<td>602 r/w</td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to hide.</td>
</tr>
<tr>
<td></td>
<td>Sets the input range low. This setting is the lowest value that the set point can have.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>rH1</td>
<td>Range High 1</td>
<td>*</td>
<td>*</td>
<td>603 r/w</td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to hide.</td>
</tr>
<tr>
<td></td>
<td>Sets the input range high. This setting is the highest value that the set point can have.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>dE1</td>
<td>Decimal 1</td>
<td>If Set Sensor Type is RTD, thermocouple, (excluding R, S, or B thermocouple)</td>
<td>0</td>
<td>606 r/w</td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to hide.</td>
</tr>
<tr>
<td></td>
<td>Sets the position of the decimal point for input readings.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fEr1</td>
<td>Input Software Filter 1</td>
<td>-60.0 to 60.0</td>
<td>0 (or 1.0 if dE1 is set to 0.0)</td>
<td>604 r/w</td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to hide.</td>
</tr>
<tr>
<td></td>
<td>Sets the filter time for the input, in seconds. This smooths out a rapidly changing input signal. Positive values affect the monitor readings only. Negative values affect both the monitor readings and the control values.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*See specifications in the appendix for sensor ranges and defaults.

NOTE: For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
### Input 2 Menu

**Input 2**

Sets the input type parameter of input 2.

**Event Function**

Selects the event function.

**Event Condition**

Selects the condition to trigger an event.

### Output 1 Menu

**Limit Active Sides**

Selects output 1 active sides.

**Limit Hysteresis**

Sets the switching hysteresis for output 1.

### Output 2 Menu

**Output 2**

Selects output 2 function.

---

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
### Alarm Hysteresis 2
Sets the switching hysteresis for the alarm output. This defines a band on the inside of the alarm set point. When the process temperature is in this band, the alarm state will not change.

<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>952</td>
<td>Alarm Hysteresis 2</td>
<td>1 to 9999</td>
<td>3</td>
<td>720 r/w</td>
<td>Active if Output 2 is enabled, hardware is present (not 97 _ _ A _ _ _ _ _ _ _ _ ), Output 2 (Output 2 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h.dE].</td>
</tr>
</tbody>
</table>

### Latching 2
Enables Latching.

<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>952</td>
<td>Latching 2</td>
<td>no action (0)</td>
<td>no</td>
<td>721 r/w</td>
<td>Active if Output 2 (Output 2 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h.dE].</td>
</tr>
</tbody>
</table>

### Silencing 2
Enables Silence 2.

<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>952</td>
<td>Silencing 2</td>
<td>no action (0)</td>
<td>no</td>
<td>722 r/w</td>
<td>Active if Output 2 (Output 2 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h.dE].</td>
</tr>
</tbody>
</table>

### Alarm Active Sides 2
Selects which side or sides the alarm setpoints can be programmed for.

<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>952</td>
<td>Alarm Active Sides 2</td>
<td>both (0)</td>
<td>both</td>
<td>723 r/w</td>
<td>Active if Output 2 (Output 2 Menu) is set to [AL] (Alarm), hardware is present (not 97 _ _ A _ _ _ _ _ _ _ _ _ _ ), and Setup Page Lock (Lockout Menu) is not set to [h.dE].</td>
</tr>
</tbody>
</table>

### Alarm Logic 2
Selects which side or sides the alarm setpoints can be programmed for.

<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>952</td>
<td>Alarm Logic 2</td>
<td>AL D</td>
<td>AL D</td>
<td>724 r/w</td>
<td>Active if Output 2 (Output 2 Menu) is set to [AL], hardware is present (not 97 _ _ A _ _ _ _ _ _ _ _ _ _ _ _ ), and Setup Page Lock (Lockout Menu) is not set to [h.dE].</td>
</tr>
</tbody>
</table>

### Alarm Annunciation 2
Selects alarm 2 annunciation option.

<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>952</td>
<td>Alarm Annunciation 2</td>
<td>no (0)</td>
<td>YES</td>
<td>725 r/w</td>
<td>Active if Output 2 is set to [AL], hardware is present (not 97 _ _ A _ _ _ _ _ _ _ _ _ _ _ _ ), and Setup Page Lock (Lockout Menu) is not set to [h.dE].</td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller's operation, see Chapter Five, Features.
### Output 3 Menu

**Setup Page**

**Output 3**
- **Selects type of output 3.**
  - Off (0)
  - Alarm (1)
- **Default:** Off (0)
- **Address:** 734
- **Range:** Read/Write
- **Modbus Conditions for Parameters to Appear:**
  - Active if Output 3 hardware is present (97, _-_ D _-_ _ _ _ _), Output 3 (Output 3 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [hid].

**Alarm Hysteresis 3**
- **Sets the switching hysteresis for the alarm output. This defines a band on the inside of the alarm set point. When the process temperature is in this band, the alarm state will not change.**
  - **Default:** 3
  - **Address:** 737
  - **Range:** Read/Write
  - **Modbus Conditions for Parameters to Appear:**
  - Active if Output 3 hardware is present (97, _-_ D _-_ _ _ _ _), Output 3 (Output 3 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [hid].

**Latching 3**
- **Enables Alarm 3 Latching.**
  - No action (0)
  - Latching enabled (1)
- **Default:** No action (0)
- **Address:** 738
- **Range:** Read/Write
- **Modbus Conditions for Parameters to Appear:**
  - Active if Output 3 hardware is present (97, _-_ D _-_ _ _ _ _), Output 3 (Output 3 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [hid].

**Silencing 3**
- **Enables Silence 3.**
  - No action (0)
  - Silence 3 enabled (1)
- **Default:** No action (0)
- **Address:** 739
- **Range:** Read/Write
- **Modbus Conditions for Parameters to Appear:**
  - Active if Output 3 hardware is present (97, _-_ D _-_ _ _ _ _), Output 3 (Output 3 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [hid].

**Alarm Active Sides 3**
- **Selects alarm 3 side option.**
  - Both (0)
  - High (1)
  - Low (2)
- **Default:** Both (0)
- **Address:** 740
- **Range:** Read/Write
- **Modbus Conditions for Parameters to Appear:**
  - Active if Output 3 hardware is present (97, _-_ D _-_ _ _ _ _), Output 3 (Output 3 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [hid].

**Alarm Logic 3**
- **Selects alarm 3 output condition in the alarm state.**
  - Alarm condition de-energizes output (fail safe operation) (0)
  - Alarm condition energizes output (1)
- **Default:** Alarm condition de-energizes output (0)
- **Address:** 741
- **Range:** Read/Write
- **Modbus Conditions for Parameters to Appear:**
  - Active if Output 3 hardware is present (97, _-_ D _-_ _ _ _ _), Output 3 (Output 3 Menu) is set to [AL] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [hid].

