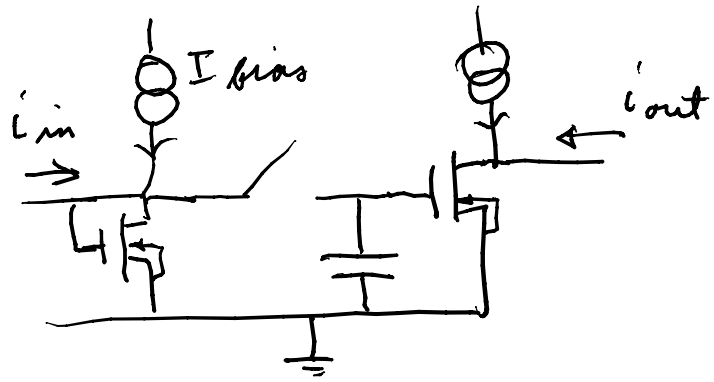
EE 303
04/10/06

Homework 5 due M 04/17/06

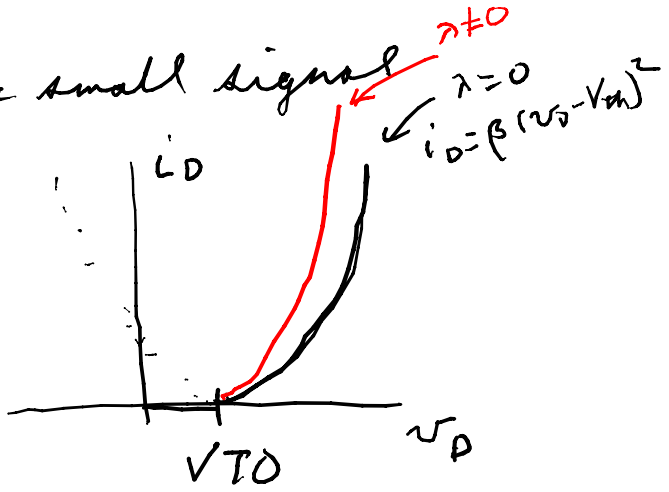
current mode

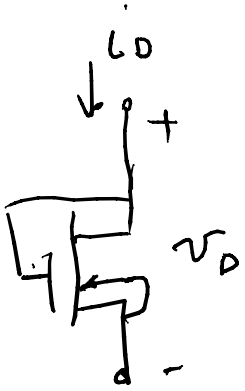
currents added to zero into a node KCL

switched current circuits



i_{in} = small signal





here $v_{DS} = v_D$

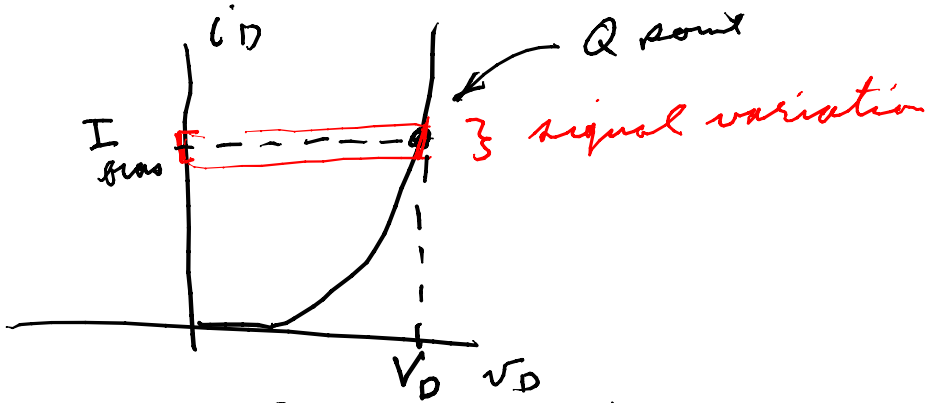
$v_{GS} = v_D$

so $v_{DS} \geq v_{GS} - VTO$

if assume $VTO > 0$ (enhancement mode)

in saturation region if $v_D > VTO$

$$i_D = \frac{KP}{2}\frac{W}{L}(v_D - VTO)^2(1+\lambda v_D)$$



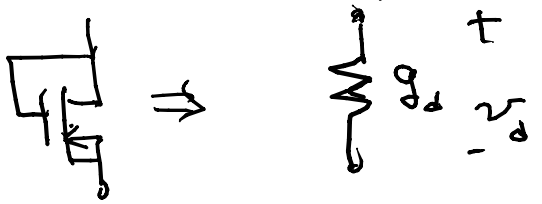
small signal analysis

$$i_D = \beta (v_D - V_{th})^2 (1 + \lambda v_D)$$

$$\frac{\partial i_D}{\partial v_D} = \beta \{ 2(v_D - V_{th})(1 + \lambda V_D) + (v_D - V_{th})^2 (\lambda) \} = g_d$$

