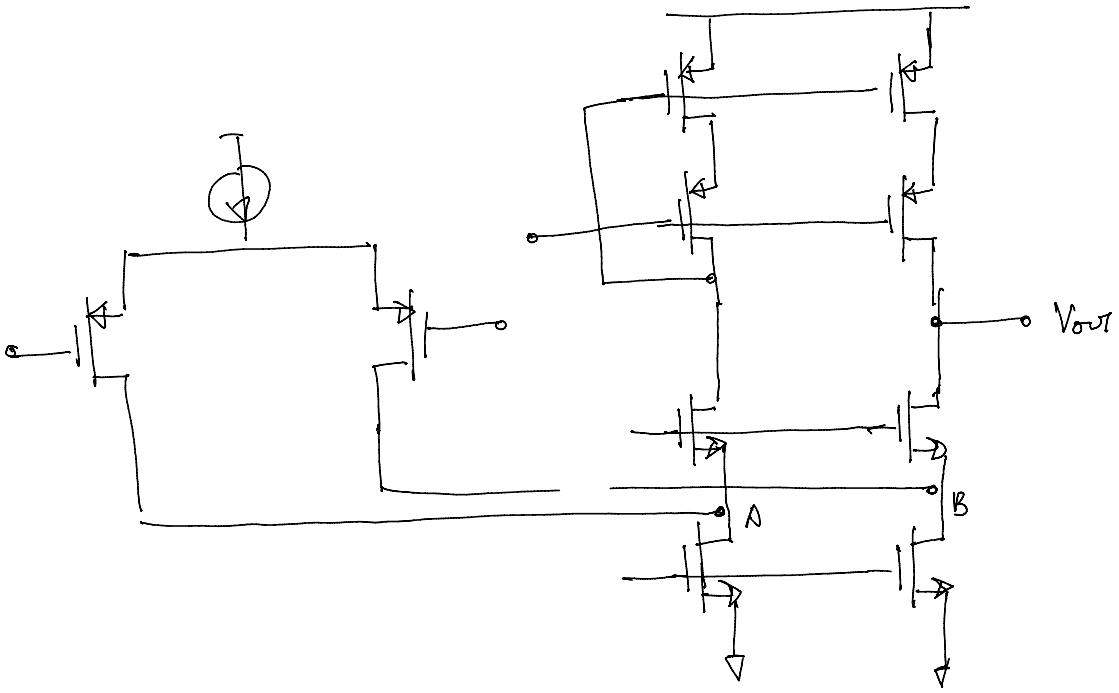
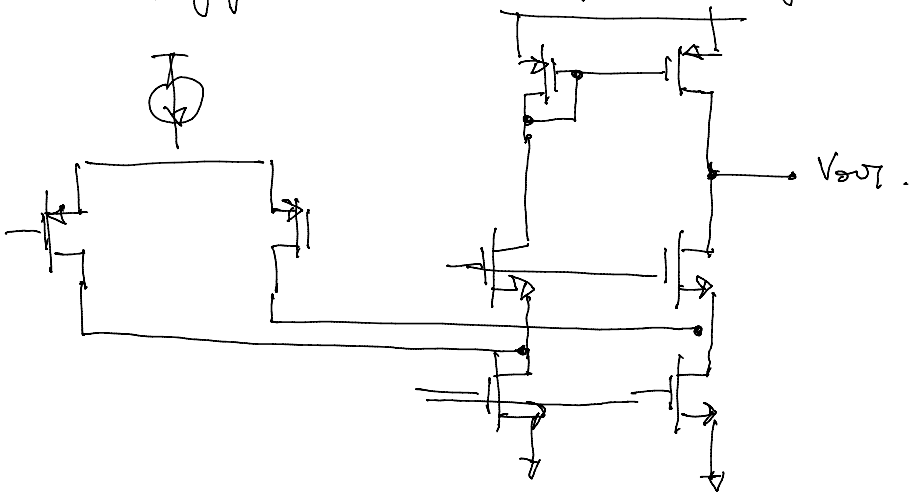
FOLDED CASCODE OPAMP ANALYSIS



