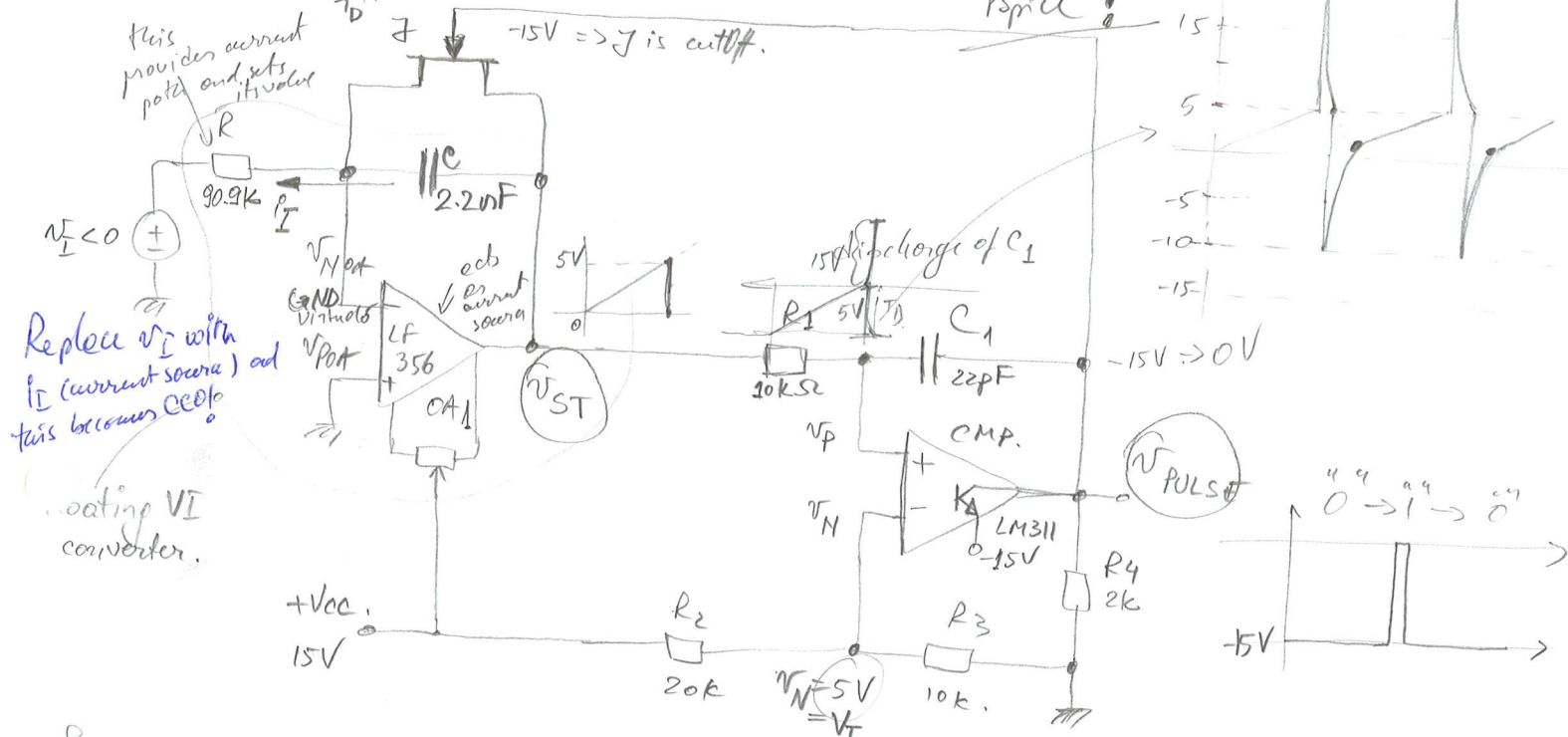
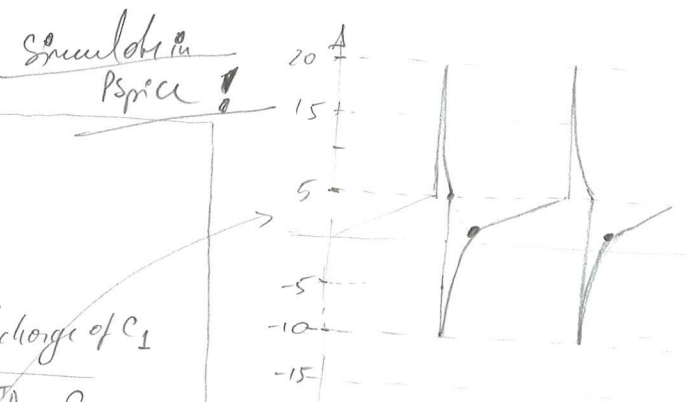
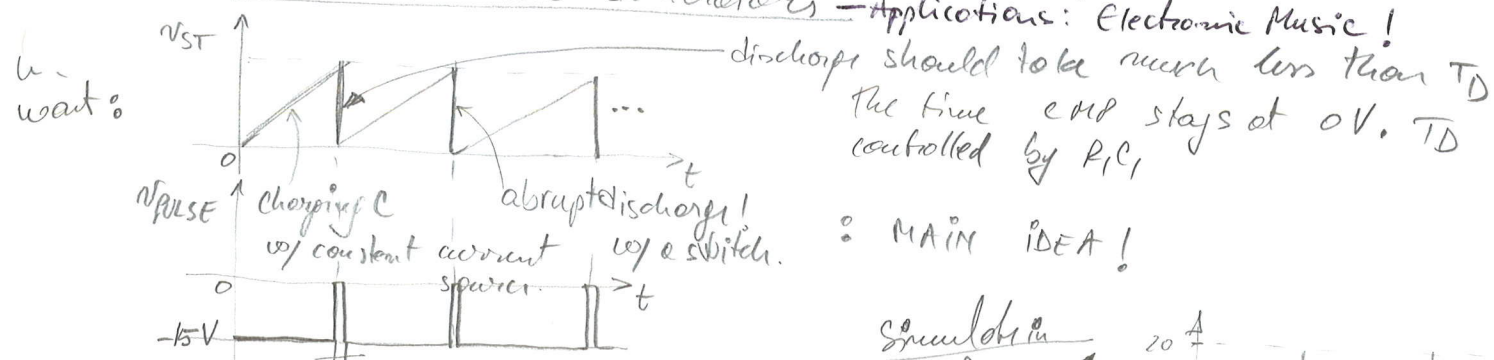


