VBA Curve Tracer

Verification & Calibration Procedure

1. **Preparation:**
    - What you need:
        i. A 3.5 digit or better DMM with floating inputs to measure DC voltages up to 200V.
        ii. An oscilloscope with a 10x probe. This can be a DSO or a CRT type. We'll assume you'll use a DSO for this procedure.
        iii. A Phillips screwdriver to open up the enclosure.
        iv. A small flat head screwdriver to adjust the calibration trimmers.
        v. Two BNC cables to connect the Curve Tracer to the DSO. Three if you want to use the blanking signal from the Z-output when you are using a CRT scope.
        vi. A 1K 1% 0.5W THT resistor. (p/n is in the offPCBParts BOM)
        vii. A 2K 1% 5W minimum THT resistor. (Or calibrate a set of resistors to a 2K0 value. A higher wattage is recommended.) (p/n for a 10W version is in the offPCBParts BOM)

2. **First power on:**
    - Make sure that you have selected the right mains voltage (230V or 115V)
    - If you just built the instrument and have verified the most important signs of life, you can perform a full functionality test and initial calibration with this procedure.
    - Turn off the power to the instrument and remove the mains lead.
    - To get access to test points, you may want to lengthen or extend the interconnect cables between the Sandwich and the Main board by using Dupont style male-female leads for the following connectors on the Main board:
        i. Use longer leads (that can carry 2A+) to connect the DUT power wires from J6

ii. The 3-way volt selector, J4
iii. The VcSet potmeter, J102
iv. The Fault/HV signals from J106
v. The Fault/Led signals from J103
vi. The current limit circuit from J106

- The other leads should be long enough, if not, you can extend them also.

3. **When you already have a functioning Curve Tracer:**
    - Turn off the power to the instrument and remove the mains lead.
    - Take the cover off the instrument by removing the 4 screws from the bottom. Do not put it fully upside down, just place it on one side or keep it upright while removing the screws because the Face Plate/Front Boards may fall out. When the screws are removed, put it back on its feet and remove the top cover to get access to the PCB's in the instrument.

2. **Get started**

- *Inside the instrument, when powered, there will be **lethal voltages** present, not only mains related. Take care not to touch the components. Use only one hand and keep the other in your pocket when you need to attach probes and adjust trimmers. If in doubt, disconnect power first and then connect probes and test leads to hard-to-get places.*

- Set all trimmers on the Main Board and the Front Board in the mid position.
- On the front panel:
    i. Set the Step Delay function to off (turn CCW to the off indent).
    ii. Set the Offset switch in the off position.
    iii. Turn the Offset Adjustment to Min.
    iv. Set the Polarity switch to N.
    v. Set the device type switch to FET.
    vi. Set the Step Output to 1mA/1V.
    vii. Set the Steps to 7.
    viii. Set the DUT selector switch to off.
    ix. Set the Current adjustment to 100%.
    x. Set the Current ranges to X1.
    xi. Set the Sweep/DC output to Sweep.
    xii. Set the Y-Amp to X1.
    xiii. Set the Voltage Ranges to 35V/2A.
    xiv. Set the Voltage adjustment to 50%.
- On the back panel:
    i. Remove all cables to the three BNC connectors to avoid an earth ground connection short while we make some adjustments. Only add the BNC cables when instructed.

- Note that when you switch to another Voltage range, the High Voltage and the Fault indicator may come on for a very short period. This is normal and shows that the protection circuits are working.

4. Check some of the vital signs

- Connect the mains cable and turn the instrument on.
    i. Check that the green power light is on.
    ii. Check that the red Current Limit indicator LED is off.
    iii. Check that the red High Voltage indicator LED is off.
    iv. Check that the blue Fault indicator LED is off.
- Use a DMM to test the rails
    i. Connect the negative input of the DMM to an **ISOGND** test point (TP).
    ii. Check the +15V supply (+/- 2%) on the plusStep test point.
    iii. Check the -15V supply (+/- 2%) on the minusStep test point.
    iv. Connect the negative input of the DMM to a **GND** test point.
    v. Check the +10V supply (between 9.9 and 10.1V) on the plusTri test point, the value will be calibrated later.
    vi. Check the -5V supply (+/-2%) on the minusTri test point.
    vii. Check the +24V supply for a voltage between 22V and 26V on the xyPlus test point.
    viii. Check the +7.5V supply for a voltage of 7.5V (+/-2%) on the 7.5V test point.
    ix. Connect the negative input of the DMM to the TransM test point.
    x. Connect the positive input of the DMM to the TransP test point.
    xi. Check for the presence of a DC voltage between 42V and 46V.
    xii. Select the 70V range and check for a voltage between 80 and 90V.
    xiii. Select the 200V range and check for a voltage between 220 and 240V.
    xiv. Select the 35V range.
    xv. Measure the voltage between test point TransMinus and the metal part of the heatsink (connected to the Collector) of the Current Source transistor Q91. The voltage should be about 120-130mV indicating a current of between 12 and 13mA.
    xvi. Disconnect both DMM leads from the instrument.

- Use a DSO/CRTO to test the Step Gen
- ***Warning****:*
  The instrument by itself is floating from Earth ground. Do not use a DSO or CRT oscilloscope with probes to measure points inside the enclosure when you also have BNC cables connected to the instrument. Connecting the ground clip of the probe can cause a short due to the different ground systems.

    i. Set the DSO time base to 2ms/Div. and CH1 Vertical to 5V/div.

ii. Connect a single X10 scope probe with the tip to the TransM test point and the ground clip to test point marked **GND** both on the Main board.
iii. Check for a negative going triangle waveform on the DSO of approx. -20Vp-p or 4 divisions.
iv. While changing the Voltage adjustment between 25% and 75%, verify that the amplitude changes. Return the Voltage setting to 50%.
v. Disconnect both probe connections.
vi. Set the DSO time base to 10ms/Div. and CH1 to 2V/Div.
vii. Connect a single scope probe with the tip to test point BuffStep and connect the ground clip to an **ISOGND** test point on the Front board. Set the ground indicator of the DSO to the first line of the graticule from the bottom. Adjust the trigger for a stable display.
viii. Check for a positive going step waveform with 7 steps relative to ground.
ix. Set the time base to 20ms/Div. Enable the Step Delay by rotating the adjustment to 100%.
x. Verify that there is about a 120ms period between two full step cycles. You may have to select a single shot trigger or freeze the acquisition to get a stable display.
xi. Turn the Step Delay fully CCW to the off position.
xii. Set the DSO time base to 10ms/Div. and CH1 to 5V/Div. Set the GND indicator of CH1 to the center graticule line.
xiii. Select the BJT mode.
xiv. Connect a 1K resistor between one of the Base DUT sockets and the Emitter socket on the front panel. The 1K resistor will convert the Base current into a voltage that is easier to see on the DSO. This is what we do in the FET mode as well to get a Gate voltage, but the FET offset circuit is different.
xv. Clip the probe tip to the Base and the probe ground to the Emitter. Select that DUT socket.
xvi. Select the Positive Offset and turn the Offset Adjustment from Min to Max. Observe that the waveform goes positive in relation to ground. When you measure the voltage at testpoint BuffStep, the waveform will start to clip at about 14V. When you measure across the 1K resistor, the clipping will be at around 7V with the Step size at 1V/Step and 7 steps. Set the Offset Adjustment back to Min.
xvii. Change the Offset to Neg. Observe that the waveform now goes negative from ground with the Offset Adjustment going from Min to Max. The waveform will start to clip at about -14V measured at testpoint BuffStep.
xviii. Set the Offset to off and the Offset Adjustment to Min.
xix. Change the device Polarity switch from N to P and check that the step waveform is now going negative from ground.

xx. Select the Positive Offset and turn the Offset Adjustment from Min. to Max. Observe that the waveform goes positive in relation to ground. The waveform will start to clip at about +14V. Set the Offset Adjustment back to Min.
xxi. Change the Offset to Neg. Observe that the waveform now goes negative from ground with the Offset Adjustment going from Min to Max. The wave form will start to clip at about -14V.
xxii. Note that the offset travel in the BJT mode is depending on the Step Output setting. The travel will be lower in the lower Base current settings.
xxiii. Select the FET-mode and verify that the offset has a maximum of +/-2V regardless of the Step Output voltage settings.
xxiv. Set the Offset to off, the Offset Adjustment to Min. and the device Polarity back to N.
xxv. Disconnect the probe connections.

