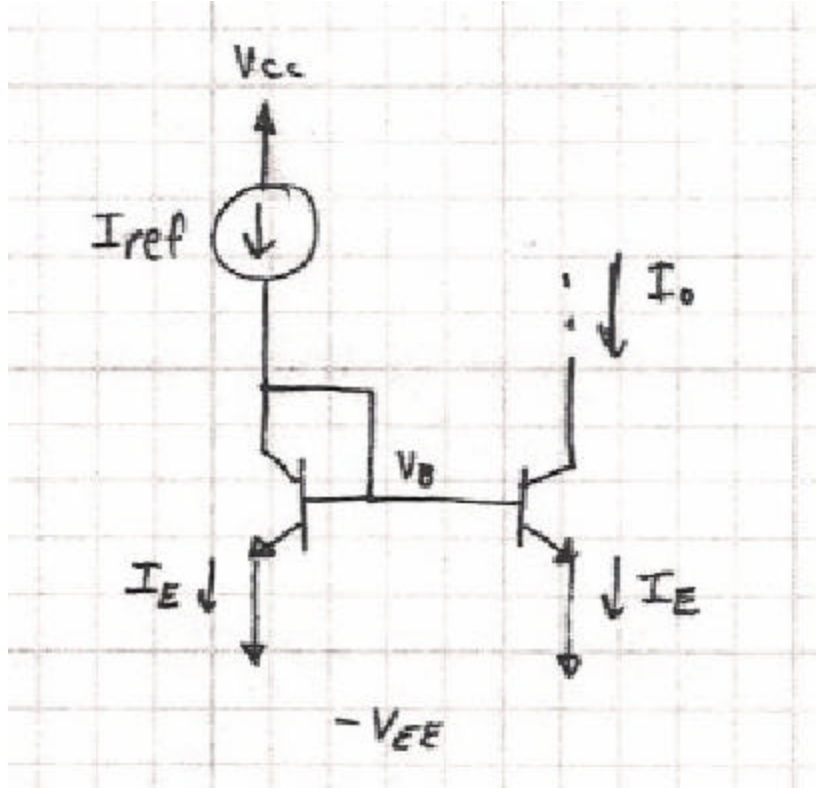


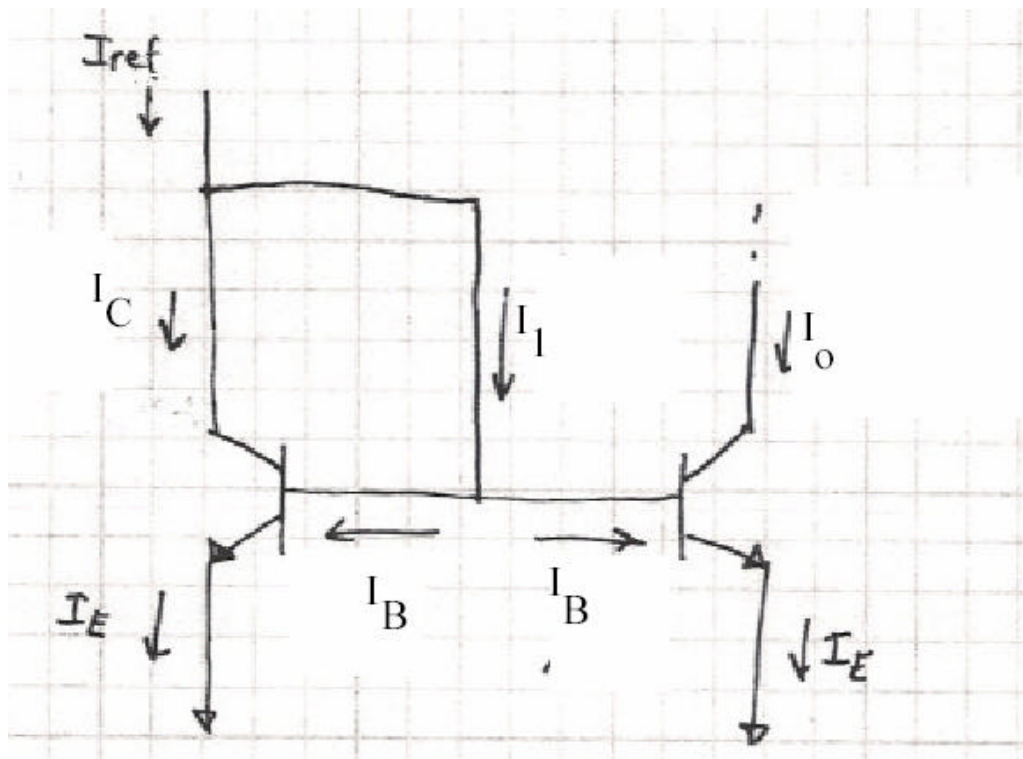
CURRENT SOURCES

How do we build current sources to bias our differential amplifiers?

