Hypothèses :

$\alpha = 100$ [µV/K]

$\rho_{TE} = 1.8\times10^{-5}$ [Ω·m]

$k = 1.5$ [W/m.K]

$k_p = 35{,}3$ [W/m·K]

$L_{TOT} = 40$ [mm]

~ $H_{TOT} = 4$ [mm] → NON

$\theta = 80$ [K]

$A = 1.6\times10^{-3}$ [m²] → 40mm × 40mm

$K = 1.6$ [W/K]

~ $H_p = 1.25$ [mm]

~ $H = 1.5$ [mm] ? → NON

$V = L^2 \cdot H \cdot N$ [m³]

$K = U \cdot A = 1000 \cdot 1.6\times10^{-3}$

$N = N_{ID}^2$

Contraintes :

$x \geq 0.5$ [mm]

$dT < \Delta T$

$L \geq 1{,}2$ [mm]

$$N \leq \left(\frac{L_{TOT}-x}{1{,}2+x}\right)^2$$

$\Delta T < \theta$

Formules :

① $P = N\alpha I dT - I^2 R_i$

② $$I = \frac{N\alpha dT}{R_i + R_L}$$

③ $$P = \frac{(N\alpha dT)^2}{2R_i} - \frac{(N\alpha dT)^2 R_i}{(2R_i)^2}$$

$$P = \frac{(N\alpha dT)^2}{2R_i} - \frac{(N\alpha dT)^2}{4R_i}$$

$$P = \frac{4R_i(N\alpha dT)^2 - 2R_i(N\alpha dT)^2}{8R_i^2}$$

$$P = \frac{2R_i(N\alpha dT)^2}{8R_i^2}$$

$$\boxed{P = \frac{(N\alpha dT)^2}{4R_i}}$$ → Puissance maximale à optimiser avant changement des variables.

④ $$R_i = N \cdot \rho_{TE} \cdot \frac{H}{L^2}$$

⑤ $$dT = \frac{Q}{K_o}$$

⑥ $$K_o = \frac{2N k_{TE} L^2 K_p}{2N k_{TE} L^2 + K_p H}$$

⑦ $$K_p = \frac{k_p L_{TOT}^2}{H_p}$$

⑧ $$H_p = \frac{H_{TOT} - H}{2}$$

⑨ $L_{TOT} = N_{ID}(L+x) + x$

$$\frac{L_{TOT}-x}{N_{ID}} = L + x$$

$$L = \frac{L_{TOT}-x}{N_{ID}} - x$$

⑩ $$dT = \frac{K}{K+2K_o}\Delta T$$

⑪ $Q = \dot{m} c_p (\theta - \Delta T)$

⑫ $$Q = \frac{K_o K}{K + K_o} \cdot \Delta T$$