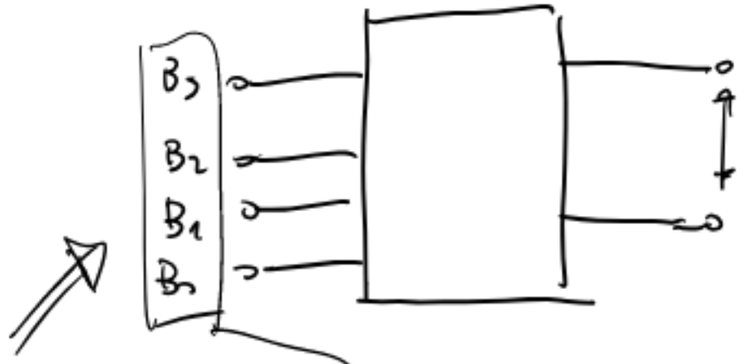
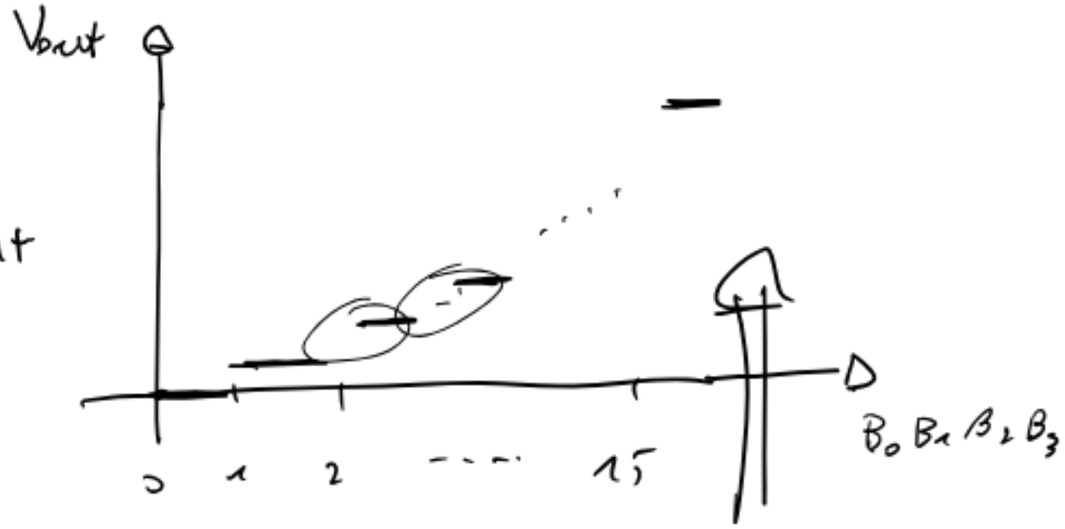
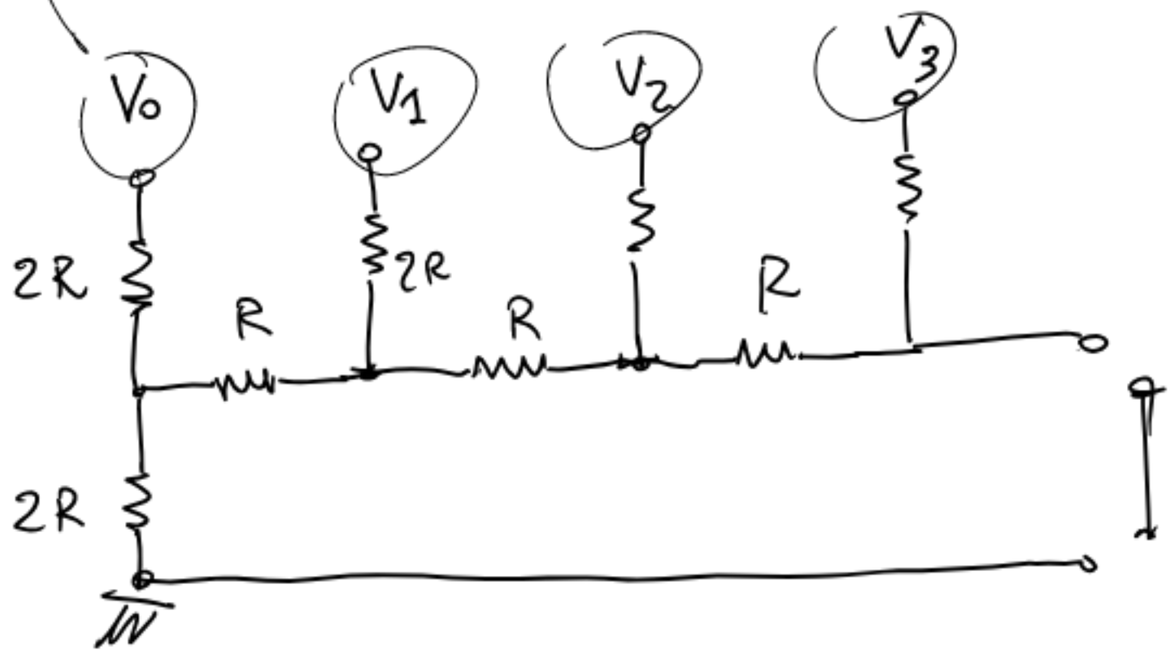
DAC : DIGITAL TO ANALOG CONVERTER





