RELIABILITY QUALIFICATION REPORT FOR CVxxx-xF CONVERTERS IN THE LEAD-FREE/RoHS-COMPLIANT 28-PIN 6x6mm QFN PACKAGE

I. SUMMARY

The 28-Pin QFN 6X6 mm package has been lead-free/RoHS qualified to a maximum reflow profile of 260 °C, and the MSL rating at this reflow profile is level 2. The lead finish is 100% Matte-Tin, 300-800 micro-inches thick and is post plating annealed, bake of 150°C for a minimum of 1 hour within 24 hours of plating, to improve solder joint robustness. The CV210-1F was selected to qualify the CV family of devices because it has the largest die count of the converter product line. The parameters monitored for the qualification tests were Supply Current, Conversion Gain, OIP3 and OIP2. Failures are defined as any variation of 10% or greater for Supply Current, a variation of 2 dB or greater for OIP3 and OIP2 and a variation of 1 dB or greater for Conversion Gain.

II. SCOPE

This report summarizes the reliability qualification of the CV210-1F. The CV210-1F is an integrated dual channel converter containing two mixers, two IF amplifiers, one LO amplifier and a passive IF filtering structure in a lead-free, RoHS-qualified 6x6 mm 28-pin QFN surface-mount package. The Application Note "*453654-000 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.

The qualification of the CV210-1F will qualify other WJ components also in the lead-free, 6mm 28-pin QFN package. The CV210-2F, CV210-3F, CV211-1F, CV211-2F, and CV211-3F can be qualified by similarity as each model type uses internal devices from the same process technologies as the CV210-3, and all are encapsulated in the same package type. The CV110-1F, CV110-2F, CV110-3F, CV111-1F, CV111-2F, and CV111-3F can also be qualified by similarity as these devices contain one less mixer and are encapsulated in the same package type. The RF amplifier is manufactured using the same process flow as the IF amplifier and also has the same DC bias characteristics. The LO and IF amplifier in the CV1xxF Series uses the same die material as what is used in the CV2xxF Series products.

The CVxxx-xAF family of converters, including the CV210-1AF, CV210-2AF, CV2103AF, CV211-1AF, CV211-2AF, CV110-1AF, CV110-2AF, CV110-3AF, CV111-1AF, and CV111-3AF, are qualified by similarity with same statements above except that the mixers in the CVxxx-xAF versions are manufactured at a different foundry. The same mixer die are used in the MHxxxA family of devices and have been fully qualified. Details of this report can be found on the WJ website at:

http://www.wjcommunications.com/pdf/appnotes/453417%20MHxxxA%20Qualification%20Report.pdf

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 1 Lead Free	External visual 40x High Temp. Storage Life 24 hrs @+125°C Temp. & Humidity Test 168 hrs. @ +85°C/ 85% RH Convection Solder Reflow test 3 cycles w/flux immersion, peak temperature 260°C	N/A	3 lots, a total of 660 parts	0	JESD22-A113C JESD22-A101-B JESD22-B101 JESD22-A103-B J-STD-020B	CV210-1F
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	CV210-1F
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	CV210-1F
Highly-Accelerated Temperature and Humidity Stress Test (HAST)	Test Condition A Temp. 130°C (+/- 2°C) Pressure = 33.3 +/-1psig Relative Humidity = 85%	96 (-0, +2) hours	3 lots, a total of 135 parts	0	JESD22-A110-B	CV210-1F
Solderability Lead-Free solder	Lead-Free Solder: Sn96Ag4 Flux Type: R145 Solder Bath Requirements: 260°C	N/A	3 lot, a total of 30 parts, 840 pins	0	IPC/EIA/JEDEC J-STD-002B Method 2003)	CV210-1F
Solderability Lead solder	Lead-Free Solder: Sn63Pb37 Flux Type: R145 Solder Bath Requirements: 245°C	N/A	3 lot, 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 250°C, 3X External Visual Electrical test C-SAM Die, Paddle and leads	N/A	3 lot, a total of 300 parts		J-STD-20B	CV210-1F
Unbiased High Temperature Storage (HTB)	Temp. 150°C (+ 5°C, -0°C)	1000 hours	1 lot, a total of 80 parts	0	JESD22-A103-B	CV210-3
ESD Complete details see section V ESD	Charged Device Model (CDM)	N/A	1 lot, a total of 33 parts	0 failures thru 500 volts	JESD22-C101-A	CV210-3
	Human Body Model (HBM)	N/A	1 lot, a total of 33 parts	0 failures thru 500 volts	JESD22-A114-B	CV210-3
Physical Dimensions	N/A	N/A	2 lots, a total of 2 parts	0	JESD22-B100-A	CV210-3
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C (+5, -0°C)	1,000 (-0, +10) hours	3 lots, a total of 240 parts	0	JESD22-A108-B	CV210-3

