ECE3204 Lecture 11

Lab 2 Circuits Review
- Integrator (2.5)
- Push-pull
- Bypass capacitors

Finish
- Summation (2.4)
- Subtraction

Comparator (17.4)

Handout:
LM311 data sheet

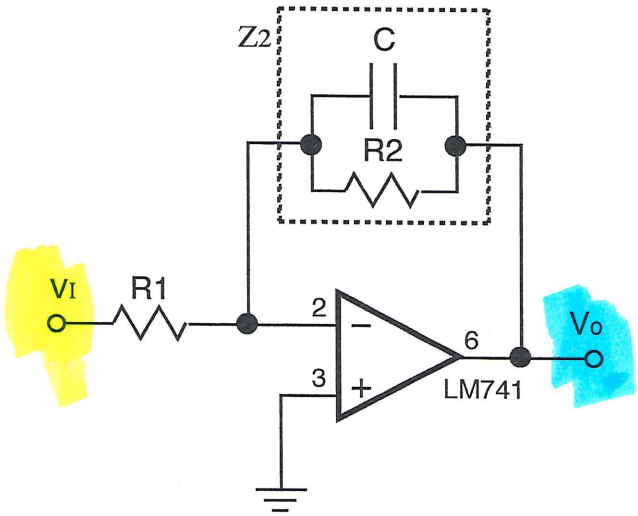


Figure 2.5

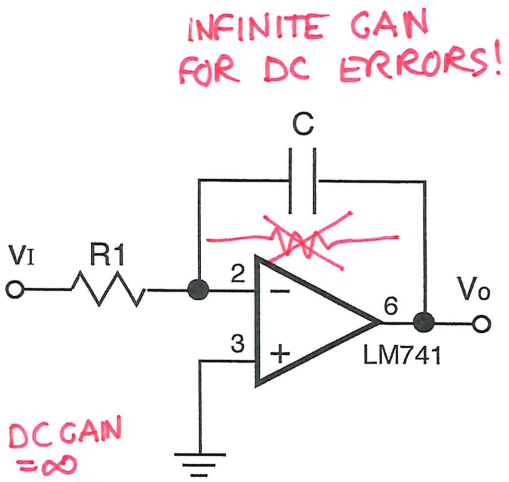
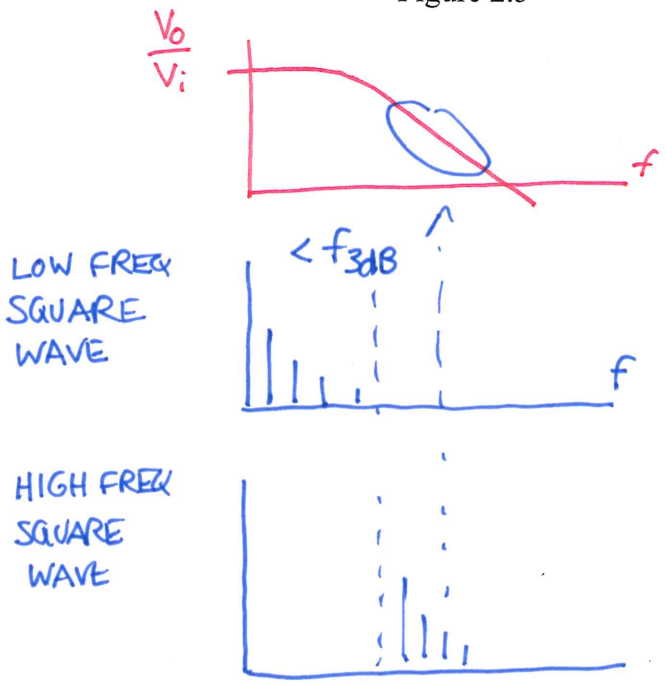
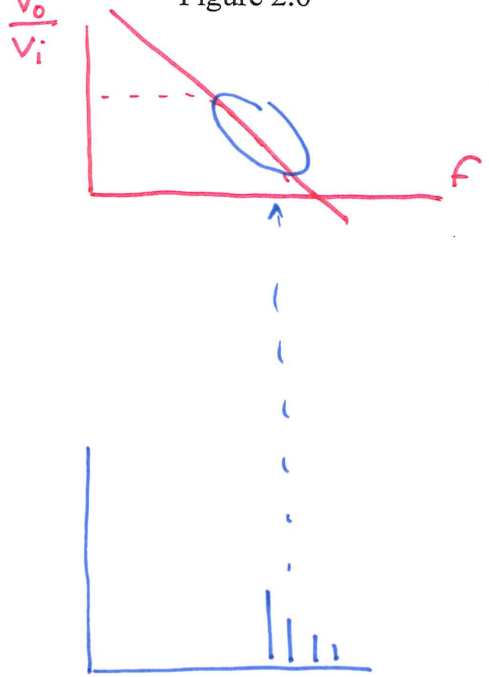


