



PRODUCT RELIABILITY REPORT

Product: MPM3550E

**Reliability Department
Monolithic Power Systems
79 Great Oaks Boulevard
San Jose, CA 95119
Tel: 408-826-0600
Fax: 408-826-0601**

1. Device Information

Product:	MPM3550E
Package:	18-PIN LGA MODULE (12MM×12MM×4.2MM)
Process Technology:	BCD
Report Date:	12/10/2018

2. Summary of Test Results

Test	Test Condition	Lot# or Date Code	Test Results (S.S./Rej)	Comment
Temperature, Bias, and Operating Life	JESD22-A108, @+125°C for 1000 hours or equivalent	G2831808 F881608.8 GB865918	77/0 77/0 77/0	
Moisture/Reflow Sensitivity	J-STD-020	1651 1729 1815	276/0 276/0 276/0	MSL = 3
High Temperature Storage Life	JESD22-A103, @150°C for 1000 hours	1651 1729 1815	45/0 45/0 45/0	
Temperature Cycling	JESD22-A104, from -65°C to 150°C for 1000 cycles or equivalent	1651 1729 1815	77/0 77/0 77/0	
Accelerated Moisture Resistance- Unbiased Autoclave	JESD22-A102, @121°C/100%RH for 168 hours or equivalent	1651 1729 1815	77/0 77/0 77/0	
Steady State Temperature Humidity Bias Life Test	JESD22-A101, @85°C/85%RH static bias at Vinmax for 1000 hours or equivalent	1651 1729 1815	77/0 77/0 77/0	



3. Failure Rate Calculation

Sample Size:	9750
Rejects:	0
Activation Energy (eV):	0.7
Equivalent Device Hours:	7.61×10^8 Hours
Failure Rate (FIT@60%CL):	1.2 FIT
MTBF (years):	94,880 Years

Revision / Update History

<u>Revision</u>	<u>Reason for Change</u>	<u>Date</u>	<u>Rel Engineer</u>
1.0	Initial Release	December 2018	Ramon Lei

Appendix: Description of Reliability Test and Failure Rate Calculation

High Temperature Operating Life Test

Purpose: This test is a worst-case life test that checks the integrity of the product. The high temperature testing is for acceleration of any potential failures over time. The calculation for failure rate (FIT) is completed using the Arrhenius equation.

Condition: 125°C @ Vinmax

Pass Criteria: All units must pass the min/max limits of the datasheet.

Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices

Purpose: The purpose of this standard is to identify the classification level of nonhermetic solid state surface mount devices (SMDs) that are sensitive to moisture-induced stress so that they can be properly packaged, stored, and handled to avoid damage during assembly solder reflow attachment and/or repair operations.

Condition: Bake + moisture sock + 3X reflow at 260°C

Pass criteria: All units must pass the min/max limits of the datasheet

High Temperature Storage Life

Purpose: The test is typically used to determine the effects of time and temperature, under storage conditions, for thermally activated failure mechanisms and time-to-failure distributions of solid state electronic devices, including nonvolatile memory devices (data retention failure mechanisms).

Condition: Bake at 150°C

Pass Criteria: All units must pass min/max limits of the datasheet

Accelerated Moisture Resistance- Unbiased Autoclave

Purpose: To check the performance of the device in humid environments. This test checks the integrity of the passivation, poor metal to plastic seal and contamination level during assembly and material compatibility.

Condition: 121°C/15psig/100% RH (no bias)

Pass Criteria: All units must pass min/max limits of the datasheet

Temperature Cycle Test

Purpose: This test is used to evaluate the die attach integrity and bond integrity. This is similar to the Thermal Shock test, but can generate different failure modes due to the longer dwell time and gradual temperature change.

Condition: -65°C to 150°C

Pass Criteria: All units must pass min/max limits of the datasheet

Steady State Temperature Humidity Bias Life Test

Purpose: This is to check the performance of the device in humid environments. This test checks the integrity of the passivation, poor metal to plastic seal and contamination level during assembly and material compatibility.

Condition: 85%RH at 85°C with Vin=Vinmax

Pass Criteria: All units must pass min/max limits of the datasheet

Highly Accelerated Temperature and Humidity Stress Test

Purpose: This is an equivalent test to Steady State Temperature Humidity Bias Life test with different (higher) temperature stress condition.

Condition: 85%RH at 130°C with Vin=Vinmax

Pass Criteria: All units must pass min/max limits of the datasheet

Failure Rate Calculation

The failure rate is gauged by a Failures-In-Time (FIT) based upon accelerated stress data. The unit for FIT is failure per billion device hour.

$$FIT\ Rate = \frac{(\chi^2/2) \times 10^9}{EDH}$$

Where

χ^2 (Chi-Squared) is the goodness-of-fit test statistic at a specified level of confidence;
EDH= Equivalent Device Hours = AF × (Life test sample size) × (test duration);
AF= Acceleration Factor.

High Temperature Operating Life (HTOL) test is usually done under acceleration of temperature and voltage. The total number of failures from the stress test determines the chi-squared factor.

$$AF = AF_T \times AF_V$$

The Temperature Acceleration Factor AF_T :

$$AF_T = \exp\left(\frac{E_a}{K} \left(\frac{1}{T_{J(Use)}} - \frac{1}{T_{J(stress)}} \right)\right)$$

T_{Use} = Junction temp under typical operating conditions;
 $T_{J(stress)}$ = Junction temp under accelerated test conditions;
 E_a is Activation energy=0.7eV;
 K =Boltzmann's constant=8.62×10⁻⁵ eV/K.

The voltage Acceleration Factor AF_V :

$$AF_V = e^{\beta \times [V_{stress} - V_{use}]}$$

V_{use} = Gate voltage under typical operating conditions;
 V_{stress} = Gate voltage under accelerated test conditions;
 β = Voltage acceleration factor (in 1/Volts) and specified by technology.
Note: For calculation in the report, $AF_V = 1$ for simplicity.

MTBF (Mean Time Between Failure) equals to 10⁹/FIT (in hours).