Emiteer Follower
BJT

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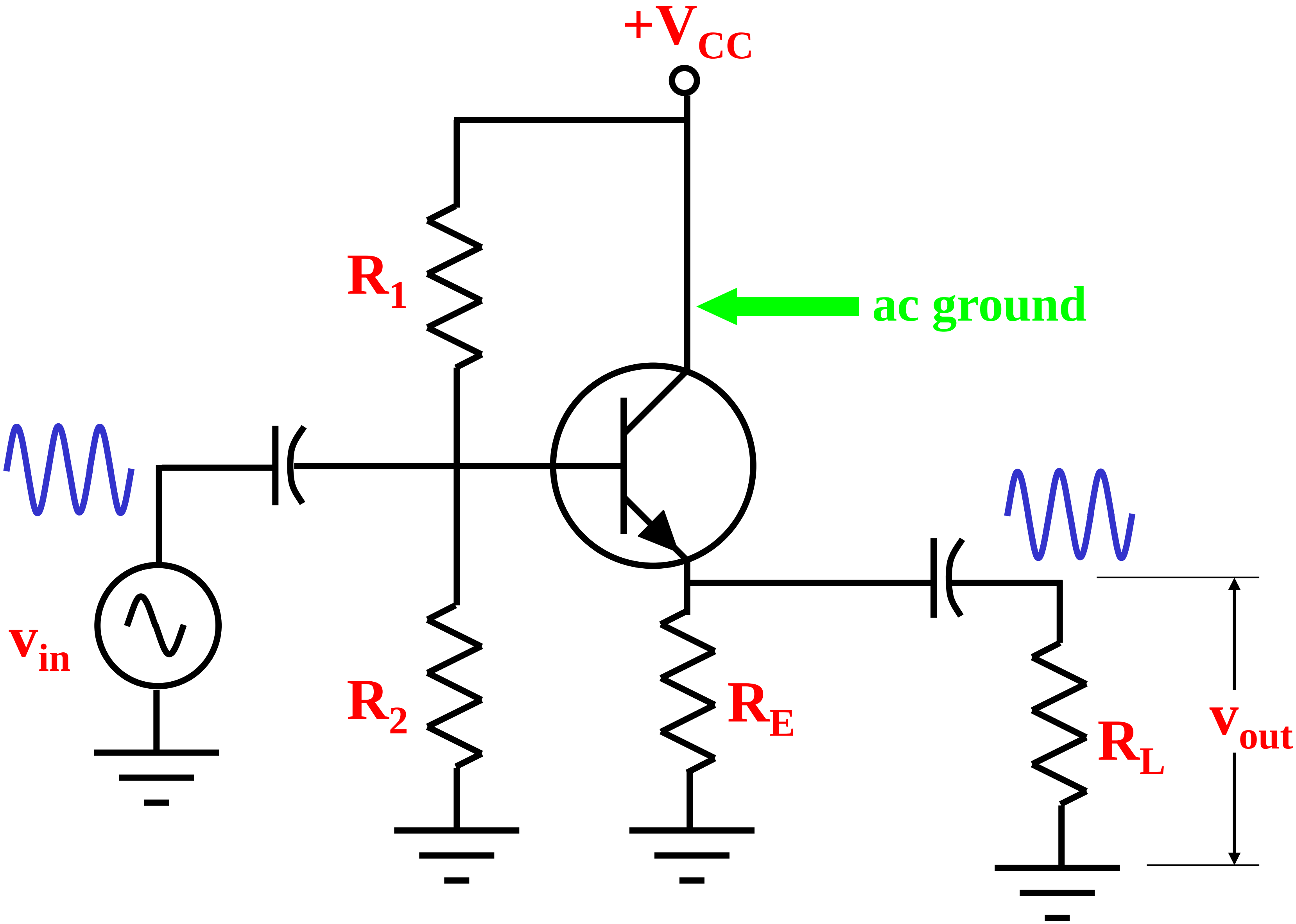
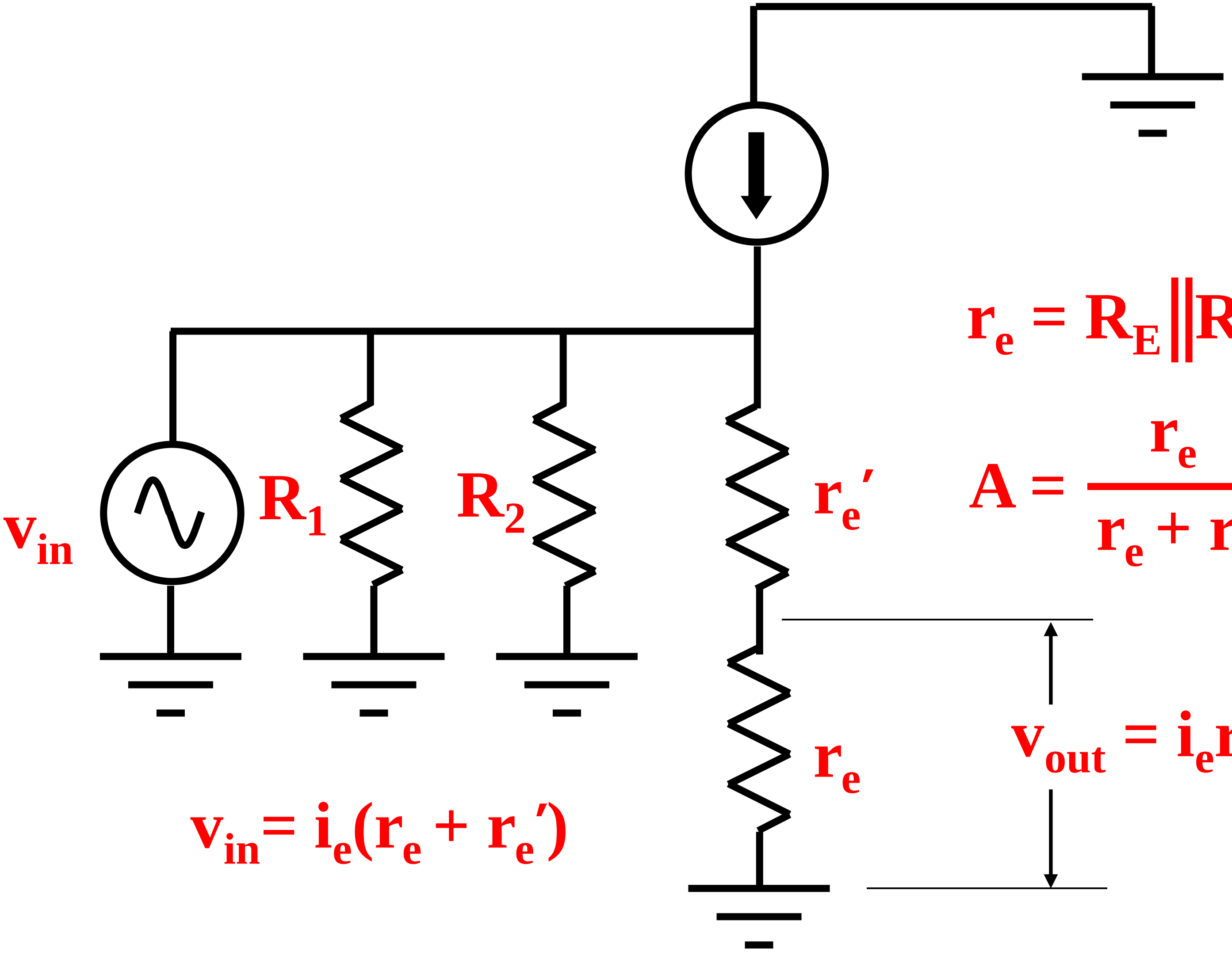
The common-collector or *emitter follower* amplifier



