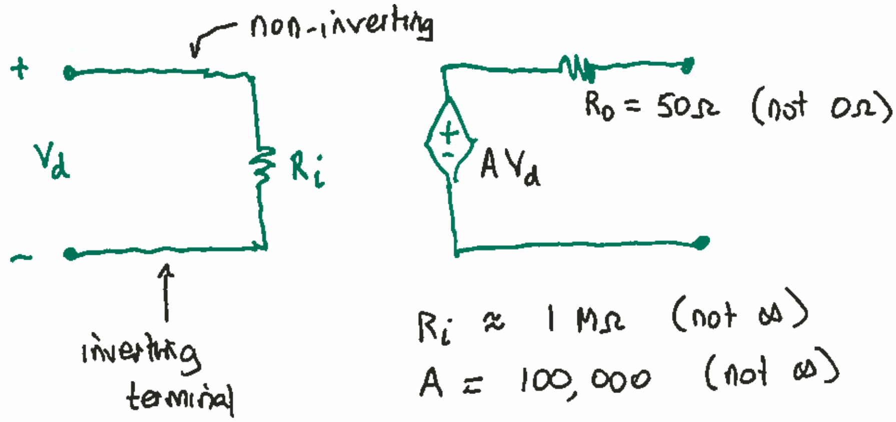
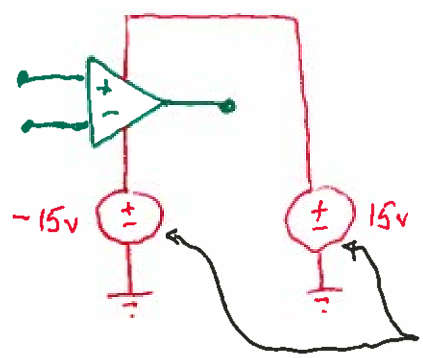
Monday, February 29, 2016



Since the op-amp is an electronic circuit, it requires an external power source to operate.



when we draw op-amp circuits, we seldom draw the external power sources - we always assume they're there!

Key properties — the summing-point constraints

1. The virtual short circuit

For any practical circuit, v_o must be finite-valued $|v_o| < \infty$.

For an ideal op-amp, $A = \infty$, and

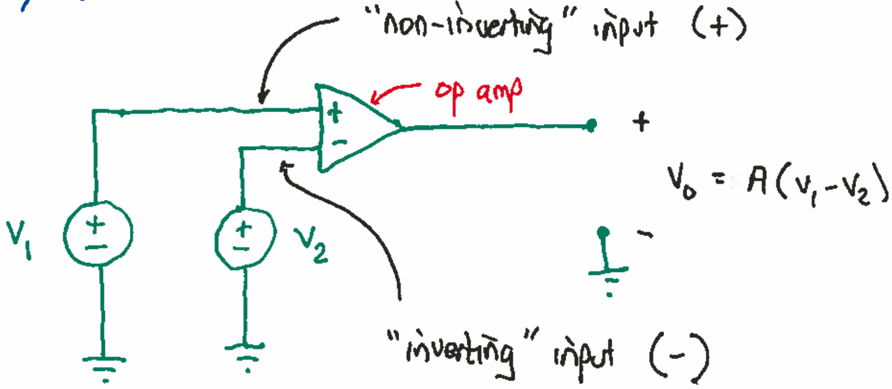
$$v_o = A\,v_d$$

So, $\frac{v_o}{A} = v_d \Rightarrow \frac{v_o}{\infty} = 0$ $\boxed{v_d = 0}$ NO VOLTAGE ACROSS INPUT TERMINALS.

2. The virtual open circuit

For an ideal op-amp, $R_i = \infty$, so

Circuit symbol:

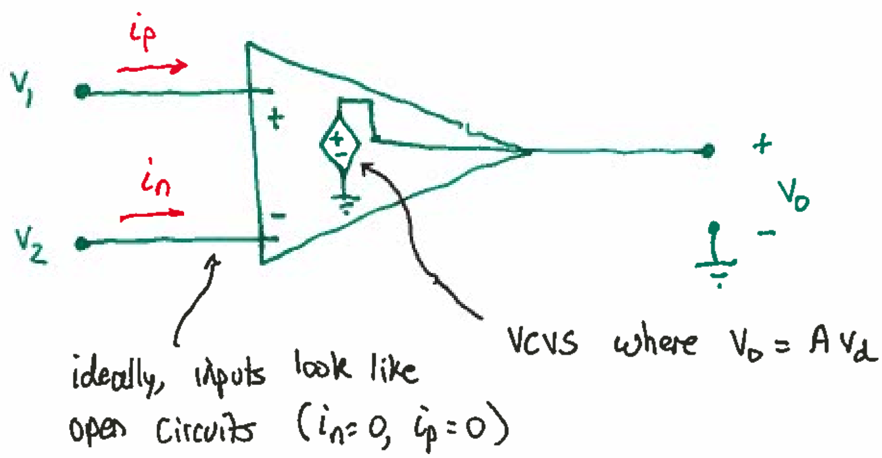


The op-amp amplifies the <u>differential</u> input voltage V_d, where

$$V_d = V_1 - V_2 \longrightarrow V_o = A V_d$$

big number!

The model of ideal op-amp:



The main characteristics of an ideal op-amp:

- infinite input resistance, so $i_n = i_p = 0$
- $A = \infty$ ("A" is called the "open-loop gain")
- zero output resistance (the effective resistance of a voltage source is 0Ω).

A real-world op-amp

$\boxed{i_n = i_p = 0}$ NO CURRENT FLOWS INTO INPUT TERMINALS.

In summary,

$$\boxed{\begin{matrix} V_d = 0 \\ i_n = i_p = 0 \end{matrix}}$$ SUMMING-POINT CONSTRAINTS.

Circuit analysis is then by all of your favorite methods while observing these constraints.

Op-amps not very useful by themselves; instead we use them in circuits designed to use these constraints.

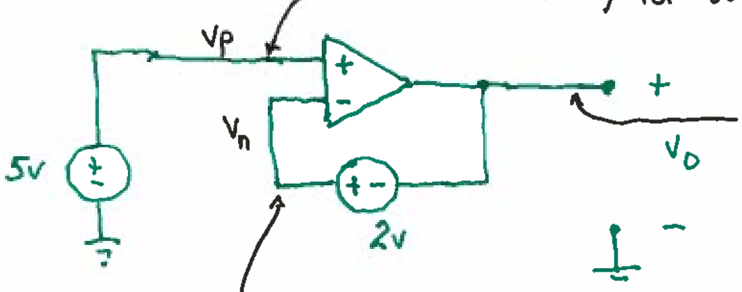
- always designed to operate with "negative feedback" (useless otherwise)
- In ENGG 225, we'll always assume this is so.

⟶ It is these summing-point constraints that give op-amp circuits a wide diversity of important applications.

<u>Applying the summing-point constraints</u>

<u>Example 1</u>: Find V_o in the following circuit

1. We can say for sure that $V_p = 5v$.



3. And $V_n - V_o = 2v$

so $V_o = V_n - 2$

$= 3v.$

2. Therefore, we know $V_p = V_n = 5v$ (virtual short circuit)