



Experimental Science

P7: Ohm's law.

1. Purpose

- Experimental verification of direct proportionality between two physical quantities.

2. Introduction

When a conducting wire is subject to a voltage (U) at its terminals, it is run through by an electric current with a certain intensity (i).

Ohm's law states that at a constant temperature these two physical quantities are directly proportional. That is, for a 10% increase in voltage there is also a 10% increase in current intensity.

This is equivalent to saying that the ratio between the two is constant. This constant is named electric resistance (R):

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

The flow of electric current through a resistance produces heat (Joule's effect).

The energy dissipated per unit of time is the dissipated power (P):

$$P = \frac{U^2}{R}$$

If the resistance manages to transfer this heat to its vicinity it will reach thermal equilibrium and remain at a constant temperature. Otherwise, there will be a buildup of thermal energy that will cause the resistance's fusion.

The resistances being used on this experiment can dissipate a maximum of 0.25 W. So when we apply a voltage to their terminals they should obey the condition:

$$U \ll \sqrt{0.25 \cdot R}$$

The applied voltage will be controlled with a voltage supply (see circuit).

3. Safety calculations

What is the minimum voltage value you should apply to a 1 k Ω resistance to burn it? What if it is a 3.3 k Ω resistance?

Repeat the previous calculation for a 100 Ω resistance.

4. Experimental activity

4.1 Material

1 K and 3K3 resistances, 1 voltage supply, 1 oscilloscope, 1 multimeter, 1 circuit breadboard and 3 connection wires.

4.2 Additional information

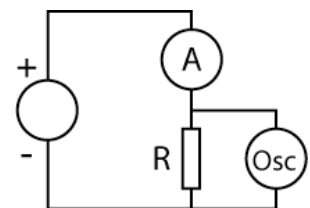
The voltage measurements will be made with an oscilloscope that is way some recommendations are in order:

- Since all voltages are constant and positive adjust the grid's zero to be the lowest horizontal screen line.
- Before **EVERY** measurement set the GND switch and check if the zero line did not move.
- Always work with the most sensitive scale to obtain the intended potential. You will know you're at the most sensitive scale if a decrease in scale causes the line to disappear.
- Record the maximum device error for each measurement and used scale.

The current intensity measurements will be made with a multimeter working as an ammeter. Always choose the most sensitive scale and **DO NOT CLOSE THE CIRCUIT BEFORE THE TEACHER CONFIRMS THE CONNECTIONS.**

4.3 Procedure

Build the picture's circuit. Start with the 1K resistance. Record the current intensities measured at the ammeter for each of the following voltages at the resistance terminals: 0.00, 0.50, 1.00, 1.52, 2.00, 2.50, 3.00, 3.50, 4.00, 4.6 and 5.0 V (in this order). Repeat these measurements from the start (0.00 V) another 2 times.



Repeat the previous measurements for a 3K3 resistance.

Organize your data into tables. The tables should contain the error for each measurement as well as the physical quantity units.

Measure the two resistances values with the multimeter in the ohmmeter setting.