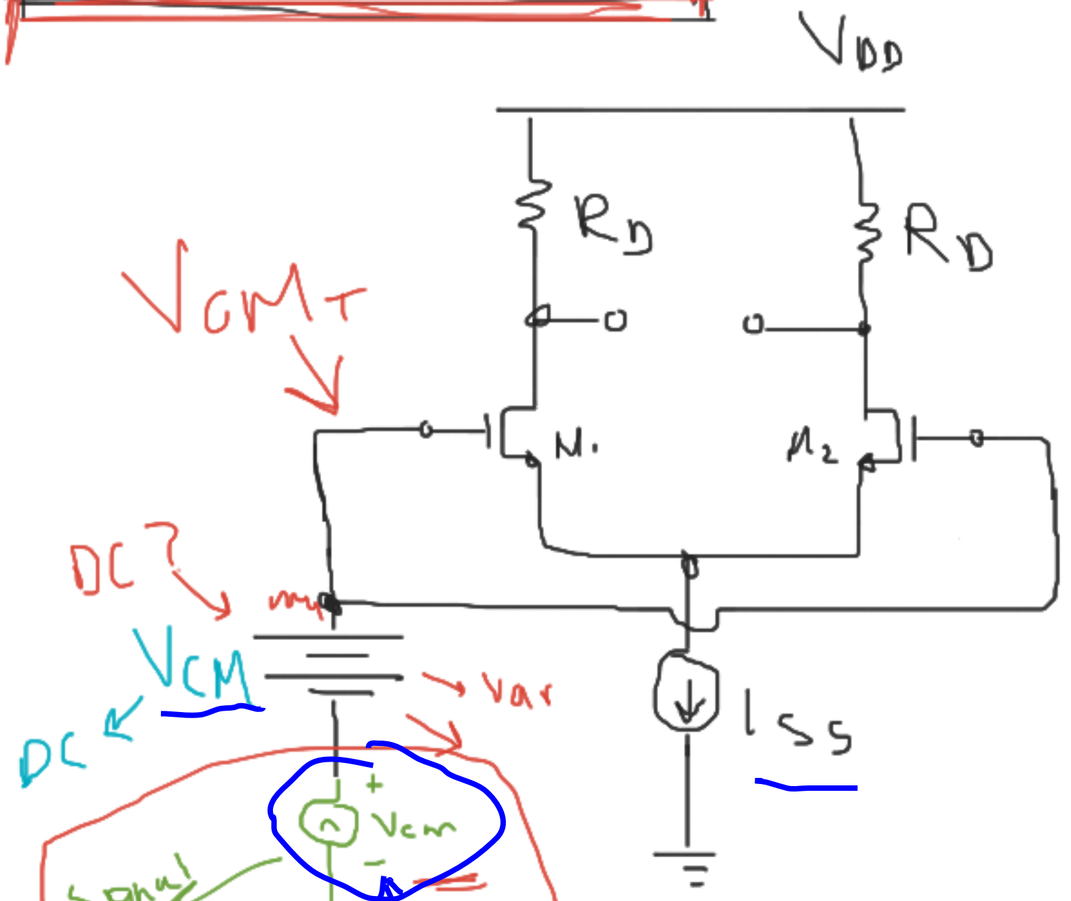
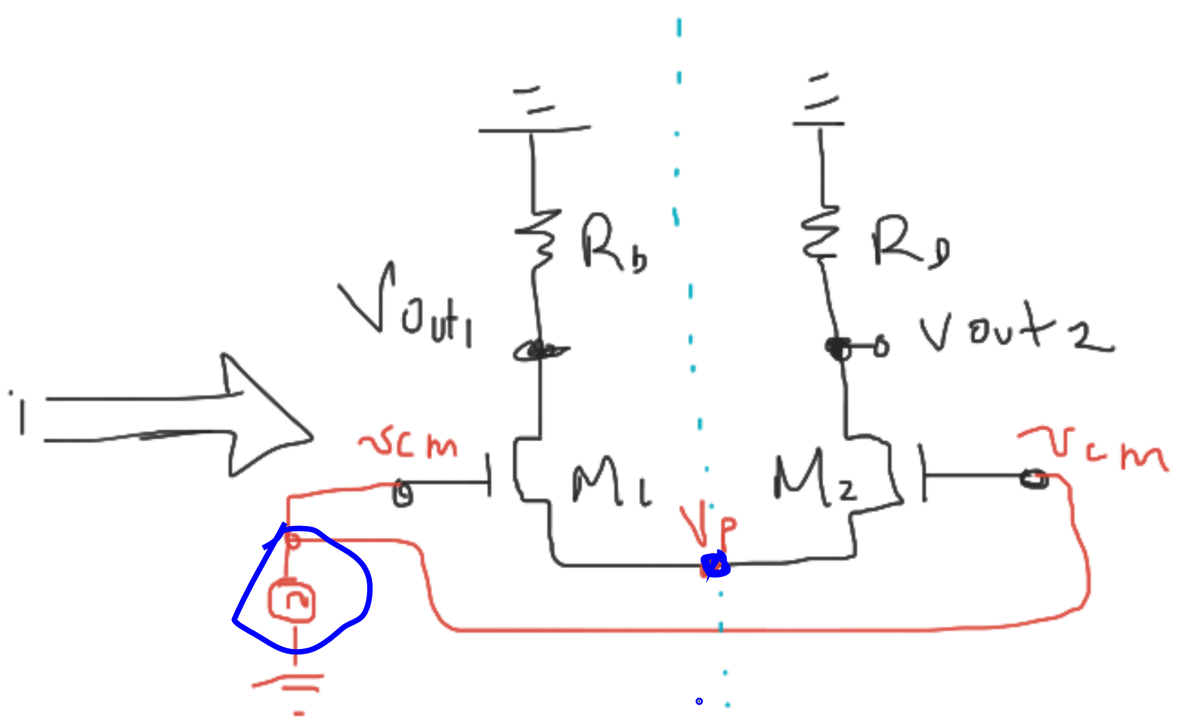
Common Mode

