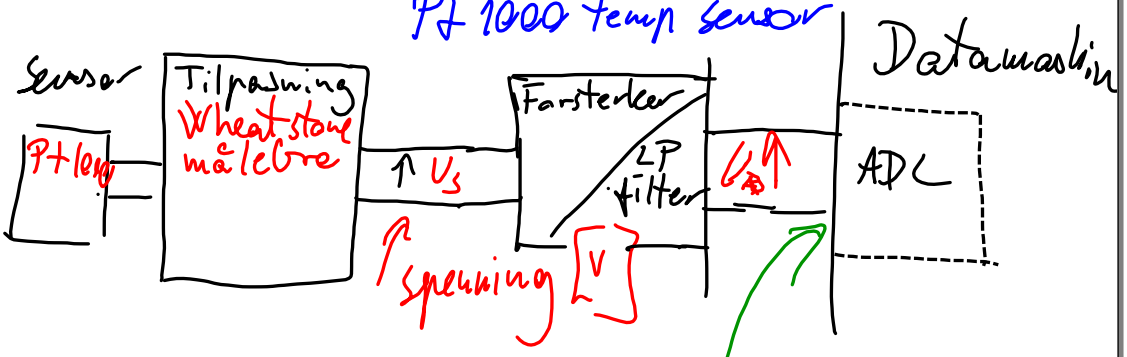
Et balansert målesystem

Temperatur måler

Pt 1000 temp sensor

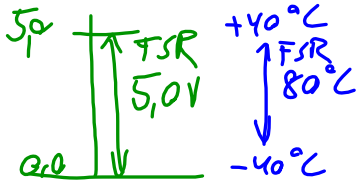


Bestemme temp område

$-40{,}0\,^\circ C \rightarrow +40{,}0\,^\circ C$

0,0 [V] → 5,0 [V]

Hvor mange bit bør ADC ha?



→ 8 bit : FSR : 5,0V

$$1LSB = \frac{FSR}{2^n - 1} = \frac{5{,}0[V]}{2^8 - 1} = 0{,}019[V]$$

$$1LSB = \frac{80\,^\circ C}{2^8 - 1} = 0{,}31\,^\circ C$$

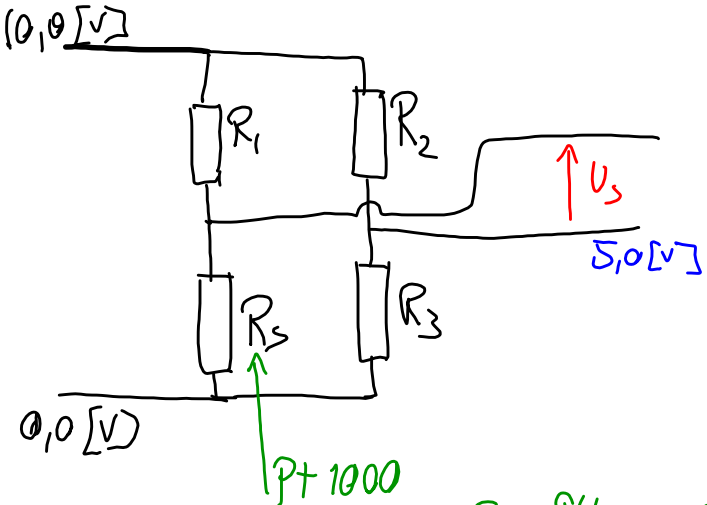
Kvantiseringsfeil $\pm \frac{1}{2} LSB$

$$\frac{0{,}31}{2} = 0{,}15 \Rightarrow \pm 0{,}15\,^\circ C$$

LP-filter:

Grensefrekvens: 100 Hz ← $f_g > 10 \cdot f_s$

Hva er høyeste frekvens i temp-signalet $f_s = 10$ Hz



$-40{,}0°C \Rightarrow R_S = 842{,}70\,\Omega$

$+40{,}0°C \Rightarrow R_S = 1155{,}40\,\Omega$

$U_S = 0{,}0\,[V]$ ved $-40{,}0°C$

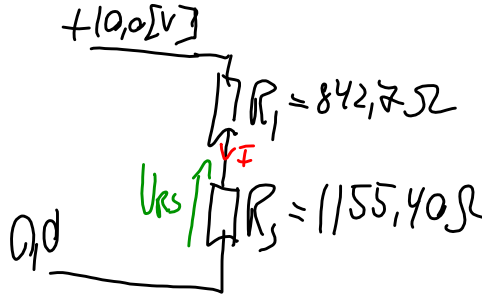
Da må $R_1 = R_S = 842{,}70\,\Omega$

↑ ved $-40°C$

$R_3 = R_4$ for at ref spenning er 5,0[V]

