

	PIE Model 850 FIELD CALIBRATION PROCEDURE	DOCUMENT NO. 850-0300 REV B	82 Main Street Suite 3.14 Webster New York 14580 Phone (585) 872-9350 Fax (585) 872-2638
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Rev.	Date	Appd	CHANGE	Approved
A	8/05/14	IT	Initial Revision	
B	11/04/14	PB-G	Changed drawing number	

Equipment Needed:

- 1) Precision DC Voltage Meter with accuracy of
 - a. ± 0.0076 mV @ 0, and 103.000 mV
 - b. ± 0.076 mV @ 0, and 1.03000V
 - c. ± 0.00004 V @ 0.5V, ± 0.0013 V @ 2 V, ± 0.00075 V @ 10V, ± 0.0045 V @ 60V
- 2) Precision DC Voltage Source with resolution of
 - a. 0.001 mV @ 90 mV
 - b. 0.001 V @ 60 V
- 3) Precision DC Current Source with resolution of 0.0001 mA @ 50 mA
- 4) Precision 2 Wire Transmitter Simulator with resolution of 0.001 mA @ 50 mA
- 5) Precision Ohm Meter with accuracy of
 - a. 0.043 Ohms @ 0.000 and 400.000 Ohms
 - b. 0.33 Ohms @ 0.00 and 4000.00 Ohms
- 6) Precision 100 Ω Resistor accurate to ± 0.004 Ohms and rated to 52 mA
- 7) Precision Frequency Counter and Generator with accuracies of:
 - a. ± 0.0015 KHz @ 20 KHz
 - b. ± 0.75 Hz @ 9999.9 Hz
- 8) Oscilloscope
- 9) Power supply capable of ~12V
- 10) 2 sets of quality test leads with banana plugs.

Abbreviations:

UUC = Unit Under Calibration = PIE Model 850

Disassembly:

Begin by removing the Boot, EZ-Dial™ Knob and the nut under the knob. Next turn the unit over and remove the battery cover, the batteries and the four black Phillips head corner screws. While holding the PIE 850 in one hand, carefully remove the top of the housing. Place the EZ-DIAL knob back on to make adjusting the calibrator easier.

Place fresh Lithium batteries in and allow 15 minutes for the Model 850 to stabilize to the ambient temperature. *Note: Fresh (<1.5 V) Alkaline batteries may be used.*

Enabling Calibration:

On the back side of the PCB is a pair of small switches (Dual in Line Package or DIP Switches). Move DIP switch 2 (the switch on the right) up (ON). Turn the UUC / Unit Under Calibration /PIE 850 ON. The word "CALIBRATION" will appear on instead of the normal splash screen. Verify it is in calibration mode by making sure the word "CAL" is in the upper left corner of the display.

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As you calibrate the PIECAL 850 please be patient and wait a few seconds after you press the knob to store values before double clicking the knob to go to the next step.

This is the SOURCE section of the calibration procedure

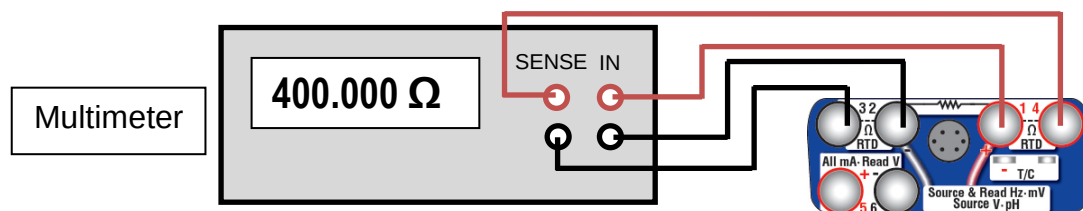
Source Ohms

Source 400 Ohms Range (400 Ω):

- 1) Connect 4 leads from the UUC to the meter using 4 wire hookup and set meter to 1mA excitation current (##.#### K Ω).
- 2) Move EZ-CHECK switch to LO. SOURCE 0.00 Ω should appear on the UUC display.
- 3) Dial the UUC output until the meter reads as close to 0.000 Ω as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.006 Ω .
- 4) Press the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 400.00 Ω should appear on the UUC display.
- 6) Dial the UUC output until the meter reads as close to 400.000 Ω as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.006 Ω .
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to change to the next function to be calibrated.

Source 4000 Ohms Range (4K Ω):

- 1) Connect 4 leads from the UUC to the meter using 4 wire hookup and set meter to 100 μ A excitation current (##.#### K Ω).
- 2) Move EZ-CHECK switch to LO. SOURCE 0.00 Ω should appear on the UUC display.
- 3) Dial the UUC output until the meter reads as close to 0.00 Ω as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.06 Ω .
- 4) Press the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 4000.0 Ω should appear on the UUC display.
- 6) Dial the UUC output until the meter reads as close to 4000.00 Ω as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be ± 0.06 Ω .
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.

