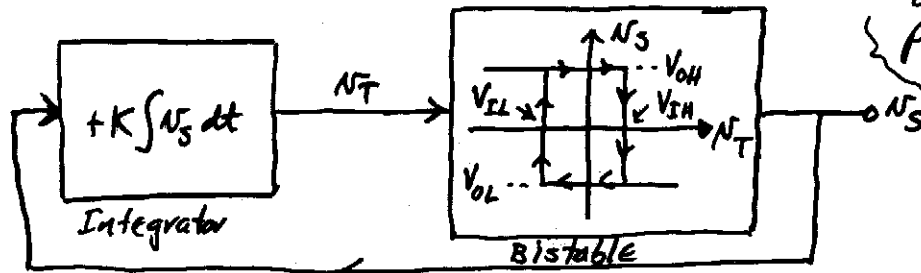
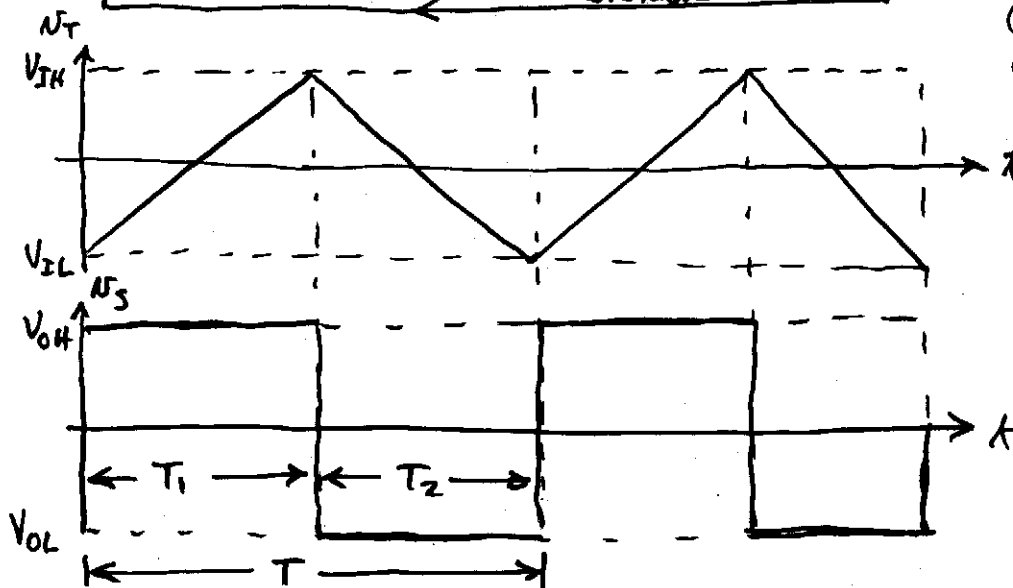


Waveform Generators (Graded Homeworks 10-13 in back of room)



Prob. Session
Sunday
April 27
4pm

Final
Exam
2:50pm
Monday
April 28



$T = ? \Rightarrow f_{osc} = \frac{1}{T}$

$0 \leq t \leq T_1$

$N_T(t) = V_{IL} + K \int_0^{T_1} V_{OH} dt = V_{IH} \Rightarrow V_{IL} + K V_{OH} T_1 = V_{IH}$

$T_1 = \frac{V_{IH} - V_{IL}}{K V_{OH}}$

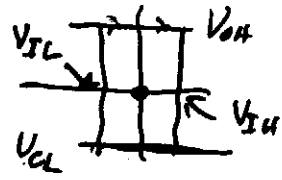
$T_1 \leq t \leq T_2$

$N_T(t) = V_{IH} + K \int_{T_1}^{T_2} V_{OL} dt = V_{IL} \Rightarrow T_2 = \frac{-V_{IH} + V_{IL}}{K V_{OL}}$

$\therefore T = T_1 + T_2 = \frac{-V_{IH} + V_{IL}}{K V_{OH}} + \frac{-V_{IH} + V_{IL}}{K V_{OL}} = \frac{V_{IH} - V_{IL}}{K} \left(\frac{1}{V_{OH}} + \frac{1}{V_{OL}} \right)$

$f_{osc} = \frac{1}{T}$

Assume that $V_{OH} = -V_{OL}$ and $V_{IH} = -V_{IL}$



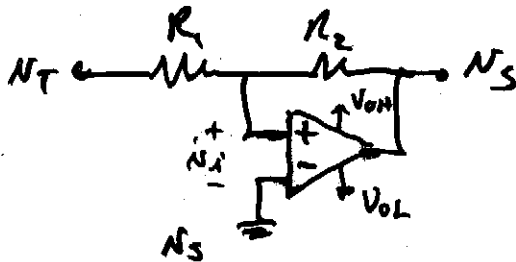
$$T = \frac{2V_{IH}}{K} \left(\frac{1}{V_{OH}} + \frac{1}{V_{OL}} \right) = \frac{4}{K} \frac{V_{IH}}{V_{OH}}$$

$$f_{osc} = \frac{K}{4} \frac{V_{OH}}{V_{IH}}$$

$$V_{OH} = 5V \text{ and } V_{IH} = 1V \rightarrow f_{osc} = \frac{K}{4} S$$

Bistable

CCW Bistable



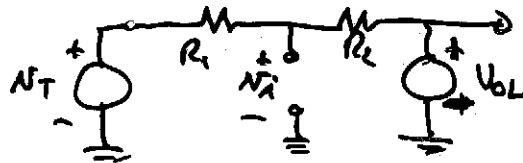
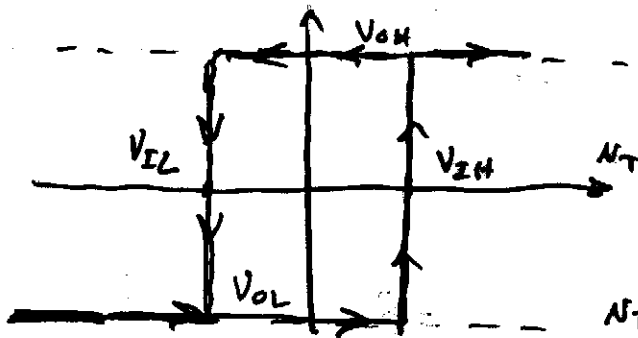
Assume $N_T \ll 0$