16 mesi bin. 0 ÷ 15



$V_{out} = f(V_0, V_1, V_2, V_3)$

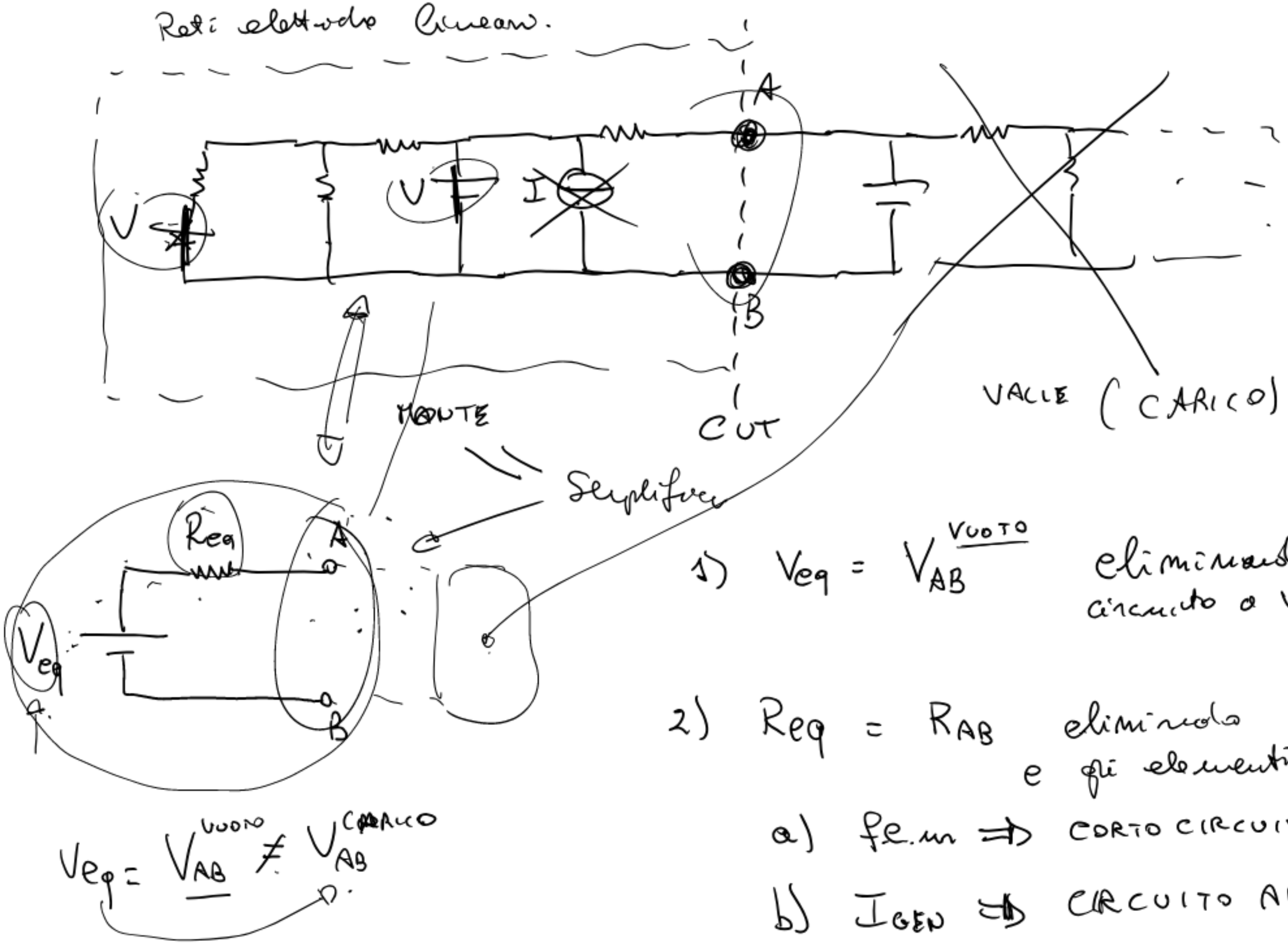
V_i < 0 → 0V
1 → 5, 10 V
HIGH

P. K.

⇒ { TEOREMA THEVENIN
PRINCIPIO DI SOVRAPPOSIZIONE

②

TEOREMA DI THÉVENIN



$V_{eq} = V_{AB}^{VUOTO} \neq V_{AB}^{CARICO}$

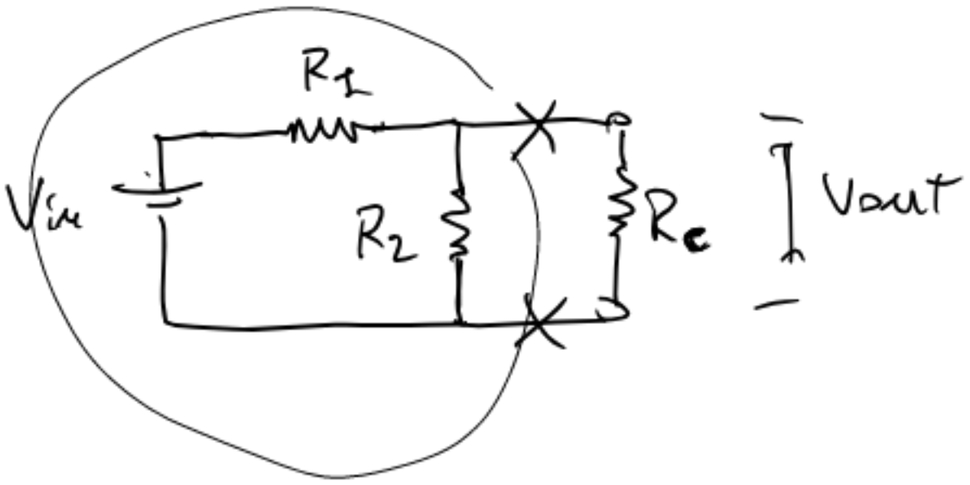
1) $V_{eq} = V_{AB}^{VUOTO}$ eliminando il circuito a VALLE

2) $R_{eq} = R_{AB}$ eliminando VALLE e gli elementi attivi:

a) f.e.m $\Rightarrow$ CORTO CIRCUITI

b) $I_{GEN} \Rightarrow$ CIRCUITO APERTO.

