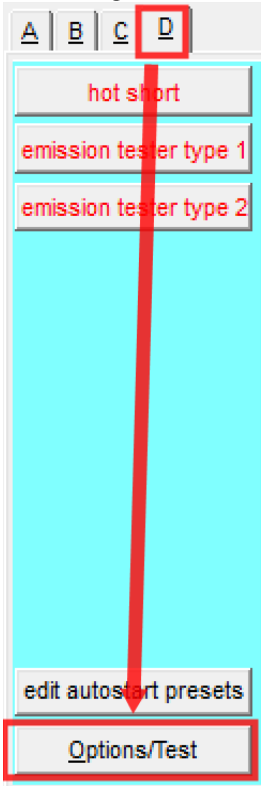
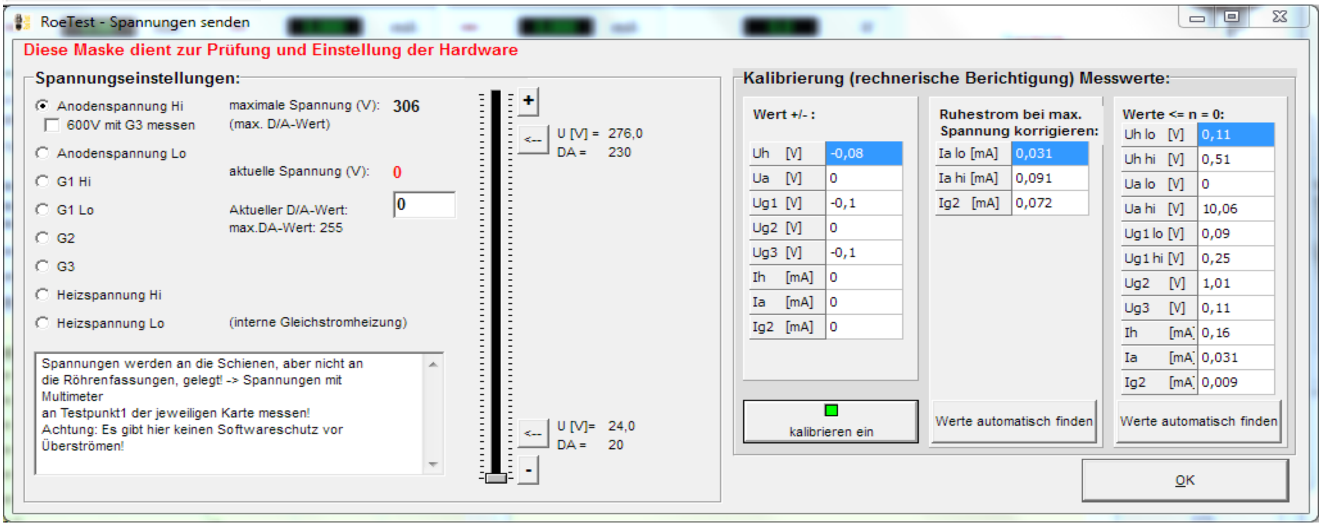
manual Calibration
(from Hardware >= V9 it is easier to use the calibration assistant)

To calibrate the hardware, select menu “D” ->Options/Test->sending voltages and you should see the following screen:





Here you can set the output voltages of each individual card.

