

uTracer 3.2 Calibration

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PC-to-microcontroller Communication

This test should be performed each time the uTracer is put into use. If a calibration is to be performed, begin with this test.

- 1) Connect the uTracer to the PC.
- 2) Connect the power supply to the uTracer (~20VDC, 1A).
- 3) Start the GUI.
- 4) Switch on the uTracer power supply.
- 5) Open the Debug/Communications window by pressing the “Debug” button in the “Miscellaneous” section of the main window.
- 6) Select the appropriate Com port if necessary.
- 7) Press the “Ping” button.
- 8) Verify that the Debug form shows the following values:
 - The “Send” and “Echo” strings should both read 500000000000000000
 - In the third row below “Vpower,” the supply voltage should appear
 - In the third row below “Vneg,” a value of approximately -40V should appear

Calibration Procedures

A calibration must be performed if the calibration data file is lost through a software re-load or upgrade, which will be indicated by all of the sliders on the calibration form being centered. Otherwise, a check of the calibration should be made on an annual basis.

Supply voltage

- 1) Measure the supply voltage using a DVM.
- 2) Compare the measurement to the voltage as displayed on the Debug form as in step 8) above.
- 3) If there is a discrepancy, open the calibration form by pressing “Cal” in the miscellaneous section of the main form.
- 4) Adjust the slider labeled “Vsupp” in the direction to reduce the error (i.e. move the slider to the right to increase the display value).
- 5) Press “Ping” on the Debug/Calibration form and observe the supply voltage display.

- 6) Repeat steps 4) and 5) as necessary until the display is in agreement with the DVM measurement.
- 7) Press the "Save to Calibration File" button on the calibration form.

Grid bias circuit

Warning: High voltages will be present in the uTracer circuit during this test!

- 1) Connect a DVM to the uTracer's cathode terminal (positive lead) and grid terminal (negative lead).
- 2) Select measurement type $I(V_g, V_a)$, with V_s, V_h constant, and set measurement parameters for V_g Start = -40, Stop = 0, Nintervals = 1, $V_a = 200$, $V_s = 200$, $V_h = 6.3$. Set Range and Averaging = Auto, Compliance = 200 mA, and Delay = 5 (sec).
- 3) Open the Calibration form by pressing the "Cal" button in the miscellaneous section of the main form.
- 4) Switch on the uTracer power supply.
- 5) Press the "Heater On!" button on the main form twice.
The second press of the "Heater On!" button will cause the uTracer to skip the delayed heating function, which is not necessary for this test.
- 6) Press "Measure Curve" (which was formerly "Heater On!") on the main form.
- 7) Read the actual grid voltage on the DVM during the -40V phase of the measurement.
- 8) Adjust the Vgrid gain slider on the calibration form in the appropriate direction to close any discrepancy between the DVM measurement and the -40V set value (i.e. move the slider to the right to increase the measured grid voltage).
- 9) Repeat steps 6) through 8) as necessary until the measured voltage is -40V.
- 10) Press the "Save to Calibration File" button on the calibration form.

The set-up for the grid bias voltage calibration can be saved under an appropriate name such as "Cal Grid Bias" for future use.

Screen grid boost converter

Warning: High voltages will be present and measured during this test!

- 1) Connect a DVM to the exposed leads of the screen reservoir capacitor C13.
- 2) Switch the uTracer power supply on and note the idle state voltage on the DVM.
- 3) Select measurement type $I(V_a=V_s, V_g)$, with V_h constant, and set measurement parameters for $V_a = V_s$ Start = 100, Stop = 200, Nintervals = 1, $V_g = -1$, $V_h = 6.3$. Set Range and Averaging = Auto, Compliance = 200 mA, and Delay = 5 (sec).

- 4) Open the calibration form by pressing “Cal” in the miscellaneous section of the main form.
- 5) Press “Heater On!” twice.
- 6) Press “Measure Curve” and observe the voltage measured by the DVM during the 200V phase of the measurement and compare it to a value of $V_{idle} + 200V$, where V_{idle} is the voltage observed in step 2).
- 7) Adjust the V_s Gain slider on the calibration form in the appropriate direction to close any discrepancy between the DVM measurement and $V_{idle} + 200V$ (i.e. move the slider to the right to increase the measured grid voltage).
- 8) Repeat steps 6) and 7) as necessary until the measured voltage during the 200V phase equals $V_{idle} + 200V$.
- 9) Press the “Save to Calibration File” button on the calibration form.
- 10) After the “HV On” indicator goes out, switch off the uTracer power supply and disconnect the DVM.

Anode boost converter

Warning: High voltages will be present and measured during this test!

- 1) Repeat the procedure above, except in step 1) connect the DVM to the anode reservoir capacitor C18, and in step 7) adjust the V_a Gain slider on the calibration form so that the DVM measurement equals $V_{idle} + 200V$.

The set-up for the anode and screen voltage calibrations can be saved under an appropriate name such as “Cal Boost Converters” for future use.

Current amplifiers

Warning: High voltages will be present during this test!

- 1) Make sure that the power supply is off and that the reservoir capacitors are discharged
- 2) Connect a 10k, 1% resistor between the anode terminal and the cathode terminal
- 3) Connect a 10k, 1% resistor between the screen terminal and the cathode terminal
- 4) Select Measurement type I($V_a = V_s, V_g$), with V_h constant, and set measurement parameters for $V_a = V_s$ Start = 195, Stop = 210, Nintervals = 4, $V_{gs} = -1$, $V_h = 6.3$. Set Range $I_a = 0 - 40$ mA, $I_s = 0 - 40$ mA, Average = 4X, Compliance = 200 mA, and Delay = 0 (sec).
- 5) Set plot controls:
 Display I_a on the left Y-axis and I_s on right Y-axis.
 Set all axes scale ranges to manual.
 Set the X-axis scale range for 190 to 210V, with 2 tick marks.

- Set both Y-axis scale ranges for 19 to 21 mA, with 2 tick marks.
- 6) Open the calibration form by pressing “Cal” in the miscellaneous section of the main form.
 - 7) Switch on the uTracer power supply, and press “Heater On!” twice.
 - 8) Press “Measure Curve” on the main form to start the measurement.
 - 9) Observe the resulting plot and adjust the Ia and Is gain sliders on the calibration form in the appropriate direction so that the straight lines on the plot (indicating a pure resistance) will pass through 200V at 20 mA at the center of the plot.
 - 10) Repeat from step 8) until both the Ia and Is lines pass through 200V and 20 mA.
 - 11) Press the “Save to Calibration File” button on the calibration form.

The set-up for the current amplifier calibrations can be saved under an appropriate name such as “Cal Current Amps” for future use.