Exercise 3: SC Circuit

Purpose of the lecture is to get familiar with:

- SC circuits,
- Analysis of SC amplifier
- Analysis and comparison between SC and CT integrators

Exercise 1: **Low pass filter and its SC circuit analysis.**

Design a low pass passive first order filter with f_c=1kHz and write a transfer function H (s). Same structure must be realized in discrete z-domain (resistor must be replaced with SC circuit) where transfer function H(z) must be plotted and compared with continuous time H (s) transfer function. Draw the SC schematic. Use freqs() and freqz functions.

Draw low pass filter and its corresponding SC schematic

Exercise 2: **Analysis of inverting and non-inverting SC amplifier**

Determine transfer function of the circuits in the Figure 1 and 2. Capacitors must be calculated from the switching frequency Fs=1 MHz and its value should not exceed 1 pF. The gain at low frequencies is 40 dB. The characteristics of the opamp and the switches are ideal.

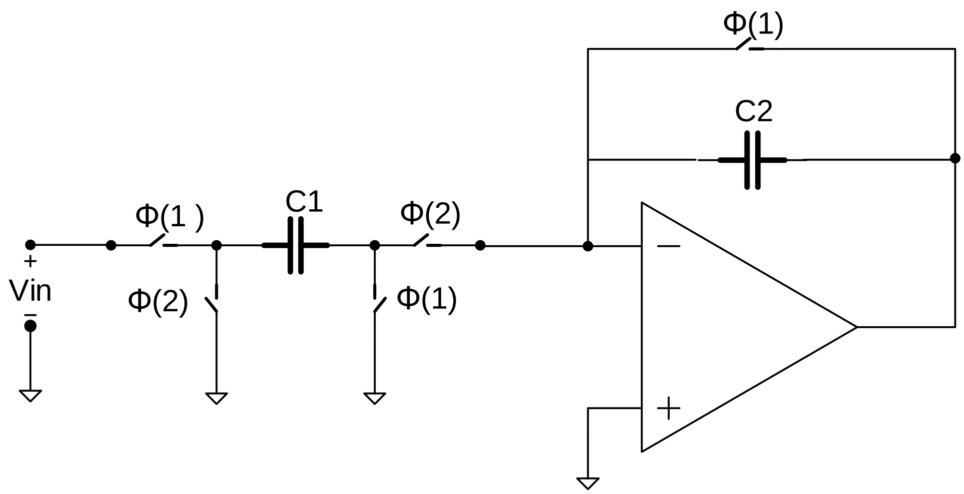

Figure 1: Non-inverting SC amplifier.

$H(z) =$

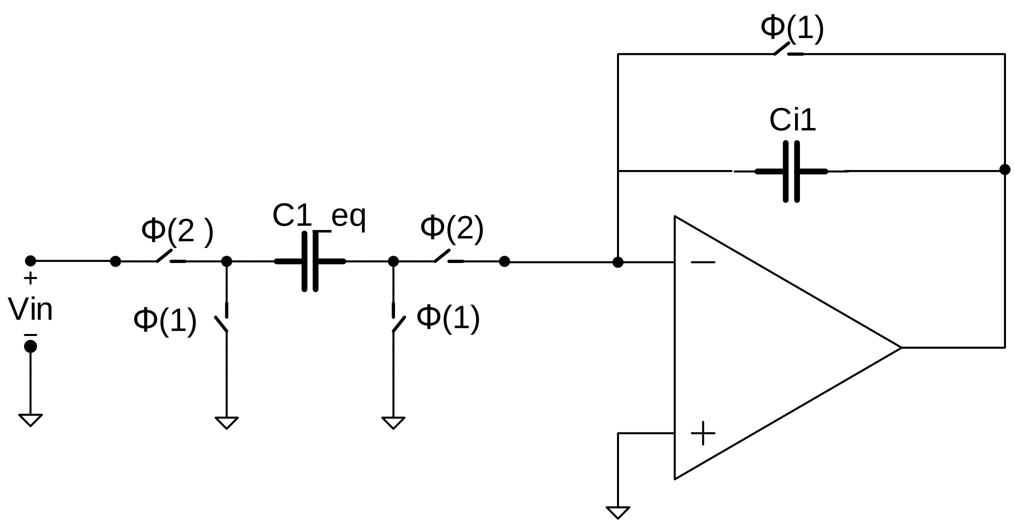

Figure 2: Inverting SC amplifier.