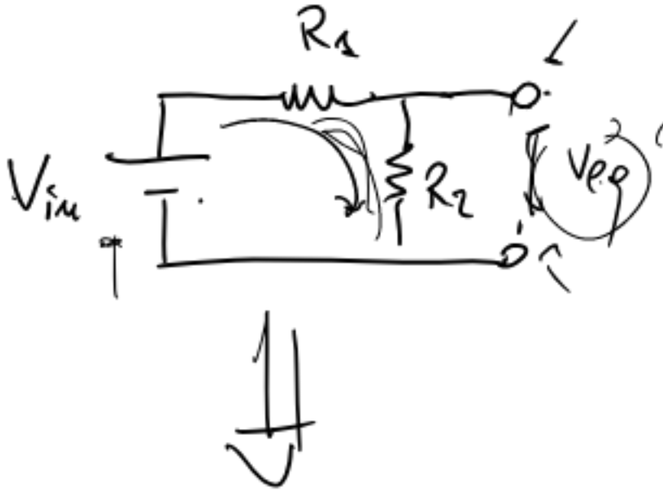
ES. THEVENIN / PARTITORE CARICO



$$V_{out} = V_1 \cdot \frac{R_{2c}''}{R_1 + R_{2c}''}$$ P. fc

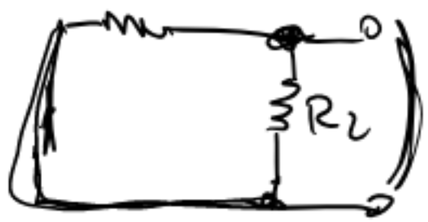
$V_{eq} = R_2 \cdot I$

$I = \frac{V_{in}}{R_1 + R_2}$

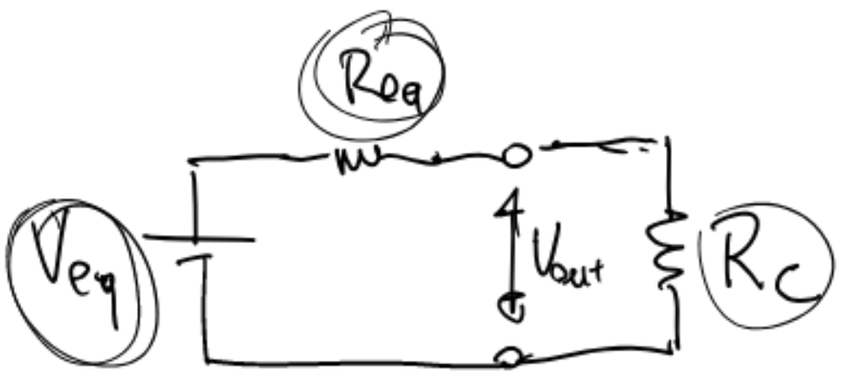


1) $V_{eq} = V_1 \frac{R_2}{R_1 + R_2}$

2)



$R_{eq} = R_{12}'' = \frac{R_1 \cdot R_2}{R_1 + R_2}$



$$V_{out} = V_{eq} \cdot \frac{R_c}{R_{eq} + R_c}$$

$$V_{out} = \frac{\text{PRINCIPIO SOVRAPPOSIZIONE}}{\frac{R_{eq}}{R_{eq}+R_C}} \cdot \frac{R_C}{\frac{R_1 R_2}{R_1+R_2} + R_C}$$

$$= V_1 \frac{R_2 \cdot R_C}{R_1 \cdot R_2 + R_1 R_C + R_2 R_C} = V_1 \frac{\frac{R_2 R_C}{R_2 + R_C}}{R_1 \left(R_2 + R_C\right) + R_2 \cdot R_C}$$

