EE303

10/18/12 - 22/12

Note Title 10/18/2012

Exam questions, preliminary
- inverter MOS sizing
- compare BJT & MOS biasing; saturation, etc.
- MOS equivalent circuit
- $\frac{v_o}{v_i}(s)$ transfer function
- poles & zeroes

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741 op amp. p. 1003, F. 12.13

ring oscillator, p. 1239, F. 15.28

Floating gate, p. 1243, F. 15.31

Hysteresis, p. 1359, F. 17.20

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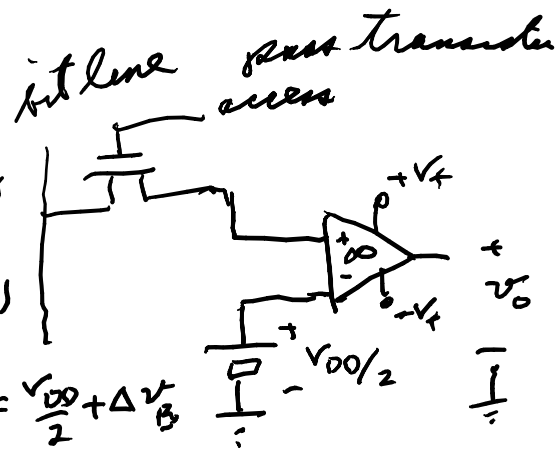
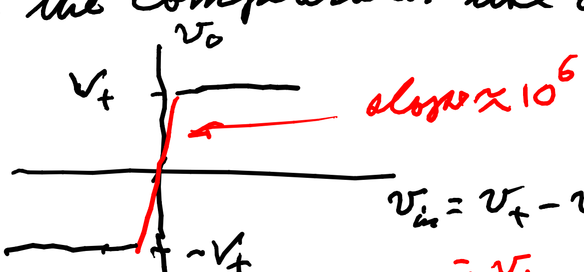
comparator to sense Δv_B

$v_o = V_+$ if $\Delta v_B > 0$ (a 1 in memory)

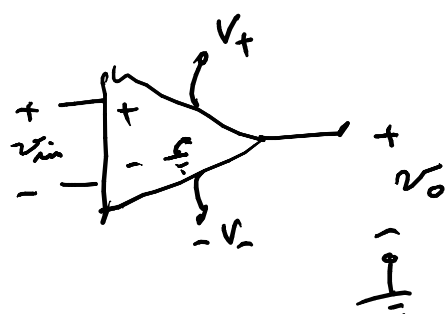
$v_o = -V_+$ if $\Delta v_B < 0$ (a 0 in memory)

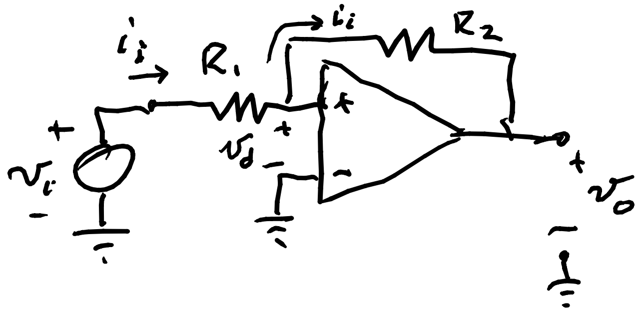


for the comparator use an op-amp

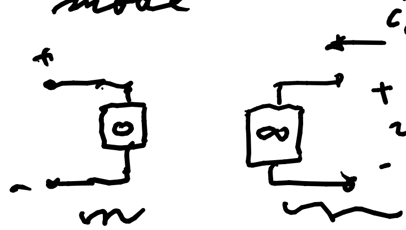


$v_{in} = v_+ - v_-$
$= v_d$





ideal op-amp linear mode



a nullator: $i=0,\ v=0$

a norator: $i_o =$ arbitrary, $v_o =$ " " (independent of i_o)

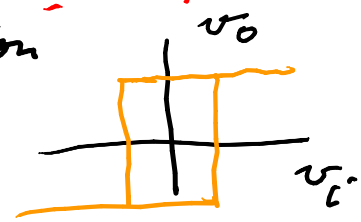
$$(v_i - v_d) = R_1 \cdot i_i$$
$$(v_d - v_o) = R_2\, i_i$$

if linear $v_d = 0$ by virtual ground at op-amp input

$i_i = G_i v_i$, $-v_o = R_2 G_i v_i \Rightarrow \underbrace{\frac{v_o}{v_i} = -\frac{R_2}{R_1}}$ irrespective of input of op-amp at $\pm$ or $\mp$

$G_i = 1/R_i$

for an actual op-amp we get saturation; actually get hysteresis

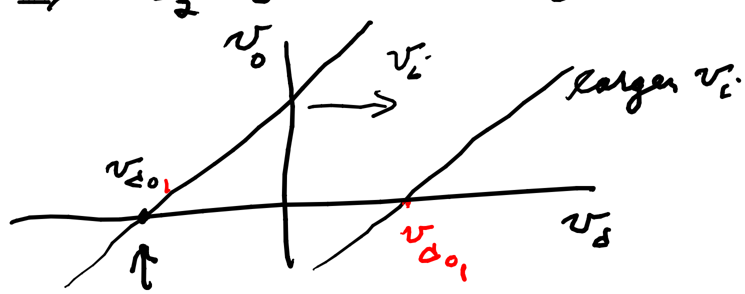


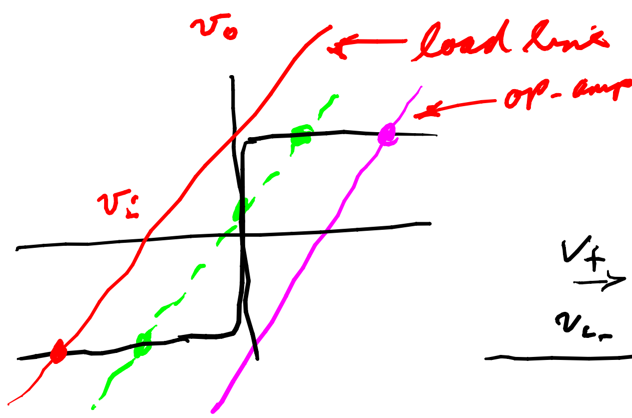
solve for v_o vs $v_d = v_{in}$ with v_i as a parameter

