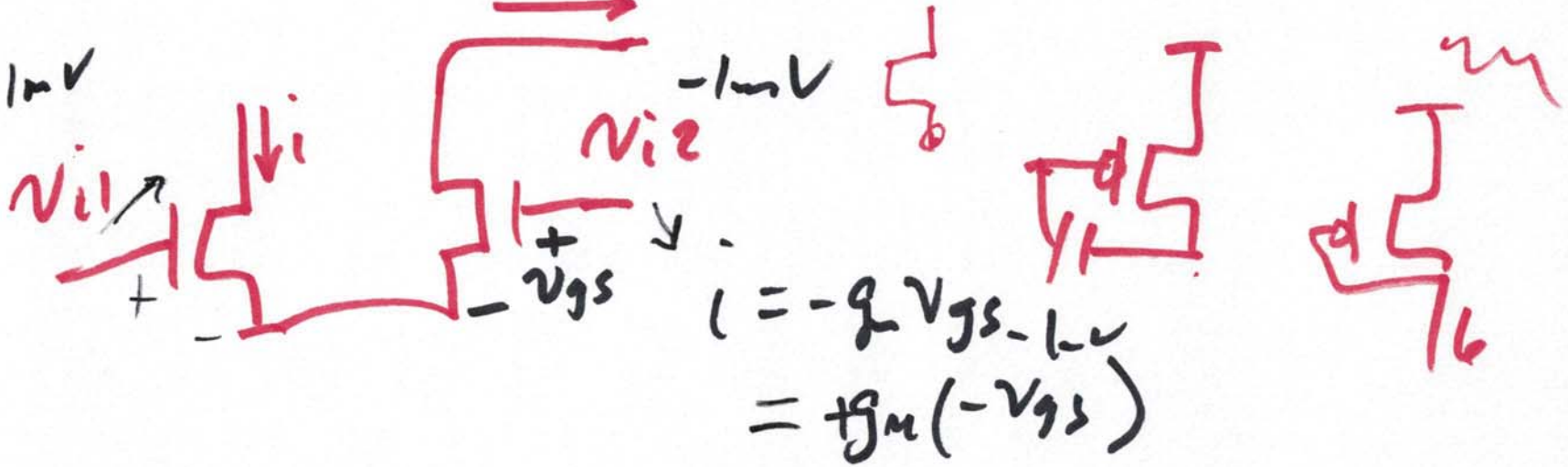
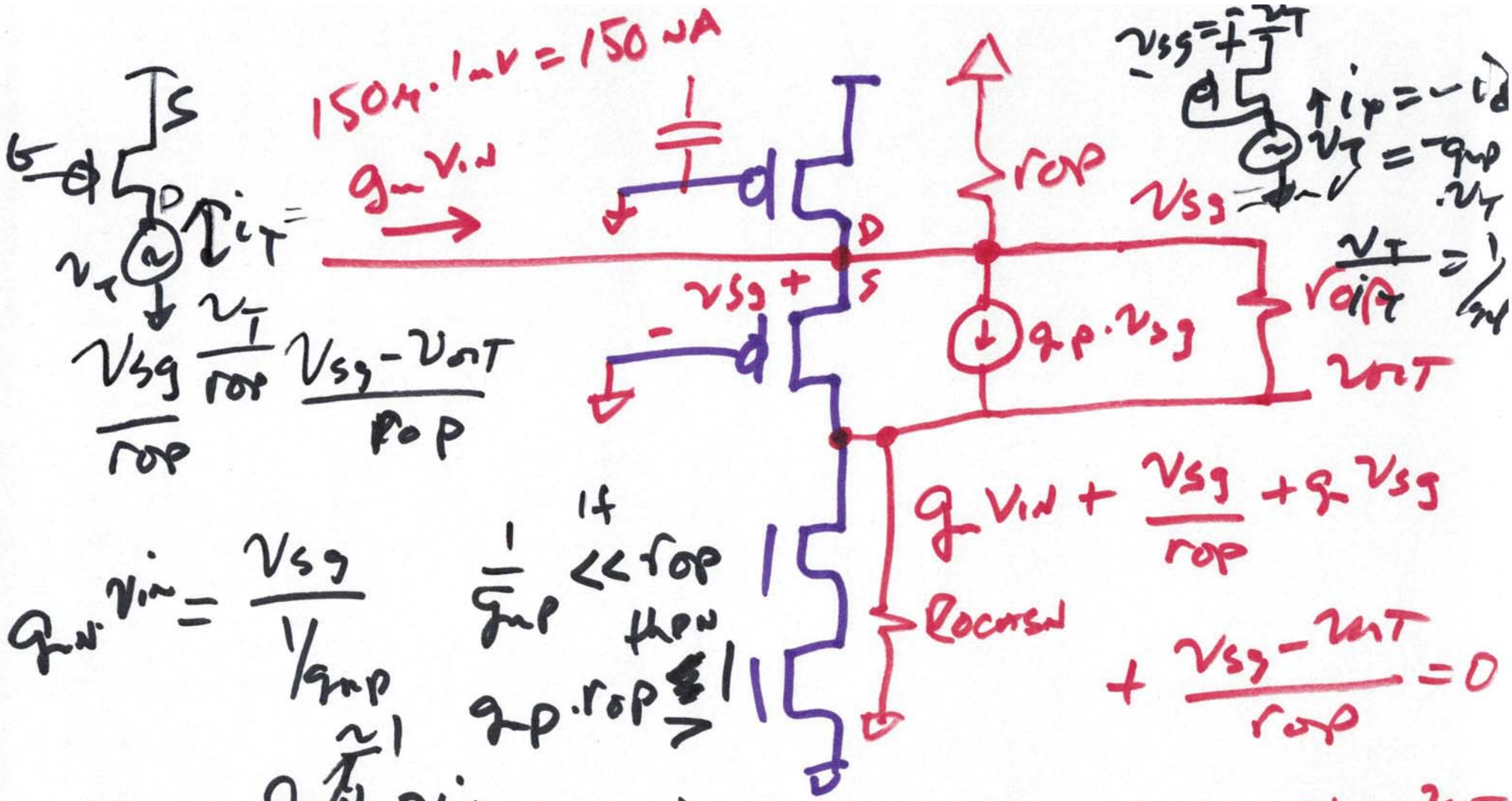
