



## I. SUMMARY

The AH1, AH2, AH3, AH31, and AG103 devices are driver amplifiers that offer high dynamic range in a low-cost surface-mount SOT-89 package. The FH1, FH101, and FHF1 contain the high dynamic range discrete MESFET also used in the MMIC amplifiers (AH1, AH2, AH3, AH31, and AG103). All the amplifiers listed only differ with the values of passive component in the internal feedback of the amplifier. In addition the active device used in the AH1, AH2, AH3, AH31, and AG103 amplifiers are all the same type and size. In other words, the AH1, AH2, AH3, AH31, and AG103, FH1, FH101, and FHF1 are processed using the same process flow and are all packaged in the SOT-89, therefore this qualification performed on the AH1 also applies to the AH2, AH3, AH31, AG103, FH1, FH101, and FHF1 by similarity.

The parameters monitored for the qualification tests were Supply Current, Gain and OIP3. Failures are defined as any variation of 10% or greater from the initial pre-stressed testing. The results of the individual qualification tests are located in Section V.

## II. SCOPE

This report summarizes the reliability qualification of the AH1, AH2, AH3, AH31, and AG103 amplifiers as well as the FH1, FH101, and FHF1 MESFETs. They are produced at the WJ Communications' GaAs fabrication facility in Milpitas, CA and assembled in a SOT-89 surface mount plastic package. The reliability data are obtained through the performance of specified accelerated stress tests described in this document.

## 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.

## IV. QUALIFICATION TEST PLAN

Stress or Test	Procedures / Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Date	Reference Document	Part Tested
Preconditioning Level 3	External visual 40x High temp storage life: 24 hrs @+125°C Temp. & Humidity Test 168 hrs. @ +85°C / 85% RH Infrared Solder Reflow (IR) test 3 cycles w/flux immersion, peak temp: 235°C	N/A	907 parts (used for TC, UA, & HAST tests)	N/A		JESD22-A113 JESD22-A101 JESD22-B101 JESD22-103 JESD22-A112.4	AH1
Temperature Cycle	Test Condition C Temp. -65°C to +150°C Dwell time = 10 to 15 min.	1000 cycles	75 parts	1	1997	JESD22-A104-B	AH1
			154 parts	2	1998		AH1
			50 parts	0	1999		AH1
			77 parts	1	2000		AH1
Unbiased Autoclave	Test Condition C Temp. 121°C, 15 psig, RH = 100%	96 hours	32 parts	3	1997	JESD22-A102-C	AH1
			200 parts	0	1998		AH1
			50 parts	0	1999		AH1
			77 parts	1	2000		AH1
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1,000 hours	154 parts	0	1998	JESD22-A108-B	AH1
			38 parts	0	1999		AH1
			77 parts	0	2000		AH1
Unbiased High Temperature Storage	Temp. 150°C	1000 hours	77 parts	1	1997	JESD22-A108-B	AH1
Highly-Accelerated Temperature and Humidity Stress Test (HAST)	Test Condition A Temp. 130°C, 33.3 psig, RH = 85%	96 hours	50 parts	0	1997	JESD22-A110-A	AH1
			52 parts	0	1998		AH1
			13 parts	0	1999		AH3
			77 parts	0	2000		
ESD Complete details are given in section V	Charged Device Model (CDM)	N/A	18 parts	Class IV	1998	JESD22-C101-A	AH1
	Human Body Model (HBM)	N/A	18 parts	Class 1B	1998	JESD22-A114	AH1
Physical Dimensions	N/A	N/A	12 parts	0	2001	JESD22-B100-A	AH1
Solderability	N/A	N/A	74 parts	0	2000	JESD22-B102	AH1, AH3
Lead Integrity	N/A	N/A	36 parts	0	1997	JESD22-B105	AH1, AH3
Mark Permanency	N/A	N/A	9 parts	0	2001		AH1
Res. To Solvents	N/A	N/A	15 parts	0	1997		AH1
Flammability	N/A	N/A	3 parts	0	1997	IEC 695-2-2	AH1



## V. DISCUSSION OF RESULTS

### 1. Testing procedures

All of the qualification tests were performed with the AH1 mounted to a PCB except for the following tests: ESD, Physical Dimensions, Solderability, Lead Integrity, Mark Permanency, Resistance to Solvents, and Flammability, which were performed on loose parts.

### 2. Pre-Conditioning

A total of 907 devices completed pre conditioning.

### 3. Temperature Cycle

A total of 356 devices completed 1000 temperature cycles with four failures. One part failed during the 1997 qualification due to a broken bond wire. The manual bonding process has thus been changed to auto bonding. No parts have failed for this problem since the change to automated bonding. After failure analysis, including electrical test and de-encapsulation, three parts were determined to have failed due to ESD. It should be noted that this type of failure mode is not a targeted failure mode for the HTOL stress test and this unit will not be considered as a stress failure for this lot. In summary, five lots contained four failures from a total sample size of 356 parts, thus meeting the WJ requirement of LTPD=5 for this test.

### 4. Unbiased Autoclave

A total of 359 devices completed 96 hours of Autoclave with four failures. Three parts failed during the 1997 qualification due to broken bond wires. The manual bonding process has been changed to auto bonding. No parts have failed for this problem since the change to automated bonding. After failure analysis, including electrical test and de-encapsulation, one part were determined to have failed due to ESD. It should be noted that this type of failure mode is not a targeted failure mode for the HTOL stress test and this unit will not be considered as a stress failure for this lot. In summary, six lots contained four failures from a total sample size of 359 parts, thus meeting the WJ requirement of LTPD=5 for this test.

### 5. High Temp Op Life (HTOL)

A total of 269 devices completed 1000 hours of HTOL testing with no failures.

### 6. Unbiased High Temperature Storage

A total of 75 devices completed 1000 hours of Unbiased High Temperature Storage with one failure. One part failed during the 1997 qualification due to broken bond wires. The manual bonding process has been changed to auto bonding. No parts have failed for this problem since the change to automated bonding. The one failure from a lot of 75 devices meets the WJ requirement of LTPD=5 for this test.

### 7. Highly Accelerated Temperature and Humidity Stress Test (HAST)

A total of 192 devices completed 96 hours of HAST testing with no failures.

### 8. ESD

18 AH1 devices completed CDM testing and another 18 devices completed HBM ESD testing at a variety of different voltage level with no unexpected failures. 2 additional devices were used in the testing as control units. The AH1 device (and its product family) 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 between 1000V and 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 200, 400, 500, 600, 800, 1000 volts. The HBM test voltages were 250, 400, 500, 600, 800, 1000 volts. No failures occurred for the devices used in the CDM ESD tests. Failures occurred at 800 volts or greater for the 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.

### 9. Physical Dimensions

A total of 12 devices completed inspection with no failures.

### 10. Solderability

A total of 74 devices completed solderability with no failures.



# Qualification Report

AH1, AH2, AH3, AH31, AG103, FH1, FH101, and FHF1

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## 11. Lead Integrity

A total of 36 devices completed lead integrity testing with no failures.

## 12. Mark Permanency

A total of 15 devices completed testing of the device ink with no failures

## 13. Resistance To Solvents

A total of 15 devices completed testing against various solvents with no failures.

## 14. Flammability

A total of 3 devices completed flammability testing with no failures.

## VI. CONCLUSIONS

The Reliability Qualification Data demonstrates that the AH1, AH2, AH3, AH31, and AG103 amplifiers as well as the FH1, FH101, and FHF1 MESFETs fabricated at the WJ Communications Milpitas facility and assembled in a SOT-89 surface-mount package demonstrates high reliability and quality levels.