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Product Information Note
072-40194-B

Subject: **Temperature Input Module Calibration Procedure for PRO-Series Bargraphs**	Initial Release Date: 11/10/94	Revision Date: 03/01/00	
	Product Group:	Pro-Series Bargraph	

1. Introduction

Bargraphs equipped with the optional Temperature Measurement Module have the additional functionality of a direct-reading thermocouple or RTD instrument. These bargraphs can be programmed with coefficients from a linearized polynomial that correspond to the type of input device used, providing a high degree of accuracy and reliability.

This document describes how to calibrate Pro-Series models BB, BJ, BK, and BW bargraphs that have the optional Temperature Measurement Module. It is valid for Type E, J, K, and T thermocouples, and for 100-ohm RTD inputs.

Instructions for converting between RTD and thermocouple inputs are given in Section 7.

AMETEK Dixson recommends that temperature programming be done using Mode C. Although this requires the use of a computer and AMETEK Dixson's Programming and Calibration software, it also permits automatic downloading of the correct temperature compensation values for each thermocouple type.

2. Required Equipment and Documentation

- *PC computer, 386 or later, with an available serial (COM1, COM2, etc.) port

- *AMETEK Dixson Programming and Calibration Software Kit, PN 239-53033 (required for Mode C operation only)

- *Product Information Note #072-40152 revision D or later, *Programming and Calibrating the Pro-Series Bargraphs using the RS-232 Interface*

- *Calibration fixture (included with the Programming/Calibration Software Kit)

- Calibrated DC voltage source that can output 0.000 volts DC (Electronic Development Corporation Model #520A or equivalent)

- (For thermocouple input units) Zero-Point Calibrator (Hart Scientific Model 9101 or equivalent)

- (For thermocouple input units) Type E, J, K, or T thermocouple probe

- (For RTD input units) Decade resistance box that can output 0.000 ohms (General Resistance Instruments Model RTD-100X or equivalent)

- Product Information Note #072-40253, *Commercial Bargraph Installation and User Guide* (BB, BK and BW models)

- Product Information Note #072-40151, *Pro-Series Programmable Bargraph Instruction Manual* (for nuclear applications where Software Verification and Validation requirements must be met)

Note - *Starred items are required for Mode C operation only.*

3. Helpful Reference Documents

The following documents will be helpful during the calibration procedure:

- NIST #Monograth 175, *Temperature—Electromotive Force Tables for the Letter-Designated Thermocouple Types* (based on ITS-90 dated April 1993)

Product Information Notes are available free from the AMETEK Dixson Sales Department.

4. Calibration Set-Up

To obtain the specified accuracy, you must follow the steps in the order given and use the calibration equipment specified in Section 2. If recalibration is required and you do not have the necessary equipment, return the indicator to AMETEK Dixson for recalibration.

4.1   Initial Bargraph Set-Up

1. Determine what kind of bargraph you have:

   a. Look at the 14th digit of the bargraph's part number. An **E**, **J**, **K**, or **T** indicates the bargraph has a type E, J, K, or T thermocouple input; an **R** indicates a 100-ohm RTD input.

   b. Look at the 11th digit of the bargraph's part number. An **F** indicates Fahrenheit, and a **C** indicates Centigrade.

   c. Look at the bargraph's scaleplate to determine its range.

2. Locate Thermocouple Type Option switch SW1 on the Auxiliary Option Board and verify that its switch settings are correct. See Product Information Note 072-40253 (or 072-40151) for switch locations and switch settings tables.

3. Locate Input Range Selection switches SW4, SW5 and SW6 on the Input board(s) and verify their settings are also correct.

4. Connect the 8-pin connector from the Calibration Fixture to the bargraph.

5. Connect an available serial port on the computer to the DB9 connector on the Calibration Fixture (Mode C operation only).

6. Turn the Calibration Fixture power OFF and connect the bargraph to a power source as follows:

   a. AC-powered units: connect the 2-pin connector from the Calibration Fixture to E10 on the bargraph Input Board, and connect the power cord from the Calibration Fixture to the AC source (120 or 240 VAC). Do not apply power until instructed.

   b. DC-powered units: ***do not connect the AC power cord to the Calibration Fixture***. Instead, disconnect the wires from the Calibration Fixture's 2-pin connector and connect the appropriate external DC power source in their place as shown in Figure 1. Then plug the 2-pin connector into E10 on the bargraph Input Board.

7. Switch on the calibrated DC voltage source and allow it to stabilize. Refer to the manufacturer's instructions to determine the stabilization time.

4.2 Connections for Thermocouple Input Units

If your bargraph has an RTD input, skip to the next section.

1. Turn on the Zero-Point Calibrator and allow it to reach temperature stabilization. Refer to the documentation that came with your calibrator to determine the stabilization time.

