Series SD

User's Manual

PID Temperature Controller

CE

TOTAL
CUSTOMER
SATISFACTION
3 Year Warranty

ISO 9001
Registered Company
Winona, Minnesota USA

WATLOW

1241 Bundy Boulevard., Winona, Minnesota USA 55987
Phone: +1 (507) 454-5300, Fax: +1 (507) 452-4507 http://www.watlow.com

0600-0041-0000 Rev. A
August 2002

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.

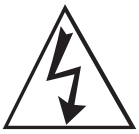
A “NOTE” marks a short message to alert you to an important detail.

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.

CAUTION or WARNING

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



Electrical Shock Hazard

CAUTION or WARNING

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, review 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 configuration of the controller, you can get technical assistance from your local Watlow representative (see back cover), or by dialing +1 (507) 494-5656 between 7 a.m. and 5 p.m., Central Standard Time (CST). Ask for for an Applications Engineer. Please have the following information available when calling:

- Complete model number
- All configuration information
- User’s Manual
- Factory Page

Warranty

The series SD is manufactured by ISO 9001-registered processes and is backed by a three-year warranty.

Return Material Authorization (RMA)

1. Call Watlow Customer Service, (507) 454-5300, for a Return Material Authorization (RMA) number before returning any item for repair. We need this information:

- Ship to address
- Bill to address
- Contact name
- Phone number
- Method of return shipment
- Your P.O. number
- Detailed description of the problem
- Any special instructions
- Name and phone number of person returning the product.

2. Prior approval and an RMA number, from the Customer Service Department, is needed when returning any unused product for credit. Make sure the RMA number is on the outside of the carton, and on all paperwork returned. Ship on a Freight Prepaid basis.

3. After we receive your return, we will examine it and determine the cause for your action.

4. In cases of manufacturing defect, we will enter a repair order, replacement order, or issue credit for material. A 20 percent restocking charge is applied for all returned stock controls and accessories.

5. If the unit is unrepairable, it will be returned to you with a letter of explanation. Repair costs will not exceed 50 percent of the original cost.

TC Table of Contents

Chapter 1: Overview 2

Chapter 2: Install and Wire 4

Dimensions 4

Installation 6

Wiring 11

Chapter 3: Keys and Displays 20

Home Page Overview 21

Operations Page Overview 21

Setup Page Overview 22

Programming Page Overview 23

Factory Page Overview 23

Chapter 4: Home Page 24

Chapter 5: Setup Page 25

Chapter 6: Operations Parameters Table 32

Chapter 7: Factory Page and Calibration 36

Chapter 8: Features 41

Saving and Restoring User Setings 42

Operations Page 42

Autotuning 42

Inputs 43

Control Methods 44

Alarms 48

Communications 50

Troubleshooting 52

Error Messages 54

Appendix 55

Specifications 55

Ordering Information 57

Index 58

Declaration of Conformity 61

1 Overview

The Watlow Series SD family of PID, microprocessor-based temperature controllers is available in 1/32, 1/16, 1/8 and 1/4 DIN panel mount sizes*. The Series SD has a single, universal input that accepts various thermocouples, RTDs (resistive temperature devices) or process inputs. (See the Specifications in the Appendix for further details).

The Series SD PID controllers offer up to two outputs on the 1/32 DIN, and up to three outputs on all others. Outputs can be configured as heat, cool, alarm or off (deactivated). The control outputs can be independently configured for PID or On-Off control. PID settings include proportional band, reset (or integral) and rate (or derivative).

Standard Series SD features include an IP65/NEMA 4X front panel rating; CE compliance; dual, four-digit displays in red or green**; autotuning for heat and cool outputs; ramp to set point, to gradually warm up your thermal system; and automatic/manual capability with bumpless transfer. A low-voltage model is also available.

Advanced features include Modbus, EIA-485 serial communications to interface with PC software applications; InfoSense™ technology that provides low-cost, high-accuracy thermal sensing; and infrared remote communication for easy-to-use controller setup and monitoring.***

Other operator-friendly features include LED indicators to aid in monitoring and setting up the controller, as well as a calibration offset at the front panel. The Watlow Series SD family automatically stores all information in non-volatile memory and provides an additional back-up for user-selected settings.

For more information on these and all other product features, refer to the Features Chapter and the Appendix.

* Also available in an FM-approved limit version.

** The 1/32 DIN controller comes only with a red left and green right display.

*** Not available in the 1/32 DIN size.

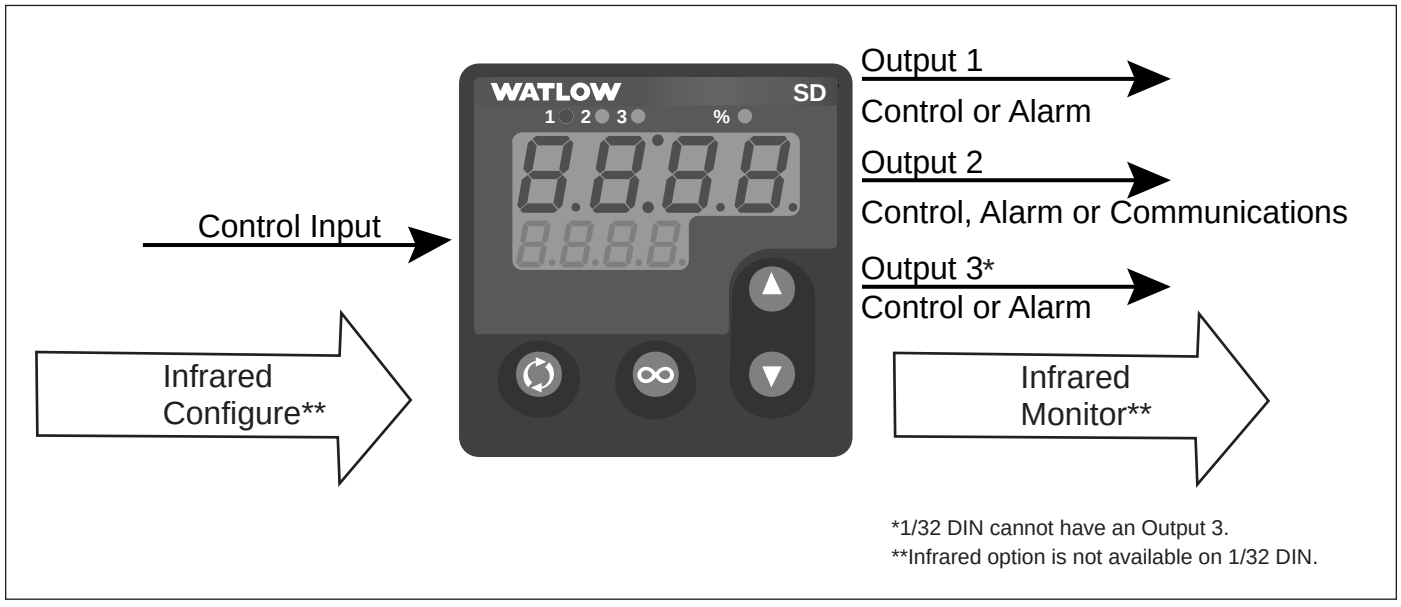


Figure 2 — Series SD inputs and outputs.

Features and Benefits

InfoSense™ Technology

- Improves sensor accuracy by a minimum of 50%.

Advanced Control Algorithm

- Improved process control.

WatView™ Software

- Operation, configuration and data logging with a standard Windows® PC. Contact Watlow or your local sales agent.

Infrared Communications

- Facilitates controller setup, operation and monitoring.

Up to three outputs (1/32 DIN two outputs only)

- Application versatility.

Dual Displays on all models

- Better monitoring of process changes.

Ramp to Set Point

- Controls the rate of temperature changes.

Available in an FM-approved limit version.

How to use the Series SD controller

Before you use your Series SD controller, it must be installed and configured correctly. **Which setup steps you need to perform will depend on how you will use it.**

If you purchased the controller to design into your products:

You will need to do the first three steps and maybe some of the fourth step. Some wiring, such as the final wiring of a communications connection or an alarm output for signaling an external device, might be left to the end user. In highly specialized applications with little variation in operation and heat load, the OEM might configure almost all the parameters.

If you purchased the controller to design and install into new equipment for your own use or to retrofit into existing equipment:

You will need to complete all four steps.

If you purchased the controller installed in equipment designed around it:

You will probably only need to do the fourth step. In some instances, you may need to wire it for serial communications and/or an alarm output. Some serial communications parameters on the Setup Page may need to be changed.

Step 1: Mount and install the controller.

The Series SD controller is designed to be panel mounted in a standard DIN opening. The Series SD is available in 1/32 DIN, 1/16 DIN, 1/8 DIN-horizontal, 1/8 DIN-vertical and 1/4 DIN sizes. Cut the correct size hole into the panel and mount the controller, using its mounting brackets. See Chapter Two for details on installation and mounting.

If you retrofit the Series SD controller into an existing application, you may need to modify an existing opening, either by cutting it larger for a larger controller or using a Watlow adapter plate to adapt it to a smaller controller.

Step 2: Wire the controller.

The controller will need to have its power, input and output wiring installed. The wiring depends on the specific model number of the Series SD controller. The dimension illustrations in Chapter Two show the location of the model number on each DIN size. Use the model number to determine which wiring diagrams to follow for your controller. See Chapter Two for wiring details.

Step 3: Configure the Setup Page.

Setup Page parameters tell the controller what input and output devices are wired to the controller and how the controller should function. Without the proper Setup Page settings, the controller will not operate or could operate erratically. Since these settings require detailed knowledge on the wiring and operation of the equipment, the OEM or the designer normally programs these parameters. Some settings, such as the baud rate or controller address, are Setup Page parameters, but would probably be set by the end user.

These settings should be recorded for future reference. The settings can also be stored using the USrS parameter, on the Factory Page. For saving and restoring parameters, see Chapter Eight, Features. For details on configuring the Setup Page, see Chapter Five, Setup Page.

Step 4: Configure the Operations Page.

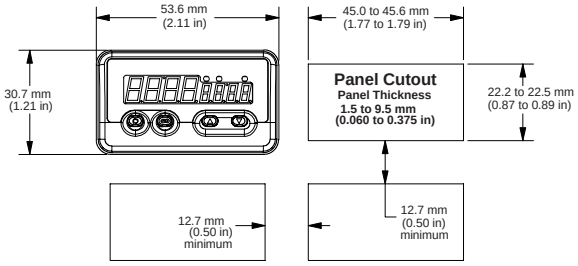
The Operations Page contains the parameters that the equipment operator may need to set or change from time to time. This includes calibration offset, autotune, PID parameters and alarm set points. In some cases the OEM manufacturer may set most of these parameters because the equipment operates with little variation (i.e., always the same temperature, always the same heat load). In equipment where demands could vary significantly, the OEM may leave parameter adjustments to the end user (i.e., many different temperature settings, different heat loads).

The Operations Page on the Series SD controller is customizable so that only the parameters that the operator may need to use will appear in the display. Settings that won't need to be adjusted can be hidden from the operator, using the Programing Page. For more details on the Programing Page, see Chapter Eight, Features. For details on configuring parameters in the Operations Page, see Chapter Six, Operations Parameters Tables.

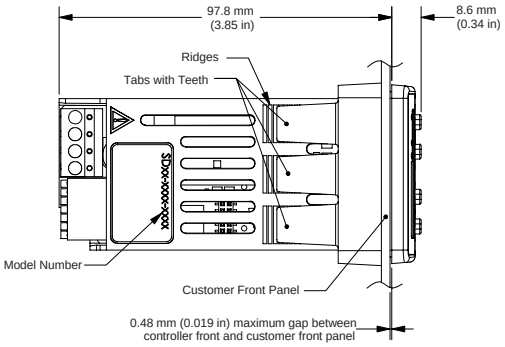
2 Install and Wire

1/32 DIN Series SD Controller Dimensions

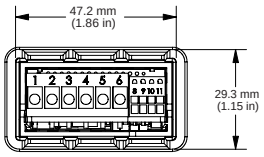
Front



Top



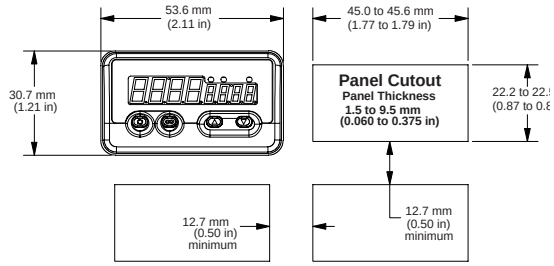
Back



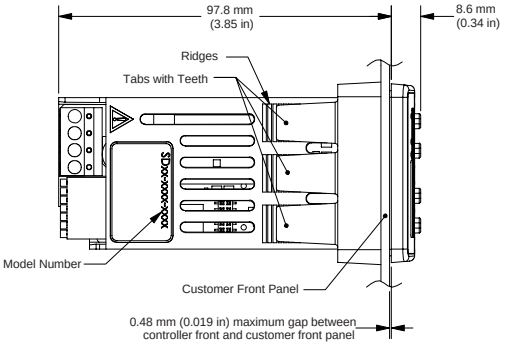
Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

1/16 DIN Series SD Controller Dimensions

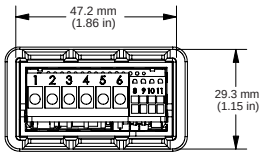
Front



Side



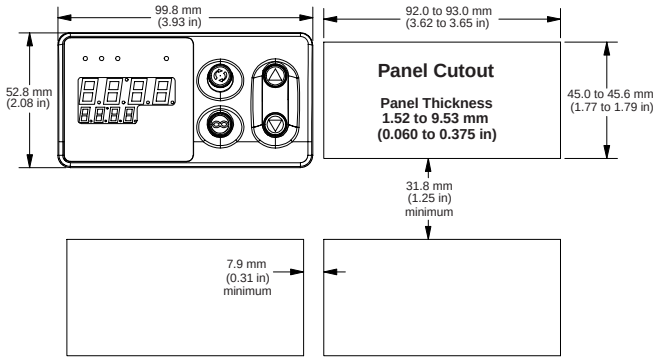
Back



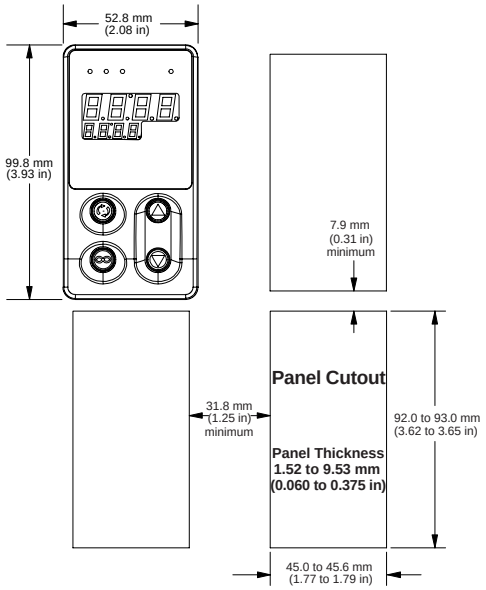
Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

1/8 DIN Series SD Controller Dimensions

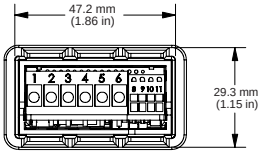
Front (horizontal)



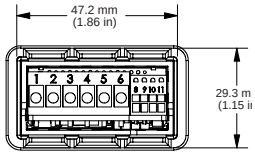
Front (vertical)



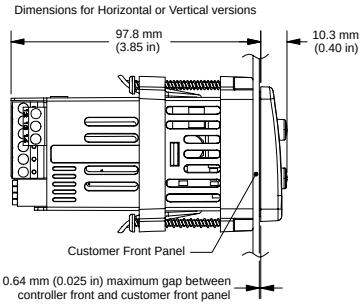
Back (horizontal)



Back (vertical)



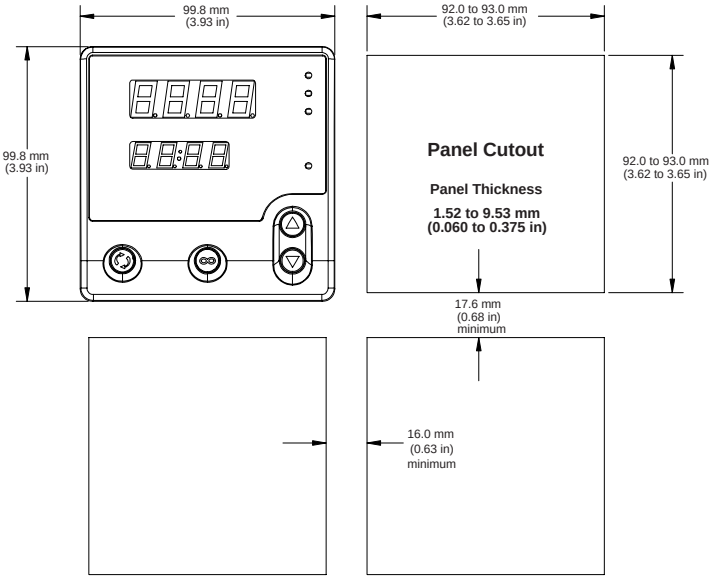
Side (horizontal)



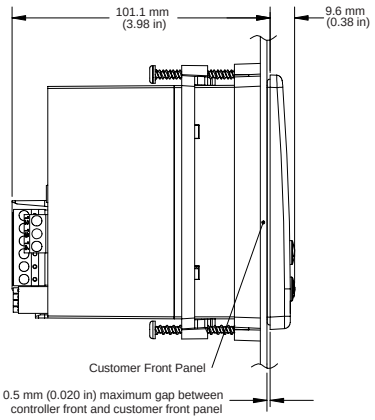
Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

1/4 DIN Series SD Controller Dimensions

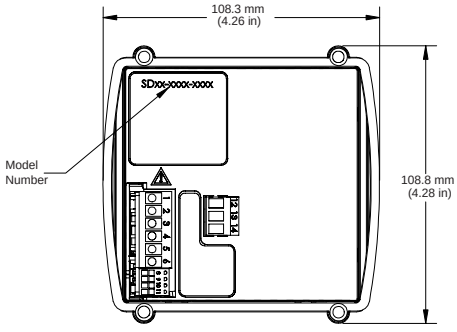
Front



Side



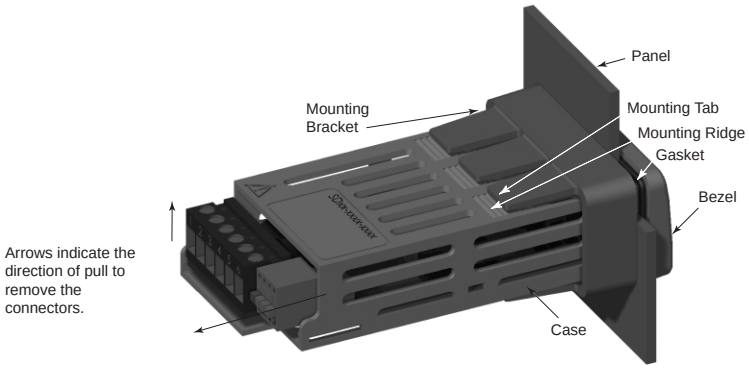
Back

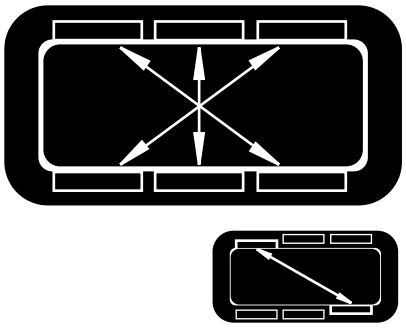


Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

Installing the 1/32 DIN Series SD Controller

Caution: Follow the installation procedure exactly to guarantee a proper IP65/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.





IP65/NEMA 4X Seal Example

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

1. Make the panel cutout using the mounting template dimensions in this chapter.
2. Check that the rubber gasket lies in its slot at the back of the bezel. Insert the controller into the panel cutout.
3. While pressing the bezel firmly against the panel, slide the mounting bracket over the back of the controller.
4. If the installation does not require an IP65/NEMA 4X seal, slide the bracket up to the back of the panel enough to eliminate the spacing between the gasket and the panel.

   For an IP65/NEMA 4X seal, use your thumb to lock the tabs into place while pressing the controller from side to side. Don't be afraid to apply enough pressure to properly install the controller. If you can move the controller back and forth in the cutout, you do not have a proper seal. The tabs on each side of the bracket have teeth that latch into the ridges.

   Each tooth is staggered at a different depth (from the front) so only one of the tabs on each side is ever locked into the ridges at any time. Either the two middle tabs or the two tabs diagonal from each other will be engaged.
5. If the matching tabs are not engaged, you do not have an IP65/NEMA 4X seal. The space between the bezel and panel must be 0 to 0.48 mm (0 to 0.019 in) maximum.

Removing the 1/32 DIN Controller

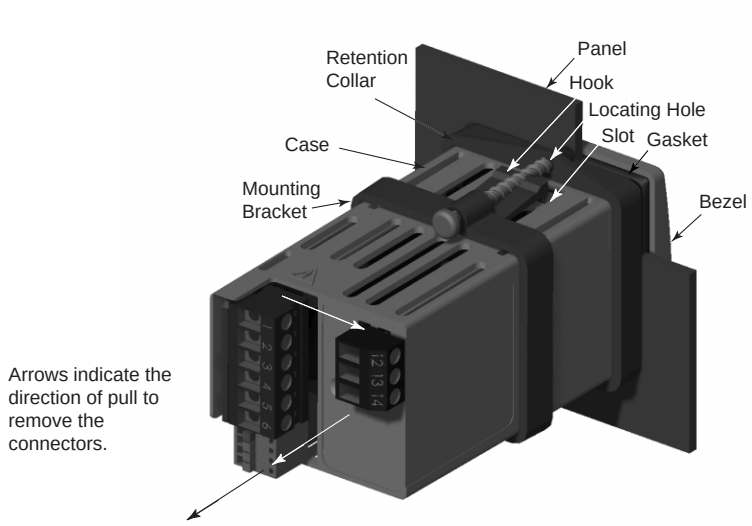
Tools required: Putty knife or equivalent

1. Remove all the wiring connectors from the back of the controller.
2. Slide a thin, wide tool (putty knife) under all three mounting tabs, top then bottom, while pushing forward on the back of the case. Be ready to support the controller as it slides out of the panel cutout.

Installing the 1/16 DIN Series SD Controller

Caution: Follow the installation procedure exactly to guarantee a proper IP65/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 overtighten the screws. This may cause the mounting bracket to fail. If the front bezel is touching the front panel, the mounting bracket is too tight.



