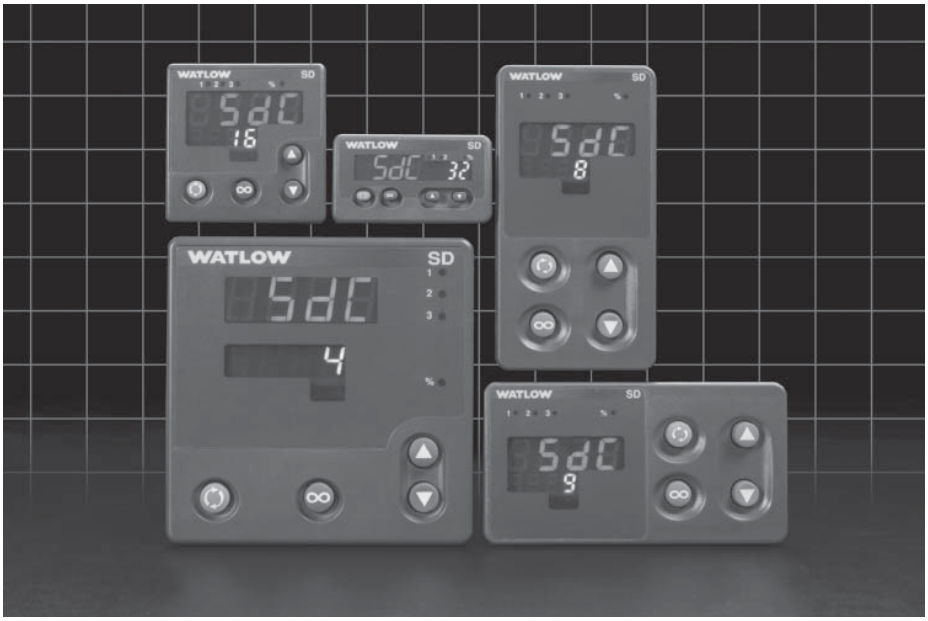
Series SD

User's Manual



PID Controller and PID Profiling 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. F

Made in the U.S.A.

April 2006

$15.00

Safety Information

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

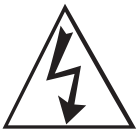
A “NOTE” marks a short message to alert you to an important detail.

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.

CAUTION or WARNING

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

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



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, you can get technical assistance from your local Watlow representative (see back cover), by e-mailing your questions to wintechsupport@watlow.com 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. If you do not know why the product failed, contact an Application Engineer or Product Manager. All RMA’s require:
    - 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 required when returning any product for credit, repair or evaluation. 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 try to verify the reason for returning it.
4. In cases of manufacturing defect, we will enter a repair order, replacement order or issue credit for material returned. In cases of customer mis-use, we will provide repair costs and request a purchase order to proceed with the repair work.
5. To return products that are not defective, goods must be be in new condition, in the original boxes and they must be returned within 120 days of receipt. A 20 percent restocking charge is applied for all returned stock controls and accessories.
6. If the unit is unrepairable, you will receive a letter of explanation. and be given the option to have the unit returned to you at your expense or to have us scrap the unit.
7. Watlow reserves the right to charge for no trouble found (NTF) returns.

TC

Table of Contents

1 Chapter 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 product family includes a static set point PID control version, a PID profiling (ramp and soak) version and an FM approved limit version. All models have 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).

The Series SD PID profiling (ramp and soak) controllers are available as a factory order option for any of the Series SD DIN sizes. The profiling feature allows the user to program up to 4 profiles of 10 steps each. The files can be linked to support a single file of up to 34 unique steps. The Series SD profiling units can also operate as a closed loop static set point controller or manual mode (open loop, percent power) operation capabilities. Outputs can be configured as heat, cool, alarm, event or off (deactivated).

Standard Series SD features include an IP65/NEMA 4X front panel rating; CE compliance, UL, CUL, CSA and NSF agency approvals; 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.

*** Infrared option not available on 1/32 DIN.

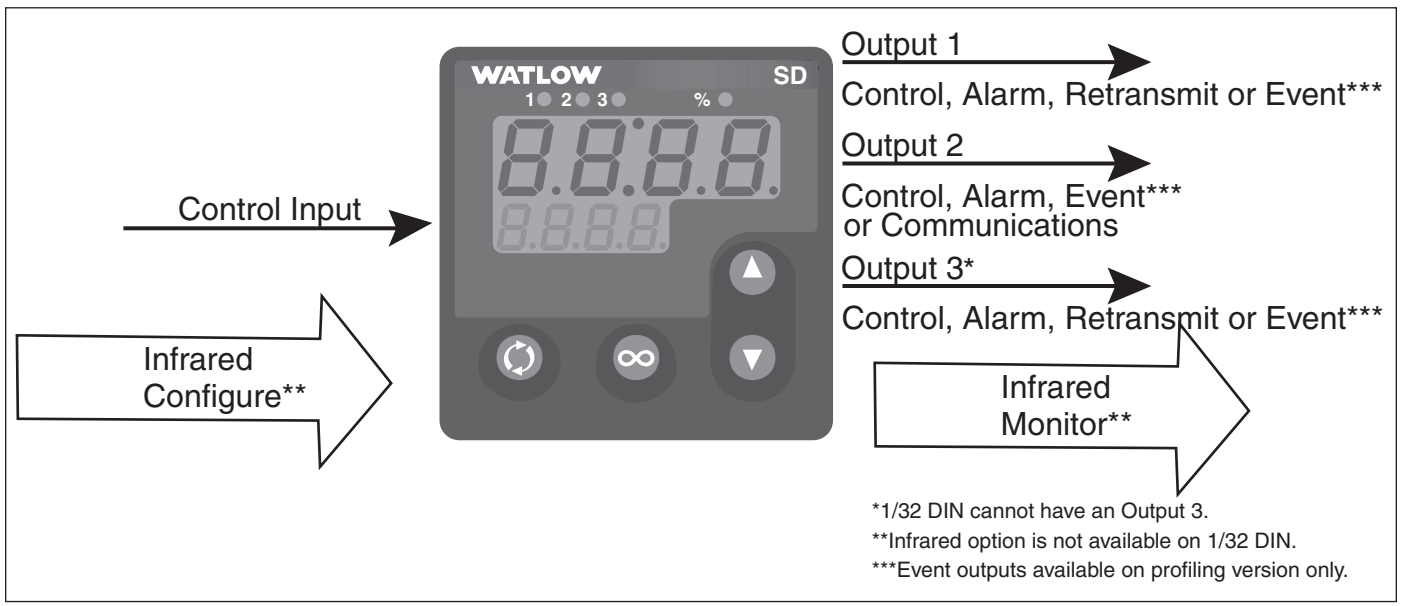


Figure 2 — Series SD inputs and outputs.

Features and Benefits

INFOSENSE™ Technology
- Improves sensor accuracy by a minimum of 50%.

User Definable Menu System
- Simplifies operator interface

User Definable Default Settings
- Restores to user defined controller settings

WATVIEW™ Software
- Operation, configuration and data logging with a standard Windows® PC.

Infrared Communications
- Facilitates controller setup, operation and monitoring.

Up to three outputs (1/32 DIN two outputs only)
- Application versatility.
- Configuration flexibility.

Dual Displays on all models
- Better monitoring of process changes.

Ramp to Set Point
- Controls the rate of temperature changes.

Profiling (ramp and soak) Capability
- 4 Profiles with 10 steps each
- Profiles can be linked together
- wait-for Process
- Guaranteed Soak
- Programmable Event Outputs
- Customer/OEM Profile save/restore

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. **The 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 the Install and Wire chapter 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 the Install and Wire chapter 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 the Install and Wire chapter 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 USr.S parameter, on the Factory Page. For saving and restoring parameters, see the Features chapter. For details on configuring the Setup Page, see the Setup Page chapter.

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. In equipment where demands could vary significantly, the OEM may leave parameter adjustments to the end user.

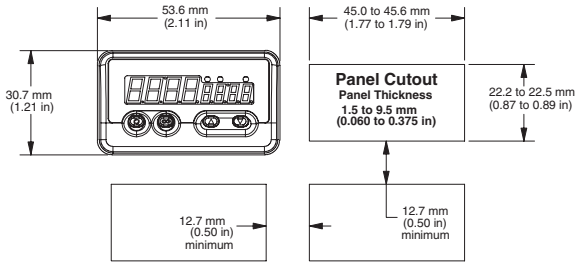
The Operations Page on the Series SD controller is customizable so that only the parameters that the operator may need to use will appear in the display. Settings that won't need to be adjusted can be hidden from the operator, using the Programming Page. For more details on the Programming Page, see the Features chapter. For details on configuring parameters in the Operations Page, see the Operations Parameters Tables. Once you have verified the controller is operating properly, be sure to document all of your parameter settings. **Each parameter table has a settings column for you to write in your values.**

2 Chapter 2: Install and Wire

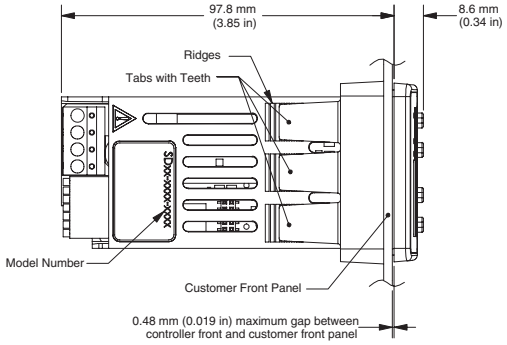
Dimensions

1/32 DIN Series SD Controller Dimensions

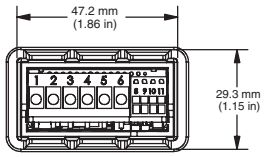
Front



Top



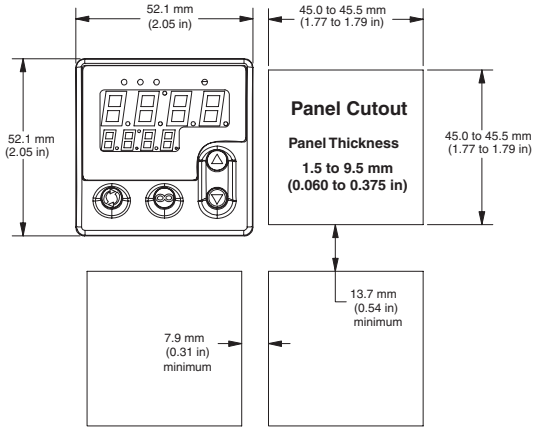
Back



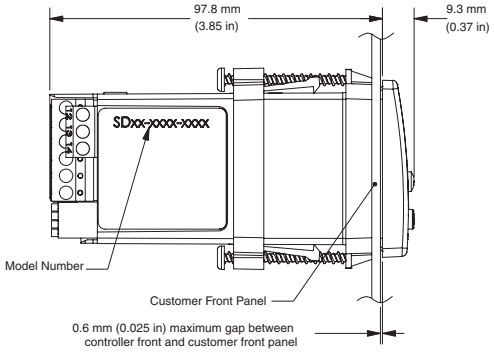
Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

1/16 DIN Series SD Controller Dimensions

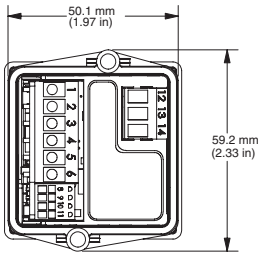
Front



Side



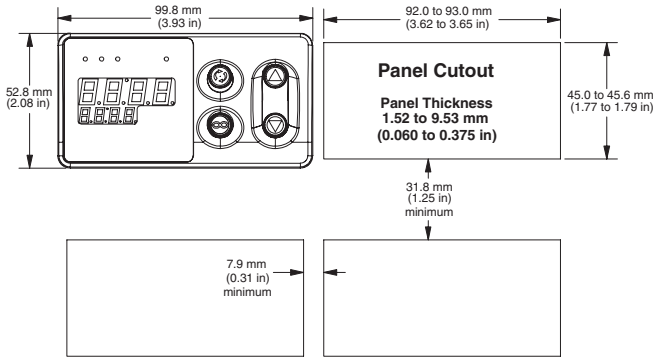
Back



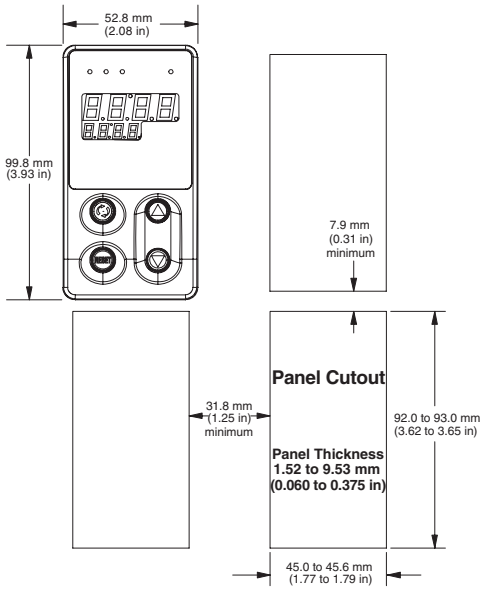
Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

1/8 DIN Series SD Controller Dimensions

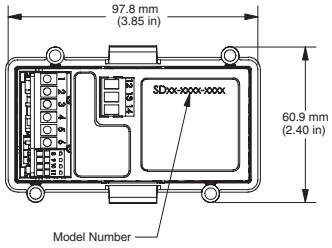
Front (horizontal)



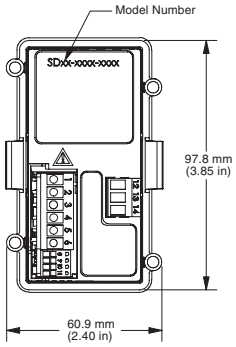
Front (vertical)



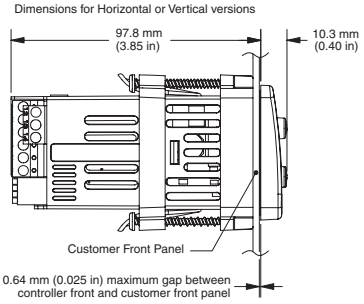
Back (horizontal)



Back (vertical)



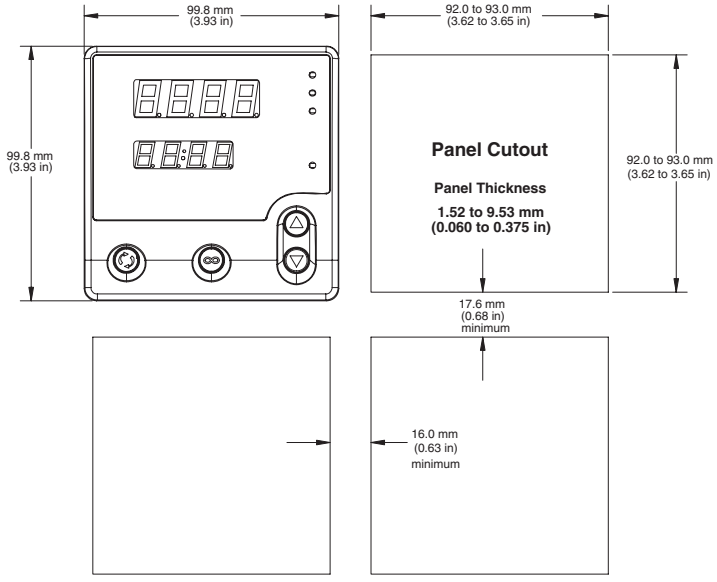
Side (horizontal)



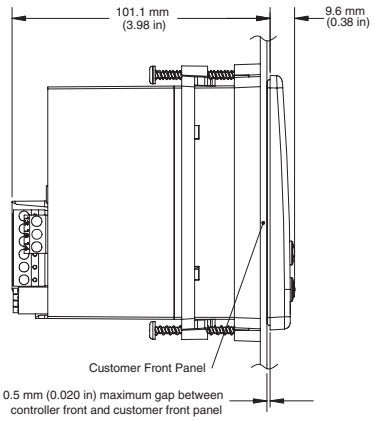
Contact your local Greenlee supplier for the appropriate punch kit and cutout tools required for rapid mounting.

1/4 DIN Series SD Controller Dimensions

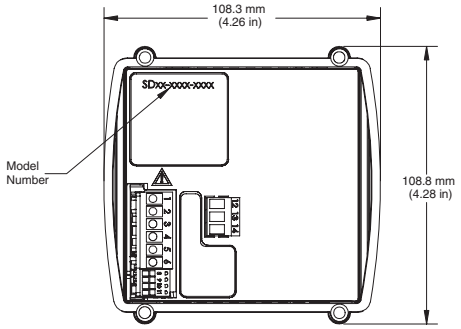
Front



Side



Back



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

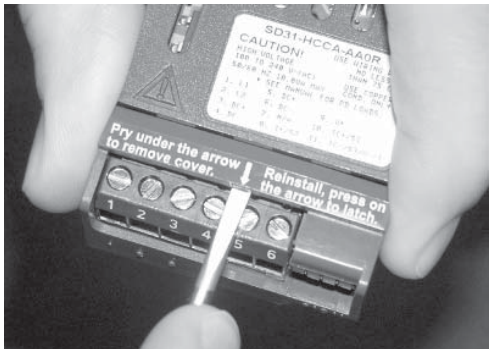
Removing the Screw Clamp Connectors

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.

To prevent component damage when removing the screw clamp connector, please follow these steps:

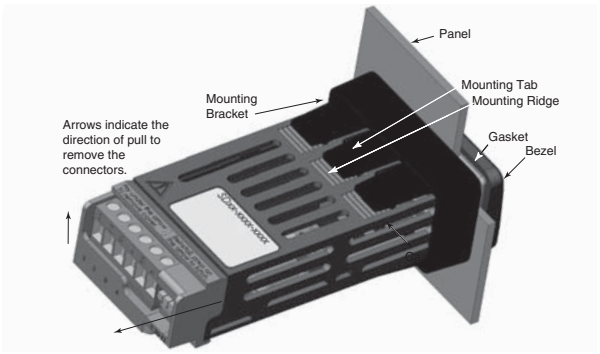
1. Insert a screwdriver in the top of the spring clamp and lift it up as shown.
2. Pull out the sensor connector (pins 8 to 11).
3. Lift up the screw clamp connector.

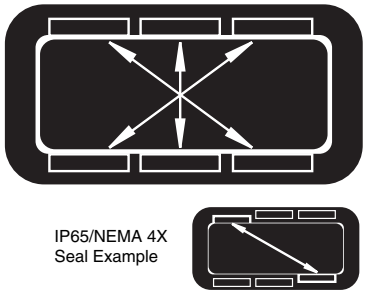
Note: These directions apply to all Series SD



Installation

Installing the 1/32 DIN Series SD Controller





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.

Tools required: Putty knife or equivalent

Removing the 1/32 DIN Series SD Controller

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, on the top and then the bottom, while pushing forward on the back of the case. Be ready to support the controller as it slides out of the panel cutout.

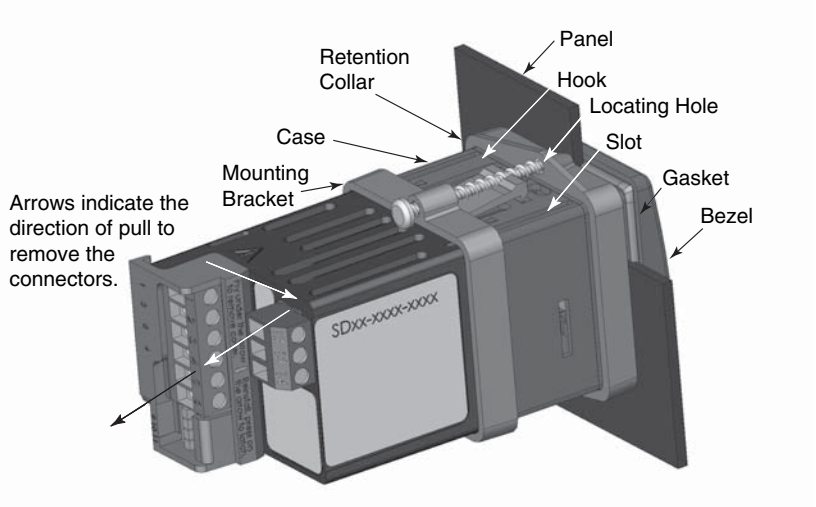
Caution: Follow the installation procedure exactly to guarantee a proper IP65/ NEMA 4X seal. Make sure the gasket between the panel and the rim of the case is not twisted and is seated properly. Failure to do so could result in damage to equipment.

Note: Be careful not to over-tighten 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.

Installing the 1/16 DIN Series SD Controller



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

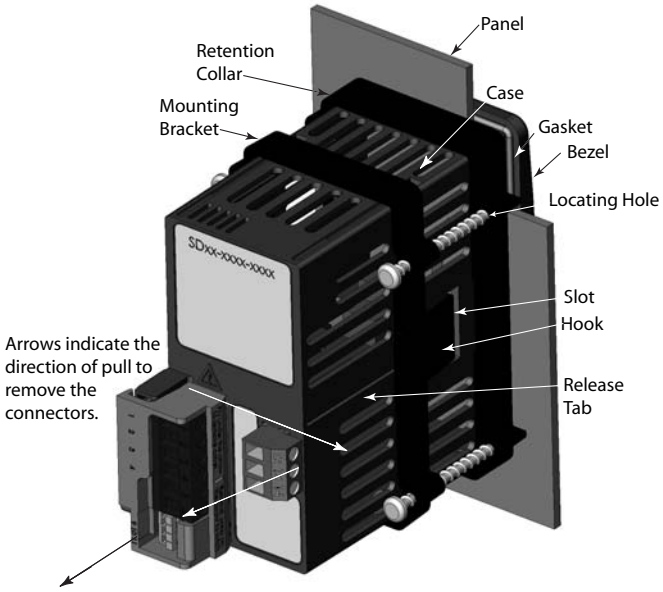
Tools required: one #2 Phillips screwdriver.

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 over-tighten 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 1/8 DIN Series SD 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.

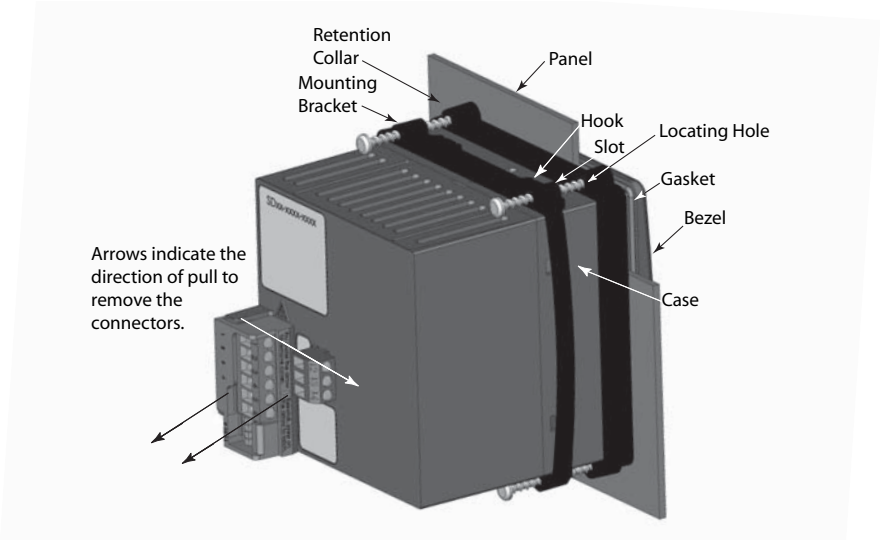
Installing the 1/4 DIN Series SD Controller

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 over-tighten 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.