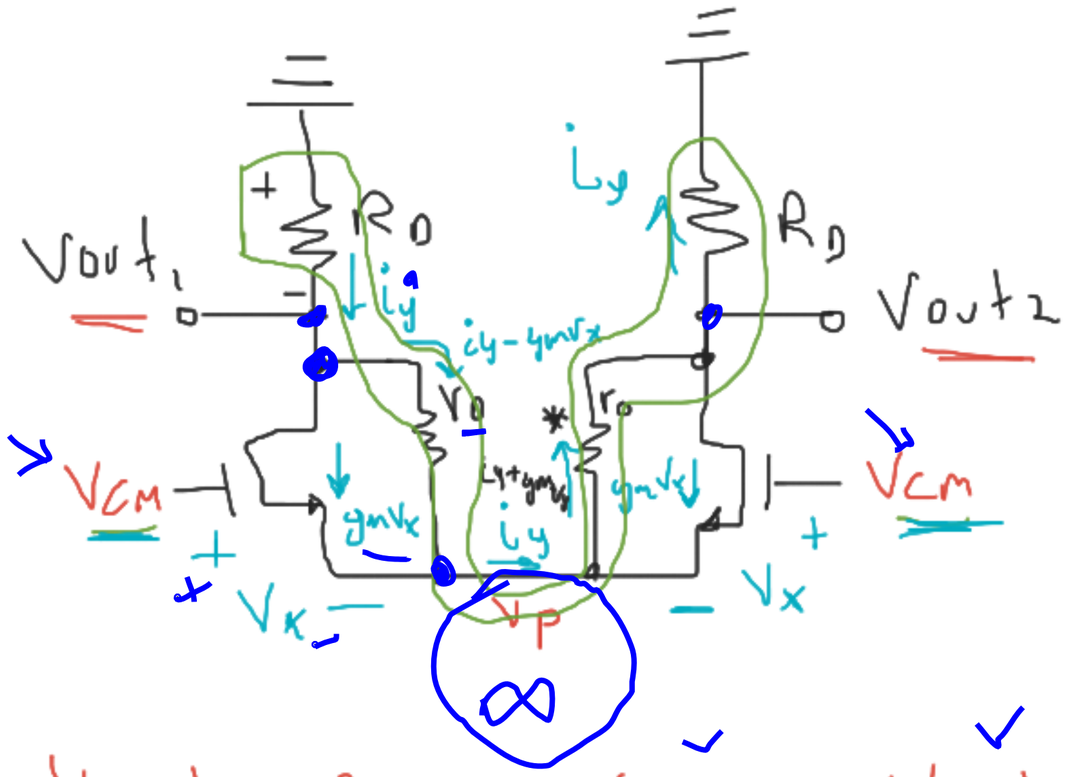




$V_P \rightarrow$ Tierra ~~Virtual~~

- Simetría
- Entrada: Dif

$$V_{CMT} = V_{CM_{DC}} + V_{cm_{sig}}$$



$\lambda \neq 0$ *

$$2 i_y R_D + 2 i_y r_o = 0$$

$$i_y \cdot 2 (R_D + r_o) = 0.$$

$$i_y = 0.$$

$$V_{out\,diff} = V_{out1} - V_{out2} = 0$$

$$V_{out1} = V_{out2}$$

