



# December 2024

## Quarterly Reliability Report

Document Number DOC-123616, Revision 1



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# pSemi Reliability System

The Quarterly Reliability Report is a compilation of reliability stress test results that crosses the entire product & technology family of pSemi products. Data is collected on a regular basis through the efforts of product and process qualifications, standard product monitoring and lot acceptance testing. To date, a total of **163,500 devices** have been tested in HTOL with a total of **9.9 billion equivalent device hours**. The overall failure rate for the pSemi family of products is **0.09 FIT**. (Using  $E_{a} = 0.7\text{eV}$ ,  $T_j = 55^\circ\text{C}$  at 60% UCL)

pSemi reliability testing standards conform to industry standard qualification procedures as detailed in the JEDEC guidelines. In addition, where clear guidelines have not been established yet, pSemi has developed stringent reliability requirements to ensure consistent high reliability performance.

pSemi makes use of accelerated life testing results, along with thermal acceleration factors in the prediction of failure rates. High Temperature Operating Life (HTOL) stress testing is performed at accelerated voltage and temperature conditions which are based Jedec-JESD22-A108 standards. Resulting data collected from HTOL tests is de-rated to a typical use operating junction temperature ( $T_j$ ) of  $55^\circ\text{C}$ . Early Life Failure Rate (ELFR) is derived after 48-hr performance.

pSemi conducts an ongoing product reliability monitoring program to evaluate sample products from high volume, major product families on a quarterly basis. The reliability monitoring process is a continuously improving system within pSemi as we strive for superior product knowledge and performance.

pSemi performs the majority of Reliability testing using an ISO17025 certified test laboratories located in San Jose, CA. Regular auditing of the laboratory is performed to ensure compliance to ISO standards.

*Note: December 2024 QRR data is truncated due to application database turnover.*

# Failure Rate Calculation

## Acceleration Factor (AF)

For a given failure mechanism, acceleration factor (AF), is the ratio of the time it takes for a certain fraction of the population to fail, following application of one stress or use condition, to the corresponding time at a more severe stress or use condition.

The industry uses the thermal acceleration model formula based on Arrhenius equation noted below:

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$$AF(T_{use}, T_{stress}) := e^{\frac{E_{aa}}{k_B} \cdot \left( \frac{1}{T_{use}} - \frac{1}{T_{stress}} \right)}$$

where:

$E_{aa} := 0.7 \text{ eV}$ , is the Apparent Activation Energy

$e = 2.718$ , is the base of natural logarithm

$k_B := 8.62 \cdot 10^{-5} \frac{\text{eV}}{\text{K}}$ , is the Boltzmann constant

$T_{use}$  &  $T_{stress}$ , are the use and stress test temperatures, respectively, in Kelvin

---

## Sample Calculation

Find the Acceleration Factor (AF) with the following conditions.

(a)  $T_{use} := 55 \text{ }^\circ\text{C}$  and  $T_{stress} := 125 \text{ }^\circ\text{C}$

$$AF(T_{use}, T_{stress}) = 77.5$$

(b)  $T_{use} := 55 \text{ }^\circ\text{C}$  and  $T_{stress} := 150 \text{ }^\circ\text{C}$

$$AF(T_{use}, T_{stress}) = 258.7$$

## Failure Rate Calculation (continued)

### Failure in Time Calculation

Mean time to failure (M.T.T.F.) is defined as the average time it takes for a failure to occur. Failure in Time (F.I.T.) is the number of units predicted to fail in a billion ( $1e^9$ ) device hours at a specified temperature. After the life test is completed and accelerated device hour data is calculated, the failure rate is estimated using the Chi-Square approximation ( $\chi^2$ ) as follows:

$$FIT = \left( \frac{\chi^{2(2r+2)}}{2 * EDH} \right) * 1e^9$$

where:

$\chi^2$  = chi square function

$r$  = number of failures

$EDH$  = equivalent device hours (units tested x test hours x AF)

### Sample Calculation

Given:            Units Tested (Sample Size) = 231 devices  
                      Test temperature = 150°C  
                      Test duration = 500 hours  
                      Failures = 0

$EDH = (231 \times 500 \times 259.2) = 2.99E+7$  equivalent device hours

$\chi^2$  @ 60% confidence level and 0 failures = 1.83

$FIT$  (60% confidence level) =  $[1.83 / (2 \times 2.99E+7)] \times 1.0E+9 = \underline{30.6 FIT}$



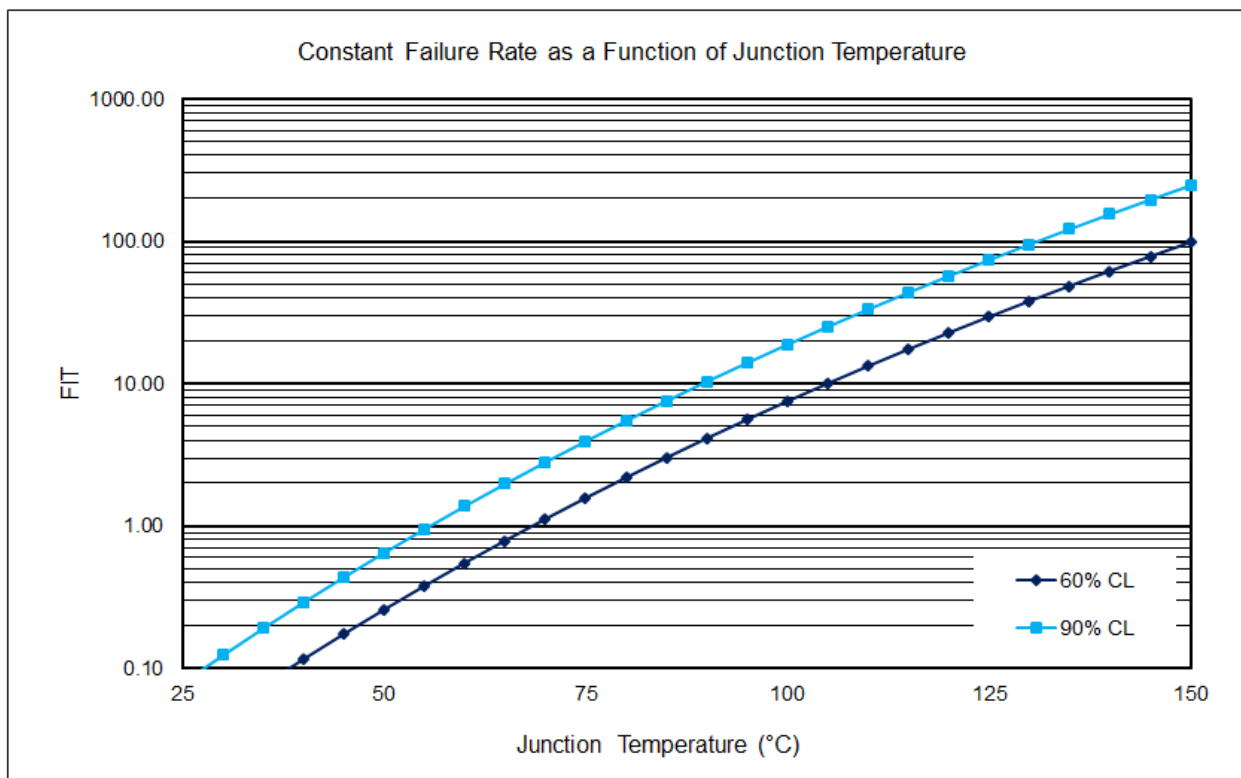


# Technology Classification

# UltraCMOS<sup>®</sup> 2 Process Technology

Generation : 500 nm CMOS Silicon Epi Process (U500E)  
 Units Tested : 36,095  
 Product Family : DC-DC, DSA, MXR, PLL, PSR, Switch

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	2.93E+08	3.1	3.19E+08
Constant (Random)	2.42E+09	0.4	2.64E+09

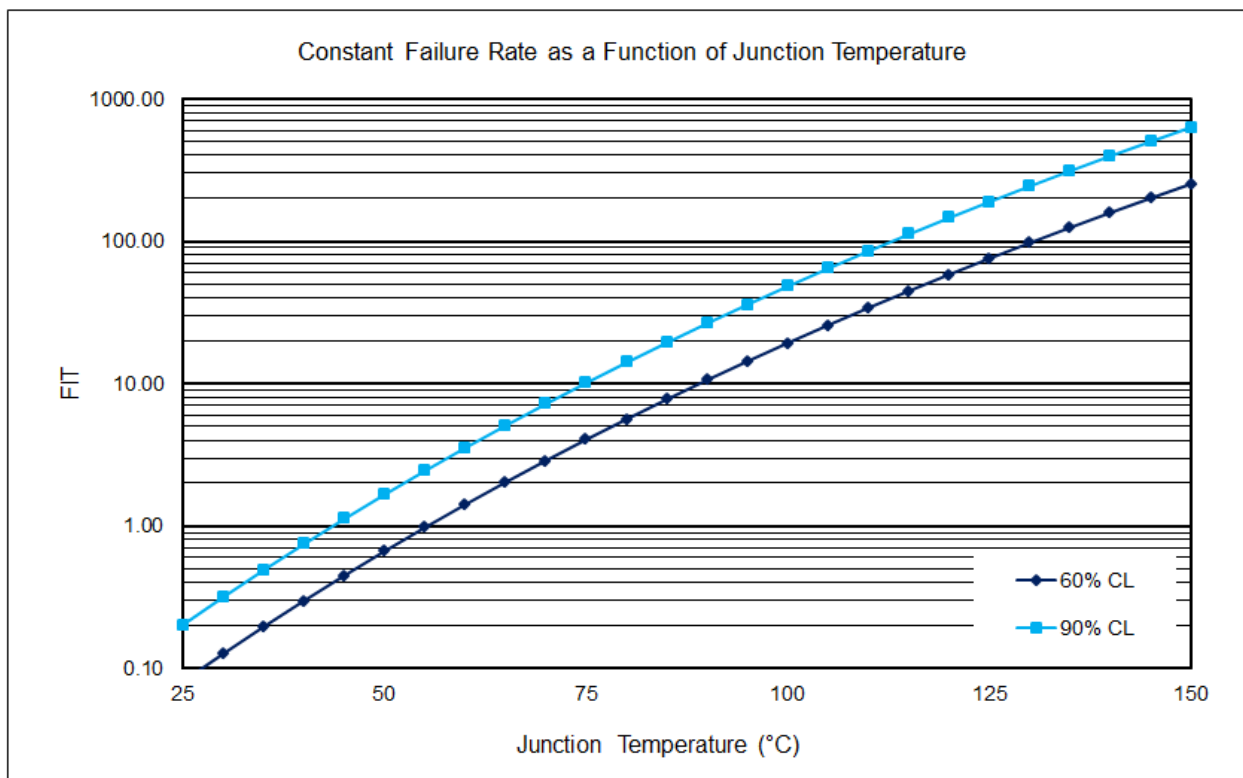




# UltraCMOS<sup>®</sup> 3.5 Process Technology

Generation : 350 nm CMOS Silicon Epi Process (U350E)  
 Units Tested : 9,772  
 Product Family : DSA, DTC, Switch

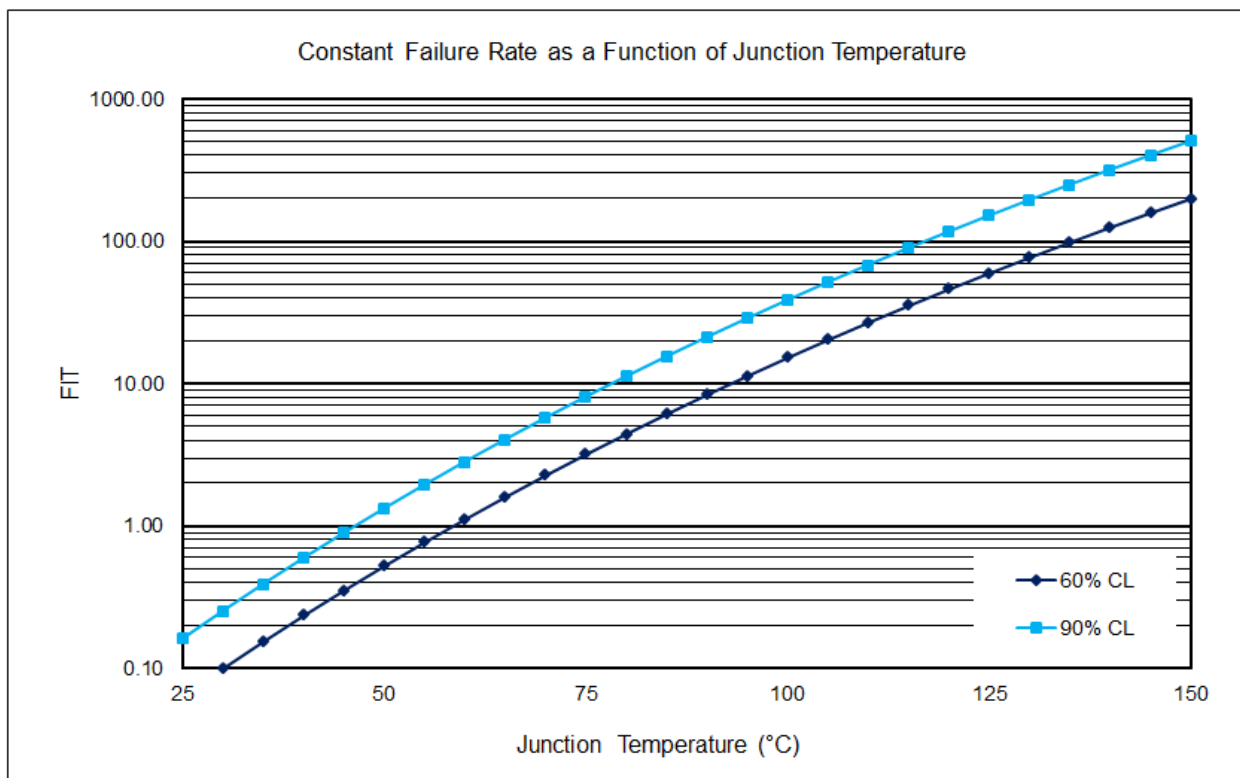
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.18E+08	7.8	1.28E+08
Constant (Random)	9.34E+08	1.0	1.02E+09



# UltraCMOS<sup>®</sup> 5 Process Technology

Generation : 350 nm CMOS Bonded Silicon Process (U350B)  
 Units Tested : 9,216  
 Product Family : DSA, DTC, LMTR, MPAC, PLL, PSH, Switch

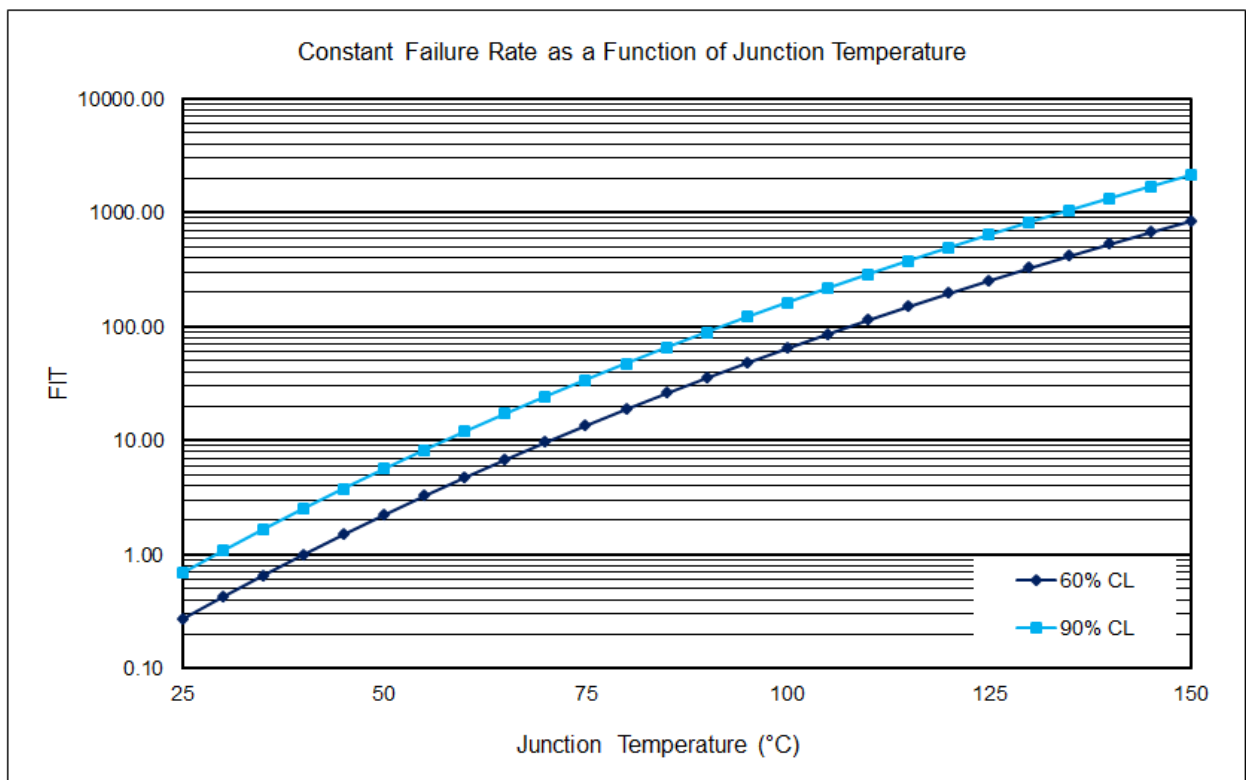
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.12E+08	8.2	1.23E+08
Constant (Random)	1.18E+09	0.8	1.29E+09



# UltraCMOS<sup>®</sup> 6 Process Technology

Generation : 250 nm CMOS Silicon Epi Process (U250E2)  
 Units Tested : 2,271  
 Product Family : Switch

