Quality and Reliability Report

Second Quarter 2019

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Quality and Reliability Report Overview

Silicon Labs is pleased to share this Quality and Reliability Report with our customers. It provides the latest quality performance data along with failure rate estimates and reliability monitor data for integrated circuit products.* These data are collected on a continual basis as qualification, production and reliability monitors are completed. The report is published and updated quarterly to provide customers visibility to the most recent information. The Quality Trend charts on page 5 are shown on a rolling five-year basis. All other reports include data from the previous four quarters on a rolling, one-year basis.

The report provides data covering:

- Estimates of shipped product quality
- Long-term operating life estimates
- Mean time to failure estimates
- Data retention life estimates
- Reliability monitor results

Silicon Labs is registered to ISO 9001:2015, ISO 14001:2015 and maintained certification to ISO/TS 16949:2009 from January 2008 to October 2014. Due to a change in the ISO/TS 16949 certification eligibility requirements in 2013, fabless semiconductor companies are no longer eligible for certification. Silicon Labs now conforms to IATF 16949 and continues to internally audit to IATF 16949 as well as being audited externally with IATF 16949 certified auditors. Silicon Labs uses IATF 16949 certified suppliers for automotive products.

Silicon Labs is committed to quality excellence. That commitment is demonstrated by extensive product and process qualification. Each product undergoes extensive qualification testing prior to production release. Silicon Labs qualifies integrated circuit products using JEDEC JESD47, *Stress-Test-Driven Qualification of Integrated Circuits* or AEC-Q100, *Stress Test Qualification for Integrated Circuits*, as appropriate.

Once a product is qualified, on-going product quality and reliability is verified through monitoring programs. Monitors are scheduled to periodically sample wafer fab technologies and package technologies. The results are published in this report. Any failures are used to drive corrective action and process and product improvement.
We hope you find this report useful. Please let us know if you have any specific questions or suggestions.

*Module data will be added in 2019. Reliability qualification reports are available on www.silabs.com.

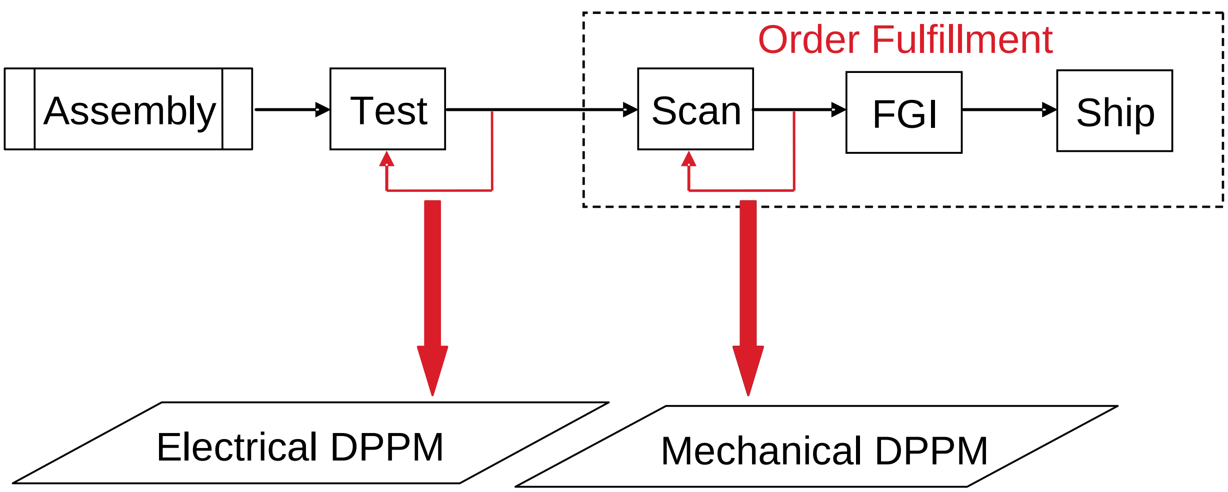
Average Outgoing Quality (AOQ)

Overview

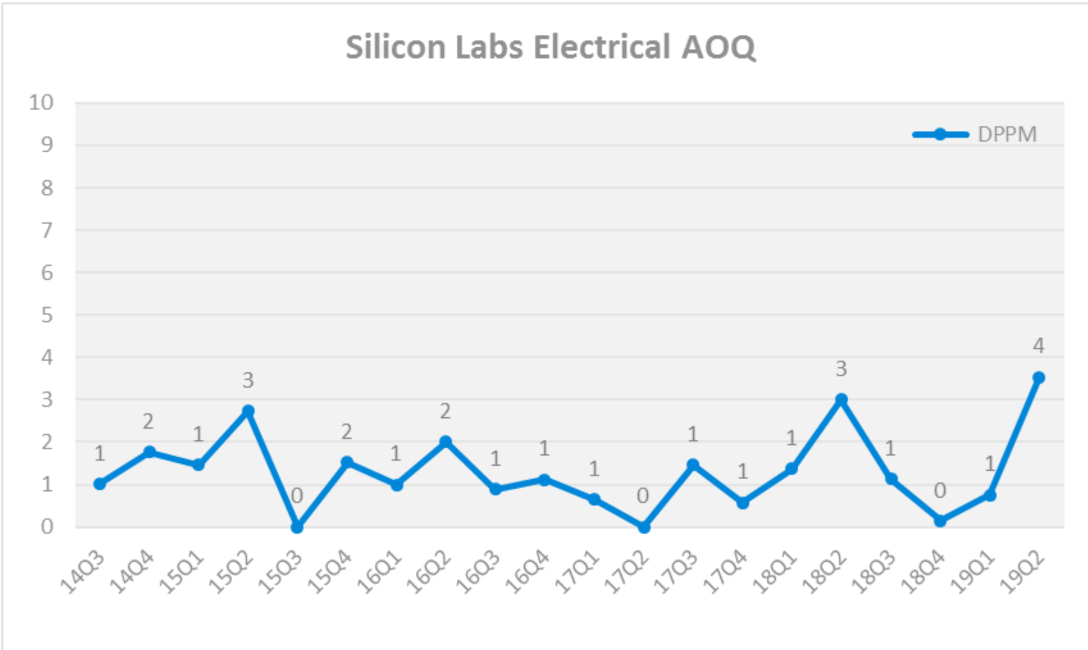
Two elements of product quality are reported – electrical quality and mechanical/visual quality. We measure electrical quality by taking a sample (monitor) of production parts and retesting the sample to the datasheet limits (see Figure 1). The sample electrical test may be performed at an alternate test temperature to verify part performance across the datasheet temperature range. This sample method identifies defects introduced at the test process step or that have escaped the test process. Any failures drive corrective actions and product/process improvements.

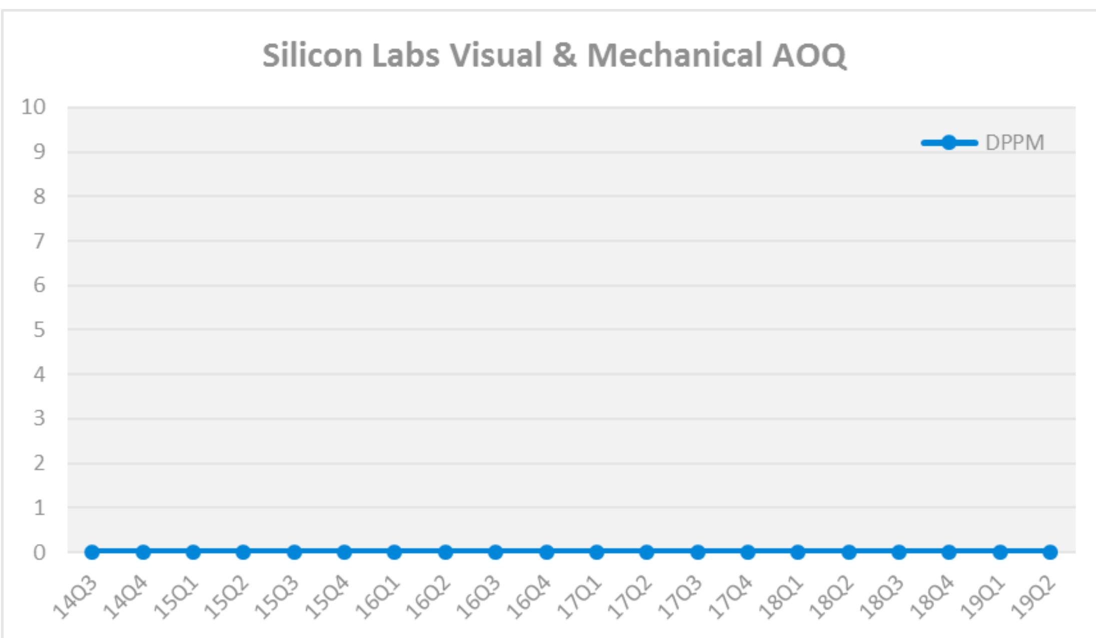
Visual/Mechanical quality is estimated by sample inspection of the completed product prior to final pack. Inspection items cover a broad range of characteristics and include mark, count, label, cover tape workmanship, moisture barrier bag integrity, lead location, part placement, and many other general workmanship items required for customer satisfaction and product protection during shipment. Any failures drive corrective actions and process improvements.

Figure 1 – Quality Monitor Flow



Electrical and Visual / Mechanical Outgoing Quality Graphs





Part Numbers by Fab Technology

Part Number	Technology
530X	55 nm
5XX	0.13 um
BGM11X	90 nm, embedded flash
BGM12X	90 nm, embedded flash
BGM13S22FX	90 nm, embedded flash
BGM13S3X	90 nm, embedded flash
BGX13S22GX	90 nm, embedded flash
BM1X	90 nm, embedded flash
C8051F0XX	0.35 um, embedded flash
C8051F1XX	0.35 um, embedded flash
C8051F2XX	0.35 um, embedded flash
C8051F30X	0.35 um, embedded flash
C8051F31X	0.35 um, embedded flash
C8051F32X	0.35 um, embedded flash
C8051F33X	0.35 um, embedded flash
C8051F34X	0.35 um, embedded flash
C8051F35X	0.35 um, embedded flash
C8051F36X	0.35 um, embedded flash
C8051F37X	0.18 um, embedded flash
C8051F37X	0.35 um, EEPROM
C8051F38X	0.18 um, embedded flash
C8051F39X	0.18 um, embedded flash
C8051F4XX	0.25 um, embedded flash
C8051F5XX	0.25 um, embedded flash
C8051F7XX	0.18 um, embedded flash
C8051F8XX	0.18 um, embedded flash
C8051F9XX	0.18 um, embedded flash
C8051TXXX	0.18 um, OTP
CF0XX	0.35 um, embedded flash
CF1XX	0.35 um, embedded flash
CF2XX	0.35 um, embedded flash
CF30X	0.35 um, embedded flash
CF31X	0.35 um, embedded flash
CF32X	0.35 um, embedded flash
CF33X	0.35 um, embedded flash
CF34X	0.35 um, embedded flash

Part Number	Technology
CF35X	0.35 um, embedded flash
CF36X	0.35 um, embedded flash
CF37X	0.35 um, embedded flash
CF38X	0.18 um, embedded flash
CF39X	0.18 um, embedded flash
CF4XX	0.25 um, embedded flash
CF5XX	0.25 um, embedded flash
CF7XX	0.18 um, embedded flash
CF8XX	0.18 um, embedded flash
CF9XX	0.18 um, embedded flash
CP2101	0.35 um, embedded flash
CP2102	0.35 um, embedded flash
CP2102N	0.18 um, embedded flash
CP2103	0.35 um, embedded flash
CP2104	0.18 um, OTP
CP2105	0.18 um, OTP
CP2107	0.18 um, OTP
CP2108	0.18 um, embedded flash
CP2109	0.18 um, OTP
CP211X	0.18 um, OTP
CP2120	0.35 um, embedded flash
CP213X	0.18 um, OTP
CP22XX	0.35 um, embedded flash
CP240X	0.18 um
CP250X	0.35 um, embedded flash
CP254X	0.18 um, OTP
CP26XX	0.18 um, embedded flash
CP4000	0.13 um
CPTXXXX	0.18 um, embedded flash
CTXXX	0.18 um, OTP
CY2815	0.6 um - 1.0 um
CYWXXX	0.45 um - 0.5 um
EFM32G2X	0.18 um, embedded flash
EFM32G3X	0.18 um, embedded flash
EFM32G8X	0.18 um, embedded flash
EFM32GG1X	90 nm, embedded flash

Part Number	Technology
EFM32GG2X	0.18 um, embedded flash
EFM32GG3X	0.18 um, embedded flash
EFM32GG8X	0.18 um, embedded flash
EFM32GG9X	0.18 um, embedded flash
EFM32HG	0.18 um, embedded flash
EFM32JG	90 nm, embedded flash
EFM32LG	0.18 um, embedded flash
EFM32PG	90 nm, embedded flash
EFM32TG108X	0.18 um, embedded flash
EFM32TG110X	0.18 um, embedded flash
EFM32TG11BX	90 nm, embedded flash
EFM32TG2X	0.18 um, embedded flash
EFM32TG8X	0.18 um, embedded flash
EFM32WG	0.18 um, embedded flash
EFM32ZG	0.18 um, embedded flash
EFM8X	0.18 um, embedded flash
EFR32BG1X	90 nm, embedded flash
EFR32BG2X	40 nm, embedded flash
EFR32FGX	90 nm, embedded flash
EFR32MG12PX	90 nm, embedded flash
EFR32MG13P6X	90 nm, embedded flash
EFR32MG13P7X	90 nm, embedded flash
EFR32MG13P8X	90 nm, embedded flash
EFR32MG13P8X	90 nm, flash
EFR32MG14PX	90 nm, embedded flash
EFR32MG1B1X	90 nm, embedded flash
EFR32MG1B2X	90 nm, embedded flash
EFR32MG1B6X	90 nm, embedded flash
EFR32MG1B6X	90 nm, flash
EFR32MG1B7X	90 nm, embedded flash
EFR32MG1B7X	90 nm, flash
EFR32MG1P1X	90 nm, embedded flash
EFR32MG1P2X	90 nm, embedded flash
EFR32MG1P6X	90 nm, embedded flash
EFR32MG1P6X	90 nm, flash
EFR32MG1P7X	90 nm, embedded flash
EFR32MG1P7X	90 nm, flash
EFR32MG1V1X	90 nm, embedded flash

Part Number	Technology
EFR32MG2X	40 nm, embedded flash
EFR32Z	90 nm, embedded flash
EM25X	0.18 um, embedded flash
EM26X	0.18 um, embedded flash
EM31X	0.11 um
EM31X	0.18 um, embedded flash
EM34X	0.18 um, embedded flash
EM35X	0.18 um, embedded flash
EZR32X	0.11 um
EZR32X	0.18 um, embedded flash
IA10XX	Diode
IA12XX	0.6 um - 0.8 um BiCMOS
IA14XX	0.6 um - 0.8 um BiCMOS
IA32XX	0.6 um - 0.8 um BiCMOS
IAP4XX	0.6 um - 0.8 um BiCMOS
IAP6XX	0.6 um - 1.0 um
IAP7XX	0.6 um - 1.0 um
IAP86X	0.6 um - 0.8 um BiCMOS
IAP87X	0.315 um - 0.35 um
IAP90X	0.6 um - 1.0 um
IAP91X	0.6 um - 0.8 um BiCMOS
IAP93X	0.6 um - 1.0 um
MGM1X	90 nm, embedded flash
RM2	40 nm, embedded flash
RWM3	0.11 um
S3CX	0.18 um, embedded flash
S3UX	0.18 um, embedded flash
SD35X	0.13 um, embedded flash
Si100X	0.18 um, embedded flash
Si100X	0.18 um, RF
Si101X	0.18 um, embedded flash
Si101X	0.18 um, RF
Si102X	0.18 um, embedded flash
Si102X	0.18 um, RF
Si103X	0.18 um, embedded flash
Si103X	0.18 um, RF
Si106X	0.11 um
Si106X	0.18 um, embedded flash

Part Number	Technology
Si108X	0.11 um
Si108X	0.18 um, embedded flash
Si1102	0.6 um - 0.8 um BiCMOS
Si1102	Diode
Si1120	0.6 um - 0.8 um BiCMOS
Si1120	Diode
Si1132	0.18 um, OTP
Si1133	0.18 um
Si114X	0.18 um, OTP
Si115X	0.18 um
Si117X	0.18 um
Si118X	0.18 um
Si210X	0.13 um
Si2111	0.11 um
Si2113	0.11 um
Si2115	0.11 um
Si2124	55 nm
Si2127	55 nm
Si2128	55 nm
Si2136	0.11 um
Si2137	55 nm
Si2138	55 nm
Si2140	0.11 um
Si2141	55 nm
Si2143	0.11 um
Si2144	55 nm
Si2145	0.11 um
Si2146	0.11 um
Si2147	55 nm
Si2148	55 nm
Si2150	55 nm
Si2151	55 nm
Si2153	0.11 um
Si2155	0.11 um
Si2156	0.11 um
Si2157	55 nm
Si2158	55 nm
Si2159	55 nm

Part Number	Technology
Si2160-X	55 nm
Si2161-X	0.11 um
Si2162-X	55 nm
Si2163-X	0.11 um
Si2164-X	55 nm
Si2165-X	0.11 um
Si2166-AXX	0.11 um
Si2166-BXX	55 nm
Si2166-CXX	55 nm
Si2166-DXX	55 nm
Si2167-AXX	0.11 um
Si2167-BXX	55 nm
Si2167-CXX	55 nm
Si2167-DXX	55 nm
Si2168-X	55 nm
Si2169-X	55 nm
Si216XX-X	55 nm
Si2170	0.11 um
Si2171	0.11 um
Si2172	0.11 um
Si2173	0.11 um
Si2176	0.11 um
Si2177	55 nm
Si2178	55 nm
Si2180	55 nm
Si2181	55 nm
Si2182	55 nm
Si2183	55 nm
Si2185	0.11 um
Si2190	55 nm
Si2191	55 nm
Si2196	0.11 um
Si220X	0.315 um - 0.35 um
Si221X	0.25 um
Si2400	0.45 um - 0.5 um
Si2401	0.18 um
Si2403	0.18 um
Si2404-C	0.18 um

Part Number	Technology
Si2404-D	0.11 um
Si2415-D	0.11 um
Si2417-D	0.18 um
Si2417-E	0.11 um
Si241X-A	0.18 um
Si241X-B	0.18 um
Si241X-C	0.18 um
Si241X-F	0.18 um
Si241X-G	0.18 um
Si241X-H	0.18 um
Si242X	0.18 um
Si2433	0.18 um
Si2434-C	0.18 um
Si2434-D	0.11 um
Si2435-B	0.18 um
Si2435-C	0.18 um
Si2435-D	0.18 um
Si2435-E	0.11 um
Si2435-F	0.11 um
Si2436	0.18 um
Si2437	0.18 um
Si2438	0.18 um
Si2439	0.11 um
Si2456	0.18 um
Si2457-C	0.18 um
Si2457-D	0.11 um
Si2457-FT	0.18 um
Si2493-C	0.18 um
Si2493-D	0.11 um
Si2494	0.11 um
Si2535	0.25 um
Si3000	0.45 um - 0.5 um
Si3005	0.25 um
Si3006	0.25 um
Si3007	0.25 um
Si3008	0.25 um
Si3009	0.25 um
Si3010	0.25 um

Part Number	Technology
Si3011	0.25 um
Si3012	0.45 um - 0.5 um
Si3014	0.45 um - 0.5 um
Si3015	0.45 um - 0.5 um
Si3016	0.45 um - 0.5 um
Si3017	0.25 um
Si3018	0.25 um
Si3019	0.25 um
Si302X	0.45 um - 0.5 um
Si3050-D	0.25 um
Si3050-E	0.18 um
Si3052	0.25 um
Si3054	0.25 um
Si3056	0.25 um
Si306X	0.25 um
Si307X	0.25 um
Si308X	0.25 um
Si31XX	0.25 um
Si320X	High Voltage
Si3210	0.45 um - 0.5 um
Si3211	0.45 um - 0.5 um
Si3215	0.45 um - 0.5 um
Si3216	0.45 um - 0.5 um
Si3217X	0.18 um
Si3217X	High Voltage
Si3218X	0.18 um
Si3218X	High Voltage
Si3219X	0.18 um
Si3219X	High Voltage
Si3220	0.45 um - 0.5 um
Si3225	0.45 um - 0.5 um
Si3226-X	0.18 um
Si3226X-C	0.18 um
Si3226X-C	High Voltage
Si3227	0.18 um
SI3228X	0.18 um
SI3228X	High Voltage
SI3229X	0.18 um

Part Number	Technology
Si3229X	High Voltage
Si3230	0.45 um - 0.5 um
Si3232	0.45 um - 0.5 um
Si3233	0.45 um - 0.5 um
Si3238	High Voltage
Si3239X	High Voltage
Si324X	0.18 um
Si3291X	0.25 um
Si340X	High Voltage
Si3450	0.18 um
Si3452	0.18 um, OTP
Si3452	High Voltage
Si3453	0.18 um, OTP
Si3453	High Voltage
Si3454	0.18 um, OTP
Si3454	High Voltage
Si3455	High Voltage
Si3456	0.35 um, embedded flash
Si3456	High Voltage
Si3457	0.18 um, OTP
Si3457	High Voltage
Si3458	0.18 um, OTP
Si3458	High Voltage
Si3459	0.18 um, OTP
Si3459	High Voltage
Si346X	0.18 um, OTP
Si348X	0.35 um, embedded flash
Si35XX	High Voltage
Si401X	0.13 um
Si402X	0.6 um - 0.8 um BiCMOS
Si403X	0.18 um, RF
Si405X	0.11 um
Si406X	0.11 um
Si41XX	0.315 um - 0.35 um
Si4310	0.13 um
Si4311	0.13 um
Si4312	0.13 um
Si4313	0.18 um, RF

Part Number	Technology
Si432X	0.6 um - 0.8 um BiCMOS
Si433X	0.18 um, RF
Si435X	0.11 um
Si436X	0.11 um
Si442X	0.6 um - 0.8 um BiCMOS
Si4430	0.18 um, RF
Si4431	0.18 um, RF
Si4432	0.18 um, RF
Si4438	0.11 um
Si445X	0.11 um
Si446X	0.11 um
Si46XX	55 nm
Si4708	0.11 um
Si4709	0.11 um
Si470X-C19	0.11 um
Si4732-AXX	0.11 um
Si474X	0.13 um
Si475X	0.11 um
Si476X	0.11 um
Si477X	0.11 um
Si4780	0.13 um
Si4780	0.35 um, embedded flash
Si479XX	55 nm
Si47XX-B1X	0.13 um
Si47XX-B2X	0.13 um
Si47XX-B3X	0.13 um
Si47XX-C3X	0.13 um
Si47XX-C4X	0.13 um
Si47XX-D	0.11 um
Si482X	0.11 um
Si4830	0.13 um
Si4834	0.13 um
Si4836	0.11 um
Si483X-B	0.11 um
Si484X	0.11 um
Si49XX	0.6 um - 0.8 um BiCMOS
Si500	0.13 um
Si5010	0.25 um

Part Number	Technology
Si50122	0.13 um
Si50122	0.18 um
Si5013	0.25 um
Si502X	0.25 um
Si504X	0.13 um
Si510X	0.15 um
Si511X	0.15 um
Si512X	0.18 um
Si5211X	0.18 um
Si5213X	0.18 um, RF
Si5214X	0.18 um, RF
Si5216X	0.18 um, RF
SI522X	0.18 um
Si53019	0.18 um, RF
Si5301C	0.13 um
Si5306	0.13 um
Si53102	0.18 um
Si53106	0.18 um, RF
Si53108	0.18 um, RF
Si5310-C	0.25 um
Si5311X	0.18 um, RF
Si5315X-A	0.18 um, RF
Si5315X-C	0.13 um
Si5316	0.13 um
Si5317	0.13 um
Si5319	0.13 um
Si5320	0.18 um
SI53212X	0.18 um
SI5321-H	0.25 um
SI5322	0.13 um
SI5323	0.13 um
SI5324	0.13 um
SI5325	0.13 um
SI5326	0.13 um
SI5327	0.13 um
SI5328	0.13 um
Si5330X	0.13 um
Si5331X	0.13 um
Si5332X	0.13 um
Si5334X	0.13 um
Si5335X	0.13 um
Si5336X	0.13 um
Si5338X	0.13 um
SI5339X	0.13 um
Si534X	55 nm
Si535X	0.13 um
Si5364	0.25 um
Si5365	0.13 um
Si5366	0.13 um
Si5367	0.13 um
Si5368	0.13 um
Si5369	0.13 um
Si5371X	55 nm
Si5372X	55 nm
Si5374X	0.13 um
Si5375X	0.13 um
Si5376X	0.13 um
Si5380X	55 nm
Si5381X	55 nm
Si5382X	55 nm
Si5383X	0.18 um, embedded flash
Si5383X	55 nm
Si5384X	0.18 um, embedded flash
Si5384X	55 nm
Si5386X	55 nm
SI5388X	55 nm
SI5388X	90 nm, embedded flash
SI5389X	55 nm
SI5389X	90 nm, embedded flash
SI539X	55 nm
Si5409X	0.18 um, OTP
Si7005	0.18 um, RF
Si7006	0.18 um, embedded flash
Si7007	0.18 um, embedded flash
Si7008	0.18 um, embedded flash
Si701X	0.18 um, embedded flash

Part Number	Technology
Si702X	0.18 um, embedded flash
Si703X	0.18 um, OTP
Si705X-A10	0.18 um, OTP
Si705X-A20	0.18 um, embedded flash
SI7060X	0.18 um
Si72X	0.18 um
Si803X	0.25 um
Si804X	0.25 um
Si805X	0.25 um
Si806X	0.25 um
Si822X	0.25 um
Si822X	High Voltage
Si823X	0.25 um
Si823X	High Voltage
Si824X	0.25 um
Si824X	High Voltage
Si825X	0.25 um, embedded flash
Si826X	0.25 um
Si826X	High Voltage
SI8271-D-IDI	0.25 um
SI8271-D-YDI	0.25 um
SI8273-D-IDI	High Voltage
Si827X	0.25 um
Si827X	High Voltage
Si828X	0.25 um
Si828X	High Voltage
Si83XX	0.25 um
Si84XX	0.25 um
Si850X	0.315 um - 0.35 um
Si851X	0.315 um - 0.35 um
Si854X	0.6 um - 1.0 um
Si86XX	0.25 um
Si87XX	0.25 um
Si87XX	High Voltage
Si88XX	0.25 um
Si890X	0.18 um, OTP
Si890X	0.25 um
Si892X	0.25 um

Part Number	Technology
SI8SX	0.25 um
SI8SX	High Voltage
SiM3XXXX	0.18 um, embedded flash
SL151	0.18 um, RF
SL15100CZC-1	0.35 um, EEPROM
SL153	0.18 um, RF
SL15300DZC-56	0.35 um, EEPROM
SL15300EZC-70	0.35 um, EEPROM
SL15300EZC-75	0.35 um, EEPROM
SL158	0.18 um, RF
SL16XX	0.18 um, RF
SL188X	0.18 um, RF
SL2304	0.18 um, RF
SL2305	0.18 um, RF
SL2309	0.18 um, RF
SL23EP	0.18 um, RF
SL281XX	0.18 um
SL2850	0.25 um
SL2854	0.25 um
SL2861	0.18 um, RF
SL2864	0.25 um
SL2874	0.18 um
SL28770	0.18 um
SL28773	0.18 um
SL28774	0.18 um
SL28775	0.18 um, RF
SL28776	0.18 um, RF
SL28779	0.18 um
SL28DB	0.25 um
SL28EB636	0.18 um
SL28EB717	0.18 um
SL28EB719	0.18 um
SL28EB720	0.18 um
SL28EB721	0.18 um
SL28EB725	0.18 um, RF
SL28EB731	0.18 um, RF
SL28EB735	0.18 um, RF
SL28EB740	0.18 um

Part Number	Technology
SL28EB742	0.18 um
SL28EB745	0.18 um
SL28EB774	0.18 um
SL28EB781	0.18 um, RF
SL28EB797	0.18 um, RF
SL28PCIE06	0.18 um
SL28PCIE10	0.18 um
SL28PCIE14	0.18 um, RF
SL28PCIE16	0.18 um
SL28PCIE19	0.18 um, RF
SL28PCIE2	0.18 um
SL28PCIE30	0.18 um
SL28PCIE50	0.18 um, RF
SL28SR	0.18 um
SL3800	0.18 um, RF
SL38020	0.18 um, OTP
SL3816	0.18 um, RF
SL38160CZC-30B	0.35 um, EEPROM
TS1001	High Voltage
TS1002	High Voltage
TS1003	0.18 um
TS1004	High Voltage
TS1005	0.18 um
TS11XX	0.6 um - 1.0 um
TS12XX	High Voltage
TS3001	0.18 um

Part Number	Technology
TS3002	0.18 um
TS3003	High Voltage
TS3004	High Voltage
TS3005	High Voltage
TS3006	High Voltage
TS3300	High Voltage
TS331X	0.18 um
TS4XXX	High Voltage
TS6XXX	0.6 um - 1.0 um
TS7XXX	0.18 um
TS9XXX	0.18 um
TSAXXXX	0.18 um
TSM12XX	0.18 um
TSM60XX	0.6 um - 1.0 um
TSM91XX	0.18 um
TSM92XX	0.18 um
TSM93XX	0.18 um
TSM96XX	0.6 um - 1.0 um
TSM97XX	0.18 um
TSM98XX	0.18 um
TSM99XX	0.6 um - 1.0 um
WF200	40 nm
ZGM	90 nm, embedded flash
ZM5X	0.13 um, embedded flash
ZW0X	0.18 um, embedded flash

Failure Rate Estimation by Fab Technology

Failure in Time (FIT)

A long-term, steady-state failure rate is often required by circuit and system engineers for allocations of the failure rates at the component level during system design. FIT, which stands for failure-in-time, is a widely-used term to describe failure rates of electronic components, and as used here, represents the number of failures in a billion hours of operation. FIT rates are reported in the following section as curves and in tables for specific temperatures and assumptions.

