

Mean Failure Time

Chip Resistor and Chip Resistor Array Series

Purpose of Accelerated Life Testing:

Accelerated Life Testing is the main reason to accelerate product worse on physics and time
Take shorter time to test, and estimate the life and failure rate under normally operation.

Experimental conditions of Load Life :

Rated Voltage is Added on Resistor at 70 °C , and ON for 90 minutes and
OFF for 30 minutes are Kept for 1000 hours

Sample Counts:

Resistor is tested for 1000 hours, it turns out the confidential level of 95% that Resistor has
MTTF of 6500 hours.

The Sample Counts is 20 pcs under estimating the condition without failure

$$\begin{aligned}
 & \mathbf{r = 1 - e^{-nt / \theta L}} && r : \text{reliability level} \\
 \Rightarrow & \mathbf{1 - 0.95 = e^{-1000n / 6500}} && n : \text{sample counts} \\
 & \mathbf{n \geq -6500 * \ln 0.05 / 1000} && t : \text{testing time} \\
 \Rightarrow & \mathbf{n \geq 19.47} && \theta L : \text{mean failure time}
 \end{aligned}$$

Arrhenius Accelerated Life Testing:

$$\text{Accelerated Factor, } A \eta = \eta_n / \eta_a = e^{(E/K)(1/T_n - 1/T_a)}$$

IF Failure Performance is λ ($\lambda = 1/\eta$) then Failure Accelerated Factor ($A \lambda$) is

$$A \lambda = \lambda_a / \eta_n = e^{(E/K)(1/T_n - 1/T_a)}$$

$A \lambda$: Accelerated Fator of Failure

E : Energy (Normal range is 0.7 ~ 1.0)

K : Boltzmann Constant(= 8.623 * 0.00001 eV / °K)

Tn : Temperature of Normal Operation

Ta : Temperature of Accelerted Life Testing

$$A \lambda = e^{(0.7 / (8.623 * 0.00001)) * (1/(273+25) - 1/(273+70))} = 35.6552$$

Mean Failure Time of Resistor at 70°C (θL) is 6500 hours

Measn Failure Performance of Resistor at 25°C under normally operation is

$$\eta_{25} = (\theta L) \text{ Mean Failure Time} * (A \eta) \text{ Failure Accelerated Factor}$$

$$\text{Mean Failure Time at } 25^\circ\text{C} \quad \eta_{25} = 6500 * 35.6552 = 231758.79 \text{ hours}$$