$$i_y R_D + (i_y - g_m V_x) r_o + (i_y + g_m V_x) r_o + i_y R_D = 0$$

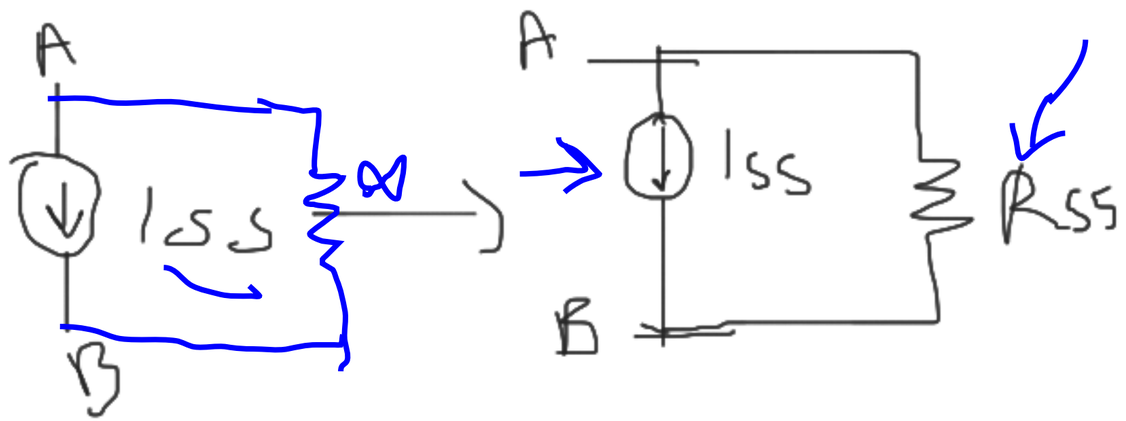
$V_{out1} = 0\ V$

$V_{out2} = 0\ V$

Con lss ideal

Vcm NO Impacta

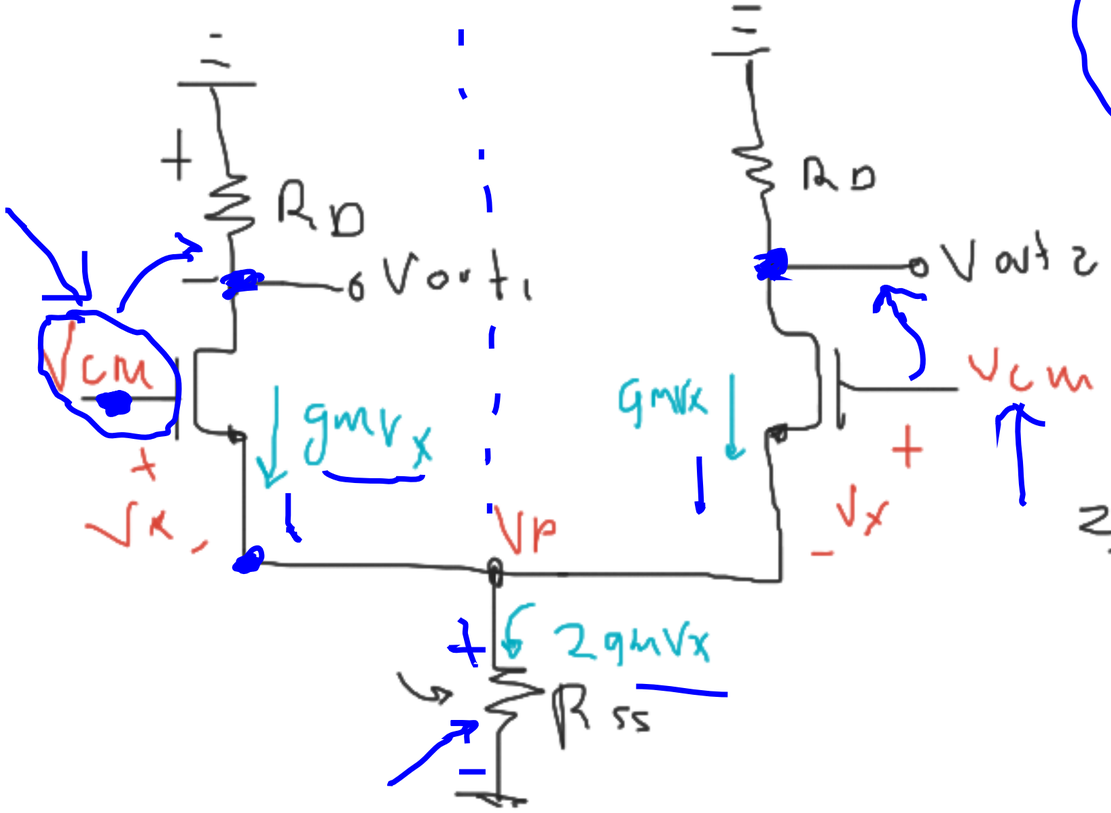
* Iss con R finita



Típicamente MUY GRANDE.

$\lambda = 0$.

$V_{outdiff} = 0$



