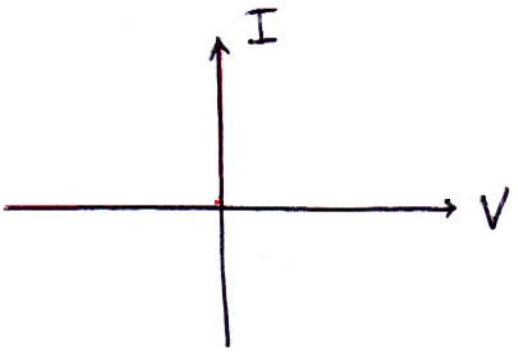
Lecture 13

Diodes

- 2 terminal

1) ideal diode



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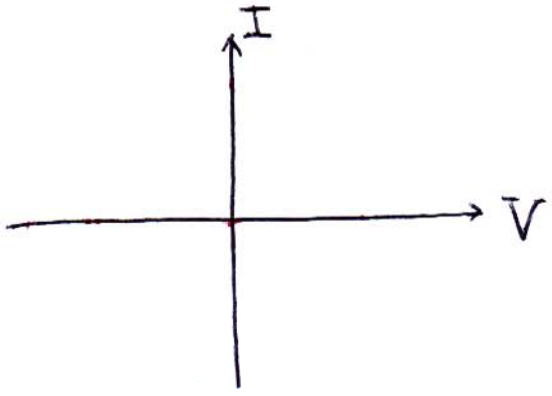
2) real diode



Shockley equation

$$I = I_0\left(e^{\frac{V}{V_T^*}} - 1\right)$$

I_0 –

V_T^* –

3) diode resistance

$$R_D = \frac{V}{I} =$$

$$r_d = \frac{dV}{dI} =$$

4) modes of operation

V	I(mA)	$R_D(\Omega)$	$r_d(\Omega)$
0.1			
0.2			
0.3			
0.4			
0.5			
0.6			
0.7			
0.8			
0.9			
1.0			

5) max ratings

forward I_{max} (DC)

V_{br}

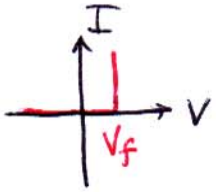
Power dissipation on a diode $P = I \cdot V$

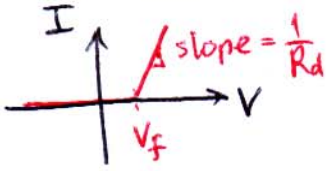
For fixed I, $dV/dT \approx -2mV/°C$

E.g. fixed voltage bias:

Diode circuit analysis

ideal diode 

→ approximate model 

→ approximate resistive model 

→ Shockley eqn.

Diode types

- signal: fast, small I
- power (rectifier): large I
- Zener: const $V_{br} = V_z$
- LED: GaAs, InP $V_f \sim 1.5$-2V

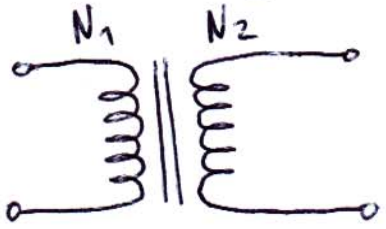
Diode applications

① rectifiers

High voltage lines:

To step down high volt:

DC power supply



i) transformer

Lecture 14

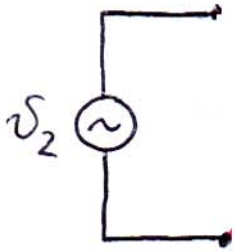
Diode Applications (contd.)

① rectifiers

recall filter capacitor

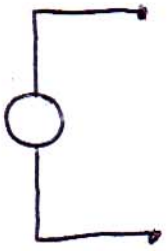
ripple: $\frac{dV}{dt} = \frac{I}{C}$,

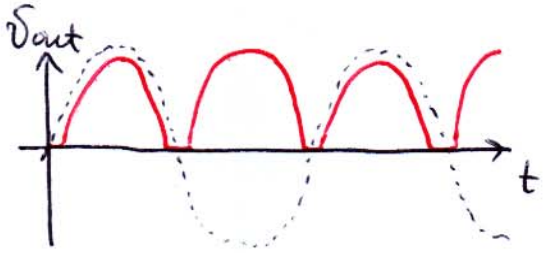
full wave rectifier



a)

b)

