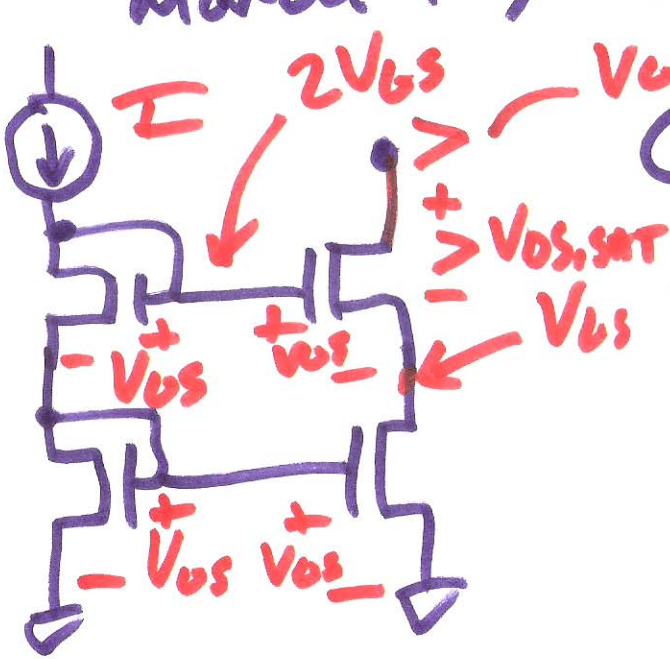
Lecture 11

EE 422 ECG 622

March 1, 2013

$V_{GS} = V_{DS,SAT} + V_{THN}$

$V_{DS,SAT} = V_{GS} - V_{THN}$



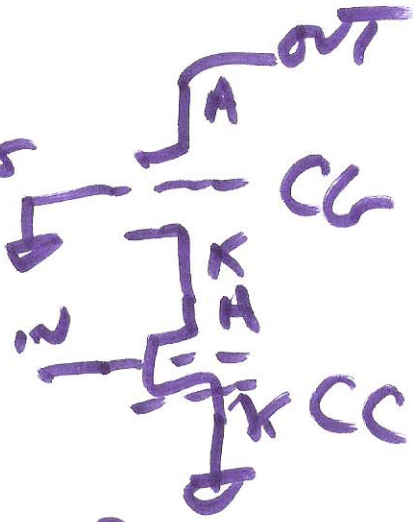
CASCODE

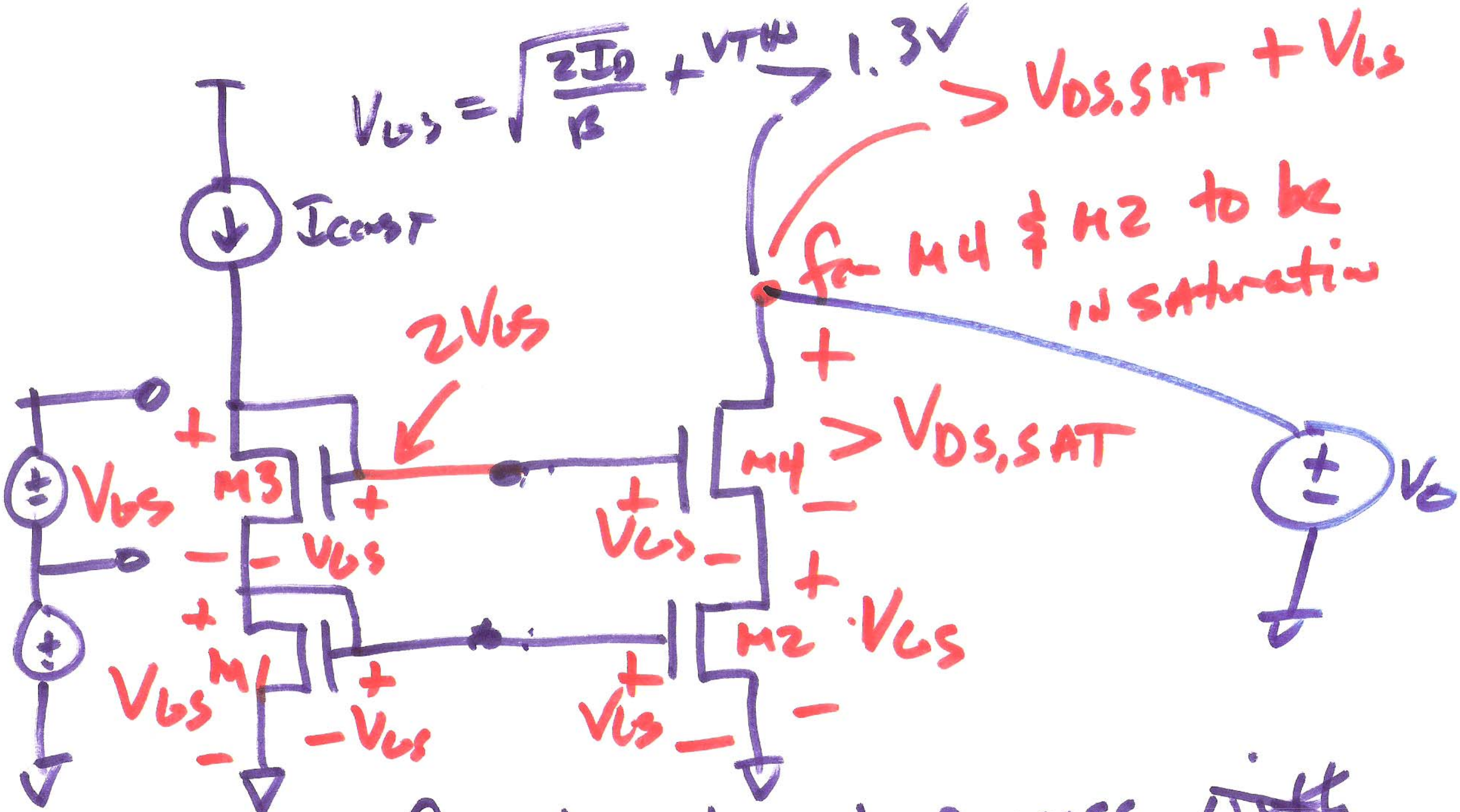
cascade of

Common-gate

AND

Common-Cathode



