Reliability Report

DAC121S101-SEP Production Flow and Reliability Report

ABSTRACT

This report presents the reliability and qualification results for the DAC121S101-SEP, a single channel, 12-bit digital-to-analog converter (DAC) in space-enhanced plastic (SEP). The DAC121S101-SEP is manufactured with a controlled baseline that has the following:

- Outgassing test performed per ASTM E595
- Vendor item drawing (VID) V62/24641
- Military temperature range: –55°C to +125°C
- One Fabrication, assembly and test site
- Wafer lot traceability and Radiation lot acceptance testing
- Extended product life cycle

Table of Contents

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1 Texas Instruments Enhanced Product Qualification and Reliability Report

TI 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 maintain continuity of supply to customers. TI Enhanced Products are qualified with industry standard test methodologies performed to the intent of Joint Electron Devices Engineering Council (JEDEC) standards and procedures. Texas Instruments enhanced products are certified to meet GEIA-STD-0002-1 Aerospace Qualified Electronic Components.

2 Space-Enhanced Plastic Production Flow

2.1 Device Introduction

The DAC121S101-SEP is a radiation-hardened device in a plastic package that allows these devices to be used in space applications. The device was verified immune to 43 MeV × cm^2/mg at 125°C for single-event latch-up (SEL). Each fabrication lot was tested according to MIL-STD-883 for radiation lot acceptance tested (RLAT) up to 30 krad(Si) and each assembly and test lot follows the process flow shown in Figure 2-1. To verify the quality of the DAC121S101-SEP, the device is qualified with SEP requirements. For more details, see Section 3.

2.2 DAC121S101-SEP Space-Enhanced Plastic Production Flow Chart

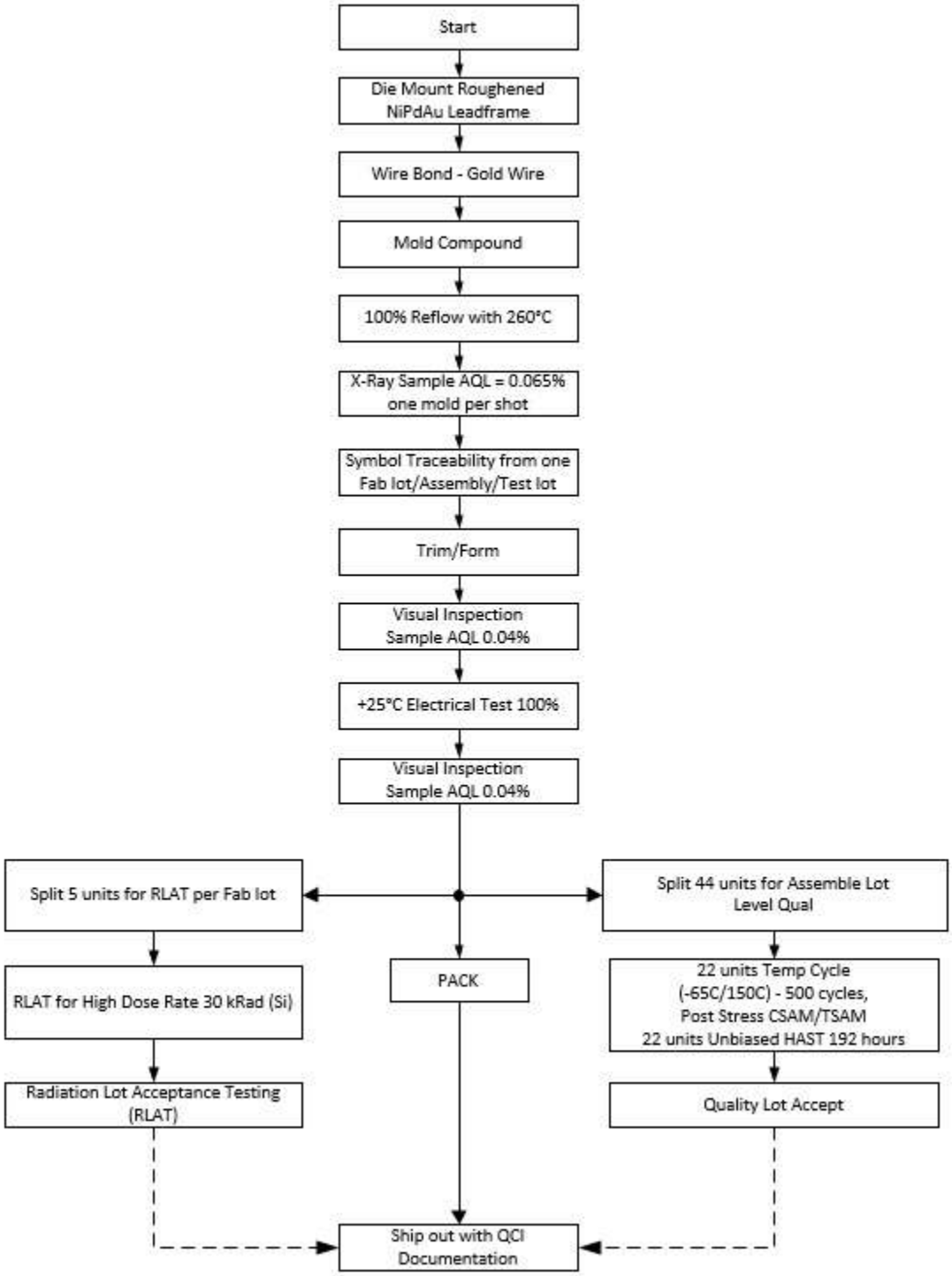

Figure 2-1. DAC121S101-SEP Space-Enhanced Plastic Production Flow Chart

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 devices 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.

The QBS rules for a technology, product, test parameters or package shall define which attributes are required to remain fixed for the QBS rules to apply. The attributes which are expected and allowed to vary are reviewed and a QBS plan shall be developed, based on the reliability impact assessment above, specifying what subset of the full complement of environmental stresses is required to evaluate the reliability impact of those variations. Each new device shall be reviewed for conformance to the QBS rule sets applicable to that device. See JEDEC JESD47 for more information.

Table 3-1. Device Baseline

TI Device:	DAC121S101DGKTSEP		**Assembly Site:**	TI-MLA (Malaysia)
DLA VID:	V62/24641		**Test Site:**	TI-EM (Malaysia)
Wafer fab:	MAINFAB		**Pin and package type:**	8 | DGK
Fab process:	C7L21M4		**Leadframe:**	Cu
Fab technology:	CMOS		**Termination finish:**	NiPdAu
Die revision:	A		**Mount Compound:**	HENKEL QMI 505MT
Die name:	GHXDAC121S101A		**Bond wire:**	24.4µm Au
ESD CDM:	±500V		**Mold Compound:**	SUMITOMO EME-G633C
ESD HBM:	±2000V		**Moisture sensitivity:**	MSL 2 | 260°C

Table 3-2. Space Enhanced Products New Device Qualification Matrix

DESCRIPTION	CONDITION	SAMPLE SIZE USED | REJECTS	LOTS REQUIRED	TEST METHOD
Electromigration	Maximum recommended operating conditions	N/A	N/A	Per TI Design Rules
Wire bond life	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	JESD22-A114
	CDM			JESD22-C101
Latch-up	Per technology	3 | 0	1	JESD78
Physical dimensions	TI data sheet	5 | 0	1	JESD22- B100
Thermal impedance	θ_{JA} onboard	Per Pin-Package	N/A	JESD51
Bias life test	125°C | 1000 hours or equivalent	77 | 0	1	JESD22-A108 (1)
Biased HAST	130°C | 85% | 96 hours	77 | 0	1	JESD22-A110 (1)
Extended biased HAST	130°C | 85% | 250 hours (for reference)	77 | 0	1	JESD22-A110 (1)
Unbiased HAST	130°C | 85% | 96 hours	77 | 0	1	JESD22-A.118 (1)
Temperature Cycle	-65°C to +150°C non-biased for 500 cycles	77 | 0	1	JESD22-A104 (1)
Solder heat	260°C for 10 seconds	22 | 0	1	JESD22-B106
Resistance to Solvents	Ink symbol only	12 | 0	1	JESD22-B107
Solderability	Condition A (steam age for 8 hours)	22 | 0	1	ANSI J-STD-002-92
Flammability	Method A | Method B	5 | 0	1	UL-1964
Bond shear	Per wire size	5 units x 30 | 0 bonds	1	JESD22-B116
Bond pull strength	Per wire size	5 units x 30 | 0 bonds	1	ASTM F-459
Die shear	Per die size	5 | 0	1	TM 2019
High temp storage	150 °C | 1,000 hours	77 | 0	3	JESD22-A103-A (1)
Moisture sensitivity	Surface mount only	12	1	J-STD-020-A (1)
Radiation response characterization	Total ionization dose, single-event latch-up	5 Units for HDR	1	MIL-STD-883/Method 1019
Outgassing characterization	TML (total mass lost), CVCM (collected volatile condensable material)	5	1	ASTM E595

(1) Precondition performed per JEDEC Std. 22, Method A112, Method A113.

4 Outgas Test Report

The 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 5×10^{-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 < 0.1%	CVCM < 0.1%
DAC121S101DGKTSEP	0.07	<0.01

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