• MOSFET tranzisztor LESZ!

2013.12.18.

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ÁRAMKÖRÖK

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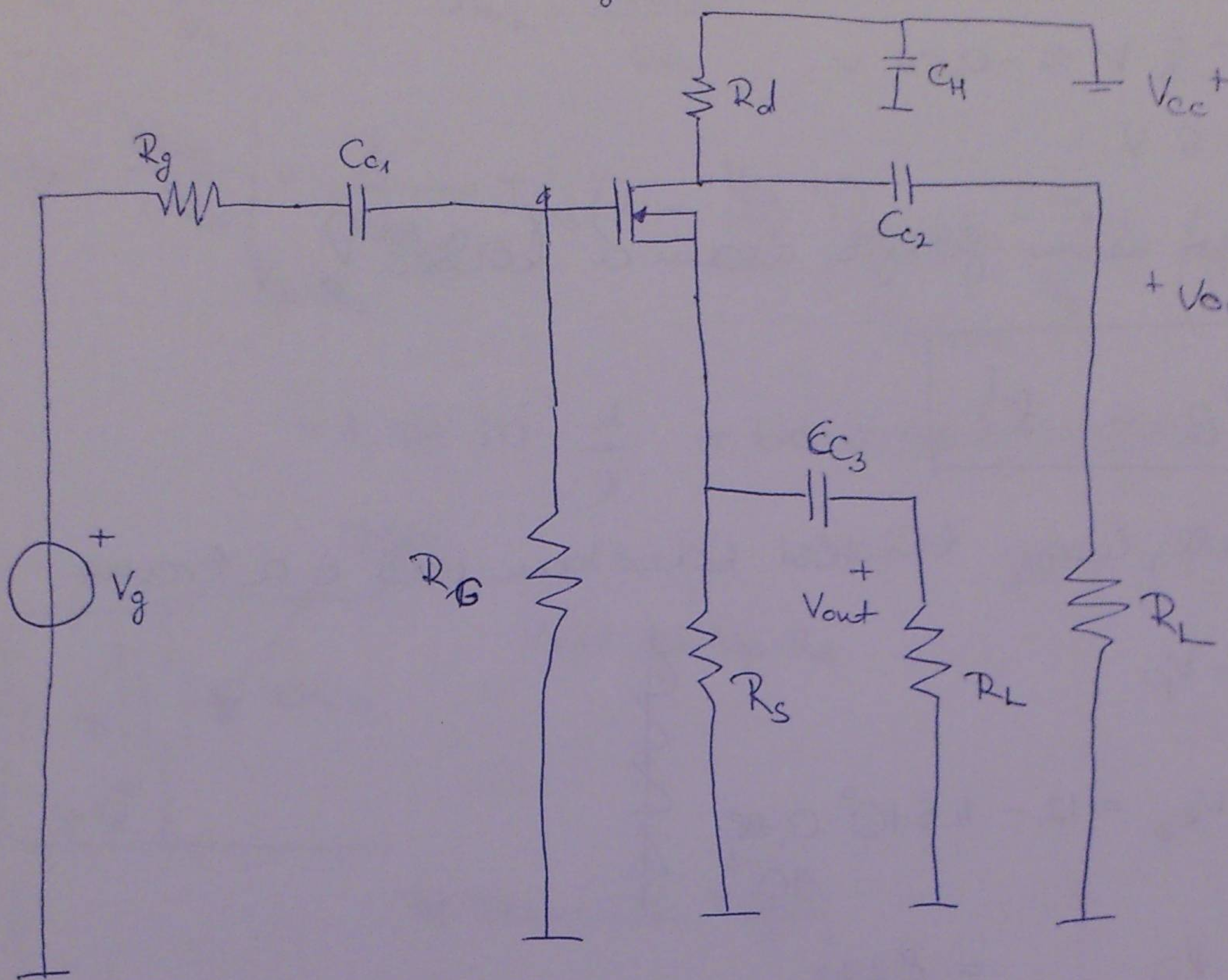
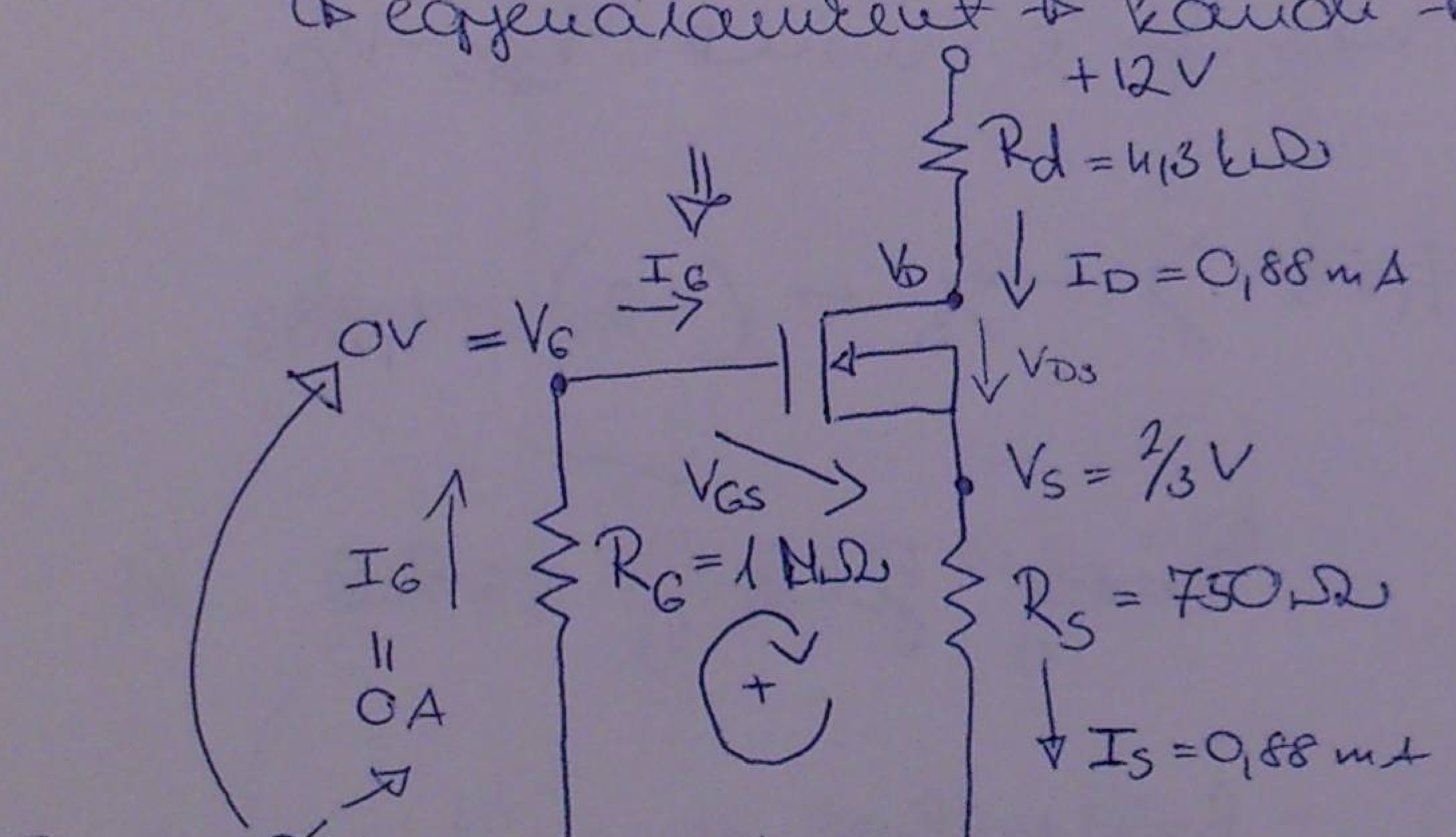