Figure 2.6





Push-Pull Amplifier

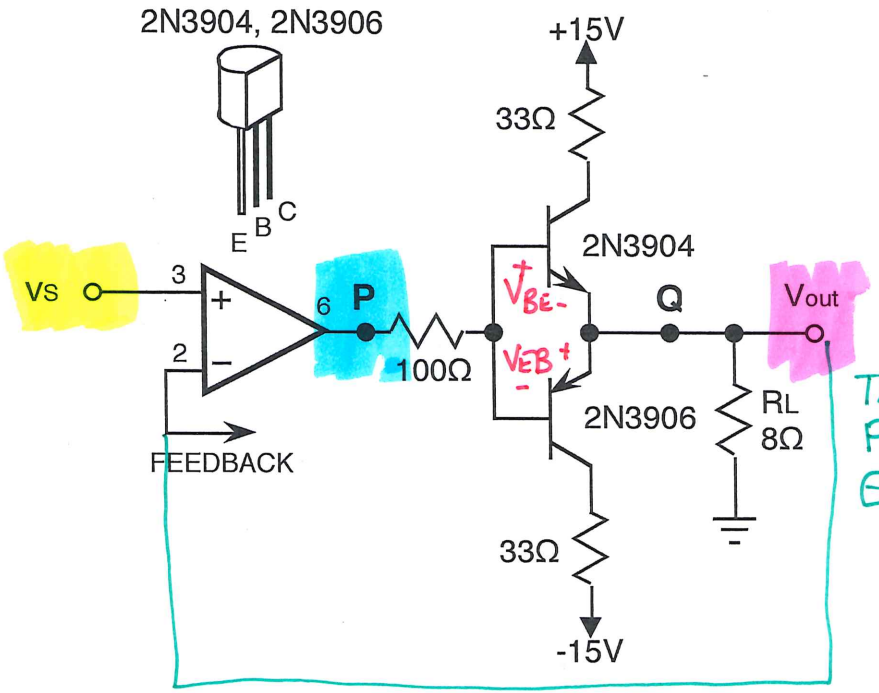
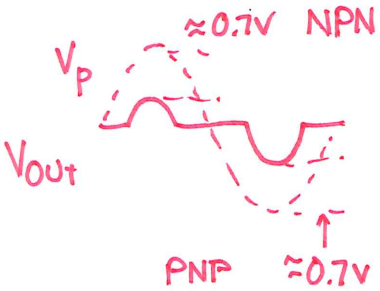
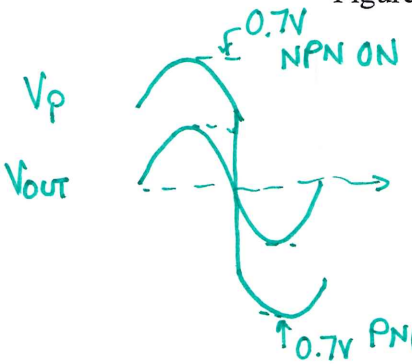


Figure 2.7

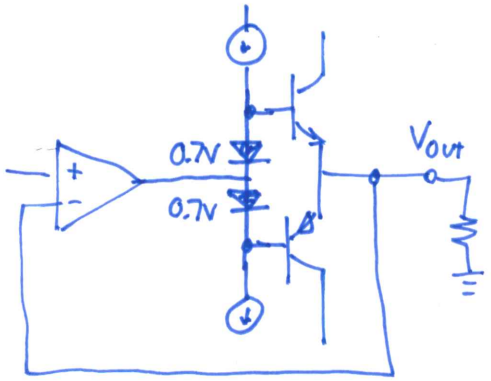
CROSSOVER DISTORTION





HOW DOES OP-AMP "KNOW" TO
0.7 HIGHER
0.7 LOWER
?