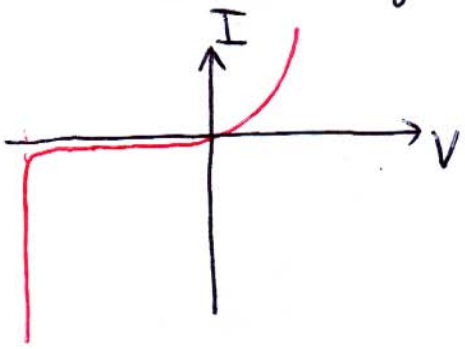




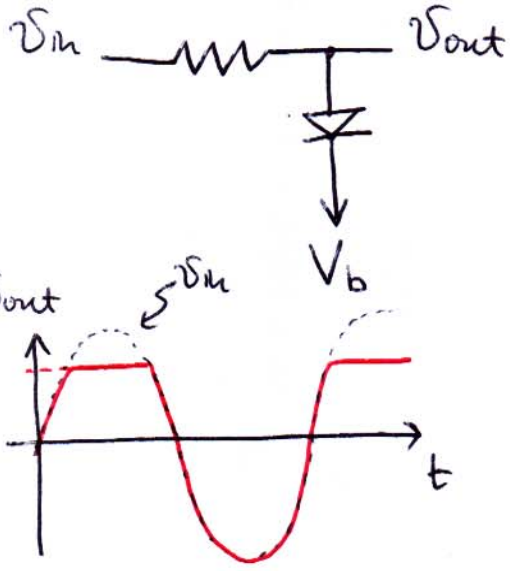
Pros: –

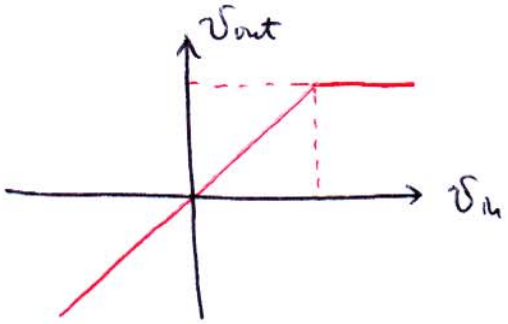
–

② Zener voltage reference

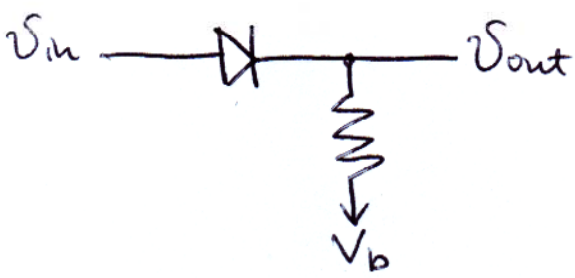


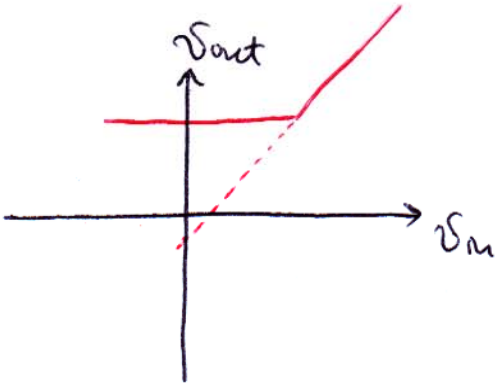
③ Clipping circuit

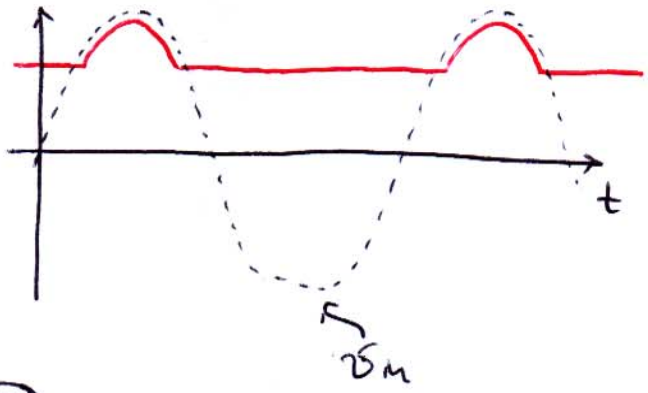




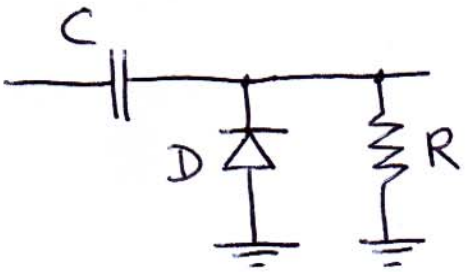
④ Pickoff circuit





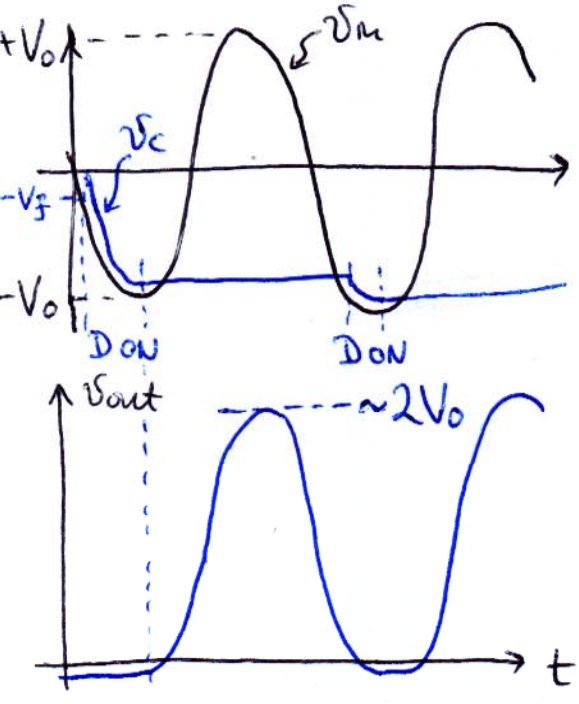