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

Tools required: one #2 Phillips screwdriver

1. Make the panel cutout using the mounting template dimensions in this chapter.
2. Check that the rubber gasket lies in its slot at the back of the bezel. Insert the controller into the panel cutout. Slide the retention collar over the controller, with the locating holes on the top and bottom, facing the back of the controller.
3. Slide the mounting bracket over the back of the controller with the screw tips pointed toward the panel, aligning with the locating holes in the retention collar. Push it gently but firmly over the controller until the hooks snap into the slots at the front.
4. If the installation does not require an IP65/NEMA 4X seal, tighten the two screws with the Phillips screwdriver just enough to eliminate the spacing between the rubber gasket and the panel.

   For an IP65/NEMA 4X seal, tighten the two screws until the gap between the bezel and panel surface is 0.6 mm (0.024 in) maximum. Make sure that you cannot move the controller back and forth in the cutout. If you can, you do not have a proper seal. Do not over-tighten. Over-tightening could damage the mounting bracket.

Removing the 1/16 DIN Series SD Controller

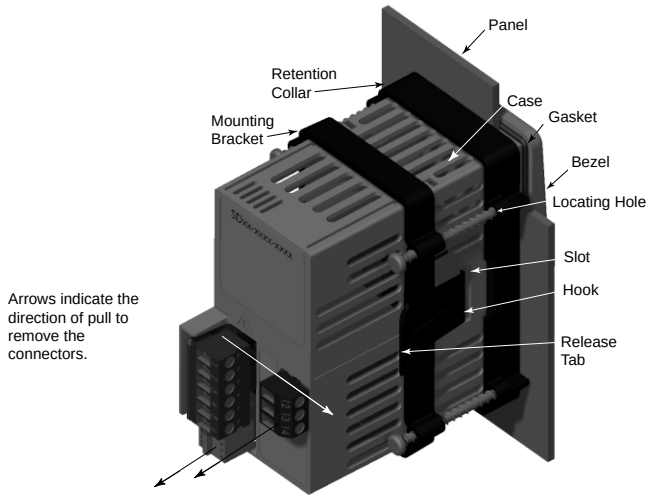
Tools required: one #2 Phillips screwdriver.

1. Remove all the wiring connectors from the back of the controller. While supporting the controller with one hand, use the Phillips screwdriver to unscrew the two screws on the mounting bracket until the tips are flush or past the end of the hooks.
2. Squeeze the two screws together on the mounting bracket to release the hooks from the slots and slide it off the controller. Remove the retention collar and push the controller out of the panel cutout. Be ready to support the controller as it comes through the front panel.

Installing the 1/8 DIN Series SD Controller

Caution: Follow the installation procedure exactly to guarantee a proper IP65/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 overtighten the screws. This may cause the mounting bracket to fail. If the front bezel is touching the front panel, the mounting bracket is too tight.



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

Tools required: one #2 Phillips screwdriver.

1. Make the panel cutout using the mounting template dimensions in this chapter.
2. Check that the rubber gasket lies in its slot at the back of the bezel. Insert the controller into the panel cutout. Slide the retention collar over the controller, with the locating holes facing the back of the controller.
3. Slide the mounting bracket over the back of the controller with the screw tips pointed toward the panel, aligning with the locating holes in the retention collar. Push it gently but firmly over the controller until the hooks snap into the slots at the front.
4. If the installation does not require an IP65/NEMA 4X seal, tighten the four screws with the Phillips screwdriver just enough to eliminate the spacing between the rubber gasket and the panel.

   For an IP65/NEMA 4X seal, tighten the four screws until the gap between the bezel and panel surface is 0.5 mm (0.020 in) maximum. Make sure that you cannot move the controller back and forth in the cutout. If you can, you do not have a proper seal. Do not over-tighten. Over-tightening could damage the the mounting bracket.

Removing the 1/8 DIN Controller

Tools required: one #2 Phillips screwdriver.

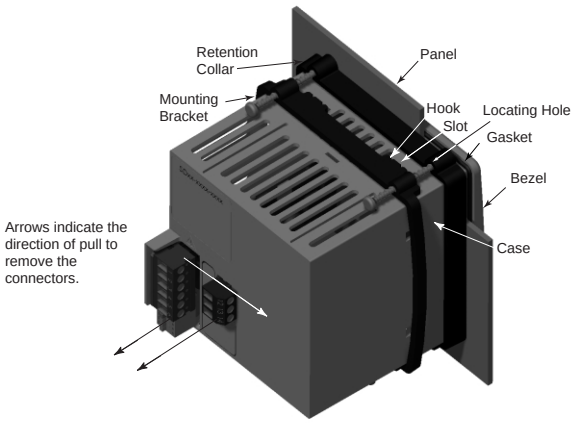
1. Remove all the wiring connectors from the back of the controller. Using the Phillips screwdriver, unscrew the four screws on the mounting bracket until they disengage from the retention collar.
2. Squeeze the release tabs on the long sides of the mounting bracket and slide the mounting bracket off the back of the controller. Remove the retention collar and push the controller out of the panel cutout. Be ready to support the controller as it comes through the front panel.

Installing the 1/4 DIN Series SD Controller

Caution: Follow the installation procedure exactly to guarantee a proper IP65/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 overtighten the screws. This may cause the mounting bracket to fail. If the front bezel is touching the front panel, the mounting bracket is too tight.

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



Tools required: one #2 Phillips screwdriver

1. Make the panel cutout using the mounting template dimensions in this chapter.
2. Check that the rubber gasket lies in its slot at the back of the bezel. Insert the controller into the panel cutout. Slide the retention collar over the controller, with the locating holes facing the back of the controller.
3. Slide the mounting bracket over the back of the controller with the screw tips pointed toward the panel, aligning with the locating holes in the retention collar. Push it gently but firmly over the controller until the hooks snap into the slots at the front.
4. If the installation does not require an IP65/NEMA 4X seal, tighten the four screws with the Phillips screwdriver just enough to eliminate the spacing between the rubber gasket and the panel.

   For an IP65/NEMA 4X seal, tighten the four screws until the gap between the bezel and panel surface is 0.5 mm (0.020 in) maximum. Make sure that you cannot move the controller back and forth in the cutout. If you can, you do not have a proper seal. Do not over-tighten. Over-tightening could damage the mounting bracket.

Removing the 1/4 DIN Series SD Controller

Tools required:
- **one #2 Phillips screwdriver**
- **one flat-head screwdriver**

1. Remove all the wiring connectors from the back of the controller. Using the Phillips screwdriver, unscrew the four screws on the mounting bracket (two on top, two on bottom) until they disengage from the retention collar.
2. Slide the tip of a flat screwdriver between the controller and the center top side of the mounting bracket. Rotate the screwdriver 90 degrees, stretching the bracket away from the controller so the hooks on the bracket disengage from the slots. Hold the bracket and press the controller forward slightly to prevent the disengaged hooks from snapping back into the slots.
3. Repeat this operation to disengage the hooks on the bottom side of the mounting bracket.
4. Press with one or two fingers on the lower half of the back of the unit so that the controller slides forward toward the panel. Hold the bracket steady; do not pull back. Be ready to support the controller as it comes through the front panel.

Series SD Family — Back Views in Scale

NOTE: The SD model number determines which diagram applies to your unit.

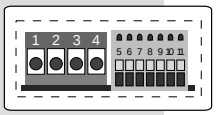


Figure 10a — 1/32 DIN with a Universal Process Output installed for output 1 (S D 3 _ - _ F _ _ - _ _ _ _).

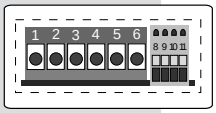


Figure 10b — 1/32 DIN with other than a Universal Process Output installed for output 1 (S D 3 _ - _ (C,K or J) _ _ - _ _ _ _).

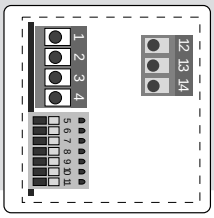


Figure 10c — 1/16 DIN with a Universal Process Output installed for output 1 (S D 6 _ - _ F _ _ - _ _ _ _).

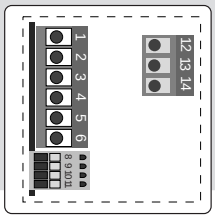


Figure 10d — 1/16 DIN with other than a Universal Process Output installed for output 1 (S D 6 _ - _ (C,K or J) _ _ - _ _ _ _).

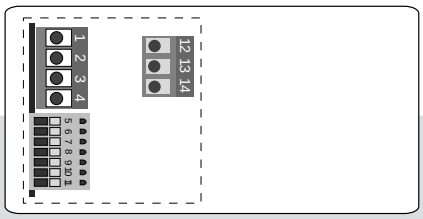


Figure 10e — 1/8 DIN Horizontal with a Universal Process Output installed for output 1 (S D 9 _ - _ F _ _ - _ _ _ _).

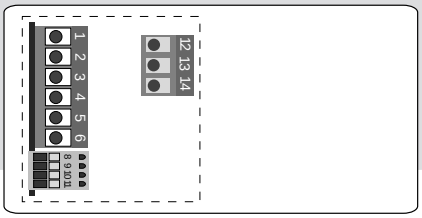


Figure 10f — 1/8 DIN Horizontal with other than a Universal Process Output installed for output 1 (S D 9 _ - _ (C,K or J) _ _ - _ _ _ _).

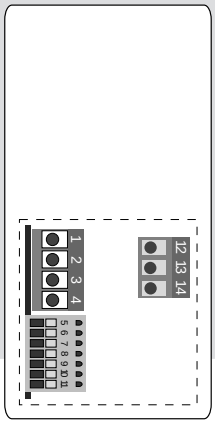


Figure 10g — 1/8 DIN Vertical with a Universal Process Output installed for output 1 (S D 8 _ - _ F _ _ - _ _ _ _).

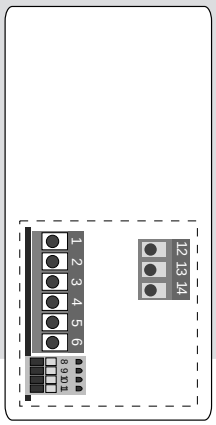


Figure 10h — 1/8 DIN Vertical with other than a Universal Process Output installed for output 1 (S D 8 _ - _ (C,K or J) _ _ - _ _ _).

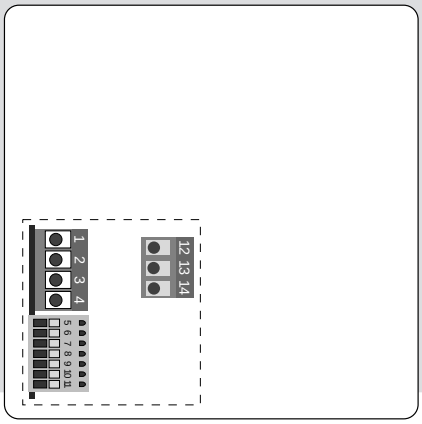


Figure 10i — 1/4 DIN with a Universal Process Output installed for output 1 (S D 4 _ - _ F _ _ - _ _ _ _).

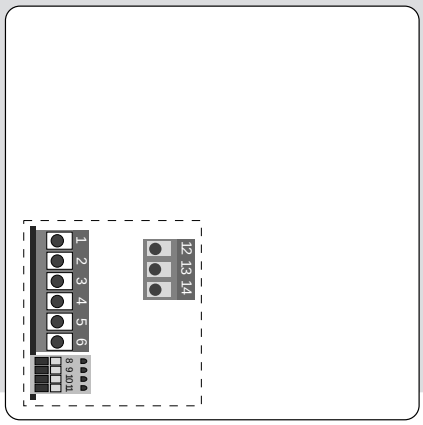


Figure 10j — 1/4 DIN with other than a Universal Process Output installed for output 1 (S D 4 _ - _ (C,K or J) _ _ - _ _ _ _).

NOTE:
Terminals 12, 13 and 14 are not installed on controllers without an output 3 (SD _ _-_ _ _ A-_ _ _ _).

Wiring the Series SD

Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

Isolation Blocks

There are no electrical connections between these blocks.

Sensor Input Switched DC Outputs Analog Process Outputs	Power Supply Input	EIA/TIA-485 Communications Input

Relay outputs (mechanical and solid-state) provide isolation through their relay contacts. Each relay output is isolated from the blocks above and is isolated from other relay outputs.

The model number for each output option appears with its wiring diagram. Check the label on the controller and compare your model number to those shown here and to the model number breakdown in the Appendix of this manual.

The connectors on the back of the Series SD are different for different model numbers. Where two different combinations of connectors may appear, we show both in the diagrams.

All outputs are referenced to a de-energized state.

All wiring and fusing must conform to the National Electric Code and to any locally applicable codes as well.

WARNING: If high voltage is applied to a low-voltage controller, irreversible damage will occur.

Figure 11a — High Voltage AC Power Wiring

SD_ _ - **H** _ _ _ - _ _ _ _ High

- Nominal voltage: 100 to 240V~ (ac)

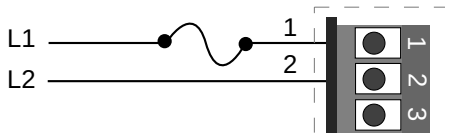
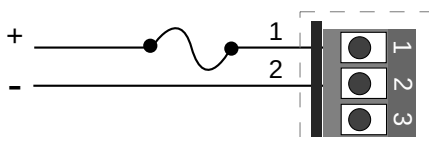


Figure 11b — Low Voltage AC Power Wiring

SD_ _ - **L** _ _ _ - _ _ _ _ Low

- Nominal voltage: 24≂ (ac/dc)
- Class 2 power source required for agency compliance



Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Spring clamp wiring connector note:
To insert the wire, push the wire into the desired connection number, and it should automatically lock into place. To remove the wire, press and hold the orange release tab with a small screwdriver. Pull the wire out of the connection.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

WARNING: Process input may not have sensor break protection. Outputs can remain full on.

Figure 12a — Thermocouple Input

(all model numbers)

Thermocouples are polarity sensitive. The negative lead (usually red) must be connected to terminal 11.

- Input impedance: >100 MΩ

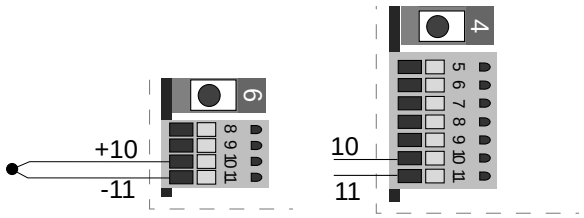


Figure 12b — RTD Input (100 Ω DIN curve 0.00385 Ω/Ω/°C)

(all model numbers)

Terminals 8 and 11 must be shorted for a two-wire RTD. For three-wire RTDs, the S1 lead (usually white) must be connected to terminal 10.

- Nominal excitation current: 390 mA

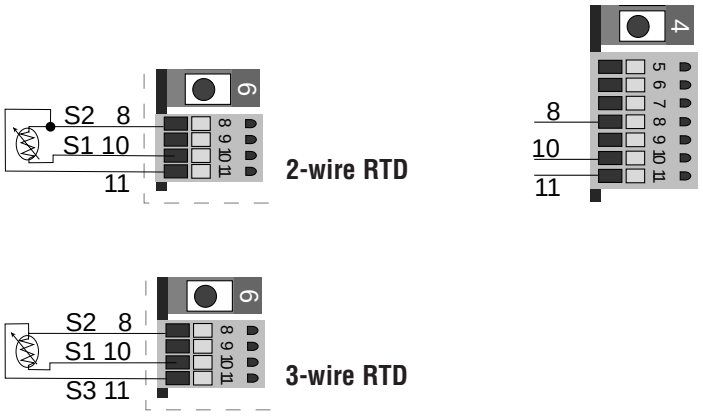
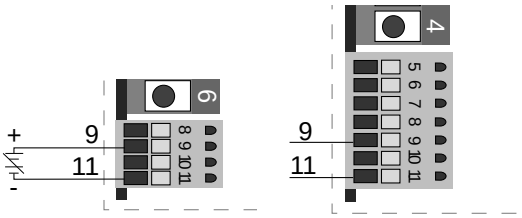


Figure 12c — 0 to 10V⎓ (dc) Process Input

(all model numbers)

- Input impedance 20 kΩ, dc only.



WARNING: Process input may not have sensor break protection. Outputs can remain full on.

Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Quencharc 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 Paktron. Watlow Part No. 0804-0147-0000.

Spring clamp wiring connector note:
To insert the wire, push the wire into the desired connection number, and it should automatically lock into place. To remove the wire, press and hold the orange release tab with a small screwdriver. Pull the wire out of the connection.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

Figure 13a — **0 to 20 mA Process Input**

(all model numbers)

- Input impedance 100 Ω, dc only.
- Controller does not supply power for the current loop.

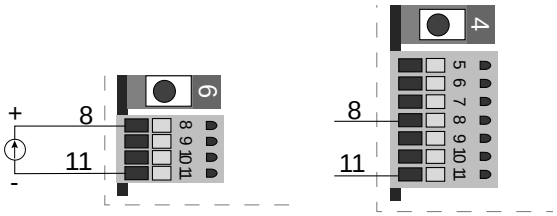
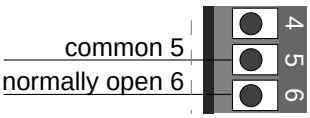


Figure 13b — **Output 1 Mechanical Relay**

SD_ _ - _ **J** _ _ - _ _ _ _

- 2 A, Form A.
- 240V~ (ac) maximum.
- 30V⎓ (dc) maximum.
- See Quencharc note.
- For use with ac or dc.
- Minimum load current 10 mA
- Output does not supply power.



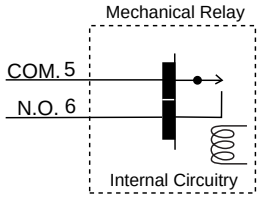
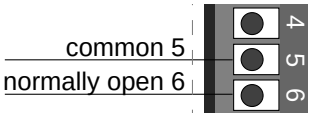
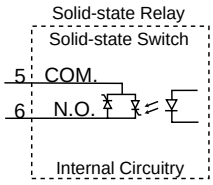


Figure 13c — **Output 1 Solid-state Relay**

SD_ _ - _ **K** _ _ - _ _ _ _

- 0.5 A maximum, Form A.
- 24 to 240V~ (ac).
- See Quencharc note.
- Minimum load current 10 mA
- Maximum leakage current 100 µA
- Not for use with direct current (dc).
- Output does not supply power.





Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Quencharc 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 Paktron. Watlow Part No. 0804-0147-0000.

Spring clamp wiring connector note:
To insert the wire, push the wire into the desired connection number, and it should automatically lock into place. To remove the wire, press and hold the orange release tab with a small screwdriver. Pull the wire out of the connection.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

Figure 14a — **Output 1 Switched DC**

SD_ _ - _ **C** _ _ - _ _ _ _

- Supply current 30 mA⎓ (dc) maximum.
- Supply voltage 6 to 12V⎓ (dc).
- Not recommended for switching mechanical relays.
- Output supplies power.

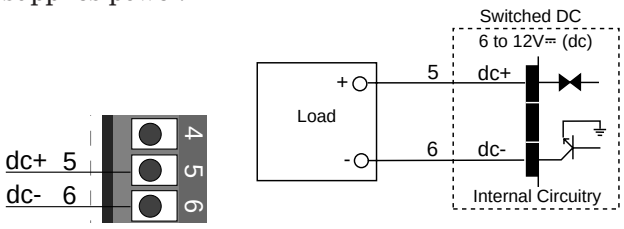


Figure 14b — **Output 1 Process**

SD_ _ - _ **F** _ _ - _ _ _ _

- Analog output is scalable between 0 to 10V⎓ (dc) or 0 to 20 mA⎓ (dc).
- Load capability: voltage 1 kΩ minimum; current 800 Ω maximum.
- Output supplies power.
- Cannot use voltage and current output at the same time.

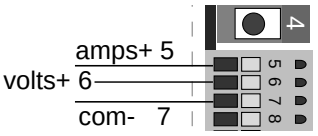
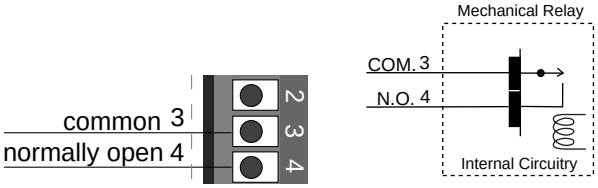


Figure 14c — **Output 2 Mechanical Relay**

SD_ _ - _ _ **J** _ - _ _ _ _

- 2 A; Form A.
- 240V~ (ac) maximum.
- 30V⎓ (dc) maximum.
- See Quencharc note.
- For use with ac or dc.
- Minimum load current: 10 mA
- Output does not supply power.



Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Quencharc 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 Paktron. Watlow Part No. 0804-0147-0000.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

Figure 15a — Output 2 Solid-state Relay

SD_ _ - _ _ **K** _ - _ _ _ _

- 0.5 A maximum, Form A.
- 24 to 240V~ (ac).
- See Quencharc note.
- Minimum load current 10mA
- Maximum leakage current 100µA
- Not for use with direct current (dc).
- Output does not supply power

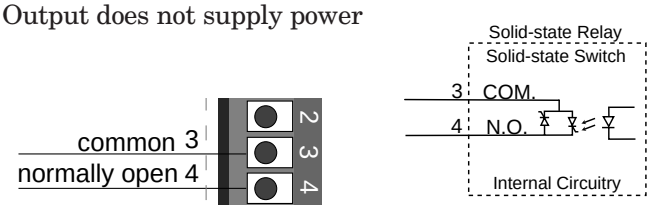


Figure 15b — Output 2 Switched DC

SD_ _ - _ _ **C** _ - _ _ _ _

- Maximum supply current 30 mA⎓ (dc).
- Supply voltage 6 to 12V⎓ (dc).
- Not recommended for switching mechanical relays.
- Output supplies power.

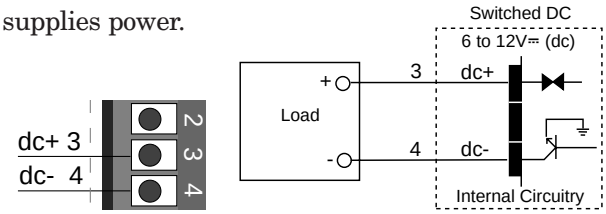
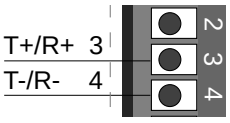


Figure 15c — Output 2 EIA/TIA-485

SD_ _ - _ _ **U** _ - _ _ _ _

- Isolated
- Half duplex
- For more communications information, see the Features chapter.



Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Quencharc 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 Paktron. Watlow Part No. 0804-0147-0000.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

Figure 16a — Output 3 Mechanical Relay

SD_ _ - _ _ _ **E** - _ _ _ _

- 5 A; Form C.
- 240V~ (ac) maximum.
- 30V⎓ (dc) maximum.
- See Quencharc note.
- For use with ac or dc.
- Minimum load current: 10 mA
- Output does not supply power.