$$\boxed{V_{out} = V_1 \frac{R_{2C}}{R_1 + R_{2C}}}$$

PRINCIPIO DI SOVRAPPOSIZIONE

$\sum$ CAUSE $\Rightarrow$ $\sum$ EFFETTI

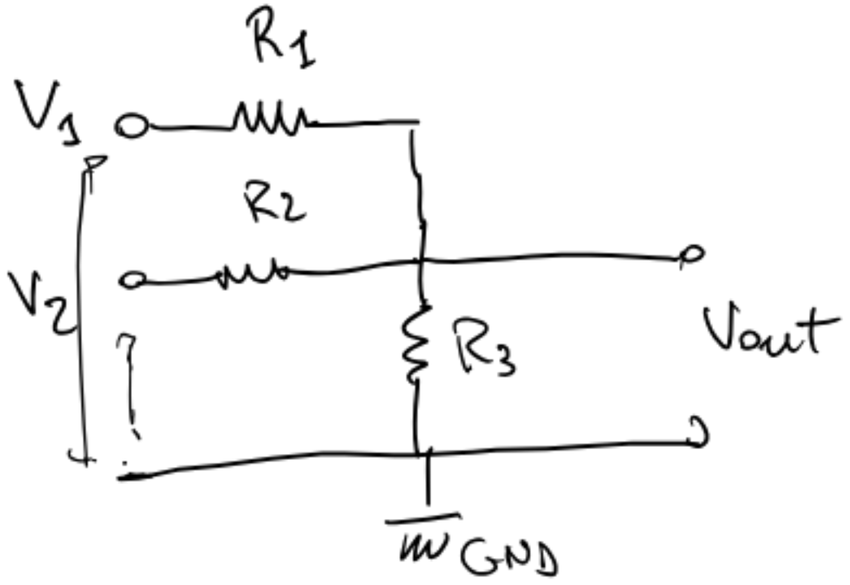
elementi attivi: V_{IN} I_{IN}

CAUSA 1 $\rightarrow E_1$
CAUSA 2 $\rightarrow E_2$
$\Big\}$ $E_1 \vee E_2$

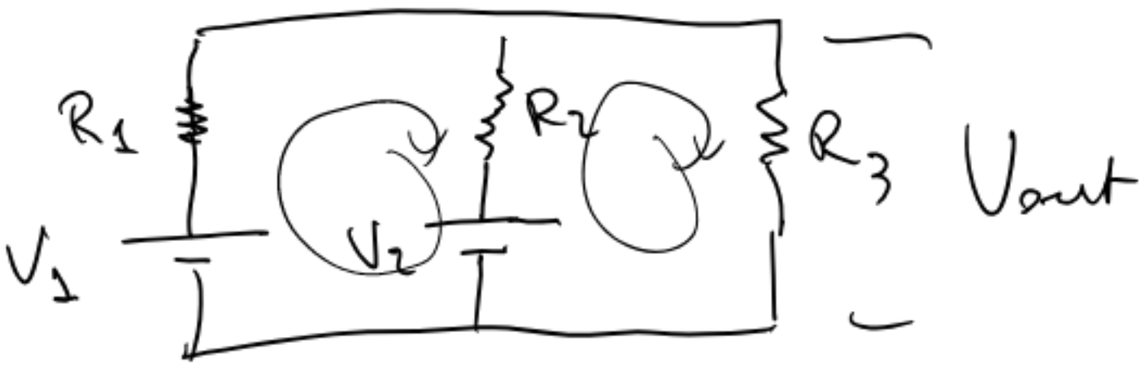
$V_{GEN} \Rightarrow$ CORTOCIRCUITO

$I_{GEN} \Rightarrow$ CIRCUITO APERTO

MIXER



$V_{out} = f(V_1, V_2, R_{1,2,3})$



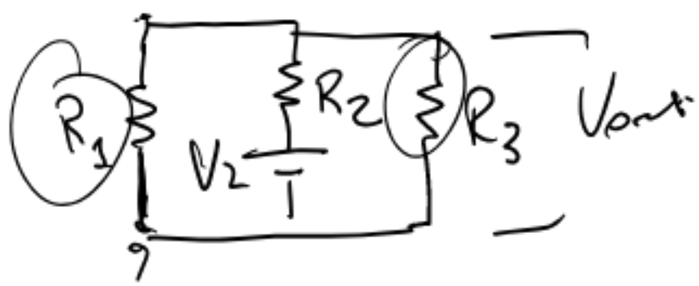
SOVRAPP. V_1 / V_2.

$$V_{out}^{(1)} = V_1 \cdot \frac{R_{23}''}{R_1 + R_{23}''}$$

V_1)

$$+$$

V_2)



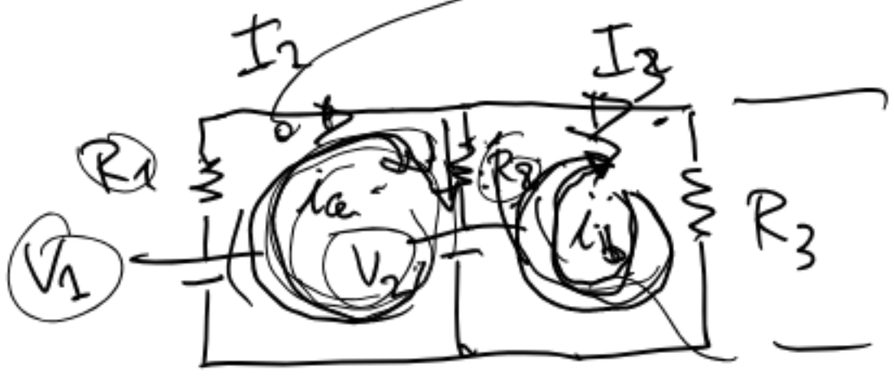
$$V_{out}^{(2)} = V_2 \cdot \frac{R_{13}''}{R_2 + R_{13}''}$$

$$V_{out} = V_1 \frac{\overline{R_{23}}}{R_1 + \overline{R_{23}}} + V_2 \frac{\overline{R_{13}}}{R_2 + \overline{R_{13}}} =$$

$$\overline{R_{13}} = \frac{R_1 \cdot R_3}{R_1 + R_3}$$

$$= V_1 \frac{R_2 \cdot R_3}{(R_2+R_3) R_1 + (R_2+R_3) \frac{R_2 R_3}{R_2+R_3}} + V_2 \frac{R_1 R_3}{R_1R_2 + R_2R_3 + R_1R_3}$$

$$= V_1 \frac{R_2R_3}{R_1R_2 + R_1R_3 + R_2R_3} + V_2 \frac{R_1R_3}{R_1R_2 + R_1R_3 + R_2R_3}$$



$$\begin{cases} V_1 - V_2 = (R_1+R_2)\, i_a - R_2\, i_b \\ V_2 = (R_2+R_3)\, i_b - R_2\, i_a \end{cases}$$

