Series 935B

Temperature Controller with Countdown Timer

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• Expert User ................................. Go to page 51

Installers:
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• Wiring Information ........................Go to page 44
Safety Information in this Manual

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

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

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

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

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

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

Technical Assistance

If you encounter a problem with your Watlow controller, review all configuration information to verify that your selections are consistent with your application: inputs; outputs; alarms; limits; etc. If the problem persists after checking the above, you can get technical assistance by calling your local Watlow representative (see back cover of this manual), or in the U.S., dial +1 (507) 494-5656. For technical support, ask for an Applications Engineer.

Please have the following information available when you call:

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

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

Your Comments

Your comments or suggestions on this manual are welcome. Please send them to the Technical Literature Team, Watlow, 1241 Bundy Boulevard, P.O. Box 5580, Winona, Minnesota, 55987-5580 U.S.; Telephone: +1 (507) 454-5300; fax: +1 (507) 452-4507.

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Where to find it...

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Welcome to the Watlow Series 935B!

General Description
The Series 935B is a temperature controller with countdown timer for industrial, commercial, or scientific applications. It offers 1/32 DIN panel-mounting, digital indication, single temperature sensor input from a thermocouple or RTD, and dual control outputs. Both outputs are fully DIN-a-mite® compatible, and may operate in combinations of heat or cool, and alarm or timer.

Special Features
• Easy to use operator interface and user’s manual
• Compact panel footprint; 1/32 DIN size
• Water and corrosion proof; NEMA 4X / IP65 rated
• Reliable; built to UL, CUL approved safety standards with a three year warranty
• Accuracy with economy
• Universal power supply for worldwide application

Unique Features
The Series 935B is configured with dual dc DIN-a-mite® compatible control outputs and a separate logic input for remote timer start or front panel lock. The Series 935B timer functions include heat/timer or cool/timer countdown modes in hours:minutes or minutes:seconds.
**Single Input**
Type J, K, T, N, S, E Thermocouple, 1° RTD, or 0.1° RTD

### Output 1
Switched dc

- Heat
- Cool
- Alarm
- None

### Output 2
Electromechanical Relay, Switched dc or Solid-state Relay

- Heat
- Cool
- Alarm
- Timer (Hr:Min or Min:Sec)
- None

- The function of Output 1 determines the options available for Output 2.
- First select the function of Output 1. Refer to the table (right), then select the function of Output 2.

**Table 1 - Valid Output Functions**

<table>
<thead>
<tr>
<th>First select Output 1:</th>
<th>Then select Output 2:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td>None, Cool, Alarm, Timer</td>
</tr>
<tr>
<td>Cool</td>
<td>None, Heat, Alarm, Timer</td>
</tr>
<tr>
<td>Alarm</td>
<td>None, Heat, Cool</td>
</tr>
<tr>
<td>None</td>
<td>Heat, Cool, Alarm</td>
</tr>
</tbody>
</table>
Press & read or press & change

Reading or Changing
Information is Easy

You can simply:
• Read the normally displayed actual temperature, or…
• Press and hold $\text{SET}$ to read the set point, or…

1. Press and hold $\text{SET}$ and $\text{ARROW}$ simultaneously for three seconds to move to a software menu.
2. Press and hold $\text{SET}$ to display a choice or value.
3. While continuing to press $\text{SET}$, press $\text{ARROW}$ or $\text{ARROW}$ to choose new data or select a new value.
4. Release $\text{SET}$ and the arrow key to complete the change.

NOTE: The normally displayed actual temperature and set point can be altered to show different combinations of actual temperature, set point temperature, or time in hours:minutes or minutes:seconds. See $\text{J ISP}$ p. 18.
Seven-segment alphanumeric display:
• Shows process value, set point information, time, or
• Shows prompt name or value, depending on the key combination pressed.

Set Key: SET
• Configurable to shift between normally-displayed value and set values. See DISP, p.18.
• Clears a latched alarm.

LED 1:
Lit when Output 1 is active.

LED 2:
Lit when Output 2 is active.

RDY:
Lit when the process temperature is inside the timer ready band.

Up / (Increment)
Down / (Decrement) Arrow Key:
• Selects new information when Set Key is pressed.
• Steps through software menus and parameters.
• Starts and stops the timer.

• To set up the control, go to the Easy Software Map, p. 11.
To Begin Controlling:

1. Apply power to the system.
   A properly-wired Series 935B will begin controlling the thermal system as soon as you apply power to it.
2. Look at the Series 935B’s display. It is reading actual temperature, set point temperature, or time.

   • To change set point, go to p. 9.
   • The Series 935B will auto-tune when you tell it to, go to p. 34.
   • If you see an error, go to p. 10.
To Change the Set Point:

Your Series 935B displays the actual process temperature when it comes from the factory. You can change it to normally display the set point or time. Go to p. 18, see [dISP].

1. Press and hold SET.
2. Press one of the arrow keys to alter the set point either upward or downward.
3. Release SET to complete the change.

Figure 4 - Changing the Set Point
If You See An Error Code:

1. Be aware that most errors are input (sensor) related.
2. Read the table below and follow its recommendations.

**Table 2 - Error messages and recommended action**

<table>
<thead>
<tr>
<th>Display</th>
<th>Probable Cause</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Er1</td>
<td>Reversed thermo-couple connection + to – 1 and 2.</td>
<td>Change the sensor leads on Terminals 1 and 2.</td>
</tr>
<tr>
<td>Er2</td>
<td>Sensor type mismatch or open RTD.</td>
<td>Go to <code>In</code> prompt, check selection (see p. 22), or check RTD, replace as necessary.</td>
</tr>
<tr>
<td>Er3</td>
<td>Sensor type mismatch.</td>
<td>Go to <code>In</code> prompt, check selection (see p. 22).</td>
</tr>
<tr>
<td>Er4</td>
<td>Open Thermocouple, bad connection, or broken wire.</td>
<td>Check the sensor, replace as necessary.</td>
</tr>
<tr>
<td>Er5</td>
<td>Electrical noise.</td>
<td>Cycle power to system. See if error clears. Check system for electrical interference.</td>
</tr>
<tr>
<td></td>
<td>Control is inoperable.</td>
<td>Check for line voltage at terminals 7 and 8.</td>
</tr>
</tbody>
</table>

• Simply correct the cause.
• Errors are non-latching and self-clearing.
• For advanced error and troubleshooting information, go to p. 39.
Software Organization

- The Series 935B has three primary menus in addition to a normal display.
- The software reverts to the normal display after 60 ± 5 sec. with no key action.

Table 3 - Software Organization

<table>
<thead>
<tr>
<th>Display</th>
<th>Operations, p. 12</th>
<th>PID, p. 14</th>
<th>Configuration, p. 18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Temperature, Set Point, or Time Remaining</td>
<td>Start / Stop: Autotune Set</td>
<td>Set: Heat PID Functions Dead Band Cool PID Functions Calibration Offset</td>
<td>Set: Inputs / Functions Output Types Display Default Alarms / Functions Timer Functions Failure Mode Lockout Functions</td>
</tr>
</tbody>
</table>

To access the Operations Menu, press the and keys simultaneously for three seconds.

At the [pid] or [Cnfg] prompt, press and hold the ß key, and the or key to select [yes]. Release the keys to move to the new menu.

Navigation Example

- Move through each menu with the or key.
- Make changes by pressing and holding the ß key, and then the or key to select a new choice or value. Release the keys to complete the change.

To exit any menu: Press and hold the and keys for three seconds, or the display will revert to normal display after 60± 5 seconds.
Learn the Operations Menu

The Series 935B Operations Menu is the first menu you encounter when you press the \( \text{Esc} \) and \( \text{Esc} \) keys simultaneously for three seconds. The Operations Menu provides a location to initiate the following actions or complete the following tasks:

- **Auto-tune \( \text{Aut} \):** Start or stop the auto-tuning process. Auto-tuning selects a set of viable proportional, integral, and derivative values for heat and/or cool output.

- **Alarm Points, \( \text{ALO} \) and \( \text{AhI} \):** Select the values for the high alarm point and the low alarm point. Alarm points, dependent on sensor type high and low ranges, reside in the Operations Menu for easy access.

- **Timer Countdown Time \( \text{LmR} \):** Select a countdown time value between 00:00 and 99:59 hours:minutes or minutes:seconds. Time interval choices \( \text{LhR} \) and \( \text{LmS} \) reside in the Configuration Menu for Output 2.

- **Idle Set Point \( \text{Idl} \):** Choose \( \text{L} \) or an adjustable value between \( \text{rL} \) and \( \text{rh} \). Choose to have the Idle Set Point track \( \text{Ac} \) or equal, the Primary Set Point; or select an Idle Set Point value in °F or °C between the range low \( \text{rL} \) and range high \( \text{rh} \) values. The Idle Set Point is active both before and after the timing sequence. The normal or Primary Set Point controls during the timing sequence.

- **Go to the PID Menu \( \text{Pid} \):** Choose \( \text{YES} \) to proceed to the PID Menu.

- **Go to the Configuration Menu \( \text{CnFg} \):** Choose \( \text{YES} \) to proceed to the Configuration Menu.

The table on the next page presents this information in graphic form.

**NOTE:** Not every prompt listed here or on p. 13 in the Operations Menu will appear in your unit. Prompts vary with lockout function and output set-up. Whether or not prompts appear in the Operations Menu depends on two features of the Series 935B:

- **Lockout function;** the Lockout Tag \( \text{tAg} \) function masks prompts from view in the various menus. (If you cannot see a prompt, you can make no change.) See Using Lockout Functions, p. 20, for more information.

- **Output 1 and 2 Configuration;** some outputs are mutually exclusive. For example, if Output 1 is Alarm, then Output 2 cannot be Timer. Therefore, the Operations menu will have no timer-related prompts. See the Valid Output Functions Table, p. 5, or Setting Up Inputs and Outputs, p. 22.
### Table 4 - Operations Menu Overview

To enter the **Operations Menu**, press the and keys simultaneously for three seconds.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Description</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Auto-tune</strong></td>
<td>Start the auto-tune action to automatically select a set of viable PID values; will flash during auto-tuning.</td>
<td><img src="image" alt="Auto" /></td>
</tr>
<tr>
<td><strong>Alarm Low</strong></td>
<td>Select a low alarm point, adjustable between Off, Range Low and Alarm High.</td>
<td><img src="image" alt="Alarm Low" /></td>
</tr>
<tr>
<td><strong>Alarm High</strong></td>
<td>Select a high alarm point, adjustable between Alarm Low and Range High, or OFF.</td>
<td><img src="image" alt="Alarm High" /></td>
</tr>
<tr>
<td><strong>Countdown Timer</strong></td>
<td>Select a countdown time duration.</td>
<td><img src="image" alt="Countdown Timer" /></td>
</tr>
<tr>
<td><strong>Idle Set Point Type</strong></td>
<td>Choose to track set point, or select a separate idle set point adjustable between Range Low and Range High. When , or , view the idle set point from the set point display with a three second press.</td>
<td><img src="image" alt="Idle Set Point Type" /></td>
</tr>
<tr>
<td><strong>PID Menu</strong></td>
<td>Go to the PID Menu.</td>
<td><img src="image" alt="PID Menu" /></td>
</tr>
<tr>
<td><strong>Configuration Menu</strong></td>
<td>Go to the Configuration Menu.</td>
<td><img src="image" alt="Configuration Menu" /></td>
</tr>
</tbody>
</table>
Learn the PID Menu

Choosing a PID Setting Strategy

You may rely solely on the Auto-tune [Aut] function (p. 34) and factory defaults to determine PID values for your system, or you may use auto-tuning and additional manual adjustments. You must select dead band [db] and calibration offset [cal] values manually.

