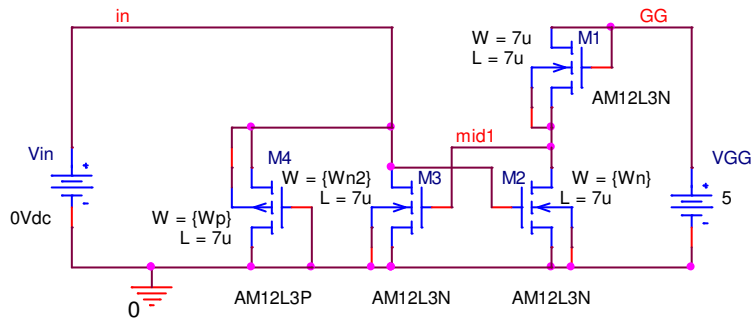


303H Spring 2009 – Homework 7 Due Tu 04/28/09

1. NDR circuit

For the following negative differential resistor (NDR) circuit

- a) Do a DC run and plot I_{in} vs V_{in} and calculate the maximum negative differential resistance (take I_{in} as up through V_{in} so it is the current flowing into the NDR).
- b) Vary W_n and then W_p and note the differences



PARAMETERS:

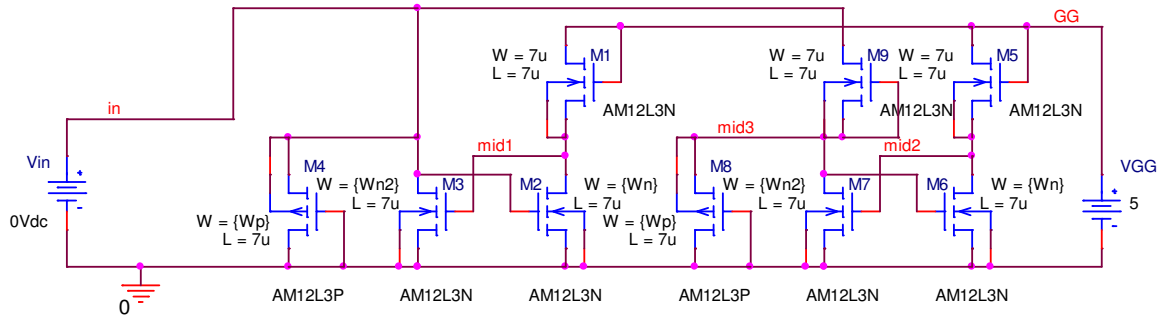
$W_n = 14\mu$
 $W_p = 7\mu$
 $W_{n2} = 7\mu$

2. Use this NDR I_{in} vs V_{in} as the $F(V_{in})$ for realizing by a CMOS-C circuit the oscillator state variable equations

$$\frac{dx_1}{dt} = x_2 - F(x_1)$$

$$\frac{dx_2}{dt} = -\omega_0^2 x_1$$

- a) Set this up in Spice; use $\omega_0 = 1$ (justified by time-capacitor normalization)
 - b) Show via Spice transient analysis, plotting $x_2(t)$ vs $x_1(t)$, that there is a limit cycle.
 - c) Plot the Spice time functions $x_1(t)$ and $x_2(t)$ for the limit cycle.
3. Repeat problem 1 for the following double NDR circuit and investigate obtaining two limit cycles using the equations of 2. Note that the right portion is a copy of the circuit in problem 1 but with a diode connected NMOS which forces the PMOS to turn on at a larger V_{in} to give the second valley.



PARAMETERS:

$W_n = 14\mu$

$W_p = 7\mu$

$W_{n2} = 7\mu$