

ELG2331: Experiment 1  
DC Circuits  
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**1. Objective:**

The objective of this experiment is to build up various electric circuits in DC, analyze current flow, and understand the use of measuring equipment. The experiment will allow the experimental verification of the theoretical analysis.

**2. Theory:**

***Current and Resistance***

Electric current is the amount of charge that flows through a given cross section of wire per time. It is measured in Ampere, defined as one Coulomb/Second.

Circuit elements, which oppose the flow of current, have a certain quantity of resistance and are sometimes called resistors; the basic unit of resistance is Ohm. The common carbon resistors used in electronic instruments are supposed to be within a specified percent tolerance of the marked value. Three colored bands painted around one end of the resistor indicate the resistance value. The first band gives the first digit, the second band gives the second digit, and the third band gives the number of zeros to be added to these first two digits to give the resistance in ohms. A fourth band codes the precision or tolerance of the resistor. If the fourth band is gold, the actual value should be within 5% of the marked value, and if the band is silver, the actual value should be within 10% of the marked value. The absence of a fourth band implies a tolerance of 20%. The color code for resistor is as follows:

| <b>Color</b> | <b>Value</b> | <b>Muliplier</b> |
|--------------|--------------|------------------|
| Black        | 0            | x1               |
| Brown        | 1            | x10              |
| Red          | 2            | x100             |
| Orange       | 3            | x1000            |
| Yellow       | 4            | x10000           |
| Green        | 5            | x100000          |
| Blue         | 6            | x1000000         |
| Violet       | 7            | x10000000        |
| Gray         | 8            | x100000000       |
| White        | 9            | x1000000000      |

For example, a 5.6 kW resistor would have green, blue, and red bands, respectively.

***Combinational Circuits***

The ammeter is used to measure the current flowing through a resistor combination. In order to do this, we need to cause all current, which flows through the resistor to flow through the ammeter as well. The ammeter will be connected directly into the circuit line. This means for example that current leaving the resistor will flow directly into the ammeter input. This type of connection is called a series connection. We will also

measure the voltage drop across resistor combinations. This requires connecting the voltmeter across the element. This type of connection is called a parallel connection.

### ***Equipment***

- Power supply.
- Digital multimeter (DMM, which includes the functions of ammeter, voltmeter, and ohmmeter).
- Resistors.
- Connection boards.

In connecting these circuits, you should understand the role of the measuring equipment, such as ammeter and voltmeter in particular. When they are connected into the circuit, either in parallel (voltmeter) or serial (ammeter) fashion, they are not actually part of the circuit, i.e. their presence does not (to a very good degree) affect the functioning of the circuit.

## **3. Procedure**

### ***A. Resistors Measuring Procedure***

- Measure and record the resistance of each of four resistors of the same indicated value and tolerance using the digital multimeter as ohmmeter (in resistance mode).
- Find if the measured value for each resistor agree with the color code value to within the tolerance indicated.

### ***B. Current Measurement in Series Circuits***

Select two resistors of different values (measure them using the DMM) and connect the resistors and power supply as shown in Figure 1. Follow the procedure:

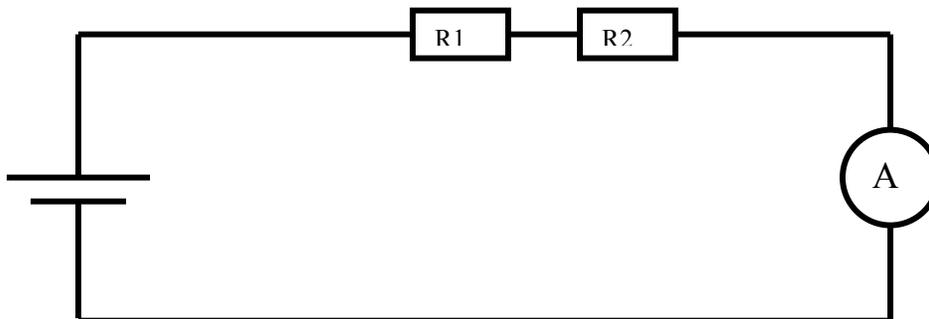


Figure 1: Current measurement in series resistances

1. Set the DC power supply to provide 5 V as shown in the digital display on the power supply front panel.
2. Set the multimeter to measure DC current, making sure the leads are set for current, not voltage measurement.
3. Measure the current using the multimeter.
4. Repeat the same procedure for another three sets of resistors.

**C. Voltage Measurement in Series Circuits**

Connect the voltmeter into the circuit as shown in Figure 2. The voltmeter is usually connected in parallel with the circuit element of interest. This means that current entering the junction preceding the voltmeter input is divided between it and the resistor. Voltmeters are designed to have high resistance and accordingly conduct little current; therefore, all the current passes through the resistor.