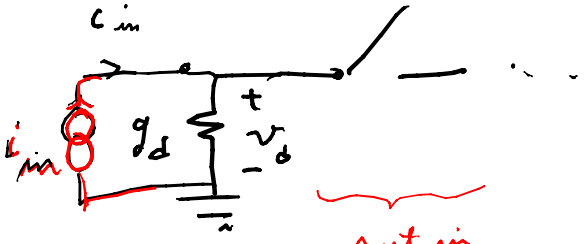
$$i_D = I_{bias} + g_D \cdot (v_D - V_D) + \cdots$$

$$i_d = g_d \cdot v_d$$



for g_d need V_D

small signal

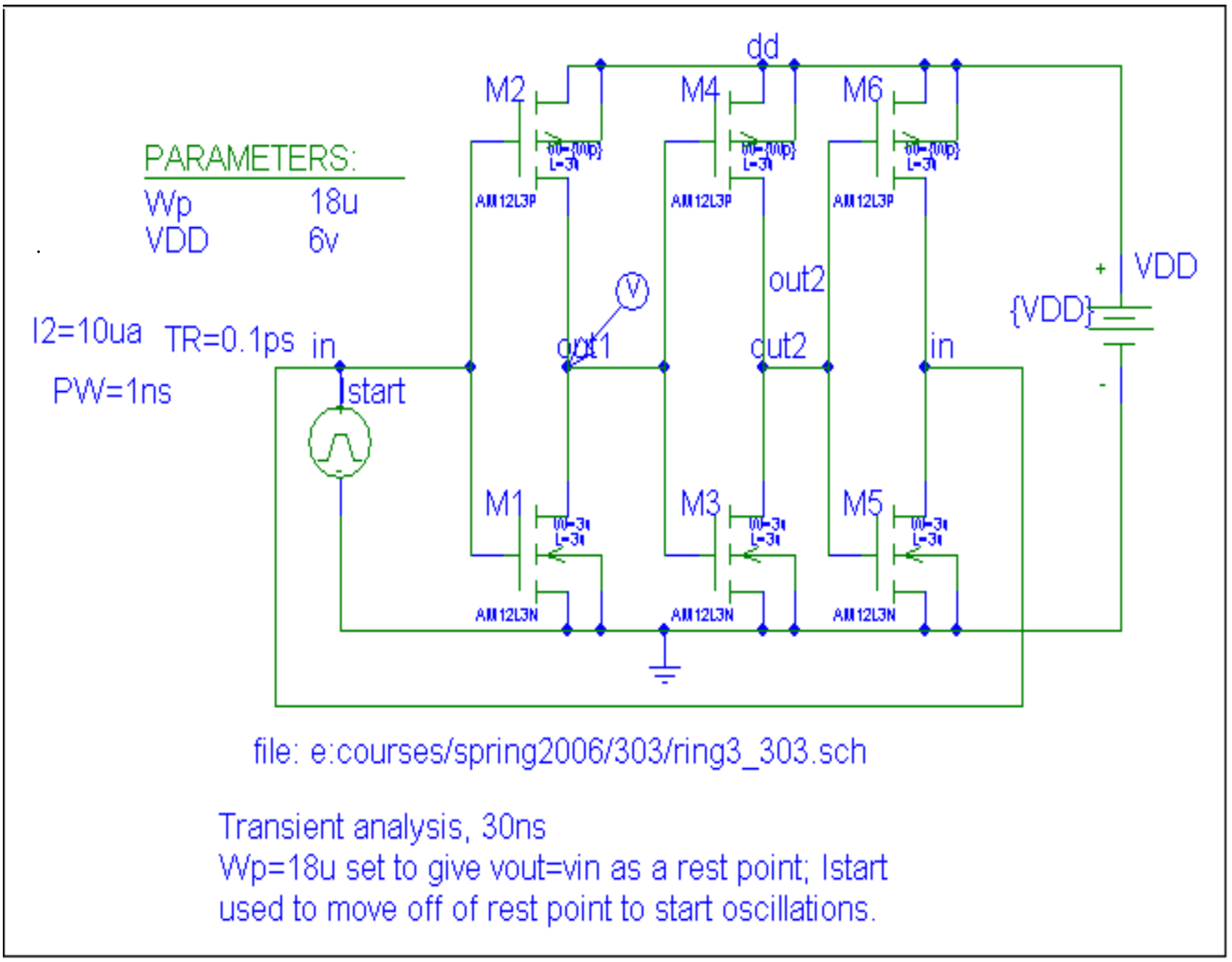


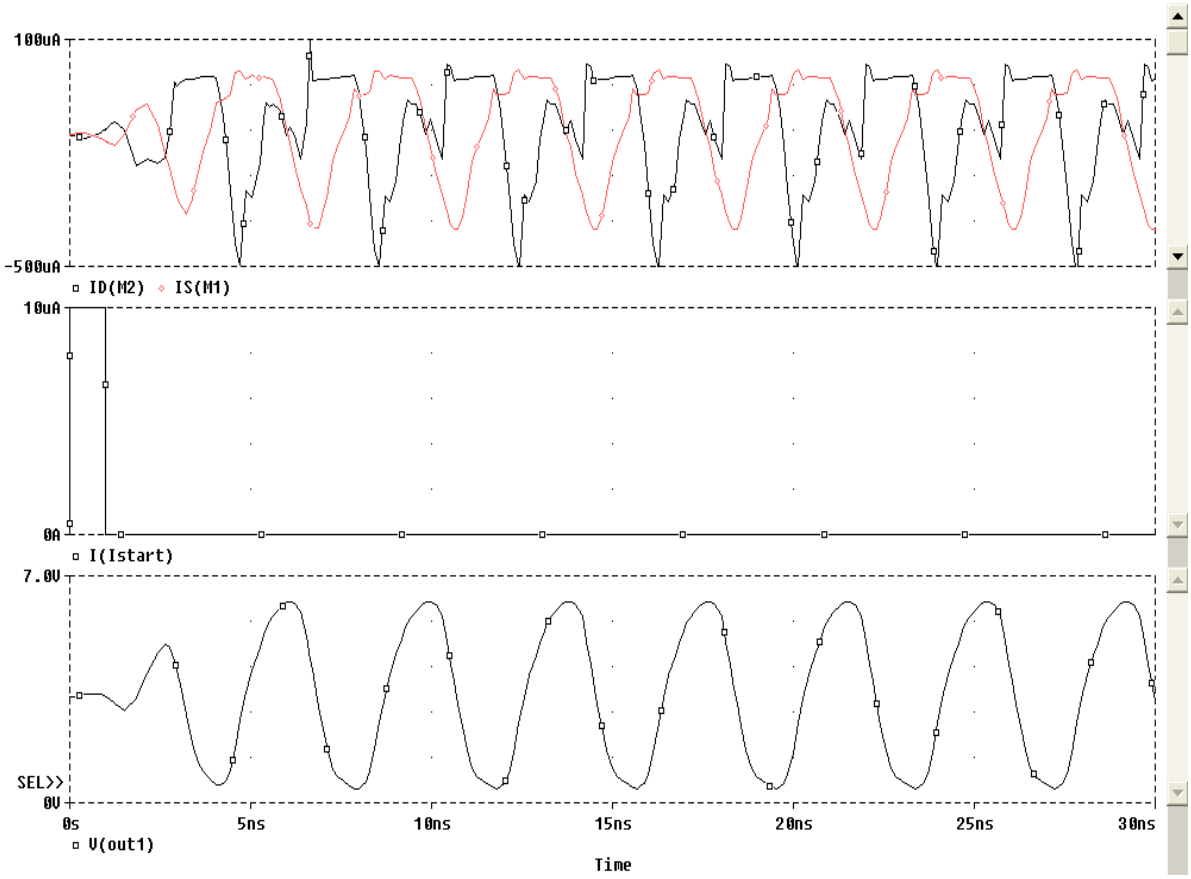
put in small signal equivalents

(if λ small)

$$V_D = V_{th} + \sqrt{\frac{I_{bias}}{\beta}}$$

β ↖ $\frac{KP}{2}\frac{W}{L}$


PARAMETERS:
Wp 18u
VDD 6v
I2=10ua TR=0.1ps
PW=1ns
in
start
dd
M2
M4
M6
M1
M3
M5
AM12L3P
AM12L3N
out1
out2
cut2
in
VDD
{VDD}
file: e:courses/spring2006/303/ring3_303.sch
Transient analysis, 30ns
Wp=18u set to give vout=vin as a rest point; Istart
used to move off of rest point to start oscillations.


100uA
-500uA
ID(M2)
IS(M1)
10uA
0A
I(Istart)
7.0V
SEL>>
0V
0s
5ns
10ns
15ns
20ns
25ns
30ns
V(out1)
Time