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VERIFY OF OHM'S LAW AND MEASURE SERIES CIRCUIT

Measurement practice I.

FOR VEHICLE ENGINEER STUDENTS

Version: 1.1

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1. Introduction

In this measurement exercise we will verify Ohm's law and measure series DC circuits. We will also look at the use and wiring of current meters, voltmeters, and resistance meters. The measurement results will be verified by simulation and calculation.

1.1 Objectives

- Knowledge of electrical wiring diagram;
- Verify Ohm's law;
- Studying behavior of serial circuits;
- Current and voltage measurement in a circuit by digital multimeter;
- Resistance measurement in a circuit by a digital multimeter;

1.2 Required instruments and components

- DC voltage supply (see Fig. 1.);
- resistor table (see Fig. 2.);
- digital multimeter (see Fig. 3.);
- measuring cables (to the digital multimeter).

Fig.1. Power supply (TP-2303)

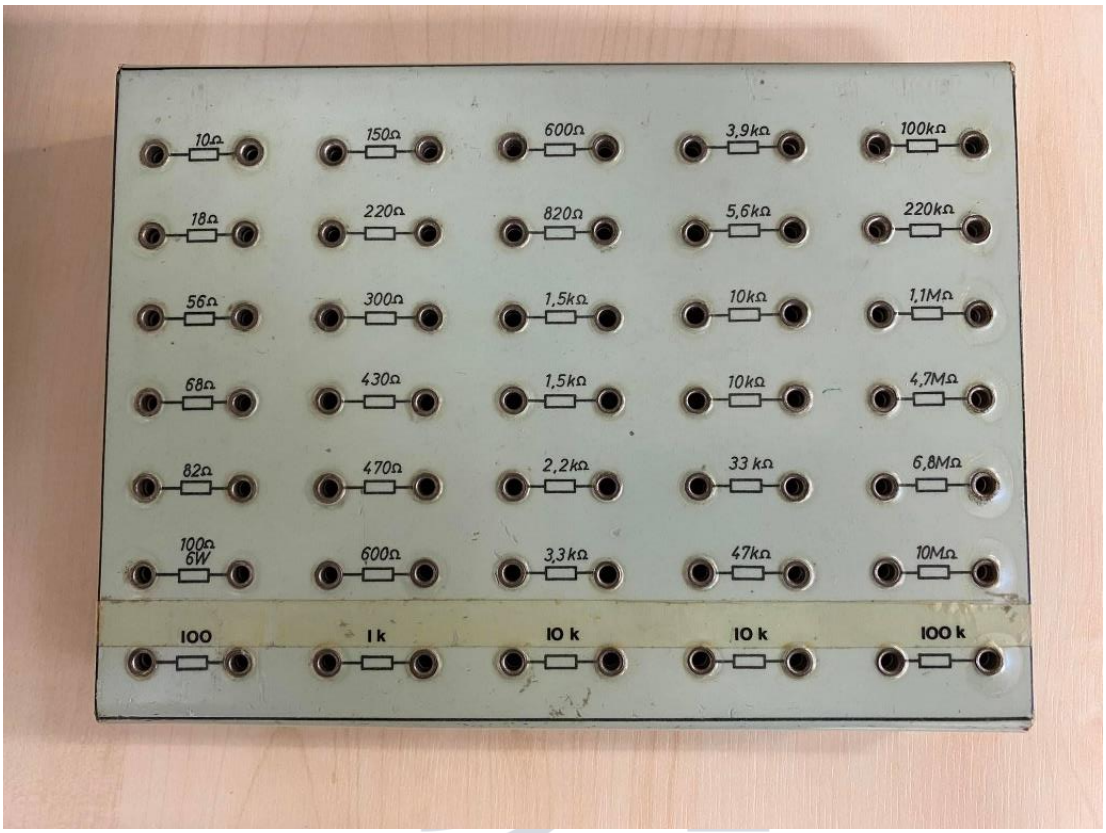

Fig.2. Resistor table

Fig.3. Digital multimeter

3. Measurement exercises

3.1 Ohm's law verification

The measurement is performed to check Ohm's law. To start the measurement, select the value of the resistance to be measured, first 820Ω, then 1.5 kΩ. Enter the values in the table. The circuit diagram of the measurement is shown in Figure 4.
The steps of measurement:

1. Set up the DC power supply to produce a 0V(DC)! Adjust the current limit to 0.5A!
2. Connect the resistor to the power supply with the multimeter! Make sure that the multimeter is set to the correct measuring volume (current) and that the test leads are connected correctly.
3. Increase the DC power supply voltage in 1V steps up to 15V. In each case, record the measured current in the table below.
4. Graph the current of the resistor as a function of voltage!

