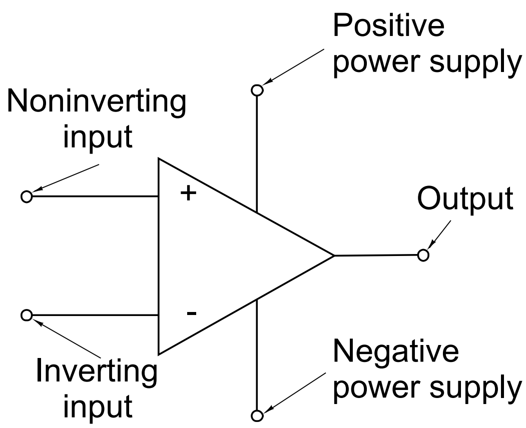
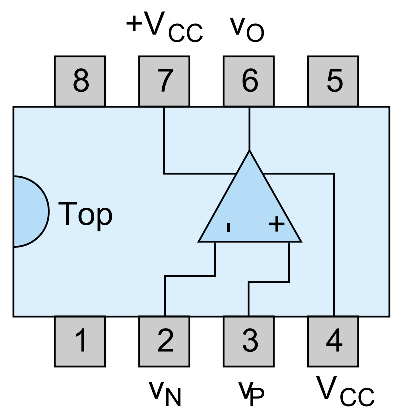
Homework set #5, due 4/30/08

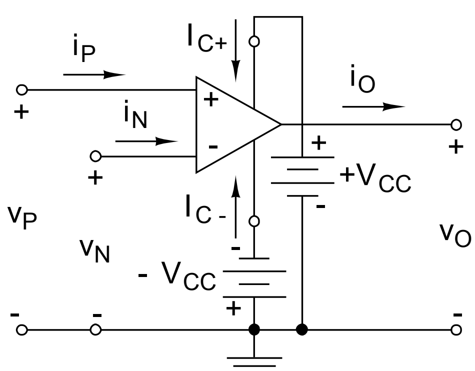
4-2, 4-7, 4-13, 4-14, 4-16, 4-17, 4-20, 4-21, 4-23, 4-26

Meet the Operational Amplifier, its friends call it "the Op Amp"

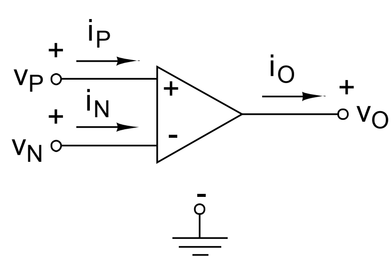




This is a real device that you can buy... made up of lots of transistors and stuff. We will be working with a few simple models of the Op Amp...

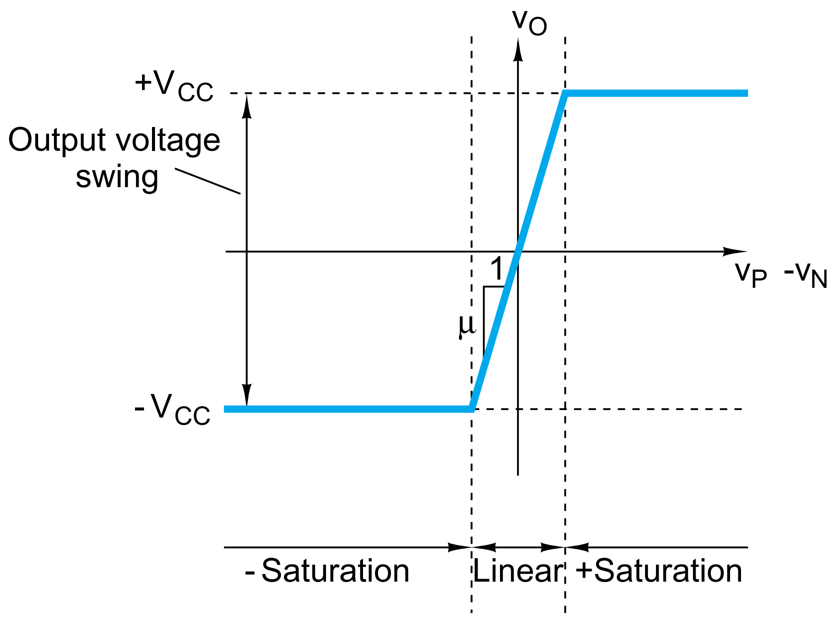


$i_O=I_{C+}+I_{C-}+i_P+i_N$



$i_O \neq i_P+i_N$

Transfer characteristic for an Op Amp



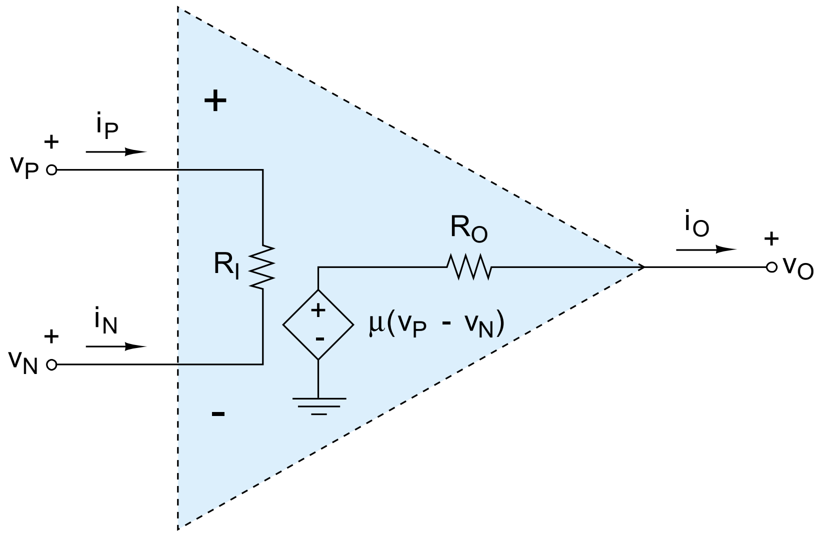
noninverting input	v_P
inverting input	v_N
output voltage	v_O
voltage gain	μ

$$v_O=\mu(v_P-v_N)$$

3 modes of operation:

- saturation
linear
+ saturation

Model of an Ideal Op Amp operating in the linear region



$R_1 \in [10^6, 10^{12}]\Omega$
$R_O \in [10, 100]\Omega$
$\mu \in [10^5, 10^8]$

$-V_{CC} < v_O < +V_{CC}$

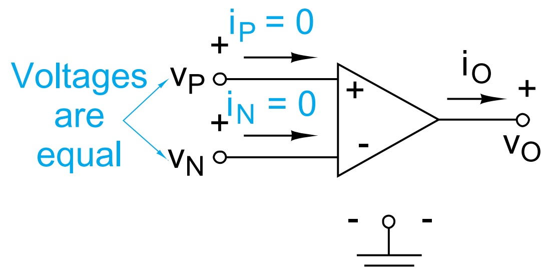
$-V_{CC}/\mu < (v_P - v_N) < +V_{CC}/\mu$

Since $V_{CC} \sim 15V$; $\mu >> 0$, $(v_P - v_N) \approx 0$

Next, we assume $\mu \to \infty$ and arrive at the "ideal model" of the Op Amp:

$v_P = v_N$
$i_P = i_N = 0$

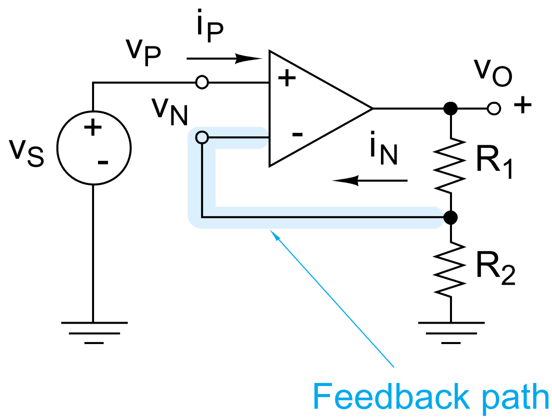
In other words (pictures?)

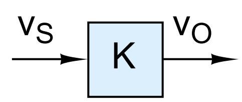


Now for the final piece of the puzzle: feedback.

Feedback ensures $(v_P - v_N) \approx 0$ and thus, keeps the Op Amp in the linear region.

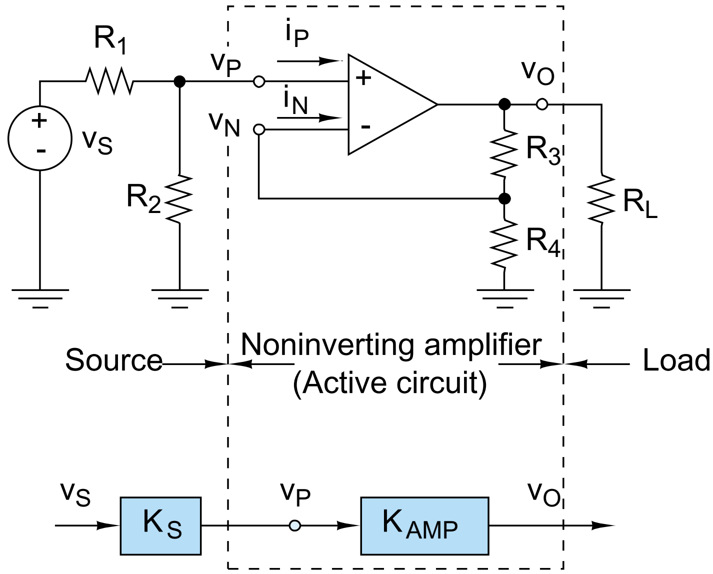
My friends call me an example- I'm a non-inverting Op Amp circuit



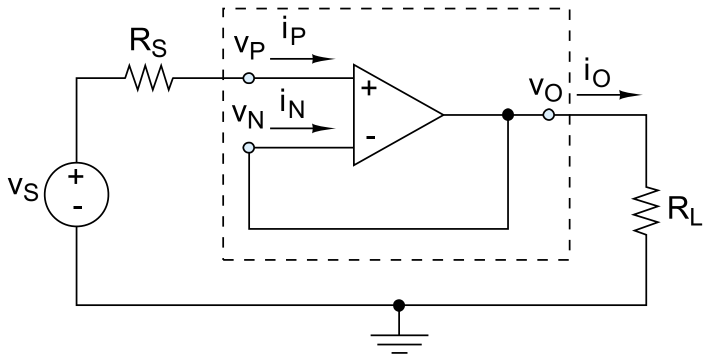


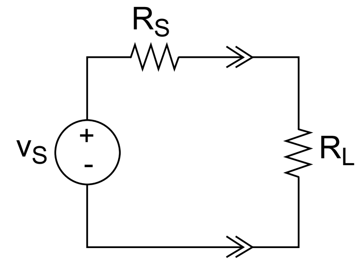
K= closed loop gain (of the circuit)

Placing the non-inverting Op Amp circuit into a larger circuit...



Now for a voltage follower





And an inverting amplifier