0) $V_{out1} = -g_m V_x \cdot R_D$

1) $V_x = V_{cm} - V_p$

2) $V_p = 2 g_m V_x \cdot R_{SS}$

$$V_x = \frac{V_p}{2 g_m R_{SS}}$$

$$V_x = V_{cm} - 2g_m V_x R_{ss}$$

$$V_x = \frac{V_{cm}}{1 + 2g_m R_{ss}}$$

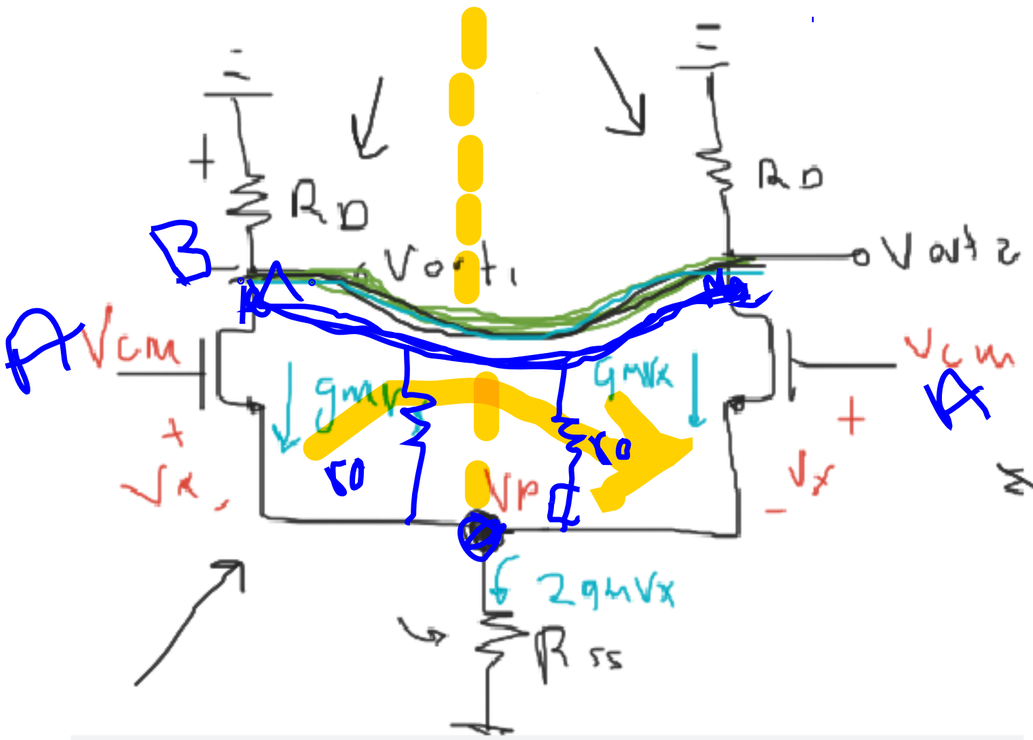
$$V_{out_1} = \frac{-g_m R_D \cdot V_{cm}}{1 + 2g_m R_{ss}} = V_{out_2}$$