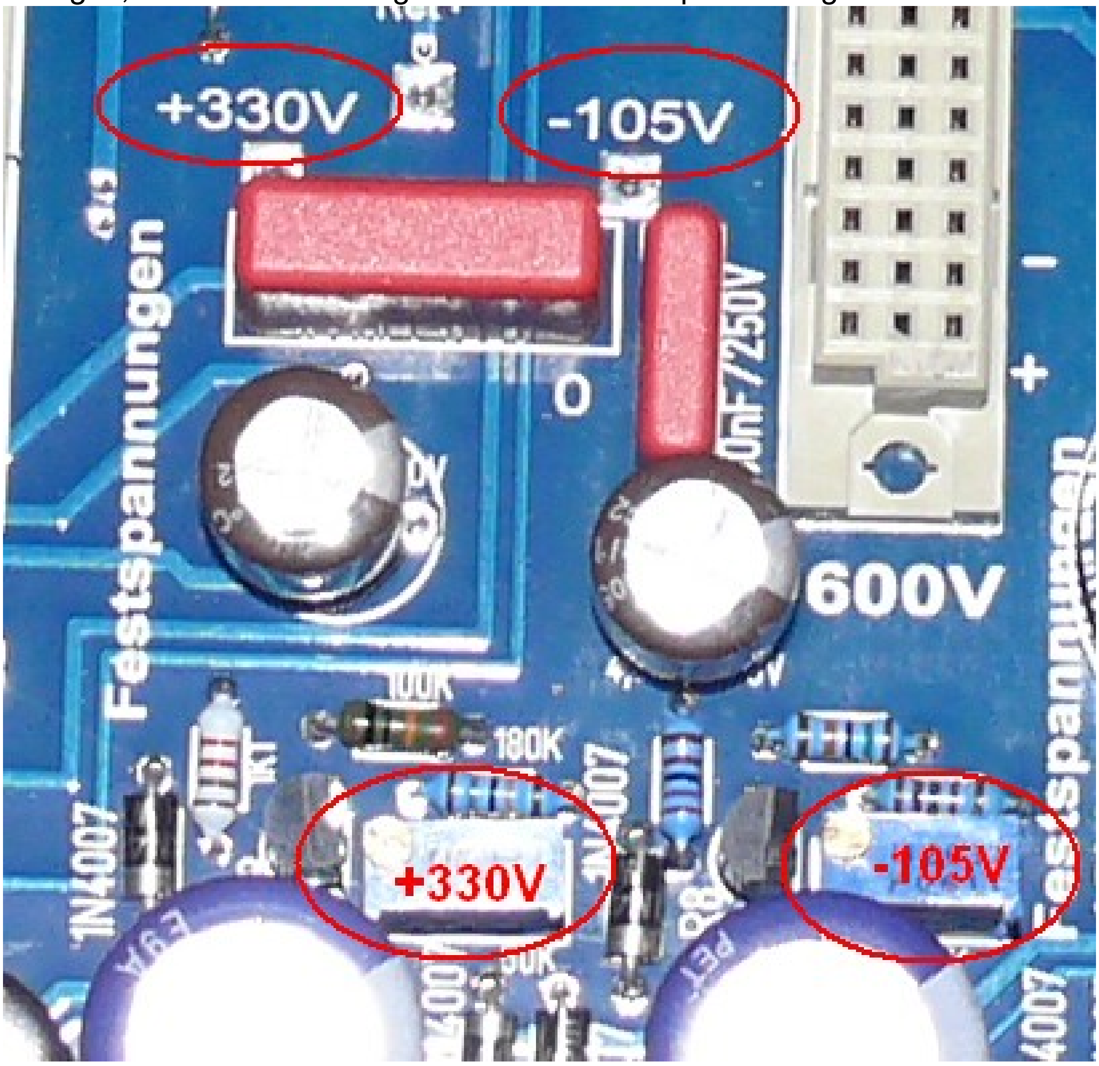
Note:

- The output voltages are connected to the voltage rails but not to the tube sockets. Connect your test instrument and load resistor to test point 1 on each of the cards.
- There is no software over current or short circuit protection – don’t overload the MOSFETs (for instance, don’t connect the maximum anode board output voltage of 300V to ground to simulate a short circuit for any length of time). The hardware limited maximum output current is about 350 mA. That means that with a source-drain voltage of about 350V the MOSFET has to dissipate some 115W, and it can do that only for a very limited amount of time and will get very hot. If it gets too hot the MOSFET will short-circuit.

- Make all voltage calibrations without a load resistor.

Constant voltages

The +330V and -105V constant voltages can be calibrated using the trim pots marked with the red arrows in the picture below. Use the test points indicated with the red arrows to measure the voltages, measure the voltage between the test point and ground.



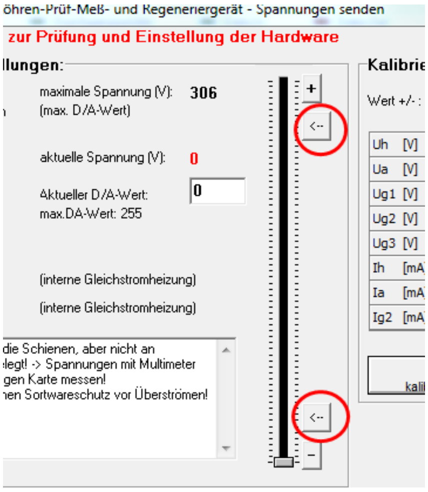
Variable/microcontroller controlled output voltages:

The next section describes the calibration procedure of the anode board. The heater and G2 boards are calibrated in a similar manner.

Select the 400V range on your multimeter and connect it between test point 1 on the anode board and ground.

