Lab Session 07

Analyze and implementation of Thevenin's Theorem:

Objective:

- Verify Thevenin's theorem theoretically and practically for a given circuit

Equipments and Components Required:

- DC Power supply
- Ammeter
- Voltmeter
- Resistors (Different values)
- Connecting wires
- Ohm meter (DMM)

Theory / Statement:

Any linear, bilateral network having a number of voltage, current sources and resistances can be replaced by a simple equivalent circuit consisting of a single voltage source in series with a resistance, where the value of the voltage source is equal to the open circuit voltage and the resistance is the equivalent resistance measured between the open circuit terminals with all energy sources replaced (open the current source and short the voltage source)

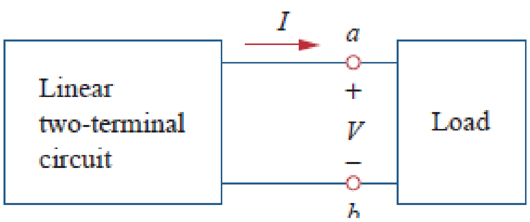


Figure 7.1 a (linear two-terminal circuit)

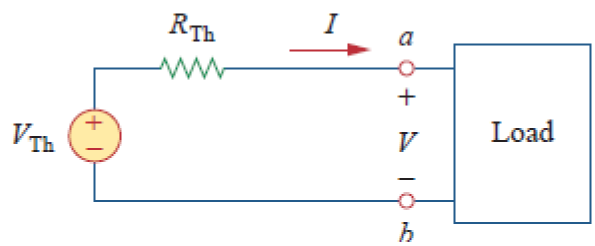
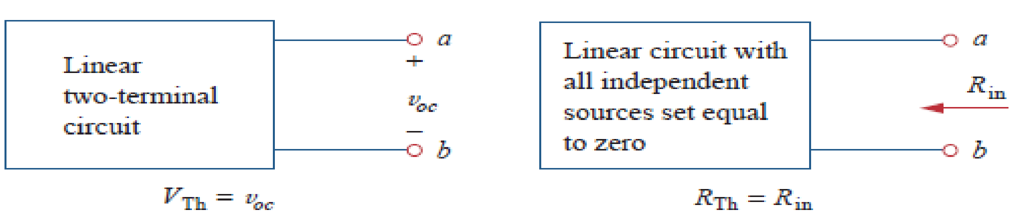


Figure 7.1 b (The Thevenin equivalent circuit)

According to Thevenin's theorem, the linear circuit in Fig. 7.1(a) can be replaced by that in Fig. 7.1(b). (The load may be a single resistor or another circuit.) The circuit to the left of the terminals in Fig. 7.1(b) is known as the Thevenin equivalent circuit;

" Thevenin's theorem states that a linear two-terminal circuit can be replaced by an equivalent circuit consisting of a voltage source V_{Th} in series with a resistor R_{Th}, where V_{Th} is the open-circuit voltage at the terminals and R_{Th} is the input or equivalent resistance at the terminals when the independent sources are turned off.

$$V_{Th} = v_{oc} \qquad (4$$



Find the Thevenin equivalent circuit of the circuit shown in Fig. 7.2 to the left of the terminals a-b, Then find the current through $R_L = 6\ \Omega$,

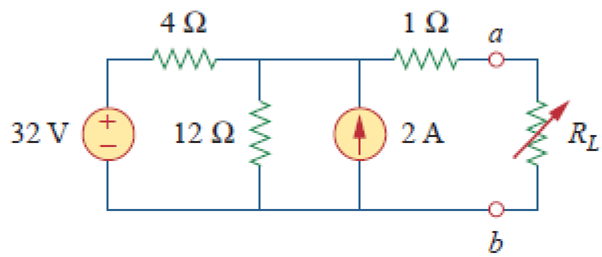


Figure (7.2)

Theoretical demonstration

1. We find R_{Th} by turning off the 32-V voltage source (replacing it with a short circuit) and the 2-A current source (replacing it with an open circuit). The circuit becomes what is shown in Fig. 7.3

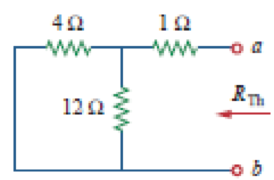
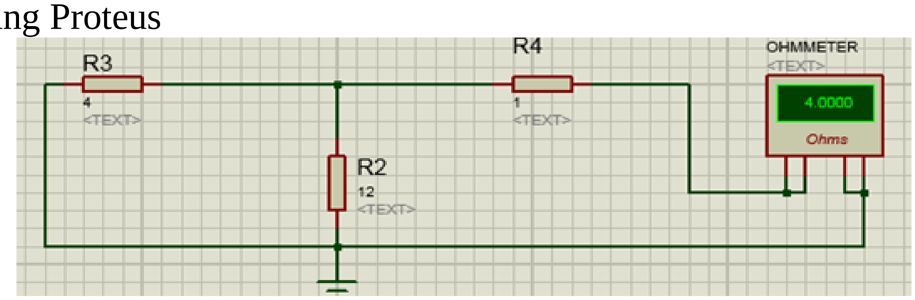