Mean Time to Failure (MTTF)

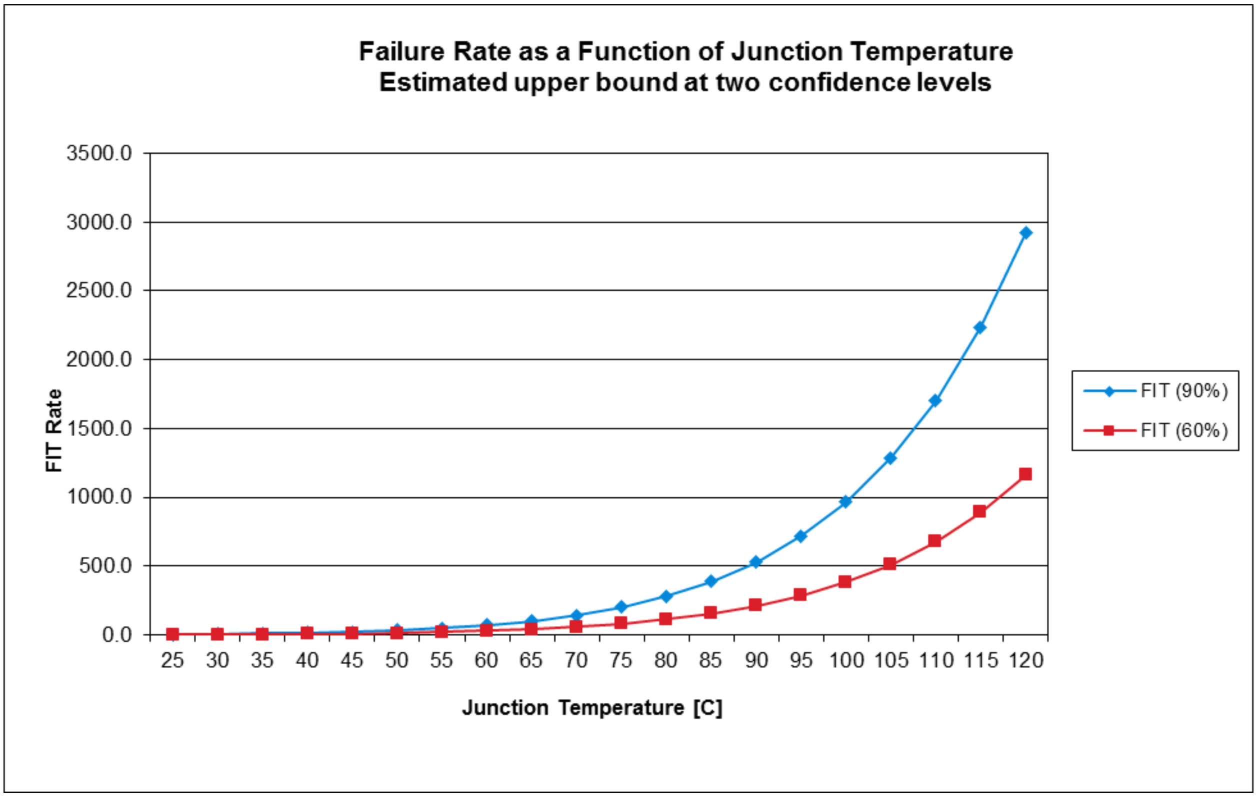
Another way to express failure rates is by mean time to failure (MTTF). MTTF is the inverse of the FIT rate and is useful for repair and maintenance planning. This relationship can be seen by examining the units of each measure: MTTF is given in time/failure; FIT is given in failure/time.   MTTF is reported in the tables following the FIT rate curves for each specific fab technology.

Failure Rate Calculation Method

Long-term failure rates are estimated by applying the Arrhenius equation to data collected from long term operating life tests. A confidence factor is applied based upon the sample size and number of failures to estimate the maximum failure rate at a specific confidence level. The calculation details are provided in the table below each of the following FIT rate curves.

FIT Rate Curves and Data

Process – 40 nm



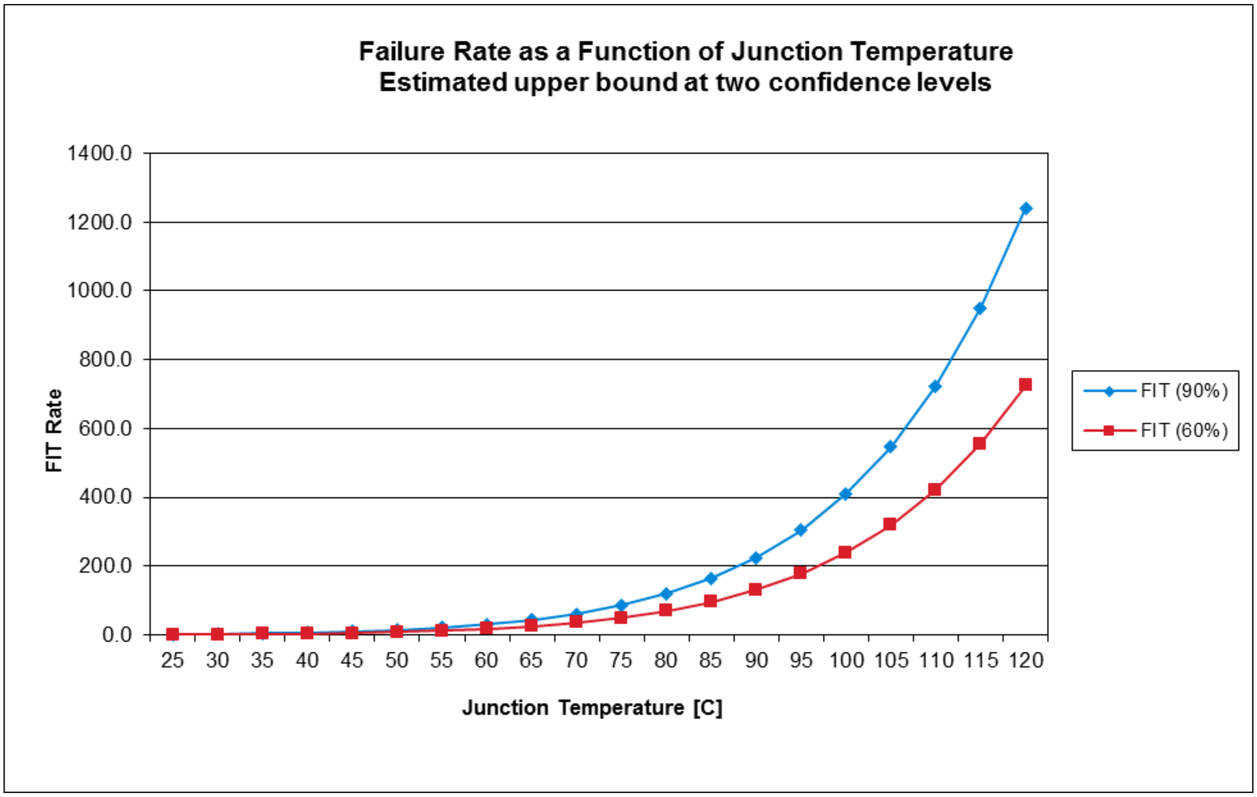
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 40 nm			
Variables:	90%	60%	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	290	290	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	290016	290016	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	33.2	13.2	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	3.0E+07	7.6E+07	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	3441.7	8648.9	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 40 nm

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	4.0	1.6	28349	71238
30	1257.7	6.3	2.5	18084	45444
35	814.1	9.8	3.9	11706	29416
40	534.4	14.9	5.9	7683	19307
45	355.4	22.3	8.9	5110	12841
50	239.4	33.2	13.2	3442	8649
55	163.2	48.7	19.4	2346	5896
60	112.5	70.6	28.1	1618	4066
65	78.5	101.2	40.3	1128	2835
70	55.3	143.6	57.2	795	1997
75	39.3	201.8	80.3	566	1421
80	28.3	280.9	111.8	406	1021
85	20.5	387.3	154.1	295	741
90	15.0	529.3	210.6	216	542
95	11.1	717.2	285.4	159	400
100	8.2	964.1	383.6	118	298
105	6.2	1285.8	511.7	89	223
110	4.7	1702.0	677.3	67	169
115	3.5	2236.7	890.1	51	128
120	2.7	2919.1	1161.6	39	98

Process – 40 nm w/ embedded flash



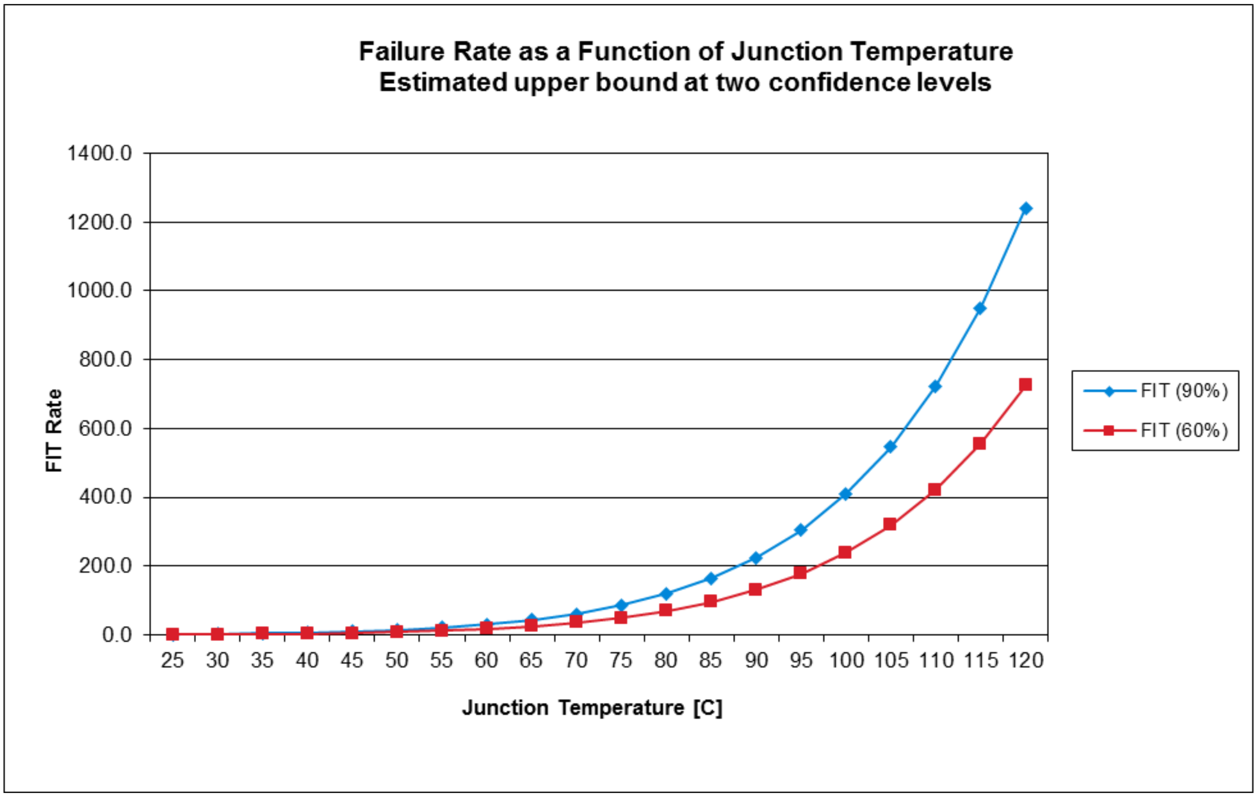
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 40 nm w/ embedded flash			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	328	328	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	327664	327664	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	29.4	11.7	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	3.4E+07	8.6E+07	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	3888.5	9771.6	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 40 nm w/ embedded flash

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	3.6	1.4	32029	80486
30	1257.7	5.6	2.2	20432	51343
35	814.1	8.6	3.4	13225	33234
40	534.4	13.2	5.2	8680	21813
45	355.4	19.8	7.9	5773	14508
50	239.4	29.4	11.7	3889	9772
55	163.2	43.1	17.1	2651	6661
60	112.5	62.4	24.9	1828	4594
65	78.5	89.6	35.6	1274	3203
70	55.3	127.1	50.6	898	2256
75	39.3	178.6	71.1	639	1606
80	28.3	248.6	98.9	459	1154
85	20.5	342.8	136.4	333	837
90	15.0	468.4	186.4	244	612
95	11.1	634.8	252.6	180	452
100	8.2	853.3	339.6	134	336
105	6.2	1138.0	452.9	100	252
110	4.7	1506.4	599.5	76	190
115	3.5	1979.7	787.8	58	145
120	2.7	2583.7	1028.1	44	111

Process – 55 nm



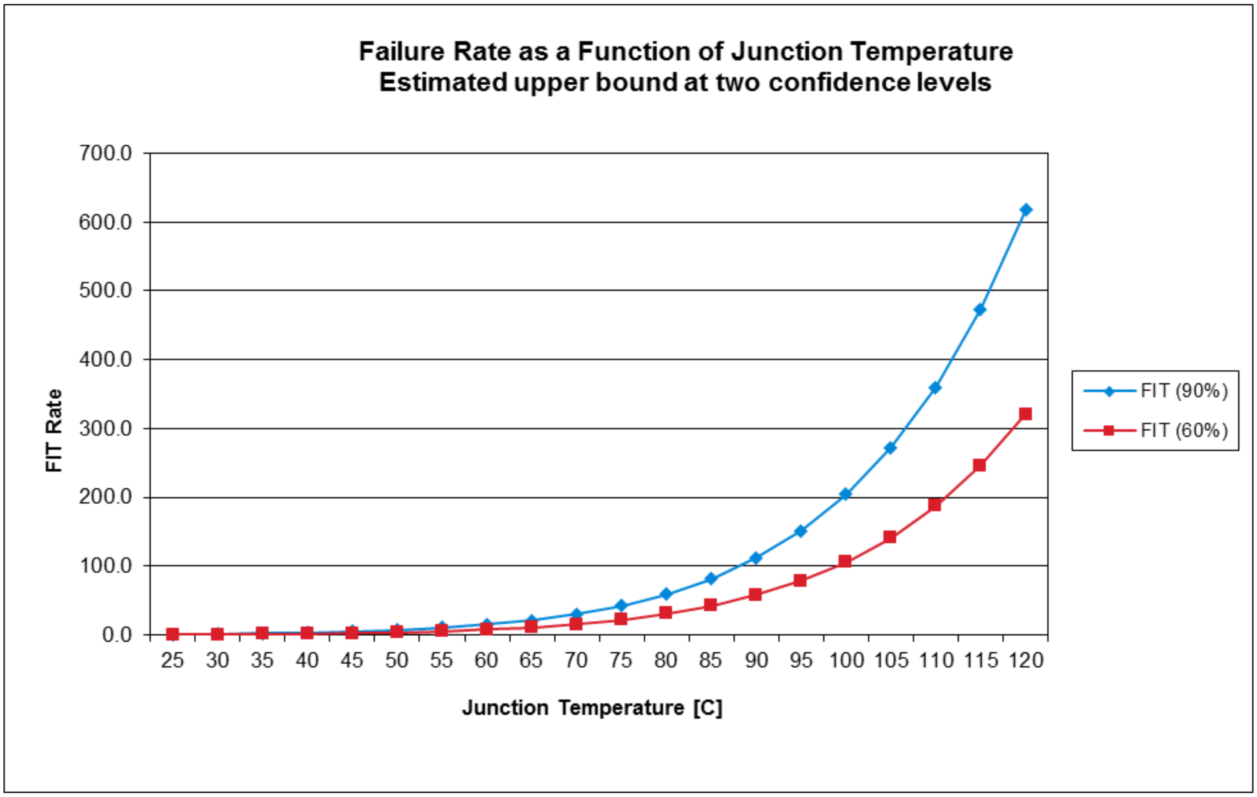
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 55 nm			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	1576	1576	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	2	2	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	6.0	6.0	degrees of freedom [2(F+1)]
DH	1575980	1575980	Total device hours D*H
X2	10.6	6.2	Chi-Square Distribution Value
FIT	14.1	8.2	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	7.1E+07	1.2E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	8091.3	13867.8	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 55 nm

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	1.7	1.0	66646	114225
30	1257.7	2.7	1.6	42515	72866
35	814.1	4.1	2.4	27520	47166
40	534.4	6.3	3.7	18062	30957
45	355.4	9.5	5.5	12013	20589
50	239.4	14.1	8.2	8091	13868
55	163.2	20.7	12.1	5516	9454
60	112.5	30.0	17.5	3804	6519
65	78.5	43.0	25.1	2652	4545
70	55.3	61.1	35.6	1868	3202
75	39.3	85.8	50.1	1330	2279
80	28.3	119.5	69.7	956	1638
85	20.5	164.7	96.1	693	1188
90	15.0	225.1	131.4	507	869
95	11.1	305.1	178.0	374	641
100	8.2	410.1	239.3	278	477
105	6.2	546.9	319.1	209	358
110	4.7	724.0	422.4	158	270
115	3.5	951.4	555.1	120	206
120	2.7	1241.6	724.5	92	158

Process – 90 nm w/ embedded flash



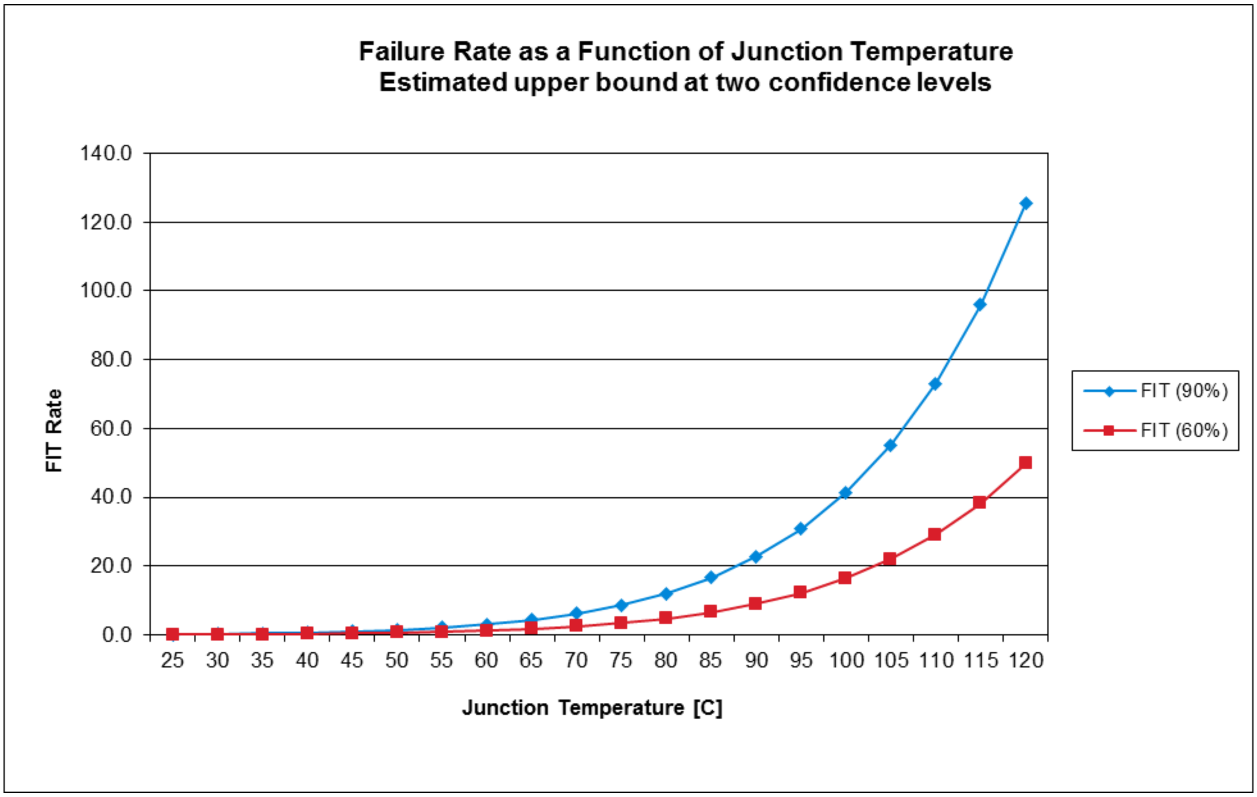
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 90 nm w/ embedded flash			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	2316	2316	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	1	1	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	4.0	4.0	degrees of freedom [2(F+1)]
DH	2316272	2316272	Total device hours D*H
X2	7.8	4.0	Chi-Square Distribution Value
FIT	7.0	3.6	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	1.4E+08	2.7E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	16272.0	31297.6	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 90 nm w/ embedded flash

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.9	0.4	134028	257789
30	1257.7	1.3	0.7	85499	164449
35	814.1	2.1	1.1	55343	106447
40	534.4	3.1	1.6	36324	69866
45	355.4	4.7	2.5	24159	46467
50	239.4	7.0	3.6	16272	31298
55	163.2	10.3	5.4	11093	21336
60	112.5	14.9	7.8	7649	14713
65	78.5	21.4	11.1	5333	10258
70	55.3	30.4	15.8	3758	7227
75	39.3	42.7	22.2	2674	5144
80	28.3	59.4	30.9	1922	3696
85	20.5	81.9	42.6	1394	2681
90	15.0	111.9	58.2	1020	1961
95	11.1	151.7	78.9	752	1447
100	8.2	203.9	106.0	560	1077
105	6.2	272.0	141.4	420	807
110	4.7	360.0	187.2	317	610
115	3.5	473.1	246.0	241	464
120	2.7	617.4	321.0	185	356