On the PC software, select Options/Test->sending voltages. Make sure software offset compensation is set to off.

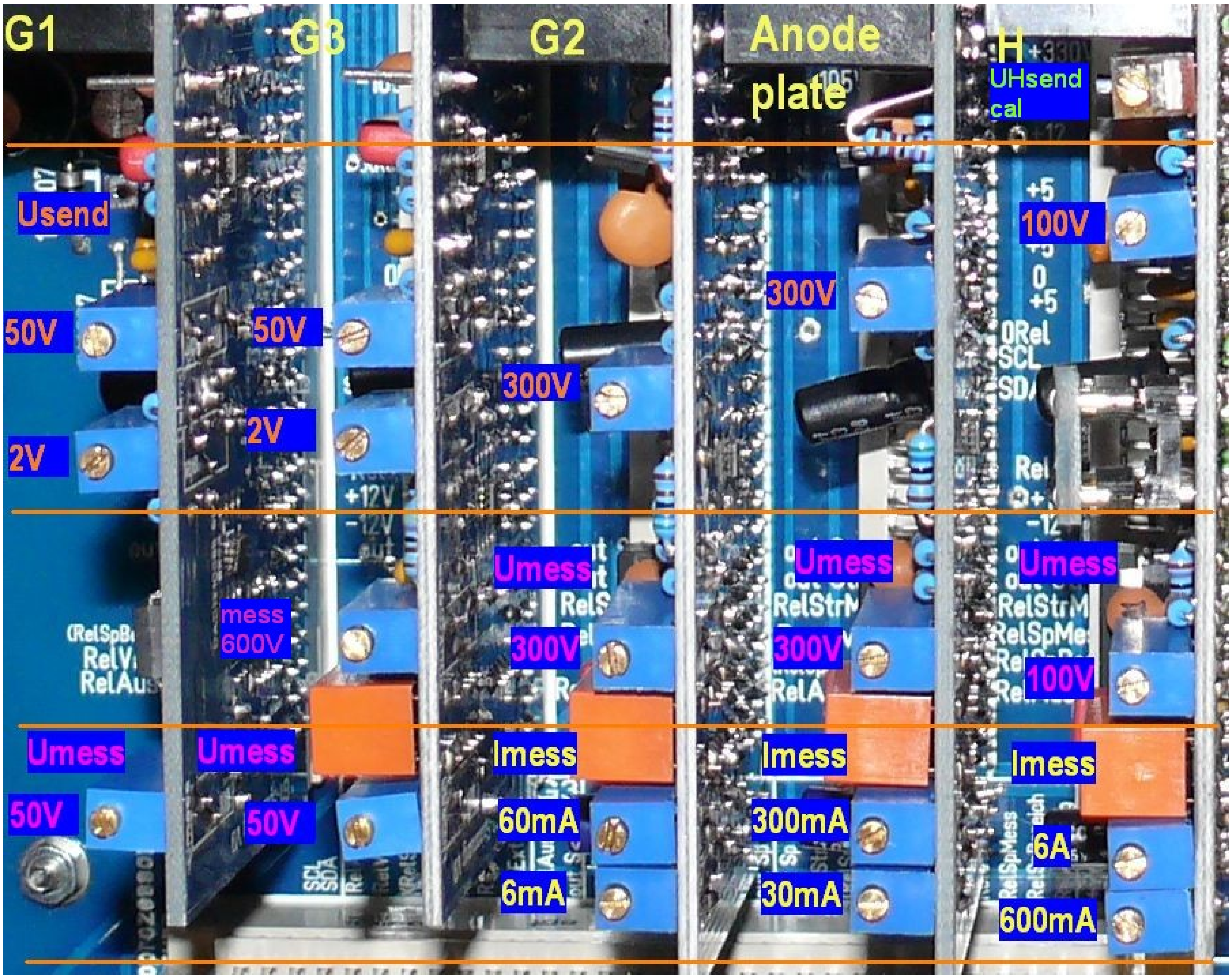
The output voltage is calibrated for both the low and high ends of the output voltage range.



Buttons for upper and lower calibration points

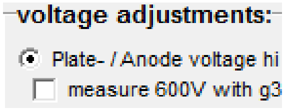
Position of the trimmers on the PCB's:

Usend and Umess: voltage alignment points
Imess: current measure range

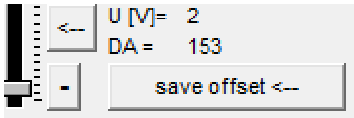


Anode (plate) voltage, Heater voltage, G2 voltage

1. Connect multimeter to TP 1 of the A-board (use 400V range)

2. 

