$$V_c(s) = \frac{5}{s} + \hat{V}_c(s) = \frac{5}{s} + \left(\frac{10}{s} - \frac{5}{s}\right)\frac{\frac{1}{sC}}{1+\frac{1}{sC}}$$

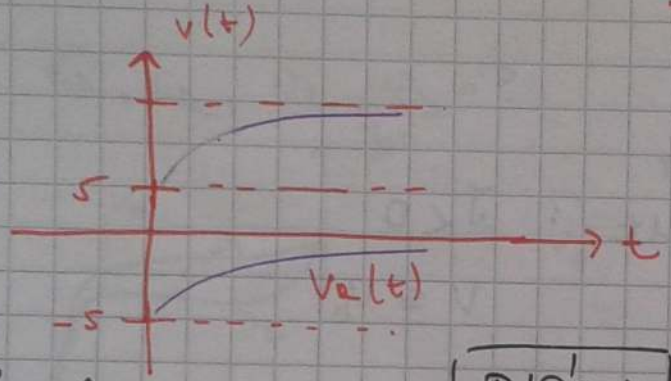
$$V_R(s) = \frac{-2{,}5}{s} \cdot \frac{sL}{sL+(2+2)} \cdot 2$$

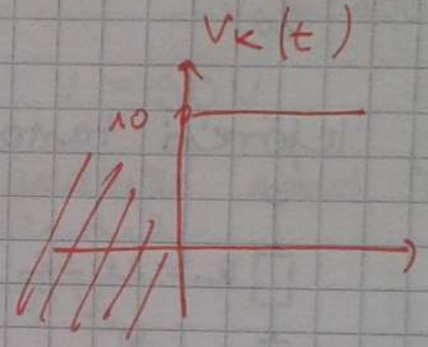
τ_1

4

τ_2

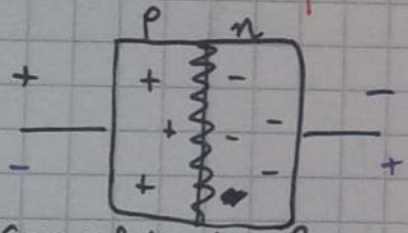
$$V_R(s) = V_c(s) - V_R(s) = \frac{10}{s} \longleftrightarrow 10\,u(t)$$





DIÓDA

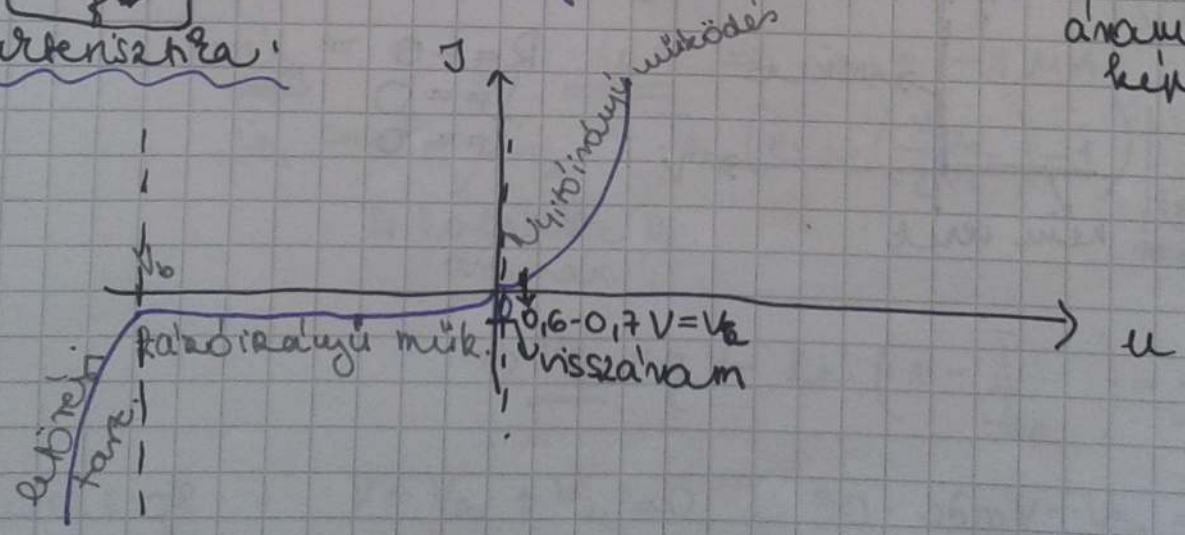
nov. 21.