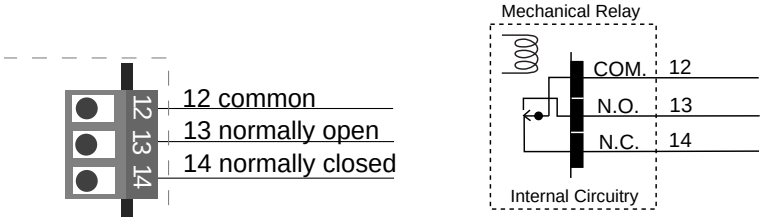


Figure 16b — Output 3 Solid-state Relay

SD_ _ - _ _ _ **K** - _ _ _ _

- 0.5 A maximum, Form A.
- 24 to 240V~ (ac).
- See Quencharc note.
- Minimum load current 10 mA
- Maximum leakage current 100 µA
- Not for use with direct current (dc).
- Output does not supply power.

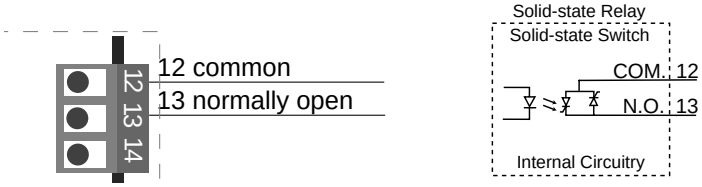
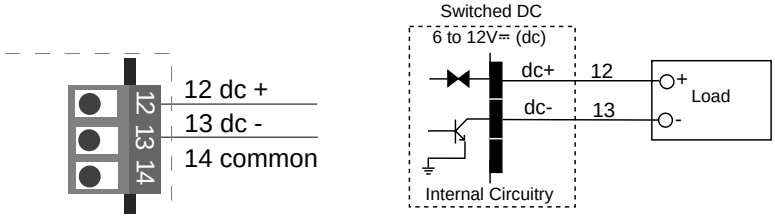


Figure 16c — Output 3 Switched DC

SD_ _ - _ _ _ **C** - _ _ _ _

- Maximum supply current 30 mA⎓ (dc).
- Supply voltage 6 to 12V⎓ (dc).
- Not for switching mechanical relays.
- Output supplies power.



Warning:
Use National Electric (NEC) or other country-specific standard wiring and safety practices when wiring and connecting this controller to a power source and to electrical sensors or peripheral devices. Failure to do so may result in damage to equipment and property, and/or injury or loss of life.

Quencharc 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 Paktron. Watlow Part No. 0804-0147-0000.

Note: To prevent ground loops, isolation needs to be maintained from input to output when using switched DC or analog process outputs.

Figure 17a — Output 3 Open Collector

SD_ _ - _ _ _ **C** - _ _ _ _

- Maximum current sink 250 mA⎓ (dc).
- Maximum supply voltage 42V⎓ (dc).
- For inductive loads, see Quencharc note.
- Output does not supply power.

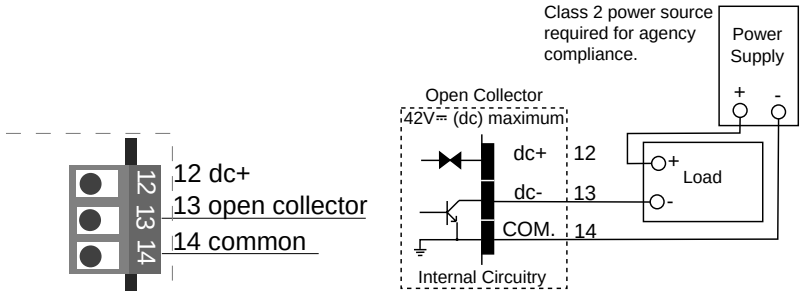
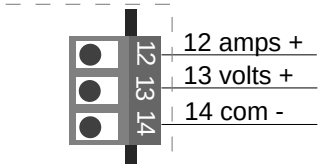


Figure 17b — Output 3 Process

SD_ _ - _ _ _ **F** - _ _ _ _

- Analog output scalable from 0 to 10V⎓ (dc) or 0 to 20 mA⎓ (dc).
- Load capability: voltage, 1 kΩ minimum; current, 800 Ω maximum.
- Output supplies power.
- Cannot use voltage and current output at the same time.



Selecting an EIA/TIA-232 to EIA/TIA-485 Converter

When choosing an EIA/TIA 232 to 485 converter, look for one with the following features:

Two-wire capability

EIA/TIA-485 can be implemented as a two-wire system or a four-wire system. Most Watlow controllers, including the Series SD, use two-wire communications when working with EIA/TIA-485. The converter selected must have a two-wire mode. Some converters can only be used in a four-wire mode.

Automatic Send Data control

In a two-wire system, both the transmitted signals and the received signals travel over the same pair of wires, so the converter must have a method of changing from the transmit mode to the receive mode. Some converters require the toggling of a control line (usually the RTS line) to perform this transition, while others use an automatic timing circuit. The toggling method is dependent on the PC software to toggle the control line and the PC's operating system to make that transition happen in a timely manner. Because of these dependencies, the best choice for a converter is one with automatic control.

Isolation

Converters are available with or without input-to-output isolation. An isolated converter is not a requirement when used with the Series SD, but it could be a consideration when the Series SD will be used on a network with other devices that may require isolation.

Power Supply

Many converters can be powered up either through the signals of a serial port or through an external power supply. Because some computers, such as laptops, do not always provide enough power to supply the converter, we recommend using an external power supply with specifications as recommended by the converter manufacturer. Isolated converters may require two supplies.

Biasing and termination

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 (3 and 4) of the last controller in the network and the converter box. Pull-up and pull-down resistors may be needed at the converter to maintain the correct voltage during the idle state. The pull-up resistor is connected between the positive of the DC supply and the T+/R+ terminal. The pull-down resistor is connected between the negative of the DC supply and the T-/R- terminal.

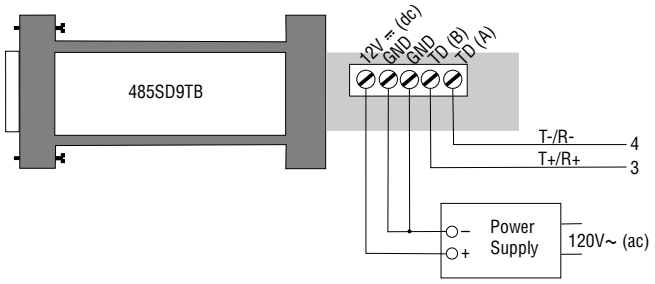


Figure 18a — B&B Converter.
B&B Electronics Manufacturing Company, (815) 433-5100, http://www.bb-elec.com/

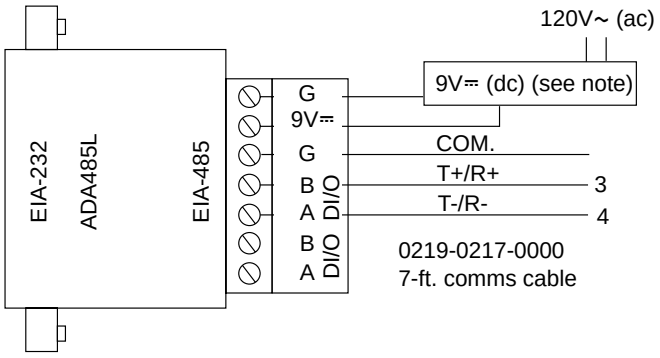


Figure 18b — CMC Converter.
CMC Connecticut Micro-Computer, Inc., 1-800-426-2872, http://www.2cmc.com/

NOTE:

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

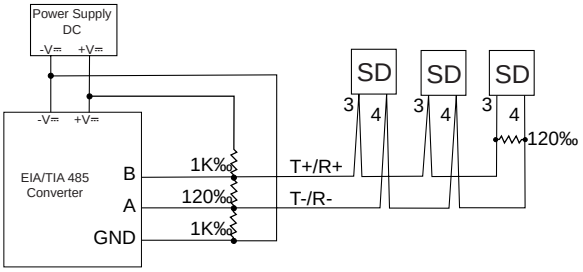


Figure 18c — Wiring bias and termination resistors.
Controllers must be wired in a daisy chain configuration.

Ethernet Gateway

The EM00-GATE-0000 is a gateway / bridge that allows up to 32 Series SD or other Watlow controllers to be directly connected to an Ethernet network. Using an HTTP Browser such as Microsoft Internet Explorer or Netscape Navigator you may access up to 16 controllers and view the Series SD controllers' parameters via an onboard Web (HTTP) server. The Ethernet gateway provides a means for monitoring and configuring runtime parameters of multiple controllers via a web browser.

The gateway is also a bridge for Modbus messages between the Ethernet bus and EIA-485 or EIA-232 links. The Gateway supports full product configuration monitoring and configuration of runtime parameters via MODBUS TCP over TCP/IP using a software package such as WatView sold by Watlow.

For more information, go to www.watlow.com and search on *EM Gateway*.

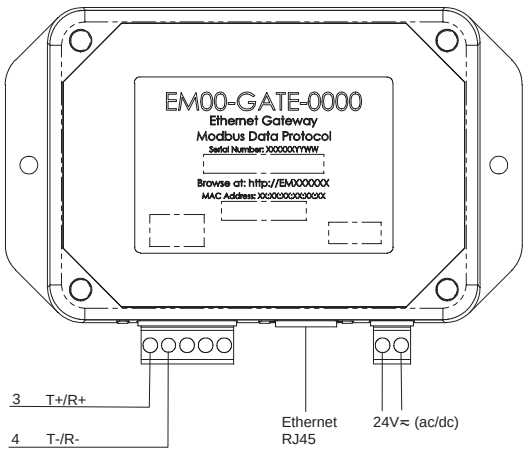


Figure 19a — Connecting to the Watlow EM Gateway (Ethernet to EIA/TIA 485 Serial Modbus connection). Controllers must be wired in a daisy chain configuration.

Note: UL Approved, Class 2, power supply required as EM Gateway power source: 24V⎓ (dc), part 0830-0474-000.

3 Keys and Displays

1/32 DIN

1/16 DIN

1/8 DIN Horizontal

1/8 DIN Vertical

1/4 DIN

Upper Display (Left Display on 1/32 DIN): Indicates the process in the Home Page, or the value of the parameter in the lower display in other pages.

Lower Display (Right Display on 1/32 DIN): Indicates the set point or output power value during operation, or the parameter whose value appears in the upper display.

1/32 DIN

Advance Key

Advances the lower display through parameter prompts.

Infinity Key

Returns to the Home Page.

Up and Down Keys

In the Home Page, adjusts the set point.

In other pages, changes the upper display to a higher or lower value.

1● 2○ 3○

Active Output Indicator Lights

Lit when the corresponding controller output or alarm is on.

%○

Auto-Manual Control Indicator Light

On: Manual Mode (open-loop control)

Off: Auto Mode (closed-loop control)

Note: After 60 seconds with no key presses, the controller reverts to the Home Page.

Home Page Overview

The Home Page is the default display of the Series SD controller. The process value is usually shown in the upper display.

Automatic Mode

The % indicator light is off.

75	Actual temperature
75	Temperature set point (Use Up ▲ or Down ▼ keys to raise or lower the set point.)

Manual Mode

The % indicator light is on.

75	Actual temperature
00	Output power setting (Use Up ▲ or Down ▼ keys to raise or lower the set point.)

Error condition

The % indicator light is on. If the controller was in Auto mode it will switch to Manual mode when it detects an input error.

- - - -	Dashed lines
Er In	Error message

Alarm Message

75 75 Process value

A1 Lo 75

Alarm message alternates with set point (auto) or power setting (manual).

The corresponding output indicator light is on.

During Ramping

The lower display alternates between the current set point achieved in the ramp and the target set point.

75	75	75	75	Actual temperature
rP	75	rP t9	100	
Current set point prompt	Current set point value	Ramp target prompts	Ramp target set point value	

Adjusting the set temperature

Adjust the temperature set point in the Home Page. It is not necessary to enter any other page. The temperature set point appears in the lower display. It only appears when the controller is in the automatic mode.

To adjust the set point:

1. Ensure the controller is in the automatic mode and the display is at the Home Page. If you are at any other page, press the Infinity Key ∞.
2. The temperature set point is displayed in the lower display window. Press the Up Key ▲ to increase the temperature. Press the Down Key ▼ to decrease the temperature.
3. The controller will automatically begin using the new set point after three seconds. Press the Infinity Key ∞ to override the three-second delay.

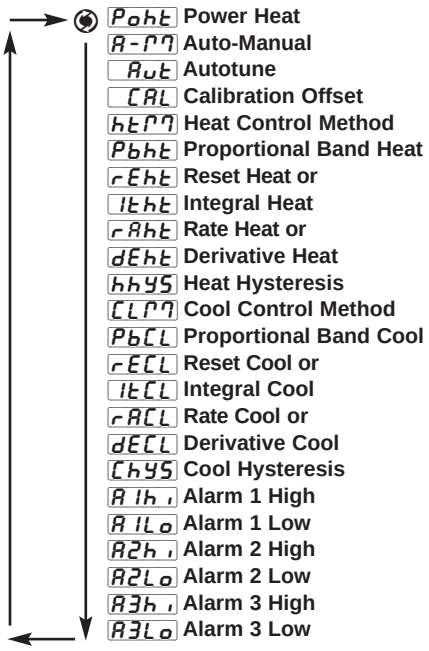
Note: The Loc parameter can lock the ability to adjust the set point. If you are having trouble adjusting the set point, check the Loc setting on the Setup Page.

Operations Page Overview

The Operations Page contains parameters accessed during normal day-to-day operation. The Series SD provides a patented user-definable menu system, allowing the user to customize the Operations Page contents. To go to the Operations Page, press the Advance Key ◉ once from the Home Page.

- Press the Advance Key ◉ to move through the parameter prompts. At the end of the operations parameters, press the Advance Key ◉ to return to the Home Page.
- Press the Up ▲ or Down ▼ keys to change the parameter value.
- Press the Infinity Key ∞ at any time to return to the Home Page.

Operations Page (defaults)



Note: Hardware configuration and programming selections determine what parameters appear on the Operations Page.

Caution:
The controller is in the manual mode when the percent LED % is lit. If the controller is in the manual mode, the number displayed in the lower display is the manual output power level. Setting this value can force an output to stay on regardless of the temperature reading. Always ensure you are in the automatic mode when adjusting the temperature set point.

Setup Page Overview

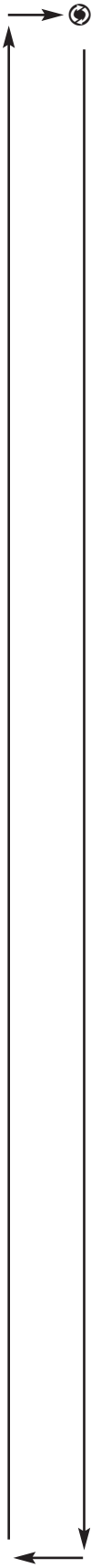
SEt PAGE

The Setup Page contains parameters that define basic controller functions. Go to the Setup Page for initial configuration or if your application requirements change. Be sure to program the Setup Page first!

To go to the Setup Page, press both the Up ▲ and Down ▼ keys for three seconds from the Home Page.

- Press the Advance Key ◉ to move through the parameter prompts.
- Press the Up ▲ or Down ▼ keys to change the parameter value.
- Press the Infinity Key ∞ at any time to return to the Home Page.

Note: Hardware configuration and programming selections determine what parameters appear on the Setup Page.



Setup Page

- SEn **Sensor Type**
- L in **Linearization**
- C-F **Temperature Units**
- SdEC **Temperature Decimal Places**
- PdEC **Process Decimal Places**
- ISEn **InfoSense Enable**
- ISP1 **InfoSense Point 1**
- ISP2 **InfoSense Point 2**
- ISP3 **InfoSense Point 3**
- ISP4 **InfoSense Point 4**
- ScLo **Process Scale Low**
- Sch i **Process Scale High**
- rGLo **Units Scale Low**
- rGh i **Units Scale High**
- SPLo **Set Point Low Limit**
- SPh i **Set Point High Limit**
- FtrE **Enable Input Filter**
- FLtr **Filter Value**
- Ot 1 **Output 1 Type**
- Ctr 1 **Control Method 1**
- Ftb1 **Fixed Time Base 1**
- PL 1 **Power Limit 1**
- PSL1 **Output Power Scale Low 1**
- PSH1 **Output Power Scale High 1**
- nLF1 **Output Nonlinear Function 1**
- A01U **Analog Output 1 Units**
- O1Lo **Analog Output 1 Scale Low**
- O1h i **Analog Output 1 Scale High**
- Ot 2 **Output 2 Function**
- Ctr2 **Control Method 2**
- Ftb2 **Fixed Time Base 2**
- PL 2 **Power Limit 2**
- PSL2 **Output Power Scale Low 2**
- PSH2 **Output Power Scale High 2**
- nLF2 **Output Nonlinear Function 2**
- Ot 3 **Output 3 Function**
- Ctr3 **Control Method 3**
- Ftb3 **Fixed Time Base 3**
- PL 3 **Power Limit 3**
- PSL3 **Output Power Scale Low 3**
- PSH3 **Output Power Scale High 3**
- nLF3 **Output Nonlinear Function 3**
- A03U **Analog Output 3 Units**
- O3Lo **Analog Output 3 Scale Low**
- O3h i **Analog Output 3 Scale High**
- hYS1 **Alarm 1 Hysteresis**
- L9c1 **Alarm 1 Logic**
- LAt1 **Alarm 1 Latching**
- S iL1 **Alarm 1 Silencing**
- dSP1 **Alarm 1 Message**
- hYS2 **Alarm 2 Hysteresis**
- L9c2 **Alarm 2 Logic**
- LAt2 **Alarm 2 Latching**
- S iL2 **Alarm 2 Silencing**
- dSP2 **Alarm 2 Message**
- hYS3 **Alarm 3 Hysteresis**
- L9c3 **Alarm 3 Logic**
- LAt3 **Alarm 3 Latching**
- S iL3 **Alarm 3 Silencing**
- dSP3 **Alarm 3 Message**
- Un it **Units of Measurement**
- IErr **Input Error Latching**
- FAIL **Input Error Failure Mode**
- InPn **Input Error Power**
- dSP **Active Displays**
- rP **Ramp to Set Point Mode**
- rPSc **Ramp Scale**
- rPrt **Ramp Rate**
- Addr **Modbus Device Address**
- bAud **Baud Rate**
- LOC **Lockout**

Programming Page Overview

PrOG PAGE

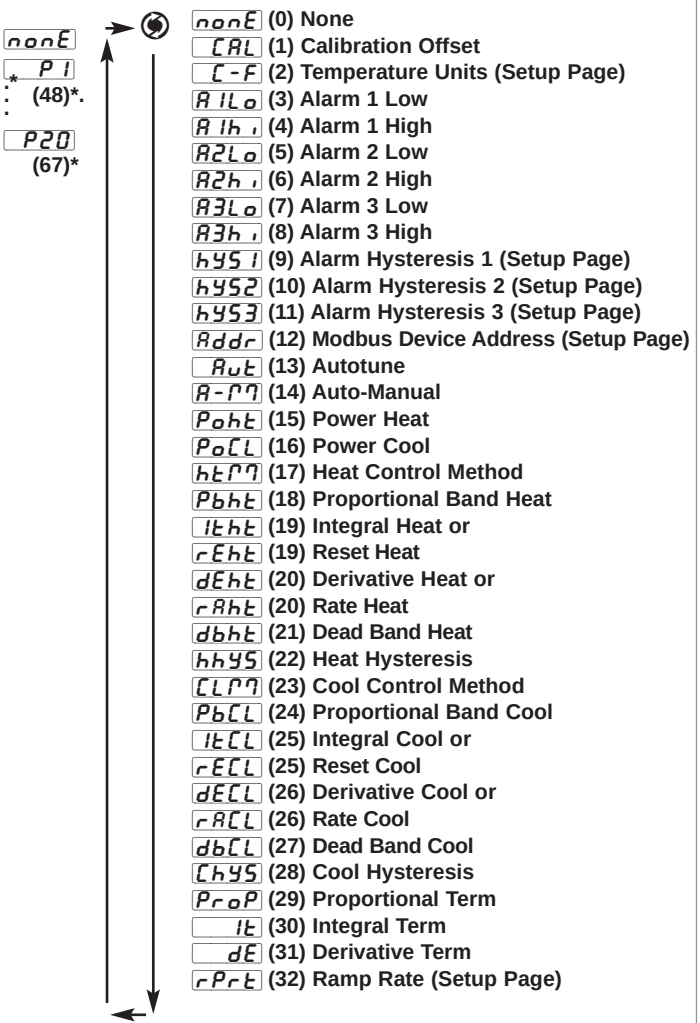
The Programming Page determines what parameters the user wants to appear on the Operations Page. Select a parameter for any of the 20 Programming Page locations, P1 to P20. These now appear on the Operations Page. All 20 locations have parameters selected as defaults.

To go to the Programming Page, hold down the Infinity key, then press the Advance Key, and hold both down for about six seconds.

- Press the Advance Key to move through the parameter prompts.
- Press the Up or Down keys to change the parameter value.
- Press the Infinity Key at any time to return to the Home Page.

Note: The hardware configuration and programming selections will also determine what parameters appear on the Operations Page. A Programming Page selection will not appear on the Operations Page if the parameter is not active.

Programming Page



***Programming Page parameters Modbus register numbers P1 through P20 are 48 through 67**

Factory Page Overview

FACt PAGE

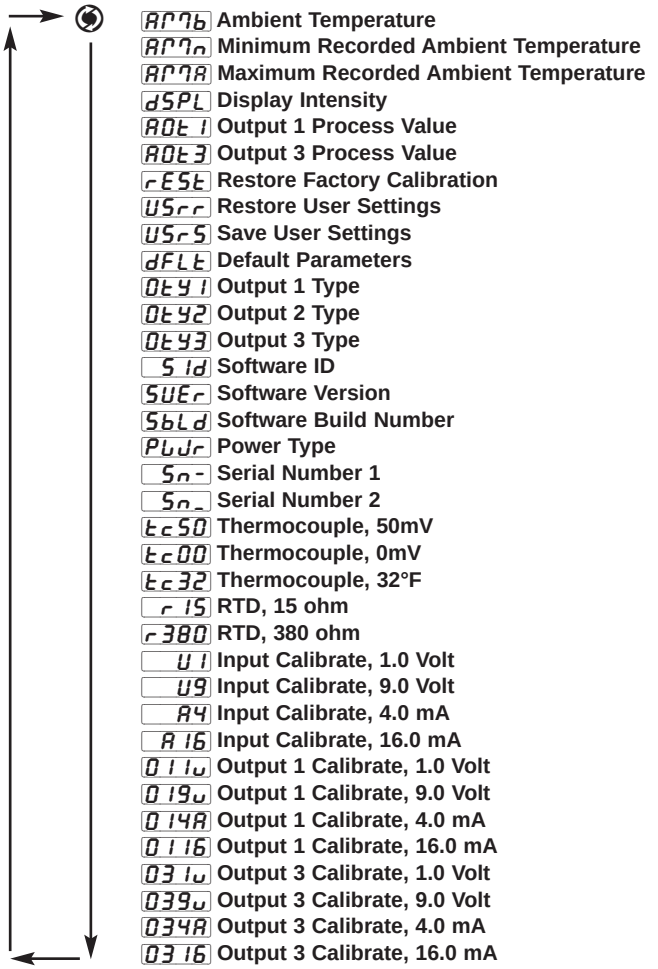
The Factory Page contains information on diagnostics, calibration and restore-parameter functions.