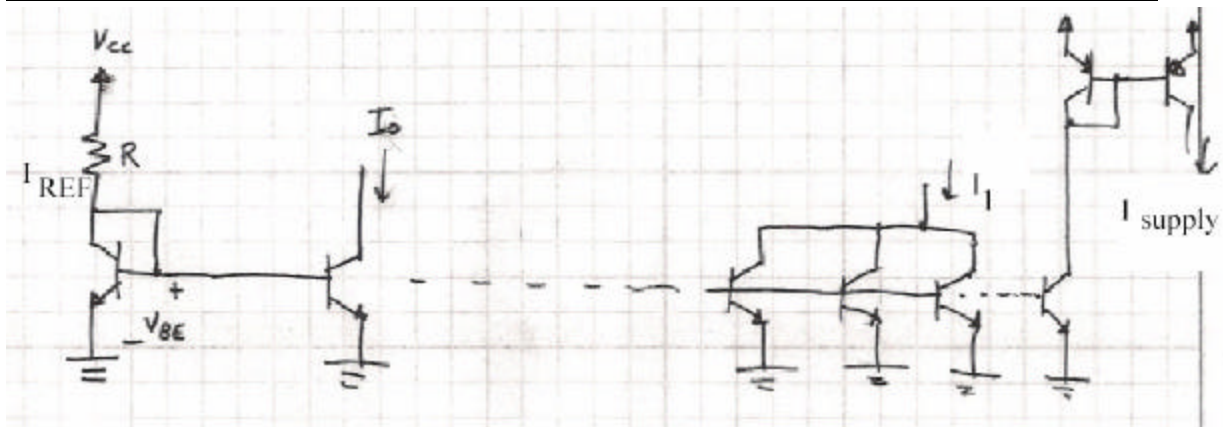


*output $R = r_o$

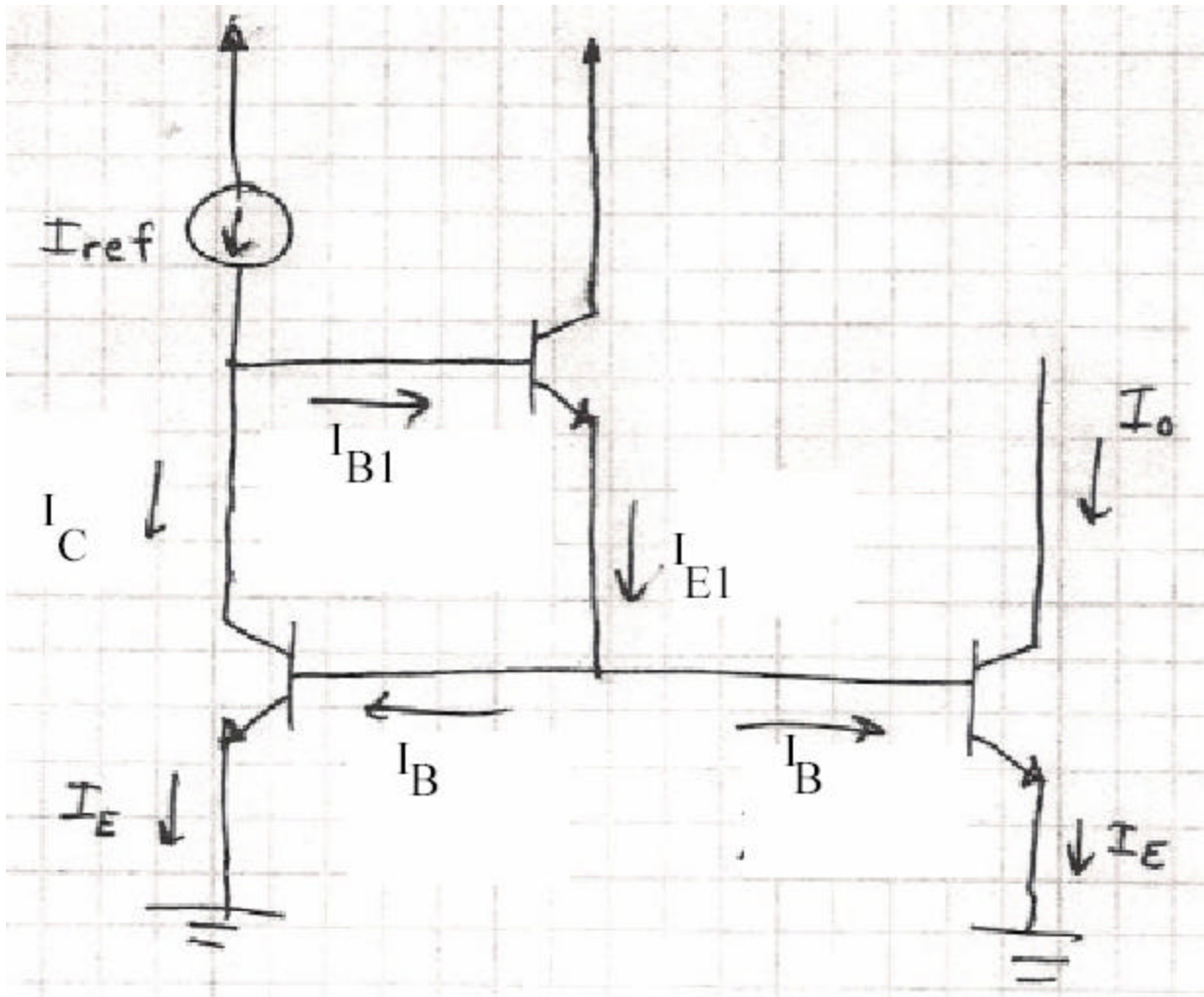
Since V_{BE} is the same in both BJT's, I_E must be the same.