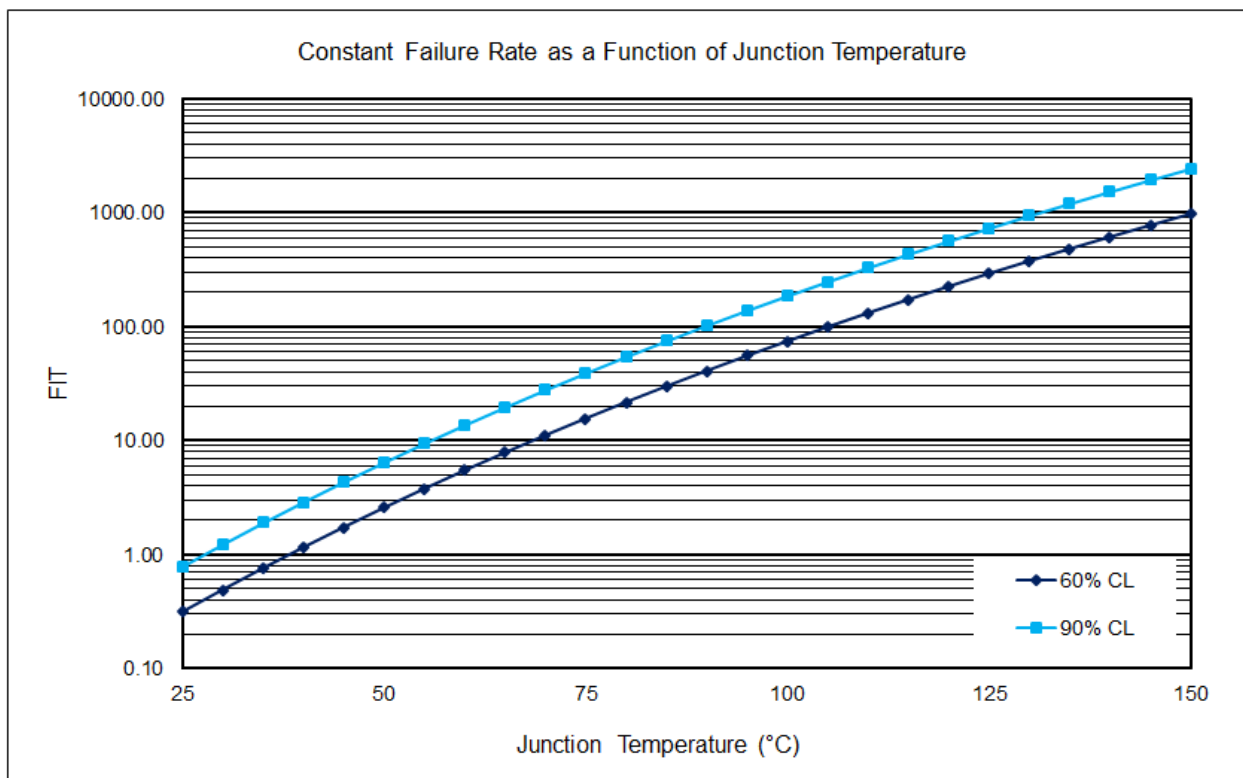
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	2.71E+07	33.8	2.96E+07
Constant (Random)	2.79E+08	3.3	3.05E+08



# UltraCMOS<sup>®</sup> 6.5 Process Technology

Generation : 250 nm CMOS Silicon Epi Process (U250E4)  
 Units Tested : 1,946  
 Product Family : Driver, DSA, Switch

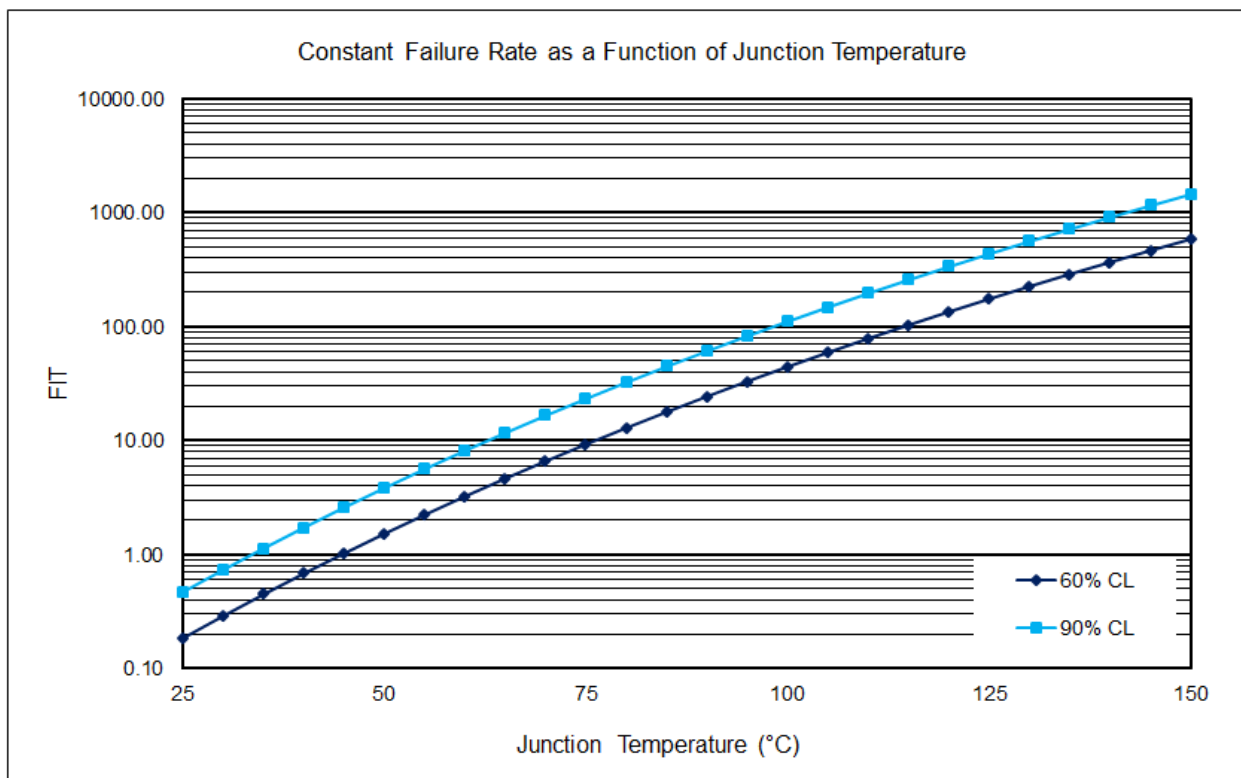
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.97E+07	46.6	2.15E+07
Constant (Random)	2.43E+08	3.8	2.66E+08



# UltraCMOS<sup>®</sup> 8 Process Technology

Generation : 250 nm CMOS Bonded Silicon Process (U250B)  
 Units Tested : 3,173  
 Product Family : Driver, DSA, DTC, LMTR, MPAC, MXR, PSR, Switch

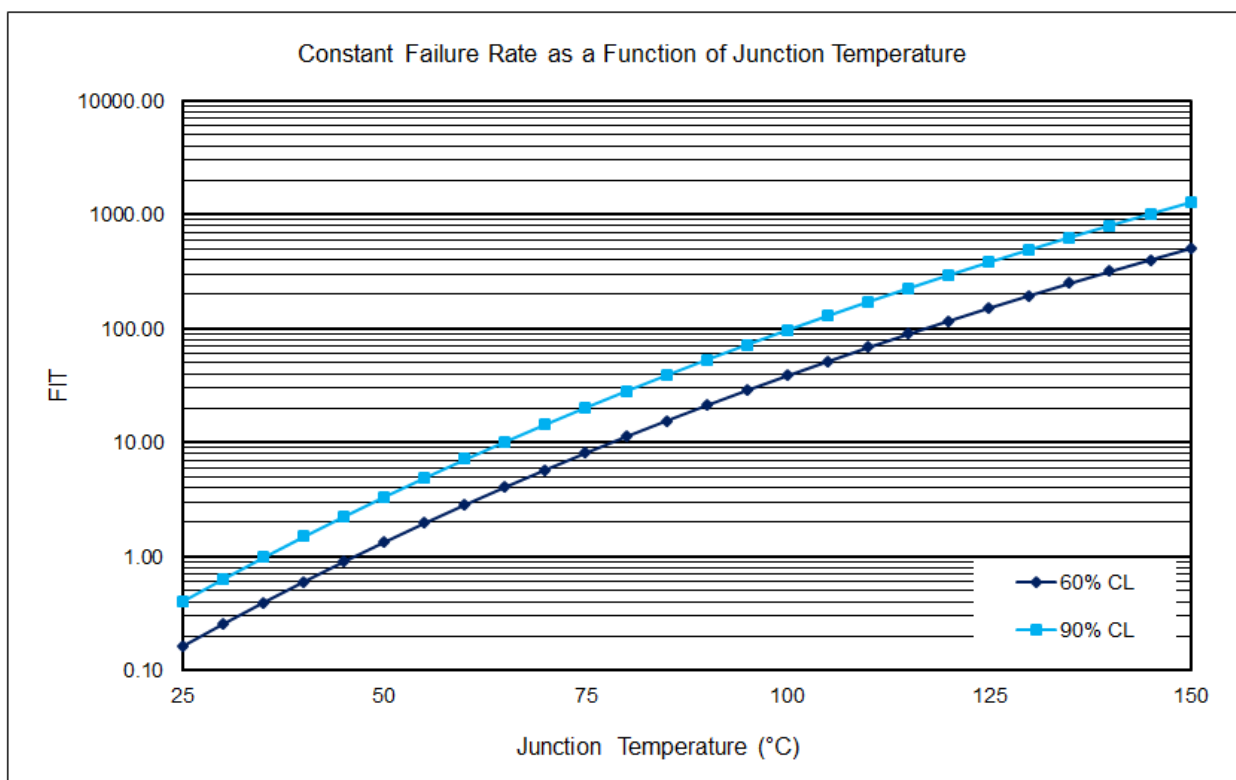
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	3.76E+07	24.4	4.10E+07
Constant (Random)	4.07E+08	2.2	4.45E+08



# UltraCMOS<sup>®</sup> 10 Process Technology

Generation : 130nm CMOS Silicon-On-Insulator in 200mm wafer(U130S1)  
 Units Tested : 3,869  
 Product Family : Switch

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	4.14E+07	22.1	4.52E+07
Constant (Random)	4.68E+08	2.0	5.10E+08

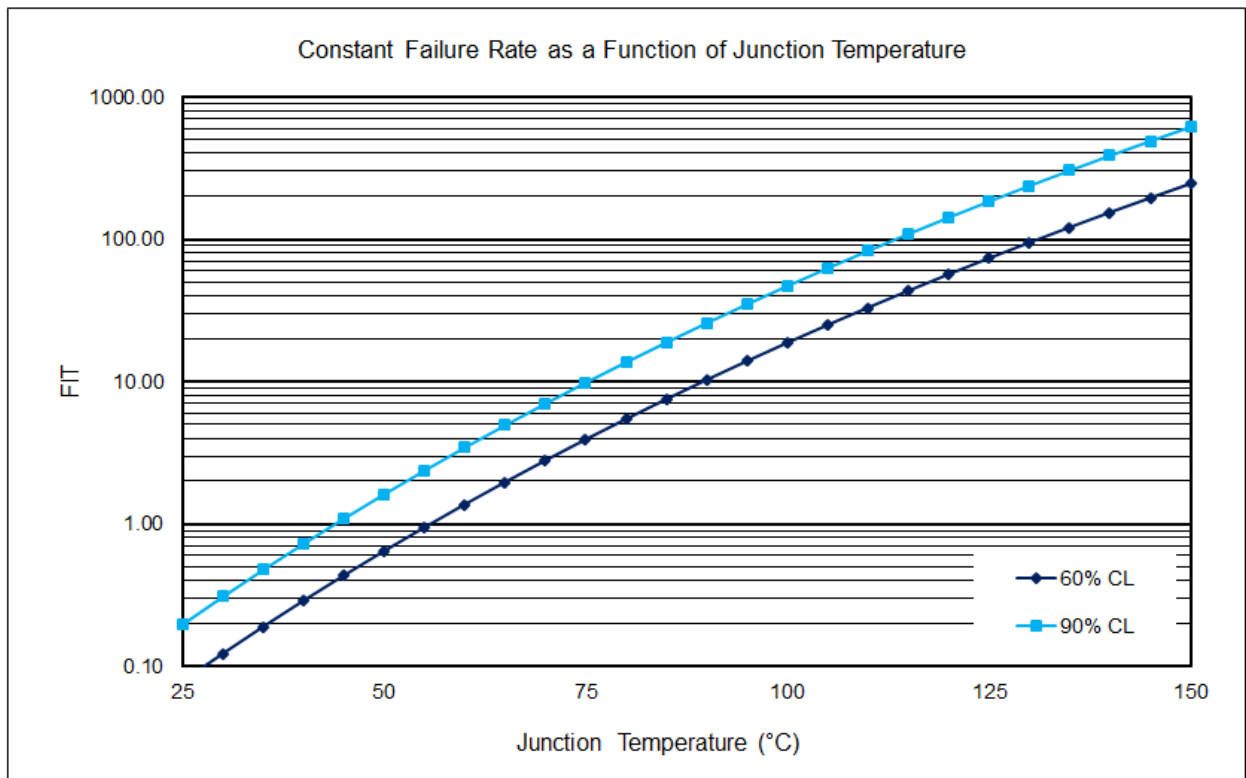




# UltraCMOS<sup>®</sup> 11 Process Technology

Generation : 130nm CMOS Silicon-On-Insulator in 300mm wafer (U130S2)  
 Units Tested : 12,888  
 Product Family : Amplifier, DC-DC, Switch

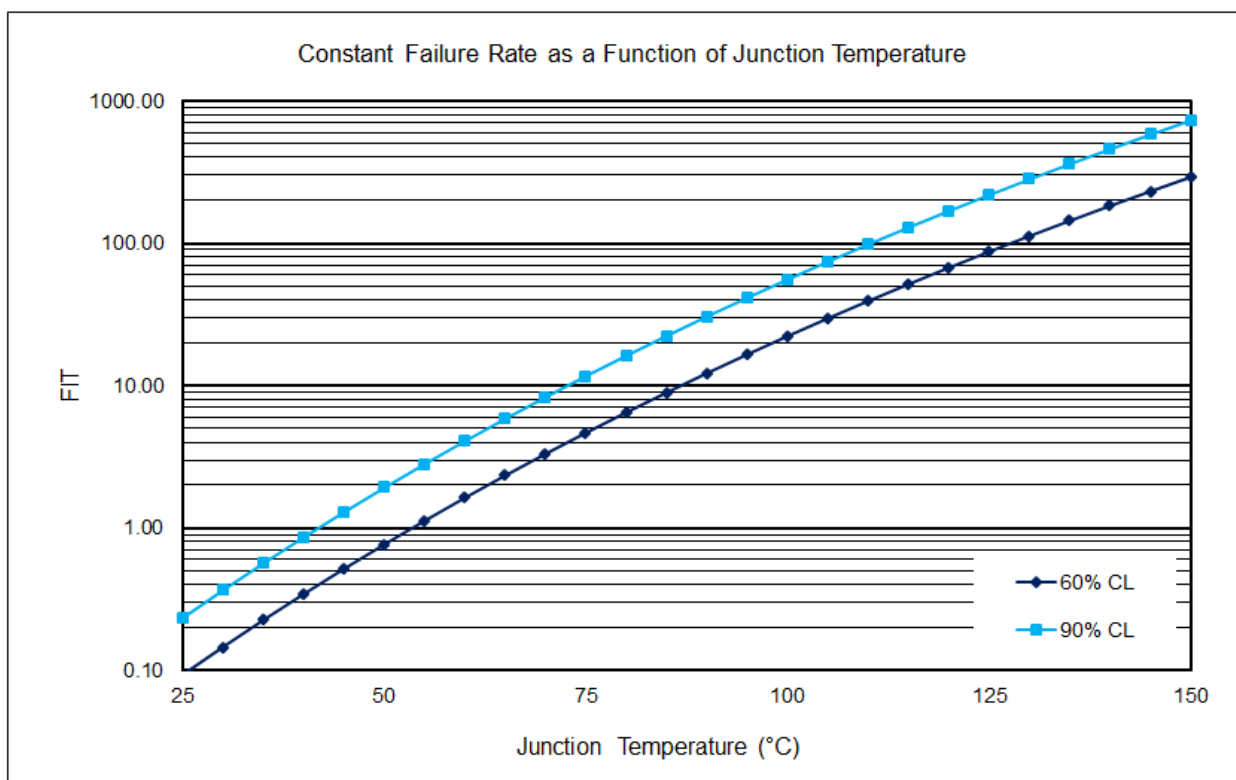
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	7.77E+07	11.8	8.48E+07
Constant (Random)	9.69E+08	0.9	1.06E+09



# UltraCMOS<sup>®</sup> 12 Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U130S3)  
 Units Tested : 17,601  
 Product Family : Amplifier, DSA, PAC, Switch

