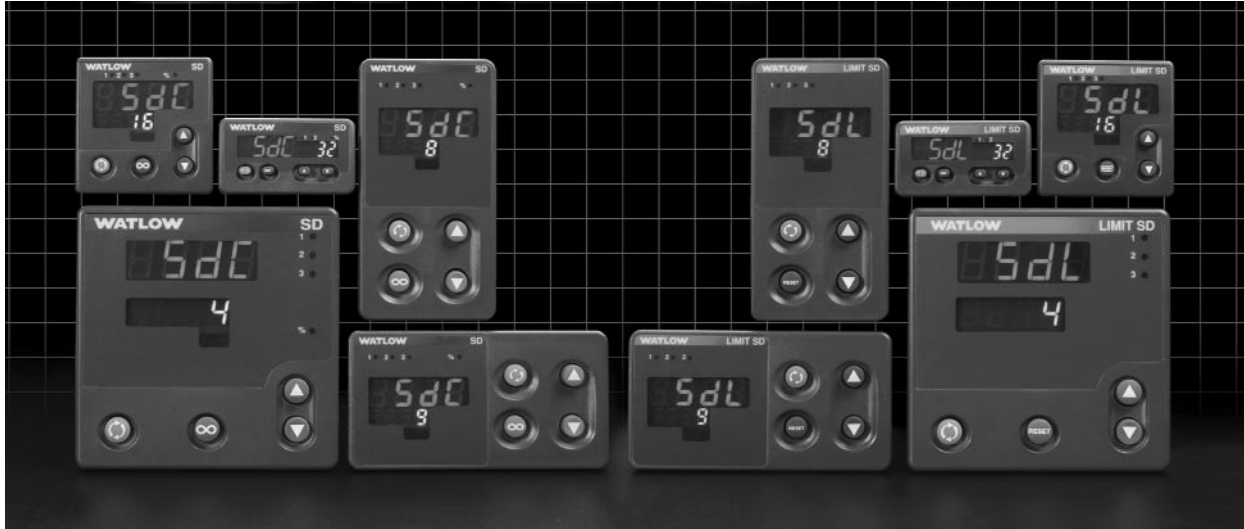




# Series SD Family

## Calibration Manual



## PID, PID Profiling, DeviceNet, and Limit Controllers



**TOTAL  
CUSTOMER  
SATISFACTION**  
3 Year Warranty



**ISO 9001**  
  
Registered Company  
Winona, Minnesota USA

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Phone: +1 (507) 454-5300, Fax: +1 (507) 452-4507 <http://www.watlow.com>

0600-0041-0030 Rev. A

Made in the U.S.A.



August 2003

\$5.00


## Safety Information

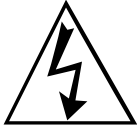
We use note, caution and warning symbols throughout this book to draw your attention to important operational and safety information.

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

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

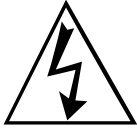
A “WARNING” safety alert appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.

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

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



CAUTION or  
WARNING



Electrical  
Shock Hazard

CAUTION or WARNING

## 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](mailto:wintechsupport@watlow.com) or by dialing +1 (507) 494-5656 between 7 a.m. and 5 p.m., Central Standard Time (CST). Ask 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
- Contact name
- Method of return shipment
- Detailed description of the problem
- Name and phone number of person returning the product.
- Bill to address
- Phone number
- Your P.O. number
- Any special instructions

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 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.

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# Factory Page and Calibration

This Calibration Manual applies to all Series SD controllers, including the PID, PID Profiling, DeviceNet and Limit controller versions. For the user's manual, go to [www.watlow.com](http://www.watlow.com) and search on *Series SD User's Manual*.

