4.0 CALIBRATION

There are several calibration procedures for various Series 76 controls and options. Follow only the procedures applicable to your controller.

NOTE: Early in production of the Series 76 controls, cold-junction compensation was modified, with the addition of a compensating resistor to the terminal block. Hence, initial production controls in the field do not have this compensating resistor on the rear terminal.

If the controller incorporates this compensating resistor, be sure to connect the resistor to PCB terminals 7 and 9 by jumper wires or similar means, when removing the control from its housing for calibration.

To aid in bench calibration, Partlow can supply the following tools:

Y-560A test stand to power instrument, provides signal and simulated loads.

Y-613 instrument enclosure with cutouts for access to potentiometer adjustment.

YA-615, 77°F simulating cold junction compensating resistor for thermocouple input models.

PPA310 cold junction compensating resistor for thermocouple input units.

The calibration procedure and check which follow require supplying the input signal for various types of input. The procedure in Section 4.1 shows how to determine what the appropriate input signal should be.

Before unnecessarily recalibrating a Series 76 instrument, apply the calibration check in Section 4.2. A 4-1/2 digit digital voltmeter is required for the calibration procedure. Make sure that other equipment called for in the following procedure, such as millivolt or volt sources, RTD simulators and decade boxes, are calibrated.

4.1 Determination of Input Signal Values

4.1.1 Percent of Span Points

The calibration instructions refer to input signal values in percent of span. The span of the instrument is the difference between the maximum and minimum temperature on the scale or range. For example: the span on a 100-650°F temperature range is 550°F. The 20% of span point is 20% of 550 (the span) plus the minimum temperature of the span, 100°F - in this case, 210°F. In like manner, 80% of span is 540°F. Determine all percent of span points in this manner. If the percent of span point for a particular range is an odd number, use the nearest major division for calibration and check-out purposes.

4.1.2 Thermocouple Input Signals

Thermocouples are sensors that vary in millivolts as the thermocouple junction varies in temperature. When a millivolt source is used to simulate a thermocouple and is the input to a cold junction-compensated instrument, it is necessary to compensate the millivolt values obtained from a thermocouple table. To accomplish this:

1. Determine the type thermocouple for which the instrument is calibrated.

2. Look up the millivolt equivalent of the thermocouple for the desired input temperature from the thermocouple table included in this section.

3. Measure the ambient temperature in the area of the instrument terminal block and then find the millivolt equivalent for that temperature for your type thermocouple. Use caution in avoiding

temperature changes in the area of the compensator due to drafts, etc.

4. Subtract the millivolt equivalent determined in Step 3 from the one in Step 2.

5. The value determined in Step 4 is the millivolt equivalent of the type thermocouple for the input temperature, adjusted to compensate for ambient temperature error of the thermocouple cold junction.

NOTE: The preceding procedure is for millivolt sources that are not already compensated for cold junction error. If a compensated source is used, millivolt and temperature values can be used without compensation. However, the compensated source must be at the same temperature as the compensator of the instrument under test.

4.1.3 Millivolt and Volt Inputs

Millivolt and volt input controls usually have some form of transducer as an input, or another Series 76 controller. Because cold junction error is not a factor in calibration, millivolt and volt input values can be used directly from a chart relating the input signal to temperature or other process variable. Such units will not have the compensating resistor on terminals 7 and 9.

4.1.4 RTD Inputs

RTDs vary in resistance with temperature. RTD values can be used directly from the RTD tables included in this section. An accurate decade box can be used to simulate an RTD.

The Partlow Corporation also makes an RTD simulator (#Y538) which contains precision resistors that simulate an RTD at different temperatures. The simulator is designed to simulate a 100 ohm RTD with a .00385 ohm/ohm/°C temperature coefficient.

4.2 Calibration Check

To check the accuracy of a Series 76 control:

1. Supply the appropriate input signal to the input terminals of the controller for approximately 50% of span and set the setpoint, if one exists, to 50% of span also.

2. If it is an indicating controller, take a reading of the temperature and compare for accuracy in the appropriate category below:

6" Analog Meter	- accuracy ±2% of span.
LED Process Meter	- accuracy ±.5% of span.
Deviation Meter	- accuracy ±5% of span. In this case only, the span is that of the meter itself, which is not the full span of the instrument. The deviation meter ideally would read 0 in this case. Any deviation from 0 is the amount of error.
Process Edgemeter	- accuracy ±5% of span.

If the control is properly calibrated, the reading taken in this step will be within the accuracy limits stated.

3. If a setpoint exists on the control, adjust by one of the following:

   On-Off Control - Start below the 50% of span point and slowly increase the setpoint until the red light is activated on a heating application control or deactivated on a cooling application control.

   Proportional Control - Attach a digital voltmeter to points PIN 1 (error signal) on connector J8 and TPC (common) on the first motherboard (see Figure 4.1). The plus lead should go to PIN 1. Start below the 50% of span point and increase the setpoint slowly until the DVM reads .000 volts.

   Record the setpoint measurements made in the preceding procedure.

4. Compare the reading determined in Step 3 for accuracy in the appropriate category below.

   Analog Setpoint - accuracy ±1% of span.

   Digital Thumbwheel Setpoint - accuracy ±1% of span.

5. Repeat Steps 1, 2, 3 and 4 for approximately 20 and 80 percent of span points. If the control is within the specified accuracies at all points, recalibration is not necessary.

4.3 Calibration Procedure

There are five different calibration procedures depending upon setpoint indication options. In some cases, it is necessary to perform only part of the procedure. For instance, if the preceding calibration check revealed that only the analog setpoint was in error, just that procedure would have to be performed.

Calibration adjustments are located on the R76101 or R76102 boards, the R76010 board and either the R76103 or R76104 boards, as shown in Figure 4.1. All controls incorporate either an R76101 or R76102 board; however, the appearance of the other boards listed depends upon the options present on the control. A change was made on the R76101 board, adding meter adjustment pot R40. This change affects the analog meter adjustment only, and the change in procedure is noted in that section.

Refer to Figure 4.1 for all trimpot and test point locations in the following procedures:

4.3.1 R76101 and R76102 boards - 0-10V Process Signal

1. First, short terminals 8 and 9, sensor input. Terminals 7 and 8 must also be shorted on RTD 3-wire input controls only. Connect the instrument to line power and allow a minimum of 20 minutes for warmup and stabilization. For RTD input, proceed to Step 5a.

   If the control has been previously calibrated and no major changes in the motherboard have been made, and if the thermocouple type has not been changed, Steps 3-9 can be omitted; otherwise proceed with Step 2.

2. Connect digital voltmeter, red lead to TP1, black lead to TPC (test point common) for entire procedure.

3. With voltmeter connected to TP1, adjust pot R10 until voltmeter reads 0.000 VDC. For millivolt or volt input controls, skip Steps 5-9.

4. Turn pots R27 and R12 fully counterclockwise. (With red lead voltmeter on TP3, the display will stop changing when full CCW position is reached for each pot.)

5. a) RTD Inputs Only - connect a milliammeter to terminals 8 (black lead) and 9 (red lead) (remove the short) and adjust R10 until the milliammeter reads -5.00 milliamps. Skip Steps 6-9.

   b) Thermocouple Inputs Only - connect red lead of voltmeter to TP2 and record voltage reading.

      NOTE: This reading will be negative.

Treat the number as positive in following steps:

6. Connect red lead to TP3 and adjust pot R20 so that the voltmeter reading equals voltage recorded in Step 5b.

7. Refer to Table I and determine temperature coefficient for particular thermocouple type (J = .513).

TABLE I

THERMOCOUPLE TYPE	COEFFICIENT
J	.513
K	.404
R	.063
S	.063
T	.406
E	.606

8. Multiply the value adjusted in Step 6 by the temperature coefficient determined in Step 7, and adjust pot R12 to read this on the voltmeter with the red lead on TP3.

9. Recheck voltage at TP-2. If the reading has changed more than ±2 millivolts from previous reading obtained in Step 5, multiply the magnitude of the new reading by the coefficient from Table I, and adjust R12 to read this on the voltmeter with the red lead on TP3. Repeat Step 9 until TP2 voltage is within ±2 mv of previous reading.

10. a) Thermocouple, millivolt, and volt inputs only - Appropriately, connect either a millivolt or volt source to terminals 8 and 9. Terminal 9 is positive.

    b) RTD inputs only - connect decade box or RTD simulator to terminals 8 and 9. For 3-wire RTD inputs, terminals 7 and 8 must be shorted.

11. Adjust the input device (millivolt source, etc.) to supply the equivalent of the minimum temperature of the span. See Section 4.1, Determination of Input Signal Values, for instructions.

