SCXI™-1327 TERMINAL BLOCK

Introduction

This document contains information and step-by-step instructions for verifying the temperature sensor and voltage attenuator performance of the National Instruments SCXI-1327 terminal block.

What Is Calibration?

For SCXI-1327 terminal blocks, calibration is simply determining the measurement accuracy of the components on the terminal block. Because these components are not user-adjustable, calibration consists of a verification procedure only.

Why Calibrate?

Electronic components drift with time, which can affect measurement accuracy as the device ages. Calibration ensures that your SCXI-1327 terminal block is still meeting National Instruments standards. If the results of the procedure indicate that your terminal block is out of specification, return it to National Instruments for repair.

How Often Should You Calibrate?

The measurement accuracy requirements of your application determine the calibration interval of your SCXI-1327 terminal block. National Instruments recommends you perform a complete calibration at least once every year. You can shorten this interval to six months or 90 days, based on the demands of your application.

Equipment and Other Test Requirements

This section describes the equipment, software, documentation, and test conditions needed for verification.

Test Equipment

Verification requires a high-precision voltage source with at least 50 ppm accuracy, and a multiranging 5 1/2 digit digital multimeter (DMM) with 15 ppm accuracy.

National Instruments recommends you use the following instruments for verification of an SCXI-1327:

- Calibrator—Fluke 5700A
- DMM—NI 4060 or HP34401A

If the exact instrument is not available, use the accuracy requirements listed above to select a substitute calibration standard.

Software and Documentation

No software is required to verify the operation of the SCXI-1327. All required documentation is found in this calibration procedure. However, if you would like more information on the product, refer to the *SCXI-1327 Terminal Block Installation Guide.*

Test Conditions

Follow these guidelines to optimize the connections and the environment during verification:

- Keep connections to the SCXI terminal block short. Long cables and wires act as antennae, picking up extra noise that can affect measurements.
- Use shielded copper wire for all cable connections to the device. Use twisted-pair wire to eliminate noise and thermal offsets.
- Keep relative humidity below 80%.
- Maintain temperature between 15 °C and 35 °C.

Verification Procedures

The following procedures allow you to verify the performance of two key components of your SCXI-1327: the temperature sensor and the voltage attenuator.

Temperature Sensor Verification Procedure

1. Connect a +5 VDC power source to the terminal block.
   a. Hold the terminal block vertically and view it from the rear. The terminals on the 96-pin DIN connector are designated as follows for the purposes of this procedure:
      – Column A is on the right, Column B is in the middle, and Column C is on the left.
      – Row 1 is at the bottom and Row 32 is at the top.
      – Individual pins are identified by their column and row. For example, “A3” denotes the terminal located in Column A and Row 3.

      This conforms to the labeling of pins on the front connector of a matching SCXI module. It does not necessarily correspond to the labeling of pins on the rear of the terminal block connector itself, which you can only view by opening the terminal block enclosure.
   b. Strip 0.5 in. of insulation from one end of a 22 AWG solid wire. Insert the stripped end of the wire into terminal **A4** on the 96-pin female DIN connector on the rear of the terminal block. Attach the other end of this wire to the **positive** terminal of the +5 VDC power supply.
   c. Strip 0.5 in. of insulation from one end of a 22 AWG solid wire. Insert the stripped end of the wire into terminal **A2** on the 96-pin female DIN connector on the rear of the terminal block. Attach the other end of this wire to the **negative** terminal of the +5 VDC power supply.
2. Connect a calibrated DMM to the temperature sensor output of the terminal block.
   a. Strip 0.5 in. of insulation from one end of a 22 AWG solid wire. Insert the stripped end of the wire into terminal **C4** on the 96-pin female DIN connector on the rear of the terminal block. Attach the other end of this wire to the positive input terminal of the calibrated DMM.
   b. Connect the negative input terminal of the calibrated DMM to the negative terminal of the +5 VDC power supply.

