East West University
Department of Computer Science and Engineering

Course: CSE209 Electrical Circuits
Expt No.: 6
Title: Verification of Thevenin's theorem

Objective:

1. To verify the Thevenin's theorem theoretically, experimentally, and using PSpice simulation.

Theory:

Thevenin's theorem states that a linear two-terminal network can be replaced by an equivalent circuit containing a voltage source E_{th} in series with a resistance R_{th}. E_{th} is equal to the open circuit voltage between the terminals and R_{th} is the ratio of the open circuit voltage to the short circuit current through the terminals. Experimentally, E_{th} may be measured by measuring the open circuit voltage and R_{th} can be calculated by measuring the open circuit voltage and the short circuit current.

Circuit Diagrams:

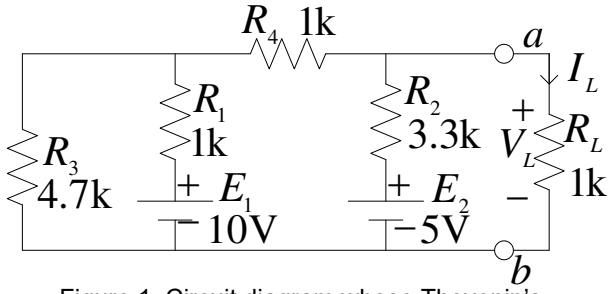

Figure 1. Circuit diagram whose Thevenin's equivalent to be determined.

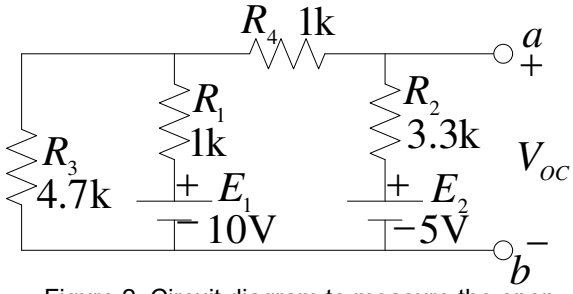

Figure 2. Circuit diagram to measure the open circuit voltage.

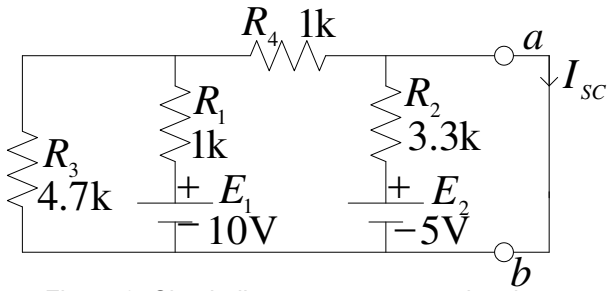

Figure 3. Circuit diagram to measure the short circuit current.

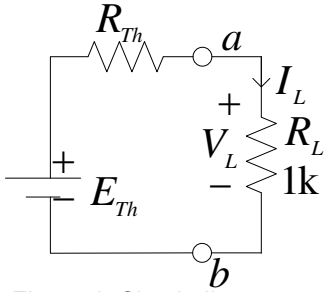

Figure 4. Circuit diagram to verify Thevenin's theorem.

Pre-Lab Report Questions:

1. Theoretically calculate V_L and I_L in Figure 1. Then theoretically calculate V_{OC} in Figure 2 and I_{SC} in Figure 3. From the values of V_{OC} and I_{SC}, determine E_{th} and R_{th}. Theoretically calculate V_L and I_L in Figure 4. Verify the Thevenin's theorem from calculated data?

Equipments and Components Needed:

1. DC power supply
2. Trainer board
3. DC ammeter
4. Multimeter
5. Resistors (three 1kΩ, one 4.7kΩ, one 3.3kΩ)
6. Decade Resistance box
7. Breadboard
8. Connecting wires

Lab Procedure:

1. Measure the resistance values of the given resistors and record them in Table 1.
2. Construct the circuit of Figure 1. Use DC power supply for the 10V source and trainer board for the fixed 5V source. Measure E_1, E_2, V_L, and I_L and record them in Table 1.
3. Remove R_L as shown in Figure 2. Measure the open circuit voltage V_{OC} and record it in Table 1.
4. Connect nodes *a* and *b* with a wire as shown in Figure 3. Measure the short circuit current I_{SC} and record it in Table 1.
5. Determine $E_{th} = V_{OC}$ and $R_{th} = V_{OC}/I_{SC}$ and record them in Table 2.
6. Construct the circuit of Figure 4. Adjust the power supply voltage to make its value equal to E_{th}. Select R_{th} from the decade resistance box. Measure V_L and I_L and record them in Table 2.
7. Verify the Thevenin's theorem from data of Tables 1 and 2.
8. Have the datasheet signed by the instructor.

Table 1. Experimental Datasheet for determining Thevenin's equivalent circuit.

Measured Value of E_1	Measured Value of E_2	Measured Value of V_L	Measured Value of I_L	Measured value of V_{OC}	Measured value of I_{SC}	Measured values of resistors (kΩ)
						R_1 = R_2 = R_3 = R_4 = R_L =

Table 2. Experimental Datasheet for Thevenin's equivalent circuit.

$E_{th} = V_{OC}$	$R_{th} = V_{OC}/I_{SC}$	Measured Value of V_L	Measured Value of I_L

Post-Lab Report Questions:

1. Theoretically calculate V_L and I_L in Figure 1 using measured values of E_1, E_2, R_1, R_2, R_3, R_4, and R_L. Then theoretically calculate V_{OC} in Figure 2 and I_{SC} in Figure 3 using measured values of E_1, E_2, R_1, R_2, R_3, R_4, and R_L. From the values of V_{OC} and I_{SC}, determine E_{Th} and R_{Th}. Theoretically calculate V_L and I_L in Figure 4 using calculated values of E_{Th} and R_{Th} and the measured value of R_L. Verify the Thevenin's theorem from calculated data?
2. Compare the measured values and the calculated values from step 1 and comment on any observed discrepancy.
3. Using PSpice, simulate the circuit of Figure 1 and determine V_L and I_L. Simulate the circuit of Figure 2 and determine VOC. For this purpose, connect a 0A current source between nodes *a* and *b*. Simulate the circuit of Figure 3 and determine I_{SC}. For this purpose, connect a 0V voltage source between nodes *a* and *b*. Determine the values of E_{th} and R_{th}. Simulate the circuit of Figure 4 and determine V_L and I_L. Verify the Thevenin's theorem from simulated data.