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:
<b>RP7b</b> [AMb]	<b>Ambient Temperature</b> Displays the current calculated ambient temperature.		-50.0 to 300.0°F	NA	277 R 278 R	Always active.
<b>RP7n</b> [A.Mn]	<b>Minimum Recorded Ambient Temperature</b> Displays the minimum recorded ambient temperature.		-50.0 to 300.0°F	NA	NA	Always active.
<b>RP7R</b> [A.MA]	<b>Maximum Recorded Ambient Temperature</b> Displays the maximum recorded ambient temperature.		-50.0 to 300.0°F	NA	NA	Always active.
<b>dSPL</b> [dSPL]	<b>Display Intensity</b> Increase or decrease the brightness of the upper and lower display.		15 to 100% duty	100	NA	Always active.
<b>ROt1</b> [A.Ot1]	<b>Output 1 Process Value</b> Monitors Process Output 1 value via Modbus.		00.00 to 22.00 units (0000 to 2200)		283 R	Process output installed for Output 1
<b>ROt3</b> [A.Ot3]	<b>Output 3 Process Value</b> Monitors Process Output 3 value via Modbus.		00.00 to 22.00 units (0000 to 2200)		285 R	Process output installed for Output 3
<b>rESE</b> [rEst]	<b>Restore Factory Calibration</b> Replaces the user calibration parameters with the factory calibration parameters.	<input type="checkbox"/> <b>na</b> (0) <input type="checkbox"/> <b>YES</b> (1)	<input type="checkbox"/> <b>na</b> (0)	208 R/W	Always active.	
<b>USrr</b> [Usr.r]	<b>Restore User Settings</b> Restores the customer's configured settings.	<input type="checkbox"/> <b>na</b> (0) <input type="checkbox"/> <b>YES</b> (1)	<input type="checkbox"/> <b>na</b> (0)	209 R/W	Always active.	
<b>USrS</b> [USr.S]	<b>Save User Settings</b> Saves the current customer-configured settings.	<input type="checkbox"/> <b>na</b> (0) <input type="checkbox"/> <b>YES</b> (1)	<input type="checkbox"/> <b>na</b> (0)	210 R/W	Always active.	
<b>dFLt</b> [dFLt]	<b>Default Parameters</b> Reset all parameters to their default values.	<input type="checkbox"/> <b>na</b> (0) <input type="checkbox"/> <b>YES</b> (1)	<input type="checkbox"/> <b>na</b> (0)	207 R/W	Always active.	
<b>OEY1</b> [O.ty1]	<b>Output 1 Type</b> Displays the hardware type for Output 1.	<input type="checkbox"/> <b>none</b> (0) <input type="checkbox"/> <b>dc</b> DC/open collect. (1) <input type="checkbox"/> <b>RLAY</b> mech. relay (2) <input type="checkbox"/> <b>SSr</b> solid-state relay (3) <input type="checkbox"/> <b>Proc</b> process (4)	<input type="checkbox"/> <b>none</b> (0)	202 R	Always active.	

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
<b>0E92</b> [O.ty2]	<b>Output 2 Type</b> Displays the hardware type for Output 2.		<b>none</b> none (0) <b>dc</b> DC/open collect. (1) <b>RLRY</b> mech. relay (2) <b>SSr</b> solid-state relay (3) <b>CP7</b> communications (5)	<b>none</b> (0)	203 R	Always active.
<b>0E93</b> [O.ty3]	<b>Output 3 Type</b> Displays the hardware type for Output 3.		<b>none</b> none (0) <b>dc</b> DC/open collect. (1) <b>RLRY</b> mech. relay (2) <b>SSr</b> solid-state relay (3) <b>Proc</b> process (4)	<b>none</b> (0)	204 R	Always active.
<b>5id</b> [S.id]	<b>Software ID</b> Displays the software ID number.		0 to 9999	NA	10 R	Always active.
<b>5VER</b> [S.VER]	<b>Software Version</b> Displays the firmware revision.		0.00 to 99.99	NA	11 R	Always active.
<b>5bLd</b> [S.bLd]	<b>Software Build Number</b> Displays the software build number.		0 to 9999 Build Number	NA	13 R	Always active.
<b>PLJr</b> [PWR]	<b>Power Type</b> Displays the type of input power.		<b>RC</b> high voltage <b>LOLJ</b> low voltage	NA	*NA	Always active.
<b>5n-</b> [Sn-]	<b>Serial Number 1</b> Displays the first four characters of the serial number.		0 to 9999	NA	7, 8 R	Always active.
<b>5n_</b> [Sn_]	<b>Serial Number 2</b> Displays the last four characters of the serial number.		0 to 9999	NA	7, 8 R	Always active.
<b>Ec50</b> [tc.50]	<b>Thermocouple, 50mV</b> Calibrate the thermocouple input to 50mV (see "Calibrating the Series SD").		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>Ec00</b> [tc.00]	<b>Thermocouple, 0mV</b> Calibrate the thermocouple input to 0mV (see "Calibrating the Series SD").		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>Ec32</b> [tc.32]	<b>Thermocouple, 32°F</b> Calibrate the thermocouple input to 0°C (32°F) (see "Calibrating the Series SD").		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>r.15</b> [r.15]	<b>RTD, 15 ohm</b> Calibrate the RTD input to 15 ohm (see "Calibrating the Series SD").		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>r.380</b> [r.380]	<b>RTD, 380 ohm</b> Calibrate the RTD input to 380 ohms. (see "Calibrating the Series SD").		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>v.1</b> [v.1]	<b>Input Calibrate, 1.0 Volt</b> Calibrate the process voltage input to 1.0 Volt (see "Calibrating the Series SD").		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.