CURRENT SOURCES

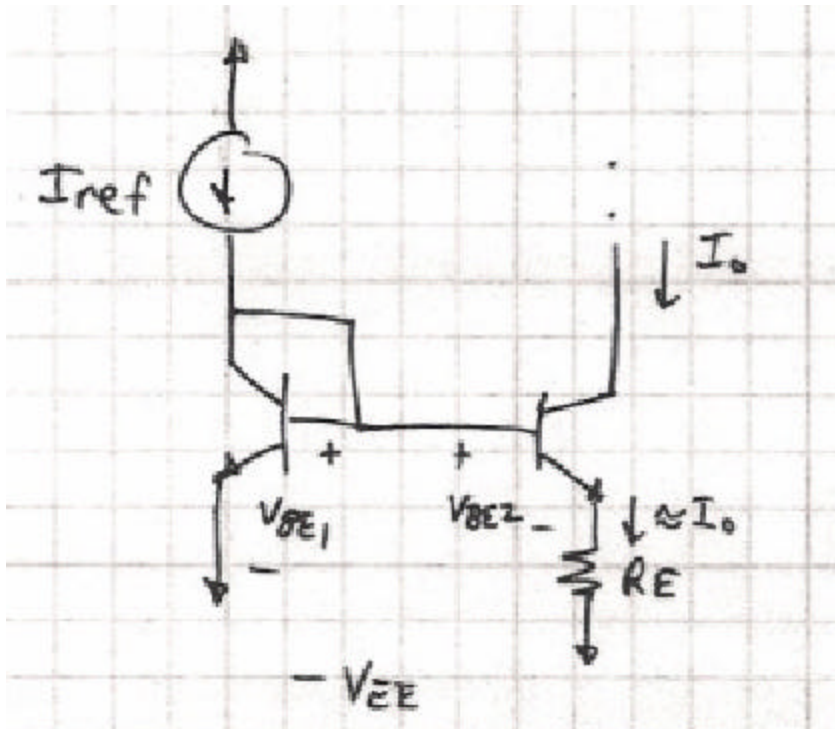


Improved current mirror with base current compensation

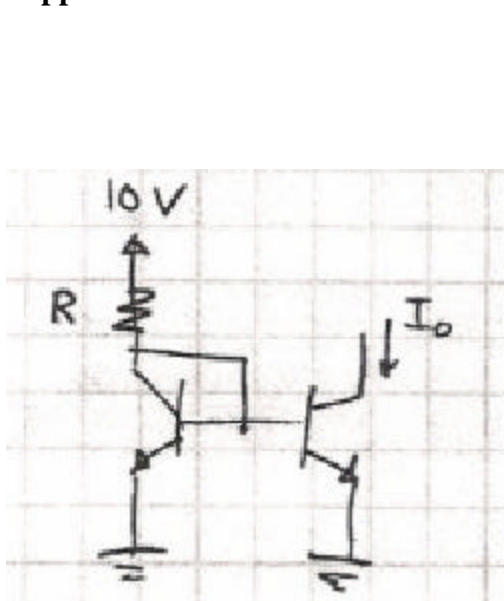


Widlar Current Source

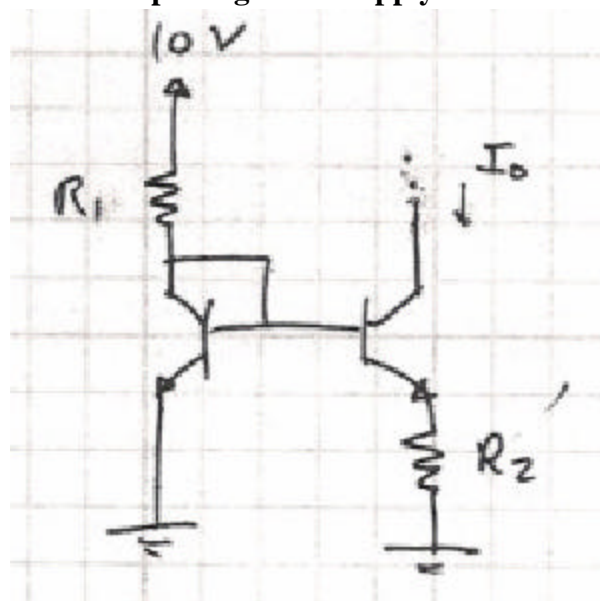