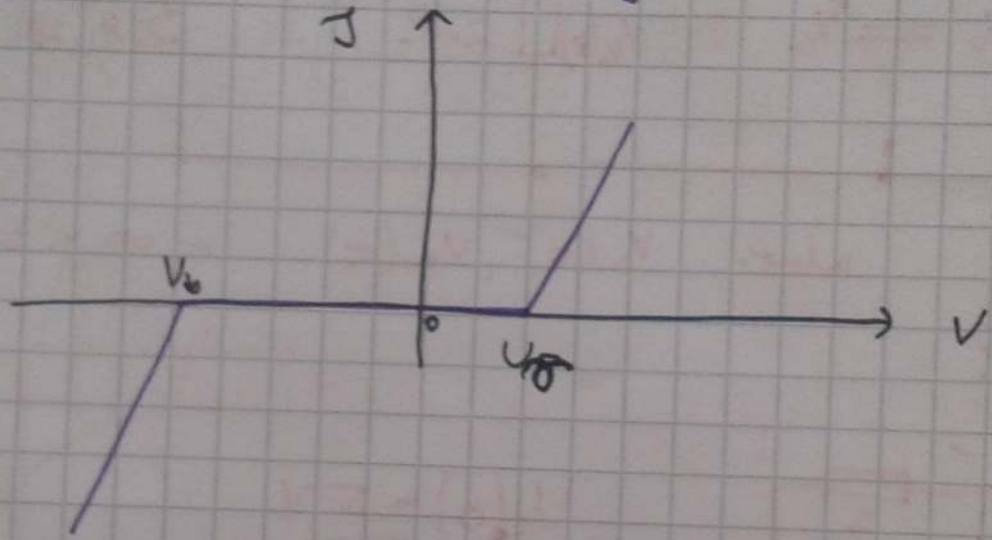
elvégzendő a p-n -átmenet vastagodik

szerkezete:

áramkörben:

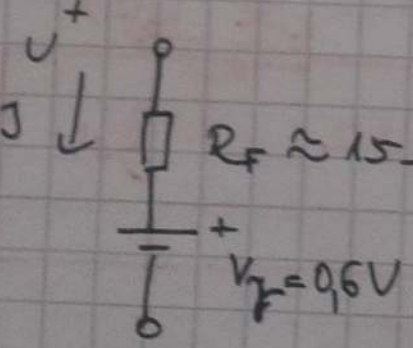


Tűrtvonalas karakterisztika:



1.) nyitóirányú előfeszítés

felt: $I > 0$



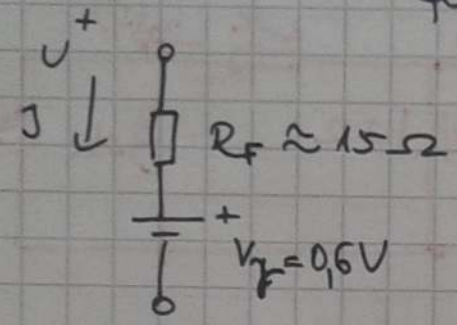
$$V_F = V_\gamma + R_F I_F \simeq 0{,}7V$$

2.) záró irányú előfeszítés

felt.: $I < 0$

1.) nyitóirányú előfeszítés

felt: $I > 0$

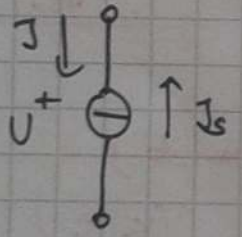


$$V_F = V_\gamma + R_F I_F \approx 0{,}7\,V$$

2.) záró irányú előfeszítés

felt.: $I < 0$

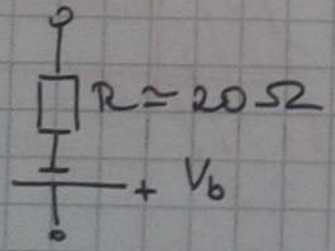
$V_b < V < 0$



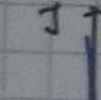
3.) lavinaráti tartomány

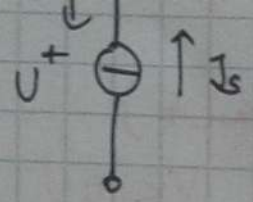
felt.: $I < 0$

$V \leq V_b$



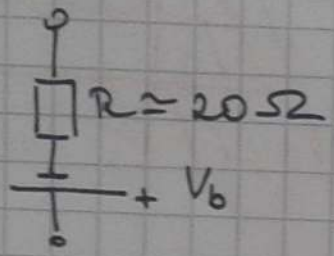
Ideális dióda karakterisztika:





$V_b < V < 0$

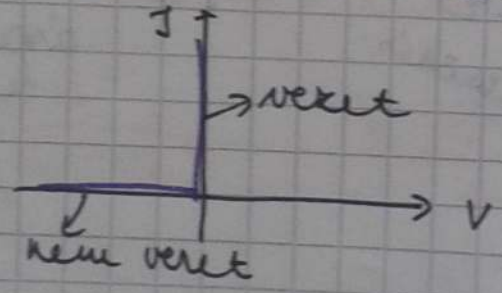
3.) lekörélti tartomány



felt.: $I < 0$

$V \leq V_b$

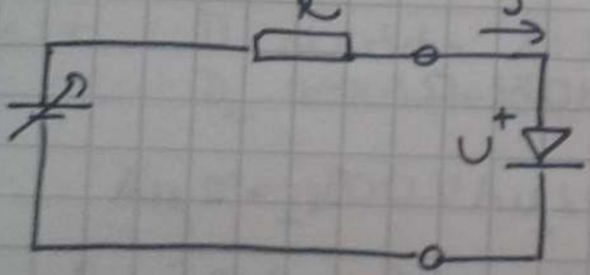
Ideális dióda karakterisztika:



$R_F = 0$
$V_F = 0$
$I_F = 0$

Dióda egyenlet

- kis áramok esetén, csak a nyitó- és záró-tartományban érvényes



$$I = I_S\left(e^{\frac{V}{\eta V_T}} - 1\right)$$

$$V_T = 25 mV \left(= \frac{kT}{e}\right)$$

I_S : visszáram

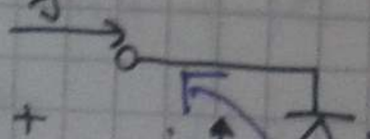
V : dióda feszültsége

η : technológia függő paraméter ?

$\eta \in [1;2]$

Feladatok

(1)



Adott: vissz…

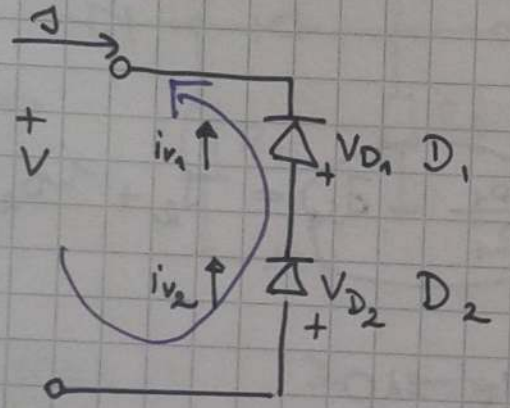
V: dióda feszültsége

ζ: technológia függő paraméter

$\zeta \in [1 ; 2]$?

Feladatok

①



Adott: visszáramok D_1 és D_2-n:

$I_{S_1} = 1\,\mu A$

$I_{S_2} = 2\,\mu A$

letörési fesz-ek D_1 és D_2-n:

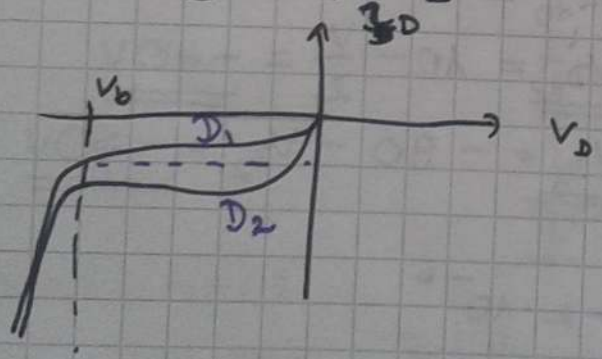
$V_b = 100\ V$

$V = 90\ V$ $\quad \zeta = 2$

Mindenütt záró irányban üzemel.

