



### I. SUMMARY

This report summarizes the reliability qualification of the CV1xx and CV2xx Series WJ Communications products: CV110-1, CV111-1, CV111-2, CV111-3, CV210-1, CV210-3, CV211-1, CV211-2, and CV211-3. The reliability data are obtained through the performance of specified accelerated stress tests described in this document. The parameters monitored for the qualification tests were supply current, conversion gain, third-order intercept point (OIP3), and second-order intercept point (OIP2). Failures are defined as any variation of 10% or greater. Results of the qualification tests are recorded in Section IV and discussed in Section VI.

### II. SCOPE

The CV1xx Series devices are integrated single-channel downconverters each containing a mixer, RF amplifier, IF amplifier, and LO amplifier and offering excellent dynamic range in a 6 x 6 mm 28 pin QFN surface-mount package. The CV2xx Series devices are integrated dual channel downconverters with each chip containing two mixers, two IF amplifiers and one LO amplifier in the same type of package. This report summarizes the reliability qualification tests and results of the CV210-3 in particular. The CV210-1, CV211-1, CV211-2, and CV211-3 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 CV110-1, CV111-1, CV111-2, and CV111-3 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 CV1xx Series uses the same die material as what is used in the CV2xx Series products.

### III. APPLICABLE DOCUMENTS

All test procedures and test methods are consistent with industry standards. The standards referenced in this document are JEDEC standard 22. Qualification Family is defined in JESD47-A.

### IV. QUALIFICATION TEST PLAN AND RESULTS

Stress or Test	Procedures / Conditions	Device Hours/ Cycles	Sample Size	Failed Units	Date	Reference Document	Part Tested
Preconditioning Level 1 Lead-free profile	Moisture Sensitivity Level 1 High temp storage life: 24 hrs @ +125°C Temp. & Humidity Test 168 hrs. @ +85°C / 85% RH Convection Reflow test 3 cycles w/flux immersion, peak temp: 250°C	N/A	3 lots, a total of 780 parts (for TC, UA, & HAST tests)	0	Q1 2003	JESD22-A113-C J-STD-020B	CV210-3
Temperature Cycle (TC)	Test Condition C Temp. -65° C to +150° C Dwell time = 10 to 15 min.	500 cycles	3 lots, 80 parts per lot	0	Q1 2003	JESD22-A104-B	CV210-3
Unbiased Autoclave (UA)	Test Condition C Temp. 121°C, 15 psig, RH = 100%	96 hours	3 lots, 80 parts per lot	0	Q1 2003	JESD22-A102-C	CV210-3
Unbiased High Temperature Bake (HTB)	Temp. 150° C	1000 hours	1 lot, 80 total parts	0	Q1 2003	JESD22-A103-B	CV210-3
Highly-Accelerated Temperature & Humidity Stress Test (HAST)	Test Condition A Temp. 130°C, 33.3 psig, RH = 85%	96 hours	3 lots, 80 parts per lot	1	Q1 2003	JESD22-A110	CV210-3
High Temp Op Life (HTOL)	Test Condition B Temp. 125°C	1000 hours	3 lots, 80 parts per lot	0	Q1 2003	JESD22-A108-B	CV210-3
Electrostatic Discharge (ESD)	Charged Device Model (CDM)	N/A	1 lot, 33 total parts	0 failures thru 500 V	Q4 2002	JESD22-C101-A	CV210-3
	Human Body Model (HBM)	N/A	1 lot, 33 total parts	0 failures thru 500 V		JESD22-A114	CV210-3
Physical Dimensions	N/A	N/A	2 lots, 2 total parts	0	Q1 2003	JESD22-B100-A	CV210-3
Solderability	N/A	N/A	3 lots, 3 total parts	0	Q1 2003	JESD22-B102	CV210-3
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	N/A	1 lot, 100 total parts	0	Q4 2002	J-STD-20B	CV210-1



## V. STRESS AND TEST METHODOLOGY

All qualification tests were performed with the CV210-3 using loose parts except for HAST and HTOL tests where loose parts were mounted to a PCB. The PCB layout and application circuit is the same as what is published in the WJ Communications Data Sheet, including the recommended via pattern. The application circuit was duplicated ten times on one large PCB for qualification testing. A control board consisting of ten CV210-3 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: a variation 10% or greater in a) supply current, b) conversion gain, c) OIP3, or d) OIP2. Acceptance criterion consists of having zero or one failure out of 80 parts to meet WJ's requirement of LTPD=5 for each test.

