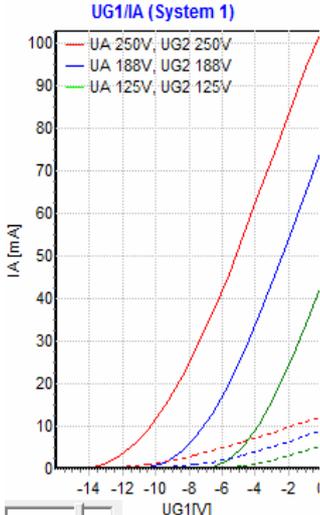
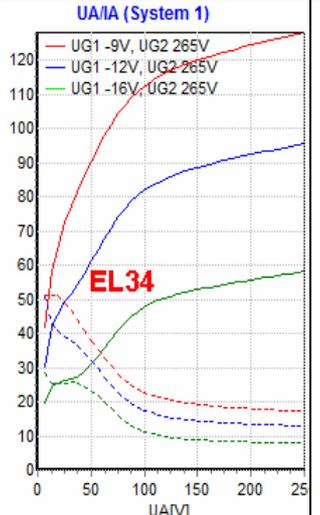
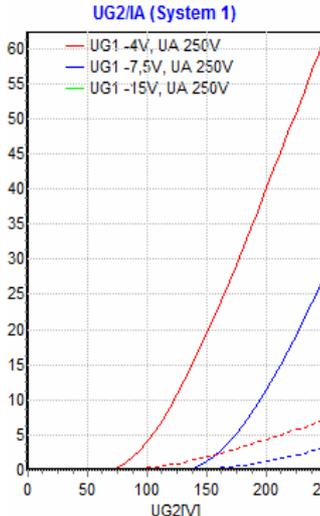


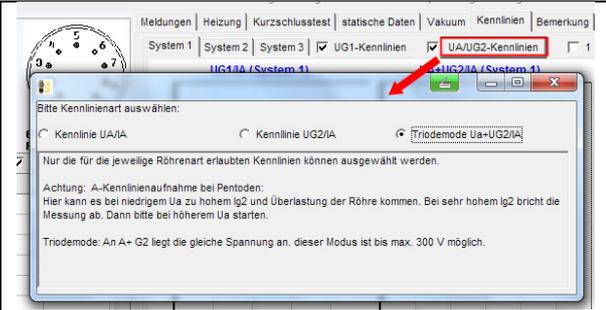
english translation by Gerhard Oed (thank you very much to him)

Recording the characteristic curve (curve trace)

The following curves can be recorded **fully automatic**:

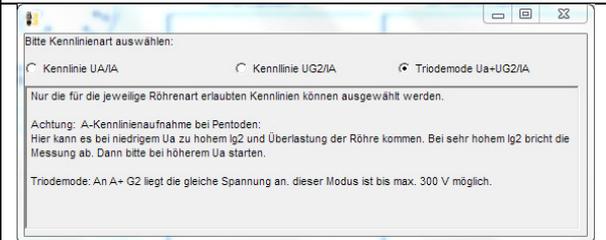
<p>Input curve $I_a = f(U_{g1})$:</p>	 <p>UG1/Ia (System 1)</p> <ul style="list-style-type: none"> UA 250V, UG2 250V UA 188V, UG2 188V UA 125V, UG2 125V
<p>Output curve $I_a = f(U_a)$: - also usable with pentodes</p>	 <p>Ua/Ia (System 1)</p> <ul style="list-style-type: none"> UG1 -9V, UG2 265V UG1 -12V, UG2 265V UG1 -16V, UG2 265V <p>EL34</p>
<p>Output characteristic curve $I_a = f(U_{g2})$:</p> <p>with software version $\geq 8.1.0.0$ additional pentode in triode mode or ultralinear mode $I_a = f(U_{g2} \text{ and } U_a)$</p>	 <p>UG2/Ia (System 1)</p> <ul style="list-style-type: none"> UG1 -4V, Ua 250V UG1 -7,5V, Ua 250V UG1 -15V, Ua 250V

With pentodes, switching between $f(U_a)$ and $f(U_{g2})$ is done using the red marked button (shown here: system 1, as the selected tab left to the button selects system 1).