The Series 935B PID Menu is the first sub-menu you encounter after moving to the Operations Menu. The PID Menu provides a software location to select the individual heat or cool proportional band, hysteresis, and cycle time values; and the dead band, integral, derivative, and calibration offset values.

To go to the PID Menu:
1. Go first to the Operations Menu by pressing [Esc] and [Esc] simultaneously for three seconds.
2. Scroll through the Operations Menu with [Esc] until you see the [Pid] prompt.
3. While pressing [Esc] to display [no], choose [yes] with [Esc] or [Esc].
4. Release [Esc] to see the first PID prompt.

NOTE: Access to the PID Menu and the prompts there varies with lockout function and output set-up. The PID Menu is locked out when the 935B leaves the factory.
• Lockout function; the Lockout Tag [tAg] function masks menus from view (if you cannot see a prompt, you can make no change). See Using Lockout Functions, p. 20.
• Output set-up; you must choose [Heat] or [Cool] in either Output 1 or Output 2 to have access to the PID Menu. With a [Heat] only choice, [Cool] prompts are not visible, and vice versa. See the Valid Output Functions Table, p. 5, or Setting Up Inputs and Outputs, p. 22.

NOTE: Proportional Band, Integral, Derivative, Dead Band, and Calibration Offset values are adjustable in whole or tenth °F or °C, depending on input type [In] and [C_F] Celsius/Fahrenheit Configuration Menu choices.
Setting PID Menu Values

• **Proportional Band, Heat and Cool** \(P_b^h\) and \(P_b^c\): Select a value (degrees) to set up band on either side (±) of the Primary Set Point in which the heat and/or cool proportioning function(s) will be active.
  For on/off control, set \(P_b^h\) or \(P_b^c\) = 0.
  Range: 0 to 999°F/555°C, or 0.0 to 999.0°F/555.0°C
  Default: 25°F/17°C, or 25.0°F/17.0°C

• **Hysteresis, Heat and Cool** \(hY^h\) and \(hY^c\): For use with on/off control only. Select the value (degrees) for the process variable change required to re-energize the control heat and/or cool output.
  For ON/off control, set \(P_b^h\) or \(P_b^c\) = 0.
  Range: 1 to 999°F/555°C, or 0.1 to 999.0°F/555.0°C
  Default: 3°F/2°C, or 3.0°F/2.0°C

• **Cycle Time**, \(Ct^h\) and \(Ct^c\): Select the value (seconds) required for the heat and/or cool output(s) to complete a full ON through off cycle.
  Range: Switched dc/Solid State Relay: 0.1 to 60.0 seconds
  Default: 5.0 seconds
  Range: Electromechanical Relay: 5.0 to 60.0 seconds
  Default: 30.0 seconds

• **Dead Band** \(db\): Dead Band adjusts the effective cool set point above the primary set point by the Dead Band value in degrees. This creates a band between the heating and cooling proportional bands where only integral and derivative activity will occur. For more information on Dead Band fine tuning, go to p. 35.
  Range: 0 to 999°F/555°C, or 0.0 to 999.0°F/555.0°C
  Default: 0°

• **Integral** \(It\): Select a value (minutes/repeat) for the integral function. Integral is the inverse of Reset; \(It(value) = 1/Reset(value)\).
  Range: 0.00 to 99.99 minutes/repeat
  Default: 5.0 minutes/repeat

• **Derivative** \(dE\): Select a value (minutes) for the derivative function.
  Range: 0.00 to 9.99 minutes
  Default: 0.00 minutes

• **Calibration Offset** \(CAL\): Eliminates the difference between the displayed process temperature and the actual process temperature value.
  Range: -999 to 999°F/C, or -99.9 to 999.9°F/C
  Default: 0°
**Table 5 - PID Menu Overview**

### Set-Up Heat

**Proportional Band Heat** - Select a heat proportional band value.

<table>
<thead>
<tr>
<th>Pb</th>
<th>0</th>
<th>999</th>
<th>0</th>
<th>555</th>
<th>0</th>
<th>9990</th>
<th>0</th>
<th>5550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°F to 999°F, or</td>
<td>0°C to 555°C, or</td>
<td>0.0°F to 999.0°F, or</td>
<td>0.0°C to 555.0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hysteresis Heat** - Select a heat ON/off control switching hysteresis.

<table>
<thead>
<tr>
<th>hySh</th>
<th>1</th>
<th>999</th>
<th>1</th>
<th>555</th>
<th>0.1</th>
<th>9990</th>
<th>0.1</th>
<th>5550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1°F to 999°F, or</td>
<td>1°C to 555°C, or</td>
<td>0.1°F to 999.0°F, or</td>
<td>0.1°C to 555.0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cycle Time Heat** - Select a heat output cycle time.

<table>
<thead>
<tr>
<th>Ct</th>
<th>0.1</th>
<th>60.0</th>
<th>5.0</th>
<th>60.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 to 60.0 seconds</td>
<td>5.0 to 60.0 seconds</td>
<td>(SSR or Switched dc)</td>
<td>(Electromechanical Relay)</td>
</tr>
</tbody>
</table>

**Dead Band** - Select a dead band value.

<table>
<thead>
<tr>
<th>db</th>
<th>0</th>
<th>999</th>
<th>0</th>
<th>555</th>
<th>0</th>
<th>9990</th>
<th>0</th>
<th>5550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°F to 999°F, or</td>
<td>0°C to 555°C, or</td>
<td>0.0°F to 999.0°F, or</td>
<td>0.0°C to 555.0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Set-Up Cool

**Proportional Band Cool** - Select a cool proportional band value.

<table>
<thead>
<tr>
<th>Pb</th>
<th>0</th>
<th>999</th>
<th>0</th>
<th>555</th>
<th>0</th>
<th>9990</th>
<th>0</th>
<th>5550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0°F to 999°F, or</td>
<td>0°C to 555°C, or</td>
<td>0.0°F to 999.0°F, or</td>
<td>0.0°C to 555.0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hysteresis Cool** - Select a cool ON/off control switching hysteresis.

<table>
<thead>
<tr>
<th>hySc</th>
<th>1</th>
<th>999</th>
<th>1</th>
<th>555</th>
<th>0.1</th>
<th>9990</th>
<th>0.1</th>
<th>5550</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1°F to 999°F, or</td>
<td>1°C to 555°C, or</td>
<td>0.1°F to 999.0°F, or</td>
<td>0.1°C to 555.0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cycle Time Cool** - Select a cool output cycle time.

<table>
<thead>
<tr>
<th>Ct</th>
<th>0.1</th>
<th>60.0</th>
<th>5.0</th>
<th>60.0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.1 to 60.0 seconds</td>
<td>5.0 to 60.0 seconds</td>
<td>(SSR or Switched dc)</td>
<td>(Electromechanical Relay)</td>
</tr>
</tbody>
</table>
Set-Up General

**Integral Function** - Select an integral value.

```
[``It] [000 9999]
```

0.00 to 99.99 minutes/repeat

**Derivative Function** - Select a derivative value.

```
[``dE] [000 999]
```

0.00 to 9.99 minutes

**Calibration Offset** - Select a calibration offset value.

```
[CAL] [-999 9999] [-999 9999]
```

-999° to 9999°F or C or -99.9° to 999.9°F or C

**NOTE:** Access to the PID Menu and the prompts there varies with lockout function and output set-up. The PID Menu is locked out when the 935B leaves the factory.

- Lockout function; the Lockout Tag ([``tAg]) function masks menus from view (if you cannot see a prompt, you can make no change). See Using Lockout Functions, p. 20.

- Output set-up; you must choose **HEAT** or **COOL** in either Output 1 or Output 2 to have access to the PID Menu. With a **HEAT** only choice, **COOL** prompts are not visible, and vice versa. See the Valid Output Functions Table, p. 5, or Setting Up Inputs and Outputs, p. 22.
**Learn the Configuration Menu**

The Configuration Menu is the second sub-menu in the Operations Menu. Use it to set Inputs, Ranges, Output Types, Alarms, Timer, Failure Mode, and Lockouts.

**To go to the Configuration Menu:**

1. Go first to the Operations Menu by pressing `[` and `]` simultaneously for three seconds.
2. Scroll through the Operations Menu with `[` until you see the `[CnFg]` prompt.
3. While holding `[Enter]` to display `no`, choose `[YES]` with `[<]` or `[>]`.
4. Release `[Enter]` to see the first `[CnFg]` prompt. `[In]`.
5. To leave the Configuration Menu, press `[Enter]` and `[Esc]` for 3 seconds.

**Table 6 - Configuration Menu Overview**

<table>
<thead>
<tr>
<th>Input Type</th>
<th>J t/c</th>
<th>K t/c</th>
<th>T t/c</th>
<th>N t/c</th>
<th>E t/c</th>
<th>S t/c</th>
<th>1.0° RTD</th>
<th>0.1° RTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Celsi/Fahrenheit</td>
<td>°F</td>
<td>°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Range Low</td>
<td>Select lowest displayable set point. Ranges, p. 23.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Range High</td>
<td>Select highest displayable set point. Ranges, p. 23.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 1 Function</td>
<td>Choose Output 1 type; see Valid Outputs Table, p. 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output 2 Function</td>
<td>Choose Output 2 type (dependent on Output 1 choice).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote Timer Start</td>
<td>Choose remote timer start operation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display Default</td>
<td>Choose the primary (last 2 characters) and secondary (first 2 characters) default displays. Press <code>[Set]</code> to toggle to the secondary display for 15 seconds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Type</td>
<td>Choose alarm type with output action.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Alarm Hysteresis** - Choose alarm switching band.

```
1 1
1 555
0.1 9990
0.1 5550
```
1° F to 999° F, or 1°C to 555°C, or 0.1°F to 999.0°F, or 0.1°C to 555.0°C

**Alarm Latch** - Choose latching or non-latching alarms.
A latching alarm requires a SET press to clear it after the alarm condition clears.

```
no YES
```

**Alarm Silencing** - Choose to silence alarms on startup, or not.
Silence an alarm with a SET press.

```
no YES
```

**Failure Mode** - Choose output action after a sensor failure.
Bumpless transfer provides a smooth transition to percent power control without output state change.

```
FAIL
```

**Timer Output Function** - Choose output function for the end of the timer.
Delay ON = Turn ON, Delay Off = Turn off, Signal ON = Toggle ON, Signal off = Toggle off

```

delay on, delay off, signal on, signal off
```

**Start Timer Function** - Choose the start timer conditions:
Immediate start on a SET press; Ready Band = press, plus Actual temp. is inside the Ready Band, then acknowledge with a SET press; Power-up = immediate start on power-up without waiting for Ready Band temp. or a SET press.

```
Start
```

**Timer Ready Band** - If start = Ready or power-up, select ready band high/low values.

```
0 999
0 555
0 9990
0 5550
```
0°F to 999°F, or 0°C to 555°C, or 0.0°F to 999.0°F, or 0.0°C to 555.0°C

**Signal Time** - If signal = Signal ON or Signal off, select a Signal ON or Signal off time duration to trigger an annunciator or other action at completion of countdown time.

```
Signals
```
1 sec. to 99:59 min:sec.

**Set Point Lock** - Choose to lock the Primary Set Point from change, not view.

```
no YES
```

**Lockout Tag** - Choose undisplayable/unchangeable menus; P = PID Menu, C = Configuration Menu (except [TAG]), O = Operations Menu (except [TAG]), A = Auto-tune.

Choose the menus / function that will not be displayed, and therefore cannot be changed. P = PID Menu, C = Configuration Menu (except [TAG]), O = Operations Menu (except [TAG]), A = Auto-tune.
# Key Lockout Information

The Series 935B offers three different security, or “lockout,” options. Set up one or all three lockout options in the Configuration Menu.

- **Front Panel Lock** [FPL] uses an input for an external hardware switch; it requires wiring, see p. 25. Choose Front Panel Lock [FPL] from the [rts] choices.
- **Choose Set Point Lock** [SLOC] as the simplest lockout option. It locks the Primary Set Point from change, but not from view.
- **Choose the Security Tag** [tAG] as a means of masking the Series 935B software menus from view. By selecting all or part of the four-digit binary acronym, [PCOA] (Proportional / Configuration / Operation / Autotune), you can choose to mask those items from view, and therefore from change. For example: In the Configuration Menu [tAG] set-up, if you can see the P, the operator cannot see the PID menu.
- Exceptions to [PCOA] [tAG] are:
  - “C” does not lock out [tAG].
  - “O” does not lock out [CnFG].

### Configuration Menu

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Celsius/Fahrenheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Range Low</td>
<td></td>
</tr>
<tr>
<td>Input Range High</td>
<td></td>
</tr>
<tr>
<td>Output 1 Function</td>
<td></td>
</tr>
<tr>
<td>Output 2 Function</td>
<td></td>
</tr>
<tr>
<td>Remote Timer Start</td>
<td></td>
</tr>
<tr>
<td>Display Default</td>
<td></td>
</tr>
<tr>
<td>Alarm Type</td>
<td></td>
</tr>
<tr>
<td>Alarm Hysteresis</td>
<td></td>
</tr>
<tr>
<td>Alarm Latch</td>
<td></td>
</tr>
<tr>
<td>Alarm Silencing</td>
<td></td>
</tr>
<tr>
<td>Failure Mode</td>
<td></td>
</tr>
<tr>
<td>Timer Function</td>
<td></td>
</tr>
<tr>
<td>Start Timer</td>
<td></td>
</tr>
<tr>
<td>Timer Ready Band</td>
<td></td>
</tr>
<tr>
<td>Signal Time</td>
<td></td>
</tr>
<tr>
<td>Set Point Lockout</td>
<td></td>
</tr>
<tr>
<td>Lockout Tag</td>
<td></td>
</tr>
</tbody>
</table>
### Table 7 - Series 935B Lockout Options

<table>
<thead>
<tr>
<th>Option</th>
<th>FPL</th>
<th>P</th>
<th>C</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Process</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>View Set Point</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Change Set Point</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Auto-tune</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>View, Change Operation Menu</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>View, Change Configuration Menu (except tag)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>View, Change PID</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

- **FPL** = Front Panel Lockout
- **P** = PID Menu
- **C** = Configuration Menu (except tag)
- **O** = Operations Menu (except tag)
- **A** = Auto-tune

Note: Front Panel Lockout requires an external hardware switch. For set-up and wiring information, see p. 25. For more wiring information, see p. 45.
Setting Inputs and Outputs

Key Input/Output Set-up Information

- All initial input and output set-up occurs in the Configuration Menu.
- Indication of °C or °F units of measure occurs only in the `C_F` prompt.
- Sensor input type minimum and maximum range (see p. 53) is further defined with Range Low `rL` and Range High `rh` to set the working span of set points and remote set point scaling.
- Output 1 and Output 2 configure the prime functions of the Series 935B, they are the "golden" prompts.
- Output 1 must be heat or cool to use Output 2 as a timer.
- Front Panel Lock `FPL` requires a customer-supplied external switch wired on Terminals 3 and 4. Switch open = unlocked; closed = locked. Select this feature with `rts` = `FPL`.
- Remote Timer Start requires a customer-supplied switch on Terminals 3 and 4. Switch closed = start. Select this feature with `rts` = `tmr`.
- Output 2 sets timer interval in hours:minutes `thM` or minutes:seconds `tMS`.
- Display Default `dISP` lets you choose the primary (last 2 characters) and secondary (first 2 characters) default displays. Press `ß` to toggle to the secondary display for 15 seconds.

- Normal Display: Actual Temperature
  - Secondary: None
- Normal Display: Set Point Temperature
  - Secondary: Actual Temperature
- Normal Display: Time Remaining
  - Secondary: Actual Temperature
- Normal Display: Actual Temperature
  - Secondary: Time Remaining
- Normal Display: Set Point Temperature
  - Secondary: Time Remaining

Configuration Menu

<table>
<thead>
<tr>
<th>Input Type</th>
<th>C_F</th>
<th>Celsius/Fahrenheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Range Low</td>
<td><code>rl</code></td>
<td></td>
</tr>
<tr>
<td>Input Range High</td>
<td><code>rh</code></td>
<td></td>
</tr>
<tr>
<td>Output 1 Function</td>
<td><code>Ot1</code></td>
<td></td>
</tr>
<tr>
<td>Output 2 Function</td>
<td><code>Ot2</code></td>
<td></td>
</tr>
<tr>
<td>Remote Timer Start</td>
<td><code>rts</code></td>
<td></td>
</tr>
<tr>
<td>Display Default</td>
<td><code>dISP</code></td>
<td></td>
</tr>
<tr>
<td>Alarm Type</td>
<td><code>Alty</code></td>
<td></td>
</tr>
<tr>
<td>Alarm Hysteresis</td>
<td><code>AhYS</code></td>
<td></td>
</tr>
<tr>
<td>Alarm Latch</td>
<td><code>LAt</code></td>
<td></td>
</tr>
<tr>
<td>Alarm Silencing</td>
<td><code>Sil</code></td>
<td></td>
</tr>
<tr>
<td>Failure Mode</td>
<td><code>FAIL</code></td>
<td></td>
</tr>
<tr>
<td>Timer Function</td>
<td><code>tIM</code></td>
<td></td>
</tr>
<tr>
<td>Start Timer</td>
<td><code>Strt</code></td>
<td></td>
</tr>
<tr>
<td>Timer Ready Band</td>
<td><code>rdY</code></td>
<td></td>
</tr>
<tr>
<td>Signal Time</td>
<td><code>SE</code></td>
<td></td>
</tr>
<tr>
<td>Set Point Lockout</td>
<td><code>SLoc</code></td>
<td></td>
</tr>
<tr>
<td>Lockout Tag</td>
<td><code>TAG</code></td>
<td></td>
</tr>
</tbody>
</table>

### Configuration Menu

#### Table 8 - Setting Inputs and Outputs

<table>
<thead>
<tr>
<th>Input Type</th>
<th>J</th>
<th>H</th>
<th>k</th>
<th>n</th>
<th>E</th>
<th>S</th>
<th>rtd</th>
<th>rtd</th>
</tr>
</thead>
<tbody>
<tr>
<td>J t/c</td>
<td>32 to 1382°F or 0 to 750°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K t/c</td>
<td>-328 to 2282°F or -200 to 1250°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T t/c</td>
<td>-328 to 662°F or -200 to 350°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N t/c</td>
<td>32 to 2282°F or 0 to 1250°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S t/c</td>
<td>32 to 2642°F or 0 to 1450°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1° RTD (DIN):</td>
<td>-328 to 1292°F or -200 to 799°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1° RTD:</td>
<td>-99.9 to 999.9°F or -99.9 to 700.0°C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Celsius/Fahrenheit</th>
<th>°F</th>
<th>°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>°F</td>
<td>C</td>
<td>°C</td>
</tr>
</tbody>
</table>

**Input Range Information**

- J t/c: 32 to 1382°F or 0 to 750°C
- K t/c: -328 to 2282°F or -200 to 1250°C
- T t/c: -328 to 662°F or -200 to 350°C
- N t/c: 32 to 2282°F or 0 to 1250°C
- S t/c: 32 to 2642°F or 0 to 1450°C
- 1° RTD (DIN): -328 to 1292°F or -200 to 799°C
- 0.1° RTD: -99.9 to 999.9°F or -99.9 to 700.0°C

**Output 1 Function** - Choose Output 1 type.

- Heat
- Cool
- Alarm
- None

**Valid Output Functions**

- First select Output 1: Then select Output 2:
  - Heat
  - None, Cool, Alarm, Timer
  - Cool
  - None, Heat, Alarm, Timer
  - Alarm
  - None, Heat, Cool
  - None
  - Heat, Alarm

**Output 2 Function** - Choose Output 2 type (dependent on Output 1 choice).

- Heat
- Cool
- Alarm
- Timer
- Timer
- None

**Remote Timer Start** - Choose Off, Front Panel Lock, or Timer (Hrs:Min).

**Display Default** - Choose the primary (last 2 characters) and secondary (first 2 characters) default displays. Press to toggle to the secondary display for 15 seconds.

- Actual temp.
- Set point temperature
- Actual temp.
- Time remaining
- Actual temp.
- Time remaining
- Time remaining
- Time remaining
Using Remote Timer Start Input

To Set Up Remote Timer Start...

1. Wire the control per the example below and the information on p. 44-45.
2. Make \texttt{In} and \texttt{C-F} choices, then
3. Select \texttt{tmr} at the \texttt{rts} prompt.
4. Close switch to remotely start the timer.

\textbf{Figure 5 - Remote Timer Start Wiring}

See p. 45 for more wiring information.

(Closed switch = Starts Timer)

\textbf{WARNING:} All wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.

\textbf{Note:} Customer-supplied N.O. momentary switch.
Using Front Panel Lockout

To Set Up Front Panel Lock...

1. Install an external switch.
2. Wire the control per the example below and the information on p. 44-45.

Table 9 - Using Front Panel Lock

<table>
<thead>
<tr>
<th><code>rts</code> = <code>FPL</code></th>
<th>View Process</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>View Set Point</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Change Set Point</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Auto-tune</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Reset Alarm</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>View or Change Operation Menu (Except Config. Menu)</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>View or Change Configuration Menu (Except Tag)</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>View or Change PID Menu</td>
<td>No</td>
</tr>
</tbody>
</table>

Figure 6 - Front Panel Lock Wiring

See p. 44 and 45 for more wiring information.

(Closed switch = locked panel)

Note: Customer-supplied two-position switch.
Learning Alarms

Key Alarm Information

Alarms signal an excursion from normal operating conditions. In general, audible alarms or lights connected to alarm outputs will signal a problem. In the 935B the front panel LED “1” or “2” indicates an alarm with "hI" or "LO" flashing on the main display.

- **Process alarms** use absolute high and low values to trigger an alarm. Use this alarm type if your process may be subject to temperatures that it must not exceed. Use "AhI" and "ALO" to set alarm points at or near these values. See Table 10: [ALtY], next page.

- **Deviation alarms** are triggered by a deviation from the set point. The alarm high value "AhI" is the deviation above set point, and the low value "ALO" is the deviation below set point. Whenever the set point is adjusted, the alarm settings are relative to that value. Deviation alarms use the currently controlling set point, whether primary, remote, idle, or 90% of primary, during auto-tuning. See Table 10: [ALtY], next page.

- **Normally Open, dEno, or Prno, Alarms** energize the alarm output when an alarm condition occurs, and de-energize it when cleared. Use this type to activate external devices such as audible alarms or lights. See Table 10: [ALtY], next page.

- **Normally Closed, dEnc, or Prnc, Alarms** de-energize the alarm output when an alarm condition occurs, and energize it when the alarm is cleared. Use this type as a “deadman” switch where system continuity is required for operation. See Table 10: [ALtY], next page.

  For example, by running the control output through the alarm output, you can set a normally closed process alarm to disable the process when the process exceeds the alarm set point. The alarm output will be off when power is off.

- **Alarm Hysteresis** sets a point the process must pass on a return (from an alarm condition excursion) to the "ALO" and "AhI" points before the alarm can clear. This prevents the alarm output from “chattering” if the process is hovering around the alarm set point. See Table 10: [AhYS], next page.

- **Latching Alarms** require the operator to clear them with a SET press after the process returns to a safe, or non-alarm condition. Non-latching alarms self-clear. See Table 11: [LAt], p. 29.

- **Silenced Alarms** provide a means to clear the alarm output with a SET press even if the alarm condition still exists. The flashing "hI" or "LO" message will persist until the alarm condition ceases. See Table 11: [SIL], p. 29. If [SIL] = YES, alarms are disabled (no message or output) on startup until the safe area is reached.

- **Alarm High and Low Points**, "AhI" and "ALO", in the Operations menu determine where alarms will trigger. Alarm hysteresis [AhYS] determines where an alarm condition clears. See Table 11, page 29.
• To Clear an Alarm that is latched or "silence-able" requires the operator to press the \texttt{SEL} key after the process returns to a safe, or non-alarm condition. Non-latching alarms self-clear. See Table 11: \texttt{LAR} and \texttt{SIL}, p. 29.

Table 10 (below) and Table 11 (p. 29) illustrate the Series 935B alarm features.

Table 10 - Alarm Functions

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Deviation Alarm</th>
<th>Process Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>\texttt{dEnc}</td>
<td>\texttt{dEno}</td>
</tr>
<tr>
<td>Non-Alarm State</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>LED off</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>Alarm Output:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm State</td>
<td>\text{\textbullet}</td>
<td>\text{\textbullet}</td>
</tr>
<tr>
<td>LED on</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>Alarm Output Status:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silenced-Alarm State</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>LED off</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>Alarm Output Status:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power-Off State</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>LED off</td>
<td>\textbullet</td>
<td>\textbullet</td>
</tr>
<tr>
<td>Alarm Output Status:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Function:

A deviation alarm tracks set point.

A process alarm is a fixed value, independent of set point.

Alarm Hysteresis is the change in the process variable (actual) required to clear the alarm relay after an alarm occurs.

Note: With no power connected to the unit, the alarm output will be in an open state.
To Set Up Series 935B Alarms…

1. Plan an alarm strategy. What do you want to happen when an alarm occurs?
2. Wire the appropriate control output, Output 1 or Output 2, and associated switching and annunciators. See p. 44-45 for wiring information.
4. Set either Output 1 (Ot1) or Output 2 (Ot2) as the (ALM) output.
5. Set Alarm Type (ALty).
6. Set alarm hysteresis (AhYS).
7. Set alarm latching (LAt).
8. Set alarm silencing (SIL).
10. Go to the 935B’s Operation Menu. See p.12.
11. Set the alarm high and low (ALO and AhI) points.
12. Test and adjust the alarm system.
13. Document the alarm settings and system.

CAUTION: Verify, in Table 10, p. 27, the alarm state / alarm output condition you want before making the Alarm Type (ALty) choice. Failure to do so could result in damage to equipment and property.

WARNING: Do not rely on the Series 935B alarms to provide redundant temperature limit control. Use correctly specified, properly installed temperature limit controls instead. Failure to do so could result in injury, death or damage to equipment and property. (See accompanying Watlow Bulletin 89.4.3.)

To Clear a Series 935B Alarm…
In general, press the (Sil) key to clear a latched or ‘silence-able’ (SIL) alarm.
Ultimately, the system process value must return within the safe area for the alarm to remain clear. Non-latching alarms self-clear.
Table 11 (below) and Table 10 (p. 27) illustrate the Series 935B alarm features.

**Table 11 - Alarm Functions**

<table>
<thead>
<tr>
<th>Latching alarm</th>
<th>Silence alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="latch.png" alt="Latch" /></td>
<td><img src="silence.png" alt="Silence" /></td>
</tr>
<tr>
<td>Latched alarm requires the operator to press the SET key to clear after the actual temperature returns to within the safe area.</td>
<td>With this selection, an alarm cannot be silenced at the 935B front panel (unless the alarm is latched [LAt:yes] and the alarm condition no longer exists).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alarm Low</th>
<th>Alarm High</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="alarm_low.png" alt="Alarm Low" /></td>
<td><img src="alarm_high.png" alt="Alarm High" /></td>
</tr>
<tr>
<td>A value from input Range Low to [AhI]. At the Range Low value, a press displays off and AhI disables.</td>
<td>A value from [AhL] to input Range High. At the Range High value, a press displays off and AhI disables.</td>
</tr>
</tbody>
</table>
Learn the Countdown Timer

**Configuration Menu**

- **Input Type**
  - C_F: Celsius/Fahrenheit
- **Input Range Low**
- **Input Range High**
- **Output 1 Function**
- **Output 2 Function**
- **Remote Timer Start**
- **Display Default**
- **Alarm Type**
- **Alarm Hysteresis**

**Operations Menu**

- **Auto-tune**
- **Countdown Timer**
- **Idle**

**Key Timer Information**

- The timer requires Output 1 to work as either a heat or as a cool output.
- The 935B timer is a function of Output 2, a switched dc output.
- Hours: minutes (hh:mm) or minutes:seconds (mm:ss) choices reside in Output 2 ['C_F'].
- Timer set-up occurs in two locations, in the Configuration Menu and the Operations Menu.
- \( \) starts the timer.
- \( \) stops the timer.
- \( \) choices set up the timer display (see p. 18).
- LED colon flashes when timer runs.
- LED colon ON steadily when timer is not running.

**Configuration Menu set-up includes:** (see p. 18)

- Output 1 ['heat'] or ['cool']
- Output 2 ['L_H', 'L_M', 'L_S'] timing interval, hours:minutes or minutes:seconds
- Remote Timer Start ['off', 'timer', 'front panel lockout'] choices:
  1. Manual start
  2. Remote Timer Start
  3. Front Panel Lockout
- Timer (Output 2) function ['on', 'off', 'signal on', 'signal off'] can perform one of four possible actions after timing: 
  1. Turn ON, also called, “delay ON” \( \text{dLon} \)
  2. Turn off, also called, “delay off” \( \text{dLoF} \)
  3. Toggle ON, also called, “signal ON” \( \text{sgon} \)
  4. Toggle off, also called, “signal off” \( \text{sgOf} \)
- Start timer function ['immediate', 'once inside ready band', 'once inside ready band and acknowledge', 'start immediately on control power up'] choices:
  1. Immediate start \( \text{imMed} \)
  2. Start once inside a ready band \( \text{rdy} \)
  3. Start once inside a ready band, acknowledging \( \text{rdya} \) with a \( \beta \) press
  4. Start immediately on control power up \( \text{plup} \) without waiting for Ready Band temp. or \( \text{plup} \) press.
- Ready band width \( \text{rdy} \) above and below set point: degrees
- Signal time \( \text{st} \) (if applicable) duration: seconds

**Operations Menu set-up includes:** (see p. 12)

- Countdown Time [' IMF'], hours:minutes or minutes:seconds
- Idle Set Point Type ['Traditional', 'two choices:
  1. Track primary set point
  2. Set an idle set point

The next page presents this information in graphic format with additional detail.
Table 12 - Series 935B Timer Functions/Settings

<table>
<thead>
<tr>
<th>Function</th>
<th>Delay ON</th>
<th>Delay OFF</th>
<th>Signal ON</th>
<th>Signal OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 2 Timer</td>
<td>dLon</td>
<td>dLoF</td>
<td>S9on</td>
<td>S9oF</td>
</tr>
<tr>
<td>Output Function;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose one of four possible output actions for the end of the timer periods.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Start Timer</th>
<th>Start Timer Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer starts immediately on a key press at the normal display.</td>
<td>Timer starts immediately on control Power up. See p.57.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remote Start Timer</th>
<th>Remote Start Timer</th>
</tr>
</thead>
<tbody>
<tr>
<td>No remote timer start or front panel lock feature.</td>
<td>Front panel lock with a customer-supplied switch on Terminals 3 and 4; a closed switch=locked front panel. Start timer via an external, customer-supplied switch on Terminals 3 and 4 closed switch=start.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timer Ready Band</th>
<th>Timer Ready Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP RDY RDY</td>
<td>SP RDY RDY</td>
</tr>
<tr>
<td>• Start timer when [Ot2] = [thm] or [tms], a 3 second press will display the set point.</td>
<td>• Read the set point.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Signal Time</th>
<th>Signal Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sets the signal time from 00:01 to 99:59 min:sec to run after Timer.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operations Menu</th>
<th>Operations Menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timer Function OFF.</td>
<td>Timer Function OFF.</td>
</tr>
</tbody>
</table>

- Idle Set Point

- Idle is set point used when not timing.
- If Trac selected Idle is the same as Set Point.
- The Set Point value controls the process during the Timer sequence.
To Set Up the 935B Timer...

1. Plan a timer strategy.

2. Wire the Output 2 control output, associated switching devices and annunciators. See p. 44-45.

3. Go to the 935B’s Configuration Menu [CnFG].

4. Choose the Output 2 [Ot2] function as time; hrs:min [thM], or time; min:sec [tMS].

5. Choose Remote Timer Start [rts] to function as; manual [off], or remote timer start [tMr].

6. Choose a display default [Disp] (see page 18):
   - Actual Temperature only [Ac]
   - Actual; Set Point [AcSP]
   - Actual; Time [Acti]
   - Time; Actual [tiAc]
   - Time; Set Point [tiSP]

7. Choose a Timer Output Function [tIM]:
   - Delay ON [dLon]
   - Delay off [dLoF]
   - Signal ON [sgon]
   - Signal off [sgoF]

8. Choose a start timer [Strt] function; either immediate [IMd], ready band [rdY], Ready Acknowledge [rdYA], or Power [PWr].

9. If you chose [rdY] or [rdya], then select a ready band [rdY] value.

10. If you chose [sgan] or [sgoF], then select a signal time [St] value.

11. Go to the 935B’s Operation Menu.

12. Set the countdown time [tMr].

13. Choose the idle set point [Idle] to track the primary set point, or select a separate idle set point value between the range high [rh] and range low [rL] values.

14. Run the system, and test the timer start with a [ dispute ] press or [rts] signal.

15. Document the timer settings and system.
Convection Oven Application

Scenario
A master chef bakes bread at 350°F for 30 minutes. He wants the oven at the proper temperature with an indication when it is ready to begin baking. He isn’t concerned if the oven is 10° cool at first. After he loads the oven, the chef wants to start the countdown time by pressing a key. When the baking time is complete, he wants a 10 second audible indication that the bread is done.

Recommended Control
A Series 935B-1CCX-000X control.
- Switched dc Output 1 wired to a dc input solid state relay (SSR) switches the heaters.
- Switched dc Output 2 wired to a DC SSR-T0 SSR-240-10A-DC1 or A External Mechanical Relay audible indicator provides “done” indication.

Configuration Menu Set-up
- `C_F` = °F
- `dISP` = After a press, actual temperature appears for 15 seconds.
- `Ot1` = Heating output
- `Ot2` = Time; minutes:seconds
- `rdY` = RTS must be set to OFF in this application
- `rMs` = Output 2 turns ON briefly at the end of the timing cycle.
- `rdY` = Timer waits to countdown until temperature deviation from set point < value and the key is pressed.
- `St` = Output 2 turns ON for 10 sec. at the end of the timing cycle.

Operations Menu Set-up
- `tMr` = Bake time; 30 minutes
- `IdLE` = The set point temperature before a timing cycle starts and after a timing cycle completes.

