# BJT POWER AMPLIFIER

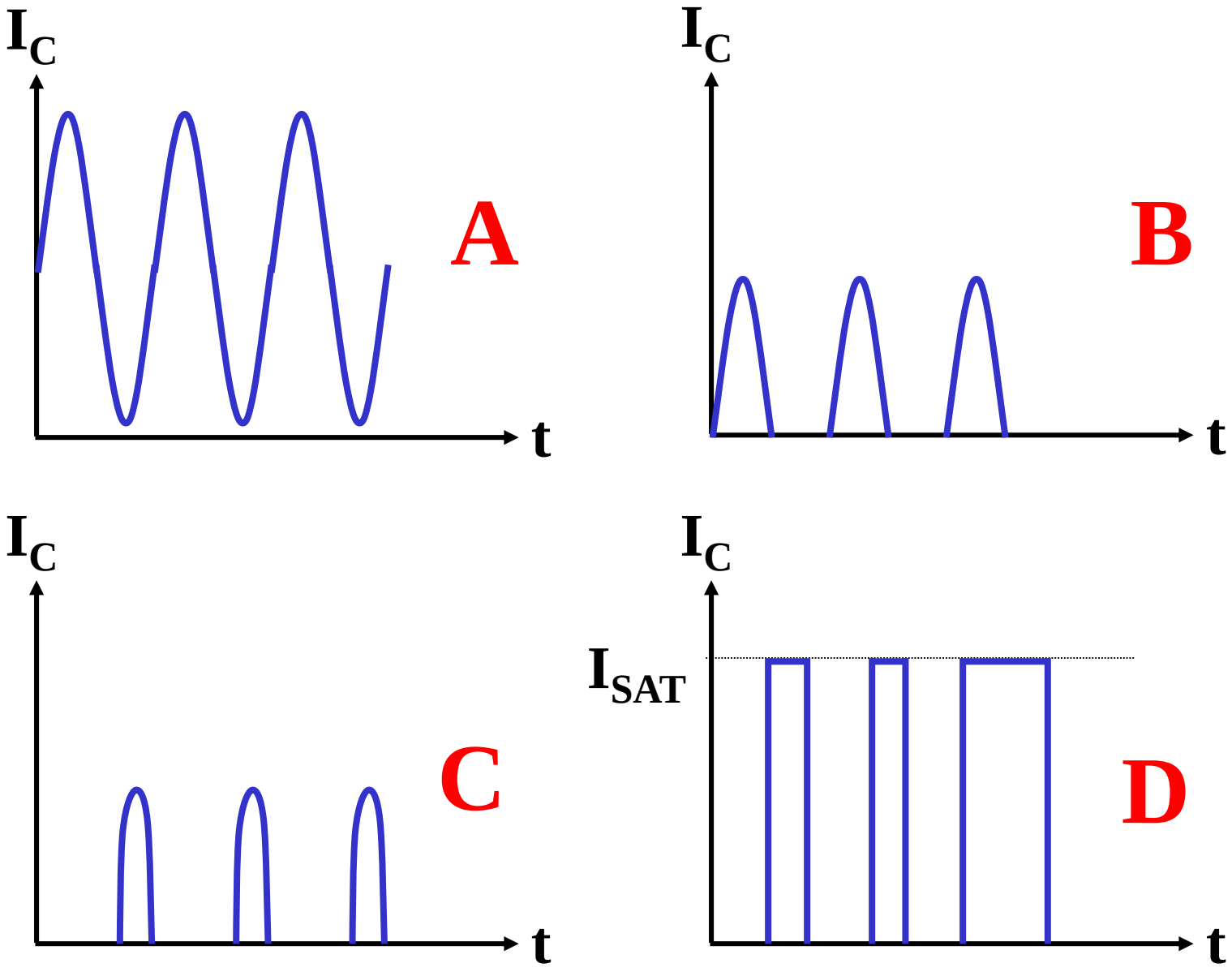
# Elektronika
## (TKE 4012)

Eka Maulana

maulana.lecture.ub.ac.id

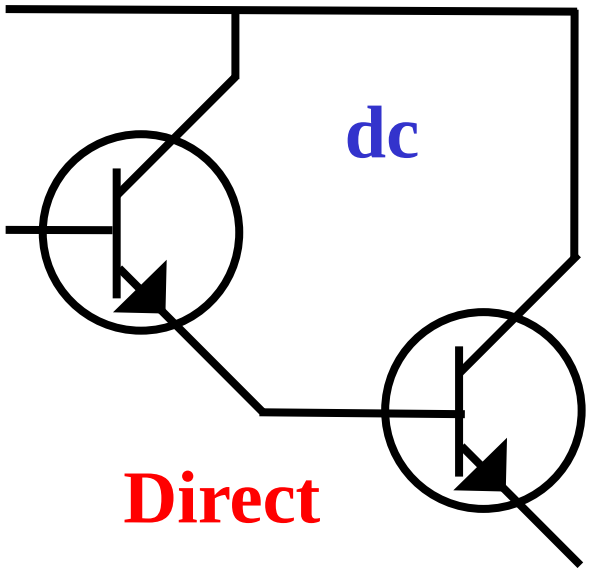
# Kelas Kerja Transistor

- **Kelas *A*: arus kolektor transistor mengalir siklus $360^o$.**
- **Kelas *B*: arus kolektor transistor mengalir siklus $180^o$.**
- **Kelas *C*: arus kolektor mengalir mengalir siklus kurang dari $180^o$.**
- **Kelas *D*: penguat switch on dan off, dan bekerja pada mode linear.**

