

RELIABILITY QUALIFICATION REPORT FOR LEAD-FREE/ROHS-COMPLIANT/GREEN SOT-363 PACKAGE AG SERIES SEMICONDUCTORS

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 SOT-363 package, and these changes prompted this qualification effort. The AG303-63G was selected to qualify the InGaP HBT products AGxxx Amplifier family of devices in the SOT-363 package because it has the highest DC power consumption, the highest RF output power and the highest current density of the AG Series SOT-363 amplifier family. 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.

II. SCOPE

This report summarizes the reliability qualification of the AG303-63G and by similarity AG201-63G, AG202-63G, AG203-63G, and AG302-63G. 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 825 parts	0	JESD22-A113D JESD22-A101-B JESD22-B101A JESD22-A103C J-STD-020C	AG303-63G



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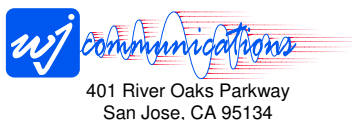
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Stress or Test	Procedures/Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Reference Document	Part Tested
Temperature Cycle	Test Condition C Temp. -55°C (+0°/-10°C) to +125°C (+10°/-0°C) Dwell time = 15 min.	1000 cycles	3 lots, a total of 135 parts	0	JESD22-A104-B	AG303-63G
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	AG303-63G
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	AG303-63G
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, 60 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	AG303-63G
Solderability Lead solder	Lead-Free Solder: Sn63Pb37 Flux Type: R145 Solder Bath Requirements: 245°C	N/A	3 lots, a total of 10 parts, 60 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	AG303-63G
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	3 lots, a total of 360 parts		J-STD-20C	AG303-63G
Unbiased High Temperature Storage (HTB)	Temp. 150°C (+ 5°C, -0°C)	1000 hours	1 lot, a total of 60 parts	0	JESD22-A103-C	AG303-63G
Physical Dimensions	N/A	N/A	2 lots, a total of 2 parts	0	JESD22-B100-B	AG303-63G
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1,000 (-0, +10) hours	3 lots, a total of 180 parts	0	JESD22-A108-B	AG303-63G

V. DISCUSSION OF RESULTS

1. Testing procedures

All of the qualification tests were performed using loose parts except HAST, Temperature cycle, Autoclave, HTB 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 20 times on one large PCB for the qualification testing. A control board consisting of 20 devices was tested before and after each set of the stressed devices to ensure measurement accuracy and repeatability.



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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 AG303-63G: 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 275 for a total of 825 AG303-63G devices completed pre-conditioning with no electrical failures. 30 of the 825 devices underwent pre and post stress Scanning Acoustic Microscope inspection with no failures.

3. Temperature Cycle

Devices from three lots for a total of 135 AG303-63G devices completed 1000 temperature cycles with no failures.

4. Unbiased Autoclave

Devices from three lots for a total of 135 AG303-63G devices completed Autoclave with no failures.

5. Highly Accelerated Temperature and Humidity (HAST)

Devices from three lots for a total of 135 AG303-63G devices, completed HAST with no failures.

6. Solderability

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

7. Moisture/Reflow Sensitivity Classification (MSL)

Devices from three lots for a total of 360 completed MSL level 3 lead free testing with no failures. The MSL results are confirmed by the pre and post preconditioning Scanning Acoustic Microscope testing of 96 pre-conditioned AG303-63G devices underwent (MSL level 3 lead free profile, 260 °C peak Temperature).

8. Unbiased High Temperature Storage (HTB)

A total of 60 AG303-63G devices completed 1000 hours of Unbiased High Temperature Storage with no failures.

9. Physical Dimensions

A total of 2 AG303-63G devices completed Inspection with no failures.

10. High Temp Op Life (HTOL)

Devices from three lots for a total of 180 AG303-63G devices completed 1,000 hours of HTOL with no failures.

VI. CONCLUSIONS

The Reliability Qualification Data for the AG303-63G device assembled in a lead-free/RoHS-compliant/green SOT363 surface mount package demonstrates high reliability and quality levels. The HBT AG201-63G, AG202-63G, AG203-63G, and AG302-63G is also qualified in the lead-free green SOT-363 package by similarity.



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