CURRENT SOURCES



Suppose we want a 10mA current source on a chip using a 10V supply:



Traditional



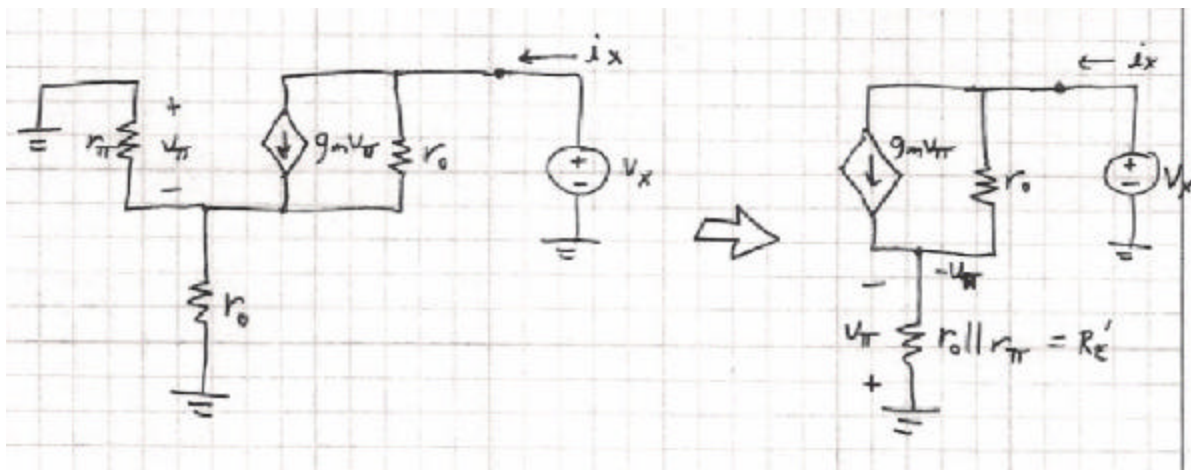
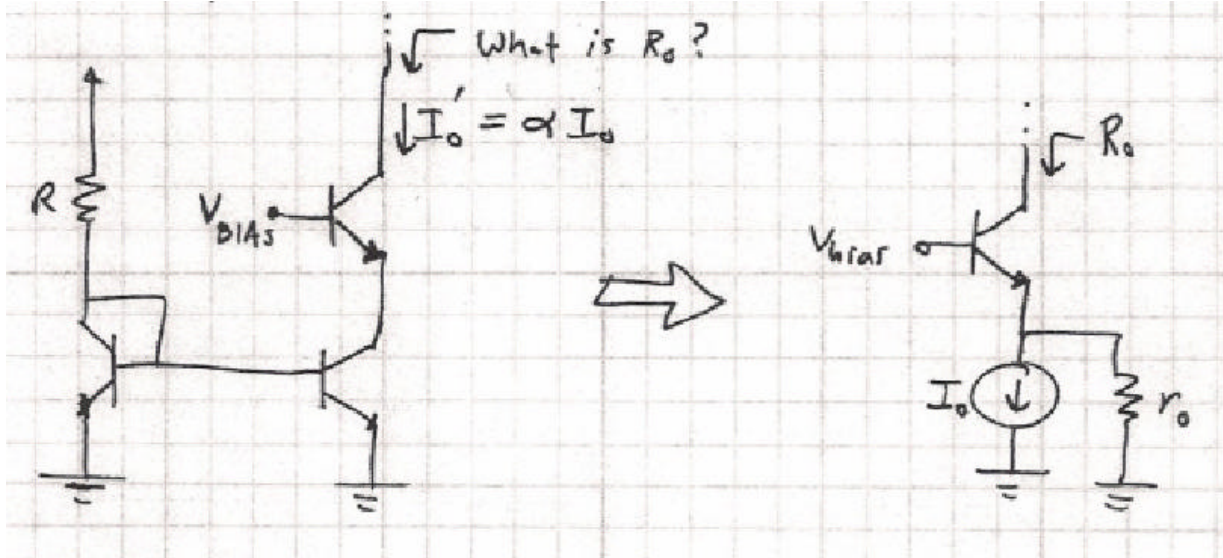
Widlar

Large R 's consume lots of chip area! Expensive!

The output R for the Widlar is large: (pg. 655) $R_o \sim [1 + g_m(R_E || r_\pi)]r_o$

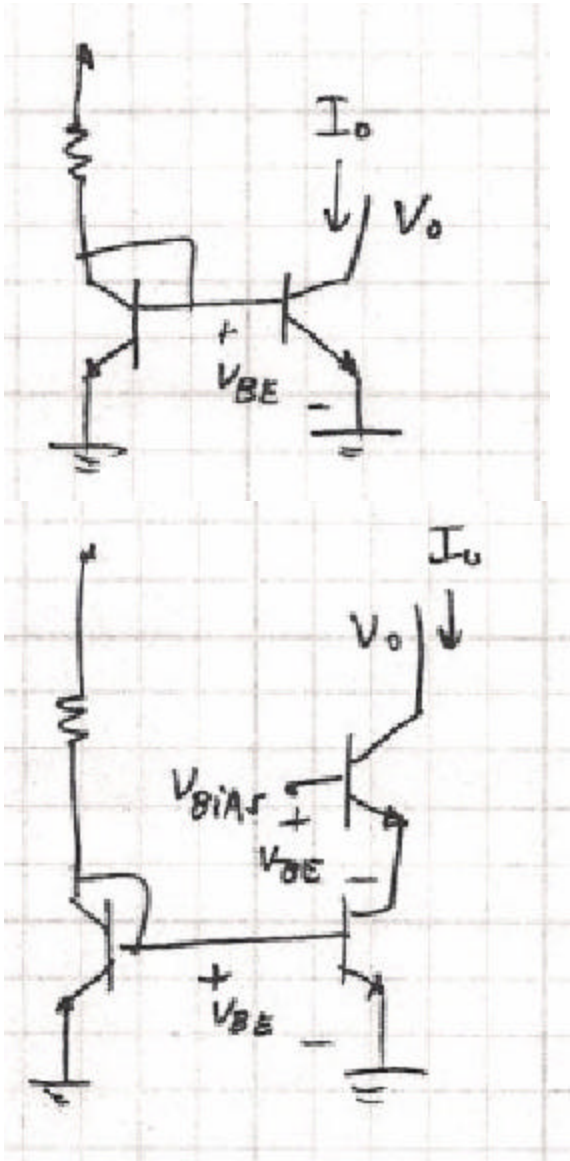
