17. Usi non lineari dell'opAmp

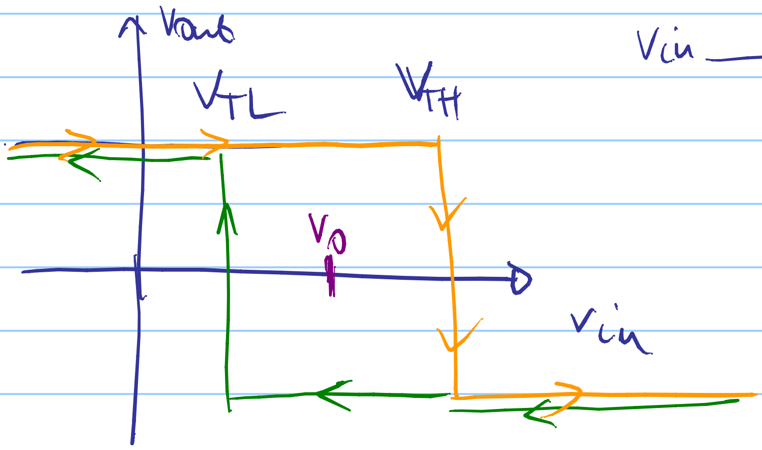
Titolo nota 4/23/2008

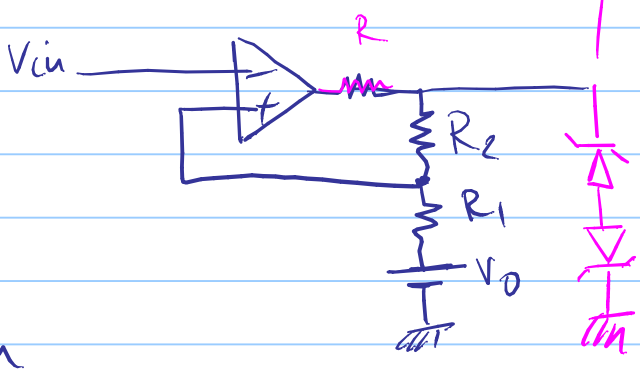
3. Applicazioni non lineari

a) Comparatore

b) Trigger di Schmidt (isteresi)

tensione diversa da Vcc





$$V_{TH} = V_0 + \frac{V_{CC} R_1}{R_1 + R_2} \qquad V_{TL} = V_0 - \frac{V_{EE} R_1}{R_1 + R_2}$$

