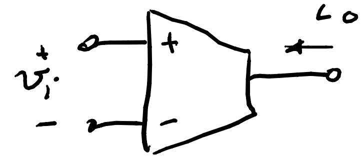
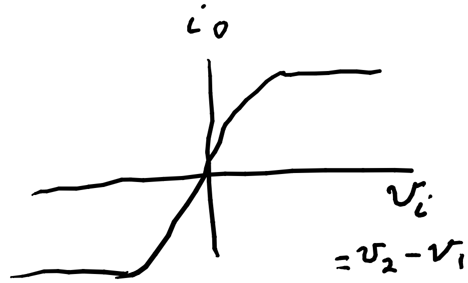
EE303H
10/06/11

Note Title 10/6/2011

Symbol
OTA
operational
transconductance
amplifier

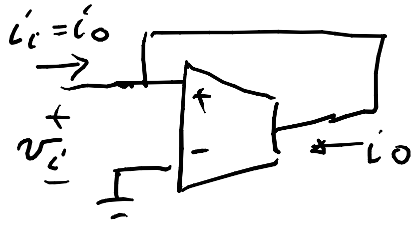




$i_o = I_T f(v_i)$

for the 4007
can use the breakout transistors in PSpice
MbreakN & MbreakP
read in the transistor models

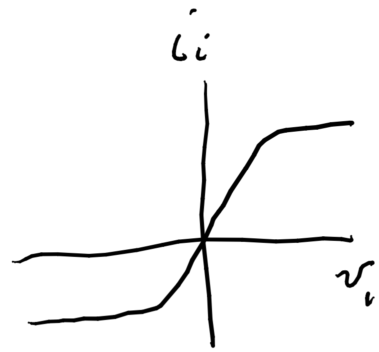
using the OTA as a resistor



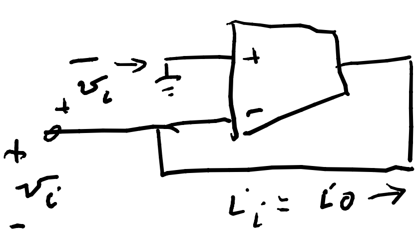
$v_o = f(v_i)\ i_i =$

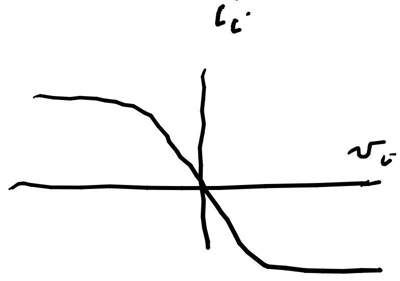
$i_i = f(v_i) =$

⇒ curve of a resistor



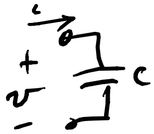
for the MOS = gives linear near origin



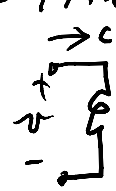


⇒ negative resistor

How to make an inductor from OTAs and a capacitor

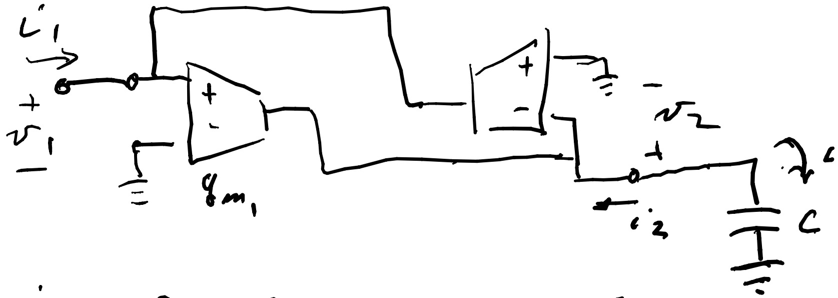


$i = C\frac{dv}{dt}$,



$v = L\frac{di}{dt}$

duals ($v \leftrightarrow i$)



$$Y = \begin{bmatrix} 0 & -g_{m_2} \\ g_{m_1} & 0 \end{bmatrix}$$

$$i_c = c\frac{dv_2}{dt}$$

1) $i_1 = -g_{m_2} v_2$; $i_2 = -c\dfrac{dv_2}{dt} = g_{m_1} v_1$ 2) & 3)

4) $$\frac{di_1}{dt} = -g_{m_2}\frac{dv_2}{dt} = (-g_{m_2})\left(-\frac{g_{m_1}}{c}\right)v_1$$

