Thevenin and Norton's Theorems

Aditya Arora
Winter 2018

April 12, 2018

STATEMENTS

A Statement of Thevenins Theorem

1. Given any linear circuit, rearrange it in the form of two networks, A and B, connected by two wires. Network A is the network to be simplified; B will be left untouched.

2. Disconnect network B. Define a voltage v_{oc} as the voltage now appearing across the terminals of network A.

3. Turn off or zero out every independent source in network A to form an inactive network. Leave dependent sources unchanged.

4. Connect an independent voltage source with value v_{oc} in series with the inactive network. Do not complete the circuit; leave the two terminals disconnected.

5. Connect network B to the terminals of the new network A. All currents and voltages in B will remain unchanged.

CASE 1: If the network has no dependent sources, we turn off all the independent sources.

CASE 2: If the network has dependent sources we turn off all independent sources. We can either then choose to apply a 1V source or a 1A source across the terminals and find R_{th} accordingly using the help of other circuit theorems

A Statement of Nortons Theorem

1. Given any linear circuit, rearrange it in the form of two networks, A and B, connected by two wires. Network A is the network to be simplified; B will be left untouched. As before, if either network contains a dependent source, its controlling variable must be in the same network.

2. Disconnect network B, and short the terminals of A. Define a current i_{sc} as the current now flowing through the shorted terminals of network A.

3. Turn off or zero out every independent source in network A to form an inactive network. Leave dependent sources unchanged.

4. Connect an independent current source with value i_{sc} in parallel with the inactive network. Do not complete the circuit; leave the two terminals disconnected.

5. Connect network B to the terminals of the new network A. All currents and voltages in B will remain unchanged.

We can find any two of the following three to determine the Norton equivalent of a circuit:

1. The open-circuit voltage v_{oc} across terminals a and b (no current flows out from this open circuit)

2. The short-circuit current i_{sc} at terminals a and b

3. The equivalent or input resistance at terminals a and b when all the independent sources are turned off

Using these we can find the Norton's equivalent since:

$$I_N = i_{sc}, V_{Th} = v_{oc}, R_{Th} = \frac{v_{oc}}{i_{sc}} = R_N$$