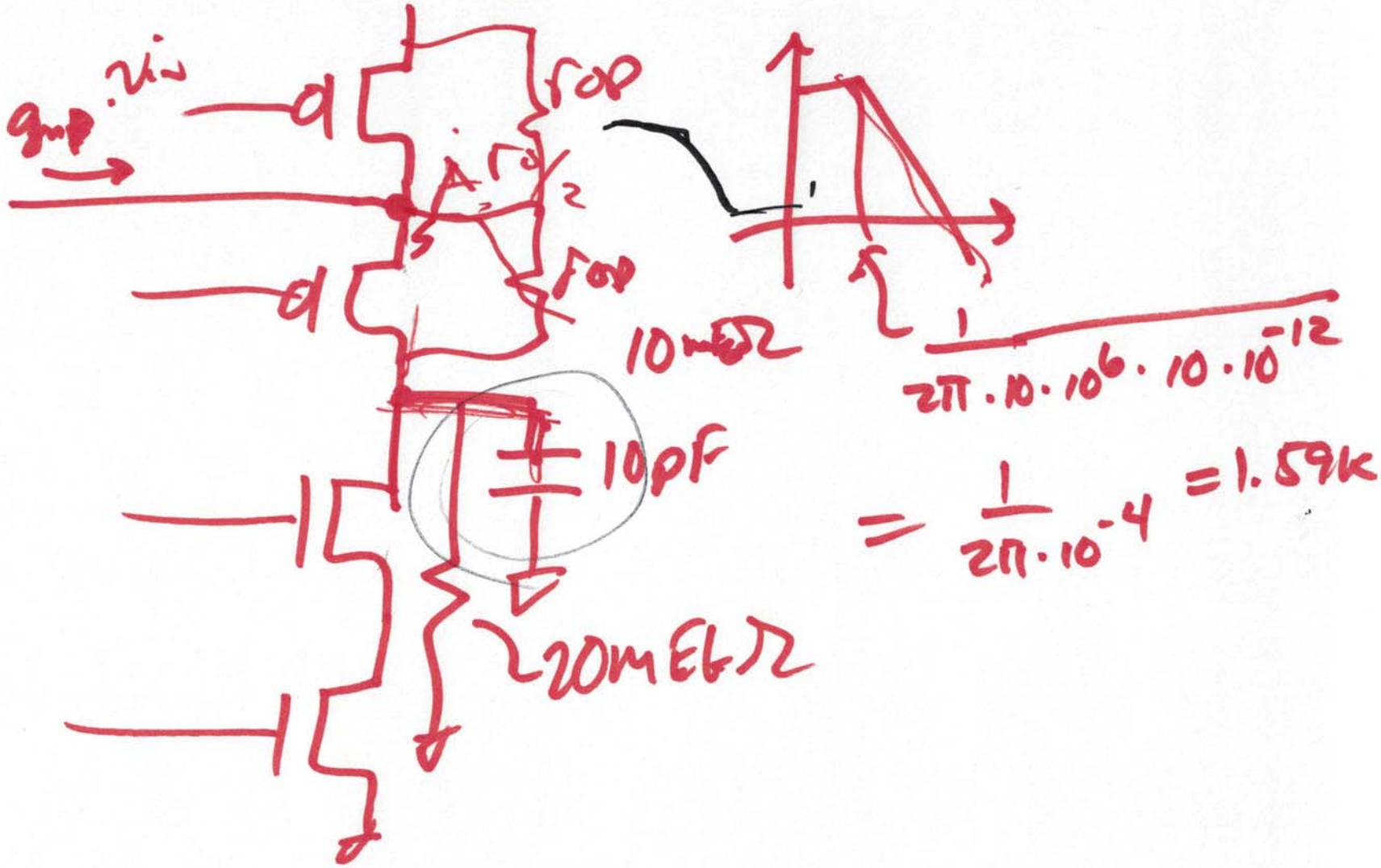
