



I. SUMMARY

The reliability data are obtained through the performance of specified accelerated stress tests described in this document. The parameters monitored for the qualification tests are Drain Current, Small Signal Gain and Output Power at 1-dB gain compression. Failures are defined by any of the following: a) a variation of more than 20% in drain current, b) a variation of more than 1 dB in small-signal gain, or c) a variation of more than 1 dB for P1dB for the parameters as compared to the initial pre-stressed testing. Results of the qualification tests are recorded in Section IV and discussed in Section V. The Physical dimensions and Solderability tests can be qualified by similarity with the results from a pre-existing qualification report for the AH1, as the HFET devices and AH1's are both packaged in the same SOT-89 package.

II. SCOPE

The FP2189 and FP1189 are 1-Watt and 1/2-Watt GaAs Heterostructure Field Effect Transistors (HFETs), respectively. Both are targeted for use as driver amplifiers and are encapsulated in a SOT-89 surface-mount package. This report summarizes the reliability qualification tests and results of the FP2189 HFET. The die for the FP1189 and FP2189 are produced at WJ Communications' GaAs fabrication facility in Milpitas, CA from common wafer material, using the same wafer fabrication processes. Both are packaged at an independent plastic package foundry. The FP2189 and FP1189 belong to the same qualification family; therefore, product family association with the FP2189 qualifies the FP1189.

III. APPLICABLE DOCUMENTS

All the test procedures and test methods are consistent with industry standards. The standards referenced in this document are JEDEC standard 22. Pass/Failure Criteria are defined in JEDEC publication, JEP 118. Qualification Family is defined in JESD47-A.

IV. QUALIFICATION TEST PLAN AND RESULTS

Stress or Test	Procedures / Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Date	Reference Document	Part Tested
Preconditioning Level 1	Moisture Sensitivity Level 3 High temp storage life: 24 hrs @ +125°C Temp. & Humidity Test 192 hrs. @ +30°C / 60% RH Convection Reflow test 3 cycles w/flux immersion, peak temp: 235°C	N/A	3 lots, a total of 533 parts (for TC, UA, & HAST tests)	N/A	Q4 2002	JESD22-A113-B J-STD-020A	FP2189
Temperature Cycle (TC)	Test Condition C Temp. -65° C to +150° C Dwell time = 10 to 15 min.	500 cycles	3 lots, 45 parts per lot	0	Q4 2002	JESD22-A104-B	FP2189
Unbiased Autoclave (UA)	Test Condition C Temp. 121°C, 29.7 psig, RH = 100%	96 hours	3 lots, 77 parts per lot	0	Q2 2002	JESD22-A102-C	FP2189
Unbiased High Temperature Storage	Temp. 150° C	1000 hours	1 lot, 77 total parts	0	Q2 2002	JESD22-A103-B	FP2189
Highly-Accelerated Temperature & Humidity Stress Test (HAST)	Test Condition A Temp. 130°C, 33.3 psig, RH = 85%	96 hours	2 lots, 45 parts per lot, 1 lot, 77 parts	0	Q4 2002	JESD22-A110	FP2189
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1,000 hours	3 lots, 45 parts per lot	0	Q1 2003	JESD22-A108-B	FP2189
Electrostatic Discharge (ESD)	Charged Device Model (CDM)	N/A	1 lot, 21 total parts	0 failures thru 2000 V	Q2 2002	JESD22-C101-A	FP2189
	Human Body Model (HBM)	N/A	1 lot, 21 total parts	0 failures thru 750 V		JESD22-A114	FP2189
Lead Integrity	Test Condition B	N/A	1 lot, 5 parts 3 leads/part	0	Q2 2002	JESD22-B105-B	FP2189
Physical Dimensions	N/A	N/A	1 lot, 12 total parts	0	2001	JESD22-B100-A	AH1
Solderability	N/A	N/A	1 lot, 74 total parts	0	2000	JESD22-B102	AH1



V. STRESS AND TEST METHODOLOGY

All of the qualification tests were performed with the devices mounted to a PCB except for the following tests: Autoclave, Temperature Cycle, ESD and Lead Integrity, which were performed on loose parts. Fifteen identical application circuits with active biasing were designed into each Qualification Circuit Board used. The active bias network supplies the devices with a required negative gate-to-source voltage, a positive drain voltage, and targeted drain current. More details regarding the active bias network can be found on a separate Application Note found on the website as “Active-Bias Constant - Current Source Recommended for WJ HFET devices.” The input and output matching circuitry were designed so that the amplifier circuit was unconditionally stable.

