Lecture 14

Diode Applications (contd.)

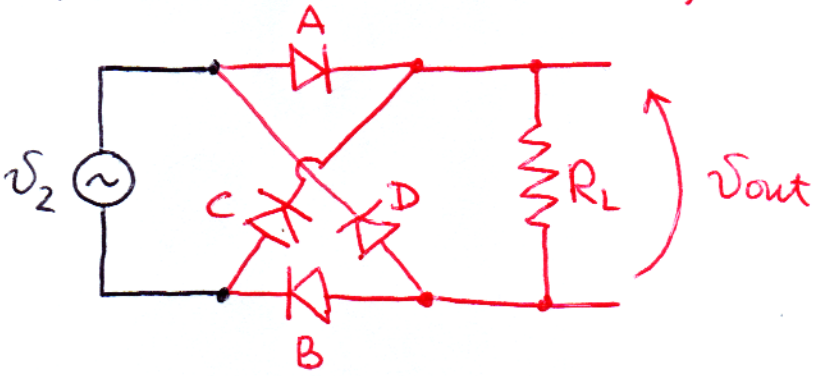
① rectifiers

recall filter capacitor

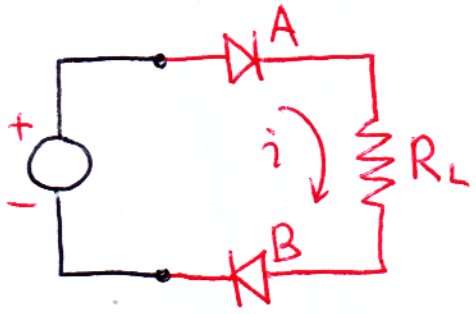
ripple: $\frac{dV}{dt} = \frac{I}{C}$, $\frac{\Delta V_{out}}{T} = \frac{I_{LOAD}}{C} \Rightarrow \Delta V_{out} = \frac{I_{LOAD}}{C}\frac{1}{f}$

f: 60Hz

full wave rectifier half-wave rect. wastes $\frac{1}{2}$ volt. cycles

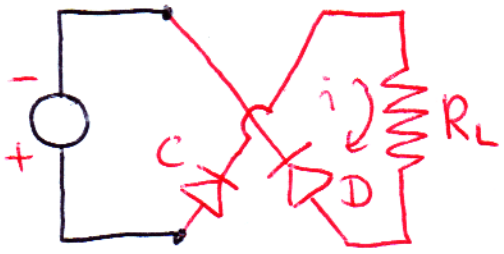


a)

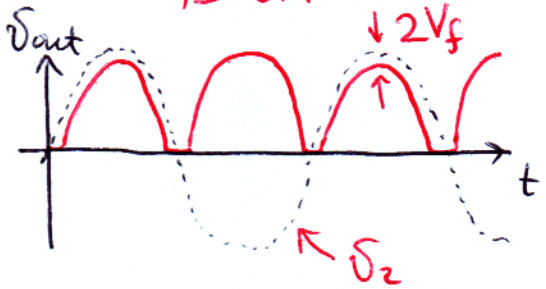


C, D OFF

b)



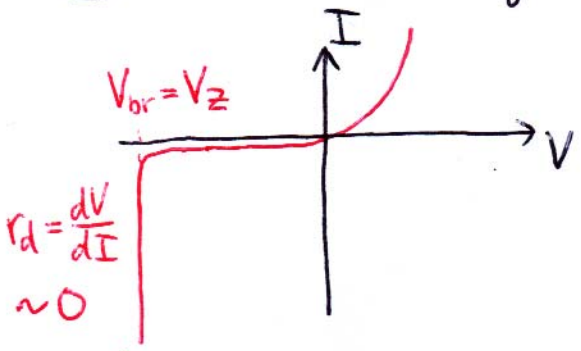
A, B OFF



Pros: – full wave used

– ripple freq 120Hz (smaller ripple)

