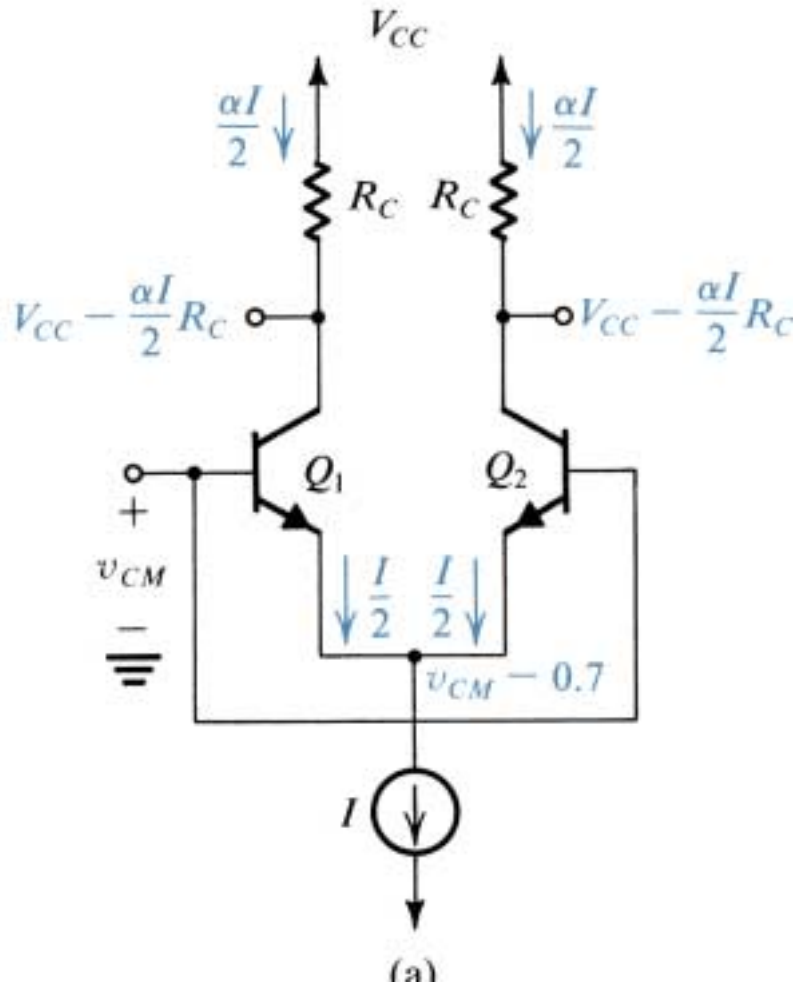
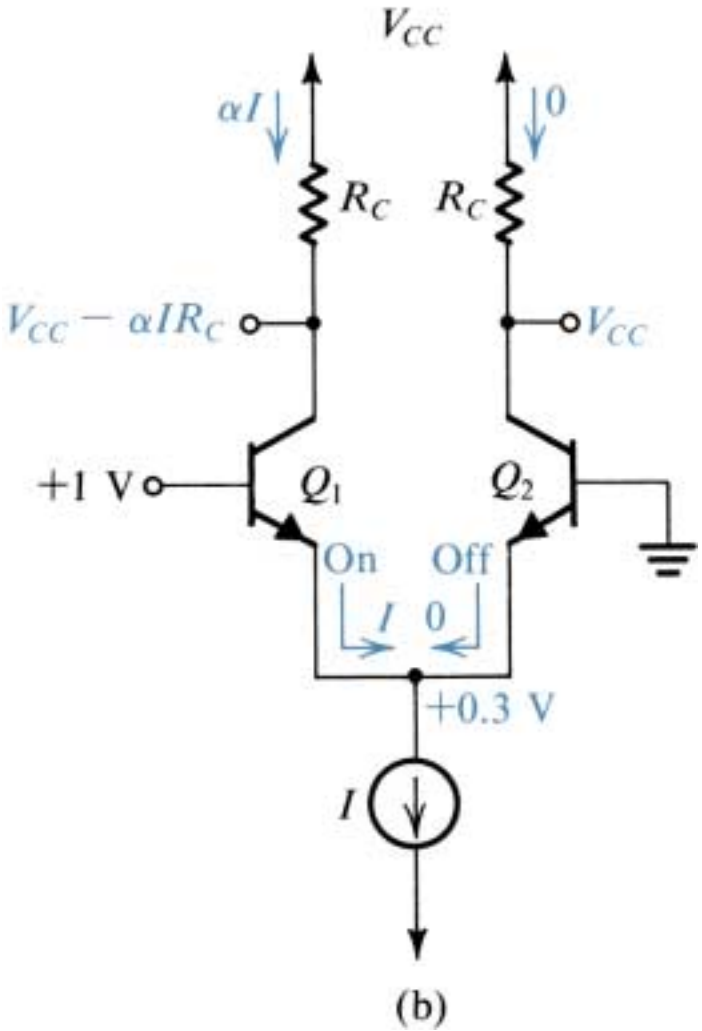
EE-4232

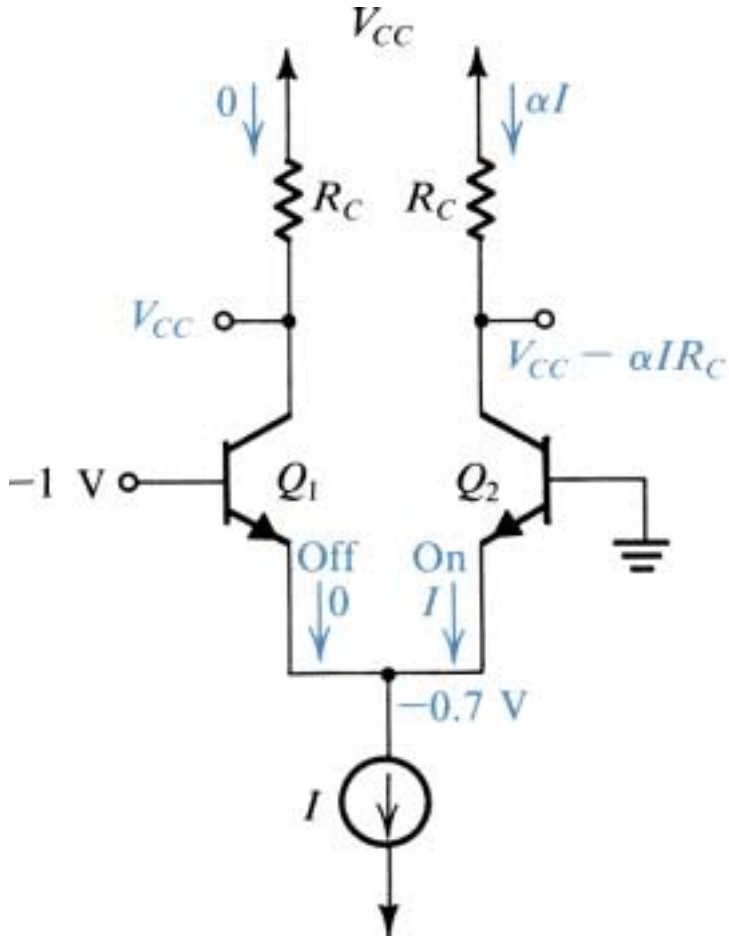
Differential Amplifiers



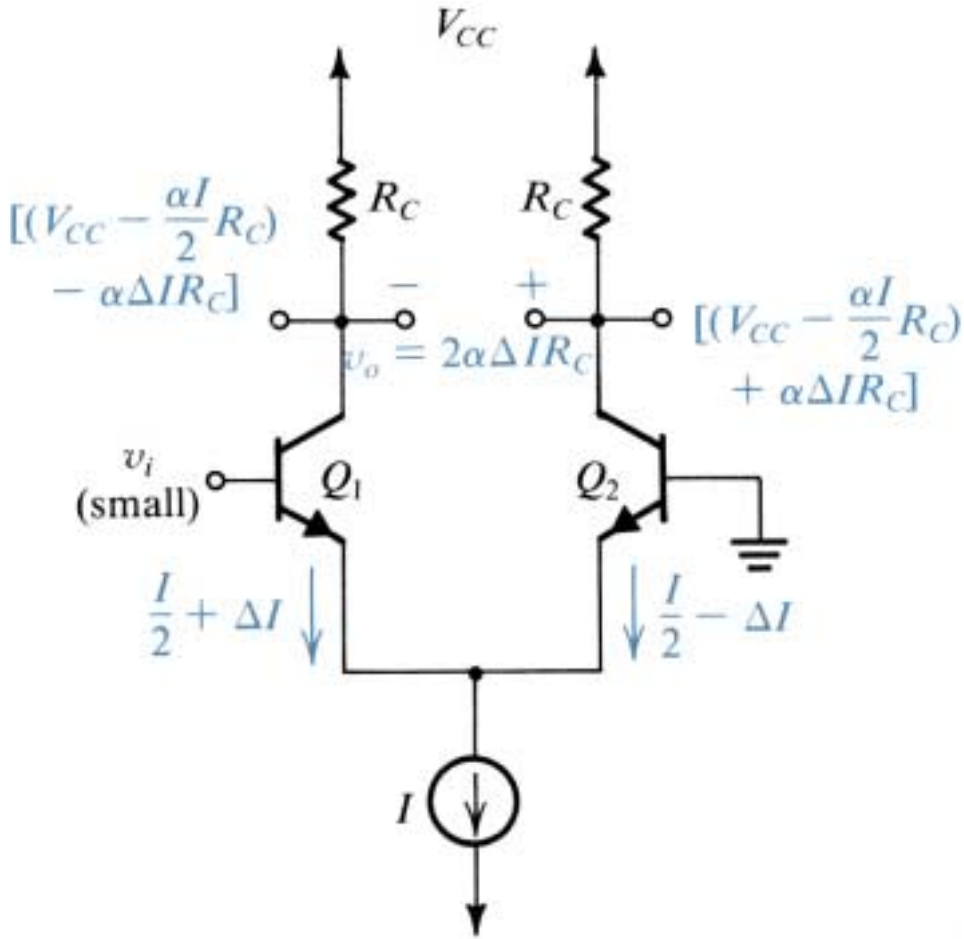
Different modes of operation of the differential pair: The differential pair with a common-mode input signal v_{CM}.



