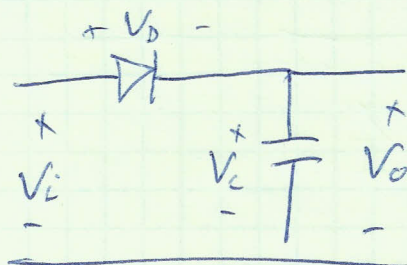


Peak Detector

$$V_i = V_D + V_C$$

$$V_O = V_C$$

Diode ON: $V_D = V_{D0}$

$$V_C = V_i - V_{D0}$$

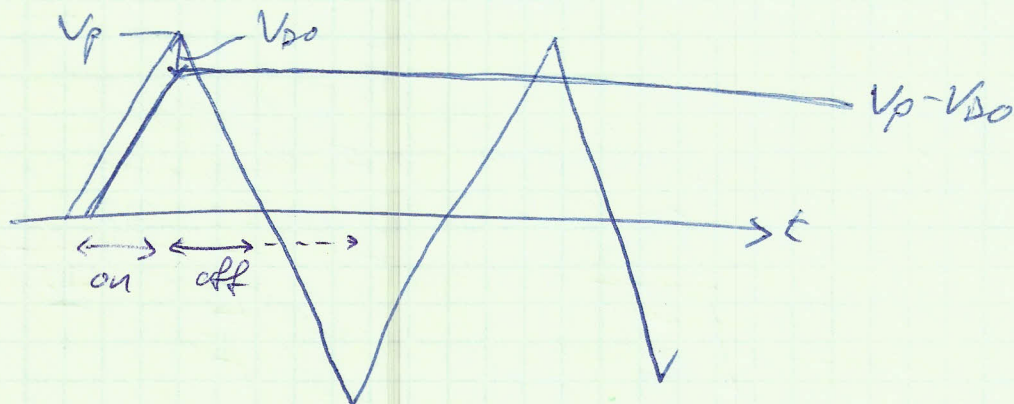
$$i_D = i_C = C \frac{dV_C}{dt} = C \frac{d}{dt} (V_i - V_{D0})$$

for $i_D \geq 0$, $\frac{dV_i}{dt}$ must be > 0

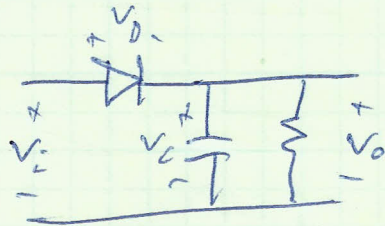
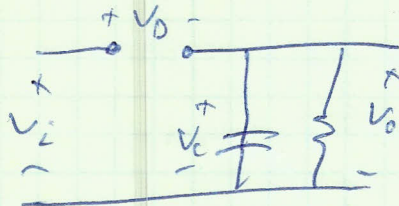
Diode OFF

diode is OFF as long as $V_D = V_i - V_C \leq V_{D0}$

or $V_i \leq V_C + V_{D0}$



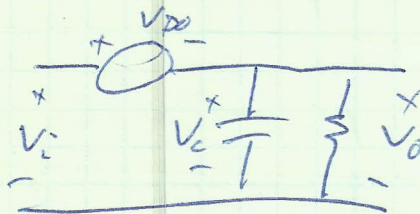
- Charges capacitor up to $V_p - V_{D0}$ and then stays there

Peak detector with resistor - for practical loadDiode OFFcapacitor discharges with time constant $\tau = RC$

$$V_O = V_{C0} e^{-(t-t_0)/\tau}$$

diode is OFF when $V_D = V_i - V_O < V_{D0}$

$$\text{or } V_i < V_C + V_{D0}$$

Diode ON

$$V_O = V_C = V_i - V_{D0}$$

$$i_D = i_C + i_R = C \frac{d}{dt} (V_i - V_{D0}) + \frac{V_i - V_{D0}}{R}$$

$$= C \left[\frac{d}{dt} (V_i - V_{D0}) + \frac{1}{\tau} (V_i - V_{D0}) \right]$$