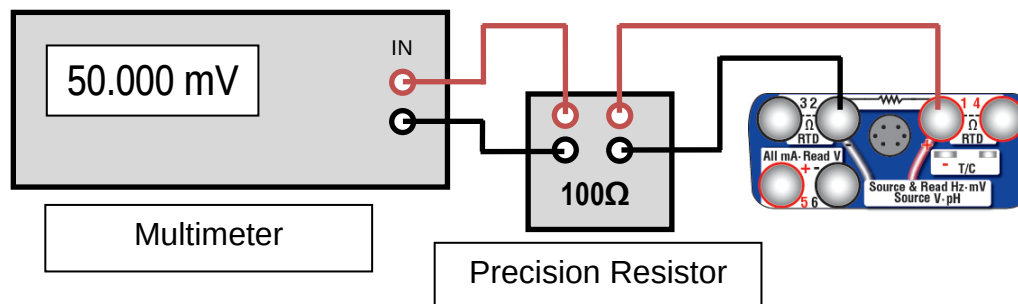


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Source mA

Open Thermocouple detection pulse (0.005 mA) & Read Ohms Excitation Current 0.500 mA) (mA Ω):

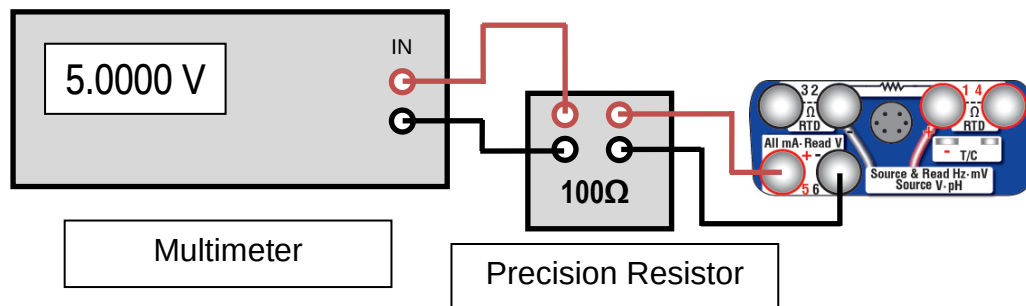
- 1) Connect leads from the UUC terminals 1 & 2 to a precision 100 Ω resistor. Connect another set of leads from the resistor to the meter and set meter to mV range (###.### mV)
- 2) Move EZ-CHECK switch to LO. SOURCE 0.005 mA should appear on the UUC display.
- 3) Dial the UUC output until the meter reads as close to 0.500 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.006 mV
- 4) Press the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 0.500 mA should appear on the UUC display.
- 6) Dial the UUC output until the meter reads as close to 50.000 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.009 mV.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.



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Source 50 mA Range (mA):

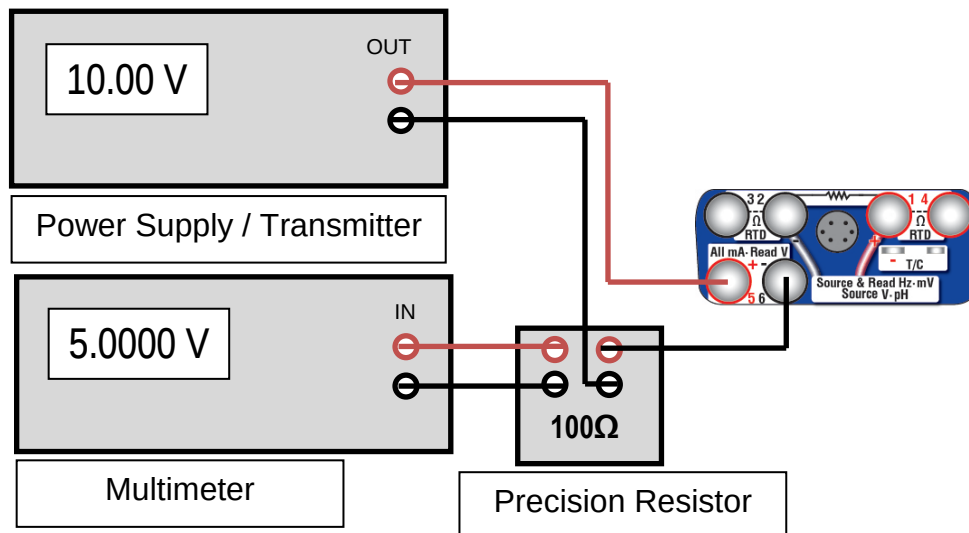
- 1) Connect leads from the UUC mA terminals to a precision 100 Ω resistor. Connect another set of leads from the resistor to the meter and set meter to mV range (##### mV)
- 2) Move EZ-CHECK switch to LO. SOURCE 0.010 mA should appear on the UUC display.
- 3) Dial the UUC output until the meter reads as close to 1.000 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.050 mV.
- 4) Set meter to V range (##### V)
- 5) Move EZ-CHECK switch to DIAL. SOURCE 10.000 mA should appear on the UUC display.
- 6) Dial the UUC output until the meter as close to 1.0000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0004 V.
- 7) Press the knob until the display shows STORE.
- 8) Move EZ-CHECK switch to HI. SOURCE 50.000 mA should appear on the UUC display.
- 9) Dial the UUC output until the meter as close to 5.0000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0004 V.
- 10) Press the knob until the display shows STORE.
- 11) Double click the knob to move to the next function to be calibrated.