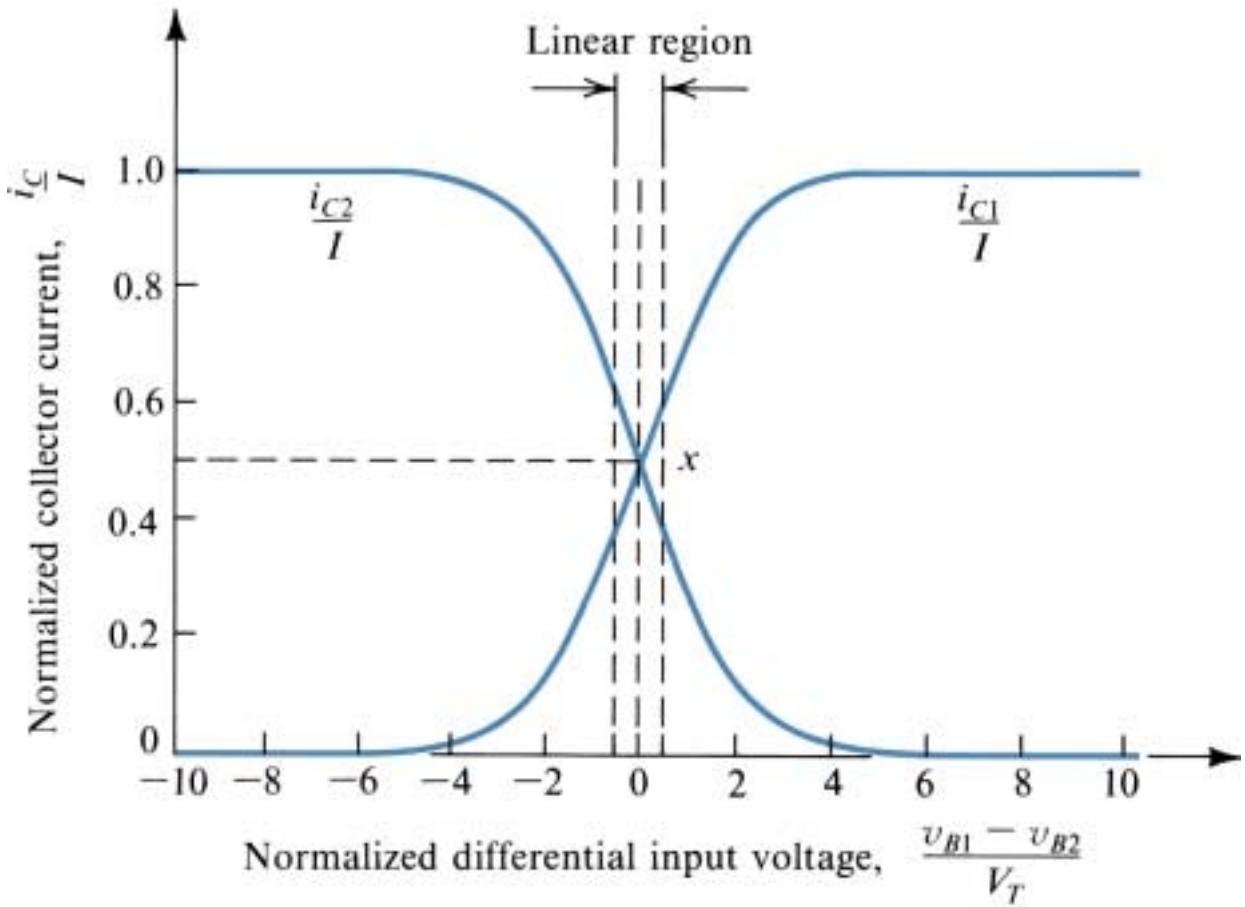
Different modes of operation of the differential pair: The differential pair with a “large” differential input signal.



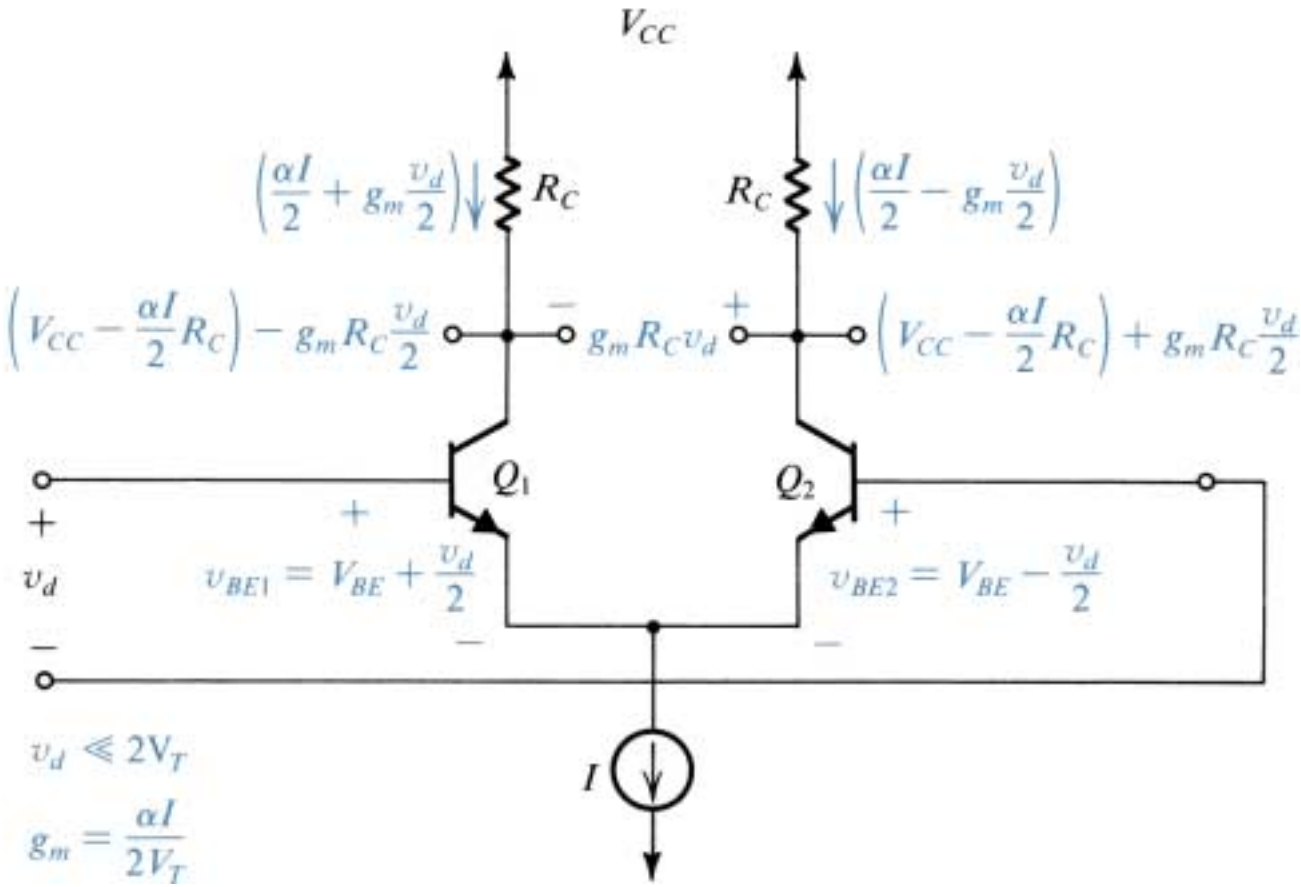
Different modes of operation of the differential pair: The differential pair with a large input signal of polarity opposite to that in (b).