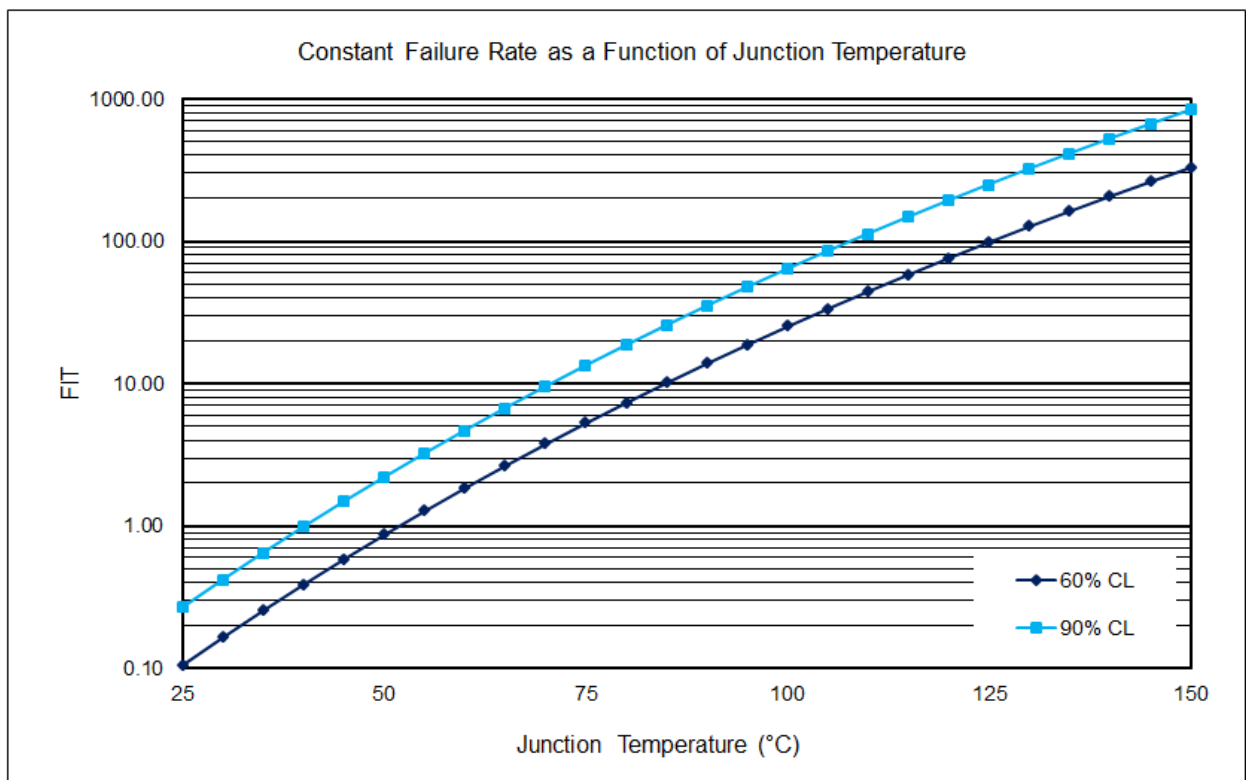
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	8.96E+07	10.2	9.77E+07
Constant (Random)	8.16E+08	1.1	8.90E+08



# UltraCMOS<sup>®</sup> 12A Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U130S4)  
 Units Tested : 11,681  
 Product Family : Amplifier, mmWave, Switch

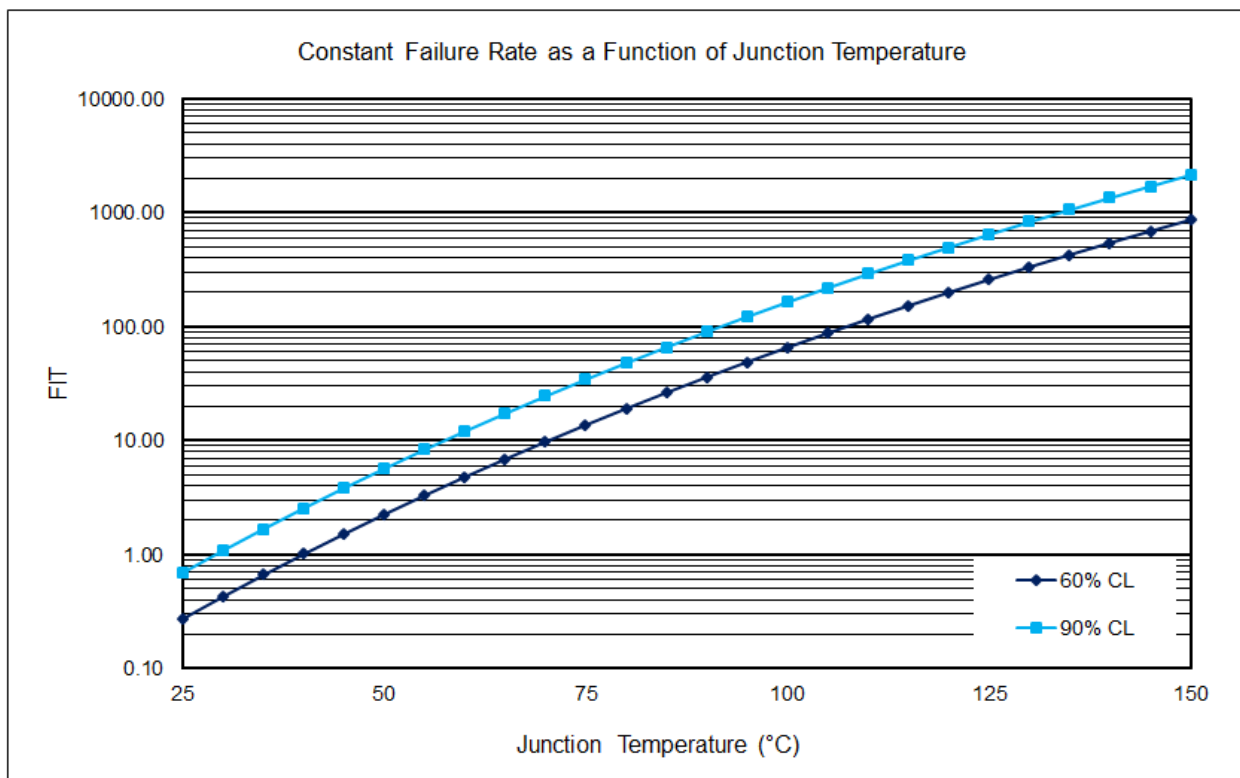
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	4.96E+07	18.5	5.41E+07
Constant (Random)	7.15E+08	1.3	7.80E+08



# UltraCMOS<sup>®</sup> 13 Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U130S4)  
 Units Tested : 6,368  
 Product Family : Amplifier, Switch

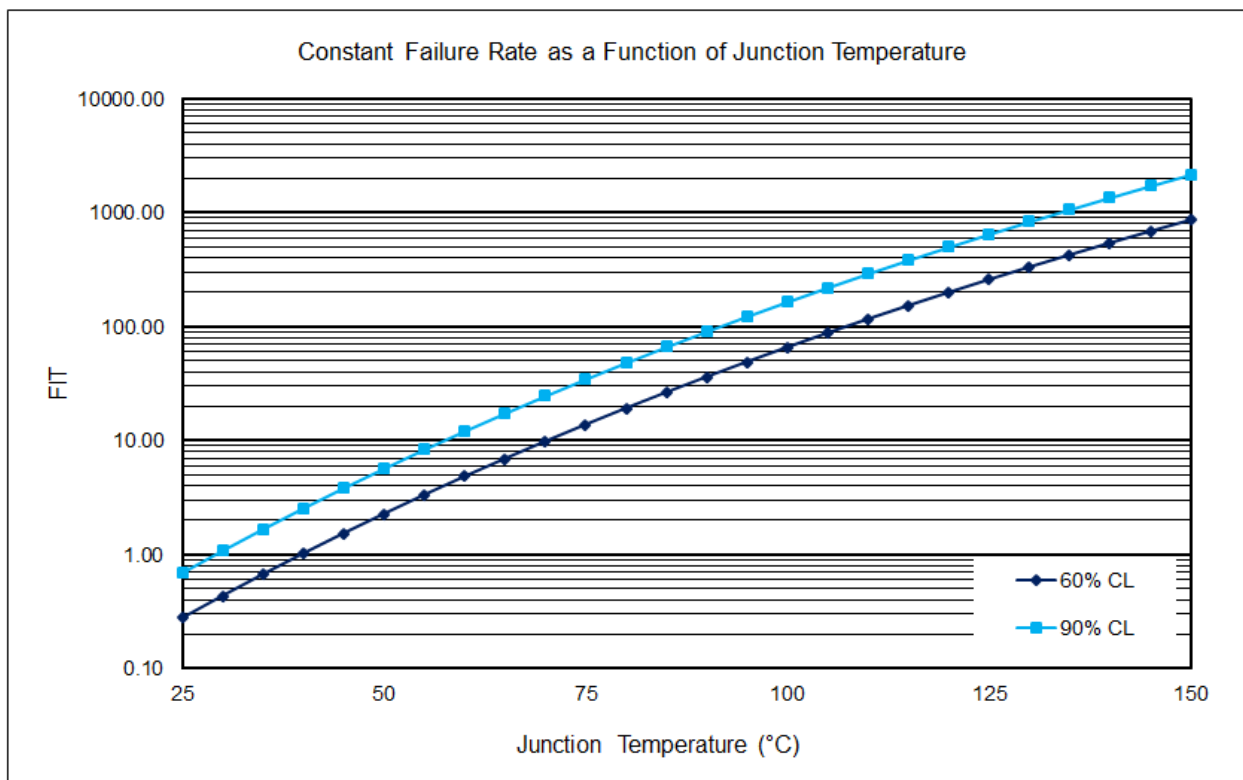
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	2.59E+07	35.4	2.82E+07
Constant (Random)	2.76E+08	3.3	3.02E+08



# UltraCMOS<sup>®</sup> 13S Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U130S4)  
 Units Tested : 13,963  
 Product Family : Amplifier, Switch

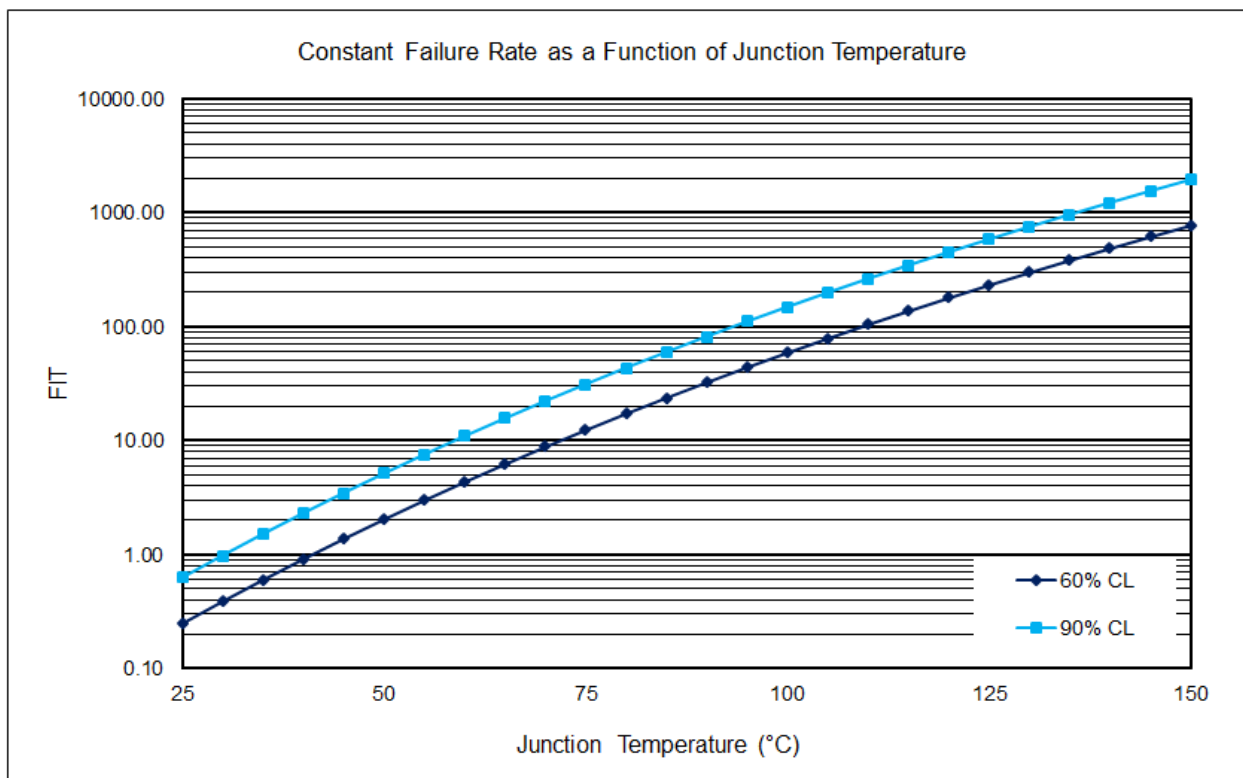
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	5.01E+07	18.3	5.46E+07
Constant (Random)	2.75E+08	3.3	3.00E+08



# UltraCMOS<sup>®</sup> 13SA Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U130S4)  
 Units Tested : 11,130  
 Product Family : Switch

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	3.90E+07	23.5	4.25E+07
Constant (Random)	3.06E+08	3.0	3.34E+08

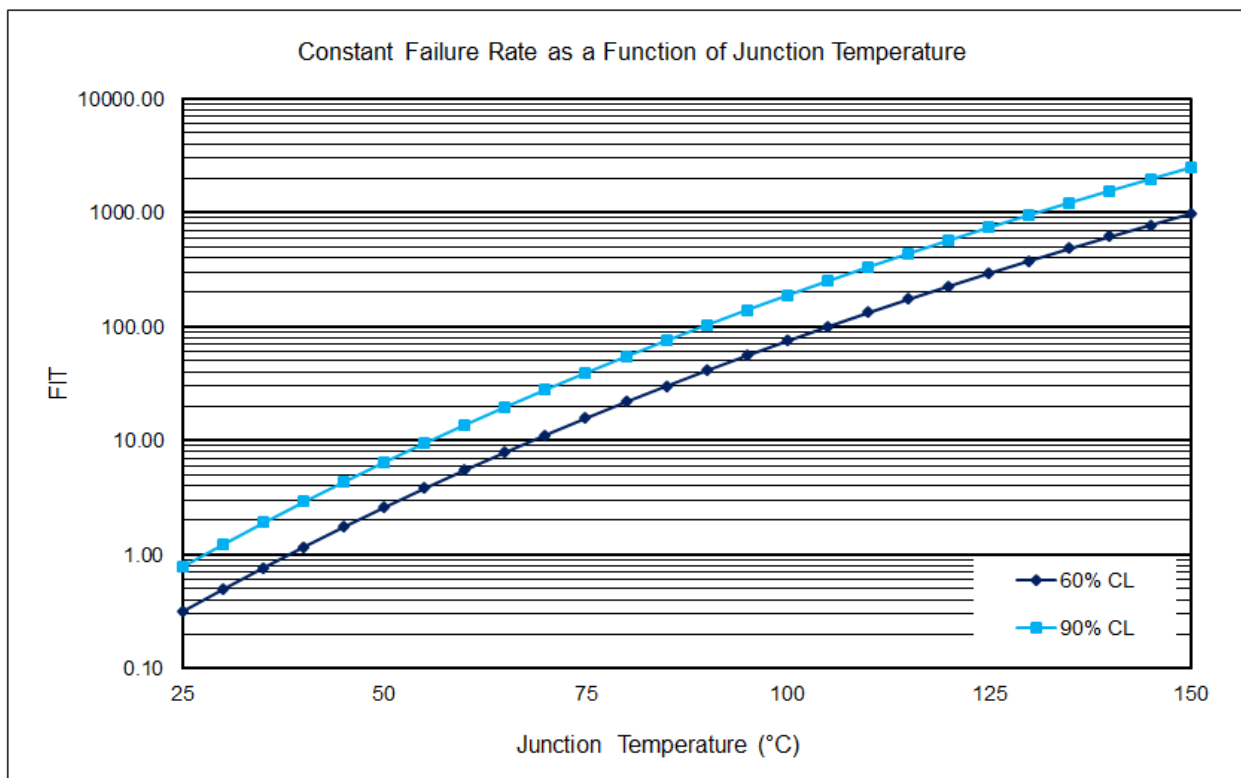




# UltraCMOS<sup>®</sup> 14 Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U14UD)  
 Units Tested : 11,898  
 Product Family : Switch

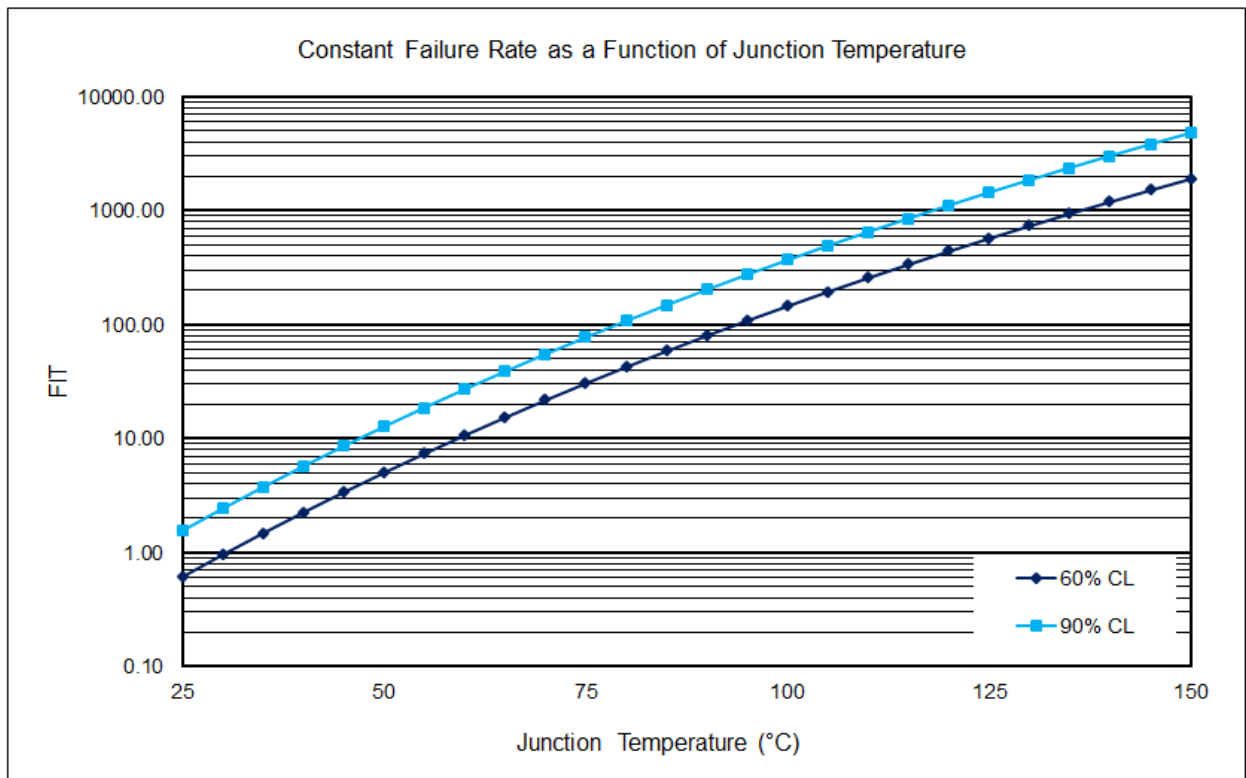
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	3.98E+07	23.0	4.34E+07
Constant (Random)	2.41E+08	3.8	2.63E+08