$R_3 // R_4 \simeq R_1 // R_S$ $\quad R_3 = R_4 = 842{,}70\,\Omega$

Hva er U_S ved $+40{,}0°C$?



$U_{RS} = I \cdot R_S$

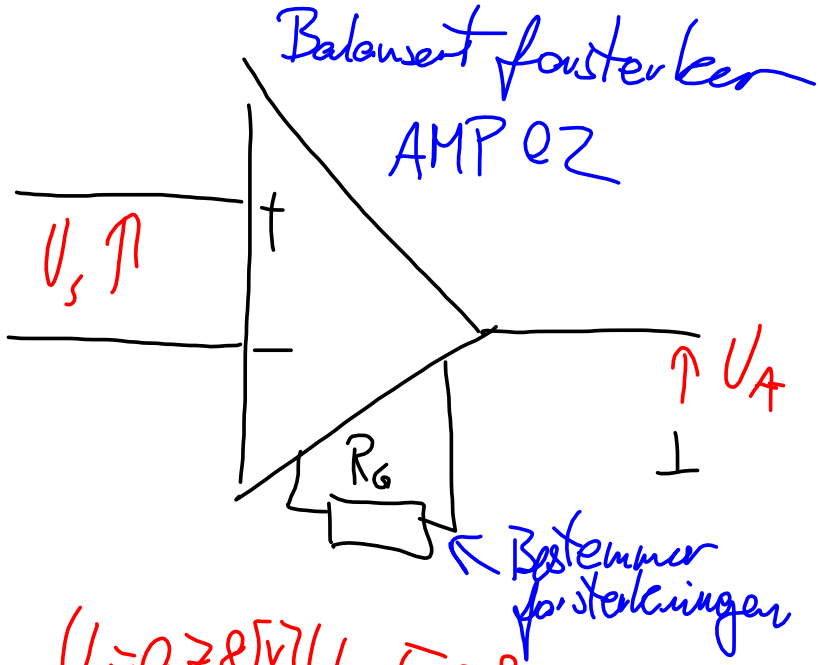
$U_{RS} = \frac{10{,}0\,V}{R_1 + R_S} \cdot R_S$

$$U_{RS} = \frac{10{,}0\,[V] \cdot 1155{,}40}{842{,}70 + 1155{,}40} = 5{,}78\,[V]$$