$i_a = I_1$

$i_b = I_3$

$I_2 = i_b - i_a$

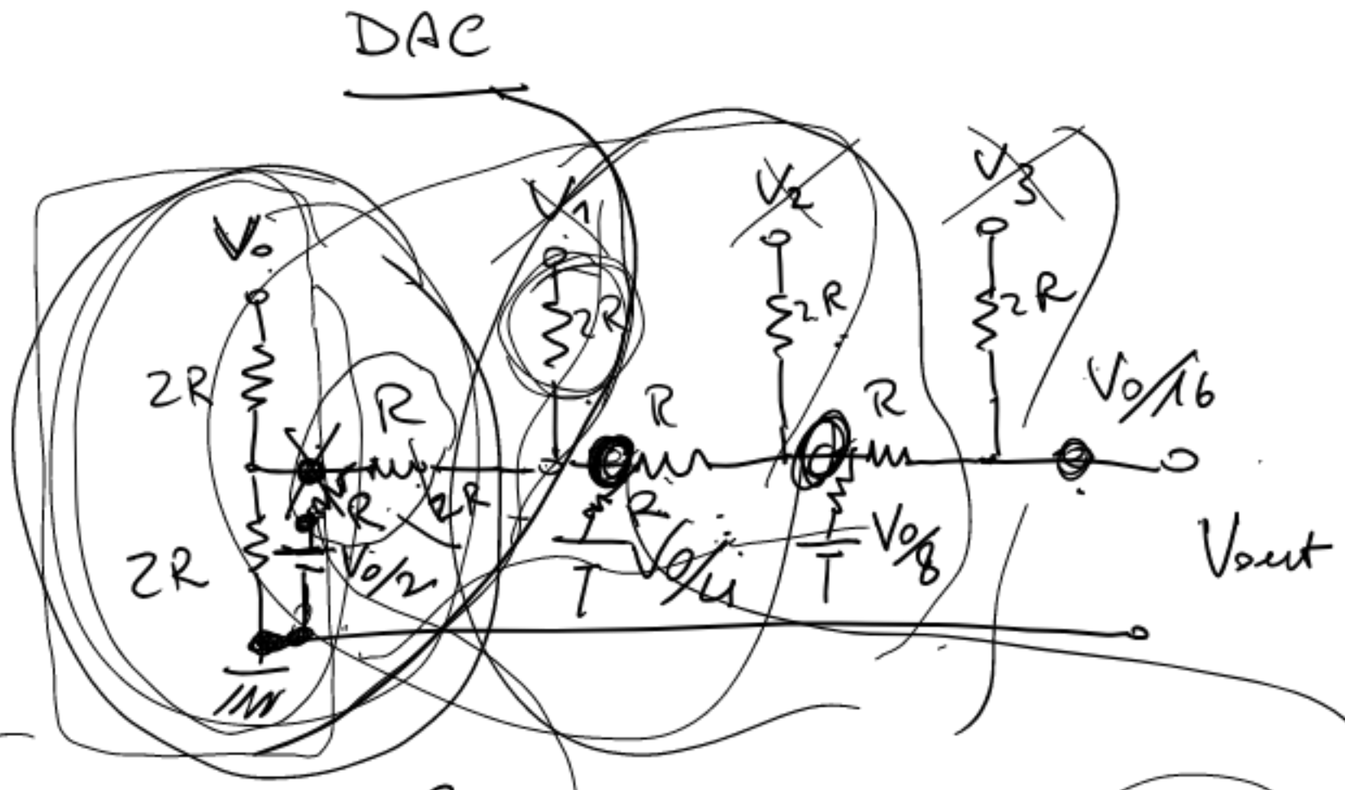
$V_{out} = i_b \cdot R_3$

$$\begin{cases} (R_1+R_2)\, i_a - R_2\, i_b = V_1 - V_2 \\ -R_2\, i_a + (R_2+R_3)\, i_b = V_2 \end{cases}$$

$$i_b = \frac{\begin{vmatrix} R_1+R_2 & V_1-V_2 \\ -R_2 & V_2 \end{vmatrix}}{\begin{vmatrix} R_1+R_2 & -R_2 \\ -R_2 & R_2+R_3 \end{vmatrix}} = \frac{V_2(R_1+R_2) + R_2(V_1-V_2)}{(R_1+R_2)(R_2+R_3) - R_2^2} =$$

$$i_b = \frac{V_2 R_1 + \cancel{V_2 R_2} + V_1 R_2 - \cancel{V_2 R_2}}{R_1 R_2 + R_1 R_3 + \cancel{R_2^2} + R_2 R_3 - \cancel{R_2^2}}$$

$$V_{out} = R_3 i_b = \frac{V_1 R_2 R_3 + V_2 R_1 R_3}{R_1 R_2 + R_1 R_3 + R_2 R_3}$$



$$V_{out} = f(V_0, V_1, V_2, V_3)$$

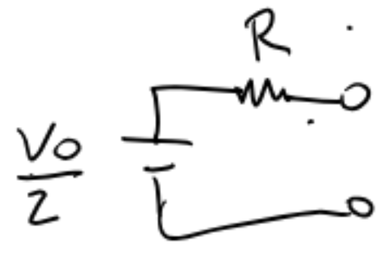
$$\boxed{V_{out}^{(0)} = \frac{V_0}{16}}$$

