Exercise - 0

Ohm's Law, I and II Kirchhoff's Law

Table of Contents

1 Purpose of the exercise

Learning Ohm's law and Kirchhoff's laws I and II.

2 The course of the exercise

2.1 Ohm's law

Use the development board to check the correctness of Ohm's law. To connect the system, select one resistor from R1, R2, R3 and one from R4, R5, R6. By changing the supply voltage from 0V to 10V in 1V steps, measure the supply current.

- Measure and analytically calculate the resultant resistance of the tested circuit
- Carry out the measurements for two different variants of resistance.
- Compare the measurements with the analytical calculations and if they differ, explain it.
- Draw the current-voltage characteristics of the tested systems.

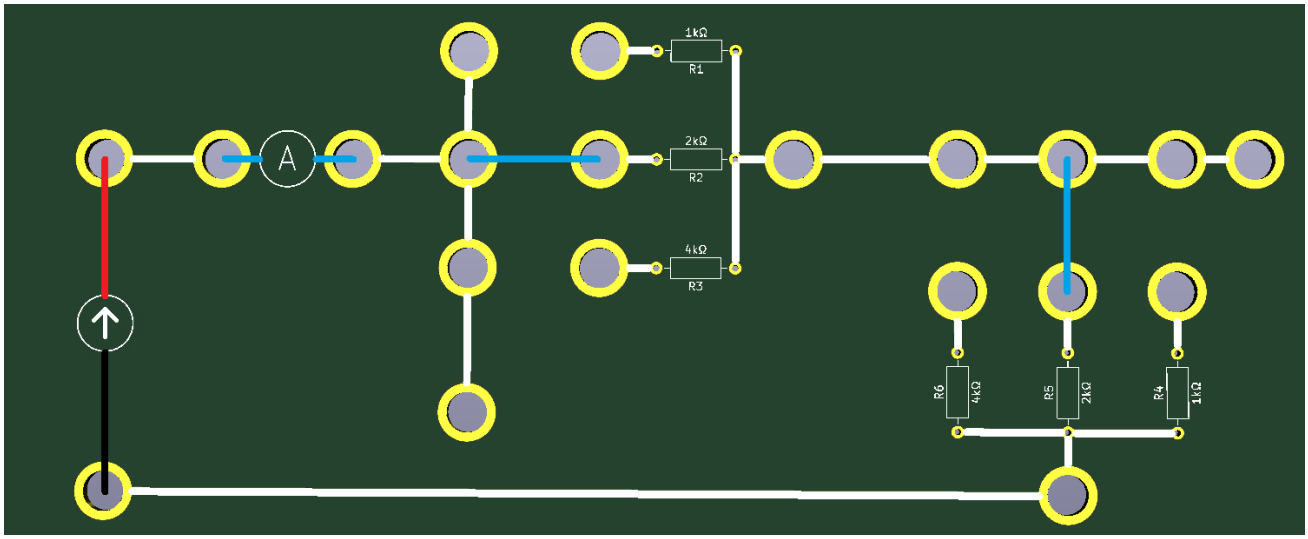


Figure 1: Example of connection implementation - Ohm's law

2.2 The resultant resistance

Use the development board to check the correctness of calculation of the resultant circuit resistance. Six resistors are available to choose, which give 56 possible different combinations.

- Choose 5 combinations.
- Calculate analytically and measure the resultant circuit resistance for each combination.
- Compare the measurements with the analytical calculations and if they differ, explain it.