Model T - Penguat Emitter Follower



$$r_e = R_E \| R_L$$

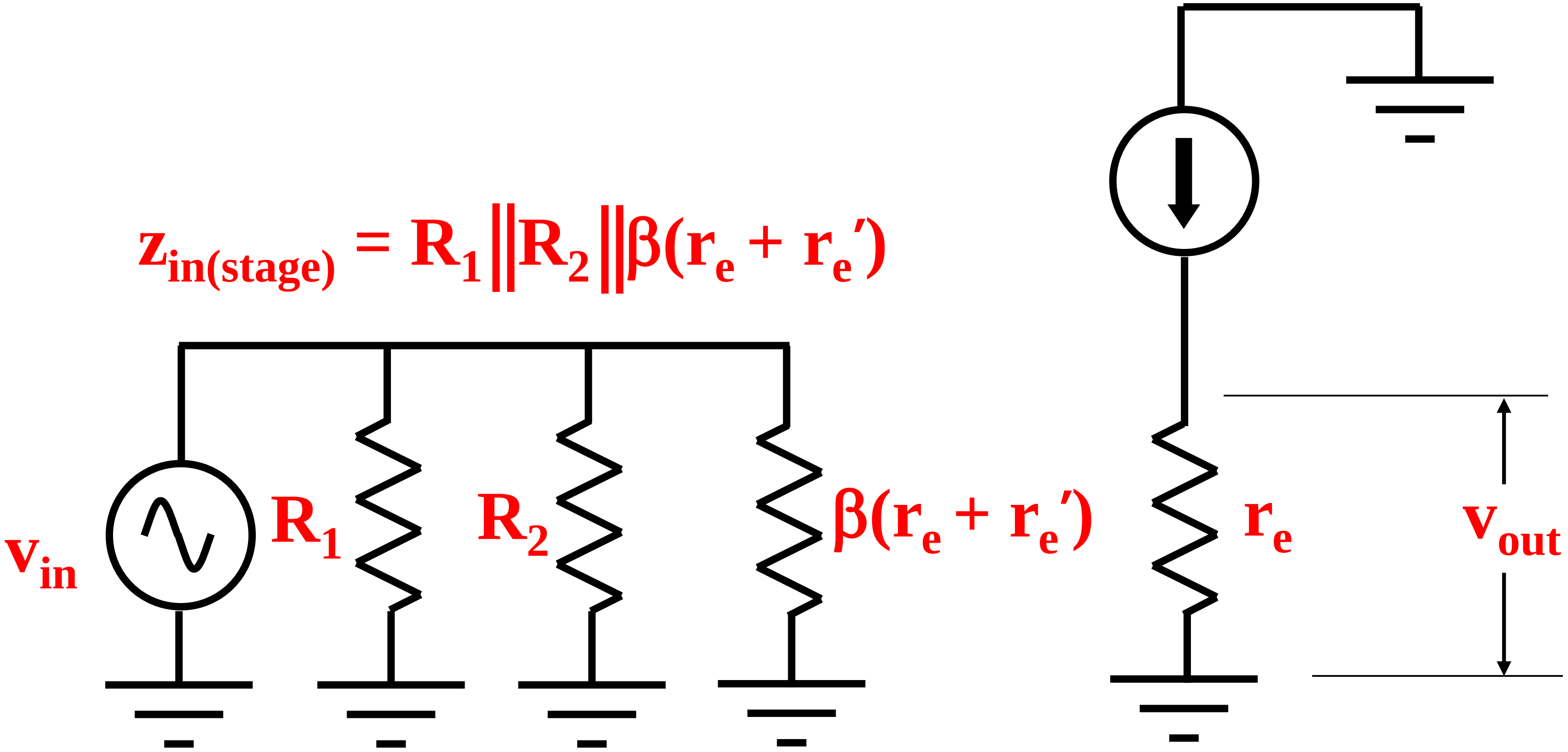
$$A = \frac{r_e}{r_e + r_e'}$$

$$v_{out} = i_e r_e$$

$$v_{in} = i_e(r_e + r_e')$$

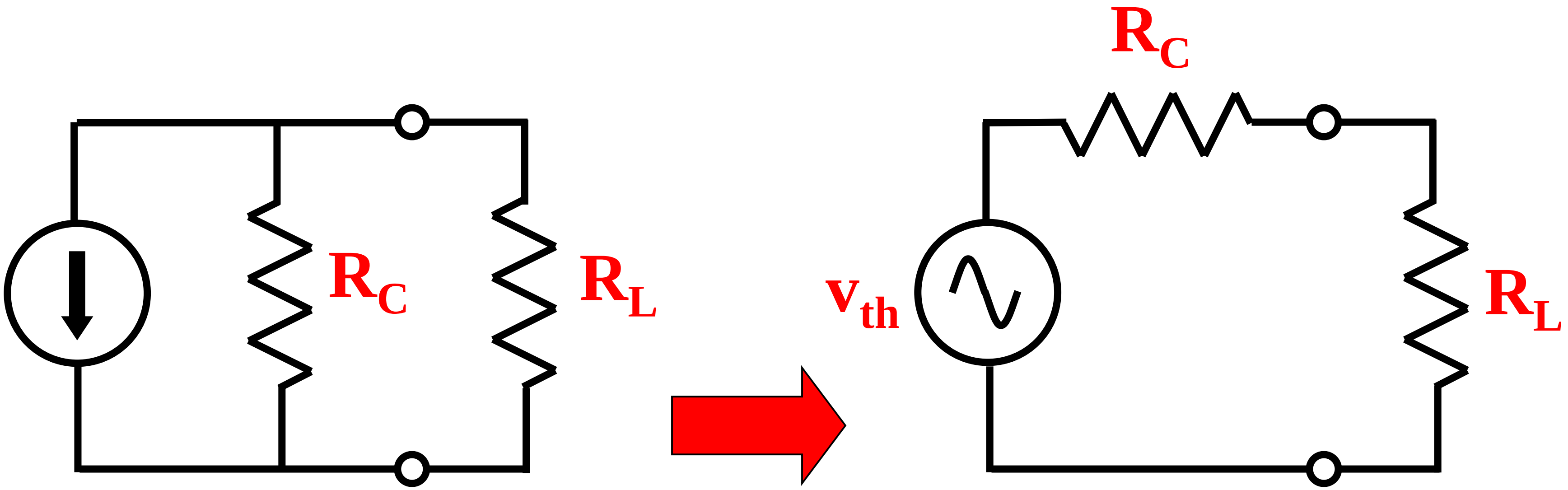
Model π - Penguat Emitter Follower

$$z_{in(stage)} = R_1 \| R_2 \| \beta(r_e + r_e')$$



Sisi Otput dari Penguant *common-emitter*

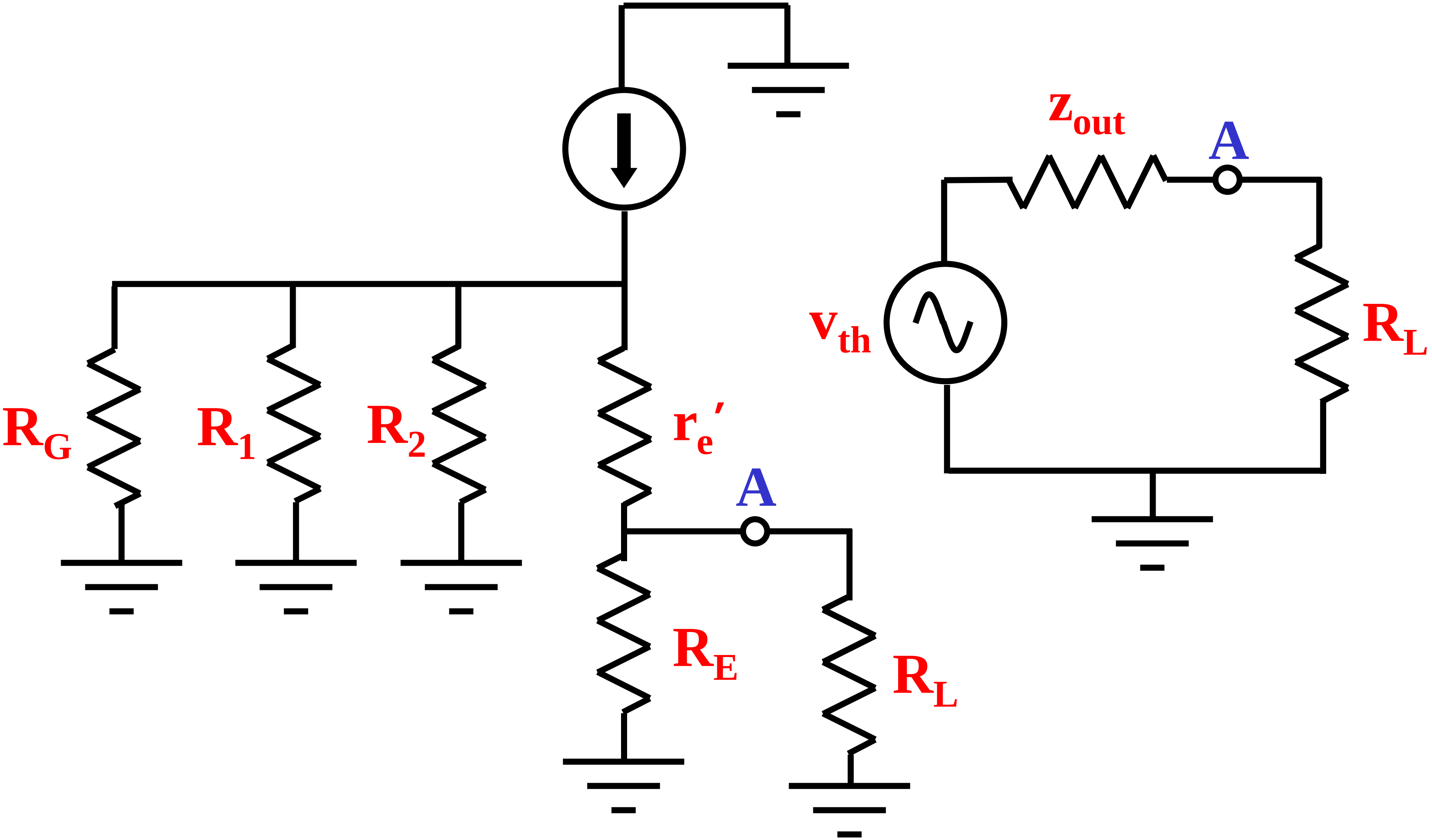
Applying Thevenin’s theorem:



The output impedance is equal to R_C.