---

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

---

**Watlow Series 97**

**Parameters** 6.11
### Output 4 Menu

#### Setup Page

<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alm3</td>
<td>Alarm Annunciation 3</td>
<td>none*</td>
<td>yes (1)</td>
<td>742 r/w</td>
<td>Active if Output 3 hardware is present (97 _ <em>-</em> _ _ D <em>-</em> _ _ <em>), Output 3 (Output 3 Menu) is set to [<code>AL</code> (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h</em>.dE].</td>
</tr>
<tr>
<td>Out4</td>
<td>Output 4</td>
<td>OFF off</td>
<td>OFF</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ <em>), and Setup Page Lock (Lockout Menu) is not set to [h</em>.dE].</td>
</tr>
<tr>
<td>Hyst4</td>
<td>Alarm Hysteresis 4</td>
<td>1 to 9999</td>
<td>3</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ <em>), Output 4 (Output 4 Menu) is set to [<code>AL</code> (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h</em>.dE].</td>
</tr>
<tr>
<td>Lat4</td>
<td>Latching 4</td>
<td>no action</td>
<td>no</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ <em>), Output 4 (Output 4 Menu) is set to [<code>AL</code> (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h</em>.dE].</td>
</tr>
<tr>
<td>Sil4</td>
<td>Silencing 4</td>
<td>no action</td>
<td>no</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ <em>), Output 4 (Output 4 Menu) is set to [<code>AL</code> (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h</em>.dE].</td>
</tr>
<tr>
<td>Sid4</td>
<td>Alarm Active Sides 4</td>
<td>both high low</td>
<td>both</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D <em>-</em> _ _ <em>), Output 4 (Output 4 Menu) is set to [<code>AL</code> (Alarm) and Setup Page Lock (Lockout Menu) is not set to [h</em>.dE].</td>
</tr>
</tbody>
</table>

*Output 4 parameters cannot be changed with the Modbus interface.

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
### Watlow Series 97 Parameters

**Address Parameters to Appear**

<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><code>{9c4}</code></td>
<td>Alarm Logic 4</td>
<td>[<strong>RL</strong> D] alarm condition de-energizes output</td>
<td>[<strong>RL</strong> D]</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D- _ _ _ _), Output 4 (Output 4 Menu) is set to [<strong>RL</strong>] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9n4}</code></td>
<td>Alarm Annunciation 4</td>
<td>[<strong>no</strong>] no</td>
<td>[<strong>YES</strong>] yes</td>
<td>none*</td>
<td>Active if Output 4 is equipped for a relay (97 _ <em>-</em> _ _ D- _ _ _ _), Output 4 is Set to [<strong>RL</strong>] (Alarm) and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9out}</code></td>
<td>Analog Output 4</td>
<td>[<strong>no</strong>] not active</td>
<td>[<strong>Proc</strong>] process</td>
<td>none*</td>
<td>Active if Output 4 is equipped for retransmit (97 _ <em>-</em> _ _ M-_ _ _ _) and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9c4}</code></td>
<td>Process 4 Type</td>
<td>[4-20] 4-20 mA</td>
<td>[4-20]</td>
<td>none*</td>
<td>Active if Output 4 is equipped for retransmit (97 _ <em>-</em> _ _ M-_ _ _ _) and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9lo}</code></td>
<td>Analog Output Low</td>
<td>-1999 to Analog Range High</td>
<td>-999</td>
<td>none*</td>
<td>Active if Output 4 is equipped for retransmit (97 _ <em>-</em> _ _ M-_ _ _ _), and Analog Output 4 (Output 4 Menu) is set to [<strong>Proc</strong>] and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9hi}</code></td>
<td>Analog Output High</td>
<td>Analog Range Low to 9999</td>
<td>999</td>
<td>none*</td>
<td>Active if Output 4 is equipped for retransmit (97 _ <em>-</em> _ _ M-_ _ _ _), and Analog Output 4 (Output 4 Menu) is set to [<strong>Proc</strong>] and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9cal}</code></td>
<td>Analog Output Offset</td>
<td>-1999 to 9999</td>
<td>0</td>
<td>none*</td>
<td>Active if Output 4 is equipped for retransmit (97 _ <em>-</em> _ _ M-_ _ _ _), and Analog Output 4 (Output 4 Menu) is set to [<strong>Proc</strong>] and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
<tr>
<td><code>{9baud}</code></td>
<td>Baud Rate</td>
<td>[1200] 1200</td>
<td>[9600]</td>
<td>none*</td>
<td>Active if Output 4 is equipped for communications (97 _ <em>-</em> _ _ R-_ _ _ _ or 97 _ <em>-</em> _ _ U-_ _ _ _) and Setup Page Lock (Lockout Menu) is not set to [<strong>hid</strong>] E.</td>
</tr>
</tbody>
</table>

*Output 4 parameters cannot be changed with the Modbus interface.*

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

---

**Watlow Series 97 Parameters**

**Parameters 6.13**
### Address

Sets communications address.

<table>
<thead>
<tr>
<th><strong>Address</strong></th>
<th><strong>Range</strong></th>
<th><strong>Default</strong></th>
<th><strong>Modbus Address</strong></th>
<th><strong>Conditions for Parameters to Appear</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Addr</strong></td>
<td>1 to 247</td>
<td>1</td>
<td>none*</td>
<td>Active if Output 4 is equipped for communications (97 _ <em>-</em> _ _ R-_ _ _ _ or 97 _ <em>-</em> _ _ U-_ _ _ _) and Setup Page Lock (Lockout Menu) is not set to hide.</td>
</tr>
</tbody>
</table>

### Upper Display

Selects the value that will appear in the upper display. Alarm messages will toggle in the upper display if out of alarm range.

- **Pr1** actual temperature (0)
- **User** user message (1)
- **L hi** high limit set point (3)
- **L Lo** low limit set point (2)

<table>
<thead>
<tr>
<th><strong>Upper Display</strong></th>
<th><strong>Range</strong></th>
<th><strong>Default</strong></th>
<th><strong>Modbus Address</strong></th>
<th><strong>Conditions for Parameters to Appear</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UdSp</strong></td>
<td></td>
<td><strong>Pr1</strong></td>
<td>1400 r/w</td>
<td>Active: Always.</td>
</tr>
</tbody>
</table>

*Output 4 parameters cannot be changed with the Modbus interface.

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
<table>
<thead>
<tr>
<th>Display 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>Upper Limit</td>
<td>0: _</td>
<td></td>
<td>1401 r/w</td>
<td>Active if Upper Display [udSP] is set to [USER].</td>
</tr>
<tr>
<td></td>
<td>1: A</td>
<td></td>
<td>1402 r/w</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2: b</td>
<td></td>
<td>1403 r/w</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3: C</td>
<td></td>
<td>1404 r/w</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4: c</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5: d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6: E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7: e</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8: F</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>9: g</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10: H</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>11: h</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>12: I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13: i</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14: J</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>15: L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16: l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17: M (1st half)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18: M (2nd half)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>19: N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20: n</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21: O</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>22: o</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>23: P</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>24: r</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>25: S</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>26: t</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>27: U</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>28: u</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>29: W (1st half)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30: W (2nd half)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>31: backwards “C”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>32: backwards “c”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>33: y</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>34: 0</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>35: 1</td>
<td></td>
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<td></td>
<td>36: 2</td>
<td></td>
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<td></td>
<td>37: 3</td>
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<td></td>
<td>38: 4</td>
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<td></td>
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<td></td>
<td>39: 5</td>
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<td></td>
<td>40: 6</td>
<td></td>
<td></td>
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<td></td>
<td>41: 7</td>
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<td></td>
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<tr>
<td></td>
<td>42: 8</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>43: 9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>44: blank</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>45: .</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>46: .</td>
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<td></td>
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<tr>
<td></td>
<td>47: -1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>48: li</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>49: il</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>50: ll</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>51: i</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>52: l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>53: l</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>54: °</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
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<tr>
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<th>Modbus Address</th>
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</tr>
</thead>
<tbody>
<tr>
<td>LdSP</td>
<td>Lower Display</td>
<td>limit status (0): SAFE; h,</td>
<td>lSk</td>
<td>1405 r/w</td>
<td>Active: Always.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lo</td>
<td>USER</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>USER</td>
<td>user message (1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lh</td>
<td>high limit set point (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lo</td>
<td>low limit set point (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lo S</td>
<td>Lower Display User Safe Message</td>
<td>see Upper Display User Limit Message</td>
<td></td>
<td>1406 r/w</td>
<td>Active if Lower Display LdSP is set to USER.</td>
</tr>
<tr>
<td>Lo L</td>
<td>Lower Display User Limit Message</td>
<td>see Upper Display User Limit Message</td>
<td></td>
<td>1410 r/w</td>
<td>Active if Lower Display LdSP is set to USER.</td>
</tr>
</tbody>
</table>

