Nonlinear resistors

All resistors examined so far are linear resistors, for which the characteristic curve $I = f(U)$ is a straight line, s. figure 1. The resistance value of a linear resistor is independent of the current I flowing through it or the applied voltage U.

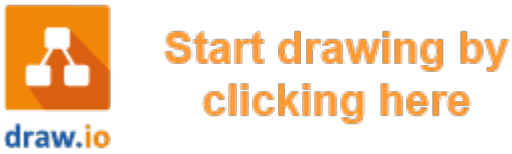


Fig. 1: Characteristic curve of a linear resistor

With nonlinear resistors, there is no proportionality between current and voltage. The characteristic curve of such a resistor is shown in figure 2. With these resistors, we talk about static resistance (R) and dynamic (or differential) resistance (r). The static resistance is determined for a specific operating point: at a specific voltage, the current is read from the resistance characteristic curve.
The calculation is performed according to Ohm's law:

$$R = \frac{U}{I}$$

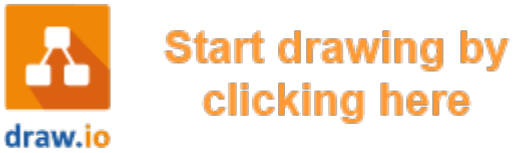
The differential resistance around the operating point is calculated from the current difference caused by a change in the applied voltage:

$$r = \frac{\Delta U}{\Delta I}$$

Fig. 2: Characteristic curve of a nonlinear resistor

A light bulb is examined as an example of a nonlinear resistor. Set up the measuring circuit shown in figure 3.

Fig. 3: Measuring circuit light bulb
Set the voltage on the power supply to the voltage values from table 1. Measure the corresponding current values and enter them in table 1.



Tab. 1: Values characteristic curve light bulb

Create the characteristic curve $I = f(U)$, s. figure 4

Fig. 4: Characteristic curve light bulb

Calculate the static resistance R at the operating point $U = 7.0\ \mathrm{V}$:

Calculate the dynamic resistance r at the operating point $U = 7.0\ \mathrm{V}$:

Compare the values with the values from table ## (direct resistance measurement)