



RELIABILITY QUALIFICATION REPORT FOR LEAD-FREE/ROHS-COMPLIANT/GREEN SOIC-8 PACKAGED AHxxx/ECPxxx HBT AMPLIFIERS FABRICATED IN MILPITAS, CA

I. SUMMARY

The HBT foundry was moved from Fremont, CA to Milpitas, CA, and the move prompted this qualification effort. The foundry move affects WJ's HBTs which include the AHxxx, ECxxx, and SCGxxx series of components. This qualification was performed on the lead-free/RoHS-compliant/green SOIC-8 package using the die fabricated in Milpitas, CA. The end product is named the AH312-S8G and is a 2-Watt, High Linearity Amplifier. The parameters monitored for the qualification tests were Supply Current, Gain and IP3. Failures are defined as any variation of 10% or greater for Supply Current, a variation of 1 dB or greater for Gain and a variation of 2 dB or greater for IP3 as compared to the initial pre-stressed testing.

II. SCOPE

This report summarizes the reliability qualification of the HBT family of amplifiers that were moved from the Fremont foundry to the Milpitas foundry in the lead-free/RoHS-compliant/green SOIC-8 package. The AH312-S8G 2-watt amplifier was chosen for the package qualification effort because it has the highest die current density, highest output power, highest DC power consumption and is the most complicated of the HBT amplifiers in the SOIC-8 package.

Because the SOIC-8 packaging house and materials did not change, the qualification tests that were previously done on this package using the AH103A-G are valid for all packaging stress tests. The Solderability tests, Moisture Sensitivity Level (MSL), Physical Dimensions and Unbiased High Temp Storage (HTB) tests are package test, and are by similarity to the previous qualification done on the on this package using the AH103A-G.

By similarity to the qualification performed on the AH312-S8G, the ECP053G-G, ECP103G-G, ECP203G-G, AH115-S8G, AH116-S8G, and AH215-S8G are also qualified. The reliability data are obtained through the performance of the 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.



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IV. QUALIFICATION TEST PLAN

Stress or Test	Procedures/Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Reference Document	Part Tested
Preconditioning Level 2 Lead Free	External visual 40x High Temp. Storage Life 24 hrs @+125°C Temp. & Humidity Test 168 hrs. @ +85°C/ 60% RH Convection Solder Reflow test 3 cycles, peak temperature 260°C	N/A	2 lots, a total of 430 parts	0	JESD22-A113D JESD22-A101-B JESD22-B101A JESD22-A103C J-STD-020C	AH312-S8G Milpitas foundry
Temperature Cycle	Test Condition C Temp. -65°C (+0°/-10°C) to +150°C (+10°/-0°C) Dwell time = 15 min.	500 cycles	2 lots, a total of 90 parts	0	JESD22-A104-C	AH312-S8G Milpitas foundry
Unbiased Autoclave	Test Condition C Temp. 121°C (+/-1°C) Pressure = 15 +/-1psig Relative Humidity = 100%	96 (-1, +5) hours	2 lots, a total of 90 parts	0	JESD22-A102-C	AH312-S8G Milpitas foundry
Highly-Accelerated Temperature and Humidity Stress Test (HAST)	Test Condition A Temp. 130°C (+/- 2°C) Pressure = 33.3 +/-1psia Relative Humidity = 85%	96 (-0, +2) hours	2 lots, a total of 90 parts	0	JESD22-A110-B	AH312-S8G Milpitas foundry
Solderability Lead-Free solder	Lead-Free Solder: Sn96Ag4 Flux Type: R145 Solder Bath Requirements: 260°C	N/A	3 lots, a total of 10 parts, 40 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003	AH103A-G
Solderability Lead solder	Lead Solder: Sn63Pb37 Flux Type: R145 Solder Bath Requirements: 245°C	N/A	3 lots, a total of 10 parts, 40 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003	AH103A-G
Moisture/Reflow Sensitivity (MSL) MSL level 3 lead free	Electrical test External Visual C-SAM Die, Paddle and leads Dry Bake 125°C, 24 hours 85°C/60 RH, 168 hours Convection reflow 260°C, 3X External Visual Electrical test C-SAM Die, Paddle and leads	N/A	1 lot, a total of 120 parts	0	J-STD-20C	AH103A-G
Physical Dimensions	N/A	N/A	2 lots, a total of 2 parts	0	JESD22-B100-B	AH103A-G
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1000 hours	2 lots, a total of 140 parts	0	JESD22-A108-C	AH312-S8G Milpitas foundry
High Temp Storage Life (HTB)	Test Condition B Temp. 150°C (+10, -0°C)	1,000 (-0, +10) hours	3 lots, a total of 135 parts	0	JESD22-A103-C	AH103A-G
ESD	Charged Device Model (CDM)	N/A	3 lot, a total of 20 parts	Class IV	JESD22-C101-C	AH312-S8G Milpitas foundry
	Human Body Model (HBM)	N/A	3 lot, a total of 24 parts	Class 1B	JESD22-A114-C	AH312-S8G Milpitas foundry



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V. DISCUSSION OF RESULTS

1. Testing procedures

The production test station was used for all of the testing. All of the qualification tests were performed using loose parts except HAST and the HTOL which were mounted to a PCB. The PCB layout is the same as the application circuit published in the WJ Communications Data Sheet, including the recommended via pattern. The application circuit was duplicated 15 times on one large PCB for the qualification testing. A control board consisting of 15 devices was tested before and after each set of the stressed devices to ensure measurement accuracy and repeatability.

2. Qualification tests by similarity

The following qualification tests are by similarity to the AH103A-G qual. Temperature Cycling, Unbiased Autoclave, Solderability, Moisture Sensitivity Level, Physical Dimensions and High Temperature Storage Life. The AH103A-G is in the same package with exactly the same materials. These qualification tests are insensitive to the die internal to the package, and using the similarity argument is reasonable. The AH103A-G qualification report can be found on the WJ website at:

<http://www.wjcommunications.com/pdf/appnotes/454343%20Qualification%20Report%20for%20AH11-G,%20AH22S-G,%20and%20AH103A-G.pdf>

3. Pre-Conditioning

A total of 430 AH312-S8G devices completed pre-conditioning with no electrical failures.

4. Temperature Cycle

A total of 90 AH312-S8G devices from two lots devices completed 500 temperature cycles with no failures.

5. Unbiased Autoclave

A total of 90 AH312-S8G devices from two lots completed Autoclave with no failures.

6. Highly Accelerated Temperature and Humidity (HAST)

A total of 90 AH312-S8G devices from two lots completed HAST with no failures.

7. Solderability

See Solderability Test Report for WJ Products With Lead-Free Packaging Finish on the WJ web site at:

<http://www.wjcommunications.com/pdf/appnotes/453654-000%20Solderability%20Test%20Report%20for%20WJ%20Products%20With%20Lead-Free%20Package%20Finish.pdf>

8. Moisture/Reflow Sensitivity Classification (MSL)

A total of 77 AH103A-G devices from one lot completed MSL level 2 lead free testing with no failures. The MSL results are confirmed by the pre and post preconditioning Scanning Acoustic Microscope testing of 30 pre-conditioned AH103A-G devices underwent (MSL level 2 lead free profile, 260 °C peak Temperature).

9. Physical Dimensions

A total of 2 AH103A-G devices from two lots completed Inspection with no failures.

10. High Temp Op Life (HTOL)

A total of 140 AH312-S8G devices from two lots completed 1000 hours of HTOL with no failures.

11. High Temp Storage Life (HTB)

A total of 135 AH103A-G devices from three lots completed 1,000 hours of HTB with no failures.



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12. ESD

A total of 44 AH312-S8G devices completed CDM and HBM ESD testing at a variety of different voltage levels with no unexpected failures.

The AH312-S8G device has been classified as a **Class 1B** device (Passes after exposure to an ESD pulse of 500V, but fails after exposure to an ESD pulse of 1000V) for Human Body Model (HBM) testing according to JEDEC Standard JESD22-A114-C01.

The AH312-S8G device has been classified as a **Class IV** device (Highest Voltage Level Passed greater than 1,000V) for Charged Device Model (CDM) testing according to JEDEC Standard JESD22-C101-C.

The CDM test voltages were 100, 200, 500, 1,000 and 2,000 volts. The HBM test voltages were 250, 500, 750, 1,000, 1,500 and 2,000 volts. A total of 4 devices were tested at each voltage step: three AH312-S8G devices from the Milpitas foundry and one AH312-S8G device from the Fremont foundry.

The HBM test results are failures occurred at 1,000 volts. The failed devices displayed a complete loss of functionality as opposed to partial degradation of RF characteristics. If any one of the four 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 four parts passed post-ESD RF testing according to the test specifications set by WJ Communications. The CDM test results are no failures occurred for any of the voltages tested (max voltage tested 2,000V).

VI. CONCLUSIONS

The Reliability Qualification Data demonstrates that the AH312-S8G device demonstrates high reliability and quality levels. The entire HBT family is also qualified in the lead-free green SOIC-8 package by similarity. This includes the ECP053G-G, ECP103G-G, ECP203G-G, AH115-S8G, AH116-S8G, and AH215-S8G.



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