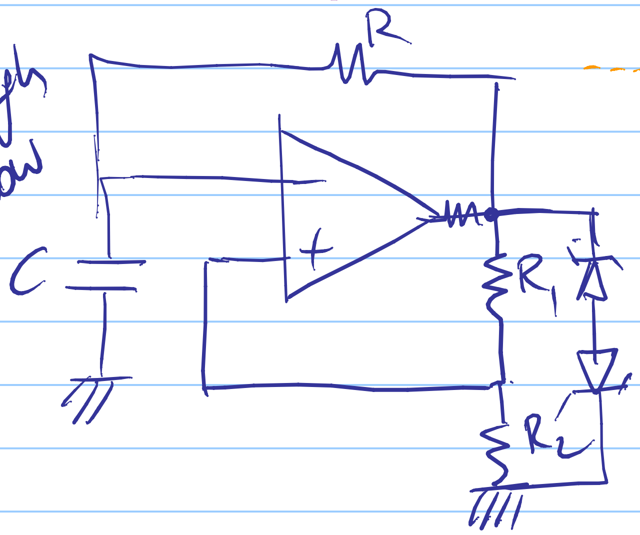
Immunità al rumore

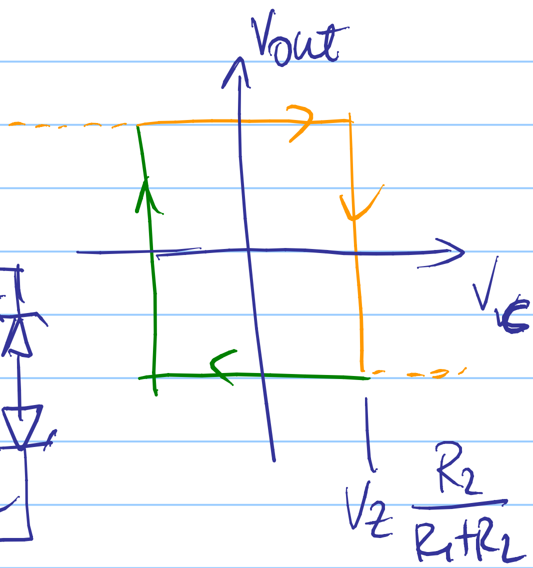
c) Multivibratore astabile

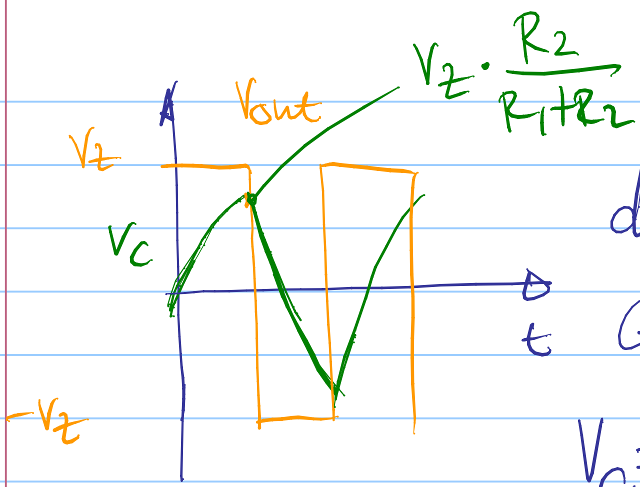
usare

V_{OH} = out high

V_{OL} = out low







Il C si carica partendo da $V_C = V_z \frac{R_2}{R_1+R_2}$ verso $-V_z$

con costante $\tau = RC$

$$V_C = -V_z + A e^{-t/\tau}$$

$$A = V_z\left(1+\frac{R_2}{R_1+R_2}\right) = V_z \frac{R_1+2R_2}{R_1+R_2}$$

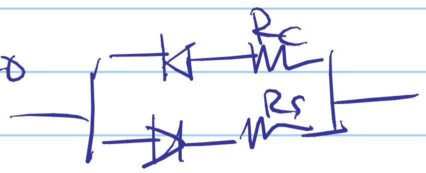
Scatta quando $V_C = -V_z \frac{R_2}{R_1+R_2}$

$$-\cancel{V_z} + \cancel{V_z} \frac{R_1+2R_2}{R_1+R_2} e^{-T/2\tau} = -\cancel{V_z} \frac{R_2}{R_1+R_2}$$

$$e^{-T/2\tau}(R_1+2R_2) = R_1$$

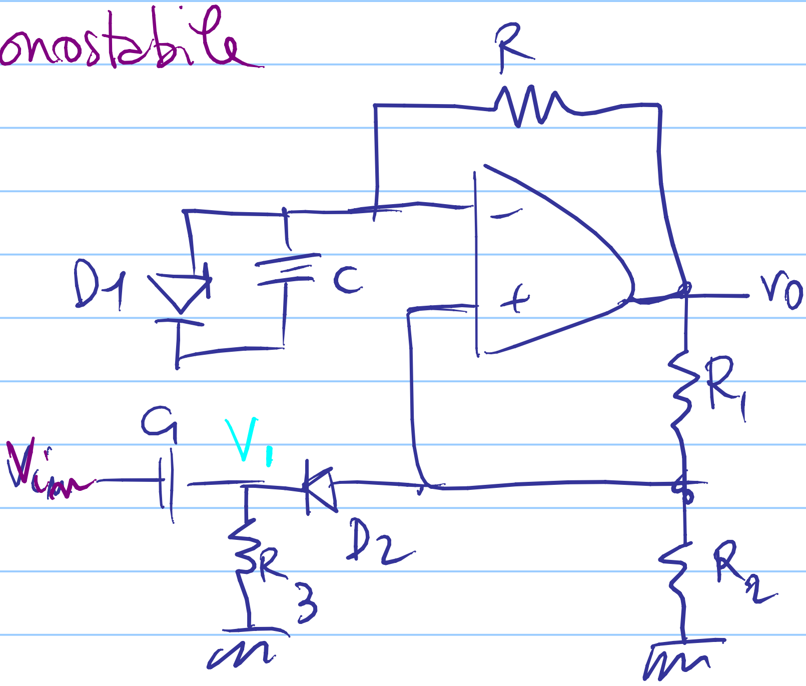
$$T = 2\tau \ln\left(1+2\frac{R_2}{R_1}\right)$$ indipendente da V_z

Se 

$\rightarrow$ 

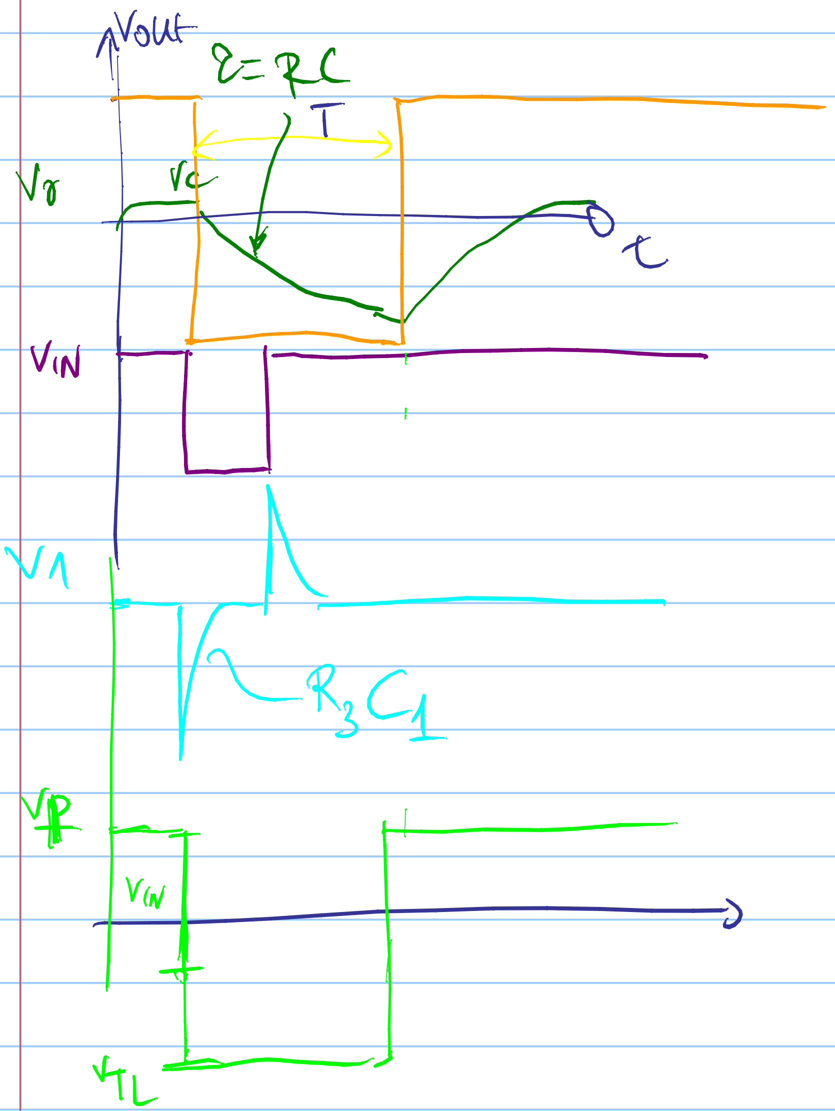
avremo $T_{up} \neq T_{down}$

d) Monostabile



Se $V_0 = V_{cc}$, la soglia $V_+ = V_{cc}\left(1+\frac{R_2}{R_1}\right)$ (V_{TH}

V_C è bloccato a $V_\gamma \to$ non scatta.



scarica da V_γ a V_{OL}

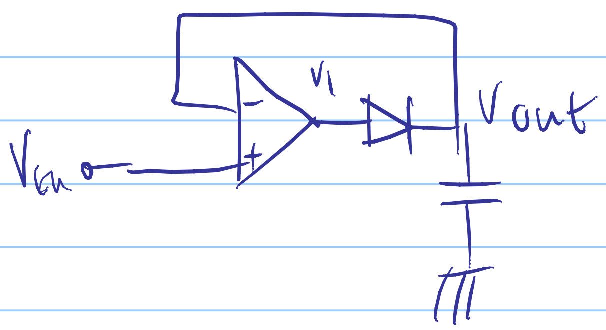
$$V = V_{OL} + (V_\gamma - V_{OL})e^{-t/\tau}$$

