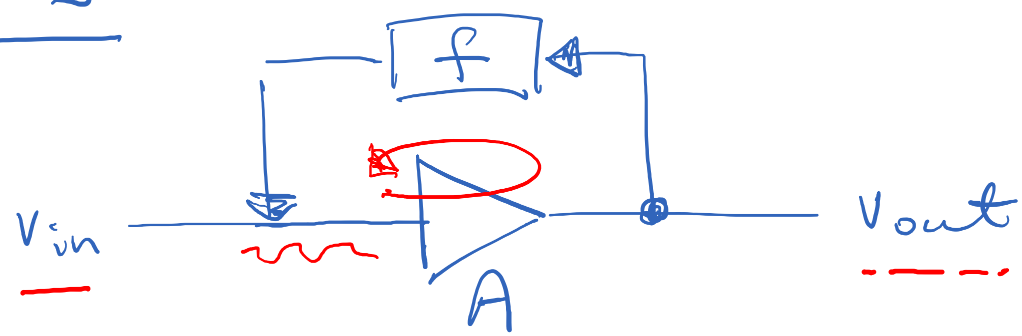
OSCILLATORS



→ OPEN LOOP GAIN A

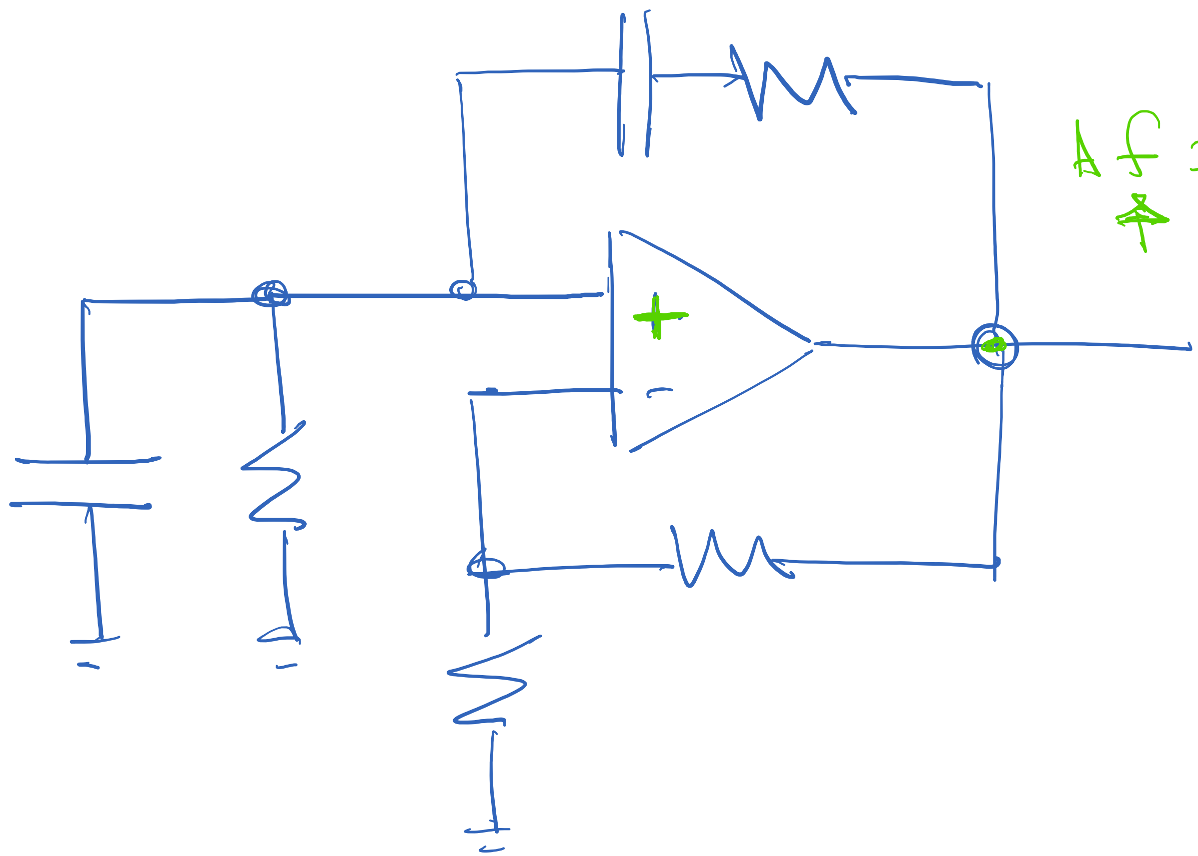
CLOSED LOOP GAIN $\dfrac{A}{1+Af} \simeq 1/f$

⇒ LOOP GAIN Af

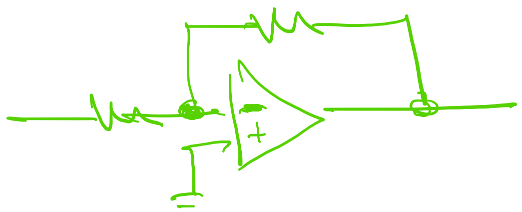
→ STABLE, SELF-SUSTAINING OSCILLATION FOR $Af = 1$