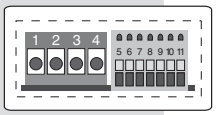


Figure 10a — 1/32 DIN with a Universal Process Output installed for output 1 (S D 3 _ - _ F _ _ - _ _ _ _).

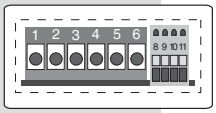


Figure 10b — 1/32 DIN with other than a Universal Process Output installed for output 1 (S D 3 _ - _ (C,K or J) _ _ - _ _ _ _).

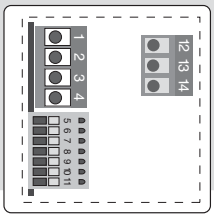


Figure 10c — 1/16 DIN with a Universal Process Output installed for output 1 (S D 6 _ - _ F _ _ - _ _ _ _).

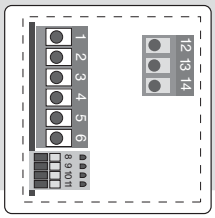


Figure 10d — 1/16 DIN with other than a Universal Process Output installed for output 1 (S D 6 _ - _ (C,K or J) _ _ - _ _ _ _).

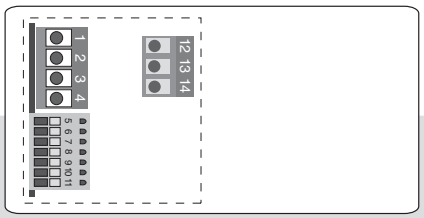


Figure 10e — 1/8 DIN Horizontal with a Universal Process Output installed for output 1 (S D 9 _ - _ F _ _ - _ _ _ _).

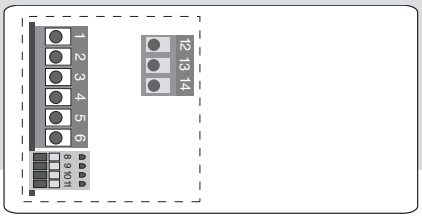


Figure 10f — 1/8 DIN Horizontal with other than a Universal Process Output installed for output 1 (S D 9 _ - _ (C,K or J) _ _ - _ _ _ _).

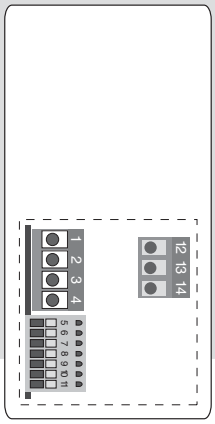


Figure 10g — 1/8 DIN Vertical with a Universal Process Output installed for output 1 (S D 8 _ - _ F _ _ - _ _ _ _).

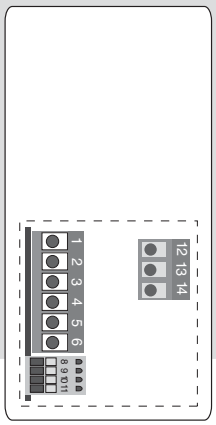


Figure 10h — 1/8 DIN Vertical with other than a Universal Process Output installed for output 1 (S D 8 _ - _ (C,K or J) _ _ - _ _ _).

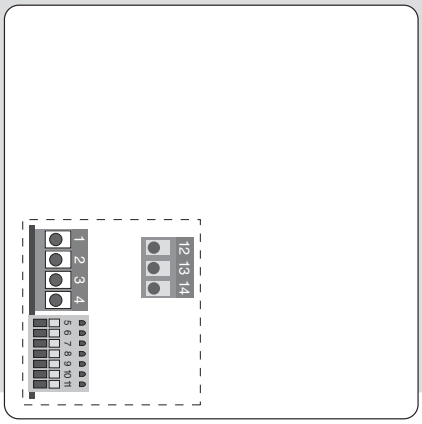


Figure 10i — 1/4 DIN with a Universal Process Output installed for output 1 (S D 4 _ - _ F _ _ - _ _ _ _).

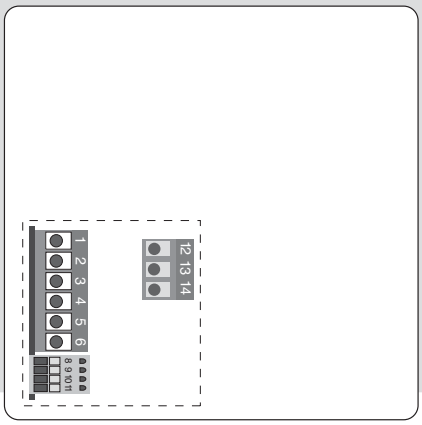


Figure 10j — 1/4 DIN with other than a Universal Process Output installed for output 1 (S D 4 _ - _ (C,K or J) _ _ - _ _ _ _).

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.

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

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, including normally open and normally closed contacts, are referenced to a de-energized state (the controller has power removed).

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

Figure 11a — High Voltage AC Power Wiring

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

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

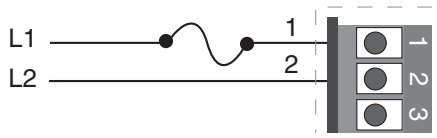
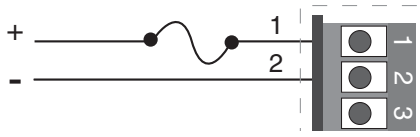


Figure 11b — Low Voltage AC Power Wiring

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. Solid or tinned wire recommended.

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. Check your input settings.

Figure 12a — **Thermocouple Input**

(all model numbers)

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

- Input impedance: >20 MΩ

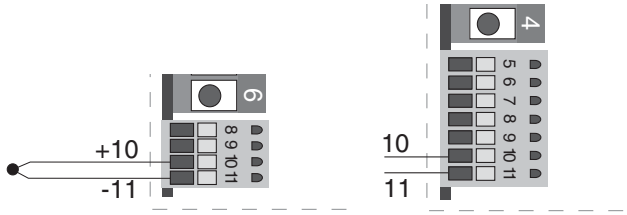


Figure 12b — **RTD Input (100 Ω DIN curve 0.00385 Ω/Ω/°C)**

(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: 390µA

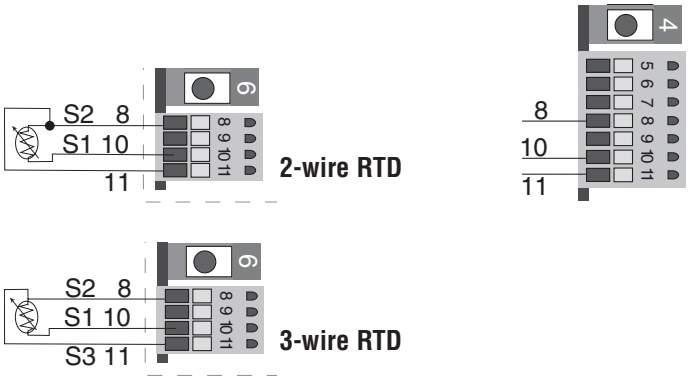


Figure 12c — **0 to 10V⎓ (dc) Process Input**

(all model numbers)

- Input impedance 20 kΩ, dc only.

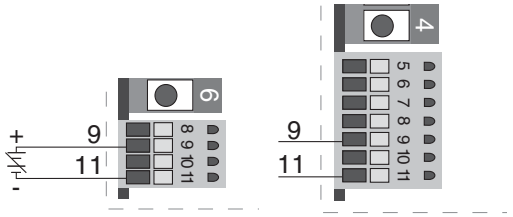
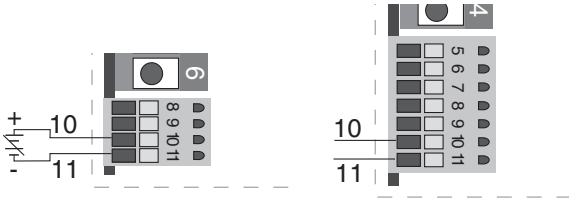


Figure 12d — **0 to 50mV⎓ (dc) Process Input**

(all model numbers)

- Input impedance >20 MΩ, dc only.



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

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 pilot duty inductive loads (relay coils, solenoids, etc.) with the mechanical relay 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.

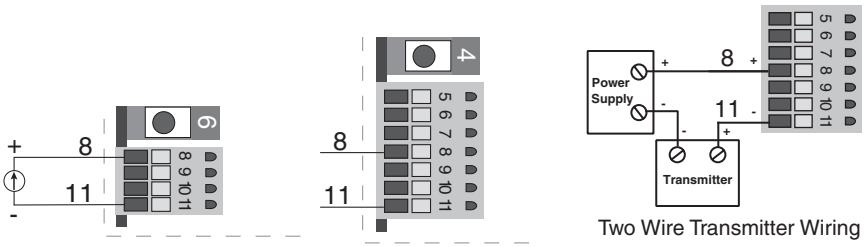
Spring clamp wiring connector note:
To insert the wire, push the wire into the desired connection number, and it should automatically lock into place. To remove the wire, press and hold the orange release tab with a small screwdriver. Pull the wire out of the connection. Solid or tinned wire recommended.

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.



Two Wire Transmitter Wiring

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

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

- Form A contact
- 2 A, resistive
- 125 VA pilot duty, 120/240V~ (ac), inductive
- See Quencharc note.
- 240V~ (ac) maximum.
- 30V⎓ (dc) maximum.
- For use with ac or dc.
- Minimum load current 10 mA
- Output does not supply power.

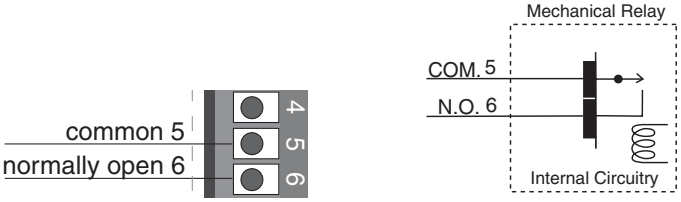
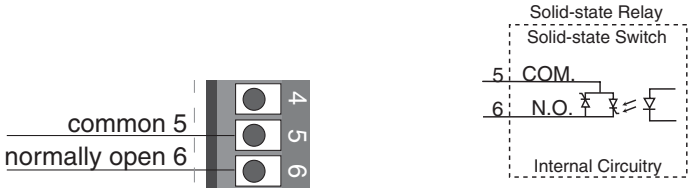


Figure 13c — **Output 1 Solid-state Relay**

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

- Form A contact
- 0.5 A maximum, resistive
- 20 VA pilot duty, 120/240V~ (ac), inductive
- See Quencharc note.
- 24 to 240V~ (ac).
- 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 pilot duty inductive loads (relay coils, solenoids, etc.) with the mechanical relay 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. Solid or tinned wire recommended.

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.

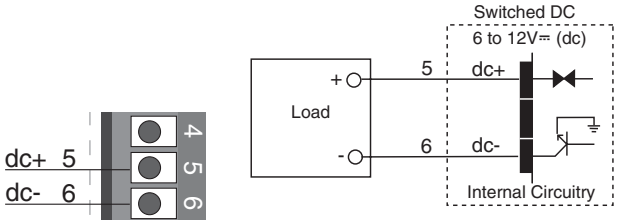


Figure 14b — **Output 1 Process**

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.

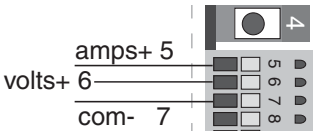
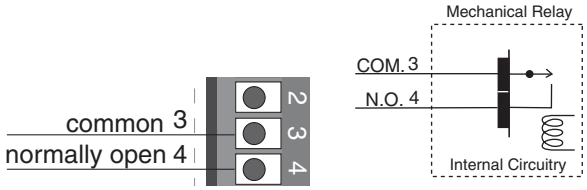


Figure 14c — **Output 2 Mechanical Relay**

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

- Form A contact
- 2 A, resistive
- 125 VA pilot duty, 120/240V~ (ac), inductive
- See Quencharc note.
- 240V~ (ac) maximum.
- 30V⎓ (dc) maximum.
- 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 pilot duty inductive loads (relay coils, solenoids, etc.) with the mechanical relay 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** _ - _ _ _ _

- Form A contact
- 0.5 A maximum, resistive
- 20 VA pilot duty, 120/240V~ (ac), inductive
- See Quencharc note.
- 24 to 240V~ (ac).
- Minimum load current 10 mA
- Maximum leakage current 100 µA
- Not for use with direct current (dc).
- Output does not supply power.

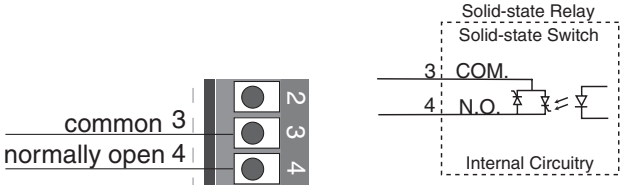


Figure 15b — **Output 2 Switched DC**

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

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

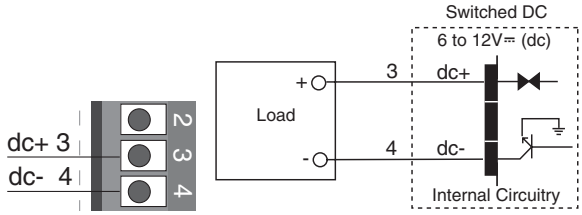
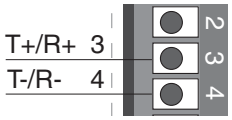


Figure 15c — **Output 2 EIA/TIA-485**

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

- Isolated [50V⎓ (dc)]
- 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 pilot duty inductive loads (relay coils, solenoids, etc.) with the mechanical relay 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** - _ _ _ _

- Form A contact
- 5 A, resistive
- 125 VA pilot duty, 120/240V~ (ac), inductive
- See Quencharc note.
- 240V~ (ac) maximum.
- 30V⎓ (dc) maximum.
- For use with ac or dc.
- Minimum load current 10 mA
- Output does not supply power.

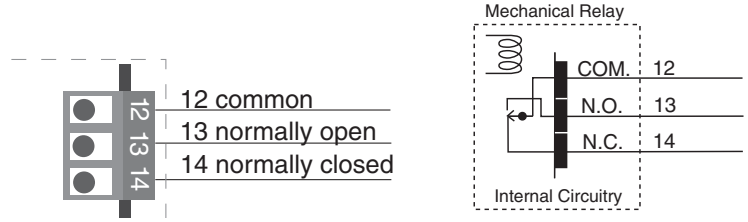


Figure 16b — **Output 3 Solid-state Relay**

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

- Form A contact
- 0.5 A maximum, resistive
- 20 VA pilot duty, 120/240V~ (ac), inductive
- See Quencharc note.
- 24 to 240V~ (ac).
- Minimum load current 10 mA
- Maximum leakage current 100 µA
- Not for use with direct current (dc).
- Output does not supply power.

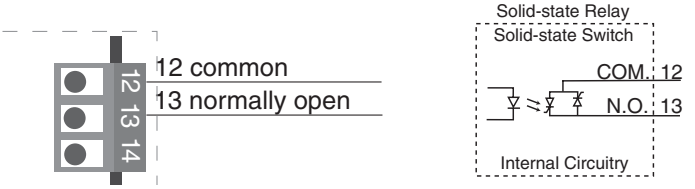
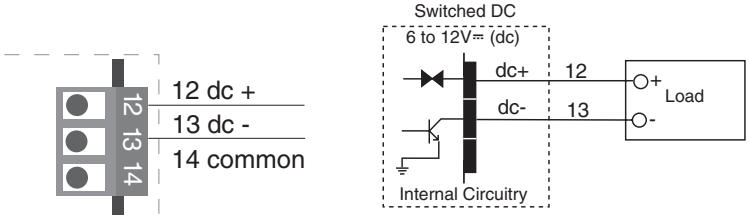


Figure 16c — **Output 3 Switched DC**

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 pilot duty inductive loads (relay coils, solenoids, etc.) with the mechanical relay 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.

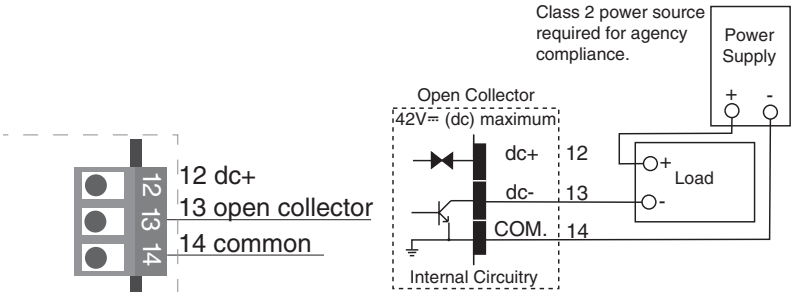
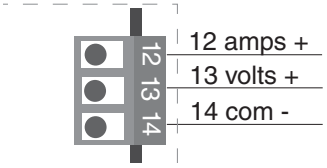


Figure 17b — **Output 3 Process**

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 is recommended to avoid ground loops. Isolation 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.

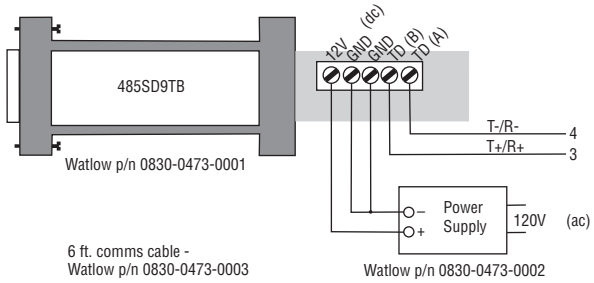


Figure 18a — B&B Converters
Isolated Converter - 4850I9TB
Non-Isolated Converter - 485SD9TB
B&B Electronics Manufacturing Company,
(815) 433-5100, http://www.bb-elec.cm/

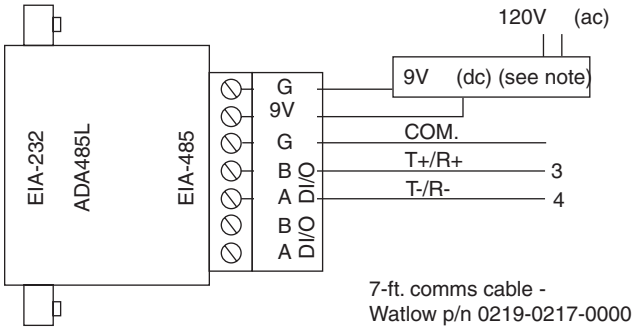


Figure 18b — CMC Non-Isolated Converter - ADA485L
CMC Connecticut Micro-Computer, Inc.,
1-800-426-2872, http://www.2cmc.com/

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

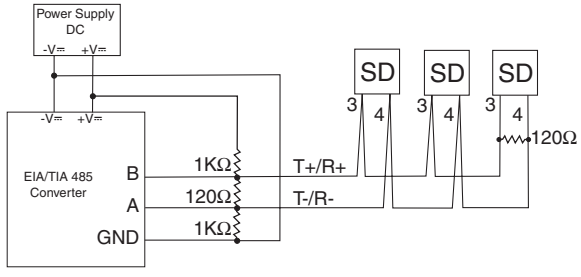


Figure 18c — Wiring bias and termination resistors. Controllers must be wired in a daisy chain configuration. Add a 120Ω termination resistor on the last controller.

Ethernet Gateway

The EM00-GATE-0000 is a bridge that allows up to 32 Watlow controllers to be directly connected to an Ethernet network.

The gateway provides 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 Watlow's WATVIEW™.

The Series SD can be configured using WATVIEW with or without the EM Gateway.

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

Note: The 32 controller maximum is a functional limitation of the Ethernet Gateway.

Note: The EM Gateway does not currently support the Series SD profiling version.

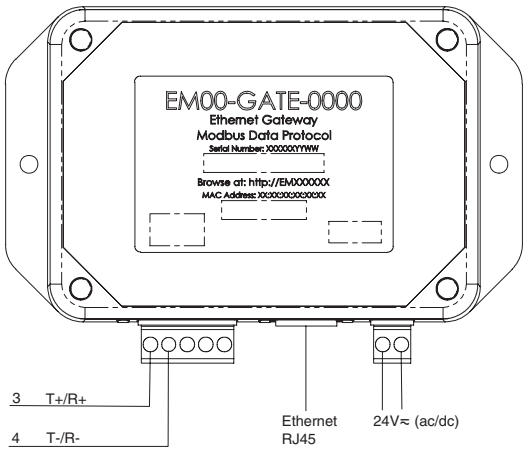
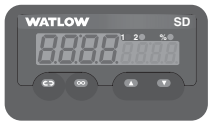


Figure 19a — Connecting to the Watlow EM Gateway (Ethernet to EIA/TIA-485 Serial Modbus connection). Controllers must be wired in a daisy chain configuration.

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

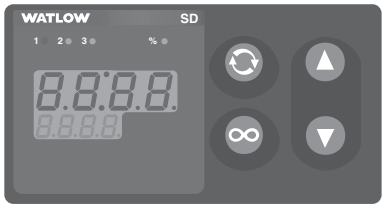
3 Chapter 3: Keys and Displays

1/32 DIN



1/16 DIN

1/8 DIN Horizontal



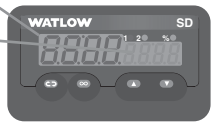
1/8 DIN Vertical

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 or right display through parameter prompts.

Toggle between File and Step in Pre-Run menu (profiling version only).

Infinity Key

Returns to the Home Page.

Clears latching alarms.

Start, hold or resume a profile (profiling version only).

Up and Down Keys

In the Home Page, adjusts the set point in the lower or right display. In other pages, changes the upper display to a higher or lower value.

Active Output Indicator Lights

Lit when the corresponding controller output or alarm is on.

Auto-Manual Control Indicator Light (static set point version only)

On: Manual Mode (open loop control)

Off: Auto Mode (closed loop control)

Profile Status Indicator Light (profiling version only)

On: Running a profile

Off: Not running a profile

Flashing: Pre-Run menu

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. Press Infinity Key ∞ to return to Home Page from any page or parameter.

Note: See the Profiling chapter for more profiling information.

Automatic Mode (static set point version) % ○ **
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 (static set point version) % ☀ **
The % indicator light is on.

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

Manual Mode (profiling version) ⩘ ○ ***

Note: A profile can be started from Manual Mode. See the Profiling chapter.

