TC-2095 Rack-Mount Terminal Block Calibration Procedure

Introduction

This document contains step-by-step instructions for verifying the performance of the temperature sensor on the National Instruments TC-2095 rack-mount terminal block. This temperature sensor is for cold-junction compensation of thermocouples on the terminal block.

What Is Calibration?

Calibration consists of verifying the measurement accuracy of a device and correcting for any measurement error. For TC-2095 terminal blocks, calibration is simply verifying the measurement accuracy of the components on the terminal block. Because these components are not user adjustable, calibration consists of verification only, without correcting for any error. *Verification* is measuring the performance of a device and comparing the results to the factory specifications of the device.

Why Should You Verify?

The accuracy of electronic components drifts with time and temperature, which can affect measurement accuracy as the device ages. Verification ensures the TC-2095 terminal block still meets NI standards. If the results of the procedure indicate that the temperature sensor on the terminal block is out of specification, return the device to NI for repair or replacement.

How Often Should You Verify?

The measurement accuracy requirements of your application determine how often you should verify the performance of the TC-2095.
NI recommends you verify the terminal block at least once every year. You can shorten this interval to six months or 90 days based on the demands of your application.

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Equipment and Other Test Requirements

This section describes the equipment, software, documentation, and test conditions required for verifying the performance of the TC-2095.

Test Equipment

Verification requires a high-precision voltage source with at least 50 ppm accuracy, a multiranging 5 1/2 digit digital multimeter (DMM) with 15 ppm accuracy, and a thermometer that is accurate to within 0.1 °C.

NI recommends you use the following instruments for verifying the performance of the TC-2095:

- Calibrator—Fluke 5700A
- DMM—NI 4060 or Agilent 34401A

Note You also need three test connector adapters that fit the 96-pin connector pins. Use a Pomona 3560 banana jack to test adapter connector (0.040 in. diameter pins) or an equivalent connector.

If these instruments are not available, use the accuracy requirements listed above to select a substitute calibration standard.

Software and Documentation

You can find all the necessary information to verify the performance of the TC-2095 in this verification procedure. No other software or documentation is required. If you would like more information on the TC-2095, refer to the *BNC/TC-205 Rack-Mount Adapter Installation Guide*, which you can download from the NI Web site at `ni.com/manuals`.

Test Conditions

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

- Keep connections to the TC-2095 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 terminal block. Use twisted-pair wire to eliminate noise and thermal offsets.
- Keep relative humidity below 80%.
- Maintain a temperature between 15 and 35 °C.

Verification Procedure

This section contains step-by-step instructions for verifying the performance of the temperature sensor on the TC-2095 terminal block.

Verifying Temperature Sensor Performance

Complete the following steps, while referring to Figures 1 and 2, to verify the performance of the temperature sensor on the terminal block.

1. Connect a +5 VDC power source to the terminal block.
   a. Hold the terminal block horizontally upright and view it from the rear. The terminals on the 96-pin DIN connector are designated as follows:
      – Column A is on the bottom, Column B is in the middle, and Column C is on the top.
      – Row 1 is on the right and Row 32 is on the left.

      Figure 1 illustrates the connector pin assignments. Individual pins are identified by their column and row. For example, A3 denotes the terminal located in Column A and Row 3. This corresponds to the labeling of the pins on the front connector of a mating SCXI module.