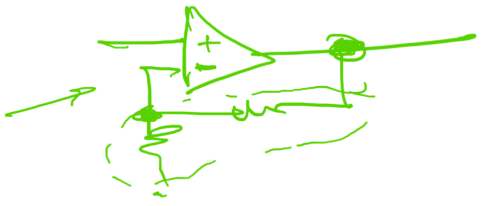
$|Af| = 1$ & PHASE SHIFT → $0°$

WIEN BRIDGE OSCILLATOR

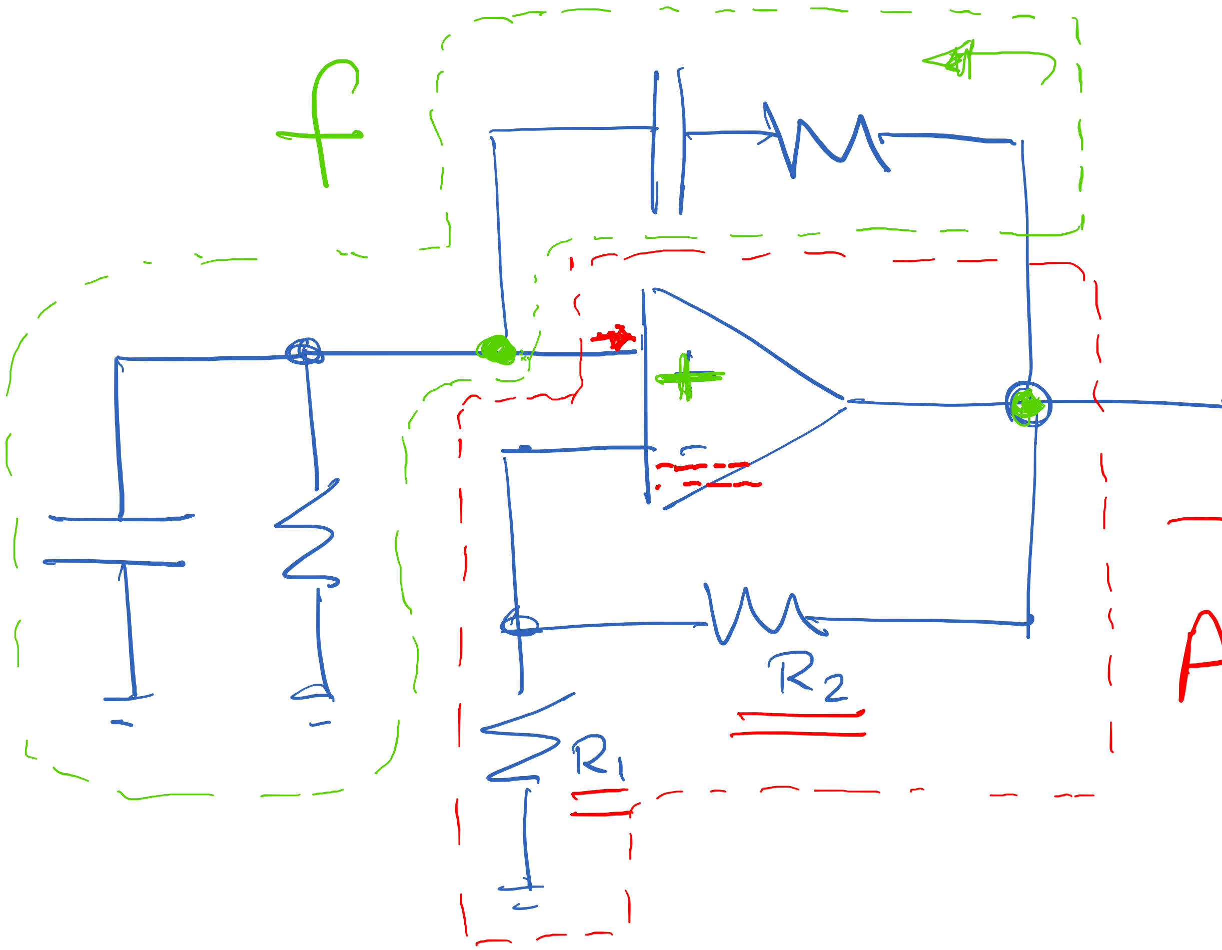


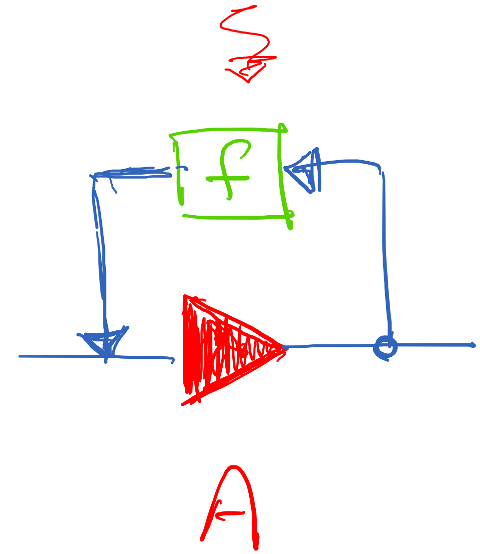
$A_f = 1$





WIEN BRIDGE OSCILLATOR

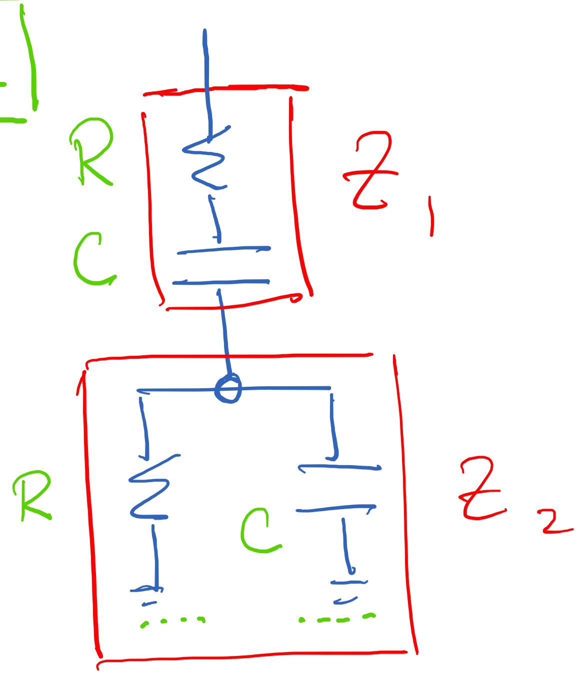




$$A = 1 + \frac{R_2}{R_1}$$

FEEDBACK NETWORK

$$\tau = RC$$



$$f = \frac{Z_2}{Z_1 + Z_2}$$

$$Z_1 = R - \frac{j}{\omega C} = R\left[1 - \frac{j}{\omega\tau}\right]$$