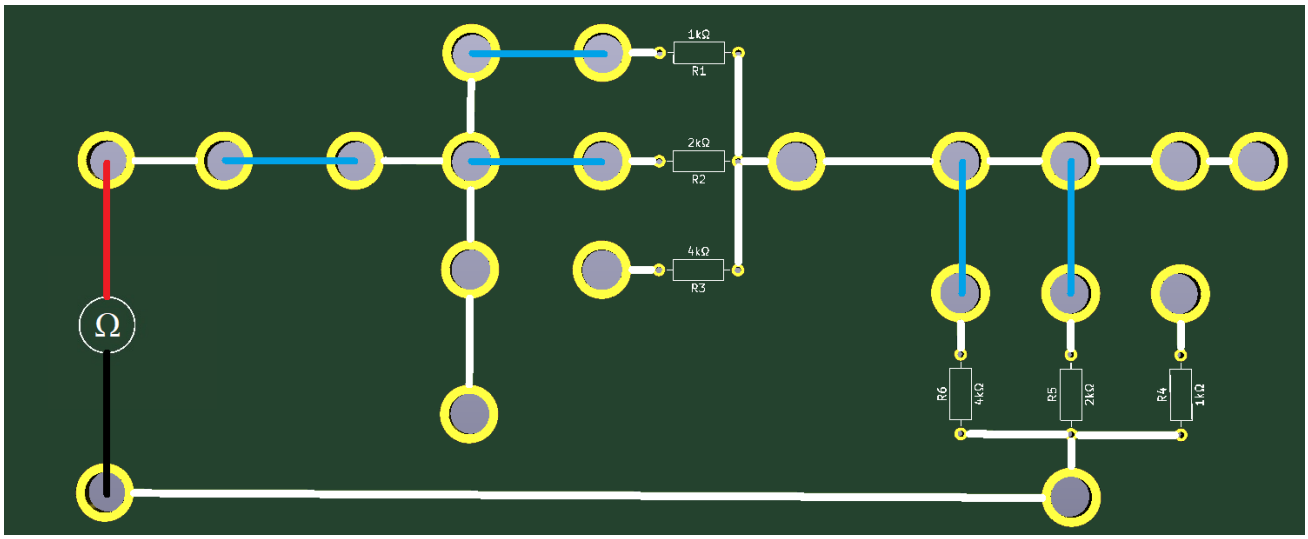


Figure 2: Example of connection implementation - resultant resistance

2.3 Voltage divider

Use the development board to check the correctness of the voltage calculation in the voltage divider. The system should be powered by 5V. Six resistors are available to choose, which give 9 connection possibilities (parallel connections are not considered).

- Choose 3 combinations.
- For each combination, calculate analytically the voltage across R4, R5 or R6 (depending on your choice), then measure this voltage.
- Compare the measurements with the analytical calculations and if they differ, explain it.

