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 1dB 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 Sections IV and V below. Physical dimensions and Solderability qualifications for earlier WJCI 6 x 6 mm QFN devices are extant and applicable to these devices.

II. SCOPE

The FP31QF is a 2-Watt Heterostructure Field Effect Transistor (HFET) and is encapsulated in a 6 x 6 mm 28-pin QFN surface-mount package. This report summarizes the reliability qualification tests and results of the FP31QF amplifier. The die for the FP31QF is produced at WJ Communications' GaAs fabrication facility in Milpitas, CA and is packaged at an independent plastic package foundry.

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

Stress or Test	Procedures / Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Date	Reference Document	Part Tested
Preconditioning Level 1	Moisture Sensitivity Level 1, Pb free High temp storage life: 24 hrs @ +125°C Temp. & Humidity Test 168 hrs. @ +85°C / 85% RH Convection Reflow test 3 cycles w/ flux immersion, peak temp: 250°C	N/A	3 lots, a total of 600 parts (for TC, UA, & HAST tests)	N/A	Q2 2003	JESD22-A113-B J-STD-020A	FP31QF
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	Q2 2003	JESD22-A104-B	FP31QF
Unbiased Autoclave (UA)	Test Condition C Temp. 121°C, 29.7 psia, RH = 100%	96 hours	3 lots, 45 parts per lot	0	Q2 2003	JESD22-A102-C	FP31QF
Unbiased High Temperature Storage	Temp. 150°C (+/- 10 C)	1000 hours	1 lot, 45 total parts	0	Q3 2002	JESD22-A103-B	FP2189 AH201
Electrostatic Discharge (ESD)	Charged Device Model (CDM)	N/A	1 lot, 15 total parts	0 failures thru 2000 V	Q2 2003	JESD22-C101-A	FP31QF
	Human Body Model (HBM)	N/A	1 lot, 15 total parts	0 failures thru 1000 V	Q2 2003	JESD22-A114-B	FP31QF
Highly-Accelerated Temperature and Humidity Stress Test (HAST)	Test Condition A Temp. 130°C, 33.3 psia , RH = 85% Bias Conditions: Pinched Off with Vg = -4 V, Vd = +9 V	96 hours	3 lots, a total of 135 parts	0	Q2 2003	JESD22-A110-B	FP31QF
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1,000 hours	3 lots, a total of 135 parts	0	Q2 2003	JESD22-A108-B	FP31QF
Physical Dimensions	N/A	N/A	1 lot, 10 parts	0	Q3 2002	JESD22-B100-A	AH201
Solderability	N/A	N/A	1 lot, 3 parts	0	Q3 2002	JESD22-B102	AH201

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, and ESD, 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 FP31QF 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 failures out of 45 parts to meet WJ's requirement of LTPD=5 for each test.

VI. DISCUSSION OF RESULTS

1. **Pre-Conditioning**
   A total of 600 FP31QF devices from three lots, 200 devices per lot, completed pre-conditioning.

2. **Temperature Cycle**
   A total of 135 FP31QF devices from three lots, 45 per lot, completed 500 temperature cycles with no failures.

3. **Unbiased Autoclave**
   A total of 135 FP31QF devices from three lots, 45 per lot, completed 96 hours of Autoclave with no failures.

4. **Unbiased High Temperature Storage**
   Device is qualified by similarity to the FP2189 and package is qualified by 6x6 mm QFN package family.

5. **ESD**
   A total of 30 FP31QF devices completed CDM and HBM ESD testing at a variety of different voltage levels with no unexpected failures. The FP31QF device has been classified as a **Class 1C device** (Highest Voltage Level Passed between 1000V and 2000V) 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.

   3 units were subjected at each test voltage for both CDM and HBM ESD testing. The CDM test voltages were 100, 200, 500, 1,000 and 2,000 volts. The HBM test voltages were 250, 500, 750, 1,000 and 2000 volts. Failures occurred at 2,000 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. 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. There were no failures of devices subjected to CDM test voltages up through 2000 volts.

6. **Highly Accelerated Temperature and Humidity Stress Test (HAST)**
   A total of 135 FP31QF devices from three lots completed 96 hours of HAST with no failures. Parts were biased for Pinchoff conditions with –4 volts on the gate and +9 volts on the drain to minimize power dissipation, distribute potential differences across chip metallization as much as possible and maximize voltage within operating range of bias conditions.

7. **High Temp Op Life (HTOL)**
   A total of 135 FP31QF devices from three lots, 45 per lot, completed 1000 hours of HTOL with no failures.

8. **Physical Dimensions and Solderability**
   Qualified by package similarity to the AH201, which has been previously qualified.

9. **Conclusion**
   The FP31QF is fully qualified and meet the failure criteria for all tests shown in the Qualification Test Plan.

VI. CONCLUSIONS

The data presented demonstrates that the WJ Communications' product: FP31QF 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 FP31QF.