Process - 0.11 micron



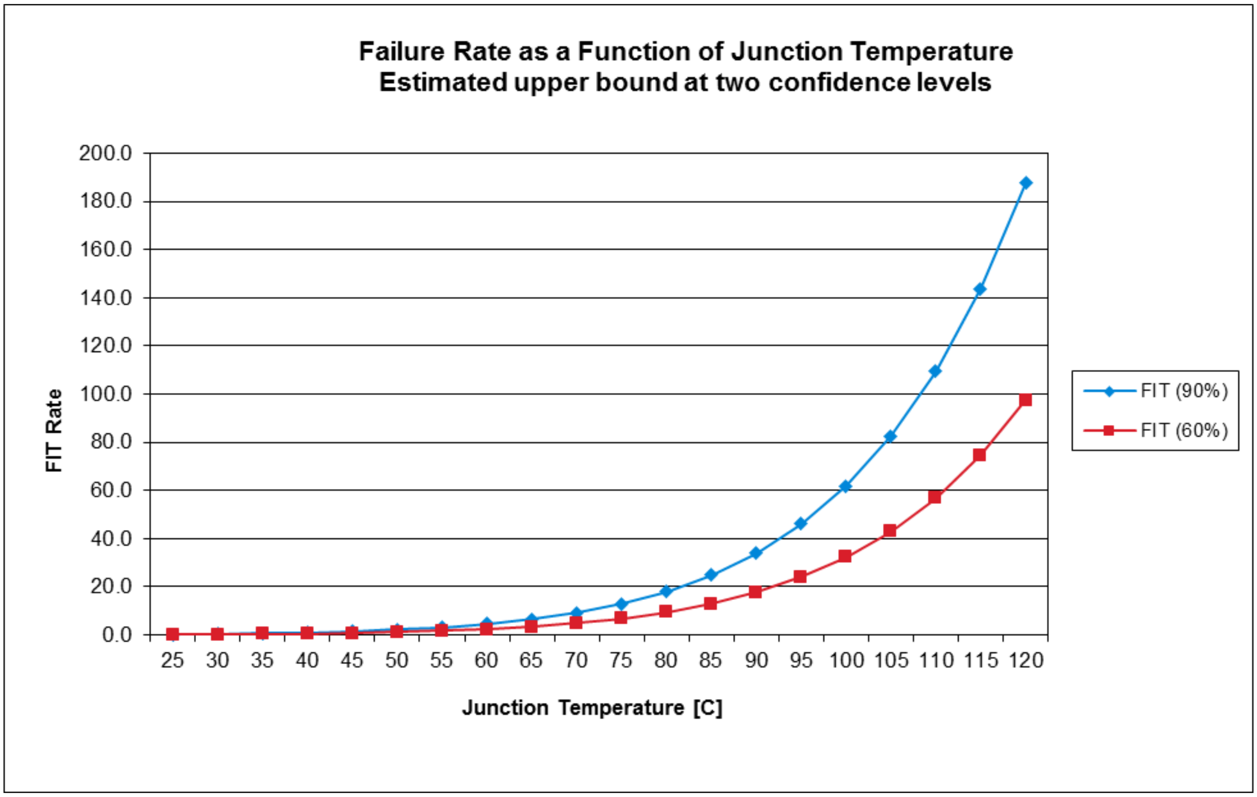
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.11 micron			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	6753	6753	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	6752504	6752504	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	1.4	0.6	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	7.0E+08	1.8E+09	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	80134.5	201373.4	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.11 micron

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.2	0.1	660044	1658653
30	1257.7	0.3	0.1	421055	1058088
35	814.1	0.4	0.2	272547	684894
40	534.4	0.6	0.3	178885	449529
45	355.4	1.0	0.4	118975	298978
50	239.4	1.4	0.6	80135	201373
55	163.2	2.1	0.8	54628	137276
60	112.5	3.0	1.2	37670	94664
65	78.5	4.3	1.7	26264	66000
70	55.3	6.2	2.5	18505	46502
75	39.3	8.7	3.4	13170	33095
80	28.3	12.1	4.8	9464	23782
85	20.5	16.6	6.6	6863	17248
90	15.0	22.7	9.0	5022	12620
95	11.1	30.8	12.3	3706	9312
100	8.2	41.4	16.5	2757	6928
105	6.2	55.2	22.0	2067	5195
110	4.7	73.1	29.1	1562	3924
115	3.5	96.1	38.2	1188	2986
120	2.7	125.4	49.9	911	2288

Process - 0.13 micron



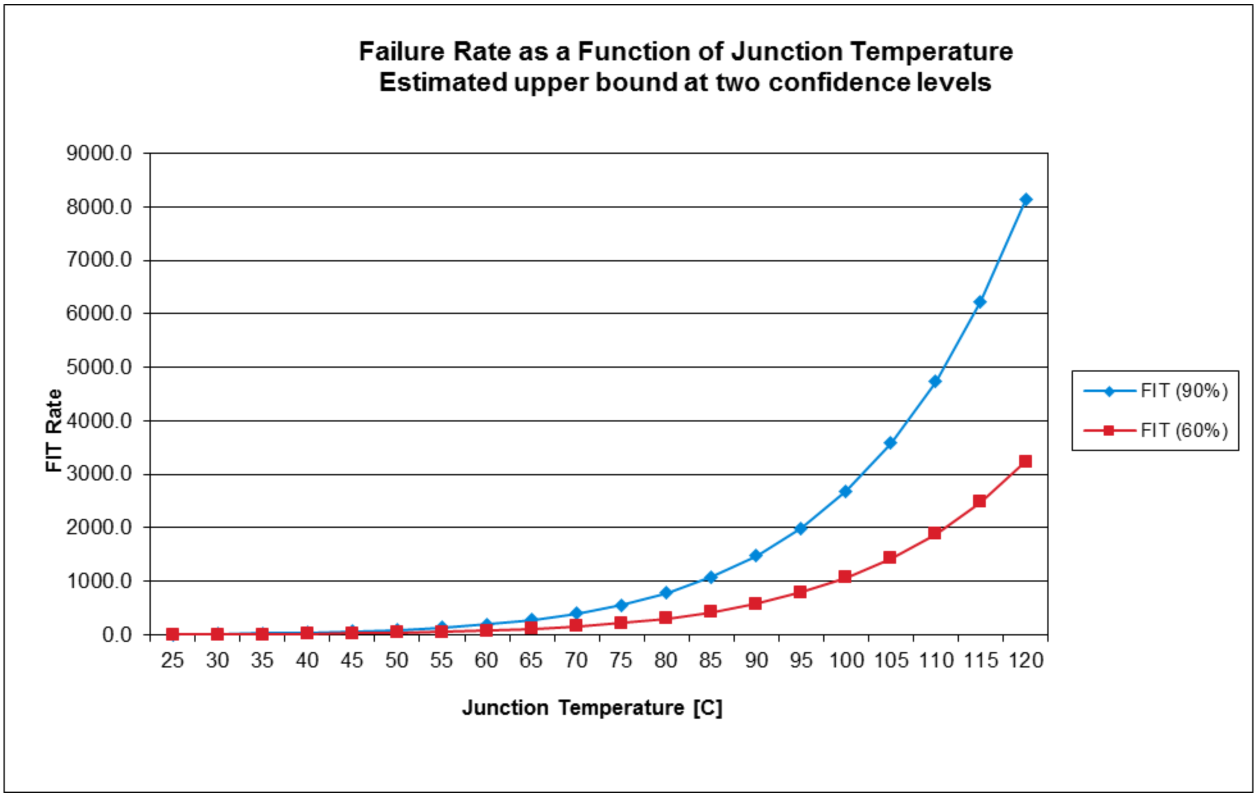
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.13 micron			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	7625	7625	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	1	1	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	4.0	4.0	degrees of freedom [2(F+1)]
DH	7625292	7625292	Total device hours D*H
X2	7.8	4.0	Chi-Square Distribution Value
FIT	2.1	1.1	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	4.7E+08	9.0E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	53568.4	103033.5	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.13 micron

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.3	0.1	441227	848657
30	1257.7	0.4	0.2	281467	541375
35	814.1	0.6	0.3	182192	350429
40	534.4	1.0	0.5	119582	230003
45	355.4	1.4	0.7	79533	152973
50	239.4	2.1	1.1	53568	103034
55	163.2	3.1	1.6	36518	70238
60	112.5	4.5	2.4	25182	48435
65	78.5	6.5	3.4	17557	33769
70	55.3	9.2	4.8	12370	23793
75	39.3	13.0	6.7	8804	16933
80	28.3	18.0	9.4	6326	12168
85	20.5	24.9	12.9	4588	8825
90	15.0	34.0	17.7	3357	6457
95	11.1	46.1	24.0	2477	4765
100	8.2	61.9	32.2	1843	3545
105	6.2	82.6	42.9	1382	2658
110	4.7	109.4	56.9	1044	2008
115	3.5	143.7	74.7	794	1528
120	2.7	187.5	97.5	609	1171

Process - 0.15 micron



Reliability FIT Calculations for temperature acceleration

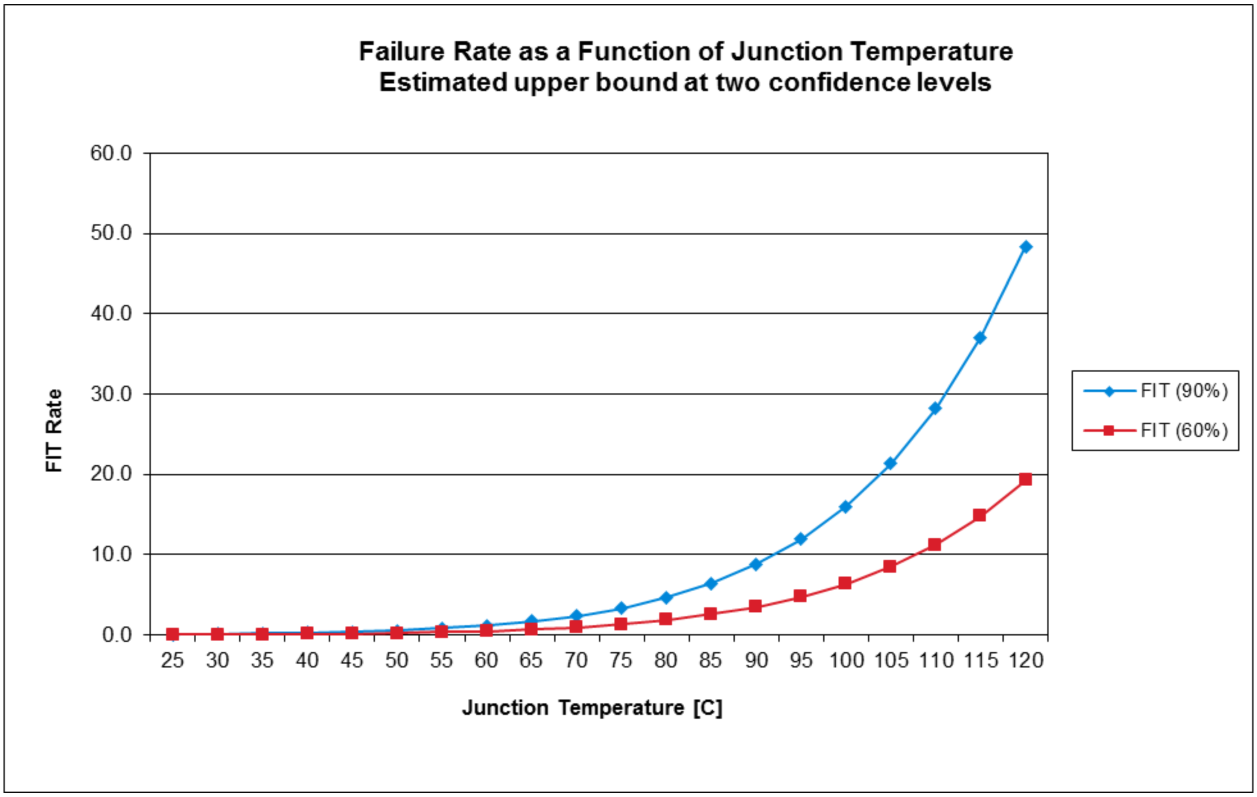
Single Point Calculation for 0.15 micron

Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	104	104	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	104144	104144	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	92.4	36.8	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	1.1E+07	2.7E+07	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	1235.9	3105.8	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.15 micron

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	11.2	4.5	10180	25581
30	1257.7	17.6	7.0	6494	16319
35	814.1	27.2	10.8	4203	10563
40	534.4	41.4	16.5	2759	6933
45	355.4	62.2	24.8	1835	4611
50	239.4	92.4	36.8	1236	3106
55	163.2	135.5	53.9	843	2117
60	112.5	196.5	78.2	581	1460
65	78.5	281.8	112.1	405	1018
70	55.3	400.0	159.2	285	717
75	39.3	562.0	223.6	203	510
80	28.3	782.1	311.2	146	367
85	20.5	1078.4	429.1	106	266
90	15.0	1473.9	586.5	77	195
95	11.1	1997.3	794.8	57	144
100	8.2	2684.7	1068.4	43	107
105	6.2	3580.6	1424.8	32	80
110	4.7	4739.6	1886.1	24	61
115	3.5	6228.7	2478.6	18	46
120	2.7	8128.9	3234.8	14	35

Process - 0.18 micron



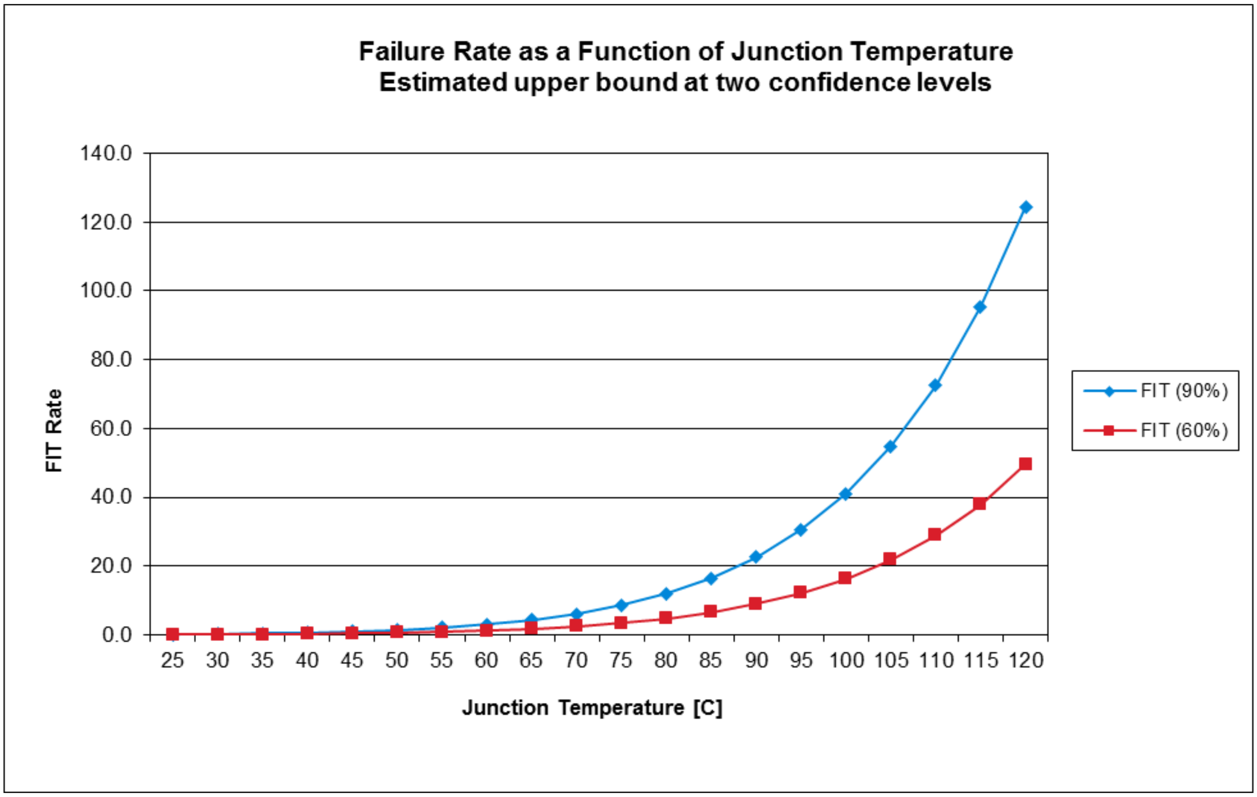
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.18 micron			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	17481	17481	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	17480886	17480886	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	0.6	0.2	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	1.8E+09	4.6E+09	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	207452.3	521315.6	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.18 micron

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.1	0.0	1708723	4293921
30	1257.7	0.1	0.0	1090028	2739178
35	814.1	0.2	0.1	705569	1773054
40	534.4	0.2	0.1	463099	1163740
45	355.4	0.4	0.1	308003	773995
50	239.4	0.6	0.2	207452	521316
55	163.2	0.8	0.3	141420	355381
60	112.5	1.2	0.5	97521	245066
65	78.5	1.7	0.7	67993	170861
70	55.3	2.4	0.9	47906	120384
75	39.3	3.3	1.3	34094	85677
80	28.3	4.7	1.9	24500	61566
85	20.5	6.4	2.6	17768	44650
90	15.0	8.8	3.5	13001	32670
95	11.1	11.9	4.7	9594	24108
100	8.2	16.0	6.4	7137	17935
105	6.2	21.3	8.5	5351	13448
110	4.7	28.2	11.2	4043	10159
115	3.5	37.1	14.8	3076	7731
120	2.7	48.4	19.3	2357	5923

Process - 0.18 micron w/ embedded flash



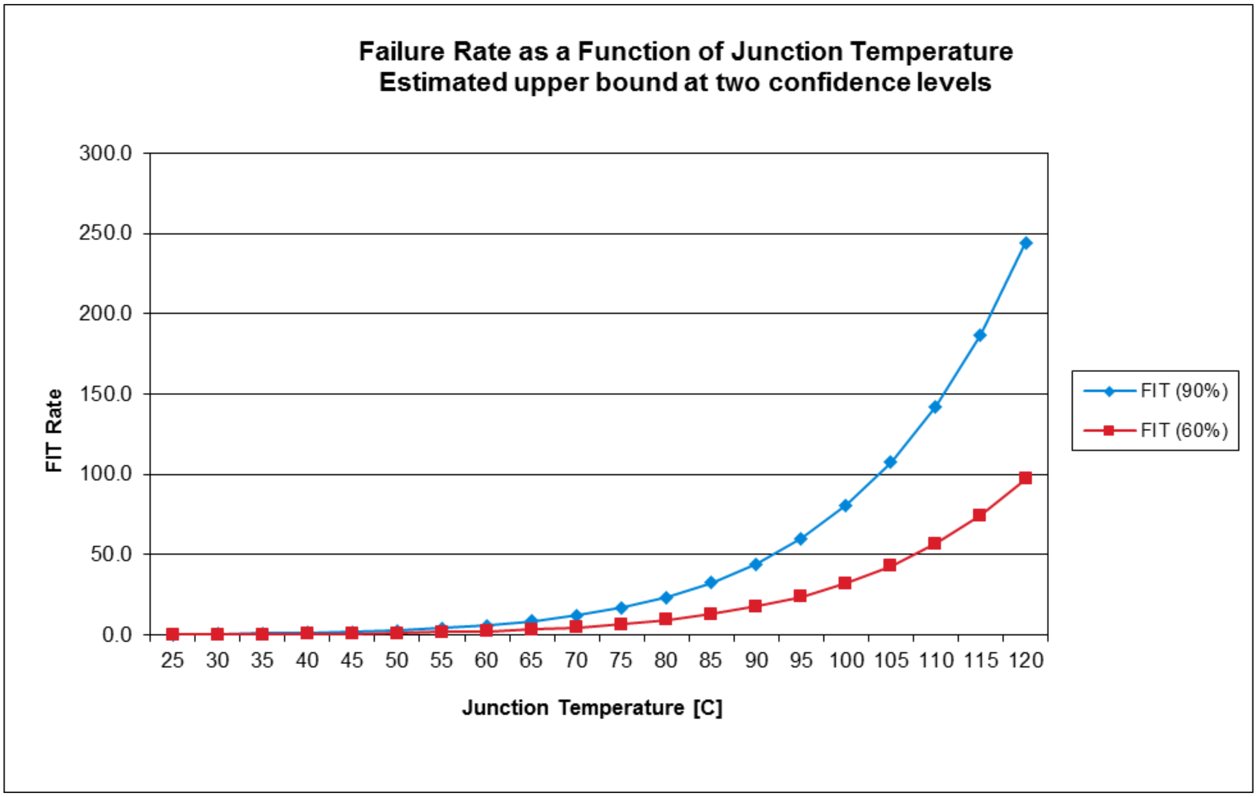
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.18 micron w/ embedded flash			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	6801	6801	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	6801305	6801305	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	1.4	0.6	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	7.1E+08	1.8E+09	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	80713.7	202828.8	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.18 micron w/ embedded flash

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.2	0.1	664815	1670640
30	1257.7	0.3	0.1	424098	1065735
35	814.1	0.4	0.2	274517	689844
40	534.4	0.6	0.3	180178	452778
45	355.4	1.0	0.4	119835	301139
50	239.4	1.4	0.6	80714	202829
55	163.2	2.1	0.8	55023	138268
60	112.5	3.0	1.2	37943	95348
65	78.5	4.3	1.7	26454	66477
70	55.3	6.1	2.4	18639	46838
75	39.3	8.6	3.4	13265	33334
80	28.3	12.0	4.8	9532	23954
85	20.5	16.5	6.6	6913	17372
90	15.0	22.6	9.0	5058	12711
95	11.1	30.6	12.2	3733	9380
100	8.2	41.1	16.4	2777	6978
105	6.2	54.8	21.8	2082	5232
110	4.7	72.6	28.9	1573	3953
115	3.5	95.4	38.0	1197	3008
120	2.7	124.5	49.5	917	2305

Process - 0.18 micron w/ OTP



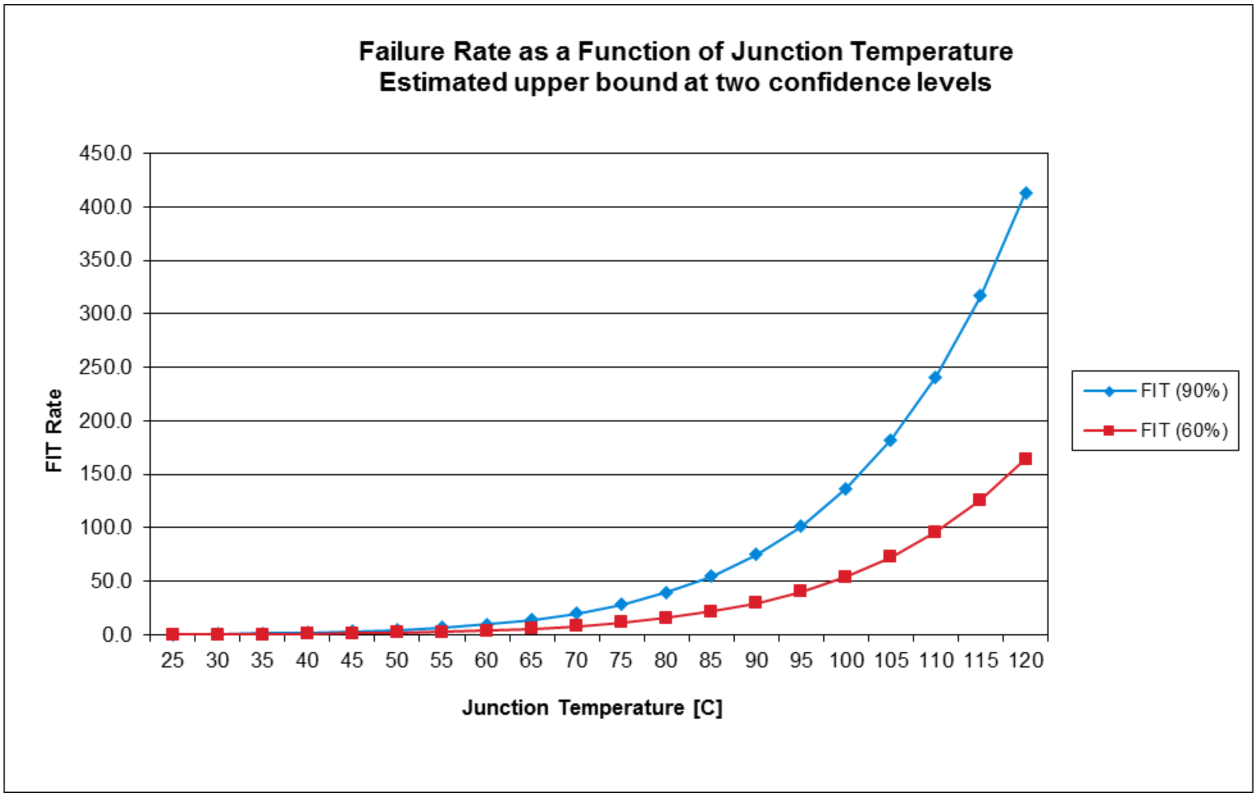
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.18 micron w/ OTP			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	3467	3467	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	3466592	3466592	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	2.8	1.1	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	3.6E+08	9.1E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	41139.4	103380.8	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.18 micron w/ OTP

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.3	0.1	338853	851517
30	1257.7	0.5	0.2	216161	543200
35	814.1	0.8	0.3	139920	351610
40	534.4	1.2	0.5	91836	230779
45	355.4	1.9	0.7	61079	153489
50	239.4	2.8	1.1	41139	103381
55	163.2	4.1	1.6	28045	70475
60	112.5	5.9	2.3	19339	48598
65	78.5	8.5	3.4	13483	33883
70	55.3	12.0	4.8	9500	23873
75	39.3	16.9	6.7	6761	16990
80	28.3	23.5	9.4	4858	12209
85	20.5	32.4	12.9	3524	8855
90	15.0	44.3	17.6	2578	6479
95	11.1	60.0	23.9	1902	4781
100	8.2	80.7	32.1	1415	3557
105	6.2	107.6	42.8	1061	2667
110	4.7	142.4	56.7	802	2015
115	3.5	187.1	74.5	610	1533
120	2.7	244.2	97.2	467	1175