Model T - Penguat Emiter Follower

Penerapan Teorema Thevenin pada titik A:



Output impedance of the *emitter follower* amplifier

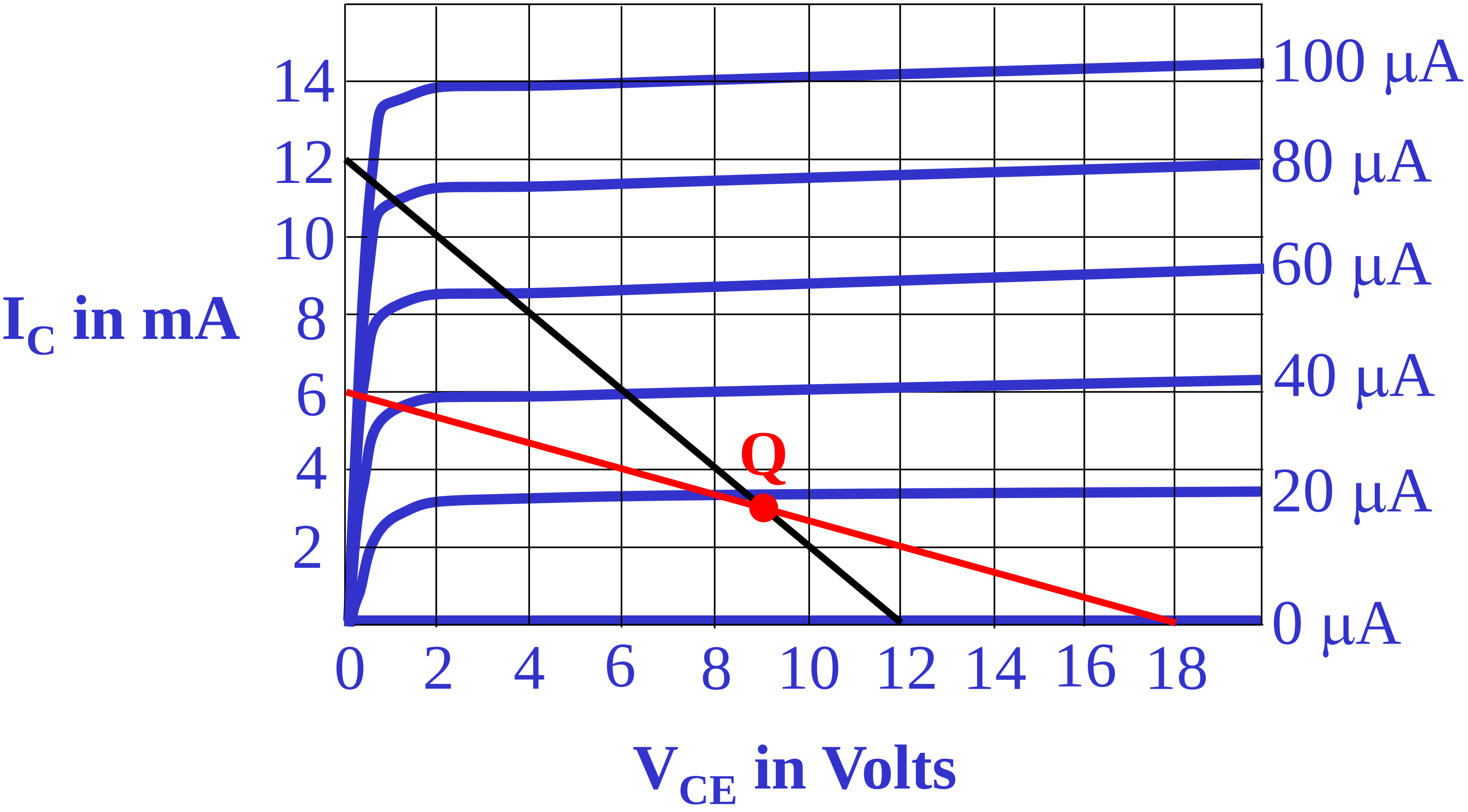
$$z_{out} = R_E \,\|\, \left(r_e' + \frac{R_1 \| R_2 \| R_G}{\beta} \right)$$

The current gain of the amplifier *steps down* the impedance of the base circuit. Thus, the output impedance of this amplifier is small.