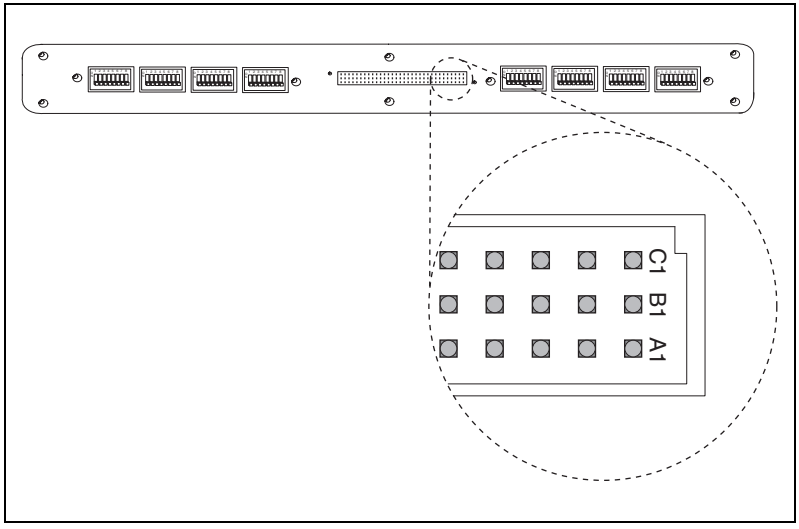


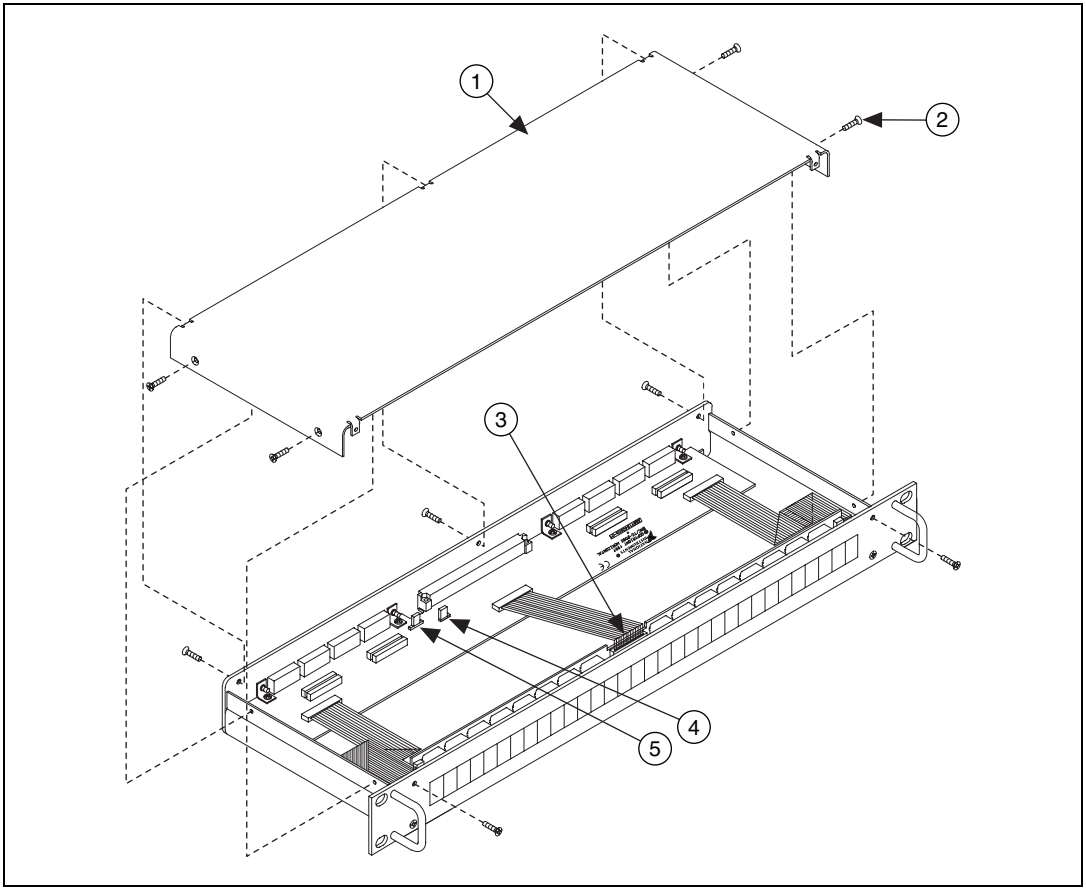
Figure 1. TC-2095 Connector Pin Assignments

b. Connect a test connector adapter to terminal A1 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. Connect a test connector adapter to 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. Refer to Figure 2 to locate jumper W1 and verify that MTEMP is jumpered on the terminal block.



1 Cover	3 CJC Sensor	5 W2 Jumper
2 Screws	4 DTEMP/MTEMP Jumper	

Figure 2. TC-2095 Terminal Block Parts Locator Diagram

b. Connect a test connector adapter to terminal A3 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.

c. 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 and 35 °C.

4. When the terminal block temperature reaches equilibrium with its surroundings, measure the temperature sensor output V_{meas} using a calibrated DMM.

5. Measure the actual temperature T_{act} in the temperature-controlled environment using a thermometer calibrated to within 0.1 °C accuracy. Position the thermometer as near as possible to the CJC sensor.

6. Convert V_{meas} (in volts) to measured temperature T_{meas} by performing the following calculations:

   a. Calculate

$$x = \frac{2.5 - V_{meas}}{5{,}000}$$

   b. Calculate

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

   c. Calculate

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

   where T_{meas} is in degrees Celsius

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

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

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

7. Compare T_{act} to T_{meas}.
   - If $(T_{meas} - 0.5\ °C) \leq T_{act} \leq (T_{meas} + 0.5\ °C)$, the performance of the terminal block temperature-sensor has been verified.
   - If $T_{act} < (T_{meas} - 0.5\ °C)$, the terminal block temperature sensor is nonfunctional. Return the terminal block to NI for repair or replacement.
   - If $T_{act} > (T_{meas} + 0.5\ °C)$, the terminal block temperature sensor is nonfunctional. Return jumper W1 to its original position. Return the terminal block to NI for repair or replacement.

You have completed verifying the performance of the temperature sensor on the TC-2095 terminal block.