Power

Amplifiers

Power Transistors:

→ Are capable of dissipating larger power (say > 1W typically)

→ Usually require a heat sink

→ Usually have lower B

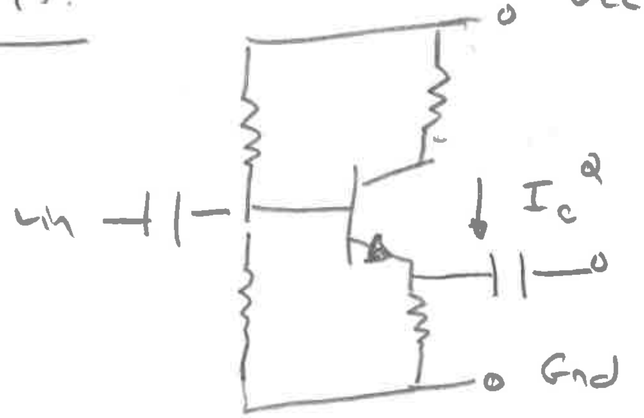
eg. BD 139:

$P = 1.25W$ w/o heatsink

$P = 12.5W$ w/ heatsink

$B > 40$ at $I_c = 0.15A$

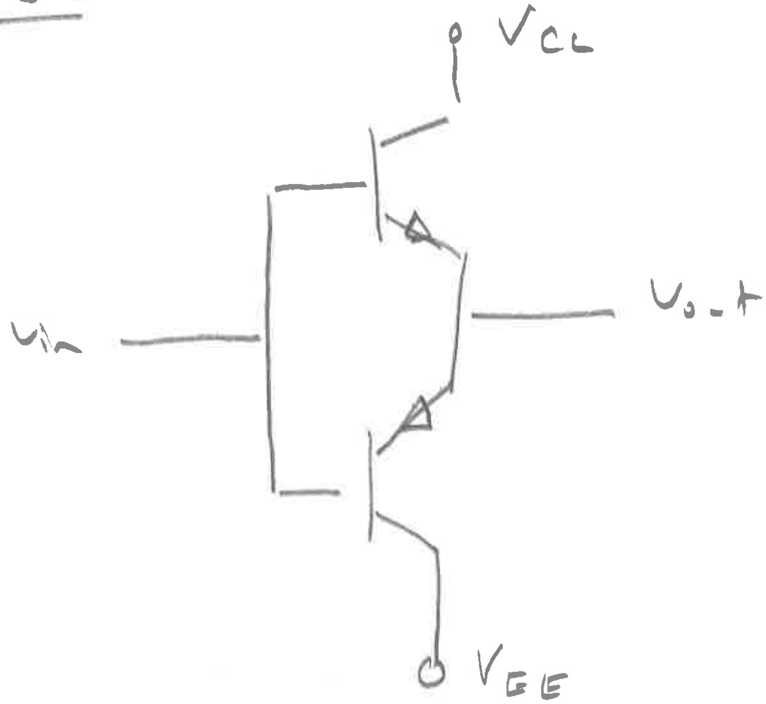
Class A:



$I_c^Q > 0$

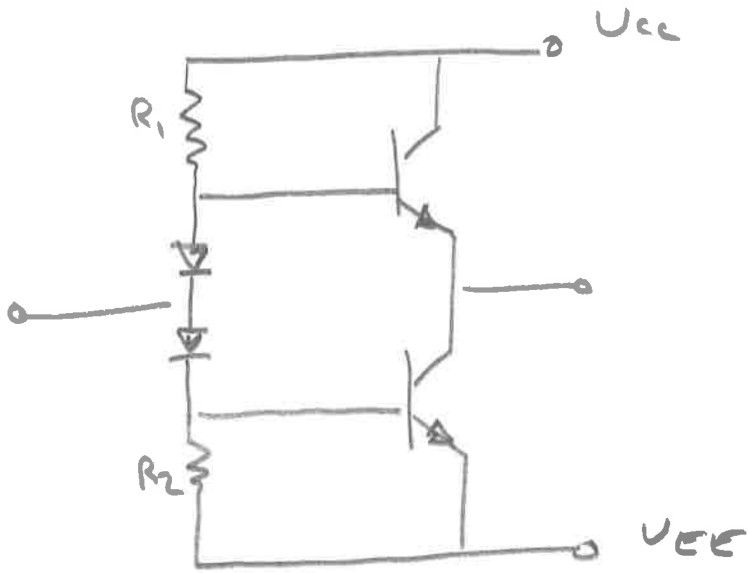
Problem: $I_c^Q > 0$ wastes energy!
Not suitable for <u>power</u> amplifiers!

