

Electric Power & Power Measurement (Lab 9)

Calculating Power Consumption

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TABLE OF CONTENTS

1.0 Purpose.....	3
2.0 Equipment Needed.....	3
3.0 Theory.....	3
4.0 Experiemntal Results	4
5.0 Conclusion	6

1.0 PURPOSE

- Understand the concept of the *Voltage Divider Rule*.
- Calculating voltage of resistors using *Voltage Divider Rule*.
- Understanding the concept of Electric Power and Power Measurement.
- Calculating power consumed by resistors in a circuit.

2.0 EQUIPMENT NEEDED

- (1x) desktop Power Supply.
- (1x) desktop Digital Multimeter.
- (3x) 4-band (1/4 watt) resistors.
- (1x) electronics breadboard.

3.0 THEORY

Electric Power & Measurement

- **POWER** is an indication of how much work (*conversion of energy from one form to another*) can be done in a specified amount of time. In other words, *POWER* is a rate of doing work. The work is measured in joules (J) and time elapsed is measured in seconds (s). Therefore, *POWER* is measured in joules/second (J/s). The electrical unit of measurement for *POWER* is watts (w). So therefore:

$$1 \text{ watt (W)} = 1 \text{ joule/second (J/s)}$$

[*POWER* is determined by:]

$$P = \frac{W}{t}$$

* (That is, *POWER* is Work/Second and unit is watts)

[*POWER* is calculated by:]

$$P = V * I$$

$$P = I^2 * R$$

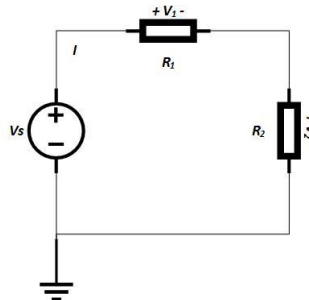
$$P = \frac{V^2}{R}$$

4.0 EXPERIMENTAL RESULTS

Results from the Procedure section:

First Experiment:

Fig.1.



PROCEDURE: ($V_S = 6V$) (Use Circuit Fig.1 from above)

- Step 1: Measure the values of the resistors and copy to Table 1.
- Step 2: Calculate the voltages of each resistor using the *Voltage Divider Rule* and copy to Table 1.
- Step 3: Calculate the current in each resistor and write in Table 1.
- Step 4: Build the circuit of Fig.1.
- Step 5: Ask your teacher to verify your circuit before you connect power supply.
- Step 6: Set the voltage source to 6V and limit the current to 500mA.
- Step 7: Measure the voltages of each resistor and copy to Table 1.
- Step 8: Measure the current of each resistor and copy to Table 1.
- Step 9: Calculate the power dissipated in each resistor and record to Table 1.

Table 1

$R_T = 3K\Omega$		Voltage			Current		
Resistor	Value	Calculated	Measured	%Error	Calculated	Measured	Power
R1	1K Ω	2V	2V	0%	2mA	2mA	4mW
R2	2K Ω	4V	4V	0%	2mA	2mA	8mW

CALCULATIONS:

[Calculated Voltage]

$$V_X = \frac{R_X * V_S}{R_T}, = \frac{1K\Omega * 6V}{3K\Omega} = 2V$$

$$V_X = \frac{R_X * V_S}{R_T}, = \frac{2K\Omega * 6V}{3K\Omega} = 4V$$

[%Error Voltage]

$$\%Error = \frac{Measured - Calculated}{Calculated} * 100 = \frac{2V - 2V}{2V} * 100 = 0\%$$

$$\%Error = \frac{Measured - Calculated}{Calculated} * 100 = \frac{4V - 4V}{4V} * 100 = 0\%$$