$\neq 0$

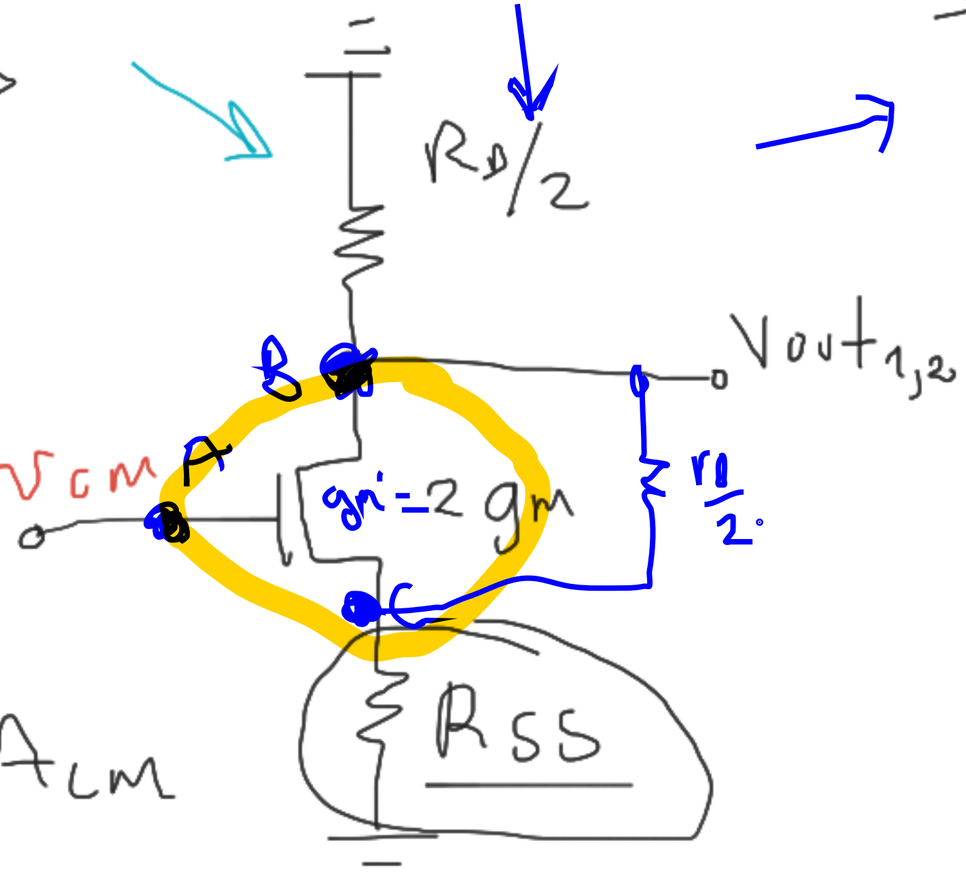
$g_m R$

$$\frac{V_{out_1}}{V_{cm}} = \frac{-g_m R_D}{1 + 2g_m R_{ss}}$$

→ Análisis de Modo Común



Análisis CM
- Simetría ✓
- Detectar nodos equivalentes. ✓
- Simplificar ✓



$\frac{1}{2}$ par

Doblado

$$A_V = \frac{V_{out_{1,2}}}{V_{cm}} = \frac{-R_D/2}{\frac{1}{2g_m} + R_{SS}}$$

R_D'

g_m'

A_{CM}

CMRR :

