# EPC GaN Transistor Qualification Report EPC8009

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***This report summarizes the Product Qualification results for EPC part number EPC8009. The EPC8009 meets all required qualification requirements and is released for production.***

## Scope

The testing matrix in this qualification report covers the qualification of the part numbers listed in the table below.

A qualification by similarity matrix approach is applied, with the table of part numbers formed by associated die family (same die process and design rules) and package family (same package process and design rules). The intent of qualification by similarity is that all potential failure mechanisms for the part numbers in the table are included and represented by the samples of each individual test.

All part numbers in the table with samples that have not been included in each of the individual tests listed in this report, are considered qualified by similarity in accordance with the above defined die and package families.

| Part Number | Voltage (V) | $R_{DS(on)}$ (mΩ) | Die Size (mm x mm) |
|---|---|---|---|
| EPC2001C | 100 | 7 | 4.1 x 1.6 |
| EPC2007C | 100 | 30 | 1.7 x 1.1 |
| EPC2016C | 100 | 16 | 2.1 x 1.6 |
| EPC2014C | 40 | 16 | 1.7 x 1.1 |
| EPC8004 | 40 | 110 | 2.1 x 0.85 |
| EPC8009 | 65 | 130 | 2.1 x 0.85 |
| EPC8010 | 100 | 160 | 2.1 x 0.85 |

## 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 a drain-source voltage at the maximum rated temperature
- High temperature gate bias (HTGB): Parts are subjected to a gate-source voltage at the maximum rated temperature
- High temperature storage (HTS): Parts are subjected to heat at the maximum rated temperature
- Temperature cycling (TC): Parts are subjected to alternating high- and low temperature extremes
- High temperature high humidity reverse bias (H3TRB): Parts are subjected to humidity under high temperature with a drain-source voltage applied
- Unbiased autoclave (AC or Pressure Cooker Test): Parts are subjected to pressure, humidity, and temperature under condensing conditions
- Moisture sensitivity level (MSL): Parts are subjected to moisture, temperature, and three cycles of reflow.

The stability of the devices is verified with DC electrical tests after stress biasing. 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) standards when possible.

Parts were mounted onto FR5 (high Tg FR4) or polyimide adaptor cards. Adaptor cards of 1.6 mm in thickness with two copper layers were used. The top copper layer was 1 oz. or 2 oz., and the bottom copper layer was 1 oz. Kester NXG1 type 3 SAC305 solder no clean flux was used in mounting the part onto an adaptor card.

### High Temperature Reverse Bias

Parts were subjected to 80% of the rated drain–source voltage at the maximum rated temperature for a stress period of 1000 hours.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Hrs) |
|---|---|---|---|---|---|---|---|
| HTRB | EPC2001C | 100 | L (4.11 x 1.63) | T = 150°C, $V_{DS}$ = 80 V | 0 | 77 x 2 | 1000 |
| HTRB | EPC2016C | 100 | M (2.11 x 1.63) | T = 150°C, $V_{DS}$ = 80 V | 0 | 77 x 3 | 1000 |
| HTRB | EPC2014C | 40 | M (1.70 x 1.09) | T = 150°C, $V_{DS}$ = 32 V | 0 | 77 x 1 | 1000 |
| HTRB | EPC8004 | 40 | S (2.05 x 0.85) | T = 150°C, $V_{DS}$ = 32 V | 0 | 77 x 1 | 1000 |

*Table 1. High Temperature Reverse Bias Test*

***Note*** - EPC8009 is qualified by matrix.

### High Temperature Gate Bias

Parts were subjected to 5.75 V or 5.5 V gate-source bias at the maximum rated temperature for a stress period of 1000 hours.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Hrs) |
|---|---|---|---|---|---|---|---|
| HTGB | EPC2001C | 100 | L (4.11 x 1.63) | T = 150°C, $V_{GS}$ = 5.75 V | 0 | 77 x 2 | 1000 |
| HTGB | EPC2016C | 100 | M (2.11 x 1.63) | T = 150°C, $V_{GS}$ = 5.75 V | 0 | 77 x 3 | 1000 |
| HTGB | EPC2014C | 40 | M (1.70 x 1.09) | T = 150°C, $V_{GS}$ = 5.5 V | 0 | 77 x 1 | 1000 |
| HTGB | EPC8004 | 40 | S (2.05 x 0.85) | T = 150°C, $V_{GS}$ = 5.5 V | 0 | 77 x 1 | 1000 |

