

CYCLE INITIAL EN TECHNOLOGIES DE L'INFORMATION DE SAINT-ÉTIENNE

2nd ORDER ACTIVE FILTER TOPOLOGY

REPORT TP ELEN2 2022



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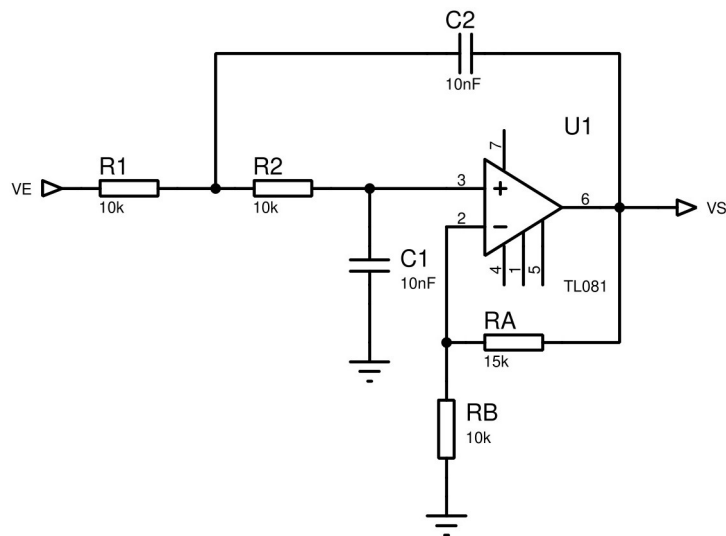
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Abstract

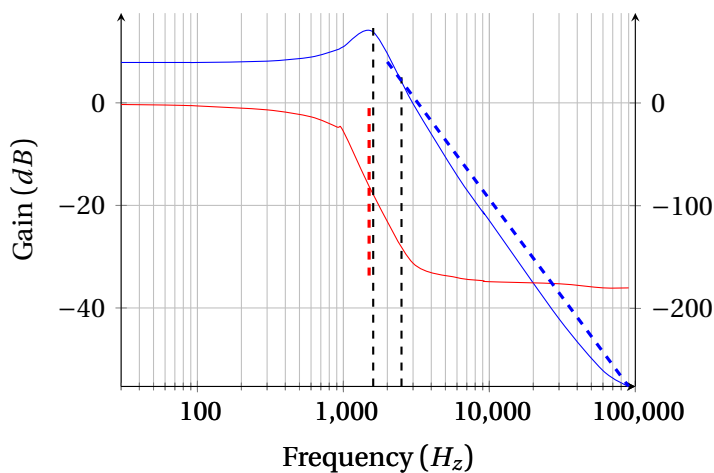
The goal of this report is to introduce ourselves to different second order active filter topologies. In this case we'll be studying the Sallen-Key and Multiple Feedback filters in an effort to understand and manipulate the effects of damping and resonance on these kinds of filters.

Sallen-Key Low-Pass Filter



Salle-Key Low-Pass Filter

Study in sinusoidal regime

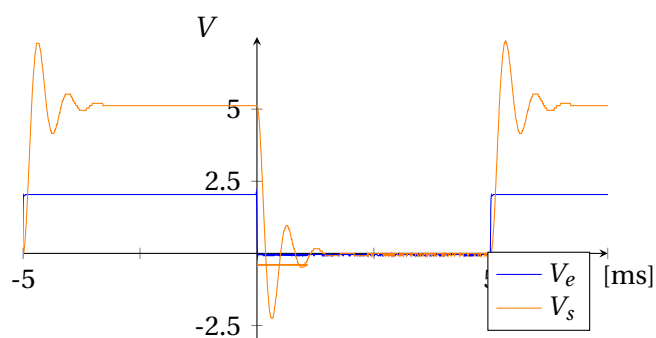


Using the formulas provided in the preparation of the experiment we quickly calculate the damping coefficient $m = 0.25$ as well as the constant gain factor $K = 2.5$

Judging by the Bode diagram we can accurately measure a cut-off frequency at about 2500 Hz as well as a resonance frequency at 1600 Hz which maxes out at the curve's maximal gain 17.5 dB , as well as a -40 dB/dec slope.

On this non-unity-gain filter we notice that due to the damping factor being inferior to 1 a peak of high gain manifests itself highlighting the resonance which can later be used for signal processing.

