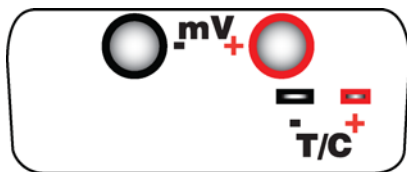


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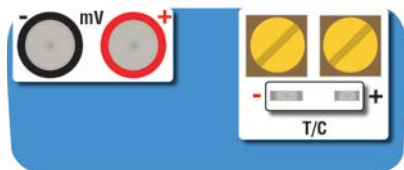
Rev.	Date	Appd	BRIEF CHANGE DESCRIPTION
A	2-3-2010	MJK	Initial Release
B	2-4-2010	MJK	Minor corrections
C	7-22-2014	PBG	Add section for new board with brass blocks & screws

Note: There are two versions of the PIECAL 322 and 422

If the end panel of the CL541-PLUS & CL542-PLUS only has a socket for miniature thermocouple connectors and two sockets for banana jacks and the firmware shown at turn on is 2.## or below follow the procedure that begins on page 2.



If the end panel of the CL541-PLUS & CL542-PLUS has brass blocks with screws for attaching bare thermocouple wires, a socket for miniature thermocouple connectors, and two sockets for banana jacks and the firmware shown at turn on is 3.## or above follow the procedure that begins on page 6.



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Equipment Needed:

1. Precision Voltage Meter with an accuracy of 0.0039% at 80.000mV.
2. Precision Voltage Source with an accuracy of 0.0039% at 80.000mV.
3. Precision Thermistor or RTD probe with an accuracy of $\pm 0.025^{\circ}\text{C}$ or better.

Precautions:

Avoid touching thermocouple connections, as this will cause temperature errors in calibration. It is recommended that the CL541-PLUS & CL542-PLUS be handled as little as possible during calibration to reduce errors. The heat from your body may cause uneven heating of temperature sensitive components.

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 CL541-PLUS & CL542-PLUS 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 batteries in and allow 15 minutes for the Model 322 or 422 to stabilize to the ambient temperature.

Enabling Calibration:

Make sure you are working at a grounded station and are wearing a ground strap. If you do not have a ground strap, make sure you touch a ground immediately before handling the calibrator. This is especially important when enabling the calibration! Place the CL541-PLUS & CL542-PLUS into calibration mode by shorting the vias (calibration points labeled J11) located on the right side of the PCB next to the power switch and turn the UUT on to SOURCE. Verify the CL541-PLUS & CL542-PLUS are in calibration mode indicated by the word "CAL TC" on the LCD. Remove the calibration short before proceeding.

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Source mV Calibration:

Connect the CL541-PLUS & CL542-PLUS mV banana jacks to a Voltage Meter (See Figure 2).

LO Calibration:

1. Slide the EZ-Check™ Switch down to the LO position.
2. Dial the CL541-PLUS & CL542-PLUS so the voltmeter reads 0.000 mV.
3. Press & hold down the EZ-Dial™ Knob.
4. The display will flash “STORED” to confirm that the value was stored. Release the knob.

HI Calibration:

1. Slide the EZ-Check™ Switch up to the HI position.
2. Dial the CL541-PLUS & CL542-PLUS so the meter reads 80.000 mV.
3. Press & hold down the EZ-Dial™ Knob.
4. The display will flash “STORED” to confirm that the value was stored. Release the knob.

Read mV Calibration:

Quickly move the power switch down to READ without pausing in the off position and make sure the CL541-PLUS & CL542-PLUS are in calibration mode indicated by the word “CAL” on the LCD. If “CAL” is not displayed follow the steps in Enabling Calibration but move the power switch to READ.

Connect the CL541-PLUS & CL542-PLUS mV banana jacks to a DC Voltage Source (See Figure 4).

LO Calibration:

1. Slide the EZ-Check™ switch down to the LO position.
2. Set the voltage source to 0.000 mV.
3. Press and hold down the EZ-Dial™ Knob
4. The display will flash “STORED” to confirm that the value was stored. Release the knob.

HI Calibration:

1. Slide the EZ-Check™ switch up to the HI position.
2. Set the voltage source to 80.000 mV.
3. Press & hold down the EZ-Dial™ Knob
4. The display will flash “STORED” to confirm that the value was stored. Release the knob.

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Cold Junction Calibration:

Double click the EZ-Dial™ Knob (with the power switch still in READ) to enter the Cold Junction Calibration Mode.

1. Place a thermistor or RTD probe as close as possible thermocouple jack (See Figure 3).
2. Connect the other side of the probe to an OHM meter or precision digital thermometer.
3. Let the temperature settle for 15 minutes.
4. Compare the Cold Junction Temperature of the UUT, located on the upper right of the LCD, with the temperature value of the probe.
5. If the UUT's reading is out of specification, dial the EZ-Dial™ Knob so that the large digits in the center of the LCD of the UUT matches the equivalent temperature value of the probe.
6. Press & hold down the EZ-Dial™ Knob.
7. The display will flash "STORED" to confirm that the value was stored. Release the knob.
8. Verify the UUT (upper right side of the LCD) Cold Junction Temperature is tracking the temperature reading of the probe. Repeat steps 4-7 if necessary.