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

The dc load line

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

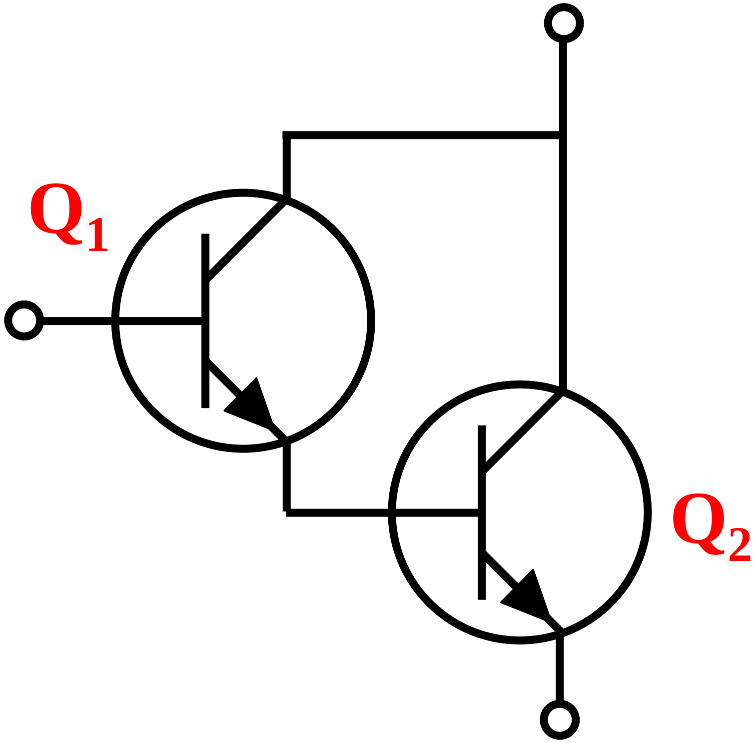


The ac load line has a higher slope: $r_e = R_E \| R_L$

Large signal operation

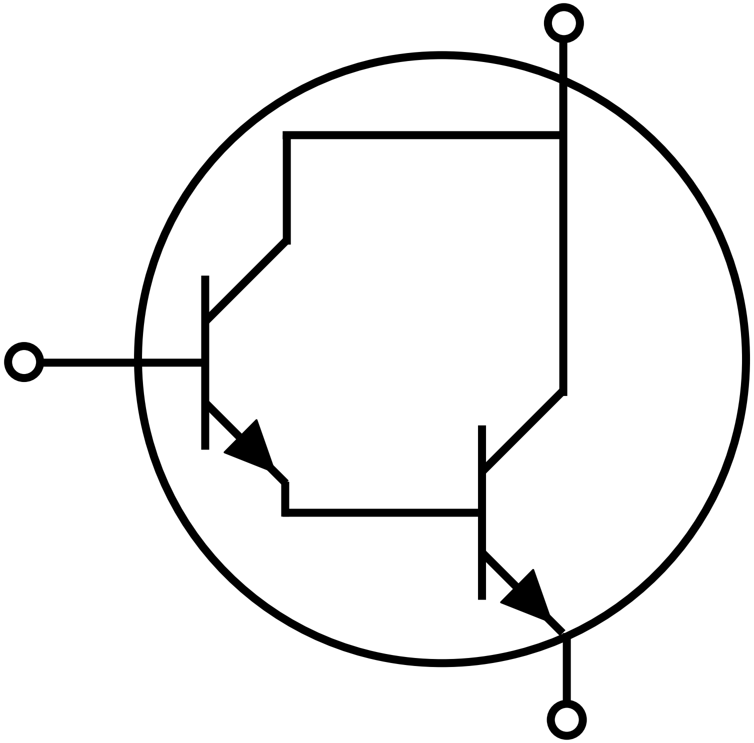
- **When the Q point is at the center of the dc load line, the signal cannot use all of the ac load line without clipping.**
- **MPP < V_{CC}**
- **MP = $I_{CQ}r_e$ *or* V_{CEQ} (*whichever is smaller*)**
- **MPP = 2MP**
- **When the Q point is at the center of the ac load line: $I_{CQ}r_e = V_{CEQ}$**