To go to the Factory Page, press both the Up and Down keys for six seconds from the Home Page.

- Press the Advance Key to move through the parameter prompts.
- Press the Up or Down keys to change the parameter value of Read/Write (R/W) parameters.
- Press the Infinity Key at any time to return to the Home Page.

Note: Hardware configuration and programming selections determine what parameters appear on the Factory Page.

Factory Page



4 Home Page

Press the Infinity Key ∞ at any time to go to the Home Page.

Depending upon the controller's status, you will see some combination of the parameters listed below. Normally, you will see the Process Value in the upper display and the Set Point in the lower display. See Home Page Overview in Chapter Three.

After 60 seconds with no key presses, the controller reverts to the Home Page.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
Measured Value	**Process Value** Displays the current process value in the upper (left in 1/32 DIN) display.		-1999 to 9999 degrees °F or units	NA	*20, 21 R	There is no input error and FtrE is set to OFF or Cont.
Set Value	**Closed Loop Set Point** Show the current closed loop control set point in the lower (right in 1/32 DIN) display.		Set Point Low Limit SPLo to Set Point High Limit SPh1	75	*27, 28 R/W	Control mode is Auto and there is no input error.
Measured Value	**Filtered Process Value** Displays the current filtered process value in the upper (left in 1/32 DIN) display.		-1999 to 9999 degrees °F or units	NA	*22, 23 R	There is no input error and FtrE is set to d1SP or both.
Set Value	**Open Loop Output Power** Show the current open loop (manual) control set point in the lower (right in 1/32 DIN) display. The % indicator light is on when the controller is in open loop (manual control).		-100.0 to 0.0% if any output is set to cool; 0.0 to 100.0% if any output is set to heat	0.0%	26 R/W	Control mode is MAn. If there is no input error and FtrE is set to OFF or Cont.
rP	**Current Ramp Set Point** The current working control set point for the ramp that is in process appears in the lower (right in 1/32 DIN) display after this prompt appears.		-1999 to 9999	NA	*254 255 R	Controller is ramping.
rPtg	**Ramp Target Set Point** The target set point for the ramp that is in process appears in the lower (right in 1/32 DIN) display after this prompt appears.		Set Point Low Limit SPLo to Set Point High Limit SPh1	NA	Same as Closed Loop Set Point	Controller is ramping.
Er In	**Input Error** Indicate an input error state.		None (0) ---- Error (1)	NA	24 R	There is an analog input error.
A1Lo	**Alarm Low 1 Status** Indicate a low alarm at output 1.		None (0) Alarm (1)	NA	29 R	There is an Alarm 1 low side alarm.
A1h1	**Alarm High 1 Status** Indicate a high alarm at output 1.		None (0) Alarm (1)	NA	30 R	There is an Alarm 1 high side alarm.
A2Lo	**Alarm Low 2 Status** Indicate a low alarm at output 2.		None (0) Alarm (1)	NA	31 R	There is an Alarm 2 low side alarm.
A2h1	**Alarm High 2 Status** Indicate a high alarm at output 2.		None (0) Alarm (1)	NA	32 R	There is an Alarm 2 high side alarm.
A3Lo	**Alarm Low 3 Status** Indicate a low alarm at output 3.		None (0) Alarm (1)	NA	33 R	There is an Alarm 3 low side alarm.
A3h1	**Alarm High 3 Status** Indicate a high alarm at output 3.		None (0) Alarm (1)	NA	34 R	There is an Alarm 3 high side alarm.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

5 Setup Page

To go to the Setup Page, press both the Up ▲ and Down ▼ keys for three seconds from the Home Page. SEt will appear in the upper display and PAGE will appear in the lower display.

- Press the Advance Key ◉ to move through the parameter prompts.
- Press the Up ▲ or Down ▼ keys to change the parameter value.
- Press the Infinity Key ∞ at any time to return to the Home Page display.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
SEn [SEn]	**Sensor Type** Set the analog sensor type.		tc (0) rtd (1) mA (2) volt (3)	tc (0)	70 R/W	Always active.
L in [Lin]	**Thermocouple Linearization** Set the analog input thermocouple linearization.		J (0) H (1) t (2) E (3) n (4) C (5) d (6) Pt II PTII (7) r (8) S (9) b (10)	tc J (0)	71 R/W	SEn is set to tc.
C-F [C-F]	**Temperature Units** Set the temperature units for thermocouple and RTD inputs.		F Fahrenheit (0) C Celsius (1)	F (0)	40 R/W	SEn is set to tc or rtd.
SdEC [S.dEC]	**Temperature Decimal Places** Set the decimal places for the displayed input value for thermocouple and RTD types.		0 (0) 0.0 (1)	0 (0)	41 R/W	SEn is set to tc or rtd.
PdEC [P.dEC]	**Process Decimal Places** Set the decimal places for the displayed input value for process types.		0 (0) 00 (1) 000 (2) 0000 (3)	0 (0)	42 R/W	SEn is set to mA or volt.
ISEn [IS.En]	**InfoSense™** Enable the sensor feature, which synchronizes the controller with a Watlow sensor.		no (0) YES (1)	No (0)	91 R/W	Always active.
ISP1 [IS.P1]	**InfoSense™ 1** Set sensor point 1 code.		0 to 999	500	92 R/W	ISEn is set to YES.
ISP2 [IS.P2]	**InfoSense™ 2** Set sensor point 2 code.		0 to 999	500	93 R/W	ISEn is set to YES.
ISP3 [IS.P3]	**InfoSense™ 3** Set sensor point 3 code.		0 to 999	500	94 R/W	ISEn is set to YES.
ISP4 [IS.P4]	**InfoSense™ 4** Set sensor point 4 code.		0 to 999	500	95 R/W	ISEn is set to YES.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
ScLo [Sc.Lo]	**Process Scale Low** Set the low scale for process inputs.		0.00 to 20.00 mA: if SEn is set to mA 0.00 to 10.00V: if SEn is set to volt	4.00 mA 0.00V	*73, 74 R/W (mA) *77, 78 R/W (V)	SEn is set to mA or volt.
Sch i [Sc.hi]	**Process Scale High** Set the high scale for process inputs.		0.00 to 20.00 mA: if SEn is set to mA 0.00 to 10.00V: if SEn is set to volt	20.00 mA 5.00V	*75, 76 R/W (mA) *79, 80 R/W (V)	SEn is set to mA or volt.
rGLo [rg.Lo]	**Units Scale Low** Set the low range for process input units.		-1999 to 9999 (Set precision with PdEC, Process Decimal	-1999	*81, 82 R/W	SEn is set to mA or volt.
rGh i [rg.hi]	**Units Scale High** Set the high range for process input units.		-1999 to 9999 (Set precision with PdEC, Process Decimal	9999	*83, 84 R/W	SEn is set to mA or volt.
SPLo [SP.Lo]	**Set Point Low Limit** Set the low range for the set point.		Min. operating range (of sensor) to SPH i -0.100: if SEn is set to tc -328 to SPh i -0.100: if SEn is set to rtd -1999 to SPh i -0.001: if SEn is set to mA or volt (Set precision with PdEC, Process Decimal	Min. operating range (J type): tc -328: rtd -999: mA and volt.	*240, 241 R/W (thermocouple) *244, 245 R/W (RTD) *248, 249 R/W (mA or V)	Always active.
SPh i [SP.hi]	**Set Point High Limit** Set the high range for the set point.		rG Lo to max. operating range (of sensor): if SEn is set to tc SPLo +0.100 to 1472: if SEn is set to rtd SPLo +0.001 to 9999: if SEn is set to mA or volt (Set precision with P dEC, Process Decimal	Max. operating range (J type): tc 1472: rtd 999: mA and volt	*242, 243 R/W (thermocouple) *246, 247 R/W (RTD) *250, 251 R/W (mA or V)	Always active.
FtrE [Ftr.E]	**Input Filter** Select filtering action.		OFF (0) (no filtering) d,SP (1) (filter only the display value) Cont (2) (filter the control input values) both (3)	OFF (0)	89 R/W	Always active.
FLtr [FLtr]	**Filter Value** Set the input filter value.		0.0 to 60.0 seconds	0.0	*87, 88 R/W	FtrE is not set to OFF.
Ot 1 [Ot 1]	**Output 1 Function** Set Output 1 function.		OFF Off (0) PrAL Process Alarm (1) dEAL Deviation Alarm (2) hEAt Heat Control (3)	hEAt (3)	143 R/W	Always active.
Ctr 1 [Ctr1]	**Control Method 1** Set output 1 control type. This parameter is only used with PID control, but can be set anytime.		Ftb Fixed Time Base (0) Vrtb Variable Time Base (1)	Ftb (0)	144 R/W	Ot 1 is set to hEAt or Cool and is not a process output (not SD _ _ - _ **F** _ _ - _ _ _ _)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
Ftb1 [Ftb1]	**Fixed Time Base 1** Set the time base for Fixed Time Base Control.		1.0 to 60.0 seconds if Output 1 is a mechanical relay 0.1 to 60.0 seconds if Output 1 is not a mechanical relay	20.0: mech. relay 5.0: solid-state relay 1.0: switched dc	*145, 146 R/W	Ot 1 is set to HEAt or Cool, Ctr 1 is set to Ftb and Output 1 is not a process output. (not SD_ _ - _ **F** _ _ - _ _ _ _)
PL 1 [PL 1]	**Power Limit 1** Set the maximum power output for a control output		0.0 to 100.0% power	100.0%	160 R/W	Ot 1 is set to HEAt or Cool.
PSL1 [PSL1]	**Output Power Scale Low 1** Set the low end of the range within which the output will scale.		0 to 100%	0%	161 R/W	Ot 1 is set to HEAt or Cool, Ctr 1 is set to Ftb and Output 1 is not a process output. (not SD_ _ - _ **F** _ _ - _ _ _ _)
PSH1 [PSH1]	**Output Power Scale High 1** Set the high end of the range within which the output will scale.		0 to 100%	100%	162 R/W	Ot 1 is set to HEAt or Cool, Ctr 1 is set to Ftb and Output 1 is not a process output. (not SD_ _ - _ **F** _ _ - _ _ _ _)
nLF1 [nLF1]	**Output Nonlinear Function 1** Select a nonlinear output curve to match the response of your system.		OFF Off (0) Cru1 curve 1 (1) Cru2 curve 2 (2)	OFF (0)	163 R/W	Ot 1 is set to HEAt or Cool.
AO1U [AO1.U]	**Analog Output 1 Units** Set the analog output units.		mA milliamperes (0) volt volts (1)	mA (0)	147 R/W	Output 1 is a process output. (SD_ _ - _ **F** _ _ - _ _ _ _)
O1Lo [O1.Lo]	**Analog Output 1 Scale Low** Set the low scale for outputs.		0.00 to 20.00 mA if output is set to mA 0.00 to 10.00V if output is set to volts	4.00 mA 0.00V	*148, 149 R/W (mA) *152, 153 R/W (V)	Output 1 is a process output. (SD_ _ - _ **F** _ _ - _ _ _ _)
O1hi [O1.hi]	**Analog Output 1 Scale High** Set the high scale for outputs.		0.00 to 20.00 mA if output is set to mA 0.00 to 10.00V if output is set to volts	20.00 mA 10.00V	*150, 151 R/W (mA) *154, 155 R/W (V)	Output 1 is a process output. (SD_ _ - _ **F** _ _ - _ _ _ _)
Ot 2 [Ot2]	**Output 2 Function** Set Output 2 function.		OFF Off (0) PrAL Process Alarm (1) dEAL Deviation Alarm (2) HEAt Heat Control (3)	OFF (0)	167 R/W	Output 2 is installed and is not a communications output.
Ctr2 [Ctr2]	**Control Method 2** Set Output 2 control type. This parameter is only used with PID control, but can be set anytime.		Ftb Fixed Time Base (0) UrtB Variable Time Base (1)	Ftb (0)	168 R/W	Ot 2 is set to HEAt or Cool and is not a communications output (not SD _ _ - _ _ **U** _ - _ _ _ _).
Ftb2 [Ftb2]	**Fixed Time Base 2** Set the time base for Fixed Time Base Control.		1.0 to 60.0 seconds if Output 2 is mechanical relay 0.1 to 60.0 seconds if Output 2 is not a mechanical relay	20.0: mech. relay 5.0: solid-state relay 1.0: switched dc	*169, 170 R/W	Ot 2 is set to HEAt or Cool, and Ctr2 is Ftb.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
PL 2 [PL2]	**Power Limit 2** Set maximum power output for a control output.		0.0 to 100.0% power	100.0%	171 R/W	Ot 2 is set to HEAt or Cool.
PSL2 [PSL2]	**Output Power Scale Low 2** Set the low end of the range within which the output will scale.		0 to 100%	0%	172 R/W	Ot 2 is set to HEAt or Cool, Ctr2 is set to Ftb and Output 2 is not a communications output. (not SD_ _ - _ _ **U** _ - _ _ _ _)
PSH2 [PSH2]	**Output Power Scale High 2** Set the high end of the range within which the output will scale.		0 to 100%	100.0%	173 R/W	Ot 2 is set to HEAt or Cool, Ctr2 is set to Ftb and Output 2 is not a communications output. (not SD_ _ - _ _ **U** _ - _ _ _ _)
nLF2 [nLF2]	**Output Nonlinear Function 2** Select a nonlinear output curve to match the response of your system.		OFF Off (0) Cru1 curve 1 (1) Cru2 curve 2 (2)	OFF (0)	174 R/W	Ot 2 is set to HEAt or Cool.
Ot 3 [Ot3]	**Output 3 Function** Set Output 3 function.		OFF Off (0) PrAL Process Alarm (1) dEAL Deviation Alarm (2) HEAt Heat Control (3)	OFF (0)	178 R/W	Output 3 is installed.
Ctr3 [Ctr3]	**Control Method 3** Set Output 3 control type. This parameter is only used with PID control, but can be set anytime.		Ftb Fixed Time Base (0) Vrtb Variable Time Base (1)	Ftb (0)	179 R/W	Ot 3 is set to HEAt or Cool and is not a process output. (not SD _ _ - _ _ _ **F** - _ _ _ _)
Ftb3 [Ftb3]	**Fixed Time Base 3** Set the time base for Fixed Time Base Control.		1.0 to 60.0 seconds if Output 3 is a mechanical relay 0.1 to 60.0 seconds if Output 3 is not a mechanical relay	20.0: mech. relay 5.0: solid-state relay 1.0: switched dc	*180, 181 R/W	Ot 3 is set to HEAt or Cool, and Ctr3 is set to Ftb, and Output 3 is not a process output. (not SD_ _ - _ _ _ **F** - _ _ _ _)
PL 3 [PL3]	**Power Limit 3** Set the maximum power output for a control output.		0.0 to 100.0%	100.0%	195 R/W	Ot 3 is set to HEAt or Cool.
PSL3 [PSL3]	**Output Power Scale Low 3** Set the low end of the range within which the output will scale		0 to 100%	0%	196 R/W	Ot 3 is set to HEAt or Cool, Ctr3 is set to Ftb and Output 3 is not a process output. (not SD_ _ - _ _ _ **F** - _ _ _ _)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
PSH3 [PSH3]	**Output Power Scale High 3** Set the high end of the range within which the output will scale.		0 to 100%	100.0%	197 R/W	Ot 3 is set to HEAt or CooL, Ctr3 is set to FtB and Output 3 is not a process output (not SD_ _ - _ _ _ **F** - _ _ _ _).
nLF3 [nLF3]	**Output Nonlinear Function 3** Select a nonlinear output curve to match the response of your system.		OFF Off (0) Cru1 curve 1 (1) Cru2 curve 2 (2)	OFF (0)	198 R/W	Ot 3 is set to HEAt or CooL.
AO3U [AO3.U]	**Analog Output 3 Units** Set the analog output units.		mA milliamperes (0) volt volts (1)	mA (0)	182 R/W	Output 3 is a process output. (SD_ _ - _ _ _ **F** - _ _ _ _)
O3Lo [O3.Lo]	**Analog Output 3 Scale Low** Set the low scale for outputs.		0.00 to 20.00 mA if output is set to mA 0.00 to 10.00V if output is set to volts	4.00 mA 0.00V	*183, 184 R/W (mA) *187, 188 R/W (V)	Output 3 is a process output. (SD_ _ - _ _ _ **F** - _ _ _ _)
O3hi [O3.hi]	**Analog Output 3 Scale High** Set the high scale for outputs.		0.00 to 20.00 mA if output is set to mA 0.00 to 10.00V if output is set to volts	20.00 mA 10.00V	*185, 186 R/W (mA) *189, 190 R/W (V)	Output 3 is a process output. (SD_ _ - _ _ _ **F** - _ _ _ _)
hyS1 [hyS1]	**Alarm 1 Hysteresis** Set the hysteresis for an alarm. This determines how far into the safe region the input needs to move before the alarm can be cleared.		1.0 to 999.0	1.0	*106, 107 R/W	Ot 1 is set to dE AL or Pr AL.
Lgc1 [Lgc1]	**Alarm 1 Logic** Select the alarm output condition in the alarm state.		AL C closed on alarm (0) AL O open on alarm (1)	AL C (0)	164 R/W	Ot 1 is set to dEAL or PrAL.
LAt1 [LAt1]	**Alarm 1 Latching** Turn alarm latching on or off.		nLAt off (0) LAt on (1)	nLAt (0)	108 R/W	Ot 1 is set to dEAL or PrAL.
SiL1 [SiL1]	**Alarm 1 Silencing** Turn alarm silencing on or off.		OFF off (0) no silencing On on (1) silencing	OFF (0)	109 R/W	Ot 1 is set to dEAL or PrAL.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
dSP1 [dSP1]	**Alarm 1 Message** Displays an alarm message when an alarm is active.		OFF off (0) no message On on (1) message	On (1)	110 R/W	Ot 1 is set to dEAL or PrAL.
hyS2 [hyS2]	**Alarm 2 Hysteresis** Set the hysteresis for an alarm. This determines how far into the safe region the input needs to move before the alarm can be cleared.		1.0 to 999.0	1.0	*121, 122 R/W	Ot 2 is set to dEAL or PrAL.
Lgc2 [Lgc2]	**Alarm 2 Logic** Select the alarm output condition in the alarm state.		AL C closed on alarm (0) AL O open on alarm (1)	AL C (0)	175 R/W	Ot 2 is set to dEAL or PrAL.
LAt2 [LAt2]	**Alarm 2 Latching** Turn alarm latching on or off.		nLAt off (0) LAt on (1)	nLAt (0)	123 R/W	Ot 2 is set to dEAL or PrAL.
SiL2 [SiL2]	**Alarm 2 Silencing** Turn alarm silencing on or off.		OFF off (0) no silencing On on (1) silencing	OFF (0)	124 R/W	Ot 2 is set to dEAL or PrAL.
dSP2 [dSP2]	**Alarm 2 Message** Displays an alarm message when an alarm is active.		OFF off (0) no message On on (1) message	On (1)	125 R/W	Ot 2 is set to dEAL or PrAL.
hyS3 [hyS3]	**Alarm 3 Hysteresis** Set the hysteresis for an alarm. This determines how far into the safe region the input needs to move before the alarm can be cleared.		1.000 to 999.0	1.000	*136, 137 R/W	Ot 3 is set to dEAL or PrAL.
Lgc3 [Lgc3]	**Alarm 3 Logic** Select the alarm output condition in the alarm state.		AL C closed on alarm (0) AL O open on alarm (1)	AL C (0)	199 R/W	Ot 3 is set to dEAL or PrAL.
LAt3 [LAt3]	**Alarm 3 Latching** Turn alarm latching on or off.		nLAt off (0) LAt on (1)	nLAt (0)	138 R/W	Ot 3 is set to dEAL or PrAL.
SiL3 [SiL3]	**Alarm 3 Silencing** Turn alarm silencing on or off.		OFF off (0) no silencing On on (1) silencing	OFF (0)	139 R/W	Ot 3 is set to dEAL or PrAL.
dSP3 [dSP3]	**Alarm 3 Message** Displays an alarm message when an alarm is active.		OFF off (0) no message On on (1) message	On (1)	140 R/W	Ot 3 is set to dEAL or PrAL.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
Un it [Unit]	**Units of Measurement** Set the type of units used for the PID control parameters.		US US (0) SI SI (1)	US (0)	45 R/W	Always active.
IErr [I.Err]	**Input Error Latching** Turn input error latching on or off.		nLAt off (0) LAt on (1)	nLAt (0)	90 R/W	Always active.
FAIL [FAIL]	**Input Error Failure Mode** Set the input error failure mode when an error is detected and the control changes to manual mode.		OFF off (0) (0% power) bPLS bumpless (1) (current power level) MAn manual (2) (fixed power level)	bPLS (1)	252 R/W	Always active.
MAn [MAn]	**Input Error Power** Set the manual power level when an input error causes a change to manual mode.		-100.0 to 100.0%	0.0%	253 R/W	FAIL is set to MAn.
dSP [dSP]	**Active Displays** Select which displays are active.		nor both displays on (0) SEt lower display only (1) Pro upper display only (2)	nor (0)	44 R/W	Always active.
rP [rP]	**Ramping Mode** Select when the control set point ramps to the defined end set point.		OFF off (0) Str ramps on start-up only (1) On ramps at start-up or any set point change (2)	OFF (0)	266 R/W	Always active.
rPSc [rP.Sc]	**Ramp Scale** Select the scale of the ramp rate.		hour degrees/hour (0) Min degrees/minute (1)	hour (0)	267 R/W	rP is set to Str or On.
rPrt [rP.rt]	**Ramp Rate** Set the rate for the set point ramp.		0 to 9999	100	*268, 269 R/W	rP is set to Str or On. Does not appear if rP is set to OFF.
Addr [Addr]	**Modbus Device Address** Set the device address for communications. Every controller on a network must have a unique address.		1 to 247	1	This can only be set from the controller front panel.	Output 2 is a communications output. (SD_ _ - _ _ **U** _ - _ _ _ _)
bAud [bAud]	**Baud Rate** Set the baud rate at which the communications occurs.		9600 192 384	9600	This can only be set from the controller front panel.	Output 2 is a communications output. (SD_ _ - _ _ **U** _ - _ _ _ _)
LOC [LOC]	**Lockout** Set the security level for the user interface.		0 (0) no lockout 1 (1) Set Point, Auto/Manual, alarms only 2 (2) Set Point, Auto/Manual, only 3 (3) Set Point only 4 (4) full lockout See the Features Chapter for details.	0 (0)	43 R/W	Always active.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

6 Operations Parameters Table

These parameters can be selected to appear in the Operations Page. Select parameters to appear in the Operations Page in the Programming Page.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
CAL [CAL]	**Calibration Offset** Offset the input reading.		-999 to 999	0.0	*85, 86 R/W	Always appears.
Aut [Aut]	**Autotune** Start an autotune.		OFF off (0) On on (1)	OFF (0)	215 R/W	At least one output is set to HEAt or Cool.
A-M [A-M]	**Auto-Manual Mode** Set the control mode.		Auto (0) MAn (1)	Auto (0)	25 R/W	Always appears.
Poht [Po.ht]	**Power Heat** Displays the current heat control power.		0.0 to 100.0% power	NA	256 R	A-M is set to Auto and at least one output is set to HEAt.
PoCL [Po.CL]	**Power Cool** Displays the current cool control power.		0.0 to 100.0% power	NA	257 R	A-M is set to Auto and at least one output is set to Cool.
htM [ht.M]	**Heat Control Method** Set the heat control method.		OFF off (0) PId PID (1) onoF on-off (2)	PId (1)	213 R/W	At least one output is set to HEAt.
Pbht [Pb.ht]	**Proportional Band Heat** Set the proportional band for the heat outputs.		1 to 999°F, if SEn is set to tc or rtd 0.001 to 999 units, if SEn is set to mA or volt.	25 25	*216, 217 R/W *220, 221 R/W	At least one output is set to HEAt and htM is set to PId.
Ithe [It.ht]	**Integral Heat** Set the PID integral in minutes per repeat for the heat outputs.		0.00 to 99.99 minutes/per repeat 0.00: disabled	0.00	*224, 225 R/W	At least one output is set to HEAt, htM is set to PId, and Unit is set to SI.
rEht [rE.ht]	**Reset Heat** Set the PID reset in repeats per minute for the heat outputs.		0.00 to 99.99 repeats per minute 0.00: disabled	0.00	*224, 225 R/W (Modbus value is integral, which is the inverse of reset.)	At least one output is set to HEAt, htM is set to PId, and Unit is set to US.