Process - 0.18 micron w/ RF



Reliability FIT Calculations for temperature acceleration

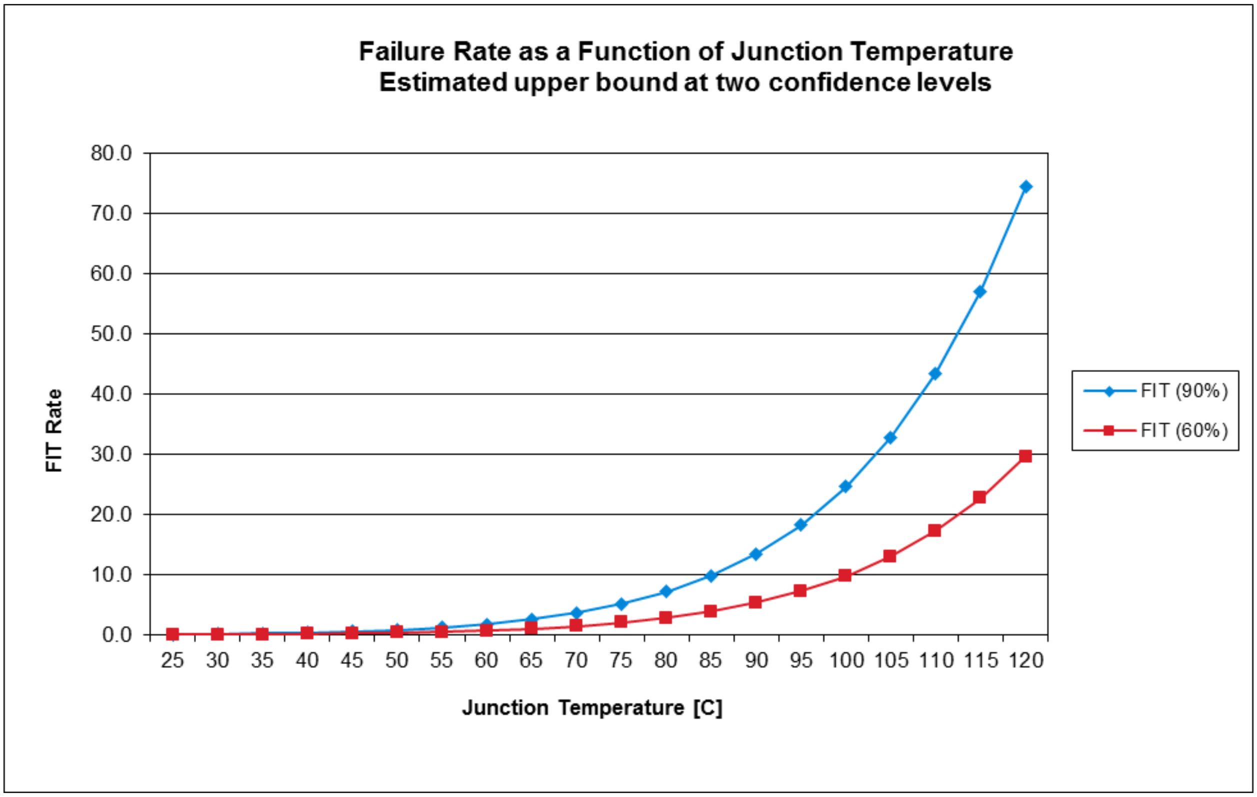
Single Point Calculation for 0.18 micron w/ RF

Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	2047	2047	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	2047163	2047163	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	4.7	1.9	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	2.1E+08	5.3E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	24294.5	61050.6	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.18 micron w/ RF

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.6	0.2	200106	502855
30	1257.7	0.9	0.4	127652	320781
35	814.1	1.4	0.5	82628	207640
40	534.4	2.1	0.8	54233	136284
45	355.4	3.2	1.3	36070	90641
50	239.4	4.7	1.9	24294	61051
55	163.2	6.9	2.7	16562	41618
60	112.5	10.0	4.0	11421	28699
65	78.5	14.3	5.7	7963	20009
70	55.3	20.3	8.1	5610	14098
75	39.3	28.6	11.4	3993	10034
80	28.3	39.8	15.8	2869	7210
85	20.5	54.9	21.8	2081	5229
90	15.0	75.0	29.8	1523	3826
95	11.1	101.6	40.4	1123	2823
100	8.2	136.6	54.3	836	2100
105	6.2	182.2	72.5	627	1575
110	4.7	241.1	95.9	473	1190
115	3.5	316.9	126.1	360	905
120	2.7	413.5	164.6	276	694

Process - 0.25 micron



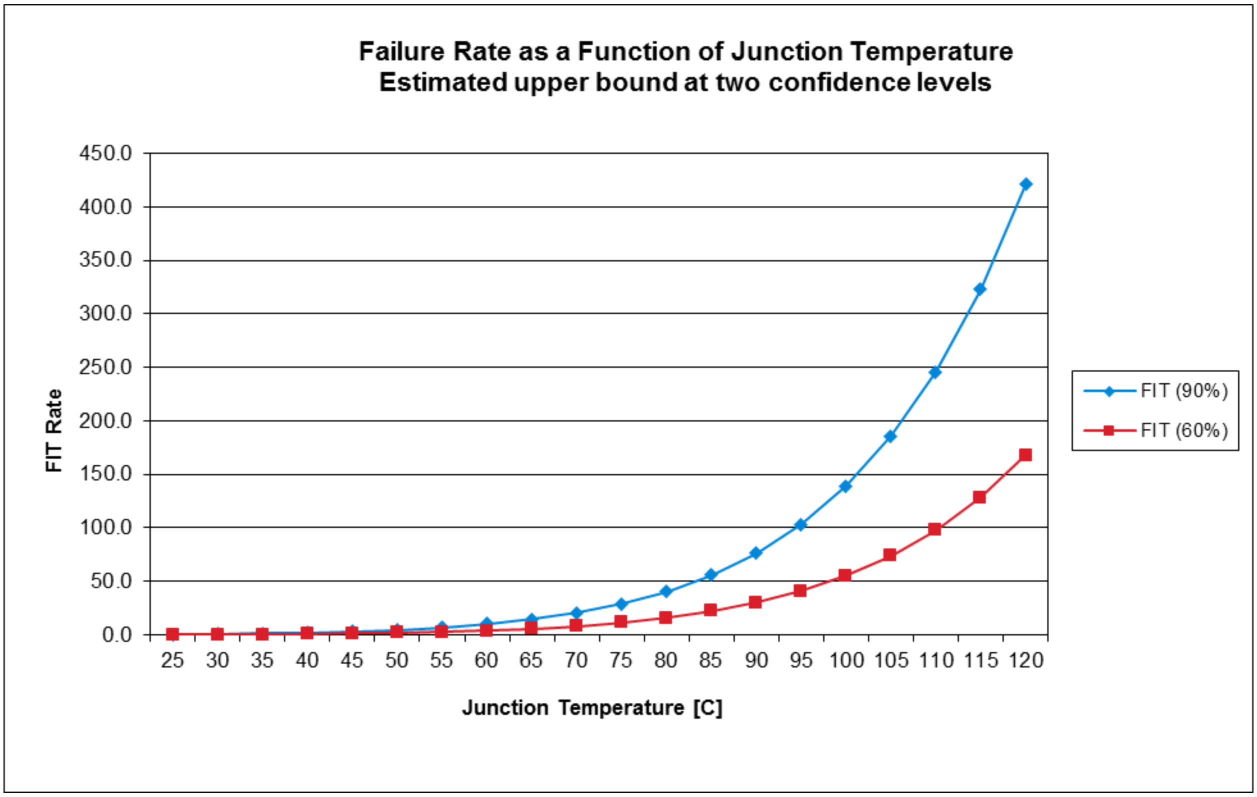
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.25 micron			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	11366	11366	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	11366015	11366015	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	0.8	0.3	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	1.2E+09	3.0E+09	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	134884.8	338957.7	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.25 micron

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.1	0.0	1111006	2791894
30	1257.7	0.2	0.1	708733	1781005
35	814.1	0.2	0.1	458759	1152834
40	534.4	0.4	0.2	301105	756660
45	355.4	0.6	0.2	200263	503249
50	239.4	0.8	0.3	134885	338958
55	163.2	1.2	0.5	91951	231067
60	112.5	1.8	0.7	63408	159341
65	78.5	2.6	1.0	44209	111093
70	55.3	3.7	1.5	31148	78274
75	39.3	5.1	2.0	22168	55707
80	28.3	7.2	2.9	15930	40030
85	20.5	9.9	3.9	11553	29032
90	15.0	13.5	5.4	8453	21242
95	11.1	18.3	7.3	6238	15675
100	8.2	24.6	9.8	4641	11662
105	6.2	32.8	13.1	3480	8744
110	4.7	43.4	17.3	2629	6606
115	3.5	57.1	22.7	2000	5026
120	2.7	74.5	29.6	1533	3851

Process - 0.25 micron w/ embedded flash



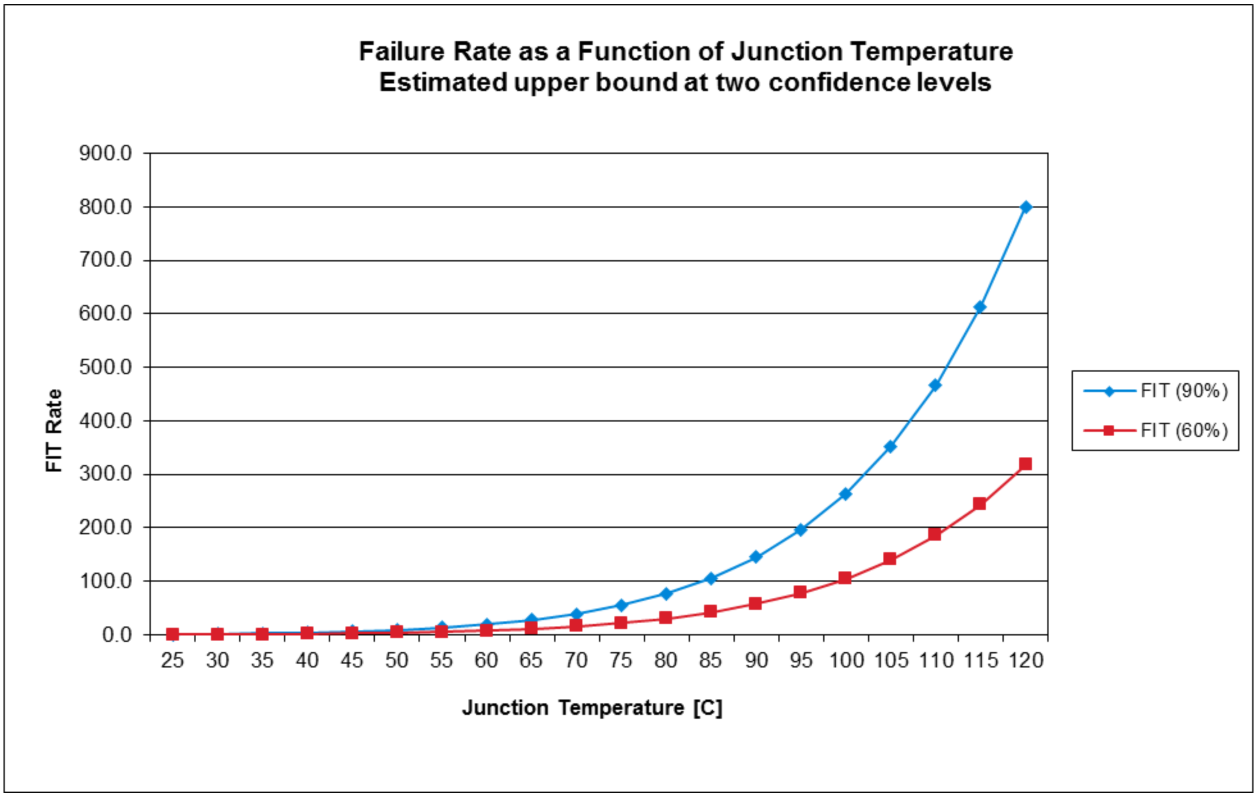
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.25 micron w/ embedded flash			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	2010	2010	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	2009540	2009540	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	4.8	1.9	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	2.1E+08	5.2E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	23848.0	59928.6	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.25 micron w/ embedded flash

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.6	0.2	196429	493614
30	1257.7	0.9	0.4	125306	314886
35	814.1	1.4	0.6	81110	203824
40	534.4	2.1	0.9	53236	133779
45	355.4	3.2	1.3	35407	88976
50	239.4	4.8	1.9	23848	59929
55	163.2	7.0	2.8	16257	40853
60	112.5	10.2	4.1	11211	28172
65	78.5	14.6	5.8	7816	19642
70	55.3	20.7	8.2	5507	13839
75	39.3	29.1	11.6	3919	9849
80	28.3	40.5	16.1	2816	7077
85	20.5	55.9	22.2	2043	5133
90	15.0	76.4	30.4	1495	3756
95	11.1	103.5	41.2	1103	2771
100	8.2	139.1	55.4	820	2062
105	6.2	185.6	73.8	615	1546
110	4.7	245.6	97.7	465	1168
115	3.5	322.8	128.5	354	889
120	2.7	421.3	167.6	271	681

Process – 0.315 - 0.35 micron



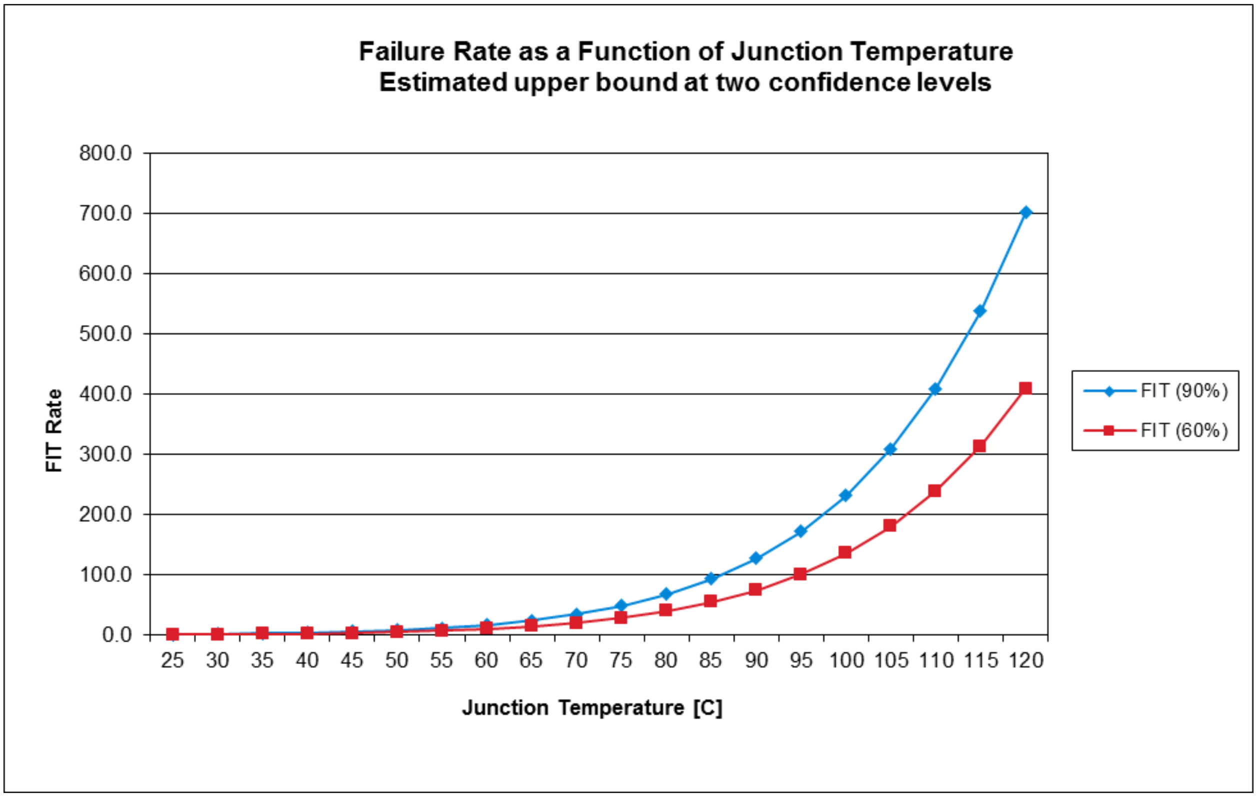
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.315 um - 0.35 um			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	1058	1058	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	1058304	1058304	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	9.1	3.6	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	1.1E+08	2.8E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	12559.3	31560.8	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.315 um - 0.35 um

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	1.1	0.4	103447	259957
30	1257.7	1.7	0.7	65991	165832
35	814.1	2.7	1.1	42716	107342
40	534.4	4.1	1.6	28036	70454
45	355.4	6.1	2.4	18647	46858
50	239.4	9.1	3.6	12559	31561
55	163.2	13.3	5.3	8562	21515
60	112.5	19.3	7.7	5904	14836
65	78.5	27.7	11.0	4116	10344
70	55.3	39.4	15.7	2900	7288
75	39.3	55.3	22.0	2064	5187
80	28.3	77.0	30.6	1483	3727
85	20.5	106.1	42.2	1076	2703
90	15.0	145.0	57.7	787	1978
95	11.1	196.5	78.2	581	1460
100	8.2	264.2	105.1	432	1086
105	6.2	352.4	140.2	324	814
110	4.7	466.4	185.6	245	615
115	3.5	612.9	243.9	186	468
120	2.7	799.9	318.3	143	359

Process - 0.35 micron



Reliability FIT Calculations for temperature acceleration

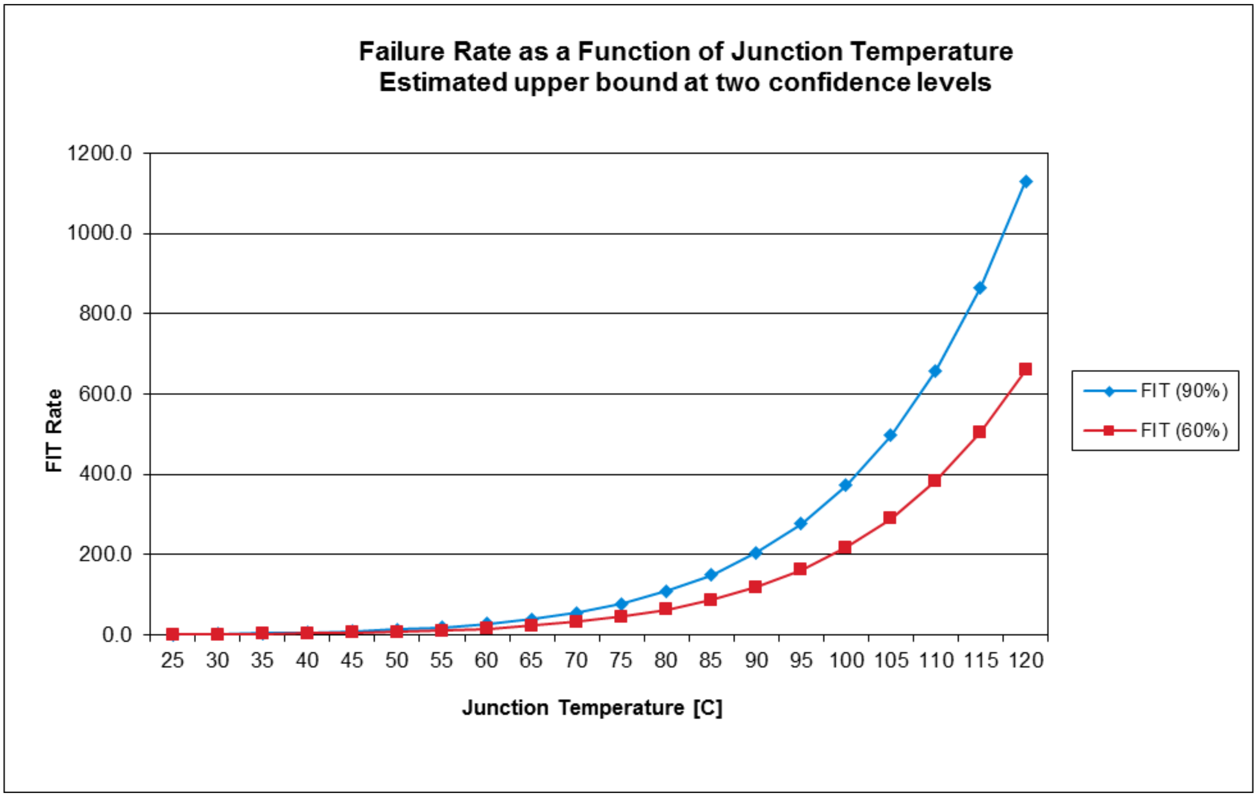
Single Point Calculation for 0.35 micron

Variables:	90%	60%	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	2790	2790	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	2	2	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	6.0	6.0	degrees of freedom [2(F+1)]
DH	2789808	2789808	Total device hours D*H
X2	10.6	6.2	Chi-Square Distribution Value
FIT	8.0	4.7	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	1.3E+08	2.2E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	14323.3	24548.8	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.35 micron

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	1.0	0.6	117977	202201
30	1257.7	1.5	0.9	75260	128988
35	814.1	2.3	1.4	48715	83493
40	534.4	3.6	2.1	31974	54801
45	355.4	5.4	3.1	21266	36447
50	239.4	8.0	4.7	14323	24549
55	163.2	11.7	6.8	9764	16735
60	112.5	17.0	9.9	6733	11540
65	78.5	24.3	14.2	4694	8046
70	55.3	34.5	20.1	3308	5669
75	39.3	48.5	28.3	2354	4035
80	28.3	67.5	39.4	1692	2899
85	20.5	93.1	54.3	1227	2103
90	15.0	127.2	74.2	898	1538
95	11.1	172.3	100.6	662	1135
100	8.2	231.7	135.2	493	845
105	6.2	309.0	180.3	369	633
110	4.7	409.0	238.6	279	478
115	3.5	537.5	313.6	212	364
120	2.7	701.4	409.2	163	279

Process - 0.35 micron w/ embedded flash



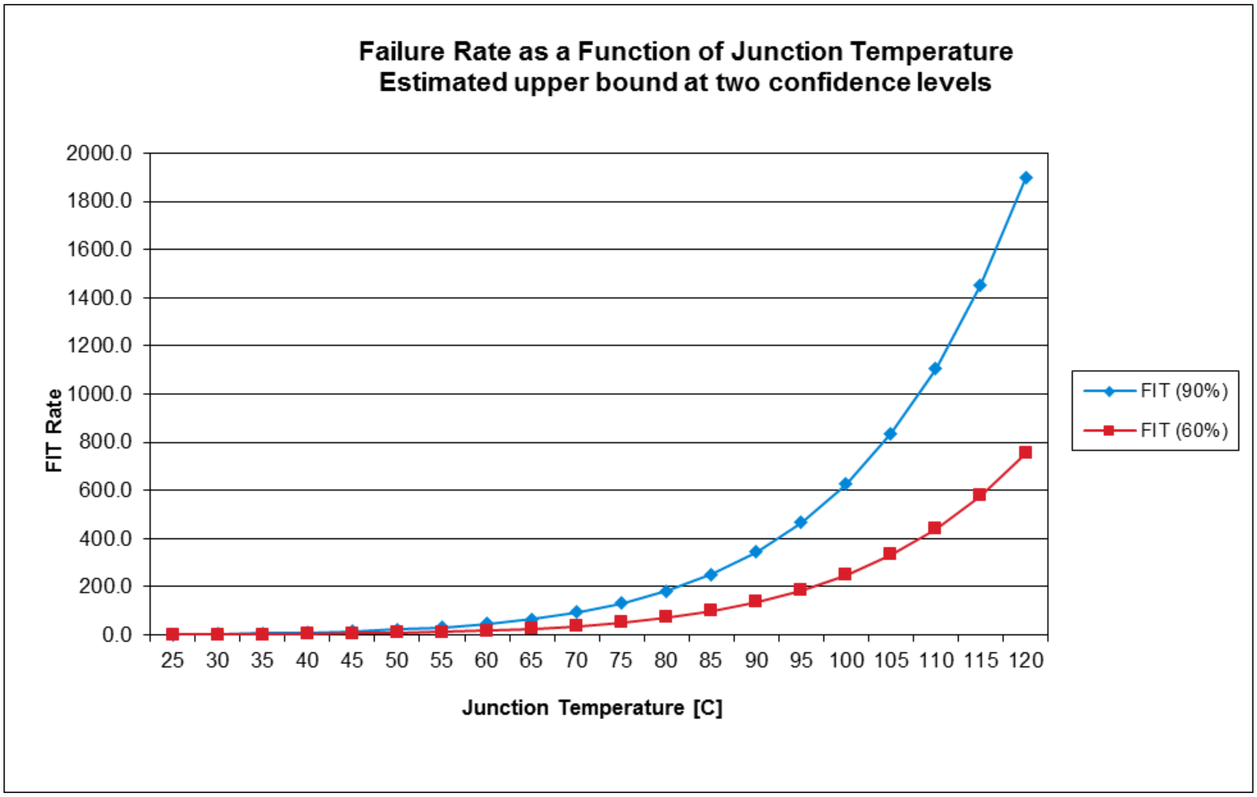
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.35 micron w/ embedded flash			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	1732	1732	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	2	2	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	6.0	6.0	degrees of freedom [2(F+1)]
DH	1731504	1731504	Total device hours D*H
X2	10.6	6.2	Chi-Square Distribution Value
FIT	12.8	7.5	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	7.8E+07	1.3E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	8889.8	15236.3	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.35 micron w/ embedded flash

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	1.6	0.9	73223	125497
30	1257.7	2.4	1.4	46710	80057
35	814.1	3.8	2.2	30235	51820
40	534.4	5.8	3.4	19845	34012
45	355.4	8.6	5.0	13199	22621
50	239.4	12.8	7.5	8890	15236
55	163.2	18.8	11.0	6060	10387
60	112.5	27.3	15.9	4179	7162
65	78.5	39.2	22.9	2914	4994
70	55.3	55.6	32.4	2053	3518
75	39.3	78.1	45.6	1461	2504
80	28.3	108.7	63.4	1050	1799
85	20.5	149.9	87.5	761	1305
90	15.0	204.9	119.6	557	955
95	11.1	277.7	162.0	411	705
100	8.2	373.2	217.8	306	524
105	6.2	497.8	290.4	229	393
110	4.7	658.9	384.5	173	297
115	3.5	865.9	505.2	132	226
120	2.7	1130.1	659.4	101	173