75	Actual temperature
P 0	Output power setting (Use Up ▲ or Down ▼ keys to raise or lower the percent power set point.)

Error condition % ☀ ** ⩘ ○ ***

The % indicator light is on** or the profile indicator light is off***.
If the controller was in Auto mode it will switch to Manual mode when it detects an input error.
If a profile is running, it switches to the Hold mode. The profile can be resumed, once the error condition is cleared.***

- - - -	Dashed lines
Er.In	Error message

Alarm Message

75 / A1.Lo	75 / 75	Process value

If alarm message is enabled for an output, the alarm message alternates with set point (auto) or power setting (manual).
The corresponding output indicator light is on.

During Ramp to Set Point**
The lower display alternates between the current set point achieved in the ramp and the target set point.

75 / rP	75 / 75	75 / rP.t 9	75 / 100	Actual temperature
Current set point prompt	Current set point value	Ramp target prompts	Ramp target set point value	

****Static set point version only**

*****Profiling version only**

Adjusting the temperature set point

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 and 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 that you are on the Home Page. If you are on 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. The set point cannot be set manually while a profile is running.
3. The controller will automatically begin using the new set point after three seconds. Or press the Infinity Key ∞ to immediately use the new value.

Note: The LOC parameter can lock the ability to adjust the set point. If you are unable to adjust the set point, check LOC setting on the Setup Page.

Note: While a profile is running, the set point cannot be manually adjusted.

Note: To stop the Series SD PID controller or PID profiling controller from controlling to a set point, press the Down Key while the set point value is equal to the SP.Lo setting. OFF will be displayed in the lower display and the controller will no longer attempt to maintain a set point.

Caution:
The controller is in the manual mode when the percent indicator is lit or P appears in the most significant digit of the lower display***. 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.**

Operations Page Overview

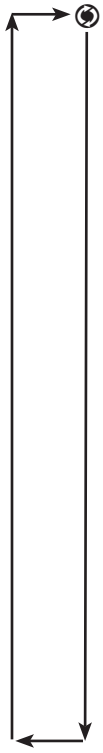
The Operations Page contains parameters accessed during normal day-to-day operation. The Series SD provides a patented user-definable menu system, allowing the user to customize the Operations Page contents. To go to the Operations Page, press the Advance Key ◉ once from the Home Page.

- Press the Advance Key ◉ to move through the parameter prompts. At the end of the Operations Page parameters, press the Infinity 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.

Note: The Operations Page is not accessible while a profile is running.***

Operations Page (typical defaults)

SD_(C or R) -_ _ _ _ - _ _ _ _



- Power Heat
- Auto-Manual**
- Guaranteed Soak Deviation Value***
- Autotune
- Calibration Offset
- Heat Control Method
- Proportional Band Heat
- Reset Heat OR
- Integral Heat
- Rate Heat OR
- Derivative Heat
- Heat Hysteresis
- Cool Control Method
- Proportional Band Cool
- Reset Cool OR
- Integral Cool
- Rate Cool OR
- Derivative Cool
- Cool Hysteresis
- Alarm 1 High
- Alarm 1 Low
- Alarm 2 High
- Alarm 2 Low
- Alarm 3 High
- Alarm 3 Low
- Event Output 1***
- Event Output 2***
- Event Output 3***

***** Profiling version only (SD_R- _ _ _ _ - _ _ _ _)**

Operations Page with TRU-TUNE+™

SD_E- _ _ _ _ - _ _ _ _

(typical defaults)

- Power Heat
- Auto-Manual**
- Autotune
- TRU-TUNE+™ Enable
- Calibration Offset
- Heat Control Method
- Proportional Band Heat
- Heat Hysteresis
- Cool Control Method
- Proportional Band Cool
- Cool Hysteresis
- Integral
- Derivative
- Alarm 1 High
- Alarm 1 Low
- Alarm 2 High
- Alarm 2 Low
- Alarm 3 High
- Alarm 3 Low
- None

Note: Hardware configuration and programming selections determine what parameters appear in the Operations Page. A maximum of 20 or 23 * parameters can be defined to appear on the Operations Page. The Programming Page settings determine what appears on the Operations Page.**

Caution:
The controller is in the manual mode when the percent indicator is lit or P appears in the most significant digit of the lower display*. 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

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!

Always press the Infinity Key to return to the Home Page.

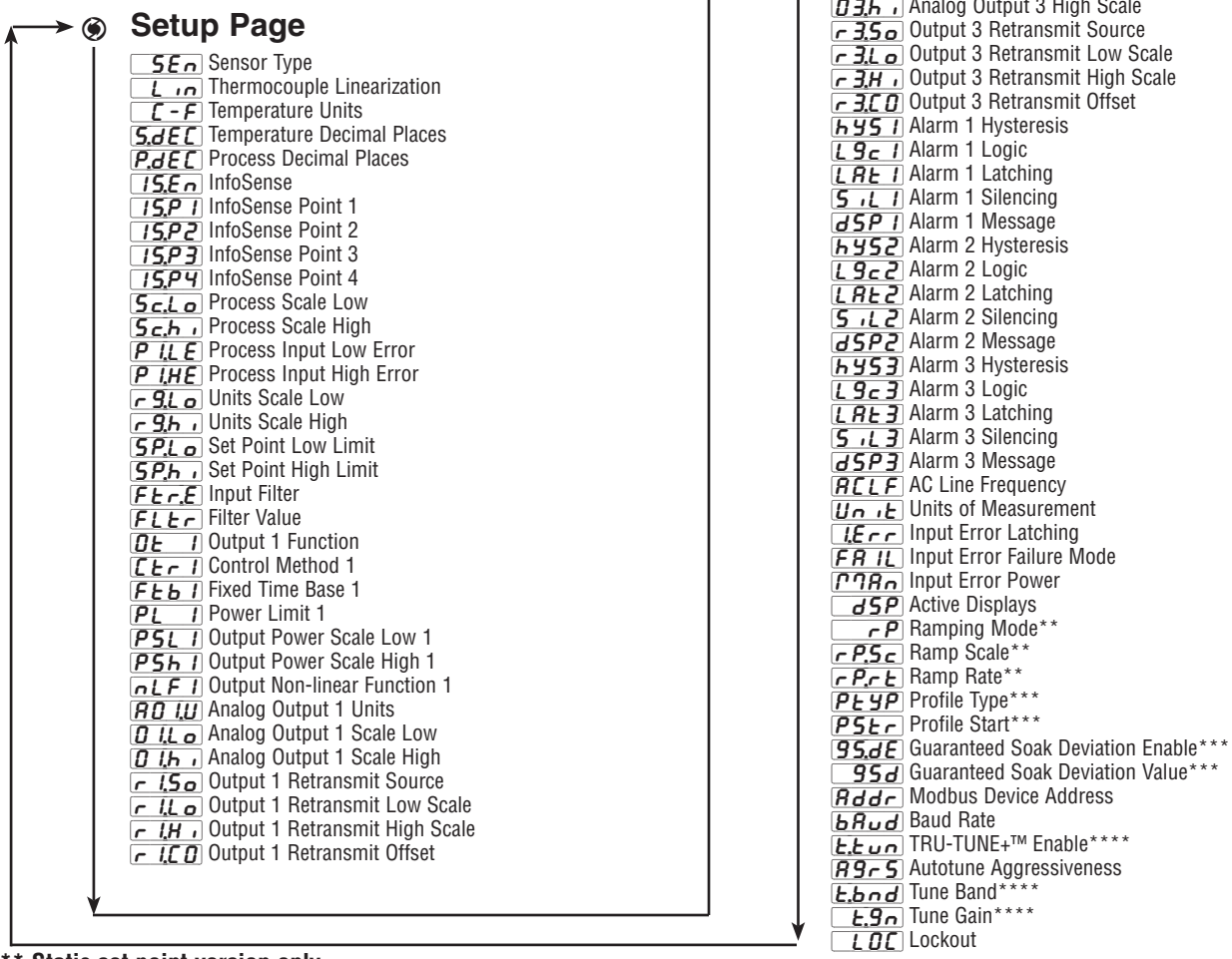
You must start from the Home Page.

To go to the Setup Page, press both the Up and Down keys for about three 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: Hardware configuration and programming selections determine what parameters appear on the Setup Page.

Note: The Setup Page is not accessible while a profile is running.***



**** Static set point version only**

***** Profiling version only**

****** TRU-TUNE+™ version only**

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 (23 for the profiling version***) Programming Page locations, P1 to P20 (P23***). These now appear on the Operations Page. All 20 (23***) 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.

Note: The Programming Page is not accessible while a profile is running. *

Programming Page

- P1 Parameter Location 1 (48)
- P2 Parameter Location 2 (49)
- P3 Parameter Location 3 (50)
- P4 Parameter Location 4 (51)
- P5 Parameter Location 5 (52)
- P6 Parameter Location 6 (53)
- P7 Parameter Location 7 (54)
- P8 Parameter Location 8 (55)
- P9 Parameter Location 9 (56)
- P10 Parameter Location 10 (57)
- P11 Parameter Location 11 (58)
- P12 Parameter Location 12 (59)
- P13 Parameter Location 13 (60)
- P14 Parameter Location 14 (61)
- P15 Parameter Location 15 (62)
- P16 Parameter Location 16 (63)
- P17 Parameter Location 17 (64)
- P18 Parameter Location 18 (65)
- P19 Parameter Location 19 (66)
- P20 Parameter Location 20 (67)
- P21 Parameter Location 21 (68)***
- P22 Parameter Location 22 (69) ***
- P23 Parameter Location 23 (47)***

*** Profiling version only

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 about 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.

Note: The Factory Page is not accessible while a profile is running. *

Factory Page

- AMBt Ambient Temperature
- AMBn Minimum Recorded Ambient Temperature
- AMBA Maximum Recorded Ambient Temperature
- dSPL Display Intensity
- Aot1 Output 1 Process Value
- Aot3 Output 3 Process Value
- rESt Restore Factory Calibration
- USrr Restore User Settings
- USrS Save User Settings
- PrFr Restore Profile Settings***
- PrFS Save Profile Settings***
- dFLt Default Parameters
- oty1 Output 1 Type
- oty2 Output 2 Type
- oty3 Output 3 Type
- S.Id Software ID
- S.UEr Software Version
- S.bLd Software Build Number
- PWJr Power Type
- Sn- Serial Number 1 (first four digits)
- Sn_ Serial Number 2 (last four digits)
- tc.50 Thermocouple, 50mV
- tc.00 Thermocouple, 0mV
- tc.32 Thermocouple, 32°F
- r.15 RTD, 15 ohm
- r.380 RTD, 380 ohm
- U.1 Input Calibrate, 1.0 Volt
- U.9 Input Calibrate, 9.0 Volt
- A.4 Input Calibrate, 4.0 mA
- A.16 Input Calibrate, 16.0 mA
- O1.1U Output 1 Calibrate, 1.0 Volt
- O1.9U Output 1 Calibrate, 9.0 Volt
- O1.4A Output 1 Calibrate, 4.0 mA
- O1.16 Output 1 Calibrate, 16.0 mA
- O3.1U Output 3 Calibrate, 1.0 Volt
- O3.9U Output 3 Calibrate, 9.0 Volt
- O3.4A Output 3 Calibrate, 4.0 mA
- O3.16 Output 3 Calibrate, 16.0 mA

Calibration information for the Series SD controllers is available in pdf format. Go to www.watlow.com / Literature / Product User Manuals and search on *Series SD Calibration Manual.*

4 Chapter 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 the Keys and Displays chapter.

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 or units (-1999000 to 9999000)	NA	*20, 21 R	There is no input error and FtrE is set to OFF or CntL.
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 SPHi OFF Stop controlling to SP (-200000001)	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 or units (-1999000 to 9999000)	NA	*22, 23 R	There is no input error and FtrE is set to d iSP 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 (-10000 to 0000, 0000 to 10000. Two decimal places implied for Modbus.)	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 (-1999000 to 9999000)	NA	*254, 255 R	Static set point version only and ramp to set point active. (SD _C - _ _ _ _ - _ _ _ _)
rPt9	**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 abter this prompt appears.		Set Point Low Limit SPLo to Set Point High Limit SPHi	NA	Same as closed loop set point.	Static set point version only and ramp to set point active. (SD _C - _ _ _ _ - _ _ _ _)
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.
A1Hi	**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.
A2Hi	**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
A3Hi	**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. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

5 Chapter 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 ▼ key 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 parenthesis.)	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) [mv] (5)	[tc] (0)	70 R/W	Always active.
[L in] [Lin]	**Thermocouple Linearization** Set the analog input thermocouple linearization.		[J] J (0) [d] D (6) [H] K (1) [Pt II] PTII (7) [t] T (2) [r] R (8) [E] E (3) [S] S (9) [n] N (4) [b] B (10) [C] C (5)	[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].
	Temperature Units via Serial Comms		Fahrenheit (0) Celsius (1)	(0)	18 R/W	[SEn] is set to [tc] or [rtd].
[S.dEC] [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].
[P.dEC] [P.dEC]	**Process Decimal Places** Set the decimal places for the displayed input value for process types.		[0] (0) [0.0] (1) [0.00] (2) [0.000] (3)	[0] (0)	42 R/W	[SEn] is set to [mA], [volt] or [mv].
[IS.En] [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.
[IS.P1] [IS.P1]	**INFOSENSE™ 1** Set sensor point 1 code.		0 to 999 (0 to 999)	500	92 R/W	[IS.En] is set to [YES].
[IS.P2] [IS.P2]	**INFOSENSE™ 2** Set sensor point 2 code.		0 to 999 (0 to 999)	500	93 R/W	[IS.En] is set to [YES].
[IS.P3] [IS.P3]	**INFOSENSE™ 3** Set sensor point 3 code.		0 to 999 (0 to 999)	500	94 R/W	[IS.En] is set to [YES].
[IS.P4] [IS.P4]	**INFOSENSE™ 4** Set sensor point 4 code.		0 to 999 (0 to 999)	500	95 R/W	[IS.En] 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. All temperature parameters through Modbus are in °F, by default. Writing to register 18 will toggle between °F and °C.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
Sc.Lo [Sc.Lo]	**Process Scale Low** Set the low scale for process inputs.		0.00 to 20.00 mA: if SEn is set to mA (0000 to 20000) 0.00 to 10.00 V: if SEn is set to volt (0000 to 10000) 0.00 to 50.00 mV: if SEn is set to mV (0000 to 50000)	4.00 mA 0.00 V 0.00 mV	*73, 74 R/W (mA) *77, 78 R/W (V) *331, 332 R/W (mV)	SEn is set to mA, SEn is set to volt. SEn is set to mV.
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 (0000 to 20000) 0.00 to 10.00V: if SEn is set to volt (0000 to 10000) 0.00 to 50.00 mV: if SEn is set to mV (0000 to 50000)	20.00 mA 5.00 V 50.00 mV	*75, 76 R/W (mA) *79, 80 R/W (V) *333, 334 R/W (mV)	SEn is set to mA, SEn is set to volt. SEn is set to mV,
P1LE [P1.LE]	**Process Input Low Error** Set the low process value that will cause an error to occur for the process input.		-1.00 to 10.00 mA (-100 to 1000) -1.00 to 5.00 V (-100 to 500) -1.00 to 25.00 mV (-100 to 2500) (two decimal places implied for Modbus)	-1.00 mA -1.00 V -1.00 mV	325 R/W (mA) 327 R/W (V) 329 R/W (mV)	SEn is set to mA. SEn is set to volt. SEn is set to mV.
P1HE [P1.HE]	**Process Input High Error** Set the high process value that will cause an error to occur for the process input.		10.00 to 21.00 mA (1000 to 2100) 5.00 to 11.00 V (500 to 1100) 25.00 to 51.00 mV (2500 to 5100) (two decimal places implied for Modbus)	21.00 mA 11.00 V 51.00 mV	326 R/W (mA) 328 R/W (V) 330 R/W (mV)	SEn is set to mA, volt. or mV.
rgLo [rg.Lo]	**Units Scale Low** Set the low range for process input units.		-1999 to 9999 (1999000 to 9999000) (Set precision with PdEC, Process Decimal Places.)	-1999	*81, 82 R/W	SEn is set to mA, volt. or mV.
rgh i [rg.hi]	**Units Scale High** Set the high range for process input units.		-1999 to 9999 (-1999000 to 9999000) (Set precision with PdEC, Process Decimal Places.)	9999	*83, 84 R/W	SEn is set to mA, volt. or mV.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default. Writing to register 18 will toggle between °F and °C.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
SP.Lo [SP.Lo]	**Set Point Low Limit** Set the low range for the set point.		Min. operating range (of sensor) to SP.Hi - 0.100: if SEn is set to tc -328 to SP.Hi -0.100: if SEn is set to rtd -1999 to SP.Hi -0.001: if SEn is set to mA, volt or mV. (Set precision with PdEC, Process Decimal Places.)	Min. operating range (J type): tc -328: rtd -999: mA, volt and mV.	*240, 241 R/W (thermocouple) *244, 245 R/W (RTD) *248, 249 R/W (mA, V or mV)	Always active.
SP.Hi [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 SP.Lo +0.100 to 1472: if SEn is set to rtd SP.Lo +0.001 to 9999: if SEn is set to mA, volt or mV. (Set precision with PdEC, Process Decimal Places)	Max. operating range (J type): tc 1472: rtd 999: mA, volt and mV.	*242, 243 R/W (thermocouple) *246, 247 R/W (RTD) *250, 251 R/W (mA, V or mV)	Always active.
Ftr.E [Ftr.E]	**Input Filter** Select filtering action.		OFF (0) (no filtering) d.SP (1) (filter only the display value) Cntl (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 (0000 to 60000)	0.0	*87, 88 R/W	Ftr.E is not set to OFF.
Ot 1 [Ot 1]	**Output 1 Function** Set Output 1 function.		OFF Off (0) Pr.AL Process Alarm (1) dE.AL Deviation Alarm (2) HEAt Heat Control (3) Cool Cool Control (4) E.out Event (5) *** rMt Retransmit (6)	HEAt (3)	143 R/W Always active.	Active only if Output 1 is a process output (SD_ _ - _ **F** _ _ - _ _ _ _)
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 output type is SD_ _-_ **C** _ _-_ _ _ _ or SD_ _-_ **K** _ _-_ _ _ _.
Ftb 1 [Ftb1]	**Fixed Time Base 1 (Cycle Time)** Set the time base for Fixed Time Base Control.		1.0 to 60.0 seconds if Output 1 is a mechanical relay (1000 to 60000) 0.1 to 60.0 seconds if Output 1 is not a mechanical relay (100 to 60000)	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** _ _ - _ _ _ _)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default. Writing to register 18 will toggle between °F and °C.

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
PL 1 [PL 1]	**Power Limit 1** Set the maximum power output for a control output		0.0 to 100.0% power (000 to 10000) (Two decimal places implied for Modbus.)	100.0%	160 R/W	Ot 1 is set to HEAt or Cool.
PSL 1 [PSL1]	**Output Power Scale Low 1** Set the low end of the range within which the output will scale.		0.0 to 100.0% (000 to 10000) (Two decimal places implied for Modbus.)	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** _ _ - _ _ _ _)
PSh 1 [PSh1]	**Output Power Scale High 1** Set the high end of the range within which the output will scale.		0.0 to 100.0% (000 to 10000) (Two decimal places implied for Modbus.)	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** _ _ -_ _ _ _)
nLF 1 [nLF1]	**Output Non-linear Function 1** Select a non-linear output curve to match the response of your system.		OFF Off (0) Cru 1 curve 1 (1) Cru2 curve 2 (2)	OFF (0)	163 R/W	Ot 1 is set to HEAt or Cool.
AO 1.U [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** _ _ - _ _ _ _)
O 1.Lo [O1.Lo]	**Analog Output 1 Scale Low** Set the low scale for the process output.		0.00 to 20.00 mA if output is set to mA (0000 to 20000) 0.00 to 10.00V if output is set to volts (0000 to 10000)	4.00 mA 0.00V	*148, 149 R/W (mA) *152, 153 R/W (V)	Output 1 is a process output. (SD_ _ - _ **F** _ _ - _ _ _ _)
O 1.hi [O1.hi]	**Analog Output 1 Scale High** Set the high scale for the process output		0.00 to 20.00 mA if output is set to mA (0000 to 20000) 0.00 to 10.00V if output is set to volts (0000 to 10000)	20.00 mA 10.00V	*150, 151 R/W (mA) *154, 155 R/W (V)	Output 1 is a process output. (SD_ _ - _ **F** _ _ - _ _ _ _)
r 1.So [r1.So]	**Output 1 Retransmit Source** Set the control variable that the retransmit signal represents.		Proc Process Value (0) SP Set Point (1)	Proc (0)	305 R/W	Output 1 is a process output (SD_ _ - _ _ _ **F** - _ _ _ _) and Ot 1 is set to rMt .
r 1.Lo [r1.Lo]	**Output 1 Retransmit Low Scale** Set the low scale for the retransmit output.		-1999.0 to 9999.0 (-1999000 to 9999000)	0	*306, 307 R/W	Output 1 is a process output (SD_ _ - _ _ _ **F** - _ _ _ _) and Ot 1 is set to rMt .
r 1.hi [r1.hi]	**Output 1 Retransmit High Scale** Set the high scale for the retransmit output.		-1999.0 to 9999.0 (-1999000 to 9999000)	500	*308, 309 R/W	Output 1 is a process output (SD_ _ - _ _ _ **F** - _ _ _ _) and Ot 1 is set to rMt .