Common Mode Rejection Ratio

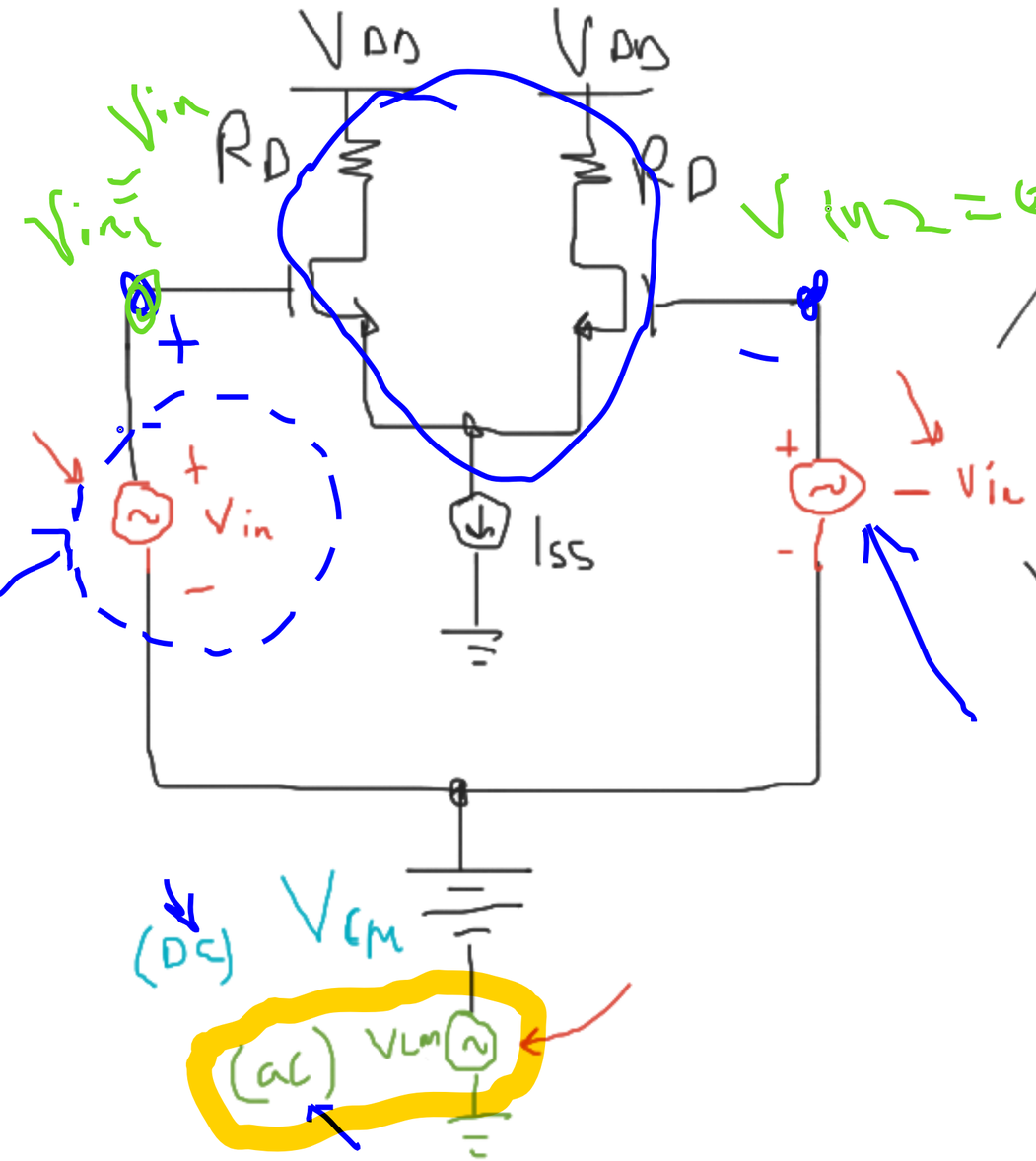
$$CMRR = \left| \frac{A_{VDIFF}}{A_{CM}} \right| \quad ; \quad CMRR_{dB} = 20 \log CMRR$$