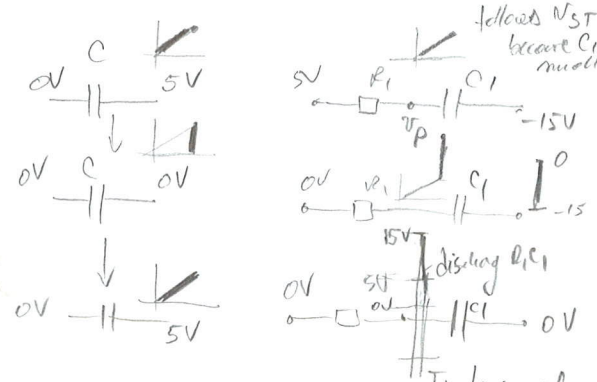
Sawtooth generator.
V-F, F-V converters.
Problem # 3 of Exam 2.

10.5. Sawtooth Wave Generators - Applications: Electronic Music!



Power on, $v_C = 0 \Rightarrow v_p \approx 0 < 5V = v_N \Rightarrow \{ \begin{aligned} v_{PULSE} = 0 \approx -15V \\ \text{JFET is cut off!} \\ \text{C is charging!} \end{aligned}$

When v_{ST} reaches $V_T = 5V \Rightarrow$ CMP trips its output!
 - R_4 pulls it to ground up!
 - C_1 helps with this pull-up because it's in a regenerative positive feedback!
 - J turns on and short-circuits C_1 !
 v_{ST} becomes zero; then:
 T_D designed such that v_{PULSE} stays high "1" long enough for J to completely discharge C.