$V_{D_1} \gg V_{D_2}$

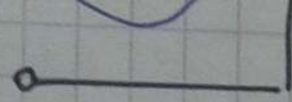
$i_{D_1}, i_{D_2}, V_{D_1}, V_{D_2} = ?$



$$i_D = I_S \left(\exp\left(\frac{V_D}{\zeta V_T} - 1 \right) \right) \qquad \exp\left(\frac{V_{D_1}}{\zeta V_T} \right) \ll 1$$

$$-i_{D_1} \simeq + I_{S_1} = 1\,\mu A \Rightarrow i_{D_1} = -1\,\mu A$$

$$i_{D_1} \simeq + I_{S_1} = -i_{D_1} = I_{S_2} \left(\exp\left(\frac{V_{D_2}}{\zeta V_T} \right) - 1 \right)$$



letörési fesz-ek D_1 és D_2-n:

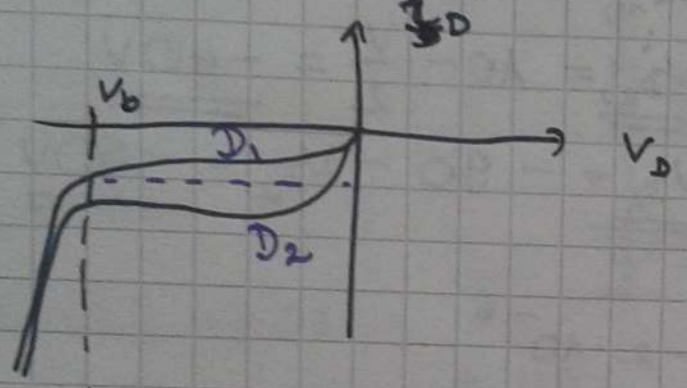
$V_b = 100\,V$

$V = 90\,V$ $\quad \eta = 2$

Miniatűr szénszál izzólámpa üzemel.

$V_{D1} \gg V_{D_2}$

$i_{D_1}, i_{D_2}, V_{D1}, V_{D_2} = ?$



$$i_D = I_S\left(\exp\left(\frac{V_D}{\eta V_T} - 1\right)\right) \qquad \exp\left(\frac{V_{D1}}{\eta V_T}\right) \ll 1$$

$$-i_{D1} \simeq +I_{S_1} = 1\mu A \Rightarrow i_{D1} = -1\,\mu A$$

$$i_{D1} \simeq +I_{S_1} = -i_{D_2} = I_{S_2}\left(\exp\left(\frac{V_{D_2}}{\eta V_T}\right) - 1\right)\Big|_{i_{D_2} = 2\mu A} =$$

D_1 karakterisztikája D_2 áramait

$$\Rightarrow V_{D_2} = \eta V_T \ln\left(1 - \frac{I_{S_1}}{I_{S_2}}\right) = -36\,mV$$

Kirchhoff: $V + V_{D_1} + V_{D_2} = 0$

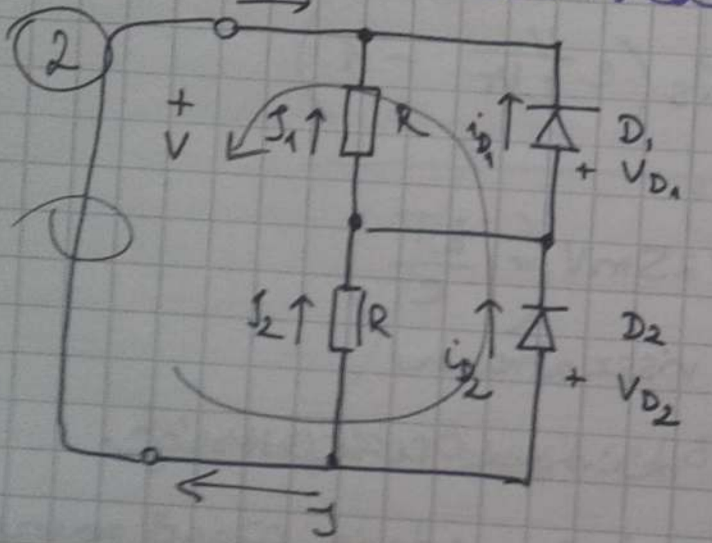
$90 - 36mV + V_{D_1} = 0$

$V_{D_1} \simeq 89,96\,V$

Feltétel ellenőrzése:

(*) $-100V < V_{D_1} < 0V$ és $-100V < V_{D_2} < 0$ ✓ ✓

lsd: köv. oldal



$V = 90V$

$R = 10 M\Omega$

$I_{S_1} = 1 \mu A$ $\quad I_{S_2} = 2 \mu A$

$V_b = 100V$ (D_1 és D_2 is)

$\eta = 2$

$V_{D_1} \simeq V_{D_2}$

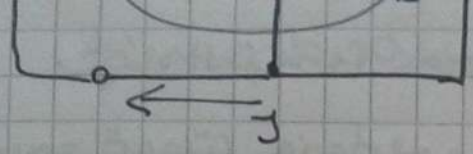
[nagyság (−45) − (−45) V]

$$i_{D_1} = I_{S_1}\left[\underbrace{\exp\left(\frac{v_D}{\eta V_T}\right)}_{\to 0} - 1\right] \approx -I_{S_1}$$

$$i_{D_2} \approx -I_{S_2}$$

Kirchhoff (csomóponti):

$$-J = J_1 + i_{D_1} = \frac{v_{D_1}}{R_1} - I_{S_1} = J_2 + i_{D_2} = \frac{v_{D_2}}{R} - I_{S_2}$$



$V_{D_1} \cong V_{D_2}$

[valszeg $(-h5)$ V $(-h5)$ V]

$V = 90V$

$$i_{D_1} = I_{S_1}\left[\underbrace{\exp\left(\frac{v_D}{2V_T} - 1\right)}_{\to 0}\right] \approx -I_{S_1}$$

$$i_{D_2} \simeq -I_{S_2}$$

Kirchhoff (csomóponti):

$$-I = I_1 + i_{D_1} = \frac{V_{D_1}}{R_1} - I_{S_1} = I_2 + i_{D_2} = \frac{V_{D_2}}{R} - I_{S_2}$$