[Calculated Current]

$$V = I * R, 2 = I * 1K\Omega, I = 2mA$$

$$V = I * R, 4 = I * 2K\Omega, I = 2mA$$

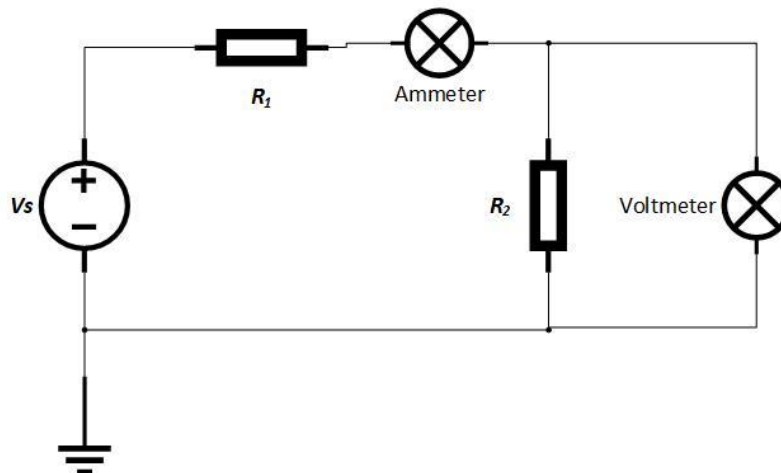
[Calculated Power]

$$P = V * I, P = 2V * 2mA, P = 4mW$$

$$P = V * I, P = 4V * 2mA, P = 8mW$$

Second Experiment:

Fig.2.



PROCEDURE: ($V_s = 6V$) (Use Circuit Fig.2.)

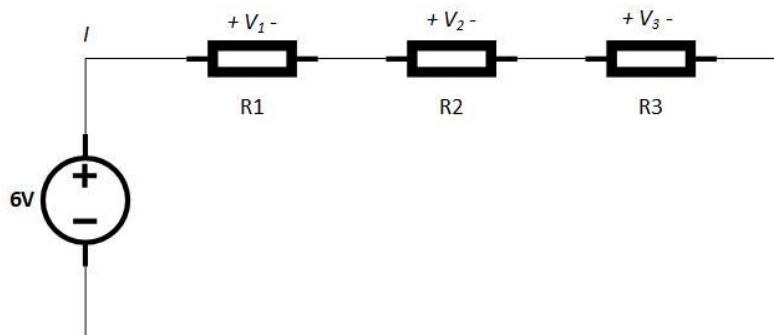
- Step 1: Set the Voltage and the Current limit to the same parameters as done with the previous experiment.
- Step 2: Connect a voltmeter and ammeter to Fig.1 to make the circuit of Fig.2.
- Step 3: Turn on the power and read voltage and current of R2. Record to Table 2.
- Step 4: Calculate the power dissipated in R2 and record in Table 2.
- Step 5: Measure the Voltage and current of R1 and record in Table 2.
- Step 6: Calculate the power dissipated in R1 and record in Table 2.
- Step 7: Compare the result with powers from Table 1.

Table 2

Resistor	Value	Voltage	Current	
		Measured	Measured	Power
R1	1KΩ	2V	2mA	4mW
R2	2KΩ	4V	2mA	8mW

Third Experiment:

Fig.3.



PROCEDURE: Open Circuits Voltages

Step 1: Make the circuit of Fig.3.

Step 2: Set the source Voltage to 6V and limit the Current to 500mA.

Step 3: Measure the voltages V_{AB} , V_{DB} , V_{CB} , V_1 , V_2 and V_3 .

Step 4: Record your result in Table 3.

Table 3

V_{AB}	V_{DB}	V_{CB}	V_1	V_2	V_3
6V	1.5V	4.5V	1.5V	3V	1.5V

5.0 CONCLUSION

- Purpose of this lab has been achieved.
- Understood the concept of the *Voltage Divider Rule*.
- Understood how to measure voltage of resistors using the *Voltage Divider Rule*.
- Understood the concept of Electric Power and Measurement.
- Understood how to calculate Power consumed by elements in a circuit.
- Used advanced functions on the lab equipment to facilitate my experiments.