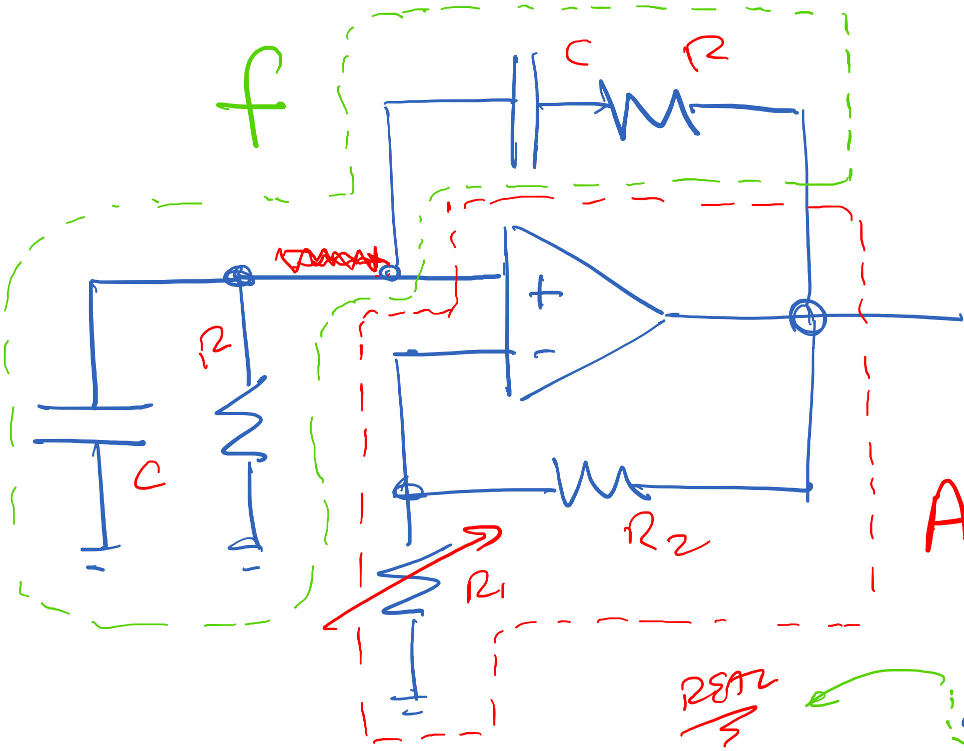
$$Z_2 = \left[\frac{1}{R} + j\omega C\right]^{-1} = \frac{R}{1 + j\omega\tau}$$

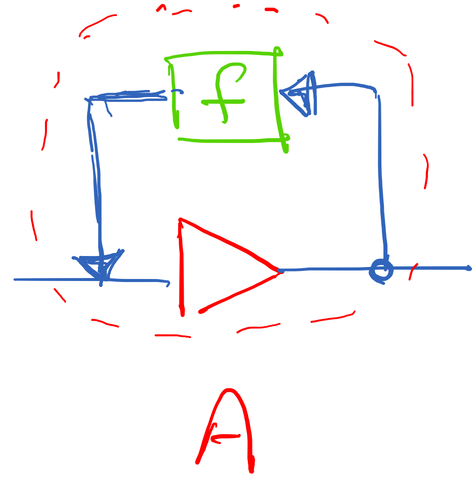
$$f = \frac{1}{3 + j\left(\omega\tau - \frac{1}{\omega\tau}\right)}$$

$\Rightarrow$ @ $\omega\tau = 1$

$$f = +\frac{1}{3}$$

WIEN BRIDGE OSCILLATOR





$A = 1 + \frac{R_2}{R_1}$

NEED

$Af = 1$

REAL ?

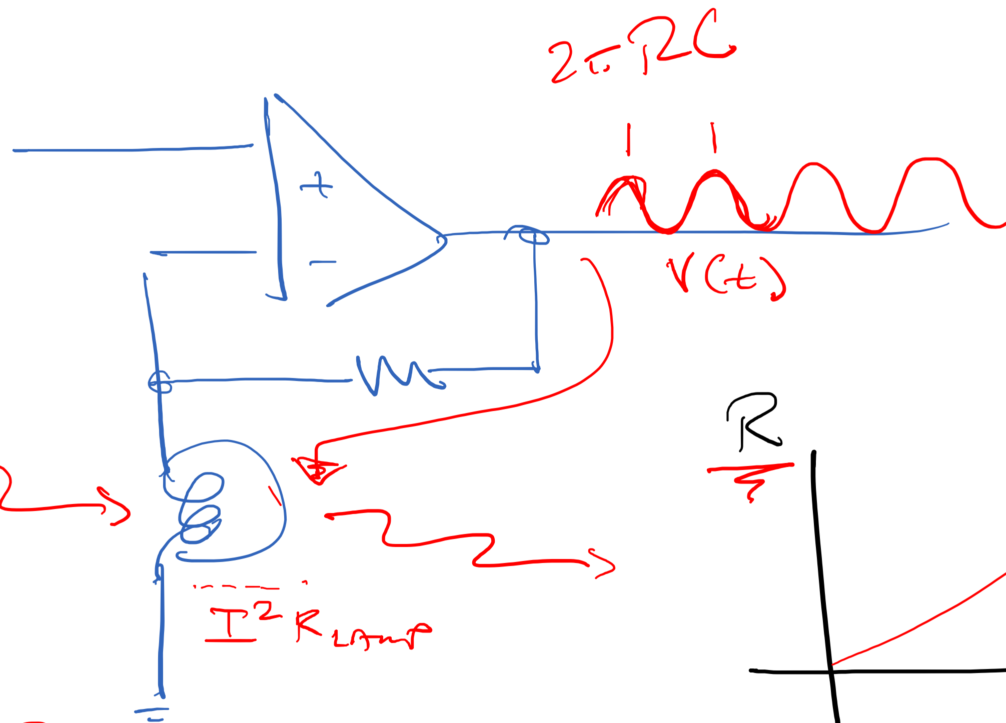
HOW TO ARRANGE ?