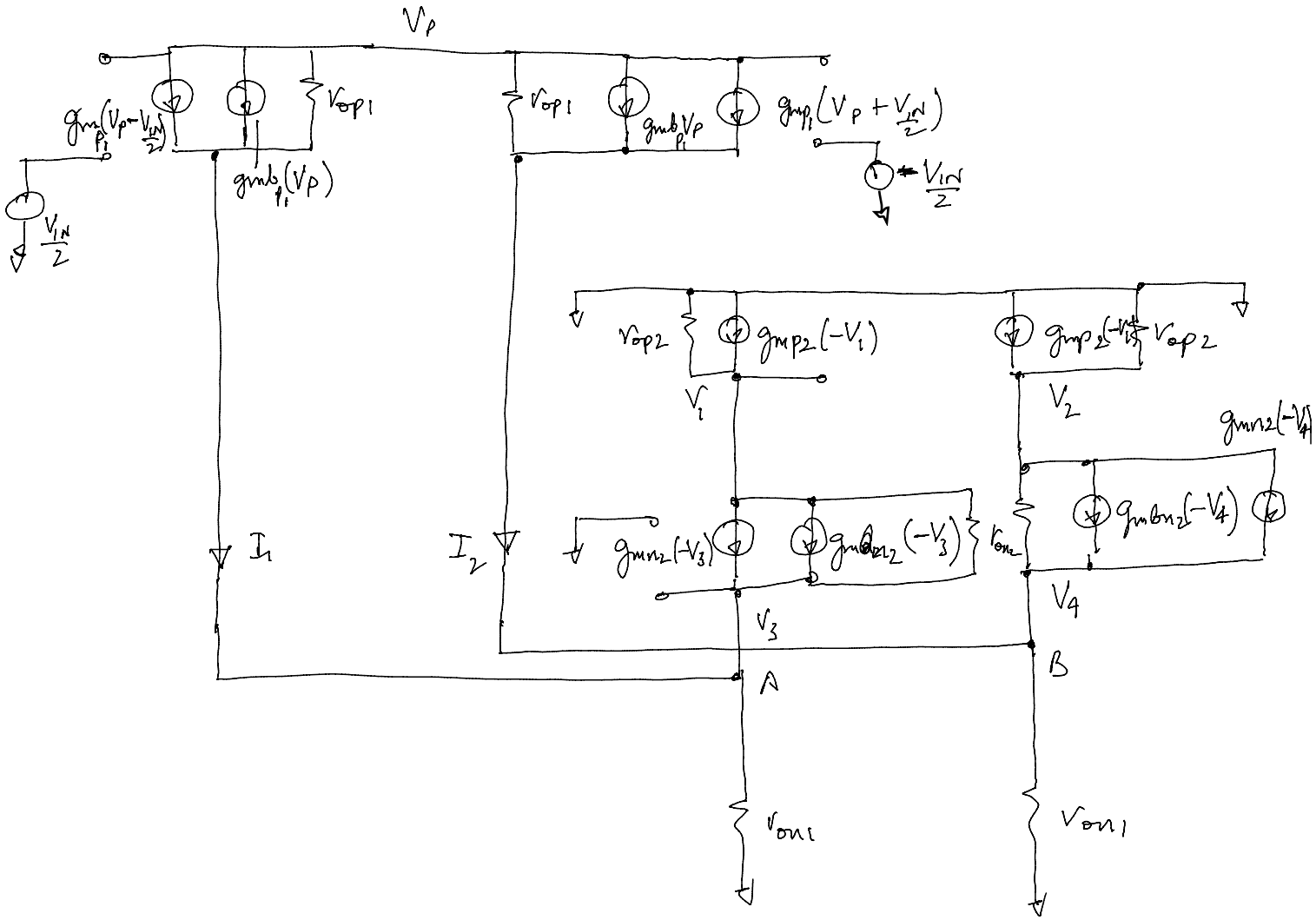
→ Question is how much small signal current goes up on nodes A & B.

→ Are nodes A & B actually low impedance on looking up so that we have minimum current division on nodes A&B ?

Let's simplify the circuit for analysis :