Darlington connection

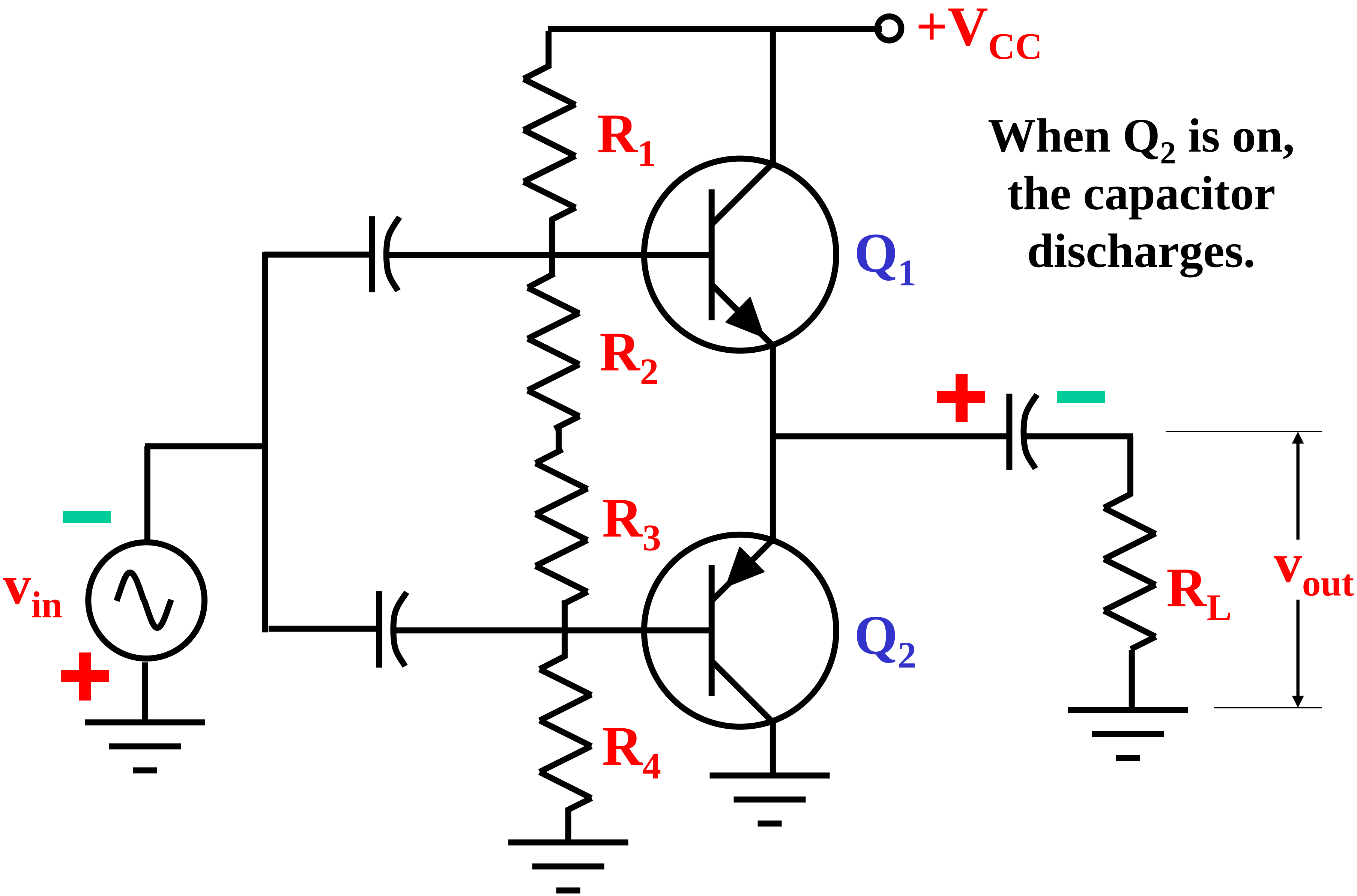


$$\beta = \beta_1\beta_2$$

Darlington transistor



Push-pull emitter follower

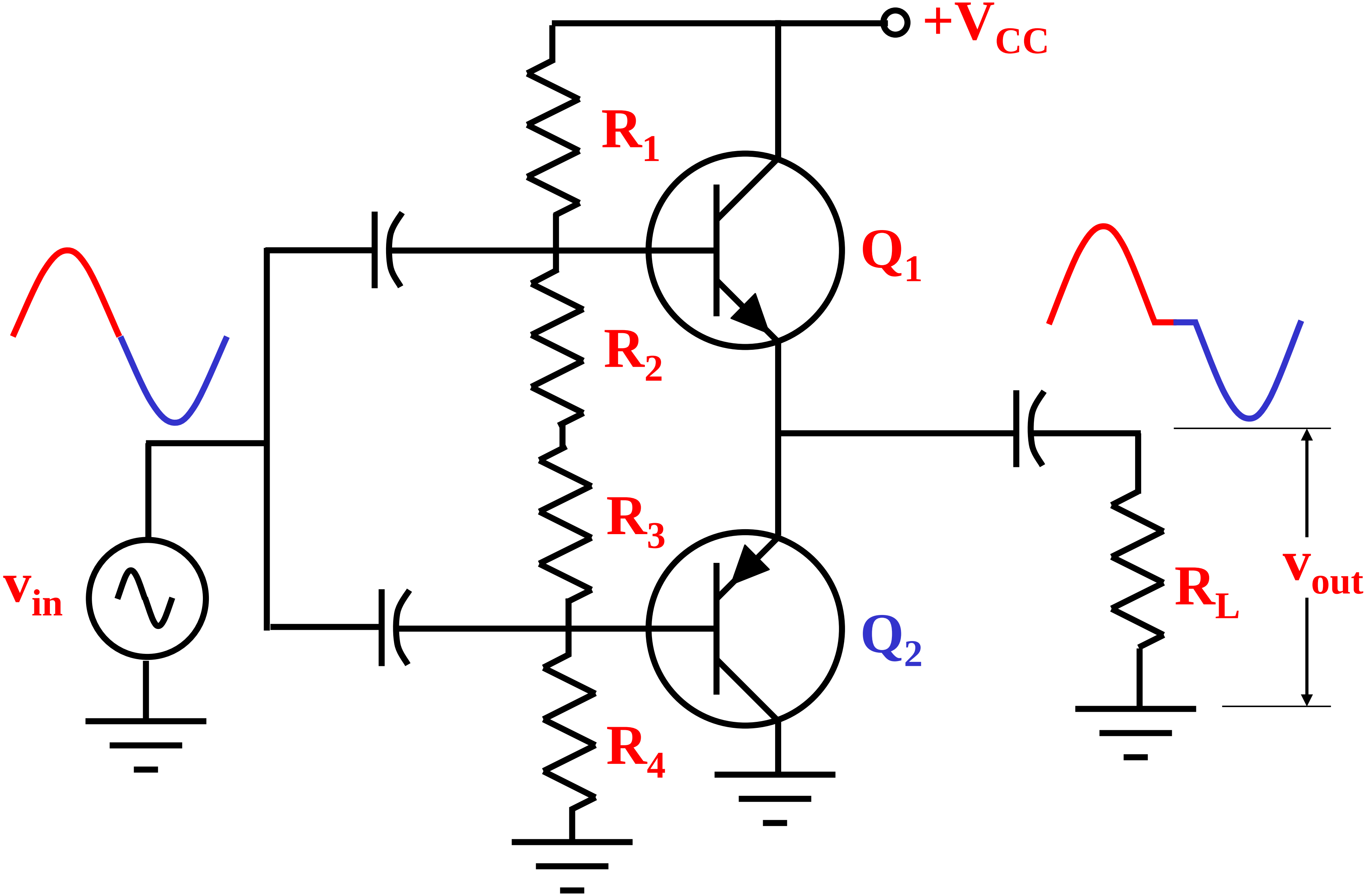


When Q_2 is on, the capacitor discharges.

Class B push-pull emitter follower

- $I_{CQ} = 0$
- $V_{CEQ} = V_{CC}/2$
- $MPP = V_{CC}$
- $A \cong 1$
- $z_{in(base)} = \beta R_L$
- $P_{D(max)} = MPP^2/40R_L$ (each transistor)