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2-Wire Sim 50 mA Range (mA):

- 1) Connect a power supply or power measure device with a source voltage set greater than 5V and less than 50V in series with UUC mA terminals and a precision 100 Ω resistor. Connect another set of leads from the resistor to the meter and set meter to mV range (##### mV)
- 2) Move EZ-CHECK switch to LO. SIM 2W 0.010 mA should appear on the UUC display.
- 3) Dial the UUC output until the meter reads as close to 1.000 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.050 mV.
- 4) Set meter to V range (##### V)
- 5) Move EZ-CHECK switch to DIAL. SIM 2W 10.000 mA should appear on the UUC display.
- 6) Dial the UUC output until the meter as close to 1.0000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0004 V.
- 7) Press the knob until the display shows STORE.
- 8) Move EZ-CHECK switch to HI. SIM 2W 50.000 mA should appear on the UUC display.
- 9) Dial the UUC output until the meter as close to 5.0000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0004 V.
- 10) Press the knob until the display shows STORE.
- 11) Double click the knob to move to the next function to be calibrated.



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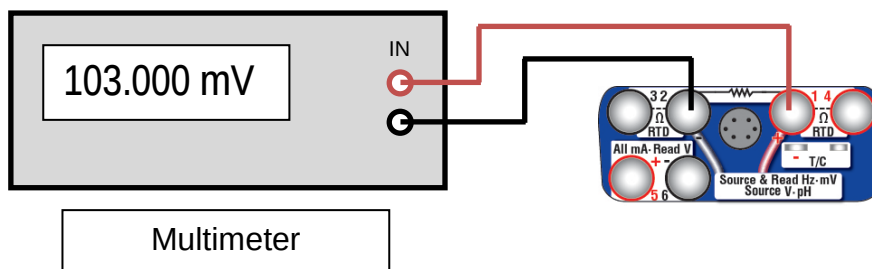
Source V

Source 100 mV Range (mV):

- 1) Connect leads from the UUC terminals 1 & 2 and set meter to mV range (##### mV).
- 2) Move EZ-CHECK switch to LO. SOURCE 0.000 mV should appear on the UUC display.
- 3) Dial the UUC output until the meter as close to 0.000 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0012 mV.
- 4) Press the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 103.000 mV should appear on the UUC display.
- 6) Dial the UUC output until the meter as close to 103.000 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0012 mV.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.

Source 1V Range (mV):

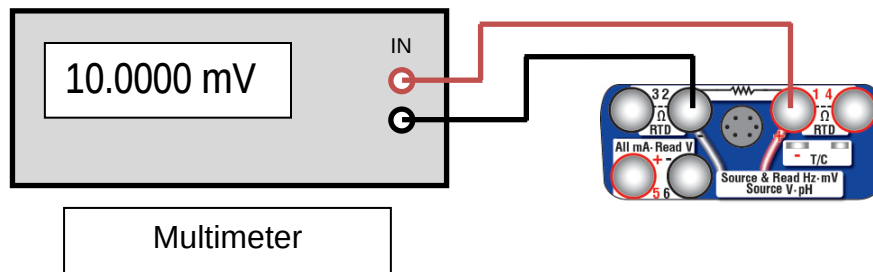
- 1) Connect leads from the UUC terminals 1 & 2 and set meter to mV range (##### V).
- 2) Move EZ-CHECK switch to LO. SOURCE 0.000 mV should appear on the UUC's display.
- 3) Dial the UUC output until the meter as close to 0.000000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.000012 V.
- 4) Press the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 1030.00 mV should appear on the UUC's display.
- 6) Dial the UUC output until the meter as close to 1.030000 V on the meter as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.000012 V.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.



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Source 10 V Range (V):

- 1) Connect leads from the UUC terminals 1 & 2 and set meter to mV range (##### V).
- 2) Move EZ-CHECK switch to LO. SOURCE 0.000 V should appear on the bottom line of the UUC display.
- 3) Dial the UUC output until the meter reads as close 0.000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0016 V.
- 4) Press the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 10.000 V will appear on the UUC display.
- 6) Dial the UUC output until the meter reads as close to 10.0000 V as possible
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within. ± 0.0016 V.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.

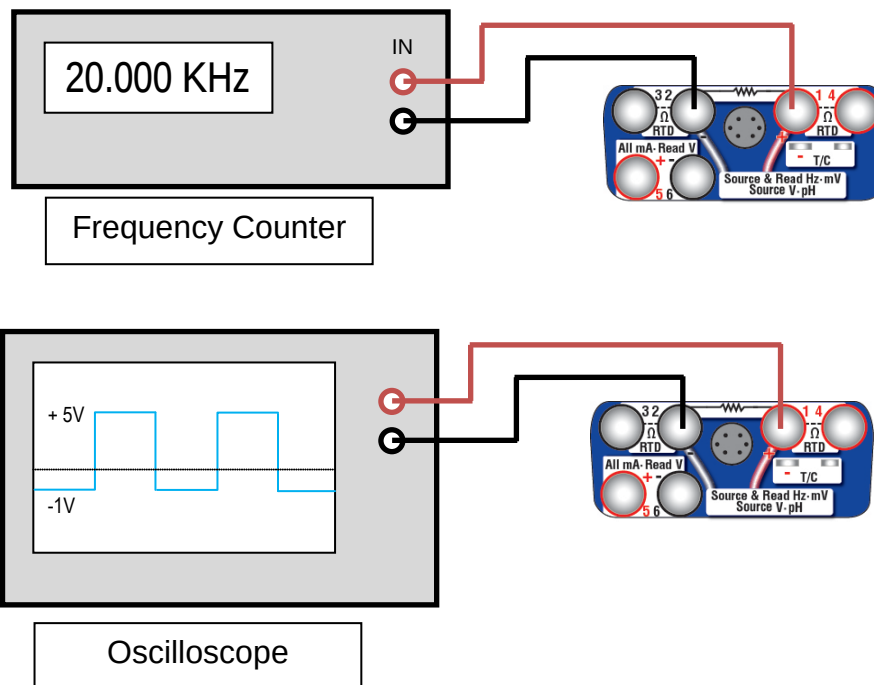


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Source Frequency (Verification Only – No Adjustments Required)

