SELECTRONIX, INC.
WOODINVILLE, WA

SUPERSTEP SERIES 4000
SEQUENCING STEP
CONTROLLERS

INSTALLATION & OPERATING
ADDENDUM
FOR THERMISTOR AND GENERAL PURPOSE SETPOINT CONTROL
INPUT CONFIGURATIONS
Introduction

This addendum describes 3 additional input configurations for the Series 4000. All other input configurations and features are retained. The thermistor and general purpose control additions, make the Series 4000 a cost-effective, stand-alone temperature or pressure sequencing controller.

Thermistor Input Control

- Provides closed-loop, temperature regulation, for legacy configurations of 2200 ohm, series-connected thermistor sensor and set point adjuster.
- Direct-acting or Reverse-acting operation is determined by field wiring.
- Programmable size of throttling band, or deadband control width.
- The Load Limiter input, also referred to as ‘Manual Reset’, controls the maximum quantity of stages to activate, of the available relays.

General Purpose Set Point Control

- Provides closed-loop control of temperature and pressure, for staged electric control applications, including hot water, steam boilers.
- Set Point sources include:
  - Potentiometer
  - 0-1.24 VDC
- Sensor input sources are:
  - 0-5V
  - 4-20 ma
  - Thermistor
  - RTD (100 ohm)

Programmable size of throttling band, or deadband control width.

Programmable Direct-acting or Reverse-acting control

0-5 VDC Input Configuration

- Additional input configuration
1 Thermistor Input Control

The thermistor control configuration is compatible with legacy series-connected thermistor sensor and set point adjusters, which provide a constant resistance at the set point. An industry standard combination is 2200 ohms.

The Series 4000 controller determines the quantity of output relays to activate, by sensing the imbalance of the thermistor/set point adjuster combination, with an external resistor of the same combined value. Direct-acting or reverse-acting operation is determined by the choice of field wiring connections. For most boiler applications, the desired configuration is direct-acting operation, where a drop in temperature, causes more stages to activate. By using an external resistor, the controller is compatible with any combination of thermistor and set point adjusters, which provide a constant resistance at the set point.

The throttling range or deadband size is field-programmable.

The load limiter input, which limits the quantity of available stages to utilize, is often used to avoid peak demand charges, during certain seasons. This input is controlled by an external potentiometer, and is available for use with the thermistor input configuration.

1.1 Required Control Components

A series-connected, combination of thermistor sensor and set point adjuster, which has a constant resistance at the set point.

1.1.1 Thermistor Sensor

Use sensors that have a compatible series-connected set point adjuster.

Compatible sensors with various temperature ranges are:

- Indeeco (formerly Solitech) 310 Series Thermistor Sensors

1.1.2 External Resistor

Use a 1%. ¼ watt or greater, resistor that matches the series-connected resistance, at the setpoint. For 2200 ohm input, use a 2210 ohm, 1%, ¼ watt resistor.

1.2 Input Configuration Settings – Thermistor Input

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>SW1-2</th>
<th>SW1-3</th>
<th>SW1-4</th>
<th>SW1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>On</td>
</tr>
</tbody>
</table>

1.2.1 Thermistor Set Point Adjuster

Use set point adjusters that have compatible series-connected sensors.

Compatible set point adjusters are:

- Indeeco (formerly Solitech) 320 Series Set Point Adjusters
1.3 Programming Deadband Width

The controller adjusts the quantity of output stages based on the deviation from the balance, or quiescent point. The amount of deadband width determines the sensitivity of the controller. The more deadband width, the less sensitive the controller is to changes of the sensor. The default sensitivity will maintain approximately +/– 1 degree F temperature change. The maximum deadband width maintains a +/– 10 degree F change. This assumes a thermistor with a temperature coefficient of approximately -20 ohms/degree F.

The User-defined limits are used to store the deadband width setting. Use the following steps to adjust the deadband width:

1.3.1 Obtain a potentiometer with a total resistance of between 1K ohms and 5K ohms.

1.3.2 With the control power off, temporarily disconnect the thermistor network, and connect the pot according to the following diagram:

1.3.3 Set the Input Cfg switches to program the User-defined limits

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>SW1-2</th>
<th>SW1-3</th>
<th>SW1-4</th>
<th>SW1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

1.3.4 Apply control power, and verify the status LED is flashing Red, then Grn, at 1 Hz, indicating the programming mode.

1.3.5 Adjust the pot to the desired deadband width. Full CW is the largest width (the least sensitive response). Full CCW is the most responsive setting, and also is the default. Any setting in between, causes a proportional deadband width.