3. Place the terminal block in a temperature-controlled environment where the temperature is between 15 °C and 35 °C.
4. When the terminal block temperature equilibrates with it surroundings, measure the temperature sensor output $\mathbf{V_{meas}}$ using a calibrated DMM.
5. Measure the actual temperature $\mathbf{T_{act}}$ in the temperature-controlled environment using a calibrated temperature-measurement instrument.
6. Convert $\mathbf{V_{meas}}$ (in volts) to measured temperature $\mathbf{T_{meas}}$ (in degrees Celsius) by performing the following calculation.
   a. Calculate.

$$x = \frac{2.5 - V_{meas}}{5000}$$

   b. Calculate.

$$y = \ln\left(\frac{V_{meas}}{x}\right)$$

   c. Calculate.

$$T_{meas} = \left[\frac{1}{a + y\left(b + cy^2\right)}\right] - 273.15$$

   where $\mathbf{T_{meas}}$ is in °C.

$$a = 1.295361 \times 10^{-3}$$

$$b = 2.343159 \times 10^{-4}$$

$$c = 1.018703 \times 10^{-7}$$

7. Compare $\mathbf{T_{act}}$ to $\mathbf{T_{meas}}$.
   - If $(\mathbf{T_{meas}} - 0.5\ °C) \le \mathbf{T_{act}} \le (\mathbf{T_{meas}} + 0.5\ °C)$, then the operation of the terminal block temperature-sensor has been verified.
   - If $\mathbf{T_{act}} < (\mathbf{T_{meas}} - 0.5\ °C)$, the terminal block temperature sensor is nonfunctional. Return the terminal block to National Instruments for repair or replacement.
   - If $\mathbf{T_{act}} > (\mathbf{T_{meas}} + 0.5\ °C)$, the terminal block temperature sensor is nonfunctional. Return the terminal block to National Instruments for repair or replacement.

Voltage Attenuator Verification Procedure

1. Open the terminal block enclosure by removing the side cover.
2. Place slide switches S1 through S16 in the "100:1" position.
3. Locate RP1 (resistor package 1) on the printed circuit board. Note that one end of RP1 is marked with a dot. This dot identifies pin 1. RP1 has a total of five pins, numbered in order starting from pin 1. The voltage divider in RP1 is associated with channel 0 on the terminal block.
4. Using a calibrated DMM, measure the resistance $\mathbf{R_{meas1}}$ between pins 1 and 3.
5. Using a calibrated DMM, measure the resistance $\mathbf{R_{meas2}}$ between pins 3 and 5.
6. Calculate.

$$Atten = \frac{R_{meas\,2}}{R_{meas\,1} + R_{meas\,2}}$$

7. Using a calibrated instrument, measure the ambient temperature $\mathbf{T_{amb}}$ of the terminal block.
8. Determine if attenuation performance is meeting the specification.
   - If $0.01 - [0.01 \times \{0.0006 + (|\mathbf{T_{amb}} - 25| \times 0.000015)\}] \leq \mathbf{Atten} \leq 0.01 + [0.01 \times \{0.0006 + (|\mathbf{T_{amb}} - 25| \times 0.000015)\}]$, then the attenuation performance of the terminal block has been verified.
   - If $\mathbf{Atten} < 0.01 - [0.01 \times \{0.0006 + (|\mathbf{T_{amb}} - 25| \times 0.000015)\}]$, then the terminal block is non-functional. Repair or replace it.
   - If $\mathbf{Atten} > 0.01 + [0.01 \times \{0.0006 + (|\mathbf{T_{amb}} - 25| \times 0.000015)\}]$, then the terminal block is non-functional. Repair or replace it.
9. Repeat steps 2 through 8 using the remaining resistor packages:
   - RP5 (channel 1)
   - RP3 (channel 2)
   - RP6 (channel 3)
   - RP8 (channel 4)
   - RP7 (channel 5)
   - RP4 (channel 6)
   - RP2 (channel 7)

You have completed the calibration verification procedure for your SCXI-1327.