$$A_{CM} = \frac{V_{out\ interds}}{V_{CM}}$$

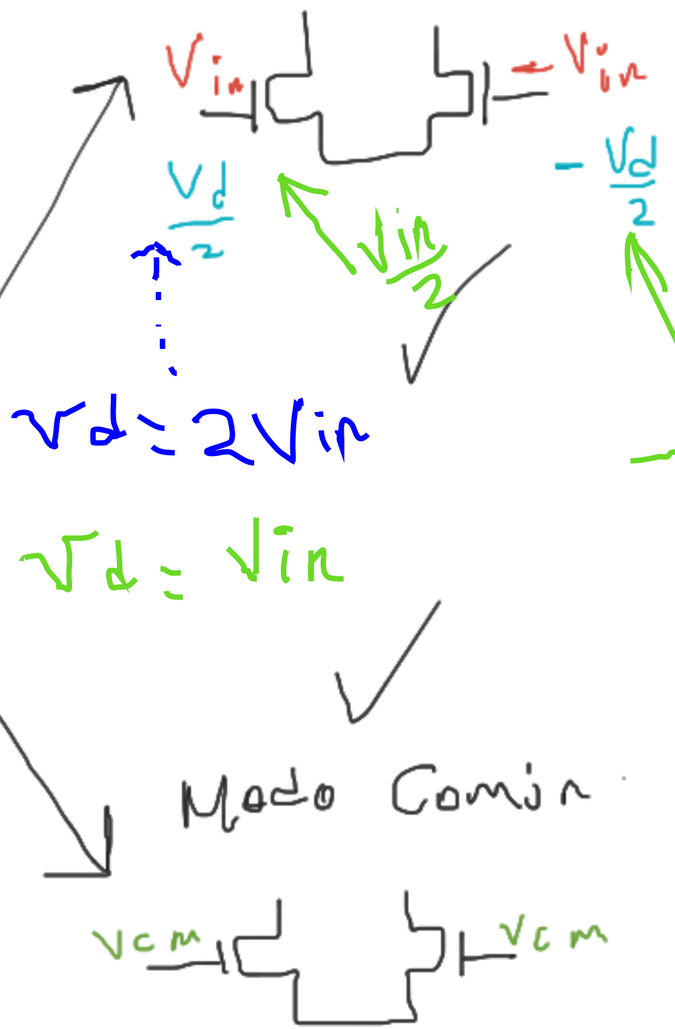
CMRR ~ Grandes

60 dB, 80 dB e

Resumen:



Modo Diferencial



- Simetría ✓
- Virtual ✓

→ Eq. 1/2 par dif. ✓

Modo Común

- Simetría ✓
- Nodos equivalentes para cortocircuitar ✓

→ Eq. 1/2 par doblado

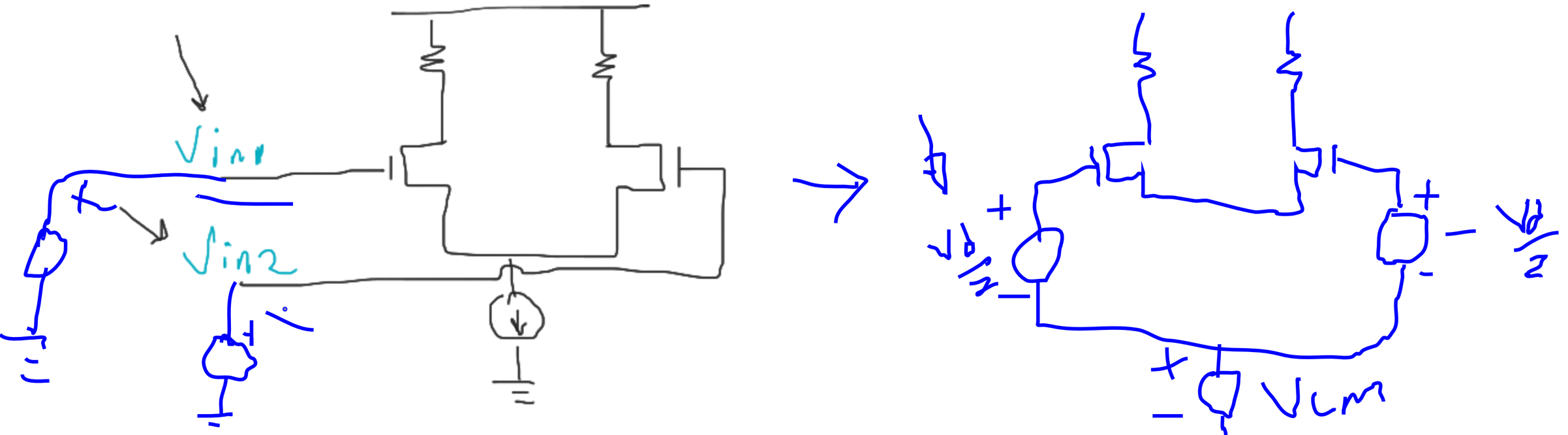
Signal

$$V_{out} = A_v \cdot V_{in_{dif}} + A_{cm} \cdot V_{cm}$$

$V_{in1} - V_{in2}$

Gain Dif (DM)

Gain CM



Generales $(V_{in1}, V_{in2}) \rightarrow (V_d, V_{cm})$

$$V_{in1} = \frac{V_{in1}}{2} + \frac{V_{in1}}{2} + \frac{V_{in2}}{2} - \frac{V_{in2}}{2}$$

$$V_{in2} = \frac{V_{in2}}{2} + \frac{V_{in2}}{2} + \frac{V_{in1}}{2} - \frac{V_{in1}}{2}$$

$$V_{in1} = \frac{V_{in1} + V_{in2}}{2} + \frac{V_{in1} - V_{in2}}{2} \rightarrow V_d$$