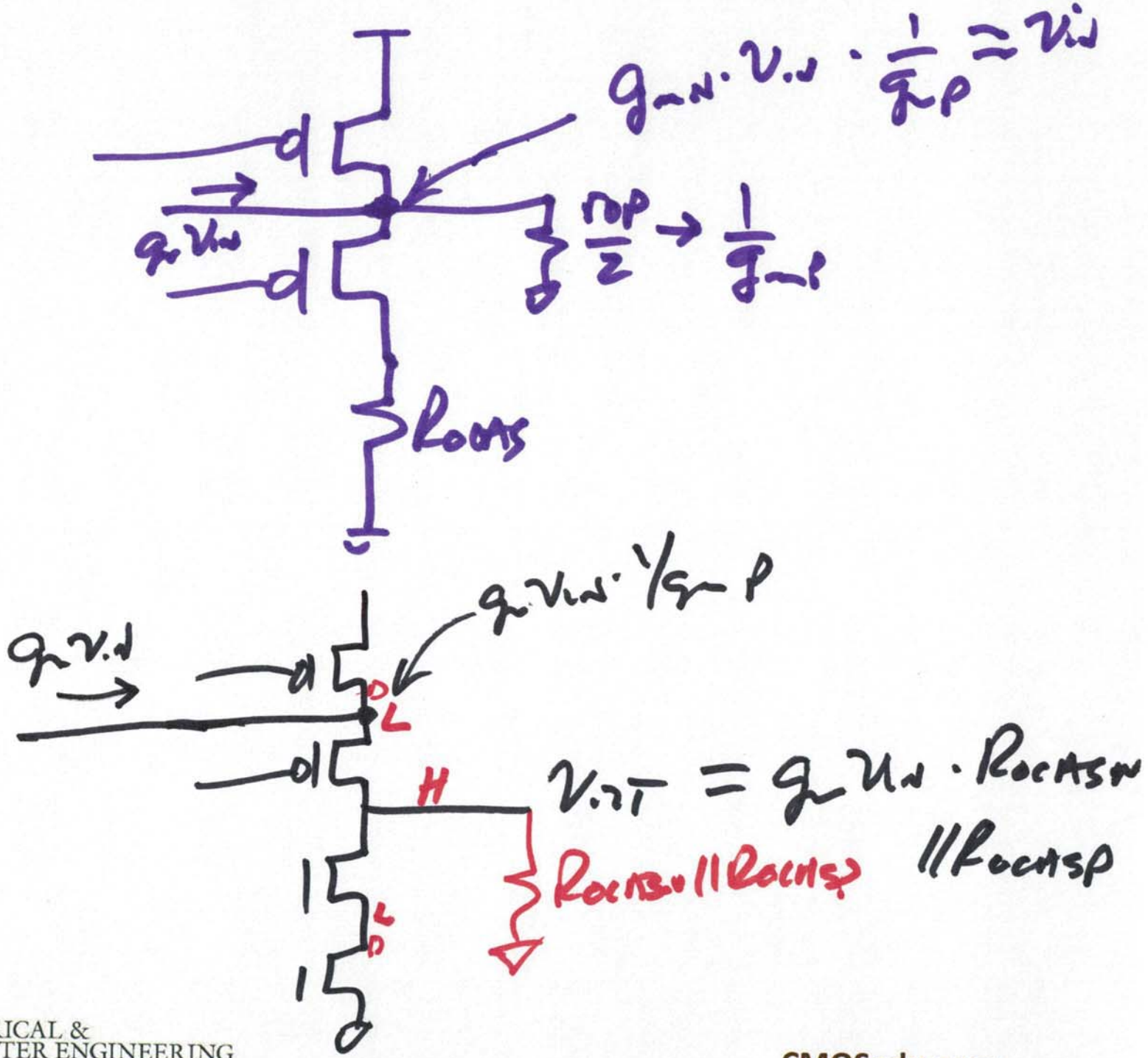
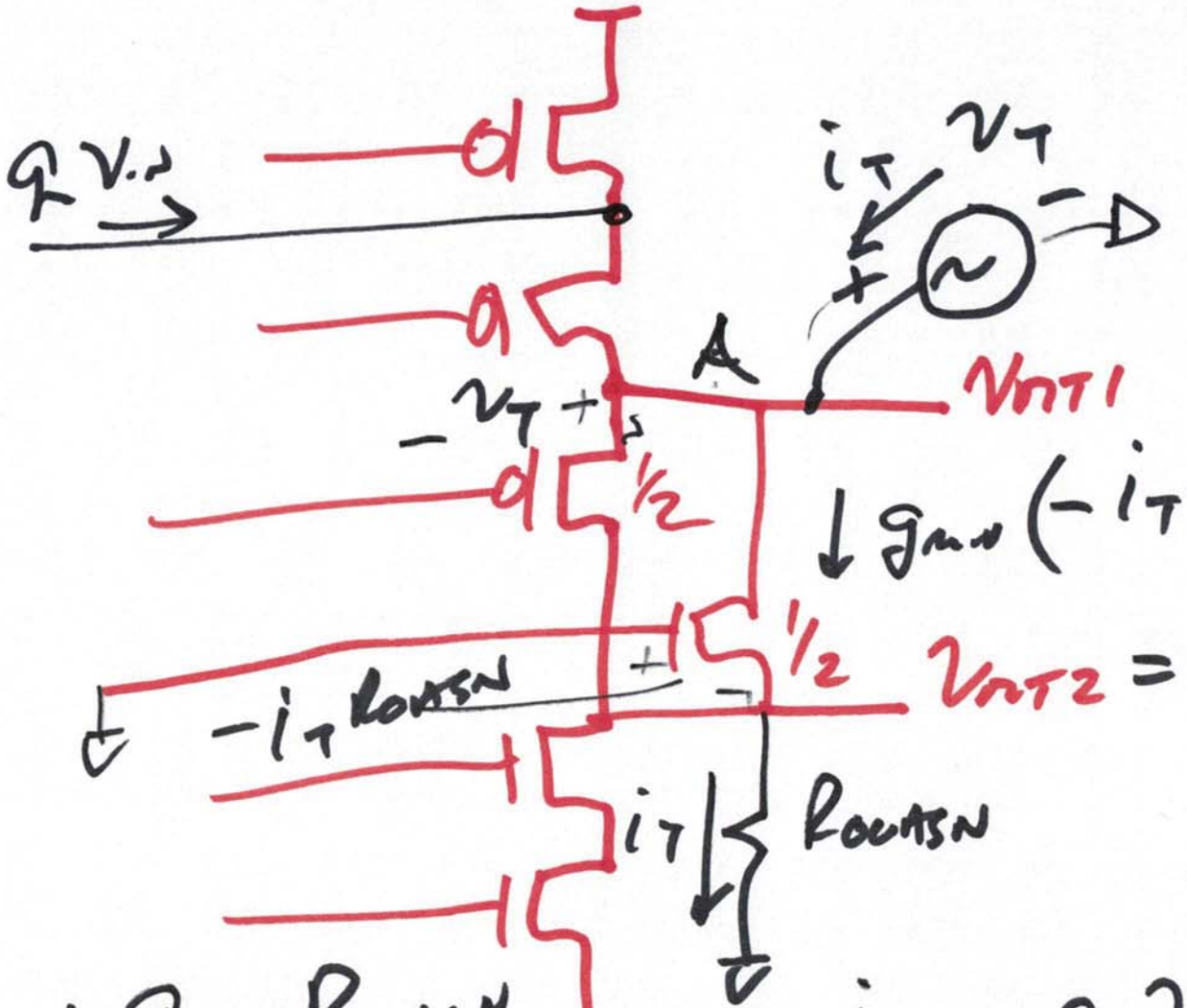
EE 420/ECE 620
Lecture 23
Analog IC Design
April 19, 2017