**Global Menu**

**Setup Page**

<table>
<thead>
<tr>
<th>C-F</th>
<th>C or F</th>
<th>Celsius (1)</th>
<th>OF</th>
<th>901 r/w</th>
<th>Active if Setup Page Lock (Lockout Menu) is not set to h dE.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fahrenheit (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Err</td>
<td>Input Error Latching</td>
<td>latching (0)</td>
<td>nLAT</td>
<td>607 r/w</td>
<td>Active if Setup Page Lock (Lockout Menu) is not set to h dE.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>no latching (1)</td>
<td>nLAT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

The factory page contains four menus:

<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><strong>Fcky</strong></td>
<td><strong>Factory Page Selection</strong></td>
<td></td>
<td></td>
<td></td>
<td>Active: Always</td>
</tr>
</tbody>
</table>

- **dIa9** | **Diagnostics Menu** | **LOC** | Lockout Menu | **cin1** | Active: Always |

- **Oper** | **Operations Page Mode Lock** | **LOC** | Factory Page | **cin1** | Active: Always |

- **See** | **Setup Page Lock** | **Loc** | Factory Page | **cin1** | Active: Always |

- **IaL** | **Calibration Menu Lock** | **Loc** | Factory Page | **cin1** | Active: Always |

- **dIa9** | **Diagnostics Menu** | **Loc** | **Factory Page** | **cin1** | Active: Always |

<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><strong>MdL</strong></td>
<td><strong>Model Number</strong></td>
<td></td>
<td></td>
<td></td>
<td>Active: Always</td>
</tr>
</tbody>
</table>

- **Cal** | **Calibration Menu** | | | | Active: Always |

<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><strong>Oper</strong></td>
<td><strong>Operations Page Mode Lock</strong></td>
<td></td>
<td></td>
<td></td>
<td>Active: Always</td>
</tr>
</tbody>
</table>

- **SEE** | **Setup Page Lock** | | | | Active: Always |

- **CAL** | **Calibration Menu Lock** | | | | Active: Always |

- **DIA** | **Diagnostics Menu** | | | | Active: Always |

- **MdL** | **Model Number** | | | | Active: Always |

- **Cal** | **Calibration Menu** | | | | Active: Always |

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
<table>
<thead>
<tr>
<th>Display Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Number 1</td>
<td>0 to 9999</td>
<td>none</td>
<td>1 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Serial Number 2</td>
<td>0 to 9999</td>
<td>none</td>
<td>2 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Software ID Number</td>
<td>0 to 9999</td>
<td>none</td>
<td>3 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Software Revision</td>
<td>0.00 to 99.99</td>
<td>none</td>
<td>4 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Input 2 Hardware Enabled</td>
<td>none (0)</td>
<td>none</td>
<td>9 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Output 1 Hardware</td>
<td>$\text{rel}_1$ relay (1)</td>
<td>$\text{rel}_1$ relay (1)</td>
<td>16 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Output 2 Hardware</td>
<td>$\text{rel}_1$ relay (1)</td>
<td>$\text{rel}_1$ relay (1)</td>
<td>17 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Output 3 Hardware</td>
<td>none (0)</td>
<td>none</td>
<td>18 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td>Output 4 Hardware</td>
<td>none (0)</td>
<td>none</td>
<td>19 r</td>
<td>Active: Always</td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller's operation, see Chapter Five, Features.
<table>
<thead>
<tr>
<th>Display</th>
<th>Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test Output</td>
<td>none (0)</td>
<td>none</td>
<td>1514 r/w</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>Test Display</td>
<td>off (0)</td>
<td>off</td>
<td>1513 r/w</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>High Resolution</td>
<td>0.0 to 99.9</td>
<td>none</td>
<td>1707 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>Ambient Temperature</td>
<td>none</td>
<td>none</td>
<td>1500 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>Ambient A-D Counts</td>
<td>none</td>
<td>none</td>
<td>1501 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>Channel 1 A-D Counts</td>
<td>none</td>
<td>none</td>
<td>1504 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>Channel 2 A-D Counts</td>
<td>none</td>
<td>none</td>
<td>1505 r</td>
<td>Active: Always</td>
</tr>
<tr>
<td></td>
<td>Communication Test and Troubleshooting</td>
<td>none</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Line Frequency</td>
<td>none</td>
<td>none</td>
<td>1515 r</td>
<td>Active: Always</td>
</tr>
</tbody>
</table>

**NOTE:** For more information about how parameter settings affect the controller’s operation, see Chapter Five, Features.
<table>
<thead>
<tr>
<th>Display Parameter</th>
<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Calibration Menu</strong></td>
<td></td>
<td></td>
<td>1601 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td><strong>Factory Page</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>r5E</strong> Restore Factory Calibration</td>
<td>no (0)</td>
<td>yes (1)</td>
<td>1602 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>dTlt</strong> Default Settings</td>
<td>no (0)</td>
<td>yes (800)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>c5o</strong> Thermocouple Calibration, 50mV</td>
<td>no (0)</td>
<td>yes (2)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>c00</strong> Thermocouple Calibration, 0mV</td>
<td>no (0)</td>
<td>yes (1)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>c32</strong> Thermocouple Calibration, 32º</td>
<td>no (0)</td>
<td>yes (3)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>gnd</strong> Set Ground</td>
<td>no (0)</td>
<td>yes (4)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lrd</strong> Lead Resistance Calibration</td>
<td>no (0)</td>
<td>yes (5)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>r15</strong> RTD Calibration, 15Ω</td>
<td>no (0)</td>
<td>yes (6)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>r380</strong> RTD Calibration, 380Ω</td>
<td>no (0)</td>
<td>yes (7)</td>
<td>1603 w</td>
<td>Active if Calibration Lock (Lockout Menu) is not set to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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<th>Range</th>
<th>Default</th>
<th>Modbus Address</th>
<th>Conditions for Parameters to Appear</th>
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<td>0.00 to 99.99</td>
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<td>1619 w</td>
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<tr>
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<td>0.00 to 99.99</td>
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<td>1620 w</td>
<td>Active if Output 4 is process (97 _ _ _ _ M _ _ _ _) and Calibration Lock (Lockout Menu) is not set to [hidE]</td>
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<td>Active if Output 4 is process (97 _ _ _ _ M _ _ _ _) and Calibration Lock (Lockout Menu) is not set to [hidE]</td>
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</table>

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

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# Troubleshooting Alarms and Errors