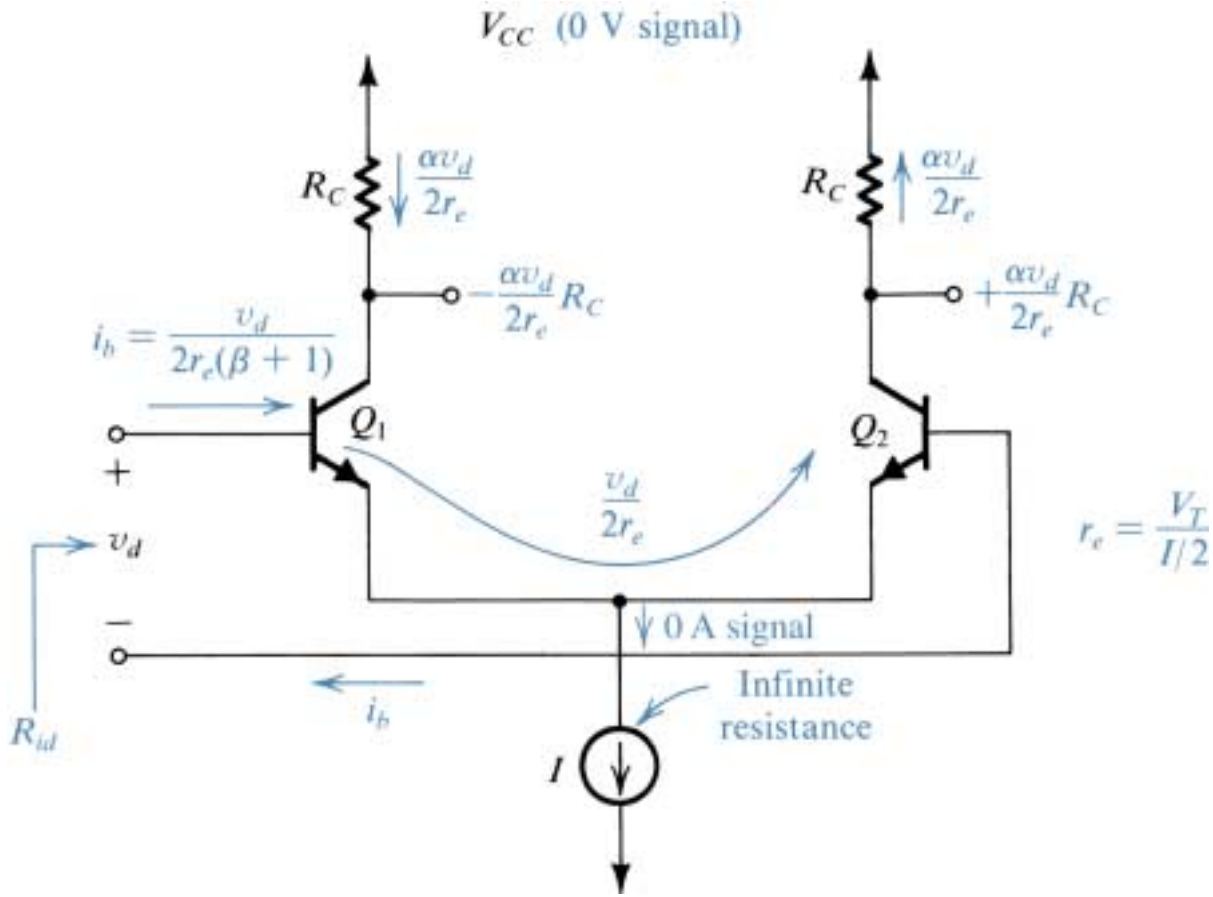
Different modes of operation of the differential pair: The differential pair with a small differential input signal v_i.



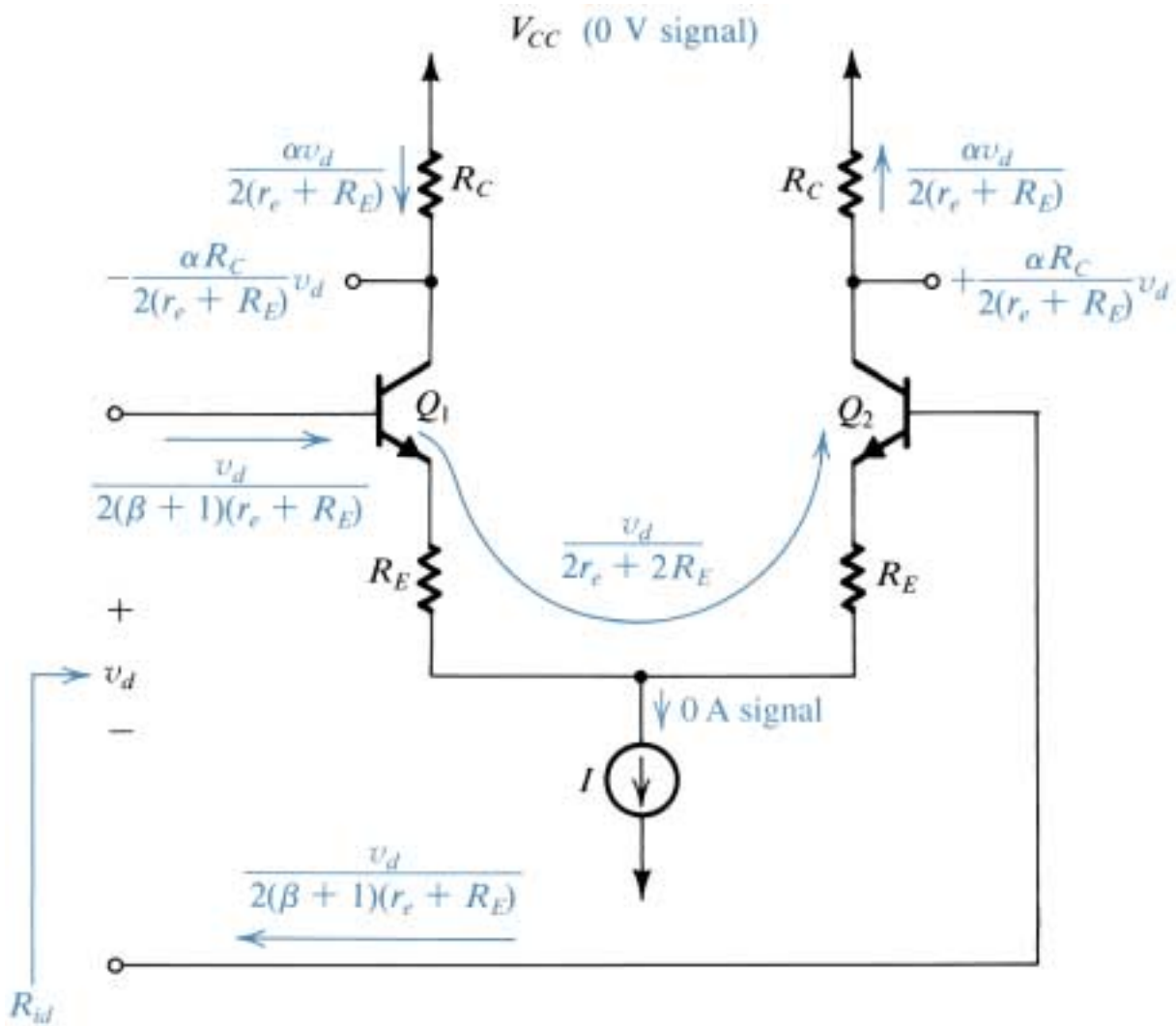
Transfer characteristics of the BJT differential pair of previous figure assuming $\alpha \cong 1$.



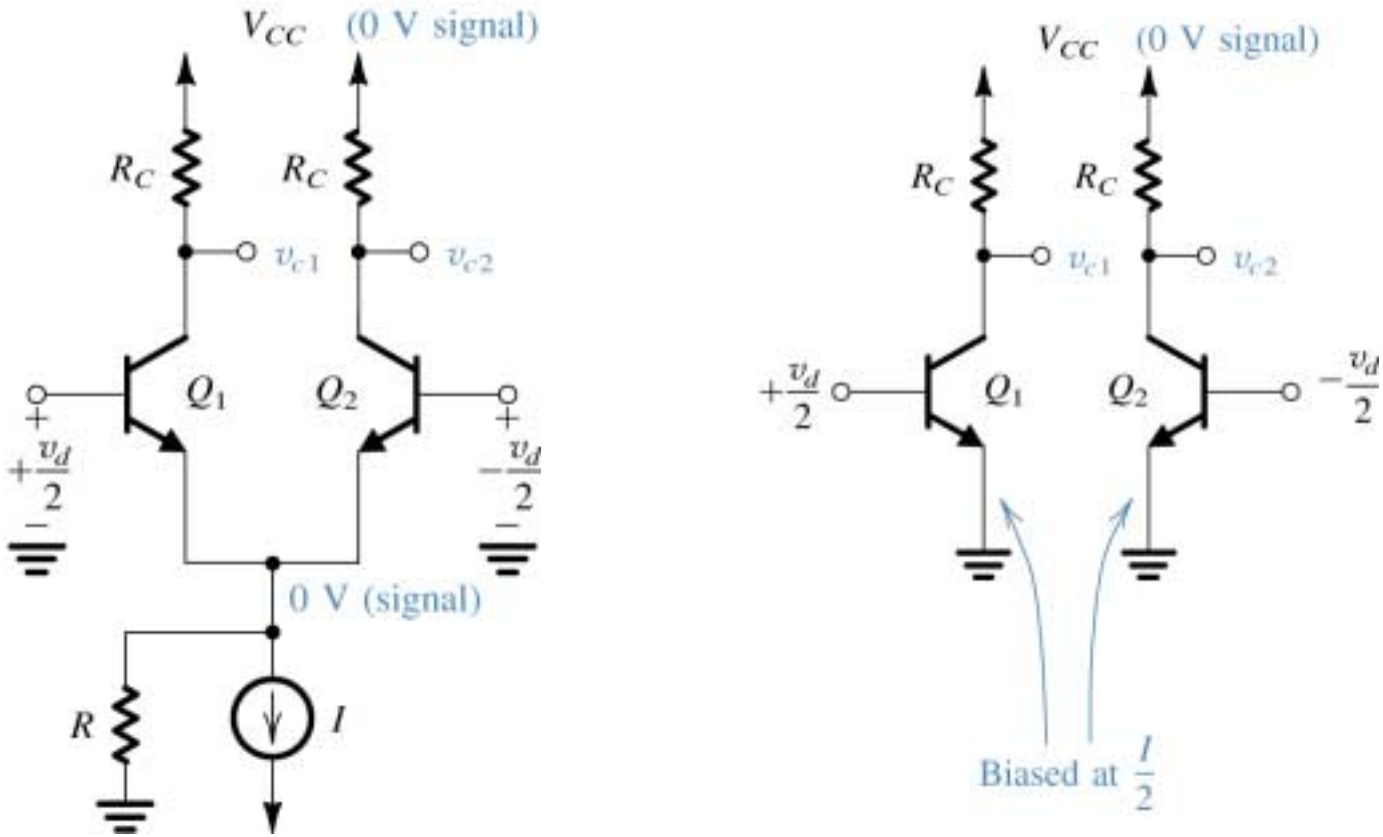
The current and voltages in the differential amplifier when a small difference signal v_d is applied.