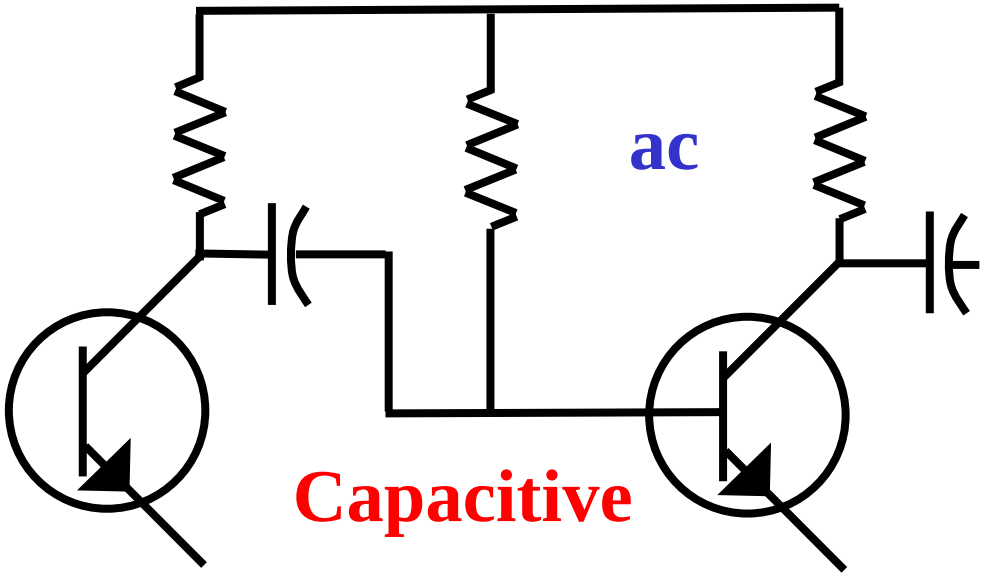

$I_C$
t
A
$I_C$
t
B
$I_C$
t
C
$I_C$
$I_{SAT}$
t
D

# Jenis-Jenis Coupling

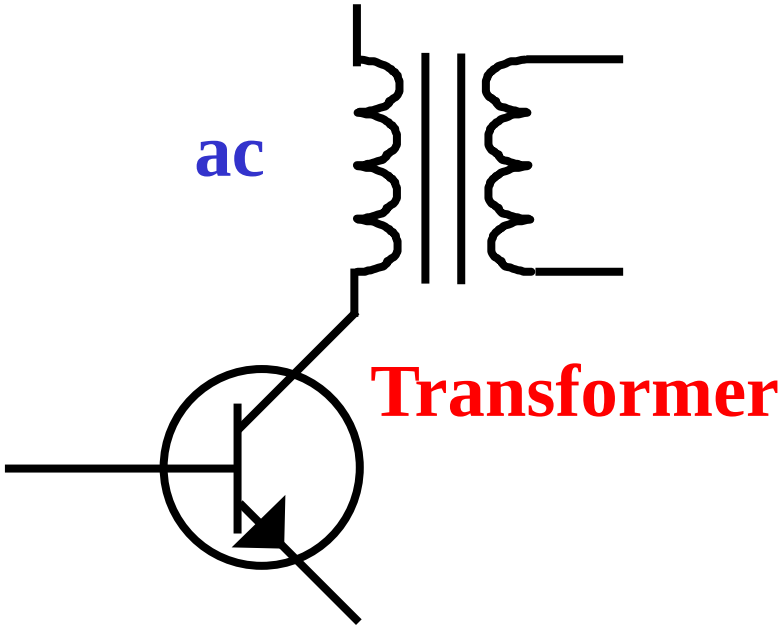
- ***Direct*** **(penguat dc)**
- ***Capacitive*** **(penguat ac)**
- ***Untuned transformer*** **(penguat ac)**
- ***Tuned transformer*** **(penguat ac pita sempit/** *narrowband***)**