## VI. DISCUSSION OF RESULTS

### 1. Pre-Conditioning Level 1

A total of 780 CV210-3 devices from three lots completed Pre-conditioning Level 1 with no electrical failures. All of devices underwent pre- and post- stress scanning acoustic microscope inspection with no failures.

### 2. Temperature Cycle (TC)

A total of 240 CV210-3 devices from three lots, 80 per lot, passed Temperature Cycle with no failures or anomalies. The worst-case changes were: conversion gain delta = 5.61% or 0.56 dB (typical gain is 10 dB), current delta = 1.82% or 7 mA (typical current is 430 mA), IP3 delta = 5.55% or 1.68 dBm (typical IP3 is 27 dBm) and IP2 delta = 2.83% or 1.12 dBm (typical IP2 is 37 dBm).

### 3. Unbiased Autoclave (UA)

A total of 240 CV210-3 devices from three lots, 80 per lot, passed Unbiased Autoclave with no failures or anomalies. The worst-case changes were: conversion gain delta = 8.94% or 0.92 dB (typical gain is 10 dB), current delta = 6.13% or 25 mA (typical current is 430 mA), IP3 delta = 8.95% or 2.56 dBm (typical IP3 is 27 dBm), and IP2 delta = 4.09% or 1.59 dBm (typical IP2 is 37 dBm).

### 4. Unbiased High Temperature Bake (HTB)

A total of 80 CV210-3 devices from one lot passed Unbiased High Temperature Bake with no failures or anomalies. The worst-case changes are: conversion gain delta = 7.9% or 0.815 dB (typical gain is 10 dB), current delta = 1.46% or 6 mA (typical current is 430 mA), IP3 delta = 4.32% or 1.127 dBm (typical IP3 is 27 dBm), and IP2 delta = 5.13% or 2.10 dBm (typical IP2 is 37 dBm).

### 5. Electrostatic Discharge (ESD)

15 CV210-3 devices completed CDM (Charged Device Model) testing and another 18 CV210-3 devices completed HBM (Human Body Model) ESD testing at a variety of different voltage levels with no unexpected failures. 3 additional CV210-3 devices were used in the testing as control units. The CV210-3 device has been classified as a **Class 1B device** (highest voltage level passed between 500V and 1000V) for HBM testing according to JEDEC Standard JESD22-A114 and as a **Class III device** (Highest Voltage Level Passed between 500V and 1000V) for CDM testing according to JEDEC Standard JESD22-C101. The CV210-1, CV211-1, CV211-2, and CV211-3 have the same ESD classification by similarity.

3 units were subjected at each test voltage for both CDM and HBM ESD testing. 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 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. 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 (lowest) voltage level at which all three parts passed post-ESD RF testing according to the test specifications set by WJ Communications.

### 6. Highly Accelerated Temperature and Humidity Stress Test (HAST)

A total of 240 CV210-3 devices from three lots, 80 per lot, passed HAST with one failure. The one failure was traced to one of the HD11 IF amplifiers, and further investigation is underway. The worst-case changes from the passing parts were: conversion gain delta = 2.72% or 0.32 dB (typical gain is 10 dB), current delta = 2.32% or 10 mA (typical current is 430 mA), IP3 delta = 2.44% or 1.35 dBm (typical IP3 is 27 dBm) and IP2 delta = 3.48% or 1.42 dB (typical IP2 is 37 dBm).



### 7. High Temp Op Life (HTOL)

A total of 240 CV210-3 devices from three lots, 80 per lot, passed HTOL with no failures or anomalies. The worst-case changes were: conversion gain delta = 2.63% or 0.31 dB (typical gain is 10 dB), current delta = 7.23% or 30 mA (typical current is 430 mA), IP3 delta = 5.43% or 1.44 dBm (typical IP3 is 27 dBm) and IP2 delta = 1.85% or 0.76 dBm (typical IP2 is 37 dBm).

### 8. Physical Dimensions

A total of 2 CV210-3 devices completed inspection for physical dimensions with no failures.

### 9. Solderability

A total of 3 CV210-3 devices completed Solderability Testing with no failures.

### 10. Moisture / Reflow Sensitivity Classification (MSL)

A total of 100 CV210-1 devices 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 693 pre-conditioned CV210-3 devices underwent (MSL level 1 lead free profile, 250 °C peak temperature).

## VII. CONCLUSIONS

The data presented demonstrates that the WJ Communications' single- and dual-branch downconverter products – the CV1xx and CV2xx Series – meet WJ's rigorous quality standards and conform to WJ's long history of producing products with high reliability and quality levels. The test results described in this document support the full qualification for the following devices:

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