LAB 4: Thevenin's Theorem

A. Objective

In this experiment you will:

- Reduce a complex resistive circuit to a single resistance (R_{TH}) in series with a single voltage source (V_{TH}).
- Experimentally verify Thevenin's theorem through voltage measurements.

B. Instruments and Materials

- DC power supply
- Digital multi-meter
- Electrical breadboard
- Resistors: 3.3$k\Omega$ [2], 10$k\Omega$ [2]
- Potentiometers: 10$k\Omega$ [1]

C. Theory

Thevenin's theorem provide a way to take complex circuit and reduce it to a simple Thevenin's voltage (V_{TH}) source in series with a Thevenin's resistance (R_{TH}). Thevenin's theorem is also used for simplifying circuits that involve more than one power source. This experiment provides a functional review of the application of Thevenin's theorem and experimental application.

D. Circuit Testing

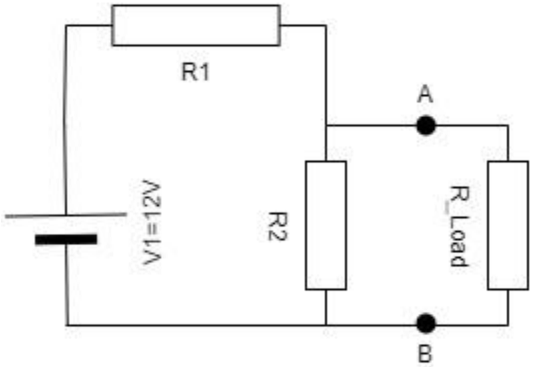

Figure 1

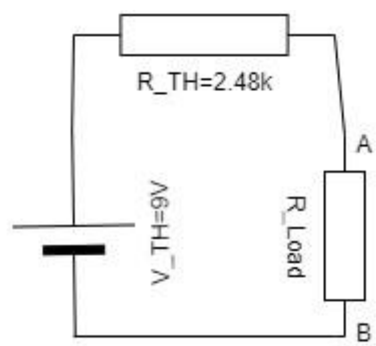

Figure 2

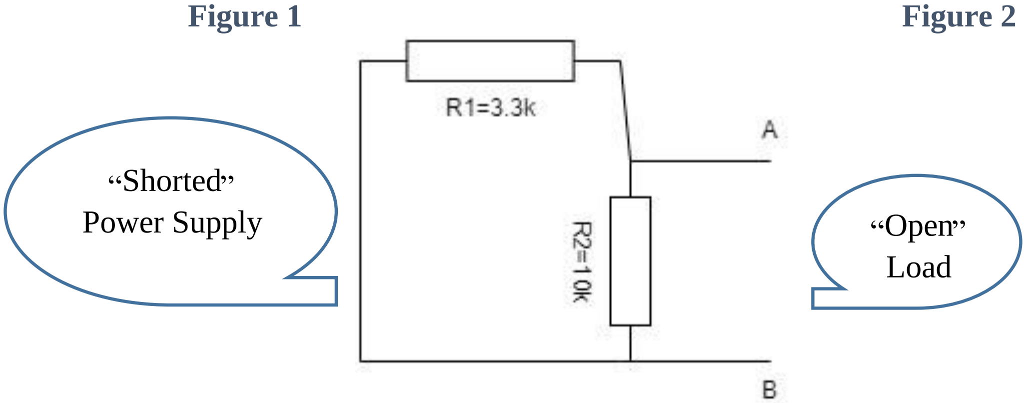

Figure 3

$R_1 = 3.3k\Omega$, $R_2 = 10k\Omega$, $R_{TH} = 2.48k\Omega$ **(Using potentiometer to get this value)**

E. Experimental Procedure

1. Construct the circuit of **Figure 1** on your circuit breadboard by use $\boldsymbol{R_{Load} = 3.3k\Omega}$**.**
2. Calculate the total current (I_T) and the load current (I_L). With this information on currents, determine the expected value of the voltage on the load.

$$V_{Load(calculate)} = 5.2\text{V}$$

3. Adjust the power supply for 12V and connect this voltage to the circuit.
   Measure load voltage and record below.

$$V_{Load(measured)} = 5.16\text{V}$$

4. Using the circuit of **Figure 1**, Thevenize and reconstruct the circuit on your breadboard. **Figure 2** shows the equivalent (Thevenized) circuit after your calculations.
   Use a $10k\Omega$ potentiometer and adjust to $\boldsymbol{R\_TH = 2.48k\Omega}$**.**

$$V_{Load(calculate)} = 5.115\text{V}$$

5. Apply $\boldsymbol{V_{TH} = 9V}$ to the Thevenized circuit and measured the voltage drop across the load.

$$V_{Load(measured)} = 5.67\text{V}$$

How does this measurement compare to the measurement across the load in step 3?

6. To verify (R_{TH}), construct the circuit of **Figure 3** and measure the resistance at points A and B.
7. Turn off the circuit power and restore your circuit to that of **Figure 1**. Change load resistor to $\boldsymbol{R_{Load} = 10k\Omega}$ load resistance. Apply **12V** DC to the circuit and measure the value of V_L.

$$V_L = 7.29\text{V}$$

8.Calculate for your circuit the value of I_T, I_L, V_L.

$$I_T = 1.44\text{mA}$$

$$I_L = 0.725\text{mA}$$

$$V_L = 7.248\text{V}$$

9. Modify your circuit to the Thevenin equivalent (**Figure 2** where $\boldsymbol{R_{Load} = 10k\Omega}$).
10. Apply **9V** DC and measure the value of V_L.

$$V_L = 8.98\text{V}$$

11. Using the Thevenin equivalent circuit form, calculate the value of I_T and V_L.

$$I_T = 0.72$$

$$V_L = 7.2\text{V}$$

Can you agree that calculations of circuit values are much easier using the "Thevenized" circuit form?

This complete the measurements of this experiment.

F. Discussion

Discuss the reasons why for any difference you might have encountered between your calculated values and your measured values.

→ the measured value is slightly smaller than calculate value because every resistand and Potentiometers is required the standard value in experiment, and the real life resistand and Potentiometers have smaller or slightly smaller than the required.