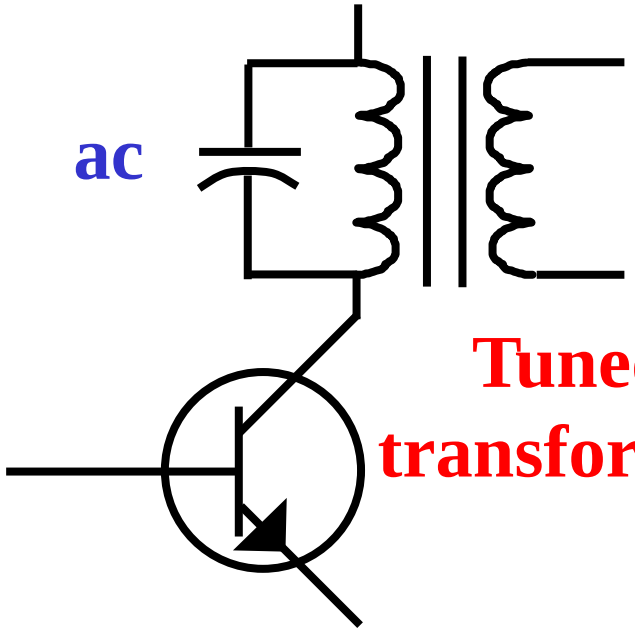

Direct




Capacitive



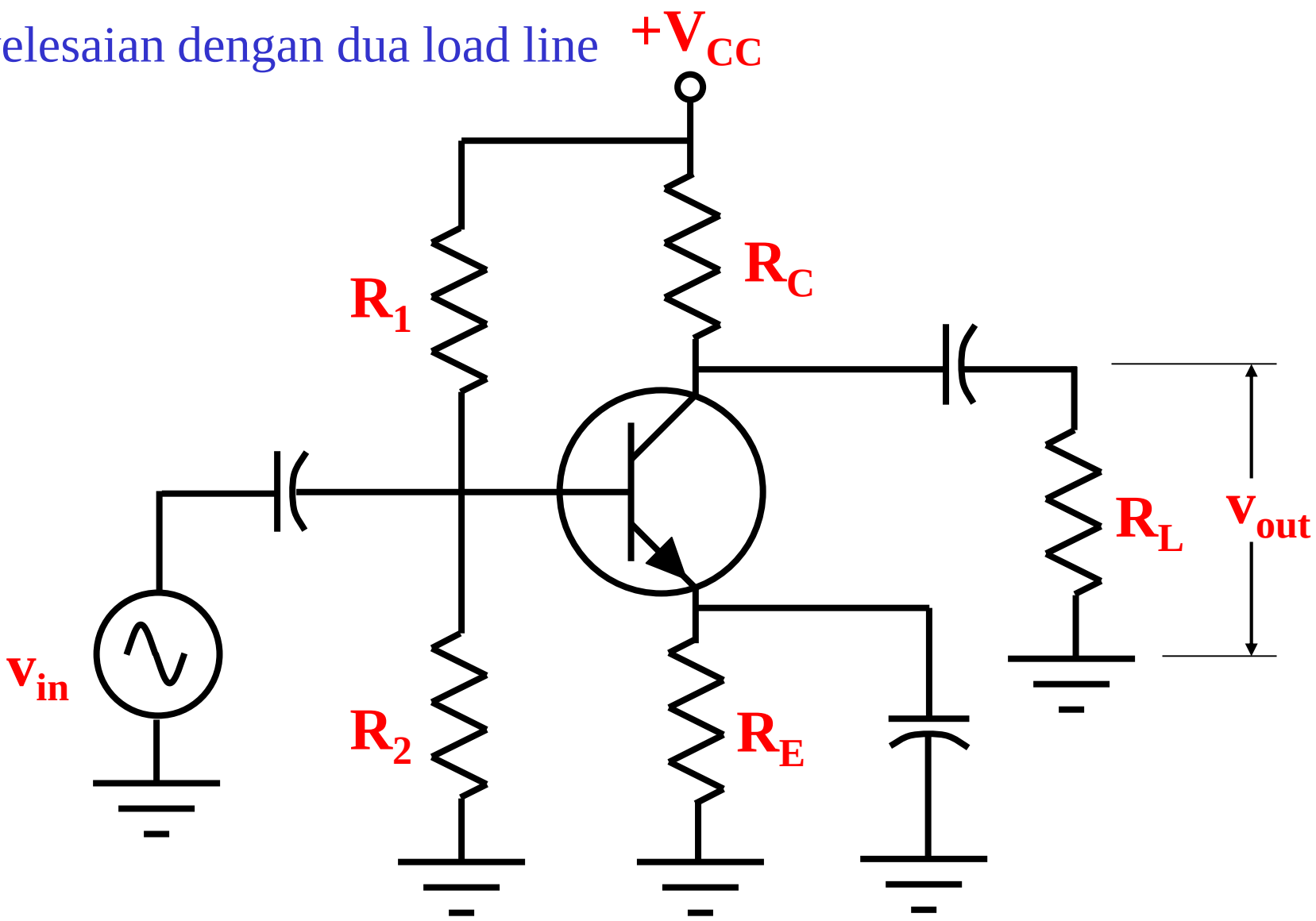

Transformer




Tuned transformer

# Penguat Kelas A

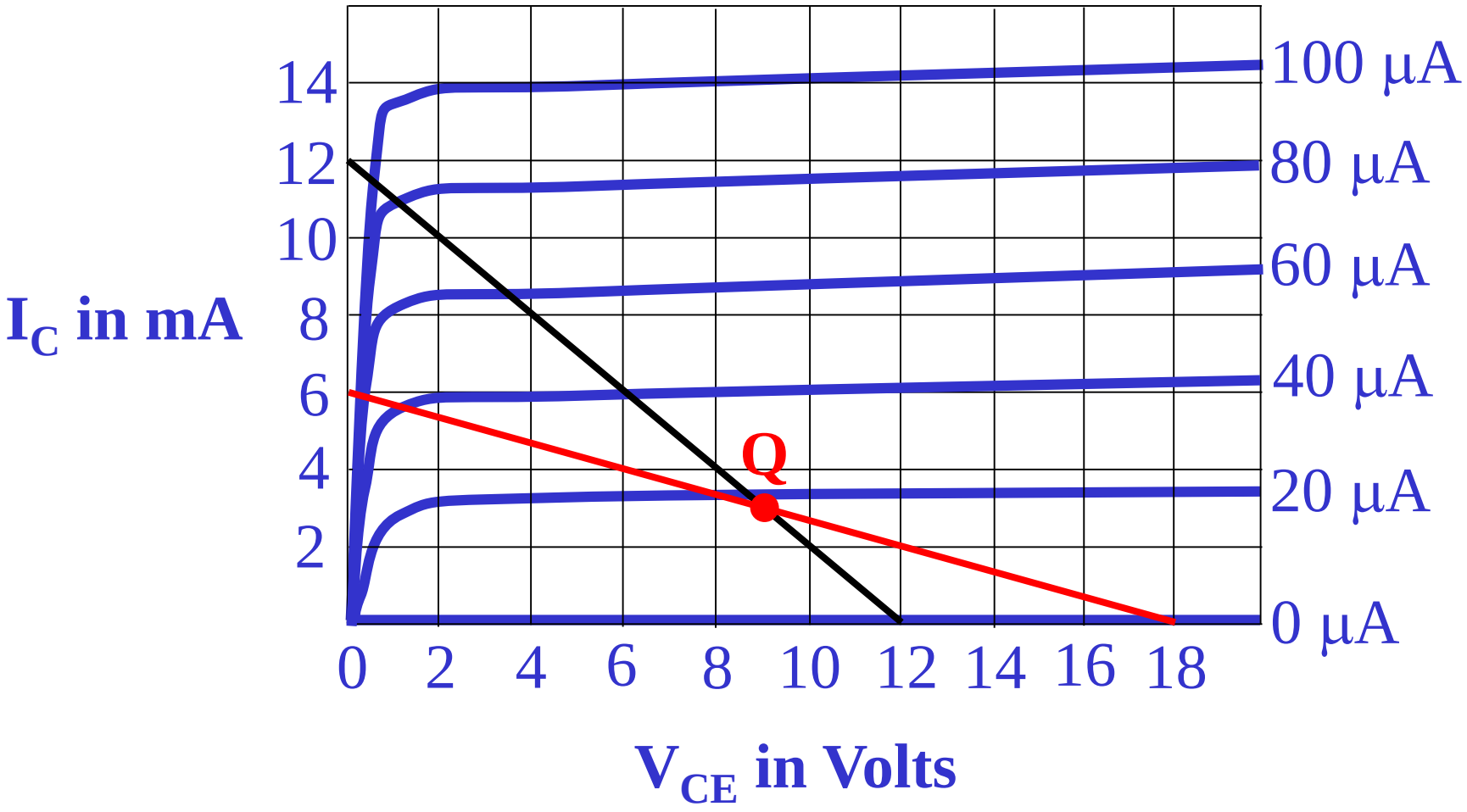
Penyelesaian dengan dua load line



$$I_{C(sat)} = \frac{V_{CC}}{R_C + R_E}$$

***The dc load line***

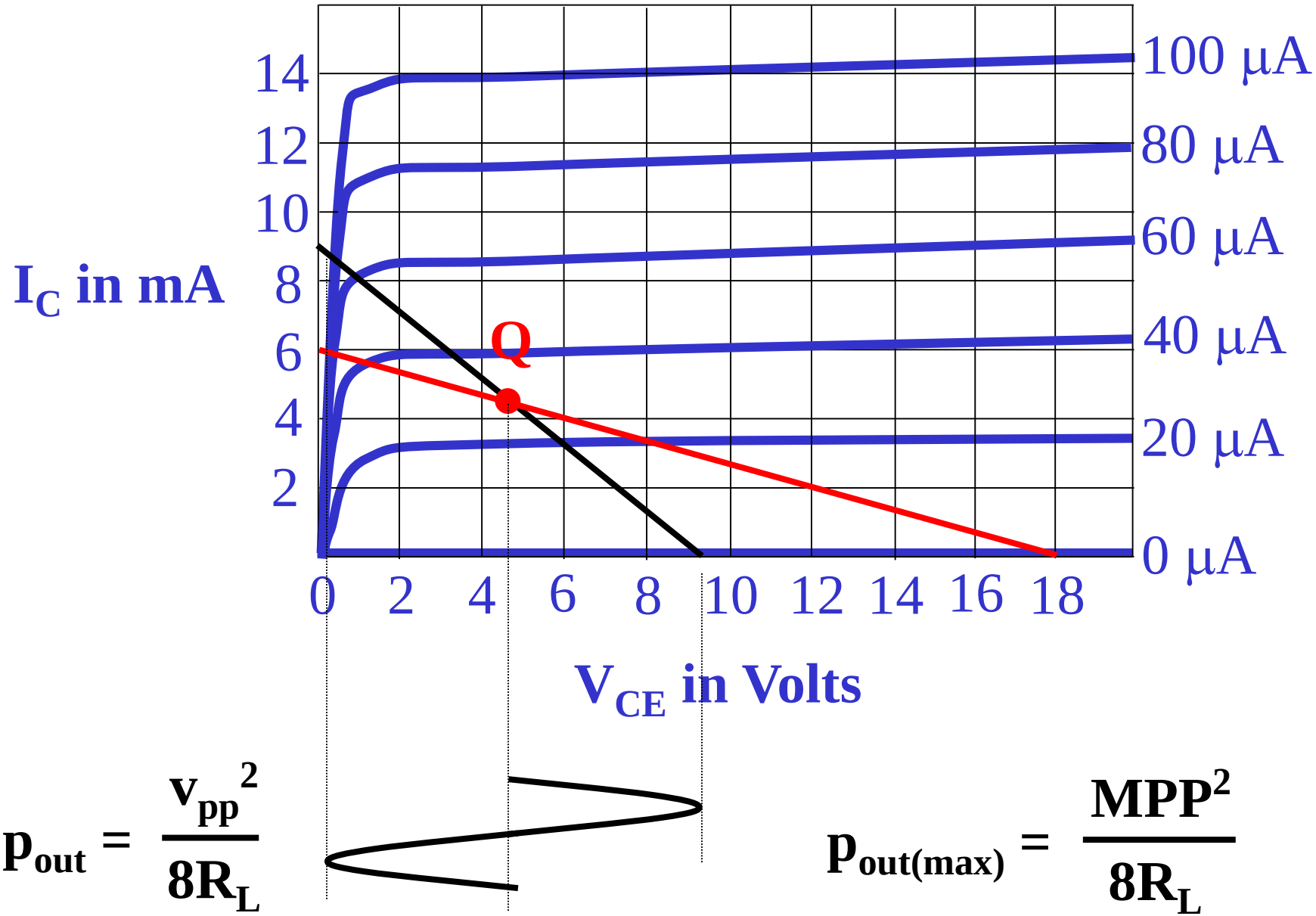
$$V_{CE(cutoff)} = V_{CC}$$




***The ac load line has a higher slope.***

# Large Signals

- **When the Q point is at the center of the dc load line, the signal cannot use all of the ac load line without clipping.**
- **MPP < $V_{CC}$ (max. peak-to-peak output)**
- **MPP = 2MP**
- **MP = $I_{CQ}r_c$ *or* $V_{CEQ}$ (*whichever is smaller*)**