Class B:



Each active device on for ~180°
No I_c^Q ...
Problem: Crossover Distortion.

Class AB Amplifier



Choose R_1 and R_2 to ensure enough base current at peak output

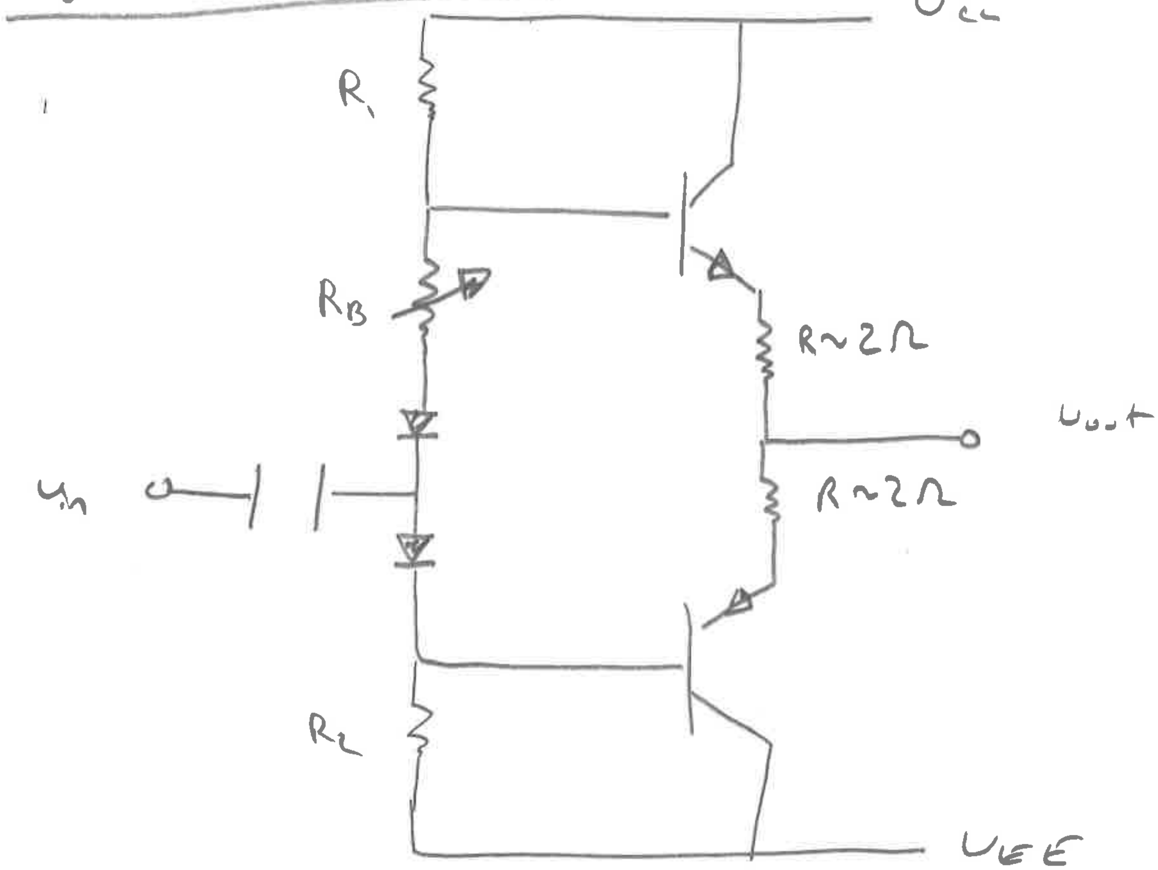
$$P_{max} = \frac{\left(\frac{1}{2}(V_{cc} - V_{EE})\right)^2}{R_L} = \frac{V_{cc}^2}{R_L}$$

$$I_{max} = \frac{V_{cc}}{R_L} = B\,\frac{V_{cc}}{R_1}$$

$$\boxed{R_1 \sim B\,R_L}$$

1st Problem: T instability ... Power transistors heat up more than diodes, Q-point moves ...