Process - 0.45 - 0.5 um SPTM



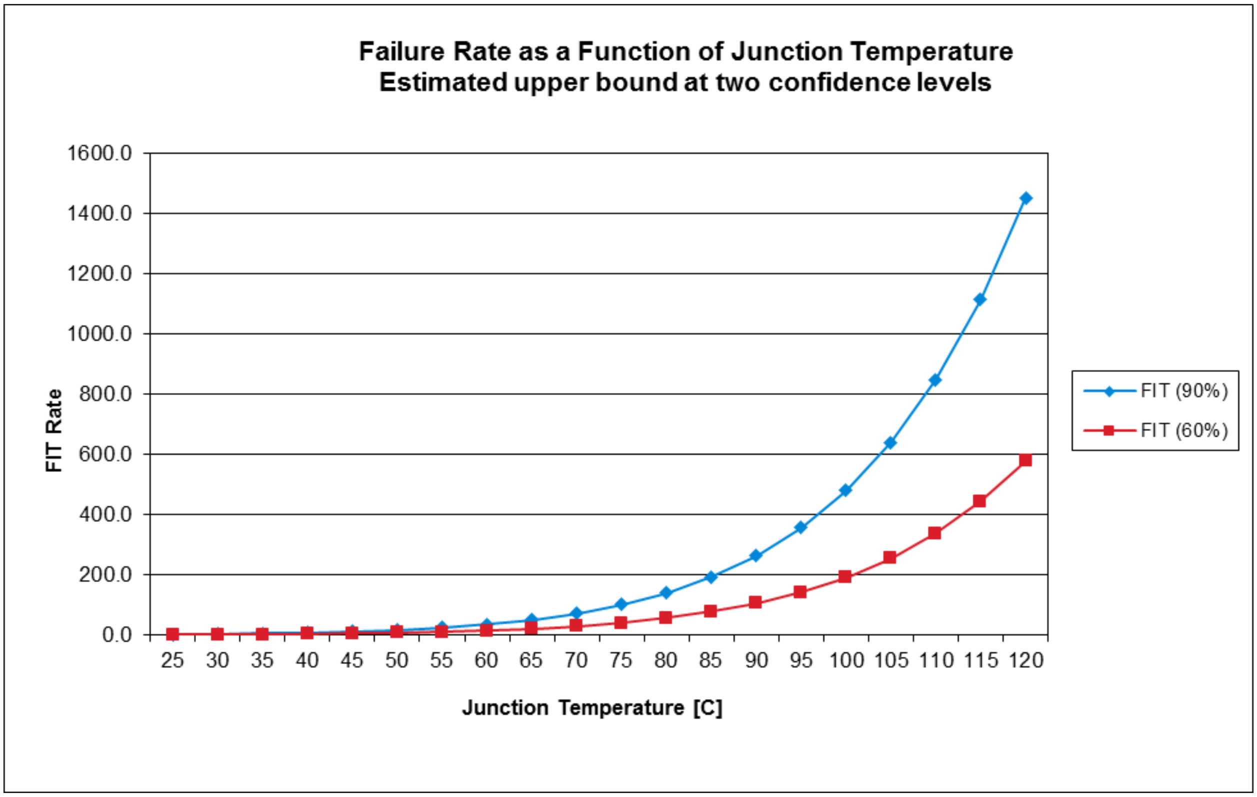
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.45 - 0.5 um SPTM			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	446	446	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	446064	446064	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	21.6	8.6	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	4.6E+07	1.2E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	5293.6	13302.5	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.45 - 0.5 um SPTM

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	2.6	1.0	43602	109569
30	1257.7	4.1	1.6	27815	69896
35	814.1	6.3	2.5	18004	45243
40	534.4	9.7	3.8	11817	29695
45	355.4	14.5	5.8	7859	19750
50	239.4	21.6	8.6	5294	13303
55	163.2	31.6	12.6	3609	9068
60	112.5	45.9	18.3	2488	6253
65	78.5	65.8	26.2	1735	4360
70	55.3	93.4	37.2	1222	3072
75	39.3	131.2	52.2	870	2186
80	28.3	182.6	72.7	625	1571
85	20.5	251.8	100.2	453	1139
90	15.0	344.1	136.9	332	834
95	11.1	466.3	185.6	245	615
100	8.2	626.8	249.4	182	458
105	6.2	836.0	332.7	137	343
110	4.7	1106.6	440.3	103	259
115	3.5	1454.2	578.7	78	197
120	2.7	1897.9	755.2	60	151

Process - 0.6 - 1.0um



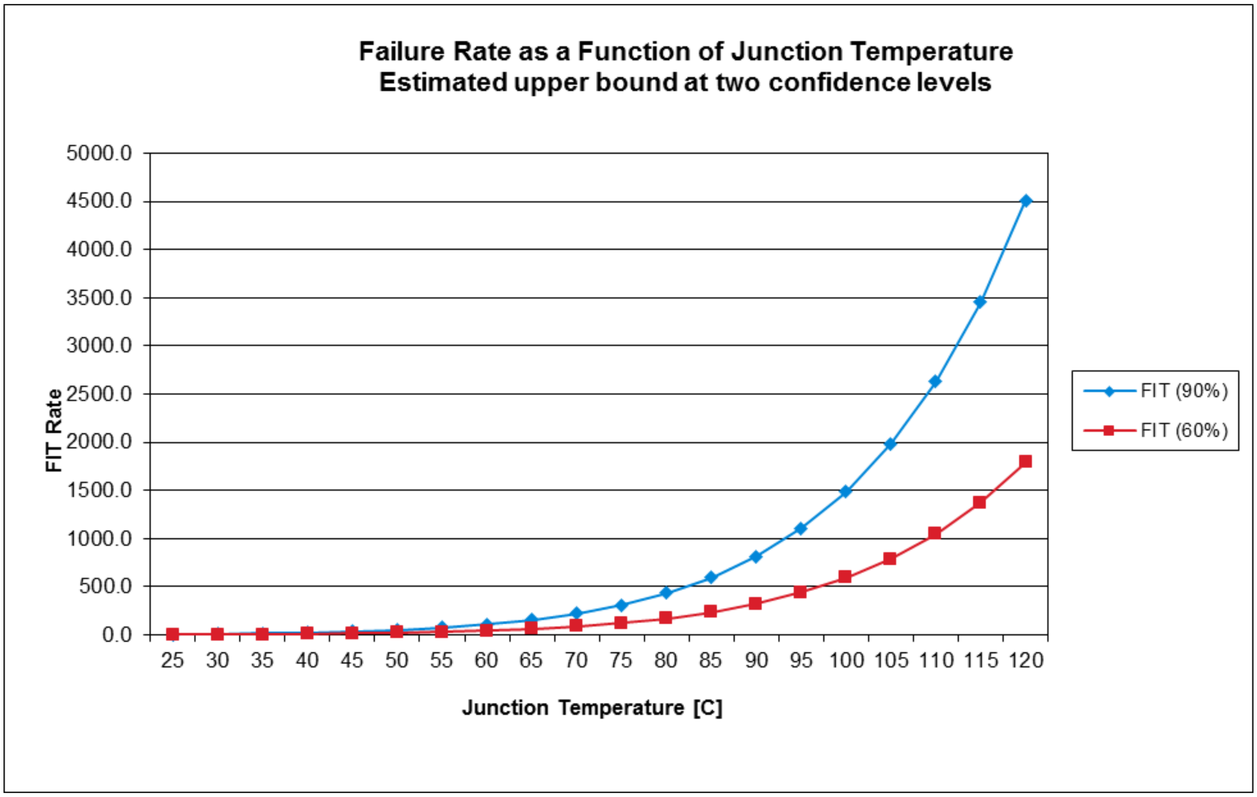
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for 0.6 - 1.0um			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	582	582	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	582487	582487	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	16.5	6.6	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	6.1E+07	1.5E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	6912.6	17370.9	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for 0.6 - 1.0um

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	2.0	0.8	56937	143079
30	1257.7	3.1	1.3	36321	91273
35	814.1	4.9	1.9	23511	59081
40	534.4	7.4	2.9	15431	38777
45	355.4	11.1	4.4	10263	25791
50	239.4	16.5	6.6	6913	17371
55	163.2	24.2	9.6	4712	11842
60	112.5	35.1	14.0	3250	8166
65	78.5	50.4	20.1	2266	5693
70	55.3	71.5	28.5	1596	4011
75	39.3	100.5	40.0	1136	2855
80	28.3	139.8	55.6	816	2051
85	20.5	192.8	76.7	592	1488
90	15.0	263.5	104.9	433	1089
95	11.1	357.1	142.1	320	803
100	8.2	480.0	191.0	238	598
105	6.2	640.2	254.8	178	448
110	4.7	847.4	337.2	135	339
115	3.5	1113.6	443.2	103	258
120	2.7	1453.4	578.4	79	197

Process – Diode



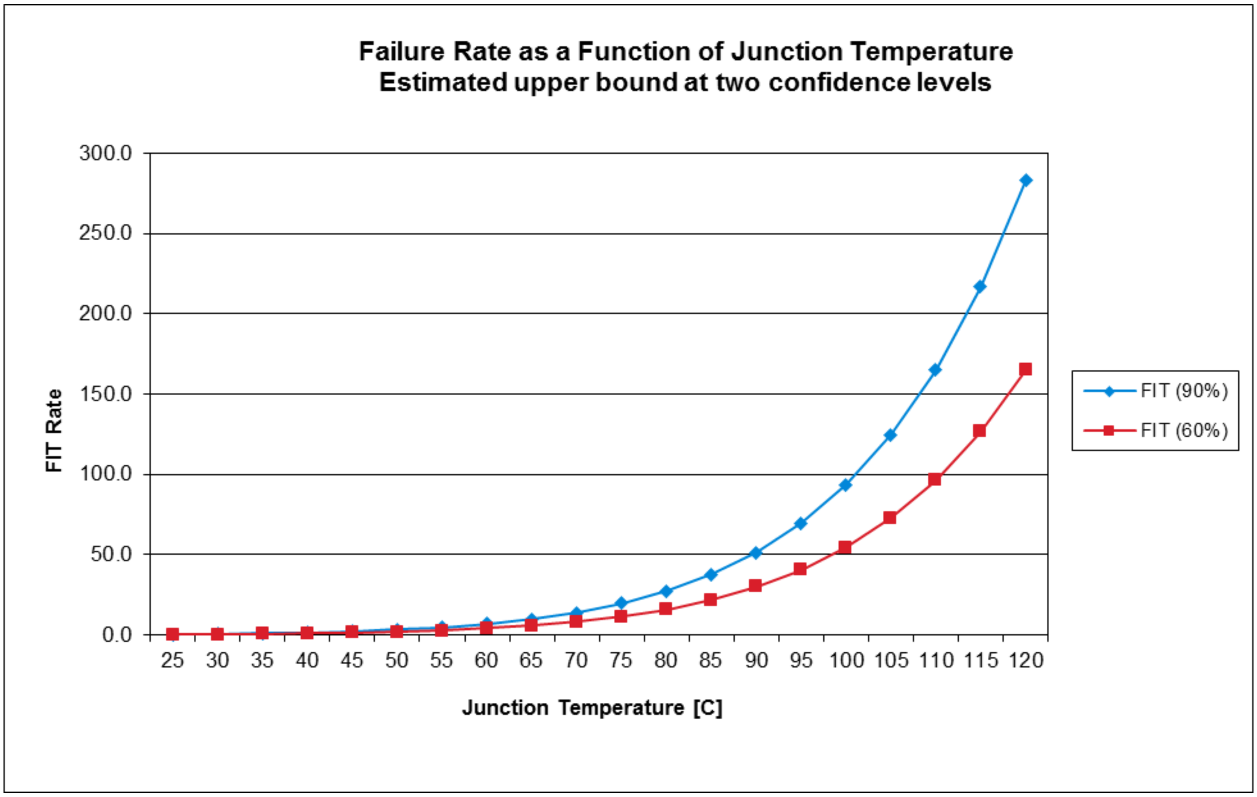
Reliability FIT Calculations for temperature acceleration

Single Point Calculation for Diode			
Variables:	**90%**	**60%**	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	188	188	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	0	0	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	2.0	2.0	degrees of freedom [2(F+1)]
DH	187703	187703	Total device hours D*H
X2	4.6	1.8	Chi-Square Distribution Value
FIT	51.2	20.4	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	2.0E+07	4.9E+07	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	2227.5	5597.7	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

FIT Estimation Curves for Diode

Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	6.2	2.5	18348	46107
30	1257.7	9.8	3.9	11704	29412
35	814.1	15.1	6.0	7576	19038
40	534.4	23.0	9.1	4973	12496
45	355.4	34.5	13.7	3307	8311
50	239.4	51.2	20.4	2228	5598
55	163.2	75.2	29.9	1519	3816
60	112.5	109.0	43.4	1047	2631
65	78.5	156.4	62.2	730	1835
70	55.3	221.9	88.3	514	1293
75	39.3	311.8	124.1	366	920
80	28.3	433.9	172.7	263	661
85	20.5	598.3	238.1	191	479
90	15.0	817.7	325.4	140	351
95	11.1	1108.2	441.0	103	259
100	8.2	1489.6	592.8	77	193
105	6.2	1986.6	790.6	57	144
110	4.7	2629.7	1046.5	43	109
115	3.5	3455.9	1375.2	33	83
120	2.7	4510.2	1794.8	25	64

Process - High Voltage



Reliability FIT Calculations for temperature acceleration

Single Point Calculation for High Voltage

Variables:	90%	60%	Confidence Level
Tja [C]	50	50	Junction Temperature at operating condition
Tsa [C]	125	125	Ambient Temperature at stress
Tjs [C]	140	140	Junction Temperature at stress (assume 15C rise)
Ea	0.7	0.7	Energy Activation
D	6914	6914	Equivalent Devices stressed (Assuming 1000hrs per device)
H	1000	1000	Number of hours on stress
F	2	2	Number of failures
P	0.1	0.4	Confidence Level [.1 = 90%; .4 = 60%]
Constants:			
k	8.61E-05	8.61E-05	Boltzman's constant [eV/K]
Calculated Values:			
Af	239.4	239.4	Acceleration Factor: [exp(Ea/k*(1/(Tja + 273.15) - (1/(Tjs + 273.15))]
v	6.0	6.0	degrees of freedom [2(F+1)]
DH	6914139	6914139	Total device hours D*H
X2	10.6	6.2	Chi-Square Distribution Value
FIT	3.2	1.9	Failures in time [failures / 1xE9 hours] =[X2/(2*AF*D*H)*1E9]
MTTF	3.1E+08	5.3E+08	Mean Time To Failure [hours] (Note: MTTF is 1/FIT)
MTTF	35498.3	60840.7	Mean Time To Failure [years] (Note: MTTF is 1/FIT)

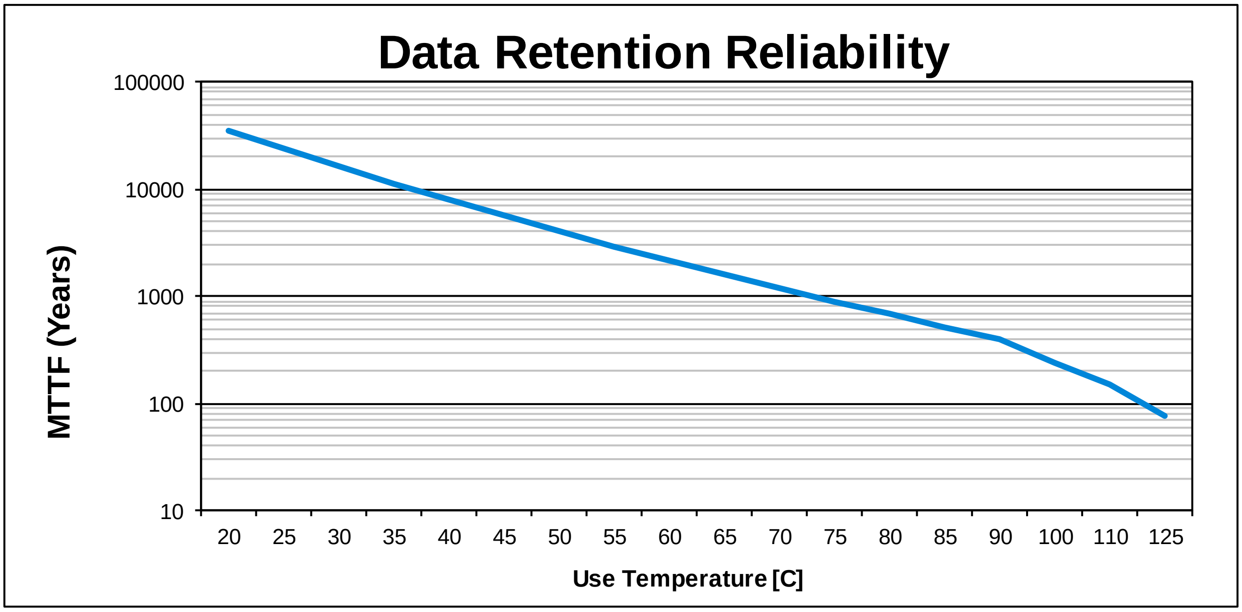
FIT Estimation Curves for High Voltage

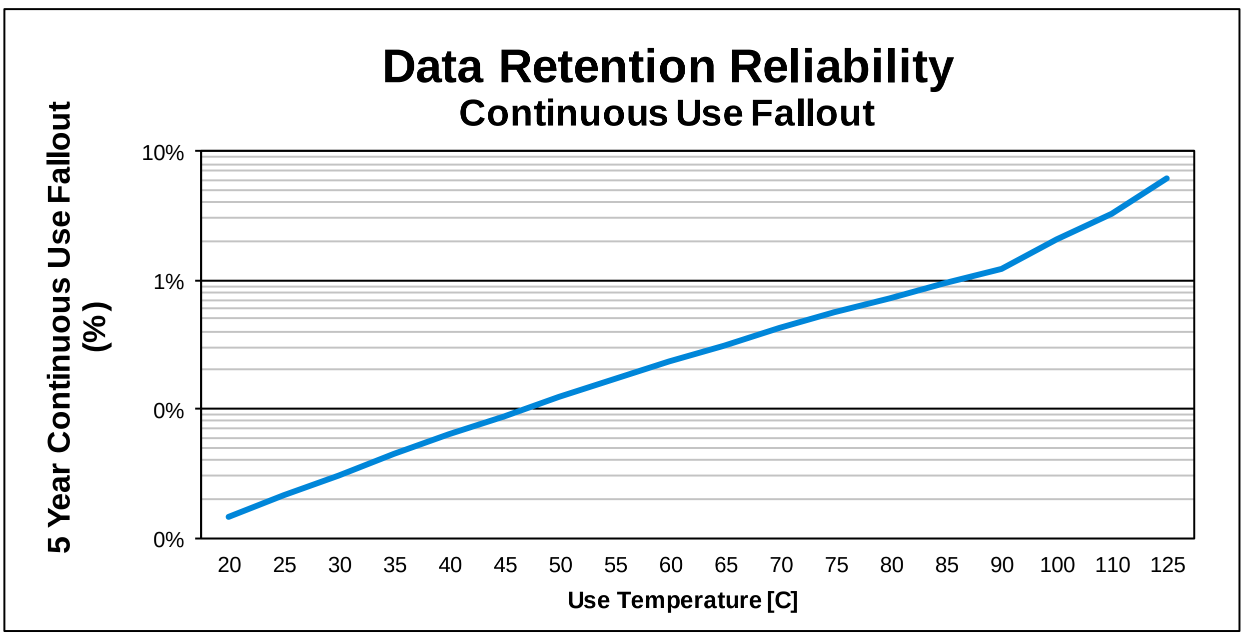
Tja	Af	FIT (90%)	FIT (60%)	MTTF 90% (yrs)	MTTF 60% (yrs)
25	1971.6	0.4	0.2	292389	501127
30	1257.7	0.6	0.4	186521	319679
35	814.1	0.9	0.6	120734	206926
40	534.4	1.4	0.8	79243	135816
45	355.4	2.2	1.3	52704	90330
50	239.4	3.2	1.9	35498	60841
55	163.2	4.7	2.8	24199	41475
60	112.5	6.8	4.0	16687	28601
65	78.5	9.8	5.7	11635	19941
70	55.3	13.9	8.1	8197	14050
75	39.3	19.6	11.4	5834	9999
80	28.3	27.2	15.9	4192	7185
85	20.5	37.5	21.9	3040	5211
90	15.0	51.3	29.9	2225	3813
95	11.1	69.5	40.6	1642	2814
100	8.2	93.5	54.5	1221	2093
105	6.2	124.7	72.7	916	1569
110	4.7	165.0	96.3	692	1186
115	3.5	216.9	126.5	526	902
120	2.7	283.0	165.1	403	691

Flash Reliability Summary by Fab Technology

40 nm Flash Reliability Summary

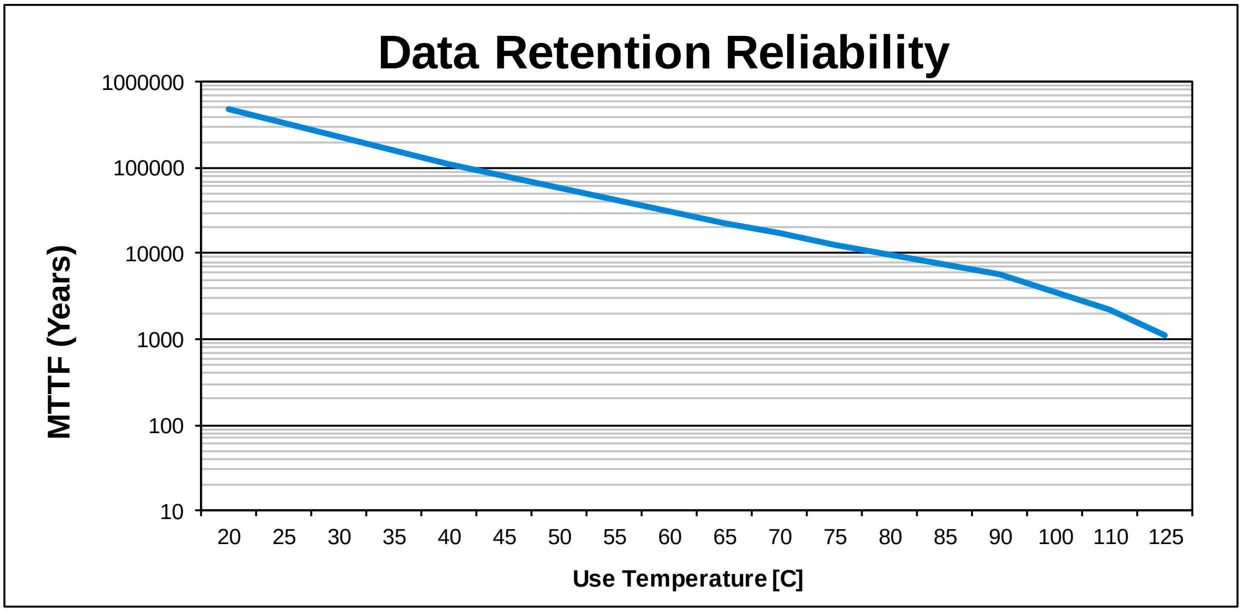
Effective Dev-Hrs at 150°C	Chargeable Failures	**Typical Case:** Predicted FIT @Ta=50˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=50°C 60% UCL	**Worst Case:** Predicted FIT @Ta=85˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=85°C 60% UCL
228,072	**0**	**28.1**	**0.246%**	**218.9**	**1.900%**

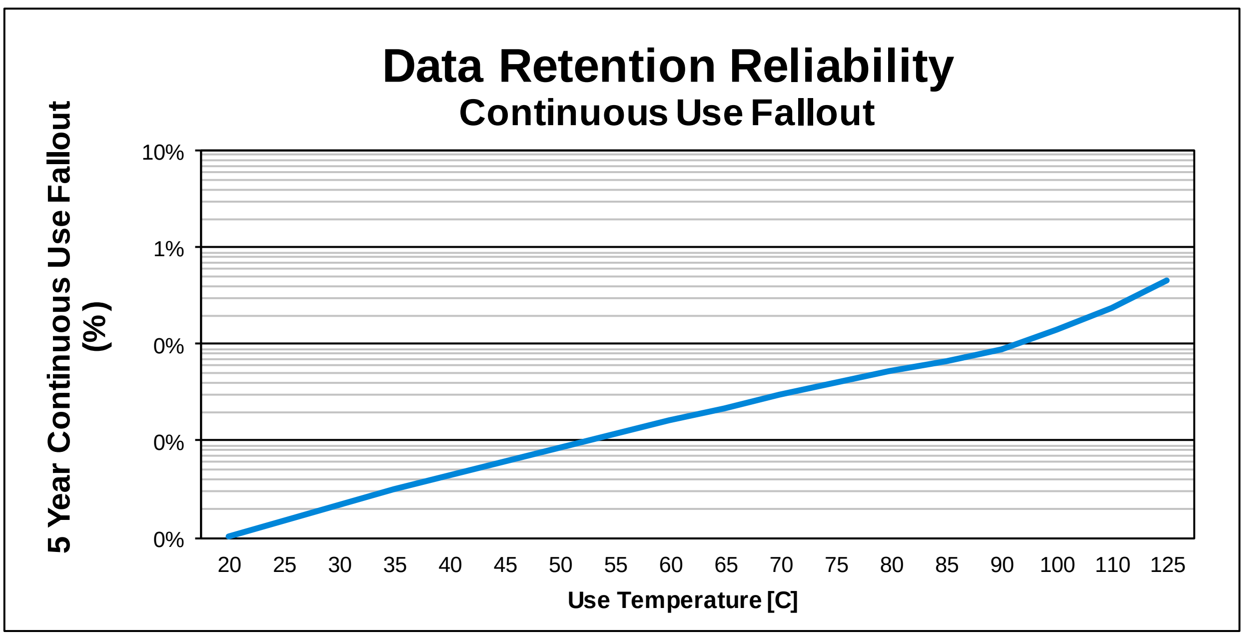




90 nm Flash Reliability Summary

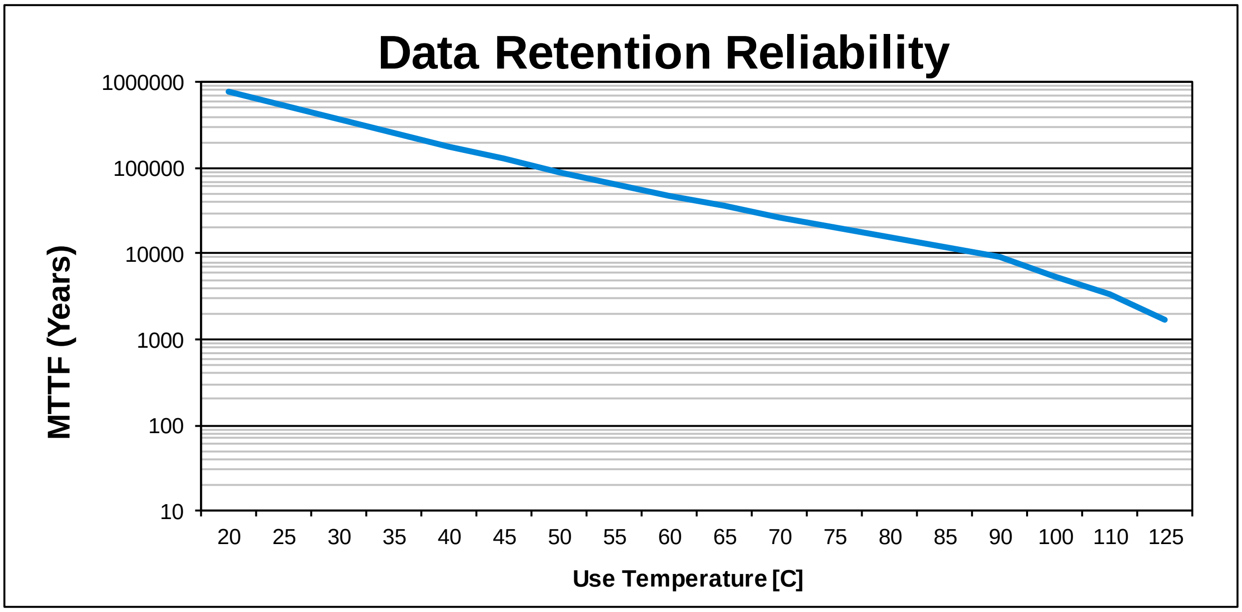
Effective Dev-Hrs at 150°C	Chargeable Failures	**Typical Case:** Predicted FIT @Ta=50˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=50°C 60% UCL	**Worst Case:** Predicted FIT @Ta=85˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=85°C 60% UCL
3,243,664	**0**	**2.0**	**0.017%**	**15.4**	**0.135%**