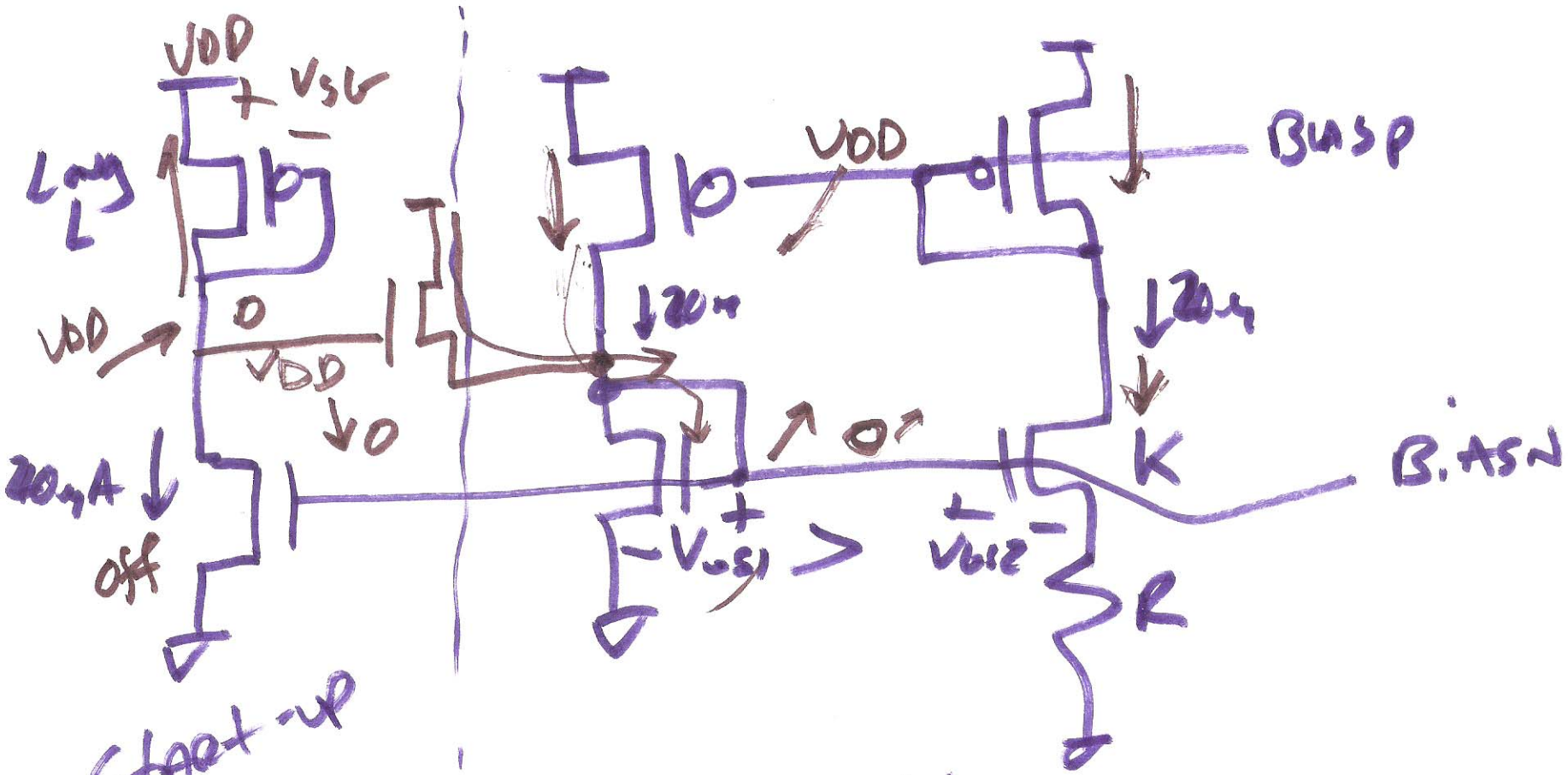


for long channel process ~~with~~ use TABLE 9.1

$V_{GS} = 1.05 \quad V_{THN} = 0.8$

$V_{DS,SAT} = .25$

START-UP CKT

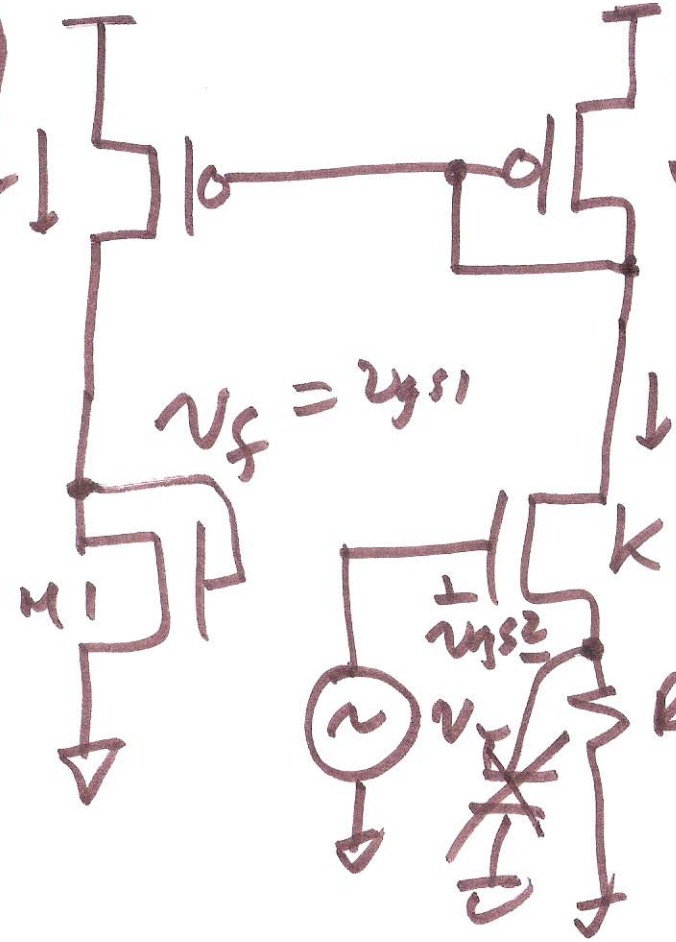


$$V_{GS1} = V_{GS2} + IR$$

$$V_{GS1} = \sqrt{\frac{2I}{\beta}} + V_{THN}$$