REAL @ $\omega = 1/RC$

NEED

$A = 3$

ELECTROTHERMAL FEEDBACK



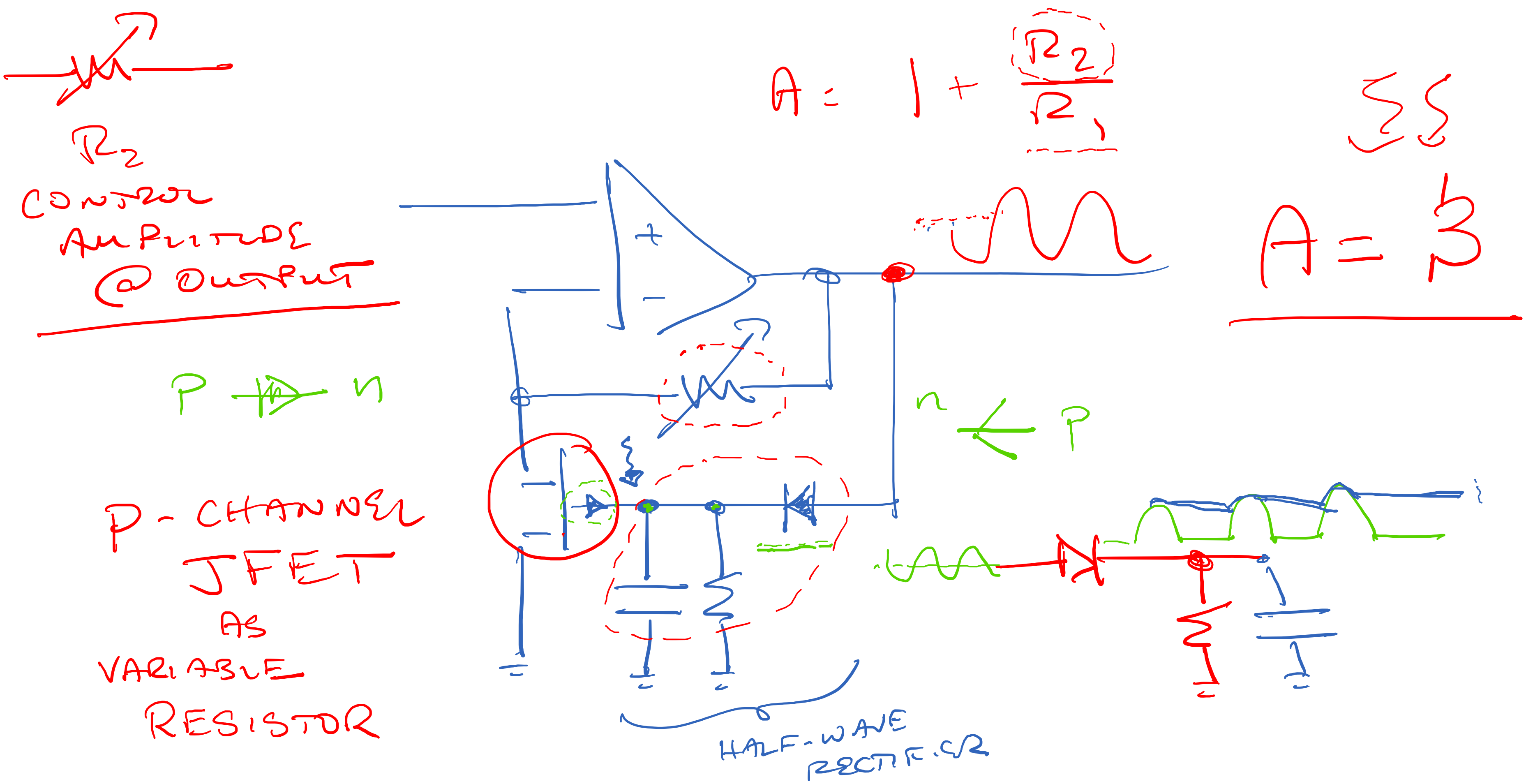
R(T)

R(OUTPUT POWER)