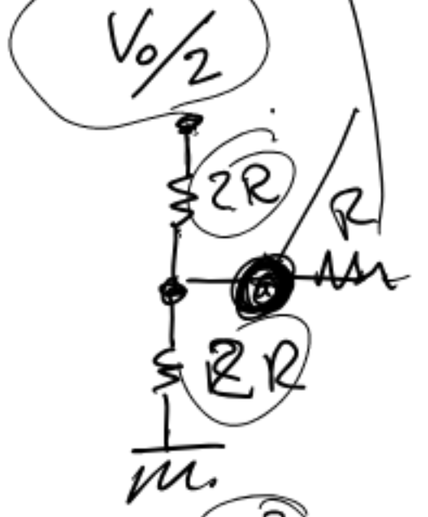
Para, somente V_0

THEVENIN

$$V_{eq} = V_0 \frac{2R}{4R} = \frac{V_0}{2}$$

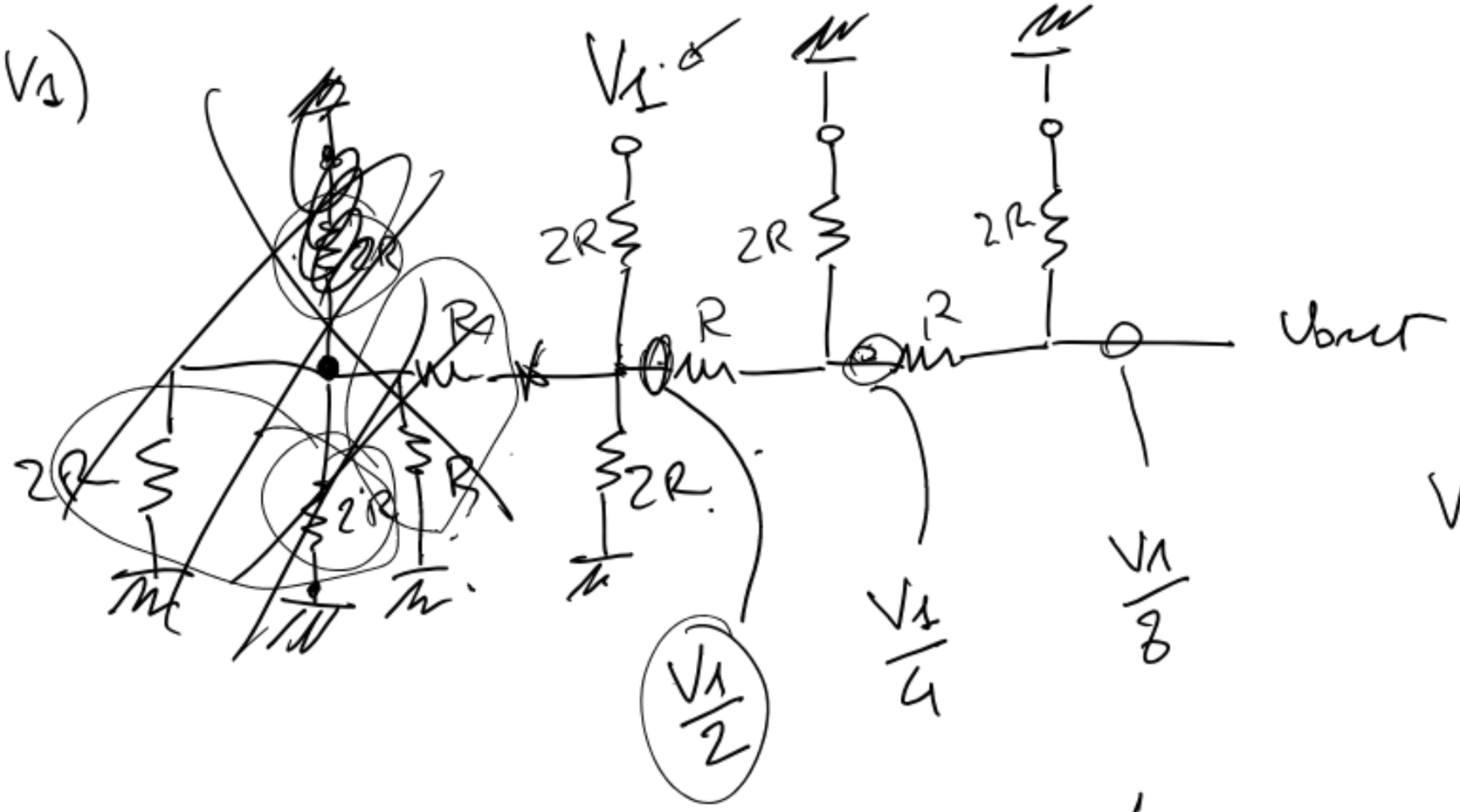
$$R_{eq} = \frac{2R \cdot 2R}{2R+2R} = \frac{4R^2}{4R} = R$$





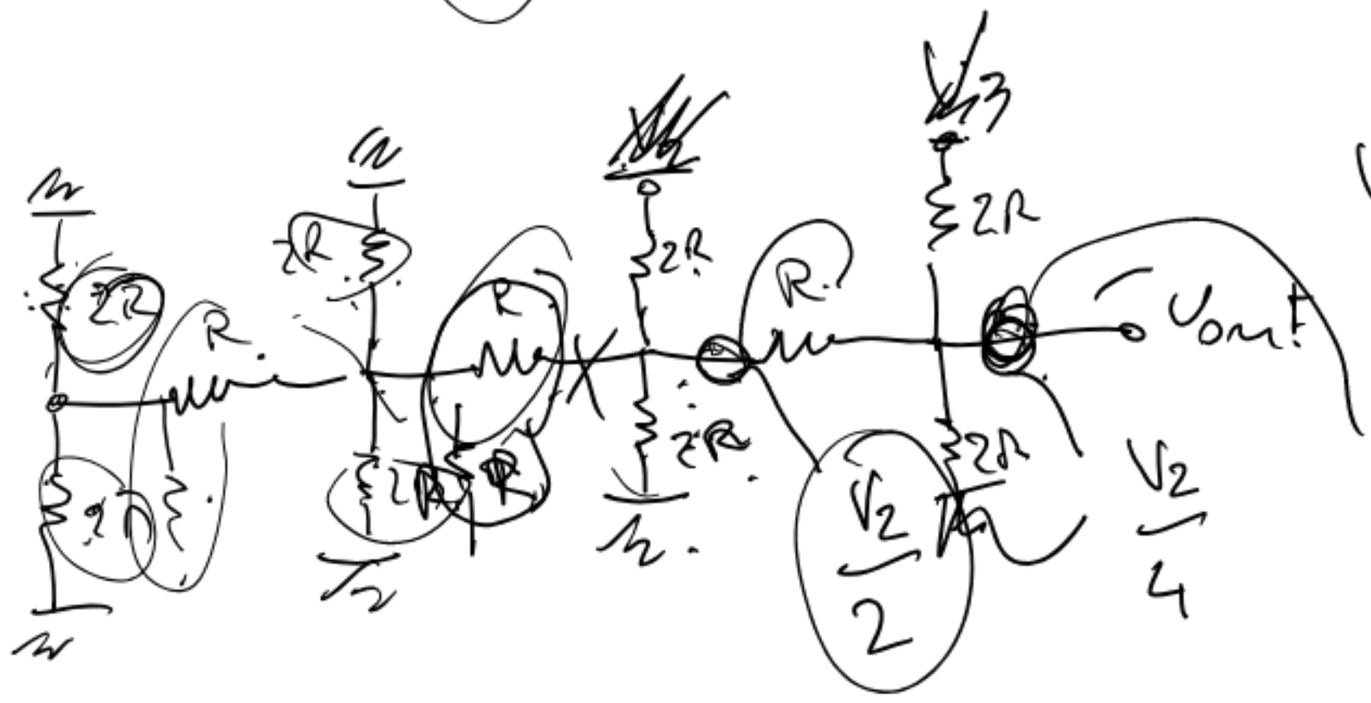
$$\frac{V_0}{2} \cdot \frac{2R}{2R+2R} = \frac{V_0}{4}$$