- $p_{out(max)} = MPP^2/8R_L$

Crossover distortion in class B



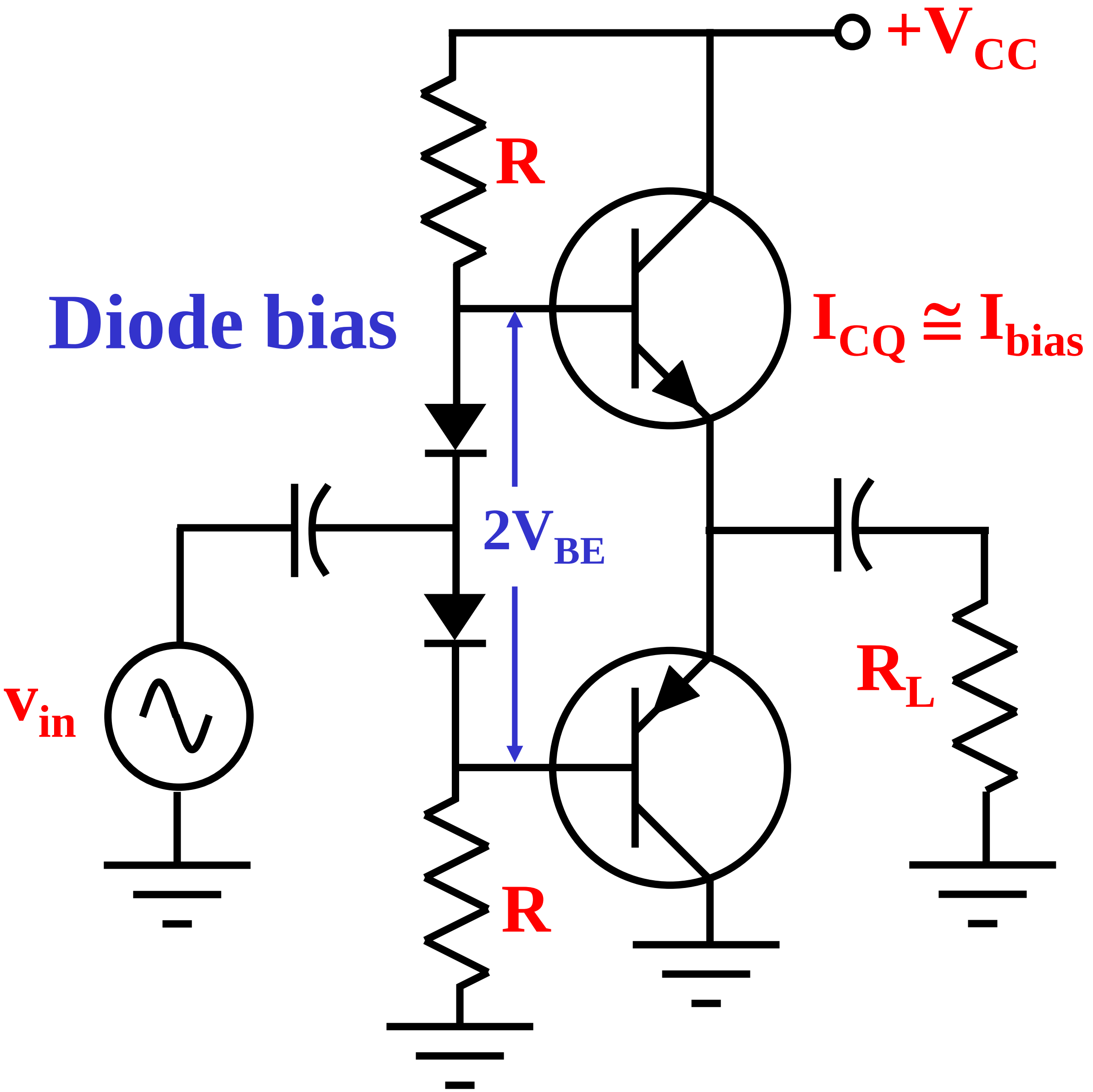
Class AB

- Crossover distortion is caused by the barrier potential of the emitter diodes.
- I_{CQ} must be increased to 1 to 5 percent of $I_{C(sat)}$ to eliminate crossover distortion.
- The new operating point is between class A and B but is much closer to B.