Prior to each electrical test, a control board consisting of fifteen unstressed FP2189 devices with their respective application circuits was measured to ensure measurement accuracy and repeatability. Components are considered to have failed if any of the following occurs after being tested post-stress and compared to their respective pre-stressed testing parameters: a) a variation of more than 20% in drain current, b) a variation of more than 1 dB in small-signal gain, or c) a variation of more than 1 dB for P1dB. Acceptance criterion consists of having zero or one failure out of 77 parts or zero failures out of 45 parts to meet WJ’s requirement of LTPD=5 for each test.

VI. DISCUSSION OF RESULTS

1. Pre-Conditioning Level 1

A total of 533 FP2189 devices from three lots completed Pre-conditioning Level 1.

2. Temperature Cycle (TC)

A total of 135 FP2189 devices from three lots, 45 per lot, passed Temperature Cycle with no failures or anomalies.

3. Unbiased Autoclave (UA)

A total of 231 FP2189 devices from three lots, 77 per lot, passed Unbiased Autoclave with no failures or anomalies.

4. Unbiased High Temperature Storage

A total of 77 FP2189 devices from one lot passed Unbiased High Temperature Storage with no failures or anomalies.

5. Electrostatic Discharge (ESD)

21 FP2189 devices completed CDM testing and another 21 FP2189 devices completed HBM ESD testing at a variety of different voltage level with no unexpected failures. 3 additional FP2189 devices were used in the testing as control units. The FP2189 device has been classified as a **Class 1B device** (Highest Voltage Level Passed between 500V and 1000V) for Human Body Model (HBM) testing according to JEDEC Standard JESD22-A114 and as a **Class IV device** (Highest Voltage Level Passed up to 2000V) for Charged Device Model (CDM) testing according to JEDEC Standard JESD22-C101. The FP1189 has the same ESD classification by similarity.

3 units were subjected at each test voltage for both CDM and HBM ESD testing. The CDM test voltages were 100, 250, 500, 750, 1,000 and 2,000 volts. The HBM test voltages were 50, 100, 150, 250, 500, 750, and 1,000 volts. No failures were observed for the CDM ESD tests up through 2000 volts. Failures occurred at 1,000 volts for HBM ESD tests. The failed devices displayed a complete loss of functionality as opposed to partial degradation of RF characteristics. If any one of the three devices failed at a given voltage level, the device was said to fail at that level. If any one of the three devices failed at a given voltage level, the device was said to fail at that level. The classification level was assigned according to the last voltage level at which all three parts passed post-ESD RF testing according to the test specifications set by WJ Communications.

6. Highly Accelerated Temperature and Humidity Stress Test (HAST)

A total of 167 FP2189 devices from three lots, 45 from two lots and 77 from one lot, passed HAST with no failures or anomalies.

7. High Temp Op Life (HTOL)

A total of 135 FP2189 devices from three lots, 45 per lot, passed HTOL with no failures or anomalies.

8. Lead Integrity

A total of 15 leads, 3 leads per part on 5 parts from one lot, with no failures.

9. Physical Dimensions

The FP2189 is qualified by similarity to the AH1, as both are encapsulated in a SOT-89 package by the same supplier.



Qualification Report

FP1189 and FP2189 Qualification Report

The Communications Edge™

Product Information

10. Solderability

The FP2189 is qualified by similarity to the AH1, as both are encapsulated in a SOT-89 package by the same supplier.

11. Conclusion

The FP1189 and FP2189 WJ products are fully qualified and meet the failure criteria for all tests shown in the Qualification Test Plan.

VII. CONCLUSIONS

The data presented demonstrates that the WJ Communications' products: FP1189 and FP2189 meet WJ's rigorous high quality standards and conform to WJ's long history of producing high quality products and superior reliability. The test results described in this document support the full qualification for the FP1189 and FP2189.