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
r1.CO [r1.CO]	**Output 1 Retransmit Offset** Set the high scale for the process output.		-999.0 to 999.0 (-999000 to 999000)	0	*310, 311 R/W	Output 1 is a process output (SD_ _ - _ _ _ F - _ _ _ _) and Ot 1 is set to [rmt] .
Ot 2 [Ot 2]	**Output 2 Function** Set Output 2 function.		OFF Off (0) Pr.AL Process Alarm (1) dEAL Deviation Alarm (2) hEAt Heat Control (3) Cool Cool Control (4) E.out Event (5)***	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 output type is SD_ _-_ _ C _-_ _ _ _ or SD_ _-_ _ K _ -_ _ _ _.
Ftb2 [Ftb2]	**Fixed Time Base 2 (Cycle Time)** Set the time base for Fixed Time Base Control.		1.0 to 60.0 seconds if Output 2 is mechanical relay (1000 to 60000) 0.1 to 60.0 seconds if Output 2 is not a mechanical relay (100 to 60000)	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.
PL 2 [PL 2]	**Power Limit 2** Set maximum power output for a control output.		0.0 to 100.0% power (000 to 10000) (Two decimal places implied for Modbus.)	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.		0.0 to 100.0% (000 to 10000) (Two decimal places implied for Modbus.)	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.		0.0 to 100.0% (000 to 10000) (Two decimal places implied for Modbus.)	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 Non-linear Function 2** Select a non-linear output curve to match the response of your system.		OFF Off (0) Cru 1 curve 1 (1) Cru2 curve 2 (2)	OFF (0)	174 R/W	Ot 2 is set to hEAt or Cool .
Ot 3 [Ot 3]	**Output 3 Function** Set Output 3 function.		OFF Off (0) Pr.AL Process Alarm (1) dEAL Deviation Alarm (2) hEAt Heat Control (3) Cool Cool Control (4) E.out Event (5)*** rMt Retransmit (6)	OFF (0)	178 R/W	Output 3 is installed. Active only if Output 3 is a process output (SD_ _ - _ _ _**F** - _ _ _ _)

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
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 output type is SD_ _-_ _ _ **C** -_ _ _ or SD_ _-_ _ _ **K** -_ _ _.
Ftb3 [Ftb3]	**Fixed Time Base 3 (Cycle Time)** Set the time base for Fixed Time Base Control.		1.0 to 60.0 seconds if Output 3 is a mechanical relay (1000 to 60000) 0.1 to 60.0 seconds if Output 3 is not a mechanical relay (100 to 60000)	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% (000 to 10000) (Two decimal places implied for Modbus.)	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.		0.0 to 100.0% (000 to 10000) (Two decimal places implied for Modbus.)	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** -_ _ _)
PSh3 [PSh3]	**Output Power Scale High 3** Set the high end of the range within which the output will scale		0.0 to 100.0% (000 to 10000) (Two decimal places implied for Modbus.)	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 Non-linear Function 3** Select a non-linear 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.
AO3.U [AO3.U]	**Analog Output 3 Units** Set the analog process output units.		mA milliamperes (0) volt volts (1)	mA (0)	182 R/W	Output 3 is a process output. (SD_ _ - _ _ _ **F** - _ _ _ _)
O3.Lo [O3.lo]	**Output 3 Low Scale** Set the low scale for the process output.		0.00 to 20.00 mA if output is set to mA (0000 to 20000) 0.00 to 10.00V if output is set to volts (0000 to 10000)	4.00 mA 0.00V	*183, 184 R/W (mA) *187, 188 R/W (V)	Output 3 is a process output. (SD_ _ - _ _ _ **F** - _ _ _ _)
O3.hi [O3.hi]	**Output 3 High Scale** Set the high scale for the process output.		0.00 to 20.00 mA if output is set to mA (0000 to 20000) 0.00 to 10.00V if output is set to volts (0000 to 10000)	20.00 mA 10.00V	*185, 186 R/W (mA) *189, 190 R/W (V)	Output 3 is a process output. (SD_ _ - _ _ _ **F** - _ _ _ _)
r3.So [r3.So]	**Output 3 Retransmit Source** Set the control variable that the retransmit signal represents.		Proc Process Value (0) SP Set Point (1)	Proc (0)	315 R/W	Output 3 is a process output (SD_ _ - _ _ _ **F** - _ _ _ _) and Ot 3 is set to rmt.

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
r3Lo [r3.Lo]	**Output 3 Retransmit Low Scale** Set the low scale for the retransmit output.		-1999.0 to 9999.0 (-1999000 to 9999000)	0	*316, 317 R/W	Output 3 is a process output (SD_ _ - _ _ _ F - _ _ _ _) and Ot 3 is set to rPTt.
r3hi [r3.hi]	**Output 3 Retransmit High Scale** Set the high scale for the retransmit output.		-1999.0 to 9999.0 (-1999000 to 9999000)	500	*318, 319 R/W	Output 3 is a process output (SD_ _ - _ _ _ F - _ _ _ _) and Ot 3 is set to rPTt.
r3CO [r3.CO]	**Output 3 Retransmit Offset** Set the offset value for the retransmit output.		-999.0 to 999.0 (-999000 to 999000)	0	*320, 321 R/W	Output 3 is a process output (SD_ _ - _ _ _ F - _ _ _ _) and Ot 3 is set to rPTt.
hyS1 [hyS1]	**Alarm 1 Hysteresis** Set the hysteresis for an alarm. This de- termines how far into the safe region the input needs to move before the alarm can be cleared.		0.0 to 999.0 (0000 to 999000)	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 dE.AL or Pr.AL.
LAt1 [LAt1]	**Alarm 1 Latching** Turn J on or off.		nLAt off (0) LAt on (1)	nLAt (0)	108 R/W	Ot 1 is set to dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
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.		0.0 to 999.0 (0000 to 999000)	1.0	*121, 122 R/W	Ot 2 is set to dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
dSP2 [dSP2]	**Alarm 2 Message** Displays an alarm message when an alarm is active.		OFF off (0) no message On on (1)	On (1)	125 R/W	Ot 2 is set to [dE;AL] or Pr.AL.

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
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.		0.0 to 999.0 (0000 to 999000)	1.000	*136, 137 R/W	Ot 3 is set to [dE;AL] or Pr.AL.
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 dE.AL.
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 dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
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 dE.AL or Pr.AL.
ACLF [Unit]	**AC Line Frequency** Set the frequency of the applied AC line power source.		50 50 (0) 60 60 (1)	60 (1)	276 R/W	If Ctr 1, Ctr2 or Ctr3 is set to Urtb.
Unit [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% (-10000 to 10000)	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	Static set point version only. (SD _**C** - _ _ _ _ - _ _ _ _)

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
rP.Sc [rP.Sc]	**Ramp Scale**** Select the scale of the ramp rate.		hour degrees/hour (0) MnUn degrees/minute (1)	hour (0)	267 R/W	rP is set to Str or On.
rP.rt [rP.rt]	**Ramp Rate**** Set the rate for the set point ramp.		0 to 9999 (0000 to 9999000)	100	*268, 269 R/W	rP is set to Str or On. Does not appear if rP is set to OFF.
PtyP [PtyP]	**Profile Type***** Set the profile ramp to time based or rate based.		tiME Time based ramp (0) rAtE Rate based ramp (1)	tiME (0)	354 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
PStr [PStr]	**Profile Start***** Select where the profile begins the starting set point of the profile, current static set point or current process temperature.		SEt Static Set Point (0) Pro Process (1)	SEt (0)	355 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
gS.dE [gS.dE]	**Guaranteed Soak Deviation Enable***** Enables the guaranteed soak deviation function in profiles.		no Disabled (0) YES Enabled (1)	no (0)	356 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
gSd [gSd]	**Guaranteed Soak Deviation Value***** Set the value of deviation allowed by the guaranteed soak deviation function.		1 to 999 (1000 to 999000)	1	*357, 358 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) gSdE is set to YES.
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 19.2 38.4	9600	This can only be set from the controller front panel.	Output 2 is a communications output. (SD_ _ - _ _ **U** _ - _ _ _ _)
t.tun [t.tun]	**TRU-TUNE+™ Enable** Enable or disable the TRU TUNE+™ adaptive tuning feature.		no No (0) YES Yes (1)	YES	350 rw	TRU-TUNE+™ version only. (SD_ **E** - _ _ _ _ - _ _ _ _)
AgrS [AgrS]	**Autotune Aggressiveness** Select the aggressiveness of the autotuning calculations. (This does not affect the TRU-TUNE+™ function.)		Undr Under (0) Cr.it Critical (1) OvEr Over (2)	Undr Under [0]	351 rw	
t.bnd [t.bnd]	**Tune Band** Set the range, centered on the set point, within which TRU-TUNE+™ will be in effect. Use this function only if the controller is unable to adaptive tune automatically.		0 Auto 1 to 999 Degrees or Units	0 Auto	353 rw	TRU-TUNE+™ version only. (SD_ **E** - _ _ _ _ - _ _ _ _)

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**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parenthesis.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
t.gn [t.gn]	**Tune Gain** Select the responsiveness of the TRU-TUNE+™ adaptive tuning calculations. More responsiveness may increase overshoot.		1 to 7 Least to most responsive.	4	354 rw	TRU-TUNE+™ version only. (SD_ **E** - _ _ _ _ - _ _ _ _).
LOC [LOC]	**Lockout** Set the security level for the user interface.		0 (0) no lockout *** Full profile access. 1 (1) Set Point, Auto/Manual, alarms only. *** Full profile access 2 (2) Set Point, Auto/Manual, only. *** Pre-Run and Run Menu access only. View a running profile. Profile editing not permitted. 3 (3) Set Point only *** Profile access not permitted. 4 (4) full lockout *** Profile access not permitted. 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. All temperature parameters through Modbus are in °F, by default. Writing to register 18 will toggle between °F and °C.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

6 Chapter 6: Operations Parameters Table

These parameters can be selected to appear in the Operations Page. Select the parameters you want to appear in the Operations Page in the Programming Page. Press the Advance Key ◉ to enter the Operations Page and to step through the parameters. For profiling controllers, set [Prog] to [no] to access the Operations Page. Press the Infinity Key ∞ to return to the Home Page at any time.

Note: This chapter only applies to the static set point and profiling versions of the Series SD (SD_C or R - _ _ _ _ - _ _ _ _).

Note: The Operations Page is not accessible when a profile is running.

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if'
[Po.ht] [Po.ht]	**Power Heat** Displays the current heat control power.		0.0 to 100.0% power (000 to 10000) (Two decimal places implied for Modbus.)	NA	256 R	[A-M] is set to [Auto] and at least one output is set to [HEAt].
[Po.CL] [Po.CL]	**Power Cool** Displays the current cool control power.		0.0 to 100.0% power (000 to 10000) (Two decimal places implied for Modbus.)	NA	257 R	[A-M] is set to [Auto] and at least one output is set to [Cool].
[A-M] [A-M]	**Auto-Manual Mode** Set the control mode.		[Auto] (0) [MAn] (1)	[Auto] (0)	25 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].
[CAL] [CAL]	**Calibration Offset** Offset the input reading.		-999 to 999 (-999000 to 999000)	0.0	*85, 86 R/W	Always appears.
[ht.M] [ht.M]	**Heat Control** Method Set the heat control method.		[OFF] off (0) [PId] PID (1) [on.oF] on-off (2)	[PId] (1)	213 R/W	At least one output is set to [HEAt].
[Pb.ht] [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] (1000 to 999000) 0.000 to 999 units, if [SEn] is set to [mA] or [volt].(0000 to 999000)	25 25	*216, 217 R/W *220, 221 R/W	At least one output is set to [HEAt] and [ht.M] is set to [PId].
[rE.ht] [rE.ht]	**Reset Heat** Set the PID reset in repeats per minute for the heat outputs.		0.00 to 99.99 repeats per minute (0000 to 99990) 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], [ht.M] is set to [PId], and [Unit] is set to [US].

Note: Parameters appear in the Operations Page only if activated from the programming page. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _-_ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _-_ _ _ _).**

****** This value multiplied by 100 equals the percent power.**

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if'
It.ht [It.ht]	**Integral Heat** Set the PID integral in minutes per repeat for the heat outputs.		0.00 to 99.99 minutes/per repeat (0000 to 99990) 0.00: disabled	0.00	*224, 225 R/W	At least one output is set to HEAt, ht.Pn is set to PId, and Un.it is set to SI.
rA.ht [rA.ht]	**Rate Heat** Set the PID rate time in minutes for the heat output.		0.00 to 9.99 minutes (0000 to 9990) 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 US.
dE.ht [dE.ht]	**Derivative Heat** Set the PID derivative time in minutes for the heat outputs.		0.00 to 9.99 minutes (0000 to 9990) 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
db.ht [db.ht]	**Dead Band Heat** An offset of the heating proportional band from the set point.		0 to 999 (0000 to 999000)	0	*279, 280 R/W	At least one output is set to HEAt and ht.Pn is set to PID.
h.hyS [h.hyS]	**Heat Hysteresis** Set the control switching hysteresis for on-off control. This determines how far into the "on" region the input needs to move before the output actually turns on.		1 to 999 degrees, if SEn is set to tc or rtd (1000 to 999000) 0.000 to 999.999 units, if SEn is set to PrA or volt (0000 to 999999)	1.0 1.000	*232, 233 R/W *234, 235 R/W	At least one output is set to HEAt, and ht.Pn is set to on.oF.
CL.Pn [CL.M]	**Cool Control Method** Set the Cool Control Method		OFF off (0) PId PID (1) on.oF on-off (2)	OFF (0)	214 R/W	At least one output is set to Cool.
Pb.CL [Pb.CL]	**Proportional Band Cool** Set the proportional band for the cool outputs.		1 to 999°F if SEn is set to tc or rtd (1000 to 999000) 0.000 to 999.0 if SEn is set to PrA or volt (0000 to 999000)	25 25.000	*218, 219 R/W *222, 223 R/W	At least one output is set to Cool, and CL.Pn is set to PId.
rE.CL [rE.CL]	**Reset Cool** Set the PID reset in repeats per minute for the cool output.		0.00 to 99.99 repeats per minute (0000 to 99990) 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, CL.Pn is set to PId, and Un.it is set to US.
It.CL [It.CL]	**Integral Cool** Set the PID integral in minutes per repeat for the cool outputs.		0.00 to 99.99 minutes per repeat (0000 to 99990) 0.00: disabled	0.00	*226, 227 R/W	At least one output is set to Cool, CL.Pn is set to PId, and Un.it is set to SI.
rA.CL [rA.CL]	**Rate Cool** Set the PID rate time in minutes for the cool outputs.		0.00 to 9.99 minutes (0000 to 99990) 0.00: disabled	0.00	*230, 231 R/W	At least one output is set to Cool, CL.Pn 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. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _-_ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _-_ _ _ _).**

****** This value multiplied by 100 equals the percent power.**

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if'
dE.CL [dE.CL]	**Derivative Cool** Set the PID derivative time in minutes for the cool outputs.		0.00 to 9.99 minutes (0000 to 99990) 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.
db.CL [db.CL]	**Dead Band Cool** An offset of the cooling proportional band from the set point.		0 to 999 (0000 to 999000)	0	*281, 282 R/W	At least one output is set to Cool and CLPM is set to PId.
C.hyS [C.hyS]	**Cool Hysteresis** Set the control switching hysteresis for on/off control. This determines how far into the "on" region the input needs to move before the output actually turns on.		1 to 999°F if SEn is set to tc or rtd (1000 to 999000) 0.000 to 999.9 if SEn is set to PrA or volt (0000 to 999000)	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 Term** View the active proportional term for PID diagnostics.		0.000 to 1.000**** (0000 to 1000)	NA	258 R	Any output is set to hEAt or Cool.
it [it]	**Integral Term** View the active integral term for PID diagnostics.		0.000 to 1.000**** (0000 to 1000)	NA	259 R	Any output is set to hEAt or Cool.
dE [dE]	**Derivative Term** View the active derivative term for PID diagnostics.		0.000 to 1.000**** (0000 to 1000)	NA	260 R	Any output is set to hEAt or Cool.
Ent1 [Ent1]	**Event Output 1***** Set Event Output 1 to an on or off state.		oFF (0) Output is off on (1) Output is on	oFF (0)	351 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 1 is set to Ent1.
Ent2 [Ent2]	**Event Output 2***** Set Event Output 2 to an on or off state.		oFF (0) Output is off on (1) Output is on	oFF (0)	352 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 2 is set to Ent2.
Ent3 [Ent3]	**Event Output 3***** Set Event Output 3 to an on or off state.		oFF (0) Output is off on (1) Output is on	oFF (0)	353 R/W	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 3 is set to Ent3.
A1.hi [A1.hi]	**Alarm 1 High** Set the high alarm set point.		Deviation: 0 to 9999 (0000 to 9999000) Process: range of sensor, if SEn is set to tc or rtd -1999 to 9999 if SEn is set to PrA or volt. (-1999000 to 9999000)	999 (dev) 1500 (pro)	*100, 101 R/W (dev) *104, 105 R/W (pro)	Ot1 is set to dEAL or PrAL.

Note: Parameters appear in the Operations Page only if activated from the programming page. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

****** This value multiplied by 100 equals the percent power.**

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if"
A1.Lo [A1.Lo]	**Alarm 1 Low** Set the low alarm set point.		Deviation: -1999 to 0 (-1999000 to 0000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt. (-1999000 to 9999000)	-999 (dev) 32 (pro)	*98, 99 R/W (dev) *102, 103 R/W (pro)	Ot 1 is set to dEAL or PrAL
A2.hi [A2.hi]	**Alarm 2 High** Set the high alarm set point.		Deviation: 0 to 9999 (0000 to 9999000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt. (-1999000 to 9999000)	999 (dev) 1500 (pro)	*115, 116 R/W (dev) *119, 120 R/W (pro)	Ot 2 is set to dEAL or PrAL.
A2.Lo [A2.Lo]	**Alarm 2 Low** Set the low alarm set point.		Deviation: -1999 to 0 (-1999000 to 0000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt. (-1999000 to 9999000)	-999 (dev) 32 (pro)	*113, 114 R/W (dev) *117, 118 R/W (pro)	Ot 2 is set to dEAL or PrAL.
A3.hi [A3.hi]	**Alarm 3 High** Set the high alarm set point.		Deviation: 0 to 9999 (0000 to 9999000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt. (-1999000 to 9999000)	999 (dev) 1500 (pro)	*130, 131 R/W (dev) *134, 135 R/W (pro)	Ot 3 is set to dEAL or PrAL.
A3.Lo [A3.Lo]	**Alarm 3 Low** Set the low alarm set point.		Deviation: -1999 to 0 (-1999000 to 0000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to mA or volt. (-1999000 to 9999000)	-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. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

**** Static set point version only (SD_C-_ _ _ _- _ _ _ _).**

***** Profiling version only (SD_R-_ _ _ _- _ _ _ _).**

****** This value multiplied by 100 equals the percent power.**

7 Chapter 7: Operations Parameters Table for TRU-TUNE+™

These parameters can be selected to appear in the Operations Page. Select the parameters you want to appear in the Operations Page in the Programming Page. Press the Advance Key ◉ to enter the Operations Page and to step through the parameters. For profiling controllers, set [ProG] to [no] to access the Operations Page. Press the Infinity Key ∞ to return to the Home Page at any time.

Note: This chapter only applies to the TRU-TUNE+™ version of the Series SD (SD_E - _ _ _ _ - _ _ _ _).

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if'
[Po.ht] [Po.ht]	**Power Heat** Displays the current heat control power.		0.0 to 100.0% power (000 to 10000) (Two decimal places implied for Modbus.)	NA	256 R	[A-M] is set to [Auto] and at least one output is set to [HEAt].
[Po.CL] [Po.CL]	**Power Cool** Displays the current cool control power.		0.0 to 100.0% power (000 to 10000) (Two decimal places implied for Modbus.)	NA	257 R	[A-M] is set to [Auto] and at least one output is set to [Cool].
[A-M] [A-M]	**Auto-Manual Mode** Set the control mode.		[Auto] (0) [MAn] (1)	[Auto] (0)	25 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].
[t.tun] [t.tun]	**TRU-TUNE+™ Enable** Enable or disable the TRU TUNE+™ adaptive tuning feature.		[no] No (0) [YES] Yes (1)	[YES]	350 rw	TRU-TUNE+™ version only. (SD_ **E** - _ _ _ _ - _ _ _ _).
[CAL] [CAL]	**Calibration Offset** Offset the input reading.		-999 to 999 (-999000 to 999000)	0.0	*85, 86 R/W	Always appears.
[ht.M] [ht.M]	**Heat Control** Method Set the heat control method.		[OFF] off (0) [PId] PID (1) [on.oF] on-off (2)	[PId] (1)	213 R/W	At least one output is set to [HEAt].
[Pb.ht] [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] (1000 to 999000) 0.000 to 999 units, if [SEn] is set to [MA] or [volt]. (0000 to 999000)	25 25	*335, 336 R/W *339, 340 R/W	At least one output is set to [HEAt] and [ht.M] is set to [PId].
[It.hc] [It.hc]	**Integral** Set the PID integral in seconds per repeat for all outputs.		0.00 to 3,600 seconds per repeat (0000 to 3600) 0.00: disabled	180.0	*343, 344 R/W	TRU-TUNE+™ version only. (SD_**E** - _ _ _ _ - _ _ _ _). [ht.M] and/or [CL.M] is set to [PId].

Note: Parameters appear in the Operations Page only if activated from the programming page. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

****** This value multiplied by 100 equals the percent power.**

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if'
dE.hc [dE.hc]	**Derivative** Set the PID derivative time in seconds for all outputs.		0.00 to 3,600 seconds (0000 to 3600) 0.00: disabled	0.00	*345, 346 R/W	TRU-TUNE+™ version only. (SD_**E** - _ _ _ _ - _ _ _ _). ht.Pn and/or CL.Pn is set to PId.
db.hc [db.hc]	**Dead Band** Set an offset of the proportional band from the set point.		0 to 999 (0000 to 999000)	0	*347, 348 R/W	TRU-TUNE+™ version only. (SD_**E** - _ _ _ _ - _ _ _ _). ht.Pn and/or CL.Pn is set to PId.
h.hyS [h.hyS]	**Heat Hysteresis** Set the control switching hysteresis for on-off control. This determines how far into the "on" region the input needs to move before the output actually turns on.		1 to 999 degrees, if SEn is set to tc or rtd (1000 to 999000) 0.000 to 999.999 units, if SEn is set to PrA or volt (0000 to 999999)	1.0 1.000	*232, 233 R/W *234, 235 R/W	At least one output is set to HEAt, and ht.Pn is set to on.oF.
CL.Pn [CL.M]	**Cool Control Method** Set the Cool Control Method		OFF off (0) PId PID (1) on.oF on-off (2)	OFF (0)	214 R/W	At least one output is set to Cool.
Pb.CL [Pb.CL]	**Proportional Band Cool** Set the proportional band for the cool outputs.		1 to 999°F if SEn is set to tc or rtd (1000 to 999000) 0.000 to 999.0 if SEn is set to PrA or volt (0000 to 999000)	25 25.000	*337, 338 R/W *341, 342 R/W	At least one output is set to Cool, and CL.Pn is set to PId.
C.hyS [C.hyS]	**Cool Hysteresis** Set the control switching hysteresis for on/off control. This determines how far into the "on" region the input needs to move before the output actually turns on.		1 to 999°F if SEn is set to tc or rtd (1000 to 999000) 0.000 to 999.9 if SEn is set to PrA or volt (0000 to 999000)	1 1.000	*236, 237 R/W *238, 239 R/W	At least one output is set to Cool and CL.Pn is set to on.oF.
ProP [ProP]	**Proportional Term** View the active proportional term for PID diagnostics.		0.000 to 1.000**** (0000 to 1000)	NA	258 R	Any output is set to HEAt or Cool.
it [it]	**Integral Term** View the active integral term for PID diagnostics.		0.000 to 1.000**** (0000 to 1000)	NA	259 R	Any output is set to HEAt or Cool.
dE [dE]	**Derivative Term** View the active derivative term for PID diagnostics.		0.000 to 1.000**** (0000 to 1000)	NA	260 R	Any output is set to HEAt or Cool.
A1h. [A1.hi]	**Alarm 1 High** Set the high alarm set point.		Deviation: 0 to 9999 (0000 to 9999000) Process: range of sensor, if SEn is set to tc or rtd -1999 to 9999 if SEn is set to PrA or volt. (-1999000 to 9999000)	999 (dev) 1500 (pro)	*100, 101 R/W (dev) *104, 105 R/W (pro)	Ot 1 is set to dEAL or PrAL.