Then the software will select this window.

Note: It depends on the tube type which characteristic curve types can be selected.



The selection made will then be stored to the white fields (bottom left in the main window).

System	1	2	3
Röhrenart	Pentode	-	-
UA/UG2-Kennlinien:	UA/IA		
1: UA [V] variabel bis	250		
1: UG1 [V]	-4		
1: UG2 [V]variabel bis	250		
1: UG3 [V]	0		
2: UA [V] variabel bis	250		
2: UG1 [V]	-7,5		
2: UG2 [V] variabel bis	250		

There is a minor problem with characteristic curves $f(U_a)$ for pentodes: At very low voltages U_a the current I_{g2} is very large. This could lead to an overload of the tube or a shutdown could happen, if the high current triggers the short circuit protection.

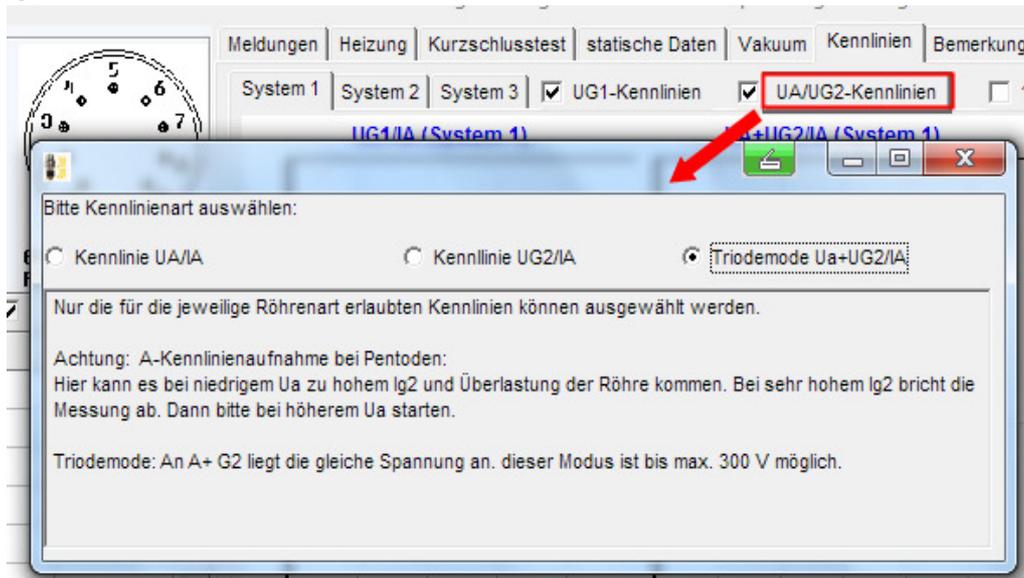
Solution: Recording of the characteristic curve does not start at $U_a=0$ Volt, but from $U_a=5V$.

This default setting can be changed for the actual tube by setting a different value (> 0) into the following white fields (if empty = 5V):

3: UG3 [V]	0		
f(UaPentode) start ab[V]	10		
AC-Simulation, +V			

Pentode as Triode or in Ultralinear mode: (since software 8.1.0.0)

With the red marked button both the parameters U_a and U_{g2} can be defined as variable.



Thus it is possible to configure Pentodes as Triodes (A and G2 get the same amount of positive voltage) or to simulate „Ultralinear mode“. With this mode U_{g2} is lower than U_a by a certain factor.

For „**Triode mode**“ U_a and U_{g2} must have the same value (please define that in the white fields of the measuring software for all 3 characteristic curves at the lower left (the picture below only shows characteristic curves 1 and 2)). Note: The G2-voltage can be at most 300V. The same variable voltage will then be applied to the tube's anode and screen grid. I_a and I_{g2} are recorded separately.