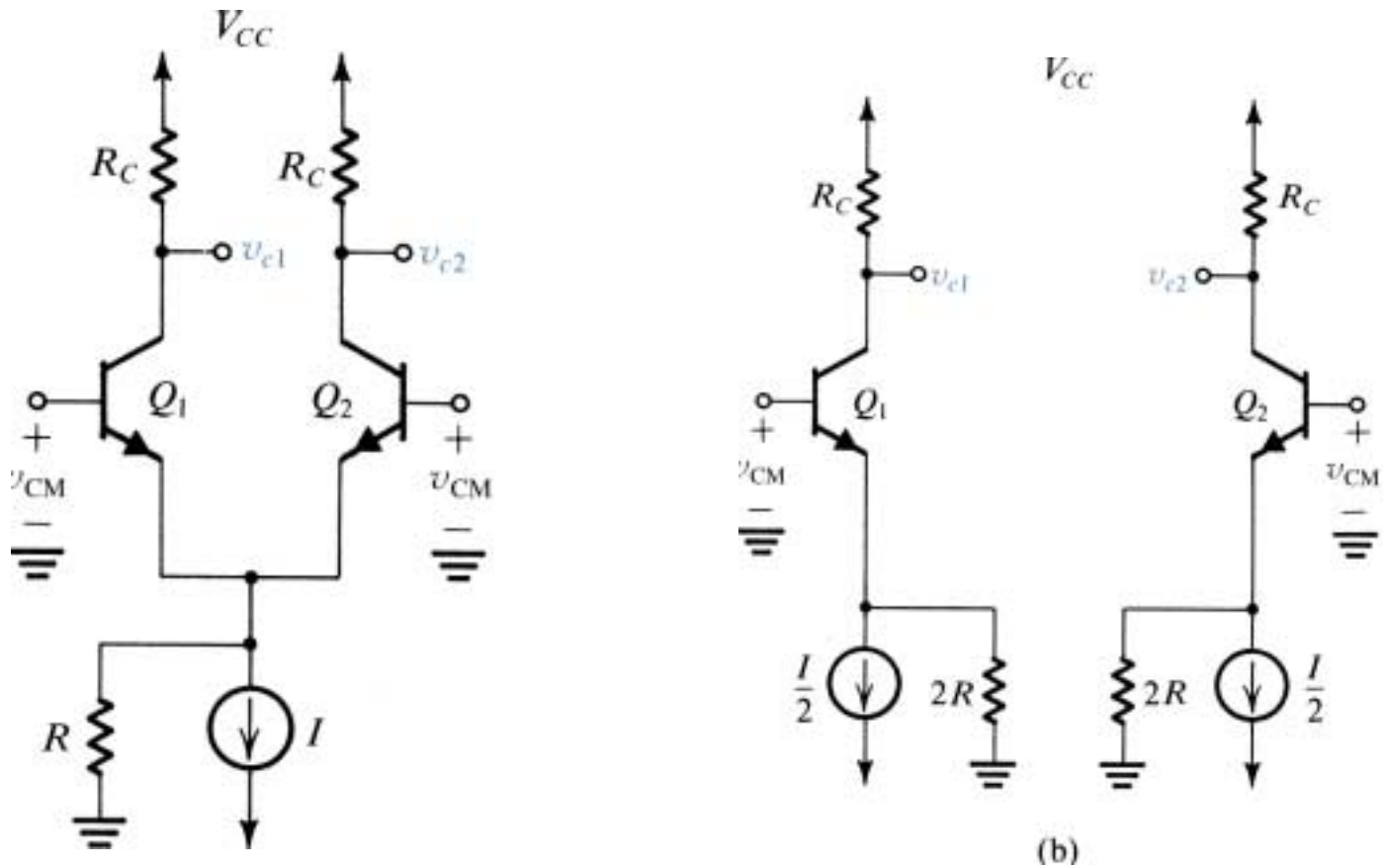
A simple technique for determining the signal currents in a differential amplifier excited by a differential voltage signal v_d; dc quantities are not shown.



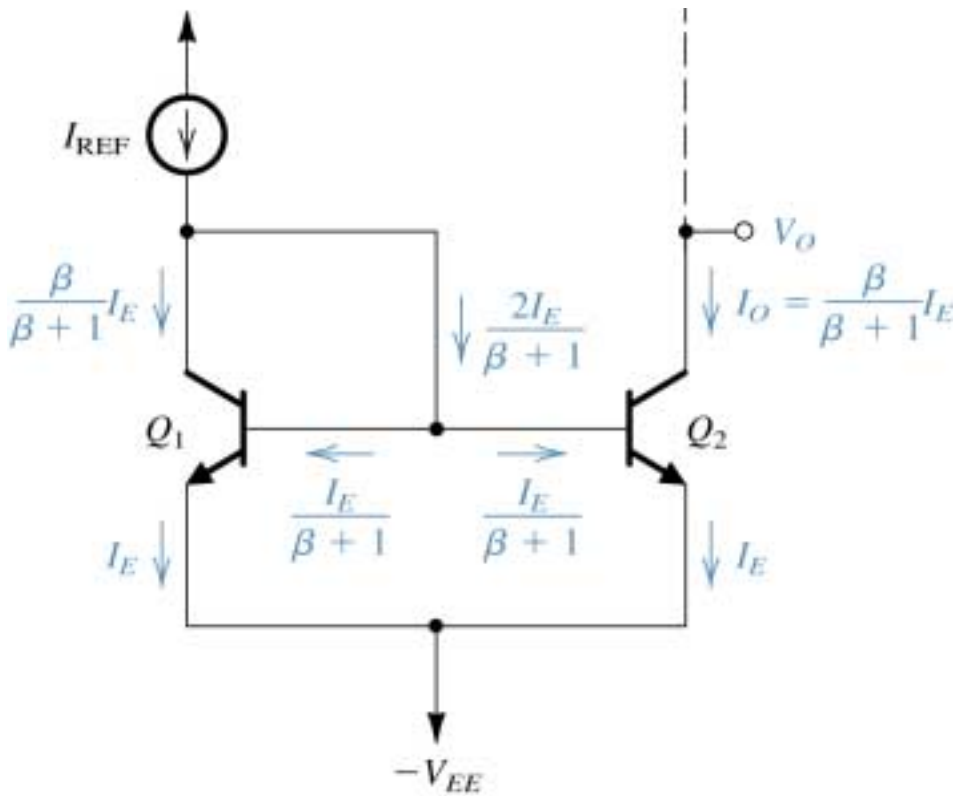
A differential amplifier with emitter existence. Only signal quantities are shown (on color).



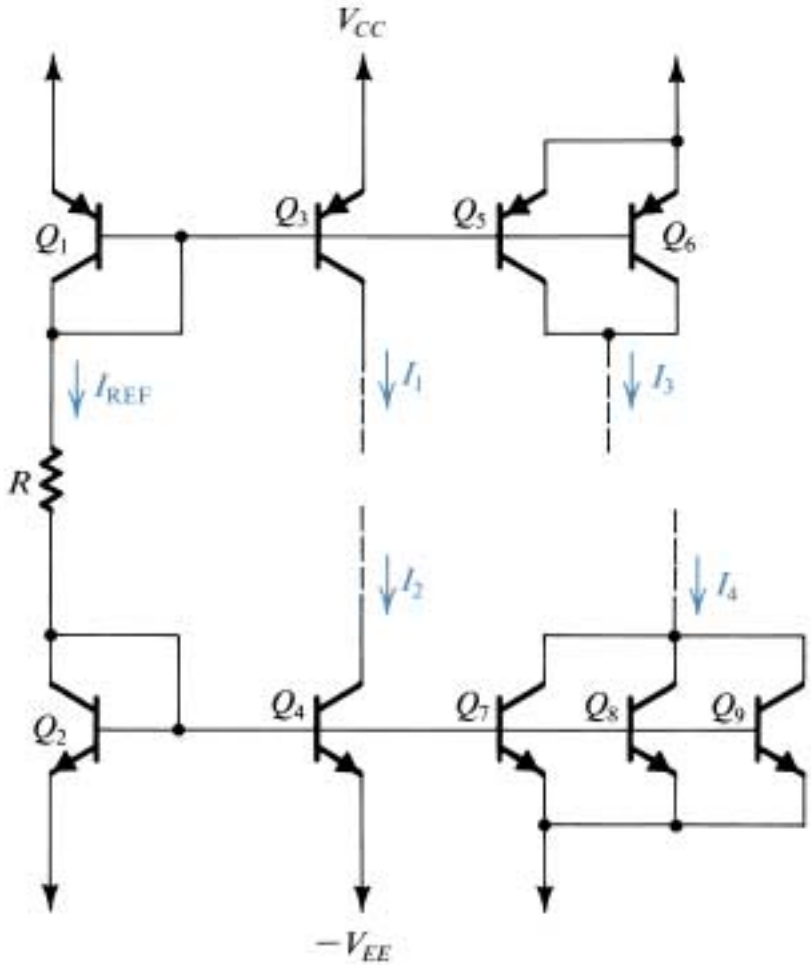
Equivalence of the differential amplifier (a) to the two common-emitter amplifiers in (b). This equivalence applies only for differential input signals. Either of the two common-emitter amplifiers in (b) can be used to evaluate the differential gain, input differential resistance, frequency response, and so on, of the differential amplifier.



