Failure Rate Calculation

Failure rate predictions are typically expressed in either

FITS = Failures per billion device hours

MTBF = Mean Time between Failures (years) = 1E9/FITS converted to years

The Arrhenius relationship is used to extrapolate failure rates at highly accelerated temperature and voltage conditions back to normal use conditions. Confidence limits are applied using the Chi Square Statistic.

For thermal acceleration the applicable Arrhenius relationship is:

$$Af(T) = exp[(Ea/k)(1/Tuse - 1/Tstress)]$$

Activation Energy (Ea) is based on the actual failure mechanism and typically ranges from 0.3eV to 1.0eV. If the failure mechanism is not known 0.5eV is used as the default.

For voltage acceleration the relationship is:

$$Af(V) = exp[Gamma(Vstress - Vuse)]$$

Voltage acceleration is highly dependent on the thickness of the gate oxide within the semiconductor. Values of Gamma in current technologies range from 2 to 6.