

# Nonlinear resistors

## Student Group

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## 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  $U$ .

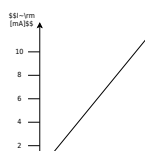


Fig. 1: Characteristic curve of a linear resistor

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](#).

|        |     |     |     |     |     |     |     |     |     |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| U [V]  | 0.5 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 |
| I [mA] |     |     |     |     |     |     |     |     |     |

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  $U = 7.0 \text{ V}$ :

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

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

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