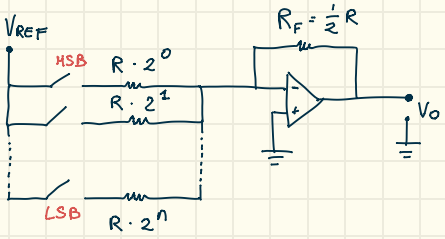


$$V_o = \sum_{i=0}^{n} V_{Ref} \cdot \left(-\frac{R_F}{R_i}\right) \qquad R_i \triangleq R \cdot 2^i$$

$$V_o = -\frac{R_F}{R\cdot 2^0}\cdot V_{Ref}\cdot d_0 - \frac{R_F}{R\cdot 2^1} V_{Ref}\cdot d_1 - \dots - \frac{R_F}{R\cdot 2^{N-2}} V_{Ref}\cdot d_{N-2} - \frac{R_F}{R\cdot 2^{N-1}} V_{Ref}\, d_{N-1}$$

$$= -\frac{R/2}{R\cdot 2^i} = -\frac{1}{2\cdot 2^i} = -\frac{1}{2^{i+1}}$$

$$= -\frac{d_1}{2^1} V_{Ref} - \frac{d_2}{2^2} V_{Ref} - \dots - \frac{d_N}{2^N} V_{Ref} = V_{Ref}\cdot \sum_{i=1}^{N} -\frac{d_i}{2^i} = V_{Ref}\cdot \text{ValoreDigitale}$$

Esempio ho 4 bit 1000 ⇝ 8 V.N.

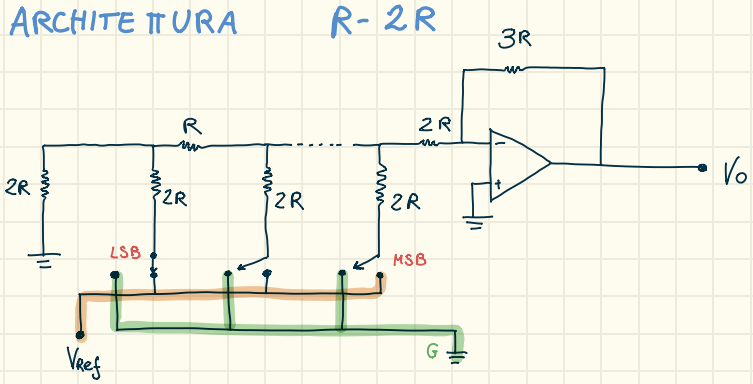
$$V_o = V_{Ref}\cdot \sum_{i=1}^{N} \frac{d_0}{2^i} = V_{Ref}\cdot \frac{1}{2^1} = \frac{V_{Ref}}{2}$$

Il primo bit vale la metà del fondoscala

ho 0001 ⇝ $V_o = V_{Ref}\cdot \frac{1}{2^4} = \frac{V_{Ref}}{16}$

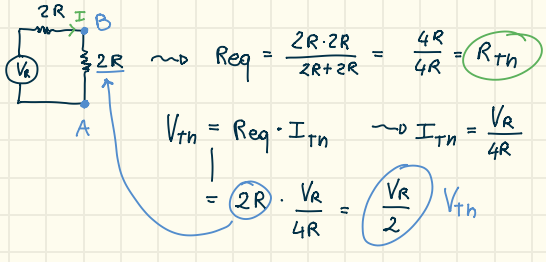
ho 0100 ⇝ $V_o = V_{Ref}\cdot \frac{1}{2^2} = \frac{V_{Ref}}{4}$

ARCHITETTURA R-2R



Supponiamo in input di MSB 0001 LSB

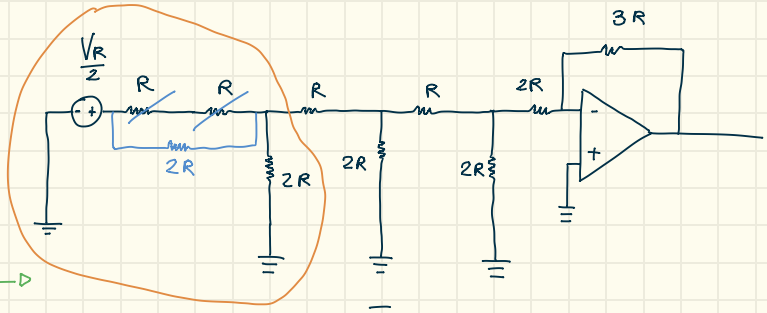
⇝ Ci aspettiamo un out di $\frac{V_{Ref}}{16}$



$$\text{Req} = \frac{2R\cdot 2R}{2R+2R} = \frac{4R}{4R} = R_{Th}$$

$$V_{Th} = \text{Req}\cdot I_{Th} \quad \rightsquigarrow I_{Th} = \frac{V_R}{4R}$$

$$= 2R\cdot \frac{V_R}{4R} = \frac{V_R}{2} \; V_{Th}$$



$$\rightsquigarrow V''_{Th} = \frac{V}{2}, \quad R''_{Th} = R$$

$$\Rightarrow V''_{Th} = \frac{V_{Ref}}{2\cdot 2} = \frac{V_{Ref}}{4}, \quad R''_{th} = R$$

$$\rightsquigarrow V'''_{Th} = \frac{V_{Ref}}{4\cdot 2} = \frac{V_{Ref}}{8}, \quad R'''_{Th} = R$$

$$\rightsquigarrow V''''_{Th} = \frac{V_{Ref}}{8\cdot 2} = \frac{V_{Ref}}{16}, \quad R''''_{Th} = R$$

0001 QED