V1)



(1) $V_{out} = \frac{V_1}{8}$

V2)



(2) $V_{out} = \frac{V_2}{4}$

$\frac{V_3}{2} \Rightarrow$ (3) $V_{out} = \frac{V_3}{2}$

$$V_{out} = \frac{V_0}{16} + \frac{V_1}{8} + \frac{V_2}{4} + \frac{V_1}{2}$$

$V_i = \begin{cases} 1 \\ 0 \end{cases}$

$V_o = 16\,V$

$V_i = 1$

$V_{out} = \frac{16}{16} + \frac{16}{8} + \frac{16}{4} + \frac{16}{2} = 1 + 2 + 4 + 8 = 15 \quad 1111$

$= 14 \quad 1110$

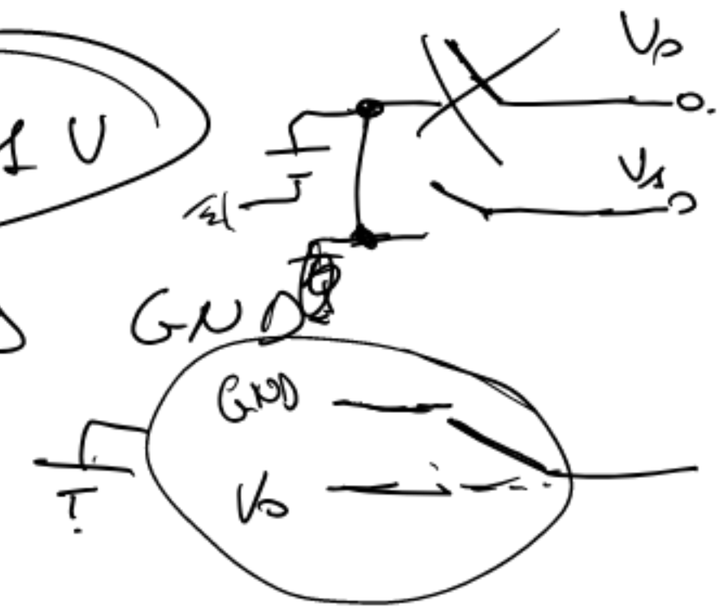
$V_o = 0$

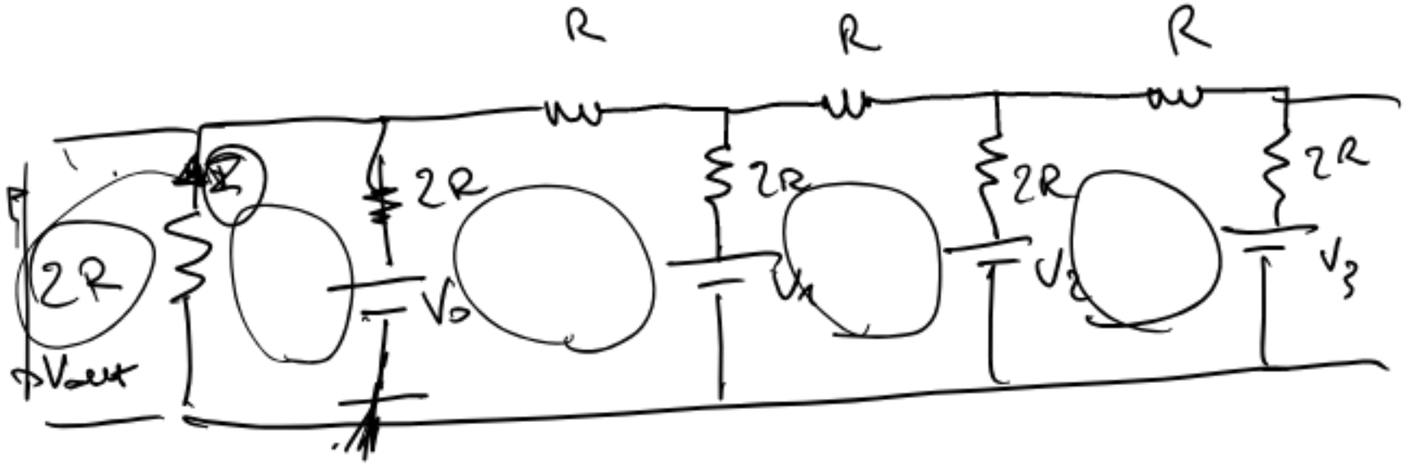
$V_{OUT} = (0 - 15)\,V$

$\Delta V = 1\,V$

DAC

$V_i = \begin{cases} 0\,V \Rightarrow GND \\ \rightarrow V_0\,V \Rightarrow \end{cases}$