150n · 1mV = 150 nA
$g_m v_{in}$
r_{op}
v_{sg}
$g_p \cdot v_{sg}$
r_{oN}
v_{oT}
v_T
i_T
$v_{sg} + v_T = 0$
$i_p = -i_d$
$v_T = g_p \cdot v_T$
$\frac{v_T}{i_T} = \frac{1}{g_p}$
$\frac{v_{sg}}{r_{op}}$
$\frac{v_T}{r_{op}}$
$\frac{v_{sg} - v_{oT}}{r_{op}}$
$g_m v_{in} + \frac{v_{sg}}{r_{op}} + g_p v_{sg}$
R_{ocmsw}
$+ \frac{v_{sg} - v_{oT}}{r_{op}} = 0$
$g_m \cdot v_{in} = \frac{v_{sg}}{1/g_{mp}}$
if $\frac{1}{g_{mp}} \ll r_{op}$ then $g_p \cdot r_{op} \gg 1$
≈ 1
$v_{sg} = \frac{g_m}{g_p} \cdot v_{in}$
$\frac{v_{oT}}{R_{ocmsw}} = g_{mp} \cdot v_{sg} + \frac{v_{sg} - v_{oT}}{r_{op}}$
$g_p \cdot v_T = i_T$
$\frac{v_T}{i_T} = \frac{1}{g_{mp}}$