$$V_{GS2} = \sqrt{\frac{2I}{\beta \cdot K}} + V_{THN}$$

$$\frac{v_f}{v_T} = \frac{1}{1 + K R_S}$$



$$\frac{v_f}{v_T} = \frac{1/g_{m1}}{R + 1/g_{m2}}$$

$$g_{m1} K = g_{m2}$$

$$i_d = \frac{v_T}{\frac{1}{g_{m2}} + R}$$

$$v_T = v_{gs2} + i_d \cdot R$$

$$= i_d \left(\frac{1}{g_{m2}} + R \right)$$

$$g_m = \beta \cdot (V_{GS} - V_{TH})$$

$$= \sqrt{2 \beta I_D}$$

$$g v_{gs} = i_d$$

$$\frac{i_d}{v_f} = g_{m1}$$

$$Z_f = \frac{i_d}{g_{m1}}$$

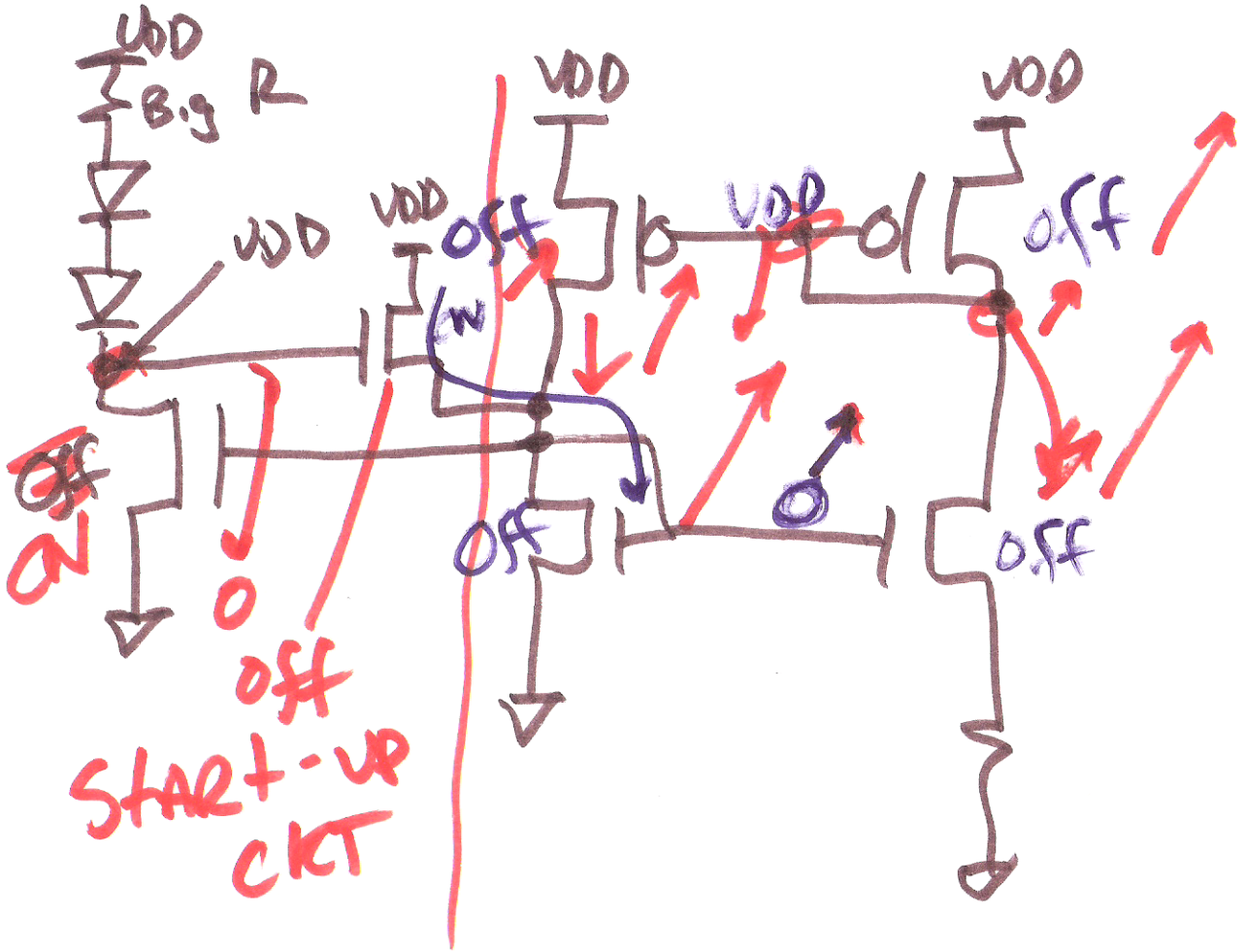
$$\frac{v_f}{v_T} = \frac{1}{g_{m1} \cdot R + \frac{g_{m1}}{g_{m2}}}$$

