Reliability Report

ADC12QJ1600-SEP Production Flow and Reliability Report

ABSTRACT

This report presents the reliability and qualification results for the ADC12QJ1600-SEP, a radiation-hardness-assured (RHA), 30-krad, 12-bit, quad 1.6-GSPS Analog-to-Digital Converter (ADC). The ADC12QJ1600-SEP is manufactured with a controlled baseline and features the following compared to commercial-grade devices:

- An extended product life cycle
- Controlled basline: one fab, assembly and test site
- Product traceability
- Lot-acceptance testing

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Trademarks

1 Texas Instruments Space-Enhanced Product Qualification and Reliability Report

Texas Instruments' qualification testing is a risk mitigation process that is engineered to verify device longevity in customer applications. Wafer fabrication process and package level reliability are evaluated in a variety of ways that can include accelerated environmental test conditions with subsequent derating to actual use conditions. Manufacturability of the device is evaluated to verify a robust assembly flow and verify continuity of supply to customers.

2 Space-Enhanced Product Production Flow

2.1 Device Introduction

The ADC12QJ1600-SEP is a radiation-tolerant device in an organic flip-chip package that is designed for space applications. The 10 × 10mm 144ALR package utilizes eutectic tin-lead (SnPb) die-bumps and external SnPb BGA balls. The device was verified as single event latch-up (SEL) immune to 43MeV × cm^2/ mg at a junction temperature of 125°C. The ADC12QJ1600-SEP is manufactured with TI's internal 65nm CMOS C021.A process.

Each fabrication lot is tested according to the MIL-STD-883 requirements for Radiation Lot Acceptance Testing (RLAT) up to 30krad(Si) and each assembly and test lot follows the process flow shown in Figure 2-1. To verify the quality of ADC12QJ1600-SEP, the device has been tested and qualified to meet space-grade requirements for VLEO, LEO, and MEO missions. See Section 3 for further details.