System	1	2
Röhrenart	Pentode	-
UA/UG2-Kennlinien:	UA+UG2/IA	
1: UA [V] variabel bis	250	
1: UG1 [V]	-3	
1: UG2 [V] variabel bis	250	
1: UG3 [V]	0	
2: UA [V] variabel bis	250	
2: UG1 [V]	-6	
2: UG2 [V] variabel bis	250	

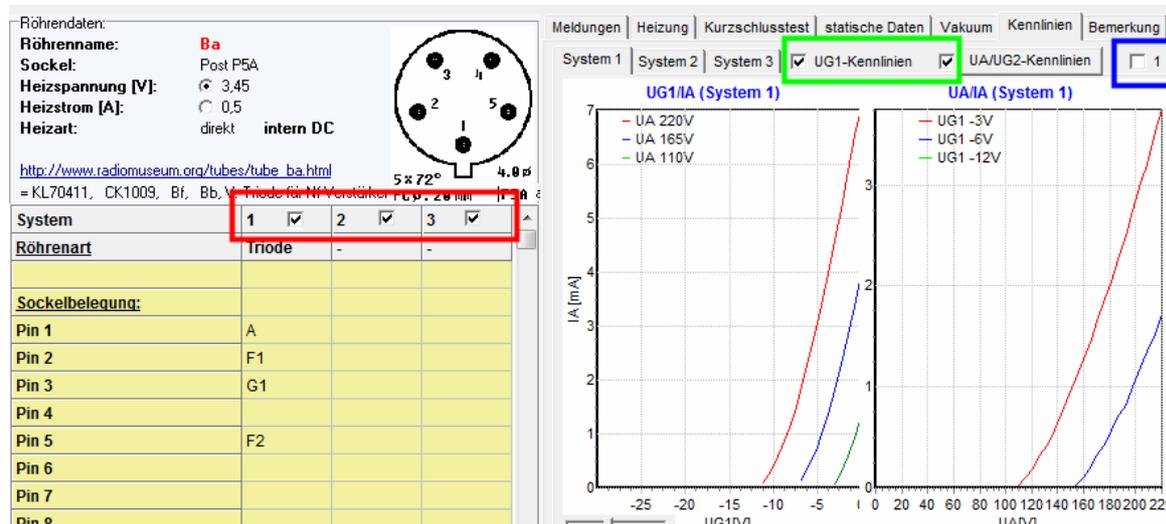
For the „**Ultralinear mode**“ the G2-voltage must be selected lower than the Ua-voltage, for example $\frac{2}{3}$ or $\frac{1}{2}$ of the Ua-voltage (please define that in the white fields of the measuring software for all 3 characteristic curves at the lower left (the picture below only shows characteristic curves 1 and 2)). Note: The anode voltage can be at most 600V, the G2-voltage at most 300V. A variable voltage will be applied to the tube's screen grid that is lower than the anode voltage by a constant factor. Ia and Ig2 are recorded separately.

Example for Ug2 with $\frac{2}{3}$ of the anode voltage:

System	1	<input checked="" type="checkbox"/>	2
<u>Röhrenart</u>	Pentode		-
UA/UG2-Kennlinien:	UA+UG2/IA		
1: UA [V] variabel bis	300		
1: UG1 [V]	-3		
1: UG2 [V] variabel bis	200		
1: UG3 [V]	0		
2: UA [V] variabel bis	300		
2: UG1 [V]	-6		
2: UG2 [V] variabel bis	200		

The RoeTest works fully automatic. Without further configurations the RoeTest will determine parameters and the characteristic curve(s) to be recorded. Note: It depends on the tube type which characteristic curves will be recorded (for example: triode: G1- and A-characteristic curves, pentode: G1- and G2-characteristic curves, rectifier tubes: only A-characteristic curve).

