UCLouvain

epl

[Report #MP3 – the music codec]

GROUP #1

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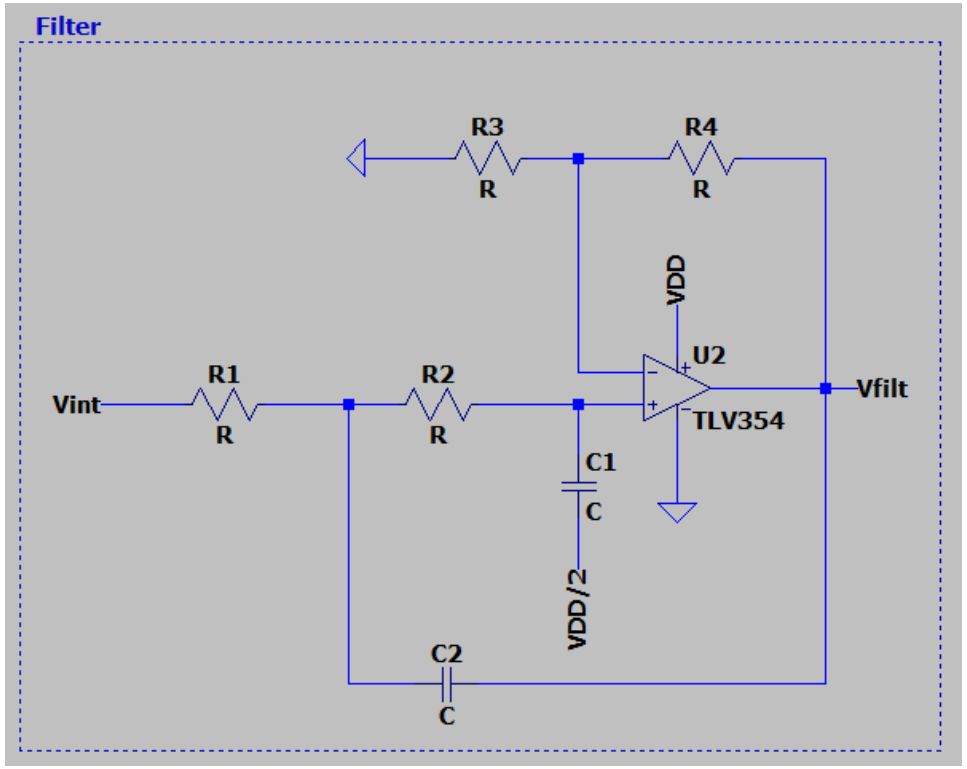
Analog filter: selection and sizing

Provide the schematics of the filter

Sallen and key second order filter where we suppose R=R1=R2=R3,C=C1=C2



Provide the values of the components

We first choose R1=100kΩ because the cut-off frequency desired is 40 hz with fc=1/2piRC so we need a large R to have an acceptable C=39.79nF, despite the bigger thermal noise this Large value of resistance will induce.

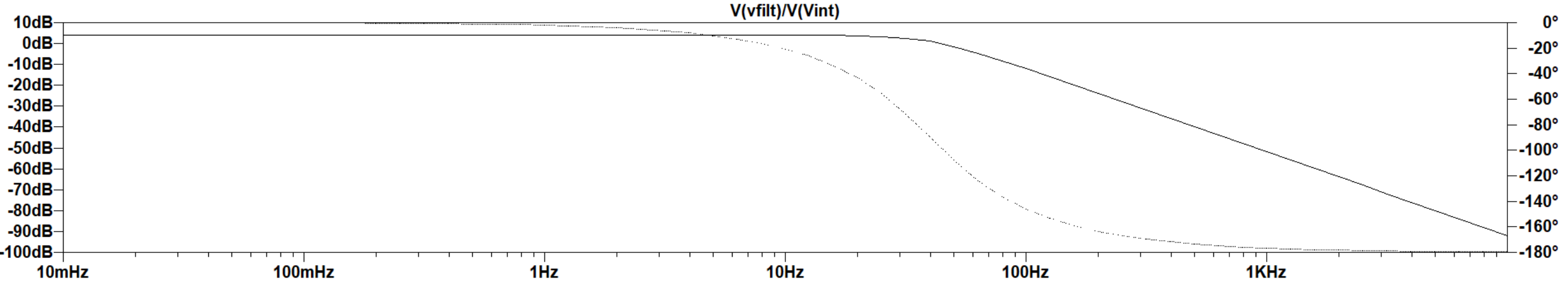
The we choose the value of R4 with the following formula

