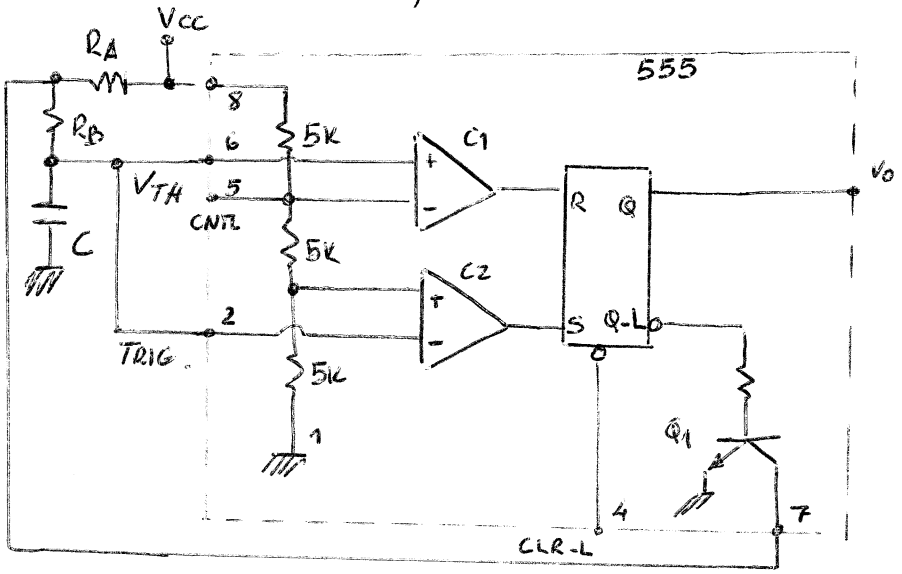
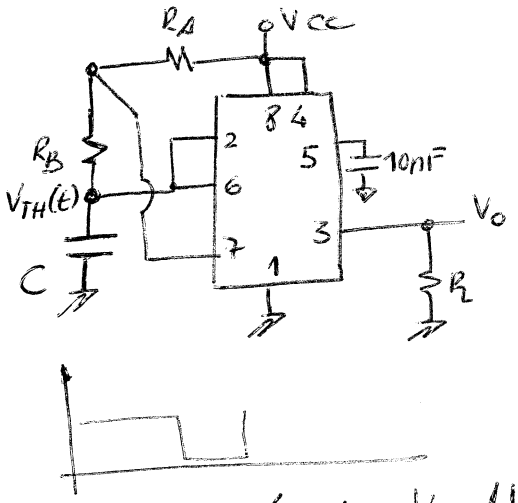
– Rellotge amb circuit versàtil 555

El 555 també es pot connectar com a circuit astable

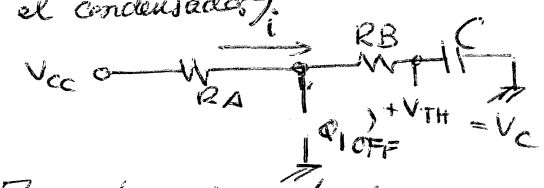




Les tensions que fan canviar de nivell els comparadors són $V_{TH} = V_{TR} = \frac{1}{3}Vcc$ i $\frac{2Vcc}{3}$

– **Per $t \geq 0$** $\quad V_{TH}(0^+) = 0V$ (suposem condensador descarregat)

$R = 0$, $S = 1$ $\Rightarrow Q = 1$, $Q\_L = 0 \Rightarrow Q1 \rightarrow OFF$



El condensador tendeix a carregar-se a través de R_A i R_B

$$v_{TH} = V_{TH}(\infty) - \left(V_{TH}(\infty) - V_{TH}(0)\right) e^{-t/\tau_1}$$

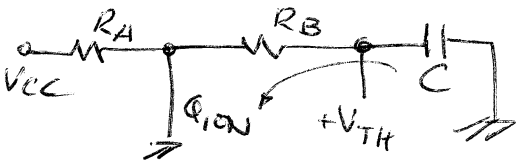
$$= Vcc\left(1 - e^{-t/\tau_1}\right)$$

$V_{TH}(\infty) = Vcc$; $V_{TH}(0) = 0$ $\qquad \tau_1 = (R_A + R_B)C$

Quan **$t = t_0$** $\quad V_{TH}(t_0) = \frac{Vcc}{3} \Rightarrow S = 0$ i $Q = 1$ no canvia

Per $t = t_1$ $\quad V_{TH}(t_1) = \frac{2}{3}Vcc \Rightarrow \begin{matrix} R = 1 \\ S = 0 \end{matrix} \Big\} Q = 0$; $Q\_L = 1 \rightarrow Q_1$ ON

El condensador començarà a descarregar-se pel transistor Q_1



$$V_{TH}(t_1) = \frac{2}{3}Vcc = Vcc\left(1 - e^{-t_1/\tau_1}\right) \Rightarrow \boxed{t_1 = \tau_1 \cdot \ln 3}$$

– **Per $t > t_1$** $\quad V_{TH}(\infty) = 0$

$V_{TH}(t_1) = 2/3\,Vcc \Rightarrow v_{TH}(t - t_1) = \frac{2}{3}Vcc\, e^{-\frac{(t-t_1)}{\tau_2}}$

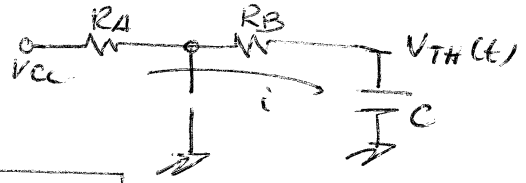
$$\boxed{\tau_2 = R_B C}$$

Fixem-nos que de seguida passa que: $V_{TH} < \frac{2}{3}Vcc$ i $R = 0$, $S = 0$

i la descàrrega continua.