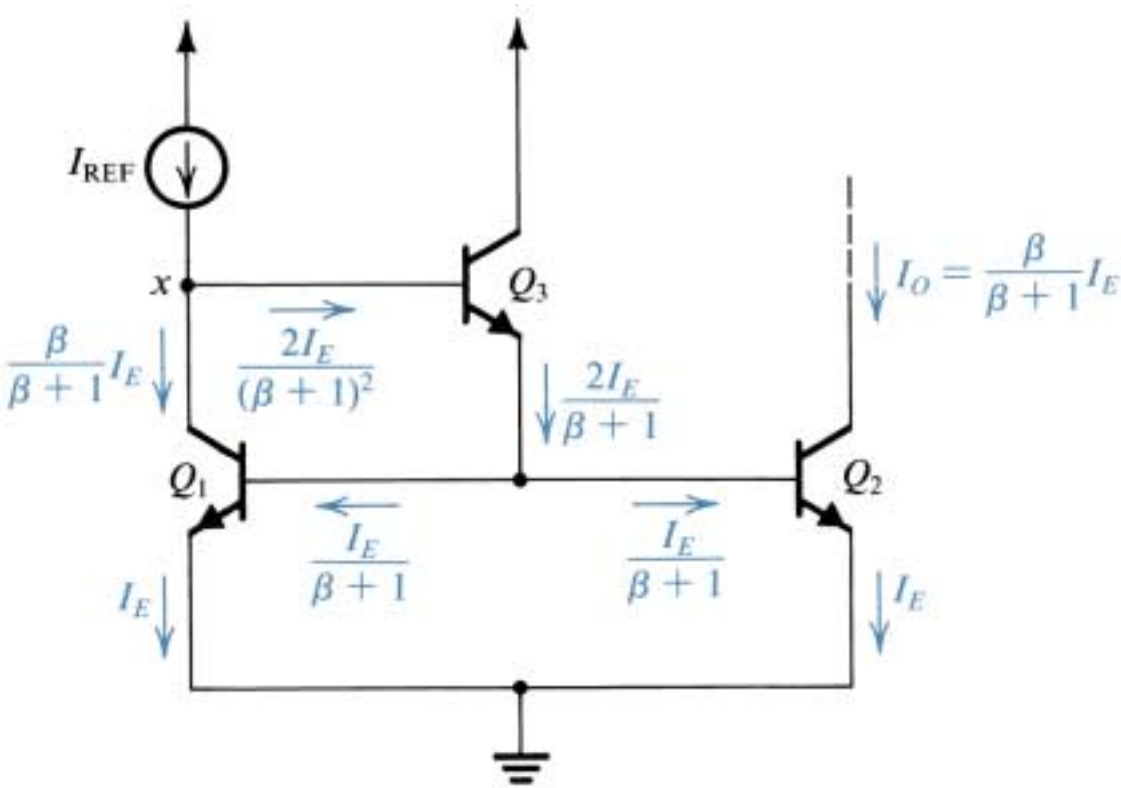
(a) The differential amplifier fed by a common-mode voltage signal. (b) Equivalent "half-circuits" for the common-mode calculations.



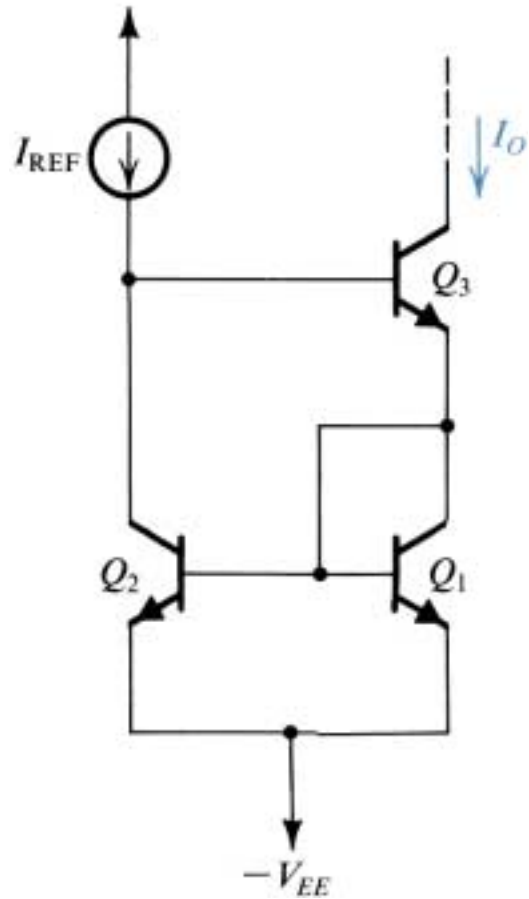
Analysis of the current mirror taking into account the finite β of the BJTs.



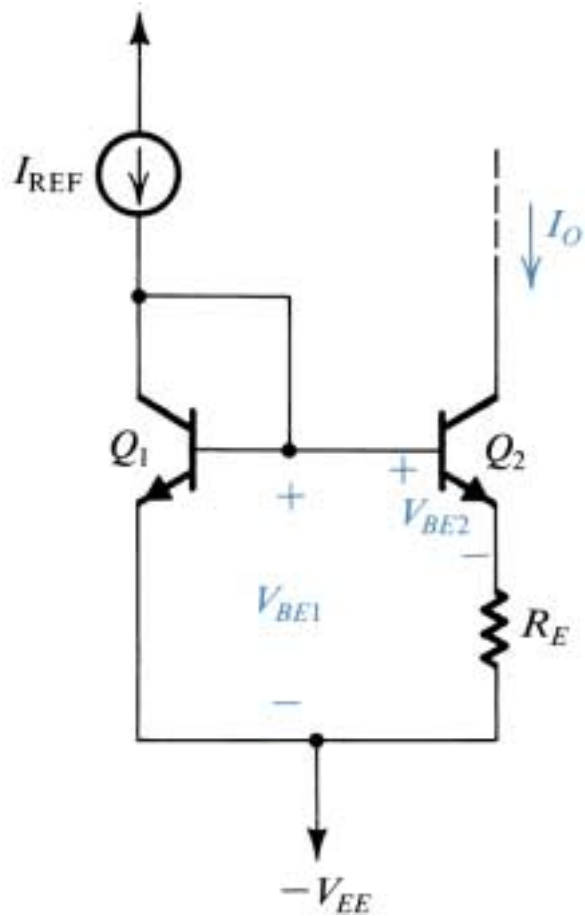
Generation of a number of cross currents.



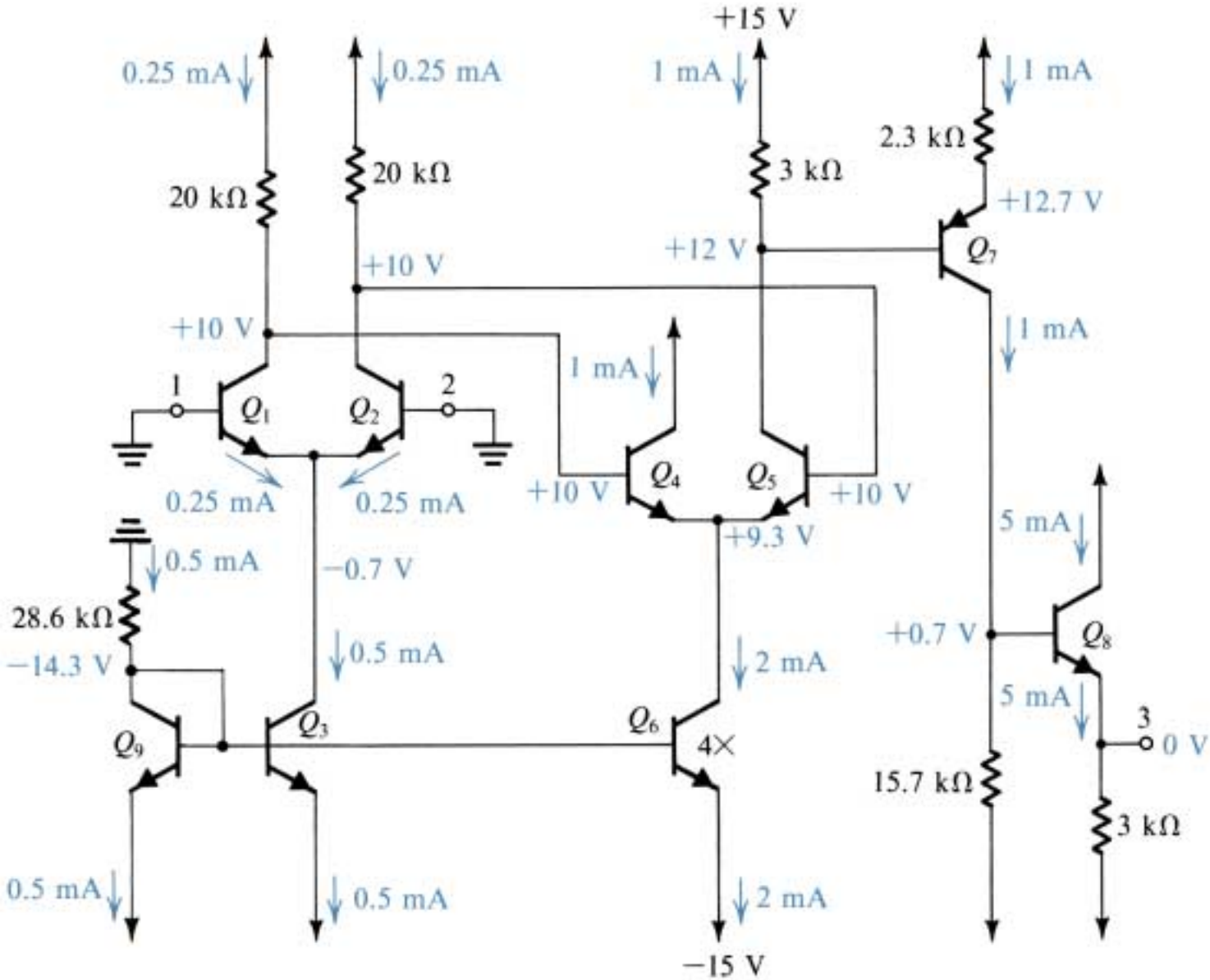
A current mirror with base-current compensation.

