

AH22S PRODUCT QUALIFICATION REPORT

I. SUMMARY

The WJ AH22S is a high dynamic range amplifier targeting cable TV markets. A combination of gain flatness, high linearity and bandwidth make it ideal for CATV distribution, cable modem and laser diode driver applications. The device is designed for 75 Ω systems. The AH22S is qualified by similarity to the AH103 for all stress tests other than Temperature Cycle, Autoclave and ESD.

The objective of this qualification is to verify the dies are robust when assembled in the SOIC-8 package. The parameters monitored before and after qualification tests are Drain Current, Small Signal Gain and OIP3. The two amplifiers in each package, Channel 1 and Channel 2, are tested independently. Failures are defined by any of the following: a) variation of more than 20% in Drain Current; b) variation in small signal gain greater than 1dB; c) variation in OIP3 greater than 3 dB.

II. SCOPE

The reliability data are obtained through the performance of specified accelerated stress tests described in this document.

III. APPLICABLE DOCUMENTS

Test procedures and test methods are consistent with industry standards. Standards referenced in this document are JEDEC standard 22 and MIL STD 883. Pass/Failure Criteria are defined in JEDEC publication, JEP 118.

IV. QUALIFICATION TEST PLAN

Four Hundred parts from each qualification lot were required for preconditioning prior to Temp Cycle and Autoclave. Autoclave, Temperature Cycle, and ESD were performed on loose parts. Thirty AH22S parts were selected for ESD classification: fifteen (15) for Human Body Model (HBM) and fifteen (15) for Charged Device Model (CDM). Sample sizes for the individual stress tests are stated in the summaries in Section IV below.

Stress or Test	Procedures / Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Date	Reference Document	Part Tested
Preconditioning Level 1	Moisture Sensitivity Level 1 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: 235°C	N/A	3 lots, a total of 1200 parts	N/A	Q3 2004	JESD22-A113-B J-STD-020A	AH22S
Temperature Cycle	Temp. -65°C to +150°C Dwell time = 10 to 15 min.	500 cycles	3 lots, a total of 199 parts	0	Q3 2004	JESD22-A104-B	AH22S



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Unbiased Autoclave	Test Condition C Temp. 121°C, 29.7 psig, RH = 100%	96 hours	3 lots, a total of 231 parts	0	Q3 2004	JESD22-A102-C	AH22S
Unbiased High Temperature Storage	Temp. 150°C (+/- 10 C)	1000 hours	1 lot, a total of 77 parts	0	Q2 2003	JESD22-A103-B	AH103
ESD	Charged Device Model (CDM)	N/A	1 lot, a total of 15 parts	0 failures thru 2000 volts	Q3 2004	JESD22-C101-A	AH22S
	Human Body Model (HBM)	N/A	1 lot, a total of 15 parts	0 failures thru 500 volts	Q3 2004	JESD22-A114-B	AH22S
Highly-Accelerated Temperature and Humidity Stress Test (HAST)	Test Condition A Temp. 130°C, 33.3 psig, RH = 85% Bias Conditions: Pinched Off with -4 volts on the gate and +9 volts on the drain	96 hours	3 lots, a total of 231 parts	1*	Q1 2003	JESD22-A110-B	AH103
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1,000 hours	3 lots, a total of 231 parts	0	Q2 2003	JESD22-A108-B	AH103
Physical Dimensions	N/A	N/A	1 lot, 10 parts	0	Q2 2003	JESD22-B100-A	AH103

* Please refer to Section VI.5 for further information.

V. DISCUSSION OF RESULTS

1. Pre-Conditioning/ Moisture/Reflow Sensitivity Classification (MSL)

Four Hundred parts from each of three lots were preconditioned prior to Temp Cycling and Autoclave. Requirements, per JESD22-A113, for Moisture Sensitivity Level 1, for non-hermetic solid state Surface Mount Devices representative of a typical industry multiple solder reflow operation. Specific to MSL 1 qualification are: High temp storage life: 24 hrs @+125°C; Temp. & Humidity Test 168 hrs. @ +85°C / 85% RH; Convection Reflow; 3 cycles w/flux immersion, peak temp: 235°C. Prior to and after preconditioning thirty parts were screened by a Scanning Acoustic Microscope using 4k X 4k scanning resolution in C-Scan mode. The C-Scan mode or pulse-echo provides a planar view image at a specific depth. Illustrations of delaminations and void formations can be generated. No voids or delaminations were found. No parts were rejected or excluded from further qualification tests.