Study in impulsive regime

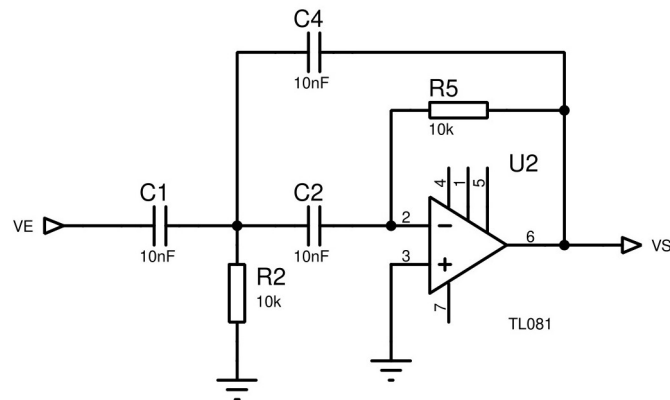


Chronograms of V_s and V_e

To study the signal response we'll be choosing a frequency of 100 Hz allowing us to clearly see the damped oscillations as the frequency goes below the resonance.

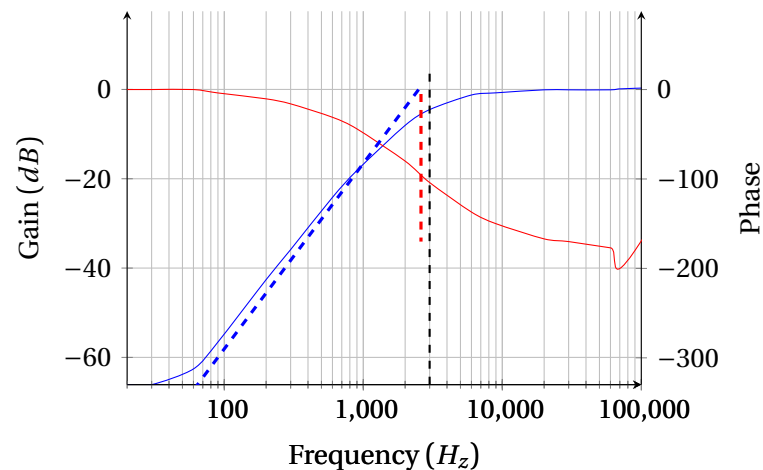
This being done we can then measure the rise at about $124 \mu\text{s}$, which can be considered slow. However the observed values correspond to our expectations since the damping coefficient remains lesser than 1, responsible for the damped oscillations.

Multiple Feedback High-Pass Filter



Multiple Feedback High-Pass Filter

Study in sinusoidal regime



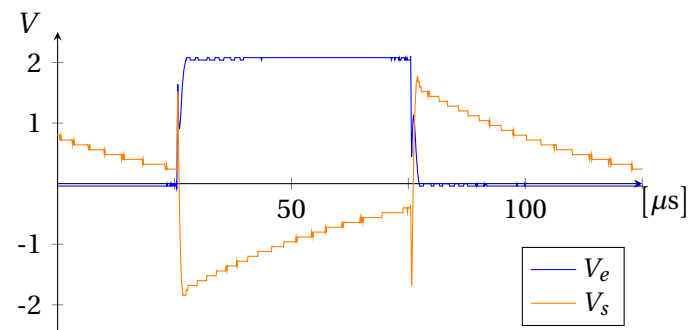
Using the formulas provided in the preparation of the experiment we quickly calculate the damping coefficient $m = 1$ as well as the cut-off frequency at $f_0 = 2321 \text{ Hz}$

Judging by the Bode diagram we can accurately measure a cut-off frequency at about 2500 Hz from which point rearwards the gain slope is at 40 dB/dec . All of which correspond to the expected values. Unlike last study, the damping coefficient is equal to 1 therefore the cut-off frequency is much clear and no resonance is expected.

We can notice a second higher cut-off frequency at about 1300 Hz this is due to the limitation of the

operational amplifier which can no longer properly process the rapid input changes.

Study in impulsive regime



Chronograms of V_s and V_e

To study the signal response we'll be choosing a frequency of 10 KHz allowing us to clearly see the exponential decay as the frequency goes above cut-off.

This being done we can then measure the rise at about 707 ns .

The observed values correspond to our expectations since the damping coefficient remains equal to 1, responsible for the exponential decay curve.