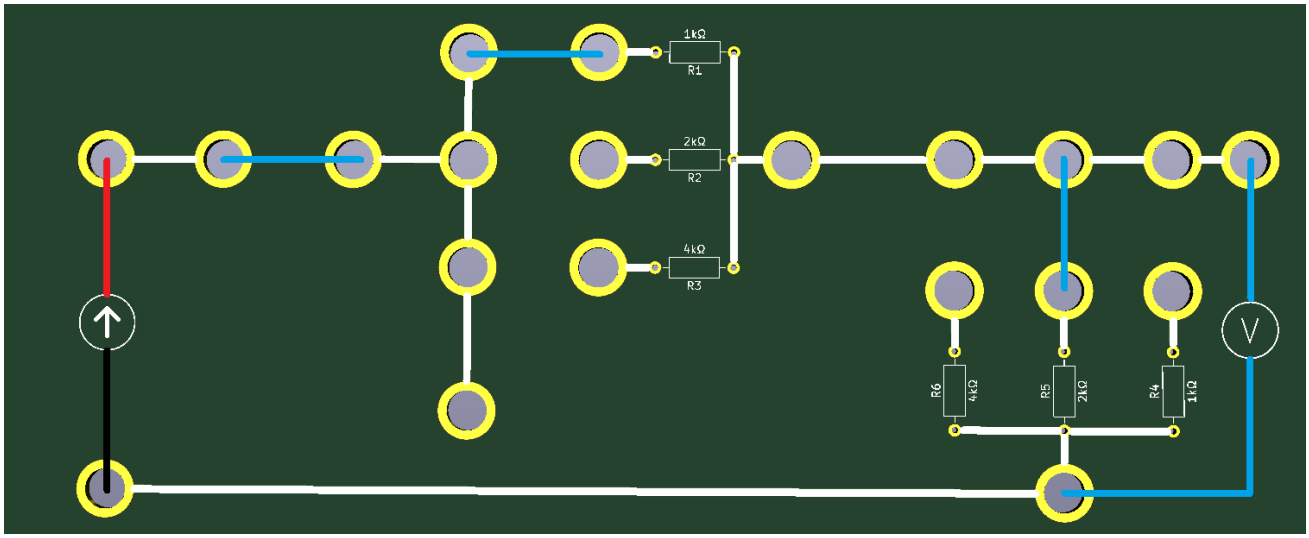


Figure 3: Example of connection implementation - voltage divider

2.4.1 I Kirchhoff's law

Use the development board to check the correctness of I Kirchhoff's laws. The system should be powered by 5V. The resistances R4, R5, R6 should be shorted by a wire.

- Make measurements for three cases, i.e. with only R1; with R1 and R2; and with R1, R2 and R3.

- Measure the current flowing into the node (supply current) and the current flowing from the node (resistance currents R1, R2, R3).
- Compare the measurements with the analytical calculations and if they differ, explain it.

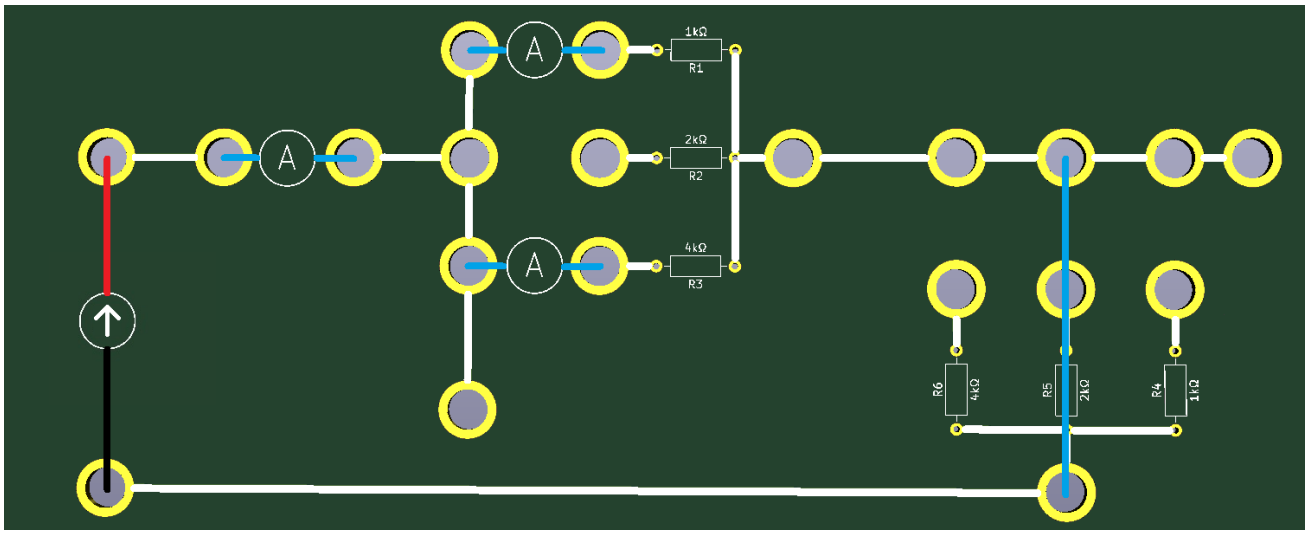


Figure 4: Example of connection implementation – I Kirchhoff's law

2.4.2
II prawo Kirchhoffa

Use the development board to check the correctness of II Kirchhoff's laws. The system should be powered by 5V.

- Select one resistor from R1, R2, R3 and one from R4, R5, R6 and measure the voltages on them.
- Take measurements for three different combinations.
- Compare the measurements with the analytical calculations and if they differ, explain it.

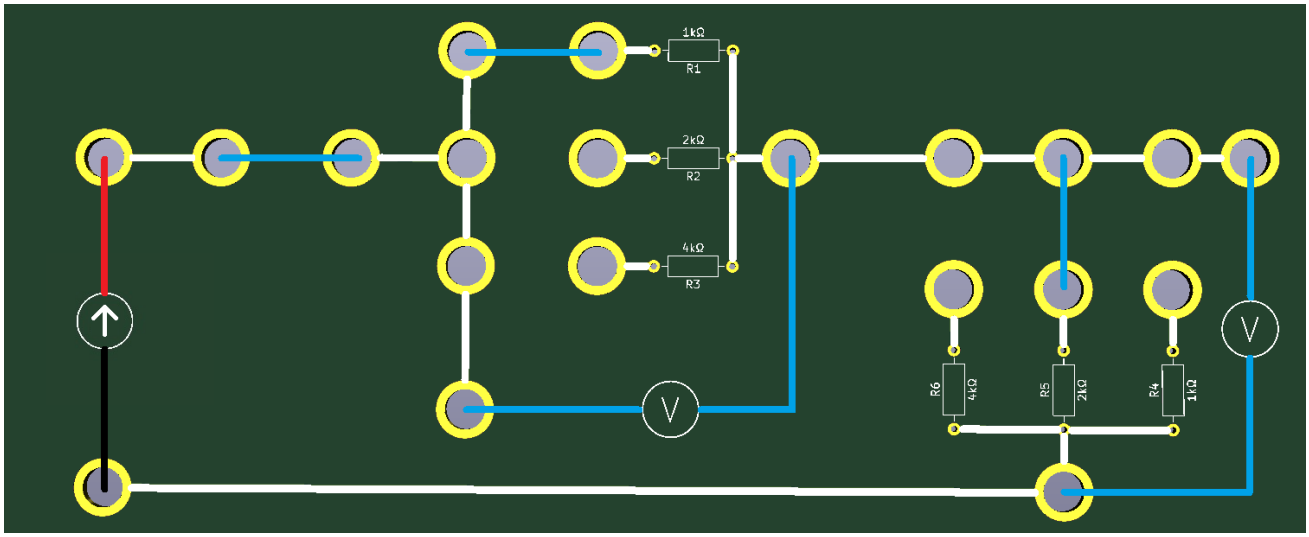


Figure 5: Example of connection implementation - II Kirchhoff's law

3 Report

The report should include:

- results of measurements and calculations
- used formulas and example calculations
- **schematic diagrams** of the tested systems
- current-voltage characteristics
- interpretation of characteristics
- comparison of measurements with analytical calculations

4 Necessary equipment

- scientific calculator
- camera for recording waveforms from an oscilloscope
- protocol

Table 1: Measurement and calculation results - Ohm's law

No.	Measurements			Calculations	
		Wariant 1	Wariant 2	Wariant 1	Wariant 2
	U[V]	I [mA]	I [mA]	I [mA]	I [mA]
1	0	0	-	0	-
2	1	252	-	0,25	-
3	2	514	-	0,5	-
4	3	771	-	0,75	-
5	4	1,021	-	1	-
6	5	1,281	-	1,25	-
7	6	1,532	-	1,5	-
8	7	1,796	-	1,75	-
9	8	2,048	-	2	-
10	9	2,309	-	2,25	-
11	10	2,567	-	2,5	-

Table 2: Measurement and calculation results - resultant resistance

No.	Measurements	Calculations
	R [Ω]	R [Ω]
1	1970	2250
2	2110	2000
3	1590	1250
4	5319	6000
5	3260	4000

Table 3: Measurement and calculation results - voltage divider

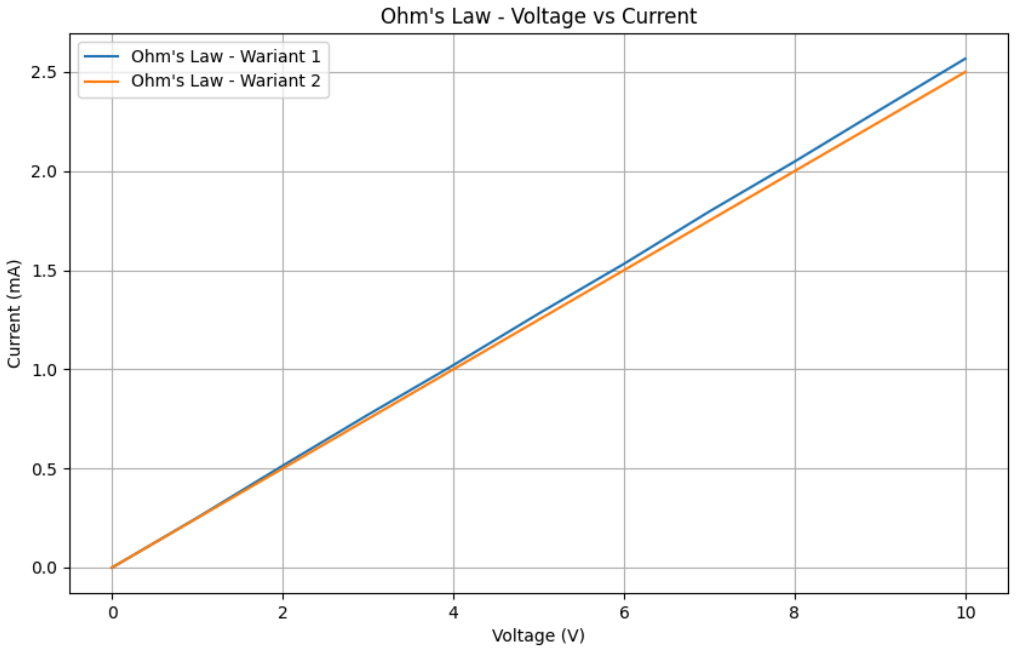
No.	Measurements	Calculations
	UIN [V]	UOUT [V]
1	3,33	3,3
2	2,51	2,5
3	1,645	1,6

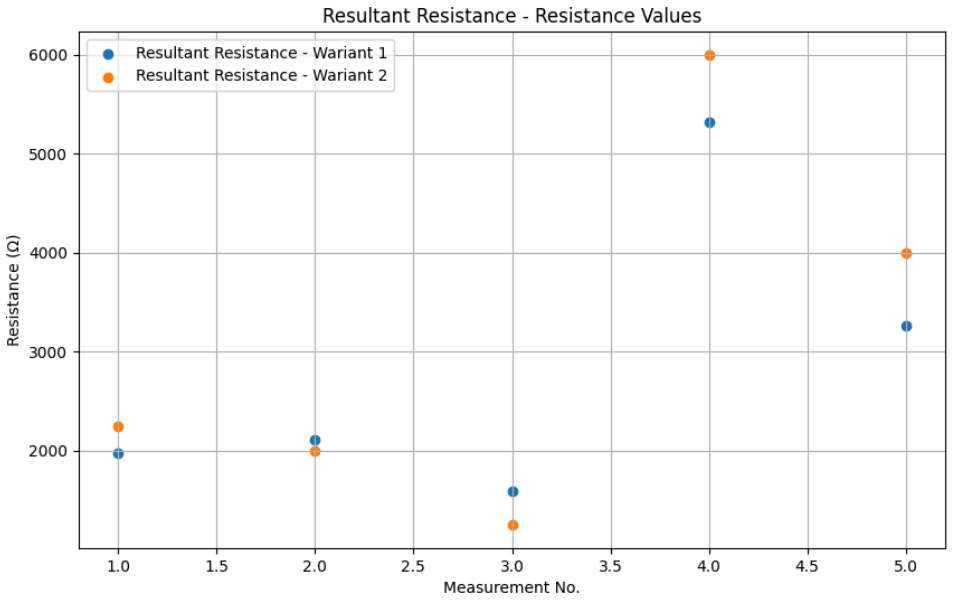
Table 4: Measurement and calculation results - First Kirchhoff's law

