EPC eGaN® FETs Qualification Report EPC2378

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This report summarizes the Product Qualification results for EPC part number EPC2378 which meets all required qualification requirements and is released for production.

Scope

This qualification report covers the qualification of EPC2378, 25 V_{DS}-rated eGaN power transistor in a QFN package with exposed silicon on top for low thermal resistance from junction to top-side heatsink

Part Number	Voltage (V)	$R_{DS(on)}$ (mΩ)	Die Size (mm x mm)
EPC2378	25	0.5	M (3.3 x 3.3)

Qualification Test Overview

EPC's eGaN FETs were subjected to a wide variety of stress tests under conditions that are typical for silicon-based power MOSFETs. These tests included:

- High temperature reverse bias (HTRB): Parts are subjected to an 80% of the maximum rated drain-source voltage at the maximum rated temperature (150°C).
- High temperature gate bias (HTGB): Parts are subjected to a gate-source voltage of 5.75 V at the maximum rated temperature (150°C).
- Preconditioning: Parts undergo the following steps in sequence: (1) 125°C bake for a minimum of 24 hours; (2) Moisture Sensitivity Level 1 (MSL1); (3) 3 times reflow.
- Biased highly accelerated test (bHAST): Parts are soaked for 96 hours at 130°C, 85% humidity, and vapor pressure of 33.3 psia with a constant drain-source voltage.
- Moisture sensitivity level (MSL): Parts are subjected to moisture, temperature, and three cycles of reflow.
- Temperature cycling (TC): Parts are subjected to alternating high and low temperature extremes from -40°C to 125°C.
- Electrostatic Discharge (ESD) Characterization: Parts are tested under Human Body Model (HBM).

The stability of the devices is verified with DC electrical tests after reliability stressing. The electrical parameters are measured at time-zero and at interim readout points at room temperature. Electrical parameters such as the gate-source leakage, drain-source leakage, gate-source threshold voltage, and on-state resistance are compared against the data sheet specifications. A failure is recorded when a part exceeds the datasheet specifications. eGaN FETs are stressed to meet the latest Joint Electron Device Engineering Council (JEDEC) JESD47M standard.

Parts for all tests were mounted onto high Tg FR4 adaptor cards. Adaptor cards of 1.6 mm in thickness with two copper layers were used. For all tests, the top copper layer was 1 oz., and the bottom copper layer was 1 oz. Kester WP616 type 4 SAC305 solder was used for mounting the parts onto an adapter card followed by appropriate flux cleaning.

High Temperature Reverse Bias

Parts from three lots for EPC2378 were subjected to 80% of the maximum rated drain-source voltage at the maximum rated temperature for a stress period of 1000 hours.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (sample x lot)	Duration (Hrs)
HTRB	EPC2378	M (3.3 x 3.3)	T = 150°C, V_{DS} = 20 V	0	77 x 3	1000

Table 1. High Temperature Reverse Bias Test

High Temperature Gate Bias

Parts from three lots for EPC2378 were subjected to 5.75 V gate-source bias at the maximum rated temperature for a stress period of 1000 hours.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (sample x lot)	Duration (Hrs)
HTGB	EPC2378	M (3.3 x 3.3)	T = 150°C, V_{GS} = 5.75 V	0	77 x 3	1000

Table 2. High Temperature Gate Bias Test

Biased Highly Accelerated Test

Parts from three lots for EPC2378 were subjected to 20 V drain-source voltage at a temperature of 130°C, with a relative humidity of 85%, and vapor pressure of 33.3 psia for a stress period of 96 hours

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
bHAST	EPC2378	M (3.3 x 3.3)	T = 130°C, RH = 85%, VP = 33.3 psia, V_{DS} = 20 V	0	77 x 3	96

Table 3. Biased Highly Accelerated Test

Moisture Sensitivity Level 1

Parts from EPC2378 were subjected to 85% RH at 85°C for a stress period of 168 hours (as defined by J-STD-020F for MSL1 products). The parts were also subjected to three cycles of Pb-free reflow in accordance with the IPC/JEDEC joint Standard J-STD-020.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
MSL1	EPC2378	M (3.3 x 3.3)	T = 85°C, RH = 85%, 3x reflow	0	77 x 6	168

Table 4. Moisture Sensitivity Level Test

Temperature Cycling

Parts mounted on FR4 test coupons from three lots were subjected to temperature cycling between -40°C and +125°C. A ramp rate of 15°C/min and dwell times of 10 minutes was used in accordance with the JEDEC Standard JESD22-A104. All parts went underwent preconditioning prior to TC.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (sample x lot)	Duration (Cys)
TC	EPC2378	M (3.3 x 3.3)	-40 to +125°C, Air	0	77 x 3	1000

Table 5. Temperature Cycling Test

Electrostatic Discharge (ESD) Sensitivity

Parts were tested for ESD sensitivity using the human body model (HBM). Testing was conducted according to JEDEC JS-001-2024 for HBM. Device parameters were measured before and after ESD testing. EPC2378 passed HBM with a rating of 1000 V.

The package size is less than the small packages definition (16 mm^2 or less) by JEDEC standard JTR002-01-25, where CDM ESD testing is no longer required. Therefore, EPC2378 should pass 1000 V CDM ESD rating.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)
ESD-HBM	**EPC2378**	M (3.3 x 3.3)	500 V	0	3 x 1
ESD-HBM	**EPC2378**	M (3.3 x 3.3)	1000 V	0	3 x 1

Table 6. ESD HBM Test