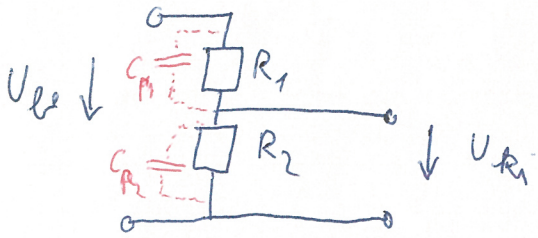
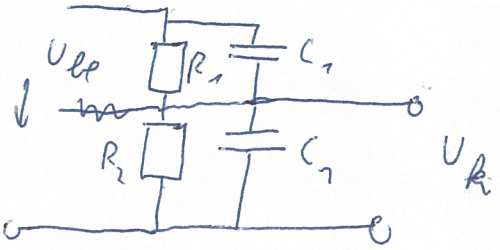
5.3. Kompenzált osztó

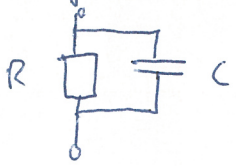



$C_1 \gg C_{P1}$

$C_2 \gg C_{P2}$




RC-tag




$$Z = \frac{R \cdot \frac{1}{sC}}{R + \frac{1}{sC}} = \frac{R}{1 + sRC}$$

osztó átvitele:

$$a = \frac{Z_2}{Z_1 + Z_2} = \frac{\frac{R_2}{1 + sR_2C_2}}{\frac{R_1}{1 + sR_1C_1} + \frac{R_2}{1 + sR_2C_2}} =$$

$R_1C_1 = R_2C_2$

$$= \frac{R_2}{R_1 + R_2}$$ ← eredeti átvitel nagyfrekvencián is!

$$a = \frac{1}{10} \qquad R_2 = 100\ k\Omega \qquad C_2 = 100\ pF$$

$R_1 = ?$ $\qquad C_1 = ?$

$$R_1 = 900\ k\Omega \qquad C_1 = \frac{R_2C_2}{R_1} = \frac{100}{9}\ pF = 11{,}1\ pF$$

Bemeneti impedancia: Z1+Z2

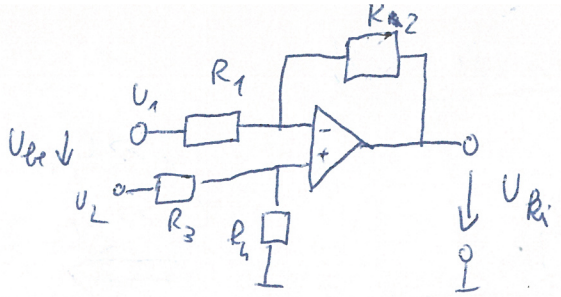
5.20. $R_1 = 1{,}5\,k\Omega$

$R_2 = 150\,k\Omega$

$R_3 = 2{,}8\,k\Omega$

$R_4 = 280\,k\Omega$

$A_s = 100$




$$U_{ki} = -\left(U_1 \cdot \frac{R_2}{R_1} + U_2 \cdot \frac{R_4}{R_3+R_4} \cdot \left(1+\frac{R_2}{R_1}\right)\right)$$

$$U_{ki,c} = -U_c \cdot \frac{R_2}{R_1} + U_c \cdot \frac{R_4}{R_3+R_4} \cdot \left(1+\frac{R_2}{R_1}\right)$$

$$U_1 = U_c + \frac{U_s}{2} \qquad U_2 = U_c - \frac{U_s}{2}$$

$$A_{ac} = \frac{U_{ki,c}}{U_c} = -\frac{R_2}{R_1} + \frac{R_4}{R_3+R_4}\left(1+\frac{R_2}{R_1}\right) = \frac{-R_2R_3 - R_2R_4 + R_1R_4 + R_2R_4}{R_1(R_3+R_4)}$$

$$= \frac{R_1R_4 - R_2R_3}{R_1(R_3+R_4)}$$

$R_1R_4 \approx R_2R_3$

$$A_c \cong \frac{R_1R_4(1+k)^2 - R_2R_3(1-k)^2}{R_1(R_3+R_4)} \cong \frac{R_4}{R_3+R_4} \cdot 4k$$

$$U_{ki,s} = -\frac{U_s}{2}\cdot\frac{R_2}{R_1} - \frac{U_s}{2}\cdot\frac{R_4}{R_3+R_4}\cdot\left(1+\frac{R_2}{R_1}\right)$$

$$A_s = -\frac{1}{2}\cdot\frac{R_2R_3 + R_2R_4 + R_1R_4 + R_2R_4}{R_1(R_3+R_4)} \approx -\frac{1}{2}\cdot\frac{2R_2R_4}{R_1\cdot R_4} = -\frac{R_2}{R_1}$$