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<td>- No power.</td>
<td>• Power to unit may be off.</td>
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<tr>
<td></td>
<td>• Fuse may be blown.</td>
</tr>
<tr>
<td></td>
<td>• Breaker may be tripped.</td>
</tr>
<tr>
<td></td>
<td>• Safety interlock door switch etc. may be activated.</td>
</tr>
<tr>
<td></td>
<td>• Wiring may be open.</td>
</tr>
<tr>
<td></td>
<td>• Input Power may not be hooked up to pins 8 and 9.</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td></td>
</tr>
<tr>
<td>- Unit will not communicate.</td>
<td>• Address parameter may be incorrectly set.</td>
</tr>
<tr>
<td></td>
<td>• Baud rate parameter may be incorrectly set.</td>
</tr>
<tr>
<td></td>
<td>• Unit-to-unit daisy chain may be disconnected.</td>
</tr>
<tr>
<td></td>
<td>• Communications wiring may be reversed, short or open.</td>
</tr>
<tr>
<td></td>
<td>• EIA-485 converter box may be incorrectly wired.</td>
</tr>
<tr>
<td></td>
<td>• Computer COM port may be incorrectly set up.</td>
</tr>
<tr>
<td></td>
<td>• Communications software setup or address may be incorrect.</td>
</tr>
<tr>
<td></td>
<td>• Protocol or parity may be wrong, should be 8, n, 1.</td>
</tr>
<tr>
<td></td>
<td>• Application software not working properly.</td>
</tr>
<tr>
<td></td>
<td>• May need termination and pull-up and pull-down resistors.</td>
</tr>
<tr>
<td><strong>Input Error</strong></td>
<td>(error number in top display, percent power in bottom)</td>
</tr>
<tr>
<td>- Input is in error condition.</td>
<td>• The sensor may be improperly wired.</td>
</tr>
<tr>
<td><strong>Err 1</strong> Underflow</td>
<td>• Sensor wiring may be reversed, shorted or open.</td>
</tr>
<tr>
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<td>• Input type setting may be for the wrong sensor / may not be calibrated.</td>
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<tr>
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<td>• Power may be incorrect.</td>
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<td><strong>Err 4</strong> Overflow</td>
<td>• Ambient temperature may be too hot or too cold.</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<td><strong>Alarms</strong></td>
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<td>- Alarm won't occur.</td>
<td>• Alarm output may be off.</td>
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<td>• Alarm set points may be incorrect.</td>
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<td>• Alarm may be silenced.</td>
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<td>• Alarm sides may be incorrect.</td>
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<td>• Controller may be in diagnostics mode.</td>
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<tr>
<td>- Alarm won't clear.</td>
<td>• Alarm may be latched.</td>
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<td></td>
<td>• Alarm set points may be incorrect.</td>
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<td></td>
<td>• Alarm hysteresis may be incorrect.</td>
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<td>• Input may be in error condition.</td>
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<td>(error number in top display, error message in bottom display)</td>
</tr>
<tr>
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<td>• There is a RAM malfunction.</td>
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<td><strong>Err 5</strong> EEC5</td>
<td>• The EEPROM data is corrupted.</td>
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<tr>
<td><strong>Err 6</strong> ROM</td>
<td>• There is a PROM malfunction.</td>
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<td><strong>Err 9</strong> Conf</td>
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<td>• Module changed.</td>
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<td><strong>Err 12</strong> Atod</td>
<td>• Calibration data is corrupted.</td>
</tr>
<tr>
<td><strong>Err 13</strong> Ethd</td>
<td>• There is an analog-to-digital hardware failure.</td>
</tr>
<tr>
<td><strong>Err 14</strong> EEP</td>
<td>• There is an EEPROM hardware problem.</td>
</tr>
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<td><strong>Err 15</strong> New</td>
<td>• It is the new unit's first power up.</td>
</tr>
<tr>
<td><strong>Err 16</strong> Addr</td>
<td>• There is an EEPROM hardware problem.</td>
</tr>
</tbody>
</table>
Corrective Action

- Check switches, fuses, breakers, interlocks, limits, connectors, etc. for energized condition and proper connection.

- Measure power upstream for required level. Check part number for input power required.
- Check wire size.
- Check for bad or incorrect connections.

- Check comms setup menu and set to correct address.
- Check comms setup menu and set to correct baud rate.
- Look for a break in the daisy chain.
- Verify correct connections and test wiring paths.
- Check converter box wiring and its documentation.
- Reconfigure computer's COM port setup and verify communications ok.
- Check the communication card documentation for setable variables and operational testing.
- Restart COMS software and check for settings agreement. Verify the COM bus is active.
- Verify operation with Watlow comms tool.

- Check sensor connections.
- Check sensor connections and sensor wiring.
- Change the Sensor Type parameter to match the sensor hardware.

- Measure power upstream for required level. Check part number for power requirements.
- Verify that the temperature surrounding the controller is 32 to 149°F (0 to 65°C).
- Check sensor function. The Open Loop Detect parameter indicates it may be broken.
- Check the Calibration Offset parameter value; set it to a lower level.

- Configure output as an alarm.
- Check alarm set points.
- To clear the alarm, correct the alarm condition; check to see if the alarm is latched.
- Check the alarm sides setting.
- Check the alarm type setting.
- Check the alarm logic for compatibility with system peripherals and annunciators.
- Check the power limit setting.
- Check the operation mode.
- Check the alarm output function.
- Check the °C or °F setting.
- Check the calibration offset value; set it to a lower level.

- Cycle power to unit. If problem persists, return unit to factory.
- Cycle power to unit.
Modbus Remote Terminal Unit (RTU)

Modbus RTU enables a computer or PLC to read and write directly to registers containing the controller’s parameters. With it you could read all 141 of the controller’s parameters with five read commands.

Because of the wide array of choices available for setting up a Series 97 controller, only a subset of the prompts contain parameters in a given situation. This manual explains the interrelations between prompts. A Modbus read command response of -32000 indicates that a register is not implemented; -32001, register not active; or -32002, not read accessible. A write command will return an exception response of 01 to indicate an illegal function, 02, illegal register; or 03, illegal data. If you try to write to an inactive prompt the controller will return an illegal data address message (02).

If you already have a software application that uses Modbus, you can simply skip to the Temperature/process Controller Prompt Table or the Modbus RTU Address Table in this chapter for the address information your program will need. The rest of this section on the Modbus provides information for writing a software application that uses Modbus.

Writing a Modbus Application

You need to code messages in eight-bit bytes, with no parity bit, one stop bit (8, n, 1). Negative parameter values must be written in twos complement format. Parameters are stored in two-byte registers accessed with read and write commands to a relative address.

Messages are sent in packets that are delimited by a pause at least as long as the time it takes to send 30 bits. To determine this time in seconds, divide 30 by your baud rate.

Because changing some parameters automatically changes or defaults other parameters, use the Complete Parameter Download Sequence table in this chapter to order write commands.

Using a controller address of 0x00 for a write command broadcasts that command to all the controllers in the network. This is a powerful feature if all the controllers on a network use all or most of the same parameters.

Packet Syntax

Each message packet begins with a one-byte controller address, from 0x01 to 0xF7. The second byte in the message packet identifies the message command: read (0x03 or 0x04); write (0x06 or 0x10); or loop back (0x08).

The next n bytes of the message packet contain register addresses and/or data.

The last two bytes in the message packet contain a two-byte Cyclical Redundancy Checksum (CRC) for error detection.

