



ABSTRACT

This report presents the reliability and qualification results for the TPS7H4001-SHP, radiation tolerant, 3-V to 7-V input, 18-A, synchronous step-down voltage converter in space High Grade Plastic (SHP) package. The TPS7H4001-SHP 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
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1 Texas Instruments High Grade Plastic 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.

2 Space High Grade Plastic Production Flow

2.1 Device Introduction

TPS7H4001-SHP is a radiation hardened device in a plastic package which allows this device to be used in space application. The device was verified immune to $75 \text{ MeV}\cdot\text{cm}^2/\text{mg}$ 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 100 krad(Si) and each assembly and test lot follows the process flow shown in [Figure 2-1](#). To ensure the quality of TPS7H4001-SHP, it is qualified with Space High Grade Plastic requirements. See [Section 3](#) for further details.

2.2 TPS7H4001-SHP Space High Grade Plastic Production Flow

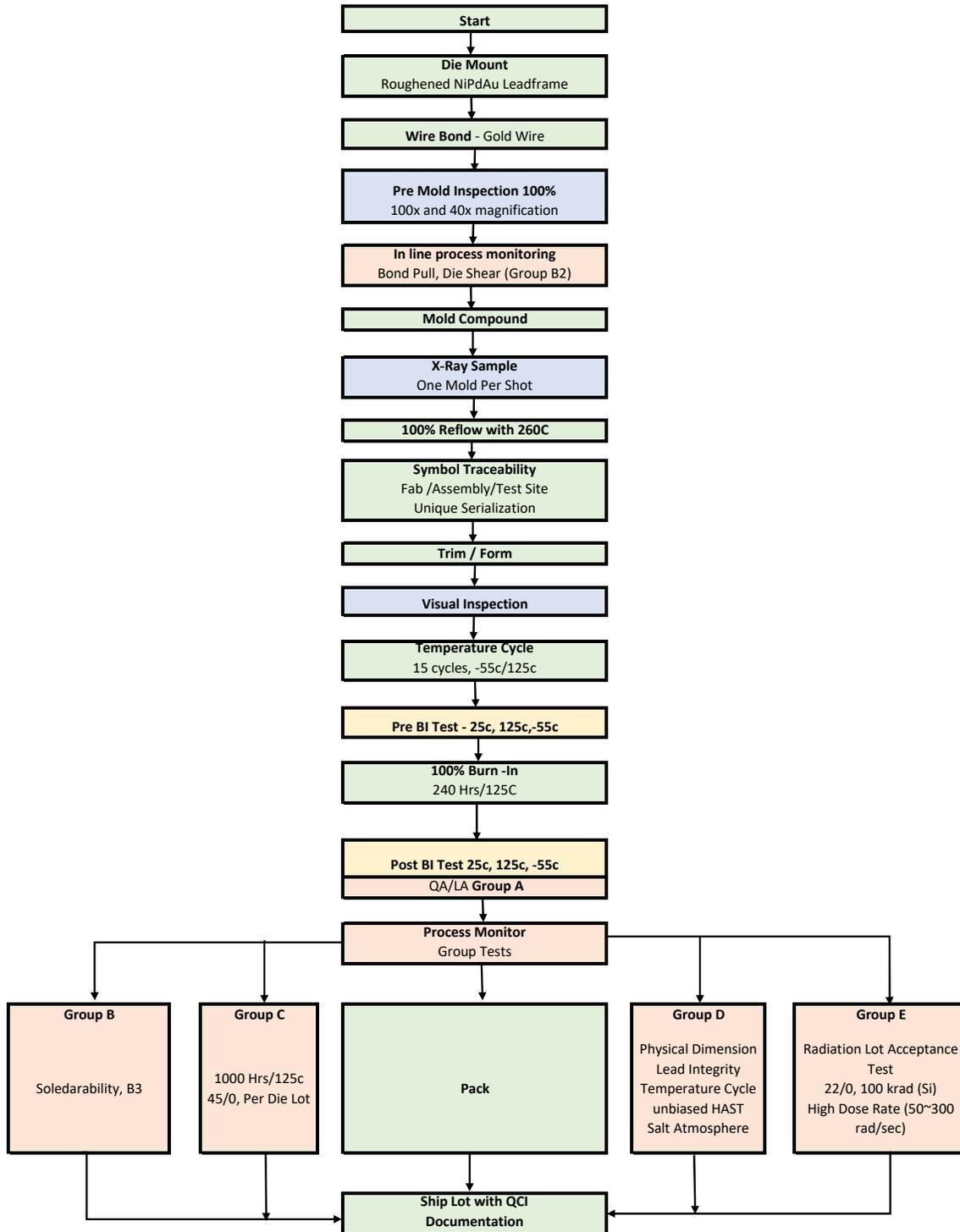


Figure 2-1. TPS7H4001-SHP Space High Grade Plastic Production Flow Chart

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 device(s) through "Qualification by Similarity" (QBS) rules. By establishing similarity between the new device and those qualified previously, repetitive tests will be 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 High Grade Plastic Products New Device Qualification Matrix

Note that qualification by similarity ("qualification family") per JEDEC JESD47 is allowed.				
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	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	45/0	1	JESD22-A108*
Biased HAST	130°C / 85% / 96 hours	77/0	1	JESD22-A110*
Extended Biased HAST	130°C / 85% / 192 hours (for reference)	77/0	1	JESD22-A110*
Unbiased HAST	130°C / 85% / 96 hours	22/0	1	JESD22-A.118*
Temperature Cycle	-65°C to +150°C non-biased for 500 cycles	77/0	1	JESD22-A104*
High Temp Storage Life	175°C, 420 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)	5 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	22/0		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
Bond Strength	22 bonds, min. 4 devices	22/0	1	TM2011
Die Shear	Per TI Internal method	3/0	1	Per TI Internal method
Internal Visual Inspection	Per TI Internal method	3/0	1	Per TI Internal method
Lead Terminal Integrity	Per TI Internal method	3/0	1	Per TI Internal method
Salt Atmosphere	Salt atmosphere, visual inspection	15/0	1	TM1009

*Precondition performed per JEDEC Std. 22, Method A112/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

SAMPLE	TML < 1.0%	CVCM < 0.1%
TPS7H4003MDDWSEP	PASS	PASS

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