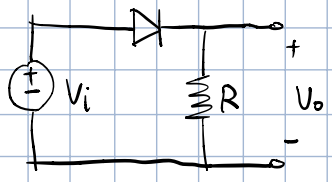
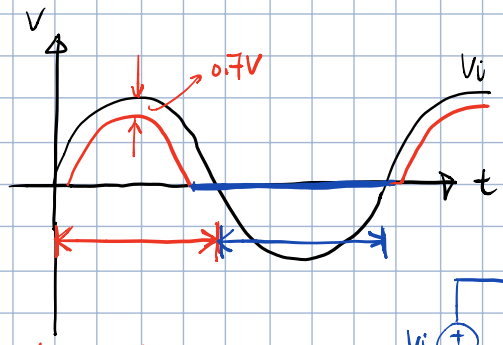
整流器.

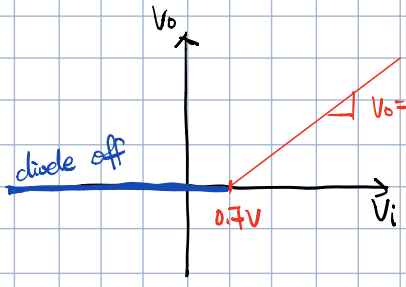
Rectifier, half wave, full wave, bridge, peak...

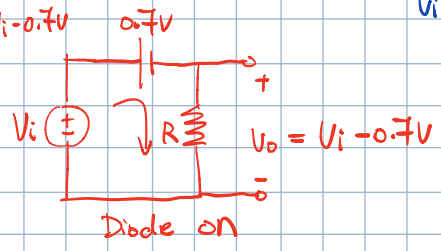
Half-Wave

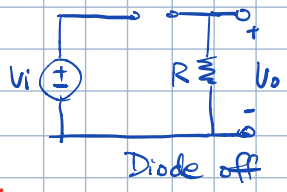
(CVD model: $V_D = 0.7V$ when on)



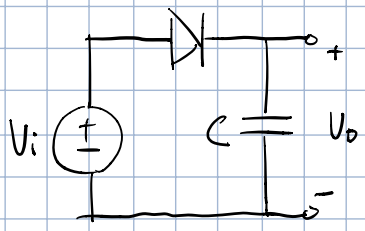


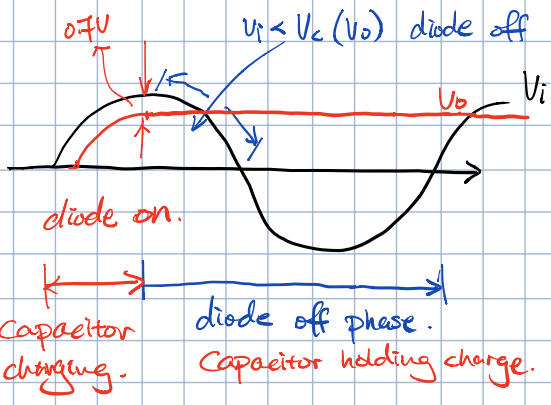




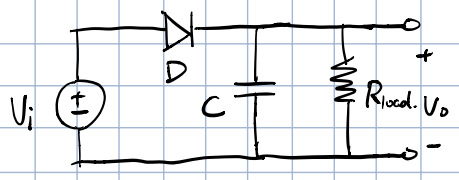


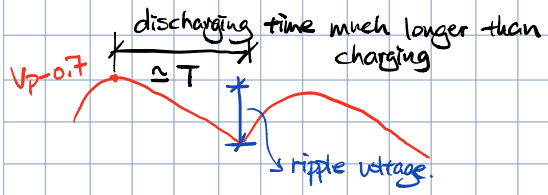
Half wave rec. with a capacitor:

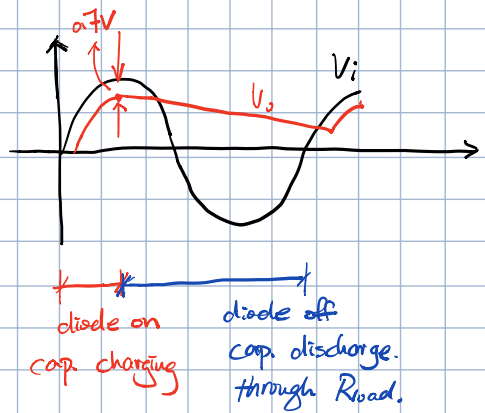


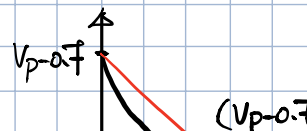


Application









$V_o = (V_p - 0.7)e^{-t/\tau} \approx (V_p - 0.7)(1 - \frac{t}{\tau})$

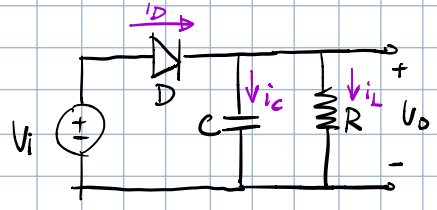
$V_o(t=T) = (V_p - 0.7)(1 - \frac{T}{\tau})$

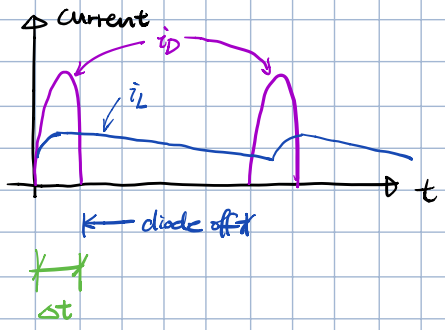
ripple voltage $= (V_p - 0.7) - V_o(t=T)$

$= V_p - 0.7 - (V_p - 0.7)(1 - T/\tau)$

$= (V_p - 0.7)\, T/\tau$

$T = 1/f$, $\tau = RC$, $V_r = \frac{V_p - 0.7}{RCf}$

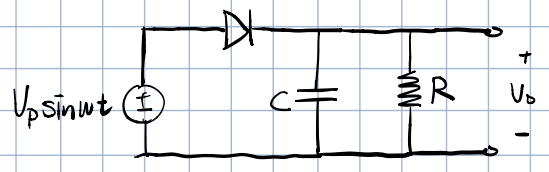




$\Delta t = \frac{\sqrt{2V_r/V_p}}{2\pi f}$

$i_{D_{max}} = i_L\,(1 + 2\pi\sqrt{2V_p/V_r})$, $i_L = \frac{V_p - 0.7}{R} \simeq \frac{V_p}{R}$

Example: a H.W.R (half-wave rectifier)

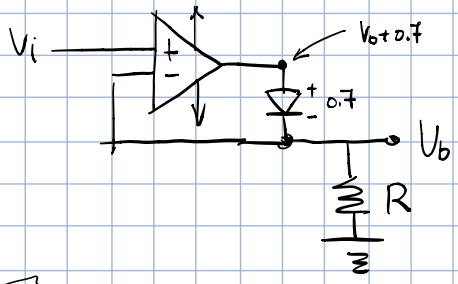


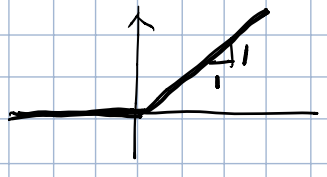
$f = 60$Hz $V_p = 10$V $R = 1$kΩ , design for $V_r = 0.02\,V_p$ find C.

$V_r = \frac{V_p}{RCf}$, $C = \frac{V_p}{RV_rf} = 833\,\mu$F

quick check $\Delta t = \frac{\sqrt{2V_r/V_p}}{2\pi f} = 530\,\mu$s for 60Hz $T = \frac{1}{60} = 16.7$ms

indeed short charging time.





when the diode is forward biased, current will flow through the diode, establish - ve feedback.

for the op-amp, hence $V_o = V_i$