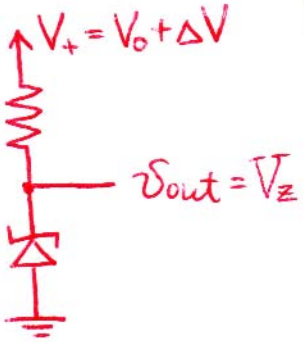
② Zener voltage reference

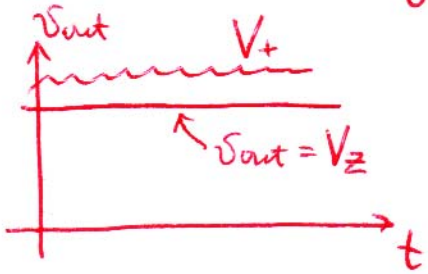


↑ uses the breakdown part of I-V curve

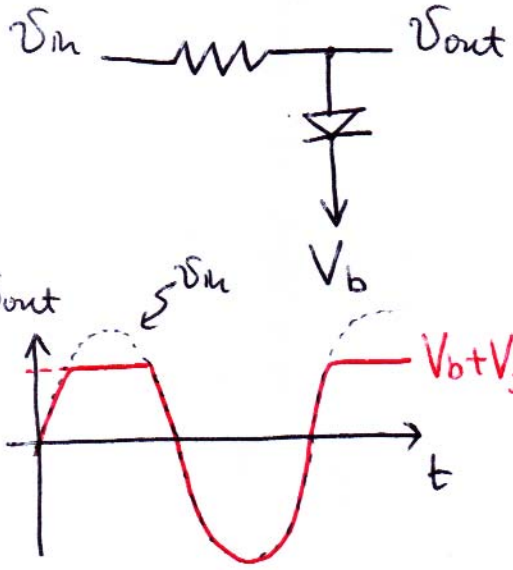
Zener diode symbol

$V_Z \sim 2\text{-}200V$ (buy)



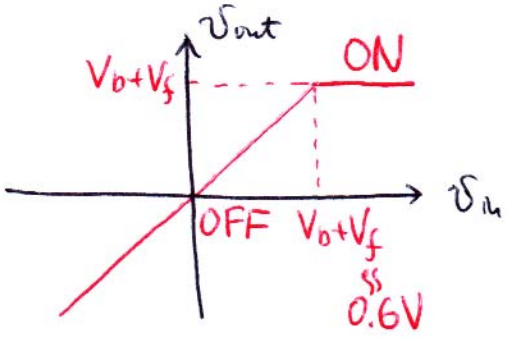


③ Clipping circuit (limiter or clamper)



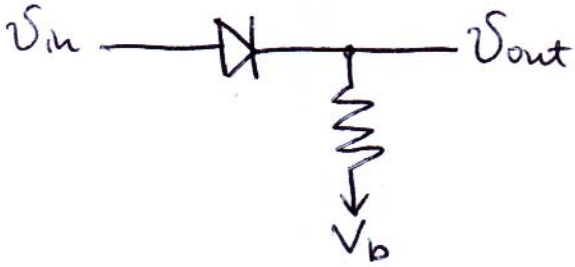
$v_{out} < V_b + V_f$, $\Rightarrow$ D is OFF
$\Rightarrow v_{out} = v_{in}$

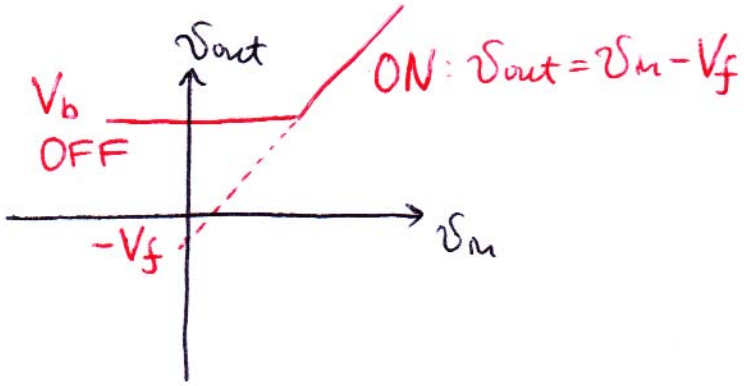
$v_{out} \gtrsim V_b + V_f$, $\Rightarrow$ D is ON
$\Rightarrow v_{out} \approx V_b + V_f$