→ először tranzisztor munkapontja

↳ egyenáramként → kondi → szakadás

$I_{DSS} = 2\,mA$

$V_p = -2\,V$



$V_{GS} = V_G - V_S$

$V_{RS} = 2/3\,V \Rightarrow I = \frac{V_{RS}}{R_S} = 888{,}7\,\mu A$

↓ $0{,}88\,mA$

$$V_{GS} + V_S = V_{GS} + I_S \cdot R_S = 0$$

$$I_S = I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_p}\right)^2$$

$$V_S = V_G - V_{GS} = 0 - \left(-\tfrac{2}{3}\right) = \tfrac{2}{3}\,V$$

$$V_{GS} + R_S \cdot I_{DSS}\left(1 - \frac{V_{GS}}{V_p}\right)^2 = 0$$

$$\frac{V_{GS}}{R_S \cdot I_{DSS}} + 1 - \frac{2}{V_p}V_{GS} + \frac{1}{V_p^2}V_{GS}^2 = 0$$

$$\frac{1}{V_p^2}V_{GS}^2 + V_{GS}\left(\frac{1}{R_S I_{DSS}} - \frac{2}{V_p}\right) + 1 = 0$$ → másodfokú megoldó

↳ behelyettesítve: V_p, I_{DSS}-t

$$V_{GS} = -\frac{2}{3} V \approx -0{,}66 V$$
$$= -6 V$$

ha $V_{GS} \overset{<}{} V_p$ → nem folyik áram a körben!

↓

$$\boxed{V_{GS} > V_p \text{ a JÓ}}$$

↳ ellenőrizni kell, hogy telítési tartományban van-e a tranz.

$$V_{DS} \overset{?}{>} V_{GS} - V_p$$

$$V_D = V_{CC} - V_{R_D} = 12 - 4{,}3 \cdot 10^{3} \cdot 0{,}88 \cdot 10^{-3} =$$
$$= 8{,}22$$

$V_S = 2/3$

$V_{DS} = V_D - V_S = \underline{7{,}55 V}$ → nagyobb-e mint $V_{GS} - V_p$

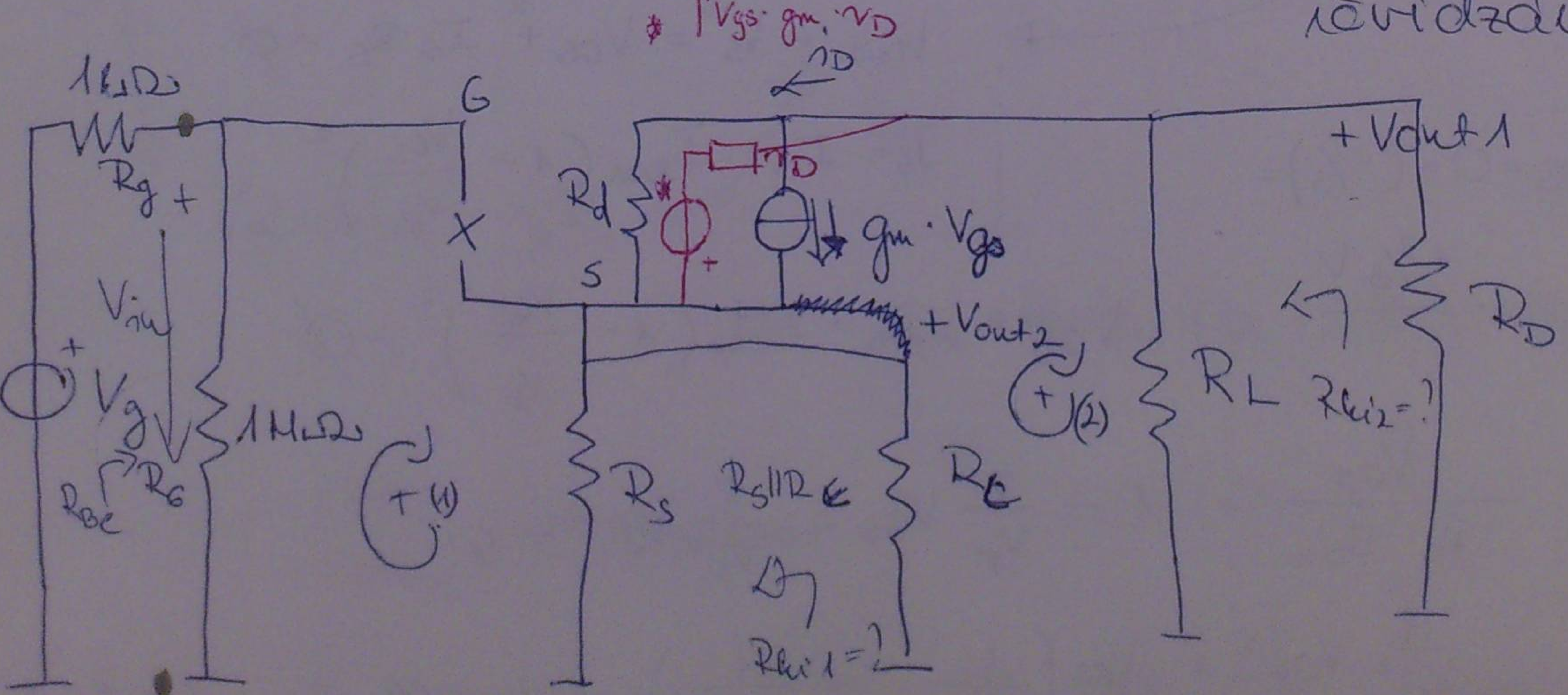
$$7{,}55 \overset{?}{>} -2/3 - (-2) = 1{,}333$$

✓

~~meg~~ felt. jó volt.

munkapont ✓

↳ kisjelű helyettesítés → üzemi fr. → kondenzátorok rövidzárnak

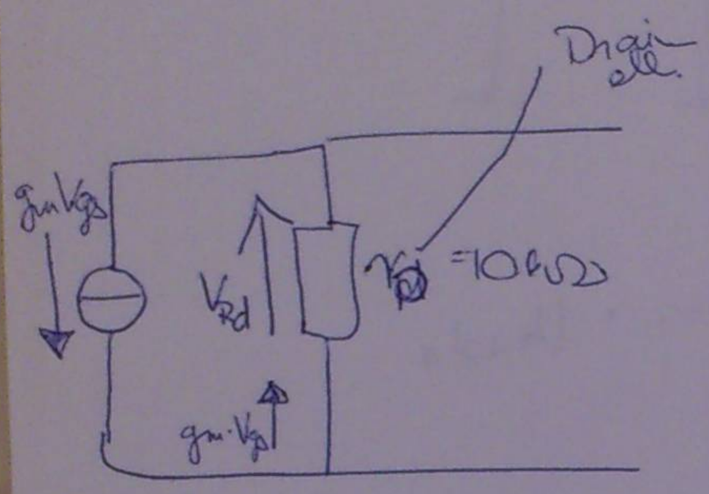


$A_{u1} = \frac{V_{out1}}{V_{in}}$ $A_{u2} = \frac{V_{out2}}{V_{in}}$ feszültségerősítés

ÁRAMKÖRÖK KOLTAI

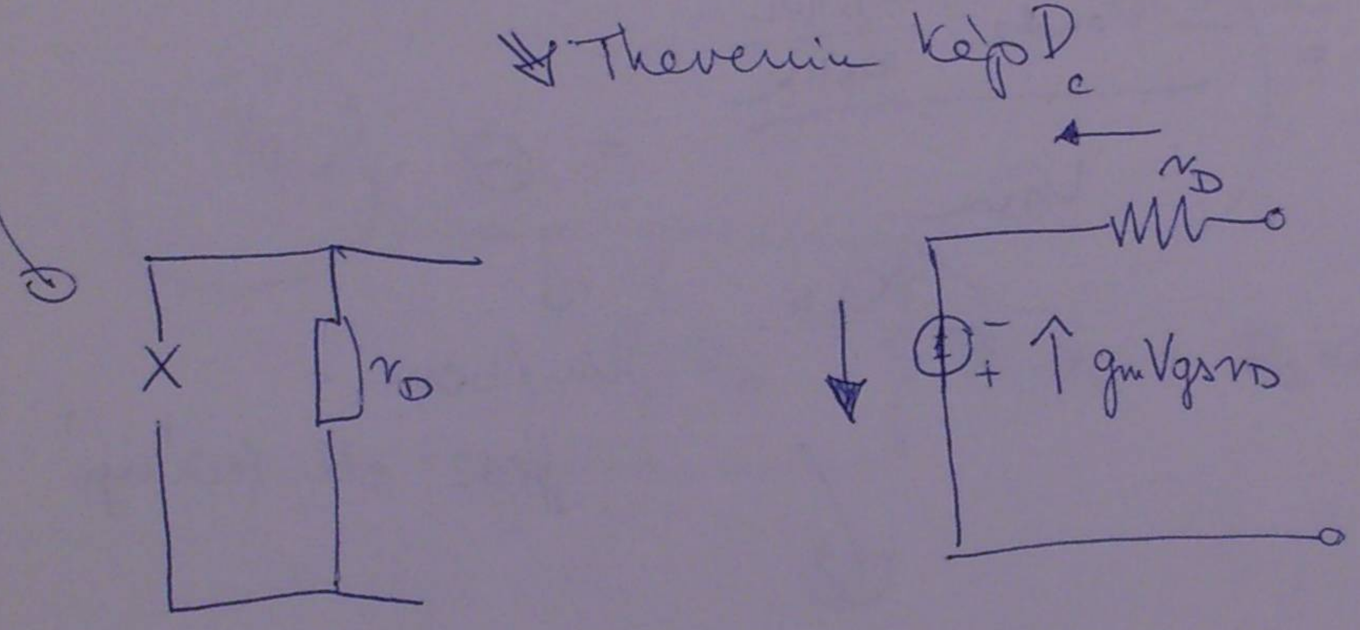
$$g_m = \left.\frac{di_D}{dv_{GS}}\right|_{V_{gs}=V_{GS}} = \left.\frac{d}{V_{gs}} I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2\right|_{V_{gs}=V_{GS}} = \left.\frac{-2 I_{DSS}}{V_P}\left(1 - \frac{V_{GS}}{V_P}\right)\right|_{V_{gs}=V_{GS}} =$$

$= 1,333 \cdot 10^{-3} \frac{A}{V}$ ⇒ tranzistor vezetése



$V_{Rd} = g_m \cdot V_{gs} \cdot R_d$

Thevenin kétpólus



at lehet rajzolni

(1) $-V_{in} + V_{gs} + i_S R_S = \emptyset$

(2) $-V_{out2} + g_m \cdot r_D V_{gs} - i_D r_D - i_D(R_D \| R_L) = \emptyset$

$V_{gs} = V_{in} - i_S R_S$

$\emptyset = -V_{out2} + g_m \cdot r_D \cdot (V_{in} - i_S R_S) - i_D r_D - i_D(R_D \| R_L)$

$i_D = i_S = \frac{V_{out2}}{R_S \| R_L}$ ~~$= V_{out2}$~~

$$-V_{out2} + g_m r_D \left(V_{in} - \frac{V_{out2}}{R_S \| R_L} R_S\right) - \frac{V_{out2}}{R_S \| R_L} \cdot r_D - \frac{V_{out2}}{R_S \| R_L}(R_D \| R_L) = \emptyset$$

⇓ ⋮

$A_{u2} = \frac{V_{out2}}{V_{in}} = 0,4$ ⇝ dB-ben ⇒ $20 \cdot lg\, 0,4 = \underline{-8\, dB}$

$-i_D (R_D || R_L) = V_{out1}$

$i_D = \frac{-V_{out1}}{R_D || R_L}$ } $\frac{-V_{out1}}{R_D || R_L} - \frac{V_{out2}}{R_S || R_L}$

⇓

$V_{out2} = \frac{R_S || R_L}{R_D || R_L} \cdot V_{out1}$

$A_{u1} = ? = \frac{V_{out1}}{V_{in}} = \frac{-V_{out2} \cdot \frac{R_D || R_L}{R_S || R_L}}{V_{in}} = \ominus$