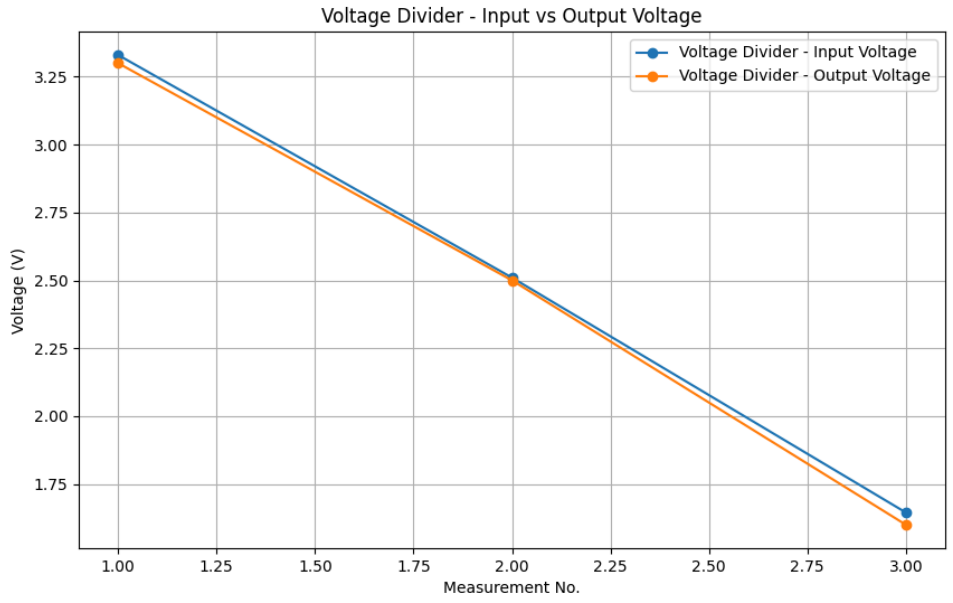
No.	Measurements				Calculations
	IIN [mA]	I OUT 1 [mA]	I OUT2 [mA]	I OUT 3 [mA]	Σ I OUT [mA]
1	5,038	6	-	-	6
2	7,586	6	3	-	9
3	8,811	7	3	2	11

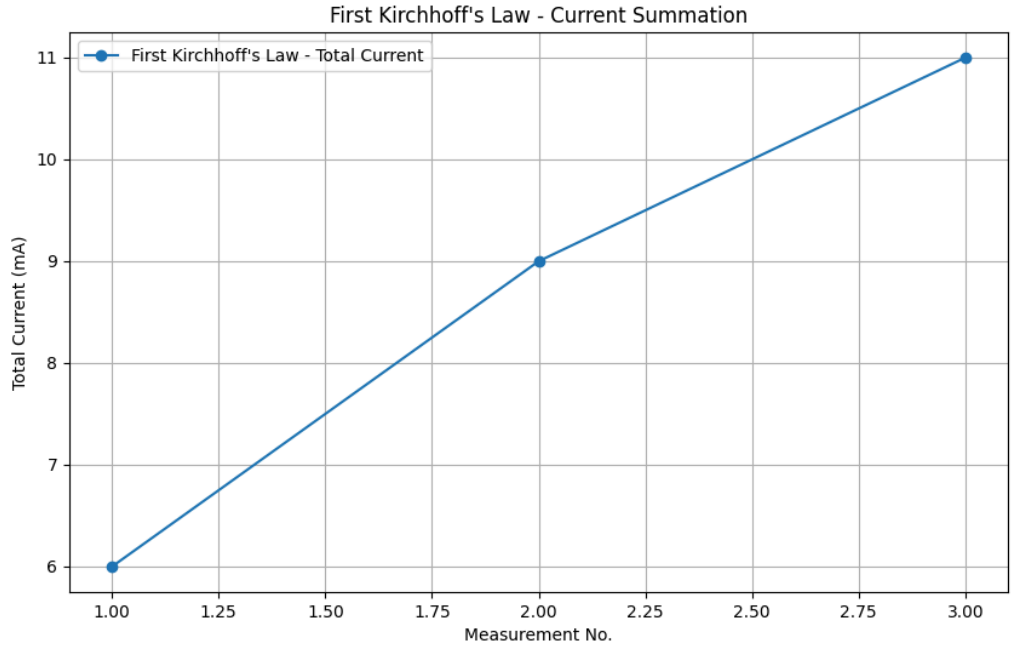
Table 5: Results of measurements and calculations - II Kirchhoff's law