FIX (SMALLER) DISTORTION



TAKE FEEDBACK FROM POINT YOU WANT EQUAL TO INPUT

Bypass capacitors

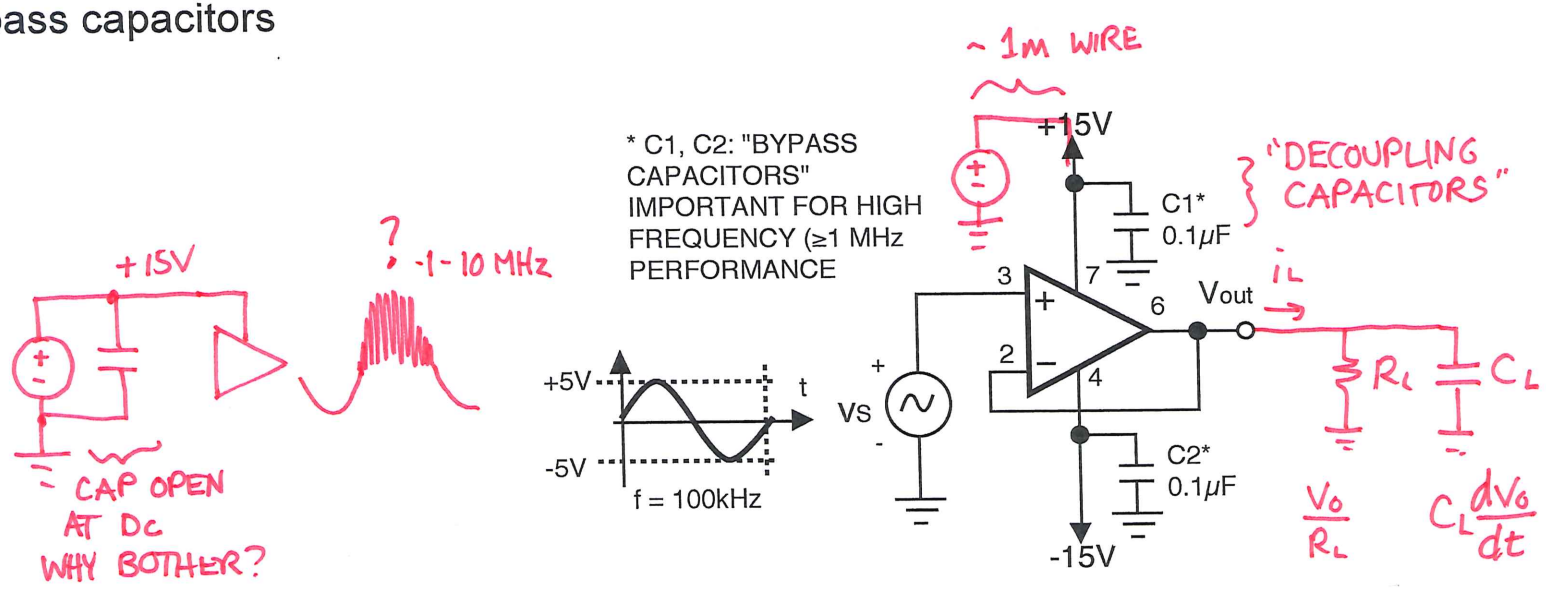
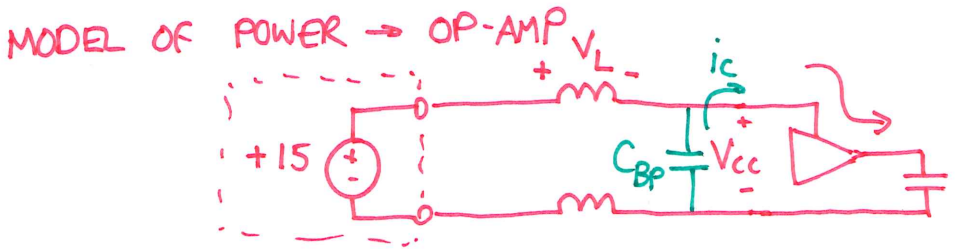
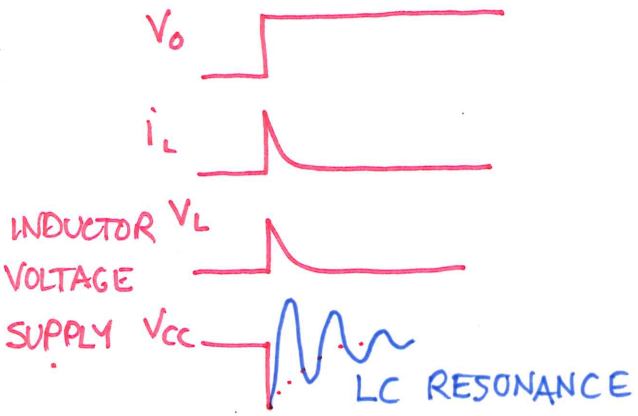