$$G_1(v_i - v_d) = G_2(v_d - v_o) \Rightarrow G_2 v_o = (G_2 + G_1)v_d - G_1 v_i$$

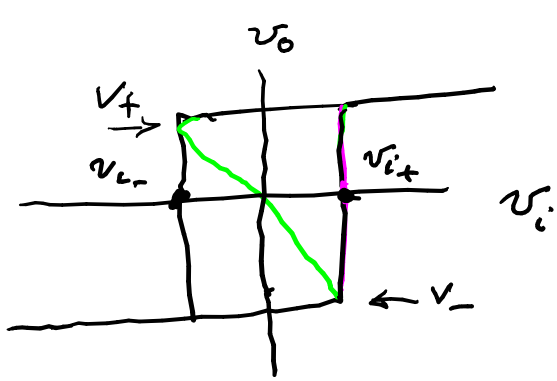
$$\boxed{v_o = \left(1 + \frac{G_1}{G_2}\right)v_d - \frac{G_1}{G_2} v_i}$$

load line eq.

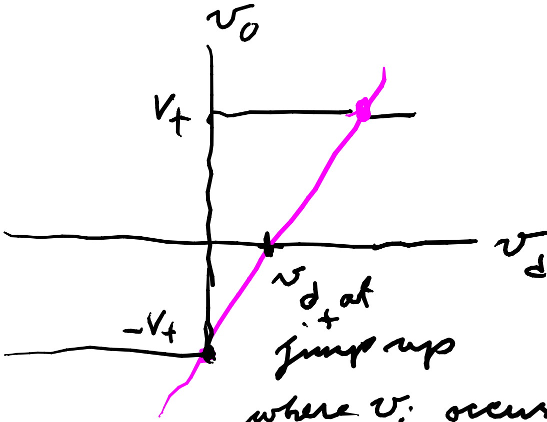




$$\left(1 + \frac{G_1}{G_2}\right) v_{d_0} = + \frac{G_1}{G_2} v_i$$ = eq. for intersect of load line on $x = v_d$ axis



to find v_{i+}



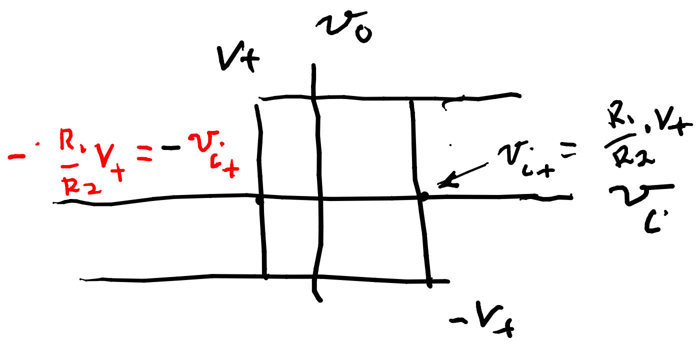
v_{d_+} at jump up where v_{i_+} occurs

$$v_o = -V_+ = \left(1+\frac{G_1}{G_2}\right) v_{d_+} - \frac{G_1}{G_2} v_{i_+} \quad \text{load line}$$

$$\frac{-(-V_+)}{v_{d_+}} = \underset{\text{of load line}}{\text{slope}} = \frac{V_+}{1+\frac{G_2}{G_1}} = \left.\frac{dv_o}{dv_d}\right|_{\text{load line}} = \left(1+\frac{G_1}{G_2}\right)$$

$$\Longrightarrow \quad v_{d_+} = \frac{V_+}{\left(\frac{G_1/G_2}{1+G_1/G_2}\right) v_i}$$

$$\Longrightarrow \quad v_{i_+} = \frac{G_2}{G_1} V_+$$

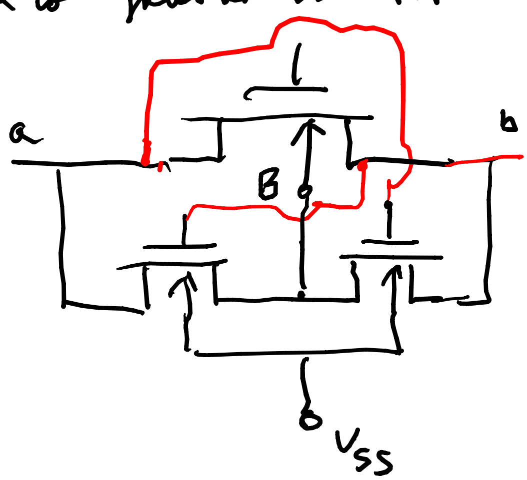


text gives

$$v_{i_+} = V_+ \times \left(\frac{R_1}{R_2}\right)$$

(Eq. (17.30)) p. 1359

back to pass transistor



ties B to a if a = S
to b if b = S