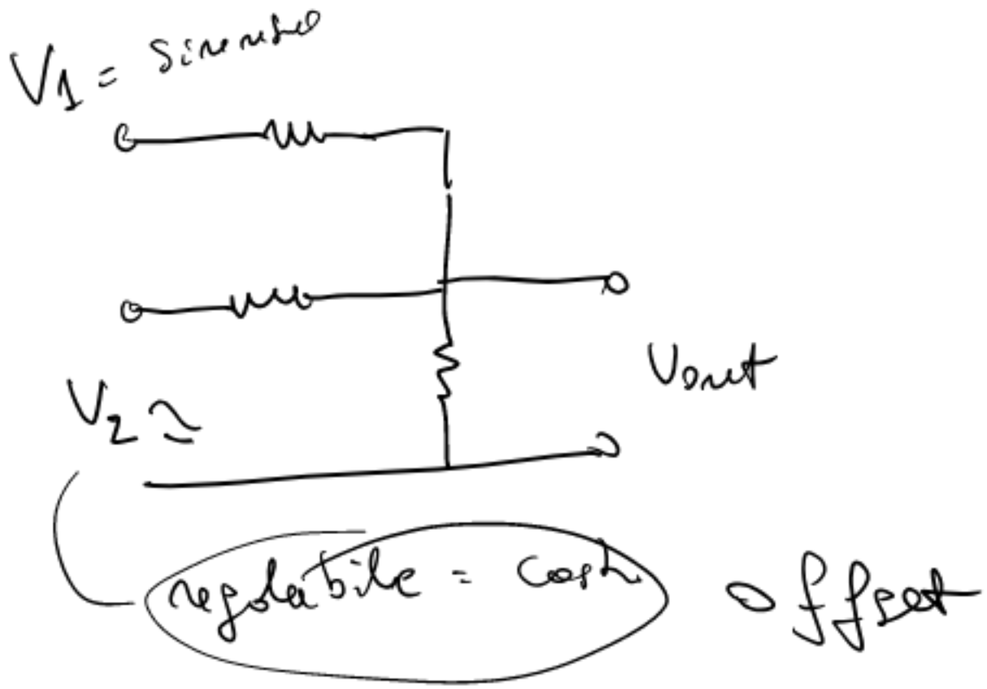


{ G eq / G incog.

$V_{out} = 2R \cdot I_a$

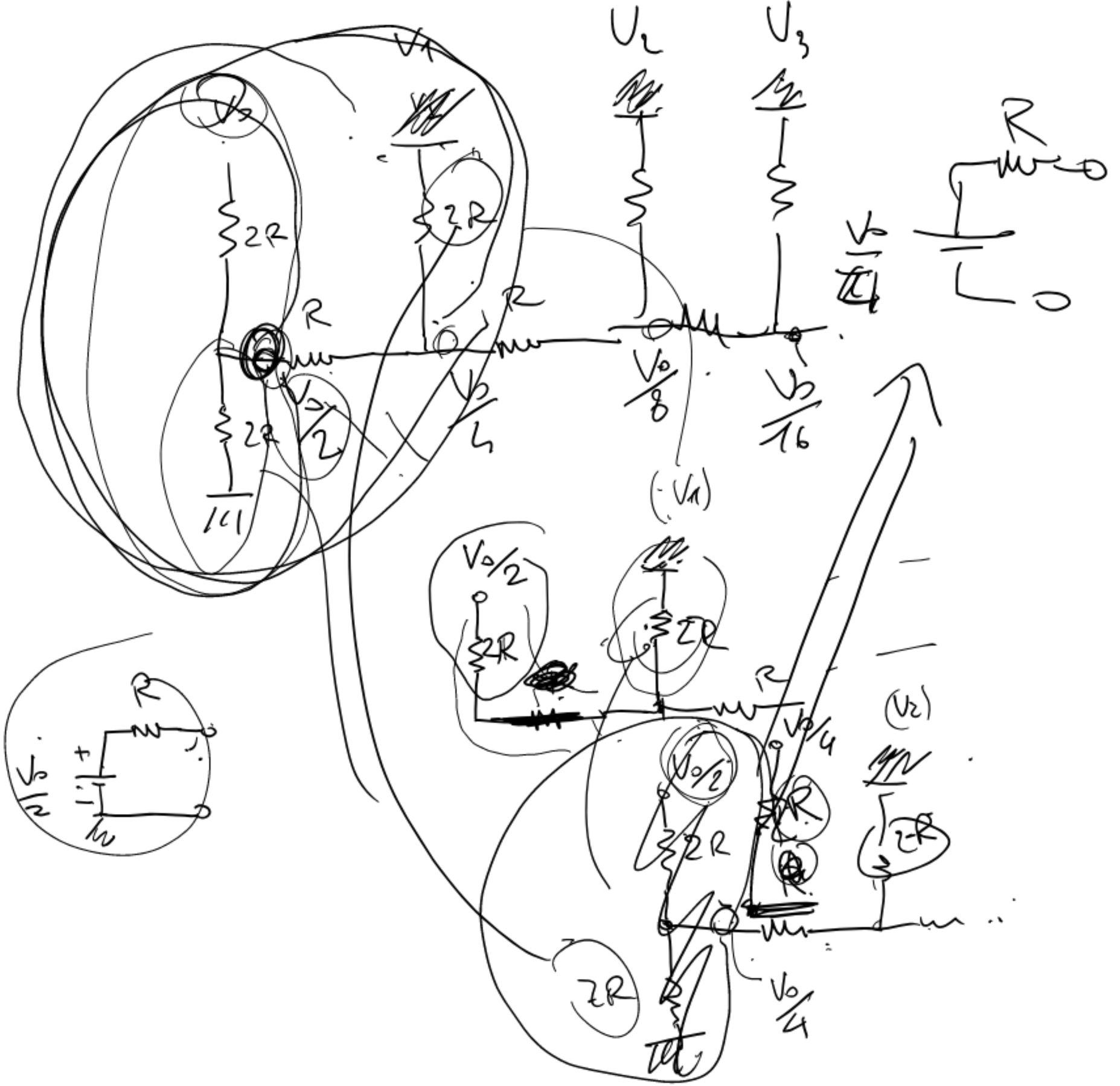
DAC

MIXER



DAC

ADC


V_1
V_2
V_3
2R
R
$V_0/2$
$V_0/4$
$V_0/8$
$V_0/16$
V_0
$V_0/2$
(-V_1)
(V_2)