

Apex Microtechnology

Failure Rate (in FIT) estimated using long-term reliability tests
(Base line Temperature of 40C Baseline Confidence Level of 90%)

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Table 1

Life Test Duration (hrs.)	Date Life Test Completed	Sample
10757.5	1/2/2019	22

Life Test Duration*Sample
236665

MTBF and Failure Rate when No Failures are observed in a Test:

n =	22	units tested
r =	0	units failed
T =	10757.5	hrs. Life test duration
α =	0.1	alpha
T _c =	125	Case temperature
CL (1- α) =	0.9	Confidence level for MTBF
$\chi^2_{\alpha;df}$ =	4.605	Critical value of the Chi-Squared distribution for $\alpha=0.1$ and df = 2
T _a =	236665	accumulated unit hours of operation

$MTBF_{L1} = 2T_a / \chi^2_{\alpha;df} =$ 102782.3 hours Lower Confidence Limit for MTBF
 thus

MTBF at 90% confidence is (102782.3 hr; ∞)
 (11.73 yr; ∞)

and

Failure rate $\leq$ 9729.301 failures per billion hours

Accelerated Reliability: MTBF and FIT for Given Use Temperature

$$\begin{aligned} L_{TA-\min} &= MTBF_{L1(0)} = 102782 \text{ minimum life at the accelerated temperature} \\ T_A &= 125 \text{ } T_c \text{ (}^\circ\text{C)} \text{ accelerated temperature} = 398 \text{ }^\circ\text{K} \\ T_U &= 40 \text{ } T_c \text{ (}^\circ\text{C)} \text{ use temperature} = 313 \text{ }^\circ\text{K} \\ EA &= 0.7 \text{ Activation energy eV for device} \\ K &= 8.62\text{E-}05 \text{ Boltzman's constant} \end{aligned}$$

$$L_{TU-\min} = 26150163.06 \text{ hours}$$

Thus

$$\begin{aligned} \text{MTBF at } 90\% \text{ confidence is } & (26150163 \text{ hr; } \infty) \\ & (2985.2 \text{ yrs; } \infty) \end{aligned}$$

Then

$$\text{Failure rate } \leq 38.24 \text{ failures per billion hours}$$

$$A_F = L_{TU-\min} / L_{TA-\min} = 254.423 \text{ Acceleration factor}$$