United Silicon Carbide, Inc.

AEC-Q101 Product Qualification Report

Discrete TO Packaged SiC Diodes

Included Products:

Die	TO-220-2L	TO-247-3L
UJ3D06504	UJ3D06504TS	UJ3D06520KSD
UJ3D06506	UJ3D06506TS	UJ3D06560KS
UJ3D06508	UJ3D06508TS	UJ3D1210KS
UJ3D06510	UJ3D06510TS	UJ3D1210KSD
UJ3D06530	UJ3D06516TS	UJ3D1220KSD
UJ3D065200Z	UJ3D06520TS	UJ3D1250K
UJ3D1202	UJ3D06530TS	
UJ3D1205	UJ3D1202TS	
UJ3D1210	UJ3D1205TS	
UJ3D1250	UJ3D1210TS	
UJ3D12100Z		

Scope

This report summarizes the AEC-Q101 qualification results for the UJ3D family of discrete SiC Diodes in Die/Wafers, as well as TO-220-2L and TO-247-3L 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 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°C, V=80% V_{max}	77x9 lots	0/693
Intermittent Operating Life (IOL)	MIL-STD-750 Method 1037 DT_J ≥125°C, 3000 cycles (5 minutes on/ 5 minutes off)	77x9 lots	0/693
Highly Accelerated Stress Test (HAST)	JESD22 A-110 (96 Hours) T_A=130°C/85%RH, V=42V	77x9 lots	0/693
Temperature Cycle (TC)	JESD22 A-104 (1000 Cycles)	77x7 lots	0/539
Autoclave (PCT)	JESD22 A-102 121°C/ RH = 100%, 96 hours, 15psig	77x9 lots	0/693
Parametric Verification	Per Datasheet, per product	100% FT x 9 lots	
Physical Dimensions	Per AEC-Q101 Rev D	30x2 packages	0/60

Reliability Evaluation:

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

FIT = 1.748 failures per billion device hours

MTTF = 65289 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 HTRB Burn-In data:

D = 693 devices for HTRB

H = 1000 hours for HTRB

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

r = 0 Failures

E_a = 0.7 eV

T_{use} = 55 °C or 328 K

T_{test} = 175 °C or 448 K