Chose anode voltage range
3. Press button for **upper** calibration point 

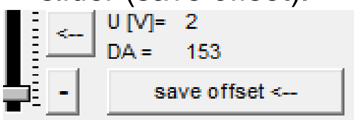
4. Align pot to the software selected voltage
5. Press button for **lower** calibration point
6. There are no such pots for the H-, A- and G2-board. Adjustment is done by selecting an offset in the software. First find the position for lower calibration point (A, G2=12V) output voltage at multimeter by setting with either the slider and/or the fine +/- buttons and then press the save button right to the slider (save offset). 

Repeat those steps restarting at 3 until synchronization is achieved

The maximum deviation from the lower calibration point is guaranteed to be <= ½ LSB (maximum of 0,05V for A- and G2-board and 0,025V for the H-board – on average it is less – and this is acceptable).

G1- and G3 board:

Calibration for these boards is slightly different. For these boards the lower voltage must be exactly adjustable down to 0V. To circumvent the non linear characteristic at the DAC's lower end of its range a small offset voltage is generated by the hardware on these boards.
The DACs will generate a board output voltage of 0V starting at DAC output values of approximately 65 (decimal).

1. First find the position for lower calibration point (2V) output voltage at multimeter by setting with either the slider and/or the fine +/- buttons and then press the save button right to the slider (save offset).


2. Press button for **upper** calibration point
3. Adjust upper range pot to the selected voltage
4. Press button for **lower** calibration point
5. Adjust lower range pot to the selected voltage
6. Repeat those steps restarting at 2 until synchronization is achieved

If the adjustment range for the lower range pot should be too small change the software offset by step 1.

The G1- and G3- voltages will then be very exact and will only deviate due to the remaining slight non-linearities of the DACs.

All adjustments are done without any load resistor.

Calibration of the 600V board:

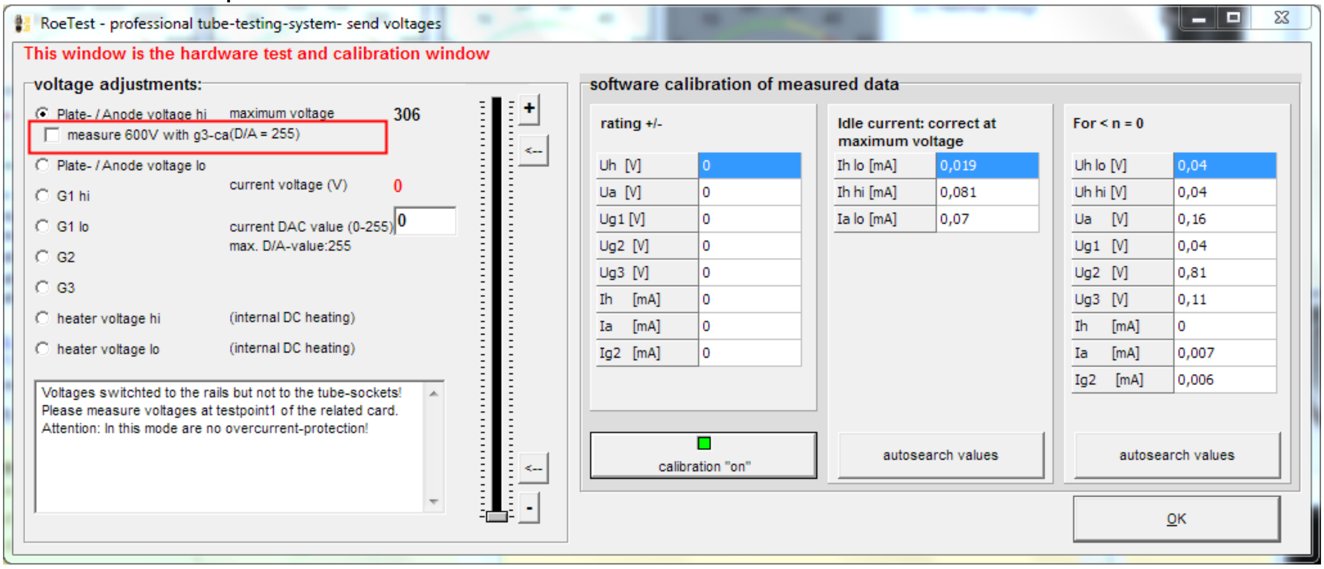
What do this card: It is a fixed 300V supply, which can switched in serial to the anode card. So up to 600V are available (300V fixed supply + 0-300V variable anode card).