$= 0,4$

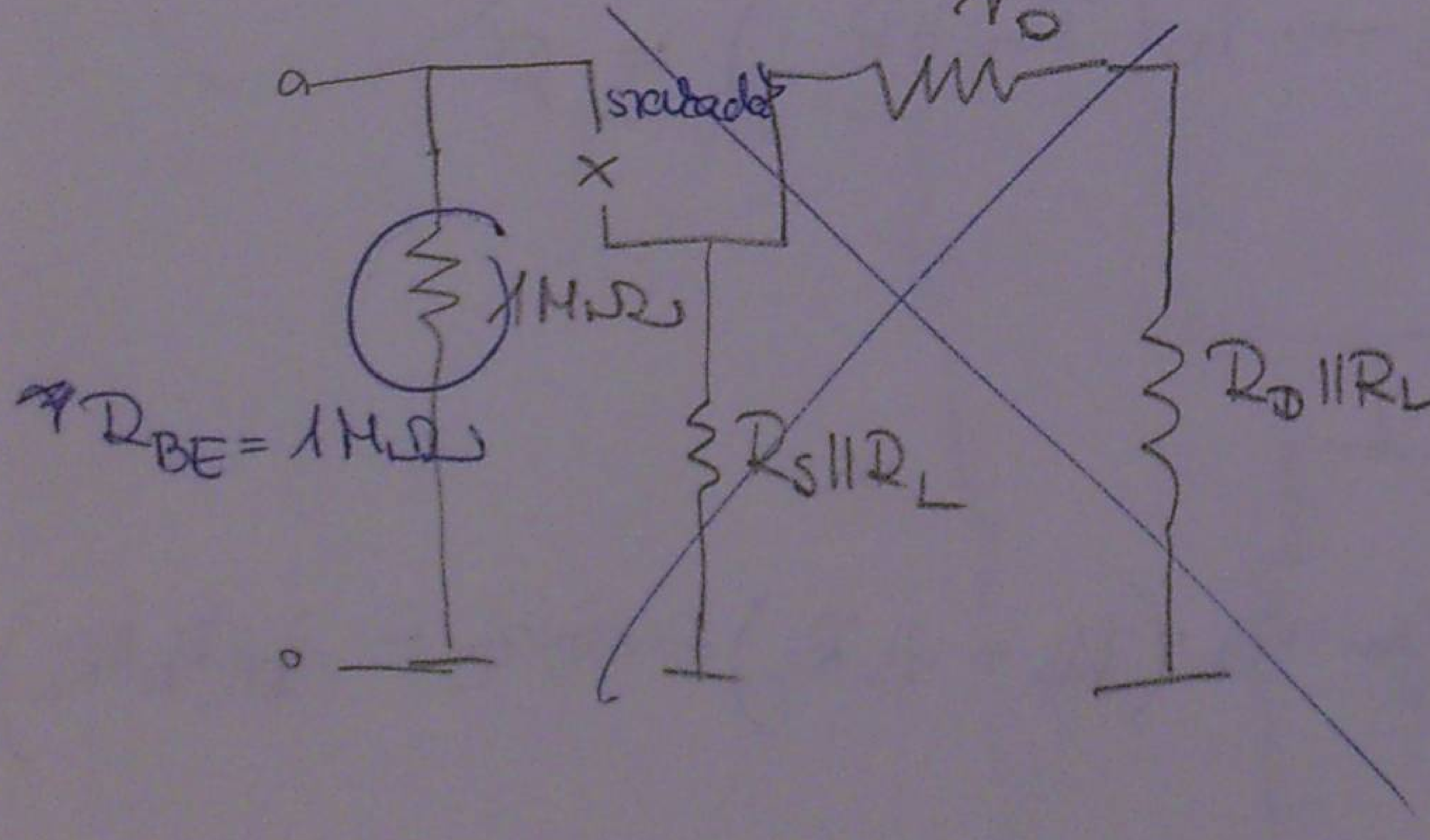
⇓

kim/bem. fesz ell. iránya

⇓

$A_{u1}(dB) = 20 \cdot lg|\ldots| = $

↳ bemenő, kimenő ellenállások

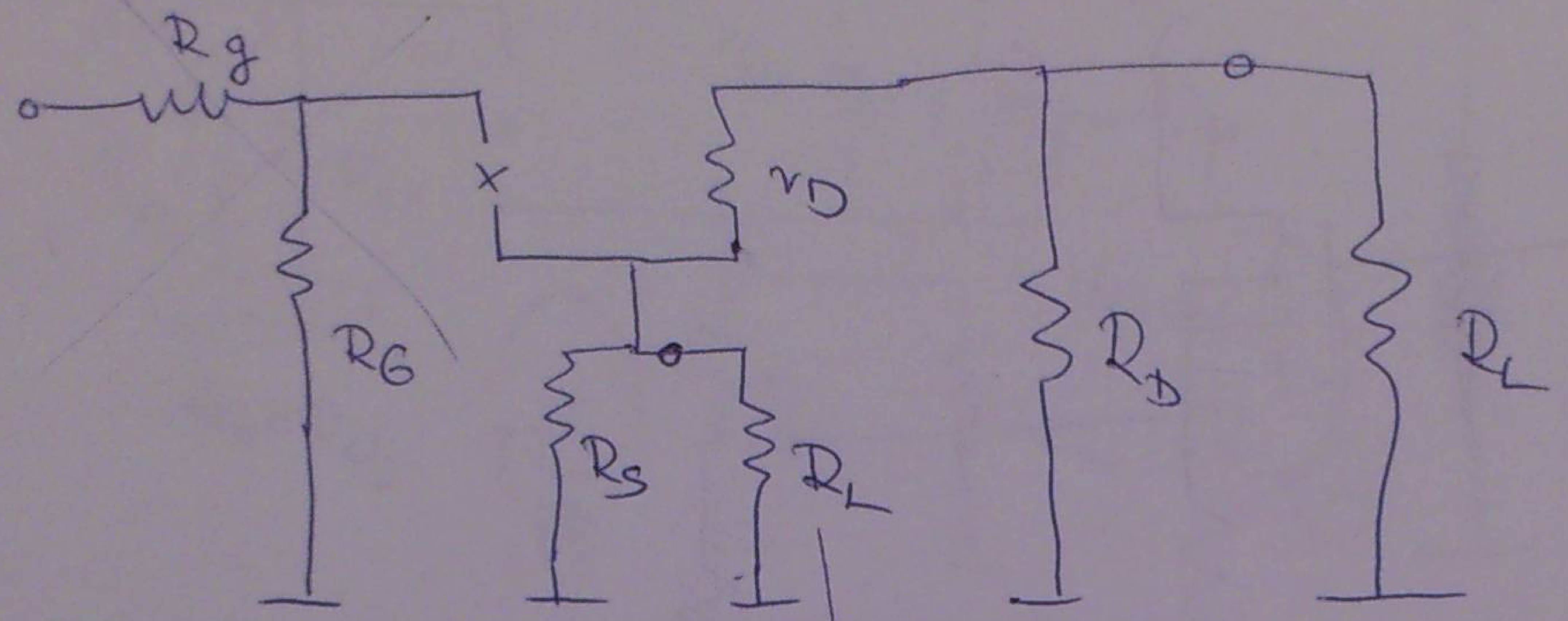


ÁRAMKÖRÖK

konzi

↳ kimenő ellenállás

R_{ki1}, R_{ki2}

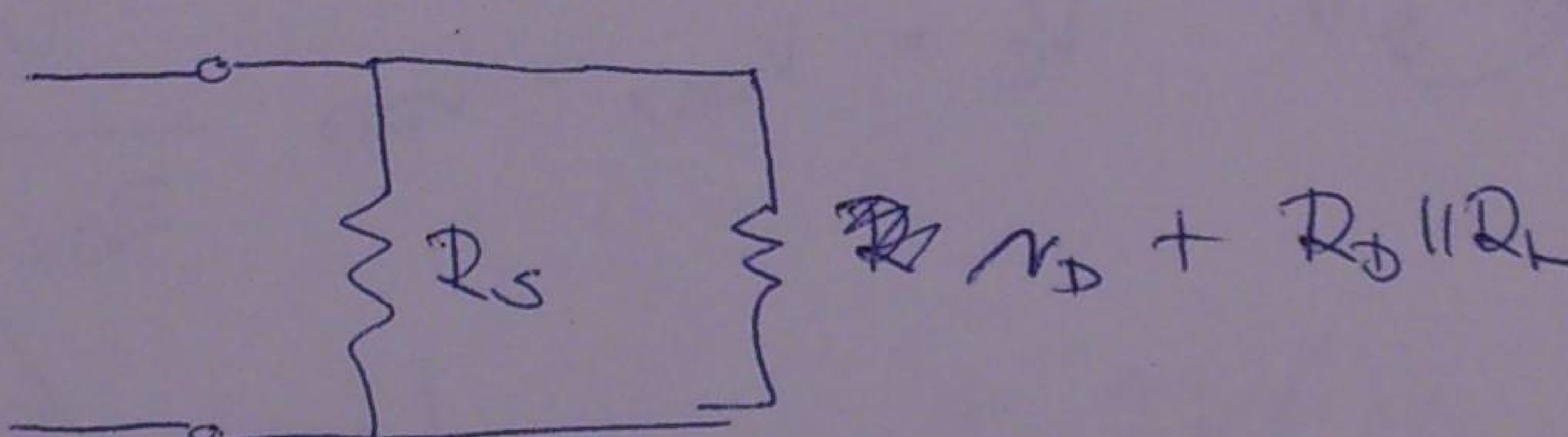


