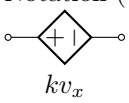
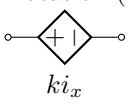
Lecture 4, Jan 24, 2022

Circuit Elements – Dependent Sources

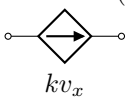
- Linear dependent sources:
  1. Voltage-dependent voltage source (controlled voltage source): voltage provided by the source is kv_x where v_x is the voltage somewhere in the circuit to which this source is connected
     - The voltage doesn't dependent on the current that passes through; it depends on the voltage somewhere else in the circuit completely
     - Notation (v_x marked in the circuit):

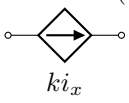
     - k is dimensionless (voltage to voltage)
  2. Current-dependent voltage source: voltage provided is ki_x, like the voltage-dependent voltage source but for current
     - Notation (i_x marked in the circuit):

     - k has dimensions of voltage over current, V/A
  3. Voltage-dependent current source: current output is kv_x
     - Notation (v_x marked in the circuit):

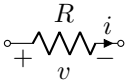
     - k has dimensions of current over voltage, A/V
  4. Current-dependent current source: current output is ki_x
     - Notation (i_x marked in the circuit):

     - k is dimensionless (current to current)
- Just like independent sources, perfectly linear dependent sources don't exist in the real world, but under certain conditions we can use them to model real things

Other Circuit Elements

- Resistors: ratio of voltage over current is always a constant, $\frac{v}{i} = R$
  - Notation:

  - The relation $\frac{v}{i} = R$ is only true when PSC holds (when it doesn't, we need a minus sign)
  - R has units of $\text{A/V} = \Omega$ (Ohm)
  - Alternatively, $G = \frac{1}{R}$ is the *conductance* (as opposed to R being the *resistance*), which has units of $\Omega^{-1} = \text{℧}$ (mho) or Siemens Si
  - Assuming R is positive, power going through will always be positive, i.e. the resistor always consumes power