Connect your multimeter to the test points marked + and - on the PCB and adjust the trim pot until you measure exactly 300V. Connect a load resistor, for instance a 15W bulb (make sure the bulb can handle the voltage), and verify that the output voltage is kept constant within approximately a 1-2V range.

Calibration of the 600V measurement range on the G3 card (from version 6 onwards):

Note: This funktion have nothing to do with the 600 V board!

The new G3 card has a function allowing you to measure anode voltages up to 600V, but only when the G3 voltage output is not needed. You can use this, for instance, when testing voltage regulator tubes. For calibration of this function, the output of the anode supply is connected to the input measurement section of the G3 card. You do this **in the software** by checking the check-box as indicated in the picture below:



Set the anode board output voltage to 280V and then calibrate the G3 board by adjusting the trim pot for the 600V range on the G3 board until it indicates 280V. **Note: you can only do this if you have set the correct version of the G3 card in the software (Options/test->Options) and your G3 card must be version 6 or higher.** Otherwise the check-box will not be displayed on the screen. Never try to connect the cards using a wire!

Calibration of the voltage measurement ranges:

The calibration of the “measurement voltage” trimmers ensures that the virtual voltmeters, displayed in software on the screen, indicate the same values as the multimeter. Make this calibration towards the high end of the output range for example at 300V anode voltage.

Adjust the various trim pots marked “measurement voltages” in the picture above so that the software voltmeters agree with the multimeter's measured output. Offset calibration is not possible with the

trimmers. Only when there is no other option (and you are sure the hardware is OK) should you set an offset voltage in the software. For example if the offset is +0.1V enter a
value of -0.1V (Options/Test->sending voltages->software calibration of measured data->rating +/-).
The calibration compensation is only activated after pressing the
"Calibration On" button.

Current measurement calibration:

Current measurement ranges must also be calibrated.

For example, for the anode current, there are two measurement ranges (a 0-30 mA low range and a 0-300 mA high range).

Connect a resistor that can handle the wattage (for example. a 1200 Ohm / 75W) in series with a milliamp meter to the anode board (test point 1) and ground.

Tip:
If you don’t have the required high watt resistors you can use a 230/240V light bulb, for example a 60W light bulb for the anode board or a 15W light bulb for the G2 board.

Increase the output voltage until the multimeter indicates about 20 mA. Now adjust the trim pot for the low current range until the virtual instrument displayed by the software indicates the same value. Then set the output voltage such that your multimeter indicates 150 mA, and adjust the trim pot for the high current measurement.

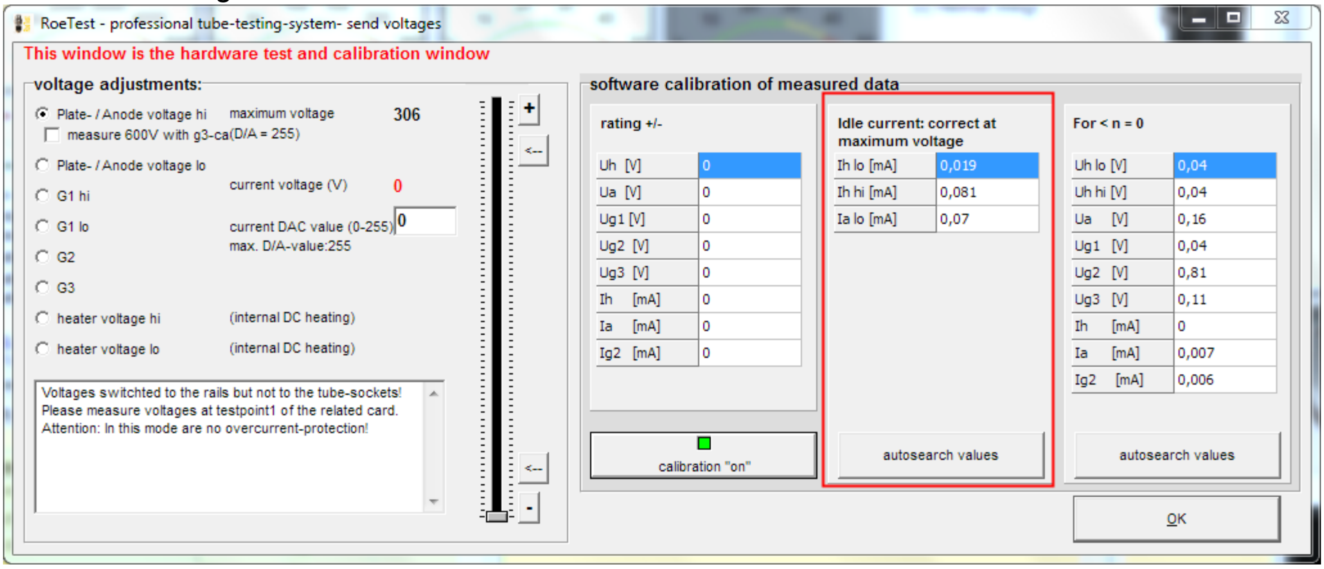
Now set the slider to 0V and slide it slowly up. At about 25 mA you should hear a click from the relay that switches the current measurement from the low to the high range. Now lower it again and it should switch back to the low range – with a little hysteresis. Only when the ranges are properly calibrated the switch from low to high range and back happens at the right value!