Completion of Calibration:

Turn the CL541-PLUS & CL542-PLUS OFF before removing the batteries. Next time the unit is turned on the Model 322 or 422 will be calibrated and in normal operational mode. Reassemble in reverse order from disassembly.

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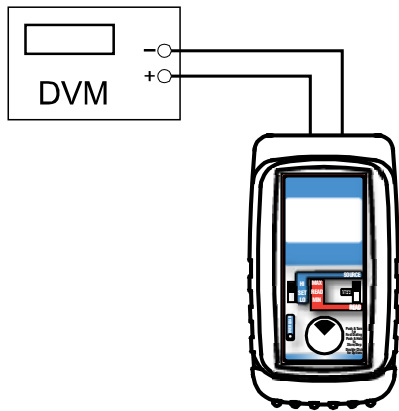


FIGURE 2 (Source mV)

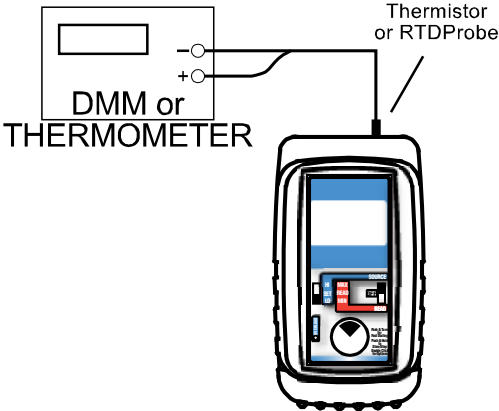


FIGURE 3 (Cold Junction Cal)

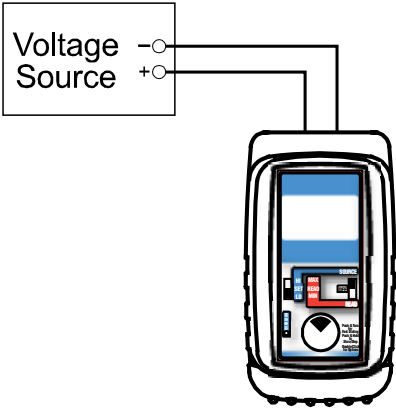


FIGURE 4 (Read mV)

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Equipment Needed:

- 1) Precision DC Voltage Meter with accuracy of
 - a. ± 0.0015 mV @ 0, and 83.000 mV
 - b. ± 0.00004 V @ 0.5 V
- 2) Precision DC Voltage Source with resolution of
 - a. 0.001 mV @ 90 mV
 - b. 0.001 V @ 60 V
- 3) Precision 100 Ω Resistor accurate to ± 0.004 Ohms
- 4) 2 sets of quality test leads with banana plugs.
- 5) Optional: Precision RTD or thermistor probe and indicator accurate to $\pm 0.0125^\circ\text{C}$ (for manual cold junction adjustment)

Abbreviations:

UUC = Unit Under Calibration = PIE Model 422 or 322

Precautions:

Avoid touching thermocouple connections, as this will cause temperature errors in calibration. It is recommended that the CL541-PLUS & CL542-PLUS be handled as little as possible during calibration to reduce errors. The heat from your body may cause uneven heating of temperature sensitive components.

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 CL541-PLUS & CL542-PLUS 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 batteries in and allow 15 minutes for the Model 322 or 422 to stabilize to the ambient temperature.

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 ON to SOURCE. 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.

As you calibrate the UUC 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.

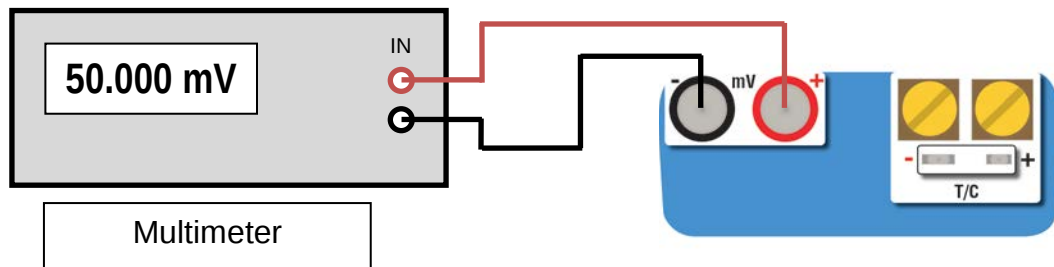
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This is the SOURCE section of the calibration procedure

Source mV

Source 80 mV Range (mV):

- 1) Connect leads from the UUC mV terminals 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 ± 0.0015 mV.
- 4) Press and hold the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. SOURCE 83.000 mV should appear on the UUC display.
- 6) Dial the UUC output until the meter as close to 83.000 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 ± 0.0031 mV.
- 7) Press and hold the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.