*Table 2. High Temperature Gate Bias Test*

***Note*** - EPC8009 is qualified by matrix.

### High Temperature Storage

Parts were subjected to heat at the maximum rated temperature.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Hrs) |
|---|---|---|---|---|---|---|---|
| HTS | EPC2001C | 100 | L (4.11 x 1.63) | T = 150°C, Air | 0 | 77 x 1 | 1000 |
| HTS | EPC2016C | 100 | M (2.11 x 1.63) | T = 150°C, Air | 0 | 77 x 2 | 1000 |

*Table 3. High Temperature Storage Test*

***Note*** - EPC8009 is qualified by matrix.

### Temperature Cycling

Parts were subjected to temperature cycling between –40°C and +125°C for a total of 1000 cycles. Ramp rate of 15°C/min and dwell time of 5 minutes were used in accordance with the JEDEC Standard JESD22A104.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Cys) |
|---|---|---|---|---|---|---|---|
| TC | EPC2001C | 100 | L (4.11 x 1.63) | –40 to +125°C, Air | 0 | 35 x 2 | 1000 |
| TC | EPC8006 | 40 | S (2.05 x 0.85) | –40 to +125°C, Air | 0 | 33 x 3 | 1000 |

*Table 4. Temperature Cycling Test*

***Note*** - EPC8009 is qualified by matrix.

**High Temperature High Humidity Reverse Bias**

Parts were subjected to a drain-source bias at 85% RH and 85°C for a stress period of 1000 hours. The testing was done in accordance with the JEDEC Standard JESD22A101.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Hrs) |
|---|---|---|---|---|---|---|---|
| H3TRB | EPC2001C | 100 | L (4.11 x 1.63) | T = 85°C, RH = 85%, $V_{DS}$ = 80 V | 0 | 25 x 1 | 1000 |
| H3TRB | EPC2016C | 100 | M (2.11 x 1.63) | T = 85°C, RH = 85%, $V_{DS}$ = 80 V | 0 | 25 x 2 | 1000 |

*Table 5. High Temperature High Humidity Reverse Bias Cycling Test*

***Note*** - EPC8009 is qualified by matrix.

**Autoclave (Unbiased Pressure Cooker)**

Parts were subjected to 100% RH at 121°C for a stress period of 96 hours in accordance with the JEDEC Standard JESD22A102. Parts were not electrically biased during stress.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Hrs) |
|---|---|---|---|---|---|---|---|
| AC | EPC2001C | 100 | L (4.11 x 1.63) | T = 121°C, RH = 100% | 0 | 25 x 1 | 96 |
| AC | EPC2016C | 100 | M (2.11 x 1.63) | T = 121°C, RH = 100% | 0 | 25 x 2 | 96 |

*Table 6. Autoclave Test*

***Note*** - EPC8009 is qualified by matrix.

**Moisture Sensitivity Level**

Parts were subjected to 85% RH at 85°C for a stress period of 168 hours. 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 | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (sample x lot) | Duration (Hrs) |
|---|---|---|---|---|---|---|---|
| MSL1 | EPC2001C | 100 | L (4.11 x 1.63) | T = 85°C, RH = 85%, 3 reflow | 0 | 25 x 1 | 168 |
| MSL1 | EPC8006 | 40 | S (2.05 x 0.85) | T = 85°C, RH = 85%, 3 reflow | 0 | 77 x 3 | 168 |

*Table 7. Moisture Sensitivity Level Test*

***Note*** - EPC8009 is qualified by matrix.