Software calibration for Measurements:

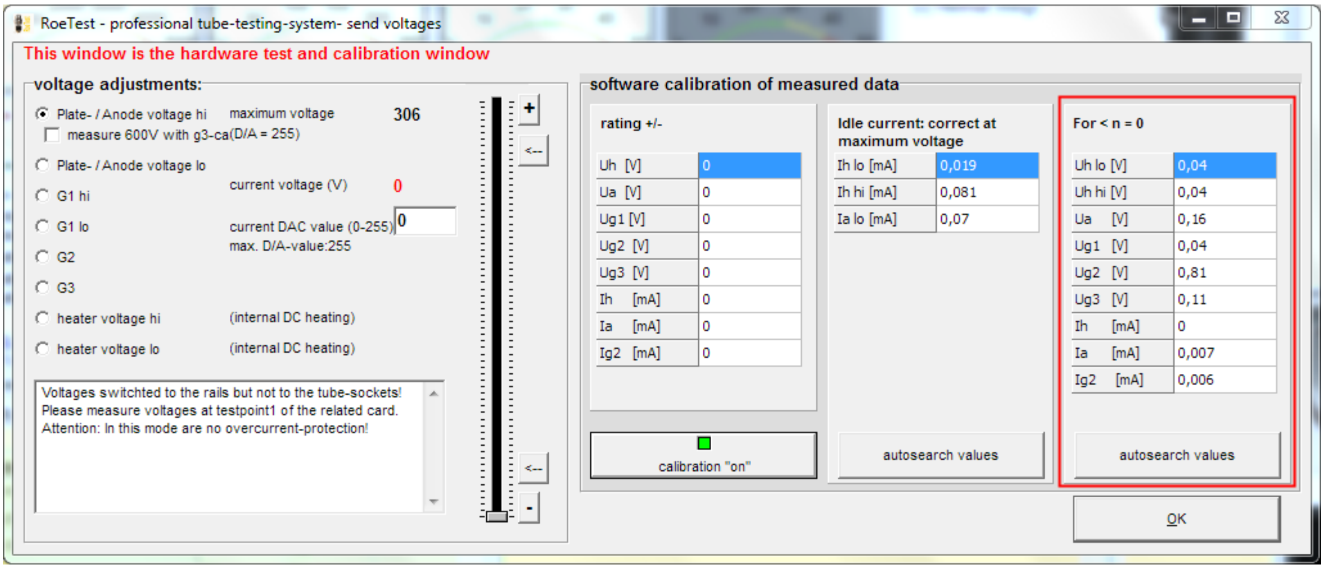
Offset calibration by trimmers is not possible. If need be you can set an offset in the software e.g. if the offset is +0.02 mA enter a -0.02 mA value in the software calibration screen (Options/Test->sending voltages->software calibration of measured data->rating +/-).
If there are large offset values you should find the cause of it and remedy the problem e.g. replace the opamp if it causes the problem.

Now remove the load resistors. Set the anode voltage to the maximum value. The current display should still indicate 0. If not and the value shown is high you likely have a ground connection problem and you should try and find the cause. My prototype shows a leakage current of 0.075 mA for the A and G2 boards. There will always be a small current flowing at maximum output voltage as the voltage divider network at the output, used to measure the output voltage, puts a small load on the output (300V : 4,733,000 Ohm = 0.065 mA) so the remaining 0.01 mA is offset. For this case there is the option to have the software „remove“ the idle current at maximum output voltage. To do that, press the button for <autosearch values> (RoeTest must be connected) and the software will adjust its indication accordingly.