$$= \frac{1}{g_{m1} \cdot R + \frac{1}{K}}$$

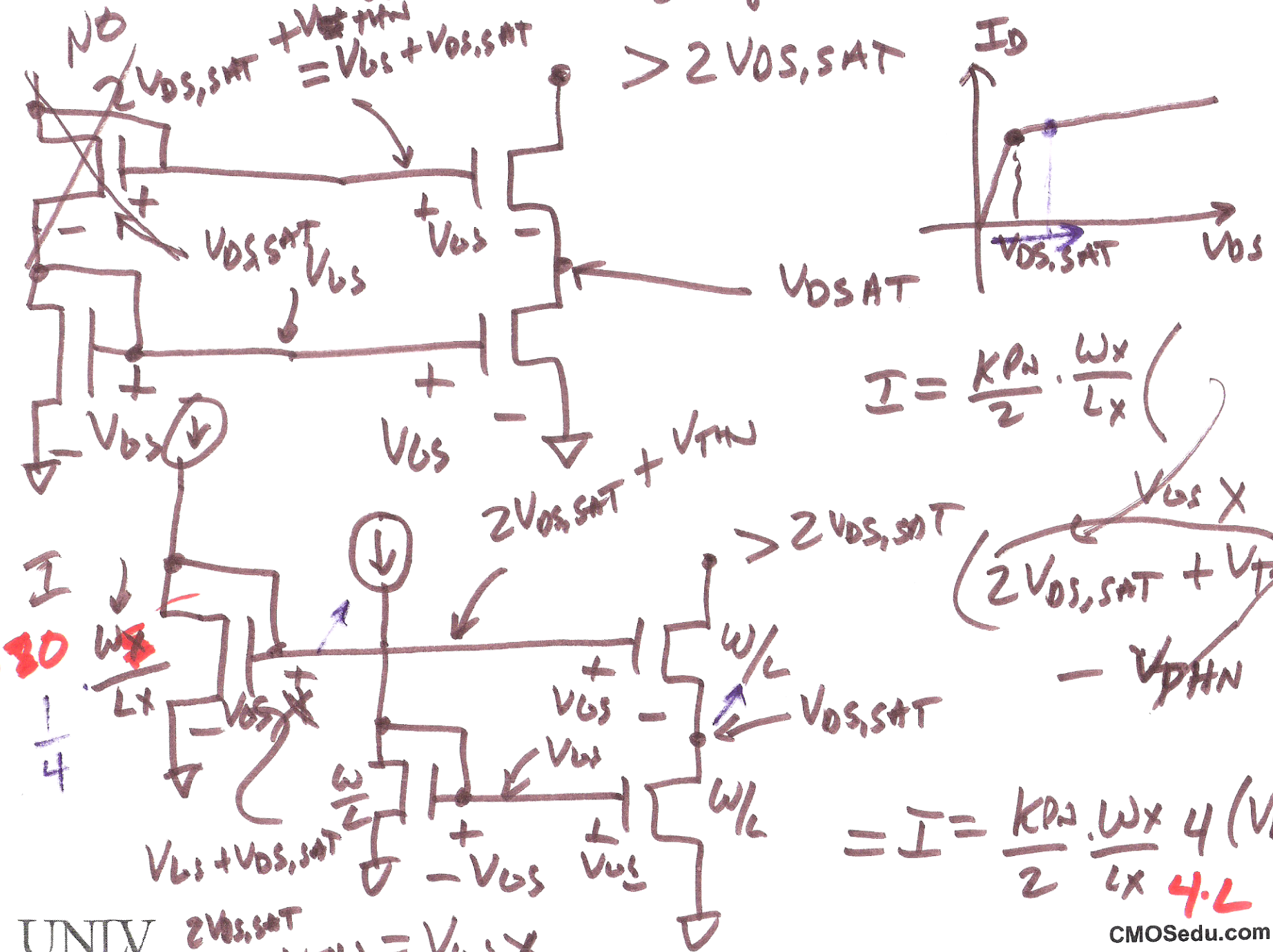
$$= \frac{1}{1 + K g_{m2} \cdot R} < 1$$