Set Point = °F

Operator/Control Actions
- With the oven “idling” at 75°F, the chef starts the preheat cycle with a press. The display immediately shows 30:00 with the colon ON steadily. The RDY LED is off. Series 935B begins to control to the 350°F bake set point.
- As the actual oven temperature increases to within the Ready Band at 350°F ±10°F, the RDY LED turns on. The chef loads the oven and presses to acknowledge the Ready Band and thereby start the bake cycle.
- Time starts counting down. Actual temperature displays for 15 seconds after the key is press. Then time displays with the colon flashing.
- If temperature deviates out of the Ready Band (less than 340°F or more than 360°F), timer countdown will pause, but will continue as soon as temperature re-enters the ready band.
- When time reaches 00:00, Output 2 turns on for 10 seconds sounding the audible indicator. The chef can stop the audible indicator by pressing . The Series 935B then automatically shifts to the 75°F idle set point.
Auto-tuning

**Auto-tuning the Series 935B**

Auto-tune automatically sets PID parameters for your system.

1. Press and for three seconds.
2. You'll see stops auto-tuning.
3. Press and hold , then select with or . will flash to indicate auto-tuning. Display reverts to normal after auto-tuning.
4. stops auto-tuning.

**Manual Tuning**

For optimum performance, tune the Series 935B to your thermal system. The settings here are for a broad spectrum of applications; your system may have different requirements.

Tune heating outputs at a set point above ambient temperature.
Tune cooling outputs at a set point below ambient temp.

1. Apply power to the 935B and enter a set point.
   In the Operations Menu, must = .
   Begin with these Configuration Menu settings:
   \( Pb = \), \( It = 000 \), \( dE = 000 \), \( Ct = 50 \), \( CAL = 0 \).
2. Proportional Band Adjustment: Gradually increase until the upper display temp. stabilizes at a constant value.
3. Integral Adjustment: Gradually decrease from 30.00 until the display temperature begins to oscillate or “hunt.” Then slowly increase until the upper display stabilizes again near set point.
4. Cycle Time Adjustment: Set as required. Faster cycle times sometimes achieve the best system control. However, if a mechanical contactor or solenoid is switching power to the load, a longer cycle time will minimize wear on relays.
5. Derivative Adjustment: Increase to 0.10 minute. Then raise set point by 20° to 30°F, or 11° to 17°C. Observe approach to set point. If load temperature overshoots, increase by 0.50 minute. Raise set point by 20 to 30°F, or 11 to 17°C and watch approach again. Repeat until system rises to new set point appropriately.
6. Calibration Offset Adjustment: Enter the offset value you want. Calibration offset adds or subtracts degrees from the value of the input signal.
Tweaking PID Settings

1. Set $P_b^h$ and $C_t^h$ in degrees.
2. If Proportional Band Heat $P_b^h = 0$, Set Hysteresis Heat $H_y^h$. The Series 935B will provide on/off control with the hysteresis value selected, and no proportioning action.
3. Proportional Bands should be decreased for tighter control but increased to eliminate oscillations.
4. Cycle Time Heat $C_t^h$ is limited to a minimum of 5.0 seconds for the electromechanical relay to help reduce wear. The electromechanical relay (D, Output 2) is not recommended for PID control. It is warranted to 100,000 contact closures only. Alarm or on/off control are appropriate applications for the Series 935B's electromechanical relay output.
5. Set Dead Band $d_b$ to adjust the effective cool set point above the primary set point by the dead band value in degrees. In cool/heat applications, dead band prevents continuous cool output action by creating a buffer between heating and cooling output action.
6. Set $P_b^c$ and $C_t^c$ in degrees.
7. If Proportional Band Cool $P_b^c = 0$, Set Hysteresis Heat $H_y^c$. The Series 935B will provide on/off control with the hysteresis value selected, and no proportioning action.
8. Proportional Bands should be decreased for tighter control but increased to eliminate oscillations.
9. Cycle Time Heat $C_t^c$ is limited to a minimum of 5.0 seconds for the electromechanical relay to help reduce wear. The electromechanical relay (D, Output 2) is not recommended for PID control. It is warranted to 100,000 contact closures only. Alarm or on/off control are appropriate applications for the Series 935B's electromechanical relay output.
10. Set Integral $I_t$ to eliminate droop in the system. Lower the value for more droop reduction. Adjustable from 0 to 99.9 minutes / repeat.
11. Set Derivative $d_E$ to prevent overshoot. Increasing the value slows the approach to set point. Adjustable from 0 to 9.99 minutes.
12. Calibration Offset $C_{al}$ eliminates the difference between the displayed process temperature and the actual process temperature value.
Calibrating the 935B

Calibration Menu

<table>
<thead>
<tr>
<th>tc50</th>
<th>tc00</th>
<th>tc</th>
<th>r15</th>
<th>r380</th>
<th>r5t</th>
</tr>
</thead>
</table>

Quick Calibration

Restore:
Press all three keys simultaneously until \([tc50]\) appears in the display, press \([tc50]\) once and \([tc50]\) will appear in the display. Press and hold \([tc50]\), the display will show \([``no\]`, press \([``yes\]` to change display to \([``yes\]`). Press and hold \([``yes\]` and \([``no\]` for 3 seconds to exit the \([``CAL\] menu.

NOTE: Restore Factory Calibration \([``yes\]` \(\Rightarrow [``yes\]` restores factory calibration values to all calibration prompts.

Calibration Key Information

Calibration requires a precision millivolt source with thermocouple compensation, an adjustable 0-10 volt source, and a decade resistance box.

- \([tc50]\) and \([tc00]\) calibrate the thermocouple span.
- \([tc]\) calibrates the ambient compensation.
- \([r380]\) and \([r15]\) calibrate the RTD span.
- When calibrating, calibrate all points for consistency in results.
- Allow the unit to warm up for 15 minutes before calibrating.

Figure 8a - Thermocouple Calibration

- \([tc50]\) \(mV\) source = 50.000mV
- \([tc00]\) \(mV\) source = 0.000mV

Figure 8b - RTD Calibration

- \([r380]\) \(mV\) source = 380.00 ohms

- \([r15]\) Decade Box = 15.00 ohms
Calibrating the 935B

Thermocouple Input Field Calibration Procedure

Equipment Required:
- Type “J” Reference Compensator with reference junction at 32°F/0°C, or Type “J” Thermocouple Calibrator set at 32°F/0°C.
- Precision millivolt source, 0-50mV min. range, 0.01mV resolution.

Set Up:
1. Connect 100-240V~ (ac) to Terminal 7 and Terminal 8.
2. Connect the millivolt source to Terminal 1 negative and Terminal 2 positive.
3. Apply power to the unit and allow it to warm up for 15 minutes.

Move to the Calibration Menu:
1. Press \( \text{SET} \) and \( \text{SEL} \) simultaneously for 3 seconds.
2. Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) is displayed.
   - Press and hold \( \text{SEL} \) – press \( \text{SEL} \) or \( \text{SEL} \) to select \( \text{YES} \), then release \( \text{SEL} \).
3. Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) is displayed.
   - Press and hold \( \text{SEL} \). Press \( \text{SEL} \) or \( \text{SEL} \) 8 times (display shall be blank).

Calibration: (Thermocouple)
1. Press and hold \( \text{SEL} \), \( \text{SEL} \), \( \text{SEL} \) simultaneously for 3 seconds until \( \text{FAT} \) is displayed.
2. Set the mV source to 50.00mV\(^{\text{dc}}\). Allow 10 seconds for sources to stabilize. Press and hold \( \text{SET} \). Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) appears. Release \( \text{SEL} \).
3. Press \( \text{SEL} \) shall be displayed.
4. Set the mV source to 0.00 mV\(^{\text{dc}}\). Allow 10 seconds for sources to stabilize. Press and hold \( \text{SET} \). Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) appears. Release \( \text{SEL} \).
5. Press \( \text{SEL} \) shall be displayed.
6. Set the MV source to 0.00 mV (if using a temperature compensator). Set calibrator to 32°F/0°C. Allow 10 seconds for sources to stabilize.
   - Press and hold \( \text{SET} \). Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) is displayed. Release \( \text{SET} \).

Calibration: (RTD)

Equipment Required:
- Precision Resistance Box with 0.01Ω Resolution.
1. Remove thermocouple wires from Terminal 1 and Terminal 2.
2. Connect S2 to terminal 1. Connect S1 to Terminal 2.
3. Press \( \text{SEL} \) shall be displayed.
4. Set the Decade box to 15.00Ω (allow 10 seconds for sources to stabilize). Press and hold \( \text{SEL} \). Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) appears. Release \( \text{SEL} \).
5. Press \( \text{SEL} \) shall be displayed.
6. Set the decade box to 380.00Ω (allow 10 seconds for sources to stabilize). Press and hold \( \text{SEL} \). Press \( \text{SEL} \) or \( \text{SEL} \) until \( \text{FAT} \) appears. Release \( \text{SEL} \).
7. Press and hold \( \text{SEL} \) and \( \text{SEL} \) for 3 seconds to Exit calibration menu.
Key Error Information

Set up an input failure operation mode at the FAIL prompt in the [CnFG] menu; choose bumpless transfer [bPLS] for smooth output action transition to percent power control, or select a percent power output value.

![FAIL bPLS]

Bumpless Transfer
when errors occur, the control output will continue at a percent output learned while stable. Default = [bPLS].

![-100 100]

Percent Power
(-100% to +100%, depending on heat/cool output configuration). The control will assume a specific output power when input errors occur.

- All except one of the possible displayed error messages are input related.
- If you see [Er5], cycle power to the controller. If the error persists, call the factory.
- Be aware of the difference between U.S. and European thermocouple color/colour codes.
- Reversed polarity input leads is one of the most common errors.
- Incorrect software input choice at the Configuration Menu [CnFG] input [In] prompt is another common error.

When calling the factory for help, please have:
1. The model number of the control.
2. A photocopy of pages 51-58 with the settings from your control, if possible.
3. Specifications of devices directly interfaced with the control.
Table 13 - Possible Displayed Error Codes and Actions

<table>
<thead>
<tr>
<th>Display</th>
<th>Probable Cause</th>
<th>Recommended Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Er1</td>
<td>Reversed thermocouple connection + to −.</td>
<td>Change the sensor leads on Terminals 1 and 2. A-D under flow</td>
</tr>
<tr>
<td>Er2</td>
<td>Sensor type mismatch or open RTD.</td>
<td>Go to In prompt, check selection (see p. 22), or check RTD, replace as necessary. Sensor under range</td>
</tr>
<tr>
<td>Er3</td>
<td>Sensor type mismatch.</td>
<td>Go to In prompt, check selection (see p. 22). Sensor over range</td>
</tr>
<tr>
<td>Er4</td>
<td>Open Thermocouple, bad</td>
<td>Check the sensor, connection, or broken wire. A-D replace as necessary.</td>
</tr>
<tr>
<td>Er5</td>
<td>Electrical noise.</td>
<td>Cycle power to system. See if error clears. Check system for electrical interference.</td>
</tr>
<tr>
<td></td>
<td>Control is inoperable.</td>
<td>Check for line voltage at terminals 7 and 8.</td>
</tr>
</tbody>
</table>

To Troubleshoot Sensor
• Remove sensor wires from Terminals 1 and 2.
• For a thermocouple sensor Series 935B, place a jumper wire on Terminals 1 and 2. Control should display the ambient temperature at the back of the control.
• For an RTD sensor Series 935B, place a 110 +/- 10 Ω resistor on Terminals 1 and 2. The control should read 100 Ω = 32°F, 110 Ω = 77°F, 120 Ω = 127°F.
• An RTD sensor Series 935B can be configured in software as if it were a thermocouple unit, and then tested as above.
• You can restore factory calibration [rST], see p. 36-37.

Table 14 - Troubleshoot Control Outputs
When indications such as significant differences between set point and actual temperatures point to no output action, check output configurations as described on p. 23. Check wiring, p. 44.

