United Silicon Carbide, Inc.

Product Qualification Report

Discrete D2PAK-7L SiC JFETs

Products:

UF3N170400B7S

This report summarizes the AEC-Q101 qualification results for United Silicon Carbide, Inc.'s UF3N170400B7S SiC JFET in D2PAK-7L plastic package.

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. This device was tested to MSL1 standards.

Reliability Stress Test Summary

Test Name	MSL 1 PreCon	Test Standard	# Samples x # Lots	Failures
MSL1 Preconditioning		JESD22-A113D J-STD-020E	77 pcs x 3 lots x 4 tests	0/924
High Temperature Reverse Bias (HTRB)		JESD22 A108 (1000 Hours) T_J=175°C, V_{GD}=1360V, Floating Source	77pcs x 3 lots	0/231
High Temperature Gate Bias (HTGB)		JESD22 A108 (1000 Hours) T_J=175°C, V_{GS}= -20V, V_{DS}= 0V	77pcs x 3 lots	0/231
High Humidity High Temperature Reverse Bias (H3TRB)	Y	JESD22 A-101D (500 Hours) T_A=85°C/85%RH, V_{GD}=100V, Floating source	77x3 lots	0/231
Intermittent Operating Life (IOL)	Y	MIL-STD-750 Method 1037 DT_J ≥125°C, 3000 cycles (5 minutes on/ 5 minutes off)	77x3 lots	0/231
Temperature Cycle (TC)	Y	JESD22 A-104 (1000 Cycles) -55°C to +150°C	77x3 lots	0/231
Autoclave (PCT)	Y	JESD22 A-102 121°C/ RH = 100%, 96 hours, 15psig	77x3 lots	0/231
Parametric Verification		Per Datasheet	100% FT x 3 lots	

Physical Dimensions		Per AEC-Q101 Rev D	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
CSAM		Per Assembly Spec	60x3lots	0/180
Lead Integrity Test		Tested in the Cascode Qual	--	--
Solderability Test		Tested in the Cascode Qual	--	--

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 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 HTGRB Burn-In data:

D = 231 devices for HTRB, and 231 devices for HTGB

H = 1000 hours for HTRB, and 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