1.3.6 Press and hold the TestUp pushbutton for greater than 1 second, until the status LED turns off, then cycles Grn, Org, and Red. It returns to flashing Red and Grn.

1.3.7 Turn off control power

1.3.8 Disconnect the programming pot, and reconnect the thermistor and set point adjuster.
1.3.9 Set the Input Cfg switches to Thermistor Input Control

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>SW1-2</th>
<th>SW1-3</th>
<th>SW1-4</th>
<th>SW1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>On</td>
</tr>
</tbody>
</table>

1.3.10 Turn on control power and verify the desired sensitivity by adjusting the set point adjuster to determine where the outputs are adjusted.

### 1.4 Calibrating the Set Point Adjuster

Due to minor differences in component tolerances, it may be necessary to calibrate the set point adjuster knob to indicate the actual set point temperature.

1.4.1 When the sensed medium is at a known temperature, adjust the knob of the set point adjuster to the same temperature.
1.5 Field Wiring Configurations

For normal boiler or heater applications, where a drop in temperature causes more stages to activate, use the following configuration:

For cooling or other applications, where a rise in temperature causes more stages to activate, use the following configuration:
2 General Purpose Set Point Control

The General Purpose Set Point control configuration provides a closed-loop, deadband control, with a field programmable deadband or sensitivity width. The control accepts a number of different sensor outputs, including 0-5 VDC, 4-20 ma, RTD, thermistor, and 0-1.24 V.

The set point input, connected to TB4, TB5, and TB6, may be a potentiometer or 0-1.24 VDC signal.

As with the thermistor input configuration, the quantity of output relays to activate is determined by sensing the imbalance of the sensor input with that of the set point adjuster input.

With RTD and thermistor inputs, an external resistor is required to establish the balance point voltage. The resistor is sized to match the series resistance of the RTD or thermistor near its set point value. This provides a resistor divider sourced by the 1.24 VDC reference.

The throttling range or deadband size is field programmable. Direct-acting or reverse-acting operation is also field programmable. See “Programming General Purpose Set Point Deadband Width and Other Options”.

The load limiter function is not available with the General Purpose Set Point control, as the input is used by the set point input.

2.1 Required Control Components

For RTD and thermistor sensors, an externally-mounted resistor with a value approximating the set point resistance is required. Use a 1%, ¼ Watt resistor.

2.1.1 Compatible Sensors

Any sensors that provide:
- 0-5 VDC
- 4 – 20 ma
- RTD
- 0-1.24 VDC
- Thermistor
- Other voltages accommodated by adding an external resistor divider.

2.1.2 External Resistor

For RTDs, use a 100 ohm, 1% ¼ Watt resistor. This creates an approximate 50% sensor input about the desired set point.

For thermistors, use a 1%, ¼ watt or greater, resistor that approximates the resistance of the thermistor at the desired set point. This creates an approximate 50% sensor input about the desired set point.

2.2 Sensor Input Configuration Settings

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>SW1-2</th>
<th>SW1-3</th>
<th>SW1-4</th>
<th>SW1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off for 0-5VDC</td>
<td>On for 0-5 VDC</td>
<td></td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>On for 4-20 ma</td>
<td>Off for 4-20 ma</td>
<td>Off</td>
<td></td>
<td>Off</td>
</tr>
<tr>
<td>Off for RTD</td>
<td>Off for RTD</td>
<td>Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off for 0-1.24V</td>
<td>Off for 0-1.24 V</td>
<td>Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off for thermistor</td>
<td>Off for thermistor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.2.1 Compatible Set Point Adjusters

The controller attempts to balance the set point value, with the sensor input. Any imbalance, outside of the deadband, results in the specified control action. The set point input, therefore, needs to provide a reference that closely approximates the sensor’s input at the desired set point.

Example 1:
- The selected sensor provides a 0-5 VDC signal, with a desired set point that outputs 4.2 VDC.
- This signal is reduced by the input attenuation network by 4:1 resulting in a 1.05 V signal.
- The set point adjuster needs to provide this same reference and may do so by using a potentiometer utilizing the on-board 1.24V reference.
- The 1.05 VDC set point voltage could, alternatively, be supplied directly by some other controller.
- To accommodate a 4-20 ma set point signal, an external 61.9 ohm resistor connected between TB5 and TB6 provides the load resistor, so that at 17 ma, the 1.05 VDC is produced.
- For 0-5 or 0-10 VDC set point signals, suitable external resistors producing the desired voltage between TB5(+) and TB6(-) is acceptable.