Note: Parameters appear in the Operations Page only if activated from the Programming Page.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
dEht [dE.ht]	**Derivative Heat** Set the PID deri for the heat outp		0.00 to 9.99 minutes 0.00: disabled	0.00	*228, 229 R/W	At least one output is set to hEAt, ht Pn is set to PId, and Un it is set to SI.
rAht [rA.ht]	**Rate Heat** Set the PID rate heat output.		0.00 to 9.99 minutes 0.00: disabled	0.00	*228, 229 R/W	At least one output is set to hEAt, htPn is set to PId, and Un it is set to US.
dbht [dB.ht]	**Dead Band Heat** An offset of the l band from the se		0 to 999	0	*279, 280 R/W	At least one output is set to hEAt and ht Pn is set to PID.
hhyS [h.hyS]	**Heat Hysteresis** Set the control s on-off control. Th into the "on" reg move before the		1 to 999 degrees, if SEn is set to tc or rtd 0.000 to 999.999 units, if SEn is set to PnA or volt	1.0 1.000	*232, 233 R/W *234, 235 R/W	At least one output is set to hEAt, and htPn is set to onoF.
CLPn [CL.M]	**Cool Control Met** Set the Cool Cor		OFF off (0) PId PID (1) onoF on-off (2)	OFF (0)	214 R/W	At least one output is set to Cool.
PbCL [Pb.CL]	**Proportional Ban** Set the proportic outputs.		1 to 999°F if SEn is set to tc or rtd 0.001 to 999.0 if SEn is set to PnA or volt	25 25.000	*218, 219 R/W *222, 223 R/W	At least one output is set to Cool, and CLPn is set to PId.
itCL [It.CL]	**Integral Cool** Set the PID inte peat for the cool		0.00 to 99.99 minutes per repeat 0.00: disabled	0.00	*226, 227 R/W	At least one output is set to Cool, CLPn is set to PId, and Un it is set to SI.
rECL [rE.CL]	**Reset Cool** Set the PID rese for the cool outp		0.00 to 99.99 repeats per minute 0.00: disabled	0.00	*226, 227 R/W (Modbus value is integral, which is the inverse of reset.)	At least one output is set to Cool, CLPn is set to PId, and Un it is set to US.

Note: Parameters appear in the Operations Page only if activated from the Programming Page.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
dECL [dE.CL]	**Derivative Cool** Set the PID deri for the cool outp		0.00 to 9.99 minutes 0.00: disabled	0.00	*230, 231 R/W	At least one output is set to Cool, CLPM is set to PId, and Unit is set to SI.
rACL [rA.CL]	**Rate Cool** Set the PID rate cool outputs.		0.00 to 9.99 minutes 0.00: disabled	0.00	*230, 231 R/W	At least one output is set to Cool, CLPM is set to PId, and Unit is set to US.
dbCL [db.CL]	**Dead Band Cool** An offset of the band from the s		0 to 999	0	*281, 282 R/W	At least one output is set to Cool and CLPM is set to PId.
ChyS [C.hyS]	**Cool Hysteresis** Set the control s on/off control. Th into the "on" reg move before the on.		1 to 999°F if SEn is set to tc or rtd 0.000 to 999.9 if SEn is set to PPA or volt	1 1.000	*236, 237 R/W *238, 239 R/W	At least one output is set to Cool and CLPM is set to onoF.
ProP [ProP]	**Proportional Ter** View the active PID diagnostics.		*0.000 to 1.000	NA	258 R	Any output is set to HEAt or Cool.
it [it]	**Integral Term** View the active agnostics.		* 0.000 to 1.000	NA	259 R	Any output is set to HEAt or Cool.
dE [dE]	**Derivative Term** View the active diagnostics.		*0.000 to 1.000	NA	260 R	Any output is set to HEAt or Cool.

*This value multiplied by 100 equals the percent power.

Note: Parameters appear in the Operations Page only if activated from the Programming Page.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
A1h.i [A1.hi]	**Alarm 1 High** Set the high ala		Deviation: 0 to 9999 Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt.	999 (dev) 1500 (pro)	*100, 101 R/W (dev) *104, 105 R/W (pro)	Ot 1 is set to dEAL or PrAL.
A1Lo [A1.Lo]	**Alarm 1 Low** Set the low alar		Deviation: -1999 to 0 Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt.	-999 (dev) 32 (pro)	*98, 99 R/W (dev) *102, 103 R/W (pro)	Ot 1 is set to dEAL or PrAL
A2h.i [A2.hi]	**Alarm 2 High** Set the high ala		Deviation: 0 to 9999 Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt.	999 (dev) 1500 (pro)	*115, 116 R/W (dev) *119, 120 R/W (pro)	Ot 2 is set to dEAL or PrAL.
A2Lo [A2.Lo]	**Alarm 2 Low** Set the low alar		Deviation: -1999 to 0 Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt.	-999 (dev) 32 (pro)	*113, 114 R/W (dev) *117, 118 R/W (pro)	Ot 2 is set to dEAL or PrAL.
A3h.i [A3.hi]	**Alarm 3 High** Set the high ala		Deviation: 0 to 9999 Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt.	999 (dev) 1500 (pro)	*130, 131 R/W (dev) *134, 135 R/W (pro)	Ot 3 is set to dEAL or PrAL.
A3Lo [A3.Lo]	**Alarm 3 Low** Set the low alar		Deviation: -1999 to 0 Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt.	-999 (dev) 32 (pro)	*128, 129 R/W (dev) *132, 133 R/W (pro)	Ot 3 is set to dEAL or PrAL.

Note: Parameters appear in the Operations Page only if activated from the Programming Page.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus.

*** Low numbers contain the two lower bytes; high numbers contain the two higher bytes of the four-byte integer. Decimal precision is set in another parameter.**

7 Factory Page and Calibration

To go to the Factory Page, press both the Up ▲ and Down ▼ keys for six seconds from the Home Page. FACt will appear in the upper display and PAGE in the lower display.

- Press the ⊙ Advance Key to move through the parameter prompts.
- Press the Up ▲ or Down ▼ keys to change the parameter value.
- Press the Infinity Key ∞ at any time to return to the Home Page.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
AMb [AMb]	**Ambient Temperature** Displays the current calculated ambient temperature.		-50.0 to 300.0°F	NA	277 R 278 R	Always active.
A.Mn [A.Mn]	**Minimum Recorded Ambient Temperature** Displays the minimum recorded ambient temperature.		-50.0 to 300.0°F	NA	NA	Always active.
A.MA [A.MA]	**Maximum Recorded Ambient Temperature** Displays the maximum recorded ambient temperature.		-50.0 to 300.0°F	NA	NA	Always active.
dSPL [dSPL]	**Display Intensity** Increase or decrease the brightness of the upper and lower display.		5 to 99% duty	50	NA	Always active.
A.Ot1 [A.Ot1]	**Output 1 Process Value** Monitors Process Output 1 value via Modbus.		00.00 to 22.00 units		283 R	Always active.
A.Ot3 [A.Ot3]	**Output 3 Process Value** Monitors Process Output 3 value via Modbus.		00.00 to 22.00 units		285 R	Always active.
rESt [rESt]	**Restore Factory Calibration** Replaces the user calibration parameters with the factory calibration parameters.		no (0) YES (1)	no (0)	208 R/W	Always active.
Usr.r [Usr.r]	**Restore User Settings** Restores the customer's configured settings.		no (0) YES (1)	no (0)	209 R/W	Always active.
USr.S [USr.S]	**Save User Settings** Saves the current customer-configured settings.		no (0) YES (1)	no (0)	210 R/W	Always active.
dFLt [dFLt]	**Default Parameters** Reset all parameters to their default values.		no (0) YES (1)	no (0)	207 R/W	Always active.
O.ty1 [O.ty1]	**Output 1 Type** Displays the hardware type for Output 1.		nonE none (0) dC DC/open collect. (1) rLAY mech. relay (2) SSr solid-state relay (3) Proc process (4)	nonE (0)	202 R	Always active.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
oty2 [O.ty2]	**Output 2 Type** Displays the hardware type for Output 2.		none (0) dC DC/open collect. (1) rLAy mech. relay (2) SSr solid-state relay (3) Proc process (4) COMM communications (5)	none (0)	203 R	Always active.
oty3 [O.ty3]	**Output 3 Type** Displays the hardware type for Output 3.		none (0) dC DC/open collect. (1) rLAy mech. relay (2) SSr solid-state relay (3) Proc process (4)	none (0)	204 R	Always active.
S.id [S.id]	**Software ID** Displays the software ID number.		0 to 9999	NA	10 R	Always active.
SUEr [S.VEr]	**Software Version** Displays the firmware revision.			NA		Always active.
SbLd [S.bLd]	**Software Build Number** Displays the software build number.		0 to 9999 Build Number	NA	13 R	Always active.
PWr [PWr]	**Power Type** Displays the type of input power.		AC (0) high voltage LOW (1) low voltage	NA	*NA	Always active.
Sn- [Sn-]	**Serial Number 1** Displays the first four characters of the serial number.		0 to 9999	NA	7 R	Always active.
Sn_ [Sn_]	**Serial Number 2** Displays the last four characters of the serial number.		0 to 9999	NA	8 R	Always active.
tc50 [tc.50]	**Thermocouple, 50mV** Calibrate the thermocouple input to 50mV (see “Calibrating the Series SD”).		no (0) YES (1)	no (0)	*NA	Always active.
tc00 [tc.00]	**Thermocouple, 0mV** Calibrate the thermocouple input to 0mV (see “Calibrating the Series SD”).		no (0) YES (1)	no (0)	*NA	Always active.
tc32 [tc.32]	**Thermocouple, 32°F** Calibrate the thermocouple input to 0°C (32°F) (see “Calibrating the Series SD”).		no (0) YES (1)	no (0)	*NA	Always active.
r15 [r.15]	**RTD, 15 ohm** Calibrate the RTD input to 15 ohm (see “Calibrating the Series SD”).		no (0) YES (1)	no (0)	*NA	Always active.
r380 [r.380]	**RTD, 380 ohm** Calibrate the RTD input to 380 ohms. (see “Calibrating the Series SD”).		no (0) YES (1)	no (0)	*NA	Always active.
v1 [v.1]	**Input Calibrate, 1.0 Volt** Calibrate the process voltage input to 1.0 Volt (see “Calibrating the Series SD”).		no (0) YES (1)	no (0)	*NA	Always active.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
u9 [v.9]	**Input Calibrate, 9.0 Volt** Calibrate the process voltage input to 9.0 Volt (see "Calibrating the Series SD").		no (0) YES (1)	no (0)	*NA	Always active.
A4 [A.4]	**Input Calibrate, 4.0 mA** Calibrate the process current input to 4.0 mA (see "Calibrating the Series SD").		no (0) YES (1)	no (0)	*NA	Always active.
A16 [A.16]	**Input Calibrate, 16.0 mA** Calibrate the process current input to 16.0 mA.		no (0) YES (1)	no (0)	*NA	Always active.
O11u [O1.1v]	**Output 1 Calibrate, 1.0 Volt** The voltage process output transmits 1.000V.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O19u [O1.9v]	**Output 1 Calibrate, 9.0 Volt** The voltage process output transmits 9.000V.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O14A [O1.4A]	**Output 1 Calibrate, 4.0 mA** The current process output transmits 4.000 mA.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O116 [O1.16]	**Output 1 Calibrate, 16.0 mA** The current process output transmits 16.000 mA.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O31u [O3.1v]	**Output 3 Calibrate, 1.0 Volt** The voltage process output transmits 1.000V.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O39u [O3.9v]	**Output 3 Calibrate, 9.0 Volt** The voltage process output transmits 9.000V.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O34A [O3.4A]	**Output 3 Calibrate, 4.0 mA** The current process output transmits 4.000 mA.		no (0) YES (1)	no (0)	*NA	The respective output is process.
O316 [O3.16]	**Output 3 Calibrate, 16.0 mA** The current process output transmits 16.000 mA.		no (0) YES (1)	no (0)	*NA	The respective output is process.

*** The Series SD controller can be calibrated only with the front panel controls. These parameters are not visible through serial communications.**

Calibrating the Series SD

Warm up the unit for 20 minutes. To reach the calibration prompts, enter the Factory Page by holding down the Up Key ▲ and Down Key ▼ for six seconds. Once in the Factory Page [FACt], use the Advance ◉ key to select a prompt. The last prompts on the Factory Page are the input and output calibration prompts.

You can restore the original factory calibration with Restore Factory Calibration [rESt] (Factory Page).

***Note: InfoSense™ should be turned off while verifying calibration of the controller with a calibration source.**

Thermocouple Input Procedure

Equipment

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

Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).
2. Connect the millivolt source to terminals 11 (-) and 10 (+) with copper wire.
3. Enter 50.00 mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 50 mV [tc50] to [YES]. Press the Advance Key ◉ to store 50.000 mV input and move to the next prompt.
4. Enter 0.000 mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 0 mV [tc00] to [YES]. Press the Advance Key ◉ to store 0.000 mV input and move to the next prompt.
5. Disconnect the millivolt source and connect the reference compensator or thermocouple calibrator to terminals 11 (-) and 10 (+). 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 0°C (32°F). Allow 10 seconds for the controller to stabilize. Set Thermocouple Calibration, 32° [tc32] to [YES]. Press the Advance Key ◉ to store type J thermocouple calibration and move to the next prompt.
6. Rewire for operation and verify calibration.

RTD Input Procedure

Equipment

- 1kΩ decade box with 0.01Ω resolution.

Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter 2).
2. Connect the decade box to terminals 10 (S1), 11 (S3) and 8 (S2), with 20 to 24-gauge wire.
3. Enter 15.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 15Ω [r15] to [YES]. Press the Advance Key ◉ to store the 15.00Ω input and move to the next prompt.
4. Enter 380.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 380Ω [r380] to [YES]. Press the Advance Key ◉ to store the 380.00Ω input and move to the next prompt.
5. Rewire for operation and verify calibration.

Voltage Process Input Procedure

Equipment

- Precision voltage source, 0 to 10V minimum range, with 0.001V resolution.

Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).

Input

2. Connect the voltage source to terminals 11 (-) and 9 (+) of the controller.
3. Enter 1.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 1V [u1] to [YES]. Press the Advance Key ◉ to store the 1.00V input and move to the next prompt.
4. Enter 9.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 9V [u9] to [YES]. Press the Advance Key ◉ to store the 9.00V input and move to the next prompt.
5. Rewire for operation and verify calibration.

Current Process Input Procedure

Equipment

- Precision current source, 0 to 20 mA range, with 0.01 mA resolution.

Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).
2. Connect the current source to terminals 11(-) and 8(+).
3. Enter 4.00 mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 4 mA [A4] to [YES]. Press the Advance Key ◉ to store the 4 mA input and move to the next prompt.
4. Enter 16.00 mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 16 mA [A16] to [YES]. Press the Advance Key ◉ to store the 16 mA input and move to the next prompt.
5. Rewire for operation and verify calibration.

Process Output Procedures

Equipment

- Precision volt/ammeter with 3.5-digit resolution.

Output 1 Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).

Volts

2. Connect the volt/ammeter to terminals 7 (-) and 6 (+).
3. At Output 1 Calibrate, 1V [O1 1u] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 1.00V, ±0.1V. Press the Advance Key ◉ to store the value and move to the next prompt.
4. At Output 1 Calibrate, 9V [O19u] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 9V, ±0.1V. Press the Advance Key ◉ to store the value and move to the next prompt.
5. Rewire for operation and verify calibration.

Milliamperes

6. Connect the volt/ammeter to terminals 7 (-) and 5 (+).
7. At Output 1 Calibrate, 4 mA [O14A] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 4.00 mA, ±0.1 mA. Press the Advance Key ◉ to store the value and move to the next prompt.
8. At Output 1 Calibrate, 16 mA [O116] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 16.00 mA, ±0.1 mA. Press the Advance Key ◉ to store the value and move to the next prompt.
9. Rewire for operation and verify calibration.

Output 3 Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).

Volts

2. Connect the volt/ammeter to terminals 14 (-) and 13 (+).
3. At Output 3 Calibrate, 1V [O31u] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 1.00V, ±0.1V. Press the Advance Key ◉ to store the value and move to the next prompt.
4. At Output 3 Calibrate, 9V [O39u] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 9.00V, ±0.1V. Press the Advance Key ◉ to store the value and move to the next prompt.
5. Rewire for operation and verify calibration.

Milliamperes

6. Connect the volt/ammeter to terminals 12 (+) and 14 (-).
7. At Output 3 Calibrate, 4 mA [O34A] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 4.00 mA, ±0.1mA. Press the Advance Key ◉ to store the value and move to the next prompt.
8. At Output 3 Calibrate, 16 mA [O316] enter the reading from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 16.00 mA, ±0.1 mA. Press the Advance Key ◉ to store the value and move to the next prompt.
9. Rewire for operation and verify calibration.

Restoring Factory Calibration

- Press the Up ▲ and Down ▼ keys together for six seconds until [FACt] appears in the upper display and [PAGE] appears in the lower display.
- Press the Advance Key ◉ to step through the parameters until the [rESt] appears.
- Use the Up Key ▲ to select [YES] in the upper display.
- Press the Infinity Key ∞ to exit the Factory Page.

8 Features

Saving and Restoring User Settings 42
Operations Page 42
Autotuning 42
Inputs
InfoSense™ Sensing 43
Calibration Offset 43
Filter Time Constant 43
Sensor Selection 43
Access Lockout 43
Set Point Low Limit and High Limit 44
High Scale and Low Scale 44
High Range and Low Range 44
Control Methods
Output Configuration 44
Auto-Manual Control 44
On-Off Control 45
Proportional Control 45
PI Control 46
PID Control 46
Dead Band 46
Power Limiting and Power Scaling 47
Nonlinear Output Curve 47
Independent Heat and Cool PID 48
Variable Time Base 48
Ramping 48
Alarms 48
Process or Deviation Alarms 49
Alarm Set Points 49
Alarm Hysteresis 49
Alarm Latching 49
Alarm Silencing 49
Communications
Overview 50
Setting Up a Modbus Network 50
Infrared Data Communications 51
Troubleshooting 52
Error Messages 54

Saving and Restoring User Settings

Recording setup and operations parameter settings for future reference is very important. If you unintentionally change these, you will need to program the correct settings back into the controller to return the equipment to operational condition.

After you program the controller and verify proper operation, use [USrS] to save the settings into a special section of memory. If the settings in the controller are altered and you want to return the controller to the saved values, use [USrr] to recall the saved settings.

To save the Setup and Operations parameters:

1. Ensure all the settings that you want to store are already programmed into the Setup Page and Operations parameters.
2. Press the Up ▲ and Down ▼ keys together for six seconds until [FAct] appears in the upper display and [PAGE] appears in the lower display.
3. Press the Advance Key ◉ to step through the prompts until the [USrS] prompt appears.
4. Use the Up Key ▲ to select [YES] in the upper display.
5. Press the Infinity Key ∞ to exit the Factory Page.

Note: Only perform the above procedure when you are sure that all the correct settings are programmed into the controller. Saving the settings overwrites any previously saved collection of settings. Be sure to document all the controller settings.

To restore a collection of saved settings:

1. Press the Up ▲ and Down ▼ keys together for six seconds until [FAct] appears in the upper display and [PAGE] appears in the lower display.
2. Press the Advance Key ◉ to step through the menu until the [USrr] prompt appears.
3. Use the Up Key ▲ to select [YES] in the upper display.
4. Press the Infinity Key ∞ to exit the Factory Page.

Operations Page

Watlow's patented user-defined menu system improves operational efficiency. The user-defined Operations Page provides you with a shortcut to monitor or change the parameter values that you use most often. You can go directly to the Operations Page from the Home Page by pressing the Advance Key ◉.

You can create your own Operations Page with as many as 20 of the active parameters from the list in the Keys and Displays chapter. When a parameter normally located in the Setup Page is placed in the Operations Page, it is accessible through both. If you change a parameter in the Operations Page, it is automatically changed in its original page. If you change a parameter in its original page it is automatically changed in the Operations Page.

The default parameters will automatically appear in the Operations Page.

To change the list of parameters in the Operations Page, hold down the Infinity key ∞, then press the Advance Key ◉, and hold both down for about six seconds. This will take you to the Programming Page.

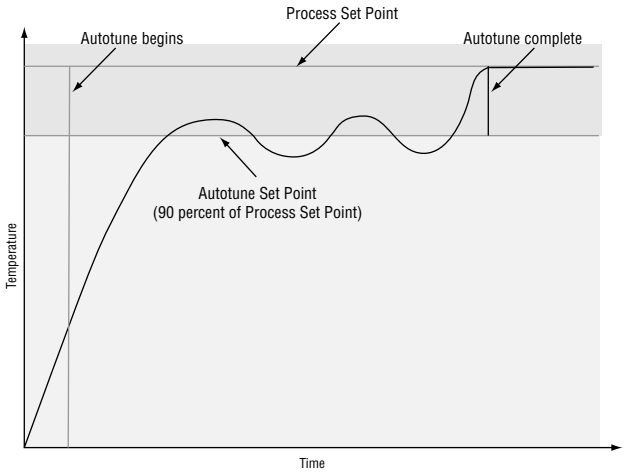
Press the Advance Key ◉ once to go to the first selection in the page. The parameter choices will appear in the top display and the selection number will appear in the bottom display. Use the Up ▲ or the Down ▼ key to change the selected parameter in the top display. If you do not want a parameter to appear for that location, select [nonE]. To change the other 19 selections, press the Advance Key ◉ to select a place in the page, [P 1] to [P20], in the bottom display and use the Up ▲ or the Down ▼ key to change the parameter selected in the top display.