Source ## Hz Range (Hz):

- 1) Connect UUC terminals 1 and 2 to a frequency counter
- 2) Move the EZ-CHECK Switch to LO verify that the LED is flashing green. The counter should read 0.001 KHz $\pm$ 0.003
- 3) Move the EZ-CHECK Switch to SET. The counter should read 1.000 KHz $\pm$ 0.0006
- 4) Move the EZ-CHECK Switch to HI. The counter should read 20.000 KHz $\pm$ 0.0015
- 5) Connect UUC terminals 1 and 2 to an oscilloscope.
- 6) The waveform should be square waves from -1 V to +5V $\pm$ 0.6 V / $\pm$ 10%
- 7) Double click the knob to move to the next function to be calibrated.



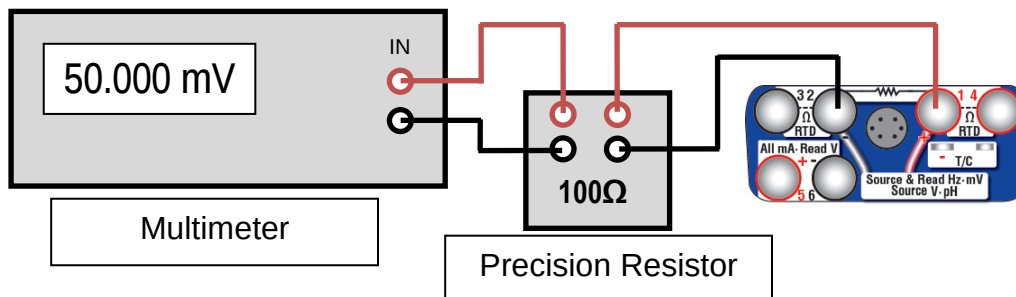
*This concludes the SOURCE section of the calibration.
The next steps are to calibrate the READ circuitry.*

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Read Ohms

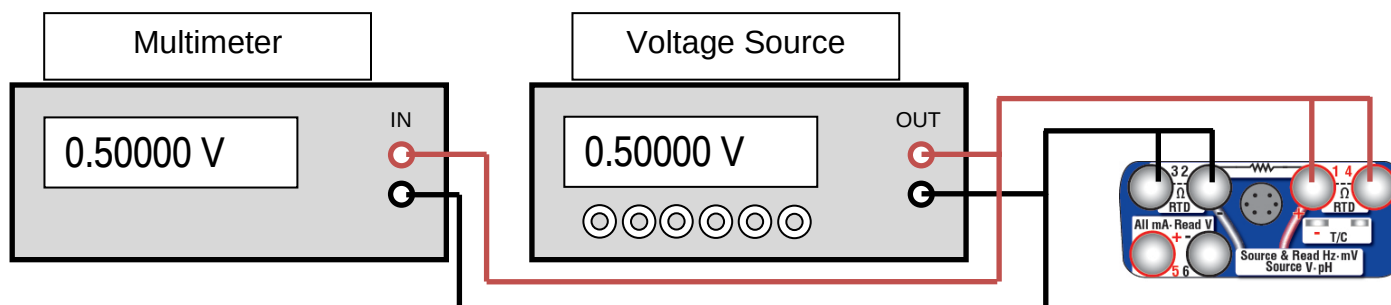
Read Ohms Excitation Current verification (mA Ω): (No Adjustments Required)

- 1) Switch the power switch to OFF, wait 5 seconds then move the power switch to Read.
- 2) Connect leads from the UUC terminals 1 & 2 to a precision 100 Ω resistor. Connect another set of leads from the resistor to the precision V meter and set meter to mV range (##.### mV).
- 3) Verify that the meter (50.000 mV) matches the display (50000) to ± 0.012 mV (± 12 counts). If not, repeat Source Ohms Excitation Currents from the Source Ohms section of the calibration procedure.
- 4) Double click the knob to move to the next function to be calibrated.