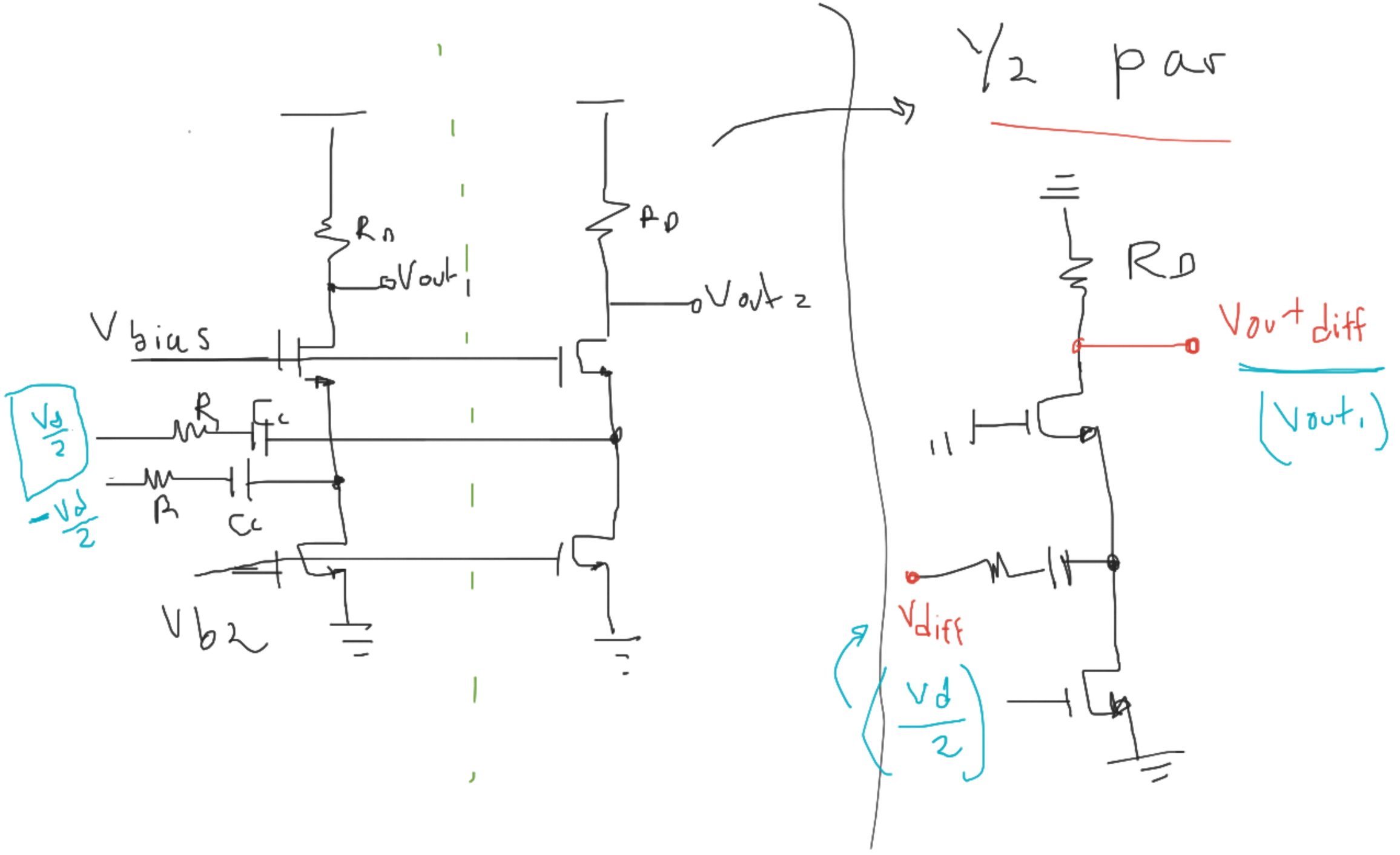
$$V_{in2} = \frac{V_{in1} + V_{in2}}{2} + \frac{V_{in2} - V_{in1}}{2}$$

$$V_{in1} = V_{cm} + \frac{V_d}{2}$$

C.M. + D.M.

$$V_{in2} = V_{cm} - \frac{V_d}{2}$$

C.M. + D.M.


Y/2 par
RD
Vout diff
(Vout1)
Vdiff
(Vd/2)
RD
Vout1
Vout2
Vbias
R
C
R
CC
Vd/2
-Vd/2
Vb2