Changes made to the Operations Page will persist until changed by the operator or defaulted by full defaults or user defaults. User-defined parameters are not over-written by default parameters if those features become enabled. Only parameters supported by a controller's particular hardware configuration and programming settings will appear.

Autotuning

The autotuning feature allows the controller to measure the system response to determine effective settings for PID control. When autotuning is initiated the controller reverts to on-off control. The temperature must cross the Autotune Set Point four times to complete the autotuning process. Once complete, the controller controls at the normal set point, using the new parameters.

To initiate an autotune, set Autotune [AUt] (Operations parameters) to [On].



Inputs

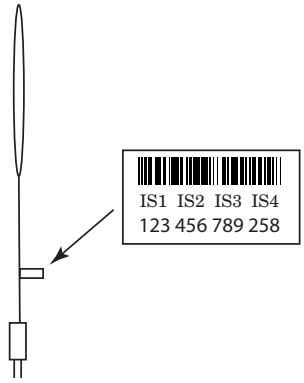
InfoSense™ Temperature Sensing

Watlow's InfoSense™ feature can improve temperature sensing accuracy by 50%. Watlow's InfoSense™ thermocouples and RTD temperature sensors must be used together to achieve these results.

Each InfoSense™ "smart" sensor contains four numeric values that are programmed into the SD memory. These values characterize Watlow sensors, for the controller to provide greater accuracy.

Turn the InfoSense™ feature on or off with Info Sense™ Enable [ISEn] (Setup Page). Set the four numerical values supplied with Watlow's InfoSense™ in the [ISP1], [ISP2], [ISP3] and [ISP4] parameters.

Contact your Watlow salesperson or Watlow authorized distributor for the pricing and availability of Watlow InfoSense™ products.

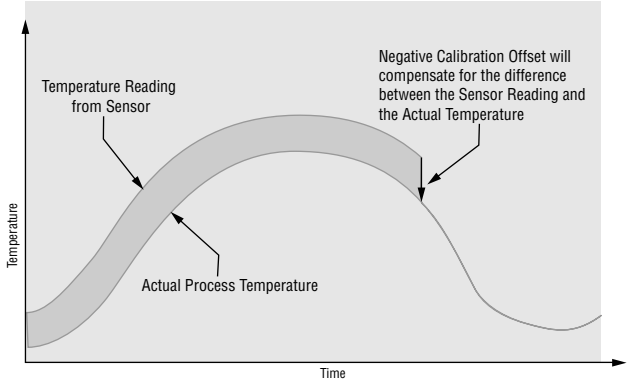


The four numerical values are found on the tag attached to the sensor.

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.

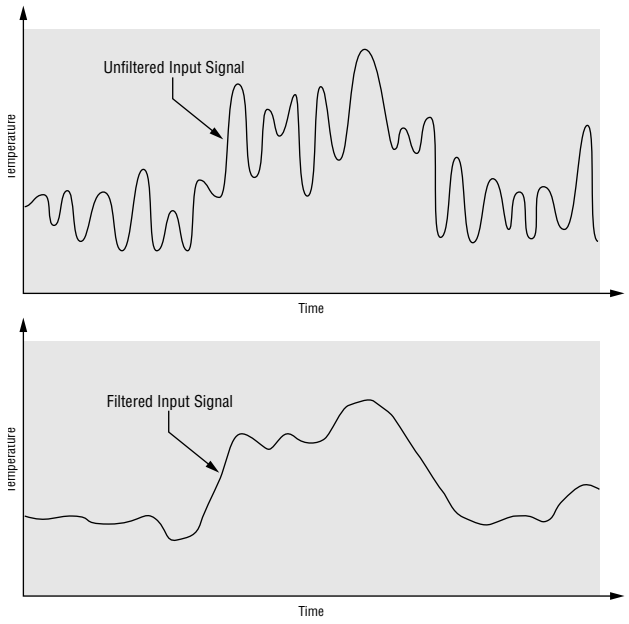
The input offset value can be viewed or changed with Calibration Offset [CAL] (Operations parameters).



Filter Time Constant

Filtering smoothes an input signal by applying a first-order filter time constant to the signal. The displayed value, the controlled value or both the displayed and control values can be filtered. Filtering the displayed value makes it easier to monitor. Filtering the signal may improve the performance of PID control in a noisy or very dynamic system.

Select filter options with Input Filter [FtrE]. Select the Filter Value with [FLtr] (Setup Page).



Sensor Selection

You need to configure the controller to match the input device, which is normally a thermocouple, RTD or process transmitter. 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 set point range-high and range-low values.

Select the sensor type with Sensor Type [SEn] (Setup Page).

Access Lockout

The user's access to the Operations Page can be controlled through the [Loc] parameter. The [Loc] parameter appears at the end of the Setup Page. It does not affect the Setup, Factory or Programming Pages.

[0] All the Operations Page parameters may be viewed or changed.

[1] The set point, process value, auto-manual selection and alarm settings are the only visible Operations Page parameters. Set point is adjustable in this level. Auto-manual selection and autotune are permitted. During manual operation, the percent power is adjustable.

[2] The set point, process value, auto-manual selection and alarm settings are the only visible Operations Page parameters. Set point is adjustable in this level. Auto-manual selection is permitted. During manual operation, percent power is adjustable.

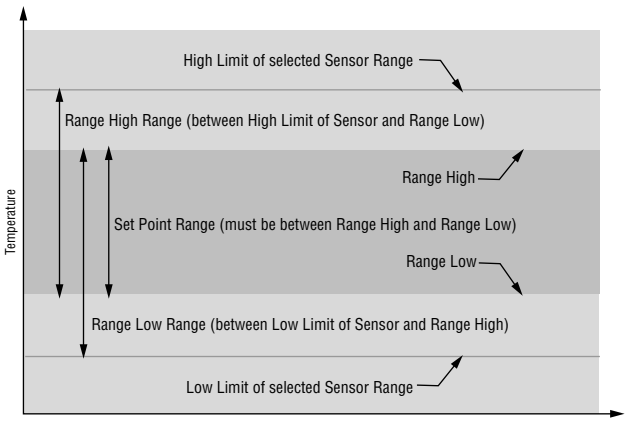
[3] The set point, process value and alarm settings are the only visible Operations Page parameters. Set point is adjustable. Auto-manual selection is **not** permitted. During manual operation, percent power is adjustable.

[4] The set point and process values are the only visible Operations Page parameters, set point is not adjustable. During manual operation, percent power is **not** adjustable.

Set Point Low Limit and High Limit

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

Set the set point range with Set Point Low [SPLo] and Set Point High [SPHi] (Setup Page).



High Scale and Low Scale

When an analog input is selected as process voltage or process current input, you must choose the value of voltage or current to be the low and high ends. For instance, when using a 4 to 20 mA input, the scale low value would be 4.00 mA and the scale high value would be 20.00 mA. Commonly used scale ranges are: 0 to 20 mA, 4 to 20 mA, 0 to 5V, 1 to 5V and 0 to 10V.

The Series SD allows you to create a scale range for special applications other than the standard ones listed above. Reversing of the scales from high values to low values is permitted for analog input signals that have a reversed action.

Select the high and low values with Process Scale Low [01Lo] and [03Lo], and Process Scale High [01Hi] and [03Hi] (Setup Page).

High Range and Low Range

With a process input, you must choose a value to represent the low and high ends of the current or voltage range. Choosing these values allows the controller's display to be scaled into the actual working units of measurement. For example, the analog input from a humidity transmitter could represent 0 to 100 percent relative humidity as a process signal of 4 to 20 mA. Low scale would be set to 0 to represent 4 mA and high scale set to 100 to represent 20 mA. The indication on the display would then represent percent humidity and range from 0 to 100 percent with an input of 4 to 20 mA.

Select the high and low values with Units Scale Low [rgLo] and Units Scale High [rgHi] (Setup Page).

Control Methods

Output Configuration

Each controller output can be configured as a heat output, a cool output, an alarm output or deactivated. No dependency limitations have been placed on the available combinations. The outputs can be configured in any combination. For instance, all three could be set to cool.

Analog outputs can be scaled for any desired current range between 0 and 20 mA or voltage range between 0 to 10V. The ranges can be reversed to high-to-low for reverse acting devices.

Heat and cool outputs use the set point and Operations parameters to determine the output value. All heat and cool outputs use the same set point value. Heat and cool each have their own set of control parameters. All heat outputs use the same set of heat control parameters and all cool outputs use the same set of cool output parameters.

Each alarm output has its own set of configuration parameters and set points, allowing independent operation.

Auto (closed loop) and Manual (open loop) Control

The controller has two basic modes of operation, auto mode and manual mode. Auto mode allows the controller to decide whether to perform closed loop control or to follow the settings of the Input Error Failure Mode parameter (Setup Page). The manual mode only allows open loop control. The Series SD controller is normally used in the auto mode. The manual mode is usually only used for specialty applications or for troubleshooting.

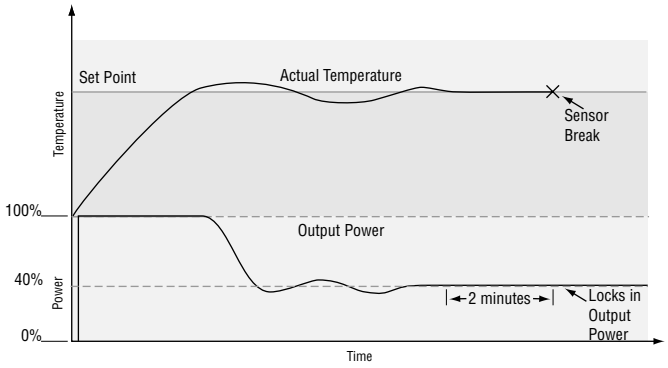
Manual mode is open loop control that allows the user to directly set the power level to the controller's output load. No adjustments of the output power level occur based on temperature or set point in this mode.

In auto mode, the controller monitors the input to determine if closed loop control is possible. The controller checks to make certain a functioning sensor is

providing a valid input signal. If a valid input signal is present, the controller will perform closed loop control. Closed loop control uses a process sensor to determine the difference between the process value and the set point. Then the controller applies power to a control output load to reduce that difference.

If a valid input signal is not present, the controller will indicate an input error message [Er In] and then use the Input Error Failure Mode [FAIL] setting to determine operation. You can choose to have the controller perform a "bumpless" transfer, switch power to output a preset manual level or turn off output power.

Bumpless transfer will allow the controller to transfer to the manual mode using the last power value calculated in the auto mode if the process had stabilized at a ±5 percent output power level for two minutes prior to sensor failure, and that power level is less than 75 percent.



Input Error Latching [I Err] (Setup Page) determines the controller's response once a valid input signal returns to the controller. If latching is on [LAt], then the controller will continue to indicate an input error until the error is cleared. To clear a latched alarm, press the Infinity Key ∞. If latching is off [nLAt], the controller will automatically clear the input error and return to reading the temperature. If the controller was in the auto mode when the input error occurred, it will resume closed loop control. If the controller was in manual mode when the error occurred, the controller will remain in open loop control.

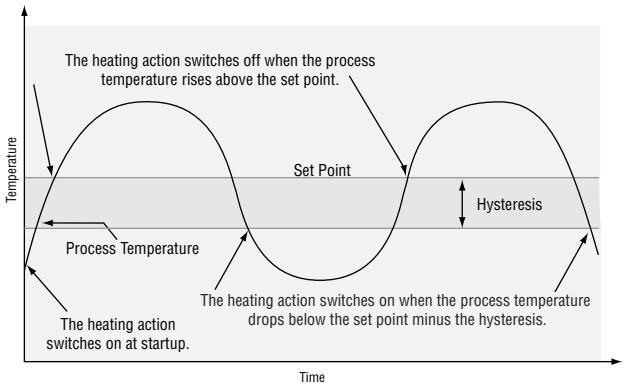
The Auto-Manual Control Indicator Light % is on when the controller is in the manual mode and it is off while in the auto mode. You can switch between modes if the Auto-Manual Mode [A-Mn] parameter is selected to appear in the Operations Page. To toggle between manual and auto mode, press the Advance Key ⟳ until [A-Mn] appears in the lower display. The upper display will display [MAn] for manual mode or [Auto] for the Auto mode. Use the Up ▲ or Down ▼ keys to select the desired mode. Changes take effect after three seconds or immediately upon pressing either the Advance Key ⟳ or the Infinity Key ∞.

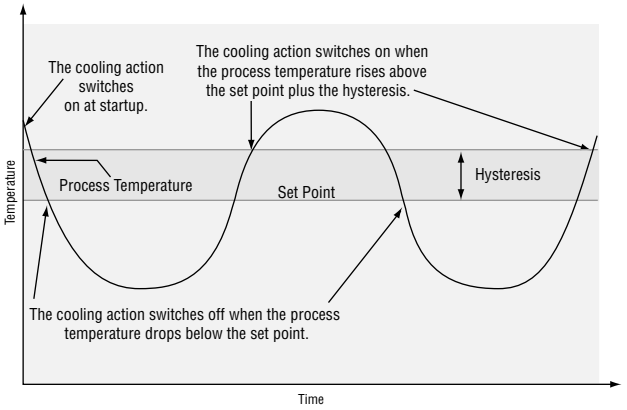
On-Off Control

On-off control switches the output either full on or full off, depending on the input, set point and hysteresis values. The hysteresis value indicates the amount the process value must deviate from the set point to turn on the output. Increasing the value decreases the number of times the output will cycle. Decreasing hysteresis improves controllability. With hysteresis set to 0, the process value would stay closer to the set point, but the output would switch on and off more frequently, and may result in the output "chattering." On-off control can be selected with Heat Control Method [ht Mn] or Cool Control Method [CLMn] (Operations parameters).

NOTE:
Input Error Failure Mode [FAIL] does not function in on-off control mode. The output goes off.

NOTE:
In on-off control set Power Limit 1, 2 and 3 ([PL 1], [PL 2] and [PL 3]) and Output Power Scale High 1, 2 and 3 ([PSH1], [PSH2] and [PSH3]) to 100%. Set Output Power Scale Low 1, 2 and 3 ([PSL1], [PSL2] and [PSL3]) to 0%.





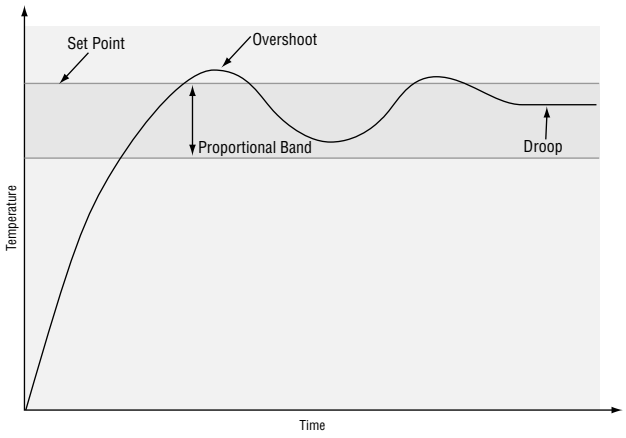
Proportional Control

Some processes need to maintain a temperature or process value closer to the set point than on-off control can provide. Proportional control provides closer control by adjusting the output when the temperature or process value is within a proportional band. When the value is in the band, the controller adjusts the output based on how close the process value is to the set point; the closer to set point the lower the output. This is similar to backing off on the gas pedal of a car as you ap-

proach a stop sign. It keeps the temperature or process value from swinging as widely as it would with simple on-off control. However, when a system settles down, the temperature or process value tends to “droop” short of the set point.

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

Adjust the proportional band with Proportional Band Heat [PbHt] or Proportional Band Cool [PbCL] (Operations parameters).



Proportional plus Integral (PI) Control

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

Integral (if PID Units are set to SI) is measured in minutes per repeat. A low integral value causes a fast integrating action.

Reset (if PID Units are set to U.S.) is measured in repeats per minute. A high reset value causes a fast integrating action.

Adjust the integral with Integral Heat [ItHt] or Integral Cool [ItCL] (Operations parameters).

Adjust the reset with Reset Heat [rEHt] or Reset Cool [rECL] (Operations parameters).

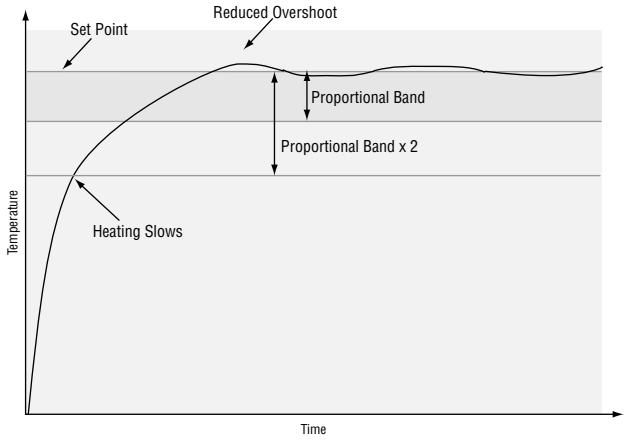
Proportional plus Integral plus Derivative (PID) Control

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

Rate action is active only when the process value is within twice the proportional value from the set point.

Adjust the derivative with Derivative Heat [dEHt] or Derivative Cool [dECL] (Operations parameters).

Adjust the rate with Rate Heat [rAHt] or Rate Cool [rACL] (Operations parameters).

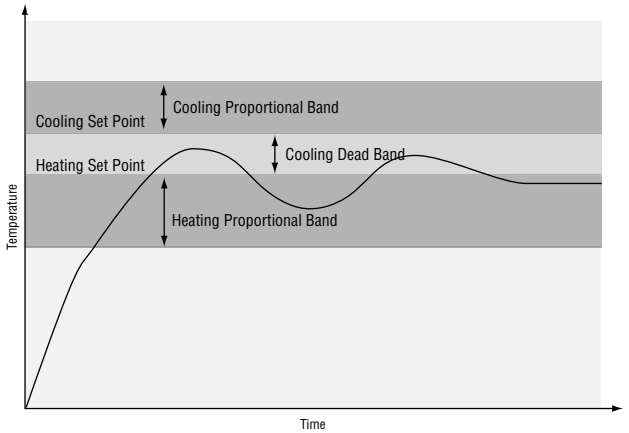


Dead Band

In a PID application the dead bands above and below the set point can save an application's energy and wear by maintaining process temperature within acceptable ranges. Shifting the effective cooling set point and heating set point keeps the two systems from fighting each other.

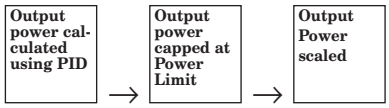
Proportional action ceases when the process value is within the dead band. Integral action continues to bring the process temperature to the set point. When the dead band value is zero, the heating element activates when the temperature drops below the set point, and the cooling element switches on when the temperature exceeds the set point.

Adjust the dead bands with Dead Band Heat [dbHt] and Dead Band Cool [dbCL] (Operations parameters).



Power limiting and power scaling

Power limiting and power scaling are two methods of placing limitations on a control output. The functions can be used independently or together. An output level calculated from the PID algorithm first has the power limit applied, then the resulting value is processed using power scaling.



Using both power limiting and power scaling would not usually be necessary. Power limiting provides a basic static cap on power, while power scaling provides a more dynamic range of power limitation.

Note:
When output power must be limited, in most cases power scaling will provide better autotune performance than power limiting.

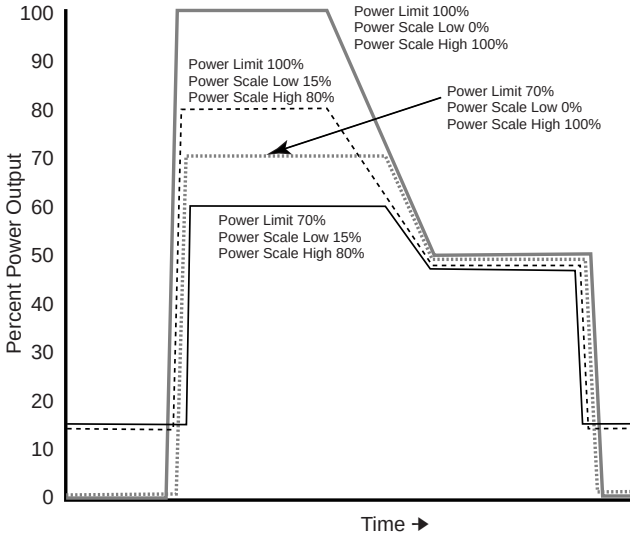
NOTE:
In on-off control set Power Limit 1, 2 and 3 (PL 1, PL 2 and PL 3) and Output Power Scale High 1, 2 and 3 (PSH1, PSH2 and PSH3) to 100%. Set Output Power Scale Low 1, 2 and 3 (PSL1, PSL2 and PSL3) to 0%.

The power limit sets the maximum power for a heat or cool control output. Each control output has its own power limit. For heating outputs it determines the maximum level of heat power and for cool outputs it determines the maximum level of cooling power. A power limit of 100% in effect disables the power limit. If the PID calculations yield a power level that is greater than the power limit setting, then the output power level will be the power limit setting. For example, with a power limit setting of 70%, a PID-calculated power output of 50% would result in an actual output power level of 50%. But if the PID calculated power output is 100%, then the power level will be 70%.

Power scaling establishes the maximum power output and the minimum power output. The output power is then linearly scaled within that range. The default values of Output Power Scale Low of 0% and Output Power Scale High of 100% in effect disable power scaling.

Linear scaling allows the controller to do calculations over the full range of power (0 to 100%) and adjust that calculation within the actual output span. For instance, if scale low is set to 15% and scale high is set to 80%, the output power will always be between 15 and 80%. If the PID calculation is 100%, the output power will be 80%, which is the same result you would get from a power limit of 80%. However, if the PID calculation for heat is 50%, the output will be 50% of the allowable range, which scales to an actual output of 47.5%.

Power limiting and power scaling affect the specified output at all times, including in on-off control, manual mode and autotuning

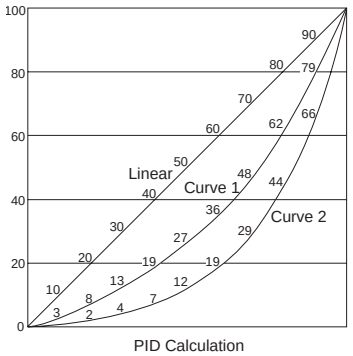


The Power Limit 1, 2 and 3 (PL 1, PL 2 and PL 3) and Output Power Scale Low 1, 2 and 3 (PSL1, PSL2 and PSL3) and Output Power Scale High 1, 2 and 3 (PSH1, PSH2 and PSH3) appear in the Setup Page. The calculated PID heat and cool power values can be viewed with Power Heat PoHt and Power Cool PoCL parameters in the Operations Page.