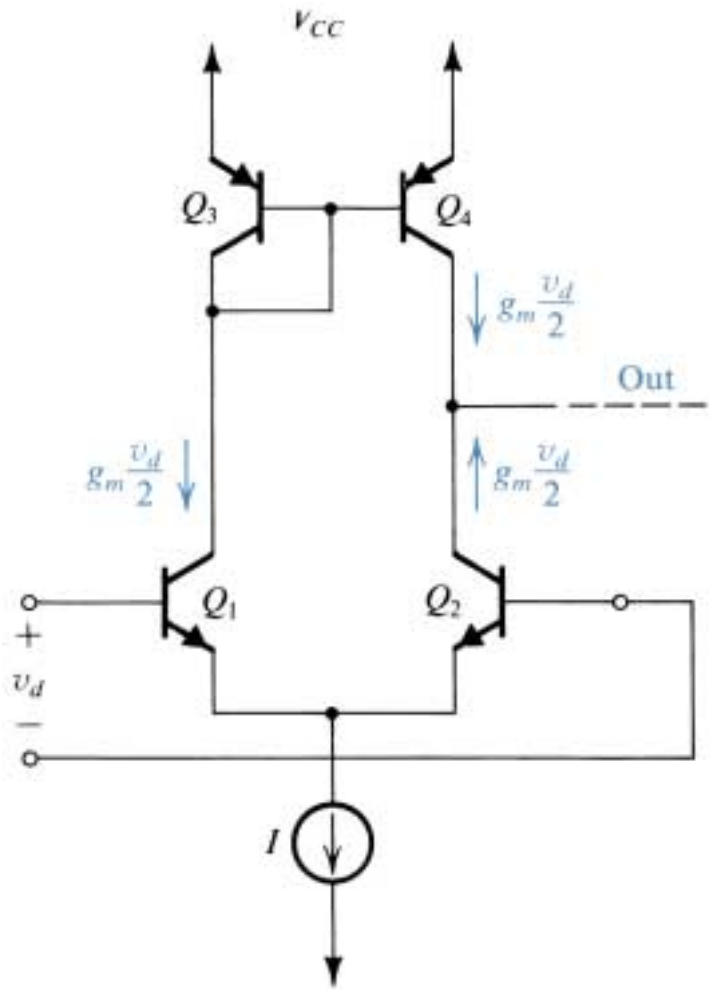


The Wilson current mirror.

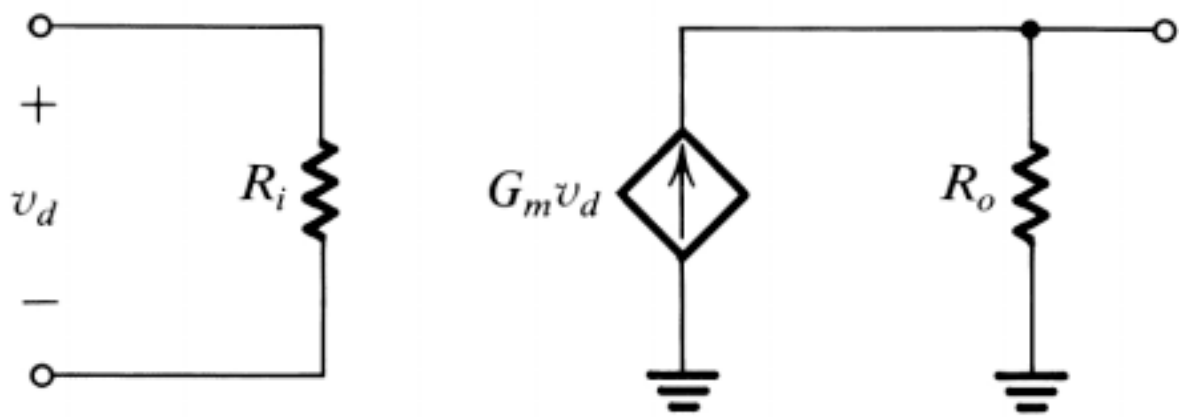


The Widlar current source.

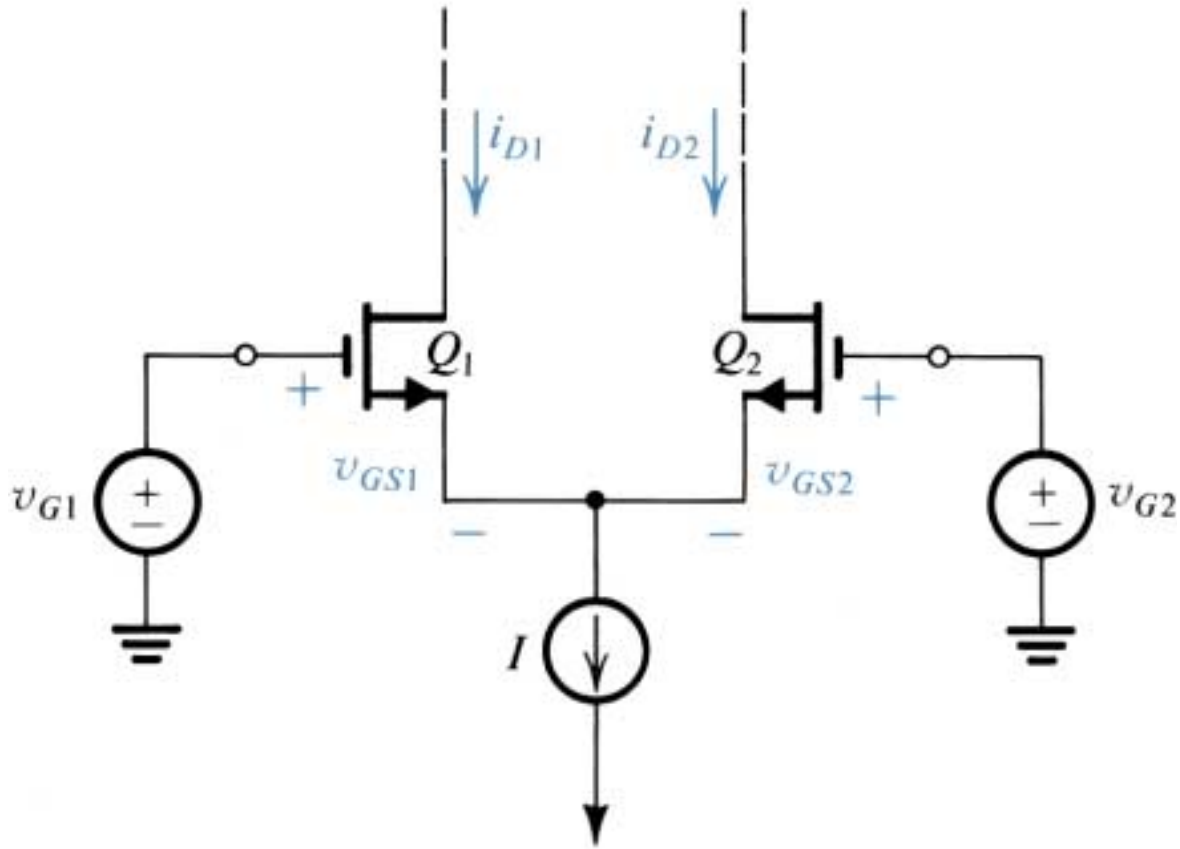

+15 V
0.25 mA
0.25 mA
1 mA
1 mA
20 kΩ
20 kΩ
3 kΩ
2.3 kΩ
+12.7 V
+10 V
+12 V
Q7
+10 V
1 mA
1
2
Q1
Q2
1 mA
Q4
Q5
0.25 mA
0.25 mA
+10 V
+10 V
+9.3 V
5 mA
0.5 mA
−0.7 V
28.6 kΩ
+0.7 V
Q8
0.5 mA
2 mA
−14.3 V
5 mA
3
0 V
Q9
Q3
Q6
4×
15.7 kΩ
3 kΩ
0.5 mA
0.5 mA
2 mA
−15 V



