MST

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

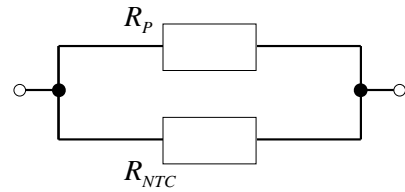CHEMNITZ UNIVERSITY
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NTC temperature sensor

Soil temperature should be measured by using a NTC-temperature-sensor. The working point should be at 12°C. At the working point the linearization of the NTC-temperature sensor is done by connecting a resistor R_P in parallel to the temperature depended resistor R_{NTC}. The technical data for the temperature depended resistor R_{NTC} is given by $R_{T0}=2000\Omega$, $T_0=310K$ and $B=3000K$.

a) What is the resistance value of the temperature depended resistor R_{NTC} at the working point?

b) Calculate the analytical expression for the sensitivity. What is the numerical value at the working point?

c) Calculate the value of the resistor R_P for optimized linearity at the working point. **Notice:** Why linearity of a curve is optimal at the inflection point?

d) What is the resistance value (R_{PC}) of the parallel connection of R_P and R_{NTC} at the working point?

e) Calculate the analytical expression for the sensitivity of the parallel connection of R_P and R_{NTC}. What is the numerical value at the working point? Compare the sensitivity to the value of the not linearized sensor. Explain the difference.

f) What is the resistance value (R_{PC}) of the parallel connection of R_P and R_{NTC} at 0°C?

g) The linearized model of the parallel connection of R_P and R_{NTC} should be considered. The slope of the linear model and the sensitivity of the parallel connection of R_P and R_{NTC} at the working point should be the same. What are the numerical values of the coefficients of the universal linear model y=mx+n?

h) What is the numerical value of the relative resistance error at 0°C?

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Resistance Thermometer

The linearity of a Pt100 resistance thermometer should be considered. The resistance is given by: $R(T) = R_0\left[1 + A(T - T_0) + B(T - T_0)^2\right]$

A=3,9083 10^{-3} 1/K
B=-5,775 10^{-6} 1/K^2

   a) What is the value of R_0 and T_0 according to DIN EN 60751?

   b) Plot a curve of the resistance value from 0°C to 100°C

A Pt100 resistance thermometer is now used to measure temperature. A resistance value of 109Ω was measured.

   c) What is the value of the corresponding temperature?

The influence of the quadratic term now should be neglected.

   d) Add the plot of the curve with the quadratic term neglected to the diagram of number b)

   e) What is the value of the indicated temperature when neglecting the influence of the quadratic term?

   f) How big is the absolute temperature error?