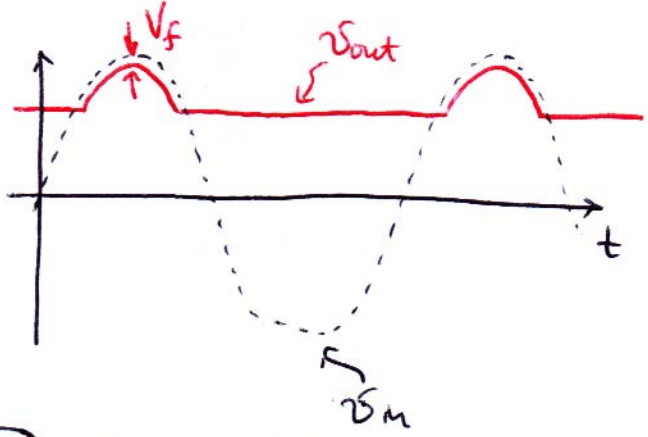


- e.g. use in IC overvoltage protection

④ Pickoff circuit

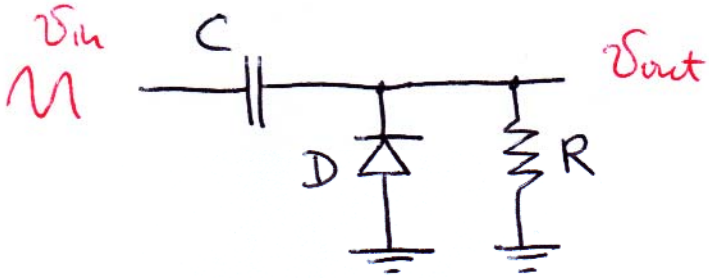






- e.g. set signal threshold ③

⑤ Voltage doubler



let $\frac{1}{2\pi RC} \ll f$

$v_{in} - v_c < -V_f$ ⇒ D is ON, R_D is small

v_c time const ~ $R_D C \ll RC$

$v_{out} \sim -V_f$ (0.6V)

$v_c = v_{in} + V_f$

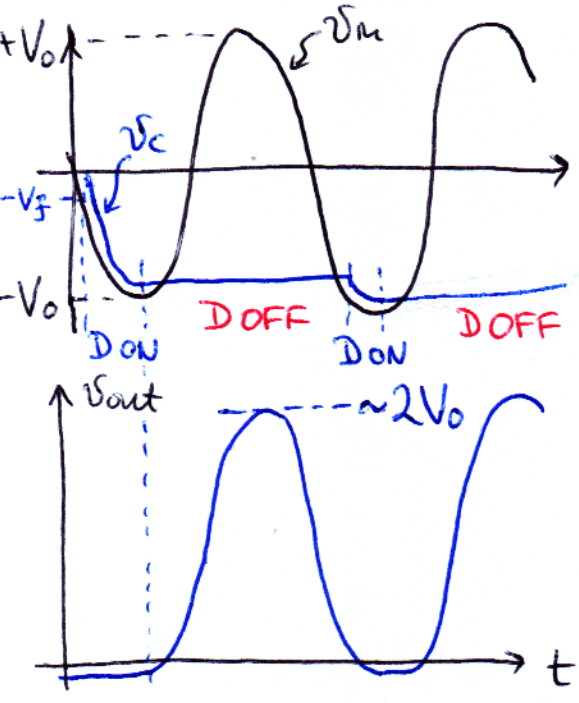
$v_{in} - v_c > -V_f$ ⇒ D is OFF, R_D is large