$$= V_{OL}\cdot\left(1+\frac{R_2}{R_1}\right) \text{ soglia } (V_{TL})$$

$$T = \tau \ln \frac{V_\gamma - V_{OL}}{V_{TL} - V_{OL}}$$

$$\simeq \tau \ln\left(1+\frac{R_2}{R_1}\right)$$

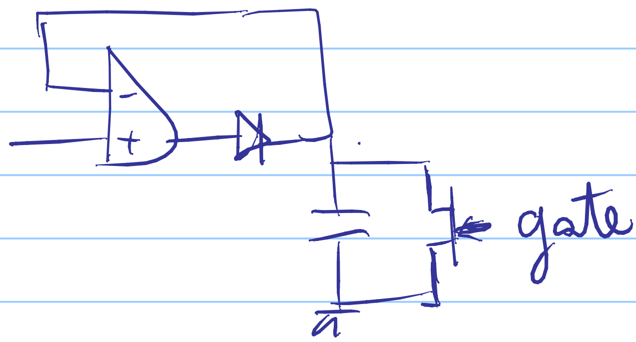
d) Rivelatore di picco



(si elimina la caduta del diodo)

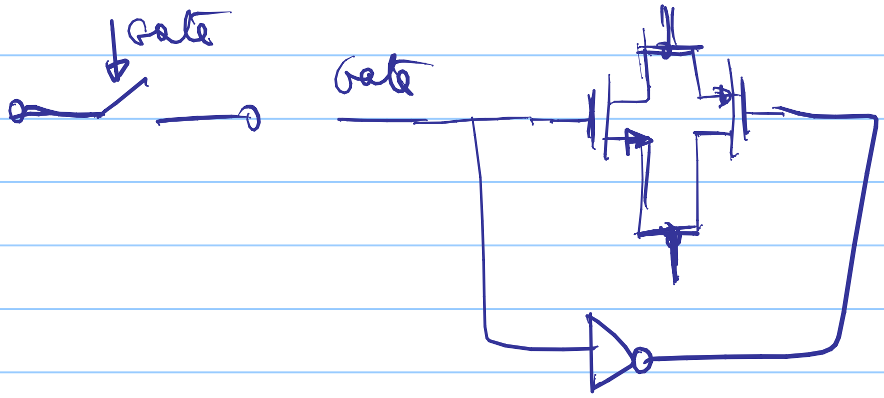
$V_1 = V_{out} + V_\gamma$

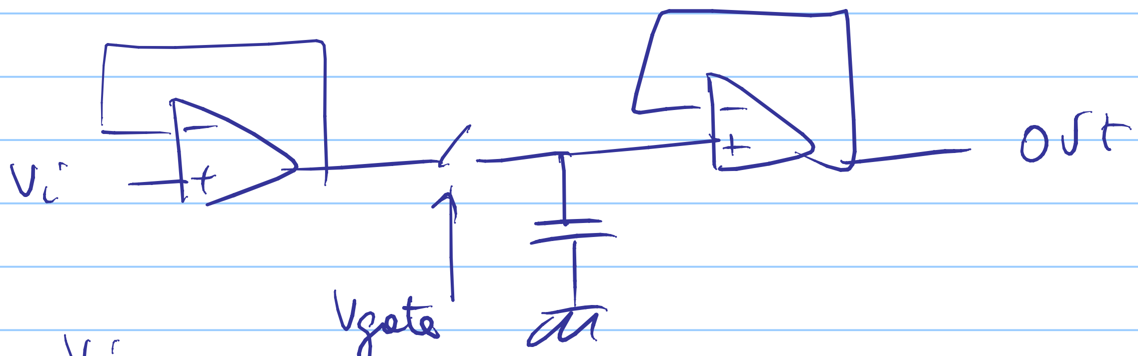
Resettabile



Sample & Hold

Interruttore controllato in tensione

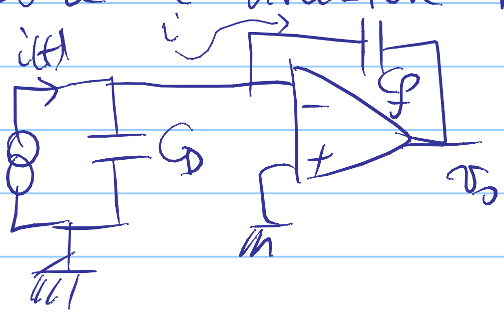




Effetto della resistenza dell'interruttore

Amplificatore di carica

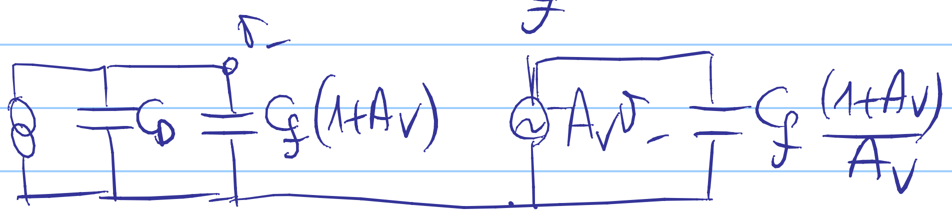
Converte la carica (ad esempio raccolta da un rivelatore) in tensione. Il rivelatore genera un impulso di corrente $i(t)$ con $Q = \int i\, dt$.