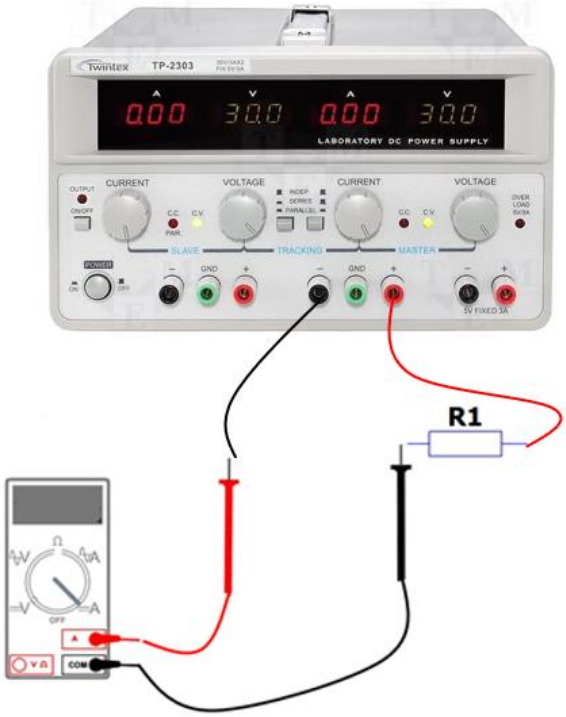

Fig.4. Verification of Ohm's law, circuit diagram

3.2 Resistance measure of series circuit

The series circuit diagram is shown in Fig.5. During the measurement, three resistors are connected in series. The value of the resistors can be chosen arbitrarily according to the following criteria: all resistors must be in the range 1.5 - 50 kΩ.
IMPORTANT! In all cases, the resistance is measured in a voltage and current free condition. The circuit must NOT be connected to the DC power supply!

The steps of measurement:

1. Prepare the necessary tools and instruments.
2. Build the circuit with tree kΩ size resistor!
3. Make sure that the multimeter is set to the correct measuring volume (resistance) and that the test leads are connected correctly.
4. Measure the total resistance of circuit and write the measured values down in the table!

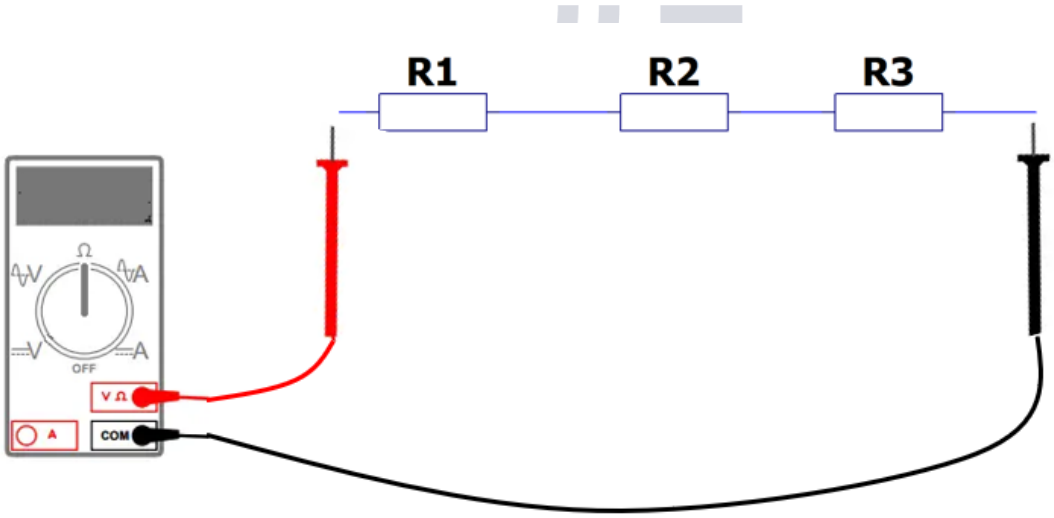

Fig.5. Measuring of circuit resistance

3.3 Voltage measure of series circuit

The circuit values are the same as for resistance measurement. The circuit diagram of this measurement is shown in Fig. 6.

The steps of measurement:

1. Prepare the necessary tools and instruments.
2. Set up the DC power supply to produce a 20V(DC)! Adjust the current limit to 0.5A!
3. Check the set voltage with a digital multimeter. Make sure that the multimeter is set to the correct measuring volume (voltage) and that the test leads are connected correctly. Build the circuit with tree kΩ size resistor!
4. Connect the circuit to the DC generator!
5. Measure the voltage of R1! Repeat the same for R2 and R3!
6. Write the measured values down in the table!