⑤ Voltage doubler

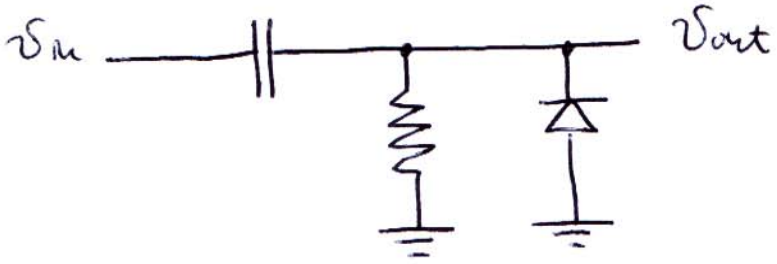


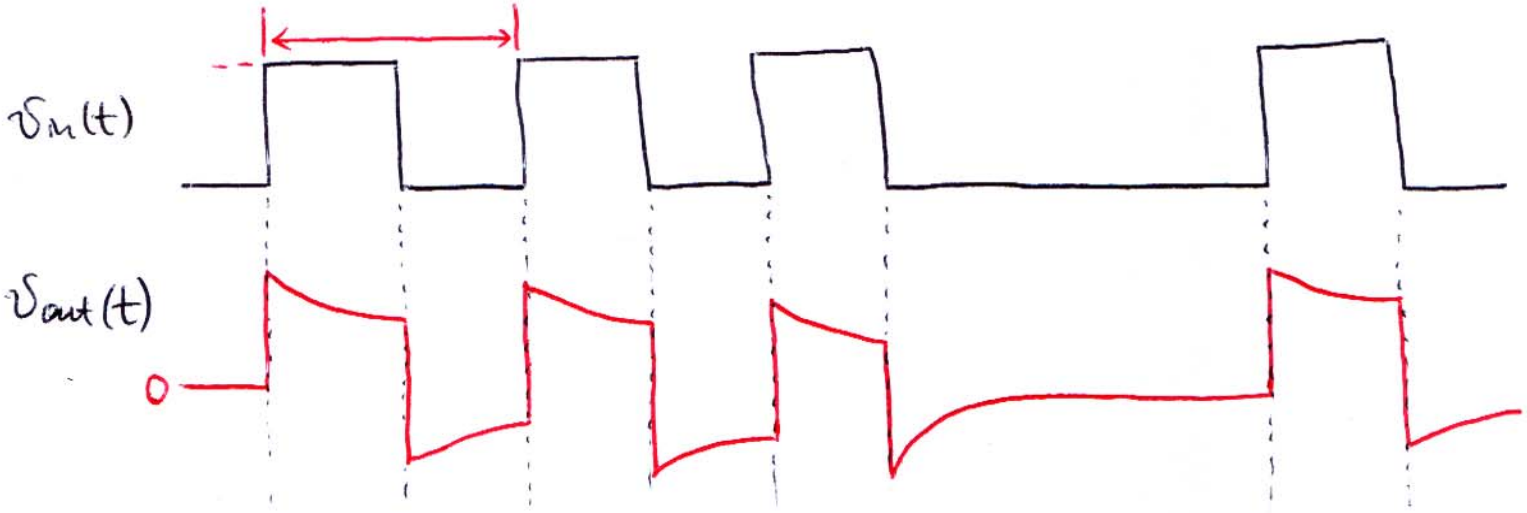
$v_m - v_c < -V_f$

$v_m - v_c > -V_f$

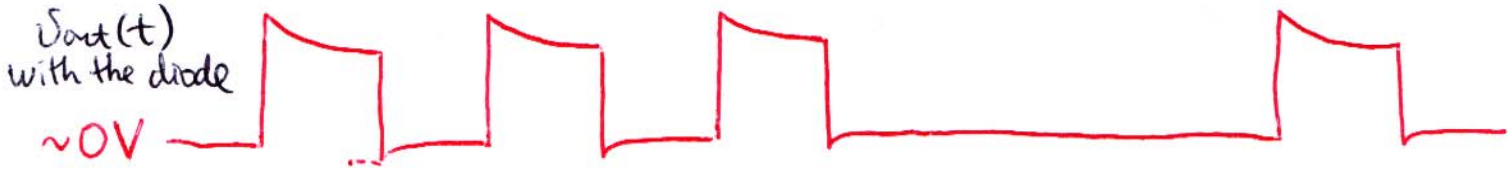


⑥ DC restoration circuit





Problem :

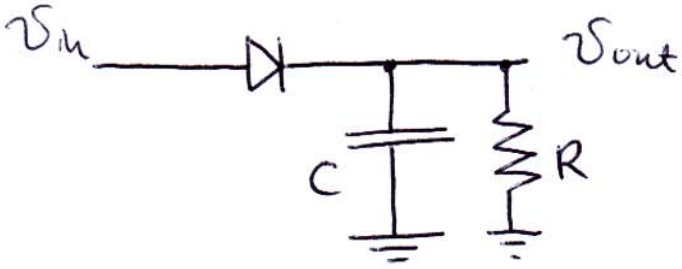


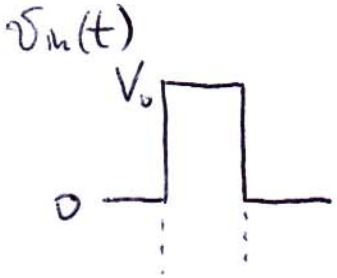
P3360/AEP 3630

Lecture 15

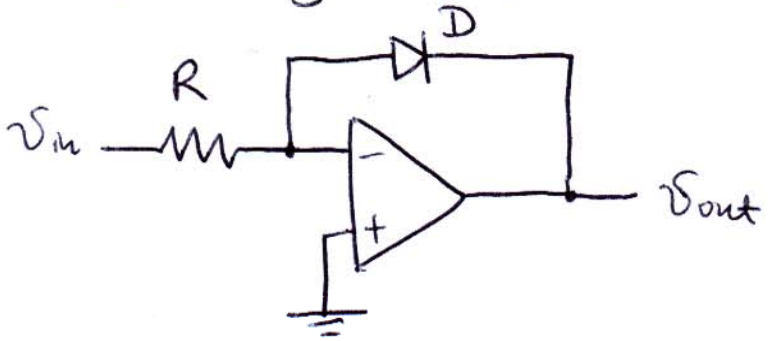
Diode applications (contd.)

