Reliability Report

SN54SC4T08-SEP Production Flow and Reliability Report

ABSTRACT

This report presents the reliability and qualification results for the SN54SC4T08-SEP Radiation-tolerant, 1.2-V to 5.5-V, quadruple 2-input positive-AND gate. The SN54SC4T08-SEP is manufactured with a controlled baseline and has the following:

- An extended product life cycle
- One assembly and test site
- Product traceability
- Extended product-change notification

Table of Contents

List of Figures

List of Tables

Trademarks

1 Texas Instruments Enhanced Product Qualification and Reliability Report

TI qualification testing is a risk mitigation process that is engineered to assure device longevity in customer applications. Wafer fabrication process and package level reliability are evaluated in a variety of ways that may 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 assure 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

SN54SC4T08-SEP is a radiation hardened device in a plastic package which allows this device 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 20 krad (Si) and each assembly and test lot follows the process flow shown in Figure 2-1. To maintain the quality of SN54SC4T08-SEP, the device is qualified with Space EP requirements. For further details, see Section 3.1.

2.2 SN54SC4T08-SEP Production Flow Chart

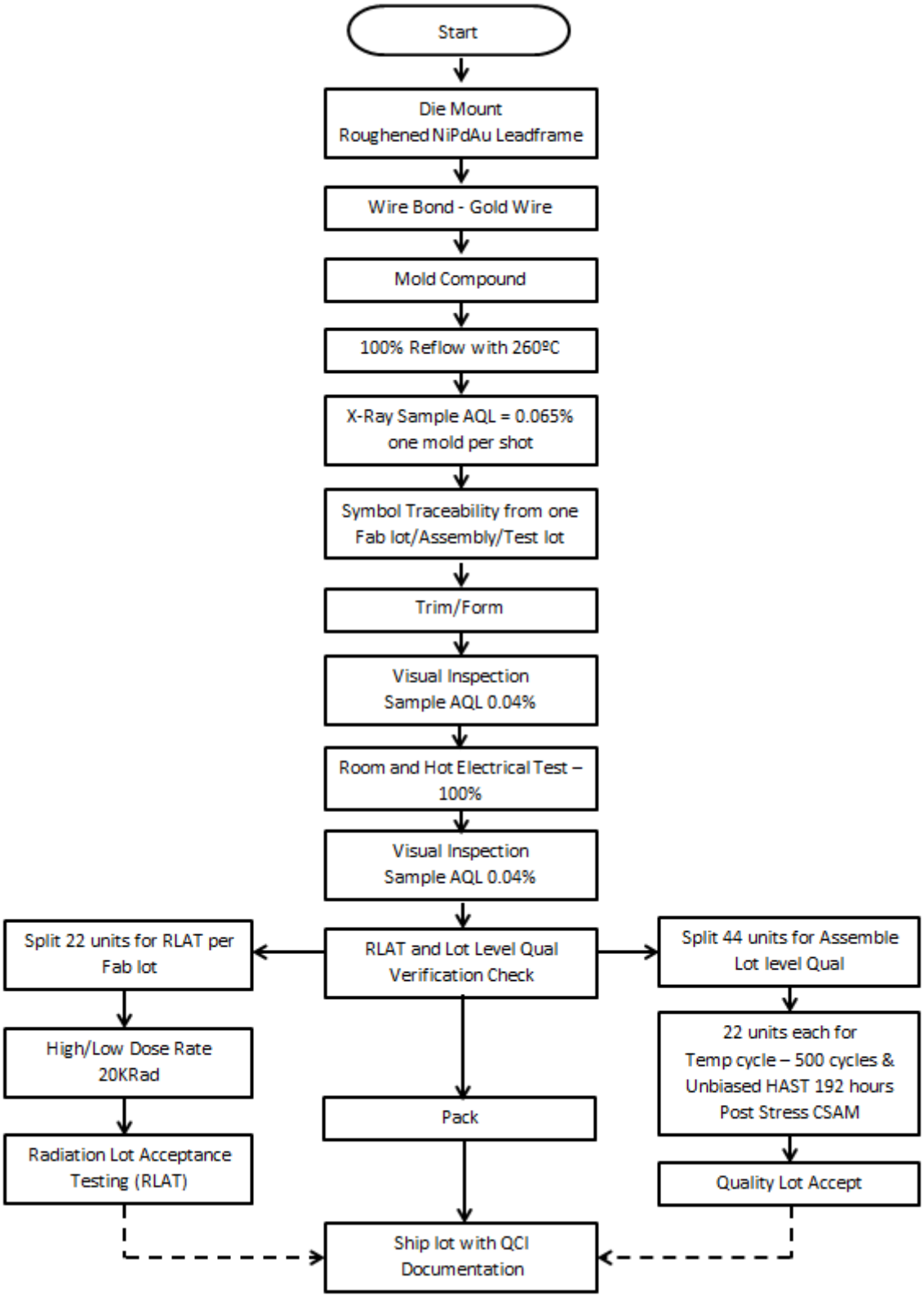

Figure 2-1. Space Enhanced Plastic Production Flow

3 Device Qualification

The following is the device qualification summary.

3.1 Qualification by Similarity (Qualification Family)

A new device can be qualified either by performing a full scale quality and reliability test on the actual device or using one or more previously qualified devices through *Qualification by Similarity* (QBS) rules. By establishing similarities between the new device and those qualified previously, repetitive tests were eliminated, allowing for a timely production release. Qualifying the differences between a previously qualified product and the new product under consideration was emphasized when adopting the QBS methodology.

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

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
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	EIA/JESD22-A114
	CDM			EIA/JESD22-C101
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	EIA/JESD51
Bias life test	125°C / 1000 hours or equivalent	77/0	3	JESD22-A108(1)
Biased HAST	130°C / 85% / 96 hours	77/0	3	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	3	JESD22-A110(1)
Temperature cycle	−65°C to +150°C non-biased for 500 cycles	77/0	3	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 × 30/0 bonds	3	JESD22-B116
Bond pull strength	Per wire size	5 units × 30/0 bonds	3	ASTM F-459
Die shear	Per die size	5/0	3	TM 2019
High temperature storage	150°C / 1000 hours	15/0	3	JESD22-A103-A(1)
Moisture sensitivity	Surface mount only	12	1	J-STD-020-A(1)
Radiation response characterization	Total ionization dose, and single-event latch-up	5 units/dose level	1	MIL-STD-883/Method 1019
Outgassing characterization	TML (Total mass lost), CVCM (collected volatile condensable material), WVR (water vapor recorded)	5	1	ASTM E595

(1) Precondition performed per JEDEC Std. 22, Method A112 and 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 × 10 –5 torr according to ASTM E 595, for a duration of 24 hours, at 125°C. The TML, CVCM, and the amount of Water Vapor Recovered (WVR) were measured after the test.

Table 4-1. Outgas Test Results

Sample	TML < 1.0%	CVCM < 0.1%
SN54SC4T08MPWTSEP	Pass	Pass

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265