Use Eq. 10.2 =>

$$\begin{cases} \Delta T = T_{CH} \\ I = \frac{|v_{E1}|}{R} \\ \Delta v = V_T \end{cases}$$

(2)

$$f_0 = \frac{1}{T_{CH} + T_D}$$

$$\Rightarrow f_0 = \frac{1}{RC \frac{V_T}{|v_{E1}|} + T_D} \stackrel{T_D \ll T_{CH}}{\approx} \frac{|v_{E1}|}{RC V_T}$$

linearly proportional to $|v_{E1}|$ (!)

$$v_{E1} \in [-10mV, -10V] \Rightarrow f_0 \in [10Hz, 10kHz]!$$

10.6 Monolithic Waveform Generators

ICL-8038 (Harris Semiconductor)
XR-2206 (Exar)

Exercise!

10.7 V-F and F-V converters

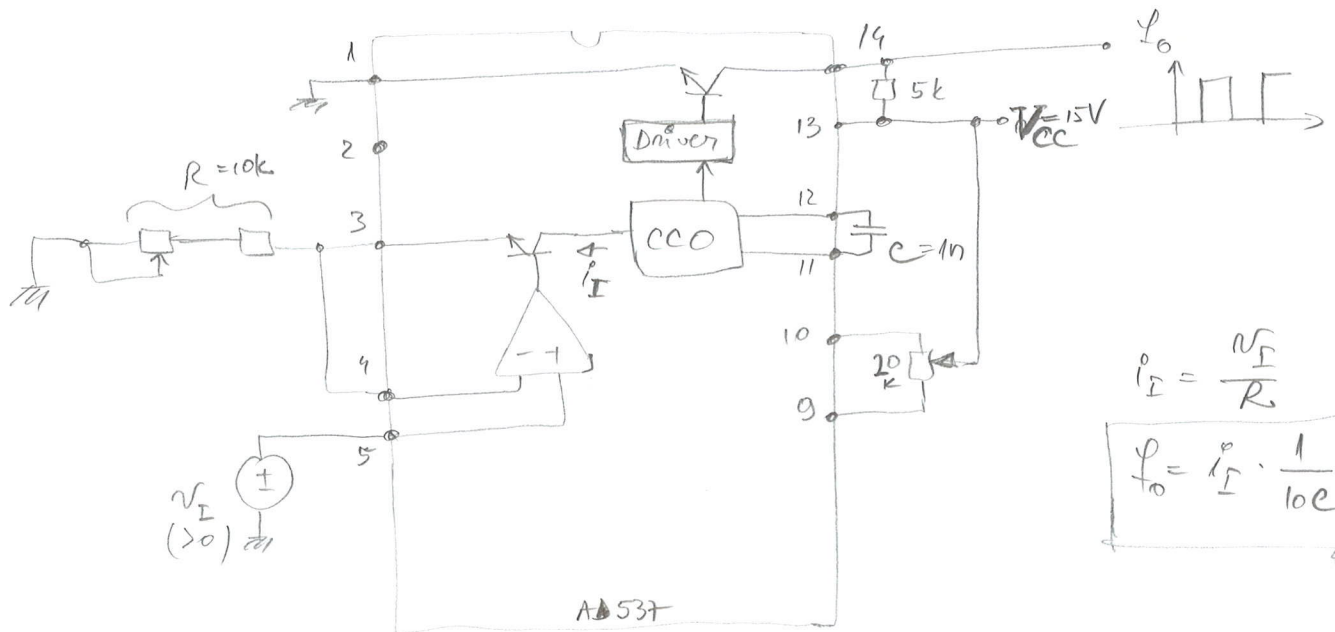
(a) Voltage-to-Frequency (V-F):

$$f_0 = k \cdot v_{E1}$$

(similar to VCO but of higher performance!)

