

RELIABILITY QUALIFICATION REPORT FOR LEAD-FREE/ROHS-COMPLIANT/GREEN SOT-89 PACKAGED EC SERIES SEMICONDUCTORS

I. SUMMARY

The SOT-89 package using EC Series InGaP HBT devices has been lead-free/RoHS qualified to a maximum reflow profile of 260°C, and the MSL rating at this reflow profile is level 3. The lead finish is NiPdAu. The ECG003B-G amplifier was selected to qualify the EC Series HBT amplifier family of devices. It has the highest RF output power and the highest current density of the amplifier family in the SOT-89 package. The parameters monitored for the qualification tests were Supply Current and Gain. Failures are defined as any variation of 10% or greater for Supply Current and a variation of 1 dB or greater for Gain as compared to the initial pre-stressed testing.

II. SCOPE

This report summarizes the reliability qualification of the ECG003B-G; and by similarity the ECG001B-G, ECG002B-G, ECG004B-G, ECG005B-G, ECG006B-G, ECG008B-G, ECG009B-G, ECG012B-G, ECG014B-G, ECG015B-G, ECG040B-G, ECG050B-G, ECG055B-G, ECG099B-G, EC1019B-G, EC1078B-G, EC1089B-G, EC1119B-G, SCG002B-G, AH110-89G, AH114-89G and AH118-89G. The reliability data are obtained through the performance of the specified accelerated stress tests described in this document. The Application Note "453654 Solderability Test Report for WJ Products With Lead-Free Package Finish" has a detailed description of the lead-free solderability tests; results of the solderability testing are shown in Section IV. 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	Reference Document	Part Tested
Preconditioning Level 3 Lead Free	External visual 40x High Temp. Storage Life 24 hrs @+125°C Temp. & Humidity Test 192 hrs. @ +30°C/ 60% RH Convection Solder Reflow test 3 cycles w/flux immersion, peak temperature 260°C	N/A	3 lots, a total of 630 parts	0	JESD22-A113D JESD22-A101-B JESD22-B101A JESD22-A103C J-STD-020C	ECG003B-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	ECG003B-G
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, 30 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	AH102A-G
Solderability Lead solder	Lead-Free Solder: Sn63Pb37 Flux Type: R145 Solder Bath Requirements: 245°C	N/A	3 lots, a total of 10 parts, 30 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	AH102A-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 30°C/60 RH, 192 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	AH102A-G
Unbiased High Temperature Storage (HTB)	Temp. 150°C (+ 5°C, -0°C)	1000 hours	1 lot, a total of 45 parts	0	JESD22-A103-C	AH102A-G
Physical Dimensions	N/A	N/A	2 lots, a total of 2 parts	0	JESD22-B100-B	AH102A-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	ECG003B-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	AG604-89G

V. DISCUSSION OF RESULTS

1. Testing procedures

The HAST and the HTOL test were performed with the devices 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 input and output stability resistors were increased to 20 ohms so that the circuit would be stable with no input or output loads. 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.

Components are considered to have failed if any of the following occurs after being tested post-stress and compared to respective pre-stressed testing parameters for the ECG003B-G: variation of 10% or greater for Supply Current and a variation of 1 dB or greater for Gain. Acceptance criterion consists of having zero failures out of 45 parts to meet WJ's requirement of LTPD=5 for each test.

2. Pre-Conditioning

Three lots of 210, a total of 630 ECG003B-G devices, completed pre-conditioning with no electrical failures. 30 of the 630 devices underwent pre and post stress Scanning Acoustic Microscope inspection with no failures.

3. High Temp Op Life (HTOL)

A total of 135 ECG003B-G devices from three lots completed 1,000 hours of HTOL with no failure.



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4. Qualification tests by similarity

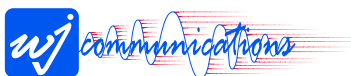
The external package tests and the non-biased tests are by similarity to the AH102A-G and the AG604-89G. These tests include High Temperature Bake, Temp Cycling, Autoclave, Physical Dimensions, Solderability and Moisture Sensitivity Level. The AH102A-G and the AG604-89 are in same package, have the same materials and they are packaged at the same packaging house. See the Lead-free/Green Qualification Reports for the AH102A-G and AG604-89G on the website for further details.

5. Highly Accelerated Temperature and Humidity (HAST)

Devices from three lots for a total of 135 ECG003B-G devices, completed HAST with no failures.

VI. CONCLUSIONS

The Reliability Qualification Data demonstrates that the ECG003B-G device assembled in a lead-free/RoHS-compliant/green SOT-89 surface-mount package demonstrates high reliability and quality levels. Other products in the EC Series amplifier family are also qualified in the lead-free/RoHS-compliant/green SOT-89 package by similarity. This includes the following device models: ECG001B-G, ECG002B-G, ECG004B-G, ECG005B-G, ECG006B-G, ECG008B-G, ECG009B-G, ECG012B-G, ECG014B-G, ECG015B-G, ECG040B-G, ECG050B-G, ECG055B-G, ECG099B-G, EC1019B-G, EC1078B-G, EC1089B-G, EC1119B-G, SCG002B-G, AH110-89G, AH114-89G and AH118-89G.



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