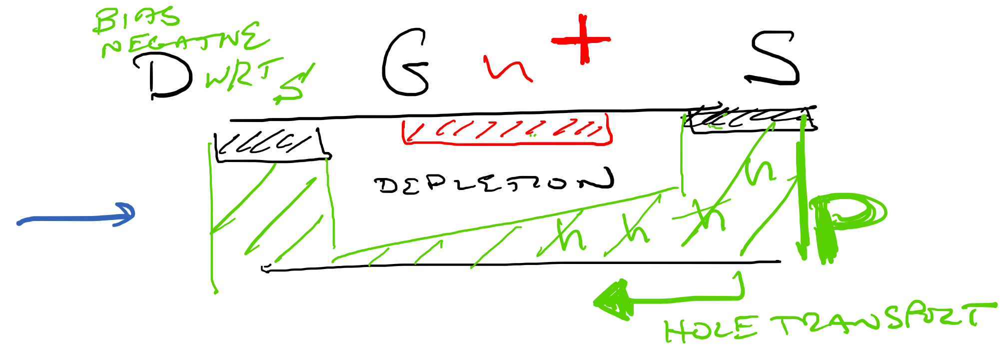
$$\rightarrow A = 1 + \frac{R_2}{R_1}$$

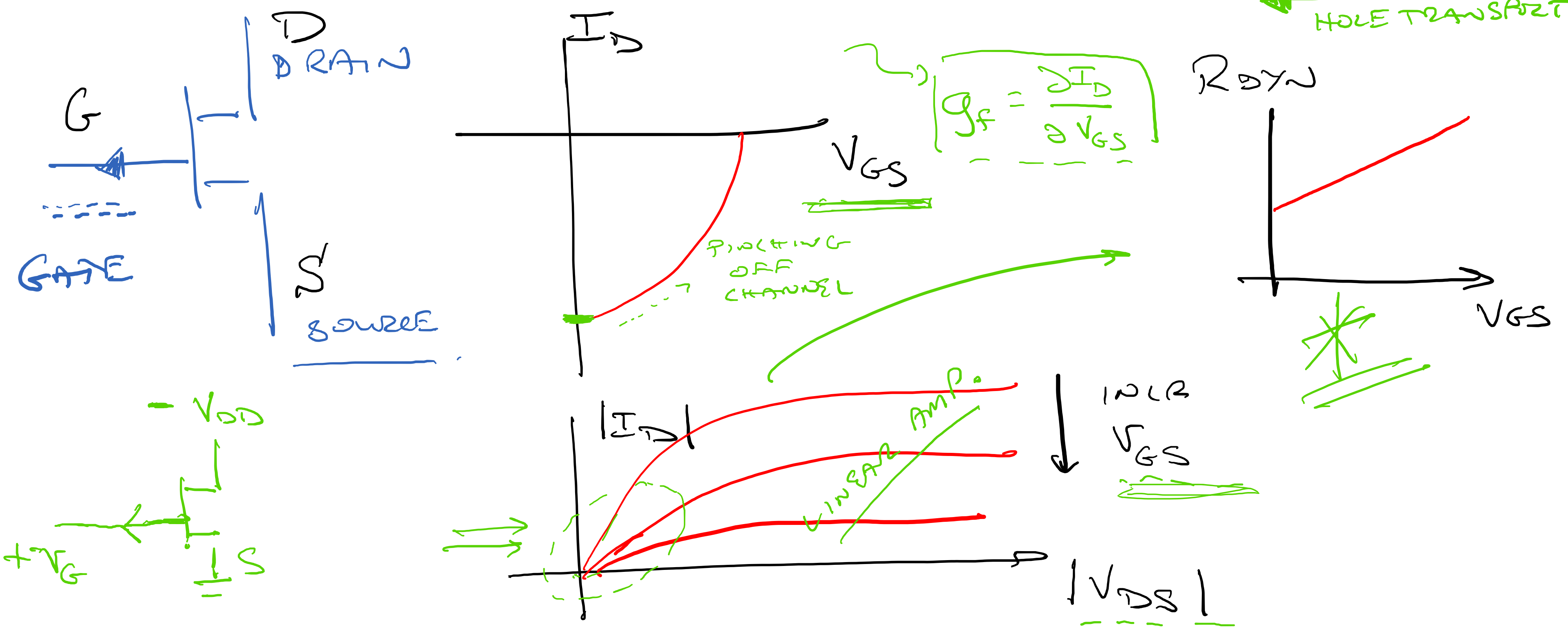
WANT A ↘ AS AMPLITUDE ↗

ALTERNATIVE WAY TO STABILIZE GAIN

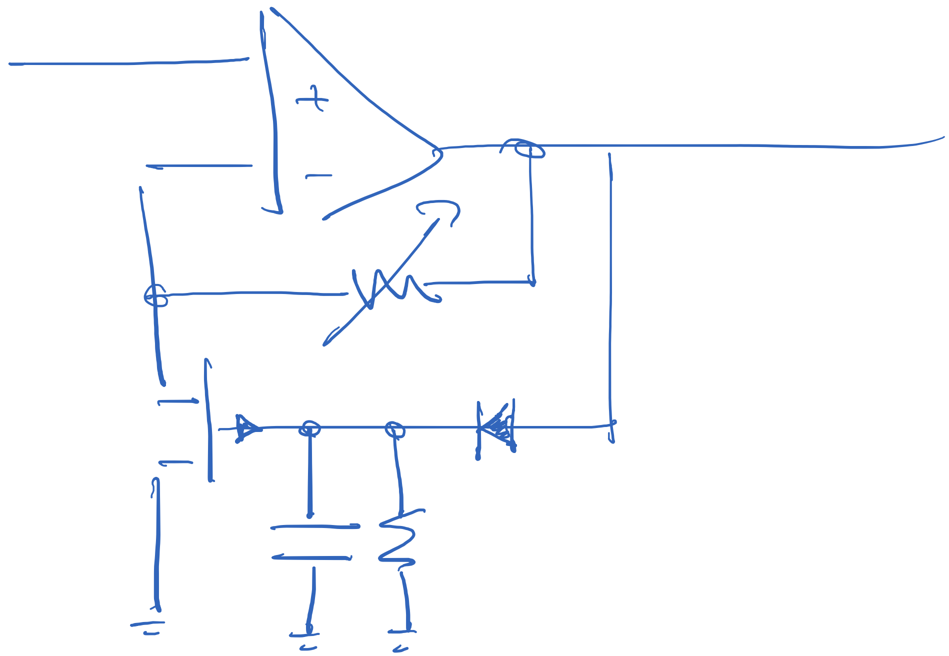


P-CHANNEL JFET

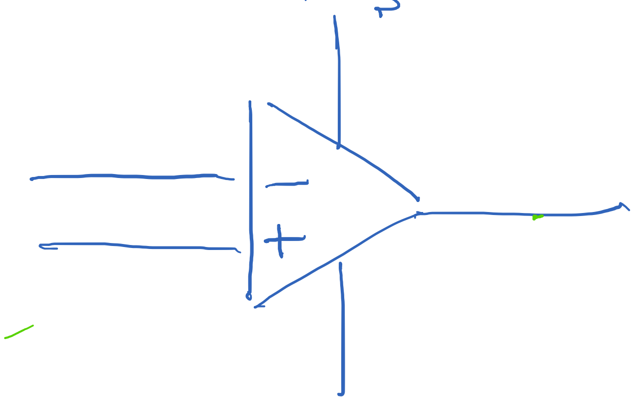


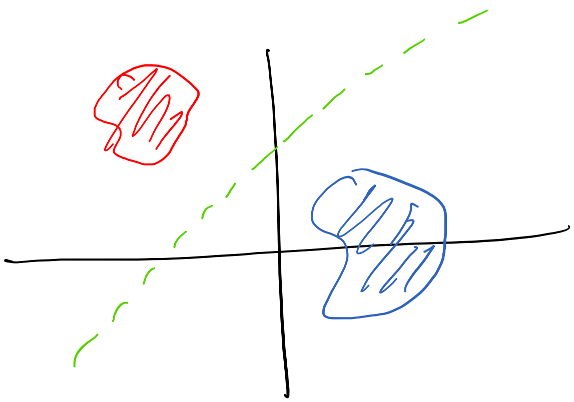


ALTERNATIVE WAY TO STABILIZE GAIN



