Thévenin's Theorem

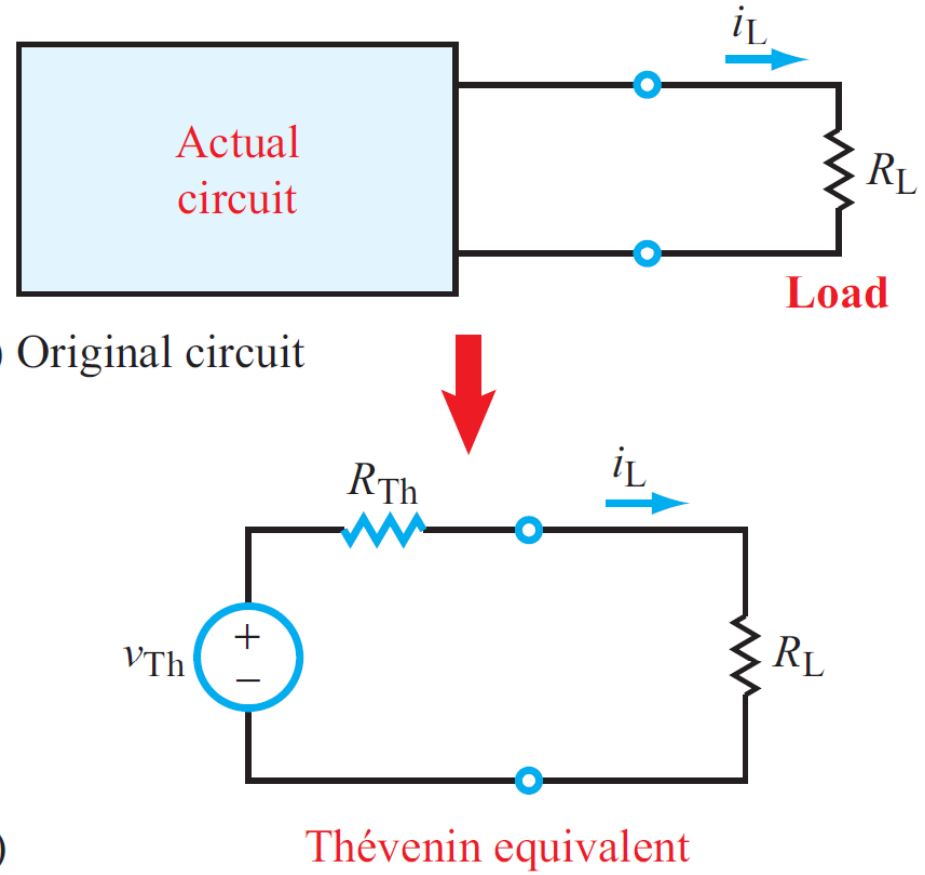
Linear two-terminal circuit can be replaced by an equivalent circuit composed of a voltage source and a series resistor

$$v_{\text{Th}} = v_{\text{oc}}$$

voltage across output with no load (open circuit)