Adjustable Q-point



Now bias point can be adjusted with R_B so that

$$U_{out}^{Q} = 0$$

Real Example:

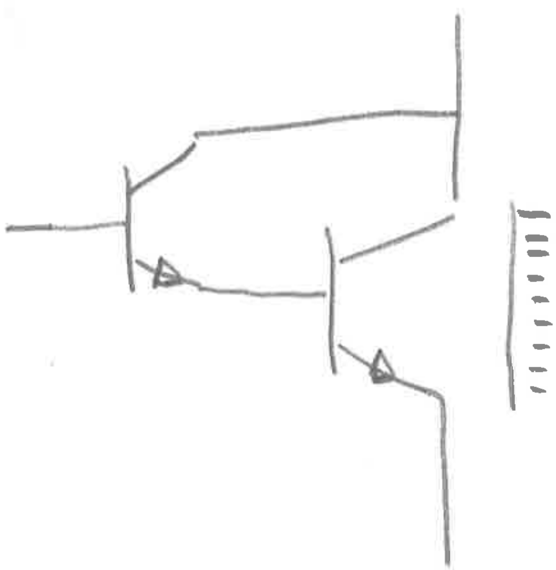
$P_{max} = 12.5\ W$, $V_{cc} = 10V$, $R_L = 8\Omega$, $B = 40$

$R_1 = B R_L = 320\ \Omega$

$P_R = \frac{V^2}{R} = \frac{100\ V^2}{320\ \Omega} > \frac{1}{4} W$

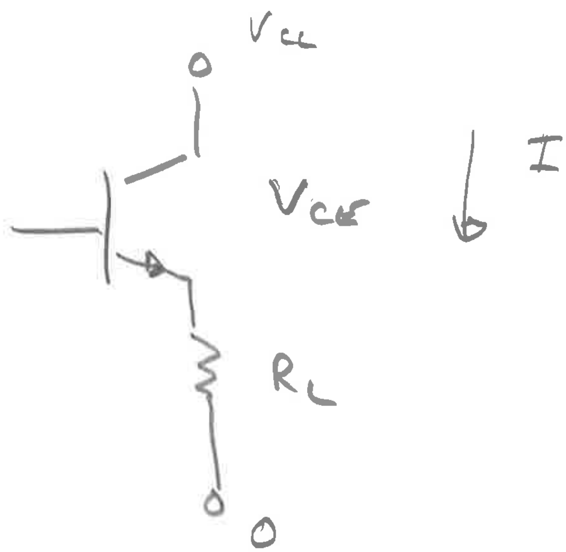
Solutions: Get power $\uparrow R$!

B-boosting Darlington Transistor



$B = B_1 \times B_2$

Power Limitations:



$$P_T = V_{CE} \cdot I$$

$$= V_{CE} \frac{(V_{cc} - V_{CE})}{R_L}$$

$$\frac{dP_T}{dV_{CE}} = \frac{V_{cc} - 2V_{CE}}{R_L} = 0 \Rightarrow \boxed{V_{CE} = \frac{1}{2} V_{cc}}$$

$$P_T^{max} = \left(\frac{1}{2} V_{cc}\right)^2 / R_L$$

$$V_{cc}^{(max)} = 2 \cdot \left(P_T^{max} R_L\right)^{\frac{1}{2}}$$

e.g. $12.5\,W$, $8\,\Omega$ $\Rightarrow$

$$V_{cc}^{max} = 2 \cdot (12.5 \times 8)^{\frac{1}{2}}\ V$$

$$V_{cc}^{max} = 20\ V \quad (\text{or } +10V, -10V)!$$

(40W speakers :(!)

Feed back !