COMPARATOR / LATCH





$$V_{out} = A[V_+ - V_-]$$

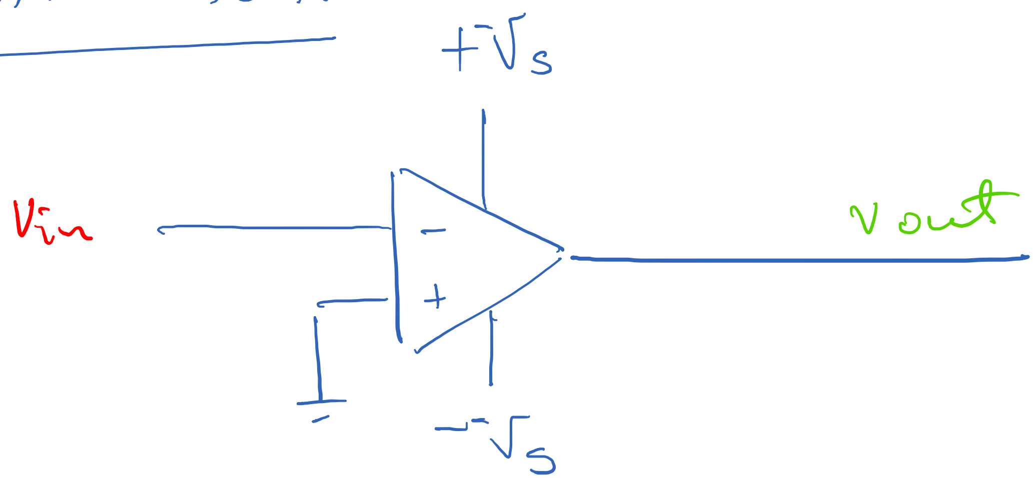
$A \gg 1$

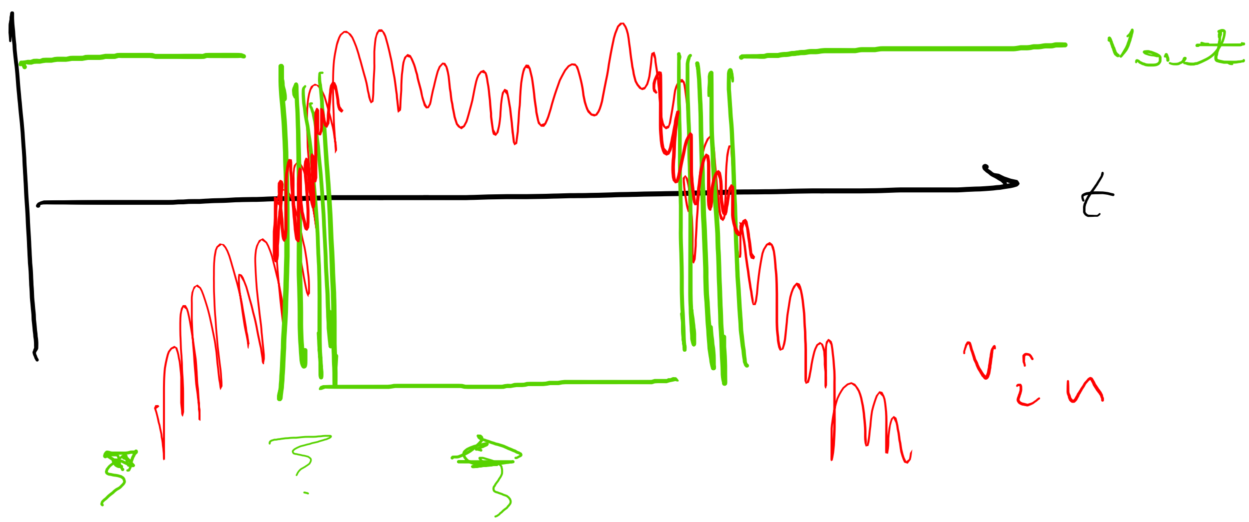
$\Rightarrow$ OUTPUT EITHER @

$+V_S$ [FOR $V_+ > V_-$]

$-V_S$ [FOR $V_+ < V_-$]

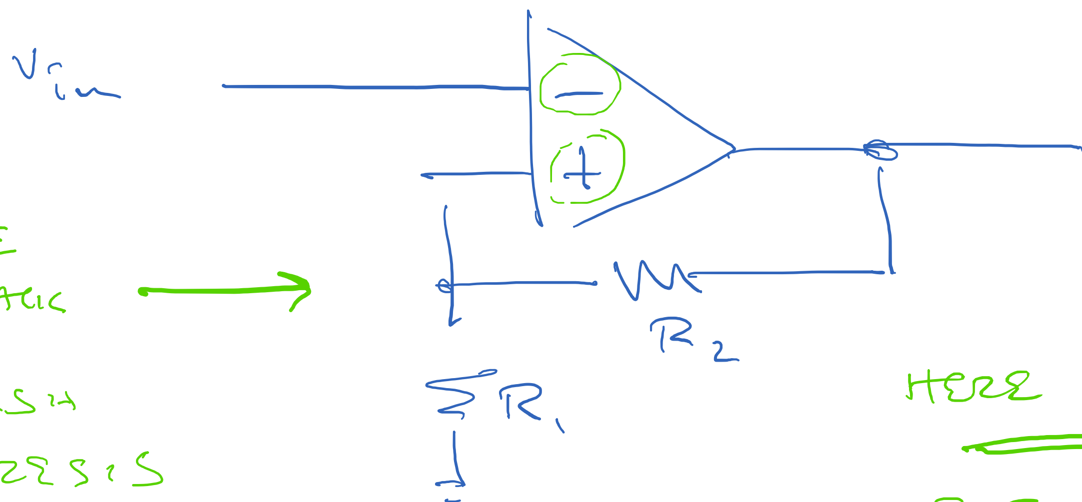
NAIVE APPROACH.





BETTER APPROACH

LOOKS LIKE NONINVERTING AMP.