Nonlinear output curve

A nonlinear curves may improve performance when the response of the system to the output device is nonlinear. If Output Nonlinear Function is set to curve 1 Cru1 or curve 2 Cru2, a PID calculation yields a lower actual output level than the linear output requires.

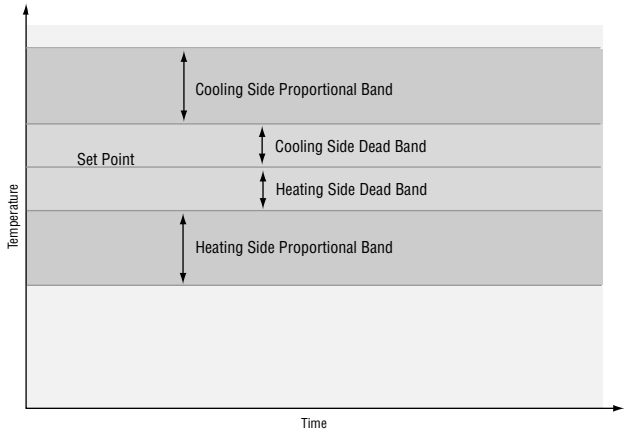
Change the linearity with Output Nonlinear Function 1, 2 or 3 (nLF1, nLF2 or nLF3) in the Setup Page.



Independent Heat and Cool PID

In an application with one output assigned to heating and another assigned to cooling, each will have a separate set of PID parameters and separate dead bands. The heating parameters take effect when the process temperature is lower than the set point and the cooling parameters take effect when the process temperature is higher than the set point.

Adjust heat and cool PID parameters are Operations parameters.



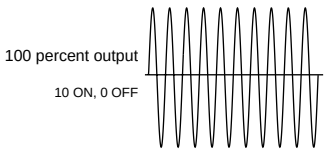
Variable Time Base

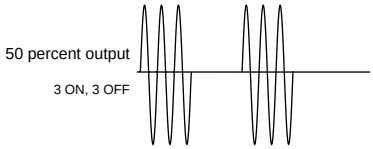
Variable time base is the preferred method for controlling a resistive load, providing a very short time base for longer heater life. Unlike phase-angle firing, variable-time-base switching does not limit the current and voltage applied to the heater.

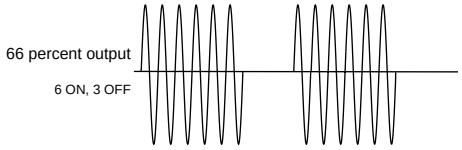
With variable time base outputs, the PID algorithm calculates an output between 0 and 100%, but the output is distributed in groupings of three ac line cycles. For each group of three ac line cycles, the controller decides whether the power should be on or off. There is no fixed cycle time since the decision is made for each group of cycles. When used in conjunction with a zero cross (burst fire) device, such as a solid-state power controller, switching is done only at the zero cross of the ac line, which helps reduce electrical noise (RFI).

Variable time base should be used with solid-state power controllers, such as a solid-state relay (SSR) or SCR power controller. Do not use a variable time base output for controlling electromechanical relays, mercury displacement relays, inductive loads and heaters with unusual resistance characteristics.

The combination of variable time base output and a solid-state relay can inexpensively approach the effect of analog, phase-angle fired control.







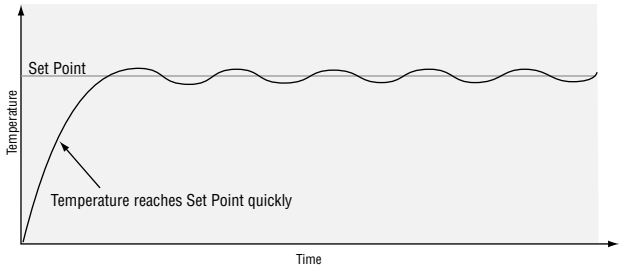
Ramping

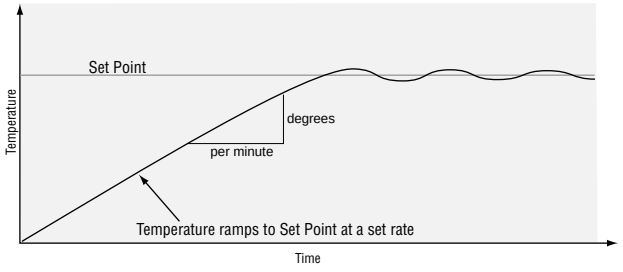
Ramping protects materials and systems that cannot tolerate rapid temperature changes. The value of the ramp rate is the maximum degrees per minute or hour that the system temperature can change.

Select Ramping Mode [rP] (Setup Page):

- [OFF] ramping not active.
- [Str] ramp at startup.
- [On] ramp at startup or when the set point changes.

Select whether the rate is in degrees per minute or degrees per hour with Ramp Scale [rP Sc] (Setup Page). Set the ramping rate with Ramp Rate [rP rt] (Setup Page).





Alarms

Alarms are activated when the process value or temperature leaves a defined range. A user can configure how and when an alarm is triggered, what action it takes and whether it turns off automatically when the alarm condition is over.

Configure alarm outputs in the Setup Page before setting alarm set points.

Process or Deviation Alarms

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

A deviation alarm uses one or two set points that are defined relative to the control set point. High and low alarm set points are calculated by adding and/or subtracting offset values from the control set point. If the set point changes, the window defined by the alarm set points automatically changes with it.

Select the alarm type with the Setup Page parameters. View or change process or deviation set points with the Operations parameters.

Alarm Set Points

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

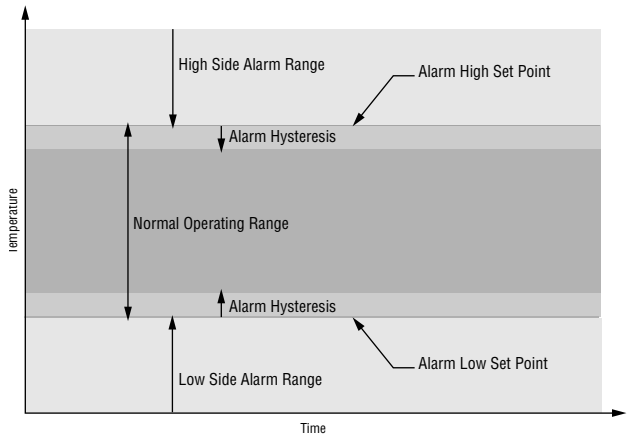
View or change alarm set points with the Operations parameters.

Alarm Hysteresis

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.

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.

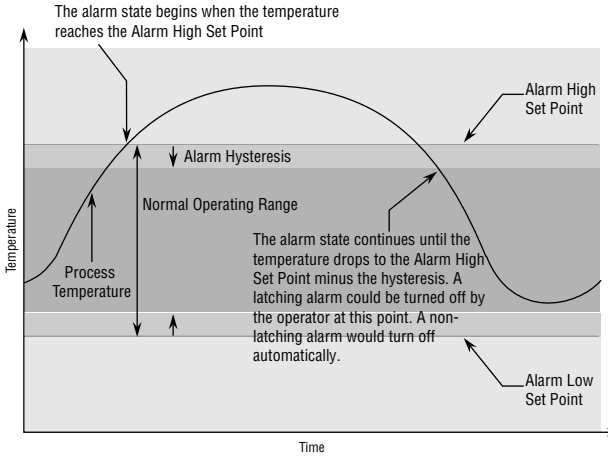
View or change alarm hysteresis Alarm 1, 2, or 3 Hysteresis, [HYS1], [HYS2] or [HYS3] (Setup Page).



Alarm Latching

A latched alarm will remain active after the alarm condition has passed. To clear a latched alarm, press the Infinity Key ∞. It can only be deactivated by the user. An alarm that is not latched (self-clearing) will deactivate automatically when the alarm condition has passed.

Turn alarm latching on or off with Alarm 1, 2, or 3 Latching [LAT1], [LAT2] or [LAT3] (Setup Page).



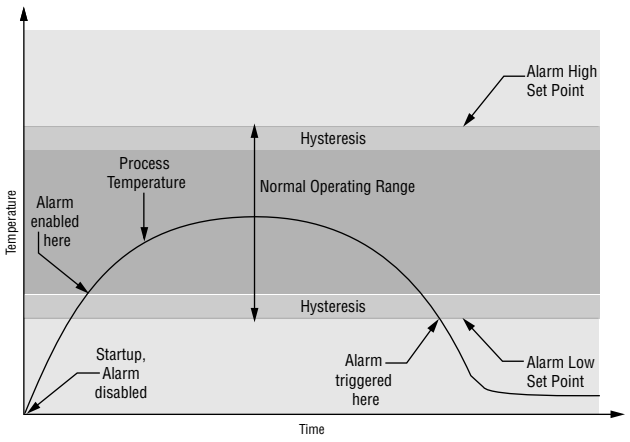
Alarm Silencing

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 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 to activate the alarm output function.

If the Series SD has an output that is functioning as a deviation alarm, the alarm is blocked when the set point is changed, until the process value re-enters the normal operating range.

Turn alarm silencing on or off with Alarm 1, 2, or 3 Silencing [SIL1], [SIL2] or [SIL3] (Setup Page).



Communications

Overview

A Series SD controller can also be programmed and monitored by connecting it with a personal computer or programmable logic controller (PLC) via serial communications. To do this it must be equipped with an EIA/TIA 485 (SD_ _ - _ _ U_ - _ _ _ _) communications option for Output 2. Your PC or PLC must have available an EIA/TIA-485 interface or use an EIA/TIA-232 to EIA/TIA-485 converter. See "Selecting an EIA/TIA-232 to EIA/TIA-485 converter" in Chapter 2. The EIA/TIA-485 option directly supports communication with up to 32 devices on a network or up to 247 devices using a 485 repeater.

To view or change controller settings with a personal computer, you need to run software that uses the Modbus RTU protocol to read or write to registers in the controller. See the parameter tables for information about the Modbus registers. These registers contain the parameter values that determine how the controller will function and current input and output values of the system. The address in the tables have been offset by subtracting 40,001 from each one.

Basic communications settings must first be configured on the controller in the Setup Page. Match the Baud Rate [bAUd] to that of the computer and select a unique Address [Addr] for each Series SD.

Setting Up a Modbus Network

1. Wire the controllers.

The Series SD uses an EIA/TIA-485 serial port, which is not typically found in a PC, but can be found on many PLC's. The type of port found in a typical PC is an EIA-232 port. Internal EIA/TIA-485 PC ports are available, but the most common way for a PC to communicate using a EIA-485 port is with an EIA/TIA-232 to EIA/TIA-485 converter.

The advantages of EIA/TIA-485 are that it is less susceptible to noise and it allows a PC or PLC to communicate with multiple controllers on the same port to form a network. It is important when using EIA/TIA-485, to install the termination resistors along with pull-up and pull-down resistors to ensure reliable communications.

Some newer PCs may only have a USB port. USB-to-serial adapters (usually EIA/TIA 232) are available from a variety of different PC vendors. Some companies offer adapters to convert from USB to EIA/TIA-485 directly.

2. Configure each controller's communications parameters in the Setup Menu using the front panel.

Only a couple of communications parameters need to be configured on the controller, Baud Rate and Modbus Address. The choices for Baud Rate are 9600 bps, 19200 bps or 38400 bps. 38400 baud allows for the fastest communication. For compatibility with other devices, reducing noise susceptibility, or increasing communications distance, 9600 bps could be chosen. When using EIA/TIA-485, all devices connected to that port must use the same Baud Rate. The Modbus address is used to identify each controller on the network. With EIA/TIA-485, every controller on the network must have a unique address.

3. Choose a device to communicate with the controller.

The controller can communicate with devices, such as a computer running a software program, a PLC (Programmable Logic Controller) or an OIT (Operator Interface Terminal). Whichever device is chosen, it needs to be able to communicate using the Modbus RTU Protocol. OITs would need to be ordered with Modbus RTU support. PLCs would either have Modbus RTU as a standard feature or it can be made available with an I/O module. On a computer, the software package to be used would need to have the Modbus RTU capability.

4. Select a software package for the computer.

Select the software package based on what is required from the application. For basic communications (such as reading the process value or setting the set point), Watlow has the Comm6 software package. This is mainly used for diagnostics and basic communications.

The WatView™ software package offers more advanced features. WatView is available in three editions, each offering increasing levels of functionality. If you need functionality beyond WatView or need to interface with an existing software package, many other third party software packages can interface with the Series SD

When purchasing a third-party software package, be sure to look for a package that is Modbus RTU compatible or has Modbus RTU drivers. Most third-party packages require you to specify the Modbus registers of the controller to setup the package.

Another option is to custom-create a software package. Using the Modbus register and data information in this user's manual, a software package can be created and tailored to the desired application. To assist in application development, Watlow offers WATCONNECT™, which is a Windows-based software library for Modbus RTU communications. For further information on WatView software packages, the WATCONNECT™ software library, or to download the Comm6 software, go to the Watlow web site at http://www.watlow.com.

5. Configure the software's communications parameters.

A software package, (be it software for a Computer, a PLC or an OIT) will need to be configured just as the controller was configured, setting the Baud Rate and Address to match. The software package may have additional parameters to set, such as number of data bits, parity and stop bits. For Watlow controllers using modbus, these should always be set at 8 data bits, no parity, and 1 stop bit. This is often written as "8N1". Some software packages may give the option to control the activi-

ty of the RTS, CTS and DTR lines, which are sometimes used by EIA-232 to EIA-485 converters. On packages where the Modbus registers for the controller need to be defined, these values can be entered at this time. Be sure to account for offsets.

6. Test the communications.

Once communications is configured, test the link to the controller for verification that everything is wired and configured properly. Check the wiring and configurations if things aren't working. One misplaced wire or one incorrect setting will keep communications from working. When using an EIA-232 to EIA-485 converter, be sure to follow the configuration instructions provided with the converter, as some may require special jumper/switch settings, external power supply requirements or special signals from the software. Some software packages have built-in routines for testing the communications or use Comm6 to help diagnose problems.

7. Start communications with the controller.

With the communications successfully verified, the software is now ready for use with the controller. The above guidelines are the general steps to establishing communications with controllers using Modbus. Some applications may require other steps not mentioned, but would follow the same general process.

8. Programming and configuring the controllers.

When programming and configuring the controllers with a software program, a couple of things must be kept in mind. If the software allows changing Setup parameters such as Input Type, other parameter values that are dependent on that setting may be automatically changed. Some software packages may warn you of this possibility and others may not.

Also, some controllers require that any changes made by the software program to controller parameters that need to be retained in the controller memory must be saved in the non-volatile memory writes register. Any settings not saved to controller memory will be lost when the controller's power is turned off.

Infrared Data Communications (IDC)

Infrared Data Communications is an option available on the 1/16th, 1/8th and 1/4 Din Series SD products. This option supports wireless communications with PDAs (personal digital assistants) or other devices equipped with infrared communications that support the IrDA 1.0 Standard. IrDA is an acronym for the Infrared Data Association, www.irda.org. A PDA or other master device communicates with the SD Series using Modbus ASCII via IRCOMM over IrDA. IDC supports wireless communications through transparent material to a distance of no less than one meter between devices at a maximum angle of 15 Degrees.

IDC can support complete Series SD parameter configuration and operation. The actual user interface or configuration is dependent on the master device (PDA) application software. A source for this software is Instant HMI from Software Horizons. For more information, go to www.InstantHMI.com or call (978) 670-8700.

Advantages of this feature include automated logging of key process variables, increased accuracy and ease of use for recipe or configuration setups, and easier controller data exchange in physically restricting environments, such as semiconductor clean rooms. This feature reduces the use of paper to record instrument information as well as human transposition errors.

Troubleshooting

Indication	Probable Cause(s)	Corrective Action
No power. Controller appears dead. No display indication in either window.	Power to unit may be off. Fuse may be blown. Breaker may be tripped. Safety interlock door switch, etc. may be activated. Separate system limit control may be latched. Wiring may be open. Input power may be incorrect.	Check switches, fuses, breakers, interlocks, limit devices, connectors, etc. for energized condition and proper connection. Measure power upstream for required level. Verify supply power requirements using the part number. Check wire size. Check for bad connections.
One of the displays is not on.	Active Displays d,SP (Setup) is not set to nor.	Verify that d,SP is at the desired setting.
Cannot establish serial data communications with the controller.	Address parameter may be incorrectly set. Baud rate parameter may be incorrectly set. Unit-to-unit daisy chain may be disconnected. Communications wiring may be reversed, shorted or open. EIA-485 converter box may be incorrectly wired. Computer's COM port may be incorrectly set up. Communications software setup or address may be incorrect. PC software's protocol or parity may be wrong. Parity should be 8, n, 1. Application software is not working properly. May need termination, pull-up and pull-down resistors.	Check Setup Page and set to correct address. Check Setup Page 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 that communications are ok. Check the communication card documentation for settable variables and operational testing. Restart PC software and check for settings agreement. Verify the COM bus is active. Verify operation with Watlow communications tool available at www.watlow.com. Add termination resistors for EIA/TIA-485 (see Install and Wire chapter).
Cannot establish infrared communications link.	Optical transceiver path obstructed. Infrared device too far away.	Hold the infrared device within range and angle of view to the controller.
	Infrared device software settings do not match controller's infrared settings.	Verify infrared settings.
Output signal is on when it should not be.	Output wiring is incorrect.	Verify the output wiring.
	Output parameters are set incorrectly.	Verify the output parameter settings.
	DC voltage applied to output option "K" (solid-state relay output).	Solid-state relay option can be used with alternating current (ac) voltage only.
Output signal is not on when it should be.	Output wiring is incorrect.	Verify the output wiring.
	For solid-state relay (option "K") and mechanical relay (option "E" or "J"), power must be applied.	Verify that power is applied to the output. The output simply acts as a switch.
	Output parameters are set incorrectly.	Verify the output parameter settings.

Indication	Probable Cause(s)	Corrective Action
Getting alarm message A1h1, A2h1, A3h1, A1Lo, A2Lo or A3Lo.	The process value is beyond an alarm set point.	Determine when alarms messages will display and the proper response to an alarm message.
Alarm is occurring when it should not.	Alarm settings are incorrect.	Adjust the alarm settings to be correct for the application.
	Input may be in an error condition.	See error messages.
	Alarm may be latched.	Press the Infinity Key ∞ to unlatch an alarm.
Alarm output indication is incorrect.	Alarm settings are incorrect.	Adjust the alarm settings to be correct for the application.
	Alarm may be silenced.	See the Features Chapter for information on alarm silencing.
Alarm is not occurring when it should.	Alarm settings are incorrect.	Adjust the alarm settings to be correct for the application.
Output cycles (turns on and off) too frequently.	Wrong control mode. PID control selected instead of On-Off control. The cycle time is not set properly.	Select On-Off control mode (hEAt or CLAt Operations Page) and set the desired hysteresis value. Adjust the cycle time.
Controller does not control close enough to the set point.	Wrong control mode. On-Off control selected instead of PID. PID is not tuned properly.	Select PID control and perform tuning. Run autotune or perform manual tuning.
Controller's process value reading is decreasing but actual process is increasing.	Thermocouple polarity is reversed.	Check thermocouple connections. All thermocouple connections, including thermocouple extension wire, must maintain the correct polarity for proper operation.
	Analog voltage or analog current input scaling is reversed or incorrect.	Check the settings of the analog output scale low and scale high parameter (Setup Page).
Parameter(s) do not appear.	Parameter is not active.	See Setup and Operation chapters to determine when parameters should appear.
	Parameter lockout is active.	Set the correct level of lockout for access (Setup Page).
	Operations Page is not configured properly.	Select the desired parameters for the Programming Page.
Cannot access Operation Page. Cannot change the set point.	Parameter lockout is active.	Set the correct level of lockout for access (Setup Page).

Error Messages

Indication	Probable Cause(s)	Corrective Action
Er In Input error	The sensor may be improperly wired. Sensor wiring may be reversed, shorted or open. The input may be set to the wrong sensor or the controller may not be calibrated. Calibration may have been corrupted.	Check sensor connections. Check sensor connections and sensor wiring. Change Sensor Type SEn (Setup Page) to match the sensor hardware. Restore factory calibration.
ErAb Ambient temperature error	Ambient temperature may be too hot or too cold. Calibration may be corrupted.	Verify that the temperature surrounding the controller is 0 to 65°C (32 to 149°F). Restore factory calibration.
ErCS Checksum error	Settings may have changed unexpectedly.	Press the Infinity Key ∞ to clear the error. Verify settings. If error message persists, contact the factory.

