



# WJ HBT QFN GREEN PACKAGE QUALIFICATION REPORT

## I. SUMMARY

The lead-free/RoHS-comp QFN package using InGap HBT devices has been qualified to a maximum reflow profile at 260 °C and the MSL rating at this reflow is level 2. The plating finish is annealed matte tin over copper. The ECP100D-G (One Watt, High Linearity Amplifier) was selected to qualify the HBT amplifier family of devices in the QFN package. The ECP100D-G has high RF output power and has one of the highest current densities of the HBT amplifier family in the green QFN package. The parameters monitored for the qualification tests were Supply Current, Gain, and IP3. Failures were defined as any variation, relative to pre-stress testing, of: 10% or greater for Supply Current, a variation of 1 dB or greater for Gain, or a variation of 2 dB or greater for IP3.

## II. SCOPE

This report summarizes the reliability qualification of the ECP100D-G, and by similarity the ECP050D-G, ECP052D-G, ECP053D-G, ECP103D-G, ECP200D-G, ECP203D-G, and AH212-EG. The qualification data was 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 390 parts	0	JESD22-A113D JESD22-A101-B JESD22-B101A JESD22-A103C J-STD-020C	ECP100D-G



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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 = 10 to 15 min.	1000 cycles	3 lots, a total of 180 parts	0	JESD22-A104-B	ECP100D-G
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 112 parts	0	JESD22-A102-C	VG025-G
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 120 parts	0	JESD22-A110-B	ECP100D-G
Solderability Lead-Free solder	Lead-Free Solder: Sn96Ag4 Flux Type: R145 Solder Bath Requirements: 260°C	N/A	3 lots, a total of 30 parts, 840 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	CV210-1F
Moisture/Reflow Sensitivity (MSL) MSL level 1 lead free	Electrical test External Visual C-SAM Die, Paddle and leads Dry Bake 125°C, 24 hours 85°C/85 RH, 168 hours Convection reflow 260°C, 3X External Visual Electrical test C-SAM Die, Paddle and leads	N/A	3 lot, a total of 150 parts	0	J-STD-20C	ECP100D-G
Physical Dimensions	N/A	N/A	2 lots, a total of 2 parts	0	JESD22-B100-B	VG025-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	AH312-S8G
ESD	Charged Device Model (CDM)	N/A	3 lot, a total of 20 parts	Class IV	JESD22-C101-C	AH312-S8G
ESD	Human Body Model (HBM)	N/A	3 lot, a total of 24 parts	Class 1B	JESD22-A114-C	AH312-S8G

## 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, HTOL, and Temperature Cycle tests which were performed with parts 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

Many of the qualification tests listed in the Qualification Test Plan were performed on devices other than the ECP100D-G. These tests are deemed applicable due to similarities in design, materials, methods, and application. The specific similarity arguments are described below:



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HTOL – similarity to the AH312-S8G. The die in the AH312-S8G is the same HBT process technology with the same circuit design as the die in the ECP100D-G but is scaled for higher output power. The two device types have the same operating current density.

Solderability – similarity to the CV210-1F. The CV210-1F uses a similar leadframe and the same leadframe plating from the same package assembly vendor as the ECP100D-G and both are in a QFN configuration.

Physical Dimensions – similarity to the VG025-G. The VG025-G uses the same 4x4 mm, 16 lead QFN package from the same package assembly vendor as used in the ECP100D-G.

Unbiased Autoclave - similarity to the VG025-G. The VG025-G is the same 4x4 mm, 16 lead QFN package from the same package assembly vendor as used in the ECP100D-G. The die in the VG025-G is a MESFET process technology and the die in the ECP100D-G is an HBT process technology.

3. Pre-Conditioning

A total of 390 ECP100D-G devices completed pre-conditioning to MSL 2 with no electrical failures. 30 of the 390 devices underwent pre and post stress Scanning Acoustic Microscope inspection with no failures.

4. Temperature Cycle

ECP100D-G devices from three lots, 180 devices, completed 1000 temperature cycles with no failures.

5. Unbiased Autoclave

VG025-G devices from two lots, 112 devices, completed Autoclave with no failures.

6. Highly Accelerated Temperature and Humidity (HAST)

ECP100D-G devices from three lots, 120 devices, completed HAST with no failures.

7. Solderability

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

8. Moisture/Reflow Sensitivity Classification (MSL)

A total of 150 ECP100D-G devices from three lots completed MSL 1 lead-free testing with no failures. The MSL results were confirmed by Scanning Acoustic Microscope testing (before and after preconditioning) on forty-five ECP100D-G devices. [Note: preconditioning for the HAST & Temperature Cycling tests was done to MSL 2. The ECP100D-G and the other HBT devices in the green QFN package are intended to be rated as MSL 2]

9. Physical Dimensions

A total of 2 VG025-G devices from completed Inspection with no failures.

10. High Temp Op Life (HTOL)

Devices from three lots, 135 AH312-S8G completed 1,000 hours of HTOL with no failures.

11. 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-C.01.

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.



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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.

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 data presented here demonstrates that the ECG100D-G device assembled in a green, 4x4 mm QFN package demonstrates high reliability and quality levels. The balance of the HBT amplifier family, in the green QFN package, is also qualified by similarity. This includes the ECP050D-G, ECP052D-G, ECP053D-G, ECP103D-G, ECP200D-G, ECP203D-G, and AH212-EG.



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Specifications and information are subject to change without notice.  
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