Fig. 7.3 (Finding R_{Th})

$$R_{Th} = 4 \parallel 12 + 1 = \frac{4 \times 12}{16} + 1 = 4\ \Omega$$

Find R_{Th} using Proteus



2. To find consider the circuit in Fig. 7.4 a. use nodal analysis or mesh , we are using nodal analysis

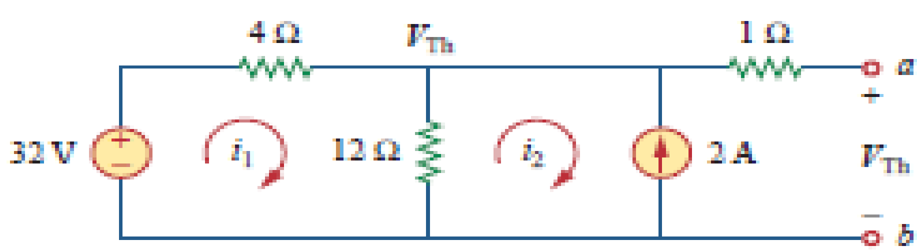


Fig. 7.4 a (finding V_{Th}.)

$$-32 + 4i_1 + 12(i_1 - i_2) = 0, \qquad i_2 = -2 \text{ A}$$

Solving for i_1, we get $i_1 = 0.5$ A. Thus,

$$V_{Th} = 12(i_1 - i_2) = 12(0.5 + 2.0) = 30 \text{ V}$$

Alternatively, it is even easier to use nodal analysis. We ignore the 1-Ω resistor since no current flows through it. At the top node, KCL gives

$$\frac{32 - V_{Th}}{4} + 2 = \frac{V_{Th}}{12}$$

or

$$96 - 3V_{Th} + 24 = V_{Th} \quad \Rightarrow \quad V_{Th} = 30 \text{ V}$$

Find V_{Th} using Proteus

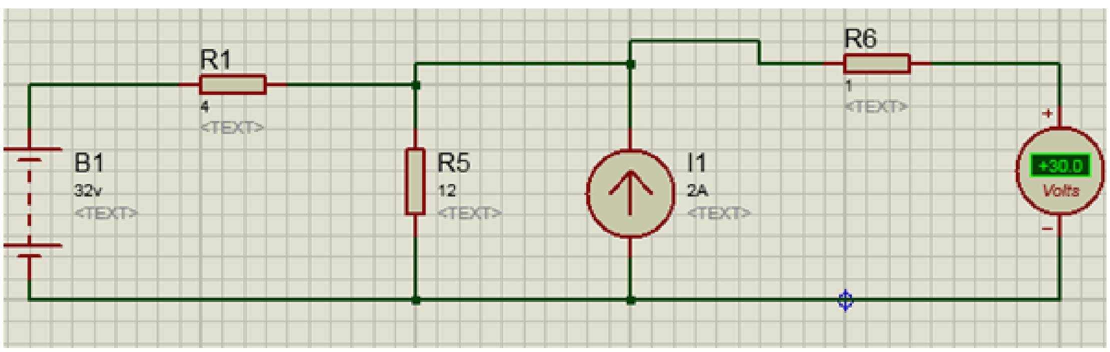


Fig. 7.4 b (finding V_{Th}.)

The Thevenin equivalent circuit is shown in Fig. 4.29.

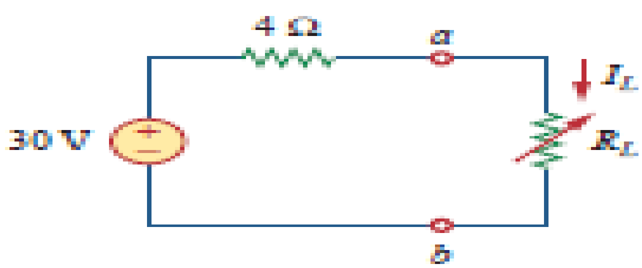


Figure 7.5 (The Thevenin equivalent circuit)

The current through R_L is

$$I_L = \frac{V_{Th}}{R_{Th} + R_L} = \frac{30}{4 + R_L}$$

When $R_L = 6$,

$$I_L = \frac{30}{10} = 3 \text{ A}$$

Results & Observation:

Table 7.1

Parameters	**V_{oc}**	**R_{TH}**	**I_L**
Theoretical Values			
Practical Values			

Task

Using Thevenin's theorem, find the equivalent circuit to the left of the terminals in the circuit of Fig. 7.6 Then find *I*.

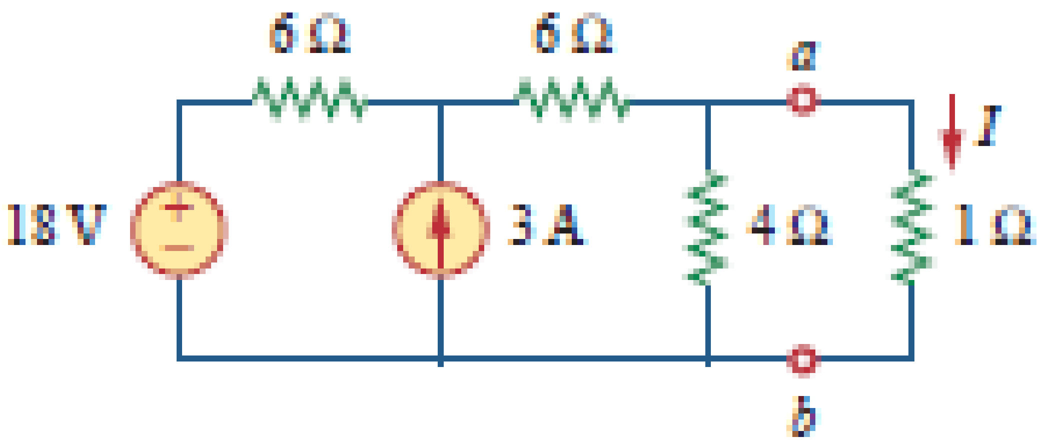


Fig. 7.6 (task)

Conclusion& Comments:
