



United Silicon Carbide, Inc.

AEC-Q101 Product Qualification Report

Discrete Surface Mount Devices

Included Products:

D2PAK-3L

UF3C065080B3

UF3C065040B3

UF3C065030B3

UJ3C065080B3

UJ3C065030B3



This report summarizes the AEC-Q101 qualification results for the UF3C and UJ3C family of Discrete SiC Cascodes in D2Pak-3L plastic packages.

The environmental stress tests listed below are performed with pre-stress and post-stress electrical tests. Reviewing the electrical results for new failures and any significant shift performance satisfies the AEC-Q101 qualification requirements, as well as UnitedSiC's Quality requirements.

Reliability Stress Test Summary

Test Name	Test Standard	# Samples x # Lots	Failures
High Temperature Reverse Bias (HTRB)	MIL-STD-750-1 M1038 Method A (1000 Hours) $T_J=175^{\circ}\text{C}$, $V=80\% V_{\text{max}}$	77 pcs per lot x 3 lots	0/231
High Temperature Gate Bias (HTGB)	JESD22 A-108 (1000 Hours) $T_J=175^{\circ}\text{C}$, $V=100\% V_{\text{max}}$ (+25V), bias in one direction	77 pcs per lot x 3 lots	0/231
MSL 1 Preconditioning	JEDEC Standard 22-A113D (168 Hours) $T_A=85^{\circ}\text{C}/85\%\text{RH}$	77x10 lots & 30x1lot	0/800
Highly Accelerated Stress Test (HAST) [†]	JESD22-A110 (96 Hours) $T_A=130^{\circ}\text{C}$, 85% RH,	77 pcs per lot x 3 lots	0/231
Intermittent Operating Life (IOL) [†]	MIL-STD-750 Method 1037 $DTJ \geq 125^{\circ}\text{C}$, 3000 cycles (5 minutes on/ 5 minutes off)	77x1 lots	0/77
Temperature Cycle (TC) [†]	JESD22 A-104 -55°C to +150°C 2 cycles/Hr, 1000 cycles	77 pcs per lot x 3 lots	0/231
Autoclave (PCT) [†]	JESD22 A-102 121°C/ RH = 100%, 96 hours, 15psig	77 pcs per lot x 3 lots	0/231
Resistance to Solder Heat (RSH) [†]	JESD22 A-111(SMD)	30 pcs per lot x 1 lots	0/30

Parametric Verification	Per Datasheet	100% FT x 3 lots	
Physical Dimensions	Per AEC-Q101 Rev D	30x1 packages	0/30
ESD – Charged Device Model	AEC-Q101-005 Field Induced Charged-Device Model, 3 positive and 3 negative pulses applied to All Pins	30x1 lots	0/30
ESD – Human Body Model	AEC-Q101-001 Human Body Model: R=1500 ohm, C=100 pf, 3 positive and 3 negative pulses applied to All Pins	30x1 lots	0/30
Bondline Thickness	Per Assembly Spec	10x3 lots	0/30
Die Shear	Per Assembly Spec	10x3 lots	0/30
Die Attach Voids	Per Assembly Spec	10x3 lots	0/30
Wire Pull	Per Assembly Spec	10x3 lots	0/30
Wedge Shear	Per Assembly Spec	10x3 lots	0/30
CSAM	Per Assembly Spec	60x3 lots	0/180
Lead Integrity Test	Per AEC-Q101 Rev D	30x1 lots	0/30
Solderability Test	Per AEC-Q101 Rev D	10x1 lots	0/10

†:HAST, PCT, TC, IOL, and RSH samples were subjected to MSL1 Pre-Conditioning before their tests.

ESD Testing:

UnitedSiC FETs have integrated ESD protection. The ESD protection will vary with the chip size. All products will meet a minimum rating of C3 (>1000V) for the Charged Device Model, and H2 (>2000V and <4000V) for the Human Body Model.

Reliability Evaluation:

The FIT rate data presented below is determined according to JEDEC Standard JESD 85 and is determined from the HTRB and HTGB Burn-In sample size.

FIT = 2.608009298 failures per billion device hours

MTTF = 43771.03 years

From the equations:

$$\lambda_{hours} = \frac{X^2(\alpha, \nu)}{2 \times D \times H \times A_f}$$

$$FIT = \lambda_{hours} \times 10^9$$

$$MTTF_{hours} = 1/\lambda_{hours}$$

And

$$A_f = e^{\frac{E_a}{k} \left(\frac{1}{T_{use}} - \frac{1}{T_{test}} \right)}$$

Where:

X^2 = Chi-Squared probability function for a given Confidence Level (α) and Degree of Freedom ($\nu = 2r+2$, where r = the number of failures in the Test Population),

D = Number of Devices in the Test Population,

H = Test Hours per Device,

A_f = Acceleration Factor from the Arrhenius equation,

E_a = Activation Energy (eV),

T_{use} = standardized Use Temperature,

T_{test} = Temperature of Stress Test,

and

k = Boltzmann's Constant.

In our calculations, we used our HTGB and HTRB Burn-In data:

D = 231 devices for HTGB and 231 for HTRB,

H = 1000 hours for HTGB and 1000 hours of HTRB,

$1 - \alpha = 0.6$ (60% Confidence Level)

$r = 0$ Failures

$E_a = 0.7$ eV

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$T_{\text{use}} = 55\text{ }^{\circ}\text{C}$ or 328 K

$T_{\text{test}} = 175\text{ }^{\circ}\text{C}$ or 448 K