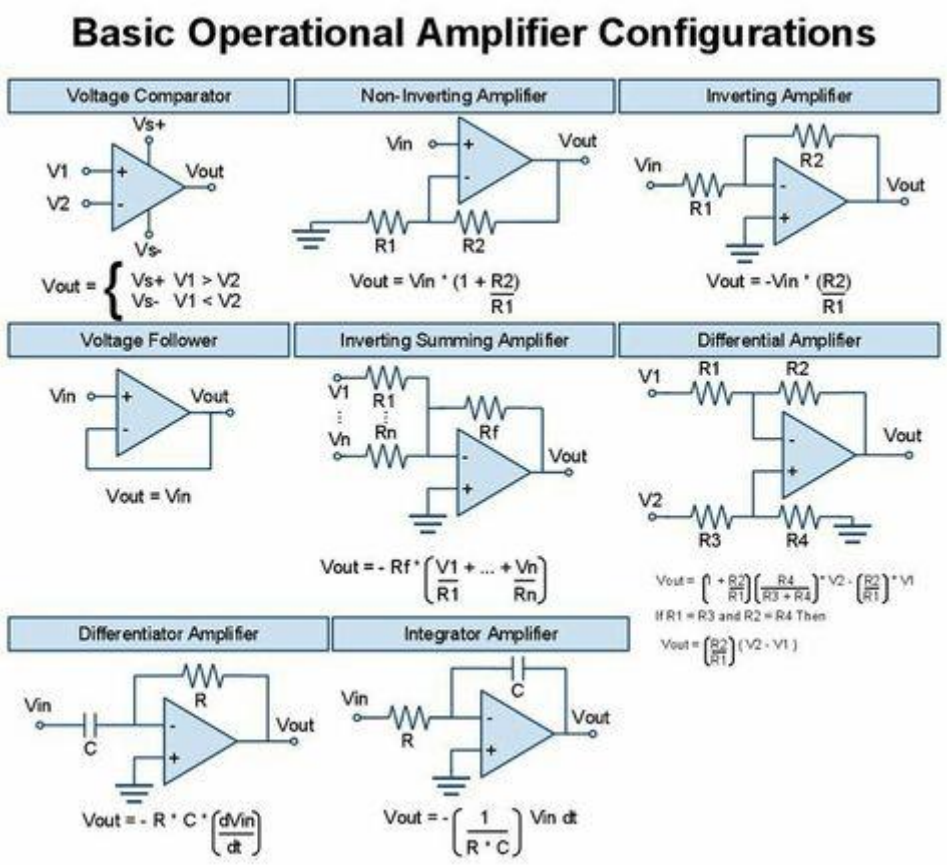
Hoja de Resumen de Op-Amps



COMMON EQNS:

$I = \frac{V}{R} = \frac{V}{I}$ $\quad I = \frac{P}{V} = \frac{P}{I}$

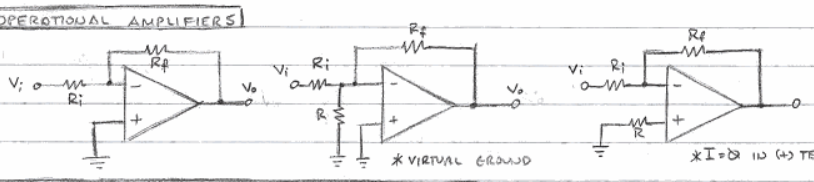
$V_o = V_i\left(\frac{R_2}{R_1+R_2}\right)$

$V_{rms} = \frac{1}{\sqrt{2}}V$

NASH ECE 3913 TEST 1 NOTE SHEET

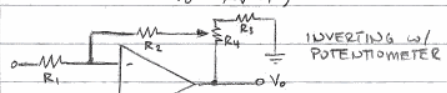
OPERATIONAL AMPLIFIERS

INVERTING



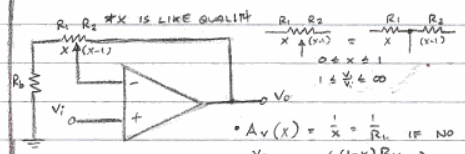
- $A_V = -\left(\frac{R_f}{R_i}\right)$
- $V_o = A_V V_i$

} NORMAL



$\frac{V_o}{V_i} = -\frac{R_2}{R_1} = -1\left(\frac{R_4}{R_3}+\frac{R_1}{R_2}+1\right)$