Example characteristic curve: here for a Ba tube:



The **box selection marks** define:

red outlined:

Which tube system's characteristic curves shall be recorded (used for multiple tubes with multiple systems).

green outlined:

Determines whether to record both input- and output characteristic curves.

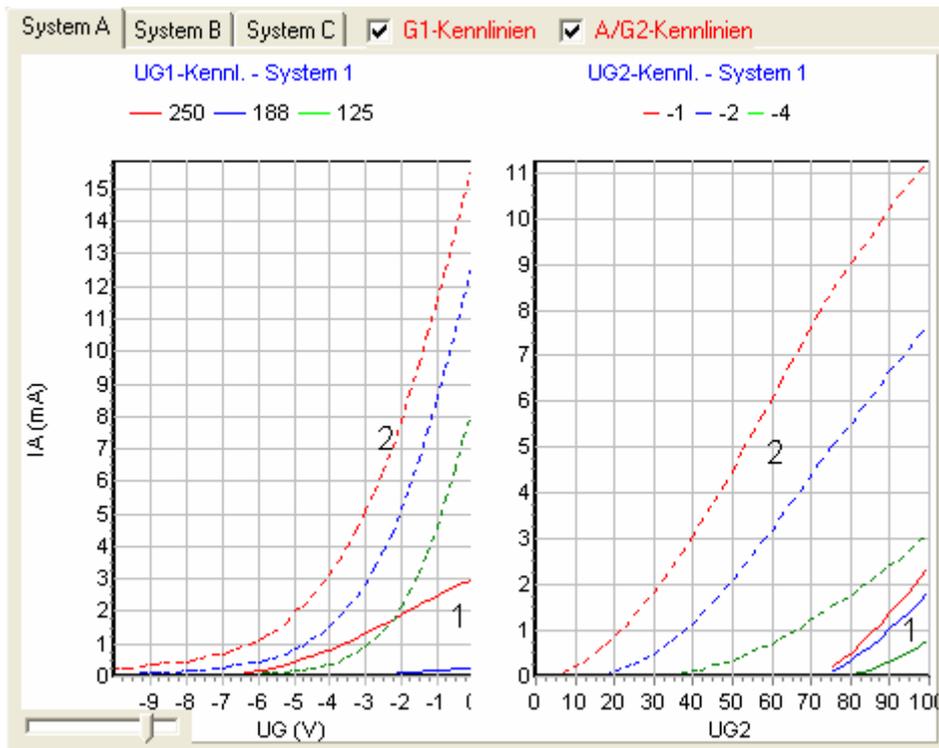
blue outlined:

If this field is selected, only one characteristic curve will be recorded. If not selected normally 3 characteristic curves are recorded (band of characteristic curves).

It is wise to reduce the number of to be recorded characteristic curves to a minimum. Much measuring time can be saved that way. For example: to match an EL84 only one input or output characteristic curve is required.

What do the characteristic curves mean ?

(here the characteristic curves of an ECH4)



The fully drawn lines are the currents of the first positive voltage source (1), the dashed lines are the currents of the second positive voltage source (2).

Which electrodes that are for the selected 'tube type' is defined in the correspondent database. There is, for example, defined for an heptode that the first positive voltage is the 'anode' → corresponds to the fully drawn line in the graphics above, and the second positive voltage is 'G2+G4' → corresponds with the dashed line.

RoeTest - Datenbank

Röhrenart

Heptode

	A	K	G1	G2	G3	G4	G5	F1	F2	FM	IV	S
m/k (muß/kann)	m	k	m	m	m	k	k	m	m	k	k	k
an Schiene Nr.	2	0	3	4	5	4	0	0	1			

Bezeichnung der Schienen:

Schiene 0:	Masse	0V										
Schiene 1:	+ (ext) Heizung	Heizung										
Schiene 2:	+ 306V/ 250 mA	Anode										erste pos.Sp.
Schiene 3:	-51V (-5,1V)	G1										
Schiene 4:	+306V/ 50 mA	G2+G4										zweite pos.Sp.
Schiene 5:	-51 V (ext.Heiz.)	G3										

With pentodes, assignment is more simple. The fully drawn lines are the anode currents, the dashed lines are the screen grid currents (is also defined in the tube type database).

