



ABSTRACT

This report presents the reliability and qualification results for the Texas Instruments TPS7H2140-SEP. The TPS7H2140-SEP device is a fully protected quad-channel eFuse with four integrated 160-mΩ NMOS power FETs in enhanced plastic (SEP). The TPS7H2140-SEP is manufactured with a controlled baseline that has the following:

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

Table of Contents

1 Texas Instruments Enhanced Product Qualification and Reliability Report	2
2 Space Enhanced Plastic Production Flow	2
2.1 Device Introduction.....	2
2.2 TPS7H2140-SEP Space Enhanced Plastic Production Flow.....	2
3 Device Qualification	3
4 Outgas Test Report	4

List of Figures

Figure 2-1. TPS7H2140-SEP Space Enhanced Plastic Production Flow Chart.....	2
---	---

List of Tables

Table 3-1. Space Enhanced Products New Device Qualification Matrix.....	3
Table 4-1. Outgas Test Results.....	4

Trademarks

All trademarks are the property of their respective owners.

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 Device 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

TPS7H2140-SEP series is a radiation hardened device family in a plastic package which allows these devices to be used in space applications. The device was verified immune to 43 MeV·cm²/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 TPS7H2140-SEP, the device is qualified with Space EP requirements. See Section 3 for further details.

2.2 TPS7H2140-SEP Space Enhanced Plastic Production Flow

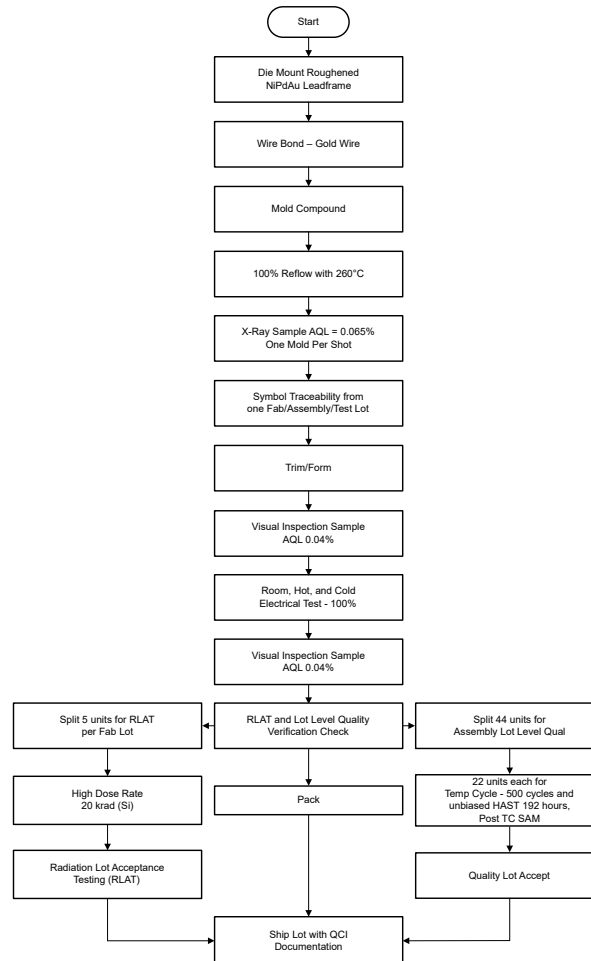


Figure 2-1. TPS7H2140-SEP Space Enhanced Plastic Production Flow Chart

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 is reviewed and a QBS plan is 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 is 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 ("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	10	3	N/A
Electrostatic discharge sensitivity	HBM	3 units/voltage	1	EIA/JESD22-A114
	CDM			EIA/JESD22-C101
Latch-up	Per technology	6/0	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*
Biased HAST	130°C / 85% / 96 hours	77/0	3	JESD22-A110*
Extended biased HAST	130°C / 85% / 250 hours (for reference)	77/0	1	JESD22-A110*
Unbiased HAST	130°C / 85% / 192 hours	77/0	3	JESD22-A118*
Temperature cycle	-65°C to +150°C non-biased for 500 cycles	77/0	3	JESD22-A104*
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 or 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 Temp storage	150 °C / 1000 hours	15/0	3	JESD22-A103-A*
Moisture sensitivity	Surface mount only	12	1	J-STD-020-A*
Radiation response characterization	Total ionization dose, 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)	5	1	ASTM E595

- *Precondition performed per JEDEC Std. 22, Method A112/A113.

4 Outgas Test Report

Outgassing test was performed on Die attach and Mold compound used for the TPS7H2140-SEP. 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%
TPS7H2140MPWPTSEP	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](https://www.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
Copyright © 2023, Texas Instruments Incorporated