2. Select the appropriate type of thermocouple probe for your application.

3. Connect the thermocouple probe to the calibrated DC voltage source and the to the T/C (+) and T/C (–) inputs on the bargraph Auxiliary Option Board (E1 and E5) as shown in Figure 1.
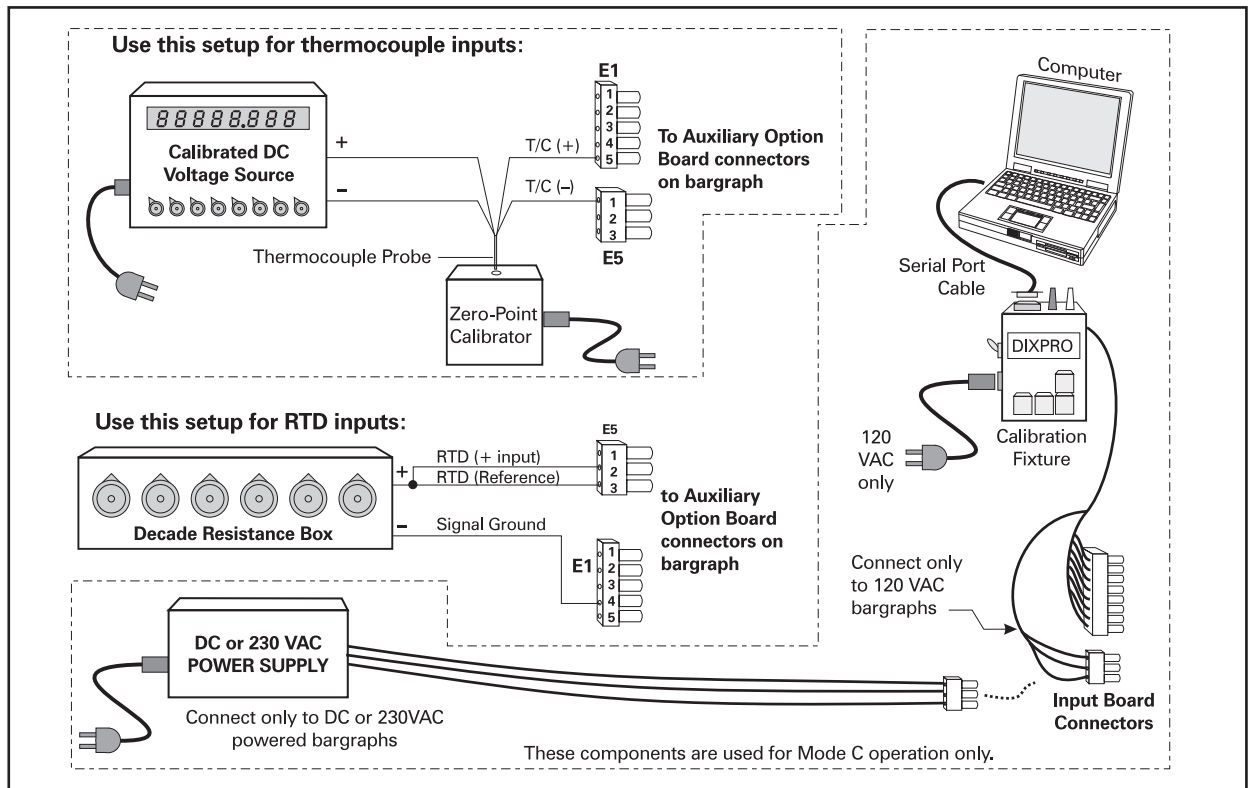
Figure 1 *Connecting the bargraph to the test equipment.*

4. Insert the thermocouple probe into the Zero-Point Calibrator and allow at least ten minutes for it to reach temperature stabilization.

5. Make sure the calibrated DC voltage source has stabilized, then set its output as near zero millivolts as possible.

4.3 Connections for RTD Input Units

Follow these steps only if your bargraph has an RTD input.

1. Connect the positive output of the decade resistance box to the RTD + Input and RTD Reference pins on the bargraph Auxiliary Option Board as shown in Figure 1.

2. Connect the negative output of the decade resistance box to the Signal Ground pin on the Auxiliary Option Board as shown in Figure 1.

3. Set the output of the decade resistance box as near zero ohms as possible.

4.4 Computer Set-Up (Mode C Operation Only)

Notes - *Instructions on using the Programming and Calibration software are given in Product Information Note 072-40152.*

You cannot calibrate the instrument for just the displayed portion of the thermo-couple's range—you must calibrate the instrument for the entire linear range of the appropriate thermocouple and use the "Min" and "Max" values given in Table 1.