Manual change:

The RoeTest determines the parameters automatically. In most cases this is suitable but not always. At times manual changes are needed. This is of course possible.

The screenshot shows the RoeTest software interface. At the top, it displays 'RoeTest - professional tube-testing-system - Testmodus (kein RS232-Port vorhanden oder festgelegt)'. The main area is divided into several sections:

- Meßwerte:** Seven analog-style gauges showing H-Spannung, A-Spannung, G2-Spannung, G1-Spannung, H-Strom, A-Strom, G2-Strom, and a final Spannung gauge. All values are currently 0.00.
- Version:** 6.6.0.0
- RoeTest professional-tube-testing-system** logo and a photo of a vacuum tube.
- Manufacturer:** (c) Helmut Weigl
- Tube Info:** #74, 20.5 °C, Testmod.
- Röhrendaten:** Röhrenname: PL504, Socket: Magnoval B9D, Heizspannung [V]: 27, Heizstrom [A]: 0.3, Heizart: indirekt intern DC. Includes a pinout diagram and physical dimensions: 8 x 36° 1.276, PC ø: 17.5 mm [D9D].
- System:** A table with columns 1, 2, 3 and rows for Röhrenart (Pentode) and Daten f. Kennlinien.
- Daten f. Kennlinien:** A table with columns for UA [V], UG1 [V], UG2 [V] and rows for 1: and 2: measurements. Values include 130, -45, 130, 0, 98, -45, 98, 0.
- Meldungen:** Heizung | Kurzschlussstest | statische Daten | Vakuum | Kennlinien | Bemerkung. A yellow message box displays: '= CV10955, 28GB5A, ASoll aus Kennlinie Vap = 7000 V, Rg1 max 0,5 MOhm Prüfe Röhrendaten auf Schlüssigkeit: 1: o.k.'
- Control Panel:** Buttons for 'laden Röhrendaten', 'Daten akt. Röhre', 'Datenbanken', 'Eadentest', 'Kurzschlussstest', 'statische Messung', 'Kennlinien aufnehmen', 'manuell', 'Leistungsprüfer1', 'Leistungsprüfer2', 'Schnelltest', 'Stapelverarbeitung', 'Info', and 'Ende'.

Manual changes are always applied to the white fields at bottom left. The default given parameters can easily be overwritten.

Examples for manual Design of the G1-characteristic curve:

The RoeTest assumes static data and states: the static data tells anode voltage is 130V, so do measure 3 characteristic curves at 100%(130V), 75% (98V) and 50%(65V).

If we interact manually and overwrite (see hardcopy, white field to the bottom left) 130V with 100V, 98V with 90V and 65V with 80V the RoeTest will measure individual due to the selected parameters (for the given example we normally also should adjust the screen grid voltage).

Next example:

The characteristic curve starts out at G1 = -50V (automatically determined by the RoeTest). If this is too low, we can change this value at any time to (for example) -20V (should be changed the same way for all 3 characteristic curves!).