2. Temperature Cycle

77 devices from two lots and 45 from a third lot for a total of 199 devices completed 500 temperature cycles per JESD22-104-B. Parts were subjected to Test Condition C: -65 to 150 degrees C. There were no parametric or catastrophic failures.

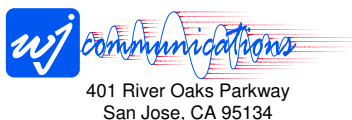
3. Unbiased Autoclave

A total of 231 devices from the three qualification lots completed 96 hours of Autoclave with no failures.

4. ESD

A total of 30 AH22S devices completed CDM and HBM testing at a variety of different voltage levels with no unexpected failures. The AH22S device has been classified as a **Class 1B device** for Human Body Model (HBM) testing according to JEDEC Standard JESD22-A114 and as a **Class IV device** for Charged Device Model (CDM) testing according to JEDEC Standard JESD22-C101.

Three (3) units were subjected to ESD stresses 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 750 volts for HBM ESD tests. The failed devices displayed either a complete loss of functionality or degradation in RF parametric measurements. There were no failures in the population of CDM



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parts. 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.

VI. QUALIFICATION BY SIMILARITY

The following tests were performed using the AH103 since it has the highest RF output power and the highest current density of the MESFET amplifier family in the SOIC8 package.

1. Testing Procedure

Qualifications tests for HTOL and HAST were performed with the AH103 surface mount re-flowed to a Qualification PCB. All other Qualification tests were performed on loose parts. The PCB layout contains 15 individual circuits nearly identical to the 900 MHz Application Circuit published in the WJ Communications' AH103 Data Sheet, using the recommended via pattern. One qualification PCB is reserved, as a control board. This control board is never exposed to any environment and is tested before and after each set of the stressed devices to ensure measurement accuracy and repeatability. Acceptance criterion consists of having zero or one failure out of 77 parts to meet WJCI's requirement of LTPD = 5 (Lot Tolerance Percent Defective) for each test. Failures are defined as any variation of 2 dB or greater for P1dB or a variation of 10% or greater for the other measured parameters as compared to the initial pre-stressed testing.

2. High Temp Op Life (HTOL)

A total of 231 AH103 devices from three lots completed 1,000 hours of HTOL with no failure.

3. Physical Dimensions

A total of ten AH103 devices from one lot completed this with no failures.

4. Unbiased High Temperature Storage (HTB)

A total of 77 AH103 devices from one lot completed High Temperature Bake (HTB) at 150°C for 1000 hours with no failures.

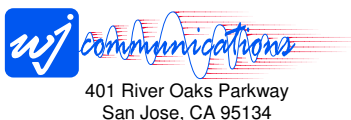
5. Highly Accelerated Temperature and Humidity Stress Test (HAST)

77 devices from each of three lots for a total of 231 AH103 devices completed 96 hours of HAST. The devices were operated at a "pinchoff" where the gate voltage to each of the single-stage amplifiers was set at -2.0 V so that Idss was limited. The drain voltage for the AMP 1 was set at +4.5 Volts and the drain voltage for the AMP 2 was set at +9 Volts.

For the three lots, there were no failures; however one device was disqualified from the test. An inductor serving as the bias choke on the PCB went open during the test thereby invalidating the AH103 device it was connected to. Each of the individual AH103's on the PCB has bias inductors serving to provide bias to the device without disturbing the RF performance. The disqualified part was found to be operational within the qualification specification requirements. The cause of the inductor failure was due the HAST exposure and was not related to the operation of the AH103 device it was connected to. One disqualification from a single lot sample of 77 parts, meets the WJCI requirement of LTPD** = 5 for this test. The other two lot samples exhibited no failures.

VII. CONCLUSIONS

The Reliability Qualification Data demonstrates that the AH22S device assembled in a SOIC-8 surface-mount package demonstrates high reliability and quality levels.



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