Figure 2.3

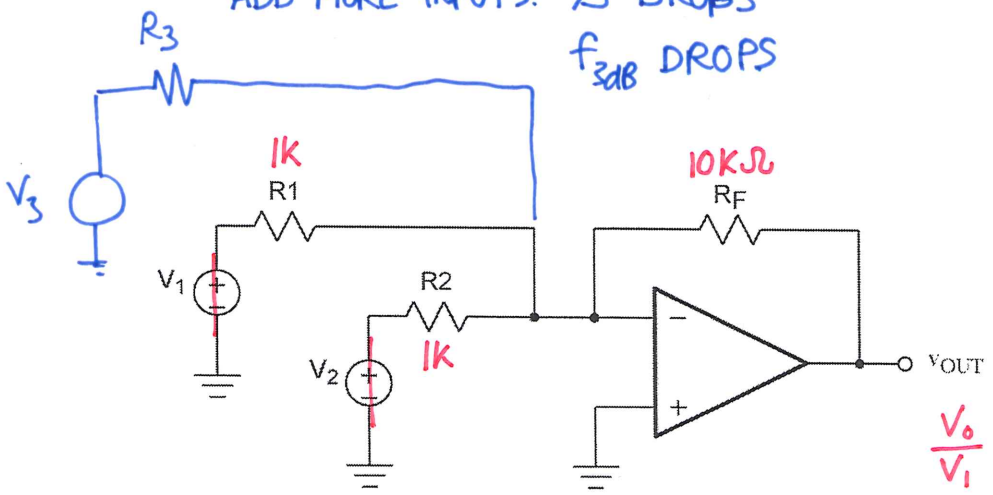




CBP LOCAL "RESERVOIR" OF CHARGE
CAN PROVIDE QUICK CURRENT

Summation

ADD MORE INPUTS: β DROPS
f_{3dB} DROPS



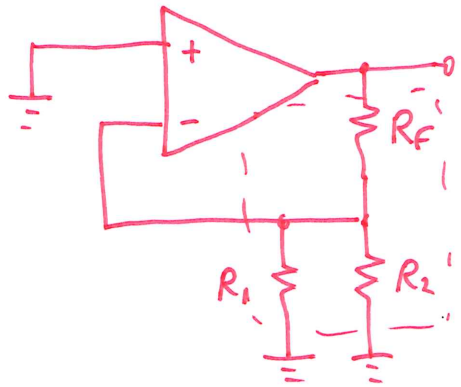
$f_{3dB} \geq 100kHz$?

$\frac{V_o}{V_1} = -10$ $\frac{V_o}{V_2} = -10$

GAIN - BANDWIDTH ?