$$R_{\text{Th}} = R_{\text{in}}$$

Resistance at terminals with all independent circuit sources set to zero



Norton's Theorem

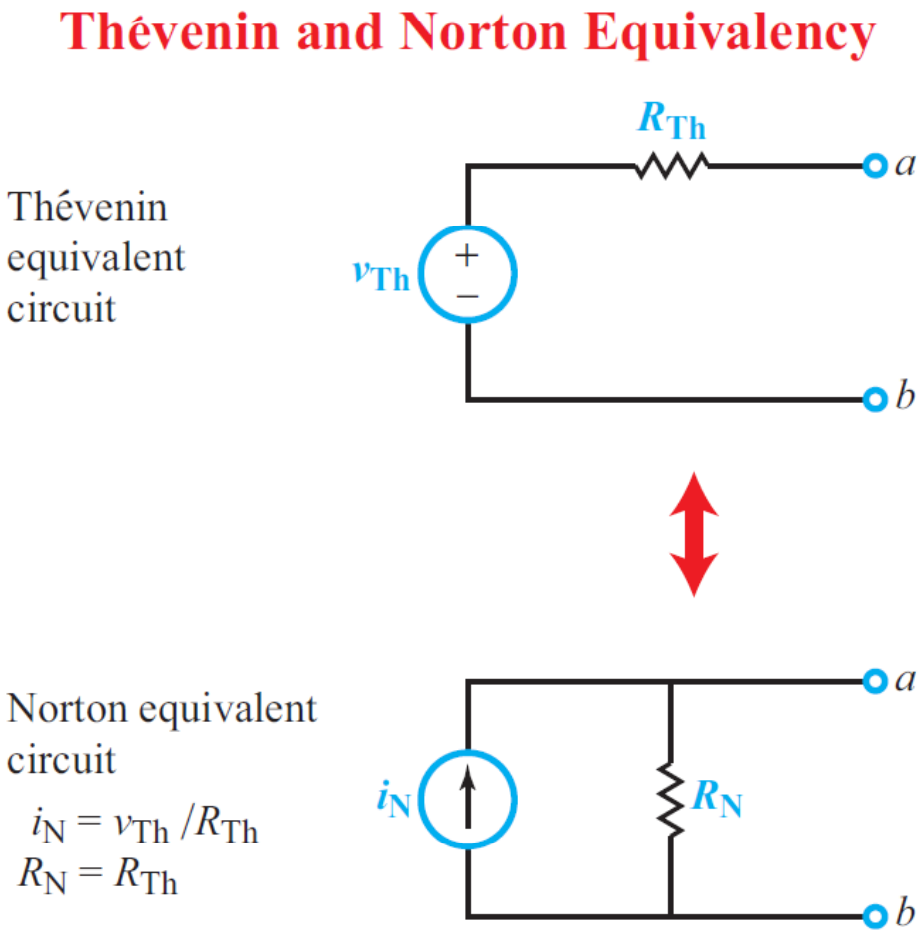
Linear two-terminal circuit can be replaced by an equivalent circuit composed of a current source and parallel resistor

$$i_N = \frac{v_{Th}}{R_{Th}}$$

Current through output with short circuit

$$R_N = R_{Th}.$$

Resistance at terminals with all circuit sources set to zero



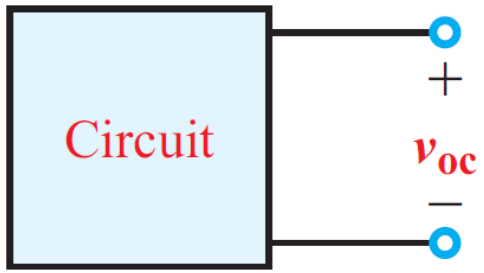
How Do We Find Thévenin/Norton Equivalent Circuits ?

- Method 1: Open circuit/Short circuit

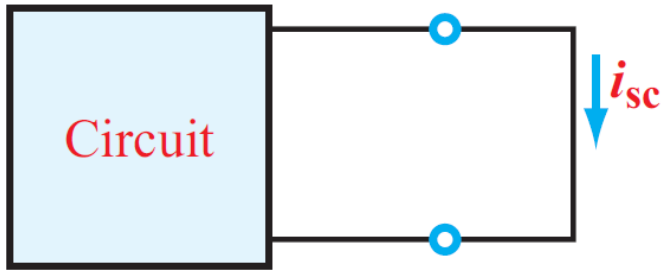
1. Analyze circuit to find v_{oc}
2. Analyze circuit to find i_{sc}

$$v_{Th} = v_{oc}$$

$$R_{Th} = \frac{v_{Th}}{i_{sc}}$$



(a) $v_{Th} = v_{oc}$



(b) $R_{Th} = v_{oc} / i_{sc}$

Note: This method is applicable to "any circuit", whether or not it contains dependent sources.

The circuit must include at least one (nonzero) independent source, otherwise $v_{Th} = i_{sc} = 0$!