DEVICE	DEGREES (C or F)	INPUT "MIN"	INPUT "MAX"	DISPLAY "MIN"	DISPLAY "MAX"
Thermocouple Type **J**	C	–0.896 mV	42.919 mV	–18	760
	F	–0.896 mV	42.917 mV	0	1400
Thermocouple Type **E**	C	–5.237 mV	76.373 mV	–100	1000
	F	–5.237 mV	76.373 mV	–148	1832
Thermocouple Type **T**	C	–4.865 mV	20.872 mV	–160	400
	F	–4.865 mV	20.872 mV	–256	752
Thermocouple Type **K**	C	–0.701 mV	54.819 mV	–18	1370
	F	–0.692 mV	54.819 mV	0	2498
RTD	C	18.49 Ω	390.2 Ω	–200	850
	F	18.49 Ω	390.2 Ω	–328	1562

Table 1 *Minimum and maximum input signal values*

1. Turn on the computer and load the Programming and Calibration program.

2. Enter the programming parameters by selecting Options…Digital Display and filling in the fields on the screen. Refer to Product Information Note 072-40152 for help with the program, and to the examples that follow:

   a. **"Do you have a digital display?":** Check **Yes** unless your bargraph has neither a digital display nor a temperature input option. In that case only, check **No**.

   b. **Decimal Location:** Check the appropriate decimal location. For example, if the highest absolute value your bargraph will read is 1000 or greater, check 0000. If the highest absolute value is 100 to 999.9, check 000.0 If the highest absolute value is 10 to 99.9, check 99.99, etc.

   c. **Min Scale:** Enter the temperature value you want the bottom (or left) bargraph segment to represent. The value you enter must not be less than the value in Table 1 column 5 for your particular thermocouple type. Always enter four digits including the decimal point.

   d. **Full Scale:** Enter the temperature value you want the top (or right) bargraph segment to represent. The value you enter must not be greater than the value in Table 1 column 6. Always enter four digits including the decimal point.

   e. **Update Rate:** Set to 700 milliseconds.

Example 1: If your bargraph is going to measure from 50 degrees at the bottom to 200 degrees at the top, enter 50.00 for Min. Scale, and 200.0 for Full Scale.

Example 2: If your bargraph is going to measure from 0 degrees at the top to −75 degrees at the bottom, enter −75.00 for Min. Scale, and 00.00 for Full Scale.

Example 3: If your bargraph is going to measure from −100 degrees at the bottom to +25 degrees at the top, enter −100.0 for Min. Scale, and 25 for Full Scale.

5. Calibration Procedure (when using Mode C)

1. Open the Inputs menu and press Enter twice. An "Input Type Box" should appear.

2. Mark the signal type an units type that correspond to your bargraph's input and press Enter. This will close the Input Type Box.

3. Referring to 074-40152, select and configure the other options as appropriate for your bargraph (i.e., set points, bar start, signal averaging, etc.).

4. Open the Download menu. "Transmit to Bargraph" will be highlighted.

   a. Press Enter. A Comm Port selection box will appear.

   b. Select the comm port that is connected to the fixture and then select Transmit.

5. Follow the instructions on the screen to program the bargraph. *During the process, you must use the values in Table 1 for the Input Min and Input Max signal values.* **Failure to use these values will result in mis-calibration.**

6. Verifying Accuracy

Check the accuracy of the instrument at 0, 25, 50, 75, and 100 percent of full scale reading. Refer to NIST #Monograth 175, *Temperature—Electromotive Force Tables for the Letter-Designated Thermocouple Types*, based on ITS-90 dated April 1993, for the correct input values for your thermocouple type at each checkpoint. The bargraph's specified accuracy is:

Digital Accuracy: ±0.8 C (1.44 F) ±1 count of the rightmost digit

Bar Accuracy: Segments should align with the scaleplate indicators at each test point.

7. Converting between RTD and Thermocouple Inputs

Note - *Be sure that proper ESD precautions are observed at all times when handling any of the printed circuit board assemblies (PCBAs).*

Use the following table to determine parts usage and SW1 switch settings depending upon the type of thermocouple input you wish to connect. The table refers to the Input Board.

Thermocouple Type	R17	R47	R48	W9	W10	SW1-1234
No Thermocouple or RTD Input	don't care	don't care	don't care	don't care	don't care	0000
RTD	3.16K ±1%	Out	Out	In	Out	1000
E	Out	1.58K ±1%	Out	Out	In	1001
J	Out	Out	1.10K ±1%	Out	In	1010
K or T	Out	Out	1.10K ±1%	Out	In	1100

8. Technical Support

Free telephone support for these procedures is available by calling the Bargraph Service Department at (970) 244-1245, Monday through Thursday from 7 a.m. to 5:30 p.m., and Friday from 7 a.m. to 3:30 p.m.