United Silicon Carbide, Inc.

Product Qualification Report

Discrete D2PAK-7L Packaged Generation 4 SiC Cascodes

Included Products:

D2PAK-7L
UJ4C075060B7S

Scope

This report summarizes the qualification results for the UJ4C075060B7S discrete SiC Cascode in D2PAK-7L surface mount plastic packages. The part was qualified to MSL1 + AEC-Q101 standards in a 3 lot qual.

The environmental stress test 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 Customer's request.

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}=600V	77x3 lots	0/231
High Temperature Gate Bias (HTGB)	JESD22 A-108 (1000 Hours) T_J=175°C, V=100% V_{max} (+20V), bias in one direction	77x3 lots	0/231
High Humidity, High Temperature Reverse Bias (H3TRB)†	JESD22-A101C (1000 Hours) T_A=85°C, 85% RH, V_{GS}=0V, V_{DS}=100V	77x3 lots	0/231
Temperature Cycle (TC)†	JESD22 A-104 -55°C to +150°C 2cycles/Hr (1000 Cycles)	77x3 lots	0/231
Autoclave (PCT)†	JESD22 A-102 121°C/ RH = 100%, 96 hours, 15psig	77x3 lots	0/231
Intermittent Operating Life (IOL)†	MIL-STD-750 Method 1037 DTJ ≥125°C, 3000 cycles (5 minutes on/ 5 minutes off)	77x3 lots	0/231
Parametric Verification	Per Datasheet	100% FT x 3 lots	
Physical Dimensions	Per AEC-Q101 Rev E	30x1 packages	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

† Tested with MSL1 Preconditioning

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 = 2.608 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 for HTRB, and 231 for HTGB

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

$1 - \alpha$ = 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