Note: Parameters appear in the Operations Page only if activated from the programming page. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

****** This value multiplied by 100 equals the percent power.**

Display	Parameter name Description	Settings	Range	Default	Modbus* (less 40,001 offset) Read/Write	Appears if'
A1.Lo [A1.Lo]	**Alarm 1 Low** Set the low alarm set point.		Deviation: -1999 to 0 (-1999000 to 0000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to PROR or volt. (-1999000 to 9999000)	-999 (dev) 32 (pro)	*98, 99 R/W (dev) *102, 103 R/W (pro)	Ot 1 is set to dE.AL or Pr.AL
A2.hi [A2.hi]	**Alarm 2 High** Set the high alarm set point.		Deviation: 0 to 9999 (0000 to 9999000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to PROR or volt. (-1999000 to 9999000)	999 (dev) 1500 (pro)	*115, 116 R/W (dev) *119, 120 R/W (pro)	Ot 2 is set to dE.AL or Pr.AL.
A2.Lo [A2.Lo]	**Alarm 2 Low** Set the low alarm set point.		Deviation: -1999 to 0 (-1999000 to 0000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to PROR or volt. (-1999000 to 9999000)	-999 (dev) 32 (pro)	*113, 114 R/W (dev) *117, 118 R/W (pro)	Ot 2 is set to dE.AL or Pr.AL.
A3.hi [A3.hi]	**Alarm 3 High** Set the high alarm set point.		Deviation: 0 to 9999 (0000 to 9999000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to PROR or volt. (-1999000 to 9999000)	999 (dev) 1500 (pro)	*130, 131 R/W (dev) *134, 135 R/W (pro)	Ot 3 is set to dE.AL or Pr.AL.
A3.Lo [A3.Lo]	**Alarm 3 Low** Set the low alarm set point.		Deviation: -1999 to 0 (-1999000 to 0000) Process: range of sensor, if SEN is set to tc or rtd -1999 to 9999 if SEN is set to PROR or volt. (-1999000 to 9999000)	-999 (dev) 32 (pro)	*128, 129 R/W (dev) *132, 133 R/W (pro)	Ot 3 is set to dE.AL or Pr.AL.

Note: Parameters appear in the Operations Page only if activated from the programming page. See page 22 for Operations Page defaults.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters through Modbus are in °F, by default.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

****** This value multiplied by 100 equals the percent power.**

8 Chapter 8: Programming Page

The Programming Page allows you to select what parameters appear on the Operations Page. To go to the Programming Page, press both the Advance ⓢ and Infinity ♾ keys for six seconds from the Home Page. PrOG 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 ▼ key to change the parameter value.
- Press the Infinity Key ♾ at any time to return to the Home Page display.

Note: This chapter only applies to the static set point and profiling versions of the Series SD (SD_C or R - _ _ _ _ - _ _ _ _).

Display	Parameter name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if"
P1	Parameter Location 1		nonE (0) None CAL (1) Calibration Offset C-F (2) Temperature Units (Setup Page) A1.Lo (3) Alarm 1 Low A1.hi (4) Alarm 1 High A2.Lo (5) Alarm 2 Low A2.hi (6) Alarm 2 High A3.Lo (7) Alarm 3 Low A3.hi (8) Alarm 3 High hYS1 (9) Alarm Hysteresis 1 (Setup Page) hYS2 (10) Alarm Hysteresis 2 (Setup Page) hYS3 (11) Alarm Hysteresis 3 (Setup Page) Addr (12) Modbus Device Address (Setup Page) Aut (13) Autotune A-M (14) Auto-Manual Po.ht (15) Power Heat Po.CL (16) Power Cool ht.M (17) Heat Control Method Pb.ht (18) Prop. Band Heat It.ht (19) Integral Heat or rE.ht (19) Reset Heat dE.ht (20) Derivative Heat or rA.ht (20) Rate Heat db.ht (21) Dead Band Heat hy.hY (22) Heat Hysteresis CL.M (23) Cool Control Method Pb.CL (24) Prop. Band Cool It.CL (25) Integral Cool or rE.CL (25) Reset Cool dE.CL (26) Derivative Cool or rA.CL (26) Rate Cool db.CL (27) Dead Band Cool C.hYS (28) Cool Hysteresis ProP (29) Proportional Term It (30) Integral Term dE (31) Derivative Term rP.rt (32) Ramp Rate (Setup Page)**	Po.ht (15)	48 R/W	All parameter locations always appear on the Programming Page. Static set point version (SD_**C** - _ _ _ _ - _ _ _ _) P1 to P20 Profiling version only. (SD_**R** - _ _ _ _ - _ _ _ _) P1 to P23
P2	Parameter Location 2			95d (35)	49 R/W	
P3	Parameter Location 3			Aut (13)	50 R/W	
P4	Parameter Location 4			CAL (1)	51 R/W	
P5	Parameter Location 5			ht.M (17)	52 R/W	
P6	Parameter Location 6			Pb.ht (18)	53 R/W	
P7	Parameter Location 7			rE.ht (19)	54 R/W	
P8	Parameter Location 8			rA.ht (20)	55 R/W	
P9	Parameter Location 9			h.hYS (22)	56 R/W	
P10	Parameter Location 10			CL.M (23)	57 R/W	
P11	Parameter Location 11			Pb.CL (24)	58 R/W	
P12	Parameter Location 12			rE.CL (25)	59 R/W	
P13	Parameter Location 13			rA.CL (26)	60 R/W	
P14	Parameter Location 14			C.hYS (28)	61 R/W	
P15	Parameter Location 15			A1.hi (4)	62 R/W	
P16	Parameter Location 16			A1.Lo (3)	63 R/W	
P17	Parameter Location 17			A2.hi (6)	64 R/W	
P18	Parameter Location 18			A2.Lo (5)	65 R/W	
P19	Parameter Location 19			A3.hi (8)	66 R/W	
P20	Parameter Location 20			A3Lo (7)	67 R/W	
P21	Parameter Location 21***			Ent1 (32)	68 R/W	
P22	Parameter Location 22***			Ent2 (33)	69 R/W	
P23	Parameter Location 23***			Ent3 (34)	47 R/W	

Note: All parameter locations have the same range of possible values.

****Static set point version (SD_ C - _ _ _ _ - _ _ _ _)**

*****Profiling version only. (SD_ R - _ _ _ _ - _ _ _ _)**

Programming Page Example

An oven manufacturer wants users of their ovens to have easy access to the Series SD PID parameters. They also want to limit access to other parameters they do not want them to change. This can be achieved by customizing the Operations Page. The Programming Page configuration determines which parameters appear on the Operations Page. The static set point version (SD_C-_ _ _ _- _ _ _ _.) has 20 Programming Page locations, P1 to P20. The profiling version (SD_R-_ _ _ _- _ _ _ _.) has 23 Programming Page locations, P1 to P23.

The oven manufacturer wants only these parameters to appear on the Operations Page:

- Heat Output Power
- Fahrenheit/Celsius
- Autotune
- Modbus Device Address

To go to the Programming Page, press the Advance ◉ and Infinity ∞ keys for six seconds from the Home Page. [PrOG] 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.

On the Programming Page, select the following settings:

[Ht.Pt] [C-F] [Aut] [Addr] [nonE] [nonE]

[P1] [P2] [P3] [P4] [P5] thru [P20]

To access the Operation Page parameters, press the Infinity Key ∞ to return to the Home Page. Press the Advance Key ◉ to see the Operation Page parameters. Only the parameters selected on the Programming Page appear on the Operations Page.

[50] [F] [OFF] [1]

[Ht.Pt] [C-F] [Aut] [Addr]

9 Chapter 9: Programming Page for TRU-TUNE+™

The Programming Page allows you to select what parameters appear on the Operations Page. To go to the Programming Page, press both the Advance and Infinity keys for six seconds from the Home Page. PrOG 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 key to change the parameter value.
- Press the Infinity Key at any time to return to the Home Page display.

Note: This chapter only applies to the TRU-TUNE+™ version of the Series SD (SD_E - _ _ _ _ - _ _ _ _).

Display	Parameter name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus (less 40,001 offset) Read/Write	Appears if"
P1	Parameter Location 1		nonE (0) None CAL (1) Calibration Offset C-F (2) Temperature Units (Setup Page) A1Lo (3) Alarm 1 Low A1Hi (4) Alarm 1 High A2Lo (5) Alarm 2 Low A2Hi (6) Alarm 2 High A3Lo (7) Alarm 3 Low A3Hi (8) Alarm 3 High HYS1 (9) Alarm Hysteresis 1 (Setup Page) HYS2 (10) Alarm Hysteresis 2 (Setup Page) HYS3 (11) Alarm Hysteresis 3 (Setup Page) Addr (12) Modbus Device Address (Setup Page) Aut (13) Autotune A-M (14) Auto-Manual Po.Ht (15) Power Heat Po.CL (16) Power Cool Ht.M (17) Heat Control Method Pb.Ht (18) Prop. Band Heat It.hc (19) Integral dE.hc (20) Derivative db.hc (21) Dead Band h.HYS (22) Heat Hysteresis CL.M (23) Cool Control Method Pb.CL (24) Prop. Band Cool C.HYS (28) Cool Hysteresis ProP (29) Proportional Term It (30) Integral Term dE (31) Derivative Term rP.rt (32) Ramp Rate (Setup Page) (33) (34) (35) t.tun (36) TRU-TUNE+™ Enable	Po.Ht (15)	48 R/W	All parameter locations always appear on the Programming Page.
P2	Parameter Location 2			A-M (14)	49 R/W	
P3	Parameter Location 3			Aut (13)	50 R/W	
P4	Parameter Location 4			t.tun (36)	51 R/W	
P5	Parameter Location 5			CAL (1)	52 R/W	
P6	Parameter Location 6			Ht.M (17)	53 R/W	
P7	Parameter Location 7			Pb.Ht (18)	54 R/W	
P8	Parameter Location 8			h.HYS (22)	55 R/W	
P9	Parameter Location 9			CL.M (23)	56 R/W	
P10	Parameter Location 10			Pb.CL (24)	57 R/W	
P11	Parameter Location 11			C.HYS (28)	58 R/W	
P12	Parameter Location 12			It.hc (19)	59 R/W	
P13	Parameter Location 13			dE.hc (20)	60 R/W	
P14	Parameter Location 14			A1Hi (4)	61 R/W	
P15	Parameter Location 15			A1Lo (3)	62 R/W	
P16	Parameter Location 16			A2Hi (6)	63 R/W	
P17	Parameter Location 17			A2Lo (5)	64 R/W	
P18	Parameter Location 18			A3Hi (8)	65 R/W	
P19	Parameter Location 19			A3Lo (7)	66 R/W	
P20	Parameter Location 20			nonE (0)	67 R/W	

Note: All parameter locations have the same range of possible values.

Programming Page Example

An oven manufacturer wants users of their ovens to have easy access to the Series SD PID parameters. They also want to limit access to other parameters they do not want them to change. This can be achieved by customizing the Operations Page. The Programming Page configuration determines which parameters appear on the Operations Page.

The oven manufacturer wants only these parameters to appear on the Operations Page:

- Heat Output Power
- Fahrenheit/Celsius
- Autotune
- Modbus Device Address

To go to the Programming Page, press the Advance and Infinity keys for six seconds from the Home Page.

Pro9 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.

On the Programming Page, select the following settings:

Po.ht C-F Aut Addr nonE nonE

P1 P2 P3 P4 P5 thru P20

To access the Operation Page parameters, press the Infinity Key to return to the Home Page. Press the Advance Key to see the Operation Page parameters. Only the parameters selected on the Programming Page appear on the Operations Page.

50 F OFF 1

Po.ht C-F Aut Addr

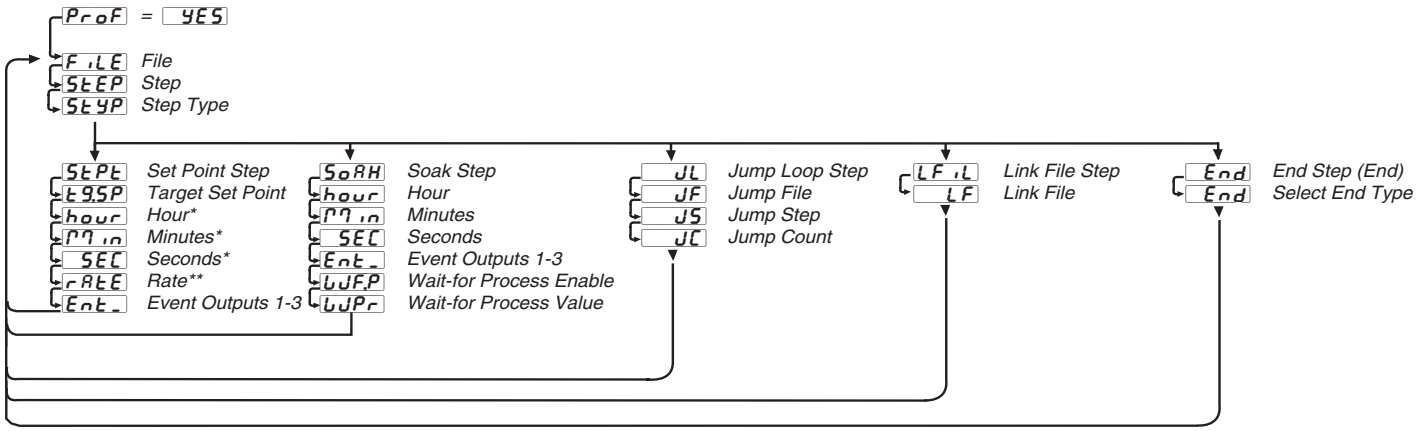
10 Chapter 10: Profiling Page

The Profiling Page allows you to enter your ramp and soak profile information. To go to the Profiling Page from the Home Page, press the Advance Key and PrOF appears in the lower display. Press the Up Key to change the upper display to YES.

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

Note: The Profiling Page only appears if the profiling version has been ordered (SD_R- _ _ _ _- _ _ _ _).

Note: The Profiling Page is only accessible if the profile is on hold or not running.



*** Hour, minutes and seconds appear if Profile Type PtYP is set to t1.**

**** Rate appears if Profile Type PtYP is set to rAtE.**

The Profiling Menu

Display	Parameter name Description	Set-tings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
FILE [FiLE]	**File** Represents the profile to be edited or viewed.		1 (1) 2 (2) 3 (3) 4 (4)	1	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
STEP [StEP]	**Step** Represents the current step of the profile to be edited or viewed. Up to ten steps per file.		1 (1) • • thru • 10 (10)	1	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
STYP [StYP]	**Step Type** Select from five different step types.		End End (0) StPt Set Point (1) SoAH Soak (2) JL Jump Loop (3) LFIL Link File (4)	End (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

Display	Parameter name Description	Set-tings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
	StYP Set Point Step					
tgSP [tg.SP]	**Target Set Point** Indicates ending set point value the controller ramps to during the set point step.		-1999 to 9999 (-1999000 to 9999000) Target set point values must be between SP.Lo to SP.Hi or step will fail the Pre-Run check and will not run.	75	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
hour [hour]	**Hours** The number of hours, (plus Min and Sec parameters) equal the total step time to achieve the ending set point under the [styp] step type.		0 to 99	0	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Active if the value set for PtYP is t1 or time based profiles.
Min [Min]	**Minutes** The number of minutes, (plus Hour and Sec parameters) equal the total step time to achieve the ending set point under the [styp] step type.		0 to 59	0	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Active if the value set for PtYP is t1 or time based profiles.
SEc [SEc]	**Seconds** The number of seconds, (plus Hour and Min parameters) equal the total step time to achieve the ending set point under the StYP step type.		0 to 59	0	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Active if the value set for PtYP is t1 or time based profiles.
rAtE [rAtE]	**Rate** Indicates rate at which the set point changes in degrees per minute.		0 to 9999	100	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Active if the value set for PtYP is rAtE or rate based profiles.
Ent1 [Ent1]	**Event Output 1** Selects whether Event Output 1 is on or off during the program step.		OFF (0) On (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 1 is set to Ent1.
Ent2 [Ent2]	**Event Output 2** Selects whether Event Output 2 is on or off during the program step.		OFF (0) On (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 2 is set to Ent2.
Ent3 [Ent3]	**Event Output 3** Selects whether Event Output 3 is on or off during the program step.		OFF (0) On (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 3 is set to Ent3.

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

Display	Parameter name Description	Set-tings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
	SoAK Soak Step					
hour [hour]	**Hours** The number of hours, (plus Min and Sec parameters) equal the total soak step time at set point under the SoAK step type.		0 to 99	0	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
Min [Min]	**Minutes** The number of minutes, (plus Hour and Sec parameters) equal the total soak step time at set point under the SoAK step type.		0 to 59	0	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
SEc [SEc]	**Seconds** The number of seconds, (plus Hour and Min parameters) equal the total soak step time at set point under the SoAK step type.		0 to 59	0	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
Ent1 [Ent1]	**Event Output 1** Selects whether Event Output 1 is on or off during the program step.		OFF (0) On (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 1 is set to Ent1.
Ent2 [Ent2]	**Event Output 2** Selects whether Event Output 2 is on or off during the program step.		OFF (0) On (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 2 is set to Ent2.
Ent3 [Ent3]	**Event Output 3** Selects whether Event Output 3 is on or off during the program step.		OFF (0) On (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _) Output 3 is set to Ent3.
WJFP [WF.P]	**Wait-for Process Enable** Select to enable Wait-for Process value.		no (0) YES (1)	no (0)	See page 53.	Profiling version only.
WJPr [WPr]	**Wait-for Process Value** The program will not begin to decrement the soak time during the programmed step until process value is equal to the Wait-for Process Value setting. Once the Wait-for Process is satisfied, this function is no longer active for this step.		-1999 to 9999 (-1999000 to 9999000)	75	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

Display	Parameter name Description	Set-tings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
	JL Jump Loop Step					
JF [JF]	**Jump File** Selects the file which is to be jumped to. This is a zero-time step.		1 to 4	1	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
JS [JS]	**Jump Step** Selects the step which is to be jumped to. This is a zero-time step.		1 to 10	1	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
JC [JC]	**Jump Count** Indicates the number of times the jump is to be done. A value of 0 results in an infinite loop.		0 to 9999	1	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
	LF iL Link File Step					
LF [LF]	**Link File** Selects the file to link to.		1 to 4	1	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)
	End End Step					
End [End]	**End** Selects the state of the control and auxiliary outputs when a profile is ended.		OFF (0) hold (1)	OFF (0)	See page 53.	Profiling version only. (SD_ **R** - _ _ _ _ - _ _ _ _)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

How to Navigate the Profiling Menus

	Pre-Run Menu - Profile Off	Pre-Run Menu - Profile Run or Hold	Profile Menu	Run Menu
Menu function	Start a profile.	Holding, resuming or stopping a profile.	Programming a profile.	Viewing profile status.
Enter menu	Press the Infinity Key ∞.	Press the Infinity Key ∞.	Press the Advance Key ◉. At the PrOF prompt, select YES.	Press the Advance Key ◉.
Scroll through menu	Press the Advance Key ◉.	N/A	Press the Advance Key ◉.	Press the Advance Key ◉.
Change prompt values	Press the Up ▲ or down ▼ key.	Press the Up ▲ or down ▼ key.	Press the Up ▲ or down ▼ key.	Read only.
Exit menu*	Press the Infinity Key ∞ at the FILE prompt.	Select the desired mode and press the Infinity Key ∞.	Press the Infinity Key ∞.	Press the Infinity Key ∞.
Start profile	Press the Infinity Key ∞ while at the STEP prompt.	N/A	N/A	N/A

Pre-Run Menu**

The Pre-run prompts are only visible when in the Pre-Run mode. The Pre-Run mode is entered by pressing the Infinity Key ∞ one time while at the Home Page. The profile indicator light flashes while in the Pre-Run mode.

The menu consists of the File FILE, Step STEP and Select SELC prompts. It allows the user to stop or start a profile.

When no profile is running, entering the Pre-run menu allows the selection of a profile and step number to run. Pressing the Advance Key ◉ toggles between the two prompts. Pressing the Infinity Key ∞ at the STEP prompt will start the profile. Pressing the Infinity Key ∞ at the FILE prompt will exit the pre-run menu without starting the profile. Pressing the Infinity Key ∞ while a profile is running or on hold will activate the SELC prompt. The profile indicator light flashes when SELC is displayed. The prompt allows you to choose to hold the profile hold, turn off the profile OFF or resume running a profile rESU.

Pre-Run Menu - Profile off

FILE File to start profile with
STEP Step to start profile on

Pre-Run Menu - Profile Run or Hold

hold Hold current profile
SELC

OFF Terminate profile
SELC

rESU Resume running current profile
SELC

Note: If there isn't any key press activity for 15 seconds while in the Pre-Run Menu, the controller exits the Pre-Run Menu and returns to the Home Page.

***Exit menu refers to returning back to the display of process value in the upper display and active set point value in the lower display. The ramping set point will be active while running a profile and the manual adjustable set point will be active when a profile is not running.**

****The Lockout parameter in the Setup Page determines your level of access to the other pages and menus, including the Pre-Run and Run menus.**

Run Menu*

The Run Menu is active when a program is running. Enter the Run Menu by pressing the Advance Key ◉ once from the Home Page. The profile indicator light will be lit when in the Run Mode. The file-step F.St prompt is visible in the Run Menu and shows the current file and step number of the running profile. Other prompts in the Run menu show the target end set point, as well as status for time remaining, ramp rate, wait-for, event status and jump count if relevant.

Run Menu

F.St File number - step number
EnSP End set point for step
hour Hours remaining in step
Min Minutes remaining in step
SEC Seconds remaining in step
rAtE Ramp rate in minutes for step
Ent1 Event Output 1.
Ent2 Event Output 2
Ent3 Event Output 3
WPr Wait-for process value
EJC Elapsed jump count for last jump step

Running a Profile

To run a profile:

1. You must start from the Home Page. Press the Infinity Key ∞ to exit a menu and return to the Home Page. Press the Infinity Key ∞ from the Home Page to enter the Pre-Run menu. The profile light will begin flashing. The lower display will indicate FILE and upper display will indicate the file number.
2. Use the Up ▲ or Down ▼ key to select the desired file number to run. Press the Advance Key ◉. The lower display will indicate STEP and the upper display will indicate the step number.
3. Use the Up ▲ or Down ▼ key to select the desired step number to start the profile on. Press the Infinity Key ∞ to begin the profile. The profile light will go full on.

Profile Errors

If the lower display alternates between a set point and file.step, there is an error in the step. For example, if the display flashes 1.1, there is a problem with File1, Step 1, and the profile will not run until the problem has been corrected. Check the program step for accuracy.

Holding and Resuming a Profile

If for some reason you need to pause a profile that is running, the profile can be put into a hold mode. While the profile is on hold, you may have full access* to the Setup, Operation and Programming menus to make any required changes. The profile can continue from where it left off using the resume function.

To hold or stop a running profile:

1. You must start from the Home Page. Press the Infinity Key ∞ to exit a menu and return to the Home Page. Press the Infinity Key ∞ to enter the Pre-Run menu.The profile light will begin flashing. SELC will appear in the lower display.
2. Use the Up ▲ or Down ▼ key to select hold in the upper display to maintain the present set point and pause the profile. The profile will now be on hold until either rESU or OFF is selected from the Pre-Run menu. Selecting OFF in the upper display will stop the profile and move the set point to OFF.