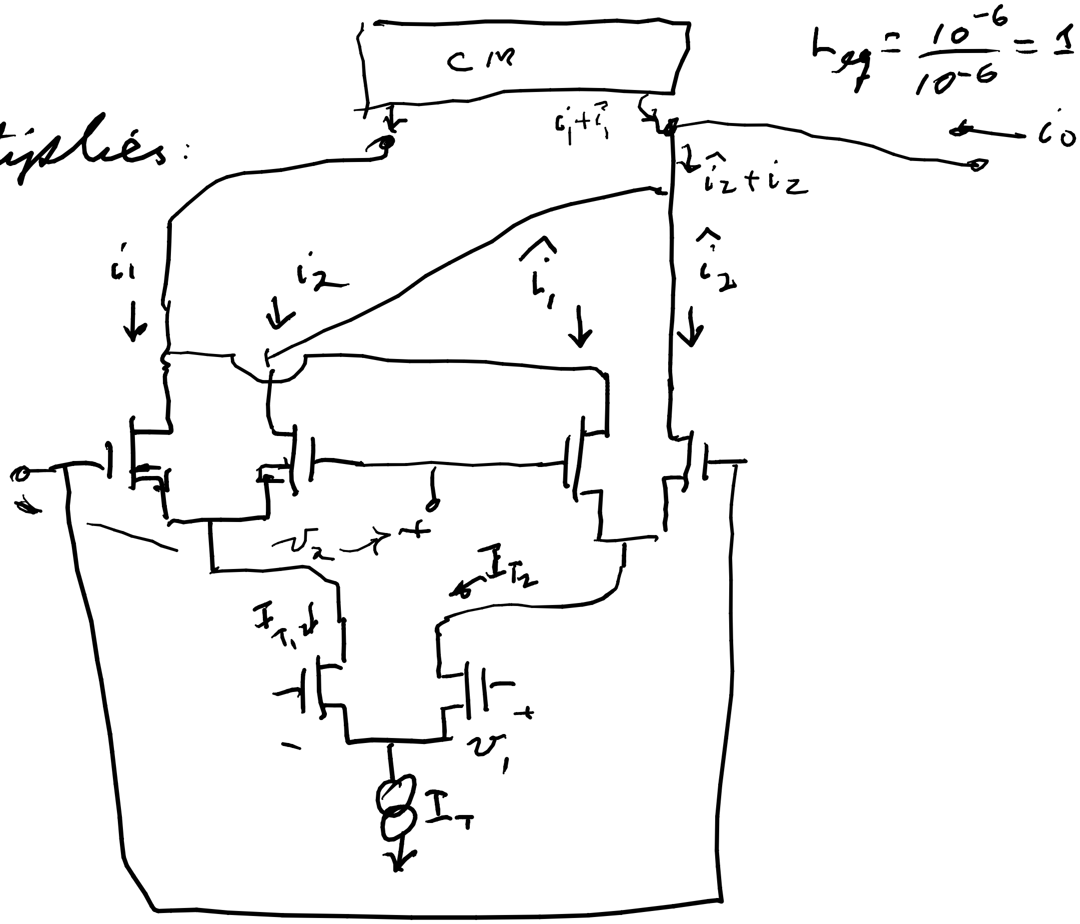
$$v_1 = \frac{c}{g_{m_2} g_{m_1}} \cdot \frac{di}{dt} = L_{eq} \cdot \frac{di}{dt}$$

$c = 1\,\text{pfd}$

$g_{m_1} = g_{m_2} = 10^{-3}$

$L_{eq} = \dfrac{10^{-6}}{10^{-6}} = 1\,\text{hy}$

Multiplies:



will give $v_1 \cdot v_2$

1) $i_2 - i_1 = I_{T_1} f(v_2)$ $\hat{i}_2 - \hat{i}_1 = I_{T_2} f(-v_2) = -I_{T_2} f(v_2)$

2) ⟶ $\hat{i}_1 - \hat{i}_2 = I_{T_2} f(v_2)$

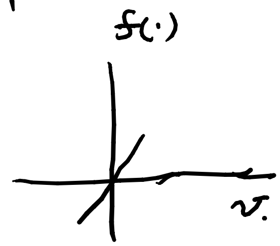
3) $I_{T_2} - I_{T_1} = I_T f(v_1)$

4): 1) − 2) ⇒ $(i_2-i_1)-(\hat{i}_1-\hat{i}_2) = I_{T_1} f(v_2) - I_2 f(v_2)$

$= (i_2+\hat{i}_2)-(i_1+\hat{i}_1) \qquad = (I_{T_1}-I_2)\, f(v_2)$

$\overset{3)}{=} -I_T f(v_1)\cdot f(v_2)$

$i_0 = I_T f(v_1) f(v_2) = (i_1+\hat{i}_1)-(i_2+\hat{i}_2)$



$f(v) = \tilde{I}_T \tanh(v/V_T)$ BJT

linear near origin

gives an excellent multiplier for small v

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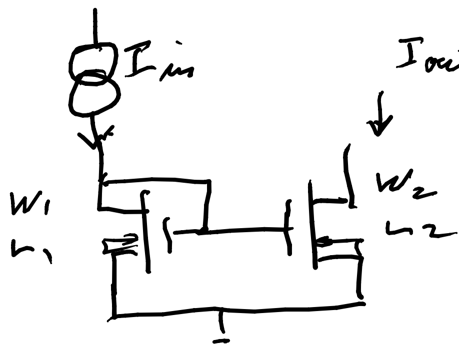

$I_{out} = I_{in}\left(\frac{W_2/L_2}{W_1/L_1}\right)$