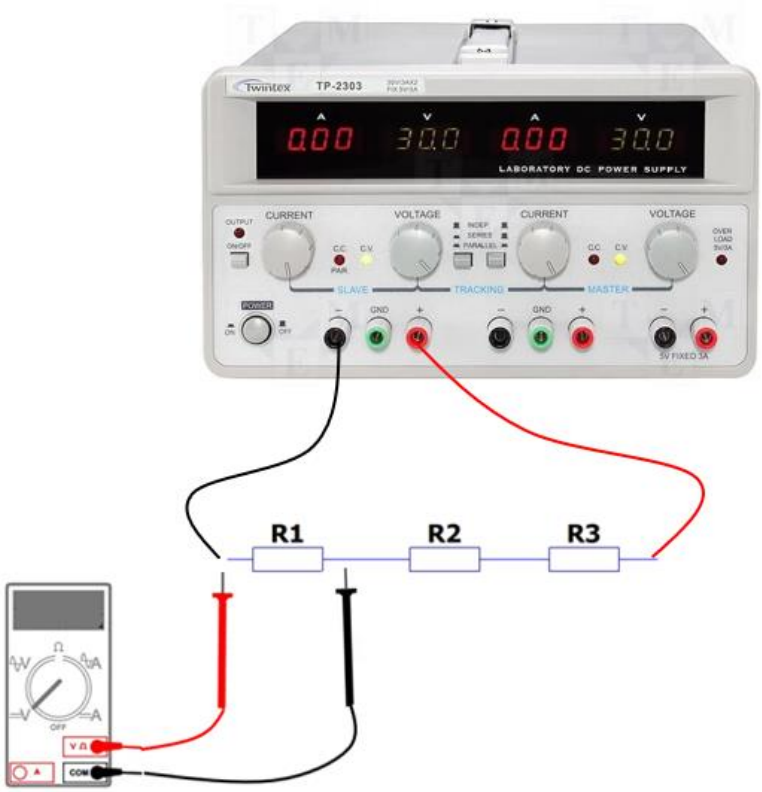

Fig.6. Measuring of voltage in series circuit

3.4 Current measure of series circuit

The measurement setup and circuit values are the same as for voltage measurement. The circuit diagram of this measurement is shown in Fig. 7.

The steps of measurement:

1. Prepare the necessary tools and instruments.
2. Set up the DC power supply to produce a 20V(DC)! Adjust the current limit to 0.5A!
3. Check the set voltage with a digital multimeter. Make sure that the multimeter is set to the correct measuring volume and that the test leads are connected correctly. Build the circuit with tree kΩ size resistor!
4. Connect the circuit to the DC generator!
5. Measure the current between R1 and R2! Repeat the measurement between R2 and R3. Write the measured values down in the table!

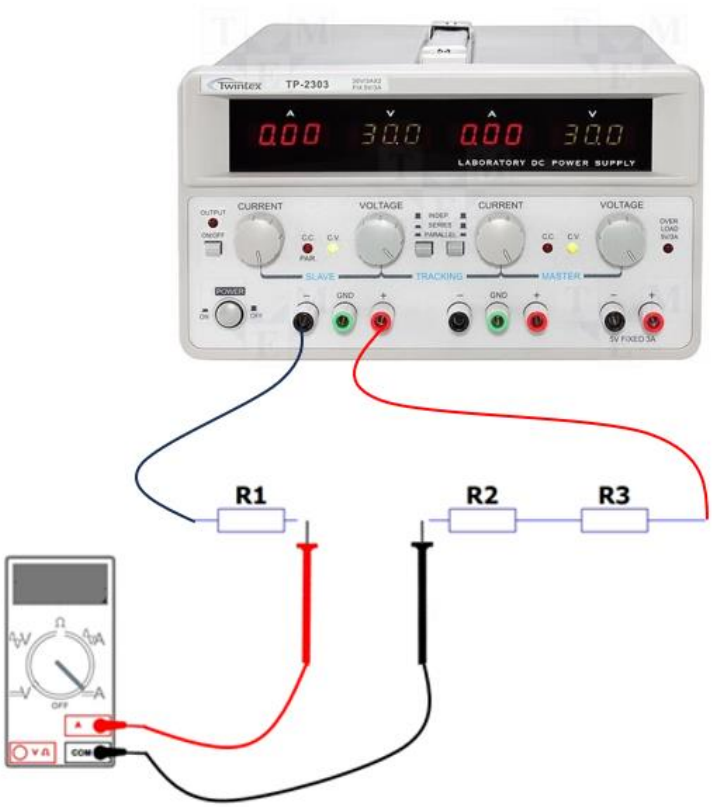

Fig.7. Measuring of current in series circuit

4. Measurement results

4.1 Ohm's law results

DC supply voltage [V]	Measured current if R=820Ω [mA]	Measured current if R=1,5kΩ [mA]

And the drawing of V-I curve of resistor…

Serial circuit measurement results

Selected resistances:
R1:
R2:
R3:

Total resistance of circuit:

Measured voltage:
U_{R1}:
U_{R2}:
U_{R3}:

Measured current between R1 and R2:
Measured current between R2 and R3:

5. Conclusions

How is the voltage proportional to the resistance?
How is the voltage proportional to the current?
How depend on the current from the resistance?
For series-connected elements, does the measured current depend on the location of the instrument?
On what principle can a multimeter measure resistance?
Summarize the voltages measured on R1, R2 and R3 during the third measurement. What do you observe?
How does the total resistance depend on the series connection?

6. Homework, report

Check the measurement results by calculation (by hand on paper) and by Ltspice simulation. Make a measurement report from the measured results and the simulation. Keep the criteria in mind!
You need to include to the measurement report:

- calculated results (in equation form, or by hand form in photo);
- simulated form with Ltspice (circuit + results (DC operating point simulation));
- measurement results
    - First measurement in table and graph form (in case both resistor);
    - Second measurement results (resistance, voltage, and current in table form).