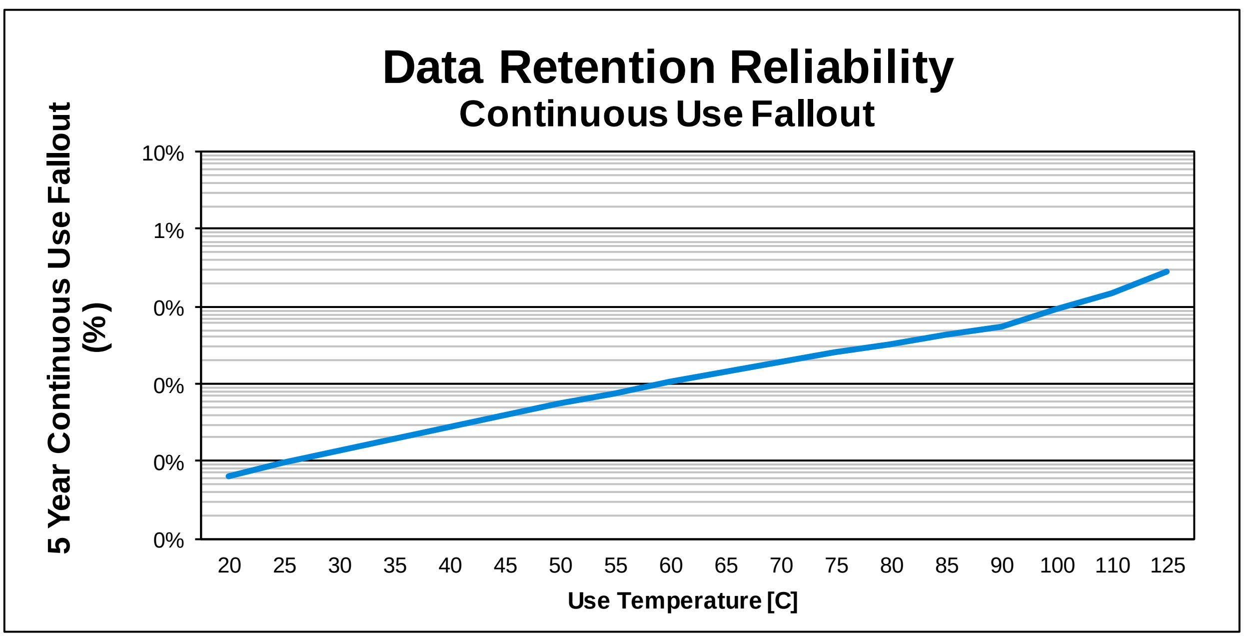




0.11um OTP Reliability Summary

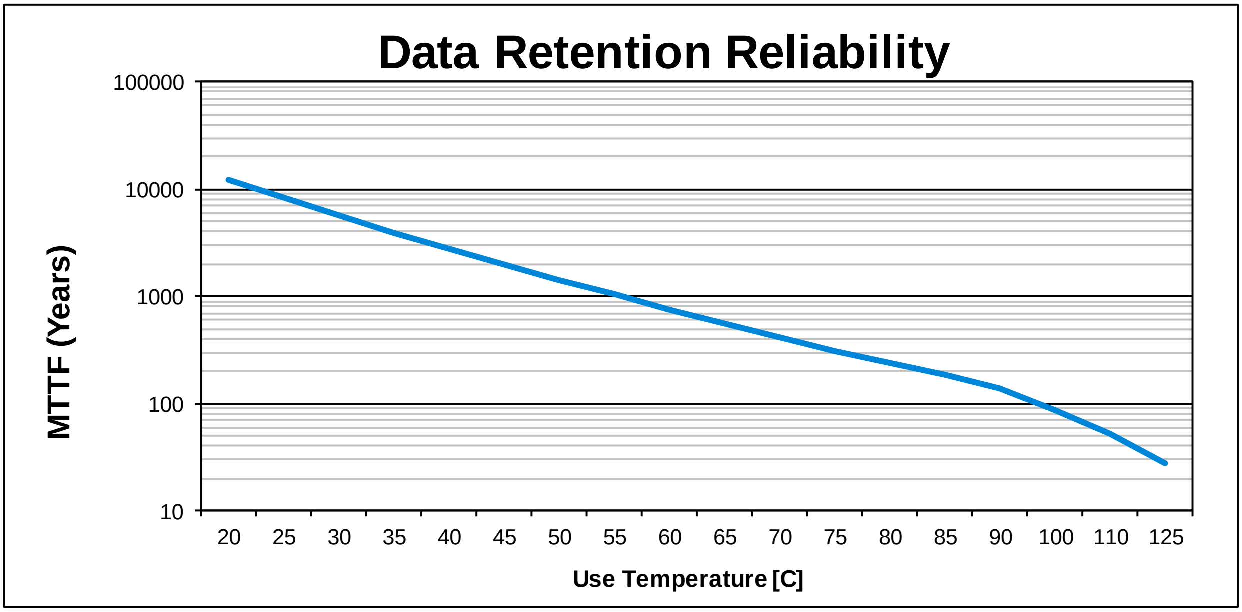
Effective Dev-Hrs at 150°C	Chargeable Failures	Typical Case: Predicted FIT @Ta=50°C, 60% UCL	10 Year Predicted Failure Rate Ta=50°C 60% UCL	Worst Case: Predicted FIT @Ta=85°C, 60% UCL	10 Year Predicted Failure Rate Ta=85°C 60% UCL
5,102,196	0	1.3	0.011%	9.8	0.086%

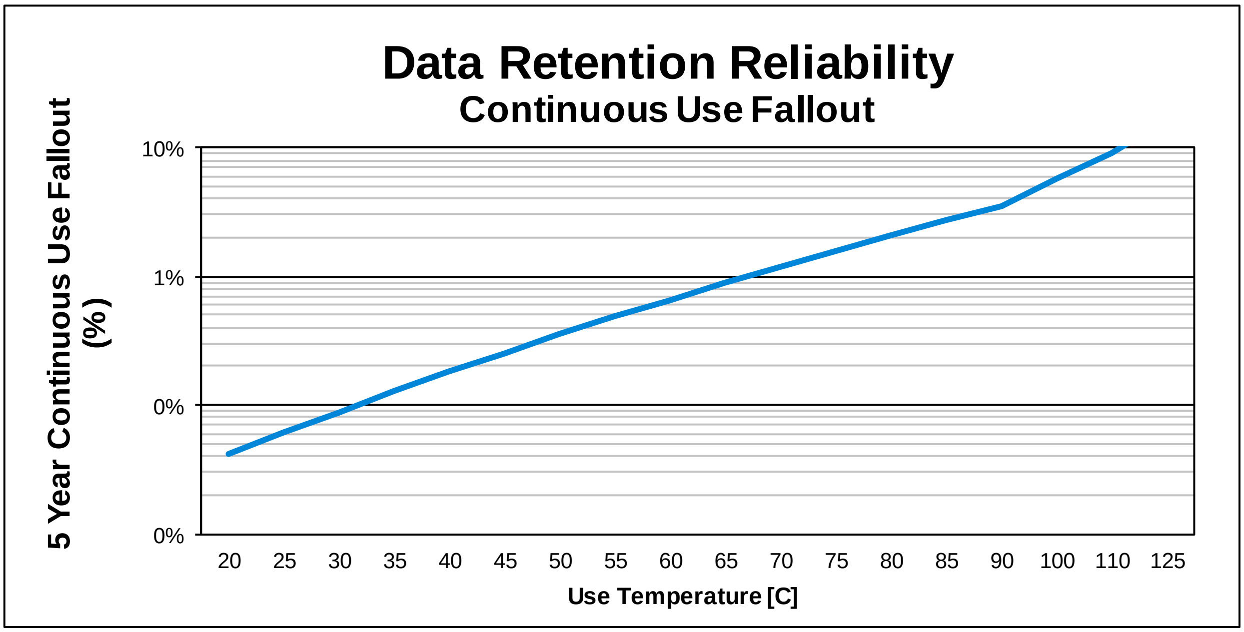




0.13um Flash Reliability Summary

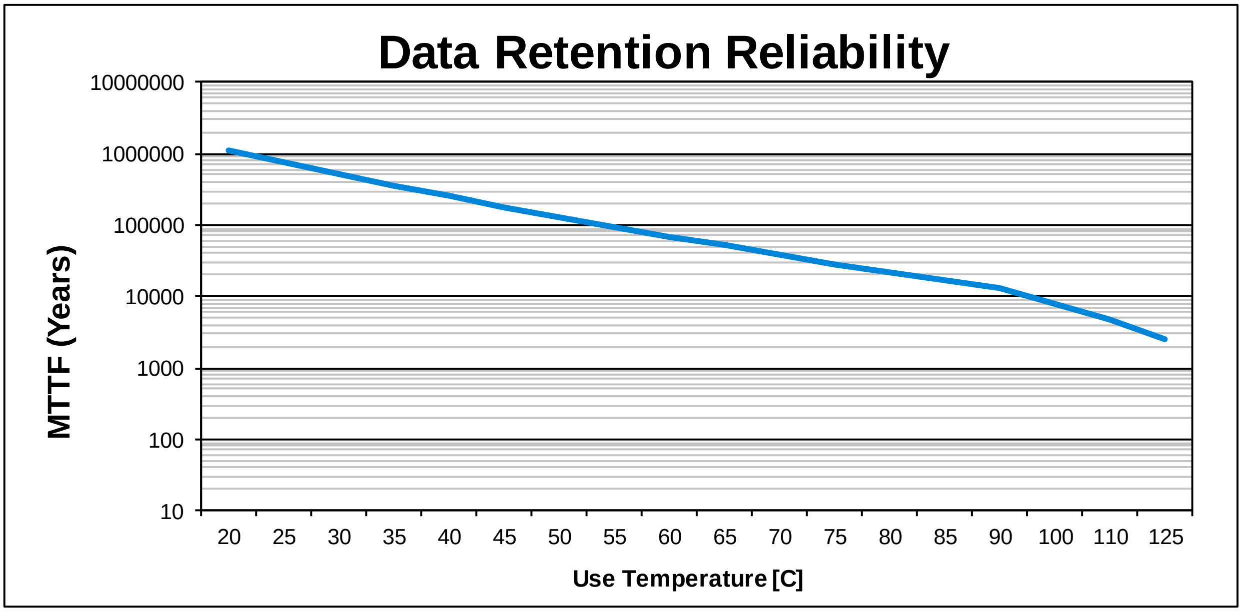
Effective Dev-Hrs at 150°C	**Chargeable Failures**	**Typical Case:** Predicted FIT @Ta=50˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=50°C 60% UCL	**Worst Case:** Predicted FIT @Ta=85˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=85°C 60% UCL
80,000	**0**	**80.2**	**0.700%**	**624.2**	**5.321%**

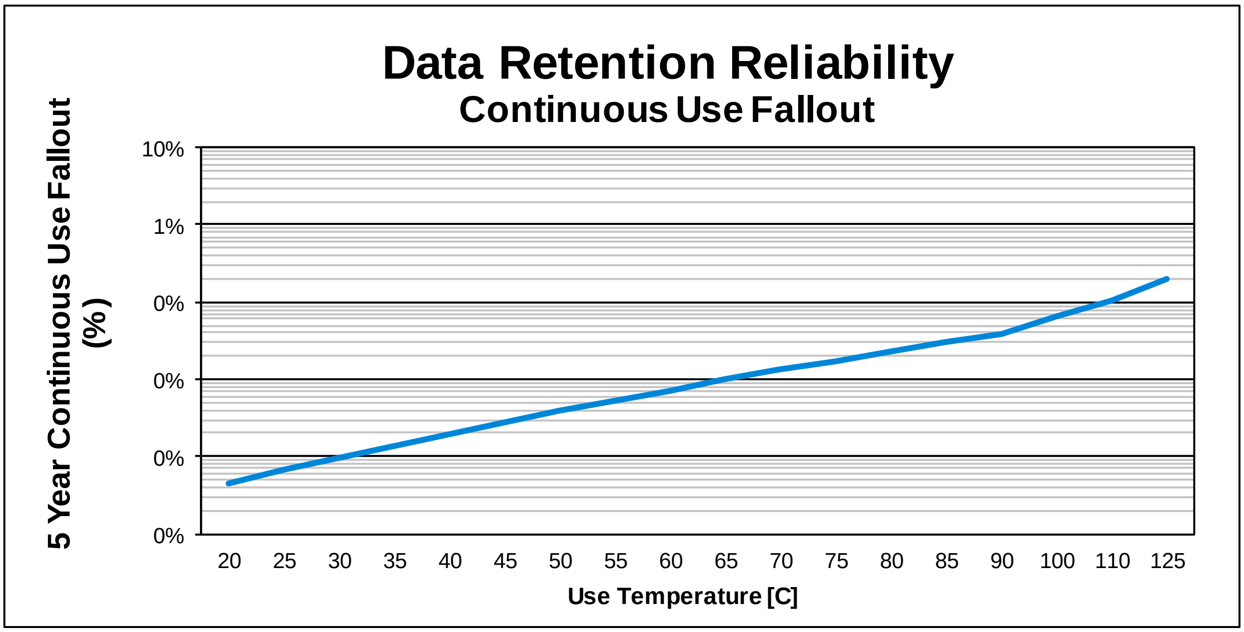




0.13um OTP Reliability Summary

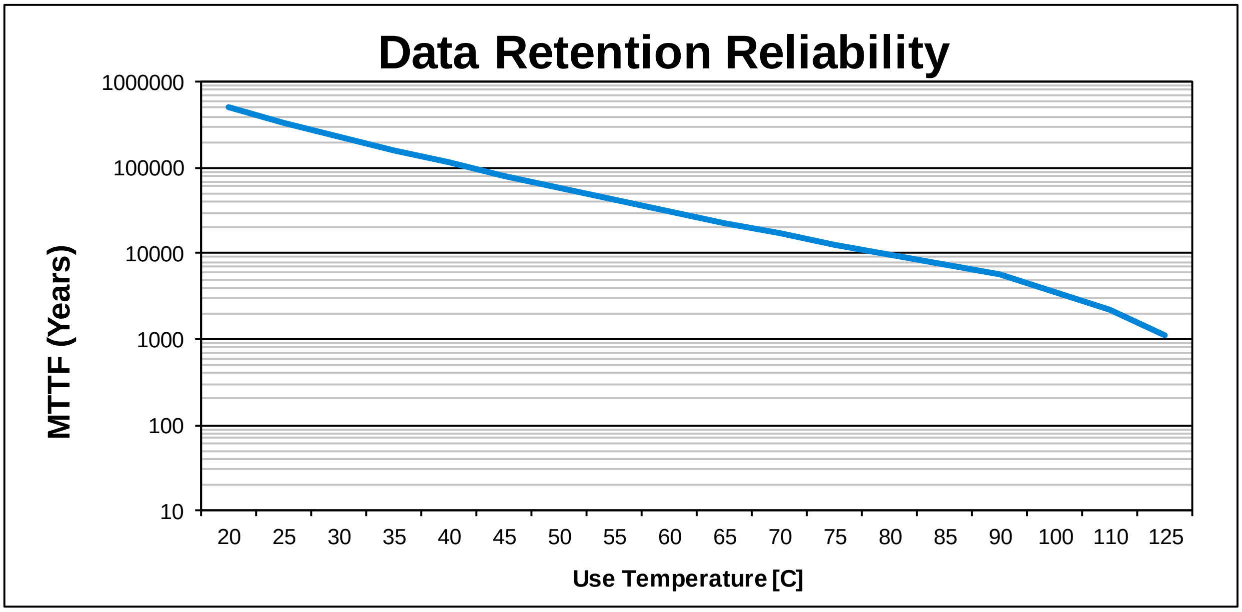
Effective Dev-Hrs at 150°C	Chargeable Failures	Typical Case: Predicted FIT @Ta=50˚C, 60% UCL	10 Year Predicted Failure Rate Ta=50°C 60% UCL	Worst Case: Predicted FIT @Ta=85˚C, 60% UCL	10 Year Predicted Failure Rate Ta=85°C 60% UCL
7,307,719	0	0.9	0.008%	6.8	0.060%

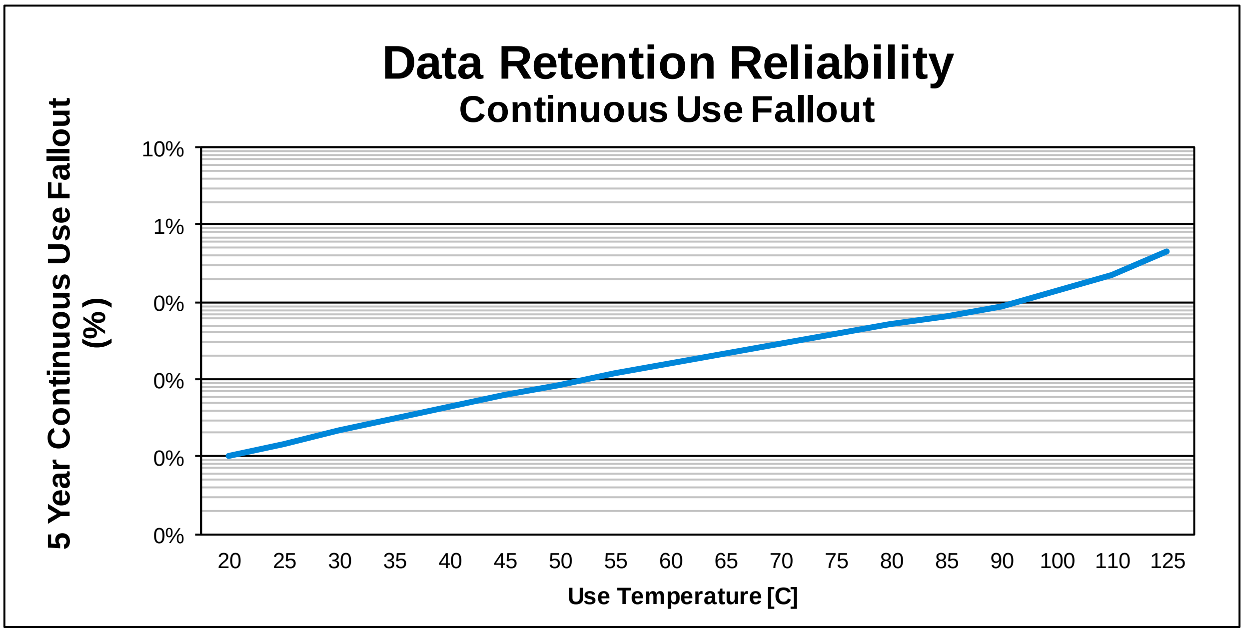




0.18um Flash Reliability Summary

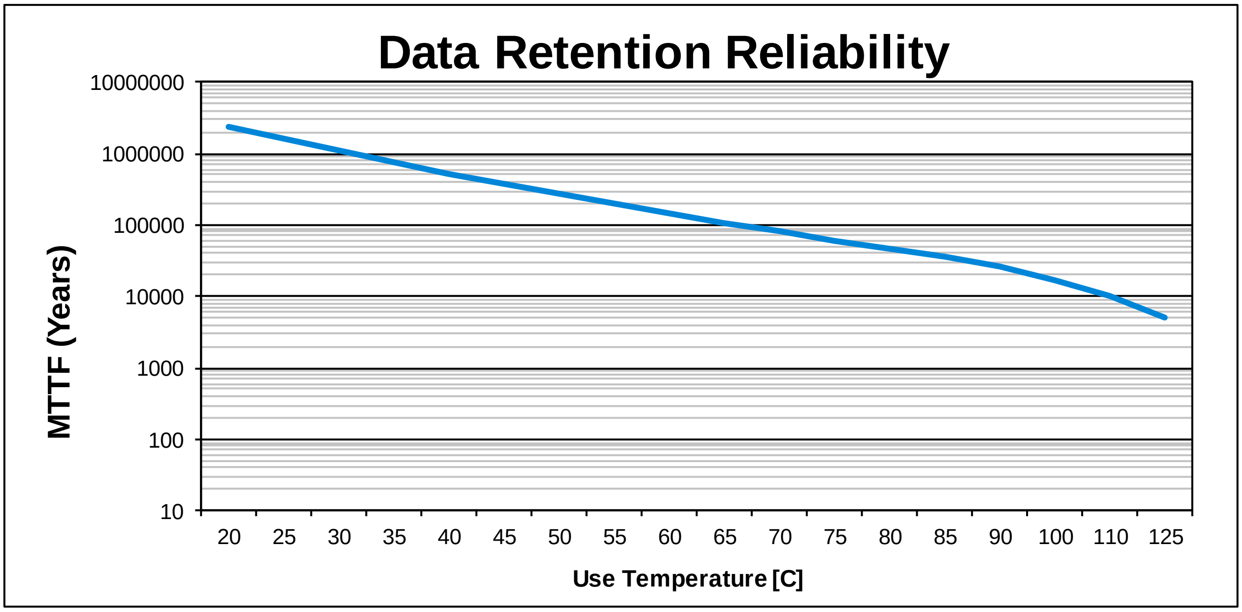
Effective Dev-Hrs at 150°C	Chargeable Failures	**Typical Case:** Predicted FIT @Ta=50˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=50°C 60% UCL	**Worst Case:** Predicted FIT @Ta=85˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=85°C 60% UCL
26,268,808	**6**	**2.0**	**0.017%**	**15.2**	**0.133%**

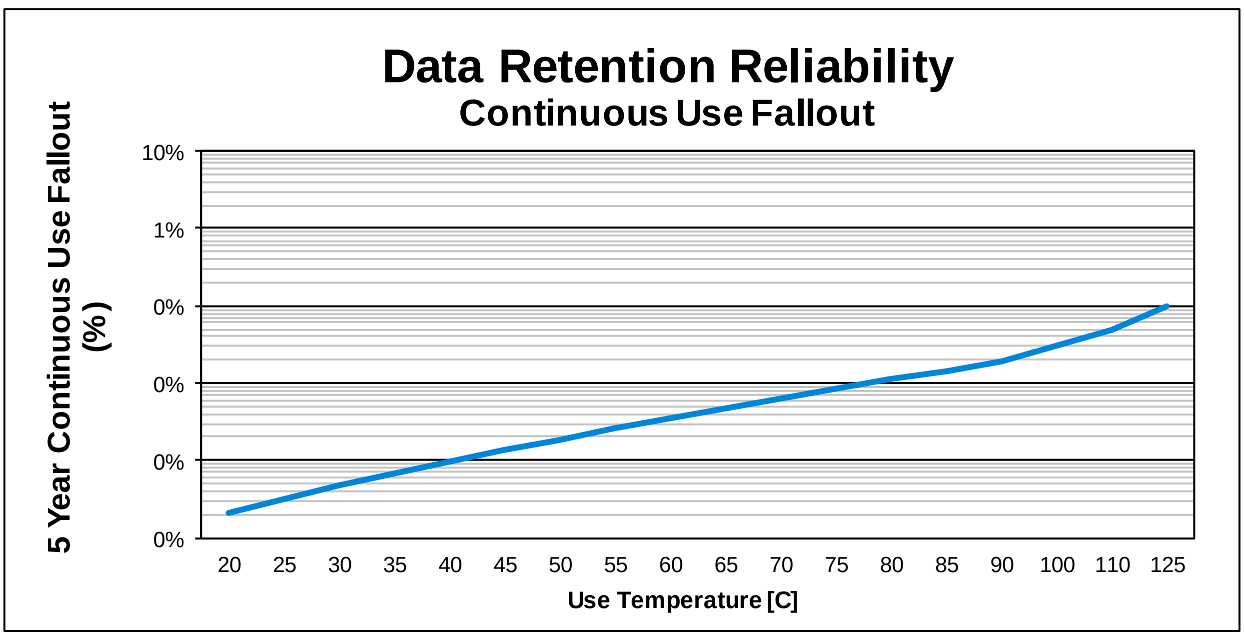




0.18um OTP Reliability Summary

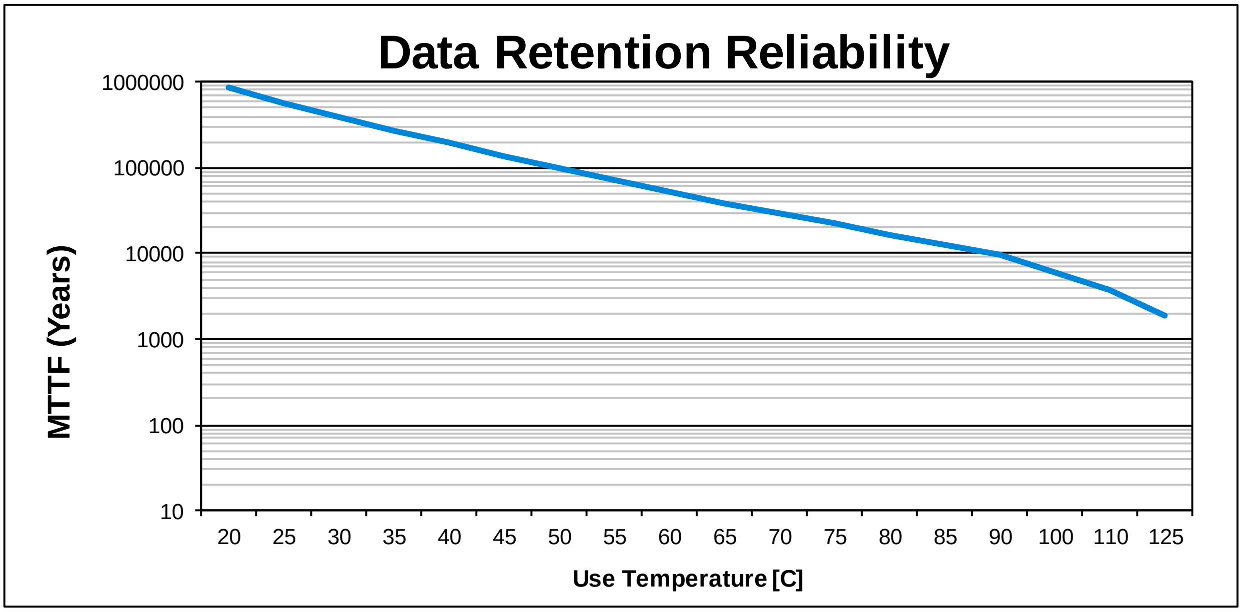
Effective Dev-Hrs at 150°C	Chargeable Failures	Typical Case: Predicted FIT @Ta=50˚C, 60% UCL	10 Year Predicted Failure Rate Ta=50°C 60% UCL	Worst Case: Predicted FIT @Ta=85˚C, 60% UCL	10 Year Predicted Failure Rate Ta=85°C 60% UCL
15,260,848	0	0.4	0.004%	3.3	0.029%