Thermal runaway

- **When temperature increases, collector current increases.**
- **More current produces more heat.**
- ***Compensating diodes* that match the V_{BE} curves of the transistors are often used.**
- **Any increase in temperature reduces the bias developed across the diodes.**

Diode bias



$$I_{bias} = \frac{V_{CC} - 2V_{BE}}{2R}$$

$$I_{C(sat)} = \frac{V_{CC}}{2R_L}$$

$$I_{av} = \frac{I_{C(sat)}}{\pi}$$

$$I_{dc(total)} = I_{CQ} + I_{av}$$

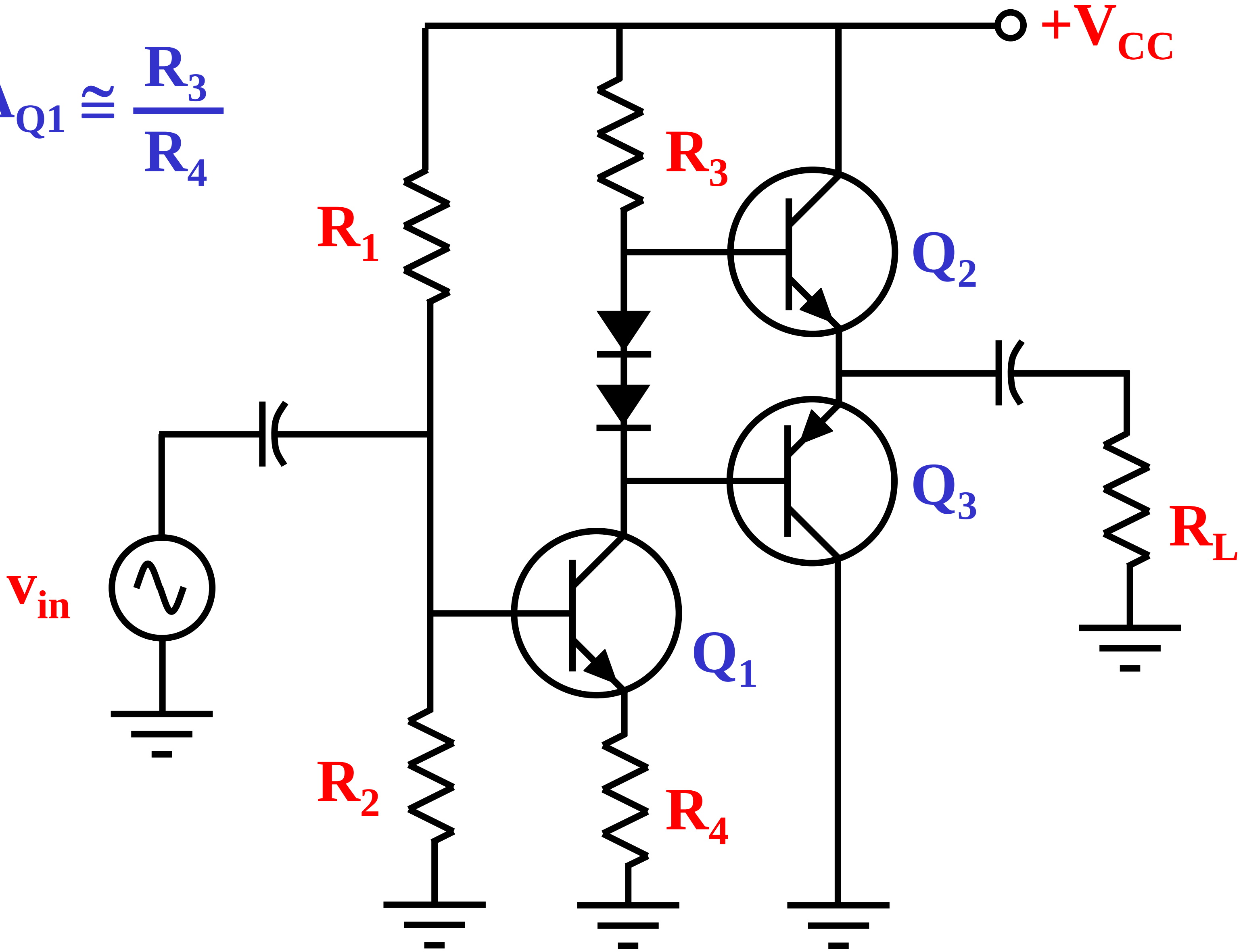
$$P_{dc(in)} = V_{CC} I_{dc(total)}$$