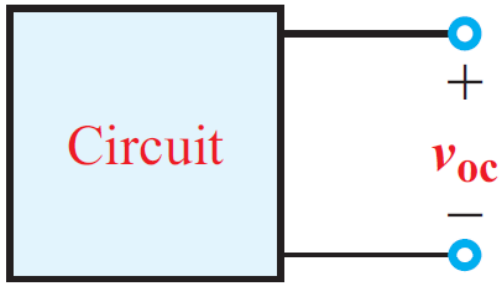
How Do We Find Thévenin/Norton Equivalent Circuits?

Method 2: Equivalent Resistance

1. Analyze circuit to find either

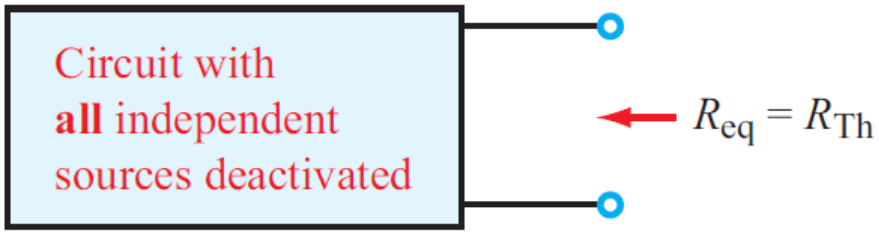
v_{oc} or i_{sc}

2. Deactivate all independent sources by replacing voltage sources with short circuits and current sources with open circuits.
3. Simplify circuit to find equivalent resistance



(a) $v_{Th} = v_{oc}$

Equivalent-Resistance Method



Note: This method does not apply to circuits that contain dependent sources.

Why does this method work for finding R_{Th}?

How Do We Find Thévenin/Norton Equivalent Circuits?

Method 3:

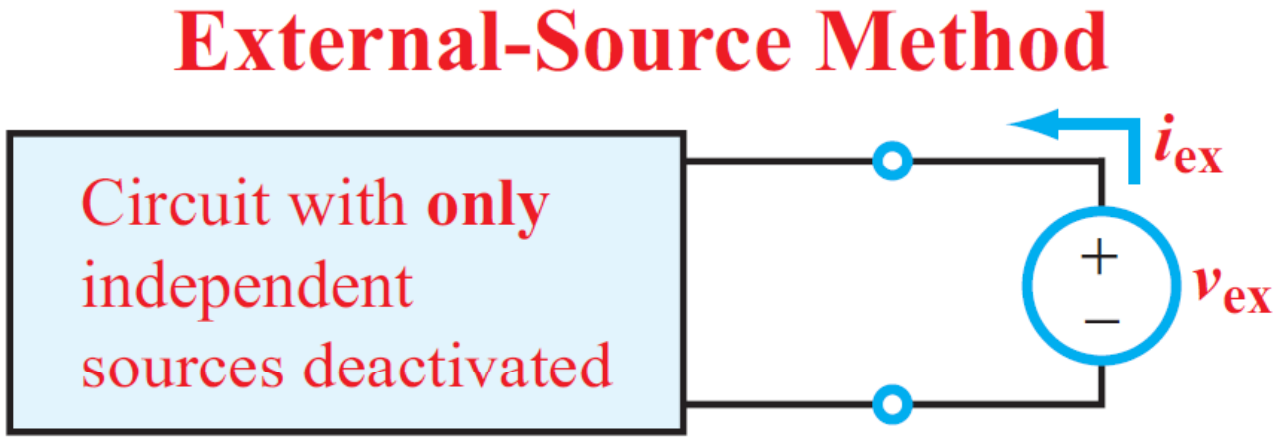


Figure 3-22: If a circuit contains both dependent and independent sources, R_{Th} can be determined by (a) deactivating independent sources (only), (b) adding an external source v_{ex}, and then (c) solving the circuit to determine i_{ex}. The solution is $R_{Th} = v_{ex}/i_{ex}$.

This method must be used if the circuit contains no independent sources.
Still need to find $v_{Th} = v_{oc}$.