



ABSTRACT

This report presents the reliability and qualification results for the TMP9R01-SEP device, a radiation-hardened, high accuracy, low-power remote temperature sensor monitor in SEP (Space Enhanced Plastic). The TMP9R01-SEP device is manufactured with a controlled baseline and has the following:

- One assembly and one test site
 - Product traceability
 - An extended product life cycle
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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 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 meet GEIA-STD-0002-1 Aerospace Qualified Electronic Components.

2 Space Enhanced Plastic Production Flow

2.1 Device Introduction

TMP9R01-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 $43\text{MeV} \times \text{cm}^2 / \text{mg}$ 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 50krad(Si) and each assembly and test lot follows the process flow shown in Figure 2-1. To maintain the quality of TMP9R01-SEP, the device is qualified with Space EP requirements. See Section 3 for further details.

2.2 TMP9R01-SEP Space Enhanced Plastic Production Flow

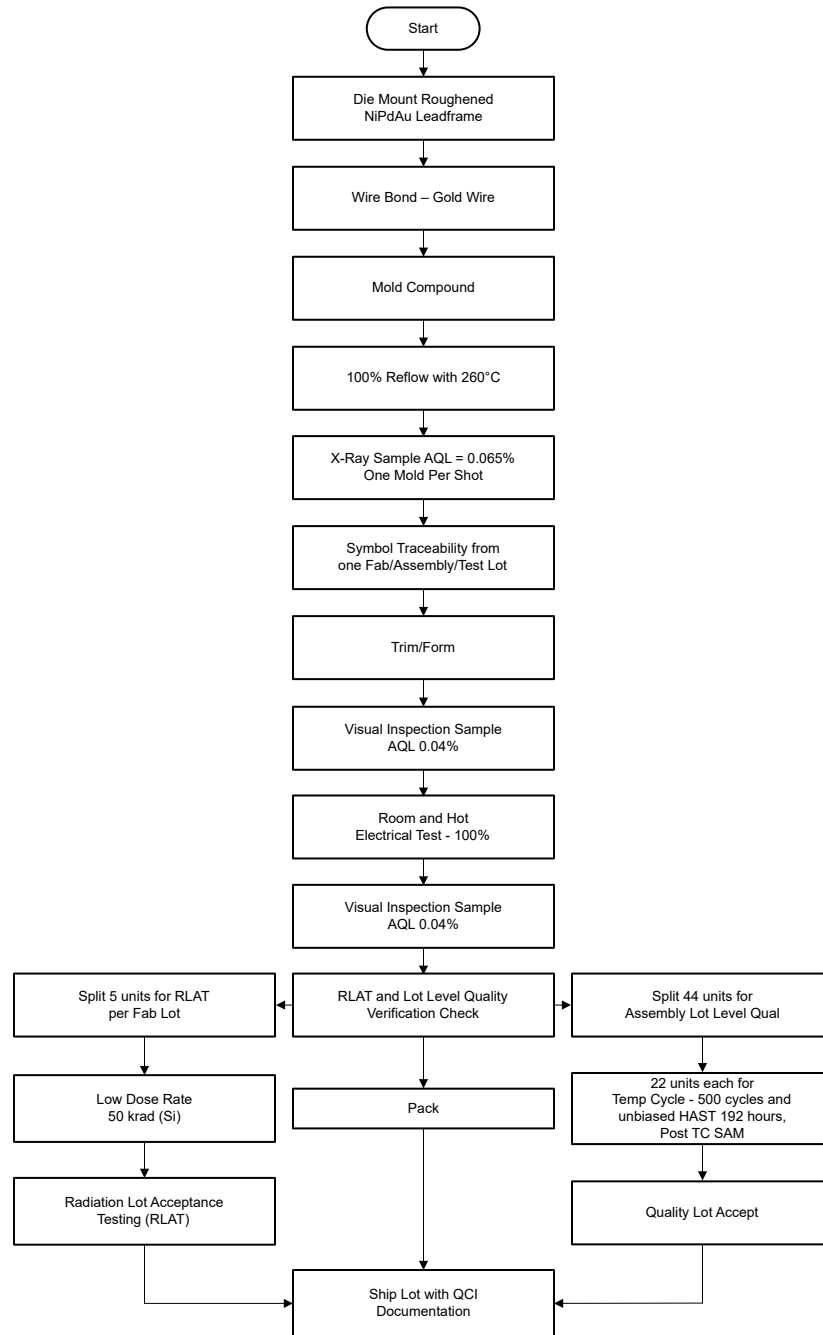


Figure 2-1. TMP9R01-SEP Space Enhanced Plastic Production Flow Chart

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. Space Enhanced Products New Device Qualification Matrix

Note that qualification by similarity (<i>qualification family</i>) per JEDEC JESD47 is allowed.				
DESCRIPTION	CONDITION	SAMPLE SIZE USED/ REJECTS	LOTS REQUIRED	TEST METHOD
Electromigration	Maximum Recommended Operating Conditions	N/A	N/A	PerTI Design Rules
Wire Bond Life	Maximum Recommended Operating Conditions	N/A	N/A	PerTI Design Rules
Electrical Characterization	TI Data Sheet	30	3	N/A
Electrostatic Discharge Sensitivity	HBM per TI Data sheet	3 units/voltage	1	JEDEC JS-001 or EIA/JESD22-A114
	CDM per TI Data sheet			JEDEC JS-002 or 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 or 110°C/ 85% / 264 hours or 85°C/ 85% / 1000 hours	77/0	1	JESD22-A110/A101 ¹
Extended Biased HAST	130°C/ 85% / 192 hours (for reference) or 110°C/ 85% / 528 hours or 85°C/ 85% / 2000 hours	77/0	1	JESD22-A110/A101 ¹
Unbiased HAST	130°C/ 85% / 96 hours or equivalent	77/0	1	JESD22-A.118 ¹
Temperature Cycle	-65°Cto +150°C non-biased 500 cycles or equivalent	77/0	1	JESD22-A104 ¹
Solderability	Bake Preconditioning	22/0	1	ANSI/J-STD-002
Flammability	Method A - UL 94V-0 or Method B - IEC standard 695- 2-2 or Method C - UL 1694	5/0	1	UL 94V-0 IEC standard 695-2-2 UL 1694
Bond Shear	Per wire size	4units x 30/0 bonds	3	JESD22-B116
Bond Pull Strength	Per wire size	4units x 30/0 bonds	3	ASTM F-459
Die Shear	Per die size	5/0	3	MIL-STD-883, TM 2019
High Temperature Storage	150 °C / 1000 hours	77/0	3	JESD22-A103 ¹
Moisture Sensitivity	Surface Mount Only	12	1	J-STD-020 ¹
Radiation Response Characterization	Per TI Data sheet	5units/dose level	1	MIL-STD-883/Method 1019

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

Note that qualification by similarity (<i>qualification family</i>) per JEDEC JESD47 is allowed.				
DESCRIPTION	CONDITION	SAMPLE SIZE USED/ REJECTS	LOTS REQUIRED	TEST METHOD
Outgassing Characterization	TML <=1% (Total Mass Lost) CVCM <=0.1% (Collected Volatile Condensable Material)	5	1	ASTM E595

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

4 Outgas Test Report

Outgassing test was performed on 5 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

Device	TML < 1.0%	CVCM < 0.1%
TMP9R01MDGSTSEP	Pass	Pass

5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (June 2025) to Revision A (August 2025)	Page
• Changed TMP9R01DGSTSEP to TMP9R01MDGSTSEP.....	6

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