⑦ Pulse stretcher





⑧ Log amplifier



- use to

- use to

(9) Anti-log amplifier

Diode :

Transistor : _

_

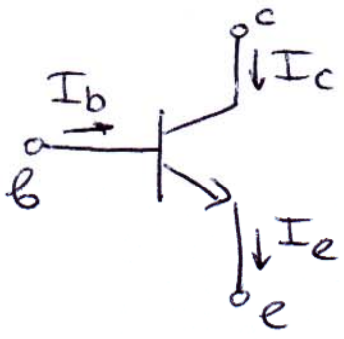
Bipolar junction transistor

2 types

arrow on emitter :

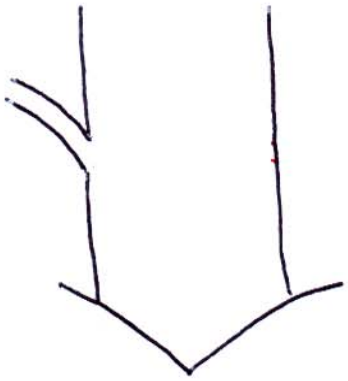
npn ↔ pnp

npn



KCL : $I_e = I_b + I_c$

Typical values:



I_c is controlled by I_b

$\Rightarrow$ transistor in normal operation

N.B. transistor