Read Ohms 2 & 4 Wire Calibration (2WV 4WV Ω):

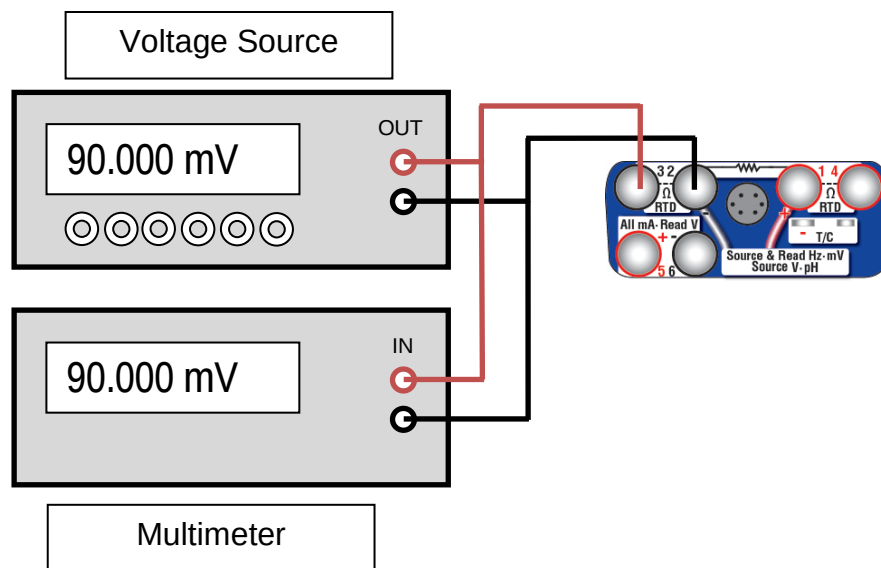
- 1) Put a four terminal shorting bar across UUC terminals 1, 2, 3 & 4.
- 2) Move EZ-CHECK switch to LO. APPLY 0.000 V should appear on the UUC display.
- 3) Press the knob until the display shows STORE.
- 4) Move EZ-CHECK switch to SET. APPLY 500 mV should appear on the UUC display.
- 5) Connect a precision voltage source + to terminals 1 & 4 and – to 2 & 3 on the UUC. Connect another set of leads to a precision DC voltage meter.
- 6) Dial the voltage source as close to 0.50000 V as possible. NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within. ± 0.00004 V.
- 7) Press the knob until the display shows STORE.
- 8) Move EZ-CHECK switch to HI. APPLY 2.0 V should appear on the UUC display.
- 9) Dial the voltage source to as close 2.0000 V as possible. NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0013 V.
- 10) Press the knob until the display shows STORE.
- 11) Double click the knob to move to the next function to be calibrated.



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Read Ohms 3 Wire Calibration (3WV Ω):

- 1) Put a two terminal shorting bar across UUC terminals 2 & 3.
- 2) Move EZ-CHECK switch to LO. APPLY 0.000 mV should appear on the UUC display.
- 3) Press the knob until the display shows STORE.
- 4) Move EZ-CHECK switch to HI. APPLY 90.000 mV should appear on the UUC display.
- 5) Connect a precision voltage source + to terminal 3 and – to 2. Connect another set of leads to a precision DC voltage meter.
- 6) Dial the voltage source to as close to 90.0000 mV as possible. NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0135 mV.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.

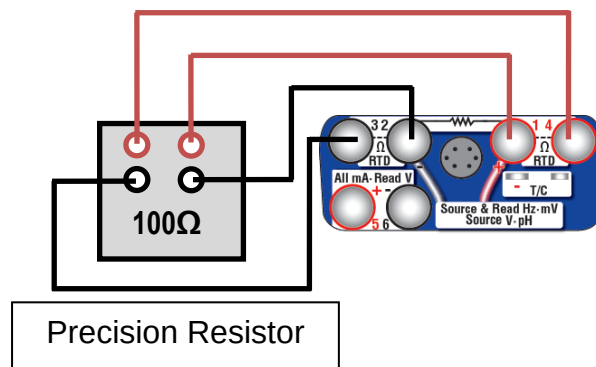


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Note: The Ohms verification test requires that all four leads are of equal low ($< .1 \text{ ohm}$) resistance (equal length with identical connectors on each end).

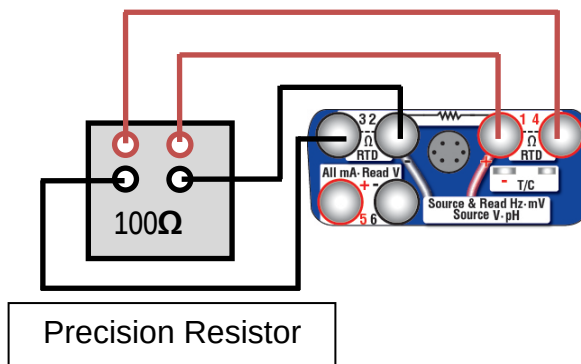
Read 400 Ohms Verification (400 Ω):

- 1) Connect one pair of identifiable test leads to the meter and short the ends. Note this reading (lead wire resistance) for use in steps 3 and 8.
- 2) Connect a precision 100 Ohm resistor to all four Ω terminals.
- 3) Move EZ-CHECK switch to LO (2 W). Verify display is $100.00 \Omega \pm 0.06 \Omega$ + Wire Resistance noted in step 1 Ω .
- 4) Move EZ-CHECK switch to SET (3 W). Verify display reads $100.00 \Omega \pm 0.06 \Omega$.
- 5) Move EZ-CHECK switch to HI (4 W). Verify display reads $100.00 \Omega \pm 0.06 \Omega$.
- 6) Double click the knob to move to the next function to be calibrated.