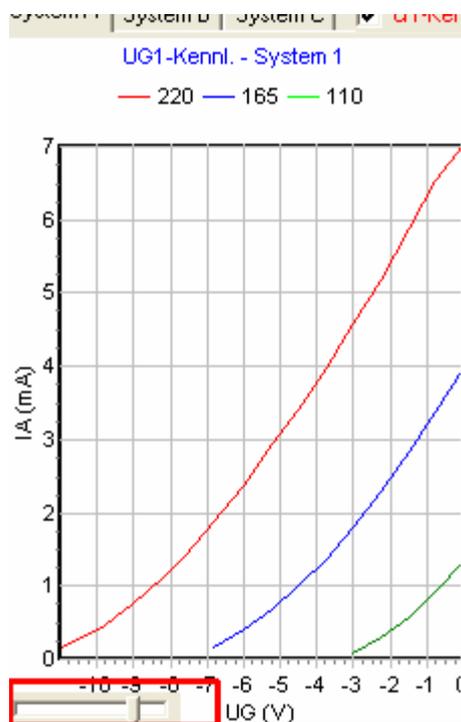
Another characteristic curve: Hexode characteristic curve of G3

This also is possible, just interchange the connection assignment of G1 and G3 (left window, tube data). G1 of the tube will be connected to a fixed voltage (the G3 voltage) and G3 of the tube will be connected to the variable G1 voltage of the RoeTest. Note: you have to manually adjust the G1 and G3 voltages to the appropriate values (obey that G1 and G3 voltages are also interchanged).

As you can see: Nearly almost anything is possible. But when using manual control you should exactly know what you are doing!

Display of the G1-characteristic curve:

The resolution of the G1-source voltage can be changed using a slider and so the characteristic curve can be viewed optimal (this only applies to the display; the recorded data stay as they are).



Special Solutions:

Problem:

The G1-characteristic curves are compressed at the right side while there is still enough space left in the graphics at the left side.

Solution:

The automatic display algorithm tries to determine the range of the data for the characteristic curve(s). In most cases this works fine. But there are cases when the measurements are in a unfavorable range.

There are 2 possibilities to change that:

1. Permanently applied to the database
2. Temporarily within the measurement program (marked red – changes for characteristic curves 1-3 needed)

Heizstrom (A): 0,2
Heizart: indirekt int. Gleichstrom

http://www.radiomuseum.org/tubes/tube_ech11.html

δ x 26° 50'
PC ø: 28 mm Y9A

	System A <input checked="" type="checkbox"/>	System B <input checked="" type="checkbox"/>	System C <input checked="" type="checkbox"/>
Röhrenart:	Hexode	Triode	-
UG1-Kennlinien:	UG1-Kennl.	UG1-Kennl.	
1: Anodenspannung:	250	100	
1: G1-Spannung ab:	-10	-5	
1: G2-Spannung:	100	0	
1: G3-Spannung:	-10	0	
2: Anodenspannung:	188	75	
2: G1-Spannung ab:	-10	-5	
2: G2-Spannung:	75	0	
2: G3-Spannung:	-10	0	
3: Anodenspannung:	125	50	

System A: o.k.
System B: o.k.

Problem:

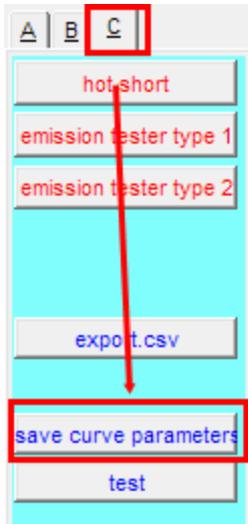
Recording of the G1 characteristic curve system A: The ranges are automatically selected at 250V, 188V and 125V. But we want to measure at 250, 200 and 150V.

Solution:

Overwrite the green marked entries in the picture above as desired.

Characteristic parameters file:

The changed data in the above shown **white** fields are only temporary. When restarting the program or loading new tube data the original values are restored. Now there is a possibility to store those data permanently. You can store the data inside the white fields to a characteristic parameter file.



For this tube a file named "Tubename.kpa" will be created. If such a file already exists for a tube then the stored parameters are used instead of the software calculated ones. So you can define individual parameters for the characteristic curve of a tube. This is, for example, needed for an E130L; the automatic algorithm would chose inappropriate values for that tube. If the parameter file is deleted the automatic parameters will be used.

Why use a specific file for characteristic curve parameters ?

These parameters are only required for very few tubes. The many additional fields would bloat the database unnecessarily. That is the reason for a distinct file.

Problem:

When recording the characteristic curve I want to stop at a defined current value to avoid damage of the tube.

Solution:

There is an automatism: When reaching about 2.5 times of the tube limit or, if no limit is given, when reaching 2.5 times the nominal value, recording is stopped. If a different limit is desired this can be set up in the tube data for the specific tube:

	System 1	System 2	System 3
type of tube system:	Pentode	-	-
exceptions:			
For simulation of AC voltage heater the voltage at electrodes will be increased by V (if no value entered, then the heater is increased by	0,0	0,0	0,0
heater range lo/hi: (automatic mode if left empty)			
Heater current abort [A]	0,000		
Abort due to plate current, limit: [mA]	0,0	0,0	0,0
grid1-curve starting at [V]:	-6,00		

Automatic smoothing of characteristic curves:

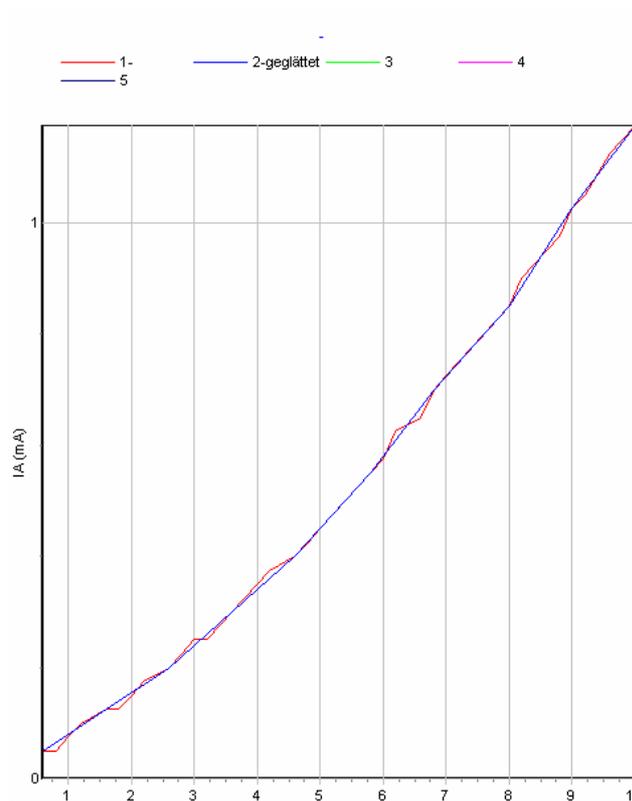
(only required up to RoeTest V4)

Problem:

At very low currents (mA) the resolution of the A/D converters comes into effect. The curves get somewhat rippled. The small measuring range for the anode current is 25.6 mA. The A/D converter has 1024 steps (10-bit converter).
 $25.6\text{mA} : 1024 = 0.025\text{mA}$ resolution. When recording a characteristic curve 40 points are measured. At very low currents, assume 0.5mA, the distance between the measurements would be $0.5\text{mA} : 40 = 0.0125\text{mA}$ (assumed that the characteristic curve were a straight line; with standard characteristic curves the distances are even smaller in the range of the lower curvature). The recorded characteristic curve will therefore be somewhat distorted in contiguity.

Solution:

Record the characteristic curve using fewer sample points. The distances of the sampling points are larger. The points between the sampling positions are merely interconnected, intermediate values are interpolated. There is a setting in the options menu of the RoeTest software. I have set up a default value of 2.1mA. The switch point for reducing the sampling count depends on the tube's data (nominal anode current). Below the afore mentioned value the characteristic curve will be recorded using 10 samples, above 40 samples will be used. You can experiment using other default settings. If you do not want any smoothing at all just set the value "0" in the options.



Note: Starting with RoeTest5 a 12 Bit A/D converter is built in. Due to the higher resolution smoothing normally is no longer necessary.