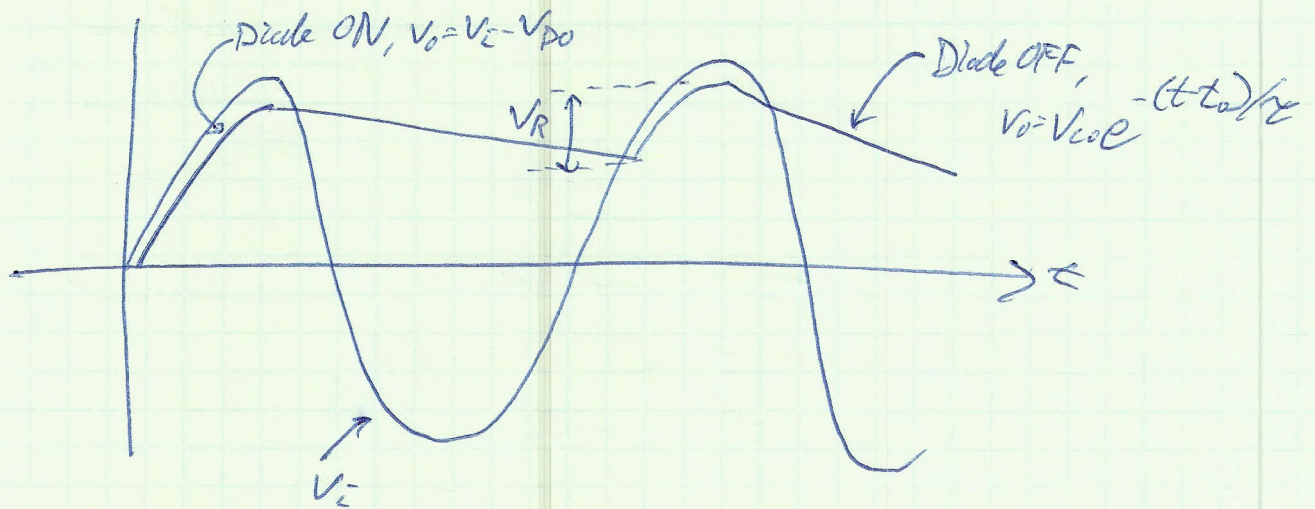
- assume $\tau \ll T$ (period of signal)

then first term is small, and circuit behaves as simple rectifier

- assume $\tau \gg T$

then second term is small, circuit behaves as ideal peak detector

Peak detector - continued



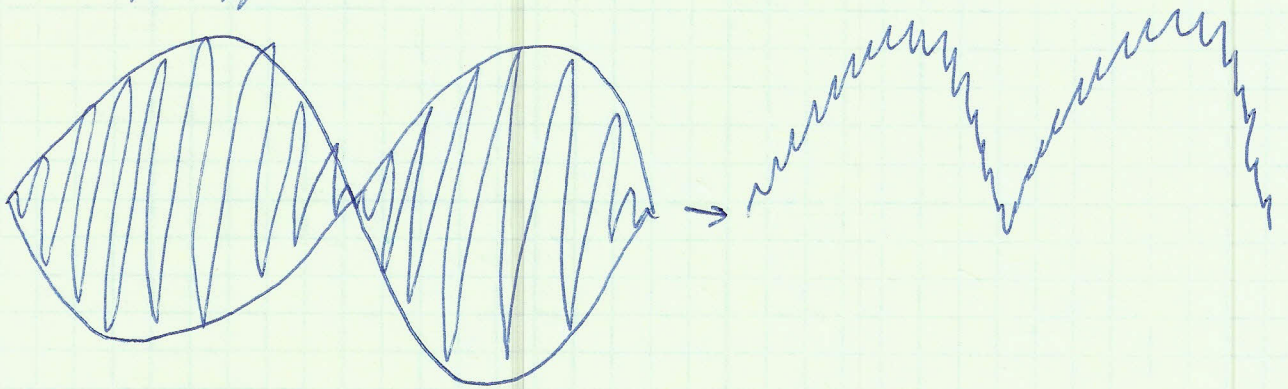
V_R = ripple voltage

time to bottom of ripple is approximately T

$$V_C = (V_P - V_{D0}) e^{-T/\tau} \approx (V_P - V_{D0}) \left(1 - \frac{T}{\tau}\right)$$

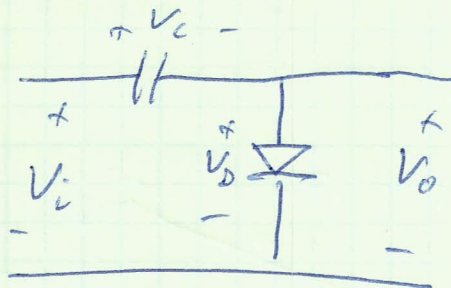
$$\left| \frac{V_R}{V_P - V_{D0}} \right| \approx \frac{T}{\tau}$$