CURRENT SOURCES

The output R can be improved by using a CASCODE



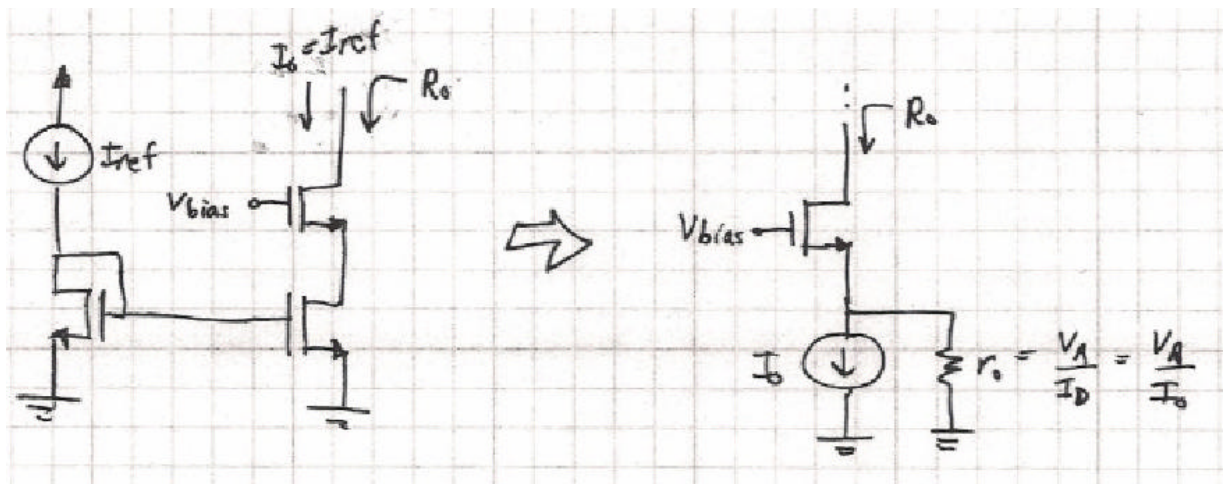
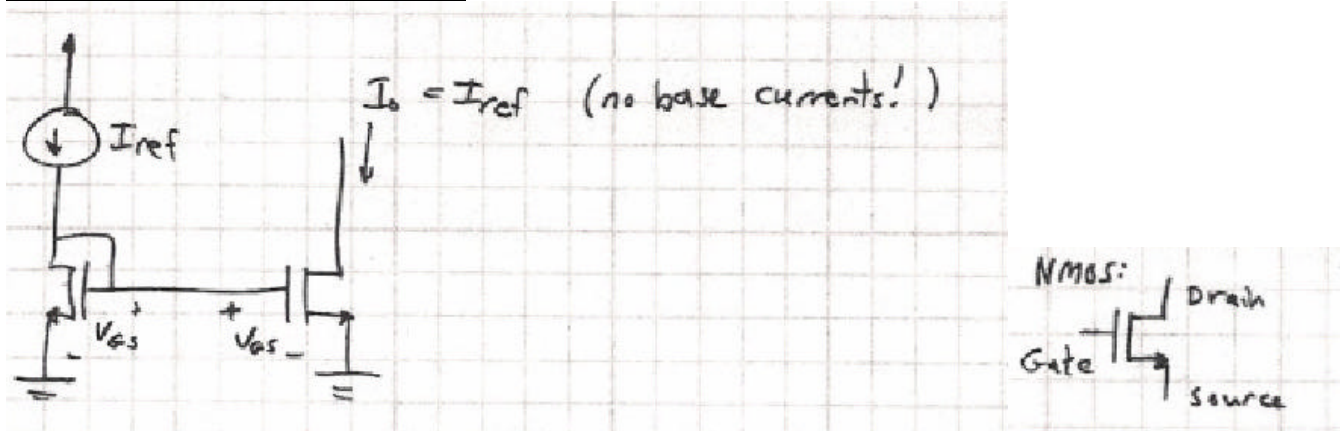
CURRENT SOURCES