Display	Parameter Name Description	Settings	Range (Integer values for Modbus in parentheses.)	Default	Modbus* (less 40,001 offset) Read/Write	Appears if:
<b>U9</b> [ v.9]	<b>Input Calibrate, 9.0 Volt</b> Calibrate the process voltage input to 9.0 Volt (see “Calibrating the Series SD”).		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>R4</b> [ A.4]	<b>Input Calibrate, 4.0 mA</b> Calibrate the process current input to 4.0 mA (see “Calibrating the Series SD”).		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>R16</b> [ A.16]	<b>Input Calibrate, 16.0 mA</b> Calibrate the process current input to 16.0 mA.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Always active.
<b>O1.1v</b> [O1.1v]	<b>Output 1 Calibrate, 1.0 Volt</b> The voltage process output transmits 1.000V.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 1.
<b>O1.9v</b> [O1.9v]	<b>Output 1 Calibrate, 9.0 Volt</b> The voltage process output transmits 9.000V.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 1.
<b>O1.4A</b> [O1.4A]	<b>Output 1 Calibrate, 4.0 mA</b> The current process output transmits 4.000 mA.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 1.
<b>O1.16</b> [O1.16]	<b>Output 1 Calibrate, 16.0 mA</b> The current process output transmits 16.000 mA.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 1.
<b>O3.1v</b> [O3.1v]	<b>Output 3 Calibrate, 1.0 Volt</b> The voltage process output transmits 1.000V.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 3.
<b>O3.9v</b> [O3.9v]	<b>Output 3 Calibrate, 9.0 Volt</b> The voltage process output transmits 9.000V.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 3.
<b>O3.4A</b> [O3.4A]	<b>Output 3 Calibrate, 4.0 mA</b> The current process output transmits 4.000 mA.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 3.
<b>O3.16</b> [O3.16]	<b>Output 3 Calibrate, 16.0 mA</b> The current process output transmits 16.000 mA.		<b>no</b> <b>YES</b>	<b>no</b>	*NA	Process output installed for Output 3.

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

# Calibrating the Series SD

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

You can restore the original factory calibration with Restore Factory Calibration **RESET** (Factory Page).




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

## Thermocouple Input Procedure

### Equipment

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

### Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).
2. Connect the millivolt source to terminals 11 (-) and 10 (+) with copper wire.
3. Enter 50.00 mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 50 mV **EC50** to **YES**. Press the Advance Key  to store 50.000 mV input and move to the next prompt.
4. Enter 0.000 mV from the millivolt source. Allow at least 10 seconds to stabilize. Set Thermocouple Calibration, 0 mV **EC00** to **YES**. Press the Advance Key  to store 0.000 mV input and move to the next prompt.
5. Disconnect the millivolt source and connect the reference compensator or thermocouple calibrator to terminals 11 (-) and 10 (+). With type J thermocouple wire, if using a compensator, turn it on and short the input wires. When using a type J calibrator, set it to simulate 0°C (32°F). Allow 10 seconds for the controller to stabilize. Set Thermocouple Calibration, 32° **EC32** to **YES**. Press the Advance Key  to store type J thermocouple calibration and move to the next prompt.
6. Rewire for operation and verify calibration.



## RTD Input Procedure

### Equipment

- 1 kΩ decade box with 0.01Ω resolution.

### Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter 2).
2. Connect the decade box to terminals 10 (S1), 11 (S3) and 8 (S2), with 20 to 24-gauge wire.



3. Enter 15.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 15Ω **RT15** to **YES**. Press the Advance Key  to store the 15.00Ω input and move to the next prompt.
4. Enter 380.00Ω from the decade box. Allow at least 10 seconds to stabilize. Set RTD Calibration, 380Ω **RT380** to **YES**. Press the Advance Key  to store the 380.00Ω input and move to the next prompt.
5. Rewire for operation and verify calibration.