$V_{out} = \pm V_S$

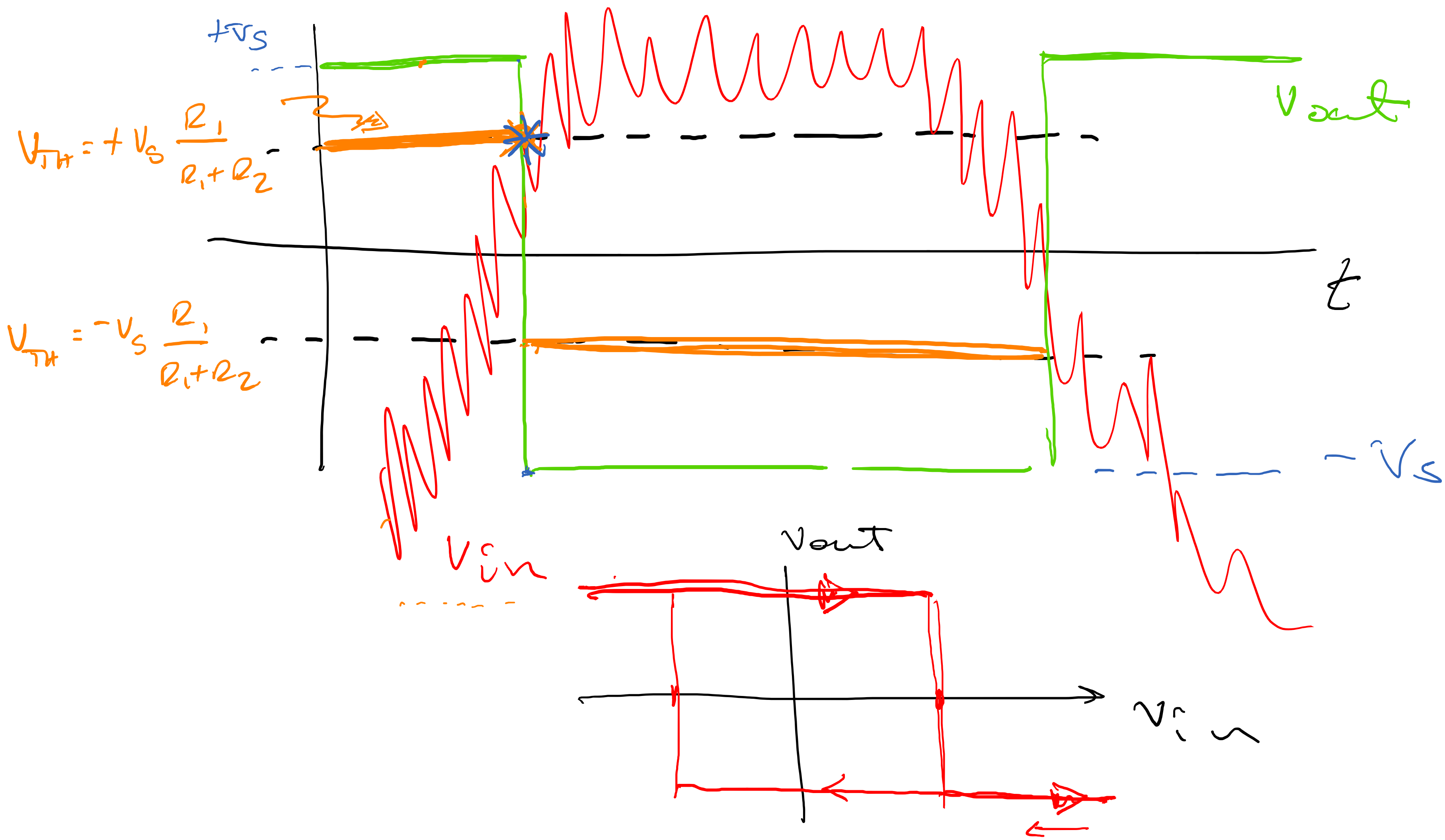
POSITIVE FEEDBACK TO ESTABLISH HYSTERESIS IN THRESH. DETECTOR.

HERE $V_- \neq V_+$

BUT, STILL, INPUTS DRAW NO CURRENT.

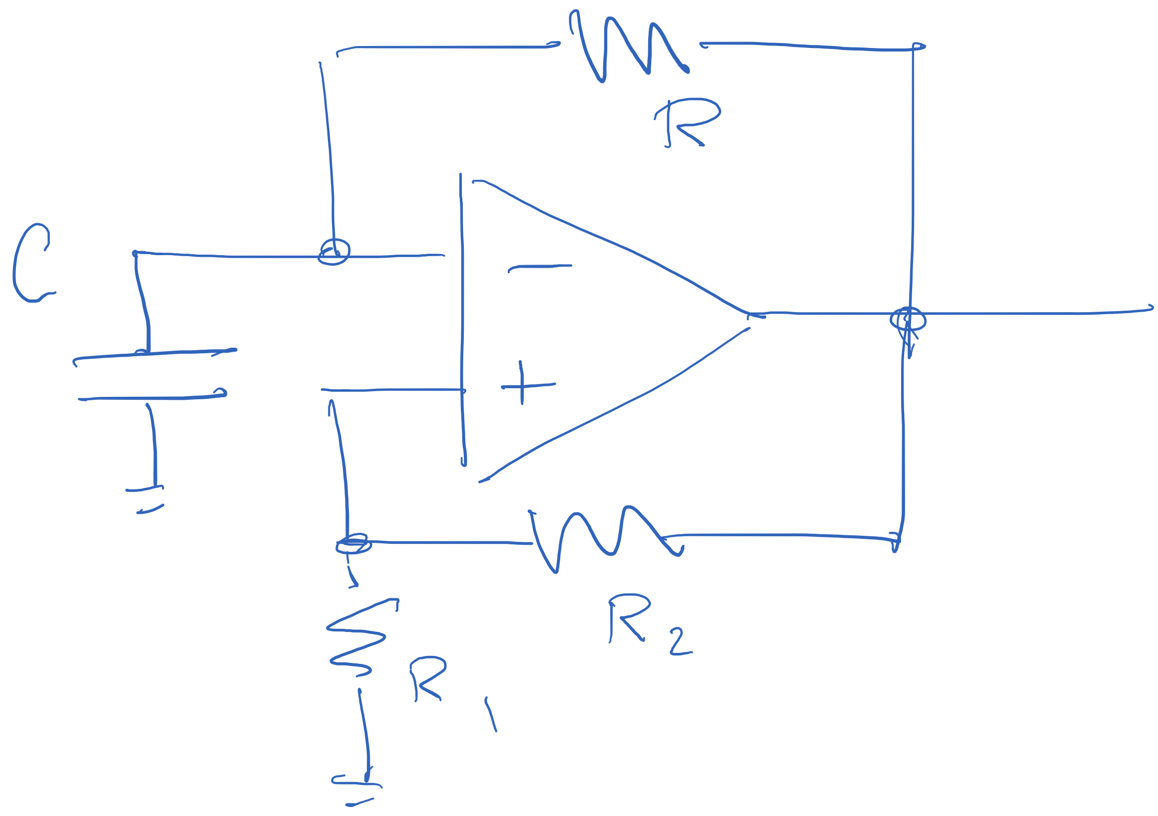
$$V_{TH} = \pm V_S \cdot \frac{R_1}{R_1 + R_2}$$