V. DISCUSSION OF RESULTS

1. Testing procedures

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 ten times on one large PCB for the qualification testing. A control board consisting of ten devices was tested before and after each set of the stressed devices to ensure measurement accuracy and repeatability.

The qualification tests that do not require preconditioning (HTB, ESD, Physical Dimensions, and HTOL) are by similarity to the CV210-3 qualification. These tests do not require the 260°C reflow profile, and the test is exactly the same as that performed on the CV210-3. The CV210-3 was built with the same materials.

2. Pre-Conditioning

Three lots of 220, a total of 660 CV210-1F devices, completed pre-conditioning with no electrical failures. Sixty of the 660 devices underwent pre and post stress Scanning Acoustic Microscope inspection with no failures.

3. Temperature Cycle

135 CV210-1F devices from three lots completed 500 temperature cycles with 0 failures.

4. Unbiased Autoclave

135 CV210-1F devices from three lots completed Autoclave with 0 failures.

5. Highly Accelerated Temperature and Humidity (HAST)

135 CV210-1F devices from three lots completed HAST with 0 failures.

6. Solderability

30 CV210-1F devices from three lots completed Lead-Free and Lead solderability testing with 0 failures. The Application Note "*453654 Solderability Test Report for WJ Products With Lead-Free Package Finish*" on the WJ WJ website has a detailed description of the lead-free solderability tests.

7. Moisture/Reflow Sensitivity Classification (MSL)

300 CV210-1F devices from three lots completed MSL level 1 lead free testing with no failures. The MSL results are confirmed by the pre and post preconditioning Scanning Acoustic Microscope testing that the 60 pre-conditioned CV210-1F devices underwent (MSL level 1 lead free profile, 260 °C peak Temperature).

8. Unbiased High Temperature Storage (HTB)

A total of 80 CV210-3 devices from one lot completed 1000 hours of Unbiased High Temperature Storage with 0 failures.

9. ESD

A total of 33 CV210-3 devices from one lot completed CDM and HBM ESD testing at a variety of different voltage levels with no unexpected failures. The CV210-3 device has been classified as a Class 1B device (Highest Voltage Level Passed between 500V and 1000V) for Human Body Model (HBM) testing according to JEDEC Standard JESD22-A114-B and as a Class III device (Highest Voltage Level Passed between 500V and 1000V) for Charged Device Model (CDM) testing according to JEDEC Standard JESD22-C101-A.

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. Failures occurred at 500 volts or greater for both the CDM and HBM ESD tests. The failed devices displayed a complete loss of functionality as opposed to partial degradation of RF characteristics. If any one of the three 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 three parts passed post-ESD RF testing according to the test specifications set by WJ Communications.

10. Physical Dimensions

A total of 2 CV210-3 devices from two lots completed Inspection with no failures.

11. High Temp Op Life (HTOL)

240 CV210-3 devices from three lots completed 1,000 hours of HTOL with 0 failures.

VI. MSL RATING

The MSL rating of the QFN 6X6 28-pin package is MSL 2, 260°C. The package did pass MSL l preconditioning. It is being rated MSL 2 so that the parts will be baked out and dry packed. This will also force better handling of the device at contract manufacturers, and should improve the robustness of the device.

VII. CONCLUSIONS

The Reliability Qualification Data demonstrates that the CV210-1F Converter demonstrates high reliability and quality levels. Including the other CV models which are also qualified by similarity, this qualification report applies for the full qualification of the following devices:

CV210-1F	CV110-1F	CV210-1AF	CV110-1AF
CV210-2F	CV110-2F	CV210-2AF	CV110-2AF
CV210-3F	CV110-3F	CV210-3AF	CV110-3AF
CV211-1F	CV111-1F	CV211-1AF	CV111-1AF
CV211-2F	CV111-2F	CV211-3AF	CV111-3AF
CV211-3F	CV111-3F		