hozzákapcsolt ell. vevő ellenállása

↳ áramkör belső ellenállásánál

nem vesszük az aktuális R_L-t

R_{ki1}



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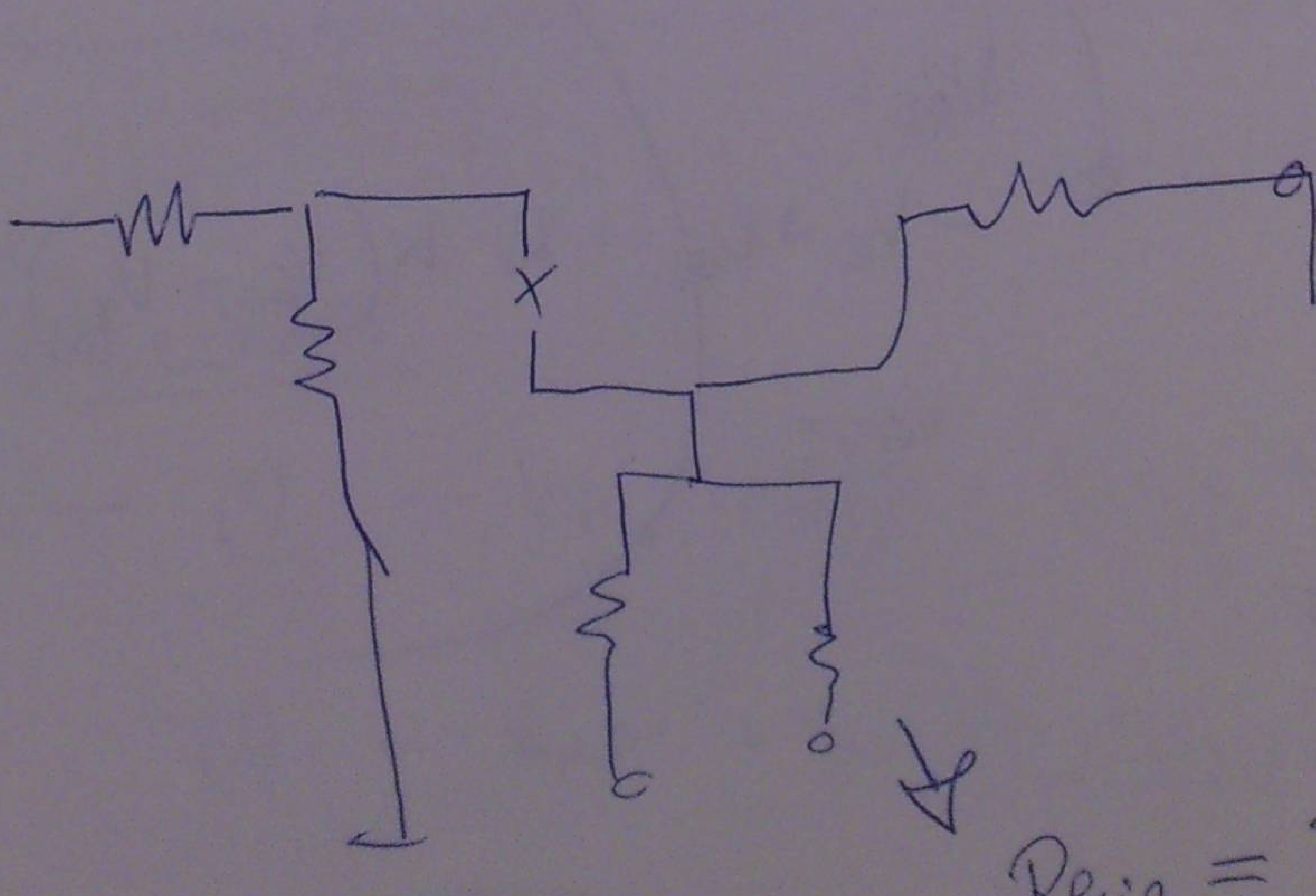
$R_{ki1} = R_S \| (r_D + R_D \| R_L)$

R_{ki2}



mert nézek, nem figyeltem.