$U_S = U_{RS} - 5{,}0\,[V] = 5{,}78 - 5{,}0 = 0{,}78\,[V]$

$U_S = 0{,}0\,[V]$ $-40{,}0°$ $\quad U_S = 0{,}78\,[V]$ $+40°C$

Vi må bestemme forsterkningen i forsterkeren



$U_s = 0{,}78\,[V]$ $U_A = 5{,}0\,[V]$

$U_s = 0{,}0\,[V]$ $U_A = 0{,}0\,[V]$

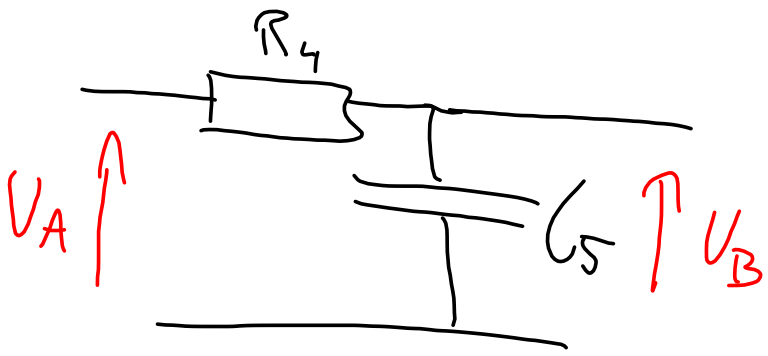
$0{,}78 \cdot G = 5{,}0$

$G = \frac{5{,}0}{0{,}78} = 6{,}4\,[ggr] = \frac{50K\Omega}{R_G} + 1$

$6{,}4 - 1 = \frac{50K}{R_G} = 5{,}4$

$R_G = \frac{50K}{5{,}4} = 9{,}3\,K\Omega$

LP-filter



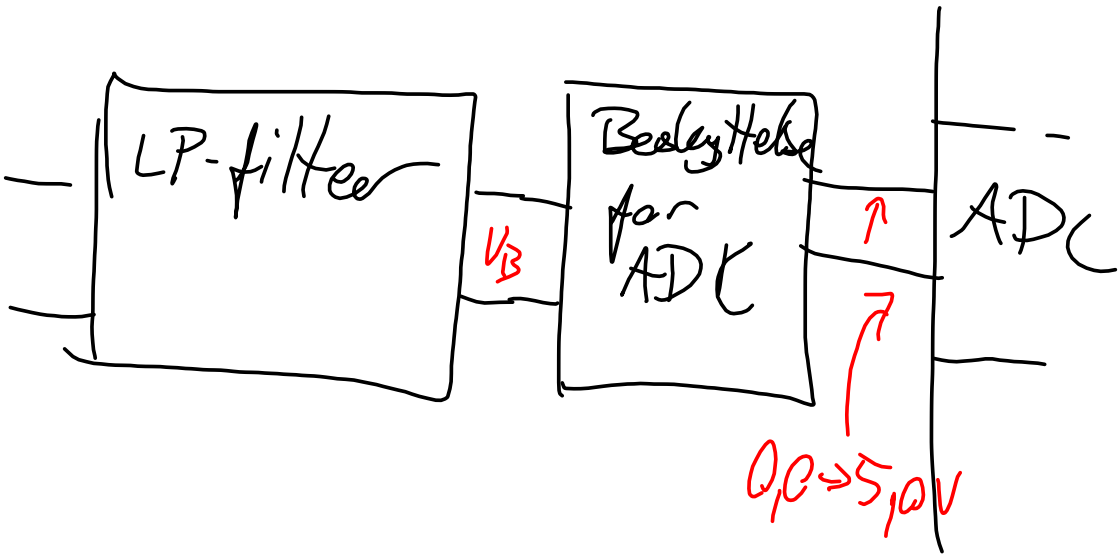
$$f_G = \frac{1}{2\pi R_4 C_5} = 100\ [Hz]$$