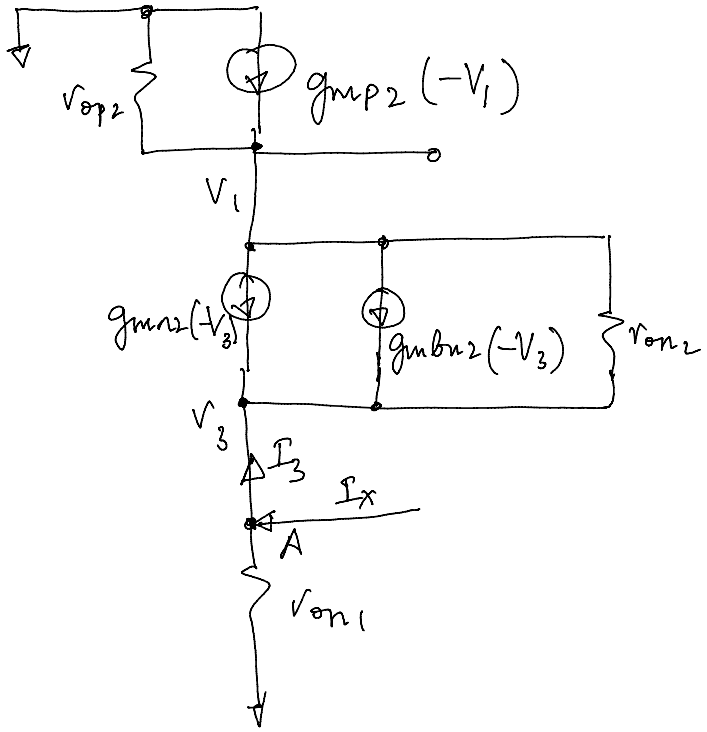


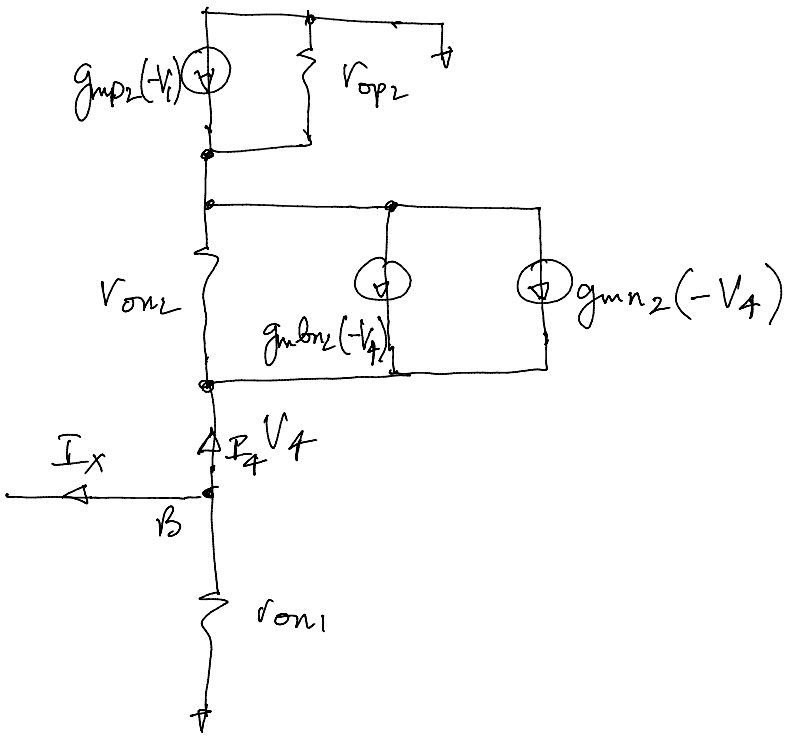
Small Signal Model



From this we see $I_1 = -I_2$

Since we are interested in the impedances of nodes A and B lets simplify the circuit further based on this result to concentrate on A & B.





→ Combine g_{mn2} & g_{mbn2} → ~~G_{mn2}~~ G_{mn2}

$$I_3 = g_{mp2} V_1 + \frac{V_1}{r_{op2}} \Rightarrow V_1 = \frac{r_{op2}}{g_{mp2} r_{op2} + 1} I_3$$

Also $I_3 = \frac{r_{on1}}{r_{on1} + R_{v1}} I_x = K I_x$ R_{v1} = Resistance looking up at node A

$= \frac{V_3}{I_3}$

$$R_{v1} = \frac{r_{on2} + \frac{r_{op2}}{g_{mp2} r_{op2} + 1}}{1 + r_{on2} G_{mn2}} = \frac{r_{on2} + r_{op2} \| (1/g_{mp2})}{1 + r_{on2} G_{mn2}}$$

$\therefore V_1 = B I_x$ where $B = \frac{r_{on1}}{r_{on1} + R_{v1}} \cdot \frac{r_{op2}}{g_{mp2} r_{op2} + 1}$

$$I_4 = g_{mp2} B I_X + \frac{V_2}{r_{op2}} = A I_X + \frac{V_2}{r_{op2}}$$

where $A = \dfrac{g_{mp2} r_{op2}}{g_{mp2} r_{op2} + 1} \dfrac{r_{op1}}{r_{on1} + R_{u1}}$

$$R_{u1} = \frac{r_{on1} + \dfrac{r_{op2}}{g_{mp2} r_{op2} + 1}}{1 + r_{on2} G_{mn2}}$$

$$\therefore V_2 = (I_4 - A I_X) r_{op2}$$

$$\& \quad I_4 = G_{mn2} V_4 + \frac{V_4 - (I_4 - I_X A) r_{op2}}{r_{on2}}$$

$$R_{u2} = \frac{r_{on2} + r_{op2}(A + 1)}{G_{mn2} r_{on2} + 1 - A \dfrac{r_{op2}}{r_{on1}}}$$

where $A = \dfrac{g_{mp2} r_{op2}}{g_{mp2} r_{op2} + 1} \dfrac{r_{on1}}{r_{on1} + R_{u1}}$

$$R_{u1} = \frac{r_{on2} + \dfrac{r_{op2}}{g_{mp2} r_{op2} + 1}}{1 + r_{on2} G_{mn2}}$$

If $g_{mp2} r_{op2} \gg 1$ & $R_{eq} \ll r_{on1}$ → for nice amp to let all small signal current go up.

$A = 1$

Let $R_{eq} = \dfrac{r_{on2} + 2r_{op2}}{g_{mn2} r_{on2} + 1 - \dfrac{2r_{op2}}{2r_{on1}}}$

$A \to 1$

C_{mn2}

⟹ Thus the impedance on node B is more than on node A due to the control by V_x on node A

⟹ on node A the impedance looking up (R_{eq1}) was simply the impedance looking into the source of the transistor since this part is not affected by the other string in any way.

⟹ For most of the current to go up on node A R_{eq1} should be less

⟹ For most of the current to go up on node B R_{eq2} ~~(node)~~ should be less.