$$N_i = \frac{R_1}{R_1 + R_2} V_{OL} + \frac{R_2}{R_1 + R_2} N_T$$

When $N_i = 0$, then $N_T = V_{IH}$

$$0 = \frac{R_1}{R_1 + R_2} V_{OL} + \frac{R_2}{R_1 + R_2} V_{IH}$$

$$\therefore V_{IH} = -\frac{R_1}{R_2} V_{OL}$$

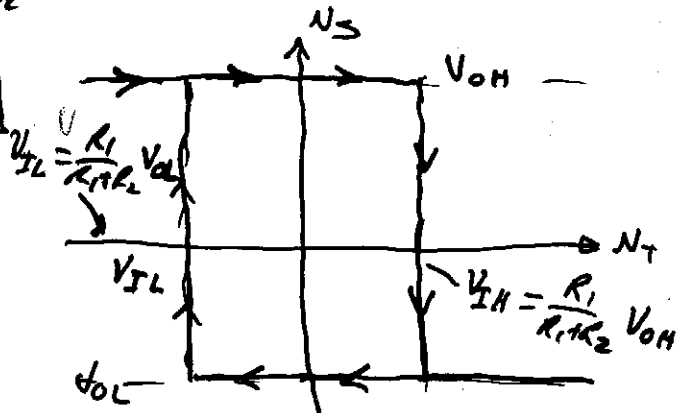
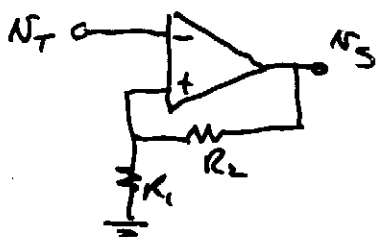


If $N_T \gg 0$, then $N_S = V_{OH}$

$$N_i = \frac{R_1}{R_1 + R_2} V_{OH} + \frac{R_2}{R_1 + R_2} N_T \rightarrow N_i = 0 \text{ then } N_T = V_{IL}$$

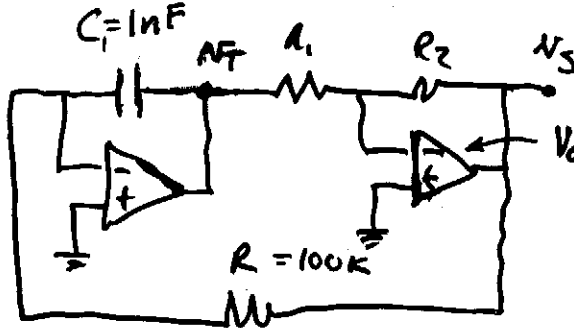
$$V_{IL} = -\frac{R_1}{R_2} V_{OH}$$

CW Bistable-



Real Waveform Generator

- + Integrator + CW bistable
- Integrator + CCW bistable



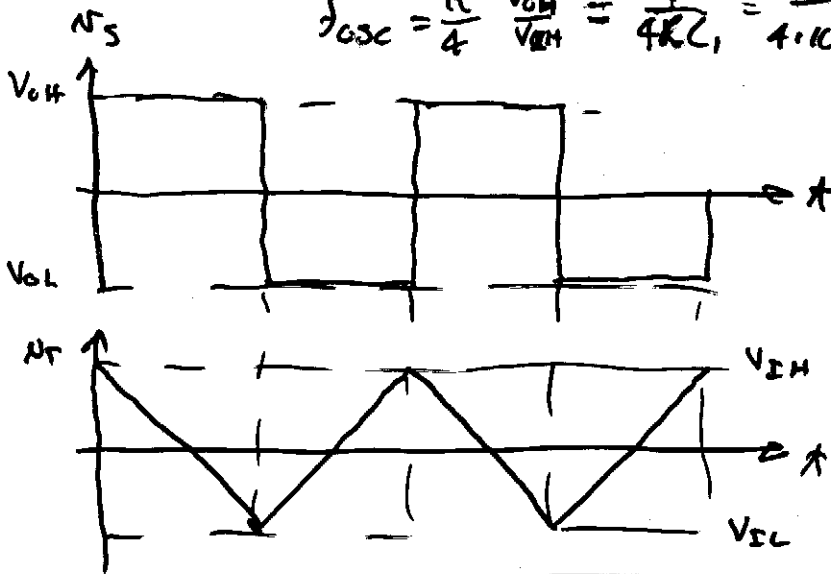
$$K = \frac{1}{RC_1}$$

$$R_1 = R_2$$

$$V_{IH} = -V_{OL}$$

$$V_{IL} = -V_{OH}$$

$$f_{OSC} = \frac{K}{4} \frac{V_{OH}}{V_{IH}} = \frac{1}{4RC_1} = \frac{1}{4 \cdot 10^5 \cdot 10^{-9}} = \frac{10^4}{4} = \underline{\underline{2500 \text{ Hz}}}$$



Quiz 13

$$T(s) = \frac{A_0}{\left(\frac{s}{1000} + 1\right)\left(\frac{s}{10K} + 1\right)}$$