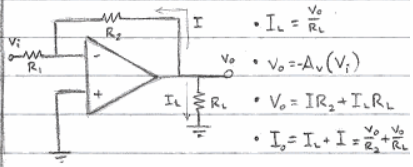
NON-INVERTING



- $\frac{V_o}{V_i} = A_V = -\frac{R_2}{R_1}$
- $V_o = V_i\left(1+\frac{R_2}{R_1}\right)$
- $A_V(x) = \frac{1}{x} = \frac{1}{R_L}$ IF NO R_b

R_M = max R from POT. $\quad \frac{V_o}{V_i} = 1+\frac{(1-x)R_M}{x(R_M)+R_b} = 1+\frac{R_2}{R_1+R_b} = A_V$

NOTABLE CONFIGURATIONS

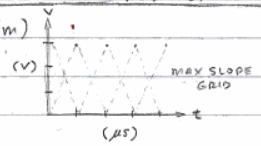


- $I_L = \frac{V_o}{R_L}$
- $V_o = -A_V(V_i)$
- $V_o = IR_2 + I_L R_L$
- $I_o = I_L + I = \frac{V_o}{R_2}+\frac{V_o}{R_L}$

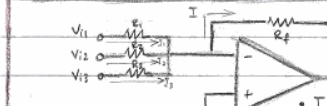
SLEW = $\frac{V}{t}$ = SLOPE (m)

$V(t) = mt$

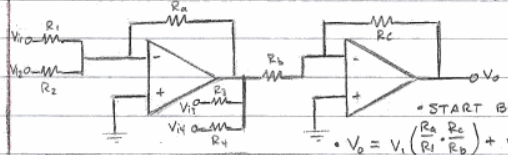
$t_{min} = \frac{V}{m}$



SUMMING AMPS



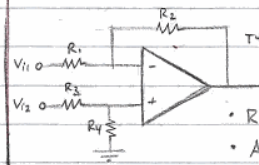
- $I = \Sigma I_n$
- $V_o = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right)$



- START BY CHOOSING $R_4 \sim 10k\Omega$
- $V_o = V_1\left(\frac{R_a}{R_1}\cdot\frac{R_c}{R_b}\right) + V_2\left(\frac{R_a}{R_2}\cdot\frac{R_c}{R_b}\right) - V_3\left(\frac{R_c}{R_3}\right) - V_4\left(\frac{R_c}{R_4}\right)$

- IDEAL AMPS HAVE HIGH R_i/LOW R_o
- CLOSED-LOOP AMPS: $A_V \sim 1$
- DIFF. AMP IDEAL TO ELIM. "HUM"
- RMS ONLY FOR POWER CALCULATIONS

DIFFERENCE AMP



TYPICAL TO ASSUME $R_1 = R_3$ AND $R_2 = R_4$

SO $\frac{R_2}{R_1} = \frac{R_4}{R_3}$

- $R_{id} = 2R_1$ * R_{id} = DIFFERENTIAL INPUT R
- $A_d = \frac{R_2}{R_1} = \frac{R_4}{R_3}$ * A_d = DIFFERENTIAL GAIN, A_{cm} = COMMON MODE GAIN

CMRR = $\frac{A_d}{A_{cm}}$

- $V_o = A_d(V_i^+ - V_i^-)$ *(IDEAL, $R_1 = R_3$ & $R_2 = R_4$)

CMRR = $20\log\left(\frac{A_d}{A_{cm}}\right)$

- $V_o = A_d(V_i^+ - V_i^-) + \frac{1}{2}A_{cm}(V_i^+ - V_i^-)$
- $V_o = \left(\frac{R_2+R_1}{R_4+R_3}\right)\left(\frac{R_4}{R_1}\right)V_{i2} - \left(\frac{R_2}{R_1}\right)V_{i1}$ (NON-IDEAL)

USING SUPERPOS: 1. SET V_{i1} TO G, CALC V_{i2} → $V_{o1} = -\left(\frac{R_2}{R_1}\right)V_{i1}$

2. SET V_{i2} TO G, CALC V_{i1} → $V_{o2} = V_{i2}\left(\frac{R_2}{R_1}\right)$

3. CALC. V_{id} → $V_o = \frac{R_2}{R_1}(V_{i2}-V_{i1}) = \frac{R_2}{R_1}V_{id}$

4. CALC DIFF. GAIN → $A_d = \frac{2R_2}{R_3} = \frac{2R_4}{R_3}$

M. Nash
2010

CMRR = COMMON MODE REJECTION RATIO; MEASURES ABILITY OF AMP TO ACCURATELY CANCEL VOLTAGES