$H(z) =$

<u>Exercise 3</u>: **<u>Comparison of CT and SC integrators</u>**

Calculate transfer function of the integrator in Figure 3. Determine the value of R1, Rf and Cf in a way, to achieve low frequency gain of A_{DC}=10 with corner frequency f_c=1 kHz. Realize SC integrator and replace R1 and R_f with circuit shown in the Figure 4. For proper inverting operation, it is essential to pay attention to the phases on each switch driven with 1 MHz. Prepare .m file to analyse and compare CT and SC transfer functions. Use freqs() and freqz() functions.

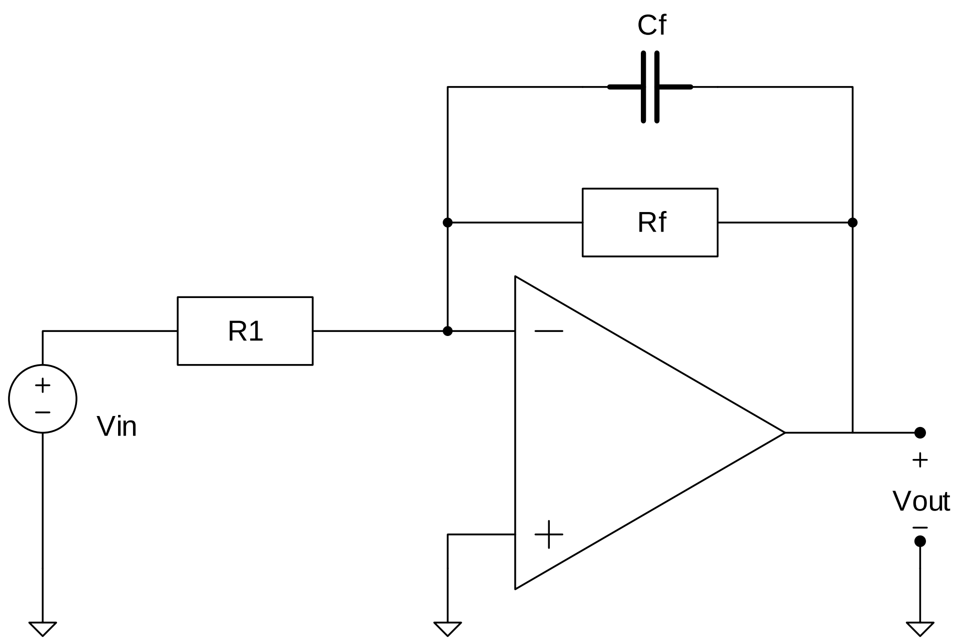

Figure 3: CT integrator.

a) Transfer function of CT integrator (Figure 3)

$$H(s) = \frac{V_{out}}{V_{in}} =$$

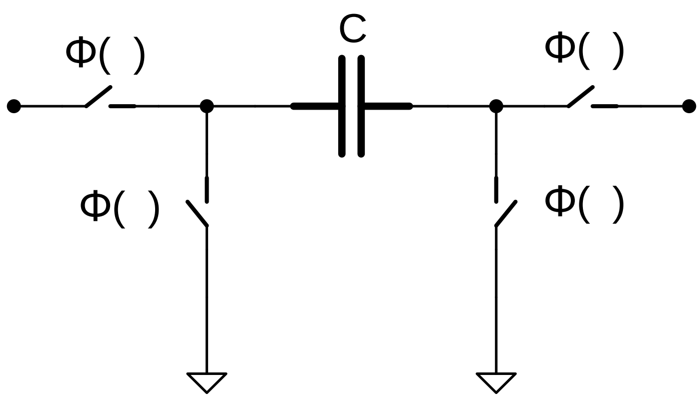

Figure 4: SC realization of resistor.

b) Transfer function of SC integrator (Figure 3)

$$H(z) = \frac{V_{out}}{V_{in}} =$$