

EPC eGaN[®] FET

Qualification Report

EPC2066



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This report summarizes the Product Qualification results for EPC part number EPC2066. The EPC2066 meets all required qualification requirements and is released for production.

Scope

The testing matrix in this qualification report covers the qualification of EPC2066, a 40 V eGaN power transistor. For some of the required tests, EPC2066 is qualified by matrix with EPC2067, a qualified product within the same device family.

| Part Number | Voltage (V) | R _{DS(on)} (mΩ) | Die Size (mm x mm) |
|-------------|-------------|--------------------------|--------------------|
| EPC2066 | 40 | 1.1 | XL (6.05 x 2.30) |
| EPC2067 | 40 | 1.55 | L (2.85 x 3.25) |

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
- Moisture sensitivity level 1 (MSL1): Parts are subjected to moisture, temperature, and three cycles of reflow. MSL1 is the most stringent of the moisture sensitivity levels, requiring 85°C and 85% humidity for 168 hours.
- 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
- Electrostatic Discharge (ESD) Sensitivity: Parts are tested under Human Body Model (HBM) to assess device susceptibility to electrostatic discharge events.

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 for all tests except for TC were mounted onto high Tg FR4 adaptor cards. Adaptor cards of 1.6 mm in thickness with two copper layers were used. The top and bottom copper layers were 1 oz in thickness.

High Temperature Reverse Bias

Parts from two lots of EPC2066 were subjected to 80% of the rated drain-source voltage at the maximum rated temperature for a stress period of 1000 hours. The same conditions were used for qualification of EPC2067, where 3 lots were tested.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (unit x lot) | Duration (Hrs) |
|-------------|----------------|-------------|--------------------|-----------------------------------|--------------|--------------------------|----------------|
| HTRB | EPC2066 | 40 | XL (6.05 x 2.30) | T = 150°C, V _{DS} = 32 V | 0 | 77 x 2 | 1000 |
| HTRB | EPC2067 | 40 | L (2.85 x 3.25) | T = 150°C, V _{DS} = 32 V | 0 | 77 x 3 | 1000 |

Table 1. High Temperature Reverse Bias Test

High Temperature Gate Bias

Parts from two lots of EPC2066 were subjected to gate-source bias at the maximum rated temperature for a stress period of 1000 hours. The same conditions were used for qualification of EPC2067, where 3 lots were tested.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (unit x lot) | Duration (Hrs) |
|-------------|----------------|-------------|--------------------|------------------------------------|--------------|--------------------------|----------------|
| HTGB | EPC2066 | 40 | XL (6.05 x 2.30) | T = 150°C, V _{GS} = 5.5 V | 0 | 77 x 2 | 1000 |
| HTGB | EPC2067 | 40 | L (2.85 x 3.25) | T = 150°C, V _{GS} = 6 V | 0 | 77 x 3 | 1000 |

Table 2. High Temperature Gate Bias Test

High Temperature Storage

This test is covered by the same samples used for HTGB and HTRB since the ambient temperature for those tests was the maximum rated temperature of the product, which is the same condition required for HTS. The test duration was 1000h.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (unit x lot) | Duration (Hrs) |
|-------------|----------------|-------------|--------------------|----------------|--------------|--------------------------|----------------|
| HTS | EPC2066 | 40 | XL (6.05 x 2.30) | T = 150°C, Air | 0 | 154 x 2 | 1000 |
| HTS | EPC2067 | 40 | L (2.85 x 3.25) | T = 150°C, Air | 0 | 154 x 3 | 1000 |

Table 3. High Temperature Storage Test

Temperature Cycling

Parts (bare dies) from one lot of EPC2066 were subjected to temperature cycling between -40°C and +125°C, with dwell time of 10 minutes and 2 cycles/hour in accordance with the JEDEC Standard JESD22A104. Total duration of the test was 850 cycles. The same conditions were used for qualification of EPC2067, where 3 lots were tested.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (unit x lot) | Duration (Cys) |
|-------------|----------------|-------------|--------------------|--------------------|--------------|--------------------------|----------------|
| TC | EPC2066 | 40 | XL (6.05 x 2.30) | -40 to +125°C, Air | 0 | 77 x 1 | 850 |
| TC | EPC2067 | 40 | L (2.85 x 3.25) | -40 to +125°C, Air | 0 | 77 x 3 | 850 |

Table 4. Temperature Cycling Test

High Temperature High Humidity Reverse Bias

Parts from one lot of EPC2066 were subjected to a drain-source bias at 85% relative humidity and 85°C for a stress period of 1000 hours. The testing was performed in accordance with the JEDEC Standard JESD22A101. The same conditions were used for qualification of EPC2067, where 3 lots were tested.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (unit x lot) | Duration (Hrs) |
|-------------|----------------|-------------|--------------------|--|--------------|--------------------------|----------------|
| H3TRB | EPC2066 | 40 | XL (6.05 x 2.30) | T = 85°C, RH = 85%, V _{DS} = 32 V | 0 | 77 x 1 | 1000 |
| H3TRB | EPC2067 | 40 | L (2.85 x 3.25) | T = 85°C, RH = 85%, V _{DS} = 32 V | 0 | 77 x 3 | 1000 |

Table 5. High Temperature High Humidity Reverse Bias Test

Moisture Sensitivity Level

Parts from one lot of EPC2066 were subjected to 85% RH at 85°C for a stress period of 168 hours (as defined by J-STD-020E for MSL1 products). The parts were then 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 (unit x lot) | Duration (Hrs) |
|-------------|----------------|-------------|--------------------|------------------------------|--------------|--------------------------|----------------|
| MSL1 | EPC2066 | 40 | XL (6.05 x 2.30) | T = 85°C, RH = 85%, 3 reflow | 0 | 77 x 1 | 168 |
| MSL1 | EPC2067 | 40 | L (2.85 x 3.25) | T = 85°C, RH = 85%, 3 reflow | 0 | 77 x 3 | 168 |

Table 6. Moisture Sensitivity Level Test

Electrostatic Discharge (ESD) Sensitivity Testing

Parts from one lot of EPC2066 were tested to assess device susceptibility to electrostatic discharge events. The test was performed in accordance with ESDA/JEDEC Joint Standard JS-001-2017, Electrostatic Discharge Sensitivity Testing Human Body Model (HBM)–Component Level. Device parameters were measured before and after ESD testing. The results are shown in Table 7 below. EPC2066 passed ESD-HBM with a rating of 500 V.

| Stress Test | Part Number | Voltage (V) | Die Size (mm x mm) | Test Condition | # of Failure | Sample Size (unit x lot) |
|-------------|----------------|-------------|--------------------|----------------|--------------|--------------------------|
| ESD-HBM | EPC2066 | 40 | XL (6.05 x 2.30) | 500 V | 0 | 10 x 1 |
| ESD-HBM | EPC2066 | 40 | XL (6.05 x 2.30) | 1000 V | 2 | 10 x 1 |

Table 7. Electrostatic Discharge (ESD) Characterization