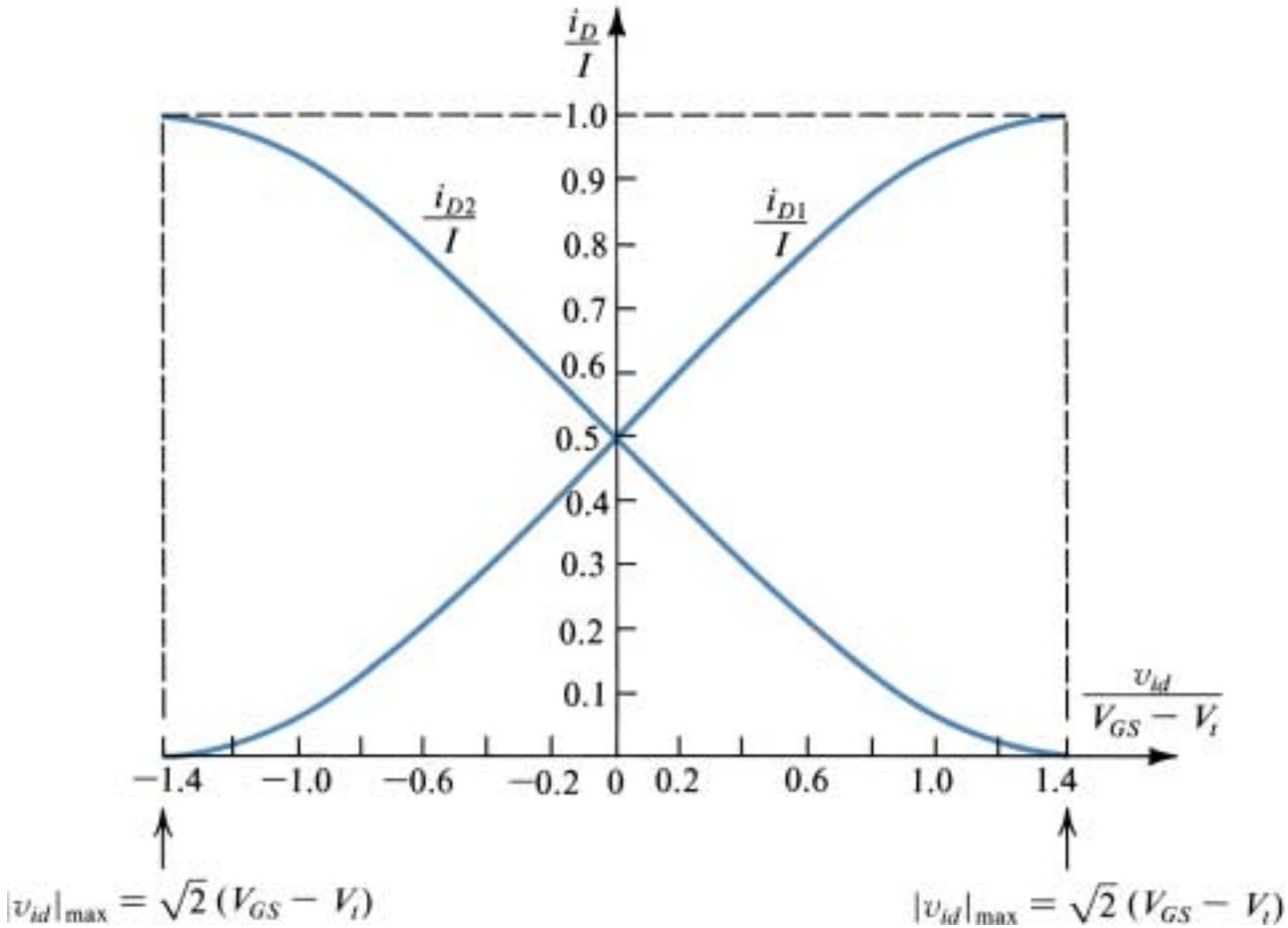
A differential amplifier with an active load.



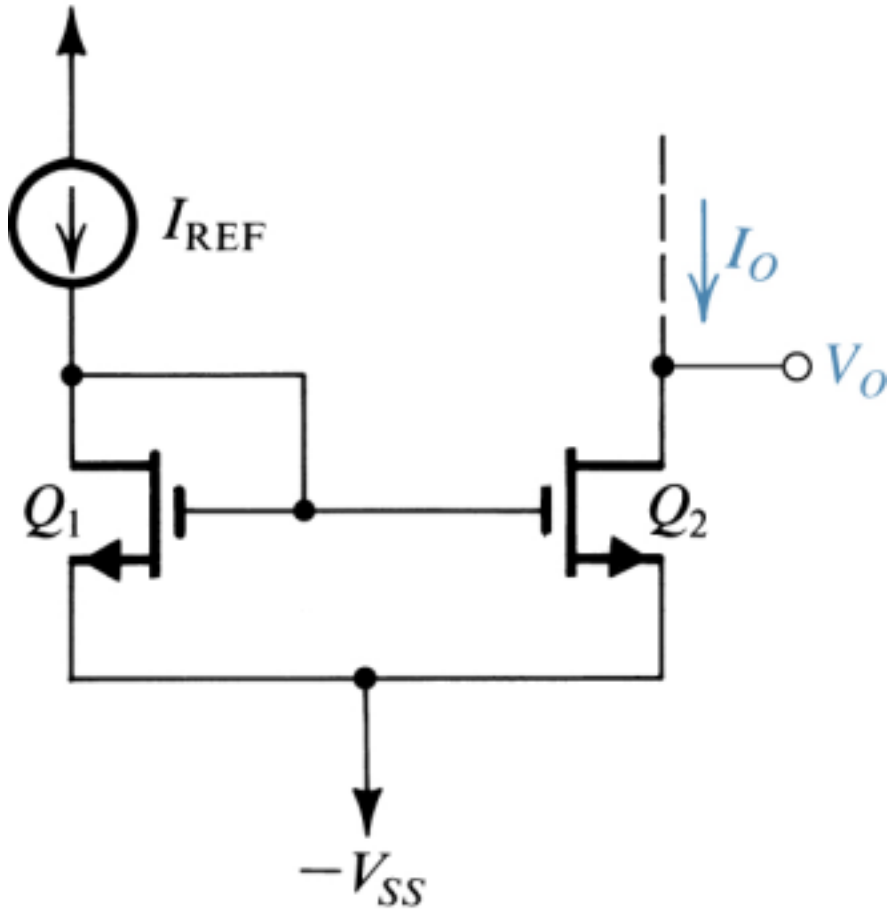
Small-signal model of the differential amplifier.



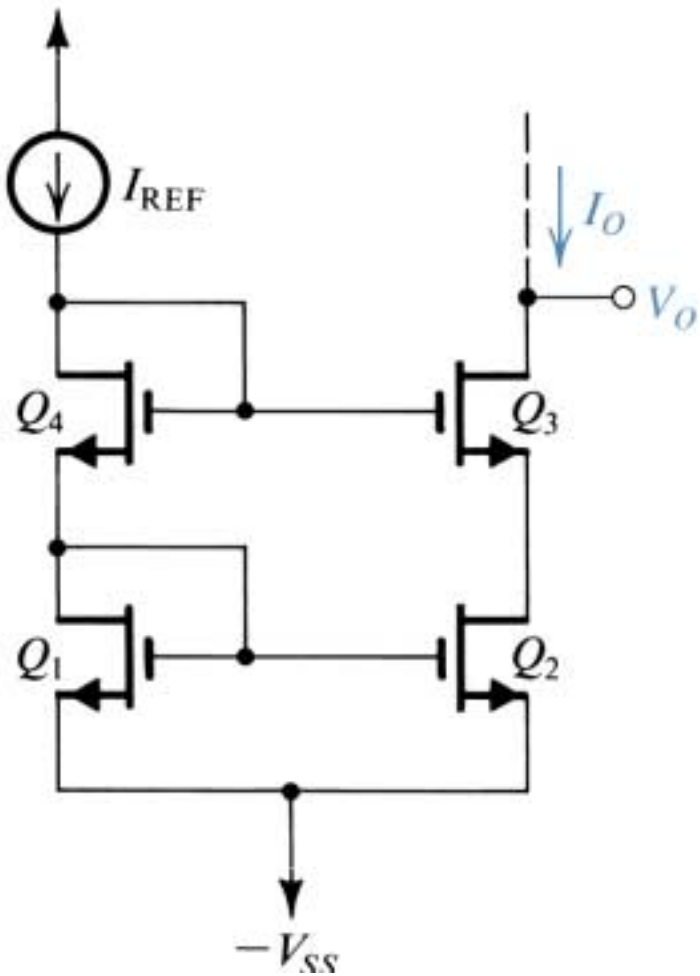
The MOSFET differential pair.