Read 4000 Ohms Verification (4000 Ω):

- 7) Connect a precision 100 Ω resistor to all four Ω terminals.
- 8) Move EZ-CHECK switch to LO (2 W). Verify display is $100.0 \Omega \pm 0.6 \Omega$ + Wire Resistance noted in step 1 Ω .
- 9) Move EZ-CHECK switch to SET (3 W). Verify display reads $100.0 \Omega \pm 0.6 \Omega$.
- 10) Move EZ-CHECK switch to HI (4 W). Verify display reads $100.0 \Omega \pm 0.6 \Omega$.
- 11) Double click the knob to move to the next function to be calibrated.

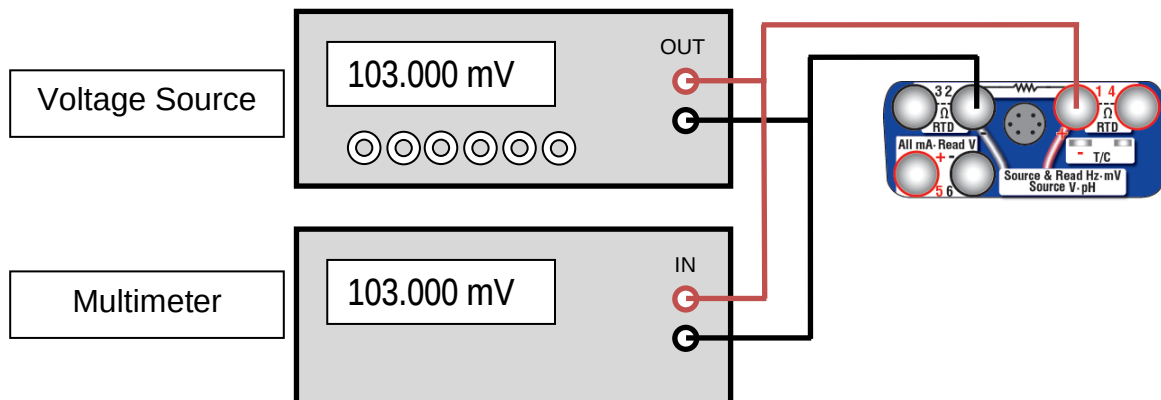


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Read V

Read mV Range:

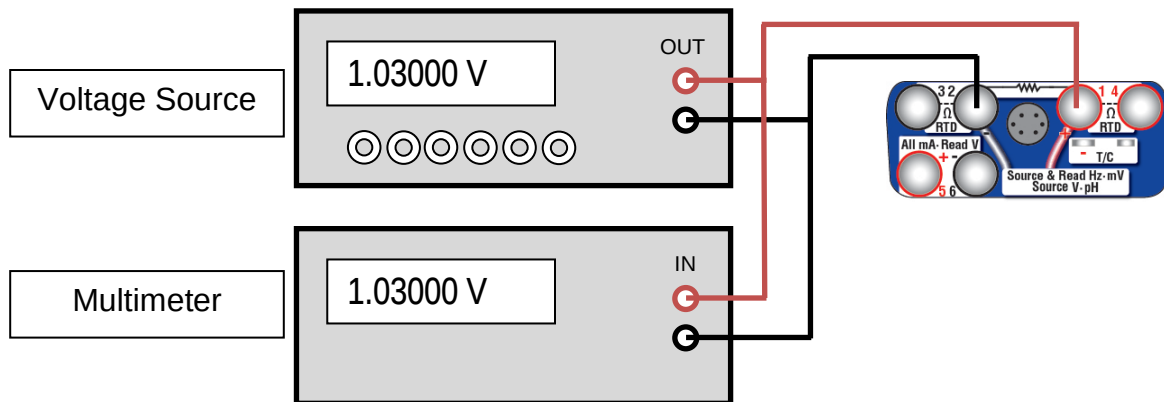
- 1) Put a two terminal shorting bar across terminals 1 & 2.
- 2) Move EZ-CHECK switch to LO. APPLY 0.000 mV should appear on the UUC display.
Wait several seconds for the UUC's readings to stabilize (when the least significant digits stop changing)
- 3) Press the knob until the display shows STORE.
- 4) Move EZ-CHECK switch to HI. APPLY 103.000 mV should appear on the UUC display.
- 5) Connect a precision voltage source + to terminal 1 and – to terminal 2 and connect another set of leads to a precision volt meter.
- 6) Dial the precision voltage source to as close to 103.000 mV as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0076 mV.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.



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Read 1V Range:

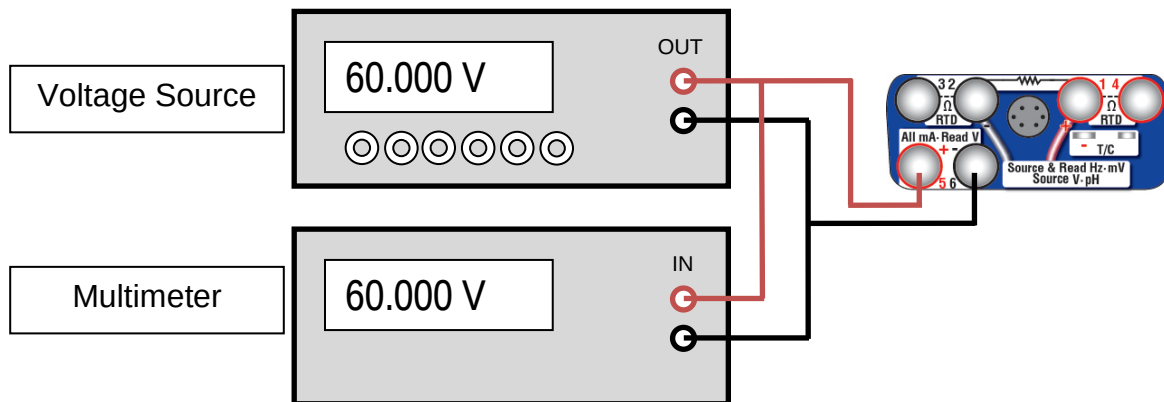
- 1) Put a two terminal shorting bar across terminals 1 & 2.
- 2) Move EZ-CHECK switch to LO. APPLY 0.000 mV should appear on the UUC display. Wait several seconds for the unit to stabilize (when the least significant digits stop changing).
- 3) Press the knob until the display shows STORE.
- 4) Move EZ-CHECK switch to HI. APPLY 1.03000 V should appear on the UUC display.
- 5) Connect a voltage source + to terminal 1 and – to terminal 2 and connect another set of leads to a precision volt meter.
- 6) Dial the voltage source to as close to 1.03000 V as possible.
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.76 mV.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.



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Read 60V Range:

- 1) Put a two terminal shorting bar across Read V terminals.
- 2) Move EZ-CHECK switch to LO. APPLY 0.000 V should appear on the UUC display.
- 3) Press the knob until the display shows STORE.
- 4) Move EZ-CHECK switch to HI. APPLY 60.000 V should appear on the UUC display.
- 5) Connect a precision voltage source to Read V terminals. Connect another set of leads to a precision V meter.
- 6) Dial the voltage source as close to 60.000 V as possible. NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0045 V.
- 7) Press the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.

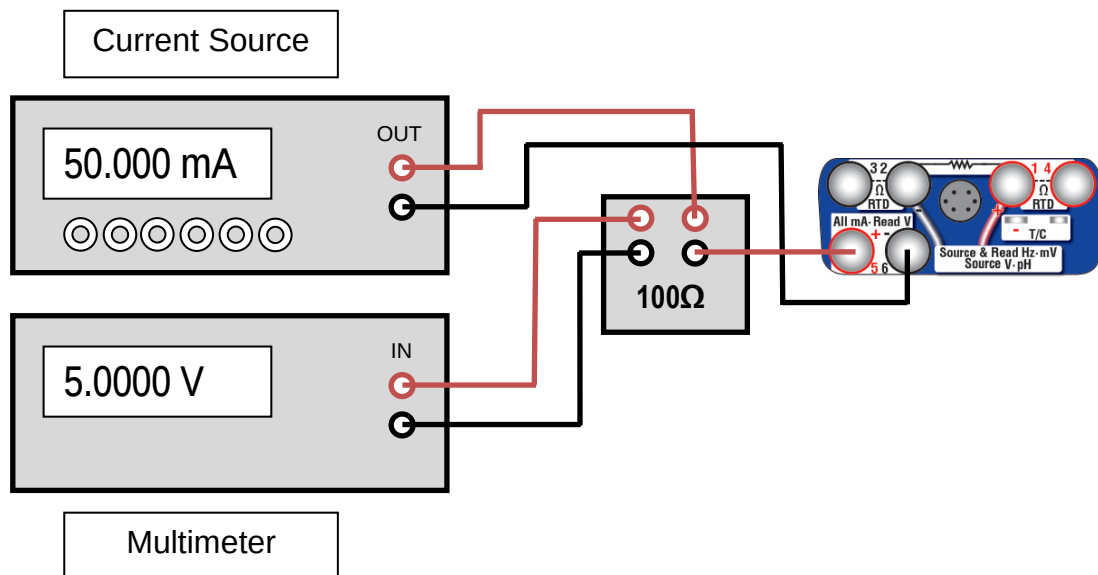


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Read mA

Read 50 mA Range:

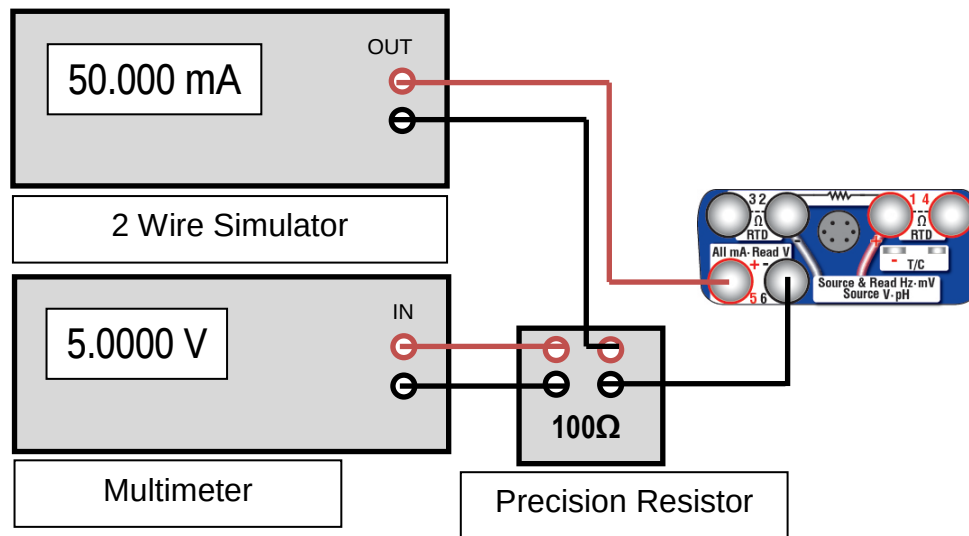
- 1) Leave all connections open.
- 2) Move EZ-CHECK switch to LO. APPLY 0.000 mA should appear on the UUC display.
- 3) Press the knob until the display shows STORE.
- 4) Move EZ-CHECK switch to HI. APPLY 50.000 mA should appear on the UUC display.
- 12) Connect leads from the mA terminals in series with a current source and a precision 100 Ω resistor. Connect another set of leads from the resistor to the precision V meter and set meter to V range (##### V).
- 5) Dial the current source as close to 50.000 mA as possible. The meter will read 5.0000 V
NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0003 V.
- 6) Press the knob until the display shows STORE.
- 7) Double click the knob to move to the next function to be calibrated.