$$K = 1 + \frac{R4}{R3} \qquad Q = \frac{1}{3 - K}$$

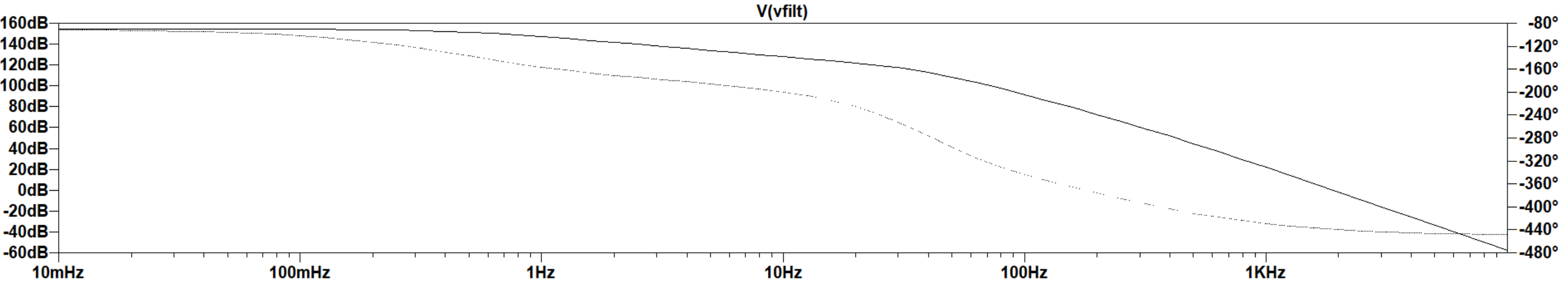
We found, for Q=0.707(to avoid overshoot response) , R4=58kΩ

Simulation

Simulate the filter frequency response using LTSpice:



Simulate the whole instrumentation chain using LTSpice:



Whole chain noise analysis (1/2)

Evaluate the impact of each noise source on the performance of the whole chain.

- Use the final expression of the noise analysis document Part 1 for the charge amplifier block.

- Consider only the noise of the TLV354 for the filter block (do not account for noise coming from the resistors).

Bring back the noise reference of the enter of the filter for the output noise filter (only TLV354 noise considered)

Voltage:

From datasheet: Low Noise: 7.5 nV/$\sqrt{Hz}$, with a band from 0.5 to 40 Hz.

Gain is 4dB. We find voltage_noise_input_filter=187 nV

Current:

From datasheet:

i_n	Current noise density	f = 1 MHz	50	fA/$\sqrt{Hz}$

We find current_noise_input_filter=1.25pA

Bring back at the input in Coulombs by dividing these value by the charge amplifier gain (30dB) : IRN_filter=5.91 nC

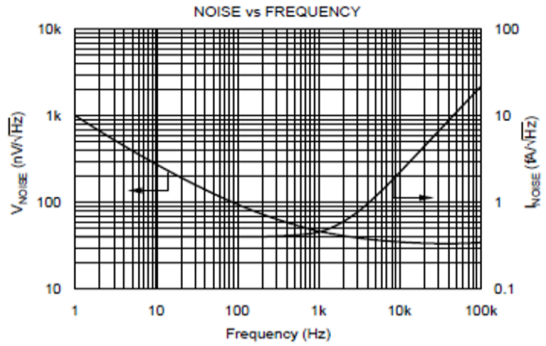
Then we compute the value flicker noise constant for the voltage noise of the charge amplifier from the datasheet (neglect the thermal one car small in our band)

We find K_fa=1.99*10^-14 V^2

For the current in the band of interest, we have I^2_charge amplifier=5.06 10^-29 A^2

For the given formula, we got an IRN_amplifier=6.04 10^-12 V^2 , and so 2.45 µC

The total IRN is so 2.455 µC



Whole chain noise analysis (2/2)

Give the equivalent charge noise of each block of the chain and evaluate their impact.

See previous slide (no impact of the filter)