AD537 (Analog Devices)

Bring Datasheet and discuss it!



$$i_{E1} = \frac{v_{E1}}{R}$$

$$f_0 = i_{E1} \cdot \frac{1}{10e}$$

$$v_{E1} \in [1mV, 10V] \Rightarrow f_0 \in [10Hz, 100kHz]$$

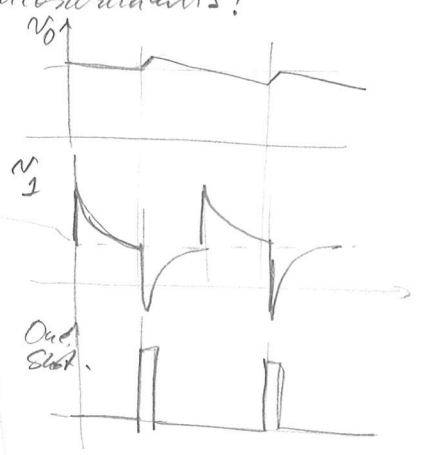
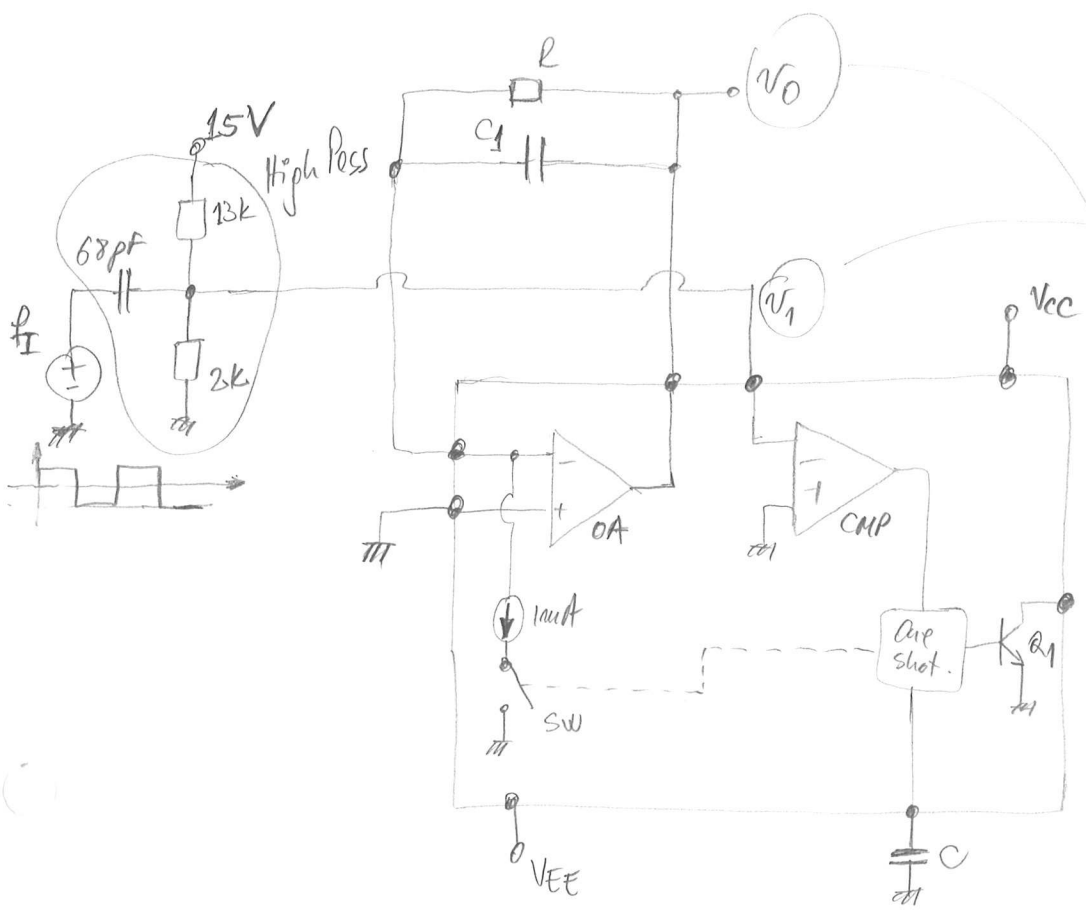
(a) Charge balancing VFC

Uses a precision-one-shot!?

(b) Frequency-to-voltage conversion.

$$V_0 = K \frac{f}{I}$$

Tachometers in motor speed control, rotational measurements!



$$V_0 = 7.5 RC f_I$$