

UNIVERSITY OF CALIFORNIA
College of Engineering
Department of Electrical Engineering
and Computer Sciences

Homework #2

EECS 140

B. E. Boser

Due 09/08/99 before noon in 497 Cory

Fall 1999

Note: Use the device parameters given in the class handout “Device Parameters & SPICE Models” and also available on the EECS 140 website, <http://kowloon.eecs.berkeley.edu/~courses/140>. Assume $\beta \rightarrow \infty$ and $V_A \rightarrow \infty$ for all BJTs and $\lambda \rightarrow 0$ for all MOSFETs. You will have to modify the standard SPICE Models from the website to match the idealized parameters.

- 1) Given is the self-biasing V_{BE} reference circuit in Fig.1. The resistor R has a temperature coefficient of 1500ppm/°C. Assume $dV_{BE}/dT = -1.8 \text{ mV}/^\circ\text{C}$ for Q1.
 - a) Calculate the current I_{OUT} at room temperature (R.T.), 0°C and 100°C.
Hint: Use an iterative approach or a numerical solver to find V_{BE} at R.T.
 - b) Use SPICE to verify your hand analysis. In the device models, set all $\lambda=0$, $V_A=1000\text{V}$ and $\beta=10^6$. Printout your SPICE input file and a plot of I_{OUT} versus temperature. Mark the result from part (a) in the plot with three circles. How good is the agreement? Explain all discrepancies.
 - c) Compute the maximum deviation of I_{OUT} over the temperature range 0°C...100°C as a percentage of the nominal output at room temperature.



