Non-linear resistors

Student Group

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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.

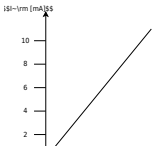

Fig. 1: Characteristic of a linear resistor

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.

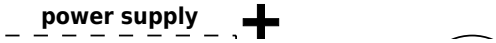

Fig. 3: Measurement circuit for incandescent lamp

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_{mes} [V]	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
I_{mes} [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 $U = 7.0 ~{\rm V}$.

Calculate the dynamic resistance r at the operating point $U = 7.0 ~{\rm V}$.

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