Transconductance and Plate Resistance

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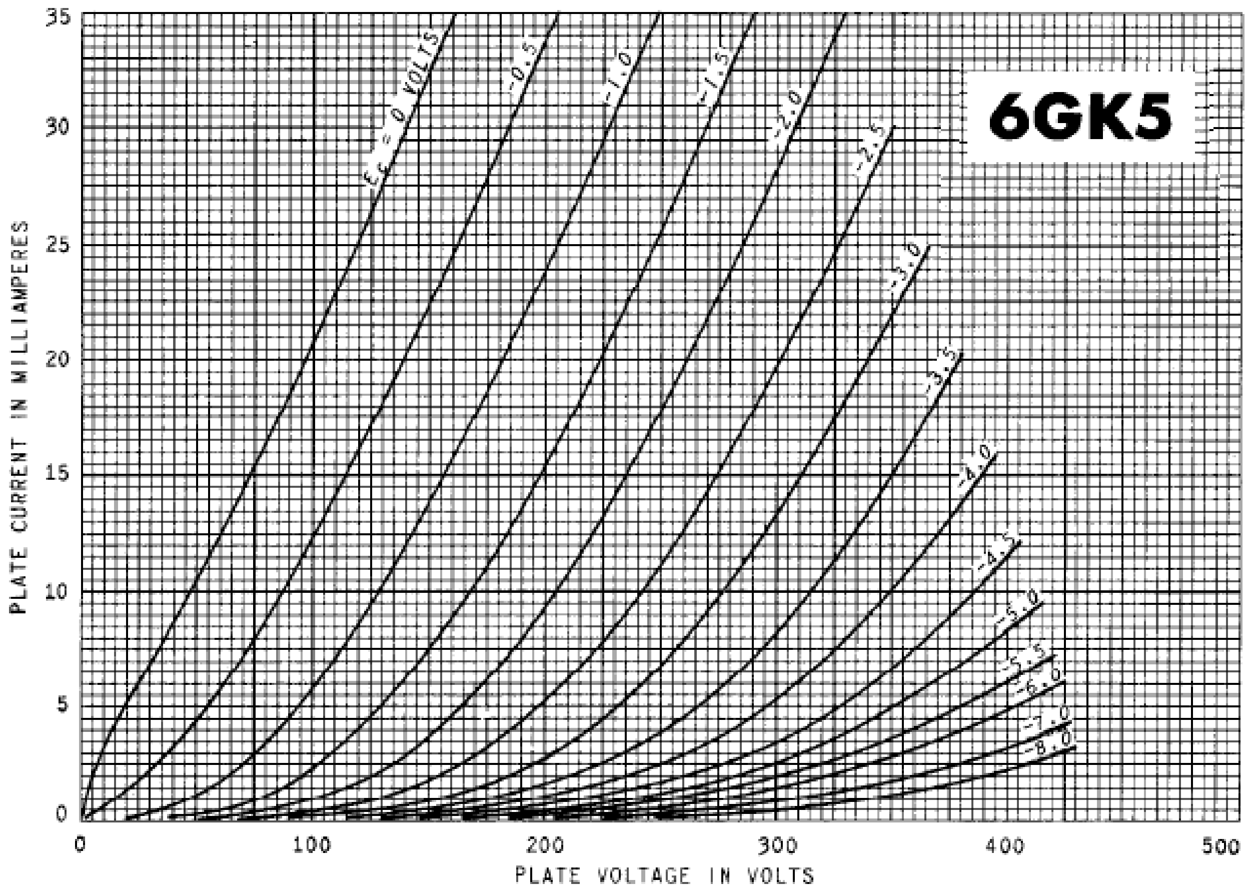
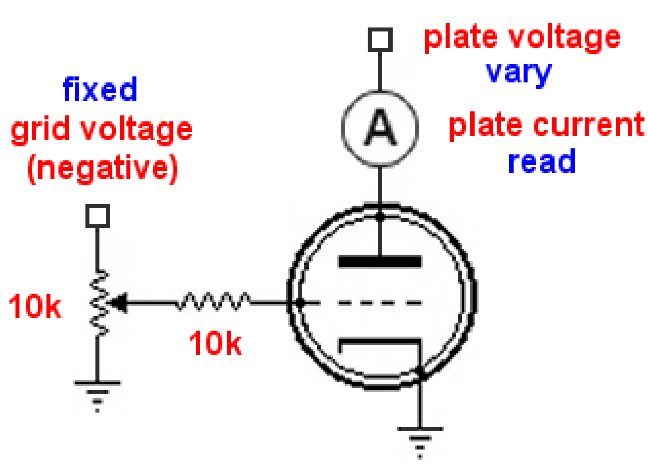
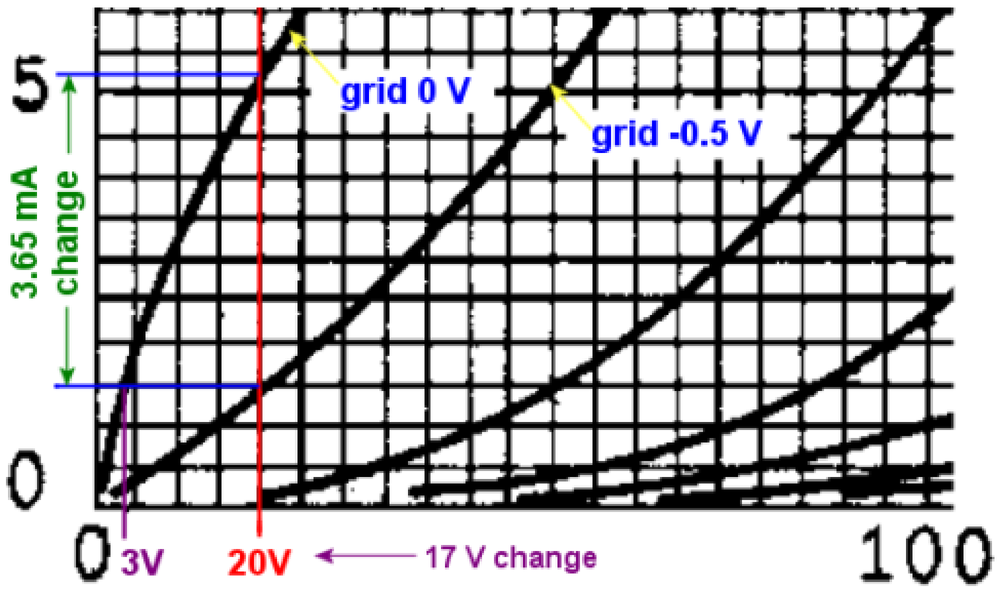
The information below is not guaranteed to be free of errors.



This is a quick guide to calculating transconductance and plate resistance. Values are often not given for the lower plate voltages run in our radios. Above are curves for a 6GK5 triode as per GE's data. Each line represents a plot of plate current versus plate voltage for a fixed grid voltage. This plate characteristic curve can be created: attach a 10k-Ω pot between ground and a negative supply. Then feed the wiper through a ~10k-Ω resistor and into tube's grid. Attach the cathode to ground. For a given grid voltage, alter the plate voltage and read plate current using an ammeter.





Using an editor, the graph above was magnified. For values at 20 V, draw a line up from 20 Volts (red). Notice where the red line intersects the 0 Volt and -0.5 Volt grid lines. Run each left to determine current (blue lines). The change between the blue lines is 3.65 mA. Pixels may be counted using an editor and values extrapolated. Divide a 3.65 mA current change by a 0.5 V voltage change, for a transconductance of 7300 µMHOs. At 20 V, the current for 0 volts of grid is ~5.2 mA. Where the lower blue line intersects the 0 Volt grid line, drop a line (purple). A change of 17 Volts (20 minus 3) is noted. Divide a 17 V voltage change by a 3.65 mA current change for 4660 ohms of plate resistance (17 divided by 0.00365). The values are then used in calculations.

$$\text{gain} = \frac{\text{transconductance x plate load resistance x plate resistance}}{\text{1,000,000 x (plate load resistance + plate resistance)}}$$

For example, the values can be used in the gain equation above which appears in the *RCA Receiving Tube Manual* (http://www.netads.com/~meo/Guitar/Tubes/t4.pl has an online calculator). Using the Bogen T725 transformer, 16-Ω Sparkplug earbuds appear as 80k-Ω. Plugging in a 7300 µMHOs transconductance, 4660 ohm plate resistance, and 80k-Ω load, results in a gain of 30.5 or 29.7 dB (the log of 30.5 times 20). The values below were calculated, similar to the above values but for 40 Volts. The list is organized by highest gain: read from upper left, down, and then right.

Tube	plate Ω	uMHOs	mA
7721	1980	31720	18.9
7722	2120	26370	18.7
6GK5	5450	11000	8.5
8627	4250	12000	12.0
6C45	3930	12500	6.8
6CW4	5600	10000	6.5
7462	13800	5800	**3.5**

Tube	plate Ω	uMHOs	mA
6ES8	2625	16000	13.9
7895	5260	9500	7.3
6C52H	5230	8720	6.5
6C51H	2450	13960	13.8
6HA5	4625	8000	6.2
6HQ5	5350	7100	7.7
6HM5	5170	7000	7.5

Tube	plate Ω	uMHOs	mA
6AM4	15700	3400	**2.1**
E288CC	1660	13500	21.5
6DJ8	3000	9000	12.5
8058	5130	6000	4.0
12AX7	48000	1250	**1.0**
6H30PI	2390	6700	34.0
49	5200	920	5.8

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