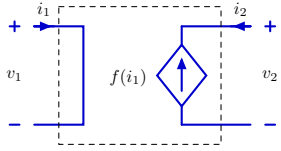
6.200 Circuits and Electronics

Week 5 Recitation:
Dependent Sources

No new hardware kit this week. No pre-lab either (but yes lab on Friday).
PCB people: boards are in! Take them today if you want, or we'll have them in lab.
Student in class needs copies of notes from a paid note-taker. `das-student@mit.edu`

Dependent Sources

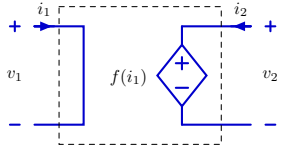
A *dependent source* produces a voltage or current whose value depends on another voltage or current elsewhere in a circuit.



CCCS

$v_1 = 0$

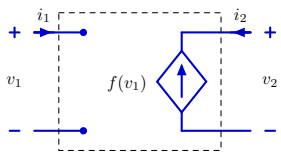
$i_2 = -f(i_1)$



CCVS

$v_1 = 0$

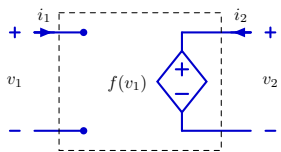
$v_2 = f(i_1)$



VCCS

$i_1 = 0$

$i_2 = -f(v_1)$



VCVS

$i_1 = 0$

$v_2 = f(v_1)$

Why Do We Care?

Everything we've talked about here so far is a way of *modeling* physical systems. Some kinds of devices can sometimes be modeled as dependent sources:

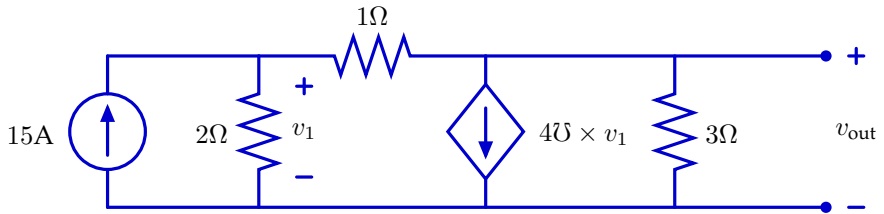
- A Bipolar Junction Transistor (BJT) can* be modeled as a CCCS.
- A MOSFET can* be modeled as a VCCS.
- An operational amplifier (op-amp) can* be modeled as a VCVS.

*under certain circumstances

We'll see some of these devices in the upcoming labs!

Solving With Dependent Sources

We need to be careful with superposition and Thévenin/Norton, but other solution/simplification methods still work fine. Let's solve this one with the node method:



Superposition

In a network consisting of only* constant resistors, ideal independent voltage and current sources, **and linear dependent sources**, the solution for *any* branch current or branch voltage will be a linear combination of the strengths of the independent sources.

A dependent source is **linear** if $f(x) = kx$ for some constant k.

Approach: solve for each *independent* source's contribution to the solution separately by zeroing out the other *independent* source values and solving.

DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!!
DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!!
DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!!

* we'll add more to this list later

Superposition

DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!

Superposition

DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!

Superposition

DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!!

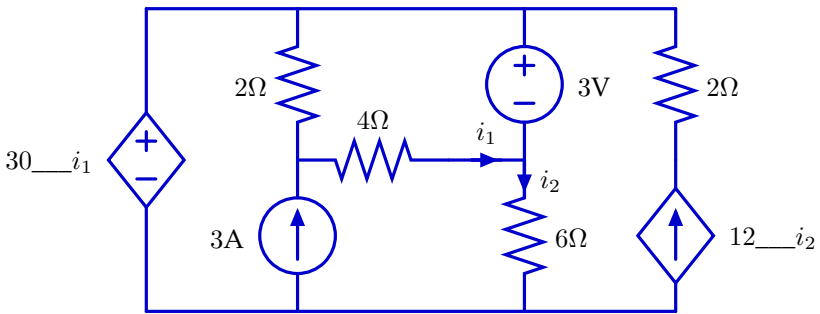
Superposition

DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!!

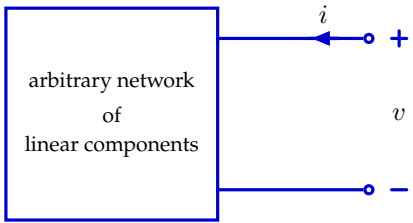
Superposition

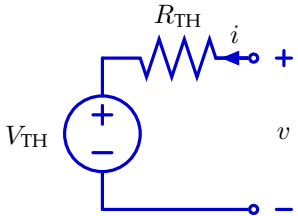
DON'T ZERO OUT THE DEPENDENT SOURCES!!!!!!!!!

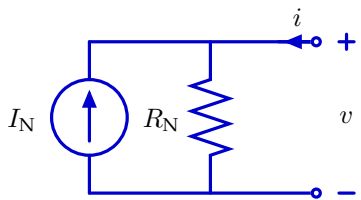
Superposition: Example



Thévenin/Norton







Equivalents: Example