United Silicon Carbide, Inc.

Product Qualification Report

Discrete D2PAK-7L SiC JFETs

Products:

UF3N170400B7S

This report summarizes the JEDEC 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 JEDEC 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 \geq$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