NOTE: For more information about communicating with Watlow controllers, go to www.watlow.com and download the Data Communications Reference: Electronic User’s Manual. It is located under Literature, User’s Manuals, English and search on data communications reference.
Packet format:

| nn | nn | nn nn… | nn nn |

- address
- command
- registers and/or data
- CRC

Read Multiple Registers Command (0x03 or 0x04)

This command returns from 1 to 32 registers.

Packet sent to controller:

| nn | 03 | nn nn | 00 | nn nn |

- controller address (one byte)
- read command (0x03 or 0x04)
- starting register high byte
- starting register low byte
- number of registers high byte (0x00)
- number of registers low byte
- CRC low byte
- CRC high byte

Packet returned by controller:

| nn | 03 | nn | nn nn… nn nn | nn nn |

- controller address (one byte)
- read command (0x03 or 0x04)
- number of bytes (one byte)
- first register data high byte
- first register data low byte
- register n data high byte
- register n data low byte
- CRC low byte
- CRC high byte
Example: Read register 0 (model number) of the controller at address 1.
Sent: 01 03 00 00 00 01 84 0A
Received: 01 03 02 00 61 79 AC
Message: 97 (0x0061).

Example: Read register 1 and 2 (Serial number 1 and Serial number 2) of controller at address 5.
Sent: 05 03 00 01 00 02 94 4F
Received: 05 03 04 00 64 00 C8 FF BA
Message: 100 (0x0064) and 200 (0x00C8).

Write to a Single Register Command (0x06)
This command writes a parameter to a single register. The controller will echo back the command. An attempt to write to a read-only parameter returns an illegal data address error (0x02).

Packet sent to controller: 
| n | 6 | n | n | n | n |
controller address (one byte)
write to a register command (0x06)
register high byte
register low byte
data high byte
data low byte
CRC low byte
CRC high byte

Example: Set register 702 (High limit set point) to 200 (0x00C8) on controller at address 9.
Sent: 09 06 02 BE 00 C8 E8 88
Received: 09 06 02 BE 00 C8 E8 88

Write to Multiple Registers Command (0x10)
This command actually writes a parameter to only a single register. An attempt to write to a read-only parameter returns an illegal data address error (0x02).

**Packet sent to controller:**

```
| nn | 10 | nn nn | 00 01 | 02 | nn nn | nn nn |
```

- controller address (one byte)
- write to multiple registers command (0x10)
- starting register high byte
- starting register low byte
- number of registers to write high byte (0x00)
- number of registers to write low byte (must be 0x01)
- number of data bytes (must be 0x02)
- data high byte
- data low byte
- CRC low byte
- CRC high byte

**Packet returned by controller:**

```
| nn | 10 | nn nn | 00 01 | nn nn |
```

- controller address (one byte)
- write to multiple registers command (0x10)
- starting register high byte
- starting register low byte
- number of registers to write high byte (0x00)
- number of registers to write low byte (must be 0x01)
- CRC low byte
- CRC high byte

**Loop Back Command (0x08)**

This command simply echoes the message. This serves as a quick way to check your wiring.
Example: Run loop back test on controller at address 40 (0x28).
Sent: 28 08 55 66 77 88 31 B7
Received: 28 08 55 66 77 88 31 B7

Exception Responses
When a controller cannot process a command it returns an exception response and sets the high bit (0x80) of the command.
0x01 illegal command
0x02 illegal data address
0x03 illegal data value

Packet returned by controller: |nn|nn|nn|nn|nn|nn|
controller address (one byte)
command + 0x80
exception code (0x01 or 0x02 or 0x03)
CRC low byte
CRC high byte

Messages with the wrong format, timing or CRC are ignored. A read command sent to an inactive parameter returns 0x0000.

Example: Exception 01 - Command 02 is not supported.
Sent: 01 02 00 01 00 02 A8 0B
Received: 01 82 01 81 60

Example: Exception 02 - The parameter at register 45 (0x002D) is inactive.
Sent: 01 06 00 2D 00 01 D8 C3
Received: 01 86 02 C3 A1

Example: Exception 03 - Cannot write 12,000 (0x2EE0) to register 7, out of range, illegal data value.
Sent: 01 06 02 59 2E E0 44 49
Received: 01 86 03 81 82

**Cyclical Redundancy Checksum (CRC) Algorithm**

This C routine, `calc_crc()`, calculates the cyclical redundancy checksum, CRC, for a string of characters. The CRC is the result of dividing the string by 0xA001. Modbus applications calculate the packet’s CRC then append it to the packet.

```c
#define POLYNOMIAL 0xA001;

unsigned int calc_crc(unsigned char *start_of_packet, unsigned char *end_of_packet)
{
    unsigned int crc;
    unsigned char bit_count;
    unsigned char *char_ptr;

    /* Start at the beginning of the packet */
    char_ptr = start_of_packet;

    /* Initialize CRC */
    crc = 0xffffffff;

    /* Loop through the entire packet */
    do{
        /* Exclusive-OR the byte with the CRC */
        crc ^= (unsigned int)*char_ptr;

        /* Loop through all 8 data bits */
        bit_count = 0;
        do{
            /* If the LSB is 1, shift the CRC and XOR the polynomial mask with the CRC */
            if(crc & 0x0001){
                crc >>= 1;
                crc ^= POLYNOMIAL;
            }
            else{
                crc >>= 1;
            }
        } while(bit_count++ < 7);

    } while(char_ptr++ < end_of_packet);

    return(crc);
}
```
# Modbus Register Numbers

<table>
<thead>
<tr>
<th>Absolute</th>
<th>Relative</th>
<th>Parameters</th>
<th>Absolute</th>
<th>Relative</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>40001</td>
<td>0</td>
<td>Model Number</td>
<td>41402-41405</td>
<td>1401-1404</td>
<td>Upper Display User</td>
</tr>
<tr>
<td>40002</td>
<td>1</td>
<td>Serial Number 1</td>
<td>41406</td>
<td>1405</td>
<td>Limit Message (4 characters)</td>
</tr>
<tr>
<td>40003</td>
<td>2</td>
<td>Serial Number 2</td>
<td>41407-41410</td>
<td>1406-1409</td>
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</tr>
<tr>
<td>40004</td>
<td>3</td>
<td>Software ID Number</td>
<td>41411-41414</td>
<td>1410-1413</td>
<td>Lower Display User Safe Message (4 characters)</td>
</tr>
<tr>
<td>40005</td>
<td>4</td>
<td>Software Revision</td>
<td>41501</td>
<td>1500</td>
<td>Ambient Temperature</td>
</tr>
<tr>
<td>40006</td>
<td>5</td>
<td>Date of Manufacture</td>
<td>41502</td>
<td>1501</td>
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<td>40604</td>
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<td>Input Software Filter 1</td>
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<td>607</td>
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<td>Input 2</td>
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<td>Low Limit Set Point</td>
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Calibrating the Series 97

To enter the calibration menu, first warm up the unit, then enter the Factory Page by holding down the Reset Key and ⊗ for six seconds. Once in the Factory Page [Fcty] use the up-arrow ⊙ or down-arrow ◊ key to select a menu. The last two menus on the Factory Page are Input Calibration Menu [cin1] and Output Calibration Menu [cout]. If [Oty] is not a process output, the [cout] prompt will not appear.

You can restore the original factory calibration with Restore Factory Calibration [rSt] (Calibration 1 Menu) or revert to the default parameter range value with Default Settings [dFLt] (Calibration 1 Menu).

Figure A.11 — The Calibration Menus.
Thermocouple Input Procedure

Equipment

- Type J reference compensator with reference junction at 32°F/0°C, or type J thermocouple calibrator to 32°F/0°C.
- Precision millivolt source, 0 to 50mV minimum range, 0.002mV resolution.

Input 1 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Chapter Three and the Appendix).
2. Connect the millivolt source to terminals 6 (-) and 7 (+) with copper wire.
3. Enter 50.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 50mV \([tc50]\) (Input Calibration Menu) to \[Y\ES\]. Press the Advance Key \[\text{Adv}\] to store 50.000mV input and move to the next prompt.
4. Enter 0.000mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 0mV \([tc00]\) (Input Calibration Menu) to \[Y\ES\]. Press the Advance Key \[\text{Adv}\] to store 0.000mV input and move to the next prompt.
5. Disconnect the millivolt source and connect the reference compensator or thermocouple calibrator to terminals 6 (-) and 7 (+). With type J thermocouple wire, if using a compensator, turn it on and short the input wires. When using a type J calibrator, set it to simulate 32°F/0°C. Allow 10 seconds for the controller to stabilize. Set Thermocouple Calibration, 32°F \([tc32]\) (Input Calibration Menu) to \[Y\ES\]. Press the Advance Key \[\text{Adv}\] to store type J thermocouple calibration and move to the next prompt.
6. Rewire for operation and verify calibration.

RTD Input Procedure

Equipment Required

- 1kΩ decade box with 0.01Ω resolution.

Input 1 Setup and Calibration

1. Connect the correct power supply to terminals 8 and 9 (see Chapter Three and the Appendix).
2. Short terminals 5, 6 and 7 together with less than 0.1Ω. Set Ground \[gnd\] (Input Calibration Menu) to \[Y\ES\]. Press the Advance Key \[\text{Adv}\] to store ground input and move to the next prompt.
3. Short terminals 5 and 7 together with less than 0.5Ω. Set Lead Resistance Calibration \[LEAd\] (Input Calibration Menu) to \[Y\ES\]. Press the Advance Key \[\text{Adv}\] to store the lead resistance and move to the next prompt.
4. Connect the decade box to terminals 5 (S2), 6 (S3) and 7 (S1), with 20- to 24-gauge wire.
5. Enter 15.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 15Ω \([r\_15]\) (Input Calibration Menu) to \[Y\ES\]. Press the Advance Key \[\text{Adv}\] to store the 15.00Ω input and move to the next prompt.
6. Enter 380.00Ω from the decade box. Allow at least 10 seconds to stabilize.
Set RTD Calibration, 380Ω [r380] (Input Calibration Menu) to [yES].
Press the Advance Key ✗ to store the 380.00Ω input and move to the next prompt.

7. Rewire for operation and verify calibration.

**Process Output Procedures**

**Equipment**

- Precision volt/ammeter with 3.5-digit resolution.

**Output 4 Setup and Calibration**

1. Connect the correct power supply to terminals 8 and 9 (see Chapter Three and the Appendix).

**Milliamperes**

2. Connect the volt/ammeter to terminals 20 (-) and 21 (+).

3. At Output Calibration 4, 4mA [4`4] (Output Calibration Menu) enter the reading from the ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 4.00mA, ±0.1mA. Press the Advance Key ✗ to store the value and move to the next prompt.

4. At Output Calibration 4, 20mA [4`20] (Output Calibration Menu) enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the ammeter reads 20.00mA, ±0.1mA. Press the Advance Key ✗ to store the value and move to the next prompt.

**Volts**

5. Connect the volt/ammeter to terminals 19 (+) and 20 (-).

6. At Output Calibration 4, 1V [4`1] (Output Calibration Menu) enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the voltmeter reads 1.00V, ±0.1V. Press the Advance Key ✗ to store the value and move to the next prompt.

7. At Output Calibration 4, 10V [4`10] (Output Calibration Menu) enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 10.00V, ±0.1V. Press the Advance Key ✗ to store the value and move to the next prompt.

8. Rewire for operation and verify calibration.
Glossary

annunciator — A visual display that uses pilot lights to indicate the former or existing condition of several items in a system.

burst fire — A power control method that repeatedly turns on and off full ac cycles. Also called zero-cross fire, it switches close to the zero-voltage point of the ac sine wave. Variable-time-base burst fire selectively holds or conducts ac cycles to achieve the desired power level. See zero cross.

calibration offset — An adjustment to eliminate the difference between the indicated value and the actual process value.

CJC — see cold junction compensation.

closed loop — A control system that uses a sensor to measure a process variable and makes decisions based on that feedback.

cold junction — see junction, cold.

cold junction compensation — Electronic means to compensate for the effective temperature at the cold junction.

default parameters — The programmed instructions that are permanently stored in the microprocessor software.

derivative — The rate of change in a process variable. Also known as rate. See PID.

derivative control (D) — The last term in the PID control algorithm. Action that anticipates the rate of change of the process, and compensates to minimize overshoot and undershoot. Derivative control is an instantaneous change of the control output in the same direction as the proportional error. This is caused by a change in the process variable (PV) that decreases over the time of the derivative (TD). The TD is in units of seconds.

Deutsche Industrial Norm (DIN) — A set of technical, scientific and dimensional standards developed in Germany. Many DIN standards have worldwide recognition.

DIN — See Deutsche Industrial Norm.

droop — In proportional controllers, the difference between set point and actual value after the system stabilizes.

duty cycle — The percentage of a cycle time in which the output is on.

external transmitter power supply — A dc voltage source that powers external devices.

filter, digital (DF) — A filter that slows the response of a system when inputs change unrealistically or too fast. Equivalent to a standard resistor-capacitor (RC) filter.

form A — A single-pole, single-throw relay that uses only the normally open (NO) and common contacts. These contacts close when the relay coil is energized. They open when power is removed from the coil.

form B — A single-pole, single-throw relay that uses only the normally closed (NC) and common contacts. These contacts open when the relay coil is energized. They close when power is removed from the coil.

form C — A single-pole, double-throw relay that uses the normally open (NO), normally closed (NC) and common contacts. The operator can choose to wire for a form A or form B contact.
**hysteresis** — A change in the process variable required to re-energize the control or alarm output. Sometimes called switching differential.

**integral** — Control action that automatically eliminates offset, or droop, between set point and actual process temperature. See auto-reset.

**integral control (I)** — A form of temperature control. The I of PID. See integral.

**isolation** — Electrical separation of sensor from high voltage circuitry. Allows use of grounded or ungrounded sensing element.

**Joint Industrial Standards (JIS)** — A Japanese agency that establishes and maintains standards for equipment and components. Also known as JISC (Japanese Industrial Standards Committee), its function is similar to Germany’s Deutsche Industrial Norm (DIN).

**junction, cold** — Connection point between thermocouple metals and the electronic instrument. See junction, reference.

**junction, reference** — The junction in a thermocouple circuit held at a stable, known temperature (cold junction). Standard reference temperature is 32°F (0°C).

**Modbus™** — A digital communications protocol owned by AEG Schneider Automation for industrial computer networks.

**Modbus™ RTU** — Remote Terminal Unit, an individual Modbus™-capable device on a network.

**NEMA 4X** — A NEMA specification for determining resistance to moisture infiltration. This rating certifies the controller as washable and corrosion resistant.

**on/off controller** — A temperature controller that operates in either full on or full off modes.

**open loop** — A control system with no sensory feedback.

**output** — Control signal action in response to the difference between set point and process variable.

**overshoot** — The amount by which a process variable exceeds the set point before it stabilizes.

**P control** — Proportioning control.

**PD control** — Proportioning control with derivative (rate) action.

**PDR control** — Proportional derivative control with manual reset, used in fast responding systems where the reset causes instabilities. With PDR control, an operator can enter a manual reset value that eliminates droop in the system.

**PI control** — Proportioning control with integral (auto-reset) action.

**PID** — Proportional, integral, derivative. A control mode with three functions: proportional action dampens the system response, integral corrects for droop, and derivative prevents overshoot and undershoot.

**proportional** — Output effort proportional to the error from set point. For example, if the proportional band is 20° and the process is 10° below set point, the heat proportioned effort is 50 percent. The lower the PB value, the higher the gain.
**proportional band (PB)** — A range in which the proportioning function of the control is active. Expressed in units, degrees or percent of span. See PID.

**proportional control** — A control using only the P (proportional) value of PID control.

**range** — The area between two limits in which a quantity or value is measured. It is usually described in terms of lower and upper limits.

**rate** — Anticipatory action that is based on the rate of temperature change, and compensates to minimize overshoot and undershoot. See derivative.

**rate band** — A range in which the rate function of a controller is active. Expressed in multiples of the proportional band. See PID.

**reference junction** — see junction, reference.

**remote** — A controller that receives its set point signal from another device called the master.

**remote set point** — A signal that indicates the set point for the process, and is sent from another device.

**reset** — Control action that automatically eliminates offset, or droop, between set point and actual process temperature. Also see integral.

  - **automatic reset** — The integral function of a PI or PID temperature controller that adjusts the process temperature to the set point after the system stabilizes. The inverse of integral.
  - **automatic power reset** — A feature in latching limit controls that does not recognize power outage as a limit condition. When power is restored, the output is re-energized automatically, as long as the temperature is within limits.
  - **manual reset** — 1) A feature on a limit control that requires human intervention to return the limit to normal operation after a limit condition has occurred. 2) The adjustment of a proportional control to raise the proportional band to compensate for droop.

**resistance temperature detector (RTD)** — A sensor that uses the resistance temperature characteristic to measure temperature. There are two basic types of RTDs: the wire RTD, which is usually made of platinum, and the thermistor, which is made of a semiconductor material. The wire RTD is a positive temperature coefficient sensor only, while the thermistor can have either a negative or positive temperature coefficient.

**RTD** — See resistance temperature detector.

**thermal system** — A regulated environment that consists of a heat source, heat transfer medium or load, sensing device and a control instrument.

**thermocouple (t/c)** — A temperature sensing device made by joining two dissimilar metals. This junction produces an electrical voltage in proportion to the difference in temperature between the hot junction (sensing junction) and the lead wire connection to the instrument (cold junction).

**thermocouple break protection** — The ability of a control to detect a break in the thermocouple circuit and take a predetermined action.

**three-mode control** — Proportioning control with integral (reset) and derivative (rate). Also see PID.
**time proportioning control** — A method of controlling power by varying the on/off duty cycle of an output. This variance is proportional to the difference between the set point and the actual process temperature.

**transmitter** — A device that transmits temperature data from either a thermocouple or a resistance temperature detector (RTD) by way of a two-wire loop. The loop has an external power supply. The transmitter acts as a variable resistor with respect to its input signal. Transmitters are desirable when long lead or extension wires produce unacceptable signal degradation.

**WatLink** — A Watlow software application for configuring and communication with Watlow controllers via a EIA-485 network and a Microsoft Windows-compatible personal computer.

**zero cross** — Action that provides output switching only at or near the zero-voltage crossing points of the ac sine wave. See burst fire.

**zero switching** — See zero cross.
Specifications

(2195)

Controller
- Microprocessor-based, user selectable control modes
- Input sample period; Single input 10Hz (100 msec), dual input 5Hz (200 msec) digital filter adjustable
- Display update; 2Hz (500 msec), time filter adjustable
- Input/Output/Communication isolation
- Displayed in °C or °F

Operator Interface
- Dual 4-digit LED displays: upper 10.2 mm (0.4 in), lower 6.2 mm (0.244 in)
- Advance, Up Arrow, Down Arrow, Reset tactile keys

Standard Conditions For Specifications
- Ambient temperature 25°C/77°F ±3°C, rated line voltage, 50 to 60Hz, 0 to 90% RH non-condensing, 15 minute warm-up

Universal Input 1
Thermocouple
- Type J, K, T, N, C (W5), E, PTII, D (W3), B, R, S thermocouple types
- >20MΩ input impedance
- Maximum 20Ω source resistance
- 30mA open detection bias

RTD
- 2- or 3-wire platinum, 100Ω
- DIN and JIS curves
- Whole or tenth degree indication
- 150µA nominal RTD excitation current

Input 2
Event Input
- Contact or voltage
- 20KΩ input impedance
- Voltage input: event high state 3 to 36V (dc), event low state 0 to 2V (dc)
- Resistance/contact input: event high state > 23kΩ, event low state 0 to 2kΩ

Output Types
Open Collector/Switched DC
- Open collector configuration:
  Maximum voltage 42V (dc)
  Maximum current 200mA
  Maximum “on” resistance 1.1Ω
  Maximum offstate leakage current 100µA
- Switched dc configuration:
  Switched dc supply voltage 22 to 28V (dc)
  dc supply current limited to 30mA

Solid-state Relay
- Optically isolated
- Zero cross switched
- Without contact suppression
- Minimum load current 0.5mA rms
- Maximum current 0.5A rms at 20 to 280V (ac)
- Maximum offstate leakage current 10µA rms
- For resistive loads only, must use RC suppression for inductive loads

Electromechanical Relay
- Form C contact configuration
- Minimum load current 10mA @ 5V (dc)
- Rated resistive and inductive loads: 2A @ 250V (ac) or 30V (dc) maximum
- Electrical life 100,000 cycles at rated current
- For resistive loads only, must use RC suppression for inductive loads

Retransmit
- Range selectable: 0-20mA, 4-20mA, 0-5V (dc), 1-5V (dc), 0-10V (dc)
- 0 to 10V (dc) voltage output into a 1,000Ω minimum load resistance
- 0 to 20mA current output into an 800Ω maximum load resistance
- Resolution:
  dc ranges = 2.5mV nominal
  mA ranges = 5µA nominal
- Calibration accuracy:
  dc ranges = ±15mV
  mA ranges = ±30µA
- Temperature stability 100ppm/°C

Communications
- EIA/TIA-485, EIA/TIA-232
- Opto-isolated
- Modbus™ RTU protocol
- 1200, 2400, 4800, 9600, 19200 baud rates
- 32 maximum units can be connected (With additional 485 repeater hardware, up to 247 units may be connected)