Inoltre il rivelatore ha una sua capacità C_D



(Massa virtuale)

$$v_o = -\frac{Q}{C_f}$$

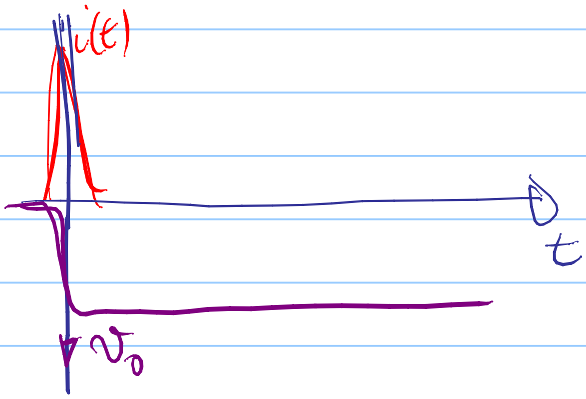
Con Miller:



$$Z_{1M} = \frac{Z_f}{1-K} = \frac{Z_f}{1+A_V} \qquad Z_{2M} = \frac{-K Z_f}{1-K} = \frac{A_V Z_f}{1+A_V}$$

$$C' = C_D + \overbrace{C_f(1+A_v)}^{C_{IN}} \qquad v_- = \frac{Q}{C'}$$

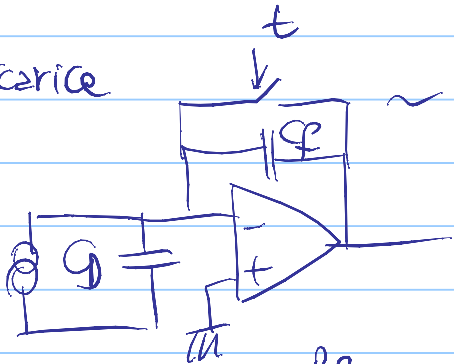
$$v_o = -\frac{A_v Q}{C_D + C_f(1+A_v)}$$



Non si scarica mai!

Due metodi di scarica

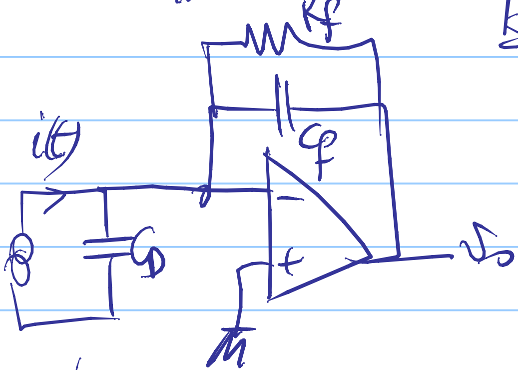
1) Switch



~ interruttore controllato (MOS)

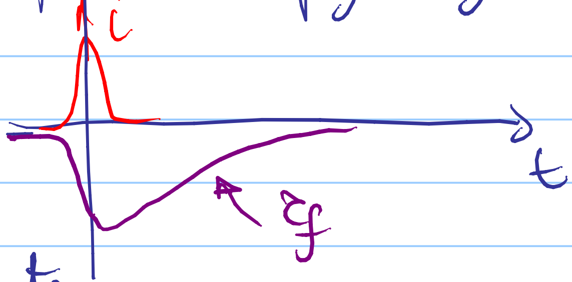
Bisogna sapere quando farlo scattare!

2) Resistenza



Se la corrente è breve rispetto a $R_f C_f = \tau_f$ →

$$v_o = -\frac{Q}{C_f} e^{-t/\tau_f}$$



Segnale "formato" indipendente dalla durata dell'impulso iniziale