A Appendix

Specifications

(2288)

Controller

- Microprocessor-based, user-selectable control modes
- Heat and cool autotune for control outputs
- 1 Universal input, 3 outputs (2 outputs on 1/32 DIN)
- Control outputs user-selectable as on-off, P, PI, PID
- Display update: 10 Hz, adjustable digital filter
- Output update: burst, 0.1 to 999.9 seconds
- Communication output isolated
- Displayed in °C, °F or process units

Operator Interface

- Dual 4-digit LED displays
- Advance, Up Arrow, Down Arrow, Infinity (Home) 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

- Update rate: 6.5 Hz

Thermocouple

- Type J, K, T, N, C (W5), E, PTII (F), D (W3), B, R, S thermocouple types. Whole or tenth of a degree resolution.
- >100 MΩ input impedance
- Maximum 20 Ω source resistance

RTD

- 2- or 3-wire platinum, 100 Ω
- DIN curve (.00385 curve)
- Whole or tenth degree indication
- 390 µA nominal RTD excitation currrent

Process

- Range selectable: 0 to 10V⎓ (dc), 0 to 5V⎓ (dc), 1 to 5V⎓ (dc), 0 to 20 mA, 4 to 20 mA. (Can reverse low and high values.)
- Voltage input impedance 20 kΩ
- Current input impedance 100 Ω
- Minimum current source resistance 1 MΩ
- Input resolution 50,000 bits (approximately) at full scale

Input Accuracy

Input ranges

Type J:	32	to	1,382°F	or	0	to	750°C
Type K:	-328	to	2,282°F	or	-200	to	1,250°C
Type T:	-328	to	662°F	or	-200	to	350°C
Type N:	32	to	2,282°F	or	0	to	1,250°C
Type E:	-328	to	1,470°F	or	-200	to	900°C
Type C (W5):	32	to	4,200°F	or	0	to	2,315°C
Type D (W3):	32	to	4,200°F	or	0	to	2,315°C
Type PTII (F):	32	to	2,540°F	or	0	to	1,393°C
Type R:	32	to	2,642°F	or	0	to	1,450°C
Type S:	32	to	2,642°F	or	0	to	1,450°C
Type B:	1,598	to	3,092°F	or	870	to	1,700°C
RTD:	-328	to	1,472°F	or	-200	to	800°C
Process:	-1,999	to	9,999 unit				

Allowable Operating Ranges

Type J:	32	to	1,500°F	or	0	to	815°C
Type K:	-454	to	2,500°F	or	-270	to	1,370°C
Type T:	-454	to	750°F	or	-270	to	400°C
Type N:	32	to	2,372°F	or	0	to	1,300°C
Type E:	-454	to	1,470°F	or	-270	to	800°C
Type C:	32	to	4,200°F	or	0	to	2,315°C
Type D:	32	to	4,200°F	or	0	to	2,315°C
Type PTII (F):	32	to	2,543°F	or	0	to	1,395°C
Type R:	32	to	3,200°F	or	0	to	1,760°C
Type S:	32	to	3,200°F	or	0	to	1,760°C
Type B:	32	to	3,300°F	or	0	to	1,816°C
DIN	-328	to	1,472°F	or	-200	to	800°C
Process	-1,999	to	9,999 ur				

Thermocouple Input

- Calibration accuracy: ±0.1% of input span ±1°C at standard conditions
- Temperature stability: ±0.2 degree per degree change in ambient for J, K, T, N, E, F

  ±0.3% for C and D

  ±0.4% for B, R (excluding 0 to 100°C) and S (excluding 0 to 100°C)

  ±0.5% for R and S (entire input accuracy range)

RTD Input

- Calibration accuracy ±0.1% of input range ±1°C at standard conditions
- Temperature stability: ±0.05 degree per degree change in ambient

Process Input

- Voltage input ranges

  Accuracy ±10mV ±1 LSD at standard conditions

  Temperature stability ±100 ppm/°C maximum
- Milliamp input ranges

  Accuracy ±20µA ±1 LSD at standard conditions

  Temperature stability ±100 ppm/°C maximum

Output Types

Open Collector

- Maximum voltage: 42V⎓ (dc)
- Maximum current: 250 mA
- Class 2 power source required

Switched DC

- Supply voltage minimum: 6V⎓ (dc) @ 30 mA
- Supply voltage maximum: 12V⎓ (dc) into an infinite load

Solid-state Relay

- Optically isolated
- Zero cross switched
- Without contact suppression
- Minimum load current: 10 mA rms
- Maximum current: 0.5A rms at 24 to 240V~ (ac)
- Maximum offstate leakage current: 100 µA rms
- For resistive loads only, must use RC suppression for inductive loads

Electromechanical Relay, Form A

- Minimum load current: 10 mA
- Rated resistive: 2 A @ 240V~ (ac) or 30V⎓ (dc) maximum
- 125VA pilot duty, rated 120/240V~ (ac)
- Electrical life 100,000 cycles at rated current
- For resistive loads only, must use RC suppression for inductive loads

Electromechanical Relay, Form C

- Minimum load current: 10 mA
- Rated resistive: 5 A @ 240V~ (ac) or 30V⎓ (dc) maximum
- 125VA pilot duty, rated 120/240V~ (ac)
- Electrical life 100,000 cycles at rated current
- For resistive loads only, must use RC suppression for inductive loads

Process

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

Communications

EIA/TIA-485

- Isolated
- Modbus™ RTU protocol
- 9600, 19200 and 38400 baud rates
- A maximum of 32 units can be connected (with additional 485 repeater hardware, up to 247 units may be connected)
- Update rate: 20 Hz

IrDA

- Modbus™ RTU via IRCOMM over IrDA
- Update rate: 20 Hz

Agency Approvals

- UL3121®, c-UL, CE, IP65 (NEMA 4X)

  Modbus™ is a trademark of AEG Schneider Automation.

  UL® is a registered trademark of the Underwriter's Laboratories, Inc.
- Submitted to Canadian Standards Association for testing.

Terminals

- Touch-safe
- Input power and control outputs: 12 to 22 AWG, 6 mm (10.25 in) strip length
- Sensor inputs and process outputs: 20 to 28 AWG, 8 mm (10.30 in) strip length
- Torque: terminal blocks 1 to 6 (SD _ _ - _ [C, K or J] _ _ - _ _ _ _) and 1 to 4 (SD _ _ - _ F _ _ - _ _ _ _) are 7 lb-in; terminal blocks 12, 13, 14 are 8 lb-in.

Power

- 100 to 240V~ (ac) +10%; -15%; 50/60 Hz, ±5%
- 24V≂ (ac/dc) +10%; -15%; 50/60 Hz, ±5%; Class 2 power source is required for low-voltage model.
- 10VA maximum power consumption
- Data retention upon power failure via nonvolatile memory

Operating Environment

- -18 to 65°C (0 to 149°F)
- 0 to 90% RH, non-condensing
- Storage temperature: -40 to 85°C (-40 to 185°F)

Dimensions

DIN Size	Behind Panel	Width	Height
1/32	97.8 mm (3.85 in)	53.6 mm (2.11 in)	30.8 mm (1.21 in)
1/16	97.8 mm (3.85 in)	52.1 mm (2.05 in)	52.1 mm (2.05 in)
1/8 Vertical	97.8 mm (3.85 in)	52.8 mm (2.08 in)	99.8 mm (3.93 in)
1/8 Horizontal	97.8 mm (3.85 in)	99.8 mm (3.93 in)	52.8 mm (2.08 in)
1/4	101.1 mm (3.98 in)	99.8 mm (3.93 in)	99.8 mm (3.93 in)

Functionality Matrix

	Universal Input	Control	Alarm	Process	485 Comm
Input 1	■				
Output 1		■	■	■	
Output 2		■	■		■
Output 3		■	■	■	

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

Ordering Information and Model Numbers (2289)

		S	D		C	—					—		A		
DIN Sizes	**3, 6, 8, 9 or 4**														
3	1/32 DIN														
6	1/16 DIN														
8	1/8 DIN Vertical														
9	1/8 DIN Horizontal														
4	1/4 DIN														
Control Type	**C***														
C	PID Control														
Power Supply	**H or L**														
H	100 to 240V≂ (ac/dc)														
L	24V≂ (ac/dc)														
Output 1	**C, K, F or J**														
C	Switched DC														
K	Solid-state Relay Form A, 0.5 Amp														
F	Universal Process														
J	Mechanical Relay Form A, 2 Amp														
Output 2	**A, C, K, J or U**														
A	None														
C	Switched DC														
K	Solid-state Relay Form A, 0.5 Amp														
J	Mechanical Relay Form A, 2 Amp														
U	EIA/TIA-485 Modbus Communications														
Output 3 (not a															
A	None														
C	Switched DC/Open Collector														
K	Solid-state Relay Form A, 0.5 Amp														
F	Universal Process														
E	Mechanical Relay Form C, 5 Amp														
Infrared comm															
A	None														
R	Infrared Communications Ready (not availab														
Display Colors															
RG	Red Green (Only color option available on 1/32 I														
RR	Red Red														

*FM-approved limit version is available. For more information, go to www.watlow.com.

Index

1/16 DIN 20
1/32 DIN 20
1/8 DIN Horizontal 20
1/8 DIN Vertical 20
Access Lockout 43
Active Displays 31
Active Output Indicator Lights 20
Address 50
adjust the set point 21
Adjusting the set temperature 21
Advance Key 20
Advanced Control Algorithm 3
Agency Approvals 56
Alarm 1 Hysteresis 29
Alarm 1 Latching 29
Alarm 1 Logic 29
Alarm 1 Message 30
Alarm 1 Silencing 29
Alarm 1, 2, or 3 Silencing 49
Alarm 2 Hysteresis 30
Alarm 2 Latching 30
Alarm 2 Logic 30
Alarm 2 Message 30
Alarm 2 Silencing 30
Alarm 3 Hysteresis 30
Alarm 3 Latching 30
Alarm 3 Logic 30
Alarm 3 Message 30
Alarm 3 Silencing 30
Alarm High 1 Status 24
Alarm High 2 Status 24
Alarm High 3 Status 24
Alarm Hysteresis 49
Alarm Latching 49
Alarm Low 1 Status 24
Alarm Low 2 Status 24
Alarm Low 3 Status 24
Alarm Message 21
Alarm Set Points 49
Alarm Silencing 49
Alarms Features 48
Ambient Temperature 36
Ambient temperature error 54
Analog Output 1 Scale High 27
Analog Output 1 Scale Low 27
Analog Output 1 Units 27
Analog Output 3 Scale High 29
Analog Output 3 Scale Low 29
Analog Output 3 Units 29
Appendix 55
Auto (closed loop) and Manual (open loop) Control 44
Auto (closed loop) control 44
Auto-Manual Control Indicator Light 20
Automatic Mode 21
Automatic Send Data control 18
Autotune 42
B&B Converter 18
Back Views 10
Baud Rate 31, 50
Biasing and termination 18
Calibration 36, 39
Calibration Offset 43
Checksum error 54
Closed Loop 44
Closed Loop Set Point 24
CMC Converter 18
Communications features 50
Communications specifications 56
Control Method 1 26
Control Method 2 27
Control Method 3 28
Control Methods features 44
Cool Control Method 33, 45
Current Process Input Procedure 40
Current Ramp Set Point 24
Dead Band 46
Dead Band Cool 46
Dead Band Heat 46
Default Parameters 36
Derivative Cool 46
Derivative Heat 46
Derivative Term 34
Deviation Alarms 49
Dimensions 4, 5
    1/16 DIN 4
    1/32 DIN 4
    1/4 DIN 5
    1/8 DIN 5
Dimensions specifications 56
Display Intensity 36
EIA/TIA-232 to EIA/TIA-485 Converter 18
EIA/TIA-485 50, 56
EIA/TIA-485 serial port 50
EM Gateway 19
Error condition 21
Error Messages 54
Ethernet Gateway 19
Factory Page 36
Factory Page Overview 23
Features and Benefits 3
Filter Time Constant 43
Filter Value 26
Filtered Process Value 24
Fixed Time Base 1 27
Fixed Time Base 2 27
Fixed Time Base 3 28
Functionality Matrix 56
Greenlee 4, 5
Heat Control Method 45
Heat Hysteresis 33
High Range and Low Range 44
High Scale and Low Scale 44
Home Page 24
Home Page Overview 21
IDC 51
Independent Heat and Cool PID 48
Infinity Key 20
InfoSense™ 3, 25, 43
InfoSense™ 1, 2, 3, 4 25
infrared 52
Infrared Communications 3
Infrared Data Association 51
Infrared Data Communications 51
Input Accuracy 55
Input Calibrate, 1.0 Volt 37
Input Calibrate, 16.0 mA 38
Input Calibrate, 4.0 mA 38
Input Calibrate, 9.0 Volt 38
Input Error 24, 54
Input Error Failure Mode 31
Input Error Latching 31
Input Error Power 31
Input Filter 26, 43
Input ranges 55
Inputs 43
inputs and outputs 2
Install and Wire 4
Installation
    1/32 DIN 6
    1/16 DIN 7
    1/8 DIN 8
    1/4 DIN 9
Integral Cool 33, 46
Integral Heat 46
Integral Term 34
IP65/NEMA 4X seal 6
IrDA 56
Isolation 18
Isolation Blocks 11
Keys and Displays 20
Left Display 20
Lockout 31
Lower Display 20
Manual (open loop) Control 44
Manual Mode 21
Maximum Recorded Ambient Temperature 36
Measured Value 24
Minimum Recorded Ambient Temperature 36
Modbus Device Address 31
Modbus Network 50
Modbus RTU protocol 50
Model Numbers 57
National Electric (NEC) 11
NEMA 4X 7
Nonlinear output curve 47
On-Off Control 45
Open Loop 44
Open Loop Output Power 24
Operating Environment 56
Operating Ranges 55
Operations Page 42
Operations Page Overview 21
Operations Parameters Table 32
Operator Interface 55
Ordering Information 57
Output Nonlinear Function 1 27
Output Nonlinear Function 2 28
Output Nonlinear Function 3 29
Output Power Scale High 1 27
Output Power Scale High 2 28
Output Power Scale High 3 29
Output Power Scale Low 1 27
Output Power Scale Low 2 28
Output Power Scale Low 3 28
Output 1 Calibrate, 1.0 Volt 38
Output 1 Calibrate, 16.0 mA 38
Output 1 Calibrate, 4.0 mA 38
Output 1 Calibrate, 9.0 Volt 38
Output 1 Function 26
Output 1 Process Value 36
Output 1 Type 36
Output 2 Function 27
Output 2 Type 37
Output 3 Calibrate, 1.0 Volt 38
Output 3 Calibrate, 16.0 mA 38
Output 3 Calibrate, 4.0 mA 38
Output 3 Calibrate, 9.0 Volt 38
Output 3 Function 28

Output 3 Process Value 36
Output 3 Setup and Calibration 40
Output 3 Type 37
Output Configuration 44
Output Types 56
Overview 2
Paktron 13
PI Control 46
PID Control 46
Power Limit 1, 2, 3 27, 28, 47
Power Scaling 47
Power specifications 56
Power Supply 18
Power Type 37
Process Alarms 49
Process Decimal Places 25
Process Output Procedures 40
Process Scale High 26, 44
Process Scale Low 26, 44
Process Value 24
Programming Page Overview 23
Proportional Band Cool 33, 46
Proportional Band Heat 46
Proportional Control 45
Proportional plus Integral (PI) Control 46
Proportional plus Integral plus Derivative (PID) Control 46
Quencharc 13
Ramp Rate 31, 48
Ramp Scale 31, 48
Ramp Target Set Point 24
Ramping 48
Ramping Home Page display 21
Ramping Mode 31, 48
Rate Cool 46
Rate Heat 46
Removal
    1/32 DIN 6
    1/16 DIN 7
    1/8 DIN 8
    1/4 DIN 9
Reset Cool 33, 46
Reset Heat 46
Restore Factory Calibration 36
Restore User Settings 36
Restoring Factory Calibration 40
Right Display 20
RTD Input Procedure 39
RTD, 15 ohm 37
RTD, 380 ohm 37
Save User Settings 36
Saving and Restoring User Settings 42
Sensor Selection 43
Sensor Type 25, 43
Serial Number 1 37
Serial Number 2 37
Set Point High 44
Set Point High Limit 26
Set Point Low 44
Set Point Low Limit 26
Set Point Low Limit and High Limit 44
Set Value 24
Setting Up a Modbus Network 50
Setup Page 25
Setup Page Overview 22
Software Build Number 37
Software ID 37
Software Version 37
Specifications 55
Temperature Decimal Places 25
Temperature set point 21
Temperature Units 25
Terminals 56
Thermocouple Input Procedure 39
Thermocouple Linearization 25
Thermocouple, 0mV 37
Thermocouple, 32°F 37
Thermocouple, 50mV 37
Troubleshooting 52
Two-wire capability 18
Units of Measurement 31
Units Scale High 26, 44
Units Scale Low 26, 44
Universal Input 55
Up and Down Keys 20
Upper Display 20
Variable Time Base 48
Voltage Process Input Procedure 39
WATCONNECT™ 50
Watlow web site 50
WatView™ 50
WatView™ Software 3
Wiring
    0 to 10V ⎓ Process Input 12
    0 to 20mA Process Input 13
    EM Gateway 19
    High Voltage AC Power Wiring 11
    Low Voltage AC Power Wiring 11
    Output 1 Mechanical Relay 13
    Output 1 Process 14
    Output 1 Solid-state Relay 13
    Output 1 Switched DC 14
    Output 2 EIA-485 15
    Output 2 Mechanical Relay 14
    Output 2 Solid-state Relay 15
    Output 2 Switched DC 15
    Output 3 Mechanical Relay 16
    Output 3 Open Collector 17
    Output 3 Process 17
    Output 3 Solid-state Relay 16
    Output 3 Switched DC 16
    RTD Input 12
    Thermocouple Input 12

Prompt Index

A16 38
A1hi 24
A1Lo 24
A2hi 24
A2Lo 24
A3hi 24
A3Lo 24
AMMA 36
AMMn 36
AOt1 36
AOt3 36
Addr 31
AMMb 36
AO1W 27
AO3W 29
Aut 42
bAud 31, 50
C-F 25
CAL 43
CLrM 33, 45
Ctr1 26
Ctr2 27
Ctr3 28
dbCL 46
dbht 33, 46
dE 34
dECL 46
dEht 46
dFLt 36
dSP 31
dSP1 30
dSP2 30
dSP3 30
dSPL 36
ErAb 54
ErCS 54
Er In 24, 54
FAIL 31
FLtr 26, 43
Ftb1 27
Ftb2 27
Ftb3 28
FtrE 26, 43
hhYS 33
htMM 45
hYS1 29, 49
hYS2 30, 49
hYS3 30, 49
I16A 38
IErr 31
ISEn 25, 43
ISP1 25
ISP2 25
ISP3 25
ISP4 25
It 34
ItCL 33, 46
Ithi 46
I 4A 38
LAt1 29, 49
LAt2 30, 49
LAt3 30, 49
L9c1 29
L9c2 30
L9c3 30
L in 25
LOC 31, 43
MMAn 31
nLF1 27
nLF2 28
nLF3 29
O116 38
O11u 38
O14A 38
O19u 38
O1hi 27, 44
O1Lo 27, 44
O316 38
O31u 38
O34A 38
O39u 38
O3hi 29, 44
O3Lo 29, 44
OtY1 36
OtY2 37
OtY3 37
Ot 1 26
Ot 2 27
Ot 3 28
PdEC 25
PbCL 33, 46
Pbht 46
PL 1 27, 47
PL 2 28, 47
PL 3 28, 47
PrOP 34
PSH1 27, 47
PSH2 28, 47
PSH3 29, 47
PSL1 27, 47
PSL2 28, 47
PSL3 28, 47
PuJr 37
r 15 37
r380 37
rACL 46
rAht 46
rECL 33, 46
rEht 46
rESt 36
r9hi 26, 44
r9Lo 26, 44
rP 24, 31, 48
rPrt 31, 48
rPSc 31, 48
rPt9 24
SbLd 37
SdEC 25
SUEr 37
Schi 26
ScLo 26
SEn 25, 43
Sid 37
SiL1 29, 49
SiL2 30, 49
SiL3 30, 49
Sn_ 37
Sn] 37
SPhi 26, 44
SPLo 26, 44
tc00 37
tc32 37
tc50 37
u1 37
u9 38
Unit 31
USrr 36
USrS 36

Declaration of Conformity

Series SD

Watlow Winona, Inc.
1241 Bundy Blvd.
Winona, MN 55987 USA

Declares that the following product:

Designation:	**Series SD**
Model Numbers:	SD(3, 4, 6, 8 or 9)(C or L) – (H or L)(C, F, J or K)(A, C, J, K or U) (A, C, E, F or K) – (A or R)(any three letters or numbers)
Classification:	Temperature control, Installation Category II, Pollution degree 2
Rated Voltage:	100 to 240V~ (ac) or 24V≂ (ac or dc) Rated Frequency: 50 or 60 Hz
Rated Power Consumption:	10VA maximum

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

89/336/EEC Electromagnetic Compatibility Directive

EN 61326:	**1997**	**With A1:1998: A2:2002:**	**Electrical equipment for measurement, control and laboratory use – EMC requirements (Industrial Immunity, Class B Emissions).**
EN 61000-4-2:	1996	With A1, 1998:	Electrostatic Discharge Immunity
EN 61000-4-3:	1997:		Radiated Field Immunity
EN 61000-4-4:	1995:		Electrical Fast-Transient / Burst Immunity
EN 61000-4-5:	1995	With A1, 1996:	Surge Immunity
EN 61000-4-6:	1996:		Conducted Immunity
EN 61000-4-11:	1994:		Voltage Dips, Short Interruptions and Voltage Variations Immunity
EN 61000-3-2:	ED.2.	2000:	Harmonic Current Emissions
EN 61000-3-3:	1995	With A1:1998:	Voltage Fluctuations and Flicker

73/23/EEC Low-Voltage Directive

EN 61010-1:	**1993 With A1: 1995**	**Safety Requirements of electrical equipment for measurement, control and laboratory use. Part 1: General requirements**

Dean Hoffmann	Winona, Minnesota, USA
Name of Authorized Representative	Place of Issue
General Manager	August 2002
Title of Authorized Representative	Date of Issue

Signature of Authorized Representative

(2287)

How to Reach Us

Your Authorized Watlow Distributor:

Corporate Headquarters in the U.S.:

Watlow Electric Manufacturing Co.
12001 Lackland Road
St. Louis, Missouri, USA 63146
Telephone: +1 (314) 878-4600
Fax: +1 (314) 878-6814

Europe:

Watlow GmbH
Industriegebiet Heidig
Lauchwasenstr. 1, Postfach 1165
Kronau 76709 Germany
Telephone: +49 (0) 7253-9400 0
Fax: +49 (0) 7253-9400-44

Watlow France S.A.R.L.
Immeuble Somag,16 Rue Ampère,
Cergy Pontoise CEDEX 95307 France
Telephone: +33 (1) 3073-2425
Fax: +33 (1) 3073-2875

Watlow Italy S.R.L.
Via Meucci 14,
20094 Corsico MI
Italy
Telephone: +39 (02) 4588841
Fax: +39 (02) 458-69954

Watlow Limited
Robey Close, Linby Industrial Estate,
Linby Nottingham England, NG15 8AA
Telephone: +44 (0) 115 9640777
Fax: +44 (0) 115 9640071

Latin America:

Watlow de México
Av. Fundición #5,
Col. Parques Industriales,
Querétaro, Qro. México CP-76130
Telephone: +52 (442) 217-6235
Fax: +52 (442) 217-6403

Asia/Pacific:

Watlow Australia Pty., Ltd.
23 Gladstone Park Drive,
Tullamarine, Victoria 3043 Australia
Telephone: +61 (39) 335-6449
Fax: +61 (39) 330-3566

Watlow China, Inc.
179, Zhong Shan Xi Road
Hong Qiao Cointek Bldg, Fl. 4, Unit P
Shanghai 200051 China
Telephone: +86 (21) 6229-8917
Fax: +86 (21) 6228-4654

Watlow Japan Ltd. K.K.
Azabu Embassy Heights 106,
1-11-12 Akasaka,
Minato-ku, Tokyo 107-0052 Japan
Telephone: +81 (03) 5403-4688
Fax: +81 (03) 5403-4646

Watlow Korea Co., Ltd.
Hanil Bldg., 3rd Floor
210-5 Yangje-Dong Seocho-Gu
Seoul, 137-130 Korea
Telephone: +82 (2) 575-9804
Fax: +82 (2) 575-9831

Watlow Malaysia Sdn Bhd
38B Jalan Tun Dr Awang
11900 Bayan Lepas
Penang Malaysia
Telephone: +60 (4) 641-5977
Fax: +60 (4) 641-5979

Watlow Singapore Pte. Ltd.
Ayer Rajah Crescent
#03-23, Ayer Rajah Industrial Estate
Singapore 139949
Telephone: +65 773 9488
Fax: +65 778 0323

Watlow Electric Taiwan
10F-1 No. 189
Chi-Shen 2nd Road,
Kaohsiung, Taiwan
Telephone: +886 (7) 288-5168
Fax: +886 (7) 288-5568