What price do we pay? _____

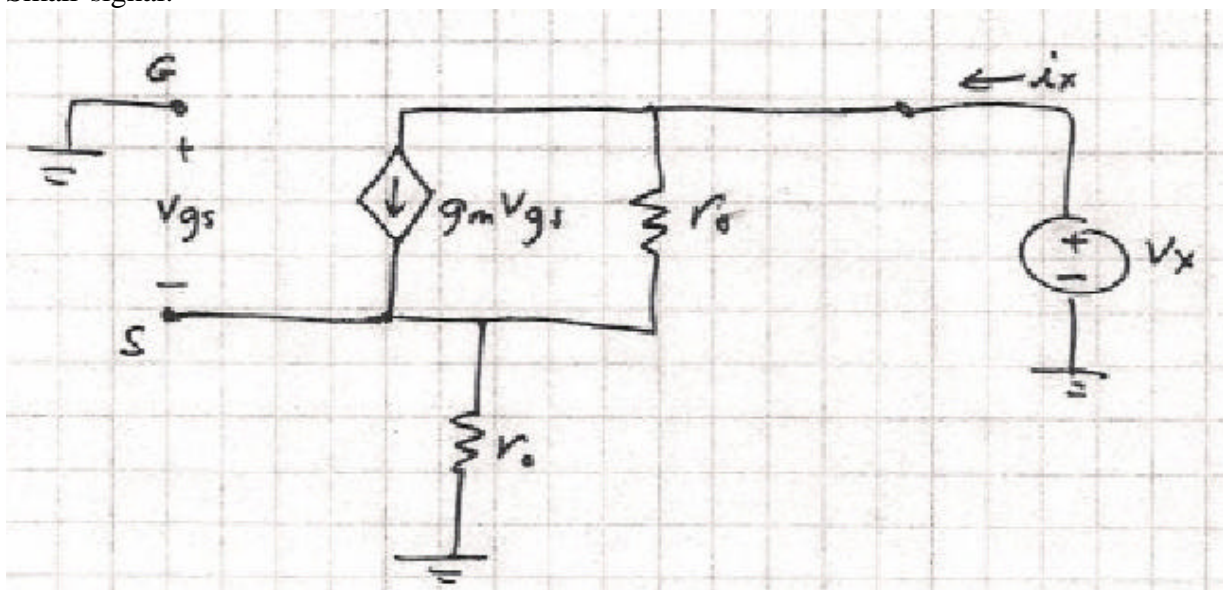


CURRENT SOURCES

Current mirrors with MOSFETs:

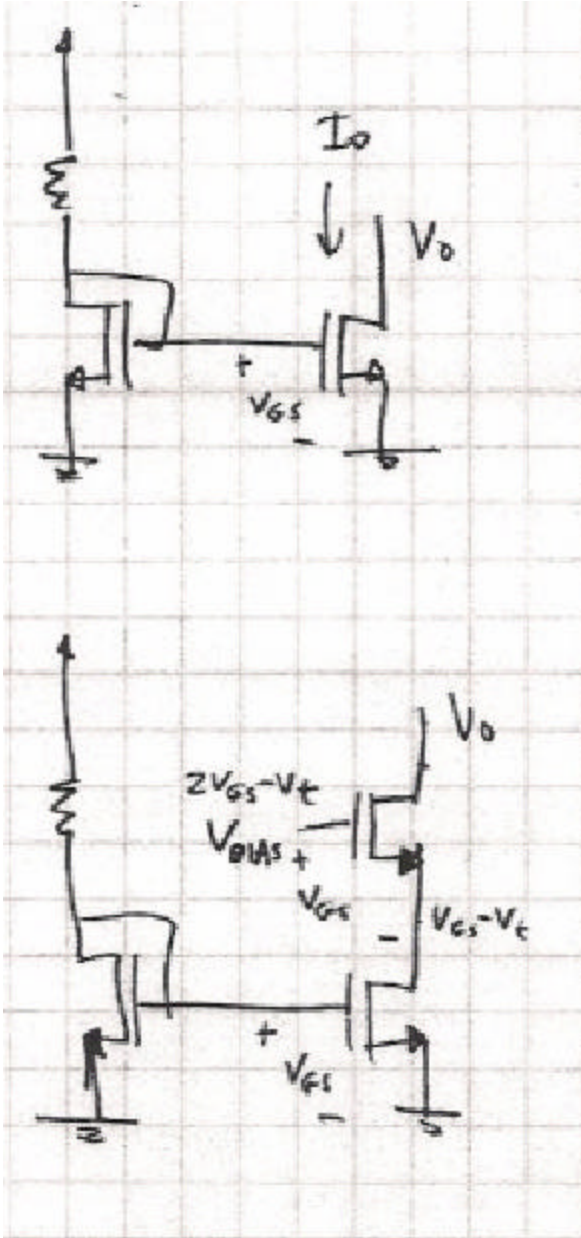


Similar to BJT
Small-signal:



CURRENT SOURCES

Overhead:



CURRENT SOURCES

Convenient way to bias cascade:

