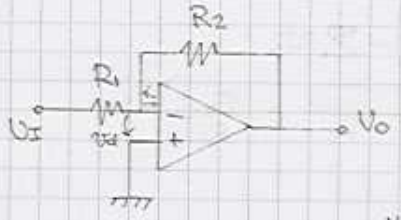
AMPLIFICATORI OPERAZIONALI

INVERTENTE



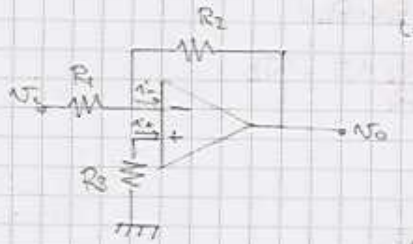
CONDIZIONE $V_{OMIN}\frac{R_1}{R_1+R_2} \le V_{IN} \le V_{OMAX}\frac{R_1}{R_1+R_2}$ (RAD)

CASO IDEALE: $V_O = -\frac{R_2}{R_1}V_I = i_- R_2$ $\rightarrow A(s) = -\frac{R_2(s)}{R_1(s)}$

CASO REALE: $V_O = -\frac{R_2}{R_1}\frac{1}{1+\frac{1}{A_T}\left(1+\frac{R_2}{R_1}\right)}V_I$

ALTRIMENTI SATURAZIONE

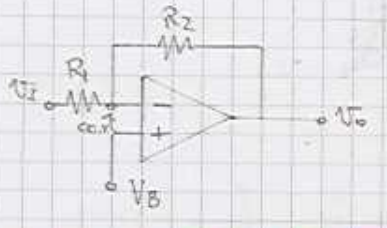
$V_{IMAX} = -L_- \frac{R_1}{R_2}$; $V_{IMIN} = -L_+\frac{R_1}{R_2}$



$V_O = -\frac{R_2}{R_1}V_I$ (è come se $R_3 = 0$)

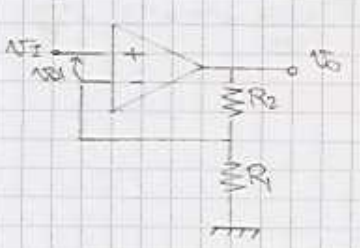
$V_O = i_- R_2 - i_+ R_3 \frac{R_1+R_2}{R_1}$;

$i_- \approx i_+ \Rightarrow V_O \approx 0 \Leftrightarrow R_3 = \frac{R_1 R_2}{R_1+R_2} = R_1 \| R_2$; $V_O = i_+\left(R_2 R_3 \frac{R_1+R_2}{R_1}\right)$



$V_O = -\frac{R_2}{R_1}V_I + V_B\frac{R_1+R_2}{R_1}$

NON INVERTENTE



CASO IDEALE: $V_O = \frac{R_1+R_2}{R_1}V_I$ $A_N = \frac{R_1+R_2}{R_1}$

CASO REALE: $V_O = \frac{A_N}{1+A_T\left(\frac{R_1}{R_1+R_2}\right)}V_I$

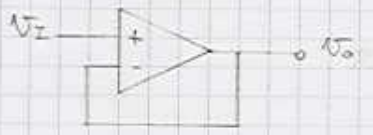
CONVERTITORE CORRENTE – TENSIONE

CASO IDEALE: $i_- = 0$; $V_O = -i_I R_2$

CASO REALE: $i_- \neq 0$; $V_O = -R_2(i_I - i_-)$

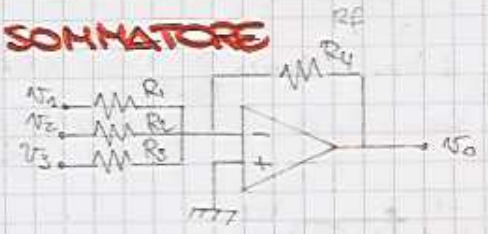
$i_I = -\frac{V_O}{R_2} + i_-$

FOLLOWER



$V_O = V_I$

SOMMATORE

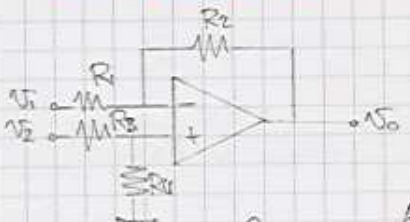


$$v_0 = \left(\frac{v_1}{R_1} + \frac{v_2}{R_2} + \frac{v_3}{R_3}\right)(-R_4)$$

se $R_1 = R_2 = R_3 = R_4$ $\quad v_0 = -\sum v_i$

se $v_1 = 0 \Rightarrow R_1 = 0$ $\quad -\sum \frac{v_{in}}{R_i} = \frac{v_{out}}{R_f}$

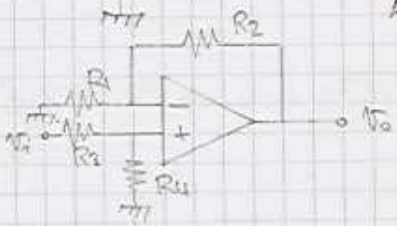
SOTRAENTE (AMPLIFICATORE DIFFERENZIALE)



$$v_0 = -\frac{R_2}{R_1} v_1 + \left(\frac{R_1+R_2}{R_1} \cdot \frac{R_4}{R_3+R_4}\right) v_2$$

se $\frac{R_1}{R_2} = \frac{R_3}{R_4} \rightarrow v_0 = -\frac{R_2}{R_1}(v_1 + v_2)$

$$A_D = \frac{R_4}{R_3}\left(1 + \frac{2R_2}{R_1}\right)$$



$$v_0 = v_1 \left(\frac{R_4}{R_3+R_4}\right)\left(\frac{R_1+R_2}{R_1}\right) = v_1 \frac{1+\frac{R_2}{R_1}}{1+\frac{R_3}{R_4}}$$

INTEGRATORE INVERTENTE

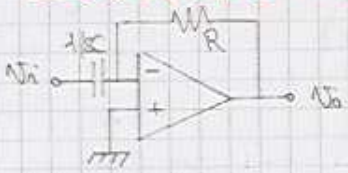
$$v_0 = -\frac{1}{sCR} v_I$$

$$v_0(t) = -\frac{1}{CR}\int_0^t v_i(t)\,dt + v_0$$

SAT

$$-C\frac{dv_0}{dt} = i_C = i_R = \frac{v_I}{R}$$

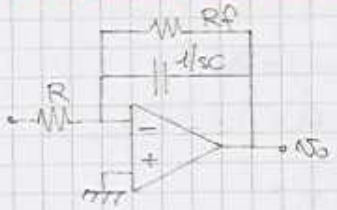
DERIVATORE INVERTENTE



$$v_0 = -sCR\,v_i$$

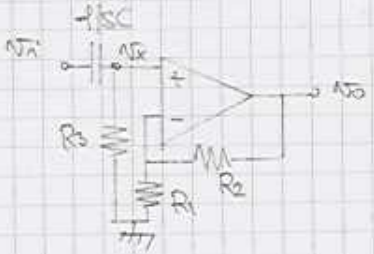
$$v_0(t) = -\frac{dv_i}{dt} RC$$

INTEGRATORE DI MILLER



$$v_0 = -\frac{R_f}{R} \cdot \frac{1}{1+sR_fC} v_i$$

$$A_{DC} = -\frac{R_f}{R} \qquad \omega_{-3dB} = \frac{1}{R_fC}$$



$$v_0 = \frac{R_1+R_2}{R_1} v_x = \frac{R_1+R_2}{R_1} \frac{sCR_3}{1+sCR_3} v_i$$

$$v_x = \frac{sCR_3}{1+sCR_3} v_i$$