example application: AM radio reception



Clamp Circuit

$$V_i = V_c + V_D$$

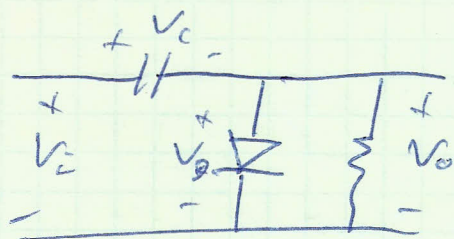


for ideal, $V_c = V_p - V_{D0}$, just like peak detector

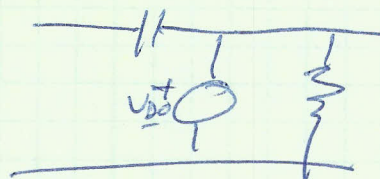
$$\begin{aligned} V_i &= V_p - V_{D0} + V_D \\ V_o &= V_D \end{aligned} \quad \rightarrow \quad V_o = -(V_p - V_{D0}) + V_i$$

Voltage at output is shifted by DC value of $-(V_p - V_{D0})$

There is usually also a resistor (load)

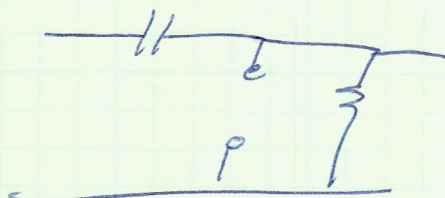


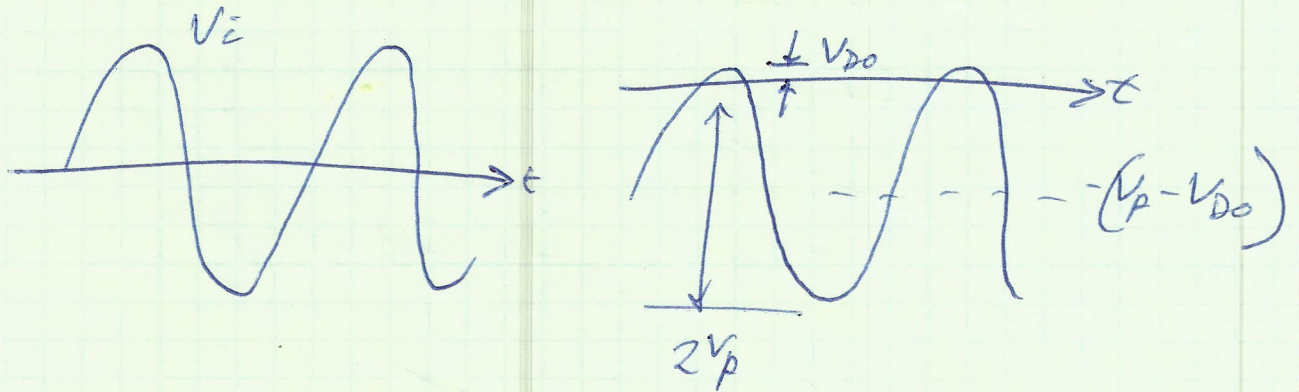
Diode ON $V_c = V_p - V_{D0}$



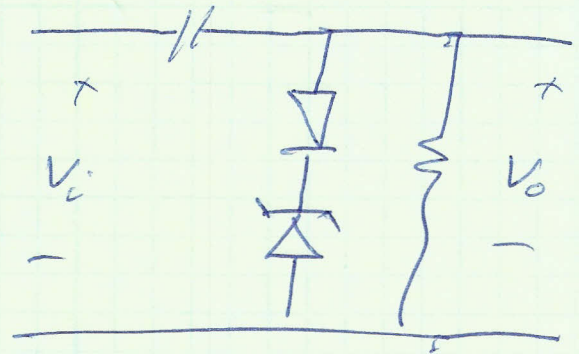
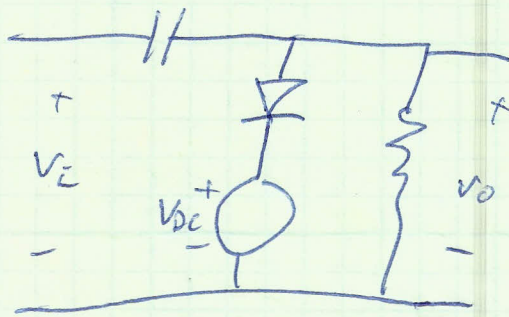
Diode OFF

$$\begin{aligned} V_o &= V_i - V_c \\ &= V_i - (V_p - V_{D0}) \end{aligned}$$





can also use DC offset or Zener diodes



can also produce up-shift