$R \to 0$

$\frac{v_f}{v_T} \to 1$


VDD
B.g R
VDD
VDD
VDD
off
VDD
VDD
off
W
off
ON
0
off
off
off
START-UP
CKT

Wide-swing operation



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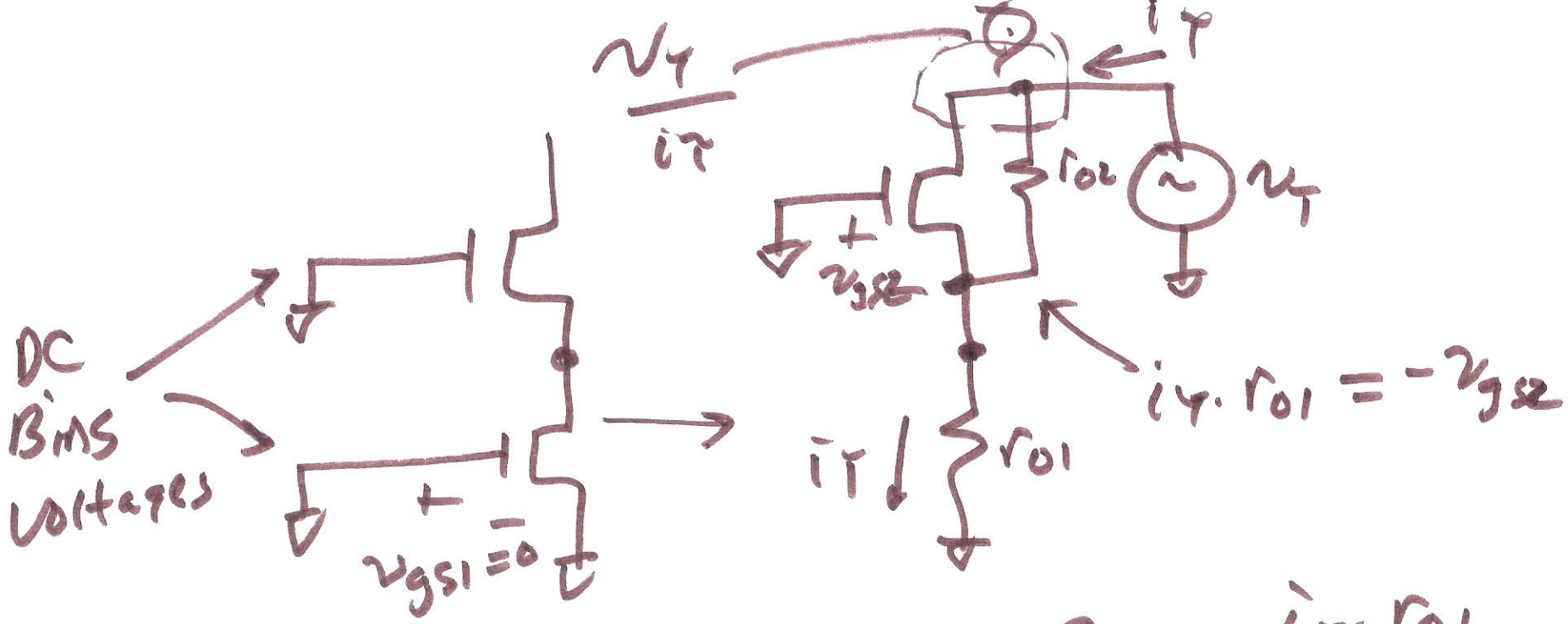

$$i_T = g_{m2} v_{gs2} + \frac{v_T - i_T \cdot r_{o1}}{r_{o2}}$$

$$i_T = g_{m2}(-i_T \cdot r_{o1}) + \frac{v_T}{r_{o2}} - i_T \cdot \frac{r_{o1}}{r_{o2}}$$

$$i_T\left(1 + g_{m2} r_{o1} + \frac{r_{o1}}{r_{o2}}\right) = \frac{v_T}{r_{o2}}$$

$$\frac{v_t}{i_t} = r_{o2}(1 + g_{m2} r_{o1}) + r_{o1}$$

EXACT

$$= r_{o2} + r_{o1} + \underbrace{g_{m2} r_{o2} r_{o1}}_{g_{m2} r_{o2}}$$

$$R_{CCAS} = \frac{v_t}{i_t} \approx g_m r_o^2 \quad \text{Approx.}$$

$r_{o1} = r_{o2}$