To provide for fine resolution of the set point value, connect fixed or variable resistors, in series with either or both sides of the potentiometer, which will establish the desired minimum and maximum operating range for the potentiometer. Total resistance for the set point network should be between 1K to 5K ohms. A regulated 1.24V is provided at TB4(+) referenced to TB6(-).

2.3 Programming Deadband Width and Other Options

The controller adjusts the quantity of output stages based on the deviation from the balance, or quiescent point. The amount of deadband width determines the sensitivity of the controller. The more deadband width, the less sensitive the controller is to changes of the sensor. The default sensitivity will maintain approximately +/- 0.4% of the full input signal range. The least sensitive setting is approximately +/- 2.9% of the input signal range.

The User-defined limits are used to store the deadband width setting. Use the following steps to adjust the deadband width:

2.3.1 Obtain a potentiometer with a total resistance of between 1K ohms and 5K ohms.

2.3.2 With the control power off, temporarily disconnect any wires connected to TB1, TB2, and TB3, and connect the pot according to the following diagram:

```
  SLC4000
  TB1 (B) 1.24 V Ref
  TB2 (R) Cmd Input
  TB3 (W) Sig Com

1K to 5K Pot
```

2.3.3 Set the Input Cfg switches to program the User-defined limits

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>SW1-2</th>
<th>SW1-3</th>
<th>SW1-4</th>
<th>SW1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>
2.3.4 Apply control power, and verify the status LED is flashing Red, then Grn, at 1 Hz, indicating the programming mode.

2.3.5 Adjust the pot to the desired deadband width. Full CW is the largest width (the least sensitive response). Full CCW is the most responsive setting, and also is the default. Any setting in between, causes a proportional deadband width.

2.3.6 Press and hold the TestUp pushbutton for greater than 1 second, until the status LED turns off, then cycles Grn, Org, and Red. It returns to flashing Red and Grn.

2.3.7 For direct-acting or reverse-acting control, there a few choices:

- If a potentiometer is being used as the set point control, simply switching the CW with the CCW terminals, will switch the control sense.

- If the sensor is either an RTD or a thermistor, then switching the connections with the fixed resistor, will switch the control sense.

- If a voltage or current source is being used for both the sensor and the set point command, then the following field programmable method accomplishes the control sense change. For direct-acting, which is when the sensor input is lower than the set point input, and more relays are to be activated, turn the pot to full CCW. For reverse-acting control, turn the pot to full CW.

Press and hold the TestDn pushbutton for greater than 1 second, until the status LED turns off, then cycles Grn, Org, and Red. It returns to flashing Red and Grn.

2.3.8 Turn off control power

2.3.9 Disconnect the programming pot, and reconnect the sensor input.

2.3.10 Set the Input Cfg switches to General Purpose Set Point Control per section 2.2

2.3.11 Turn on control power and verify the desired sensitivity by adjusting the set point adjuster to determine where the outputs are adjusted.

### 2.4 Calibrating the Set Point Adjuster

Due to minor differences in component tolerances, it may be necessary to calibrate the set point adjuster knob to indicate the actual set point temperature.

2.4.1 When the sensed medium, is at a known temperature, adjust the knob of the set point adjuster to the same temperature.
2.5 Field Wiring Configurations

For heating or other applications, where a rise in temperature causes more stages to activate, use the following configuration. See “Programming Deadband and Other Options” to change to reverse-acting control.

Example showing voltage or current loop connections
3 0-5 VDC Input Configuration

3.1.1 Set the Input Cfg switches to program the User-defined limits

<table>
<thead>
<tr>
<th>SW1-1</th>
<th>SW1-2</th>
<th>SW1-3</th>
<th>SW1-4</th>
<th>SW1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>On</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

**Configuration Switches**

- Turn switch ON by pressing down on the side of the switch closest to the legend number.
- The logic state of all switches, except the ON DELAY MINUTES and the OFF DELAY SEC are changeable, **only when all the relays are off**. This prevents inadvertent configuration changes during normal operation.
### 4 Input Configuration Switch Table