12. With the voltmeter red lead on TP3, black lead on TPC, adjust pot R20 to read 0.000 VDC on voltmeter.

13. Adjust the input device to supply the equivalent of the maximum temperature of the span.

14. With the red lead on TP3, adjust pot R27 to equal 10.000 VDC on voltmeter.

15. Repeat Steps 11 through 14 until all readings are correct.

4.3.2 Analog Meter Adjustment - R76101 or R76102 Board

Meter adjustment pot R40 was added to the R76101 board. Initial production (R76001 boards) does not have this adjustment. If R40 is not present, use procedure 2 below; otherwise use procedure 1.

1. Adjust the input device to supply the equivalent temperature of 50% of span. Adjust R40 so that the meter reads correctly.

   NOTE: If the control is used at a small range of temperatures and you desire better accuracy at this point on the scale, insert the appropriate input for this temperature and adjust R40 accordingly.

2. a) Adjust the input device to supply the equivalent temperature of 20% of span. Adjust R20 so the meter reads correctly.

   b) Adjust the input device to supply the equivalent of 80% of span. Adjust R27 so the meter reads correctly.

   c) Repeat a and b until both points are within tolerances.

4.3.3 Analog Setpoint

1. Acjust setpoint to 50% of scale.

2. Connect the appropriate input device per Step 10 in Section 4.3.1.

3. Adjust the input device to supply the equivalent temperature of 50% of span.

4. Connect digital voltmeter to red lead to PIN 1 on J8 (error signal), and black lead to TPC on first motherboard.

5. Adjust R33 on first motherboard so reading equals 0.000 VDC.

4.3.4 Linearization Board and Thumbwheel Digital Setpoint - R76010 Board

1. Connect digital voltmeter, red lead to TP1 on linearization board, and black lead to TPC on motherboard.

2. Adjust R18 so the reading equals -5VDC.

3. Connect red lead to TP2 on linearization board.

4. Connect the appropriate input signal per Step 10 in Section 4.3.1.

5. Adjust the input device to supply the equivalent temperature of 100% of span.

6. Adjust R2 so the reading equals 10.00 VDC. (R2 is not present for ranges 002, 902, 905, 907, 908 or 909.)

7. Adjust setpoint to 50% of scale.

8. Adjust the input device to supply the equivalent of 50% of span.

9. Connect red lead of voltmeter to PIN 1 on connector J8 on the first motherboard.

10. Adjust R1 on linearization board so the reading equals 0.000 VDC.

4.3.5 LED Process Meter - R76103 Board

NOTE: The first motherboard must be correctly calibrated to proceed with calibration of the LEDs.

1. Adjust the input device to supply the equivalent of the minimum temperature of the span.

2. Connect red lead on voltmeter to TP1 on R76103 board and black lead on TPC on the first motherboard. Record reading after allowing one minute to stabilize.

   NOTE: This reading will be approximately zero; difference can be either positive or negative. Observe polarity in Step 4.

3. Adjust the input device to supply the equivalent temperature of 100% of span.

4. The procedure followed in this step depends upon the range of the instrument. Follow the appropriate procedure below:

   a) Maximum temperature of span is less than 200°F or C. Add 10 millivolts (-.010 VDC) for every degree of span, plus the reading obtained in Step 2.

      Adjust R23 on the R76103 board to read this on the voltmeter.

      Example: Range = 0-200°F, Step 2 Reading = -0.01

      Span = 200 x -.01 = -2.00 + Step 2 Reading =

      -2.00 + (-.010) = -2.010 volts

   b) Maximum temperature of span is between 300 and 2000°F or C. Add -1 millivolt (-.001 VDC) for every degree of span, plus the reading obtained in Step 2.

      Adjust R23 on the R76103 board to read this on the voltmeter.

      Example: Range = 0-800°F, Step 2 Reading = -0.01

      Span = 800 x -.001 = -.8 + Reading in Step 2 =

      -.8 + (-.01) = -0.810 volts

   c) Maximum temperature of span is between 200° and 299°F or C, or between 2000° and 3000°F or C. Add -2 volts to value determined in Step 2.

      Adjust R23 on the R76103 board to read this on the voltmeter.

      Example: Range = 0-2500°F, Step 2 Reading = -0.01

      -2.00 + value in Step 2

      -2.00 + (-.01) = -2.01 volts

5. Adjust R10 on R76103 board until LED display reading equals maximum temperature of the span.

6. Adjust input device to provide temperature equivalent of the minimum temperature of the span.

7. Adjust R9 on R76103 board until LED display reading equals the minimum value of the span.

8. Adjust the input device so that it supplies the equivalent of 80% of span. Adjust R10 until the LED display reads 80% of span.