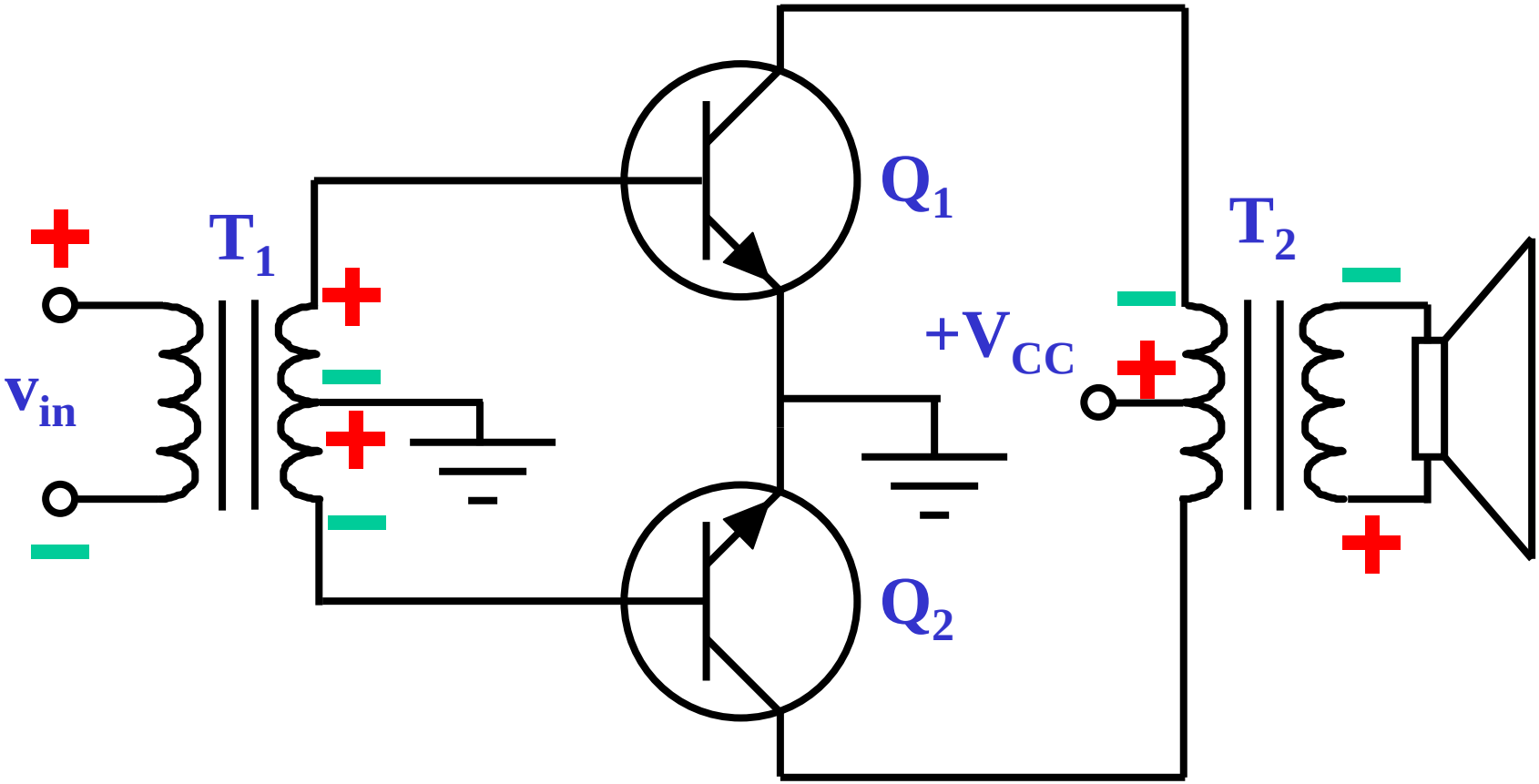

$$p_{out} = \frac{v_{pp}^2}{8R_L}$$

$$p_{out(max)} = \frac{MPP^2}{8R_L}$$

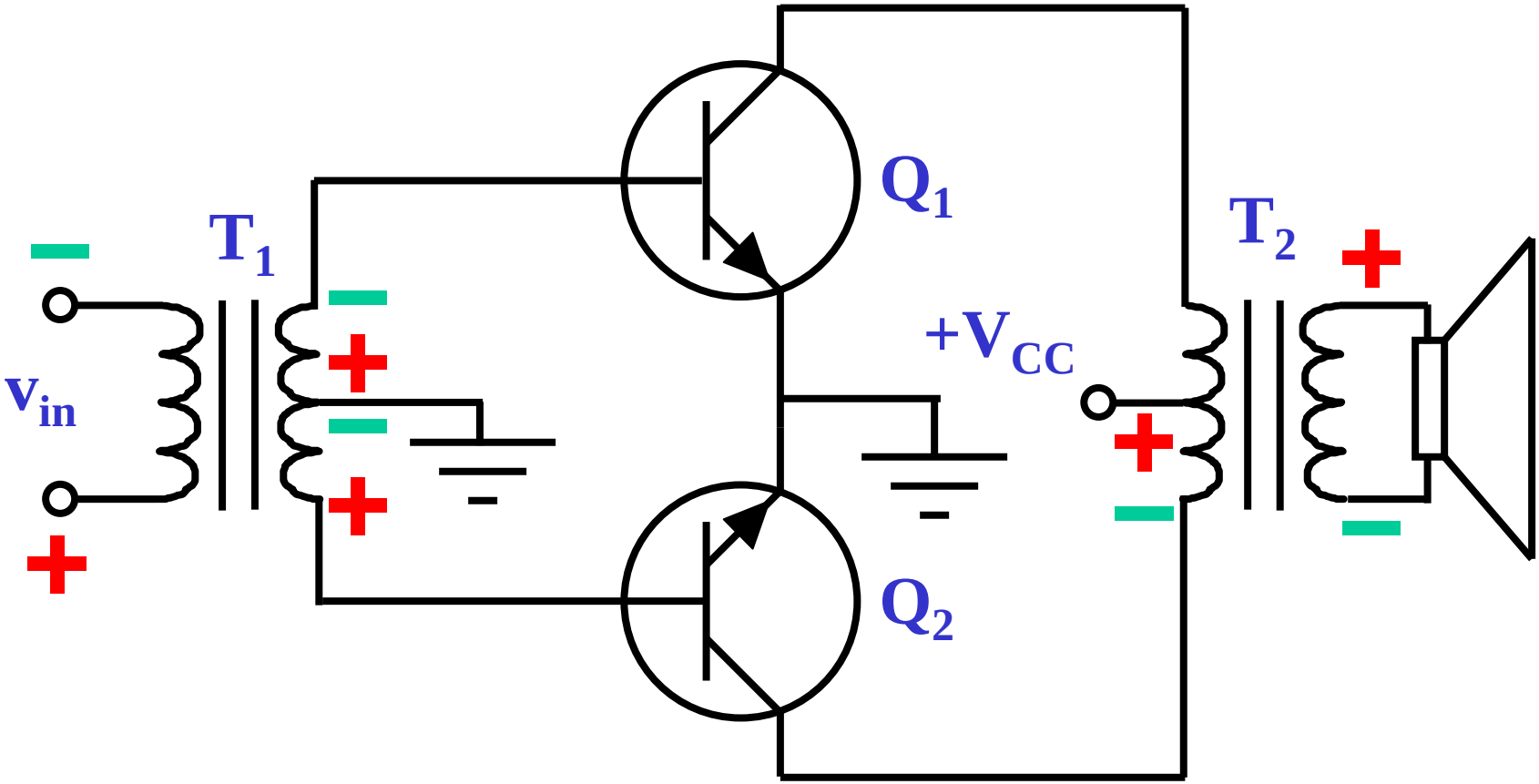
# Efficiency

- The dc power supplied to an amplifier is $P_{dc} = V_{CC}I_{dc}$
- Efficiency = $\eta = p_{out}/P_{dc}$ x 100%
- The *maximum efficiency* for Class A amplifiers with a dc collector resistance and a separate load resistance is 25%.
- Class A is usually not acceptable when watts of power are required.