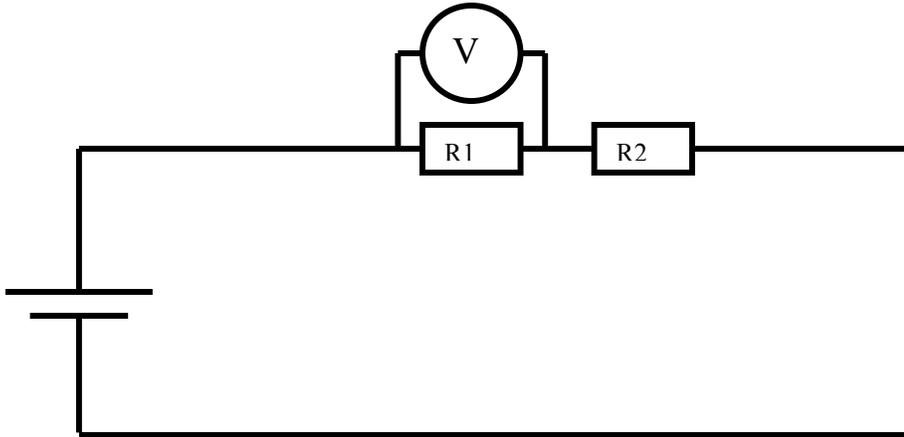


Figure 2: Measuring voltage in series circuit.

1. Set the DC power supply to provide 5 V.
2. Measure the voltage drop across R1.
3. Measure the voltage drop across R2.
4. Measure its voltage drop across both R1 and R2.
5. Measure the voltage drop across the power supply.

**D. Current Measurements in Parallel Circuits**

Connect the circuit as shown in Figure 3. Avoid connecting the ammeter until the rest of the circuit is complete. Insert the ammeter as shown in the figure.

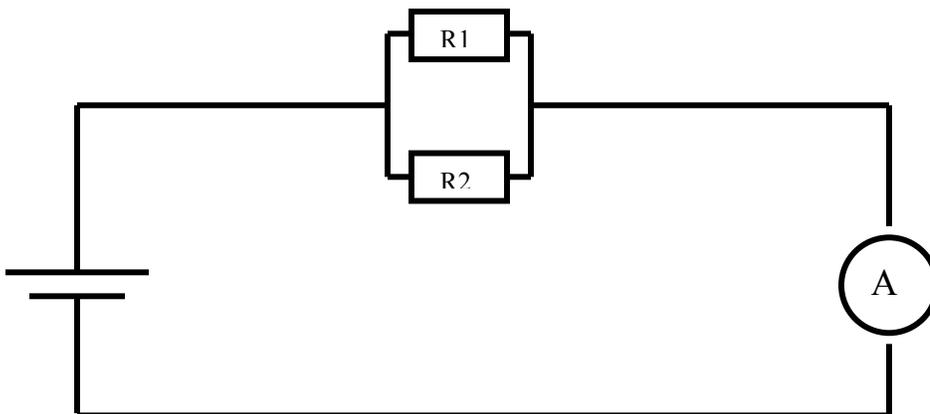


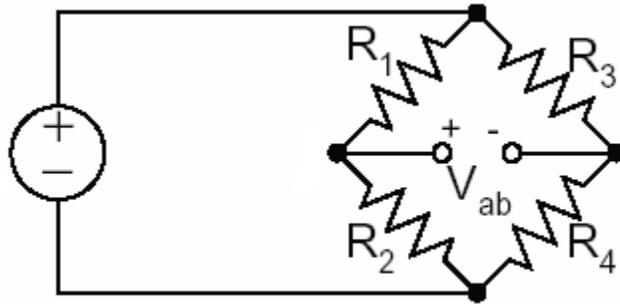
Figure 3: Current measurement in a parallel circuit.

***E. Voltage Measurement in a Parallel Circuit***

Set the DC power supply to provide 5 V. Measure the voltage drop across  $R_1$ ,  $R_2$ , and across the combination of  $R_1$  and  $R_2$ .

***F. Voltage Measurement in a Wheatstone bridge circuit***

Set the DC supply voltage to provide 5 V. Set  $R_1 = 2R_2$ , and  $R_3 = 2R_4$ . Measure the voltage  $V_{ab}$ .



**4. Notes**

- How do we know which is more correct: the DMM or the labels on the resistors?
- Does the values obtained agree with Ohm's Law.
- Can a single resistor replace two resistors in series in the circuit? How would the equivalent resistor be related to the individual resistors?
- When resistors are connected in parallel in a circuit, which resistor carries the largest current? How may the currents be related to the resistances?

**5. Report**

Make sure to include all the data and calculations that are needed to make a judgment on the validity of Ohm's law for the resistors you are using. You may probably need to see the course outline to find the proper format when writing up your report.