



# RELIABILITY QUALIFICATION REPORT FOR LEAD-FREE/ROHS-COMPLIANT/GREEN SOIC-8 PACKAGED AH<sub>XXX</sub>/ECP<sub>XXX</sub> HBT AMPLIFIERS

## I. SUMMARY

The industry transition to lead free green parts that can withstand the lead-free reflow profile of 260°C required the material stack to be changed on the SOIC-8 package, and these changes prompted this qualification effort. The ECP200G-G 2-Watt, High Linearity Amplifier was selected to qualify the HBT amplifier family of devices encapsulated in the SOIC-8 package. It has the highest RF output power and the highest current density of the HBT amplifier family. 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 ECP200G-G, and by similarity the ECP050G-G, ECP052G-G, ECP053G-G, ECP100G-G, ECP103G-G, ECP203G-G, AH115-S8G, AH116-S8G, AH215-S8G and AH312-S8G. 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.

## 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 Temperature Cycle, -40 to 60°C, 5 cycles; 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	3 lots, a total of 756 parts	0	JESD22-A113D JESD22-A101-B JESD22-B101A JESD22-A103C J-STD-020C	ECP200G-G
Temperature Cycle	Test Condition C Temp. -65°C (+0°/-10°C) to +150°C (+10°/-0°C) Dwell time = 10 to 15 min.	500 cycles	3 lots, a total of 135 parts	0	JESD22-A104-B	AH103A-G
Unbiased Autoclave	Test Condition C Temp. 121°C (+/-1°C) Pressure = 15 +/-1psig Relative Humidity = 100%	96 (-1, +5) hours	3 lots, a total of 135 parts	0	JESD22-A102-C	AH103A-G



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Stress or Test	Procedures/Conditions	Device Hours/Cycles	Sample Size	Failed Units	Reference Document	Part Tested
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	3 lots, a total of 135 parts	0	JESD22-A110-B	ECP200G-G
Solderability Lead-Free solder	Lead-Free Solder: Sn96Ag4 Flux Type: R145 Solder Bath Requirements: 260°C	N/A	1 lot, a total of 10 parts, 80 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	1 lot, a total of 10 parts, 80 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	AH103A-G
Moisture/Reflow Sensitivity (MSL) MSL level 2 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 77 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)	1,000 (-0, +10) hours	3 lots, a total of 135 parts	0	JESD22-A108-B	ECP200G-G
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-A103C	AH103A-G
ESD	Human Body Model (HBM)	N/A	45 (15 of each model)	0 (up to Class 1B)	JESD22-A114	AH115 AH215 AH312

## 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>



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3. Pre-Conditioning

A total of 756 ECP200G-G devices completed pre-conditioning with no electrical failures. 15 of the 756 devices underwent pre and post stress Scanning Acoustic Microscope inspection with no failures.

4. Temperature Cycle

135 AH103A-G devices from three lots completed 500 temperature cycles with no failures.

5. Unbiased Autoclave

135 AH103A-G devices from three lots completed Autoclave with no failures.

6. Highly Accelerated Temperature and Humidity (HAST)

135 ECP200G-G devices from three 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)

135 ECP200G-G devices from three lots completed 1,000 hours of HTOL with no failures.

11. High Temp Storage Life (HTB)

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

12. Electrostatic Discharge (ESD)

For the AH115, AH215, and AH312, different sets of three units were exposed to ESD voltages of 250, 500, 600, 1000, and 2000V. Any unit that deviated in bias current by more than 5% failed the entire set of three for that voltage level. Since 600V was the highest level at which all three units of a set pass, these AHxxx family members are classified as Class 1B HBM devices.

## VI. CONCLUSIONS

The Reliability Qualification Data demonstrates that the ECG200G-G 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 ECP050G-G, ECP052G-G, ECP053G-G, ECP100G-G, ECP103G-G, ECP203G-G, AH115-S8G, AH116-S8G, AH215-S8G and AH312-S8G.



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