MST

Smart Sensor Systems
Chair for Measurement and Sensor Technology
*Univ. Prof. Dr.-Ing. O. Kanoun*

CHEMNITZ UNIVERSITY
OF TECHNOLOGY

multiplexing analog to digital converter PC interface card

The signal of two sensors should be measured using a multiplexing analog to digital converter PC interface card. Sensor signals are amplified with operational amplifiers. The output signals of the amplifiers are directly connected to the input of the PC-interface card. The PC interface card consists of one analog to digital converter (ADC) and one multiplexer. After each conversion of an analog value the multiplexer switches to the other input.
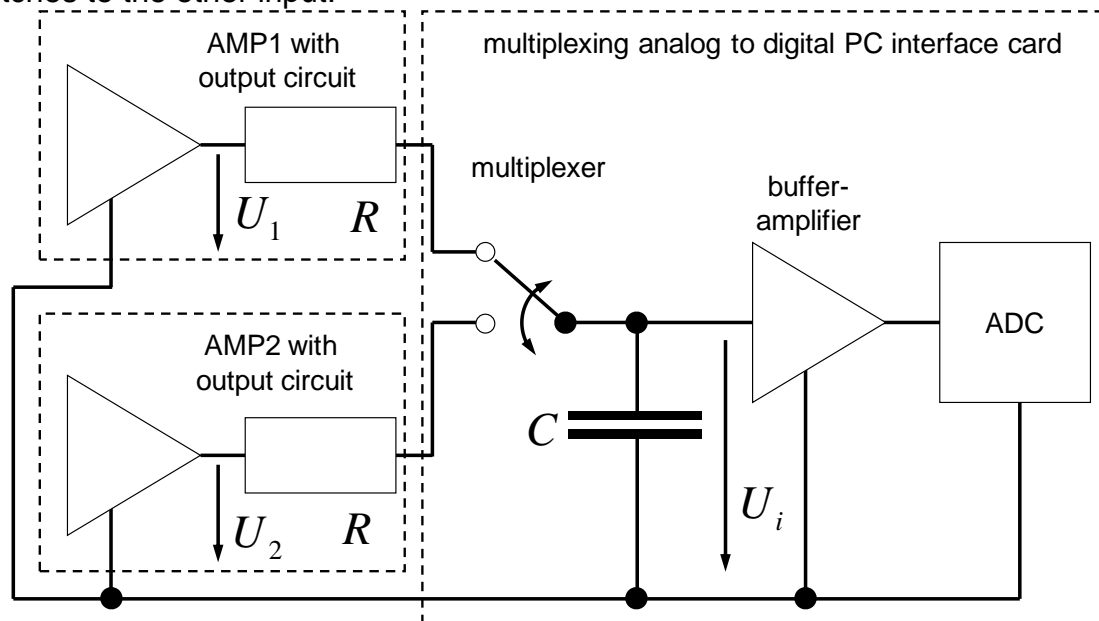
technical data of the PC interface card

- ADC conversion rate 100kS/s
- ADC resolution 16 bit
- Input capacitance C=100pF

The output signals of the operational amplifiers are -1V < U < 1V.

a) Calculate the absolute value of the quantization error. The whole output range of the operational amplifier is quantized with the resolution of the ADC.

b) How long are the times, while the output signals of the AMP1 and AMP2 are connected to the buffer amplifier? Use a drawing to give a reason for your decision.

c) Errors because of aliasing must be avoided. How big is the value of the maximum allowed frequency contained in the signals U_1 and U_2?

d) The multiplexer switches from output voltage of AMP1 to the output voltage of AMP2. Calculate the timely behavior of voltage U_i after the multiplexer switched from voltage U_1 to voltage U_2. Plot the behavior of voltage U_i into a diagram.

e) The maximum error because of recharging the input capacitor C should be less than the absolute quantization error. What is the maximum allowed value of the operational amplifiers output resistor R?

MST

Smart Sensor Systems
Chair for Measurement and Sensor Technology
Univ. Prof. Dr.-Ing. O. Kanoun

CHEMNITZ UNIVERSITY
OF TECHNOLOGY

bridge circuit in unbalanced mode

The figure shows a bridge circuit in unbalanced mode for measuring a resistance change of R_X.
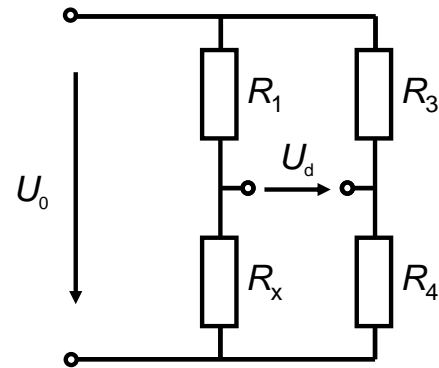
a) How R_1, R_3, R_4 must be selected for balancing the bridge to $U_D = 0\,V$ when $R_{X0} = 1\,k\Omega$. The sensitivity dU_D / dR_x should have its maximum at R_{X0}?

b) The maximum power at R_X should be $P_{W\max} = 0{,}125\,W$. What must be the value of U_E when $R_{X0} = 1\,k\Omega$?

c) For small resistance changes of R_X ($\Delta R_X << R_{x0}$) the bridge voltage can be approximated by $U_d \approx -U_0 \cdot \dfrac{\Delta R_x}{4R_{x0}}$. The error because of the approximation should be smaller than 1%. What is the allowed maximum value of ΔR_X?

balancing AC bridges

The following bridge circuits are used for measuring capacitances and inductances and their losses.
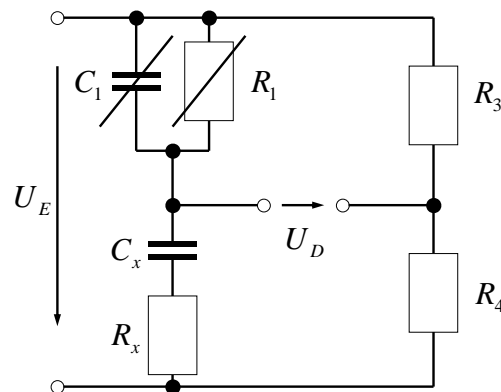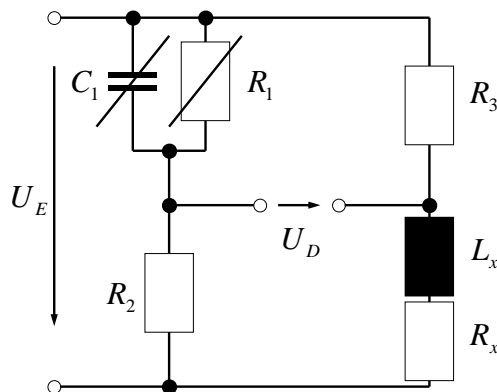
a) Calculate the impedances $\underline{Z}_1$, $\underline{Z}_2$, $\underline{Z}_4$ und $\underline{Z}_4$ and the conditions for balancing the bridges.

b) The values of R_1 and C_1 are used to balance the bridges. Calculate the values of unknown quantities R_x and L_x and R_x and C_x depending on the values of R_1 and C_1 in balanced condition.

c) Draw a bridge that cannot be balanced. Give a reason for your decision.