Enter the leakage current!



If the meters don't read zero at idle condition, the settings in the right column can be used. Do this with the button <autosearch values> with RoeTest connected



Fine Calibration of the Heater Voltage (UHsend cal):

Problem:

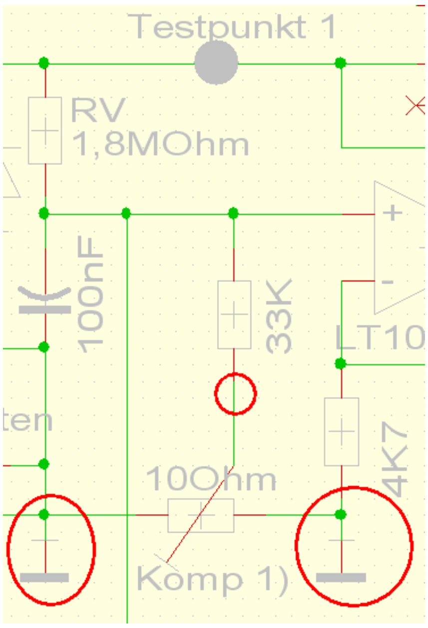
When you connect a multimeter to the tube socket and measure the heater voltage (using manual mode for heater voltage control) the measured voltage will be the same as indicated by software. However, if a load is connected, like a tube that requires 1A heater current, it is possible that the multimeter's measured value won't exactly match the software indicated value. The multimeter will indicate a slightly lower voltage than the RoeTest – depending on how much current is drawn.

Cause:

Copper traces, connector pins, relay contacts, wires etc. all have a resistance. If there is a current there will be a voltage drop. This will have an impact on the measured values and test results in the RoeTest, even if this voltage drop is very small. This matters only for the heater low voltage range (0 - 12,75V) for the following reasons:

- The low voltage range has high currents
- The measurement system amplification is high
- The deviation is large compared to the low voltage in the heater circuit (in case of a 300V anode voltage a measurement error of 0.1V can be ignored!)

The problem with the voltage drop is mostly a ground connection problem. Even though the ground traces are wide (and e.g. fortified with 2,5 mm² wire) there is still a voltage drop. This effectively shifts the 0 point for the measurement amplifier with respect to the point where the voltage divider is connected to:



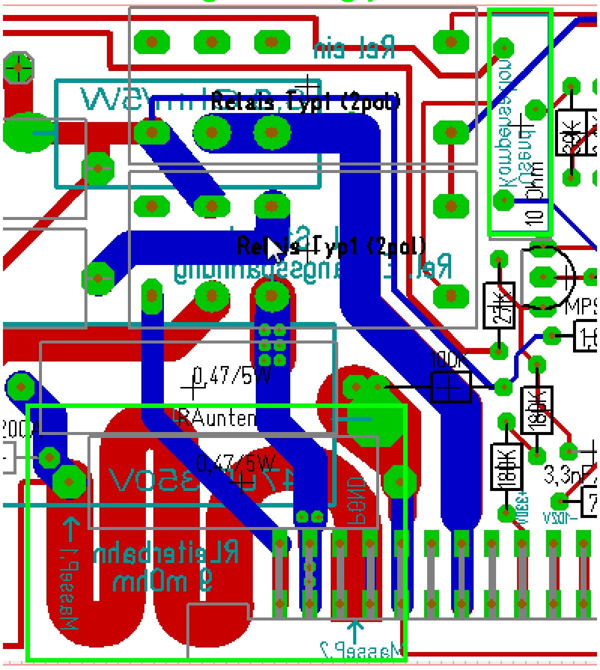
Therefore it’s important where the GND points on the main PCB are connected. Slight voltage variations at the different ground connections impact the amplifier output and result in measurement errors.

Solution:

There is a trim pot on the heater PCB marked (“Kompensation Spannungsmessung”) that can be used to compensate for the voltage differential at the ground connection points. The trim pot appears - at first sight - to be connected in a useless manner since both ends are connected to ground. However these are actually different ground points. There is a minimal voltage differential between these points depending on how much current flows through the ground connection. This trim pot can therefore be used to compensate for measurement errors ('steering forward in the regulation

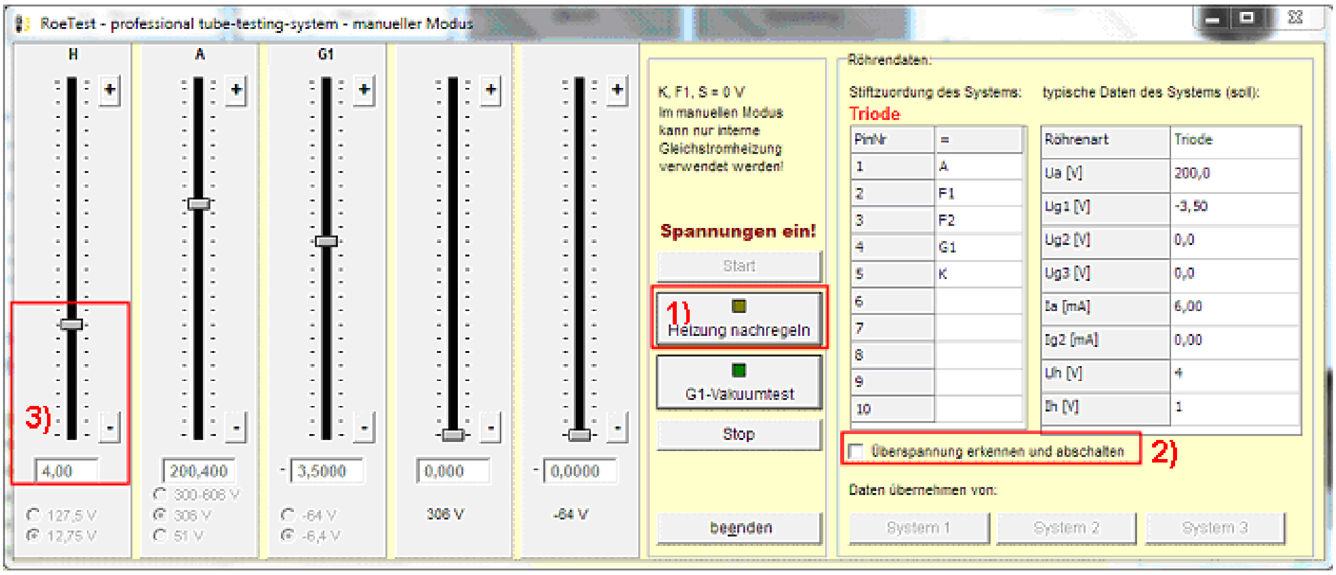
circuitry'). Note that the RoeTest can only correctly auto-adjust the heater voltage when the heater voltage is measured correctly!
(Despite all of this still take all measures to minimize voltage drop e.g. fortify the copper tracks with wire, keep wire connections to the tube socket as short as possible etc.)

two different grounding points



Calibration Steps for Voltage Drop Compensation to the Tube Sockets:

1. Pick a tube that requires about 1A heater current, for example a REN914 (or a 6L6 for US users). Load the tube data but don't insert the tube yet.
2. Select manual control mode and use the slider control to set the heater voltage to the manufacturer's specification (e.g. 4V (3)). Disable the "heater adjustment" (only up to V8.1)(1). Disable overvoltage detection (2) still without tube.
3. Press the start button and **measure the heater voltage at the tube socket** (for the REN914 at pins 2 and 3). Don't measure at test point 1 and ground connector since we want to determine the voltage directly at the tube without the current depending voltage drop from the connecting wires etc!
4. Now insert the tube so that a heater current actually starts to flow (again don't select the heater adjustment function)
5. If now the multimeter and the RoeTest software indicate different values, adjust the trim pot (**UHsend cal**) until the values indicated are the same. Now, whether the tube is removed or reinserted, the indicated values should remain the same.


RoeTest - professional tube-testing-system - manueller Modus
H
A
G1
3)
4,00
200,400
3,5000
0,000
0,0000
127,5 V
12,75 V
300-606 V
306 V
51 V
-64 V
-6,4 V
306 V
-64 V
K, F1, S = 0 V
Im manuellen Modus kann nur interne Gleichstromheizung verwendet werden!
Spannungen ein!
Start
1)
Heizung nachregeln
G1-Vakuumtest
Stop
beenden
Röhrendaten:
Stiftzuordnung des Systems:
Triode
typische Daten des Systems (soll):
PinNr
1 A
2 F1
3 F2
4 G1
5 K
6
7
8
9
10
Röhrenart Triode
Ua [V] 200,0
Ug1 [V] -3,50
Ug2 [V] 0,0
Ug3 [V] 0,0
Ia [mA] 6,00
Ig2 [mA] 0,00
Uh [V] 4
Ih [V] 1
Überspannung erkennen und abschalten
2)
Daten übernehmen von:
System 1
System 2
System 3