- With the above steps, we have verified the functionality of several critical functions. We can now proceed to calibrate the instrument and verify the remaining functions.

5. Calibration of the +10V supply

- This supply is used as a reference for several settings and functions in the instrument.
- ***Changing this supply will require a complete re-calibration.***
- At this point, the instrument has warmed up so we can perform this calibration.
- Connect a DMM between TP plusTri and a TP called GND on the Main board.
- Adjust trimmer Pot10 on the Main board for a reading of 10.00V. When needed, you can install a parallel resistor R12 to the trimmer to reduce the range.

6. Check the Current Limit indicator operation

- Select the X.02 Current range on the Front panel.
- Turn the Current adjustment to 0% (no current) and check that the Current Limit (CL) indicator LED comes on.
- Set the Current adjustment back to 100% and select the X1 Current range.

7. Verify the triangle operation

- Set the DSO time base to 2ms/Sec and CH1 to 2V/Div.
- Connect a DSO probe between the Tri test point and GND on the Main board.
- Obtain a stable display.
- The triangle waveform should have a minimum of 7.6Vp-p.
- Switch from the Sweep mode to the DC mode with the switch on the front panel.
- Connect the DSO probe or a DMM to test point TRI-DC.

- Verify that you now have a DC voltage of about +7.5V.
- Switch back to the Sweep mode.

8. Calibration of the base frequency

- This will set the triangle frequency and also determines the refresh rate of the DSO display.
- With the same settings as in the previous step, adjust trimmer Pot52 for a frequency of about 170Hz or about 3 divisions between two of the top or bottom peaks of the waveform.
- Disconnect the probe.

9. Calibrate the Step Gain

- Set the DSO time base to 10ms/Div. and CH1 to 1V/Div.
- Set the GND indicator of the scope to the lowest graticule line.
- Connect a DSO probe with the pin to the Base and the Ground clip to the Emitter of the left DUT or 2mm sockets. To connect the probe, you can insert two pieces of wire (or resistors) into the DUT socket, or use the 2mm banana sockets.
- Select the left DUT socket.
- Check that you have a positive going stepped waveform with an equal distribution of the seven steps.
- With the CH1 Vertical Position of the DSO, adjust the first step (not the bottom) of the waveform to the first graticule line of the DSO.
- Adjust the 1V/Step trimmer Pot1 on the Front board for 1V per step, or the top at 7Vp-p.

10. Calibration of the 200V Supply

- Connect a scope probe with the tip to the C/D DUT output using a wire into the DUT connector, or use the 2mm banana connector. Connect the GND clip to the E/S connection of the DUT socket with a wire or use the 2mm banana connector.
- Set the DSO time base to 2ms/Div and CH1 to 10V/Div.
- Using the CH1 Position adjustment, move the ground indicator of the DSO to the first graticule line from the bottom.
- Trigger on the waveform and observe that you have a positive going triangle waveform of about 15-20Vp-p with the Volt potmeter at the 50% mark.
- Change the CH1 Vertical input to 10V/Div.
- Set the Voltage adjustment to 100% and observe that you now have a wave form with an amplitude between 30 and 40Vp-p.
- Set the DSO CH1 Vertical input to 20V/Div. and select the 70V range.
- Observe that the high voltage warning indicator on the front panel is on.
- Observe that you have a waveform between 70 and 80Vp-p.

- Set the DSO CH1 Vertical input to 50V/Div.
- Select the 200V Volt range and use the trigger adjustment to get a stable display.
- Observe that you have a triangle waveform of about 190-220Vp-p.
- Make sure that the Voltage adjustment and the Current adjustments are both at 100%.
- Adjust the 200V trimmer Pot 101 on the Main board such that you have an amplitude of 200Vp-p.
- Disconnect the probe.

11. Verification and calibration for the full 100mA budget at 200V

- This calibration will cancel out all currents occurring in the circuits, like the 12.5mA Current Source, to create a net 100mA setting in the 200V range.
- Set the DSO time base to 2ms/Div.
- Set CH1 of the DSO to 200mV/Div.
- Connect a DSO probe to a GND test point on the Main board and the tip to test point Vcur on the Main board.
- Set the DUT selector to off.
- Install a 2K 5W resistor between C-E on one of the DUT 2mm banana sockets.
- Select the 200V range, set the voltage to 100%.
- Set the Current adjustment to 100%.
- Select the X1 Current range.
- Note: The 2K resistor will get hot, so limit the time with full current. Be careful not to touch the resistor leads to test the temperature. 200V is present!
- Select the proper DUT socket.
- Observe that you have a triangle waveform of about 1Vp-p.
- Adjust the Current Null trimmer Pot103 on the Main board so the top of the waveform is just not clipping. If there is no clipping, it means that you have the full 100mA available in the 200V setting.
- Verify that the CL LED is off.
- Slowly reduce the Current adjustment to 0% and observe that the top of the triangle becomes a straight line going down to almost 0V (about a minor division).
- Verify that as soon as you reduce the setting away from 100%, the CL LED comes on.
- Switch the DUT selector to the off position.
- Select the 70V range.
- Turn the Current potmeter to 0% and verify that the CL LED is on. If not, turn Pot103 a little bit clockwise so the CL LED is just turning on.
- Select the 35V range and verify that the CL LED is on.
- Let the 2K resistor cool off and remove it.

12. Calibration of the 70V Supply

- Connect a scope probe with the tip to the C/D DUT output using a wire into the DUT connector, or use the 2mm banana connector. Connect the GND clip to the E/S connection of the DUT socket with a wire or use the 2mm banana connector.
- Select the 70V Volt range.
- Set the DSO CH1 Vertical input to 20V/Div.
- Adjust the trigger such that you have a stable triangle waveform.
- Adjust the 70V trimmer Pot 100 on the Main board such that you have an amplitude of 70Vp-p.
- Leave the DSO probe attached.

13. Verify the High Voltage indicator tripping point

- Turn the Voltage down to 25%.
- Increase the Voltage until the High Voltage indicator LED starts to glow. Verify that the voltage is at least 40Vp-p. Further increasing the voltage will also increase the intensity of the LED, which will reach the maximum intensity at about 60V.
- Turn the Voltage up to 100%.
- Leave the DSO probe attached.

14. Calibration of the 35V Supply

- Select the 35V Volt range.
- Set the DSO CH1 Vertical input to 5V/Div.
- Adjust the trigger such that you have a stable triangle waveform.
- Adjust the 35V trimmer Pot 102 on the Main board such that you have an amplitude of 35V.
- Turn the voltage down to about 10Vp-p.
- Leave the DSO probe attached.

15. Verify and calibrate the DC mode

- Select the DC Mode on the front panel.
- Note that the triangle waveform is now a DC voltage with an amplitude of about 10V.
- Set the Voltage to 100% and verify that the DSO shows 35V +/- 5%.
- Set the DSO CH1 Vertical input to 20V/Div.
- Select the 70V range
- Verify that the DC level is 70V +/- 5%
- Set the DSO CH1 Vertical input to 50V/Div.
- Select the 200V range
- Verify that the DC level is 200V +/- 5%
- Select the Sweep mode, select the 35V range and set the Voltage to 20%.
- Disconnect the scope probe from the test points

- Remove the DSO X10 probe from the CH1 input channel of the DSO.

16. Calibrate the Zero level for the triangle waveform

- Make sure you are in the 35V range.
- Connect a BNC cable between the Horizontal (X) output connector of the instrument to CH1 of the scope.
- Make sure you do not have a scope probe connected to the instrument anymore.
- Set the time base of the DSO to 1ms/Div. and set CH1 to 5V/Div. and obtain a stable display.
- Move the ground indicator of the DSO to the first graticule line from the bottom of the display.
- Check that the input multiplier of the DSO CH1 is still 10X.
- Verify that you have a triangle waveform on the display that is going positive in reference to ground and adjust the Voltage adjustment so you have a wave form of about 6 divisions (at about 80%).
- Look at the bottom peaks of the wave form in relation to the ground indicator. It should be on or near zero Volt to this indicator.
- Calibrate the lower peaks of the waveform with the 0V Adjust trimmer located on the Main board so they are at or not more than a fraction of a minor division above the ground level of the DSO.
- Going below the ground level will distort the wave form, keep it on or just above the ground level. Adjust CH1 to 2V/Div so you can see this in more detail when needed. The integrity of the triangle waveform transitions is very important.
- Set the DSO CH1 back to 10V/Div. and the time base to 1ms/Div.

17. Calibrate the gain of the horizontal (X) Amplifier

- Select the 35V range. Set the Voltage adjustment to 100%.
- Verify that you have the X-Chan output of the CT connected to CH1 of the DSO with a BNC cable.
- Disconnect the Y-Chan BNC cable to CH2 of the DSO.
- Set CH1 and CH2 both to 5V/Div. **and invert CH2.**
- Position both CH1 and CH2 GND indicators at the lowest graticule line.
- Set the Time-Base to 1ms/Div.
- ***Be careful with this step, because it is counter intuitive!***
  Connect CH2 of the scope with a 10x probe with the tip to the DUT E/S connection, and the ground clip to the C/D connection. *If you make a mistake and reverse the probe connections, you will short the output of the DUT supply.*
- The two waveforms are about the same size and will almost overlap.
- Adjust the H Gain (horizontal gain) trimmer of the X amplifier Pot 70 on the Front board to make both waveforms overlap so they are exactly the same.

- This will calibrate the Collector supply voltage output level with the DSO in a 1:1 ratio with the 10X setting of the DSO input channel. (so 1V of the DUT supply is also 1V of deflection on the DSO)
- Disconnect the 10x probe from the DUT and also from the scope. Remove the inverting of CH2.

Verify the 1/10 current multiplier for the vertical (Y) Amplifier

- Connect a second BNC cable between the Vertical (Y) output connector of the instrument to CH2 of the DSO. This will display the current through the DUT.
- Set the Y-Amp gain on the Front panel to X1. This is the large current setting. You should now also should select the 1X Ratio multiplier for the CH2 input channel. The Y-channel multiplier setting goes hand-in-hand with the CH2 Ratio setting to keep 1V = 1A
- Set the DSO vertical of CH1 to 5V/Div. and CH2 to 5mV/Div.
- Set both ground indicators to the first graticule from the bottom.
- Verify that the CH2 horizontal line is level with the ground indicator of the scope. If not, adjust the offset trimmer Pot71.
- Install a 1K 1% 0.5W resistor between the C/D and E/S terminals on the DUT connector. Keep the DUT selector to off.
- Adjust the CT Voltage so that you have a wave form of 6 divisions, or 30V (at about 80%).
- Select the DUT socket with the resistor. Both channels should now have voltage and current waveforms that are virtually the same and will overlap, plus or minus a minor division. (5V/1K=5mA/Div)
- Set CH2 to 50mV/Div. and select the .1x Ratio multiplier. This multiplier setting goes hand-in-hand with the setting for the Y mA/Div to keep the V/div or rather the A/Div correct of the DSO the same.
- Select the X10 multiplier for the Y mA/Div on the Front panel.
- Verify that the waveform is again 6 divisions plus or minus a minor division. They should still virtually overlap.

18. Verify the correct operation of the Current Limiting

- Set CH1 to 2V/Div., and CH2 to 100mV/Div.
- Set the Y-Amp to X10. Remember that you now also should select the X1 multiplier of the CH2 input. This multiplier setting goes hand-in-hand with each other to keep the V/div or rather the A/Div correct.
- Select the X.05 Current range.
- Set the DUT selector to off.
- Install a 2K 5W or 10W resistor in the left DUT socket between C-E.
- Select the DUT side where the resistor is mounted.
- Select the 35V range and set the Voltage so you have a CH1 wave form of 6 divisions on the DSO

- Both CH1 and CH2 displays should be close in size, and virtually overlap.
- Adjust the Current such that the triangle waveform will just be clipping and the CL LED comes on to signal that. Adjust the Current (10%) so you have display of three divisions.
- Note that both DSO channels show a clipped triangle waveform with a gradual change (almost a dome) without any under- or overshoot in the transitions from the triangle to the clipping (limiting) portion. (the dome shape, not a flat line, is caused by the very low amount of current <2mA in this Voltage range)
- Select the 70V range and adjust the Current adjustment (30%) to have three divisions again. Observe that the corners will get sharper and the limiting line flatter.
- Select the .2 current range.
- Select the 200V range and adjust the current adjustment (50%) to have three divisions again. Observe that the corners will be sharp, but without glitches, over- and undershoot and a straight limiting line.
- Select the off position for the DUT selector.
- Select the X1 position for the Current range, the X1 position for the Y-amplifier and the X1 multiplier for CH2.