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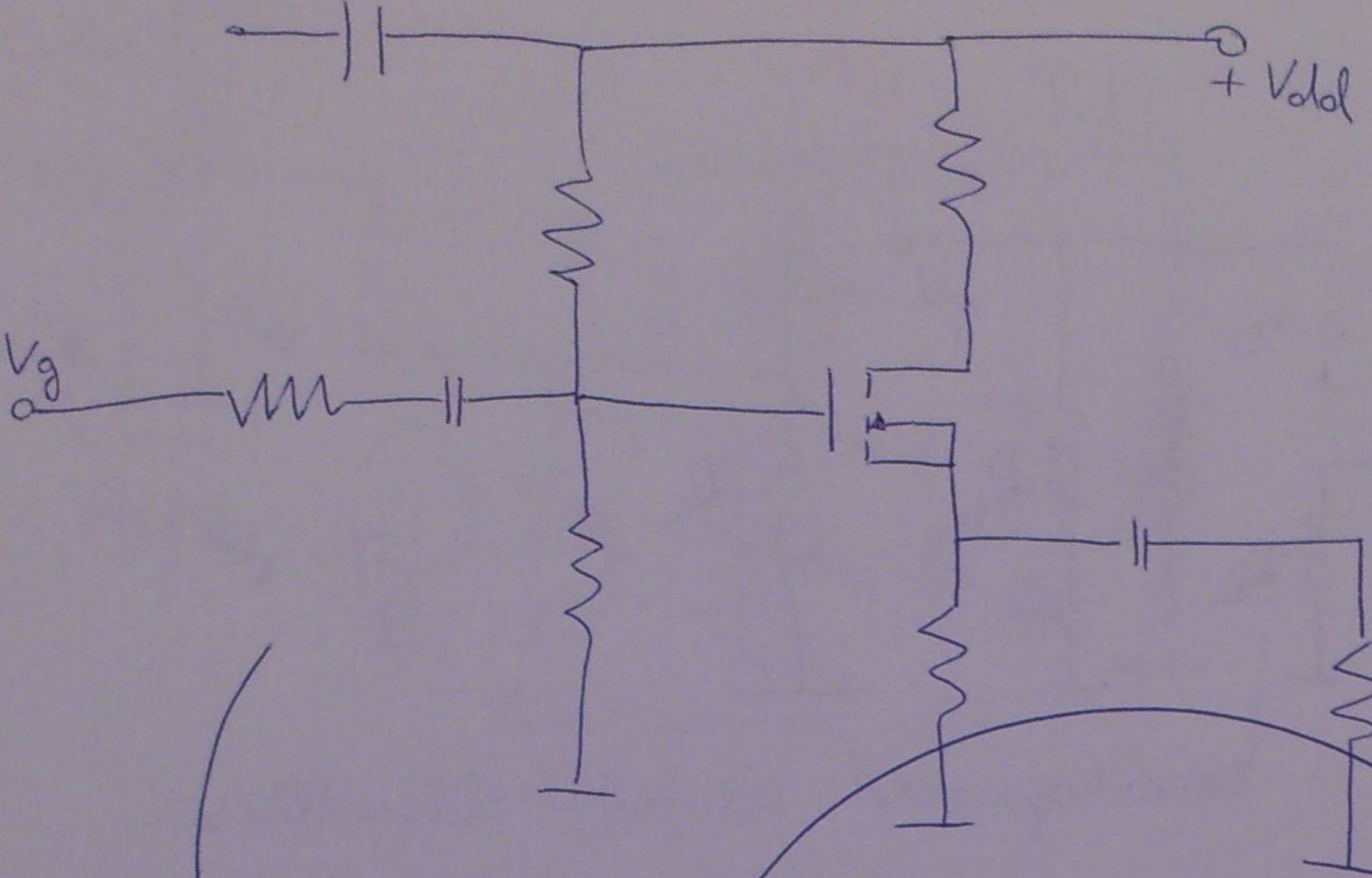
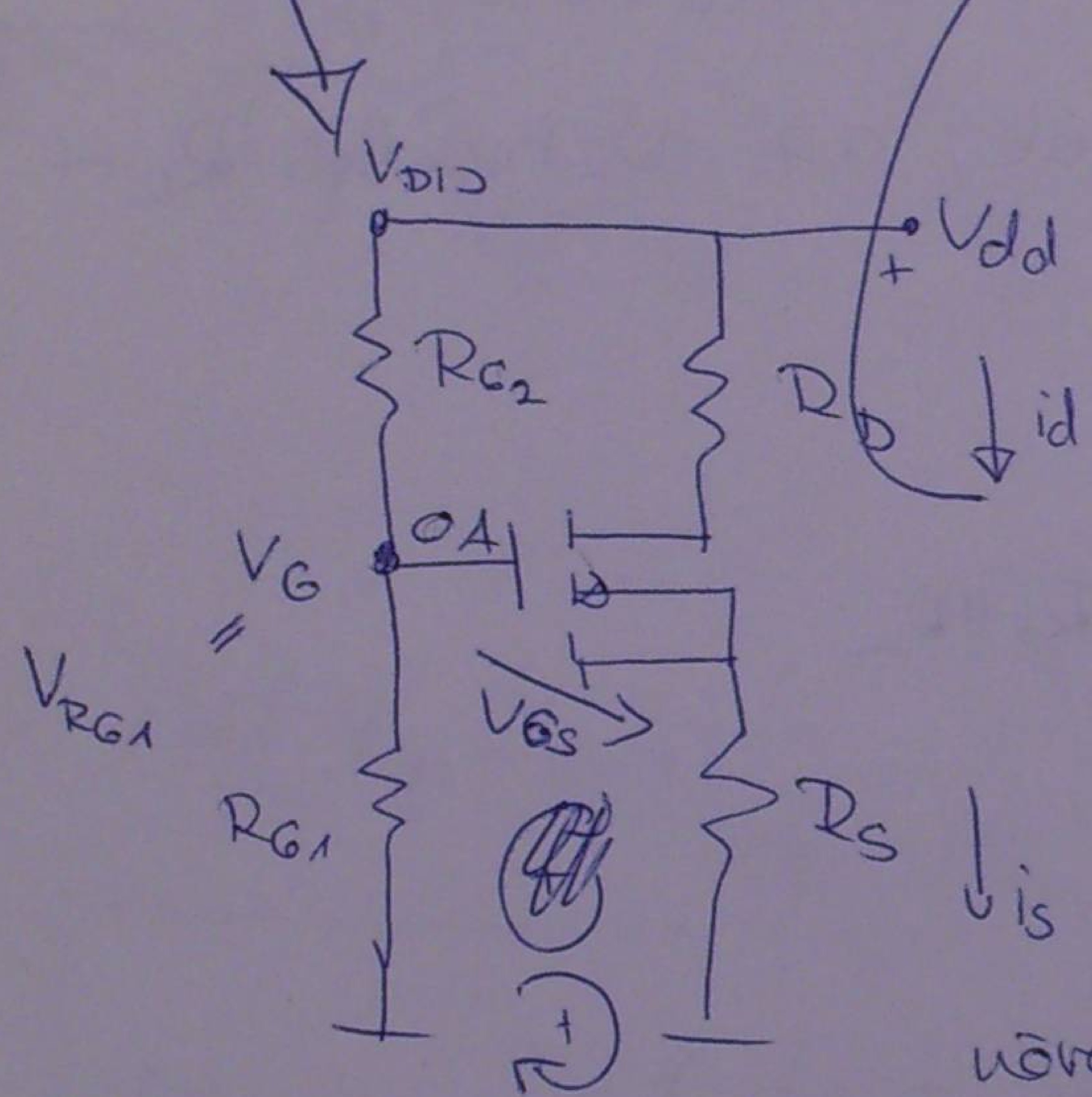
$R_{ki2} = R_D \| (r_D + R_S \| R_L)$





$$V_G = V_{RG1} = V_{DD} \cdot \frac{R_{G1}}{R_{G2}+R_{G1}}$$

$$-V_G + V_{GS} + I_S \cdot R_S = 0$$

növekményes mosfet!