Note: A Pre-Run check verifies that all profile steps are valid before allowing a profile to be started or resumed. A flashing File/Step number in the lower display indicates invalid information in a profile step. See Troubleshooting section.

*** The Lockout parameter in the Setup Page determines your level of access to the other pages and menus, including the Pre-Run and Run menus.**

To resume a profile on hold:

1. You must start from the Home Page. Press the Infinity Key ∞ to exit a menu and return to the Home Page. Press the Infinity Key ∞ to enter the Pre-Run menu. SELC will appear in the lower display.
2. Use the Up ▲ or Down ▼ key to select rESU in the upper display. The profile will continue starting with the step it was running when it was placed on hold.

Editing a Profile on Hold

The profile can be edited* while in the hold mode. If you edit a step that has not yet been executed, the controller will execute that step using the new settings once the profile is resumed. When editing a step that is already in progress, the controller will adjust the current step utilizing the changed settings once the profile is resumed. The step will run as if it was the beginning of the step, including the jump count for a jump step. For example, if you are 3 minutes into a 20 minute step and you change the time, the step starts over at the beginning of the step when the profile is resumed. The new settings will be retained and used in future runs of that profile.

Step Types

Set Point Step

The set point step is used to establish a controller setting within a profile. Set points can be established instantaneously or over some period of time. Establishing a set point over time is also referred to as ramping. The Series SD allows for two methods of expressing a set point ramp, time-based or rate-based. Use the Profile Type PtyP parameter on the Setup Page to select the ramp type.

When expressed as time t i, the user enters the target set point and the amount of time desired to increment the current set point towards the target set point. Setting a time of 0 hours, 0 minutes, and 0 seconds causes the set point to be established instantaneously.

When expressed as rate rAtE, the user enters the target set point and the rate in degrees per minute to increment the current set point towards the target set point. Setting a ramp rate of 0 degrees per minute causes the set point to be established instantaneously. In either time or rate based programming, it is only a manipulation (increment or decrement) of the controller's setting, not the actual process value. To limit set point movement or timing based on the actual process value, use the Guaranteed Soak function and/or the Wait-for Process function of a Soak step.

Soak Step

A Soak step maintains the set point from the previous step for the time in hours, minutes and seconds entered into the step. It is not necessary to enter a set point for this step, only the time duration, the event output states and the Wait-for Process function. The Wait-for function can be enabled or disabled from the Wait-for Process Enable [WJF.P] for each individual Soak step. The Wait-for Process function causes the controller to pause the timer until the process value passes through the Wait-for Process value [WJPr]. Once the Wait-for Process value is satisfied, the Wait-for function is not active until the step runs again.

Note: If you have Guaranteed Soak Deviation enabled, the Wait-for Process function is satisfied once the process enters the Guaranteed Soak Deviation window.

*** The Lockout parameter in the Setup Page determines your level of access to the other pages and menus, including the Pre-Run and Run menus.**

Jump-loop Step

A profile can jump forward or backwards from any step, except Step 1 of any file. You cannot jump-loop to the step that you are on.

Jump-loop example:

Step 1 [StPt] Set Point Step

Step 2 [StPt] Set Point Step

Step 3 [SoAK] Soak Step

Step 4 [StPt] Set Point Step

Step 5 [JL] Jump-loop

[JF] = 1 [JS] = 2 [JC] = 1

Step 6 [End] End

In this example the program will execute steps 2 through 4 a total of 2 times. This includes the initial pass and the pass associated with the Jump Count of 1. Following the second pass, the End step (Step 6) will be executed and the program will end. The Jump Count can be any number from 0 to 255. If you enter 0, this will be an infinite loop and never progresses to Step 6. When Jump File is not set to the current program file, the profile may jump to any step of any programmed files.

Link File Step

The Link File step enables you to link any step other than the first step of a profile to the first step of another profile. Linking profiles allows for a simple method to effectively extend the number of steps available in a profile. All four profiles of the Series SD can be linked together to effectively give you a profile with 40 steps. However, each link step consumes one of the available profile steps and Step 10 of each profile is an End step. If you link File 1 to File 2, File 2 to File 3 and File 3 to File 4, only 34 steps would be available to perform the actual functions of a user's profile. In this example, linking the last profile to the first profile causes the profile to run endlessly.

End Step

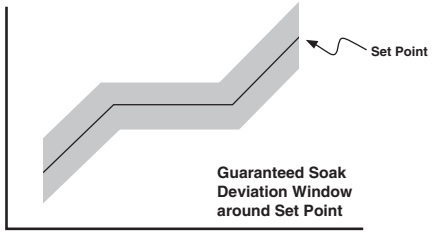
The End step ends the profile and selects the status of the control set point and event outputs when a profile finishes. When Hold [hold] is selected, the control set point and event outputs maintain the same state they were in before the End step was executed. When selected as Off [OFF], the control set point will be set to off (control outputs off) and any event outputs will be set to the off state.

Event Outputs

The flexibility of the Series SD allows configuration of any available output as an event output. An event output is simply an output that can be turned on or off through a profile step, or manually from the front panel if a profile is not running. The event may turn any number of peripheral devices on or off to assist you in controlling your process or system. For instance, an environmental chamber might need to energize a fan to circulate air at a given time in your profile for one or more steps. The chamber might need to turn lights on or off, lock out the humidification system or activate a video recorder. Each output can be configured as an event output on the Setup Page. Once configured, the option to set an event output's state appears while programming the steps in a profile. The state can be selected as on or off for each set point step and soak step in the profile.

Guaranteed Soak

The Guaranteed Soak Deviation feature insures that the actual temperature tracks a programmed profile within a window around set point. See figure below. If the deviation value from set point is exceeded, the timer function pauses, and the lower display alternately flashes between [GSd] and the current parameter until the process variable returns within the deviation window. Setting [GSdE] to [YES] enables the Guaranteed Soak Deviation function. When enabled, it applies to all steps within the profiles. Programmed in degrees or units, the value entered for Guaranteed Soak Deviation sets up a plus and minus deviation around the set point. [GSdE] and [GSd] are located on the Setup Page. The [GSd] parameter can also be added to the Operation's Page.



Note: If you have Guaranteed Soak Deviation enabled, the Wait-for Process function is satisfied once the process enters the Guaranteed Soak Deviation window.

Example profile

Gwen, of Smith Manufacturing needs to perform a burn-in test of their product in an environmental chamber. The test should take the product through the following sequence:

1. Heat from room temperature to a temperature of 150°F over a 1-hour period.
2. Hold the temperature at 150°F for 2 hours.
3. Cool the temperature to 32°F as quickly as possible.
4. Once the temperature reaches 32°F, hold that temperature for 2 hours.
5. Stop controlling the temperature and allow it to return to room temperature naturally.

Use the master step chart to map out the profile.

Circle File Number: 1 (2) 3 4				**Master Step Chart**					
Step 1	___ ~~Stpt~~ (Ptyp=ti)	Tg.SP **150**	Hour **1**	Min. **0**	Sec. **0**	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 2	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min	Sec.	Ent1: On Off.	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ ~~Soak~~	Hour **2**	Min. **0**	Sec. **0**	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 3	___ ~~Stpt~~ (Ptyp=ti)	Tg.SP **32**	Hour **0**	Min. **0**	Sec. **0**	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 4	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min	Sec	Ent1: On Off.	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ ~~Soak~~	Hour **2**	Min. **0**	Sec. **0**	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes (No)	W.Pr **32**
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 5	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ ~~End~~	End: Off (Hold)							

Step 1	1	1	StPt	150	1	0	0	
	FILE	STEP	STYP	t9.5P	hour	MIn	SEC	
Step 2	1	2	SoAk	2	0	0	no	
	FILE	STEP	STYP	hour	MIn	SEC	bUF.P	
Step 3	1	3	StPt	32	0	0	0	
	FILE	STEP	STYP	t9.5P	hour	MIn	SEC	
Step 4	1	4	SoAk	2	0	0	YES	32
	FILE	STEP	STYP	hour	MIn	SEC	bUF.P	bUPr
Step 5	1	5	End	OFF				
	FILE	STEP	STYP	End				

Circle File Number: 1 2 3 4				**Master Step Chart** (Make a copy and write in your settings)					
Step 1	___ Stpt (Ptyp=ti)	Tg.	Hou	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	W.FP: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 2	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min	Sec.	Ent1: On Off.	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min. 0	Sec. 0	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P Yes No	WPr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 3	___ Stpt (Ptyp=ti)	Tg.SP	Hour 0	Min. 0	Sec. 0	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P Yes No	WPr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 4	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min	Sec	Ent1: On Off.	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min. 0	Sec. 0	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P Yes No	WPr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 5	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P Yes No	WPr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 6	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P Yes No	WPr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step7	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 8	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 9	___ Stpt (Ptyp=ti)	Tg.SP	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	
	___ Stpt (Ptyp=rate)	Tg.SP	Rate	Ent1: On Off	Ent2: On Off	Ent3: On Off			
	___ Soak	Hour	Min.	Sec.	Ent1: On Off	Ent2: On Off	Ent3: On Off	WF.P: Yes No	W.Pr
	___ JL	JF	JS	JC					
	___ LFil	LF							
	___ End	End: Off Hold							
Step 10									
	___ End	End: Off Hold		**Note: Step 10 in each file can only be an End Step.**					

Series SD Profiling Modbus Registers

This section contains information for creating, editing and running profiles using Modbus. Some of these are available only through Modbus and others can be accessed through the front panel and Modbus. If a parameter is accessible only through Modbus, N/A appears in the display column. Parameters appear in profiling version only.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
PtyP [Ptyp]	**Profile Type** Set the profile ramp to time based or rate based.		t i Time based ramp (0) rAtE Rate based ramp (1)	t i (0)	354 R/W	Always
PStr [PStr]	**Profile Start** Select where the profile begins the starting set point of the profile, current static set point or current process temperature.		SEt Static Set Point (0) Pro Process (1)	SEt (0)	355 R/W	Always
gS.dE [gS.dE]	**Guaranteed Soak Deviation Enable** Enables the guaranteed soak deviation function in profiles.		no Disabled (0) yES Enabled (1)	no (0)	356 R/W	Always
gSd [gSd]	**Guaranteed Soak Deviation Value** Set the value of deviation allowed by the guaranteed soak deviation function.		1 to 999 (1 to 999000)	1	*357, 358 R/W	gS.dE set to yES
N/A	**Profile State** Indicates current profile status.		Profile off (0) Profile is holding (1) Profile is running (2) Pre-run check failed when starting the profile (3) Pre-run check failed when resuming the profle (4)	0	359 R	Available through Modbus only.
N/A	**Jump Count Step Enabled** Indicates whether a Jump Step is currently being executed.		Profile is not running or profile is running and is not currently executing a Jump Step (0) Profile is running and the profile is currently executing a Jump Step (1)	0	363 R	Available through Modbus only.
FiLE [FiLE]	**Start File Number** Selects the file to start running.		1 to 4	1	361 R/W	Always
StEP [StEP]	**Start Step Number** Selects the profile step to be run.		1 to 10	1	362 R/W	Always
SELC [SELC]	**Profile Select** Selects what to do when a profile is on hold.		OFF Terminate current profile (0) rESU Resume running current profile (1) hold Hold current profile (2)		360 R/W	If profile is holding or running.
gSd [GSd]	**Guaranteed Soak Deviation Message** Monitors guaranteed soak deviation status.		Message Disabled [GSD is disabled or within range if enabled. No message is flashing] (0) Message Enabled [GSD outside range and a message is flashing] (1)	0	364 R	gS.dE set to yES

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

Monitoring Profile Status from Modbus

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
N/A	**File Running** File number that is currently running.		1 to 4	1	900 R	Profile is running.
N/A	Step Running Step number that is currently running.		1 to 10	1	901 R	Profile is running.
EnSP [EnSP]	**End Set Point Value** Set point value reached at the end of the current step.		SPLo to SPHi		*902, 903 R	Profile is running.
hour [hour]	**Hours Remaining** Indicates number of hours remaining in the step currently running.		0 to 99		904 R	Profile is running. Active if the value set for PtyP is t1 or time based profiles.
Min [~Min]	**Minutes Remaining** Indicates number of minutes remaining in the step currently running.		0 to 59		905 R	Profile is running. Active if the value set for PtyP is t1 or time based profiles.
SEc [SEc]	**Seconds Remaining** Indicates number of seconds remaining in the step currently running.		0 to 59		907 R	Profile is running. Active if the value set for PtyP is t1 or time based profiles.
rAtE [rAtE]	**Ramp Rate** Rate at which the profile changes in degrees or units per minute.		0.0 to 9999.9 (0 to 9999900)		*907, 908 R	Profile is running. Active if the value set for PtyP is rAtE or rate based profiles.
Ent1 [Ent1]	**Event Output 1 status** Indicates Event Output 1 status.		OFF (0) On (1)		909 R	Profile is running. Output 1 is set to Ent1.
Ent2 [Ent2]	**Event Output 2 status** Indicates Event Output 2 status.		OFF (0) On (1)		910 R	Profile is running. Output 2 is set to Ent2.
Ent3 [Ent3]	**Event Output 3 status** Indicates Event Output 3 status.		OFF (0) On (1)		911 R	Profile is running. Output 3 is set to Ent3
WPr [WPr]	**Wait-for Process Value** Profile clock waits until the process value matches the Wait-for value and then continues with the step.		SPLo to SPHi		*912, 913 R	Profile is running. WJFP set to YES.
EJC [EJC]	**Elapsed Jump Count** Number of times the profile has been through the Jump Loop Step.		0 to 9999 (0 to 9999000)		914 R	Profile is running and the current profile step running is a Jump Loop Step Type.
N/A	**Failed File Number** Indicates the file number that failed the Pre-Run check.		1 to 4		365 R	Profile State is set to 3 (Pre-Run Failed Start) or 4 (Pre-Run Failed Resume)
N/A	**Failed Step Number** Indicates the step number that failed the Pre-Run check.		1 to 10		366 R	Profile State is set to 3 (Pre-Run Failed Start) or 4 (Pre-Run Failed Resume)

Note: Some values will be rounded off to fit in the four-character display. Full values can be read with Modbus. All temperature parameters are in °F through Modbus.

*** Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted.**

Series SD Profiling Modbus Register Numbers

This table contains the Modbus register numbers. The number in ( ) identifies the file number for that register.

Parameter	File (X) Step 1	File (X) Step 2	File (X) Step 3	File (X) Step 4	File (X) Step 5	File (X) Step 6	File (X) Step 7	File (X) Step 8	File (X) Step 9	File (X) Step 10
Step Type	1000 (1) 1250 (2) 1500 (3) 1750 (4)	1025 (1) 1275 (2) 1525 (3) 1775 (4)	1050 (1) 1300 (2) 1550 (3) 1800 (4)	1075(1) 1325 (2) 1575 (3) 1825 (4)	1100 (1) 1350 (2) 1600 (3) 1850 (4)	1125 (1) 1375 (2) 1625 (3) 1875 (4)	1150 (1) 1400 (2) 1650 (3) 1900 (4)	1175 (1) 1425 (2) 1675 (3) 1925 (4)	1200 (1) 1450 (2) 1700 (3) 1950 (4)	
Target Set Point (two registers)	1001 (1) 1251 (2) 1501 (3) 1751 (4)	1026 (1) 1276 (2) 1526 (3) 1776 (4)	1051 (1) 1301 (2) 1551 (3) 1801 (4)	1076 (1) 1326 (2) 1576 (3) 1826 (4)	1101 (1) 1351 (2) 1601 (3) 1851 (4)	1126 (1) 1376 (2) 1626 (3) 1876 (4)	1151 (1) 1401 (2) 1651 (3) 1901 (4)	1176 (1) 1426 (2) 1676 (3) 1926 (4)	1201 (1) 1451 (2) 1701 (3) 1951 (4)	
Hours	1003 (1) 1253 (2) 1503 (3) 1753 (4)	1028 (1) 1278 (2) 1528 (3) 1778 (4)	1053 (1) 1303 (2) 1553 (3) 1803 (4)	1078 (1) 1328 (2) 1578 (3) 1828 (4)	1103 (1) 1353 (2) 1603 (3) 1853 (4)	1128 (1) 1378 (2) 1628 (3) 1878 (4)	1153 (1) 1403 (2) 1653 (3) 1903 (4)	1178 (1) 1428 (2) 1678 (3) 1928 (4)	1203 (1) 1453 (2) 1703 (3) 1953 (4)	
Minutes	1004 (1) 1254 (2) 1504 (3) 1754 (4)	1029 (1) 1279 (2) 1529 (3) 1779 (4)	1054 (1) 1304 (2) 1554 (3) 1804 (4)	1079 (1) 1329 (2) 1579 (3) 1829 (4)	1104 (1) 1354 (2) 1604 (3) 1854 (4)	1129 (1) 1379 (2) 1629 (3) 1879 (4)	1154 (1) 1404 (2) 1654 (3) 1904 (4)	1179 (1) 1429 (2) 1679 (3) 1929 (4)	1204 (1) 1454 (2) 1704 (3) 1954 (4)	
Seconds	1005 (1) 1255 (2) 1505 (3) 1755 (4)	1030 (1) 1280 (2) 1530 (3) 1780 (4)	1055 (1) 1305 (2) 1555 (3) 1805 (4)	1080 (1) 1330 (2) 1580 (3) 1830 (4)	1105 (1) 1355 (2) 1605 (3) 1855 (4)	1130 (1) 1380 (2) 1630 (3) 1880 (4)	1155 (1) 1405 (2) 1655 (3) 1905 (4)	1180 (1) 1430 (2) 1680 (3) 1930 (4)	1205 (1) 1455 (2) 1705 (3) 1955 (4)	
Ramp Rate (two registers)	1006 (1) 1256 (2) 1506 (3) 1756 (4)	1031 (1) 1281 (2) 1531 (3) 1781 (4)	1056 (1) 1306 (2) 1556 (3) 1806 (4)	1081 (1) 1331 (2) 1581 (3) 1831 (4)	1106 (1) 1356 (2) 1606 (3) 1856 (4)	1131 (1) 1381 (2) 1631 (3) 1881 (4)	1156 (1) 1406 (2) 1656 (3) 1906 (4)	1181 (1) 1431 (2) 1681 (3) 1931 (4)	1206 (1) 1456 (2) 1706 (3) 1956 (4)	
Event Output 1	1008 (1) 1258 (2) 1508 (3) 1758 (4)	1033 (1) 1283 (2) 1533 (3) 1783 (4)	1058 (1) 1308 (2) 1558 (3) 1808 (4)	1083 (1) 1333 (2) 1583 (3) 1833 (4)	1108 (1) 1358 (2) 1608 (3) 1858 (4)	1133 (1) 1383 (2) 1633 (3) 1883 (4)	1158 (1) 1408 (2) 1658 (3) 1908 (4)	1183 (1) 1433 (2) 1683 (3) 1933 (4)	1208 (1) 1458 (2) 1708 (3) 1958 (4)	
Event Output 2	1009 (1) 1259 (2) 1509 (3) 1759 (4)	1034 (1) 1284 (2) 1534 (3) 1784 (4)	1059 (1) 1309 (2) 1559 (3) 1809 (4)	1084 (1) 1334 (2) 1584 (3) 1834 (4)	1109 (1) 1359 (2) 1609 (3) 1859 (4)	1134 (1) 1384 (2) 1634 (3) 1884 (4)	1159 (1) 1409 (2) 1659 (3) 1909 (4)	1184 (1) 1434 (2) 1684 (3) 1934 (4)	1209 (1) 1459 (2) 1709 (3) 1959 (4)	
Event Output 3	1010 (1) 1260 (2) 1510 (3) 1760 (4)	1035 (1) 1285 (2) 1535 (3) 1785(4)	1060 (1) 1310 (2) 1560 (3) 1810 (4)	1085 (1) 1335 (2) 1585 (3) 1835 (4)	1110 (1) 1360 (2) 1610 (3) 1860 (4)	1135 (1) 1385 (2) 1635 (3) 1885 (4)	1160 (1) 1410 (2) 1660 (3) 1910 (4)	1185 (1) 1435 (2) 1685 (3) 1935 (4)	1210 (1) 1460 (2) 1710 (3) 1960 (4)	
Wait-for Process Enable	1011 (1) 1261 (2) 1511 (3) 1761 (4)	1036 (1) 1286 (2) 1536 (3) 1786 (4)	1061 (1) 1311 (2) 1561 (3) 1811 (4)	1086 (1) 1336 (2) 1586 (3) 1836 (4)	1111 (1) 1361 (2) 1611 (3) 1861 (4)	1136 (1) 1386 (2) 1636 (3) 1886 (4)	1161 (1) 1411 (2) 1661 (3) 1911 (4)	1186 (1) 1436 (2) 1686 (3) 1936 (4)	1211 (1) 1461 (2) 1711 (3) 1961 (4)	
Wait-for Process Value (two registers)	1012 (1) 1262 (2) 1512 (3) 1762 (4)	1037 (1) 1287 (2) 1537 (3) 1787 (4)	1062 (1) 1312 (2) 1562 (3) 1812 (4)	1087 (1) 1337 (2) 1587 (3) 1837 (4)	1112 (1) 1362 (2) 1612 (3) 1862 (4)	1137 (1) 1387 (2) 1637 (3) 1887 (4)	1162 (1) 1412 (2) 1662 (3) 1912 (4)	1187 (1) 1437 (2) 1687 (3) 1937 (4)	1212 (1) 1462 (2) 1712 (3) 1962 (4)	
Jump File	1014 (1) 1264 (2) 1514 (3) 1764 (4)	1039 (1) 1289 (2) 1539 (3) 1789 (4)	1064 (1) 1314 (2) 1564 (3) 1814 (4)	1089 (1) 1339 (2) 1589 (3) 1839 (4)	1114 (1) 1364 (2) 1614 (3) 1864 (4)	1139 (1) 1389 (2) 1639 (3) 1889 (4)	1164 (1) 1414 (2) 1664 (3) 1914 (4)	1189 (1) 1439 (2) 1689 (3) 1939 (4)	1214 (1) 1464 (2) 1714 (3) 1964 (4)	
Jump Step	1014 (1) 1264 (2) 1514 (3) 1764 (4)	1040 (1) 1290 (2) 1540 (3) 1790 (4)	1065 (1) 1315 (2) 1565 (3) 1815 (4)	1090 (1) 1340 (2) 1590 (3) 1840 (4)	1115 (1) 1365 (2) 1615 (3) 1865 (4)	1140 (1) 1390 (2) 1640 (3) 1890 (4)	1165 (1) 1415 (2) 1665 (3) 1915 (4)	1190 (1) 1440 (2) 1690 (3) 1940 (4)	1215 (1) 1465 (2) 1715 (3) 1965 (4)	
Jump Count	1016 (1) 1266 (2) 1516 (3) 1766 (4)	1041 (1) 1291 (2) 1541 (3) 1791 (4)	1066 (1) 1316 (2) 1566 (3) 1816 (4)	1091 (1) 1341 (2) 1591 (3) 1841 (4)	1116 (1) 1366 (2) 1616 (3) 1866 (4)	1141 (1) 1391 (2) 1641 (3) 1891 (4)	1166 (1) 1416 (2) 1666 (3) 1916 (4)	1191 (1) 1441 (2) 1691 (3) 1941 (4)	1216 (1) 1466 (2) 1716 (3) 1966 (4)	
Link File	1017 (1) 1267 (2) 1517 (3) 1767 (4)	1042 (1) 1292 (2) 1542 (3) 1792 (4)	1067 (1) 1317 (2) 1567 (3) 1817 (4)	1092 (1) 1342 (2) 1592 (3) 1842 (4)	1117 (1) 1367 (2) 1617 (3) 1867 (4)	1142 (1) 1392 (2) 1642 (3) 1892 (4)	1167 (1) 1417 (2) 1667 (3) 1917 (4)	1192 (1) 1442 (2) 1692 (3) 1942 (4)	1217 (1) 1467 (2) 1717 (3) 1967 (4)	
End Step	1018 (1) 1268 (2) 1518 (3) 1768 (4)	1043 (1) 1293 (2) 1543 (3) 1793 (4)	1068 (1) 1318 (2) 1568 (3) 1818 (4)	1093 (1) 1343 (2) 1593 (3) 1843 (4)	1118 (1) 1368 (2) 1618 (3) 1868 (4)	1143 (1) 1393 (2) 1643 (3) 1893 (4)	1168 (1) 1418 (2) 1668 (3) 1918 (4)	1193 (1) 1443 (2) 1693 (3) 1943 (4)	1218 (1) 1468 (2) 1718 (3) 1968 (4)	1243 (3) 1493 (2) 1743 (3) 1993 (4)

Low register numbers contain the two higher bytes; high register numbers contain the two lower bytes of the four-byte integer. Decimal precision is implied at three decimal places unless otherwise noted. All temperature parameters are in °F through Modbus.