2.2 ADC12QJ1600-SEP Space-Enhanced Product Production Flow

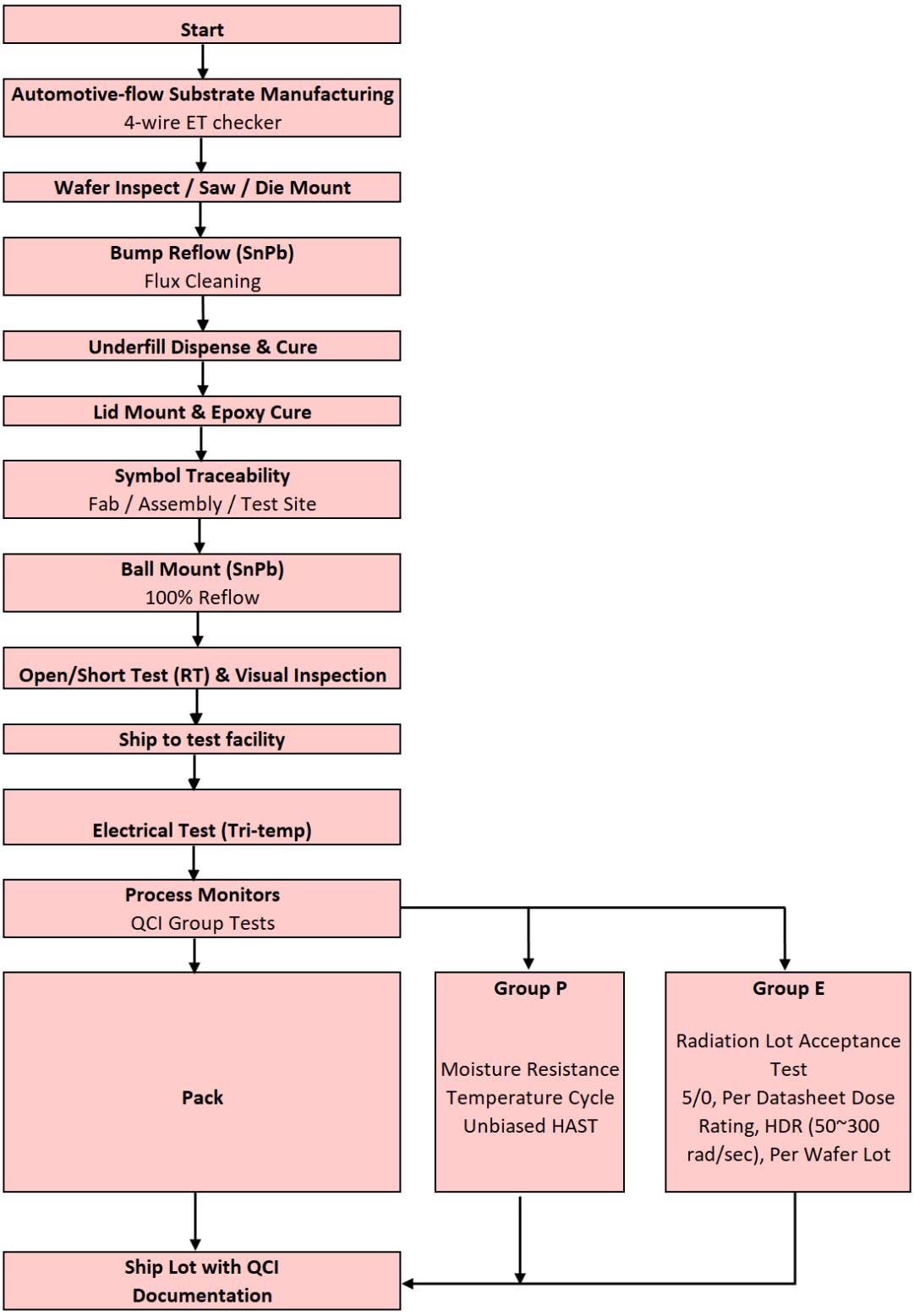

Figure 2-1. ADC12QJ1600-SEP Space-Enhanced Product Production Flow Chart

3 Device Qualification

The following is the device qualification summary.

Qualification by Similarity (Qualification Family)

A new device can be qualified either by performing full scale quality and reliability tests on the actual device or using previously qualified device(s) through *Qualification by Similarity* (QBS) rules. By establishing similarity between the new device and those qualified previously, repetitive tests are eliminated, allowing for timely production release. When adopting QBS methodology, the emphasis is on qualifying the differences between a previously qualified product and the new product under consideration.

Table 3-1. Space-Enhanced Products New Device Qualification Matrix

Note that qualification by similarity (*qualification family*) per JEDEC JESD47 is allowed.				
Description	**Condition**	**Sample Size Used and Rejects**	**Lots Required**	**Test Method**
Electromigration	Maximum Recommended Operating Conditions	N/A	N/A	Per TI Design Rules
Electrical Characterization	TI Data Sheet	30	1	N/A
Electrostatic Discharge Sensitivity	HBM	3 units / voltage	1	JS-001
	CDM			JS-002
Latch-up	Per Technology	3/0	1	EIA/JESD78
Physical Dimensions	TI Data Sheet	5/0	1	EIA/JESD22- B100
Thermal Impedance	Theta-JA on board	Per Pin-Package	N/A	Modelling
Bias Life Test	125°C / 1000 hours or equivalent	77/0	1	JESD22-A108*
Temperature Humidity Bias	85°C / 85% / 1000 hours	77/0	1	JESD22-A110*
Extended THB	85°C / 85% / 2600 hours (for reference)	77/0	1	JESD22-A110*
Unbiased HAST	110°C / 85% / 528 hours	77/0	1	JESD22-A.118*
Temperature Cycle	-55°C to +125°C non-biased for 1000 cycles	77/0	1	JESD22-A104*
High Temperature Storage Life	150°C, 1000 hours	77/0	1	JESD22-A103*
Solderability	22 leads, min 3 devices, 245C +5C	22/0	1	J-STD-002
Flammability	Method A / Method B	5/0	1	UL 94V0, Method A
Radiation Response Characterization	Total Ionization Dose (TID)	Two units / dose level	1	MIL-STD-883/Method 1019
Radiation Response Characterization	Single Event Latch-up (SEL)	3	1	MIL-STD-883/Method 1019
RLAT	Radiation Lot Acceptance Testing	5/0		MIL-STD-883/Method 1019
Outgassing Characterization, packaged unit	TML (Total Mass Lost)<=1%, CVCM (Collected Volatile Condensable material) <= 0.1%	5/0	1	ASTM E595
*Precondition performed per JEDEC Std. 22, Method A112/A113.				

4 Outgas Test Report

Outgassing test was performed on five units. A total mass loss (TML) of 1.00% and collected volatile condensable material (CVCM) of 0.10% were used as screening levels for rejection of spacecraft materials. The outgas test was performed in a vacuum environment of less than 5 × 10e–5 torr according to ASTM-E-595, for a duration of 24 hours, at 125°C. The TML and CVCM were measured after the test.

Table 4-1. Outgas Test Results

SAMPLE	TML < 1.0%	CVCM < 0.1%
ADC12QJ1600ALRSEP	PASS	PASS

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