$g_{mp} \cdot v_{in}$
r_{op}
r_{op}
10mΩ
10pF
20mΩ
$\frac{1}{2\pi \cdot 10 \cdot 10^6 \cdot 10 \cdot 10^{-12}}$
$= \frac{1}{2\pi \cdot 10^{-4}} = 1.59k$

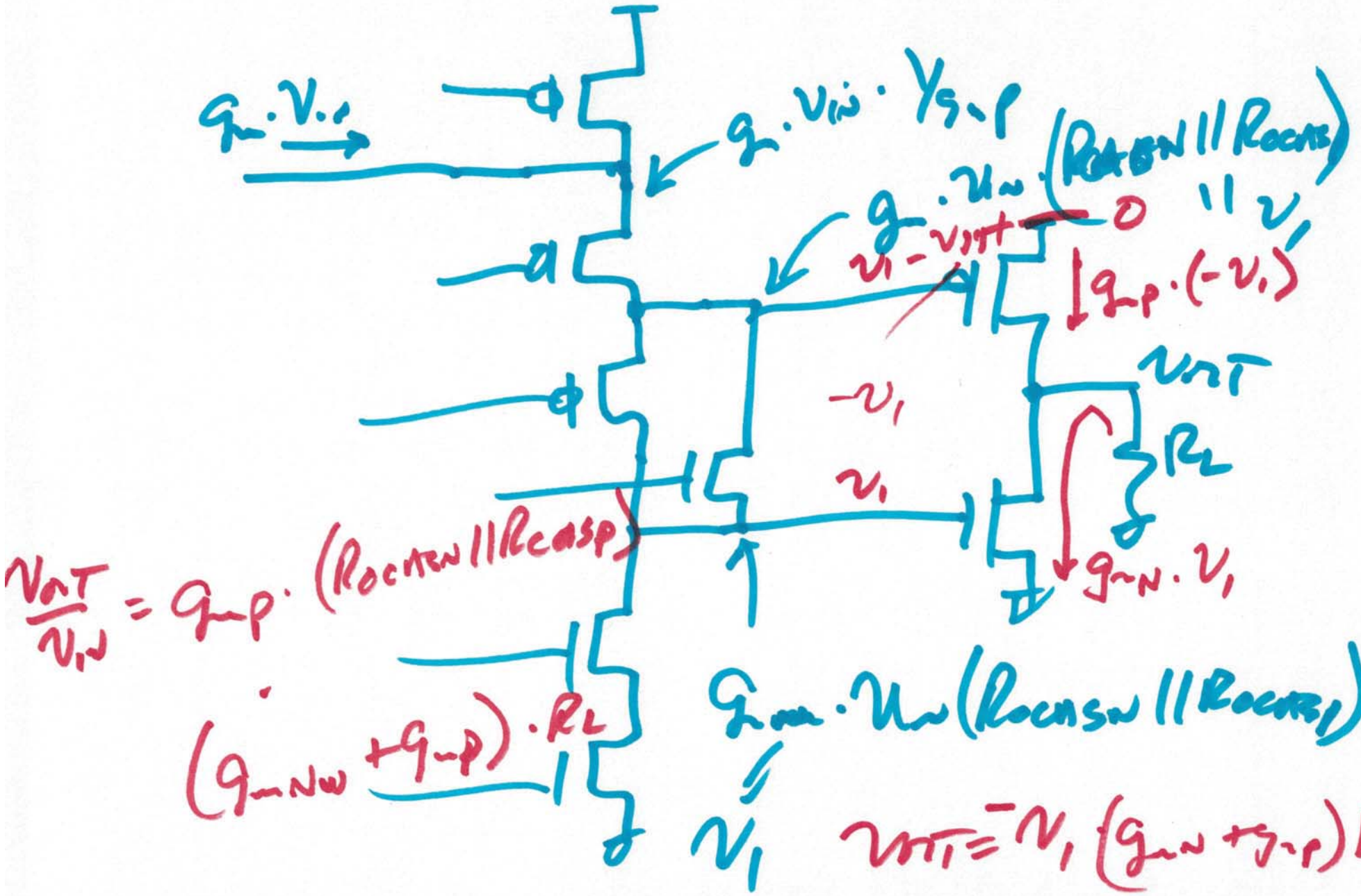

$g_{mN} \cdot V_{in} \cdot \frac{1}{g_{mP}} \simeq V_{in}$
$g_m V_{in}$
$\frac{r_{oP}}{2} \rightarrow \frac{1}{g_{mP}}$
R_{onMS}
$g_m V_{in} \cdot 1/g_{mP}$
$g_m V_{in}$
H
$V_{out} = g_m V_{in} \cdot R_{onMSN} \| R_{onMSP}$
$R_{onMSN} \| R_{onMSP}$



