

# 1. KOLOKVIJ za predmet KOMPONENTE IN SESTAVI

2. letnik – Elektronika – VSP

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in REŠITVE

## Naloga 1

Določite temperaturo, pri kateri je treba testirati komponente, da bo 1000 urna meritev omogočila določitev odpovedi za obdobje 40 let, če bodo komponente delovale pri temperaturi okoli 40°C. Za aktivacijsko energijo degradacijskega procesa upoštevajte  $E_a = 0,625$  eV.

$$E_a = 0,625 \text{ eV}$$

$$t_t = 1000 \text{ h}$$

$$k = 1,38 \cdot 10^{-23} \text{ J/K}$$

$$t = 40 \text{ let}$$

$$q_0 = 1,6 \cdot 10^{-19} \text{ As}$$

$$T_a = 40^\circ\text{C}$$

**Rešitev:**

$$E_a = 0,625 \text{ eV} \cdot 1,6 \cdot 10^{-19} \text{ As} = 1 \cdot 10^{-19} \text{ J}$$

$$AF = \frac{t_t}{t} = \frac{RR}{RR_t} = e^{-\frac{E_a}{k} \left( \frac{1}{T_a} - \frac{1}{T_t} \right)}$$

$$\ln(AF) = -\frac{E_a}{k} \left( \frac{1}{T_a} - \frac{1}{T_t} \right)$$

$$\frac{1}{T_t} = \frac{1}{T_a} - \frac{k}{E_a} \ln(AF)$$

$$T_t = \frac{1}{\frac{1}{T_a} - \frac{k}{E_a} \ln\left(\frac{t}{t_t}\right)} = \frac{1}{\frac{1}{313 \text{ K}} - \frac{1,38 \cdot 10^{-23} \text{ J/K}}{10^{-19} \text{ J}} \cdot \ln\left(\frac{350400 \text{ h}}{1000 \text{ h}}\right)}$$

$$T_t = 419 \text{ K} = 146^\circ\text{C}$$

## Naloga 2

Kolikšno je razmerje  $S/N$  signalnega izvora z notranjo upornostjo  $10 \text{ k}\Omega$  in pasovno širino  $100 \text{ kHz}$  pri minimalni signalni napetosti  $U_{Smin} = 40 \text{ }\mu\text{V}$  pri sobni temperaturi. Razmerje  $S/N$  izrazite kot razmerje in v dB.

$$R = 10 \text{ k}\Omega$$

$$B = 100 \text{ kHz}$$

$$U_{Smin} = 40 \text{ }\mu\text{V}$$

$$k = 1,38 \cdot 10^{-23} \text{ J/K}$$

**Rešitev:**

$$U_N^2 = 4kBT R = 4 \cdot 1,38 \cdot 10^{-23} \text{ J/K} \cdot 100 \cdot 10^3 \text{ Hz} \cdot 300 \text{ K} \cdot 10 \cdot 10^3 \text{ }\Omega = 4 \text{ }\mu\text{V}$$

$$\frac{S}{N} = \frac{U_{Smin}^2}{U_N^2} = \frac{(40 \text{ }\mu\text{V})^2}{(4 \text{ }\mu\text{V})^2} = 100$$

$$\frac{S}{N} = 20 \cdot \log \frac{U_{Smin}}{U_N} = 10 \cdot \log \frac{U_{Smin}^2}{U_N^2} = 10 \cdot \log 100 = 20 \text{ dB}$$

### Naloga 3

Kolikšna mora biti nazivna upornost hladnega NTC termistorja  $R_{25}$ , da rele v vezju preklopi pri temperaturi termistorja  $T_P = 60^\circ\text{C}$ ? Materialna konstanta termistorja je  $B = 2500 \text{ K}$ .

Upornost navitja releja je  $R_{RE} = 1 \text{ k}\Omega$ , minimalna pritezna napetost pa je  $U_{min} = 6 \text{ V}$ .

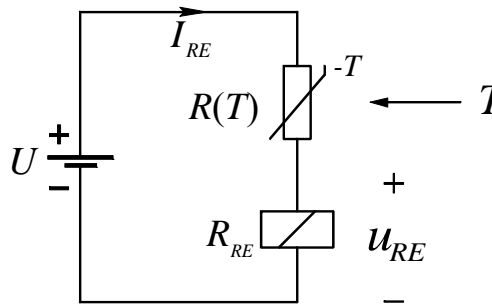
$$B = 2500 \text{ K}$$

$$T_P = 60^\circ\text{C}$$

$$R_{RE} = 1 \text{ k}\Omega$$

$$U_{min} = 6 \text{ V}$$

$$U = 12 \text{ V}$$



**Rešitev:**

$$U_{R_{TP}} = U - U_{min} = 12 \text{ V} - 6 \text{ V} = 6 \text{ V}$$

$$I_P = \frac{U_{min}}{R_{RE}} = \frac{6 \text{ V}}{1 \text{ k}\Omega} = 6 \text{ mA}$$

$$R_{TP} = R_{T60} = \frac{U_{R_{TP}}}{I_P} = \frac{6 \text{ V}}{6 \text{ mA}} = 1 \text{ k}\Omega$$

$$R_{T25} = A \cdot e^{\frac{B}{T_{25}}}$$

$$R_{T60} = A \cdot e^{\frac{B}{T_{60}}}$$

$$\frac{R_{T25}}{R_{T60}} = e^{B \left( \frac{1}{T_{25}} - \frac{1}{T_{60}} \right)}$$

$$R_{T25} = R_{T60} \cdot e^{B \left( \frac{1}{T_{25}} - \frac{1}{T_{60}} \right)} = 1 \text{ k}\Omega \cdot e^{2500 \text{ K} \left( \frac{1}{298 \text{ K}} - \frac{1}{333 \text{ K}} \right)} = 2,4 \text{ k}\Omega$$

#### Naloga 4

Kolikšna sta tok in diferencialna upornost varistorja pri napetosti 50 V? Podatki varistorja so:  $U_N = 40 \text{ V}$ ,  $I_N = 1 \text{ mA}$  in  $\alpha = 18$ .

**Rešitev:**

$$\begin{aligned} I &= k \cdot U^\alpha \\ I_N &= k \cdot U_N^\alpha \\ \frac{I}{I_N} &= \left( \frac{U}{U_N} \right)^\alpha \Rightarrow I = I_N \left( \frac{U}{U_N} \right)^\alpha \\ I(50 \text{ V}) &= 1 \text{ mA} \left( \frac{50}{40} \right)^{18} = \underline{55,5 \text{ mA}} \\ g &= \frac{dI}{dU} = k \alpha U^{\alpha-1} = k U^\alpha \frac{\alpha}{U} = \alpha \frac{I}{U} \\ r &= \frac{1}{g} = \frac{U}{\alpha I} = \frac{50 \text{ V}}{18 \cdot 55,5 \cdot 10^{-3} \text{ A}} = \underline{50 \Omega} \end{aligned}$$