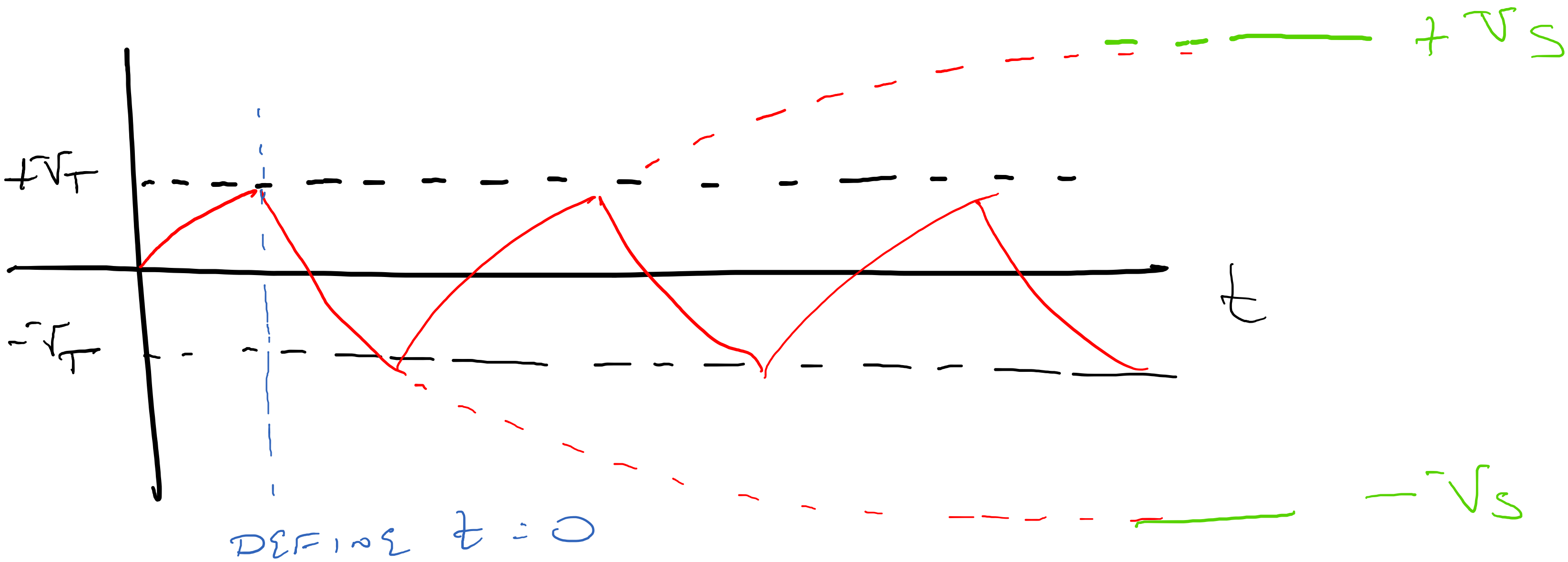
V_+



+Vs
$V_{TH} = +V_S \frac{R_1}{R_1+R_2}$
$V_{TH} = -V_S \frac{R_1}{R_1+R_2}$
Vout
t
-Vs
Vin
Vout
Vin

RELAXATION OSCILLATOR





$$V_{out}(t) = A e^{-t/\tau} + B \quad ; \quad V_{out}(t=0) = +V_T$$

$$V_{out}(t \to \infty) = -V_S$$

$$\Rightarrow V_{out}(t) = (V_T + V_S)\, e^{-t/\tau} - V_S$$

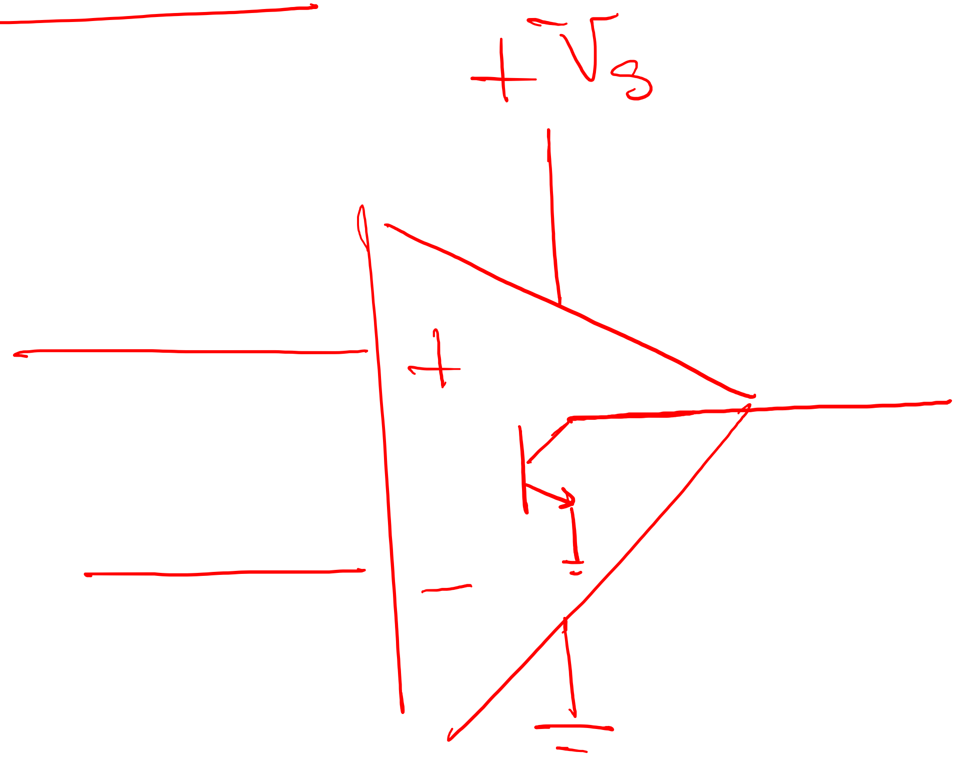
PERIOD?

$$-V_T = (V_T + V_S)\, e^{-T/2\tau} - V_S$$

$$\Rightarrow \quad T = 2\tau \ln\left(\frac{V_S + V_T}{V_S - V_T}\right)$$

e.g. $V_T = V_S/2 \Rightarrow T = 2\tau \ln 3$

COMPARATOR



Colpitts Oscillator