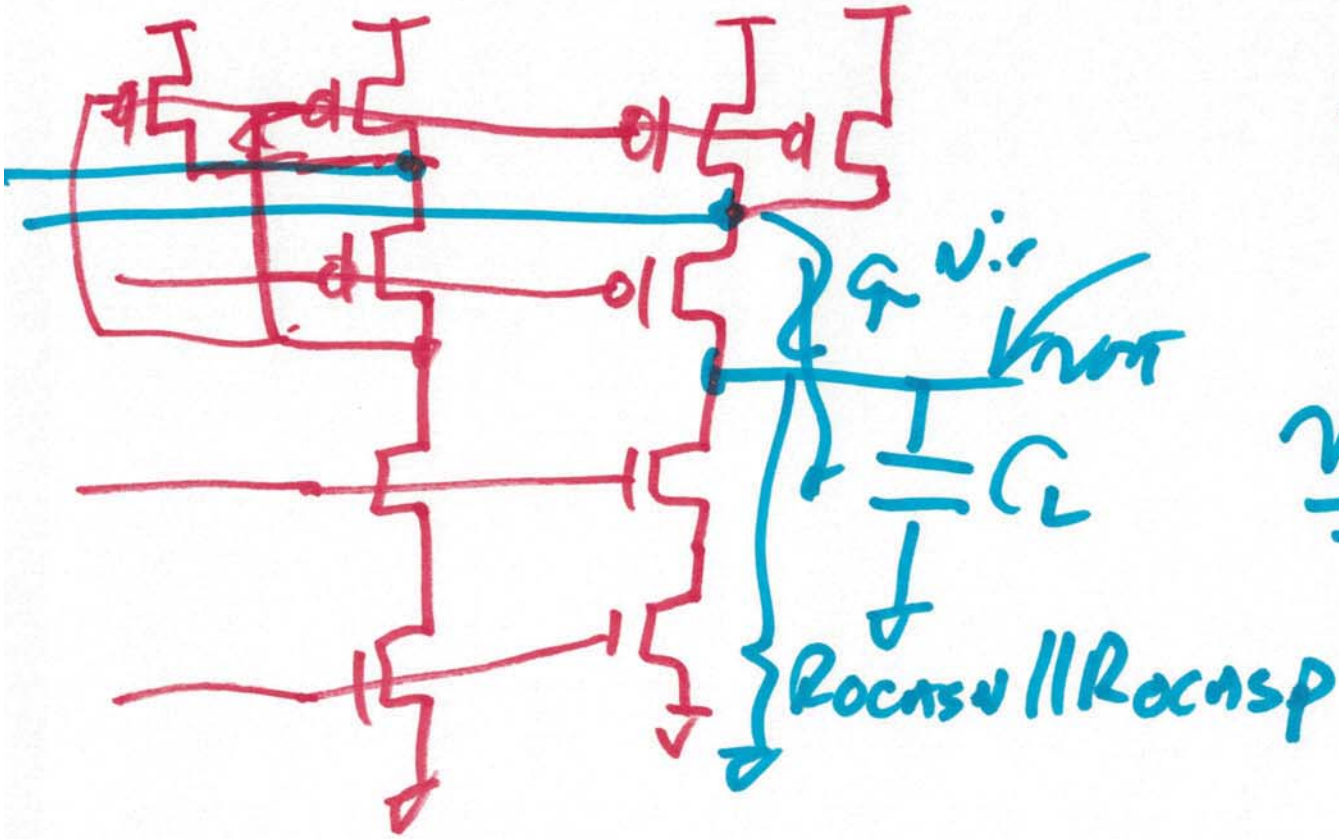
$$\frac{V_T}{I_T} = \frac{1 + g_{mN} \cdot R_{OACSN}}{g_{mP}} \simeq R_{OACSN}$$

$$i_T = g_{mP} V_T - g_{mN} i_T R_{OA...}$$

$$i_T(1 + g_{mN} \cdot R_{OACSN}) = g_{mP} \cdot V_T$$



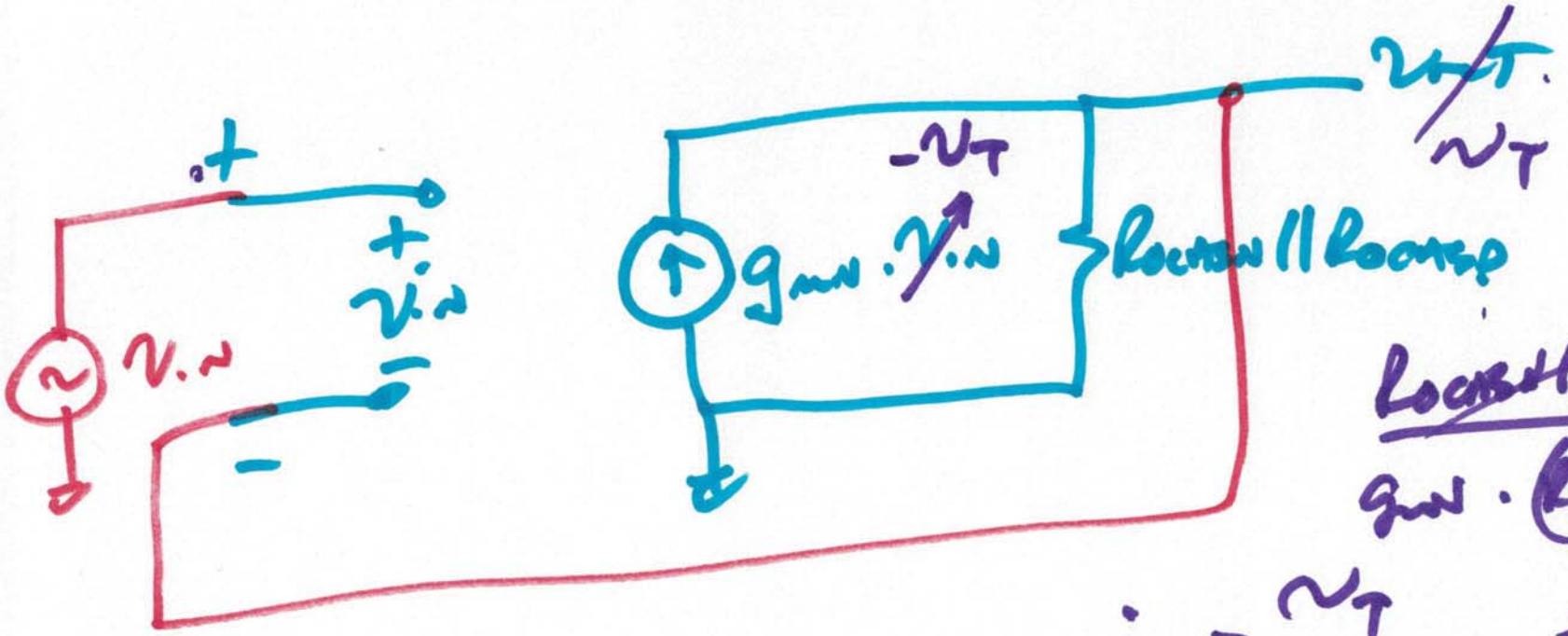
6)