19. Verify the correct operation of the X-Y mode and calibrate the Y-channel offset

- Set the DUT selector to the off position.
- Set the Voltage range to 35V.
- Set the time base of the DSO to 1ms/Div.
- Set the DSO in the X-Y time base mode.
- Reduce the acquisition Memory Depth to a lower value, like 70K Points. This will make the lines less fuzzy.
- Set Ch1 to 5V/Div. and a 10x Ratio multiplier.
- Set CH2 to 5mV/Div. and a 1X Ratio multiplier
- Select the X1 setting on the Front panel for the X-amplifier.
- Limit the bandwidth of both channels to the lowest setting to reduce noise.
- Adjust the CH1 Position to the first graticule line from the left.
- Adjust the CH2 Position to the first graticule line from the bottom.
- Verify that the trace of the waveform is a straight line and at the same level as the CH2 GND marker. If not, use Pot71, the Y-Offset calibration to set it at the CH2 GND marker position.

  If you find that you need to regularly require a new offset calibration, you can drill a small hole in the side panel of the enclosure to adjust the Y-Offset without opening it.
- This is now the 0V, 0A origin.
- Select the X.05 Current range.
- Set Current to 100% and Voltage to 50%.
- Insert a 1K 0.5W resistor in one of the DUT sockets.
- Select that DUT socket.

- Note that there is a diagonal line from the origin up and to the right with equal graticule sizes.
- Adjust the Voltage to 30V (3 divisions horizontally) and verify that there is a diagonal line of 3 divisions up and 3 divisions to the right.
- This represents 30V and a current of 30mV = 30mA. (30V / 1K)
- There should not be more than a vertical minor division offset from the center graticule lines.
- Slowly reduce the Current adjustment and verify that the diagonal line is reduced linearly back to the origin. The Current range of X0.05 at 2A in the 35V range is 0-100mA. This means that the reduction will start to have an effect just below about 40%.
- Set the DUT selector to the off position.
- Remove the resistor and set the Voltage to 50% and the Current to 50%.
- Set CH1 to 50V/Div.
- Select the 200V range and the X.1 Current setting
- Turn the Voltage up to 100% and verify that there is a horizontal line of 4 divisions or 200V.
- Select the 35V range, set the Voltage to 50% and the Current to 50%, select the X.1 Current range to leave the settings at safe operating levels.

20. **Verify the operation of the Curve Tracer with a BJT**
    - Set the Step Output to 10uA/step.
    - Select the BJT device setting
    - Select the N polarity
    - Set the DUT selector to off
    - Put a 2N3904 or equivalent transistor in one of the DUT connectors.
    - Select the X.1 Current range and set Current to 50%.
    - Select the 35V range and set Volt to 50%.
    - Select the X10 multiplier for the Y-channel.
    - Set the Timebase to 5mS/Div or less to reduce the acquisition flicker.
    - Set CH1 to 5V/Div and CH2 to 5mV/Div and the Ratio multiplier to 0.1X.
    - Select the DUT with the transistor.
    - Verify that you see the typical transistor I/V curves with 7 steps.

21. Calibrate the propagation delay of the Step Generator circuit
    - With same the settings left as in the previous step, set CH1 to 1V/Div. and CH2 to 2mV/Div., to zoom in on the 0V, 0A origin.
    - Turn the DelayAdjust trimmer on the Main board back and forth to see the effect on the waveform.
    - Adjust the DelayAdjust trimmer so you only just see the tiny beginning of a flat line before the first rising edge of the curves. This compensates for the propagation delay in

the Step Gen circuits so the first step starts at the beginning of the Triangle transition for the DUT supply, to make sure they start at the same point.

- Set the DUT selector to off and remove the transistor.

