SMSC-TC Thermocouple Input, Field Configurable Signal Conditioner

**Description**

The SMSC-TC isolating thermocouple conditioner offers wide ranging input and output capability. The SMSC-TC can be field configured by the user to accept input from thermocouple types J, K, T, R, S, E, and B and to provide current or voltage output. The output is linearized to temperature according to the particular thermocouple type.

The SMSC-TC is a three-port industrial isolator — the output is optically isolated from the input up to 1500V, and both input and output are transformer isolated from the line power. Isolation allows the noise reduction benefits of grounded thermocouples to be maintained without creating ground loop problems and it provides faster response. The SMSC-TC utilizes the latest in advanced analog/digital signal processing technology. In addition to its microprocessors, it employs special ASIC circuitry for high accuracy and reliability.

The SMSC-TC is equipped with cold-junction compensation (CJC) circuitry to provide ice-point reference. Upscale, downscale or disabled thermocouple burnout detection is switch selectable.

**Application**

The AP431 is useful in any application requiring an isolated DC output from a thermocouple input. Typical applications include energy management and data acquisition of process temperatures. The output of the SMSC-TC can drive a digital meter for direct display or interface with a computer for monitoring and control applications.

**Status LEDs**

Model SMSC-TC is equipped with top-mounted LEDs for INPUT (green), TROUBLE (yellow) and CAL OK (yellow). At start-up, both the INPUT and CAL 5K LED lights up momentarily for 1 second. Afterwards, these LEDs flash alternately for 10 seconds while start-up takes place.

**Input LED**

This input LED is a diagnostic tool. It remains continuously lit if the measured temperature is within the selected range of the thermocouple. However, if the measured temperature is outside the full range of the thermocouple (for example, for a type J - below minus 200°F or above 750°F), the LED will flash at a rate of 4 or 8Hz for under/over range, respectively. If the thermocouple is within the full temperature range, but outside the selected sub-range (for example, if a type J thermocouple is set for range 13 and the temperature is either below 375°F or above 500°F) the LED will flash at 0.5 or Hz respectively.

**Trouble LED**

This LED is continuously on when the device is properly storing the factory calibration reference voltage.

**Options**

- Uses urethane coating of internal circuitry for protection from corrosive atmospheres.
- C620 Factory calibration (specify input thermocouple type, temperature range and output).

**Configuration**

A major advantage of the SMSC-TC is its wide ranging capabilities and ease of configuration. The SMSC-TC enables 50% input zero and span adjustability within the selected sub-range.

For example, range #5 for an E-Type thermocouple in Table 6 specifies -18°C to 125°C. Since the span can be contracted by 50%, this enables an input range of 50°C to 125°C, or 72°C. This span can then be positioned anywhere within the temperature range and can have a zero step-up as large as 50% of the full scale range (e.g. span can start up as high as 53°C).

Unless otherwise specified, the factory pre-sets the Model SMSC-TC as follows:

- Input: J-type
- Output: 0-500ºF
- Burn Out: Upscale

**Specifications**

**Inputs:**
- Ranges: field configurable, see Table 6
- Impedance: >1M Ohms
- Input Bias Current (burnout detection): <1.5 microamps
- Overvoltage: >10V differential
- Common Mode (Input to Ground): 1500VDC or peak AC, max
- Zero and Span Range: 0 to full of full scale range
- Span Turn-Down: 100 to 100% of full scale range

** Outputs:**
- Voltage Output: field-configurable
- Ranges: 0-V, 0-10V
- Impedance: 10kΩ, max
- Drive: 10mA, max (1k Ohms, min)
- Current Output: field-configurable
- Ranges: 0-1mA, 4-20mA
- Impedance: >10kΩ
- Compliance: 10V, max (500 Ohms, max. >20mA)

**Pin Connections**

1. Power (+)
2. No Connection
3. Power (Nau)
4. Do not use
5. Input (+)
6. Output (+)
7. Output (-)
8. Input (-)

**Accuracy (Including Linearity, Hysteresis):**
- see Table 6
- Response Time (10-90%): 500 microsec, typical
- Stability: ±0.04%/°C of full scale range
- Isolation: 1500VDC or peak AC between input, output and power