# UltraCMOS<sup>®</sup> 16 Process Technology

Generation : 65nm CMOS Silicon-On-Insulator in 300mm wafer (U16UD)  
 Units Tested : 7,365  
 Product Family : Switch

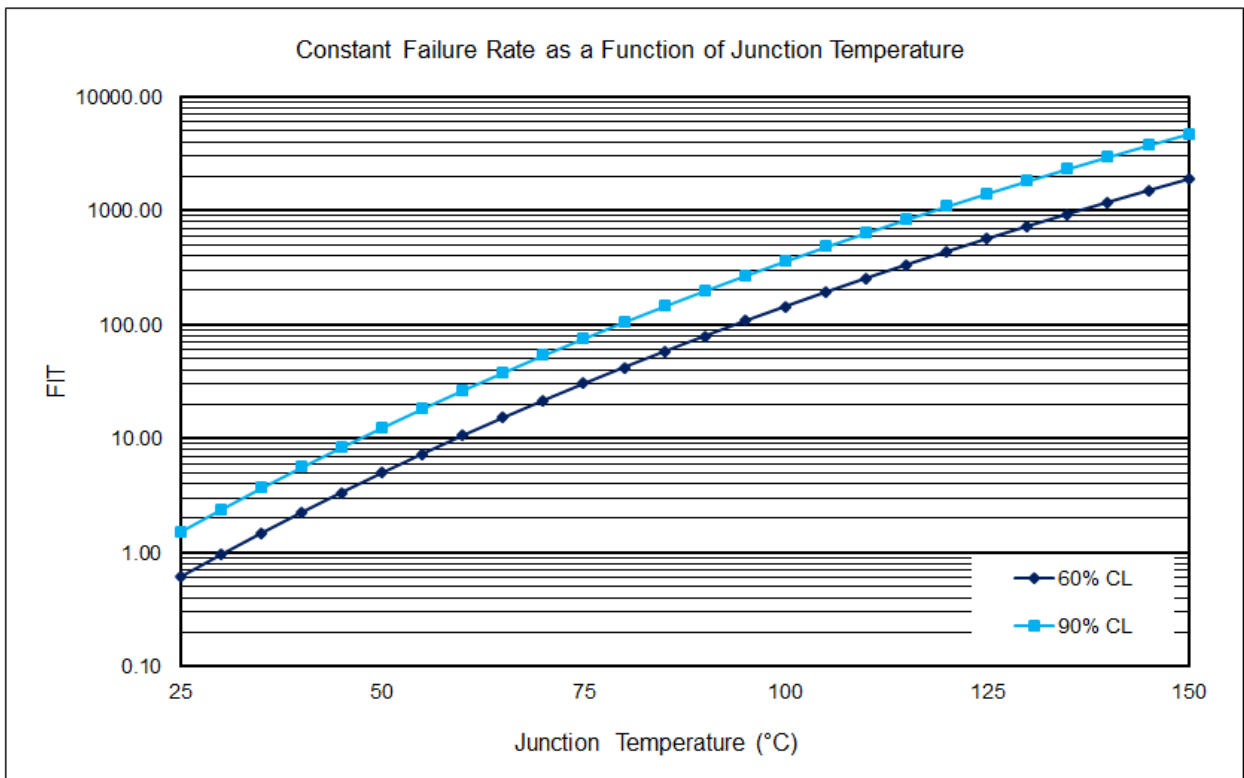
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	2.36E+07	38.8	2.58E+07
Constant (Random)	1.23E+08	7.4	1.35E+08



# BCD GEN II Process Technology

Generation : 180nm BCD Gen 2 Process  
 Units Tested : 1,616  
 Product Family : DC-DC

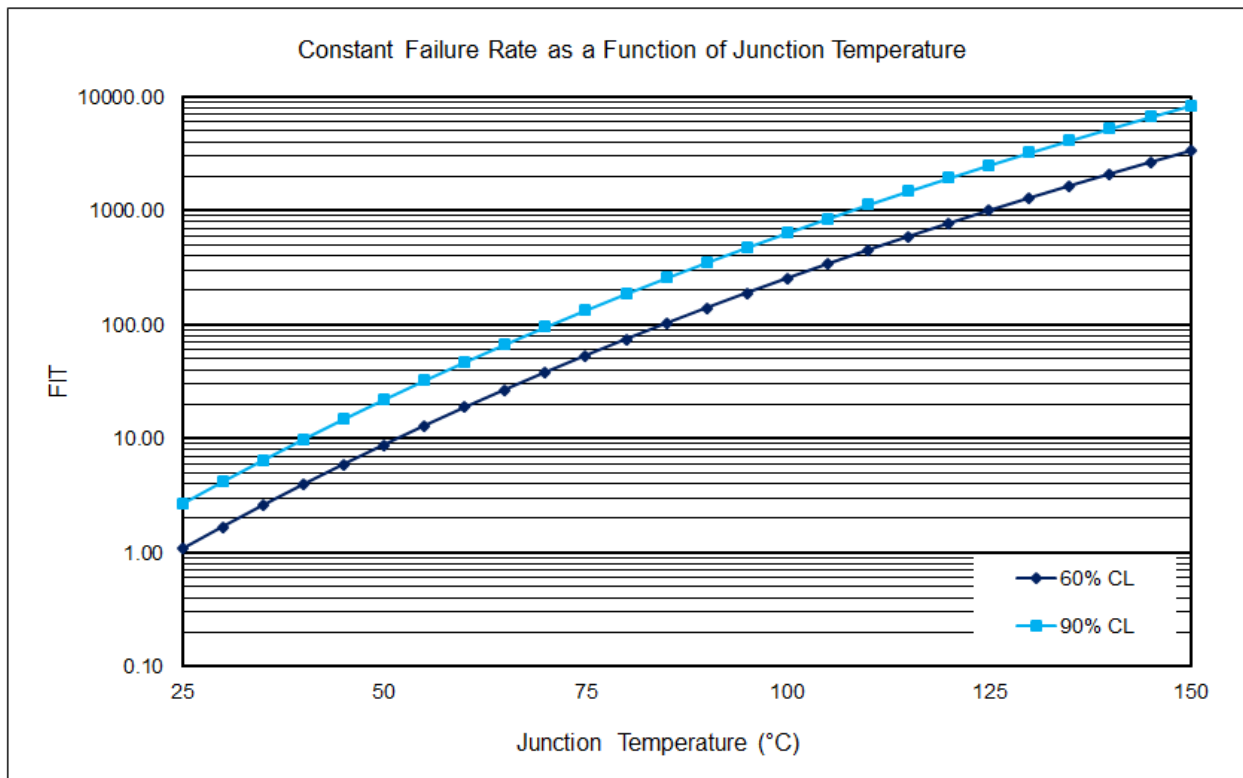
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	6.01E+06	152.3	6.56E+06
Constant (Random)	1.25E+08	7.3	1.37E+08



# BCD GEN III Process Technology

Generation : 180nm BCD Gen 3 Process  
 Units Tested : 915  
 Product Family : DC-DC

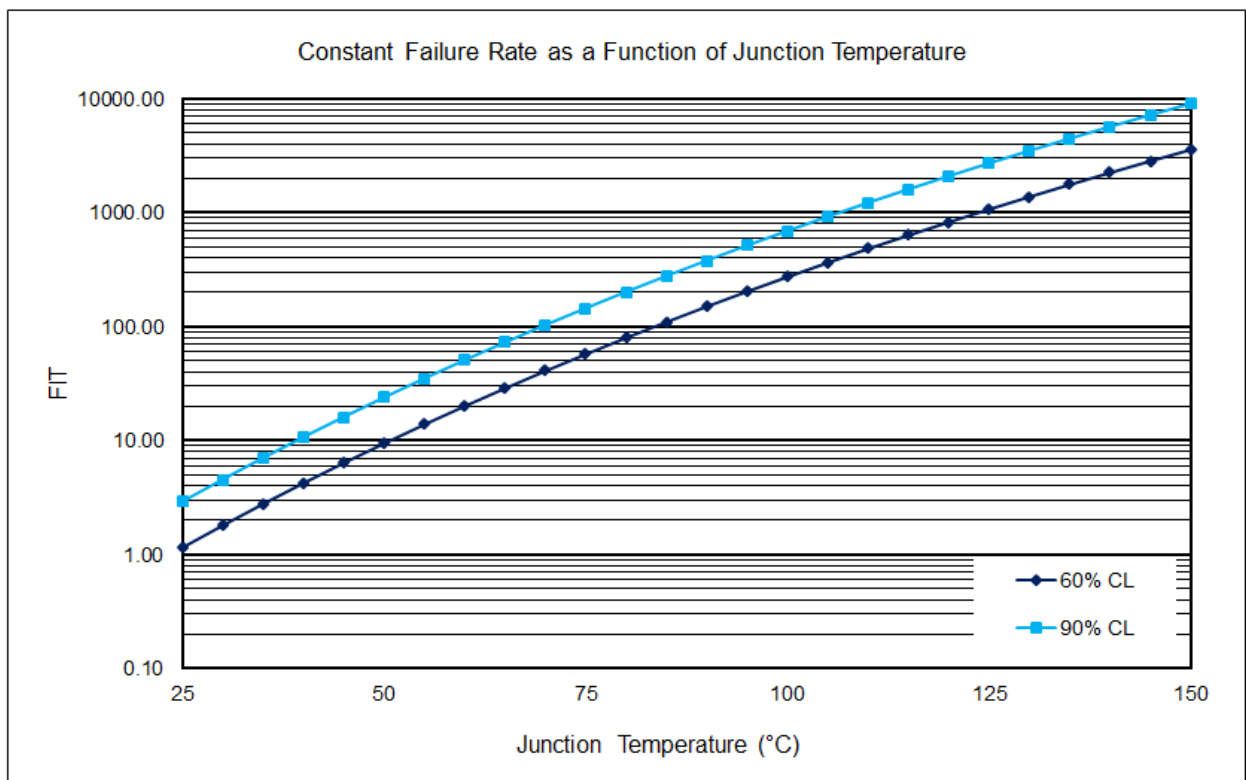
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	3.41E+06	269.1	3.72E+06
Constant (Random)	7.09E+07	12.9	7.74E+07



# BCDLite Process Technology

Generation : 130nm BCDLite Process  
 Units Tested : 786  
 Product Family : DC-DC

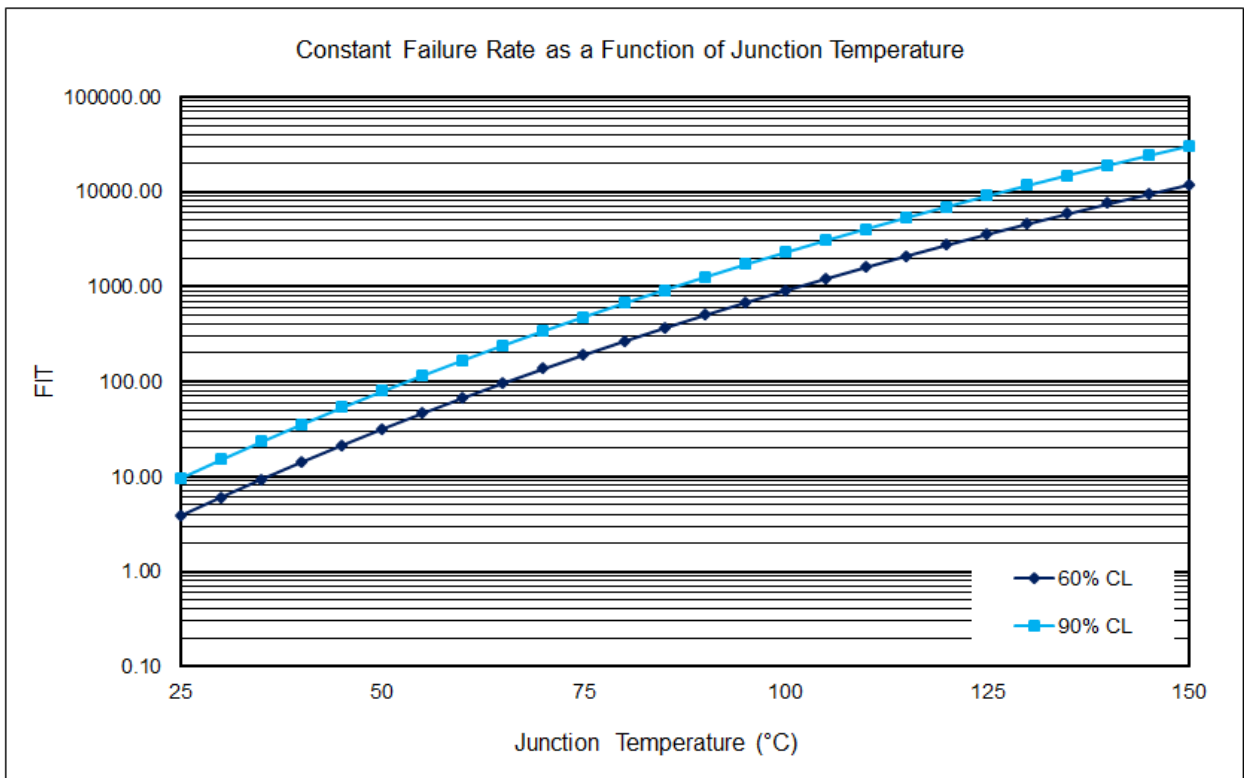
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	4.82E+06	190.0	5.26E+06
Constant (Random)	6.59E+07	13.9	7.19E+07



# CM18 Process Technology

Generation : 180nm CMOS Process  
 Units Tested : 255  
 Product Family : DC-DC

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	9.49E+05	965.4	1.04E+06
Constant (Random)	1.98E+07	46.3	2.16E+07

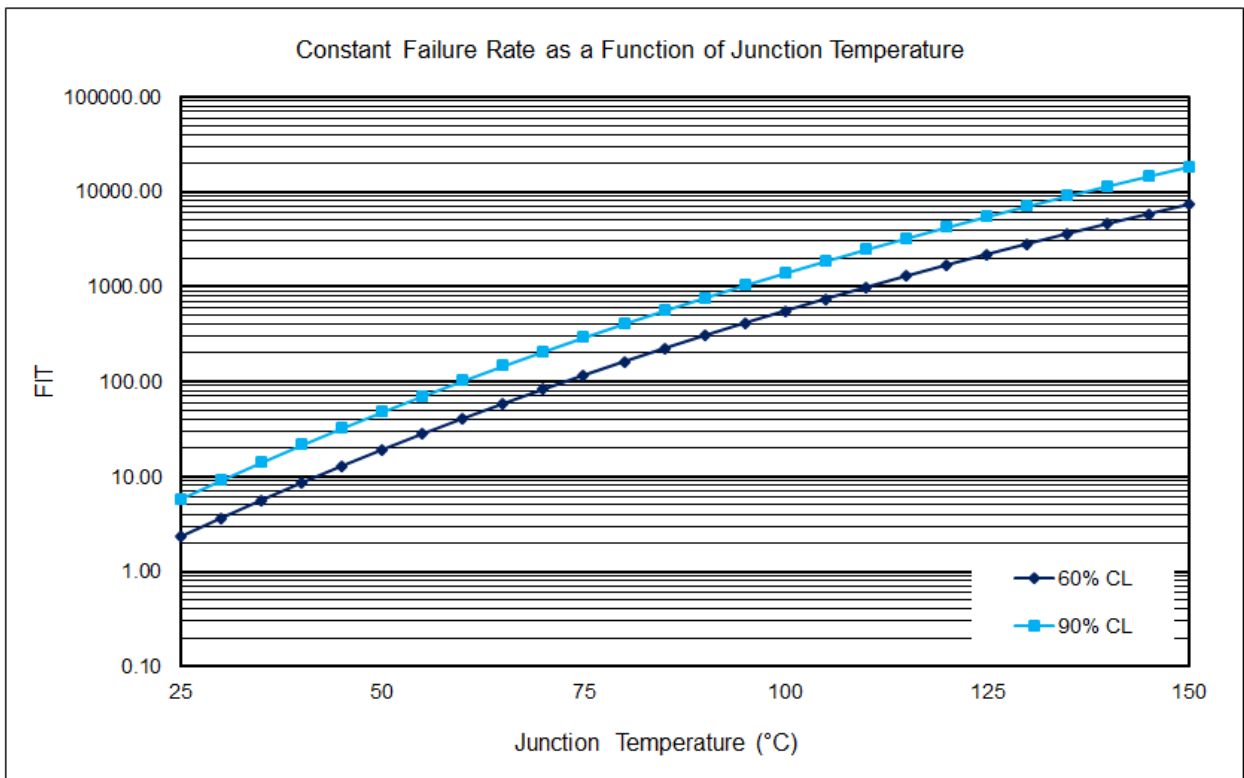




# 55LPx Process Technology

Generation : 55nm 300mm wafer (C055C1E6)  
 Units Tested : 420  
 Product Family : ASIC

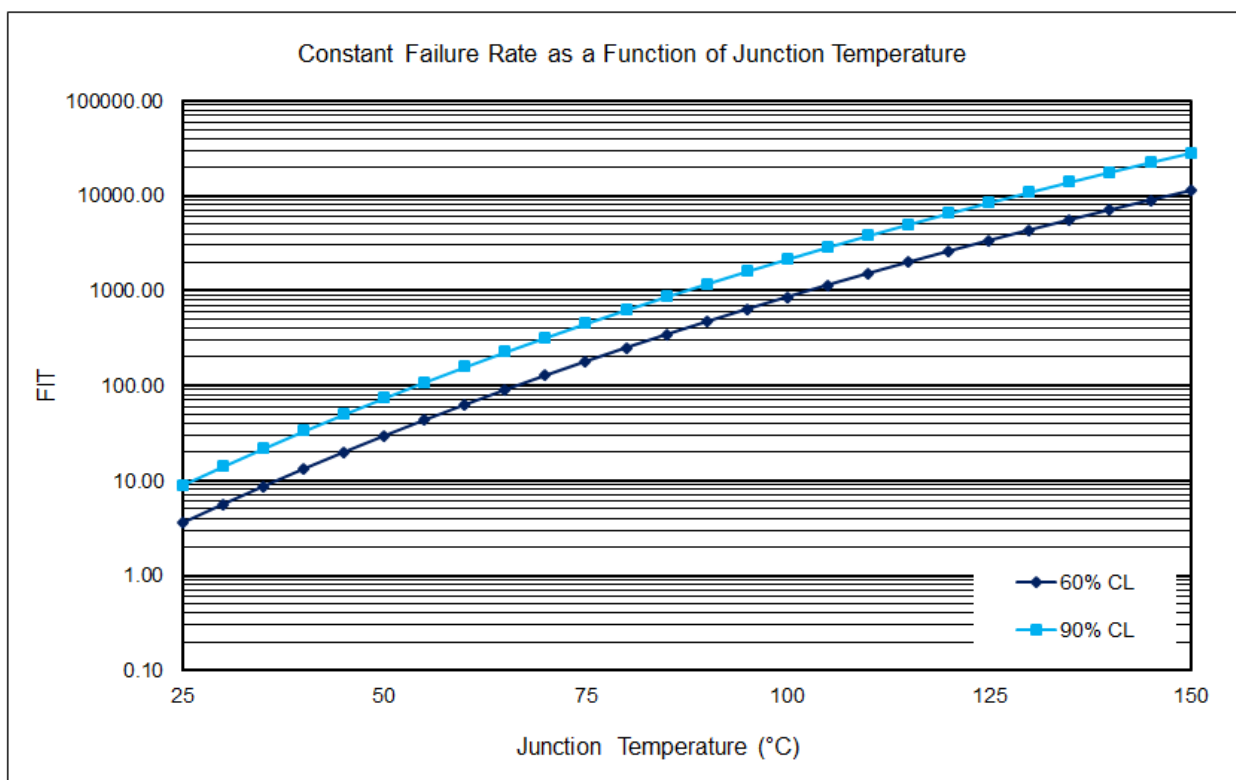
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.56E+06	586.2	1.71E+06
Constant (Random)	3.26E+07	28.1	3.55E+07



# 45RFSOI Process Technology

Generation : 55nm 300mm wafer (C045S1E8)  
 Units Tested : 272  
 Product Family : mmWave

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.01E+06	905.1	1.10E+06
Constant (Random)	2.11E+07	43.4	2.30E+07



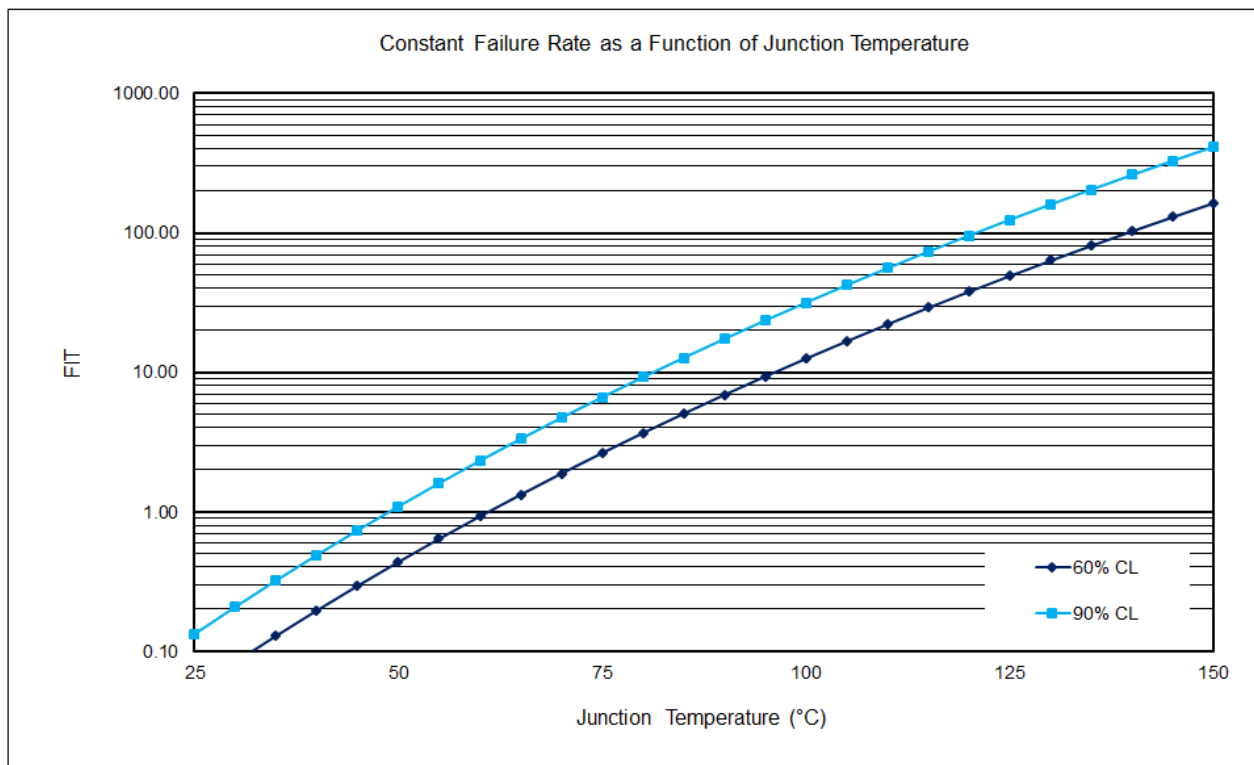


# **Product Family Classification**

# Amplifiers (LNA & PA)

Description : UltraCMOS Low-Noise Amplifiers (LNA) and Power Amplifiers (PA)  
 Products in Family : See Appendix A (page 51)  
 Process Technology : UltraCMOS® 11, UltraCMOS® 12, UltraCMOS® 12A, UltraCMOS® 13, UltraCMOS® 13S  
 Units Tested : 29,454

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.23E+08	7.4	1.34E+08
Constant (Random)	1.44E+09	0.6	1.57E+09



# Switches (ASW, HPSW, ATS & BSW)

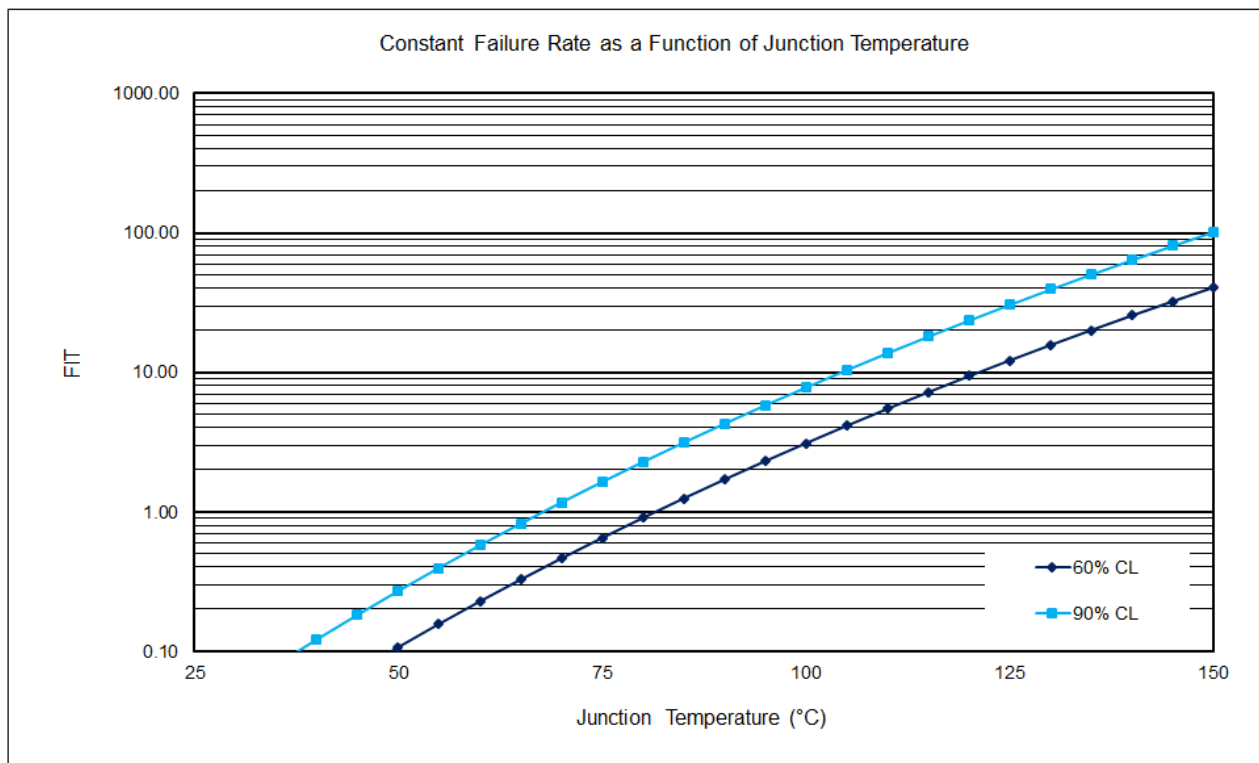
Description : Multi-pole & multi-throw high power handling antenna switch products for Mobile Wireless RF, broadband infrastructure, and Test Equipment /ATE applications.

Products in Family : See Appendix B (page 53)

Process Technology : UltraCMOS<sup>®</sup> 2, UltraCMOS<sup>®</sup> 3.5, UltraCMOS<sup>®</sup> 5, UltraCMOS<sup>®</sup> 6, UltraCMOS<sup>®</sup> 6.5, UltraCMOS<sup>®</sup> 8, UltraCMOS<sup>®</sup> 10, UltraCMOS<sup>®</sup> 11, UltraCMOS<sup>®</sup> 12, UltraCMOS<sup>®</sup> 12A, UltraCMOS<sup>®</sup> 13, UltraCMOS<sup>®</sup> 13S, UltraCMOS<sup>®</sup> 13SA, UltraCMOS<sup>®</sup> 14, UltraCMOS<sup>®</sup> 16

Units Tested : 94,115

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	6.97E+08	1.3	7.60E+08
Constant (Random)	5.83E+09	0.2	6.36E+09



# ASIC

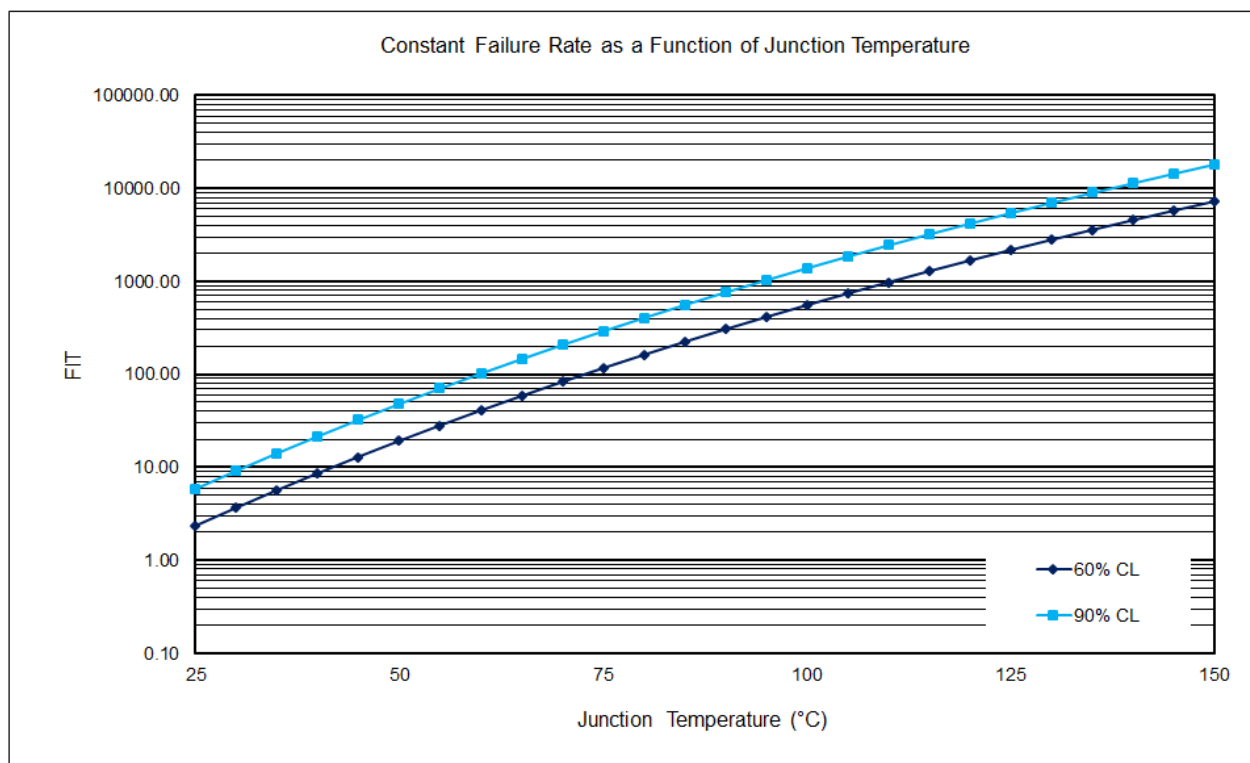
Description : These ICs have high precision ADCs for sensing MEMS capacitance and high accuracy temperature sensors to support high conversion rates and low latency.

Products in Family : PE71910, WP71900, WP71901, WP71902

Process Technology : 55LPx

Units Tested : 420

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.56E+06	586.2	1.71E+06
Constant (Random)	3.26E+07	28.1	3.55E+07





# DC-DC

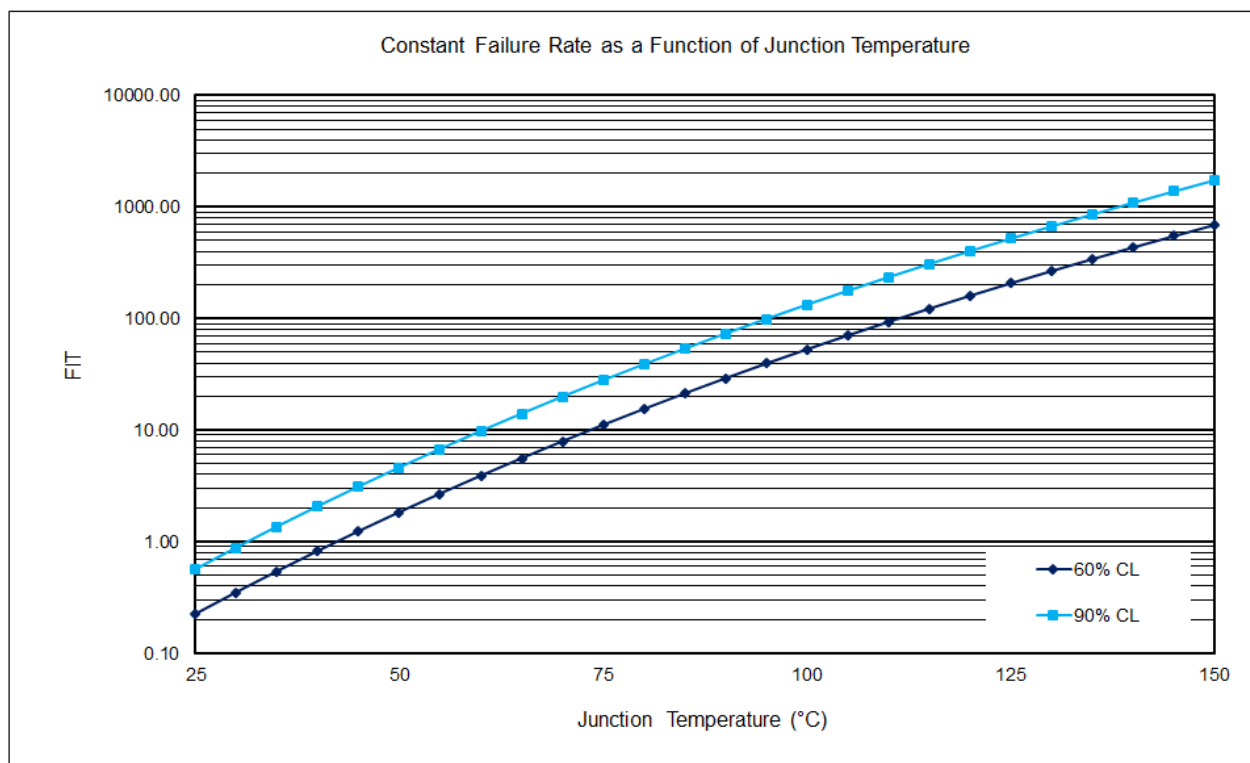
**Description** : These devices are ultra-high efficiency DC/DC converter solution with integrated programmable current sinks that drive strings of LEDs.

**Products in Family** : PE22100, PE23100, PE23102, PE23108, PE23261, PE23363, PE24101, PE24102, PE24103, PE24108, PE25200, PE25204, PE25208, PE27100, PE27500, PE99151, PE99151-11, PE99153,

**Process Technology** : BCD GEN II, BCD GEN III, BCDLite, CM18, UltraCMOS® 2, UltraCMOS® 11

**Units Tested** : 4,858

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	2.04E+07	44.9	2.22E+07
Constant (Random)	3.41E+08	2.7	3.73E+08



# Digital Step Attenuators (DSA)

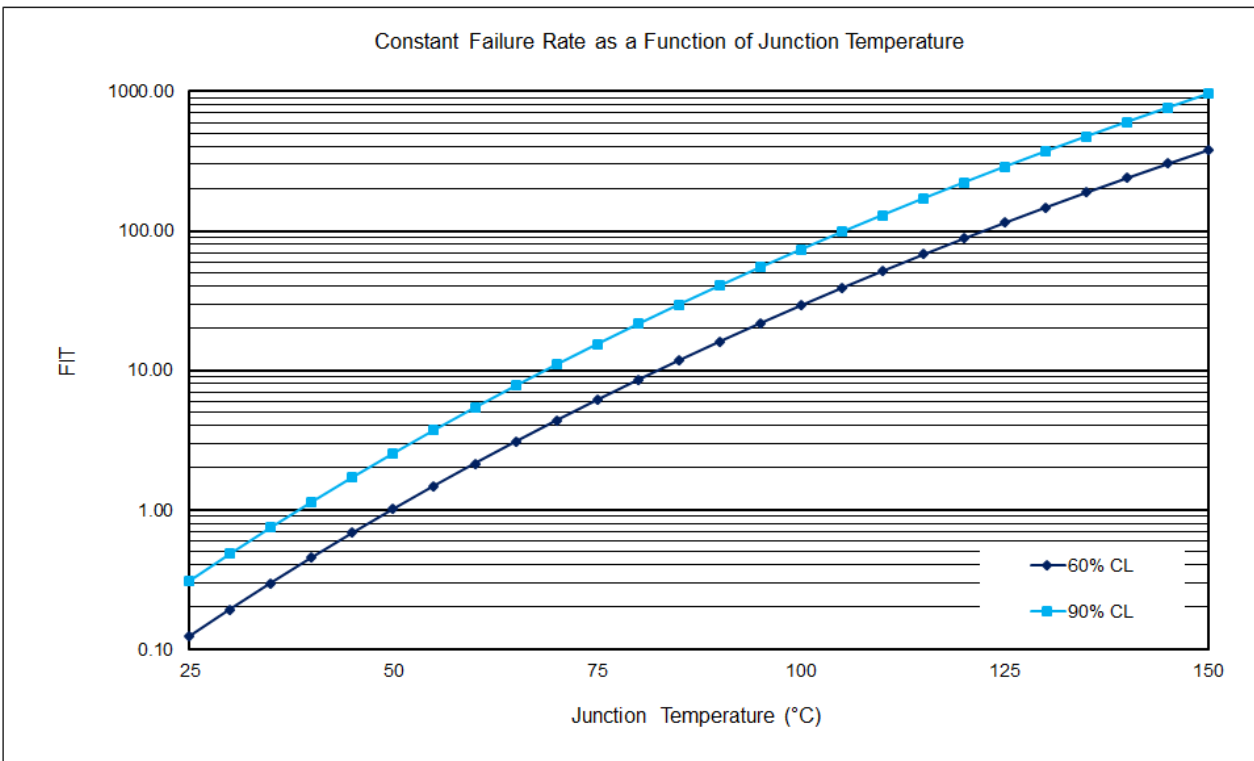
Description : 50Ω and 75Ω Digital Step Attenuators for wireless infrastructure, microwave, test equipment and high reliability space applications.

Products in Family : PE4302, PE4306, PE4308, PE4309, PE4312, PE4314, PE43204, PE43205, PE43508, PE43610, PE43614, PE43620, PE43650, PE43665, PE43670, PE43701, PE43702, PE43703, PE43704, PE43705, PE43711, PE43712, PE43713, PE94302

Process Technology : UltraCMOS<sup>®</sup> 2, UltraCMOS<sup>®</sup> 3.5, UltraCMOS<sup>®</sup> 5, UltraCMOS<sup>®</sup> 6.5, UltraCMOS<sup>®</sup> 8, UltraCMOS<sup>®</sup> 12

Units Tested : 6,935

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	5.76E+07	15.9	6.29E+07
Constant (Random)	6.18E+08	1.5	6.75E+08



# Digitally Tunable Capacitors (DTC)

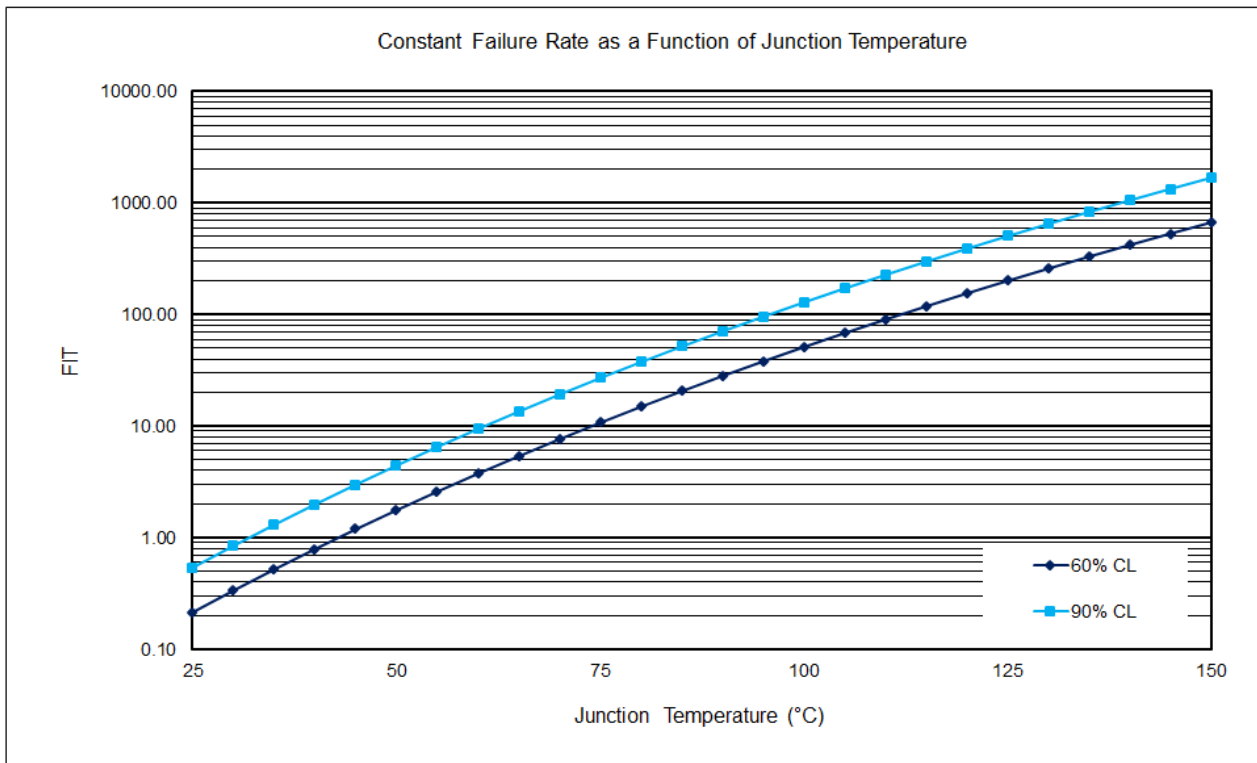
Description : Supports a wide range of tuning applications, from tuning the center frequency of mobile-TV and antennas, to tunable impedance matching and filters.

Products in Family : PE613040, PE613050, PE62304, PE62305, PE623060, PE623090, PE64102, PE64904, PE64906, PE64907, PE64909

Process Technology : UltraCMOS<sup>®</sup> 3.5, UltraCMOS<sup>®</sup> 5, UltraCMOS<sup>®</sup> 8

Units Tested : 2,885

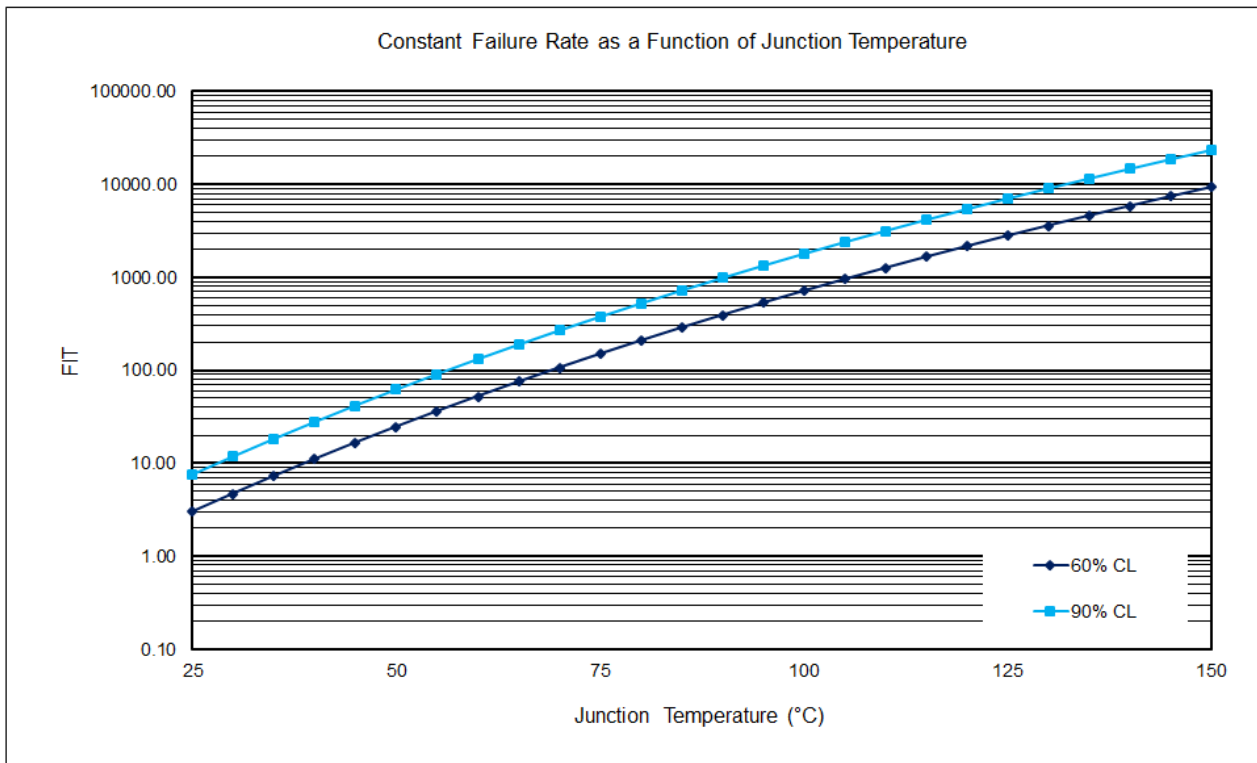
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	3.38E+07	27.1	3.68E+07
Constant (Random)	3.53E+08	2.6	3.85E+08



# GaN Driver Product Family

Description : High-speed FET Driver  
 Products in Family : PE29100, PE29101, PE29102  
 Process Technology : UltraCMOS® 6.5, UltraCMOS® 8  
 Units Tested : 327

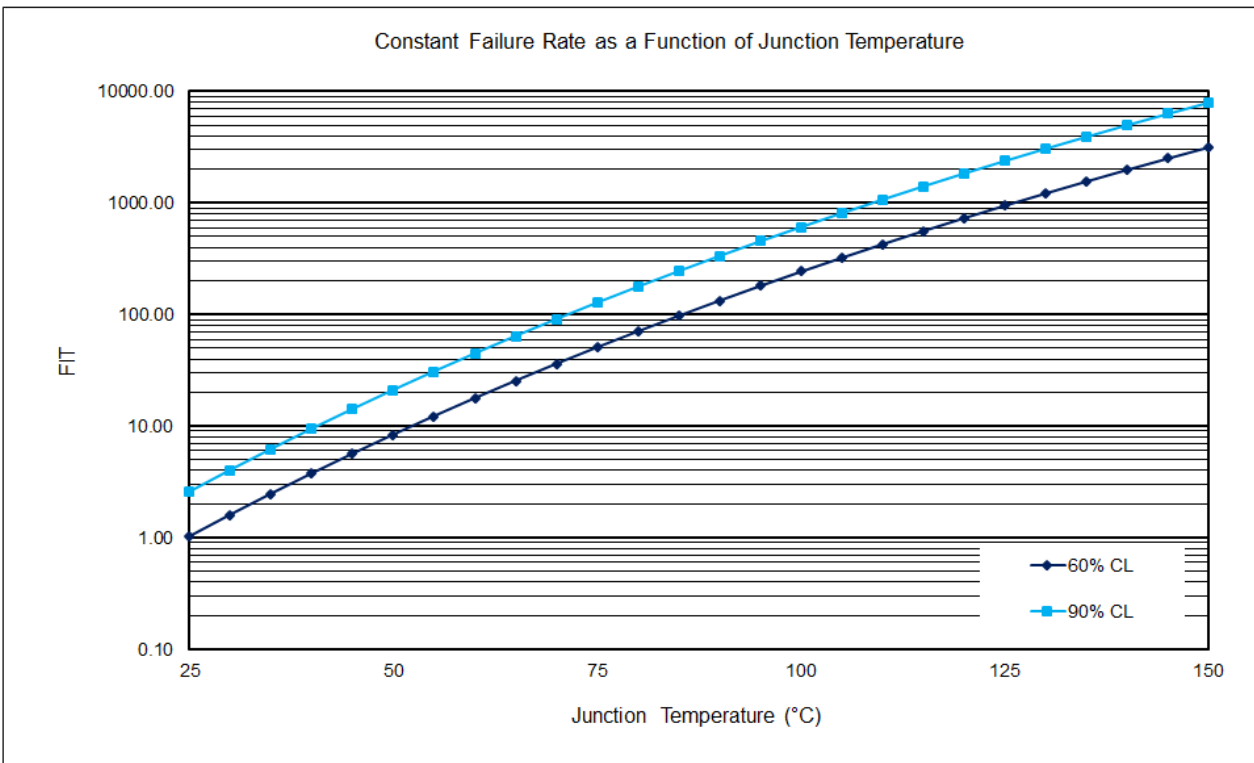
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.22E+06	752.9	1.33E+06
Constant (Random)	2.54E+07	36.1	2.77E+07



# Power Limiters (LMTR)

Description : UltraCMOS Power Limiters.  
 Products in Family : PE45140, PE45361, PE45450  
 Process Technology : UltraCMOS<sup>®</sup> 5, UltraCMOS<sup>®</sup> 8  
 Units Tested : 589

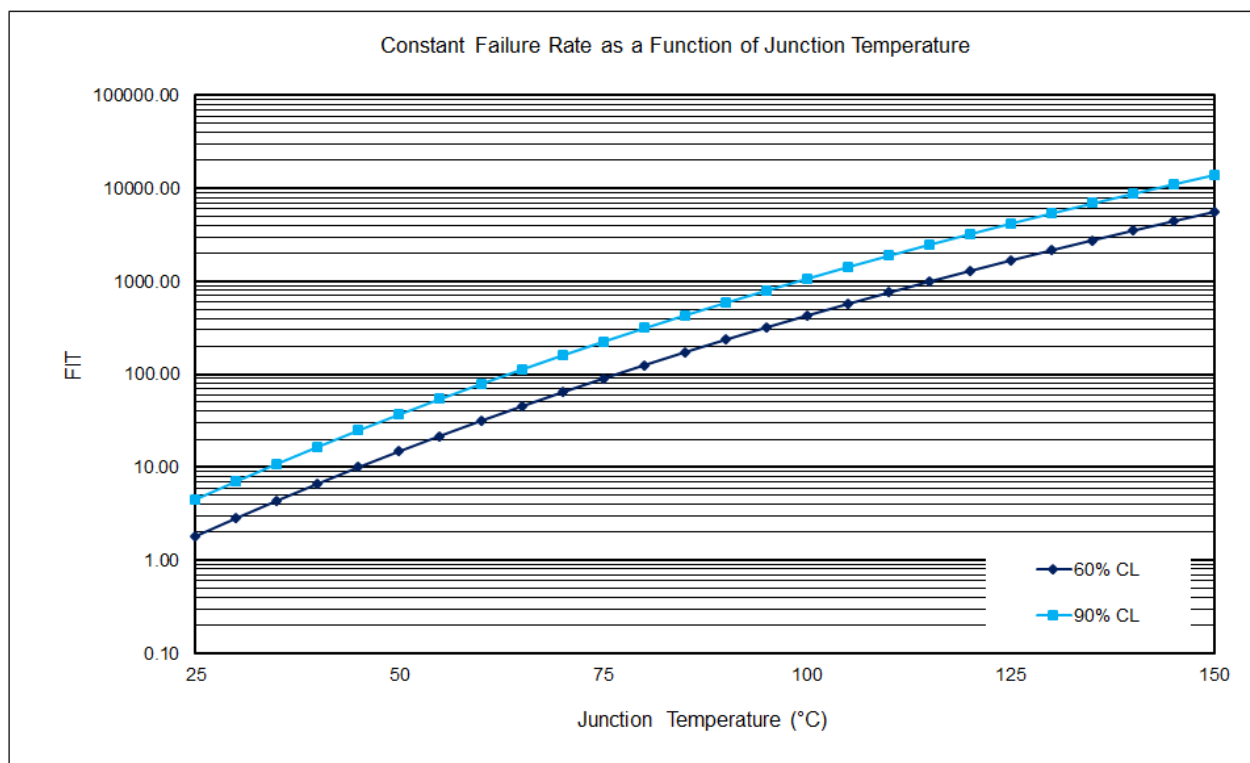
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	7.04E+06	130.2	7.68E+06
Constant (Random)	7.45E+07	12.3	8.13E+07



# mmWave

Description : mmWave FEM  
 Products in Family : PE188200, PE1283x0  
 Process Technology : UltraCMOS® 12A, 45RFSOI  
 Units Tested : 543

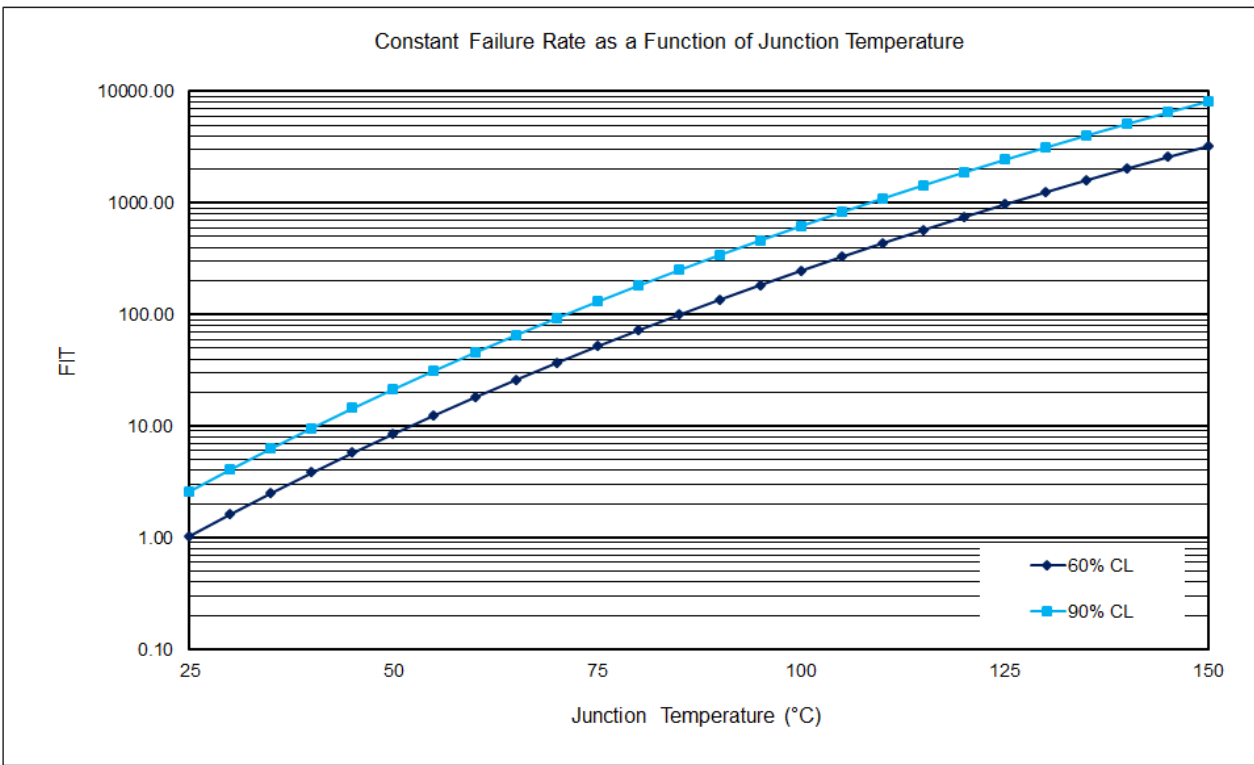
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	2.02E+06	453.4	2.21E+06
Constant (Random)	4.21E+07	21.8	4.60E+07



# Monolithic Phase & Amplitude Controller (MPAC)

Description : UltraCMOS RF MPACs.  
 Products in Family : PE19601, PE46120, PE46130, PE46140  
 Process Technology : UltraCMOS® 5, UltraCMOS® 8  
 Units Tested : 565

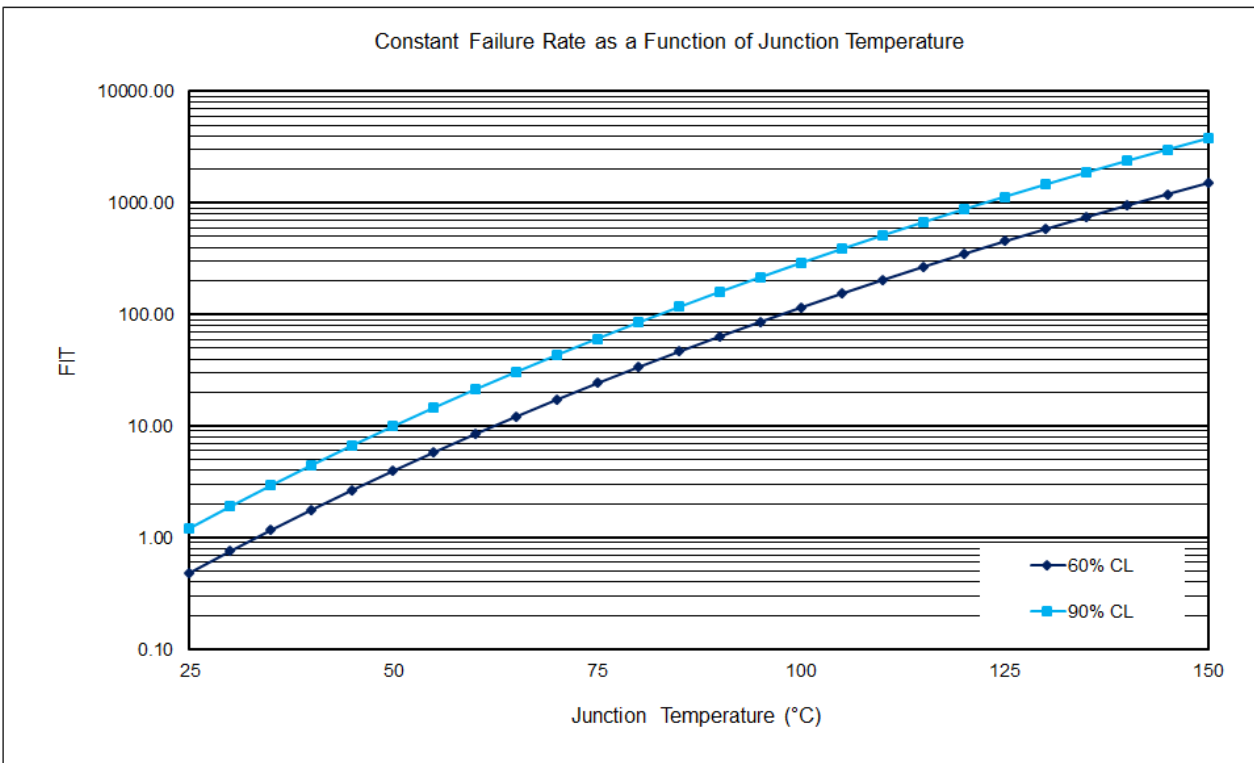
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	7.02E+06	130.6	7.66E+06
Constant (Random)	7.31E+07	12.5	7.98E+07



# Mixers (MXR)

Description : UltraCMOS MOSFET quad array broadband and tuned mixers.  
 Products in Family : PE4120, PE4122, PE4126, PE4134, PE4140, PE4141, PE4150, PE4151, PE4152, PE41901  
 Process Technology : UltraCMOS<sup>®</sup> 2, UltraCMOS<sup>®</sup> 8  
 Units Tested : 1,136

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	9.15E+06	100.1	9.99E+06
Constant (Random)	1.57E+08	5.9	1.71E+08





# PA Controller (PAC)

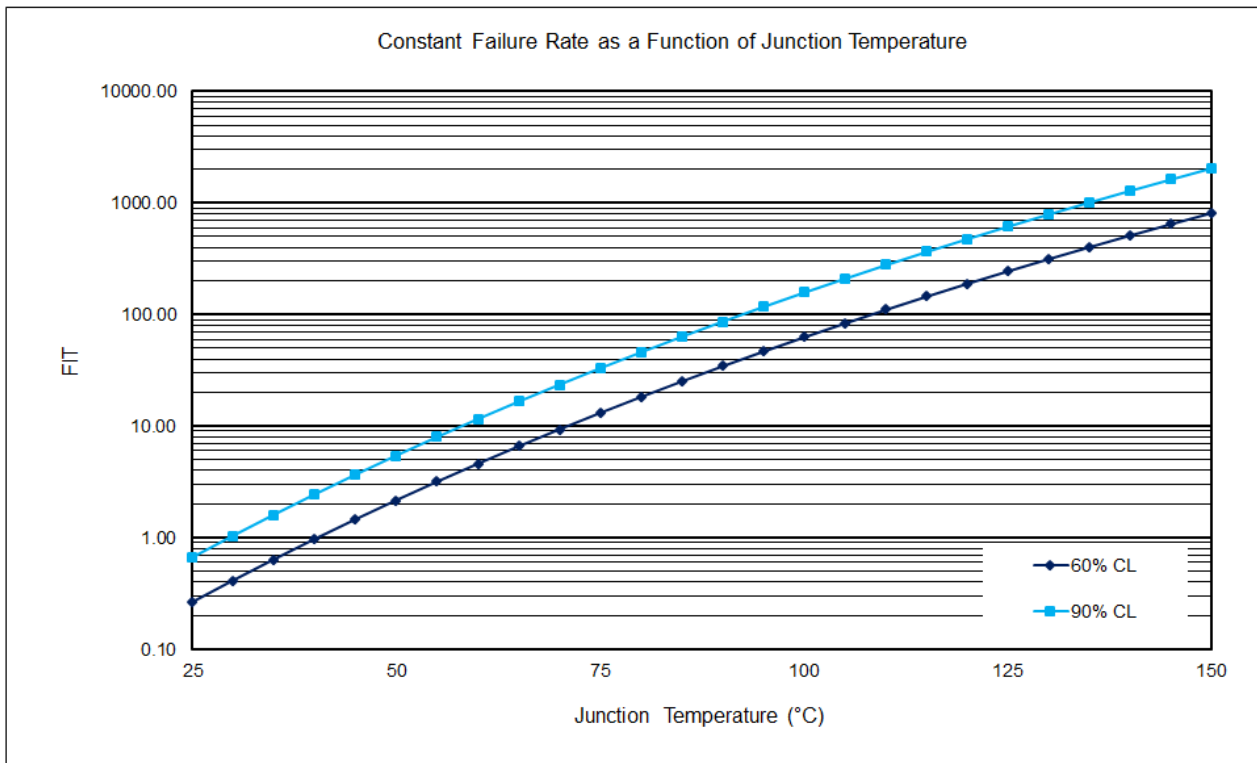
Description : PA Controller controls the PA bias current in PAD modules for RF Front Ends

Products in Family : PE510021, PE515131, PE515190, PE515200, PE515211,

Process Technology : UltraCMOS® 12

Units Tested : 9,275

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	3.75E+07	24.4	4.09E+07
Constant (Random)	2.89E+08	3.2	3.15E+08



# Phase Locked-Loop Synthesizers (PLL)

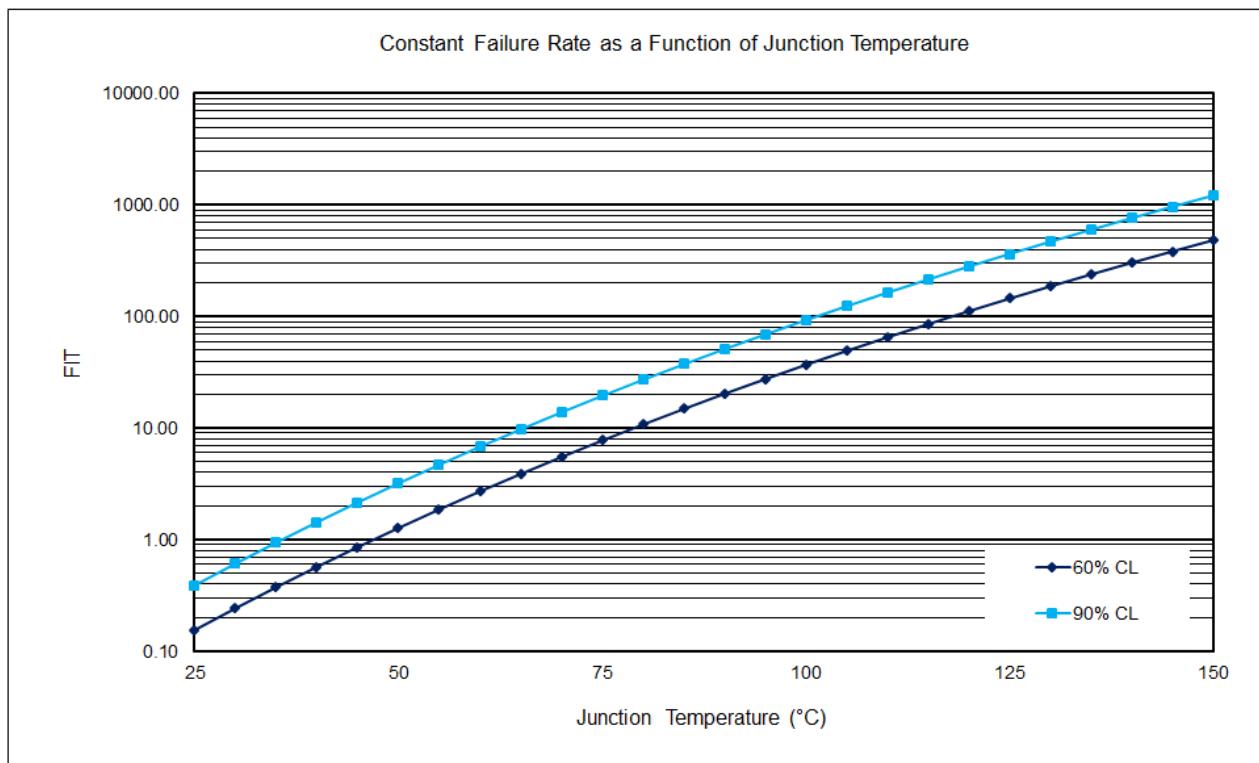
Description : Integer-N, Fractional-N and Delta Sigma Modulated frequency synthesizers for base station, mobile wireless and high reliability space applications.

Products in Family : PE3236, PE33241, PE3335, PE3336, PE33361, PE3341, PE3342, PE34641, PE83336-21, PE9601, PE9701, PE9702, PE97022, PE9704, PE97042, PE97240, PE9763, PE9763-14, PE97632,

Process Technology : UltraCMOS<sup>®</sup> 2, UltraCMOS<sup>®</sup> 5

Units Tested : 9,269

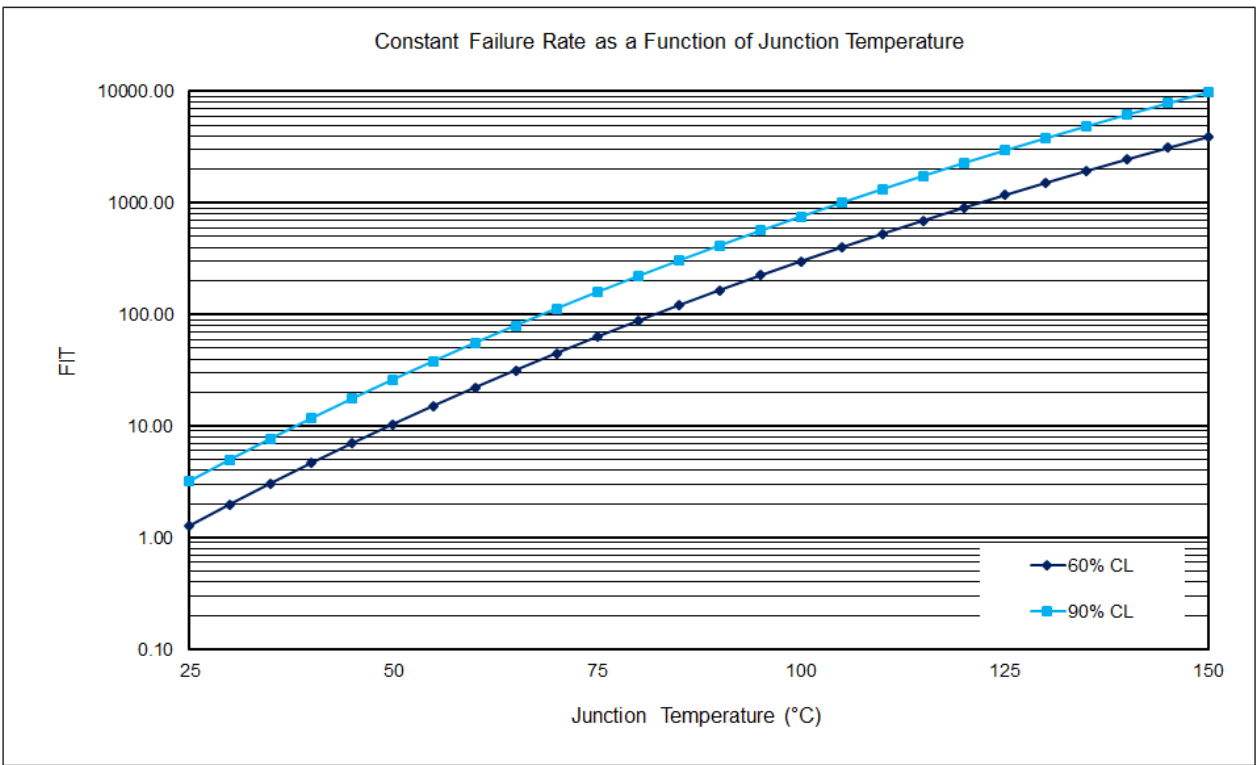
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	4.54E+07	20.2	4.95E+07
Constant (Random)	4.89E+08	1.9	5.34E+08



# Phase Shifters (PSH)

Description : UltraCMOS RF Phase Shifters.  
 Products in Family : PE44820  
 Process Technology : UltraCMOS® 5  
 Units Tested : 432

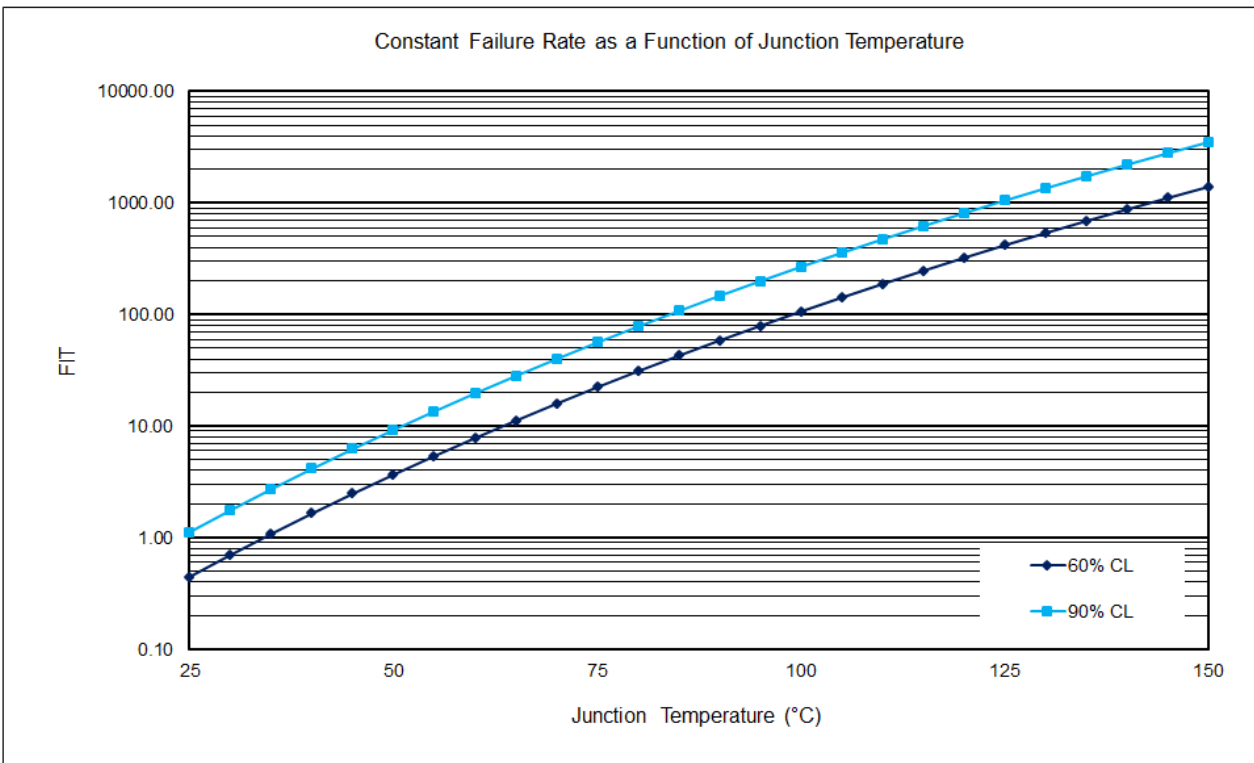
Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	5.37E+06	170.8	5.86E+06
Constant (Random)	6.00E+07	15.3	6.55E+07



# Prescalers (PSR)

Description : UltraCMOS RF Prescalers.  
 Products in Family : PE3501, PE3503, PE3511, PE3512, PE35400, PE83512, PE9301, PE9303, PE9304, PE9308, PE9309, PE9311, PE9312, PE9313  
 Process Technology : UltraCMOS® 2, UltraCMOS® 8  
 Units Tested : 2,697

Standard Failure Rate Calculations at 55°C and 60% CL			
	EDH (hours)	FITs	MTTF (hours)
Early Life	1.35E+07	68.1	1.47E+07
Constant (Random)	1.69E+08	5.4	1.85E+08



The background of the slide features a repeating pattern of a light gray circuit board. The pattern consists of various traces, pads, and vias, creating a complex, interconnected grid that covers the entire page. The lines are thin and light, providing a subtle technical aesthetic.

# Reliability Data

(Periodic Testing for the last 8 Quarters)

# High Temperature Operating Life (HTOL)

- Reference Standards : JESD22-A108
- Test Conditions :  $T_A = 125^{\circ}\text{C}$  (A) or  $150^{\circ}\text{C}$  (B)  
 :  $V_{\text{bias}} = \text{max operating voltage}$
- Test Duration (typical) : HTOL: 1,000 hrs. at (A) or 500 hrs. at (B)  
 ELFR: 48 hrs. at (A) or 24 hrs. at (B)

HTOL & ELFR	2023	2023	2023	2023	2024	2024	2024	2024
Process Technology	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
UltraCMOS® 2	-	0/159	0/78	0/400	-	-	-	-
UltraCMOS® 12	0/84	-	-	0/80	0/80	-	0/341	-
UltraCMOS® 13S	-	-	-	-	-	-	-	-
UltraCMOS® 11	-	-	-	-	-	-	-	-
UltraCMOS® 14	-	0/3,994	0/2,135	0/1,084	0/1,248	0/464	0/350	0/90
UltraCMOS® 12A	0/359	0/85	0/339	0/83	0/78	0/87	0/1,114	0/172
UltraCMOS® 13SA	-	-	0/100	-	0/100	-	-	-
UltraCMOS® 3.5	-	-	-	0/320	-	-	0/80	-
UltraCMOS® 5	0/240	0/170	-	-	-	-	-	-
UltraCMOS® 16	0/84	0/168	0/252	0/219	0/1,305	0/3,231	0/616	0/251
UltraCMOS® 13	0/90	0/256	-	0/255	-	0/79	-	-
UltraCMOS® 10	-	-	-	-	-	-	-	-
UltraCMOS® 8	-	-	-	-	-	-	-	-
UltraCMOS® 6	-	-	-	-	-	-	-	-
UltraCMOS® 6.5	0/85	-	-	-	-	-	-	-
BCD Gen II	-	-	-	0/246	-	-	-	-
BCD Gen III	-	0/255	-	-	-	-	0/320	-
BCD Lite	-	-	-	-	-	-	-	-
55LPx	-	-	-	0/77	-	-	-	-
<b>Total</b>	<b>0/1,197</b>	<b>0/5,087</b>	<b>0/2,904</b>	<b>0/2,764</b>	<b>0/2,811</b>	<b>0/3,861</b>	<b>0/2,821</b>	<b>0/513</b>

HTOL & ELFR	2023	2023	2023	2023	2024	2024	2024	2024
Product Group	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Switch	0/84	0/4,321	0/2,642	0/2,103	0/2,733	0/3,695	0/1,136	0/341
Amplifier	0/449	0/341	0/262	0/83	0/78	0/166	0/1,365	0/172
PAC	0/84	-	-	0/255	-	-	-	-
PLL	-	-	-	-	-	-	-	-
DSA	0/85	-	-	-	-	-	-	-
DC-DC	0/255	0/255	-	0/246	-	-	0/320	-
DTC	0/240	0/170	-	-	-	-	-	-
PSR	-	-	-	-	-	-	-	-
MXR	-	-	-	-	-	-	-	-
LMTR	-	-	-	-	-	-	-	-
MPAC	-	-	-	-	-	-	-	-
mmWave	-	-	-	-	-	-	-	-
PSH	-	-	-	-	-	-	-	-
ASIC	-	-	-	0/77	-	-	-	-
Driver	-	-	-	-	-	-	-	-
<b>Total</b>	<b>0/1,197</b>	<b>0/5,087</b>	<b>0/2,904</b>	<b>0/2,764</b>	<b>0/2,811</b>	<b>0/3,861</b>	<b>0/2,821</b>	<b>0/513</b>

# Temperature Cycle (TC)

Reference Standards : JESD22-A104  
 Test Conditions : -55°C to +125°C (B)  
 : -65°C to +150°C (C)  
 Test Duration (typical) : 1,000 cyc. at (B) or 500 cyc. at (C)

TC	2023	2023	2023	2023	2024	2024	2024	2024
Package Family	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WLCSP	0/1,168	0/409	0/335	0/150	0/476	0/710	0/1,100	0/120
32L 5x5 QFN	-	-	-	0/135	-	-	-	-
20L 4x4 QFN	-	-	-	-	0/45	-	-	-
6L SC70	-	-	-	0/305	-	-	-	-
12L 2x2 QFN	-	-	-	0/50	-	-	0/50	-
16L 3x3 QFN	-	0/159	0/79	0/50	-	-	-	-
Flip Chip Die	0/165	-	-	0/150	0/164	-	-	-
32L 5x5 FCLGA	-	-	-	-	-	-	-	-
24L 4x4 QFN	0/50	-	-	-	-	-	-	-
12L 3x3 QFN	-	-	-	-	-	-	-	-
6L 1.5x1.5 UDFN	-	-	-	-	-	-	-	-
20L 4x4 FCLGA	-	-	0/45	-	-	-	-	-
10L 2x2 FCETSLP	0/90	0/135	-	-	-	-	-	-
29L 4x4 FCLGA	-	-	-	-	-	-	-	-
30L 3x3.8 QFN	-	-	-	-	-	-	-	-
<b>Total</b>	<b>0/1,623</b>	<b>0/748</b>	<b>0/459</b>	<b>0/990</b>	<b>0/1,035</b>	<b>0/794</b>	<b>0/1,619</b>	<b>0/120</b>

Note

- n/a - Reliability data not available. Package (family) not yet qualified at the specified period.
- dash (-) - Test not performed at the specified period.
- \* Plastic encapsulated packages had undergone MSL Preconditioning prior to test.



# Highly Accelerated Stress Test (HAST)

Reference Standards : JESD22-A110  
 Test Conditions : 130°C, 85% RH, 2.27 atm. (A)  
                               : 110°C, 85% RH, 1.20 atm. (B)  
 Test Duration (typical) : 96 hrs. at (A) or 264 hrs. at (B)

HAST	2022	2023	2023	2023	2023	2024	2024	2024
Package Family	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
WLCSP	0/80	0/618	0/635	0/156	-	-	-	-
32L 5x5 QFN	-	-	-	-	-	-	-	-
20L 4x4 QFN	-	-	-	-	-	-	-	-
6L SC70	-	-	-	-	0/304	-	-	-
12L 2x2 QFN	0/49	-	-	-	0/305	-	-	-
16L 3x3 QFN	-	-	-	-	0/50	-	-	-
Flip Chip Die	-	-	-	-	0/150	-	-	-
32L 5x5 FCLGA	-	-	-	-	-	-	-	-
24L 4x4 QFN	-	0/50	-	-	-	-	-	-
12L 3x3 QFN	-	-	-	-	-	-	-	-
6L 1.5x1.5 UDFN	-	-	-	-	-	-	-	-
20L 4x4 FCLGA	-	-	-	-	-	-	-	-
10L 2x2 FCETSLP	-	0/135	0/135	-	-	-	-	-
29L 4x4 FCLGA	-	-	-	-	-	-	-	-
30L 3x3.8 QFN	-	-	-	-	-	-	-	-
<b>Total</b>	0/129	0/953	0/770	0/201	0/809	0/250	-	-

Note

- n/a - Reliability data not available. Package (family) not yet qualified at the specified period.
- dash (-) - Test not performed at the specified period. HAST may not apply to hermetic packages.
- \* Plastic encapsulated packages had undergone MSL Preconditioning prior to test.



# High Temperature Storage (HTS)

Reference Standards : JESD22-A103

Test Conditions : Ta = 150°C

Test Duration (typical) : 1,000 hrs.

HTS	2022	2023	2023	2023	2023	2024	2024	2024
Package Family	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
WLCSP	0/237	0/240	0/486	-	0/84	0/486	0/471	-
32L 5x5 QFN	-	-	-	-	0/135	-	-	-
20L 4x4 QFN	-	-	-	-	-	-	-	-
6L SC70	-	-	-	-	0/200	-	-	-
12L 2x2 QFN	0/50	-	-	-	0/200	-	-	0/50
16L 3x3 QFN	-	-	0/100	0/50	0/50	-	-	-
Flip Chip Die	-	-	-	-	-	-	-	-
32L 5x5 FCLGA	-	-	-	-	-	-	-	-
24L 4x4 QFN	-	0/85	-	-	-	-	-	-
12L 3x3 QFN	-	-	-	-	-	-	-	-
6L 1.5x1.5 UDFN	-	-	-	-	-	-	-	-
20L 4x4 FCLGA	-	-	-	0/45	-	-	-	-
10L 2x2 FCETSLP	-	0/135	0/231	-	-	-	-	-
29L 4x4 FCLGA	-	-	-	-	-	-	-	-
30L 3x3.8 QFN	-	-	-	-	-	-	-	-
<b>Total</b>	<b>0/287</b>	<b>0/760</b>	<b>0/817</b>	<b>0/95</b>	<b>0/819</b>	<b>0/636</b>	<b>0/554</b>	<b>0/100</b>

Note

n/a - Reliability data not available. Package (family) not yet qualified at the specified period.

dash (-) - Test not performed at the specified period.



# Appendix A

(RF Amplifiers Products List)

# Amplifiers (LNA &PA)

Description : UltraCMOS Low-Noise Amplifiers (LNA) and Power Amplifiers (PA)

Products in Family : PE470021, PE47004X, PE470081, PE47051X, PE47066X, PE470681, PE471110, PE471112, PE47164X, PE47165X, PE47166X, PE474061, PE474140, PE474180, PE471741, PE472110, PE473560, PE477180, PE477181, PE478011, PE478021, PE478031, PE478041, PE478051, PE478070, PE478090, PE478091, PE478100, PE478110, PE478130, PE478140, PE478180, PE478190, PE478201, PE478211, PE47822x, PE47823x, PE479011, PE479021, PE479041, PE479050, PE479070, PE479081, PE479091, PE479381, PE479641, PE521200, PE521221, PE523211, PE523212,

Process Technology : UltraCMOS® 11, UltraCMOS® 12, UltraCMOS® 12A, UltraCMOS® 13, UltraCMOS® 13S

Units Tested : 29,454

The background of the page is a light gray, repeating pattern of a circuit board. The pattern consists of various traces, pads, and vias, creating a complex, interconnected network of lines and dots. This pattern is visible at the top and bottom of the page, framing the central text.

# Appendix B

(RF Switch Products List)

# Switches (ASW, HPSW, ATS & BSW)

Description : Multi-pole & multi-throw high power handling antenna switch products for Mobile Wireless RF, broadband infrastructure, and Test Equipment / ATE applications.

Products in Family : PE420011, PE420021, PE42020, PE420540, PE420551, PE420560, PE4210, PE421080, PE42111x, PE42112, PE421130, PE421141, PE421160, PE421230, PE421240, PE421261, PE421281, PE421292, PE421293, PE421294, PE421321, PE421422, PE421450, PE421451, PE421453, PE421454, PE421460, PE421510, PE421550, PE421592, PE421603, PE421628, PE42164x, PE42165X, PE42166X, PE421690, PE421711, PE42171X, PE421729, PE421752, PE421812, PE42181x, PE421821, PE421841, PE421880, PE421890B, PE421941, PE421951, PE421959, PE421979, PE422020, PE4230, PE4231, PE423150, PE4232, PE423422, PE423424, PE4235, PE423560, PE42359, PE423641, PE4237, PE4239, PE424061, PE42412, PE42420, PE42421, PE42422, PE42423, PE42424, PE42426, PE42427, PE42430, PE4244, PE42440, PE42441, PE42442, PE42443, PE42444, PE42445, PE42446, PE4245, PE42450, PE42451, PE42452, PE42462, PE42482, PE4250, PE4251, PE42510, PE42512, PE42520, PE42521, PE42522, PE42524, PE42525, PE42540, PE42542, PE42543, PE42545, PE42546, PE42552, PE42553, PE42556, PE4256, PE42562, PE4257, PE4259, PE4261, PE426140, PE42615, PE4263, PE42633, PE426331, PE42641, PE426412, PE426462, PE426482, PE42650, PE42660, PE42672, PE426810, PE42682, PE426823, PE426850, PE426860, PE426880, PE426882, PE42691, PE426911, PE42695, PE42696, PE426960, PE426970, PE4270, PE42721, PE42722, PE42723, PE42724, PE42726, PE42742, PE42750, PE4280, PE42820, PE42821, PE42822, PE42823, PE42850, PE42851, PE429001, PE429002, PE429011, PE429560, PE429561, PE429562, PE429563, PE429564, PE429565, PE429566, PE429570, PE4314, PE43705, PE43711, PE612030, PE612033, PE612934, PE612935, PE61293x, PE613010, PE613020, PE614030, PE614036, PE614910, PE614912, PE614932, PE61493x, PE615030, PE61503x, PE636030, PE636040, PE84140, PE84244, PE926C31, PE926C32, PE9354, PE94257, PE95420, PE95421

Process Technology : UltraCMOS® 2, UltraCMOS® 3.5, UltraCMOS® 5, UltraCMOS® 6, UltraCMOS® 6.5, UltraCMOS® 8, UltraCMOS® 10, UltraCMOS® 11, UltraCMOS® 12, UltraCMOS® 12A, UltraCMOS® 13, UltraCMOS® 13S, UltraCMOS® 13SA, UltraCMOS® 14, UltraCMOS® 16

Units Tested : 94,115