# Push-pull Class B amplifier




**On the positive half-cycle of the input, $Q_1$ is on.**

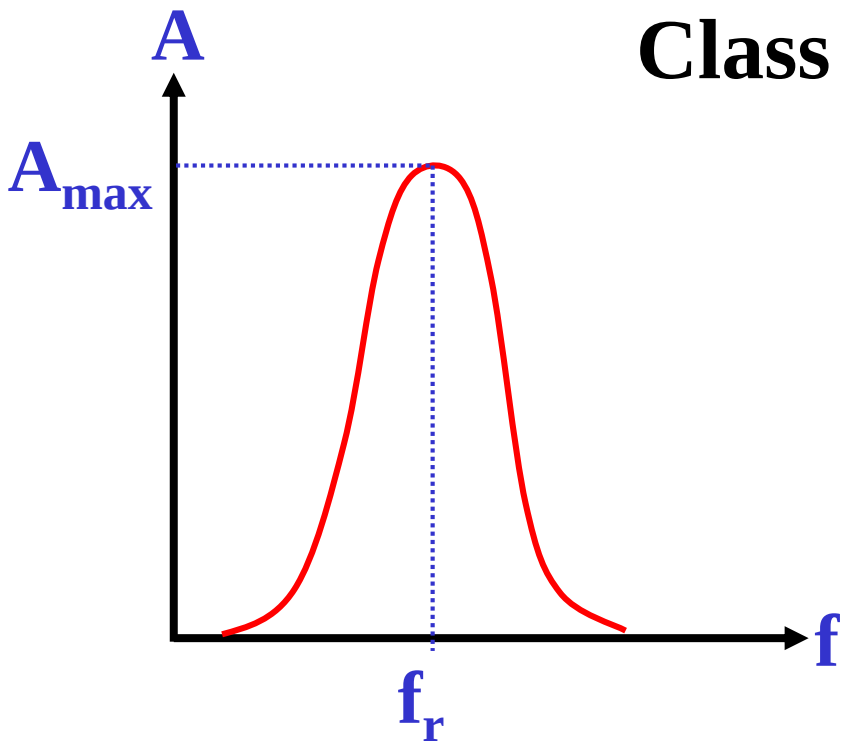



**On the negative half-cycle of the input, $Q_2$ is on.**

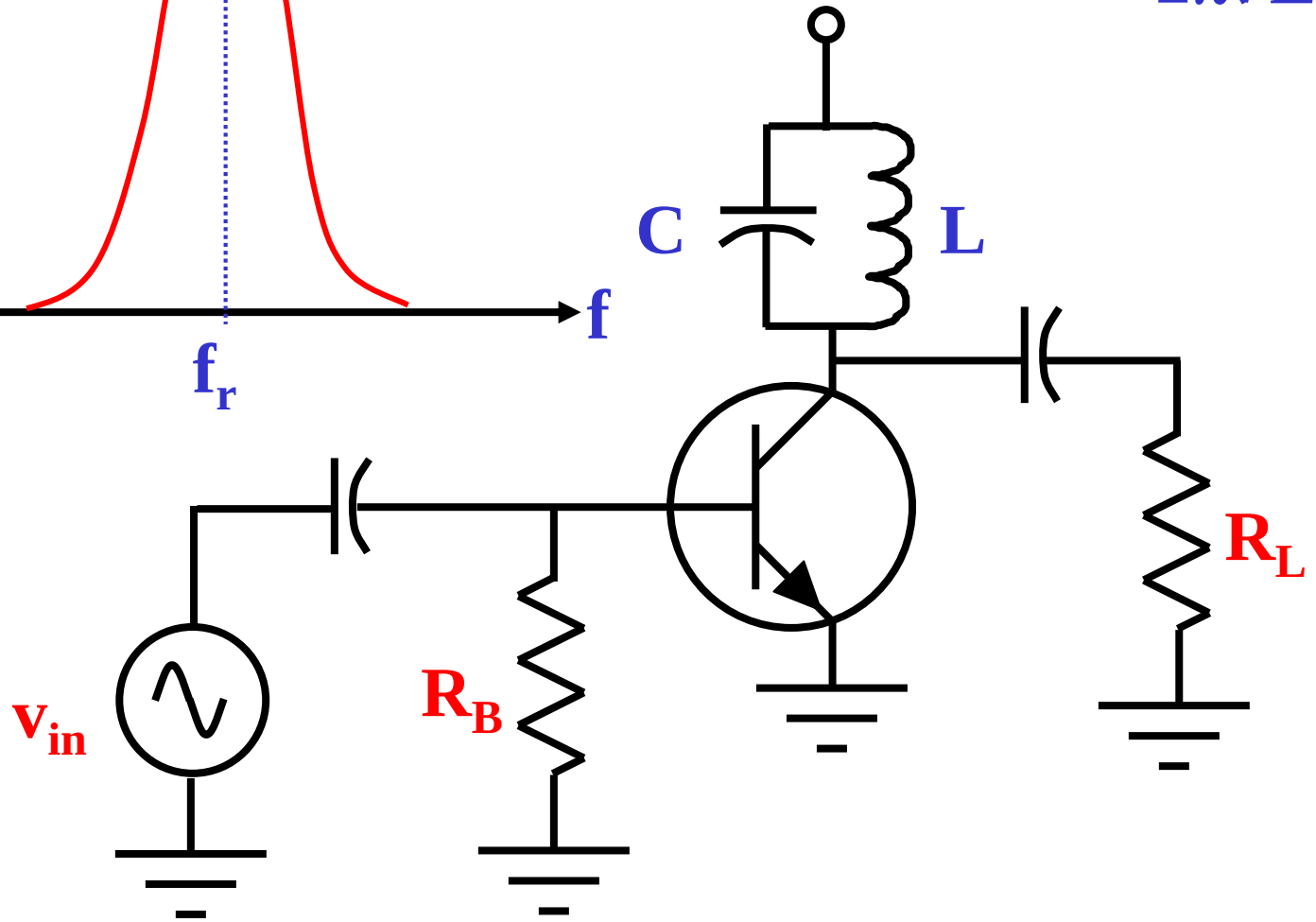
# Class B operation

- Each transistor conducts for half a cycle.
- There is no bias so each transistor is at cutoff with no input signal.
- The maximum efficiency is 78.5 percent.
- Transformers are bulky and expensive.
- The transformers can be eliminated.