Accuracy
- Input ranges
  Type J: 32 to 1382°F or 0 to 750°C
  Type K: -328 to 2282°F or -200 to 1250°C
  Type T: -328 to 662°F or -200 to 350°C
  Type N: 32 to 2282°F or 0 to 1250°C
  Type E: -328 to 1470°F or -200 to 900°C
  Type C(W5): 32 to 4200°F or 0 to 2315°C
  Type D(W3): 32 to 4200°F or 0 to 2315°C
  Type PTII: 32 to 2540°F or 0 to 1393°C
  Type R: 32 to 2642°F or 0 to 1450°C
  Type S: 32 to 2642°F or 0 to 1450°C
  Type B: 1598 to 3092°F or 870 to 1700°C
  DIN: -328 to 1166°F or -200 to 630°C
  JIS: -328 to 1166°F or -200 to 630°C
- Output ranges
  Type J: 32 to 1382°F or 0 to 750°C
  Type K: -328 to 2282°F or -200 to 1250°C
  Type T: -328 to 662°F or -200 to 350°C
  Type N: 32 to 2282°F or 0 to 1250°C
  Type E: -328 to 1470°F or -200 to 900°C
  Type C(W5): 32 to 4200°F or 0 to 2315°C
  Type D(W3): 32 to 4200°F or 0 to 2315°C
  Type PTII: 32 to 2540°F or 0 to 1393°C
  Type R: 32 to 2642°F or 0 to 1450°C
  Type S: 32 to 2642°F or 0 to 1450°C
  Type B: 1598 to 3092°F or 870 to 1700°C
  DIN: -328 to 1166°F or -200 to 630°C
  JIS: -328 to 1166°F or -200 to 630°C

Thermocouple Inputs
- Calibration accuracy ±0.1% of span ±1°C at standard conditions
- Exceptions:
  Type T: 0.12% of span for -200°C to -50°C,
  Types R and S: 0.15% of span for 0°C to 100°C
  Types B: 0.24% of span for 870°C to 1700°C
- Accuracy span: 540 C/1000°F minimum
- Temperature stability: ±0.1 degree per degree change in ambient

Appendix Watlow Series 97
RTD Inputs
• Calibration accuracy ±0.1% of span ±1°C at standard conditions
• Accuracy span: 540°C/1000°F minimum
• Temperature stability: ±0.05 degree per degree change in ambient

Agency Approvals
• FM Class 3545 File J1. 1B5A6.AF, Temperature Limit Switches, Indicating
• CE EN 61326 Industrial Immunity, Class A emissions and EN61010-1 Safety standard.
• IP65, UL 50 Recognized Enclosure (Nema 4X & 12)

Terminals
• Touch safe
• 22 to 12 AWG

Power
• 100-240V~ (ac) +10%, -15%; 50/60Hz, ±5%
• 24-28V~ (ac) or Vm (dc) +10%, -15%; 50/60Hz, ±5%
• 7.0 VA maximum power consumption
• Data retention upon power failure via nonvolatile memory

Operating Environment
• 0 to 65°C, 32 to 149°F
• 0 to 90% RH, non-condensing
• Storage temperature: -40 to 85°C, -40 to 185°F

Dimensions
• Width 52 mm or 2.05 in
• Height 52 mm or 2.05 in
• Length 107 mm or 4.2 in
• Depth behind panel surface 98.4 mm or 3.875 in
• Approximate controller weight 0.2 kg (0.4 lbs)

Allowable Operating Ranges
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Note: These specifications are subject to change without prior notice.

Modbus™ is a trademark of AEG Schneider Automation.
UL® is a registered trademark of the Underwriter’s Laboratories, Inc.
Ordering Information

(1635)

Series 97
Microprocessor-based 1/8 DIN
with thermocouple and RTD input 1.
Options include: software, power
supply, input 2, four outputs and
display color

Power Supply
A = 100-240V (ac)
B = 24-28V (ac/dc)

Input 2
0 = None
1 = Event input

Output 1
D = Electromechanical relay, Form C,
2A, without RC suppression

Output 2
A = None
C = Switched dc output/open collector
D = Electromechanical relay, Form C,
2A, without RC suppression
K = 0.5A solid-state relay without
RC suppression

Output 3
A = None
D = Electromechanical relay, Form C,
2A, without RC suppression

Output 4
A = None
D = Electromechanical relay, Form C,
2A, without RC suppression
R = 232 Communications
U = 485 Communications
M = Universal Retransmit, range selectable: 0-20mA,
4-20mA, 0-5V (dc), 1-5V (dc),
0-10V (dc)

Software/Preset Parameters
00 = Standard software

Display/Overlay
Upper/Lower
RR = Red/Red display
RG = Red/Green display
GR = Green/Red display
GG = Green/Green display
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Declaration of Conformity

Series 97

WATLOW Winona, Inc.
1241 Bundy Boulevard
Winona, Minnesota 55987 USA

Declarations of Conformity.

Declares that the following product: English
Designation: Series 97
Model Number(s): 97(A or B) (0 or 1) - D (A, C, D or K) (A or D) (A, D, R, U or M) - (Any four letters or numbers)
Classification: Temperature control, Installation Category II, Pollution degree 2
Rated Voltage: 100 to 240V ac or 24 to 28V ac or dc
Rated Frequency: 50 or 60 Hz
Rated Power Consumption: 7VA maximum
Meets the essential requirements of the following European Union Directives by using the relevant standards show below to indicate compliance.

89/336/EEC Electromagnetic Compatibility Directive
EN 61000-4:3-1997 – Radiated Field Immunity
EN 61000-4:4-1995 – Electrical Fast-Transient / Burst Immunity
EN 61000-4:6-1996 – Conducted Immunity
EN 61000-4:11-1994 Voltage Dips, Short Interruptions and Voltage Variations Immunity

73/23/EEC Low-Voltage Directive

73/23/EEC Directive on Electrical Equipment for Measurement, Control and Laboratory Use

389/89/EEC Electromagnetic Compatibility Directive
EN 89/389/EEC Electromagnetic Compatibility Directive

Declaration of Conformity

Declarata que el producto siguiente:

Designation: Serie 97
Números de modelo: 97 (A o B) (0 o 1) - D (A, C, D o K) (A o D) (A, D, R, U o M) - (Cualquier combinación de cuatro números y letras)
Clasificación: Control de temperatura, Clase de instalación II, Grado de contaminación 2
Tensión nominal: 100 a 240V (CA) o 24 a 28 V< (CA o CD)
Frecuencia nominal: 50 o 60 Hz
Consumo nominal de energía: 7 VA máximo
Cumple con los requisitos esenciales de las siguientes Directrices de la Unión Europea mediante el uso de las normas aplicables que se muestran a continuación para indicar su conformidad.

73/23/EEC Direktiv de compatibilidad electromagnética
EN 61000-4:2-1996 con A1, 1998 – Inmunidad a descarga electrostática
EN 61000-4:3-1997 – Inmunidad a campo radiado
EN 61000-4:4-1995 – Inmunidad a incremento repentino/rápidas fluctuaciones eléctricas transitorias
EN 61000-4:5-1995 con A1, 1996 – Inmunidad a picos de voltaje o corriente
EN 61000-4:6-1996 – Inmunidad por conducción
EN 61000-4:11-1994 Inmunidad a caídas de voltaje, variaciones y pequeñas interrupciones de voltaje

73/23/EEC Direktiv de bajo voltaje

Jim Boigenzahn
Name of Authorized Representative
Winona, Minnesota, USA
Place of Issue
September, 2001
Date of Issue

Signature of Authorized Representative

(2196)
Enter your settings on a photocopy of this page.

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 Appendix.
How to Reach Us

Contact

Your Authorized Watlow Distributor is:

- Phone: (507) 454-5300.
- Fax: (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 a Series 97 Product Manager.

Warranty

The Watlow Series 97 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, and also on a written description of the problem.
- A restocking charge of 20% of the net price is charged for all standard units returned to stock.