<table>
<thead>
<tr>
<th>Output</th>
<th>Measure Terminals</th>
<th>Load-on State</th>
<th>Load-off State</th>
</tr>
</thead>
<tbody>
<tr>
<td>“C” Output 1</td>
<td>3 &amp; 4</td>
<td>LED 1 on 3.0 to 7.0V= (dc)</td>
<td>LED 1 off 0.0V= (dc)</td>
</tr>
<tr>
<td>“C” Output 2</td>
<td>5 &amp; 6</td>
<td>LED 2 on 3.0 to 7.0V= (dc)</td>
<td>LED 2 off 0.0V= (dc)</td>
</tr>
</tbody>
</table>
Panel Thickness
0.060" to 0.38" (1.5 mm to 9.7 mm)

Figure 9 - Panel Cut-out Dimensions

Figure 10 - Mounting Layout for Knockouts

Layout for four 1/32 DIN knockouts with punch and die

Punch and Die Supplier
Greenlee Textron, Inc., Phone: 1-800-435-0786.
Catalog Number: 50740180; Available: 4-6 weeks, Greenlee distributor.
Dimensions

Figure 11- Series 935B Dimensions

Panel Thickness
0.060" to 0.38"
(1.5mm to 9.7mm)

Panel Cutout

Maximum Overall Depth
4.50" (114.3mm)

0.870"
(22.10mm)

0.50" (12.7mm)

1.770" (44.96mm)

2.09" (53.1mm)

1.14"
(29.0mm)

4.00" (101.6mm)

0.060" to 0.38"
(1.5mm to 9.7mm)
Installing the Series 935B

Installation Procedure

1. Make a panel cutout using the tear-out mounting template, or the dimensions in Figure 9, p. 40.

2. Insert the 935B into the cutout. Check to see that the gasket is not twisted. Make sure the rounded side of the D-shaped external case gasket faces the panel surface, and the gasket is fully seated in its bezel channel. See Figure 12.

3. While pressing the bezel firmly against the panel, slide the mounting collar over the back of the control. The tabs on the collar must line up with the mounting ridges on the case for secure installation. See Figure 12 again.

4. Slide the collar firmly against the back of the panel, getting it as tight as possible. Make sure you cannot move the case within the cutout, if you can, you do not have a NEMA 4X/IP65 seal!

5. Make sure you have a tight seal. Use your thumb to lock the tabs into place while pressing the case from side to side. Don’t be afraid to apply enough pressure to install the control. The tabs on each side of the collar have teeth which latch into the ridges. See Figure 12. 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.

6. Look at Figure 13; you see that the tabs on one side of the collar correspond with those on the opposite side. Be sure only the two corresponding tabs are locked in the ridges at the same time. If the matching tabs are not holding the case, no NEMA 4X/IP65 seal exists. Make a visual check, or use your finger nail to pull out on each tab. The space between the bezel and panel must be 0 to 0.019” (0.48 mm).

Collar Removal

To remove the mounting collar:
Slide a thin, wide tool (putty knife) under all three mounting tabs, top then bottom, while pushing forward on the back of the case.

NOTE: To guarantee a proper NEMA 4X / IP65 seal, make sure the gasket between the panel and the rim of the case is not twisted and is seated properly. Press firmly.

NOTE: Make sure the rounded side of the D-shaped external case gasket faces the panel surface, and the gasket is fully seated in its bezel channel. See Figure 12.
Terminal Block Removal

Figure 14- Terminal Block Removal Procedure

1. Press in on sides of cover to release the terminal cover hooks.

2. Move your grip rearward slightly, then lift the terminal cover straight up.
**Wiring a 935B**

**Figure 15 - Wiring the Series 935B**

**WARNING:** All wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.

### Power Wiring

![Power Wiring Diagram]

**NOTE:** Both Output 1 and Output 2 are DIN-a-mite® compatible.

### Remote Timer Start

(Closed switch = Starts Timer)

![Remote Timer Start Diagram]

**CAUTION:** Using grounded thermocouples with non-isolated output switching devices could introduce ground loops into the control system, and possibly damage the controller and product.

### Front Panel Lock

(Closed switch = locked panel)

![Front Panel Lock Diagram]

**NOTE:** Customer-supplied two-position switch.

### Input Wiring

**NOTE:** Customer-supplied N.O. momentary switch.

**NOTE:** Both Output 1 and Output 2 are DIN-a-mite® compatible.
System Wiring Examples

WARNING: All electrical wiring and fusing must conform to local and national electric codes. Contact local authorities for further information. Failure to comply with electric codes could result in injury or death, or damage to property.

Figure 16 - Series 935B System Wiring Examples

CAUTION: Using grounded thermocouples with non-isolated output switching devices could introduce ground loops into the control system, and possibly damage the grounder and product.

Figure 17 - Series 935B Ladder Diagram Wiring Example
Alarm
A condition, generated by the controller, indicating that the process has exceeded or fallen below the set or limit point.

Alarm Hysteresis
A change in the process variable required to re-energize the alarm output.

Ambient Temperature
Temperature surrounding the components of a thermal system.

Auto-tune
Automatically sets PID values to fit a particular thermal system.

Bumpless Transfer
When transferring from auto to manual operation, the control output(s) will maintain the same output level.

Calibration
Adjusting an instrument to a known value.

Configuration Menu - The second software sub menu of the Series 935B Operations Menu; provides a location to set inputs, ranges, output types, alarm type, timer function, failure mode, and lockout types.

Control Mode
The method of control, i.e. ON/OFF, time proportioning, PI, PID or manual.

Cycle Time
Time required for a control to complete one ON through OFF cycle.

Dead Band
Adjusts the effective cool set point above the primary set point by the dead band value in degrees. In cool/heat applications, dead band prevents continuous cool output action by creating a buffer between heating and cooling output action.

Delay OFF
A Series 935B timer output (Output 2) choice that turns the output OFF at the end of the countdown timer time.

Delay ON
A Series 935B timer output (Output 2) choice that turns the output ON at the end of the countdown timer time.

Derivative
Limits the rate of change of the process to eliminate overshoot in slow or lagging loads (de=ra).

Deviation Alarm
An offset value which tracks the set point. Process changes beyond this value register an alarm condition.

DIN-a-mite®
Watlow family of DIN rail-mounted SCR power controllers.

Droop
The difference between the set point and actual values once the system stabilizes.

Hysteresis
A change in the process variable required to re-energize the control or alarm output.

Idle Set Point
Desired control value before and after timing period.

Integral
Accumulates error to eliminate offset or droop (It=1/re).

Local Set Point
Primary set point, not remote.

ON/OFF
Control by turning the output full ON until set point is reached, and then turning OFF until the process error exceeds the hysteresis.

Operations Menu
Series 935B software menu; provides a location to start auto-tune, set alarm points, set countdown time, choose an idle or normal set point type, and to go to the PID or Configuration Menus.

Overshoot
The amount a process variable exceeds set point before stabilizing.

Percent Power Control
Open loop control with output power set at a particular level.

PID
(Proportional, Integral, Derivative). A control mode; proportional action sets the system, integral reduces droop, derivative reduces overshoot and undershoot.

PID Menu
The first software sub menu of the Series 935B Operations Menu; provides a location to manually set values for proportional band, hysteresis, cycle time, integral, derivative, and calibration offset.

Process Alarm
A fixed value independent of set point. Process changes beyond this value register an alarm condition.

Process Error
The difference between the set point and the actual process.

Proportional
Output effort proportional to the error from set point. If the proportional band is 20° and the process is 10° below set point, the heat proportioned effort is 50%. The lower the Pb value, the higher the gain.

Proportional Band
A range in which a control’s proportioning function is active (See PID).

Range
The area between two limits in which a quantity or value is measured. Usually expressed in terms of lower and upper limits.

Ready Acknowledge
A Series 935B timer output (Output 2) choice that toggles the output ON, then OFF at the end of the countdown timer cycle for a period equal to the signal time.

Ready Band
Thermal area above and below primary set point in which the timer will count down.

Relay, Electromechanical
A power switching device that completes or interrupts a circuit by physically moving electrical contacts. Not recommended for PID control.

RTD
Resistive Temperature Detector. A sensor whose resistance increases with increasing temperature.

Remote Timer Start
Activation of the timer functions using an external remotely mounted switch connected to the 935B RTS input.

Set Point
The desired process value programmed into a control.

Signal
Any electrical transmittance that conveys information.

Signal OFF
A Series 935B timer output (Output 2) choice that toggles the output OFF, then ON at the end of the countdown timer cycle for a period equal to the signal time.

Signal ON
A Series 935B timer output (Output 2) choice that toggles the output ON, then OFF at the end of the countdown timer cycle for a period equal to the signal time.

Signal Time
Time duration the timer output will turn ON or OFF after a complete timing period.

SCR
Silicon controlled rectifier. A solid state device, or thyristor, with no moving parts, that is used in pairs to control AC voltages within one cycle. SCRs control voltage from a power source to the load by burst firing (also called zero-cross firing) or phase angle firing.

SSR
Solid State Relay. A solid state switching device that switches current ON and OFF. It has no moving parts.

Thermal System
A regulated environment consisting of a heat source, heat transfer medium, sensing device, a control instrument, and a redundant control device (limit).

Thermocouple
A temperature sensing device made by joining two dissimilar metals. This junction produces an electrical voltage in proportion to the difference in temperature between the hot junction and lead wire connection to the sensing device (cold junction).

Undershoot
The amount a process variable falls below set point before stabilizing.
### Specifications

**Specifications—(1951)**

**Control Mode**
- Auto-tune PID.
- PID, PD, PI, on/off.
- Countdown timer; hours:minutes, minutes:seconds.
- Timer output modes; Delay-off, Delay-on, Signal-off, Signal-on.

**Agency Approvals**
- UL/C-UL 508, File #E102269.
- NEMA 4X1 (IP65) rated front panel.

**Operator Interface**
- Single, seven-segment digital display, factory selectable red or green.
- Outputs/operation annunciators, three discrete LEDs.
- Three tactile feedback momentary switches.
- Front panel lock dry contact closure disables front panel operation.

**Accuracy**
- ±0.25% of span +/- 1 LSD, or
- Types S and T thermocouple @ < 200°C, ±0.32% of span +/- 1 LSD, typical.

**Ambient Rejection**
- < 0.15°C/°C rise in ambient, or
- Types S and T thermocouple, @ < 0.47°C/°C rise in ambient typical.

**Sensors/Inputs**
- Sensor input sampling rate: 10 samples/second (10Hz).
- Type E, J, K, N, S and T thermocouple, grounded or ungrounded junction.
- RTD, two-wire 100Ω base (DIN) resistance.
- Dry contact closure on RTS input enables remote timer start function or front panel lock, depending on menu selection.

### Input Range

Specified temperature ranges represent the controller's operational span.

<table>
<thead>
<tr>
<th>Thermocouple</th>
<th>Type</th>
<th>Min. to Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type E</td>
<td>-328 to 1470°F (-200 to 799°C)</td>
<td></td>
</tr>
<tr>
<td>Type J</td>
<td>32 to 1382°F (0 to 750°C)</td>
<td></td>
</tr>
<tr>
<td>Type K</td>
<td>-328 to 2282°F (-200 to 1250°C)</td>
<td></td>
</tr>
<tr>
<td>Type N</td>
<td>32 to 2282°F (0 to 1250°C)</td>
<td></td>
</tr>
<tr>
<td>Type S</td>
<td>32 to 2642°F (0 to 1450°C)</td>
<td></td>
</tr>
<tr>
<td>Type T</td>
<td>-328 to 662°F (-200 to 350°C)</td>
<td></td>
</tr>
</tbody>
</table>

### RTD Resolution (DIN)

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Min. to Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1°</td>
<td>-328 to 1292°F (-200 to 700°C)</td>
</tr>
<tr>
<td>0.1°</td>
<td>-199.9 to 999.9°F (-128.8 to 537.7°C)</td>
</tr>
</tbody>
</table>

**Control Output**
- Output update rate: 1/second (1Hz).

**1 Output**
- Switched dc logic signal, 6V (dc) @ 60mA nominal, short circuit protected, non-isolated (Watlow DIN-a-mite® power controller compatible).