9. Adjust the input device so it provides the equivalent of 20% of span. Adjust R9 until the LED display reads 20% of span.

10. Repeat Steps 8 and 9 until no further adjustments are needed.

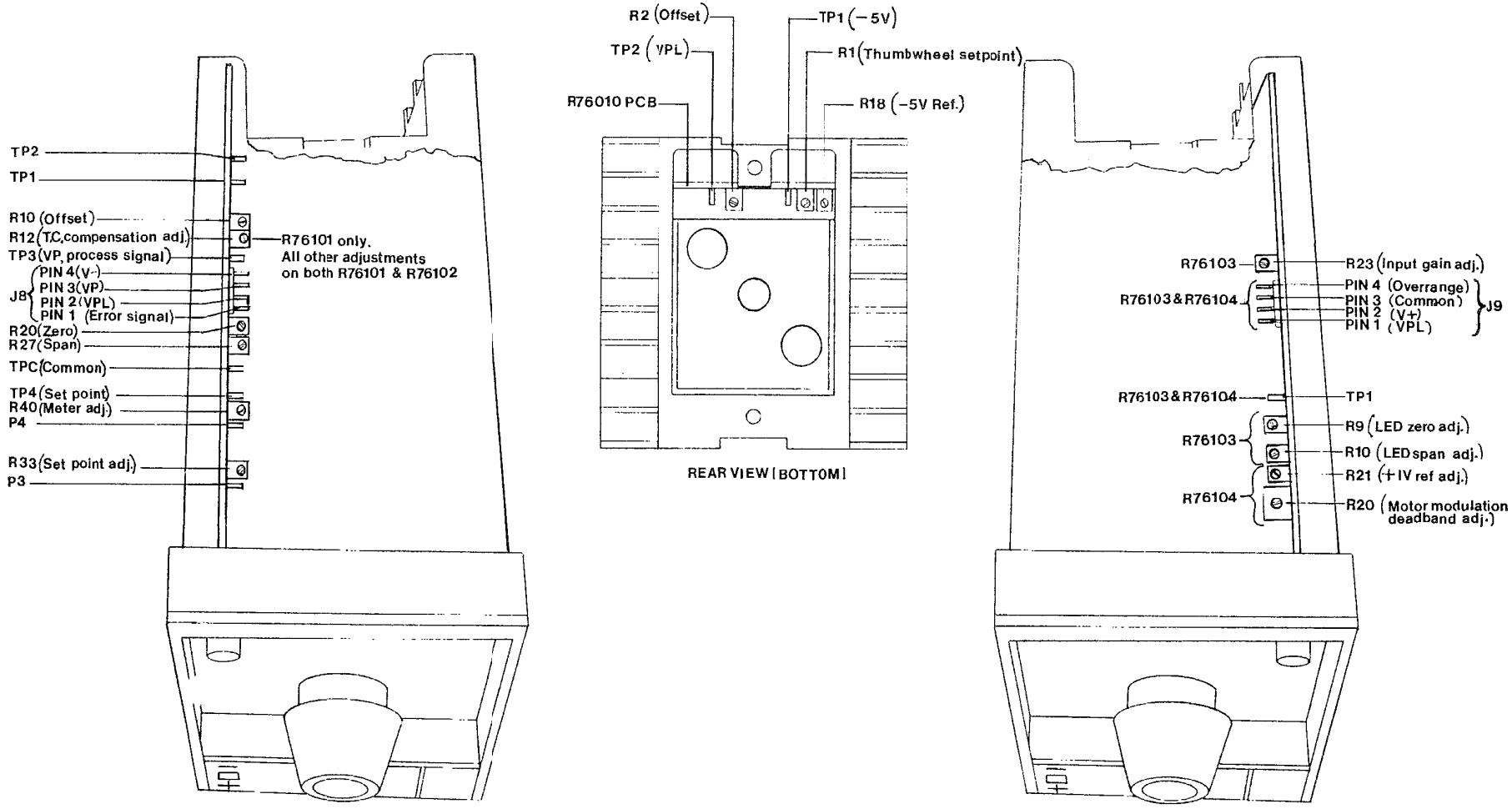

FIG. 4.1
SERIES 76 POTENTIOMETER AND TEST POINT LOCATIONS