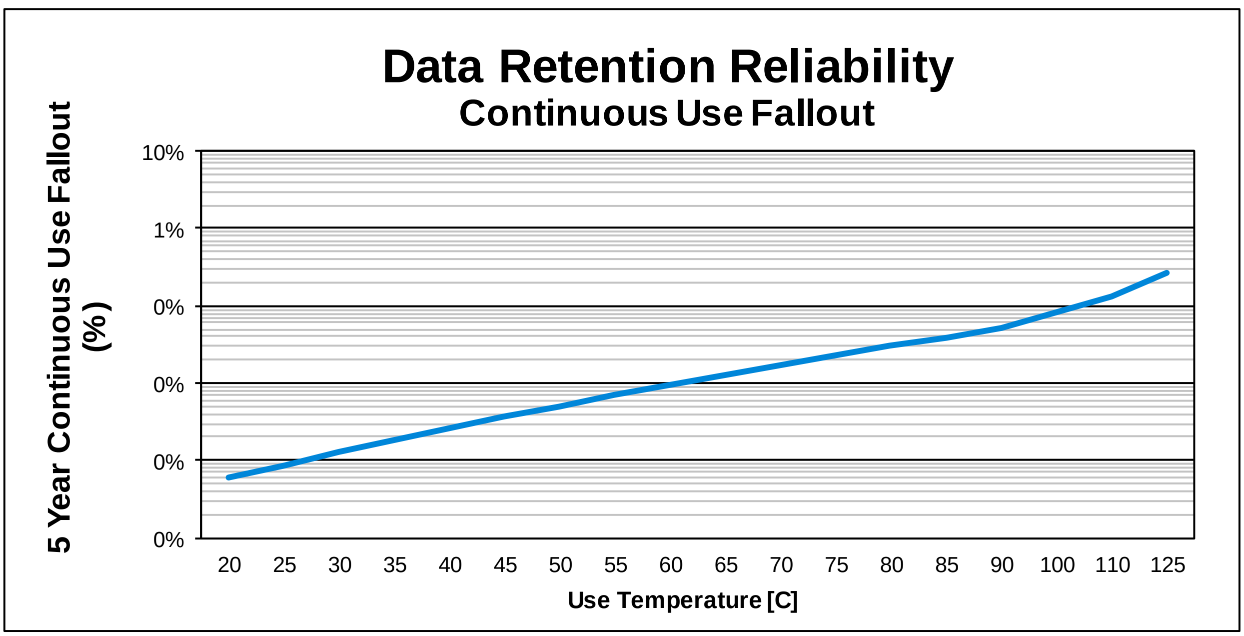




0.25um HDR Flash Reliability Summary

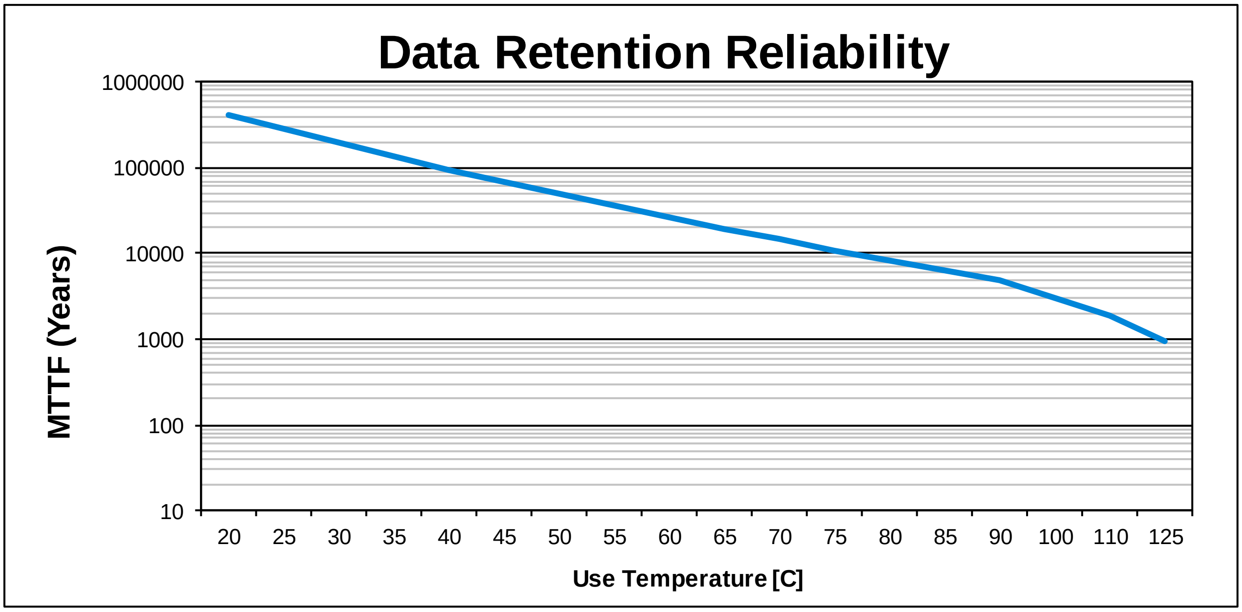
Effective Dev-Hrs at 150°C	Chargeable Failures	**Typical Case:** Predicted FIT @Ta=50˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=50°C 60% UCL	**Worst Case:** Predicted FIT @Ta=85˚C, 60% UCL	**10 Year** Predicted Failure Rate Ta=85°C 60% UCL
5,591,033	**0**	**1.1**	**0.010%**	**8.9**	**0.078%**

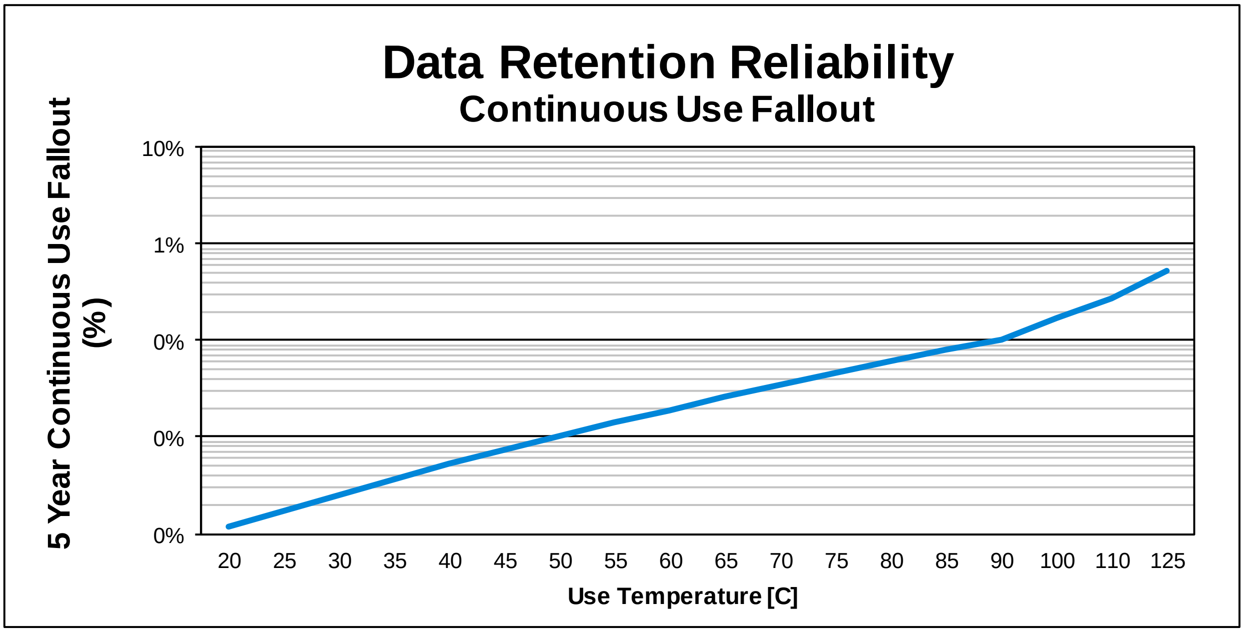




0.35um HE Flash Reliability Summary

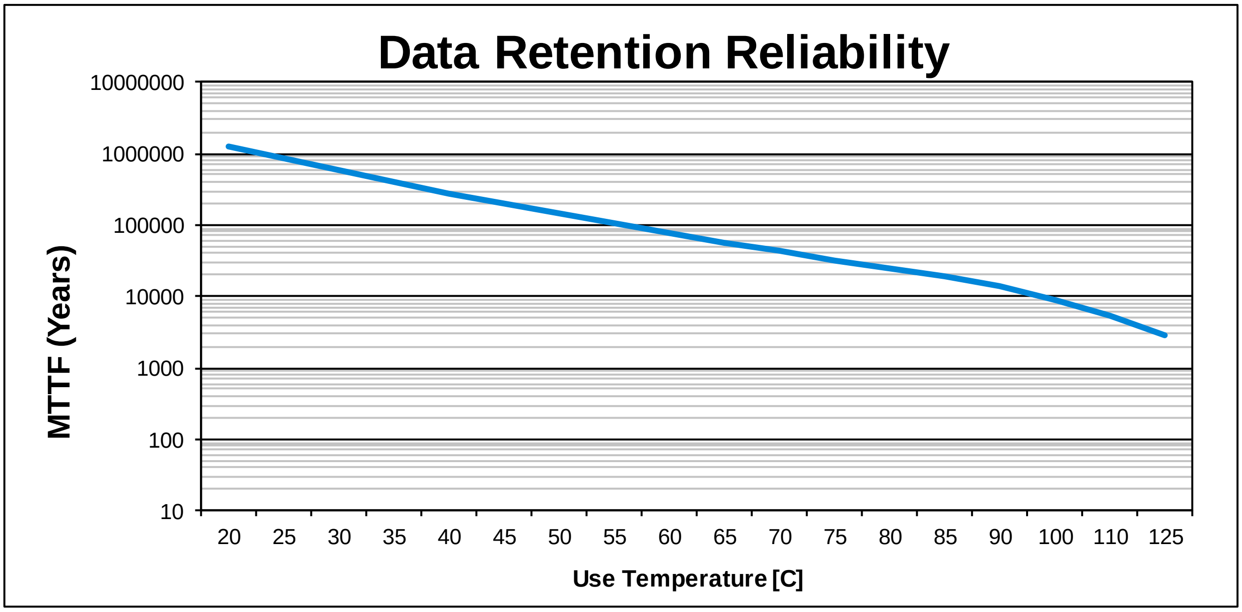
Effective Dev-Hrs at 150°C	Chargeable Failures	**Typical Case:** Predicted FIT @Ta=50°C, 60% UCL	**10 Year** Predicted Failure Rate Ta=50°C 60% UCL	**Worst Case:** Predicted FIT @Ta=85°C, 60% UCL	**10 Year** Predicted Failure Rate Ta=85°C 60% UCL
2,770,053	**0**	**2.3**	**0.020%**	**18.0**	**0.158%**

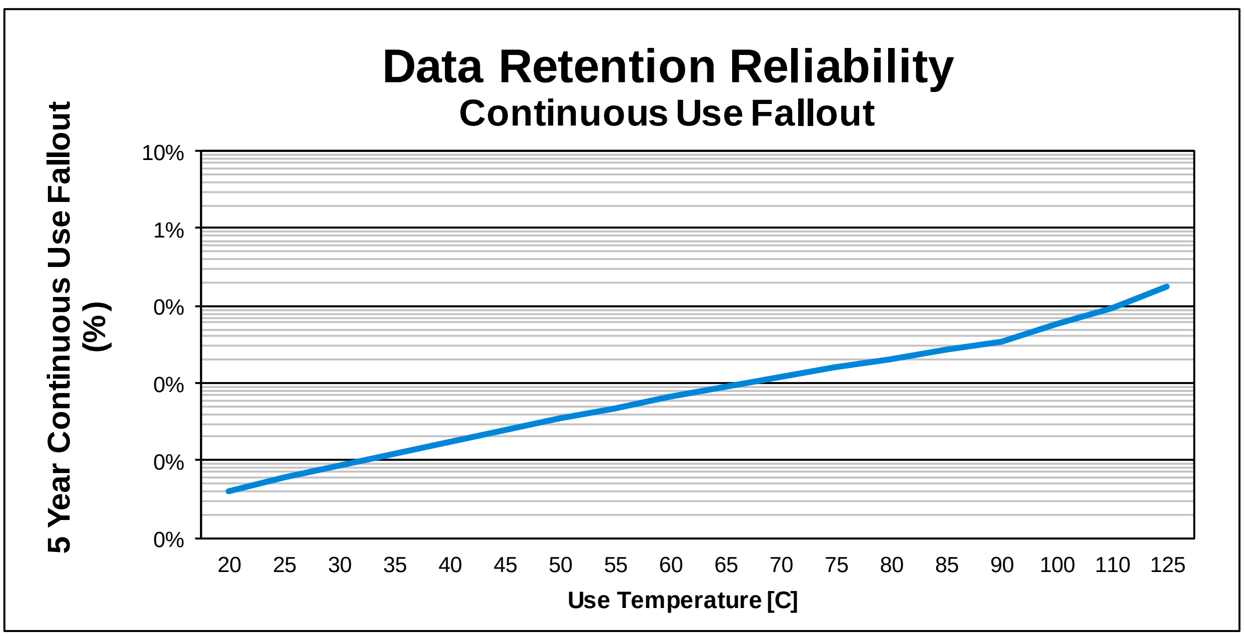




0.35um Non-HE Flash Reliability Summary

Effective Dev-Hrs at 150°C	Chargeable Failures	Typical Case: Predicted FIT @Ta=50˚C, 60% UCL	10 Year Predicted Failure Rate Ta=50°C 60% UCL	Worst Case: Predicted FIT @Ta=85˚C, 60% UCL	10 Year Predicted Failure Rate Ta=85°C 60% UCL
8,112,366	0	0.8	0.007%	6.2	0.054%





Reliability Monitors

Overview

Once a product is qualified, we verify continued product reliability with a reliability monitor program. The monitor program is scheduled to periodically sample wafer fab and package technologies. The results are published in this report. Any failures are used to drive corrective action and product and process improvement.

Stress Descriptions

Silicon Labs follows JEDEC as the preferred industry standard. The most common reliability tests and conditions are listed in the following table. The specific JEDEC documents are available on the Internet at www.jedec.org.

Reliability Tests, Procedures and Conditions Table

	Stress Name	Stress Procedure	Standard Conditions
DR	Data Retention Bake	AEC_Q100	150°C (pkg form); 250C (wafer)
ELFR	Early Life Failure Rate	JEDEC JESD22-A108	125°C; Max operating voltage
HAST	Highly-Accelerated Temperature and Humidity Stress Test	JEDEC JESD22-A110	130°C; 85%rh; 22.2 psia; biased
HTB	High Temperature Bake	JEDEC JESD22-A103	150°C
LTOL	Low Temperature Operating Life	JEDEC JESD22-A108	-10°C; Max operating voltage
HTOL	High Temperature Operating Life	JEDEC JESD22-A108	125°C; Max operating voltage
PC	Preconditioning	JEDEC JESD22-A113	According to MSL level prior to package stresses (listed below)
TC	Temperature Cycle	JEDEC JESD22-A104	Condition C: -65 to 150°C
U-HAST	Unbiased HAST	JEDEC JESD22-A118	130°C; 85%rh
THB	Temperature Humidity Bias	JEDEC JESD22-A101	85°C; 85%RH; Max operating voltage
Qualification Guideline	Stress Test Driven Qualification of Integrated Circuits; EIA / JEDEC EIA/JESD47 / AEC-Q100		

Silicon Reliability Test Method and Conditions

Early Life Failure Rate (ELFR)

The purpose of this test is to simulate the user operation over the first portion of the product lifetime, also called early life. Silicon Labs typically uses dynamic conditions, meaning the device is powered up, and the inputs are toggled to exercise a maximum number of transistors and circuit area. Reliability acceleration is accomplished primarily by temperature and secondarily by voltage.

High Temperature Operating Life (HTOL)

The purpose of this test is to simulate the user part operation over the expected life of the product. We typically use dynamic conditions, meaning the device is powered up, and the inputs are toggled to exercise a maximum number of transistors and circuit area. Reliability acceleration is accomplished primarily by temperature and secondarily by voltage.

High Temperature Storage Life (HTSL) / High Temperature Bake (HTB)

The purpose of this test is to determine the effect of storage at elevated temperature. This is performed to assess the stability of semiconductor device materials and interfaces.

Low Temperature Operating Life (LTOL)

The purpose of this test is to simulate the user operation at low temperature. This is a specialized test to address specific fab failure mechanisms, such as hot-carrier injection. Wafer level reliability tests are more effective for this characterization and are the primary qualification method. Silicon Labs typically uses dynamic conditions, meaning the device is powered up, and the inputs are toggled to exercise a maximum number of transistors and circuit area.

Nonvolatile Memory Data Retention (DR)

The purpose of this test is to measure the ability of a nonvolatile memory cell to retain its charge state at elevated temperature in the absence of applied external bias. This test can be done either in wafer form or on packaged units.

Reliability Monitor Report – Silicon Stresses

QLotNum	Stress	Fab Process	Read Date	Sample Size	Read Pt	Fails	ºC
Q043792	HTOL	0.11 um	18-Dec-18	80	1000	0	125
Q043206	HTSL	0.11 um	16-Oct-18	80	1000	0	150
Q044044	HTSL	0.11 um	07-May-19	80	1000	0	150
Q044068	HTSL	0.11 um	14-Jun-19	80	1000	0	150
Q043801	HTOL	0.13 um	19-Dec-18	80	1000	0	125
Q043252	HTSL	0.13 um	03-Oct-18	80	1000	0	150
Q043256	HTSL	0.13 um	03-Oct-18	80	1000	0	150
Q043218	HTSL	0.13 um	02-Nov-18	80	1000	0	150
Q043190	HTSL	0.13 um	11-Nov-18	80	1000	0	150
Q043737	HTSL	0.13 um	11-Jan-19	27	1000	0	150
Q043740	HTSL	0.13 um	11-Jan-19	27	1000	0	150
Q043923	HTSL	0.13 um	09-Apr-19	27	1000	0	150
Q043995	HTSL	0.13 um	06-May-19	80	1000	0	125
Q044048	HTSL	0.13 um	07-May-19	80	1000	0	150
Q043990	HTSL	0.13 um	08-May-19	80	1000	0	125
Q044012	HTSL	0.13 um	13-May-19	80	1000	0	150
Q044072	HTSL	0.13 um	15-Jun-19	80	1000	0	150
Q043186	HTSL	0.13 um, embedded flash	19-Oct-18	80	1000	0	150
Q043357	ELFR	0.18 um	10-Dec-18	800	48	0	125
Q043358	ELFR	0.18 um	15-Jan-19	797	48	0	125
Q043368	ELFR	0.18 um	22-Jan-19	400	48	0	125
Q043354	HTOL	0.18 um	03-Oct-18	80	1000	0	125
Q043355	HTOL	0.18 um	14-Nov-18	80	1000	0	125
Q043198	HTSL	0.18 um	27-Aug-18	80	1000	0	150
Q043202	HTSL	0.18 um	19-Sep-18	80	1000	0	150
Q043407	HTSL	0.18 um	23-Oct-18	30	1000	0	150
Q043408	HTSL	0.18 um	23-Oct-18	30	1000	0	150
Q044056	HTSL	0.18 um	09-May-19	80	1000	0	150
Q044008	HTSL	0.18 um	27-May-19	80	1000	0	150
Q044188	HTSL	0.18 um	05-Jun-19	26	1000	0	150
Q044192	HTSL	0.18 um	05-Jun-19	29	1000	0	150
Q044263	HTSL	0.18 um	12-Jun-19	30	1000	0	150
Q044129	HTSL	0.18 um	13-Jun-19	80	1000	0	150
Q043327	HTOL	0.18 um, embedded flash	03-Dec-18	78	1000	0	125
Q043326	HTOL	0.18 um, embedded flash	18-Feb-19	80	1000	0	125
Q043162	HTSL	0.18 um, embedded flash	15-Jul-18	80	1000	0	150

QLotNum	Stress	Fab Process	Read Date	Sample Size	Read Pt	Fails	ºC
Q043230	HTSL	0.18 um, embedded flash	06-Oct-18	80	1000	0	150
Q043178	HTSL	0.18 um, embedded flash	18-Oct-18	80	1000	0	150
Q044052	HTSL	0.18 um, embedded flash	30-Apr-19	80	1000	0	150
Q044064	HTSL	0.18 um, embedded flash	14-Jun-19	80	1000	0	150
Q043323	HTSL	0.18 um, OTP	15-Dec-18	80	1000	0	150
Q044060	HTSL	0.18 um, OTP	14-Jun-19	80	1000	0	100
Q043904	HTOL	0.18 um, RF	23-Nov-18	78	1000	0	125
Q043626	HTSL	0.18 um, RF	07-Jan-19	80	1000	0	150
Q043721	HTSL	0.18 um, RF	07-Jan-19	80	1000	0	150
Q043137	ELFR	0.25 um	20-Jul-18	818	48	0	125
Q043965	ELFR	0.25 um	11-Mar-19	250	48	0	125
Q043972	ELFR	0.25 um	11-Mar-19	250	48	0	105
Q043294	HTOL	0.25 um	19-Dec-18	80	1000	0	125
Q043917	HTOL	0.25 um	22-Feb-19	80	336	0	105
Q043947	HTOL	0.25 um	05-Apr-19	80	1000	0	105
Q042936	HTSL	0.25 um	06-Jul-18	80	1000	0	150
Q043182	HTSL	0.25 um	19-Oct-18	80	1000	0	150
Q043954	HTSL	0.25 um	05-Apr-19	27	1000	0	150
Q044016	HTSL	0.25 um	26-May-19	80	1000	0	150
Q044088	HTSL	0.25 um	16-Jun-19	80	1000	0	150
Q043795	HTOL	0.25 um, embedded flash	19-Feb-19	80	1000	0	125
Q043319	HTSL	0.25 um, embedded flash	07-Jan-19	76	1000	0	150
Q043794	HTOL	0.35 um, embedded flash	01-Feb-19	80	1000	0	125
Q043793	HTOL	0.35 um, embedded flash	18-Feb-19	80	1000	0	125
Q043226	HTSL	0.35 um, embedded flash	20-Sep-18	80	1000	0	150
Q044020	HTSL	0.35 um, embedded flash	13-May-19	80	1000	0	150
Q043790	HTOL	0.45 um - 0.5 um	13-Dec-18	80	1000	0	125
Q043529	ELFR	40 nm	26-Oct-18	520	48	0	125
Q043678	HTOL	40 nm	02-Jan-19	80	1000	0	125
Q044241	HTSL	40 nm	10-Jun-19	28	1000	0	150
Q044259	HTSL	40 nm	14-Jun-19	28	1000	0	150
Q044260	HTSL	40 nm	17-Jun-19	28	1000	0	150
Q043614	ELFR	40 nm, embedded flash	12-Nov-18	526	48	0	125
Q043696	ELFR	40 nm, embedded flash	19-Nov-18	13	48	0	125
Q043759	ELFR	40 nm, embedded flash	20-Dec-18	506	48	0	125
Q043074	HTDR	40 nm, embedded flash	16-Jul-18	40	1000	0	150
Q043130	HTDR	40 nm, embedded flash	11-Aug-18	40	1000	0	150
Q043153	HTDR	40 nm, embedded flash	17-Aug-18	40	1000	0	150

QLotNum	Stress	Fab Process	Read Date	Sample Size	Read Pt	Fails	ºC
Q043527	HTOL	40 nm, embedded flash	15-Oct-18	80	100	0	80
Q043587	HTOL	40 nm, embedded flash	05-Nov-18	78	100	0	80
Q043613	HTOL	40 nm, embedded flash	14-Dec-18	77	1000	0	125
Q043835	HTOL	40 nm, embedded flash	17-Jan-19	90	100	0	85
Q043797	HTOL	40 nm, embedded flash	06-Feb-19	83	1000	0	125
Q043116	HTSL	40 nm, embedded flash	06-Aug-18	40	1000	0	150
Q043117	HTSL	40 nm, embedded flash	06-Aug-18	38	1000	0	150
Q043126	LTDR	40 nm, embedded flash	18-Jul-18	40	500	0	25
Q043349	LTDR	40 nm, embedded flash	05-Sep-18	40	500	0	25
Q043715	ELFR	55 nm	18-Jan-19	485	48	0	75
Q043652	ELFR	55 nm	07-Feb-19	1100	48	0	75
Q043653	ELFR	55 nm	08-Mar-19	1100	48	0	75
Q044314	ELFR	55 nm	29-May-19	594	48	0	75
Q044403	ELFR	55 nm	07-Jun-19	570	48	0	75
Q043791	HTOL	55 nm	17-Dec-18	80	1000	0	90
Q043569	HTOL	55 nm	18-Dec-18	78	1000	0	75
Q043650	HTOL	55 nm	10-Jan-19	78	1000	0	75
Q044107	HTOL	55 nm	09-May-19	78	1000	0	75
Q044108	HTOL	55 nm	09-May-19	78	1000	0	75
Q043111	HTSL	55 nm	06-Aug-18	26	1000	0	150
Q043332	HTSL	55 nm	28-Sep-18	26	1000	0	150
Q043606	HTSL	55 nm	11-Jan-19	27	1000	0	150
Q043607	HTSL	55 nm	11-Jan-19	27	1000	0	150
Q043656	HTSL	55 nm	18-Jan-19	27	1000	0	150
Q043657	HTSL	55 nm	18-Jan-19	27	1000	0	150
Q043822	HTSL	55 nm	04-Feb-19	26	1000	0	150
Q043838	HTSL	55 nm	21-Feb-19	26	1000	0	150
Q043841	HTSL	55 nm	21-Feb-19	26	1000	0	150
Q043876	HTSL	55 nm	01-Mar-19	26	1000	0	150
Q043880	HTSL	55 nm	01-Mar-19	26	1000	0	150
Q043889	HTSL	55 nm	07-Mar-19	26	1000	0	150
Q043905	HTSL	55 nm	13-Mar-19	25	1000	0	150
Q043717	HTSL	55 nm	18-Apr-19	80	1000	0	150
Q044024	HTSL	55 nm	24-May-19	80	1000	0	150
Q044004	HTSL	55 nm	27-May-19	80	1000	0	150
Q043315	ELFR	90 nm, embedded flash	27-Aug-18	510	48	0	125
Q043435	ELFR	90 nm, embedded flash	26-Sep-18	510	48	0	125
Q043941	ELFR	90 nm, embedded flash	27-Feb-19	516	48	0	125

QLotNum	Stress	Fab Process	Read Date	Sample Size	Read Pt	Fails	ºC
Q043293	HTOL	90 nm, embedded flash	22-Oct-18	79	1000	0	125
Q043434	HTOL	90 nm, embedded flash	02-Nov-18	80	1000	0	125
Q043966	HTOL	90 nm, embedded flash	19-Apr-19	80	1000	0	125
Q043170	HTSL	90 nm, embedded flash	20-Jul-18	80	1000	0	150
Q043234	HTSL	90 nm, embedded flash	06-Oct-18	80	1000	0	150
Q043222	HTSL	90 nm, embedded flash	17-Oct-18	80	1000	0	150
Q043438	HTSL	90 nm, embedded flash	30-Oct-18	27	1000	0	150
Q043444	HTSL	90 nm, embedded flash	30-Oct-18	30	1000	0	150
Q043472	HTSL	90 nm, embedded flash	06-Nov-18	30	1000	0	150
Q043512	HTSL	90 nm, embedded flash	15-Nov-18	30	1000	0	150
Q043518	HTSL	90 nm, embedded flash	16-Nov-18	30	1000	0	150
Q043866	HTSL	90 nm, embedded flash	13-Jan-19	77	1000	0	150
Q043867	HTSL	90 nm, embedded flash	13-Jan-19	77	1000	0	150
Q043868	HTSL	90 nm, embedded flash	13-Jan-19	77	1000	0	150
Q043703	HTSL	90 nm, embedded flash	14-Jan-19	30	1000	0	150
Q043704	HTSL	90 nm, embedded flash	14-Jan-19	30	1000	0	150
Q043705	HTSL	90 nm, embedded flash	14-Jan-19	30	1000	0	150
Q044085	HTSL	90 nm, embedded flash	30-Apr-19	30	1000	0	150
Q044086	HTSL	90 nm, embedded flash	30-Apr-19	30	1000	0	150
Q044036	HTSL	90 nm, embedded flash	24-May-19	80	1000	0	150
Q044040	HTSL	90 nm, embedded flash	27-May-19	80	1000	0	150
Q043403	ELFR	High Voltage	14-Sep-18	509	48	0	95
Q043918	ELFR	High Voltage	13-Feb-19	809	48	0	125
Q044206	ELFR	High Voltage	24-Apr-19	810	48	0	125
Q043310	HTOL	High Voltage	12-Nov-18	80	1000	0	125
Q043541	HTSL	High Voltage	05-Dec-18	30	1000	0	150

Package Reliability Test Method and Conditions

Preconditioning (PC)

This test method is performed to simulate the various shipping conditions, the end use environment and customer board mounting process for a given packaging system. Preconditioning is an industry standard flow for non-hermetic (plastic) integrated circuit packages that is representative of a typical industry solder reflow operation. The test parts are subject to bake, moisture soak and three reflow cycles prior to being submitted to package reliability testing.

Temperature Cycling (TC)

This test evaluates potential reliability degradation due to thermal cycling effects. Devices are placed in a chamber using forced air to cycle devices between the specified temperature extremes. This test is conducted to determine the ability of components and solder interconnects to withstand mechanical stresses induced by alternating high and low temperature extremes. Permanent changes in electrical and/or physical characteristics can result from these mechanical stresses.

Temperature Humidity and Bias (THB)

This test evaluates the reliability of non-hermetic packaged integrated circuits in humid environments. It employs severe conditions of temperature, humidity and bias to accelerate the penetration of moisture through the external protective material (encapsulant) or along the interface between the external protective material and the metallic conductors passing through it. This test is less accelerated than autoclave and unbiased HAST and takes longer to complete. It provides more realistic results in line with actual field performance. The dominant failure mechanism is aluminum corrosion accelerated by moisture, bias and contamination.

Highly-Accelerated Temperature and Humidity Stress Test (HAST)

This test evaluates the reliability of non-hermetic packaged integrated circuits in humid environments. It employs severe conditions of temperature, humidity, and bias which accelerate the penetration of moisture through the external protective material (encapsulant or seal) or along the interface between the external protective material and the metallic conductors which pass through it. The stress usually activates the same failure mechanisms as the “85/85” Temperature Humidity and Bias (THB) test.

Unbiased Highly-Accelerated Stress Test (U-HAST)

This test is performed to evaluate the reliability of non-hermetic packaged integrated circuits in humid environments. It is an alternate to Autoclave and tests for the same failure mechanisms. It employs severe conditions of temperature, humidity, and pressure to accelerate the penetration of moisture through the external protective material (encapsulant) or along the interface between the external protective material and the metallic conductors passing through it. UHAST is preferred over the autoclave stress method due to the reduction in artifacts induced by the 100%rh environment of autoclave, such as lead corrosion or contamination transfer by liquid water. The dominant failure mechanism is corrosion of internal materials.

Reflow Profile and Moisture Sensitivity Level

Overview

Non-hermetic (plastic) integrated circuit packages are classified by moisture sensitivity level per IPC/JEDEC J-Std-020. It is critical for final product quality that the board assembly process account for package moisture sensitivity, especially the peak reflow temperature and the maximum manufacturing expose time (MET).

Reflow Profile

Non-hermetic integrated circuit SMD (surface mount devices) are qualified in compliance to the applicable reflow profiles provided in IPC/JEDEC J-Std-020. The board assembler should not exceed the limits defined in the reflow profile tables of IPC/JEDEC J-Std-020.

Moisture Sensitivity Level

The Moisture Sensitivity Level (MSL) and peak reflow temperature are indicated on each product packing label.

Reliability Monitor Report – Package Stresses

QLotNum	Stress	Package Type	Read Date	Sample Size	Read Point	Fails
Q043738	HAST	6-CLCC-5x3.2	10-Dec-18	27	96	0
Q043735	HAST	6-CLCC-5x3.2	18-Dec-18	27	96	0
Q043474	LTSL	6-CLCC-5x7	09-Oct-18	8	100	0
Q043475	LTSL	6-CLCC-5x3.2	09-Oct-18	9	100	0
Q043661	LTSL	6-CLCC-5x3.2	04-Dec-18	10	100	0
Q043257	Temp Cycle	6-CLCC-5x3.2	12-Sep-18	80	500	0
Q043398	Temp Cycle	6-CLCC-5x3.2	02-Oct-18	27	1000	0
Q043400	Temp Cycle	6-CLCC-5x7	02-Oct-18	27	1000	1
Q043539	Temp Cycle	6-CLCC-5x7	26-Nov-18	170	1000	0
Q043736	Temp Cycle	6-CLCC-5x3.2	14-Dec-18	27	1000	0
Q043739	Temp Cycle	6-CLCC-5x3.2	14-Dec-18	27	1000	0
Q043673	Temp Cycle	6-CLCC-5x3.2	10-Jan-19	27	1000	0
Q043997	Temp Cycle	6-CLCC-5x7	12-Apr-19	80	1000	0
Q043992	Temp Cycle	6-CLCC-5x3.2	18-Apr-19	80	1000	0
Q042994	UHAST	6-CLCC-5x3.2	02-Jul-18	80	96	0
Q043258	UHAST	6-CLCC-5x3.2	12-Sep-18	80	96	0
Q043659	UHAST	6-CLCC-5x3.2	21-Dec-18	27	192	0
Q043993	UHAST	6-CLCC-5x3.2	02-Apr-19	80	96	0
Q043996	UHAST	6-CLCC-5x7	02-Apr-19	80	96	0
Q043909	HAST	8-LGA-2.5x3.2	05-Mar-19	26	264	0
Q043910	HAST	8-LGA-2.5x3.2	19-Mar-19	26	264	0
Q044076	HAST	8-SOIC-150mils	26-Mar-19	80	96	0
Q043447	LTSL	8-CLCC-5x7	22-Sep-18	10	100	0
Q043448	LTSL	8-CLCC-5x7	22-Sep-18	10	100	0
Q043449	LTSL	8-CLCC-5x7	22-Sep-18	10	100	0
Q043590	LTSL	8-CLCC-5x7	14-Nov-18	10	100	0
Q043591	LTSL	8-CLCC-5x7	14-Nov-18	10	100	0
Q043660	LTSL	8-CLCC-5x3.2	04-Dec-18	10	100	0
Q043895	LTSL	8-LGA-2.5x3.2	13-Feb-19	10	100	0
Q043253	Temp Cycle	8-CLCC-5x7	13-Sep-18	80	500	0
Q043542	Temp Cycle	8-SOIC-150mils	01-Nov-18	80	500	0
Q043674	Temp Cycle	8-CLCC-5x7	09-Jan-19	26	1000	0
Q043675	Temp Cycle	8-CLCC-5x7	09-Jan-19	27	1000	0
Q043672	Temp Cycle	8-CLCC-5x3.2	10-Jan-19	27	1000	0
Q043875	Temp Cycle	8-CLCC-5x7	31-Jan-19	27	1000	0
Q043878	Temp Cycle	8-LGA-2.5x3.2	31-Jan-19	27	1000	0

QLotNum	Stress	Package Type	Read Date	Sample Size	Read Point	Fails
Q043879	Temp Cycle	8-LGA-2.5x3.2	31-Jan-19	27	1000	0
Q044191	Temp Cycle	8-TDFN-1.4x1.6	25-Apr-19	27	500	0
Q044506	Temp Cycle	8-TDFN-1.4x1.6	10-Jun-19	30	500	0
Q044185	THB	8-TDFN-1.4x1.6	18-Jun-19	25	1000	0
Q044189	THB	8-TDFN-1.4x1.6	18-Jun-19	25	1000	0
Q043254	UHAST	8-CLCC-5x7	13-Sep-18	80	96	0
Q043543	UHAST	8-SOIC-150mils	01-Nov-18	80	96	0
Q043604	UHAST	8-CLCC-5x7	18-Dec-18	27	192	0
Q043605	UHAST	8-CLCC-5x7	18-Dec-18	27	192	0
Q043658	UHAST	8-CLCC-5x3.2	21-Dec-18	27	192	0
Q044186	UHAST	8-TDFN-1.4x1.6	24-Apr-19	27	96	0
Q044190	UHAST	8-TDFN-1.4x1.6	24-Apr-19	28	96	0
Q043324	Temp Cycle	10-OLGA-2.85X4.90	14-Dec-18	80	1500	0
Q044014	Temp Cycle	10-MSOP-3x3	15-Apr-19	80	500	0
Q044062	Temp Cycle	10-COL-ODFN-2x2	16-May-19	80	1500	0
Q044213	THB	10-COL-ODFN-2x2	30-May-19	79	1000	0
Q043325	UHAST	10-OLGA-2.85X4.90	07-Nov-18	80	96	0
Q044013	UHAST	10-MSOP-3x3	06-Apr-19	80	96	0
Q043922	HAST	16-QFN-3x3	13-Feb-19	27	96	0
Q043980	HAST	16-SOIC-150mils	14-Mar-19	80	96	0
Q043183	Temp Cycle	16-TSSOP-5x4.4	19-Sep-18	80	500	0
Q043207	Temp Cycle	16-UQFN-2.5x2.5	20-Sep-18	80	500	0
Q043930	Temp Cycle	16-ESOIC-150mils	02-Feb-19	77	500	0
Q043924	Temp Cycle	16-QFN-3x3	12-Mar-19	26	500	0
Q044018	Temp Cycle	16-SOIC-300mils	13-Apr-19	80	500	0
Q044090	Temp Cycle	16-SOIC-150mils	18-May-19	80	500	0
Q043208	UHAST	16-UQFN-2.5x2.5	07-Sep-18	80	96	0
Q043184	UHAST	16-TSSOP-5x4.4	10-Sep-18	80	96	0
Q043982	UHAST	16-SOIC-150mils	14-Mar-19	80	96	0
Q044017	UHAST	16-SOIC-300mils	11-Apr-19	80	96	0
Q044089	UHAST	16-SOIC-150mils	08-May-19	80	96	0
Q043227	Temp Cycle	20-SLP-4x4	27-Aug-18	80	500	0
Q043231	Temp Cycle	20-TQFN-3x3	29-Aug-18	80	500	0
Q044046	Temp Cycle	20-UQFN-3x3	08-Apr-19	80	500	0
Q044022	Temp Cycle	20-SLP-4x4	15-Apr-19	80	500	0
Q043228	UHAST	20-SLP-4x4	13-Aug-18	80	96	0
Q043232	UHAST	20-TQFN-3x3	23-Aug-18	80	96	0
Q044045	UHAST	20-UQFN-3x3	01-Apr-19	80	96	0

QLotNum	Stress	Package Type	Read Date	Sample Size	Read Point	Fails
Q044021	UHAST	20-SLP-4x4	06-Apr-19	80	96	0
Q044050	Temp Cycle	24-QFN-4x4	04-Apr-19	80	500	0
Q044070	Temp Cycle	24-TSSOP-7.8x4.4	16-May-19	80	500	0
Q044503	Temp Cycle	24-ODFN-3x3	21-Jun-19	30	1500	0
Q044505	Temp Cycle	24-ODFN-3x3	21-Jun-19	30	1500	0
Q044049	UHAST	24-QFN-4x4	28-Mar-19	80	96	0
Q044069	UHAST	24-TSSOP-7.8x4.4	06-May-19	80	96	0
Q043122	HAST	32-QFN-4x4	02-Jul-18	80	96	0
Q043123	HAST	32-QFN-4x4	02-Jul-18	80	96	0
Q043955	HAST	32-DFN-9x9	05-Mar-19	26	96	0
Q043118	Temp Cycle	32-QFN-4x4	05-Jul-18	80	500	0
Q043119	Temp Cycle	32-QFN-4x4	05-Jul-18	80	500	0
Q043235	Temp Cycle	32-QFN-5x5	29-Aug-18	80	500	0
Q043191	Temp Cycle	32-LGA-5x5	11-Nov-18	80	500	0
Q043320	Temp Cycle	32-QFN-5x5	13-Nov-18	80	500	0
Q043722	Temp Cycle	32-TQFN-5x5	28-Nov-18	80	500	0
Q043869	Temp Cycle	32-QFN-5x5	08-Dec-18	77	500	0
Q043870	Temp Cycle	32-QFN-5x5	08-Dec-18	77	500	0
Q043871	Temp Cycle	32-QFN-5x5	08-Dec-18	77	500	0
Q043953	Temp Cycle	32-DFN-9x9	05-Mar-19	27	500	0
Q044054	Temp Cycle	32-VQFN-6x6	01-Apr-19	80	500	0
Q044042	Temp Cycle	32-QFN-5x5	02-May-19	80	500	0
Q044074	Temp Cycle	32-LGA-5x5	17-May-19	80	500	0
Q043120	UHAST	32-QFN-4x4	02-Jul-18	80	96	0
Q043121	UHAST	32-QFN-4x4	02-Jul-18	80	96	0
Q043236	UHAST	32-QFN-5x5	23-Aug-18	80	96	0
Q043192	UHAST	32-LGA-5x5	03-Oct-18	80	96	0
Q043321	UHAST	32-QFN-5x5	04-Nov-18	80	96	0
Q043628	UHAST	32-TQFN-5x5	19-Nov-18	80	96	0
Q043723	UHAST	32-TQFN-5x5	19-Nov-18	80	96	0
Q043872	UHAST	32-QFN-5x5	04-Dec-18	77	96	0
Q043873	UHAST	32-QFN-5x5	04-Dec-18	77	96	0
Q043874	UHAST	32-QFN-5x5	04-Dec-18	77	96	0
Q044053	UHAST	32-VQFN-6x6	25-Mar-19	80	96	0
Q044041	UHAST	32-QFN-5x5	12-Apr-19	80	96	0
Q044073	UHAST	32-LGA-5x5	07-May-19	80	96	0
Q043219	Temp Cycle	36-QFN-6x6	02-Nov-18	80	500	0
Q043220	UHAST	36-QFN-6x6	02-Nov-18	80	96	0

QLotNum	Stress	Package Type	Read Date	Sample Size	Read Point	Fails
Q044010	Temp Cycle	38-MQFN-4X6	27-May-19	80	500	0
Q044131	Temp Cycle	38-QFN-4X6	13-Jun-19	80	500	0
Q044009	UHAST	38-MQFN-4X6	27-May-19	80	96	0
Q044130	UHAST	38-QFN-4X6	13-Jun-19	80	96	0
Q043199	Temp Cycle	42-LGA-5x7	25-Jul-18	80	500	0
Q043203	Temp Cycle	42-LGA-MCM-5x7	20-Aug-18	80	500	0
Q043200	UHAST	42-LGA-5x7	18-Jul-18	80	96	0
Q043204	UHAST	42-LGA-MCM-5x7	13-Aug-18	80	96	0
Q043273	HAST	44-LGA-MCM-7x7	20-Aug-18	26	264	0
Q043331	HAST	44-LGA-MCM-7x7	18-Sep-18	26	264	0
Q043892	HAST	44-LGA-MCM-7x7	21-Feb-19	26	264	0
Q043110	Temp Cycle	44-LGA-MCM-7x7	05-Jul-18	26	500	0
Q043330	Temp Cycle	44-LGA-MCM-7x7	23-Aug-18	26	500	0
Q043522	Temp Cycle	44-LGA-MCM-7x7	02-Nov-18	26	500	0
Q043888	Temp Cycle	44-LGA-MCM-7x7	11-Feb-19	26	500	0
Q044058	Temp Cycle	47-LGA-6x8	01-Apr-19	80	500	0
Q044057	UHAST	47-LGA-6x8	25-Apr-19	80	96	0
Q043179	Temp Cycle	48-QFN-7x7	18-Sep-18	80	500	0
Q043223	Temp Cycle	48-QFN-7x7	17-Oct-18	80	500	0
Q044066	Temp Cycle	48-QFN-7x7	15-May-19	80	500	0
Q044038	Temp Cycle	48-QFN-7x7	24-May-19	80	500	0
Q044006	Temp Cycle	48-MQFN-7x7	27-May-19	80	500	0
Q043180	UHAST	48-QFN-7x7	08-Sep-18	80	96	0
Q043224	UHAST	48-QFN-7x7	17-Oct-18	80	96	0
Q044065	UHAST	48-QFN-7x7	06-May-19	80	96	0
Q044037	UHAST	48-QFN-7x7	24-May-19	80	96	0
Q044005	UHAST	48-MQFN-7x7	27-May-19	80	96	0
Q043729	HAST	51-SiP_LGA-6.5X6.5	12-Dec-18	25	264	0
Q043730	HAST	51-SiP_LGA-6.5X6.5	12-Dec-18	25	264	0
Q043731	HAST	51-SiP_LGA-6.5X6.5	12-Dec-18	25	264	0
Q043078	Temp Cycle	51-SiP_LGA-6.5X6.5	06-Jul-18	25	700	0
Q043082	Temp Cycle	51-SiP_LGA-6.5X6.5	06-Jul-18	25	700	0
Q043706	Temp Cycle	51-SiP_LGA-6.5X6.5	10-Dec-18	25	700	0
Q043707	Temp Cycle	51-SiP_LGA-6.5X6.5	10-Dec-18	25	700	0
Q043708	Temp Cycle	51-SiP_LGA-6.5X6.5	11-Dec-18	25	700	0
Q043610	Temp Cycle	56-SiP_LGA-8x8	07-Sep-18	77	500	0
Q043611	Temp Cycle	56-SiP_LGA-8x8	07-Sep-18	77	500	0
Q043612	Temp Cycle	56-SiP_LGA-8x8	07-Sep-18	77	500	0

QLotNum	Stress	Package Type	Read Date	Sample Size	Read Point	Fails
Q043187	Temp Cycle	56-SiP_LGA-8x8	19-Sep-18	80	500	0
Q043188	UHAST	56-SiP_LGA-8x8	11-Sep-18	80	96	0
Q044242	Temp Cycle	58-SiP_LGA-6.5X6.5	10-May-19	28	850	0
Q044244	Temp Cycle	58-SiP_LGA-6.5X6.5	10-May-19	28	850	0
Q044257	Temp Cycle	58-SiP_LGA-6.5X6.5	22-May-19	28	850	0
Q044258	Temp Cycle	58-SiP_LGA-6.5X6.5	22-May-19	28	850	0
Q044243	THB	58-SiP_LGA-6.5X6.5	14-Jun-19	27	1000	0
Q044255	THB	58-SiP_LGA-6.5X6.5	17-Jun-19	27	1000	0
Q043405	HAST	64-QFN-9x9	09-Oct-18	30	192	0
Q043406	HAST	64-QFN-9x9	23-Oct-18	30	192	0
Q043821	HAST	64-SiP_LGA-9x9	22-Jan-19	26	264	0
Q043837	HAST	64-SiP_LGA-9x9	21-Feb-19	26	264	0
Q043840	HAST	64-SiP_LGA-9x9	19-Mar-19	26	264	0
Q043409	Temp Cycle	64-QFN-9x9	19-Sep-18	30	500	0
Q043410	Temp Cycle	64-QFN-9x9	19-Sep-18	30	500	0
Q043436	Temp Cycle	64-VQFN-9x9	25-Sep-18	30	500	0
Q043441	Temp Cycle	64-TQFP-10x10	25-Sep-18	30	500	0
Q043473	Temp Cycle	64-SiP_LGA-9x9	10-Oct-18	30	700	0
Q043514	Temp Cycle	64-SiP_LGA-9x9	16-Oct-18	30	700	0
Q043519	Temp Cycle	64-SiP_LGA-9x9	16-Oct-18	30	700	0
Q043820	Temp Cycle	64-SiP_LGA-9x9	08-Jan-19	26	500	0
Q043836	Temp Cycle	64-SiP_LGA-9x9	22-Jan-19	26	500	0
Q043839	Temp Cycle	64-SiP_LGA-9x9	22-Jan-19	26	500	0
Q043906	Temp Cycle	64-FCLGA-MCM-9x9	08-Feb-19	25	500	0
Q043718	Temp Cycle	64-QFN-9x9	18-Apr-19	80	500	0
Q044026	Temp Cycle	64-QFN-9x9	24-May-19	80	500	0
Q043471	THB	64-SiP_LGA-9x9	07-Nov-18	26	1000	0
Q043517	THB	64-SiP_LGA-9x9	16-Nov-18	26	1000	0
Q043911	THB	64-FCLGA-MCM-9x9	15-Mar-19	25	1000	0
Q044109	THB	64-SiP_LGA-9x9	09-May-19	26	1000	0
Q044266	HAST	68-MQFN-8x8	28-May-19	29	264	0
Q044368	HAST	68-MQFN-8x8	11-Jun-19	30	264	0
Q044264	Temp Cycle	68-MQFN-8x8	13-May-19	30	500	0
Q044365	Temp Cycle	68-MQFN-8x8	28-May-19	30	500	0
Q044370	Temp Cycle	68-MQFN-8x8	28-May-19	30	500	0
Q044404	Temp Cycle	68-QFN-8x8	03-Jun-19	30	500	0
Q044406	Temp Cycle	68-QFN-8x8	03-Jun-19	30	500	0
Q044407	Temp Cycle	68-QFN-8x8	03-Jun-19	30	500	0

QLotNum	Stress	Package Type	Read Date	Sample Size	Read Point	Fails
Q044265	UHAST	68-MQFN-8x8	15-May-19	30	264	0
Q044367	UHAST	68-MQFN-8x8	12-Jun-19	30	264	0
Q044372	UHAST	68-MQFN-8x8	12-Jun-19	30	264	0
Q044411	UHAST	68-QFN-8x8	12-Jun-19	30	264	0
Q044412	UHAST	68-QFN-8x8	12-Jun-19	30	264	0
Q044413	UHAST	68-QFN-8x8	12-Jun-19	30	264	0
Q043827	Temp Cycle	80-PBGA-10x10	14-Mar-19	25	500	0
Q043828	Temp Cycle	80-PBGA-10x10	14-Mar-19	25	500	0
Q043829	Temp Cycle	80-PBGA-10x10	14-Mar-19	25	500	0
Q043830	Temp Cycle	80-PBGA-10x10	14-Mar-19	25	500	0
Q043479	HAST	100-TQFP-14x14	05-Nov-18	27	264	0
Q044080	HAST	100-TQFP-14x14	16-Apr-19	27	264	0
Q044311	HAST	100-TQFP-14x14	28-May-19	27	264	0
Q043439	Temp Cycle	100-TQFP-14x14	16-Oct-18	25	500	0
Q044091	Temp Cycle	100-TQFP-14x14	01-Apr-19	28	500	0
Q044092	Temp Cycle	100-TQFP-14x14	01-Apr-19	28	500	0
Q043440	UHAST	100-TQFP-14x14	25-Sep-18	25	96	0
Q044093	UHAST	100-TQFP-14x14	25-Mar-19	27	96	0
Q044094	UHAST	100-TQFP-14x14	25-Mar-19	27	96	0
Q043412	HAST	112-LFBGA-10x10	24-Sep-18	30	264	0
Q043414	Temp Cycle	112-LFBGA-10x10	19-Sep-18	30	500	0
Q043415	UHAST	112-LFBGA-10x10	25-Sep-18	30	96	0
Q043442	Temp Cycle	120-VFBGA-7x7	25-Sep-18	30	500	0
Q043443	UHAST	120-VFBGA-7x7	25-Sep-18	30	96	0

Revision History

Rev No	Description	Effective Date
01	Original	19-Jul-2019