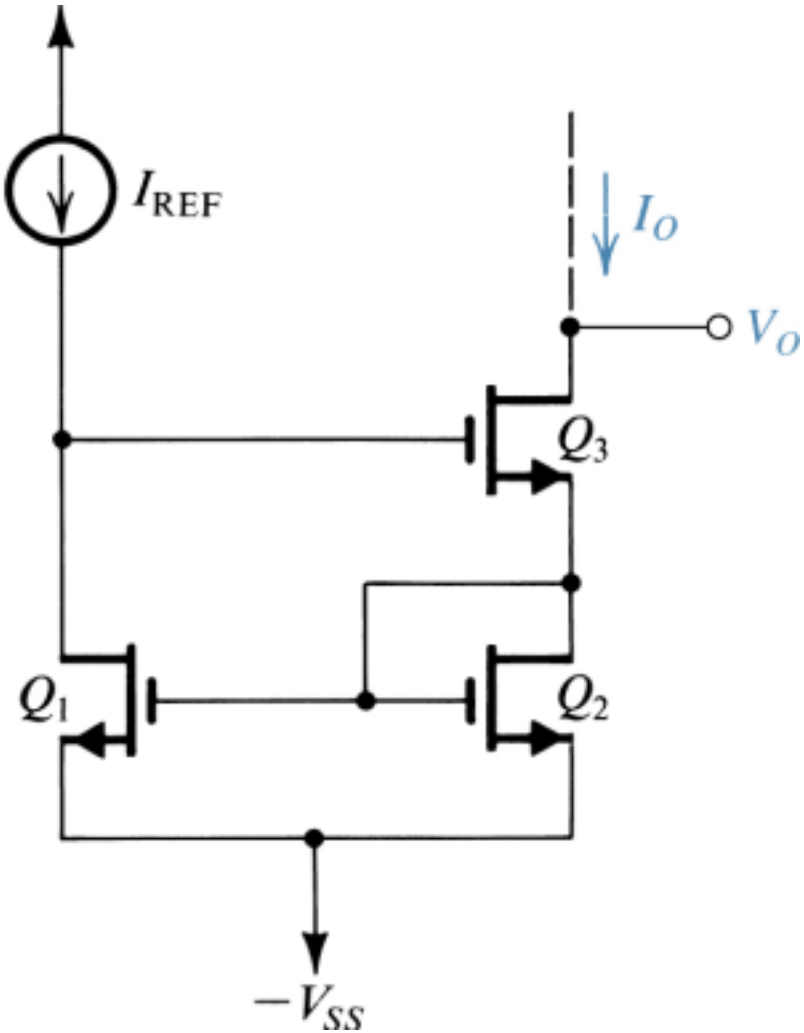
Normalized plots of the currents in a MOSFET differential pair. Note that V_{GS} is the gate-to-source voltage when the drain current is equal to the dc bias current (I/2).



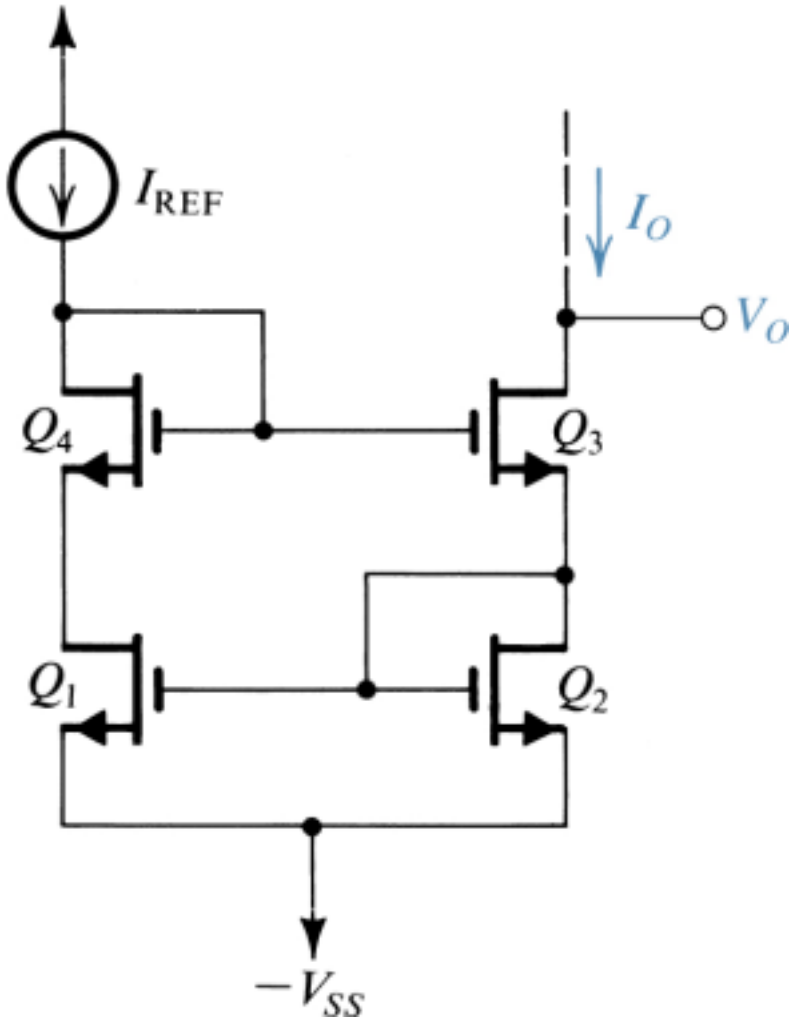
MOS current mirrors: basic



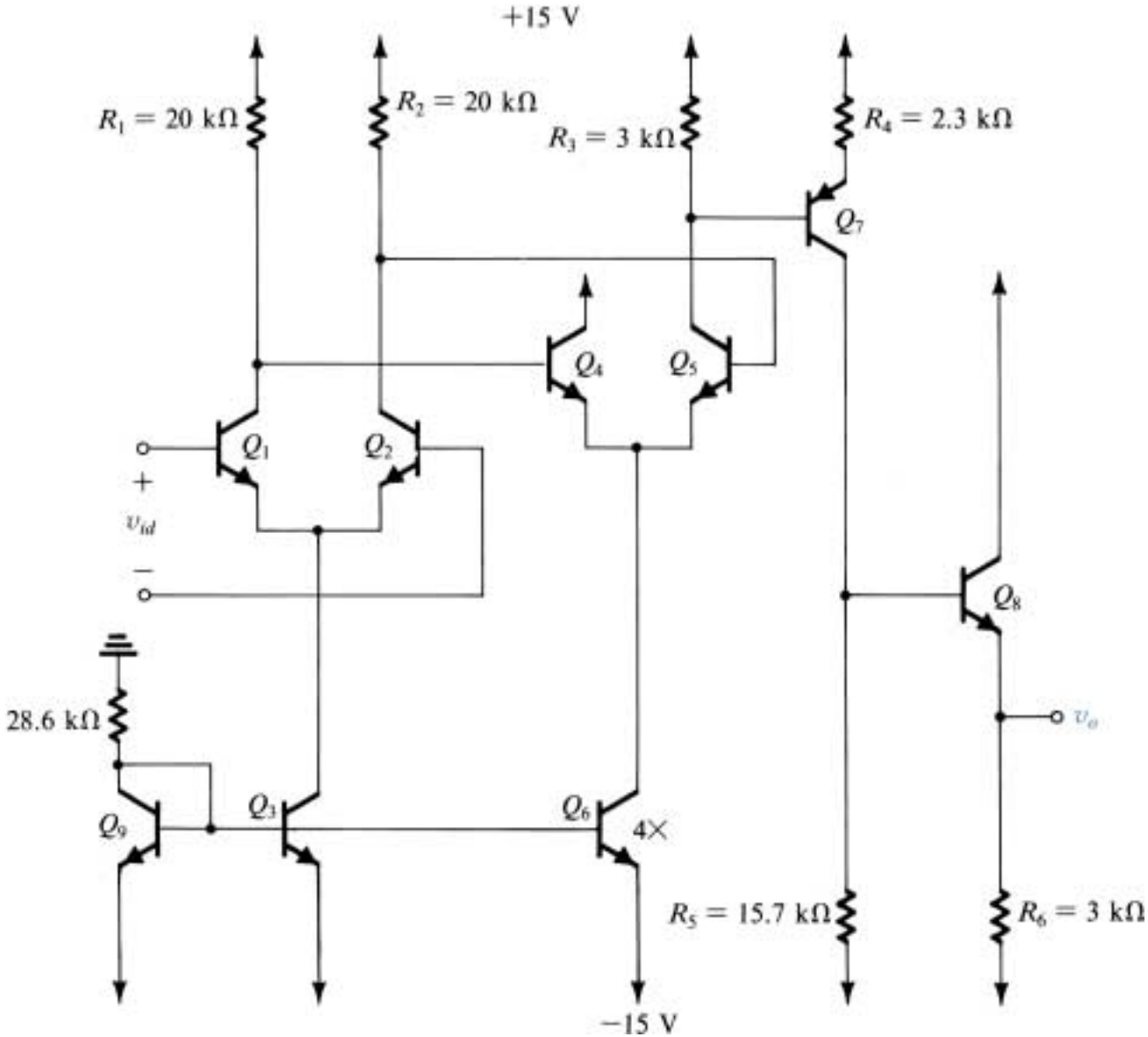
MOS current mirrors: cascode



MOS current mirrors: Wilson



MOS current mirrors: modified Wilson



A multistage amplifier circuit.

References

- *Electronics* by A. Hambley
- *Microelectronics Circuits* by Sedra & Smith
- Other books on Electronics