$$I_S = I_D = K \cdot (V_{GS} - V_T)^2$$

~~V_{GS}F~~

$$-V_G + V_{GS} + R_S \cdot K(V_{GS} - V_T)^2 = 0$$

$V_{GS} =$

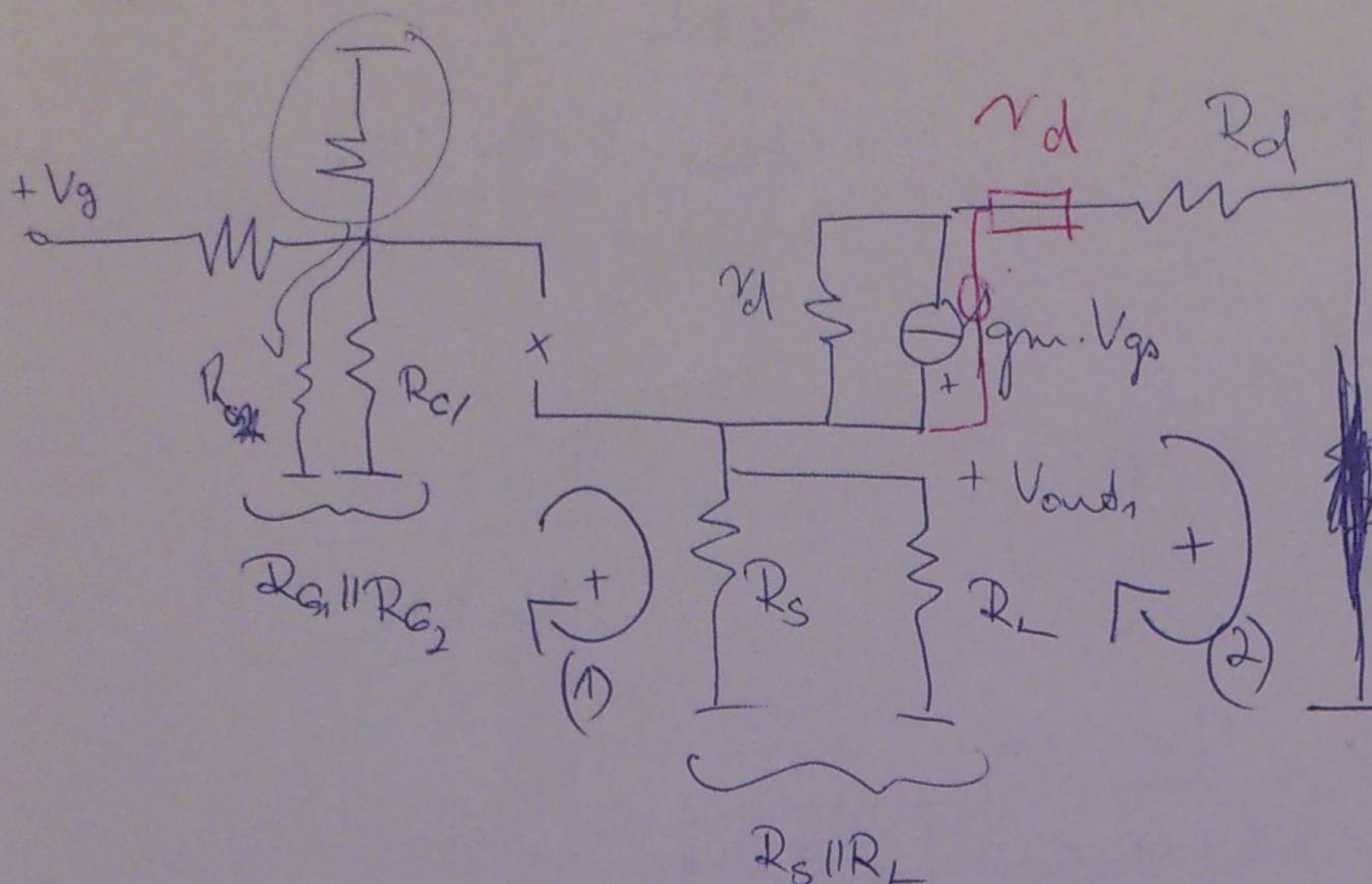
$=$

$V_{GS} > V_T$

$V_{gs} \geq V_{GS} - V_T$

-▷ kisjelű hely.

ÁRAMKÖRÖK

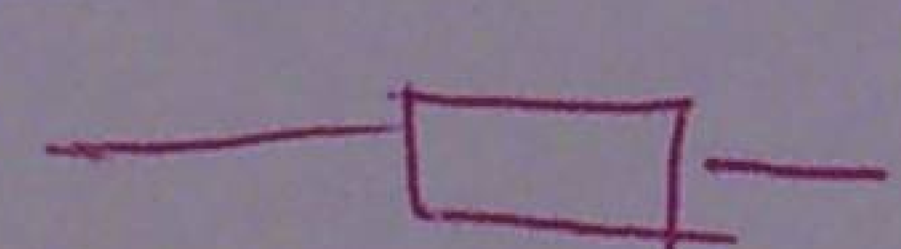


$$g_m = \left.\frac{d i_D}{d V_{gs}}\right|_{V_{gs}=V_{GS}} = \left.\frac{d}{dV_{gs}} K\left(V_{gs} - V_T\right)^2\right|_{V_{gs}=V_{GS}} =$$

$$= 2K\left(V_{gs}-V_T\right)\Big|_{V_{gs}=V_{GS}} = 2K\left(V_{GS}-V_T\right)$$

$$K = 0{,}5\ \frac{mA}{V^2} = 0{,}5 \cdot 10^{-3}\ \frac{A}{V^2}$$

ÁT KELL VÁLT



fesz. erősítés:

$$(1)\quad -V_{in} + V_{gs} + V_{out} = 0 \Rightarrow V_{gs} = V_{in} - V_{out}$$

$$(2)\quad -V_{out} + g_m \cdot V_{gs} \cdot r_D - \left(r_D + R_d\right) i_D = 0$$

$$V_{out} = i_S\left(R_S \| R_L\right) \rightarrow i_S = i_D - \frac{V_{out}}{R_S \| R_L}$$

f)

$$-V_{out} + g_m \cdot r_D (V_{in} - V_{out}) - (r_D + R_D) \frac{V_{out}}{R_S \| R_L} = 0$$

$$-V_{out} + g_m \cdot r_D V_{in} - g_m r_D \cdot V_{out} - V_{out} \cdot \frac{R_D + r_D}{R_S \| R_L} = 0$$

$$g_m \cdot r_D V_{in} = V_{out} \left(1 + g_m \cdot r_D - \frac{R_D + r_d}{R_S \| R_L} \right)$$

$$A_u = \frac{V_{out}}{V_{in}} = \frac{g_m \cdot r_D}{1 + g_m r_D - \frac{R_d + r_d}{R_S \| R_L}}$$

↳ be és ki ell.?

$R_{BE} = R_{G1} \| R_{G2}$

$R_{KI} = R_S \| (R_D + r_d)$