Principles of EE I Laboratory

Lab 3

Thevenin's Theorem

Student A	Student B
Full name: ……	Full name: ……
Student number: ……	Student number: ……

I. Objectives

In this laboratory, you will investigate:

1. The values for a Thevenin's equivalent circuit.
2. The conditions for maximum power delivered to a load.

II. Procedure

****PRELAB:** You must provide all **calculations** in-details in separate sheets and/or **simulation results** as attachments.

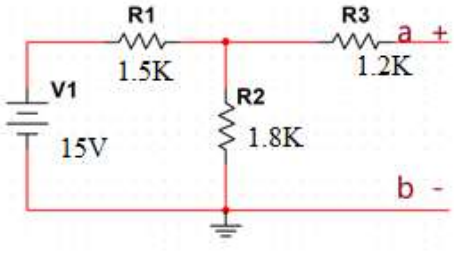


Figure 1. The original circuit

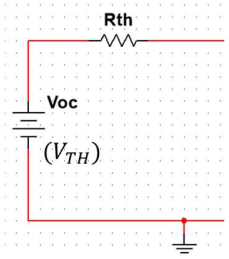


Figure 2. The Thevenin's equivalent circuit of the original circuit.

A. Find Thévenin equivalent circuit using short-circuit current. (Method 1)

Construct the circuit shown in Figure 1.

a. Using DMM, measure the open-circuit voltage (V_{Th}=V_{oc}) between terminals **a** and **b**.
b. Calculate** and measure the short circuit current (I_{sc}) of going through terminal **a** to terminal **b**.
c. Calculate** the Thévenin Equivalent resistance using these two measured values. Use R_{th} = V_{Th} / I_{sc} for this calculation.
d. Is it safe method to find Rth (in general)? If not, explain?

B. Find Thévenin equivalent circuit using variable load resistor. (Method 2)

Construct the circuit shown in Figure 1,

a. Using DMM, measure the open-circuit voltage (V_{Th}=V_{oc}) between terminals **a** and **b**.
b. Insert a 10K-ohm potentiometer across the terminals **a** and **b**, as followed:

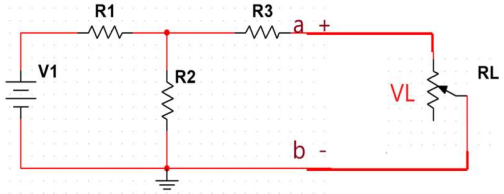


Figure 3

c. Adjust the R_L until $V_L = \frac{1}{2}V_{Th}$. Carefully disconnect the potentiometer out of the circuit to measure R_L correctly. This value of R_L is <u>now</u> equal to R_{th}.

In your report, you should derive the equation of voltage divider to prove that $R_L = R_{Th}$ when $V_L = \frac{1}{2}V_{Th}$.

C. Determine maximum power transfer

Using the circuit in Figure 3, **adjust** the potentiometer to complete the Table 1. Use another potentiometer if needed.

Remember to disconnect the potentiometer out of the circuit every time you measure its value R_L.

Table 1.

$V_L \approx$	V_L Measured	R_L Measured	$P_L = \frac{V_L^2}{R_L}$
0.3*V_{Th}	2.32	850 Ohm	6.33x10^-3 W
0.4*V_{Th}	3.24	1290 Ohm	8.14x10^-3 W
0.5*V_{Th}	4.05	2000 Ohm	8.2x10^-3 W
0.6*V_{Th}	4.86	2970 Ohm	7.953x10^-3 W
0.7*V_{Th}	5.67	4580 Ohm	7.02x10^-3 W

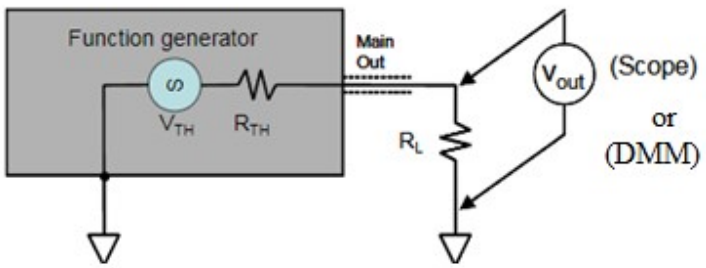
Use a spreadsheet (Excel) to plot a graph of P_L (y-axis) versus R_L (x-axis).

In your report, you should derive some equations to theoretically determine the value of R_L so that maximum power P_L is transferred. Comment your calculations and measurements.

D. APPLICATION: Thevenin Equivalent Circuit of the Function Generator

The function generator is a complex electronic instrument, but it is possible to model the function generator with a simple Thevenin equivalent circuit (TEC).

Rth = 60 Ohm



Rth = 60 Ohm

Vth = 0.7
VL = 0.35

Figure 4. Equivalent circuit of Function Generator with a Load Resistor