**2 Output**
- Switched dc logic signal, 6V (dc) @ 60mA nominal, short circuit protected, non-isolated (Watlow DIN-a-mite® power controller compatible).

**Output Cycle Time**
- Switched dc; 5.0 second default, 0.1 second minimum.

**Line Voltage/Power**
- 100-240V~ (ac) +10%, -15%; (85-264V~ [ac]) 50/60Hz, ±5%.
- Fused internally (factory replaceable only) time-lag type, 2A, 250V.
- Power consumption 6VA maximum.
- Data retention upon power failure via non-volatile memory.

**Operating Environment**
- 32 to 149°F (0 to 65°C).
- 0 to 90% RH, non-condensing.

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

**Terminals**
- Touch-safe set screw type, accepts 22 to 12-gauge wire.

**Controller Weight**
- 4.0 oz (113.4 g).

**Shipping Weight**
- 7.3 oz (208 g).

These specifications are subject to change without prior notice.
Ordering a 935B

Ordering Information—(1952)
935B - 1 C C 0 - 0

Single thermocouple or RTD (DIN) input, dual output, single display temperature control with time function

Output 1/Remote Input
C = Switched dc, logic signal, non-isolated

Output 2
C = Switched dc, logic signal, non-isolated

Power Supply
0 = 100 to 240V~ (ac)

Custom Options
00 = None
AA-ZZ = Consult factory for options

Display
R=Red Displays
G=Green Displays

Table 15 - Input Range Information

<table>
<thead>
<tr>
<th>Type</th>
<th>Range</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>J t/c</td>
<td>32 to 1382°F or 0 to 750°C</td>
<td></td>
</tr>
<tr>
<td>K t/c</td>
<td>-328 to 2282°F or -200 to 1250°C</td>
<td></td>
</tr>
<tr>
<td>T t/c</td>
<td>-328 to 662°F or -200 to 350°C</td>
<td></td>
</tr>
<tr>
<td>N t/c</td>
<td>32 to 2282°F or 0 to 1250°C</td>
<td></td>
</tr>
<tr>
<td>S t/c</td>
<td>32 to 2642°F or 0 to 1450°C</td>
<td></td>
</tr>
<tr>
<td>E t/c</td>
<td>-328 to 1470°F or -200 to 799°C</td>
<td></td>
</tr>
<tr>
<td>1° RTD (DIN)</td>
<td>-328 to 1292°F or -200 to 700°C</td>
<td></td>
</tr>
<tr>
<td>0.1° RTD:</td>
<td>-99.9 to 999.9°F or -99.9 to 700.0°C</td>
<td></td>
</tr>
</tbody>
</table>

To effect NEMA 4X (IP65) rating requires a minimum mounting panel thickness of 0.06 inch (1.5mm) and a surface finish not rougher than 0.000032 inch (0.000812 mm).
Declarations that the following product:  

**Designation:** Series 935  
**Model Number(s):** 935A or B - 1C (C D or K) (0 or 1) - (Any four numbers or letters)  
**Classification:** Control, Installation Category II, Pollution Degree II  
**Rated Voltage:** 100 to 240V~ or 24 to 28V±  
**Rated Frequency:** 50/60 Hz  
**Rated Power Consumption:** 6VA maximum  
**Rated Frequency:** 50/60 Hz  

**Nennspannung:** 100 bis 240 V~ oder 24 bis 28 V±  
**Nennfrequenz:** 50/60 Hz  
**Stromverbrauch:** Max. 6 VA  

**89/336/EEC Electromagnetic Compatibility Directive**  
**EN 50082-2:** 1995 EMC Generic immunity standard, Part 2: Industrial environment  
**EN 61000-4-2:** 1995 Electrostatic discharge  
**EN 61000-4-4:** 1995 Electrical fast transients  
**EN 61000-4-3:** 1996 Radiated immunity  
**EN 61000-4-6:** 1996 Conducted immunity  
**ENV 50204:** 1995 Cellular phone  
**EN 50081-2:** 1994 EMC-Rahmennorm für Emissionen, Teil 2: Industrielle Umgebung  
**EN 55011:** 1991 Baschränkungen und Methoden der Messung von Funkstörungen und Störsignalen der Klasse A  
**EN 61000-3-2:** 1995 Grenzen der Oberwellenstromemissionen  
**EN 61000-3-3:** 1995 Grenzen der Spannungsschwellen und Flicker  
**EN 61010-1:** 1993 Grenzwerte und Methoden der Messung von Funkstörungseigenschaften von industriellen, wissenschaftlichen und medizinischen Hochfrequenzgeräten (Klasse A)  

**73/23/EEC Low-Voltage Directive**  
**EN 61010-1:** 1993 Safety requirements for electrical equipment for measurement, control, and laboratory use, Part 1: General requirements  

**389/336/EEC Directive de compatibilité électromagnétique**  
**EN 50082-2:** 1995 Norme générique immunité 2e partie: Environnement industriel  
**EN 61000-4-2:** 1995 Décharge électrostatique  
**EN 61000-4-4:** 1995 Transitoires rapides électriques  
**EN 61000-4-3:** 1996 Immunité rayonnée  
**EN 61000-4-6:** 1996 Immunité conduite  
**ENV 50204:** 1995 Téléphone cellulaire  
**EN 50081-2:** 1994 Norme générique émission - 2e partie  
**EN 55011:** 1991 Limites de perturbations radioélectriques (Groupe 1, Catégorie A)  
**EN 61000-3-2:** 1995 Niveau de perturbation radioélectrique  
**EN 61000-3-3:** 1995 Limites d’émissions de tension et de pulsation  

**73/23/EEC Directive de basse tension**  
**EN 61010-1:** 1993 Normes de sécurité des équipements électriques de mesure, de contrôle et à usage laboratoire, section 1: normes générales  

Erwin D. Lowell  
Name of Authorized Representative  
Winona, Minnesota, USA  

**General Manager**  
**Title of Authorized Representative**  
**Date of Issue**  

Signature of Authorized Representative
<table>
<thead>
<tr>
<th>Prompt</th>
<th>Range</th>
<th>Default</th>
<th>Hidden if *</th>
<th>Your Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SP</strong></td>
<td>![Range](rL rH)</td>
<td>75°F or 23°C</td>
<td>Appears always</td>
<td></td>
</tr>
<tr>
<td>Primary Set Point</td>
<td>Select a value, adjustable between Input Type Range Low and Input Type Range High.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aut</strong></td>
<td>![Range](no YES)</td>
<td>no</td>
<td>$tA9 = _A$</td>
<td>$tA9 = _A$</td>
</tr>
<tr>
<td>Auto-tune</td>
<td>Choose YES to Autotune the 935A.</td>
<td></td>
<td>or if $Ot1 = Ot2 \neq ALM$</td>
<td></td>
</tr>
<tr>
<td><strong>AlO</strong></td>
<td>![Range](Rh l)</td>
<td>Type J Range Low</td>
<td>$tA9 = _0$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td>Alarm Low</td>
<td>Select a value, adjustable between Range Low and Alarm High.</td>
<td></td>
<td>or if $Ot1 \neq _lm$ or $tMs$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td><strong>Rhl</strong></td>
<td><img src="rLO" alt="Range" /></td>
<td>Type J Range High</td>
<td>$tA9 = _0$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td>Alarm High</td>
<td>Select a value, adjustable between Alarm Low and Range High.</td>
<td></td>
<td>or if $Ot2 \neq _Alm$ or $tPrs$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td><strong>tPrs</strong></td>
<td><img src="0000" alt="Range" /></td>
<td>0</td>
<td>$tA9 = _0$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td>Countdown Timer</td>
<td>Select a countdown time value, adjustable between 00:00 and 99:59 hrs:mins or min:sec.</td>
<td></td>
<td>or if $Ot2 \neq _thr$ or $tPrs$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td><strong>ideL</strong></td>
<td>![Range](trAc rL trAc)</td>
<td>$tA9 = _0$</td>
<td>$tA9 = _0$</td>
<td>$tA9 = _0$</td>
</tr>
<tr>
<td>Idle Set Point Type</td>
<td>Choose an idle Set Point. Trac is an Idle Set Point equal to the Primary Set Point; or select a value between Input Type Range Low and Input Type Range High.</td>
<td></td>
<td>or if $Ot2 \neq _thr$ or $tPrs$</td>
<td>$tA9 = _0$</td>
</tr>
</tbody>
</table>

*NOTE:
All prompts, except **SP** and $tA9$, are hidden if $Ot1 = \_Fpl$. |
<table>
<thead>
<tr>
<th>Prompt</th>
<th>Range</th>
<th>Default</th>
<th>Hidden if *</th>
<th>Your Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PID Menu</td>
<td><img src="image" alt="PID Menu" /></td>
<td>Choose YES to move to the PID Menu.</td>
<td>no</td>
<td><img src="image" alt="PID Menu" /></td>
</tr>
<tr>
<td>Configuration Menu</td>
<td><img src="image" alt="Configuration Menu" /></td>
<td>Choose YES to move to the Configuration Menu.</td>
<td>no</td>
<td>The front panel is locked out.</td>
</tr>
</tbody>
</table>

**PID Menu**

**Proportional Band Heat**

- **Range:** ![Proportional Band Heat](image)
- **Default:** 25°F or 17°C
- **Hidden if *:** ![Proportional Band Heat](image)

**Hysteresis Heat**

- **Range:** ![Hysteresis Heat](image)
- **Default:** 3°F or 2°C
- **Hidden if *:** ![Hysteresis Heat](image)
<table>
<thead>
<tr>
<th>Prompt</th>
<th>Range</th>
<th>Default</th>
<th>Hidden if *</th>
<th>Your Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cycle Time Heat</strong></td>
<td>0.1 60.0 0.5 60.0</td>
<td>1.0 second</td>
<td>( t_{RA} = P ); or if ( PB_{h} = 0 )</td>
<td></td>
</tr>
<tr>
<td><strong>Dead Band</strong></td>
<td>0 999 0 555</td>
<td>0ºF or 0ºC</td>
<td>( t_{RA} = P ); or if ( 0t_{1} = \text{cool} ) and ( 0t_{2} = \text{hEAT} ); or if ( 0t_{1} = \text{hEAT} ) and ( 0t_{2} = \text{cool} )</td>
<td></td>
</tr>
<tr>
<td><strong>Proportional Band Cool</strong></td>
<td>0 999 0 555</td>
<td>25ºF or 17ºC</td>
<td>( t_{RA} = P ); or if ( 0t_{1} = \text{cool} ) and/or ( 0t_{2} = \text{cool} )</td>
<td></td>
</tr>
<tr>
<td><strong>Hysteresis Cool</strong></td>
<td>0.1 999.0 0.1 555.0</td>
<td>3ºF or 2ºC</td>
<td>( t_{RA} = P ); or if ( PB_{c} \neq 0 )</td>
<td></td>
</tr>
<tr>
<td>Prompt</td>
<td>Range</td>
<td>Default</td>
<td>Hidden if *</td>
<td>Your Settings</td>
</tr>
<tr>
<td>--------------</td>
<td>---------------</td>
<td>-------------</td>
<td>------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td><code>e c</code> Cycle Time Cool</td>
<td>0.1</td>
<td>600</td>
<td>5.0 seconds</td>
<td><code>t A9 = P ;</code> or if <code>P b c</code> = 0; or if <code>P b h</code> is hidden</td>
</tr>
<tr>
<td><code>iE</code> Integral Function</td>
<td>0.00</td>
<td>9999</td>
<td>5.00 minutes/repeat</td>
<td><code>t A9 = P ;</code> or if <code>P b h</code> = 0; or if <code>P b c</code> is hidden and if <code>P b c</code> = 0; or if <code>P b c</code> is hidden</td>
</tr>
<tr>
<td><code>dE</code> Derivative Function</td>
<td>0.00</td>
<td>999</td>
<td>0 minutes</td>
<td><code>t A9 = P ;</code> or if <code>P b h</code> = 0; or if <code>P b c</code> is hidden and if <code>P b c</code> = 0; or if <code>P b c</code> is hidden</td>
</tr>
<tr>
<td><code>CAL</code> Calibration Offset</td>
<td>-999</td>
<td>9999</td>
<td>0°F or 0°C</td>
<td><code>t A9 = P </code></td>
</tr>
</tbody>
</table>
### Configuration Menu

