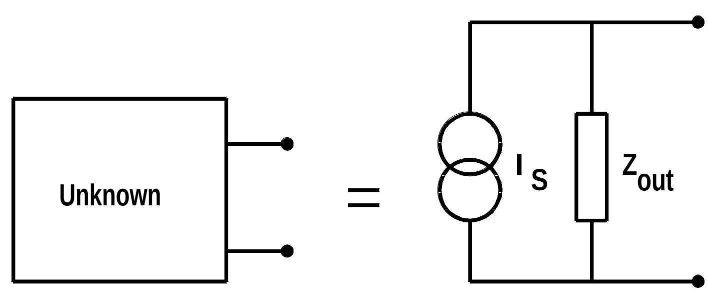
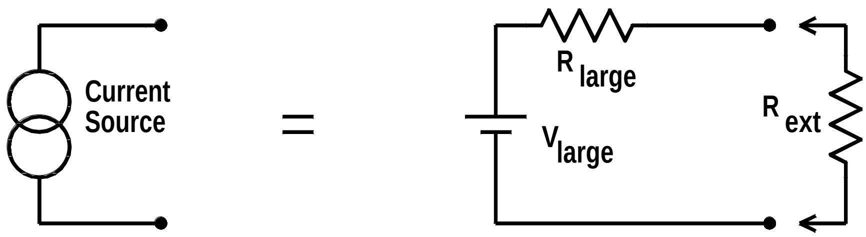
Any linear two terminal electronic system can be fully modelled by a current source, I_S, in parallel with a shunt impedance Z_{out}.

A current source drives a constant current through any circuit connected to it.
The circuit symbol used for a current source is two intersecting circles as shown in the diagram.



Norton's Theorem complements Thévenin's Theorem

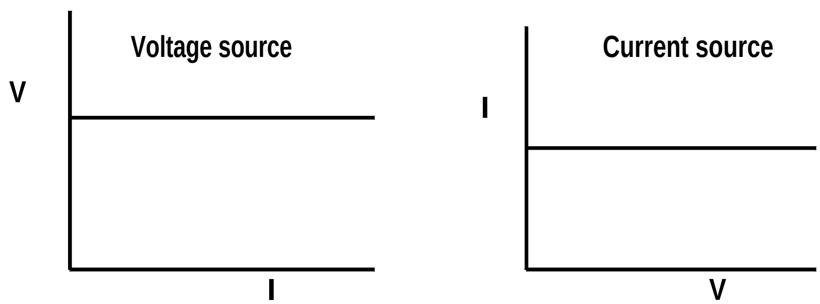
Visualise a current cource as a high voltage source in series with a large series resistor



For a wide range of externally connected resistors, the current will be essentially independent of the external resistance because if

$$R_{Large} \gg R_{ext}$$

$$\frac{V_{Large}}{R_{Large} + R_{ext}} \approx \frac{V_{Large}}{R_{Large}} = I_S$$

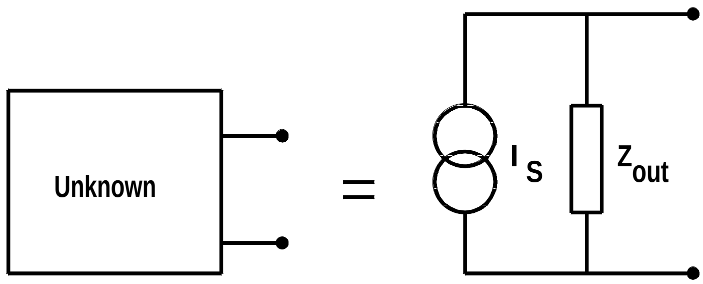


The characteristic curves for a voltage source and for a current source

In modelling circuit devices and systems, either the Thévenin or the Norton model can be used

Examples of devices and systems where the Thévenin approach is appropriate are:— batteries, diodes, DC constant voltage power supplies, audio and RF signal generators, lead acid battery chargers.

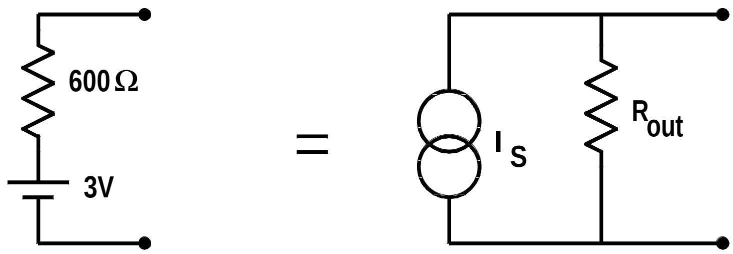
Examples of suitable applications of the Norton analysis approach are:— photo diodes in reverse bias, output characteristics of transistors and FETs in amplifiers, NiCd battery chargers, constant current supplies for fluorescent lamps and laboratory spectral lamps



In order to measure the Norton equivalent of any circuit, it is only necessary to measure the open circuit voltage and the short circuit current.

- The current source is then given by:—
  $I_S =$ Short circuit current.

- The output impedance is given by:—
  $Z_{out} = \frac{V_{\text{open circuit}}}{I_{\text{short circuit}}}$



Calculate the Norton equivalent circuit
Short circuit current.

$$I_S = I_{\text{short circuit}} = \frac{V_{\text{out}}}{R_{\text{out}}}$$

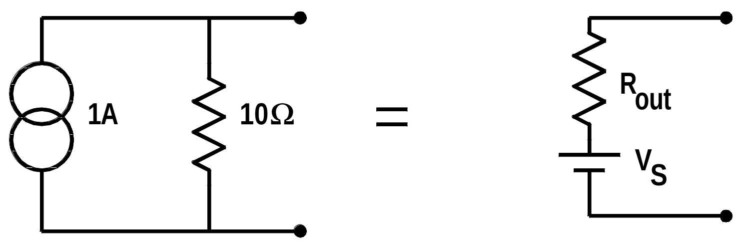
$$= \frac{3V}{600\Omega} = 5mA$$

Open circuit voltage.

$$V_{\text{out}} = V_{\text{open circuit}} = I_S \times R_{\text{out}}$$

$$\text{therefore} \quad 3V = 5mA \times R_{\text{out}}$$

$$R_{\text{out}} = \frac{3V}{5mA} = 600\Omega$$



Convert from Norton to Thévenin equivalent circuit:— Calculate the Thévenin equivalent of the Norton circuit

Open circuit voltage.

$$V_{\text{out}} = I_S \times R_S = 1A \times 10\Omega = 10V$$

Short circuit.

$$I_{\text{short circuit}} = \frac{V_S}{R_{\text{out}}} = 1A$$

$$\text{Therefore} \quad R_{\text{out}} = \frac{10V}{1A} = 10\Omega$$