V_1, V_2 OFF

REDRAW



CLOSED LOOP f_{3dB}

$\frac{1}{21}$ 1MHz ≈ 48 kHz

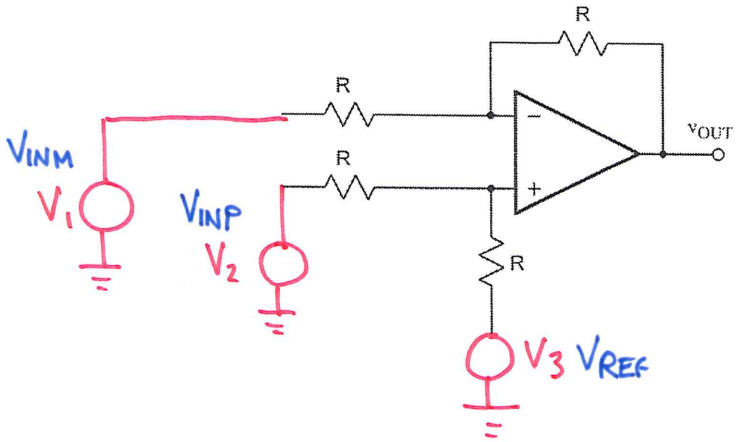
LM741

$$\beta = \frac{R_1 \| R_2}{R_1 \| R_2 + R_F} = \frac{500\Omega}{500 + 10K} = \frac{1}{21}$$

$$\beta \quad \frac{R_1 \| R_2 \| R_3}{R_1 \| R_2 \| R_3 + R_F}$$

(INSTRUMENTATION AMPLIFIER)

Subtraction



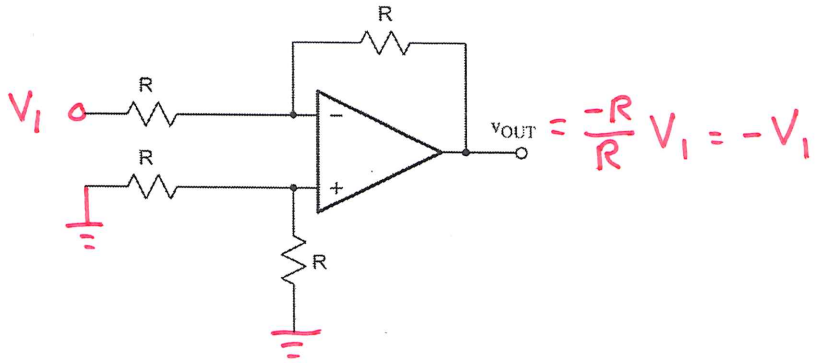
NEG FB: $V_- = V_+$

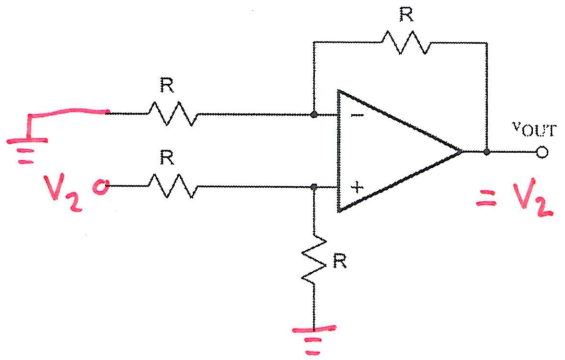
$$V_{OUT} = V_2 + V_3 - V_1$$

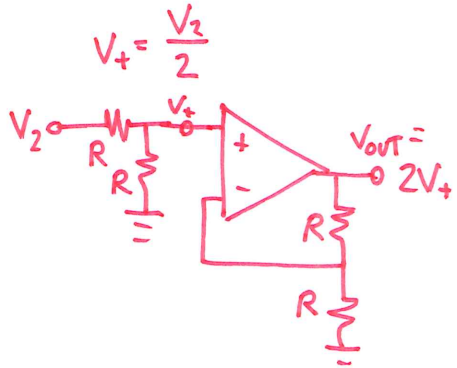
$$V_{OUT} = (V_{INP} - V_{INM}) + V_{REF}$$

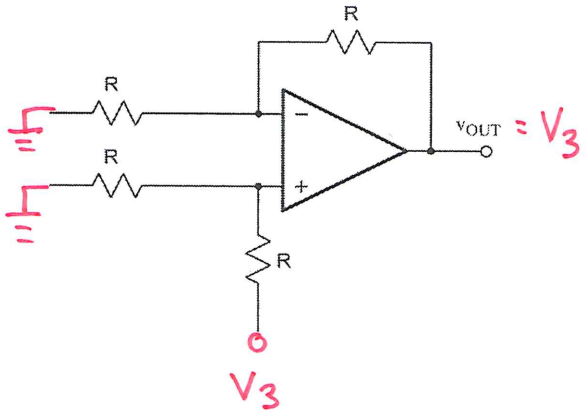
CAUTION: RESISTOR RATIOS!