22. Verify the correct operation of the Step Gen protection circuit

- Set the Voltage range to 35V.
- Set the Current range to .2X.
- Set the polarity to N.
- Set the DUT selector to off.
- Set the Current adjustment to 50%.
- Set the Voltage adjustment to 20%.
- Connect a 1K resistor (or a wire jumper) between the Collector and Base terminals of a DUT connector.
- Set the DSO to the Time-base (Y-T) display so you can see the triangle waveform.
- Set CH1 to 5V/Div.
- Set the time-base to 5mS.
- Adjust the CH1 GND indicator to the first graticule line.
- Select the DUT with the resistor.
- You should have a triangle waveform of about 6Vp-p.
- Slowly increase the Voltage. At about 18V, the protection circuit will be activated.
- Verify that the Fault indicator on the front panel is turned on.
- You will see part of the triangle, but it is cut-off at about 18V, even when you further increase the voltage. After about 18 mS, the protection is released to be turned-on again when the next triangle reaches the limit. This protection ensures that inputs and outputs of the Opamps in the Step Gen circuits will not go much beyond their rails, potentially destroying them. The protection will work in all three voltage ranges where voltages can reach up to 200V.
- Reduce the Voltage to 20% again.
- Change the polarity to P.
- Due to the way we switch the signals, you will still see a positive going waveform, but it's actually going negative from GND now. (If you want, disconnect the two X-Y BNC's and use a 10x prove connected with the GND clip to E and the probe tip to C, to see the polarity change of the triangle)
- Increase the voltage again and verify that the Fault indicator comes on at about 18V.
- Reduce the voltage to 20% and set the DUT selector to off. Remove the resistor.
- This concludes the calibration and verification procedure.

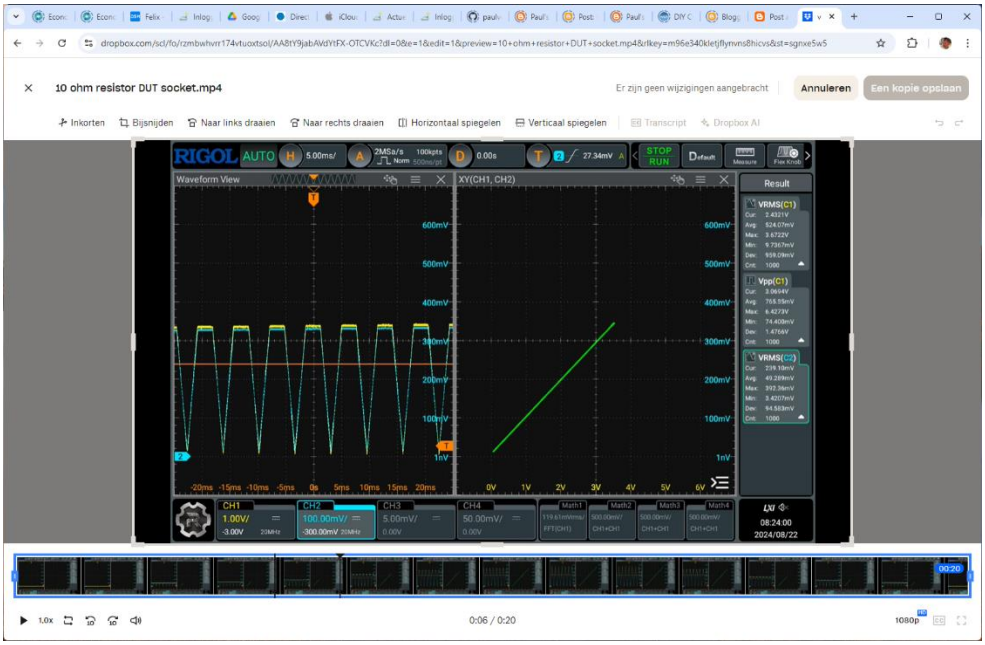
WARNING:

Before making any measurements on a DUT yourself, make sure you are limiting the current to the DUT when powering them. It is very easy to blow them up if you are not careful. This is especially true for MOSFET's and their low RDSON.

The effect of leads to connect to a DUT:

Maker Matt Webb discovered that the length of the leads connecting to a DUT by using the 2mm Banana Jacks, can cause oscillation of the Collector voltage at higher currents. The added inductance of the leads is causing this issue.

Below are three measurements that show the effect. First a picture showing the triangle waveform with a 10 Ohm power resistor connected directly to the DUT socket. All is well.



Then a picture of the same resistor, but now connected through leads with a 1 meter length:
The oscillation during the Current Limiting phase is easy to see.

Lastly a picture of the same resistor connected to the end of a 3 meter long 75 Ohm coax cable: All is well again although there is a bit of a current drop introduced.