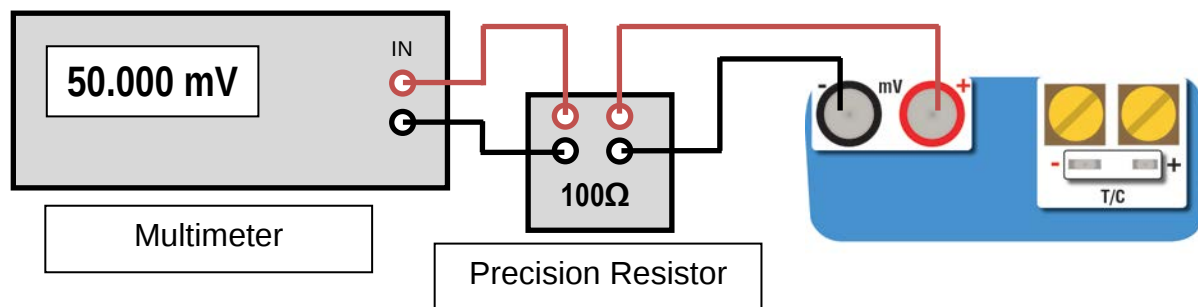


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Open Thermocouple

Open Thermocouple detection pulse:

- 1) Connect leads from the UUC mV 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 0.005 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 and hold 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 and hold the knob until the display shows STORE.
- 8) Double click the knob to move to the next function to be calibrated.



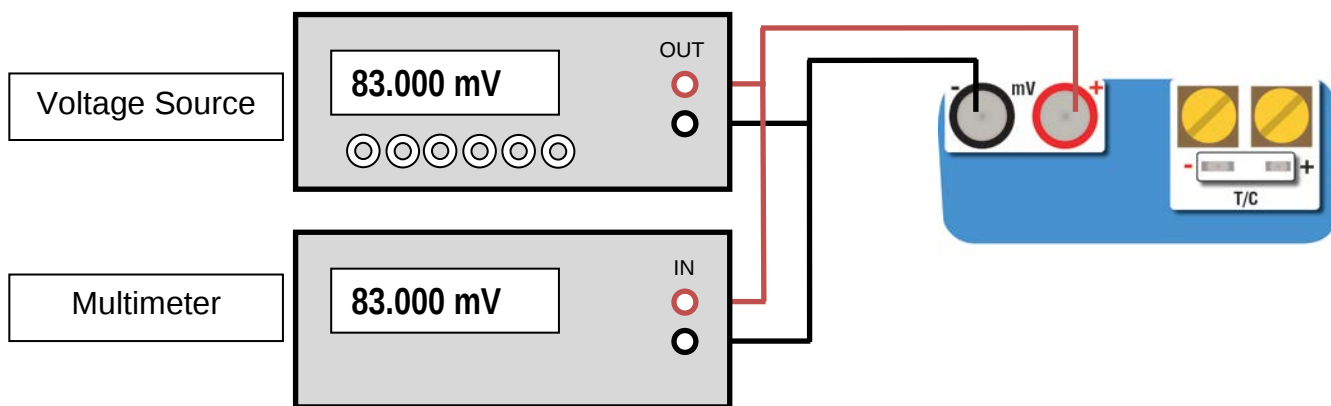
*This concludes the SOURCE section of the calibration.
The next steps are to calibrate the READ circuitry.*

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Read V

Read mV Range:

- 1) Short the mV terminals.
- 2) Move the power switch to READ.
- 3) 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)
- 4) Press and hold the knob until the display shows STORE.
- 5) Move EZ-CHECK switch to HI. APPLY 83.000 mV should appear on the UUC display.
- 6) Connect a precision voltage source + to terminal 1 and – to 2 and connect another set of leads to a precision voltmeter.
- 7) Dial the precision voltage source to as close to 83.000 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 ± 0.0031 mV.
- 8) Press and hold the knob until the display shows STORE.
- 9) 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 stores a temperature that is manually entered from readings of an external reference temperature device (RTD or thermistor) thermally attached to the UUC.

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) A user may perform a Manual Cold Junction Calibration however this will create an offset from the calibrated Cold Junction Temperature and this may cause the unit to not meet manufacturer's specifications.
- 3) Remove one of the brass screws and place a small RTD or thermistor temperature probe into the hole in the brass block. Alternatively place the temperature probe under the screw and gently tighten the screw to hold the probe in place. Protect the temperature probe from drafts.
- 4) Move EZ-CHECK switch to LO. MANUAL CAL TEMP should appear on the UUC LCD. *Important! Allow at least 15 minutes for the temperature to stabilize.*
- 5) Dial the UUC to the Desired CJC temperature as measured by the temperature probe.
- 6) 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

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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 UUC will be calibrated and in normal operational mode. Reassemble in reverse order from disassembly.