<table>
<thead>
<tr>
<th>Prompt</th>
<th>Range</th>
<th>Default</th>
<th>Hidden if</th>
<th>Your Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image" alt="ln" /></td>
<td><img src="Image" alt="J" /></td>
<td><img src="Image" alt="J" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td>Input Type</td>
<td><img src="Image" alt="K" /></td>
<td><img src="Image" alt="K" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="K" /></td>
<td><img src="Image" alt="T" /></td>
<td><img src="Image" alt="T" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="N" /></td>
<td><img src="Image" alt="E" /></td>
<td><img src="Image" alt="E" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="S" /></td>
<td><img src="Image" alt="1.0°RTD" /></td>
<td><img src="Image" alt="1.0°RTD" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="0.1°RTD" /></td>
<td><img src="Image" alt="0.1°RTD" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="C_F" /></td>
<td><img src="Image" alt="°F" /></td>
<td><img src="Image" alt="°F" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td>Celsius/Fahrenheit</td>
<td><img src="Image" alt="°C" /></td>
<td><img src="Image" alt="°C" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="rL" /></td>
<td><img src="Image" alt="ln" /></td>
<td><img src="Image" alt="ln" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td>Range Low</td>
<td><img src="Image" alt="rh" /></td>
<td><img src="Image" alt="rh" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="rH" /></td>
<td><img src="Image" alt="rl" /></td>
<td><img src="Image" alt="rl" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td>Range High</td>
<td><img src="Image" alt="ln" /></td>
<td><img src="Image" alt="ln" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="0E_t" /></td>
<td><img src="Image" alt="heat" /></td>
<td><img src="Image" alt="heat" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td>Output 1 Function</td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="ALM" /></td>
<td><img src="Image" alt="RS" /></td>
<td><img src="Image" alt="RS" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
<tr>
<td><img src="Image" alt="FPL" /></td>
<td><img src="Image" alt="none" /></td>
<td><img src="Image" alt="none" /></td>
<td><img src="Image" alt="C" /></td>
<td><img src="Image" alt="C" /></td>
</tr>
</tbody>
</table>

Choose Heat, Cool, Alarm, Remote Set Point, Front Panel Lock or No output action.
<table>
<thead>
<tr>
<th>Prompt</th>
<th>Range</th>
<th>Default</th>
<th>Hidden if *</th>
<th>Your Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output 2 Function</td>
<td>HEAT COOL</td>
<td>none</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ALRM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>THRM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>none</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose Heat, Cool, Alarm, Timer (Hrs:Min), Timer (Min:Sec) or No output action.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Remote Timer Start</td>
<td>OFF FPL</td>
<td>Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>THRM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose Off, Front Panel Lock, or Timer (Hrs:Min)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display Default</td>
<td>PRNC Prno</td>
<td>Ac</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RC RCSP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose the primary (last 2 characters) and secondary (first 2 characters) Default displays. Press SET to toggle to the secondary display for 15 seconds.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Type</td>
<td>PRNC Prno</td>
<td>Prnc</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RC RCSP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose an alarm type: Process normally closed, Process normally open, Deviation normally closed or Deviation normally open.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Hysteresis</td>
<td>t 999</td>
<td>3°F or 2°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>t 555</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1 999.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.1 555.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select a value in whole degrees (1°F to 999°F or 1°C to 555°C) or in tenths of degrees (0.1°F to 999.0°F or 0.1°C to 555.0°C).</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prompt</td>
<td>Range</td>
<td>Default</td>
<td>Hidden if *</td>
<td>Your Settings</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>---------</td>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>LAT</strong></td>
<td><strong>no</strong></td>
<td><strong>YES</strong></td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Alarm Latch</td>
<td>Choose YES for a Latching Alarm.</td>
<td></td>
<td>or if</td>
<td></td>
</tr>
<tr>
<td><strong>SIL</strong></td>
<td><strong>no</strong></td>
<td><strong>YES</strong></td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>Alarm Silencing</td>
<td>Choose YES for a Silenced Alarm on start-up or silencing during operation.</td>
<td></td>
<td>or if</td>
<td></td>
</tr>
<tr>
<td><strong>FAIL</strong></td>
<td><strong>bPL5</strong></td>
<td><strong>-100</strong></td>
<td>Bumpless</td>
<td></td>
</tr>
<tr>
<td>Input Failure Mode</td>
<td>Choose Bumpless Transfer or Percent Power.</td>
<td></td>
<td>or if</td>
<td></td>
</tr>
<tr>
<td><strong>tIM</strong></td>
<td><strong>dLoN</strong></td>
<td><strong>dLoF</strong></td>
<td>Delay OFF</td>
<td></td>
</tr>
<tr>
<td>Timer Output Function</td>
<td>Choose Delay ON, Delay OFF, Signal ON, or Signal OFF.</td>
<td></td>
<td>or if</td>
<td></td>
</tr>
<tr>
<td><strong>Stt</strong></td>
<td><strong>rdyA</strong></td>
<td><strong>PDr</strong></td>
<td>Immediate</td>
<td></td>
</tr>
<tr>
<td>Start Timer Function</td>
<td>Choose Immediate, Ready Band, Ready Band Acknowledge, or Power.</td>
<td></td>
<td>or if</td>
<td></td>
</tr>
<tr>
<td><strong>rdy</strong></td>
<td><strong>0</strong></td>
<td><strong>999</strong></td>
<td>0°F or 0°C</td>
<td></td>
</tr>
<tr>
<td>Timer Ready Band</td>
<td>0°F or 0°C</td>
<td></td>
<td>or if</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0</strong></td>
<td><strong>555</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.0</strong></td>
<td><strong>999.0</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>0.0</strong></td>
<td><strong>555.0</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Configuration Menu

<table>
<thead>
<tr>
<th>Prompt</th>
<th>Range</th>
<th>Default</th>
<th>Hidden if *</th>
<th>Your Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ST</strong></td>
<td>1 9959</td>
<td>00:01</td>
<td>[tA9] = [C]</td>
<td>Always appears</td>
</tr>
<tr>
<td><strong>Set Time</strong></td>
<td></td>
<td></td>
<td>or if [tIM] ≠ [SGon] or [SGof] 00:01</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>If [tIM] = [SGon] or [SGof], then select a value between 00:01 and 99:59 min:sec.</td>
<td></td>
</tr>
<tr>
<td><strong>SLC</strong></td>
<td>no YES</td>
<td>no</td>
<td>[tA9] = [C]</td>
<td></td>
</tr>
<tr>
<td><strong>Set Point Lockout</strong></td>
<td></td>
<td></td>
<td>Choose YES to Lock the Primary Set Point.</td>
<td></td>
</tr>
<tr>
<td><strong>tA9</strong></td>
<td>PC OA COA</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Lockout Tag</strong></td>
<td>PC O CO PC A CA PC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>POA ORA PO A A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Choose the menus/functions that will not be displayed, and therefore cannot be changed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>P = PID Menu</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C = Configuration Menu (except tag)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>O = Operations Menu (except [tCnF9])</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A = Auto-tune</td>
<td></td>
</tr>
</tbody>
</table>
About Watlow Winona

Watlow Winona is a U.S. division of Watlow Electric Manufacturing Company, St. Louis, Missouri, a manufacturer of industrial electric heating products since 1922. Watlow products include electric heaters, sensors, controllers and switching devices. The Winona operation has been designing solid-state electronic control devices since 1962, and has earned the reputation as an excellent supplier to original equipment manufacturers. These OEMs and end users depend upon Watlow Winona to provide compatibly engineered controls that they can incorporate into their products with confidence. Watlow Winona resides in a 100,000-square-foot marketing, engineering and manufacturing facility in Winona, Minnesota.

Warranty

The Watlow Series 935 is warranted to be free of defects in material and workmanship for 36 months after delivery to the first purchaser for use, providing that the units have not been misapplied. Since Watlow has no control over their use, and sometimes misuse, we cannot guarantee against failure. Watlow’s obligations hereunder, at Watlow’s option, are limited to replacement, repair or refund of purchase price, and parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse, or abuse.

Returns

• Call or fax your distributor or the nearest Watlow sales office for best information about returns. (See outside back cover.)

• To return directly to Watlow Winona in the U.S., first call or fax Customer Service for a Return Material Authorization (RMA) number (telephone: +1 (507) 454-5300; fax: +1 (507) 452-4507).

• Put the RMA number on the shipping label, along with on a written description of the problem.

• A restocking charge of 20% of the net price is charged for all standard units returned to stock.
How to Reach Us

Quality and Mission Statement:
To position Watlow Winona as the world’s best supplier of superior thermal solutions, by exceeding the expectations of our customers, shareholders, and employees.

Europe:
Watlow Electric GmbH
Lauchwasenstr. 1, Postfach 1165,
Kronau 76709 Germany
Telephone: +49 (0) 7253 9400
Fax: +49 (0) 7253 9400 99

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

Watlow Italy S.r.l.
Via Meucci 14
20094 Corsico, Milano Italy
Telephone: +39 (02) 458 8841
Fax: +39 (02) 458 69954

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

Asia/Pacific:
Watlow Australia Pty. Ltd.
3 Belmont Place, Gladstone Park,
Tullamarine, Victoria 3043 Australia
Telephone: +61 (3) 9335 6449
Fax: +61 (3) 9330 3566

Watlow China, Inc.
179, Zhong Shan
Hong Qiao Cointek Bldg., Fl. 4, Unit P
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Fax: +86 21-6228-4654

Watlow Japan Ltd. K.K.
Azabu Embassy Heights 106,
1-11-12 Akasaka,
Minato-ku, Tokyo 107-0052 Japan
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Fax: +61 (3) 9330 3566

Watlow Korea
3rd Fl. DuJin Bldg.
158 Samsun-dong, Kangnam-ku
Seoul, 135-090 Korea
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Fax: +82 (02) 563 5779

Watlow Singapore Pte. Ltd.
38-B Jalan Tun Dr. Awang
Bayan Lepas
Penang, Malaysia 11900
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Fax: +60 (4) 641-5979

Latin America:
Watlow de México
Av. Fundición #5,
Col. Parques Industriales,
Querétaro, Qro. México CP-76130
Telephone: +52 (42) 17 6235
Fax: +52 (42) 17 6403

For other information:
Watlow FAX REPLY: (908) 885-6344 (outside the U.S.); or (800) 367-0430 (inside the U.S.)