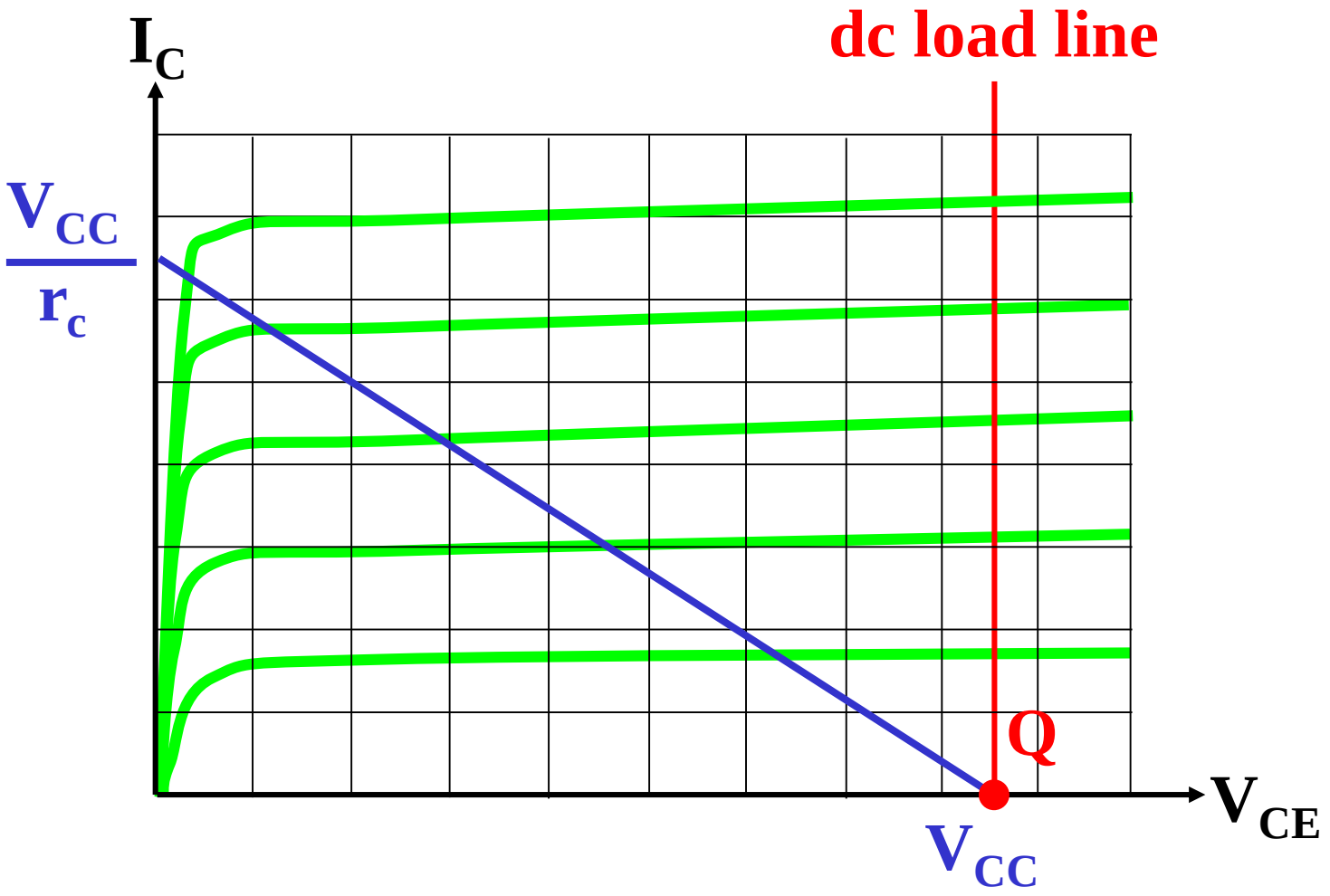
# Class C amplifier



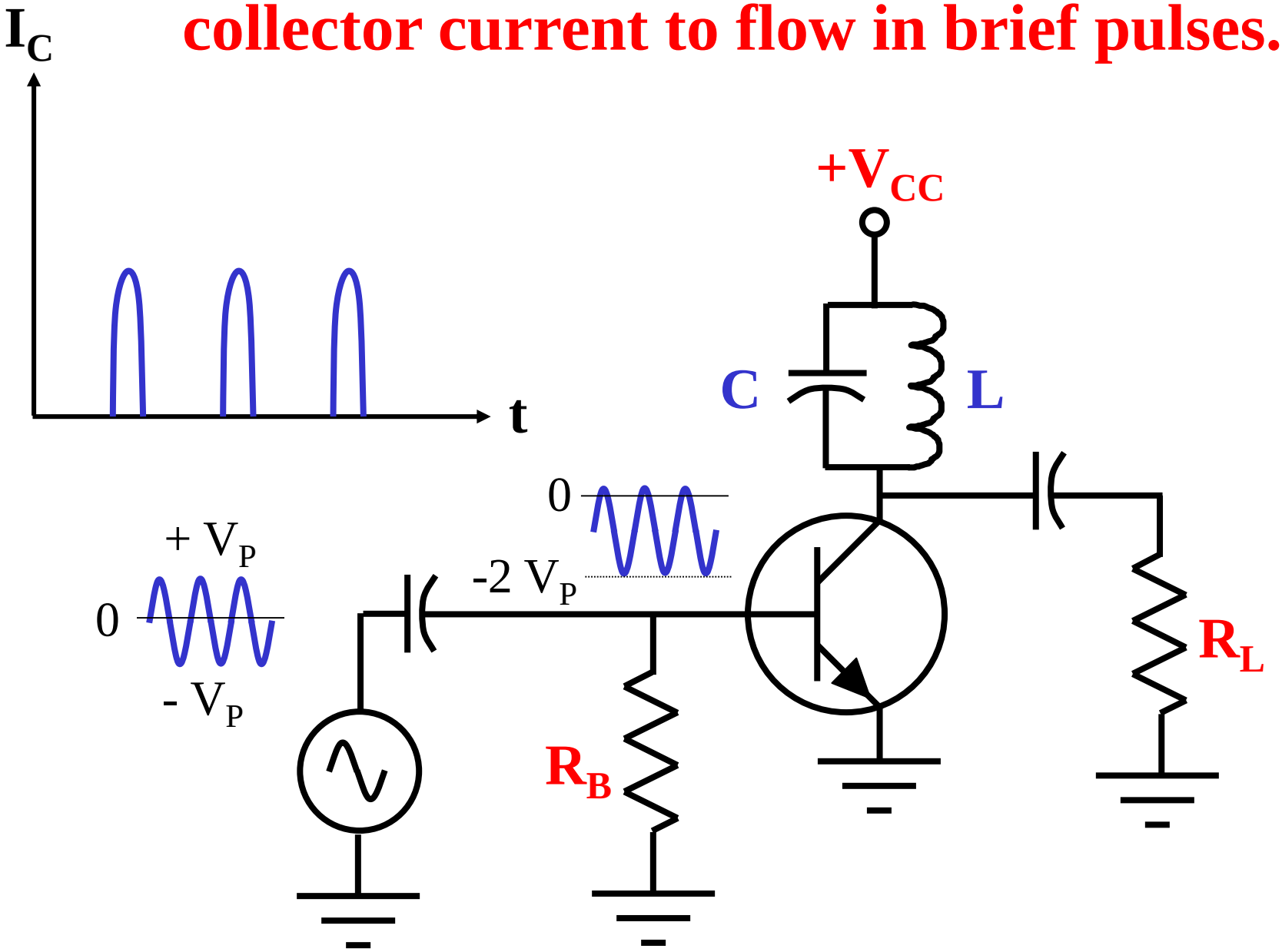

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$



# Class C amplifier dc and ac load lines



# Negative clamping at the base causes the collector current to flow in brief pulses.

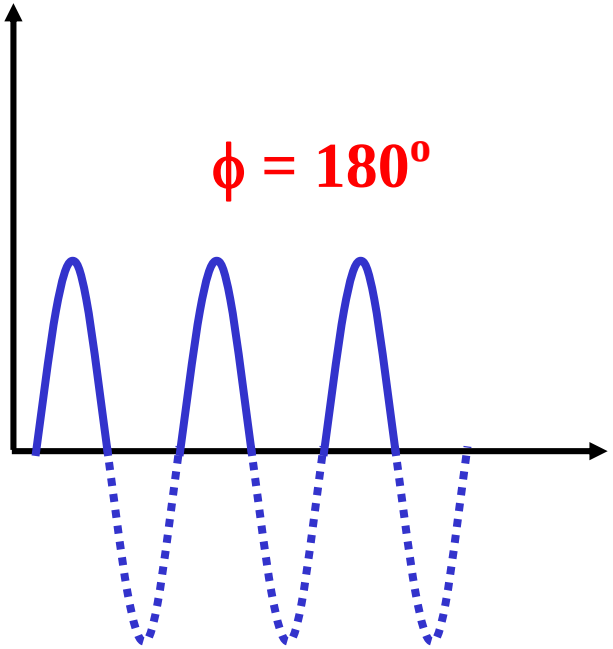


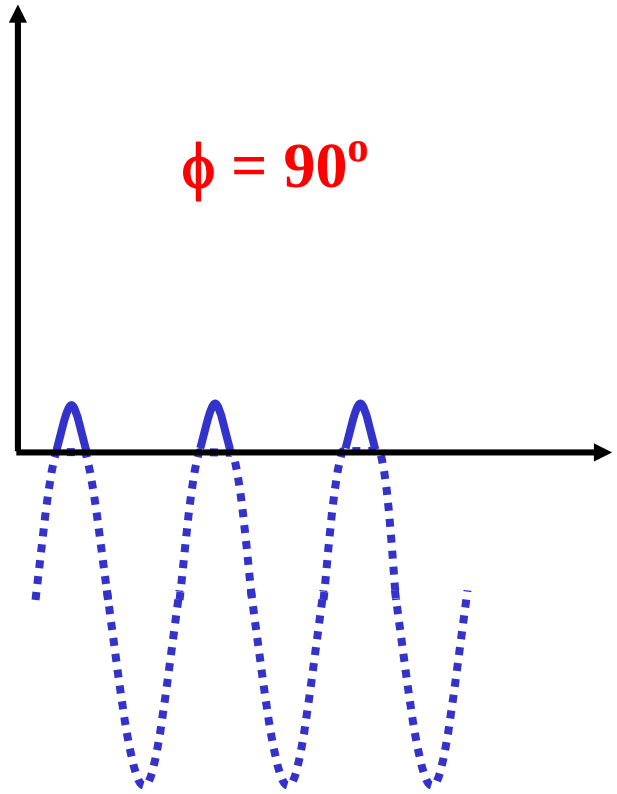
# Class C formulas

- $BW = f_2 - f_1 = f_r/Q$
- $Q_L = X_L/R_S$ (inductor only)
- $R_P = Q_L X_L$ (equiv. parallel resistance)
- $r_c = R_P \| R_L$ (ac resistance)
- $Q = r_c/X_L$ (overall circuit)