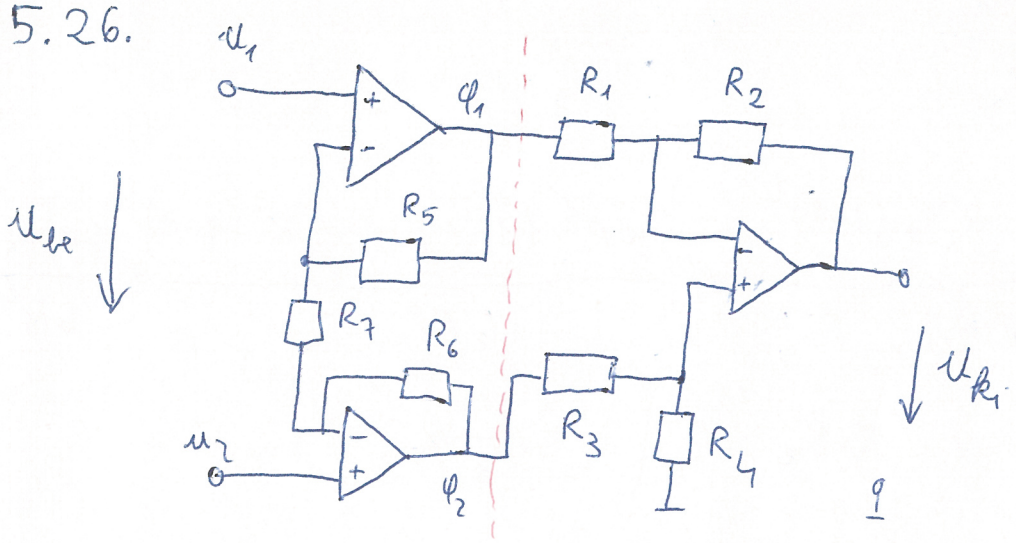
$R_2R_4 \gg R_2R_3 \approx R_1R_4$

$R_4 \gg R_3$

$$-\frac{1}{2}\cdot\frac{R_2(R_3+R_4)+2R_2R_4}{R_1(R_3+R_4)} \approx -\frac{1}{2}\cdot\frac{2R_2(R_3+R_4)}{R_1(R_3+R_4)} = -\frac{R_2}{R_1}$$

$$E_{w.c} = \frac{|A_c|}{|A_s|} = \frac{R_2}{R_1}\cdot\frac{R_3+R_4}{R_4\cdot 4k} = 12625 \cong 82\,dB$$

5.26.




1-es fokozat  2-es fokozat

4db 25 kΩ
2db 5 kΩ
1db 5,55 kΩ

$A_S \overset{!}{=} 50$

② Differenciálerősítő $\Rightarrow$ $A_{c,2} = \dfrac{R_1 R_4 - R_2 R_3}{R_1 (R_3 + R_4)}$

$A_{s,2} \simeq -\dfrac{R_2}{R_1}$

$R_1 R_4 \overset{!}{=} R_2 R_3$

①

$$\varphi_1 = u_1 \cdot \left(1 + \frac{R_5}{R_7}\right) - u_2 \cdot \frac{R_5}{R_7}$$

$$\varphi_2 = u_2 \left(1 + \frac{R_6}{R_7}\right) - u_1 \left(R_6/R_7\right)$$

$$\varphi_{1,c} = u_c \left(1 + \frac{R_5}{R_7}\right) - u_c \frac{R_5}{R_7} = u_c \Big\} A_{c,1} = 1$$

$$\varphi_{2,c} = u_c$$

$$\varphi_{1,s} = \frac{u_s}{2} \cdot \left(1 + \frac{R_5}{R_7}\right) + \frac{u_s}{2} \cdot \frac{R_5}{R_7} = \frac{u_s}{2}\left(1 + 2\frac{R_5}{R_7}\right)$$

$$\varphi_{2,s} = -\frac{u_s}{2}\left(1 + 2\frac{R_6}{R_7}\right)$$

$\Big\}$ $\dfrac{R_5}{R_7} = \dfrac{R_6}{R_7}$ legyen

$\Downarrow$

$R_5 = R_6$

$R_1 = R_3 = 5\ k\Omega \quad R_2 = R_4 = R_5 = R_6 = 25\ k\Omega \quad R_7 = 5{,}55\ k\Omega$

$$A_S = -\frac{R_2}{R_1}\left(1 + 2\frac{R_5}{R_7}\right) = -50{,}045 \Rightarrow k_r = 0{,}09\%$$

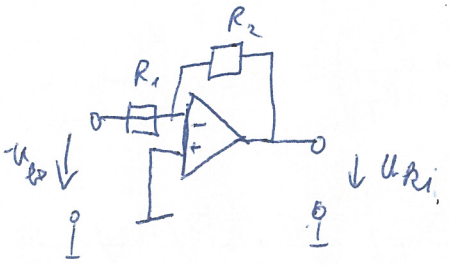
$$A_c = A_{c12} = \frac{R_1 R_4 - R_2 R_3}{R_1 (R_3 + R_4)} \qquad R_1' = 1 \pm h$$

$$A_{c,wc} \cong \frac{R_1 R_4 (1+h)^2 - R_2 R_3 (1-h)^2}{R_1 (R_3 + R_4)} = \frac{5R^2 (1+h)^2 - 5R^2 (1-h)^2}{6R^2} \cong \frac{5R^2 4h}{6R^2} =$$

$$R_1 = R_3 = R \quad R_2 = R_4 = 5R \qquad = \frac{10}{3} h$$

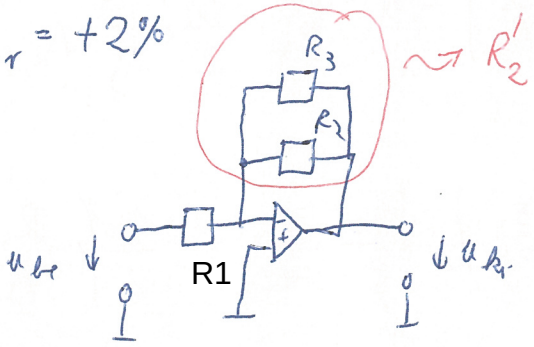
$$E = \frac{|A_s|}{|A_c|} = \frac{|A_s|}{|A_c|} = \frac{-\frac{R_2}{R_1}\left(1 + 2\frac{R_5}{R_7}\right)}{\frac{10}{3} h} = 75000 = 97{,}5\,dB$$

5.16 $A \overset{!}{=} -5$ $R_1 = 1\,k\Omega$ $R_2 = 5{,}1\,k\Omega$




-0.1 +2%

$$A = -\frac{R_2}{R_1} = -5{,}1 \qquad h_r = +2\%$$




b) $R_3 = 270\,k\Omega$

$$R_2' = R_2 \times R_3 = 5{,}0055\,k\Omega$$

$$A' = -5{,}0055 \qquad h_r' = +0{,}11\%$$

$$R_2' = \frac{R_2 R_3}{R_2 + R_3}$$

$$\frac{\partial R_2'}{R_2} = \frac{R_3}{R_2 + R_3} - \frac{R_2 R_3}{(R_2 + R_3)^2} = \frac{R_3^2}{(R_2 + R_3)^2}$$

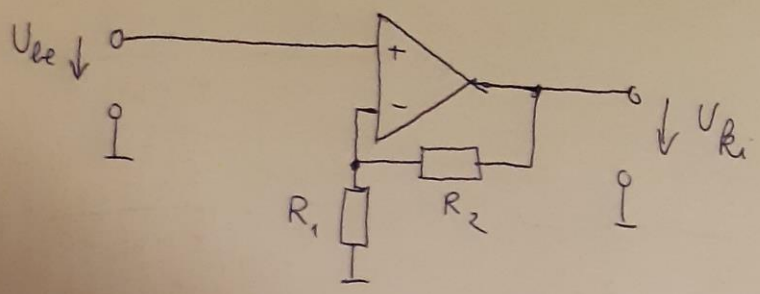
$$\left.\frac{\Delta R_2'}{R_2'}\right|_{R_1} = \frac{\frac{R_3^2}{(R_2+R_3)^2} \cdot R_2}{\frac{R_2 R_3}{R_2 + R_3}} \cdot \frac{\Delta R_2}{R_2} = \frac{R_3}{R_2 + R_3} \cdot \frac{\Delta R_2}{R_2}$$

