Wrocław University of Science and Technology

ELECTRIONIC MEASUREMENTS
LABORATORY REPORT

Chair of Electronic and Photonic Metrology
ELECTRIONIC MEASUREMENTS LABORATORY

Theme of class: RESISTANCE MEASUREMENT

Group no: 1

Students:
1. Paulina Nowak 251002
2. Ivan Melnyk 275510
3. Stanislav Kustov 275512

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Lab assistant: mgr inż. Krzysztof Adamczyk

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1 Introduction

1.1 Theory

Resistance can be measured using two methods: direct or indirect. To take a direct measurement, the measured component must be connected to the ohmmeter as shown in Fig. 1. The component cannot be connected to a circuit, and must be passive and linear. The final result is obtained by calculating the limiting error and applying it to the measured value.

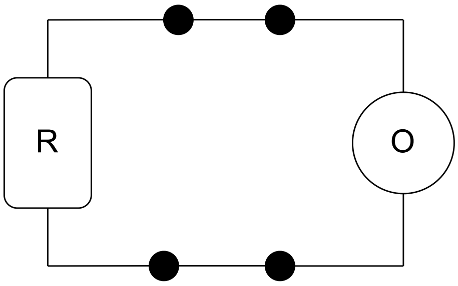

Figure 1: Direct resistance measurement schematic

1.2 Equipment

The following devices were used during the laboratory:

- digital meter: UT803;
- linear resistor;
- diode resistor.

2 Experiment

2.1 Direct resistance measurement

For direct measurements, we used linear resistors (R_2, R_4) and a diode (D). Measurements were taken for three different ranges and both polarities. Tab. 1 shows all of the measurements along with the final results.

R_x	$R_m[\Omega]$	$R_r[\Omega]$	Accuracy	$\Delta_{res}[\Omega]$	$\Delta R[\Omega]$	$\delta R[\%]$	$R \pm \Delta R[\Omega]$
Positive polarity							
R_2	424.4	600	$0.8+3$	0.1	3.6952	0.870688	424.4 ± 3.7
R_4	OL	600	$0.8+3$	0.1			
D	OL	600	$0.8+3$	0.1			
R_2	420	60000	$0.5+2$	10	22.1	5.261905	420 ± 23
R_4	2650	60000	$0.5+2$	10	33.25	1.254717	2650 ± 34
D	OL	60000	$0.5+2$	10			
R_2	400	600000	$0.5+2$	100	202	50.5	400 ± 202
R_4	2600	600000	$0.5+2$	100	213	8.192308	2600 ± 213
D	OL	600000	$0.5+2$	100			
Negative polarity							
R_2	424.4	600	$0.8+3$	0.1	3.6952	0.870688	424.4 ± 3.7
R_4	OL	600	$0.8+3$	0.1			
D	OL	600	$0.8+3$	0.1			
R_2	420	60000	$0.5+2$	10	22.1	5.261905	420 ± 23
R_4	2650	60000	$0.5+2$	10	33.25	1.254717	2650 ± 34
D	42.69	60000	$0.5+2$	10	20.21345	47.349379	42.69 ± 20.22
R_2	400	600000	$0.5+2$	100	202	50.5	400 ± 202
R_4	2600	600000	$0.5+2$	100	213	8.192308	2600 ± 213
D	178400	600000	$0.5+2$	100	1092	0.612108	178400 ± 1092

Table 1: Direct resistance measurements (for: R_m – measured resistance, R_r – range, Accuracy: $\pm$ (a% of reading + n – number of uncertain digits), Δ_{res} – resolution, $\Delta R, \delta R$ – limiting error)

Example calculations for $R_r = 600\,\Omega$ (R_2, positive polarity) are shown in the equations below.

$$\Delta R = \frac{a}{100\%} \cdot R_m + n \cdot \Delta_{res} = \frac{0.8\%}{100\%} \cdot 424.4\,\Omega + 3 \cdot 0.1\,\Omega = 3.6952\,\Omega \tag{1}$$

$$\delta R = \frac{\Delta R}{R_m} \cdot 100\% = \frac{3.6952\,\Omega}{424.4\,\Omega} \cdot 100\% \approx 0.870688\% \tag{2}$$

2.2 Indirect resistance measurement

3 Conclusion

During this laboratory we practiced measuring DC current and learned how the internal resistance of a meter affects the circuit. To be thorough, we tried both direct and indirect methods of measurements.

Both experiments showed us that the internal meter resistance can introduce measurement errors. When the meter's internal resistance was lower than the circuit's, the device was functioning properly and the systematic error had very small values. However, when the circuit's resistance dropped below the meter's, the results became unreliable and lay far outside the expected set of values, sometimes even with the systematic error added. This was caused by the meter losing its primary function and blocking the current from flowing through. Thus, when high precision is desired, measurements should taken on circuits with a much higher resistance than that of the meter.