- $P_D = MPP^2/40r_c$

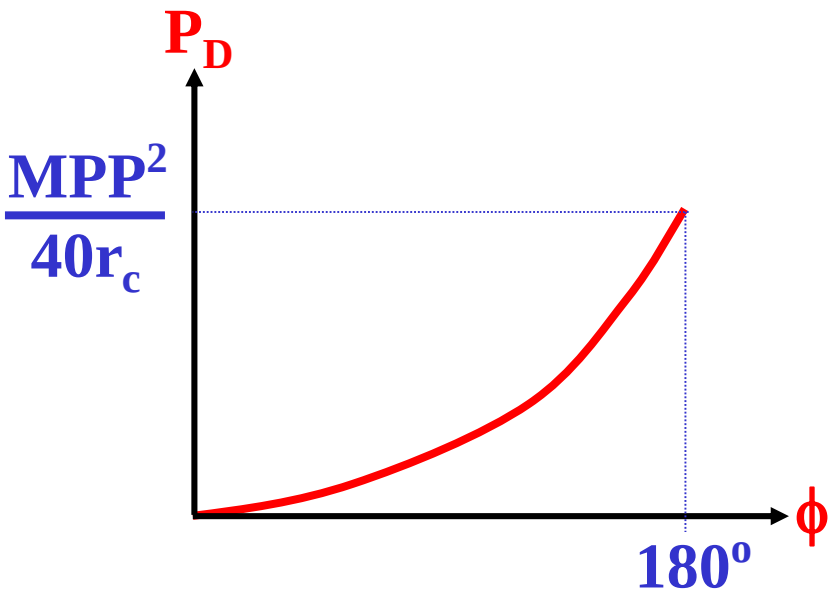
# Duty cycle and conduction angle

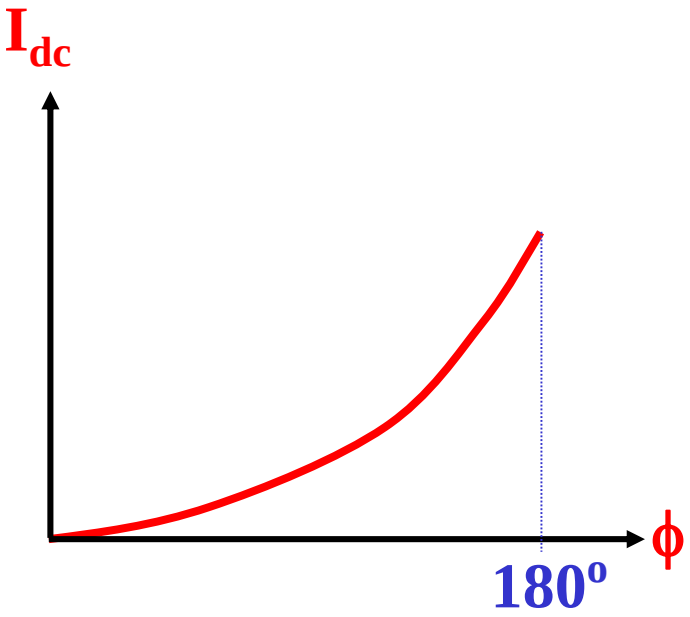
$$D = \frac{W}{T} = \frac{\phi}{360^o}$$

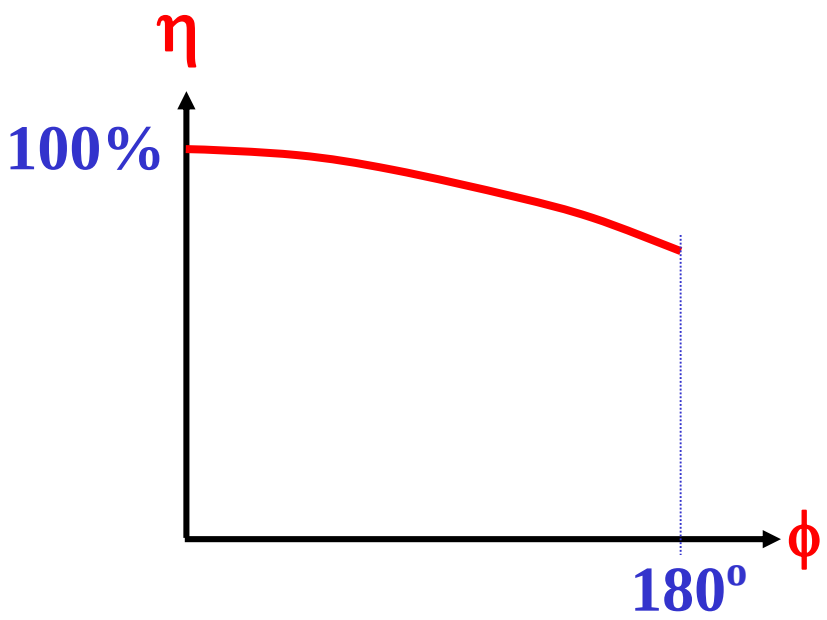


# The effects of conduction angle in a Class C amplifier



# Derating factor

- Power devices generate heat
- $P_{D(max)}$ rating good up to 25 $^{o}C$
- Decrease in rating = $\Delta P$
- Derating factor = D (W/$^{o}C$)
- $T_A$ = ambient temperature ($^{o}C$)

$$\Delta P = D(T_A - 25\ ^{o}C)$$

- $P_{D(safe)} = P_{D(max)} - \Delta P$