$$f_{3dB} = \frac{1}{2\pi C_L \cdot R_{OCASCN} \| R_{OCASCP}}$$

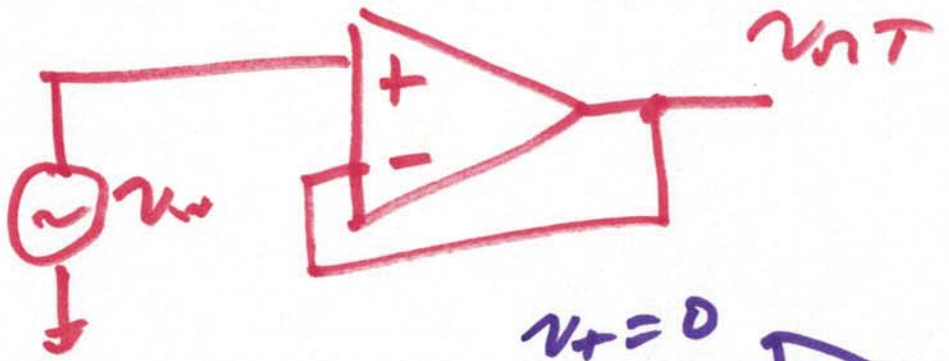
$$\frac{V_{OUT}}{V_{in}} = g_{mN} \cdot R_{OCASCN} \| R_{OCASCP}$$

folded cascode



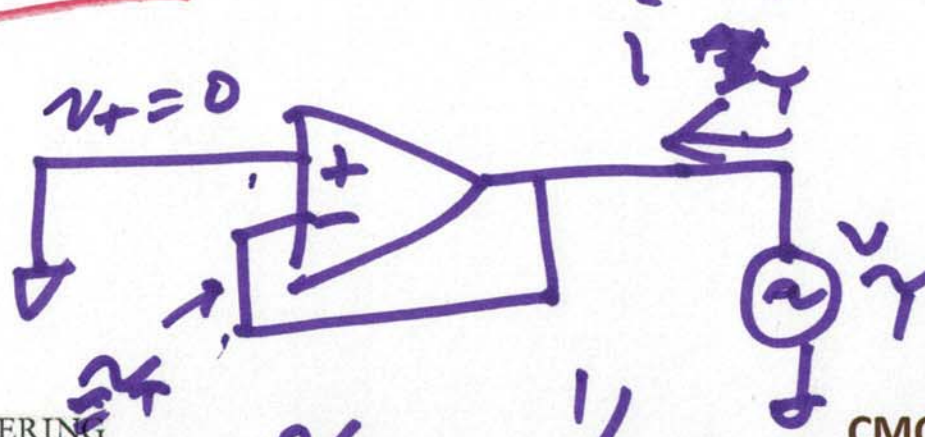
$$\frac{R_{ON} \| R_{OP}}{g_{mN} \cdot (R_{ON} \| R_{OP})}$$

$$i_T = \frac{v_T}{R_{ON} \| R_{OP}} + g_{mN} \cdot v_{in}$$



$$i_T = 2 \cdot \left(\frac{g_{mN} \cdot R_{ON} \| R_{OP}}{R_{ON} \| R_{OP}} \right)$$

$$\frac{2}{g_{mN}}$$



$$\frac{v_T}{i_T} = \frac{1}{g_{mN}}$$