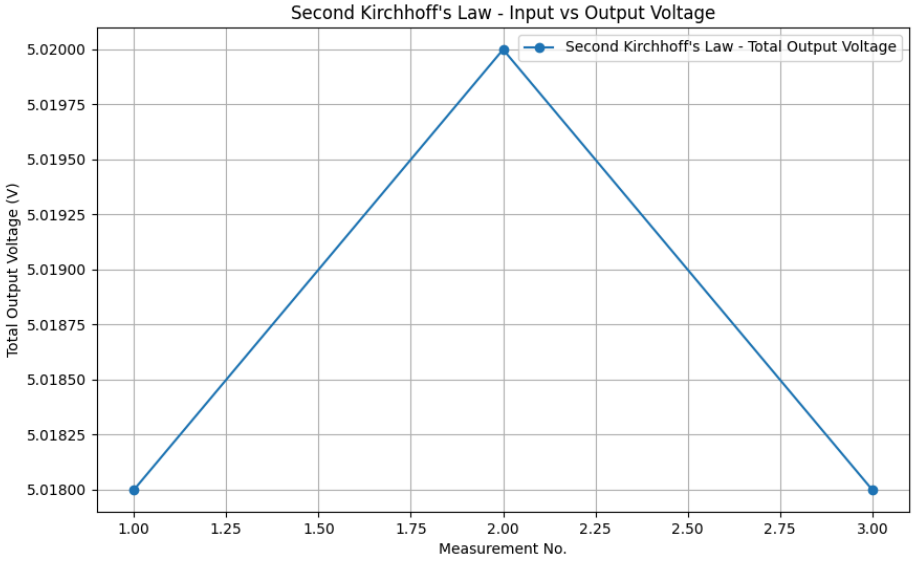
No.	Measurements			Calculations
	UIN [V]	UOUT 1 [V]	UOUT 2 [V]	Σ UOUT [V]
1	5V	3,33	1,68	5,018
2	5V	2,51	2,51	5,02
3	5V	1,648	3,37	5,018




Resultant Resistance - Resistance Values
Resultant Resistance - Wariant 1
Resultant Resistance - Wariant 2
Resistance (Ω)
6000
5000
4000
3000
2000
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Measurement No.


Voltage Divider - Input vs Output Voltage
Voltage Divider - Input Voltage
Voltage Divider - Output Voltage
Voltage (V)
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00
Measurement No.


First Kirchhoff's Law - Current Summation
First Kirchhoff's Law - Total Current
Total Current (mA)
Measurement No.
11
10
9
8
7
6
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00


Second Kirchhoff's Law - Input vs Output Voltage
Second Kirchhoff's Law - Total Output Voltage
Total Output Voltage (V)
Measurement No.
5.02000
5.01975
5.01950
5.01925
5.01900
5.01875
5.01850
5.01825
5.01800
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00