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Power Transmitter 50 mA Range:

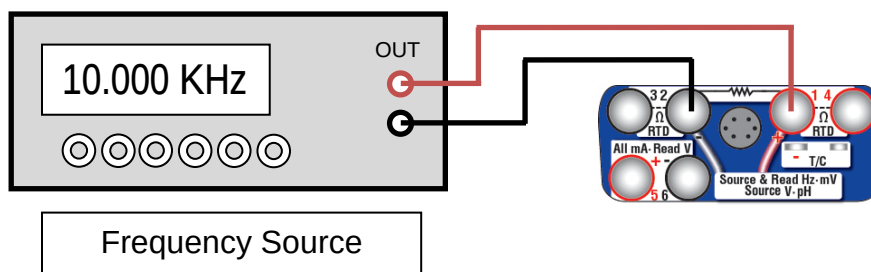
- 1) Leave all connections open.
 - 2) Move EZ-CHECK switch to LO. PWRM 0.000 mA should appear on the UUC display.
 - 3) Press the knob until the display shows STORE.
 - 4) Move EZ-CHECK switch to HI. PWRM 50.000 mA should appear on the UUC display.
 - 13) Connect leads from the mA terminals in series with a 2 Wire Transmitter Simulator and a precision 100 Ω resistor. Connect another set of leads from the resistor to the precision V meter and set meter to V range (##### V).
 - 5) Dial the 2 Wire Simulator as close to 50.000 mA as possible. The meter will read 5.0000 V
- NOTE: This value may be above or below the target value. Always select value closest to the target value. This should be within ± 0.0003 V.
- 6) Press the knob until the display shows STORE.
 - 7) Double click the knob to move to the next function to be calibrated.



Read Frequency (Verification Only – No Adjustments Required)

Read ## Hz Range:

- 1) Connect terminals 1 & 2 to a precision frequency source
- 2) Set the frequency source to 10.000 KHz & verify that the UUC reads 10000 Hz
Note: display will be noisy in calibration mode. – this is a functional check only.
- 3) Double click the knob to move to the next function to be calibrated.



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Thermocouple Cold Junction Temperature & LCD Contrast

Important! The cold junction sensor is a NIST traceable thermistor that is accurate to $\pm 0.05^{\circ}\text{C}$ for 10 years. There should not be any need to perform the following adjustments. Perform this calibration ONLY if you require repeatability of the UUC to match other temperature device calibrated in your laboratory to within 0.05°C . If you decide not to do any of the optional adjustments skip to Completion of Calibration.

Note: There are two possible ways to calibrate the cold junction sensor.

- 1) Automatic Adjustment (recommended) of the UUC stores the actual cold junction temperature as measured by the cold junction thermistor.
- 2) Manual Adjustment (optional) of the UUC applies an offset to the UUC cold junction sensor to match thermocouple standards of the calibration laboratory.

Note: There is also an optional step to adjust the contrast of the LCD display. This is set at the factory and should not require adjustment.

Automatic Cold Junction Temperature Reading:

- 1) Leave all connections open
 - 2) Move EZ-CHECK switch to SET. AUTOCAL TEMP should appear on the UUC LCD.
 - 3) Press and hold the knob until the display shows STORE.
- NOTE: This will reset Manual Temp calibration.

Manual Cold Junction Temperature Reading:

- 1) Leave all connections open
- 2) Move EZ-CHECK switch to LO. MANUAL CAL TEMP should appear on the UUC LCD.
- 3) Dial the UUC to the Desired CJC temperature as measured by the temperature probe.
- 4) Press and hold the knob until the display shows STORE.

Contrast Adjustment:

- 1) Move EZ-CHECK switch to HI. CAL CONTRAST should appear on the UUC LCD.
- 2) Dial the UUC to the Desired LCD contrast
- 3) Press and hold the knob until the display shows STORE

Completion of Calibration

Turn the UUC OFF and Move DIP switch 2 (the switch on the right) down toward the batteries (OFF). The next time the unit is turned on the PIECAL 850 will be calibrated and in normal operational mode. Reassemble in reverse order from disassembly.