

EPC eGaN[®] FET

Qualification Report

EPC21601



Dr. Alejandro Pozo Arribas, Director of Reliability, Efficient Power Conversion

This report summarizes the Product Qualification results for EPC part number EPC21601 which meets all required qualification requirements and is released for production.

Scope

This report covers the qualification tests performed on EPC21601 for its component-level qualification. EPC21601 is a 40 V, 10 A, 3.3 V logic, eToF™ Laser Driver Integrated Circuit (IC) and it uses wafer level chip scale packaging with a ball grid array (BGA) configuration.

Part Number	Die Size (mm x mm)
EPC21601	S (1.5 x 1)

Qualification Test Overview

Samples of EPC21601 were subjected to a wide variety of stress tests, according to JEDEC standard JESD47K. The stress tests include the following:

- High Temperature Operating Life (HTOL): Parts are subjected to recommended operating conditions at $T_j = 125^\circ\text{C}$ for 1000 hours.
- Temperature Humidity Bias (THB): Parts are tested at recommended operating conditions while exposed to ambient temperature of 85°C and 85% relative humidity (RH).
- High Temperature Storage Life (HTSL): Parts are subjected to a bake at 150°C for 1000 hours.
- Preconditioning (PC): Parts undergo the following steps in sequence: (1) 125°C bake for a minimum of 24 hours; (2) Moisture Sensitivity Level 1 (MSL1) conditions (see MSL1 details below); (3) three times reflow.

- Unbiased highly accelerated test (uHAST): Parts are stressed in a non-condensing humid environment for 96 hours at 130°C , 85% RH, and vapor pressure 33.3 psia.
- Temperature cycling (TC): Parts are subjected to alternating low and high temperature extremes from -40°C to $+125^\circ\text{C}$ for a total of 850 cycles.
- MSL1: Parts are subjected to moisture and temperature conditions, and three cycles of reflow. MSL1 is the most stringent of the moisture sensitivity levels, requiring 85°C and 85% RH for 168 hours.

All devices tested in this qualification underwent external visual inspection. Chips were inspected using an optical microscope to check for signs of physical damage to the chip-scale package, e.g., edge chipping or cracks, resulting from assembly, transit, or inadequate handling. Damaged parts were removed from the test population.

Parametric measurements were performed at 25°C on all the samples before and after the stress tests to verify compliance with the specifications listed on the product datasheet. The parameters measured include quiescent and operating currents of the driver (V_{DD} pin), DC static parameters of the output transistor such as threshold voltage and drain-source leakage current, and input threshold voltages and hysteresis for the logic input signal (V_{IN}).

For most of the qualification tests, parts were mounted onto high Tg FR-4 adaptor cards with four layers and 1.6 mm in thickness. Type-4 SAC305 solder paste with water-soluble (W/S) flux was used for mounting the parts onto the adaptor cards. After assembly, flux residue was cleaned using deionized (DI) water.

High Temperature Operating Life

Parts were subjected to the maximum recommended operating voltages at the maximum recommended operating temperature for a stress period of 1000 hours. As shown in Table 1 below, three lots and 77 samples per lot were tested. Parts were mounted on high Tg FR-4 adapter cards. The test was conducted in accordance with JESD22-A108.

Stress Test	Part Number	Voltage (V)	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
HTOL	EPC21601	40	S (1.5 x 1)	$T_J = 125^{\circ}\text{C}$ $V_{DD} = 5.5\text{ V}$ $V_{D_DC} = 30\text{ V}$ $R_{LOAD} = 2\ \Omega$ $V_{IN} = 3.3V_{p,p}$ (10-pulse burst; burst frequency = 1 kHz; pulse frequency = 25-30 MHz)	0	77 x 3	1000

Table 1. High Temperature Operating Life Test

Temperature Humidity Bias

Parts were subjected to maximum recommended operating voltages and 85°C and 85% relative humidity for a stress period of 1000 hours. As shown in Table 2 below, three lots and 25 samples per lot were tested. Parts were mounted on high Tg FR-4 adapter cards. Stress testing was conducted in accordance with JESD22-A101.

Stress Test	Part Number	Voltage (V)	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
THB	EPC21601	40	S (1.5 x 1)	$T_A = 85^{\circ}\text{C}$ $R_H = 85\%$ $V_{DD} = 5.5\text{ V}$ $V_{D_DC} = 30\text{ V}$ $R_{LOAD} = 2\ \Omega$ $V_{IN} = 0\text{ V}$	0	25 x 3	1000

Table 2. High Temperature Gate Bias Test

High Temperature Storage Life

Parts from three lots were exposed to ambient temperature of 150°C for a total of 1000 hours.

Stress Test	Part Number	Voltage (V)	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
HTS	EPC21601	40	S (1.5 x 1)	$T_A = 150^{\circ}\text{C}$ Air Unbiased	0	25 x 3	1000

Table 3. High Temperature Storage Test

Unbiased Highly Accelerated Test

Parts were subjected to 96 hours at a temperature of 130°C, relative humidity of 85%, and vapor pressure of 33.3 psia. As summarized in Table 4 below, three lots and 25 samples per lot were tested.

Stress Test	Part Number	Voltage (V)	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
uHAST	EPC21601	40	S (1.5 x 1)	$T_A = 130^{\circ}\text{C}$ $RH = 85\%$ $VP = 33.3\text{ psia}$ Unbiased	0	25 x 3	850

Table 4. Unbiased Highly Accelerated Test

Temperature Cycling

Parts were subjected to temperature cycling between -40°C and 125°C for a total of 850 cycles. In accordance with JEDEC Standard JESD22-A104, minimum dwell time was five minutes and heating/cooling rates were approximately 5°C per minute.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Cys)
TC	EPC21601	S (1.5 x 1)	T _A = -40°C to +125°C Unbiased	0	25 x 3	850

Table 5. Temperature Cycling Test

Moisture Sensitivity Level 1

Parts were subjected to MSL1 conditions in accordance with the IPC/JEDEC joint Standard J-STD-020 for Pb-free solder.

Stress Test	Part Number	Die Size (mm x mm)	Test Condition	# of Failure	Sample Size (unit x lot)	Duration (Hrs)
MSL1	EPC21601	S (1.5 x 1)	T _A = 85°C RH = 85% 3x reflow	0	25 x 3	168

Table 6. Moisture Sensitivity Level Test