The Thévenin Equivalent Circuit

A Thévenin equivalent circuit consists of a voltage source (V_{Th}) in series with a resistor (R_{Th}) and two terminals, **A** and **B**, as shown in Figure 1.

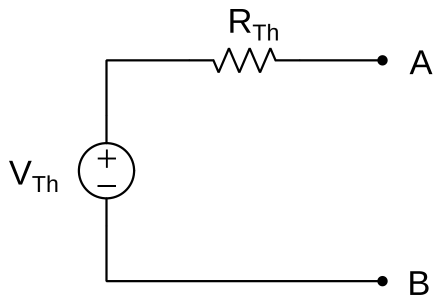

Figure 1: Thévenin equivalent circuit.

Two terminals, **A** and **B**, in an arbitrary circuit can be represented by a Thévenin equivalent circuit. To compute the Thévenin equivalent circuit:

1. To calculate V_{Th}, determine the open circuit voltage (V_{AB}) between terminal **A** and terminal **B**. This calculation can be performed using KVL, KCL, Ohm's law, nodal analysis, mesh analysis, source transformations or any combination of these. The Thévenin equivalent voltage is equal to this open circuit voltage: $V_{\text{Th}} = V_{\text{AB}}$.
2. To calculate R_{Th}, deactivate all independent voltage sources and independent current sources in the circuit. Independent voltage sources are replaced with a short circuit; independent current sources are replaced with an open circuit. Calculate the Thévenin equivalent resistance (R_{Th}) by one of the three methods below:
   (a) Attach an independent "test" voltage source (V_{test}) or an independent "test" current source (I_{test}) between terminal **A** and terminal **B**. Calculate the current through V_{test}, or the voltage across I_{test}. R_{Th} is the resistance seen by the "test" source: $R_{\text{Th}} = V_{\text{test}}/I_{\text{test}}$. Set the "test" source voltage or current to 1, to simplify the calculation.
   (b) If the circuit does not contain any dependent voltage sources or dependent current sources, calculate the equivalent resistance between terminal **A** and terminal **B**. R_{Th} is equal to this equivalent resistance.
   (c) If the Thévenin equivalent voltage (V_{Th}) and the Norton equivalent current (I_{N}) (see next page) are both known, then: $R_{\text{Th}} = V_{\text{Th}}/I_{\text{N}}$.

The Norton Equivalent Circuit

A Norton equivalent circuit consists of a current source (I_{N}) in parallel with a resistor (R_{N}) and two terminals, **A** and **B**, as shown in Figure 2.

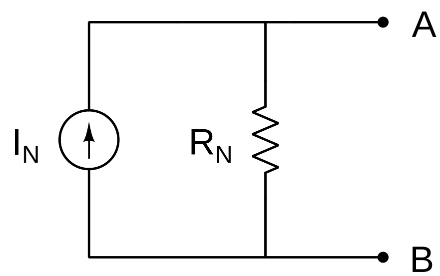

Figure 2: Norton equivalent circuit.

Two terminals, **A** and **B**, in an arbitrary circuit can be represented by a Norton equivalent circuit. To compute the Norton equivalent circuit:

1. To calculate I_{n}, determine the short circuit current (I_{AB}) between terminal **A** and terminal **B**. This calculation can be performed using KVL, KCL, Ohm's law, nodal analysis, mesh analysis, source transformations or any combination of these. The Norton equivalent current is equal to this short circuit current: $I_{\text{N}} = I_{\text{AB}}$.
2. The Norton equivalent resistance (R_{N}) is equal to the Thévenin equivalent resistance (R_{Th}). Calculate R_{Th} as described in step 2 in the Thévenin equivalent circuit.

Notes:

The Norton equivalent circuit is the source transformation of the Thévenin equivalent circuit. Applying the source transformation: $I_{\text{N}} = \frac{V_{\text{Th}}}{R_{\text{Th}}}$ and $R_{\text{N}} = R_{\text{Th}}$.

The Thévenin equivalent circuit is the source transformation of the Norton equivalent circuit. Applying the source transformation: $V_{\text{Th}} = I_{\text{N}} R_{\text{Th}}$ and $R_{\text{Th}} = R_{\text{N}}$.