

# Non-linear resistors

## Student Group

| First Name | Surname | Matrikel Nr. |
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# Non-linear resistors

All resistors examined so far are linear resistors, for which the characteristic  $I = f(U)$  is a straight line; see [figure 1](#). The resistance of a linear resistor is independent of the current  $I$  flowing through it and of the applied voltage  $U$ .

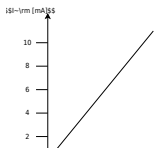


Fig. 1: Characteristic of a linear resistor

For non-linear resistors, there is no proportionality between current and voltage. The characteristic of such a resistor is shown in [figure 2](#). For these resistors, one distinguishes between static resistance  $R$  and dynamic (or differential) resistance  $r$ .

The static resistance is determined for a specific operating point: at a given voltage, the current is read from the characteristic. The calculation is carried out according to Ohm's law:

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

The dynamic 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 of a non-linear resistor

An incandescent lamp is investigated as an example of a non-linear resistor. Build the measurement circuit shown in [figure 3](#).

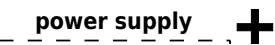


Fig. 3: Measurement circuit for incandescent lamp

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: Measured values for the incandescent-lamp characteristic

Plot the characteristic  $I = f(U)$ .

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 those from the direct resistance measurement (table ##).

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