R1 = $h_1 = 0{,}1\%$
$h_2 = 0{,}1\%$
$h_3 = 5\%$

A' = -R2' / R1= -(R2xR3)/R1

$$\left.\frac{\Delta A'}{A'}\right|_{w.c} = h_r' + \frac{\Delta R_1}{R_1} + \frac{\Delta R_2'}{R_2'} = h_r' + \frac{\Delta R_1}{R_1} + \frac{R_3}{R_2 + R_3} \frac{\Delta R_2}{R_2} + \frac{R_2}{R_2 + R_3} \cdot \frac{\Delta R_3}{R_3} = 0{,}4\%$$

5.17




$R_1 = 1\,k\Omega$
$R_2 = 9.1\,k\Omega$

$A_m = 1 + \frac{R_2}{R_1} = 10{,}1$

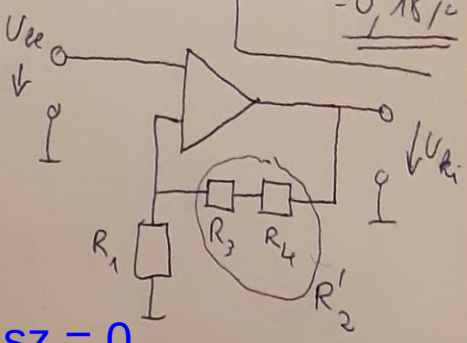
$A_V \doteq 10$ → $h_r = +1\%$

$R_3 = 6{,}8\,k\Omega \quad R_4 = 2{,}2\,k\Omega$

$R_2' = R_3 + R_4$

$R_2' = 9\,k\Omega$

$A_m = 1 + \frac{R_2'}{R_1} = 10$ $\quad h_r = 0$

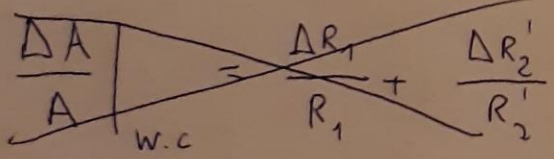



h_rendsz = 0

$h_V = 0{,}1\%$

$$\frac{\Delta A}{A}\bigg|_{W.C} = \frac{R_2 + R_4}{R_1 + R_3 + R_4} \cdot h_r + \frac{R_3}{R_1 + R_3 + R_4} \cdot h_V + \frac{R_4}{R_1 + R_3 + R_4} h_V = \frac{2(R_3 + R_4)}{R_1 + R_3 + R_4} \cdot h_V$$

$\frac{2{,}9\,k\Omega}{10\,k\Omega} \cdot 0{,}1\% = 0{,}18\%$




$$A = 1 + \frac{R_2'}{R_1} = 1 + \frac{R_3 + R_4}{R_1} = \frac{R_1 + R_3 + R_4}{R_1}$$

$$\frac{\partial A}{\partial R_1} = -\frac{R_3 + R_4}{R_1^2} \qquad \frac{\Delta A}{A}\bigg|_{R_1} = \frac{-\frac{R_3 + R_4}{R_1^2} \cdot R_1}{\frac{R_1 + R_3 + R_4}{R_1}} \cdot \frac{\Delta R_1}{R_1} = \frac{R_3 + R_4}{R_1 + R_3 + R_4} \cdot \frac{\Delta R_1}{R_1}$$

$$\frac{\partial A}{\partial R_3} = \frac{1}{R_1} \qquad \frac{\Delta A}{A}\bigg|_{R_3} = \frac{\frac{1}{R_1} \cdot R_3}{\frac{R_1 + R_3 + R_4}{R_1}} \cdot \frac{\Delta R_3}{R_3} = \frac{R_3}{R_1 + R_3 + R_4} \cdot \frac{\Delta R_3}{R_3}$$

$$\frac{\partial A}{\partial R_4} = \frac{1}{R_1} \qquad \frac{\Delta A}{A}\bigg|_{R_4} = \frac{\frac{1}{R_1} \cdot R_4}{\frac{R_1 + R_3 + R_4}{R_1}} \cdot \frac{\Delta R_4}{R_4} = \frac{R_4}{R_1 + R_3 + R_4} \cdot \frac{\Delta R_4}{R_4}$$