$$\vdots$$

$$V_{D_1} = V_{D_2} - 10$$

huroktv: $V + V_{D_1} + V_{D_2} = 0$

$90 + V_{D_2} - 10 + V_{D_2} = 0$

$$V_{D_2} = 10 - \frac{V}{2} = -40V$$

$$V_{D_1} = -90 - V_{D_2} = -50V$$

$$\frac{V_{D_1}}{10^7} - 10^{-6} = \frac{V_{D_2}}{10^7} - 2\cdot 10^{-6}$$

$$V_{D_1} - 10 = V_{D_2} - 20$$

Ell: $-100V < V_{D_1} = -40V < 0$

R_1 R

$V_{D_1} = V_{D_2} - 10$

kurioktw: $V + V_{D_1} + V_{D_2} = 0$

$90 + V_{D_2} - 10 + V_{D_2} = 0$

$\underline{\underline{V_{D_2} = 10 - \frac{V}{2} = -40V}}$

$\underline{\underline{V_{D_1} = -90 - V_{D_2} = -50V}}$

$\frac{V_{D_1}}{10^7} - 10^{-6} = \frac{V_{D_2}}{10^7} - 2 \cdot 10^{-6}$

$V_{D_1} - 10 = V_{D_2} - 20$

Ell: $-100V < V_{D_1} = -40V < 0$

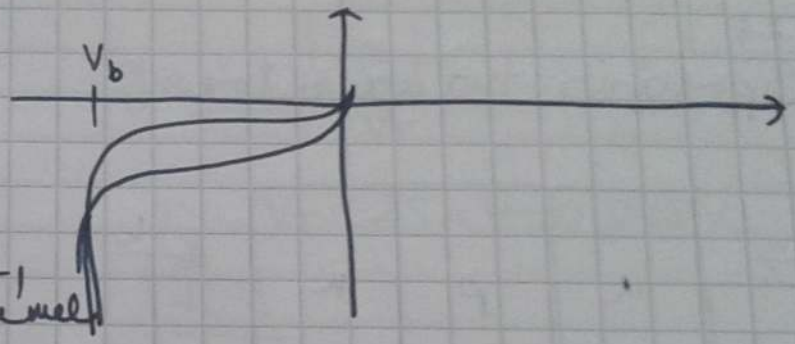
$-100V < V_{D_2} = -50V < 0$ ✓

$\underline{V = 110V}$ $V_{D_1} = -50V$ $V_{D_2} = -60V$

Bode, Fourier, Laplace ← kis ±2

(*) Előző feladat:

$V = 110\ V$-ra



Felt.: D_1 dióda lehörik,
D_2 záró irányba üzemel

$V_{D_1} = -100\ V$

$J = -i_{D_2} = 2\mu A$

Huroktv: $V + V_{D_1} + V_{D_2} = 0$

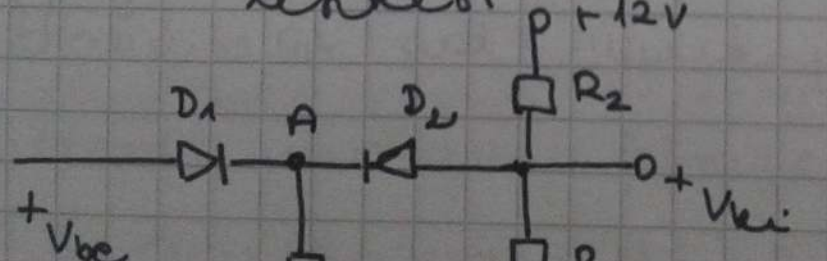
$110 - 100 + V_{D_2} = 0 \Rightarrow V_{D_2} = -10\ V$

Ell.: $V_{D_1} \ll V$ $\quad -V_b < V_{D_2} < 0$

$100V$

lehörési $\quad$ záráti

(3)