11 Chapter 11: Factory Page

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		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.		15 to 100% duty	100	NA	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 customer configured settings. Two sets of user settings for non-profiling version and one set of user settings for profiling version.		no (0) SEt 1 (1) SEt2 (2) no (0) YES (1)	no (0)	209 R/W	Non-profiling version only. (SD_ C - _ _ _ _ - _ _ _ _) Profiling version only. (SD_ R - _ _ _ _ - _ _ _ _)
USr.S [USr.S]	**Save User Settings** Saves customer configured settings. Two sets of user settings for non-profiling version and one set of user settings for profiling version.		no (0) SEt 1 (1) SEt2 (2) no (0) YES (1)	no (0)	210 R/W	Non-profiling version only. (SD_ C - _ _ _ _ - _ _ _ _) Profiling version only. (SD_ R - _ _ _ _ - _ _ _ _)
PrF.r [PrF.r]	**Restore User Profiles** Restores the current customer configured profiles		no (0) YES (1)	no (0)	209 R/W	Profiling version only. (SD_ R - _ _ _ _ - _ _ _ _)
PrF.S [Prf.S]	**Save User Profiles** Saves the current customer configured profiles.		no (0) YES (1)	no (0)	210 R/W	Profiling version only. (SD_ R - _ _ _ _ - _ _ _ _).
dFLt [dFLt]	**Default Parameters** Reset all parameters to the default values (may take up to 4 seconds to complete).		no (0) YES (1)	no (0)	207 R/W	Always active.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
O.ty1 [O.ty1]	**Output 1 Type** Displays the hardware type for Output 1.		none (0) dC DC/open collect. (1) rLAY mech. relay (2) SSr solid-state relay (3) Proc process (4)	none none (0)	202 R	Always active.
O.ty2 [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) COMM communications (5)	none none (0)	203 R	Always active.
O.ty3 [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 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.
S.VEr [S.VEr]	**Software Version** Displays the firmware revision.		0.00 to 99.99	NA	11 R	Always active.
S.bLd [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 high voltage LOW low voltage	NA	*NA	Always active.
Sn- [Sn-]	**Serial Number 1** Displays the first four characters of the serial number.		0 to 9999	NA	7,8 R	Always active.
Sn_ [Sn_]	**Serial Number 2** Displays the last four characters of the serial number.		0 to 9999	NA	7,8 R	Always active.

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.

Calibration information for the Series SD controllers is available in pdf format. Go to www.watlow.com > Literature > Product User Manuals and search on Series SD Calibration Manual.

12 Chapter 12: Features

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 [USr.S] 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 [USr.r] to recall the saved settings. The non-profiling version has two sets of user settings and the profiling version only has one set.

To save the Setup and Operations parameters:

1. Ensure all the settings that you want to store are already programmed into the Setup, Programming, and Operations Page parameters.
2. From the Home Page, 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 [USr.S] prompt appears.
4. Use the Up Key ▲ to select [YES]*** or ([SEt 1] or [SEt2])** 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 [USr.r] prompt appears.
3. Use the Up Key ▲ to select [YES] in the upper display.
4. Press the Infinity Key ∞ to exit the Factory Page.

Saving and Restoring User Profiles

Profiles can be backed up and saved independently from other user settings. Once all the necessary files and steps have been programmed, the [PrF.S] parameter is used to save the profiles into a special section of memory. All ten steps of each of the four profiles is saved even if they are not all being used. If the profile information is altered and the user wants to return to the backup profiles, the [PrF.r] parameter will restore the saved profiles.

**** Static set Point version only**

*****Profiling version only**

To save a backup of the profiles:

1. Be sure all profiles are programmed as desired.
2. From the Home Page, 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 menu until the [PrF.S] parameter appears.
4. Press the Up Key ▲ to select [YES] in the upper display.
5. Press the Infinity Key ∞ to exit the Factory Page.

Caution: Only perform this procedure when you are sure that all the correct profile information is programmed into the controller. This will overwrite all previously saved profiles.

To restore a backup of the profiles:

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 [PrF.r] parameter appears.
3. Press 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 (23 on profiling version) 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.

Note: On profiling version, keys must be pressed exactly at the same time to enter 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, [P1] to [P20] ([P23] for the profiling version), in the bottom display and use the Up or the Down key to change the parameter selected in the top display.

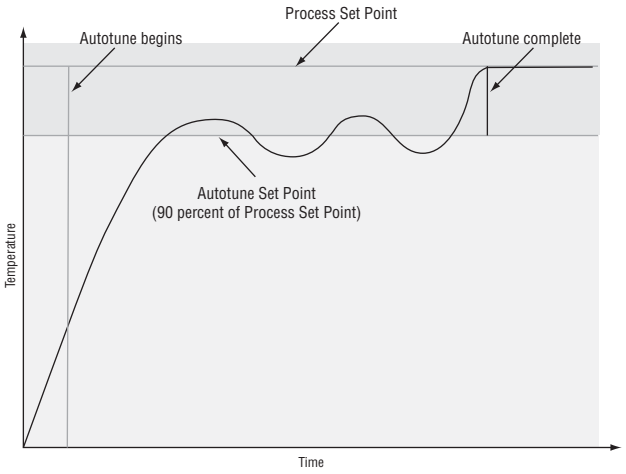
Changes made to the Operations Page will persist until changed by the operator or defaulted by full defaults or user defaults. User-defined parameters are not overwritten by default parameters if those features become enabled. Only parameters supported by a controller's particular hardware configuration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

Tuning the PID Parameters

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 [AuE] (Operations parameters) to [On]. A profile can't be running.



Manual Tuning

In some applications, the autotune process may not come up with PID parameters that provide the process characteristics you desire. If the autotune does not provide satisfactory results, you will have to perform a manual tune on the process:

1. Apply power to the Series SD and establish a set point typically used in your process. If the controller includes the TRU-TUNE+™ option (SD_E-_ _ _ - _ _ _ _), set TRU-TUNE+™ Enable to [no].
2. Go to the Operations Page, and establish values for the PID parameters: Proportional Band = 5; Reset* = 0.00; Rate* = 0.00. Autotune should be set to off.
3. When the system stabilizes, watch the process value. If this value fluctuates, increase the proportional band setting until it stabilizes. Adjust the proportional band in 3° to 5° increments, allowing time for the system to stabilize between adjustments.
4. When the process has stabilized, watch the percent power, [Po.ht] or [Po.CL]. It should be stable ±2%. At this point, the process temperature should also be stable, but it will have stabilized before reaching set point. The difference between set point and actual can be eliminated with reset.
5. Start with a reset* value of 0.01 (99.99)** and allow 10 minutes for the process temperature to get to set point. If it has not, double (halve) ** the setting and wait another 10 minutes. Continue doubling (halving) ** every 10 minutes until the process value equals the set point. If the process becomes unstable, the reset* value is too large (small) **. Decrease (increase) ** the reset value until the process stabilizes.
6. Increase Rate* to 0.10 minute. Then increase the set point by 11° to 17°C. Monitor the system's approach to the set point. If the process value overshoots the set point, increase Rate* to 0.50 minute. Increase the set point by 11° to 17°C and watch the approach to the new set point. If you increase Rate* too much, the approach to the set point will be very sluggish. Repeat as necessary until the system rises to the new set point without overshoot or sluggishness.

***Note: With the [Unit] parameter set at [SI] (Setup Page) Integral will appear in place of Reset and Derivative will appear in place of Rate.**

****Note: Integral is the reciprocal of reset. For Integral instead of reset, use the values in parentheses.**

For additional information about autotune and PID control, see related features in this chapter.

TRU-TUNE+™ Adaptive Control

If your Series SD controller was ordered with the TRU-TUNE+™ option (SD_E - _ _ _ _ - _ _ _ _) the TRU-TUNE+™ feature can be enabled or disabled in the Setup Page. The TRU-TUNE+™ feature is enabled as the default condition. If TRU-TUNE+™ is disabled, the controller will control using fixed PID settings (non adaptive).

The TRU-TUNE+™ adaptive algorithm will optimize the Series SD controller's PID values to improve the controller's ability to control difficult-to-control or dynamic processes. TRU-TUNE+™ monitors the process variable and adjusts the control parameters automatically to keep your process at set point during set point and load changes. When the controller is in the adaptive control mode, it determines the appropriate output signal and, over time, adjusts the control parameters to optimize responsiveness and stability. The TRU-TUNE+™ feature does not function for on-off control.

Autotune Enable [AUt]: The Autotune Enable parameter appears in the Operations Page.

The autotune feature can be enabled if TRU-TUNE+™ is enabled or disabled.

Autotuning with TRU-TUNE+™ adaptive control is a process by which the Series SD controller calculates the PID settings for optimum control. Both heating and cooling PID parameter settings are determined. The autotune feature can also be enabled if TRU-TUNE+™ has been disabled. The autotune generated PID settings are used until the autotune feature is rerun or the PID variable values are manually adjusted by the user or if TRU-TUNE+™ is enabled.

The preferred and quickest method for tuning the Series SD controller when TRU-TUNE+™ is enabled is to use the autotune feature to establish initial control settings and continue with the adaptive mode to fine tune the settings. Enabling the autotune function from the Operations Page starts this two-step tuning function. First the autotune determines initial, rough settings for the PID parameters. Second the loop automatically switches to the adaptive mode, which fine tunes the PID parameters. This function can be used for heat-only, heat-and-cool, and cool-only PID control systems.

Once the process value has been at set point for a suitable period of time (about 30 minutes for a fast process to roughly 2 hours for a slower process) and if no further tuning of the PID parameters is desired or needed, TRU-TUNE+™ can then be disabled. However, only operating the controller in the adaptive mode allows it to automatically adjust to load changes and compensate for differing control characteristics at various set points for processes that are not entirely linear.

Once the PID parameters have been set by the TRU-TUNE+™ adaptive algorithm, the process, if shut down for any reason, can be restarted in the adaptive control mode.

Autotune Aggressiveness [AGrS]: This parameter appears in the Setup Page. This parameter is used by the autotune feature to determine how aggressively power is applied to the controllers output to enable the process value to reach the set point.

[Undr] Under damped. Aggressive PID values are selected during autotune that bring the load quickly to the set point. Overshoot is not critical and is allowed.

[OvEr] Over damped. PID values are selected during autotune that minimize overshoot. It is not critical that the load reach the set point quickly. Overshoot is critical and is not allowed or kept to a minimum.

[Cr.it] Critical damped. PID values are selected during the autotune that bring the load up to the set point at power levels that allow for some overshoot. It is critical to get the load to the set point as fast as possible with minimal overshoot.

[Cr.it] Critical damped is the default setting.

Tune Band [t.bnd]: This parameter appears in the Setup Page if TRU-TUNE+™ is enabled. Set the controller to automatically adjust the range around set point over which the controller will continuously tune the control parameters, or enter a fixed value. This parameter is provided for use only in the unlikely event that the controller is unable to automatically tune and stabilize at set point. This may occur with very fast processes. In that case select a large value, such as 300. Otherwise, leave this parameter set to auto.

Values: auto (0) and 1 (1) to 999 (999)

Default: auto (0)

Tune Gain [t.Gn] This parameter appears in the Setup Page if TRU-TUNE+™ is enabled. Choose the target responsiveness of the control algorithm. Settings range from 1, with the least aggressive response and least potential overshoot (lowest gain), to 7, with the most aggressive response and most potential for overshoot (highest gain). The default setting, 4, is recommended for loops with thermocouple feedback and moderate response and overshoot potential.

Values: 1 (1) to 7 (7)

Default: 4 (4)

Inputs

INFOSENSE™ Temperature Sensing

Watlow's INFOSENSE™ feature can improve temperature sensing accuracy by 50%. Watlow's INFO-SENSE™ 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.

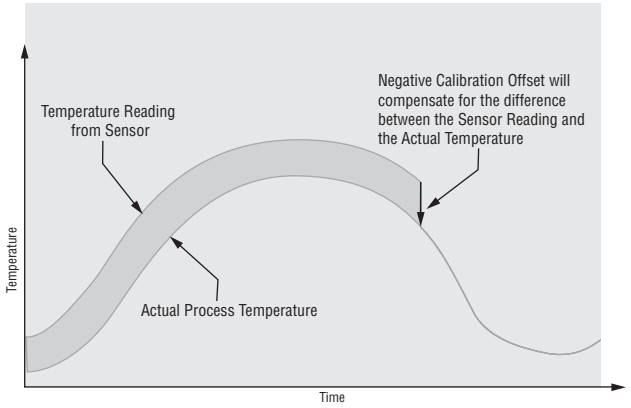
Turn the INFOSENSE™ feature on or off with INFO-SENSE™ Enable [IS.En] (Setup Page). Set the four numerical values supplied with Watlow's INFO-SENSE™ in the [IS.P1], [IS.P2], [IS.P3] and [IS.P4] parameters.

The four numerical values are found on the tag attached to the INFOSENSE™ sensor. Contact your Watlow salesperson or Watlow authorized distributor for the pricing and availability of Watlow INFOSENSE™ products.

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.

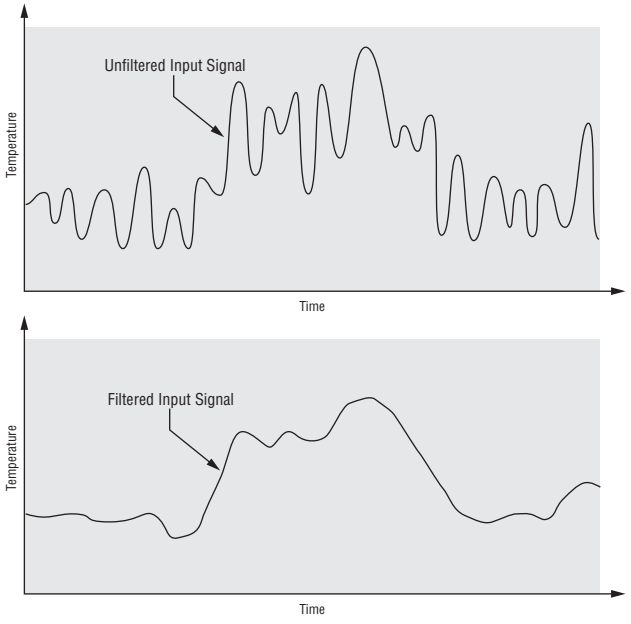
The input offset value can be viewed or changed with Calibration Offset [CAL] (Operations parameters).



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 controlled 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. Full access to profiles on profiling version.

[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. Full access to profiles on profiling version.

[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. Can run profiles, but cannot enter or edit profile information on profiling version.

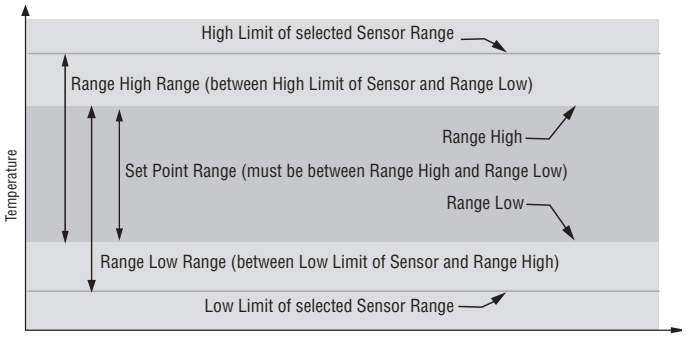
[3] The set point, process value and alarm settings are the only visible Operations Page parameters. Set point is adjustable. Auto-manual selection is **not** permitted. During manual operation, percent power is adjustable. No access to profile functions on profiling version.

[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. No access to profile functions on profiling version.

Set Point Low Limit and High Limit

The controller constrains the set point to a value between a SP low limit and a SP high limit. Note: To stop the Series SD controller from controlling to a set point, press the Down Key while the set point value is equal to the SP.Lo setting. [OFF] will be displayed in the lower display and the controller will no longer attempt to maintain a set point.

Set the set point range with Set Point Low Limit [SP.Lo] and Set Point High Limit [SP.hi] (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 example, 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. For example, 50 psi = 4 mA and 10 psi = 20 mA.

Select the low and high values with Process Scale Low [SC.LO] and Process Scale High [SC.HI] (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 low and high 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

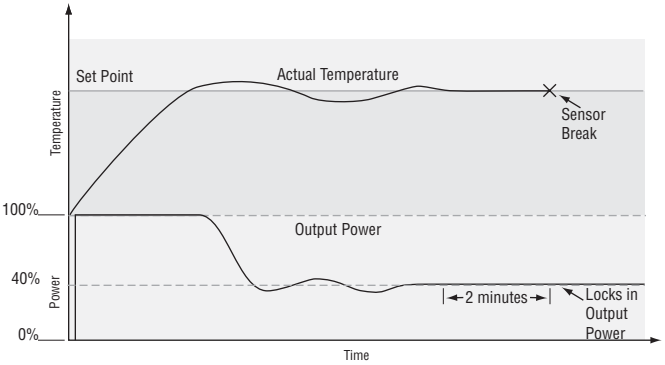
The controller has two basic modes of operation, auto mode and manual mode. Auto mode allows the controller to decide whether to perform closed loop control or to follow the settings of the Input Error Failure Mode parameter (Setup Page). The manual mode only allows open loop control. The Series SD controller 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 the output power off.

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 [LErr] (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 static set point controller is in the manual

mode and it is off while in the auto mode. For the profiling controller, the letter P appears in the left side of the lower display followed by the manual % power set point value. For example, P 75 indicates the profiling controller is in Manual Mode at 75% power output. You can easily switch between modes if the Auto-Manual Mode A-M parameter is selected to appear in the Operations Page.

To transfer to manual mode from auto mode, press the Advance Key until A-M appears in the lower display. The upper display will display Auto for auto mode. Use the Up or Down keys to select MAn . The manual set point value will be recalled from the last manual operation.

To transfer to auto mode from manual mode, press the Advance Key until A-M appears in the lower display. The upper display will display MAn for manual mode. Use the Up or Down keys to select Auto . The automatic set point value will be recalled from the last automatic operation.

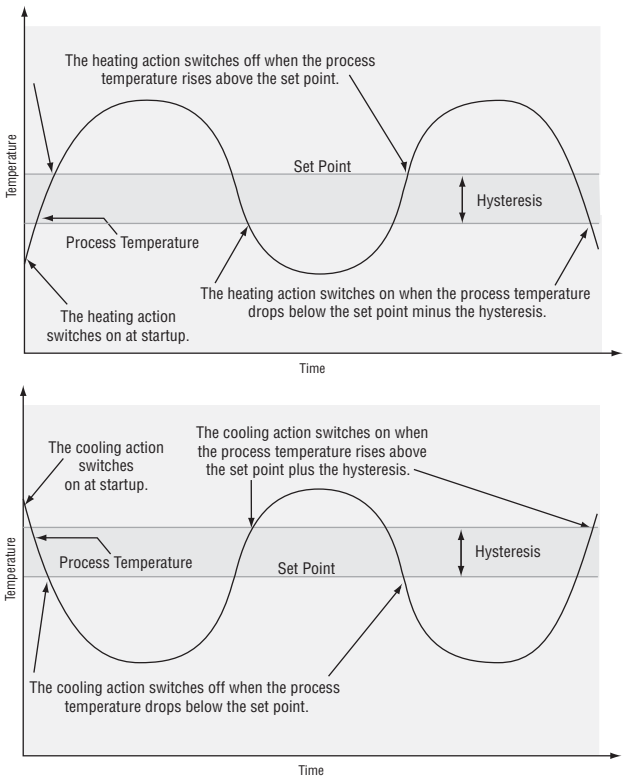
Changes take effect after three seconds or immediately upon pressing either the Advance Key or the Infinity Key .

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.M or Cool Control Method CL.M (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%.



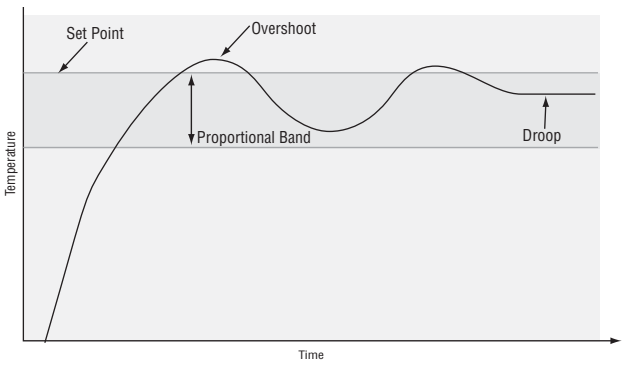
Proportional Control

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

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

Adjust the proportional band with Proportional Band Heat Pb.ht or Proportional Band Cool Pb.CL (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 is in effect if PID Units are set to SI, and is measured in minutes per repeat. A low integral value causes a fast integrating action.

Reset is in effect if PID Units are set to US, and is measured in repeats per minute. A high reset value causes a fast integrating action.

Adjust the integral with Integral Heat [1t.ht] or Integral Cool [1t.CL] (Operations parameters).

Adjust the reset with Reset Heat [rE.ht] or Reset Cool [rE.CL] (Operations parameters).