SUPERPOSITION



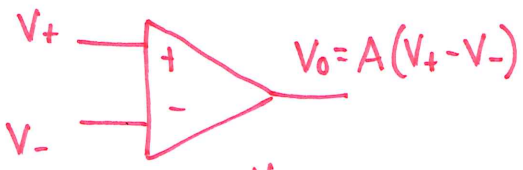


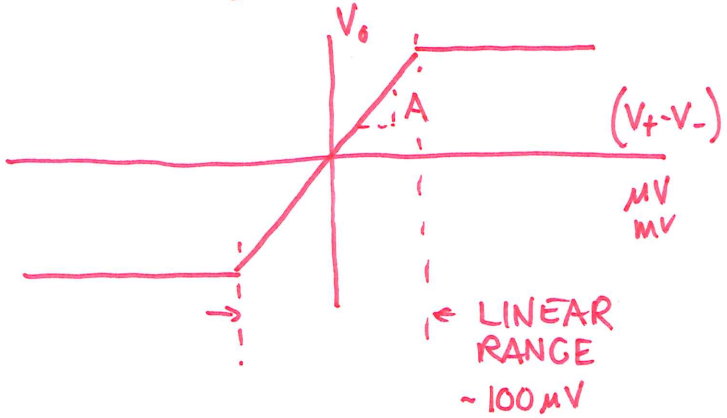


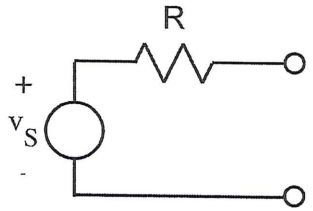


Application: Temperature Sensor for ON/OFF Heating Control

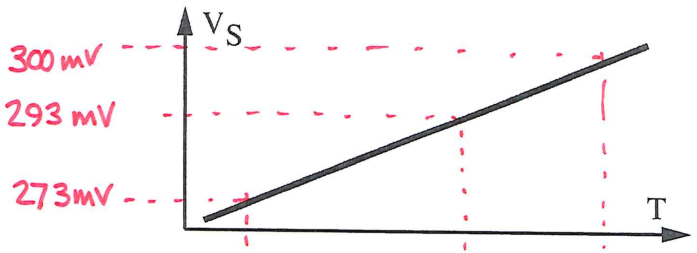
OP-AMP "RULE"







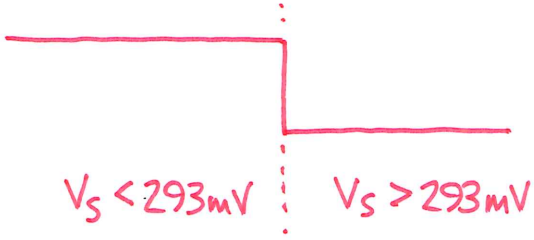
1mV / K



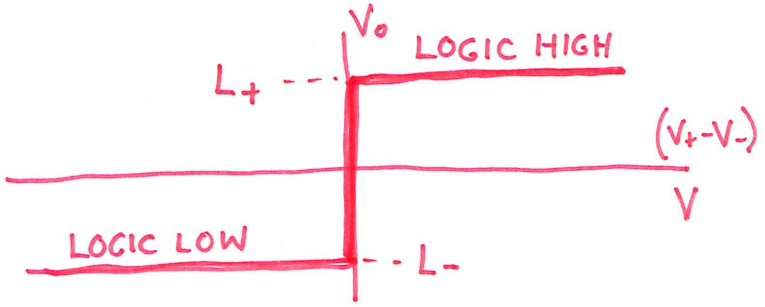
FURNACE CONTROL

1 ON

0 OFF



EXPAND HORIZONTAL AXIS



V- > V+ V+ > V-

USE OP-AMP OPEN LOOP TO COMPARE V-, V+

COMPARATOR

TRUTH TABLE

V+ > V- ?	Vo
YES	L+
NO	L-