$R_1 = R_2 = 3\ k\Omega$

Ell.: $V_{D_1} \ll V_{D_2}$

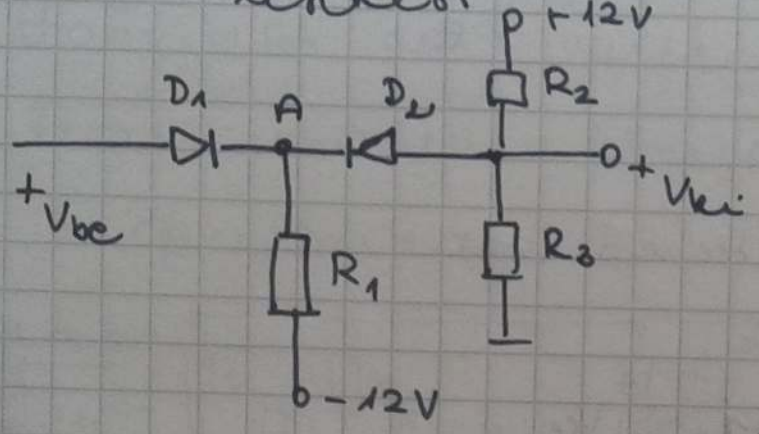
$-V_b < V_{D_2} < 0$

100V

lehúzási

záróirányú

③



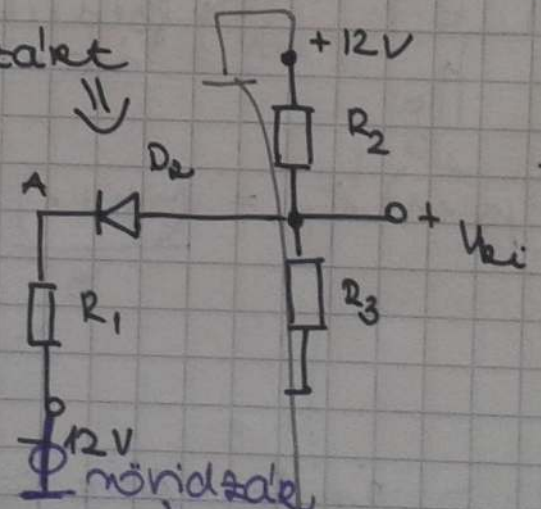
$R_1 = R_2 = 3\,k\Omega$

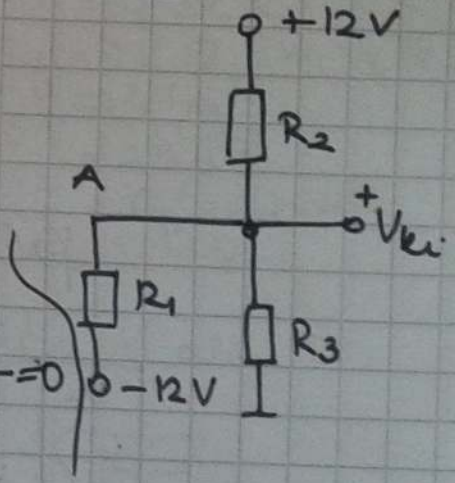
$R_3 = 1{,}5\,k\Omega$

$-4V < V_{be} < 8V$

Átviteli karakterisztika

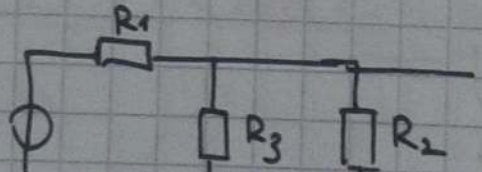
Felt.: D_1 zárt ⇒ D_2 nyitva





Szuperpoz.:

$$V_{ki} = 12 \cdot \frac{R_1 \| R_3}{R_1 \| R_3 + R_2} + (-12) \cdot \frac{R_2 \| R_3}{R_2 \| R_3 + R_1} = 0$$

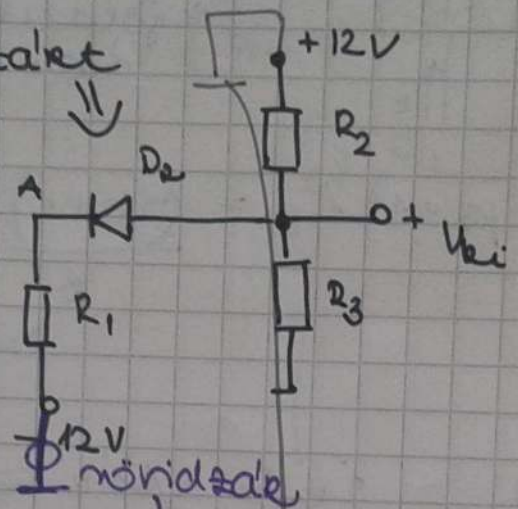


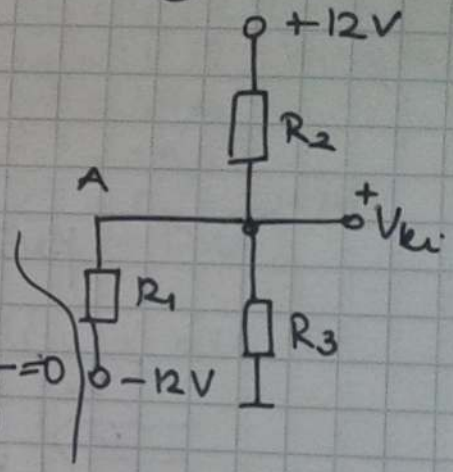
$-4V < V_{be} < 8V$

-12V

Átviteli karakterisztika

Felt.: D_1 zárt ⇒ D_2 nyitva

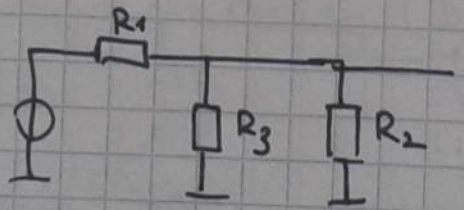




nöridzár

Szuperpoz.:

$$V_{ki} = 12 \cdot \frac{R_1 \| R_3}{R_1 \| R_3 + R_2} + (-12) \cdot \frac{R_2 \| R_3}{R_2 \| R_3 + R_1} = 0$$



$V_A = 0$

D_1 zárva, ha $V_{be} < 0$

D_2 veret