<table>
<thead>
<tr>
<th>Signal Type</th>
<th>SW1-1 Current Loop</th>
<th>SW1-2 Input Attn</th>
<th>SW1-3 Input Type</th>
<th>SW1-4 Input Type</th>
<th>SW1-5 Input Type</th>
<th>User-Defined Upper Lmt or Control Option</th>
<th>User-Defined Lower Lmt or Control Option</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-10 VDC</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>Factory Default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>Off</td>
<td>On</td>
<td>On</td>
<td>On</td>
<td>Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 VDC</td>
<td>Off</td>
<td>On</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-20 ma</td>
<td>On</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>On</td>
<td></td>
<td></td>
<td>Input loop resistance is 62 ohms</td>
</tr>
<tr>
<td>Ohmic</td>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
<td>Range is 0 ohms to anything between 100 and 5000 ohms Dry contact between TB1 and TB2 Connect a 10K ext resistor between TB2 and TB3 or connect DPST with NC contact between TB2 and TB3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Slidewire) or Dry Contact</td>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>Off</td>
<td>Current loop and input attenuator enabled as applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User-defined</td>
<td>See: Note 1</td>
<td>See: Note 2</td>
<td>Off</td>
<td>On</td>
<td>On</td>
<td>Defines Upper Lmt</td>
<td>Defines Lower Lmt</td>
<td>Current loop and input attenuator enabled as applicable</td>
</tr>
<tr>
<td>GenPurp Setpoint Controller</td>
<td>See: Note 5</td>
<td>See: Note 5</td>
<td>Off</td>
<td>On</td>
<td>Off</td>
<td>Sets Deadband Width</td>
<td>Direct or ReverseActing</td>
<td>See Note 4</td>
</tr>
<tr>
<td>Thermistor Setpoint Controller</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>On</td>
<td>Sets Deadband Width</td>
<td>May also utilize Load Limiter feature</td>
<td></td>
</tr>
<tr>
<td>Program User Input Range OR Control Options</td>
<td>See: Note 1</td>
<td>On to use the voltage divider netwrk Off for direct</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
<td>TestUp button pgms Upper Lmt value</td>
<td>TestDn button pgms Lower Lmt value</td>
<td>Press TestUp for &gt;1 sec Sequences Off, Grn, Org, and Red confirms Upper range pgm'd</td>
</tr>
</tbody>
</table>

**Note 1:** SW1-1 ON connects a 62 ohm resistor to circuit common, for use with current loop inputs.

**Note 2:** SW1-2 ON attenuates the input signal by 25%. Resistor divider of 5.9K and 2.0K.

**Note 3:** For series-connected 2200 ohm Thermistor and Setpoint Adjuster combination, add an external 2.21K ohm, 1%, ¼ watt min. See wiring diagram. For other series-connected Thermistor/Setpoint Adjuster combinations, add an external resistor matching the series combination resistance.

**Note 4:** Use 1K pot to pgm User-defined Low Lmt: Less than 50% is DirectActing, more than 50% ReverseActing control option.
**Note 5: THE FOLLOWING TABLE IS FOR THE GENERAL PURPOSE SETPOINT CONTROLLER:**

1) A Sensor is connected to the normal Command Input terminals TB1, TB2, TB3.
2) The command input is connected to TB4, TB5, and TB6.
3) THE LOAD LIMIT FUNCTION IS NOT AVAILABLE WITH THIS INPUT CONFIGURATION

<table>
<thead>
<tr>
<th>Input</th>
<th>SW1-1</th>
<th>SW1-2</th>
<th>TB1-TB2</th>
<th>TB2-TB3</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5 VDC</td>
<td>Off</td>
<td>On</td>
<td>None</td>
<td>TB2(+) TB3(-)</td>
<td>Req Ext 7.87K ohm 1%, 1/4w resistor in series with input signal and TB2</td>
</tr>
<tr>
<td>0-10 VDC</td>
<td>Off</td>
<td>On</td>
<td>None</td>
<td>TB2(+) TB3(-)</td>
<td>DirectActing For ReverseActing use User-defined option</td>
</tr>
<tr>
<td>4-20ma</td>
<td>On</td>
<td>Off</td>
<td>None</td>
<td>TB2(+) TB3(-)</td>
<td>DirectActing For ReverseActing use User-defined option</td>
</tr>
<tr>
<td>Thermistor</td>
<td>Off</td>
<td>Off</td>
<td>Ext resistor with ohms close to set pt R of thermistor</td>
<td>Thermistor</td>
<td>DirectActing</td>
</tr>
<tr>
<td>Thermistor</td>
<td>Off</td>
<td>Off</td>
<td>Thermistor</td>
<td>Ext resistor with ohms close to set pt R of thermistor</td>
<td>ReverseActing</td>
</tr>
<tr>
<td>100 ohm RTD</td>
<td>Off</td>
<td>Off</td>
<td>100 ohm, 1%, 1/4W Resistor</td>
<td>100 ohm RTD</td>
<td>DirectActing</td>
</tr>
<tr>
<td>100 ohm RTD</td>
<td>Off</td>
<td>Off</td>
<td>100 ohm RTD</td>
<td>100 ohm, 1%, 1/4W Resistor</td>
<td>ReverseActing</td>
</tr>
</tbody>
</table>