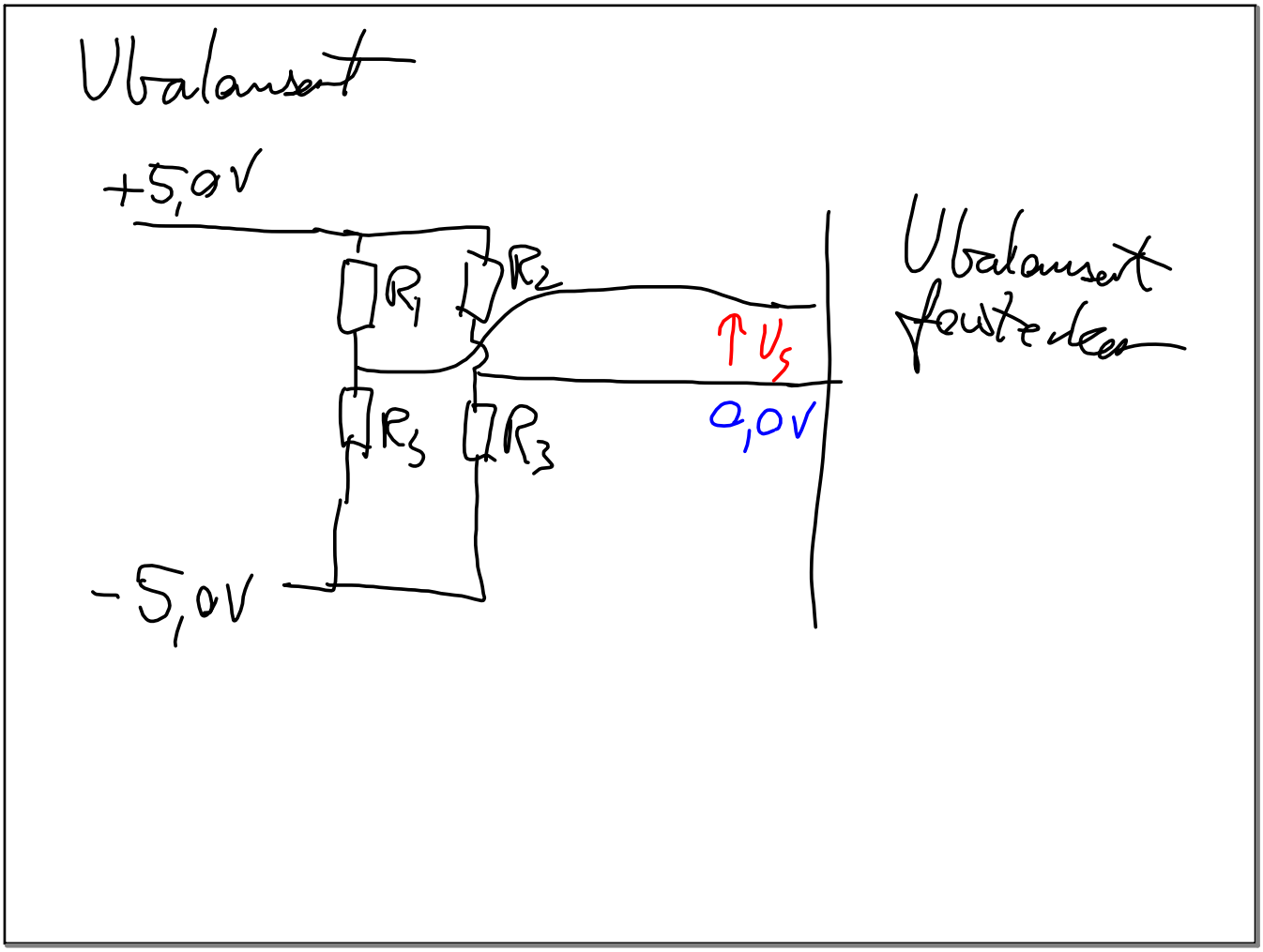
↑ Velger

$$R_4 = \frac{1}{2\pi \cdot 100 \cdot C_5} = \frac{1}{2\pi \cdot 100 \cdot 220 \cdot 10^{-9}}$$

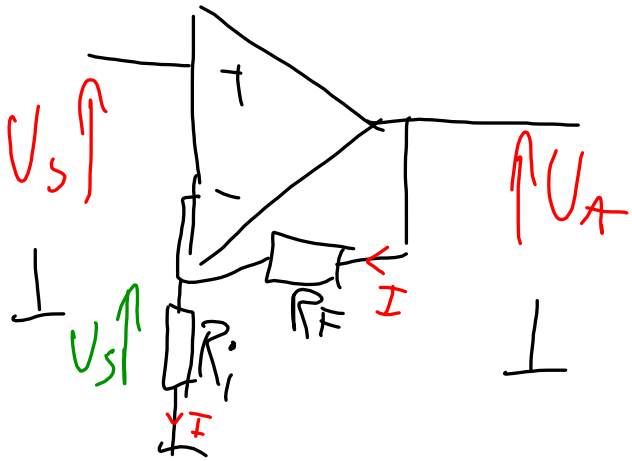
↑ f_G ↑ $220\ nF$

$$\approx 7234\ \Omega$$




Ubalansert
+5,0V
R1
R2
R4
R3
-5,0V
↑ Us
0,0V
Ubalansert
forsterker

Ubalansert Forsterker



Forsterkning på 6,4

$$\left(\frac{U_A}{R_F + R_1}\right) \cdot R_1 = U_s$$

I

$$\frac{U_A}{U_s} = \frac{R_F + R_1}{R_1} = 1 + \frac{R_F}{R_1} = 6{,}4$$

$$\frac{R_F}{R_1} = 6{,}4 - 1 = 5{,}4$$

$$R_F = 5{,}4 \cdot R_1$$

Velger 1,2K

$$= 5{,}4 \cdot 1{,}2K = 6{,}5K\Omega$$