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

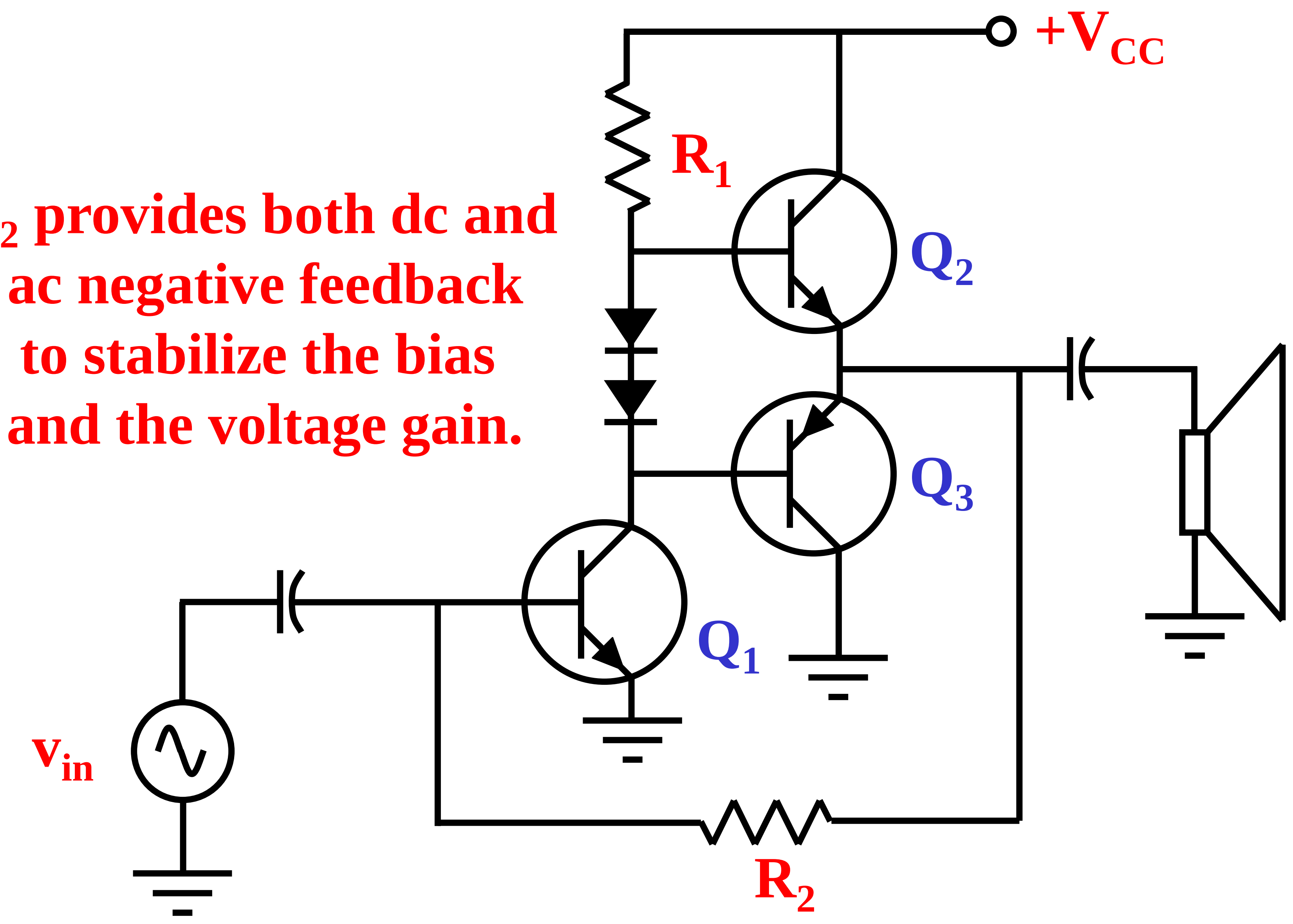
$$\eta = \frac{p_{out}}{P_{dc}} \text{ x } 100\%$$

Direct-coupled common emitter driver

$$A_{Q1} \cong \frac{R_3}{R_4}$$

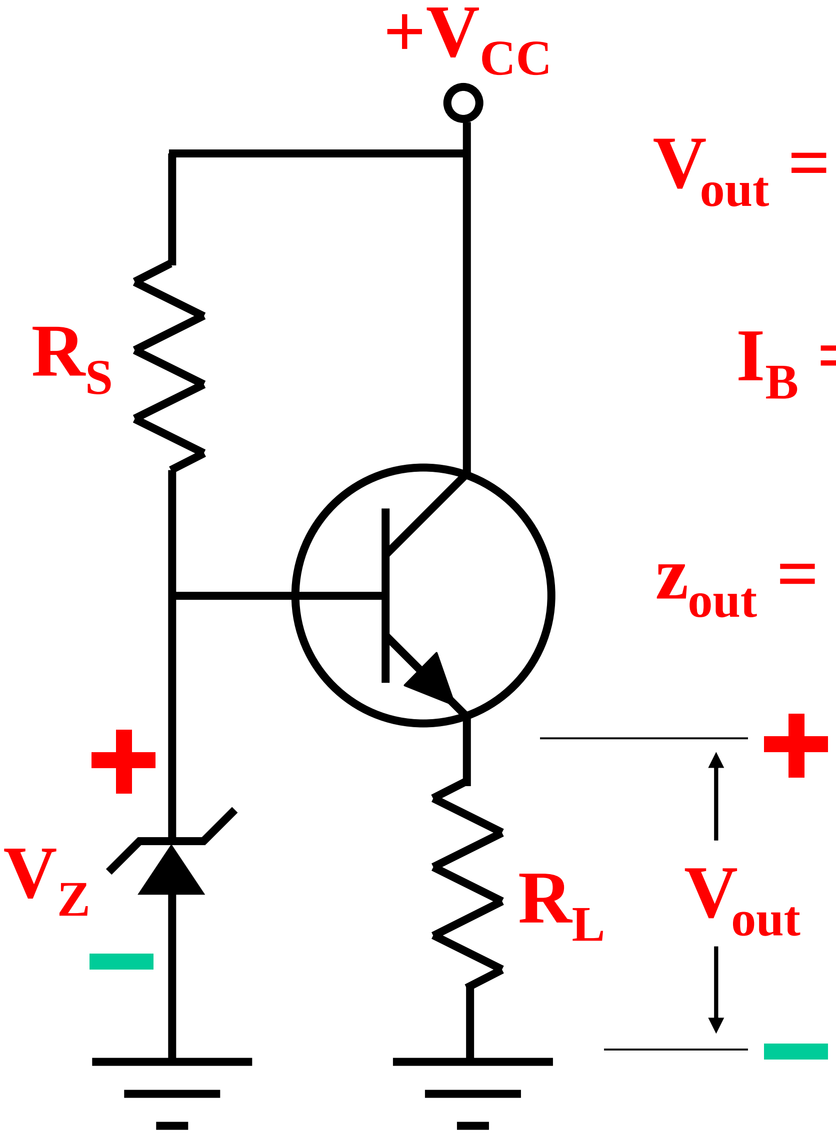


Two-stage negative feedback



R_2 provides both dc and ac negative feedback to stabilize the bias and the voltage gain.

Zener follower



$$V_{out} = V_Z - V_{BE}$$

$$I_B = \frac{I_{out}}{\beta_{dc}}$$

$$z_{out} = r_e' + \frac{R_Z}{\beta_{dc}}$$

Two-transistor voltage regulator

$$V_{out} = \frac{R_3 + R_4}{R_4}(V_Z + V_{BE})$$