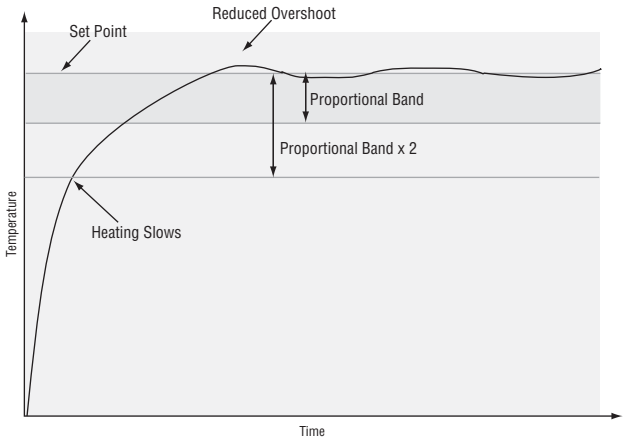
Proportional plus Integral plus Derivative (PID) Control

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 [dE.ht] or Derivative Cool [dE.CL] (Operations parameters).

Adjust the rate with Rate Heat [rA.ht] or Rate Cool [rA.CL] (Operations parameters).

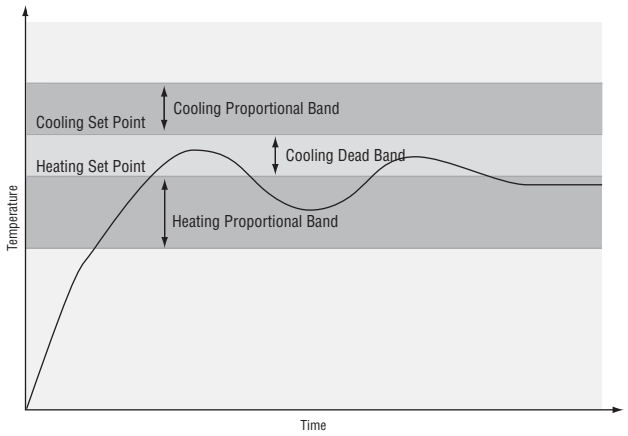


Dead Band

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.

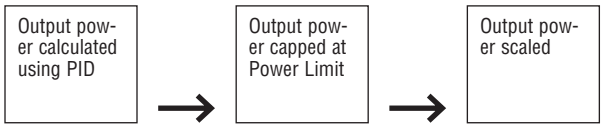
Proportional action ceases when the process value is within the dead band. Integral action continues to bring the process temperature to the set point. When the dead band value is zero, the heating element activates when the temperature drops below the set point, and the cooling element switches on when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

Adjust the dead bands with Dead Band Heat [db.ht] and Dead Band Cool [db.CL] (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 ([PSh 1], [PSh2] and [PSh3]) to 100%. Set Output Power Scale Low 1, 2 and 3 ([PSL 1], [PSL2] and [PSL3]) to 0%.

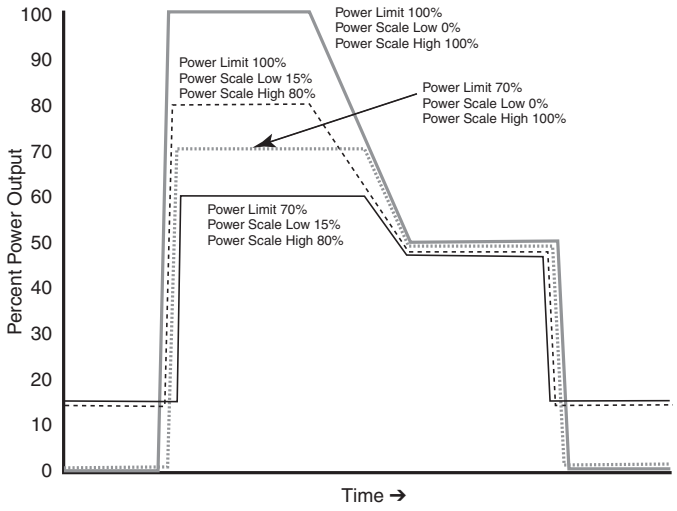
The power limit sets the maximum power for a heat or cool control output. Each control output has its own power limit. For heating outputs it determines the maximum level of heat power and for cool outputs it determines the maximum level of cooling power. A power limit of 100% in effect disables the 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.

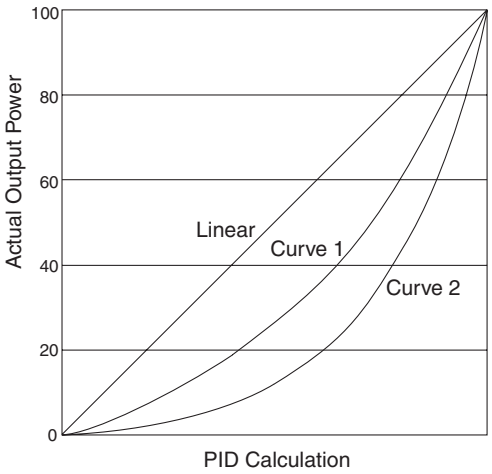


The Power Limit 1, 2 and 3 (PL 1, PL 2 and PL 3) and Output Power Scale Low 1, 2 and 3 (PSL 1, PSL2 and PSL3) and Output Power Scale High 1, 2 and 3 (PSh 1, PSh2 and PSh3) appear in the Setup Page. The calculated PID heat and cool power values can be viewed with Power Heat Po.ht and Power Cool Po.CL parameters in the Operations Page.

Non-linear Output Curve

A non-linear output curve may improve performance when the response of the output device is non-linear. If Output Non-linear Function is set to curve 1 Cru 1 or curve 2 Cru2, a PID calculation yields a lower actual output level than the linear output provides. These output curves are used in plastics extruder applications. Curve 1 is for oil cooled extruders and curve 2 is for water cooled extruders.

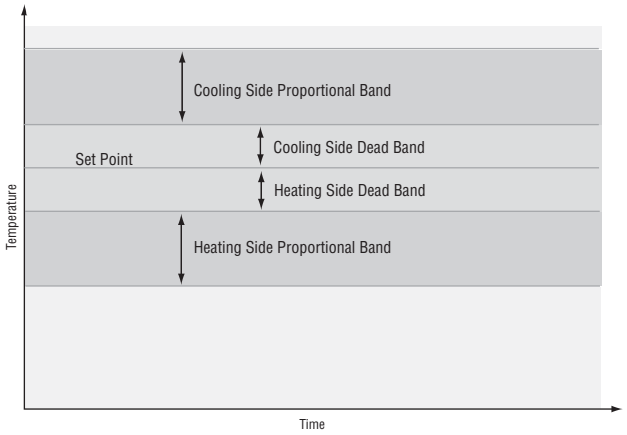
Change the linearity for each output with Output Non-linear Function 1, 2 or 3 (nLF 1, nLF2 or nLF3) in the Setup Page.



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.

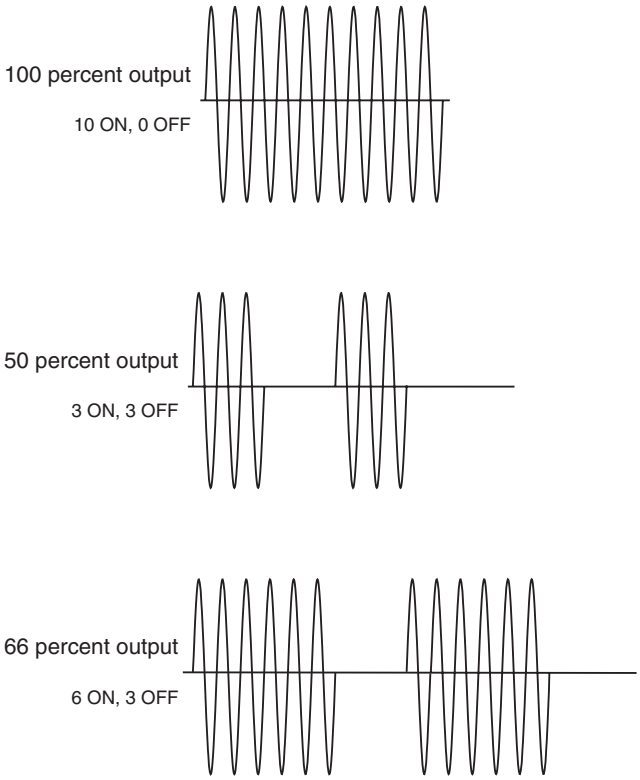
With variable time base outputs, the PID algorithm calculates an output between 0 and 100%, but the output is distributed in groupings of three ac line cycles. For each group of three ac line cycles, the controller decides whether the power should be on or off. There is no fixed cycle time since the 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, switch-

ing 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 silicon controlled rectifier (SCR) power controller. Do not use a variable time base output for controlling electromechanical relays, mercury displacement relays, inductive loads or 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.

You must select the AC Line Frequency, 50 or 60 Hz.



Single Set Point Ramping

(static set point version only SD_C- _ _ _ _- _ _ _ _)

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.

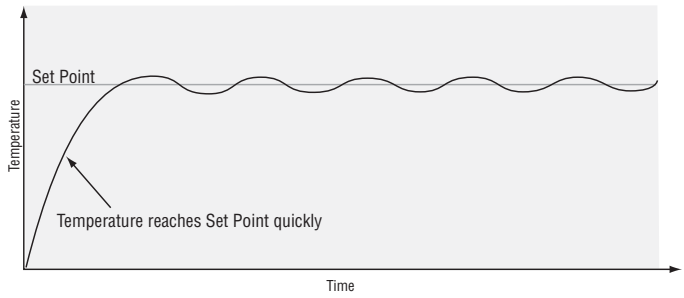
Select Ramping Mode [rP] (Setup Page):

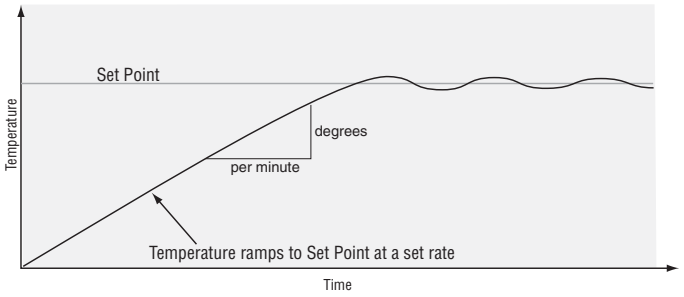
[OFF] ramping not active.

[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.

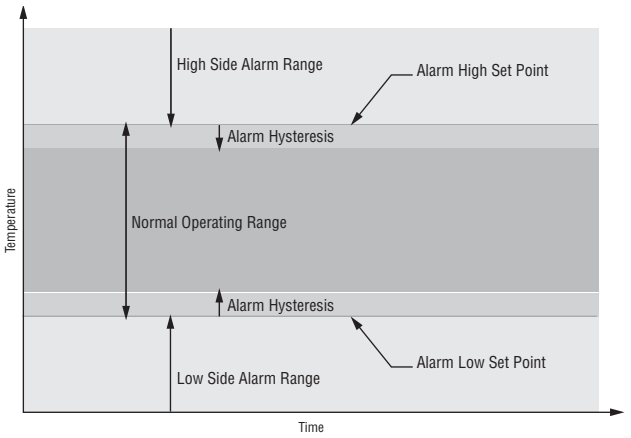
View or change alarm set points with the Operations parameters.

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.

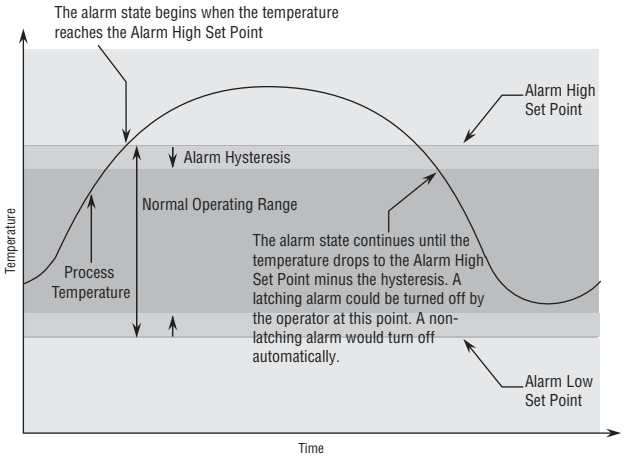
View or change alarm hysteresis Alarm 1, 2, or 3 Hysteresis, [hYS1], [hYS2] or [hYS3] (Setup Page).



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).



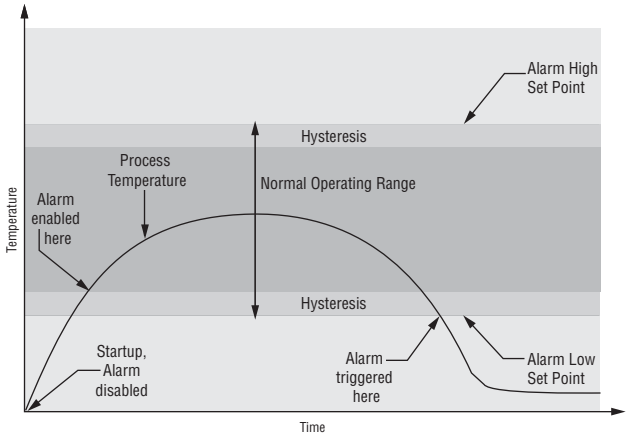
Alarm Silencing

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).



Retransmit

The retransmit feature allows a process output to provide an analog signal that represents the set point or actual process value. The signal may serve as a remote set point for another controller or as an input for a chart recorder to document system performance over time. Any process output can be configured as a retransmit output.

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 the Install and Wire chapter. 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.

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.

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.

Two consecutive registers are addressed for 32-bit data types. The first word, or lower register number, contains the two higher bytes. The second word, or higher register number, contains the two lower bytes of the four byte integer value.

Note: All temperature related values accessed via Modbus are in degrees F.

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. See "Selecting an EIA/TIA-232 to EIA/TIA-485 converter" in the Install and Wire chapter.

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 Device 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 Comm7 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 Comm7 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 activity 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 Comm7 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.

Writing to Non-Volatile Memory

The Series SD stores parameter values in non-volatile EEPROM memory. This type of memory has a finite life of approximately 100,000 write cycles. In some applications, you might need to constantly write new values to a particular register. Examples might be the writing of ramping set points or repetitive loops through serial communications. Continuous writes may result in premature controller failure and system downtime.

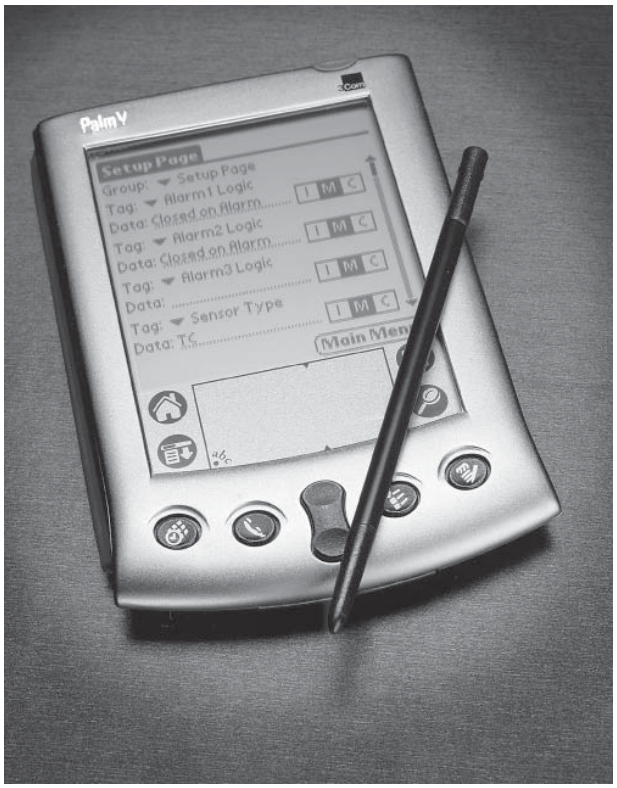
To prevent premature failure of the EEPROM when frequently writing register values, write a 0 to register 17. Any values written after that, will not be stored to EEPROM. However, this data is lost when power is removed. Register 17 defaults to a value of 1 after each power cycle, writing values to EEPROM again. You must write a 0 to register 17 upon power up to prevent data from being written to EEPROM.

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	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 dSP (Setup) is not set to oPr.	Verify that dSP 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.

Troubleshooting

Indication	Probable Cause	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).
Profile will not start or resume. Lower display flashes between static set point value and File Number / Step Number. For example, if File 1, Step 1 is not valid, the display will flash 1.1.	Profile step has target set point or Wait-for Process values that are outside of SP.Lo or SP.h1 values. Jump Loop step is trying to jump to itself.	Keep target set point or Wait-for Process values inside set point limits or adjust set point limits. Correct Jump Loop step (cannot jump to itself).
Profile takes more time to complete than what is programmed. dEv flashes in the lower display.	Guaranteed Soak Deviation is enabled. The program will stop the count down time until the process value returns to within the deviation window. The dEv value may be too small.	If Guaranteed Soak Deviation function isn't required, set dEv.E to no to disable it. If Guaranteed Soak Deviation function is required, increase dEv value to reduce the amount of time the process is outside of the deviation window.

Troubleshooting

Error Messages

Indication	Probable Cause	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.
Er.Ab Ambient Temperature Error	Ambient temperature may be too hot or too cold. Calibration may be corrupted.	Verify that the temperature surrounding the controller is -18 to 65°C (0 to 149°F). Restore factory calibration.
Er.CS 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

(2396)

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
- Static set point model has ramp to set point capability
- Profiling (ramp and soak) model has four profiles, 10 steps per profile. Profiles can be linked together.

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 60 Hz, 0 to 90% RH non-condensing, 15-minute warm-up

Universal Input

- Sampling rate: 6.5 Hz.

Input Accuracy Span 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 E:	-328	to	1,470°F	or	-200	to	799°C
Type N:	32	to	2,282°F	or	0	to	1,250°C
Type C (W5):	32	to	4,200°F	or	0	to	2,316°C
Type D (W3):	32	to	4,200°F	or	0	to	2,316°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 units				

Thermocouple

- Type J, K, T, E, N, C (W5), D (W3), PTII (F), R, S, B thermocouple types. Whole or tenth of a degree resolution.
- >20 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 50 mV⎓ (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

Thermocouple Input

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

Allowable Operating Ranges

Type J:	32	to	1,500°F	or	0	to	816°C
Type K:	-328	to	2,500°F	or	-200	to	1,371°C
Type T:	-328	to	750°F	or	-200	to	399°C
Type E:	-328	to	1,470°F	or	-200	to	799°C
Type N:	32	to	2,372°F	or	0	to	1,300°C
Type C (W5):	32	to	4,200°F	or	0	to	2,316°C
Type D (W3):	32	to	4,200°F	or	0	to	2,316°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
RTD (DIN)	-328	to	1,472°F	or	-200	to	800°C
Process	-1,999	to	9,999 units				

Output Types

- Output update rate: 6.5 Hz.

Switched DC

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

Open Collector

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

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), resistive
- 20 VA pilot duty, 120/240V~ (ac), inductive
- Must use RC suppression for inductive loads
- Maximum offstate leakage current: 100 µA rms

Electromechanical Relay, Form A

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

Electromechanical Relay, Form C

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

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)
- Sampling rate: 20 Hz

IrDA

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

Agency Approvals

- UL Listed Process Control UL3121® (UL 61010C-1), c-UL, IP65 (NEMA 4X). File # E185611.

  UL® is a registered trademark of the Underwriter's Laboratories, Inc.
- CE approved. See Declaration of Conformity.
- CSA approved C22.2#24, File 158031
- NSF 2 approved for type E, J, K, T and RTD sensors, File 49660-0002-000.

Terminals

- Touch-safe
- Input power and control outputs: 0.2 to 4 mm2 (22 to 12 AWG), 6 mm (0.25 in) strip length
- Sensor inputs and process outputs: 0.1 to 0.5 mm2 (28 to 20 AWG), 8 mm (0.30 in) strip length
- Solid or tinned wire recommended for spring clamp style connectors.
- Torque: terminal blocks 1 to 6 (SD _ _ - _ [C, K or J] _ _ - _ _ _ _) and 1 to 4 (SD _ _ - _ F _ _ - _ _ _ _) are 0.8 Nm (7 in-lb); terminal blocks 12, 13, and 14 are 0.9 Nm (8 in-lb).

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 (max.)	Width	Height	Display Height (in.)
1/32	97.8 mm (3.85 in)	52.6 mm (2.07 in)	29.7 mm (1.17 in)	L — 7.6 mm (0.30) R — 5.6 mm (0.22)
1/16	97.8 mm (2.05 in)	52.1 mm (3.85 in)	52.1 mm (2.05 in)	U — 10.2 mm (0.40) L — 6.1 mm (0.24)
1/8 Vertical	97.8 mm (3.85 in)	52.8 mm (2.08 in)	99.8 mm (3.93 in)	U — 10.2 mm (0.40) L — 6.1 mm (0.24)
1/8 Horizontal	97.8 mm (3.85 in)	99.8 mm (3.93 in)	52.8 mm (2.08 in)	U — 10.2 mm (0.40) L — 6.1 mm (0.24)
1 /4	101.1 mm (3.98 in)	99.8 mm (3.93 in)	99.8 mm (3.93 in)	U — 14.2 mm (0.56) L — 10.2 mm (0.40)

Weight (approximate)

- SD3 - 75 g (0.16 lbs)
- SD6 - 100 g (0.22 lbs)
- SD8 - 145 g (0.32 lbs)
- SD4 - 200 g (0.43 lbs)

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

S D ___ ___ - ___ ___ ___ ___ - ___ 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, R* or F**
C	PID Control
R	Profiling PID Control
E	PID Control with TRU-TUNE+™
Power Supply	H or L
H	100 to 240V~ (ac)
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 available on 1/32 DIN)	**A, C, K, F or E**
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 comms options	**A or R**
A	None
R	Infrared Communications Ready (not available on 1/32 DIN or with TRU_TUNE+™)
Display Colors and Custom options	**RG or RR**
RG	Red Green
RR	Red Red (Not available on 1/32 DIN)

***FM-approved limit version is available. For more information, go to www.watlow.com or contact your Watlow representative.**

Note: User documentation may be available in other languages. Check www.watlow.com for availability.

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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)(Any letter or number) – (H or L)(C, F, J or K) (A, C, J, K or U) (A, C, E, F or K) – (A, D, or R) (any three letters or numbers)
Classification:	Temperature control, Installation Category II, Pollution degree 2
Rated Voltage:	100 to 240V~ (ac 50/60 Hz) or 24V to 28 ≂ (ac 50/60 Hz or dc)
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:	2000:	ED.2.	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**

Raymond D. Feller III
Name of Authorized Representative

Winona, Minnesota, USA
Place of Issue

General Manager
Title of Authorized Representative

August 2003
Date of Issue

Signature of Authorized Representative

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3 Year Warranty

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