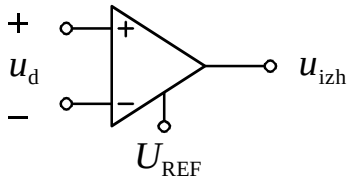
ANALOG ELECTRONIC CIRCUITS
Laboratory work

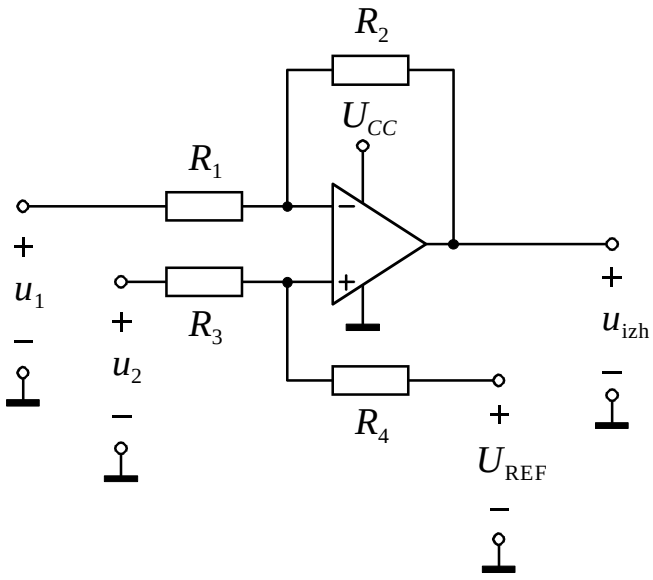
Exercise 7 – Differential amplifier

Task:

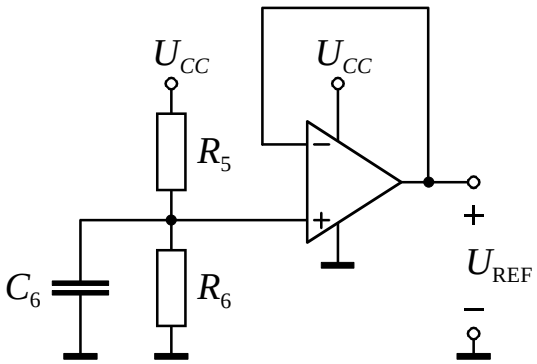
- Design and construct differential amplifier with transfer function $u_{izh} - U_{REF} = A_d \cdot u_d$.



- Use a single power supply U_{CC} = 20 V and operational amplifier of type 741 and the proposed topology. Differential voltage amplification should be set to A_d = 20; ($u_d = u_2 - u_1$).



- Use the proposed circuit to generate reference voltage U_{REF} = 5 V.



Calculation of component value:

Component values:

R_1 =

R_2 =

R_3 =

R_4 =

R_5 =

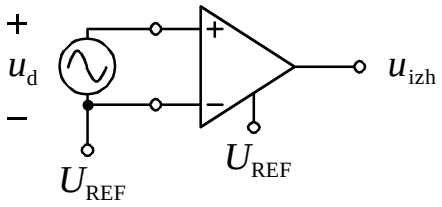
R_6 =

C_6 =

Amplification measurements:

- Measure differential-mode amplification
  $A_d = u_{izh} / u_d$ (u_d: sine signal, U_0 = 100 mV, f = 10kHz).
- Measure common-mode amplification $A_s = u_{izh} / u_s$ (u_s: sine signal, U_0 = 1 V, f = 10kHz).
- While measuring A_d and A_s observe the alternating component of the input and output signal. Reference potential for the measurement of u_{izh} is U_{REF} and not GND!
- Obtain CMRR

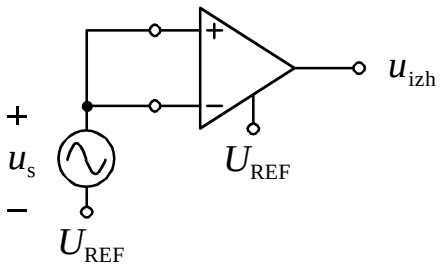
<u>Differential-mode amplification</u>:



$A_d = u_{izh} / u_d$ =

A_d = A_d = dB

<u>Common-mode amplification</u>:



$A_s = u_{izh} / u_s$ =

A_s = A_s = dB

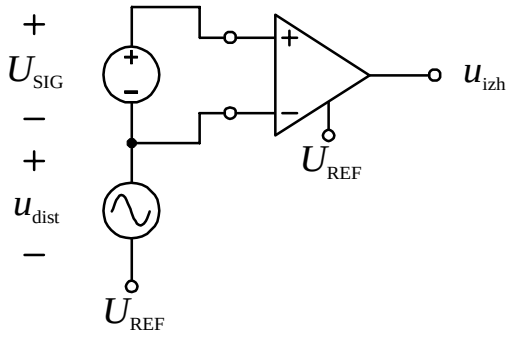
<u>CMRR</u>:

CMRR = A_d / A_s =

CMRR = CMRR = dB

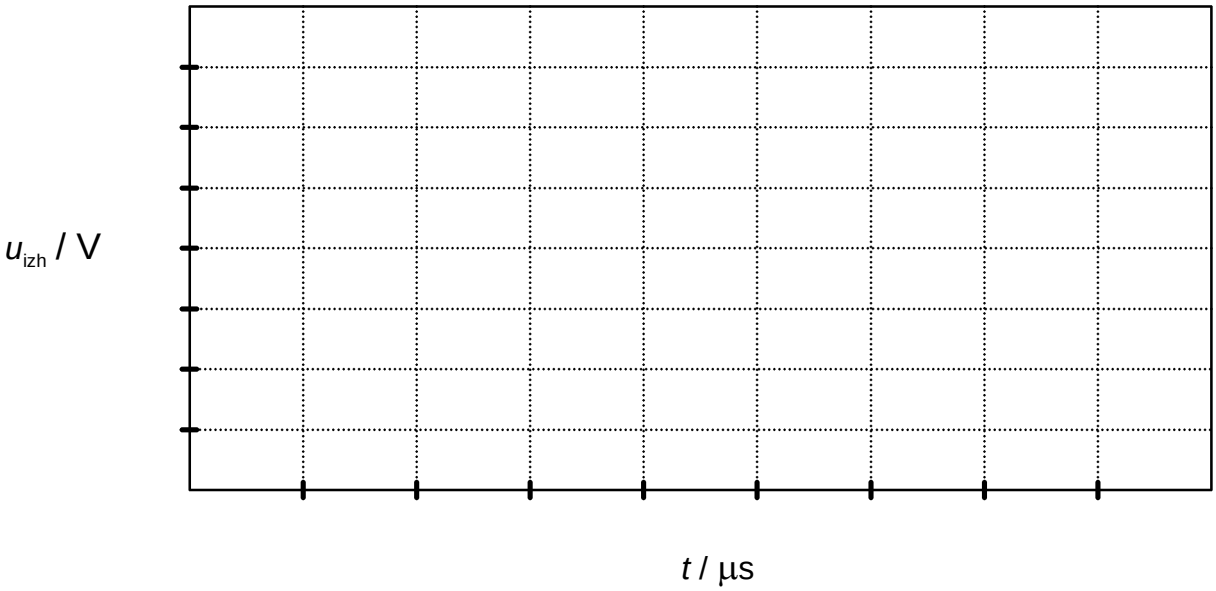
Gain measurements of a real signal:

Real excitation of the amplifier will be simulated by using a DC power source U_{SIG}, which represents a useful signal, and function generator u_{dist}, which represents common-mode disturbance (see figure below).



<u>Measurement 1</u>:

Set the voltage of useful signal to U_{SIG} = 20 mV. Disturbance signal u_{dist} should be represented as a sine signal with frequency of 10 kHz. Change the amplitude of the disturbance signal from 0 V to 3 V in steps of 1 V. Draw all four waveforms of the output signal to the graph.

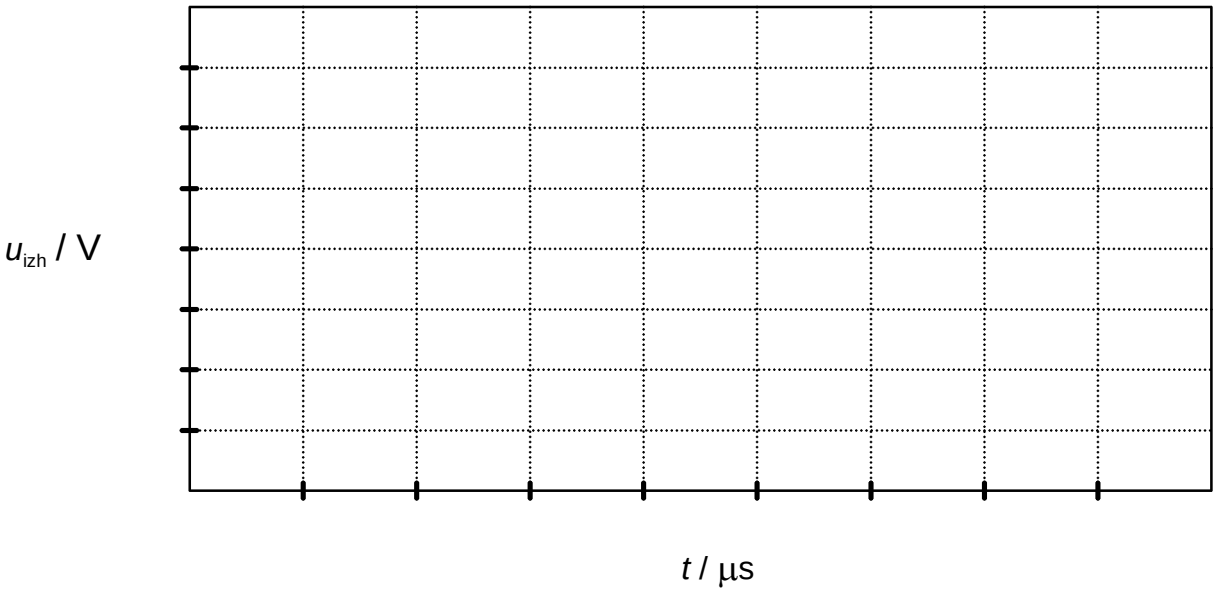


- Increase the amplitude of the disturbance u_{dist} and find out at which value the amplifier stops working properly. What happens in the circuit at that value?

$U_{dist\ max}$ =

Measurement 2:

Set the amplitude of sine disturbance to 2 V and frequency to 10 kHz. Change the voltage of useful signal U_{SIG} from 0 V to 60 mV in steps of 20 mV. Draw all four waveforms of the output signal to the graph.



- Increase the amplitude of the useful signal U_{SIG} and find out at which value the amplifier stops working properly. What happens in the circuit at that value?

$U_{SIG\ max}$ =

izh – izhod, english output