v_c time const $RC \gg \frac{2\pi}{f}$

v_c stays const

$v_{out} = v_{in} - v_c$

const & negative

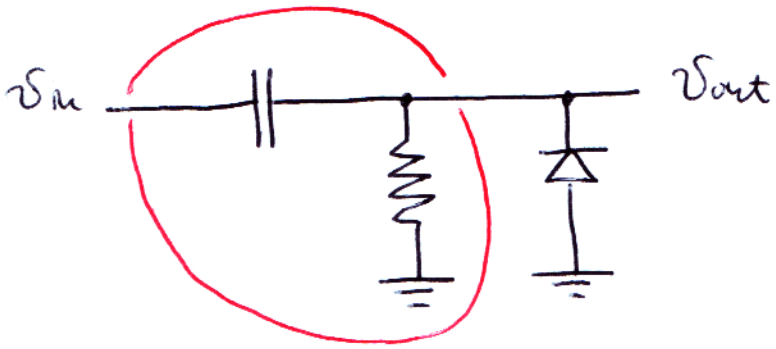


HW: Walton Cockroft generator

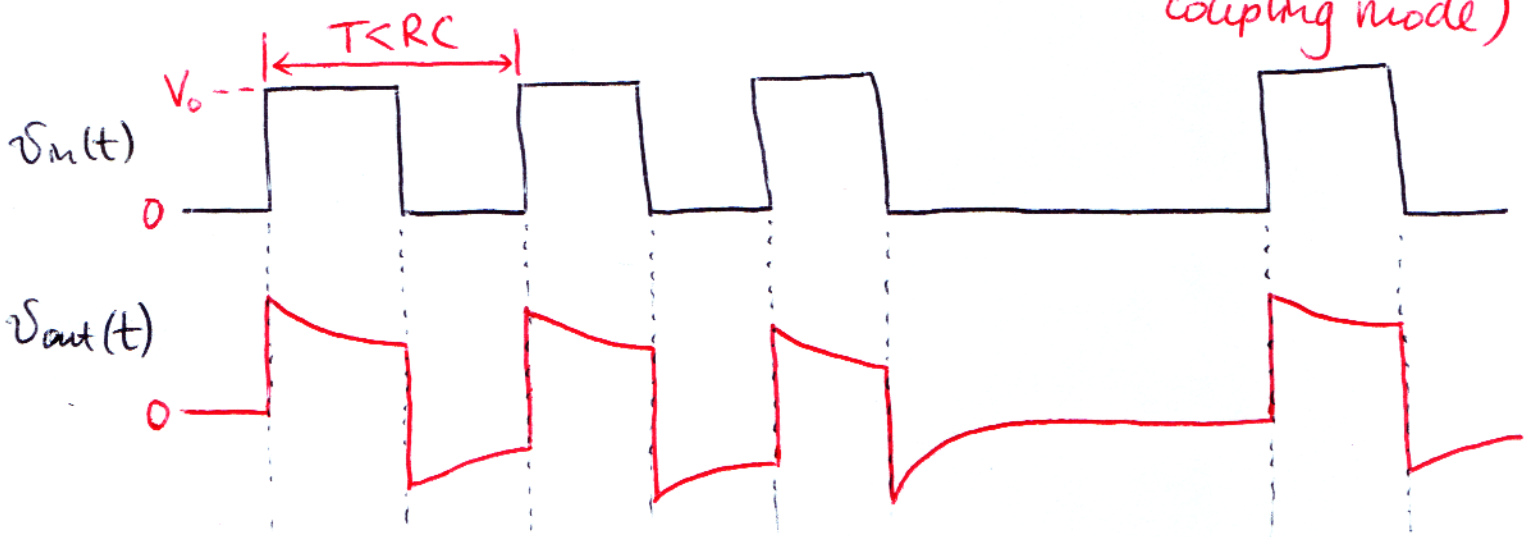
~1.5 MV proton accelerator

p + Li → He + ...

⑥ DC restoration circuit (same circuit, different way to look at it)



RC form HP filter : C blocks DC of v_{in} (e.g. scope's AC coupling mode)



Problem : if pulse separation varies in time, DC level of output changes

Soln :

- RC const for "−"ve part of the waveform much shorter than for "+" part b/c D is ON