Quan $t = t_1$ $\quad V_{TH}(t_2 - t_1) = \frac{V_{cc}}{3}$ i $\begin{matrix} S=1 \\ R=0 \end{matrix} \Rightarrow \begin{matrix} Q=1 \\ Q\_L=0 \end{matrix} \Rightarrow Q_1$ OFF

i tornem al 1er muntatge equivalent de càrrega de C.



$$t_2 - t_1 = \frac{1}{3}V_{cc} = \frac{2}{3}V_{cc}\left(1 - e^{-\frac{(t_2-t_1)}{\tau_2}}\right)$$

$$(t_2 - t_1) = T_L = R_B \cdot C \cdot (\ln 2)$$

- Per $t > t_2$ $\quad V_{TH}(t_2) = \frac{1}{3}V_{cc}$; $V_{TH}(\infty) = V_{cc}$ $\quad V_{TH}(t - t_2) = V_{cc}\left(1 - \frac{2}{3}e^{-(t-t_2)/\tau_1}\right)$

Fixem-nos que just després de t_2 $\quad V_{TH} > \frac{1}{3}V_{cc}$ i $\begin{matrix} S=0 \\ R=0 \end{matrix}$ $\begin{matrix} Q=1 \\ Q\_L=0 \end{matrix}$ és manté la inicial

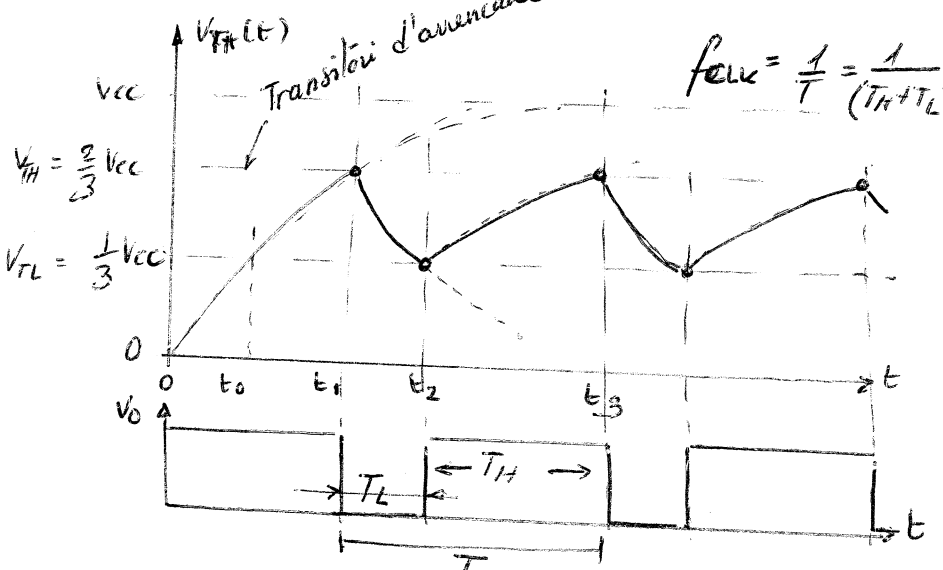
Quan $t = t_3$ $\quad V_{TH}(t_3 - t_2) = \frac{2}{3}V_{cc} \rightarrow \begin{matrix} R=1 \\ S=0 \end{matrix} \Rightarrow \begin{matrix} Q=0 \\ Q\_L=1 \end{matrix} \Rightarrow Q_1$ ON

i comença la descàrrega:

$$\frac{2}{3}V_{cc} = V_{cc}\left(1 - \frac{2}{3}e^{-(t_3-t_2)/\tau_1}\right)$$

$$\Rightarrow t_3 - t_2 = T_H = (R_A + R_B)C \cdot \ln 2$$

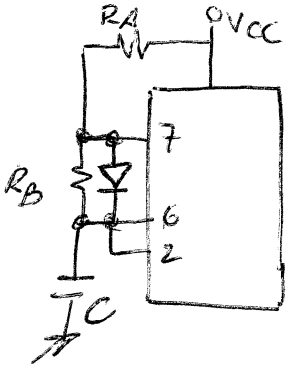
i així successivament



$$f_{clk} = \frac{1}{T} = \frac{1}{(T_H + T_L)} = \frac{1}{C(\ln 2)(R_A + 2R_B)}$$

Si volem una ona quasi quadrada DC ≃ 50%, cal que:

$\tau_1 \simeq \tau_2$



$T_H \simeq R_A C \ln 2$ Càrrega de C (D ON) (Q_1 OFF)

$T_L \simeq R_B C \ln 2$ Descàrrega de C (D OFF) (Q_1 ON)

$R_A = R_B$

$$f_{clk} \simeq \frac{1}{R_A C (\ln 2)}$$