calculatons

Sunday, March 24, 2024 1:23 PM

TCS = -0.00140193 1/C	Using T0 = 25 and T1 = 80

$$\mathrm{TCS} = \frac{[V_{FS}(T) - V_{OS}(T)] - [V_{FS}(T_0) - V_{OS}(T_0)]}{(T - T_0)[V_{FS}(T_0) - V_{OS}(T_0)]} \times 100\%$$

TCR = 0.00243 ppm/C?	Using T0 = 25 and T1 = 80 C

$$\mathbf{R = R_{ref}\,[1 + \alpha(T - T_{ref})]}$$

Where,

$\mathbf{R}$ = Conductor resistance at temperature "T"

$\mathbf{R_{ref}}$ = Conductor resistance at reference temperature T_{ref}, usually 20°C, but sometimes 0°C.

$\boldsymbol{\alpha}$ = Temperature coefficient of resistance for conductor material.

$\mathbf{T}$ = Conductor temperature in degrees Celcius.

$\mathbf{T_{ref}}$ = Reference temperature that α is specified at for the conductor material

Pezoresistive constant = 0.09	Provided by Taipro

$$R_{(T,P)} = R_0 * (1 + \alpha_T(T - T_{ref}) + \gamma_P(P - P_{ref}))$$

$$V_{out} = V_{out2} - V_{out1} = \frac{(R_1 - \Delta R)(R_3 - \Delta R) - (R_2 + \Delta R)(R_4 + \Delta R)}{(R_1 - \Delta R + R_2 + \Delta R)(R_3 - \Delta R + R_4 + \Delta R)} \bullet V_{DD} = \frac{\Delta R}{R} \bullet V_{DD}$$

Resistor behavior is given and supported by other papers
Which is an assumption made for simplicity, and lack of ability to test for values.

//note: values are idealized to be the same on each branch resistor
//irl this will not be the case

Case 1 prototype
R0 = 6000, at T0
Rf = 7000
T0 = 25 C = 298.15 K
T1 = 80 C
P0 = 1 bar, maybe change to 0 bar differs from intern work of 1-2 bar range
//do we have a speific pressure range we care about? Only have resistance range

Restrictions
Range P = 0-6 bar (shouldn't matter?)

Range T = 0-40 max 80 C
Range R = 5k - 9k

Network Resistors

$$R_S = KR_B \tag{1}$$

$$R_{P2} = \frac{(1+K)\left(\sqrt{1+K}+1\right)}{K} R_B \approx \frac{2R_B}{K},\ K = \frac{4V_{OS}}{V_B} \tag{2}$$

$$R_{P1} = -\frac{\alpha}{\alpha + TCR_B} R_B \tag{3}$$

//higher temperature improvement is also detailed in paper, but requires certain test points from real sensor, which is currently not obtainable
//Purpose of each resistor location is explained

Series branch component resistor controls TCR, however not doable with our resistor, will omit
Parallel component resistors control offset, can be pos or neg depending on location placed
Series R fitted to input (or output) controls sensitivity decrease tendency

//Rs is directly proportional to reducing the sensitivity change, must strike balance with noise

$$R_{P1} = -\frac{TCS}{TCS+TCR_B} R_B$$

$$SV'_B = -S'V_B or, \frac{V'_B}{V_B} = \frac{-S'}{S} - TCS$$