**ESD Susceptibility:**
- Meets IEC 801-2, Level 2 (1kV)
- Common Mode Rejection: DC -60kV: 120dB

**LED Indicators:**
- TROUBLE LED: Yellow - off if within normal device operation
- INPUT LED: Green - continuously on if input is within selected range, flashes otherwise
- CAL OK LED: Yellow - continuously on in normal device operation

**Thermocouple Burnout Detection:**
- Field-configurable Up or Downsacle, or disabled

**Humidity (Non-Condensing):**
- Operating: 0 to 95% (2°C to 40°C)
- Storage: -15 to 75°C (5 to 167°F)
- Power: Consumption: 3W typical, 5W max
- Standard: 120vac ±10%, 50 - 60Hz
- Optional: 240VAC
- Weight: 0.62lbs
- Approvals: UL recognized per standard UL508. (File No. E99775)

**Specifications**

- Provides Isolated, Linearized DC Output in Proportion to Thermocouple Input
- Field Configurable Thermocouple Types
- Linearized Outputs
- Wide-Ranging Zero and Span Adjustability (50%)
- Eliminates Ground Loops
- Thermocouple Burnout Detection
- ASIC Technology for Enhanced Reliability
For other settings, remove the four base screws and polycarbonate case to access the configuration switches.

Refer to Tables 1 through 6 and Figures 1 through 3 for the proper switch locations and settings. Using the switch on the input board, select thermocouple type, temperature range, and thermocouple burnout detection. Using the switch on the output board, select desired type of output. Replace the case prior to applying power to the unit.

Calibration
1. Connect the input to a calibrated thermocouple source and apply power. Wait 1-2 hours for thermal stability before monitoring the voltage/current output. Refer to PIN CONNECTIONS.

2. Set the calibrator to the desired minimum input and adjust the zero potentiometer for the desired minimum output.

3. Set the calibrator to the desired maximum input and adjust the span potentiometer for the desired maximum output.

4. Repeat steps 2 and 3, as necessary, for best accuracy.

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Number</th>
<th>Temperature Range</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>-150 to 400°C (-238 to 752°F)</td>
<td>±2°C (0°F)</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>-200 to 1200°C (-328 to 2122°F)</td>
<td>±4°C (6°F)</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>-150 to 0°C (-238 to 32°F)</td>
<td>±4°C (6°F)</td>
</tr>
</tbody>
</table>

Table 2: Thermocouple burnout detection switch settings (SW 1 on Input Board)

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Range</th>
<th>Input</th>
<th>Offset</th>
<th>On/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Range</th>
<th>Input</th>
<th>Offset</th>
<th>On/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
</tbody>
</table>

Table 3: Output switch settings (SW 1 on Output Board)

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Range</th>
<th>Input</th>
<th>Offset</th>
<th>On/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Range</th>
<th>Input</th>
<th>Offset</th>
<th>On/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
</tbody>
</table>

Table 4: Output switch settings (SW 1 on Output Board)

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Range</th>
<th>Input</th>
<th>Offset</th>
<th>On/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>OFF</td>
<td>ON</td>
<td>ON/ON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Range</th>
<th>Input</th>
<th>Offset</th>
<th>On/Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, J</td>
<td>1</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>K</td>
<td>2</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
<tr>
<td>T</td>
<td>8</td>
<td>OFF</td>
<td>ON</td>
<td>OFF/ON</td>
</tr>
</tbody>
</table>

Table 5: SMSC-TC Accuracy

<table>
<thead>
<tr>
<th>TC Type</th>
<th>Temperature Range (°C)</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>-20 to 80°C (-4 to 176°F)</td>
<td>±2°C (0°F)</td>
</tr>
<tr>
<td>K</td>
<td>-200 to 1200°C (-328 to 2122°F)</td>
<td>±4°C (6°F)</td>
</tr>
<tr>
<td>T</td>
<td>-150 to 0°C (-238 to 32°F)</td>
<td>±4°C (6°F)</td>
</tr>
</tbody>
</table>

Table 6: Thermocouple Range Settings

Mounting
All models feature plug-in installation. Model SMSC-TC uses an 8-pin base and molded-sockets SKT-SM-8P, or DIN-socket SKT-DR-8P.

Dimensions
Dimensions are in millimeters (inches)