## Voltage Process Input Procedure

### Equipment

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

### Input Setup and Calibration



1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).
- Input**
2. Connect the voltage source to terminals 11 (-) and 9 (+) of the controller.
3. Enter 1.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 1V **U1** to **YES**. Press the Advance Key  to store the 1.00V input and move to the next prompt.
4. Enter 9.00V from the voltage source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 9V **U9** to **YES**. Press the Advance Key  to store the 9.00V input and move to the next prompt.
5. Rewire for operation and verify calibration.

## Current Process Input Procedure

### Equipment

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

### Input Setup and Calibration

1. Connect the correct power supply to terminals 1 and 2 (see Chapter Two).
2. Connect the current source to terminals 11(-) and 8(+).
3. Enter 4.00 mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 4 mA **RA4** to **YES**. Press the Advance Key  to store the 4 mA input and move to the next prompt.
4. Enter 16.00 mA from the current source to the controller. Allow at least 10 seconds to stabilize. Set Input Calibrate, 16 mA **RA16** to **YES**. Press the Advance Key  to store the 16 mA input and move to the next prompt.
5. Rewire for operation and verify calibration.

## Process Output Procedures

### Equipment

- Precision volt/ammeter with 3.5-digit resolution.

### Output 1 Setup and Calibration

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

#### Volts

2. Connect the volt/ammeter to terminals 7 (-) and 6 (+).
3. At Output 1 Calibrate, 1V **01.10** select **YES** and press the Advance Key **➡**. The voltage output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 1.00V,  $\pm 0.1V$ . Press the Advance Key **➡** to store the value and move to the next prompt.
4. At Output 1 Calibrate, 9V **01.90** select **YES** and press the Advance Key **➡**. The voltage output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 9.00V,  $\pm 0.1V$ . Press the Advance Key **➡** to store the value and move to the next prompt.
5. Rewire for operation and verify calibration.

#### Milliamperes

6. Connect the volt/ammeter to terminals 7 (-) and 5 (+).
7. At Output 1 Calibrate, 4 mA **01.48** select **YES** and press the Advance Key **➡**. The current output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 4.00 mA,  $\pm 0.1mA$ . Press the Advance Key **➡** to store the value and move to the next prompt.
8. At Output 1 Calibrate, 16 mA **01.16** select **YES** and press the Advance Key **➡**. The current output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 16.00 mA,  $\pm 0.1 mA$ . Press the Advance Key **➡** to store the value and move to the next prompt.
9. Rewire for operation and verify calibration.

### Output 3 Setup and Calibration

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

#### Volts

2. Connect the volt/ammeter to terminals 14 (-) and 13 (+).

3. At Output 3 Calibrate, 1V **03.10** select **YES** and press the Advance Key **➡**. The voltage output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 1.00V,  $\pm 0.1V$ . Press the Advance Key **➡** to store the value and move to the next prompt.
4. At Output 3 Calibrate, 9V **03.90** select **YES** and press the Advance Key **➡**. The voltage output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 9.00V,  $\pm 0.1V$ . Press the Advance Key **➡** to store the value and move to the next prompt.
5. Rewire for operation and verify calibration.

#### Milliamperes

6. Connect the volt/ammeter to terminals 14 (-) and 12 (+).
7. At Output 3 Calibrate, 4 mA **03.48** select **YES** and press the Advance Key **➡**. The current output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 4.00 mA,  $\pm 0.1mA$ . Press the Advance Key **➡** to store the value and move to the next prompt.
8. At Output 3 Calibrate, 16 mA **03.16** select **YES** and press the Advance Key **➡**. The current output value appears in the upper display. Press the Up **▲** or Down Key **▼** to adjust the upper display value to match the value from the volt/ammeter. The unit should stabilize within one second. Repeat until the volt/ammeter reads 16.00 mA,  $\pm 0.1 mA$ . Press the Advance Key **➡** to store the value and move to the next prompt.
9. Rewire for operation and verify calibration.

### Restoring Factory Calibration

- Press the Up **▲** and Down **▼** keys together for six seconds until **FACE** appears in the upper display and **PAGE** appears in the lower display.
- Press the Advance Key **➡** to step through the parameters until the **RESET** appears.
- Use the Up Key **▲** to select **YES** in the upper display.
- Press the Infinity Key **⊕** to exit the Factory Page.

# How to Reach Us

**TOTAL  
CUSTOMER  
SATISFACTION**

3 Year Warranty

Your Authorized Watlow Distributor:

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